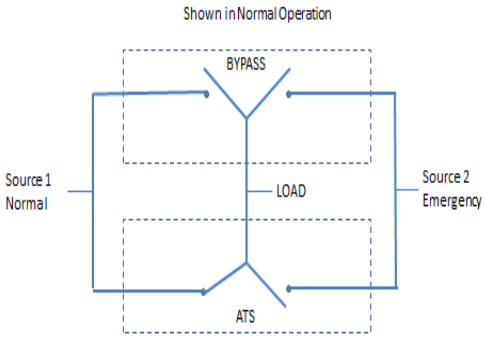
Automatic Transfer Switch - Introductory Course



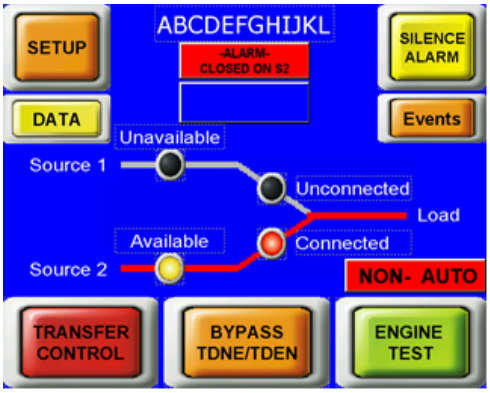


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TABLE OF CONTENT

Introduction

Your instructor will present an introduction to the following topics as they relate to the work of a field-service technician in Transfer Switch Equipment.

- The basic purpose and types of Transfer Switch Equipment in the power system.
- Application of Transfer Switch Equipment
- Identifying an EATON transfer switch product.
- Eaton ATS Controller Operation
- Hands on Experience with the ATC-300 Controller (Setup and Programming).
- Transfer Switch Operation
- Basic Troubleshooting

Students will be required to describe and demonstrate various aspects of the above topics as they apply to the role of transfer switch equipment

WARNING

Eaton recognizes that personnel should only work on de-energized equipment. Due to the nature of work on electrical equipment, it is recognized that there are occasions where work on or near energized circuits is needed to find or correct a problem. Any work performed under these conditions requires the use of proper procedures, tools, and PPE. While the equipment you will encounter in this class represents little or no arc flash hazards by the design of the training and configuration of the equipment, we as the training instructors recognized that there is an electrical shock hazard present and therefore require the use of voltage rated gloves and safety glasses unless the equipment has been placed into an electrically safe work condition.

Technical Support for Eaton Transfer Switches is available by calling:

1-800-809-2772, Option 4, Option 3

Email: ATSTechsupport@eaton.com

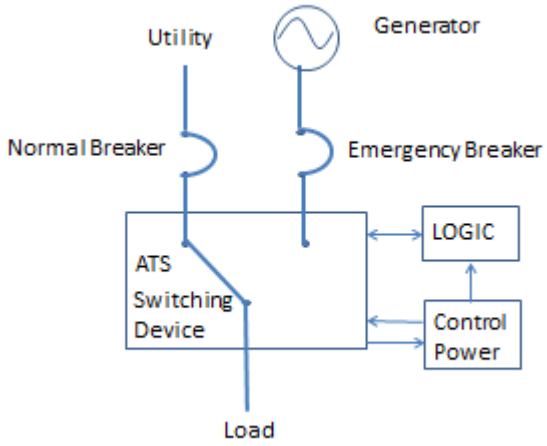
Technical Support is currently available from 8AM to 5PM Eastern Time

The Purpose of Transfer Switch Equipment

Introduction

A transfer switch is a critical component of any emergency or standby power system. When the normal (preferred) source of power is lost, a transfer switch quickly and safely shifts the load circuit from the normal source of power to the emergency (alternate) source of power. This permits critical loads to continue running with minimal or no outage. After the normal source of power has been restored, the retransfer process returns the load circuit to the normal power source.

Transfer switch – A device for transferring one or more load conductor connections from one power source to another. (UL1008 7th Edition Jul 6th 2012, Paragraph 3.12)



Typical Utility / Generator Transfer Switch

The three basic components of a typical transfer switch are:

1. Power switching device to shift the load circuits to and from the power source.

2. Transfer Logic Controller to monitor the condition of the power sources and provide the control signals to the power switching device and initiate the backup generator startup.

3. Control power source to supply operational power to the controller and switching device.

To be called a transfer switch the equipment must be designed to meet the requirements set forth by UL 1008, and typically are 100% rated. This means that the transfer switch may be loaded continuously to 100% of its rating.

Transfer Switch Equipment (TSE) Types (as defined by UL1008)

Manual or Nonautomatic Transfer Switches

This type of transfer switch is operated manually, by hand or electrically with no logic to cause an automatic transfer.

Automatic Transfer Switches

This type of transfer takes place automatically per the programmable settings in the ATS controller. The ATS controller senses source availability and when the programmed conditions are met, initiates a command to start the transfer including the generator start command (when transferring from a utility to a generator source). An automatic transfer switch can be configured to perform a utility-to-utility transfer or a generator-to-generator transfer provided the ATS controller has this capability.

Closed Transition Transfer Switches

Has overlapping contacts, so that the transfer switch exhibits a *Make-before-break* operation. As a result the two sources are paralleled for no more than 100 milliseconds. The two sources must be in synchronism at the time of transfer.

Solid State Transfer Switch

A transfer switch that incorporates power solid state switching devices is also called a *Static Transfer Switch.* Static Transfer Switches derive their name from the fact that they have no moving parts. They are only effective where there are two continuously available sources. They do an *open transition* but with a very short dead bus time (typical < 8 msec), making them effective for transferring critical loads without the use of a *make before break* system thereby eliminating cross connection of sources.

Hybrid Transfer Switches

This type of transfer switch has two modes of operation, Open transition or hybrid transition. In the hybrid mode a static (solid state) operator is paralleled with a mechanical transfer switch while the mechanical switch transfers. This is similar to a Solid State Transfer Switch, but different in the respect that the solid state devices are only used during the transfer and therefore can use devices at an intermittent rating. This makes this version less expensive than a solid state transfer switch.

Transfer Switches for Fire Pumps

These transfer switches even though listed under UL1008, must meet special requirements described in NFPA20. Most notably, the Fire Pump ATS must be able to withstand locked rotor current (LRC) indefinitely. Electric Fire pump systems also can have no overload protection upstream and are unique in that application.

Softload Transfer Switches

Transfer Switch which has active control of the governor and regulator of the generator with the purpose of loading and unloading the generator gradually during the transfer between two good sources.

Transfer Switches intended for use as Service Equipment

A transfer switch containing the required circuit breaker or fuse and service disconnect connected to the load end of the service conductors intended to provide the function of a service disconnect. In a breaker type ATS, this functionality can be integral to the ATS switching device, saving the customer both space and money.

Bypass / Isolation Transfer Switch

This type of transfer switch includes an automatic transfer switch and a bypass switch. Isolation is typically accomplished by drawing out the ATS section. This equipment has been designed in most cases to allow the capability to transfer the load to the bypass switch without interrupting the power. The Bypass section of the equipment is used to provide continuity of power while the Transfer Switch section may be removed for maintenance. This type of switch often sees application in life safety systems.

Automatic Transfer Switch Operation

In basic applications, the Automatic Transfer Switch simply needs to:

- Sense a loss of NORMAL power
- Start a generator
- Sense availability of EMERGENCY
- Transfer to EMERGENCY
- Sense return of NORMAL
- Retransfer to NORMAL
- Shut down the generator.

Transfer Switches usually have a source that is preferred. If that source is available then the ATS will connect to that source and stay there even if the backup source is available, until the preferred source fails.

HANNA's Laws

- **Volts is Volts.**
- **You cannot connect to a BAD SOURCE.**
- **You cannot remain disconnected from the ONLY GOOD SOURCE.**
    - **You cannot leave a bad source if there is not a good source available.**
- **Any two sources when not in-phase, if connected together suddenly will be.**

Introduction to the ATC-300 DEMO / Simulator

ATC 300 Controller Demo / Simulator

The ATC-300 Demo unit can simulate several conditions and react automatically as a transfer switch would. The demo also has the capability to create specific failure scenarios.

MAIN POWER SWITCH – Turns demo ON/OFF

SOURCE 1 SELECTOR - Turns Source 1 (NORMAL) ON/OFF

Green Indicator indicates Source 1 Enabled (Lit) / Disabled

SOURCE 2 SELECTOR - Turns Source 2 (EMERGENCY) ON/OFF

Red Indicator indicates Source 2 Enabled (Lit) / Disabled (Not

ENGINE START INDICATOR – Indicates Engine Start Contact Status

LIT – Controller Engine Start Contact is closed, and calling for Engine Generator to Run.

POSITION SELECTOR SWITCH

(Demo Function Only)

NORMAL – Demo will act like an AUTOMATIC TRANSFER SWITCH, connecting automatically to the source that the controller initiates.

S1 CONN – Demo is connected to Source 1, no automatic control.

OFF – Demo is in the NEUTRAL position, no automatic control

S2 CONN – Demo is connected to Source 2, no automatic control.

The other switches (LOCKOUT, S2 INHIBIT, GO TO S2, MONITOR MODE) react with inputs to further demonstrate the controller capabilities. They all should be in the “OFF” position.

The SERVICE ENTRANCE Switch should be in “ENERGIZE”.

Connected LED's indicated source to which the ATS is connected

Available LED's indicate which sources are available (meet setpoint criteria)

Display shows status and Alarm Messages as needed

ATC-300+ Controller

The ATC-300+ controller in the demo is set up to act exactly like a Contactor Type Transfer Switch. More information on the controller will be seen later in the workbook.

Lab 1: Demonstrate ATS Operation.

Part 1: Normal Operation – This lab will demonstrate normal operation of Automatic Transfer Switch

1. On you demonstrator set the selector switches as follows:

   Main Power "ON" (White indicator should light)

   Source 1 "ON" (Green indicator should light)

   Source 2 "OFF"

   Position Selector Switch "NORMAL" (In this mode the simulator will act exactly as an Automatic Transfer Switch)

   All **INPUT** Switches "OFF"

   Service Entrance "ENERGIZE"

2. What LED's on the ATC-300 are lit?

   S1 Available ◯

   S2 Available ◯

   S1 Connected ◯

   S2 Connected ◯

   Is Unit Status Flashing? ◯ Yes ◯ No

This is how a Transfer Switch would be found in its normal state.

Now what happens in a power failure will be demonstrated.

3. Turn Source 1 "OFF"
4. Did the BLUE ENGINE START indicator light up? _____
5. If so, the controller is waiting on the generator to start. Turn SOURCE 2 "ON". The Red indicator should light.
6. Did the ATC-300 Source 2 Available LED light? _____
7. The controller should go through some timing functions and should now indicate that it has connected to Source 2. Is the Source 2 Connected LED lit? _____

This is how the ATS indicates it is operating on EMERGENCY power.

Now demonstrate what happens when the preferred source becomes available.

8. Turn SOURCE 1 "ON". The GREEN Indicator should light, and the Source 1 Available LED should light.
9. The ATC-300 should go through some timing sequences and then reconnect to Source 1.

10. After another timing sequence the BLUE Engine Start Indicator should go out. When that happens, turn SOURCE 2 "OFF". The RED indicator and the Source 2 Available LED should extinguish, and the controller should now indicate Source 1 Available and Connected. This demonstrates the simple operation of an Automatic Transfer Switch.

Part 2: Demonstrate an ATS Failure – This lab will demonstrate what happens when the Automatic Transfer Switch fails to operate properly and results in an alarm**.**

1. On you demonstrator set the selector switches as follows:

   Main Power "ON" (White indicator should light)

   Source 1 "ON" (Green indicator should light)

   Source 2 "OFF"

   Position Selector Switch "S1 Conn" (demo is connected to S1, with no automatic control)

   All **INPUT** Switches "OFF"

   Service Entrance ENERGIZE
2. What LED's on the ATC-300 are lit?

   S1 Available ◯

   S2 Available ◯

   S1 Connected ◯

   S2 Connected ◯

   Is Unit Status Flashing? ◯ Yes ◯ No

   The ATS is operating on the good Source 1.

   Now we are going to demonstrate the power failure again, and this time the ATS will be unable to disconnect from Source 1
3. Turn Source 1 "OFF"
4. Did the BLUE ENGINE START indicator light up? _____
5. If so, the controller is waiting on the generator to start. Turn SOURCE 2 ON. The Red indicator should light.
6. Did the ATC-300 Source 2 Available LED light? _____
7. The controller should go through some timing functions and should now indicate that it has connected to Source 2. Is the Source 2 Connected LED lit? _____
8. What is the message on the display? _____

You should see a message “Source 1 Device” . The “Source 1 Device” Alarm means that the controller tried to open or close the S1 device and failed to get a readback that it happened.

Since you are showing Source 2 Available, and Source 1 Connected on the controller what should you conclude?

S1 failed to _____. There could be several reasons that this occurred, the controller is giving a hint where to begin troubleshooting,

Part 3: Clearing an Alarm and restoring operation.

Let’s assume that you have found the problem and corrected it, and now you must restore operation of the ATS. An alarm prevents the controller from any further automatic operation.

1. Place the Position Selector in “NORMAL”. (Simulator will now allow automatic operation)
2. Turn Source 1 “ON”. The Green indicator, and the Source 1 Available LED should light.
3. To clear the ALARM, press ALARM RESET on the ATC-300 controller. (Increase and Decrease simultaneously)
4. ATS should now indicate Source 1 Available and Connected. When Engine Start Light turns off, turn SOURCE 2 OFF.

Part 4: Lessons Learned

1. The controller indicates normal operation by showing connected source voltage, date and time.
2. When the controller has determined there is a problem it will display an alarm message.
3. To restore normal operation the problem must first be cleared.
4. The Alarm message must be reset to restore controller to normal operation.

Codes and Standards

There are a number of organizations which manage codes and standards for transfer switch equipment.

National Fire Protection Association (NFPA)

NFPA70 (National Electric Code)

NFPA99 Standard for Healthcare Facilities

NFPA110 Standard for Emergency and Standby Power Systems

NFPA20 Standard for the Installation of Stationary Pumps for Fire Pump systems.

Note: TSE listed for use on Fire pump systems are may be listed under UL1008, but MUST meet requirements in NFPA20.

Underwriters Laboratories (UL)

ANSI / UL 1008 (Note 1) - Safety Standard for Transfer Switch Equipment - is the standard used most commonly in the US for listing TSE product. When listed to this standard it means the finished product has been tested and certified by a National Recognized Laboratory as a transfer switch.

Canadian Standards Association (CSA)

CSA C22.2 No. 178.1-12 (Note 1) - is used for listing transfer switch equipment in Canada.

Association of Standardization and Certification (ANCE)

NMX-J-672 ANCE, First Edition (Note 1) – Safety Standard used in Mexico for listing Transfer Switch Equipment.

Note 1: ANSI/UL1008, C22.2 No. 178.1-12, and NMX-J-672 ANCE are the same physical document, the result of a North American harmonization effort, but the document retains the national standards number for that country.

International Electrotechnical Commission (IEC)

Standard 60947-6-1 is commonly used outside of North America for certifying Transfer Switch Equipment. It is different from UL in that equipment is self-certified to the standard by the manufacturer.

National Electrical Manufacturers Association (NEMA)

ICS 10 provides a guide specification to help engineers, manufacturers and users to select and apply transfer switches.

Electrical Generating Systems Association (EGSA)

EGSA 100-S A marketing and technical certification organization that provides guide specification for generators and transfer switches, and training to certify technicians..

Installation Types

NFPA 70 Article 700, Emergency Systems

Typical Hospital Emergency System

Those systems legally required and classed as emergency by municipal, state, federal, or other codes or by any government agency having jurisdiction.

Generally installed in places of assembly where artificial lighting is required for safe evacuation. Also used where power interruption would produce serious life safety or health hazards. Must be permanently installed. Emergency power shall be available and connected to the load in 10 seconds or less.

NFPA 70 Article 701, Legally Required Standby Systems

Those systems required and so classed as legally required standby systems by municipal, state, federal, or other codes or by any government agency having jurisdiction.

These are not life safety systems and include typical loads like heating or refrigeration, communications systems, ventilation or smoke removal systems, sewage disposal, lighting systems, and industrial processes that when stopped by an interruption of the normal electrical supply, could create hazards or hamper rescue or fire-fighting operations. Must be permanently installed. Standby power must be available within a maximum of 60 seconds.

NFPA 70 Article 702, Optional Standby Systems

Systems intended to supply power to public or private facilities or property where life safety does not depend on the performance of the system.

System may be operated manually, and may be permanently installed or supplied from a portable system.

NFPA 70 Article 708, Critical Operations Power Systems (COPS)

Although not used for listing transfer switch equipment, transfer switch equipment may be required for a system to meet this article. Article 708 requires that transfer equipment shall be automatic and identified for emergency use.

Note: It is acceptable to apply an ATS listed for use on Emergency Systems on an Optional system. It is NOT acceptable to apply an ATS listed for use on an Optional System on an Emergency System.

Application of Transfer Switch Equipment

Transfer Switch Equipment is applied anywhere there is a need for longer term (minutes to days) backup power.

Eaton builds both molded-case switch (breaker based) and the Magnum DS™ Insulated Case Breaker configurations

- Breaker type using Series C up to 1000 amps
- Magnum DS up to 5000 amps.

Eaton Contactor based designs are available up to 1600A.

All designs are 100% rated.

Application considerations may favor one design over the other, and it is up to the specifier to determine which design best meets his needs. While it is ultimately up to the specifier to, we will investigate some of these needs.

Eaton TSE up to 4000A has UL 1008 listing and carries the UL 1008 label. The 5000A have not been tested to the UL1008 standard and are listed under UL891 – Standard for Switchboards.

Eaton also builds Bypass / Isolation Transfer switches in a Contactor design and in a Magnum DS Breaker design. Both the contactor and Magnum design are available in an open or closed transition version. The Bypass section of the equipment is used to provide continuity of power while the Transfer Switch section may be removed for maintenance.

A key EATON design feature of the Contactor Bypass / Isolation ATS is the ability of the controller to operate the bypass section automatically, exactly like the ATS section. This means that while in Bypass the user still has automatic availability of backup power in the event of a failure of the normal source. This is a huge benefit, unlike competitor designs that require manual intervention to transfer to the backup source if the preferred source suddenly becomes unavailable.

UL1008 Test Requirements are unique

Withstand Rating

Withstand Rating is the ability of the ATS to withstand a tested short circuit fault current until the upstream breaker opens to clear the fault. Currents are specified in the standard at certain levels, and acceptable times are .050, .067, .083 or .100 seconds. This rating only requires that the ATS be coordinated with the upstream breaker, which means the ATS is rated to withstand the let-through current from the upstream overcurrent device. The ATS must also have the ability to transfer to the alternate source after the fault is cleared by the upstream breaker.

Short Time Rating

Short Time Rating is the ability of the ATS to withstand a tested short circuit for a specific time. This is proven with a test to verify contact viability after the short time test. The Short Time test is optional and assumes the TSE must survive until a downstream device clears a fault. This rating is applied to coordinate with upstream circuit breakers which have a Short Time setting for better coordination of trip curves in the system.

The UL1008 standard does say that a Transfer Switch may not be used downstream from a circuit breaker with a Short Time trip element, unless the ATS has an appropriate Short Time Rating.

The needed short time rating in the transfer switch is related to the ability to withstand:

- The instantaneous pickup for the short time delay of the upstream breaker, or,
- The maximum available fault current for the short time delay of the upstream device.

Endurance Testing

Endurance Testing is significant in UL1008 to the listing of the product for use on Emergency Systems. The ATS is switched back and forth between sources which are out of synchronism, and a specified quantity of the operations must be run at 200% of rated current.

Overload Testing

Overload Testing is done for a specified number of transfer operations, with the sources out of synchronism at 6 times rated current (for total system load),

Summary

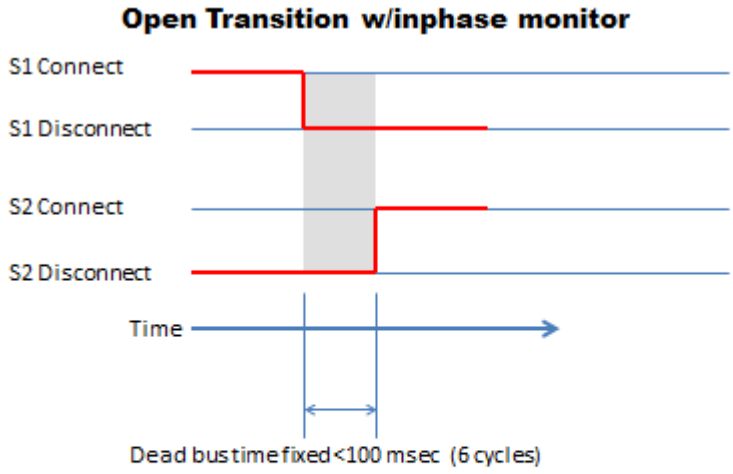
The intent of UL1008 is to prove the ability of the transfer switch to handle abuse above and beyond its ratings, essentially making it a “piece of wire”, and not a weak link in the electrical system. It is assumed it will be switching under the worst conditions and will continue to operate as intended.

Dealing with Regenerated Voltages

Whenever a load is disconnected from a source, an inductive load such as a motor becomes a generator. In a transfer switch, immediately connecting to another source that is not synchronized with this *regenerated voltage* may cause a large *inrush current*. If this inrush is higher than normal starting current, the inrush may trip motor protectors, breakers, or actually cause damage to equipment by loosening motor (or generator) windings and can possibly result in permanent damage to the motor, or generator. The regenerated voltages decay over a period of time, allowing several methods to deal with them, and prevent the excessive inrush current. These are described in the following options.

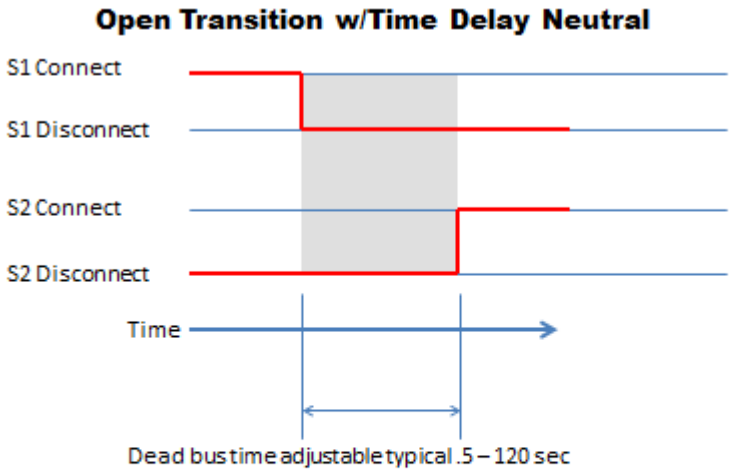
Open In-Phase Transition

This is a *break-before-make* transfer. There is a definite break in power of less than 100 msec as the load is taken off one source and connected to the other source. The ATS controller allows the transfer only when the two sources are synchronized according to the controller. In-Phase transfer is usually accomplished with a Two-position ATS, that is, only capable of being in the NORMAL or EMERGENCY position.



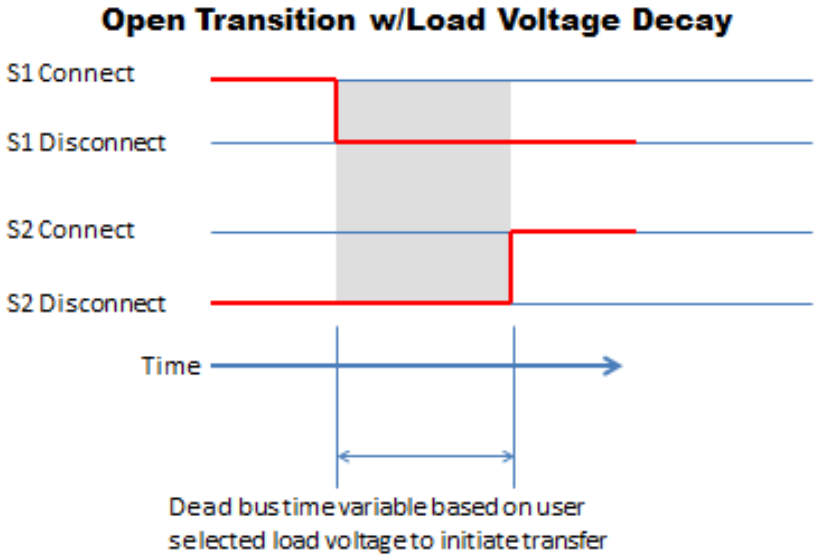
Delayed Transition

This is a *break-before-make* or open transition that also has a “center off” or neutral position with a programmable time delay setting for the neutral position. This is a Three Position Transfer Switch being capable of NORMAL, CENTER OFF, or EMERGENCY positions. The intent of Delayed Transition is to allow the regenerated voltage (or “back emf”) to decay to a level that will limit inrush current to a value less than the normal staring current of the inductive load. Some calculation is necessary to determine the proper time delay.



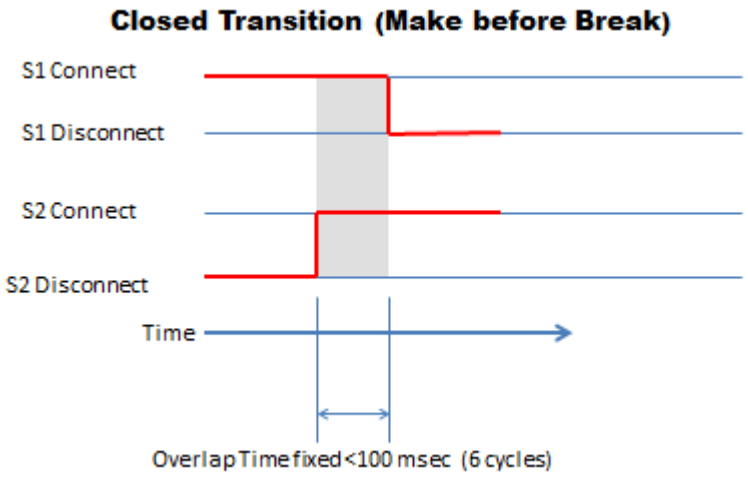
Delayed Transition with Load Voltage Decay

This is a delayed transition with the optional feature to delay in the neutral position to a point where the load voltage has decayed to a programmable voltage level. The transfer switch opens the connected source device, and begins to monitor the load voltage. When the load voltage level (regenerated voltage or “back emf”) falls below the programmable set point, the transfer from the neutral position to the connecting source takes place. The idea, again, is to prevent an excessive inrush current caused by an out-of-sync regenerated voltage or “back emf”. Here the time delay is variable on each transfer and the controller is determining when it is safe to complete the transfer from the “neutral” position to the connecting source. This keeps the “dead bus” time to the minimum needed, for each specific transfer.



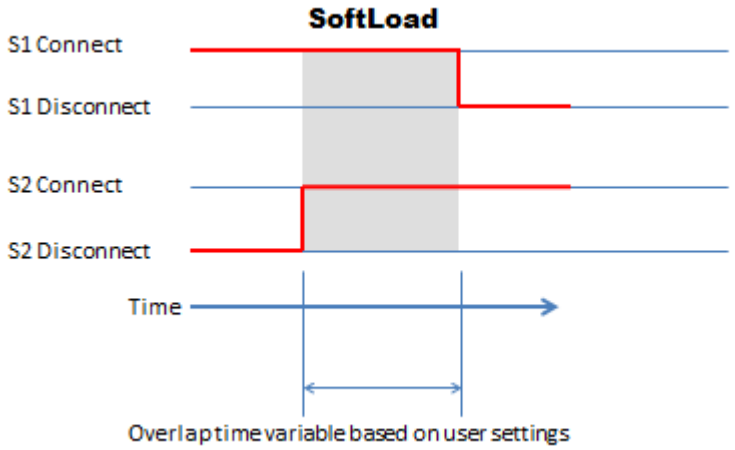
Closed Transition

This is a *make-before-break* transfer. Both sources are paralleled and connected to the load for less than 100ms before opening the source to be disconnected. The two power sources have to be in synchronism and be good sources for the transfer to take place. Programmable settings for relative phase angle difference, frequency and voltage difference are made in the ATS controller. Closed Transition is used where a seamless transfer is desired between two good sources. It does NOT however remove the *block loading* effect which is the sudden dumping of load on the generator. *Block loading* can cause a momentary sag in the voltage and frequency produced by the generator. In a test scenario, when both sources are good, the controller may see this as a source (generator) failure, and result in an immediate retransfer to the good normal source.



Softload

This is a closed transition type transfer with the soft load ATS controller having the ability to take active control of the generator voltage and frequency to load and unload the generator gradually when both sources are available. This prevents a *block loading* or unloading of the generator when both sources are available. Extended paralleling is possible to allow peak shaving and base loading possibilities. This means that the user may make the overlap time anything from a few minutes to many hours. Note: Softload switches may need to meet the requirements of NFPA 70, Article 705 – Interconnected Electric Power Production Sources.



Summary - Regenerated Voltages

In the beginning, the type of operation was more the result of a specific design rather than an effort to find the best way to solve the issue of regenerated voltages. One design (the 2 position contactor), necessitated the development of the in-phase monitor. This design was found to be acceptable in many cases where large motors were involved. There was the incidental occurrence of a motor starter dropping out during the transfer due to the fact the dead bus time was too long to hold the starter coil in, resulting in a motor dropout during transfer. The breaker type ATS, with it slower single motor operator had a longer dead bus time making it incapable of an effective in-phase transition This necessitated a deliberate adjustable dead bus time to allow the regenerated voltage to decay to a safe value.

As time progressed, systems with switching power supplies (data centers, computers, electronic equipment) showed that in many cases the short dead bus time exhibited by the two position contactor was too long to allow reconnection to a source which was no longer in sync with a rapidly decaying load, but too short to completely allow the regenerated voltage to decay properly. In the case of Variable Frequency Drives, the short dead bus time would not allow the drive to reset properly, causing it to shut down anyway. This led to the manufacturers developing ATS equipment with several types of open transition operation. It is the responsibility of the specifier to choose the proper method for the requirements of the application.

Matching

Transition Type		Description
1. Open transition	☐	**A —This is a closed transition type transfer with the ATS controller having the ability to take active control of the generator voltage and frequency**
2. Open in-phase transition	☐	**B —This is a "break-before-make" or open transition that also has a "center off" or neutral position with a programmable time delay setting for the neutral position**
3. Delayed transition w/ in-phase monitor	☐	**C —This is a "break-before-make" transfer. There is a definite break in power as the load is taken off one source and connected to the other source. The ATS controller allows the transfer only when the phase difference between the two sources is near zero.**
4. Delayed transition w/ load voltage decay	☐	**D —This is a "make-before-break" transfer. Both sources are connected to the load for less than 100ms before the break occurs. The two power sources have to be in synchronism and be good sources for the transfer to take place.**
5. Closed transition	☐	**E —This is a delayed transition with the optional feature to delay in the neutral position to until the load voltage decays to a programmable voltage level.**
6. Soft load transition	☐	**F —This is a "break-before-make" transfer. There is a definite break in power as the load is taken off one source and connected to the other source.**

Transfer Switch Standard and Optional Features

Eaton Transfer Switch Equipment has several features. The features may be standard or optional depending on the application. Features are numbered and named. See specific Instruction booklets for the ATS and controller. Not all features are available on all transfer switches or controllers. Available settings may be different on different controllers.

Feature Descriptions

1 Time Delay Normal to Emergency (TDNE)

Time delay which starts as soon as Source 2 (Emergency) is available and delays the transfer. Used to allow Generator to Stabilize. In a Dual Utility application this timer is used to prevent transfer if the outages on Source 1 do not exceed the time delay programmed.

Related to the TDNE is a feature called COMMIT / NO COMMIT. If No Commit is chosen, while TDNE is timing out, should S1 become available no transfer occurs and the generator is shut down. If Commit is chosen, transfer to S2 will take place even if S1 becomes good during TDNE timing.

2 Time Delay Engine Start (TDES)

Time delay which delays start of the engine generator to allow for momentary outages on Source 1 (Normal). Not used in a dual utility application.

3 Time Delay Emergency to Normal (TDEN)

Time delay used to insure that Source 1 (Normal) is stable before a retransfer is permitted, thereby preventing the transfer switch from bouncing between sources.

4 Time Delay Engine Cooldown (TDEC)

Timer used to allow engine generator to cool under a no load condition after the load is removed by retransfer to Source 1 (Normal).

5 Emergency Source Sensing

See specific ATS and Controller for standard functions, and optional availability.

6 Engine/System Test functions

Pushbutton / Switches provided to simulate power failure and test transfer function, or to run generator.

7 Time Delay Engine Fail (TDEF)

Time delay which allows the controller to ignore a temporary unacceptable source condition on the generator to prevent an immediate retransfer to a good NORMAL source. This timer functions during the initial transfer to Source 2 and while connected to Source 2, if Source 1 is good. Ex: During a test function, or when TDEN is counting down. TDEF has no effect if Source 1 is NOT good.

8 TDNE/TDEN Bypass Pushbutton

Pushbutton to bypass either the TDEN or TDNE timer and allow immediate transfer to a source. Source must be good.

9 Maintenance Selector Switch

Electrical Operator Isolator Switch. Prevents automatic operation of the ATS.

10 Preferred Source Selector

Allows selection of the source to be preferred. Can be used with dual utility, utility / generator or dual generator applications depending on the controller provided.

12 Indicator Lights

Source Available, and Transfer Switch Position indicators

14 Auxiliary Relay Contacts

Source Available Contacts for customer connection.

15 Position Contacts

ATS position contacts indicating Source connected to load for customer use.

16 Overcurrent protection w/LOCKOUT

Generally provided only on breaker type switches. Includes a thermal magnetic or electronic trip depending on specific type of ATS.

18 Metering

Optional metering available depending on type of ATS. See IB and Sales literature.

21 Nonstandard Terminals

Each Eaton ATS is provided with standard terminal for cable connections. Customer may have the option of specifying an available nonstandard terminal for use.

23 Plant Exerciser

Feature to provide periodic test of engine generator either under load, or not with load. See IB and Sales literature for specifics.

26 Source 1 (Normal) Sensing Options

See IB and Sales Literature for specifics.

29 Manual Operation of an Automatic Transfer Switch

Provides manual return to normal or manual operation of the ATS.

32 Delayed Transfer Operation Modes

Selection of delayed operation, either time delay, load voltage decay, or inphase.

34 Extender Cables

Used where customer buys a transfer switch to mount in his own enclosure. Allows placement of logic further from the switching mechanism.

35 Pretransfer Signal Contacts

Customer contacts used to indicate a transfer will be happening. Contact closes a user set time before the transfer happens. Used typically in elevator control schemes or where customer wants something to happen before the transfer takes place.

36 Load Shed from Emergency

Customer input to tell the ATS to disconnect from the generator. Used where customer has generator paralleling gear to disconnect a load that is too large to be supported, or in the case where another load has a priority higher than this ATS.

37 Service Disconnect

Used on Service Equipment Transfer Switches to disconnect load from the ATS.

38 Stainless Steel Device Covers

Pad lockable covers provided for the controller or the Service Disconnect to limit access or protect from unauthorized tampering.

41 Space Heater

Heater provided to reduce condensation issues in outdoor rated enclosures. Highly recommended in all applications where ATS will be exposed to large temperature variations and high humidity.

42 Seismic Rating

All Eaton Transfer Switches are rated for use per the International Building Code and the Universal Building Code. Some special mounting requirements may apply. See IB for specifics.

45 Load Sequencing Contacts

Customer contacts supplied to sequence loads onto a generator. Used where generator may not be able to handle large starting motor loads.

47 Closed Transition Mode

Specifies fallback modes of operation if closed transition cannot be achieved due to failure to obtain synchronization of the sources. MUST BE USER SELECTED AT TIME OF ORDER. See IB and Sales Literature for specifics.

48 Communications

See controller IB and literature for choices. Varies with controller.

49 Sensing Isolation Transformers

Transformer package to provide isolation between the system and the sensing inputs on the controllers. Highly recommended for High Resistance Grounded Wye systems, and Delta Systems with one leg intentionally grounded.

51 Surge Protection

User selectable surge protection. Recommended for use only on the utility side of the ATS. See IB and Sales Literature for choices available.

54 Front Access (Magnum only)

Front access compartment available on Magnum products. Adds an addition pull section mounted beside the Transfer Switch.

59a Silver Plated Bus

Standard on Magnum Transfer Switches

59b Tin Plated Bus

Optional on Magnum Transfer Switches. For added corrosion protection.

80A Source 2 (Emergency) Inhibit contact

Input to inhibit transfer to Emergency. Used typically with paralleling gear to not permit transfer until adequate generated power is available to allow connection to Source 2.

81 Alarm Contact

Customer contact indicating Failure to Transfer. Only available of certain ATS products. See IB and Sales Literature for specifics.

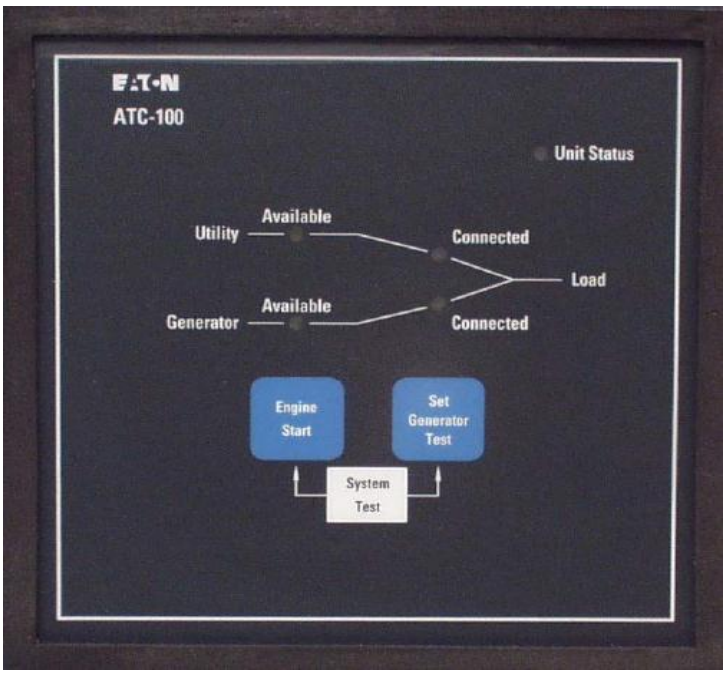
NOTE: The Consulting Application Guide provided on your flash drive, pages 25.5-1 through page 25.5-12 has charts for Contactor, Breaker, and Magnum Transfer Switches by catalog number showing standard and optional features available.

EATON ATS Controllers

Eaton offers a variety of controllers for transfer switches, from the simplistic inexpensive ATC-100 to the full featured ATC-900 which has the highest versatility and flexibility in the industry.

All current EATON Transfer Switch controllers are microprocessor based allowing flexibility to add features without the need for adding hardware.

ATC-100 Controller



The ATC-100 controller is available in two versions. They are NOT interchangeable in the field, and cannot be changed to another version in the field. Do NOT attempt to use a controller intended for one version on a transfer switch for which the controller was NOT intended.

8160A00G23 For use on breaker ATS (has Time Delay Neutral)

8160A00G24 For use on 2/3 -position contactor ATS (has inphase and TDN)

The LED's

Unit Status LED

The green Unit Status LED blinks at a rate of once per second while the ATC-100 is operational. This indicates that the ATC-100 has completed a self-diagnostic cycle. The self-diagnostic cycle checks include the:

- Microprocessor operation and
- Memory operation.

Utility Available LED

The white Utility Available LED illuminates if the utility power source meets the criteria to be considered "available". That is, when it is within its undervoltage ranges for the nominal voltage setting.

Utility Connected LED

The green Utility Connected LED illuminates when the utility switching device and its associated position indicating auxiliary contacts are closed. The Utility Connected LED will blink to indicate an alarm condition for an unsuccessful transfer.

Generator Available

The amber Generator Available LED illuminates if the generator power source meets the criteria to be considered "available". That is, when it is within its programmed setpoints.

The Generator Available LED will blink to indicate an alarm condition if the Generator did not become available within 90 seconds for a System Test, Generator Test, or Engine Start Test.

Generator Connected LED

The red Generator Connected LED illuminates when the generator switching device and its associated position indicating auxiliary contacts are closed.

The Generator Connected LED will blink to indicate an alarm condition for an unsuccessful transfer.

The Pushbuttons and Combinations

Engine Start Pushbutton

Pressing and holding the Engine Start pushbutton for a period of five seconds will initiate a No Load Generator Test. The test will run for 15 minutes and then terminate. If the Engine Start pushbutton is pressed while the engine/generator is running, the test will terminate.

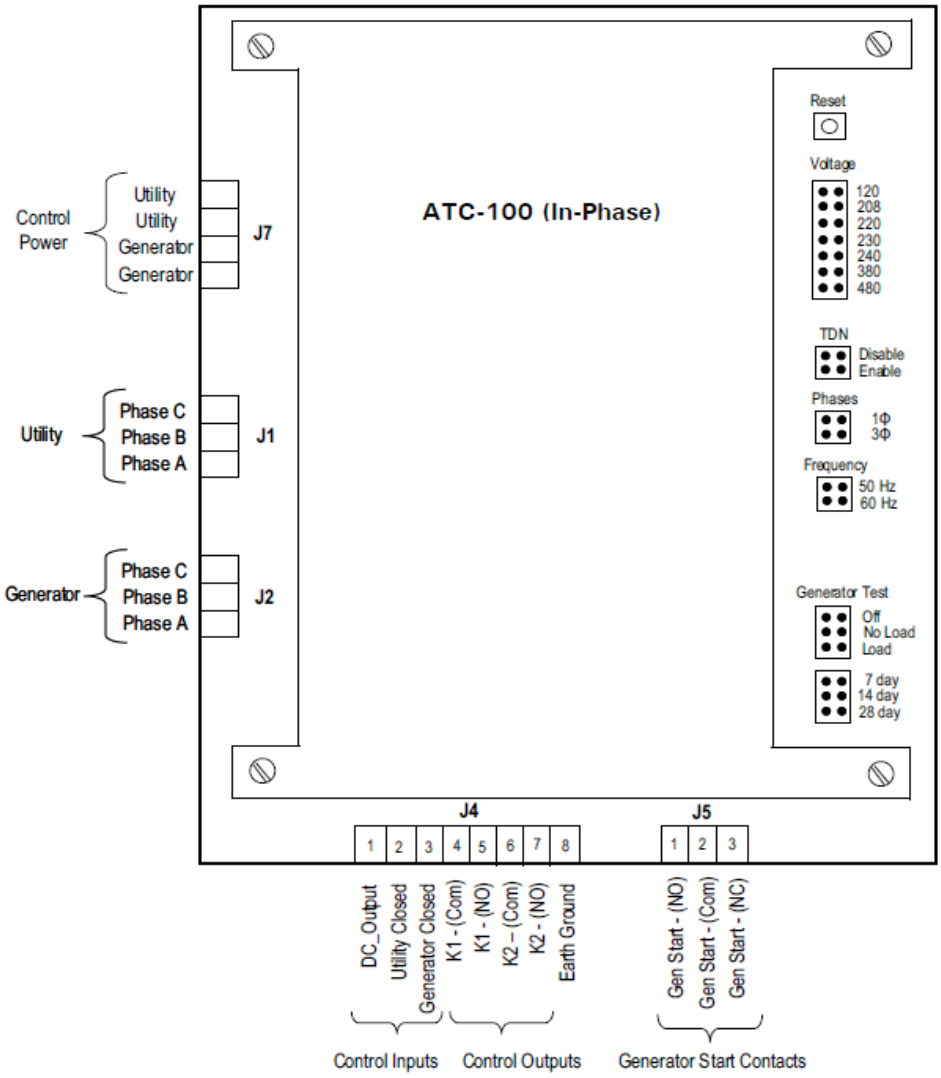
Set Generator Test Pushbutton

The Set Generator Test pushbutton allows the user to test the generator automatically on a periodic (every 7, 14, or 28 days) basis. Pressing and holding the Set Generator Test pushbutton for a period of five seconds will initiate a Generator Test. The Utility

Available and Generator Available LED's will flash twice indicating that the Generator Test is programmed. The Generator Test can be deprogrammed by pressing and holding the Set Generator Test pushbutton for a period of five seconds. The Utility Available and Generator Available LED's will flash four times, indicating that the Generator Test is no longer programmed. The Generator Test jumpers can be set to one of three positions to allow flexibility in how the test is run:

System Test (Engine Start + Set Generator Test Pushbuttons)

Pressing the Engine Start and Set Generator Test pushbuttons simultaneously will initiate a System Test. The System Test will start the generator, transfer the load to generator, run on generator for a run time of 15 minutes, time out TDEN for five minutes, then retransfer, run the engine cool down cycle, and then terminate. To abort the System Test, simultaneously press the Engine Start and Set Generator Test pushbuttons.



ATC-100 Rear View

Programming Jumpers

The ATC-100 is programmable via the jumpers on the back of the unit. See the IB for instructions.

Reset Pushbutton

The ATC-100 has a Reset pushbutton in the top right corner to reset the following alarm conditions:

• “Utility Connected” LED is blinking

• “Generator Connected” LED is blinking

• “Generator Available” LED is blinking.

Note: Pressing the Reset pushbutton will also clear the Generator Test programming. It will be necessary to set up the Generator Test again after pressing the Reset pushbutton.

Customer Connections

Generator Start Relay

The generator start relay is a latching relay with Form C contacts of silver alloy with gold flashing for closure of the generator start circuit.

- The Form C contact is implemented with the Common Pin (J-5, Pin 2), the Normally Open Pin (J-5, Pin 1) and the Normally Closed Pin (J-5, Pin 3).
- The generator start relay contacts are rated for 5 A, 1/6 HP @ 250 Vac. The DC rating is 5 A @ 30 Vdc with a 150 W maximum load.

See **IB01602019E** for more information on the ATC-100 Controller.

ATC-300 CONTROLLER

The ATC-300/300+ is the most commonly applied Eaton controller, and available on all breaker and contactor based switches except the Magnum ATS. It is front panel programmed, supports Modbus RTU communications and there is no user programming software.

ATC-300+ Front Panel

The ATC-300 controller is available in three versions. They are NOT interchangeable in the field, and cannot be changed to another version in the field. Do NOT attempt to use a controller intended for one version on a transfer switch for which the controller was NOT intended.

8160A00G100 For use on breaker ATS (has Time Delay Neutral)

8160A00G104 For use on 2-position contactor ATS (has inphase monitor)

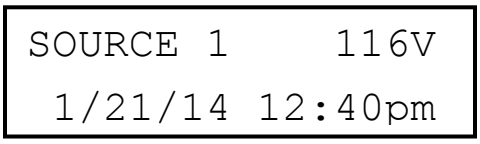
8160A00G108 For use on 3-position contactor ATS (has Inphase and Time Delay Neutral)

The Display

A 2-line, 16-character alphanumeric LCD Display module is used to display all ATC-300+ Controller monitored parameters, setpoints, and messages in easy to read formats. 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 LCD Display:

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



"Home Screen"

As a default when there are no active commands or timers being displayed, the display shows information from the source that is connected to the load. This is referred to as the "**Home screen."**

The LEDs

Unit Status

The green Unit Status LED blinks at a rate of once per second while in the ATC-300 Controller is in the "Run" Mode. This indicates that the ATC-300+ has completed a self-diagnostic and system diagnostic cycle. The self-diagnostic cycle checks include the:

- Microprocessor and memory operation.

The system diagnostic cycle checks include the:

- Output relay operation;
- Control input operation; and
- Transfer switch operation.

The Unit Status LED blinks at an increased rate while the ATC-300+ Controller is in the "Program" Mode.

Source 1 Available

The white Source 1 Available LED illuminates if the Source 1 power source meets the criteria to be considered "available", when it is within its programmed setpoints.

Source 1 Connected

The green Source 1 Connected LED illuminates when the Source 1 switching device and its associated position indicating auxiliary contact are closed.

Source 2 Available

The amber Source 2 Available LED illuminates if the Source 2 power source meets the criteria to be considered “available”, when it is within its programmed setpoints.

Source 2 Connected

The red Source 2 Connected LED illuminates when the Source 2 switching device and its associated position indicating auxiliary contact are closed.

The Pushbuttons and Combinations

Help/Lamp Test Pushbutton

The Help/Lamp Test pushbutton serves two functions.

- If the Help/Lamp Test pushbutton is pressed when a message is present on the LCD Display, a detailed description of the message will scroll across the bottom of the display. The detailed description can be aborted by pressing Help/Lamp Test key a second time.

- If the LCD Display is on the Home screen when the Help/Lamp Test key is pressed, all of the LED’s will momentarily illuminate, then the following information will scroll across the display:
  - Hardware Revision Number;
  - Firmware Version;
  - Serial Number;
  - Feature code – a decodable string listing all optional features programmed in the ATC-300+ Controller. To decode the ATC300 features see **Appendix B**.

Engine Test Pushbutton

The Engine Test pushbutton allows the user to test the Source 2 (generator) engine. The engine test function can be set with the ATC-300+ Controller to one of three setpoint modes to allow flexibility in how the test is run:

0 = No Load Engine Test (Factory Default)

1 = Load Engine Test

2 = Disabled

Step/Enter Pushbutton

The Step/Enter pushbutton allows the user to scroll through the information and setpoint displays. By pressing the Step/Enter pushbutton, the information on the LCD Display will advance through the

- Source 1 voltage(s), frequency, and status.
- Source 2 voltage(s), frequency, and status
- Time and date information
- History information.
- Setpoints.

Increase Pushbutton

The Increase pushbutton allows the user to increase the value of the setpoints. When ATC-300+ Controller is in the “Program” Mode (to change setpoint values), each time the Increase pushbutton is pressed, the value of the displayed item will increase by one.

Decrease Pushbutton

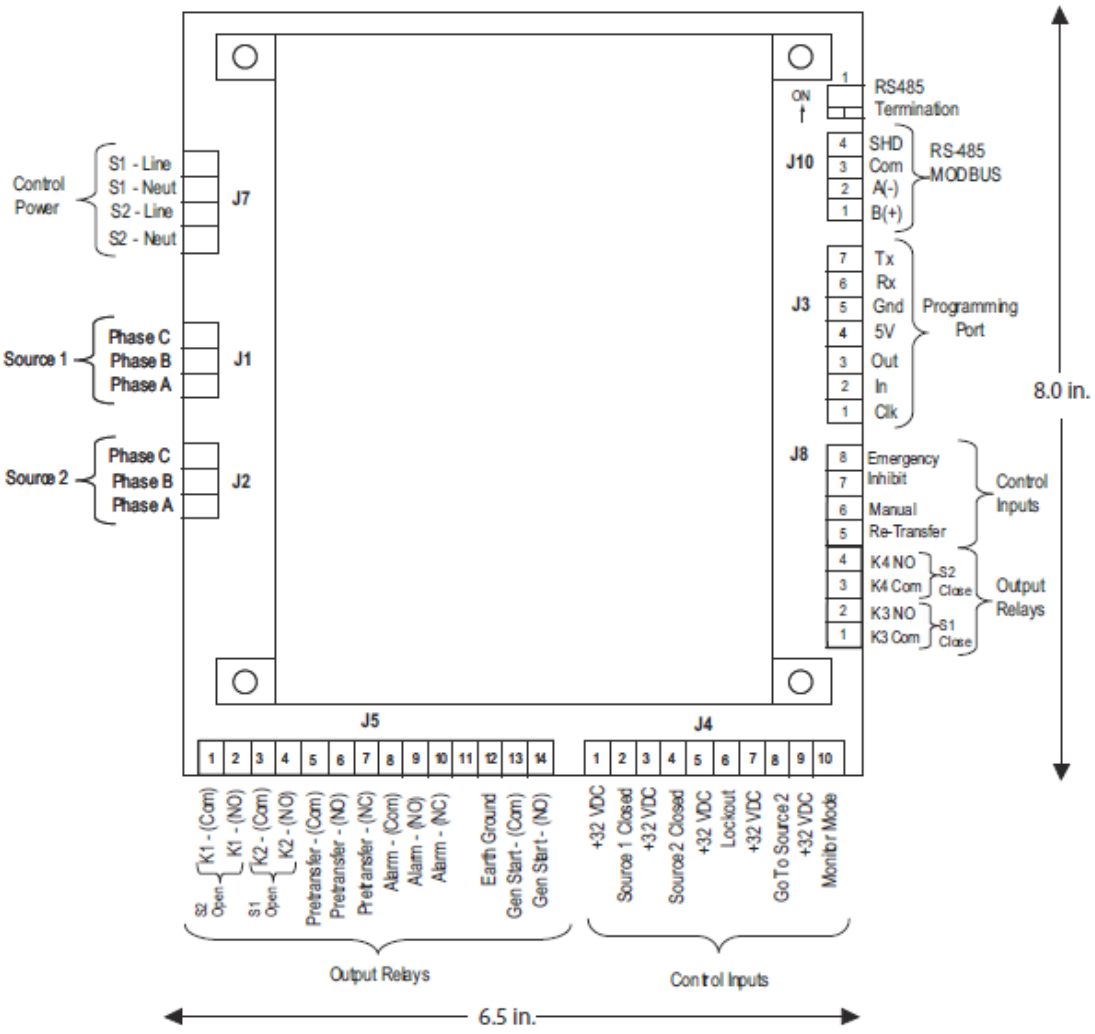
The Decrease pushbutton allows the user to decrease the value of the setpoints. When ATC-300+ Controller is in the “Program” Mode (to change setpoint values), each time the Decrease pushbutton is pressed, the value of the displayed item will decrease by one.

Alarm Reset Function (Increase + Decrease Pushbuttons)

Pressing the Increase and Decrease pushbuttons simultaneously will reset the Alarm function. In addition, if both pushbuttons are pressed simultaneously while viewing any of the historical logged values in the program mode, the value of the current item displayed resets to zero.

Bypass Time Delay Function (Step/Enter + Help/Lamp Test)

Pressing the Step/Enter and Help/Lamp Test pushbuttons simultaneously will bypass the TDNE or TDEN functions when they actively counting. The feature is standard and cannot be disabled by the user.



ATC-300 Rear View

Customer Connections

Generator Start Contact (J5, 13 and 14)

This latching relay is the generator start relay for system configurations that employ a generator as the Source 2 power source. This relay provides a Form A contact of silver alloy with gold flashing for closure of the generator start circuit. The Form A contact is implemented with the Common Pin (J-5, Pin 13) and the Normally Open Pin (J-5, Pin 14). The generator start relay contacts are rated for 5 A, 1/6 HP @ 250 Vac. The DC rating is 5 A @ 30 Vdc with a 150 W maximum load.

Procedure for testing the Gen Start contact.

When you are in the field there will be a voltage on J5,13-14. It will likely be 12 or 24 Volts DC from the engine controller. You may test the contact by using your voltmeter function, which should show full voltage when the contact is open, or zero volts when the contact is closed.

If the generator is not starting on loss of Source 1, remove the wires from the Generator Start Contact and check for continuity. If the generator start contact is closed, short the two wires coming from the generator together to see if the generator starts. If it does not, wiring to the generator and the generator controller must be checked.

Alarm Relay (J5, 8, 9 and 10)

The Form C alarm relay is energized to indicate the presence of one of the following alarm conditions which are fixed in firmware. These conditions will be accompanied by a displayed message. There are no user programmed alarms.

- Circuit breaker (or contactor) fails to open or close within six [6] seconds)
- Motor operator failure (Breaker Type ATS only)
- Lockout (most likely a breaker trip)
- Failsafe condition (Source 2 failed during TDEN timing, causing an immediate retransfer to Source 1)
- Aborted engine test due to Source 2 unavailability
- Aborted plant exerciser test due to Source 2 unavailability
- Unsuccessful in-phase transition

The alarm relay will remain energized until the alarm condition is cleared and "Alarm Reset" is pressed. The Form C contact of this relay may be wired to an alarm annunciator panel to indicate a problem with the ATS. The Form C contact of this relay is implemented with the Common Pin (J-5, Pin 8), the Normally Closed Pin (J-5, Pin 10), and Normally Open Pin (J-5, Pin 9). The alarm relay contacts are rated for 10 A, 1/3 HP @ 250 VAC. The DC rating is 10A @ 30 VDC.

Pre-transfer Relay (J5, 5, 6, and 7)

This Form C relay energizes on a timed basis (1 to 120 seconds) prior to the transfer operation between two available sources. After TDNE/TDEN times out, this relay energizes and the Pre-transfer timer (TD PRE-TRAN) starts timing. After TD PRE-TRAN times out, the transfer proceeds. The pre-transfer relay de-energizes after the transfer is complete. The Form C contact of this relay is implemented with the Common Pin (J-5, Pin 5), the Normally Closed Pin (J-5, Pin 7), and the Normally Open Pin (J-5, Pin 6). The pre-transfer relay contacts are rated for 10 A, 1-3 HP @ 250 VDC. The DC rating is 10 A @ 30 VDC. This contact can be used for elevators, datacenters, or healthcare facilities where prior notification of an impending transfer is desired.

Troubleshooting

The IB for the ATC-300+ Controller (IB01602009E Section 7, Table 3, on page 24) has a detailed troubleshooting guide which lists symptoms, probable causes and possible solutions:

Lab 2: Menu Navigation and Programming Exercise

The objective of this exercise is to teach the student how to navigate the ATC-300+ controller and program setpoints. You will be guided through a scenario where you will be required to identify and correct an erroneous setting. Navigation through the menu is done with the *STEP* button.

Note: There is no way to back up in the menu!

Menu Navigation

1. Confirm Source 1 is "On", Source 2 is "Off" and the Position Selector Switch is on "S1 Conn". This sets the initial state of the demo as source 1 ON, Source 2 OFF and the switch connected to S1.
2. Record what is on the display of the ATC-300 demo? _____
3. Why do you think the message is there? _____
4. Press the STEP button.
5. Record what is on the display. _____
6. Press the STEP button to continue through the menu.
7. Record what is on the display. _____
8. Press the STEP button.
9. Record what is on the display. _____
10. Is the Source 1 Available LED lit? _____
11. Why? (Press the HELP button) _____
12. What could be the problem? _____ _____ _____

View and change setpoints:

You have discovered that Source 1 is not good due to an undervoltage condition however there is what looks like a correct voltage on S1 as recorded in step 5 above. You will now navigate through the menu to investigate and possibly change any incorrect setpoints.

1. Press the STEP button until you see "View System Counters". Use the INCREASE or DECREASE buttons to make it "YES" and press ENTER.
2. What is the total LOAD ENERGIZED HOURS? _____
3. Press STEP until you see "View Setpoints?". Make sure it says "Yes" and press ENTER.

4. Enter “No” for “Change Setpoints?”.

5. Step through the “View Setpoints” menu to find any questionable setpoints. Record those setpoints and their value.

TDES _____	Nominal Voltage_____
TDNE _____	S1 UV Drop _____
TDEN _____	S2 UV Drop _____
TDEC _____	S1 UV Pick _____
Nom Freq. _____	S2 UV Pick _____

6. Do these setpoints explain the problem? _____

7. Change Nominal Voltage to 120 Volts. (password = “0300”)

8. Did you notice that changing the Nominal Voltage automatically changed the individual S1 and S2 voltage setpoints to: (Record the new values)

S1 UV Drop _____	S1 UV Pick _____
S2 UV Drop _____	S2 UV Pick _____
S1 OV Drop _____	S1 OV Pick _____
S2 OV Drop _____	S2 OV Pick _____

9. Continue through the menu and “Save Setpoints”

10. If you have done everything correctly you should see the base status screen with the Source 1 Voltage, Date and Time on the display and “S1 AVAILABLE” LED should be lit.

Program Plant Exerciser

The Plant Exerciser is a feature that provides an automatic test of the generator. The test can be run daily, every 7 days, every 14 days or every 28 days with run duration equal to the programmed engine test time. Step 1 below identifies the parameters that you must enter in order to have the Plant Exercise function. Included below are the parameters from Table 2, Programmable Features and Setpoints from the ATC-300+ Instruction Booklet

This is a paper exercise, it is not necessary to enter these values in the controller. Fill in the values using the table below.

1. Set Plant Exerciser to test weekly on Sunday at 1:30 PM and only run engine for 15 minutes.

    a. Plant Exer = _____

    b. PEDAY = _____

    c. PEHOUR = _____

    d. PEMIN = _____

    e. TER = _____

    f. PE LOAD XFR = _____

PLANT EXER	Days	Plant Exerciser Programming	OFF, DAILY, 7-DAY, 14-DAY or 28 DAY	OFF
PE LOAD XFR		Plant Exerciser Load Transfer	0 or 1 (1 = yes)	0

PE DAY	Days	Plant Exerciser Day of the Week	1 SUN, 2 MON, 3 TUE, 4 WED, 5 THU, 6 FRI or 7 SAT	
PE HOUR	Hours	Plant Exerciser Hour	0 to 23	0
PE MINUTE	Minutes	Plant Exerciser Minute	0 to 59	0

TER	Hours: Minutes	Engine run test time	0 min to 600 min	5:00

Lab 3: Change setpoints in the field per customer request.

Often in the field you may be asked to make setpoint changes by the engineer or the end customer to tailor the ATS to his/her system requirements.

In this particular case the customer has a UPS downstream from the ATS. The UPS will go to battery if the supply voltage drops below 85% of nominal.

1. What is the potential issue with the ATS default dropout set at 80% of Nominal?

   _____

2. Could the UPS go to battery BEFORE the ATS goes to generator? _____

3. The customer has requested that you change the default undervoltage pickup (90% x NOMV) and dropout (80% x NOMV) values. He wants the pickup to be 94% of Nominal, and the dropout to be 86% of Nominal so that the ATS transfers to Source 2 before the UPS goes to battery. Since the setpoints are set in volts, calculate the new values below:

   a. S1 UV PICK = _____.

   b. S1 UV DROP = _____

4. In order to demonstrate this in the classroom hook up the variable voltage supply for Source 1.

   a. Turn OFF MAIN POWER on the controller demo.
   b. You will need to open the sloping panel on the demo. A quarter works very well!
   c. Unplug P1/J1 (Source 1 Sensing) on the back of the controller.
   d. Insert the variable supply inline, then reconnect AC power to the controller demo.

5. Set the dial on the voltage supply to 90%,

6. Set Source 1 to “On”.

7. Set Source 2 to “Off”.

8. Set the Operation Selector Switch to “S1”.

9. Record the controller setpoint values for:

   a. NOM VOLTS _____

   b. S1 UV DROP _____

   c. S1 UV PICK _____

10. Using the variable voltage supply, turn the knob slowly to verify the S1 Pickup and dropout settings.

    a. Press the STEP button for the S1 Voltage display.

    b. With the S1 Available LED lit test for S1 dropout voltage. _____volts

    c. Test for S1 pickup voltage. _____volts.

    d. Do these recorded values verify the values recorded above? _____

11. Change the setpoint values to those requested by the customer.

12. Repeat the verification step, and record the actual pickup and dropout values.

    a. New S1 UV DROP _____

    b. New S1 UV PICK _____

13. Were the values what you expected?

Lab 4: Demonstrate Modified Sequence of Operation.

In this lab you will use the ATC-300+ controller to demonstrate a modified sequence of operation by changing inputs to the controller. **It may be necessary to clear an alarm message. Use ALARM RESET.**

Part 1: Simulated Breaker Trip in a Service Equipment rated Transfer Switch

The LOCKOUT input may be applied as a signal from a breaker bell alarm contact to indicate a trip condition. LOCKOUT "freezes" the controller so that the ATS will not transfer into a fault. The breaker must be reset, and the alarm cleared before the controller will resume normal operation. The LOCKOUT can also be used in some special applications to cause the controller to stop normal operation

1. Put the ATC-300 on the Status Screen. (S1 Voltage, Date and Time). Set Source 1 "On", Source 2 "Off", and set the Position Selector Switch to "Normal".
2. Adjust S1 Voltage to 120 Volts. Is Source 1 Available? _____. If not fix it.
3. Turn the LOCKOUT switch on the demo to "ON".
4. What message appears on the display? _____
5. Return the LOCKOUT Switch to "OFF" Did the "Lockout" message go away? _____
6. Press ALARM RESET and clear the alarm message.

.

Part 2: Failure of the Emergency Source (Source 2)

This lab will demonstrate what happens when the Source 2 fails while waiting to retransfer to Source 1. Normally TDEN will time out but in the case of a Source 2 failure, the controller will first verify the failure of Source 2, check that Source 1 is available, then bypass TDEN and retransfer immediately

7. Turn Source 1 "OFF". When Engine Start Indicator lights, Turn Source 2 "ON"..
8. Wait for transfer to Source 2.
9. Turn Source 1 "ON"
10. While TDEN is counting down, Turn Source 2 "OFF".
11. Note TDEN aborts, TDEF countdown, TDN countdown, retransfer to Source 1.

12. After TDEC a message appears._____

13. What does TDEF mean? _____

14. What does “Failsafe” mean? _____

15. Press Help

16. Record Transfer history details (holds a history of the last 16 transfers).

    Log details _____ Time and date _____

17. Disconnect AC power to the demo, unplug the variable voltage supply and reconnect P1, J1 on the back of the demo. Reconnect AC power to the demo unit.

Part 3: Use the Engine Test button and Run a Load Transfer Engine Test

The Engine Test is intended to permit a periodic performance test of the system. The exact test conditions are determined by the programmed setpoints. Eaton ATS’s are provided with a Test Pushbutton that simulates a loss of the Source 1 power source as standard (Feature 6B). All programmed time delays (TDNE, TDEN, etc.) will be performed as part of the Test.

Engine Run Time of the Test is equal to TER. TER is used by both the Plant Exerciser and the Engine Test PB. All Tests are Failsafe protected. (this means that if connected to Source 2 and the generator fails, an immediate retransfer to Source 1 will take place.)

1. Programmable setpoints for the Engine Test Pushbutton (Setpoint: Test Mode) Include:
    a. Setting an engine test can be:
        - No load engine test = 0
        - Load engine test = 1;
        - Disabled =2;
    b. Engine run time (Setpoint: TER) is the same TER used Plant Exerciser Feature 23)
2. Set the controller to run a “load test” for 2 minutes.
3. Run the Engine test. (you will need to turn Source 2 ON, when the ENGINE START Indicator lights.)
4. Did the engine start and run for 2 minutes? _____
5. Did the history log show a successful test? _____

SEQUENCE OF OPERATION FOLLOW-UP

This exercise applies to all EATON automatic transfer switches. It is to confirm your understanding of the sequence of operation.

Pick one of the timer functions at the bottom of the page for each blank, and fill in the indicators as appropriate.

Status	**Indicators**
1. Normal Power Good/Connected	◯ S1 Avail ◯ S2 Avail ◯ S1 Conn ◯ S2 Conn
2. Loss of Normal Power	◯ S1 Avail ◯ S2 Avail ◯ S1 Conn ◯ S2 Conn
a. _____ Times Out	
b. Generator good	◯ S1 Avail ◯ S2 Avail ◯ S1 Conn ◯ S2 Conn
c. _____Times Out	
d. ATS Connects to GENERATOR	◯ S1 Avail ◯ S2 Avail ◯ S1 Conn ◯ S2 Conn
3. Normal Returns	◯ S1 Avail ◯ S2 Avail ◯ S1 Conn ◯ S2 Conn
a. _____Times Out	
b. ATS Connects to NORMAL	◯ S1 Avail ◯ S2 Avail ◯ S1 Conn ◯ S2 Conn
c. _____Times Out	
d. Generator shuts down	◯ S1 Avail ◯ S2 Avail ◯ S1 Conn ◯ S2 Conn

Use each only once:

TDNE Time Delay Normal to Emergency

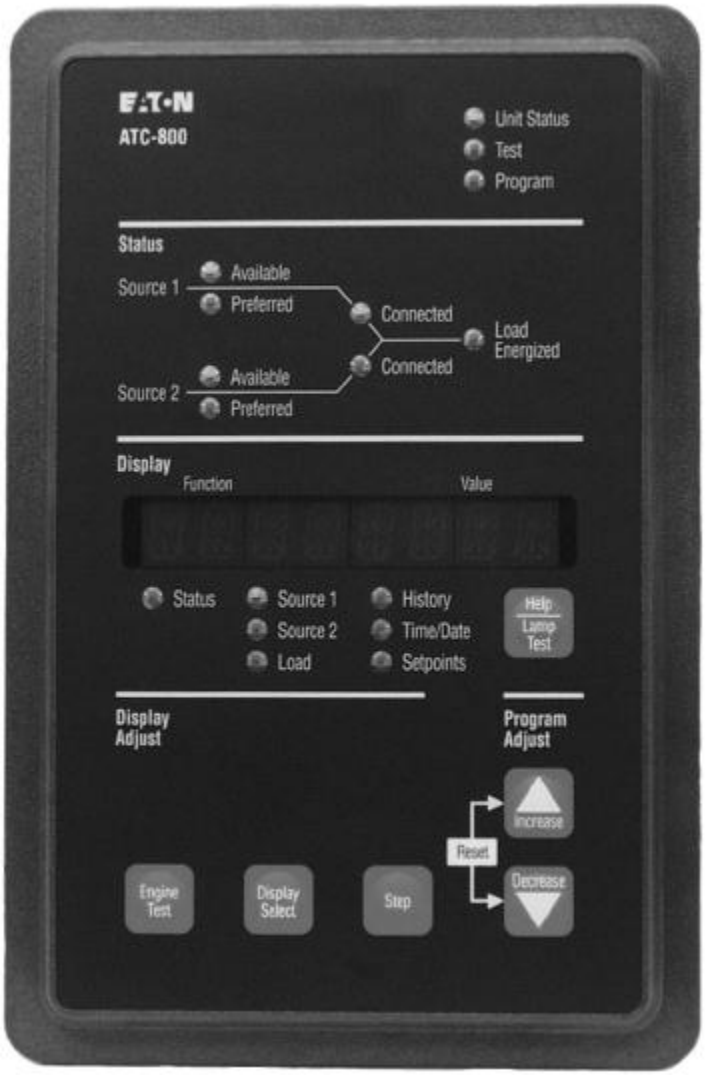
TDES Time Delay Engine Start

TDEN Time Delay Emergency to Normal

TDEC Time Delay Engine Cooldown

ATC-600/800 Controller

The ATC-600/800 is the premium controller currently offered by EATON. It is the standard controller on the MAGNUM ATS, and MAGNUM Bypass/Isolation Transfer Switch. It is also the controller used on all Closed Transition Switches. Because of its reliability over many years, and maximum flexibility it continues to be a mainstay of the EATON ATS line.



ATC 600/800 Controller Front Panel

The ATC-600 and ATC-800 are very similar. The ATC-600 is used on Breaker Type Transfer Switches, both motor operated and Magnum Open Transition. The ATC-800 is used on Magnum Closed Transition, and all Contactor type transfer switches, both open and closed transition.

Care should be taken when replacing a controller. It is advisable to contact the factory with the GO Number and Catalog Number for the exact replacement.

The Display

A single line, 8-character alphanumeric Red LED Display module is used to display all ATC-600/800 Controller monitored parameters, setpoints, and messages in easy to read formats. The red LED display is easily visible, but may be difficult to read in bright direct sunlight.

As a default, when not in use the display will be blank. If an LED below the display is lit, the display will be active.

The LED's

Unit Status

This LED blinks green indicating that the ATC-800 is operating and providing the transfer switch control function in keeping with programmed setpoints. If the LED is not lit or is on continuously, a problem may be indicated.

Test Mode

This LED is lit red upon entering the Test Mode. The Test Mode can only be entered with the LEDs below the display window not lit. When a test is initiated, the Test LED and the Status LED (in the Display Section) both light. Both LEDs will turn off upon the successful completion of a test cycle.

Program Mode

This LED is lit red when the Run/Program switch on the rear of the chassis is in the Program position. This condition permits programming of control setpoints. When the setpoints LED is lit indicating that existing setpoints can be changed, the Program Mode LED blinks.

Source 1 Available

This LED is lit amber if Source 1 meets the criteria for programmed Source 1 setpoints.

Source 1 Preferred

This LED is lit red if Source 1 is the preferred source choice.

Source 1 Connected

This LED is lit green if Source 1 is connected. This is accomplished by sensing a Source 1 device status via an internal closed auxiliary contact in the device.

Source 2 Available

This LED is lit amber if Source 2 meets the criteria for programmed Source 2 setpoints.

Source 2 Preferred

This LED is lit red if Source 2 is the preferred source choice.

Source 2 Connected

This LED is lit red if Source 2 is connected. This is accomplished by sensing a Source 2 device status via an internal closed auxiliary contact in the device.

Load Energized

This LED is lit red if the load is connected to a source that is available.

CAUTION! LOAD LED NOT LIT IS NOT A POSITIVE INDICATION THAT VOLTAGE IS NOT PRESENT ON THE LOAD TERMINALS.

Status

This LED is lit red when action is occurring, such as a timer timing down, and one of the other display categories has not been selected. When the action is completed, the display goes blank and the LED turns off. The Status position is the default position of the display.

Source 1

This LED is lit green when displaying Source 1 voltage, frequency, and status information. The LED also lights when displaying specific Source 1 setpoint information.

Source 2

This LED is lit red when displaying Source 2 voltage, frequency, and status information. The LED also lights when displaying specific Source 2 setpoint information.

Load

This LED is lit red when load voltage is being displayed.

History

This LED is lit red when displaying historical information.

Time/Date

This LED is lit red when displaying the time or date.

Setpoints

This LED is lit red when displaying the programmed setpoints of the ATC-600/800. When a specific displayed setpoint is associated with one of the sources, the specific source LED will also be lit.

The Pushbuttons

The front operations panel supports six blue membrane 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. The Run/Program Switch, located on the right rear chassis, is not a membrane pushbutton. It will, however, be addressed in this section since it is required to move between the Run and Program Modes.

Run/Program Toggle Switch

The right rear mounted Run/Program Toggle Switch establishes whether the ATC-800 is in the Run Mode or the Program Mode. Normally the switch is set in the Run position to permit normal programmed operations. Programmed setpoints can only be altered with the switch in the Program position. Altered setpoints are stored and establish the new operating conditions of the ATC-800 only after the switch is moved back to the Run position.

Help Pushbutton

When the Help Pushbutton is pressed and released with the ATC-800 in any mode, an English language message will scroll across the display. Pushing and releasing the pushbutton a second time will abort the message. Messages and explanations relative to what is being viewed in the display are intended to prompt and assist the operator.

Note: pressing and releasing the help pushbutton with the ATC-600/800 display window blank causes all of the front Panel LEDs to momentarily light before scrolling a message Across the display (figure 4). The message indicates the software version, revision number, and an encoded Catalog number that reveals to EATON what specific Options are included with this particular unit. The customer May be asked for this information by EATON during A troubleshooting or return process.

Display Select Pushbutton

As the Display Select Pushbutton is pressed and released, ATC-600/800 steps through the following display categories:

- Status
- Source 1
- Source 2
- Load
- History
- Time
- Date
- Setpoints

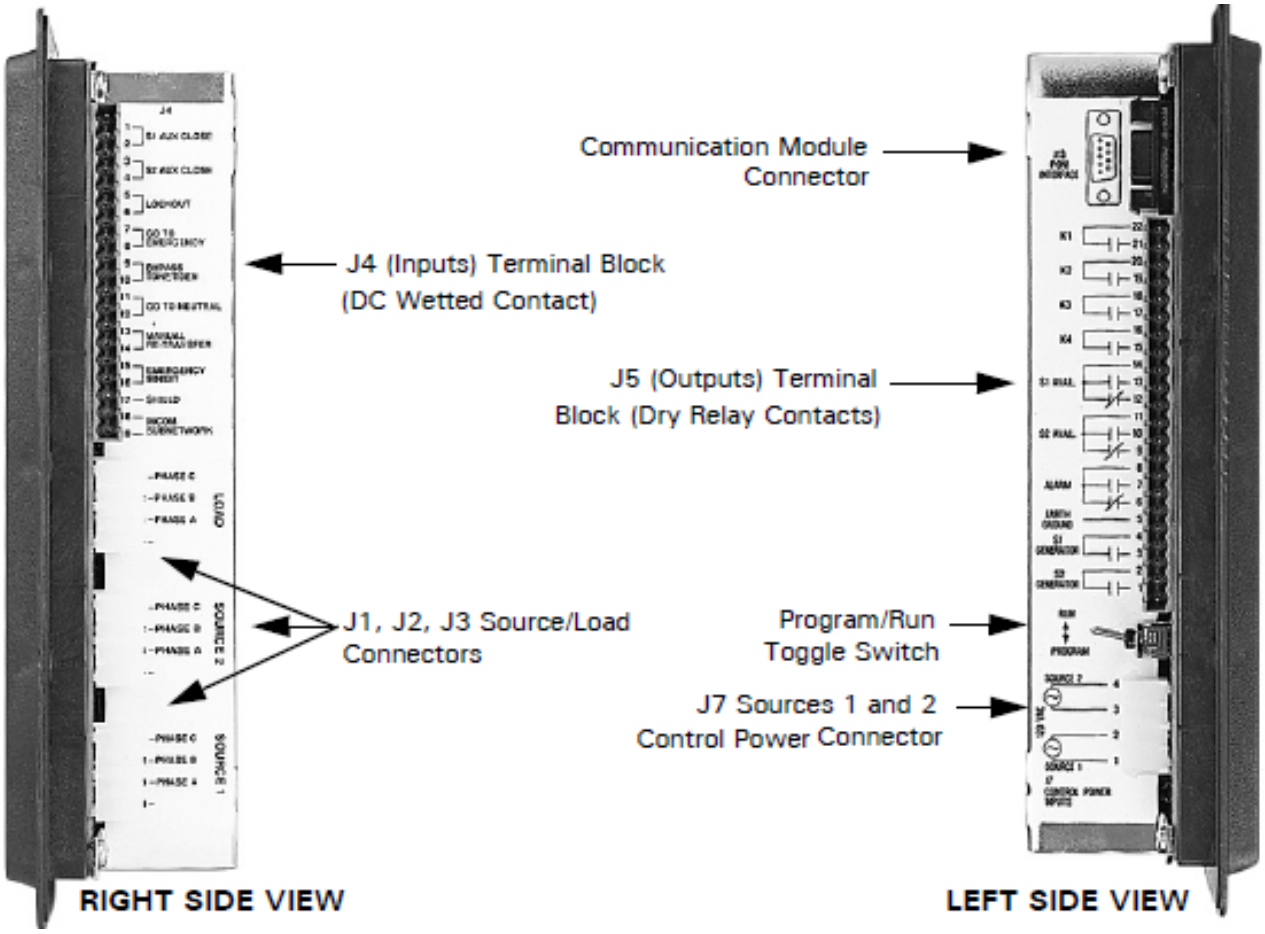
Step Pushbutton

The Step Pushbutton steps through the different available information within the display category selected as the pushbutton is pressed and released. When Source 1 is the category displayed for example, use of the Step Pushbutton will step the display through the voltages, frequency and status condition associated with Source 1. In the Time/Date category, however, this pushbutton has an additional purpose. The Step Pushbutton is also used to permit programming of the time and date by stepping through the different time and date categories (Hours, Minutes, Month, Day and Year). The actual time or date category is moved up or down using the Decrease or Increase Pushbuttons described next.

Increase and Decrease Pushbuttons

These pushbuttons, when pressed and released for step by step changes or held depressed for scrolling, increase or decrease setpoints while in the Programming Mode or make Time/Date changes. While historical information is being displayed, the Increase Pushbutton will scroll through events, and the Decrease Pushbutton will scroll through the actual time and date of the event. In addition, if both buttons are pressed and released simultaneously while viewing any of the historical logged values, the value resets to zero. Refer to paragraph 3.4.4 and Appendix B in the IB for additional information pertaining to accessing historical information and historical data definitions. Simultaneously pressing and releasing the Increase and Decrease Pushbuttons will also reset an alarm condition.

ATC-600/800 Rear View



Communications Module Connector

ATC-600/800 is an IMPACC (Integrated Monitoring Protection and Control Communications) compatible device. As such, it can be remotely monitored, controlled and programmed when equipped with the communications option. The ATC-600/800 is supplied with a communications port as standard. As such devices like the IPONI, MPONI, etc. may be directly mounted to the controller, and communications may be achieved using Power Xpert®, PowerNet®, PowerPort® or Modbus. Consult the factory for available communications options.

Further information on the ATC-600 and ATC-800 controllers may be obtained in the following Instruction Booklets:

ATC-600 IB-ATS-1005

ATC-800 IB-ATC-CI03

ATC-900 Controller

The ATC-900 is the newest Eaton ATS controller. It is a comprehensive, multifunction, microprocessor based controller which provides an unmatched degree of flexibility to address the needs of any system. Ultimately destined to replace the ATC-600/800 in all applications, it will be standard on the Magnum ATS and Bypass / Isolation and closed transition switches, and it will be the high end controller on the open transition contactor and breaker type transfer switches.

ATC-900 Front Panel

Display

The Color Thin Film Transistor Liquid Crystal Display (TFT) window is used to display all ATC-900 monitored parameters, setpoints and messages in easy to read formats. The display is approximately 2.25" x 4" (57.15mm x 101.6mm).

USB Port

Every ATC-900 transfer switch includes a front panel, NEMAT 4X rated, USB port for use in uploading set points or downloading event data to a USB flash drive. Set points can be preconfigured and saved on the flash drive to reduce the time spent on-site for commissioning or set points can quickly be copied from one ATS and uploaded to another. No laptop is required. Downloading event data provides the ability to more thoroughly analyze information using a PC or data can be quickly e-mailed when offsite troubleshooting support is required.

LED'S

LEDs are used to indicate the device's mode of operation, the status of the system, and the operations and/or conditions of displayed functions. The LED at the top of the ATC-900 provides a quick snapshot of the unit's status (Mode). Six LEDs, just above the display window, indicate which portions of the mimic bus are active, and the actual status of both sources

Unit Status

This LED blinks green indicating that the ATC-900 is operating and providing the transfer switch control function in keeping with programmed setpoints. If the LED is not lit or is on continuously, a problem may be indicated.

Source 1 Available

This LED is lit white if Source 1 meets the criteria for programmed Source 1 setpoints.

Source 1 Preferred

This LED is lit red if Source 1 is the preferred source choice.

Source 1 Connected

This LED is lit green if Source 1 is connected. This is accomplished by sensing the Source 1 breaker via the S1 closed auxiliary contact.

Source 2 Available

This LED is lit amber if Source 2 meets the criteria for programmed Source 2 setpoints.

Source 2 Preferred

This LED is lit red if Source 2 is the preferred source choice.

Source 2 Connected

This LED is lit red if Source 2 is connected. This is accomplished by sensing the Source 2 breaker via the S2 closed auxiliary contact.

Pushbuttons

The front operations panel supports seven blue membrane pushbuttons. Certain pushbuttons, like the Increase and Decrease Pushbuttons, will also continue to scroll if they are pressed and not released.

Help Pushbutton

When the Help pushbutton is pressed and released with the ATC-900 in any mode, the display will show a message. Pushing and releasing the pushbutton a second time will abort the message. Messages and explanations relative to what is being viewed in the display are intended to prompt and assist the operator.

Engine Test Pushbutton

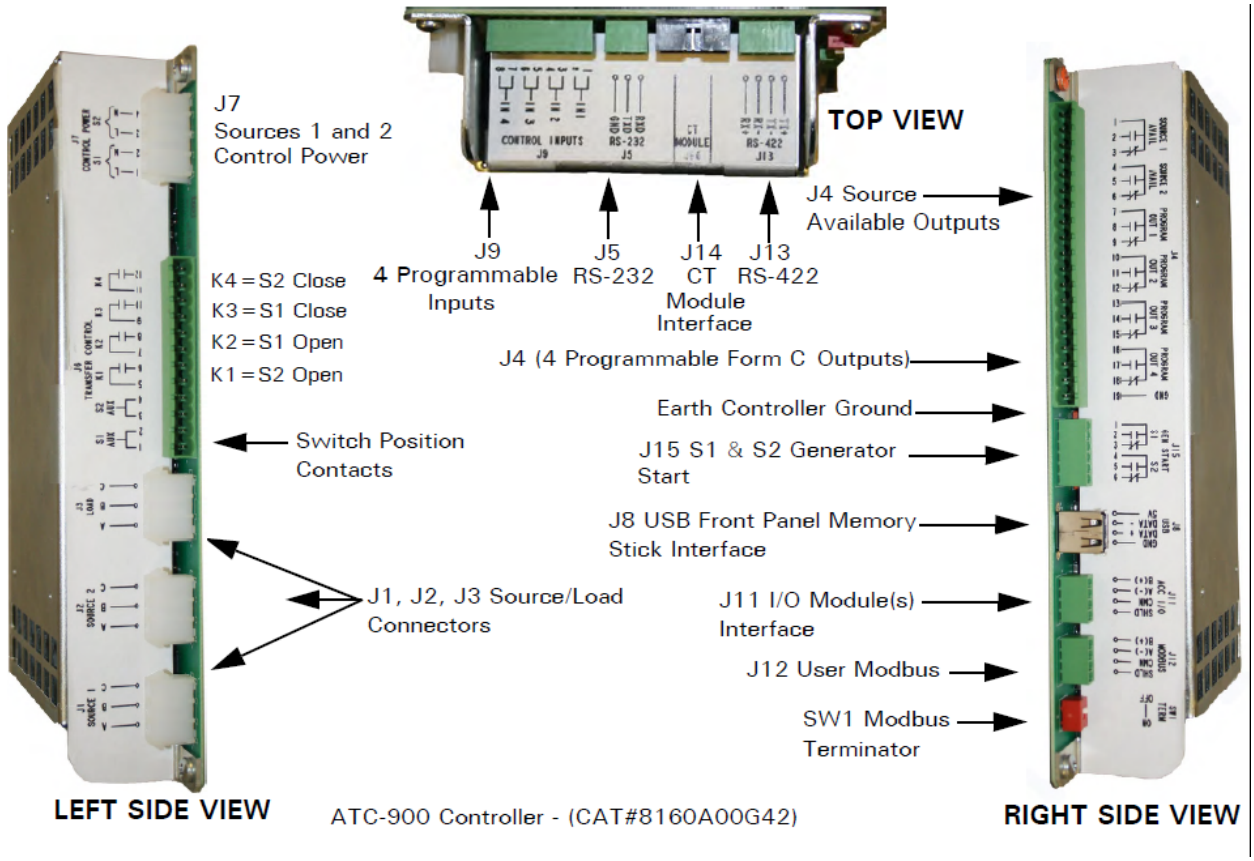
A self-test is initiated when the engine test pushbutton is pressed and the controller password is entered. (Default is 0900) Pressing the Engine Test Pushbutton again while in the engine run condition aborts the test. Upon test initiation, a generator start of the non-preferred source is engaged after the Time Delay Engine Start timeout. If a load test is programmed, a transfer with all programmed times occurs. The ATC-900 includes a unique set of independently programmable time delays activated during a test. The test engine run timer will hold the load for the required timeout and the test is concluded with a retransfer cycle. For an engine run only test, no transfer will occur and the engine will run for the programmed run time.

Enter Pushbutton

The Enter pushbutton allows the user to select different areas of the display after arrow buttons complete the area of need.

Increase, Decrease, Left, and Right Arrow Pushbuttons

These pushbuttons, when pressed and released for step by step changes or held depressed for scrolling, increase, or decrease setpoints. While historical information is being displayed, the Increase pushbutton will scroll through events, and the Decrease pushbutton will scroll through the actual time and date of the event. The pushbuttons allow for navigation through the menus for all functionality.



Rear Panel ATC-900 Controller

Inputs

The rear access area provides for access to all input connections. Each contact input is wetted by 50 volts at 10 ma. There are two types of I/O, programmable and fixed. Most I/O is programmable by the user at any time. There are a few that are fixed from the factory. These I/O are fixed as the functions they performed are critical, therefore cannot be reprogrammed by a user. (Ex: Go to Emergency, Option 26, is initiated by a contact closure on IN 4.)

There are two inputs which are always needed for ATS operation.

Source 1 Aux

This input is located on pins 1 and 2 of connector J6 and wired to the Source 1 breaker (or contactor) dry auxiliary contact that is closed when the Source 1 breaker is closed.

Source 2 Aux

This input is located on pins 3 and 4 of connector J6 and wired to the Source 2 breaker (or contactor) dry auxiliary contact that is closed when the Source 2 breaker is closed.

There are FOUR standard programmable input functions. Listed below are more common available functions. If these functions are provided by the factory, they will be locked, therefore not allowing a field change by the user. Additional I/O modules with 4 Inputs and 4 outputs are available. A maximum of THREE additional modules may be used for a maximum total of 20 inputs and 20 outputs.

Lockout

The Lockout contact is closed to indicate normal, automatic operation. Opening this contact will inhibit all automatic operation. This feature is included when Non-automatic control is required. The ATC-900 continues to monitor source status and will accurately display status on the controller's MIMIC bus.

Go To Emergency

When the external contact is closed, a transfer to the Emergency Source will be initiated. If the Emergency Source should fail and the Normal Source is available, the ATC-900 will initiate a transfer back to the Normal Source (failsafe). The Go To Emergency input is only active when either Source 1 or Source 2 is preferred. This input is not active when the Preferred Source selection is set to None. The ***Emergency Inhibit*** input takes priority over the Go To Emergency input if both inputs are activated at the same time. In this case, the generator will start but a transfer to the Emergency Source will be inhibited until the Emergency Inhibit input is de-activated.

Bypass Timers

A momentary contact will bypass the timer for TDNE and/or TDEN. By pushing the two buttons on the front of the controller (Bypass Timer) will also bypass either timer. There is also a programmable input that will allow the bypass timer to be completed remotely if desired.

Go To Neutral

A maintained closed contact forces the controller to switch to the Neutral position, thereby disconnecting the load from both sources. Manual Re-Transfer With manual operation set, a momentary closure allows the ATC-900 to proceed with a re-transfer operation at the operator’s discretion. Should a failure of the emergency source occur while waiting for the manual return, the re-transfer precedes automatically failsafe.

Manual Re-Transfer

With manual operation set, a momentary closure allows the ATC-900 to proceed with a re-transfer operation at the operators' discretion. Should a failure of the emergency source occur while waiting for the manual return, the re-transfer precedes automatically failsafe.

Emergency Inhibit

This input is enabled when the Emergency Inhibit optional feature (36) is enabled. The contact is closed for normal operation. Opening this contact will activate the Emergency Inhibit input. If the Emergency Inhibit contact is opened when the load is connected to the Normal Source, no action will be taken if the Normal Source is available. If the Normal Source is not available, an immediate transfer to the Neutral position will occur. If the Emergency Inhibit contact is opened when the load is connected to the Emergency Source, the ATC-900 will transfer the load to the Normal Source if it is available. If the Normal Source is not available, an immediate transfer to the Neutral position will occur if the Emergency Source is available. The Emergency Inhibit input is only active when either Source 1 or Source 2 is preferred. This input is not active when the Preferred Source selection is set to None. The Emergency Inhibit input takes priority over the Go To Emergency input if both inputs are activated at the same time. In this case, the generator will start but a transfer to the Emergency Source will be inhibited until the Emergency Inhibit input is de-activated. The switch will transfer to the Neutral position.

The ATC-900 Master/Slave controller

Functionality provides the user with the ability to control a three source system consisting of a utility and two generator sources. In a three source system, the Master ATS controls the engine starting and stopping of the Slave ATS. In the event of a source 1 power failure, the Master ATS engine start relay closes signaling the Slave ATS to start the preferred generator. (Note: The Slave ATS requires the DCT module for a DC power input.) The Master ATS handles all transfer time delays between the Utility to Generator transfer. If the preferred generator does not start within the programmed time delay, the Slave ATC-900 will signal the non-preferred generator to start. If "None Preferred" is selected, then both generators will start and the slave ATS will transfer to the first generator source available. The second generator will shut down after the ATC-900 senses the load is connected to an available source.

Outputs

S1 Available

This Form C relay is used to indicate the availability of Source 1. The full Form C contact of this relay is implemented with common pin 1, normally closed pin 3, and normally open pin 2 of connector J4. This relay duplicates the Source 1 available status LED meaning that the setpoint criteria have been met. The relay contacts are rated for 10 A, 1-3 HP @ 250 VAC. The DC rating is 10 A @30 VDC.

S2 Available

This Form C relay is used to indicate the availability of Source 2. The full Form C contact of this relay is implemented with common pin 4, normally closed pin 6, and normally open pin 5 of connector J4. This relay duplicates the Source 2 available status LED meaning that the setpoint criteria have been met. The relay contacts are rated for 10 A, 1-3 HP @ 250 VAC. The DC rating is 10 A @30 VDC.

S1 Generator

This latched coil relay provides a Form C contact on pins 1(COM), 2 (NO), 3 (NC) of connector J15. The relay is the generator start relay for system configurations employing a generator on the input source designated Source 1. The generator start relay contacts are rated for 5 A, 1/6 HP @ 250 VAC. The DC rating is 5 A @ 30 VDC.

S2 Generator

This latched coil relay provides a Form C contact on pins 4 (COM), 5 (NO), 6 (NC) of connector J15. The relay is the generator start relay for system configurations employing a generator on the input source designated Source 2. The generator start relay contacts are rated for 5 A, 1/6 HP @ 250 VAC. The DC rating is 5 A @ 30 VDC

Output Relays K1, K2, K3, K4

The K relay outputs are used to control the transfer device. Although the K relays are usually the same for all switches, Power Breakers, Contactors, and Motor Driven Breakers. The K function as follows

K1 = S2 Open (Trip)

K2 = S1 Open (Trip)

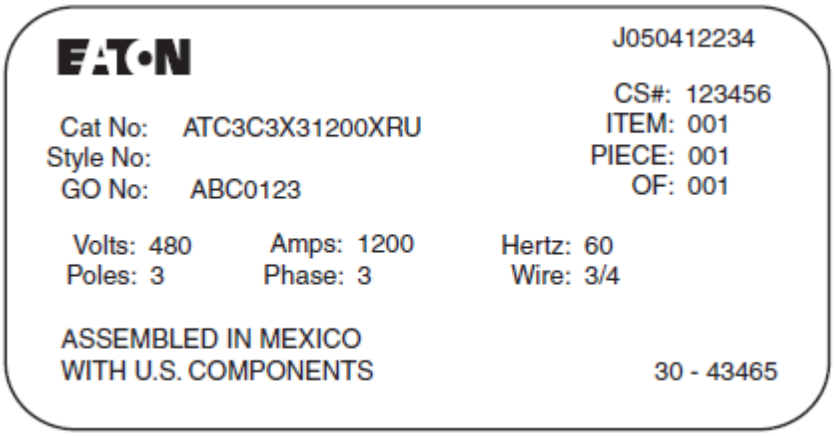
K3 = S1 Close

K4 = S2 Close.

Unidirectional motor, and two-position contactor switches use only the K1 and K2 contacts.

Identifying an EATON Transfer Switch

In the following pages, details will be presented on the available Eaton Products. The focus is to provide the service person with the ability to gather information should it be necessary to get help from ATS Technical Support. Each Transfer Switch will have a nameplate affixed to the chassis that looks like this:



Information that is helpful is:

Catalog Number (Cat No:) determines the basic Transfer Switch configuration.

Style Number (Older Transfer Switches may have this)

General Order Number (GO No:) will help factory determine supplied optional features or COE items.

Item Number (ITEM:) Identifies specific switch on GO#

Rating Information, Volts, Amps, Hertz, Poles, Phase, and Wire

Actual System Voltage of the user site. Does it differ from supplied system?

Is this a StartUp / Commissioning or Problem Call.

The catalog system charts that follow have been developed to help you determine the basic switch configuration from the catalog number.

Contactor Transfer Switches

Contactor based designs tend to have a smaller footprint due to fewer moving parts and a smaller power contactor. The Contactor based ATS can be applied for those applications not requiring a higher withstand rating. Applications requiring open in-phase transfer are more suited to two-position contactor type design. A two-position solenoid operated contactor type design will operate with a shorter dead bus time than a comparable motor operated breaker-based design. This shorter dead bus time enables the ATS controller to perform the open in-phase transfer. In applications where delayed transition is required, a three-position contactor type design is used.

Contactor type Transfer Switches are not protective devices and MUST have a breaker or fuse ahead of the TSE for protection.

Contactor Transfer Switches are used in all types of ATS. (Open In-Phase, Open Time Delay Transition, Open Load Voltage Decay, and Closed Transition)

Typical Eaton Contactor ATS

EXERCISE: Contactor Type ATS Cat#

Using the Eaton Catalog number **ATC3C3X31000XRU** fill in the 10 characteristics of the ATS from the Contactor ATS chart on the following page.

#	Characteristic	Description
1	Basic Device	
2	Switching Device	
3	Control	
4	Switch Type	
5	Device Mounting	
6	# Poles	
7	Amperes	
8	System Voltage	
9	Enclosure	
10	Listing	

Using the Eaton Catalog number from the Contactor Demo Transfer Switch, fill in the 10 characteristics of the ATS.

#	Characteristic	Description
1	Basic Device	
2	Switching Device	
3	Control	
4	Switch Type	
5	Device Mounting	
6	# Poles	
7	Amperes	
8	System Voltage	
9	Enclosure	
10	Listing	

Eaton Contactor Type ATS Catalog System
Use ONLY to identify existing Switch! Do NOT build a Catalog Number from this table.

Example: **AT C 3 C3 X 2 0225 W R U**
1 2 3 4 5 6 7 8 9 10

1	Basic Device	2	Switching Device	3	Control
AT	Automatic Transfer Switch	C	Contactor	1	ATC100
NT	Nonautomatic Transfer Switch			3	ATC300
CT	Closed Transition Transfer Switch			8	ATC800
				E	Electromechanical

4	Switch Type	5	Device Mounting	6	# Poles
C2	Two Position Contactor	X	Fixed Mount	2	Two (2)
C3	Three Position Contactor			3	Three (3)
C5	Three Position Contactor w/InPhase & TDN			4	Four (4)

7	Amperes	8	Voltage	9	Enclosure
0040	40	A	120VAC/60Hz	S	Type 1
0080	80	B	208VAC/60Hz	J	Type 12
0100	100	E	600VAC/60Hz	R	Type 3R
0150	150	G	220VAC/50Hz	K	None
0200	200	H	380VAC/50Hz		
0225	225	M	230VAC/50Hz		
0260	260	O	415VAC/50Hz	**10**	**Listing**
0400	400	W	240VAC/60Hz		
0600	600	X	480VAC/60Hz	U	UL/ULC
0800	800			X	No Listing
1000	1000				
1200	1200				
1600	1600				

Breaker Transfer Switches 30 – 1000 Amps

Breaker TSE designs typically use the Eaton Series C™ Molded Case Switch (Special Instantaneous Trip) or Molded Case Circuit Breaker. Where higher withstand ratings are required the Series C™ devices have a withstand rating of 65ka at 480 volts.

Applications requiring a service entrance rating are more readily met with a breaker-based design. An overcurrent trip is added to the molded-case switch without increasing the footprint and the entire SE rated switch is UL 1008 approved.

The Eaton breaker-based designs are inherently delayed transition type and this transition type is more suited to highly inductive loads, dual utility applications, and where older AFDs may be used downstream.

All of the Eaton Breaker Transfer Switches may be configured with overcurrent trip units and listed as Suitable for Use as Service Equipment, saving the customer money and space.

Typical EATON Breaker Type ATS (Deadfront Removed)

EXERCISE: Breaker Type ATS Cat#

Using the Eaton Catalog number **ATVILDC30400WRU** fill in the 10 characteristics of the ATS from the Breaker ATS chart on the following page.

#	Characteristic	Description
1	Basic Device	
2	Breaker Orientation	
3	Control	
4	Breaker Frame	
5	MCS/MCCB	
6	# Poles	
7	Amperes	
8	System Voltage	
9	Enclosure	
10	Listing	

Using the Eaton Catalog number from the Breaker Demo Transfer Switch, fill in the 10 characteristics of the ATS.

#	Characteristic	Description
1	Basic Device	
2	Breaker Orientation	
3	Control	
4	Breaker Frame	
5	MCS/MCCB	
6	# Poles	
7	Amperes	
8	System Voltage	
9	Enclosure	
10	Listing	

Eaton Breaker Type ATS Catalog System
Use ONLY to identify existing Switch! Do NOT build a Catalog Number from this table.

Example: **AT V I KD A 3 0225 X R U**
1 2 3 4 5 6 7 8 9 10

1	**Basic Device**
AT	Automatic Transfer Switch
NT	Nonautomatic Transfer Switch
MT	Manual

2	**Breaker Orientation**
H	Horizontal
V	Vertical

3	**Control**
1	ATC100
3	ATC300
I	ATC600
E	Electromechanical
X	None

4	**Breaker Frame**
FD	HFD Frame
KD	HKD Frame
LD	HLD Frame
MD	HMD Frame
NB	HNB Frame

5	**MCS/MCCB**
A	MCS (Both)
B	MCCB (Both)
C	MCCB (N) / MCS (E)
D	MCS (N) / MCCB (E)

6	**# Poles**
2	Two (2)
3	Three (3)
4	Four (4)

7	**Amperes**
0030	30
0070	70
0100	100
0150	150
0225	225
0300	300
0400	400
0600	600
0800	800
1000	1000
1200	1200

8	**Voltage**
A	120VAC/60Hz
B	208VAC/60Hz
E	600VAC/60Hz
G	220VAC/50Hz
H	380VAC/50Hz
K	600VAC/50Hz
M	230VAC/50Hz
N	401VAC/50Hz
O	415VAC/50Hz
W	240VAC/60Hz
X	480VAC/60Hz
Z	365VAC/50Hz

9	**Enclosure**
S	Type 1
J	Type 12
R	Type 3R
K	None

10	**Listing**
U	UL/ULC
X	No Listing

Magnum Transfer Switch (600 – 5000 Amp)

The Magnum ATS comes in both a standard transfer switch, and a Bypass/Isolation Transfer Switch version.

The ATS is available in both Drawout and Fixed Mount version, and both of these are available with a Through-Door Option. Standard is an Insulated Case Switch with no trip unit. The full line of Digitrip Trip Units are available as options. Magnum ATS is available in OPEN Transition with Time Delay, Load Voltage, or In-phase, or CLOSED Transition.

The Magnum is also available in a Bypass/Isolation Transfer Switch design, only in a drawout version.

Through-the Door **Behind-the-Door**

Typical Magnum Transfer Switches

EXERCISE: Magnum Type ATS Cat#

Using the Eaton Catalog number **CBVIMGG33200XJU** fill in the 10 characteristics of the ATS from the Magnum ATS chart on the following page.

#	Characteristic	Description
1	Basic Device	
2	Breaker Orientation	
3	Control	
4	Breaker Frame	
5	MCS/MCCB	
6	# Poles	
7	Amperes	
8	System Voltage	
9	Enclosure	
10	Listing	

Eaton Magnum Type ATS Catalog System
Use ONLY to identify existing Switch! Do NOT build a Catalog Number from this table.

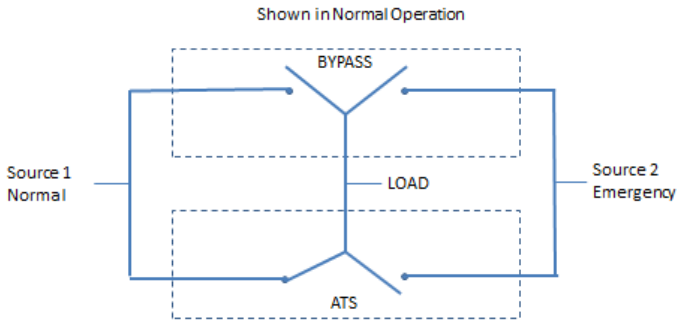
Example: **AT V I MG A 3 2000 X R U**
1 2 3 4 5 6 7 8 9 10

1	Basic Device	2	Breaker Orientation	3	Control
AT	Automatic Transfer Switch	V	Vertical	I	ATC600 (AT & BI)
CT	Closed Transition Transfer Switch			I	ATC800 (CT & CB)
BI	Bypass / Isolation Transfer Switch			E	Electromechanical
CB	Closed Transition Bypass / Isolation				
NT	Nonautomatic Transfer Switch				

4	Breaker Frame	5	MCS/MCCB	6	# Poles
MG	Magnum DS	A	Fixed MCS (Both)	2	Two (2)
		B	Fixed MCCB (Both)	3	Three (3)
		C	Fixed MCCB (N) / MCS (E)	4	Four (4)
		D	Fixed MCS (N) / MCCB (E)		
		E	Drawout MCS (Both)		
		F	Drawout MCCB (Both)		
		G	Drawout MCCB (N) / MCS (E)		
		H	Drawout MCS (N) / MCCB (E)		

7	Amperes	8	Voltage	9	Enclosure
0200	200	A	120VAC/60Hz	S	Type 1
0300	300	B	208VAC/60Hz	J	Type 12
0400	400	E	600VAC/60Hz	R	Type 3R
0600	600	G	220VAC/50Hz	K	None
0800	800	H	380VAC/50Hz		
1000	1000	K	600VAC/50Hz		
1200	1200	M	230VAC/50Hz	**10**	**Listing**
1600	1600	N	401VAC/50Hz		
2000	2000	O	415VAC/50Hz	U	UL/ULC
2500	2500	W	240VAC/60Hz	X	No Listing
3200	3200	X	480VAC/60Hz		
		Z	365VAC/50Hz		

Bypass / Isolation Transfer Switch



The Bypass / Isolation Transfer Switch is applied where there is a desire to maintain power to a load even when the ATS needs to be down for maintenance. The schematic above indicates that the equipment is really two transfer switches connected in parallel with the ATS section typically in a drawout configuration so that it may be maintained.

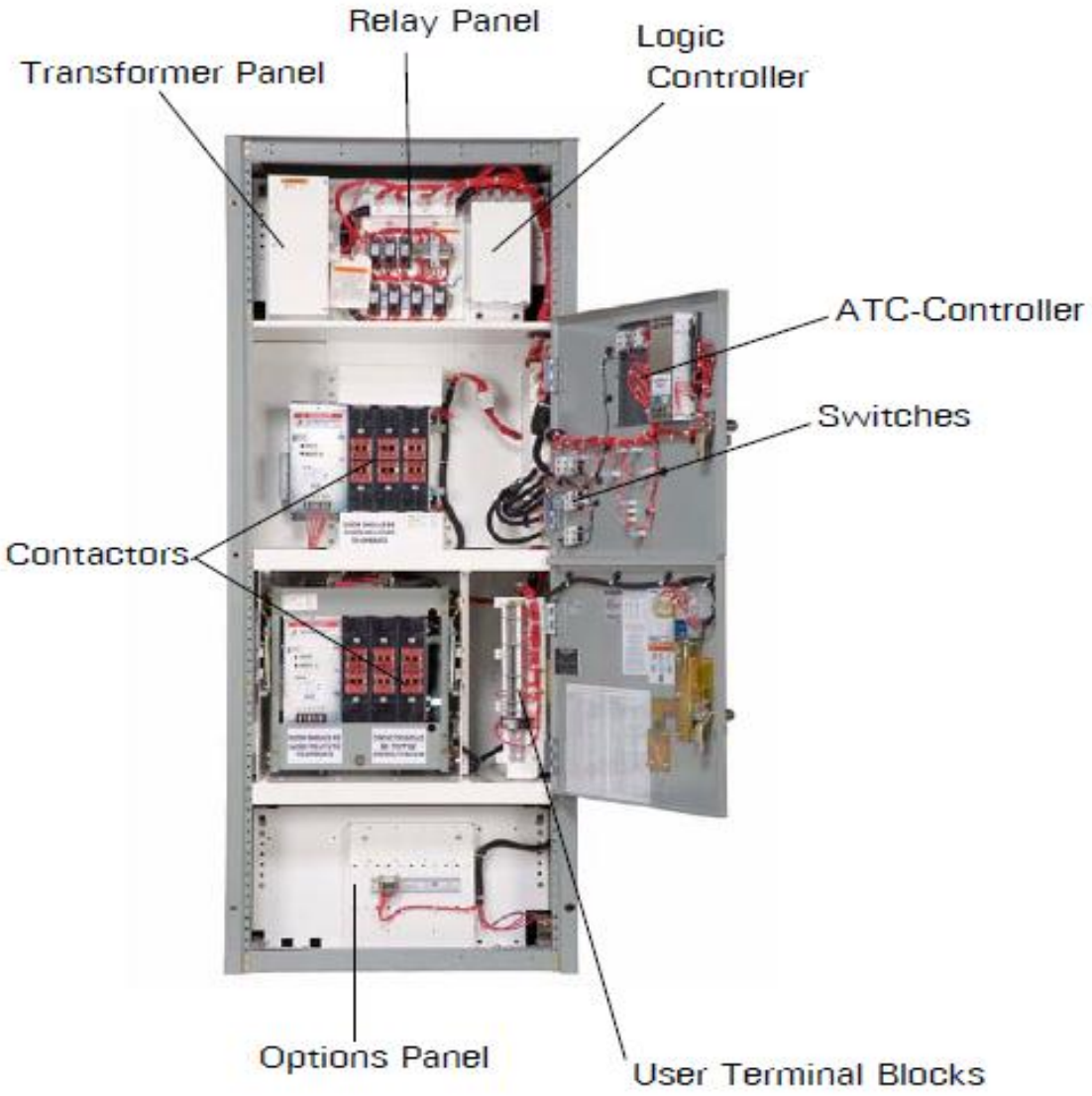
EATON makes two Bypass / Isolation Transfer Switches:

1. A contactor type, which is available from 40 to 1600 amps.
2. A MAGNUM type which uses 4 Magnum Breakers and is available from 600 to 3200 amps.

The Eaton designs offer some significant benefits:

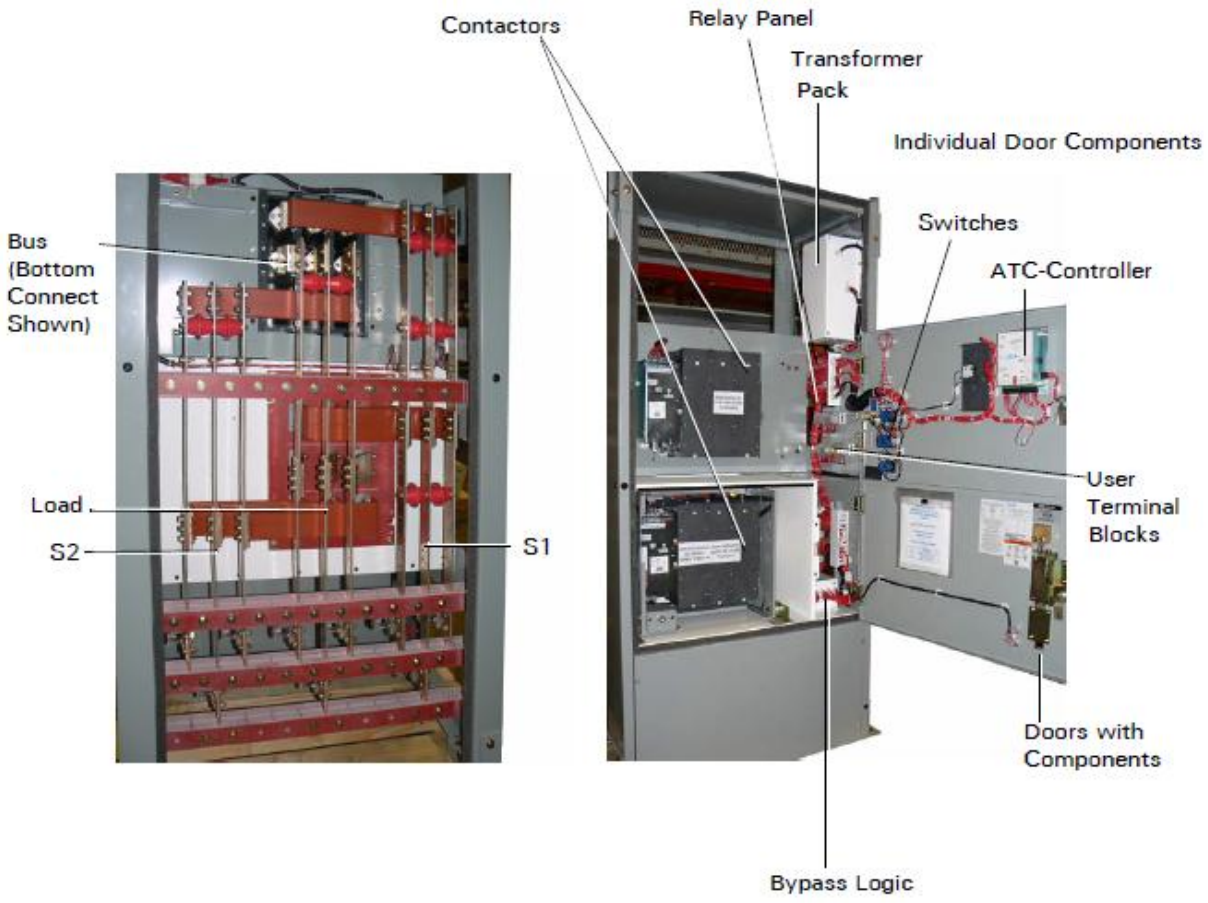
- The contactor ATS is available optionally in a dual drawout design, making maintenance of the bypass section as easy as maintaining the ATS section. In the drawout design the contactors are interchangeable allowing maximum flexibility.
- The contactor type, when switched to BYPASS operation redirects the controller to act with the BYPASS section making it fully automatic. This feature is unique to the EATON design.
- The MAGNUM Bypass/Isolation uses drawout type switches or breakers. This allows manual bypass operation and maximum flexibility with interchangeability of switching devices.
- The MAGUM Bypass / Isolation has the highest standalone ratings in the industry. With 85ka at 480 volt UL1008 Short Time Ratings, the equipment offers maximum flexibility to meet the NEC requirements for coordination of the Emergency System.

Typical EATON Contactor Type Bypass / Isolation Transfer Switches



Up to 400 Amp Construction

Typical EATON Contactor Type Bypass / Isolation Transfer Switches



Rear View **Front View**

Typical 600-1600 Amp Construction

Eaton Bypass/Isolation Contactor Type ATS Catalog System
Use ONLY to identify existing Switch! Do NOT build a Catalog Number from this table.

Example: **CB C 8 C3 X 3 0600 X S U**
1 2 3 4 5 6 7 8 9 10

1	Basic Device	2	Switching Device	3	Control
BI	Open Transition Bypass / Isolation	C	Contactor	3	ATC300
CB	Closed Transition Bypass / Isolation			8	ATC800

4	Switch Type	5	Device Mounting	6	# Poles
C3	Three Position Contactor	X	Fixed Mount Bypass	2	Two (2)
C5	Three Position Contactor w/InPhase & TDN	E	Drawout Bypass	3	Three (3)
				4	Four (4)

7	Amperes	8	Voltage	9	Enclosure
0040	40	A	120VAC/60Hz	S	Type 1
0080	80	B	208VAC/60Hz	J	Type 12
0100	100	E	600VAC/60Hz	R	Type 3R
0150	150	G	220VAC/50Hz		
0200	200	H	380VAC/50Hz		
0225	225	K	600VAC/50Hz	**10**	**Listing**
0260	260	M	230VAC/50Hz		
0400	400	N	401VAC/50Hz	U	UL/ULC
0600	600	O	415VAC/50Hz	X	No Listing
0800	800	W	240VAC/60Hz		
1000	1000	X	480VAC/60Hz		
1200	1200	Z	365VAC/50Hz		
1600	1600				

Typical EATON MAGNUM Bypass / Isolation Transfer Switch

Note Cable Pull Section for Front Connection

600-2000 Amp Magnum w/ Front Connected Cable Pull Section

For catalog information, see the MAGNUM catalog sheet on Page 62.

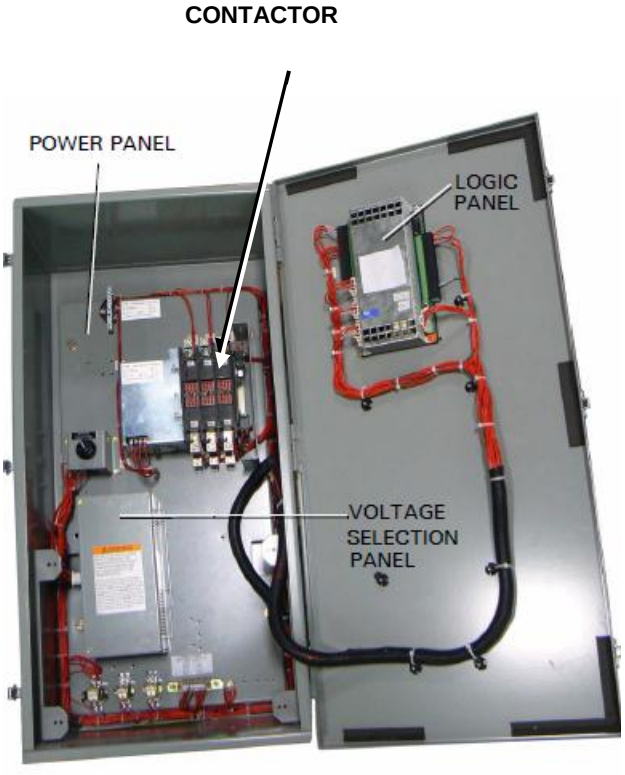
EATON Transfer Switch Operation

The Eaton Contactor ATS

The Contactor ATS has three basic components.

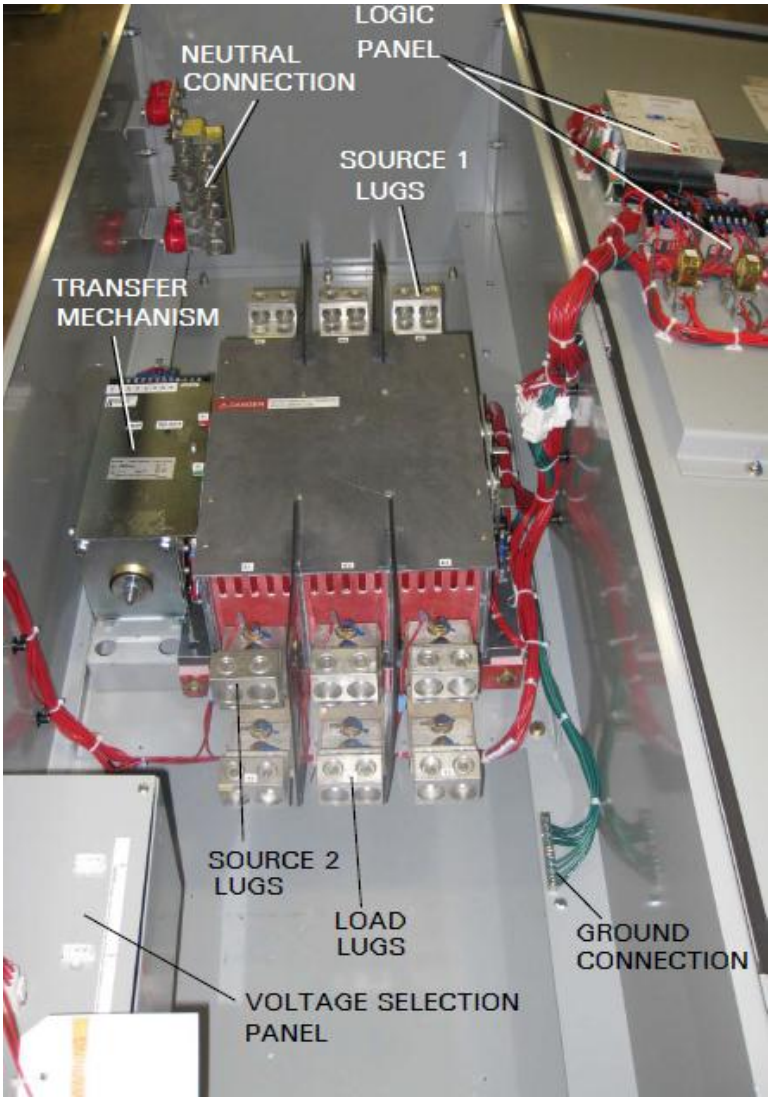
1. The power panel;
2. The voltage selection and transformer panel; and
3. The microprocessor-based logic panel.

These panels are interconnected via connector plugs and mounted in an enclosure.



Typical 40 – 400 Amp Wall Mount Contactor ATS (Open Transition)

Typical Wall Mount Contactor ATS



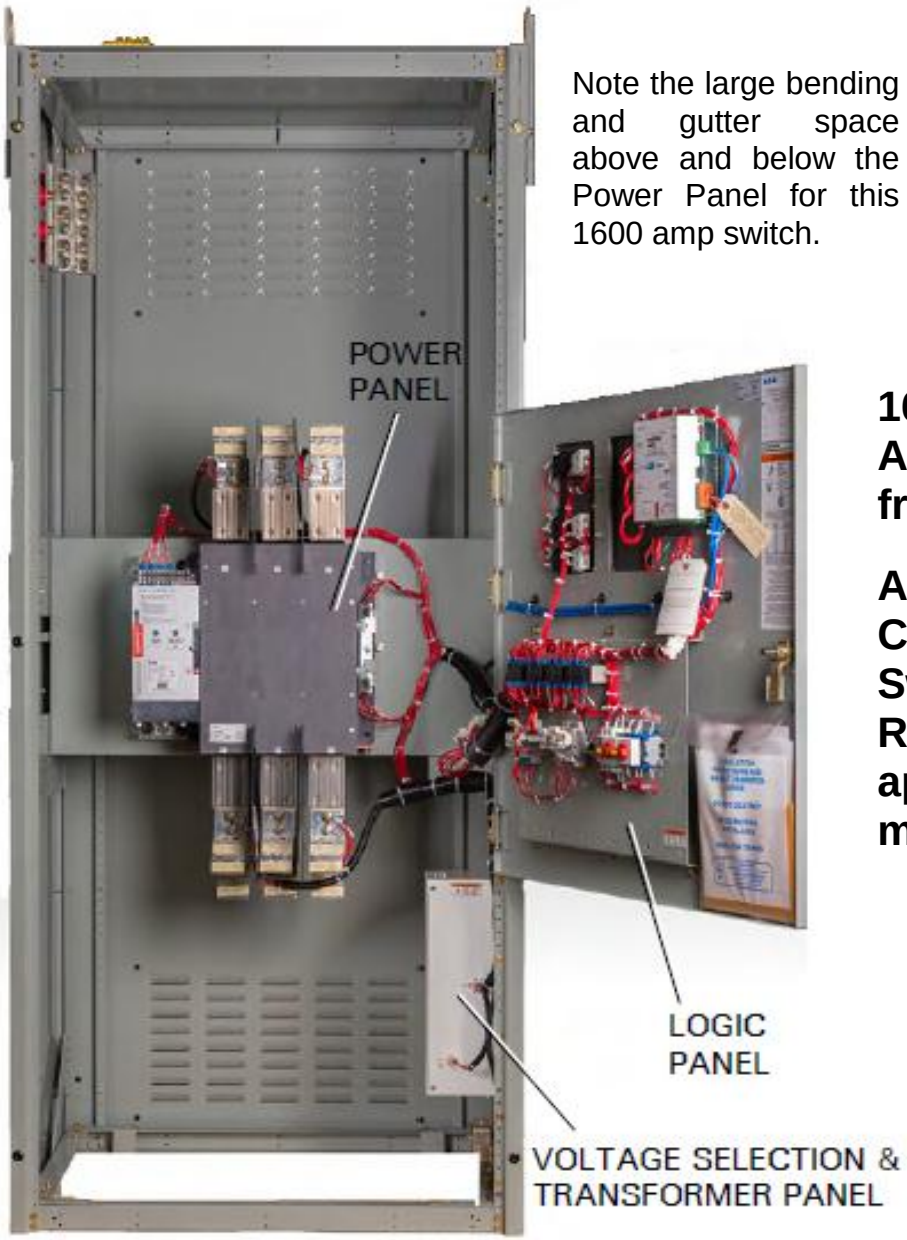
The contactor ATS (all amp ratings) is available using the full line of controllers.

- **ATC-100**
- **ATC-300**
- **ATC-800**
- **ATC-900**

The ATC-300 is the most popular in application.

TYPICAL 600 – 1200 Amp Wall Mount Contactor ATS (Open Transition)

Typical Wall Mount Contactor ATS



Note the large bending and gutter space above and below the Power Panel for this 1600 amp switch.

1600 Amp Contactor ATS is ALWAYS floor mounted, free standing.

All EATON Contactor Contactor Transfer Switches are Seismic Rated. Check the appropriate IB for mounting instructions.

Typical 1600 Amp Floor Mount Contactor ATS

Typical Wall Mount Contactor ATS

Typical 40 – 400 Contactor ATS (Closed Transition)

Question:

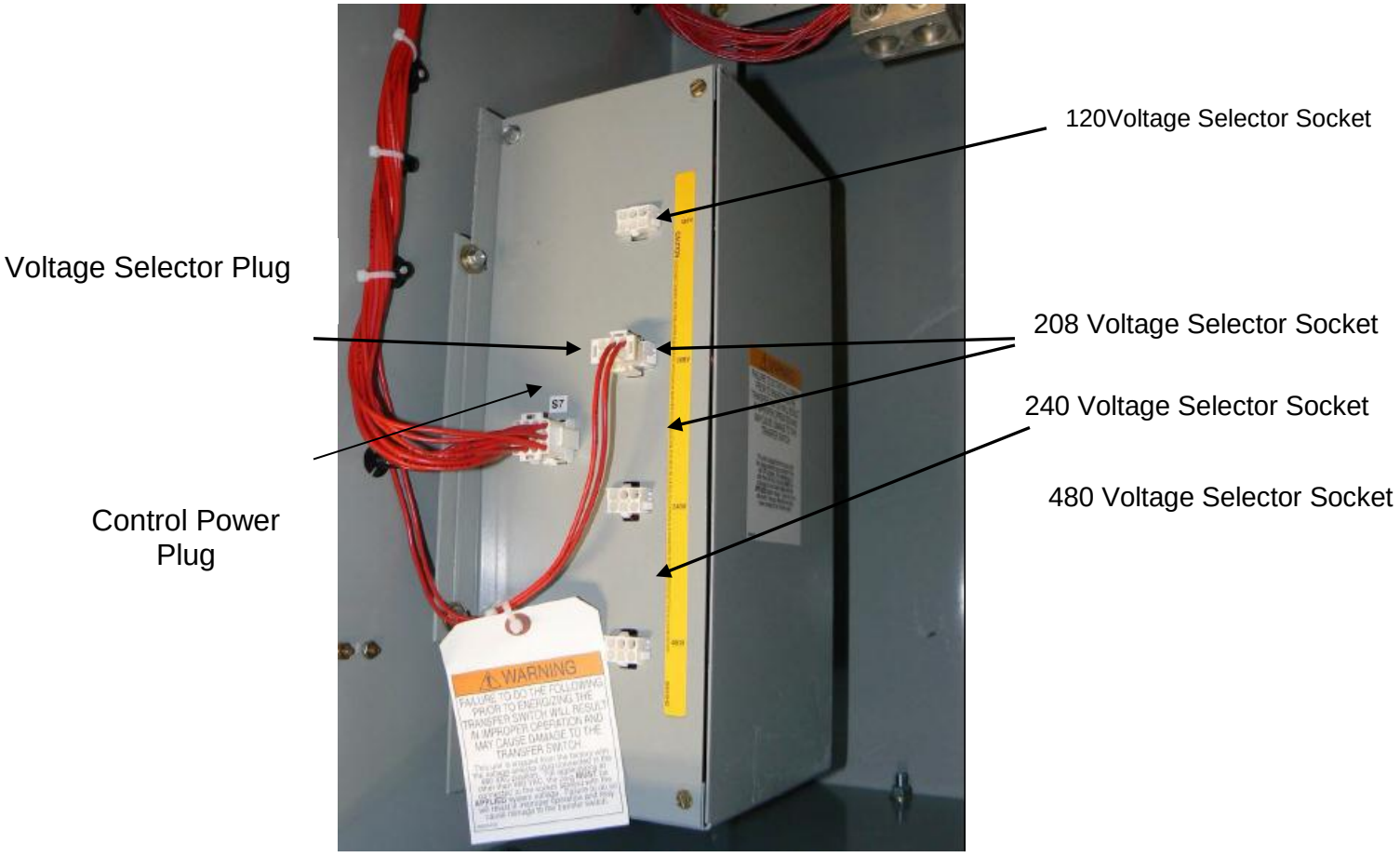
1. What obvious difference do you see between the Closed Transition and the Open Transition Contactor ATS (on page 77)? _____
2. Why is the extra contactor necessary? _____

CONTACTOR TRANSFER SWITCH TRANSFORMER PACKAGE

Make sure voltage is set correctly before ATS is energized

The North American market voltage selection panel consists of multi-tap transformers, contained in a steel case mounted in the transfer switch enclosure. The cover has two connectors on it, with the one on the right being selectable depending on the voltage applied to Source 1 and Source 2. . The voltage is selected by simply moving the plug to the desired voltage. Plugs are provided for 120 to 600 Vac to satisfy any required North American market application voltage.

The transformer unit is easily removed by removing the two front screws and disconnecting the two plugs. The factory default position is 480 Vac or 600 Vac. There is a similar selection panel for international voltages.



North American Voltage Selection (600 – 1600 Amp Contactor ATS)

(120, 208,240,480, 60 Hz)

CONTACTOR TRANSFER SWITCH TRANSFORMER PACKAGE

Standard Voltage Selection Panel 40 – 400 Amp Contactor A

TOP = "Normal" Transformer

Bottom = "Emergency "Transformer

Note that voltage selection is done internally in the box. Unit shown is set for 480 volts

MANUAL OPERATION

Manual Operation of a Contactor Transfer Switch must be done correctly. Failure to do this could result in damage to the equipment, or possibly injury or even death.

Manually operate (40-400 Amp):

1. Disconnect all sources of power (Open both upstream feeders), **And check for absence voltage on the Load Terminals.**

   Note: this MUST be done because the contactor type ATS is ONLY quick make/quick break when operated electrically.

2. Disconnect the J7 connector from the controller.
3. Locate the handle used to manually transfer the switch.
4. Attach the handle to the manual lever.
5. Rotate the lever down to go to Source 1.
6. Rotate the lever down again to go to Source 2.
7. REMOVE THE MANUAL OPERATING HANDLE BEFORE RESTORING POWER.
8. Restore the power sources.
9. When automatic operation is desired, reconnect J7 on the controller. You should be in PPE based on the max. available incident energy inside the enclosure.

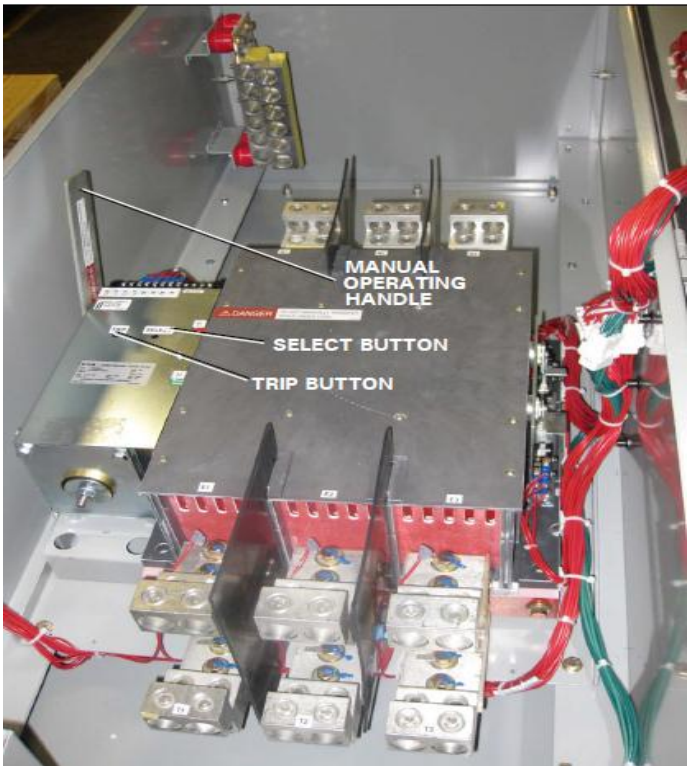
40-400 Amp Manual Operator Handle Installed

Manually operate (600 – 1600 Amp):

1. Disconnect all sources of power.

   Note: this MUST be done because the contactor type ATS is ONLY quick make/quick break when operated electrically.

2. Disconnect the J7 connector from the ATC-300+ controller.
3. Depress the “trip” button located on the operating mechanism of the contactor to bring the contactor to neutral (trip) position.
4. Locate the handle used to manually transfer the switch.
5. Attach the handle to the manual lever.
6. Rotate the lever up to go to Source 1.
7. Depress the “trip” button located on the operating mechanism of the contactor to bring the contactor to neutral (trip) position.
8. Depress the “select” button located on the operating mechanism of the contactor and rotate the lever up keeping the “select” button depressed to go to Source 2
9. Restore the power sources to the ATS.
10. When automatic operation is desired, reconnect J7 on the controller. You should be in PPE based on the max. available incident energy inside the enclosure.



600 – 1200 Amp Manual Handle installed

The Eaton Breaker Based Transfer Switch

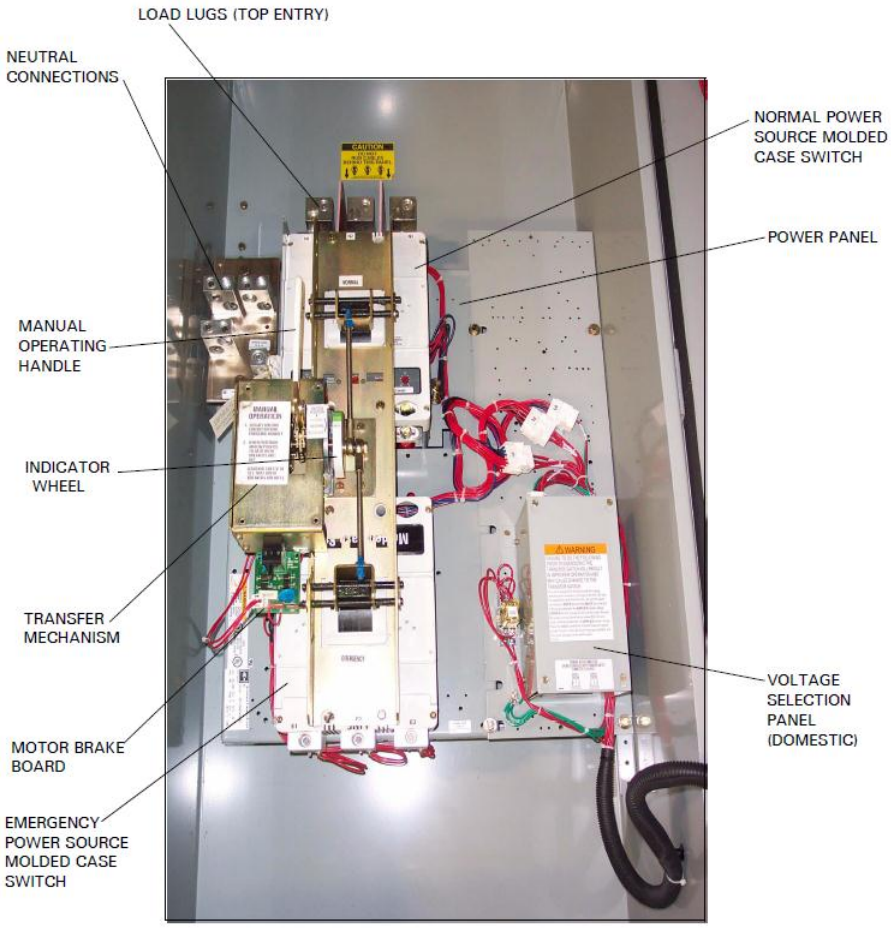
The Breaker-based ATS has three basic components.

1. The power panel;
2. The voltage selection and transformer panel; and
3. The microprocessor-based logic panel.

These panels are interconnected via connector plugs and mounted in an enclosure.

Typical Vertical Breaker Transfer Switch 225-600 Amps

Callout of Breaker Based Transfer Switch

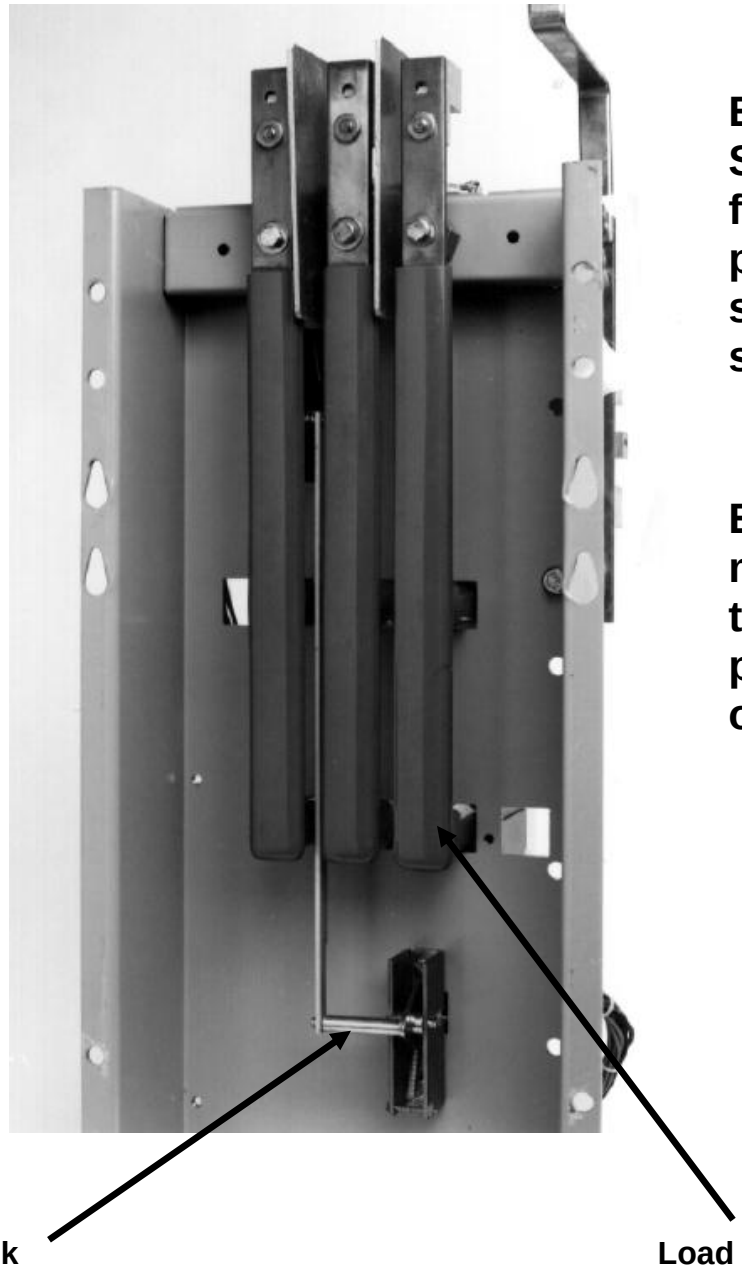


Typical 225-1000 Amp Breaker ATS (Dead Front removed)

Mechanical Interlocking

Eaton Breaker Type Transfer Switches have an interlock for added protection to prevent closure of both switching devices at the same time. This interlock is behind the mounting panel and is normally not accessible. Even if the transfer mechanism were removed, the interlock reduces the possibility of improper operation. Field adjustment of the interlock is neither necessary nor expected. Removal and reinstallation of the interlock without factory fixtures may result in poor operation.

Typical Rear View of Power Switching Panel



Eaton Breaker Type Transfer Switches have an interlock for added protection to prevent closure of both switching devices at the same time.

Even if the transfer mechanism were removed, the interlock reduces the possibility of improper operation.

Breaker Transfer switch rear view

BREAKER TRANSFORMER PACKAGES

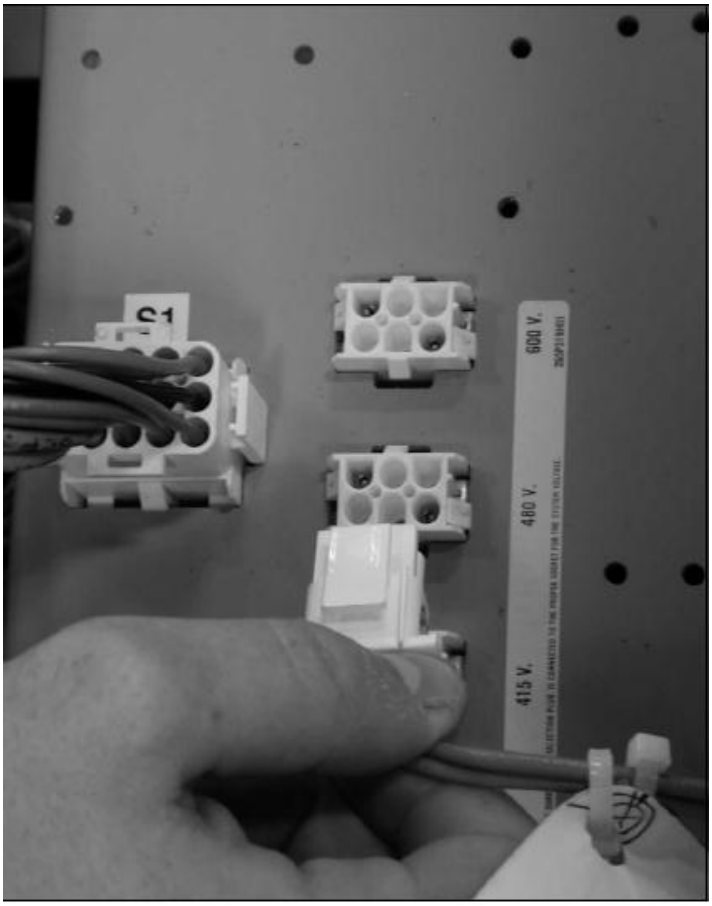
Make sure voltage is set correctly before ATS is energized

Domestic Transformer Package

Transformer package may be programmed for 120, 208, 240, 480 or 600 volts. Shown is 120 volts.

International Breaker Based Transformer Panel

Make sure voltage is set correctly before ATS is energized



International Voltage Selection (208, 220, 240, 380, 415, and 600 V – 50/60 Hz)

The International market voltage selection panel is a multi-tap, enclosed transformer mounted in the enclosure (Figure 14).

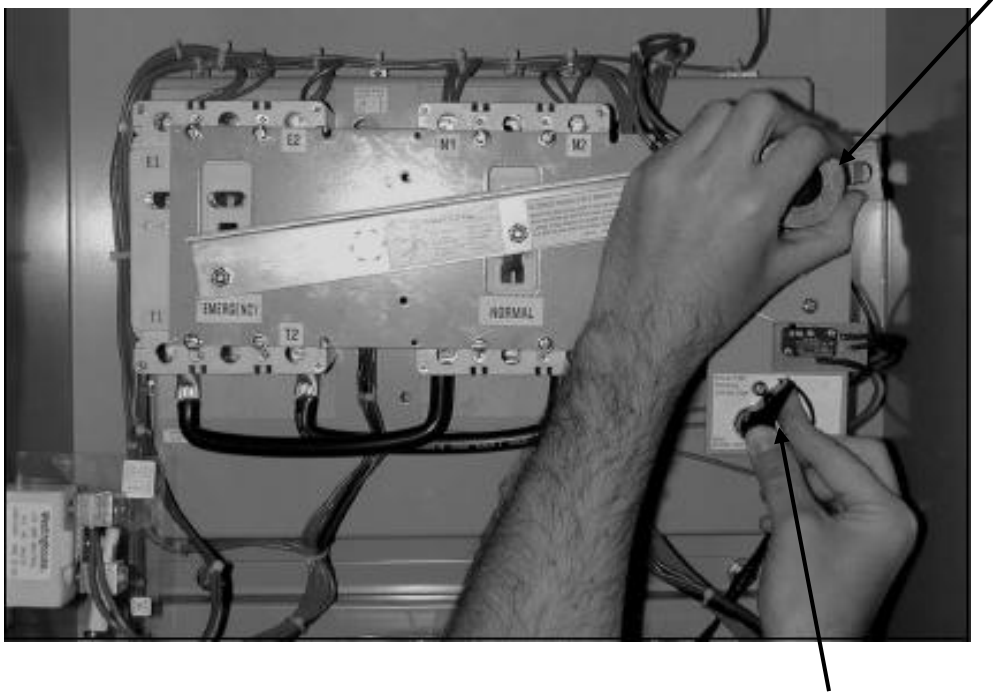
- Seven front accessible voltages taps from 208 to 600 Vac satisfy any required domestic or international market application voltage.
- A quick change capability from one voltage to another is provided by a small disconnect plug.
- The factory default position is 600 VAC.

WARNING: The Breaker Type ATS is designed for manual operation under load. If operated under load particular attention to applicable codes and standards regarding potential arc flash possibilities and proper use of Personal Protective Equipment is advised.

Manual Operation (30 - 150 A)

To operate the breaker manually, or if the breaker trips:

1. Unplug P3 from S3 to disconnect the motor circuit. Failure to do so may cause an automatic transfer.
2. Turn and hold the break release lever to the “HOLD FOR MANUAL OPERATION” position, and then rotate the manual operator knob in either direction to move the ATS into the desired position and let go of the Brake Release Lever.
3. For automatic operation, reconnect P3/S3.



30-150 Amp Manual Operation

Manual Operation (225 – 1000A)

To operate the breaker manually, or if the breaker trips:

1. Unplug P3 from S3 to disconnect the motor circuit. Failure to do so may cause an automatic transfer.
2. Operate the manual ratcheting handle until the ATS has reached the desired position, either NORMAL, EMERCENCY, or NEUTRAL.
3. For automatic operation, reconnect P3/S3.

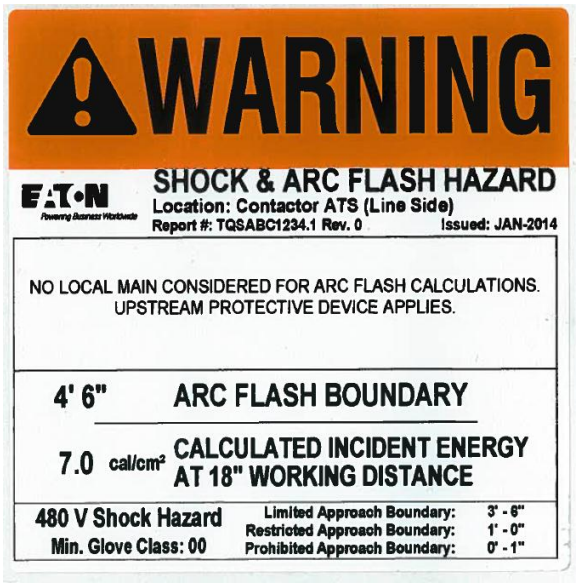
Typical 225 – 1000 Amp Manual Operation

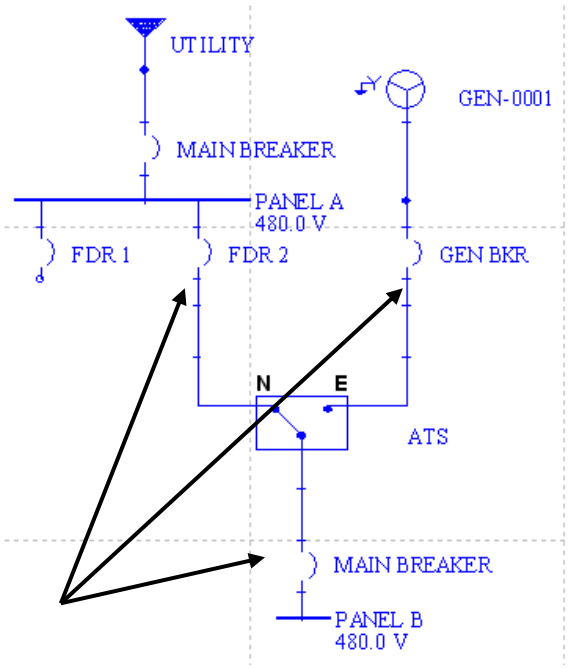
Lab 5: Personal Safety when working with Contactor TSE

Introduction – TSEs, like other electrical equipment, include the identification and mitigation of electrical and mechanical hazards for safe work to be performed. Just because we are in an instructional setting, it does not equate to these hazards becoming non-existent. It is essential in class, just as in the "real world", you identify and mitigate these hazards. Sources of shock and arc flash exist from 4 sources: normal source, emergency source, load, and control power.

Written Exercise – In this exercise you will be working with a 225 amp wall mount contactor type ATS. There is an ARC Flash label on the door.

1. Identify electrical hazards
   - Shock Hazard _____V.
   - Arc Flash Hazard _____ cal/cm^2.





Locks Applied

2. Assume upstream (Utility & Generator) and downstream devices will have to be Locked Out and Tagged Out in accordance with established standards. These breakers have been identified on the drawing above

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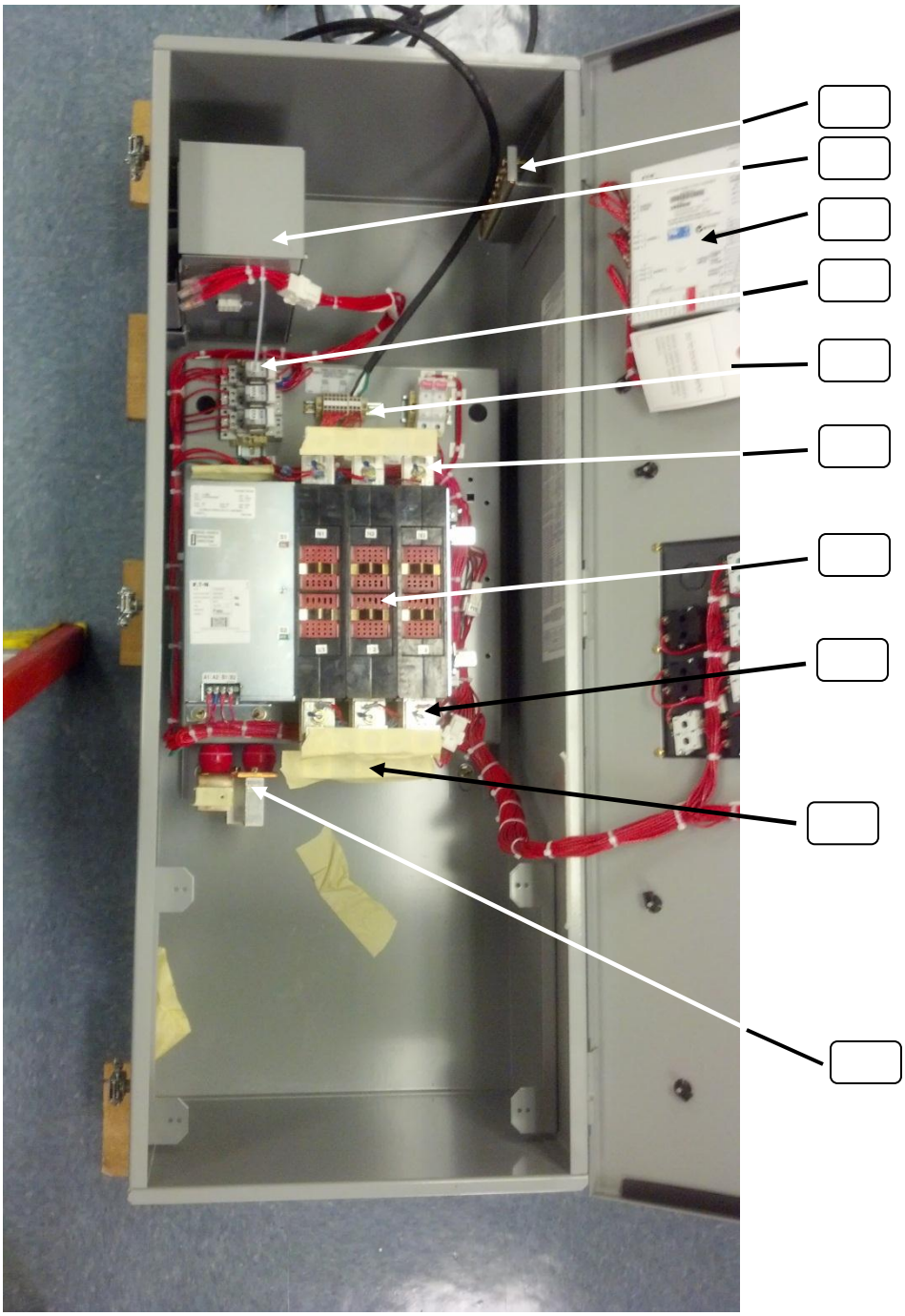
Identify the components of the ATS

Simply put the numbers from the selection list in the correct box.



1. Power Panel
2. Transformer/Voltage Selection Panel
3. Logic Panel
4. Neutral Bar
5. Ground Bar
6. Control Relays
7. Customer Connections
8. NORMAL Lugs
9. EMERGENCY Lugs
10. LOAD Lugs

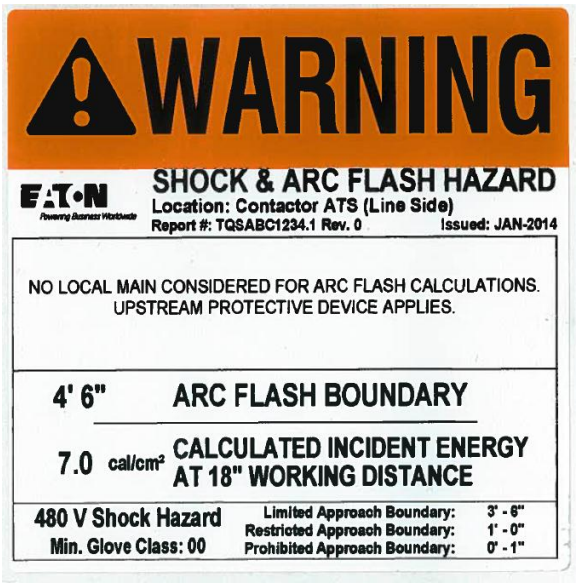
225 Amp Contactor ATS

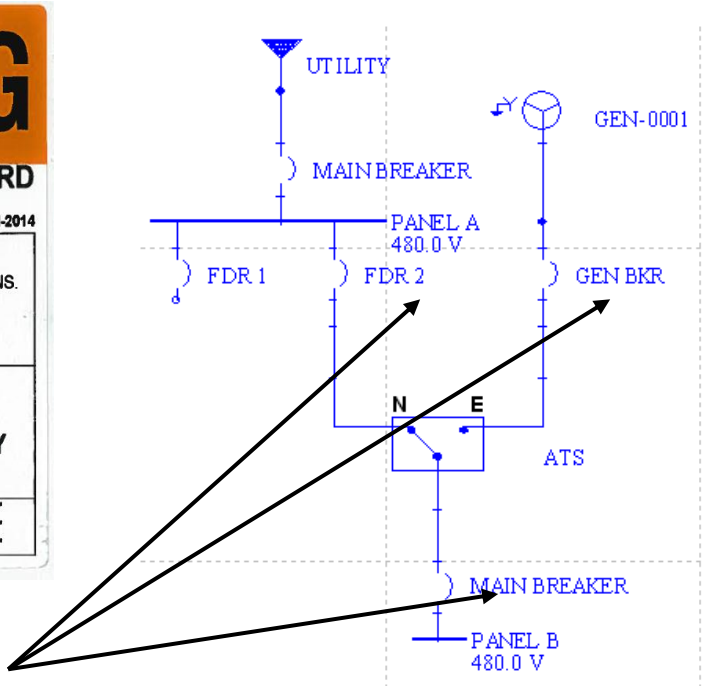
Lab 5: Working with the demo Contactor Transfer Switch

Introduction – TSEs, like other electrical equipment, include the identification and mitigation of electrical and mechanical hazards for safe work to be performed. Just because we are in an instructional setting, it does not equate to these hazards becoming non-existent. It is essential in class, just as in the "real world", you identify and mitigate these hazards. Sources of shock and arc flash exist from 4 sources: normal source, emergency source, load, and control power.

Hands On Exercise – In this exercise you will be working with a 225 amp wall mount contactor type ATS. There is an ARC Flash label on the door.

1. Identify electrical hazards
   - Shock Hazard _____V.
   - Arc Flash Hazard _____ cal/cm^2.





Locks Applied

2. Assume upstream (Utility & Generator) and downstream devices will have to be Locked Out and Tagged Out in accordance with established standards. These breakers have been identified on the drawing above

3. What is the system voltage ? _____V

4. **Unplug the Demo from the Wall Socket. You have now established an electrically safe work condition**.

Lab 5 Part B: You will torque a cable into one of the lugs on the ATS.

1. Find the cable torque chart on the ATS
2. Using the wire size given determine the correct torque requirement
3. Using the torque wrench, **properly tighten the lug**.

Lab 5 Part C: Manually Operate the Contactor ATS

1. Using the procedure on page 82 demonstrate the proper method for operating the Contactor ATS manually.

Lab 5 Part D: Demonstrate the sequence of operation of the Contactor ATS.

1. Close the door on the demo. Make sure demo has been reconnected to the wall outlet.
2. Start with MAIN POWER and NORMAL switches “ON” and EMERGENCY “OFF”.
3. Turn NORMAL “OFF”. Wait for Blue Engine Start Indicator to light.
4. Turn EMERGENCY switch ON. You should see TDNE count down, and at end ATS should transfer to EMERGENCY.
5. Turn NORMAL switch “ON”. You should see TDEN time out and ATS should transfer to NORMAL. TDEC begins to count down.
6. When the Blue Light goes out, turn EMERGENCY switch OFF.
7. Now, change the MAN RETRANSFER setpoint to “1 (Enabled)”.
8. Repeat steps 3 and 4.

9. Turn NORMAL switch ON. You should immediately see a message “Manual Retransfer” on the display.
10. When you are ready, press the button marked “Press to return to Source 1”. You should immediately transfer to NORMAL.
11. Turn off EMERGENCY when the blue Light goes out
12. Please reprogram the MAN RETRANSFER setpoint back to “0 Disabled”.

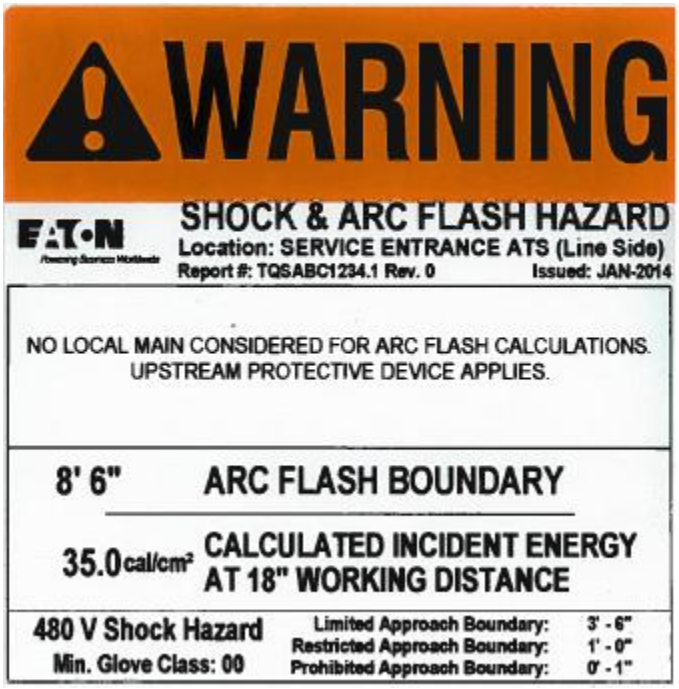
QUESTION: Where would Manual Return to NORMAL be useful or desired? _____

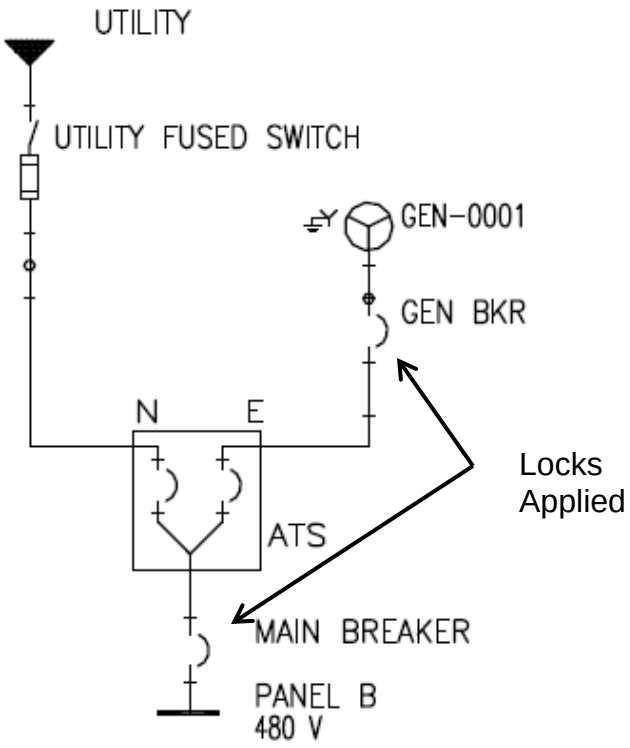
Lab 6: Personal Safety when working with Breaker TSE

Introduction – TSEs, like other electrical equipment, include the identification and mitigation of electrical and mechanical hazards for safe work to be performed. Just because we are in an instructional setting, it does not equate to these hazards becoming non-existent. It is essential in class, just as in the "real world", you identify and mitigate these hazards. Sources of shock and arc flash exist from 4 sources: normal source, emergency source, load, and control power.

Written Exercise – In this exercise you will be working with a **225 amp Service Entrance Rated** wall mount breaker type ATS. There is an ARC Flash label on the door.

1. Identify electrical hazards
   - Shock Hazard _____V.
   - Arc Flash Hazard _____ cal/cm^2.





2. Because this ATS is the **Service Equipment** it may be impractical to lockout upstream utility devices, therefore you will be working on the ATS while it is energized.

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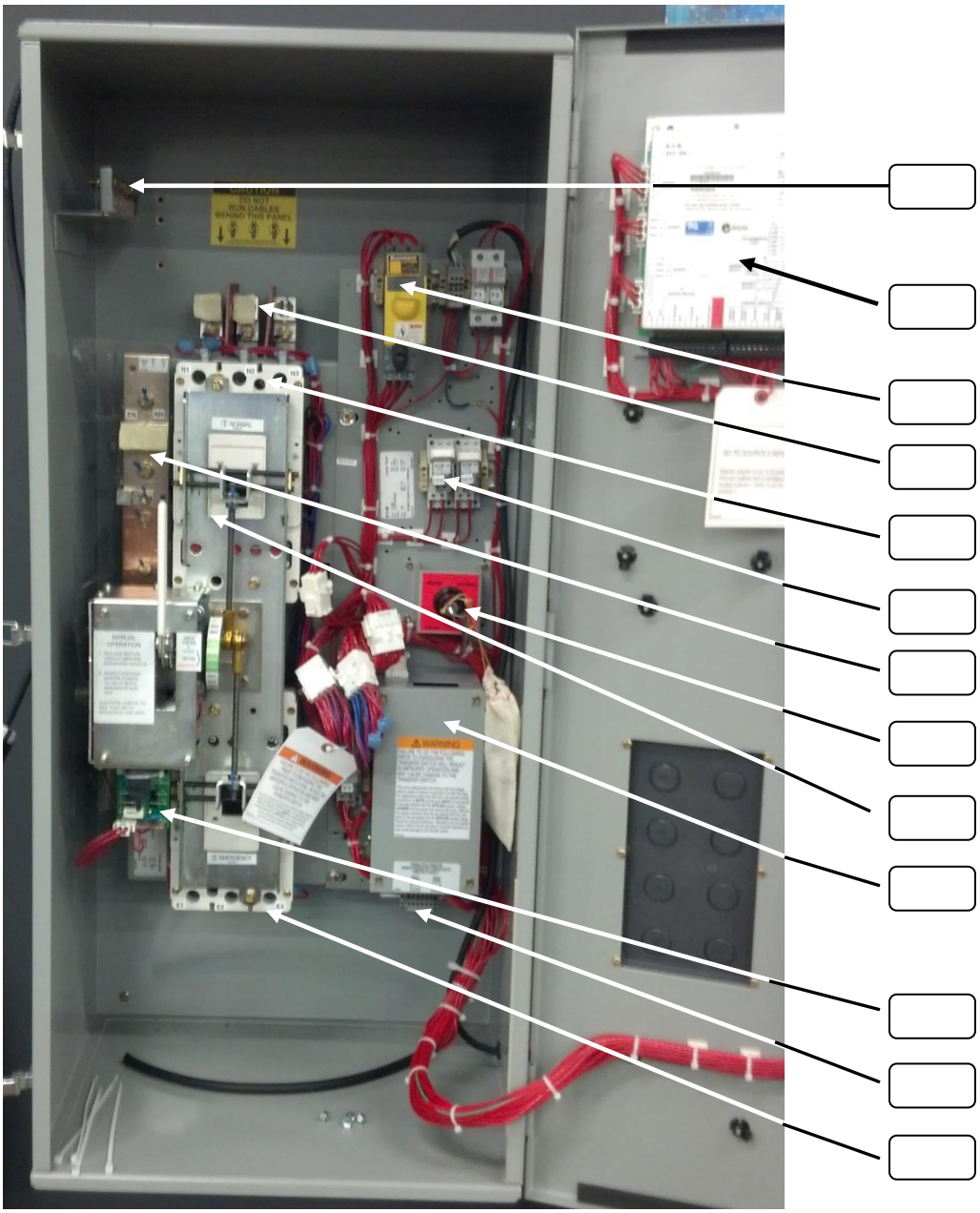
Lab 6: Using the demo Breaker Transfer Switch, identify the components of the ATS.

Simply put the numbers from the selection list in the correct box.



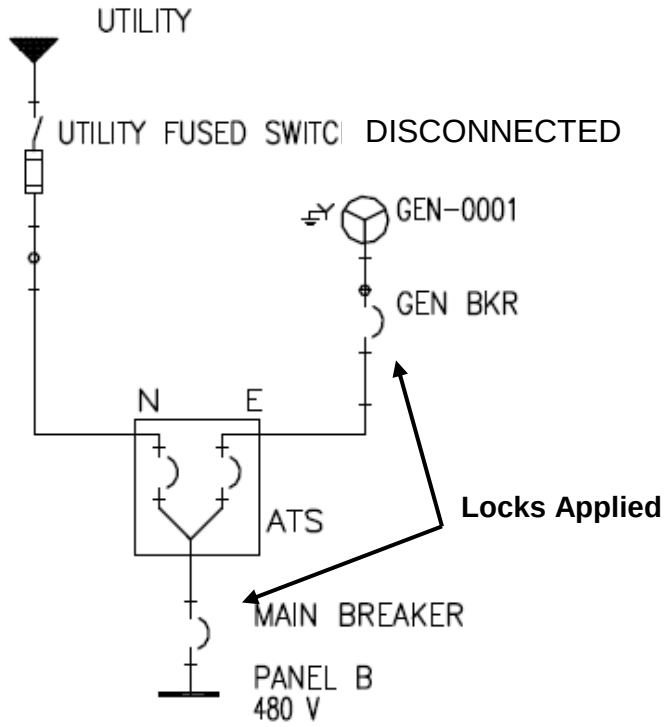
1. Power Panel
2. Transformer/Voltage Selection Panel
3. Logic Panel
4. Neutral Bar
5. Ground Bar
6. Control Relays
7. Customer Connections
8. NORMAL Lugs
9. EMERGENCY Lugs
10. .LOAD Lugs
11. Motor Brake Board
12. Service Disconnect
13. NORMAL Control Power Disconnect

Lab 6: Working with the demo Breaker Transfer Switch

Introduction – TSEs, like other electrical equipment, include the identification and mitigation of electrical and mechanical hazards for safe work to be performed. Just because we are in an instructional setting, it does not equate to these hazards becoming non-existent. It is essential in class, just as in the "real world", you identify and mitigate these hazards. Sources of shock and arc flash exist from 4 sources: normal source, emergency source, load, and control power.

Hands On Exercise – In this exercise you will be working with a **225 Amp Service Entrance Rated Breaker ATS**. There is an ARC Flash label on the door.

1. Identify electrical hazards
   - Shock Hazard _____V.
   - Arc Flash Hazard _____ cal/cm^2.



2. **At this point you should disconnect the Demo Plug from the wall socket.**

3. Assume the Utility has disconnected the incoming service, the generator breaker and load main breaker has been locked out, and you checked for voltage on the load side.

4. What is the system voltage ? _____V

5. **Unplug the Demo from the Wall Socket. You have now established an electrically safe work condition**.

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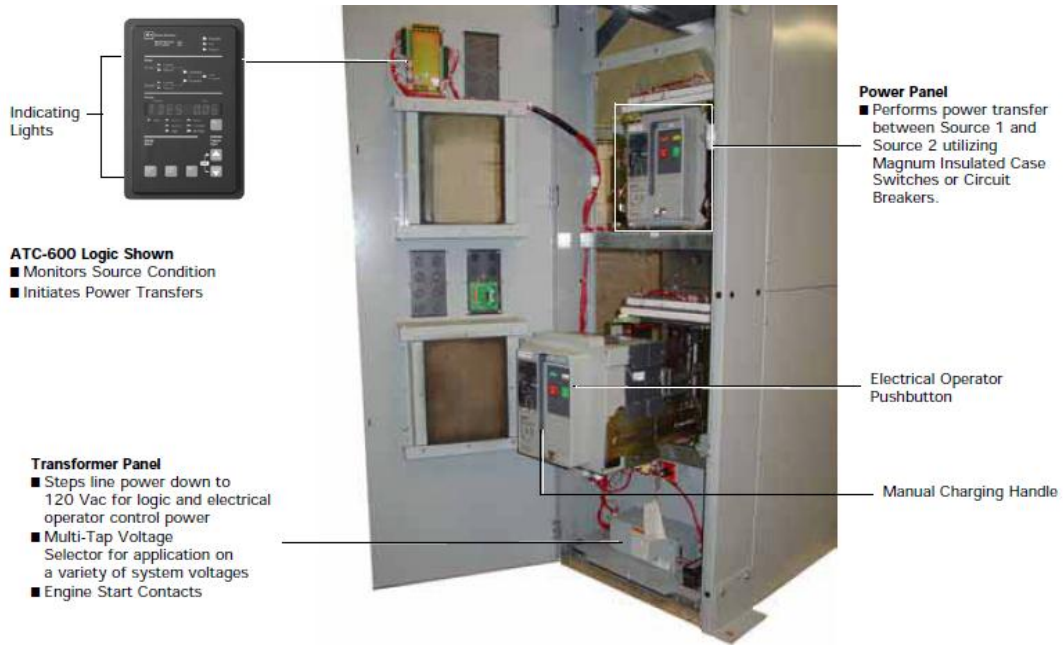
Magnum Transfer Switch

The EATON Magnum ATS is available in several configurations. Typical are shown below.

Fixed Mount Switching Device

Drawout Switching Device



Through the door Drawout Magnum ATS

Magnum Mechanical Interlocking

All OPEN TRANSITION Magnum Transfer Switches are provided with cable mechanical interlocking. The interlock is provided to prevent both devices from closing simultaneously. If there is ANY reason to believe the interlock is not functioning properly, consult the factory for proper test and adjusting procedures.

Cable Interlock

Side view of MAGNUM ATS showing Interlock

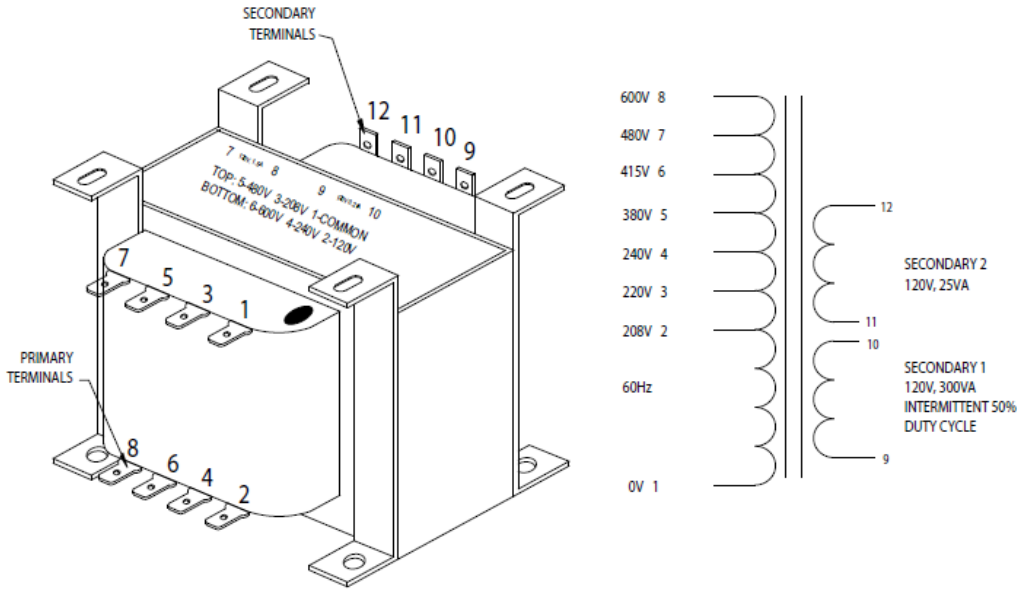
Magnum Transformer / Voltage Selection Panel

MAKE SURE VOLTAGE IS SET CORRECTLY BEFORE ENERGIZING EQUIPMENT!

Transformer package in bottom of enclosure

Transformer package with cover removed

Magnum Control Transformer Voltage Selection



Magnum Control Transformer Detail

Magnum ATS Manual Operation

WARNING: The Magnum Type ATS is designed for manual operation under load. If operated under load particular attention to applicable codes and standards regarding potential arc flash possibilities and proper use of Personal Protective Equipment is advised.

To operate the ATS manually:

1. Disconnect P7/J7 on the controller.
2. If, however, a transfer switch is supplied with a four-position selector switch (option 6h), it can be turned to the off position, making it unnecessary to unplug the logic.
3. Manually operate MAGNUM device by charging if necessary.

Charging the Magnum Breaker

Open the breaker by pushing the Red *Push Off* button.

Close the breaker by pushing the Green *Push On* button.

CAUTION: On a Closed Transition ATS Check Breaker flag and MAKE SURE only one breaker is closed at a time. Closing both breakers simultaneously is dangerous and could cause equipment damage, injury, or death.

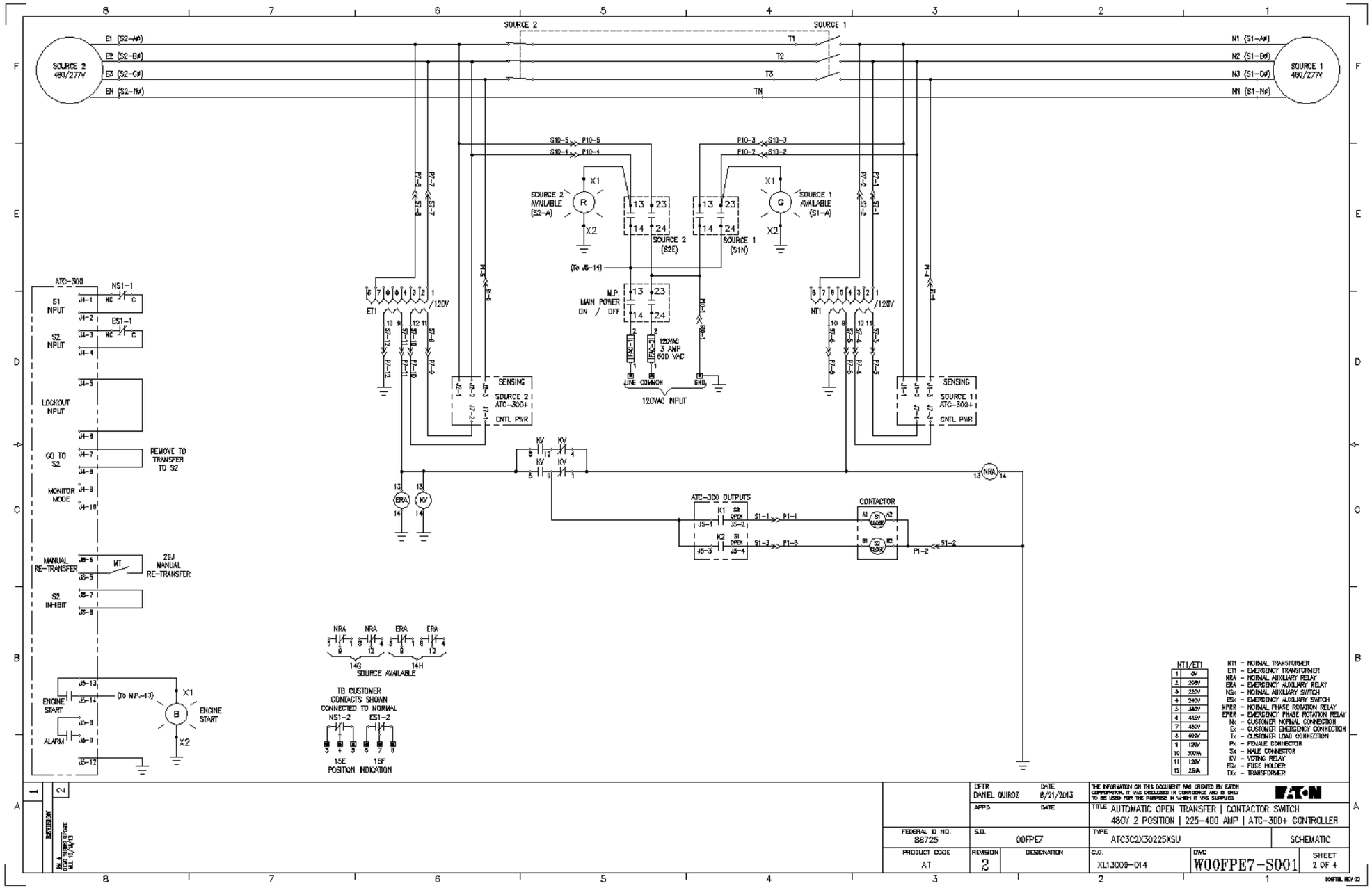
BASIC Troubleshooting

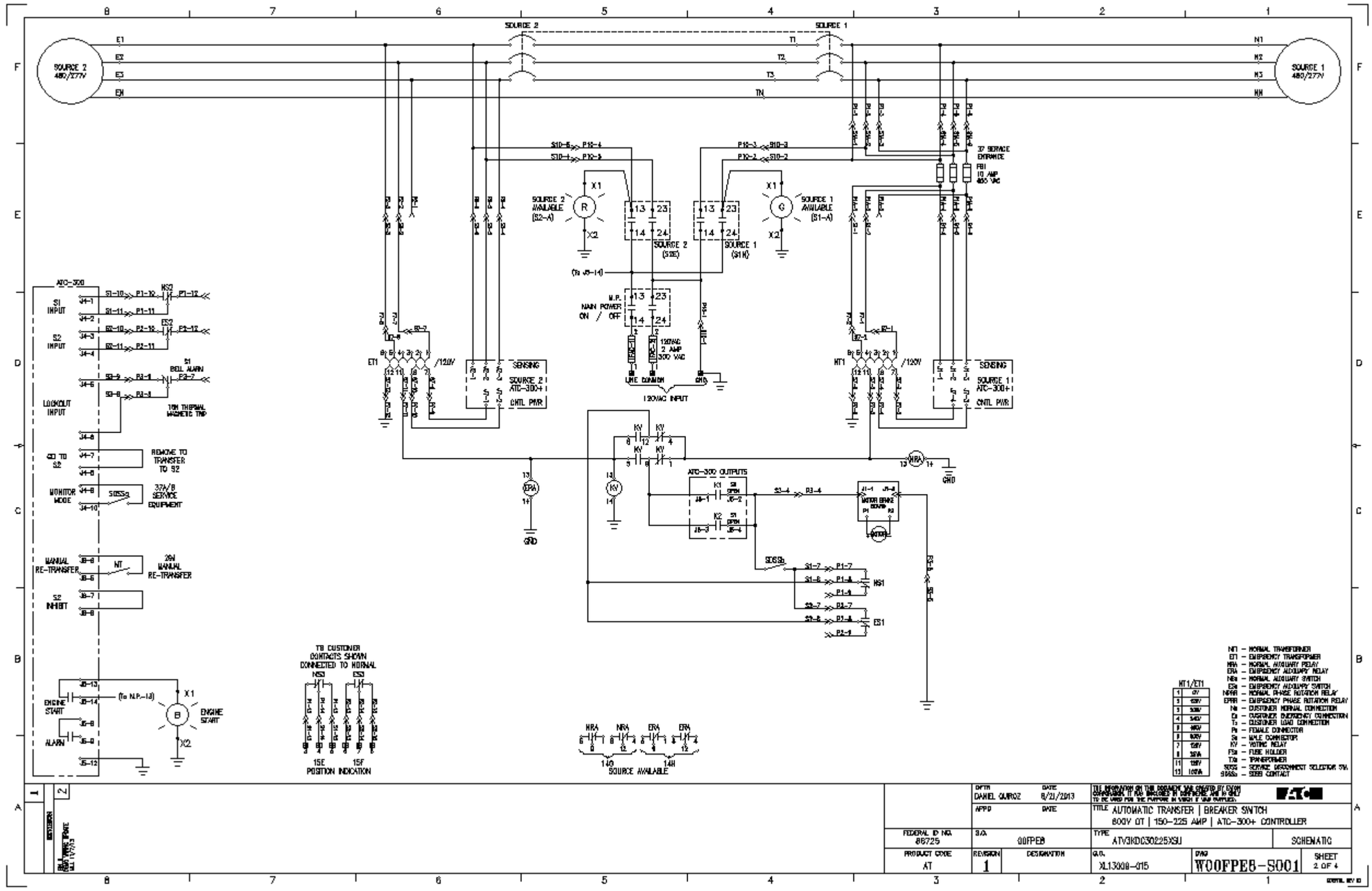
- Troubleshooting is easiest if you understand how the device works.
- Transfer Switches come with a drawing package which includes a schematic, wiring diagrams, component layouts and Instruction Booklets. Since the ones sent with the switch have probably disappeared into a contractor's truck Get diagrams and books. P/L tech support can furnish order specific wiring!
- DON'T PANIC
- Look at the ATS Controller, then the switching devices
- Document findings and actions
- If effort does not produce results call technical support

REMEMBER: A Transfer Switch is a TWO SOURCE device. If you shut off the utility, an AUTOMATIC Transfer Switch will try to start the generator. Make sure you shut off the generator AT THE GENERATOR and lock the Generator Breaker!

Contactor / Breaker Schematic Discussion

- Electrical Operation of the ATS
- Deriving Control Power from two sources
    - Controller has both control power sources internally voted
    - KV relay votes control power to other ATS components.
- How Solenoids and motor operator work.
- User Connections
- Feedback to controller


SOURCE 2
SOURCE 1
SOURCE 2 480/277V
SOURCE 1 480/277V
E1 (S2-N#)
E2 (S2-B#)
E3 (S2-C#)
EN (S2-N#)
T1
T2
T3
TN
N1 (S1-A#)
N2 (S1-B#)
N3 (S1-C#)
NN (S1-N#)
SOURCE 2 AVAILABLE (S2-A)
SOURCE 1 AVAILABLE (S1-A)
SOURCE 2 (S2E)
SOURCE 1 (S1N)
(To J6-14)
N.P. MAIN POWER ON / OFF
120VAC 3 AMP 60D VAC
LINE COMMON
GND
120VAC INPUT
ET1
NT1
/120V
SENSING
SOURCE 2 ATC-300+ CNTL PWR
SOURCE 1 ATC-300+ CNTL PWR
ATC-300
NS1-1
ES1-1
S1 INPUT
S2 INPUT
LOCKOUT INPUT
GO TO S2
REMOVE TO TRANSFER TO S2
MONITOR MODE
MANUAL RE-TRANSFER
MT
29J MANUAL RE-TRANSFER
S2 INHIBIT
ENGINE START
(To N.P.-13)
ALARM
ATC-300 OUTPUTS
CONTACTOR
NRA
ERA
KV
14G SOURCE AVAILABLE
14H
TB CUSTOMER CONTACTS SHOWN CONNECTED TO NORMAL
NS1-2
ES1-2
15E POSITION INDICATION
15F
NT1/ET1
1 0V
2 208V
3 220V
4 240V
5 380V
6 415V
7 480V
8 600V
9 120V
10 300VA
11 120V
12 28VA
NT1 - NORMAL TRANSFORMER
ET1 - EMERGENCY TRANSFORMER
NRA - NORMAL AUXILIARY RELAY
ERA - EMERGENCY AUXILIARY RELAY
NSx - NORMAL AUXILIARY SWITCH
ESx - EMERGENCY AUXILIARY SWITCH
NPRR - NORMAL PHASE ROTATION RELAY
EPRR - EMERGENCY PHASE ROTATION RELAY
Nx - CUSTOMER NORMAL CONNECTION
Ex - CUSTOMER EMERGENCY CONNECTION
Tx - CUSTOMER LOAD CONNECTION
Px - FEMALE CONNECTOR
Sx - MALE CONNECTOR
KV - VOTING RELAY
FSx - FUSE HOLDER
TXx - TRANSFORMER
DFTR DANIEL QUIROZ
DATE 8/21/2013
APPD
DATE
THE INFORMATION ON THIS DOCUMENT WAS CREATED BY EATON CORPORATION. IT WAS DISCLOSED IN CONFIDENCE AND IS ONLY TO BE USED FOR THE PURPOSE IN WHICH IT WAS SUPPLIED.
TITLE AUTOMATIC OPEN TRANSFER | CONTACTOR SWITCH 480V 2 POSITION | 225-400 AMP | ATC-300+ CONTROLLER
FEDERAL ID NO. 88725
S.O. 00FPE7
TYPE ATC3C2X30225XSU
SCHEMATIC
PRODUCT CODE AT
REVISION 2
DESIGNATION
C.O. XL13009-014
DWG W00FPE7-S001
SHEET 2 OF 4


SOURCE 2
480/277V
SOURCE 1
480/277V
SOURCE 2
SOURCE 1
E1
E2
E3
EN
T1
T2
T3
TN
N1
N2
N3
NN
37 SERVICE ENTRANCE
FB1
10 AMP
600 VAC
SOURCE 2 AVAILABLE (S2-A)
SOURCE 1 AVAILABLE (S1-A)
SOURCE 2 (S2E)
SOURCE 1 (S1N)
M.P. MAIN POWER ON / OFF
LINE COMMON
120VAC INPUT
120VAC 2 AMP 300 VAC
ET1
NT1
/120V
SENSING
SOURCE 2 ATC-300+ CNTL PWR
SOURCE 1 ATC-300+ CNTL PWR
ATC-300
S1 INPUT
S2 INPUT
LOCKOUT INPUT
S1 BELL ALARM
TRN THERMAL MAGNETIC TRP
GO TO S2
REMOTE TO TRANSFER TO S2
MONITOR MODE
S3SSg
37A/B SERVICE EQUIPMENT
MANUAL RE-TRANSFER
NT
29N MANUAL RE-TRANSFER
S2 INHIBT
ENGINE START
ALARM
(To N.P.-13)
ENGINE START
ATC-300 OUTPUTS
MOTOR SENSE BOARD
MOTOR
GND
TB CUSTOMER CONTACTS SHOWN CONNECTED TO NORMAL
15E POSITION INDICATION
15F
14G
14H
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NT1 – NORMAL TRANSFORMER
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Tx – CUSTOMER LOAD CONNECTION
Px – FEMALE CONNECTOR
Sx – MALE CONNECTOR
KV – VOTING RELAY
FBx – FUSE HOLDER
TDx – TRANSFORMER
3SSS – SOURCE DISCONNECT SELECTOR SW.
S3SSx – 3SSS CONTACT
NT1/ET1
1 0V
3 120V
5 240V
6 480V
8 600V
7 208Y
9 347A
11 208Y
13 120VA
DRWN DANIEL QUIROZ DATE 8/21/2013
APPD DATE
TITLE AUTOMATIC TRANSFER | BREAKER SWITCH
600V OT | 150-225 AMP | ATC-300+ CONTROLLER
FEDERAL ID NO. 86725
S.O. 00FPE8
TYPE ATV3KDC3022.25XSU
SCHEMATIC
PRODUCT CODE AT
REVISION 1
DESIGNATION
G.O. XL13308-015
DWG W00FPE8-S001
SHEET 2 OF 4
REVISION
ADD WIRE PAGE 11/7/13

Apr 2014

Scenarios

The following scenarios are not all inclusive, but are some basic guidance to the problems that have been seen in the field.

No Power in Building

Source 1 Available, ATC-300 Controller display: "Not in Automatic" or ATC-600 Controller display "Neutral".

- Make sure Service Disconnect Switch in "Energize"

Source 1 Available, Display shows "Lockout".

- Source 1 Breaker has tripped. Check for cause! DOCUMENT.
- Reset Breaker, reset controller Source 1 Breaker should close automatically.

Source 2 Available. Display shows "S1 Brkr" or "S2 Brkr"

- Manually transfer to EMERGENCY
- Press "reset" on controller
- ATS SHOULD BE TESTED TO SEE IF PROBLEM REPEATS.

Controller Dark, Generator Running

- Check Generator Breaker is Closed.
- Check generator output (Preferably at E1,E2,E3 terminals on ATS)
- If sure generator is good, attempt manual transfer.
- Check ATS

Controller is Dark, Generator is NOT running

- Check generator for faults (if fault call generator service!)
- Attempt to start generator manually
- Transfer to Source 2 should occur if Source 2 is good.
- Check generator engine start circuit and wiring.

Building on Generator, does not return to utility

S1 Avail LED is lit, Display shows S1 or S2 breaker.

- Attempt manual transfer
- If successful, reset controller
- Check ATS

S1 Avail LED is lit, TDEN is counting down.

- Wait for TDEN to time out.

S1 Avail LED is NOT lit

Check S1 Status on ATC-300, 600, 800, or 900 controller.

Discussion Scenario #1

- Customer reports that generator keeps starting and then shutting down, ATS is NOT transferring and customer says building power is not going off. He has shut off the generator. You go over and see the controller is not lit up.
- What do you check?
- How do you test to confirm?

Discussion Scenario #2

- Customer reports that they test the ATS by doing a load transfer every week, it has worked fine!
- Last night there was a power failure, the generator started but the building did not transfer to the generator. Their maintenance man operated the ATS to Emergency manually and when utility power came the ATS transferred back to normal automatically and shut down the generator.
- You observe that Source 1 Available and Connected are lit, everything seems OK.
- Where do you go from here?

ATS Review Questions

1. A Transfer Switch listed for use on Emergency Systems under Article 700 may be used in a residence. (True or False)
2. The 3 basic components of all transfer switches are:

   _____ _____ _____

3. A manual or non-automatic transfer switch may be used on an Emergency System. (True or False)
4. A non-automatic transfer switch may be electrically operated.
   (True or False)
5. An Emergency system specifies power to be available in 10 sec or less. A legally required Standby System stipulates standby power must be available within a maximum of _____ seconds.
6. To be classified as a transfer switch, the equipment must meet requirements set forth by UL _____.
7. A transfer switch, not labeled otherwise, may be loaded up to what percent of its rating
   a. 80% c. 85%
   b. 90% d. 100%
8. On a 3-Phase system what does the "source available LED" on the mimic bus of an ATC controller indicate about the source?
   a. _____
   b. _____
   c. _____
   d. _____
9. If the generator does not start on loss of the Normal Source, what error message will be on the controller display? _____
10. Eaton offers a _____ type design and a _____type design for its Transfer Switch Equipment. .
11. What is option code 80A? _____. What is it typically used for? _____
    Is the input blocking when true or permissive when true? _____
12. Eaton's Bypass Isolation Transfer Switch is unique in the industry. What feature makes it unique? _____
13. When working on a Transfer Switch in the field, you should remember there are _____ sources of supply.
14. In an ATS to assure that it is totally de-energized, you should always check the _____, _____, and _____ connections for voltage.
15. What controller is used on the Transfer Switch with the following catalog number: ATC3C2X30200XSU

a. ATC-100
b. ATC-200
c. ATC-300
d. No controller is provided

16. Before the generator contact closes, what timer must time out?
    a. TDES
    b. TDNE
    c. TDEC
    d. None of the Above

17. TDEN will abort if:
    a. S1 is good, and TDEN is manually bypassed
    b. S1 is good, and Source 2 Fails
    c. A or B
    d. S2 is the only good source

18. The ATC-300+ controller have what communications capability?
    a. Modbus TCP
    b. Powernet
    c. Modbus RTU
    d. None

19. A Static Transfer Switch

    (Check all that apply)

    a. Has a dead bus time of 100 milliseconds
    b. Uses Time Delay Neutral
    c. Has a dead bus time of less than 8 milliseconds
    d. Is useful only with two continuously available sources.

20. All transfer switches listed under UL1008 may be applied on Fire-pump systems

    True or False

21. Commit / No Commit are related to what Feature?
    a. Option 1 (TDNE)
    b. Option 23 (Plant Exerciser)
    c. Option 3 (TDEN)
    d. Option 4 (TDEC)

Appendix A: Basic Transfer Switch Startup Checklist

- EATON Transfer Switch Equipment is shipped with three things.
    - Transfer Switch Instruction Booklet ◯ Yes ◯ No
    - Controller Instruction Booklet ◯ Yes ◯ No
    - Wiring Diagrams ◯ Yes ◯ No
- Verify the Installation
    - Mounting and Seismic requirements

      ◯ Correct ◯ Not Correct ◯ Can't tell
    - Check cable lugs for proper torque. Label should be nearby indicating proper torque.

      ◯ OK ◯ Not Done
    - Operate the ATS MANUALLY several times. No power on the unit for this test.

      ◯ Done
    - Verify the System voltage and the TSE design voltage are the same. Check the transformer taps!

      ◯ Checked
    - Apply Normal Power

      ◯ Done
    - Check that controller "lights up".

      ◯ Done

        1. Check the control voltage on J7. Should be 120V ±10%

           ◯ Done
    - If controller has been set for correct nominal voltage, "S1 Avail" will probably light up, and ATS will transfer to S1, if not already there.

      ◯ Done
- Program the Controller
    - Setpoints MUST be supplied by the user. You may set Nominal Voltage setpoint correctly if necessary. ATS should operate with defaults.

      ◯ Done
- Verify ATS operation.
    - Make sure the customer knows and understands that power interruption is necessary to properly test the ATS.

      ◯ Done
    - Run a load test using the TEST pushbutton. Change setpoint if necessary to do this.

      ◯ Done
    - Run the load test by shutting off the utility feed to the ATS. This is necessary to verify proper operation of the engine start circuit with no power on the controller, and to verify that EMERGENCY power will power up the controller.

      ◯ Done

Appendix B: ATC300 Feature Decoder

The Feature Code is displayed when the Help button is pressed from the ATC-300 Home screen.

Firmware Version 1.4 and below

Feature Code = XX-XX-XX-XXX-XXX

The first 9 characters correspond to the following options. The last 3 characters are the Number of Transfers.

1. Source 2 Overfrequency monitoring (0=disabled, 1=enabled)
2. Source 2 Overvoltage monitoring (0=disabled, 1=enabled)
3. Source 1 Underfrequency monitoring (0=disabled, 1=enabled)
4. Source 1 Overfrequency monitoring (0=disabled, 1=enabled)
5. Source 1 Overvoltage monitoring (0=disabled, 1=enabled)
6. Overcurrent Protection (0=disabled, 1=enabled)
7. Phase Reversal (0=disabled, 1=enabled)
8. Voltage Unbalance (0=disabled, 1=enabled)
9. Type of Transition (0=open transition, 1=in-phase)

Firmware Version 2.x

Feature Code = XX-XX-XX-XX-XX-XXX

The first 10 characters correspond to the following options. The last 3 characters are the Number of Transfers.

1. Source 2 Overfrequency monitoring (0=disabled, 1=enabled)
2. Source 2 Overvoltage monitoring (0=disabled, 1=enabled)
3. Source 1 Underfrequency monitoring (0=disabled, 1=enabled)
4. Source 1 Overfrequency monitoring (0=disabled, 1=enabled)
5. Source 1 Overvoltage monitoring (0=disabled, 1=enabled)
6. Overcurrent Protection (0=disabled, 1=enabled)
7. Phase Reversal (0=disabled, 1=enabled)
8. Voltage Unbalance (0=disabled, 1=enabled)
9. Type of Transition (0=open transition, 1=in-phase)
10. Device Type (0=contactor 1=breaker)

Firmware Version 3.x

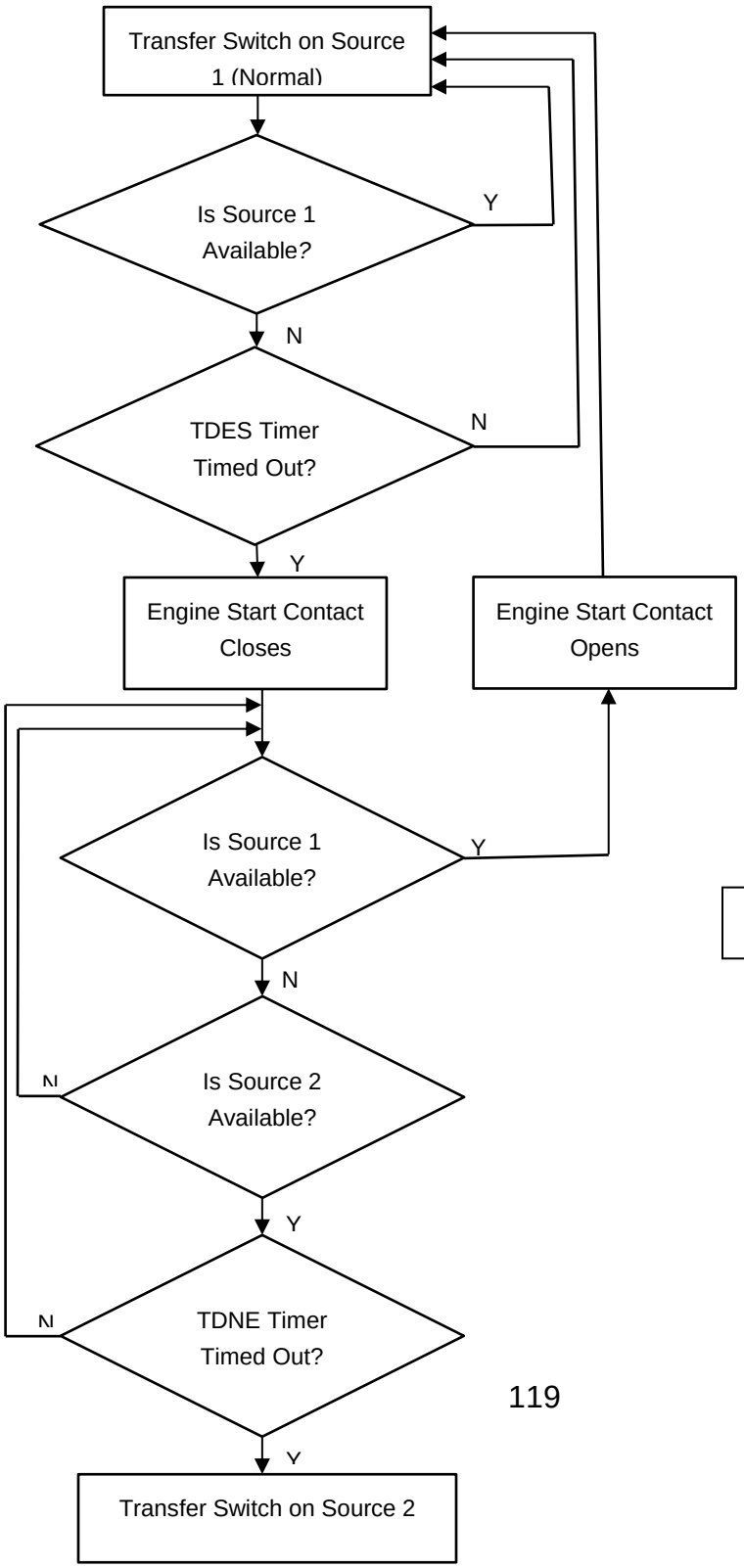
Feature Code = XX-XX-XX-XX-XXX-XXX

The first 11 characters correspond to the following options. The last 3 characters are the Number of Transfers.

1. Source 2 Overfrequency monitoring (0=disabled, 1=enabled)
2. Source 2 Overvoltage monitoring (0=disabled, 1=enabled)
3. Source 1 Underfrequency monitoring (0=disabled, 1=enabled)
4. Source 1 Overfrequency monitoring (0=disabled, 1=enabled)
5. Source 1 Overvoltage monitoring (0=disabled, 1=enabled)
6. Overcurrent Protection (0=disabled, 1=enabled)
7. Phase Reversal (0=disabled, 1=enabled)
8. Voltage Unbalance (0=disabled, 1=enabled)
9. Type of Transition (0=open transition, 1=in-phase)
10. Device Type (0=contactor 1=breaker)
11. Modbus (0=disabled 1=enabled)

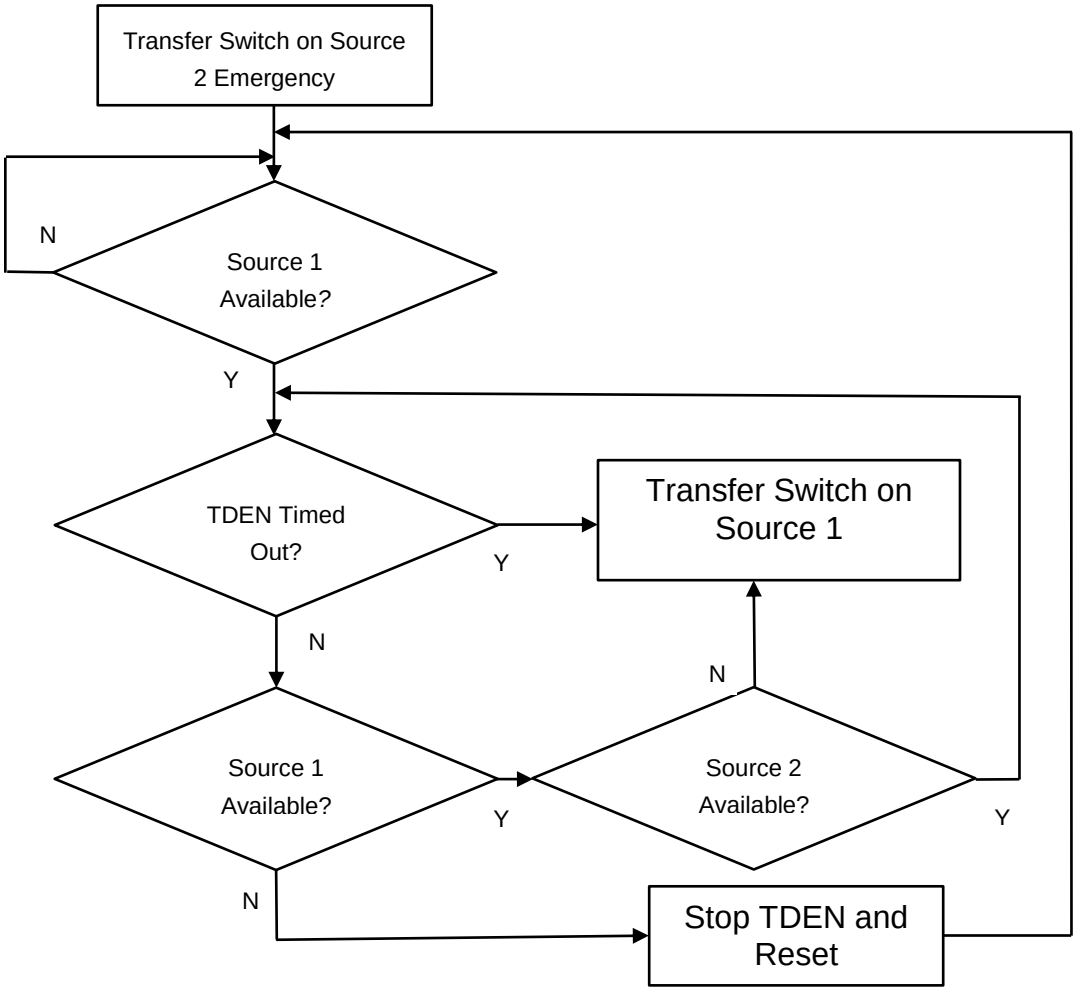
Appendix C: Basic Transfer Switch Operational Sequences

Basic Transfer Switch Flowchart – Transfer to Source 2



Example shown is for NO COMMIT.

Basic Transfer Switch Flowchart – Transfer to Source 1



Appendix D: HANNA's Laws

- Volts is Volts.
- You cannot connect to a BAD SOURCE.
- You cannot remain disconnected from the ONLY GOOD SOURCE.
    - You cannot leave a bad source if there is not a good source available.
- Any two sources when not in-phase, if connected together suddenly will be.

Appendix E: Key Contacts Tech Support / Warranty

Technical Support for Eaton Transfer Switches is available by calling:

1-800-809-2772, Option 4, Option 3

Email: ATSTechsupport@eaton.com

Technical Support is currently available from 8AM to 5PM Eastern Time

ATS Warranty: Initial contact on warranty issues MUST be made through Technical Support. Warranty contact is for follow-up only.

Ken Owenby

1-828-687-3024

Email: ATSWarranty@eaton.com

Definitions

CSA – Canadian Standards Association

EGSA – Electrical Generation Systems Association

IEC – International Electrotechnical Commission

NEMA – National Electrical Manufacturers Association

NFPA – National Fire Protection Association

TSE - Transfer Switch Equipment

Three-Position – Switching Device capable of being in either NORMAL (Source 1), CENTER (OFF), or EMERGENCY (Source 2)

Two Position - Switching Device only capable of being in either NORMAL (Source 1) or EMERGENCY (Source 2)