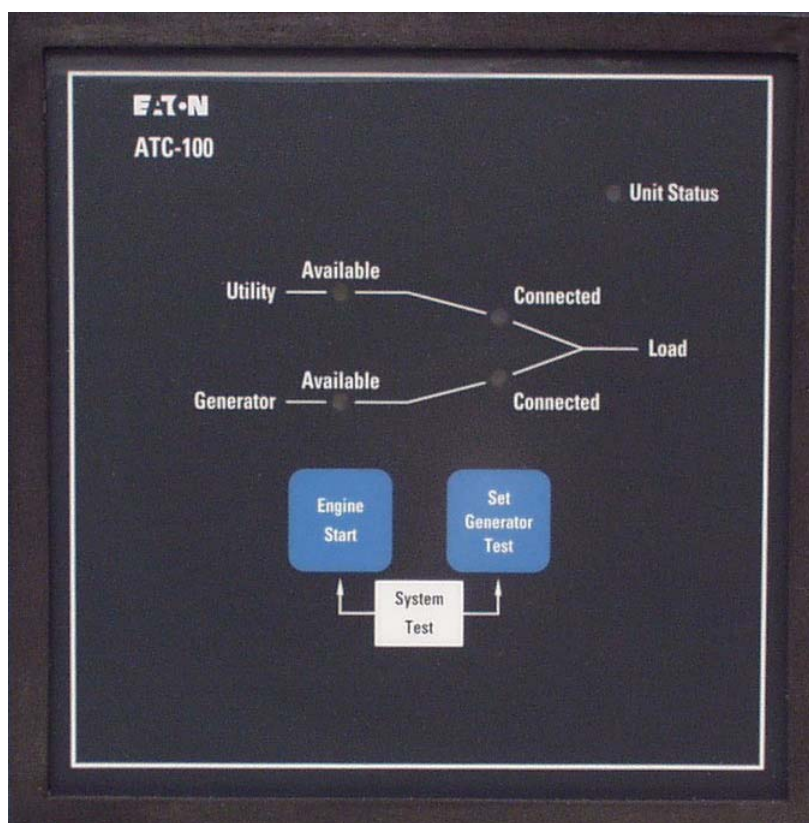


O & M Manual for the Eaton ATC-100 Automatic Transfer Switch Controller

Instructional Booklet

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Section 1: Introduction

CAUTION

THE ATC-100 CONTROLLER IS FACTORY PROGRAMMED FOR A SPECIFIC AUTOMATIC TRANSFER SWITCH. DO NOT ATTEMPT TO INTERCHANGE ATC-100 CONTROL DEVICES WITHOUT CONSULTING EATON ELECTRICAL, INC.

All possible contingencies that may arise during installation, operation, or maintenance, and all details and variations of this equipment do no purport to be covered by these instructions. If further information is desired by the purchaser regarding an installation, operation, or maintenance of particular equipment, please contact an authorized Eaton Electrical Sales Representative or the installing contractor.

1.1 Preliminary Comments and Safety Precautions

This technical document is intended to cover most aspects associated with the installation, application, operation, and maintenance of the Automatic Transfer Controller (ATC-100). It is provided as a guide for authorized and qualified personnel only in the selection and application of the ATC-100. Please refer to the specific WARNING and CAUTION in Section 1.1.2 before proceeding. If further information is required by the purchaser regarding a particular installation, application, or maintenance activity, please contact an authorized Eaton, Electrical sales representative or the installing contractor.

1.1.1 Warranty and Liability Information

No warranties, expressed or implied, including warranties of fitness for a particular purpose of merchantability, or warranties arising from course of dealing or usage of trade, are made regarding the information, recommendations and descriptions contained herein. In no event will Eaton be responsible to the purchaser or user in contract, in tort (including negligence), strict liability or otherwise for any special, indirect, incidental or consequential damage or loss whatsoever, including but not limited to damage or loss of use of equipment, plant or power system, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the information and descriptions contained herein.

1.1.2 Safety Precautions

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

WARNING

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

WARNING

COMPLETELY READ AND UNDERSTAND THE MATERIAL PRESENTED IN THIS DOCUMENT BEFORE ATTEMPTING INSTALLATION, APPLICATION, OPERATION, OR MAINTENANCE OF THE EQUIPMENT. IN ADDITION, ONLY QUALIFIED PERSONS SHOULD BE PERMITTED TO PERFORM ANY WORK ASSOCIATED WITH THIS EQUIPMENT. ANY WIRING INSTRUCTIONS PRESENTED IN THIS DOCUMENT MUST BE FOLLOWED PRECISELY. FAILURE TO DO SO COULD CAUSE PERMANENT EQUIPMENT DAMAGE.

1.2 Background

Transfer switches are used to protect critical electrical loads against loss of power. The load's utility power source is backed up by a generator power source. A transfer switch is connected to both the utility and generator power sources and supplies the load with power from one of the two sources. In the event that power is lost from the utility, the transfer switch transfers the load to the generator power source. Once utility power is restored, the load is automatically transferred back to the utility power source.

In Automatic Transfer Switch (ATS) equipment, the switch's intelligence system initiates the transfer when the utility power falls below or rises above a preset voltage or frequency. The ATS initiates generator start up then transfers to the generator power source when sufficient generator voltage is available. When utility power is restored, the ATS automatically transfers back to the utility power source and initiates generator engine shutdown.

An ATS consists of three basic elements:

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

This manual deals with the third basic element of the ATS, the required intelligence/supervisory circuits. Earlier ATSs were controlled by relay logic type or a solid-state, single-board controllers. In either case, the control panel consisted of a number of individually mounted and wired devices offering a limited amount of system flexibility, especially in the case of the relay logic design. The ATC-100 advances the application of intelligence, supervisory, and programming capabilities for ATS equipment.

1.3 Product Overview

The ATC-100 is a comprehensive, multi-function, microprocessor based ATS controller. It is a compact, self-contained, panel mounted device designed to replace traditional relay and solid-state logic panels.

Designed to meet the needs of markets worldwide, the ATC-100:

- Is an Underwriters Laboratories (UL) recognized component
- Complies with UL 1008/ Canadian Standards Association (CSA) 22.2-178
- Complies with UL 991 environmental tests
- Complies with International Electrotechnical Commission (IEC) 61000-4-2, 61000-4-3, 61000-4-4, 61000-4-5, 61000-4-6, and 61000-4-11

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- Complies with Comité Internationale Spécial des Perturbations Radioelectrotechnique (CISPR) 11, Class B
- Complies with Federal Communications Commission (FCC) Part 15, Class B
- Meets European Standards Conformance (CE mark)

The ATC-100 provides an unmatched degree of programmed flexibility to address the needs of any system. It operates from system voltages between 120 and 480 Vac, single-phase or 3-phase, at 50 or 60 Hz. In addition, a period of no control power operation is provided. The ATC-100 monitors the condition of the 3-phase line-to-line voltage and frequency of both the utility and generator power sources. It can also be set up for single-phase operation. The ATC-100 provides the necessary intelligence to insure that the transfer switch operates properly through a series of programmed sensing and timing functions.

A standard ATC-100 will:

- Monitor utility and generator power source voltages and generator power source frequency
- Provide undervoltage protection of the utility and generator power sources
- Provide underfrequency and overfrequency protection of the generator power source
- Permit easy customer set up
- Permit system testing
- Provide faceplate source status indications

1.4 Glossary

With respect to their use within this document and as they relate to ATS and controller operation, the following terminology is defined.

Available

A source is defined as "available" when it is within its undervoltage / underfrequency/overfrequency (if applicable) set-point ranges for the nominal voltage and frequency setting.

Connected

Connected is defined as when the input is shorted by an external contact or connection.

Failed or Fails

A source is defined as "failed" when it is outside of the applicable voltage and frequency set-point ranges for the nominal voltage and frequency setting for a time exceeding 0.5 seconds after the time delay emergency fail (TDEF) time delays expires.

Failsafe

Failsafe is a feature that prevents disconnection from the only available power source and also forces a transfer or re-transfer operation to the only available power source.

Re-Transfer

Re-transfer is defined as a change of the load connection from the generator to the utility.

Utility

Utility is the primary source (normal source, normal power source, or normal).

Generator

Generator is the secondary source (emergency source, emergency power source, emergency, standby, or backup source).

Utility: Failed or Fails

Utility is defined as "failed" when it is outside of its undervoltage set-point range for the nominal voltage setting.

Generator: Failed or Fails

Generator is defined as "failed" when it is outside of its undervoltage/ underfrequency/overfrequency (if applicable) set-point ranges for the nominal voltage and frequency setting for a time exceeding 0.5 seconds after the TDEF time delay expires.

Switching Device

A switching device is used to change available power sources to a common load. (i.e. circuit breaker, molded case switch, power contactor)

Transfer

Transfer is defined as a change of the load connection from the utility to the generator power source.

Unconnected

Unconnected is defined as when the input is not shorted by an external contact or connection.

$V_{IN, RMS}$

Refers to the operating input voltage (Vac, RMS).

1.5 Functions/Features/Options

The primary function of ATC-100 is to accurately monitor power sources and provide the necessary intelligence to operate an ATS in an appropriate and timely manner. In addition, the ATC-100 provides status information through the device's faceplate.

1.5.1 Operational Simplicity

From installation to programming to usage, the ATC-100 was designed with operational simplicity in mind. Only one style needs to be considered, regardless of input/output requirements or system voltages and frequencies. The ATC-100 provides the functionality of numerous other devices combined in one package that mounts in 6.5 by 8.5 in. (165.1 by 215.9 mm) of panel space.

1.5.2 Features

The following is a list of the features of the ATC-100.

1. Time Delay Normal to Emergency (TDNE)

This feature provides a time delay when transferring from the utility source to the generator power source. Timing begins when the generator source becomes available. It permits controlled transfer of the load circuit to the generator source.

Jumper selectable at 2 or 15 seconds.

2. Time Delay on Engine Starting (TDES)

This feature provides a time delay of the signal to initiate the engine/generator start cycle in order to override momentary power outages or voltage fluctuations of the utility source.

Fixed setting of three seconds

3. Time Delay Emergency to Normal (TDEN)

This feature provides a time delay of the re-transfer operation to permit stabilization of the utility source. Timing begins when the utility source becomes available. If the generator source fails during timing, then a re-transfer is immediate, overriding the time delay.

Fixed setting of five minutes.

4. Time Delay for Engine Cool-down (TDEC)

This feature provides a time delay of the signal to initiate the engine/generator stop cycle after the re-transfer operation. This allows the engine/generator to cool down by running unloaded. Timing begins on completion of the re-transfer cycle.

Fixed setting of five minutes.

5. Generator Monitoring and Protection

This feature provides monitoring and protection based on the generator voltage and/or frequency set points. All Feature 5 functions are "failsafe" operations.

5B. Single Phase Undervoltage and Underfrequency Protection

Undervoltage:
Dropout: 80% of nominal
Pickup: 90% of nominal

Underfrequency:
Dropout: 90% of nominal
Pickup: 95% of nominal

5C. 1-Phase Overfrequency

Overfrequency:
Dropout: 115% of nominal
Pickup: 110% of nominal

5N. All Phase Overfrequency

Overfrequency:
Dropout: 115% of nominal
Pickup: 110% of nominal

5J. 3-Phase Undervoltage and Underfrequency Protection

Undervoltage:
Dropout: 80% of nominal
Pickup: 90% of nominal

Underfrequency:
Dropout: 90% of nominal
Pickup: 95% of nominal

6. Test Operators

Eaton automatic transfer switch controllers are provided with a "System Test" pushbutton.

6B. System Test Pushbutton

The System Test pushbutton will start the generator, transfer the load to the generator source, run on generator for a run time of 15 minutes, and then re-transfer back to the utility source. All programmed time delays (TDNE, TDEN, etc.) will be performed as part of the System Test. The System Test is failsafe protected.

7. Time Delay Emergency Fail (TDEF)

This feature provides a time delay that prevents a connected emergency source from being declared "failed" in order to override momentary generator fluctuations. If the generator power source remains in the failed state then, 0.5 seconds after the TDEF timer expires, the transfer switch will proceed with the programmed sequence for re-transfer.

Fixed setting of six seconds

12. Power Source Annunciation

This feature provides LED's to indicate switch position and power source availability indications.

Switch Position

Provides LED's to indicate the transfer switch position.

12C. Utility - Source Connected

This feature provides a green LED that, when lit, indicates that the load is connected to the utility source.

12D. Generator - Source Connected

This feature provides a red LED that, when lit, indicates the load is connected to the generator source.

Power Source Availability

Provides LED's to indicate if a power source is available. LED's may be integral or separate from the controller.

12G. Utility - Available

This feature provides a white LED that, when lit, indicates that the utility source is available.

12H. Generator - Available

This feature provides an amber LED that, when lit, indicates that the generator source is available.

23. Generator Test

This feature provides a means for automatic testing of the engine/generator set or standby power system. All programmed time delays will be performed during generator test operations.

23A. Generator Test Selectable – Off / 7 / 14 / 28 Day Interval (Jumper Selectable Only)

This feature provides for automatic test operation of the generator. Available test cycles are 7, 14, or 28 days with a 15-minute duration.

Programmable jumpers allow for selection of three test cycles:

- Generator Start/Run Only (No Load);
- Generator Test with Load Transfer; or
- Disabled

This is a "Failsafe" operation.

26. Utility - Monitoring and Protection

This feature provides utility monitoring and protection functions. If the utility power source fails, then the ATC-100 will begin the sequence of operations necessary to transfer the load circuit to the generator power source. All Feature 26 monitoring and protection functions are "failsafe" operations.

26P. All Phase Undervoltage Protection

This feature provides all phase undervoltage monitoring and protection.

Undervoltage:
Dropout: 80% of nominal
Pickup: 90% of nominal

32G. Time Delay Neutral (TDN)

This feature provides a time delay in the neutral position during the transfer and re-transfer operations during which both the Utility source and the Generator source are disconnected from the load circuit. TDN cannot be implemented on a transfer switch using a 2-position contactor.

Jumper selectable at Disable (0 seconds) or Enable (2 seconds).

32F. In-Phase Transition

Provides In-phase transition, which is a feature that will permit a transfer or re-transfer between 2 available sources that have a phase angle difference of 8 degrees or less. The In-phase transition feature includes permissible frequency difference and synchronization time setpoints. In-phase transition is not customer selectable. In-phase transition is attempted for 10 minutes. If unsuccessful, an open transition is performed. Time Delay Neutral (TDN) feature will be disabled for 2-position contactor type automatic transfer switch. Time Delay Normal to Emergency (TDNE) will be fixed at 15 sec and Generator Over-frequency will be fixed at "OFF".

Section 2: Hardware Description**2.1 General**

The purpose of this section is to familiarize the reader with the ATC-100 hardware, its nomenclature, and to list the unit's specifications.

2.2 Front (Operator) Panel

The front panel, depending on the installation, is normally accessible from the outside of a panel or door. The front panel provides a means to:

- alert the user to specific conditions;
- perform an Engine Start;
- perform a System Test; and
- program a Generator Test.

The ATC-100 front panel serves two primary functions: output and input (see Figure 1). The output function consists of five LED outputs:

1. Unit Status;
2. Utility Available;
3. Utility Connected;
4. Generator Available; and
5. Generator Connected.

There are three input functions accessible through the pushbuttons:

1. Engine Start;
2. Set Generator Test; and
3. System Test.

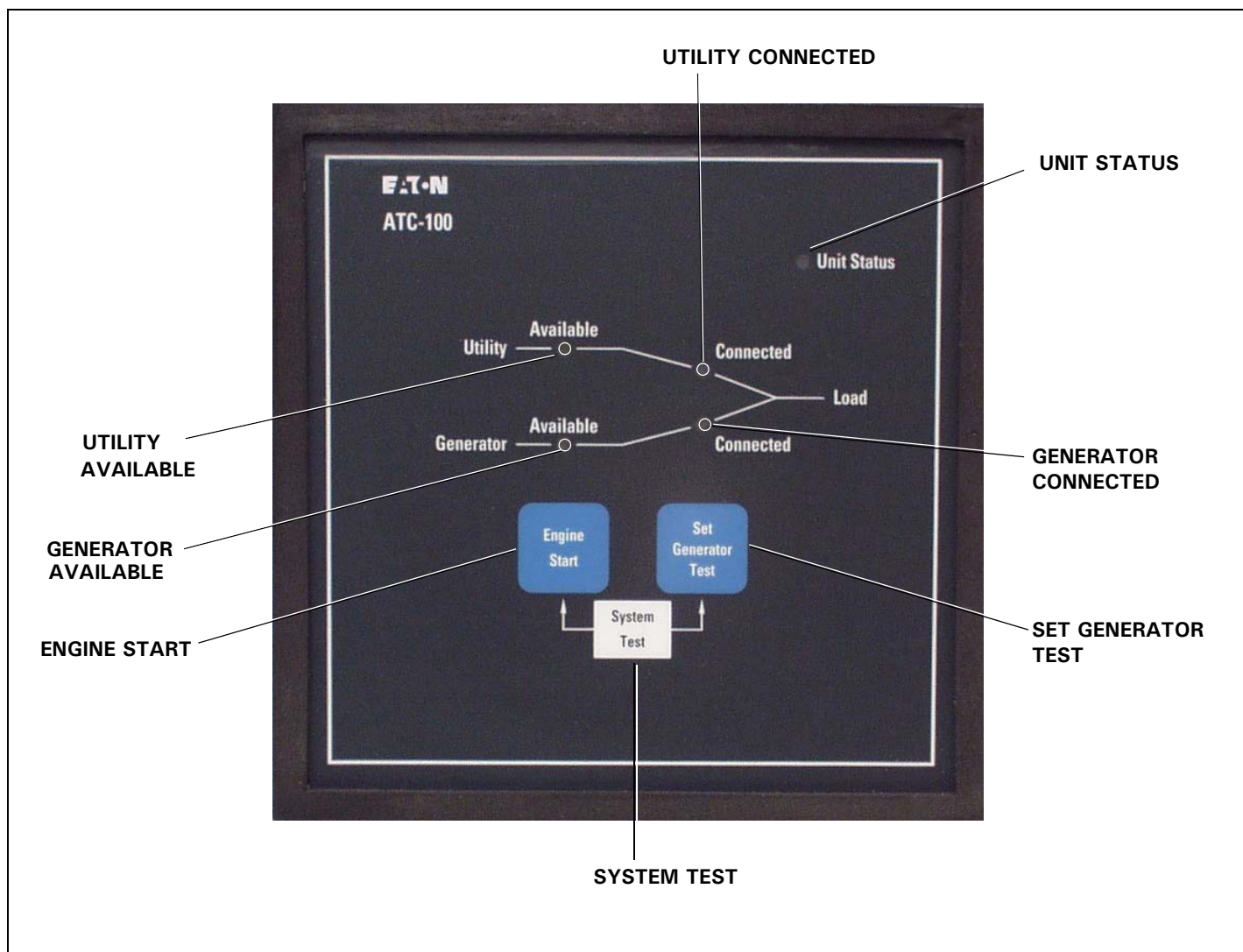


Figure 1. The ATC-100 Front Panel.

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2.2.1 The Output Function 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 (see Section 5.2, ATC-100 Troubleshooting).

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 undervoltage/underfrequency/overfrequency (if applicable) ranges for the nominal voltage and frequency setting.

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, (see Section 5.2, ATC-100 Troubleshooting).

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 (see Section 5.2, ATC-100 Troubleshooting).

2.2.2 The Input Function Components

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:

- No Load Generator Test;
- Generator Test with Load Transfer; or
- Disabled.

For complete information on the Generator Test function, see Section 3.4.3.

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.

2.3 Rear Access Area

The rear access area of the ATC-100 is normally accessible from the rear of an open panel door (see Figure 2).

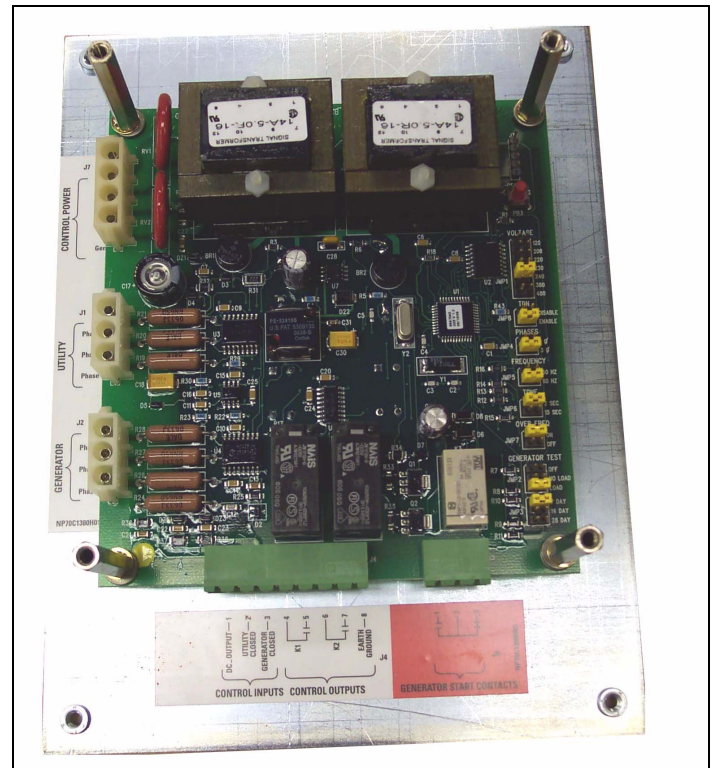


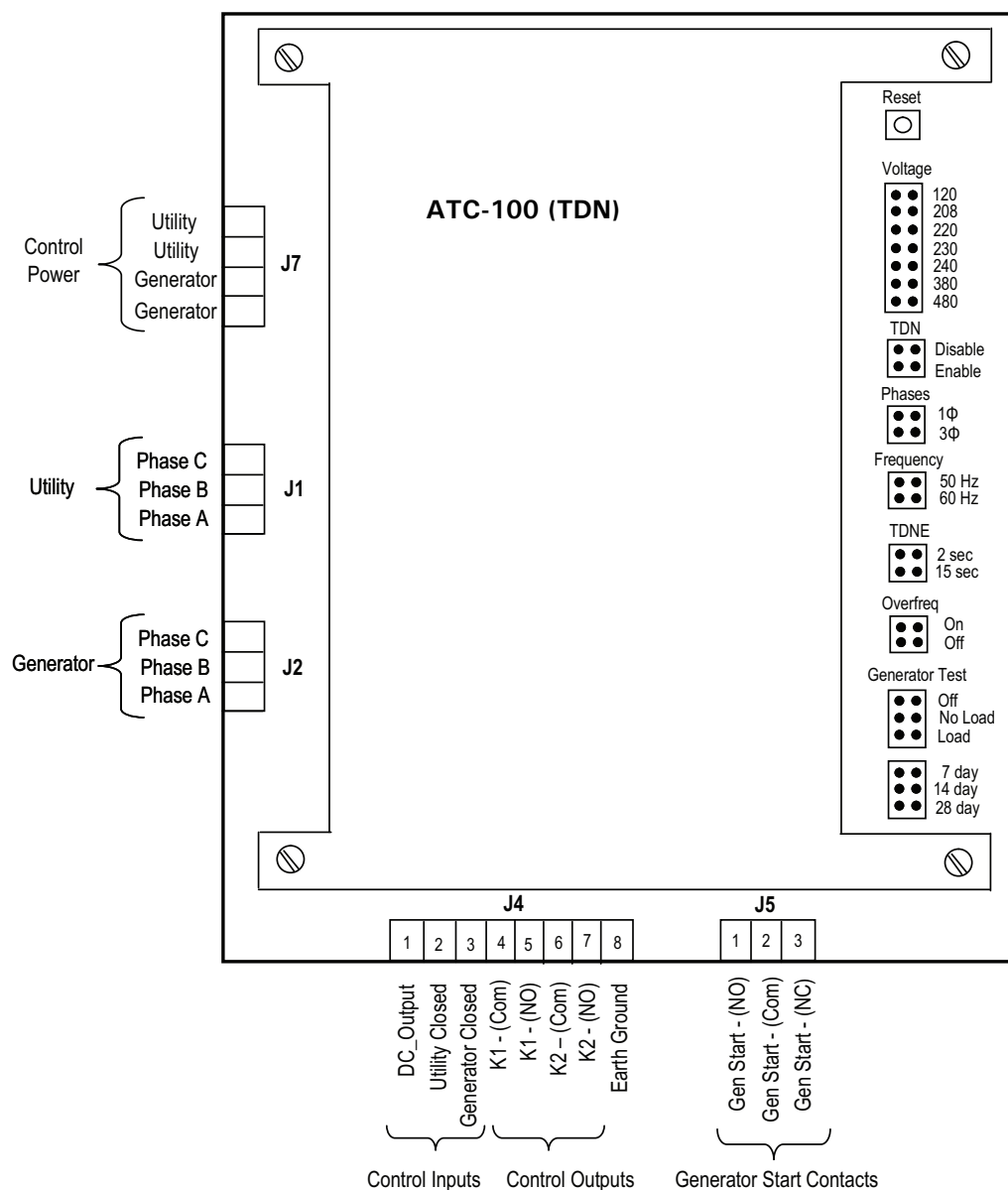
Figure 2. ATC-100 (Rear View).

All wiring connections to the ATC-100 are made at the rear of the chassis.

Note: To allow for uniform identification, the frame of reference when discussing the rear access area is with the panel door open and the User facing the back of the ATC-100.

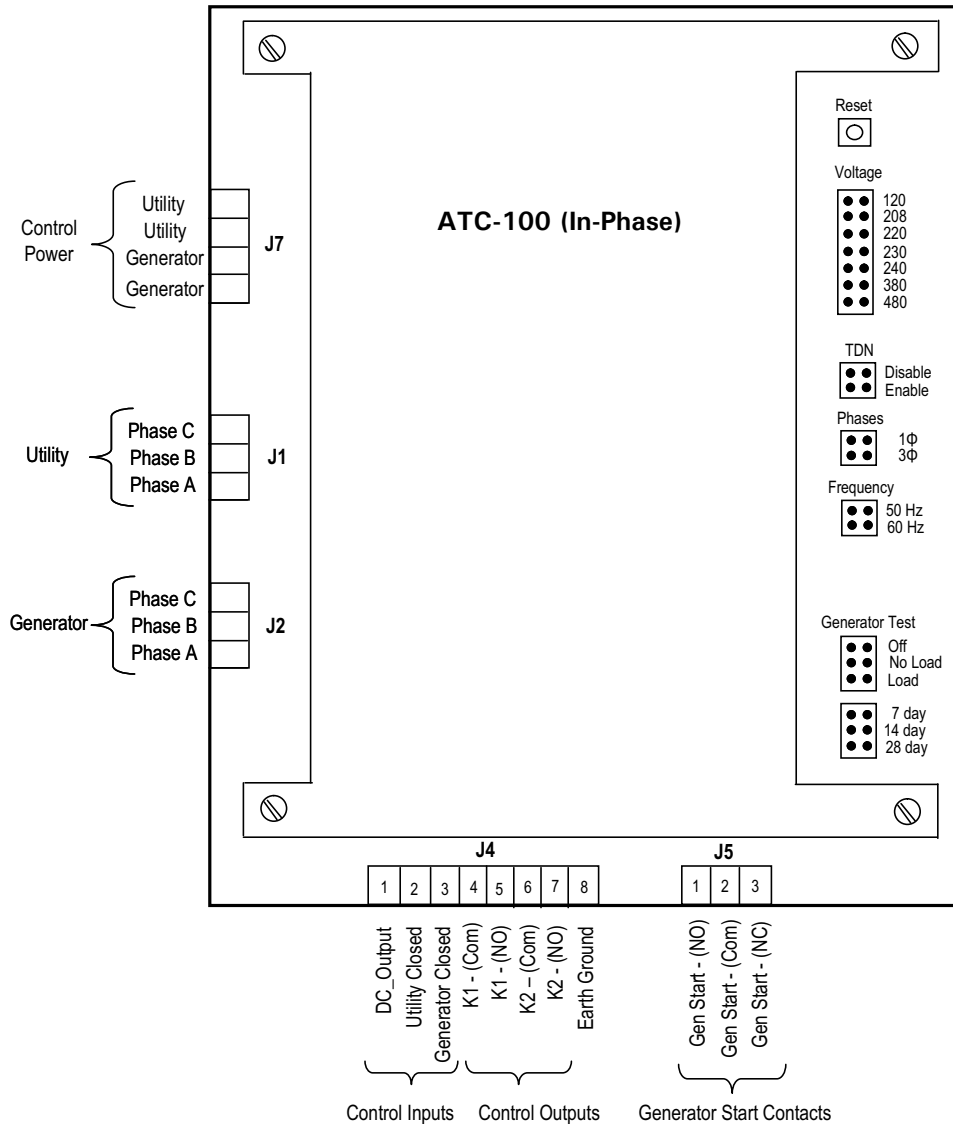
Located at the left rear of the ATC-100 are connectors J1, J2, and J7. J1 and J2 provide for voltage monitoring of the utility and generator respectively. J7 is provided for utility and generator control power input. The J4 and J5 connectors are located at the bottom of the controller. The J4 connector provides connections for the control inputs and dry relay contacts for primary control outputs. The J5 connector provides the Generator Start dry relay contacts for starting the generator (see Figures 3A and 3B).

See Section 2.5 for contact ratings.



ATC-100 Controller (TDN) - CAT#8160A00G23

Figure 3A. ATC-100 Controller (TDN)



ATC-100 Controller (In-Phase) - CAT#8160A00G24

Figure 3B. ATC-100 Controller (In-Phase)

2.3.1 Programming Jumpers

The ATC-100 is programmable via the jumpers on the back of the unit. The jumper selections are discussed in Section 5, Programming.

2.3.2 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; and
- "Generator Available" LED is blinking.

See Section 5.2, ATC-100 Troubleshooting for further information on these alarm conditions.

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.

2.4 Control Inputs

The ATC-100 has two individual control input signals that are used to sense transfer switch position. The inputs require an external contact closure to the DC_Output pin (J4, Pin1). The DC_Output pin is connected internally to the unregulated DC supply (26 V) and appropriate current-limiting to provide a nominal current of 10 mA per channel.

2.4.1 Control Input Descriptions

The Control Input "State" definitions are as follows.

Connected - When the input is shorted by an external contact or connection.

Unconnected - When the input is NOT shorted by an external contact or connection.

The Control Input operations are defined as follows.

Utility Closed

When this input (J4, Pin 2) is in the "Connected" state, it indicates to the ATC-100 that the utility switching device is closed. When this input is in the "Unconnected" state, it indicates to the ATC-100 that the utility switching device is open. This input is typically wired to the utility device auxiliary contact that is closed when the utility switching device is closed.

Generator Closed

When this input (J4, Pin 3) is in the "Connected" state, it indicates to the ATC-100 that the generator switching device is closed. When this input is in the "Unconnected" state, it indicates to the ATC-100 that the generator switching device is open. This input is typically wired to the generator device auxiliary contact that is closed when the generator switching device is closed.

2.5 Output Relays

The primary control outputs of the ATC-100 are dry relay contacts. These relays are comprised of one latching "Form C" relay to provide the generator start contacts, and two conventional coil "Form C" relays (that implement only the Form A contact) necessary to complete the electrical control function. Since the outputs were tested per the UL 1008 Dielectric Test and the IEC 947-6 Dielectric Test, the dielectric rating for each output is a minimum of 1500 Vac.

The Output Relay functions are divided into two categories:

- Customer Connections and
- Transfer Operation Connections.

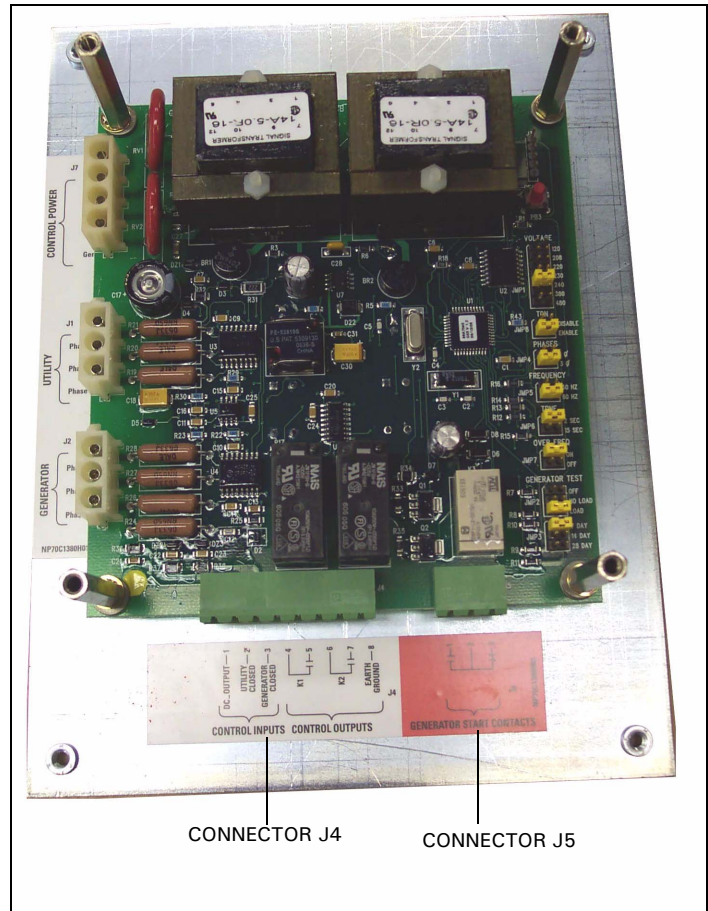


Figure 4. J-4 and J-5 Connector Connections.

2.5.1 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) (see Figure 4). 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.

Note: Note: The ATC-100 MUST BE properly grounded at J-4, Pin 8 for proper operation.

2.5.2 Transfer Operations Connections

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

Output Relay K1

This relay is used to control transfer switch position. Only the Form A contact is available for connection.

This output is used to close the utility switching device. The K1 relay momentarily energizes until the ATC-100 senses that the utility switching device is closed, then K1 de-energizes. The K1 outputs are the Common Pin (J-4, Pin 4) and Normally Open Pin (J-4, Pin 5) (see Figure 4).

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Output Relay K2

This relay is used to control transfer switch position. Only the Form A contact is available for connection.

This output is used to close the generator switching device. The K2 relay momentarily energizes until the ATC-100 senses that the generator switching device is closed, then K2 de-energizes. The K2 outputs are the Common Pin (J-4, Pin 6) and Normally Open Pin (J-4, Pin 7) (see Figure 4).

Note: The ATC-100 MUST BE properly grounded at J-4, Pin 8 for proper operation.

2.6 Specification Summary

Table 1. ATC-100 Specifications.

Input Control Voltage	95 to 145 Vac	50/60 Hz
Voltage Measurements of	Utility VAB Utility VBC Utility VCA	Generator VAB Generator VBC Generator VCA
Voltage Measurement Range	0 to 575 Vac RMS (50/60 Hz)	
Voltage Measurement Accuracy	± 1% of Full Scale	
Frequency Measurements of	Generator	
Frequency Measurement Range	40 Hz to 70 Hz	
Frequency Measurement Accuracy	± 0.3 Hz Over the Measurement Range	
Undervoltage Dropout	80% of the Nominal System Voltage	
Undervoltage Pickup	90% of the Nominal System Voltage	
Underfrequency Dropout Range	90% of the Nominal System Frequency	
Underfrequency Pickup Range	95% of the Nominal System Frequency	
Overfrequency Dropout Range	115% of the Nominal System Frequency	
Overfrequency Pickup Range	110% of the Nominal System Frequency	
Operating Temperature Range	-20 to +70°C (-4 to +158°F)	
Storage Temperature Range	-30 to +85°C (-22 to +185°F)	
Operating Humidity	0 to 95% Relative Humidity (Non-condensing)	
Operating Environment	Resistant to Ammonia, Methane, Nitrogen, Hydrogen, and Hydrocarbons	
Generator Start Relay	5 A, 1/6 HP @ 250 Vac 5 A @ 30 Vdc with a 150 W Maximum Load	
K1, K2 Relays	10 A, 1-3 HP @ 250 Vac 10 A @ 30 Vdc	
Applicable Testing	UL Recognized Component UL 1008, UL 991 Environmental IEC 61000-4-2, 61000-4-3, 61000-4-4, 61000-4-5, 61000-4-6, 61000-4-11 CISPR 11, Class B FCC Part 15, Class B	
Enclosure Compatibility	NEMA 1, NEMA 3R, and NEMA 12 UV Resistant ATC-100 Faceplate	

Section 3: Operation

3.1 General

This section specifically describes the operation and functional use of the ATC-100. The practical use of and operation within each category will be discussed. In this section, it is assumed that prior sections of this manual were reviewed and that the operator has a basic understanding of the hardware.

The ATC-100 provides for automatic transfer and re-transfer from source to source. It provides a summary of the ATC-100 intelligence and supervisory circuits that constantly monitor the condition of both the utility and generator power sources, thus providing the required intelligence for transfer operations. These circuits, for example, automatically initiate an immediate transfer of power when the power fails or the voltage level drops below a preset value.

3.2 Operating Voltage and Measurements

The ATC-100 operates with control power from 95 to 145 Vac (120 Vac ± 20%). The ATC-100 operates on single and 3-phase systems with selectable frequency settings of 50 or 60 Hz.

The ATC-100 can perform the time delay engine start function without control power.

The ATC-100 operates directly from the line sensing inputs of the utility and generator power sources. The nominal operating system input is jumper-selectable from 120 to 480 Vac. The standard system assumes that neutral is available and that the switching device can therefore be powered from an available 120 Vac source. If a neutral conductor is not available, 120 Vac is created by an external transformer.

All voltage monitoring and measurements are true RMS measurements.

3.3 Typical Transfer Operation

A typical transfer request will begin with a utility outage (utility voltage falls below the 80% dropout level), a System Test, or a Generator Test with Load Transfer. After Time Delay Engine Start (TDES) times out, the Generator Start relay will energize which closes its Normally Open contacts and opens its Normally Closed contacts.

When the generator source meets the requirements to be considered available, the Time Delay Normal to Emergency (TDNE) timer will start timing. After TDNE times out, the K2 relay contacts will close. If TDN is enabled, the K2 relay contacts will open when the Utility Connected input is open (load is disconnected from utility). TDN will then time out and the K2 relay contacts will close until the Generator Connected input is closed. Once the Generator Connected input is satisfied (load is connected to generator), the K2 relay contacts will open..

When the utility becomes available (utility voltage is above the 90% pickup level), the Time Delay Emergency to Normal (TDEN) timer will start timing. After TDEN times out, the K1 relay contacts will close. If TDN is enabled, the K1 relay contacts will open when the Generator Connected input is open (load is disconnected from generator). TDN will then time out and the K1 relay contacts will close until the Utility Connected input is closed. Once the Utility Connected input is satisfied (load is connected to utility), the K1 relay contacts will open and the Time Delay Engine Cooldown (TDEC) timer will start timing. When TDEC times out, the Generator Start relay will de-energize which opens its Normally Open contacts and closes its Normally Closed contacts.

3.4 Test Modes

There are three test modes:

1. Engine Start – a no load generator test;
2. System Test – a generator test with load transfer; and
3. Generator Test – a programmed generator test with or without load transfer.

3.4.1 Engine Start

The Engine Start test is intended to start and run the engine/generator under no-load conditions. The load remains connected to the utility source for this test.

The Engine Start test is initiated by pressing and holding the Engine Start pushbutton for a period of five seconds. The test will run for 15 minutes and then terminate.

If the generator source does not become available within 90 seconds of the ATC-100 providing the generator start command, the Engine Start test will abort and the Generator Available LED will blink. This alarm condition can be reset by pressing the Reset pushbutton on the rear of the unit.

The Engine Start test may be aborted in the following ways:

1. Press the Engine Start pushbutton;
2. If the generator source does not become available within 90 seconds of the ATC-100 providing the generator start command; and
3. If the utility source becomes unavailable.

3.4.2 System Test

Pressing the Engine Start and Set Generator Test pushbuttons simultaneously will initiate a System Test. The System Test will start the generator, time out TDNE, transfer the load to generator source, 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.

If the generator source does not become available within 90 seconds of the ATC-100 providing the generator start command, the Engine Start test will abort and the Generator Available LED will blink. This alarm condition can be reset by pressing the Reset pushbutton on the rear of the unit.

NOTICE

IF THE ATS IS UNABLE TO PROCESS A SYSTEM TEST REQUEST DUE TO THE ATS STATUS, THE REQUEST IS IGNORED.

All operations are “failsafe”, that is they prevent disconnection from the only available power source and also force a transfer or re-transfer operation to the only available power source.

A System Test may be aborted in the following ways:

1. Simultaneously press the Engine Start and Set Generator Test pushbuttons;
2. If the generator source does not become available within 90 seconds of the ATC-100 providing the generator start command;
3. If, during the TDNE countdown, the generator source goes unavailable more than three times (TDNE will restart each time);
4. If the generator source is powering the load and it goes unavailable for more than the TDEF setting of six seconds; and
5. If the utility source becomes unavailable.

3.4.3 Generator Test

NOTICE

THE GENERATOR TEST FEATURE ALLOWS FOR AUTOMATIC PROGRAMMING OF THE DESIRED TEST CYCLE ON A 7-DAY, 14-DAY, OR 28-DAY BASIS. IF THE ATS IS UNABLE TO PROCESS A GENERATOR TEST REQUEST DUE TO THE ATS STATUS, THE REQUEST IS IGNORED.

The Generator Test is a feature that provides an automatic test of the generator. The Generator Test is initiated by pressing and holding the Set Generator Test pushbutton for five seconds. The Utility Available and Generator Available LED's will blink twice, indicating that the Generator Test is programmed. The test will run with a 15-minute engine run time. The Generator Test will then run again automatically every 7 days, every 14 days, or every 28 days depending on the Generator Test jumper setting.

Two optional modes of generator testing are available which are also based on the Generator Test jumper setting:

- No-load Test – the generator starts and runs for 15 minutes with no transfer and
- Load Transfer Test – the load is transferred to the generator for 15 minutes.

Once the Generator Test is programmed, it may be deprogrammed by pressing and holding the Set Generator Test pushbutton for five seconds. The Utility Available and Generator Available LED's will blink four times. The Generator Test can also be disabled by placing the Generator Test jumper in the “OFF” position.

Generator testing in the Load Transfer Test mode is “failsafe”. If the generator fails during testing for any reason, the ATC-100 will signal the transfer switch to return to the utility power source.

A Generator Test may be aborted in the following ways:

1. Press and hold the Set Generator Test pushbutton for 5 seconds;
2. If the generator source does not become available within 90 seconds of the ATC-100 providing the generator start command;
3. If, during the TDNE countdown, the generator source goes unavailable more than three times (TDNE will restart each time);
4. If the generator source is powering the load and it goes unavailable for more than the TDEF setting of six seconds; and
5. If the utility source becomes unavailable.

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Section 4: Programming

4.1 Introduction

The ATC-100 is programmable via the jumpers on the back of the unit (see Figure 5).



Figure 5. Jumpers on ATC-100.

Table 2 shows the Fixed and Jumper-selectable settings that are available in the ATC-100.

Table 2. Fixed and Jumper-Selectable Settings.

DESCRIPTION	RANGE	FACTORY DEFAULT	FIXED/JUMPER
Time Delay Engine Start	3 seconds	3 seconds	Fixed setting
Time Delay Normal to Emergency (for ATC-100 with TDN)	2 or 15 seconds	15 seconds	Jumper-selectable
Time Delay Emergency to Normal	5 minutes	5 minutes	Fixed setting
Time Delay Engine Cool-off	5 minutes	5 minute	Fixed setting
Time Delay Emergency Fail Timer	6 seconds	6 seconds	Fixed setting
Nominal Frequency	50 or 60 Hz	As ordered	Jumper-selectable
Nominal Voltage	120, 208, 220, 230, 240, 380, or 480 volts	As ordered	Jumper-selectable
Three phase or single phase	1 or 3	As ordered	Jumper-selectable
Utility Undervoltage Dropout	80% of Nominal Voltage	80% of Nominal Voltage	Fixed setting
Generator Undervoltage Dropout	80% of Nominal Voltage	80% of Nominal Voltage	Fixed setting
Utility Undervoltage Pickup	90% of Nominal Voltage	90% of Nominal Voltage	Fixed setting
Generator Undervoltage Pickup	90% of Nominal Voltage	90% of Nominal Voltage	Fixed setting
Generator Underfrequency Dropout	90% of Nominal Frequency	90% of Nominal Frequency	Fixed setting
Generator Underfrequency Pickup	95% of Nominal Frequency	95% of Nominal Frequency	Fixed setting
Generator Overfrequency Dropout (for ATC-100 with TDN)	Off or 115% of Nominal Frequency	Off	Jumper-selectable
Generator Overfrequency Pickup (for ATC-100 with TDN)	Off or 110% of Nominal Frequency	Off	Jumper-selectable
Generator Test On/Off	Off, No Load Transfer, Load Transfer	Off	Jumper-selectable
Generator Test Interval	7-Day, 14-day, or 28-day	7-day	Jumper-selectable
Engine Run Test Time	15 minutes	15 minutes	Fixed setting
Time Delay Neutral	Disabled (0 seconds) or Enabled (2 seconds)	Enabled (2 seconds)	Jumper-selectable

Section 5: Troubleshooting and Maintenance

5.1 Level of Repair

This manual is written with the assumption that only ATS troubleshooting will be performed. If the cause of malfunction is traced to an ATC-100, the unit should be replaced with a new unit. The malfunctioning unit should then be returned to Eaton Electrical, Inc. for factory repairs.

5.2 ATC-100 Troubleshooting

The Troubleshooting Guide (Table 3) is intended for service personnel to identify whether a problem being observed is external or internal to the unit. For assistance with this determination, contact Eaton Electrical. If a problem is identified to be internal, the unit should be returned to the factory for replacement.

Table 3. Troubleshooting Guide.

SYMPTOM	PROBABLE CAUSE	POSSIBLE SOLUTION(S)
All front panel LED's are off.	Control power is deficient or absent.	Verify that control power is connected at J7 and that it is within specifications.
	ATC-100 is malfunctioning.	Replace the unit.
"Unit Status" LED is not blinking.	Control power is deficient or absent.	Verify that control power is connected at J7 and that it is within specifications.
	ATC-100 is malfunctioning.	Replace the unit.
Front panel pushbuttons do not work.	Bad connection inside the ATC-100.	Replace the unit.
Utility source or Generator source is not available when it should be.	Voltage and/or frequency are not within set-point values.	Verify voltage and/or frequency with multimeter. Check the programmed setpoint values.
"Utility Connected" LED is blinking.	Utility switching device did not open when it was commanded to open (within 6 seconds).	Check the utility circuit breaker shunt trip (ST) wiring.
	Utility switching device did not close when it was commanded to close (within 6 seconds).	Check the utility circuit breaker spring release (SR) wiring.
	Utility closed contacts did not open when Utility switching device opened (within 6 seconds)	Check the utility closed control input wiring on J-4, Pins 1 and 2.
	Utility closed contacts did not close when Utility switching device closed (within 6 seconds).	Check the utility closed control input wiring on J-4, Pins 1 and 2.
		Press Reset pushbutton on rear of unit to reset the fault.
"Generator Connected" LED is blinking.	Generator switching device did not open when it was commanded to open (within 6 seconds).	Check the generator circuit breaker shunt trip (ST) wiring.
	Generator switching device did not close when it was commanded to close (within 6 seconds).	Check the generator circuit breaker spring release (SR) wiring.
	Generator closed contacts did not open when Generator switching device opened (within 6 seconds).	Check the generator closed control input wiring on J-4, Pins 1 and 3.
	Generator closed contacts did not close when Generator switching device closed (within 6 seconds).	Check the generator closed control input wiring on J-4, Pins 1 and 3.
		Press Reset pushbutton on rear of unit to reset the fault.
"Generator Available" LED is blinking.	Generator source voltage and/or frequency were not within setpoint values within 90 seconds of trying to execute a System Test, Engine Start, or Generator Test.	Verify generator voltage and/or frequency with multimeter. Check the engine maintenance.
		Press Reset pushbutton on rear of unit to reset the fault.
Unit will not perform an Engine Start test.	Engine Start pushbutton was not pressed.	Press and hold (for 5 seconds) the Engine Start pushbutton to initiate the test.
	Generator source voltage and/or frequency did not become available within 90 seconds of engine starting.	Verify the voltage and/or frequency with a multimeter. Check the engine maintenance.
Unit will not perform a System Test.	System Test pushbuttons were not pressed.	Simultaneously press the Engine Start and Set Generator Test pushbuttons to initiate the test.
	Generator source became unavailable when connected to the load.	Check the generator/load sizing.
	Generator source became unavailable before connecting to the load.	Check the generator for proper function.
	Generator source voltage and/or frequency did not become available within 90 seconds of engine starting.	Verify the voltage and/or frequency with a multimeter. Check the engine maintenance.
Generator Test failed to exercise.	Generator source voltage and/or frequency did not become available within 90 seconds of engine starting.	Verify the voltage and/or frequency with a multimeter. Check the engine maintenance.
	Generator source became unavailable when connected to the load.	Check generator/load sizing.
	Generator source became unavailable before connecting to the load.	Check the generator for proper function.
Engine fails to start after the TDES timer times out.	Incorrect wiring.	Check the wiring between the Generator Start relay (J-5) and the engine.
	Generator Start relay Normally Open contacts are not closed.	Replace the unit.
	Engine did not start.	Check the generator for proper function.

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5.3 ATC-100 Replacement

Follow these procedural steps to replace the ATC-100.

- Step 1:** Turn off the control power at the main disconnect or isolation switch of the control power supply. If the switch is not located within view from the ATC-100, lock it out to guard against other personnel accidentally turning it on.
- Step 2:** Verify that all "foreign" power sources wired to the ATC-100 are de-energized. These foreign power sources may also be present on some of the terminal blocks.
- Step 3:** Before disconnecting any wires from the unit, make sure they are individually identified to assure that reconnection can be correctly performed. Make a sketch to help with the task of terminal and wire identification.
- Step 4:** Remove all wires and disconnect the plug-type connectors.

CAUTION

SUPPORT THE ATC-100 FROM THE REAR WHEN THE SCREWS ARE LOOSENED OR REMOVED IN STEP 5. WITHOUT SUCH SUPPORT, THE UNIT COULD FALL OR THE PANEL COULD BE DAMAGED.

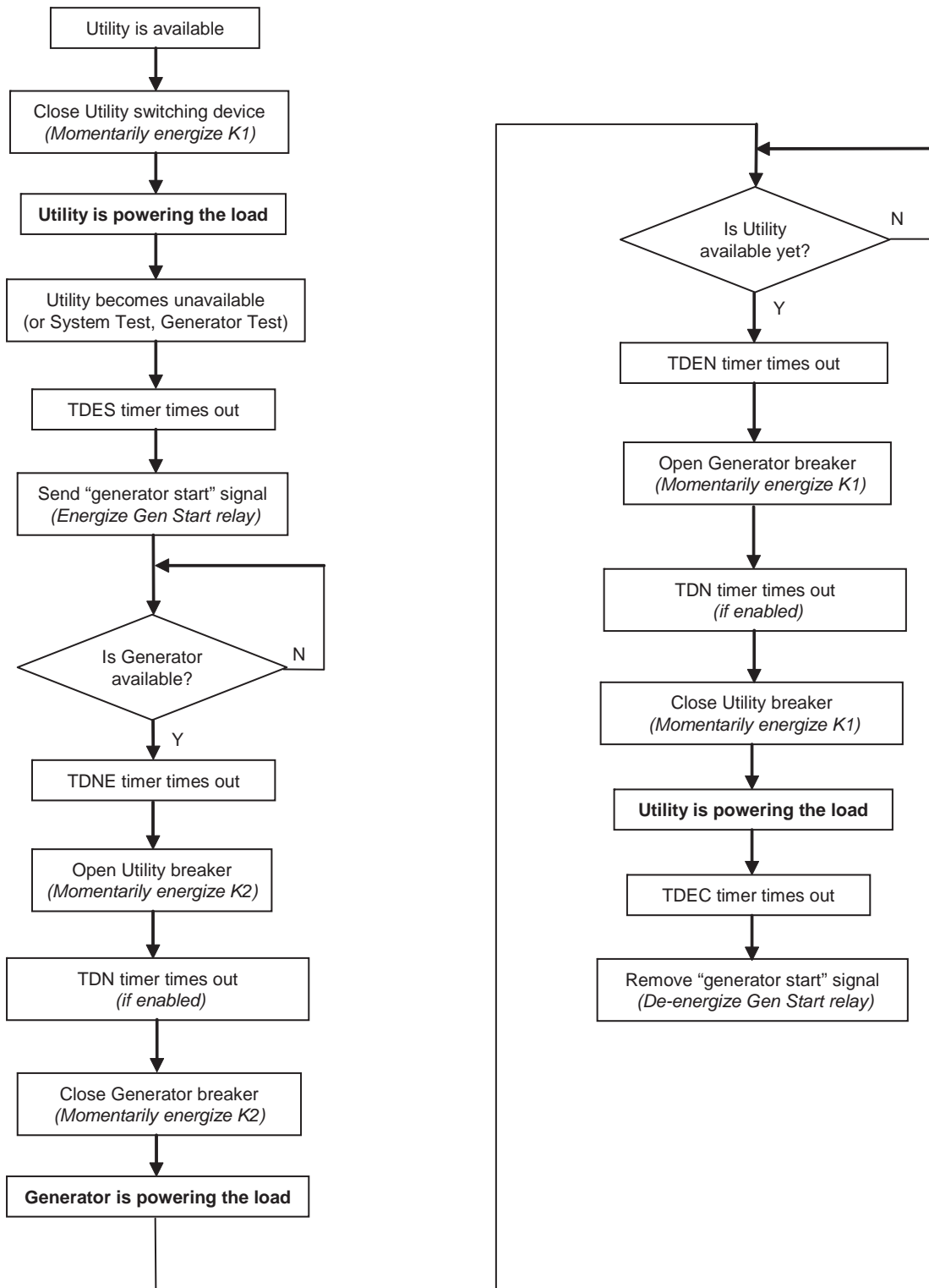
- Step 5:** Remove the four (4) mounting screws, located on the four corners, that hold the unit and trim plate against the door or panel. These are accessed from the front of the unit. Support the unit and remove the two center screws.
- Step 6:** Remove the unit from the door or panel. Set the original mounting screws aside for later use.
- Step 7:** Align the unit with the opening in the door or panel.
- Step 8:** Using the original mounting hardware, secure the replacement unit to the door or panel.
- Step 9:** Using the sketch mentioned in Step 3, re-connect each wire at the correct terminal and make sure each is secure. Make certain that each harness plug is securely seated.
- Step 10:** Restore control power to the unit.

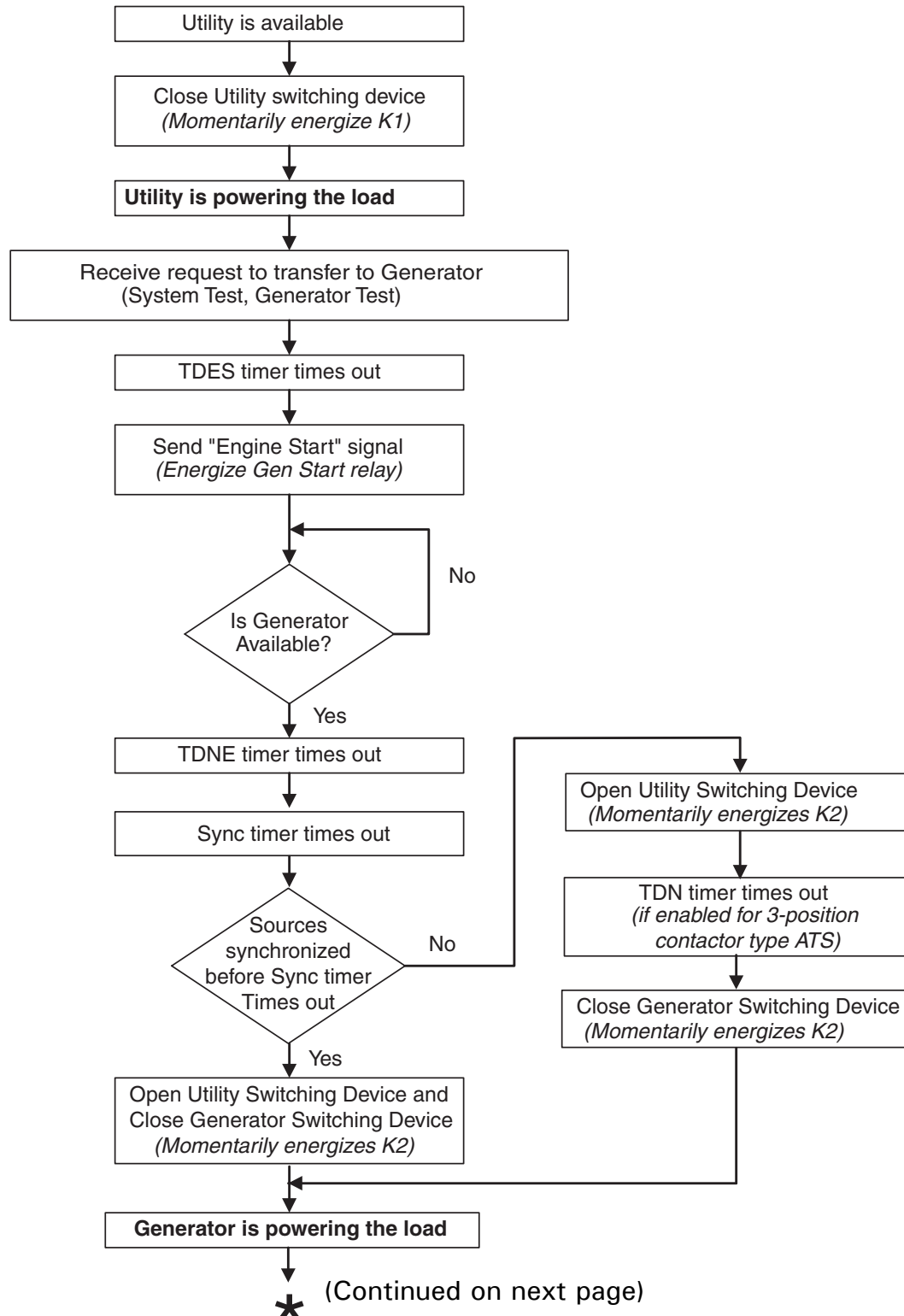
5.4 Maintenance and Care

The ATC-100 is designed to be a self-contained and maintenance-free unit. The printed circuit board is conformally coated at the factory. The ATC-100 is intended for service by factory-trained personnel only.

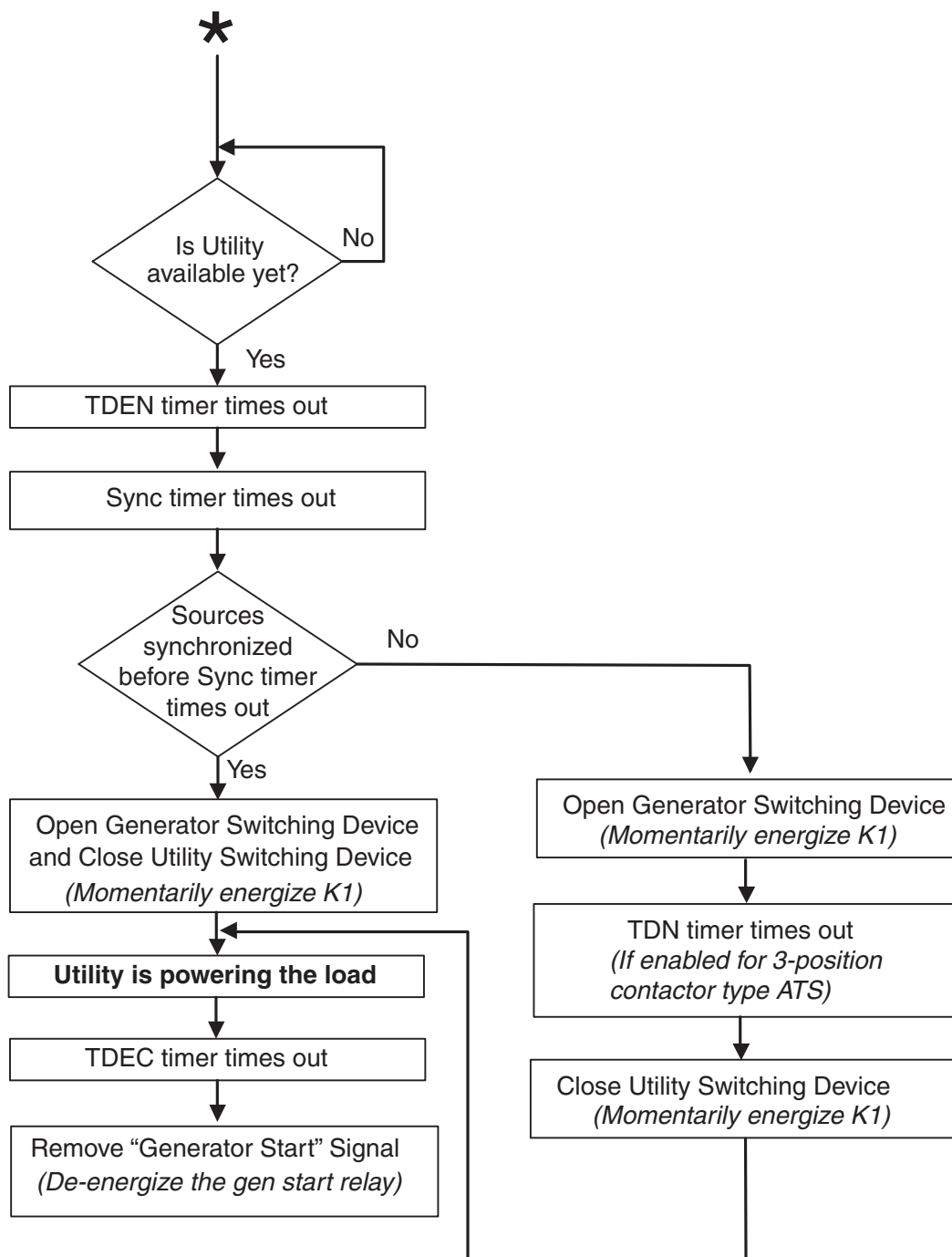
Appendix A: Operational Flowchart

TDN Implementation (Only for Breaker Type ATS)



Appendix A: Operational Flowchart (Continued)
In-Phase Transition Implementation (only for 2-position and 3 position contactor type ATS)


Appendix A: Operational Flowchart (Continued)



Notes:

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