Installation, Operation and Maintenance of the ATC-400

CAUTION

THE ATC-400 IS FACTORY PROGRAMMED FOR A SPECIFIC TRANSFER SWITCH. DO NOT ATTEMPT TO INTERCHANGE ATC-400 CONTROL DEVICES WITHOUT CONSULTING THE FACTORY.

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding this particular installation, operation or maintenance of this equipment, the local Cutler-Hammer representative should be contacted.

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SECTION 1: INTRODUCTION

1.1 PRELIMINARY COMMENTS AND SAFETY PRECAUTIONS

This technical document is intended to cover most aspects associated with the installation, application, operation and maintenance of the ATC-400 Controller. It is provided as a guide for authorized and qualified personnel only in the selection and application of the ATC-400 Controller. Please refer to the specific WARNING and CAUTION in Section 1.1.2 before proceeding. If further information is required by the purchaser regarding a particular installation, application or maintenance activity, a Cutler-Hammer representative should be contacted.

1.1.1 WARRANTY AND LIABILITY INFORMATION

NO WARANTIES, EXPRESSED OR IMPLIED, INCLUDING WARANTIES OF FITNESS FOR A PARTICULAR PURPOSE OF MERCHANTABILITY, OR WARRANTIES ARISING FROM COURSE OF DEALING OR USAGE OF TRADE, ARE MADE REGARDING THE INFORMATION, RECOMMENDATIONS AND DESCRIPTIONS CONTAINED HEREIN. In no event will Cutler-Hammer be responsible to the purchaser or user in contact, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing facilities, or claims against the purchaser or user by its customers resulting from the use of the information and description contained herein.

1.1.2 SAFETY PRECAUTION

All safety codes, safety standards and/or regulations must be strictly observed in the installation, operation and maintenance of this device.

WARNING

THE WARNINGS AND CAUTIONS INCLUDED AS PART OF THE PROCEDURAL STEPS IN THIS DOCUMENT ARE FOR PERSONNEL SAFETY AND PROTECTION OF THE EQUIPMENT FROM DAMAGE. AN EXAMPLE OF A TYPICAL WARNING LABEL HEADING IS SHOWN IN REVERSE TYPE TO FAMILIARIZE PERSONNEL WITH THE STYLE OF PRESENTATION. THIS WILL HELP TO INSURE THAT PERSONNEL ARE ALERT TO WARNINGS, WHICH MAY APPEAR THROUGHOUT THE DOCUMENT. IN ADDITION, CAUTIONS ARE ALL UPPER CASE AND BOLDFACE AS SHOWN BELOW.

CAUTION

COMPLETELY READ AND UNDERSTAND THE MATERIAL IN THIS DOCUMENT BEFORE ATTEMPTING INSTALLATION, OPERATION OR APPLICATION OF THE EQUIPMENT. ANY WIRING INSTRUCTIONS PRESENTED IN THIS DOCUMENT MUST BE FOLLOWED PRECISELY. FAILURE TO DO SO COULD CAUSE PERMANENT EQUIPMENT DAMAGE.

1.2 BACKGROUND

Transfer switches are used to protect critical electrical loads against loss of power. The load's normal power source is backed up by a secondary (emergency) power source. A transfer switch is connected to both the normal and emergency sources and supplies the load with power from one of these two sources. In the event that power is lost from the Normal Source, the transfer switch transfers the load to the secondary source. Transfer can be automatic or manual, depending upon the type of transfer switch equipment being used. Once normal power is restored, the load is transfer back to the normal power source.

In automatic transfer switch equipment, the switch's intelligence system initiates the transfer when normal power falls below a preset voltage or frequency. If the emergency source is a standby generator, the transfer switch initiates generator starting and transfers to the emergency source when sufficient generator voltage is available. When normal power is restored, the transfer switch automatically transfers back and initiates engine shutdown.

An automatic transfer switch consist of three basic elements:

- Main contacts to connect and disconnect the load to and from the source of power.
- A transfer mechanism to affect the transfer of the main contacts from source to source.
- Intelligence/supervisory circuits to constantly monitor the condition of the power sources and thus provide the intelligence necessary for the switch and related circuit operation.

This manual deals with the third basic element of the automatic transfer switch, the required intelligence/supervisory circuits. Prior to the introduction of ATC-400 Controller, this function was performed by a door mounted logic panel. The logic panel could

be the relay logic type or a solid state single board controller type. In either case, the panel consisted of a number of individually mounted and wired devices offering a limited amount of system flexibility, especially in the case of the relay logic design. The ATC-400 Controller brings intelligence, supervisory and programming capabilities to automatic transfer switch equipment.

1.3 PRODUCT OVERVIEW

The ATC-400 Controller is a comprehensive, multi-function, microprocessor based automatic transfer switch controller. It is compact, self-contained, panel mounted device designed to replace traditional relay and solid state logic panels.

Designed to meet the needs of markets worldwide, ATC-400 Controller:
- Is a UL Recognized Component
- Complies with UL 1008/CSA 178.22
- Meets Intent of UL 991
- Meets IEC 1000-4-2, 1000-4-3, 1000-4-4, 1000-4-5, 1000-4-6, and 1000-4-11
- Meets CISPR 11
- Complies with FCC Part 15, Class A

The ATC-400 Controller provides an unmatched degree of programmed flexibility to address the needs of any system. It operates from all system voltages between 110 VAC and 600 VAC, single phase and three phase, at 50 or 60 Hz. In addition, a period of no control power operation is provided. The ATC-400 Controller monitors the condition of the 3-phase line-to-line voltage and frequency of both the Normal and Emergency sources. It can also be programmed for single phase operation. The ATC-400 Controller provides the necessary intelligence to insure that the switch operates properly through a series of programmed sensing and timing functions.

A standard ATC-400 Controller will:
- Monitor Normal and Emergency source voltages and frequencies
- Provide undervoltage monitoring of Normal and Emergency sources
- Permit customer programming
- Display real time and historical information
- Permit system testing
- Store customer/factory established parameters in nonvolatile memory
- Communicate with laptop or remote PC using PowerNet software
- Provide faceplate source status indications

1.4. FUNCTIONS/FEATURES/OPTIONS

The primary function of ATC-400 Controller is to accurately monitor power sources and provide the necessary intelligence to operate a transfer switch in an appropriate and timely manner. In addition, the ATC-400 Controller provides programming through the device's faceplate or communication option.

1.4.1 OPERATIONAL SIMPLICITY

From installation to programming to usage, the ATC-400 Controller was design with operational simplicity in mind. Only one style needs to be considered, regardless of input/output requirements or system voltages and frequencies. ATC-400 Controller provides the functionality of numerous other devices combined in one package that mounts in less than 7 by 11 inches of panel space.

The user-friendly front panel interface simplifies routine operation, programming, data presentation and setting adjustments. An LCD-based display provides the flexibility of back lit display for enhanced visibility. The operation of front panel membrane pushbuttons move the ATC-400 Controller display from function to function or step to step within a function.

1.4.2 STANDARD AND OPTIONAL FEATURES

A variety of programmable features are available to meet a wide variety of application requirements. Individual features or feature combinations provide the intelligence required to tailor switches to individual needs.

The features are factory activated, depending upon customer requirements. The specific variable setpoints associated with standard and factory activated features are stored in a nonvolatile memory. Activated feature setpoints are available for customer adjustment. Any feature not selected and factory activated cannot be viewed or adjusted.

NOTICE

With respect to their use in this document and as they relate to automatic transfer switch operation, the following words or phrases are defined:

Available
A source is defined as "available" when it is within all undervoltage / overvoltage / underfrequency / overfrequency setpoint ranges for the nominal voltage and frequency setting.

Source 1
is the preferred source, or Normal Source, or Normal.

Source 2
is the secondary, Emergency Source, or Emergency, or backup source.

Failed or Fails
A source is defined as "failed" when it is outside of any undervoltage / overvoltage / underfrequency / overfrequency setpoint ranges for the nominal voltage and frequency setting for a time exceeding 0.5 seconds.

Failsafe
Failsafe refers to the condition whereby the transfer switch is connected to the Emergency Source. In the event that the Emergency Source fails, with TDEF set to zero, and the Normal Source available, an immediate retransfer to the Normal Source shall occur.

Transfer
A "transfer" is defined as when the ATC-400 initiates a change of the load connection from Source 1 to Source 2 except when specifically used as "Transfer to Neutral".

Re-transfer
A "re-transfer" is defined as when the ATC-400 initiates a change of the load connection from Source 2 to Source 1.

Transfer to Neutral
A "Transfer to Neutral" is defined as the load circuits are disconnected from both Source 1 and Source 2.

$V_{IN, RMS}$
Refers to the operating input voltage ($V_{AC, RMS}$).

FEATURE #
For personnel who are familiar with previous transfer switch controller option specifications, an attempt at equivalence to some of the features is made.

The ATC-400 Controller features are described below. The actual programmable setpoints for each feature are covered in Section 5.

Standard Feature 1: Time Delay Normal to Emergency (TDNE)

TDNE provides a time delay when transferring from the Normal Source to the Emergency Source. It ensures stability of the Emergency Source. Timing begins when the Emergency Source becomes available. If the Normal Source becomes available while timing, the TDNE timer will reset.

Standard Feature 2: Time Delay Engine Start (TDES)

TDES delays the initiation of the engine start circuit in order to override momentary power outages or voltage fluctuations of the Normal Source. The TDES timer shall start when the Normal Source becomes unavailable. If the Normal Source becomes available while timing, the TDES timer will reset. The controller can perform the time delay engine start function without control power for 120 seconds

Standard Feature 3: Time Delay Emergency to Normal (TDEN)

TDEN delays the transfer from the Emergency Source to the Normal Source to permit stabilization of the Normal Source before retransfer is made. Timing begins when the Normal Source becomes available. If the Normal Source becomes unavailable while timing, the TDEN timer will reset.

Standard Feature 4: Time Delay Engine Cooldown (TDEC)

Permits the generator to continue to run unloaded after retransfer to the Normal Source has occurred. Timing begins when the transfer to normal has been completed.

Standard Feature 5B/5J: All Phase Undervoltage/Underfrequency Sensing

The controller monitors the voltage of each phase of the emergency /standby power source. Frequency is also monitored. User adjustable dropout and pickup settings are provided.

Standard Feature 7: Time Delay Emergency Fail (TDEF)

TDEF will delay a connected Emergency Source which is not within the required voltage and frequency setpoints from being declared "Failed" in order to override momentary generator fluctuations. This time delay is only implemented when the Emergency Source is a generator, is connected, and has "failed".

Standard Feature 8: Pushbutton Bypass of Time Delays (TDNE/TDEN)

This enables the user to bypass the TDNE or TDEN timer during a transfer. Simultaneously pressing the Step and Help/Lamp Test pushbuttons shall cause the transfer switch to transfer to the Normal and/or Emergency Source without a time delay. This feature does not bypass the TDN feature (32A).

Standard Feature 12C: Source 1 Connected (Green)

Indicates that the transfer switch is connected to Source 1.

Standard Feature 12D: Source 2 Connected (Red)

Indicates that the transfer switch is connected to Source 2.

Standard Feature 12G: Source 1 Available (Amber)

Indicates that Source 1 is available and the voltage and frequency are within the programmed parameters.

Standard Feature 12H: Source 2 Available (Amber)

Indicates that Source 2 is available and the voltage and frequency are within the programmed parameters.

Standard Feature 23J: Plant Exerciser

This feature provides for automatic test operation of the generator. The test is user-selectable to run daily, every 7 days, every 14 days, or every 28 days with duration equal to the programmed engine test time. Two optional modes of plant exercising are available:

a) No Load Exercise
b) Load Exercising with failsafe

This feature can be disabled by programming the "PE Enable" setpoint to "0".

Load testing is failsafe. If the generator fails during testing for any reason, the ATC-400 will signal the transfer switch to return to Normal Source if the Normal Source is available.

Standard Feature 26: Normal Source Undervoltage Sensing

The controller monitors each phase of the Normal Source voltage for an undervoltage condition. When the normal voltage is below the dropout setpoint, the source will become unavailable. A transfer to the Emergency Source shall be initiated when the Emergency Source is available. The Normal Source voltage will then have to be above the pickup setpoint to become available again.

Standard Feature: System Nominal Frequency

There are only two choices for system nominal frequency of the distribution system, 50 or 60 Hertz. The dropout/pickup, underfrequency and overfrequency upper and lower setting limits are based on the nominal frequency value.

Standard Feature: System Nominal Voltage

This refers to the standard system nominal RMS line to line voltage. A wide range (120 to 600 VAC) of sensing voltage is available to be programmed. The dropout/pickup, undervoltage and overvoltage upper and lower setting limits are based on the nominal frequency value.

Standard Feature: Commit to Transfer During TDNE Timing

This feature provides for selection as to whether or not commitment to transfer is desired when Time Delay Normal to Emergency countdown has begun. If no commitment is chosen and the Normal Source returns to availability when the TDNE timer is counting down, the transfer is aborted and the engine generator (if applicable) is cooled down.

Standard Feature: Engine Test Mode

This feature provides selection of the type of test that can be initiated by the front panel Engine Test pushbutton. An engine test without transferring the load to it, or an engine test with a full transfer of the load to the engine can be chosen. Load testing is fail-safe. If the generator fails during testing for any reason, the ATC-400 will signal the transfer switch to return to the Normal Source. If disable test mode is chosen, the front panel pushbutton cannot be used to initiate a test.

Standard Feature: Test Engine Run

This feature provides selection of the length of time in hours and minutes that the ATC-400 will enable the generator contacts during an Engine Test that was initiated from the front panel pushbutton or for the plant exerciser feature, if applicable.

Optional Feature 5C/5K: Emergency/Standby Source Overvoltage/Overfrequency Sensing

The controller monitors the voltage of each phase of the emergency/standby power source. Frequency is also monitored. User adjustable dropout and pickup settings are provided.

Optional Feature 9B: Maintenance Selector Switch

Marked "OFF", "ON". This feature locks out the automatic transfer operation for maintenance when the switch is in the "OFF" position.

Optional Feature 16: Overcurrent Protection (Lockout)

When integral overcurrent protection is provided for either one or both sources, the need for separate upstream overcurrent protection, in most instances, is eliminated. With this factory installed feature in the ATC-400, further automatic transfer operation is locked out until the appropriate source breaker is reset.

Optional Feature 26C: Normal Source Overvoltage Sensing

The controller monitors each phase of the Normal Source voltage for an overvoltage condition. When the normal voltage is above the dropout setpoint, the source will become unavailable. A transfer to the Emergency Source shall be initiated when the Emergency Source is available. The Normal Source voltage will then have to be below the pickup setpoint to become available again.

Optional Feature 26D: Go To Emergency / S2

This feature enables an external contact closure to initiate a transfer from the Normal Source to the Emergency Source. If the external contact is closed and the Emergency Source fails, the ATC-400 will transfer the load back to the Normal Source.

Optional Feature 26E: Normal Source Underfrequency Sensing

The controller monitors the Normal Source frequency for an underfrequency condition. When the normal frequency is below the dropout setpoint, the source will become unavailable. A transfer to the Emergency Source shall be initiated when the Emergency Source is available. The Normal source frequency will then have to be above the pickup setpoint to become available again.

Optional Feature 26F: Normal Source Overfrequency Sensing

The controller monitors each phase of the Normal Source frequency for an overfrequency condition. When the normal frequency is above the dropout setpoint, the source will become unavailable. A transfer to the Emergency Source shall be initiated when the Emergency Source is available. The Normal Source frequency will then have to be below the pickup setpoint to become available again.

Optional Feature 29J: Type of Re-transfer (Automatic or Manual)

This feature provides for a selection between an automatic re-transfer mode or a manual pushbutton re-transfer mode when transferring from Emergency to Normal. If this option is not selected, the factory default selection is automatic.

Optional Feature 32A: Time Delay Neutral (TDN)

TDN provides a time delay in the transfer switch neutral position during transfer and retransfer operations. This is to prevent excessive inrush currents due to out-of-phase switching of large inductive loads. If the TDN timer is programmed to 0 seconds, the transfer switch shall operate as if the TDN option is disabled.

Optional Feature 32D: In-phase/Time Delay Neutral

In-phase Transition is a feature that will allow a transfer between two live sources only when the phase difference between the two sources is near zero. This is an open transition transfer that prevents in-rush currents from exceeding normal starting currents in the case where motor loads are being transferred.

Time Delay Neutral provides a time delay in the transfer switch neutral position when both breakers are open. This delay takes place when the load is transferred in either direction to prevent excessive in-rush currents due to out-of-phase switching of large motor loads.

Optional Feature 35: Pretransfer Relay

This provides one form C contact (NO/NC) for interface with other equipment (typically elevator controls). The contacts close/open on a timed basis (adjustable 1 - 120 seconds) prior to transfer in either direction. After TDNE/TDEN times out, this relay closes and the Pretransfer timer (TPRE) starts timing. After the TPRE times out, the transfer proceeds by starting the TDN timer is enabled. The pretransfer relay opens after the transfer is complete.

Optional Feature 36: Load Shed From Emergency

This feature enables an external N/O contact to initiate a transfer when the load is connected to Source 2. If the contact is opened when Source 1 is not available, the ATC-400 will go to the neutral position with both sources disconnected from the load. If the contact is opened when Source 1 is available, the ATC-400 will transfer the load from Source 2 to Source 1.

Optional Feature 46: Potential Transformer (PT) Ratio

This feature allows external voltage transformers to be used on the ATC-400's source sense inputs. Once this option is enabled, the PT Ratio setpoint can be adjusted in steps of 1, between 2:1 and 500:1. Also when this option is enabled the Nominal System Voltage setting will be fixed at 120 VAC or 110 VAC, depending upon the Nominal System Frequency setting. If the Nominal System Frequency setting is 60 Hz, then the Nominal System Voltage will be fixed at 120 VAC and all voltage pick-up an drop-out setpoints will be based upon the 120 volt level. The same is true of a Nominal System Frequency of 50 Hz whose Nominal System Voltage will be fixed at 110 VAC. The metering display will use the PT ratio to calculate and display the source voltages with up to three significant digits. There will be four possible types of displays, as an example, they could display 999K, 99,9K, 9,99K, or 999 volts.

SECTION 2: HARDWARE DESCRIPTION

2.1 GENERAL

The purpose of this section is to familiarize the reader with the ATC-400 hardware, its nomenclature, and to list the unit specifications. The information presented is divided into the following three parts:

- Operator Panel
- Rear Access Area
- Specification Summary

2.2 OPERATOR PANEL

The operator panel, which is normally accessible from the outside of a panel or door, provides a means for:
- Being alerted to specific conditions
- Programming
- Parameter Monitoring/Selection/Metering

LEDs, a display window, pushbuttons and a mimic bus make up the front accessible operator panel (Figure **2-1**).

Five individual LEDs are lit when performing or indicating a specific function. For detailed information on individual LEDs refer to Paragraph 3.2.

A two-line 16-character alphanumeric LCD display is used to display all ATC-400 Controller monitored parameters, setpoints and messages in easy to read formats. For details concerning the kind of information that can be viewed in the display window refer to Paragraph 3.4.

The front operator panel supports five long-life membrane pushbuttons. Pushbuttons accomplish their function when pressed and released. Refer to Paragraph 3.3 for information concerning the function of specific pushbuttons.

2.3 REAR ACCESS AREA

The rear access area of the ATC-400 Controller is normally accessible from the rear of an open panel door (Figure **2-2**).

All wiring connections to the ATC-400 Controller are made at the rear of the chassis. For the sake of uniform identification, the frame of reference when discussing the rear access area is facing the back of the ATC-400 Controller with the panel door open.

The left rear of the chassis provides connectors J1 and J2 for voltage monitoring of Source 1 and Source 2 respectively. Connector Terminal block J4 provides DC wetted connections for various control inputs. Customer programming is provided through the Program/Run toggle switch. While the switch is in the Program position, the ATC-400 continues to operate in keeping with previously programmed setpoints.

The right rear of the chassis provides a port that will accept the D-sub male connector of the optional Communication Module (IPONI). Remote communication with the controller is provided through this connector, J13. A self-locking female connector J7 is provided for Sources 1 and 2 control power input. Terminal block J5 provides dry relay contacts for primary control outputs. See Section 4.5.1 for contact ratings.

2.4 EXTERNAL HARDWARE (COMMUNICATION MODULE)

Communications are made possible by mounting a small, addressable communication module (IPONI) to the back of the ATC-400 and connecting to J13. Since the ATC-400 is always supplied with a communications port, an IPONI can be easily retrofitted to the ATC-400 at any time. **It is recommended that the control power to the ATC-400 be removed prior to connecting or disconnecting the IPONI.** Refer to the instructions supplied with the IPONI for more details.

Figure 2-1 ATC-400 Controller Operator Panel

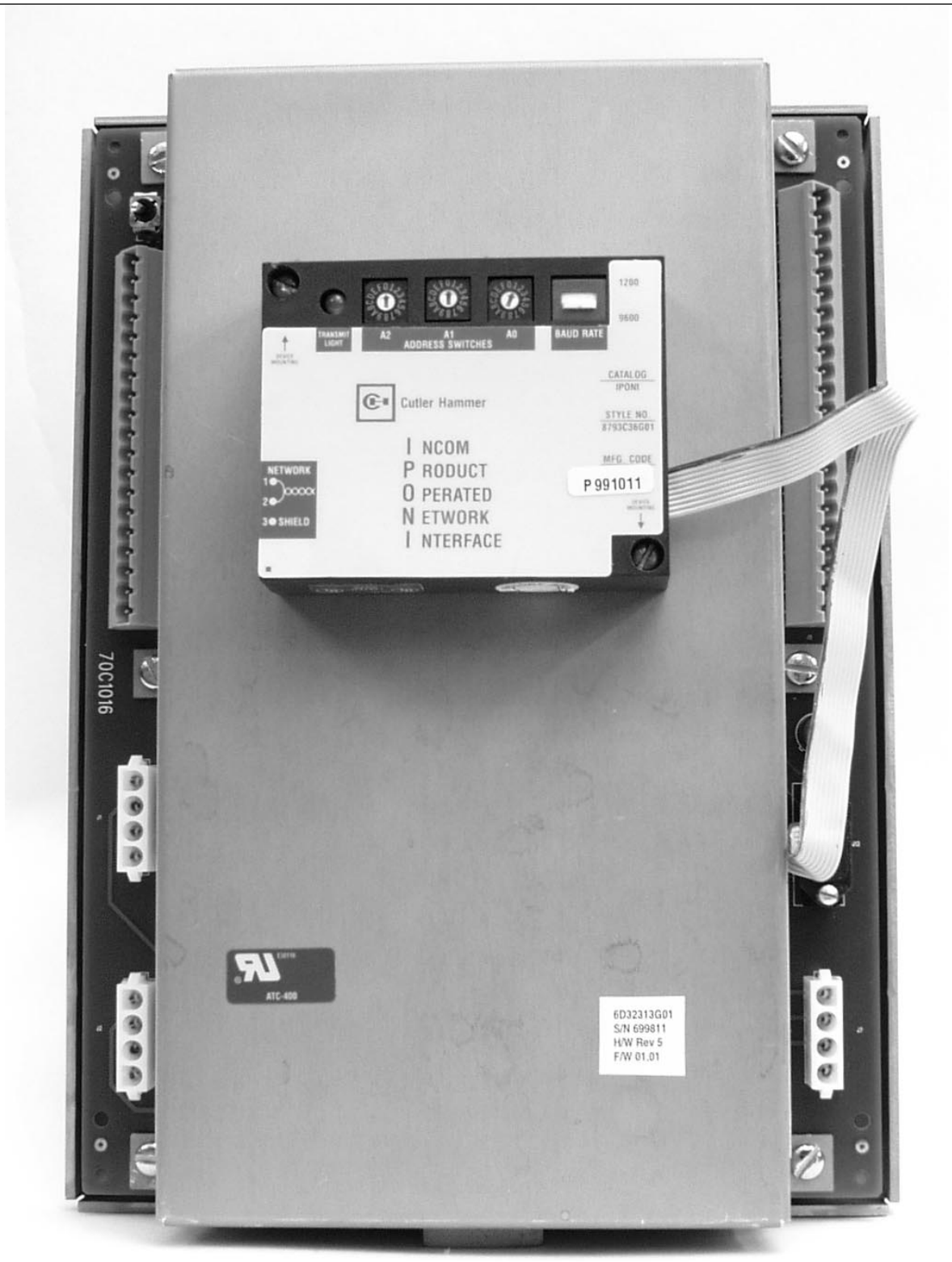


Figure 2-2 ATC-400 Controller (Rear View) with IPONI Communications Module Installed

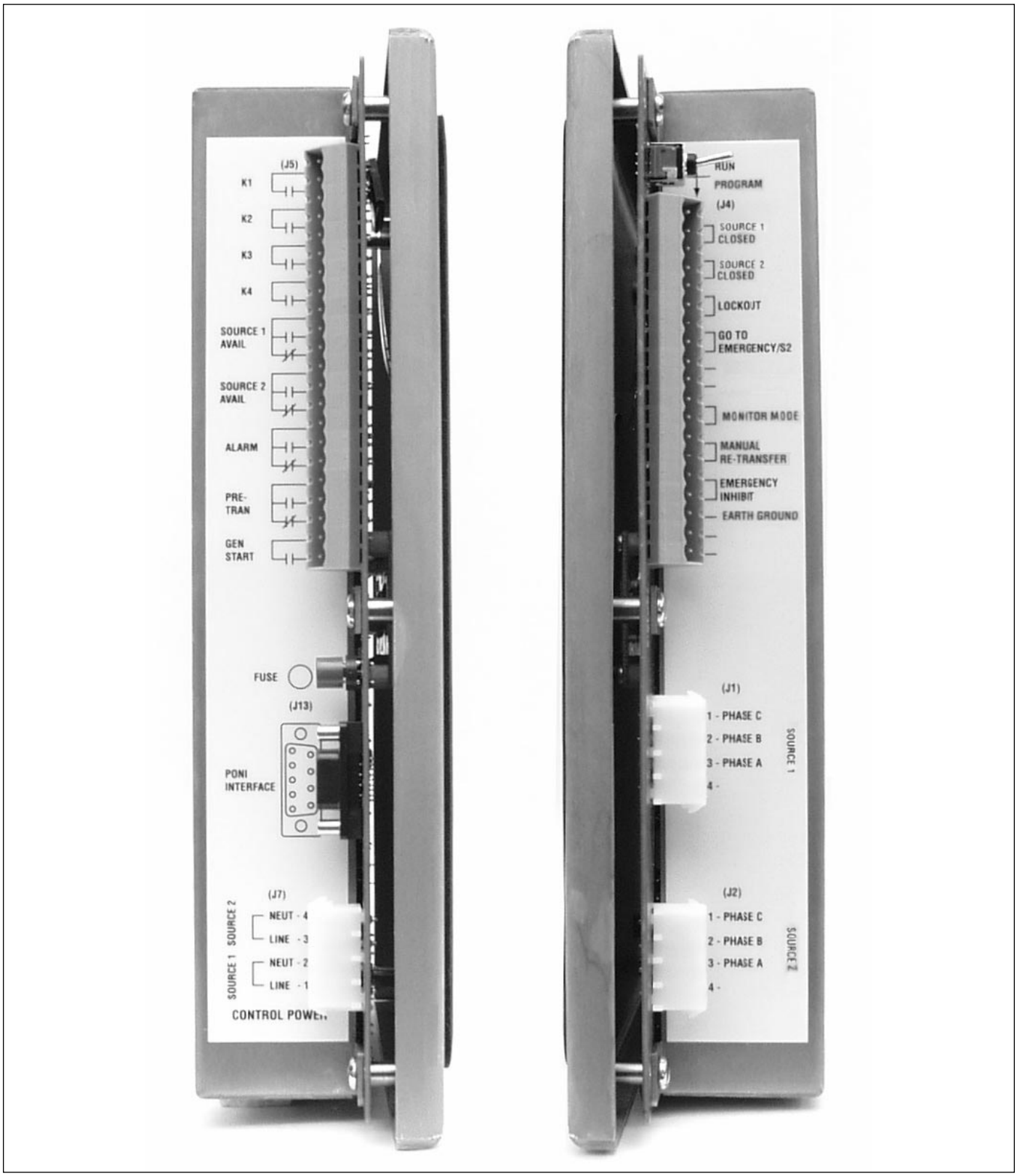


Figure 2-3 ATC-400 Controller (Left and Right Side Views)

2.5 SPECIFICATION SUMMARY

Table 2.1 ATC-400 Controller Specifications

Input Control Voltage	65 VAC to 145 VAC	50/60 Hz
Voltage Measurements of	Source 1 V_{AB} Source 1 V_{CA} Source 2 V_{BC}	Source 1 V_{BC} Source 2 V_{AB} Source 2 V_{CA}
Voltage Measurement Range	0 to 360 VAC RMS (50/60Hz)	
Voltage Measurement Accuracy	± 1% of Full Scale	
Frequency Measurements of	Source 1 (Normal), Source 2 (Emergency)	
Frequency Measurement Range	40 Hz to 70 Hz	
Frequency Measurement Accuracy	± 0.3 Hz over the measurement range	
Undervoltage Dropout Range	50% to 97% of the nominal system voltage	
Undervoltage Pickup Range	(Dropout +2%) to 99% of the nominal system voltage	
Overvoltage Dropout Range	105% to 120% of the nominal system voltage	
Overvoltage Pickup Range	103% to (Dropout -2%) of the nominal system voltage	
Underfrequency Dropout Range	90% to 97% of the nominal system frequency	
Underfrequency Pickup Range	(Dropout + 1Hz) to 99% of the nominal system frequency	
Overfrequency Dropout Range	103% to 110% of the nominal system frequency	
Overfrequency Pickup Range	101% to (Dropout - 1Hz) of the nominal system frequency	
Operating Temperature Range	-20°C to + 70°C	
Storage Temperature Range	-30°C to + 85°C	
Operating Humidity	0 to 95% relative humidity (non-condensing)	
Generator Start Relay:	5A, 1/6 HP @ 250VAC 5A @ 30VDC with a 150W maximum load	
Alarm Relay	10A, 1-3 HP @ 250VAC 10A @ 30VDC	
Applicable Testing	UL Recognized Component Meets Intent of UL991 Meets IEC 1000-4-2, 1000-4-3, 1000-4-4, 1000-4-5, 1000-4-6, 1000-4-11 Meets CISPR 11 Complies with FCC Part 15, Class A	
Enclosure Compatibility	NEMA 1 NEMA 3R (outdoor) UV Resistant ATC-400 Faceplate	

SECTION 3: OPERATOR PANEL

3.1 GENERAL

The operator panel, which is normally accessible from the outside of a panel or door, provides a means for being alerted to specific conditions, receiving functional help, programming and parameter monitoring/selecting. For the purpose of familiarization, the panel is divided into three sub-sections and discussed individually:

- LEDs
- Pushbuttons
- Display Window

3.2 LEDS

The five LED's indicate the actual status of both sources.

Unit Status LED
This green LED blinks at a rate of once per second, indicating that the ATC-400 is operating correctly. The LED blinks at a faster rate when the Run/Program switch is in the Program position and the setpoints are being displayed. If the LED is not lit or is lit continuously, a problem may be indicated.

Source 1 Available LED
This amber LED is lit when Source 1 (Normal Source) meets the user programmed setpoint criteria.

Source 1 Connected LED
This green LED displays the status of the transfer switch position. It illuminates when the load is connected to Source 1 (normal position). Indication of the transfer switch in normal position is accomplished by sensing the closed A-contact of the normal breaker auxiliary.

Emergency Source Available LED
This amber LED is lit when the Source 2 (Emergency Source) meets the user programmed setpoint criteria.

Emergency Source Connected LED
This red LED displays the status of the transfer switch position. It illuminates when the load is connected to Source 2 (emergency position). Indication of the transfer switch in emergency position is accomplished by sensing the closed A-contact of the emergency breaker auxiliary.

3.3 PUSHBUTTONS

There are five front panel membrane type pushbuttons. Pushbuttons accomplish their function when pressed and released. Certain pushbuttons, like the Increase and Decrease Pushbuttons, will also continue to scroll if they are pressed and not released.

Engine Test Pushbutton
When the Engine Test Pushbutton is pressed and released two times with the Normal Source available and connected, a self-test is initiated. Pressing the Engine Test Pushbutton again while in the engine run condition aborts the test.

Upon test initiation, the generator start relay is energized after TDES timeout. If a full test is programmed, a transfer with all programmed timers occurs. The test engine run timer will hold the load for the required time-out and the test is concluded with a re-transfer cycle. For an engine run only test, no transfer will occur and the engine will run for the programmed run time.

NOTICE

The Plant Exerciser feature allows for automatic programming of the desired test cycle on a daily, 7-day, 14-day, or 28-day basis. If the switch is unable to process either a plant Exerciser request or the Engine Test pushbutton itself due to transfer switch status, the request is ignored.

Step Pushbutton
By pushing the Step key, the LCD display will advance through the voltage(s), frequency, and status condition of the normal source, then the emergency source, then the time and date information, then the history information, and then the setpoints. The information on the LCD display shall advance one (1) step through the displayed information cycle with each push of the Step key.

When the setpoints are displayed and the ATC-400 is in the Program mode, the Unit Status LED will blink faster and allow the user to change the selected setpoint using the Decrease or Increase keys.

Increase Pushbutton
When the ATC-400 is in the Program mode, pressing and releasing the Increase button will cause the displayed setpoint to be increased by one. The Increase Pushbutton will continue to scroll if it is pressed and not released. If held down for more than 3 seconds, the setpoint value will continue increasing by ten.

Decrease Pushbutton
When the ATC-400 is in the Program mode, pressing and releasing the Decrease button will cause the displayed setpoint to be decreased by one. The Decrease Pushbutton will continue to scroll if it is pressed and not released. If held down for more than 3 seconds, the setpoint value will continue decreasing by ten.

Help/Lamp Test Pushbutton
The Help/Lamp Test key can be pressed for a detailed description of the message that is currently being displayed on the LCD display. The help message will scroll across the bottom of the display, and can be aborted by a second push of the Help/Lamp Test key.

If the display is blank when the Help/Lamp Test key is pressed, all of the LED's will momentarily illuminate then the following information will be scrolled across the display:

1. Hardware revision number
2. Firmware version number
3. Serial number
4. Feature code - a decodable 9-digit string listing all optional features programmed in the controller.

The customer may be asked for this information by Cutler-Hammer during a troubleshooting or return process.

Increase and Decrease Pushbutton Simultaneously
Simultaneously pressing and releasing the Increase and Decrease Pushbuttons will reset the Alarm function. In addition, if both keys are pressed simultaneously while viewing any of the historical logged values, the value resets to zero.

Step and Increase Pushbutton Simultaneously
Simultaneously pressing and releasing the Step and Increase Pushbuttons will cause the display information to jump to the beginning of the setpoints menu. If the ATC-400 is already displaying setpoints, the display will jump to the end of the setpoints menu.

Step and Help/Lamp Test Pushbutton Simultaneously
Simultaneously pressing the Step and Help/Lamp Test Pushbuttons while TDNE or TDEN is counting down will bypass the TDNE and/or TDEN functions.

3.4 DISPLAY WINDOW

The ATC-400 Controller includes a two-line 16-character alphanumeric LCD display. The display has a green high contrast background that allows clear visibility of any information displayed. The display is continuously lit for clear visibility under poorly lit or no light conditions.

Six different displays can be presented via the Display Window:

- Status Display
- Source 1 Display
- Source 2 Display
- Time/Date Display
- History Display
- Setpoints Display

NOTICE

Although a wide variety of parameters and setpoints can be displayed, they are not displayed if they were not originally ordered and programmed.

NOTICE

Whether viewing or programming, the display is blanked if no pushbutton activity is detected for approximately 2 1/2 minutes.

3.4.1 STATUS DISPLAY

This display provides messages regarding anything that is presently changing or happening to the switch's status, including source information, timer countdown, and failure reports. Refer to Appendix A for a complete list of Status Display messages.

3.4.2 SOURCE 1 AND 2 DISPLAYS

These displays indicate the present status of the sources in terms of voltage and frequency. If the source is available, the condition display will be "SOURCE 1 GOOD" or "SOURCE 2 GOOD". If it is unavailable, one of the following possible conditions will be shown:
SOURCE 1 U-V SOURCE 2 U-V
The source voltage has dropped below the dropout setting and not risen above the pickup setting.

SOURCE 1 O-V SOURCE 2 O-V
The source voltage has risen above the dropout setting and not dropped below the pickup setting.

SOURCE 1 U-F SOURCE 2 U-F
The source frequency has dropped below the dropout setting and not risen above the pickup setting.

SOURCE 1 O-F SOURCE 2 O-F
The source frequency has risen above the dropout setting and not dropped below the pickup setting.

3.4.3 TIME/DATE DISPLAY

This display indicates real time in terms of hours, minutes, and seconds, and month, day, and year. It also indicates individual time and date items for programming purposes. The day of the week can also be set with 1=Sunday, 2=Monday, etc.

3.4.4 HISTORY DISPLAY

This display indicates historical and cumulative values as follows:

Engine Run Time
This counter will log the generator run time in hours. Time will start being logged at the time the GEN START contacts are closed, and it will stop as soon as they are opened. This counter will count up to 9999 hours and then turn over. When viewing this value, it can be reset to zero by pressing the Increase and Decrease pushbuttons at the same time.

Source 1 Connected Time
This counter logs the time in hours that Source 1 has been connected to the load. Time will be logged while the SOURCE 1 CLOSED control input is in the "connected" state. This counter will count up to 9999 hours and then turn over. When viewing this value, it can be reset to zero by pressing the Increase and Decrease pushbuttons at the same time.

Source 2 Connected Time
This counter logs the time in hours that Source 2 has been connected to the load. Time will be logged while the SOURCE 2 CLOSED control input is in the "connected" state. This counter will count up to 9999 hours and then turn over. When viewing this value, it can be reset to zero by pressing the Increase and Decrease pushbuttons at the same time.

Source 1 Available Time
When Source 1 meets the voltage and frequency setpoint criteria, this counter logs the time in hours. This counter will count up to 9999 hours and then turn over. When viewing this value, it can be reset to zero by pressing the Increase and Decrease pushbuttons at the same time.

Source 2 Available Time
When Source 2 meets the voltage and frequency setpoint criteria, this counter logs the time in hours. This counter will count up to 9999 hours and then turn over. When viewing this value, it can be reset to zero by pressing the Increase and Decrease pushbuttons at the same time.

Load Energized Time
When either of the two sources is connected to the load and the connected source is available, this counter will start logging the time in hours. This counter will count up to 9999 hours and then turn over. When viewing this value, it can be reset to zero by pressing the Increase and Decrease pushbuttons at the same time.

Total Number of Transfers
This counter logs the number of transfer cycles that occur. This counter will count up to 9999 hours and then turn over. When viewing this value, it can be reset to zero by pressing the Increase and Decrease pushbuttons at the same time.

Reason/Date/Time for 16 Most Recent Transfers
The 16 most recent transfer events are stored in history and may be viewed at the front panel display as follows:

- Use the Step pushbutton to step to the "TRANSFER HISTORY" message.
- Press the Increase pushbutton to display the most recent transfer event, "T01", along with the type and cause of the event.
- Press the Decrease pushbutton to display the date and time of the event.
- Continually pressing the Decrease pushbutton will cycle the display between the event display and the date/time of event display.
- Press the Increase pushbutton to display the next most recent transfer event, "T02".
- Pressing the Step pushbutton, while viewing any of the transfer history displays, will exit the Transfer History displays.

3.4.5 SETPOINTS DISPLAY

This display indicates presently programmed setpoints. The setpoints can be altered either with the Run/Program switch in the Program position or with valid password entry. Keep in mind, if a feature was not originally ordered and programmed, it will not be displayed. Refer to Section 5 for details.

3.4.6 HELP DISPLAY

This display presents moving English language messages, explanations, and prompts to assist the operator. When the Help/Lamp Test Pushbutton is pressed and released a second time during the scrolling of a message, the message is aborted.

SECTION 4: OPERATION

4.1 GENERAL

This section specifically describes the operation and functional use of the ATC-400 Controller.

The practical use of and operation within each category will be discussed. In this section it is assumed that prior sections were reviewed and that operator has a basic understanding of the hardware.

4.2 AUTOMATIC MODE

The Automatic Mode of the ATC-400 Controller provides for automatic transfer and re-transfer from source to source as dictated by the features supplied and their programmed setpoint values. It provides a summary of the ATC-400 Controller intelligence and supervisory circuits which constantly monitor the condition of both normal and emergency power sources thus providing the required intelligence for transfer operations. These circuits, for example, automatically initiate an immediate transfer of power when power fails or voltage level drops below a preset value. Exactly what the ATC-400 Controller will initiate in response to a given system condition depends upon the combination of standard and selected optional features.

4.3 MONITOR MODE

Monitor Mode is a special operating mode in which the ATC-400 does not provide control for transfer operations. The ATC-400 will, however, continuously monitor both source voltages and frequencies.

The ATC-400 will be in Monitor Mode when the "Monitor Mode" control input is in the "Connected" state as described in paragraph 4.4. While in the "Monitor Mode" of operation, the ATC-400 will display "ATS NOT IN AUTOMATIC".

4.4 CONTROL INPUTS

The control inputs of the ATC-400 Controller are wetted DC inputs. Each control input provides 50 volts at 10 mA. Refer to Figure 2.3 for a graphical representation and position of all input connections. The input "state" definitions are as follows:

"Connected" - when the input is shorted by an external contact or connection.
"Unconnected" - when the input is not shorted by an external contact or connection.

NOTICE

In applications where long wire runs are necessary to provide the "Connected" signal, it may be necessary to install shunt resistors to eliminate unwanted noise that affects the control inputs. The resistor would be installed between the bottom input of the control input and earth ground. For example, if noise was affecting the Go To Emergency/S2 input, the shunt resistor would be installed from J4-8 (bottom input) to J4-17 (ground). The recommended resistor value is 10k, 1/4W, 5%. If a 10k resistor is not available, the recommended resistance range is from 4.7k to 15k.

The inputs are as follows:

Source 1 Closed
When the input is in the "Connected" state, it indicates to the ATC-400 that the Source 1 device is closed. When this input is in the "Unconnected" state, it indicates to the ATC-400 that the Source 1 device is open. This input is typically wired to the Source 1 device auxiliary contact that is closed when the Source 1 device is closed. This input is located on pins 1 and 2 of connector J4.

Source 2 Closed
When the input is in the "Connected" state, it indicates to the ATC-400 that the Source 2 device is closed. When this input is in the "Unconnected" state, it indicates to the ATC-400 that the Source 2 device is open. This input is typically wired to the Source 2 device auxiliary contact that is closed when the Source 2 device is closed. This input is located on pins 3 and 4 of connector J4.

Lockout (Requires Optional Feature 16)
When the "Lockout" input is in the "Unconnected" state, the ATC-400 will not permit an automatic transfer operation. When the "Lockout" input is in the "Unconnected" state, the LCD Display will display "LOCKOUT" on line 1 and "OVERCURRENT TRIP" on line 2.

When the "Lockout" input is in the "Connected" state, the ATC-400 will permit automatic transfer operation. This input is typically wired to the normally closed Source 1 and Source 2 devices' alarm contact that opens when one of the devices has tripped due to a fault current.

The "Lockout" input is selectable as enabled or disabled via factory control only. This input is located on pins 5 and 6 of connector J4.

Go To Emergency / S2 (Requires Optional Feature 26D)
When the "Go To Emergency/Source 2" input is in the "Connected" state, the ATC-400 controller will initiate a generator start and transfer to Source 2. The ATC-400 will maintain connection to Source 2 until the input changes to the "Unconnected" state, upon which it will initiate a re-transfer to Source 1. When the "Go To Emergency/Source 2" input is in the "Connected" state, the LCD Display will display "GO TO EMERG/S2" on line 2 of the LCD Display screen constantly. This operation is "Failsafe".

When the "Go to Emergency/S2" input is in the "Unconnected" state, the ATC-400 controller will be in a normal automatic operation mode.

If the Load Shed From Emergency feature is enabled, and the "Emergency Inhibit" input is in the "Unconnected" state, the ATC-400 will ignore the "Go To Emergency/S2" input.

The "Go To Emergency/Source 2" input is selectable as enabled or disabled via factory control only. This input is located on pins 7 and 8 of connector J4.

Monitor Mode
When the "Monitor Mode" input is in the "Connected" state, the ATC-400 controller will monitor source voltages and frequencies but will not provide any control capabilities. While in the "Monitor Mode" of operation, the ATC-400 LCD Display will display "ATS NOT IN AUTOMATIC".

When the "Monitor Mode" input is in the "Unconnected" state operation of the ATC-400 will not be affected.

The "Monitor Mode" input is always enabled. This is NOT a Failsafe operation. This input is located on pins 11 and 12 of connector J4.

Manual Re-transfer (Requires Optional Feature 29J)
When the "Manual Re-Transfer" input is in the "Connected" state while the ATC-400 is connected to Source 2, the ATC-400 will initiate a re-transfer if the following two conditions are true:

a) Manual Re-Transfer was enabled via factory control
b) The Manual Re-transfer setpoint is equal to 1.

If the Manual Re-transfer setpoint is equal to one (1) and the "Source 2 Closed" input is in the "Connected" state, the LCD Display will display "MAN RETRANSFER REQUIRED."

When the "Manual Re-Transfer" input is in the "Unconnected" state, the operation of the ATC-400 will not be affected.

The "Manual Re-transfer" input is selectable as enabled or disabled via factory control. If factory enabled then the "Manual Re-transfer" input has a user accessible programmable setpoint as follows: zero (0) equals automatic return, one (1) equals pushbutton return. This is a "failsafe" operation. This input is located on pins 13 and 14 of connector J4.

Emergency Inhibit (Requires Optional Feature 36)
When the "Emergency Inhibit" input is in the "Unconnected" state, the ATC-400 is prohibited from sending a signal to transfer to Source 2. If the "Emergency Inhibit" input changes to the "Unconnected" state while the Source 2 Closed input is in the "Connected" state, then the ATC-400 will send a signal to re-transfer to Source 1. If Source 1 is not available, the ATC-400 will send a signal to "Transfer to Neutral."

When the "Emergency Inhibit" input is in the "Connected" state, operation of the ATC-400 will not be affected.

The "Emergency Inhibit" input will take priority over the "Go To Emergency/S2" input in the case when "Emergency Inhibit" input is in the "Unconnected" state and "Go To Emergency/S2" is in the "Connected" state. The ATC-400 will respond to the "Emergency Inhibit" input and ignore the "Go To Emergency/S2" input.

The "Emergency Inhibit" input is selectable as enabled or disabled via factory control. This is a "failsafe" operation. This input is located on pins 15 and 16 of connector J4.

4.5 RELAY OUTPUTS

The control outputs of the ATC-400 Controller are dry relay contacts. The dielectric rating for each relay output is a minimum of 1500 VAC. Refer to Figure 2.3 for a graphical representation and position of all output connections. The relay functions are divided into two categories:

- Customer Connections
- Transfer Operation Contacts

4.5.1 CUSTOMER CONNECTIONS

Gen Start Output
This latching relay is the generator start relay for system configurations that use a generator on Source 2. This relay provides a Form A contact for closure of the generator start circuit. The generator start relay contacts are rated for 5A, 1/6 HP @ 250 VAC. The DC rating is 5A @ 30VDC with a 150W maximum load.

Source 1 Avail Output
This Form C relay is used to indicate the availability of Source 1. This relay essentially duplicates the Source 1 Available LED, meaning that the setpoint criteria have been met. The Source 1 Avail relay will be energized when Source 1 meets the definition of "Available" and de-energized when Source 1 does not meet the definition of "Available".

The full Form C contact is implemented with Common Pin 14, Normally Closed Pin 13, and Normally Open Pin 12 of Connector J5. The S1 Available relay contacts are rated for 10A, 1-3 HP @ 250 VAC. The DC rating is 10A @ 30VDC.

Source 2 Avail Output
This Form C relay is used to indicate the availability of Source 2. This relay essentially duplicates the Source 2 available status LED, meaning that the setpoint criteria have been met. The Source 2 Avail relay will be energized when Source 2 meets the definition of "Available" and de-energized when Source 2 does not meet the definition of "Available".

The full Form C contact is implemented with Common Pin 11, Normally Closed Pin 10, and Normally Open Pin 9 of Connector J5. The S2 Available relay contacts are rated for 10A, 1-3 HP @ 250 VAC. The DC rating is 10A @ 30VDC.

Alarm Output
This relay is normally de-energized to indicate an absence of an alarm state and energized to indicate the presence of an alarm condition. Alarm conditions include:

* Improper circuit breaker operation (breaker fails to open or close)
* Motor operator failure
* Unsuccessful in-phase transition
* Lockout condition
* Aborted engine test
* Aborted plant exercise

The full Form C contact of this relay may be wired to an alarm annunciator panel to indicate a problem with the ATS. Common is on Pin 8, while Normally Closed is on Pin 7, and Normally Open is on Pin 6 of Connector J5. The alarm relay contacts are rated for 10A, 1-3 HP @ 250 VAC. The DC rating is 10A @ 30VDC.

Pretransfer Output
This relay shall open/close on a timed basis (adjustable 1-120 seconds) prior to any transfer operation to allow the load to be de-energized prior to transfer in either direction. After TDNE/TDEN times out, this relay energizes and the Pretransfer timer (TD PRE-TRAN) starts timing. After TD PRE-TRAN times out, the transfer proceeds. The pretransfer relay de-energizes after the transfer is complete.

The full Form C contact of this relay is implemented. Common is on Pin 5, while Normally Closed is on Pin 4, and Normally Open is on Pin 3 of Connector J5. The pretransfer relay contacts are rated for 10A, 1-3 HP @ 250 VAC. The DC rating is 10A @ 30VDC.

4.5.2 TRANSFER OPERATION CONNECTIONS

K1, K2, K3, and K4 are factory wired to operate the transfer switch. The relay contacts for each are rated for 10A, 1/3 HP @ 250 VAC. The DC rating is 10A @ 30VDC.

K1 Relay
This Form A output is used for control of the transfer switch motor to close the Source 1 device (i.e. circuit breaker) for motor-operator transfer switches. The K1 relay momentarily energizes until the ATC-400 senses that the Source 1 device is closed, then K1 de-energizes. For SPB transfer switches, this relay opens the Source 2 device (i.e. circuit breaker) via its shunt trip. The K1 output is found on Pins 21 and 22 of Connector J5.

K2 Relay
This Form A output is used for control of the transfer switch motor to close the Source 2 device (i.e. circuit breaker) for motor-operator transfer switches. The K1 relay momentarily energizes until the ATC-400 senses that the Source 1 device is closed, then K1 de-energizes. For SPB transfer switches, this relay opens the Source 1 device (i.e. circuit breaker) via its shunt trip. The K2 output is found on Pins 19 and 20 of Connector J5.

K3 Relay
This Form A output is used for control of the SPB close coil of the Source 1 device (i.e. circuit breaker). The K3 relay momentarily energizes until the ATC-400 senses that the Source 1 device is closed, then K3 de-energizes. The K3 output is found on Pins 17 and 18 of Connector J5.

K4 Relay
This Form A output is used for control of the SPB close coil of the Source 2 device (i.e. circuit breaker). The K4 relay momentarily energizes until the ATC-400 senses that the Source 2 device is closed, then K4 de-energizes. The K4 output is found on Pins 15 and 16 of Connector J5.

4.6 OPERATING VOLTAGE AND MEASUREMENTS

The ATC-400 Controller operates directly from the line sensing inputs of the two different sources (normal and

emergency). The nominal operating system inputs are from 120VAC-600VAC. The standard system assumes that neutral is available and that the transfer motor can therefore be powered from an available 120 VAC source. If a neutral conductor is not available, a 120VAC supply is created by an external transformer. The unit operates on single and three phase systems with selectable frequency settings of 50Hz or 60Hz.

All voltage monitoring and measurements are true RMS measurements.

The ATC-400 Controller is capable to perform the time delay engine start function without control power for a minimum of 120 seconds.

4.7 ENGINE TEST

The Engine Test is intended to permit the periodic performance of tests of the system. The exact test conditions are determined by the programmed setpoints. The operator-selected parameters include setting the engine run time and the test mode. Refer to Table 5.1 for test programming details.

There are three test modes:

Engine Start Only Mode

When the "Engine Test" pushbutton is depressed, the LCD Display will read "START TEST?". Upon a second press of the "Engine Test" pushbutton, the ATC-400 will initiate an engine start command to start the generator. The engine run duration will be per the "Engine Run Test Time" setpoint. Transfer will not occur.

Load Transfer Mode

This will function the same as "Engine Start Only Mode" except a transfer to Source 2 will occur. On completion of the test, a re-transfer will occur.

Disable Mode

The Engine Test pushbutton is disabled and has no effect.

If the "Number of Generators" setpoint is programmed to zero, the Engine Test pushbutton is not functional.

To start an engine test, the display window must be blank. At this point, if the initiation of a test is not desired, pressing the Increase and Decrease pushbuttons simultaneously will cancel the test. If a test is desired, the Engine Test pushbutton must be pressed a second time before 2 1/2 minutes have expired. At this time, the test will begin.

All enabled and programmed time delays will be performed per the setpoints during engine tests. The time delays are to appear on the LCD Display with "count-down to zero" when active. These include: TDES, TDNE, TDEN, TDEC, TDN, and TD-PRETRAN. All operations shall be "Failsafe" as defined in Section 3.1.

When an engine test is in progress, it may be aborted the following ways:

1) By pressing the "Engine Test" pushbutton.
2) If the Emergency Source does not become available within 30 seconds of the ATC-400 providing the engine start command.
3) If, during the TDNE countdown, the Emergency Source goes unavailable more than three times. (Each time, TDNE will restart.)
4) If the Emergency Source is powering the load and it goes unavailable for more than the TDEF setting.
5) If the Normal source becomes unavailable.

When an engine test is aborted due to an unavailable source, the Alarm relay will energize, a "TEST ABORTED" message with appear on the display, and the event will be logged into the Transfer History as "Aborted Test".

4.8 PLANT EXERCISER

The plant exerciser is a feature that provides an automatic test of the generator. The test is run daily, every 7 days, every 14 days, or every 28 days with duration equal to the programmed engine test time. Two optional modes of plant exercising are available:

a) No Load Exercise
b) Load Exercising with failsafe

The time that the plant exerciser is performed is programmed with the "PE HOUR" and "PE MINUTE" setpoints where "PE HOUR" is in military time (1:00 PM = 13:00)

The test day is programmed with the "PE DAY" setpoint. The ATC-400 compares the "PE DAY" setpoint with the "WEEKDAY" setting, which is set along with the time and date. If a 7-day plant exercise is programmed, the selections are from "1 SUN" through "7 SAT".

If a 14-day plant exercise is programmed, the "PE DAY" setpoint can be set from "1 SUN" to "14 SAT" where "1 SUN" is the first Sunday of the 14-day period and "14 SAT" is the second Saturday of the 14-day period.

If a 28-day plant exercise is programmed, the "PE DAY" setpoint can be set from "1 SUN" to "28 SAT" where "1 SUN" is the first Sunday of the 28-day period and "28 SAT" is the fourth Saturday of the 28-day period.

If desired, plant exerciser can be disabled by choosing "0" for the "PE Enable" setpoint.

Load testing is failsafe. If the generator fails during testing for any reason, the ATC-400 will signal the transfer switch to return to normal. The ATC-400 will display "FAILSAFE" until a pushbutton is pressed.

4.9 IN-PHASE TRANSITION

In-phase transition is an open transition with both sources in-phase. An anticipatory scheme is used for controlling the circuit breakers. The advance angle is calculated based on the frequency difference between the two sources and also the response time of the breaker. This results in the optimum reconnect angle of 0 degrees for all of the frequency difference values.

Both sources must be available and the frequency difference must be less than the in-phase transition frequency difference setpoint (0.0 to 3.0 Hz). When these conditions are met, the ATC-400 will monitor the phase difference between the two sources. The synchronization timer will count down and be displayed as "SYNC TIME" while waiting for synchronization to be detected. When the phase difference is within the advance angle window, the "transfer" command is given. This is an open transition but both sources will be in-phase when the transfer occurs.

If the synchronization does not occur within a specified amount of time, the transfer will take place under delayed transition. The Alarm relay will energize and the failure will be logged into the Transfer History as either "Sync Fail - Freq" or "Sync Fail - Phase" depending on whether the frequency difference or the phase difference was excessive.

4.10 PROGRAM MODE

The ATC-400 Controller is fully programmable from the device's faceplate once in the Program Mode. Any operator associated with programming the ATC-400 Controller will quickly discover that ATC-400 Controller programming is just a matter of simple, repetitive steps. Because of the importance placed, however, on this function and its critical relationship to the system proper functioning, Section 5 is dedicated to the Program Mode. Refer to that section and Table 5.1 for details.

4.11 COMMUNICATIONS

The ATC-400 is a PowerNet compatible device. As such, it can be remotely monitored, controlled, and programmed when equipped with a communications module. The ATC-400 is supplied with a communications port as standard. Communications is achieved by mounting a small, addressable communications module, the IPONI (Incom Product Operated Network Interface), to the back of the ATC-400 (See Figure 2.2).

PowerNet is a noise immune communications system that permits communications from the ATC-400 to a master computer via a high frequency carrier signal over a shielded twisted pair of conductors. The shielded twisted pair of conductors can extend up to 7500 feet without the use of repeaters. Communications between PowerNet compatible devices, such as ATC-400 and the master computer is made possible by the INCOM (Industrial Communications) chip, which accounts for the system's high degree of reliability.

4.12 POWERNET COMMUNICATIONS SOFTWARE

PowerNet software provides the ability to monitor and record power distribution system data as it is occurring. PowerNet is a Microsoft Windows compatible application featuring user-friendly, menu-driven screens with easy setup and operation. Additional features include:

- System/device alarm logging and reporting
- Time/event historical data logging
- Data trending
- Information storage/retrieval by device event
- Hardware diagnostics
- Dedicated computer not required
- Security password protection
- Gateway interface for connectivity to other information networks

PowerNet also provides the following features unique to the ATC-400:

- Duplication of ATC-400 front panel mimic bus showing available and connected sources.
- Voltage and frequency measurements of Source 1 and Source 2.
- Capability to initiate an engine test.
- Updates the ATC-400 real-time clock.
- Display of all programmed setpoint values. These values may be changed and either saved to a file or downloaded to the ATC-400 over PowerNet.

NOTICE

If the ATC-400 is in the Program mode, the setpoints cannot be remotely downloaded over PowerNet.

SECTION 5: PROGRAMMING

5.1 INTRODUCTION

NOTICE

Although all ATC-400 Controller programmable features are addressed in this section, only those ordered by the customer and initially programmed at the factory will appear in the display for programming changes in the field.

The ATC-400 Controller is fully programmable from the device's faceplate or remotely through the communications port. Users can reprogram setpoints as well as other parameters. The time and date can be changed while the device is in either the Run mode or the Program mode. Setpoints, however, can only be changed while the device is in the Program mode.

Program mode is achieved by either setting the Run/Program switch in the back of the unit to the Program position or by entering a valid password when prompted by the Setpoints screens. The Unit Status LED will blink at a faster rate when viewing the setpoints while in Program mode.

NOTICE

While in the Program mode, the ATC-400 is never off-line and continues to function in accordance with previously programmed setpoints.

5.2 PASSWORD

To enter the program mode from the front panel, the ATC-400 Controller requires a password to prevent unauthorized persons from modifying setpoint values.

There are four screens related to the password which is a four-digit number from 0000 to 9999:

1)

CHANGE SETPOINTS?	**YES**

Use the INCREASE/DECREASE keys to select YES or NO, then use the STEP key to enter the selection and move to the next screen. If NO is selected, the next three screens will be bypassed.

2)

PASSWORD (Use Inc/Dec)	**0000**

Use the INCREASE/DECREASE keys to scroll to the desired value (0 - 9) for the first digit, then use the STEP key to enter the value and move to the next digit. Repeat for remaining three digits.

Note: The factory default password is "0400". If the password is forgotten, contact the factory for the backdoor password.

3)

CHANGE PASSWORD?	**YES**

Use the INCREASE/DECREASE keys to select YES or NO, then use the STEP key to enter the selection and move to the next screen. If NO is selected, the next screen will be bypassed.

4)

NEW PASSWORD (Use Inc/Dec)	**0000**

Use the INCREASE/DECREASE keys to scroll to the desired value (0 - 9) for the first digit, then use the STEP key to enter the value and move to the next digit. Repeat for remaining three digits.

The user then steps through the setpoint screens and can change the setpoint values. During this time, the Unit Status LED will blink at a faster rate. At the end of the setpoint screens, the user will be prompted to save the setpoints.

5.3 SETPOINTS MENU

Any setpoint values can be adjusted using the Step key to select the setpoint that needs to be changed. The setpoint value can be adjusted using Increase or Decrease keys. To save a new value to memory, set the Run/Program switch back to the Run position. Once this is completed, the controller acknowledges that the setpoint values have been programmed by momentarily displaying the message "PROGRAMMING SETPOINTS".

5.4 PROGRAMMABLE FEATURE/SETPOINTS

CAUTION

CHANGING THE SYSTEM NOMINAL VOLTAGE OR FREQUENCY SETPOINT WILL AUTOMATICALLY CHANGE ALL THE PICKUP AND DROPOUT SETTINGS TO THE NEW DEFAULT VALUES.

All ATC-400 Controller programmable features and associated setpoint possibilities with any required explanations are presented in Table **5.1**. Remember that only features originally ordered and factory programmed will appear in the display.

The following setpoints are programmable if the corresponding feature is programmed:

Table 5.1 Programmable Features/Setpoints

	Setpoint Value	Setpoint
TDES	0 sec to 120 sec	Time Delay Engine Start Timer
TDNE	0 sec to 1800 sec	Time Delay Normal to Emergency Timer
TDEN	0 sec to 1800 sec	Time Delay Emergency to Normal Timer
TDEC	0 sec to 1800 sec	Time Delay Engine Cooldown Timer
NOM FREQ	50 Hz or 60 Hz	System Nominal Frequency (hertz)
NOM VOLTAGE	120 VAC to 600 VAC	System Nominal Voltage (volts)
S1 UV DROP	50% to 97% of Nominal	Source 1 Undervoltage Dropout (volts)
S2 UV DROP	50% to 97% of Nominal	Source 2 Undervoltage Dropout (volts)
S1 UV PICK	(Dropout + 2%) to 99% of Nominal	Source 1 Undervoltage Pickup (volts)
S2 UV PICK	(Dropout + 2%) to 99% of Nominal	Source 2 Undervoltage Pickup (volts)
S1 OV DROP	105% to 120% of Nominal	Source 1 Overvoltage Dropout (volts)
S2 OV DROP	105% to 120% of Nominal	Source 2 Overvoltage Dropout (volts)
S1 OV PICK	103% of Nominal to (Dropout - 2%)	Source 1 Overvoltage Pickup (volts)
S2 OV PICK	103% of Nominal to (Dropout - 2%)	Source 2 Overvoltage Pickup (volts)
S1 UF DROP	90% to 97% of Nominal	Source 1 Underfrequency Dropout (hertz)
S2 UF DROP	90% to 97% of Nominal	Source 2 Underfrequency Dropout (hertz)
S1 UF PICK	(Dropout + 1 Hz) to 99% of Nominal	Source 1 Underfrequency Pickup (hertz)
S2 UF PICK	(Dropout + 1 Hz) to 99% of Nominal	Source 2 Underfrequency Pickup (hertz)
S1 OF DROP	103% to 110%	Source 1 Overfrequency Dropout (hertz)
S2 OF DROP	103% to 110%	Source 2 Overfrequency Dropout (hertz)
S1 OF PICK	101% to (dropout - 1 Hz)	Source 1 Overfrequency Pickup (hertz)
S2 OF PICK	101% to (dropout - 1 Hz)	Source 2 Overfrequency Pickup (hertz)
TDN	0 sec to 120 sec	TDN Timer
PLANT EXER-	OFF, DAILY, 7-DAY, 14-DAY, or 28-DAY	Plant Exerciser Programming
PE LOAD XFR	0 or 1 (1 = yes)	Plant Exerciser Load Transfer
PE DAY	SUN, MON, TUE, WED, THU, FRI, or SAT	Plant Exerciser Day of Week
PE HOUR	0 to 23	Plant Exerciser Hour
PE MINUTE	0 to 59 minutes	Plant Exerciser Minute
MAN-RETRAN	0 or 1 (0 = auto, 1 = pushbutton return)	Manual re-transfer mode
COMMIT TDNE	0 or 1 (1 = committed)	Commit to transfer in TDNE
TEST MODE	0, 1, or 2 (0 = engine start only,	Test mode
	1 = load transfer, 2 = disable)	
TER	0 min to 600 min	Engine run test time in minutes
TPRE	1 sec to 120 sec	Pretransfer delay timer
NUM OF GENS	0 or 1	Number of generators
PHASES	1 or 3	Three phase or single phase
PT RATIO	2:1 to 500:1	PT ratio
TDEF	0 sec to 6 sec	Time Delay Emergency Fail Timer
IN-PHASE	0 or 1	In-phase Transition Enable/Disable
IP FREQ DIFF	0.0 Hz to 3.0 Hz	In-phase Transition Frequency Difference
SYNC TIME	1 min to 60 min	In-phase Transition Synchronization Timer

SECTION 6: TROUBLESHOOTING AND MAINTENANCE

6.1 LEVEL OF REPAIR

This manual is written with the assumption that only transfer switch system troubleshooting will be performed. If the cause of malfunction is traced to an ATC-400, the unit should be replaced with a new unit. The malfunctioning unit should then be returned to Cutler-Hammer for factory repairs.

6.2 ATC-400 DEVICE TROUBLESHOOTING

The Troubleshooting Guide (Table **6.1**) is intended for service personnel to identify whether a problem being observed is external or internal to the unit. For assistance with this determination, contact Cutler-Hammer. If a problem is identified to be internal, the unit should be returned to the factory for replacement.

Table 6.1 Troubleshooting Guide

Symptom	Probable Cause	Possible Solution(s)
All front panel indicator LED's are off.	Control power is deficient or absent.	Verify that control power is connected at J7 and that it is within specifications.
	ATC-400 is malfunctioning.	Replace the unit.
"Unit Status" LED is not blinking.	Control power is deficient or absent.	Verify that control power is connected at J7 and that it is within specifications.
	ATC-400 is malfunctioning.	Replace the unit.
One or more voltage phases read incorrectly.	Incorrect wiring.	Verify voltage with multimeter. Check wiring.
	ATC-400 is malfunctioning.	Replace the unit.
Front panel pushbuttons do not work.	Bad connection inside the ATC-400.	Replace the unit.
Unit did not accept new setpoints via front panel.	Operator error.	Change setpoints with switch in Program position. Return switch to Run position when done.
	No pushbuttons pressed for 2.5 minutes.	Avoid intervals of 2.5 minutes of inactivity with pushbuttons when changing setpoints.
Source 1 or Source 2 is not available when it should be.	Voltage and/or frequency are not within setpoint values.	Verify voltage and/or frequency with multimeter. Check programmed setpoint values.
Unit displays "LOCK-OUT".	Circuit breaker tripped.	Check for overload/short circuit condition.
	Maintenance Selector Switch is in disable position.	Check Maintenance Selector Switch.
	Lockout circuit wiring problem.	Check lockout circuit wiring.

Symptom	Probable Cause	Possible Solution(s)
Unit displays “SOURCE 1 DEVICE”.	Source 1 breaker/contactor did not open when it was commanded to open.	Check Source 1 circuit breaker shunt trip (ST) wiring.
	Source 1 breaker/contactor did not close when it was commanded to close.	Check Source 1 circuit breaker spring release (SR) wiring.
	Source 1 Closed contacts did not open when Source 1 breaker opened.	Check Source 1 Closed control input wiring on J4-1,2.
	Source 1 Closed contacts did not close when Source 1 breaker closed.	Check Source 1 Closed control input wiring on J4-1,2.
Unit displays “SOURCE 2 DEVICE”.	Source 2 breaker/contactor did not open when it was commanded to open.	Check Source 2 circuit breaker shunt trip (ST) wiring.
	Source 2 breaker/contactor did not close when it was commanded to close.	Check Source 2 circuit breaker spring release (SR) wiring.
	Source 2 Closed contacts did not open when Source 2 breaker opened.	Check Source 2 Closed control input wiring on J4-3,4.
	Source 2 Closed contacts did not close when Source 2 breaker closed.	Check Source 2 Closed control input wiring on J4-3,4.
Unit fails to communicate over PowerNet.	Incorrect or conflicting address set on IPONI.	Check that IPONI has a unique address on the system and that software is addressing proper unit.
	Communications wiring errors.	Verify wiring is in conformance to PowerNet wiring.
	Blown fuse, F1.	Check and replace fuse, F1, if necessary.
	IPONI failure	Replace the IPONI.
	ATC-400 is malfunctioning.	Replace the unit.
Remote downloading of setpoints over PowerNet is unsuccessful.	Run/Program switch is not in the Run position.	Set Run/Program switch to Run position.
	PowerNet communications error.	See “Unit fails to communicate over PowerNet.”

Symptom	Probable Cause	Possible Solution(s)
Unit will not perform an Engine Test.	Engine Test pushbutton was not pressed twice.	Press Engine Test pushbutton twice to initiate test.
	Display is not blank before initiating test.	Use Step pushbutton to step to blank status display. If a timer is timing down, wait until it is done.
	Engine Test setpoint is set to Disable (value of “2”).	Re-program Engine Test setpoint.
	Number of Generators setpoint is set to 0.	Re-program Number of Generators setpoint.
	Generator became unavailable when connected to load.	Increase Time Delay Emergency Fail (TDEF) timer setpoint.
	Generator became unavailable before connecting to load.	Check generator for proper function.
Plant Exerciser failed to exercise.	Incorrect date or time setting.	Verify real time clock settings for time and date.
	Incorrect setpoint programmed for PE DAY, PE HOUR, and/or PE MINUTE.	Re-program PE DAY, PE HOUR, and/or PE MINUTE setpoint.
	Generator voltage and/or frequency did not become available within 30 seconds of engine starting.	Verify voltage and/or frequency with multimeter. Check programmed setpoint values. Check engine maintenance.
	Generator became unavailable when connected to load.	Increase Time Delay Emergency Fail (TDEF) timer setpoint.
	Generator became unavailable before connecting to load.	Check generator for proper function.
Engine fails to start after TDES times out.	Incorrect wiring.	Check wiring between Gen Start relay (J5-1,2) and engine.
	Gen Start relay contacts not closed.	Replace the unit.
	Engine did not start.	Check generator for proper function.

6.3 ATC-400 REPLACEMENT

Follow these procedural steps to replace the ATC-400:

Step 1: Turn off control power at the main disconnect or isolation switch of the control power supply. If the switch is not located in view from the ATC-400, lock it out to guard against other personnel accidentally turning it on.

Step 2: Verify that all "foreign" power sources wired to the ATC-400 are de-energized. These may also be present on some of the terminal blocks.

Step 3: Before disconnecting any wires from the unit, make sure they are individually identified to assure that reconnection can be correctly performed. Make a sketch to help with the task of terminal and wire identification.

Step 4: Remove all wires and disconnect plug-type connectors.

CAUTION

SUPPORT THE ATC-400 FROM THE REAR WHEN THE SCREWS ARE LOOSENED OR REMOVED IN STEP 5. WITHOUT SUCH SUPPORT, THE UNIT COULD FALL OR THE PANEL COULD BE DAMAGED.

Step 5: Remove the four (4) mounting screws located on the four corners holding the unit and trim plate against the door or panel. These are accessed from the front of the unit. Then support the unit and remove the two center screws.

Step 6: Carefully lay the screws aside for later use.

Step 7: Mount the replacement unit.

Step 8: Reverse the procedure outlined in Steps 4 and 5.

Step 9: Using the sketch mentioned in Step 3, replace each wire at the correct terminal, and make sure each is secure. Make certain that each plug is securely seated.

Step 10: Restore control power.

6.4 MAINTENANCE AND CARE

The ATC-400 is designed to be a self-contained and maintenance-free unit. The printed circuit boards are calibrated and conformally coated at the factory. They are intended for service by factory trained personnel only.

APPENDIX A: DISPLAY MESSAGES FOR STATUS AND TIMERS

Display Message

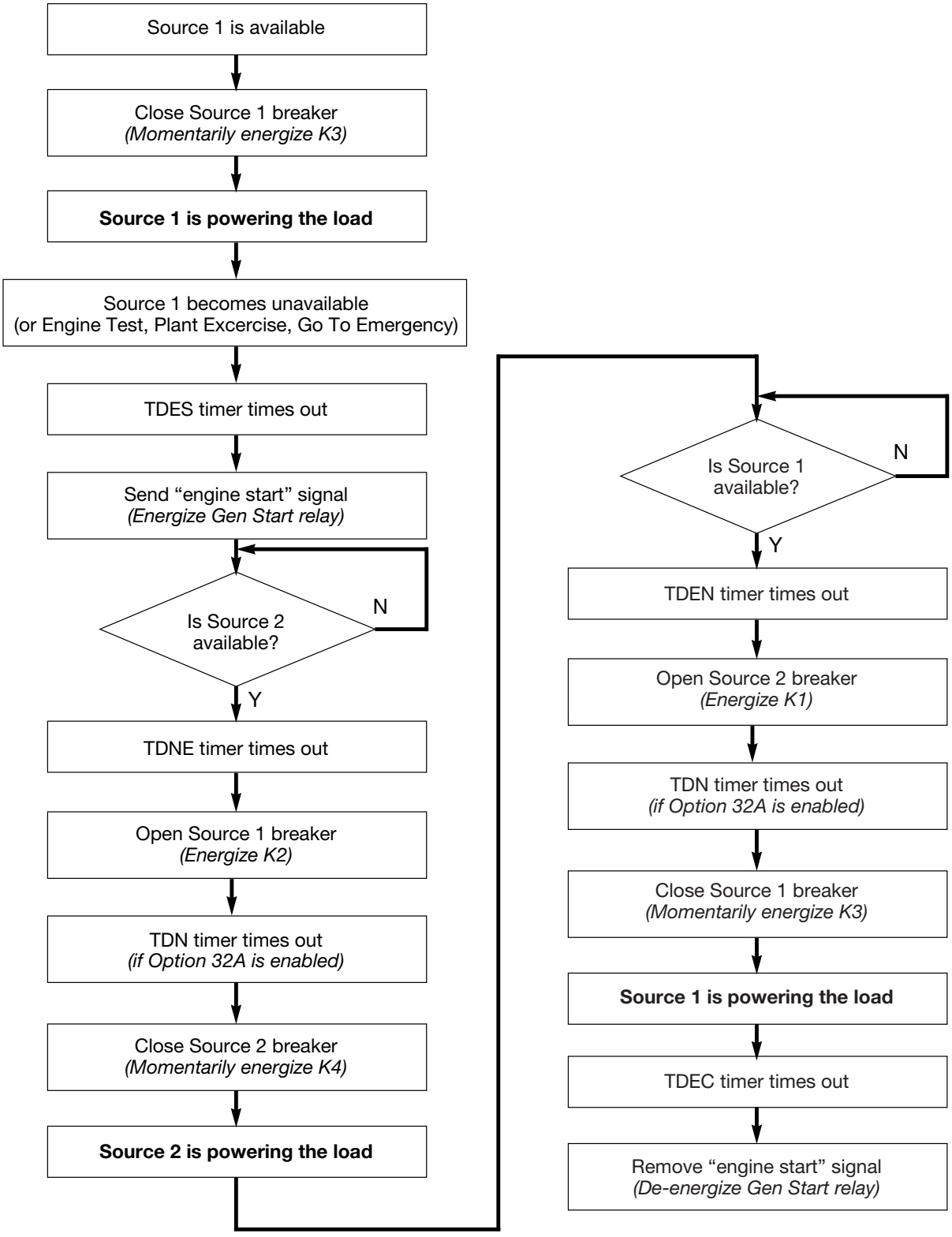
TDEC	Countdown cool off timing before generator contacts are opened.
TDES	Countdown timing before generator contacts are closed.
TDNE	Countdown timing before Source 1 is disconnected before transferring to Source 2. Timing begins when Source 2 is available.
TDN	Countdown timing with both sources disconnected from the load.
TDEN	Countdown timing before Source 2 is disconnected before transferring to Source 1. Timing begins when Source 1 becomes available.
TRANSFER	Waiting for the switch to make the transfer from neutral position to the intended source.
ATS NOT IN AUTOMATIC	Control input for monitor mode is closed.
MAN RETRANSFER REQUIRED	Waiting for an input signal to complete the manual re-transfer.
LOCK-OUT OVERCURRENT TRIP	A trip condition has been detected by either breaker and the system is locked out from further transfers.
ENGINE RUN	The engine run test timer is counting down before the test is completed. Pressing the Engine Test pushbutton will abort this timer and the test.
START TEST?	To initiate an engine test sequence, press Engine Test pushbutton again or press Increase and Decrease simultaneously to clear.
WAIT FOR S2	Waiting for the generator source voltage and frequency to become available.
TD PRE-TRAN	Countdown timer while waiting for a pre-transfer acknowledge input.
LOAD SHED	Indicates that a transfer to Source 2 is inhibited.
SYNC TIME	Countdown timing in minutes while waiting for sources to synchronize during an in-phase transition.
SOURCE 1 DEVICE	Indicates that the Source 1 device (i.e. circuit breaker, contactor) failed to open or close.
SOURCE 2 DEVICE	Indicates that the Source 2 device (i.e. circuit breaker, contactor) failed to open or close.
TDEF	Countdown timing before declaring Source 2 unavailable (accounts for momentary generator fluctuations).
TEST ABORTED	Indicates that an engine test or plant exercise was aborted after three unsuccessful attempts. Source 2 did not remain available while TDNE was timing.
GO TO EMERG/S2	Indicates that the load is connected to Source 2 because the Go To Emergency/S2 control input is in the “connected” state.

FAILSAFE	Indicates that the load was connected to Source 2 but Source 2 became unavailable so the load transferred back to Source 1.
SETPOINTS ERROR	Memory problem with the setpoints. Contact factory.
OPTIONS ERROR	Memory problem with the factory options. Contact factory.
PROGRAMMING SETPOINTS	Setpoints are being saved in memory.
WAITING FOR NEUTRAL	Waiting for the neutral position to be reached by the switch.
WAITING FOR S1 TO OPEN	Waiting for the Source 1 device (i.e. circuit breaker) to open.
WAITING FOR S2 TO OPEN	Waiting for the Source 2 device (i.e. circuit breaker) to open.
WAITING FOR S1 TO CLOSE	Waiting for the Source 1 device (i.e. circuit breaker) to close.
WAITING FOR S2 TO CLOSE	Waiting for the Source 2 device (i.e. circuit breaker) to close.

APPENDIX B: OPERATIONAL FLOWCHARTS

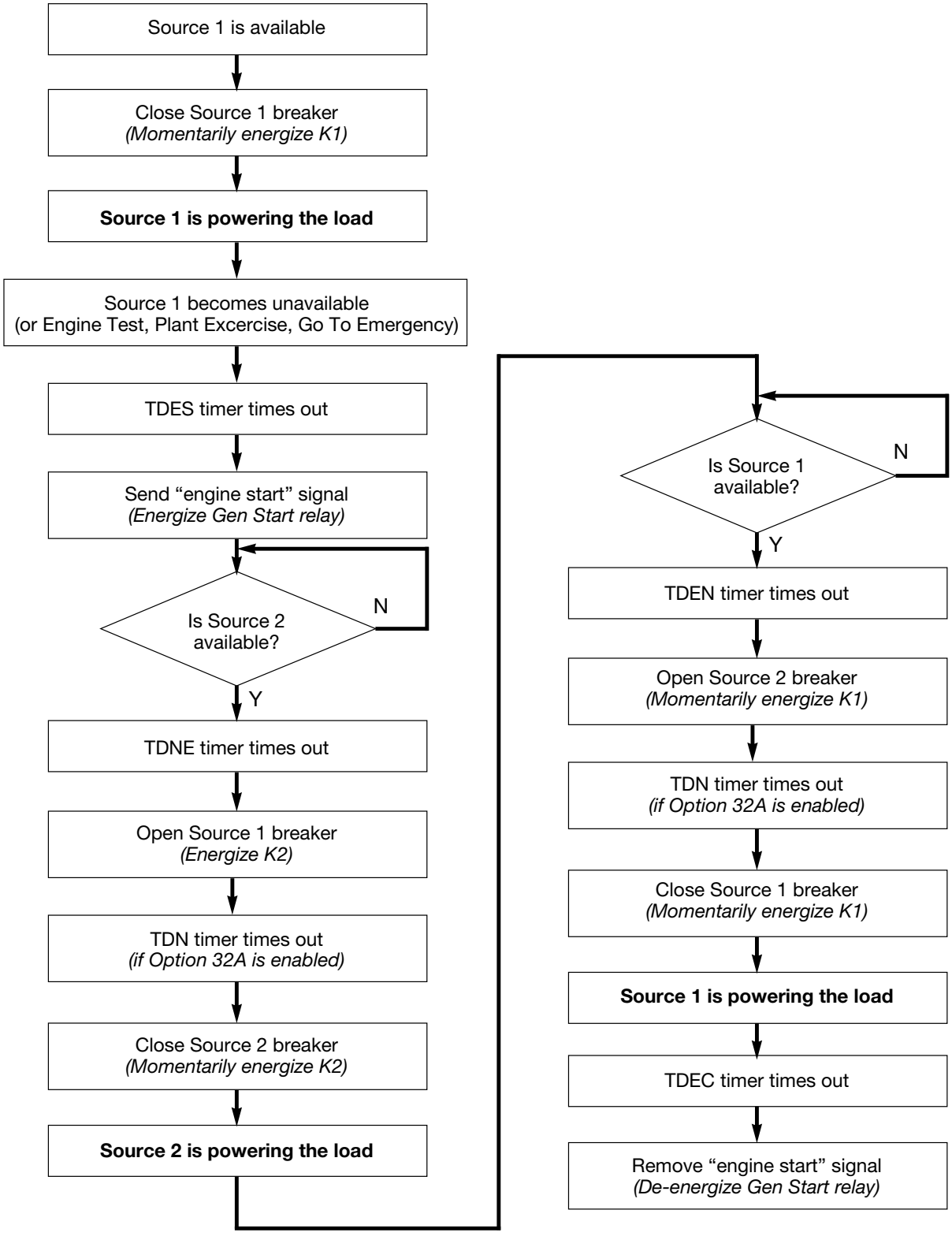
- Utililty - Generator SPB Transfer Switch
- Utility - Generator Motor-operated Transfer Switch
- Dual-Utility SPB Transfer Switch
- Dual-Utility Motor-operated Transfer Switch
- In-phase Transition Implementation

UTILITY - GENERATOR SPB TRANSFER SWITCH

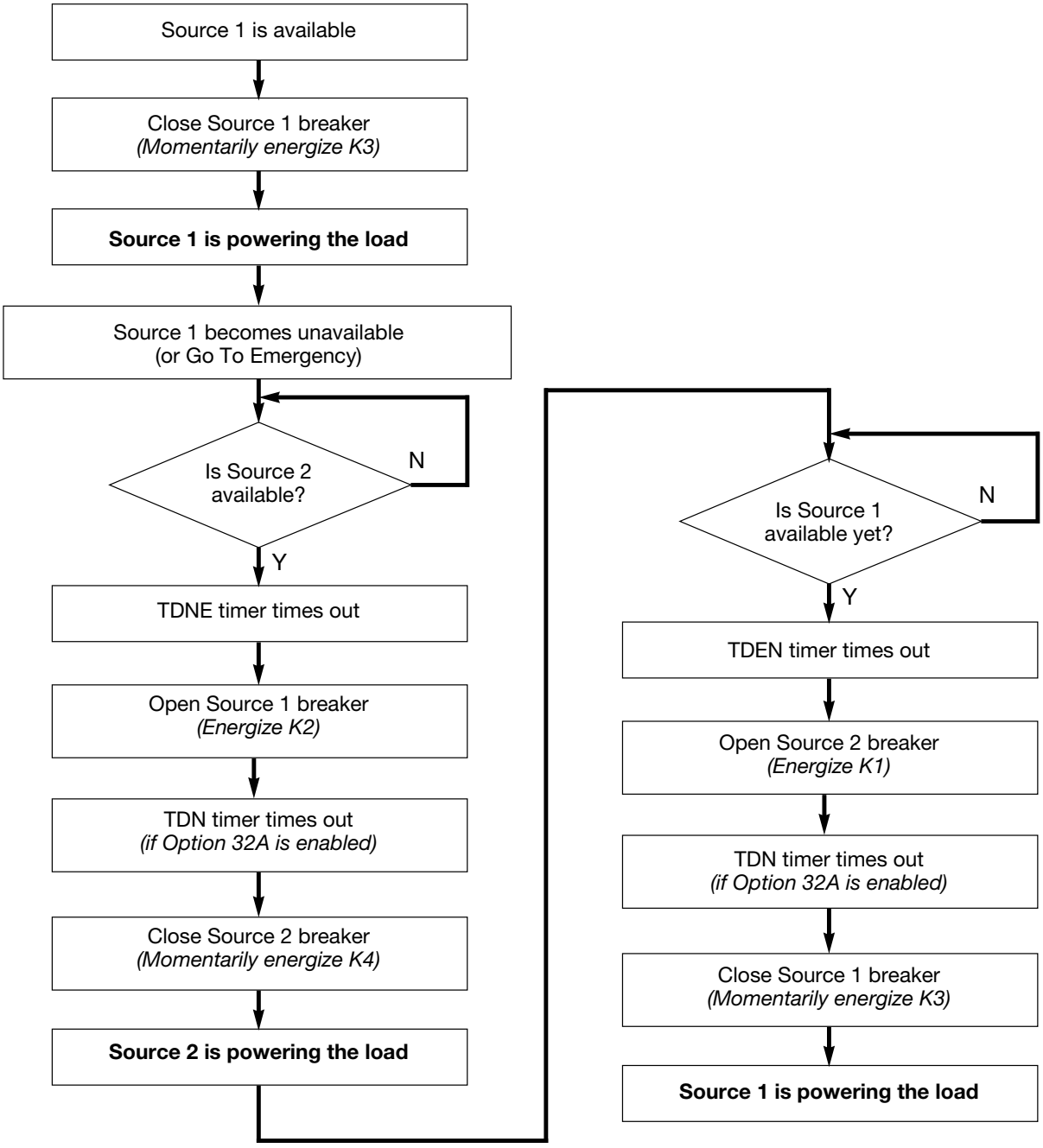


1

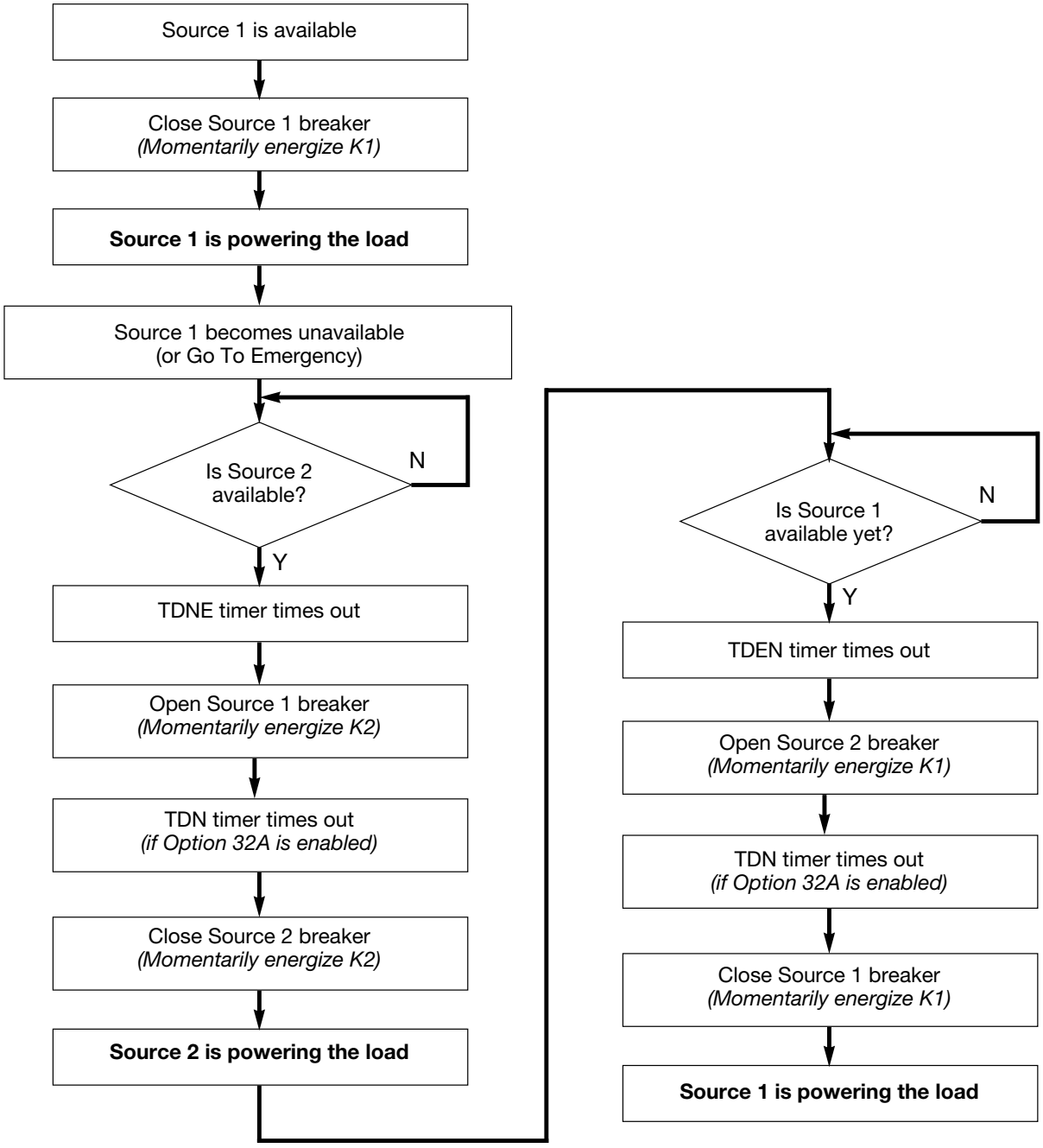
UTILITY - GENERATOR MOTOR-OPERATED TRANSFER SWITCH



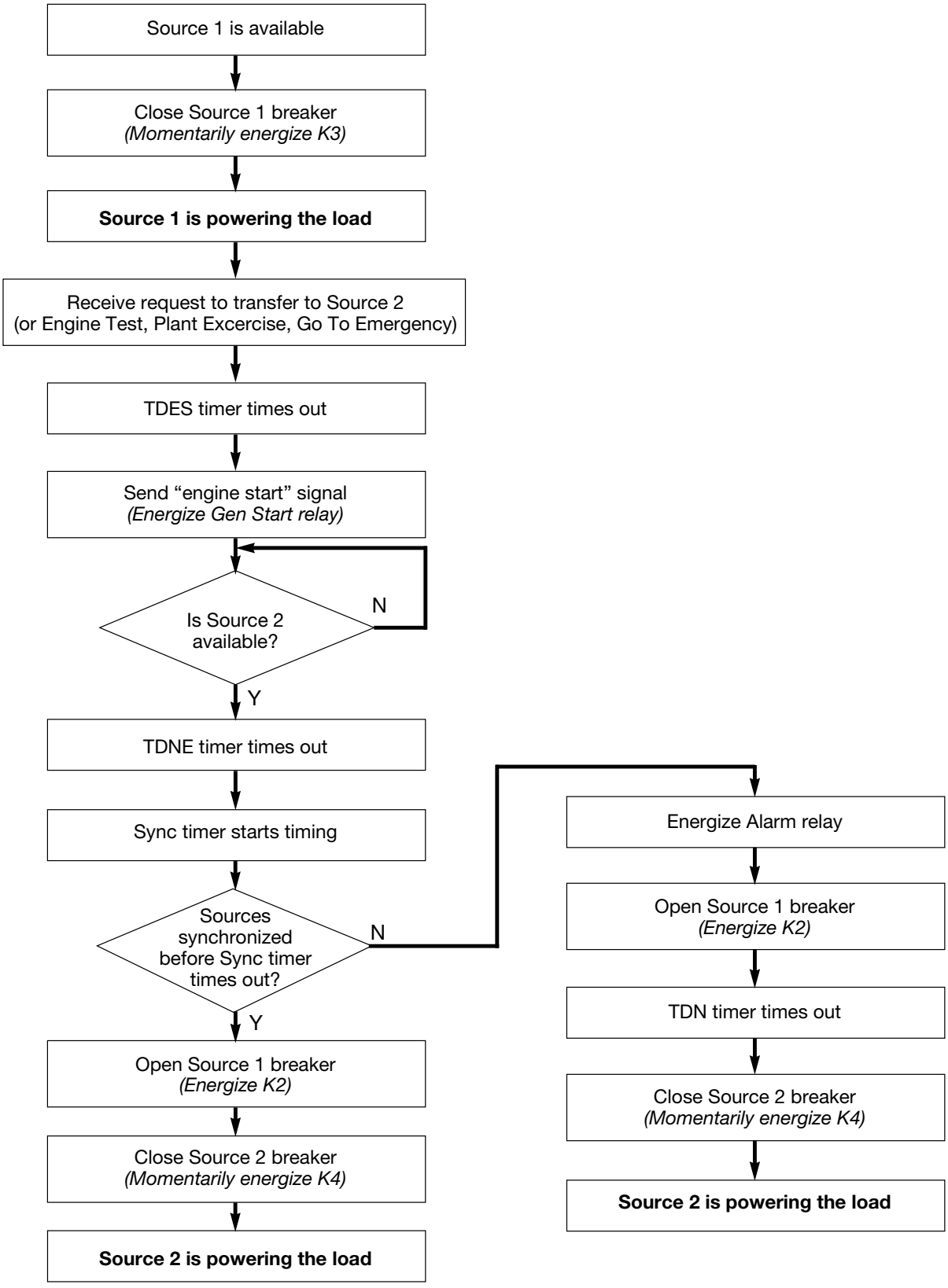
DUAL UTILITY SPB TRANSFER SWITCH



DUAL UTILITY MOTOR-OPERATED TRANSFER SWITCH



IN-PHASE TRANSITION IMPLEMENTATION



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