Transfer Switch TS850/890
TSC800 Controller
Training Manual

1) GENERAL

Corporate Overview
Sales & Marketing Contacts
Agent & Distributor Contacts

2) MISCELLANEOUS

Work Safe Report

3) TRANSFER SWITCHES

TSC800 - Controller - Manual & data sheets.
TS850 Switch - Manual & drawings.
TSB850 - Bypass Switch - Manual & drawings.
TS890 - Switch - Manual & drawings.

4) ENGINE CONTROLLER

MEC20 Controller , Manual, data sheets & drawings.

5) SOFTWARE

THS 2000 Information & Manual

PRODUCT TRAINING
COURSE EVALUATION FORM
Instructor: Glenn Drayson

1. The course was:
   ______ Very informative.
   ______ Informative.
   ______ Not informative.

2. The course was:
   ______ Very well done.
   ______ Well done.
   ______ Okay.

3. The course instructor was:
   ______ Well prepared.
   ______ Prepared.
   ______ Not well prepared.

4. During the course I gained:
   ______ A lot more knowledge about the products covered.
   ______ More knowledge about the products covered.
   ______ Some knowledge about the products covered.

5. I felt the facility in which the course was presented in was:
   ______ Good.
   ______ Adequate.
   ______ Poor.

6. The hands-on training sessions were:
   ______ The most valuable portion of the course.
   ______ An important part of the course.
   ______ Of minimum value.

7. The classroom/theory sessions were:
   - ________ The most important part of the course.
   - ________ A valuable part of the course.
   - ________ Not as valuable as other parts of the course.

8. The information in the supplied Service Manual was:
   - ________ Very good.
   - ________ Adequate.
   - ________ Poor.

9. Future courses should have:
   - ________ More hands on training.
   - ________ More classroom sessions.
   - ________ More audio/visual aids.

10. What additional information was not covered in the course that you would like to see?

11. How could these training courses be improved?

12. What particular parts of this course should future courses concentrate on?

____
____
____
____
____
____
____

13. Any general comments you have regarding the course would help with future courses:

____
____
____
____
____
____
____
____

14. I would like to be contacted again for future training courses:

_______ Yes.

_______ No thank you.

Name / Title (please print)	*Company Name / Address (please print)*

A Subsidiary of
Regal-Beloit Corporation

CORPORATE OVERVIEW

Thomson Technology Inc. is a leading manufacturer of electrical products and systems for use in the Power Generation Industry. T.T.I. products are currently operating in conjunction with power generation systems around the world. Products including System 2000 Switchgear and Controls, TS 850 and TS 890 Automatic Transfer Switches, *TSB 850* Bypass/Isolation Switches, *UCS* 200 Auto Start Generator Control Panels *are applied in industrial, commercial, institutional and marine installations.*

T.T.I. manufactures a full line of control components and monitoring devices for use in its control equipment. These products include MEC 20 microprocessor based engine/generator controller, TSC 800 automatic transfer switch control modules, engine speed switches, electrical sensing devices, battery chargers and system controllers.

Thomson Technology's THS 2000 software provides remote management of generator systems, allowing operators to communicate with T.T.I.'s engine generator control systems via telephone or other link. Features include automatic data logging, auto callout upon alarm and remote system reconfiguration.

T.T.I. provides complete field service and customer training. Field service engineers are available 24 hours a day for startup commissioning, repair, or modification of your power generation systems or components. Service representatives are located in key centers in North America and China. Training packages can be designed to meet customer specific requirements in the field or at T.T.I.'s factory training centre.

Thomson Technology's Design Engineering Department provides in-house system design for all of our products. Design services are available to customers wishing to develop new power generation facilities or to upgrade existing ones, including field verification to determine system requirements.

T.T.I. is committed to Research and Development. A substantial percentage of all sales revenues is returned to R & D, assuring the company's position as an industry leader in new product development and system innovation.

A dedicated quality assurance staff is responsible for supervising quality procedures to ISO 9000 certified standards. Certification under ISO 9001 ensures that all products are subjected to documented inspection and testing procedures so that our customers consistently receive products of the highest quality.

Thomson Technology Inc. was founded in 1973 and today directly employs over 100 people. Branch offices, agents and distributors in Canada, U.S.A. and Asia provide customer support.

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CONTROLS ENGINEERING INC.

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THOMSON TECHNOLOGY INC.

INSTALLATION GUIDELINES

TTI ENGINE/GENERATOR CONTROL PANELS

EB001 Rev 3 96/02/15

19214 - 94th Avenue, Surrey, B.C. Canada V3N 4E3 Telephone (604) 888-0110 Telefax (604) 888-3381

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1) GENERAL INFORMATION

> **NOTE**
> Installations should be done in accordance with all applicable electrical regulation codes as required.

The following installation guidelines for Thomson Technology Inc. engine generator control panels are provided for general information only pertaining to typical site installations. For specific site installation information, consult Thomson Technology Inc. as required. Note: Factory installations of integral control equipment that have been tested and proven may deviate from these recommendations.

> **CAUTION!**
> All installation and/or service work performed must be done by qualified personnel only. Failure to do so may cause personal injury or death.

2) CONTROL WIRING

As a minimum, all control wiring shall conform to the Canadian Electrical Code (CEC) Part 1. Specific wire sizes for typical circuits[2] (of distances up to 100ft (30m)[1]) are as follows:

2.1	Battery Control Power	#10 AWG (6mm^2)
2.2	Engine Alarm/Shutdown Contacts	#14 AWG(2.5mm^2)
2.3	Remote Start Contact for Transfer Switch	#14 AWG (2.5mm^2)
2.4	Crank & Preheat Output Wiring	#10 AWG (6mm^2) (To main solenoids)
2.5	Speed Sensing Wiring	#16 AWG (1.5mm^2)-2 Conductor Shielded Cable
2.6	Metering Voltage Inputs	#14 AWG (2.5mm^2)
2.7	Metering Current Inputs (from CT's)	#10 AWG (6mm^2)

[1] For distances exceeding 100 Ft. (30m) consult TTI.
[2] For unit mounted control panels, wire sizes may be reduced to the next smallest wire size available.

All shielded cables are recommended to be run in separate conduits to help reduce the effects of electrical noise interference (EMI/RFI etc). Note: For very short conduit runs (ie. less than 25 feet (10m) common control wiring conduits may be used.)

All AC & DC control wiring should be run in separate AC & DC conduits to help reduce the effects of electrical noise interference (EMI/RFI etc).

3) PHASE ROTATION

TTI control panels are designed to accept 3 phase power systems which provide a positive or A - B - C phase rotation. Control circuits which are affected by phase rotation are as follows:

- Kilowatt meters / transducers
- Kilovar meters / transducers
- Power Factor meters / transducers
- Engine Governor Load Sharing modules
- Var/Power Factor Control modules
- Synchronizing controls
- Reverse power relays
- Negative Sequence protective relays

If a negative or C - B - A phase rotation power supply is used, the above circuits will not operate correctly. If a positive A - B - C phase rotation power system is *not obtainable, consult TTI for possible circuit modifications.*

Note: It is the customers' responsibility to ensure a positive A - B - C is supplied to all TTI control panels, unless specifically stated otherwise by contract documents.

4) REMOTE START CONTACT FIELD WIRING

Field wiring of a remote start contact from a transfer switch to a control panel should conform to the following guidelines to avoid possible controller malfunction and/or damage.

a) Remote start contact wires (2 #14 AWG ($2.5mm^2$)) should be run in a separate conduit.
b) Avoid wiring near AC power cables to prevent pick-up of induced voltages.
c) An interposing relay should be installed if field wiring distance is excessively long (i.e. greater than 100 feet (30m)) or remote contact has a resistance of greater than 5.0 ohms (see Fig. 1).
d) The remote start contact must be voltage free (i.e. dry contact). The use of a "powered" contact will damage the engine controller.

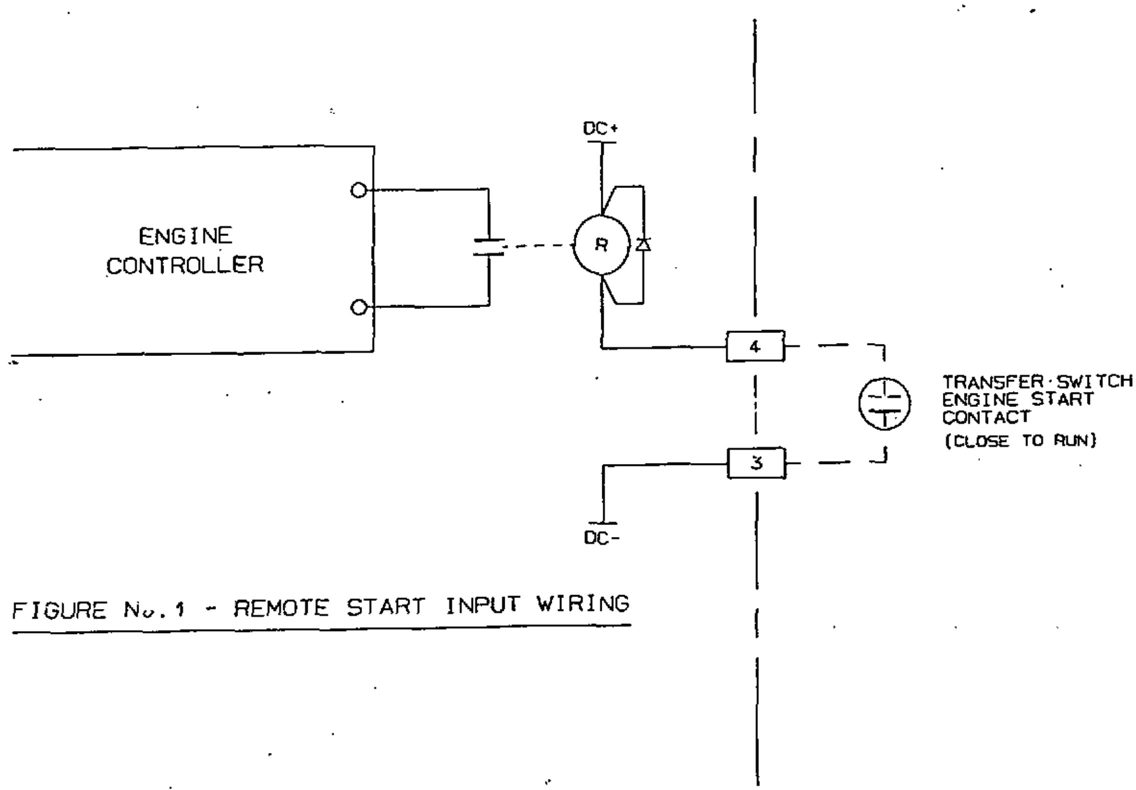


FIGURE No. 1 - REMOTE START INPUT WIRING

5) SPEED SENSING SIGNAL WIRES

Field wiring of the speed sensing signal wires should conform to the following guidelines to avoid possible controller malfunction and/or damage.

a) Transformer Sensing

> **NOTE**
> When transformer sensing is utilized, the voltage sensing must be connected to the line side of the generator circuit breaker (i.e. not the load side). Failure to do so will cause failure of the speed sensing circuitry if the breaker is opened.

- Avoid using system neutral conductor to prevent pick-up of harmonic voltages (i.e. use phase to phase connection for sensing).
- Avoid wiring near unrelated AC power cables to prevent pick up of induced voltages.
- Where non-linear loads represent a substantial portion of load on a generator, false operation of the controller's speed sensing network may occur in some applications if transformer sensing is used. If this problem exists, magnetic pickup speed sensing is recommended. Examples of non-linear loads would be U.P.S. systems, variable speed motors, and other devices which employ phase angle or pulse width modulated control.

b) Magnetic Pickup

- Wiring from magnetic pickup must utilize a 2 conductor shielded/twisted cable. The drain (shield) wire must be connected at the control panel end only (see Fig. 2).

- Magnetic pickup voltage at cranking speed must be greater than 3.0VAC. At nominal speed, mag pickup voltage should be between 3 - 40VAC.

- A single dedicated magnetic pickup is recommended for connection to the speed sensing input terminals. Note: One common magnetic pickup may be utilized for the system provided specific test measurements are done with the equipment installed (ie. mag pickup voltage levels meet the required levels).

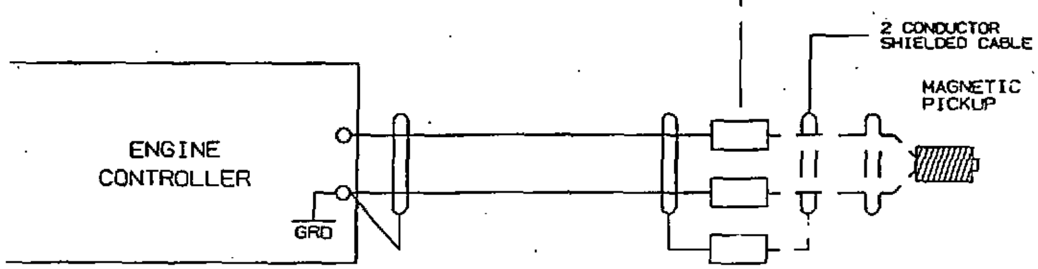


FIGURE No.2 - SPEED SENSING INPUT WIRING

6) BATTERY SUPPLY

DC Power supply control wiring from the engine cranking battery to the control panel should conform to the following guidelines to avoid possible controller malfunction and/or damage.

a) Avoid wiring from the engine starter terminals - wiring should go directly from the battery terminals to the engine control panel (to avoid voltage drop in the starter cables and starter motor commutator noise - (See Fig. 3) Note: Unit mounted control panels with short wiring runs may utilize connections from the starter terminals provided that the speicific application is tested satisfactorily.

b) Wiring from battery to engine control panel should be two - #10 AWG ($6mm^2$) wires (i.e. do not use the engine block as one of the common conductors).

c) Under noisy environments (i.e.. gas engines with high voltage ignitions, etc.), wiring from battery should be a twisted pair of #14 AWG ($2.5mm^2$) wires (use #10 AWG ($6mm^2$)) wires if a DC ammeter is used).

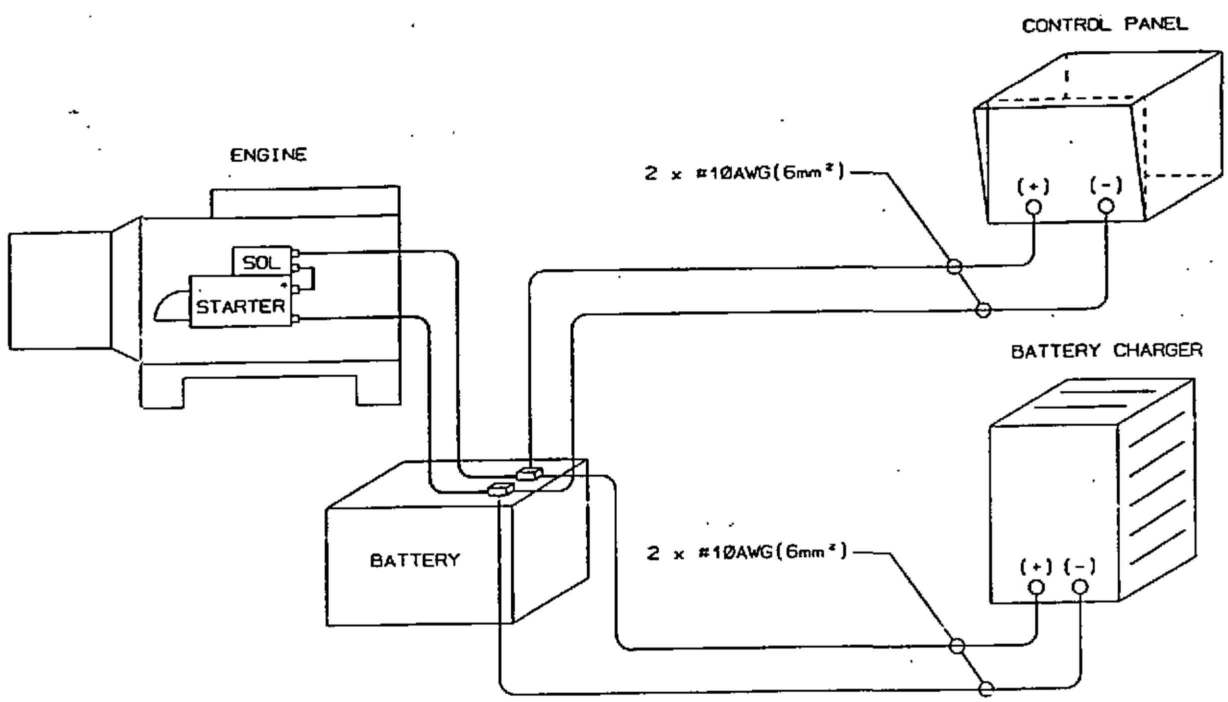


FIGURE No.3 - BATTERY SUPPLY WIRING

7) BATTERY CHARGERS

Field wiring of an engine cranking battery charger should conform to the following guidelines to avoid possible engine controller malfunction and/or damage.

a) Wiring from DC output of battery charger must be connected directly to the battery terminals (i.e.. not to the control panel power inputs terminals or the engine starter motor (see Fig. 3).

> **CAUTION!**
>
> *The battery charger must be turned **off before** battery cables are removed from* the battery (i.e.. for servicing). Failure to do so may subject the control panel to an overvoltage condition in which damage may result.

8) RELAY / SOLENOID PROTECTION

The use of AC or DC operated solenoids or relays in control systems can sometimes cause high voltage spikes on the DC power supply, which may cause electronic devices to fail.

Transient suppression devices are recommended for all inductive devices sharing wiring or if physically located near engine/generator control panels.

For DC operated relays or solenoids, use a suitably rated counter EMF Diode (or commonly known as "freewheeling" diode) (see Fig. 4).

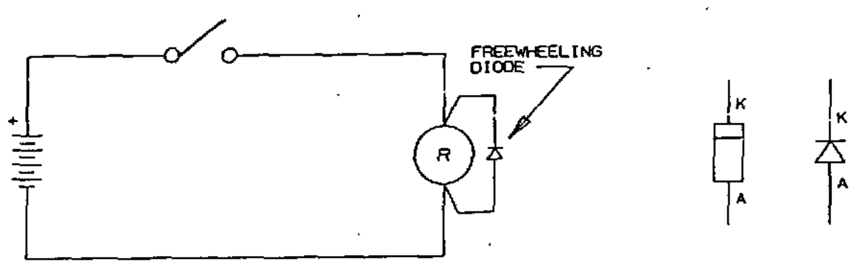


FIGURE No.4 - DC RELAY COIL PROTECTION

For AC operated relays or solenoids, use a suitably rated metal oxide varistor (MOV) or capacitor/resistor suppressor (see Fig 5).

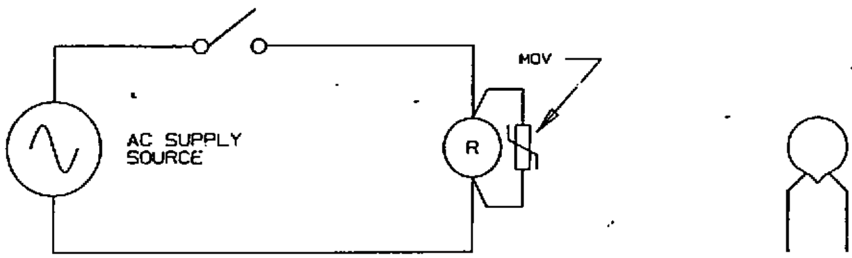


FIGURE No.5 - AC RELAY COIL PROTECTION

9) CURRENT TRANSFORMERS

When current transformers (CT's) are used to supply ammeter circuits only, CT polarity is not critical for correct circuit operation.

When CT's are used to supply circuits utilizing 3 phase power measurement devices (such as KW meters, power factor meters, load sharing modules, reverse power relays, etc). CT polarity must be carefully observed during installation.
To install CT's correctly, use the following guidelines and refer to the specific panels schematic diagrams.

> **CAUTION!**
> When installing or performing any service work on CT circuits, always de-energize the system before proceeding with any work. Never open circuit on an energized CT as extreme high voltages may result which may cause serious injury or death.

9.1 Install the CT with the polarity dot (white) or H1 side facing towards the supply source (see Fig. 6).

9.2 Connect the secondary "white" wire or terminal marked X1 or S1 to the ungrounded phase CT input terminal (typically marked C1, C2, or C3).

9.3 Connect the secondary "black" wire or terminal marked X2 or S2 to the grounded common CT input terminal (typically marked C0).

9.4 Always ensure that the power conductor phase CT matches the secondary CT wiring phase input terminal (i.e. typically - phase A CT should have its white or S1 secondary wire connected to the C1 terminal, phase B to C2, and phase C to C3. Common black wires should be connected to terminal C0.

Note: Always ensure that the corresponding voltage connections match the same phasing as the CT connections (ie. phase A voltage connection should correspond to the phase A CT and C1 secondary wiring terminal input).

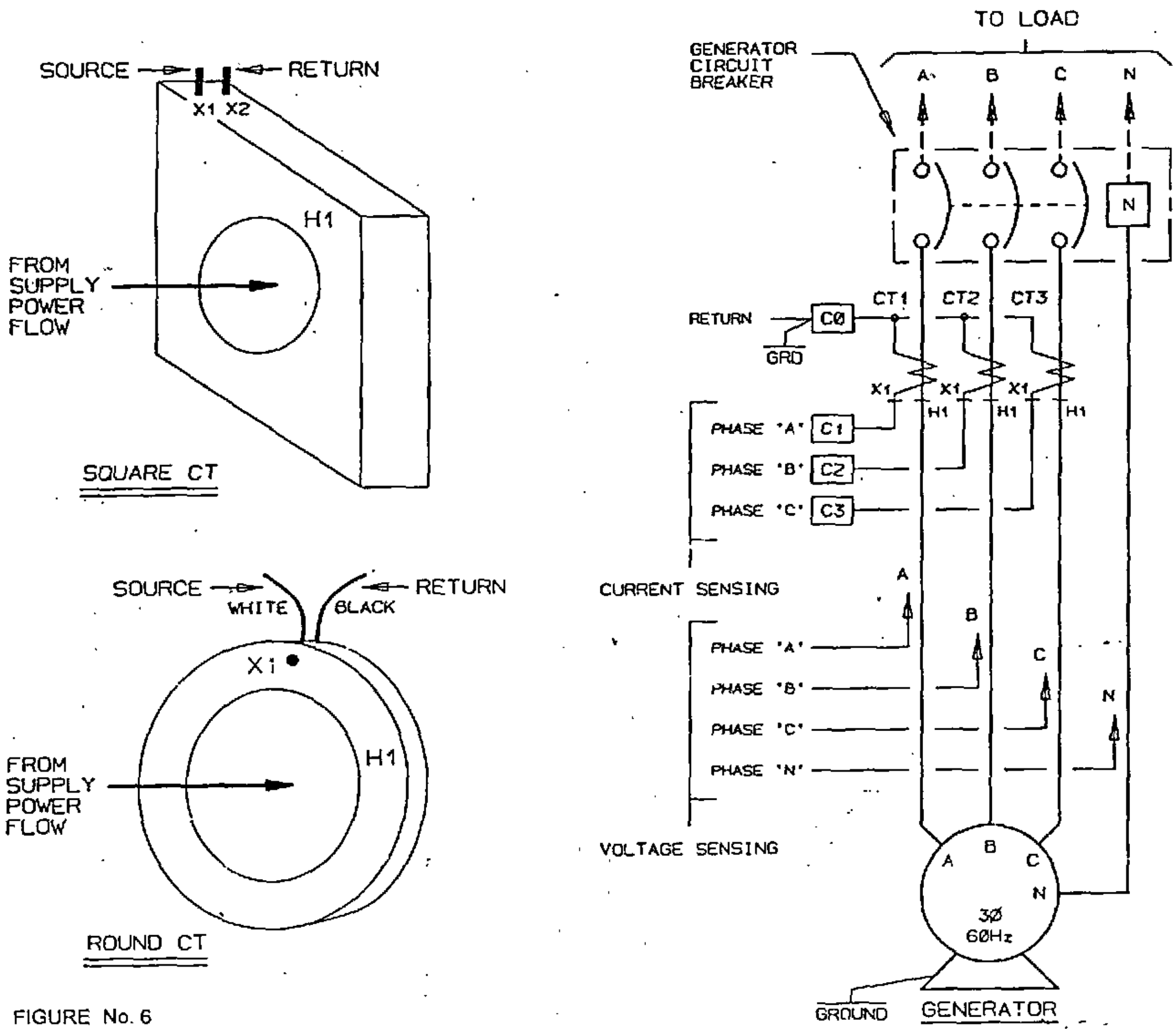


FIGURE No. 6

WORK SAFE

SAFETY

Safety should be the prime concern when working with any mechanical or electrical equipment. Identifying safety hazards on electrical equipment is more difficult than on mechanical equipment. Live terminals look exactly the same as dead terminals. All electrical equipment must be approached with caution. It takes only 20 milliamps of current to kill a human being. That is ¼ the current required to light a flash light! What happens when a person comes into contact with a live conductor, is largely dependent on the conditions at the time, such as skin area contacted, skin resistance, current path through body, voltage level etc. The result of body contact could be anything from a slight tickle to instant death.

DON'T GAMBLE WITH YOUR LIFE – PLAY IT SAFE !

W O R K  S A F E

Listed Below are some safety rules which **MUST** be followed when working with electrical equipment.

1. Do not attempt to do any work on the generator or the controls unless you are familiar with their operation. If you are not sure, READ THE MANUAL !

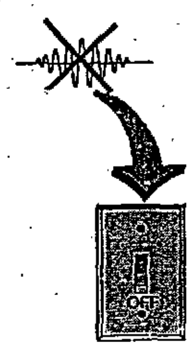
2. Disconnect the engine battery before you attempt to do any work on the engine or generator.

3. Do not work with loose clothing, open jackets or scarfs, which can be caught in rotating equipment.

4. When opening a panel do not stand directly in front of the door. A loose wire or loose terminals could cause a flash. Stand to the hinge side when opening the door.

5. Treat all exposed terminals as live until you have personally checked them out with a meter. It is good practice to check your meter on a known potential before testing parts to be worked on. Do not depend on someone else to switch off or check a circuit. It is your safety at stake.

6. Never service live AC circuits. Cut power first before attempting to change or tighten components. If power cannot be cut, call a qualified electrician.



W O R K

S A F E

7. When isolating a circuit to be worked on, turn the switch "OFF" and lock it in the off position. If a tagging procedure is policy, be sure to fill in your name, date, and work being performed. If none of these methods can be conducted, remove the main fuses, place a tag or note on the switch and take the fuses with you.

See Accident Prevention Module 216.08 – 216.10 for details

8. Do not crowd a panel. One person at a time should be working in a panel.

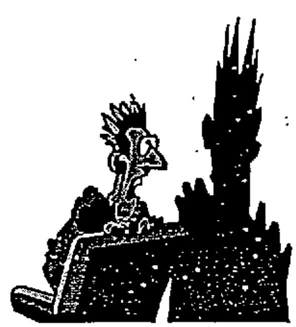
9. If work is required in a partially live panel, do not attempt to do it until a partner is in attendance. Cover live sections with insulating material where practical.

See Accident Prevention Module 106 on "Insulating Blankets"

10. Never leave dropped screws, washers go unaccounted. Retrieve every dropped part. Failure to do so may cause equipment blow out.

11. If panel wiring must be unlaced or wireway covers, etc. have to be removed, be sure things are put back in place upon completion of the job.

Remember that the generator is designed to start automatically. Don't let it catch you by surprise.



W O R K S A F E

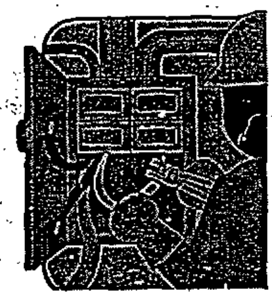
Safety depends on good **maintenance**. All screws on terminals should be checked regularly for tightness. This is especially important on prime power sites. The constant vibration in the generator room makes it especially difficult to keep connections tight.

Be especially careful of the engine battery. Do not use the battery as a tool rack. A wrench dropped across the battery terminal could cause blow out of battery or wrench. This could cause serious burns.

Keep light and open flame away from batteries. Especially if they have been charging. The charging of a battery produces hydrogen gas, which is highly explosive.

Safety with Fuses

12. Testing fuses is not a simple matter and sound safe practices should be used. If the circuit can be isolated, (and this is the safest method) open the disconnect switch and (referring to Diagram 1-A, *on page 6*) test between points marked D & E, D & F, E & F, then D, E, and F to ground respectively to establish a zero potential on the open circuit. Stray voltage may be present by an unintentional cross connection or an induced voltage from parallel lines. When it is certain no potential exists, a battery-powered OHM meter can be used to test for fuse continuity.



SAFETY NOTE:

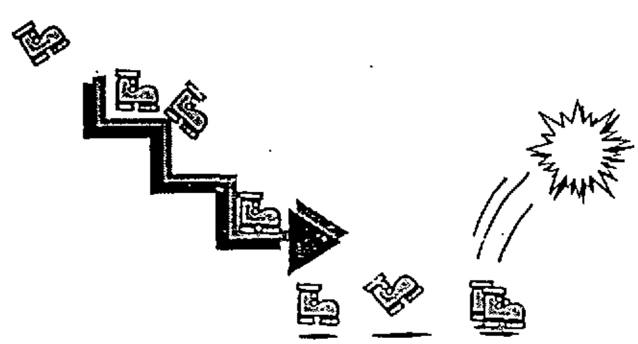
When installing or removing fuses, use the proper sized fuse pullers, not pliers or screwdrivers.

W O R K S A F E

13. If fuses must be tested while energized and in the circuit, you may get some erroneous voltage readings caused by connected loads (refer to Diagram 1-B, *Next page*). Select a tester designed for the job – don't use makeshift sockets, bulbs, etc.. With this tester, first establish if all phases ahead of the fuses are energized by testing between L1 and L2, L1 and L3, and L2 and L3. All readings should be in the same range e.g. 208 to 230 volts or 575 to 600 volts. With a situation as shown in Diagram 1-B, you should test and read as follows:

- Between points A-E = Zero or reduced voltage
- Between points A-F = Full Potential
- Between points B-D = Full Potential

This will establish a blown fuse in a center phase (between Points B-E).



W O R K S A F E

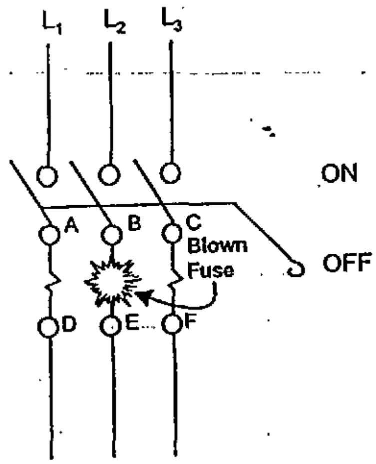


Diagram 1-A
Disconnect Switch OPEN

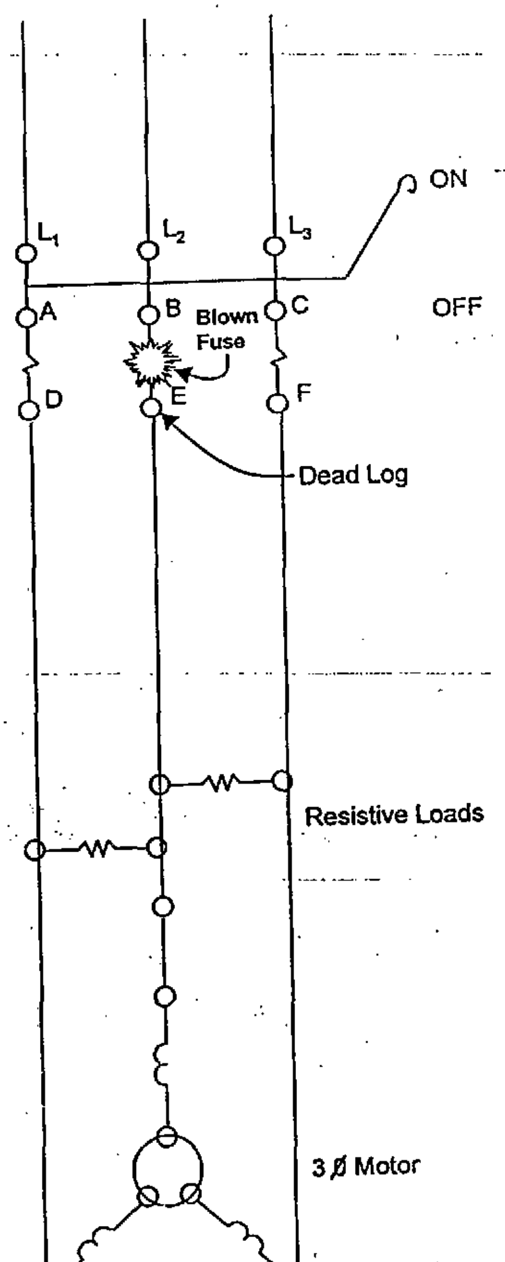


Diagram 1-B
Disconnect Switch CLOSED

Disconnect Switch, Fuses & Connected Loads

W O R K

S A F E

Cont...

13. Don't be fooled by the feedback voltage at Terminal E. This can be sustained by continuity through transformer windings or any other load connected between either of the opposite outer phases.

SAFETY NOTE:

When the fuse is to be replaced, never install it with the disconnect switch in the "ON" position, the resulting current inrush and electrical discharge can cause sever burns.

14. Replace the fuse with one of the same voltage, current rating and type.

15. Before restoring the main switch, open any circuit breakers or disconnects downstream of the blown fuse.

16. After replacing the fuse **close the door** on the disconnect and standing to one side, engage the switch. If possible, establish line voltage with a meter on all three secondary lines.

17. Build up secondary loads slowly until full load is established. If the fault is still in the circuit, the fuse is likely to blow again as the breaker or switch is cut on line. If this is the case, go back to *Step 13* and follow through, leaving the faulty circuit open until repairs can be made.

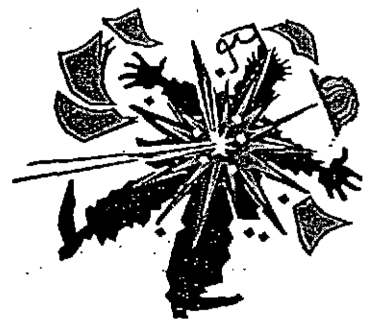
W O R K S A F E

Testing Terminals for Power Before Working On Them

If you have to work on terminals or lines that at one time have been energized, you must be sure they are "dead" before commencing work.

If possible, test the circuit with power on and then again after the control switch has been properly disconnected, tagged, and locked out. This will confirm you are tagging and locking the correct switch.

When you have tested the terminals between phases and from each phase to ground, and you are satisfied the circuit is "dead" and safe, ONLY THEN should you use a finger thumb test. This is done by holding your thumb on a grounded frame or the like and touching each terminal with a finger of the SAME hand. This may sound a little foolhardy at first, but if you think about it, keeping in mind you intend to work on the equipment with bare hands anyway – wouldn't you rather get a "tingle" between your thumb and finger than a possible fatal jolt from one hand, through your body and out the other hand or foot? Remember, this test can only be made after your meter has pronounced the line "dead".



Reference Information:

Accident Prevention Process (APP) – Modules 6, 105, 106 & 216

Objectionable Current Flowing Through the Grounding Path: Part 1

Mike Holt, Mike Holt Enterprises Inc, Tamarac, Florida

The 1999 National Electrical Code specifies in Section 250-6(a) that electrical systems, circuit conductors, electrical equipment and conductive metal parts be installed so that objectionable current does not flow through the grounding path.

To apply this rule, we must understand that the purpose of the NEC "is the practical safeguarding of persons and property from hazards arising from the use of electricity" [90-1(a)]. This rule is to prohibit current from flowing through the grounding path causing a fire or electric shock. NEC Section 250-6(c) clarifies this rule by stating: "Temporary ground-fault current on the grounding path for the purpose of opening the circuit overcurrent protection device to remove dangerous voltage from metal parts is not classified as objectionable current" (*Figure 1.*)

Author's Comment: Any current flow through the grounding path, except temporary ground-fault current, is considered objectionable current flow and prohibited by the NEC.

To ensure proper grounding of sensitive electronic equipment, Section 250-6(d) states that current on the grounding path, which causes electrical noise, electromagnetic interference or data errors, is not objectionable. This section requires sensitive electronic equipment to be properly grounded by a low impedance path so that a phase-to-ground fault can be quickly cleared and dangerous voltage on the metal parts of the electrical system removed (*Figure 2*).

Author's Comment: See Sections 210-7(c), 250-96(b), 250-146(d) and 384-20 for more details on grounding sensitive electronic equipment.

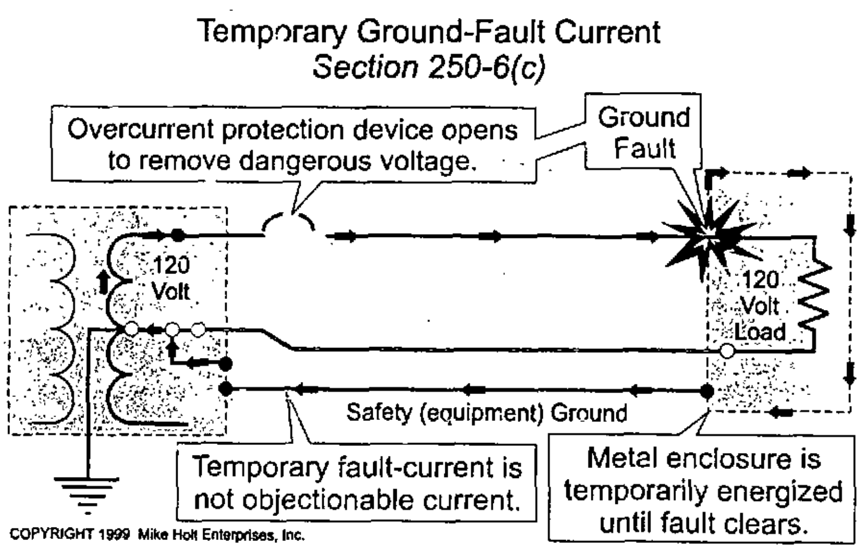


Figure 1. *Temporary Ground-Fault Current: Section 250-6(c)*

What Causes Objectionable Current to Flow Through the Grounding Path?

Objectionable current on the grounding path is always created by improper wiring of the electrical system. Three ways this objectionable current occurs:

- An improper neutral-to-ground connection
- Errors in the wiring installation
- Improperly using the grounding path to carry neutral current

Improper Neutral-to-Ground Connection – Panelboards

The National Electrical Code specifies that a neutral-to-ground connection *is not* permitted on the load side of service equipment, except as permitted for separately derived systems [Sections 250-24(a)(5) and 250-142]. However, because of ignorance and a lack of

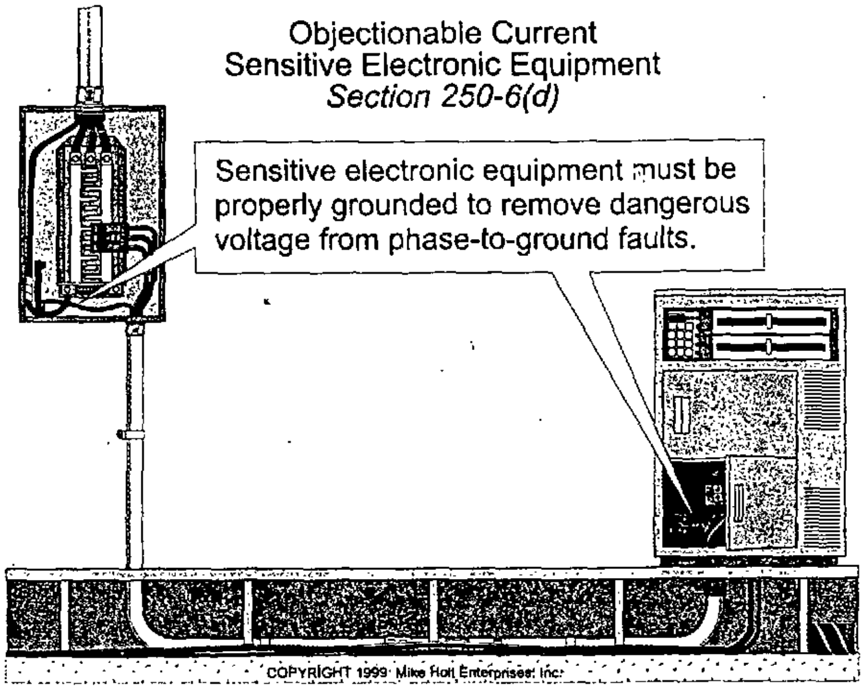


Figure 2. *Objectionable current sensitive electronic equipment: Section 250-6(d)*

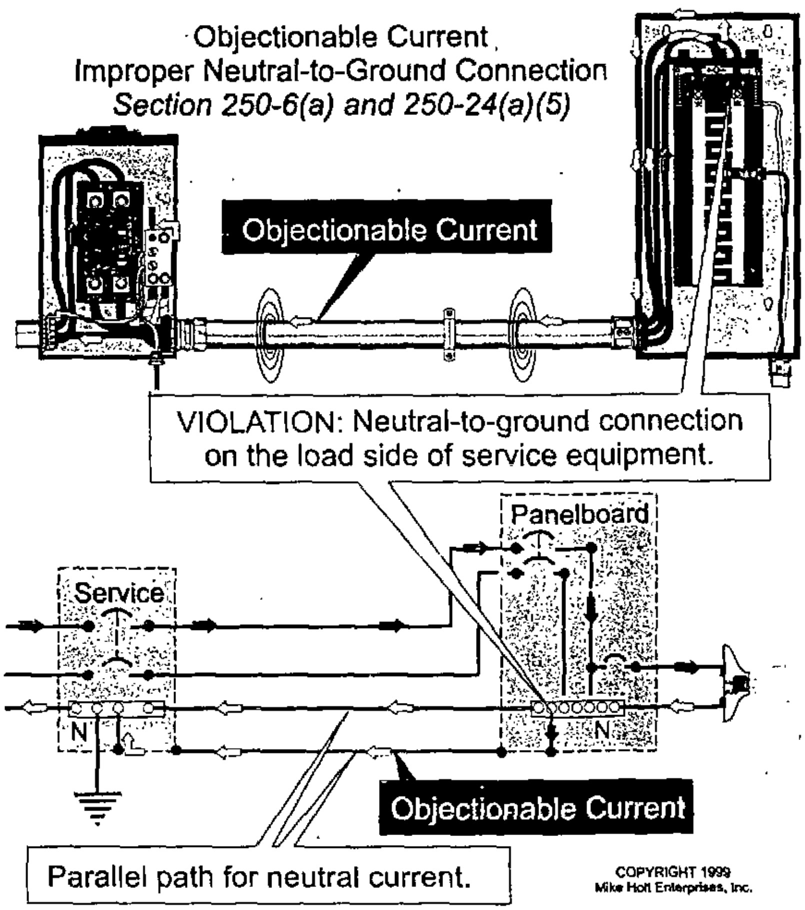


Figure 3. *Objectionable current improper neutral-to-ground connection: Section 250-24(a)(b).*

proper training, many in the electrical industry make or are instructed to make a neutral-to-ground connection at panelboards that are located on the load side of service equipment.

Bonding of neutral-to-ground in a panelboard located on the load side of service equipment creates a parallel path for neutral current. This parallel path allows neutral current to flow on the neutral conductor as well as objectionable (neutral) current to flow through the grounding path. *(Figure 3).*

Separately Derived Systems

The National Electrical Code requires a neutral-to-ground connection for a separately derived system (transformer, generator UPS system) to be installed at the separately derived system or at the first disconnect after the separately derived system, but not at both locations [250-30(a)(1) Exception].

Transformers: If a neutral-to-ground connection is made at both the transformer and at the secondary panelboard, then neutral current will return on the neutral conductor and objectionable (neutral) current will flow through the grounding path. *(Figure 4).*

Generators: Section 250-20(d) of the NEC requires a neutral-to-ground connection for a generator that is a separately derived system to be installed at the generator or at the first disconnect. In addition, Fine Print Note No. 1 to Section 250-20(d) warns the NEC user "*An alternate ac power source such as an on-site generator is not a separately derived system if the neutral is solidly interconnected to a service system neutral.*" *(Figure 5).*

If the neutral conductor in the transfer switch is not switched, then the neutral from the generator will be solidly interconnected to a service system neutral. Under this condition, the generator is not considered a separately derived system and a neutral-to-ground connection must not be made at the generator or at the generator disconnect. In addition, there is no requirement for the generator to be grounded to a grounding electrode (earth). *(Figure 6).*

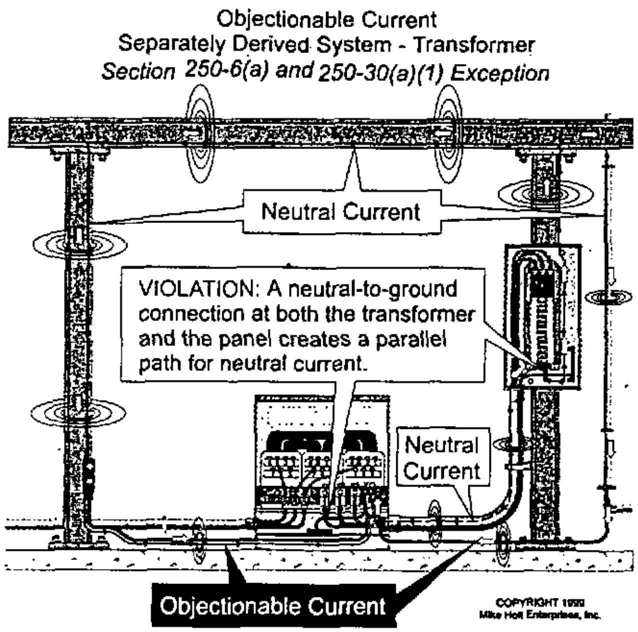


Figure 4. *Objectionable current separately derived system: transformer section 250-6(a)(1) exception.*

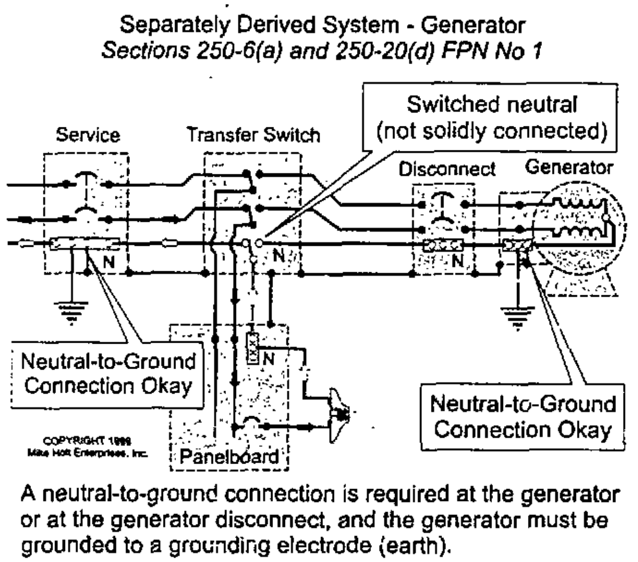


Figure 6. *Separately derived system – Generator: sections 250-6(a) and 250-20(d) FPN no 1.*

Author's Comment: *Generators are often improperly grounded in the field resulting in objectionable (neutral) current flow through the grounding path. The main reasons for this is that the generator is supplied from the manufacturer with a neutral-to-ground connection made in the generator (in accordance to UL requirements), and many use transfer switches that do not switch the neutral because they are less expensive.*

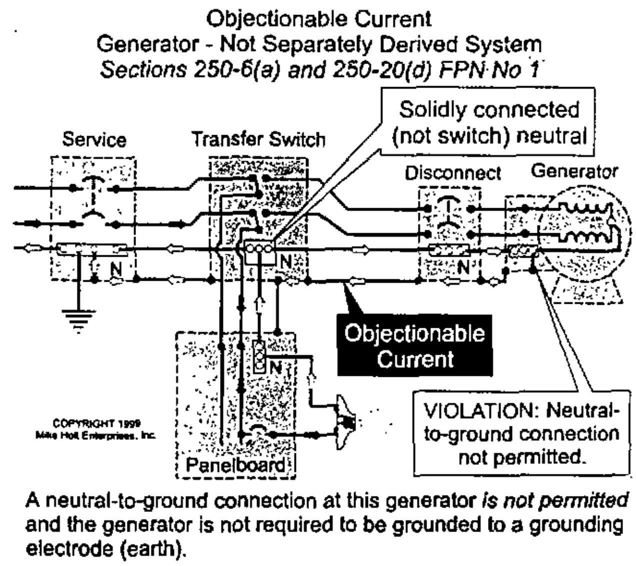


Figure 5. *Objectionable current gererator – not separately derived system: sections 250-6(a) and 250-20(d) FPN no 1.*

APR 19 1999

CERTIFICATION Informs...

An INFORMATION Bulletin from the Certification Division

April 5, 1999

SPECIAL BULLETIN FOR CSA INTERNATIONAL CERTIFICATION CUSTOMERS

New marking options for the United States

CSA International is pleased to announce new marking options to help you promote your products in the U.S. The new markings, which may be used as of July 1, 1999, include the familiar CSA monogram plus the indicator "US" or "C" and "US", as follows:

for the U.S.	*for the U.S. and Canada*
US	C US

These markings provide an alternative to the CSA NRTL and CSA NRTL/C markings, which have been in use since 1992 when CSA received accreditation in the U.S. from the Occupational Safety and Health Administration (OSHA) as a Nationally Recognized Testing Laboratory (NRTL). You may either use the new U.S. marking or continue to use the original markings for products covered under the OSHA NRTL program.

Why change?

The new markings—which are being introduced at the request of manufacturers—are designed to benefit everyone in the product cycle, including manufacturers, regulators and product users. Our aim is to provide a marking scheme that is clear and easy to understand, and that emphasizes CSA International's ability to serve the U.S. market.

Products tested primarily for the Canadian market will continue to use the SP mark without indicators.

over...

Call CSA International

For more information on the new markings, visit our Website at **www.csa-international.org** (or go directly to **www.csa-international.org/product_services/index_cert.html** and click on Certification Marks). To obtain photo-ready artwork, please contact one of the following:

- your CSA International representative

or

- **Customer Service**
  CSA International
  1-800-463-6727 or (416) 747-4007

or

- **Mary Beth Sonneborn**
  Manager, Business and Quality Assurance
  CSA International
  phone: (216) 524-4990
  e-mail: mbsonneborn@ias-us.org

Yours truly,

Pat Paladino

Pat Paladino
Vice-President, Certification and Testing
CSA International

Certificate of Compliance

Certificate Number: LR 32333-34

Revision: LR 32333-41 **Date Issued:** August 29, 1996

Issued To: Thomson Technology Inc.
19214 - 94th Avenue
Surrey, B.C. V3T 4W2

The products listed below are eligible to bear the CSA Mark.

Note: The "NRTL/C" indicator appears adjacent to the CSA Mark.

Issued By: Dinarte Bairos, P. Eng.
Vancouver, BC Canada

Signature Dinarte Bairos

CLASS

3211 01 - SWITCHES - Transfer Type
3211 81 - SWITCHES - Transfer Type

PRODUCTS

PART A: Automatic Transfer Switches; Type A or B; 2-, 3-, or 4-pole; style M or T; open or enclosed; 600 V ac max, 1200 A max, series TS750C, TS850C and TS760C. Ratings as follows:

se

Certificate of Compliance

Certificate Number: LR32333-34

Revision: LR 32333-41 **Date Issued:** August 29, 1996

Series	Voltage	Amps	Poles	Type	Style
TS750C, TS850	600 (max)	100	2, 3, 4	A, B	M
TS750C, TS850	600 (max)	150	2, 3, 4	A, B	M
TS750C, TS850	600 (max)	250	2, 3, 4	A, B	M or T
TS750C, TS850	600 (max)	400	2, 3, 4	A, B	T
TS750C, TS850	600 (max)	600	2, 3, 4	A, B	T
TS750C, TS850	600 (max)	800	2, 3, 4	A, B	T
TS760C	240 (max)	100	2, 3, 4	A, B	M
TS760C	240 (max)	150	2, 3, 4	A, B	M
TS760C	240 (max)	250	2, 3, 4	A, B	M or T
TS760C	240 (max)	400	2, 3, 4	A, B	T
TS760C	240 (max)	600	2, 3, 4	A, B	T
TS760C	240 (max)	800	2, 3, 4	A, B	T
TS750C, TS850	600 (max)	1200	2, 3, 4	A, B	T

PART B: By-pass/Isolation Switches, 2-, 3-, or 4-pole; Series IBS-770C, 1200 A max, 600 V ac max.

PART C: Service Entrance Transfer Switch for "T" style. For the US only. Suffix "SE" is added to "T" Style Transfer Switches in Part A to denote Service Entrance type.

Notes:

1. These switches are not suitable for use as service entrance equipment.
2. The Transfer Switch open type construction is certified as a component in other equipment where the suitability of the combination is to be determined by CSA.
3. For the Automatic Transfer Switches, "CS" may be substituted for the "TS" in the series designation for marketing purposes only. Units similar in construction.
4. Transfer Switch and Bypass/Isolation Switch series numbers have suffixes to denote electrical and mechanical variations.
5. The style designation M or T is the submittor's designation only.
6. Models TS750 use controller type TSC 700 and Models TS850 use controller type TSC 800.

APPLICABLE REQUIREMENTS

CAN/CSA-C22.2 No 0-M91	-	General Requirements - Canadian Electrical Code, Part II
0.4-M1982	-	Bonding and Grounding of Electrical Equipment (Protective Grounding)
178-1978	-	Automatic Transfer Switches
UL 1008	-	Automatic Transfer Switches
UL 508	-	Industrial Control Equipment

se

LR 32333-40

November 23, 1995

Mr. Bob Thomson
Thomson Technology Inc.
19214 - 94th Avenue
Surrey, B.C. V3T 4W2

Subject: Addition of Service Entrance Option For "T" Style Transfer Switches For The U.S.
Update to Report LR 32333-34

Dear Mr. Thomson:

We are pleased to inform you that the subject equipment meets the applicable requirements. This equipment is therefore eligible to bear the CSA Mark with NRTL/C indicator in accordance with instructions contained in the Certification Report.

The documents listed below are enclosed for your files. Please forward a copy of the updated Certification Report to each factory producing this equipment.

In due course you will receive a statement of your account as it concerns this application.

Yours truly,

Dinarte Bairos

Dinarte Bairos, P. Eng.
Pacific Region

Encl. Updated Certificate of Compliance
Updated Certification Report
Updated Certification Record
Updated Profile of Certification Reports

cc: CSA Pacific Region, Engineering, Inspection

12.0 TRANSFER/BYPASS SYSTEMS

12.1 Transfer Switch Basics

.1) The automatic transfer switch (ATS) is the "heart" of the Standby Power Generation system or Emergency Power System. It is the first (and last!) link in the emergency power supply network. The ATS must:

(a) Sense the out of limits condition of the normal power source.

(b) Initiate the starting of the generator set.

(c) Disconnect the normal source from the load.

(d) Connect the generator set source to the load when its output is within acceptable limits (transfer load).

(e) Sense the return and stabilization of the normal source to within the desired limits.

(f) Retransfer loads from the generator set to the normal source.

(g) Provide off-load cool-down period for the generator set. (Optional)

(h) Signal the generator set to stop.

.2) In addition to the foregoing control and switching functions the ATS must also:

(a) Positively isolate the two sources to ensure **no** possibility of inadvertent paralleling.

(b) Allow (and withstand) system fault currents to pass through the switch contacts and power conductors from the source to the fault location.

.3) There are many manufacturers and types of transfer switches. Some of the common transfer mechanisms utilized are:

(a) Interlocked Contactors. This scheme utilizes two standard industrial electrical contactors or motor starter contactors. Two contactors are mounted together and are **mechanically** and **electrically** interlocked so that **only** one contactor can be closed at any one time. Reversing motor starters are similarly arranged and it is common to utilize a standard reversing motor starter as the basic mechanism for a transfer switch.

This type of switch is commonly built up using a wide variety of reversing contactors.

- Allen Bradley
- MTE
- Klockner Moeller
- Westinghouse
- GE
- etc.

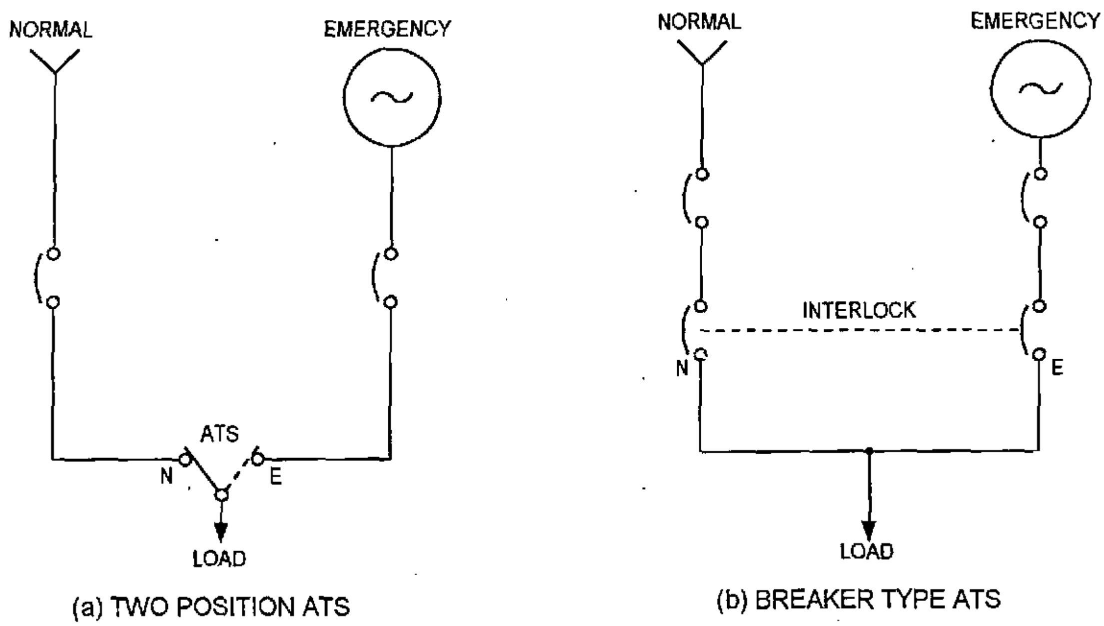


FIGURE 12.1.1

(b) **Breaker Type ATS.** Mechanically interlocked electrically operated dual circuit breakers or switches. These are commonly non automatic (no thermal trips) molded case breakers or switches with single or multiple yoke drive arms or a walking beam type operator. These designs inherently incorporate a mechanical interlock means within the mechanical linkages or placement of the breakers/switches. Most common are Thomson Technology Inc. and Westinghouse Robonic. Many manufacturers use the basic Robonic mechanism with their own controls. Klockner

Moeller, Zenith, ITE and others also build ATS's with similar arrangement.

(c) **Two Position ATS.**Transfer contacts specifically arranged for ATS duty. Usually two sets of contacts on a common operating arm (or two mechanically linked operating arms) with a solenoid or motor operated positioner. Contacts are arranged so that one set opens before the other set closes.

This arrangement is typical of Asco electric Co. ATS's. Other firms such as Zenith, Onan, etc. build similar devices.

(d) High voltage transfer switches typically utilize appropriate standard high voltage contactors or power circuit breakers. Devices are arranged so as to permit mechanical interlocking.

(e) Low voltage transfer arrangements can also be built up using interlocked power circuit breakers.

12.2 Transfer Switch Sensing/Control Systems

.1) Normal source voltage sensing may be achieved in a variety of ways. The requirements are:

(a) Sense each line to line (or line to neutral) phase voltage.

(b) Provide for initiation of start up and transfer to generator source when any phase voltage deviates from normal by some amount.

(c) Relay(s) must sense when all phases return to within the normal range.

.2) Commercially available transfer switches usually include adjustable low voltage sensing relays (VSR). The VSRs are typically adjusted to pickup when the source voltage rises above 90% of nominal. The VSRs are typically adjusted to allow dropout should the sources voltage drop below 80% of nominal. All phases are required to rise above 90% of nominal before the system is considered normal, however only 1 phase needs to drop below 80% of nominal to become deemed out of limit.

Most systems utilize two relays to monitor 3 phases. These provides adequate protection for most site applications. However where 3 phase electric motors represent a large portion of the connected load, 3 separate VSRs with close differential can be utilized. However even 3 separate VSRs may not sense for a partial low voltage condition on one phase. VSRs may not dropout in this condition resulting from regenerative voltage or Back EMF from a light loaded electric motor. Alternatively a 47N (phase balance) relay can be added to sense for this condition. The 47N relay can provide single phase protection for motors. Operating electric motors with a L-L voltage differential greater than 5-6% (recommended max.) will result in an increase in current flow for the motors to deliver the desired output. Premature motor failures will result.

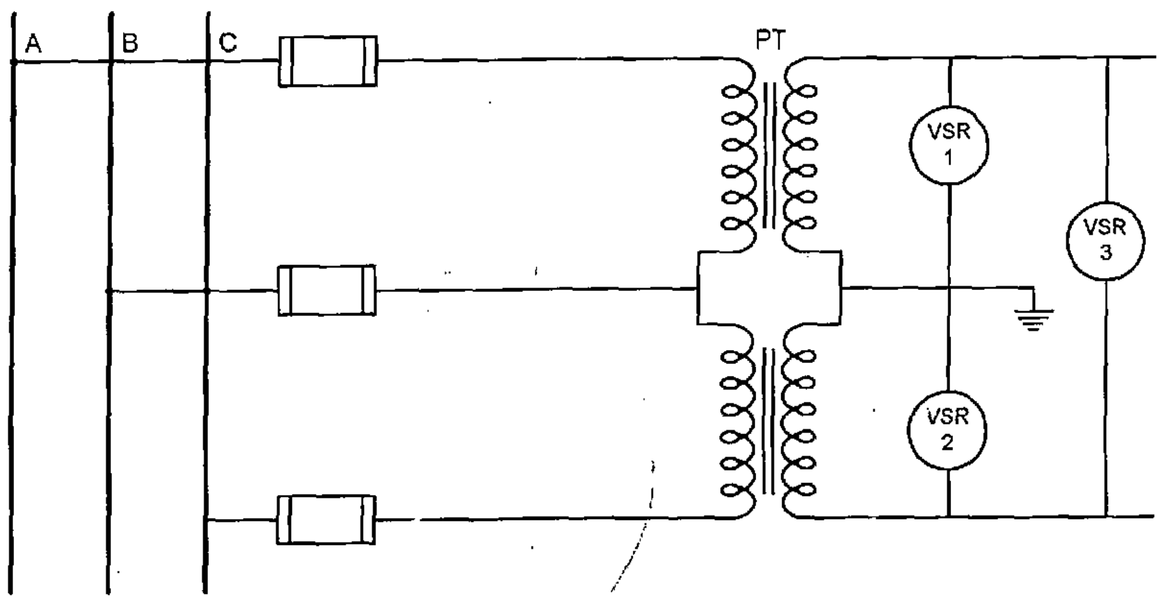


FIGURE 12.2.2

.3) Some systems utilize a "built-up" ATS consisting of reversing contactors or power circuit breakers. This type of ATS may incorporate a similar sensing arrangement as previously described or may include a 3 phase under/over voltage relay such as the Westinghouse CP reverse phase voltage relay or a Basler BE1-27/59/47 (under/over/neg. sequence) relay. These relays can provide for 3 phase monitoring with inverse time delay on low or high voltage conditions. Voltage pickup points are adjustable. The inverse time delay is not adjustable. The greater the deviation from the setpoint, the faster the relay will operate.

.4) The VSR contact(s) are used to initiate engine startup. There may be an additional start delay timer included to allow a delay of 2 or 3 seconds to avoid startup on momentary excursions. (Particularly if VSRs do not include time delay.)

.5) In some applications the emergency source voltage is also monitored, the same as normal source. If, while running, the emergency voltage exceeds adjustable high and low limits the generator set is shutdown. This monitoring is usually part of the engine/generator sensing devices, and is **not** actually part of the control or functioning of the ATS. It is an electrical protective device in the generator set controls.

.6) The ATS controls utilized, depend on the type of transfer mechanism.

(a) Electrically held contactor type ATS's require continuous control signal to maintain the required source. This is typical of reversing contactor type ATS's. These are typically utilized on single phase and some low power non critical 3 phase applications.

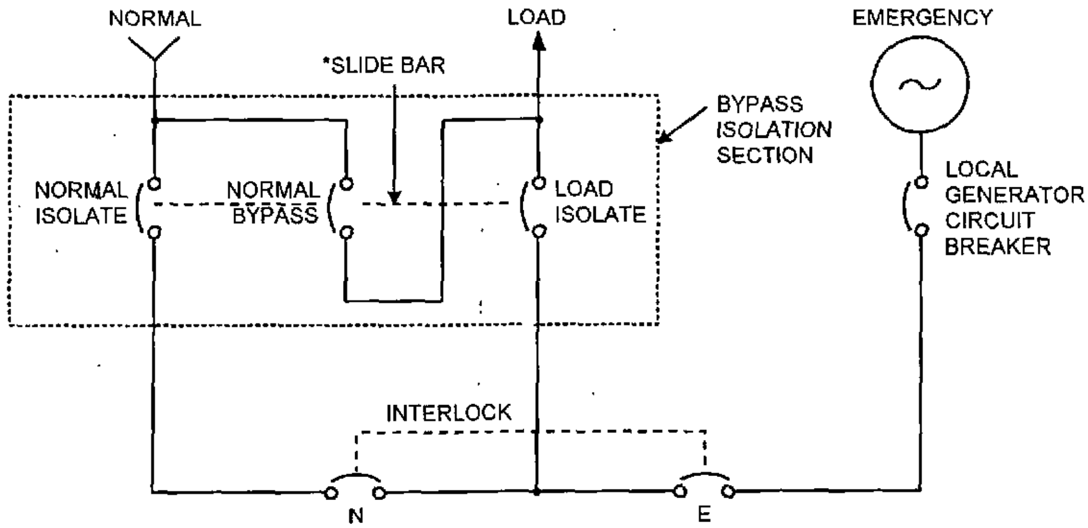
(b) Electrically operated, mechanically held ATS's require momentary open/close or pulse signals to the appropriate transfer mechanism. This is typical of TTI, Robonic or Asco type transfer switches.

(c) Electrically operated, electrically tripped contactor or breaker type ATS's require momentary close signals and momentary trip signals to both normal and emergency.

.7) Some systems require that the normal source be immediately disconnected on overvoltage conditions. This is readily accomplished with electrically held or tripped breaker or contactor type ATS's. For mechanically held ATS's it entails special circuitry or a separate device (such as an electrically operated normal source breaker).

Depending on the application it may be desirable to also immediately disconnect the normal source on a low voltage condition (rather than wait until emergency source is ready to assume the load). Again the method employed will depend on the ATS arrangement utilized.

12.3 Bypass System Basics



*NOTE: SLIDE BAR ARRANGEMENT ALLOWS NORMAL BYPASS SWITCH TO CLOSE ONLY IF LOAD ISOLATE SWITCH IS OPEN.

FIGURE 12.3.1

.1) All transfer switches ultimately require service and maintenance. The switch must then be isolated from live sources, and may require physical removal. When connected loads cannot be disrupted, some alternative route for power flow to the load is required in order to service the transfer switch while maintaining power supply to the load.

Figure 12.3.1 depicts a common arrangement where draw-out breakers are utilized for the ATS. Two additional breakers are required to achieve the bypass capability. This arrangement only allows bypass with the normal source. The emergency source cannot be utilized while the ATS is being serviced.

.2) For some ATS's the bypass and isolation system requires a somewhat different approach as shown in *Figure 12.3.2*. Again, this arrangement does not allow for use of the emergency source during ATS maintenance.

.3) Another bypass isolation arrangement which includes either emergency or normal bypass is shown in *Figure 12.3.3*. This is of a Bumpless arrangement. To provide the bumpless transfer of the current source, the alternate source isolate switch must first be opened. Slide the slide bar to allow the bypass switch of the source to be bypassed (i.e. NB to bypass NI switch) to be closed; once this breaker has been closed, the source and load isolate switches can be opened. With the switches in these positions, the transfer switch and it's controls are void of AC voltage. Should the power fail during service, the 2 bypass switches can be utilized as a manual transfer switch. The switches in the bypass arrangement have the same withstand ratings as the switches in the transfer switch.

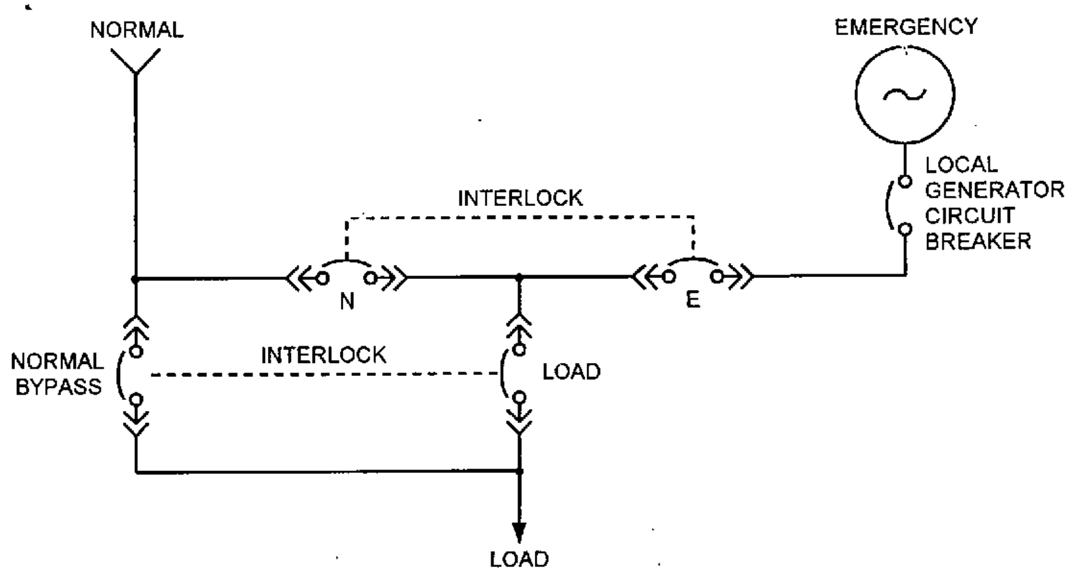
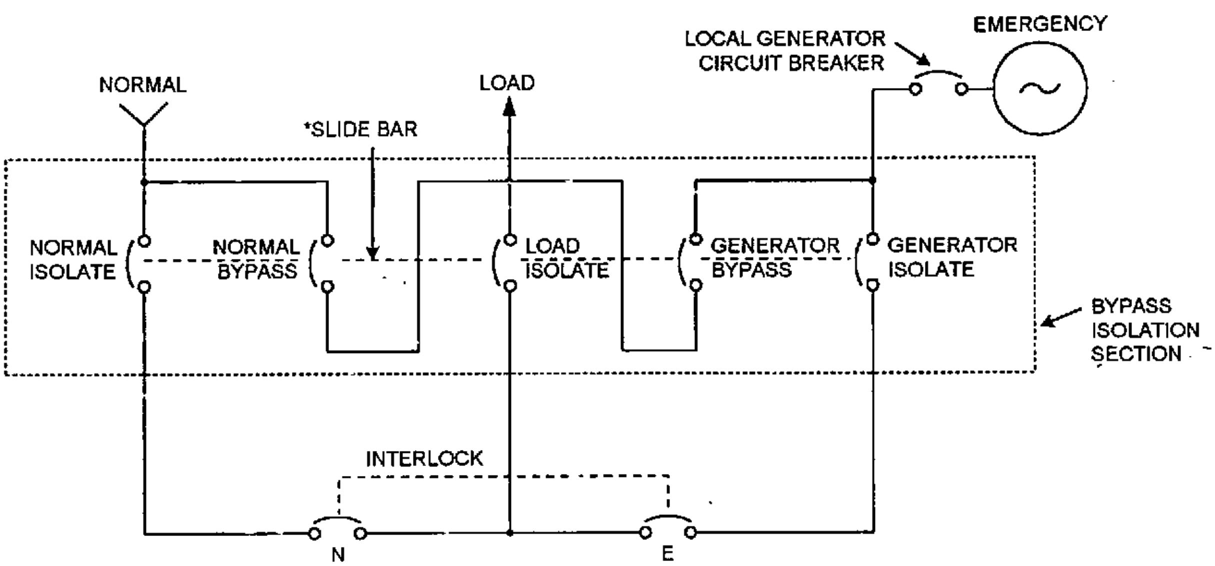


FIGURE 12.3.2



*NOTE: SLIDE BAR ARRANGEMENT ALLOWS BUMPLESS BYPASS FOR EITHER EMERGENCY OR NORMAL SOURCE, AND PERMITS MANUAL TRANSFER OPERATION WHILE SERVICING THE ATS.

FIGURE 12.3.3

.4) Bypass arrangements can be achieved with fixed or drawout breakers or with manual switches. The system protection devices and potential fault currents are a major factor in selecting the bypass arrangement. A properly confirgured bypass arrangement should remove all sources of voltage from the transfer switch controls and mechanism for servicing.

12.4 Low Voltage Systems (Under 750V)

.1) The following enclosed drawings depict some typical Low Voltage transfer and bypass arrangements. Both single line and control schematic diagrams are included for review and discussion.

–

–

12.5 High Voltage Systems (Over 750v)

.1) Typical High Voltage transfer/bypass panel arrangements and related power, control and metering schematics are shown on enclosed drawings:

–

–

12.6 Thomson Technology Inc. Equipment

.1) Thomson Technology Inc.(TTI) manufacture a complete range of low and high voltage transfer switches (up to 15kV).These can be supplied in various arrangements, electrically operated mechanically held, stored energy air circuit breaker and contactor type. A comprehensive arrangements of bypasses for the transfer switches are also available. TTI transfer switches and bypasses are specified and applied in a wide variety of applications. TTI product data enclosed includes:

–

–

–

12.7 Westinghouse Robonic and Derivatives

.1) Westinghouse manufactures a low voltage Automatic Transfer switch using two mechanically interlocked molded case circuit breakers with an electrically operated (motor driven) walking beam operating mechanism.

Westinghouse also markets the basic switching mechanism (breakers, operator and interlock) to various electrical equipment manufacturers. They in turn build a completed transfer switch using their own sensing and controls, enclosure and optional accessories mated to the basic Robonic mechanism. (These are **not** Westinghouse Robonic transfer switches!)

Robonic switches (and derivatives) generally utilize non automatic circuit breakers (no long time overload trips).

Various bypass arrangements can be utilized to permit service.

Actual schematic drawings must be utilized for service, troubleshooting and adjustments.

12.8 Contactor Schemes

.1) Electrically held mechanically interlocked contactor arrangements are commonly utilized on a wide variety of systems, but typically limited to low amperage ranges. Since 1978 when CSA's standards were upgraded, contactor schemes have largely been eliminated because they generally have inadequate withstand ratings and are difficult to apply.

.2) Suitable contactors (and reversing starter contactors) are available from a number of manufacturers.

12.9 General

.1) The basic principles of all automatic transfer and bypass systems are similar. The methods and equipment utilized to achieve the results are many and varied. Different manufacturers using identical components will often utilize different methods to achieve the same result.

.2) All ATS electrical and troubleshooting must commence with actual diagrams and instructions for the specific ATS equipment.

12.10 Self Test

____ 1. A transfer switch must positively isolate the two sources from the load at all times and under all conditions. ☐ TRUE ☐ FALSE

____ 2. In an automatic transfer switch the priority position is usually the:

- __✓__ (a) Normal source.
- ____ (b) Emergency source.
- ____ (c) Neutral or all open position.

____ 3. A single phase 3 wire (properly called 2 phase) transfer switch requires 3 voltage sensing relays to properly sense out of tolerance supply conditions. ☐ TRUE ☐ FALSE

____ 4. Electrically held contactor type transfer switches require:

- __✓__ (a) Mechanical interlocks.
- __✓__ (b) Continuous control power.
- ____ (c) Electrical interlocks.

____ 5. The voltage sensing relays of an ATS should normally be set to about:

- ____ (a) 90% drop out, 110% pickup.
- __✓__ (b) 80% drop out, 90% pickup.
- ____ (c) 30% drop out, 60% pickup.

____ 6. A transfer switch must have a frequency sensing relay on the normal and emergency sources. ☐ TRUE ☐ FALSE

____ 7. The purpose of a transfer bypass system is to permit ATS maintenance while powering the load. ☑ TRUE ☐ FALSE

____ 8. When using the bypass feature of a transfer and bypass panel, the bypass system will automatically transfer to the alternate source if one source fails. ☐ TRUE ☐ FALSE

____ 9. An ATS of a critical emergency power system should be functionally tested:

- __✓__ (a) Weekly.
- __✓__ (b) Monthly.
- ____ (c) Annually.
- ____ (d) At least every 5 years.

THOMSON TECHNOLOGY INC.

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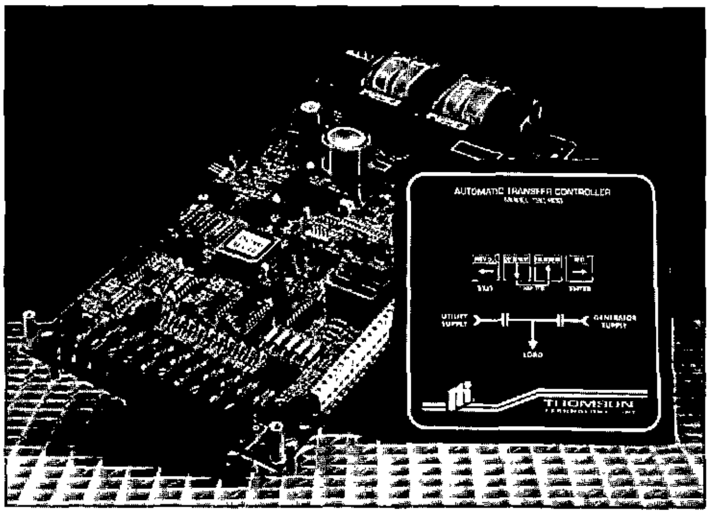
AUTOMATIC TRANSFER SWITCH CONTROLLER

Model TSC 800



- Microprocessor-based circuitry provides ultimate reliability and versatility
- User-friendly operator interface
- Backlit LCD display screen with alpha-numeric readout for display and programming
- Digital voltage and frequency display for generator and utility supply
- Optional remote communication serial port
- Non-volatile memory retains logic and setpoints if control power is lost
- Direct 3 phase voltage sensing inputs on generator and utility supplies from 120VAC to 600VAC (nominal)
- Security password-protected programming levels
- Self-diagnostic features continuously verify processing, I/O and memory circuits
- Quality Assurance System ISO 9001

GENERAL DESCRIPTION

The Thomson Technology **TSC 800** automatic transfer controller provides the latest advancements in microprocessor design technology for control of automatic transfer switches. The **TSC 800** is factory configured to control all the operational functions and display features of the automatic transfer switch. All standard and optional control features of the **TSC 800** are fully programmable from the front panel LCD display and are security password protected. The LCD display screen prompts are in plain English, providing a user-friendly operator interface with selectable display options. The microprocessor design provides high accuracy for all voltage sensing and timing functions as well as providing many standard features which are only available as add-on options on other transfer switches.

MODELS

- **TSC 800** - 115
  (for nominal 115VAC power supply inputs)
- **TSC 800** - 230
  (for nominal 230VAC power supply inputs)

STANDARD CONTROL FEATURES

- Engine start contact - Form C, 10A 120/240VAC resistive
- Utility undervoltage sensing - 3 phase, 70-100% adjustable c/w time delay
- Generator undervoltage sensing - 3 phase, 70-100% adjustable c/w time delay
- Generator under/over frequency sensing (40-70 Hz c/w time delays)
- Transfer to utility timer 0-30 min.
- Engine warm-up timer 0-1800 sec.
- Engine start delay timer 0-60 sec.
- Engine cooldown delay timer 0-30 min.
- Neutral position delay timer 0-60 sec.
- Programmable function contact - Form C, 10A, 120/240VAC resistive
  - load on utility supply
  - load on generator supply
  - utility supply normal status
  - fail to transfer
  - load shed
- Load on utility output signal 3A, 120/240VAC resistive
- Load on generator output signal 3A, 120/240VAC resistive
- On load/off load exercise timer 24 hour / 7 day (single occurrence)
- Load on utility status-green LED light
- Load on generator status-red LED light
- On load/off load test push-buttons

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OPERATOR CONTROLS

- Four front panel mounted push-buttons provide the following functions:
  - Display option menu
  - On load/off load test menu
  - Programming entry/exit
  - Programming value increment
  - Programming value decrement
  - Lamp test
- LED indicators:
  - Load on utility supply
  - Load on generator supply
- LCD Display Options:
  - *Timer countdown functions*
  - 3 phase utility voltage, frequency
  - *3 phase generator voltage, frequency*
  - Exercise time clock
  - *System status condition*

ADVANCED FEATURES

- 3-Phase voltage sensing on both utility and generator sources with direct input voltage up to 600VAC (nominal).
- Superior EMI/RFI noise immunity and surge performance design features as per IEEE C62.41 requirements.
- Under/over voltage and frequency monitoring of both sources with user adjustable transient time delays for *each individual function.*
- Dual source system logic can provide control for two *generator sources or dual utility feeder applications.*
- Automatic plant exercise timer with user selectable *time setting for on or off load exercising.*
- Optional pre/post transfer signal contacts provide signals to remote devices (ie. elevator controls) to warn system of impending transfer to either source.
- Flexible design programming allows user configuration for many system types (ie. 3-phase or 1-phase, up to system voltages of 15KV, 50 or 60Hz system frequency, etc.
- Automatic re-transfer to utility supply during test/ exercising modes when generator fails.
- Diagnostic status LEDs for:
  - CPU running (watchdog)
  - Engine start output activated
  - Transfer to utility supply output activated
  - Transfer to generator supply output activated
- Programmable auto callout signal to remote monitoring device when remote communication serial port option is ordered.

SPECIFICATIONS

- POWER SUPPLY:
  - 115 or 230VAC nominal (-30%, +10%)
  - 50/60 Hz
  - 100ma nominal (no external load connected)
- VOLTAGE SENSING:
  - Direct 120-600VAC (nominal) single or three phase
  - 50/60 Hz
  - +/-0.5% accuracy of setting @ 25°C
- OPERATING TEMPERATURE:
  - -0°C to +50°C
- OUTPUT CONTACTS (Form C, 10A, 120/240VAC resistive)
  - *Engine start*
  - Programmable function ⚠
- OUTPUT SIGNALS (120/240VAC resistive load)
  - *Transfer to utility* 10A
  - Transfer to generator10A
  - Pre/post-transfer to utility 3A
  - Pre/post-transfer to generator 3A
  - Load on utility 3A
  - Load on generator 3A

OPTIONAL CONTROL FEATURES

- Pre/post-transfer to utility signal output 3A, *120/240VAC resistive (0-30 sec.)*
- Utility under/over frequency sensing *(40-70Hz c/w time delays)*
- Pre/post-transfer to generator signal output 3A, *120/240VAC resistive (0-30sec.)*
- Dual source system control logic
- *Utility over voltage sensing - 3 phase,* 100-130% adjustable c/w time delay
- *Generator over voltage sensing - 3 phase,* 100-130% adjustable c/w time delay
- Remote Communication Port (RS422). Can be used in conjunction with external TTI Communication Module (CIM module not included). ⚠2
- Communication Interface Module with internal 14.4Kbaud modem, RS232/422/485 ports and Modbus™ protocol. One CIM module provides communication interface for up to ten TSC 800 controllers with COM per system. ⚠2

⚠ Not available with dual source system control logic

⚠2 *Refer to separate literature for additional information*

Note: Specifications subject to change without notice.
CL028 Rev8 00/11/01

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TYPICAL AUTOMATIC TRANSFER SWITCH COMMISSIONING

NOTE: Work should be performed by qualified personnel only. Ensure the Isolation Plug is pulled prior to energizing the supply sources. Failing to do this may result in equipment failure or personnel injury. Manually place the transfer switch mechanism in the neutral position prior to applying power.

Pre-Commissioning Checks Prior to Commissioning Agent On-Site (to allow loads to be supplied prior to final commissioning)

1) Verify supply source voltage to be applied to the transfer switch is of the correct nominal value. Confirm this to be the same as listed on the electrical drawings and the panel certification label.

2) Confirm cable size is correct for the lugs supplied in the transfer switch (line and load). Confirm the cables were meggered by the electrical contractor to ensure no cross phase connections or conduction to ground.

3) Confirm cable lugs are properly torqued. Confirm cable installation, ensure the cables do not interfere with normal equipment operation or cause component damage.

4) Manually operate the transfer mechanism to the appropriate source of supply. Leave the Isolation Plug pulled until final Transfer Switch Commissioning is to be completed.

Final Commissioning

1) Verify installation of the Automatic Transfer Switch (ATS) as per installation manual and verify wiring (also see the Pre-Commissioning Checks). Confirm phase, neutral and grounding conductors installed per electrical code requirements. ***Note***: Confirm neutral conductors of both sources correctly installed and solidly grounded for 3 phase 4 wire configurations.

2) Check for mechanical damage (shipping or installer).

3) Check for cable interference with mechanical moving parts or the motor brake on M-style ATS.

4) Verify correct control wire interconnects to engine generator set. Ensure the engine controller connected to does not apply a load in excess of the ATS start contacts rating. The ATS start contact is volt free and the only voltage measured should result from the engine controllers internal control logic.

5) Place the generator engine controls in "OFF" and open the generator local circuit breaker.

6) Disconnect the ATS isolation plug prior to application of voltage of the supply sources.

7) Energize each of the supply sources and verify these to meet voltage arrangement of the ATS. Once these have been confirmed to be correct the isolation plug can be reinstalled.

8) With the generator engine controls in "OFF", and power applied to the utility side of the transfer switch, verify the TSC 800 controller is operating properly. To determine correct operation look for the following:
   i) Display on front functioning (perform lamp test by depressing the 2 center buttons simultaneously - all LEDs will light and display pixels will darken)
   ii) Top diagnostic LED on back of controller is flickering
   iii) Transfer to utility diagnostic LED is on (if utility voltage and frequency are within program limits)

9) Transfer switch will motor to the utility position if the program parameters are satisfied and a green LED on the front of the TSC 800 will be illuminated indicating utility supply position is indexed.

10) Review program by entering the program menu. Select "Program Menu" on the display by scrolling with the forward arrow button (right button). Select "Yes" by using the up or down arrow then enter. Password will be displayed. Enter password "1" for read only access or password "2" for read /write access (Select password 3 only if passwords are to be changed).

11) Set the time clock, as there is no battery installed on the circuit board. The time clock is a 7 day 24 hour clock. Month and year are not utilized as no data logging is provided for with the product. The 7-day timer is used primarily for weekly automatic load testing.

12) Set the start and stop times for the test feature, ensure the stop time appends the start time on the same day. Having it set for a time prior to the start time of the same day will cause the generator to operate for a full week in a mode selected later in the program loop.

13) Set the test type as none until later.

14) Review the remainder of the program by using the enter key to navigate through the program. Verify each program value is the same as the value which is entered on the program data sheets. If any of these values are modified to suit site conditions or requirements these should be noted on the data sheets for future reference. Near the end of the program loop are calibration values for utility, generator and load voltages. At this point measure actual voltages at the bus with an accurately calibrated meter. Verify that each phase to phase reading at the TSC 800 is correct. (The number on the right is what the controller portrays the voltage is, and number on the left is the calibration number 0-255. Increasing the calibration number will cause the portrayed number to rise, lowering the number will cause the opposite.) For each phase to phase reading there is a 'Zero' value calibration and a 'Span' value calibration. When voltage is present on the bus only calibrate by adjusting the span values. If Zero voltage calibration is to be performed the sensing leads of the source must see ground potential which is typically achieved through the windings of the alternator to the star point (neutral) to ground. The same remains true for the utility supply through the building transformer. If the source windings are isolated up-steam via a breaker the voltage at the controller may float and a true zero calibration may not be achieved. (Note: Zero voltage calibration is seldom required in the field.) Remember that if any values are changed, the enter button must be pressed to save the change. Document any changes on the program data sheets. To exit the program, press and hold the exit key for a minimum of 2-3 seconds.

15) Once program has been verified, manually start generator and verify its voltage calibration. The TSC 800 will indicate that the generator is running.

16) Turn Generator off then place in Auto position.

17) Perform a no load test by entering manual test "Yes" on the display. Select "Off Load" then enter. The engine will start and the engine starting diagnostic LED on the back of the TSC 800 will be illuminated. To terminate the test, select manual test "Yes" enter and "None" enter. The engine starting diagnostic LED will go out and the engine will shut off after cool down.

18) Perform a full load test by selecting manual test menu "Yes" enter, then "On Load" enter. Generator will start and the transfer switch will transfer once the TSC 800 controller is satisfied that the frequency and voltage are in limits and after all timing set points are completed. The engine starting and transfer to generator diagnostic LEDs will be illuminated on the rear of the controller. Also the red LED on the front of the TSC 800 will be illuminated indicating generator supply position is indexed. To terminate the test, select manual test menu, select "Yes" then enter; select "None" then enter. The transfer switch will transfer back to the utility supply after timing set points are complete. The engine starting diagnostic LED will go out with the engine shutting off after the cool down time.

19) Perform a power outage test by opening the upstream utility feeder breaker. The TSC 800 controller display will go blank; the generator set will start after the appropriate engine start delays have expired. Once the generator is running, the TSC 800 controller display will return and transfer to generator will be initiated if the generator voltage and frequency are within programmed limits. When the timing set points have been completed the transfer switch will transfer to generator.

20) Return the transfer switch to utility power by re-closing the upstream utility breaker. The TSC 800 controller will confirm that the utility power remains within limits for the programmed utility return delay time. When satisfied the TSC 800 controller will initiate transfer return and the transfer switch will transfer back to utility after timing set points are complete. The engine will shut off after completion of the cool down time.

21) The weekly automatic test feature can also be tested by setting the start and stop times to the current time and allowing for the stop time to append the start time by a few minutes. On completion of this test if performed the feature should be turned off by selecting "NONE" as the test mode, or program in the users' desired test time.

22) On completion of commissioning ensure all controls are left in automatic.

23) Forward document or drawing updates to TTI if revisions are required and provide the end user with a set of marked-ups to be retained on site.

24) Ensure copies of manuals for the equipment are on site.

25) Record and forward list of deficiencies to the appropriate parties where applicable.

TSC 800

TRANSFER SWITCH CONTROLLER

(WITH REMOTE COMMUNICATION OPTION)

INSTALLATION, OPERATING & SERVICE MANUAL

PM049 REV 5 00/07/31

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1. INSTALLATION

1.1. GENERAL INFORMATION

> **NOTE:**
> Installations should be done in accordance with all applicable electrical regulation codes as required.

The following installation guidelines are provided for general information only pertaining to typical site installations. For specific site installation information, consult Thomson Technology Inc. as required. **Note:** Factory installations of TTI supplied transfer switches that have been tested and proven may deviate from these recommendations.

1.2. NOTES TO INSTALLER

If the transfer switch has programmable/multi-tap system voltage capability (refer to electrical schematic), confirm the transfer switch has been configured for the system voltage.

> ***WARNING***
> ***Failure to confirm and match transfer switch voltage with the system voltage could cause serious equipment damage.***

If the transfer switch requires reconfiguring, the TSC 800 controller will require reprogramming as well.

> ***CAUTION!!!***
> ***All installation and/or service work performed must be done by qualified personnel only. Failure to do so may cause personal injury or death.***

1.3. MOUNTING LOCATION/INSTALLATION

The TSC 800 transfer controller is designed for mounting directly onto a transfer switch door. Considerations should be given for the following:

The controller should be installed in a dirt free, dry location away from extreme heat sources.

The LCD window should be installed at an optimum height for operator viewing.

Adequate space should be provided around the rear of the TSC 800 circuit board for control wiring.

Verify that the intended AC voltage input to the controller does not exceed the maximum allowable level on the control panel door as per the applicable control panels certification standard.

The TSC 800 controller can be installed onto a door of a transfer switch using two different methods:

- The first method requires a special door cutout for the LCD display and LED's as shown in FIGURE 5. This mounting method requires the Lexan faceplate to be mounted directly onto the door of the transfer switch enclosure via its adhesive tape on the rear of the Lexan. The controller must be disassembled to mount on the door, then re-assembled.
- The second method of controller mounting requires a factory supplied adapter faceplate as shown in FIGURE 6. This method only requires a simple large rectangular hole to be cut out of the door as shown in FIGURE 6(a). The controller is then inserted into this hole and the faceplate is mounted on top of the door with studs as supplied with the faceplate. Note: #8-32 AWG nuts will be required to attach the faceplate to the door.

1.4. AC VOLTAGE SENSING INPUT

The TSC 800 can accept direct AC voltage sensing inputs on the generator and utility supplies from 120-600Vac (nominal). **Note:** Direct input voltage sensing can only be used when the system utilizes a 3 phase, 4 wire distribution system which has the neutral conductor *solidly* grounded. For 3 phase, 3 wire systems (i.e. no neutral) or high voltage systems, potential transformers must be used. Refer to FIGURES 1-4 for voltage sensing connections.

1.5. AC CONTROL POWER INPUT

The TSC 800 is factory supplied for either 115Vac or 230Vac (nominal) control power input voltage. Independent AC control power is required from both utility and generator supplies. AC control power is utilized for internal TSC 800 control circuits and external control device loads. The TSC 800 requires approximately 12VA AC power for internal control circuits. The maximum external load is limited by output contact ratings (i.e. 10A resistive, 120VAC). Total AC control power requirements for each supply must be determined by adding both internal and external load requirements.

1.6. FOUR POSITION TEST SWITCH INPUTS (FTS4)

The function of the Four Position Test Switch Input is to allow operators to select various operating scenarios for test or maintenance purposes, inaddition to the use of the faceplate mounted pushbuttons.

NOTE: When an external FTS4 switch is used, the TSC 800 operation as selected from the faceplate pushbuttons will be overridden.

OFF: Disables the engine start output from the transfer switch. If the primary source is available, and within normal limits, the TSC 800 will initiate a transfer to the primary source. The transfer switch will not automatically transfer to the secondary (alternate) source should the primary source fail.

AUTO: All automatic functions are enabled.

ENGINE START: (No load test) An engine start signal will be initiated and will remain on until the FTS4 is placed in another position. The engine will start if the engine's auto start controller is in the "Auto" mode. If the primary source fails in this mode, and the secondary source is within parameters, the TSC 800 will initiate a transfer to the secondary source.

TEST: (Full load test) A primary source failure is simulated and an engine start signal will be initiated. When the secondary source is within normal limits, the TSC 800 will initiate a transfer to the secondary source. The system will remain in this state until the FTS4 is placed in another position or the secondary supply fails. Upon a secondary supply failure, if the primary supply is available, the TSC 800 will initiate a transfer to the primary supply.

1.7. OUTPUTS

The TSC 800 provides the following types of output circuits:

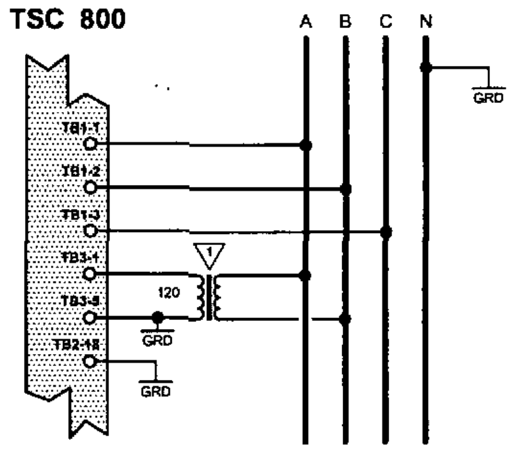
Engine Start Contact	Isolated Form C contact (10A, 120VAC Resistive)
Programmable Output Contact	Isolated Form C contact (10A, 120VAC Resistive)
Transfer to Utility Output	120VAC[1], 10A (Resistive) powered output contact
Transfer to Generator output	120VAC[1], 10A (Resistive) powered output contact
Pre/post-transfer to utility	120VAC[1], 3A (Resistive) powered output contact
Pre/post-transfer to generator	120VAC[1], 3A (Resistive) powered output contact
Load on utility	120VAC[1], 3A (Resistive) powered output contact
Load on generator	120VAC[1], 3A (Resistive) powered output contact

[1] **Note:** Output voltage is dependent upon AC control power input voltage (i.e. 120VAC or 230VAC nominal).

Interposing relays are required between the TSC 800 outputs and the end device if loads exceed the output current rating.

Transient suppression devices are required for all inductive devices sharing wiring or if physically located near the transfer switch controller.

For AC operated relays or solenoids, use a suitably rated metal oxide varistor (MOV) or capacitor/resistor suppressor.



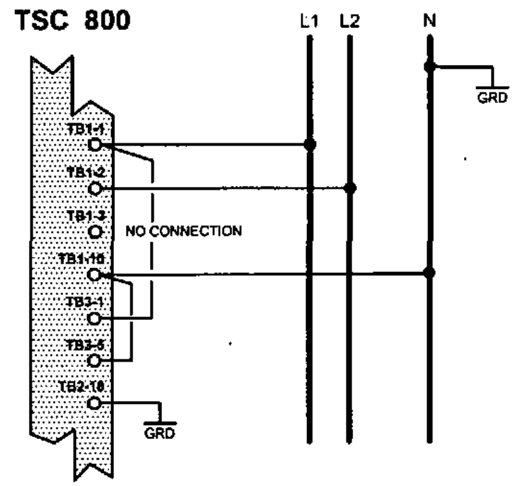
VOLTAGE INPUTS

600VAC L-L, 347VAC L-N
480VAC L-L, 277VAC L-N
380VAC L-L, 220VAC L-N
208VAC L-L, 120VAC L-N

1 PT REQUIRED FOR TRANSFER SWITCH MECHANISM POWER (MUST BE SIZED TO SUIT POWER REQUIREMENTS).

FIG:1
3Ø, 4W 208/380/480/600VAC DIRECT SENSING

NOTE: UTILITY VOLTAGE SENSING AND CONTROL POWER SHOWN ONLY.

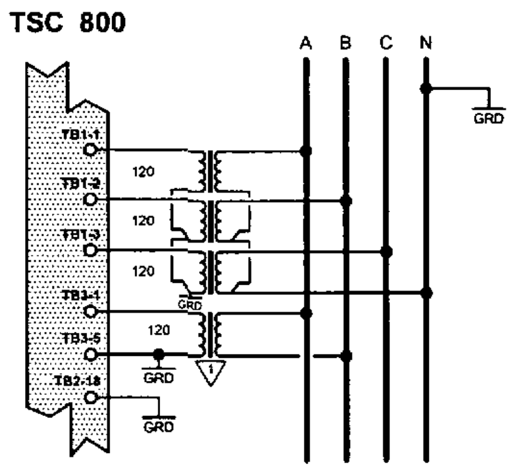


VOLTAGE INPUTS

240VAC L-L, 120VAC L-N

FIG:2
1Ø, 3W 120/240VAC DIRECT SENSING

NOTE: UTILITY VOLTAGE SENSING SHOWN ONLY.



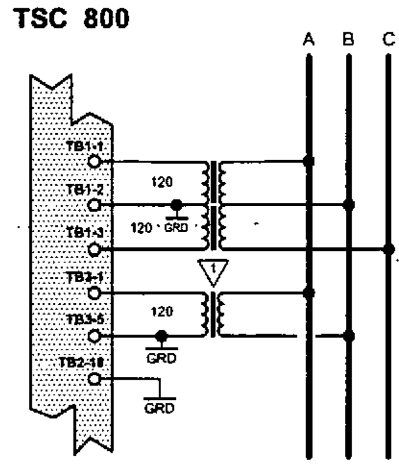
SECONDARY PT VOLTAGE

208VAC L-L, 120VAC L-N
120VAC L-L, 69VAC L-N

1 PT REQUIRED FOR TRANSFER SWITCH MECHANISM POWER (MUST BE SIZED TO SUIT POWER REQUIREMENTS).

FIG:3
3Ø, 4W WYE PT's

NOTE: UTILITY VOLTAGE SENSING SHOWN ONLY.



SECONDARY PT VOLTAGE

120VAC L-L [NO NEUTRAL]

NOTE: ØB IS GROUNDED

1 PT REQUIRED FOR TRANSFER SWITCH MECHANISM POWER (MUST BE SIZED TO SUIT POWER REQUIREMENTS).

FIG:4
3Ø, 3W DELTA PT's

NOTE: UTILITY VOLTAGE SENSING SHOWN ONLY.

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1.8. EXTERNAL PANEL CONTROL WIRING

As a minimum, all control wiring shall conform to the local regulatory authority on electrical installations. Specific wire sizes for typical circuits (of distances up to 100ft (30m)[1]) are as follows:

Utility or Generator Voltage Sensing	#14 AWG ($2.5mm^2$)
Transfer output signals	#14 AWG ($2.5mm^2$)
Remote Start Contact for Engine Controls	#14 AWG ($2.5mm^2$)

[1] For distances exceeding 100 ft. (30m) consult Thomson Technology Inc.

1.9. REMOTE START CONTACT FIELD WIRING

Field wiring of a remote start contact from a transfer switch to a control panel should conform to the following guidelines to avoid possible controller malfunction and/or damage.

1.8.1. Remote start contact wires (2 #14 AWG ($2.5mm^2$)) should be run in a separate conduit.

1.8.2. Avoid wiring near AC power cables to prevent pick-up of induced voltages.

1.8.3. An interposing relay may be required if field wiring distance is excessively long (i.e. greater than 100 feet (30m)) and/or if a remote contact has a resistance of greater than 5.0 ohms.

1.8.4. The remote start contact must be voltage free (i.e. dry contact). The use of a "powered" contact will damage the transfer controller.

1.10. COMMMUNICATION CABLE

Communication cable wiring from the controller's com port must be suitably routed to protect it from sources of electrical interference. Guidelines for protection against possible electrical interference are as follows:

- Use high quality, 8 conductor shielded cable only with drain wire grounded at the controller end only.
- Route the communication cable at least 3 M (10') away from sources of electrical noise such as variable speed motor drives, high voltage power conductors, UPS systems, transformers, rectifiers etc.
- Use separate, dedicated conduit runs for all communication cables. Do not tightly bundle communication cables together in the conduit. Conduit should be ferromagnetic type near sources of possible electrical interference. The entire length of conduit should be grounded to building earth ground.

- When communication cables must cross over low or high voltage AC power conductors, the communication cables must cross at right angles and not in parallel with the conductors.

For additional information on protection against electrical interference, contact TTI factory.

1.11. FACEPLATE MOUNTING DIMENSIONS

Refer to FIGURE 5 for the TSC 800 faceplate mounting dimension information.

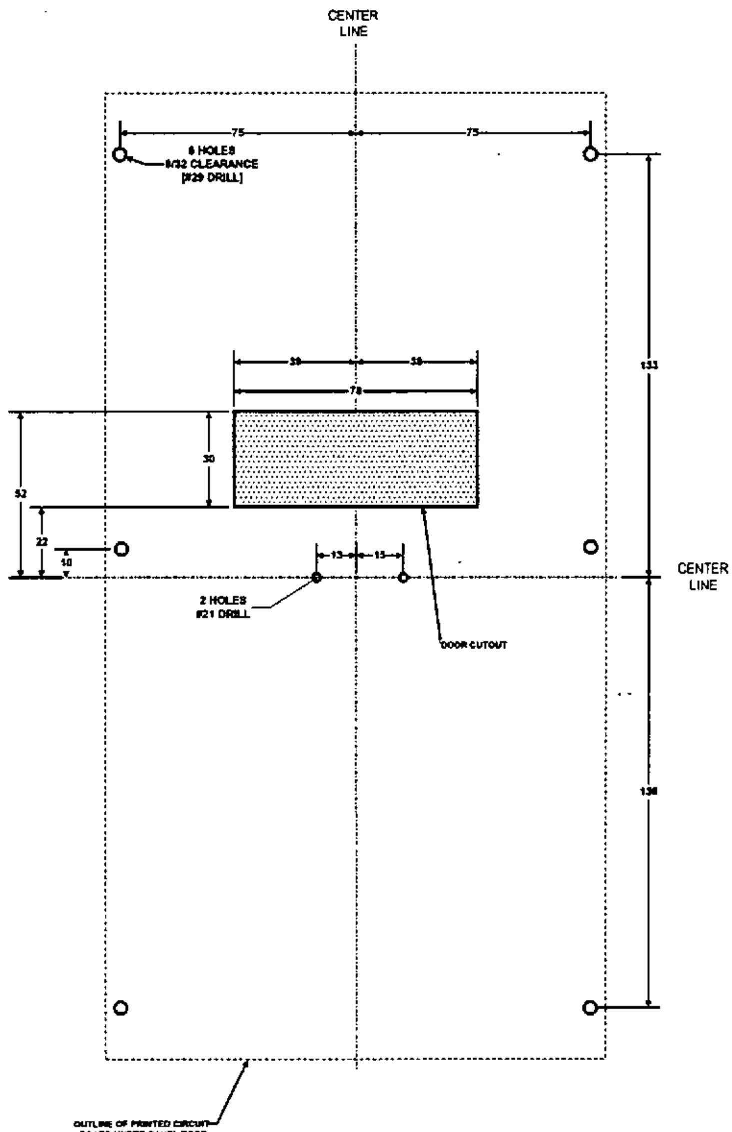

FIGURE 5
REFER TO:
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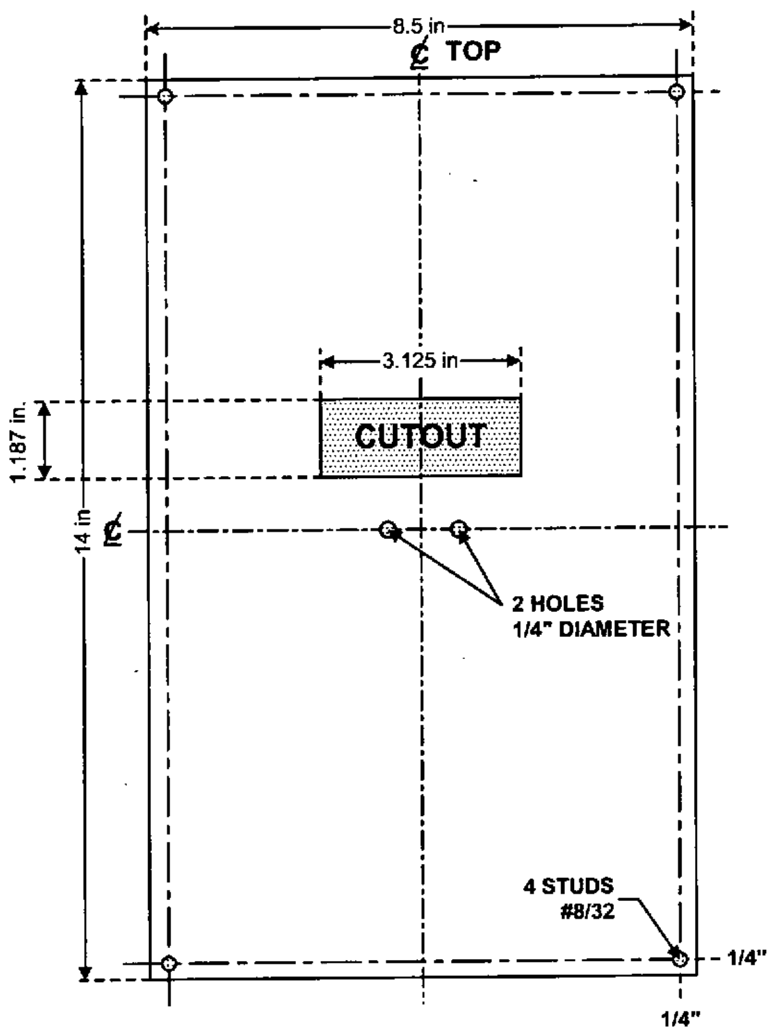

FIGURE 6: ADAPTER FACEPLATE

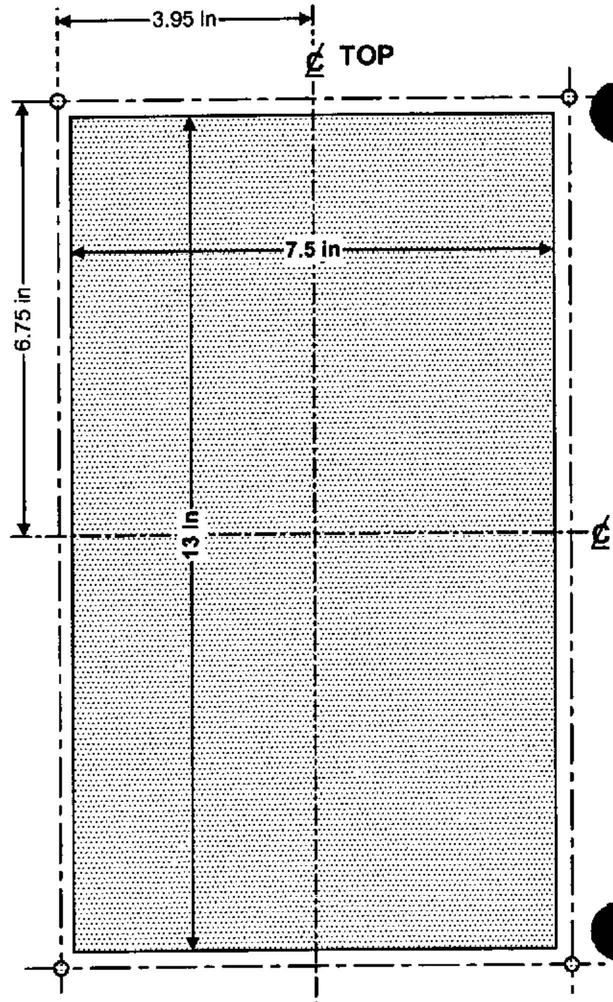

FIGURE 6(a):
DOOR CUTOUT FOR ADAPTER FACEPLATE

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1.12. DIELECTRIC TESTING

Do not perform any high voltage dielectric testing on the transfer switch with the TSC 800 controller connected into the circuit as serious damage will occur to the controller. All AC control fuses or control circuit isolation plugs connected to the TSC 800 must be removed if high voltage dielectric testing is performed on the transfer switch.

2. DESCRIPTION

The TSC 800 controller utilizes microprocessor-based design technology which provides high accuracy for all voltage sensing and timing functions. The **TSC 800** is factory configured to control all the operational functions and display features of the automatic transfer switch. All standard and optional control features of the **TSC 800** are fully programmable from the front panel LCD display and are security password protected. The LCD display screen prompts are in plain English, providing a user-friendly operator interface with many display options available. The microprocessor design provides many standard features which were previously only available as add-on optional features.

The TSC 800 controller consists of two parts; a Lexan faceplate which is mounted externally on the transfer switch door, and a printed circuit board (PCB) which is mounted inside the transfer switch door.

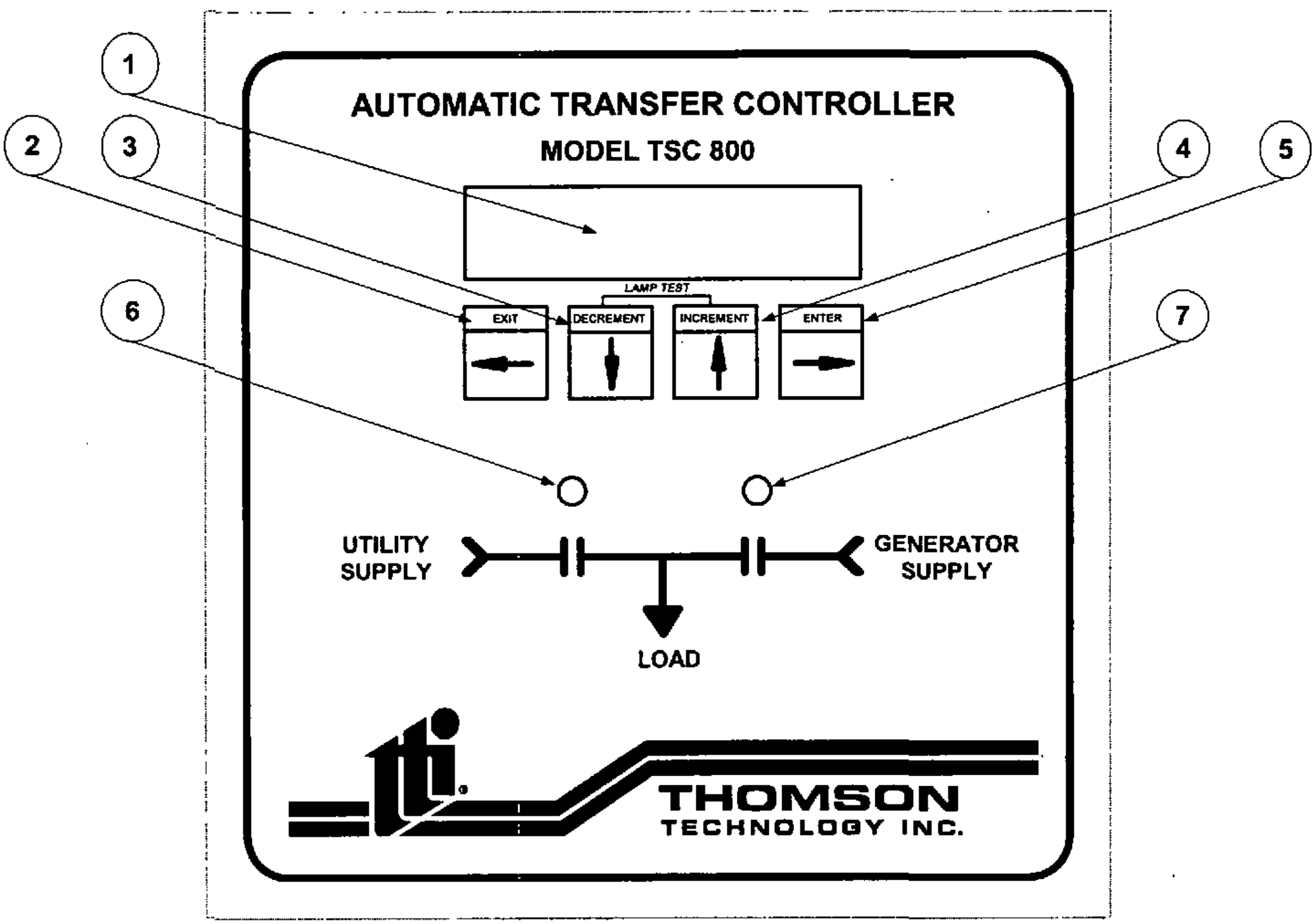

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FIGURE 7

2.1. LEXAN FACEPLATE

The Lexan faceplate is shown as in FIGURE 7. The Lexan pushbuttons are connected to the main PCB via plug-in ribbon cable. The main features of the Lexan faceplate are described as follows with reference to FIGURE 7.

① LCD viewing window. The LCD display is mounted on the main PCB which is visible from the lexan faceplate.

② EXIT push-button. The EXIT function is used to scroll backwards through the status menus or programming prompts to the previous item. The EXIT function is used to "exit" the programming menu by holding this button down for approximately 2 seconds while in the programming mode.

③ DECREMENT push-button. The DECREMENT function is used to change a programming value while in the programming mode. When this push-button is held down, the displayed value will be "decremented" to a lower value as desired. Note: The longer the push-button is held down, the faster the value will be decremented.

④ INCREMENT push-button. The INCREMENT function is used to change a programming value while in the programming mode. When this push-button is held down, the displayed value will be "incremented" to a higher value as desired. Note: The longer the push-button is held down, the faster the value will be incremented.

⑤ ENTER push-button. The ENTER function is used to scroll forwards through the status menus or programming prompts to the next item. The ENTER function is used to "enter" a programming or test mode as well as accepting changed programming values. **Note:** In the programming mode, the longer the ENTER push-button is held down, the faster the next menu prompt will appear.

⑥ Load on Utility supply LED light viewing window

⑦ Load on Generator supply LED light viewing window

2.1.1. LAMP TEST

A lamp test feature is provided to test all LED lights as well as the LCD display. To activate the lamp test feature, simultaneously push the INCREMENT and DECREMENT push-buttons. All LED's and LCD display should illuminate for approximately 2 seconds then return to their original status.

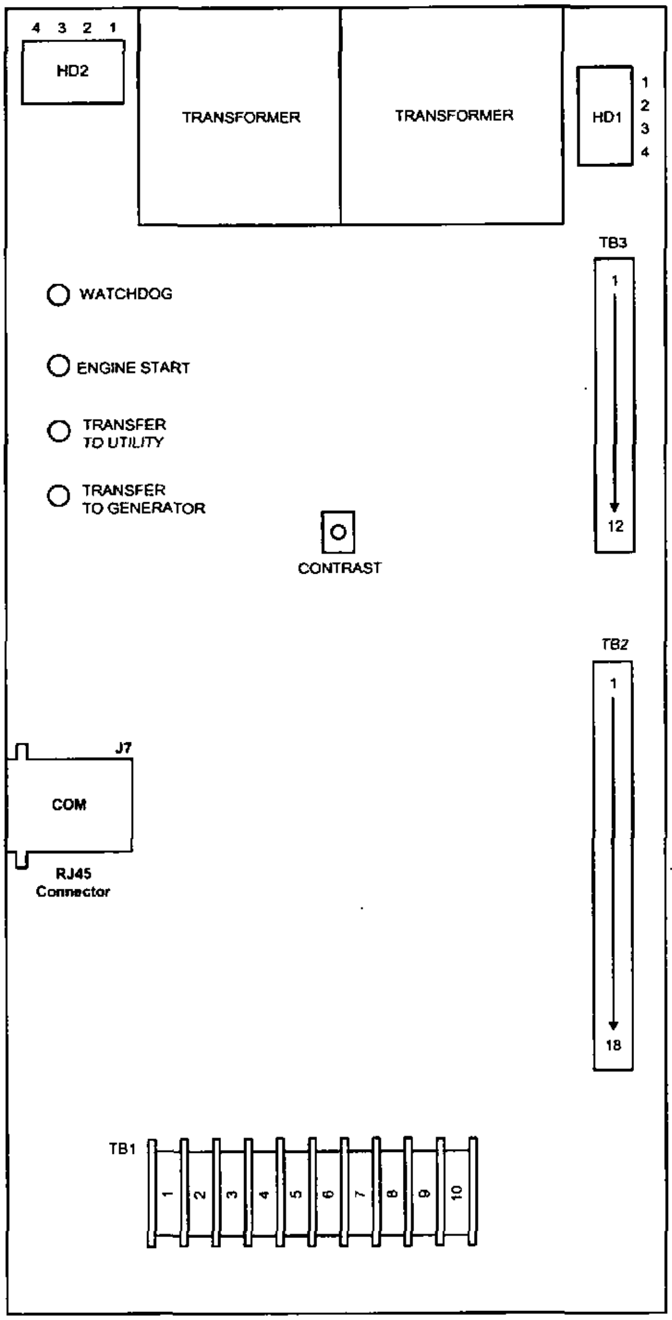

FIGURE 8

2.2. PRINTED CIRCUIT BOARD

The printed circuit board (PCB) is shown in FIGURE 8. The PCB contains the following user interface items:

2.2.1. VOLTAGE SELECTION

The voltage selection is made via two connector plugs which are located on the PCB and are identified as HD1 and HD2. A different plug assembly is required for a voltage change.

The TSC 800 is factory configured for a specific power supply voltage input as designated by voltage header plugs labeled as follows:

115V - designates a 115V power supply input voltage

230V - designates a 230V power supply input voltage

2.2.2. TERMINAL BLOCKS

Three terminal blocks are located on the PCB as follows:

TB1 high voltage sensing terminal block (120-600VAC)

> **WARNING**
>
> Voltage sensing circuits are capable of lethal voltages while energized. Standard safety procedures should be followed and be performed by qualified personnel only. Failure to do so may cause personnel injury and/or death.

TB2 transfer control terminal block for output contacts and low voltage inputs

TB3 transfer control terminal block for 115/230v input and output circuits

2.2.3. DIAGNOSTIC LED'S

The TSC 800 controller provides four diagnostic LED lights which are mounted on the rear of the printed circuit board as per FIGURE 8. Their functions are described as follows:

WATCHDOG	This LED flashes on and off at irregular intervals which indicates that the microprocessor is functioning normally.
TRANSFER TO UTILITY	This LED is illuminated whenever the TSC 800 is initiating a Transfer to Utility signal.
TRANSFER TO GEN	This LED is illuminated whenever the TSC 800 is initiating a Transfer to Generator signal.
ENGINE START	This LED is illuminated whenever the TSC 800 is initiating a Engine Start signal.

Note: All LED's will be illuminated whenever a lamp test function is performed.

2.2.4. COMMUNICATION PORT

A communication port is provided to interconnect to a remote communication system for remote monitoring and control of the transfer switch. Refer to section 3 for additional information.

2.2.5. CONTRAST ADJUSTMENT

A contrast adjustment potentiometer is located on the PCB and is factory set for ambient temperatures of 15° to 30° Celsius. For different ambient temperatures, consult the factory for adjustment procedures.

3. REMOTE COMMUNICATION OPTION

The TSC 800 transfer switch controller is available with an optional remote communication feature. The remote communication feature allows a TSC 800 controller to be monitored and controlled from a remote location via serial communication link to a personal computer (PC). PC's may be connected locally via serial communication cable to the TSC 800 or remotely via modem and telephone systems. Remote communication can be via customer supplied equipment or with an external communication interface module (CIM) as manufactured by Thomson Technology Inc.

NOTE:

The CIM module may be located in the engine control panel provided the maximum distance between the CIM and TSC 800 controller is not exceeded as per the following information. Refer to the installation section of this manual for further information.

The CIM module utilizes an internal modem and contains Modbus™ protocol to interface with different remote monitoring software programs. Refer to separate literature for detailed information on the CIM module. The TSC 800 remote communication option must be ordered and be factory enabled prior to shipment. The communication feature cannot be user enabled once shipped from the factory.

The TSC 800 communication port utilizes a RS422 data transmission signal which is directly interconnected to the CIM module via 8 conductor, shielded cable with plug-in RJ45 connectors. Refer to FIGURES 9 & 10 for detailed information on direct connected or remote connected PC applications with CIM module.

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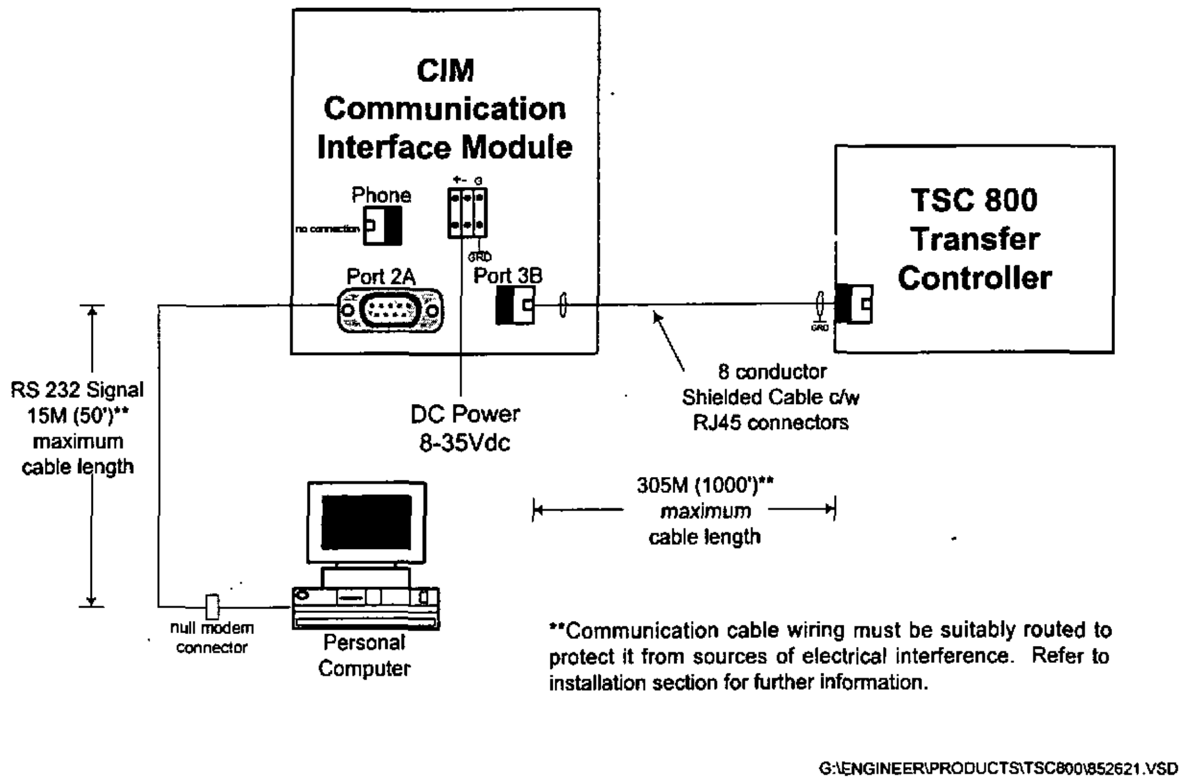


FIGURE #9 TSC 800 WITH CIM MODULE & DIRECT CONNECTED PC (RS232)

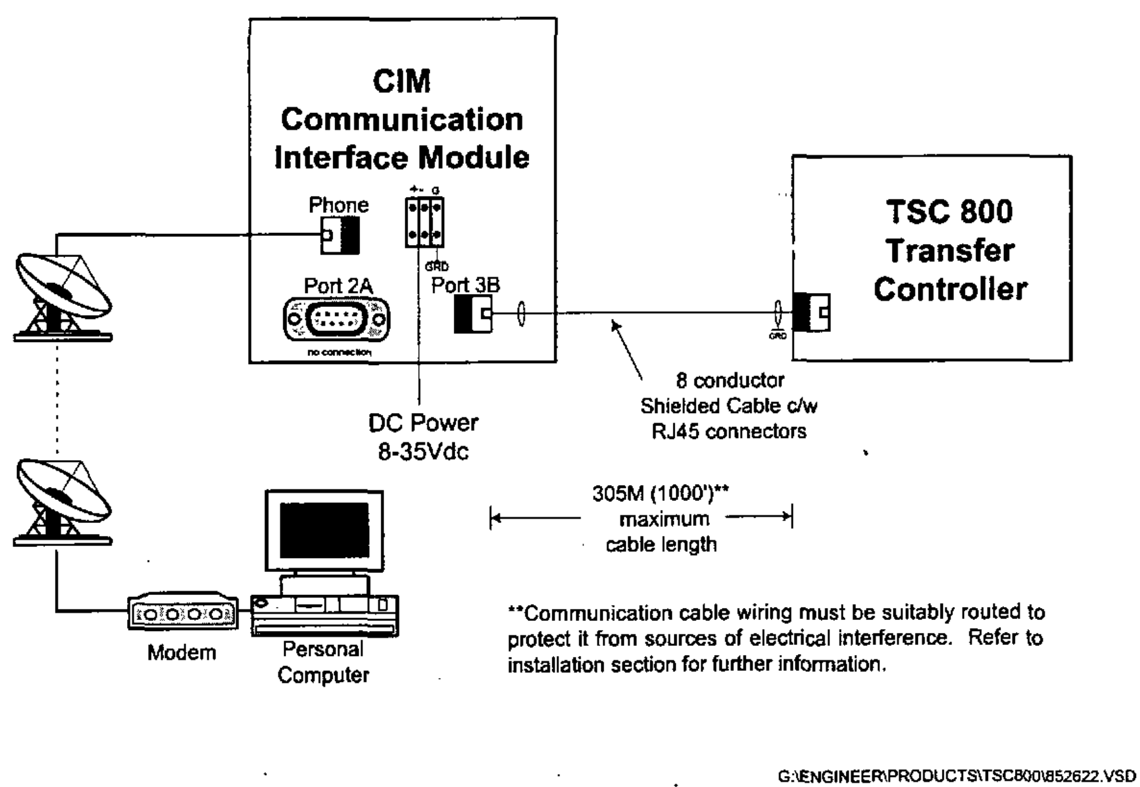
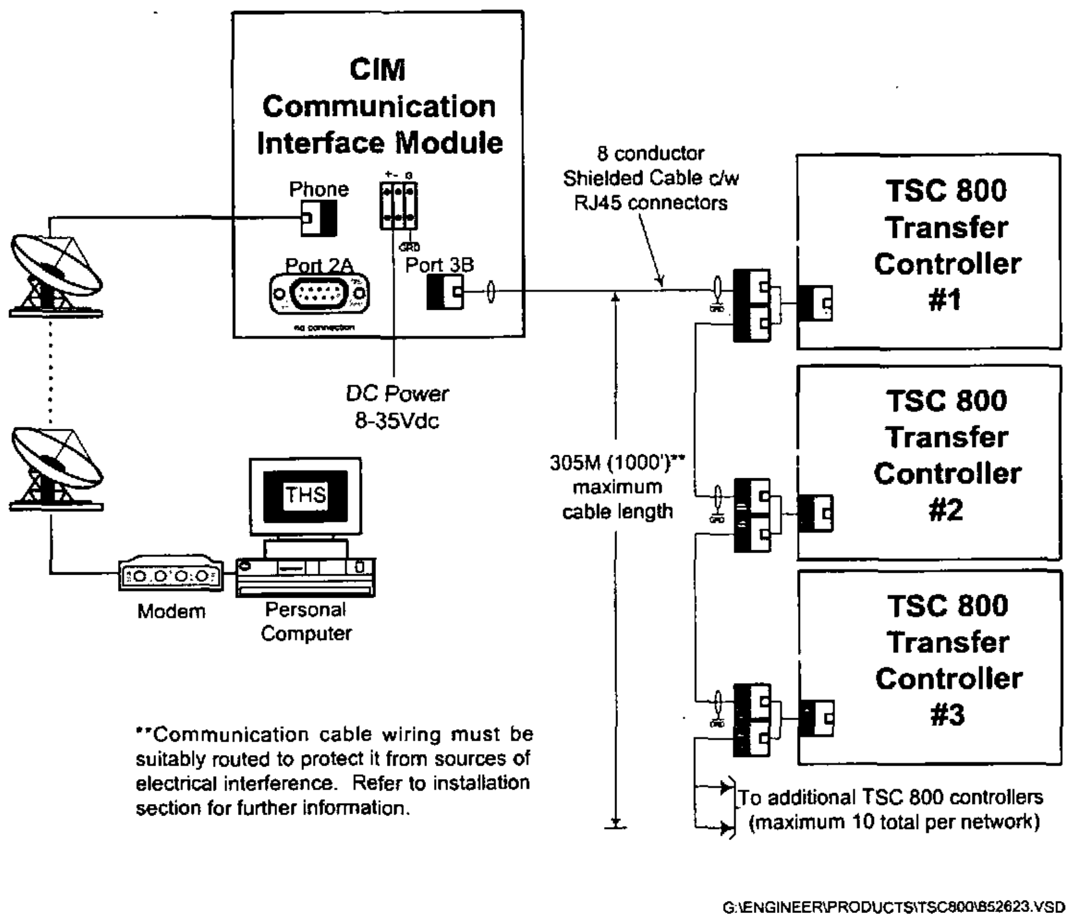


FIGURE #10 TSC 800 WITH CIM MODULE & REMOTE CONNECTED PC

The TSC 800 RS422 communication port allows multiple TSC 800 controllers to be directly interconnected together to form a single network system. Up to 10 TSC 800 controllers may be interconnected to a single CIM module.

> **NOTE:**
> TSC 800 controllers <u>and</u> MEC 20 engine/generator controllers may be interconnected together via the <u>same</u> communication network provided the maximum number of controllers and interconnection distances are not exceeded. For additional *information, refer to associated product instruction manuals.*

Each TSC 800 controller is programmed with an unique communication node address number for the remote communication system to reference. The network system may be connected to a local PC or to a remote PC via telephone system and CIM module. Refer to FIGURE #11 for a typical TSC 800 network system with CIM module.



<u>FIGURE #11</u> NETWORKED TSC 800 INTERCONNECTION DIAGRAM

4. TSC 800 DISPLAY MENUS

The TSC 800 contains a Liquid Crystal Display (LCD) which is visible on the front faceplate. The LCD has preprogrammed display menus which may be selected by pressing the *ENTER* or *EXIT* push-buttons in succession until the desired menu is displayed. The display menu types and order in which they are programmed are as follows:

SYSTEM TIME

MANUAL TEST MENU

PROGRAM MENU

SYSTEM STATUS → **TIMER COUNTDOWN**

UTILITY SUPPLY MENU

GEN SUPPLY MENU

4.1. *SYSTEM TIME MENU*

The system time menu is used to show current system time. The TSC 800 controller uses its internal time clock to reference when an automatic exercising operation (if pre-programmed) is to occur. To change the system time, refer to the "time clock adjustment" section of this manual.

LCD DISPLAY

SYSTEM TIME
MON[1] 12:24:31[2]

[1] Displays the day of the week

[2] Displays the current time in hours (24-hour clock): hour: min: seconds

4.2. MANUAL TEST MENU

The Manual Test Menu may be selected to initiate a specific type of generator testing operation.

The test sub-menus are organized as follows:

- **MANUAL TEST MENU**
  - **NO**
  - **YES**
    - **NONE**
    - **OFF LOAD**
    - **ON LOAD**

<u>LCD DISPLAY</u>

MAN TEST MENU
NO[1]

[1] Displays two messages which may be toggled between *YES* or *NO* by pressing the *INCREMENT* push-button. Their functions are described as follows:

- **NO** Testing operation menu is disabled when NO is displayed.
- **YES** Testing operation menu is enabled when YES is displayed and entered.

The following Test Mode options are provided:

NONE Testing operation is disabled when the NONE prompt is selected. To terminate a previously-set testing mode, select NONE and enter.

OFF LOAD When OFF LOAD prompt is selected and entered, the generator will immediately start and operate off load and will <u>not</u> permit a load transfer. **Note:** If the utility supply fails during this test mode, the generator will transfer on load. The generator will remain running until a different test mode is selected and entered.

ON LOAD When the ON LOAD prompt is selected and entered, the generator will immediately start and transfer on load. The generator will remain on load until a different test mode is selected and entered.

4.3. TSC 800 PROGRAM MENU

The programming menu is used to access the TSC 800's programmable functions such as time delays, voltage/frequency setpoints, calibration and time clock adjustments.

Access to the programming sub-menus can only be obtained with a security password number. The sub menus are organized as follows:

PROGRAMMING MENU
- **NO**
- **YES** **PASSWORD**

LCD DISPLAY

PROGRAM MENU
NO[1]

[1] Displays two messages which may be toggled between YES or NO by pressing the *INCREMENT* push-button. Their functions are described as follows:

- **NO** Programming sub-menus are disabled when NO is displayed.
- **YES** *Programming sub-menus are enabled when YES is displayed.*

4.4. SYSTEM STATUS MENU

The system status menu provides the operator with information as to current status of both the utility and generator supplies.

> **NOTE:**
> The system status menu screen may be momentarily replaced with a time delay countdown screen when a transfer sequence is initiated. The display will automatically return to the previous menu following expiry of the timing sequence.

The system status sub-menus are organized as follows:

UTILITY
- **NORMAL**
- **FAILED**
- **READY**

GEN
- **OFF**
- **NORMAL**
- **OFF LOAD TEST**
- **ON LOAD TEST**
- **GEN SW OFF**
- **FAILED**
- **STARTING**

LCD DISPLAY

```
UTIL NORMAL[1]
GEN  OFF[2]
```

[1] Displays utility supply status conditions. There are three status conditions:

NORMAL	Load is on the utility supply and the utility's voltage and frequency is normal.
FAILED	Utility supply voltage and/or frequency is outside the nominal programmed limits(i.e. failed condition).
READY	Load is on the generator supply and the utility supply is ready to transfer. This is a temporary condition due to either a test mode being selected or during a utility return time delay.

[2] Displays generator supply status conditions. There are seven status conditions as follows:

OFF	Load is on the utility supply and the generator is off, ready to start upon utility failure condition.
NORMAL	The generator is running due to a failed utility supply.
OFF LOAD TEST	The generator is running off load due to manually initiated test mode via the front-panel push-buttons or exercise timer mode.
ON LOAD TEST	The generator is running on load due to a manually initiated test mode via the front panel push-buttons or an automatic test mode as programmed in the time clock exercising menu.
GEN SW OFF	The four position test switch has been set to the OFF position, disabling generator starting and transferring operation.
FAILED	Generator is signaled to operate, however its voltage and/or frequency is outside the nominal programmed limits (i.e. failed condition).
STARTING	Engine start signal has been initiated, and the TSC 800 sensors are waiting for generator voltage to build up.

4.5. TIMER COUNTDOWN MENUS

Timer countdown menus are <u>automatically</u> displayed when a specific time delay function occurs during a transfer sequence. When a time delay begins, the LCD display will indicate the time delay function name (e.g. GEN. START DELAY) and the current time remaining in the countdown sequence. When the timing function is complete, the LCD display will automatically change to either the next timing sequence countdown display or return to the original system status screen menu.

<u>**LCD DISPLAY**</u>

GEN START
DELAY[1] 45 SEC[2]

[1] Displays specific time delay function currently in operation

[2] Displays current time in seconds or minutes that are left in the specific timing sequence.

> <u>**NOTE:**</u>
> During a timer countdown sequence, a different display menu may be selected by pressing the *ENTER* push-button.

The following timer countdown screens are provided:

GEN START DELAY	**XX SEC.**
GEN WARMUP DELAY	**XX SEC.**
GEN COOLING DELAY	**XX SEC.**
UTILITY RETURN DELAY	**XX MIN.**
PRE-TRANSFER DELAY	**XX SEC.**
NEUTRAL DELAY	**XX SEC.**
POST-TRANSFER DELAY	**XX SEC.**

4.6. UTILITY SUPPLY MENU

The utility supply menu allows the operator to view the utility supply voltage and frequency values.

LCD DISPLAY

```
UTIL     60.0 HZ①
600②  600③  600④
```

① Displays utility supply frequency in hertz (HZ). The frequency is displayed with a resolution of 1/10 of a hertz.

② Displays utility supply voltage as follows:

- 3-phase system: LINE TO LINE VOLTAGE--Phases A to B
- 1-phase system: LINE TO LINE VOLTAGE--Phases L1 to L2

③ Displays utility supply voltage as follows:

- 3-phase system: LINE TO LINE VOLTAGE--Phases B to C
- 1-phase system: LINE TO NEUTRAL VOLTAGE--Phases L1-N

④ Displays utility supply voltage as follows:

- 3-phase system: LINE TO LINE VOLTAGE--Phases C-A
- 1-phase system: LINE TO NEUTRAL VOLTAGE--Phases L2-N

4.7. GENERATOR SUPPLY MENU

The generator supply menu allows the operator to view the generator supply voltage and frequency values.

LCD DISPLAY

```
GEN      60.0 HZ①
600②  600③  600④
```

① Displays generator supply frequency in hertz (HZ). The frequency is displayed with a resolution of 1/10 of a hertz.

② Displays generator supply voltage as follows:

- 3-phase system: LINE TO LINE VOLTAGE--Phases A to B
- 1-phase system: LINE TO LINE VOLTAGE--Phases L1 to L2

③ Displays generator supply voltage as follows:

- 3-phase system: LINE TO LINE VOLTAGE--Phases B to C
- 1-phase system: LINE TO NEUTRAL VOLTAGE--Phases L1-N

® Displays generator supply voltage as follows:

- 3-phase system: LINE TO LINE VOLTAGE--Phases C-A
- 1-phase system: LINE TO NEUTRAL VOLTAGE--Phases L2-N

5. OPERATING INSTRUCTIONS

To operate the TSC 800 controller and associated transfer switch using the front faceplate push-buttons, refer to the following detailed operating instruction sub-section descriptions.

5.1. DISPLAY MENUS

The TSC 800 will display the last selected menu when normal utility or generator power is energized. To view another display menu, press the *ENTER* push-button to scroll to the next available menu. Keep pressing the ENTER push-button to view the complete list of display menu types. Note that the menu list will automatically loop back to the first menu item when the end of the list is reached.

5.2. TESTING INSTRUCTIONS

To perform a testing operation on the transfer switch using the front faceplate push-buttons, follow the procedure listed below.

To Initiate the Test Mode:

- Using the *ENTER* push-button, scroll to the **MANUAL TEST MENU**.
- Using the *INCREMENT* push-button, select the **YES** message and press the *ENTER* push-button.
- Using the *INCREMENT* push-button, select the **ON LOAD** or **OFF LOAD** test option as required.
- Press the *ENTER* push-button.

To Exit the Test Mode:

- Using the *ENTER* push-button, scroll to the **MANUAL TEST MENU.**
- Using the *INCREMENT* push-button, select the **YES** message and press the *ENTER* push-button.
- Using the *INCREMENT* push-button, select the **NONE** test option.
- Press the *ENTER* push-button.

5.3. TIME CLOCK ADJUSTMENT

To adjust the TSC 800 controllers internal time clock, follow the detailed procedure below. Note normal utility or generator power must be energized to enable adjustment.

- Using the *ENTER* push-button, scroll to the **PROGRAM MENU.**
- Using the *INCREMENT* push-button, select the **YES** message and press the *ENTER* push-button.
- Press the *ENTER* push-button when the **PASSWORD** message is displayed.
- Using the *INCREMENT* push-button, select the current ***day*** of the week message and press the *ENTER push*-button.
- Using the *INCREMENT* push-button, select the current ***hour*** of the day (i.e. 24 hour clock) and press the *ENTER push*-button.
- Using the *INCREMENT* push-button, select the current ***minute*** of the day (i.e. 60 minute) and press the *ENTER push*-button.
- Press the EXIT push-button and hold for 2 seconds to exit the time clock adjustment mode.

6. PROGRAMMING INSTRUCTIONS

Access to the programmable parameters of the **TSC 800** Transfer Controller is via a security password number. Three levels of security passwords are provided as described below:

READ ONLY MODE

User can view the programmable parameters only and cannot change any values. The Factory default number for the read-only level is one (1).

READ / WRITE MODE

User can view and modify any programming parameter as required. The Factory default number for the read/write level is two (2).

MASTER READ / WRITE MODE

User can view/modify any programming parameter as well as view/modify the security password level numbers. Consult TTI factory for master password number if required.

To enter the programming mode, follow the procedure as shown:

PROGRAM MENU
YES

Select the Program Menu by scrolling through the display menus using the ENTER push-button. When displayed, use the INCREMENT push-button to select the YES prompt and push the ENTER button .

PASSWORD
0

Use the INCREMENT or DECREMENT push-buttons to ramp the displayed number up or down to the desired password access number. Press the ENTER push-button when the correct number is displayed.

> **NOTE:**
> If an invalid number is entered, programming access will be limited to time clock adjustment only. To exit the programming mode, press the EXIT push-button and hold for two seconds until the display changes.

When the programming mode is accessed, the programming parameters will be displayed in the same order as the Programming Sheet. To skip over parameters that do not require changes, push and hold the ENTER push-button until the desired function is displayed. The EXIT push-button may be used to scroll backwards through the programming parameter loop.

To change a programmed parameter, use the INCREMENT or DECREMENT push-buttons to scroll through the available options or to adjust a value up or down to the desired number. When the desired option or number is displayed, press the ENTER push-button to accept the new value.

> **NOTE:**
> If the programming mode is terminated before the last change had been entered, the programming parameter will remain unchanged.

To exit the programming mode, press the EXIT push-button and hold for two seconds until the display changes.

6.1. EXERCISE TIMER

The TSC 800 controller has a built-in exercise timer which is programmable for a single occurrence, weekly exercise time period. The timer is fully programmable for time of day, duration of the test and type of test mode (i.e. On-Load or Off-Load). The exercise timer utilizes the TSC 800's internal time clock for referencing all timing functions. The time clock has a 10 minute power reserve feature to retain correct time settings during short duration utility power failures. Note: During any On-Load exercise test mode, the transfer switch will automatically re-transfer back to the utility supply if the generator set fails. To program the exercise timer prompts refer to the following descriptions:

6.1.1. AUTO TEST START DAY

Select the day of the week (e.g. Monday, Tuesday, etc.) that the generator set is to be started to begin its exercise period.

6.1.2. AUTO TEST START HOUR

Select the hour of the day (i.e. 0-23 hour) that the generator set is to be started to begin its exercise period.

6.1.3. AUTO TEST START MINUTE

Select the minute of the day (i.e. 0-59 minutes) that the generator set is to be started to begin its exercise period.

6.1.4. AUTO TEST STOP DAY

Select the day of the week (e.g. Monday, Tuesday, etc.) that the generator set is to be stopped following its exercise period.

6.1.5. AUTO TEST STOP HOUR

Select the hour of the day (i.e. 0-23 hour) that the generator set is to be stopped following its exercise period.

6.1.6. AUTO TEST STOP MINUTE

Select the minute of the day (i.e. 0 to 59 minutes) that the generator set is to be stopped following its exercise period.

6.1.7. AUTO TEST MODE

Select type of test mode desired. Three test modes are available as follows:

6.1.7.1.NONE: The exercise test mode is de-activated.

6.1.7.2.OFF LOAD: The generator set will be started during the exercise period but no transfer will occur. Note: the generator will transfer on load if the utility supply fails during the test period.

6.1.7.3.ON LOAD: The generator will be started and will transfer on load. Note: During the On-Load exercise test mode, the transfer switch will automatically re-transfer back to the utility supply if the generator set fails.

6.2. SYSTEM CONFIGURATION

The TSC 800 controller provides a flexible control system to allow specific operation for a wide range of power distribution types. To program the system configuration, refer to the following descriptions:

6.2.1. NODE ADDRESS

Set to unique controller address (1-255) for use with network connected TSC 800 controllers.

Note: This programming feature is only active when the remote communication option is enabled. Default setting for single TSC 800 applications is 1.

6.2.2. SYSTEM VOLTAGE

Set to nominal system voltage as expressed in "phase to phase" voltage.(i.e. a 347/600 volt system would be entered as "600". The programmable range of values is 120V-15,000V.

6.2.3. VOLTAGE SENSING RATIO

For direct voltage sensing wiring connections from 208 to 600 volts, enter a ratio of "1:1". When potential transformers are utilized for voltage sensing, enter the transformer ratio.(e.g. when using a 600:120 transformer, enter a ratio of "5:1".

6.2.4. SYSTEM FREQUENCY

Set to nominal system frequency of either 50 HZ or 60 HZ.

6.2.5. SYSTEM PHASES

Set to match the power distribution system used on the automatic transfer switch (i.e. either 1 phase or 3 phase system).

6.3. VOLTAGE SENSING

The TSC 800 controller provides 3-phase overvoltage and undervoltage sensing on both utility and generator supplies. Each sensor is individually programmable for pickup and dropout voltage setpoints (i.e. adjustable hysteresis) in addition to transient time delay settings. To program the voltage sensing features, refer to the following descriptions:

6.3.1. UTILITY UNDERVOLTAGE SENSOR PICKUP

Set to the desired utility undervoltage setpoint at which the internal voltage sensor *picks up* (i.e. the sensor energizes to a normal state when the utility voltage is above the setpoint). The setting is entered based on a phase to phase voltage value within a range of 70% to 100% of nominal system voltage. Note: The difference between the pickup and dropout setting is considered the dead band or hysteresis value.

6.3.2. UTILITY UNDERVOLTAGE SENSOR DROPOUT

Set to the desired utility undervoltage setpoint at which the internal voltage sensor *drops out* (i.e. the sensor de-energizes to an abnormal state when the utility voltage is below the setpoint). The setting is entered based on a phase to phase voltage value within a range of 70% to 100% of nominal system voltage. Note: The difference between the pickup and dropout setting is considered the dead band or hysteresis value.

6.3.3. UTILITY UNDERVOLTAGE SENSOR TIME DELAY (DROPOUT)

Select the desired utility undervoltage time delay setting. The setting is entered in seconds within a range of 0 to 10 seconds. If no delay is required, set this time delay to zero.

6.3.4. UTILITY OVERVOLTAGE SENSOR PICKUP

Note: This feature is optional and must be factory ordered with the transfer switch. Set to the desired utility overvoltage setpoint at which the internal voltage sensor *picks up* (i.e. the sensor energizes to an abnormal state when the utility voltage is above the setpoint). The setting is entered based on a phase to phase voltage value within a range of 100% to 130% of nominal system voltage. **Note:** The difference between the pickup and dropout setting is considered the dead band or hysteresis value.

6.3.5. UTILITY OVERVOLTAGE SENSOR DROPOUT

Note: This feature is optional and must be factory ordered with the transfer switch. Set to the desired utility overvoltage setpoint at which the internal voltage sensor *drops out* (i.e. the sensor de-energizes to a normal state when the utility voltage is below the setpoint). The setting is entered based on a phase to phase voltage value within a range of 100% to 130% of nominal system voltage. **Note:** The difference between the pickup and dropout setting is considered the dead band or hysteresis value.

6.3.6. UTILITY OVERVOLTAGE SENSOR TIME DELAY (PICKUP)

Note: This feature is optional and must be factory ordered with the transfer switch. Select the desired utility overvoltage time delay setting. The setting is entered in seconds within a range of 0 to 5 seconds. If no delay is required, set this time delay to zero.

6.3.7. GENERATOR UNDERVOLTAGE SENSOR PICKUP

Set to the desired generator undervoltage setpoint at which the internal voltage sensor *picks up* (i.e. the sensor energizes to a normal state when the generator voltage is above the setpoint). The setting is entered based on a phase to phase voltage value within a range of 70% to 100% of nominal system voltage. **Note**: The difference between the pickup and dropout setting is considered the dead band or hysteresis value.

6.3.8. GENERATOR UNDERVOLTAGE SENSOR DROPOUT

Set to the desired generator undervoltage setpoint at which the internal voltage sensor *drops out* (i.e. the sensor de-energizes to an abnormal state when the generator voltage is below the setpoint). The setting is entered based on a phase to phase voltage value within a range of 70% to 100% of nominal system voltage. **Note**: The difference between the pickup and dropout setting is considered the dead band or hysteresis value.

6.3.9. GENERATOR UNDERVOLTAGE SENSOR TIME DELAY (DROPOUT)

Select the desired generator undervoltage time delay setting. The setting is entered in seconds within a range of 0 to 10 seconds. If no delay is required, set this time delay to zero.

6.3.10. GENERATOR OVERVOLTAGE SENSOR PICKUP

Note: This feature is optional and must be factory ordered with the transfer switch. Set to the desired generator overvoltage setpoint at which the internal voltage sensor *picks up* (i.e. the sensor energizes to an abnormal state when the generator voltage is above the setpoint). The setting is entered based on a phase to phase voltage value within a range of 100% to 130% of nominal system voltage. Note: The difference between the pick up and drop out setting is considered the dead band or hysteresis value.

6.3.11. GENERATOR OVERVOLTAGE SENSOR DROPOUT

Note: This feature is optional and must be factory ordered with the transfer switch. Set to the desired generator overvoltage setpoint at which the internal voltage sensor *drops out* (i.e. the sensor de-energizes to a normal state when the generator voltage is below the setpoint). The setting is entered based on a phase to phase voltage value within a range of 100% to 130% of nominal system voltage. **Note**: The difference between the pickup and dropout setting is considered the dead band or hysteresis value.

6.3.12. GENERATOR OVERVOLTAGE SENSOR TIME DELAY (PICKUP)

Note: This feature is optional and must be factory ordered with the transfer switch. Select the desired generator overvoltage time delay setting. The setting is entered in seconds within a range of 0 to 5 seconds. If no delay is required, set this time delay to zero.

6.4. *FREQUENCY SENSING*

The **TSC 800** controller provides under and over frequency sensing on both utility and generator supplies. Each sensor is individually programmable for pickup and dropout frequency setpoints (i.e. adjustable hysteresis) in addition to transient time delay settings. To program the frequency sensing features, refer to the following descriptions:

6.4.1. UTILITY UNDERFREQUENCY SENSOR

Note: This feature is optional and must be factory ordered with the transfer switch.

Set to the desired utility underfrequency setpoint at which the internal frequency sensor *drops out* (i.e. the sensor de-energizes to an abnormal state when the utility frequency is below the setpoint). The setting is entered in a frequency value within a range of 40.0 to 60.0 HZ.

6.4.2. UTILITY UNDERFREQUENCY SENSOR TIME DELAY (DROPOUT)

Note: This feature is optional and must be factory ordered with the transfer switch.

Select the desired utility underfrequency time delay setting. The setting is entered in seconds within a range of 0 to 10 seconds. If no delay is required, set this feature to zero.

6.4.3. UTILITY OVERFREQUENCY SENSOR

Note: This feature is optional and must be factory ordered with the transfer switch.

Set to the desired utility overfrequency setpoint at which the internal frequency sensor *picks up* (i.e. the sensor energizes to an abnormal state when the utility frequency is above the setpoint). The setting is entered in a frequency value within a range of 50.0 to 70.0 HZ.

6.4.4. UTILITY OVERFREQUENCY SENSOR TIME DELAY (PICKUP)

Note: This feature is optional and must be factory ordered with the transfer switch.

Select the desired utility overfrequency time delay setting. The setting is entered in seconds within a range of 0 to 5 seconds. If no delay is required, set this time delay to zero.

6.4.5. GENERATOR UNDERFREQUENCY SENSOR

Set to the desired generator underfrequency setpoint at which the internal frequency sensor *drops out* (i.e. the sensor de-energizes to an abnormal state when the generator frequency is below the setpoint). The setting is entered in a frequency value within a range of 40.0 to 60.0 HZ.

6.4.6. GENERATOR UNDERFREQUENCY SENSOR TIME DELAY (DROPOUT)

Select the desired generator underfrequency time delay setting. The setting is entered in seconds within a range of 0 to 10 seconds. If no delay is required, set this time delay to zero.

6.4.7. GENERATOR OVERFREQUENCY SENSOR

Set to the desired generator overfrequency setpoint at which the internal frequency sensor *picks up* (i.e. the sensor energizes to an abnormal state when the generator frequency is above the setpoint). The setting is entered in a frequency value within a range of 50.0 to 70.0 HZ.

6.4.8. GENERATOR OVERFREQUENCY SENSOR TIME DELAY (PICKUP)

Select the desired generator overfrequency time delay setting. The setting is entered in seconds within a range of 0 to 5 seconds. If no delay is required, set this time delay to zero.

6.5. TIME DELAYS

The TSC 800 provides many time delay control functions which are individually programmable as described below.

6.5.1. GENERATOR START DELAY

The generator (i.e. engine) start signal will be initiated following expiry of the start delay timer. Select desired generator start delay time in seconds. The range of setting is 0 to 60 seconds. If no delay is required, set this time delay to zero. **Note**: The output relay is normally energized when the utility power is within limits and de-energizes to start the generator.

6.5.2. GENERATOR WARM UP DELAY

A transfer to the generator supply will be initiated when the voltage and frequency are within limits and upon expiry of the warm up delay timer. Select desired generator warm up delay time in seconds. The range of settings is 0 to 1800 seconds. If no delay is required, set this time delay to zero.

6.5.3. GENERATOR COOLDOWN DELAY

The generator (i.e. engine) cooldown period will be initiated once the load has transferred from the generator supply. The engine start signal will be maintained until expiry of the cooldown delay timer. Select desired generator cooldown delay time in minutes. The range of settings is 0 to 30 minutes. If no delay is required, set this time delay to zero.

6.5.4. UTILITY RETURN DELAY

The utility return delay period will be initiated once the utility supply has returned within limits following a utility power failure condition. Select desired utility return delay time in minutes. The range of settings is 0 to 30 minutes. If no delay is required, set this time delay to zero. **Note**: The utility return delay will be bypassed should the generator fail during the time delay period.

6.5.5. PRE/POST TRANSFER DELAY (LDC)

Note: This feature is optional and must be factory ordered with the transfer switch.

The pre/post transfer delay period will be initiated upon a impending transfer in either direction. The pre/post transfer output relays will momentarily energize (as per the pre-transfer time setting) prior to a load transfer and will stay energized until the post-transfer delay time period expires. Select desired pre- and post-delay time in seconds. The range of settings is 0 to 30 seconds. If no delay is required, set this time delay to zero.

6.5.6. MINIMUM FIND NEUTRAL DELAY

The TSC 800 transfer control logic includes an adjustable time delay feature to compensate for the minimum time that a transfer switch mechanism takes to operate when load sensing voltage is lost due to a power failure. This time delay is set to a time value which is approximately *equal* to the time that the *transfer mechanism* typically takes to operate from one supply position to the neutral position. This feature is factory set to match the specific transfer switch mechanism as supplied with the unit.

6.5.7. MAXIMUM FIND NEUTRAL DELAY

The TSC 800 transfer control logic includes an adjustable time delay feature to compensate for the maximum time that a transfer switch mechanism takes to operate when load sensing voltage is used to detect the neutral position. This time delay is set to a time value which is *greater than* the typical time that the transfer mechanism typically takes to operate from one supply position to the neutral position. When the TSC 800 controller is supplied from the factory with a TTI transfer mechanism the Maximum Find Neutral Delay will be factory set for correct operation. Note: When the TSC 800 controller is supplied loose without a transfer mechanism, the Maximum Find Neutral Delay function must be user set for correct operation with the appicable transfer mechanism. For applications using electrically held contactors, the Maximum Find Neutral Delay function must typically be set for 0.0 seconds for correct operation.

6.5.8. NEUTRAL DELAY TIMER (NDT)

The neutral delay time period will be initiated once both of the supply breakers are open during a transfer sequence. Select desired neutral delay time in seconds. The range of settings is 0 to 60 seconds. If no delay is required, set this time delay to zero. **Note**: The neutral delay will be bypassed should the operating power fail for longer than the timer setting.

NOTE: Model TS 890 transfer switches may use NDT timers which are external to the TSC 800 controller. In this case the TSC 800 NDT function is not used and must be set at zero seconds. Refer to TS 890 drawings for further information.

6.5.9. MAXIMUM TRANSFER TIME

The TSC 800 transfer control logic includes an adjustable time delay feature to detect when a transfer switch mechanism fails to operate. This time delay is set to a time value which is *greater than* the typical time that the transfer mechanism typically takes to operate from one supply position to the opposite supply position. This feature is factory set to match the specific transfer switch mechanism as supplied with the unit.

6.5.10. TRANSFER FAIL

Note: This feature is user selectable in TSC 800 software version 1.3 (or greater).

The TSC 800 transfer controller contains a "TRANSFER SWITCH FAIL" detection feature which is user selectable for enabled or disabled. Operating logic is as follows:

DISABLED: The "TRANSFER SWITCH FAIL" feature is disabled in this mode. The TSC 800 controller will not verify that the transfer mechanism has operated correctly.

ENABLED: The "TRANSFER SWITCH FAIL" feature is enabled in this mode. The TSC 800 controller will verify that the transfer switch mechanism has correctly transferred or is in the correct position. If the TSC 800 controller senses an abnormal condition (i.e. load voltage and transfer switch position contacts are not at the normal levels or states) the controller will activate an alarm message to the LCD display. The transferring output signals from the controller will be de-activated and the engine start contact will remain in its last state (before the alarm was activated). The controller has an internal 30 sec. timer to provide an alarm bypass to enable correct operating sequences. To reset the alarm condition, the "lamp test" function must be activated. Note: The "TRANSFER SWITCH FAIL" feature will typically be enabled when supplied from the factory.

6.5.11. <u>TRANSFER LOGIC</u>

Note: This feature is user selectable in TSC 800 software version 1.3 (or greater).

The TSC 800 transfer controller software contains a user selectable function for type of transfer logic required for specific applications. This feature will be factory set for specific type of application and transfer mechanism used and therefore should not require resetting.

Selectable operating logic is as follows:

MAINTAINED: The TSC 800 transfer output signals will stay in the 'MAINTAINED" energized state upon a source failure and will only de-energize when the alternate source becomes available. Note: the transfer output signal will de-energize upon a total loss of source voltage.

DROPOUT: The TSC 800 transfer output signals will "DROPOUT" (or de-energize) when the connected source goes out of normal voltage or frequency limits. The transfer output signal will only re-energize when the connected source returns to normal limits.

6.5.12. <u>PROGRAMMABLE OUTPUT</u>

The TSC 800 transfer controller includes a standard programmable output relay signal. The output relay energizes when one of the following conditions occurs. Note: Only <u>one function</u> may be programmed.

LOAD ON UTILITY	Output energizes when the utility transfer breaker is closed and load voltage is present.
LOAD ON GENERATOR	Output energizes when the generator transfer breaker is closed and load voltage is present.
LOAD SHED	Output energizes when generator is on load and frequency drops below underfrequency setpoint for longer than the time delay setting.
UTILITY SUPPLY NORMAL	Output relay energizes when the utility supply is energized and is within voltage and frequency limits.
FAIL TO TRANSFER	Output relay energizes when the transfer switch mechanism fails to operate for the given time delay period. Note: This output feature is only activated when the "TRANSFER SWITCH FAIL" feature is enabled. (Refer to programming item #11 for additional information.)

6.5.13. UTILITY FAIL CALLOUT

When the remote communication option is enabled, this programming prompt will appear. This feature may be enabled or disabled by programming selection.

ENABLED: The controller will initiate a callout signal via the communication port to a remote connected device when a Utility (Source 1) power failure is detected. The callout signal will be reset when the Utility (Source 1) power returns to normal condition.

DISABLED: The controller will not initiate a callout when a Utility (Source 1) power failure is detected.

6.5.14. LOAD ON GENERATOR CALLOUT

When the remote communication option is enabled, this programming prompt will appear. This feature may be enabled or disabled by programming selection.

ENABLED: The controller will initiate a callout signal via the communication port to a remote connected device when the load is connected to the generator supply. The callout signal will be reset when the load transfers back to the utility supply.

DISABLED: The controller will not initiate a callout when the load transfers to the generator supply.

6.5.15. TRANSFER FAIL CALLOUT

When the remote communication option is enabled, this programming prompt will appear. This feature may be enabled or disabled by programming selection.

ENABLED: The controller will initiate a callout signal via the communication port to a remote connected device when the transfer switch fails to operate. The callout signal will only reset when the "Fail to Transfer" alarm is manually reset via local push-buttons or with the remote communication software.

DISABLED: The controller will not initiate a callout when a "Fail to Transfer " alarm condition occurs.

6.5.16. AUTO TEST CALLOUT

When the remote communication option is enabled, this programming prompt will appear. This feature may be enabled or disabled by programming selection.

ENABLED: The controller will initiate a callout signal via the communication port to a remote connected device when a automated test is initiated at the controller via the TSC 800 exercise time clock. The callout signal will reset when the Auto Test condition is terminated.

DISABLED: The controller will not initiate a callout an Auto Test condition is initiated.

6.5.17. MAN TEST CALLOUT

When the remote communication option is enabled, this programming prompt will appear. This feature may be enabled or disabled by programming selection.

ENABLED: The controller will initiate a callout signal via the communication port to a remote connected device when a manual test is initiated at the controller via the TSC 800 push-buttons or external control switch. The callout signal will reset when the Manual Test condition is terminated.

DISABLED: The controller will not initiate a callout a Manual Test condition is initiated.

6.5.18. SWITCH NOT IN AUTO CALLOUT

When the remote communication option is enabled, this programming prompt will appear. This feature may be enabled or disabled by programming selection.

ENABLED: The controller will initiate a callout signal via the communication port to a remote connected device when the TSC 800 controllers' operating mode is "Not In Auto" as locally selected via the four position external control switch. The callout signal will reset when the control switch is returned to the Auto position.

DISABLED: The controller will not initiate a callout if the TSC 800 controller is not in the Auto mode of operation.

6.5.19. BACK LIGHT TIME OUT

The LCD back light function can be programmed so it will automatically turn off after the selected time.

6.6. VOLTAGE SENSING CALIBRATION

Voltage sensing calibration for the utility, generator and load sensors is provided by the TSC 800 software program. All voltage sensing circuits are factory calibrated to specific voltage levels prior to shipment of the transfer switch.

Should field calibration of any voltage sensing circuit be required, the following procedure may be used.

WARNING
Voltage sensing circuits are capable of lethal voltages while energized. Standard safety procedures should be followed and be performed by qualified personnel only. Failure to do so may cause personnel injury and/or death.

6.6.1. GENERAL

6.6.1.1. To access the TSC 800's software programming loop for programming, the program menu must be selected, the YES prompt entered and read/write security password level (or higher) must be entered.

6.6.1.2. Once the programming loop has been accessed, scroll to the voltage calibration screens as shown below.

```
UTIL AB① ZERO②
     99③   600V④
```

① Displays the selected supply's phase voltages to be calibrated.

② Displays the type of calibration function, either ZERO or SPAN.

③ Displays the calibration correction factor number (0-255) used to obtain the correct voltage reading. **Note**: To correctly calibrate any of the voltage sensors, the ZERO function must be calibrated before the SPAN function.

④ Displays the actual voltage measurement which will be the same value as shown on the TSC 800 display menus for generator or utility supplies. This voltage reading may be calibrated higher or lower by changing the correction factor number.

NOTE:
To accurately calibrate the TSC 800's voltage sensors, an external test voltage meter is required, with an accuracy of 0.5% or better.

6.6.2. UTILITY VOLTAGE CALIBRATION

To adjust the utility supply voltage sensors, perform the following procedure:

6.6.2.1.ZERO CALIBRATION

6.6.2.1.1.Energize the generator supply to power up the controller and de-energize the utility supply.

6.6.2.1.2.Scroll to the desired utility supply voltage phases with the **ZERO** function selected.

6.6.2.1.3.Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number while observing the displayed voltage level. Adjust the correction factor number to obtain 0 VAC on the display.

6.6.2.1.4.With the correct voltage displayed, press the ENTER push-button to accept the correction factor number. Record the correction factor number on the TSC 800 programming sheet for future reference if required.

6.6.2.1.5.Repeat the above procedure for all remaining phases of the utility supply as required.

6.6.2.2.SPAN CALIBRATION

6.6.2.2.1.Energize the utility supply voltage to the controller at nominal level. The generator supply may be de-energized.

6.6.2.2.2.In the programming mode, scroll to the desired utility supply voltage phases with the **SPAN** function selected.

6.6.2.2.3.Connect an external AC voltmeter of adequate voltage range and accuracy to the TSC 800 controller terminal associated with the voltage phases to be calibrated.

WARNING

Voltage sensing circuits are capable of lethal voltages while energized. Standard safety procedures should be followed and be performed by qualified personnel only. Failure to do so may cause personal injury and/or death.

6.6.2.2.4. Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number while observing the displayed voltage level on the TSC 800. Adjust the correction factor number to obtain an identical voltage reading as measured with the external AC voltmeter.

6.6.2.2.5. With the correct voltage displayed, press the *ENTER* push-button to accept the correction factor number. Record the correction factor number on the TSC 800 programming sheet for future reference if required.

6.6.2.2.6. Repeat the above procedures for all remaining phases of the utility supply as required.

NOTE:

Once the span calibration setting has been done, do not readjust any zero calibration points as this will cause incorrect voltage readings.

7. TSC 800 PROGRAMMING DATA SHEETS

SUMMARY CONFIGURATION DATA SHEET

WORK ORDER #:	________	REV.	________	REV. DATE:	________
INITIATED BY:	________	CUSTOMER:	________	DEFAULT PROGRAM #:	________
DATE:	________	PROJECT:	________	TPS VERSION:	________
NOTES:					

SYSTEM AC INPUTS

SYSTEM AC VOLTS:________ PHASES:____ FREQUENCY:________ CONTROL TYPE:________

DIGITAL DISPLAY FEATURES

☐ GEN AC VOLTAGE ☐ UTILIY AC VOLTAGE ☐ TIME CLOCK

☐ GEN AC FREQUENCY ☐ UTILITY AC FREQUENCY

STANDARD FEATURES

☐ Level 1 Features

- 3 phase Utility (SRC 1) Undervoltage Sensing
- 3 phase Gen (SRC 2) Undervoltage Sensing
- Generator Underfrequency Sensing
- Generator Start Delay Timer
- Generator Cooldown Timer
- Utility Return Timer
- Generator Warm-up Timer
- Automatic Exercise Timer
- Neutral Delay Timer

☐ Level 2 Features (Level 1 features plus)

- Utility/Gen 3 Phase Overvoltage Sensing
- Utility Overfrequency Sensing

☐ Level 3 Features (Level 1& 2 features plus)

- Dual Source Logic

OPTIONAL FEATURES

☐ Utility/Gen 3 Phase Overvoltage Sensing

☐ Utility Overfrequency Sensing

☐ Load Disconnect Contact

☐ COM Port Enabled

STANDARD PROGRAMMABLE OUTPUTS

OUTPUT NAME	OUTPUT FUNCTION
☐ Programmable Output	☐ Load on Gen
________	☐ Load on Utility
________	☐ Utility Normal
________	☐ Transfer Fail
	☐ Load Shed

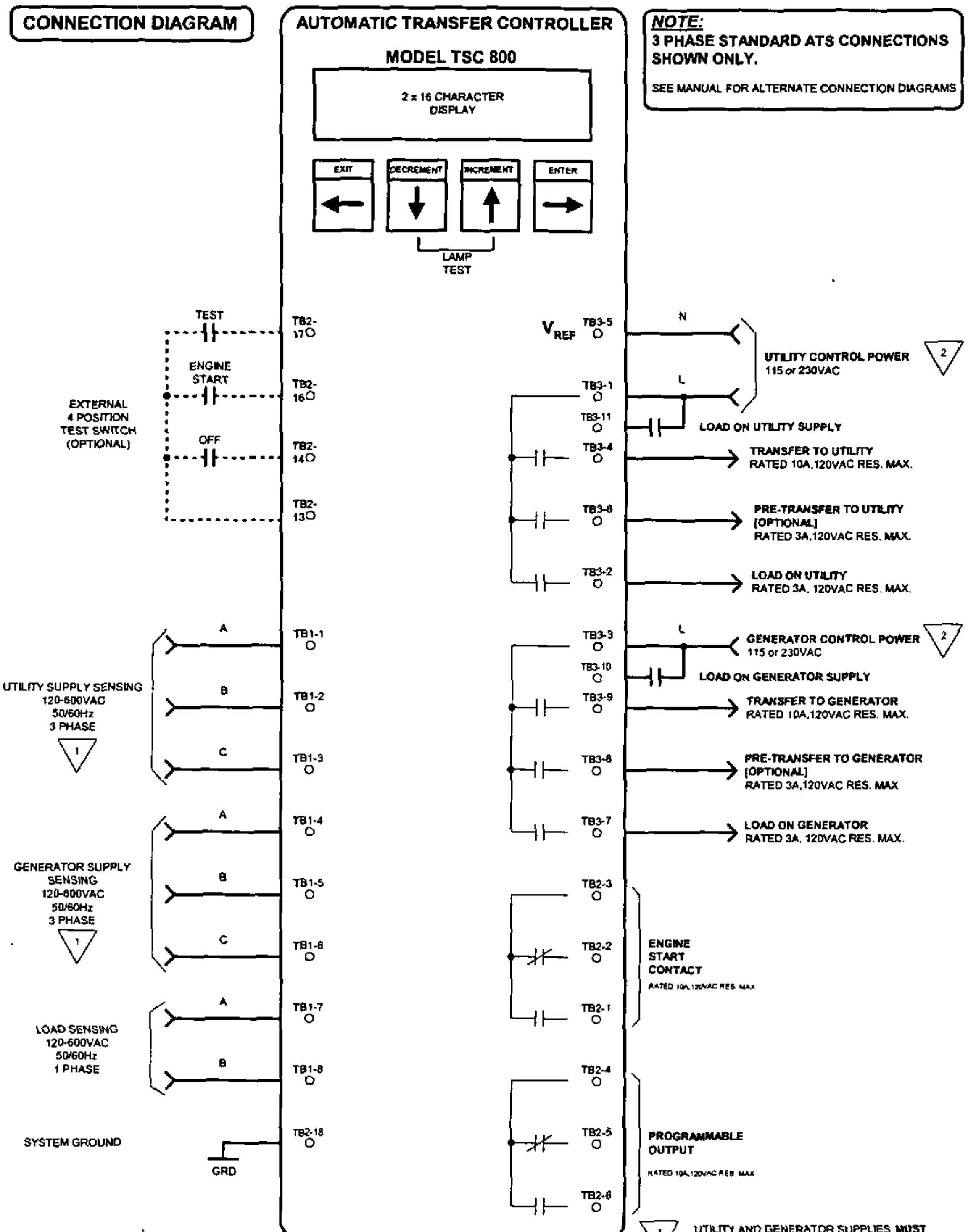
8. MAIN MENU PROGRAMMING SHEET

PARAMETER		VALUE	RANGE LOW		RANGE HIGH
CONTROL TYPE	STD ATS / DUAL SOURCE				
AUTO TEST START DAY					
AUTO TEST START HOUR					
AUTO TEST START MIN					
AUTO TEST STOP DAY					
AUTO TEST STOPHOUR					
AUTO TEST STOP MIN					
AUTO TEST MODE					
COMMUNICATION OPTION	toggle enabled/disabled				
NODE ADRESS	#		1		255
SYSTEM VOLTAGE	[***VAC]				
VOLTAGE SENSING RATIO	RATIO		1		208
SYSTEM FREQUENCY	[***Hz]		0		125
SYSTEM PHASES	TOGGLE 1 OR 3 PHASE				
UTILITY UNDERVOLTAGE SENSORS PICK UP	[***VAC]		0	to	0
UTILITY UNDERVOLTAGE SENSORS DROP OUT	[***VAC]		0	to	0
UTILITY UNDERVOLTAGE SENSORS TIME DELAY DROP OUT	[**SEC]		0	to	10
UTILITY OVERVOLTAGE SENSORS PICK UP	[***VAC]		0	to	0
UTILITY OVERVOLTAGE SENSORS DROP OUT	[***VAC]		0	to	0
UTILITY OVERVOLTAGE SENSORS TIME DELAY PICK UP	[**SEC]		0	to	5
UTILITY UNDER FREQUENCY SENSORS	[***Hz]		48.0	to	60.0
UTILITY UNDER FREQUENCY SENSORS TIME DELAY DROPOUT	[**SEC]		0	to	10
UTILITY OVER FREQUENCY SENSORS	[***Hz]		50.0	to	70.0
UTILITY OVER FREQUENCY SENSORS TIME DELAY PICK UP	[**SEC]		0	to	5
GENERATOR UNDERVOLTAGE SENSORS PICK UP	[***VAC]		0	to	0
GENERATOR UNDERVOLTAGE SENSORS DROP OUT	[***VAC]		0	to	0
GENERATOR UNDERVOLTAGE SENSORS TIME DELAY DROP OUT	[**SEC]		0	to	10
GENERATOR OVERVOLTAGE SENSORS PICK UP	[***VAC]		0	to	0
GENERATOR OVERVOLTAGE SENSORS DROP OUT	[***VAC]		0	to	0
GENERATOR OVERVOLTAGE SENSORS TIME DELAY PICK UP	[**SEC]		0	to	5
GENERATOR UNDER FREQUENCY SENSORS	[***Hz]		40.0	to	60.0
GENERATOR UNDER FREQUENCY SENSORS TIME DELAY DROP OUT	[**SEC]		0	to	10
GENERATOR OVER FREQUENCY SENSORS	[***Hz]		50.0	to	70.0
GENERATOR OVER FREQUENCY SENSORS TIME DELAY PICK UP	[**SEC]		0	to	5
GENERATOR START DELAY	[****SEC]		0	to	60
GENERATOR WARM-UP DELAY	[****SEC]		0	to	1800
GENERATOR COOLDOWN DELAY	[****MIN]		0	to	30
UTILITY RETURN DELAY	[****MIN]		0	to	30
PRE-TRANSFER DELAY	[****SEC]		0	to	30
MIN FIND NEUTRAL DELAY	[****SEC]		0.0	to	20.0
MAX FIND NEUTRAL DELAY	[****SEC]		0.0	to	20.0
NEUTRAL DELAY	[****SEC]		0	to	60
MAX TRANSFER TIME	[****SEC]		0	to	30
POST TRANSFER DELAY	[****SEC]		0	to	30
TRANSFER FAIL	toggle enabled/disabled				
TRANSFER OUTPUT LOGIC	toggle maintained/dropout				
PROGRAMMABLE OUTPUT	A=LD ON UTIL,B= LD ON GEN,C= LD SHED,D= UTIL NORMAL,E=FAIL TO XFER		A	to	E
UTILITY FAIL CALLOUT	toggle enabled/disabled				
LOAD ON GEN CALLOUT	toggle enabled/disabled				
TRANSFER FAIL CALLOUT	toggle enabled/disabled				
AUTO TEST CALLOUT	toggle enabled/disabled				
MAN TEST CALLOUT	toggle enabled/disabled				
SWITCH NOT IN AUTO CALLOUT	toggle enabled/disabled				
BACKLIGHT	[****SEC]		0	to	999

9. CALIBRATION DATA SHEET

UTILITY PHASE A - B ZERO	[*CORRECTION FACTOR*]		0	to	255
UTILITY PHASE A - B SPAN	[*CORRECTION FACTOR*]		0	to	255
UTILITY PHASE B - C ZERO	[*CORRECTION FACTOR*]		0	to	255
UTILITY PHASE B - C SPAN	[*CORRECTION FACTOR*]		0	to	255
UTILITY PHASE C - A ZERO	[*CORRECTION FACTOR*]		0	to	255
UTILITY PHASE C - A SPAN	[*CORRECTION FACTOR*]		0	to	255
GENERATOR PHASE A - B ZERO	[*CORRECTION FACTOR*]		0	to	255
GENERATOR PHASE A - B SPAN	[*CORRECTION FACTOR*]		0	to	255
GENERATOR PHASE B - C ZERO	[*CORRECTION FACTOR*]		0	to	255
GENERATOR PHASE B - C SPAN	[*CORRECTION FACTOR*]		0	to	255
GENERATOR PHASE C - A ZERO	[*CORRECTION FACTOR*]		0	to	255
GENERATOR PHASE C - A SPAN	[*CORRECTION FACTOR*]		0	to	255
LOAD PHASE A - B ZERO	[*CORRECTION FACTOR*]		0	to	255
LOAD PHASE A - B SPAN	[*CORRECTION FACTOR*]		0	to	255

10. TSC 800 TYPICAL CONNECTION DIAGRAM



DIMENSIONS

FACEPLATE: 5.5" x 5.5" [140mm x 140mm]

PRINTED CIRCUIT BOARD: 6.30"W x 12.00"H [160mmW x 305mmH]

1: UTILITY AND GENERATOR SUPPLIES MUST UTILIZE A SOLIDLY GROUNDED NEUTRAL SYSTEM. REFER TO INSTRUCTION MANUAL FOR ALTERNATE CONNECTIONS

2: CONTROL POWER INPUT VOLTAGE MUST MATCH TSC 800 MODEL TYPE

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11. TSC 800 SPECIFICATIONS

- POWER SUPPLY:
  - 115 or 230 VAC nominal (+10% -30%)
    - 50/60 Hz
    - 100ma nominal (no external load connected)

- VOLTAGE SENSING:
  - Direct 120-600 VAC nominal, single or three phase
  - 50/60 Hz
  - +/- 0.5% accuracy of setting @ 25°C

- OPERATING TEMPERATURE:
  - 0°C to +50°C

- OUTPUT CONTACTS (Form C, 10A,120/240VAC resistive)
  - Engine start
  - Programmable function (not available with dual source system logic)

- OUTPUT SIGNALS (120/240 VAC resistive load)
  - Transfer to utility 10A
  - Transfer to generator 10A
  - Pre/post-transfer to utility 3A
  - Pre/post-transfer to generator 3A
  - Load on utility 3A
  - Load on generator 3A

12. TROUBLESHOOTING

A number of problems can cause the TSC 800 controller not to function properly. Refer to the following list of typical problems. Consult the factory for any detailed information or for any problems not listed.

CAUTION!!!

Before opening the enclosure to perform any service task, it is imperative to isolate the transfer switch from any possible source of power. Failure to do so may result in serious personal injury or death due to electrical shock.

Service procedures must be undertaken by qualified personnel only!

Symptom	Possible Causes
- Will not re-transfer to utility source upon restoration	- a test mode has been activated (check TSC 800 status LCD display) - utility voltage or frequency is outside the pre-programmed limits (check utility source for adequate voltage & frequency) - a loose control connection - faulty contactor auxiliary contact - defective utility contactor coil - defective TSC 800 controller (verify output signals with circuit board mounted diagnostic LED's)
- Will not transfer to generator source upon failure of utility source	- generator set not producing enough voltage/frequency or output circuit breaker open - warm-up time delay function has not timed out yet (verify TSC 800 timer setting) - a loose control connection - faulty contactor auxiliary contact - defective generator contactor coil - defective TSC 800 controller (verify output signals with circuit board mounted diagnostic LED's)
- Transfer to generator source without a power failure in the utility source	- a test mode has been activated (check TSC 800 status LCD display) - defective TSC 800 controller (verify output signals with circuit board mounted diagnostic LED's) - loose or broken wire to the utility voltage sensing terminals on the TSC 800 controller
- Generator does not start up or stop when it should	- verify remote engine control panel is set for automatic mode
- No time delay when there should be	- verify time delay function in the TSC 800 program setting as per programming sheets as supplied with the transfer switch
- Engine runs for no apparent reason	- Verify the TSC 800 has not been set for test operation. If yes, select manual test "NONE". Refer to section 4.2 for operation details

DEFECTIVE COMPONENTS

Return defective components to Thomson Technology Inc. for repair. **Be sure to advise model and serial number of the transfer switch.**

13. NOTES

TSC800

MICROPROCESSOR TRANSFER SWITCH CONTROLLER

SUMMARY CONFIGURATION DATA SHEET

TSC800 Software ver. 1.6

WORK ORDER #:	00000-00-01-TS	**REV.:**	0	**REV. DATE:**	99/05/10
INITIATED BY:	Admin	**CUSTOMER:**	TEST	**DEFAULT PROGRAM:**	P1-480
DATE:	99/05/10	**PROJECT NAME:**	DEFAULT / P1-480	**TPS VER:**	C
NOTES:					

SYSTEM AC INPUTS

SYSTEM AC VOLTS: 480 **PHASES:** 3 **FREQUENCY:** 60 **CONTROL TYPE:** STD ATS

DIGITAL DISPLAY FEATURES

- ☒ GENERATOR AC VOLTAGE
- ☒ GENERATOR FREQUENCY
- ☒ UTILITY AC VOLTAGE
- ☒ UTILITY FREQUENCY
- ☒ TIME CLOCK

STANDARD FEATURES

Level 1 Features
3 Phase Utility (Src 1) Undervoltage Sensing
3 Phase Generator (Src 2) Undervoltage Sensing
Generator Underfrequency Sensing
Generator Start Delay Timer
Generator Cooldown Delay Timer
Utility Return Delay Timer
Generator Warm-up Timer
No Load Test PB Function
Full Load Test PB Function
Automatic Exercize Test Clock

STANDARD PROGRAMMABLE OUTPUTS

OUTPUT NAME	OUTPUT TYPE
Programmable Output #1	LD on Gen

OPTIONAL FEATURES

1- Read only
2- Read write
3- master Password

Main Menu Program

TSC800

TSC800 Software ver. 1.6

CUSTOMER:	TEST
PROJECT:	DEFAULT / P1-480
PRODUCT:	TSC800

WORK ORDER:	00000-00-01-TS
REVISION #:	0
REVISION DATE:	99/05/10
START DATE:	99/05/10
START BY:	Admin
DEFAULT PROGRAM:	P1-480
TPS VERSION:	C

Control Type:	STD ATS	
Auto Test Start Day:	Sunday	Day of the week
Auto Test Start Hour:	00	00 - 23 hours
Auto Test Start Minute:	00	00 - 59 minutes
Auto Test Stop Day:	Sunday	Day of the week
Auto Test Stop Hour:	00	00 - 23 hours
Auto Test Stop Minute:	00	00 - 59 minutes
Auto Test Mode:	None	None, On Load, or Off Load
Communications Option:	No	Toggle between Yes/No
Node Address:		<- Option not enabled
System Voltage:	480	*Line to line voltage 120 - 15000*
Voltage Sensing Ratio:	1	1 - 208 ratio number
System Frequency:	60	Toggle between 50/60 Hz
System Phases:	3	Toggle between 1 & 3 phase
Util UV Pickup:	432	335 - 480 VAC
Util UV Dropout:	384	335 - 480 VAC
Util UV Dropout Delay:	1	0 - 10 seconds
Util OV Pickup:		<- Option not enabled
Util OV Dropout:		<- Option not enabled
Util OV Pickup Delay:		<- Option not enabled
Util UF:		<- Option not enabled
Util UF Dropout Delay:		<- Option not enabled
Util OF:		<- Option not enabled
Util OF Pickup Delay:		<- Option not enabled
Gen UV Pickup:	432	335 - 480 VAC
Gen UV Dropout:	384	335 - 480 VAC
Gen UV Dropout Delay:	5	0 - 10 seconds
Gen OV Pickup:		<- Option not enabled
Gen OV Dropout:		<- Option not enabled
Gen OV Pickup Delay:		<- Option not enabled
Gen UF:	57.0	0 - 125 Hz
Gen UF Dropout Delay:	5	0 - 10 seconds
Gen OF:	63.0	0 - 125 Hz
Gen OF Pickup Delay:	5	0 - 5 seconds
Gen Start Delay:	2	0 - 60 seconds
Gen Warmup Delay:	2	0 - 1800 seconds
Gen Cooldown Delay:	2	0 - 30 minutes
Util Return Delay:	2	0 - 30 minutes
Pre TransferDelay:		<- Option not enabled
Min Find Neutral Time:	0.0	0.0 - 20.0 seconds
Max Find Neutral Time:	6.0	0.0 - 20.0 seconds
Neutral Delay:		<- Option not enabled
MaxTransferTime:	15	0 - 30 seconds
Post Transfer Delay:		<- Option not enabled
Transfer Fail:	*Enabled*	*Toggle between Enable/Disable*

1Ø A-B Phases

Main Menu Program
TSC800

TSC800 Software ver. 1.6

WORK ORDER:	00000-00-01-TS
REVISION #:	0
REVISION DATE:	99/05/10
START DATE:	99/05/10
START BY:	Admin
DEFAULT PROGRAM:	P1-480
TPS VERSION:	C

CUSTOMER:	TEST
PROJECT:	DEFAULT / P1-480
PRODUCT:	TSC800

Transfer Output Logic:	Maintain	☐	Toggle between Dropout/Maintain
Programmable Output:	LD on Gen	☐	Choose from list
Util Fail Callout:		☐	<- Option not enabled
Load on Gen Callout:		☐	<- Option not enabled
Transfer Fail Callout:		☐	<- Option not enabled
Auto Test Callout:		☐	<- Option not enabled
Man Test Callout:		☐	<- Option not enabled
Switch Not in Auto Callout:		☐	<- Option not enabled
Backlight:	120	☐	0 - 999 seconds

Calibration
TSC800 *TSC800 Software ver. 1.6*

CUSTOMER: TEST
PROJECT: DEFAULT / P1-480
PRODUCT: TSC800

WORK ORDER: 00000-00-01-TS
REVISION #: 0
REVISION DATE: 99/05/10
START DATE: 99/05/10
START BY: Admin
DEFAULT PROGRAM: P1-480
TPS VERSION:

Calibration:

Util AB Zero	☐	0 - 255 Calibration correction number
Util AB Span	☐	0 - 255 Calibration correction number
Util BC Zero	☐	0 - 255 Calibration correction number
Util BC Span	☐	0 - 255 Calibration correction number
Util CA Zero	☐	0 - 255 Calibration correction number
Util CA Span	☐	0 - 255 Calibration correction number
Gen AB Zero	☐	0 - 255 Calibration correction number
Gen AB Span	☐	0 - 255 Calibration correction number
Gen BC Zero	☐	0 - 255 Calibration correction number
Gen BC Span	☐	0 - 255 Calibration correction number
Gen CA Zero	☐	0 - 255 Calibration correction number
Gen CA Span	☐	0 - 255 Calibration correction number
Load AB Zero	☐	0 - 255 Calibration correction number
Load AB Span	☐	0 - 255 Calibration correction number

TSC800

MICROPROCESSOR TRANSFER SWITCH CONTROLLER

SUMMARY CONFIGURATION DATA SHEET

TSC800 Software ver. 1.6

WORK ORDER #:	00000-00-02-TS	**REV.:**	0	**REV. DATE:**	99/05/10
INITIATED BY:	Admin	**CUSTOMER:**	TEST	**DEFAULT PROGRAM:**	P2-480
DATE:	99/05/10	**PROJECT NAME:**	DEFAULT / P2 - 480	**TPS VER:**	C
NOTES:					

SYSTEM AC INPUTS

SYSTEM AC VOLTS: 480 **PHASES:** 3 **FREQUENCY:** 60 **CONTROL TYPE:** STD ATS

DIGITAL DISPLAY FEATURES

- ☒ GENERATOR AC VOLTAGE
- ☒ GENERATOR FREQUENCY
- ☒ UTILITY AC VOLTAGE
- ☒ UTILITY FREQUENCY
- ☒ TIME CLOCK

STANDARD FEATURES

Level 2 Features
3 Phase Utility (Src 1) Undervoltage Sensing
3 Phase Generator (Src 2) Undervoltage Sensing
Generator Underfrequency Sensing
Generator Start Delay Timer
Generator Cooldown Delay Timer
Utility Return Delay Timer
Generator Warm-up Timer
No Load Test PB Function
Full Load Test PB Function
Automatic Exercize Test Clock
Neutral Delay Timer
Utility (Src 1) Overvoltage Sensing (all phases)
Generator (Src 2) Overvoltage Sensing (all phases)
Utility (Src 1) Under/Over Frequency Sensing

OPTIONAL FEATURES

STANDARD PROGRAMMABLE OUTPUTS

OUTPUT NAME	OUTPUT TYPE
Programmable Output #1	LD on Gen

Main Menu Program
TSC800

TSC800 Software ver. 1.6

WORK ORDER:	00000-00-02-TS
REVISION #:	0
REVISION DATE:	99/05/10
START DATE:	99/05/10
START BY:	Admin
DEFAULT PROGRAM:	P2-480
TPS VERSION:	C

CUSTOMER: TEST
PROJECT: DEFAULT / P2 - 480
PRODUCT: TSC800

Control Type:	STD ATS		
Auto Test Start Day:	Sunday	☐	Day of the week
Auto Test Start Hour:	00	☐	00 - 23 hours
Auto Test Start Minute:	00	☐	00 - 59 minutes
Auto Test Stop Day:	Sunday	☐	Day of the week
Auto Test Stop Hour:	00	☐	00 - 23 hours
Auto Test Stop Minute:	00	☐	00 - 59 minutes
Auto Test Mode:	None	☐	None, On Load, or Off Load
Communications Option:	No	☐	Toggle between Yes/No
Node Address:		☐	<- Option not enabled
System Voltage:	480	☐	Line to line voltage 120 - 15000
Voltage Sensing Ratio:	1	☐	1 - 208 ratio number
System Frequency:	60	☐	Toggle between 50/60 Hz
System Phases:	3	☐	Toggle between 1 & 3 phase
Util UV Pickup:	432	☐	335 - 480 VAC
Util UV Dropout:	384	☐	335 - 480 VAC
Util UV Dropout Delay:	1	☐	0 - 10 seconds
Util OV Pickup:	528	☐	0 - 3000 VAC
Util OV Dropout:	518	☐	0 - 3000 VAC
Util OV Pickup Delay:	2	☐	0 - 5 seconds
Util UF:	58.0	☐	0 - 125 Hz
Util UF Dropout Delay:	2	☐	0 - 10 seconds
Util OF:	62.0	☐	0 - 125 Hz
Util OF Pickup Delay:	2	☐	0 - 5 seconds
Gen UV Pickup:	432	☐	335 - 480 VAC
Gen UV Dropout:	384	☐	335 - 480 VAC
Gen UV Dropout Delay:	5	☐	0 - 10 seconds
Gen OV Pickup:	528	☐	0 - 3000 VAC
Gen OV Dropout:	518	☐	0 - 3000 VAC
Gen OV Pickup Delay:	2	☐	0 - 5 seconds
Gen UF:	57.0	☐	0 - 125 Hz
Gen UF Dropout Delay:	5	☐	0 - 10 seconds
Gen OF:	63.0	☐	0 - 125 Hz
Gen OF Pickup Delay:	5	☐	0 - 5 seconds
Gen Start Delay:	2	☐	0 - 60 seconds
Gen Warmup Delay:	2	☐	0 - 1800 seconds
Gen Cooldown Delay:	2	☐	0 - 30 minutes
Util Return Delay:	2	☐	0 - 30 minutes
Pre TransferDelay:		☐	<- Option not enabled
Min Find Neutral Time:	0.0	☐	0.0 - 20.0 seconds
Max Find Neutral Time:	6.0	☐	0.0 - 20.0 seconds
Neutral Delay:	3	☐	0 - 60 seconds
MaxTransferTime:	15	☐	0 - 30 seconds
Post Transfer Delay:		☐	<- Option not enabled
Transfer Fail:	Enabled	☐	Toggle between Enable/Disable

Main Menu Program
TSC800
TSC800 Software ver. 1.6

CUSTOMER:	TEST
PROJECT:	DEFAULT / P2 - 480
PRODUCT:	TSC800
WORK ORDER:	00000-00-02-TS
REVISION #:	0
REVISION DATE:	99/05/10
START DATE:	99/05/10
START BY:	Admin
DEFAULT PROGRAM:	P2-480
TPS VERSION:	C

Transfer Output Logic:	Maintain	☐	Toggle between Dropout/Maintain
Programmable Output:	LD on Gen	☐	Choose from list
Util Fail Callout:		☐	<- Option not enabled
Load on Gen Callout:		☐	<- Option not enabled
Transfer Fail Callout:		☐	<- Option not enabled
Auto Test Callout:		☐	<- Option not enabled
Man Test Callout:		☐	<- Option not enabled
Switch Not in Auto Callout:		☐	<- Option not enabled
Backlight:	120	☐	0-999 seconds

Calibration
TSC800

TSC800 Software ver. 1.6

WORK ORDER:	00000-00-02-TS
REVISION #:	0
REVISION DATE:	99/05/10
START DATE:	99/05/10
START BY:	Admin
DEFAULT PROGRAM:	P2-480
TPS VERSION:	C

CUSTOMER: TEST
PROJECT: DEFAULT / P2 - 480
PRODUCT: TSC800

Calibration:

Util AB Zero	☐	0 - 255 Calibration correction number
Util AB Span	☐	0 - 255 Calibration correction number
Util BC Zero	☐	0 - 255 Calibration correction number
Util BC Span	☐	0 - 255 Calibration correction number
Util CA Zero	☐	0 - 255 Calibration correction number
Util CA Span	☐	0 - 255 Calibration correction number
Gen AB Zero	☐	0 - 255 Calibration correction number
Gen AB Span	☐	0 - 255 Calibration correction number
Gen BC Zero	☐	0 - 255 Calibration correction number
Gen BC Span	☐	0 - 255 Calibration correction number
Gen CA Zero	☐	0 - 255 Calibration correction number
Gen CA Span	☐	0 - 255 Calibration correction number
Load AB Zero	☐	0 - 255 Calibration correction number
Load AB Span	☐	0 - 255 Calibration correction number

TSC800

MICROPROCESSOR TRANSFER SWITCH CONTROLLER

SUMMARY CONFIGURATION DATA SHEET

TSC800 Software ver. 1.6

WORK ORDER #:	00000-00-03-TS	**REV.:**	0	**REV. DATE:**	99/05/10
INITIATED BY:	Admin	**CUSTOMER:**	TEST	**DEFAULT PROGRAM:**	P3-480
DATE:	99/05/10	**PROJECT NAME:**	DEFAULT / P3-480	**TPS VER:**	C
NOTES:					

SYSTEM AC INPUTS

SYSTEM AC VOLTS: 480 **PHASES:** 3 **FREQUENCY:** 60 **CONTROL TYPE:** Dual Prime

DIGITAL DISPLAY FEATURES

- ☒ **SRC #2 AC VOLTAGE**
- ☒ **SRC #2 FREQUENCY**
- ☒ **SRC #1 AC VOLTAGE**
- ☒ **SRC #1 FREQUENCY**
- ☒ **TIME CLOCK**

STANDARD FEATURES	**OPTIONAL FEATURES**
Level 3 Features Source 1 & 2 Under/Over Voltage Sensing (all phases) Source 1 & 2 Under/Over Frequency Sensing Source 1 & 2 Start Delay Timer Source 1 & 2 Warmup Delay Timer Source 1 & 2 Cooldown Delay Timer Source 1 & 2 Return Delay Timer No Load Test PB Function Full Load Test PB Function Automatic Exercize Test Clock Preferential Source Selection	

Main Menu Program
TSC800

TSC800 Software ver. 1.6

WORK ORDER:	00000-00-03-TS
REVISION #:	0
REVISION DATE:	99/05/10
START DATE:	99/05/10
START BY:	Admin
DEFAULT PROGRAM:	P3-480
TPS VERSION:	C

CUSTOMER: TEST
PROJECT: DEFAULT / P3-480
PRODUCT: TSC800

ControlType:	Dual Prime		
Auto Test Start Day:	Sunday	☐	Day of the week
Auto Test Start Hour:	00	☐	00 - 23 hours
Auto Test Start Minute:	00	☐	00 - 59 minutes
Auto Test Stop Day:	Sunday	☐	Day of the week
Auto Test Stop Hour:	00	☐	00 - 23 hours
Auto Test Stop Minute:	00	☐	00 - 59 minutes
Auto Test Mode:	None	☐	None, On Load, or Off Load
Communications Option:	No	☐	Toggle between Yes/No
Node Address:		☐	<- Option not enabled
System Voltage:	480	☐	Line to line voltage 120 - 15000
Voltage Sensing Ratio:	1	☐	1 - 208 ratio number
System Frequency:	60	☐	Toggle between 50/60 Hz
System Phases:	3	☐	Toggle between 1 & 3 phase
Src #1 UV Pickup:	432	☐	335 - 480 VAC
Src #1 UV Dropout:	384	☐	335 - 480 VAC
Src #1 UV Dropout Delay:	5	☐	0 - 10 seconds
Src #1 OV Pickup:	528	☐	0 - 3000 VAC
Src #1 OV Dropout:	518	☐	0 - 3000 VAC
Src #1 OV Pickup Delay:	5	☐	0 - 5 seconds
Src #1 UF:	57.0	☐	0 - 125 Hz
Src #1 UF Dropout Delay:	5	☐	0 - 10 seconds
Src #1 OF:	63.0	☐	0 - 125 Hz
Src #1 OF Pickup Delay:	5	☐	0 - 5 seconds
Src #2 UV Pickup:	432	☐	335 - 480 VAC
Src #2 UV Dropout:	384	☐	335 - 480 VAC
Src #2 UV Dropout Delay:	5	☐	0 - 10 seconds
Src #2 OV Pickup:	528	☐	0 - 3000 VAC
Src #2 OV Dropout:	518	☐	0 - 3000 VAC
Src #2 OV Pickup Delay:	5	☐	0 - 5 seconds
Src #2 UF:	57.0	☐	0 - 125 Hz
Src #2 UF Dropout Delay:	5	☐	0 - 10 seconds
Src #2 OF:	63.0	☐	0 - 125 Hz
Src #2 OF Pickup Delay:	5	☐	0 - 5 seconds
Src #1 Start Delay:	2	☐	0 - 60 seconds
Src #1 Warmup Delay:	2	☐	0 - 1800 seconds
Src #1 Cooldown Delay:	2	☐	0 - 30 minutes
Src #2 Start Delay:	3	☐	0 - 60 seconds
Src #2 Warmup Delay:	5	☐	0 - 1800 seconds
Src #2 Cooldown Delay:	2	☐	0 - 30 minutes
Src #1 Return Delay:	2	☐	0 - 30 minutes
Src #2 Return Delay:	2	☐	0 - 30 minutes
PreTransfer Delay:		☐	<- Option not enabled
Min Find Neutral Time:	0.0	☐	0.0 - 20.0 seconds

Main Menu Program
TSC800
TSC800 Software ver. 1.6

WORK ORDER:	00000-00-03-TS
REVISION #:	0
REVISION DATE:	99/05/10
START DATE:	99/05/10
START BY:	Admin
DEFAULT PROGRAM:	P3-480
TPS VERSION:	C

CUSTOMER: TEST
PROJECT: DEFAULT / P3-480
PRODUCT: TSC800

Max Find Neutral Time:	6.0	☐	0.0 - 20.0 seconds
Neutral Delay:		☐	<- Option not enabled
Max Transfer Time:	15	☐	0 - 30 seconds
Post Transfer Delay:		☐	<- Option not enabled
Transfer Fail:	Enabled	☐	Toggle between Enable/Disable
Transfer Output Logic:	Maintain	☐	Toggle between Dropout/Maintain
Programmable Output:		☐	Option not Available
Util Fail Callout:		☐	<- Option not enabled
Load on Gen Callout:		☐	<- Option not enabled
Transfer Fail Callout:		☐	<- Option not enabled
Auto Test Callout:		☐	<- Option not enabled
Man Test Callout:		☐	<- Option not enabled
Switch Not in Auto Callout:		☐	<- Option not enabled
Backlight:	120	☐	0 - 999 seconds

Calibration
TSC800 *TSC800 Software ver. 1.6*

CUSTOMER: TEST
PROJECT: DEFAULT / P3-480
PRODUCT: TSC800

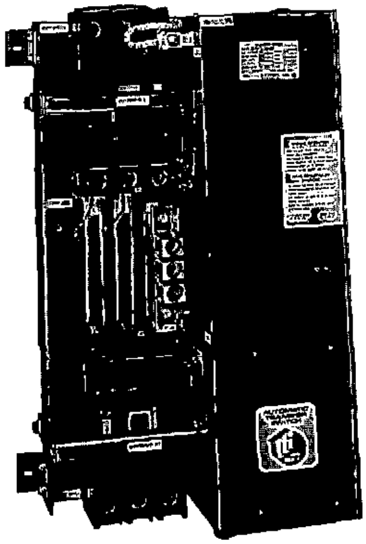
WORK ORDER: 00000-00-03-TS
REVISION #: 0
REVISION DATE: 99/05/10
START DATE: 99/05/10
START BY: Admin
DEFAULT PROGRAM: P3-480
TPS VERSION: C

Calibration:

Src #1 AB Zero	☐	0 - 255 Calibration correction number
Src #1 AB Span	☐	0 - 255 Calibration correction number
Src #1 BC Zero	☐	0 - 255 Calibration correction number
Src #1 BC Span	☐	0 - 255 Calibration correction number
Src #1 CA Zero	☐	0 - 255 Calibration correction number
Src #1 CA Span	☐	0 - 255 Calibration correction number
Src #2 AB Zero	☐	0 - 255 Calibration correction number
Src #2 AB Span	☐	0 - 255 Calibration correction number
Src #2 BC Zero	☐	0 - 255 Calibration correction number
Src #2 BC Span	☐	0 - 255 Calibration correction number
Src #2 CA Zero	☐	0 - 255 Calibration correction number
Src #2 CA Span	☐	0 - 255 Calibration correction number
Load AB Zero	☐	0 - 255 Calibration correction number
Load AB Span	☐	0 - 255 Calibration correction number

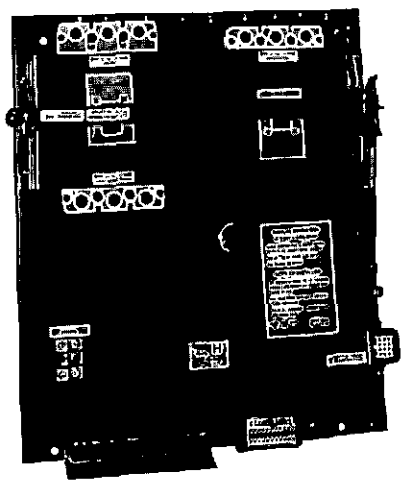
AUTOMATIC TRANSFER SWITCHES

Model Series TS 850 • 100-1200 AMP



TS 853 TCJ - 400
TRANSFER SWITCH

US PATENT No. 470278
CDN PATENT No. 1278367



TS 853 MCL - 250
TRANSFER SWITCH

NRTL/C CERTIFIED TO
UL#1008 and CSA#178

THOMSON TECHNOLOGY AUTOMATIC TRANSFER SWITCHES OFFER THE FOLLOWING OUTSTANDING FEATURES:

Molded Case Switching Units

- **fully enclosed** silver alloy contacts provide **high withstand** rating & **100% continuous** current rating.
- **completely separate** utility and generator side switching units provide superior reliability through redundancy (no common parts), as well as excellent serviceability.
- switching units may incorporate **overcurrent protection**, allowing cost savings in upstream devices.
- **not damaged if manually switched** while in service since contacts operate at same speed as when electrically operated.

Reliable Motor-Operated Transfer Mechanism

- **heavy duty** brushless gearmotor and operating mechanism provide mechanical interlocking and extreme long life with minimal maintenance.
- **safe manual operation** with a **permanently affixed handle**, permits easy operation even under adverse conditions.

Superior Serviceability

- all mechanical and control devices are **visible and readily accessible.**
- all control wires and power busses are **front-accessible** - there are no wires or connections which require removal of the transfer switch from its enclosure for servicing.

Quality Features

- **TSC 800** microprocessor based controller.
- **isolation plug** permits disconnecting control circuits from all power sources for safety and convenience.

Quality Assurance

- ISO 9001 Registered
  CSA Z 299.3 (optional)
  DND AQAP-4 (optional)

THOMSON TECHNOLOGY INC. • 19214 - 94TH AVENUE, SURREY, B.C., CANADA V4N 4E3

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GENERAL DESCRIPTION

The **THOMSON TECHNOLOGY TS 850** automatic transfer switches employ two non-automatic switches (Type A) or automatic circuit breakers (Type B).

TYPE A transfer switches are not equipped with internal tripping devices, and require protection provided by upstream protective devices, which must be co-ordinated. Type A units are suitable for 100% continuous loading, open or enclosed, and fulfill most general applications.

TYPE B transfer switches have internal tripping devices in either or both non-automatic switches, which provide the required overload and short circuit protection. Tripping devices are usually thermal-magnetic type, however sophisticated solid state units are also available, and may be supplied with ground fault protection. (Type B units are suitable for 80% continuous loading, open or enclosed.)

The **TS 850** series incorporates two basic styles of transfer switch mechanisms; style "M" which is rated maximum 250 amps, and style "T" which is rated maximum 1600[1] amps.

The style "M" & "T" transfer mechanisms comprises a power chassis in which the non-automatic switches are mounted, which is barriered from the drive mechanism, interlock assembly and manual handle. The **TSC 800** transfer controller is mounted on the door of the transfer switch enclosure. All incoming power connections are made on the power chassis.

[1] 1600 Amp TS 850 IEC only
Note: For bypass/isolation options refer to separate TSB brochure

The **TS 850** series transfer switches use a type **TSC 800** microprocessor based controller. All necessary control functions for fully automatic operation are provided by the **TSC 800**. The transfer switch controller provides automatic changeover of the load to the generator source in the event of a drop or loss of voltage in any or all phases of the utility supply. Upon restoration of the utility supply, the load is automatically returned. Numerous control features are available as standard or optional accessories to provide the desired sensing, time delay, and switching logic.

The transfer mechanism incorporates a reversible motor, and utilizes power from the source to which the load is being transferred. The mechanism provides positive mechanical interlocking of the two switches, and allows easy manual operation if so desired. Both molded-case switches are "trip free" in the closed position, permitting incorporation of overcurrent trips.

Neutral Position Delay (NDT) is available for use on systems which include motors rated over 100 HP. Neutral Position Delay should be considered when the possibility of out-of-phase reclosing exists between sources, due to residual motor voltage. There is no requirement NDT when employing a T.T.I. transfer switch with motors rated 100 HP or less, due to inherent design features. T.T.I. transfer switches, with or without NDT, have no need for "in-phase" sensing. Please request full engineering information from T.T.I.

ORDERING INFORMATION

NUMBER OF POLES (2,3 OR 4)
BASIC SWITCH MECHANISM STYLE
TYPE (A or B)

TS 853 TCK - 800A - 600 - 3W - LEV-1/AUX-U(2)/FTS-4

BASIC MODEL
SYSTEM VOLTAGE
SYSTEM CONDUCTORS (3W OR 4W)
CONTROL FEATURES LEVEL
OPTIONAL FEATURES.

NOTE: DO NOT LIST STANDARD FEATURES. SHOW QUANTITY FOR AUXILIARY CONTACTS. ENSURE STANDARD CABLE TERMINALS ARE ADEQUATE.
- SPECIFY IF OPTIONAL TYPE IS REQUIRED. STANDARD UNITS ARE RATED 60 HZ. - SPECIFY FOR OTHER FREQUENCIES.

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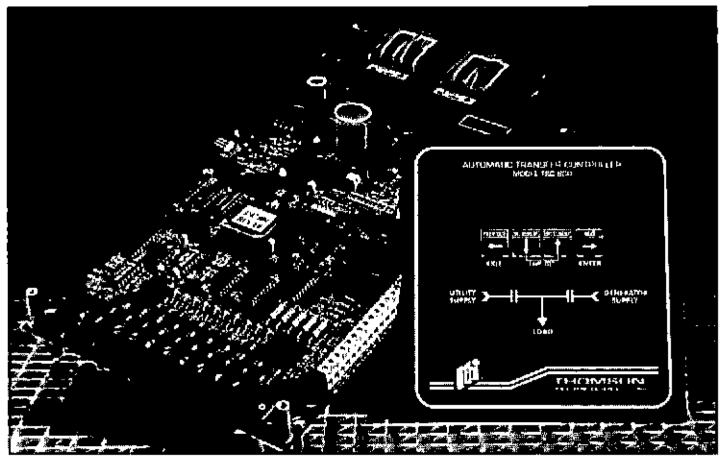
STANDARD FEATURES

CODE	DESCRIPTIONS
LEV-1*	Programmable/multi-tap system voltage selection** Load on utility & load on generator lights c/w lamp test Three phase voltage sensing on utility & generator sources Under/over frequency sensor on generator source (with adjustable time delay) Digital three phase metering of voltage & frequency on utility & generator sources Engine start delay timer 0 - 60 sec. Engine cooldown delay timer 0 - 30 min. Engine warm-up timer 0 - 1800 sec. Neutral Position Delay, (allows load voltage decay) Transfer to utility timer 0 - 30 min. Exercise timer 24 hour/7 day On/off load test selectable Programmable function output contact*** Diagnostic LED's Backlit TSC 800 LCD display NEMA 1 enclosure Solid Neutral



** Provided as standard on all TS 850 Automatic Transfer Switches*
*** Excludes TS 850-200 and all 2 pole models*
**** Not available with Level 3 optional features*

OPTIONAL FEATURES

CODE	DESCRIPTIONS
LEV-2	Level 2 ATS control package - Level 1 features plus the following: Overvoltage three phase sensor on both utility & generator sources Under/over frequency sensor on utility source (with adjustable time delay)
LEV-3	Level 3 (Dual source) control package - Level 1 features plus the following: Dual Source selector switch Overvoltage three phase sensor - both sources Under/over frequency sensor - both sources
FTS-4	4 Function Test Switch (Auto/Off/Engine Start/Test)
AUX-U	Auxiliary Contact - Utility side (any qty.)
AUX-G	Auxiliary Contact - Generator side (any qty.)
LDC	Generator Pre/Post & Utility Pre/Post Timer contacts (adjustable) for Load Disconnect prior to transfer
OVS	Overvoltage three phase sensor on both utility & generator sources
UOF	Under/over frequency sensor on utility source (with adjustable time delay)
UPA	Utility power available contact
GPA	Generator power available contact
UAL	Utility available light
GAL	Generator available light
FTT	Fail to transfer contact
PBR	Phase Balance Relay - detects "single-phasing" condition on 3 phase system
SE	Service Entrance Rated
UTR	Overload trip - Utility side (specify rating)
GTR	Overload trip - Generator side (specify rating)
COM	TSC 800 remote communication port for use with external Communication Interface Module (CIM module not included).
CIM	Communication Interface Module* with internal 14.4Kbaud modem, RS 232/422/485 ports and Modbus™ protocol. One CIM module provides communication interface for up to ten TSC 800 controllers with COM per system.

*Refer to separate literature for additional information.

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STANDARD MODELS

BASIC MODEL	MAXIMUM VOLTAGE	RATED CURRENT (A)	SHORT CIRCUIT CURRENT RATING [AVAILABLE SYMMETRICAL AMPS (RMS)][1]				
			With Upstream Circuit Breaker Protection			With Upstream Fuse Protection	
			@240V	@480V	@600V	@ up to 600V	FUSE TYPE
TS 850-MCE - 100	600	100	65,000	25,000	18,000	100,000	T,J
TS 850-MCE - 150	600	150	65,000	25,000	18,000	100,000	T,J
TS 850-MS3 - 200	240	200	10,000	N/A	N/A	N/A	T,J
TS 850-MCL - 250	600	250	65,000	35,000	25,000	100,000	T,J
TS 850-TCJ - 400	600	400	65,000	35,000	25,000	100,000	T,J
TS 850-TCJ - 600	600	600	65,000	35,000	25,000	100,000	T,J
TS 850-TCK - 800	600	800	65,000	50,000	35,000	100,000	Consult Factory
TS 850-TCK -1000	600	1000	65,000	50,000	35,000	100,000	Consult Factory
TS 850-TCK -1200	600	1200	65,000	50,000	35,000	100,000	Consult Factory
TS 850-TCK -1600 [2]	600	1600	100,000	50,000	35,000	100,000	Consult Factory

ENCLOSURE DIMENSIONS

(NEMA 1, ASA 61 GRAY)

BASIC MODEL	DIMENSION (Inches) [4]		
	HEIGHT	WIDTH	DEPTH
TS 850-MCE - 100 / 150	37	25	13
TS 850-MS3 - 200	37	25	13
TS 850-MCL - 250	37	25	13
TS 850-TCJ - 400	60	30	13
TS 850-TCJ - 600	60	30	13
TS 850-TCK - 800	87	34	13
TS 850-TCK -1000 [5]	87	34	13
TS 850-TCK -1200 [5]	87	34	13
TS 850-TCK -1600 [2]	87	34	13

Optional Nema class enclosures available — consult T.T.I. Optional paint colors available — consult T.T.I.

CABLE TERMINALS

TRANSFER SWITCH RATING (A)	SWITCH MECHANISM TYPE	TERMINAL RATING [3]			
		NUMBER OF CONDUCTORS	CONDUCTOR SIZE RANGE	TYPE	
				Cu	Al
100, 150	M	1	#4 - 4/0	X	X
200	M	1	#6 - 350 MCM	X	X
250	M	1	#1 - 350 MCM	X	X
400, 600	T	1	2/0 - 500 MCM [6]	X	
		2	2/0 - 350 MCM [6]	X	
		2	4/0 - 500 MCM [6]		X
800	T	2	2/0 - 400 MCM	X	
		3	2/0 - 300 MCM	X	
		3	4/0 - 400 MCM		X
1000,1200	T	4	3/0 - 500 MCM	X	
		4	4/0 - 500 MCM		X
1600 [2]	T	4	#2 - 600 MCM	X	X

[1] Standard ratings only are shown. Consult TTI for versions using higher short circuit current ratings.
[2] IEC only.
[3] Optional Terminal Ratings are available in some models - consult TTI.
[4] Enclosure dimensions are for reference. (DO NOT USE FOR CONSTRUCTION).
[5] 4 pole application dimensions are 90 x 36 x 18
[6] When 500MCM cable is utilized, cable entry / exit locations are restrictive. Consult TTI.

NOTE: Specifications subject to change without notice.

CL027 Rev.5 00/06/01

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TS 850

AUTOMATIC TRANSFER SWITCHES

INSTALLATION, OPERATING & SERVICE MANUAL

PM042 Rev 5 00/12/01

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1. CAUTION!

Before opening the transfer switch enclosure to perform any service task, or to manually transfer the mechanism, it is imperative to isolate the transfer switch from any possible source of power. Failure to do so may result in serious personal injury or death due to electrical shock.

Service procedures must be undertaken by qualified personnel only!

NOTE: - All information contained in this manual is for reference only and is subject to change without notice.

Contact Thomson Technology Inc. for clarification of current revisions or if in doubt about any matter relating to installation, operation or maintenance.

NOTE: This manual makes reference to a 600A transfer switch model TS 850-TCK-600 which was introduced in August of Year 2000. For 600A transfer switches manufactured prior to this date (e.g. Model TS 850-TCJ-600) refer to manual revision 0 – 3

For detailed information on Dual Source systems (Option LEV-3 refer to Information Supplement PM043.

2. NOTES TO INSTALLER

To ensure satisfactory installation of this equipment be sure to observe "Recommended Connection Tightness" and "Requirements for Upstream Circuit Protective Devices" located in this manual.

All mechanical and electrical connections must be checked for tightness prior to placing this equipment in service to ensure proper operation and to validate applicable warranty coverage.

If the transfer switch has programmable multi-tap voltage capability (refer to electrical schematic), confirm the transfer switch has been configured for the system voltage prior to installation.

Warning

Failure to confirm and match transfer switch voltage with the system voltage could cause serious equipment damage.

The voltage selections and connections are shown on the electrical schematics attached to each transfer switch. The factory default settings will be indicated on the calibration label attached on the inside of the enclosure door (supplied loose on open style models). A blank label is included to record the applicable settings if the configuration is changed from the factory default settings.

To change the transfer switch configuration the following must be accomplished:

- Change voltage taps of PT's to system voltage (refer to schematics)
- Change TSC 800 programming (refer to sections 6.2.2, 6.2.4, 6.2.5,6.3, and 6.4 of the TSC 800 instruction manual). The following settings may require reprogramming (depending on options purchased):
  - System voltage
  - System frequency
  - System phase
  - Utility undervoltage pickup (typically 90% of system voltage)
  - Utility undervoltage dropout (typically 80% of system voltage)
  - Utility overvoltage pickup (typically 110% of system voltage)
  - Utility overvoltage dropout (typically 105% of system voltage)
  - Utility underfrequency (typically 95% of system frequency)
  - Utility overfrequency (typically 105% of system frequency)
  - Generator undervoltage pickup (typically 90% of system voltage)
  - Generator undervoltage dropout (typically 80% of system voltage)
  - Generator overvoltage pickup (typically110% of system voltage)
  - Generator overvoltage dropout (typically 105% of system voltage)
  - Generator underfrequency (typically 95% of system frequency)
  - Generator overfrequency (typically 105% of system frequency)

Record any changed setting on the TSC 800 Programming Data Sheets for future reference.
Complete the blank calibration label and attach to the inside of the transfer switch enclosure door.

INSTALLATION OF OPEN TYPE TRANSFER SWITCHES - Please refer to the factory for additional information.

3. GENERAL DESCRIPTION

(See CAUTION! on Page #1)

The automatic transfer switch employs two moulded-case switching devices which may be:

a) non-automatic circuit interrupters ("type A" transfer switch)

b) automatic circuit interrupters with integral trip units; ("type B" transfer switch)

In this manual, the switching devices will be referred to as "breakers". The breakers are operated by a mechanism driven with an electric motor. The transfer switch provides automatic transfer of an electrical load to a standby power supply in the event of drop or loss of voltage of any or all phases of the primary power supply. Upon restoration of the primary supply, the electrical load is automatically retransfered to the primary power supply (after an adjustable time delay). All necessary control components for automatic transferring are located in the control compartment and on the enclosure door.

The transfer motor utilizes the power from the source to which the electrical load is being transferred. The mechanism provides a positive mechanical interlock to prevent both breakers from being closed at the same time. The mechanism is also designed to leave both breakers "trip free" in the closed position, permitting incorporation of overload and/or short-circuit protection in either or both breakers ("type B"). After tripping, the breaker of a "type B" transfer switch must be manually reset.

Note: For the purpose of this manual, the term UTILITY indicates the primary power, and the term GENERATOR indicates the standby power.

4. GENERAL THEORY OF OPERATION

4.1. STANDARD AUTOMATIC TRANSFER SWITCH

4.1.1. NORMAL OPERATION

When utility supply voltage drops below a preset nominal value (adjustable from 70% to 100% of nominal) on any phase, an engine start delay circuit will be initiated and the transfer to utility supply signal will be removed (i.e. contact opening). Following expiry of the engine start delay period (adjustable from 0 to 60 sec.) an engine start signal (contact closure) will be given.

Once the engine starts, the transfer switch controller will monitor the generator voltage and frequency levels. Once the generator voltage and frequency rises above preset values (adjustable from 70% to 100% of nominal), the engine warmup timer will be initiated. Once the warmup timer expires (adjustable from 0 to 60 sec.), the Transfer to Generator Supply signal (contact closure) will be given to the transfer switch mechanism. The load will then transfer from the utility supply to the generator supply via the motor driven mechanism. Note: An optional neutral delay timer circuit will delay the transfer sequence in the neutral position (i.e. both breakers open) until the selected time expires (adjustable from 0 to 60 sec.).

The generator will continue to supply the load until the utility supply has returned. The retransfer sequence is completed as follows: when the utility supply voltage is restored to above the preset values (adjustable from 70% to 100% of nominal) on all phases, a transfer return delay circuit will be initiated. Following expiry of the Transfer Return Timer (adjustable from 0 to 30 min.), the Transfer to Generator Supply signal will be removed (contact opening), then the Transfer to Utility Supply signal (contact closure) will be given to the transfer switch mechanism. The load will then retransfer the load from the generator supply back to the utility supply. Note: An optional neutral delay timer circuit will delay the transfer sequence in the neutral position (i.e. both breakers open) until the selected time expires (adjustable from 0 to 60 sec.).

An engine cooldown timer circuit will be initiated once the load is transferred from the generator supply. Following expiry of the cooldown delay period (adjustable from 0 to 30 min.), the engine start signal will be removed (contact opening) to initiate stopping of the generator set.

4.2. SERVICE ENTRANCE AUTOMATIC TRANSFER SWITCH

(Note: This applies only to service entrance transfer switches supplied with a Padlockable Disconnect Switch. Contact TTI for other types.)

4.2.1. NORMAL OPERATION

Under normal conditions, the load is energized from the utility supply through the closed utility transfer breaker. If the utility power fails, the generator will start and the load will be re-energized via the closed generator transfer breaker.

In the normal operating mode, the Service Disconnect switch shall be in the "energized" position.

4.2.2. SERVICE DISCONNECT PROCEDURE

To perform a service disconnect (i.e. to disconnect the utility and generator supplies), the following procedure is required:

1. Move the "Service Disconnect" control switch located on the door of the transfer switch to the "Disconnected" position.

2. Verify that the "Service Disconnected" pilot light is illuminated. *If the Light is illuminated, the service has been successfully disconnected and it is safe to perform any maintenance procedures as required*. In this condition, the transfer switch is in the neutral position, with both utility and transfer breakers open. The transfer switch will remain in this condition, regardless of condition of the utility and generator supplies (i.e. if the utility power fails, the generator will not receive a start condition, nor will the transfer switch move to the generator position). *If the Light is **not** illuminated, further procedures are required (refer to the following procedure #4).*

3. Attach safety lockout padlock to the "Service Disconnect" control switch to prevent unauthorized change in operating condition and verify transfer switch door is locked closed. If the door is not locked, turn and remove door key.

4. If the "Service Disconnected" pilot light is **not** illuminated, the service will **not** have been successfully disconnected and it is therefore **not** safe to perform any maintenance until the following additional procedures are performed:

> **Warning**
> *Qualified personnel must undertake the following procedures **only!** Failure to do so may result in **serious personal injury or death** due to electrical shock.*

- Open the door to the transfer switch using a suitable tool and opening the door lock with the key.
- Visually inspect the actual position of the transfer switch mechanism. *If the position of the transfer switch mechanism is clearly in the "neutral position", the service has been successfully disconnected*.

Notes: 1) If the position of the transfer switch mechanism is clearly in the "neutral position, the "service disconnected" pilot light may not have illuminated due to the following reasons:

a) Utility and generator supply voltages are not present (the pilot light requires AC supply voltage to be present).

b) The pilot light may be burnt out. The bulb should be immediately replaced with a suitably rated bulb.

c) Failure of one or more of the sensing/logic contacts. A qualified service technician is required to trouble shoot this specific condition. Unplug the control circuit isolation plug to de-energize all AC power to the control circuits. Note: The AC power conductors will still remain energized. Once the control circuit isolation plug is removed the "Service Disconnected" pilot light will not illuminate due to loss of control power.

Note: to return the transfer switch back to normal operation, <u>the control circuit isolation plug must be reconnected for correct operation</u>.

- The transfer switch door should then be securely closed using a suitable tool and locked in the closed position with the key. Once the transfer switch door has been positively locked closed and secured and only then is, it is safe to perform any maintenance procedures as required.
- <u>*If the position of the transfer switch mechanism is **not** in the "neutral position" further procedures are required (refer to the following procedure)*</u>

> **Warning**
>
> *Failure to positively lock closed and secure the transfer switch door may result in **<u>serious personal injury or death</u>** due to electrical shock.*

- If the position of the transfer switch mechanism is **<u>not</u>** in the "neutral position" the transfer switch mechanism must be manually operated as follows. To operate manually, pull the manual release plunger on the mechanism, releasing the motor drive rod from motor drive arm and move the knob and yoke to the marked **<u>"Neutral"</u>** position.

> **Warning**
> *Failure to move the mechanism to the Neutral Position may result in* ***serious personal injury or death*** *due to electrical shock.*

The transfer switch door should then be securely closed using a suitable tool and locked in the closed position with the key. Once the Transfer switch door has been positively locked closed and secured and only then is, it is safe to perform any maintenance procedures as required.

> **Warning**
> *Failure to positively lock closed and secure the transfer switch door may result in* ***serious personal Injury or death*** *due to electrical shock.*

To re-energize the load, the padlock(s) should be removed from the "Service Disconnect" control switch, and move the switch to the "Energized" position. The transfer switch will immediately return to the utility or generator supply if within normal operating limits.

4.3. TEST CONDITION

The transfer switch may be tested utilizing the TSC 800 controller push-buttons or optional four position test switch. A simulated utility power failure condition will be activated when the test mode is selected. The transfer switch will operate as per a normal utility power fail condition. Note the test mode is operator selectable for "On-Load" or "Off-Load" testing scenarios.

The transfer switch will remain on generator supply until the test mode is terminated. It will then immediately transfer back to the utility supply and then continue to operate the generator set for its cooldown period then stop. Note: the transfer switch will automatically return to the utility supply (if within nominal limits) if the generator set fails while in the test mode.

5. TYPE A AND TYPE B DEFINITIONS

"Type A" transfer switch means an automatic transfer switch that does not employ integral overcurrent devices.

"Type B" transfer switch means an automatic transfer switch that does employ integral overcurrent protection in at least one of its two breakers.
"Type A" transfer switches are not equipped with trip units, and require properly coordinated upstream protection. Information on closing and withstand ratings, and recommendations for maximum upstream protective devices for "type A" units are in this manual. (Note: Some "Type A" models employ "high-magnetic" trips in the breakers, however these are set to trip at a higher than normal current for that amperage circuit, therefore the possibility of tripping is very remote. Since these trips are not intended to provide overcurrent protection, but are rather employed to ensure the integrity of the transfer switch under all circumstances, they are still classed as "Type A").

"Type B" transfer switches are typically equipped with standard thermal-magnetic trips which will provide the required overload and short circuit protection. "Type B" can also be built using solid state trip breakers, which can include ground fault tripping as well as overload and short circuit protection.

It should be noted that a "Type B" transfer switch with overcurrent protection in only one breaker will require the same consideration for upstream protection in the feeder of the breaker with no trip (as applies to a "Type A" transfer switch).

6. GENERAL NOTES ON SERVICING MECHANISM

(See CAUTION! on Page #1)

When performing any service work on the transfer mechanism, it is imperative that the following be observed:

6.1. To maintain mechanical integrity, ensure that:

- All limit switches linkages are correctly adjusted to provide full travel of the breaker toggles *without* exerting unnecessary forces associated with excessive travel. Ensure that breakers travel far enough to reset any internal trip unit (it is more important for the toggle to go fully in the "off" direction, than in the "on" direction).
- Mechanical interlocking is correct one breaker must be well open before the other should close.
- All fasteners are adequately tightened.
- The operating linkages are not damaged or bent, and that all bearing points operate freely.

6.2. To maintain electrical integrity, ensure that:

- All electrical connections, especially power connections, are clean and adequately tightened. Corroded or loose power connections will cause destructive heating, and may cause premature tripping in "type B" units.
- All insulating devices are in place and in good condition.
- No moisture or other contamination is present.
- Electrical conductors are adequately secured away from moving parts.

6.3.To maintain operational integrity, ensure that:

- All control devices are in good condition and correctly calibrated.
- All control devices are adequately secured in their plug-in fixtures.

Service work should be undertaken only by qualified personnel. Failure to correctly maintain an automatic transfer switch may present a hazard to life and equipment. Full operational testing must be done prior to placing a transfer switch in service subsequent to any maintenance or repair. Any service work involving electrical components requires high-potential testing to ensure that required insulation levels have been maintained.

7. STYLE "T" TRANSFER SWITCH MECHANISM - 400 - 1200 Amp

The transfer mechanism consists primarily of the transfer motor, a hub assembly, two operating rods and two breaker operating yokes.

The reversible transfer motor drives the hub assembly, which in turn moves the operating rods which are connected to the breaker operating yokes. The breaker toggles are set inside the yokes and are moved by them. There are two limit switches which are contacted by the operating yokes (one for each direction of travel) which disconnect the transfer motor power supply when the breakers have attained full travel. The operating point of these limit switches is determined by the adjuster screws located on the yokes. Should adjustment be required, it is advisable to consult TTI for further information.

The transfer switch mechanism has three possible positions:

a) Utility breaker closed and generator breaker open;

b) Generator breaker closed and utility breaker open;

c) Both utility and generator breakers open, but <u>NEVER</u> both utility and generator breakers closed at the same time.

7.1. MANUAL OPERATION (or to reset a typical breaker)

(See CAUTION on Page 1)

Isolate the transfer switch from all sources of supply before opening the enclosure for manual operation. The control circuit isolation plug (PL12) should be unplugged to prevent subsequent operation.

To operate manually, pull the release plunger and operate the handle in the desired direction.

Automatic operation may be regained by replacing the isolation. The drive system is self engaging and will operate the transfer switch to the required position. (See manual operation instruction on front of transfer switch mechanism.)

8. STYLE "M" TRANSFER SWITCH MECHANISM - Maximum 250 Amp

The transfer mechanism consists of the transfer motor and drive assembly, which operates a common yoke which in turn operates both utility and generator breakers. Since the breakers are oriented opposite to each other, the action of turning one breaker off will result in turning the other breaker on. The geometry of the mechanism ensures that one breaker always opens before the other closes, thus maintaining the required mechanical interlocking.

The unidirectional motor, operating through the motor drive arm and rod assembly, which is normally held captive to the yoke via the manual release plunger assembly, acts upon the yoke drive arm. Both breaker toggles are set inside the common yoke and are moved by it. There are two limit switches which are contacted by the yoke at its extremes of travel, disconnecting the motor circuit at the point of full breaker toggle travel in the intended direction. Adjustment of the limit switches is accomplished by loosening the two mounting screws securing each switch and sliding them in the desired direction. Should adjustment be required it is advisable to consult TTI for further information.

The transfer switch mechanism has three possible positions:

a) Utility breaker closed and generator breaker open;

b) Generator breaker closed and utility breaker open;

c) Both utility and generator breakers open, but NEVER both utility and generator breakers closed at the same time.

8.1. MANUAL OPERATION (or to reset a typical breaker)

(See CAUTION! on Page #1)

Isolate the transfer switch from all sources of supply before opening the enclosure for manual operation. The control circuit isolation plug (PL12) should be unplugged to prevent subsequent operation.

To operate manually, pull the manual release plunger, releasing the motor drive rod from the motor drive arm and push the yoke in the desired direction.

Automatic operation may be regained by turning the release plunger until locked and replacing the isolation plug. The mechanism drive will operate until the motor drive rod is engaged and the transfer switch yoke is moved into the required position. (See manual operation instruction on door of transfer switch mechanism).

9. RECOMMENDED MAINTENANCE (STYLE "T" & STYLE "M" MECHANISMS)

(See CAUTION! on Page #1)

9.1. <u>DO NOT</u> perform dielectric tests on the equipment with the control components in the circuit.

9.2. Check if control components are tight in sockets.

9.3. Periodically inspect all terminals (load, line and control) for tightness. Re-torque all bolts, nuts and other hardware. Clean or replace any contact surfaces which are dirty, corroded or pitted.

9.4. Transfer switches should be in a clean, dry and moderately warm location. If signs of moisture are present, dry and clean transfer switch. If there is corrosion, try to clean it off. If cleaning is unsuitable, replace the corroded parts. Should dust and/or debris gather on the transfer switch, brush, vacuum, or wipe clean. <u>DO NOT</u> blow dirt into breakers.

9.5. Test the transfer switch operation. While the unit is exercising, check for freedom of movement, hidden dirt, corrosion or any excessive wear on the mechanical operating parts. Ensure that the breaker travel is correct.

9.6. Verify all program settings on the TSC 800 controller as per the programming sheet as supplied with the transfer switch.

9.7. Style "M": confirm that the yoke operates freely on the yoke pivot bushings. Should lubrication be required, apply medium weight (SAE 20) oil sparingly at these points.

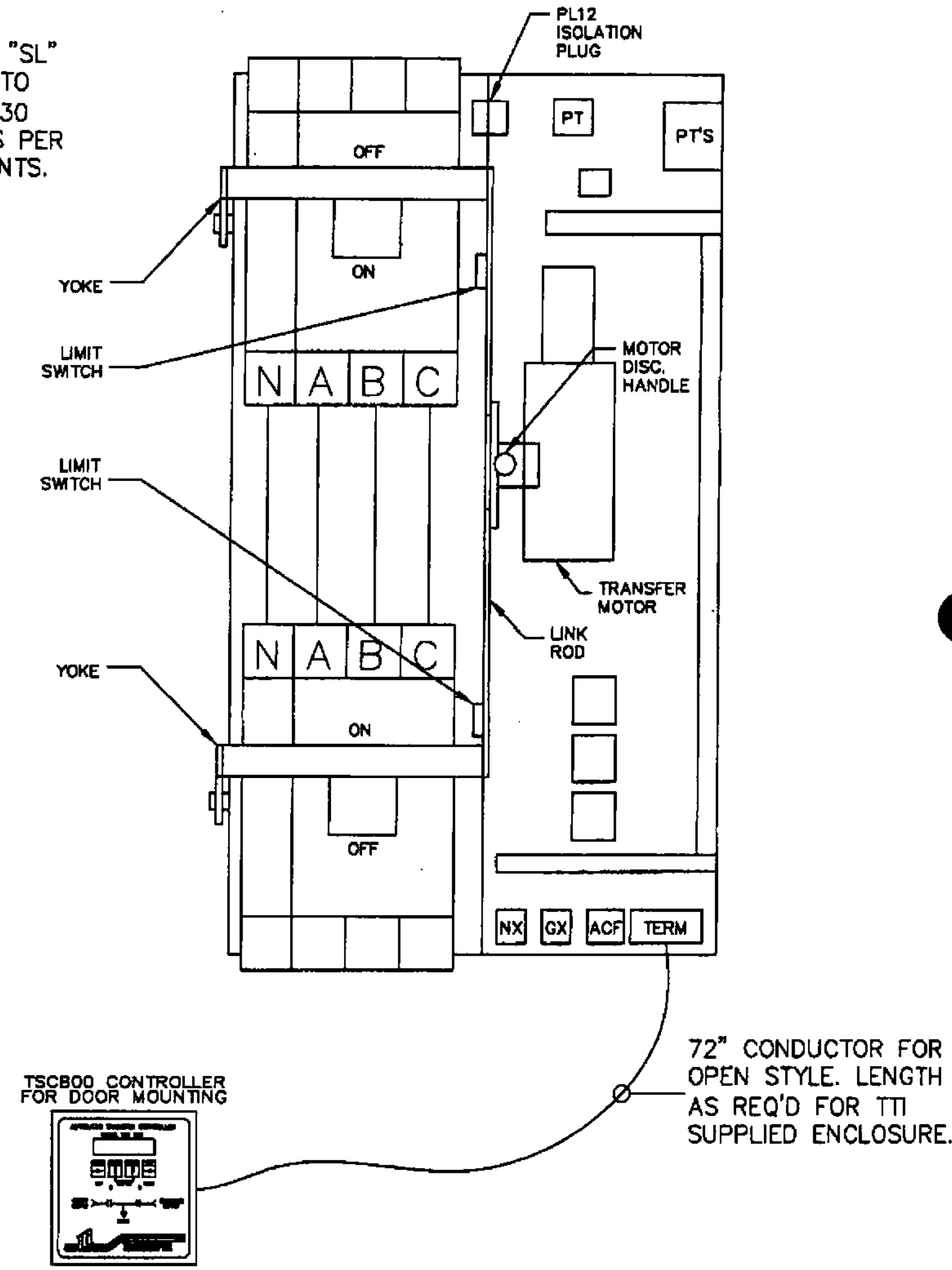
9.8. Style "T": ensure that the manual handle moves freely on the hub when the lock pin is disengaged. If lubrication is necessary, apply medium weight (SAE 20) oil sparingly.

9.9. Style "T": yoke pivot bearings and rod ends are permanently lubricated and do not require maintenance.

9.10. The motor and gearbox are permanently lubricated, and should not require attention under normal operating circumstances.

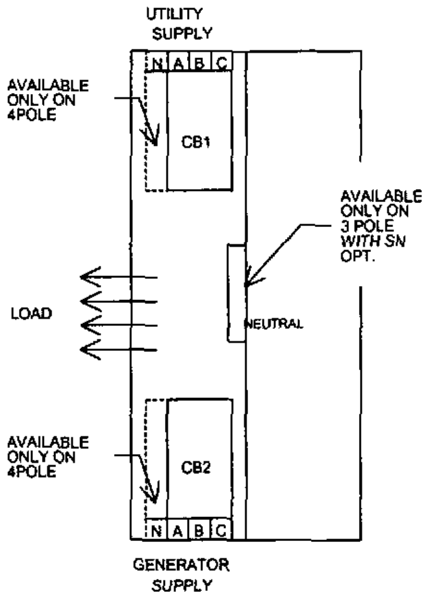
10. FRONT VIEW (TYPICAL) 3 / 4 POLE STYLE "T" TRANSFER MECHANISM

CONFIGURATION "SL" SHOWN. REFER TO DWG. EPA5015/30 FOR VARIATIONS PER JOB REQUIREMENTS.

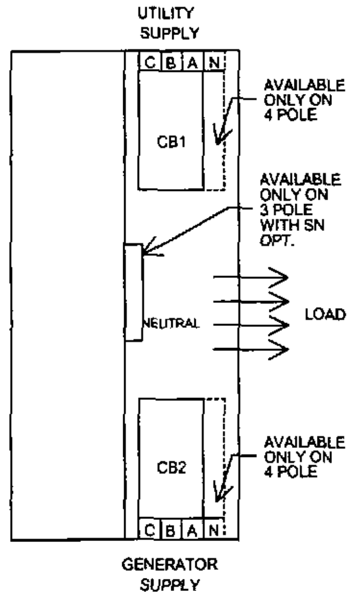


11. STYLE "T" CONFIGURATION OPTIONS

SL CONFIGURATION



XR CONFIGURATION



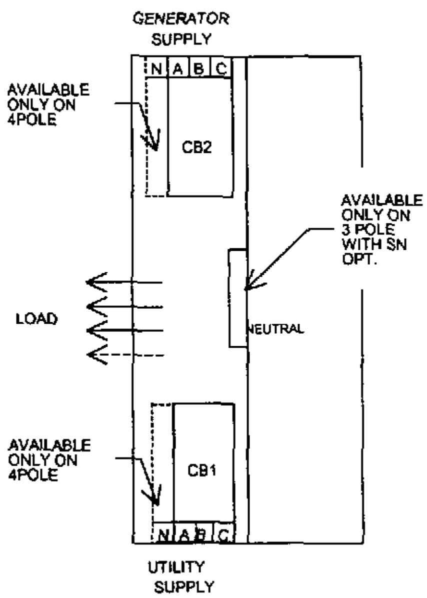
CHASSIS CONFIGURATION OPTION

- ☐ SL
- ☐ SR
- ☐ XL
- ☐ XR

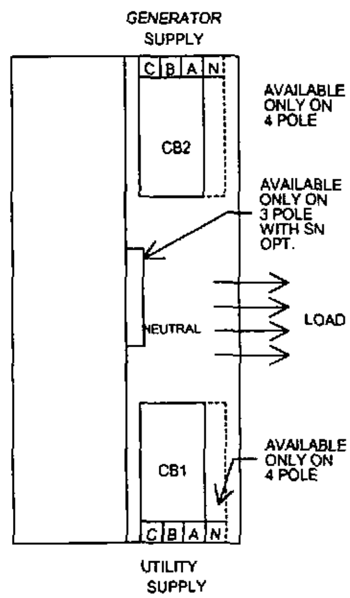
NOTE: FOR GENERAL LAYOUT ONLY, PHASING ORDER MAY CHANGE.

3 PHASE CONNECTION SHOWN. FOR SINGLE PHASE CONNECT TO A & B ONLY.

XL CONFIGURATION



SR CONFIGURATION



NOTE:

TYPICAL LOAD CONNECTIONS ONLY.

FOR EXACT LOCATIONS CONSULT FACTORY.

No	REVISIONS	BY	AUTH	DATE
7	ADDED REFERENCE TO SINGLE PHASE CONNECTION.	RG	NS	96-01-15
6	UP-DATED TITLE BLOCK, ETC.	RG	NS	95-05-16

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THOMSON TECHNOLOGY INC.

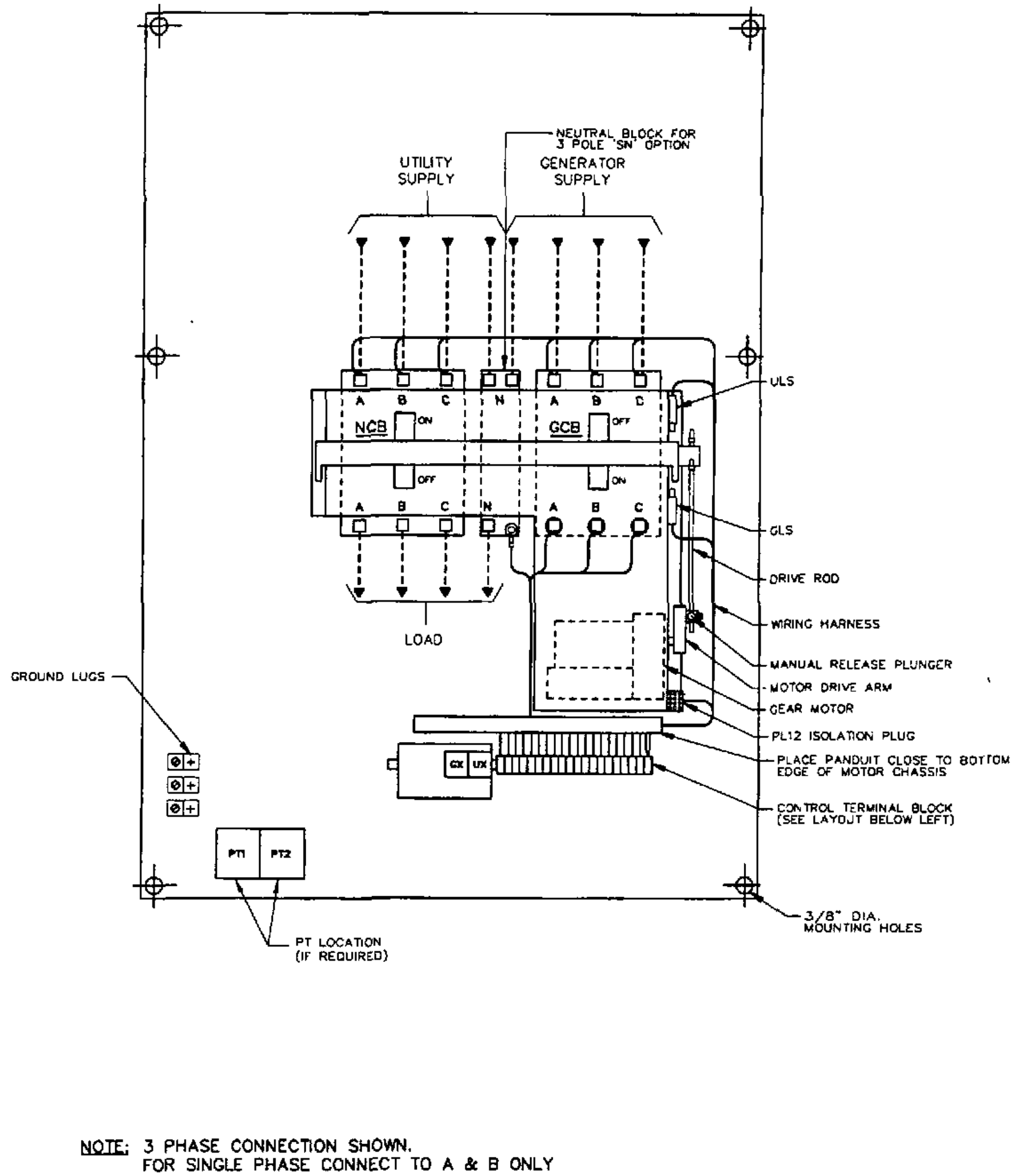
"T" STYLE
TRANSFER SWITCH
CONFIGURATIONS
STANDARD TRANSFER SWITCHES

CUSTOMER			
TTI			
CAD FILE NAME	DWN	AUTH	DATE
A501530	RG	NS	88-05-24
DRAWING No.		SHEET	REV
EPA 5015/30		1/1	7

FORM CAD No. ASHT

12. FRONT VIEW (TYPICAL) 3 / 4 POLE STYLE "M" - 100/150/250A

TRANSFER MECHANISM

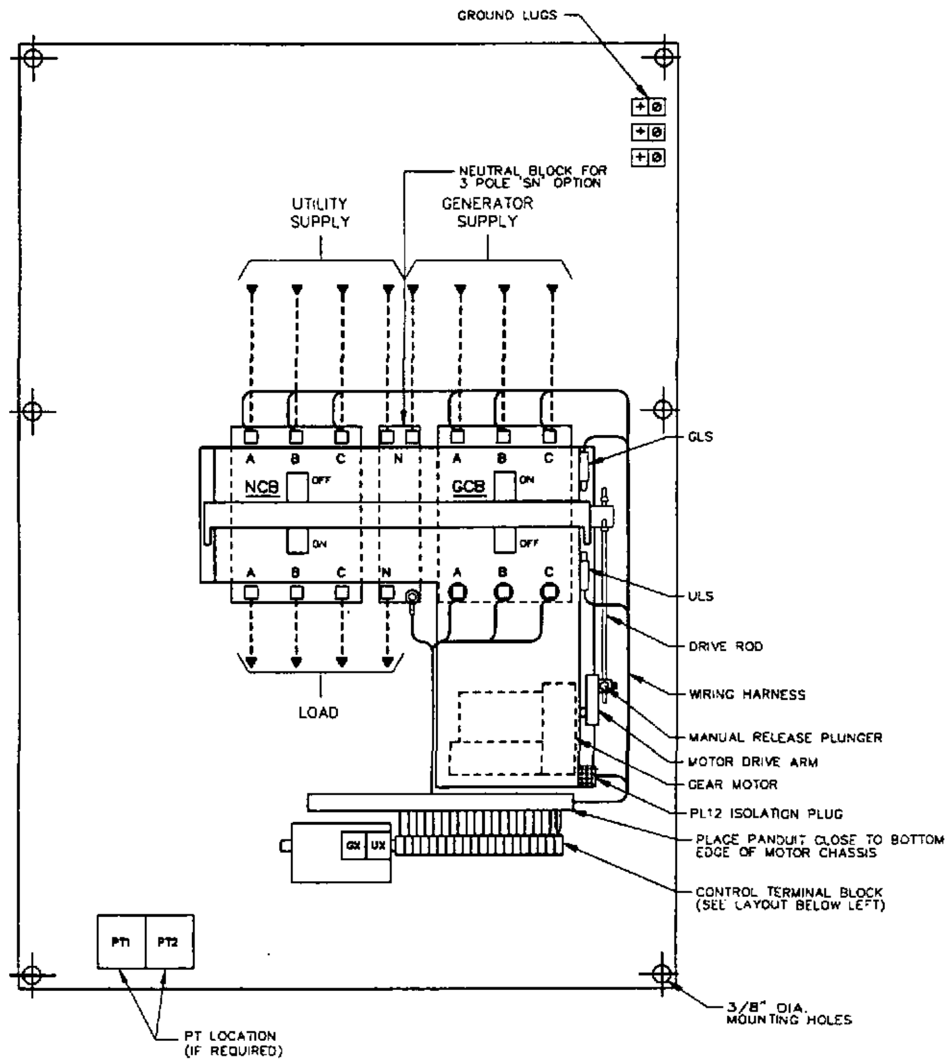


THOMSON® TECHNOLOGY INC.	FRONT VIEW (TYPICAL) 3/4 POLE STYLE 'M' TRANSFER MECHANISM - 100/150/250A	CUSTOMER: TTI				
		CAD FILE NAME: 7A001302	DWN: SH	AUTH: GS	DATE: 00-01-27	
		DRAWING No.: 7A001302			SHEET: 1/1	REV: 0

FORM CAD No. ASHT

13. FRONT VIEW (TYPICAL) 3 POLE STYLE "M" - 200A

TRANSFER MECHANISM



NOTE: 3 PHASE CONNECTION SHOWN.
FOR SINGLE PHASE CONNECT TO A & B ONLY

THOMSON TECHNOLOGY INC.

FRONT VIEW (TYPICAL)
3 POLE STYLE 'M'
TRANSFER MECHANISM – 200A

CUSTOMER: TTI			
CAD FILE NAME: 8A000301	DWN: RG	AUTH: GS	DATE: 98-07-29
DRAWING No.: 8A000301		SHEET: 1/1	REV: 1

FORM CAD No. ASHT

14. TROUBLESHOOTING (See CAUTION! on Page #1)

Symptom	Possible Causes
- will not re-transfer to utility source upon restoration	- isolation plug out - a test mode has been activated (check TSC 800 status LCD display) - utility voltage or frequency is outside the pre-programmed limits (check utility source for adequate voltage & frequency) - a loose control connection - faulty motor limit switch - defective motor - defective TSC 800 controller (verify output signals with circuit board mounted diagnostic LED's)
- will not transfer to generator source upon failure of utility source	- isolation plug out - generator set not producing enough voltage/frequency or output circuit breaker open - warmup time delay function has not timed out yet (verify TSC 800 timer setting) - a loose control connection - faulty motor limit switch - defective motor - defective TSC 800 controller (verify output signals with circuit board mounted diagnostic LED's)
- transfer to generator source without a power failure in the utility source	- a test mode has been activated (check TSC 800 status LCD display) - defective TSC 800 controller (verify output signals with circuit board mounted diagnostic LED's)
- generator does not start up or stop when it should	- verify remote engine control panel is set for automatic mode
- no time delay when there should be	- verify time delay function in the TSC 800 program setting as per programming sheets as supplied with the transfer switch
- power is not available at the load terminals but the utility or generator breaker appears to be closed to a live source	- the breaker's trip unit (Type B style only) has tripped on a fault on the system. Correct the fault, and manually reset the breaker in the transfer switch by moving it off and then on again with the manual operating handle - limit switch incorrectly adjusted
- the transfer switch has completed a transfer, but the motor has overheated and the internal thermal protector has opened	- limit switch failure or improper adjustment has failed to disconnect motor - binding or jamming of the transfer mechanism

DEFECTIVE COMPONENTS

Return defective components to Thomson Technology Inc. for repair. Be sure to advise model and serial number of the transfer switch.

15. CABLE TERMINAL INFORMATION

CABLE TERMINAL INFORMATION AND RECOMMENDED TIGHTNESS

		Cable Terminal Rating				Connection Tightness (In-Lbs)	
		Utility & Generator Supply		*Load & Neutral*			
Basic Transfer Switch Style	Transfer Switch Rating (Amps)	Qty Per Phase	Range	Qty Per Phase	Range	Terminal Mounting Screw	Cable Clamp
MCE	100 150	1 1	#4–4/0 #4–4/0	1 1	#4–4/0 #4–4/0	-- 20	100 (Socket) 50 (Slot)
MS3	200	1	#6–350MCM	1	#6–350MCM	72	275
MCE	250	1	#1–350MCM	1	#1–350MCM	90	275
TCJ	400[1]	3	250–500MCM[3]	2	2/0–500MCM 4/0–500MCM	275	375
TCK	600[1]	3	250–500MCM[3]	2	2/0–500MCM 4/0–500MCM	275	375
TCK	800[1]	3	250–600 MCM	3	250–600 MCM	275	375
TCK	1000/1200[1]	4 4	3/0–500MCM 4/0–500MCM	4 4	3/0–500MCM 4/0–500MCM	275	375
TCK	1600[2]	4	#2–600MCM	4	#2–600MCM	275	375

1. Optional Terminal Ratings are available in some models – Consult TTI.
2. IEC only.
3. 600MCM lug size is available subject to *restricted cable entry locations.*

16. REQUIREMENTS FOR UPSTREAM CIRCUIT PROTECTIVE DEVICES

Closing and Withstand Rating (Amps RMS Sym) With Upstream Fuse Protection

Basic Model	Max. Voltage	Rated Current (A)	SHORT CIRCUIT CURRENT RATING (AVAILABLE SYMMETRICAL AMPS (RMS)[1]				
			With Upstream Circuit Breaker Protection			With Upstream Fuse Protection	
			@240V	@480V	@600V	@ Up to 600V	Fuse Type
TS 850 - MCE- 100	600	100	65,000	25,000	18,000	100,000	T, J
TS 850 - MCE- 150	600	150	65,000	25,000	18,000	100,000	T, J
TS 850 - MS3- 200	240	200	100,000	N/A	N/A	N/A	T, J
TS 850 - MCJL-250	600	250	65,000	35,000	25,000	100,000	T, J
TS 850 - TCJ- 400	600	400	65,000	35,000	25,000	100,000	T, J
TS 850 - TCK- 600	600	600	65,000	50,000	35,000	100,000	T, J
TS 850 - TCK- 800	600	800	65,000	50,000	35,000	100,000	Consult Factory
TS 850 - TCK-1000	600	1000	65,000	50,000	35,000	100,000	"
TS 850 - TCK-1200	600	1200	65,000	50,000	35,000	100,000	"

1. Standard ratings only are shown. Consult TTI for versions with higher short circuit current ratings.

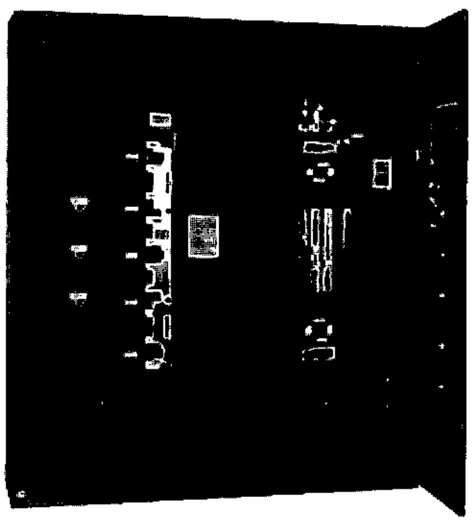
Fuse ratings shown are maximum allowable to permit use of the transfer switch in application with available fault current not exceeding that shown. Consideration must be given to fuse sizing when fuses also provide overload protection.

Please refer to the factory for further information on upstream protection requirements if required.

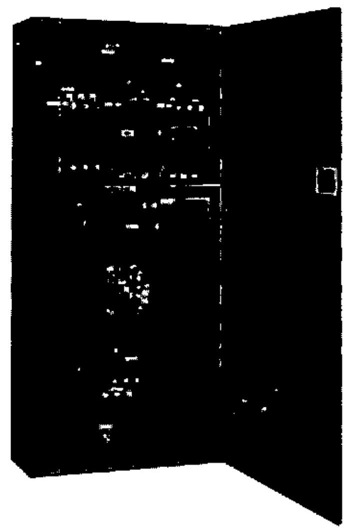
17. NOTES

BYPASS ISOLATION SWITCHES

Model TSB 850 • 100-1200 AMP



TSBD 853-TCK-800A



TSBU 853-TCJ-400A

THOMSON TECHNOLOGY BYPASS ISOLATION TRANSFER SWITCHES OFFER THE FOLLOWING OUTSTANDING FEATURES:

Molded Case Switching Units

- **fully enclosed** silver alloy contacts provide **high withstand** rating & **100% continuous** current rating.
- **completely separate** utility and generator side switching units provide superior reliability through redundancy.
- **barriers** between the transfer switch and bypass isolation switch reduce the chance of consequential damage if there is a failure in either the transfer switch or bypass isolation switch.
- when isolated there is no power in the transfer switch compartment **providing true isolation**.
- **not damaged if manually switched** while in service since contacts have inherent stored energy mechanism (quick make, quick break).

Reliable Motor-Operated Transfer Mechanism

- **heavy duty** brushless gearmotor and operating mechanism provide mechanical interlocking and long life.
- **safe manual operation** of the transfer and bypass isolation switch with two permanently affixed handles.

Superior Serviceability

- all mechanical and control devices are visible and **readily accessible**.
- all control wires and power busses are **front-accessible**, eliminating the cost and complexity of a drawout transfer switch.

Quality Features

- **TSC 800** microprocessor based controller.
- **isolation plug** permits disconnecting control circuits from all power sources for safety and convenience.
- control circuitry permits complete **off load testing** of the transfer switch when isolated (a draw out transfer switch is not required).
- available in **single** or **double sided bypass** configurations.

Isolation Switch

- available as bypass only for upgrades to systems with existing transfer switches.
- allows bypass **without load interruption** (double sided bypass only).

Quality Assurance

- ISO 9001 Registered
- CSA Z 299.3 (optional)
- DND AQAP-4 (optional)

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GENERAL DESCRIPTION

The **Thomson Technology Inc. TSB 850** bypass isolation transfer switch includes all the features of the **TS 850** transfer switch described in our **TS 850** Automatic Transfer Switch brochure.

The **TSB 850** bypass isolation switch incorporates two basic types for bypass-isolation. **Type "D" (double-sided)** isolates the transfer switch and can bypass either the utility or generator source of the load, as selected by the operator. Single-sided bypass **types "U" (utility bypass) and "G" (generator bypass)** can bypass only one source to the load, and can provide isolation when used in conjunction with a generator output circuit breaker (in accordance with **CSA 282 M89 -** Institutional & Residential Buildings Occupancy Group B and C).

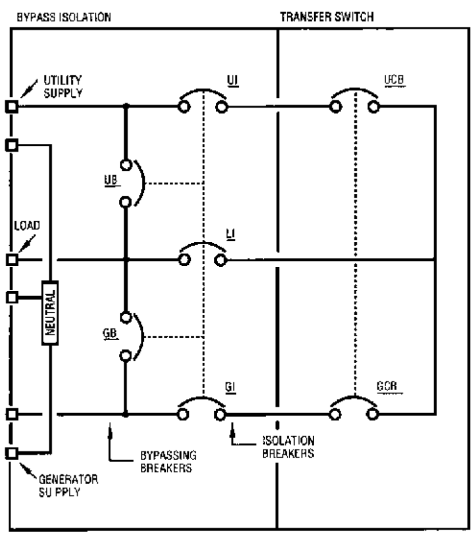
The **TSB 850** series mechanisms utilize non-automatic switches which provide a **100% continuous rating.** The switches are mounted independently on a common frame.

Independent switching units provide a degree of reliability and redundancy not available with ganged contactor type bypass systems.

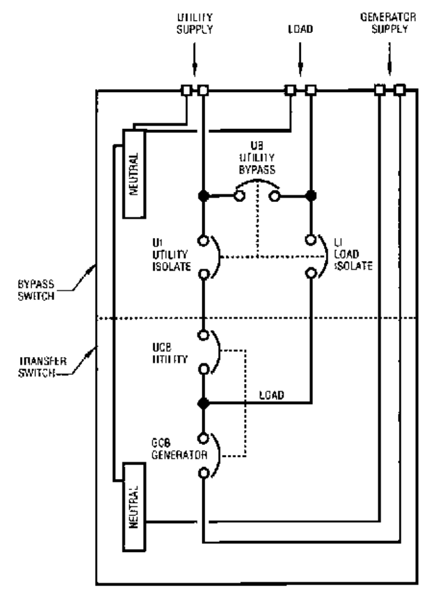
Each switching unit is equipped with an **internal quick-make, quick-break mechanism** as standard, and is **certified to switch without de-energizing any system loads.**

The **single handle bypass mechanism** is permanently mounted, and will not permit the sources to be interconnected. An operator has **three simple steps** to follow when bypassing, for servicing procedures or in cases when there is a transfer switch failure and manual transferring is required. The unique **single handle bypass design** allows bypassing with or without a load interruption (double-sided bypass only). Bypass and isolation position indication is permanently mounted at each switch position allowing the operator to clearly identify which mode the system is in (illuminated position indication is available as an option).

ONE-LINE SYSTEM DIAGRAM(Typical)



MODEL TSBD 850



MODEL TSBU 850

It is not possible to interconnect the utility and generator sources. No voltage is present at the transfer switch while isolated (i.e. isolation breakers must all be open, generator output circuit breaker must be open on single sided models).

ORDERING INFORMATION

EXAMPLE

Indicates source(s) bypassed
U=Utility, G=Generator, D= Double-i.e. both sources
Number of poles (2, 3 or 4)
Basic switch mechanism style
Type (A or B)

TSBD 853 TCK - 800A — 600 - 3W - LEV-1/AUX-U(2)/FTS-4

BASIC MODEL
SYSTEM VOLTAGE
SYSTEM CONDUCTORS (3W OR 4W)
CONTROL FEATURES LEVEL
OPTIONAL FEATURES

NOTE: Do not list standard features. Show quantity required for auxiliary contacts. Ensure standard cable terminals are adequate - Specify if optional type is required. Standard units are rated 60Hz. - Specify for other frequencies.

STANDARD MODELS

1. Standard ratings only are shown. Consult TTI for versions with higher closing/withstand ratings.

BASIC MODEL	MAXIMUM VOLTAGE	RATED CURRENT (A)	CLOSING AND WITHSTAND RATING (AVAILABLE SYMMETRICAL AMPS RMS)[1]				
			With Upstream Circuit Breaker Protection of Same Rating			With Upstream Fuse Protection of Same Rating	
			@ 240V	@ 480V	@ 600V	@ Up to 600V	FUSE TYPE
TSB 850-MCE -100	600	100	65,000	25,000	18,000	100,000	T, J
TSB 850-MCE -150	600	150	65,000	25,000	18,000	100,000	T, J
TSB 850-MCJL-250	600	250	65,000	35,000	25,000	100,000	T, J
TSB 850-TCJ -400	600	400	65,000	35,000	25,000	100,000	T, J
TSB 850-TCJ -600	600	600	65,000	35,000	25,000	100,000	T, J
TSB 850-TCK -800	600	800	65,000	50,000	35,000	100,000	Consult Factory
TSB 850-TCK -1000	600	1000	65,000	50,000	35,000	100,000	Consult Factory
TSB 850-TCK -1200	600	1200	65,000	50,000	35,000	100,000	Consult Factory

STANDARD FEATURES

CODE	DESCRIPTIONS
LEV-1*	Load on utility & load on generator lights c/w lamp test Three phase voltage sensing on utility & generator sources Under/over frequency sensor on generator source (with adjustable time delay) *Digital three phase metering of voltage & frequency on utility & generator sources* Engine start delay timer 0 - 60 sec. Engine cooldown delay timer 0 - 30 min. Engine warm-up timer 0 - 1800 sec. Transfer to utility timer 0 - 30 min. Exercise timer 24 hour/7 day On/off load test selectable Programmable function output contact** Real time clock & calendar Diagnostic LED's Backlit TSC 800 LCD display NEMA 1 enclosure Solid Neutral

* Provided as standard on all TSB Bypass Isolation Transfer Switches. ** Not available with level 3 optional features.

OPTIONAL FEATURES

CODE	DESCRIPTIONS
LEV-2	Level 2 ATS control package - Level 1 features plus the following: Neutral Position Delay (allows load voltage decay) *Overvoltage three phase sensor on both utility & generator sources* Under/over frequency sensor on utility source (with adjustable time delay)
LEV-3	Level 3 (Dual source) control package - Level 1 features plus the following: Dual Source selector switch Overvoltage three phase sensor - both sources Under/over frequency sensor - both sources
FTS-4	4 Function Test Switch (Auto/Off/Engine Start/Test)
AUX-U	Auxiliary Contact - Utility side (any qty.)
AUX-G	Auxiliary Contact - Generator side (any qty.)
LDC	Generator Pre/Post & Utility Pre/Post Timer contacts (adjustable) for Load Disconnect prior to transfer
NDT	Neutral Position Delay (allows load voltage decay)
OVS	Overvoltage three phase sensor on both utility & generator sources
UOF	Under/over frequency sensor on utility source (with adjustable time delay)
UPA	*Utility power available contact*
GPA	Generator power available contact
FTT	Fail to transfer contact
PBR	Phase Balance Relay - detects "single-phasing" condition on 3 phase system
UTR	Overload trip - Utility side (specify rating)
GTR	Overload trip - Generator side (specify rating)
COM	TSC 800 remote communication port for use with external Communication Interface Module (CIM module not included). Must order in conjunction with CIM option.*
CIM	Communication Interface Module with internal 14.4Kbaud modem, RS 232/422/485 ports and multiple interface protocols. One CIM module provides communication interface for up to five TSC800 controllers with COM per system.

*Refer to separate literature for additional information.

ENCLOSURE DIMENSIONS

(NEMA 1, ASA 61 GRAY)

SINGLE SIDED MODEL	DIMENSION (Inches)[3] — (3 and 4 pole)		
	HEIGHT	WIDTH	DEPTH
TSBU(orG) 850-MCE -100/150	55	34	13
TSBU(orG) 850-MCL -250	55	34	13
TSBU(orG) 850-TCJ -400	77	34	13
TSBU(orG) 850-TCJ -600	77	34	13
TSBU(orG) 850-TCK -800	77	80	17
TSBU(orG) 850-TCK -1000	77	80	17
TSBU(orG) 850-TCK -1200	77	80	17

Optional Nema class enclosures available - consult T.T.I. Optional paint colors available - consult T.T.I.

ENCLOSURE DIMENSIONS

(NEMA 1, ASA 61 GRAY) DIMENSION (Inches)[3]

DOUBLE SIDED MODEL	HEIGHT		WIDTH		DEPTH	
	3pole	4 pole	3 pole	4 pole	3 pole	4 pole
TSBD 850-MCE-100/150	55	55	34	34	13	13
TSBD 850-MCL-250	55	66	34	60	13	14
TSBD 850-TCJ -400	66	76	60	66	14	14
TSBD 850-TCJ -600	66	76	60	66	14	14
TSBD 850-TCK -800	74	74	80	80	17	17
TSBD 850-TCK -1000	74	74	80	80	17	17
TSBD 850-TCK -1200	74	74	80	80	17	17

CABLE TERMINALS

TRANSFER SWITCH RATING (A)	SWITCH MECHANISM TYPE	TERMINAL RATING[2]			
		NUMBER OF CONDUCTORS	CONDUCTOR SIZE RANGE	TYPE	
				Cu	Al
100, 150	M	1	#4 - 4/0	X	X
250	M	1	#1 - 350 MCM	X	X
400	T	1	2/0 - 600 MCM[4]	X	
		2	4/0 - 500 MCM[4]		X
600	T	1	2/0 - 500 MCM[4]	X	
		2	2/0 - 350 MCM[4]	X	
		2	4/0 - 500 MCM[4]		X
800	T	2	2/0 - 400 MCM	X	
		3	2/0 - 300 MCM	X	
		3	4/0 - 400 MCM		X
1000,1200	T	4	3/0 - 500 MCM	X	
		4	4/0 - 500 MCM		X

[1] Standard ratings only are shown. Consult T.T.I. for versions with higher closing/withstand ratings.
[2] Optional Terminal Ratings are available in some models — consult T.T.I.
[3] Enclosure dimensions are for reference. (DO NOT USE FOR CONSTRUCTION)
[4] When 500 MCM cable is utilized. cable entry/exit locations are resistive — Consult TTI.

Note: Specifications subject to change without notice.

CL032 Rev1 98/12/01

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THOMSON TECHNOLOGY INC.

TSB 850

BYPASS ISOLATION SWITCHES

INSTALLATION, OPERATING & SERVICE MANUAL

ISO 9001 QMI REGISTERED QUALITY SYSTEM

PM051 Rev 4 00/12/01

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NOTE:

For detailed information on Dual Source systems (Option LEV-3) refer to Information Supplement PM043.

GENERAL DESCRIPTION

Bypass isolation switches are used in conjunction with automatic load transfer switches. They enable an operator to bypass a source to the load and isolate the transfer switch for maintenance or testing.

The mechanism utilizes molded case switching devices and a positive mechanical interlock to prevent two sources from being connected at the same time and true isolation of the transfer switch.

Thomson Technology Inc. offers three types of isolation-bypass switches.

1) SINGLE SIDED BYPASS MODEL TSBU 850 (Utility), TSBG 850 (Generator)

This device may be either a utility or generator side bypass. The bypass consists of a source isolate breaker (either utility or generator), a load isolate breaker and a source bypass breaker (either utility or generator). This device provides an interrupted bypass to the selected source. The alternate source must be isolated upstream to provide complete isolation of the transfer switch.

2) DOUBLE SIDED BYPASS (MODEL TSBD 850)

This device allows bypass to either source and complete isolation of the transfer switch. The bypass consists of two source isolate breakers, two source bypass breakers (both utility and generator sides) and a load isolate breaker. This switch provides for either an interrupted or uninterrupted bypass to either source. A test circuit allows for transfer switch operation in the bypassed mode.

CAUTION: **Before opening the transfer switch or bypass isolation enclosure to perform any service task or to manually transfer the mechanism, it is imperative to <u>isolate the transfer switch from any possible source of power</u>. Failure to do so may result in <u>serious personal injury or death</u> due to electrical shock.**

NOTE: **All information contained in this manual is for reference only and is subject to change without notice.**

Contact Thomson Technology Inc. for clarification of current revision or if in doubt about any matter relating to installation, operation or maintenance.

<u>NOTE TO INSTALLER</u>

To ensure satisfactory installation of this equipment be sure to observe "Recommended Connection Tightness" and "Requirements for Upstream Circuit Protective Devices" located in this manual.

All mechanical and electrical connections must be checked for tightness prior to placing this equipment in service to ensure proper operation and to validate applicable warranty coverage.

If the transfer switch has programmable multi-tap voltage capability (refer to electrical schematic), confirm the transfer switch has been configured for the system voltage prior to installation.

Warning

Failure to confirm and match transfer switch voltage with the system voltage could cause serious equipment damage.

The voltage selections and connections are shown on the electrical schematics attached to each transfer switch. The factory default settings will be indicated on the calibration label attached on the inside of the enclosure door (supplied loose on open style models). A blank label is included to record the applicable settings if the configuration is changed from the factory default settings.

To change the transfer switch configuration the following must be accomplished:

- Change voltage taps of PT's to system voltage (refer to schematics)
- Change TSC 800 programming (refer to sections 6.2.2, 6.2.4, 6.2.5,6.3, and 6.4 of the TSC 800 instruction manual). The following settings may require reprogramming (depending on options purchased):

➢ System voltage
➢ System frequency
➢ System phase
➢ Utility undervoltage pickup (typically 90% of system voltage)
➢ Utility undervoltage dropout (typically 80% of system voltage)
➢ Utility overvoltage pickup (typically 110% of system voltage)
➢ Utility overvoltage dropout (typically 105% of system voltage)
➢ Utility underfrequency (typically 95% of system frequency)
➢ Utility overfrequency (typically 105% of system frequency)
➢ Generator undervoltage pickup (typically 90% of system voltage)
➢ Generator undervoltage dropout (typically 80% of system voltage)
➢ Generator overvoltage pickup (typically110% of system voltage)
➢ Generator overvoltage dropout (typically 105% of system voltage)
➢ Generator underfrequency (typically 95% of system frequency)
➢ Generator overfrequency (typically 105% of system frequency)

Record any changed setting on the TSC 800 Programming Data Sheets for future reference.

Complete the blank calibration label and attach to the inside of the transfer switch enclosure door.

GENERAL NOTES ON SERVICING

When performing any service work on the bypass isolation switch, it is imperative that the following be observed:

a) To maintain mechanical integrity, ensure that:

- Mechanical interlocking is correct and movement is free; proper sequence of breaker opening/closing must be maintained.
- All fasteners are adequately tightened.

b) To maintain electrical integrity, ensure that:

- All electrical connections are clean and adequately tightened.
- All insulating devices are in place and in good condition.
- No moisture or other contamination is present.

Service work should be undertaken only by qualified personnel. Failure to correctly maintain a bypass isolation switch may represent a hazard to life and equipment. Full operational testing must be done prior to placing a switch in service subsequent to any maintenance or repair. Any service work involving electrical components requires high potential testing to ensure that required insulation levels have been maintained.

OPERATION

(Refer to the operating description for the model and type of equipment installed).

NOTE: a) In this manual, the breakers are designated as follows:

UI-Utility isolate:	This breaker isolates the utility supply input from the transfer switch.
GI-Generator isolate:	This breaker isolates the generator supply input from the transfer switch.
LI-Load isolate:	This breaker isolates the load from the transfer switch.
UB-Utility bypass:	This breaker connects the utility supply directly to the load.
GB-Generator bypass:	This breaker connects the generator supply directly to the load.

b) Normal position is defined as when neither source is bypassed and the load is being supplied from either source through the transfer switch.

1) SINGLE SIDED BYPASS (MODEL TSBU (Utility), TSBG (Generator))

NOTE: Transfer switch is not completely isolated unless isolate breakers and alternate supply breakers are open.

The sequence of operation for a utility side bypass is as follows:

- Normal position: Utility isolate (UI) and Load isolate (LI) closed; Utility bypass (UB) open.

- Before bypassing, turn engine control switch to OFF if startup is not desired and/or isolate generator circuit breaker to ensure complete transfer switch isolation.

- To bypass and isolate transfer switch: Open Utility isolate (UI) and Load isolate (LI).

- Move slidebar interlock to allow closure of Utility bypass (UB).

- Close UB.

- The load is now connected directly to the utility supply and the transfer switch is isolated from the utility supply. Isolation of the transfer switch from the generator supply must be done upstream.

- To return to normal position, reverse the above steps.

The sequence of operation for a generator side bypass is as follows:

- Normal position: Generator isolate (GI) and Load isolate (LI) closed; Generator bypass (GB) open.

- Before bypassing, the generator should be running and connected to the Load through the transfer switch (to ensure complete transfer switch isolation) and/or open utility supply feeder breaker.

- To bypass and isolate transfer switch: Open Generator isolate (GI) and Load isolate (LI).

- Move slidebar interlock to allow closure of Generator bypass (GB).

- Close GB.

- The load is now connected directly to the generator supply and the transfer switch is isolated from the generator supply. Isolation of the utility supply must be done upstream.

- To return to normal position, reverse the above steps.

2) DOUBLE SIDED BYPASS (MODEL TSBD)

The sequence of operation for uninterrupted bypass is as follows:

a) Utility Bypass

- Normal position: Utility isolate (UI), Generator isolate (GI) and Load isolate (LI) are closed; Utility bypass (UB) and Generator bypass (GB) are open.
- Before bypassing, turn engine control switch to OFF if startup is not desired.
- To bypass and isolate transfer switch: Open Generator isolate (GI).
- Move slidebar interlock to allow closure of Utility bypass (UB).
- Close UB. The utility source is now parallel connected to the load through the transfer switch and UB.
- Open Utility isolate (UI).
- Open Load isolate (LI). The transfer switch is now isolated from both sources and the load.
- If the lockable slidebar is used, move slidebar to isolate position and lock to prevent accidental energization of the transfer switch.
- To return to normal position, reverse the above steps.

b) **Generator Bypass**

NOTE: The generator should be running and connected to the load through the transfer switch.

- Normal position: Utility isolate (UI), Generator isolate (GI) and Load isolate (LI) are closed: Utility bypass (UB) and Generator bypass (GB) are open.
- To bypass and isolate transfer switch: Open Utility isolate (UI).
- Move slidebar interlock to allow closure of Generator bypass (GB).
- Close GB. The generator source is now parallel connected to the load through the transfer switch and GB.
- Open Generator isolate (GI).
- Open Load isolate (LI). The transfer switch is now isolated from both sources and the load.
- If the lockable slidebar is used, move slidebar to isolate position and lock to prevent accidental energization of the transfer switch.

CAUTION: In either mode, the transfer switch is not isolated unless all three isolation breakers (UI, LI, GI) are open.

The previous sequences are for uninterrupted bypass. An interrupted bypass can be accomplished by opening all isolation breakers prior to closing the selected bypass breaker.

Note:

The transfer switch may be tested in the bypassed mode by connecting the transfer to the test plug. This allows for energization of the control circuits **only** for transfer switch function or maintenance testing. **The neutral delay control feature of the transfer switch (if supplied) will not be functional while using the test plug.**

RECOMMENDED MAINTENANCE

1) Do not perform dielectric tests on the equipment with any control components in the circuit.

2) Periodically inspect all terminals (load, line) for tightness. Re-torque all bolts, nuts and other hardware.

3) Bypass isolation switches should be in clean, dry and indoor location. If signs of moisture are present, attempt to remove. If cleaning is unsuitable, replace the corroded parts. Should dust or debris gather on the switch, brush, vacuum or wipe clean. **DO NOT** blow dirt into breakers or terminals.

4) Check for ease and correctness of interlock movement.

DEFECTIVE COMPONENTS

Return defective components to Thomson Technology Inc. for repair. Be sure to advise model and serial number of the unit.

CABLE TERMINAL INFORMATION AND RECOMMENDED TIGHTNESS

		Cable Terminal Rating				Connection Tightness (In-Lbs)	
		Utility & Generator Supply		Load & Neutral			
Basic Transfer Switch Style	Transfer Switch Rating (Amps)	Qty Per Phase	Range	Qty Per Phase	Range	Terminal Mounting Screw	Cable Clamp
MCE	100 150	1 1	#4–4/0 #4–4/0	1 1	#4–4/0 #4–4/0	-- 20	100 (Socket) 50 (Slot)
MS3	200	1	#6–350MCM	1	#6–350MCM	72	275
MCE	250	1	#1–350MCM	1	#1–350MCM	90	275
TCJ	400[1]	3	250–500MCM[3]	2	2/0–500MCM 4/0–500MCM	275	375
TCK	600[1]	3	250–500MCM[3]	2	2/0–500MCM 4/0–500MCM	275	375
TCK	800[1]	3	250–600 MCM	3	250–600 MCM	275	375
TCK	1000/1200[1]	4 4	3/0–500MCM 4/0–500MCM	4 4	3/0–500MCM 4/0–500MCM	275	375
TCK	1600[2]	4	#2–600MCM	4	#2–600MCM	275	375

1. Optional Terminal Ratings are available in some models – Consult TTI.
2. IEC only.
3. 600MCM lug size is available subject to restricted cable entry locations.

REQUIREMENTS FOR UPSTREAM CIRCUIT PROTECTIVE DEVICES

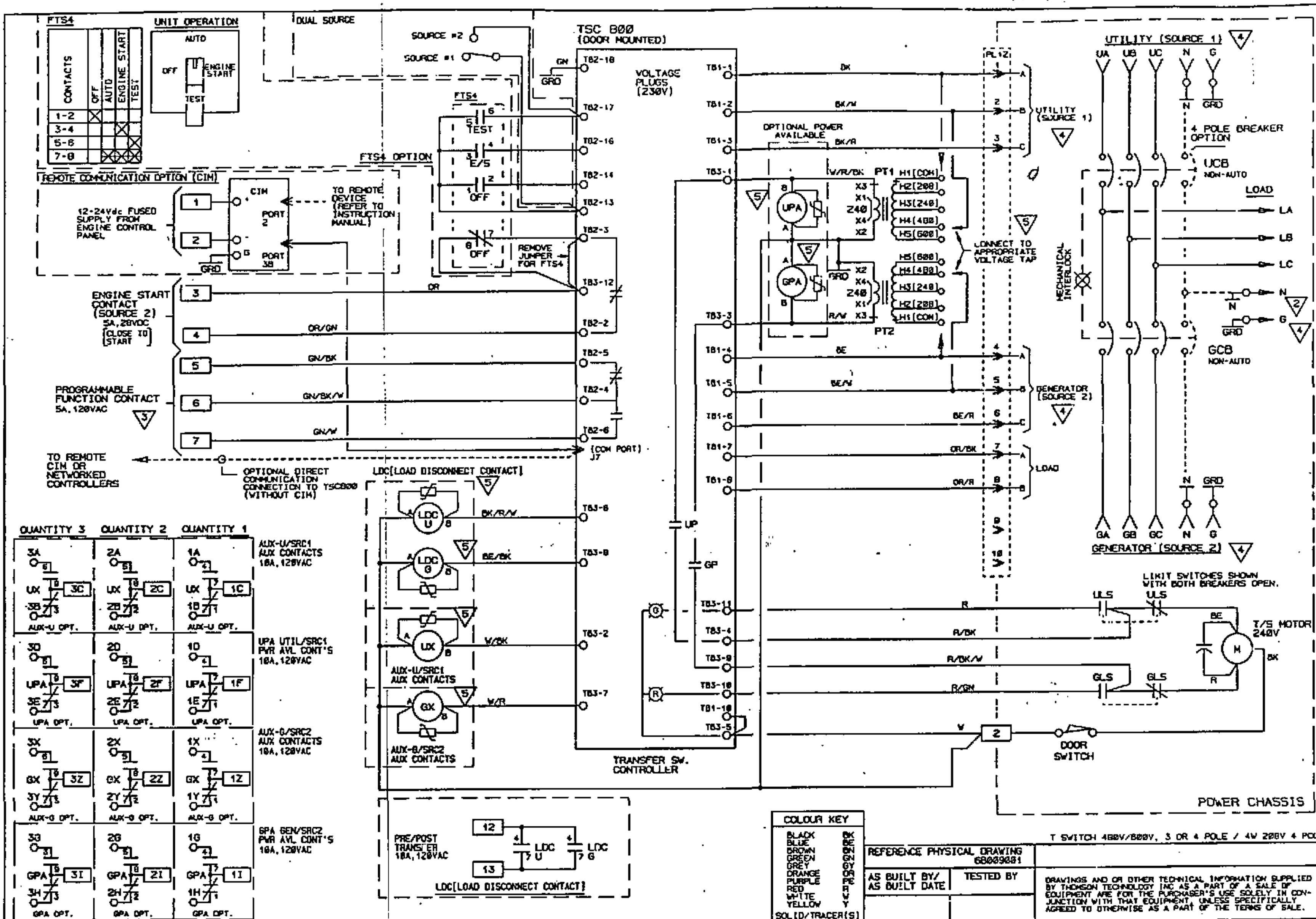
Closing and Withstand Rating (Amps RMS Sym) With Upstream Fuse Protection

Basic Model	Max. Voltage	Rated Current (A)	SHORT CIRCUIT CURRENT RATING (AVAILABLE SYMMETRICAL AMPS (RMS)[1]				
			With Upstream Circuit Breaker Protection			With Upstream Fuse Protection	
			@240V	@480V	@600V	@ Up to 600V	Fuse Type
TSB 850 - MCE-100	600	100	65,000	25,000	18,000	100,000	T, J
TSB 850 - MCE-150	600	150	65,000	25,000	18,000	100,000	T, J
TSB 850 - MS3-200	240	200	100,000	N/A	N/A	N/A	T, J
TSB 850 - MCJL-250	600	250	65,000	35,000	25,000	100,000	T, J
TSB 850 - TCJ-400	600	400	65,000	35,000	25,000	100,000	T, J
TSB 850 - TCJ-600	600	600	65,000	50,000	35,000	100,000	T, J
TSB 850 - TCK-800	600	800	65,000	50,000	35,000	100,000	Consult Factory
TSB 850 - TCK-1000	600	1000	65,000	50,000	35,000	100,000	"
TSB 850 - TCK-1200	600	1200	65,000	50,000	35,000	100,000	"

1. Standard ratings only are shown. Consult TTI for versions with higher short circuit current ratings.

Fuse ratings shown are maximum allowable to permit use of the transfer switch in application with available fault current not exceeding that shown. Consideration must be given to fuse sizing when fuses also provide overload protection.

Please refer to the factory for further information on upstream protection requirements, if required.



COLOUR KEY	
BLACK	BK
BLUE	BE
BROWN	BN
GREEN	GN
GREY	GY
ORANGE	OR
PURPLE	PE
RED	R
WHITE	W
YELLOW	Y
SOLID/TRACER(S)	

T SWITCH 480V/600V, 3 OR 4 POLE / 4W 208V 4 POLE

REFERENCE PHYSICAL DRAWING 68009001

AS BUILT BY/ AS BUILT DATE | TESTED BY

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

TRANSFER SWITCH WIRING OPTIONS

PROGRAMMABLE CONTACT [SELECT ONE ONLY]
- AUX-G(SRC2)[QTY 1] ☐
- AUX-U(SRC1)[QTY 1] ☐
- FAIL TO TRANSFER ☐

FTS4 ☐

CONTROL TYPE
- AUTOMATIC TRANSFER SWITCH ☐
- DUAL SOURCE ☐

AUX-G/SRC2 AUX CONTACTS [QTY][MAX 3] ☐

AUX-U/SRC1 AUX CONTACTS [QTY][MAX 3] ☐

UPA UTIL/SRC1 PWR AVL CONT'S [QTY][MAX 3] ☐

GPA GEN/SRC2 PWR AVL CONT'S [QTY][MAX 3] ☐

LDC[LOAD DISCONNECT CONTACT] ☐

REMOTE COMMUNICATION OPTION (WITH CIM) ☐

FOR TSC800 CONTROLLER OPTIONS, REFER TO PROGRAMMING SHEETS

2. SYSTEM MUST UTILIZE A SOLIDLY GROUNDED NEUTRAL
3. WHEN DUAL SOURCE OPTION SELECTED, PROGRAMMABLE CONTACT BECOMES SOURCE 1 ENGINE START CONTACT (TERMS 5 & 6 CLOSE TO START)
4. 3 PHASE CONNECTION SHOWN. FOR SINGLE PHASE CONNECT A AND B ONLY.
5. RELAY COILS 240VAC

PT TAP	VOLTAGE 208	240	400	480	600
H1	X	X		X	X
H2	X				
H3		X			
H4				X	
H5					X

X HIGH POLARITY MARKER

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND	
→	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

THOMSON TECHNOLOGY INC.

SCHEMATIC DIAGRAM AUTOMATIC TRANSFER SWITCH

MODEL TS 85_ - T___-___A -___   ___A, ___V, ___Ø, ___W, ___Hz

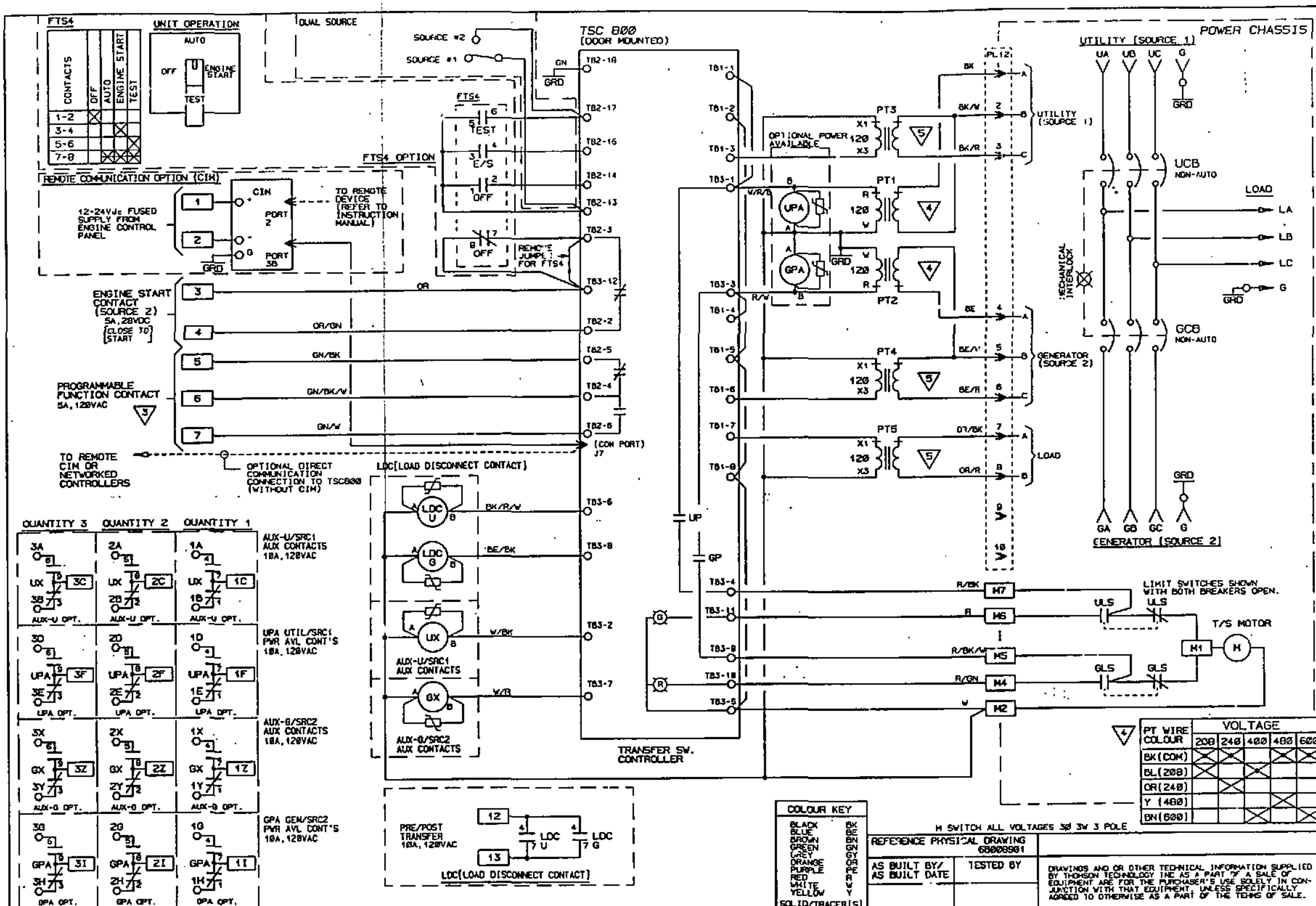
PROJECT:

SERIAL NUMBER

CUSTOMER

DATE	DWN	AUTH
96-09-11	SN	NS
DRAWING No.	SHEET	REV
88000601	1/1	3

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.



PT WIRE COLOUR	208	240	400	480	600
BK(COM)	X	X		X	X
BL(208)	X				
OR(240)		X			
Y (480)				X	
BN(600)					X

PT TAP	208	240	400	480	600
H1	X	X		X	X
H2	X				
H3		X			
H4				X	
H5					X

X HIGH POLARITY MARKER

COLOUR KEY	
BLACK	BK
BLUE	BE
BROWN	BN
GREEN	GN
GREY	GY
ORANGE	OR
PURPLE	PE
RED	R
WHITE	W
YELLOW	Y
SOLID/TRACER(S)	

TRANSFER SWITCH WIRING OPTIONS

PROGRAMMABLE CONTACT (SELECT ONE ONLY)
- AUX-G(SRC2)(QTY 1) ☐
- AUX-U(SRC1)(QTY 1) ☐
- FAIL TO TRANSFER ☐

FTS4 ☐

CONTROL TYPE
- AUTOMATIC TRANSFER SWITCH ☐
- DUAL SOURCE ☐

AUX-G/SRC2 AUX CONTACTS [QTY](MAX 3) ☐

AUX-U/SRC1 AUX CONTACTS [QTY](MAX 3) ☐

UPA UTIL/SRC1 PWR AVL CONT'S [QTY](MAX 3) ☐

GPA GEN/SRC2 PWR AVL CONT'S [QTY](MAX 3) ☐

LDC(LOAD DISCONNECT CONTACT) ☐

REMOTE COMMUNICATION OPTION (WITH CIM) ☐

FOR TSC800 CONTROLLER OPTIONS, REFER TO PROGRAMMING SHEETS

2. SYSTEM MUST UTILIZE A SOLIDLY GROUNDED NEUTRAL

3. WHEN DUAL SOURCE OPTION SELECTED, PROGRAMABLE CONTACT BECOMES SOURCE 1 ENGINE START CONTACT (TERMS 5 & 6 CLOSE TO START)

5.

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND
- ISOLATION PLUG
- OPT. OPTIONAL ITEMS

REFERENCE PHYSICAL DRAWING 68008901	
AS BUILT BY/ AS BUILT DATE	TESTED BY

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

PROJECT:

SERIAL NUMBER

CUSTOMER

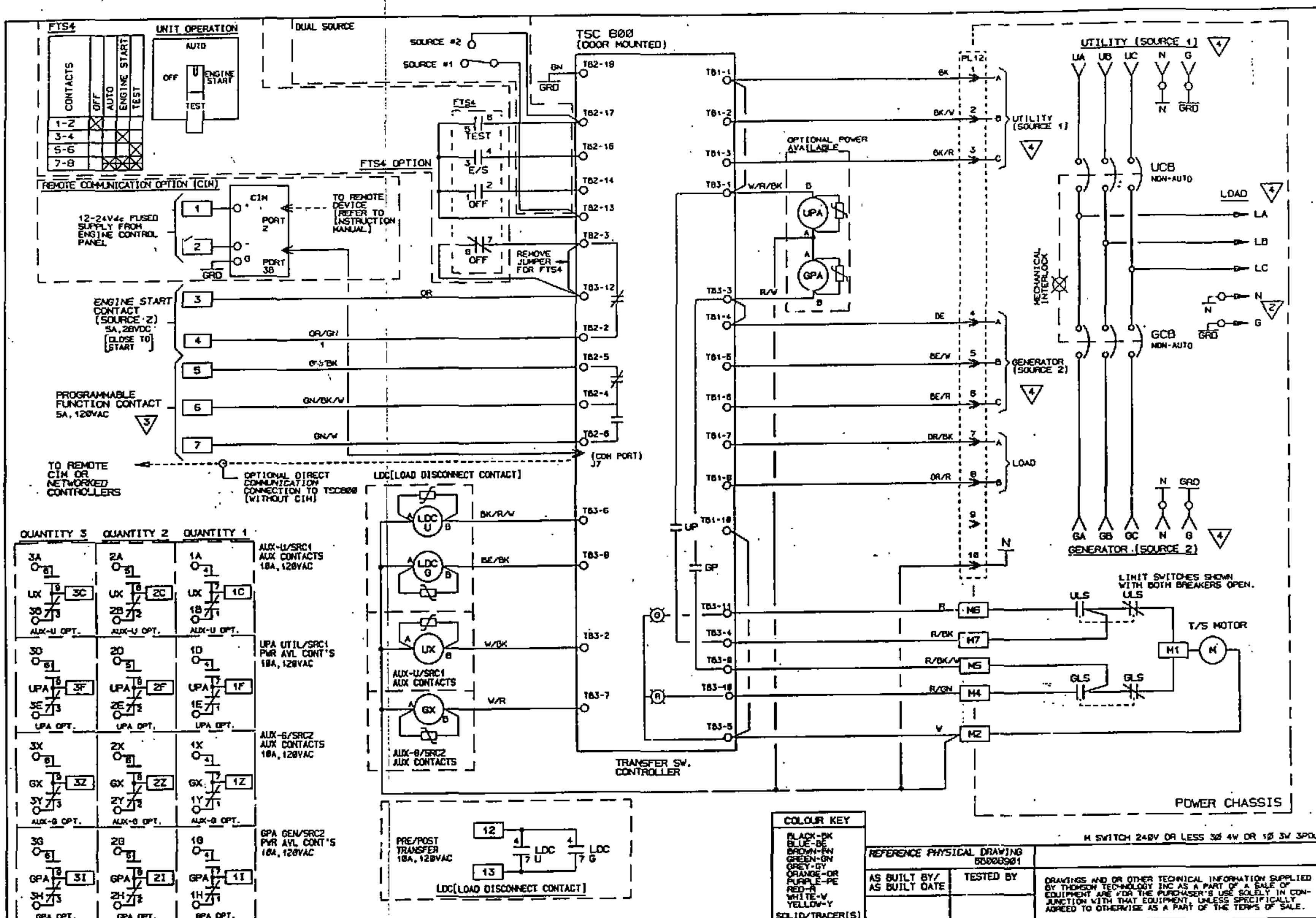
DATE	DWN	AUTH
96-09-11	SN	NS
DRAWING No.	SHEET	REV
68008301	1/1	12

THOMSON TECHNOLOGY INC.

SCHEMATIC DIAGRAM AUTOMATIC TRANSFER SWITCH

MODEL TS 853 - M____-____A -____   ____A, ____V, 3 Ø, 3 W, ____ Hz

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.



COLOUR KEY
BLACK-BK
BLUE-BE
BROWN-BN
GREEN-GN
GREY-GY
ORANGE-OR
PURPLE-PE
RED-R
WHITE-W
YELLOW-Y
SOLID/TRACER(S)

TRANSFER SWITCH WIRING OPTIONS

PROGRAMMABLE CONTACT (SELECT ONE ONLY)
- AUX-G(SRC2)(QTY 1) ☐
- AUX-U(SRC1)(QTY 1) ☐
- FAIL TO TRANSFER ☐

FTS4 ☐

CONTROL TYPE
- AUTOMATIC TRANSFER SWITCH ☐
- DUAL SOURCE ☐

AUX-G/SRC2 AUX CONTACTS [QTY](MAX 3) ☐

AUX-U/SRC1 AUX CONTACTS [QTY](MAX 3) ☐

UPA UTIL/SRC1 PWR AVL CONT'S [QTY](MAX 3) ☐

GPA GEN/SRC2 PWR AVL CONT'S [QTY](MAX 3) ☐

LDC[LOAD DISCONNECT CONTACT] ☐

REMOTE COMMUNICATION OPTION (WITH CIM) ☐

FOR TSC800 CONTROLLER OPTIONS, REFER TO PROGRAMMING SHEETS

2 SYSTEM MUST UTILIZE A SOLIDLY GROUNDED NEUTRAL

3 WHEN DUAL SOURCE OPTION SELECTED, PROGRAMMABLE CONTACT BECOMES SOURCE 1 ENGINE START CONTACT (TERMS 5 & 6 CLOSE TO START)

4 3 PHASE CONNECTION SHOWN. FOR SINGLE PHASE CONNECT A AND B ONLY.

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND	
→	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

REFERENCE PHYSICAL DRAWING 6B000901	
AS BUILT BY/ AS BUILT DATE	TESTED BY

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

PROJECT:

SERIAL NUMBER

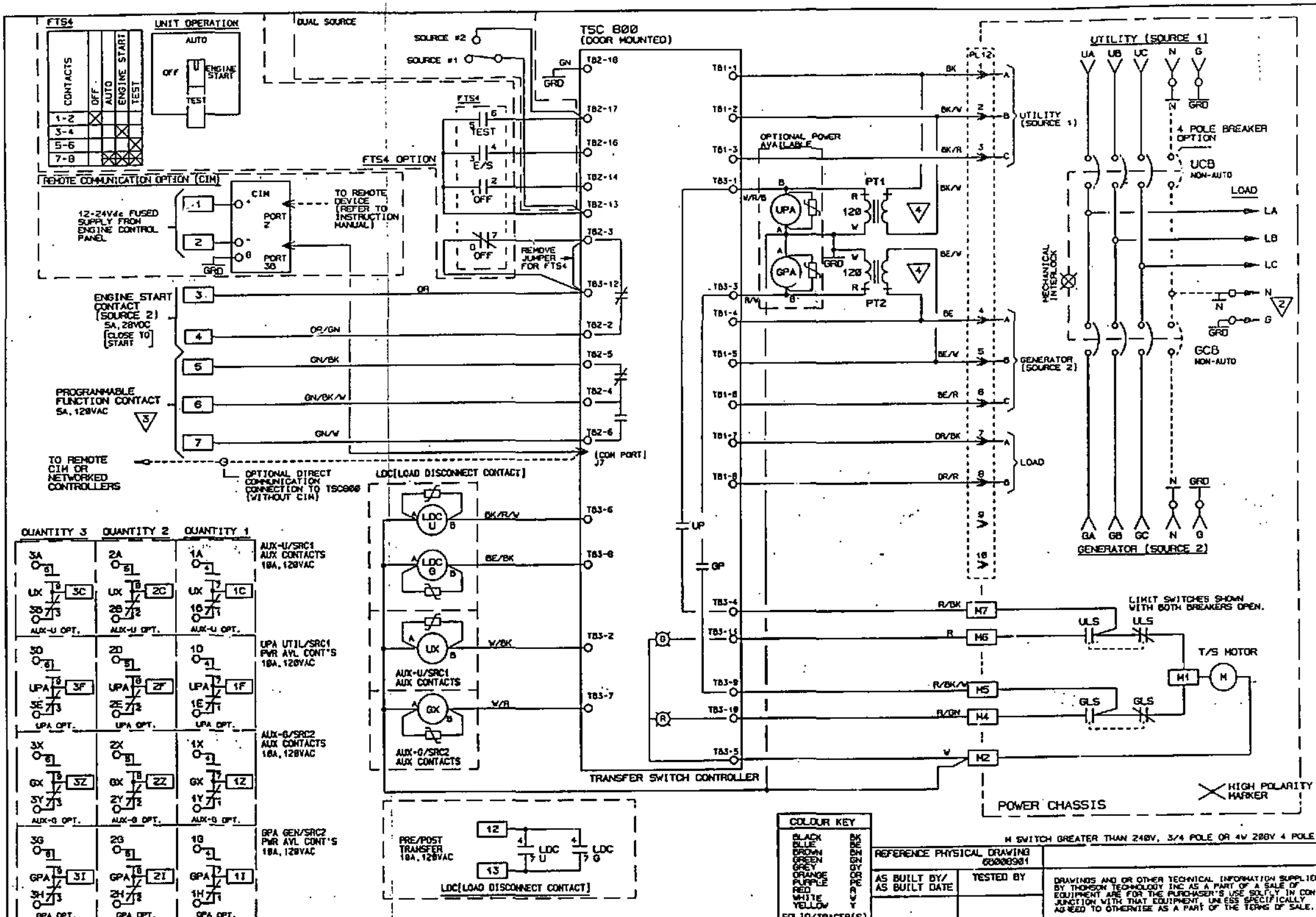
CUSTOMER

SCHEMATIC DIAGRAM AUTOMATIC TRANSFER SWITCH

THOMSON TECHNOLOGY INC.

MODEL TS 85 _ - M___ - ___A - ___ ___A, ___V, ___Ø, ___W, ___Hz

DATE	DWN	AUTH
96-09-11	SN	NS
DRAWING No.	SHEET	REV
6B000401	1/1	6



COLOUR KEY	
BLACK	BK
BLUE	BE
BROWN	BN
GREEN	GN
GREY	GY
ORANGE	OR
PURPLE	PE
RED	R
WHITE	W
YELLOW	Y
SOLID/TRACER(S)	

TRANSFER SWITCH WIRING OPTIONS

PROGRAMMABLE CONTACT [SELECT ONE ONLY]
- AUX-G(SRC2)[QTY 1] ☐
- AUX-U(SRC1)[QTY 1] ☐
- FAIL TO TRANSFER ☐

FTS4 ☐

CONTROL TYPE
- AUTOMATIC TRANSFER SWITCH ☐
- DUAL SOURCE ☐

AUX-G/SRC2 AUX CONTACTS [QTY] (MAX 3) ☐

AUX-U/SRC1 AUX CONTACTS [QTY] (MAX 3) ☐

UPA UTIL/SRC1 PWR AVL CONT'S [QTY] (MAX 3) ☐

GPA GEN/SRC2 PWR AVL CONT'S [QTY] (MAX 3) ☐

LDC[LOAD DISCONNECT CONTACT] ☐

REMOTE COMMUNICATION OPTION (WITH CIM) ☐

FOR TSC800 CONTROLLER OPTIONS, REFER TO PROGRAMMING SHEETS

2. SYSTEM MUST UTILIZE A SOLIDLY GROUNDED NEUTRAL
3. WHEN DUAL SOURCE OPTION SELECTED, PROGRAMABLE CONTACT BECOMES SOURCE 1 ENGINE START CONTACT (TERMS 5 & 6 CLOSE TO START)
4. PT VOLTAGE TAP CONNECTIONS

PT WIRE COLOUR	VOLTAGE 208	240	400	480	600
BK(COM)	X	X	X	X	X
BL(208)	X		X		
OR(240)		X			
Y (480)				X	
BN(600)					X

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND	
→	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

REFERENCE PHYSICAL DRAWING 68000901	
AS BUILT BY/ AS BUILT DATE	TESTED BY

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THOMSON ® TECHNOLOGY INC.

SCHEMATIC DIAGRAM AUTOMATIC TRANSFER SWITCH

MODEL TS 85_ - M___ - ___ A - ___   A,   V, 3 Ø, 4 W,   Hz

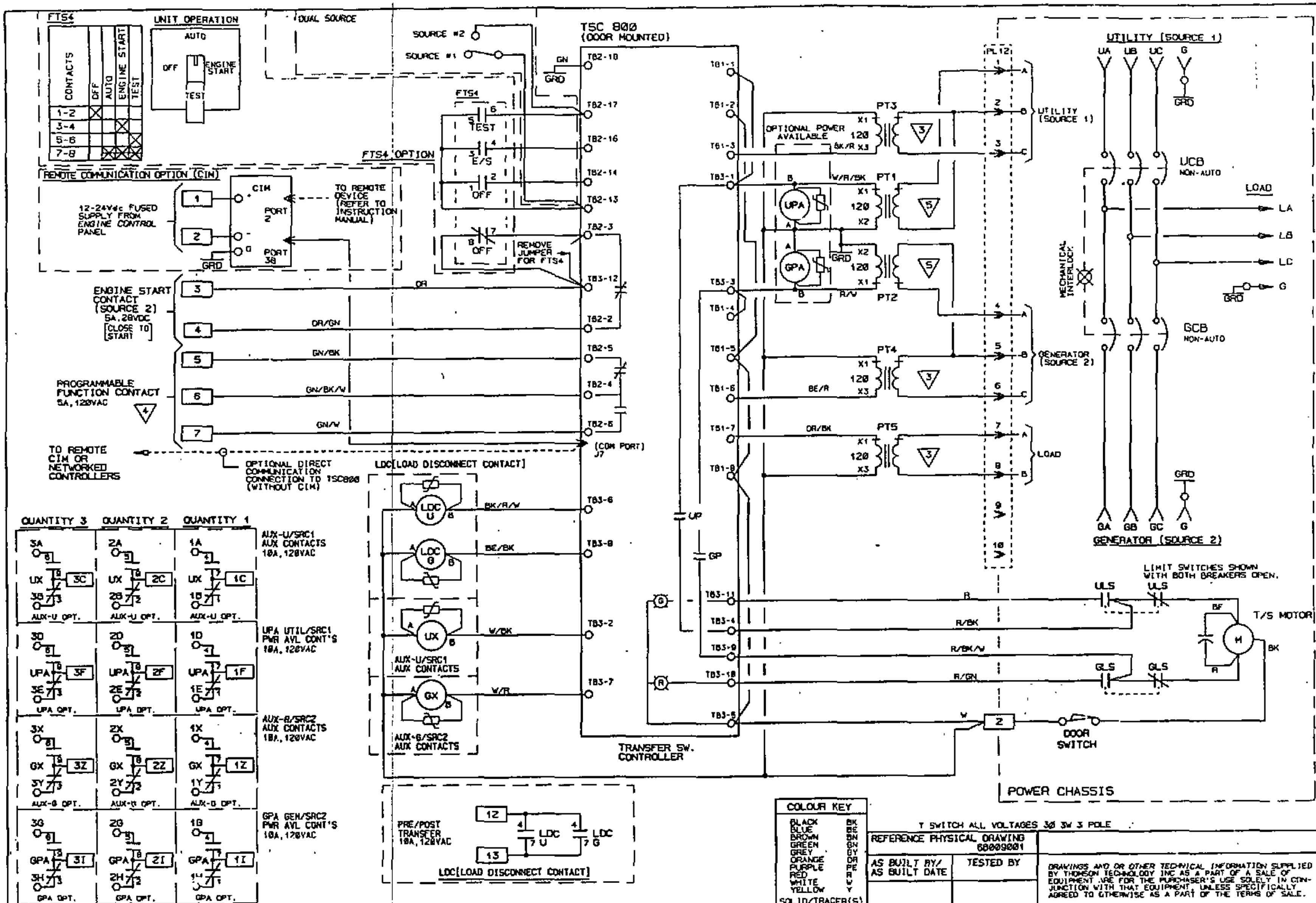
PROJECT:

SERIAL NUMBER

CUSTOMER

DATE	DWN	AUTH
96-09-11	SN	NS
DRAWING No.	SHEET	REV
68000501	1/1	B

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.



COLOUR KEY	
BLACK	BK
BLUE	BE
BROWN	BN
GREEN	GN
GREY	GY
ORANGE	OR
PURPLE	PE
RED	R
WHITE	W
YELLOW	Y
SOLID/TRACER(S)	

T SWITCH ALL VOLTAGES 3Ø 3W 3 POLE

REFERENCE PHYSICAL DRAWING 68009001

AS BUILT BY/ AS BUILT DATE	TESTED BY

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THOMSON TECHNOLOGY INC.

SCHEMATIC DIAGRAM AUTOMATIC TRANSFER SWITCH

MODEL TS 853 - T____-____A -____   ____A, ____V, 3 Ø, 3 W, ____Hz

PROJECT:

SERIAL NUMBER

TRANSFER SWITCH WIRING OPTIONS

PROGRAMMABLE CONTACT [SELECT ONE ONLY]
- AUX-G(SRC2)[QTY 1] ☐
- AUX-U(SRC1)[QTY 1] ☐
- FAIL TO TRANSFER ☐

FTS4 ☐

CONTROL TYPE
- AUTOMATIC TRANSFER SWITCH ☐
- DUAL SOURCE ☐

AUX-G/SRC2 AUX CONTACTS [QTY][MAX 3] ☐

AUX-U/SRC1 AUX CONTACTS [QTY][MAX 3] ☐

UPA UTIL/SRC1 PWR AVL CONT'S [QTY][MAX 3] ☐

GPA GEN/SRC2 PWR AVL CONT'S [QTY][MAX 3] ☐

LDC[LOAD DISCONNECT CONTACT] ☐

REMOTE COMMUNICATION OPTION (WITH CIM) ☐

FOR TSC800 CONTROLLER OPTIONS, REFER TO PROGRAMMING SHEETS

3 PT VOLTAGE TAP CONNECTIONS

PT TAP	VOLTAGE 208	240	430	480	600
H1	X	X		X	X
H2	X		X		
H3		X			
H4				X	
H5			X		X

X HIGH POLARITY MARKER

4 WHEN DUAL SOURCE OPTION SELECTED, PROGRAMABLE CONTACT BECOMES SOURCE 1 ENGINE START CONTACT (TERMS 5 & 6 CLOSE TO START)

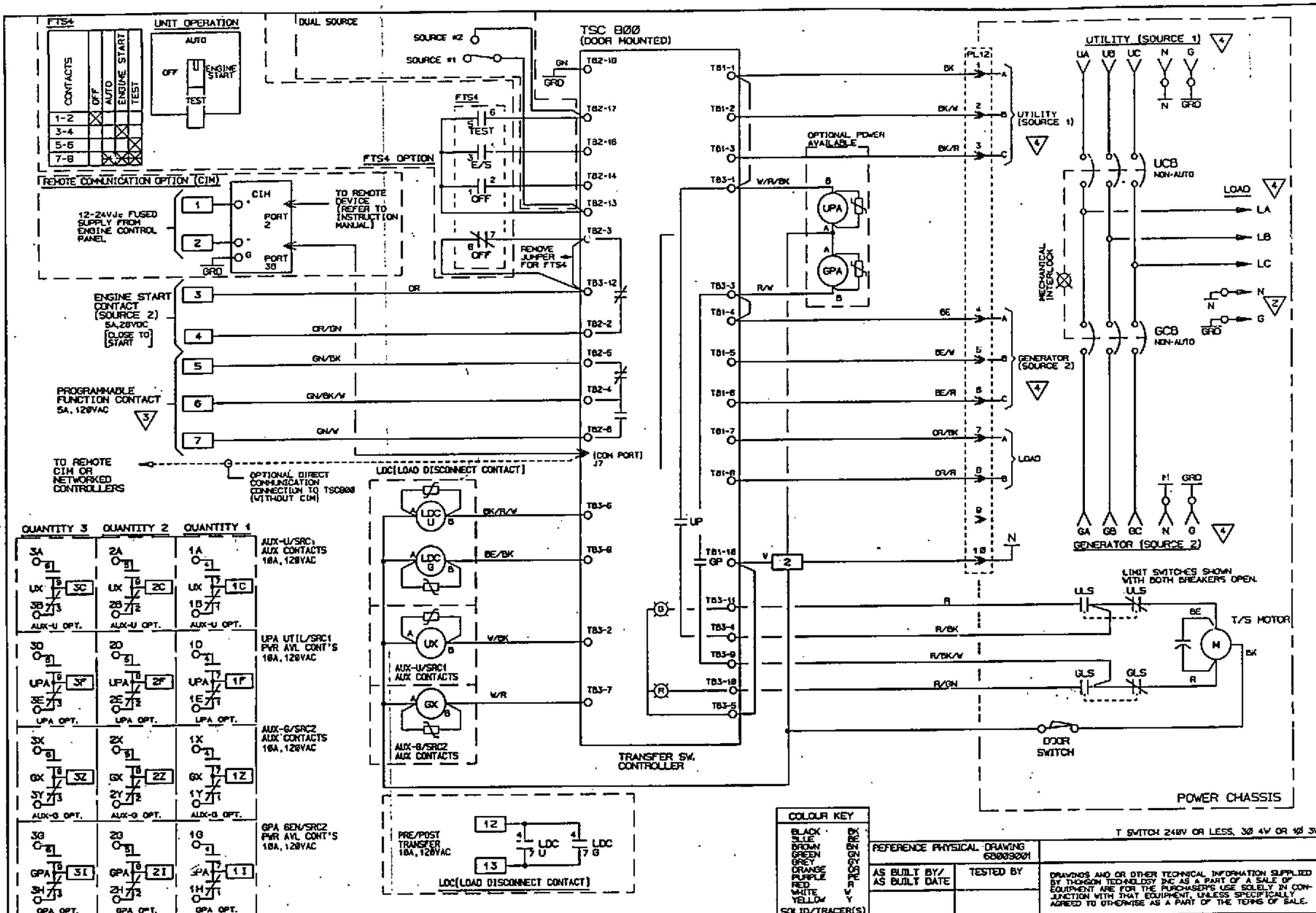
REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND
- ⇥ ISOLATION PLUG
- OPT. OPTIONAL ITEMS

CUSTOMER

DATE	DWN	AUTH
96-09-11	SN	NS
DRAWING No. 68008601	SHEET 1/1	REV 10

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.



REFERENCE PHYSICAL DRAWING 68009001	
AS BUILT BY/ AS BUILT DATE	TESTED BY

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PROJECT:

SERIAL NUMBER

TRANSFER SWITCH WIRING OPTIONS

PROGRAMMABLE CONTACT [SELECT ONE ONLY]
AUX-G(SRC2)[QTY 1] ☐
AUX-U(SRC1)[QTY 1] ☐
FAIL TO TRANSFER ☐

FTS4 ☐

CONTROL TYPE
AUTOMATIC TRANSFER SWITCH ☐
DUAL SOURCE ☐

AUX-G/SRC2 AUX CONTACTS [QTY](MAX 3) ☐

AUX-U/SRC1 AUX CONTACTS [QTY](MAX 3) ☐

UPA UTIL/SRC1 PWR AVL CONT'S [QTY](MAX 3) ☐

GPA GEN/SRC2 PWR AVL CONT'S [QTY](MAX 3) ☐

LDC(LOAD DISCONNECT CONTACT) ☐

REMOTE COMMUNICATION OPTION (WITH CIM) ☐

FOR TSC800 CONTROLLER OPTIONS, REFER TO PROGRAMMING SHEETS

2. SYSTEM MUST UTILIZE A SOLIDLY GROUNDED NEUTRAL
3. WHEN DUAL SOURCE OPTION SELECTED, PROGRAMABLE CONTACT BECOMES SOURCE 1 ENGINE START CONTACT (TERMS 5 & 6 CLOSE TO START)
4. 3 PHASE CONNECTION SHOWN. FOR SINGLE PHASE CONNECT A AND B ONLY.

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND
ISOLATION PLUG
OPT. OPTIONAL ITEMS

CUSTOMER

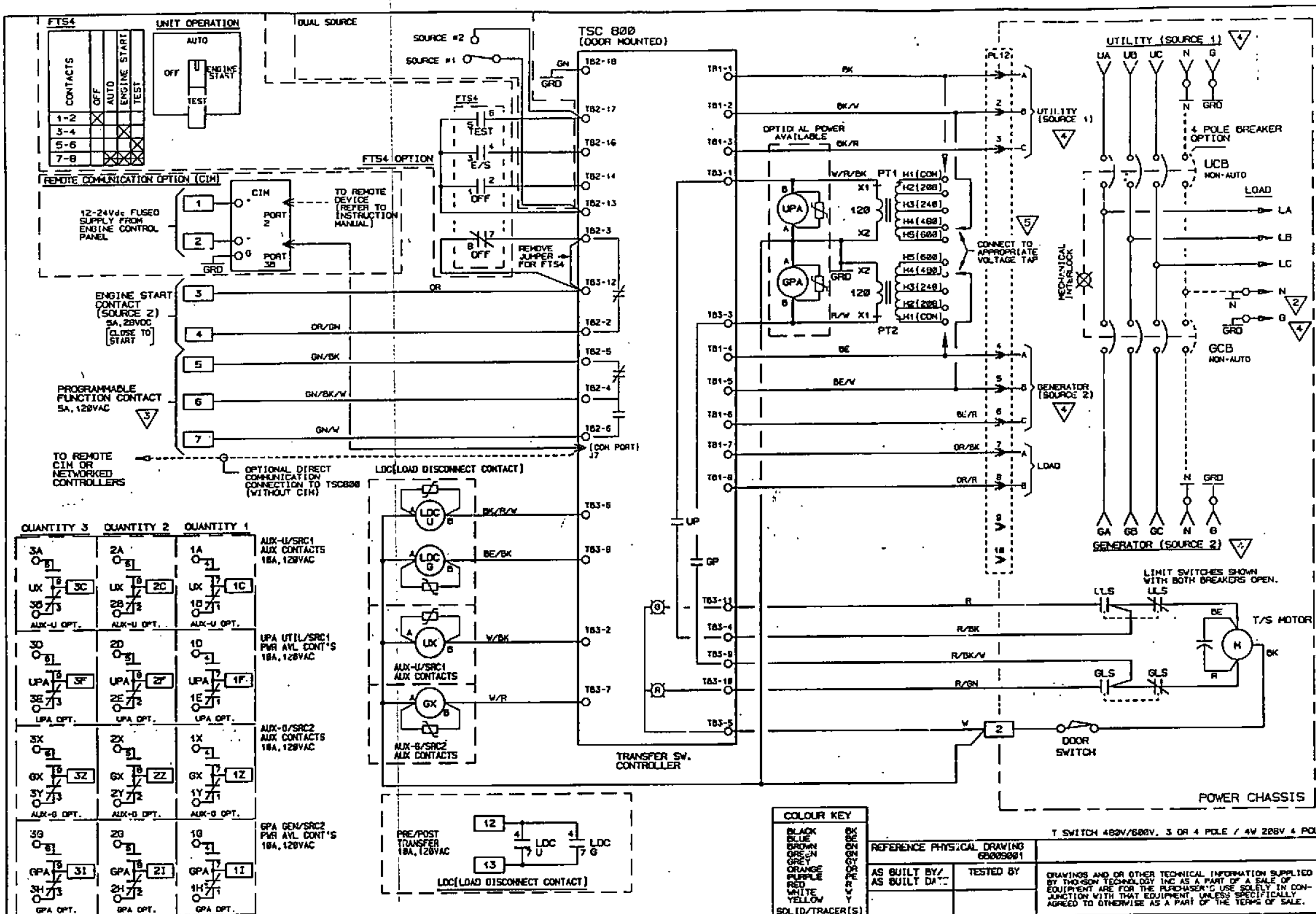
DATE	DWN	AUTH
95-09-11	SN	NS
DRAWING No. 68008701	SHEET 1/1	REV 7

THOMSON TECHNOLOGY INC.

SCHEMATIC DIAGRAM AUTOMATIC TRANSFER SWITCH

MODEL TS 85_ - T____ - ____A - ____ ____A, ____V, ____Ø, ____W, ____Hz

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.



COLOUR KEY	
BLACK	BK
BLUE	BE
BROWN	BN
GREEN	GN
GREY	GY
ORANGE	OR
PURPLE	PE
RED	R
WHITE	W
YELLOW	Y
SOLID/TRACER(S)	

T SWITCH 480V/600V, 3 OR 4 POLE / 4W 208V 4 POLE

TRANSFER SWITCH WIRING OPTIONS

PROGRAMMABLE CONTACT (SELECT ONE ONLY)
- AUX-G(SRC2)(QTY 1) ☐
- AUX-U(SRC1)(QTY 1) ☐
- FAIL TO TRANSFER ☐

FTS4 ☐

CONTROL TYPE
- AUTOMATIC TRANSFER SWITCH ☐
- DUAL SOURCE ☐

AUX-G/SRC2 AUX CONTACTS [QTY](MAX 3) ☐

AUX-U/SRC1 AUX CONTACTS [QTY](MAX 3) ☐

UPA UTIL/SRC1 PWR AVL CONT'S [QTY](MAX 3) ☐

GPA GEN/SRC2 PWR AVL CONT'S [QTY](MAX 3) ☐

LDC(LOAD DISCONNECT CONTACT) ☐

REMOTE COMMUNICATION OPTION (WITH CIM) ☐

FOR TSC800 CONTROLLER OPTIONS, REFER TO PROGRAMMING SHEETS

2. SYSTEM MUST UTILIZE A SOLIDLY GROUNDED NEUTRAL
3. WHEN DUAL SOURCE OPTION SELECTED, PROGRAMABLE CONTACT BECOMES SOURCE 1 ENGINE START CONTACT (TERMS 5 & 6 CLOSE TO START)
4. 3 PHASE CONNECTION SHOWN. FOR SINGLE PHASE CONNECT A AND B ONLY.
5.

PT TAP	VOLTAGE 208	240	400	480	600
H1	X	X		X	X
H2	X		X		
H3		X			
H4				X	
H5			X		X

X HIGH POLARITY MARKER

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND	
➔	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

REFERENCE PHYSICAL DRAWING 6B009001

AS BUILT BY/ AS BUILT DATE | TESTED BY

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PROJECT:

SERIAL NUMBER

CUSTOMER

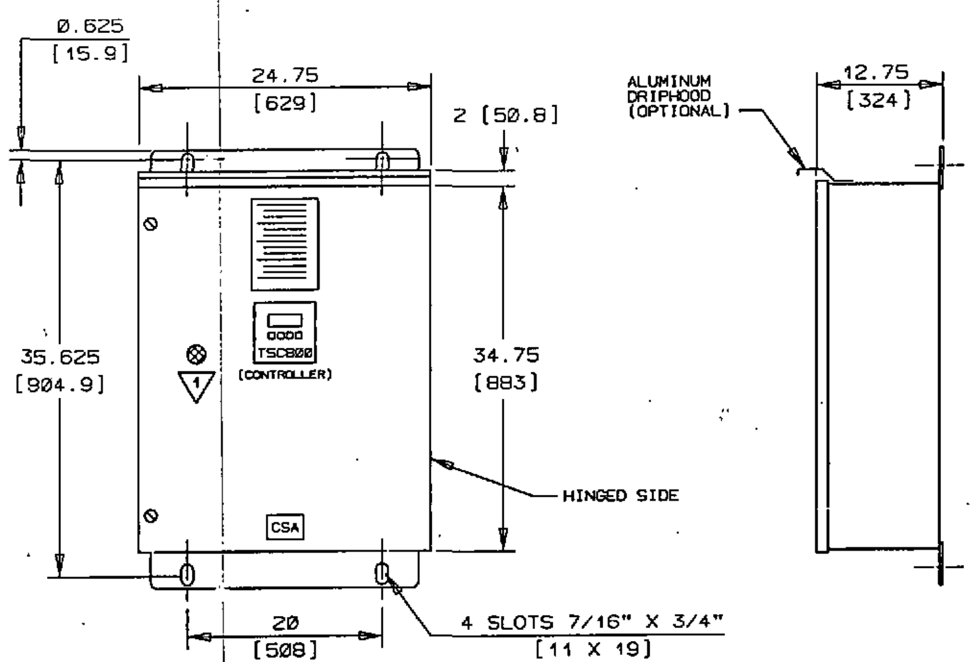
THOMSON TECHNOLOGY INC.

SCHEMATIC DIAGRAM AUTOMATIC TRANSFER SWITCH

MODEL TS 8S _ - T____ - ____ A - ____ ____ A, ____ V, 3 Ø, 4 W, ____ Hz

DATE	DWN	AUTH
96-09-11	SN	NS
DRAWING No. 6B008801	SHEET 1/1	REV 9

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.



(TYPICAL) FRONT VIEW

FINISH: ASA #61 GREY

SIDE VIEW

DIMENSIONS IN INCHES, [ ] = MILLIMETERS

- [ ] NEMA 1
- [ ] NEMA 1A C/W DRIPHOOD
- [ ] 100A
- [ ] 150A
- [ ] 250A

SWITCH FEATURES

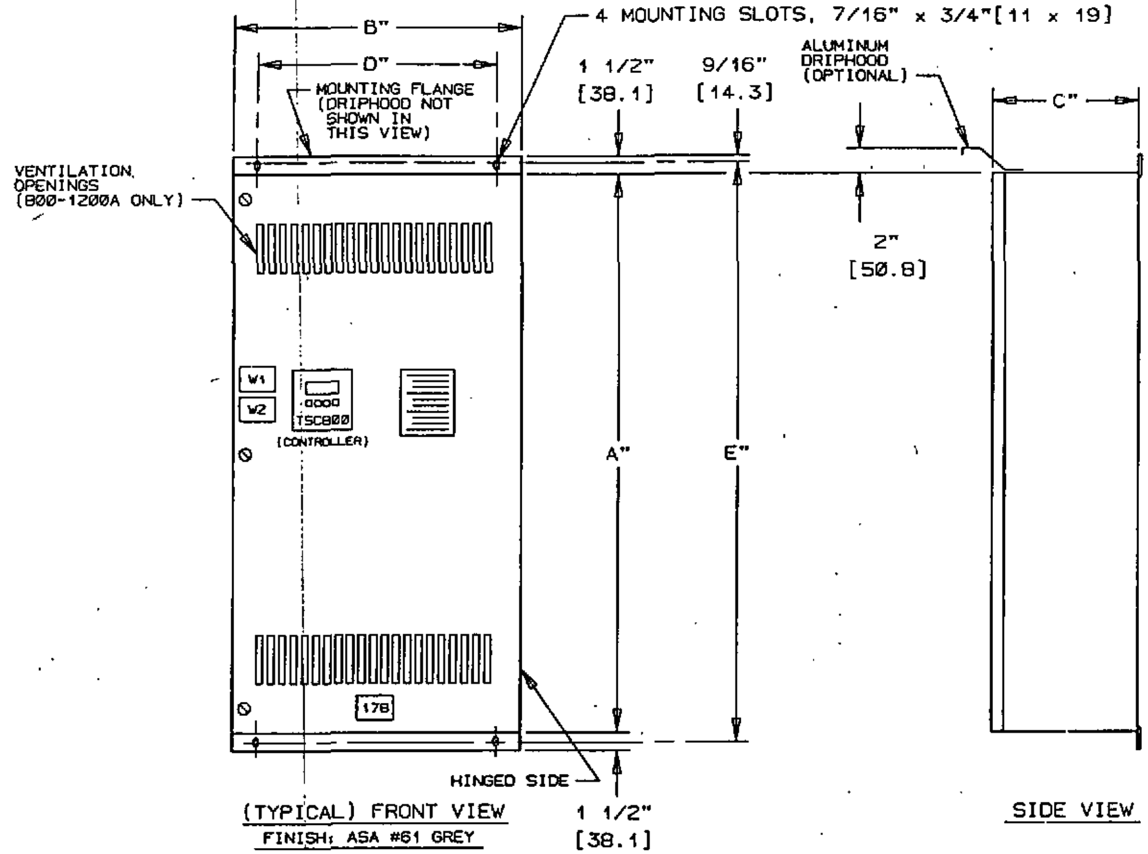
- [ ] PREFERED SOURCE SELECTOR SWITCH (ONLY WITH DUAL STANDBY SOURCE SYSTEMS)
- [ ] OPTIONAL FOUR POSITION TEST SWITCH - FTS4 - ONLY WITH ATS SYSTEMS
- [ ] NO SWITCH REQUIRED

No.	REVISIONS	BY	AUTH	DATE
4	UPDATED TO LATEST ST'D.	RG	NS	97-11-21
3	ADDED SWITCH FEATURES	SN	NS	96-11-06
2	KNOCK DOWN BOX DESIGN	SN	NS	96-10-03
1	MODIFIED FOR TSC800	SN	NS	96-09-17

THOMSON TECHNOLOGY INC.

AUTOMATIC TRANSFER SWITCH
ENCLOSURE DIMENSIONS
MODEL TS 850M
100A, 150A, 250A

CUSTOMER			
CAD FILE NAME: 6B008901	DWN: SN	AUTH: NS	DATE: 96-10-03
DRAWING No.: 6B008901		SHEET: 1/1	REV: 5



SIZE(AMPS)	A	B	C	D	E
250A,400A,600A	57[1448]	30[762]	12[305]	26[660]	58.75[1492]
800A,1000A,1200A	84[2134]	34[864]	12[305]	30[762]	85.75[2178]

DIMENSIONS IN INCHES, [ ] = MILLIMETERS

- [ ] NEMA 1
- [ ] NEMA 1A C/W DRIPHOOD
- [ ] 250A
- [ ] 400A
- [ ] 600A
- [ ] 800A
- [ ] 1000A
- [ ] 1200A

TRANSFER SWITCH CONFIGURATION

- [ ] -SL
- [ ] -SR
- [ ] -XL
- [ ] -XR

No.	REVISIONS	BY	AUTH	DATE
5	800-1200A KNOCKDOWN ENC.	RG	BB	98-09-23
4	250-600A KNOCK DOWN ENC	MH	BD	98-06-22
3	PRODUCTION UPDATES	JC	BD	98-03-06
2	UPDATED TO LATEST ST'D.	RG	NS	97-11-21
1	MODIFIED FOR TSC800	SN	NS	96-09-16

THOMSON ® TECHNOLOGY INC.

AUTOMATIC TRANSFER SWITCH
ENCLOSURE DIMENSIONS
MODEL TS 850T
250 - 1200A

CUSTOMER

CAD FILE NAME	DWN	AUTH	DATE
6B009001	SN	NS	96-09-16

DRAWING No.	SHEET	REV
6B009001	1/1	5

▽- NOTES

1 - FOR TRANSFER SWITCH OPTIONS SEE DRAWINGS 6B008301 or 6B008401 or 6B008501.

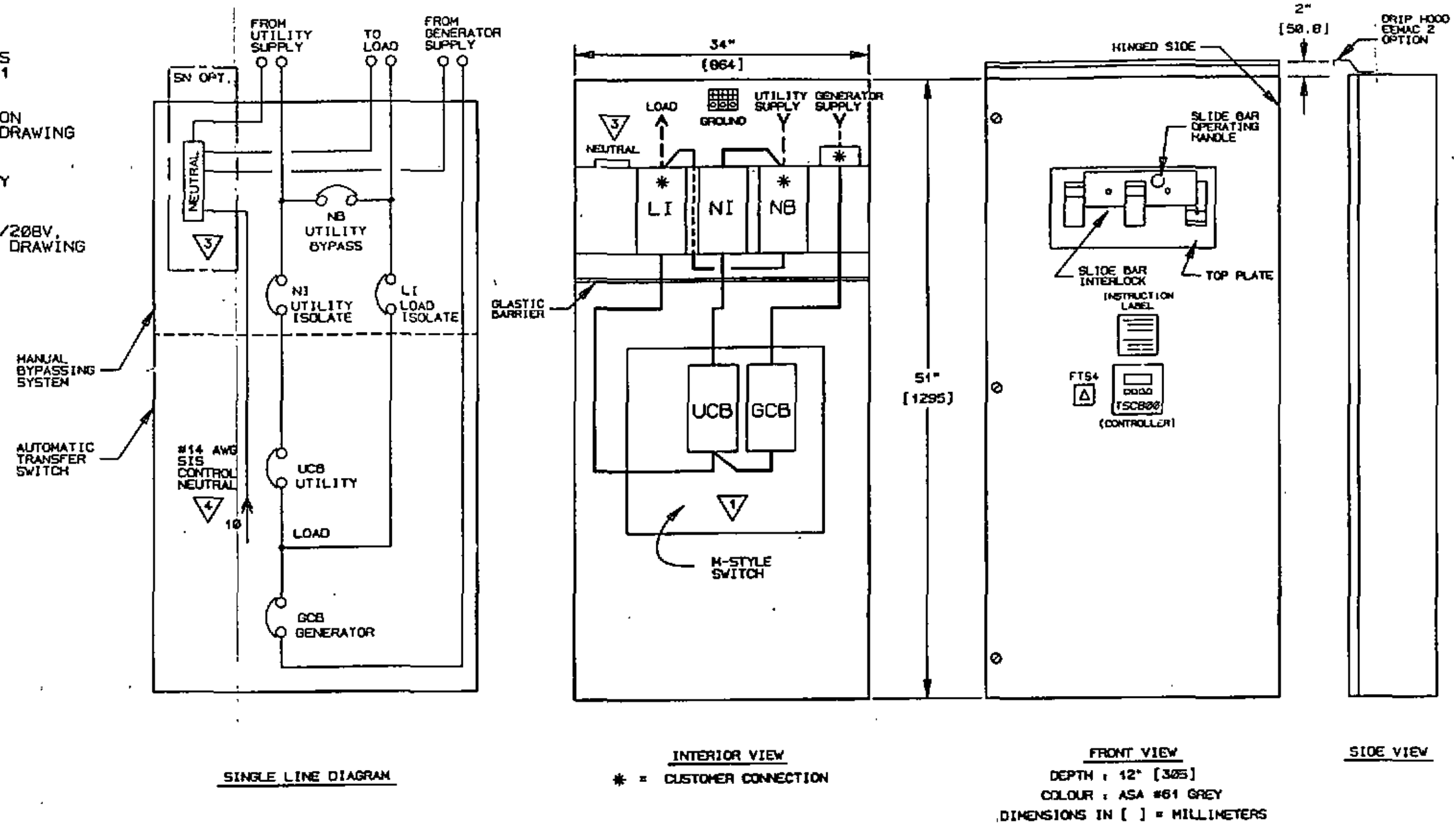
2 - FOR CLOSED TRANSITION UTILITY BYPASS SEE DRAWING 6B009104.

3 - NEUTRAL PRESENT ONLY ON 3 POLE VERSIONS.

4 - PRESENT ONLY ON 120/208V, 240V 1Ø UNITS. REF. DRAWING 6B008401.

BREAKER	BYPASS POSITION	NORMAL POSITION
NI		X
LI		X
NB	X	

X = BREAKER CLOSURE ALLOWED



OPTIONS INCLUDED IN BYPASS SWITCH	
ENCLOSURE OPTIONS	
-EEMAC 1	☐
-EEMAC 2 c/w DRIPHOOD & GASKETING	☐
SOLID NEUTRAL SN	☐
THREE POLE 3P	☐
FOUR POLE 4P	☐

AS BUILT BY/ AS BUILT DATE	TESTED BY

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

GROUND LUGS : 3 x 1C #6-2/0 Al/Cu (ALL UNITS).

NEUTRAL LUGS: FOR 3 POLE UNITS, 3 x 1C #6-2/0 Al/Cu.

LOAD, UTILITY & GENERATOR LUGS: (INCLUDING NEUTRAL LUGS IF 4 POLE) 1 x 1C #4-4/0 Cu ONLY PER POLE

N STYLE N-SIDE 100/150A 3 & 4 POLE

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

LEGEND	
—>—	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

THOMSON TECHNOLOGY INC.

1 LINE DIAGRAM & PHYSICAL LAYOUT
AUTOMATIC TRANSFER SWITCH AND 3 BREAKER UTILITY BYPASS SYSTEM

MODEL TSBU 85__-MCE-______-______ ______A, ______V, ____Ø, ____W, ____Hz

PROJECT:

SERIAL NUMBER

CUSTOMER

DATE	DWN	AUTH
96-09-18	SN	NS
DRAWING No.	SHEET	REV
6B009101	1/1	6

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

NOTES

1 - FOR TRANSFER SWITCH OPTIONS SEE DRAWINGS 6B008301 or 6B008401 or 6B008501.

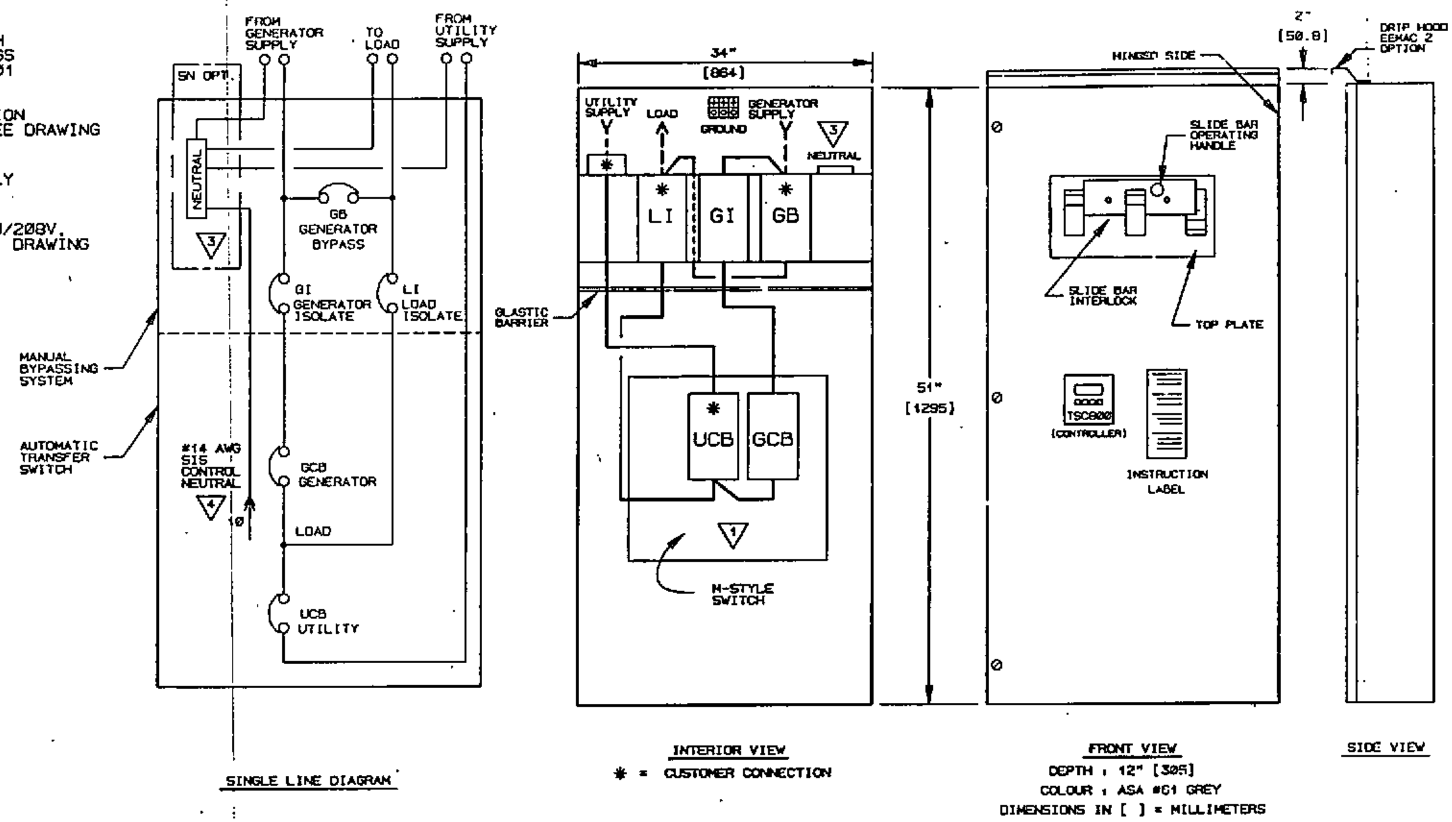
2 - FOR CLOSED TRANSITION GENERATOR BYPASS SEE DRAWING 6B009104.

3 - NEUTRAL PRESENT ONLY ON 3 POLE VERSIONS.

4 - PRESENT ONLY ON 120/208V, 240V 1Ø UNITS. REF. DRAWING 6B008401.

BREAKER	BYPASS POSITION	NORMAL POSITION
GI		X
LI		X
GB	X	

X = BREAKER CLOSURE ALLOWED



OPTIONS INCLUDED IN BYPASS SWITCH	
ENCLOSURE OPTIONS	
—EEMAC 1	☐
—EEMAC 2 c/w DRIPHOOD & GASKETING	☐
SOLID NEUTRAL SN	☐
THREE POLE 3P	☐
FOUR POLE 4P	☐

GROUND LUGS : 3 x 1C #6-2/0 Al/Cu (ALL UNITS). X #14

NEUTRAL LUGS: FOR 3 POLE UNITS: 3 x 1C #6-2/0 Al/Cu X #14

LOAD, UTILITY & GENERATOR LUGS: (INCLUDING NEUTRAL LUGS IF 4 POLE). 1 x 1C #1-4/0 Cu ONLY PER POLE

N STYLE G-SIDE 100/150A 3 & 4 POLE

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

AS BUILT BY/ AS BUILT DATE	TESTED BY

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND	
⟶	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

THOMSON TECHNOLOGY INC.

1 LINE DIAGRAM & PHYSICAL LAYOUT
AUTOMATIC TRANSFER SWITCH AND 3 BREAKER GENERATOR BYPASS SYSTEM

MODEL TS8G 85__-MCE-______-______ ______A, ______V, ____Ø, ____W, ____Hz

PROJECT:

SERIAL NUMBER

CUSTOMER

DATE	DWN	AUTH
96-09-18	SN	NS
DRAWING No.	SHEET	REV
6B009102	1/1	5

NOTES

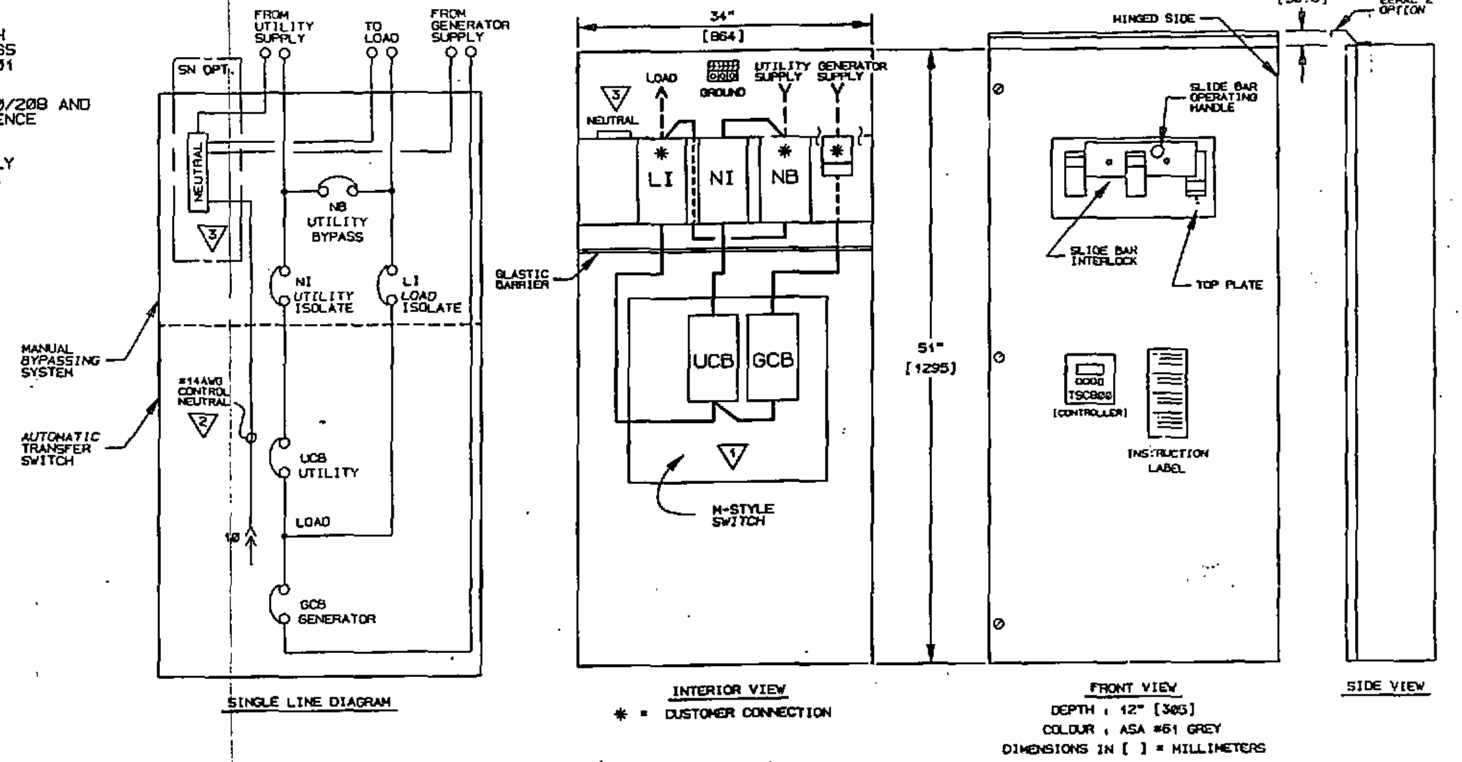
1 - FOR TRANSFER SWITCH OPTIONS SEE DRAWINGS 6B008301 or 3B008401 or 6B008501.

2 - ONLY PRESENT ON 120/208 AND 240 1Ø UNITS REFERENCE DRAWING 6B008401.

3 - NEUTRAL PRESENT ONLY ON 3 POLE VERSIONS.

BREAKER	BYPASS POSITION	NORMAL POSITION
NI		X
LI		X
NB	X	

X = BREAKER CLOSURE ALLOWED



OPTIONS INCLUDED IN BYPASS SWITCH	
ENCLOSURE OPTIONS	
-EEMAC 1	☐
-EEMAC 2 c/w DRIPHOOD & GASKETING	☐
SOLID NEUTRAL SN	☐
THREE POLE 3P	☐
FOUR POLE 4P	☐

GROUND LUGS : 3 x 1C #6-2/0 Al/Cu

NEUTRAL LUGS: 3 POLE UNITS: 3 x 1C #6-350MCM Al/Cu

GENERATOR LUGS: 1 x 1C #6-250MCM Al/Cu PER POLE

LOAD AND UTILITY LUGS, (INCLUDING NEUTRAL LUGS IF 4 POLE): 1 x 1C #3-350MCM Al/Cu PER POLE

AS BUILT BY/ AS BUILT DATE	TESTED BY

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND

→ ISOLATION PLUG

OPT. OPTIONAL ITEMS

N STYLE N-SIDE 250A 3 & 4 POLE

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

THOMSON TECHNOLOGY INC.

1 LINE DIAGRAM & PHYSICAL LAYOUT
AUTOMATIC TRANSFER SWITCH AND 3 BREAKER UTILITY BYPASS SYSTEM

MODEL TSBU 85 -MCJL-250 -

250 A, V, 3 Ø, W, Hz

PROJECT:

SERIAL NUMBER

CUSTOMER

DATE	DWN	AUTH
96-09-18	SN	NS
DRAWING No.	SHEET	REV
6B009103	1/1	3

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

NOTES

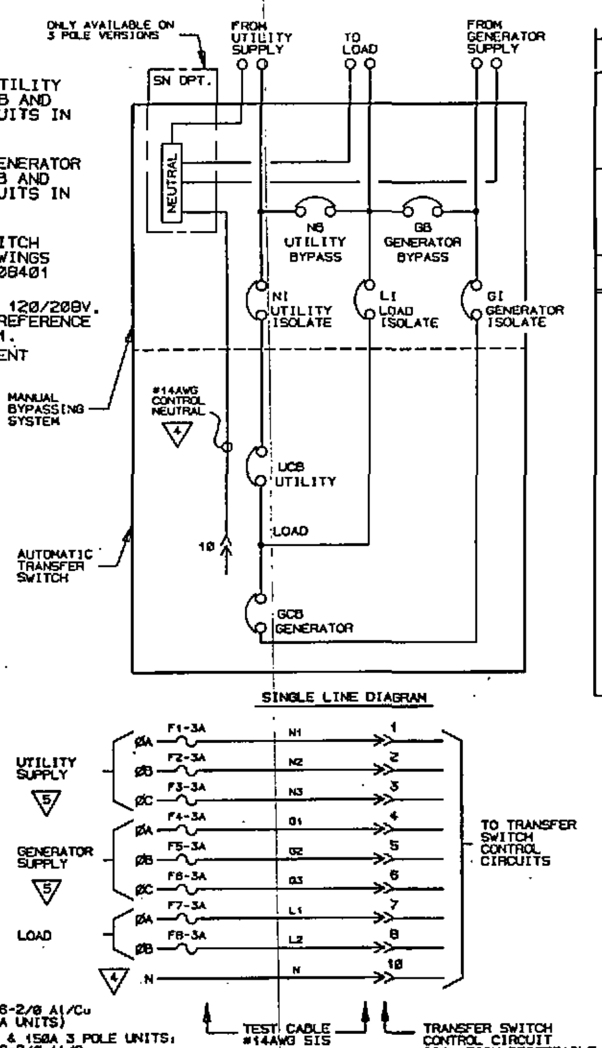
1 - FOR 4 BREAKER UTILITY BYPASS DELETE GB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

2 - FOR 4 BREAKER GENERATOR BYPASS DELETE NB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

3 - FOR TRANSFER SWITCH OPTIONS SEE DRAWINGS 68008301 or 68008401 or 68008501.

4 - PRESENT ONLY ON 120/208V. 240V 1Ø UNITS. REFERENCE DRAWING 68008401.

5 - C LINE NOT PRESENT ON 1Ø SYSTEMS.



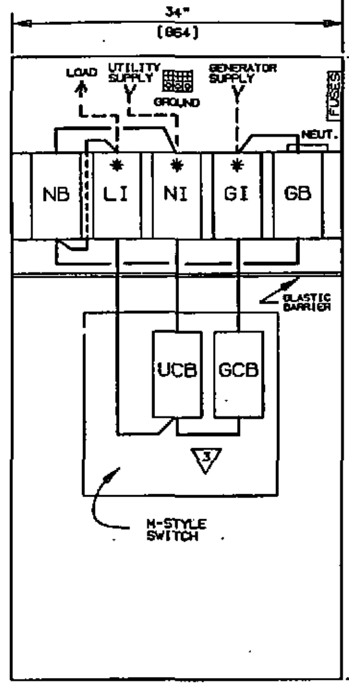
BREAKER	INTERLOCK BAR POSITION: UTILITY BYPASS 1	TRANSITION INTERLOCKING 2	3	4	GENERATOR BYPASS 5
NI		X	X		
NB	X	X			
LI		X	X	X	
GB				X	X
GI			X	X	

X = BREAKER CLOSURE ALLOWED

GROUND LUGS : 3 x 1C #6-2/0 Al/Cu (100-250A UNITS)

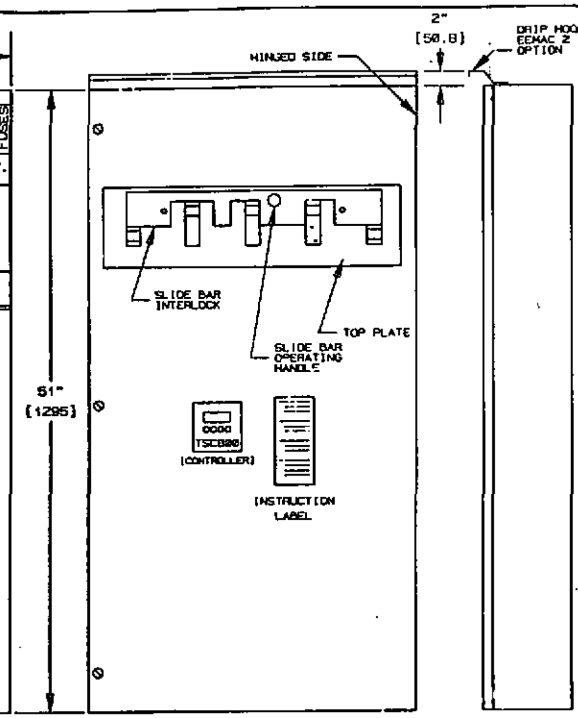
NEUTRAL LUGS: FOR 100A & 150A 3 POLE UNITS: 3 x 1C #6-2/0 Al/Cu
FOR 250A, 3 POLE UNITS: 3 x 1C #6-350MCM Al/Cu

LOAD, UTILITY & GENERATOR LUGS: (INCLUDING NEUTRAL LUGS IF 4 POLE) 1 x 1C #4-4/0 Cu ONLY PER POLE (100/150A UNITS)
1 x 1C #3-350MCM Al/Cu PER PHASE (250A, 3 POLE UNITS)



INTERIOR VIEW

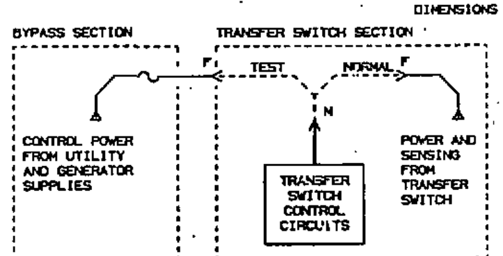
* = CUSTOMER CONNECTION



FRONT VIEW

DEPTH : 12" [305]
COLOUR : ASA #61 GREY
DIMENSIONS IN [ ] = MILLIMETERS

SIDE VIEW



CAUTION: WHEN THE TEST CABLE IS CONNECTED, THE TRANSFER SWITCH CONTROL CIRCUITS ARE LIVE! ONLY QUALIFIED PERSONNEL SHOULD PERFORM TEST!

N STYLE 100/150A 3&4P, 250A 3P ONLY

OPTIONS INCLUDED IN BYPASS SWITCH

ENCLOSURE OPTIONS
- EEMAC 1 ☐
- EEMAC 2 c/w DRIPHOOD & GASKETING ☐

SOLID NEUTRAL SN ☐

UTILITY 4 BREAKER BYPASS U4B (1) ☐

GENERATOR 4 BREAKER BYPASS G4B (2) ☐

THREE POLE 3P (ALL UNITS) ☐

FOUR POLE 4P (100/150A ONLY) ☐

AS BUILT BY/ AS BUILT DATE	TESTED BY

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND	
→≻	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

THOMSON TECHNOLOGY INC.

1 LINE DIAGRAM & PHYSICAL LAYOUT
AUTOMATIC TRANSFER SWITCH AND 5 BREAKER BYPASS SYSTEM

MODEL TS80 B5 __ -M ___ - ___ - ___ ___ A, ___ V, ___ Ø, ___ W, ___ Hz

PROJECT:

SERIAL NUMBER

CUSTOMER

DATE	DWN	AUTH
96-09-18	SN	NS
DRAWING No. 68009104	SHEET 1/1	REV 5

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

NOTES

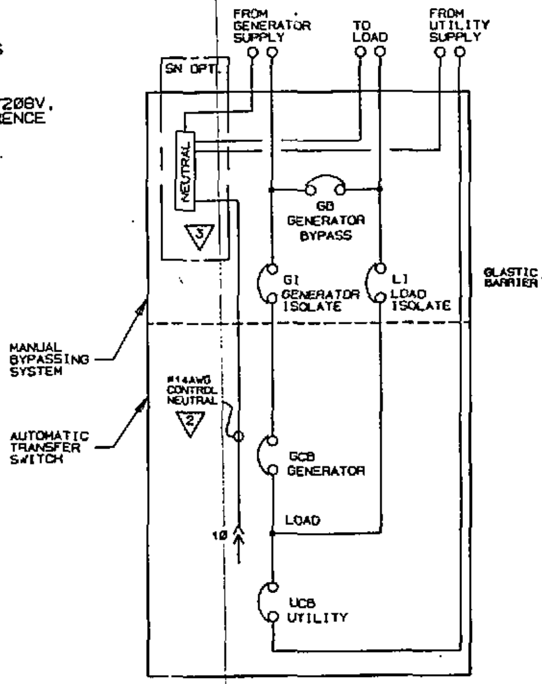
1 - FOR TRANSFER SWITCH OPTIONS SEE DRAWINGS 68008301 or 68008401 68008501.

2 - PRESENT ONLY ON 120/208V, 240V 1Ø UNITS, REFERENCE DRAWING 68008401.

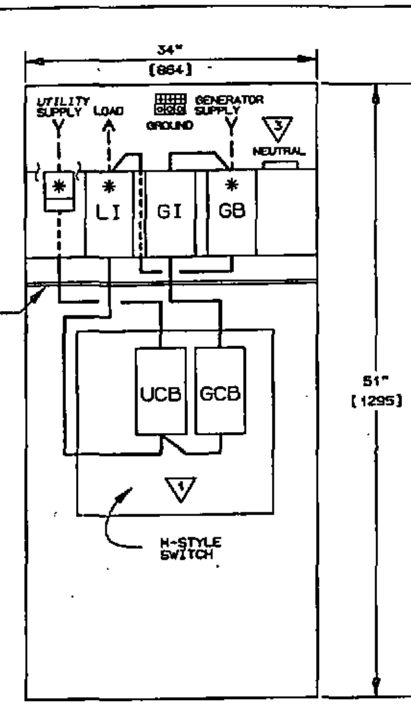
3 - NEUTRAL PRESENT ONLY ON 3 POLE VERSIONS.

BREAKER	BYPASS POSITION	NORMAL POSITION
GI		X
LI		X
GB	X	

X = BREAKER CLOSURE ALLOWED

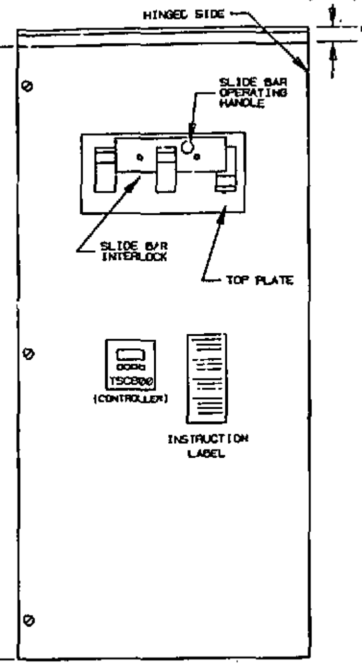


SINGLE LINE DIAGRAM



INTERIOR VIEW

* = CUSTOMER CONNECTION

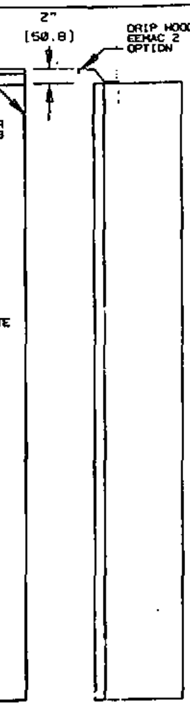


FRONT VIEW

DEPTH : 12" [305]

COLOUR : ASA #61 GREY

DIMENSIONS IN [ ] = MILLIMETERS



SIDE VIEW

OPTIONS INCLUDED IN BYPASS SWITCH	
ENCLOSURE OPTIONS	
-EEMAC 1	☐
-EEMAC 2 w/ DRIPHOOD & GASKETING	☐
SOLID NEUTRAL SN	☐
THREE POLE 3P	☐
FOUR POLE 4P	☐

GROUND LUGS : 3 x 1C #6-2/0 Al/Cu

NEUTRAL LUGS: 3 POLE UNITS; 3 x 1C #6-350MCM Al/Cu

UTILITY LUGS: 1 x 1C #6-250MCM Al/Cu PER POLE

LOAD AND GENERATOR LUGS: (INCLUDING NEUTRAL LUGS IF 4 POLE) 1 x 1C #3-350MCM Al/Cu PER POLE

H STYLE O-SIDE 250A 3 & 4 POLE

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

AS BUILT BY/ AS BUILT DATE	TESTED BY

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND	
→	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

PROJECT:

SERIAL NUMBER

CUSTOMER

DATE	DWN	AUTH
96-09-18	SN	NS
DRAWING No.	SHEET	REV
68009105	1/1	3

THOMSON TECHNOLOGY INC.

1 LINE DIAGRAM & PHYSICAL LAYOUT
AUTOMATIC TRANSFER SWITCH AND 3 BREAKER GENERATOR BYPASS SYSTEM

MODEL TSBG 85__-MCJL-250___-_______

250 A, ______V, __3 Ø, ___W, ___Hz

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

1

NOTES

1 - BYPASS SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED THROUGH A SLIDE BAR INTERLOCK. BYPASS IS CLOSED(OR OPEN) TRANSITION (SEE CHART AT RIGHT).

2 - TRANSFER SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED SO THAT ONLY ONE BREAKER IS CLOSED AT A TIME.

3 - FOR 4 BREAKER UTILITY BYPASS, DELETE GB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

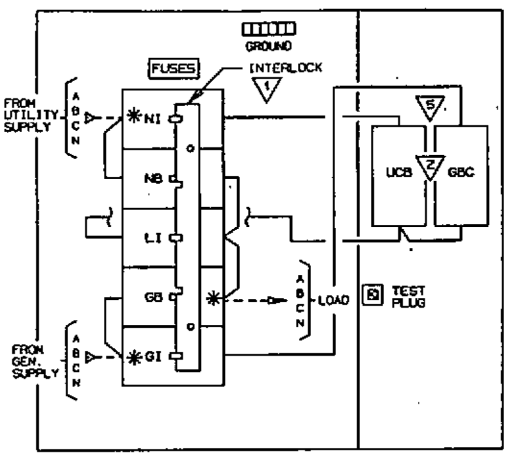
4 - FOR 4 BREAKER GENERATOR BYPASS DELETE NB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

5 - FOR TRANSFER SWITCH OPTIONS SEE DRAWINGS 6B008301 or 6B008401 or 6B008501.

6 - PRESENT ONLY ON 120/208V, 240V 1Ø UNITS, REFERENCE DRAWING 6B008401.

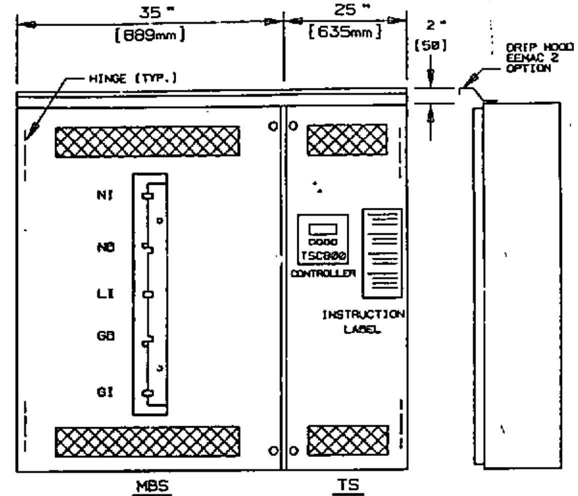
BREAKER	INTERLOCK POSITION: UTILITY BYPASS	TRANSITION INTERLOCKING			GENERATOR BYPASS
	1	2	3	4	5
NI		X	X		
NB	X	X			
LI		X	X	X	
GB				X	X
GI			X	X	

X = BREAKER CLOSURE ALLOWED



INTERIOR VIEW

* = CUSTOMER CONNECTION

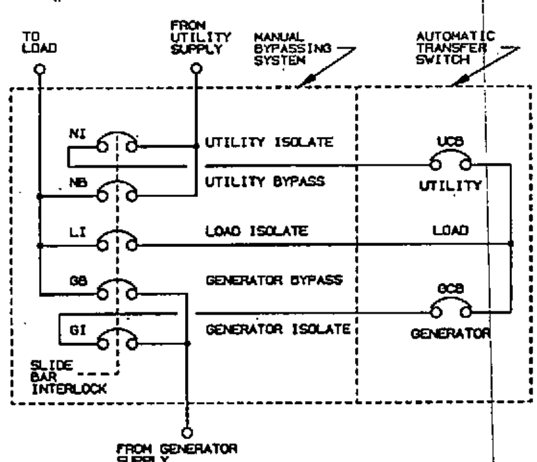


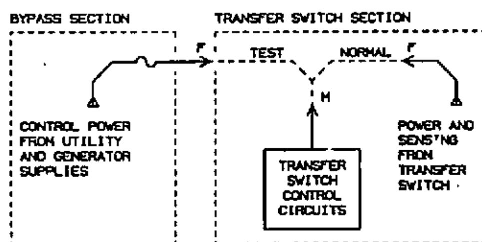
FRONT VIEW

SIDE VIEW

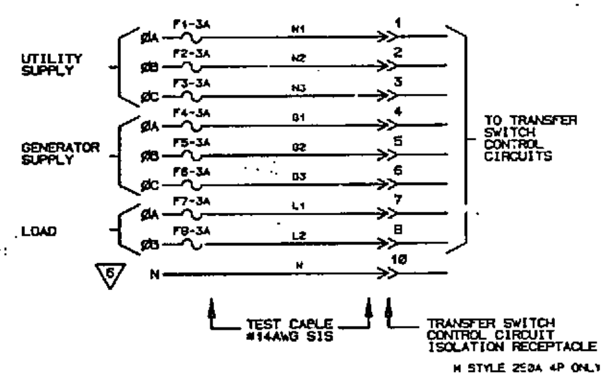
ENCLOSURE DATA	
HEIGHT:	66" [1676mm]
WIDTH:	60" [1524mm]
DEPTH:	14" [356mm] (INCLUDING 1" [25.4mm] DOOR)
COLOUR:	ASA #61 GREY

CONNECTION DATA	
GROUND LUGS:	6 x 1C #6-2/0 Al./Cu.
LOAD, UTILITY & GENERATOR LUGS:	1 x 1C #3-350MCM Al/Cu PER POLE.





CAUTION: WHEN THE TEST CABLE IS CONNECTED, THE TRANSFER SWITCH CONTROL CIRCUITS ARE LIVE! ONLY QUALIFIED PERSONNEL SHOULD PERFORM TEST!



OPTIONS INCLUDED IN BYPASS SWITCH

ENCLOSURE OPTIONS
- EEMAC 1 ☐
- EEMAC 2 c/w DRIPHOOD & GASKETING ☐

FOUR POLE 4P ☒

UTILITY 4 BREAKER BYPASS U4B (3) ☐

GENERATOR 4 BREAKER BYPASS G4B (4) ☐

AS BUILT BY/ AS BUILT DATE	TESTED BY

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND	
→–	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

PROJECT:

SERIAL NUMBER

CUSTOMER

DATE	DWN	AUTH
96-09-18	SN	NS
DRAWING No.	SHEET	REV
6B009106	1/1	3

THOMSON TECHNOLOGY INC.

1 LINE DIAGRAM & PHYSICAL LAYOUT
AUTOMATIC TRANSFER SWITCH AND 5 BREAKER BYPASS SYSTEM

MODEL TSBD 854-MCJL-250__ - ________ | 250 A, ____ V, 3 Ø, ____ W, ____ Hz

NOTES

1 - IF SN OPTION IS USED THEN BOTH NEUTRAL BLOCKS MUST BE ELECTRICALLY CONNECTED.

2 - TRANSFER SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED SO THAT ONLY ONE BREAKER IS CLOSED AT A TIME.

3 - BYPASS SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED THROUGH A SLIDE BAR INTERLOCK. BYPASS SWITCH IS OPEN TRANSITION (SEE CHART BELOW).

4 - FOR TRANSFER SWITCH OPTIONS SEE DRAWINGS 68008601 or 68008701 68008801.

5 - TRANSFER SWITCH BUILT IN CONFIGURATION "SL".

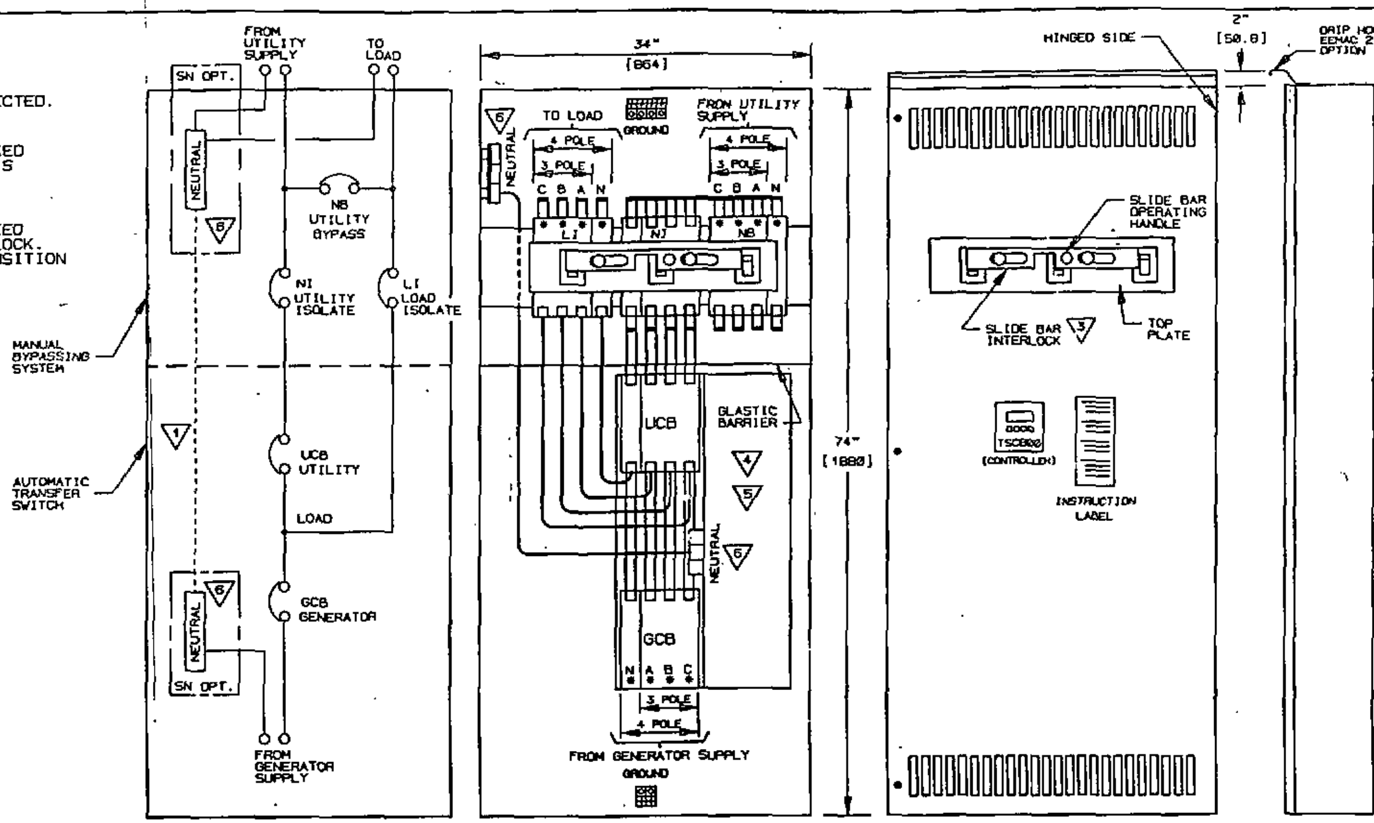
6 - NEUTRALS PRESENT ONLY ON 3 POLE VERSIONS.

BREAKER	BYPASS POSITION	NORMAL POSITION
NI		X
LI		X
NB	X	

X = BREAKER CLOSURE ALLOWED

GROUND LUGS: FOR 400A UNITS; 3 x 1C #6-2/0 Al/Cu.
FOR 600A UNITS; 6 x 1C #6-250MCM Al/Cu.

LOAD, UTILITY & GENERATOR LUGS: (INCLUDING NEUTRAL LUGS IF 4 POLE) FOR 400 & 600A UNITS; 1 x 1C 2/0-500MCM Cu or 2C 2/0-350MCM Cu or 2C 4/0-500MCM Al PER POLE.



SINGLE LINE DIAGRAM

INTERIOR VIEW

* = CUSTOMER CONNECTION

FRONT VIEW

DEPTH : 12" [305]
COLOUR : ASA #61 GREY
DIMENSIONS IN [ ] = MILLIMETERS

SIDE VIEW

OPTIONS INCLUDED IN BYPASS SWITCH

ENCLOSURE OPTIONS
- EEMAC 1 ☐
- EEMAC 2 c/w DRIPHOOD & GASKETING ☐

SOLID NEUTRAL SN ☐

THREE POLE 3P (ALL UNITS) ☐

FOUR POLE 4P (400/600A ONLY) ☐

TRANSFER SWITCH CONFIGURATION
- SL ☐
- SR ☐
- XL ☐
- XR ☐

AS BUILT BY/ AS BUILT DATE	TESTED BY

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND
- ISOLATION PLUG
- OPT. OPTIONAL ITEMS

T STYLE N-SIDE 400/600A 3 & 4 P.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

PROJECT:

SERIAL NUMBER:

CUSTOMER

THOMSON TECHNOLOGY INC.

1 LINE DIAGRAM & PHYSICAL LAYOUT
AUTOMATIC TRANSFER SWITCH AND 3 BREAKER UTILITY BYPASS SYSTEM

MODEL TSBU 85__-T____-____-____ ____A, ____V, ____Ø, ____W, ____Hz

DATE	DWN	AUTH
96-09-18	SN	NS
DRAWING No. 68009201	SHEET 1/1	REV 2

NOTES

1 - IF SN OPTION IS USED THEN BOTH NEUTRAL BLOCKS MUST BE ELECTRICALLY CONNECTED.

2 - TRANSFER SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED SO THAT ONLY ONE BREAKER IS CLOSED AT A TIME.

3 - BYPASS SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED THROUGH A SLIDE BAR INTERLOCK. BYPASS SWITCH IS OPEN TRANSITION (SEE CHART BELOW).

4 - FOR TRANSFER SWITCH OPTIONS SEE DRAWINGS 6B008601 or 6B008701 6B008801.

5 - TRANSFER SWITCH BUILT IN CONFIGURATION "XL".

6 - NEUTRALS PRESENT ONLY ON 3 POLE VERSIONS.

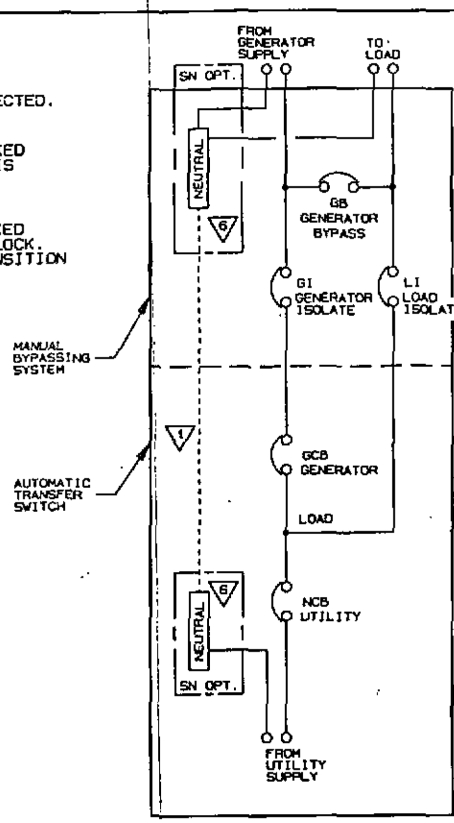
BREAKER	BYPASS POSITION	NORMAL POSITION
GI		X
LI		X
GB	X	

X = BREAKER CLOSURE ALLOWED

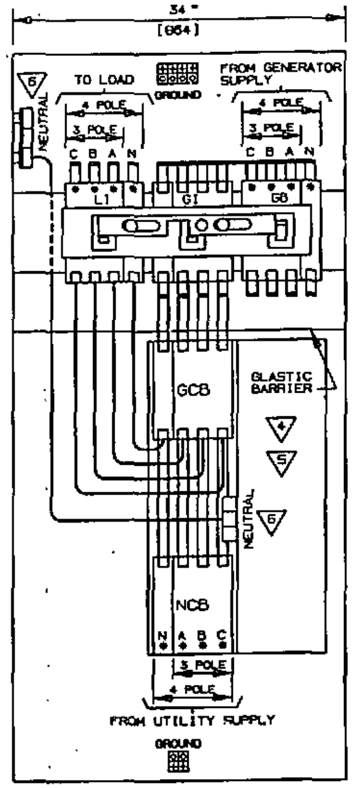
GROUND LUGS: FOR 400A UNITS; 3 x 1C #6-2/0 Al/Cu.

FOR 600A UNITS; 6 x 1C #6-250MCM Al/Cu.

LOAD, UTILITY & GENERATOR LUGS; (INCLUDING NEUTRAL LUGS IF 4 POLE) FOR 400 & 600A UNITS; 1 x 1C 2/0-500MCM Cu or 2C 2/0-350MCM Cu or 2C 4/0-500MCM Al PER POLE.

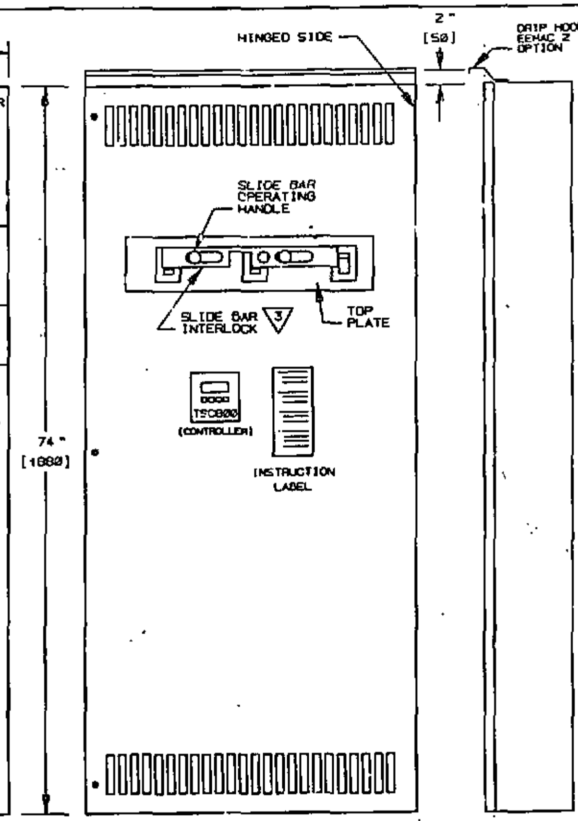


SINGLE LINE DIAGRAM



INTERIOR VIEW

✱ = CUSTOMER CONNECTION



FRONT VIEW

DEPTH : 12" [305]

COLOUR : ASA #61 GREY

DIMENSIONS IN [ ] = MILLIMETERS

SIDE VIEW

OPTIONS INCLUDED IN BYPASS SWITCH

ENCLOSURE OPTIONS
- -EEMAC 1 ☐
- -EEMAC 2 c/w DRIPHOOD & GASKETING ☐

SOLID NEUTRAL SN ☐

THREE POLE 3P (ALL UNITS) ☐

FOUR POLE 4P (400/600A ONLY) ☐

TRANSFER SWITCH CONFIGURATION
- -SL ☐
- -SR ☐
- -XL ☐
- -XR ☐

AS BUILT BY/ AS BUILT DATE	TESTED BY

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND

→ ISOLATION PLUG

OPT. OPTIONAL ITEMS

T STYLE 0-SIDE 400/600A 3 & 4 P.

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

PROJECT:

SERIAL NUMBER

CUSTOMER

DATE	DWN	AUTH
96-09-18	SN	NS
DRAWING No.	SHEET	REV
6B009202	1/1	2

THOMSON TECHNOLOGY INC.

1 LINE DIAGRAM & PHYSICAL LAYOUT
AUTOMATIC TRANSFER SWITCH AND 3 BREAKER GENERATOR BYPASS SYSTEM

MODEL TSBG B5__-T___-____-_____ ____A, ____V, ___Ø, ___W, ___Hz

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

NOTES

1 - BYPASS SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED THROUGH A SLIDE BAR INTERLOCK. BYPASS IS CLOSED(OR OPEN) TRANSITION (SEE CHART AT RIGHT).

2 - TRANSFER SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED SO THAT ONLY ONE BREAKER IS CLOSED AT A TIME.

3 - FOR 4 BREAKER UTILITY BYPASS, DELETE GB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

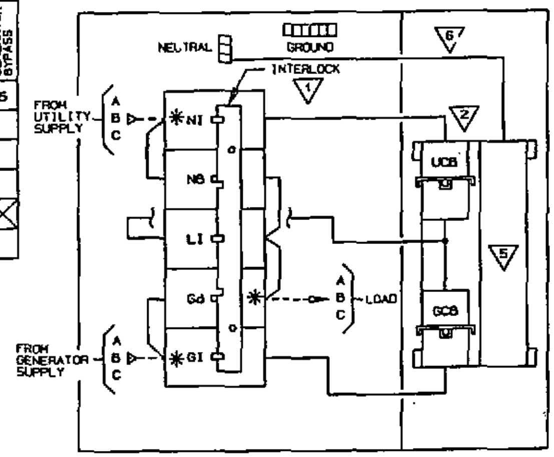
4 - FOR 4 BREAKER GENERATOR BYPASS DELETE NB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

5 - FOR TRANSFER SWITCH OPTIONS SEE DRAWINGS 6B008601 or 6B008701 6B008801.

6 - NEUTRAL CONTROL *REQUIRED* ON 120/208/240V 3 POLE MODELS SEE DRAWING 6B008701.

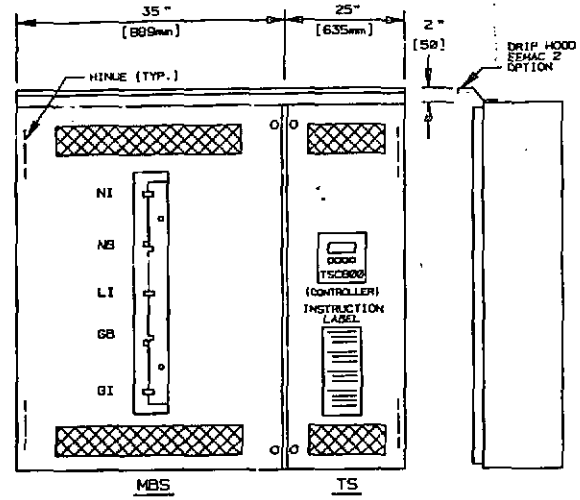
BREAKER	INTERLOCK POSITION: UTILITY BYPASS 1	TRANSITION INTERLOCKING 2	TRANSITION INTERLOCKING 3	TRANSITION INTERLOCKING 4	GENERATOR BYPASS 5
NI		X	X		
NB	X	X			
LI		X	X	X	
GB				X	X
GI			X	X	

X = BREAKER CLOSURE ALLOWED



INTERIOR VIEW

✱ = CUSTOMER CONNECTION



FRONT VIEW

SIDE VIEW

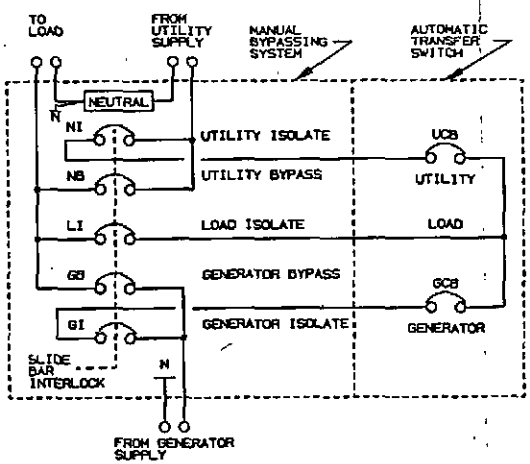
ENCLOSURE DATA

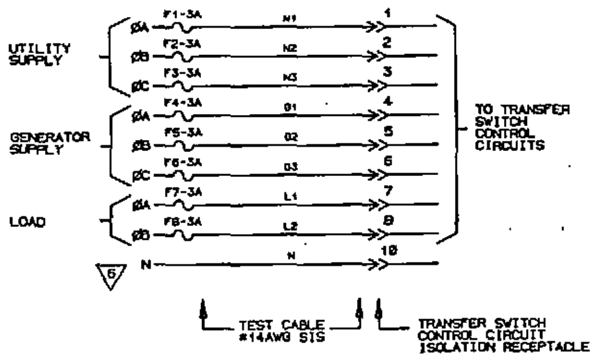
HEIGHT: 66" [1676mm]
WIDTH: 60" [1524mm]
DEPTH: 14" [356mm] (INCLUDING 1" [25.4mm] DOOR)
COLOUR: ASA #61 GREY

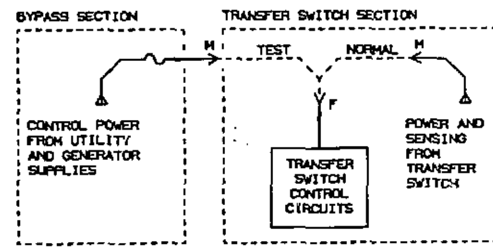
CONNECTION DATA

GROUND LUGS: FOR 400A UNITS; 6 x 1C #6-2/0 Al/Cu
FOR 600A UNITS; 6 x 1C #6-250MCM Al/Cu

NEUTRAL, LOAD, UTILITY AND GENERATOR LUGS: FOR 400 & 600A UNITS; 1 x 1C 2/0-500MCM Cu or 2C 2/0-350MCM Cu or 2C 4/0-500MCM Al PER PHASE.







CAUTION: WHEN THE TEST CABLE IS CONNECTED, THE TRANSFER SWITCH CONTROL CIRCUITS ARE LIVE! ONLY QUALIFIED PERSONNEL SHOULD PERFORM TEST!

† STYLE 403/600A 3 POLE ONLY

OPTIONS INCLUDED IN BYPASS SWITCH

ENCLOSURE OPTIONS
- –EEMAC 1 ☐
- –EEMAC 2 c/w DRIPHOOD & GASKETING ☐

SOLID NEUTRAL SN ☐

UTILITY 4 BREAKER BYPASS U4B (3) ☐

GENERATOR 4 BREAKER BYPASS G4B (4) ☐

THREE POLE 3P ☐

TRANSFER SWITCH CONFIGURATION
- –SL ☐
- –SR ☐
- –XL ☐
- –XR ☐

AS BUILT BY/ AS BUILT DATE	TESTED BY

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND	
➔	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

PROJECT:

SERIAL NUMBER

CUSTOMER

DATE	DWN	AUTH
96-09-18	SN	NS
DRAWING No. 6B009206	SHEET 1/1	REV 3

THOMSON TECHNOLOGY INC.

1 LINE DIAGRAM & PHYSICAL LAYOUT
AUTOMATIC TRANSFER SWITCH AND 5 BREAKER BYPASS SYSTEM

MODEL TSBD 853-TCJ-_______-_______ ______A, ______V, ____Ø, ____W, ____Hz

NOTES

1 - BYPASS SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED THROUGH A SLIDE BAR INTERLOCK. BYPASS IS CLOSED(OR OPEN) TRANSITION (SEE CHART AT RIGHT).

2 - TRANSFER SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED SO THAT ONLY ONE BREAKER IS CLOSED AT A TIME.

3 - FOR 4 BREAKER UTILITY BYPASS, DELETE GB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

4 - FOR 4 BREAKER GENERATOR BYPASS, DELETE NB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

5 - FOR TRANSFER SWITCH OPTIONS SEE DRAWINGS 6B008601 or 6B008701 .6B008801.

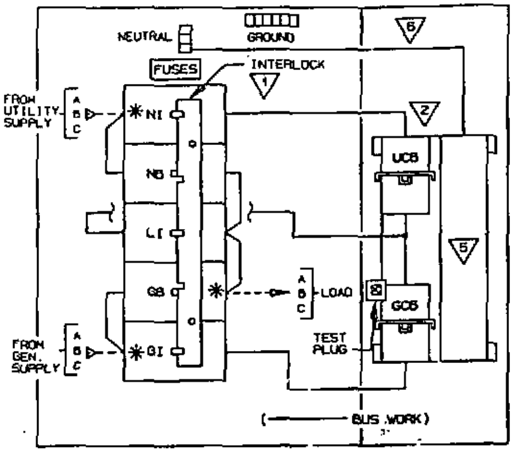
6 - NEUTRAL CONTROL REQUIRED ON 120/208/240V 3 POLE MODELS REFERENCE DRAWING 6B008701.

7 - FOR 3 BREAKER UTILITY BYPASS, DELETE GB, GI AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

8 - FOR 3 BREAKER GENERATOR BYPASS DELETE NB, NI AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

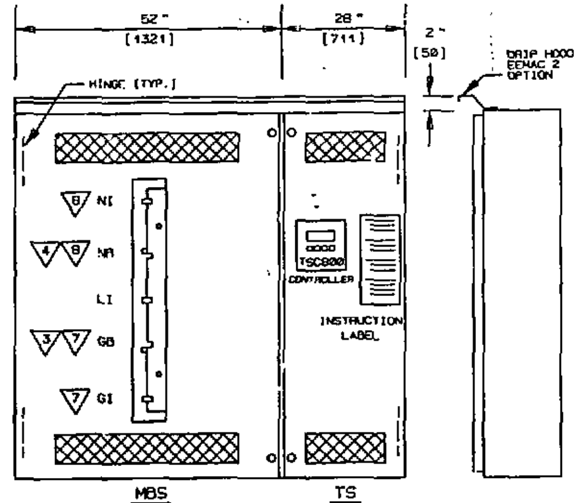
BREAKER	INTERLOCK POSITION: UTILITY BYPASS 1	TRANSITION INTERLOCKING 2	3	4	GENERATOR BYPASS 5
NI		X	X		
NB	X	X			
LI		X	X	X	
GB				X	X
GI			X	X	

X = BREAKER CLOSURE ALLOWED



INTERIOR VIEW

✱ = CUSTOMER CONNECTION



FRONT VIEW

SIDE VIEW

ENCLOSURE DATA

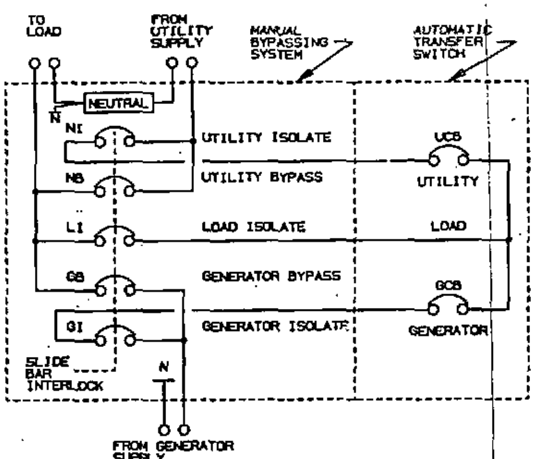
HEIGHT: 74" [1880mm]
WIDTH: 80" [2032mm]
DEPTH: 17" [432mm] (INCLUDING 1" [25.4mm] DOOR)
COLOUR: ASA #61 GREY

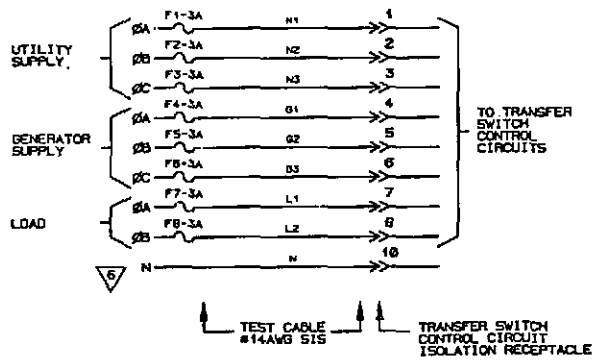
CONNECTION DATA

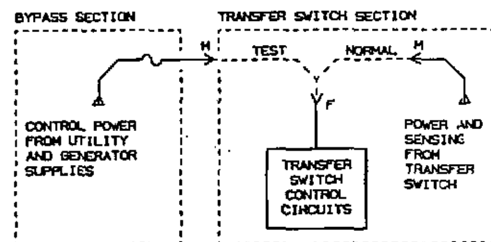
SUPPLY/LOAD: FOR 800A UNITS; 1 - 3C 2/0-400MCM Al/Cu PER PHASE
FOR 1000 & 1200A UNITS; 1 - 4C 3/0-500MCM Al/Cu PER PHASE

NEUTRAL: FOR 800A UNITS; 3 - 3C 2/0-400MCM Al/Cu
FOR 1000 & 1200A UNITS; 3 - 4C 3/0-500MCM Al/Cu

GROUND: 9 - 1C #6-250MCM Al/Cu ALL UNITS







CAUTION: WHEN THE TEST CABLE IS CONNECTED, THE TRANSFER SWITCH CONTROL CIRCUITS ARE LIVE!
ONLY QUALIFIED PERSONNEL SHOULD PERFORM TEST!

T STYLE 800A, 1000A, 1200A 3 POLE ONLY

OPTIONS INCLUDED IN BYPASS SWITCH

ENCLOSURE OPTIONS
- NEMA 1 ☐
- NEMA 2 c/w DRIPHOOD & GASKETING ☐

UTILITY 4 BREAKER BYPASS U4B (3) ☐
GENERATOR 4 BREAKER BYPASS G4B (4) ☐
UTILITY 3 BREAKER BYPASS U3B (7) ☐
GENERATOR 3 BREAKER BYPASS G3B (8) ☐

SOLID NEUTRAL SN ☐
THREE POLE 3P ☐

TRANSFER SWITCH CONFIGURATION
- SL ☐
- SR ☐
- XL ☐
- XR ☐

AS BUILT BY/ AS BUILT DATE	TESTED BY

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND	
⇾	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

PROJECT:
SERIAL NUMBER
CUSTOMER

DATE	DWN	AUTH
96-09-18	SN	NS
DRAWING No. 6B009207	SHEET 1/1	REV 4

THOMSON TECHNOLOGY INC.

1 LINE DIAGRAM & PHYSICAL LAYOUT
AUTOMATIC TRANSFER SWITCH AND BREAKER BYPASS SYSTEM

MODEL TSB_ 853-TCK-____-____ ____A, ____V, ____Ø, ____W, ____Hz

DRAWINGS SUBJECT TO CHANGE WITHOUT NOTICE.

NOTES

1 - BYPASS SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED THROUGH A SLIDE BAR INTERLOCK. BYPASS IS CLOSED(OR OPEN) TRANSITION (SEE CHART AT RIGHT).

2 - TRANSFER SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED SO THAT ONLY ONE BREAKER IS CLOSED AT A TIME.

3 - FOR 4 BREAKER UTILITY BYPASS, DELETE GB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

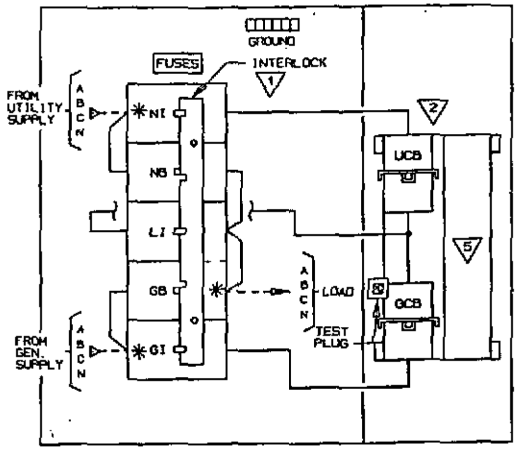
4 - FOR 4 BREAKER GENERATOR BYPASS DELETE NB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

5 - FOR TRANSFER SWITCH OPTIONS SEE DRAWINGS 6B008601 or 6B008701 6B008801.

6 - REQUIRED ONLY FOR 120/208V 240V 1Ø. SEE REEFERENCE DRAWING 6B008701.

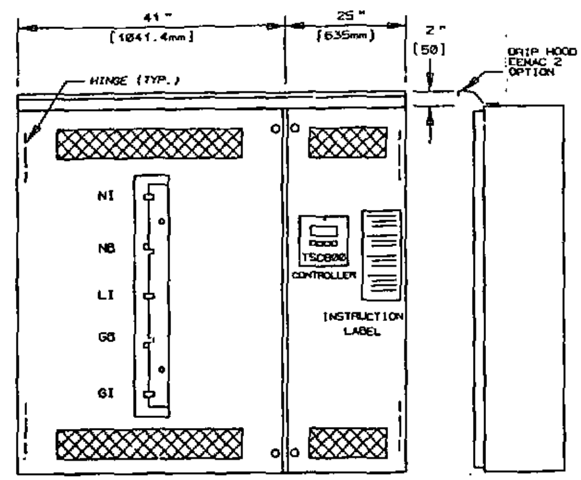
BREAKER	INTERLOCK POSITION: UTILITY BYPASS 1	TRANSITION INTERLOCKING 2	3	4	GENERATOR BYPASS 5
NI		X	X		
NB	X	X			
LI		X	X	X	
GB				X	X
GI			X	X	

X = BREAKER CLOSURE ALLOWED



INTERIOR VIEW

* = CUSTOMER CONNECTION



FRONT VIEW

SIDE VIEW

OPTIONS INCLUDED IN BYPASS SWITCH

ENCLOSURE OPTIONS
- EEMAC 1 ☐
- EEMAC 2 c/w DRIPHOOD & GASKETING ☐

FOUR POLE 4P ☒

UTILITY 4 BREAKER BYPASS U4B (3) ☐

GENERATOR 4 BREAKER BYPASS G4B (4) ☐

TRANSFER SWITCH CONFIGURATION
- SL ☐
- SR ☐
- XL ☐
- XR ☐

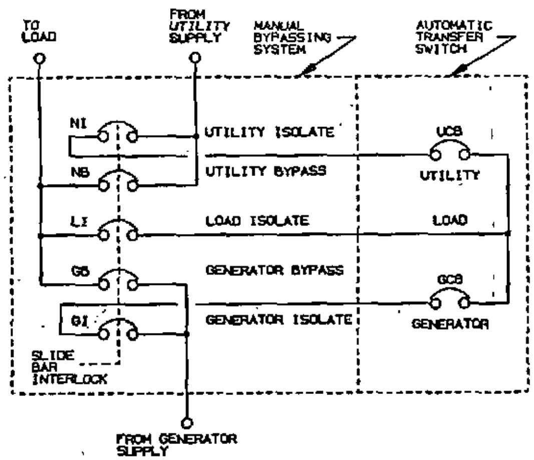
ENCLOSURE DATA

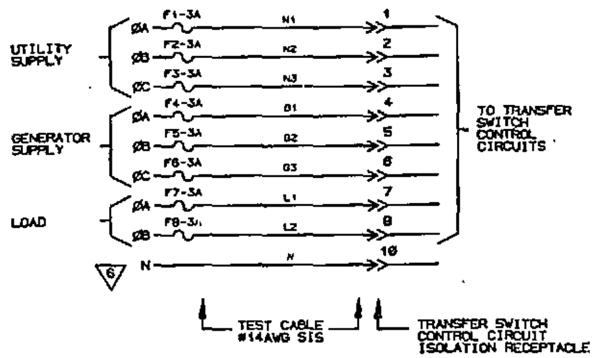
HEIGHT: 76" [1930mm]
WIDTH: 66" [1676mm]
DEPTH: 17" [432mm] [INCLUDING 1" [25.4mm] DOOR]
COLOUR: ASA #61 GREY

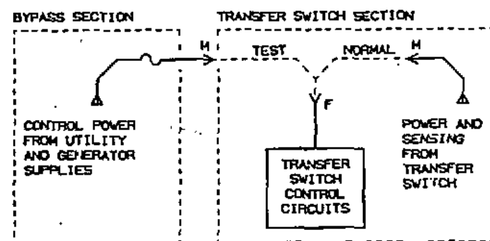
CONNECTION DATA

GROUND LUGS: FOR 400A UNITS: 6 x 1C #6-2/0 Al/Cu
FOR 600A UNITS: 6 x 1C #6-250MCM Al/Cu

LOAD, UTILITY & GENERATOR LUGS: FOR 400 & 600A UNITS: 1 x 1C 2/0-500MCM Cu or 2C 2/0-350MCM Cu or 2C 4/0-500MCM Al PER POLE







CAUTION: WHEN THE TEST CABLE IS CONNECTED, THE TRANSFER SWITCH CONTROL CIRCUITS ARE LIVE! ONLY QUALIFIED PERSONNEL SHOULD PERFORM TEST!

T STYLE 400/600A 4P ONLY

AS BUILT BY/ AS BUILT DATE	TESTED BY

REFER TO MANUAL FOR CABLE CONNECTION INFORMATION

LEGEND	
→	ISOLATION PLUG
OPT.	OPTIONAL ITEMS

THOMSON TECHNOLOGY INC.

1 LINE DIAGRAM & PHYSICAL LAYOUT
AUTOMATIC TRANSFER SWITCH AND 5 BREAKER BYPASS SYSTEM

MODEL TSBD B54-T___-______-______ | ___A, ___V, 3 Ø, ___W, ___Hz

PROJECT:

SERIAL NUMBER

CUSTOMER

DATE	DWN	AUTH
96-09-19	SN	NS
DRAWING No. 68009208	SHEET 1/1	REV 3

NOTES

1 – BYPASS SWITCH BREAKERS ARE MECHANICALLY INTERLOCKED THROUGH A SLIDE BAR INTERLOCK. BYPASS IS CLOSED(OR OPEN) TRANSITION (SEE CHART AT RIGHT).

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3 – FOR 4 BREAKER UTILITY BYPASS, DELETE GB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

4 – FOR 4 BREAKER GENERATOR BYPASS DELETE NB AND ASSOCIATED CIRCUITS IN BYPASS SWITCH.

5 – FOR TRANSFER SWITCH OPTIONS SEE SCHEMATIC DIAGRAM.

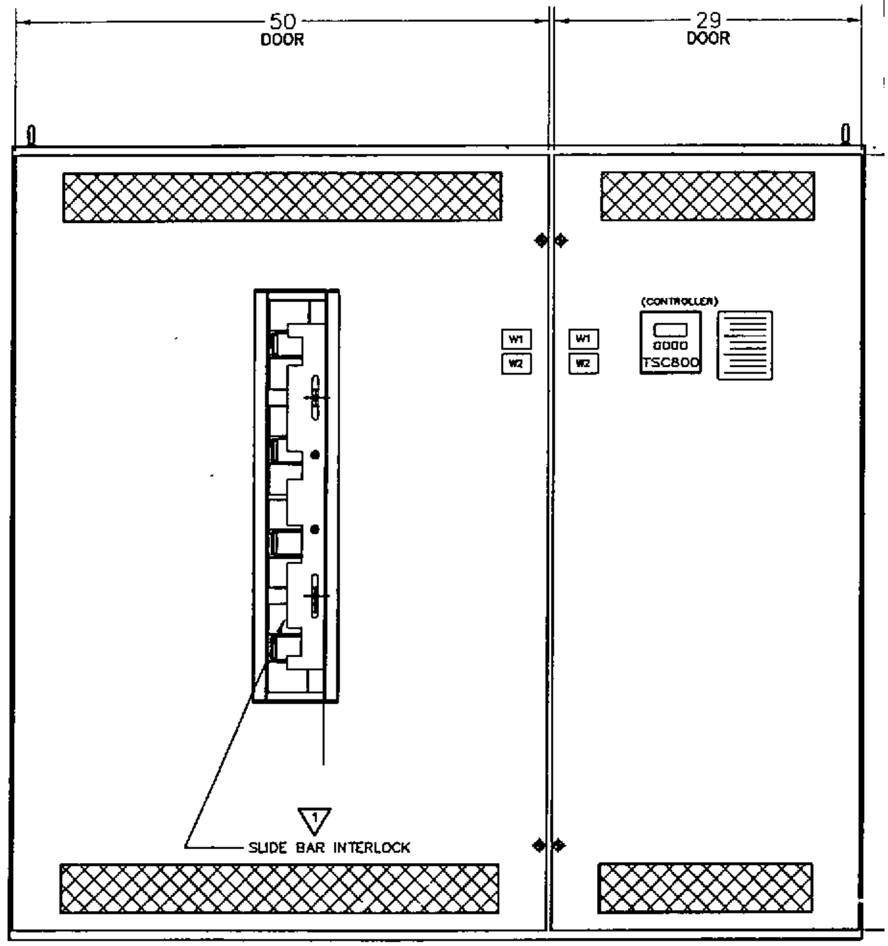
6 – NEUTRAL CONTROL REQUIRED ON 120/208/240V 1 OR 3 POLE MODELS.

BREAKER	INTERLOCK POSITION			
	UTILITY BYPASS	TRANSITION INTERLOCKING		
	1	2	3	4
NI		X	X	
NB	X	X		
LI		X	X	X
GI			X	X

X = BREAKER CLOSURE ALLOWED

CONNECTION DATA
SUPPLY/LOAD: FOR 800A UNITS:
1 – 3C 2/0–400MCM Al/Cu
PER PHASE / NEUTRAL

GROUND: FOR 800A UNITS:
9C #6–250MCM Al/Cu



FRONT VIEW

FOIL LABEL (TYPICAL)
SILVER LETTERS ON RED BACKGROUND

W1

WARNING
MORE THAN ONE LIVE CIRCUIT
SEE DIAGRAM

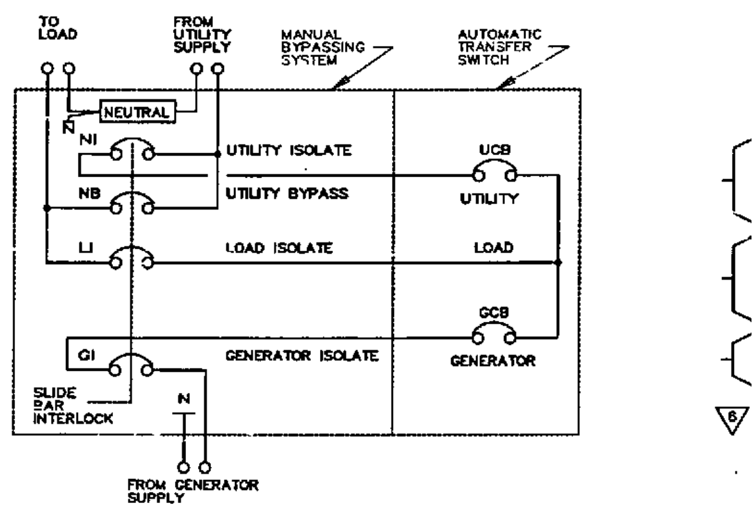
AVERTISSEMENT
PLUS D'UN CIRCUIT SOUS
TENSION VOIR SCHEMA

W2

WARNING
DISCONNECT ALL SOURCES OF
SUPPLY BEFORE SERVICING

AVERTISSEMENT
COUPER TOUTES LES SOURCES
D'ALIMENTATION AVANT DE FAIRE
L'ENTRETIEN ET LES REPARATIONS

STAND



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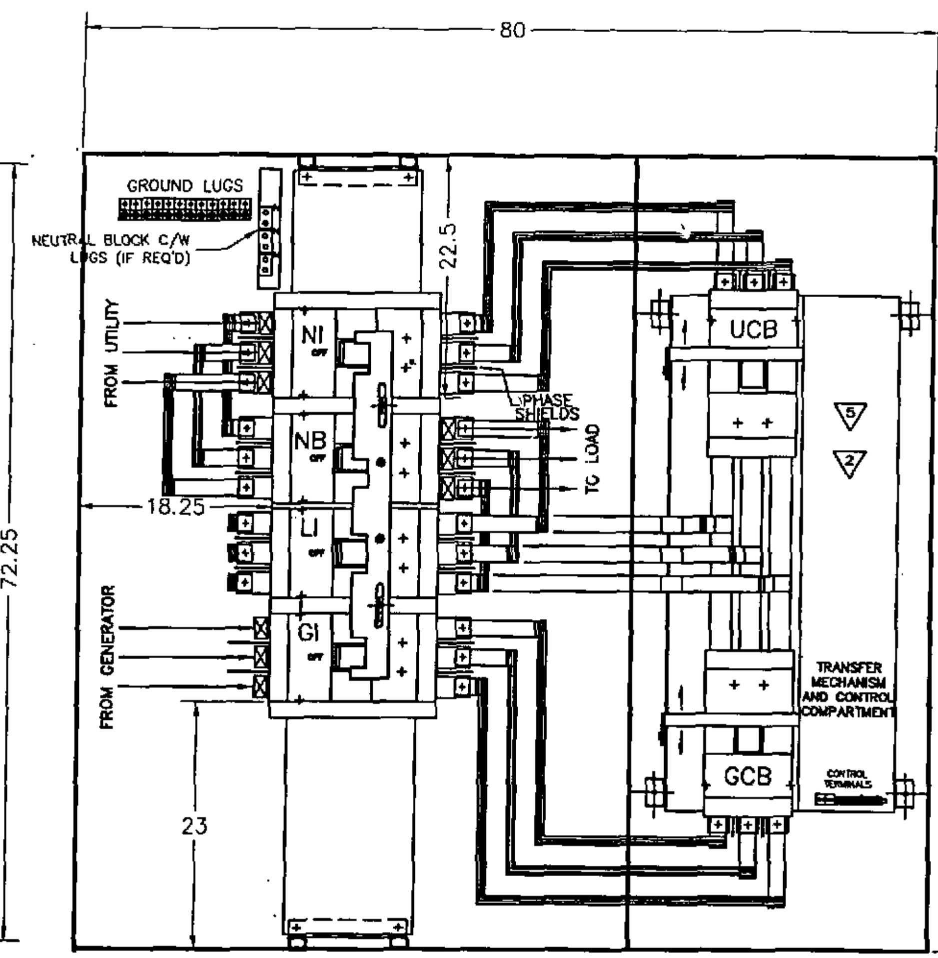
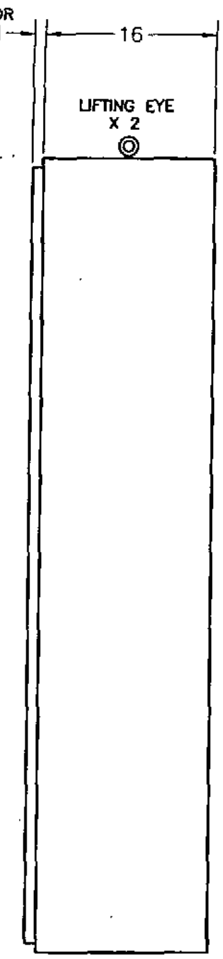
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS



INTERIOR VIEW (DOORS NOT SHOWN)



RHS VIEW

ENCLOSURE TYPE

- [X] NEMA 1
- [ ] NEMA 2 C/W DRIPHOOD

COLOUR: ASA-61 GREY

SIZE (AMPS)

- [X] 800A
- [ ] 1000A
- [ ] 1200A

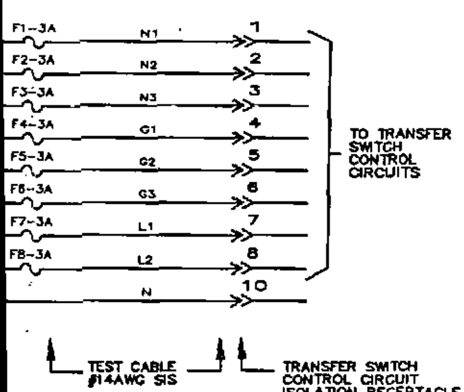
- [X] 3 POLE ONLY
- [X] SOLID NEUTRAL

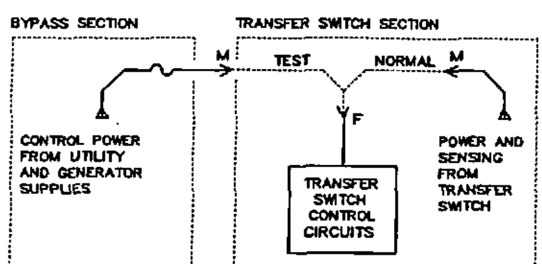
- [X] UTILITY 4 BREAKERS BYPASS (3)
- [ ] GENERATOR 4 BREAKERS BYPASS (4)

TRANSFER SWITCH CONFIGURATION

- [X] -SL
- [ ] -SR
- [ ] -XL
- [ ] -XR

RD 3Ø, 4W "SL" CONFIGURATION SHOWN





CAUTION: WHEN THE TEST CABLE IS CONNECTED, THE TRANSFER SWITCH CONTROL CIRCUITS ARE LIVE! ONLY QUALIFIED PERSONNEL SHOULD PERFORM TEST!

SPECIAL REQUIREMENTS:

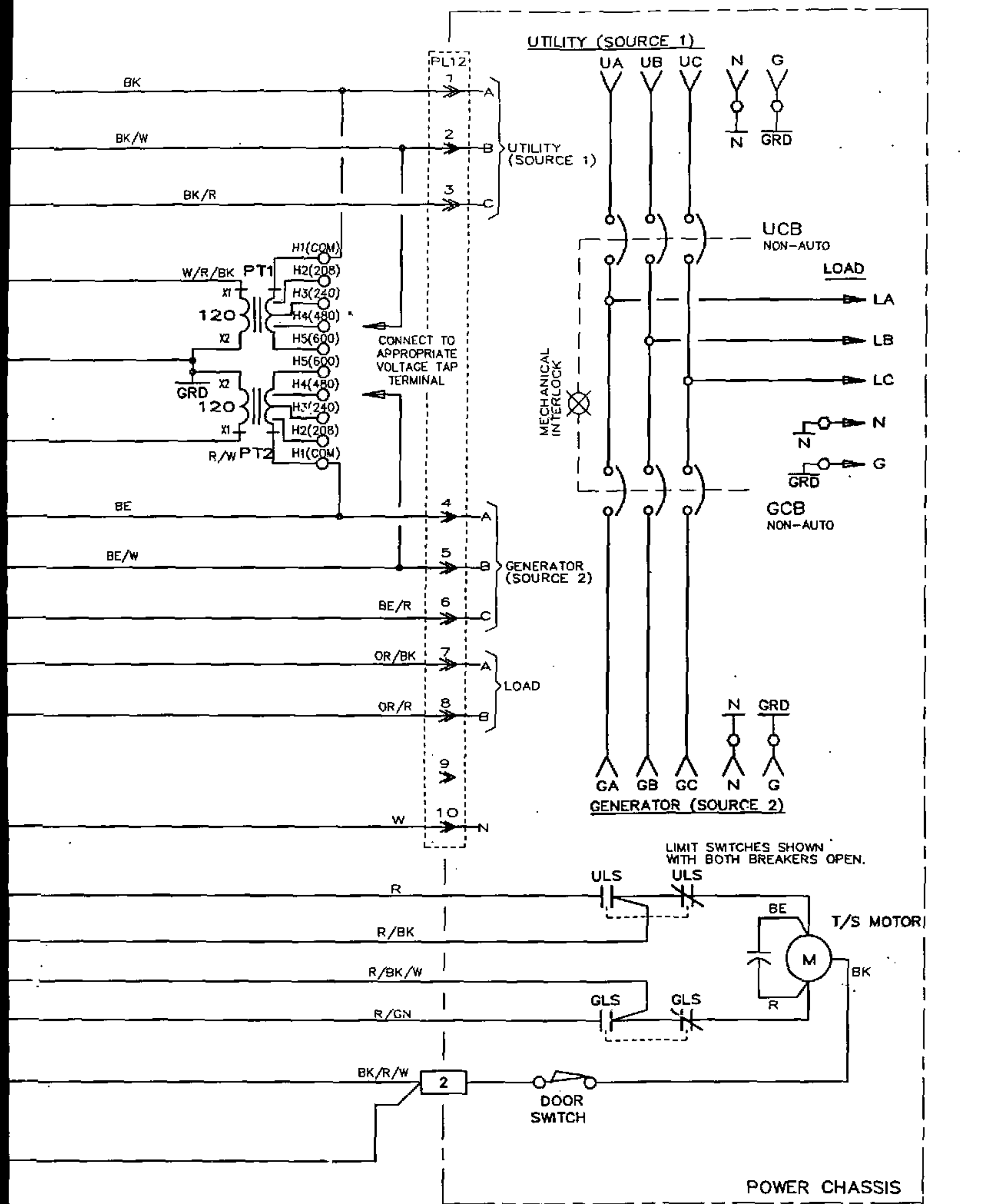
DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

BY	AUTH	DATE

THOMSON TECHNOLOGY INC.

ATS & 4 BREAKER BYPASS SYSTEM
MODEL TSBU-850
1-LINE DIAGRAM, LAYOUT & INSTALLATION DETAILS
800, 1000, 1200A

CUSTOMER			
DWN BY: SH	AUTH BY: BD	DATE: 00-09-11	REV: 0
DRAWING No.: ELB14444_01_01_01			SHEET: 1/2



FOR TSC800 CONTROLLER OPTIONS, REFER TO PROGRAMMING SHEETS

2 SYSTEM MUST UTILIZE A SOLIDLY GROUNDED NEUTRAL

COLOUR KEY	
BLACK	BK
BLUE	BE
BROWN	BN
GREEN	GN
GREY	GY
ORANGE	OR
PURPLE	PE
RED	R
WHITE	W
YELLOW	Y
SOLID/TRACER(S)	

DRAWINGS AND OR OTHER TECHNICAL INFORMATION SUPPLIED BY THOMSON TECHNOLOGY INC AS A PART OF A SALE OF EQUIPMENT ARE FOR THE PURCHASER'S USE SOLELY IN CONJUNCTION WITH THAT EQUIPMENT, UNLESS SPECIFICALLY AGREED TO OTHERWISE AS A PART OF THE TERMS OF SALE.

BY	AUTH	DATE

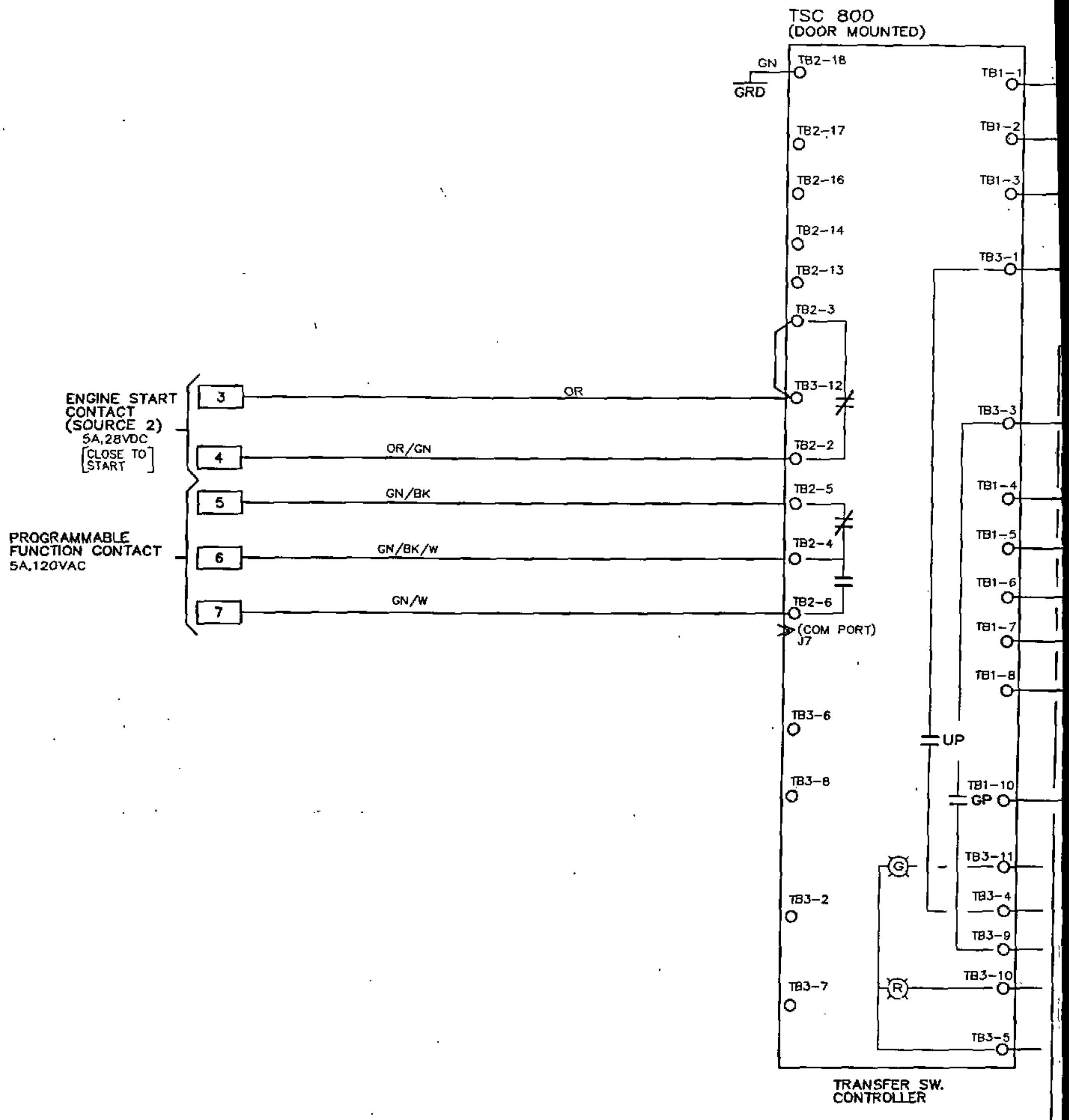
ttI ® THOMSON TECHNOLOGY INC.

SCHEMATIC DIAGRAM
AUTOMATIC TRANSFER SWITCH
MODEL TS 853-TCK-800A-208
800A, 208V, 3Ø 4W, 60Hz

CUSTOMER

DWN BY	AUTH BY	DATE	REV
SH	BD	00-09-11	0

DRAWING No.	SHEET
ELB14444_01_01_02	2/2



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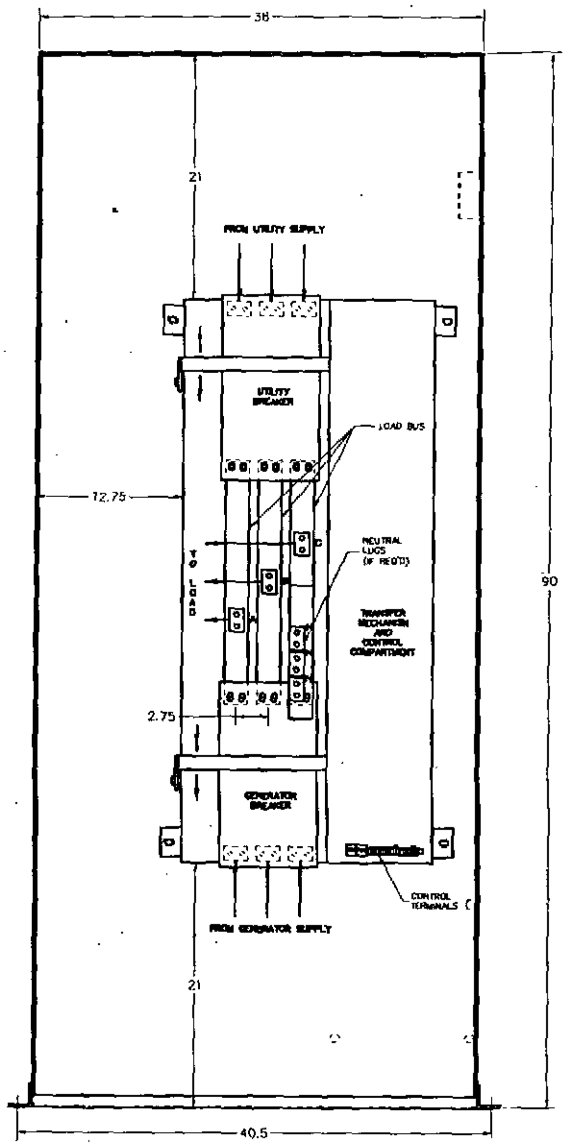
DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS



FRONT VIEW

DOOR NOT SHOWN

ENCLOSURE TYPE

- [ ] NEMA 3R (SINGLE DOOR)
- [X] NEMA 3R (DOUBLE DOOR)

SIZE (AMPS)

- [ ] 400A (S.E. ONLY)
- [ ] 600A (S.E. ONLY)
- [X] 800A
- [ ] 1000A
- [ ] 1200A

- [X] 3 POLE
- [ ] 4 POLE
- [X] SOLID NEUTRAL

TRANSFER SWITCH CONFIGURATION

- [X] -SL
- [ ] -SR
- [ ] -XL
- [ ] -XR

SPECIAL REQUIREMENTS:

MENSION	SINGLE DOOR	DOUBLE DOOR
A	14"	18"
B	N/A	14"
C	12"	16"

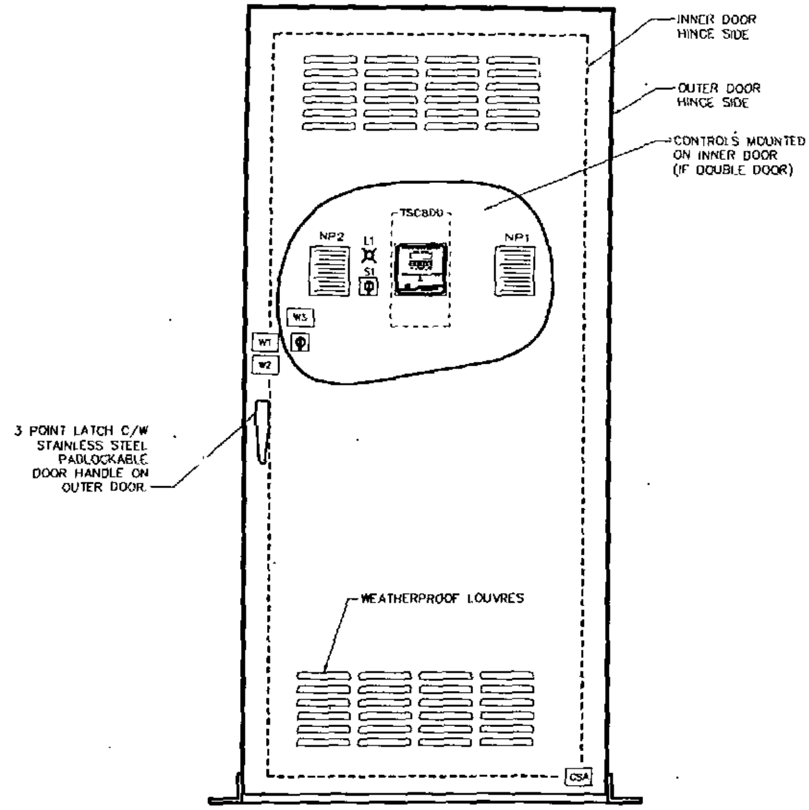
NOTE: STANDARD "SL" CONFIGURATION SHOWN:
UTILITY SUPPLY ON TOP, LOAD OUT LEFT;
3¢/4W SYSTEM WITH SOLIDLY GROUNDED NEUTRAL

	SH	BD	00-10-02
	SH	BD	00-06-07
	BY	AUTH	DATE

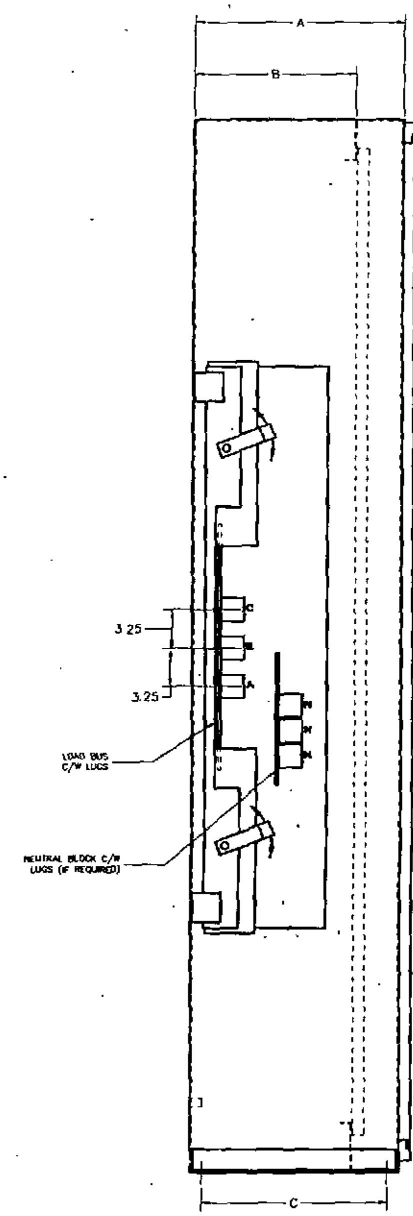
THOMSON TECHNOLOGY INC.

AUTOMATIC TRANSFER SWITCH
MODEL TS 850T
PHYSICAL LAYOUT AND INSTALLATION DETAILS

CUSTOMER			
DWN BY	AUTH BY	DATE	REV
SH	BD	00-04-26	2
DRAWING No.		SHEET	
ELB13985_01_01		1/3	



FRONT VIEW (TYPICAL)



LEFT SIDE VIEW

GROUND LUGS: FOR 800A UNITS:
9C #6–250MCM Al/Cu.
FOR 1000 & 1200A UNITS:
12C #6–250MCM Al/Cu.

LOAD, UTILITY & GENERATOR LUGS: FOR 800A UNITS:
1–3C 2/0–400MCM Al/Cu.
PER PHASE / NEUTRAL
FOR 1000 & 1200A UNITS:
1–4C 3/0–500MCM Al/Cu.
PER PHASE / NEUTRAL

FOIL LABEL (TYPICAL)
SILVER LETTERS ON RED BACKGROUND

W1

WARNING
MORE THAN ONE LIVE CIRCUIT
SEE DIAGRAM

AVERTISSEMENT
PLUS D'UN CIRCUIT SOUS
TENSION VOIR SCHEMA

W2

WARNING
DISCONNECT ALL SOURCES OF
SUPPLY BEFORE SERVICING

AVERTISSEMENT
COUPER TOUTES LES SOURCES
D'ALIMENTATION AVANT DE FAIRE
L'ENTRETIEN ET LES REPARATIONS

MATERIAL: 12GA. C.R.S. or H.R. P & O EXCEPT AS SPECIFIED.
CONSTRUCTION: FULLY WELDED, NEMA 3R, WEATHERPROOF.
FINISH: PAINTED EXTERIOR ENAMEL, ASA #61 GREY.

D

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AUTH. BY: __________ DATE: __________

		2	CHANGE TO 3 PHASE
		1	AS BUILT
DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS

P2

W3

WARNING

TO ENSURE SAFETY OF PERSONNEL, DOOR MUST BE LOCKED CLOSED WHEN USING THE "SERVICE DISCONNECT" SWITCH TO ISOLATE LOAD CIRCUITS.

FASTEN DOOR SECURELY WITH SCRWS BEFORE LOCKING

2X3/4 (TYPICAL)
WHITE LETTERS ON BLACK BACKGROUND

S1

SERVICE DISCONNECT

ENERGIZED DISCONNECTED

QTY =1

L1

SERVICE DISCONNECTED

QTY =1

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SH	BD	00-10-02
SH	BD	00-06-07
BY	AUTH	DATE

THOMSON TECHNOLOGY INC.

LABEL DETAILS
SERVICE ENTRANCE
TRANSFER SWITCH

CUSTOMER

DWN BY	AUTH BY	DATE	REV
SH	BD	00-04-28	2

DRAWING No. ELB13985_01_01 SHEET 2/3

FOIL LABEL
BLACK LETTERS ON
SILVER BACKGROUND

SERVICE DISCONNECT
INSTRUCTIONS

TO DISCONNECT UTILITY AND
GENERATOR SUPPLIES:

*MOVE SERVICE DISCONNECT SWITCH TO THE "DISCONNECTED" POSITION

*LOCK OFF SERVICE DISCONNECT SWITCH WITH SUITABLE PADLOCK

*VERIFY LOAD IS DISCONNECTED VIA ILLUMINATED "SERVICE DISCONNECTED" LIGHT. IF LIGHT IS NOT ILLUMINATED, REFER TO INSTRUCTION MANUAL

*LOCK ENCLOSURE DOOR CLOSED AND REMOVE KEY.

TO RE-ENERGIZE TRANSFER
SWITCH:

*REMOVE APPLICABLE PADLOCKS AND MOVE SERVICE DISCONNECT SWITCH BACK TO THE "ENERGIZED" POSITION

*REPLACE ENCLOSURE DOOR KEY IF FUTURE ACCESS REQUIRED.

*RESET TSC800 CONTROLLER IF DISPLAYING 'TRANSFER FAILURE'.

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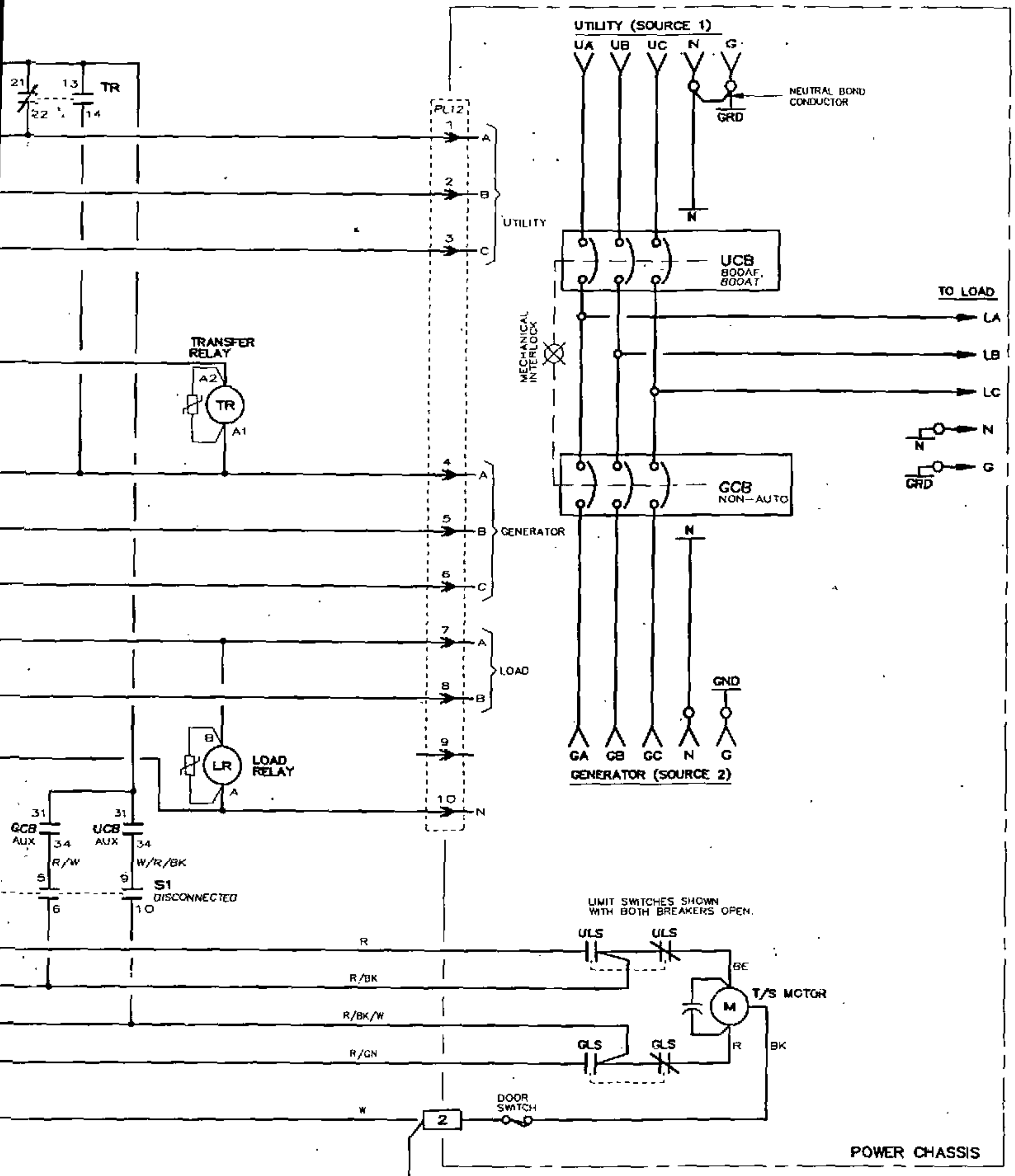
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ____________ DATE: ____________

		2	CHANGE TO 3 PHASE
		1	AS BUILT
DRAWING No	REFERENCE DRAWINGS	No.	REVISIONS



FOR TSC800 CONTROLLER OPTIONS, REFER TO PROGRAMMING SHEETS

1 SYSTEM MUST UTILIZE A SOLIDLY GROUNDED NEUTRAL

4 HIGH POLARITY MARKER

PT TAP	VOLTAGE 208	240	400	480	600
H1	X	X		X	X
H2	X		X		
H3		X			
H4				X	
H5			X		X

COLOUR KEY	
BLACK	BK
BLUE	BE
BROWN	BN
GREEN	GN
GREY	GY
ORANGE	OR
PURPLE	PE
RED	R
WHITE	W
YELLOW	Y
SOLID/TRACER(S)	

	SH	BD	00-10-02
	SH	BD	00-06-07
	BY	AUTH	DATE

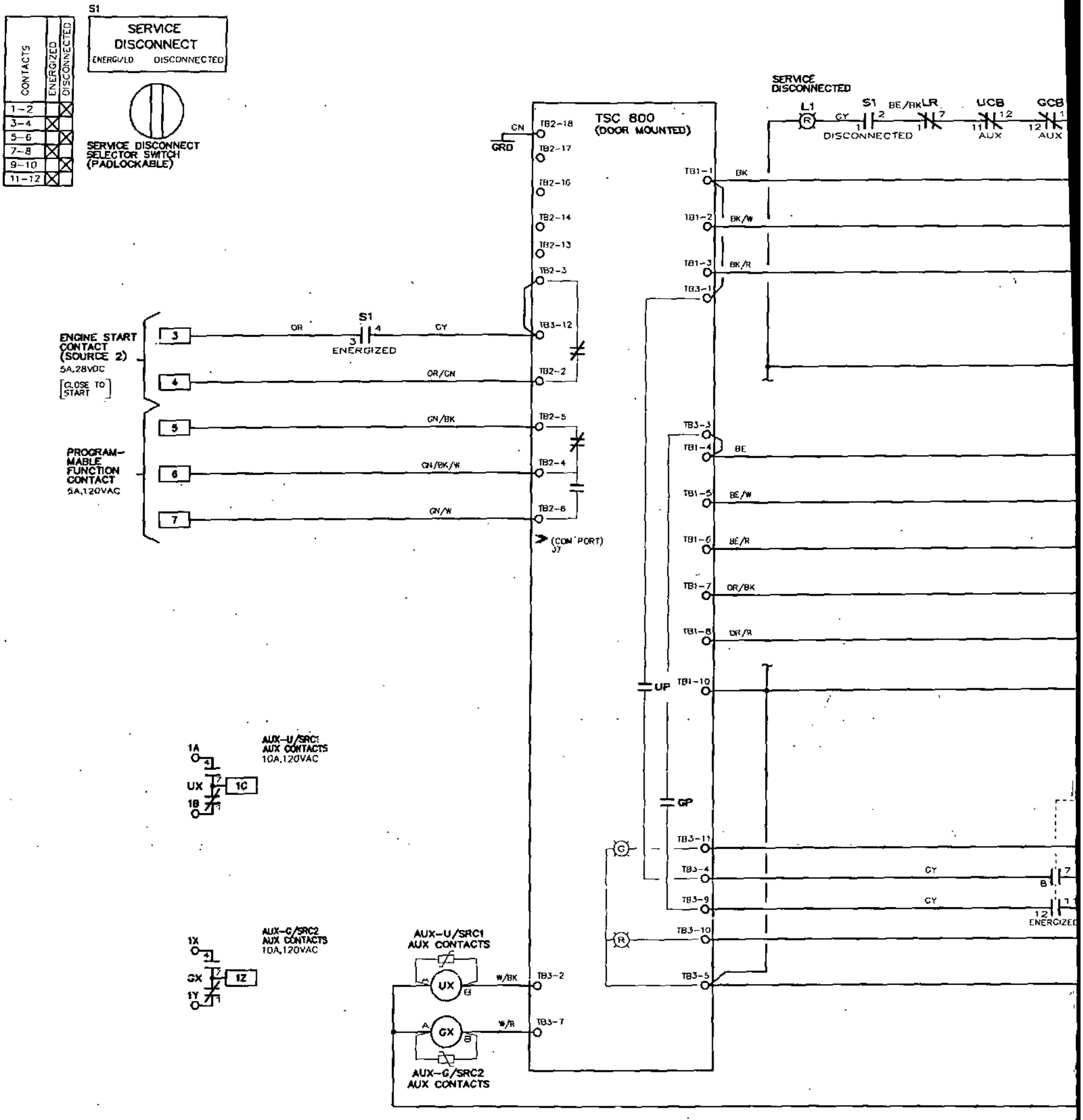
THOMSON ® TECHNOLOGY INC.

SCHEMATIC DIAGRAM
AUTOMATIC TRANSFER SWITCH
MODEL TS 853-TCK-800B-208-SE
800A, 208V, 3Ø 4W, 60Hz

CUSTOMER

DWN BY	AUTH BY	DATE	REV
SH	BD	00-04-26	2

DRAWING No. ELB13985_01_01 SHEET 3/3



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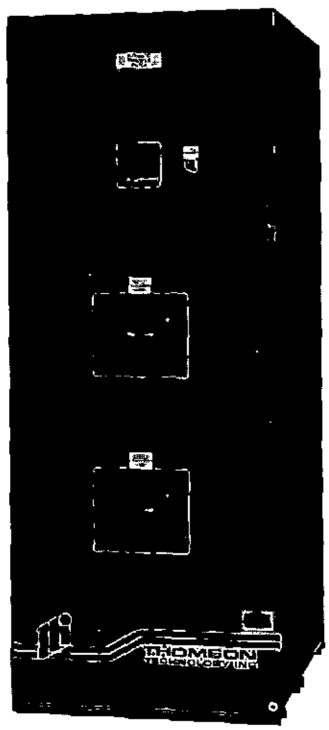
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: __________ DATE: __________

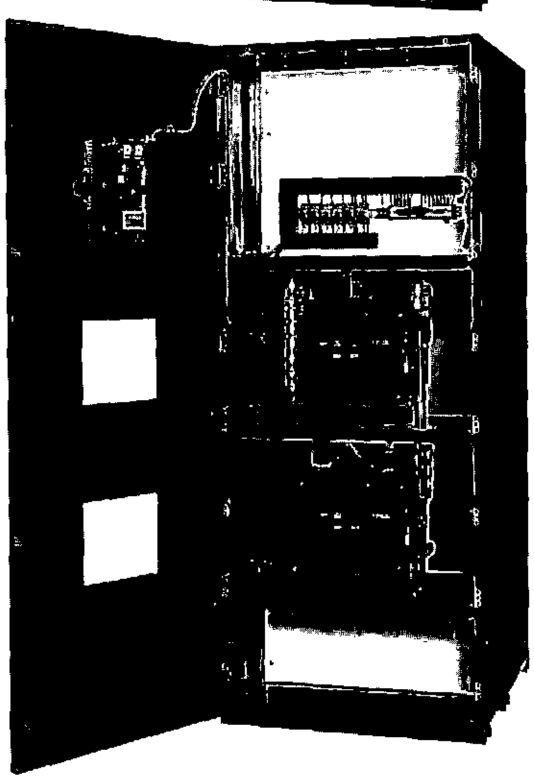
		2	CHANGE TO 3 PHASE
		1	AS BUILT
DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS

THOMSON TECHNOLOGY INC.

AUTOMATIC TRANSFER SWITCHES

Model TS 890





Typical TS 890-2500 transfer switch

Thomson Technology's TS 890 series Automatic Transfer Switches offer the following features:

Stored Energy Power Switching Units

- *fully enclosed* silver alloy contacts provide high withstand, closing and interrupting rating
- *completely separate* utility and generator side switching units provide superior reliability through redundancy (no common parts)
- switching units may incorporate *overcurrent protection*, allowing cost savings in upstream devices
- *not damaged* if manually switched while in service since contacts operate at same speed as when electrically operated

Reliable Motor-Operated Transfer Mechanism

- *heavy duty* brushless motors and operating mechanism provide mechanical interlocking and extreme long life with minimal maintenance
- *safe manual operation* with a *permanently affixed handles*, permits easy operation even under adverse conditions

Control Features

- ***TSC 800* microprocessor** based controller with comprehensive features and state of the art design
- *isolation plug* permits disconnection of control circuits from all power sources for safety and convenience of servicing
- Option LEV-3 allows use with dual standby generators or dual utility feeders

Quality Assurance

- ISO 9001 Registered
- CSA Z 299.3 (optional)
- DND AQAP-4 (optional)

Compliance

- CSA-C22.2 No. 178-1978 Automatic Transfer Switches
- UL-1008 Automatic Transfer Switches
- CSA-C31 Switchgear
- UL-891 Switchgear

Product Data

- Models from 800-3200 Amp continuous
- Available 3 or 4 Pole
- All models 50/60 Hz rated
- Voltage range 208-600
- 3 Phase, 3 or 4 wire systems

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GENERAL DESCRIPTION

TYPE A transfer switches are not equipped with internal tripping devices, and require protection provided by upstream protective devices, which must be coordinated. Type A units are suitable for 100% continuous loading, open or enclosed, and fulfill most general applications.

TYPE B transfer switches have internal tripping devices in either or both switching units, which provide the required overload and short circuit protection. Tripping devices can be solid state type. Type B units are suitable for 80% continuous loading, open or enclosed.

The **Thomson Technology TS 890** transfer mechanism employs two heavy duty high capacity stored-energy air circuit breaker switching units. The assembly is suitable for installation in a stand alone enclosure or in a switchgear lineup. Electrical connections can be made using either cable connectors, bus bars or bus duct. The air circuit breakers provide peak withstand ratings and short time withstand ratings which are unattainable with conventional transfer switches, allowing superior system coordination.

By using totally separate switching units for utility and generator supplies, the **TS 890** transfer switch provides a degree of reliability not available with 'ganged-contactor' type transfer switches. Each unit operates independently of the other, thus providing a redundant path to energize the load. If the 'drawout' feature is provided, it is even possible to perform maintenance on one switching unit while the other remains in service, in many cases eliminating any need for a 'bypass isolation' switch.

Since the switching units have stored-energy contacts (quick make, quick break), the contact opening and closing speed will be the same whether operated electrically (via automatic controls) or manually. This is in contrast to a 'contactor' type transfer switch, without stored-energy contacts, (the contact speed is proportional to the manual operator handle speed). In this case, contact speed will be very slow, and contact 'teasing' may occur when switched under load potentially damaging the transfer switch.

All **TS 890** transfer switches are equipped with a programmable neutral position delay (NDT) which allows for voltage decay of connected loads such as motors. This will ensure that switching transients are reduced to acceptable levels. Alternatively, a phase controlled transfer, which allows rapid transfer while the two sources are in phase, may be ordered (see option PCT for in-phase transfer).

For special applications where a **no-break transfer** is required, **Thomson Technology** can provide an **uninterrupted power transfer (option UPT®)**. If **peak shaving** and/or 100% load testing are desired, option **PG-UPT®** is available.
This will allow fully automatic **uninterrupted load transfer, peak shaving**, and load testing up to full capacity (without a load bank).

A bypass isolation feature is available with all **TS 890** transfer switches. This feature will allow isolation of the transfer switching units, and bypassing of either or both sources to the load. Please request information.

All necessary control functions for fully automatic operation are provided by the **TSC 800 microprocessor** based controller. The transfer switch controller provides automatic changeover of the load to the generator source in the event of a drop or loss of voltage in any or all phases of the utility supply. Upon restoration of the utility supply, the load is automatically returned. Numerous control features are available as standard or optional accessories to provide the desired sensing, time delay, and switching logic.

ORDERING INFORMATION

EXAMPLE:

NUMBER OF POLES (2, 3 OR 4)
TYPE (A OR B)

TS 894 - 2500A - 600 - 3W - 75 - D - LEV-1/AUX-U(2)/FTS-4

BASIC MODEL
SYSTEM VOLTAGE
SYSTEM CONDUCTORS (3W or 4W)
WITHSTAND RATING
BREAKER MOUNTING (D=DRAWOUT, F=FIXED)
CONTROL FEATURES LEVEL
OPTIONAL FEATURES

NOTE: DO NOT LIST STANDARD FEATURES. SHOW QUANTITY FOR AUXILIARY CONTACTS. ENSURE STANDARD CABLE TERMINALS ARE ADEQUATE - SPECIFY IF OPTIONAL TYPE IS REQUIRED. STANDARD UNITS ARE RATED 50/60HZ.

STANDARD FEATURES

CODE	DESCRIPTIONS
LEV-1*	Programmable/multi-tap system section**
	Load on utility & load on generator lights c/w lamp test
	Three phase voltage sensing on utility & generator sources
	Under/over frequency sensing on generator source (with adjustable time delay)
	Digital three phase metering of voltage & frequency on utility & generator sources
	Engine start delay timer, 0 - 60 sec.
	Engine cooldown delay timer, 0 - 30 min.
	Engine warm-up timer, 0 - 1800 sec.
	Transfer to utility timer, 0 - 30 min.
	Neutral Position Delay, 0 - 60 sec. (allows load voltage decay)
	Exercise timer 24 hour/7 day
	On/off load test selectable
	Programmable function output contact***
	Diagnostic LED's
	Backlit TSC 800 LCD display
	NEMA 1 enclosure
	Solid Neutral

** Provided as standard on all TS 890 Automatic Transfer Switches* *** Excludes TS 850-200 and all 2 pole models* **** Not available with Level 3 options*

OPTIONAL FEATURES

CODE	DESCRIPTIONS
LEV-2	Level 2 ATS control package - Level 1 features plus the following: Overvoltage three phase sensing on both utility & generator sources Under/over frequency sensing on utility source (with adjustable time delay)
LEV-3	Level 3 (Dual source) control package - Level 1 features plus the following: Dual Source selector switch Overvoltage three phase sensing - both sources Under/over frequency sensing - both sources
FTS-4	4 Function Test Switch (Auto/Off/Engine Start/Test)
AUX-U	Auxiliary Contact - Utility side (any qty.)
AUX-G	Auxiliary Contact - Generator side (any qty.)
LDC	Generator Pre/Post & Utility Pre/Post Timer contacts (adjustable) for Load Disconnect prior to transfer
OVS	Overvoltage three phase sensing on both utility & generator sources
UOF	Under/over frequency sensing on utility source (with adjustable time delay)
UPA	Utility power available contact
GPA	Generator power available contact
UAL	Utility available light
GAL	Generator available light
FTT	Fail to transfer contact
PBR	Phase Balance Relay - detects "single-phasing" condition on 3 phase system
SE	Service Entrance Rated
UTR	Overload trip - Utility side (specify rating)
GTR	Overload trip - Generator side (specify rating)
PCT	In-phase Transfer - ensures transfer takes place when both sources are in-phase to prevent system transients
BDU	Bus duct provisions for utility connect
BDL	Bus duct provisions for load connect
BDG	Bus duct provisions for generator connect
CTTS	Closed Transition Transfer Switch
PG-UPT®	Parallel Generation - Uninterrupted Power Transfer
COM	TSC 800 remote communication port (RS422). Can be used in conjunction with external TTI Communication Interface Module*, (CIM module not included).
CIM	Communication Interface Module with internal 14.4Kbaud modem, RS 232/422/485 ports and Modbus™ protocol. One CIM module provides communication interface for up to ten TSC 800 controllers with COM per system.

*Refer to separate literature for additional information. ™ Trademarks belong to their respective parties.

STANDARD MODELS (Type A)

BASIC MODEL	MAXIMUM VOLTAGE	RATED CURRENT (A)	Short Circuit Current Rating (kA Peak)		Short Circuit Current Rating (kA RMS)	
			Standard	**Optional**	**0.5 Sec.**	**1.0 Sec.**
TS 890 - 800A	600	800	105	143	65	50
TS 890 - 1200A	600	1200	105	143	65	50
TS 890 - 1600A	600	1600	105	143	65	65
TS 890 - 2000A	600	2000	105	165	75	75
TS 890 - 2500A	600	2500	105	165	75	75
TS 890 - 3000A	600	3000	105	165	75	75
TS 890 - 3200A[2]	600	3200	105	165	75	75

STANDARD MODELS (Type B)

BASIC MODEL	MAXIMUM VOLTAGE	RATED CURRENT (A)	Short Circuit Current Rating (kA Peak)	Short Circuit Current Rating (kA RMS)	
				0.5 Sec.	**1.0 Sec.**
TS 890 - 800B	600	800	143	65	50
TS 890 - 1200B	600	1200	143	65	50
TS 890 - 1600B	600	1600	143	65	65
TS 890 - 2000B	600	2000	165	75	75
TS 890 - 2500B	600	2500	165	75	75
TS 890 - 3000B	600	3000	165	75	75
TS 890 - 3200B[2]	600	3200	165	75	75

STANDARD DIMENSIONS/CABLE TERMINALS

BASIC MODEL	MAXIMUM VOLTAGE	RATED CURRENT (A)	DIMENSIONS (Inches)			Terminal Rating[1] (Copper conductors per phase & neutral)
			Height[3]	**Depth**	**Width**	
TS 890 - 800A/B	600	800	90	36	36	2 X #2 - 600MCM
TS 890 - 1200A/B	600	1200	90	36	36	3 X #2 - 600MCM
TS 890 - 1600A/B	600	1600	90	42	36	4 X #2 - 600MCM
TS 890 - 2000A/B	600	2000	90	42	36	5 X #2 - 600MCM
TS 890 - 2500A/B	600	2500	90	60	36	6 X #2 - 600MCM
TS 890 - 3000A/B	600	3000	90	60	36	7 X #2 - 600MCM
TS 890 - 3200A/B[2]	600	3200	90	60	36	7 X #2 - 600MCM

[1] Optional Terminal Ratings are available — consult T.T.I. [2] IEC only. [3] Does not include base (1.6").

Note: Specifications subject to change without notice.
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THOMSON TECHNOLOGY INC.

TS 890

AUTOMATIC TRANSFER SWITCH

INSTALLATION, OPERATING, & SERVICE MANUAL

ISO 9001 QMI REGISTERED QUALITY SYSTEM

PM045 Rev 3 00/02/29

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1. CAUTION!

Before opening the transfer switch enclosure to perform any service task, or to manually transfer the mechanism, it is imperative to isolate the transfer switch from any possible source of power. Failure to do so may result in serious personal injury or death due to electrical shock.

Service procedures must be undertaken by qualified personnel only!

NOTE: - All information contained in this manual is for reference only, and is subject to change without notice.

Contact Thomson Technology Inc. for clarification of current revisions or if in doubt about any matter relating to installation, operation or maintenance.

This revision Instruction Manual is intended for TS 890 Transfer Switch products which have been manufactured subsequent to the revision date. For products manufactured previous to this date contact Thomson Technology to obtain applicable manuals.

2. NOTE TO INSTALLER

To ensure satisfactory installation of this equipment be sure to observe "Recommended Connection Tightness" and "Requirements for Upstream Circuit Protective Devices" located in this manual.

All mechanical and electrical connections must be checked for tightness prior to placing this equipment in service to ensure proper operation and to validate applicable warranty coverage.
If the transfer switch has programmable multi-tap voltage capability (refer to electrical schematic), confirm the transfer switch has been configured for the system voltage prior to installation.

Warning

Failure to confirm and match transfer switch voltage with the system voltage could cause serious equipment damage.

The voltage selections and connections are shown on the electrical schematics attached to each transfer switch. The factory default settings will be indicated on the calibration label attached on the inside of the enclosure door (supplied loose on open style models). A blank label is included to record the applicable settings if the configuration is changed from the factory default settings.

To change the transfer switch configuration the following must be accomplished:

- Change voltage taps of PT's to system voltage (refer to schematics)
- Change TSC 800 programming (refer to sections 6.2.2, 6.2.4, 6.2.5,6.3, and 6.4 of the TSC 800 instruction manual). The following settings may require reprogramming (depending on options purchased):
    - System voltage
    - System frequency
    - System phase
    - Utility undervoltage pickup (typically 90% of system voltage)
    - Utility undervoltage dropout (typically 80% of system voltage)
    - Utility overvoltage pickup (typically 110% of system voltage)
    - Utility overvoltage dropout (typically 105% of system voltage)
    - Utility underfrequency (typically 95% of system frequency)
    - Utility overfrequency (typically 105% of system frequency)
    - Generator undervoltage pickup (typically 90% of system voltage)
    - Generator undervoltage dropout (typically 80% of system voltage)
    - Generator overvoltage pickup (typically110% of system voltage)
    - Generator overvoltage dropout (typically 105% of system voltage)
    - Generator underfrequency (typically 95% of system frequency)
    - Generator overfrequency (typically 105% of system frequency)

Record any changed setting on the TSC 800 Programming Data Sheets for future reference.
Complete the blank calibration label and attach to the inside of the transfer switch enclosure door.

<u>**INSTALLATION OF OPEN TYPE TRANSFER SWITCHES**</u> - Please refer to the factory for additional information.

3. GENERAL DESCRIPTION

(See **CAUTION!** on Page #1)

The automatic transfer switch employs two moulded-case switching devices which may be:

a) non-automatic circuit interrupters ("type A" transfer switch)

b) automatic circuit interrupters with integral trip units; ("type B" transfer switch)

In this manual, the switching devices will be referred to as "breakers". The breakers are independently operated by motor operated mechanisms within each breaker. The transfer switch provides automatic transfer of an electrical load to a standby power supply in the event of drop or loss of voltage of any or all phases of the primary power supply. Upon restoration of the primary supply, the electrical load is automatically retransferred to the primary power supply (after an adjustable time delay). All necessary control components for automatic transferring are located in the control compartment and on each associated breaker.

The transfer motor utilizes the power from the source to which the electrical load is being transferred. The mechanism provides a positive mechanical interlock to prevent both breakers from being closed at the same time. The mechanism is also designed to leave both breakers "trip free" in the closed position, permitting incorporation of overload and/or short-circuit protection in either or both breakers ("type B"). After tripping, the breaker of a "type B" transfer switch must be manually reset.

Note: For the purpose of this manual, the term UTILITY indicates the primary power, and the term GENERATOR indicates the standby power.

4. GENERAL SEQUENCE OF OPERATION

4.1. TYPE A TRANSFER SWITCH

When utility supply voltage drops below a preset nominal value (70-100% of rated adjustable) on any phase, an engine start delay circuit will be initiated and the transfer to utility supply signal will be removed (i.e. contact opening). Following expiry of the engine start delay period an engine start signal (contact closure) will be given.

Once the engine starts, the transfer switch controller will monitor the generator's output voltage. Once the generator voltage and frequency rises above preset values (70 - 100% nominal adjustable), the transfer to generator supply signal (contact closure) will be given to the transfer switch mechanism. This will trip open the utility supply breaker and following a neutral time delay period (0 - 10 sec adjustable) will close the generator supply breaker to re-energize the load.

The generator will continue to supply the load until the utility supply has returned and the retransfer sequence is completed as follows: When the utility supply voltage is restored to above the preset values (70 - 100% of rated adjustable) on all phases, a transfer return delay circuit will be initiated. Following expiry of the transfer return timer (0 - 30 min. adjustable), the transfer to generator supply signal will be removed (contact opening). This will trip open the generator supply breaker and following a neutral time delay period (0 - 10 sec adjustable) will close the utility supply breaker to re-energize the load.

An engine cooldown timer circuit will be initiated once the load is transferred from the generator supply. Following expiry of the cooldown delay period (0 - 30 min. adjustable) the engine start signal will be removed (contact opening) to initiate stopping of the generator set.

4.2. TYPE B TRANSFER SWITCH

The general sequence of operation for a type B transfer switch is identical to the type A transfer switch except for the following conditions:

4.2.1. Overcurrent Trip of Utility Transfer Breaker

Should the utility transfer breaker (UCB) contain an overcurrent trip device and it is activated due to an overcurrent condition on the load, the transfer switch logic will issue an engine start signal and will force a transfer to the generator supply (if within normal voltage and frequency limits). The transfer to the generator supply will occur irrespective of the utility supply voltage condition. The generator will remain on load until the UCB "tripped" indicator (on the breaker) is manually reset and the utility supply is within normal limits. **Note:** Type B transfer switches will be supplied with the above logic as standard. Other optional logic configurations may be installed on the transfer switch. Contact the TTI factory for further information.

3. GENERAL DESCRIPTION

(See **CAUTION!** on Page #1)

The automatic transfer switch employs two moulded-case switching devices which may be:

a) non-automatic circuit interrupters ("type A" transfer switch)

b) automatic circuit interrupters with integral trip units; ("type B" transfer switch)

In this manual, the switching devices will be referred to as "breakers". The breakers are independently operated by motor operated mechanisms within each breaker. The transfer switch provides automatic transfer of an electrical load to a standby power supply in the event of drop or loss of voltage of any or all phases of the primary power supply. Upon restoration of the primary supply, the electrical load is automatically retransferred to the primary power supply (after an adjustable time delay). All necessary control components for automatic transferring are located in the control compartment and on each associated breaker.

The transfer motor utilizes the power from the source to which the electrical load is being transferred. The mechanism provides a positive mechanical interlock to prevent both breakers from being closed at the same time. The mechanism is also designed to leave both breakers "trip free" in the closed position, permitting incorporation of overload and/or short-circuit protection in either or both breakers ("type B"). After tripping, the breaker of a "type B" transfer switch must be manually reset.

Note: For the purpose of this manual, the term UTILITY indicates the primary power, and the term GENERATOR indicates the standby power.

4. GENERAL SEQUENCE OF OPERATION

4.1. TYPE A TRANSFER SWITCH

When utility supply voltage drops below a preset nominal value (70-100% of rated adjustable) on any phase, an engine start delay circuit will be initiated and the transfer to utility supply signal will be removed (i.e. contact opening). Following expiry of the engine start delay period an engine start signal (contact closure) will be given.

Once the engine starts, the transfer switch controller will monitor the generator's output voltage. Once the generator voltage and frequency rises above preset values (70 - 100% nominal adjustable), the transfer to generator supply signal (contact closure) will be given to the transfer switch mechanism. This will trip open the utility supply breaker and following a neutral time delay period (0 - 10 sec adjustable) will close the generator supply breaker to re-energize the load.

The generator will continue to supply the load until the utility supply has returned and the retransfer sequence is completed as follows: When the utility supply voltage is restored to above the preset values (70 - 100% of rated adjustable) on all phases, a transfer return delay circuit will be initiated. Following expiry of the transfer return timer (0 - 30 min. adjustable), the transfer to generator supply signal will be removed (contact opening). This will trip open the generator supply breaker and following a neutral time delay period (0 - 10 sec adjustable) will close the utility supply breaker to re-energize the load.

An engine cooldown timer circuit will be initiated once the load is transferred from the generator supply. Following expiry of the cooldown delay period (0 - 30 min. adjustable) the engine start signal will be removed (contact opening) to initiate stopping of the generator set.

4.2. TYPE B TRANSFER SWITCH

The general sequence of operation for a type B transfer switch is identical to the type A transfer switch except for the following conditions:

4.2.1. Overcurrent Trip of Utility Transfer Breaker

Should the utility transfer breaker (UCB) contain an overcurrent trip device and it is activated due to an overcurrent condition on the load, the transfer switch logic will issue an engine start signal and will force a transfer to the generator supply (if within normal voltage and frequency limits). The transfer to the generator supply will occur irrespective of the utility supply voltage condition. The generator will remain on load until the UCB "tripped" indicator (on the breaker) is manually reset and the utility supply is within normal limits. **Note:** Type B transfer switches will be supplied with *the above logic as standard. Other optional logic configurations may be installed on* the transfer switch. Contact the TTI factory for further information.

4.2.2. Overcurrent Trip of Generator Transfer Breaker

Should the generator transfer breaker (GCB) contain an overcurrent trip device and it is activated due to an overcurrent condition on the load, the transfer switch logic will cause a transfer to the utility supply (if within normal voltage and frequency limits). The transfer to the utility supply will occur irrespective of the generator supply voltage condition. The transfer switch will not transfer to the generator supply should a subsequent utility failure occur until the GCB "tripped" indicator (on the breaker) is manually reset and the generator supply is within normal limits. **Note:** Type B transfer switches will be supplied with the above logic as standard. Other optional logic configurations may be installed on the transfer switch. Contact the TTI factory for further information.

4.3. SERVICE ENTRANCE RATED TRANSFER SWITCH

(Note: This applies only to service entrance transfer switches supplied with a Padlockable Disconnect Switch. Contact TTI for other types.)

4.3.1. Normal Operation

Under normal conditions, the load is energized from the utility supply through the closed utility transfer breaker. If the utility power fails, the generator will start and the load will be re-energized via the closed generator transfer breaker.

In the normal operating mode, the Service Disconnect switch shall be in the "energized" position.

4.3.2. SERVICE DISCONNECT PROCEDURE

To perform a service disconnect (i.e. to disconnect the utility and generator supplies), the following procedure is required:

1. Move the "Service Disconnect" control switch located on the door of the transfer switch to the "Disconnected" position.

2. Verify that the "Service Disconnected" pilot light is illuminated. *If the Light is illuminated, the service has been successfully disconnected and it is safe to perform any maintenance procedures as required.* In this condition, the transfer switch is in the neutral position, with both utility and transfer breakers open. The transfer switch will remain in this condition, regardless of condition of the utility and generator supplies (i.e. if the utility power fails, the generator will not receive a start condition,

nor will the transfer switch move to the generator position). *<u>If the Light is **not** illuminated, further procedures are required (refer to the following procedure #4).</u>*

3. Attach safety lockout padlock to the "Service Disconnect" control switch to prevent unauthorized change in operating condition and verify transfer switch door is locked closed. If the door is not locked, turn and remove door key.

4. If the "Service Disconnected" pilot light is **not** illuminated, the service will **not** have *been successfully disconnected and it is therefore* **not** *safe to perform any* maintenance until the following <u>additional</u> procedures are performed:

> ***<u>Warning</u>***
> Qualified personnel must undertake the following procedures **<u>only</u>**! Failure to do so may result in **<u>serious personal injury or death</u>** due to electrical shock.

- Open the door to the transfer switch using a suitable tool and opening the door lock with the key.
- Visually inspect the actual position of the transfer switch mechanism. *<u>If the position of the transfer switch mechanism is clearly in the "neutral position", the service has been successfully disconnected</u>*.

Notes: 1) If the position of the transfer switch mechanism is clearly in the "neutral position, the "service disconnected" pilot light may not have illuminated due to the following reasons:

a) Utility and generator supply voltages are not present (the pilot light requires AC supply voltage to be present).

b) The pilot light may be burnt out. The bulb should be immediately replaced with a suitably rated bulb.

c) Failure of one or more of the sensing/logic contacts. A qualified service technician is required to trouble shoot this specific condition. Unplug the control circuit isolation plug to de-energize all AC power to the control circuits. Note: The AC power conductors will still remain energized. Once the control circuit isolation plug is removed the "Service Disconnected" pilot light will not illuminate due to loss of control power.

Note: to return the transfer switch back to normal operation, <u>the control circuit isolation plug must be reconnected for correct operation</u>.

- The transfer switch door should then be securely closed using a suitable tool and locked in the closed position with the key. Once the transfer switch door has been positively locked closed and secured and only then is, it is safe to perform any maintenance procedures as required.
- *If the position of the transfer switch mechanism is **not** in the "neutral position" further procedures are required (refer to the following procedure)*

> **Warning**
> Failure to positively lock closed and secure the transfer switch door may result in **serious personal injury or death** due to electrical shock.

- If the position of the transfer switch mechanism is **not** in the "neutral position" the transfer switch mechanism must be manually operated as follows. To operate manually, pull the manual release plunger on the mechanism, releasing the motor drive rod from motor drive arm and move the knob and yoke to the marked **"Neutral"** position.

> **Warning**
> Failure to move the mechanism to the Neutral Position may result in **serious personal injury or death** due to electrical shock.

The transfer switch door should then be securely closed using a suitable tool and locked in the closed position with the key. Once the Transfer switch door has been positively locked closed and secured and only then is, it is safe to perform any maintenance procedures as required.

> **Warning**
> Failure to positively lock closed and secure the transfer switch door may result in **serious personal injury or death** due to electrical shock.

To re-energize the load, the padlock(s) should be removed from the "Service Disconnect" control switch, and move the switch to the "Energized" position. The transfer switch will immediately return to the utility or generator supply if within normal operating limits.

5. TYPE A AND TYPE B DEFINITION

"Type A" transfer switch means an automatic transfer switch that does not employ integral overcurrent devices.

"Type B" transfer switch means an automatic transfer switch that does employ integral overcurrent protection (in at least one of its two breakers).

"Type A" transfer switches are not equipped with trip units, and require properly coordinated upstream protection. Information on closing and withstand ratings, and recommendations for maximum upstream protective devices for "type A" units are in this manual. (Some "type A" models do employ "high-magnetic" trips in the breakers, however these are set to trip at a higher than normal current for that amperage circuit, so that the possibility of tripping is very remote. Since these trips are not intended to provide overcurrent protection, but are rather employed to ensure the integrity of the transfer switch under all circumstances, they are still classed as "type A").

"Type B" transfer switches are typically equipped with standard thermal-magnetic trips which will provide the required overload and short circuit protection. "Type B" can also be built using solid state trip breakers, which can include ground fault tripping as well as overload and short circuit protection.

It should be noted that a "type B" transfer switch with overcurrent protection in only one breaker will require the same consideration for upstream protection in the feeder of the breaker with no trip (as applies to a "type A" transfer switch).

6. GENERAL NOTES ON SERVICING

(See <u>CAUTION!</u> on Page #1)

When performing any service work it is imperative that the following be observed:

6.1. To maintain mechanical integrity, ensure that:

- All linkages are correctly adjusted.
- Mechanical interlocking is correct - it should not be possible to close a breaker without first opening the other breaker.
- All fasteners are adequately tightened.
- The operating linkages are not damaged or bent, and that all bearing points operate freely.

6.2. To maintain electrical integrity, ensure that:

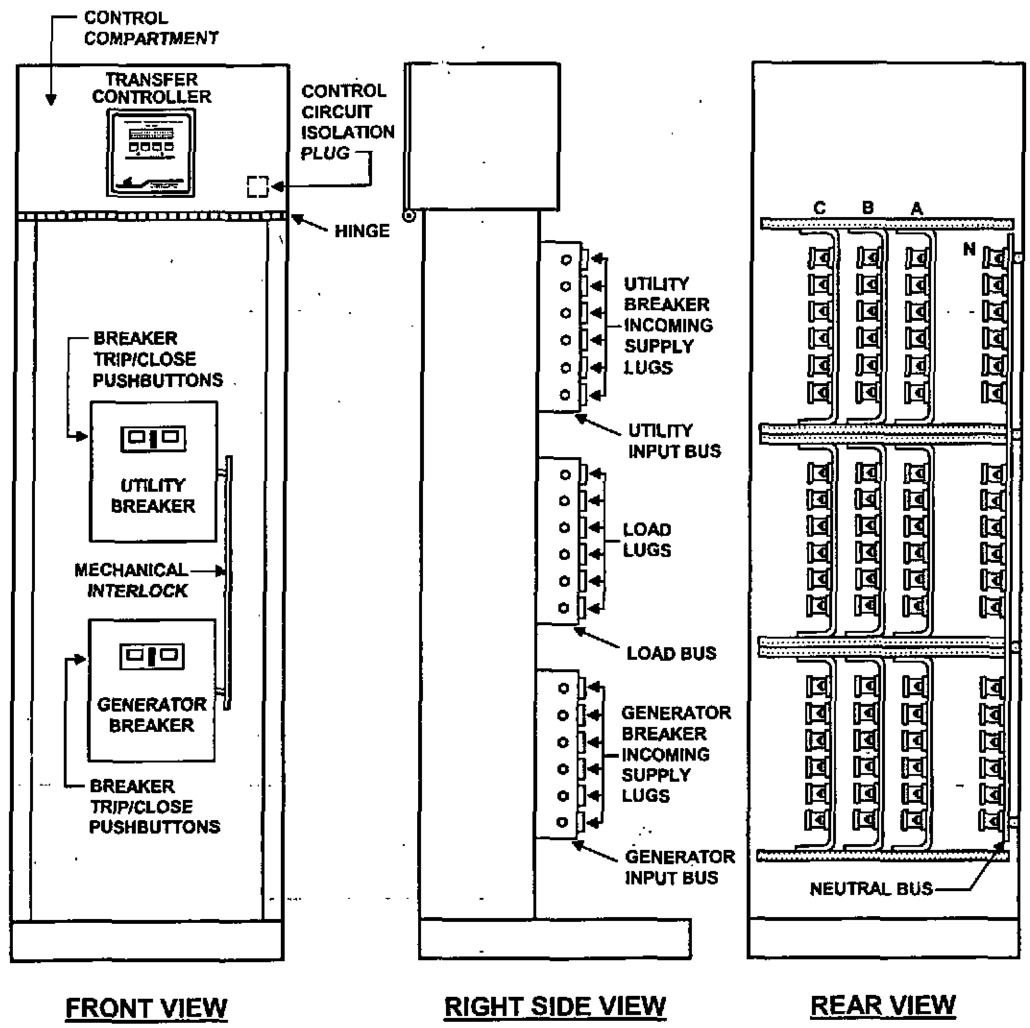
- All electrical connections, especially power connections, are clean and adequately tightened. Corroded or loose power connections will cause destructive heating, and may cause premature tripping in the type "B" units.
- All insulating devices are in place and in good condition.
- No moisture or other contamination is present.
- Electrical conductors are adequately secured away from moving parts.

6.3. To maintain operational integrity, ensure that:

- All control devices are in good condition and correctly calibrated.
- All control devices are adequately secured in their plug-in fixtures

Service work should be undertaken only by qualified personnel. Failure to correctly maintain an automatic transfer switch may represent a hazard to life and equipment. Full operational testing must be done prior to placing a transfer switch in service subsequent to any maintenance or repair. Any service work involving electrical components requires high-potential testing to ensure that required insulation levels have been maintained.

7. TRANSFER SWITCH MECHANISM DRAWING



8. TS 890 TRANSFER MECHANISM - 800 THROUGH 3200 AMP

The transfer mechanism consists of two electrically operated breakers and a mechanical interlock.

The transfer switch mechanism has three possible positions:

a) The utility breaker closed and the generator breaker open;
b) The generator breaker closed and the utility breaker open;
c) Both the utility and the generator breakers open, but **NEVER** both the utility and generator breakers closed at the same time.

8.1. MANUAL OPERATION

(See **CAUTION!** on Page#1)

Isolate the transfer switch from both sources of power before opening the enclosure for manual switching!

9. TRANSFER MODE SELECTOR

This is a two position selector switch that selects the required mode of operation of the transfer switch as described below.

9.1. **AUTO:** This selects automatic operation of the transfer switch. The transfer breakers will automatically open/close as detailed in the sequence of operation.

9.2. **MAN:** This position inhibits automatic operation. The transfer switch breakers must be manually operated via pushbuttons located on the face of the circuit breakers to open/close them as required.

To transfer manually to generator - turn the transfer mode selector to MANUAL, trip T/S utility breaker, close T/S generator breaker, using breaker trip/close pushbuttons.

To transfer manually to utility - trip T/S generator breaker, close T/S utility breaker using breaker trip/close pushbuttons.

10. RECOMMENDED MAINTENANCE

(See **CAUTION!** on Page # 1)

10.1. DO NOT perform dielectric tests on the equipment with the control components in the circuit.

10.2. Check if control components are tight in sockets.

10.3. Periodically inspect all terminals (load, line and control) for tightness. Re-torque all bolts, nuts and other hardware. Clean or replace any contact surfaces which are dirty, corroded or pitted.

10.4. Transfer switches should be in clean, dry and moderately warm locations. If signs of moisture are present, dry and clean transfer switch. If there is corrosion, try to clean it off. If cleaning is unsuitable replace the corroded parts. Should dust and/or debris gather on the transfer switch, brush, vacuum, or wipe clean. DO NOT blow dirt into the breaker or terminals.

10.5. Test the transfer switch operation. While the unit is exercising, check for freedom of movement, hidden dirt or corrosion and any excessive wear on the mechanical operating parts.

10.6. Check all adjustable control components (time delay and voltage sensing relays) for correct settings.

11. TROUBLESHOOTING

(See **CAUTION!** on Page #1)

Symptom	Possible Causes
- will not re-transfer to utility source upon restoration	- control wiring isolation plug is removed - a test mode has been activated (check TSC 800 status LCD display) - transfer mode selector is not in "auto" position - utility voltage or frequency is outside the pre-programmed limits (check utility source for adequate voltage & frequency) - a loose control connection - faulty circuit breaker (refer to Circuit Breaker Troubleshooting) - defective TSC 800 controller (verify output signals with circuit board mounted diagnostic LED's)
- will not transfer to generator source upon failure of utility source	- control wiring isolation plug is removed - generator set not producing enough voltage/frequency or output circuit breaker open - warmup time delay function has not timed out yet (verify TSC 800 timer setting) - transfer mode selector is not in "auto" position - a loose control connection - faulty circuit breaker (refer to Circuit Breaker Troubleshooting) - defective TSC 800 controller (verify output signals with circuit board mounted diagnostic LED's)
- transfer to generator source without a power failure in the utility source	- a test mode has been activated (check TSC 800 status LCD display) - defective TSC 800 controller (verify output signals with circuit board mounted diagnostic LED's)
- generator does not start up or stop when it should	- verify remote engine control panel is set for automatic mode
- no time delay when there should be	- verify time delay function in the TSC 800 program setting as per programming sheets as supplied with the transfer switch
- power is not available at the load terminals but the utility or generator breaker appears to be closed to a live source	- the breaker's trip unit (Type B style only) has tripped on a fault on the system. Correct the fault, and manually reset the breaker in the transfer switch.

DEFECTIVE COMPONENTS

Return defective components to Thomson Technology Inc. for repair. Be sure to advise model and serial number of the transfer switch.

12. CIRCUIT BREAKER TROUBLESHOOTING

MALFUNCTIONS	PROBABLE CAUSES	CORRECTIVE ACTIONS
The circuit breaker cannot be opened locally.	- *Open push-button locked.*	- *Remove the locking.*
	- Faulty mechanism or main circuits bonded.	- Contact TTI Service Department.
The circuit breaker cannot be manually closed.	- Circuit breaker closing on short-circuit.	- Clear the fault. Check circuit breaker condition before putting back into operation.
	- Fault trip indicator-button not reset . (Type B T/S's)	- Reset fault trip indicator-button.
	- Circuit breaker not fully connected. (drawout type only)	- Connect circuit breaker fully.
	- Anti-pumping function.	- Cut the closing release XF power supply, then resupply the XF.
	- Circuit breaker not charged.	- Check the geared motor power supply (U>0.85 Un). Check the power supply circuit. Attempt a manual recharging. Replace the geared motor if necessary. (Contact TTI Service Dept.)
	- Closing release XF continuously supplied.	- Cut the closing release XF power supply and try again to close the breaker only if it is ready to close.
	- Shunt release MX supplied.	- Locate the causes of this power supply. Cut the MX power supply, then try to close with the XF.
	- Undervoltage release (instantaneous or delayed) not supplied or faulty.	- Supply the MN at U>0.85 Un, then try to close with the XF. If impossible, check with the escutcheon removed, that the MN is drawing properly. If not, replace it.
	- Circuit breaker locked in "open" position.	- Remove the locking.
	- Circuit breaker interlocked.	- Check whether this refusal to close is not normal.
The circuit breaker does not recharge electrically.	- Geared motor supply voltage too low (<0.85 Un).	- Apply a voltage U<0.85 Un. Check the geared motor electrical circuit. Attempt to recharge manually. If problem: mechanism is faulty. Contact TTI Service Dept. If okay: geared motor faulty. Replace it.
It is impossible to insert the racking handle to connect or to disconnect the circuit breaker.	- There is a padlock or a key-lock for connected or disconnected position. There is a racking interlock.	- Remove disabling.
	- The extraction rails or the breaker is not completely pushed in.	- Push the rails or the breaker completely in.

MALFUNCTIONS	PROBABLE CAUSES	CORRECTIVE ACTIONS
It is impossible to extract the right side rail (on chassis alone) or the breaker.	- The racking handle is remained inserted.	- Remove the racking handle and put it in its storage.
	- The breaker is not completely disconnected. - There is a padlock or a key-lock for connected or disconnected position. There is a racking interlock.	- Disconnect the breaker. - Remove disabling.

It is impossible to extract the circuit breaker whenever it is charged.	- There is an extraction locking when breaker is charged.	- Discharge the circuit breaker (open, close then open again the circuit breaker).
		- If the circuit breaker is equipped with MN or MNR or MNRI:
		  - cut the supply of MCH
		  - come back in test position
		  - supply the MN (or if it is impossible, remove the front cover and then release MN).
		  - close the circuit breaker.
		  - draw out the circuit breaker.

It is impossible to rack in the circuit breaker.	- The chassis does not correspond with the circuit breaker. - The plastic ties which hold clusters during transport are not removed. - The clusters positions are not correct. - There is a safety shutters locking.	- Fit fouling-plate on your chassis and breakers to avoid new mistakes. - Remove the plastic ties. - Put them in order again. - Remove this locking.

13. REQUIREMENTS FOR UPSTREAM CIRCUIT PROTECTIVE DEVICES

Short Circuit Current Rating (Amps RMS Sym)

STANDARD MODELS (*Type A*)

Basic Model	Maximum Voltage	Rated Current (A)	Closing Rating (kA peak)	Short Circuit Current Rating (kA RMS)
TS 890 - 800A	600	800	105	50
TS 890 - 1000A	600	1000	105	50
TS 890 - 1200A	600	1200	105	50
TS 890 - 1600A	600	1600	105	50
TS 890 - 2000A	600	2000	105	50
TS 890 - 2500A	600	2500	105	50
TS 890 - 3200A	600	3200	105	50

STANDARD MODELS (*Type B*)

Basic Model	Maximum Voltage	Rated Current (A)	Closing Rating (kA peak)	Short Circuit Current Rating (kA RMS)
TS 890 - 800B	600	800	105	150
TS 890 - 1000B	600	1000	105	150
TS 890 - 1200B	600	1200	105	150
TS 890 - 1600B	600	1600	105	150
TS 890 - 2000B	600	2000	143	143
TS 890 - 2500B	600	2500	143	143
TS 890 - 3200B	600	3200	143	143

Please refer to the factory for further information on upstream protection requirements, if required.

INSTALLATION OF OPEN TYPE TRANSFER SWITCHES - Please refer to the factory for additional information.

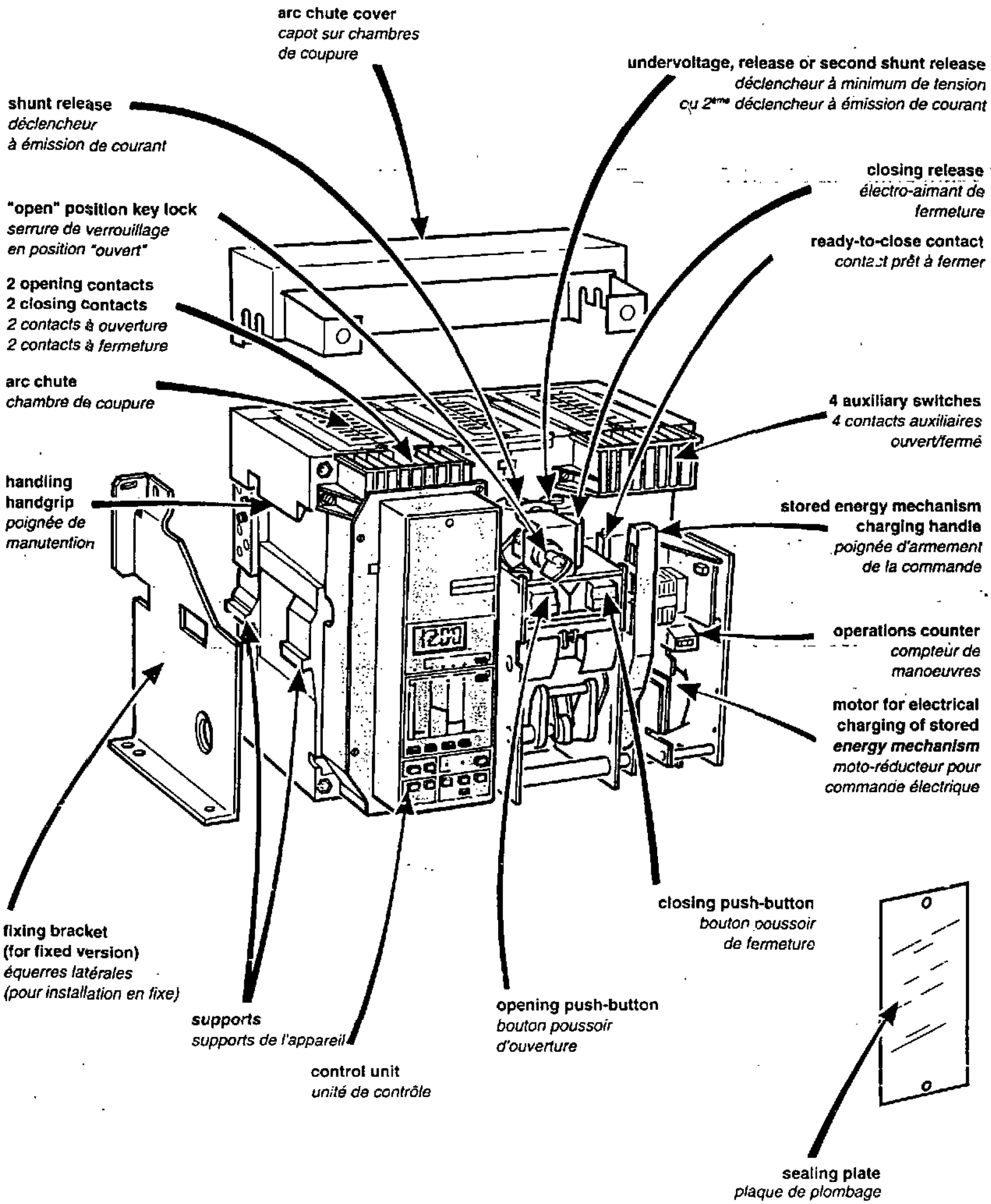
14. CABLE LUG TIGHTENING TORQUE VALUES

TIGHTENING TORQUE IN INCH POUNDS

LUG TYPE	CABLE CLAMP
TA - 2/0	180
TA - 3/0	250
TA - 4/0	250
TA - 250	325
TA - 350	325
TA - 500	375
TA - 600	375
TA - 800	375
TA - 750	375
TA - 800	500
TA - 1000	500

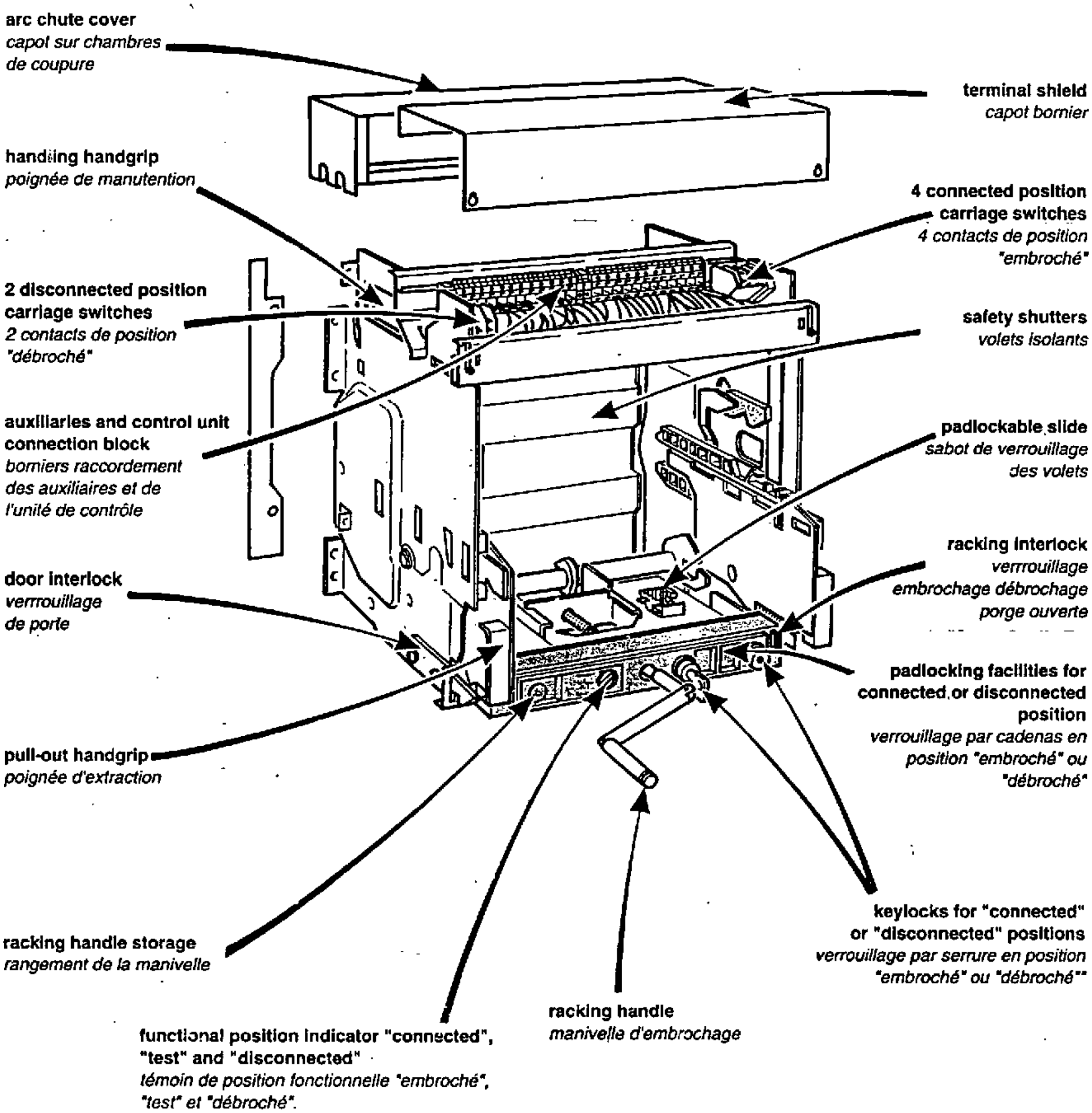
15. CIRCUIT BREAKER DRAWING

circuit-breaker
disjoncteur



16. DRAWOUT CHASSIS ENGINEERING DRAWING

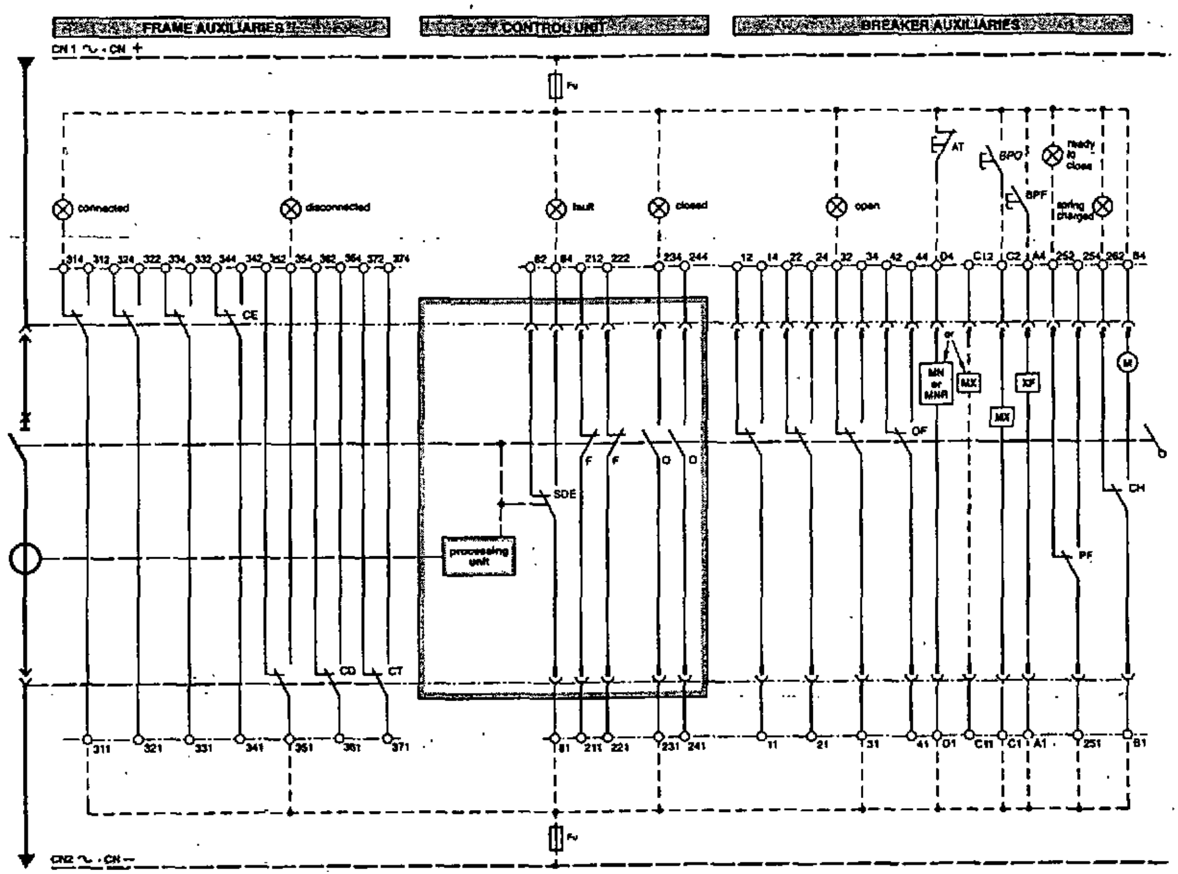
chassis
châssis



17. WIRING DIAGRAM ENGINEERING DRAWING.

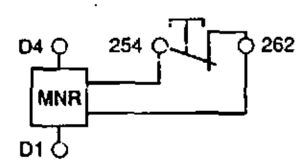
wiring diagrams

**general diagram
for basic version
STR 08 to 58**



- **Fu** : fuse 2A
- **AT** : emergency off
- **BPO** : open pushbutton
- **BPF** : close pushbutton
- **CE** : "connected" position contact (10A/240V AC)
- **M** : spring charging motor (180VA)
- **XF** : closing release (20VA)
- **MX** : shunt release (20VA)
- **MN** : undervoltage release (20VA)
- **MNR** : time delayed undervoltage release (20VA)
- **OF** : auxiliary changeover contacts (10A/240V AC)
- **O** : 2 auxiliary NO contacts (10A/240V AC)
- **F** : 2 auxiliary NC contacts (10A/240V AC)
- **SDE** : fault trip indication contact (10A/240V AC)(exept STR 08)
- **CH** : "spring charged" contact (10A/240V AC)
- **PF** : ready to close contact (10A/240V AC) (closing possible if breaker is open, not locked and operating mechanism charged)
- **CD** : "disconnected" position contact (10A/240V AC)
- **CT** : "test" position contact (10A/240V AC)

MNR wiring for instantaneous tripping



Use the terminals 262 ("spring charged contact") and 254 (normally open contact of the PF)

18. NOTES

FOIL LABEL (TYPICAL)
SILVER LETTERS ON
RED BACKGROUND

W1

WARNING
MORE THAN ONE LIVE CIRCUIT
SEE DIAGRAM

AVERTISSEMENT
PLUS D'UN CIRCUIT SOUS
TENSION VOIR SCHEMA

W2

WARNING
DISCONNECT ALL SOURCES OF
SUPPLY BEFORE SERVICING

AVERTISSEMENT
COUPER TOUTES LES SOURCES
D'ALIMENTATION AVANT DE FAIRE
L'ENTRETIEN ET LES REPARATIONS

2 X 6" (TYPICAL)

NP1

258–342
480V AUTOMATIC
TRANSFER SWITCH
(FEED TO PDC #3)

3/4 X 2" (TYPICAL)

TMS

TRANSFER
MODE
AUTO MANUAL

1 X 3" (TYPICAL)

UCB

UTILITY
TRANSFER
BREAKER

GCB

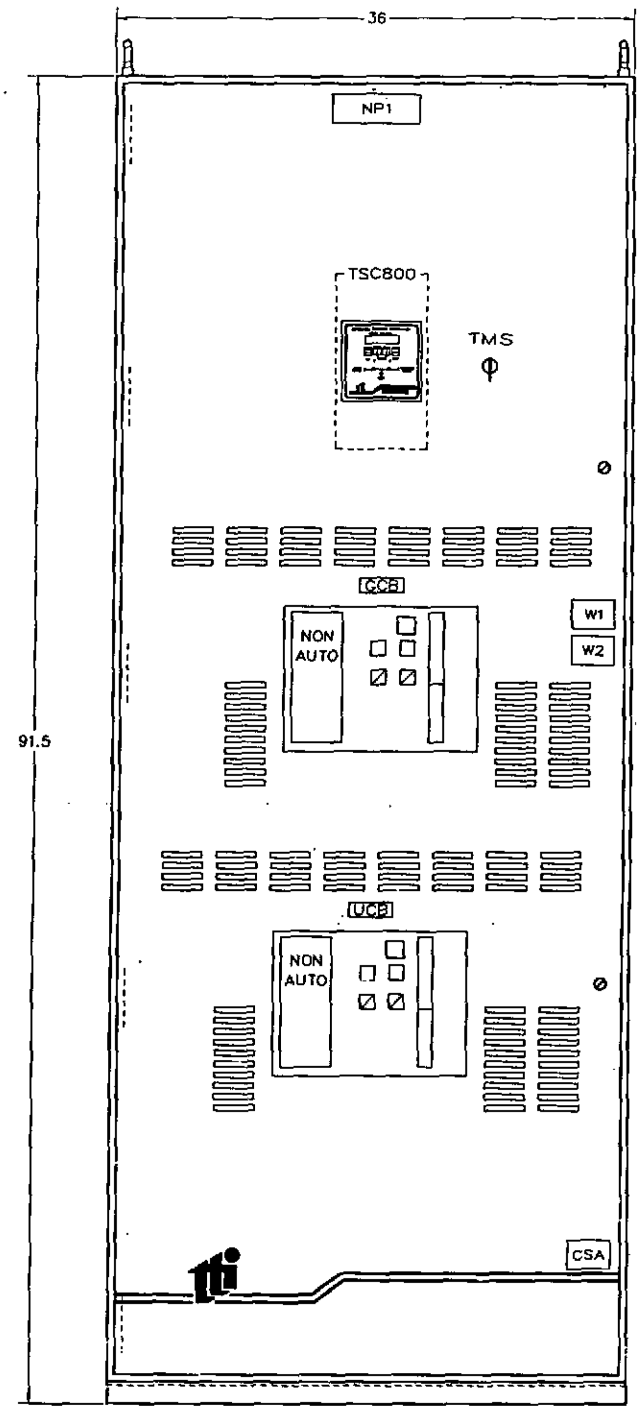
GENERATOR
TRANSFER
BREAKER

NOTES:

1) SWITCHBOARD SUPPLIED IN ONE PIECE.
2) FRONT AND REAR ACCESS REQUIRED.
3) EXTERIOR PAINT ASA #61 GREY.
4) MAIN BUS RATEING 2000A, 480, BRACED AT 75KA
5) ALL BUS WILL BE COPPER.
6) UTILITY CIRCUIT BREAKER IS M/G MASTERPACT 3P, 2000, NON-AUTO, ELECTRICLLY OPERATED, FIXED TYPE.
7) GENERATOR CIRCUIT BREAKER IS M/G MASTERPACT 3P, 2000, NON-AUTO, ELECTRICLLY OPERATED, FIXED TYPE.
8) AUTO TRANSFER SWITCH WIRING SHALL BE #18–14 AWG TEW.
9) NAMEPLATES TO BE BLACK WITH WHITE LETTERS.
10) ENCLOSURE TYPE NEMA 1 CONSTRUCTION.
11) GROUND LUGS 12 X #6 – 250MCM

2000A

12) EMERGENCY SOURCE CABLES TOP ENTRY, LUGS 2 HOLE LONG BARRELL = 1 X 1000MCM PER PHASE
13) LOAD CABLES TOP ENTRY, LUGS 2 HOLE LONG BARRELL = 3 X 1000MCM PER PHASE
14) UTILITY CABLES BOTTOM ENTRY, LUGS 2 HOLE LONG BARRELL = 6 X 1000MCM PER PHASE

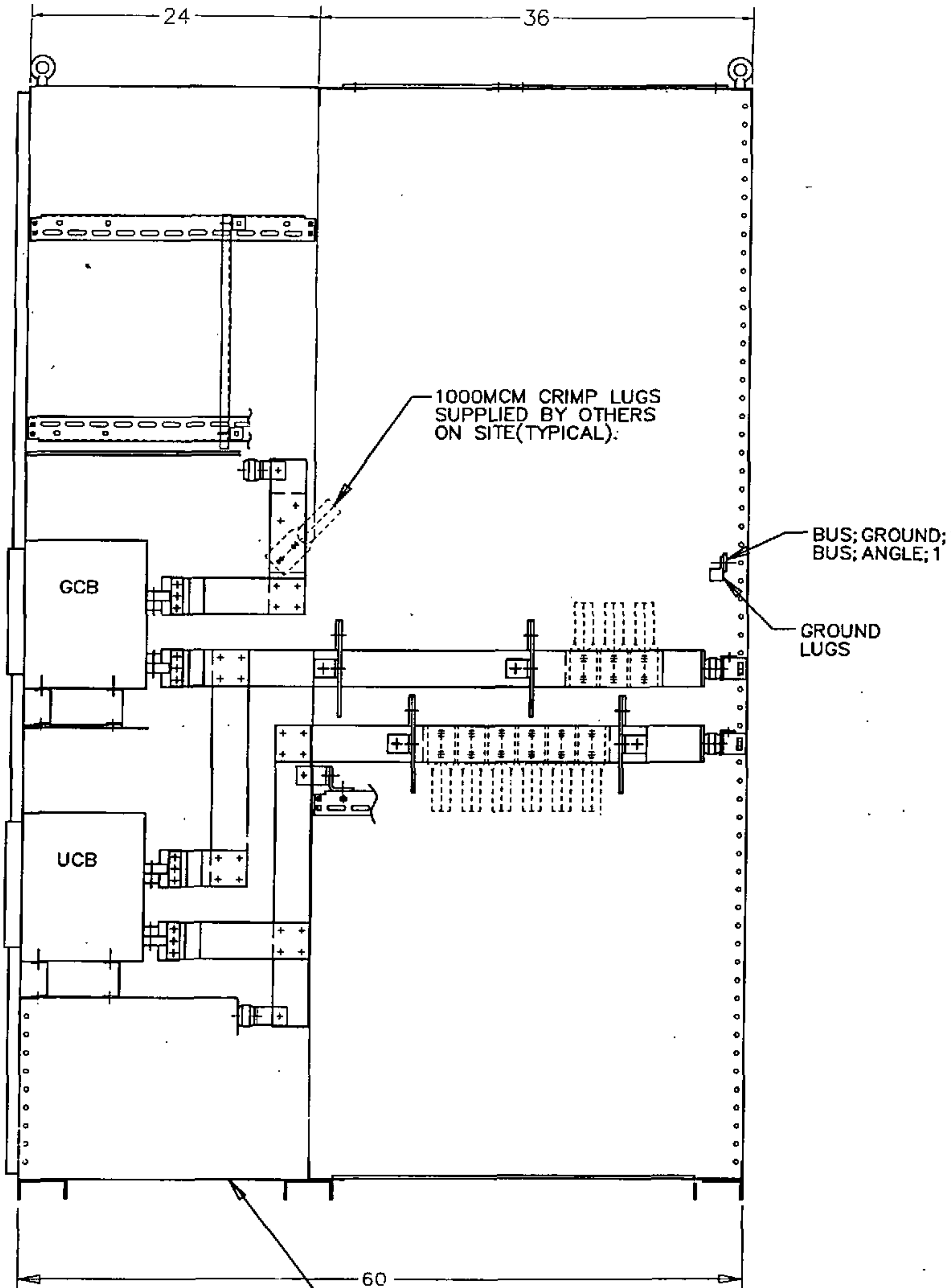


FRONT VIEW
FINISH ASA #61 GREY

EQUIPMENT
LOCATION: M

☐ APPROVED FOR CONSTRUCTION
☐ MASTER COPY ☐ REFERENCE COPY ____ OF ____
☐ MULTIPLE UNIT WORK ORDER
☐ RELEASED FOR INFORMATION
AUTH. BY: ____________ DATE: ____________

		2	AS BUILT
		1	CUSTOMER MODIFICATI
DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS



RIGHT SIDE VIEW

NO: 258–342
MCC ROOM NO 2

DOC.#: 258–342101

	LM	BD	00-08-03
NS	MC	BD	00-06-19
	BY	AUTH	DATE

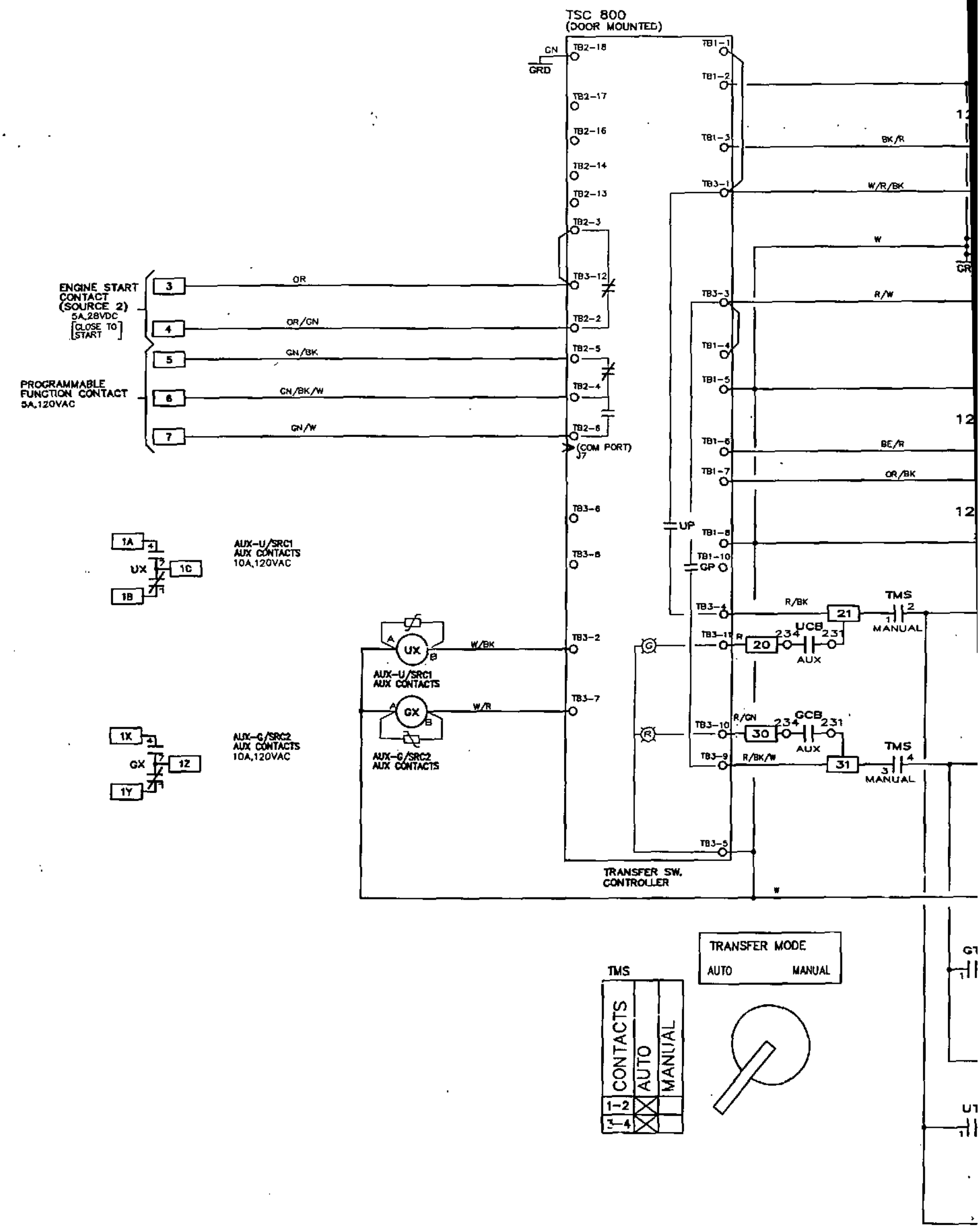
THOMSON TECHNOLOGY INC.

AUTOMATIC TRANSFER SWITCH
MODEL TS 890
PHYSICAL LAYOUT
2000A/FOOTNER FOREST

CUSTOMER

DWN BY	AUTH BY	DATE	REV
MC	BD	00-05-11	1

DRAWING No.	SHEET
ELB14004_01_01_01	1/2



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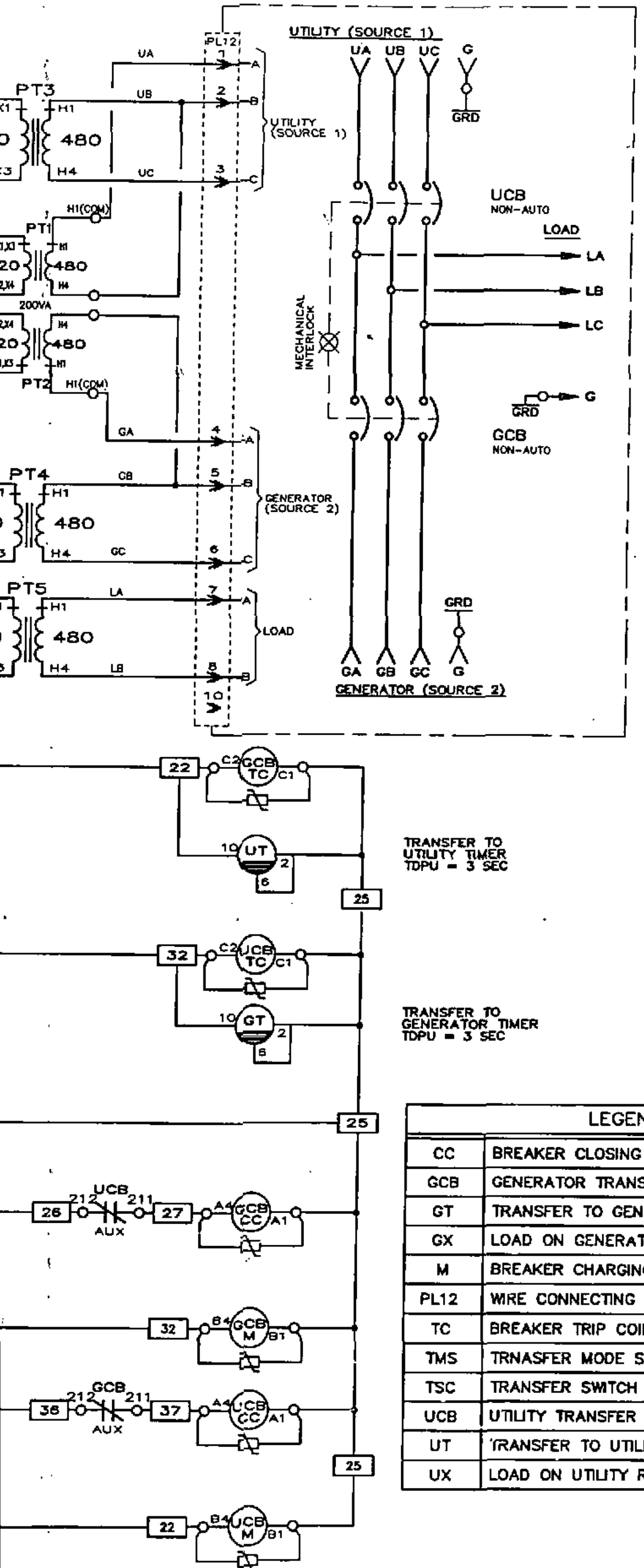
☐ MULTIPLE UNIT WORK ORDER				
☐ RELEASED FOR INFORMATION			1	AS BUILT
AUTH. BY: __________ DATE: __________	DRAWING No.	REFERENCE DRAWINGS	No.	REVISIONS



LEGEND	
CC	BREAKER CLOSING COIL
GCB	GENERATOR TRANSFER BREAKER
GT	TRANSFER TO GENERATOR TIMER
GX	LOAD ON GENERATOR RELAY
M	BREAKER CHARGING MOTOR
PL12	WIRE CONNECTING PLUG
TC	BREAKER TRIP COIL
TMS	TRNASFER MODE SWITCH
TSC	TRANSFER SWITCH CONTROLLER
UCB	UTILITY TRANSFER BREAKER
UT	TRANSFER TO UTILITY TIMER
UX	LOAD ON UTILITY RELAY

FOR TSC800 CONTROLLER OPTIONS, REFER TO PROGRAMMING SHEETS

DOC#: 258-342101

COLOUR KEY	
BLACK	BK
BLUE	BE
BROWN	BN
GREEN	GN
GREY	GY
ORANGE	OR
PURPLE	PE
RED	R
WHITE	W
YELLOW	Y
SOLID/TRACER(S)	

AS BUILT BY/ AS BUILT DATE	TESTED BY

	LM	BD	00-08-03
	BY	AUTH	DATE

THOMSON TECHNOLOGY INC.

SCHEMATIC DIAGRAM
AUTOMATIC TRANSFER SWITCH
TS 893-2000A-480-3W-75-E
2000A, 480V, 3Ø 3W, 60Hz

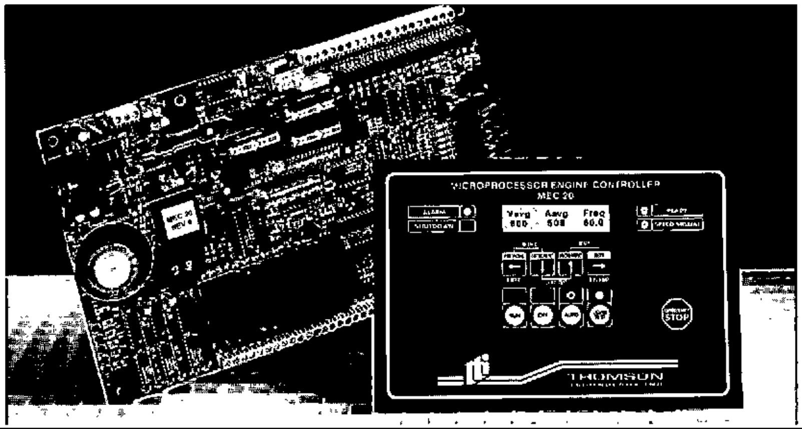
CUSTOMER

DWN BY	AUTH BY	DATE	REV
MC	BD	00-05-11	1

DRAWING No.	SHEET
ELB14004_01_01_02	2/2

MICROPROCESSOR ENGINE/GENERATOR CONTROLLER

Model MEC 20



- Microprocessor-based circuitry provides ultimate reliability and versatility
- Standard features meet or exceed requirements as defined by NFPA 110 Level 1 and CSA C282
- Backlit LCD display screen with alpha-numeric readout for display and programming
- Digital 3-phase voltage, 3-phase current and frequency metering for generator output
- Up to 28 alarm/shutdown fault circuits utilizing analog and digital inputs
- Optional remote communication serial port
- Alarm/shutdown indications are displayed in plain English language
- Optional expansion output module for individual fault output contacts
- Password protected programming levels
- Self diagnostic features continuously verify processing, I/O and memory circuits
- Superior EMI/RFI noise immunity and surge performance features as per IEEE C62.41
- Certified to UL #508 and CSA 22.2 #14 Industrial Control Equipment Standards
- Quality Assurance System ISO 9001

GENERAL DESCRIPTION

The Thomson Technology **MEC 20 Microprocessor-based Engine/Generator Controller** utilizes the latest advancements in microprocessor technology, printed circuit board assembly techniques and software development. This is the eighth generation of engine controllers from Thomson Technology, and reflects over 25 years of engine controller design experience, including a decade utilizing microprocessors. The result is an automatic engine/generator controller of superior design, providing a comprehensive array of operational, protection and display features. All functions of the **MEC 20** are fully configurable from the front panel keypad, and are password protected. The LCD display screen prompts are in plain English, providing a user-friendly operator interface with many display options available. The microprocessor design provides high accuracy for all voltage monitoring, current monitoring and timing functions as well as providing many standard features which are commonly available only as expensive add-on optional features on competitors' products.

THOMSON TECHNOLOGY INC. • 19214 - 94TH AVENUE, SURREY, B.C., CANADA V4N 4E3

TELEPHONE: (604) 888-0110 • FAX: (604) 888-3381 • E-MAIL: ttinfo@tti.bc.ca • www.thomsontechnology.com

STANDARD FEATURES

- **Digital AC Metering:** 3 phase voltage △4, 3 phase current, frequency
- **Digital Engine Gauge Display:** Oil pressure, Engine temperature, Battery Voltage, Hourmeter, Tachometer
- **15 Standard Fault Circuits:**

Shutdowns	Alarms	
• Overcrank	• Switch Not in Auto	• Low Battery Voltage
• Overspeed	• Low Fuel Level △2	• High Battery Voltage
• Loss of Speed Signal	• Low Engine Temperature	• Weak Battery
• Low Oil Pressure △2	• Low Oil Pressure Pre-Alarm	• Battery Charger Input Fail △2△3
• High Engine Temperature △2	• High Engine Temp. Pre-Alarm	
• Emergency Stop		

- **Timers:** Engine Start, Cooldown, Oil Bypass, Overcrank, Cycle crank
- **Control Switches:** Run/Off/Auto/Load Test, Horn Silence, Lamp Test, Fault Reset
- **Emergency Stop:** Faceplate mounted push-button and provision for remote contact input
- **LCD Display Menus:** AC metering, timer countdown functions, alarm/shutdown indication, engine parameters
- **LED Indicators:** Switch position (run, off, auto, load test), Common alarm, Common shutdown, Ready, Speed signal, Emergency stop
- **Diagnostic LED Indicators:** Watchdog (CPU running), run output energized, crank output energized, remote start signal initiated, common fail output energized
- **Audible Alarm Horn:** Programmable continuous or auto silence feature
- **Run & Crank Output Contacts:** (10A/240Vac, 8A/24Vdc, Form A)
- **Common Fail Output Contact:** (10A/240Vac, 8A/24Vdc, Form C)
- **1 Programmable Output Contact:** (10A/240Vac, 8A/24Vdc, Form C): User configured function (refer to programming functions available)
- **Engine Senders:** Oil pressure (1/8" NPT), Temperature (1/4" NPT) supplied loose for engine mounting
- **Future Remote Communication Capability:** Every standard MEC 20 controller can be field upgraded. Consult factory for additional information.

△1 Standard features meet or exceed requirements as defined by NFPA 110 Level 1 & CSA C282.
△2 Requires customer-supplied sensing contact.
△3 For CSA C282 applications, Battery Charger Input Fail alarm is reconfigurable as Low Coolant Level Shutdown.
△4 Generator supply must utilize a solidly grounded neutral system for standard panel connections.

NOTE: Customer to supply and install engine-mounted crank pilot relay, magnetic pickup and current transformers.

OPTIONAL FEATURES

- **COM** MEC 20 remote communication port for use with external Communication Interface Module (CIM module not included). Must order in conjunction with CIM option*
- **CIM** Communication Interface Module with internal 14.4Kbaud modem, RS232/422/485 ports and multiple interface protocols. One CIM module provides communication interface for up to ten MEC 20 controllers with COM per system.*
- **EXP** 16 point relay expansion module for individual fault output contacts on MEC 20. Specify number of expansion modules required (one module required for standard fault circuits, two modules required for standard and optional fault circuits). Relay contacts are configurable (normally open or closed) and are rated 0.5A 120Vac, 1.0A 30Vdc resistive (maximum)
- **DF** Additional digital fault circuits (specify name and quantity, maximum 8) to operate from customer-supplied contacts (All fault circuits programmable as alarm or shutdown)
- **PO** Additional programmable output contacts (10A/240Vac, 8A/24Vdc resistive, Form C) Specify function(s) and quantity (maximum 3)
- **UV** Undervoltage alarm/shutdown & indication (3 phase, programmable)
- **OV** Overvoltage alarm/shutdown & indication (3 phase, programmable)
- **OC** Overcurrent (definite time) alarm/shutdown & indication (3 phase, programmable)
- **UF** Underfrequency alarm/shutdown & indication (programmable)
- **OF** Overfrequency alarm/shutdown & indication (programmable)
- **IC** Engine Idle Control (consumes one programmable output contact and one digital fault input)
- **CL** Cycle Lube (consumes one programmable output contact)
- **PM** Additional Product Manual (One manual is included with each unit shipped)

* *(Refer to separate literature for additional information)*

PROGRAMMING

All of the following items are field programmable using the front panel keypad and LCD display. A password code restricts access.

General Programming

- Node Address (1 - 255)
- System voltage (120 - 15000 volts)
- System Frequency (50/60Hz)
- System Phases (single or 3 phase)
- Voltage sensing ratio (1 - 208)
- Current sensing ratio (1 - 999)
- Engine Temperature units (deg. F / C)
- Oil Pressure units (PSI / KPA)
- Engine start delay (0 - 999 sec.)
- Crank time (0 - 99 sec.)
- Rest time (0 - 99 sec)
- Starter re-engage cycle time (0 - 99 sec.)
- Number of crank attempts (0 - 99)
- Oil Bypass delay (0 - 99 sec)
- Cooldown time (0 - 99 min.)
- Number of flywheel teeth (0-999 teeth)
- Nominal engine speed (0-4000 RPM)
- Crank disconnect set point (0 - 100%)
- Overspeed set point (100 - 150%)
- Run output fail safe activated (yes/no)
- Loss of speed signal (alarm/shutdown)
- Remote Start signal (open or close to run)
- Common fail output for "not in auto" (yes/no)
- Programmable output #1, 2, 3, 4, 5, 6[1]
- Post lube duration (0 - 999 min.)
- Cycle lube interval (1- 9999 min.)
- Cycle lube duration (0 - 999 min.)
- Horn duration (0 = continuous, 1- 999 sec)
- Display menu time-out (60 - 999 sec)

[1] Programmable outputs #5 & #6 are available only with option **EXP**

Digital/Analog Fault Input Programming (For Each Circuit)

- Fault label description (choose from list)
- Level set point (analog fault)
- Shutdown or alarm
- Latched or non-latched alarm
- Remote reset (yes/no)
- Always active or after bypass delay
- Transient delay (0 - 99 sec.)
- Fault contact open/close to fail (digital fault)

Programmable Output Contact Functions
(select only one function per output used)

- Energize to stop
- Idle control
- Pre-lube/post-lube/cycle-lube control
- Switch not in auto alarm
- Overcurrent
- Preheat
- Ready alarm status
- Engine run alarm status
- Air flap
- Transfer switch load test
- Oil Bypass Delay Expired
- Common alarm
- Common fail

Analog Calibration Programming

- Analog zero
- Analog span

SPECIFICATIONS

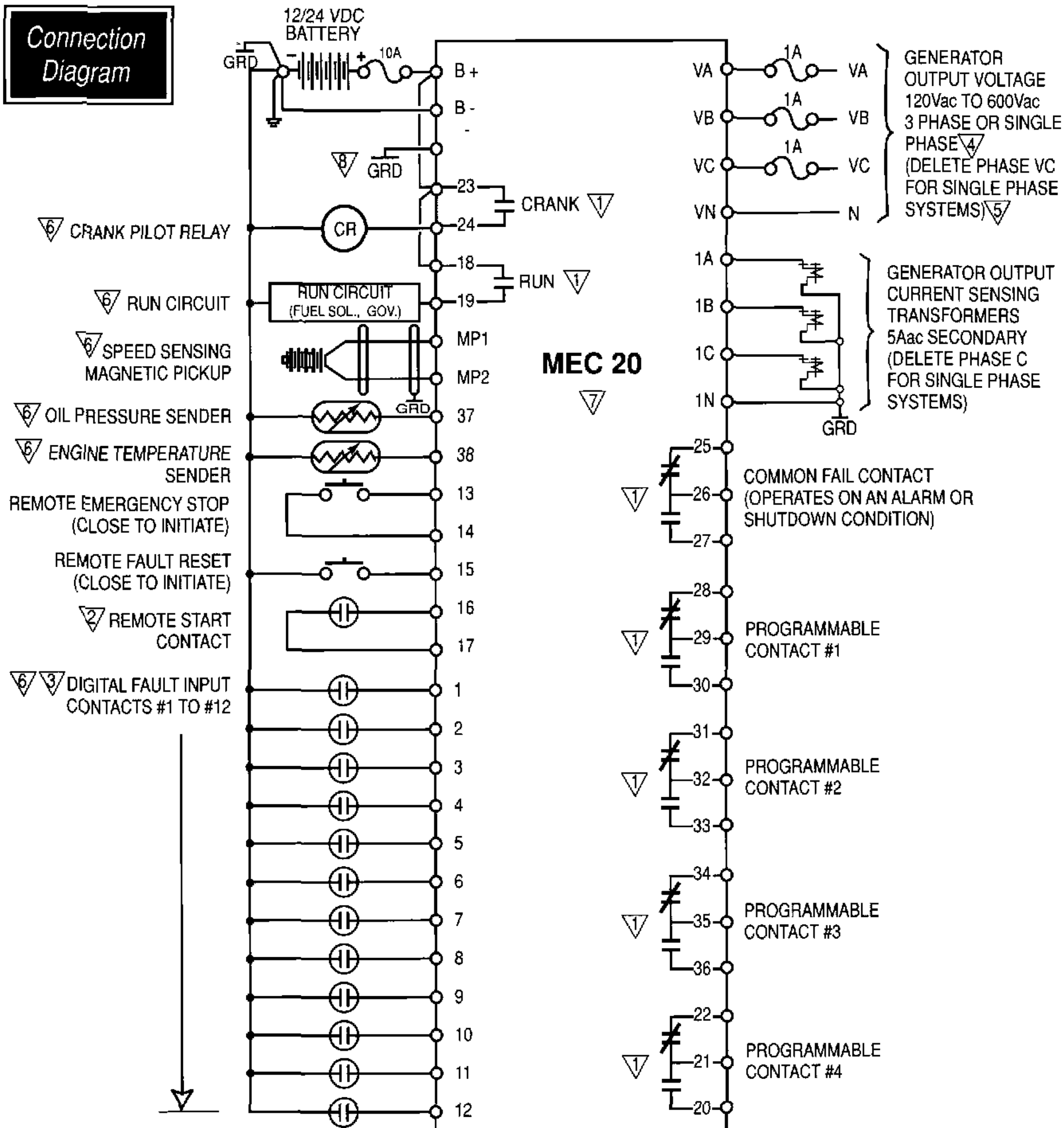
- **Power supply:** 10 to 30Vdc, negative ground
- **Operating temperature:** 0°C to +50°C
- **Environmental (Faceplate):** NEMA 12
- **Vibration:** 4g, 5-250Hz
- **Engine Gauge Display Accuracy:** ± 1.0% @ 25 °C (plus sender accuracy ± 5.0%)
- **Power consumption:** 5 watts (max.)
- **Storage temperature:** -50°C to +85°C
- **Humidity:** 5 to 95% non-condensing
- **Dimensions:** 10.75"W x 6.75"H x 2.0"D
- **AC Metering Accuracy:** ± 1.0%, @ 25 °C
- **Inputs:**

Engine speed sensing	100 - 10,000Hz, 2.0 - 20Vac, rms
AC Voltage	120 - 600Vac (nominal), 0.1VA, 3 phase, 50/60Hz
AC Current	0 - 5Aac (nominal), 1.5VA, 3 phase
Engine Parameters	Dedicated Senders (supplied loose)
Digital Fault Contacts	Open or Close to DC Negative

- **Output Contacts:**

Run, Crank	10A/240Vac, 8A/24Vdc resistive, Form A
Programmable, Common Fail	10A/240Vac, 8A/24Vdc resistive, Form C

Connection Diagram



NOTES:

1. CONTACTS RATED MAXIMUM 10A/240Vac, 8A/24Vdc RESISTIVE
2. CONTACT TO CLOSE TO INITIATE STARTING
3. LOGIC IS SOFTWARE PROGRAMMABLE FOR OPEN OR CLOSE ON FAIL
4. GENERATOR SUPPLY MUST UTILIZE A SOLIDLY GROUNDED NEUTRAL SYSTEM–REFER TO INSTRUCTION MANUAL FOR *ALTERNATE CONNECTIONS*
5. NEUTRAL CONNECTION IS REQUIRED FOR SINGLE PHASE SYSTEMS ONLY
6. ENGINE MOUNTED COMPONENTS
7. SOME FUNCTIONS SHOWN ARE OPTIONAL–REFER TO MEC 20 PROGRAM SHEETS
8. "GRD" CONNECTION TO BE MADE TO COMMON *CHASSIS/ENCLOSURE GROUND BOND SYSTEM*

NOTE: Specifications subject to change without notice.

CL 035 REV 3 00/06/01

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MEC 20

MICROPROCESSOR ENGINE/GENERATOR CONTROLLER

(WITH REMOTE COMMUNICATION & EXPANSION OUTPUT MODULE OPTIONS)

INSTALLATION, OPERATING & SERVICE MANUAL

PM047 Rev7 00/12/01

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1. INTRODUCTION

The Thomson Technology MEC 20 Microprocessor-based Engine/Generator Controller utilizes the latest advancements in microprocessor design technology for the control and monitoring of engine-generator sets. The MEC 20 provides a comprehensive array of operational, protection and display features for automatically controlling an engine/generator set. All standard and optional features of the MEC 20 are fully configurable from the front panel LCD display and are security password protected. The LCD display screen prompts are in plain English, providing a user-friendly operator interface with many display options available. The microprocessor design provides high accuracy for all voltage monitoring, current monitoring and timing functions as well as providing many standard features which were previously only available as expensive add-on optional features.

The MEC 20 provides the following advanced features:

- Up to 28 alarm/shutdown fault circuits utilizing analog and digital inputs.
- Standard model meets or exceeds CSA C282, NFPA 110 Level 1 generator set control requirements.
- RS 422 remote communciation port.
- Expansion output module communication port for individual output fault contact capability.
- Backlit LCD display screen with alpha-numeric readout for display and programming.
- Digital 3-phase voltage, 3-phase current, KVA and frequency metering for generator output.
- Non-volatile memory retains logic and set points if control power is lost.
- Direct 3-phase voltage sensing inputs on generator supply from 120Vac up to 600Vac (nominal).
- Security password-protected programming levels.
- Self diagnostic features continuously verify processing, I/O and memory circuits.
- Superior EMI/RFI noise immunity and surge performance features as per IEEE C62.41 requirements.
- Dual microprocessor design provides independent speed sensing circuitry for higher performance.

2. INSTALLATION

2.1. GENERAL INFORMATION

NOTE:
Installations should be done according to all applicable electrical regulation codes as required.

The following installation guidelines are provided for general information only pertaining to typical site installations. For specific site installation information, consult Thomson Technology Inc. as required. **Note:** Factory installations of TTI supplied control panels that have been tested and proven may deviate from these recommendations.

CAUTION!!!
All installation and/or service work performed must be done by qualified personnel only. Failure to do so may cause personal injury or death.

2.2. BATTERY SUPPLY INPUT

The MEC 20 can operate on any battery supply from 10 to 30 volts DC. The battery DC negative or common conductor must be grounded to the main generator-set frame ground. The MEC 20 is internally protected by a solid state type fuse that protects it from inadvertent shorts on the output terminals. The solid state fuse will automatically reset when the overcurrent condition is removed. Wiring from the engine cranking battery to the control panel should conform to the following guidelines to avoid possible controller malfunction and/or damage.

2.2.1. Avoid wiring from the engine starter terminals - wiring should go directly from the battery terminals to the engine control panel (to avoid voltage drop in the starter cables and starter motor commutator noise). **Note:** Unit mounted control panels with short wiring runs may utilize connections from the starter terminals provided that the specific application is tested satisfactorily.

> ***CAUTION!!!***
>
> ***The battery charger must be turned <u>off</u> <u>before</u> battery cables are removed from the battery (i.e. for servicing). Failure to do so may subject the control panel to an overvoltage condition in which damage may result.***

2.2.2. Wiring from battery to engine control panel should be two - #14 AWG ($2.5mm^2$) wires (i.e. do not use the engine block as one of the common conductors).

2.2.3. Under noisy environments (i.e. gas engines with high voltage ignitions, etc.), wiring from battery should be a twisted pair of #14 AWG ($2.5mm^2$) wires.

2.3. SPEED SENSING INPUT

Field wiring of the speed sensing signal wires should conform to the following guidelines to avoid possible controller malfunction and/or damage:

2.3.1. Wiring from magnetic pickup must utilize a 2 conductor shielded/twisted cable. The drain (shield) wire must be connected at the control panel end only.

2.3.2. Magnetic pickup voltage at <u>cranking</u> speed must be greater than 2.0VAC. At <u>nominal</u> speed, magnetic pickup voltage should be between 2 and 5VAC.

2.3.3. A single <u>dedicated</u> magnetic pickup is recommended for connection to the speed sensing input terminals. **Note:** One common magnetic pickup may be utilized for the system provided specific test measurements are done with the equipment installed (i.e. mag pickup voltage levels meet the required levels).

2.4. DC VOLTAGE INPUTS

All DC voltage inputs to the MEC 20 are optically isolated and filtered for protection from noise spikes and transients. Input wiring must be routed so that it is not near electrically "noisy" wiring such as ignition or starter wires. All contacts must be "dry" (i.e. non-powered) and one side must be connected to the common DC negative conductor.

2.5. AC VOLTAGE INPUT

The MEC 20 can accept direct AC voltage input from 120-600Vac (nominal). **Note:** Direct input voltage sensing can only be used when the generator utilizes a 3 phase, 4 wire distribution system with a solidly grounded neutral conductor. For 3 phase 3 wire systems (i.e. no neutral) or high voltage systems, potential transformers must be used. Refer to FIGURES #1 - 4 for voltage sensing connections.

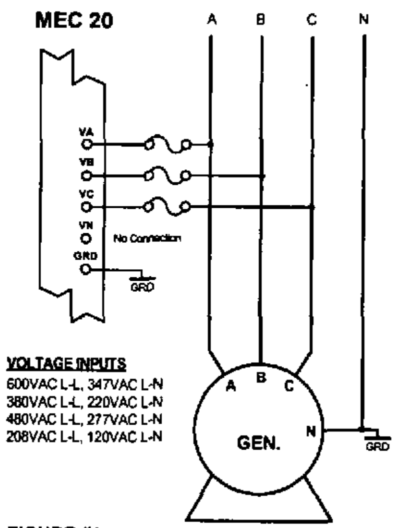

FIGURE #1

3Ø, 4W 208/380/480/600VAC DIRECT SENSING
SOLIDLY GROUNDED NEUTRAL SYSTEM

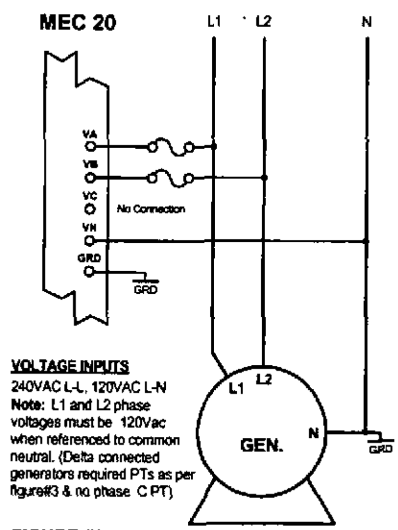

FIGURE #2

1Ø, 3W 120/240VAC DIRECT SENSING
SOLIDLY GROUNDED NEUTRAL SYSTEM

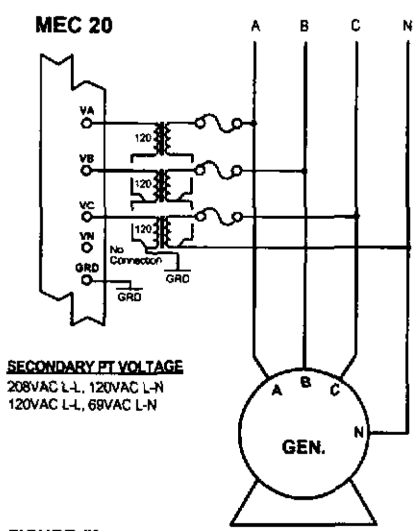

FIGURE #3

3Ø, 4W WYE PT's

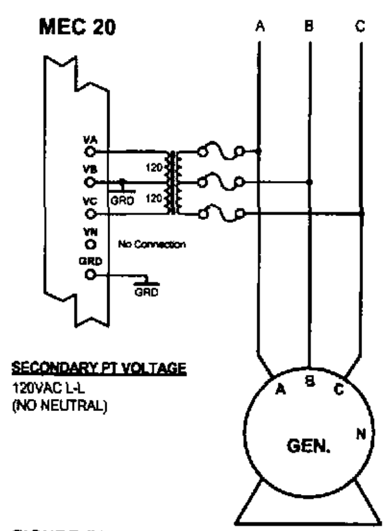

FIGURE #4

3Ø, 3W DELTA PT's

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2.6. AC CURRENT INPUT

Current transformers (CT's) must be used to supply the MEC 20 current inputs. CT polarity is not critical for correct circuit operation. **Note:** The CT secondary common conductors must be externally grounded for correct operation. CT's must be rated for a minimum of 1.5VA output at the specified accuracy.

> ***CAUTION!!!***
>
> ***When installing or performing any service work on CT circuits, always de-energize the system before proceeding with any work. Never open circuit an energized CT as extreme high voltages may result which may cause serious injury or death.***

2.7. OUTPUTS

All outputs from the MEC 20 are relay driven contacts. Relay contacts have a 10A/240Vac resistive (3 Amp inductive 0.4pf), 8A/24Vdc rating and are isolated Form A & Form C types. Interposing relays are recommended between the MEC 20 outputs and end devices to prevent internal damage due to possible excessive current draw and/or damage should an external fault occur. **Note:** These outputs will require external overcurrent protection.

The use of AC or DC operated solenoids or relays in control systems can sometimes cause high voltage spikes on the DC power supply, which may cause electronic devices to fail. Transient suppression devices are recommended for all inductive devices sharing wiring or if physically located near engine/generator control panels. For DC operated relays or solenoids, use a suitably rated counter EMF Diode (or commonly known as "freewheeling" diode). For AC operated relays or solenoids, use a suitably rated metal oxide varistor (MOV) or capacitor/resistor suppressor.

2.8. EXTERNAL PANEL CONTROL WIRING

As a minimum, all control wiring shall conform to the local regulatory authority on electrical installations. Specific wire sizes for typical circuits● (of distances up to 100ft (30m) ●) are as follows:

2.8.1.	Battery Control Power	#14 AWG (2.5mm^2)
2.8.2.	Engine Alarm/Shutdown Contacts	#16 AWG (1.5mm^2)
2.8.3.	Remote Start Contact for Transfer Switch	#14 AWG (2.5mm^2)

2.8.4.	Crank & Preheat Output Wiring	#14 AWG (2.5mm^2) (To pilot relays)
2.8.5.	Speed Sensing Wiring	#16 AWG (1.5mm^2) 2 Conductor Shielded Cable
2.8.6.	Metering Voltage Inputs	#16 AWG (1.5mm^2)
2.8.7.	Metering Current Inputs (from CT's)	#14 AWG (2.5mm^2)

- For distances exceeding 100 Ft. (30m) consult TTI.
- For unit mounted control panels, wire sizes may be reduced to the next smallest wire size available.

2.9. REMOTE START CONTACT FIELD WIRING

Field wiring of a remote start contact from a transfer switch to a control panel should conform to the following guidelines to avoid possible controller malfunction and/or damage.

2.9.1. Remote start contact wires (2 - #14 AWG (2.5mm^2) should be run in a separate conduit.

2.9.2. Avoid wiring near AC power cables to prevent pick-up of induced voltages.

2.9.3. An interposing relay may be required if field wiring distance is excessively long (i.e. greater than 100 feet (30m) and/or if a remote contact has a resistance of greater than 5.0 ohms.

2.9.4. The remote start contact must be voltage free (i.e. dry contact). The use of a "powered" contact will damage the engine controller.

2.10. REMOTE COMMUNICATION WIRING

All interconnecting wiring to/from the MEC 20 engine/generator controller communication port shall utilize #22 AWG (min.) 8 conductor, twisted, shielded cable with RJ45 connectors. The drain (shield) wire must be connected at the MEC 20 controller end only. Refer to Section #6 for further information.

Communication cable from the controllers' com port must be suitably routed to protect it from sources of electrical interference. Guidelines for protection against possible electrical interference are as follows:

- Use high quality, 8 conductor shielded cable only with drain wire grounded at the controller end only.

- Route the communication cable at least 3 M (10") away from sources of electrical noise such as variable speed motor drives, high voltage power conductors, UPS systems, transformers, rectifiers etc.
- Use separate, dedicated conduit runs for all communication cables. Do not tightly bundle communication cables together in the conduit. Conduit should be ferromagnetic type near sources of possible electrical interference. The entire length of conduit should be grounded to building earth ground.
- When communication cables must cross over low or high voltage AC power conductors, the communication cables must cross at right angles *and not in parallel with the conductors.*

For additional information on protection against electrical interference, contact TTI factory.

2.11. EXPANSION OUTPUT MODULE LOCATION/INSTALLATION

The expansion module(s) are to be mounted inside a control panel using four screws with stand-offs provided. The expansion module must be mounted within 3 metres (10 feet) wiring distance from the MEC 20 using an 8 conductor shielded cable provided with the module. The communication cable must not be bundled together with other control wiring inside the panel. Mounting dimensions for the expansion output module are shown in FIGURE #5.

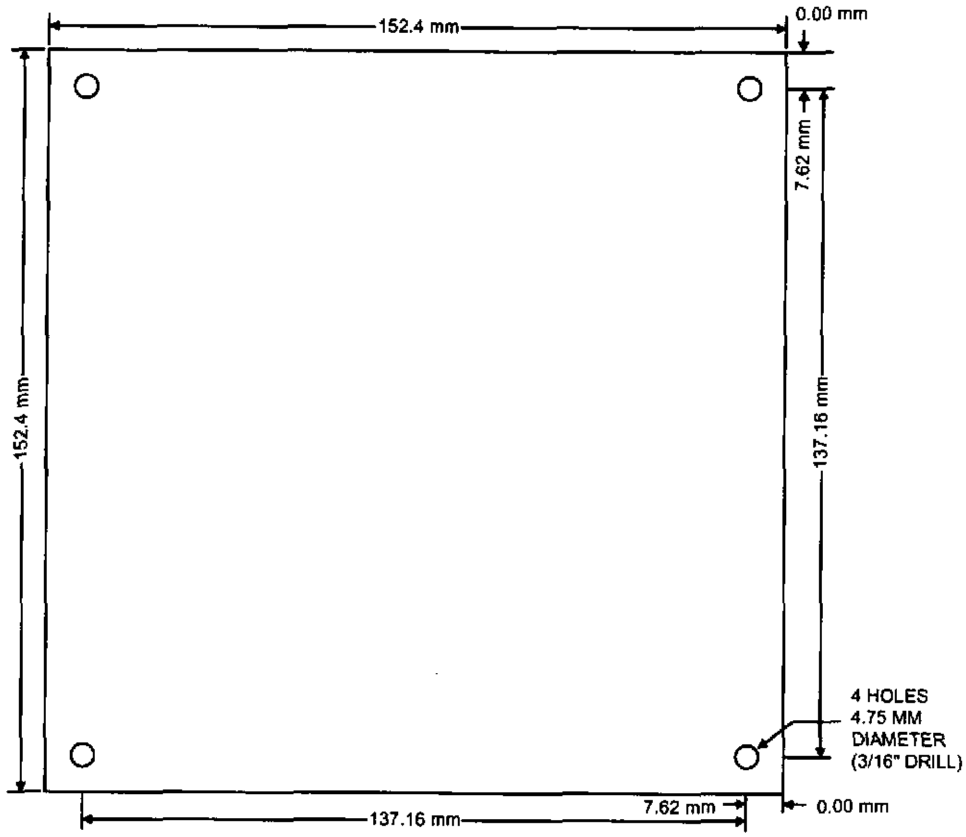

FIGURE #5: MEC 20 EXPANSION MODULE MOUNTING DIMENSIONS

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DRAWING SCALE .75:1

2.12. MEC MOUNTING LOCATION/INSTALLATION

The MEC 20 Engine-generator controller is designed for mounting directly onto a control panel door. Considerations should be given for the following:

- The controller should be installed in a dirt free, dry location away from extreme heat sources.
- The LCD window should be installed at an optimum height for operator viewing.
- Adequate space should be provided around the rear of the MEC 20 circuit board for control wiring.
- Verify that the intended AC voltage input to the controller does not exceed the maximum allowable level on the control panel door as per the applicable control panel certification standard.

The MEC 20 controller can be installed onto a door of a control panel using one of the following methods:

- The first method requires a special door cutout for the LCD display and LED's as shown in FIGURE #6. This mounting method requires the lexan faceplate to be mounted directly onto the door of the control panel. The controller must be disassembled to mount on the door, then re-assembled. Refer to FIGURE #7 for correct assembly location of all parts.
- The second method of controller mounting requires a factory supplied adapter faceplate as shown in FIGURE #8. This method only requires a single large rectangular hole to be cut out of the door as shown in FIGURE #9.

2.13. FACEPLATE MOUNTING DIMENSIONS

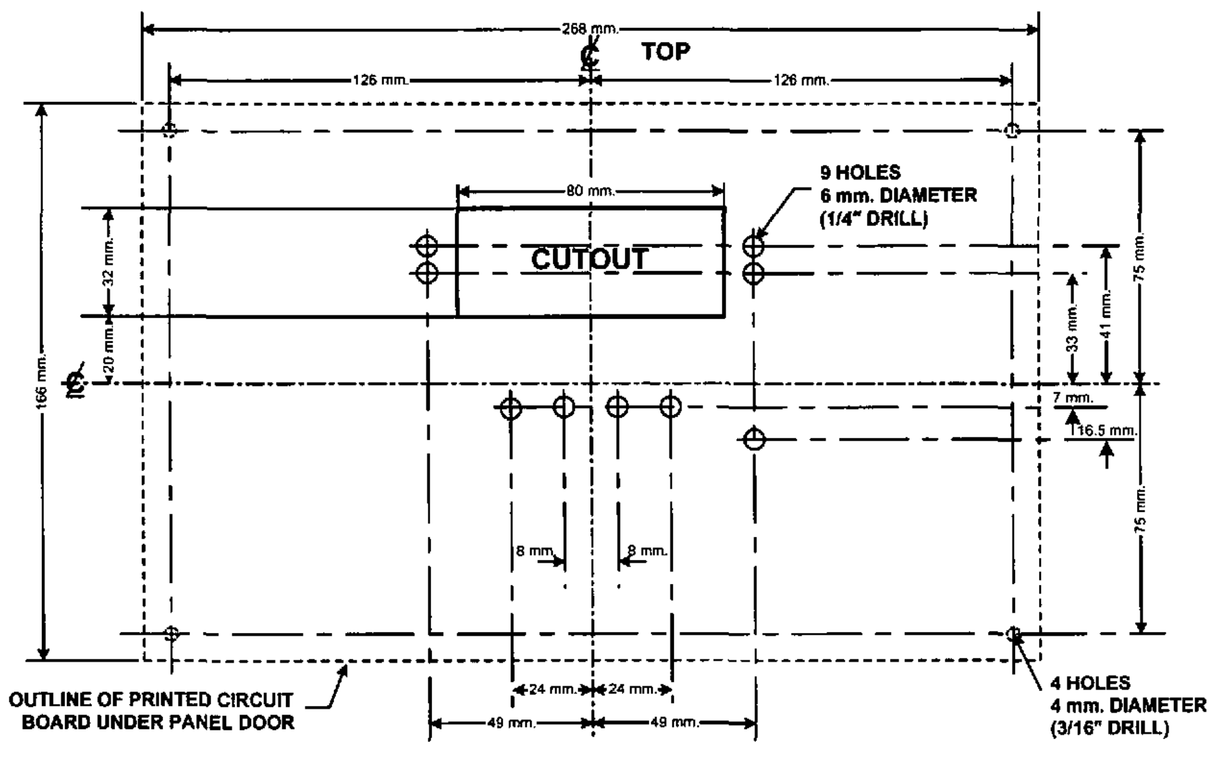

FIGURE #6

2.14. MEC 20 ASSEMBLY - SIDE VIEW

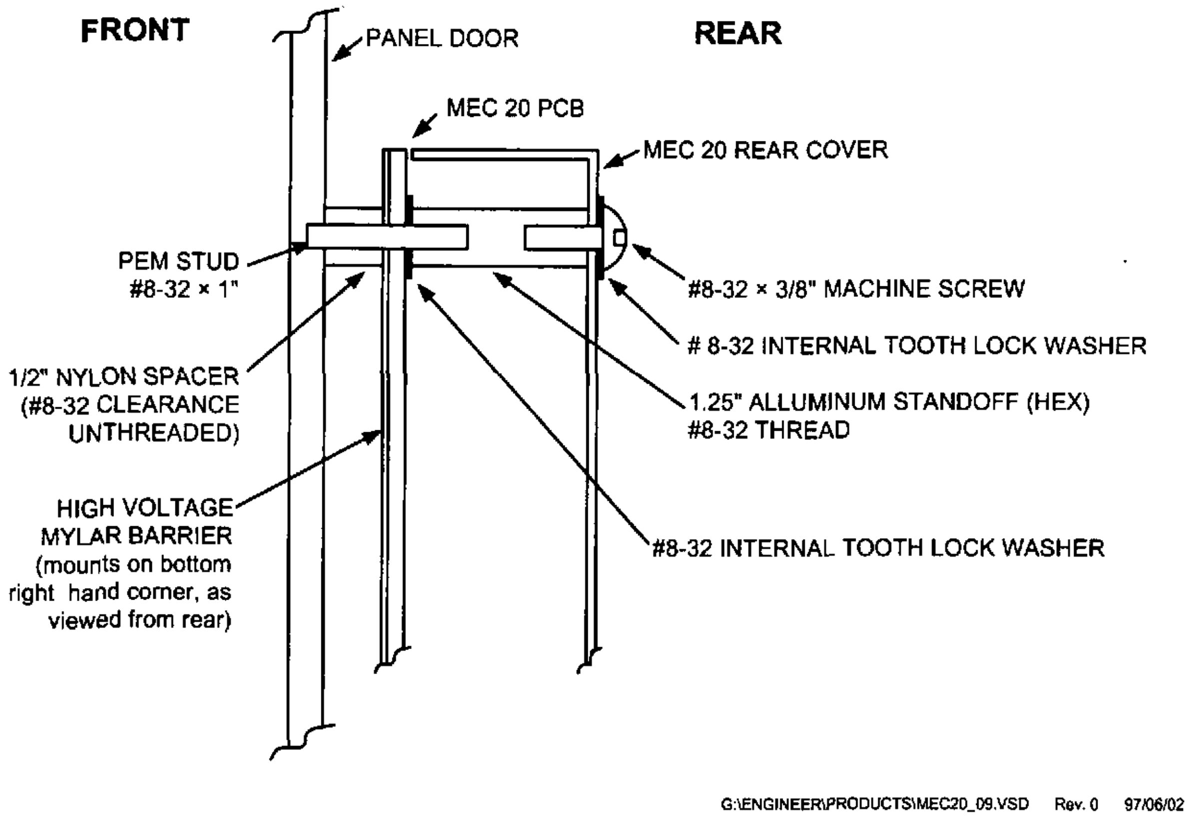

FIGURE #7

Notes:

1. Ensure that all lockwashers are installed as shown above.
2. The high voltage mylar barrier (P/N TMW;10805;1) must be installed as shown when the MEC 20 is installed onto the door of a control panel.
3. When the MEC 20 is installed on a door without 1" PEM studs, 1" machine screws must be used.

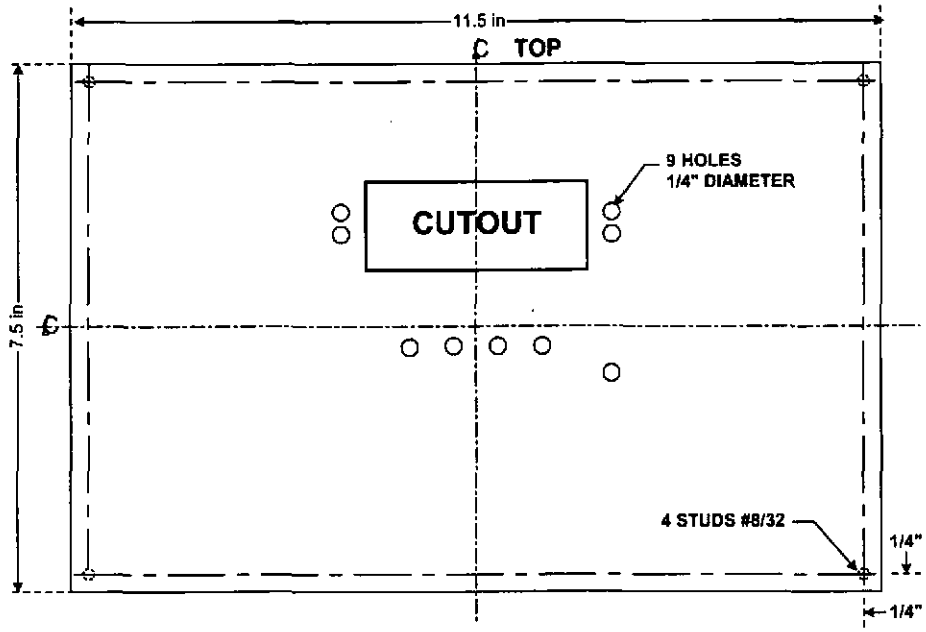

FIGURE #8: ADAPTER FACEPLATE

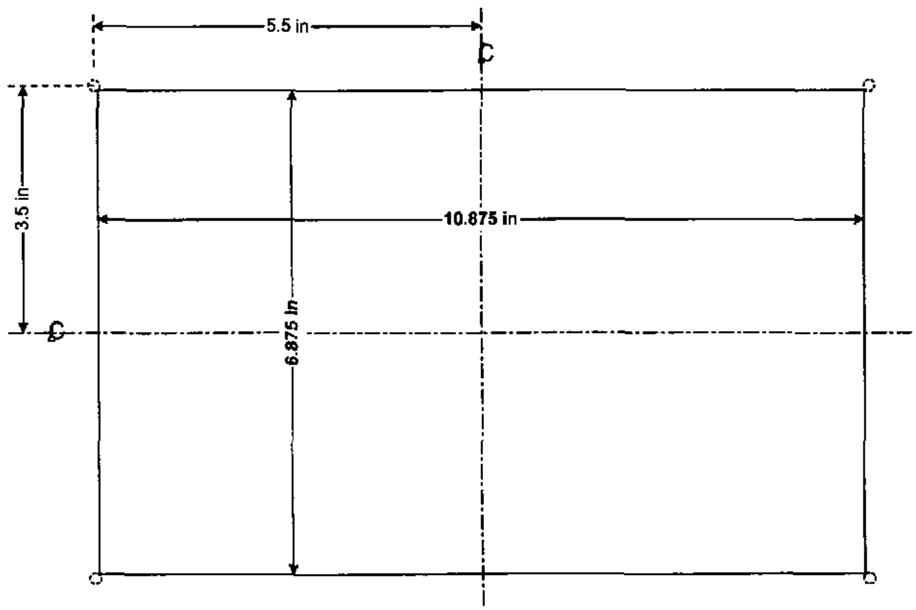

FIGURE #9: DOOR CUTOUT FOR ADAPTER FACEPLATE

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2.15. DIELECTRIC TESTING

Do not perform any high voltage dielectric testing on the control panel with the MEC 20 connected in the circuit as serious damage will occur to the controller. All AC control fuses connected to the MEC 20 must be removed if high voltage dielectric testing is performed on the control panel.

3. DESCRIPTION

The MEC 20 controller consists of three parts; a Lexan faceplate which is mounted externally on the enclosure door, a printed circuit board (PCB) which is mounted inside the enclosure door, and a rear cover for the PCB.

3.1. LEXAN FACEPLATE

The Lexan faceplate is shown as in FIGURE #10. The Lexan push-buttons are connected to the main PCB via plug-in ribbon cable. The main features of the Lexan faceplate are described as follows with reference to FIGURE #10.

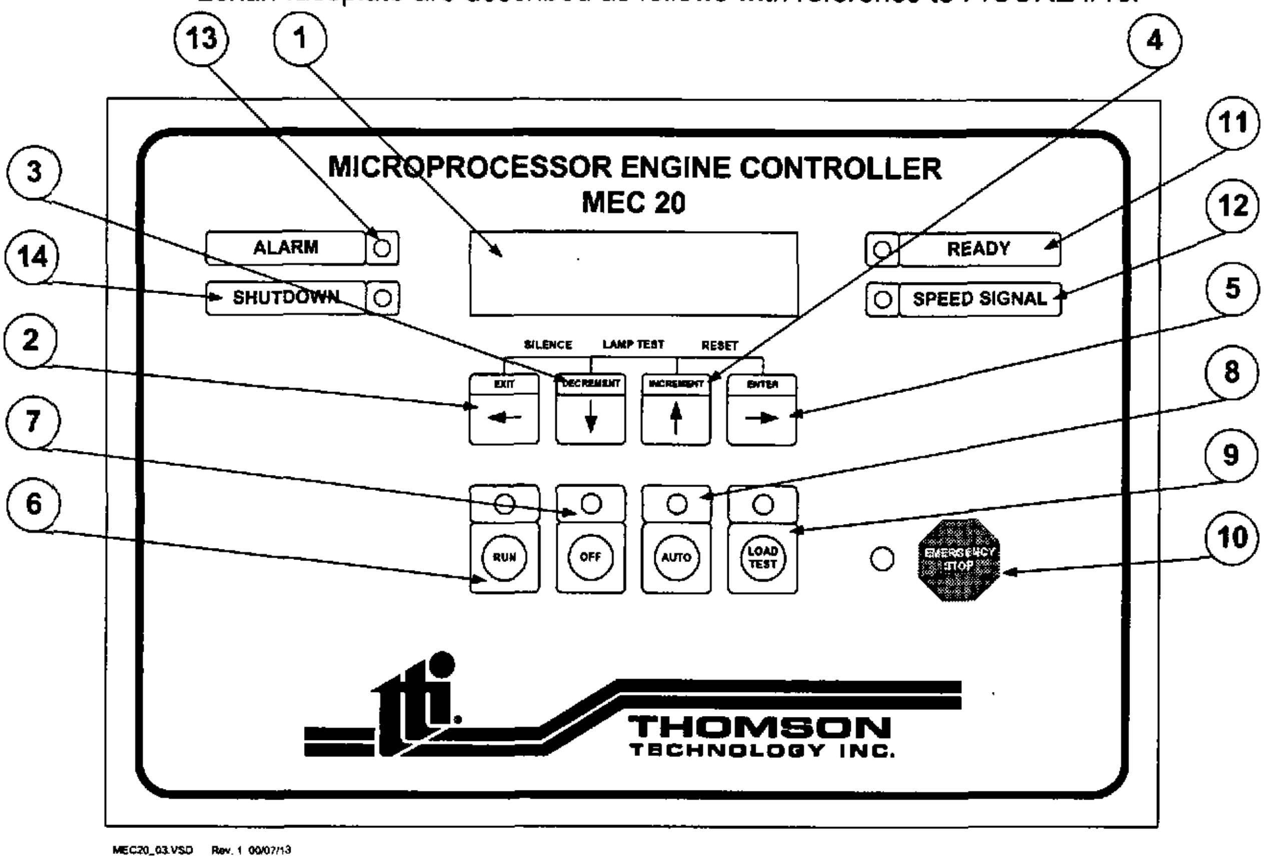

FIGURE #10

① LCD viewing window. The LCD display is mounted on the main PCB that is visible through the lexan faceplate viewing window.

② EXIT push-button. The EXIT function is used to scroll backwards through the status menus or programming prompts to the previous item. The EXIT function is used to "exit" the programming menu by holding this button down for approximately 2 seconds while in the programming mode.

③ DECREMENT push-button. The DECREMENT function is used to change a programming value while in the programming mode. When this push-button is held down, the displayed value will be "decremented" to a lower value as desired. **Note:** The longer the push-button is held down, the faster the value will be decremented.

④ INCREMENT push-button. The INCREMENT function is used to change a programming value while in the programming mode or to select a desired programming menu loop. When this push-button is held down, the displayed value will be "incremented" to a higher value as desired. **Note:** The longer the push-button is held down, the faster the value will be incremented.

⑤ ENTER push-button. The ENTER function is used to scroll forwards through the status menus or programming prompts to the next item. The ENTER function is used to "enter" a programming mode as well as accepting changed programming values. **Note:** In the programming mode, the longer the ENTER push-button is held down, the faster the next menu prompts will appear.

⑥ RUN push-button and LED light viewing window. The RUN function is used to initiate a manual start signal to the engine-generator set. Refer to the operating instructions for detailed information.

⑦ OFF push-button and LED light viewing window. The OFF function is used to initiate a stop signal to the engine-generator set. Refer to the operating instructions for detailed information.

⑧ AUTO push-button and LED light viewing window. The AUTO function is used to initiate automatic operation of the engine-generator set. Refer to the operating instructions for detailed information.

⑨ LOAD TEST push-button and LED light viewing window. The LOAD TEST function is used to initiate load test of the engine-generator set when connected to an associated transfer switch. Refer to the operating instructions for detailed information.

⑩ EMERGENCY STOP push-button and LED light viewing window. The EMERGENCY STOP function is used to initiate an emergency stop signal to the engine-generator set. Refer to the operating instructions for detailed information.

⑪ READY LED light viewing window. The READY LED illuminates when the engine-generator set is set for automatic operation and no shutdown or alarm faults have been activated.

⑫ SPEED SIGNAL LED light viewing window. The SPEED SIGNAL LED illuminates when the engines speed signal is detected (i.e. the engine is turning over).

⑬ ALARM LED light viewing window. The ALARM LED illuminates (flashes) when any pre-programmed alarm fault has been activated.

⑭ SHUTDOWN LED light viewing window. The SHUTDOWN LED illuminates (flashes) when any pre-programmed shutdown fault has been activated.

3.2. PRINTED CIRCUIT BOARD

The printed circuit board (PCB) is shown in FIGURE #11. The PCB contains the following user interface items:

MEC 20 CIRCUIT BOARD LAYOUT

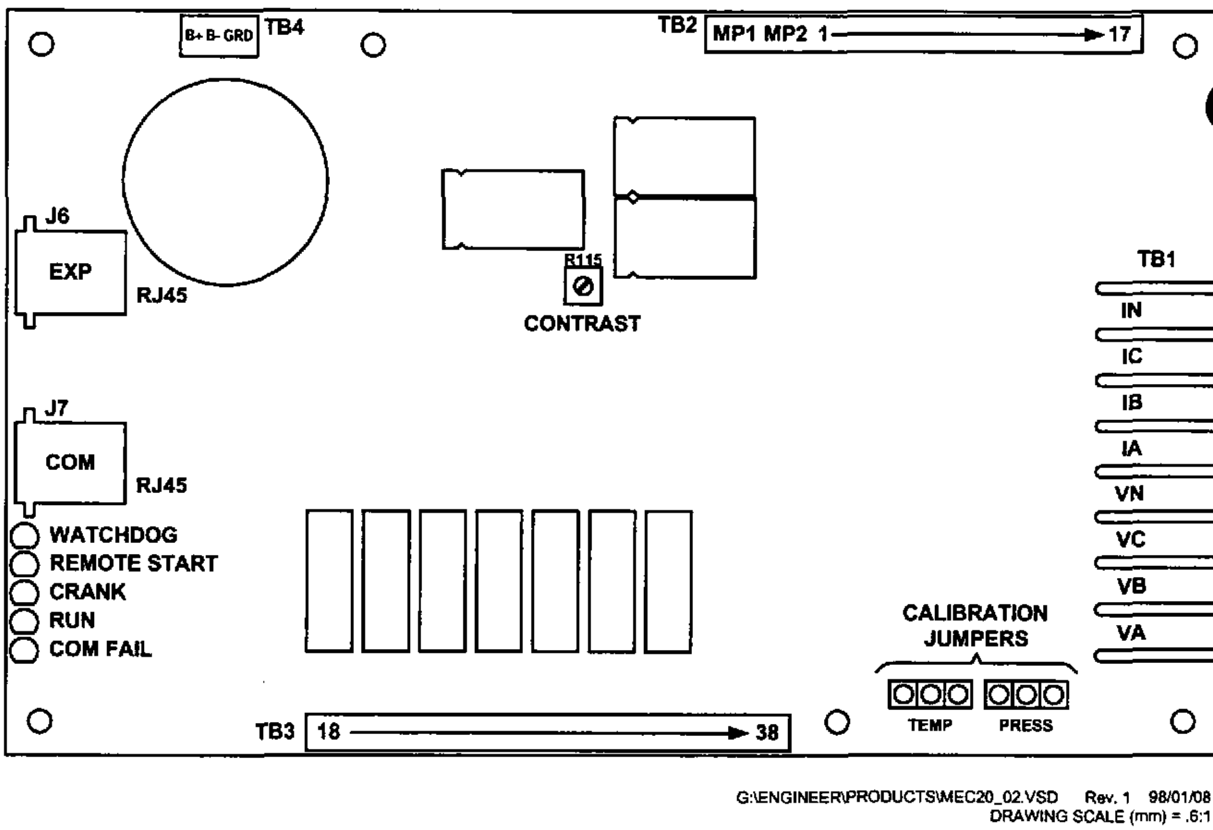

FIGURE #11

3.2.1. TERMINAL BLOCKS

Four terminal blocks are located on the PCB as follows:

TB1 AC Voltage and Current sensing terminal block (120-600VAC & 0-5AAC)

> ***WARNING!!!***
>
> ***Voltage sensing circuits are capable of lethal voltages while energized. Current transformer (CT) secondary circuits are capable of generating lethal voltages when open circuited with their primary circuit energized. Standard safety procedures should be followed and be performed by qualified personnel only. Failure to do so may cause personal injury and/or death.***

TB2 Speed sensing and digital contact input terminal block

TB3 Output contacts and engine temperature/pressure input signal terminal block

TB4 DC power input and ground connection terminal block

3.2.2. DIAGNOSTIC LED'S

The MEC 20 controller provides five diagnostics LED lights that are mounted on the rear of the printed circuit board as per FIGURE #11. Their functions are described as follows:

3.2.2.1.WATCHDOG

This LED flashes on and off at irregular intervals which indicates that the microprocessor is functioning normally.

3.2.2.2.REMOTE START

This LED is illuminated whenever the MEC 20 has received a remote start signal.

3.2.2.3.CRANK

This LED is illuminated whenever the MEC 20 is initiating an engine cranking signal.

3.2.2.4.RUN

This LED is illuminated whenever the MEC 20 has called the engine to run.

3.2.2.5.COMMON FAIL

This LED is illuminated whenever the MEC 20 has initiated a common fail signal (i.e. whenever an alarm or shutdown fault has been activated).

Note: All LED's will be illuminated whenever a lamp test function is performed.

3.2.3. CONTRAST ADJUSTMENT (R115)

A contrast adjustment potentiometer is located on the rear of the PCB and is factory set for ambient temperatures of 15° to 30° Celsius. For different ambient temperatures, consult the factory for adjustment procedures.

3.2.4. COMMUNICATION PORTS

Two RJ45 communication ports are provided on the circuit board for optional features as follows:

3.2.4.1 J6 - EXP This port is utilized to interconnect an external expansion module for additional output contacts. Refer to section #7.0 for additional information.

3.2.4.2 J7 - COM This port is utilized to interconnect to a remote communication system for remote monitoring and control. Refer to section #6.0 for additional information.

3.2.5. CALIBRATION JUMPERS

Calibration jumpers are provided for analog oil pressure and engine temperature circuits. Refer to Section #9.6.9 for further information.

4. FAULT CIRCUIT DESCRIPTIONS

The MEC 20 engine-generator controller utilizes many analog and digital inputs to perform both monitoring and control functions. Three types of fault circuits are used to monitor and control the engine-generator set. The first type is *Internal Fault Circuits* that are derived from a combination of digital and analog inputs. The second type is *Digital Input Fault circuits* that are initiated from external contact inputs. The third type is *Analog Input Fault circuits* that are initiated from external analog signal inputs. The following functional block diagram (FIGURE #12) shows how all input/output fault circuits are organized and how the standard and optional fault circuits are derived.

4.1. MEC 20 FUNCTIONAL BLOCK DIAGRAM

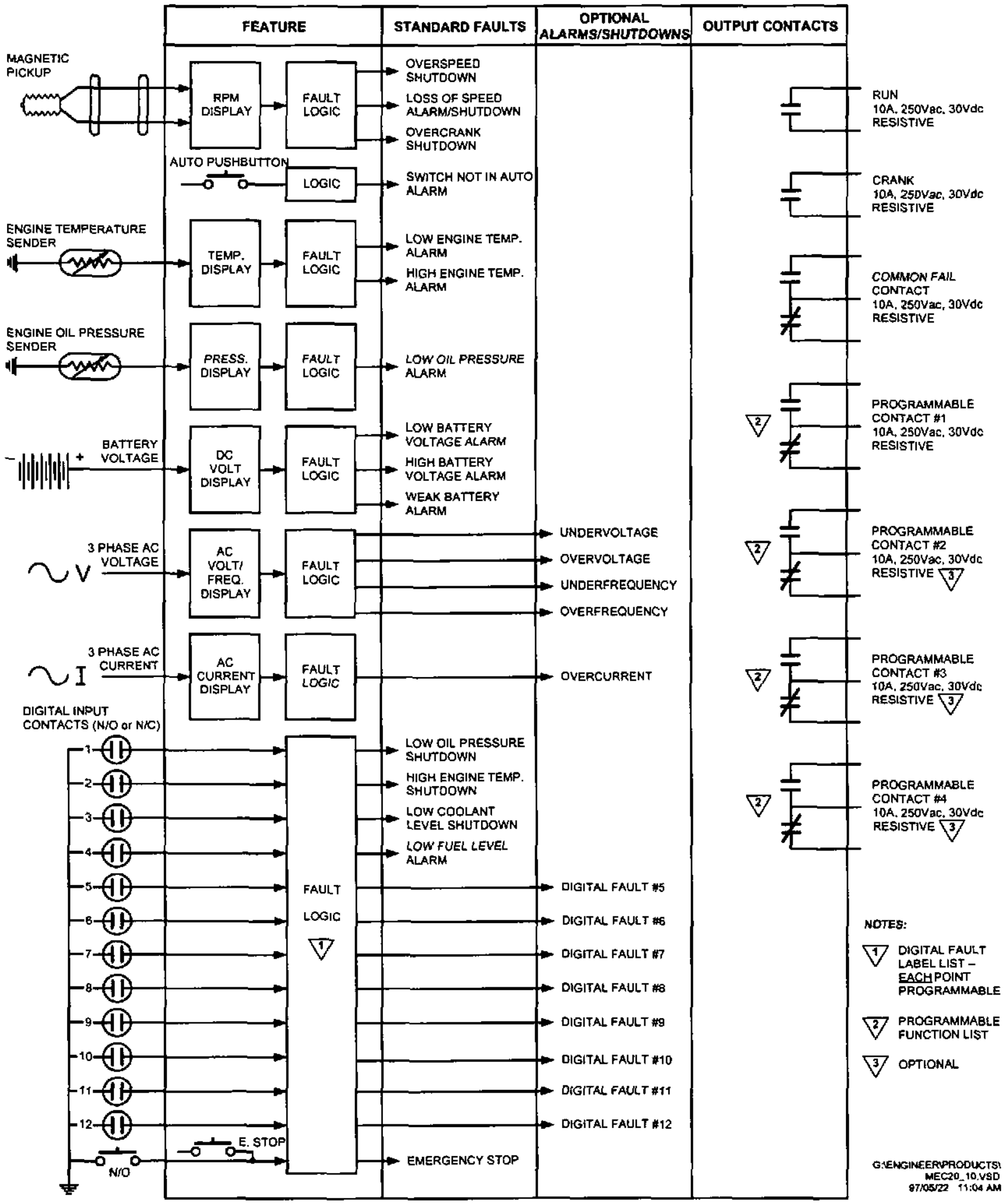

FIGURE #12

4.2. INTERNAL FAULT CIRCUITS

The MEC 20 Engine Controller provides four internally activated fault circuits as described below. All internal fault circuits are provided as standard with every MEC 20 controller.

4.2.1. OVERCRANK

The overcrank fault circuit is initiated when the engine fails to start after the selected crank time or number of crank cycles. The overcrank fault circuit is internally programmed as a latching shutdown fault and is not user programmable. Refer to the programming instructions for further information.

4.2.2. OVERSPEED

The overspeed fault circuit is initiated when the engine's speed has increased above the overspeed setpoint. The overspeed fault circuit is internally programmed as a latching shutdown fault. The overspeed shutdown fault circuit is programmable for the percentage of nominal engine speed (i.e. overspeed setpoint) and for the transient time delay period. The programming prompts for overspeed are located in the main menu programming loop. Refer to the programming instructions for further information.

4.2.3. LOSS OF SPEED

The loss of speed fault circuit is initiated when the engine's speed sensing circuit does not detect a speed signal for a period more than 2 seconds following a run signal. The loss of speed fault circuit may be user programmed as a latching shutdown fault or alarm only. The programming prompts for loss of speed are located in the main menu programming loop. Refer to the programming instructions for further information.

4.2.4. SWITCH NOT IN AUTO

The "Switch Not In Auto" fault circuit is initiated when the controller's operating mode switch is changed from the auto position to any other position via the front mounted keypad. This fault is internally programmed as a non latching alarm. In the main programming loop, this alarm may be user programmed to initiate the common fail output relay.

4.3. DIGITAL FAULT INPUT CIRCUITS

The MEC 20 Engine Controller provides up twelve digital fault input circuits that are fully user programmable. Each digital fault input circuit is activated via a remote sensing contact that is external to the controller. The controller is factory supplied with four standard digital fault circuits and the remaining eight fault circuits are available as options and must be ordered at time of equipment purchase.

Each digital fault input circuit may be programmed with a unique fault label description as stored in the controller's non-volatile memory. The following digital fault labels are provided in each MEC 20 engine controller:

AIR DAMPER TRIPPED
BAT CHARGER INPUT FAIL
BAT CHRG TROUBLE
BREAKER TRIPPED
DC FAIL
FAILED TO SYNC
GEN BREAKER OPEN
GROUND FAULT
HIGH BEARING TEMP
HIGH COOLER VIBRATION
HIGH ENGINE TEMP
HIGH ENGINE VIBRATION
HIGH FUEL LEVEL
HIGH OIL LEVEL
HIGH OIL TEMP
HIGH WINDING TEMP
IDLE●
"Blank" (i.e. no text for unused inputs)

LOW COOLANT LEVEL
LOW ENGINE TEMP
LOW FUEL PRESS
LOW FUEL LEVEL
LOW OIL LEVEL
OVERSPEED
OVER VOLTAGE
REMOTE EMERG. STOP
REVERSE POWER
UNDER VOLTAGE

● *Idle fault label is optional and may be factory ordered only*

Note: Up to six *custom "user defined"* fault label names may be specified for the MEC 20 controller at time of purchase. The six *custom* fault label names cannot be changed once shipped from the factory.

4.3.1. STANDARD DIGITAL FAULT CIRCUITS

The MEC 20 is supplied from the factory with four standard digital fault circuits as follows:

FAULT NAME	FAULT ACTION	INPUT TERMINAL #
Low Oil Pressure	Shutdown	1
High engine Temperature	Shutdown	2
Battery charger input Fail •	Alarm	3
Low Fuel Level	Alarm	4

All faults require a customer connected contact to the MEC 20 input terminal as indicated. All fault circuits may be user field programmed for different control functions or alternate fault names.

•**Note:** For CSA C282 applications the controller will be factory supplied with Low coolant level shutdown in place of Battery charger input fail alarm. Refer to the programming instructions for further information on digital fault circuits.

4.4. ANALOG FAULT INPUT CIRCUITS

The MEC 20 Engine Controller provides up to thirteen analog fault input circuits that are fully user programmable. The controller is supplied from the factory with eight standard analog fault circuits, and five optional analog fault circuits. Each analog fault input circuit is activated via specific analog signal type.

4.4.1. STANDARD ANALOG FAULT CIRCUITS

The MEC 20 is supplied from the factory with eight standard analog fault circuits as follows:

FAULT NAME	FAULT ACTION	INPUT SIGNAL
Overspeed	Shutdown	Engine speed
Loss of speed signal	Shutdown	Engine speed
Low battery voltage	Alarm	Battery voltage
High battery voltage	Alarm	Battery voltage
Weak battery	Alarm	Battery voltage
Low oil pressure	Alarm	Oil pressure
High engine temperature	Alarm	Engine temperature
Low engine temperature	Alarm	Engine temperature

All fault circuits may be user field programmed for different control functions however their designated fault function is not programmable. Refer to the programming instructions for further information.

4.4.2. ENGINE SPEED ANALOG INPUT

The MEC 20's engine speed sensor measures AC voltage and frequency from an engine mounted magnetic pick-up. The engine speed sensor provides information to perform the following control functions:

Overspeed shutdown
Crank Disconnect control
Loss of speed signal detection
Starter Re-engage control
RPM display

Refer to the programming instructions for further information.

4.4.3. BATTERY VOLTAGE ANALOG INPUT

The MEC 20's battery voltage sensor measures DC voltage on terminals B+ and B- that are connected to the engines cranking battery. The battery voltage sensor provides information to perform the following control functions:

4.4.3.1.LOW BATTERY VOLTAGE ALARM

The low battery voltage alarm fault circuit is activated when the battery voltage drops below a pre-determined setpoint for a specified time delay. The low battery voltage alarm fault is fully programmable for the voltage setpoint level, transient time delay settings and other functions. Refer to the programming instructions for further information.

4.4.3.2. HIGH BATTERY VOLTAGE ALARM

The high battery voltage alarm fault circuit is activated when the battery voltage rises above a pre-determined setpoint for a specified time delay. The high battery voltage alarm fault is fully programmable for voltage setpoint level, transient time delay settings and other functions. Refer to the programming instructions for further information.

4.4.3.3. WEAK BATTERY ALARM

The weak battery alarm fault circuit is activated when the battery voltage drops below a pre-determined setpoint for a specified time delay. The weak battery alarm will detect a low capacity (i.e. "weak") battery condition during the cranking cycle. The weak battery alarm is programmed for a lower battery voltage setpoint and shorter time delay than the low battery alarm function. The weak battery alarm fault is fully programmable for voltage setpoint level, transient time delay settings and other functions. Refer to the programming instructions for further information.

4.4.4. ENGINE OIL PRESSURE ANALOG INPUT

The MEC 20's engine oil pressure sensor measures a DC analog signal from an engine mounted sender. The MEC 20 software provides calibration for oil pressure to coordinate with the engine mounted sender and control logic to detect a wiring or sender failure (i.e. open or shorted signal). In case of a sender or wiring failure, the MEC 20 will display zero or 9999 PSI and will initiate an alarm signal as programmed by the user. The engine oil pressure analog input provides the following control function:

4.4.4.1. LOW OIL PRESSURE ALARM

The low oil pressure alarm fault circuit is activated when the oil pressure drops below a pre-determined setpoint for a specified time delay. The low oil pressure alarm fault is fully programmable for pressure setpoint level, transient time delay settings and other functions. Refer to the programming instructions for further information.

4.4.5. ENGINE TEMPERATURE ANALOG INPUT

The MEC 20's engine temperature sensor measures a DC analog signal from an engine mounted sender. The MEC 20 software provides calibration for engine temperature to coordinate with the engine mounted sender and control logic to detect a wiring or sender failure (i.e. open or shorted signal). In case of a sender or wiring failure, the MEC 20 will display zero or 9999 °C and will initiate an alarm signal as programmed by the user. The engine temperature analog input provides the following control functions:

4.4.5.1.LOW ENGINE TEMPERATURE ALARM

The low engine temperature alarm fault circuit is activated when the engine temperature drops below a pre-determined setpoint for a specified time delay. The low engine temperature alarm fault is fully programmable for temperature setpoint level, transient time delay settings and other functions. Refer to the programming instructions for further information.

4.4.5.2.HIGH ENGINE TEMPERATURE ALARM

The high engine temperature alarm fault circuit is activated when the engine temperature rises above a pre-determined setpoint for a specified time delay. The high engine temperature alarm fault is fully programmable for the level of temperature setpoint, transient time delay settings and other functions. Refer to the programming instructions for further information.

4.4.6. OPTIONAL ANALOG FAULT CIRCUITS

All optional analog fault circuits may be user field programmed for setpoint levels and transient time delays, however their designated fault function is not programmable. **Note:** All optional analog fault circuits *must be ordered at time of equipment purchase. Five optional analog* fault circuits are available with the MEC 20 as follows:

4.4.6.1.GENERATOR UNDERVOLTAGE

The MEC 20 controller provides an optional 3-phase undervoltage sensor for the generator supply. The undervoltage sensor is programmable for type of fault action (i.e. alarm or shutdown), pickup and dropout voltage setpoints (i.e. adjustable hysteresis) and transient time delay settings. Refer to the programming instructions for further information.

4.4.6.2.GENERATOR OVERVOLTAGE

The MEC 20 controller provides an optional 3-phase overvoltage sensor for the generator supply. The overvoltage sensor is programmable for type of fault action (i.e. alarm or shutdown), pickup and dropout voltage setpoints (i.e. adjustable hysteresis) and transient time delay settings. Refer to the programming instructions for further information.

4.4.6.3.GENERATOR UNDERFREQUENCY

The MEC 20 controller provides an optional underfrequency sensor for the generator supply. The underfrequency sensor is programmable for type of fault action (i.e. alarm or shutdown), frequency setpoint, and transient time delay settings. Refer to the programming instructions for further information.

4.4.6.4.GENERATOR OVERFREQUENCY

The MEC 20 controller provides an optional overfrequency sensor for the generator supply. The overfrequency sensor is programmable for type of fault action (i.e. alarm or shutdown), frequency setpoint, and transient time delay settings. Refer to the programming instructions for further information.

4.4.6.5.GENERATOR OVERCURRENT

The MEC 20 controller provides an optional 3-phase current sensor for the generator supply. The current sensor is programmable for type of fault action (i.e. alarm or shutdown), pickup current setpoint, and transient time delay settings. Refer to the programming instructions for further information.

5. CONTROL OUTPUT CONTACT DESCRIPTIONS

All output contacts from the MEC 20 Engine Controller are non-powered (i.e. dry contacts) and are rated 10A resistive (3A inductive, 0.4pf), 30Vdc, 250Vac. Output contacts are not fused therefore external overcurrent protection (maximum 10A) is required for all control circuits using these contacts. Contacts indicated on schematic drawings and connection diagrams are shown in a de-energized state and will change state upon activation of the specific control function.

5.1. RUN, CRANK, COMMON FAIL OUTPUT CONTACTS

The MEC 20 Controller provides three dedicated output contacts for basic control and alarm circuits as described below:

5.1.1. RUN OUTPUT

The Run output contact is a Form "A" dry contact and is used to control the engines "run" circuit. This typically includes external control devices such as "fuel rack solenoids" or electronic governors'. **Note:** An additional pilot relay will be required to energize high current devices that exceed the 10A resistive rating. The run output control logic provides an "energize to run signal" (i.e. the run contact closes when a run condition is activated). **Note:** For energize to *stop* control logic, refer to the programmable output control function.

5.1.2. CRANK OUTPUT

The Crank output contact is a Form "A" dry contact and is used to control an external crank pilot relay that directly controls the engine starter motor. **Note:** An external crank pilot relay is required to energize the high current starter motor pinion solenoid that exceeds the 10A resistive crank output contact rating. The crank output contact closes when a crank condition is activated and the contact will automatically open when crank disconnect speed is obtained and/or the generators output AC voltage exceeds 10% of nominal level. The generators output AC voltage is utilized for back-up crank disconnect protection should the speed sensor fail.

5.1.3. COMMON FAIL OUTPUT

The Common Fail output contact is a Form "C" dry contact and is typically used to provide a remote alarm signal should the generator set fail. The common fail output contact closes when any programmed alarm or shutdown fault condition is activated. **Note:** The MEC 20 may be programmed to activate the common fail output for any desired fault input circuits or for abnormal switch position (i.e. switch not in auto). Refer to the programming instructions for further information.

5.2. PROGRAMMABLE OUTPUT CONTACTS

The MEC 20 Controller provides one standard programmable output contact and three optional contacts. **Note:** All optional programmable outputs must be ordered at time of equipment purchase. Each programmable output is a Form "C" dry contact that is programmable for many different control functions. All programmable outputs may be user field programmed for the desired control function. The following programmable features are provided:

ENERGIZE TO STOP	IDLE CONTROL
PRE/POST/CYCLIC LUBE CONTROL	SWITCH NOT IN AUTO
OVERCURRENT	PREHEAT
READY STATUS	ENGINE RUNNING
AIR FLAP	ATS TEST
OIL BYPASS TIMER COMPLETE	COMMON ALARM
COMMON FAIL	COMMON SHUTDOWN

5.2.1. ENERGIZE TO STOP

The designated programmable output relay will energize when a stop signal has been activated. The output will remain energized for 10 seconds once the engine has come to a complete stop, then de-energizes.

5.2.2. IDLE CONTROL

The designated programmable output relay will energize when an idle signal has been issued to the engine controller. The output contact would typically be connected to the "idle/run" input control of an electronic governor. **Note:** The controller receives an idle signal from a digital input contact that must additionally be programmed for an idle function. During an idle condition, the engine controller automatically bypasses all alarm or shutdown circuits (except oil pressure and overspeed) which are programmed for "bypass on start".

5.2.3. PRE/POST/CYCLIC LUBE CONTROL

The designated programmable output relay will energize when a "lube" signal has been initiated. **Note:** The Lube function will be automatically terminated once an engine start signal is issued. Refer to the programming instructions for further information.

5.2.4. SWITCH NOT IN AUTO

The designated programmable output relay will energize when the controller's operation mode switch is not in the auto position.

5.2.5. OVERCURRENT

The designated programmable output relay will energize when the overcurrent fault circuit is activated. The output will remain energized until the fault condition has been manually reset (if programmed as a latching type fault) or until the overcurrent level drops below the setpoint.

5.2.6. PREHEAT

The designated programmable output relay will energize during the start delay timer period and cranking period until the engine starts and reaches crank disconnect speed. The preheat output is typically used for an engine starting aid such as glow plugs. **Note:** An external pilot relay is required to switch the high current glow plug load.

5.2.7. READY STATUS

The designated programmable output relay will energize when the engine controller's mode switch is in the auto mode and no shutdown or alarm conditions are present.

5.2.8. ENGINE RUNNING

The designated programmable output relay will energize when the engine has started and has reached crank disconnect speed.

5.2.9. AIRFLAP

The designated programmable output relay will energize when the engine's speed exceeds the overspeed setpoint level. The output will remain energized until the engine's speed drops below the low speed setpoint (typically 5% of rated speed). **Note:** An external pilot relay will be required if the main air flap solenoid current rating exceeds the MEC 20 contact rating.

5.2.10. ATS TEST

NOTE:
This control feature is only operative if a remote transfer switch is interconnected with remote testing capability.

The designated programmable output relay will energize when a load test operating mode is selected via the front keypad push-button. Once initiated, the engine will receive a start signal from the transfer switch and upon the generator reaching nominal voltage and frequency levels, a load transfer will be initiated. The generator set will remain running on load until a different operating mode is selected or the generator set develops an alarm or shutdown condition.

Note: The MEC 20's standard programmable output contact is factory supplied with the ATS LOADTEST function programmed.

5.2.11. OIL BYPASS TIMER COMPLETE

The designated programmable output relay will energize upon the expiary of the controller's oil bypass delay timer function, following a normal start sequence.

5.2.12. COMMON ALARM

The designated programmable output relay will energize when any alarm fault circuit has been activated.

5.2.13. COMMON FAIL

The designated programmable output relay will energize when any alarm or shutdown fault circuit has been activated.

5.2.14. COMMON SHUTDOWN

The designated programmable output relay will energize when any shutdown fault circuit has been activated.

6. REMOTE COMMUNICATION OPTION

The MEC 20 engine generator controller is available with an optional remote communication feature. The remote communication feature allows a MEC 20 controller to be monitored and controlled from a remote location via serial communication link to a personal computer (PC). PC's may be connected locally via serial communication cable to the MEC 20 or remotely via modem and telephone systems. Remote communication can be via customer supplied equipment or an external communication interface module (CIM) as manufactured by Thomson Technology Inc. The CIM module utilizes an internal modem and contains Modbus™ protocol to interface with different remote monitoring software programs. Refer to separate literature for detailed information on the CIM module. The MEC 20 remote communication option must be ordered and be factory enabled prior to shipment. The communication feature cannot be user enabled once shipped from the factory.

The MEC 20 communication port utilizes a RS422 data transmission signal which is directly interconnected to the CIM module via 8 conductor, shielded cable with plug-in RJ45 connectors. Refer to FIGURE #14 & 15 for detailed information on direct connected or remote connected PC applications with CIM module.

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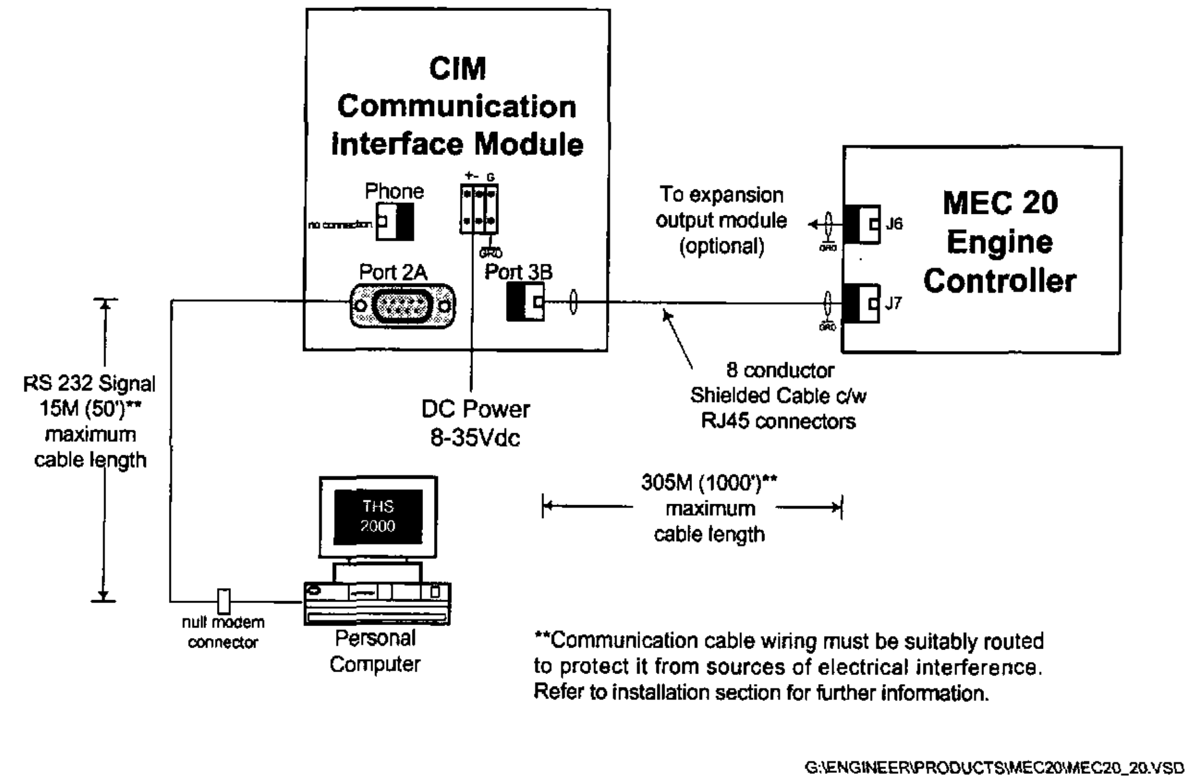

FIGURE #14 MEC 20 WITH CIM MODULE & DIRECT CONNECTED PC

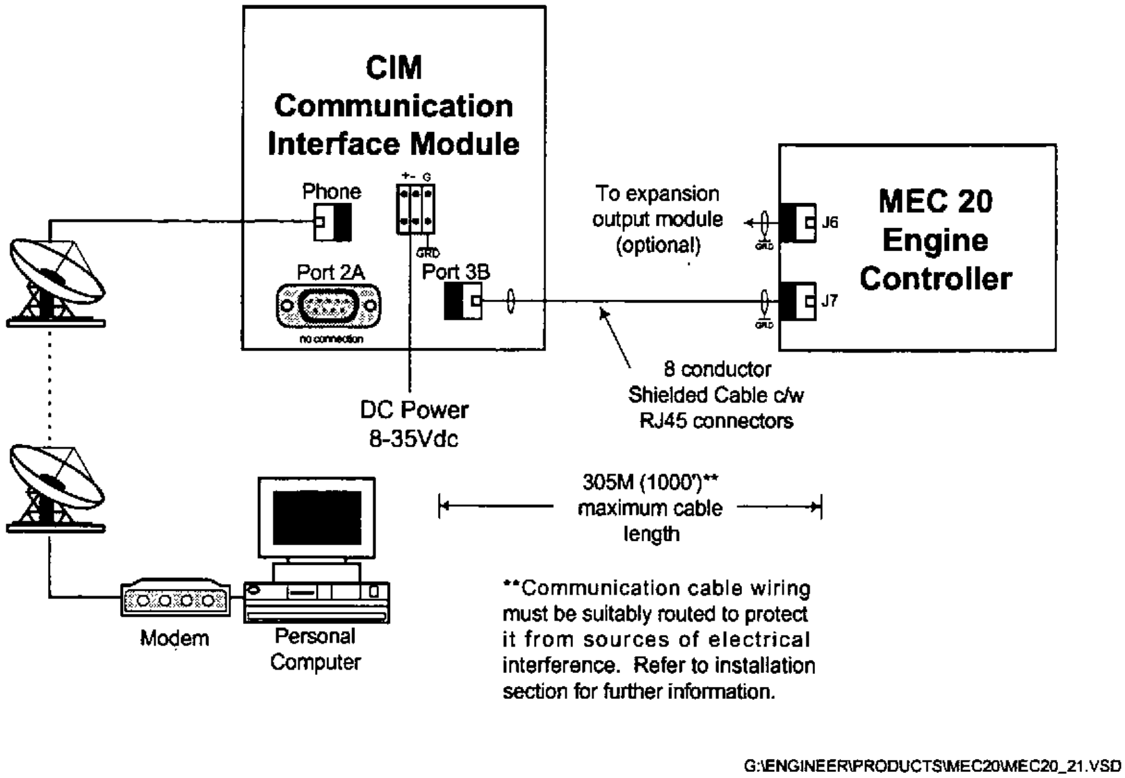

FIGURE #15 MEC 20 WITH CIM MODULE & REMOTE CONNECTED PC

The MEC 20 RS422 communication port allows multiple MEC 20 controllers to be directly interconnected together to form a single network system. Up to 10 MEC 20 controllers may be interconnected to a single CIM module. Each MEC 20 controller is programmed with an unique communication address number for the remote communication system to reference. The network system may be connected to a local PC or to a remote PC via telephone system and CIM module. Refer to FIGURE #15 for a typical MEC 20 network system with CIM module.

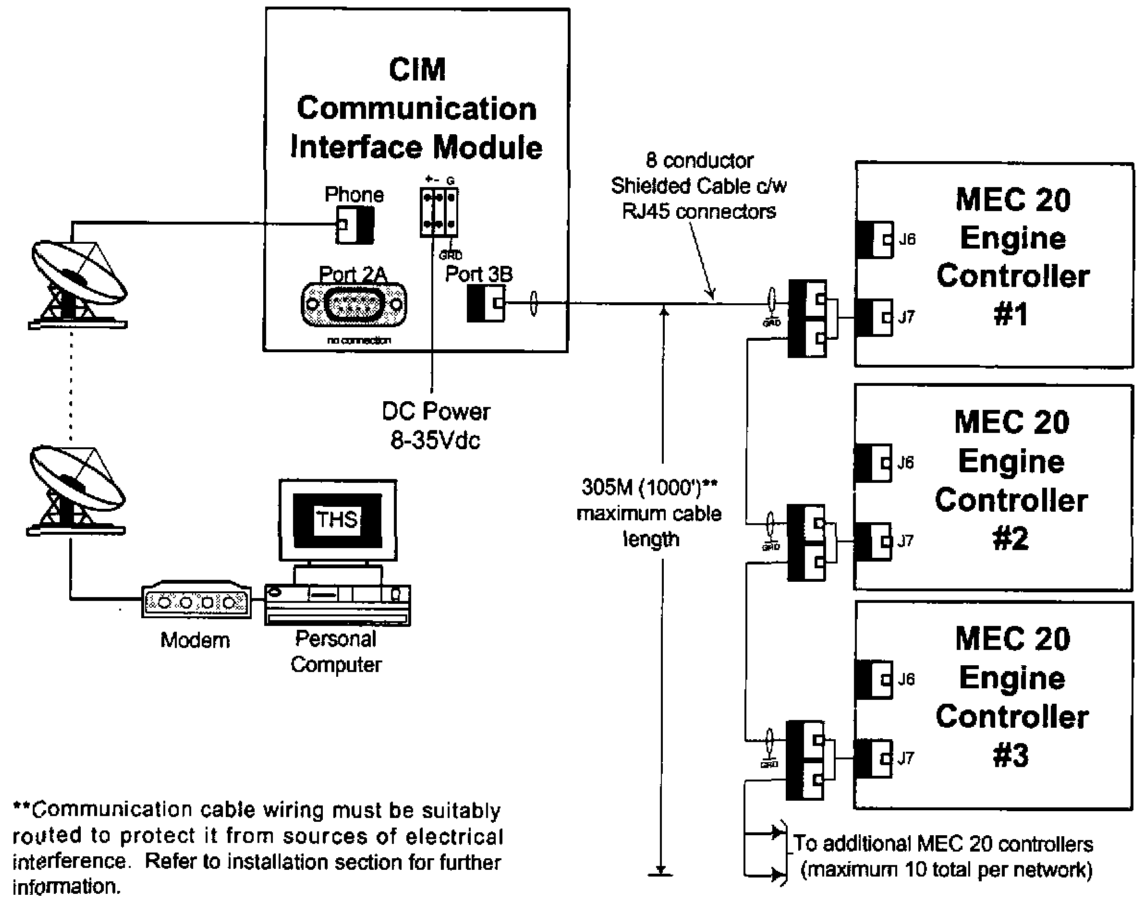

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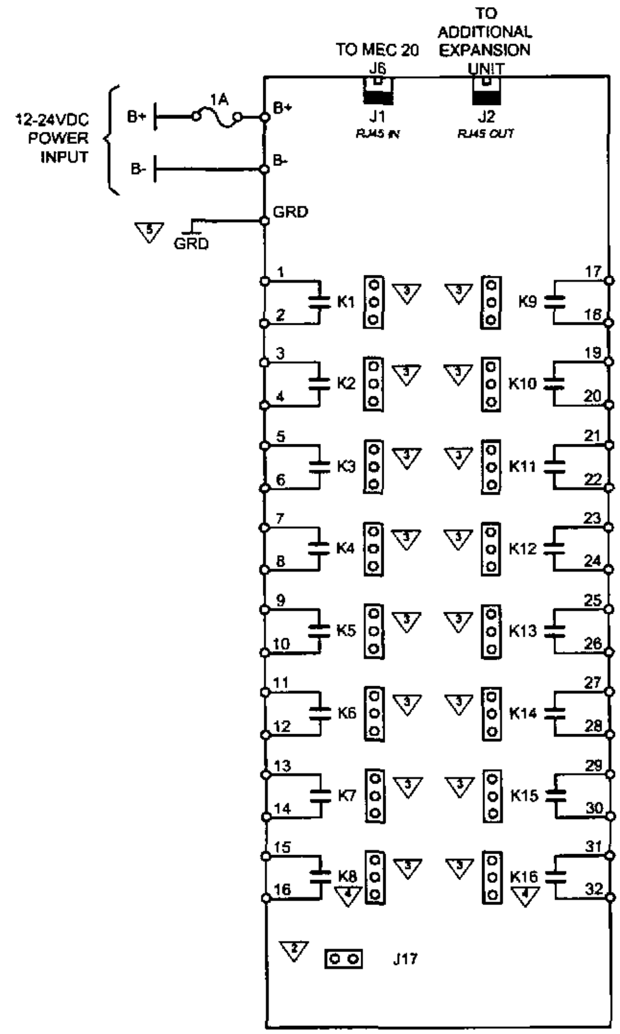
FIGURE #16 NETWORKED MEC 20 INTERCONNECTION DIAGRAM

7. EXPANSION OUTPUT MODULE OPTION

An optional expansion output module is available for the MEC 20 engine generator controller. This module provides 16 individual fault output contacts for remote alarming or control purposes. The expansion module is interconnected to the MEC 20 controller via RS 422 communication link utilizing 8 conductor shielded cable with plug-in RJ45 connectors. Refer to FIGURE #17 for the expansion output module connection diagram.



RELAY ID	STANDARD FAULTS (J17 OFF)
1	EMERGENCY STOP
2	OVERCRANK
3	OVERSPEED
4	LOSS OF SPEED SIGNAL
5	WEAK BATTERY
6	LOW BATTERY VOLTAGE
7	HIGH BATTERY VOLTAGE
8	LOW ENGINE TEMPERATURE
9	HIGH ENGINE TEMPERATURE ALARM
10	LOW OIL PRESSURE ALARM
11	DIGITAL FAULT #1
12	DIGITAL FAULT #2
13	DIGITAL FAULT #3
14	DIGITAL FAULT #4
15	SWITCH NOT IN AUTO
16	PROGRAMMABLE OUTPUT #5
	OPTIONAL FAULTS (J17 ON)
1	UNDER VOLTAGE
2	OVER VOLTAGE
3	UNDER FREQUENCY
4	OVER FREQUENCY
5	OVER CURRENT
6	FUTURE
7	FUTURE
8	DIGITAL FAULT #5
9	DIGITAL FAULT #6
10	DIGITAL FAULT #7
11	DIGITAL FAULT #8
12	DIGITAL FAULT #9
13	DIGITAL FAULT #10
14	DIGITAL FAULT #11
15	DIGITAL FAULT #12
16	PROGRAMMABLE OUTPUT #6

NOTES:

1. ALL CONTACTS RATED MAXIMUM 0.5A, 120Vac/1.0A, 30Vdc RESISTIVE
2. PROGRAMMABLE MODULE ADDRESS (REMOVE JUMPER FOR STANDARD FAULTS, ADD JUMPER FOR OPTIONAL FAULTS)
3. CONTACT LOGIC IS INDIVIDUALLY PROGRAMMABLE VIA PIN JUMPERS (CONTACT TO OPEN OR CLOSE WHEN FAULT ACTIVATED)
4. *PROGRAMMABLE CONTACT - USER CONFIGURED FUNCTION VIA MEC 20 SOFTWARE* (REFER TO MEC 20 LITERATURE)
5. "GRD" CONNECTION TO BE MADE TO COMMON CHASSIS/ENCLOSURE GROUND BOND SYSTEM

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FIGURE #17 : EXPANSION OUTPUT MODULE CONNECTION DIAGRAM

The expansion module outputs are relay contacts which may be individually configured for normally open or normally closed contact position. Contact configuration is via circuit board mounted jumper pins and clips. Refer to FIGURE #18 for jumper pin location and configuration settings. Each output contact is rated maximum 0.5A 120Vac, 1.0A 30Vdc resistive.

Each expansion module also provides one programmable contact for desired control function. The programmable contact on the first expansion module (in the system) is referenced as "Programmable Output #5". On the second expansion module, the programmable contact is referenced as "Programmable Output #6". Refer to section #9.0 of this manual for programming functions and procedures for the programmable contact feature.

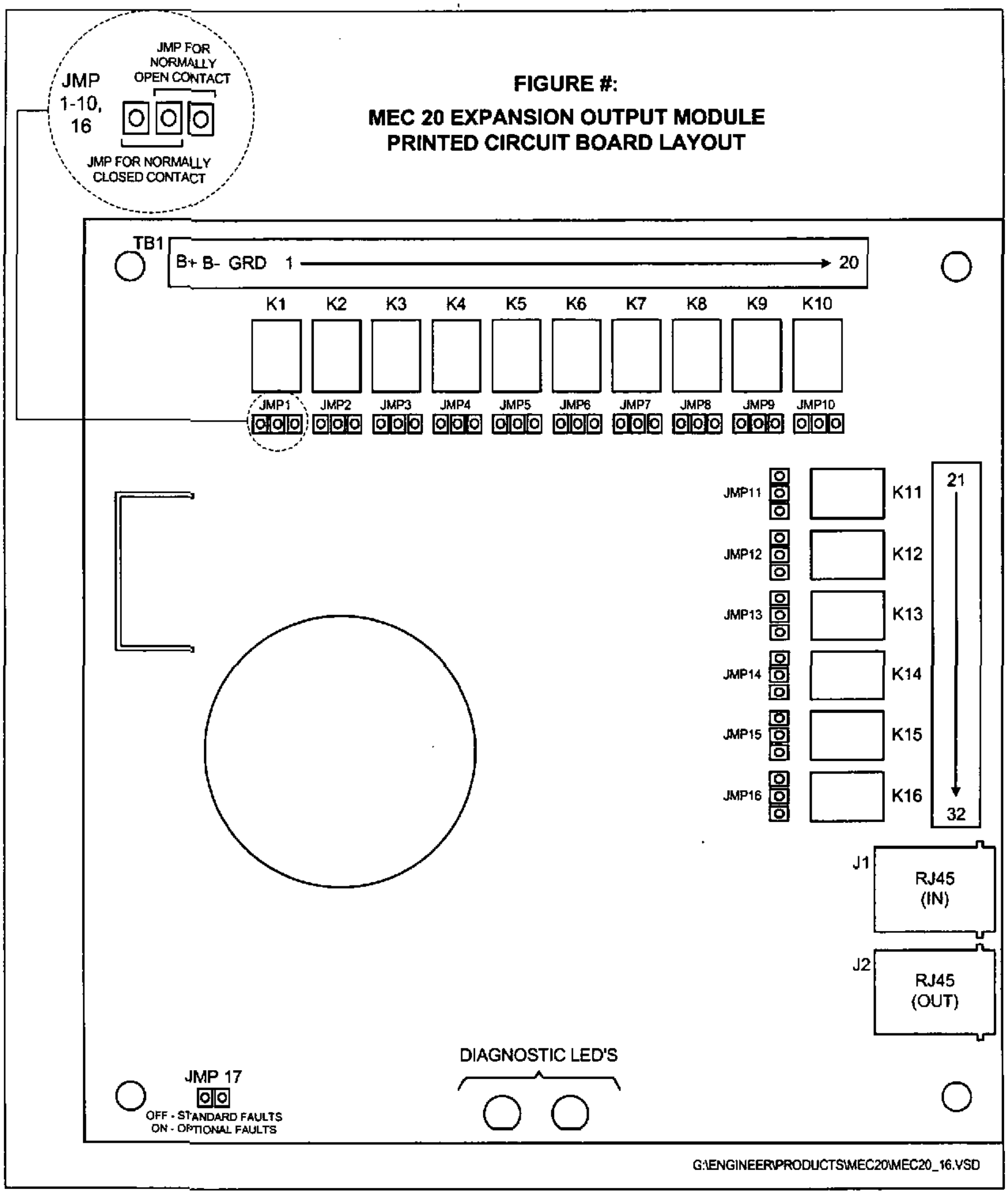


FIGURE #18: MEC 20 EXPANSION OUTPUT MODULE
PRINTED CIRCUIT BOARD LAYOUT

Diagnostic LED's are provided on each expansion module as shown in FIGURE #17. Their functions are described as follows:

WATCHDOG - This LED flashes on and off at a very high rate which indicates that the expansion module microprocessor is functioning normally.

MESSAGE - This LED flashes on and off at irregular intervals which indicates that the expansion module is correctly receiving all data messages from the MEC 20.

Two expansion modules may be connected to a single MEC 20 controller to provide a maximum of 32 output contacts. Two modules are interconnected together using a single communication cable to the MEC 20 controller. Refer to FIGURE #19 for interconnection details. The first expansion module addresses all standard MEC 20 fault circuits and the second expansion module addresses all optional fault circuits. To select which faults are addressed by each expansion module, jumper pins and clips are provided on the circuit boards. Refer to FIGURE #18 for jumper pin location and configuration settings.

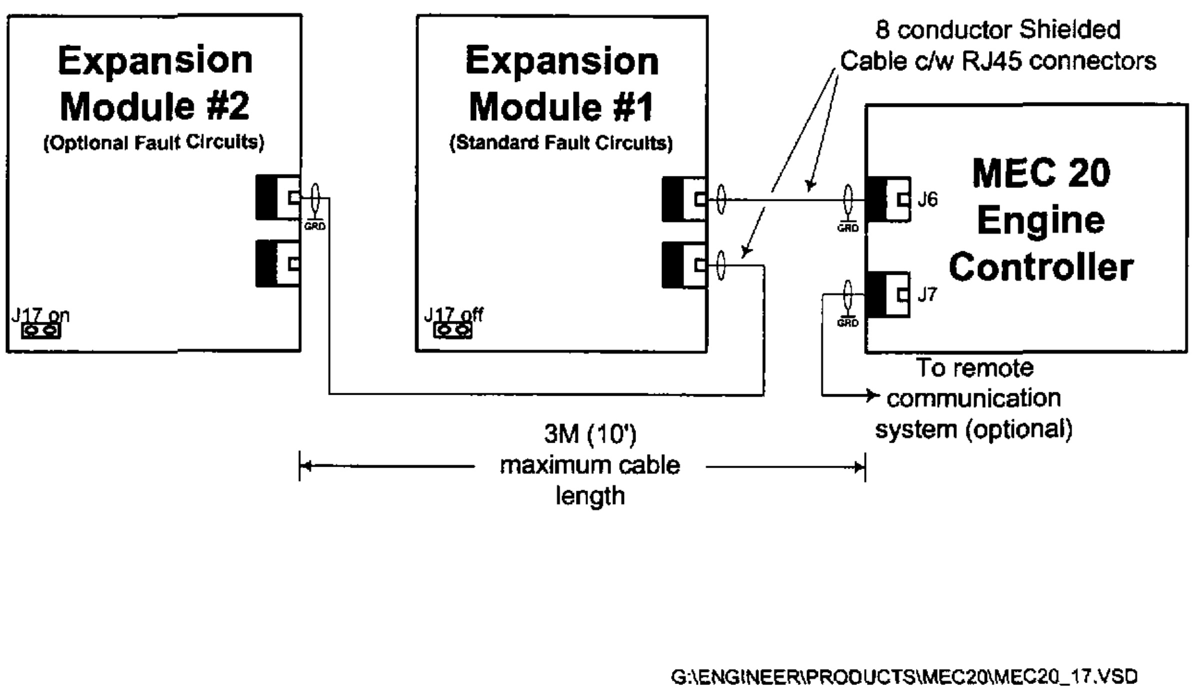


FIGURE #19 MEC 20 EXPANSION MODULE INTERCONNECTION DIAGRAM

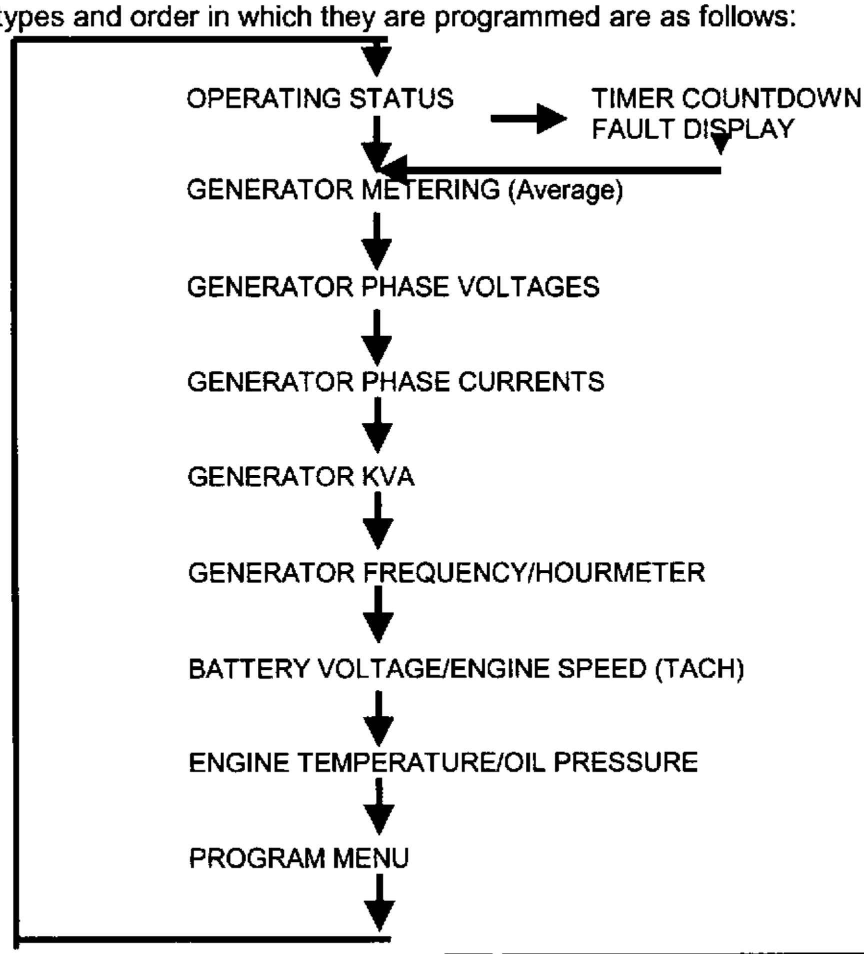
8. OPERATING INSTRUCTIONS

8.1. MEC 20 POWER-UP OPERATION SEQUENCE

When the MEC 20 is first energized with DC supply voltage at terminals B+ & B-, the controller will power-up into a fail-safe mode, preventing possible engine operation. The controller will default to an Emergency Stop failure mode and must be manually reset before the controller is put into normal operation. To reset the Emergency Stop condition, press the "OFF push-button first, then press both "INCREMENT' and "ENTER" push-buttons simultaneously. The controller will then reset, provided a *remote* emergency stop condition is not activated.

8.2. MEC 20 DISPLAY MENUS

The MEC 20 contains a Liquid Crystal Display (LCD) which is visible through the front lexan faceplate viewing window. The LCD has pre-programmed display screens and menus that may be selected by pressing the *ENTER* or *EXIT* push-buttons in succession until the desired screen or menu is displayed. The display screen types and order in which they are programmed are as follows:



8.2.1. OPERATING STATUS MENU

The operating status menu provides the operator with detailed information as to the status of the engine-generator set.

> **NOTE:**
> The operating status screen may be momentarily replaced with a time delay countdown screen when a start or stop sequence is initiated. The display will automatically return to the previous menu following expiry of the timing sequence.

The operating status sub-menus are organized as follows:

OPERATING STATUS
- SWITCH IN OFF
- UNIT RUNNING
- UNIT SHUTDOWN
- UNIT ALARM

8.2.1.1. SWITCH IN OFF

This indicates that the controller has been selected to the "off" position from the front panel keypad push-button.

8.2.1.2. UNIT RUNNING

This indicates that the engine is running and all conditions are normal.

8.2.1.3. UNIT SHUTDOWN

This indicates that one or more shutdown fault circuits are active. To display the fault condition, press the "ENTER" key.

8.2.1.4. UNIT ALARM

This indicates that one or more alarm fault circuits are active. To display the fault condition, press the "ENTER" key.

8.2.2. FAULT DISPLAY MENU

The fault display menu is automatically displayed when either an alarm or shutdown circuit is activated. The specific alarm or shutdown fault label will be displayed. To view multiple alarm conditions (if present), press the "ENTER" push-button to scroll through any other activated alarms.

8.2.3. TIMER COUNTDOWN MENUS

Timer countdown menus are automatically displayed when a specific time delay function occurs during a control sequence. When a time delay begins, the LCD display will indicate the time delay function name (i.e. ENGINE START DELAY) and the current time remaining in the countdown sequence. When the timing function has expired, the LCD display will automatically change to either the next timing sequence countdown display or return to the original system status menu.

LCD DISPLAY

ENGINE START
DELAY① 45 SEC②

① Displays specific time delay function currently in operation

② Displays current time in seconds or minutes that are left in the specific timing sequence.

> **NOTE:**
> During a timer countdown sequence, a different display screen may be selected by pressing the *"ENTER"* push-button.

The following timer countdown screens are provided:

ENG START DELAY	XX SEC.
CRANK PERIOD	XX SEC.
REST PERIOD	XX SEC.
STARTER RE-ENGAGE DELAY	XX SEC.
BYPASS DELAY	XX SEC.
COOLDOWN DELAY	XX MIN.

8.2.4. GENERATOR AC METERING

Four generator AC metering screens are provided as described below.

8.2.4.1. AVERAGE VOLTAGE/CURRENT & FREQUENCY DISPLAY

The generator average voltage/current & frequency metering screen allows the operator to simultaneously view all the listed parameters.

LCD DISPLAY

Vavg①	Aavg②	Freq③
600	432	60.1

① Displays the average generator voltage as follows:

3-phase system: AVERAGE LINE TO LINE VOLTAGE--Phases AB,BC,CA

1-phase system: LINE TO LINE VOLTAGE--Phases A to B

② Displays the average generator current as follows:

3-phase system: AVERAGE LINE CURRENT--Phases A,B,C

1-phase system: AVERAGE LINE CURRENT--Phases A,B

③ Displays generator frequency in hertz (HZ). The frequency is displayed with a resolution of 1/10 of a hertz.

8.2.4.2. GENERATOR KVA DISPLAY

The generator's total power output in kilo-voltamperes (KVA) is displayed.

LCD DISPLAY

KVA
532.31

8.2.4.3. GENERATOR PHASE VOLTAGE DISPLAY

The generator phase voltage screen allows the operator to view the generator AC voltage on all 3 phases (or single phase system as selected).

LCD DISPLAY

Vab①	Vbc②	Vca③
600	600	600

① Displays generator voltage as follows:

3-phase system: LINE TO LINE VOLTAGE--Phases A to B

1-phase system: LINE TO LINE VOLTAGE--Phases A to B

② Displays generator voltage as follows:

3-phase system: LINE TO LINE VOLTAGE--Phases B to C

1-phase system: LINE TO NEUTRAL VOLTAGE--Phases A-N

③ Displays generator voltage as follows:

3-phase system: LINE TO LINE VOLTAGE--Phases C-A

1-phase system: LINE TO NEUTRAL VOLTAGE--Phases B-N

8.2.4.4. GENERATOR PHASE CURRENT DISPLAY

The generator phase current screen allows the operator to view the generator load current on all 3 phases (or single phase system as selected).

LCD DISPLAY

Amps	a①	b②	c③
	408	451	415

① Displays generator load current as follows:

3-phase system: PHASE A CURRENT

1-phase system: PHASE A CURRENT

② Displays generator load current as follows:

3-phase system: PHASE B CURRENT

1-phase system: PHASE B CURRENT

③ Displays generator load current as follows:

3-phase system: PHASE C CURRENT

1-phase system: not applicable

8.2.4.5. GENERATOR FREQUENCY/HOURMETER DISPLAY

The generator frequency and operating hours are displayed simultaneously on this screen.

LCD DISPLAY

```
FREQ        60.1 Hz①
HOURS     56783 Hrs②
```

① Displays generator frequency in hertz (HZ). The frequency is displayed with a resolution of 1/10 of a hertz.

② Displays unit operating hours

8.2.5. ENGINE PARAMETER DISPLAY

Two engine operating parameter screens are provided as described below.

8.2.5.1. BATTERY VOLTAGE/ENGINE SPEED (tachometer)

The battery voltage and engine speed are displayed simultaneously on this screen

LCD DISPLAY

```
BATTERY    27.0Vdc①
SPEED      1800rpm②
```

① Displays battery voltage in DC volts. The voltage is displayed with a resolution of 1/10 of a volt.

② Displays engine speed in revolutions per minute (RPM).

8.2.5.2. ENGINE TEMPERATURE/OIL PRESSURE

The engines operating temperature and oil pressure are displayed simultaneously on this screen.

LCD DISPLAY

```
ENG TEMP   57 Deg C①
OIL PRESS  200 KPA②
```

[1] Displays engine temperature in either degrees Celsius or Fahrenheit (as selected).

[2] Displays engine oil pressure in either pounds per square inch (PSI) or in Kilopascals (KPA) (as selected).

8.2.6. PROGRAM MENU

The programming menu is used to access the MEC 20's programmable functions such as time delays, analog fault settings, digital fault settings and calibration .

Access to the programming *sub-menus* may only be obtained with a security password number. The sub menus are organized as follows:

PROGRAMMING MENU — NO
— YES —

PASSWORD

LCD DISPLAY

PROGRAM MENU?
NO[1]

[1] Displays two messages that may be toggled between YES and NO by pressing the *INCREMENT* push-button. Their functions are described as follows:

NO Programming sub-menus are disabled when NO is displayed.

YES Programming sub-menus are enabled when YES is displayed and a valid password number is entered.

8.3. SEQUENCE OF OPERATION

8.3.1. GENERAL

The MEC 20 Engine-generator controller is designed to start and stop an engine from either a local ("manual") or remote ("automatic") command. When this command is issued, the controller issues a run and crank output signal. The controller then monitors engine speed and when crank disconnect speed is reached, the crank signal is terminated. While the engine accelerates to normal speed, the controller continuously monitors the engines speed signal. Should the engine speed exceed the maximum predetermined setpoint, the overspeed shutdown fault circuit will activate, terminating the run signal. In addition to overspeed shutdown, the engine controller also monitors many other engine protection circuits and should they be activated, the engine will be stopped and/or alarm initiated. The engine will automatically stop for any shutdown condition, or when the remote and/or local start signal is removed. The engine controller operation includes time delay circuits for normal operating conditions such as start delays, cooldown and cranking periods.

8.3.2. MANUAL START/STOP SEQUENCE

When the controller's "RUN" push-button on the front faceplate keypad is pressed, an ENGINE START DELAY timer will be initiated. **Note:** The start sequence will not be initiated if any shutdown fault condition is present. Once the engine start delay time expires, an engine RUN and CRANK output signal will be initiated. **Note:** The RUN output may be programmed to only energize when a start signal is initiated and an engine speed signal is detected. Once the engine starts to turn over and begins to accelerate to nominal speed, the controllers speed sensor will terminate the CRANK output when engine speed reaches approximately 20% speed (i.e. CRANK DISCONNECT speed setpoint). Immediately upon reaching crank disconnect speed, the controller will initiate the BYPASS DELAY time delay function. Following the BYPASS DELAY time period (typically 10 seconds) all fault circuits programmed as BYPASS DELAY-YES will be activated. **Note:** All fault circuits programmed as BYPASS DELAY-NO are continuously armed irrespective of any operation sequence.

When the controllers "OFF" push-button on the front keypad is depressed, the controllers RUN output will be immediately terminated which will initiate the engine to stop.

8.3.3. AUTOMATIC START/STOP SEQUENCE

When the controller is selected for automatic operation (via the front keypad push-button), the engine will automatically start upon activation of the remote start contact input. **Note:** The remote start signal may be programmed to initiate a start sequence upon contact closure or contact opening. Once the remote start signal is activated, the engine will start as per the sequence of operation described for the manual start sequence.

The automatic stop sequence will be initiated by removal of the remote start signal. Once the start signal is removed, a cooldown delay function will be initiated. Once the cooldown time delay period expires (typically programmed for 5 minutes), the controllers RUN output will be immediately terminated which will initiate the engine to stop.

8.3.4. AUTOMATIC FAULT SHUTDOWN SEQUENCE

When a fault circuit is programmed as a SHUTDOWN, the engine will immediately stop once the fault circuit is activated. **Note:** A specific shutdown fault may be programmed with a definite time *transient* delay period that must expire before the shutdown is activated. The stop sequence will cause the controllers RUN output to be immediately terminated which will cause the engine to stop.

8.4. CONTROL PUSH-BUTTONS

The following control push-buttons are located on the front faceplate keypad.

8.4.1. RUN/OFF/AUTO/LOAD TEST

8.4.1.1. RUN

In this position, the engine will start and operate continuously providing no shutdown circuits are active. All protective circuits will be operative in this mode. There will be no cooldown cycle at the end of a manual run sequence.

8.4.1.2. OFF

This position immediately stops the engine and locks it out from operation. The OFF position also allows any shutdowns to be reset.

8.4.1.3. AUTO

In this position, starting and stopping of the engine will be controlled by a remote contact. When the remote start signal is removed the engine will continue to run for the cooldown period (if selected) then stop. Re-selecting the *Off* position will stop the engine immediately, even if the cooldown period is not complete.

8.4.1.4. LOADTEST

> **NOTE:**
> The control feature is <u>only</u> operative if one of the programmable output contacts is configured for "Load Test" and a remote transfer switch is interconnected with remote testing circuitry.

In this position, a signal will be issued to a remote transfer switch to permit an automatic engine start and load transfer. Once initiated, the engine will receive a start signal from the transfer switch and upon the generator reaching nominal voltage and frequency levels, a load transfer will be initiated. The generator set will remain running on load until a different operating mode is selected or the generator set develops an alarm or shutdown condition.

8.4.2. EMERGENCY STOP PUSH-BUTTON

This push-button will cause the engine to immediately stop and be locked out from operation. The engine cannot be restarted in this mode until the controller has been reset.

8.4.3. FAULT RESET FUNCTION

To initiate a fault reset function, both "INCREMENT" and "ENTER" push-buttons must be simultaneously pressed. This function resets the controller when in a shutdown mode.

> **NOTE:**
> To enable a reset command, the engine must come to a complete stop and the controller's switch must be placed in the *Off* position.

8.4.4. HORN SILENCE FUNCTION

To initiate a horn silence function, both "EXIT" & "DECREMENT" push-buttons must be simultaneously pressed. This function will silence the audible alarm horn without resetting the fail condition.

> **NOTE:**
> The MEC 20 controller may be programmed for automatic horn silencing after a desired time delay period. Refer to the programming instructions for further information.

8.4.5. LAMP TEST

A lamp test feature is provided to test all software controlled LED lights as well as the LCD display. To activate the lamp test feature, simultaneously push the INCREMENT and DECREMENT push-buttons. The LED's and LCD display will illuminate for approximately 2 seconds then return to their original status. **Note:** The emergency stop LED will not be activated by a software initiated test as it is controlled via independent hardware circuitry only.

9. PROGRAMMING INSTRUCTIONS

9.1. SECURITY PASSWORDS

Access to the programmable parameters of the MEC 20 Controller is via a security password number. Three security password levels are provided as described below:

9.1.1. READ ONLY MODE

User can view the programmable parameters only and cannot change any values. The factory default number for the read-only level is one (1).

9.1.2. READ / WRITE MODE

User can view and modify any programming parameter as required. The Factory default number for the read/write level is two (2).

9.1.3. MASTER READ / WRITE MODE

User can view/modify any programming parameter as well as view/modify the security password level numbers. Contact TTI factory for master password if required.

To enter the programming mode, follow the procedure as shown:

PROGRAM MENU?
YES

Select the Program Menu by scrolling through the display menus using the "ENTER" push-button. When displayed, use the INCREMENT push-button to select the YES prompt and push the ENTER button

PASSWORD
0

Use the INCREMENT or DECREMENT push-buttons to ramp the displayed number up or down to the desired password access number. Press the ENTER push-button when the correct number is displayed.

> **NOTE:**
> If an invalid number is entered, programming access will be denied. To exit the programming mode, press the EXIT push-button and hold for two seconds until the display changes.

9.2. BASIC PROGRAMMING OPERATION

Once the correct password number is entered, the user may choose one of four separate programming menus as shown below:

MAIN MENU LOOP

ANALOG FAULT MENU LOOP

DIGITAL FAULT MENU LOOP

CALIBRATION MENU LOOP

The MAIN MENU message will be displayed immediately upon entering the programming mode. To select the desired programming menu, press the INCREMENT push-button to scroll through the available menu types and once displayed, press the ENTER push-button to select the specific program menu.

When the programming mode is accessed, the programming parameters will be displayed in the same order as the Programming Sheets. To skip over parameters that do not require changes, push and hold the ENTER push-button until the desired function is displayed. The EXIT push-button may be used to scroll backwards through the programming parameter loops.

To change a programmed parameter, use the INCREMENT or DECREMENT push-buttons to scroll through the available options or to adjust a value up or down to the desired number. When the desired option or number is displayed, press the ENTER push-button to accept the new value.

NOTE:

If the programming mode is terminated before the last change had been entered, the programming parameter will remain unchanged.

To exit the programming mode, press the EXIT push-button and hold for two seconds.

9.3. MAIN PROGRAMMING MENU

The main programming menu contains general system configuration programming such as system input voltages, currents, transformer ratios, as well as standard operating time delay functions. The programming prompts are listed in order as they appear in the MEC 20 software. To program the specific MAIN MENU items, refer to the following descriptions:

9.3.1. NODE ADDRESS

Set to unique controller address (1-255) for use with network connected MEC 20 controllers.

Note: This programming feature is only active when the remote communication option is enabled. Default setting for single MEC 20 applications is 1.

9.3.2. SYSTEM VOLTAGE

Set to nominal system voltage as expressed in "phase to phase" voltage (i.e. a 347/600 volt system would be entered as "600"). The programmable range of values is 120V-15,000V.

9.3.3. SYSTEM FREQUENCY

Set to nominal system frequency of either 50 HZ or 60 HZ.

9.3.4. SYSTEM PHASES

Set to match the power distribution system used on the generator set (i.e. either single phase or 3 phase system).

9.3.5. VOLTAGE SENSING RATIO

For direct voltage sensing wiring connections from 208 to 600 volts, enter "1" (i.e. a ratio of "1:1"). When potential transformers are utilized for voltage sensing, enter the calculated transformer ratio (e.g. when using 600:120 transformers, enter a number of "5").

9.3.6. CURRENT SENSING RATIO

For current sensing wiring connections from current transformers (CT's), enter the calculated CT ratio (e.g. when using a 600:5 CT, enter a number of "120").

9.3.7. TEMPERATURE SCALE

Select the desired type of engineering units for the engine temperature display and analog setpoints as provided: Degrees Fahrenheit or Degrees Celsius.

9.3.8. PRESSURE SCALE

Select the desired type of engineering units for the engine pressure display and analog setpoints as provided: Pounds per square inch (PSI) or Kilopascals (KPA).

9.3.9. START DELAY

Select desired engine start delay time in seconds. If engine start delay is not required, set to zero.

Note: *If preheat and /or prelube functions are utilized, the engine start* delay time should be set as required for these functions.

9.3.10. CRANK TIME

Select desired cranking time in seconds. If cycle cranking is selected, this time will be the crank time period on each attempt.

9.3.11. REST TIME

Select desired rest time between cranking attempts. (Only valid if multiple crank attempts are selected).

Note: This value will be ignored if only one attempt has been programmed.

9.3.12. STARTER RE-ENGAGE DURATION

This feature will check for a speed signal while cranking. If no speed signal is sensed, the controller assumes that the engine starter is not turning the engine over (for whatever reason), and disengages it after the programmed time delay, and re-engages it again. This process will repeat until a speed signal is sensed or cranking time expires, whichever occurs first. If a speed signal is sensed, the cranking output will be maintained until the unit starts or an overcrank condition occurs. Set time in seconds for desired sampling period, i.e. a setting of 5 seconds will attempt cranking for 5 seconds after which time if no speed signal is detected, the crank output will be removed for a preset 1 second delay before re-engaging.

Note: This action is more than a cycle cranking function and is independent of the number of attempts selected, therefore, the "crank" time should be considered. To disable this feature, set to zero.

9.3.13.NUMBER OF CRANK CYCLES

Set to the number of cranking cycles required. (Zero will default to one.)

9.3.14.BYPASS DELAY

This setting is the time period that affected Alarm or Shutdown inputs will be ignored after crank disconnect, allowing the engine to settle into its normal operating mode (i.e. proper oil pressure, etc.). This is typically set to 10 seconds.

9.3.15.COOLDOWN TIME

Set to desired cooldown time in minutes. Up to 999 minutes of cooldown time may be programmed. Set to zero if not required.

9.3.16.NOMINAL ENGINE RPM

Set to the nominal engine speed in revolutions per minute (RPM).

9.3.17.FLYWHEEL TEETH

Set to the number of ring gear teeth that is on the engine flywheel. The magnetic pick-up must be installed to sense the same teeth for speed sensing as programmed.

9.3.18.CRANK DISCONNECT SPEED

Set crank disconnect speed in percentage of nominal speed, i.e. 30% or 540 RPM on a 1800 RPM engine.

9.3.19.OVERSPEED

Set overspeed shutdown point in percentage of nominal speed (i.e. 110% or 1980 RPM on a 1800 RPM engine).

9.3.20.OVERSPEED TRANSIENT DELAY

Select desired overspeed transient delay time in seconds. Time setting may be entered in tenths of seconds.

9.3.21. RUN OUTPUT FAIL-SAFE

When selected, this feature will inhibit the run output until the controller receives a speed sensing signal, thus preventing possible damage from starting the engine with no speed sensing for crank disconnect and overspeed. If selected, ensure that the speed signal is not less than 2.0Vac from the magnetic pick up while the engine is cranking. **Note:** If this feature is disabled, no overspeed protection or crank disconnect can be provided if the speed signal fails. If the speed signal fails it is recommended that backup crank disconnect protection and additional overspeed protection is utilized.

> **NOTE:**
> The run output Fail-safe feature will be factory programmed as enabled. The user of this equipment may elect to change this feature dependent upon site conditions and does so at their discretion.

9.3.22. LOSS OF SPEED SIGNAL

Select the desired action (i.e. alarm or shutdown) when a loss of speed signal is detected. **Note:** A loss of speed signal must be detected for longer than 2 seconds to initiate the desired action.

9.3.23. START INPUT POLARITY

The engine controller can be programmed to acknowledge a remote start contact that either opens or closes to initiate a remote start condition.

9.3.24. COMMON FAIL FOR "NOT IN AUTO" FUNCTION

Use this function to select if a "common fail" alarm condition is to be activated when the engine controller is not selected for "automatic" operation.

9.3.25. PROGRAMMABLE OUTPUT CONTACTS

Select the desired function that will activate the designated programmable relay output contact. One of the following functions may be selected:

Note: Programmable output contacts #5 and #6 are located on external expansion output module as optionally available. Refer to Section #7.0 for additional information.

Energize to stop	Idle control
Lube (pre/post/cyclic lube	Switch not in auto
Overcurrent	Preheat
Ready status	Run alarm
Air flap	ATS test
Bypass complete	Common alarm
Common fail	Common shutdown

CAUTION!!!

The programming function selected must co-ordinate with external control wiring prior to energizing the control system. Failure to do so may cause severe equipment damage.

9.3.26.AUTO CALLOUT

When the remote communication option is enabled, this programming prompt will appear. The controller can be programmed for the desired type of common fault (i.e. common shutdown, common fail or common alarm) which will initiate an automatic call out to a remote communication device.

9.3.27.POST-LUBE DURATION

Program the desired post lube duration in minutes (0 - 999) for *postlube duration* function.

Note: Lube functions are disabled in *Off* and whenever the engine is above *crank disconnect* speed.

9.3.28.CYCLE LUBE INTERVAL

A cyclic lube function can be set up to circulate oil through the engine several times per day while the engine is not running. A non-zero post-lube duration must be entered to enable the lube output. Select the desired cycle lube interval (i.e. time on/ time off) in minutes (1-9999).

9.3.29. CYCLE LUBE DURATION

Once the lube interval timer has expired it resets itself and starts the lube pump for this time duration. If the *cycle-lube duration* is longer than the *lube interval,* the pump will run continuously when the engine is not running. The pre-lube output is also energized during the engine start delay and crank cycles, and de-energized when the engine reaches crank disconnect speed. Select the desired cycle lube duration (i.e. on time) in minutes (0-999).

9.3.30. HORN DURATION

The horn duration can be programmed so that it will self silence.

Note: A setting of 0 causes the horn to sound continuously until the horn silence is pressed or the alarm fault has cleared.

9.3.31. DISPLAY MENU TIMEOUT

The display menu can be programmed so it will be automatically displayed after the selected time. This function is used to prevent the programming mode from being continuously displayed in error.

9.3.32. BACK LIGHT TIMEOUT

The LCD back light function can be programmed so it will automatically turn off after the selected time.

9.3.33. RESET RUN HOURS

The controller's engine hourmeter may be reset to zero hours when yes is programmed. **Note:** This programming prompt is only accessible while using the "Master" programming security password.

9.4. ANALOG FAULT PROGRAMMING MENU

To program the controller's analog fault circuits, refer to the following descriptions.

9.4.1. LEVEL

This setting determines the actual analog signal setpoint at which the selected fault type will be activated. **Note:** For AC voltage fault circuits, two levels (i.e. pick-up & drop-out) must be programmed.

9.4.2. ACTION

This setting allows a fault circuit to be programmed as either an *alarm* or a *shutdown.*

9.4.3. ALARM LATCH

If an alarm fault was programmed, it may be selected as a "latching" alarm or "non-latching". When "latching" is selected, it will not un-latch until a reset command clears it. **Note:** This programming prompt only appears if alarm faults are programmed. Shutdown faults are automatically set as latching.

9.4.4. SHUTDOWN REMOTE RESET

Each shutdown fault circuit may be individually enabled for remote resetting using the remote reset input to the MEC 20. This will permit some shutdowns, such as low oil pressure, to keep the engine locked out even if a remote reset command is issued.

9.4.5. BYPASS ON START DELAY

This allows the alarm or shutdown circuit to be disabled until after the bypass timer has expired. Fault circuits that are not delayed will be enabled at all times (i.e. engine running or stopped).

9.4.6. TRANSIENT DELAY TIMES

This allows the selected fault circuit to be inhibited from being activated until the specified time delay period has expired. Delay times from 0.0 to 999.9 seconds are available by entering the time required.

9.5. DIGITAL FAULT PROGRAMMING MENU

To program the controller's digital fault circuits, refer to the following descriptions.

9.5.1. DIGITAL FAULT LABEL

To select the desired fault label description, use the "increment" key to scroll through the available labels. The digital fault labels are stored in non-volatile memory and are as follows:

- AIR DAMPER TRIPPED
- BAT CHARGER INPUT FAIL
- BAT CHRG TROUBLE
- BREAKER TRIPPED
- DC FAIL
- FAILED TO SYNC
- GEN BREAKER OPEN
- GROUND FAULT
- HIGH BEARING TEMP
- HIGH COOLER VIBRATION
- HIGH ENGINE TEMP
- HIGH ENGINE VIBRATION
- HIGH FUEL LEVEL
- HIGH OIL LEVEL
- HIGH OIL TEMP
- HIGH WINDING TEMP
- IDLE°
- LOW COOLANT LEVEL
- LOW ENGINE TEMP
- LOW FUEL LEVEL
- LOW FUEL PRESS
- LOW OIL LEVEL
- LOW OIL PRESSURE
- OVERSPEED
- OVERVOLTAGE
- REMOTE EMERG.STOP
- REVERSE POWER
- UNDER VOLTAGE

° Idle fault label is optional and may be factory ordered only.

Once the desired fault label is selected, press the "enter" key to accept the selection.

> ***WARNING!!!***
> ***The digital fault label programming must match with the external control wiring to the controller. Failure to do so may cause severe equipment damage.***

9.5.2. ACTION

This setting allows a fault circuit to be programmed as either an *alarm* or a *shutdown.*

Note: All activated alarm and shutdown faults will energize the "common fail" circuit and sound the alarm horn.

9.5.3. ALARM LATCH

If an alarm fault was programmed, it may be selected as a "latching" alarm or "non-latching". When latching is selected, it will no unlatch until a reset command clears it. **Note:** This programming prompt only appears if alarm faults are programmed. Shutdown faults are automatically set as latching.

9.5.4. SHUTDOWN REMOTE RESET

Each shutdown fault circuit may be individually enabled for remote resetting using the remote reset input to the MEC 20. This will permit some shutdowns, such as low oil pressure, to keep the engine locked out even if a remote reset command is issued.

9.5.5. POLARITY

This setting allows the digital fault circuit to be set for *Open to Fail* or *Close to Fail* sensing contacts.

9.5.6. BYPASS ON START DELAY

This allows the alarm or shutdown circuit to be disabled until after the bypass timer has expired. Fault circuits that are not delayed will be enabled at all times (i.e. engine running or stopped).

9.5.7. TRANSIENT DELAY TIMES

This allows the selected fault circuit to be inhibited from being activated until the specified time delay period has expired. Delay times from 0.0 to 999.9 seconds are available by entering the time required.

9.6. CALIBRATION MENU

9.6.1. GENERAL

All analog sensing circuits are factory calibrated before shipment of the unit. Should field calibration of any analog sensing circuit be required, the following procedure may be used.

WARNING!!!
Voltage and current sensing circuits are capable of lethal voltages while energized. Standard safety procedures should be followed and be performed by qualified personnel only. Failure to do so may cause personal injury and/or death.

To access the MEC 20's software programming loop, select the program menu, enter the YES prompt, then enter read/write security password level (or higher).

Once the programming menus have been accessed, press the INCREMENT push-button to scroll to the calibration menu loop and press the ENTER push-button.

9.6.2. VOLTAGE SENSING CALIBRATION

VOLTS AB① ZERO②
99③ 600V④

① Displays the generator's phase voltages to be calibrated.

② Displays the type of calibration function, either ZERO or SPAN.

③ Displays the calibration correction factor number (0-255) used to obtain the correct voltage reading. **Note:** To correctly calibrate any of the voltage sensors, the ZERO function must be calibrated before the SPAN function.

④ Displays the actual voltage measurement that will be the same value as shown on the MEC 20 display menus for generator supply. This voltage reading may be calibrated higher or lower by changing the correction factor number.

9.6.3. VOLTAGE CALIBRATION PROCEDURE

NOTE:
To accurately calibrate the MEC 20's voltage sensors, an external test voltage meter is required, with an accuracy of 0.5% or better.

Note: Zero Calibration must be completed before Span Calibration.

To calibrate the generator supply voltage sensors, perform the following procedure:

9.6.3.1.ZERO CALIBRATION

Connect an external AC voltmeter of adequate voltage range and accuracy to the MEC 20 controller terminals associated with the voltage phases to be calibrated. With the generator stopped, confirm there is Zero volts on the phases to be calibrated.

In the programming mode, scroll to each of the desired generator supply voltage phases with the ZERO function selected.

Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number to 127.

Scroll to each of the desired generator supply voltage phases with the SPAN function selected.

Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number to 127.

Scroll back to the ZERO function and use the INCREMENT or DECREMENT *push-buttons to adjust the correction factor number* while observing the displayed voltage level. Adjust the correction factor number to obtain 0 VAC on the display.

With the correct voltage displayed, press the ENTER push-button to accept the correction factor number. Record the correction factor number on the MEC 20 programming sheet for future reference.

Repeat the above procedure for all remaining phases of the generator supply as required.

9.6.3.2.SPAN CALIBRATION

Energize the generator supply voltage to the controller at nominal level. **Note:** It may be necessary to program the optional under and over voltage shutdowns as alarms to ensure the generator will continue to operate during calibration. Caution must be taken to ensure the generator output voltage is set within nominal limits.

In the programming mode, scroll to the desired generator supply voltage phases with the SPAN function selected.

Connect an external AC voltmeter of adequate voltage range and accuracy to the MEC 20 controller terminals associated with the voltage phases to be calibrated.

<u>WARNING!!!</u>

Voltage sensing circuits are capable of lethal voltages while energized. Standard safety procedures should be followed and be performed by qualified personnel only. Failure to do so may cause personnel injury and/or death.

Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number while observing the displayed voltage level on the MEC 20. Adjust the correction factor number to obtain an identical voltage reading as measured with the external AC voltmeter.

With the correct voltage displayed, press the *ENTER* push-button to accept the correction factor number. Record the correction factor number on the MEC 20 programming sheet for future reference if required.

Repeat the above procedures for all remaining phases of the generator supply as required.

<u>NOTE:</u>

Once the span calibration setting has been completed, re-confirm the zero calibration points. If the zero calibration setpoint needs further adjustment, the span calibration point must also be re-calibrated.

9.6.4. CURRENT SENSING CALIBRATION

CURRENT A① ZERO①
99① 350A①

① Displays the generator's load current (phase A, B or C) to be calibrated.

② Displays the type of calibration function, either ZERO or SPAN.

③ Displays the calibration correction factor number (0-255) used to obtain the correct current reading. **Note:** To correctly calibrate any of the current sensors, the ZERO function must be calibrated before the SPAN function.

④ Displays the actual current measurement that will be the same value as shown on the MEC 20 display menus for generator supply. This current reading may be calibrated higher or lower by changing the correction factor number.

9.6.5. CURRENT CALIBRATION PROCEDURE

> **NOTE:**
> To accurately calibrate the MEC 20's current sensors, an external test AC ammeter and current clamp is required, with an accuracy of 0.5% or better.

Note: Zero calibration must be completed before span calibration.

To calibrate the generator supply current sensors, perform the following procedure:

9.6.5.1.ZERO CALIBRATION

Connect an external AC ammeter with current clamp of adequate current range to the MEC 20 controller terminals associated with the current phases to be calibrated. With the generator stopped, confirm there is "0" current on the phases to be calibrated. In the programming mode, scroll to each of the desired generator supply current phases with the ZERO function selected.

Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number to 127.

Scroll to each of the desired generator supply current phases with the SPAN function selected.

Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number to 127.

Scroll back to the ZERO function and use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number while observing the displayed current level. Adjust the correction factor number just until "0" amps on the display is obtained.

With the correct current displayed, press the ENTER push-button to accept the correction factor number. Record the correction factor number on the MEC 20 programming sheet for future reference.

Repeat the above procedure for all remaining generator current phases.

9.6.5.2.SPAN CALIBRATION

Apply 50%-100% load to the generator set. **Note:** It is recommended to load the generator set to 100% rated load for calibration purposes to obtain good accuracy throughout the full span of operation.

NOTE:

Do not exceed the current rating of the CT. Non-linear output of the CT will result when the secondary current exceeds 5 amps and will similarly effect the MEC 20 displayed values.

In the programming mode, scroll to the desired generator supply current phases with the SPAN function selected.

Connect an external AC ammeter and current clamp of adequate current range to the MEC 20 controller terminals associated with the current phases to be calibrated.

> ***WARNING!!!***
> ***Never open circuit an energized CT as extreme high voltages may result which may cause serious injury or death. Standard safety procedures should be followed and be performed by qualified personnel only. Failure to do so may cause personnel injury and/or death.***

Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number while observing the displayed current level on the MEC 20. Adjust the correction factor number to obtain an identical current reading as measured with the external AC ammeter.

With the correct current displayed, press the *ENTER* push-button to accept the correction factor number. Record the correction factor number on the MEC 20 programming sheet for future reference if required.

Repeat the above procedures for all remaining generator current phases.

> **NOTE:**
> Once the span calibration setting has been completed, re-confirm the zero calibration points. If the zero calibration setpoint needs further adjustment, the span calibration point must also be re-calibrated.

9.6.6. BATTERY VOLTAGE CALIBRATION

BAT VOLTS SPAN①
99② 24.6V③

① Displays the type of calibration function (SPAN).

② Displays the calibration correction factor number (0-255) used to obtain the correct voltage reading.

③ Displays the actual battery voltage measurement that will be the same value as shown on the MEC 20 display menu. This voltage reading may be calibrated higher or lower by changing the correction factor number.

9.6.7. BATTERY VOLTAGE CALIBRATION PROCEDURE

> **NOTE:**
> To accurately calibrate the MEC 20's battery voltage sensor, an external test DC voltmeter is required, with an accuracy of 0.5% or better.

To calibrate the battery voltage sensor, perform the following procedure:

9.6.7.1.SPAN CALIBRATION

Energize the battery supply voltage to the controller and connect the external test DC voltmeter to the battery terminals, B+ and B-.

In the programming mode, scroll to the battery span calibration point.

Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number while observing the displayed battery voltage level on the MEC 20. Adjust the correction factor number to obtain an identical voltage reading as measured with the external DC voltmeter.

With the correct voltage displayed, press the *ENTER* push-button to accept the correction factor number. Record the correction factor number on the MEC 20 programming sheet for future reference if required.

9.6.8. ENGINE TEMPERATURE & OIL PRESSURE CALIBRATION

ENGINE TEMP MIN①
127② 95 deg C③

① Displays the type of calibration function, either MIN or MAX.

② Displays the calibration correction factor number (0-255) used to obtain the correct Temperature or Pressure reading. **Note:** To correctly calibrate the temperature or pressure sensors, the MAX function must be calibrated before the MIN function.

③ Displays the actual temperature or pressure measurement that will be the same value as shown on the MEC 20 display menus. This *reading may be calibrated higher or lower by changing the correction* factor number.

9.6.9. TEMPERATURE / PRESSURE CALIBRATION PROCEDURE

Engine temperature and oil pressure calibration differs from all the other analog calibrations as they have a maximum and minimum calibration. The maximum calibration value **must** be adjusted first then the minimum. This maximum and minimum calibration procedure must be repeated 2 - 3 times as the adjustments interact with each other.

> **NOTE:**
> INCREMENT and DECREMENT push-buttons work in reverse for Min/Max calibration. Pressing the INCREMENT button will cause correction factor to increase but actual displayed value to decrease and vice versa for DECREMENT.

Calibration resistors are provided on the MEC 20 printed circuit board to calibrate the MEC 20. The actual engine senders are disconnected for the calibration process. The calibration resistors are required to represent values known for given temperatures or pressures. The calibration resistors are connected to the sensing circuits only when jumper clips are temporarily added to the MEC 20 circuit board.

> ***CAUTION!!!!!***
> ***All calibration jumper clips must be removed prior to placing the equipment into normal operating service. Failure to do so may cause severe equipment damage.***

Refer to FIGURE #10 for layout drawing of the calibration jumper clips.

Refer to the Analog Temperature and Pressure Calibration Table for resistance values and corresponding temperature and pressure values. The maximum calibration point for each of these analog points will be 150°C and 150 PSI respectively. The minimum calibration point for each of these analog points will be 0°C and 0 PSI respectively. The starting calibration correction factor numbers for the maximum and minimum points should be 127. When determining the maximum value, the midpoint between 149 and 151 (true 150) must be determined. When determining the minimum value, this should be just at zero (one additional decrement key stroke will cause the one to appear). This adjustment may have to be repeated several times to ensure accurate calibration.

Engine Temperature °F	Engine Temperature °C	Sensor Resistance (Ohms)	Oil Pressure KPA	Oil Pressure PSI	Sensor Resistance (Ohms)
392	200	20	1379	200	20
374	190	24	1310	190	23
356	180	28	1241	180	26
338	170	33	1172	170	29
320	160	39	1103	160	33
302	150	46	1034	150	38
284	140	55	965	140	42
266	130	65	896	130	48
248	120	76	827	120	54
230	110	90	758	110	62
212	100	106	689	100	70
194	90	147	621	90	79
176	80	197	552	80	89
150	70	290	483	70	101
140	60	426	414	60	114
122	50	622	345	50	127
104	40	952	276	40	142
86	30	1486	207	30	160
68	20	2322	138	20	183
50	10	3644	69	10	206
32	0	6284	0	0	241

ANALOG TEMPERATURE AND PRESSURE CALIBRATION TABLES

With the oil pressure senders installed, oil pressure may indicate pressure without the engine running. Adjust the minimum correction value to just obtain zero. Maximum calibration should not require further adjustments.

If a discrepancy in oil pressure readings is noted, a gauge of known calibration should be used for verification at a similar location in the main oil gallery. This should be located after the oil filters.

Engine temperature can be verified at room temperature and stable operating temperature. **Note:** The MEC 20 responds very quickly to temperature changes. If an analog meter is used for verification, the temperature must be allowed to stabilize so the analog meter reading will have any relative meaning. The meter used for verification, must be of known calibration and it is extremely important that it be mounted in the same physical location to have any validity.

The best full scale readings will be given with maximum and minimum settings over a wide range. Using the senders over a narrow range will not provide highly accurate readings.

9.6.9.1. TEMPERATURE MAX CALIBRATION PROCEDURE

Disconnect the engine mounted temperature sender signal wire and temporarily connect the calibration jumper clip for temperature (between pins MX and T).

Energize the MEC 20 with DC control power to terminals B+ and B-. In the programming mode, scroll to the temperature calibration screen with the MAX function selected.

Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number to 127.

Scroll to the temperature calibration screen MIN function selected.

Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number to 127.

Scroll back to the MAX function and use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number while observing the displayed temperature. Adjust the correction factor number to obtain 150°C on the display.

With the correct temperature displayed, press the ENTER push-button to accept the correction factor number. Record the correction factor number on the MEC 20 programming sheet for future reference.

9.6.9.2. TEMPERATURE MIN CALIBRATION

Once the MAX calibration procedure has been completed, de-energize DC control power and move the temperature calibration jumper clip between MN and T.

Energize the MEC 20 with DC control power to terminals B+ and B–. In the programming mode, scroll to the MIN function and use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number while observing the displayed temperature. Adjust the correction factor number to obtain 0°C on the display.

With the correct temperature displayed, press the ENTER push-button to accept the correction factor number. Record the correction factor number on the MEC 20 programming sheet for future reference.

Repeat the MAX and MIN calibration procedure several times to ensure each calibration setting has not effected the other setpoint.

NOTE:
Do not use the initial preset values of 127 once the first calibration procedure has been completed.

Once the calibration procedure has been completed, remove the temperature calibration jumper clip and reconnect the engine sender signal wire. The analog alarm setpoint should then be verified for correct operation before use.

9.6.9.3. OIL PRESSURE MAX CALIBRATION PROCEDURE

Disconnect the engine mounted oil pressure sender signal wire and temporarily connect the calibration jumper clip for pressure (between pins MX and P).

Energize the MEC 20 with DC control power to terminals B+ and B-. In the programming mode, scroll to the oil pressure calibration screen with the MAX function selected.

Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number to 127.

Scroll to the oil pressure calibration screen MIN function selected.

Use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number to 127.

Scroll back to the MAX function and use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number while observing the displayed oil pressure. Adjust the correction factor number to obtain 150 PSI on the display.

With the correct oil pressure displayed, press the ENTER push-button to accept the correction factor number. Record the correction factor number on the MEC 20 programming sheet for future reference.

9.6.9.4. OIL PRESSURE MIN CALIBRATION

Once the MAX calibration procedure has been completed, de-energize DC control power and move the pressure calibration jumper clip between pins MN and P. Energize the MEC 20 with DC control power to terminals B+ and B-.

In the programming mode, scroll to the MIN function and use the INCREMENT or DECREMENT push-buttons to adjust the correction factor number while observing the displayed oil pressure. Adjust the correction factor number to obtain 0 PSI on the display.

With the correct oil pressure displayed, press the ENTER push-button to accept the correction factor number. Record the correction factor number on the MEC 20 programming sheet for future reference.

Repeat the MAX and MIN calibration procedure several times to ensure each calibration setting has not effected the other setpoint.

NOTE:
Do not use the initial preset values of 127 once the first calibration procedure has been completed.

Once the calibration procedure has been completed, remove the pressure calibration jumper clip and reconnect the engine sender signal wire. The analog alarm setpoint should then be verified for correct operation before use.

10. PROGRAMMING SHEETS

10.1. SUMMARY CONFIGURATION DATA SHEET

SUMMARY CONFIGURATION DATA SHEET

WORK ORDER # ______	REV. ______	REV. DATE ______	
INITIATED BY ______		FACTORY DEFAULT PROGRAM # ______	
DATE ______	PROJECT NAME ______		
SYSTEM AC VOLTS	PHASES	FREQUENCY	DC VOLTAGE

DIGITAL DISPLAY FEATURES

☐ AC VOLTAGE ☐ AC CURRENT ☐ FREQUENCY ☐ TACHOMETER

☐ ENGINE TEMPERATURE ☐ OIL PRESSURE ☐ BATTERY VOLTAGE ☐ HOURMETER

STANDARD FAULT CIRCUITS (15)

FAULT NAME	INPUT TYPE
Overcrank Shutdown	Internal
Loss of Speed Signal Shutdown	Internal
Overspeed Shutdown	Internal
Switch Not In Auto Alarm	Internal
Low Battery Voltage Alarm	Analog (DC Volts)
High Battery Voltage Alarm	Analog (DC Volts)
Weak Battery Alarm	Analog (DC Volts)
Low Engine Temp. Alarm	Analog (Temp. Sender)
High Engine Temp. Alarm	Analog (Temp. Sender)
Low Oil Pressure Alarm	Analog (Press. Sender)
Emergency Stop	Internal/External
	External Digital Input #1
	External Digital Input #2
	External Digital Input #3
	External Digital Input #4

OPTIONAL ANALOG FAULT CIRCUITS

☐ Undervoltage	______	(Analog)
☐ Overvoltage	______	(Analog)
☐ Under Frequency	______	(Analog)
☐ Over Frequency	______	(Analog)
☐ Overcurrent	______	(Analog)

STANDARD OUTPUT CONTACTS (4)

OUTPUT NAME	OUTPUT TYPE
Run	Form A
Crank	Form A
Common Fail	Form C
ATS Test (Factory default, unless otherwise specified)	Programmable #1 - Form C

OPTIONAL DIGITAL FAULT CIRCUITS (up to 8)

FAULT NAME	INPUT TYPE
☐	External Digital Input #5
☐	External Digital Input #6
☐	External Digital Input #7
☐	External Digital Input #8
☐	External Digital Input #9
☐	External Digital Input #10
☐	External Digital Input #11
☐	External Digital Input #12

OPTIONAL PROGRAMMABLE CONTACTS (up to 3)

OUTPUT FUNCTION	OUTPUT TYPE
☐	Programmable #2 - Form C
☐	Programmable #3 - Form C
☐	Programmable #4 - Form C

OTHER OPTIONAL FEATURES

☐ Engine Idle Control

☐ Cycle Lube

☐ Remote Communications

☐ Expansion Output Module

10.2. MAIN CONFIGURATION

MAIN PROGRAMMING MENU		
NODE ADDRESS		REMOTE COM OPTION
XXX		1-255
SYSTEM VOLTAGE		LINE TO LINE VOLTAGE
XXXXX VAC		120-15000VAC
SYSTEM FREQUENCY		
50HZ/60HZ		TOGGLE BETWEEN 50/60 HZ
SYSTEM PHASES		
1 PHASE/3 PHASE		TOGGLE BETWEEN 1 & 3 PHASE
VOLTAGE SENSING		VOLTAGE SENSING PT RATIO
RATIO XXX		ENTER NUMBER 1-208 (1=DIRECT)
CURRENT SENSING		CURRENT SENSING CT RATIO
RATIO XXX		ENTER NUMBER 1-999 (1=DIRECT)
TEMPERATURE SCALE		
DEG C/DEG F		TOGGLE BETWEEN DEG C/DEG F
PRESSURE SCALE		
PSI/KPA		TOGGLE BETWEEN PSI/KPA
START DELAY		
XXX SECONDS		0-999 SECONDS
CRANK TIME		
XX SECONDS		0-99 SECONDS
REST TIME		
XX SECONDS		0-99 SECONDS
STARTER RE-ENGAGE		
DELAY XX SECONDS		0-99 SECONDS 0=DISABLED
NUMBER OF CRANKS		
XX		0-99 TIMES 0=CONTINUOUS
BYPASS DELAY		
XX SECONDS		0-99 SECONDS
COOLDOWN DELAY		
XX MINUTES		0-99 MINUTES
NOMINAL RPM		
XXXX RPM		0-4000RPM
FLYWHEEL TEETH		ENGINE SPEED SENSING VIA MAGNETIC PICK UP

MAIN PROGRAMMING MENU		
XXX		0-999 TEETH
CRANK DISCONNECT		
XX PERCENT		0-100%
OVERSPEED		
XX PERCENT		100-150%
OVERSPEED TRANSIENT		
X.X SEC		0.0-9.9 SEC
RUN OUTPUT		
FAIL SAFE YES/NO		TOGGLE BETWEEN YES/NO
RUN OUTPUT FAIL SAFE		
LOSS OF SPEED SIGNAL		
SHUTDOWN ALARM/SHUTDOWN		TOGGLE BETWEEN ALARM/SHUTDOWN
START INPUT POLARITY		REMOTE START CONTACT LOGIC TYPE
OPEN/CLOSE		TOGGLE OPEN OR CLOSE
COMMON FAIL FOR		
NOT IN AUTO YES/NO		TOGGLE BETWEEN YES/NO
PROG OUTPUT 1		ATS Test (Factory default, unless otherwise specified)
OPTION 1-15		**1-DISABLED**
		2-ENERGIZE TO STOP
		3-IDLE
PROG OUTPUT 2		**4-LUBE**
OPTION 1-15		**5-NOT IN AUTO**
		6-OVERCURRENT
		7-PREHEAT
PROG OUTPUT 3		**8-READY**
OPTION 1-15		**9-RUNNING**
		10-AIR FLAP
		11-ATS TEST
PROG OUTPUT 4		**12-BYPASS COMPLETE**
OPTION 1-15		**13-COMMON ALARM**
PROG OUTPUT 5		**14-COMMON FAIL**
OPTION 1-15		**15-COMMON SHUTDOWN**
PROG OUTPUT 6		
OPTION 1-15		
POST LUBE DURATION		

MAIN PROGRAMMING MENU		
XXX MINUTES		0-999 MIN
CYCLE LUBE INTERVAL		
XXXX MINUTES		1-9999 MIN
CYCLE LUBE DURATION		
XXX MINUTES		0-999 MIN
HORN DURATION		
XXX SECONDS		0-999 SEC (0=CONTINUOUS)
DISPLAY MENU		
TIMEOUT XXX SEC		60-999 SEC
BACKLIGHT TIMEOUT		
XXX SEC		0-999 SEC
RESET RUN HOURS		ACCESS VIA MASTER PASSWORD ONLY
YES/NO		TOGGLE YES/NO,

10.3. ANALOG FAULT PROGRAMMING MENU

ANALOG FAULT PROGRAMMING MENU

FAULT NAME	INPUT ANALOG TYPE	FAULT E=ENABLE D=DISABLE	SETPOINT LEVEL (PICK-UP)	SETPOINT LEVEL (DROP-OUT)	ACTION S=SHUTDOWN A=ALARM	ALARM LATCH Y=YES N=NO	SHUTDOWN REMOTE RESET Y=YES N=NO	BYPASS ON START Y=YES N=NO	TRANSIENT DELAY (SEC)
UNDER VOLTAGE	AC VOLTAGE	D							
OVER VOLTAGE	AC VOLTAGE	D							
UNDER FREQ	AC FREQ	D							
OVER FREQ	AC FREQ	D							
OVER CURRENT	AC CURRENT	D							
WEAK BATTERY	DC VOLTAGE	E		N/A	A	Y	—	N	3.0
LOW BATTERY VOLTAGE	DC VOLTAGE	E		N/A	A	N	—	N	120.0
HIGH BATTERY VOLTAGE	DC VOLTAGE	E		N/A	A	N	—	N	10.0
LOW ENGINE TEMP	TEMP SENDER	E		N/A	A	Y	—	N	120.0
HIGH ENG TEMP #1 ALARM	TEMP SENDER	E		N/A	A	Y	—	Y	2.0
LOW OIL PRESS#1 ALARM	PRESS SENDER	E		N/A	A	Y		Y	2.0

10.4. DIGITAL FAULT PROGRAMMING MENU

DIGITAL FAULT PROGRAMMING MENU								
FAULT NAME	INPUT #	FAULT E=ENABLE D=DISABLE	ACTION S=SHUTDOWN A=ALARM	ALARM LATCH Y=YES N=NO	SHUTDOWN REMOTE RESET Y=YES N=NO	POLARITY O=OPEN C=CLOSE	BYPASS ON START Y=YES N=NO	TRANSIENT DELAY (SEC)
LOW OIL PRESSURE	1	E	S	—	N	O	Y	0.5
HIGH ENG TEMP	2	E	S	—	N	O	Y	1.0
BATT CHGR INPUT FAIL	3	E	A	Y	—	O	N	30.0
LOW FUEL LEVEL	4	E	A	Y	—	O	N	0.1
	5	D						
	6	D						
	7	D						
	8	D						
	9	D						
	10	D						
	11	D						
	12	D						

10.5. CALIBRATION MENU

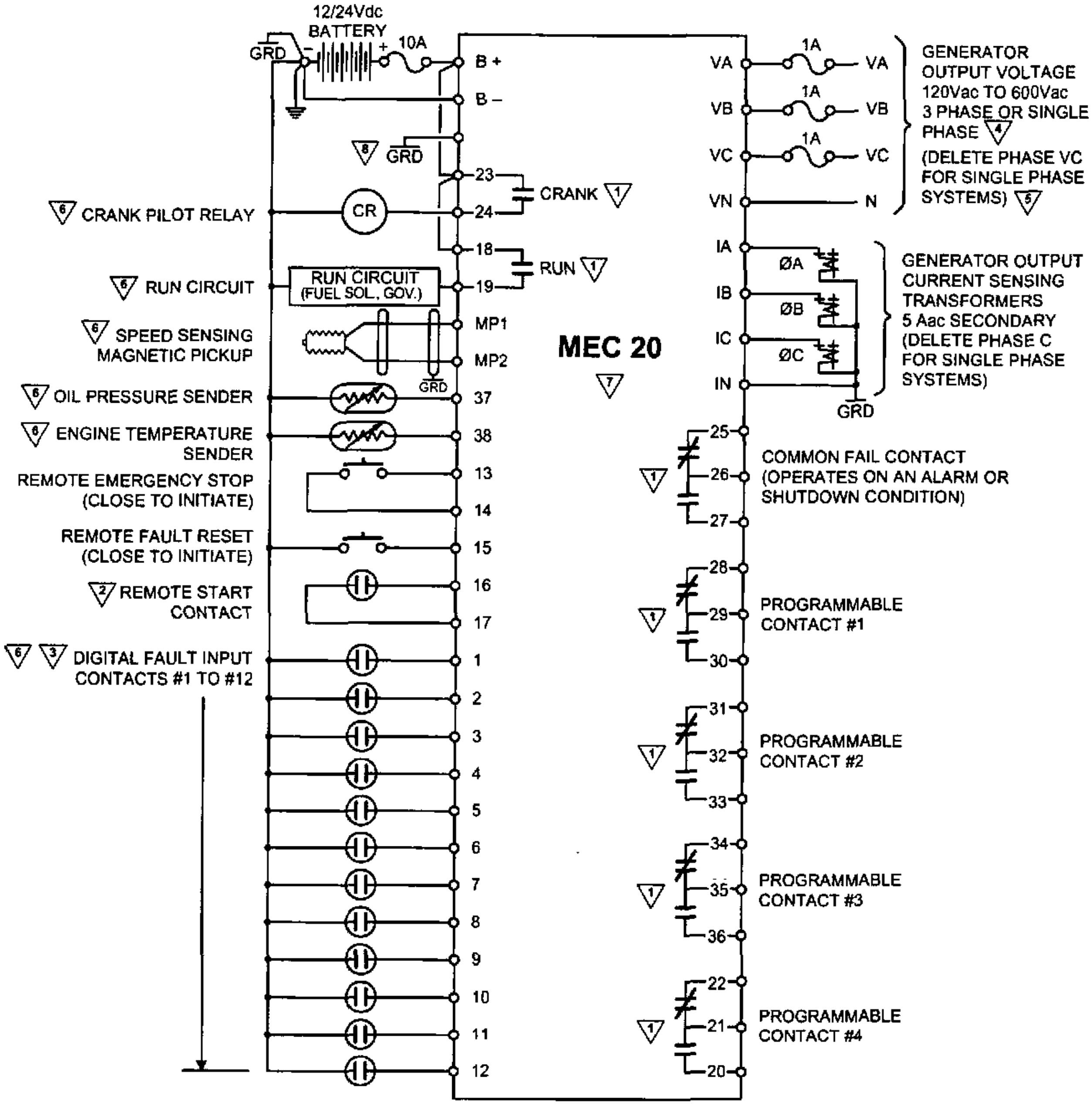
CALIBRATION MENU	
VOLTS A-B	
ZERO XXX XXXVAC	
VOLTS A-B	
SPAN XXX XXXVAC	
VOLTS B-C	
ZERO XXX XXXVAC	
VOLTS B-C	
SPAN XXX XXXVAC	
VOLTS C-A	
ZERO XXX XXXVAC	
VOLTS C-A	
SPAN XXX XXXVAC	
CURRENT A	
ZERO XXX XXXAAC	
CURRENT A	
SPAN XXX XXXAAC	
CURRENT B	
ZERO XXX XXXAAC	
CURRENT B	
SPAN XXX XXXAAC	
CURRENT C	
ZERO XXX XXXAAC	
CURRENT C	
SPAN XXX XXXAAC	
BATTERY VOLTAGE	
SPAN XXX XX.X VDC	
ENGINE TEMPERATURE	
MAX XXX XXX C/F	
ENGINE TEMPERATURE	
MIN XXX XXX C/F	
OIL PRESSURE	
MAX XXX XXXX PSI/KPA	
OIL PRESSURE	
MIN XXX XXX PSI/KPA	

11. SPECIFICATIONS

• **Power supply:**	10 to 30Vdc, negative ground
• **Operating temperature:**	0°C to +50°C
• **Environmental (Faceplate):**	NEMA 12
• **Vibration:**	4g, 5-250Hz
• **Engine Gauge Display Accuracy:**	± 1.0%, @ 25°C (plus sender accuracy ± 5.0%) KVA
• **Power consumption:**	5 watts (max.)
• **Storage temperature:**	-50°C to +85°C
• **Humidity:**	5 to 95% non-condensing
• **Dimensions:**	10.75"W x 6.75"H x 2.0"D
• **AC Metering Accuracy:**	± 1.0%, @ 25°C Volts, Amps ± 2% @25°C
• **Inputs:**	
Engine Speed Sensing	100 - 10,000Hz, 2.0 - 20Vac, rms
AC Voltage	120 - 600Vac (nominal), 0.1VA, 3 phase, 50/60Hz
AC Current	0 - 5Aac (nominal), 1.5VA, 3 phase
Engine Parameters	Dedicated Senders (supplied loose)
Digital Fault Contacts	Open or close to DC Negative
• **Output contacts:**	
Run, Crank	10A/240Vac resistive (3A inductive, 0.4pf), 8A/24Vdc, Form A
Programmable, Common Fail	10A/240Vac resistive (3A inductive, 0.4pf), 8A/24Vdc, Form C

Specifications subject to change without notice.

12. CONNECTION DIAGRAM



NOTES:

1. CONTACTS RATED MAXIMUM 10A, 250Vac, 30Vdc RESISTIVE
2. LOGIC IS SOFTWARE PROGRAMMABLE FOR OPEN OR CLOSE ON START
3. LOGIC IS SOFTWARE PROGRAMMABLE FOR OPEN OR CLOSE ON FAIL
4. GENERATOR SUPPLY MUST UTILIZE A SOLIDLY GROUNDED NEUTRAL SYSTEM – REFER TO INSTRUCTION MANUAL FOR ALTERNATE CONNECTIONS
5. NEUTRAL CONNECTION IS REQUIRED FOR SINGLE PHASE SYSTEMS ONLY
6. ENGINE MOUNTED COMPONENTS
7. SOME FUNCTIONS SHOWN ARE OPTIONAL – REFER TO MEC 20 PROGRAM SHEETS
8. "GRD" CONNECTION TO BE MADE TO COMMON CHASSIS/ENCLOSURE GROUND BOND SYSTEM

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13. TROUBLE SHOOTING

A number of problems can cause the MEC 20 controller not to function properly. Refer to the following list of typical problems. Consult the factory for any detailed information or for any problems not listed.

CAUTION!!!

Before opening the enclosure to perform any service task, it is imperative to isolate the control system from any possible source of power. Failure to do so may result in serious personal injury or death due to electrical shock.

Service procedures must be undertaken by qualified personnel only!

SYMPTOM	CORRECTIVE ACTION
Controller does not power up even with correct DC power applied	- Check that there are no wiring errors/short circuits connected to the controller. **Note:** The MEC 20 contains an electronic fuse that triggers upon an overload condition and does not reset until the supply voltage is removed, and overload condition is corrected.
LCD Display is not operational	- Check that the controller's microprocessor is running by observing a red flashing "watchdog" LED on the rear of the PCB. - Check that there is sufficient DC supply voltage to input terminals B+ & B- (10-30VDC). - Verify that the LCD contrast potentiometer (R115) on rear of PCB is adjusted for good pixel resolution for the operating temperature of the unit.
Controller cannot be "Reset"	- Check that the controller is set to the OFF mode before trying to reset. - Check that the engine has come to a complete stop before trying to reset.

SYMPTOM (CONT'D)	CORRECTIVE ACTION (CONT'D)
No "RUN" output signal	- Check that all shutdown circuits are reset (red shutdown LED must be off). - Engine speed signal must be detected (speed signal green LED on) during cranking if the "run-output fail safe" feature is enabled. Verify correct magnetic pick-up signal at cranking (2.0VAC min.). - Check that the RUN output LED (on the rear of the PCB) is on. If yes, verify relay contact operation on terminals #18 & #19.
Overspeed shutdown occurs at normal speed	- Verify that the controller has been programmed with the correct values for the number of flywheel teeth, nominal RPM, and overspeed setpoint percentage.
Voltage or current metering is reading incorrectly	- Verify that the controller has been programmed with the correct values for the voltage sensing PT ratio and/or current sensing CT ratio. - Verify that the battery supply DC negative conductor is properly grounded to the engine block (i.e. to a common ground point). - Verify that the controller's analog input has been properly calibrated as per manual instructions. - Verify the voltage sensing wiring connection to the MEC 20 matches power distribution type. (**Note:** standard *direct* voltage connection requires that the generators neutral is solidly grounded.)
Engine temperature or oil pressure display is reading incorrectly	- Verify that the controller's analog input has been properly calibrated as per manual instructions. - Verify engine sensor wiring is correct. (**Note:** engine sensors must be factory supplied units only.) - Verify that the pressure and/or temperature resistor jumper clips are removed from the circuit board. - Verify that the battery supply DC negative conductor is properly grounded to the engine block (i.e. to a common ground point).

SYMPTOM (CONT'D)	CORRECTIVE ACTION (CONT'D)
Engine temperature or oil pressure displays 9999	- Check the wiring from the MEC 20 terminal #37 & #38 to the engine mounted sender are correct (i.e. wiring is not open or shorted). - Verify the engine mounted senders have correct resistance reading for corresponding input temperature or pressure (refer to the Analog Temperature and Pressure Calibration table for values). - Verify calibration.
Engine alarms on high engine temperature or low oil pressure when engine is operating within normal limits	- Check the wiring from the MEC 20 terminals #37 & #38 to the engine mounted senders is correct (i.e. wiring is not open or shorted). - Verify the engine mounted senders have correct resistance reading for corresponding input temperature or pressure (refer to the Analog Temperature and Pressure Calibration table for values).
Key presses on the lexan faceplate do not operate	- Verify the interconnecting ribbon cable between the lexan faceplate and main printed circuit board is correctly connected.

14. NOTES

MEC20

MICROPROCESSOR ENGINE/GENERATOR CONTROLLER

SUMMARY CONFIGURATION DATA SHEET

WORK ORDER #:	00000-00-11-MEC	REV.:	0	REV. DATE:	99/05/10
INITIATED BY:	Admin	CUSTOMER:	TEST	DEFAULT PROGRAM:	P1
DATE:	99/05/10	PROJECT NAME:	P1-480V	TPS VER:	B

ENGINE/GEN SYSTEM INPUTS

SYSTEM AC VOLTS: 480 PHASES: 3 FREQUENCY: 60 DC VOLTAGE: 24

DIGITAL DISPLAY FEATURES

- ☒ AC VOLTAGE
- ☒ AC CURRENT
- ☒ FREQUENCY
- ☒ TACHOMETER
- ☒ ENGINE TEMPERATURE
- ☒ OIL PRESSURE
- ☒ BATTERY VOLTAGE
- ☒ HOURMETER

STANDARD FAULT CIRCUITS (15)

FAULT NAME	INPUT TYPE
Overcrank Shutdown	Internal
Loss of Speed Signal Shutdown	Internal
Overspeed Shutdown	Internal
Switch Not in Auto Alarm	Internal
Low Battery Voltage Alarm	Analog (DC Volts)
High Battery Voltage Alarm	Analog (DC Volts)
Weak Battery Alarm	Analog (DC Volts)
Low Engine Temp. Alarm	Analog (Temp. Sender)
High Engine Temp. Alarm	Analog (Temp. Sender)
Low Oil Pressure Alarm	Analog (Press. Sender)
Emergency Stop	Internal/External
Low oil pressure Shutdown	External Digital Input #1
High engine temp Shutdown	External Digital Input #2
Low coolant level Shutdown	External Digital Input #3
Low fuel level Alarm	External Digital Input #4

OPTIONAL DIGITAL FAULT CIRCUITS (up to 8)

FAULT NAME	INPUT TYPE
	External Digital Input #5
	External Digital Input #6
	External Digital Input #7
	External Digital Input #8
	External Digital Input #9
	External Digital Input #10
	External Digital Input #11
	External Digital Input #12

OPTIONAL ANALOG FAULT CIRCUITS

FAULT NAME	INPUT TYPE

STANDARD OUTPUT CONTACTS (4)

OUTPUT NAME	OUTPUT TYPE
Run	Form A
Crank	Form A
Common Fail	Form C
ATS Test	Programmable #1 - Form C

OPTIONAL PROGRAMMABLE CONTACTS (up to 3)

OUTPUT NAME	OUTPUT TYPE

OTHER OPTIONAL FEATURES

* indicates custom digital fault

Main Menu Program
MEC20
Software ver. 1.3

CUSTOMER:	TEST
PROJECT:	P1-480V
PRODUCT:	MEC20
WORK ORDER:	00000-00-11-MEC
REVISION #:	0
REVISION DATE:	99/05/10
START DATE:	99/05/10
START BY:	Admin
DEFAULT PROGRAM:	P1
TPS VERSION:	B

Read only password:	1	☐	
Read/write password:	2	☐	
Master password:	3	☐	
Node Address:	1	☐	1-255
System Voltage:	480	☒	Line to line voltage 120-15000
System Frequency:	60	☐	Toggle between 50/60Hz
System Phases:	3	☐	Toggle between 1 & 3 phase
Voltage Sensing:	1	☐	Voltage sensing PT ratio 1-208
CurrentSensing:	100	☐	Current sensing CT ratio 1-999
Temperature Scale:	C	☐	Toggle between Deg C/Deg F
Pressure Scale:	KPA	☐	Toggle between PSI/KPA
Start Delay:	3	☐	0-999 seconds
Crank Time:	15	☐	0-99 seconds
Rest Time:	15	☐	0-99 seconds
Starter Re-Engage:	3	☐	1-99 seconds 0=disabled
Number of Cranks:	3	☐	1-99 times 0=continuous
Bypass Delay:	10	☐	0-99 seconds
Cooldown Delay:	5	☐	0-99 minutes
Nominal RPM:	1800	☐	0-4000 RPM
Flywheel Teeth:	150	☐	0-999 teeth
Crank Disconnect:	30%	☐	0-100%
Overspeed:	110%	☐	100-150%
Overspeed Transient:	0.1	☐	0.0-9.9 seconds
Run Output Failsafe:	Yes	☐	Toggle between Yes/No
Option Yes / Option No:	Yes	☐	Toggle between Yes/No
Loss of Speed:	Shutdown	☐	Toggle between Alarm/Shutdown
Start Input Polarity:	Close	☐	Toggle between Open/Close
Common Fail for not in Auto:	Yes	☐	Toggle between Yes/No
Programmable Output1:	ATS Test	☐	Choose from list
Programmable Output2:	Disabled	☐	Choose from list
Prog Output 2 Option:	No	☐	Toggle between Yes/No
Programmable Output3:	Disabled	☐	Choose from list
Prog Output 3 Option:	No	☐	Toggle between Yes/No
Programmable Output4:	Disabled	☐	Choose from list
Prog Output 4 Option:	No	☐	Toggle between Yes/No
Programmable Output5:	Disabled	☐	Choose from list
Prog Output 5 Option:	No	☐	Toggle between Yes/No
Programmable Output6:	Disabled	☐	Choose from list
Prog Output 6 Option:	No	☐	Toggle between Yes/No
Auto Callout:	Common Fail	☐	Toggle Common Alarm, Fail, Shutdown
Post Lube Duration:	0	☐	0-999 minutes
Cycle Lube Interval:	1	☐	1-9999 minutes
Cycle Lube Duration:	0	☐	0-999 minutes
Cycle Lube Option:	No	☐	Toggle between Yes/No
Horn Duration:	60	☐	0=continuous
Display Menu:	999	☐	0-999 seconds
Back Lite Timeout:	999	☐	0-999 seconds
Voltage Metering:	Enabled	☐	Toggle between Enabled/Disabled

Main Menu Program
MEC20

Software ver. 1.3

WORK ORDER:	00000-00-11-MEC
REVISION #:	0
REVISION DATE:	99/05/10
START DATE:	99/05/10
START BY:	Admin
DEFAULT PROGRAM:	P1
TPS VERSION:	B

CUSTOMER:	TEST
PROJECT:	P1-480V
PRODUCT:	MEC20

Current Metering:	Enabled	☐	Toggle between Enabled/Disabled
Engine Temp Metering:	Enabled	☐	Toggle between Enabled/Disabled
Oil Pressure Metering:	Enabled	☐	Toggle between Enabled/Disabled
Reset Run Hours:	No	☐	Toggle between Yes/No

Calibration
MEC20 *Software ver. 1.3*

CUSTOMER: TEST
PROJECT: P1-480V
PRODUCT: MEC20

WORK ORDER: 00000-00-11-MEC
REVISION #: 0
REVISION DATE: 99/05/10
START DATE: 99/05/10
START BY: Admin
DEFAULT PROGRAM: P1
TPS VERSION: B

Calibration:

Volts A-B Zero		☐	0 - 255 Calibration correction number
Volts A-B Span		☐	0 - 255 Calibration correction number
Volts B-C Zero		☐	0 - 255 Calibration correction number
Volts B-C Span		☐	0 - 255 Calibration correction number
Volts C-A Zero		☐	0 - 255 Calibration correction number
Volts C-A Span		☐	0 - 255 Calibration correction number
Current A Zero		☐	0 - 255 Calibration correction number
Current A Span		☐	0 - 255 Calibration correction number
Current B Zero		☐	0 - 255 Calibration correction number
Current B Span		☐	0 - 255 Calibration correction number
Current C Zero		☐	0 - 255 Calibration correction number
Current C Span		☐	0 - 255 Calibration correction number
Battery Voltage Span		☐	0 - 255 Calibration correction number
Engine Temp Max		☐	0 - 255 Calibration correction number
Engine Temp Min		☐	0 - 255 Calibration correction number
Oil Pressure Max		☐	0 - 255 Calibration correction number
Oil Pressure Min		☐	0 - 255 Calibration correction number

MEC20 PROGRAMMING SHEETS
ANALOG FAULTS

CUSTOMER: TEST
PROJECT: P1-480V
PRODUCT: MEC20

WORK ORDER: 00000-00-11-MEC
REVISION #: 0
REVISION DATE: 99/05/10

TPS VERSION: B
START DATE: 99/05/10
START BY: Admin
DEFAULT PROGRAM: P1

FAULT NAME	INPUT ANALOG TYPE	FAULT ENABLE/ DISABLE	SETPOINT LEVEL (PICK-UP)	SETPOINT LEVEL (DROP-OUT)	UNITS	ACTION SHUTDOWN/ ALARM	ALARM LATCH YES/NO	SHUTDOWN REMOTE RESET YES/NO	BYPASS ON START YES/NO	TRANSIENT DELAY (SEC)
Weak battery	DC Voltage	Enable	18.0		V	Alarm	Yes		No	3
Low battery voltage	DC Voltage	Enable	25.6		V	Alarm	No		No	120
High battery voltage	DC Voltage	Enable	30.4		V	Alarm	No		No	10
Low engine temperature	Temp Sender	Enable	35		DEG C	Alarm	Yes		No	5
High engine temp #1 (AL)	Temp Sender	Enable	95		DEG C	Alarm	Yes		Yes	2
Low oil pressure #1 (AL)	Press Sender	Enable	207		KPA	Alarm	Yes		Yes	2

☒ Indicates change from default program

MEC 20 PROGRAMMING SHEETS
DIGITAL FAULTS

CUSTOMER: TEST
PROJECT: P1-480V
PRODUCT: MEC20

WORK ORDER: 00000-00-11-MEC
REVISION #: 0
REVISION DATE: 99/05/10

TPS VERSION: B
START DATE: 99/05/10
START BY: Admin
DEFAULT PROGRAM: P1

FAULT NAME	INPUT NUMBER	FAULT	ACTION	ALARM LATCH	SHUTDOWN REMOTE RESET	POLARITY	BYPASS ON START	TRANSIENT DELAY
		ENABLE/ DISABLE	SHUTDOWN/ ALARM	YES/NO	YES/NO	OPEN/CLOSE	YES/NO	(SEC)
Low oil pressure	1	Enable	Shutdown		No	Open	Yes	0.5
High engine temp	2	Enable	Shutdown		No	Open	Yes	1
Low coolant level	3	Enable	Shutdown		No	Close	No	5
Low fuel level	4	Enable	Alarm	No		Close	No	0.1

* indicates custom digital fault

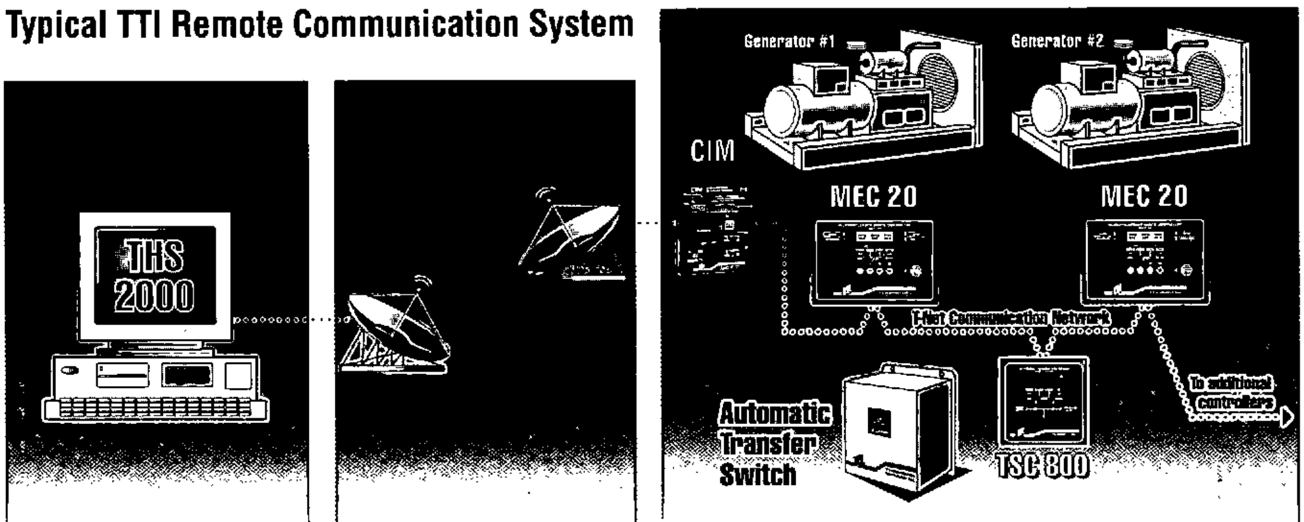
☒ Indicates change from default program

THOMSON TECHNOLOGY INC.

TTI REMOTE COMMUNICATION SYSTEM

Model THS 2000 Software with CIM Module

Typical TTI Remote Communication System



Personal Computer — Communication Link — Typical Generator Installation

GENERAL DESCRIPTION

The **TTI Remote Communication System** provides remote monitoring and control of **TTI** microprocessor-based controllers as used in the power generation industry. The **Communication Interface Module (CIM)** is a hardware interface device which allows two way data transfer between **TTI** microprocessor-based controllers (such as models **MEC 20** or **TSC 800**) and a remote monitoring/controlling system. Utilizing Modbus™ protocol, the **CIM** can be integrated with building management systems, programmable logic controllers (PLC's) or used with a stand alone personal computer (PC).
For remote monitoring and control applications utilizing a stand alone PC, **TTI** has developed model **THS 2000 Host Software** which operates on standard IBM™ compatible PCs. **THS 2000** is a user friendly, Windows™-based software program with pre-configured graphic screens showing operational status and analog data of connected controllers.

ADVANCED FEATURES

- Automatic callout from a generator site to a remote monitoring PC when a generator system or transfer switch activity occurs, such as a fault or status change. Up to three phone numbers can be programmed using 32 digit numbers to support pager use.
- Remote communication via telephone system (with modems) or a direct connected serial communication link using RS-232, -422 or -485 transmission types.
- The **THS 2000** program is designed for use with standard Windows 95™/Windows 98™, Windows NT™ and Windows 2000™ operating systems.
- One **CIM** module can control and monitor up to ten controllers at a generator site using a single telephone line or direct connected serial link.
- Direct connect configuration for applications not requiring Modbus protocol, auto-callout and the need to communicate to multiple controllers.
- Communication system parameters are configured in software using the **THS 2000** program.
- A three level password protected security system is provided to prevent unauthorized user access to a generator system.

DEVELOPMENT ASSISTANCE PROVIDED BY THE SCIENCE COUNCIL OF BC

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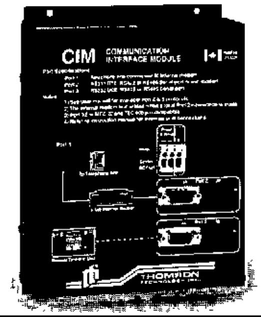
CIM MODULE



The **Communication Interface Module (CIM)** is an advanced communication interface device for remote communication to **Thomson Technology's** *latest generation* of microprocessor-based engine generator control products. *One* **CIM** can communicate with *networked **MEC 20*** engine generator controllers and/or ***TSC 800*** transfer controllers using the **TTI** developed T-Net Communication Network. The serial communication port can be used for direct connection to a personal computer or other remote connected devices. An internal modem is provided with the **CIM** for direct connection to telephone systems. The **CIM** uses **Modbus™** protocol to provide communication to other systems such as PC's, PLC's or building management control systems.

CIM ADVANCED FEATURES

- Dedicated microprocessor-based design provides high speed remote communication and control of connected devices.
- One **CIM** module can provide interface to a complete networked controller system.
- Internal 14.4 kbaud modem for direct connection to telephone systems.
- Industry standard **Modbus™** protocol provides an open, non-proprietary communication link to a wide variety of system devices.
- Standard plug-in telephone RJ45/RJ11 type jacks and DB9 computer ports provide simple system interconnection.

ORDERING INFORMATION

The TTI Remote Communication System may be ordered in conjunction with control panels or transfer switches or as separately supplied components. 1. **CIM** — 2. **PC** — 3. **DSK** — 4. **DCC**

1. **BASIC MODEL**: The **CIM** is supplied with a 6ft (1.8m) communication cable for connection between the CIM and TTI controller (PC communication cable is not included). The CIM is to be mounted at the TTI controller location. Modbus™ device communication cable* and software programming of the customer's Modbus™ device is not included.
2. **APPLICATION TYPE**: Specify **PC** (Personal Computer) or **PLC** (Programmable Logic Controller). Port 2 is auto-detecting in the PC mode for either RS232, RS422, RS485** or Modem uses.
3. **THS 2000 SOFTWARE**: Specify **DSK** to order a 3.5" floppy diskette. Leave field "blank" if THS 2000 software is to be obtained (free of charge) via downloading from Website.
4. **DIRECT CONNECT CONFIGURATION:** For applications not requiring Modbus protocol, auto-callout and the need to communicate to multiple controllers, **THS 2000 Host Software** can be used without the CIM module in **"Direct Connect"** configuration. To use the **THS 2000 Host Software** directly with TTI controllers (i.e. without the CIM module), the following additional equipment (not TTI supplied) is required; a) RS232/422 converter, b) all communication cables, and c) external modem (if required). Contact TTI for technical requirements of this equipment to ensure proper equipment coordination.

Note: All configurations of the **CIM** are set via software and are field programmable by the customer utilizing a customer supplied PC and THS 2000 software.
*For detailed information on communication cable requirements or additional communication accessories, refer to instruction manual or contact TTI factory
**For local connected PC applications using RS485, a RS232 converter is required for the PC (converter is not included).

CIM SPECIFICATIONS

• **Power Supply:**	8 to 35Vdc, negative ground
• **Power Consumption:**	5 watts (max.)
• **Operating Temperature:**	-15°C to +50°C
• **Storage Temperature:**	-40°C to +85°C
• **Environmental:**	NEMA 1
• **Vibration:**	1g, 5-250Hz
• **Humidity:**	5 to 95% non-condensing
• **Dimensions:**	150mm W x 180mm H x 50mm D
• **Internal Modem:**	14.4 kbaud, Hayes™ AT set compatible
• **Communication Ports Hardware:**	**Port 1** Telephone T/R signals **Port 2** RS232/RS422/RS485, asynchronous, 1200-19200 baud **Port 3** RS422, asynchronous, 4800 baud
• **Communication Ports Software Protocol:**	**Port 1** Telephone **Port 2** **Modbus™** protocol **Port 3** TTI T-Net protocol

Note: Specifications subject to change without notice.

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REMOTE COMMUNICATION SYSTEM

VERSION 3.0

USER MANUAL

PM055 REV 2 00/08/31

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SECTION 1
COMMUNICATION INTERFACE MODULE (CIM)
VERSION 3.0

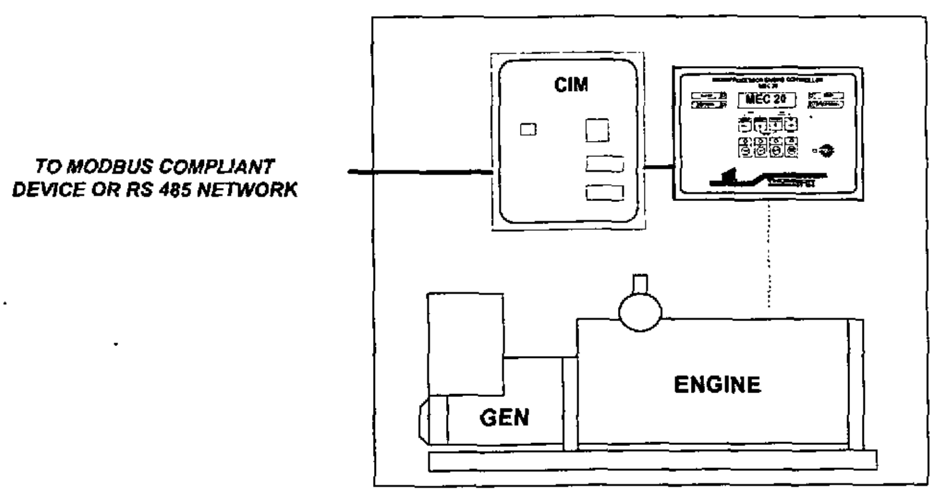
1. Introduction

This section is intended version 3.0 of the Communication Interface Module (CIM). For **other product versions, contact Thomson Technology, Inc. to obtain applicable instruction manuals.**

The Thomson Technology Inc. (TTI) remote communication system with the CIM 3.0 and Modbus™ protocol provides remote monitoring and control of TTI microprocessor-based controllers as used in the power generation industry. The system consists of 2 main components as follows:

- Communication Interface Module (CIM): The CIM provides the hardware and software interface between a Modbus compliant device (customer supplied) and the specific microprocessor-based controllers as used at a generator site.
- Remote Terminal Unit (RTU): An RTU is a device that directly operates the equipment at a generator site. These devices are the actual microprocessor-based controllers as developed by Thomson Technology, Inc. (e.g. MEC 20 engine controller or TSC 800 transfer switch controller.

The following diagram depicts a typical remote communication system.



RTU Site

Some advanced features of the remote communication system with the CIM 3.0 module and Modbus™ protocol are as follows:

- One CIM module can control and monitor up to 10 RTUs at a generator site using a single direct serial/phone link.
- Configuration of all communication system setpoints is done using software.
- CIM Port #2 can be configured for RS-232, RS-422 or RS-485 serial communication types. RS-485 communication allows multiple CIM's to be interconnected to any Modbus™ RS-485 network. RS-485 is recommended for the best distance and noise immunity. Port #2 has a hardware protocol auto-detection option that removes the confusion of determining whether the port is in RS-232 or RS-485 mode. Just plug in and communicate (assuming the baud rate etc. is set correctly).
- Security features have been implemented to allow password protection. However these features along with auto-detection and modem functionality can be bypassed with a "fixed Modbus" option that is intended for direct PLC function where remote access is not necessary.
- With onboard modem support, CIM 3.0 offers remote telephone connectivity with auto callout and pager support with up to 32 characters. Up to 3 phone numbers can be programmed into the CIM for remote THS connection or pager notification. In the case of a failed connection, retries can be specified.

Further information on the Modbus™ protocol support on the CIM can be found in SECTION 3 and at the Modicon website (www.modicon.com).

NOTE: Throughout this document, CIM's, MEC 20's and TSC 800's are generically referred to as remotes.

2. General Description

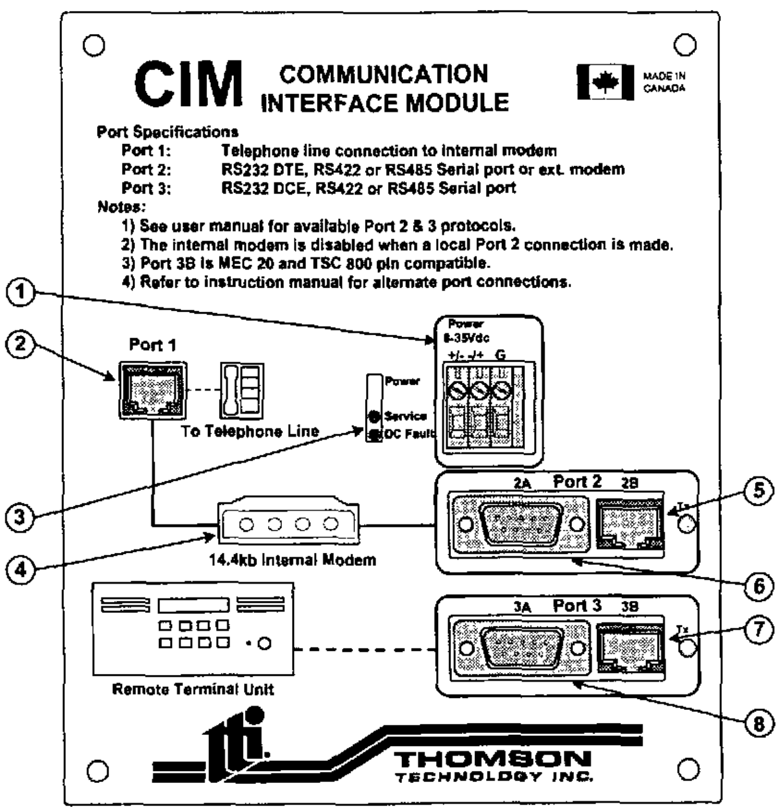
The Communication Interface Module (CIM) is an advanced communication interface device for remote communication to Thomson Technology's latest generation of Microprocessor-based engine generator and transfer switch control products. One CIM module can communicate with networked MEC 20 engine generator controllers or TSC 800 transfer controllers. The serial communication ports can be used for direct connection to a personal computer (port #2) or to other remote connected devices (port #3). An internal modem is available with the CIM, which provides direct connection to a telephone system.

The CIM provides the following advanced features:

- Dedicated Microprocessor-based design provides fast operation without restricting RTU operation.
- One CIM module can provide interface to a complete networked RTU system. This leads to a single telephone line connection per site rather than typical multiple line solutions.
- Internal 14.4 kbaud modem available for direct connection to telephone system.
- Flexible design provides two fully configurable serial ports.
- Standard plug-in telephone RJ45/RJ11 type jacks and DB9 computer ports provide simple interconnection to system.
- The ability to callout to a THS host station or pager when an RTU fault occurs frees the user from continual monitoring. It also allows for immediate remote response to problems.

3. Hardware Interface

The main features of the CIM are described as follows with reference to the following figure.



3.1. DC Power Input: Terminals are provided for DC power input to the CIM module. Power input is non-polarity sensitive and can range from 8-35Vdc.

3.2. Telephone Port: The telephone port is used to interconnect to a telephone system. This port is internally connected to a 14.4 Kbaud modem. This port uses a 6 pin RJ11 plug-in jack connection.

3.3. Diagnostic LEDs: The CIM module provides four diagnostics LED lights are described as follows:

- Power: This LED is illuminated whenever the CIM has correct DC supply voltage applied.
- Service: This LED illuminates when the CIM has an internal fault in which the unit must require service.
- DC Fault: This LED is illuminated whenever the CIM's internal power supply has shutdown do an internal fault or an external overvoltage condition from the DC supply input. To reset a DC fault, the DC supply voltage must be removed for 30 seconds, then re-applied.

3.4. Internal Modem: The CIM is provided with an internal 14.4 Kbaud modem. The modem is internally connected between the telephone port and port 2A/B.

3.5. Port 2B: Port 2B may be interconnected to a remote terminal unit (RTU) or Personal computer (PC). Port 2B can be configured to RS-232 or RS-485/-422 type transmission signal. When a personal computer is connected to Port 2B, a null modem cable or connector must be used. When the CIM modules' internal modem is used, port 2B is disabled. This port uses an 8 pin RJ45 plug-in connector. An LED indicator is provided to signal when the port is communicating. Port 2B is internally wired in parallel with Port 2A.

3.6. Port 2A: Port 2A may be interconnected to a remote terminal unit (RTU) or PC. Port 2A can be configured to RS-232 or RS-485/-422 type transmission signal. When a personal computer is connected to Port 2A, a null modem cable or connector must be used in series with the PC cable. When the CIM modules' internal modem is used, port 2A is disabled. This port uses a 9 pin standard DB9 female plug-in connector.

An LED indicator is provided to signal when the port is Transmitting. Port 2A is internally wired in parallel with Port 2B.

3.7. Port 3B: This port may be interconnected to a remote terminal unit (RTU). Port 3B utilizes a RS-422 type transmission signal that is compatible with MEC 20 or TSC 800 controllers. The standard connection for a MEC 20 or TSC 800 controller (RTU) application is for port 3B to be connected to the RTU. This port uses an 8 pin RJ45 plug-in connector and allows for a direct connection to TTI MEC 20 and/or TSC 800 controllers. Port 3B is internally wired in parallel with Port 3A.

3.8. Port 3A. This port may be interconnected to a remote terminal unit (RTU) or directly to a PC. Port 3A utilizes a RS-422 type transmission signal that is compatible with MEC 20 or TSC 800 controllers. The standard connection for a MEC 20 or TSC 800 controller (RTU) application is for port 3A to be connected to the RTU. This port uses a 9 pin DB9 female connector. Port 3A is internally wired in parallel with Port 3B.

NOTE: CIM Port 2 cannot be used concurrently with the modem (CIM Port 1). An RS-232 or RS-422 cable can be connected to the CIM, but cannot be active if the modem is to be used. An RS-485 connection will effectively disable the modem whether it is active or inactive.

4. Telephone Port 1

Detail pin numbers and usage designations for the telephone port are as follows:

Signal Type - Telephone	Direction	Port 1A RJ11 #
No Connection	No Connection	1
No Connection	No Connection	2
TIP	Input/output	3
Ring	Input/output	4
No Connection	No Connection	5
No Connection	No Connection	6

5. Port 2A/B

Detail pin numbers and usage designations for Port number 2A/B are as follows:

RS-485 half-duplex (Pending)	RS-422 full-duplex (Pending)	RS-232 (DTE)	Direction	RJ45 #	DB9 #
Sa'	Rxa	CD	Input	1	1
Sb'	Rxb	Rx	Input	2	2
Sb	Txb	Tx	Output	3	3
Sa	Txa	DTR	Output	4	4
Ground	Ground	GND	Passive	5	5
NC	NC	DSR	Input	6	6
NC	NC	RTS	Output	7	7
NC	NC	CTS	Input	8	8
		RI	n/c	n/a	9

6. Port 3A/B

Detail pin numbers and usage designations for Port number 3A/B are as follows:

RS-485 half-duplex (Pending)	RS-422 full-duplex (Pending)	RS-232 (DCE)	Direction	RJ45 #	DB9 #
Sa	Txa	CD	Output	1	1
Sb	Txb	Tx	Output	2	2
Sb'	Rxb	Rx	Input	3	3
Sa'	Rxa	DSR	Input	4	4
Ground	Ground	GND	Passive	5	5
NC	NC	DTR	Output	6	6
NC	NC	CTS	Input	7	7
NC	NC	RTS	Output	8	8
		RI	n/c	n/a	9

7. CIM Operation Functions

The CIM module provides the following main functions when used in a communication system:

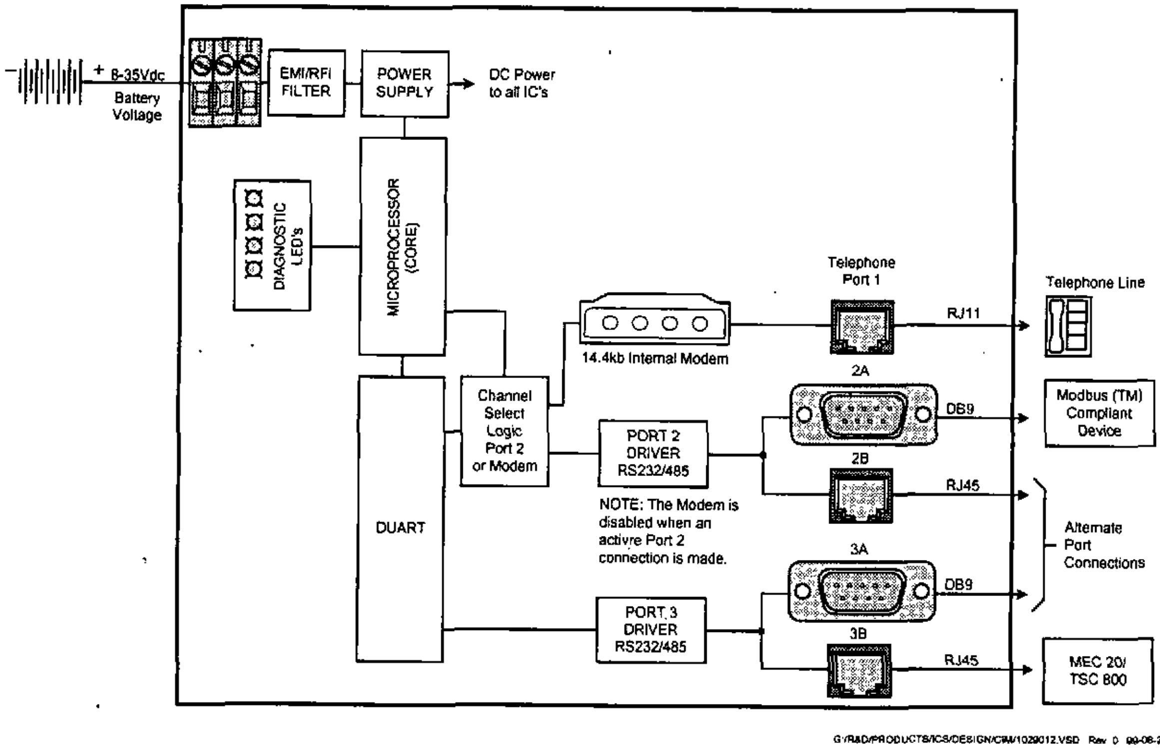
RTU & Modbus™ Device Interface: The CIM is the main communication interface component between a Modbus™ compliant device and the remote terminal units. The CIM provides the necessary hardware interface (i.e. COM Ports) as well as the Modbus™ software protocol interface.

Protocol Data Processing: The CIM receives incoming communication signals from various types of RTUs and processes the data into the specific Modbus™ language as required for the application. The processed data then gets transferred to the applicable port and transmitted to a remote Modbus™ compliant device.

CIM Configuration: The CIM stores vital information in non-volatile FLASH memory pertaining to a specific RTU site as defined by the user. Stored information includes, site name, site passwords, and auto callout phone numbers (3).

RTU Polling: The CIM module will automatically poll connected RTUs to determine their operating status and to signal an auto callout (callout is only operational when the modem feature is operational) to the remote Modbus™ compliant device to alert a user of an abnormal condition.

8. CIM Block Diagram



9. CIM Specifications

- Power supply: 8 to 35Vdc, negative ground
- Power consumption: 5 watts (max.)
- Operating temperature: -15(C to +50(C
- Storage temperature: -40(C to +85(C
- Environmental: NEMA 1
- Vibration: 1g, 5-250Hz
- Humidity: 5 to 95% non-condensing
- Dimensions: 150mm W x 180mm H x 50mm D
- Internal Modem 14.4 kbaud, Hayes™ AT set compatible
- Communication Ports Hardware Port 1 Telephone T/R Port 2 RS-232/-422/-485 asynch., 1200-19200 baud Port 3 RS-422, asynchronous 4800 baud
- Communication Ports Software Protocol Port 1 Telephone Port 2 Modbus™ Protocol Port 3 TTI T-Net Protocol

Specifications subject to change without notice.

10. CIM Installation

NOTE: Installations should be done according to all applicable electrical regulation codes as required.

The following installation guidelines are provided for general information only pertaining to typical site installations. For specific site installation information, consult Thomson Technology Inc. as required.

CAUTION!!! Qualified personnel must do all installation and/or service work performed only. Failure to do so may cause personal injury or death.

10.1. Battery Supply Input

The CIM can operate on any battery supply from 8 to 35 volts DC nominal Wiring from the system battery to the CIM should conform to the following guidelines to avoid possible communication module malfunction and/or damage.

Avoid wiring from the engine starter terminals - wiring should go directly from the battery terminals to the control panel where the CIM module is located (to avoid voltage drop in the starter cables and starter motor commutation noise).

CAUTION!!! The battery charger must be turned off before battery cables are removed from the battery (i.e. for servicing). Failure to do so may subject the control panel to an overvoltage condition in which damage may result.

Under noisy environments (i.e. gas engines with high voltage ignitions, etc.), wiring from battery should be a twisted pair of #14 AWG (2.5mm2) wires.

The use of AC or DC operated solenoids or relays in control systems can sometimes cause high voltage spikes on the DC power supply, which may cause electronic devices to fail. Transient suppression devices are recommended for all inductive devices sharing wiring or if physically located near the CIM module. For DC operated relays or solenoids, use a suitably rated counter EMF Diode (or commonly known as "freewheeling" diode). For AC operated relays or solenoids, use a suitably rated metal oxide varistor (MOV) or capacitor/resistor suppressor.

10.2. Remote Communication Wiring

All communication interconnecting wiring to/from the CIM Module shall utilize #22 AWG-8 wire, twisted, shielded cable with RJ45 connectors.

All remote communication wiring outside the control panel must be run in separate conduit and shall not be located near AC power cables to prevent pick-up of induced voltages.

10.3. Dielectric Testing

Do not perform any high voltage dielectric testing on the CIM connected in the circuit as serious damage will occur to the module.

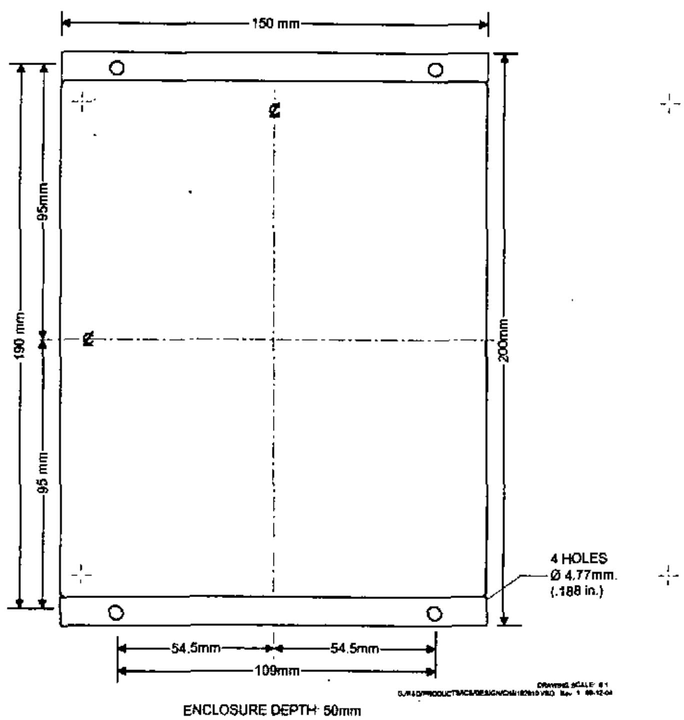
10.4. Mounting Location/Installation

The CIM Module is designed for mounting directly onto a control panel inner sub-panel. Considerations should be given for the following:

The controller should be installed in a dirt free, dry location away from extreme heat sources. Adequate space should be provided around the CIM module for control wiring.

10.5. Mounting Dimensions

The CIM mounting dimensions are shown in the following diagram:



10.6. RS-232 and RS-485422 Wiring

This section describes the cabling necessary to connect a host PC to a CIM using RS-232 and to connect to an RS-485 or RS-422 network

10.6.1. Host PC Connection

The host PC connection to the CIM requires a null-modem adapter, as both devices believe they are DTE.

10.6.1.1. Host PC DB-25 To CIM DB-9

DTE	DB-25	DB-9	CIM
GND	1	n/c	GND
TXD	2	2	RXD
RXD	3	3	TXD
RTS	4	8	CTS
CTS	5	7	RTS
DSR, DCD	6,8	4	DTR
SG	7	5	SG
DTR	20	6,1	DSR,DCD

10.6.1.2. Host PC DB-9 To CIM DB-9

DTE	DB-9	DB-9	CIM
TXD	3	2	RXD
RXD	2	3	TXD
RTS	47	8	CTS
CTS	8	7	RTS
DSR, DCD	1,6	4	DTR
SG	5	5	SG
DTR	4	6,1	DSR,DCD

10.6.2. RS-485/-422 Connection

The following hardware configuration is required for 4 wire RS-485/-422 from the port 2 on the CIM to an RS-232 port on a computer:

The following parts are connected in order from the RS-232 side (computer) to the RS-485/-422 side (the CIM).

RS-232 to RS-485 or RS-422 adapter (set to DCE)

DB-25 to RJ45 adapter (or custom cable) for RS-422/-485 on the CIM port 2(see below wiring).

Insure that the correct handshaking signals are connected on the RS-232 side of the RS-485/-422 converter. Many RS-485 converters use the RTS line to control the transmitter (which must be tri-stated during receive mode). It is important to insure that the converter is configured correctly and the correct handshaking lines are wiring appropriately. If the handshaking lines (RTS) are not wired correctly the connection may appear to work but damage may occur and communications may be unreliable over time.

DB-25 from RS-422 converter		**CIM Port 2**	
Signal	Pin	Pin	Signal
TXB+	14	1	RXB+
TXA-	2	2	RXA-
RXA-	5	3	TXA-
RXB+	17	4	TXB+
GND (optional)	7	5	GND

DB-25 from RS-485 converter		CIM Port 2	
Signal	Pin	Pin	Signal
TXB+, RXB+ (jumpered)	14,17	1,4	RXB+,TXB+ (jumpered)
TXA-, RXA- (jumpered)	2,5	2,3	RXA-, TXA- (jumpered)
GND (optional)	7	5	GND

- Note that the RS-232 side of the RS-485 converter will most likely require the RTS line be connected along with TX, RX and GND.

11. Troubleshooting

Refer to the following list of typical problems. Consult the factory for any detailed information or for any problems not listed.

CAUTION!!! Before opening the enclosure to perform any service task, it is imperative to isolate the control system from any possible source of power. Failure to do so may result in serious personal injury or death due to electrical shock.

Service procedures must be undertaken by qualified personnel only!

SYMPTOM	CORRECTIVE ACTION
CIM does not power up even with correct DC power applied	Check that there are no wiring errors/short circuits connected to the CIM. Note: The CIM Module contains an electronic fuse that triggers upon an overload or overvoltage condition and does not reset until the supply voltage is removed.
Failure to communicate with PC (direct connected).	Verify all communication cables are connected to the correct ports. Ensure that the RTU's (TSC 800 and MEC 20) are connected to Port 3 on the CIM. Ensure the correct MEC 20 communication port (J7) is utilized. Port J7 is white in color. The black RJ45 connector on the MEC

	20 is for the expansion port, damage may occur to the CIM if this port is connected! When direct connection is used from port 2A to a PC, ensure a null modem cable or connector is used. (see Host PC Connection). Verify all settings in the THS 2000 program are correct. Critical settings are as follows: Port 3 baud rate--4800 Controller address--THS setting and controller setting must match Site Name--THS setting and CIM setting must match. Note: factory default setting in CIM is "site" Site Password--THS setting and CIM setting must match. Note: factory defeat setting in CIM is "user". If multiple MEC 20 controllers are connected to a single system, verify all controller node addresses are different. RTU site may be busy calling out if an alarm condition is present on the controller. Reset all fault conditions at the controller and set for automatic mode to cancel the auto call out condition.
Failure to communicate with PC (Modem connected).	Verify PC modem operates correctly (test independently with another software system). Verify PC modem is set for 9600 baud operation. Ensure phone numbers programmed for both PC site location and RTU equipment location are correct.
Failure to communicate with PC.	If you encounter difficulty connecting to a CIM with the Host software make sure the CIM is not trying to call-out. When the CIM is trying to call-out to the Host sites it will not respond to outside requests for connection. In this situation the user can be patient and make repeated attempts at connection until the CIM has exhausted its phone numbers and retries (can be over 12 mins in some cases with 3 numbers and 3 retries). Or the user can let the host successfully call-out to the Host software. After the phone numbers are successfully attempted or retries are exhausted the CIM will go back into a log-in ready state. If time is important, the CIM may be power cycled, for a brief time after the CIM power is restored (after the 2 quick blinks on the Port 2 LED) the CIM will be log-in ready. However the CIM will eventually go into a call-out state to report the site alarm situation. The above situation is the most common cause for not being

	able to establish a connection to the CIM. For testing and configuration it is recommended that the call-out function be disabled until it is required, this will eliminate the frustration described above.
Site RTU fails to auto callout to PC.	Verify the connected controller is programmed for the specific auto callout function (i.e. common alarm, common shutdown or common fail) Verify the Host software is in auto-answer mode, see THS2000 User Manual, Auto-answer Configuration.
Port configuration changes do not work.	.The CIM port configuration changes will not go into effect until the CIM has been power cycled. For Modbus communications ensure that the CIM is being addressed with the correct node address. The factory default CIM node address is '1', this should not be confused with the RTU node addresses connected to Port 3 of the CIM.

11.1. Database Re-initialization

If state of the internal database is unknown a reset to factory default conditions can be done by the following procedure:

a) Remove power from the CIM.

b) Remove the CIM back cover.

c) Connect a wire from the CIM ground terminal located next to the power connections.

d) Connect the other end of the ground wire to the testpoint located on the bottom of the daughter board (the daughter board is plugged into the bottom of the CIM motherboard) located on the bottom of the CIM that should be visible with the bottom cover removed.

e) With the bottom testpoint grounded carefully apply power to the CIM for at least 2 seconds. You may now remove power and reassemble the CIM. The CIM has defaulted back to factory settings.

SECTION 2
THS 2000 SOFTWARE PROGRAM

1. Introduction

The THS 2000 software program remotely controls and monitors a Thomson Technology Inc. (www.thomsontechnology.com) generator/transfer-switch control system. The THS 2000 program operates on an IBM-compatible Personal Computer with Microsoft Windows 95™, Microsoft Windows 98™, Microsoft Windows NT™ 4.0 or Microsoft Windows 2000 operating systems (www.microsoft.com). The THS 2000 program uses a TTI designed protocol to communicate to TTI generator control system site. A site consists of a single Communication Interface Module (CIM) and one or more associated Remote Terminal Unit (RTU) controllers.

The THS 2000 software is designed to allow a direct connection (via RS-232, RS-422 or RS-485) to Port 2 of the CIM or a remote connection (via a host PC modem) with the internal modem of the CIM on Port 1. The host PC modem must already be configured before attempting a remote connection. See the operating-system help for installing and configuring modems.

Version 3.1 of the THS2000 is intended for operation with version 3.0 of the CIM, but also provides support for previous versions of the CIM.

Throughout this document, text that is looks like this is for filenames and other computer-type text; text that appears in menus, dialog boxes and buttons looks like *this windows-type text.*

1.1. Definitions

CIM	Communications Interface Module; the communications hub for a site
Dialog box	interactive window allowing the user to view or change settings
MEC 20	Microprocessor Engine Controller
Modbus	industry-standard serial automation protocol defined by Modicon (www.modicon.com), *part of Schneider Automation, Inc.*
RTU	Remote Terminal Unit; in this context, a MEC 20 or a TSC 800
TSC 800	Transfer Switch Controller
Site	a CIM and one or more connected RTUs
Site-list	the site-list is the list of remote sites, primarily used for auto-answer and multiple CIM sites

1.2. Improvements

A number of improvements have been made to this version of the THS 2000 software. Most of the improvements correspond to added features of CIM version 3.0, but some of the changes are applicable to the previous version of the CIM. See See Section 1 for more information on device-specific features and Section 3 for the Modbus protocol.

The most notable improvement is the use of the Modbus protocol for communications to the CIM.

The new features in THS 2000 are:

- Support for new CIM 3.0 Modbus protocol as well as previous CIM protocol versions.
- Automatic RTU (MEC 20 and TSC 800) discovery on login. This will eliminate the need for the user to program the individual node address and controller type for each site (CIM). See Controller Discovery.
- Support for these additional CIM 3.0 features:
  - 32 character telephone numbers for callout, see Auto-answer Configuration;
  - call all numbers option for CIM callout, see Auto-answer Configuration;
  - CIM Port 2 auto-detect feature for the hardware protocol, see CIM Port 2;
  - bounded controller addresses for faster detection, see CIM Advanced.
- CIM Port 2 can now be configured for speeds from 1200bps up to 19.2kbps, instead of being fixed at 9600bps. This works for old CIM versions as well.
- Support for multiple remote callout sites. THS version 1.0 and 1.1 only support auto-answer for a single site. A system with two CIM sites that can callout, would not work correctly. This has been fixed by adding multiple sites to a single THS 2000 file. The calling-in CIM is then identified from the loaded set of sites. See Site-list Management.
- The MEC 20 digital fault labels that are disabled are blanked out in THS 2000. This feature requires the latest version of the MEC 20.
- Improved communications reliability over noisy communication lines.

  THS2000 version 3.1 adds the ability to connect directly to an RTU, bypassing the CIM. A maximum of one RTU, MEC20 or TSC800, is allowed. The auto-answer feature of THS2000 is not supported in this mode, as it is a function of the CIM. The auto-discovery of controllers is likewise not available. See CIM Bypass Wiring for a wiring description.

1.3. Computer System Requirements

The supported operating-systems are:

- Microsoft Windows 95™, Service Release 2 or later;
- Microsoft Windows 98™;
- Microsoft Windows NT™ 4.0 Workstation or Server, Service Pack 3 or later;
- Microsoft Windows 2000.

A minimum of 2 MBytes of hard drive space on the chosen installation drive is necessary for proper operation.

A modem that is fully supported by the operating-system is required for remote operation. It is important that the correct modem driver software is installed correctly.

A FIFO-enabled serial-port is required for direct connections.

Microsoft Internet Explorer™ 4.01 or later is recommended for use with the on-line help. However, Microsoft Internet Explorer 3.02 is sufficient if the hhupd.exe file, included with the THS 2000 distribution, is run first; this executable is provided by Microsoft for updating help file support.

1.4. Installation

The THS 2000 software consists of two files, the THS3v0.EXE file and the THS3v0.CHM file. Both files should be copied to a directory on your hard drive, such as C:\THS. The first file, THS3v0.EXE is the THS 2000 executable. You can make a link to this file on your desktop by dragging and dropping the THS3v0.EXE from the explorer to the desktop. The second file, THS3v0.CHM, is the on-line help file.

If you are using Microsoft Internet Explorer 3.02, the file hhupd.exe will be required to execute and update a system file for HTML Help support. That file is not required if Microsoft Internet Explorer 4.01 or later is installed.

2. Quick Start

This section will get you up and running the THS 2000 quickly and easily. This chapter covers the simple tasks that are necessary to communicate with a site. More advanced topics will be covered in a later section.

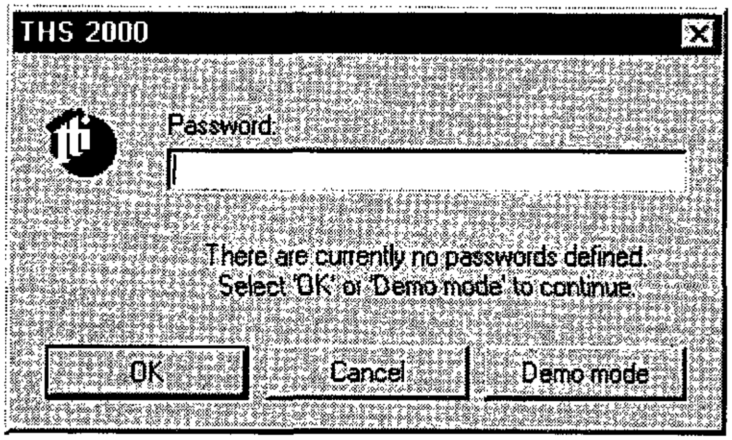
2.1. Step 1 Start THS 2000

Double-click on the THS 2000 icon (THS3v0.EXE) to start the program.

See Installation.

2.2. Step 2: Logon

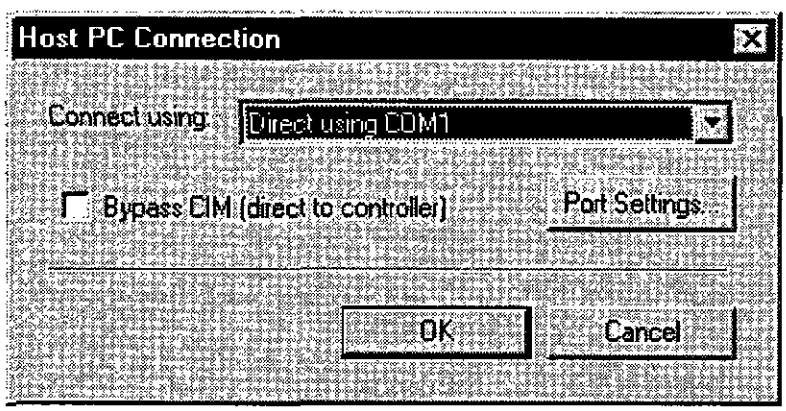
The *Password* dialog box will appear as shown below. Type in your password and click the *OK* button or just click the *OK* button if you have not programmed any passwords yet. There are no passwords configured initially, so click on *OK* to continue if you are running for the first time.



See Passwords and Starting And Logging On.

2.3. Step 3: Set Host Connection Method

Select the *Connect* command from the Site menu (or toolbar button or press F9). This command will normally bring up a list of accessible sites, however, if no sites are defined, you will be required to choose a host connection method. This dialog box is shown below.

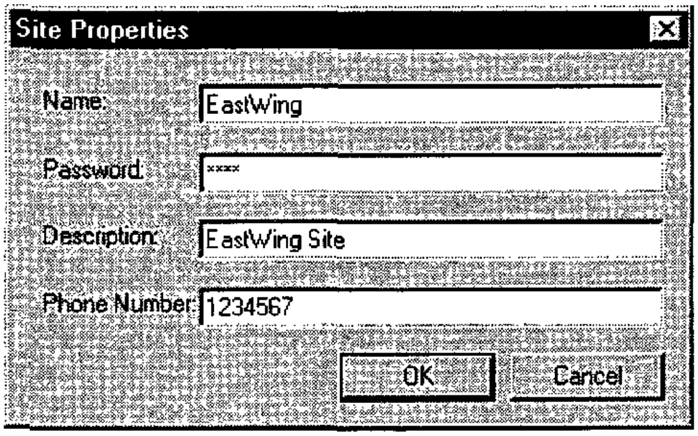


Select your connection method, either a specific modem (e.g. Hayes Accura 288 V.34 + FAX) or a serial port (e.g. Direct using COM1). If you select a direct communications port, you are also able to modify the port settings. The default settings are likely sufficient for now, so click the *OK* button.

See Host Connection.

2.4. Step 4: Enter Site Properties

Once the connection method is established, you will be prompted for the site properties, such as site name, as shown below. This allows you to enter the first site in the site-list.



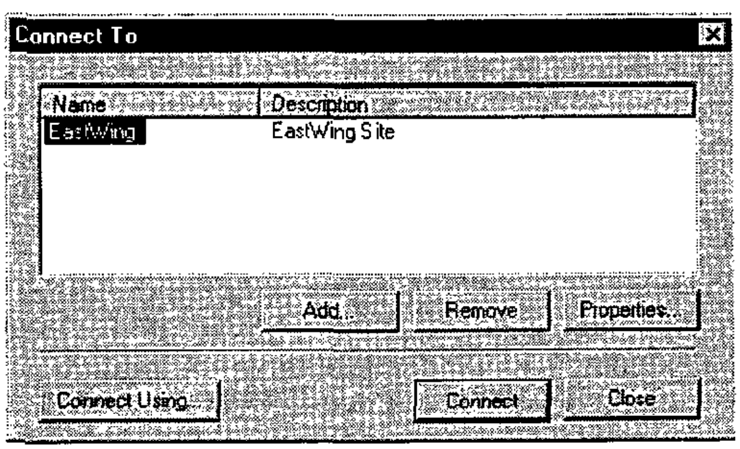
The name and password fields correspond to the name and password already programmed into the CIM that is managing the remote site. The description field is optional and can be used to describe the site. The phone number is entered for a remote site.

The name and password parameters must match the CIM on the intended site. The default name is "site" and the default password is "user." These parameters are case insensitive.

See Site Properties.

2.5. Step 5: Connect To Site

The next dialog box displays the list of sites, as shown below. At this point, there is only one site and it's already selected. From this dialog you can add, remove and modify site properties; modify the connection method; and connect to the selected site.

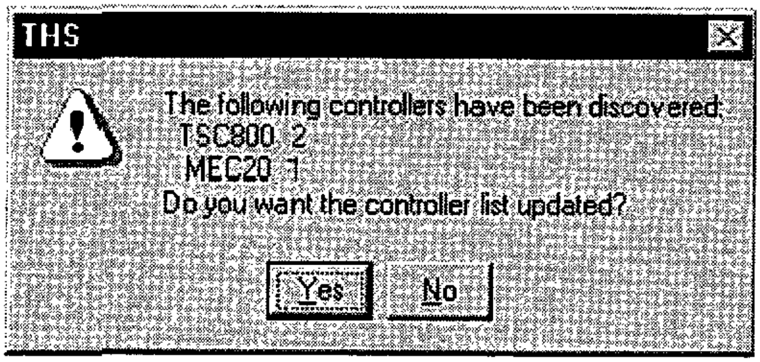


Clicking on the Connect button will begin the connection process. If you experience problems connecting to the remote site, please refer to the troubleshooting section of this manual.

See Connecting A Site.

2.6. Step 6: Identify Controllers

Once you are connected to the remote site, you need to identify the controllers on the site. If you are running CIM 3.0 or higher, the THS 2000 software will offer the controllers that have already been discovered, as shown below. You merely need to accept the controller list to have them added to the site. If you are running an older CIM, you must identify and add the controllers manually; see the Adding A Controller section later in this manual.



At this point, you are connected and communicating with the CIM and its controllers. The status bar at the bottom of the window will flicker and display a message similar to "Connected to EastWing."

2.7. Step 7: View Controller Data

A set of buttons at the top of the window will contain the word *List* and the number of each controller. This is the Controller Bar. Clicking a button on the Controller Bar selects the current view in the main part of the window. The list-view is a list of all the controllers and the controller views are representations of an individual controller.

When the selected site is connected, the dot in the middle of the controller bar button will indicate the status of the controller (green, yellow, red or black).

See Controller Views.

2.8. Step 8: Issue Controller Commands

Once connected to a site, commands can be issued to controllers through the *Mec20 Command* or *Tsc800 Command* menu items under the *Controller* menu.

See Controller Commands.

2.9. Step 9: Save/Restore Site-list Information

The current site-list can be saved by using the *Save* or *Save As* commands under the *File* menu or the toolbar button.

A previously saved site-list file can be retrieved using the *Open* command from the *File* menu or the numbered recent file list under the *File* menu or the toolbar button.

See Saving A Site-list and Opening An Existing Site-list.

3. Configuration

The THS 2000 software allows the configuration of passwords, lists of sites, the Communications Interface Module (CIM) and the auto-answer feature. Configuration of THS 2000 site-lists and other parameters is generally done once and then used many times in an operational capacity.

3.1. Passwords

The THS 2000 program can be secured with the use of passwords. The password levels are:

3.1.1. READ-ONLY

The read-only user can only monitor an RTU site and may not change any settings or modes of operation.

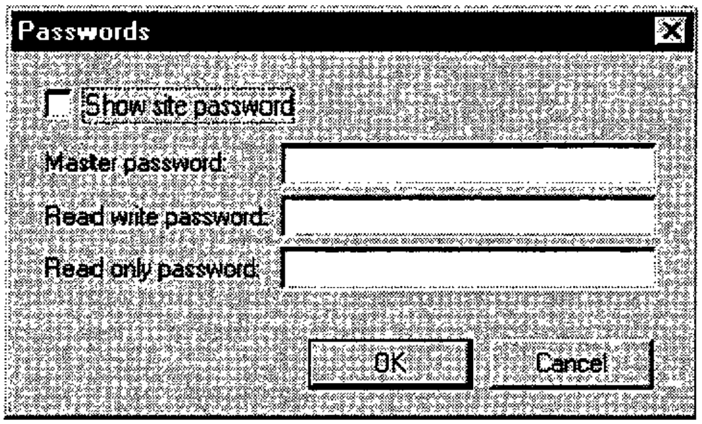
3.1.2. READ/WRITE

The read/write user can monitor an RTU site and may change any settings or modes of operation as desired.

3.1.3. MASTER

The master read/write user can monitor an RTU site and may change any settings or modes of operation as desired. The master read/write user can also view or modify the lower-level security passwords.

The *Options* item under the *Tools* menu will present the user with master security level with a choice that allows the passwords to be modified, as shown below. For a user with less than the master security level, that menu item is grayed-out.



The site passwords are normally shown as a series of asterisks (*), but can be shown in actual letters by enabling the show-site-password check box.

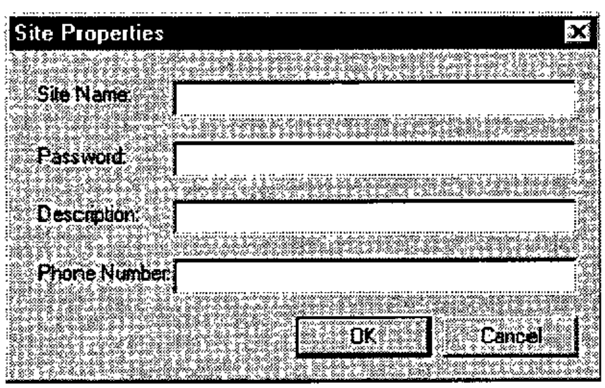
3.2. Site-list Management

THS 2000 allows you to create, save and reopen site-lists. A site-list is a collection of one or more sites that are all accessed through the same host modem. A site-list can also be configured for auto-answer, allowing any of the listed remote sites to call THS 2000 in case of an alarm condition.

The list of sites, the site properties, the connection method and the auto-answer settings are all stored in the .THS file. This file can be created, opened and saved from THS 2000.

3.2.1. Creating A New Site-list

A new site-list can be created using the *New* command from the *File* menu (or toolbar button). This command will bring up the *Site Properties* dialog, as shown, for the first site in the site-list.



The name and password fields correspond to the name and password already programmed into the CIM that is managing the remote site. All of the site names within a site-list must be unique. The description field is optional. The phone number is entered for a remote site.

3.2.2. Opening An Existing Site-list

An existing site-list can be opened using the *Open* command from the *File* menu (or the toolbar button). This command will bring up the conventional Windows dialog allowing you to select a file to open.

The *File* menu also stores the most recently used four site-list files. These can be opened directly by selecting the file name from the *File* menu or using the shortcut key sequence ALT-F followed by the number (1-4) of the desired file.

Note: files created by previous versions of THS 2000 can be opened, but they will only contain a single site in the site-list. If this file is modified and saved, you will no longer be able to open it from previous versions of THS 2000.

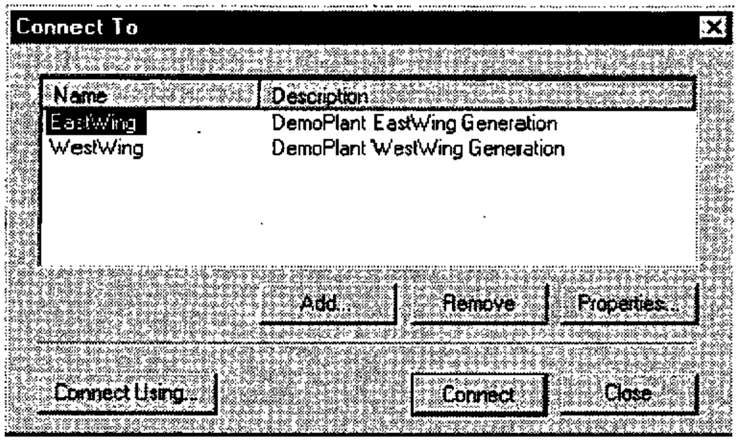
3.2.3. Saving A Site-list

A site-list can be saved to disk by using the *Save* or *Save As* commands from the *File* menu (or the toolbar button). These commands will invoke the standard Windows dialog for saving a file.

Note: files saved by this version of software will not be readable by previous versions of THS 2000.

3.3. Site Configuration

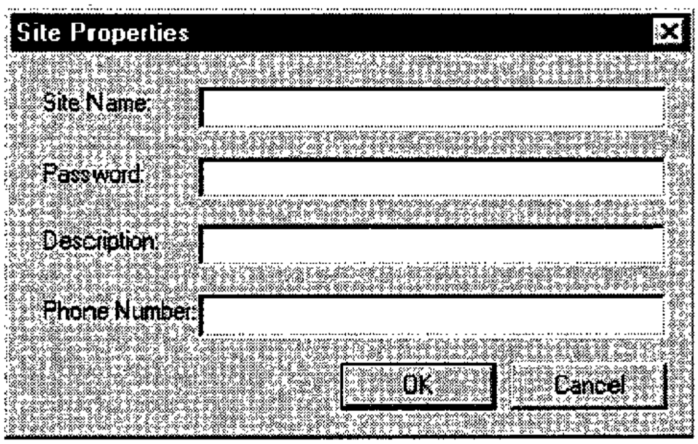
Viewing and modifying the site configuration begins with the *Connect* item under the *Site* menu. This action will produce the list of sites (see Site-list Management), as exemplified in the following diagram. From this dialog box, new sites can be added to the site-list, sites can be removed from the site-list or a site's properties viewed or modified. The host connection method can also be viewed or modified.



In addition, the site be connected (see Connecting A Site) from this dialog.

3.3.1. Adding A Site

Electing to add a site by clicking the *Add* button of the *Connect To* dialog box will present you with the *Site Properties* dialog box depicted in the following figure. This allows you to enter the name and password of the new site, which is the name and password of the CIM on that site. The description can be any descriptive text. The phone-number can only be entered for a host connection that is a modem (see Host Connection).



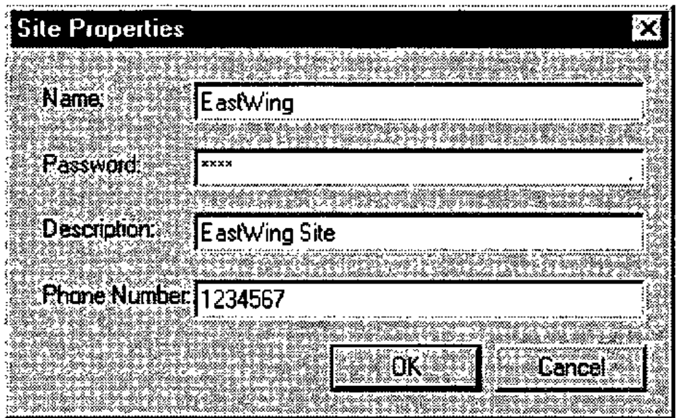
The password field is normally shown as all asterisks (*), but can be made to display the actual letters (see Passwords).

3.3.2. Removing A Site

Clicking the *Remove* button of the *Connect To* dialog box will cause THS 2000 to ask you if you really want to remove the selected site. Choosing the affirmative option will delete the selected site from the site-list.

3.3.3. Site Properties

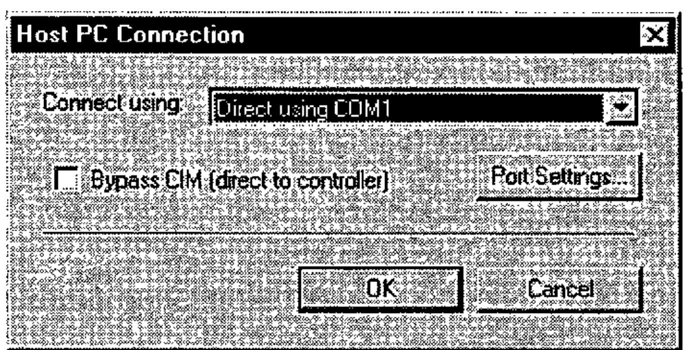
Selecting the *Properties* button of the *Connect To* dialog box will bring up the *Site Properties* dialog box, as in section Adding A Site, but with the details of the selected site, as shown here.



This dialog box can also be displayed by right-clicking on the name of the site in the site-list dialog.

3.3.4. Host Connection

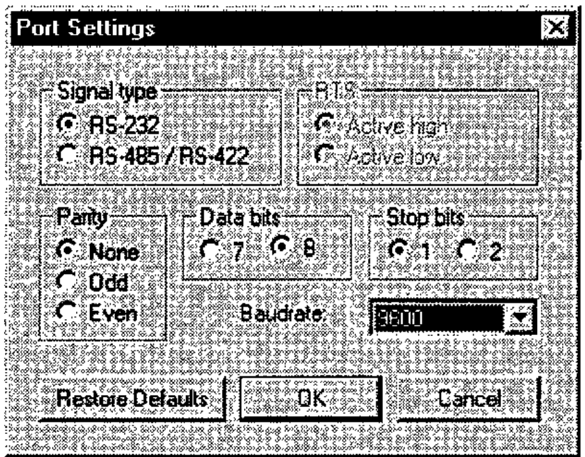
The host connection method can be changed from the *Connect Using* command of the *Site* menu or the *Connect Using* button of the *Connect To* dialog box (see Connecting A Site). This command will bring up the *Host PC Connection* dialog box, as shown here.



In the list-box, you can select any modems or communication ports that are recognized by the operating system. Modems can be added and configured in the Modem entry in the Windows Control Panel (see the operating system documentation).

In THS2000 version 3.1, an additional option allows THS2000 to bypass the CIM and connect to a single controller, MEC20 or TSC800. For a direct connection using one of the serial ports, the baudrate is automatically set to 4800 to match a direct controller connection. The CIM bypass mode does not allow THS2000 to receive alarm callouts from the site.

If a direct communication port is selected, the *Port Settings* button will click-able. Selecting the *Port Settings* button will bring up the *Port Settings* dialog box, as shown below, where advanced communications parameters can be viewed and modified.



Supported baudrates are 1200, 2400, 4800, 9600, 14400 and 19200. The *Restore Defaults* button set the parameters to RS-232 signal type, no parity, 8 data bits, 1 stop bit and 9600 baud.

The RTS activation is only applicable under RS-485. This defines the level of the RTS line that is used by RS-232 to RS-485 converters to signal a transmission. Unless otherwise specified, this should be active high for most converters.

These parameters must be matched to the Port 2 configuration of the CIM on the site (see CIM Port 2).

Changes to the port settings do not take effect until the site is reconnected.

3.4. Communications Interface Module Settings

The heart of communications to a remote site is the Communications Interface Module (CIM). All the remote controllers, TSC 800s and MEC 20s, are attached to this device. Normally, the CIM is not connected to the host computer. The normal operation for the CIM is to poll the status of each controller and attempt to discover new controllers. When the status of a controller indicates an alarm condition, the CIM can be programmed to call the host and report that an alarm condition exists.

When connected to a host computer running THS 2000, the CIM discontinues its polling and allows the THS 2000 software to interrogate the controllers.

The CIM can be configured by selected the CIM Properties item in the Site menu. This will bring up the Current Site Properties dialog box. This window is a tabbed collection of dialogs that query and display different parameters from the CIM, including the site information, version, port configuration and callout phone-numbers.

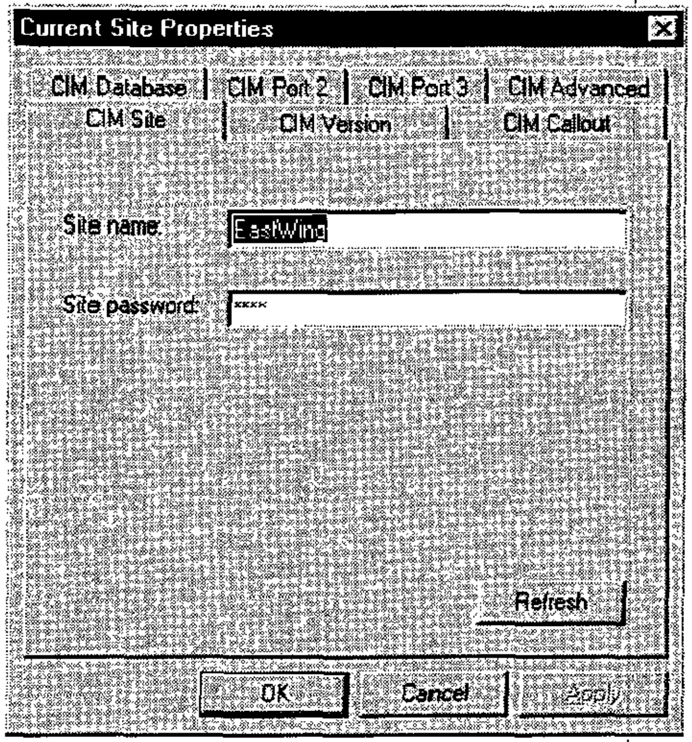
When a value is modified, the Apply button will become click-able. Clicking the Apply button will send the changes to the CIM; also, clicking the OK button will send the changes to the CIM if you answer yes to the "save changes" question. Hitting the Cancel button will abort any changes that have not yet been written. After the new values are written to the CIM, they are read from the CIM and displayed.

Some of the CIM's properties screens contain a *Refresh* button that will simply re-read the data from the CIM.

For more information on the CIM, see Section 1.

3.4.1. CIM Site

Selecting the *CIM Site* tab in the *Current Site Properties* dialog box will produce a display similar to that shown in next figure. The F2 key (or the toolbar button) can also be used to select the *Current Site Properties* dialog box. From here, you can enter the site name and site password that will be used by the site connection described in section Connecting A Site.

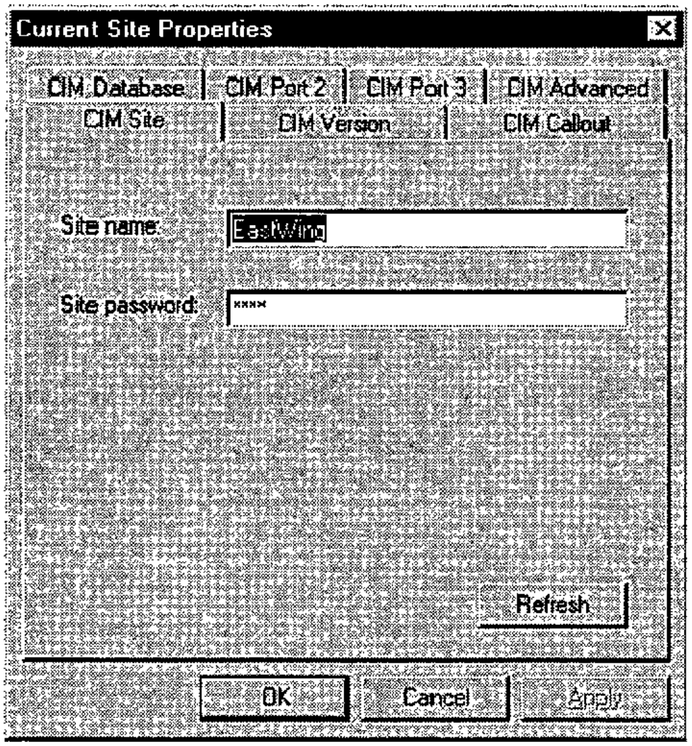


The name and password fields have a maximum length of 16 characters and case does not matter. CIM versions prior to CIM3.0 are limited to 12 characters for the site name and 8 characters for the password.

Note: all CIMs that are intended for callout operation to the same site-list must have unique site names.

3.4.2. CIM Version

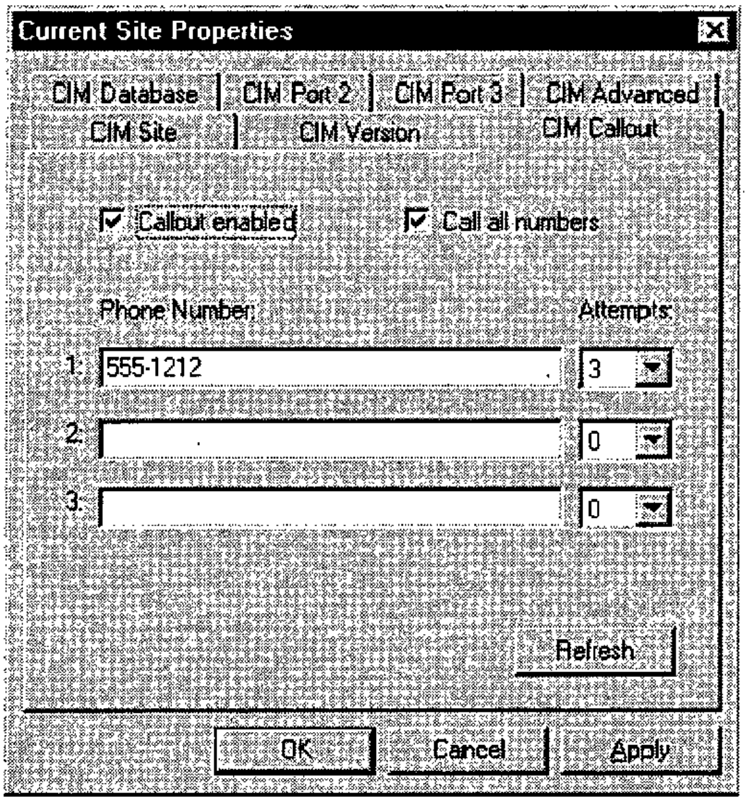
The *CIM Version* tab simply reads and displays the version information, including the serial number, from the CIM, as shown below. This may be useful for future compatibility issues and service.



Note: CIM version prior to version 3.0 did not have a serial-number or Modbus support; these fields appears as *N/A* when communicating with one of these older devices.

3.4.3. CIM Callout

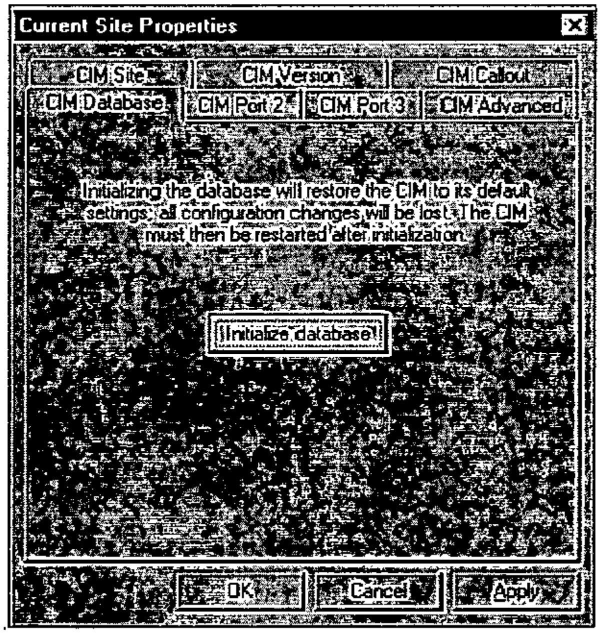
The *CIM Callout* tab configured the callout feature, which allows the CIM to call the host in case of an alarm condition. The dialog box is depicted in the next figure. Refer to section Auto-answer Operation for more information on CIM callout and THS 2000 auto-answer features.



Note: CIM versions prior to version 3.0 did not support the call-all-numbers feature; this option is grayed-out for those devices. Also, in older CIM versions, all the phone numbers shared the same number of attempts; this is reflected in this dialog box by tying all there attempts choices together, so if one is changed they are all changed.

3.4.4. CIM Database

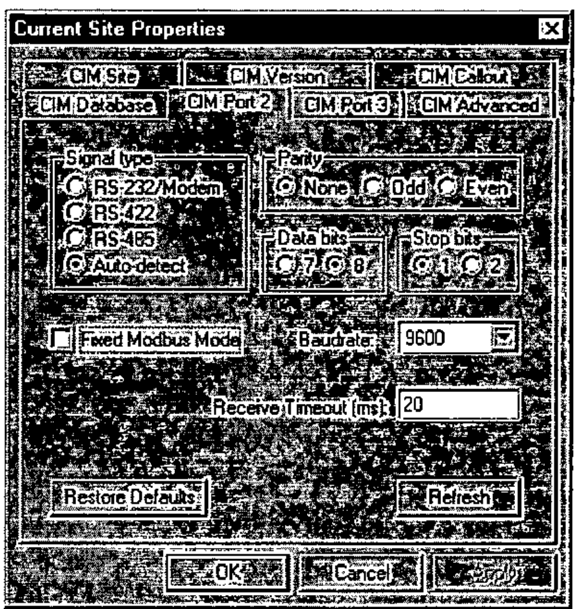
All the properties of the CIM described in this chapter are stored in an internal database. This database, and thus the CIM properties, can be reset to factory default values by initializing the database. The command to initialize the database can be found in the *CIM Database* tab of the *Current Site Properties* dialog box, as shown here.



This feature is provided as a last resort. It should not be invoked unless you know what you are doing or you are under the guidance of a qualified service person.

3.4.5. CIM Port 2

A CIM connected directly to a PC host or a Programmable Logic Controller (PLC) is connected serially to Port 2. The serial connection parameters are under the *CIM Port 2* tab of the *Current Site Properties* dialog box, as shown here.



The signal-type indicates the type of physical connection between the host and CIM. The RS-232/Modem option indicates that a connection is via a standard RS-232 cable or the internal modem (CIM Port 1). The RS-422 and RS-485 options are for multi-drop networks. The auto-detect option will allow the CIM to attempt to decide for itself which physical connection is in use. The default signal-type is auto-detect.

The other parameters are standard serial type parameters, including parity, data bit size, stop bits and baudrate. The baudrate values can be 1200, 2400, 4800, 9600, 14400 and 19200. The receive-timeout parameter describes the amount of time after receiving the last byte of the packet until the packet is processed internally.

The *Restore Defaults* button will restore all parameters to their initial values, which are no parity, 8 data bits, 1 stop bit, 9600 baud and 20 millisecond receive-timeout.

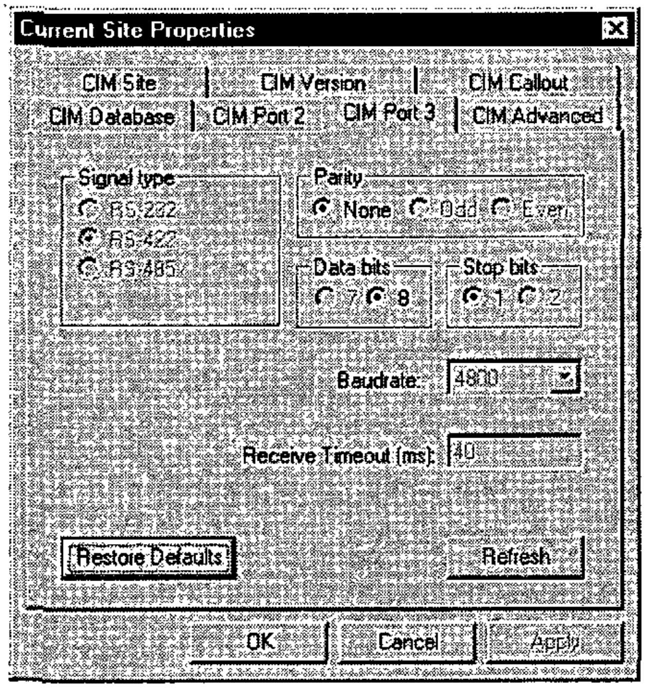
The Fixed Modbus Mode option is for enabling the fixed Modbus mode for operation with a Programmable Logic Controller (PLC). Once in fixed Modbus mode, the CIM no longer requires a password to login, it is essentially always logged-in to save the PLC from having to do so. All modem functions are disabled when in fixed Modbus mode as well, to prevent unauthorized remote access. The only way to disable fixed Modbus mode is to connect directly (via RS-232 or RS-485) with THS 2000, which will disable fixed Modbus mode when attempting to log in to the CIM.

Note: the receive-timeout and auto-detect signal-type features were not supported in previous versions of the CIM and therefore their values appears grayed-out and read-only when examined by THS 2000.

The protocol used on Port 2 is Modbus, as described in Section 3.

3.4.6. CIM Port 3

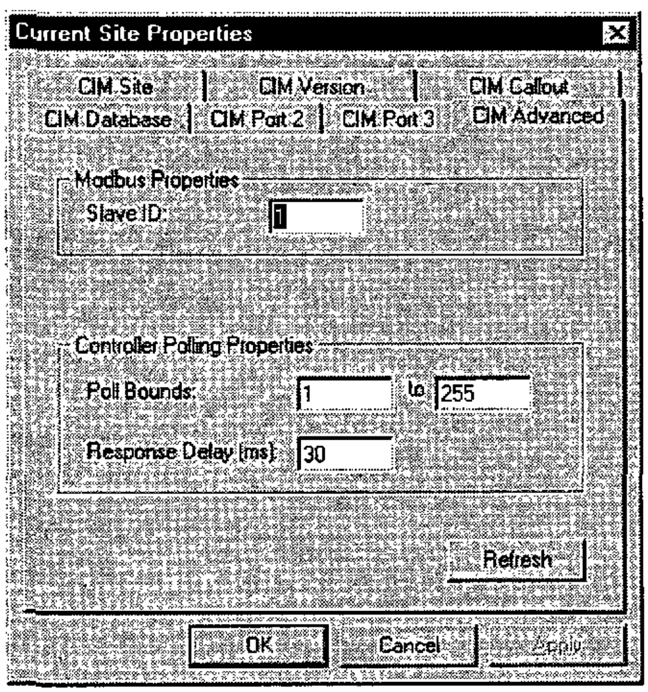
The Port 3 of the CIM is used to communicate with the controllers on the site. The parameters for this port can be found under the *CIM Port 3* tab in the *Current Site Properties* dialog box, as shown here.



These values are all currently read-only; you may not change any of these values, they are fixed.

3.4.7. CIM Advanced

The *CIM Advanced* tab of the *Current Site Properties* dialog box allows you to change some of the more advanced features of the CIM, such as Modbus characteristics and controller polling. The dialog box is shown in the next figure.



The top box contains properties unique to the Modbus operation of the CIM (see Section 3.). The Slave ID is the ID used by the PLC to reference the CIM; the valid range for a Modbus slave device is 1-247.

The Poll Bounds parameters are for changing the behavior of the controller discovery polling. Controllers have an address range of 1 to 255, but there is a limit of 10 controllers per site. The Poll Bounds parameters reduce the range of addresses that the CIM must poll in order to discover new devices. Reducing this range to the expected values of the controllers, such as 1 to 10, speeds up response time.

The Response Delay parameter dictates the amount of time, in milliseconds, to wait before sending a response.

Note: the advanced features described here are only supported in CIM version 3.0. When THS 2000 is communicating with an older CIM, the *CIM Advanced* dialog box is not available.

3.5. Controller Configuration

This section deals with the adding and removing of controllers. The controllers currently supported by THS 2000 and the CIM are the MEC 20 Microprocessor Engine Controller and the TSC 800 Transfer Switch Controller.

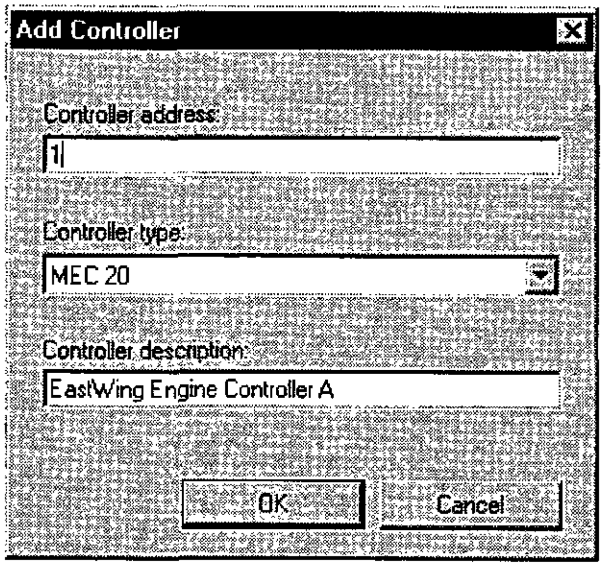
3.5.1. Controller Discovery

The THS 2000 version 3.0 in conjunction with the CIM version 3.0 supports automatic controller discovery. When THS 2000 establishes a connection to a remote CIM, it interrogates the CIM for the list of controllers present on this site. The user is then prompted to accept this list of controllers or continue with the controllers already loaded.

Version of the CIM prior to version 3.0 do not support the controller discovery and controllers must be added manually as explained in the next section (Adding A Controller).

3.5.2. Adding A Controller

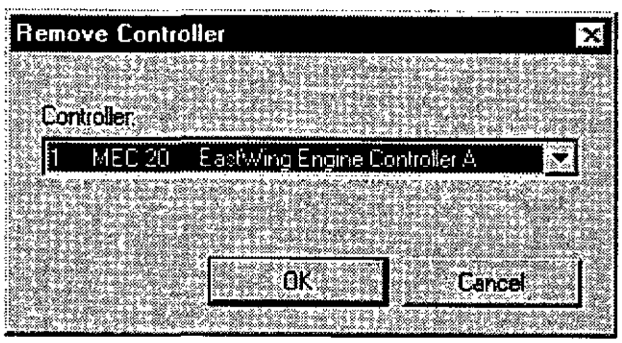
Selecting the *Add* option from the *Controller* menu allows you to add a MEC 20 or TSC 800 controller to the site from the *Add Controller* dialog box, as shown below.



The controller address can be between 1 and 255, with no duplicates allowed. The controller type can be a MEC 20 or a TSC 800. The description can be any descriptive text you wish.

3.5.3. Removing A Controller

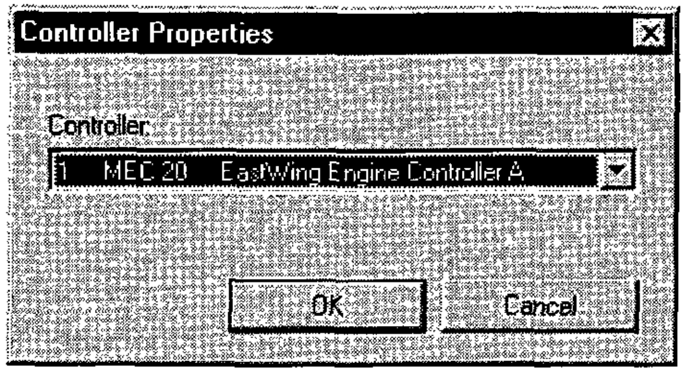
Removing a controller is accomplished by selecting the *Remove* item from the *Controller* menu which brings up the *Remove Controller* dialog box, as shown below.



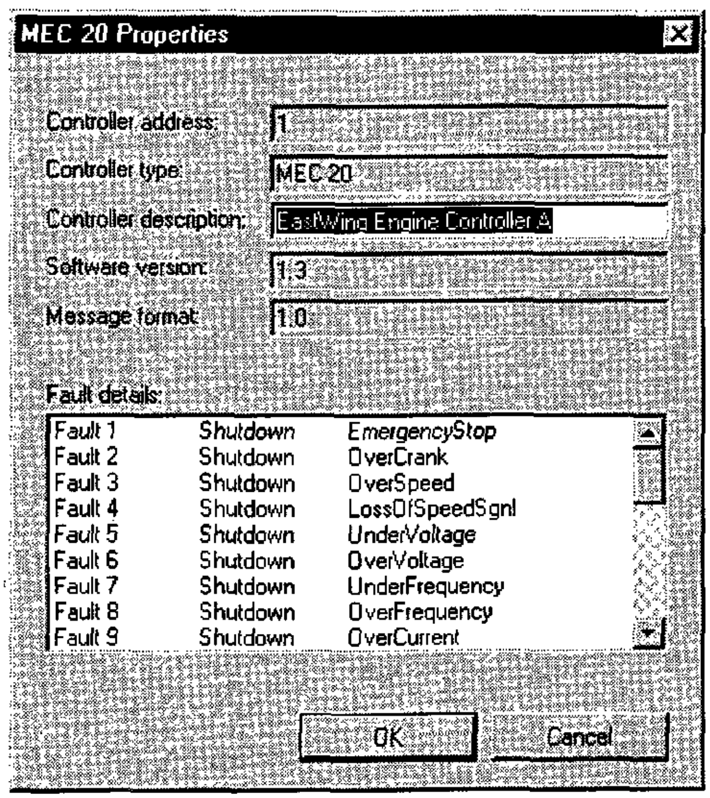
The controller to be deleted is selected from the list presented.

3.5.4. Controller Properties

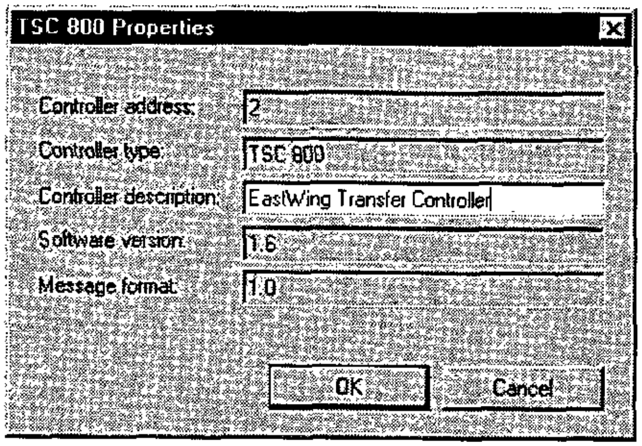
A controller's properties can be examined by selected the *Properties* item of the *Controller* menu. This brings up a menu from which you can choose the controller to be examined, as shown below.



After the desired controller is selected and the *OK* button clicked one of two dialog boxes is presented: one for the MEC 20 and one for the TSC 800. The MEC 20 properties dialog box is shown in the following figure. From this window, the description can be modified and other properties, such as the controller address and the fault-labels, can be viewed.

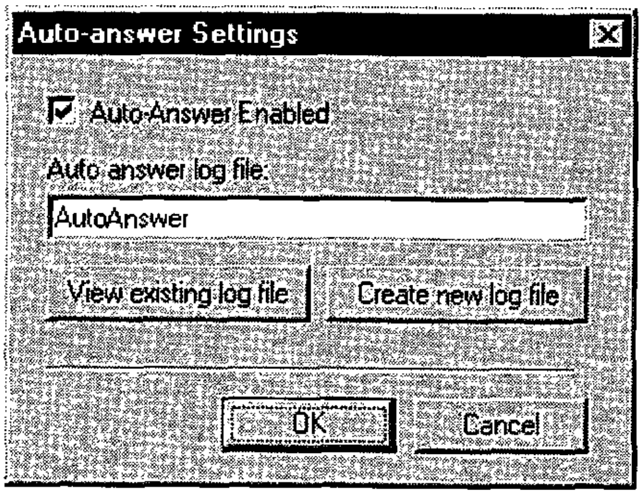


The TSC 800 properties dialog box is shown in the next diagram. From here, the controller description can be modified. Additional properties, such as the controller address, can be viewed.



3.6. Auto-answer Configuration

An important feature of remote modem sites is the ability to dial the host and report an alarm condition. The host side can be configured from the *Auto-answer Settings* command of the *Site* menu, as shown below.



When the auto-answer feature is enabled, the THS 2000 software will accept calls from any site in the currently loaded site-list.

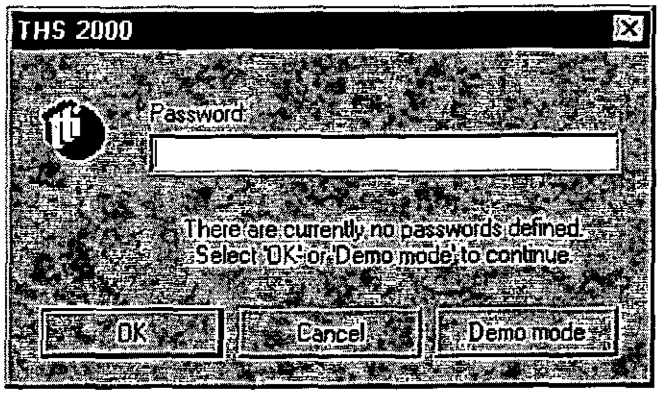
4. Operation

4.1. Basics

This section describes the basic functionality of the THS 2000 software, from logging-on to user interface to accessing the online help. See the Quick Start section for a fast get-up-and-running breakdown.

4.1.1. Starting And Logging On

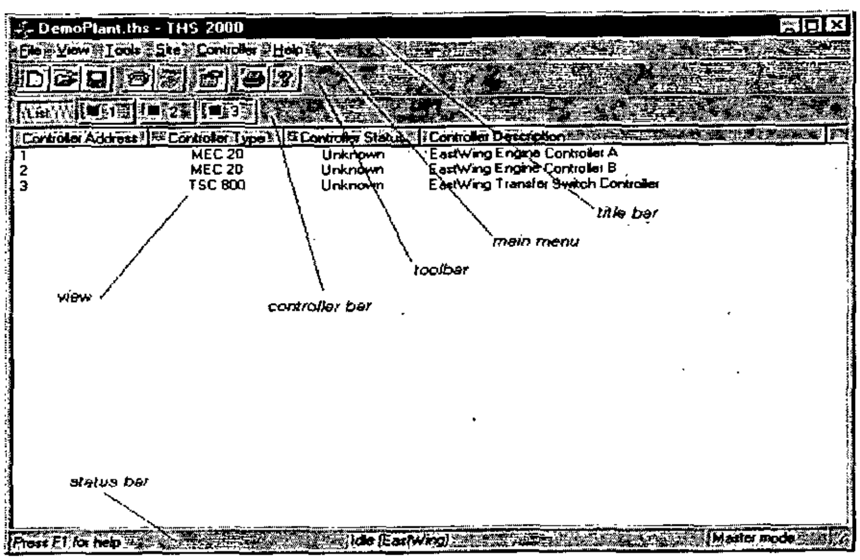
Double-clicking the THS 2000 icon starts the THS 2000 software. A splash screen indicating the version and related information is displayed for a short period. You will then be prompted to enter a password, as below.



The THS 2000 log on process allows for three different levels of security, depending on the password you entered. The levels are read-only, read/write and master (see Passwords for more information).
You also have the option of selecting "Demo mode," which allows you to create some simulated controllers and otherwise operates as if you had "read-only" security privileges.

4.1.2. The Interface

The main THS 2000 interface is shown in the next diagram. It is a relatively standard Windows-based application with a title bar, main menu, toolbar and status bar, as well as a controller bar and a special viewing area.



4.1.3. Title Bar

The title bar displays the currently loaded site-list file. The site-list file is a collection of one or more generation sites that has been configured and saved previously. The site-list file can be opened, saved and printed from the main menu or toolbar. The THS 2000 site-list files have the file extension .THS.

4.1.4. Main Menu

The main menu provides the access to the THS 2000 commands. Some commands are available only under certain circumstances; when the command is not available, it is grayed-out. For example, you will not be able to add a controller (*Add* from the Controller menu) until you have created an initial site (*Connect* from the *Site* menu or *New* from the *File* menu).

The main menu commands are also available using ALT-key combinations; the underlined character indicates the key to press in combination with the ALT key. Many of the important commands are available using function keys; these are indicated in the pull-down menus.

4.1.5. Toolbar

The toolbar provides instant access to many important menu commands. When the mouse pointer is floated over the tool item, a tool tip is displayed in the status line portion of the status bar.

4.1.6. Controller Bar

The controller bar contains a button called List and a button for each controller on the site. The controller buttons are labeled using the controller's identification number (id). Pressing a button on the controller bar will change the view to display the selected controller or the controller-list view.

When the selected site is connected, the dot in the middle of the controller bar button will indicate the status of the controller (green, yellow, red or black).

4.1.7. Status Bar

The status bar displays status messages and indicates connection status and security status. The status line displays tool tips and various status messages. The connection status indicates the state of the current connection, such as

"Idle" or "Connected to EastWing." The security status indicates with which security level you have logged on.

4.1.8. View

The view area displays one of two different views. The list-view shows a tabular list of the controllers on the selected site. The controller-view displays data from either a MEC 20 or a TSC 800.

4.1.9. Accessing Help

The command *Contents* from the *Help* menu, the toolbar button or the F1 key will bring up an online reference.

4.1.10. Exiting

The *Exit* command from the *File* menu will exit THS 2000, disconnecting any outstanding connections.

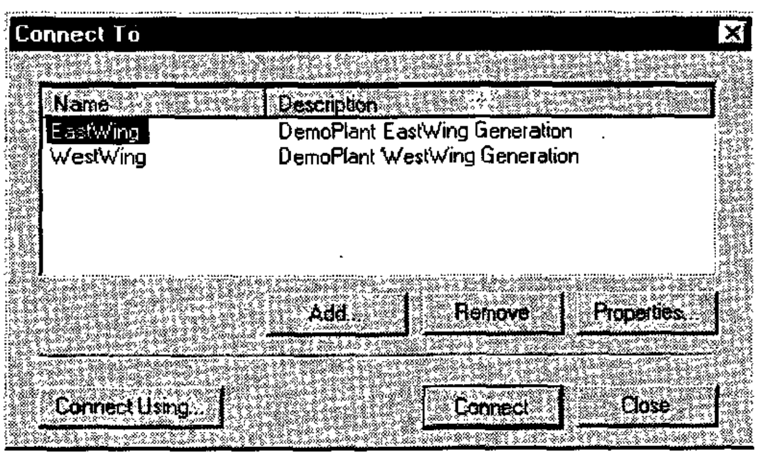
4.2. Connecting Sites

A site is made up of a single CIM connected to one or more controllers. Connecting to a site is the same as connecting to a CIM. From the user's point of view, the CIM is the site. This section describes how sites are connected and disconnected as well as various properties of the CIM and the host connection.

Only a single site from the site-list can be connected at a time.

4.2.1. Connecting A Site

A site can be connected using the *Connect* command from the *Site* menu, the toolbar button or the F9 key. This will bring up the *Connect To* dialog depicted in the next figure.



This dialog lists each site contained in the currently loaded site-list and allows you to select the site to which a connection is desired. Clicking the *Connect* button will initiate a connection attempt. In addition, double-clicking on the site name will initiate a connection attempt.

In addition, sites can be added to or removed from the site-list or simply have their properties modified. A button labeled *Connect Using* is provided to jump to the host connection settings (see Host Connection).

4.2.2. Disconnecting A Site

Selecting the *Disconnect* command from the *Site* menu, the toolbar button or the F10 key will disconnect the currently connected site. This includes hanging up the phone line for a modem connection.

4.3. Viewing And Commanding Controllers

The main function of the Communication Interface Module (CIM) is to facilitate communication to the controllers present on the site. The controllers currently supported by the CIM are the MEC 20 Microprocessor Engine Controller and the TSC 800 Transfer Switch Controller. The main view of the THS 2000 provides a simulated front-panel of a single controller.

Controllers can be added, removed and examined from menu commands.

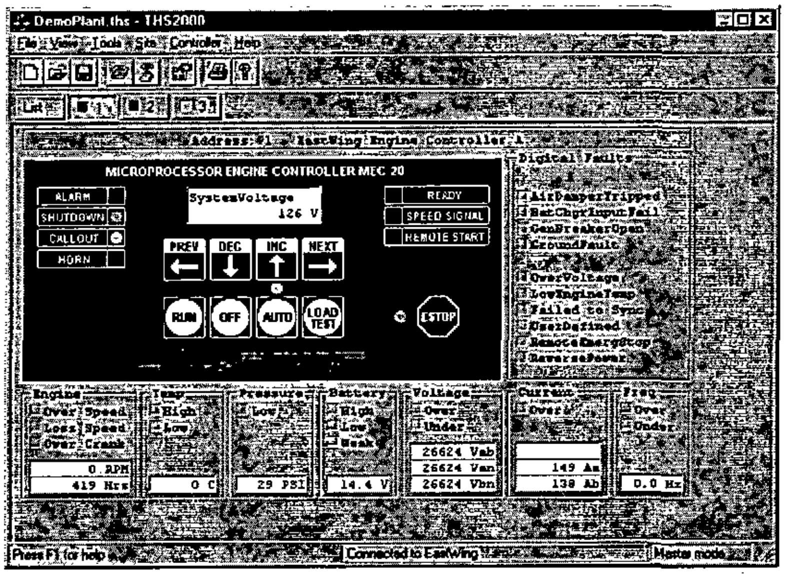
4.3.1. Controller Views

The bulk of the THS 2000 window is the view area. This area can be a simple list of the controllers or a more detailed representation of a single controller. The controller bar buttons are used to select the desired controller or the controller-list (see also The Interface).

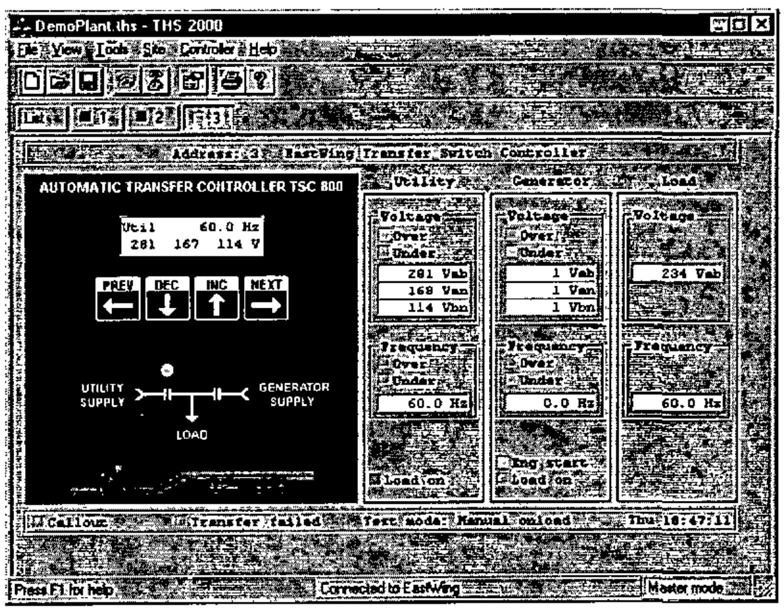
The controller bar contains a button called *List* and a button for each controller on the site. The controller buttons are labeled using the controller's identification number (id). Pressing a button on the controller bar will change the view to display the selected controller or the controller-list view.

When the selected site is connected, the dot in the middle of the controller bar button will indicate the status of the controller (green, yellow, red or black).

The next figure shows the view of a MEC 20 connected to a remote CIM. The MEC 20 indicates that it is currently in shutdown mode. The black part of the view is generally the same as the front panel of the actual MEC 20 device. The display and buttons work as it were the actual device. Additional information includes the digital fault status and labels, analog fault status and present measured values.



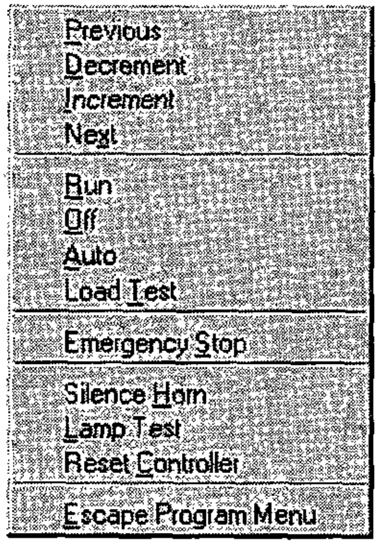
The figure below shows the view of a TSC 800 connected to a remote CIM. Just as the MEC 20, the black part of the view is a direct emulation of the TSC 800 front panel. The faults and values are displayed and updated frequently.



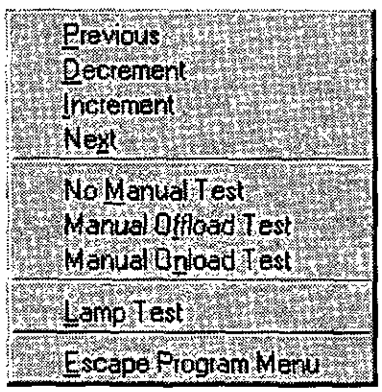
4.3.2. Controller Commands

The controllers can also be commanded to perform control functions remotely. The control functions can be found under the *MEC 20 Command* or *TSC 800 Command* items of the *Controller* menu. The controller in the current view is the controller being commanded. The control functions available vary by type of controller.

The commands available for the MEC 20 are shown in next figure.



The commands for the TSC 800 are shown in the next figure.



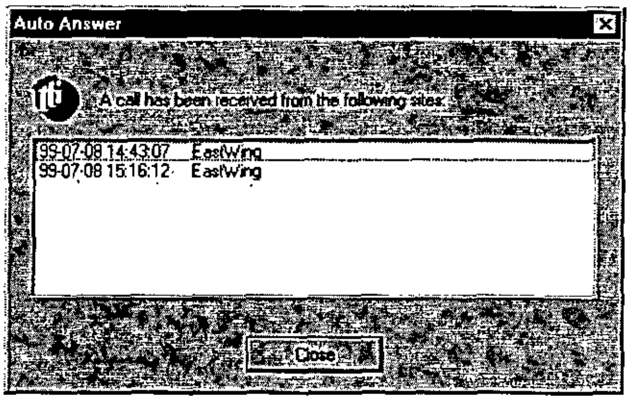
4.4. Printing

Using the print command (the *Print* item from the *File* menu or the toolbar button) while viewing a controller will print the currently displayed values in a simple text format. The print command will print the list of controllers when invoked while viewing the controller list.

4.5. Auto-answer Operation

When a remote CIM senses that a controller desires a Callout, it will start the calling out sequence. The CIM will dial its stored phone numbers some amount of times until it makes a connection (see CIM Callout). The site in which the CIM belongs must currently exist in the site-list of the THS 2000 program.

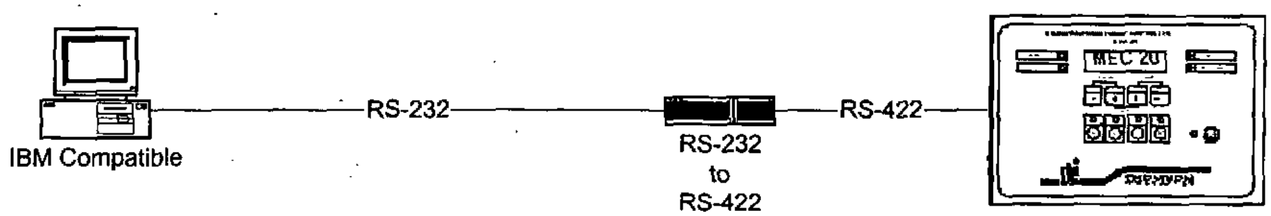
When an auto-answer connection is established, an event is registered in the *Auto Answer* dialog box, as shown below, and logged in the auto-answer log file (see Auto-answer Configuration).



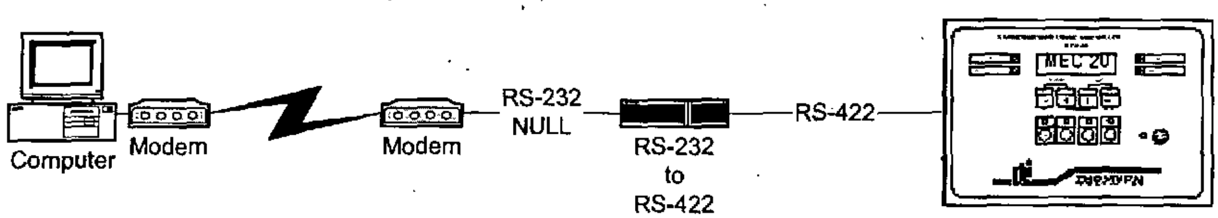
When a site has connected, it will remain connected for two minutes just as if connected by the operator. During this time, the operator can view the controllers and determine the cause of the alarm. The status bar will also display a countdown of the remaining connection time in seconds.

5. CIM Bypass Wiring

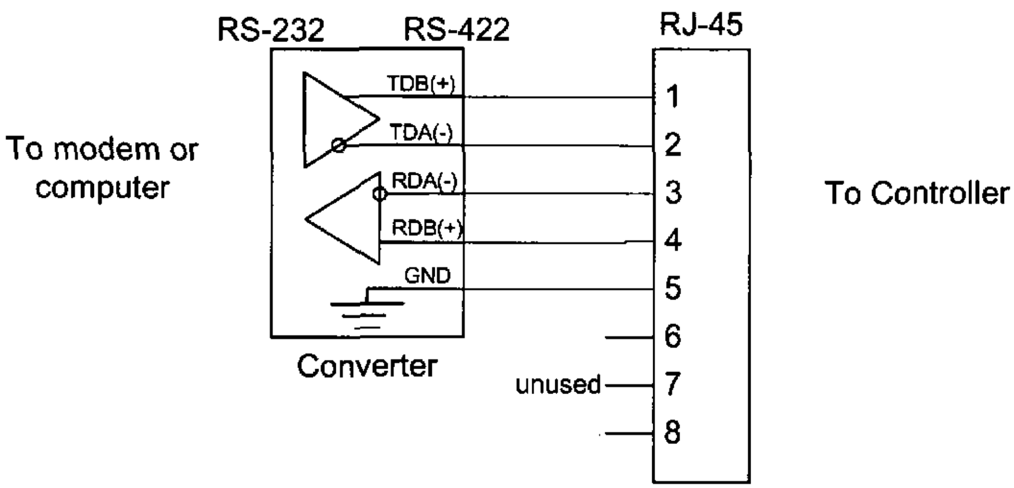
The CIM bypass connection mode of operation has a different wiring scheme than a standard CIM connection. The two possible methods of connection are: direct--from computer to controller and modem--from computer to local modem to remote modem to controller. The direct connection bypass mode is shown below:



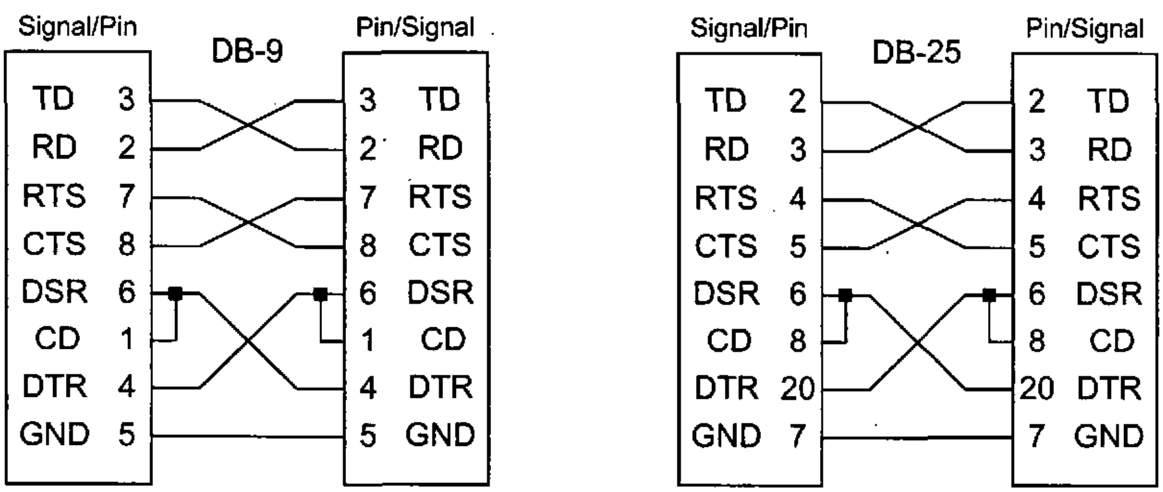
The modem connection bypass mode is shown below:



An RS-232 to RS-422 converter is required to convert the signal from the computer or modem. The required wiring from the RS-422 side of the convert to the RJ-45 connection on the controller is as shown:



The RS-232 NULL connection between the modem and the converter must pass all handshake signals, as shown in the following diagram:



The modem must store configuration in a non-volatile storage medium (such as FLASH). The modem must be configured for the following features:

- auto-answer,
- connect at 4800 bps only (no fallback),
- echo disabled,
- no error correction,
- no compression.

All RS-232 to RS-422 converters and modems are not created equal. Thomson Technology has tested many converter and modem combinations and the recommended parts are: 3Com USRobotics V.90 56K Faxmodem and B&B Electronics RS-232/RS-485 Converter Model 485PTBR (also an RS-422 converter). The modem must be configured prior to operation with the DIP switches set to (DOWN is ON):

Switch	1	2	3	4	5	6	7	8
Position:	DOWN	UP	DOWN	DOWN	UP	UP	UP	DOWN

and the following initialization strings:

AT Q0 E0 V1 X4 &K0 &D0 &M0 &B0 &H0 &R1 &N4

AT S0=1

AT &W0

6. Troubleshooting

SYMPTOM	CORRECTIVE ACTION
Cannot communicate with the site.	See the CIM User Manual Troubleshooting for possible solutions.
THS 2000 software locks up.	The Host software may lock-up if auto-answer mode is on when running in direct mode, the Host software is trying to write to a modem when it may not be present. The solution is to disable auto-answer (see Auto-answer Configuration).
Unable to view on-line help: "The THS 2000 help file (THS3v0.chm) could not be located."	Check that Microsoft Internet Explorer 4.01 or later is installed. Ensure that the THS3v0.CHM file is located in the same directory as the THS3v0.EXE file.
Unable to view on-line help: unable to load a file called hhctrl.ocx.	You need to run the hhupd.exe file included with the THS 2000 distribution diskettes.

SECTION 3
CIM PROTOCOL

1. Introduction

This protocol document is applicable to version 3.0 of the Communication Interface Module (TTI).

The Communication Interface Module (CIM) provides the hardware and software interface between a Modbus™ compliant master device (customer supplied) and the specific Remote Terminal Units (RTUs) as used at a generator site.

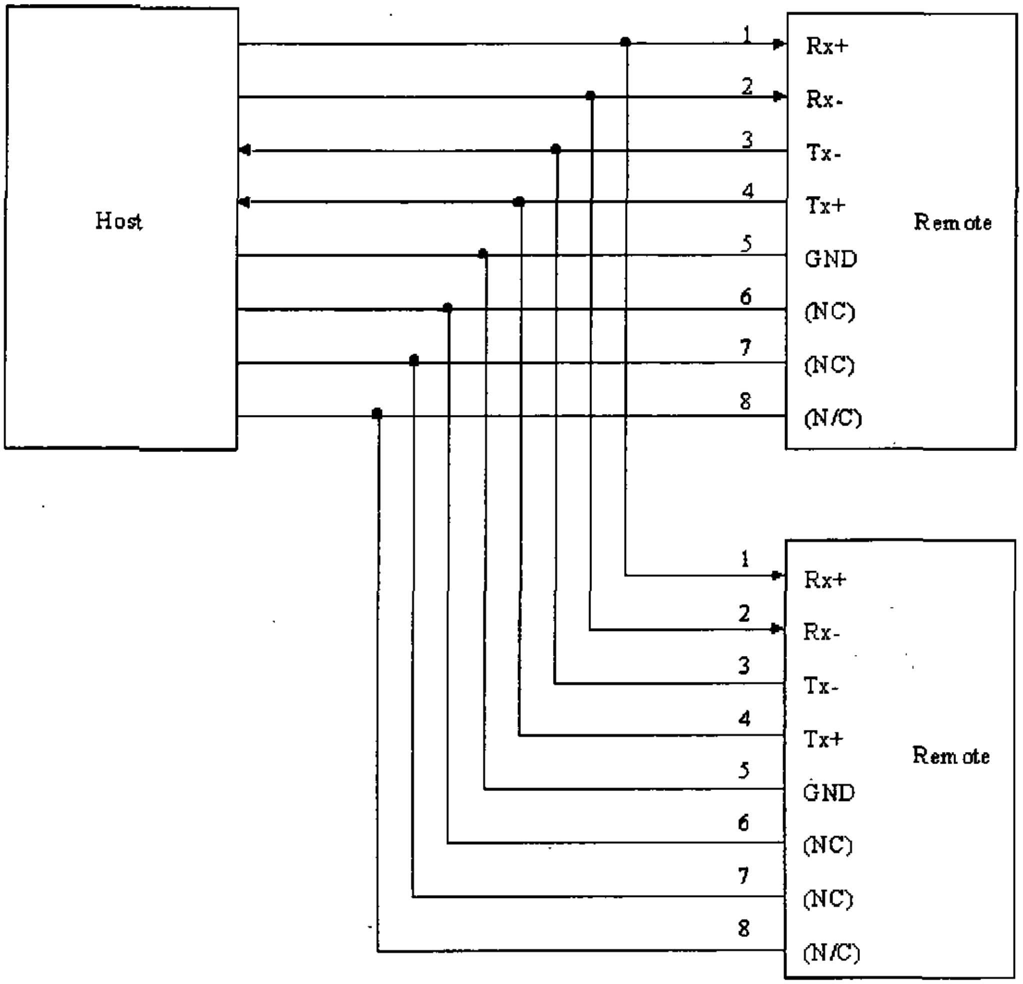
The Remote Terminal Unit (RTU) in this context is a device which directly operates the equipment at a generator site. These devices are the actual microprocessor-based controllers as developed by Thomson Technology, Inc. and include the MEC 20 Engine Controller and the TSC 800 Transfer Switch Controller.

NOTE: This instruction manual provides detailed information on the CIM 3.0 Modbus™ protocol. For detailed information on a the CIM 3.0 hardware and installation, see the Section 1. For information on operation CIM 3.0 using the THS2000 3.0 software program, see the Section 2. For more information on specific RTU devices, refer to their associated instruction manuals.

For more information on the Modbus™ protocol, visit the Modicon web site at www.modicon.com. The communications protocol is split in to the physical layer, the datalink layer and the application layer.

2. Physical Layer

At the Physical Layer, the CIM device is connected to a Modbus Master through CIM Port 2 (DB-9 or RJ-45) which is configurable to RS-232/-485/-422 and up to 19200 baud. The MEC 20s or TSC 800s connect to the CIM (Host) through an RS-422 interface via an RJ-45 connector to CIM port 3b. Up to 10 remotes can be connected to a single CIM (Host), as shown below:



The remote's receive lines are always enabled. The remote's transmit lines are only enabled while transmitting.

There is no hardware flow control.

3. Datalink Layer

NOTE: Unless noted otherwise, all fields described in this document contain unsigned binary data stored in big-endian (most significant byte first) format. Any unused fields contain zeroes. When describing the fields, FALSE equals zero, and TRUE equals non-zero.

At the Datalink Layer, the host (master) is responsible for polling the CIM's. The host sends request packets to the remotes, and the remotes respond with response packets. The CIM acts like a local host (master) to the MEC 20's connected. The CIM takes care of gathering data from the individual MEC 20's and storing it in a local database. The communication format describes an interface with the CIM database.

Unfortunately due to processing limitations response packets from the CIM to the host can have up to 25ms gaps in the data. The CIM response data is shifted out in 16 character increments, in some cases it can take up to 25 ms to shift out the next 16 character buffer.

The host pre-transmit delay is the minimum time required between the reception of the last byte of a frame (response) and the transmission of the first byte of a new frame (request). The following values show the necessary pre-transmit delays to insure reliable transmission of data to the CIM.

baudrate	delay(ms)
1200	130
2400	80
4800	40
9600	30
14400	30
19200	30

The typical CIM, MEC 20 and TSC 800 data is accessible through direct register read and writes. Programming the CIM is done using the same protocol with the CIM ID instead of the MEC ID.

4. Preset Multiple Registers (Type 16)

The preset multiple registers packet is used to write specific values to the controllers.

Numeric values are shown in hexidecimal.

Preset Multiple Registers Request

The packet format for this request is shown below.

ss	10	aaaa	pppp	bb	rrrr . . . . rrrr	cccc

ss

MEC 20 ID (00 to FF)

aaaa

Starting register (4aaaa)

pppp

Register count (number of points)

bb

Number of bytes (register count x 2)

rrrr

Register data (16 bit data)

cccc

CRC-16 (see CRC Calculation)

4.1. Preset Multiple Registers Response

The response to this packet is shown below.

ss	10	aaaa	pppp	cccc

ss

MEC 20 ID (00 to FF)

aaaa

Starting register (4aaaa, same number as the write packet)

pppp

Register count *(same number as the write packet)*

cccc

CRC-16 (see CRC Calculation)

4.2. Example: Remote Key Press Operation

SEND:

ss	10	0200	0001	02	kknn	cccc

ss

MEC 20 ID (00 to FF)

kk

keystroke number

nn

number of times to repeat keystroke

cccc

CRC-16

RECEIVE:

ss	10	0200	0001	cccc

ss

MEC 20 ID (00 to FF)

cccc

CRC-16

It is also recommended to follow up with a Display Valid Flag read to insure the operation was successful before proceeding. The CIM does attempt multiple operations in the case of a bad packet. However, if the Display Valid Flag is not valid after 900ms a retry should be performed.

5. Read Holding Registers (Type 3)

The read holding register request is used for read data from the controller.

Numeric values are shown in hexidecimal.

5.1. Read Holding Registers Request

Field addressing is done with the following format:

ss	03	aaaa	pppp	cccc

ss

MEC 20 ID (00 to FF)

aaaa

Starting register (4aaaa)

pppp

Register count

cccc

CRC-16 (see CRC Calculation)

5.2. Read Holding Registers Response

ss	03	bb	rrrr . . . . rrrr	cccc

ss

MEC 20 ID (00 to FF)

bb

Response Byte count (Register count x 2)

rrrr

Register data (16 bit data)

cccc

CRC-16 (see CRC Calculation)

5.3. Example: Read Registers 200 To 201

SEND:

ss	03	0200	0002	cccc

ss

MEC ID (00 to FF)

cccc

CRC-16

RECEIVE:

ss	03	04	aaaa	bbbb	cccc

ss

MEC ID (00 to FF)

aaaa

register 200 data

bbbb

register 201 data

cccc

CRC-16

6. Application Layer

At the Application Layer, the Master Controller sends request messages to the CIM's, and the CIM's respond with response messages. Communication with the MEC 20's is done using the MEC 20 ID and a typical Modbus packet, the CIM is transparent to the protocol. The only time the user needs to be concerned with the CIM is when CIM configuration parameters need to be modified. CIM communication is done with the same Modbus packet using the CIM ID instead of the MEC 20 ID. In the case of the same ID the CIM is smart enough to look at the registers requested to figure out whether it is meant for a CIM or MEC 20.

The data block protocol from the MEC 20 will be described in the next section.

The CIM port configuration table is used to change the port type (RS-232/-485/-422) and data protocol options such as baudrate, start bits, stop bits, and parity. The CIM port configuration table consists of 2 records that define CIM port 2 and port 3 options.

All register values are in hexidecimal notation, with certain Modbus interfaces you may be required to use a decimal value. In Modbus terminology a zero does not exist in the decimal register list therefore many PLC/software interfaces may require you to convert the Hex to decimal and then add one. (example 100Hex -> 257 not 256). The actual packet will include the below listed value with the '4' chopped off. The 4xxxx is another Modbus terminology that is not used in the actual protocol, only the lower 4 digits are converted and used in the packet description.

Values in embolded typeface are the default values for their respective fields.

7. Data Types And Formats

The following table describes the possible return data types and formats for Modbus registers defined in the CIM.

A register data value consists of two bytes: the most significant (MSB) and the least significant (LSB). Data values are arranged with the MSB first (called big-endian).

Data Type	Register Count	Maximum Range	Description
boolean	1	0 or non-zero	boolean value: 0=false, non-zero=true
enum	1	0 to max-range	enumeration: range from 0 to some maximum
uint8	1	0-255	unsigned 8-bit integer (allowable values can be further limited)
uint16	1	0-65535	unsigned 16-bit integer (allowable values can be further limited)
string	n	special	character (0-255) string, ordered: MSB1, LSB1, MSB2, LSB2, ...
struct	n	special	structure; definition depends on register range; ordered: MSB1=byte0, LSB1=byte1, MSB2=byte2, LSB2=byte3, ...

8. CIM Port Configuration

Field	Register (decimal)	Address (hex)	Register Count	Data Format	Value
Port#2 Bitrate	40257	100	1	enum	0=57600, 1=38400, 2=19200, 3=14400, 4=9600, 5=4800, 6=2400, 7=1200
Port#2 Bits/char	40258	101	1	uint8	7 to 8 (8)
Port#2 Stopbits	40259	102	1	uint8	1 to 2 (1)
Port#2 Parity	40260	103	1	enum	0=Odd, 1=Even, 2=None, 3=Mark, 4=Space
Port#2 Rx Timeout	40261	104	1	uint16	0 to 65535 (20)
Port#2 Line Protocol	40262	105	1	enum	0=RS-232, 1=RS-422, 2=RS-485, 3=auto-detect

Port#3 Bitrate	40289	120	1	enum	0=57600, 1=38400, 2=19200, 3=14400, 4=9600, 5=4800, 6=2400, 7=1200
Port#3 Bits/char	40290	121	1	uint8	7 to 8 (8)
Port#3 Stopbits	40291	122	1	uint8	1 to 2 (1)
Port#3 Parity	40292	123	1	enum	0=Odd, 1=Even, 2=None, 3=Mark, 4=Space
Port#3 Rx Timeout	40293	124	1	uint16	0 to 65535 (40)
Port#3 Line Protocol	40294	125	1	enum	0=RS-232, 1=RS-422, 2=RS-485

The Modbus Configuration table is used specifically to assign a node address (CIM ID) to the individual CIM unit. This is used in multiple CIM configurations. The CIM's are slaves to any device connected to Port 2. However the CIM acts like a Master to anything connected to Port 3. Communication to the individual MEC 20's will be done by communicating to the CIM.

9. CIM General Configuration

Field	Register (decimal)	Address (hex)	Register Count	Data Format	Value
CIM ID	40321	140	1	uint8	0 to 255 (1)
CIM response delay (ms)	40322	141	1	uint16	0 to 5000 (30)
Poll bounds	40323	142	1	struct	see below
Call out enable	40324	143	1	boolean	0=disabled, 1=enabled
Call out mode	40325	144	1	enum	0=connect once, 1=connect to all

The CIM ID is only used for programming CIM features, it is transparent when communicating with MEC 20's or TSC 800's.

The Poll Bounds structure has the following format:

byte0 = upper bound; default 255

byte1 = lower bound; default 0.

10. CIM Passwords

Field	Register (decimal)	Address (hex)	Register Count	Data Format	Value
Site Name	40337-40345	150-158	9	string	max-length =18 bytes
THS mode password	40346-40354	159-161	9	string	max-length =18 bytes
Modbus mode password	40355-40363	162-16A	9	string	max-length =18 bytes

11. CIM Login

Field	Register (decimal)	Address (hex)	Register Count	Data Format	Value
Requested Link protocol	40385	180	1	enum	0=THS, 1=Modbus, 2=Fixed-Modbus
Requested Line protocol	40386	181	1	enum	0=logoff, 1=RS-232, 2=RS-422, 3=RS-485, 4=Modem
Login Request Password	40387-40395	182-18A	9	string	max-length =18 bytes

12. CIM About

Field	Register (decimal)	Address (hex)	Register Count	Data Format	Value
TTI Device Type identifier	40417	1A0	1	enum	TTI=0xC53A
TTI 4 character device name	40418-40419	1A1-1A2	2	string	max-length = 4 bytes; "CIM3"
Call out requested	40420	1A3	1	boolean	1=call out requested
Serial Number (64bit binary)	40421-40424	1A4-1A7	4	struct	structure-length is 8 bytes; value is factory

					set
THS software version (upper)	40425	1A8	1	uint16	0 to 65535
THS software version (lower)	40426	1A9	1	uint16	0 to 65535
THS protocol version (upper)	40427	1AA	1	uint16	0 to 65535
THS protocol version (lower)	40428	1AB	1	uint16	0 to 65535
Modbus software version (upper)	40429	1AC	1	uint16	0 to 65535
Modbus software version (lower)	40430	1AD	1	uint16	0 to 65535
Modbus protocol version (upper)	40431	1AE	1	uint16	0 to 65535
Modbus protocol version (lower)	40432	1AF	1	uint16	0 to 65535

13. CIM RTU List

Field	Register (decimal)	Address (hex)	Register Count	Data Format	Value
Reason for last callout	41281	500	1	enum	0=RTU requested callout, 1=RTU removed, 2=RTU added, 3=bad slave response
Slave 1 address and type	41282	501	1	struct	see below
Slave 2 address and type	41283	502	1	struct	see below
Slave 3 address and type	41284	503	1	struct	see below
Slave 4 address and type	41285	504	1	struct	see below

Slave 5 address and type	41286	505	1	struct	see below
Slave 6 address and type	41287	506	1	struct	see below
Slave 7 address and type	41288	507	1	struct	see below
Slave 8 address and type	41289	508	1	struct	see below
Slave 9 address and type	41290	509	1	struct	see below
Slave 10 address and type	41291	50A	1	struct	see below

The slave address and type are encoded in the following 2-byte structure:

byte0 = slave type (0=none, 1=MEC 20, 2=TSC 800),

byte1 = slave address (0 to 255).

14. CIM Callout

Field	Register (decimal)	Address (hex)	Register Count	Data Format	Value
Phone Number 1	41537-41553	600-610	17	string	max-length = 34 bytes
Callout attempts count 1	41554	611	1	uint8	0 to 9 (3)
Phone Number 2	41555-41571	612-622	17	string	max-length = 34 bytes
Callout attempts count 2	41572	623	1	uint8	0 to 9 (3)
Phone Number 3	41573-41589	623-634	17	string	max-length = 34 bytes
Callout attempts count 3	41590	635	1	uint8	0 to 9 (3)

15. MEC 20 Register Tables

Specific MEC 20 data is received by addressing the MEC 20 and accessing the appropriate registers listed below. Using a MEC 20 address of "0" will cause all MEC 20's to respond to the request. This is usually reserved for communication with a single MEC 20 with an unknown address. Otherwise MEC 20 addresses range from 1 - 255 however only 10 RTU's (MEC 20 or TSC 800) can be connected to an individual CIM.

Field	Register (decimal)	Address (hex)	Register Count	Data Format	Value
MEC 20 Key Press (write only reg)	40513	200	1	struct	see MEC 20 Press Key
MEC 20 Valid Data/Display	40514	201	1	struct	see MEC 20 Valid Data/Display
MEC 20 Version	40515-40527	202-204	3	struct	see MEC 20 Get Version
MEC 20 Summary	40518-40523	205-20A	6	struct	see MEC 20 Get Summary
MEC 20 Analog Group 0	40524-40530	20B-211	7	struct	see MEC 20 Analog Values
MEC 20 Analog Group 1	40531-40539	212-21A	9	struct	see MEC 20 Analog Values
MEC 20 Display Group 0	40540-40547	21B-222	8	string	length = 16 bytes; see MEC 20 Display Details
MEC 20 Display Group 1	40548-40555	223-22A	8	string	length = 16 bytes; see MEC 20 Display Details
MEC 20 Fault Details	40556-40557	22B-22C	2	struct	length = 4 bytes; see MEC 20 Fault Details
MEC 20 Digital Fault 1 Message	40558-40565	22D-234	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Digital Fault 2 Message	40566-40573	235-23C	8	string	length = 16 bytes; see MEC 20 Fault Details

MEC 20 Digital Fault 3 Message	40574-40581	23D-244	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Digital Fault 4 Message	40582-40589	245-24C	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Digital Fault 5 Message	40590-40597	24D-254	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Digital Fault 6 Message	40598-40605	255-25C	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Digital Fault 7 Message	40606-40613	25D-264	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Digital Fault 8 Message	40614-40621	265-27C	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Digital Fault 9 Message	40622-40629	26D-274	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Digital Fault 10 Message	40630-40637	275-27C	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Digital Fault 11 Message	40638-40645	27D-284	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Digital Fault 12 Message	40646-40653	285-28C	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Estop message	40769-40776	300-307	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 OverCrank message	40777-40784	308-30F	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 OverSpeed message	40785-40792	310-317	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 LostSpeedSignal message	40793-40800	318-31F	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Under Volt message	40801-40808	320-327	8	string	length = 16 bytes; see MEC 20 Fault Details

MEC 20 Over Volt message	40809-40816	328-32F	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Under Freq message	40817-40824	330-337	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Over Freq message	40825-40832	338-33F	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Over Current message	40833-40840	340-347	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Weak Batt message	40841-40848	348-34F	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Low Batt message	40849-40856	350-357	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Hi Batt message	40857-40864	358-35F	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Low Temp	40865-40872	360-367	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Hi Temp1 message	40873-40880	368-36F	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Hi Temp2 message	40881-40888	370-377	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Low Oil1 message	40889-40896	378-37F	8	string	length = 16 bytes; see MEC 20 Fault Details
MEC 20 Low Oil2 message	40897-40904	380-387	8	string	length = 16 bytes; see MEC 20 Fault Details

16. MEC 20 Messages (Version 1.0)

The following sections describe in detail the data registers mentioned in the above tables, for single byte data the actual byte location in the registers is included in the above mentioned tables.

16.1. MEC 20 Press Key

This message is used to remotely press a key on a MEC 20's front panel. Key press actions can be used to duplicate any local action on the MEC 20 device remotely. The key press sequences can be involved therefore it is recommended to program the MEC 20's locally using the actual key pad and display. The key press write message is described below:

Field	Description
byte 0	This field contains the key, as follows: 0 = Null (This value is used to get the characters displayed on the LCD without pressing any of the keys) 1 = Lamp test 2 = Silence horn 3 = Reset controller 4 = Escape 5 = Decrement 6 = Increment 7 = Enter 8 = Manual 9 = Off 10 = Auto 11 = Test 12 = Emergency stop 13 = Escape from program menu 14-255 = Undefined
byte 1	This field contains the number of times the key is to be pressed.

The response message contains the current display contents.

16.2. MEC 20 Valid Data/Display

The Data/Display Valid byte is used to determine the following. If bit 0 is set (1) then the Current Data in the registers is valid. If bit 1 is set (1) then the Display Data is valid (i.e. the last Keypress command has executed successfully).

16.3. MEC 20 Get Version

This message is used to get the version information from a MEC 20. The request message does not have any data bytes. The response message has the following data bytes:

Field	Description
byte0	***PAD***
byte1	This field contains the remote type, as follows: 0 = MEC 20 1 = TSC 800 2-255 = Undefined
byte2	This field contains the major MEC 20 message format version

	number.
byte3	This field contains the minor MEC 20 message format version number.
byte4	This field contains the major software version number.
byte5	This field contains the minor software version number.

16.4. MEC 20 Get Summary

This message is used to get the summary information from a MEC 20. The request message does not have any data bytes. The response message has the following data bytes:

Field	Description
byte0, byte1	This field contains the summary bitmap, as follows: Bit 15 contains TRUE if a callout is required. Bit 14 contains TRUE if a shutdown is active. This bit is the equivalent of the Shutdown LED. Bit 13 contains TRUE if an alarm is active. This bit is the equivalent of the Alarm LED. Bit 12 contains TRUE if the speed signal is present. This bit is the equivalent of the Speed Signal Present LED. Bit 11 contains TRUE if the engine controller is ready. This bit is the equivalent of the Ready LED. Bit 10 contains TRUE if the emergency stop is active. This bit is the equivalent of the Emergency Stop LED. Bit 9 contains TRUE if the horn output is enabled. Bit 8 contains TRUE if the remote start input is enabled. Bits 7-0 are unused.
byte2	This field contains the start mode, as follows: 0 = Manual 1 = Off 2 = Auto 3 = Load test 4-255 = Unused
byte3	This field contains the system status, as follows: 0 = Switch in off 1 = Switch not in auto 2 = Unit ready 3 = Start delay 4 = Crank period 5 = Rest period 6 = Bypass delay 7 = Unit running 8 = Cooldown 9 = Unit shutdown 10-255 = Unused

byte4, byte5	This field contains the system status timer value (in seconds).
byte6 (MSB), byte7, byte8, byte9(LSB)	This field contains the fault state bitmap. Each bit contains TRUE if the associated fault is active. The bits are defined as follows: Bits 31-29 are unused. Bit 28 is digital fault 12 (Fault name is programmable). Bit 27 is digital fault 11 (Fault name is programmable). Bit 26 is digital fault 10 (Fault name is programmable). Bit 25 is digital fault 9 (Fault name is programmable). Bit 24 is digital fault 8 (Fault name is programmable). Bit 23 is digital fault 7 (Fault name is programmable). Bit 22 is digital fault 6 (Fault name is programmable). Bit 21 is digital fault 5 (Fault name is programmable). Bit 20 is digital fault 4 (Fault name is programmable). Bit 19 is digital fault 3 (Fault name is programmable). Bit 18 is digital fault 2 (Fault name is programmable). Bit 17 is digital fault 1 (Fault name is programmable). Bit 16 is low oil pressure 2. Bit 15 is low oil pressure 1. Bit 14 is high engine temperature 2. Bit 13 is high engine temperature 1. Bit 12 is low engine temperature. Bit 11 is high battery. Bit 10 is low battery. Bit 9 is weak battery. Bit 8 is over current. Bit 7 is over frequency. Bit 6 is under frequency. Bit 5 is over voltage. Bit 4 is under voltage. Bit 3 is loss of speed signal. Bit 2 is over speed. Bit 1 is over crank. Bit 0 is emergency stop.
byte10	***PAD***
byte11	This field contains the EEPROM write count. This value is incremented each time the configuration information in the EEPROM is changed. The host uses this value to determine when the fault details may have changed.

16.5. MEC 20 Analog Values

Analog Group 0 Registers are described in more detail below:

Analog Group 0 Data	Description
byte0, byte1	This field contains the analog values bitmap, as follows: Bit 15 contains TRUE if the engine temperature is in degrees Celsius, and FALSE if the engine temperature

	is in degrees Fahrenheit. Bit 14 contains TRUE if the oil pressure is in KPA, and FALSE if the oil pressure is in PSI. Bit 13 contains TRUE if 3 phase mode, and FALSE if 1 phase mode. Bits 12-0 are unused.
byte2, byte3	This field contains the battery voltage (in tenths of volts).
byte4, byte5	This field contains the engine RPM (in revolutions per minute).
byte6, byte7, byte8, byte9	This field contains the run hours (in hours).
byte10, byte11	This field contains the engine temperature (in degrees Celsius or degrees Fahrenheit).
byte12, byte13	This field contains the oil pressure (in KPA or PSI).

Analog Group 1 Registers are described in more detail below:

Analog Group 1 Data	Description
byte0, byte1	3 phase mode: This field contains the phase AB voltage (in volts). 1 Phase mode: This field contains the phase AB voltage (in volts).
byte2, byte3	3 phase mode: This field contains the phase BC voltage (in volts). 1 Phase mode: This field contains the phase AN voltage (in volts).
byte4, byte5	3 phase mode: This field contains the phase CA voltage (in volts). 1 Phase mode: This field contains the phase BN voltage (in volts).
byte6, byte7	3 phase mode: This field contains the average of the phase AB, BC, and CA voltages (in volts). 1 Phase mode: This field contains the phase AB voltage (in volts).
byte8, byte9	3 phase mode: This field contains the phase A current (in amps). 1 Phase mode: This field is unused.
byte10, byte11	3 phase mode: This field contains the phase B current (in amps). 1 Phase mode: This field contains the phase A current (in amps).
byte12, byte13	3 phase mode: This field contains the phase C current (in amps). 1 Phase mode: This field contains the phase B current (in amps).
byte14, byte15	3 phase mode: This field contains the average of the phase A, B, and C currents (in amps).

	1 Phase mode: This field contains the average of the phase A and B currents (in amps).
byte16, byte17	This field contains the AC frequency (in tenths of hertz).

16.6. MEC 20 Display Details

The Display details are broken into 2 groups. Group 0 contains the 16 ASCII characters from the top line of the MEC 20 display. Group 1 contains the 16 ASCII characters from the bottom line of the display. There are to many individual display messages to list all of them here, however some basic messages should be described. The 2 most useful messages are "non-valid" and "valid". This is mainly used for confirmation that a keystroke has been sent and received by the MEC 20 correctly.

Group 0

Field	Description
byte0 to byte15	This field contains the ASCII characters from the LCD top line.

Group 1

Field	Description
byte0 to byte15	This field contains the ASCII characters from the LCD bottom line.

16.7. MEC 20 Fault Details

DigFault 1 - 12 are user programmable (see the table MEC 20 Get Summary, bytes 6 to 9 for fault descriptions), the fault name register can be read or written to any value up to 16 characters long. This must be done locally on the MEC 20's.

Fault Detail Registers are described in more detail below:

Fault Status Shutdown/Alarm	Description
byte0, byte1	This field contains the fault details bitmap, as follows: The bits contain TRUE if the fault is programmed as a shutdown, and FALSE if the fault is programmed as an alarm. Byte 0 contains information for digital Faults 0 - 15 (Bit15 =#15, Bit0 = #0) Byte 1 contains information for digital Faults 16 - 28 (Bit12 =#28, Bit0 =#16)

The message format for all faults is shown below:

Fault Message Description	Description

byte0 to byte15	This field contains the ASCII fault name. Unused characters at the end of this field are padded with spaces.

17. TSC 800 Register Tables

Specific TSC 800 data is received by addressing the TSC 800 and accessing the appropriate registers listed below. Using a TSC 800 address of "0" will cause all TSC 800's to respond to the request. This is usually reserved for communication with a single TSC 800 with an unknown address. Otherwise TSC 800 addresses range from 1 - 255 however only 10 RTU's (TSC 800 or MEC 20) can be connected to an individual CIM.

[table 41025 to 41065]

Field	Register (decimal)	Address (hex)	Register Count	Data Format	Value
TSC 800 Key Press (write only reg)	41025	400	1	uint16	see TSC 800 Press Key
TSC 800 Valid Data/Display	41026	401	1	uint8	see TSC 800 Valid Data/Display
TSC 800 Version	41027-41029	402-404	3	struct	see TSC 800 Get Version
TSC 800 Summary	41030-41036	405-40B	6	struct	see TSC 800 Get Summary
TSC 800 Analog Group	41037-41049	40C-418	13	struct	see TSC 800 Get Analog Values
TSC 800 Display Group 0	41050-41057	419-420	8	string	see TSC 800 Display Details
TSC 800 Display Group 1	41058-41065	421-428	8	string	see TSC 800 Display Details

18. TSC 800 Messages (Version 1.0)

The following sections describe in detail the data registers mentioned in the above tables, for single byte data the actual byte location in the registers is included in the above mentioned tables.

18.1. TSC 800 Press Key

This message is used to remotely press a key on a TSC 800's front panel. It is also used to get the characters displayed on a TSC 800's LCD. The request message has the following data bytes:

Field	Description
byte0	This field contains the key, as follows: 0 = Null (This value is used to get the characters displayed on the LCD without pressing any of the keys). 1 = Lamp test 2 = Previous 3 = Decrement 4 = Increment 5 = Next 6 = No manual test 7 = Manual offload test 8 = Manual onload test 9 = Escape from program menu 10-255 = Unused
byte1	This field contains the number of times the key is to be pressed.

The response message contains the current display contents.

18.2. TSC 800 Valid Data/Display

The Data/Display Valid byte (byte1, LSB) is used to determine the following.

If bit 0 is set (1) then the Current Data in the registers is valid.

If bit 1 is set (1) then the Display Data is valid (i.e. the last Keypress command has executed successfully).

18.3. TSC 800 Get Version

This message is used to get the version information from a TSC 800. The request message does not have any data bytes. The response message has the following data bytes:

Field	Description
byte0	*** PAD ***
byte1	This field contains the remote type, as follows: 0 = MEC 20 1 = TSC 800 2-255 = Undefined
byte2	This field contains the major TSC 800 message format version number.

byte3	This field contains the minor TSC 800 message format version number.
byte4	This field contains the major software version number.
byte5	This field contains the minor software version number.

18.4. TSC 800 Get Summary

This message is used to get the summary information from a TSC 800. The request message does not have any data bytes. The response message has the following data bytes:

Field	Description
byte0, byte1	This field contains the summary bitmap, as follows: Bit 15 contains TRUE if a callout is required. Bit 14 contains TRUE if dual prime mode, and FALSE if standard mode. Bit 13 contains TRUE if Src2 prime, and FALSE if Src1 prime. Bit 12 contains TRUE if a transfer switch failure has occurred. Bit 11 is unused in standard mode. This bit contains TRUE if the Src1 Start output is enabled in dual prime mode. Bit 10 contains TRUE if the Src2 Start output is enabled. Bit 9 contains TRUE if the Src1 Pretransfer output is enabled. Bit 8 contains TRUE if the Src2 Pretransfer output is enabled. Bit 7 contains TRUE if the Src1 Transfer output is enabled. Bit 6 contains TRUE if the Src2 Transfer output is enabled. Bit 5 contains TRUE if the Load On Src1 input is enabled. Bit 4 contains TRUE if the Load On Src2 input is enabled. Bits 3-0 are unused.
byte2	This field contains the test mode, as follows: 0 = None 1 = Switch offload test 2 = Switch onload test 3 = Switch off 4 = Manual offload test 5 = Manual onload test 6 = Auto offload test 7 = Auto onload test 8-255 = Unused
byte3	This field contains the system status, as follows: 0 = Src1 start delay 1 = Src2 start delay 2 = Src1 warmup delay 3 = Src2 warmup delay 4 = Pretransfer delay 5 = Finding neutral 6 = Neutral delay 7 = Transferring 8 = Transfer failed, press lamptest

	9 = Posttransfer delay 10 = Src1 return delay 11 = Src2 return delay 12 = Src1 cooling 13 = Src2 cooling 14 = Src1 auto, Src2 auto 15 = Src1 auto, Src2 failed 16 = Src1 auto, Src2 normal 17 = Src1 auto, Src2 offload test 18 = Src1 auto, Src2 onload test 19 = Src1 auto, Src2 ready 20 = Src1 auto, Src2 running 21 = Src1 auto, Src2 starting 22 = Src1 auto, Src2 switch off 23 = Src1 failed, Src2 auto 24 = Src1 failed, Src2 failed 25 = Src1 failed, Src2 normal 26 = Src1 failed, Src2 offload test 27 = Src1 failed, Src2 onload test 28 = Src1 failed, Src2 ready 29 = Src1 failed, Src2 running 30 = Src1 failed, Src2 starting 31 = Src1 failed, Src2 switch off 32 = Src1 normal, Src2 auto 33 = Src1 normal, Src2 failed 34 = Src1 normal, Src2 normal 35 = Src1 normal, Src2 offload test 36 = Src1 normal, Src2 onload test 37 = Src1 normal, Src2 ready 38 = Src1 normal, Src2 running 39 = Src1 normal, Src2 starting 40 = Src1 normal, Src2 switch off 41 = Src1 offload test, Src2 auto 42 = Src1 offload test, Src2 failed 43 = Src1 offload test, Src2 normal 44 = Src1 offload test, Src2 offload test 45 = Src1 offload test, Src2 onload test 46 = Src1 offload test, Src2 ready 47 = Src1 offload test, Src2 running 48 = Src1 offload test, Src2 starting 49 = Src1 offload test, Src2 switch off 50 = Src1 onload test, Src2 auto 51 = Src1 onload test, Src2 failed 52 = Src1 onload test, Src2 normal 53 = Src1 onload test, Src2 offload test 54 = Src1 onload test, Src2 onload test 55 = Src1 onload test, Src2 ready 56 = Src1 onload test, Src2 running 57 = Src1 onload test, Src2 starting 58 = Src1 onload test, Src2 switch off

	59 = Src1 ready, Src2 auto 60 = Src1 ready, Src2 failed 61 = Src1 ready, Src2 normal 62 = Src1 ready, Src2 offload test 63 = Src1 ready, Src2 onload test 64 = Src1 ready, Src2 ready 65 = Src1 ready, Src2 running 66 = Src1 ready, Src2 starting 67 = Src1 ready, Src2 switch off 68 = Src1 running, Src2 auto 69 = Src1 running, Src2 failed 70 = Src1 running, Src2 normal 71 = Src1 running, Src2 offload test 72 = Src1 running, Src2 onload test 73 = Src1 running, Src2 ready 74 = Src1 running, Src2 running 75 = Src1 running, Src2 starting 76 = Src1 running, Src2 switch off 77 = Src1 starting, Src2 auto 78 = Src1 starting, Src2 failed 79 = Src1 starting, Src2 normal 80 = Src1 starting, Src2 offload test 81 = Src1 starting, Src2 onload test 82 = Src1 starting, Src2 ready 83 = Src1 starting, Src2 running 84 = Src1 starting, Src2 starting 85 = Src1 starting, Src2 switch off 86 = Src1 switch off, Src2 auto 87 = Src1 switch off, Src2 failed 88 = Src1 switch off, Src2 normal 89 = Src1 switch off, Src2 offload test 90 = Src1 switch off, Src2 onload test 91 = Src1 switch off, Src2 ready 92 = Src1 switch off, Src2 running 93 = Src1 switch off, Src2 starting 94 = Src1 switch off, Src2 switch off 95-255 = Unused
byte4, byte5	This field contains the system status timer value (in seconds).
byte6, byte7	This field contains the fault state bitmap. Each bit contains TRUE if the associated fault is active. The bits are defined as follows: Bits 15-8 are unused. Bit 7 is Src2 over frequency. Bit 6 is Src2 under frequency. Bit 5 is Src2 over voltage. Bit 4 is Src2 under voltage. Bit 3 is Src1 over frequency. Bit 2 is Src1 under frequency. Bit 1 is Src1 over voltage.

	Bit 0 is Src1 under voltage.
byte8, byte9	This field contains the fault visible bitmap. Each bit contains TRUE if the associated fault is visible. The bits are defined as follows: Bits 15-8 are unused. Bit 7 is Src2 over frequency. Bit 6 is Src2 under frequency. Bit 5 is Src2 over voltage. Bit 4 is Src2 under voltage. Bit 3 is Src1 over frequency. Bit 2 is Src1 under frequency. Bit 1 is Src1 over voltage. Bit 0 is Src1 under voltage.
byte10	This field contains the day of the week of the system time, as follows: 0 = Sunday 1 = Monday 2 = Tuesday 3 = Wednesday 4 = Thursday 5 = Friday 6 = Saturday 7-255 = Unused
byte11	This field contains the hour of the system time. Valid values are 0-59.
byte12	This field contains the minute of the system time. Valid values are 0-59.
byte13	This field contains the second of the system time. Valid values are 0-59.

18.5. TSC 800 Get Analog Values

This message is used to get the analog values from a TSC 800. The request message does not have any data bytes. The response message has the following data bytes:

Field	Description
byte0, byte1	This field contains the analog values bitmap, as follows: Bit 15 contains TRUE if 3 phase mode, and FALSE if 1 phase mode. Bits 14-0 are unused.
byte2, byte3	This field contains the Src1 phase AB voltage (in volts).
byte4, byte5	3 phase mode: This field contains the Src1 phase BC voltage (in volts). 1 Phase mode: This field contains the Src1 phase AN voltage (in volts).
byte6, byte7	3 phase mode: This field contains the Src1 phase CA voltage (in volts).

	1 Phase mode: This field contains the Src1 phase BN voltage (in volts).
byte8, byte9	This field contains the Src1 frequency (in tenths of hertz).
byte10, byte11	This field contains the Src2 phase AB voltage (in volts).
byte12, byte13	3 phase mode: This field contains the Src2 phase BC voltage (in volts). 1 Phase mode: This field contains the Src2 phase AN voltage (in volts).
byte14, byte15	3 phase mode: This field contains the Src2 phase CA voltage (in volts). 1 Phase mode: This field contains the Src2 phase BN voltage (in volts).
byte16, byte17	This field contains the Src2 frequency (in tenths of hertz).
byte18, byte19	This field contains the load phase AB voltage (in volts).
byte20, byte21	This field is unused.
byte22, byte23	This field is unused.
byte24, byte25	This field contains the load frequency (in tenths of hertz).

18.6. TSC 800 Display Details

The Display details are broken into 2 groups. Group 0 contains the 16 ASCII characters from the top line of the TSC 800 display. Group 1 contains the 16 ASCII characters from the bottom line of the display. There are to many individual display messages to list all of them here, however some basic messages should be described. The 2 most useful messages are "non-valid" and "valid". This is mainly used for confirmation that a keystroke has been sent and received by the TSC 800 correctly.

Group 0

Field	Description
byte0 to byte15	This field contains the ASCII characters from the LCD top line.

Group 1

Field	Description
byte0 to byte15	This field contains the ASCII characters from the LCD bottom line.

19. CRC Calculation

The Cyclical Redundancy Check (CRC) calculation used by Modbus is commonly called the CRC-16 algorithm. Refer to A Painless Guide To CRC Error Detection Algorithms by Ross N. Williams for more detailed information; using the terminology of that paper, the CRC algorithm used by the CIM is:

Name : "CRC-16"

Width : 16

Poly : 8005

Init : FFFF

RefIn : True

RefOut : True

XorOut : 0000

Check : BB3D

The following is a C code implementation of the CRC-16 method:

```
unsigned short CalculateCrc(unsigned char *pAddress, int nByteCount)
{
  unsigned short wCrcValue = 0xffff;

  while (nByteCount--)
  {
    wCrcValue ^= *pAddress;
    for (int i = 0; i < 8; i++)
    {
      if (wCrcValue & 1)
      {
        wCrcValue >>= 1;
        wCrcValue ^= 0xa001;
      }
      else
      {
        wCrcValue >>= 1;
      }
    }
    pAddress++;
  }
  return wCrcValue;
}
```

20. NOTES: