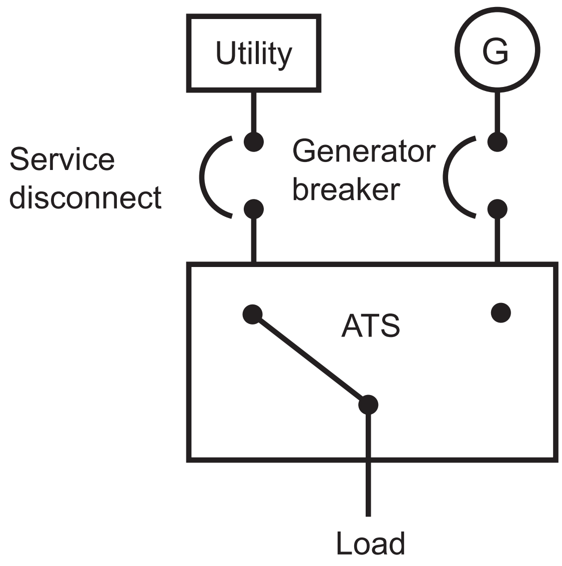
DIAGNOSTIC
REPAIR
MANUAL

GENERAC®

Residential and Commercial Transfer Switches



models:

50 - 800 Amp

STANDBY GENERATORS

Safety

Throughout this publication and on tags and decals affixed to the generator, DANGER, WARNING, and CAUTION blocks are used to alert personnel to special instructions about a particular operation that may be hazardous if performed incorrectly or carelessly. Observe them carefully. Their definitions are as follows:

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

(000001)

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

(000002)

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

(000003)

NOTE: Notes provide additional information important to a procedure or component.

These safety alerts cannot eliminate the hazards they indicate. Observing safety precautions and strict compliance with the special instructions while performing the action or service are essential to preventing accidents.

WARNING

CANCER AND REPRODUCTIVE HARM
www.P65Warnings.ca.gov.

(000393a)

Read This Manual Thoroughly

This diagnostic manual has been written and published by Generac to aid dealer technicians and company service personnel when servicing the products described herein.

It is assumed that these personnel are familiar with the servicing procedures for these products, or like or similar products manufactured and marketed by Generac, and that they have been trained in the recommended servicing procedures for these products, including the use of common hand tools and any special Generac tools or tools from other suppliers.

Generac could not possibly know of and advise the service trade of all conceivable procedures by which a service might be performed and of the possible hazards and/or results of each method. We have not undertaken any such wide evaluation. Therefore, anyone who uses a procedure or tool not recommended by Generac must first satisfy themselves that neither his nor the products safety will be endangered by the service procedure selected.

All information, illustrations and specifications in this manual are based on the latest product information available at the time of publication.

When working on these products, remember that the electrical system and engine ignition system are capable of violent and damaging short circuits or severe electrical shocks. If you intend to perform work where electrical terminals could be grounded or touched, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings of the engine are exposed during service, they should be covered to prevent accidental entry of foreign material. Entry of such materials will result in extensive damage when the engine Is started.

During any maintenance procedure, replacement fasteners must have the same measurements and strength as the fasteners that were removed. Metric bolts and nuts have numbers that indicate their strength. Customary bolts use radial lines to indicate strength while most customary nuts do not have strength markings. Mismatched or incorrect fasteners can cause damage, malfunction and possible injury.

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Section 1.1 *Transfer Switch Basics*

Introduction

This diagnostic repair manual has been prepared especially for familiarizing service personnel with testing, troubleshooting and repair of the residential product line. Every effort has been expended to ensure that the information and instructions in the manual are accurate and current. However, the manufacturer reserves the right to change, alter or otherwise improve the product at any time without prior notification.

It is not the manufacturer's intent to provide detailed disassembly and reassembly of the entire residential product line. It is the manufacturer's intent to (a) provide the service technician with an understanding of how the various assemblies and systems work, (b) assist the technician in finding the cause of malfunctions, and (c) effect the expeditious repair of the equipment.

Types of Switches

The residential product line includes the following types of transfer switches:

- Service Entrance
- 2-Pole versus 3-Pole
- 50/100/200/400/600/800 Amp Contactors

Manual Sections

This manual is divided into three sections.

Section 1 provides the description of components, and the sequence of operation for the specific switch types. The residential product uses four types of contactors:

- V-Type
- W-Type
- Wn-Type
- 50 Amp W-Type

Table 1-1 identifies which contactor is used with each voltage.

Table 1-1. Contactor Type, Voltage, Current Rating

	50 A	100 A	200 A	400 A	600 A	800 A
120/240 1P	W	V	V	W	Wn	Wn
120/240 3P		W	W	W	Wn	Wn
120/208 3P		W	W	W	Wn	Wn
277/480 3P		W	W	W	Wn	Wn

Section 2 provides troubleshooting and diagnostic testing procedures for the different switches. Flowcharts have been provided that cover the most basic faults that a transfer switch may present.

Section 3 provides repair procedures for the internal components of the W-type and Wn-type contactors.

Transfer Switch Identification

Data Plate

The data plate that is affixed to the switch contains important information pertaining to the unit, including its model number, serial number, amperage rating, and voltage rating. The information from this data plate may be required when requesting information, ordering parts, etc.

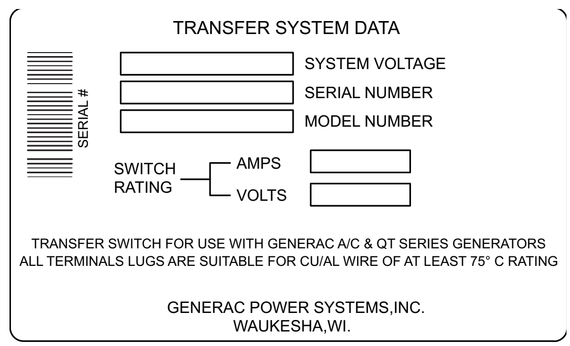

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Figure 1-1. A Typical Data Plate

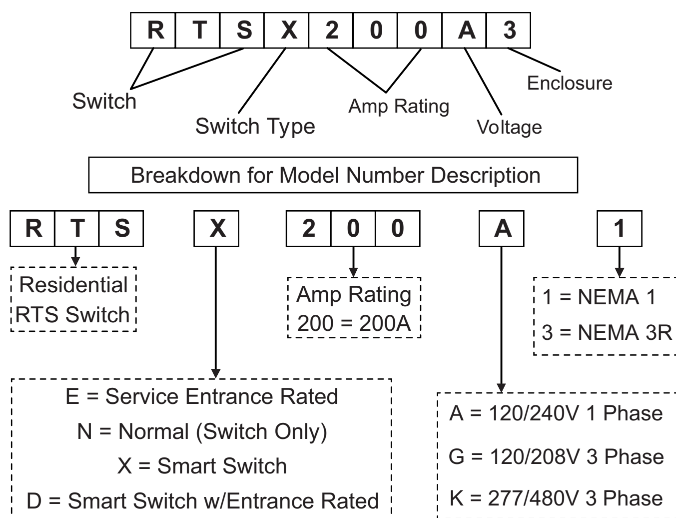

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Figure 1-2. RTS Switch Configuration

Enclosure

Most of the residential product line is equipped with a NEMA 3R enclosure (National Electrical Manufactures Association). Two exceptions to this rule are the 100 Amp pre-packaged EZ Switch with a built-in load center for the air-cooled product, and the GenReady Load Center, each of which are available with NEMA 1 or NEMA 3R enclosures. Based on NEMA Standard 250, the following standards may be defined as:

NEMA 1

Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection against falling dirt.

NEMA 3R

Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment; to provide a degree of protection against falling dirt, rain, sleet, snow, and windblown dust: and in which the external mechanism(s) remain operable when ice laden.

Safe Use of Transfer Switches

Before installing, operating or servicing this equipment, read the SAFETY RULES carefully. Comply strictly with all SAFETY RULES to prevent accidents and or damage with the equipment. The manufacturer recommends that copies of the SAFETY RULES be posted near the transfer switch. Also be sure to read instructions and information on tags, labels and decals affixed to the equipment.

Two publications that outline the safe use of transfer switches are the following:

- NFPA 70: National Electrical Code
- NFPA 70E: Standard for Electrical Safety in the Workplace

Manual Transfer Handle

All RTS transfer switches are equipped with a manual transfer switch handle, which allows the switch to be manually actuated from one position to the next.

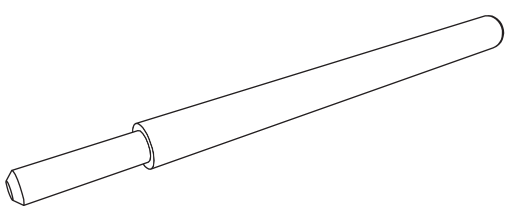

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Figure 1-3. V-Type Transfer Handle

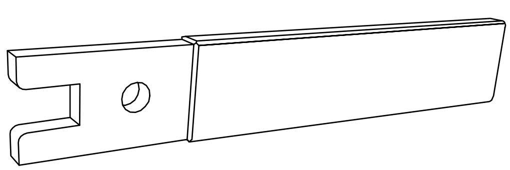

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Figure 1-4. W and Wn-Type Transfer Handle

Utility Service Disconnect Circuit

The RTS family has the option for a utility service disconnect breaker installed inside the transfer switch when needed. Consult local codes requirements before ordering the transfer switch to ensure that this option is or is not necessary for the application. The requirement of a Utility Service Disconnect may be explained as:

The service disconnecting means for ungrounded service conductors shall consist of one of the following:

1. *A manually operable switch or circuit breaker equipped with a handle or other suitable operating means.*
2. *A power-operated switch or circuit breaker, provided the switch or circuit breaker can be opened by hand in the event of a power supply failure.*

NEC 230.76

Service Entrance Breaker Specifications

100 Amp Breaker

(see unit data plate for breaker specifications)

- Siemens, Type BQ, 2-pole
- 120/240, 100A
- 50/60 Hertz
- Heating, Air Conditioning and Refrigeration (HACR) rate
- Wire range #1 - #8 AWG

200 Amp Breaker

(see unit data plate for breaker specifications)

- Generac, Type 2225AF, 2-pole
- 120/240, 200
- 50/60 Hertz
- Heating, Air Conditioning and Refrigeration (HACR) rate
- Wire range: 300 MCM – 6 STR (Line), 250 MCM – 6 STR (Load – ATS)

400 Amp Breaker

(see unit data plate for breaker specifications)

- Generac, 400AF
- 120/240 VAC, 400A
- 50/60 Hertz
- Heating, Air Conditioning and Refrigeration (HACR) rated
- Wire range: (1) #4-600 MCM or (2) 1/0-250 MCM
- CSA Service Entrance Requirements

Contactor Switching Mechanisms

The switching mechanism is physically responsible for carrying the rated electrical current and shifting the connection from one power source to another.

Contactors are constructed as a double-throw switch where a single operator opens one set of power contacts while closing a second set. In an open transition design, a mechanical interlock is often employed to prevent simultaneous closure of both contact sets.

Basic 50 Amp W-Type Contactor

These switches are used with a single-phase system when the single-phase NEUTRAL line is to be connected to a Neutral Lug and is not to be switched.

See ***Figure 1-5*** and ***Figure 1-6***. The W-type contactor is designed to meet the needs of 50 amp single-phase applications. It is available in 2-pole. The contactor consists of a pair of movable UTILITY and STANDBY contacts and a pair of stationery LOAD contacts. The main contacts are actuated by a single solenoid (closing coil), and are electrically opened and mechanically held closed.

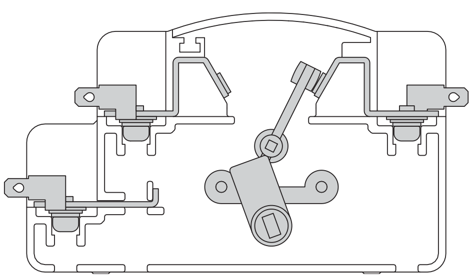

Figure 1-5. Load Connected to Utility Power Source

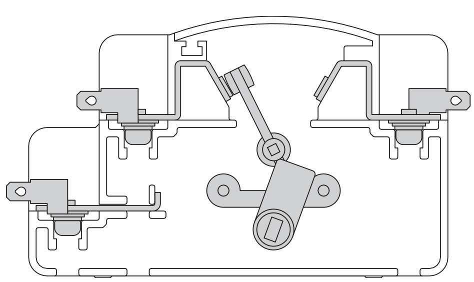

Figure 1-6. Load Connected to Standby Power Source

2-Pole Mechanism

The transfer mechanism houses the main current carrying contacts, along with other components required for switch operation. The main contacts are electrically actuated and mechanically held. They are of silver alloy or silver alloy composition, to resist welding or sticking.

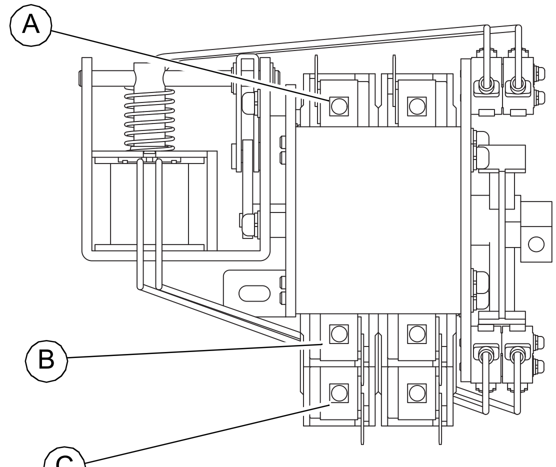

Figure 1-7. Typical 2-Pole Transfer Mechanism

A.	Utility Lugs (N1 & N2)
B.	Generator Lugs (E1 & E2)
C.	Load Lugs (T1 & T2)

Basic V-Type Contactor

The V-Type Contactor is available in 100 through 200 Amp ratings at 250 volts maximum with a 2-pole configuration (single phase only).

See ***Figure 1-8*** and ***Figure 1-9***. A basic 2-pole contactor consists of a pair of movable LOAD contacts, a pair of stationary UTILITY contacts, and a pair of stationary STANDBY contacts. The LOAD contacts connect to the UTILITY contacts by energizing a utility closing coil or to the STANDBY contacts energizing the standby closing coil. In addition, the LOAD contacts can be actuated to either the UTILITY or STANDBY position by means of a manual transfer handle. The closing coils actuate and energize using source voltage from the side to which the load is being transferred. For example, if the contactor is in the UTILITY position, the standby closing coil will energize utilizing generator voltage.

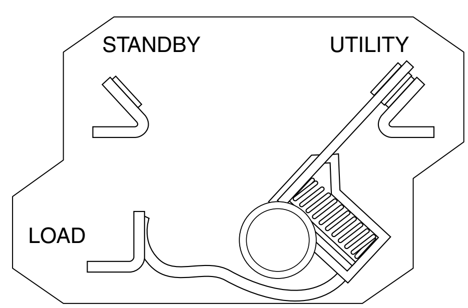

Figure 1-8. Load Connected to Utility Power Source

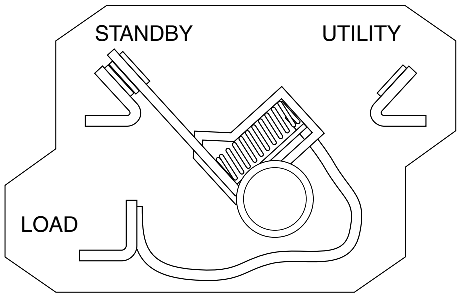

Figure 1-9. Load Connected to Standby Power Source

Utility Closing Coil C1

See *Figure 1-10*. The utility closing coil (C1) utilizes rectified Utility source power to actuate the LOAD contacts to the UTILITY position. When energized, the coil will move the LOAD contacts to an “over center” position.

A limit switch opens the circuit and the spring force will complete the transfer back to UTILITY. The bridge rectifier, which changes the Utility source, alternating current (AC), to direct current (DC), is sealed in the coil wrappings. If either the coil or the bridge rectifier replacement becomes necessary, replace the coil assembly.

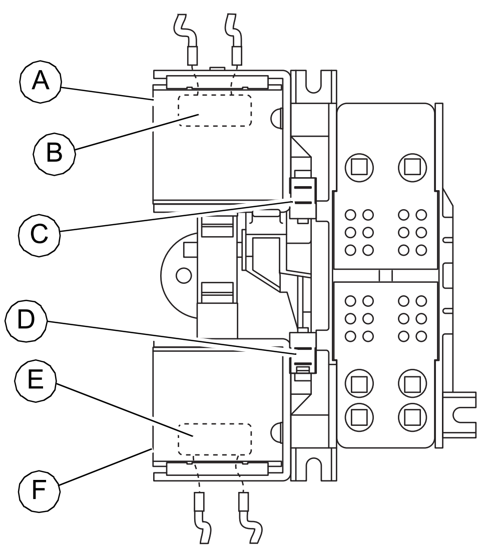

Figure 1-10. The “V-Type” Transfer Mechanism

A. Utility Closing Coil C1
B. Bridge Rectifier
C. Limit Switch XA1
D. Limit Switch XB1
E. Bridge Rectifier
F. Standby Closing Coil C2

Standby Closing Coil C2

The standby closing coil (C2) utilizes rectified standby source power to actuate the load contacts to their STANDBY position. Energizing the coil moves the load contacts to an over-center position. A limit switch opens the circuit and spring force completes the transfer to STANDBY. If replacement of either the coil or the bridge rectifier becomes necessary, replace the coil assembly.

Limit Switches XA1 And XB1

Movement of the LOAD contacts mechanically actuates the limit switches. When the LOAD contacts connect to the UTILITY contacts, limit switch (XA1) opens the Utility circuit to C1 and limit switch (XB1) closes the standby circuit to standby closing coil (C2). The limit switches arm the system for transfer back to UTILITY when the LOAD contacts connect to the STANDBY position. Respectively, when the LOAD contacts connect to the UTILITY side, XA1 and XB1 arm the system for transfer to the STANDBY position. An open condition in XA1 will prevent transfer back to UTILITY. An open condition in XB1 will prevent transfer to STANDBY.

Auxiliary Contacts

The V-Type contactor has the option* to mount auxiliary contacts on the side of the contactor. The limit switches mechanically connect to the switch and the contacts will electrically represent the position of the switch. Contacts are rated 15 amps at 250 VAC.

NOTE: *Auxiliary contacts became standard on later contactors.

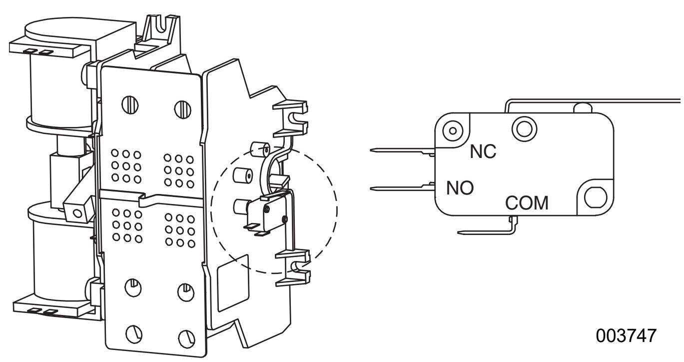

Figure 1-11. V-Type Auxiliary Contacts

NC = Normally Closed
NO = Normally Open
COM = Common

Basic W-Type Contactor

The W-type contactor is designed to meet the needs of three-phase applications and 400 amp single-phase applications. It is available in 2-pole and 3-pole. The contactor consists of a pair of movable UTILITY and STANDBY contacts and a pair of stationery LOAD contacts. The main contacts are actuated by a single solenoid (closing coil), and are electrically opened and mechanically held closed.

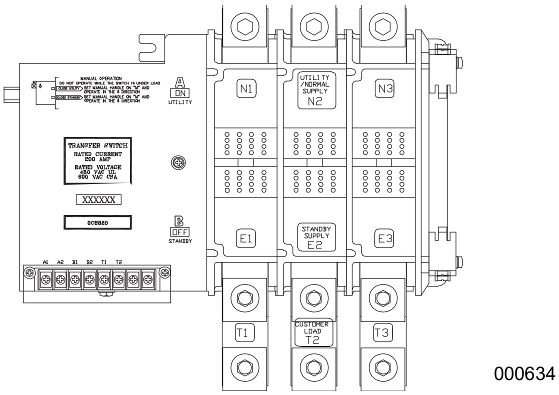

Figure 1-12. Typical 3-Pole Contactor

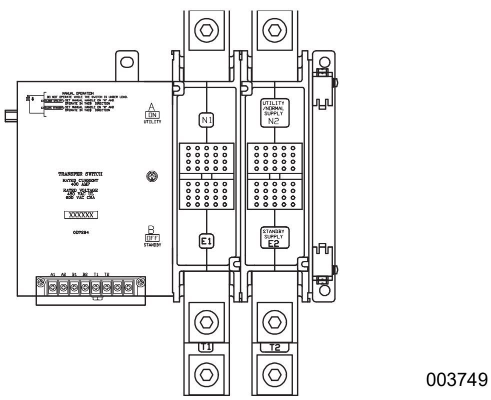

Figure 1-13. Typical 2-Pole Contactor

The contactor houses the main current carrying contacts, the mechanical and spring switching mechanism. It also contains the main closing coil (C1), bridge rectifier assembly (BR1), limit switches (LS1, LS2, and LS3), and auxiliary contacts. All of these components are required for operation of the switch, with the exception of the auxiliary contacts.

Main Closing Coil

The coil (C1) energizes utilizing rectified AC voltage to actuate the contacts from either the UTILITY or the STANDBY position. Internal to the contact, when C1 energizes, the switch mechanically trips to the NEUTRAL position. C1 must remain energized in order for it to remain in neutral. When the contactor is in the NEUTRAL position, limit switch (LS3) contacts will open removing AC voltage from the closing coil.

Utility and Standby Contacts

Figure 1-14 shows the UTILITY contacts in the UTILITY position supplying voltage to the load.

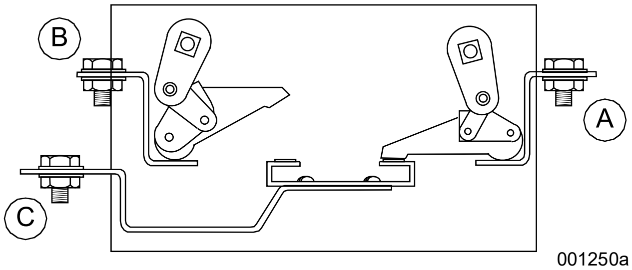

Figure 1-14. Utility Position

A. UTILITY “A” Position
B. EMERGENCY “B” Position
C. LOAD

Figure 1-15 shows both the UTILITY contacts and the STANDBY contacts disconnected from the load. In the RTS family, the time in NEUTRAL position is not adjustable. When the closing coil pulls the contactor to the NEUTRAL position, limit switch (LS3) contacts will open. This removes the voltage feeding the closing coil (de-energizing the coil) which allows the contactor spring to pull the switch to the next position.

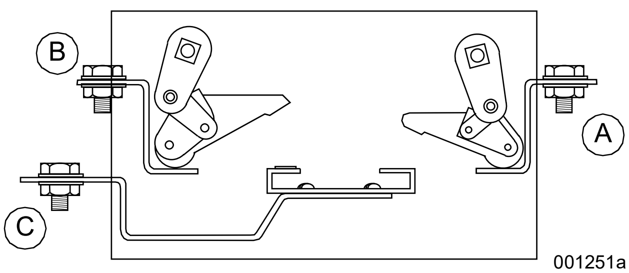

Figure 1-15. Neutral Position

A. UTILITY “A” Position
B. EMERGENCY “B” Position
C. LOAD

Figure 1-16 shows the contactor in the STANDBY position supplying voltage to the load.

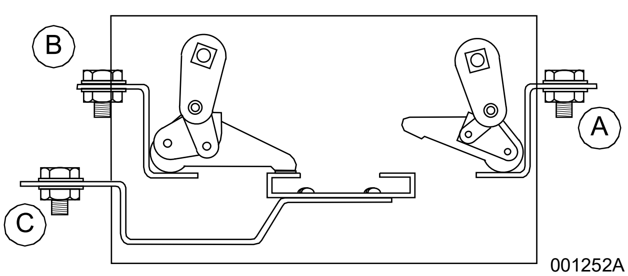

Figure 1-16. Standby Position

A. UTILITY “A” Position
B. EMERGENCY “B” Position
C. LOAD

Bridge Rectifier

The bridge rectifier receives AC voltage from either Utility or Generator. This voltage is rectified into a usable DC voltage that is capable of energizing the closing coil. It is also a terminal block for incoming wires.

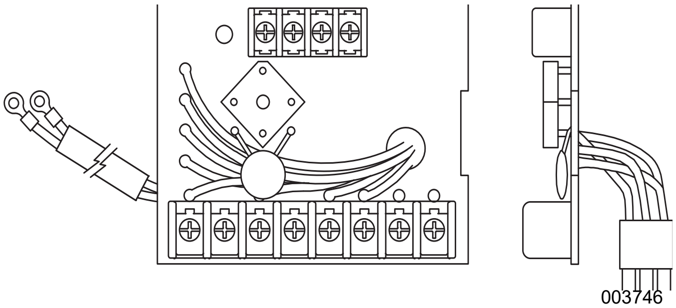

Figure 1-17. Bridge Rectifier

LS1 and LS2 Limit Switch

The switch has internal limit switches (LS1 and LS2) located between the coil housing and the arc chute. LS1 and LS2 mechanically connect to the contactor and change states when the contactor switches from one source to the other. When the switch is in the UTILITY position, the limit switch provides a path for current (generator voltage) to flow to the coil. When the switch is in the STANDBY position, the limit switch provides a path for Utility voltage to flow to the coil. The switch contacts will always arm for the next transfer.

LS3 Limit Switch

The LS3 limit switch opens when the switch is in the NEUTRAL position. This removes the source voltage that energized the coil, allowing the contactor spring to pull the switch to the next position.

Auxiliary Contacts

The W-Type contactor comes with auxiliary contacts mounted on the side of the contactor. The limit switches mechanically connect to the switch and the contacts will electrically represent the position of the switch. The contacts are rated 10 amps at 125 VAC. ***Table 1-2*** shows the electrical relationship to the position of the switch.

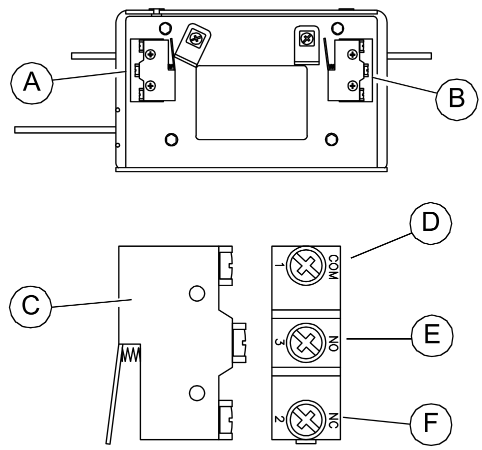

Figure 1-18. W-Type Auxiliary Contacts

A	Auxiliary Contact (Actuated)	D	Common Terminal
B	Auxiliary Contact (Non-Actuated)	E	Normally Open Terminal
C	Single Contact (Utility Position)	F	Normally Closed Terminal

Table 1-2.	Switch Position	
	UTILITY	STANDBY
Common to Normally Open	Open	Closed
Common to Normally Closed	Closed	Open

Basic Wn-Type Contactor

The Transfer Mechanism

The transfer mechanism houses the main current carrying contacts, along with other components required for switch operation. The main contacts are electrically actuated and mechanically held. They are of silver alloy or silver alloy composition, to resist welding or sticking.

A typical 3-pole transfer mechanism is shown in Figure 1 below. Also available are 4-pole transfer mechanisms.

NOTE: When a transfer switch is ordered, the purchaser must specify (a) the rated voltage, (b) rated phase, and (c) rated current. Units rated 1-phase will include a 3-pole transfer mechanism. However, since the unit is rated “1-phase”, factory wiring connections to the third pole (N3, E3, T3) are omitted and a 1-phase utility sensing interface is used.

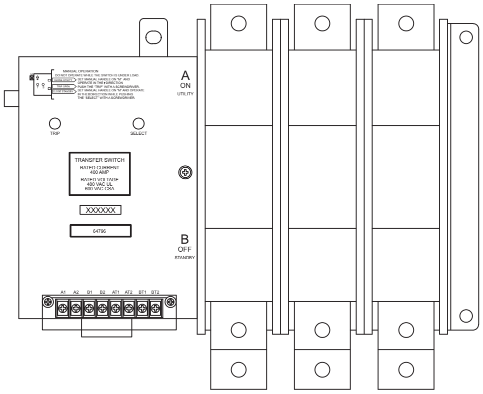

Figure 1-19. A Typical 3-Pole Transfer Mechanism

Wn-Type Main Contacts Operation

Load Connected To “Utility” Source

Figure 1-20 shows a set of movable “Utility” contacts connected to the stationary “Load” contact. The load is connected to the utility power source. On the transfer mechanism cover, window “A” will display the word “ON” and window “B” will display the word “OFF”.

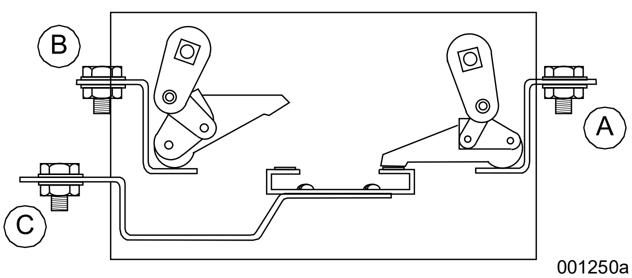

Figure 1-20. Load Connected to Utility Source

A. UTILITY “A” Position
B. EMERGENCY “B” Position
C. LOAD

Neutral Or “Tripped” Position

See *Figure 1-21*. The LOAD contacts are disconnected from both the “Utility” and “Standby” power supplies. Windows “A” and “B” will both display the word “OFF”.

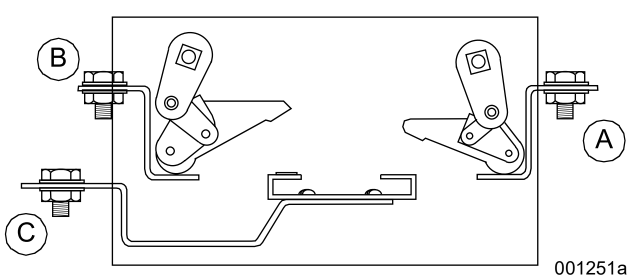

Figure 1-21. “Neutral” or “Tripped” Position

A. UTILITY “A” Position
B. EMERGENCY “B” Position
C. LOAD

Load Connected To “Standby” Source

See *Figure 1-22*. The movable standby contact is connected to the load contact. Window “A” will display the word “OFF”; window “B” the word “ON”.

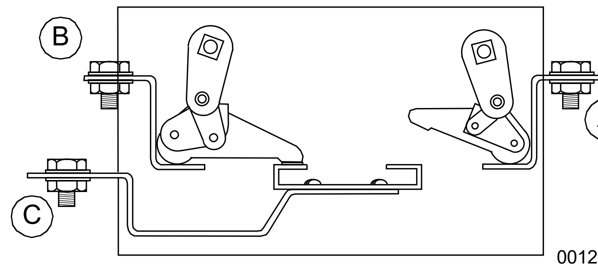

Figure 1-22. Load Connected to “Standby” Source

A. UTILITY “A” Position
B. EMERGENCY “B” Position
C. LOAD

Auxiliary Contacts

A set of auxiliary contacts may be provided on the transfer mechanism. One auxiliary contacts switch is used to operate “Switch Position” lamps on the door. The second switch may be used by the customer, if desired. A suitable power supply must be connected across the “common” terminal, for operation of customer device(s) such as remote advisory lamps, remote annunciator, etc.

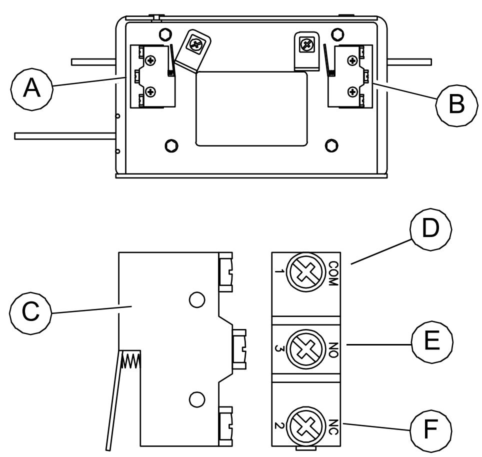

Figure 1-23. Wn-Type Auxiliary Contacts

A	Auxiliary Contact (Actuated)	D	Common Terminal
B	Auxiliary Contact (Non-Actuated)	E	Normally Open Terminal
C	Single Contact (Utility Position)	F	Normally Closed Terminal

Figure 1-24. Auxiliary Contacts

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Transfer Relay

See *Figure 1-25*. Transfer relay operation is controlled by the generator controller.

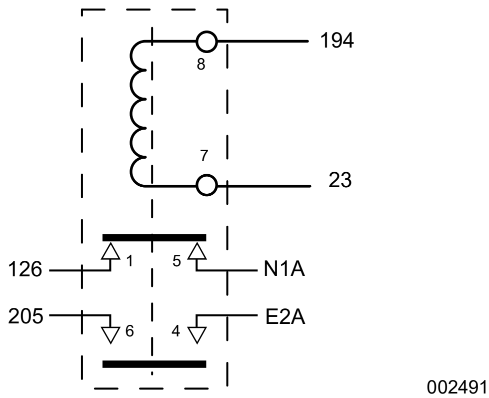

Figure 1-25. Typical Transfer Relay Schematic

The generator controller is mounted in the generator set. Relay operation may be briefly described as follows:

1. Generator battery voltage (approximately 12 VDC) is available to the transfer relay coil from the generator controller, via Wire 194 (15B on some units prior to Nexus and Evolution) and relay terminal as defined in Table 1-3 or Figure 1-30.
   a. The 12 VDC circuit is completed through the transfer relay coil and back to the generator controller, via Wire 23.
   b. Controller logic normally holds the Wire 23 circuit open to ground and the relay is de-energized.
   c. When de-energized, the normally open relay contacts are open and normally closed relay contacts are closed.
   d. The normally closed relay contacts deliver utility source power to the utility closing circuit of the contactor.
   e. The normally open relay contacts deliver standby source power to the contactor standby closing circuit when the contacts close.
2. During automatic system operation, when the generator controller senses that utility source voltage has dropped out, the controller will initiate engine cranking and startup.
3. When the controller senses that the engine has started, an engine warm-up timer in the controller starts timing.
4. When the engine warm-up timer expires, controller logic completes the Wire 23 circuit to ground.
   a. The transfer relay then energizes.
   b. The normally closed contacts open and normally open contacts close.
   c. When the normally open contacts close, standby source power is delivered to the standby closing coil and transfer to STANDBY occurs.
5. When the generator circuit board senses that utility source voltage has been restored above a preset level, the controller opens the Wire 23 circuit to ground.
   a. The transfer relay de-energizes, the normally closed contacts close and the normally open contacts open.
   b. When the normally closed relay contacts close, utility source voltage is delivered to the utility closing coil to energize that coil.
   c. Transfer back to UTILITY occurs.

Table 1-3. TR1 Relay Terminal Connections

Relay	Clear Square	Clear Rectangle	Yellow Rectangle
Wire 194	A	7	13
Wire 23	B	8	14
Wire N1A	7	5	9
Wire 126	1	1	1
Wire E1/E2A	9	6	12
Wire 205	6	4	8

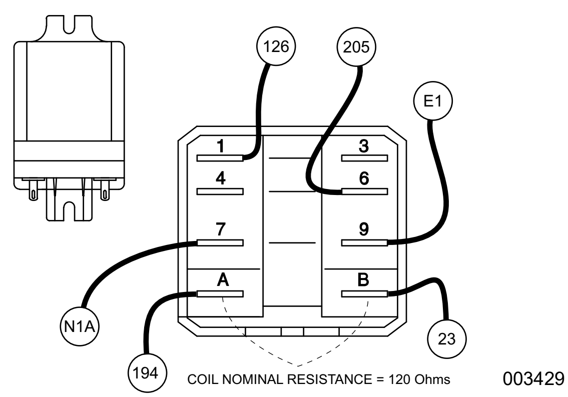

Figure 1-26. Clear Transfer Relay Test Points

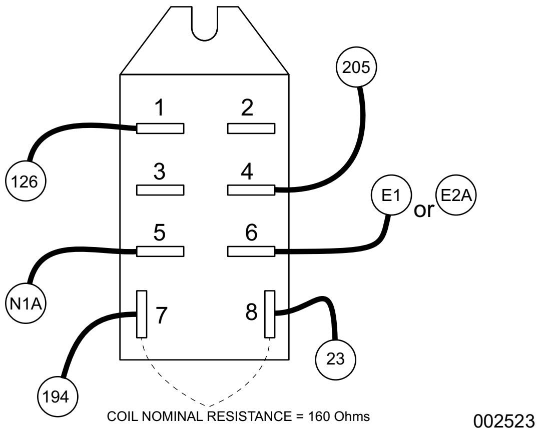

Figure 1-27. Clear Transfer Relay Test Points

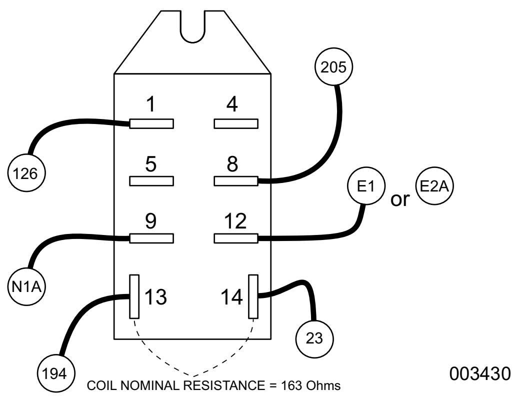

Figure 1-28. Yellow Transfer Relay Test Points

Integrated SACM Module

The Integrated SACM module incorporates the following components in one module:

- N1, N2, T1, 23, 194, and 0 connection points.
- N1, N2, and T1 6.3 amp mini fuse.
- Transfer relay.
- Load shedding SACM that has the same operating parameters as the non-integrated SACM.

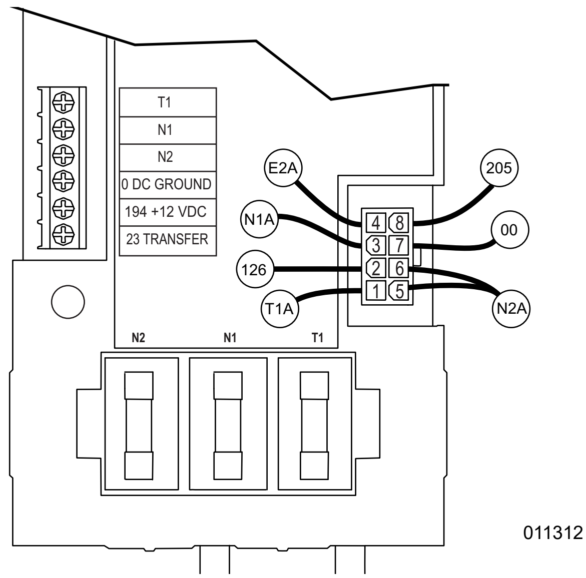

Figure 1-29. Integrated SACM Module Test Points

Table 1-4. Integrated SACM Pin Out Test Points			
Wire No.	**Integrated SACM Wire Identification**	**Interconnect Pin Location**	**Molex Pin Location**
T1	Battery Charge / Frequency Monitoring	1	N/A
N1	Utility Voltage, L1	2	N/A
N2	Utility Voltage, L2	3	N/A
0	DC Ground	4	N/A
194	12 VDC Relay Supply (current limited)	5	N/A
23	Relay Ground Control	6	N/A
T1A	Battery Charge / Frequency Monitoring	N/A	1
126	Utility Voltage, Switched	N/A	2
N1A	Utility Voltage, L1	N/A	3
E2A	Generator Voltage	N/A	4
N2A	Utility Voltage, L2	N/A	5
N2A	Utility Voltage, L3	N/A	6
00	AC Neutral Voltage	N/A	7
205	Generator Voltage, Switched	N/A	8

Phase Monitor

See *Figure 1-30*. In 3-phase applications, a Power Monitor (PM) relay in the transfer switch ensures correct phase rotation and voltages across all three phases. N1A and N2A are the sensing wires to the generator. If the PM senses low voltage on any phase, it will open Pin 1 from Pin 8. If Utility voltage remains good, the relay stays energized and closes the contact between Pin 1 and Pin 8.

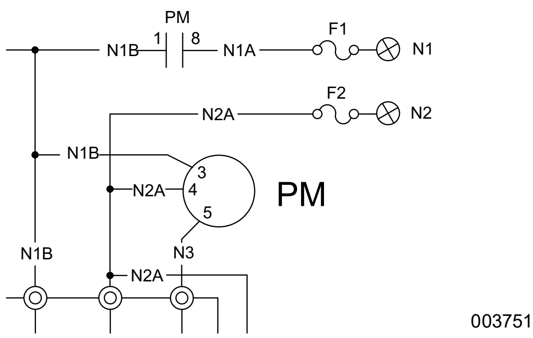

Figure 1-30. Power Monitor Relay Schematic

NOTE: See *Figure 1-31*. In some cases it may be required to isolate the neutral from the utility source during a power outage. When this is necessary, it is recommended that a 3-phase 120/240 or 120/208 switch be purchased. See service bulletin SIB14-12-31SN for instructions on performing this conversion.

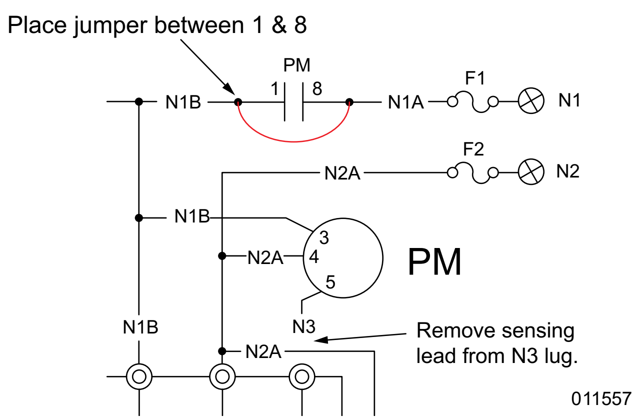

Figure 1-31. Power Monitor Relay Schematic with Neutral Isolated From Utility Source

LED

See *Figure 1-32*. The LED located on the top left (A) represents the status of the relay. See *Table 1-5* for LED indication patterns.

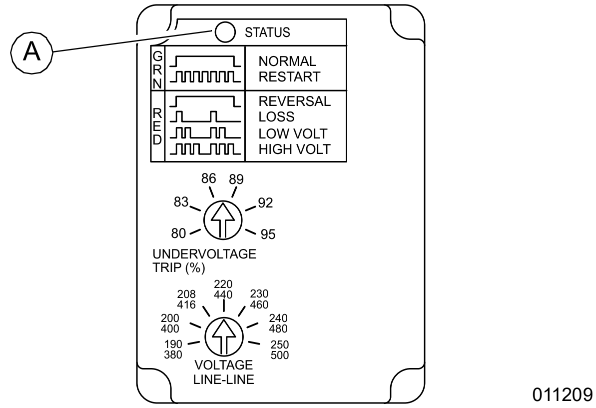

Figure 1-32. Power Monitor Relay

Table 1-5. Power Monitor Fault Indication Codes	
Green Steady	Normal / Relay On
Green Flashing	Power Up / Restart Delay
Red Steady	Unbalance
Red Flashing	Undervoltage / Overvoltage
Amber Steady	Reversal
Amber Flashing	Loss
Green / Red Alternating	Undervoltage / Overvoltage Trip Pending
Red / Amber Alternating	Normal Voltage Set Error

Nominal Voltage

This adjustment allows for changes in voltage level for the different transfer switches.

Under Voltage

With the addition of the Power Monitor, the ability to adjust the utility drop out level is added. If the utility is 120/208 VAC this adjustment allows a range of 95% to 80% of 208. For example if voltage is 208 VAC and the Power Monitor is set to 95%, the generator will be triggered to start for a Utility failure at 197 VAC.

Formula:
Voltage * Percentage (90% = 0.90) = Drop Out Level

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Introduction

These switches are used with a single-phase system when the single-phase NEUTRAL line is to be connected to a Neutral Lug and is to be switched.

Transfer Switch Contactor

These switches are equipped with solder-less, screw type lugs with typical ratings as shown. Always refer to the unit specific owner's manual for correct specifications.

Switch Rating	Wire Range	Conductor Tightening Torque
50A	1/0–14 AWG	50 **in-lbs** (5.65 Nm)

These automatic transfer switches are used for transferring critical electrical load from a utility (normal) power source to a generator (standby) power source. Such a transfer of electrical loads occurs automatically when the utility power source has failed or is substantially reduced and the generator source voltage and frequency have reached an acceptable level. The transfer switch prevents electrical feedback between two different power sources (such as the utility and generator sources) and, for that reason, codes require it in all standby electric system installations.

The transfer switch consists of a transfer mechanism, a control relay, a terminal strip and fuse holder for connection of sensing wires.

This transfer switch is suitable for control of motors, electric discharge lamps, tungsten filament and electric heating equipment where the sum of motor full load ampere ratings and the ampere ratings of other loads do not exceed the ampere rating of the switch and the tungsten load does not exceed 30 percent of the switch rating.

This UL listed transfer switch is for use in optional standby systems only (NEC article 702). For further information on the contactor assembly, refer to Section 1.2 ***Contactor Basics***.

A 50A rated switch is suitable for use on circuits capable of delivering not more than 10,000 RMS symmetrical amperes, 250 VAC maximum, when protected by a 50A maximum circuit breaker (Siemens types QP or BQ) or 50A maximum circuit breaker (Square D Q2, Westinghouse CA-CAH, General Electric TQ2 and Siemens QJ2).

Terminal Block

During system installation, this 6-point terminal block must be properly connected with an identically labeled terminal block in the generator customer connection area.

Terminals used on the terminal block are identified as: 194, 23, 0, T1, N1 and N2.

NOTE: On pre Evolution and Nexus generators, Wire 194 may be marked as 15B in the generator. Wires 194 and 15B serve the same function.

Utility N1 and N2

Wires N1 and N2 are connected with identically labeled terminals in the generator customer connection area. This is utility sensing voltage to the circuit board. The signal is delivered to the generator and on some older models is stepped down to 16 VAC using a transformer. N1 and N2 voltage is used by the circuit board as follows:

- If Utility source voltage drops below a preset level, circuit board logic will initiate automatic cranking and startup, followed by automatic transfer to the standby source.

Terminals 0, 194, 23

These terminals connect to the transfer relay and, if equipped, the Digital Load Management system.

NOTE: These terminals and wire numbers vary depending on the production date of the transfer switch. Always consult the owner's manual supplied with the unit to ensure accurate information.

Load T1

Wire T1 is connected with an identically labeled terminal in the generator customer connection area. This Load voltage is delivered to the generator to supply 120 VAC to the control board for battery charging. On some older models, this voltage is delivered to a charger external of the printed circuit board.

Fuse Holder

A separately mounted fuse holder holds three fuses, designated as fuses F1, F2, and F3. Each fuse is rated at 5 amperes.

On the Integrated SACM Module, 6.3 amp mini fuses are incorporated into the circuit board and are designated with the same functions.

Fuses F1 and F2

These two fuses protect the Utility N1 and Utility N2 circuit against overload.

Fuse F3

The F3 is installed in-line with Wire T1. It protects the battery charger circuit from overload.

Operational Analysis

Utility Source Voltage Available

Figure 1-33 shows the Switch is in the UTILITY position and utility source voltage is available.

- Rated utility source voltage is available to the transfer switch terminal lugs N1 and N2 through sensing wires to the generator controller.
- Utility voltage is available from N2 to Terminal N2A of the transfer switch.
- Utility voltage is available from N1A to the normally closed contact of the transfer relay (TR). From the transfer relay it continues on through Wire 126 to the normally open contact of the XA1 limit switch.

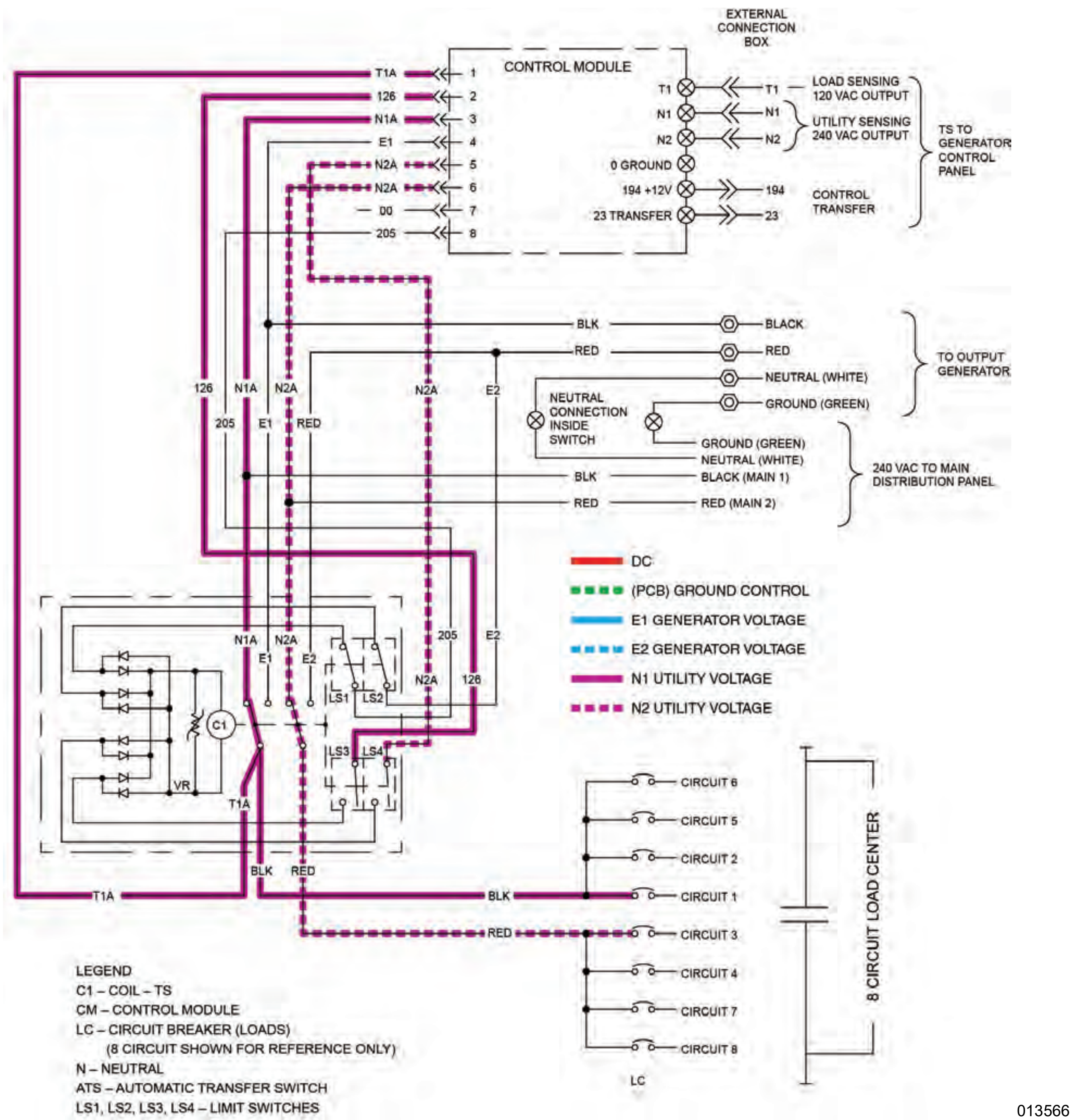

Figure 1-33. Utility Source Voltage Available

Utility Source Voltage Failure

The generator senses that utility voltage falls below a voltage dropout set point via Wires N1 and N2. The line interrupt delay timer starts. When the line interrupt delay timer expires, the generator controller responds to the utility failure and starts. Generator voltage feeds the switch through E1 and E2.

The engine warm-up timer starts and when it has expired the generator controller will energize the transfer relay (TR) by applying a ground to Wire 23. Positive 12 VDC is delivered to Wire 194 from the generator when the generator is either in AUTO or MANUAL.

Generator voltage from E2 is connected to Terminal 9 of the TR relay. Because the switch is in the UTILITY position, the XB1 limit switch contacts are closed. This connects E1 to the BR and closing coil. The closing coil requires voltage from both phases of the supply to activate. Even though E1 is connected through the XB1 contact, the coil will not energize until the TR contacts for the generator close (Wire E2 to the open TR contact).

As soon as the generator controller energizes the TR, the contacts close (UTILITY contacts open) and the switch powers to the STANDBY position.

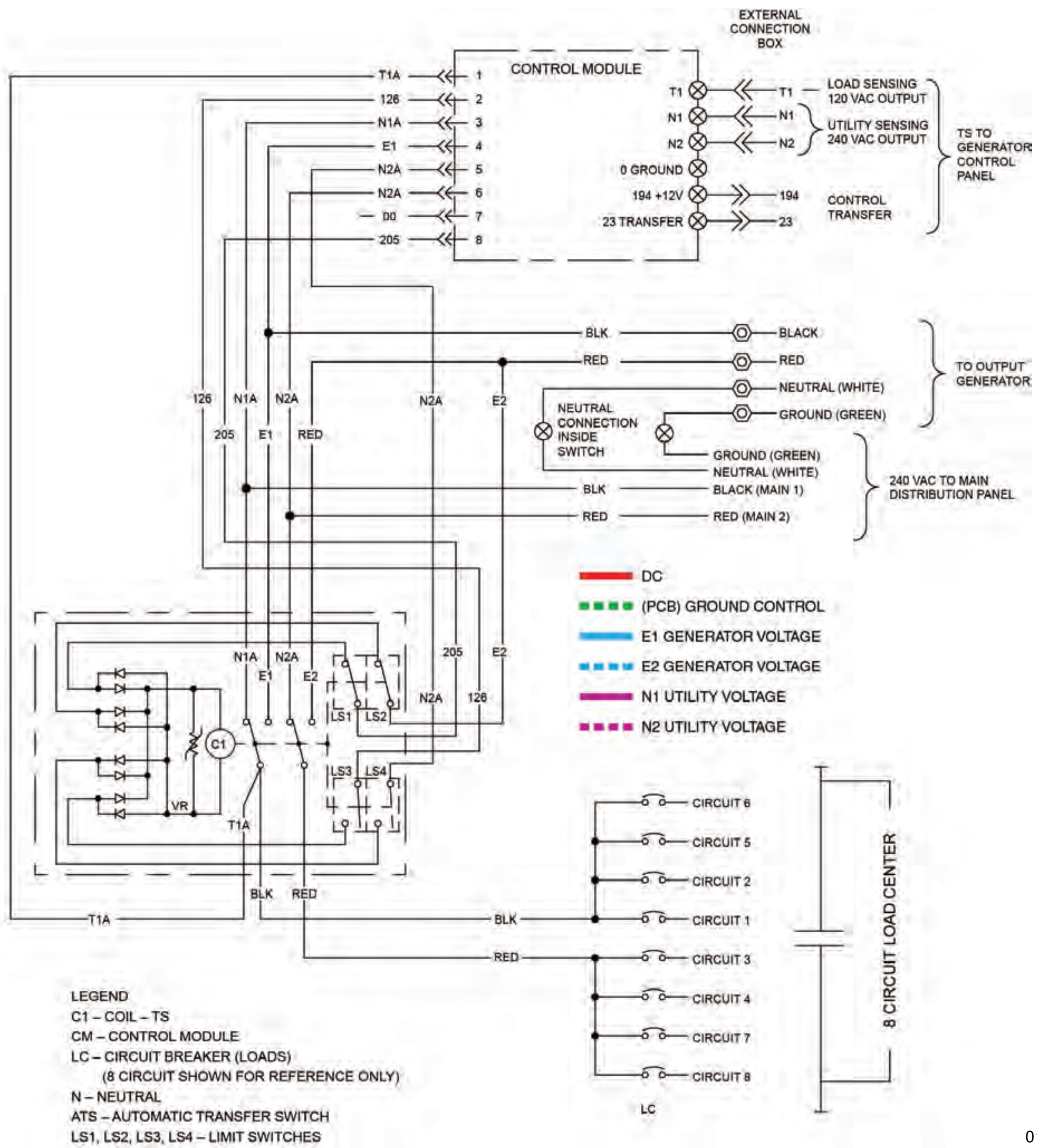

Figure 1-34. Utility Source Voltage Failure

Transferring to Generator

The generator controller takes Wire 23 to ground. This energizes the transfer relay (TR). The TR contacts change state – opening on the UTILITY side (opens Wire N1A from Wire 126) – and closing on the STANDBY side, connecting Wire E2 and 205. This allows generator voltage to be applied to the coil. Generator voltage is already available to the coil from E1. The voltage can go through to both sides of the bridge rectifier (BR). The BR rectifies the AC voltage to DC voltage and applies it to either side of the closing coil. The closing coil energizes and pulls the contactor to the STANDBY position.

In STANDBY the XB1 limit switch changes state and removes E2 generator voltage from the coil. In the STANDBY position the XA1 limit switch will also change state and go to its normally closed position, setting the switch up for the next transfer.

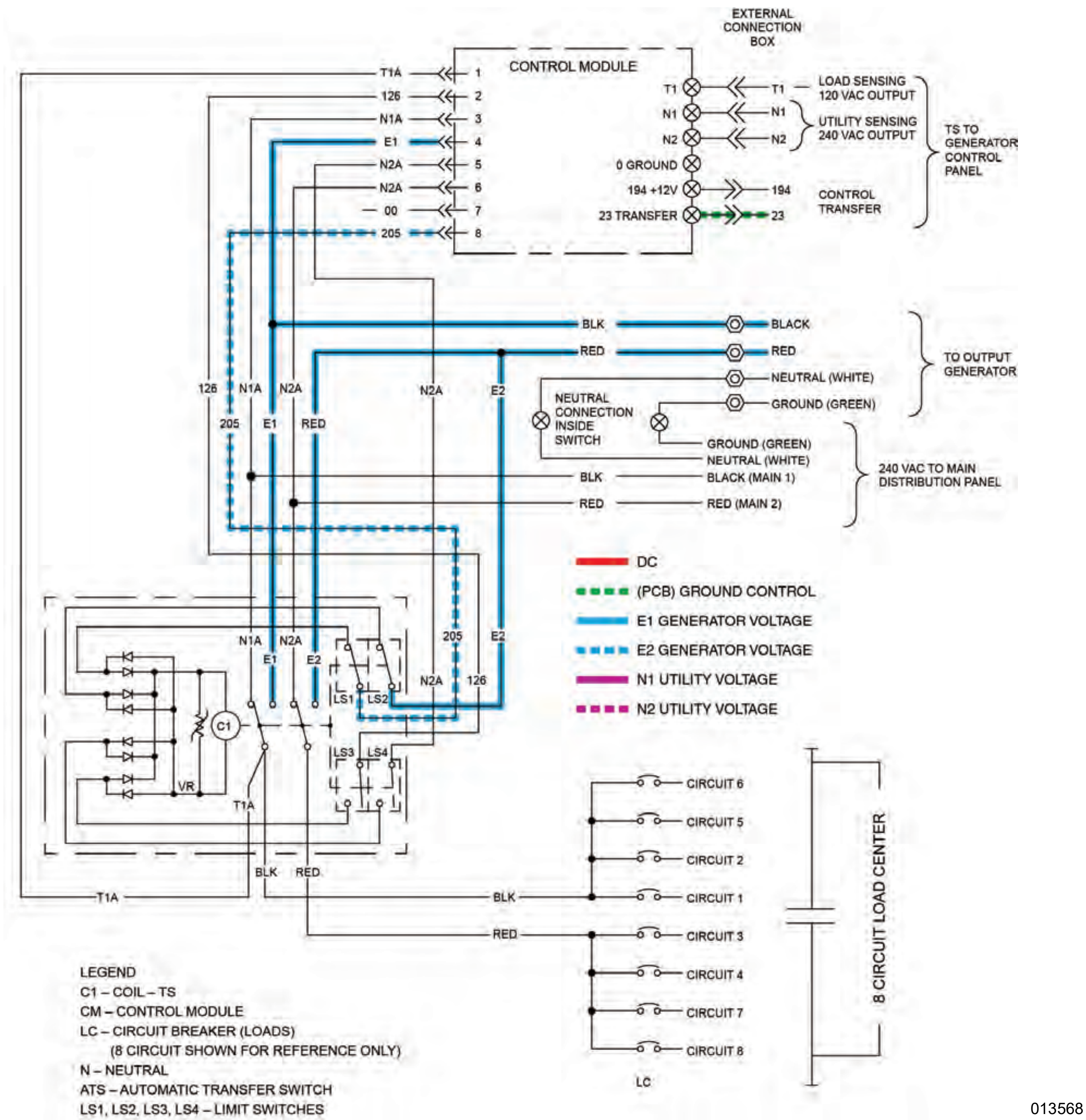

Figure 1-35. Transferring to Standby

Transferred to Standby

When the XB1 limit switch opens voltage is removed from the coil, and the coil de-energizes. Spring tension in the switch mechanism now closes the switch to STANDBY. The next time it is actuated by the coil it will transfer to UTILITY.

NOTE: The closing coil is always powered by the source it is transferring to.

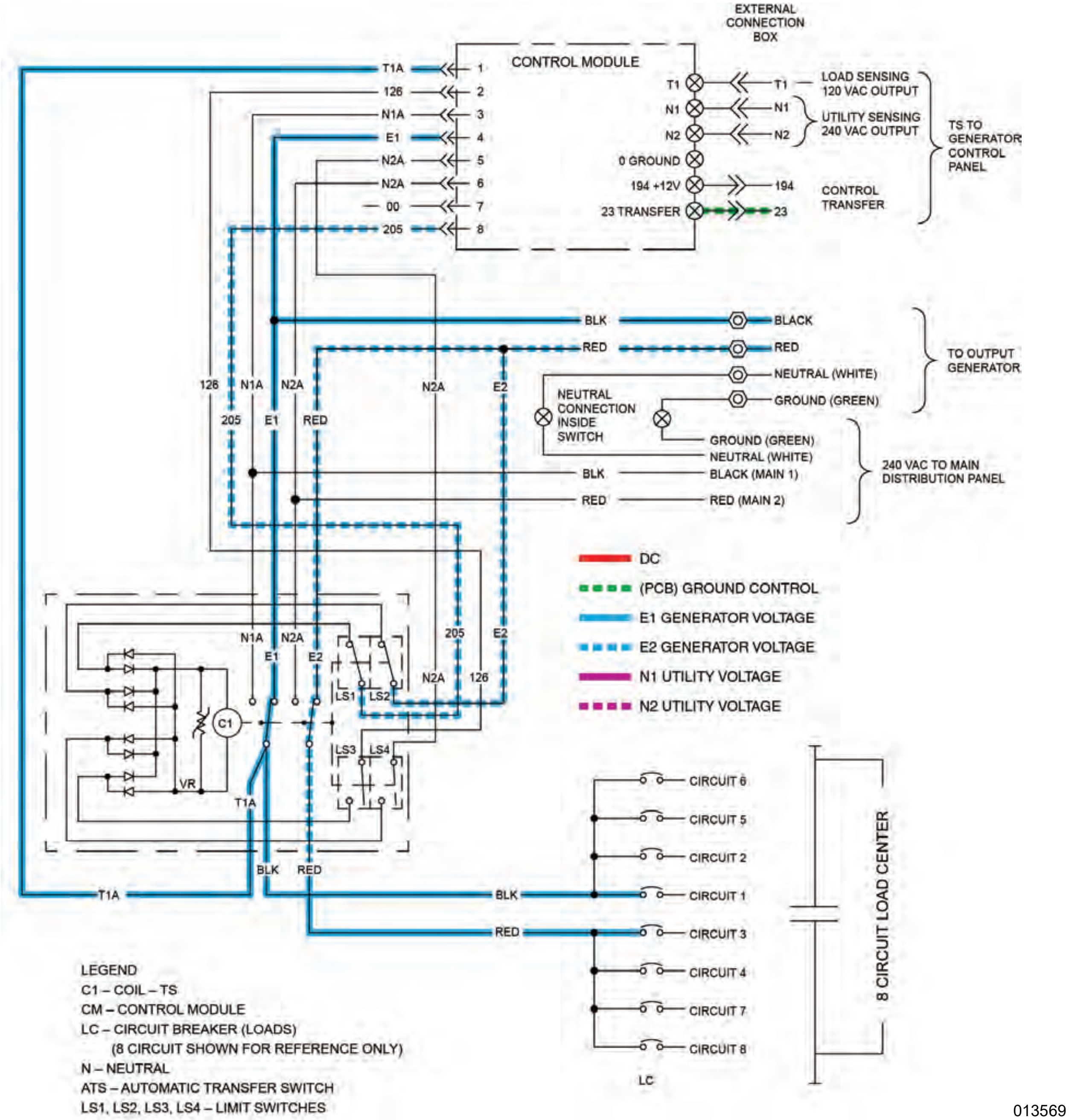

Figure 1-36. Transferred to Standby

Utility Restored

The switch is in the STANDBY position and the generator is running and powering the load.

When Utility voltage returns, the generator controller sees the voltage from N1 and N2. If the voltage is higher than the voltage pickup setting the return to utility timer starts.

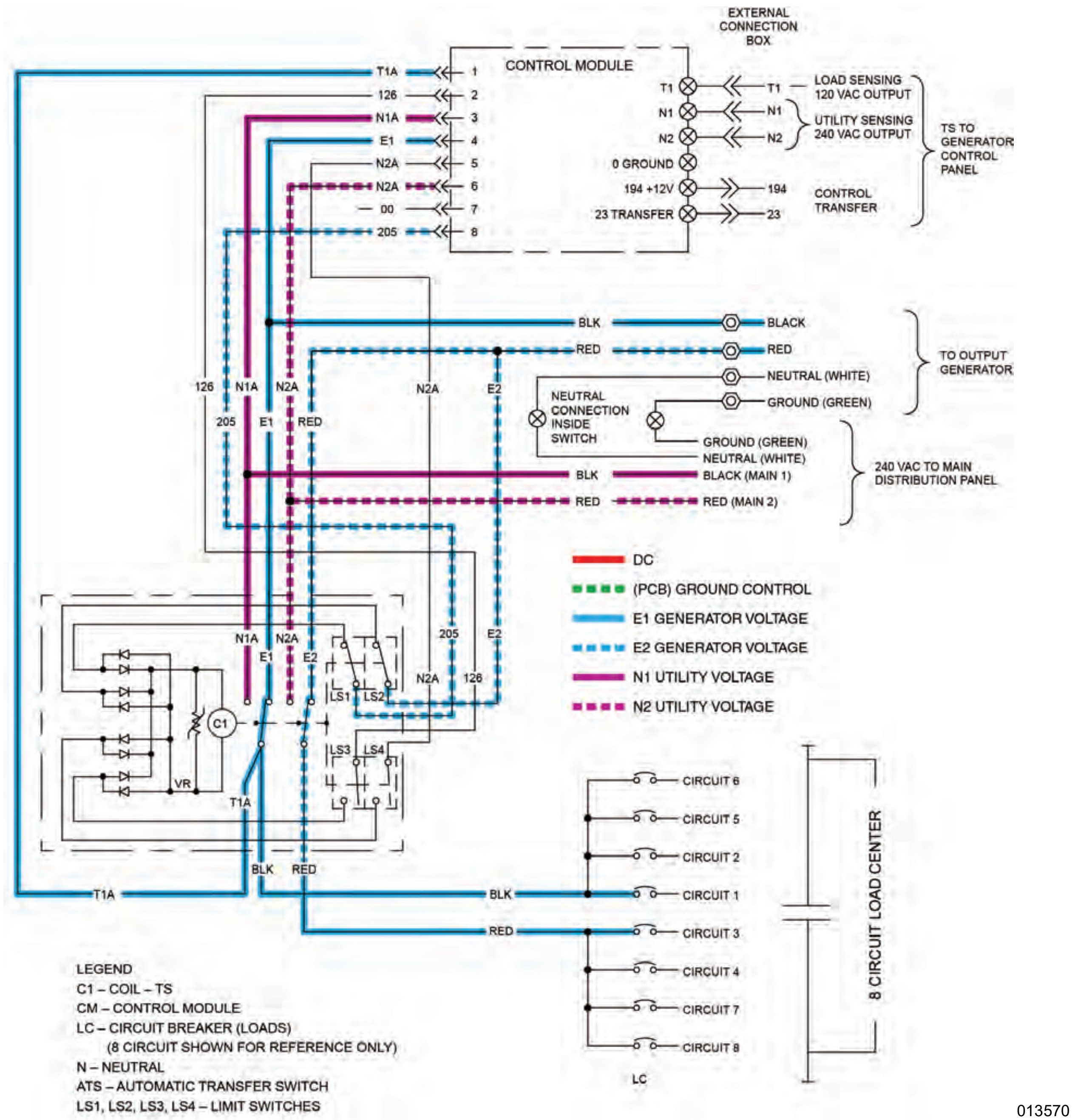

Figure 1-37. Utility Restored

Utility Restored, Transferring Back to Utility

When all of the conditions are met, the generator controller lifts the ground from Wire 23 and the transfer relay (TR) de-energizes. The TR contacts change states – opening E1 from XB1 limit switch, and closing N1A to XA1 limit switch.

Utility voltage is applied to the bridge rectifier and the coil. The closing coil energizes and pulls the switch to the UTILITY position, which opens the contacts from GENERATOR to LOAD and closes the contacts from UTILITY to LOAD.

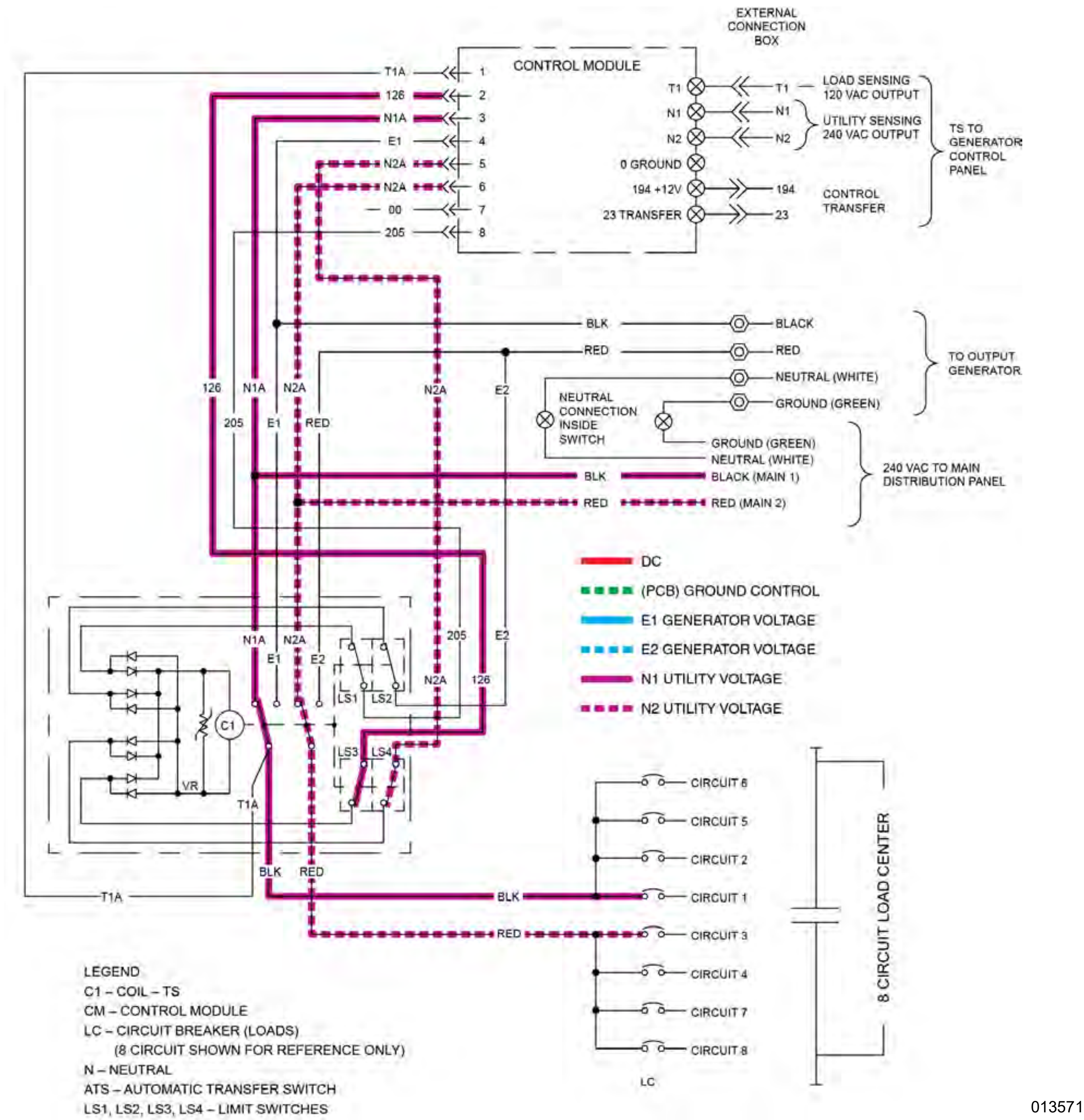

Figure 1-38. Utility Restored, Transferring Back to Utility

Utility Restored, Transferred Back to Utility

The XA1 limit switch now opens. Spring tension in the switch mechanism closes the switch to the UTILITY position, and utility voltage powers the load through the main load lug connections.

As the switch closes to the UTILITY position, the XA1 limit switch changes states. With the switch in UTILITY, voltage is disconnected from the BR and coil. XB1 is connected to the BR and closing coil. This makes the switch ready for the next transfer.

NOTE: The closing coil is always powered by the source it is transferring to.

The generator controller starts the engine cool-down timer and when it expires, shuts down the generator. The switch is ready for the next utility power loss event.

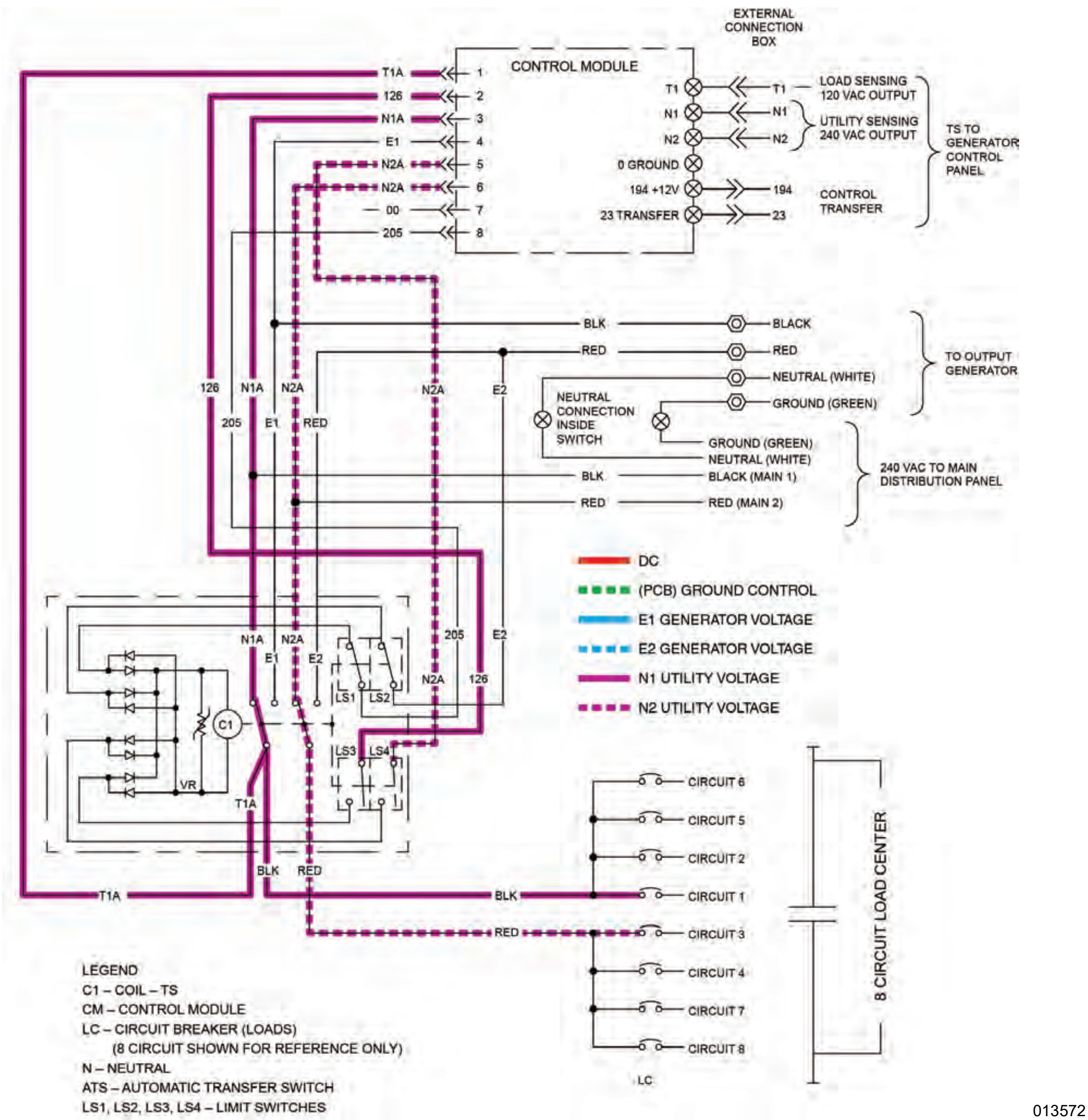

Figure 1-39. Utility Restored, Transferred Back to Utility

Introduction

Standard 100/200 amp RTS switches utilize a V-type contactor and are rated for their perspective amperages. They are available in a 2-pole configuration for use with 1-phase systems only.

A controller in the generator controls automatic operation of the transfer switch.

Transfer Switch Contactor

These switches are equipped with solder-less, screw type lugs with typical ratings as shown. Always refer to the unit specific owner's manual for correct specifications.

Switch Rating	Wire Range	Conductor Tightening Torque
100A	#14-1/0 AWG	50 **in-lbs**
200A	#6-250 MCM	275 **in-lbs**

The switch is suitable for control of motors, electric discharge lamps, tungsten filament and electric heating equipment where the sum of motor full load ampere ratings and the ampere ratings of other loads do not exceed the ampere rating of the switch and the tungsten load does not exceed 30 percent of the switch rating

The UL listed transfer switch is for use in optional standby systems only. For further information on the contactor assembly, refer to *Contactor Basics*.

Terminal Block

During system installation, each of 6 point connections must be properly connected with the identically labeled terminal block in the generator customer connection area.

Customer connection terminals are identified as: 194, 23, 0, T1, N1 and N2.

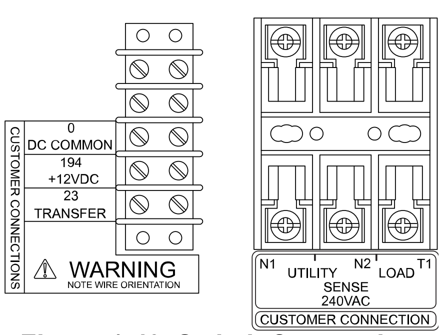

Figure 1-40. Switch Connections

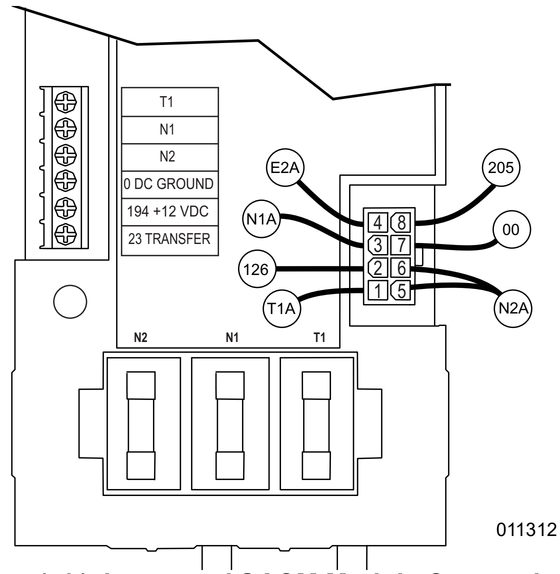

Figure 1-41. Integrated SACM Module Connections

NOTE: On pre Evolution and Nexus generators, Wire 194 may be marked as 15B in the generator. Wires 194 and 15B served the same function.

Utility N1 and N2

Wires N1 and N2 are connected with identically labeled terminals in the generator customer connection area. This is utility sensing voltage to the circuit board and this signal is delivered to the generator. On some pre Evolution and Nexus generators voltage is stepped down to 16 VAC using a transformer. N1 and N2 voltage is used by the circuit board as follows:

- If Utility source voltage drops below a preset level, circuit board logic will initiate automatic cranking and startup, followed by automatic transfer to the standby source.

Terminals 0, 194, 23

These terminals correspond to the transfer relay and, if equipped, the load management system.

NOTE: These terminals and wire numbers may vary depending on the production date of the transfer switch. Always consult the owner's manual supplied with the unit to ensure accurate information.

Load T1

Wire T1 is connected with an identically labeled terminal in the generator customer connection area. This Load voltage is delivered to the generator to supply 120 VAC to the controller for battery charging. On some pre Evolution and Nexus generators, this voltage is delivered to a charger external of the control board.

Fuse Holder

A separately mounted fuse holder holds three fuses, designated as fuses F1, F2, and F3. Each fuse is rated at 5 amperes.

On the Integrated SACM Module, 6.3 amp mini fuses are incorporated into the circuit board and are designated with the same function.

Fuses F1 and F2

These two fuses protect the Utility N1 and Utility N2 circuit against overload.

Fuse F3

Fuse F3 is installed in-line with T1 to protect the battery charger circuit.

Operational Analysis

Utility Source Voltage Available

Figure 1-42 is a schematic representation of the transfer switch with utility source power available. The circuit condition is briefly described as follows:

- Utility source voltage is available to terminal lugs N1 and N2 of the contactor; the transfer switch is in the UTILITY position; and Utility voltage is available to T1 and T2, customer load.
- Utility source voltage is available to the limit switch (XA1) via the normally closed transfer relay contacts (1 and 5) and Wire 126; however, XA1 is open and the circuit to the utility closing coil is open.
- Utility voltage sensing signals are delivered to controller on the generator, via Wire N1A, and a 5-amp fuse (F1). The second line of the utility voltage sensing circuit is via Wire N2A, and a 5 amp fuse (F2).

NOTE: This is an example of Transfer Switch Operational Analysis. For troubleshooting use the operational analysis with the appropriate wiring/schematic diagrams.

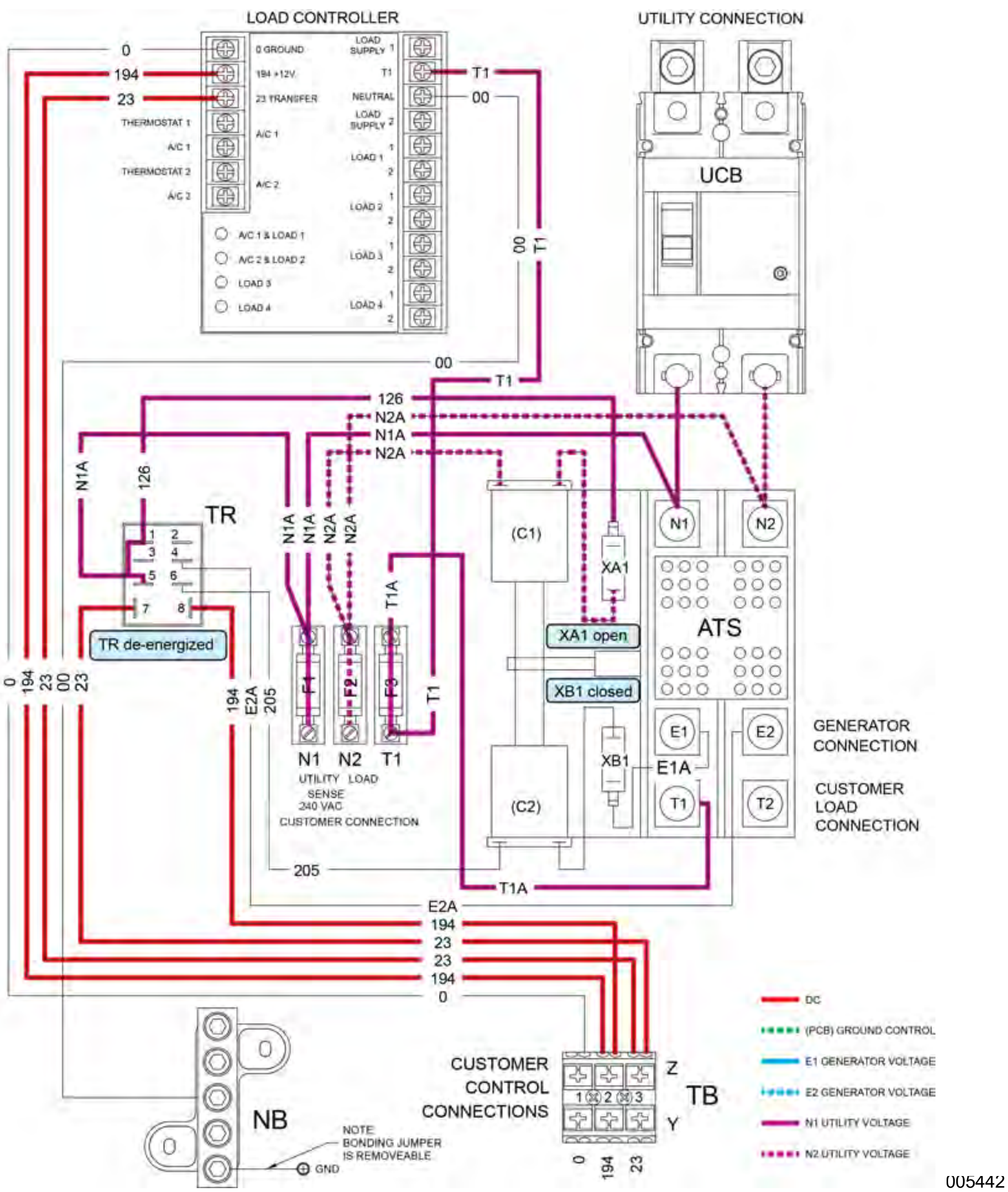

Figure 1-42. Utility Source Voltage Available

Utility Source Voltage Failure

If Utility source voltage drops below 65% of nominal voltage for five (5) seconds, the controller will initiate engine start. After the generator starts, a five (5) second engine warm-up timer is initiated. During this warm-up the generator is running at rated frequency and voltage. ***Figure 1-43*** is a schematic representation of the transfer switch with the Generator running with voltage available to the transfer switch.

Generator voltage available on contactor terminals E1 and E2.

- Controller logic is holding Wire 23 open from ground.
- Generator voltage from terminal E2 is available at the standby coil (C2); generator voltage from Terminal E1 is available to the transfer relay at Pin 9. The transfer relay is not energized so E1 voltage will not go through the N.O. contact (4 & 6) to Wire 205.

NOTE: This is an example of Transfer Switch Operational Analysis. For troubleshooting use the operational analysis with the appropriate wiring/schematic diagrams.

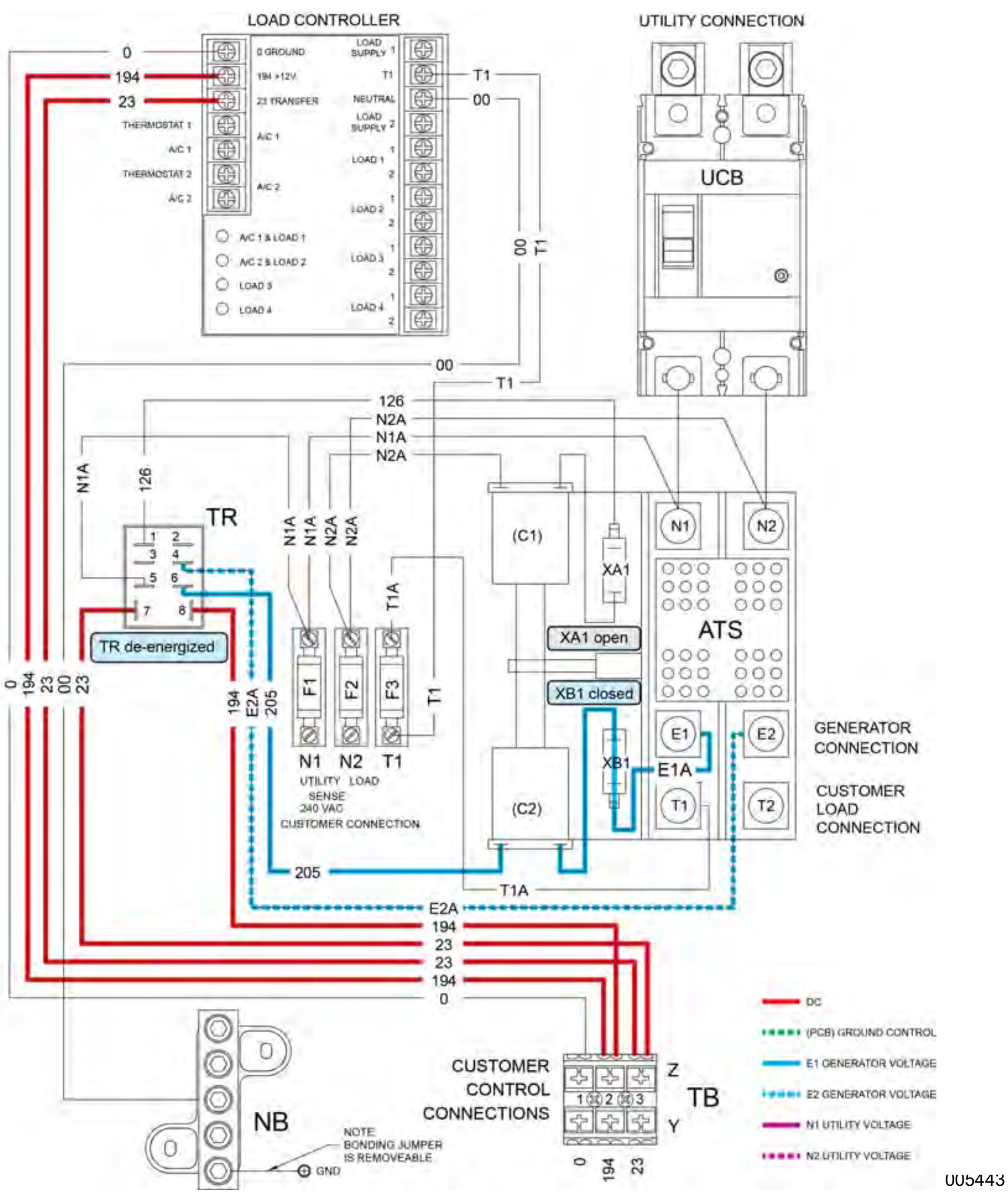

Figure 1-43. Utility Source Voltage Failure

Transferring to Standby

12 VDC is delivered to the transfer relay through Wire 194 and back to the controller through Wire 23. When the five second engine warm-up timer expires, the controller will take Wire 23 to ground which will energize the Transfer Relay. The N.O. and N.C. relay contacts will change states. This will connect generator voltage from E1 through wire 205 at relay connector 6 to E2A relay connector 4. The voltage will go through the N.C contact of XB1. Voltage from both E1 and E2 will be available at the C2 coil. This voltage will pass through the rectifier in the coil and the coil will energize.

Generator voltage is now delivered to the standby closing coil (C2), via generator voltage E1 and E2, the now closed relay contacts, Wire 205, the limit switch (XB1), Wire B, and a bridge rectifier. The standby closing coil energizes and the main current carrying contacts of the transfer switch are actuated to the “Standby” position.

- As the main contacts move toward the “Standby” position, limit switch XA1 closes (Utility Coil). When the contacts are in the “Standby” position, a mechanical interlock actuates XB1 to its open position. When XB1 opens the C2 coil de-energizes.
- Generator voltage is now available to the LOAD terminals (T1 and T2) of the transfer switch and 120 VAC is also supplied to the controller on Wire T1 for the battery charger. (220 VAC on T1 and T2 50 Hz only.)

NOTE: This is an example of Transfer Switch Operational Analysis. For troubleshooting use the operational analysis with the appropriate wiring/schematic diagrams. XA1 and XB1

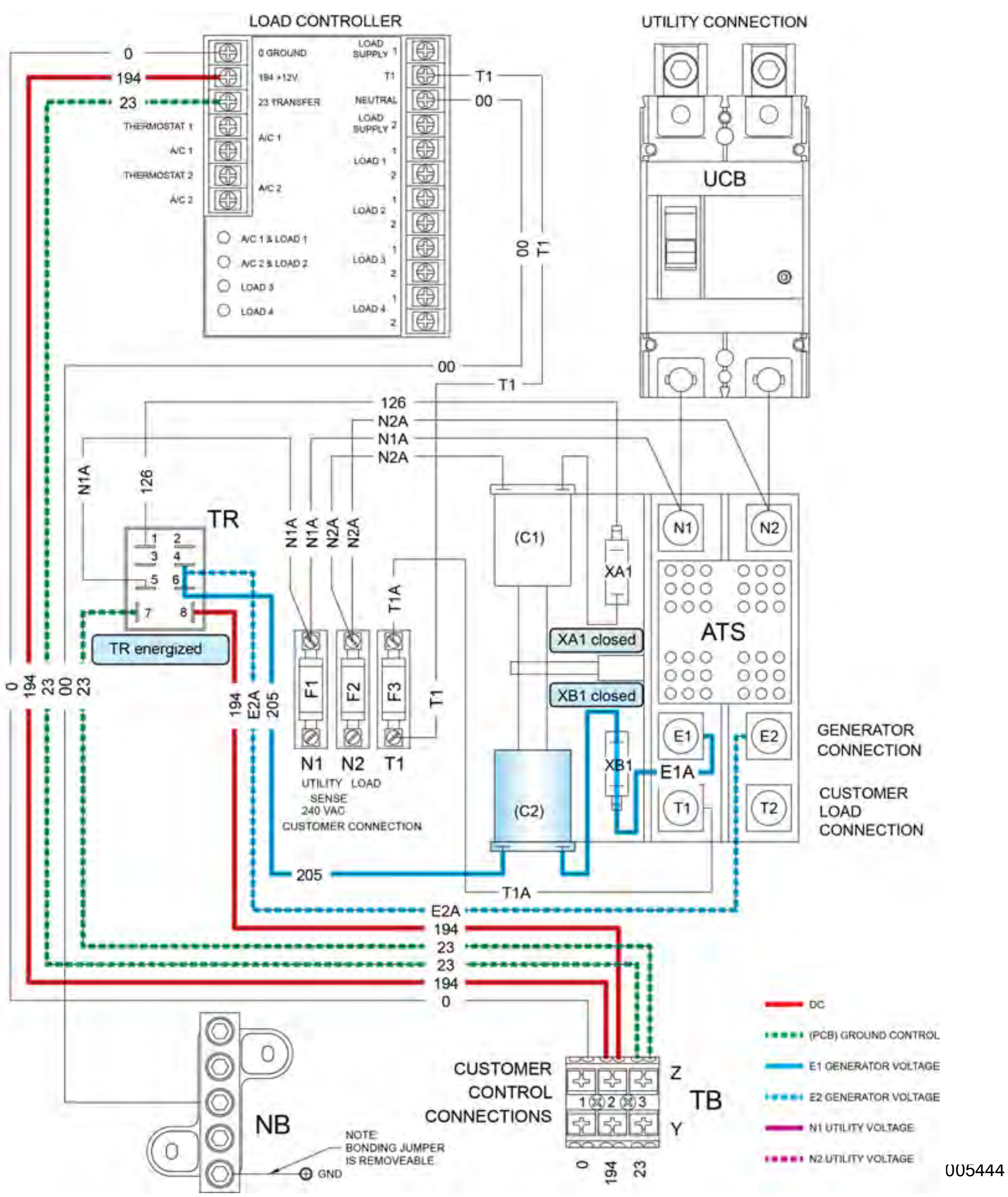

Figure 1-44. Transferring to Standby

Transferred to Standby

When the standby coil (C2) energizes it pulls the contactor to an "over center" position towards the STANDBY position, the transfer switch electronically/mechanically snaps to that position. Upon closure of the main contacts to the STANDBY position limit switches XA1 and XB1 mechanically actuate to "arm" the circuit for re-transfer to the UTILITY position. When XB1 changes, it opens the circuit providing voltage to the standby closing coil (C2). Voltage from the generator, connected through T1 and T2, provides power to customer connected loads.

NOTE: This is an example of Transfer Switch Operational Analysis. For troubleshooting use the operational analysis with the appropriate wiring/schematic diagrams.

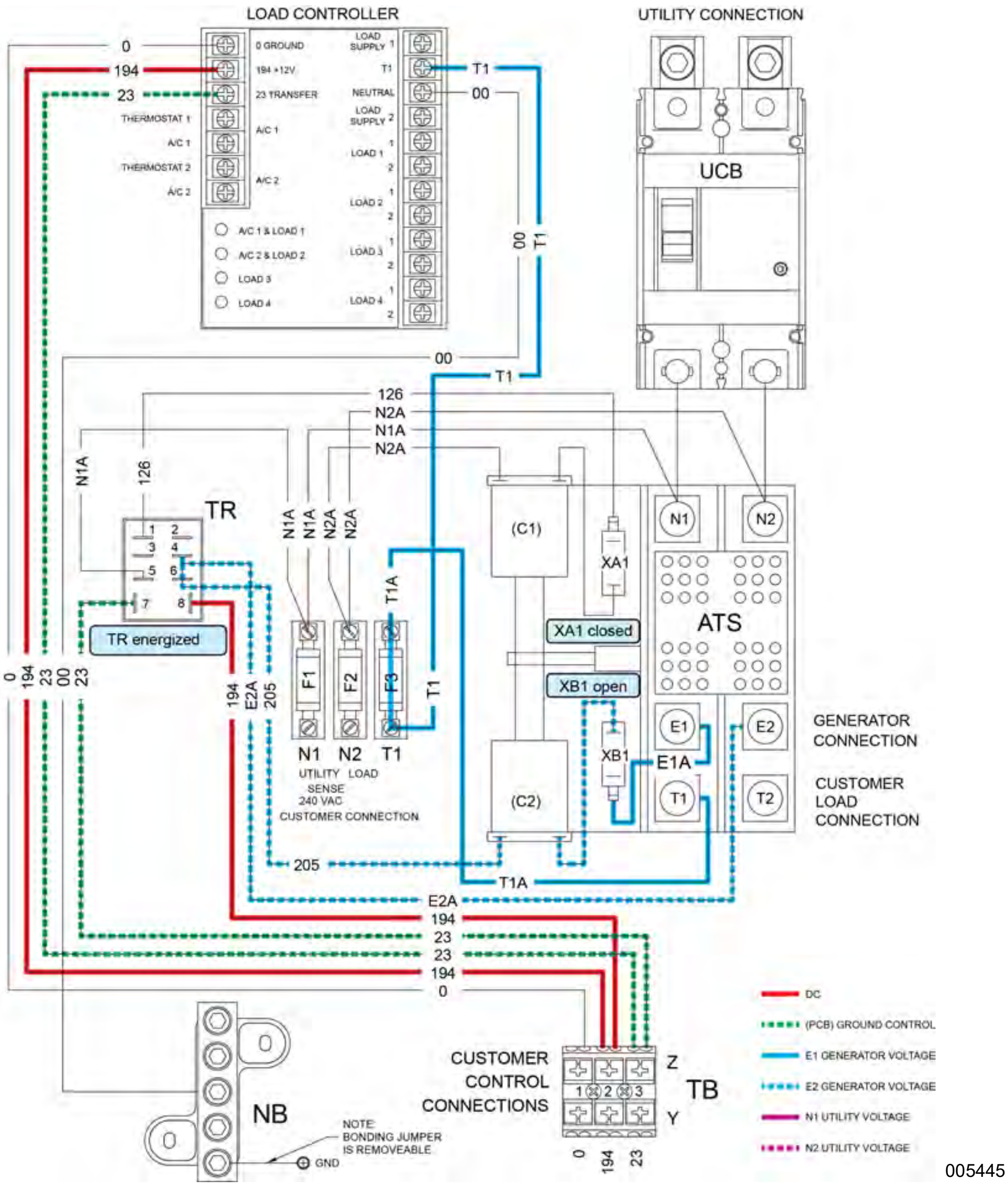

Figure 1-45. Transferred to Standby

Utility Restored

Utility voltage is restored and available to terminals N1 and N2. The Utility voltage is “sensed” by the controller and, if it is above 75% of nominal for 15 consecutive seconds, a transfer back to UTILITY will occur.

NOTE: The open contacts containing Wires N1A and 126 keep the switch from immediately transferring to the utility position.

NOTE: This is an example of Transfer Switch Operational Analysis. For troubleshooting use the operational analysis with the appropriate wiring/schematic diagrams.

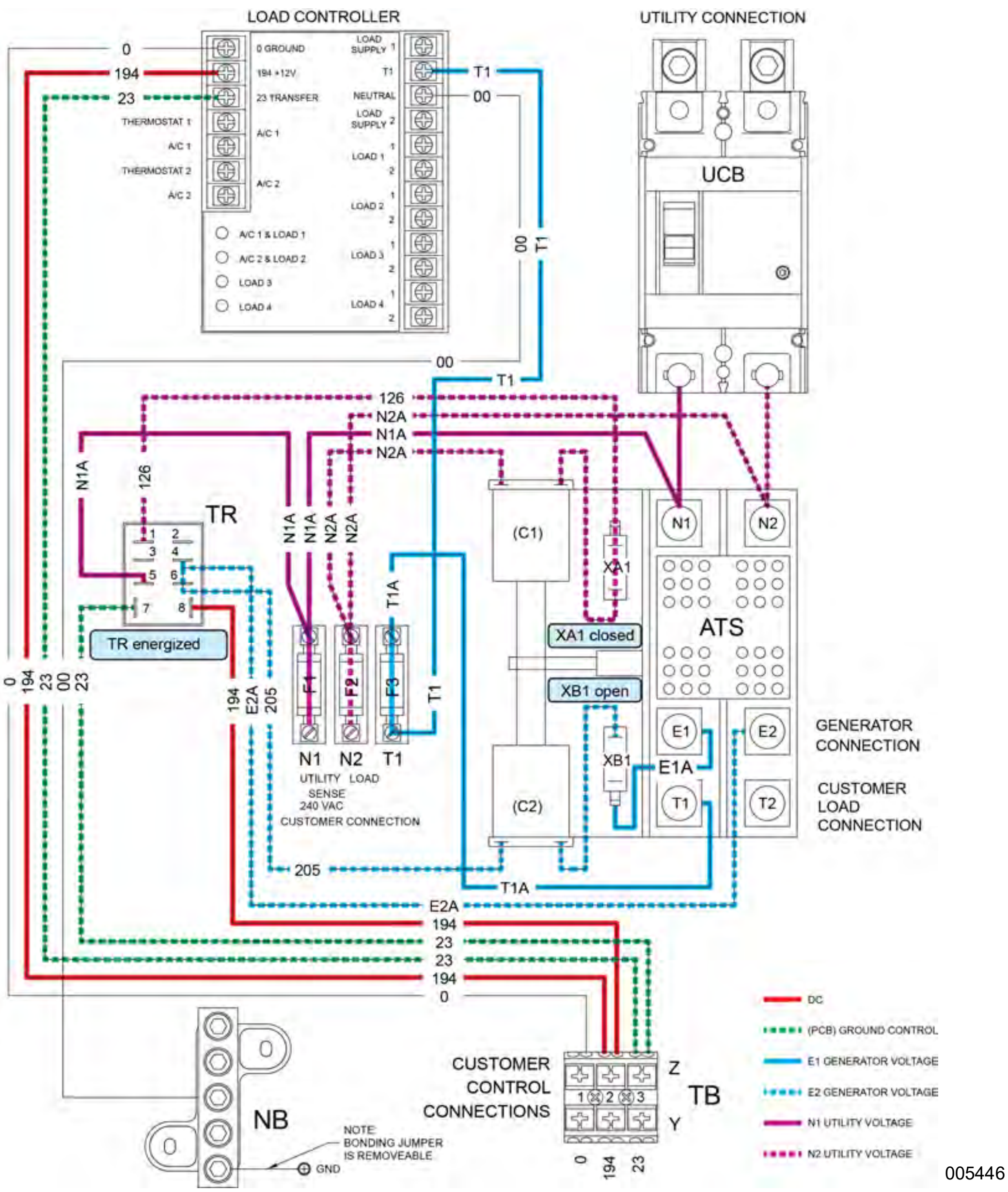

Figure 1-46. Utility Restored

Utility Restored, Transferring Back to Utility

After the 15 second return to utility delay expires, the controller will open the Wire 23 circuit from ground. The transfer relay de-energizes, the N.O. and N.C. contacts change state. Utility voltage is delivered to the utility closing coil (C1) through Wires N1A and N2A, the normally closed contacts containing Wires N1A and 126, and limit switch (XA1). With utility voltage applied to both sides of the utility closing coil (C1), the rectifier in the coil causes the coil to energize.

When the relay de-energizes its utility side contacts close, utility voltage is delivered to the utility closing coil (C1), via utility voltage from N1A and N2A, the closed relay contacts, Wire 126, limit switch (XA1), and a bridge rectifier.

- The C1 coil energizes and moves the main contacts to their "Utility" Position; the LOAD terminals are now powered by Utility.
- Movement of the main contacts to the "Utility" position actuates the limit switches. XA1 opens and XB1 closes on the Standby source side.

NOTE: This is an example of Transfer Switch Operational Analysis. For troubleshooting use the operational analysis with the appropriate wiring/schematic diagrams.

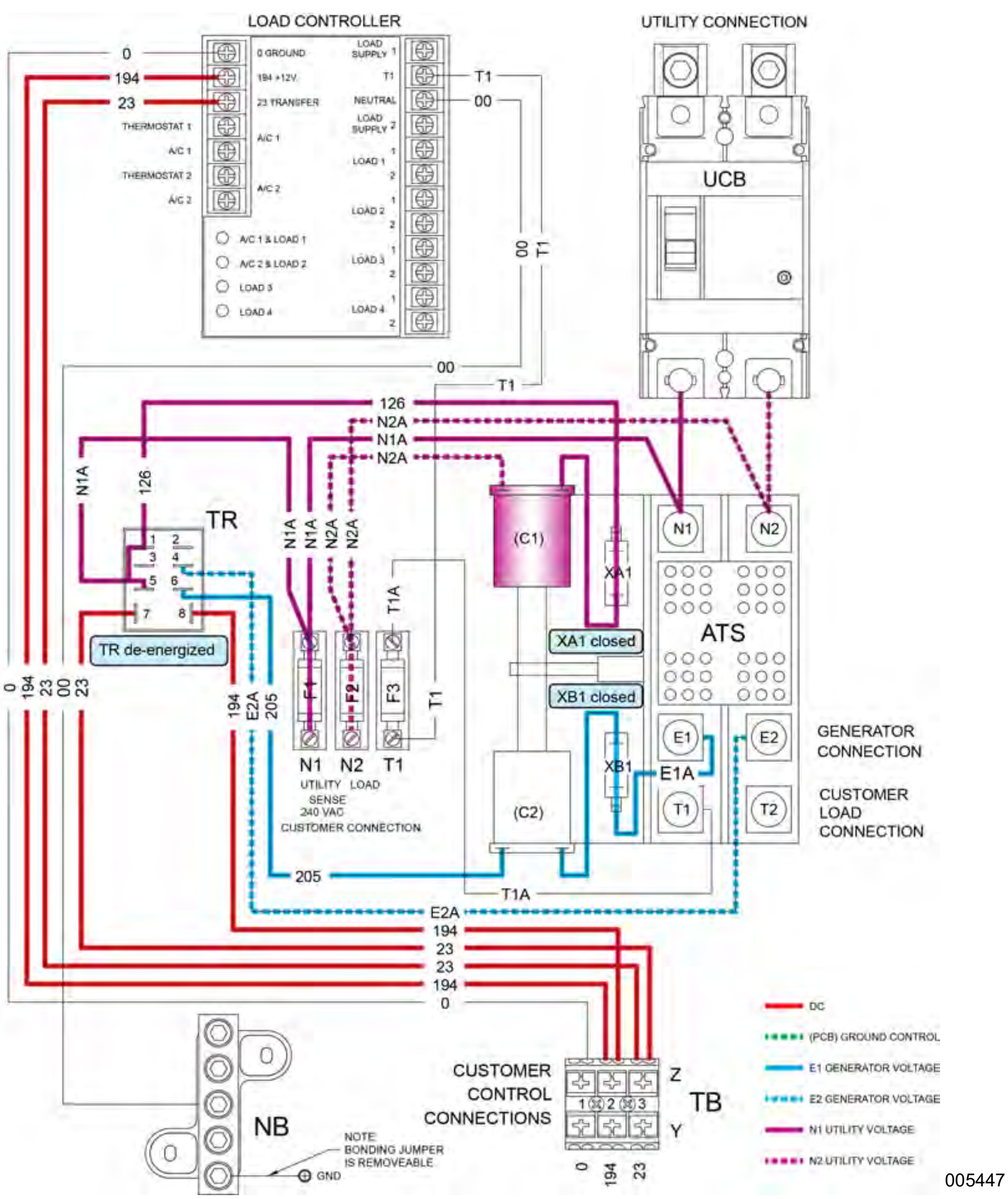

Figure 1-47. Utility Restored, Transferring Back to Utility

Utility Restored, Transferred Back to Utility

As the utility closing coil pulls the transfer switch to an "over center" position, the switch mechanically snaps to the UTILITY position. Upon closure of the contacts to UTILITY, the limit switches (XA1 and XB1) mechanically actuate to "arm" the circuit for the next transfer to STANDBY. When switch XA1 changes states, the circuit providing voltage to the utility transfer coil is opened, and the coil de-energizes.

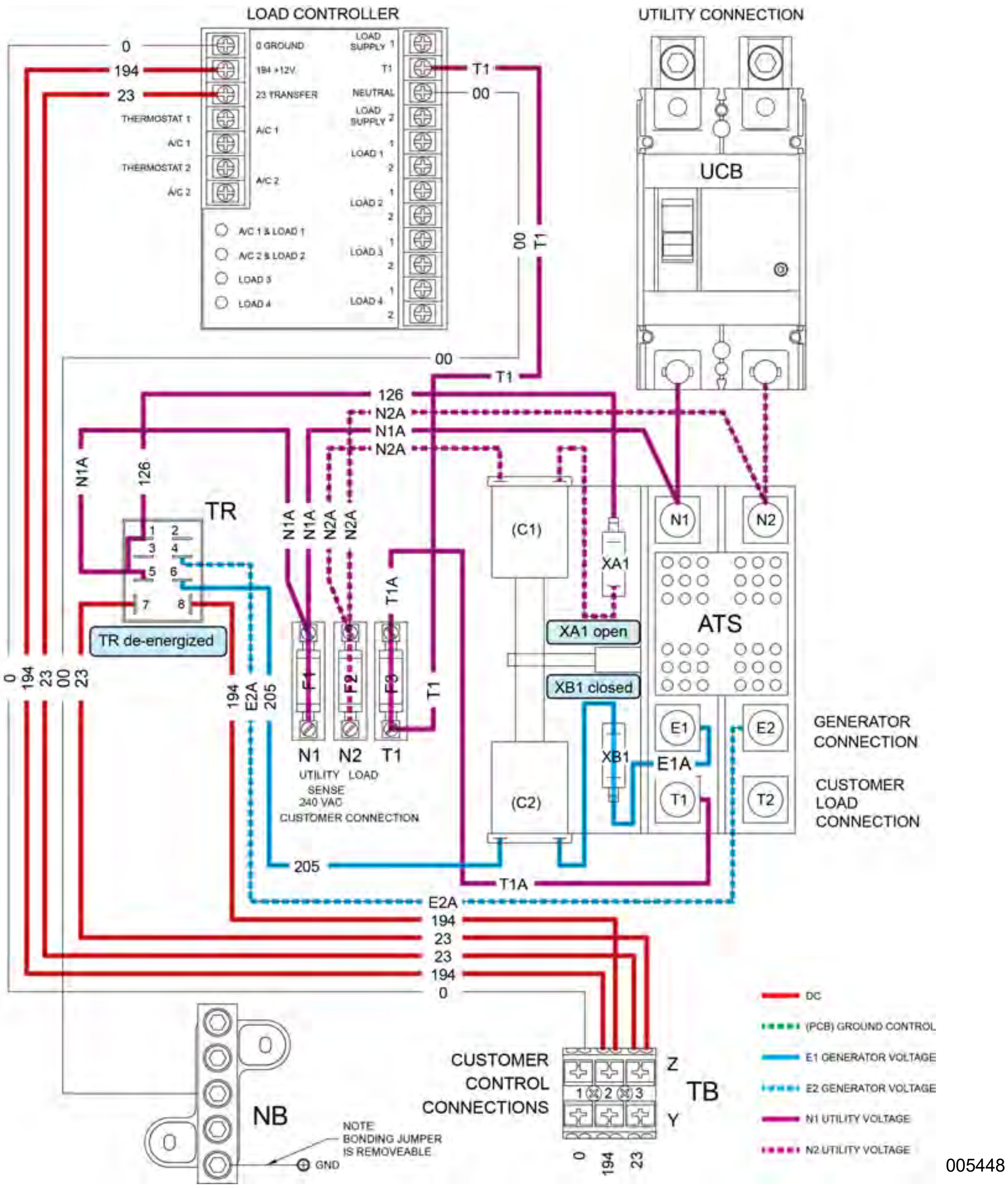

Figure 1-48. Utility Restored, Transferred Back to Utility

Transferred Back to Utility, Generator Shutdown

When the transfer switch returns to the UTILITY position the controller will shut the generator down after the one minute engine cool-down timer expires.

NOTE: This is an example of Transfer Switch Operational Analysis. For troubleshooting use the operational analysis with the appropriate wiring/schematic diagrams.

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Introduction

Standard 100/200/400 amp RTS switches and the 1-phase 400 amp switch all utilize a W-type contactor and are rated for their perspective amperages. They are available in 2-pole and 3-pole configurations for use with 1-phase and 3-phase systems.

These switches do not have intelligent systems of their own. A circuit board housed in the generator controls automatic operation of the transfer switch.

Transfer Switch Contactor

These switches are equipped with solder-less, screw type lugs with typical ratings as shown. Always refer to the unit specific owner's manual for correct specifications.

Switch Rating	Wire Range
100A	#14-1/0 AWG
200A	#6-250 MCM
400A	(1) #4-600 MCM or (2) 1/0-250 MCM

The switch is suitable for control of motors, electric discharge lamps, tungsten filament and electric heating equipment where the sum of motor full load ampere ratings and the ampere ratings of other loads do not exceed the ampere rating of the switch and the tungsten load does not exceed 30 percent of the switch rating

The UL listed transfer switch is for use in optional standby systems only. For further information on the contactor assembly, refer to Section 1.2 ***Contactor Basics***.

Terminal Block

During system installation, this 6-point terminal block must be properly connected with an identically labeled terminal block in the generator customer connection area.

Terminals used on the terminal block are identified as: 194, 23, 0, T1, N1 and N2.

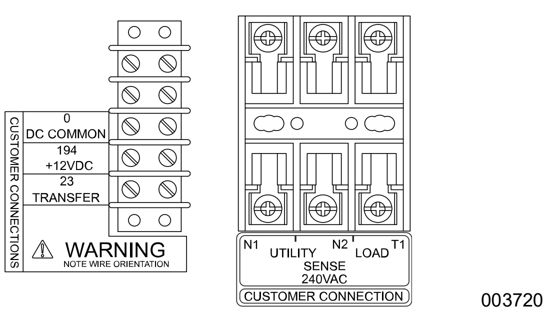

Figure 1-49. Smart Switch Connections

Utility N1 and N2

Wires N1 and N2 are connected with identically labeled terminals in the generator customer connection area. This is the utility sensing voltage to the circuit board. The signal is delivered to the generator and on some older models is stepped down to 16 VAC using a transformer. N1 and N2 voltage is used by the circuit board as follows:

- If Utility source voltage drops below a preset level, circuit board logic will initiate automatic cranking and startup, followed by automatic transfer to the standby source.

Terminal 0, 194, 23

These terminals connect to the transfer relay and if equipped the Digital Load Management system.

NOTE: These terminals and wire numbers vary depending on the production date of the transfer switch. Always consult the owner's manual supplied with the unit to ensure accurate information.

NOTE: On pre Evolution and Nexus generators, Wire 194 may be marked as 15B in the generator. Wires 194 and 15B serve the same function.

Load T1

Wire T1 is connected with an identically labeled terminal in the generator customer connection area. This Load voltage is delivered to the generator to supply 120 VAC to the control board for battery charging. On some older models, this voltage is delivered to a charger external of the printed circuit board.

Fuse Holder

A separately mounted fuse holder holds three fuses, designated as fuses F1, F2, and F3. Each fuse is rated at 5 amperes.

On the Integrated SACM Module, 6.3 amp mini fuses are incorporated into the circuit board and are designated with the same functions.

Fuses F1 and F2

These two fuses protect the Utility N1 and Utility N2 circuit against overload.

Fuse F3

The F3 is installed in-line with Wire T1 and protects the battery charger circuit from overload.

Operational Analysis

Utility Source Voltage Available

The Switch is in the UTILITY position and utility power is available. Rated utility source voltage is available to transfer switch terminal lugs N1, N2, and N3 through sensing wires to the Power Monitor. Utility voltage is available through N2/ N2A to terminal A2 of the transfer switch.

Utility voltage is available from N1B to the normally closed contact of the transfer relay (TR). From the TR relay it continues on through Wire 126 to Terminal A1 of the transfer switch.

Utility voltage goes from Terminals A1 and A2 to limit switches LS1 and LS2. These limit switches are mechanically operated by the transfer switch contactor. They connect either A1 and A2 or B1 and B2 to the common bridge rectifier and closing coil circuit. When the switch is in the UTILITY position, A1 and A2 are open from the BR and closing coil.

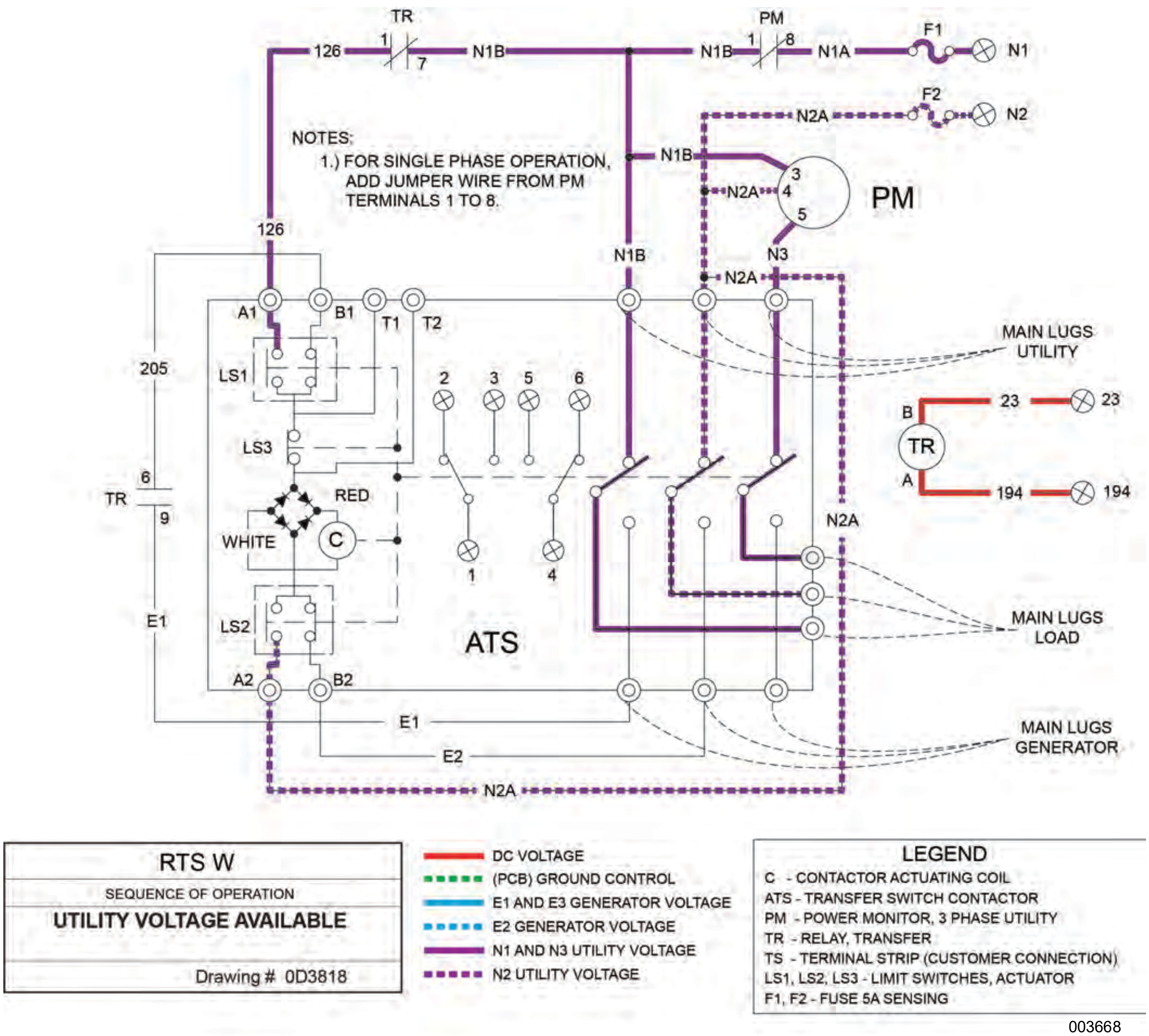

Figure 1-50. Utility Source Voltage Available

Utility Source Voltage Failure

The Power Monitor senses a voltage drop or phase loss and opens Contacts 1 and 8, removing N1 from the generator. The generator senses that the utility voltage is below the voltage dropout set point via Wires N1 and N2. The line interrupt delay timer starts. When the line interrupt delay timer expires (approximately 10 seconds) the generator controller responds to the utility failure and starts. Generator voltage feeds the switch through E1, E2 and E3. E1 and E2 provide generator voltage to the transfer contactor.

The engine warm-up timer starts. When the warm-up timer expires the generator controller will energize the TR relay by grounding Wire 23. Positive 12 VDC is delivered to Wire 194 from the generator when the generator is in either AUTO or MANUAL.

Generator voltage from E2 is connected through wire E2 to terminal B2 on the transfer switch. Because the switch is in the UTILITY position, the LS1 and LS2 contacts are closed on the B1 and B2 side. This connects B1 and B2 to the BR and closing coil. The closing coil requires voltage from both phases of the supply to activate. Even though B1 is connected through the LS1 contact, there is no power to B1 until the TR relay contacts for the generator close (Wire E1 to the open TR contact).

As soon as the generator controller energizes the TR, the GENERATOR contacts close (UTILITY side contacts open) and the closing coil energizes and moves the switch to a NEUTRAL position (both main contacts open).

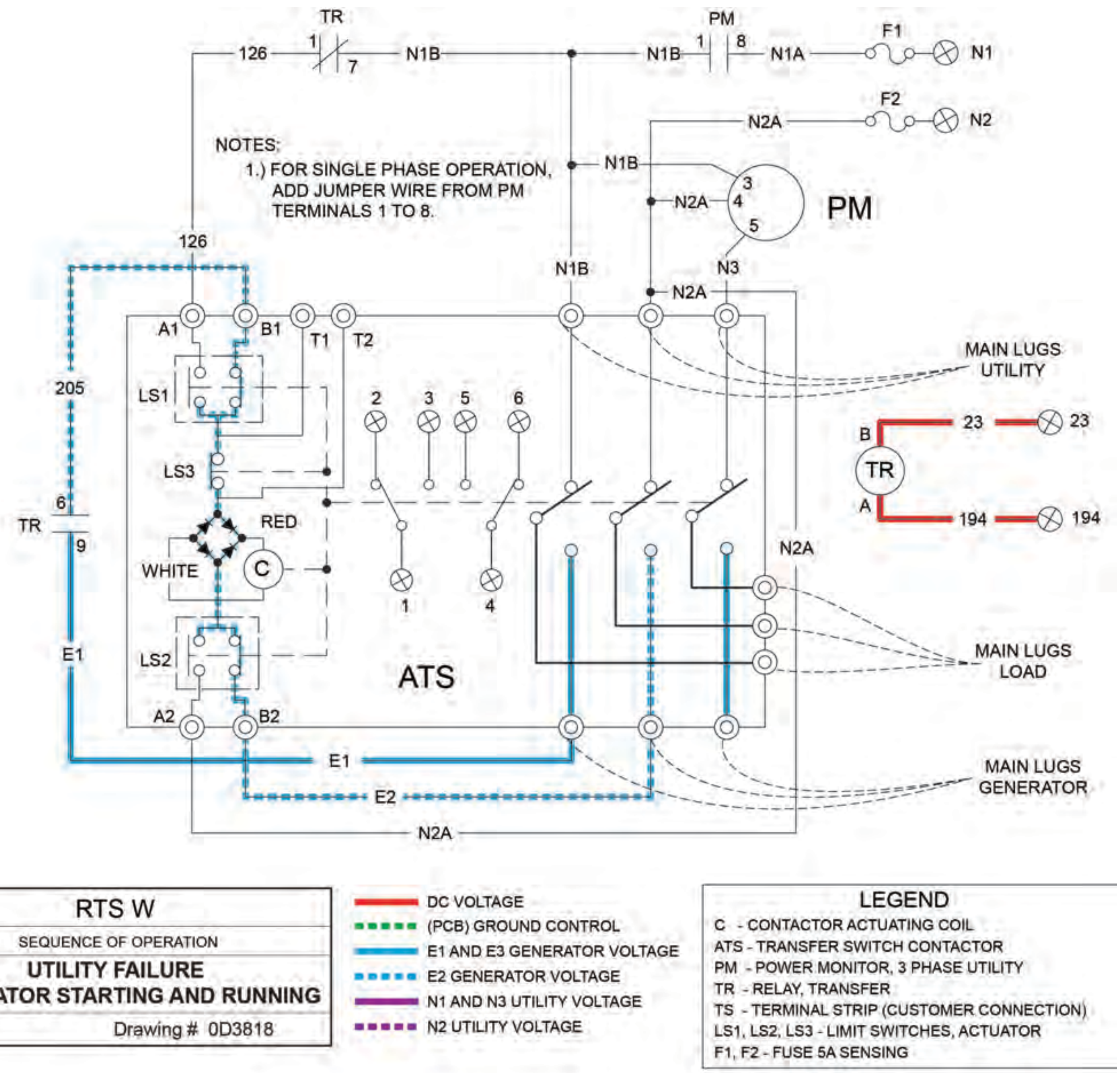

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Figure 1-51. Utility Source Voltage Failure

Transferring to Standby

The generator controller takes Wire 23 to ground. The transfer relay (TR) energizes. The TR relay contacts change state – opening on the utility side (opens Wire N1B from Wire 126) – and closing on the generator side, connecting Wire E1 and 205. This allows generator voltage from Wire E1 to be applied to B1. Generator voltage is already available to B2 from E2. The voltage can go through the closed LS1 and LS2 contacts, and to both sides of the bridge rectifier (BR). The BR rectifies the AC voltage to DC voltage and applies it to either side of the closing coil. The closing coil energizes and pulls the contactor to the NEUTRAL position.

In NEUTRAL the LS3 contact will open. Voltage from B1 goes through the LS3 contact, which is normally closed when the switch is in either the normal or emergency position. However, in the NEUTRAL position the LS3 contact will open.

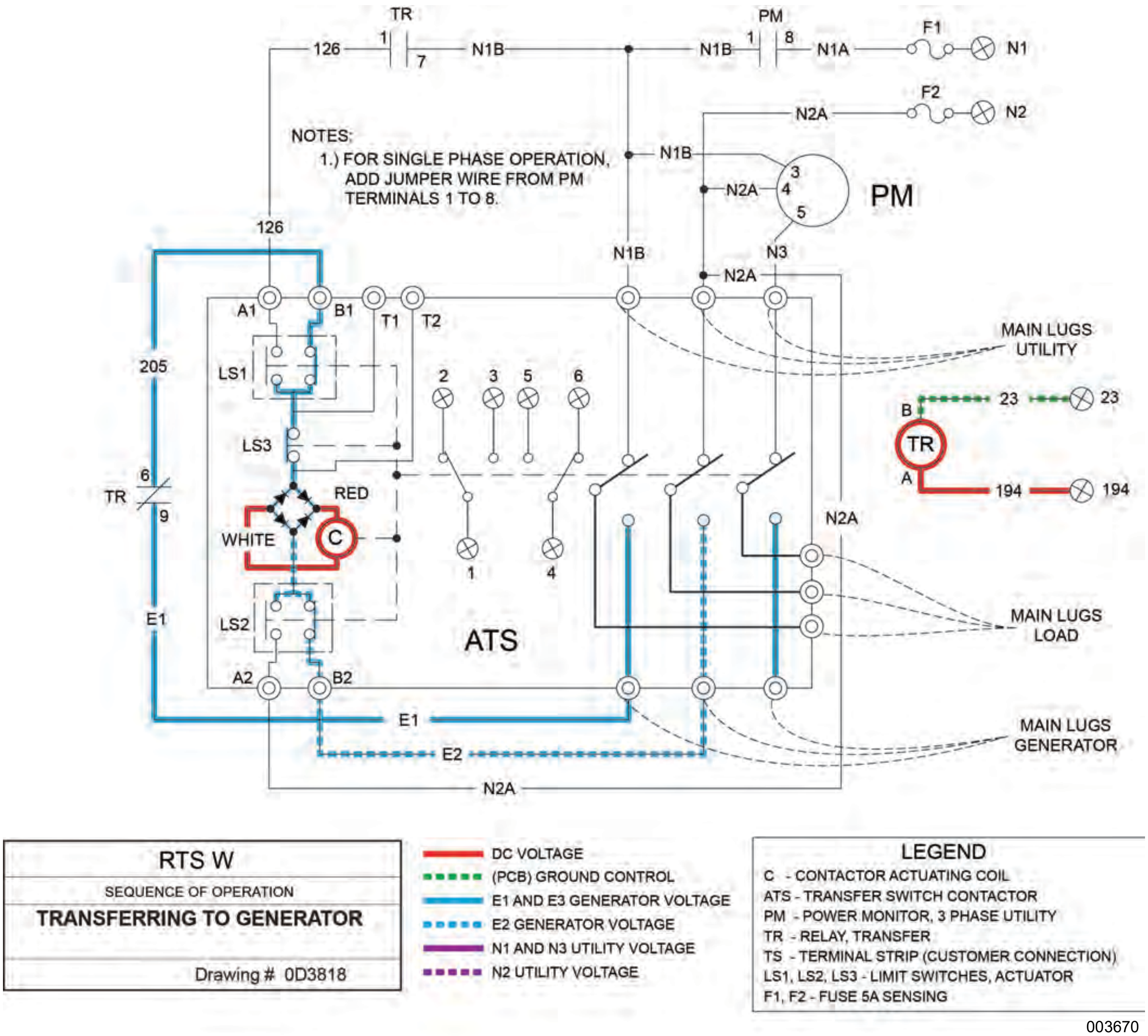


Figure 1-52. Transferring to Standby

Transferred to Standby

When the LS3 contact opens, it removes voltage from the closing coil, which de-energizes. Spring tension in the switch mechanism closes the switch to the STANDBY position, and the generator powers the load through the T1, T2 and T3 connections. The contactor ratchets each time it is actuated. The next time it is actuated by the closing coil it will transfer to the UTILITY position.

When the switch closes to the STANDBY position, the LS1 and LS2 contacts change state, and the LS3 contact closes. This sets the switch up for transfer back to the UTILITY position.

As the switch closes to the standby position, the LS1 and LS2 contacts will change states. With the switch in the standby position B1 and B2 will be disconnected from the BR and closing coil. A1 and A2 will be connected to the BR and closing coil. This is how the switch sets itself up for the next transfer.

NOTE: The closing coil is always powered by the source it is transferring to.

NOTE: The LS3 contact will also close, and the auxiliary contacts on the side of the switch will change state.

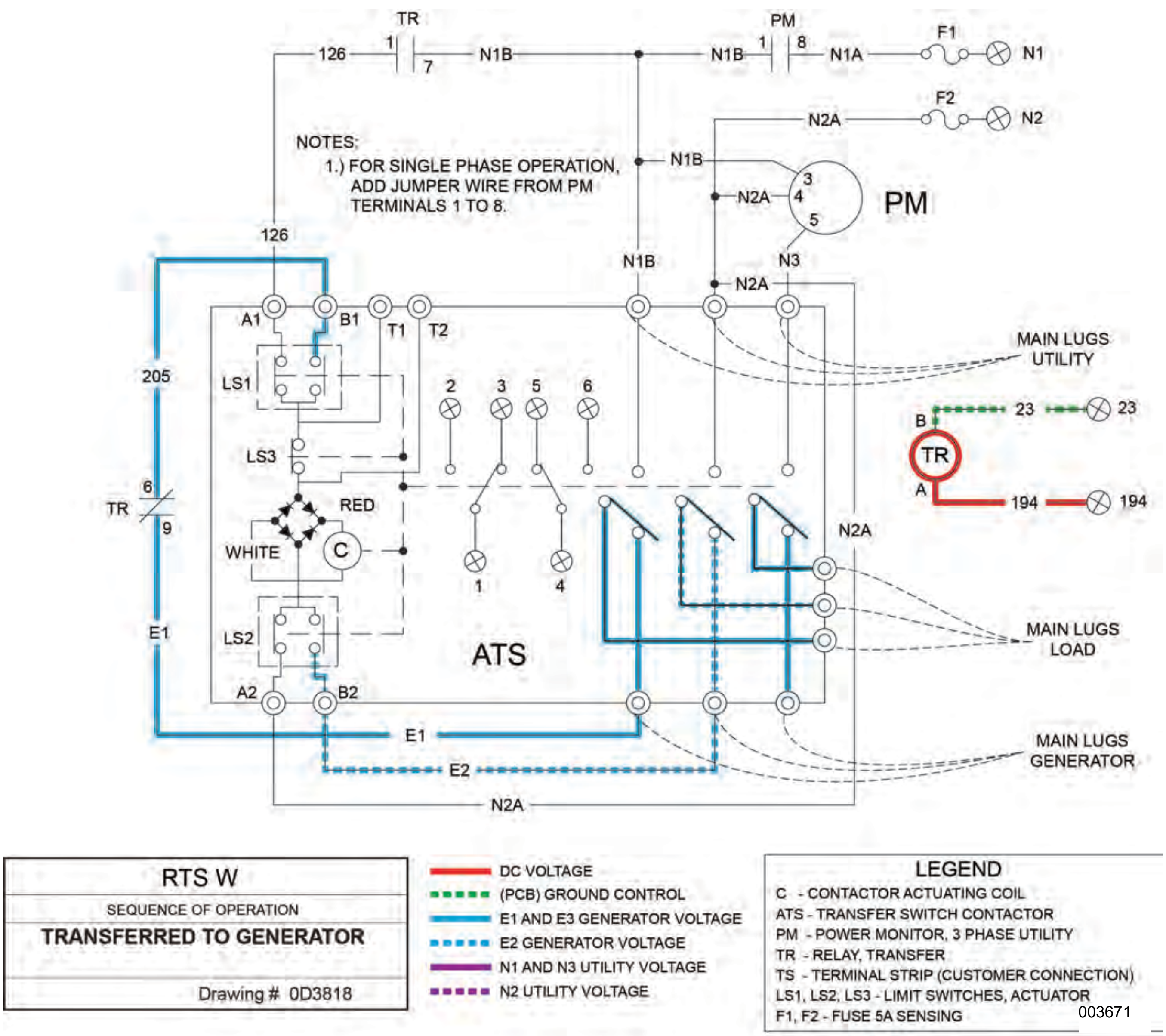


Figure 1-53. Transferred to Standby

Utility Restored

The switch is in the STANDBY position and the generator is running and powering the load.

When Utility voltage returns, the power monitor sees the voltage from N1, N2 and N3 and closes its contacts 1 and 8. The generator controller senses the voltage.

The generator controller lifts the ground from Wire 23 and de-energizes the transfer relay (TR). The TR contacts change states – opening E1 from B1, and closing N1B to A1.

Utility voltage is applied at both A1 and A2, through the closed LS1 and LS2 contacts, and to the bridge rectifier and closing coil. The closing coil energizes and pulls the switch to the NEUTRAL position, which opens the contacts from the generator to the load.

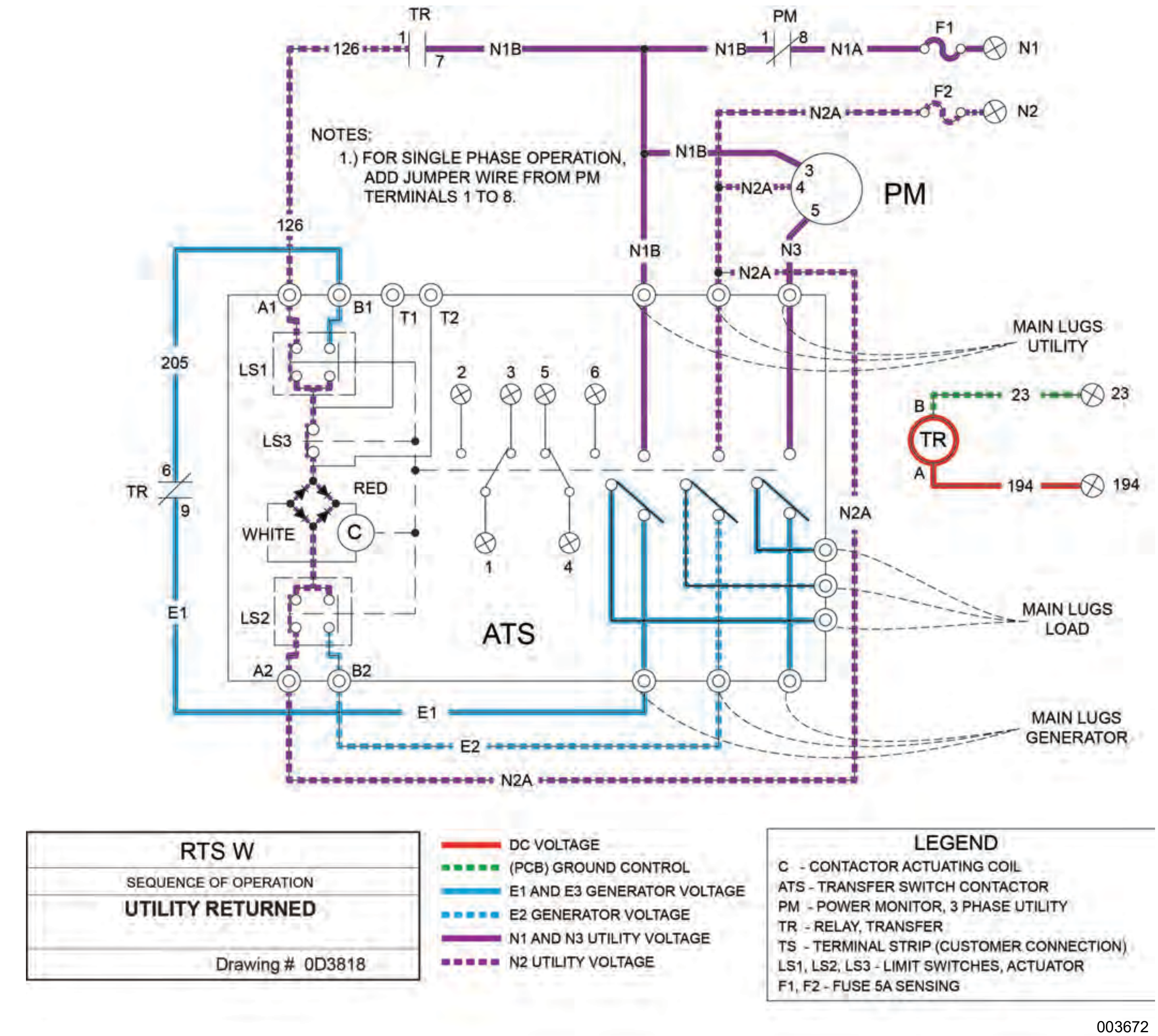


Figure 1-54. Utility Restored

Utility Restored, Transferring Back to Utility

In the NEUTRAL position the LS3 contacts open and the closing coil de-energizes. Spring tension in the switch mechanism now closes the switch to the UTILITY position, and utility voltage powers the load through the T1, T2 and T3 connections. The contactor ratchets each time it is actuated. The next time it is actuated by the closing coil it will transfer to the STANDBY position.

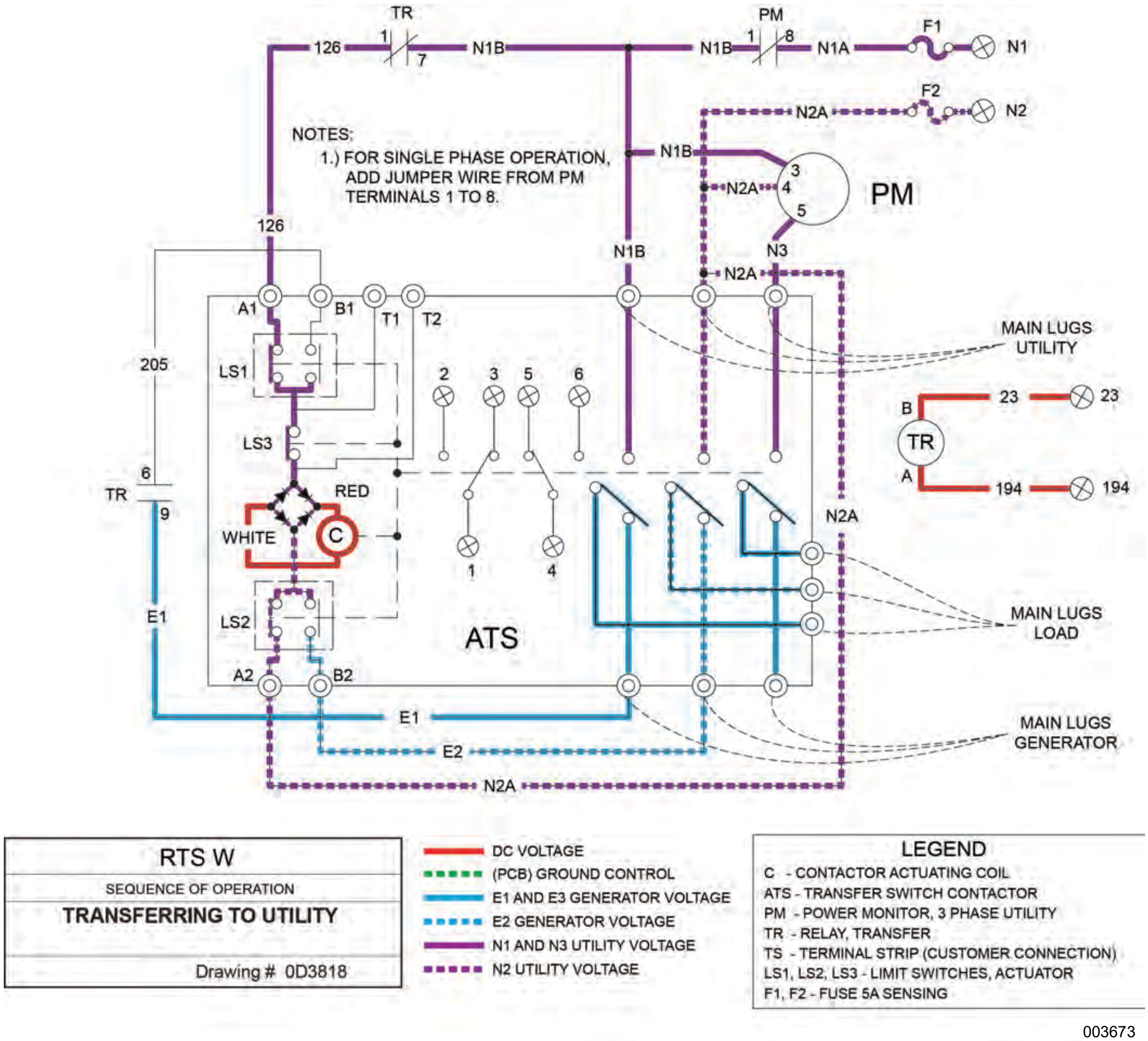


Figure 1-55. Utility Restored, Transferring Back to Utility

Utility Restored, Transferred Back to Utility

As the switch closes to the UTILITY position, the LS1 and LS2 contacts change states. With the switch in the UTILITY position A1 and A2 are disconnected from the BR and closing coil. B1 and B2 are connected to the BR and closing coil. This is how the switch sets itself up for the next transfer.

NOTE: The closing coil is always powered by the source it is transferring to.

The auxiliary contacts on the side of the switch also change state.

The generator controller starts the engine cool-down timer and when it expires, shuts down the generator. The switch is ready for the next utility power loss event.

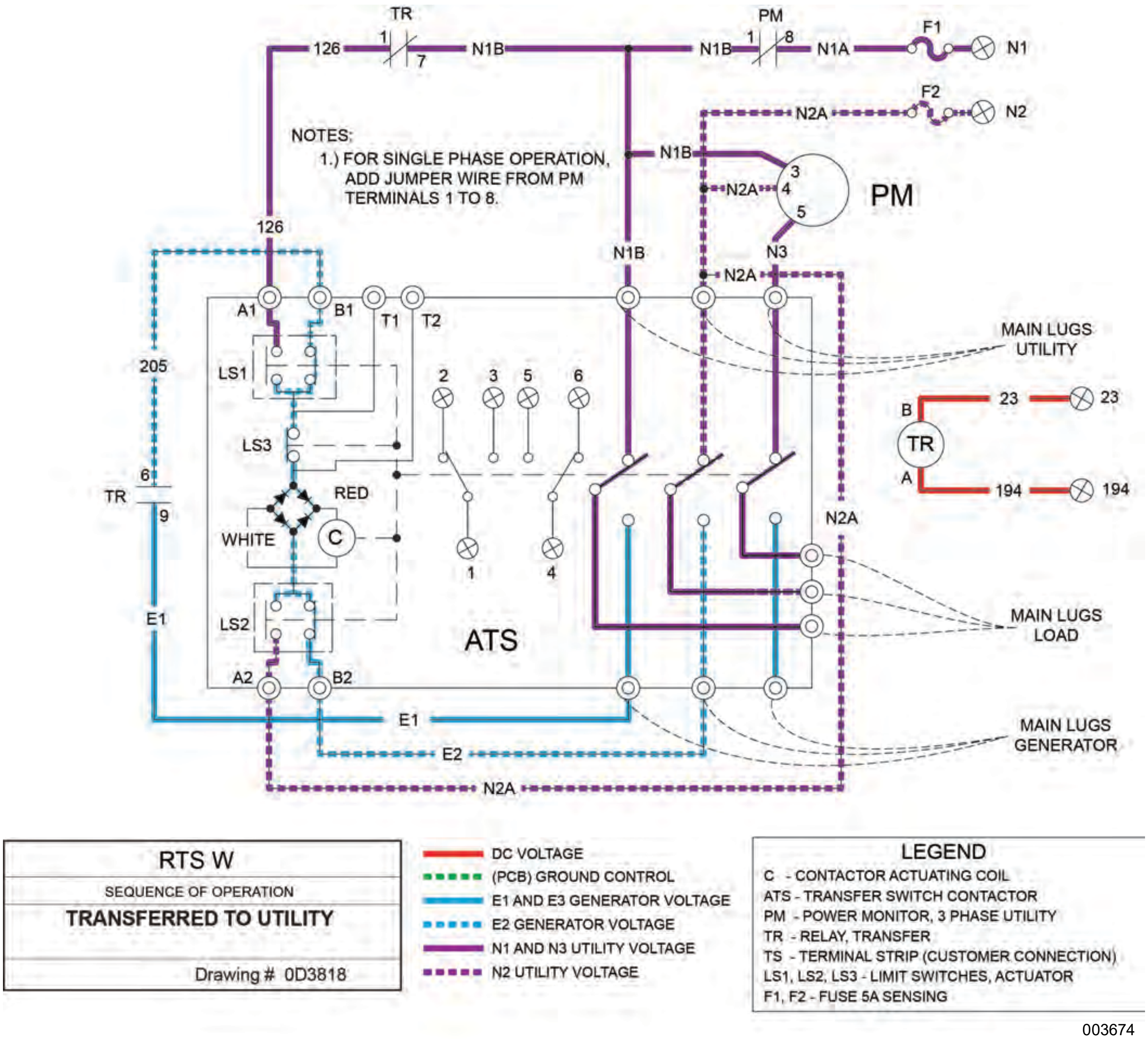


Figure 1-56. Utility Restored, Transferred Back to Utility

Introduction

Generac Wn-type automatic transfer switches are used in commercial applications. These switches are available in single and three-phase applications with current ratings from 600 to 800 amps. Wn-type switches are open transition switches. The Wn-type mechanism has a de-energized neutral—when the switch is in the Neutral position the internal actuator coils will not be powered.

Wn-type mechanisms require 208 or 240 VAC for actuation. Automatic operation is controlled by the generator controller.

The major components in a RTS Wn-type are:

- Transfer switch contactor mechanism
- Transfer relay TR1 (most switches)
- Transfer relay TR2 (480 VAC switches)
- Customer connection terminal strip
- Fuses F1 through F4
- Phase monitor relay (3-phase switches).

Transfer Mechanism

The major components in a RTS Wn-type transfer mechanism are:

- Main current carrying contacts
- Mechanical and spring switching mechanism
- Closing, trip, select coils (and related rectifier circuitry)
- ATS1 and ATS2 control contacts (micro switches)
- LS1 & LS2 limit switches
- AX, BX control contacts (micro switches)
- Auxiliary contacts

The main contacts are tripped open by a single solenoid (trip coil), and closed by a single solenoid (closing coil). They are opened electrically and held closed mechanically. Power for coil operation is taken from the side to which the load is being transferred. Therefore, transfer to any power source cannot occur unless that power source is available to the switch.

The ATS1 and ATS2, BTS1 and BTS2, LS1 and LS2, and AX and BX micro switches are mechanically actuated by the transfer mechanism. These micro switches are key to the operation of the switch.

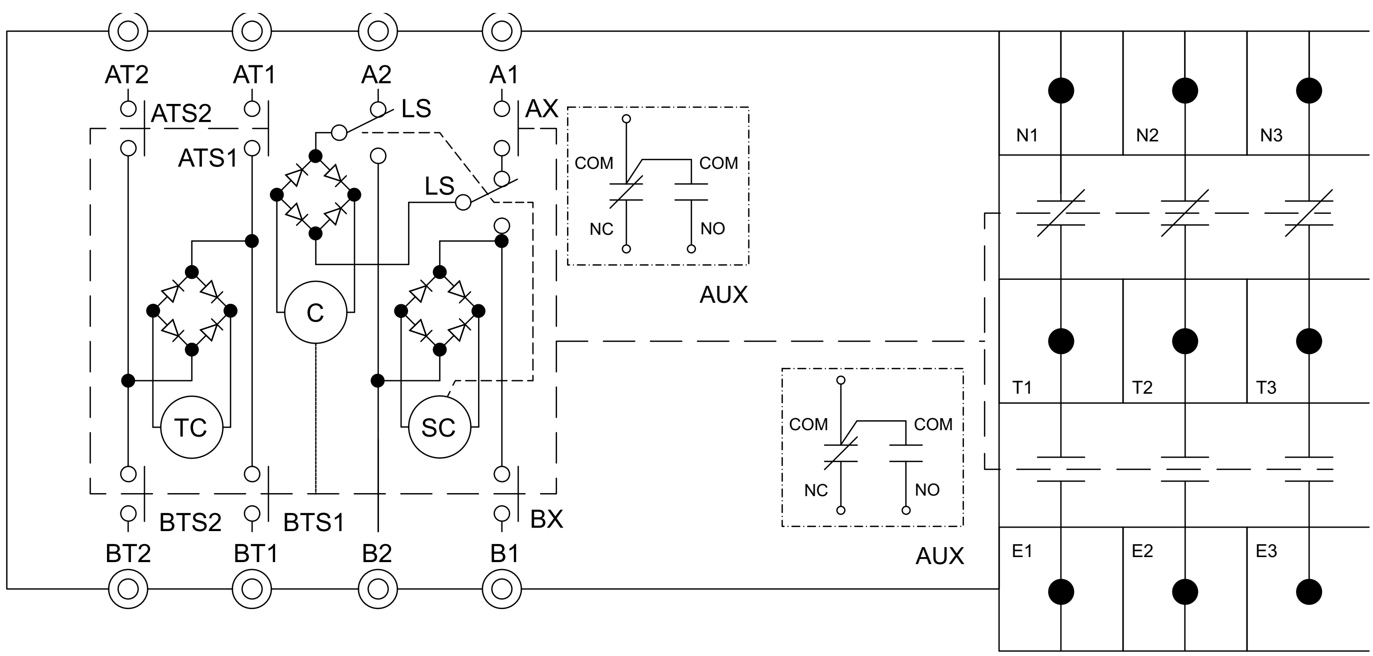


Figure 1-57.

Main Closing Coil

The main closing coil (C) is energized using rectified AC voltage to actuate the contacts from either the “Utility” or the “Standby” position. The main closing coil can only energize to the “Standby” or “Utility” position when the contactor is in the “Neutral” position.

Trip Coil

Wn-type contactors need to be mechanically tripped out of a given position. When the contactor is in the “Utility” position, the ATS limit switch is in the closed position. When the TR relay energizes it allows generator voltage to energize the trip coil, mechanically tripping the contactor to the “Neutral” position.

When the contactor is in the “Standby” position the BTS limit switch is in the closed position. When the TR relay de-energizes it allows Utility voltage to energize the trip coil mechanically tripping the contactor to the “Neutral position.

Select Coil

The select coil (SC) provides the electrical and mechanical connection to allow the contactor to transfer to the “Standby” position. With the contactor in the “Neutral” position the AX and BX limit is in the closed position. When BX is in the closed position generator voltage becomes available to the coil when the TR relay energizes. TR relay energized, generator voltage energizes the SC coil and connects the LS limit switch to generator voltage energizing the main coil. At the same time the SC is energized it mechanically changes the roller position of the contactor allowing it to transfer to the “Standby” position.

NOTE: If the SC coil is never energized, the contactor will never transfer to the “Standby” position.

Utility and Standby Contacts

Figure 1-58 shows the utility contacts in the “Utility” position supplying voltage to the load. The trip coil is responsible for disconnecting the contactor from either the “Utility” or the “Standby” position.

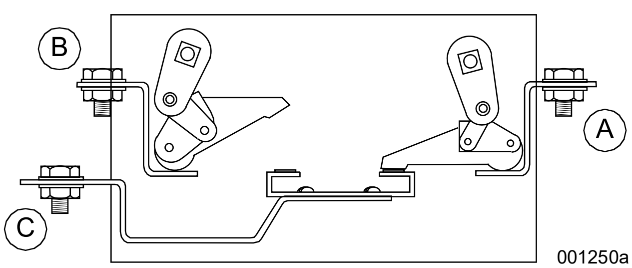


Figure 1-58. Load Connected to Utility Source

A. UTILITY “A” Position
B. EMERGENCY “B” Position
C. LOAD

Figure 1-59 shows both the utility contacts and the STANDBY contacts disconnected from the load. In RTS family, the “Neutral” position is not adjustable. When the closing coil pulls the contactor to either the “Standby” or “Utility” positions, limit switch AX and BX contacts will open. This removes the voltage feeding the closing coil (de-energizing the coil).

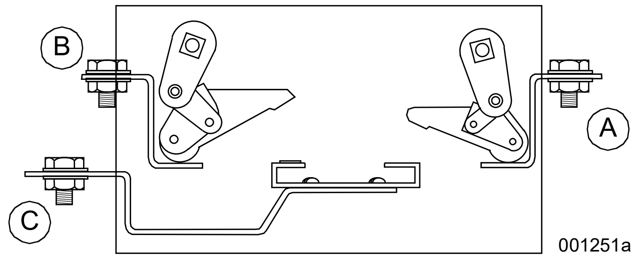


Figure 1-59. “Neutral” or “Tripped” Position

A. UTILITY “A” Position
B. EMERGENCY “B” Position
C. LOAD

Figure 1-60 shows the contactor now in the “Standby” position supplying voltage to the load.

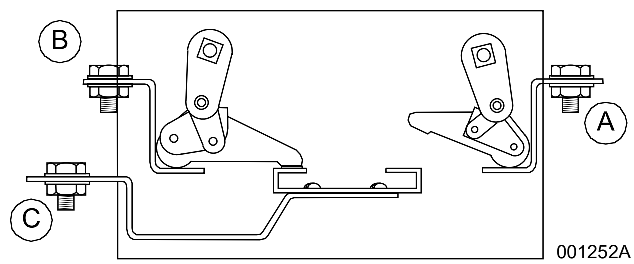


Figure 1-60. Load Connected to “Standby” Source

A. UTILITY “A” Position
B. EMERGENCY “B” Position
C. LOAD

Bridge Rectifier

The bridge rectifier receives AC voltage from either Utility or Generator. This voltage is rectified into a DC voltage that is capable of energizing the closing coil. It also acts as terminal block for incoming wires.

AX-BX Limit Switch

See ***Figure 1-61***. The AX-BX limit switch is internal to the contactor and is located on the left side of the contactor. Mechanically connected to the contactor, it is only closed in the “Neutral” position. See ***Table 1-6*** for limit switch positions.

ATS Limit Switch

See ***Figure 1-61***. The ATS limit switch is internal to the contactor and is located between the arc chute and the main coil. Mechanically connected to the contactor, it is only closed in the “Utility” position. See ***Table 1-6*** for limit switch positions.

BTS Limit Switch

See ***Figure 1-61***. The BTS limit switch is internal to the contactor and is located between the arc chute and the main coil. Mechanically connected to the contactor, it is only closed in the “Standby” position. See ***Table 1-6*** for limit switch positions.

LS Limit Switch

The LS limit switch is mechanically connected to the SC. When the SC coil energizes it allows generator voltage to energize the main coil and transfer to the “Standby” position.

Table 1-6. Limit Switch Positions

	“Utility”	“Neutral”	“Standby”
ATS1	CLOSED	OPEN	OPEN
ATS2	CLOSED	OPEN	OPEN
BTS1	OPEN	OPEN	CLOSED
BTS2	OPEN	OPEN	CLOSED
AX	OPEN	CLOSED	OPEN
BX	OPEN	CLOSED	OPEN

	Trip Coil	Select Coil	Main Coil
“Utility to Standby” Terminals	1 AT1, AT2	2 B1, B2	3 B1, B2
“Standby to Utility” Terminals	1 BT1, BT2		3 A1, A2

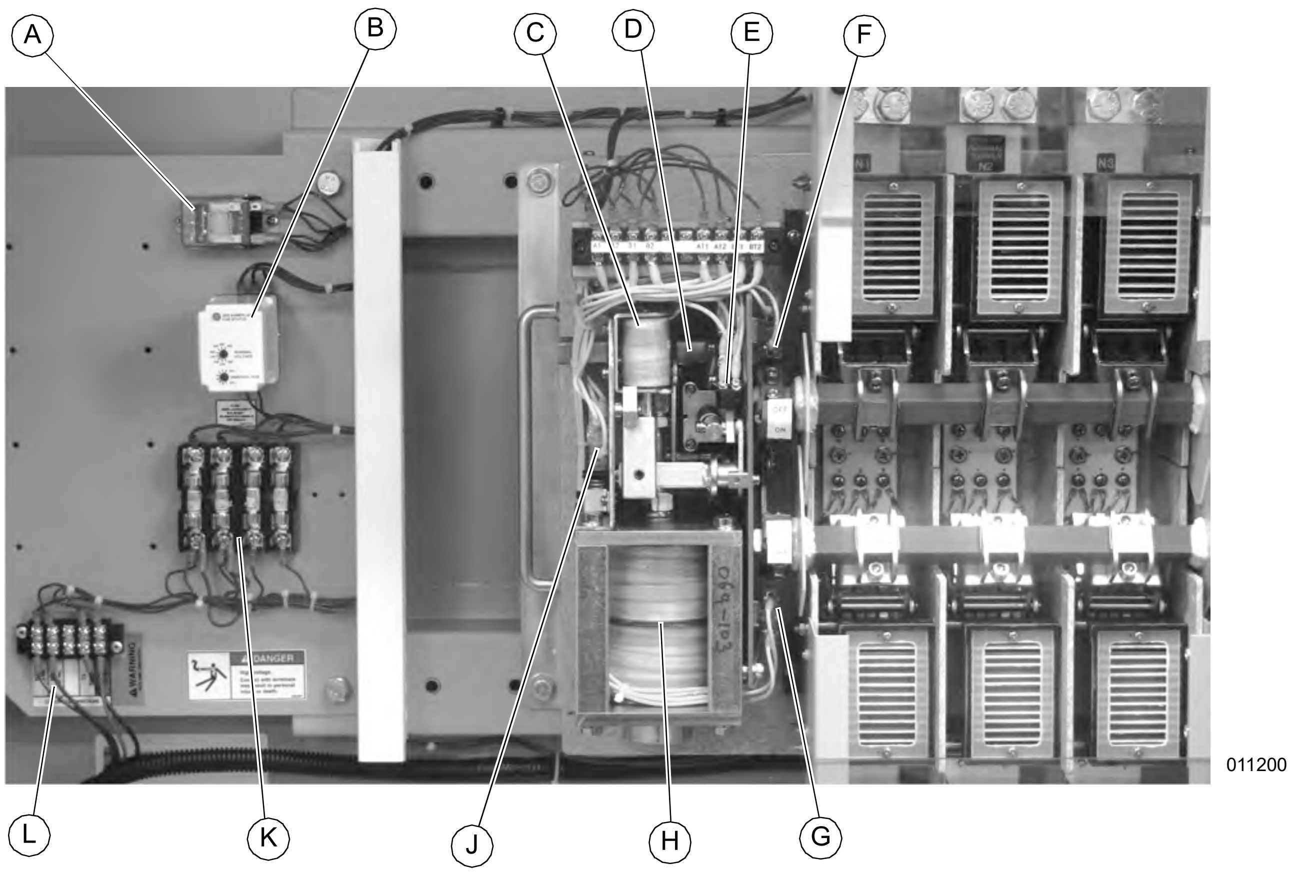
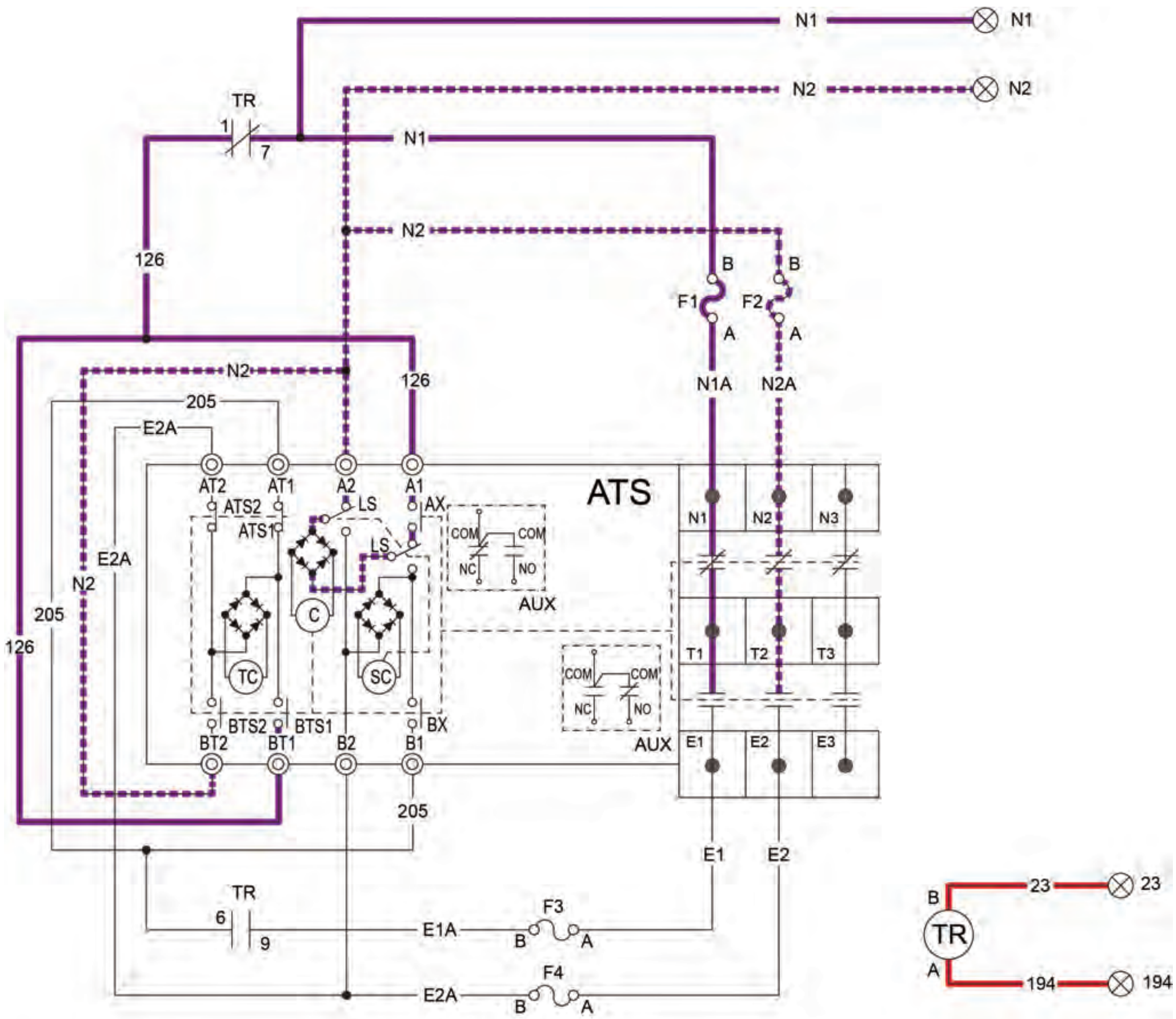


Figure 1-61. Wn-type Components

A. Transfer Relay
B. Power Monitor
C. Trip Coil
D. Select Coil
E. LS1 and LS2 Limit Switch
F. ATS1 and ATS2 Limit Switch
G. BTS1 and BTS 2 Limit Switch
H. Closing Coil
J. AX and BX Limit Switch
K. Fuse Block
L. Terminal Block

Operational Analysis

Utility Voltage Available



Limit Switch Positions			
	"Utility"	"Standby"	"Neutral"
ATS1	Closed	Open	Open
ATS2	Closed	Open	Open
BTS1	Open	Closed	Open
BTS2	Open	Closed	Open
AX	Open	Open	Closed
BX	Open	Open	Closed

LEGEND

ATS - TRANSFER SWITCH CONTACTOR
C - CONTACTOR ACTUATING COIL
TR - RELAY, TRANSFER
SC - COIL, SELECTIVE
TC - COIL, TRIP
TS - TERMINAL STRIP (CUSTOMER CONNECTION)
F1,F2 - FUSE 5A SENSING & SWITCH OPERATION
F3,F4 - FUSE 5A SWITCH OPERATION

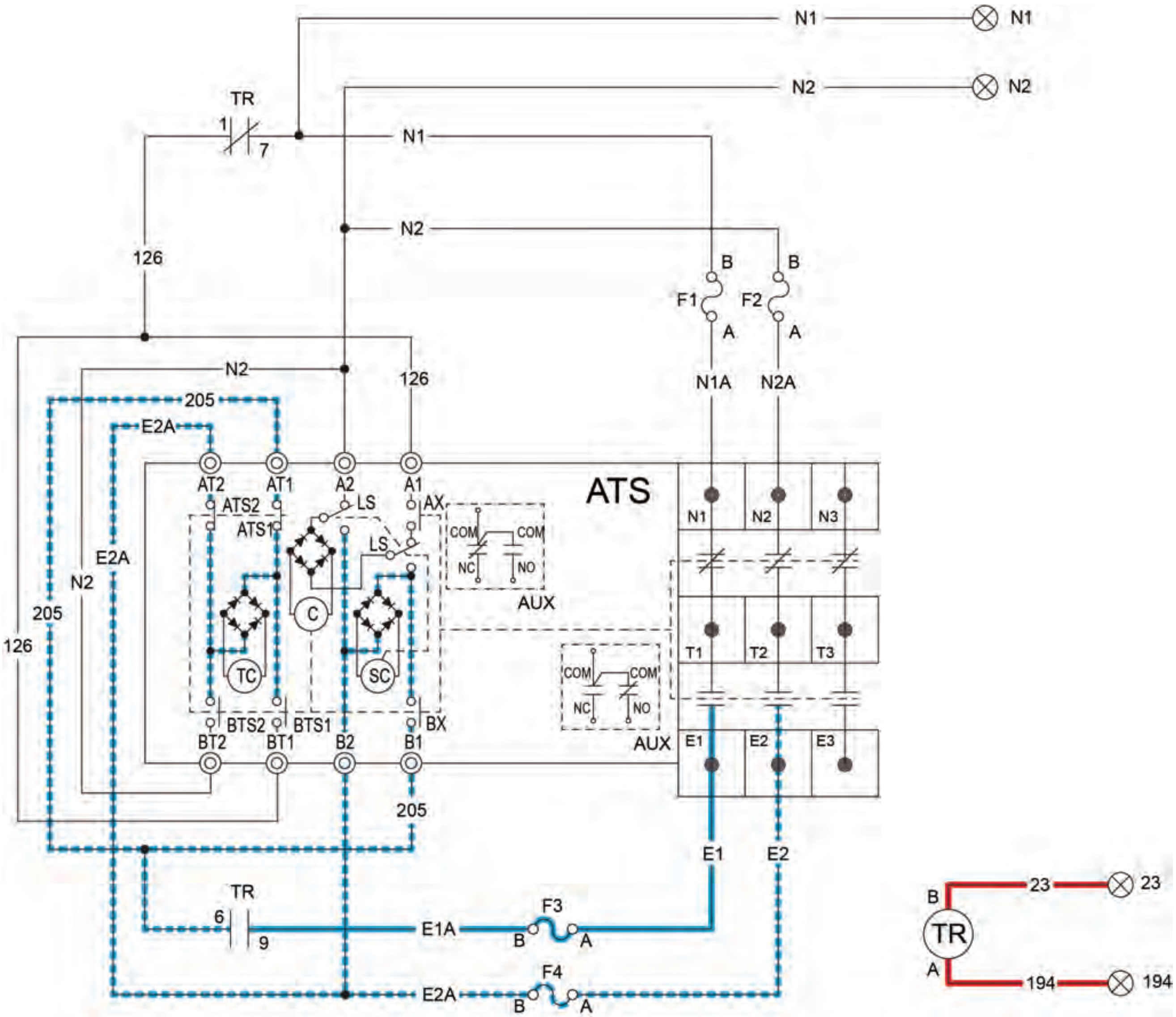
DC VOLTAGE
(PCB) GROUND CONTROL
E1 AND E3 GENERATOR VOLTAGE
E2 GENERATOR VOLTAGE
N1 AND N3 UTILITY VOLTAGE
N2 UTILITY VOLTAGE

REV A
UTILITY VOLTAGE AVAILABLE
SCHEMATIC DIAGRAM
208-240 600-800 AMP RTS-WN
0J0912

011180

Figure 1-62. Utility Voltage Available

Utility Failure Generator Running



Limit Switch Positions			
	"Utility"	"Standby"	"Neutral"
ATS1	Closed	Open	Open
ATS2	Closed	Open	Open
BTS1	Open	Closed	Open
BTS2	Open	Closed	Open
AX	Open	Open	Closed
BX	Open	Open	Closed

REV A

UTILITY FAILURE
GENERATOR RUNNING

SCHEMATIC DIAGRAM
208-240 600-800 AMP RTS-WN
0J0912

LEGEND

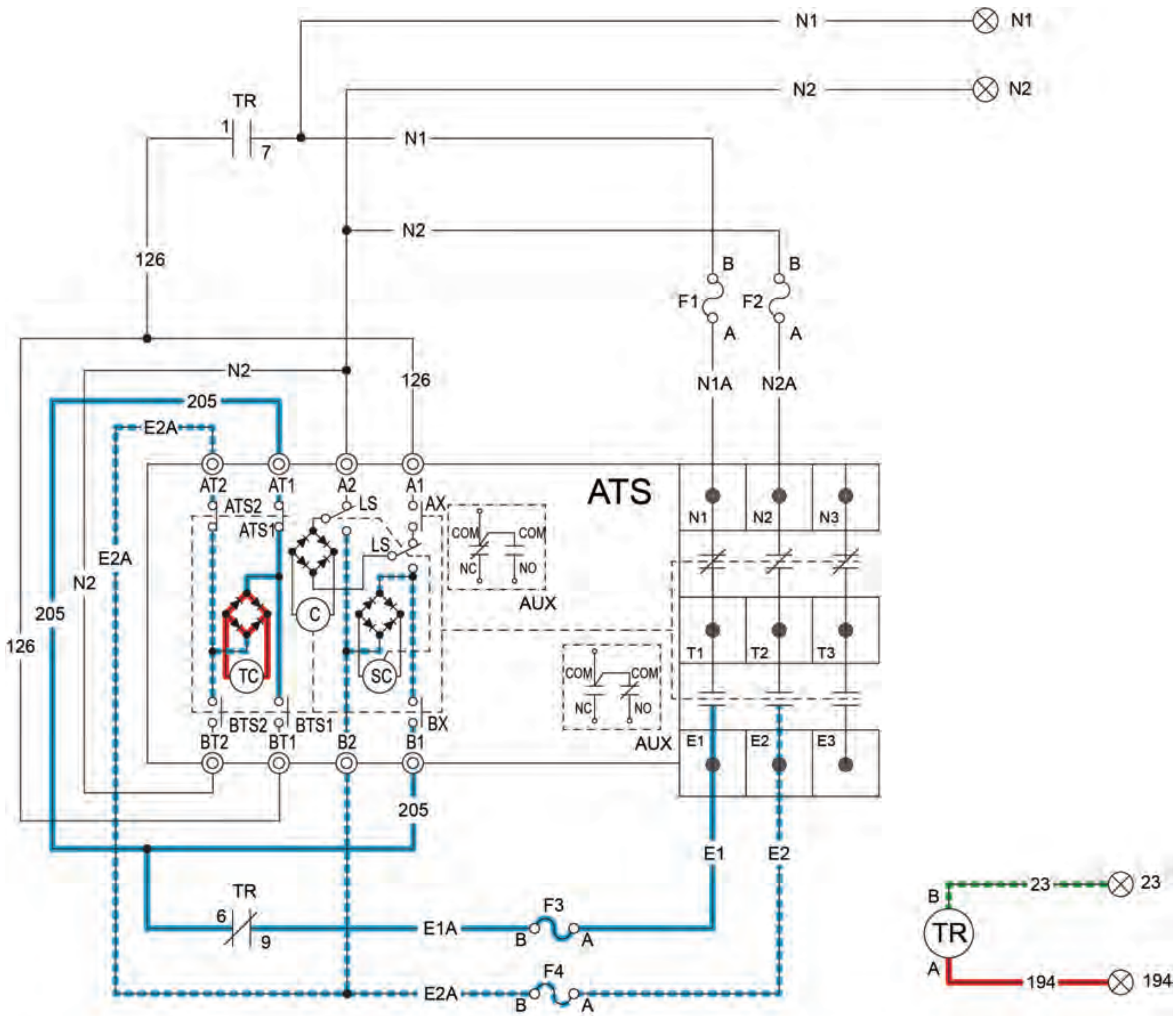
ATS - TRANSFER SWITCH CONTACTOR
C - CONTACTOR ACTUATING COIL
TR - RELAY, TRANSFER
SC - COIL, SELECTIVE
TC - COIL, TRIP
TS - TERMINAL STRIP (CUSTOMER CONNECTION)
F1,F2 - FUSE 5A SENSING & SWITCH OPERATION
F3,F4 - FUSE 5A SWITCH OPERATION

DC VOLTAGE
(PCB) GROUND CONTROL
E1 AND E3 GENERATOR VOLTAGE
E2 GENERATOR VOLTAGE
N1 AND N3 UTILITY VOLTAGE
N2 UTILITY VOLTAGE

011181

Figure 1-63. Utility Failure Generator Running

Tripping From Utility



Limit Switch Positions			
	"Utility"	"Standby"	"Neutral"
ATS1	Closed	Open	Open
ATS2	Closed	Open	Open
BTS1	Open	Closed	Open
BTS2	Open	Closed	Open
AX	Open	Open	Closed
BX	Open	Open	Closed

LEGEND

ATS - TRANSFER SWITCH CONTACTOR
C - CONTACTOR ACTUATING COIL
TR - RELAY, TRANSFER
SC - COIL, SELECTIVE
TC - COIL, TRIP
TS - TERMINAL STRIP (CUSTOMER CONNECTION)
F1,F2 - FUSE 5A SENSING & SWITCH OPERATION
F3,F4 - FUSE 5A SWITCH OPERATION

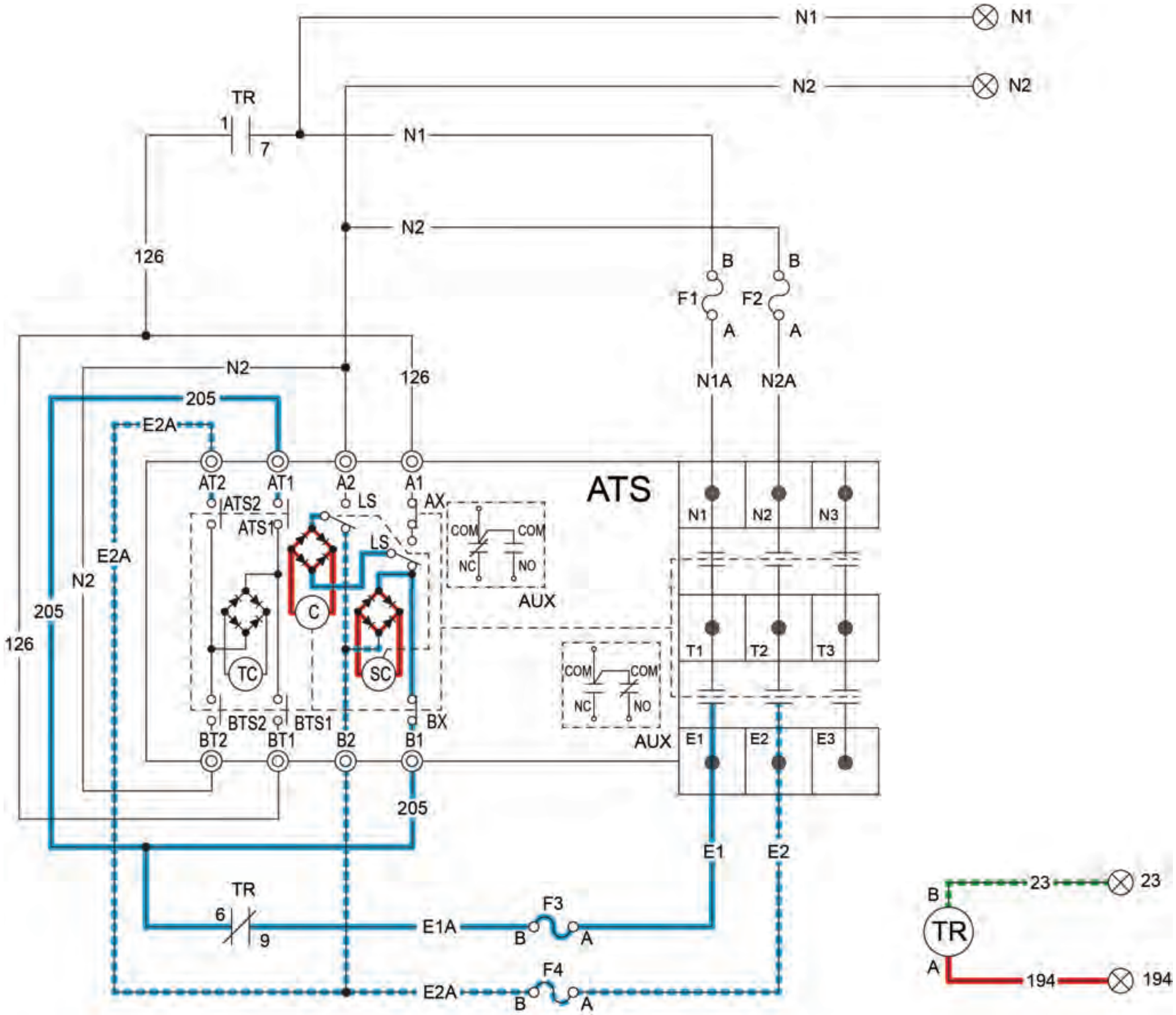
DC VOLTAGE
(PCB) GROUND CONTROL
E1 AND E3 GENERATOR VOLTAGE
E2 GENERATOR VOLTAGE
N1 AND N3 UTILITY VOLTAGE
N2 UTILITY VOLTAGE

REV A
TRIPPING FROM UTILITY
SCHEMATIC DIAGRAM
208-240 600-800 AMP RTS-WN
0J0912

011182

Figure 1-64. Tripping From Utility

Transferring to Standby



Limit Switch Positions			
	"Utility"	"Standby"	"Neutral"
ATS1	Closed	Open	Open
ATS2	Closed	Open	Open
BTS1	Open	Closed	Open
BTS2	Open	Closed	Open
AX	Open	Open	Closed
BX	Open	Open	Closed

REV A

TRANSFERRING TO STANDBY

SCHEMATIC DIAGRAM
208-240 600-800 AMP RTS-WN
0J0912

LEGEND

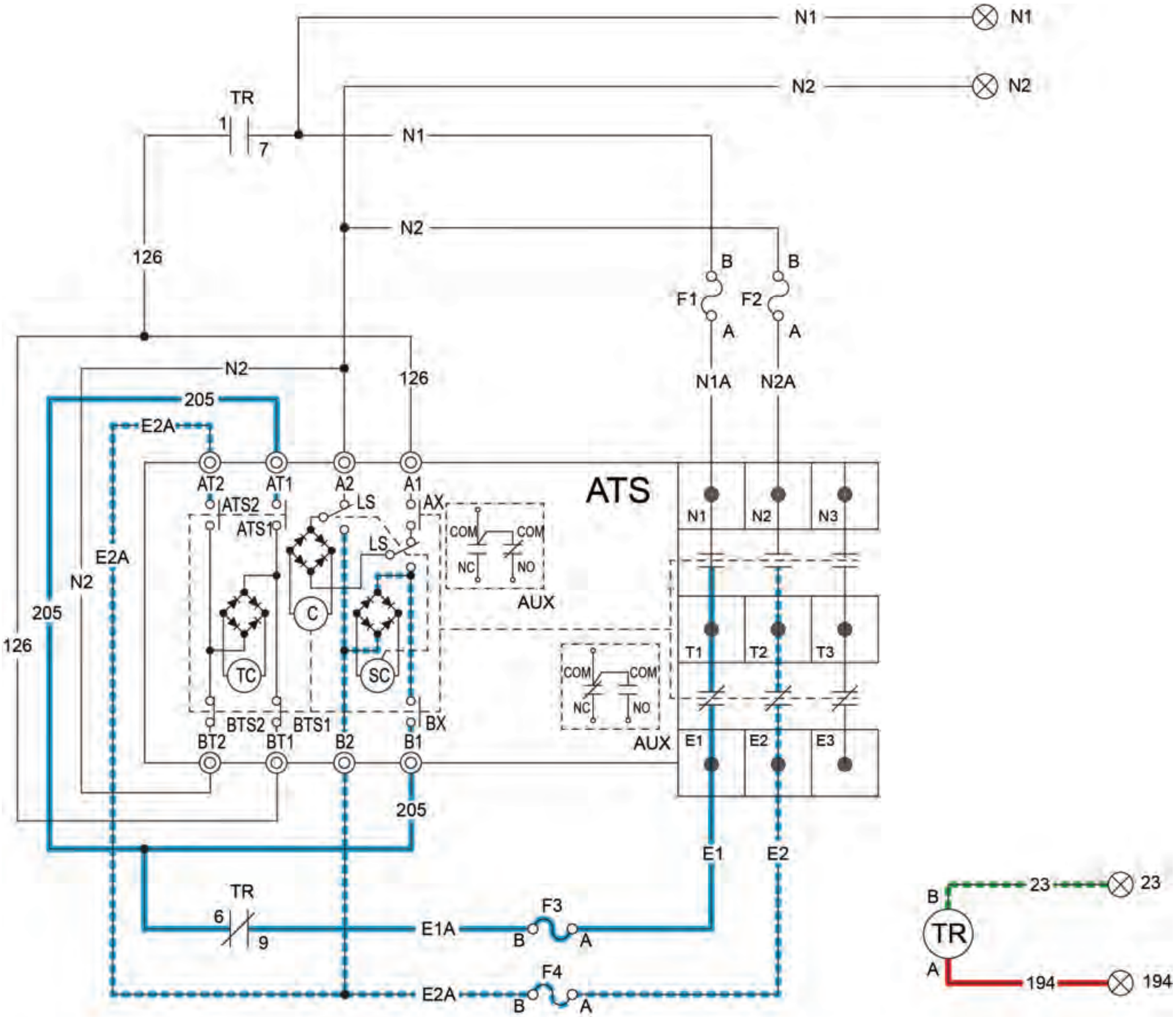
ATS - TRANSFER SWITCH CONTACTOR
C - CONTACTOR ACTUATING COIL
TR - RELAY, TRANSFER
SC - COIL, SELECTIVE
TC - COIL, TRIP
TS - TERMINAL STRIP (CUSTOMER CONNECTION)
F1,F2 - FUSE 5A SENSING & SWITCH OPERATION
F3,F4 - FUSE 5A SWITCH OPERATION

DC VOLTAGE
(PCB) GROUND CONTROL
E1 AND E3 GENERATOR VOLTAGE
E2 GENERATOR VOLTAGE
N1 AND N3 UTILITY VOLTAGE
N2 UTILITY VOLTAGE

011183

Figure 1-65. Transferring to Standby

Transferred to Standby



Limit Switch Positions			
	"Utility"	"Standby"	"Neutral"
ATS1	Closed	Open	Open
ATS2	Closed	Open	Open
BTS1	Open	Closed	Open
BTS2	Open	Closed	Open
AX	Open	Open	Closed
BX	Open	Open	Closed

REV A

TRANSFERRED TO STANDBY
SCHEMATIC DIAGRAM
208-240 600-800 AMP RTS-WN
0J0912

LEGEND

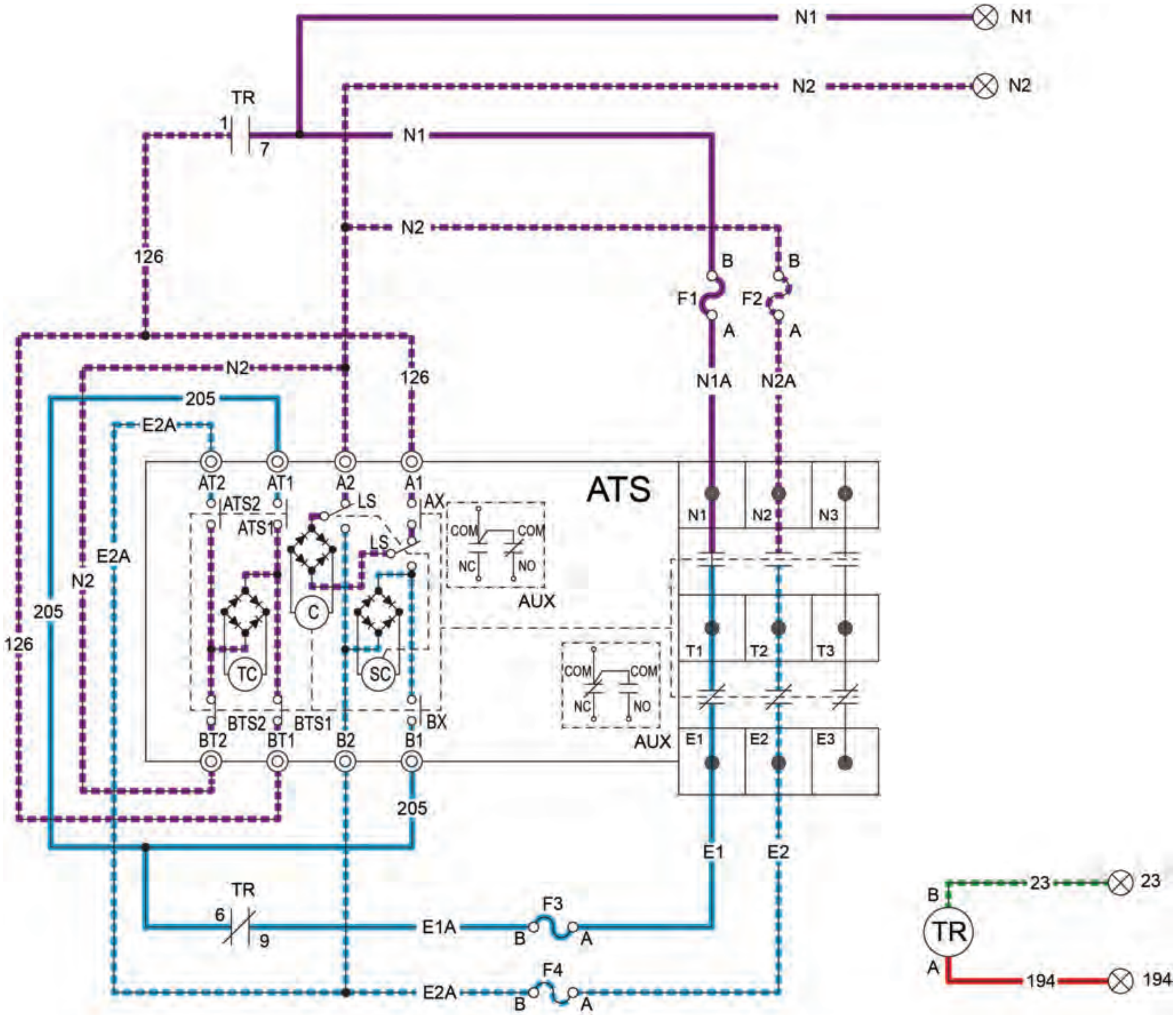
ATS - TRANSFER SWITCH CONTACTOR
C - CONTACTOR ACTUATING COIL
TR - RELAY, TRANSFER
SC - COIL, SELECTIVE
TC - COIL, TRIP
TS - TERMINAL STRIP (CUSTOMER CONNECTION)
F1,F2 - FUSE 5A SENSING & SWITCH OPERATION
F3,F4 - FUSE 5A SWITCH OPERATION

DC VOLTAGE
(PCB) GROUND CONTROL
E1 AND E3 GENERATOR VOLTAGE
E2 GENERATOR VOLTAGE
N1 AND N3 UTILITY VOLTAGE
N2 UTILITY VOLTAGE

011184

Figure 1-66. Transferred to Standby

Return Of Utility



Limit Switch Positions			
	"Utility"	"Standby"	"Neutral"
ATS1	Closed	Open	Open
ATS2	Closed	Open	Open
BTS1	Open	Closed	Open
BTS2	Open	Closed	Open
AX	Open	Open	Closed
BX	Open	Open	Closed

LEGEND

ATS - TRANSFER SWITCH CONTACTOR
C - CONTACTOR ACTUATING COIL
TR - RELAY, TRANSFER
SC - COIL, SELECTIVE
TC - COIL, TRIP
TS - TERMINAL STRIP (CUSTOMER CONNECTION)
F1,F2 - FUSE 5A SENSING & SWITCH OPERATION
F3,F4 - FUSE 5A SWITCH OPERATION

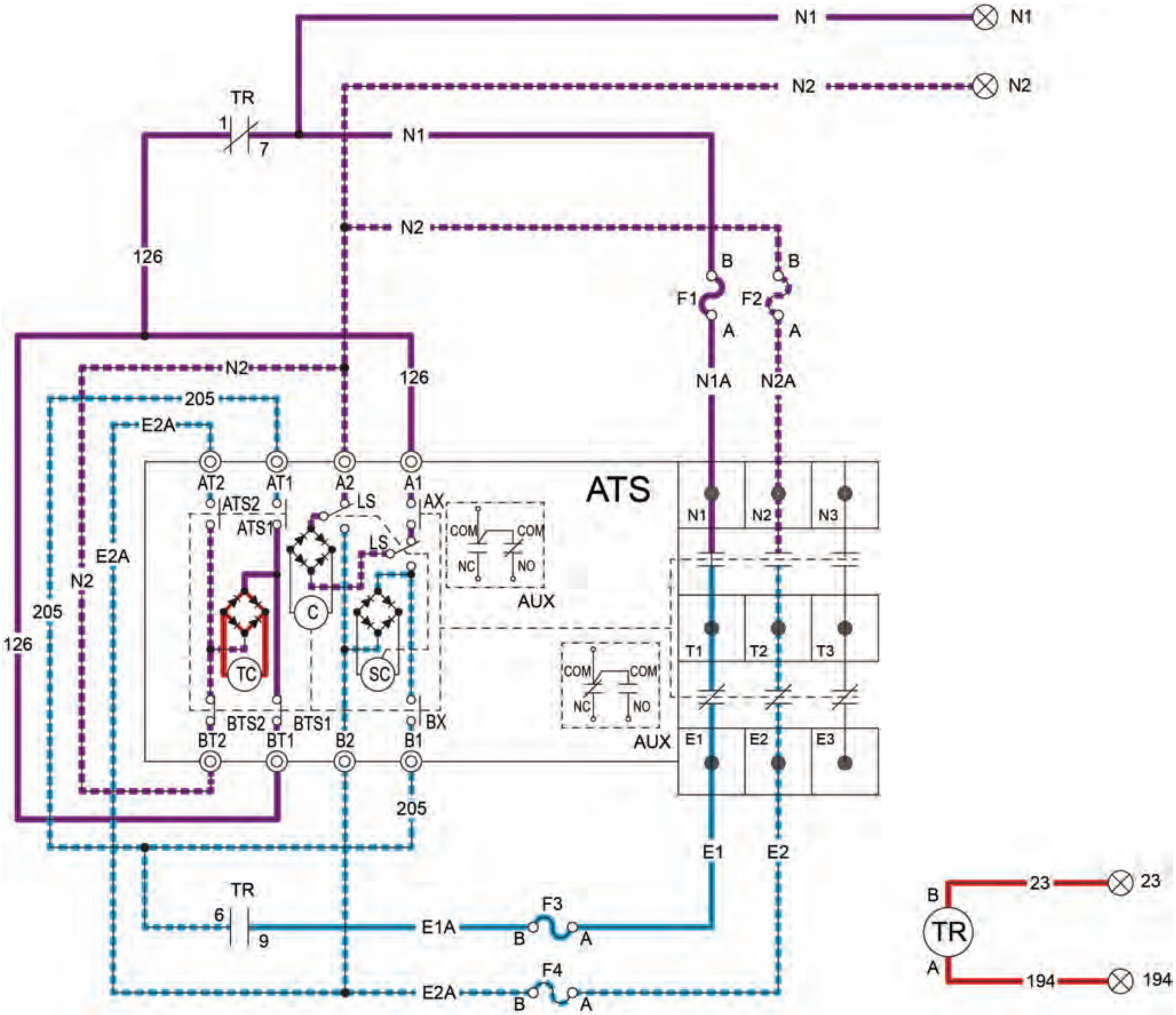
DC VOLTAGE
(PCB) GROUND CONTROL
E1 AND E3 GENERATOR VOLTAGE
E2 GENERATOR VOLTAGE
N1 AND N3 UTILITY VOLTAGE
N2 UTILITY VOLTAGE

REV A
RETURN OF UTILITY
SCHEMATIC DIAGRAM
208-240 600-800 AMP RTS-WN
0J0912

011185

Figure 1-67. Return Of Utility

Tripping From Standby



Limit Switch Positions			
	"Utility"	"Standby"	"Neutral"
ATS1	Closed	Open	Open
ATS2	Closed	Open	Open
BTS1	Open	Closed	Open
BTS2	Open	Closed	Open
AX	Open	Open	Closed
BX	Open	Open	Closed

LEGEND

ATS - TRANSFER SWITCH CONTACTOR
C - CONTACTOR ACTUATING COIL
TR - RELAY, TRANSFER
SC - COIL, SELECTIVE
TC - COIL, TRIP
TS - TERMINAL STRIP (CUSTOMER CONNECTION)
F1,F2 - FUSE 5A SENSING & SWITCH OPERATION
F3,F4 - FUSE 5A SWITCH OPERATION

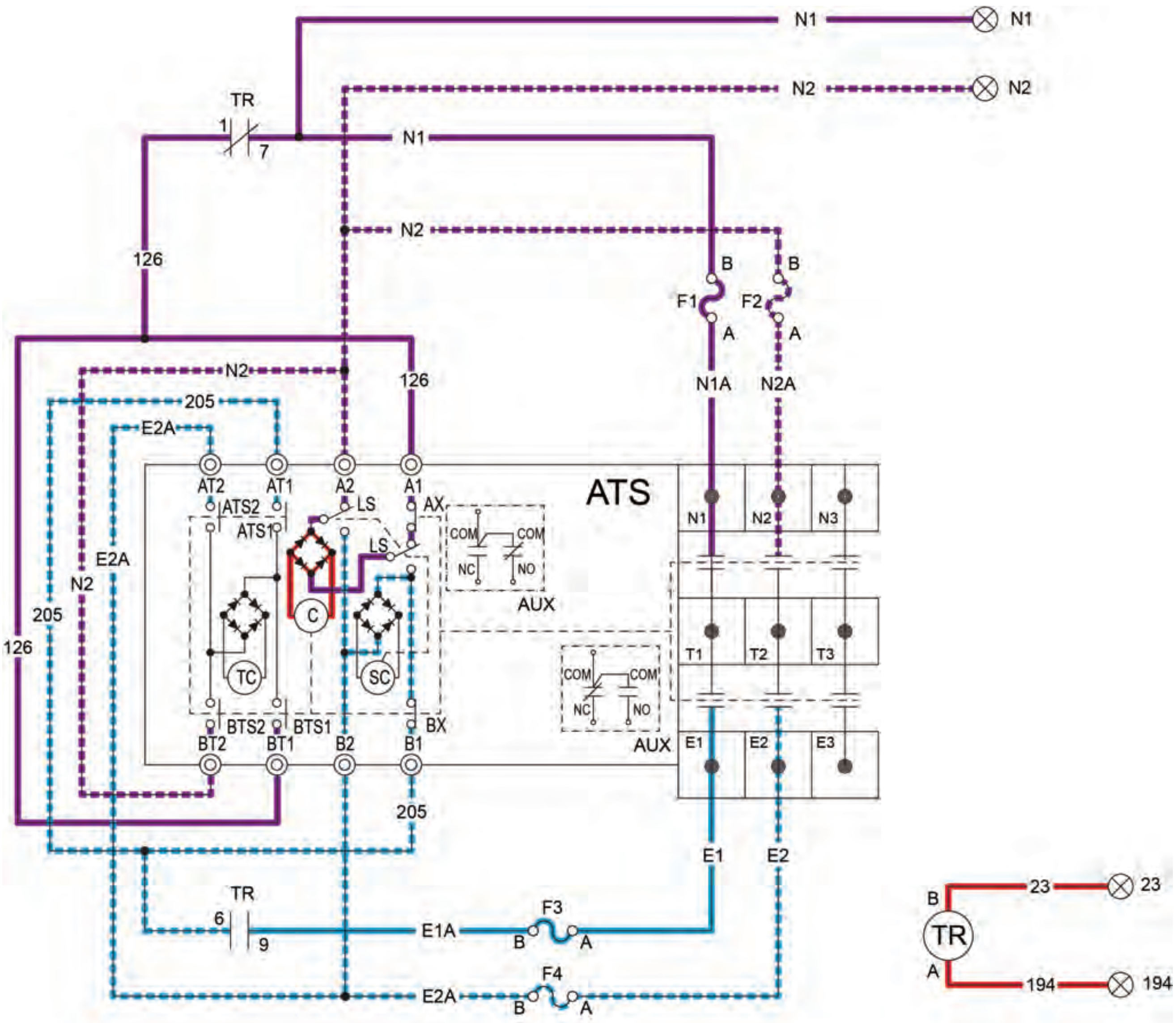
DC VOLTAGE
(PCB) GROUND CONTROL
E1 AND E3 GENERATOR VOLTAGE
E2 GENERATOR VOLTAGE
N1 AND N3 UTILITY VOLTAGE
N2 UTILITY VOLTAGE

REV A
TRIPPING FROM STANDBY
SCHEMATIC DIAGRAM
208-240 600-800 AMP RTS-WN
0J0912

011186

Figure 1-68. Tripping From Standby

Transferring to Utility



Limit Switch Positions			
	"Utility"	"Standby"	"Neutral"
ATS1	Closed	Open	Open
ATS2	Closed	Open	Open
BTS1	Open	Closed	Open
BTS2	Open	Closed	Open
AX	Open	Open	Closed
BX	Open	Open	Closed

LEGEND

ATS - TRANSFER SWITCH CONTACTOR
C - CONTACTOR ACTUATING COIL
TR - RELAY, TRANSFER
SC - COIL, SELECTIVE
TC - COIL, TRIP
TS - TERMINAL STRIP (CUSTOMER CONNECTION)
F1,F2 - FUSE 5A SENSING & SWITCH OPERATION
F3,F4 - FUSE 5A SWITCH OPERATION

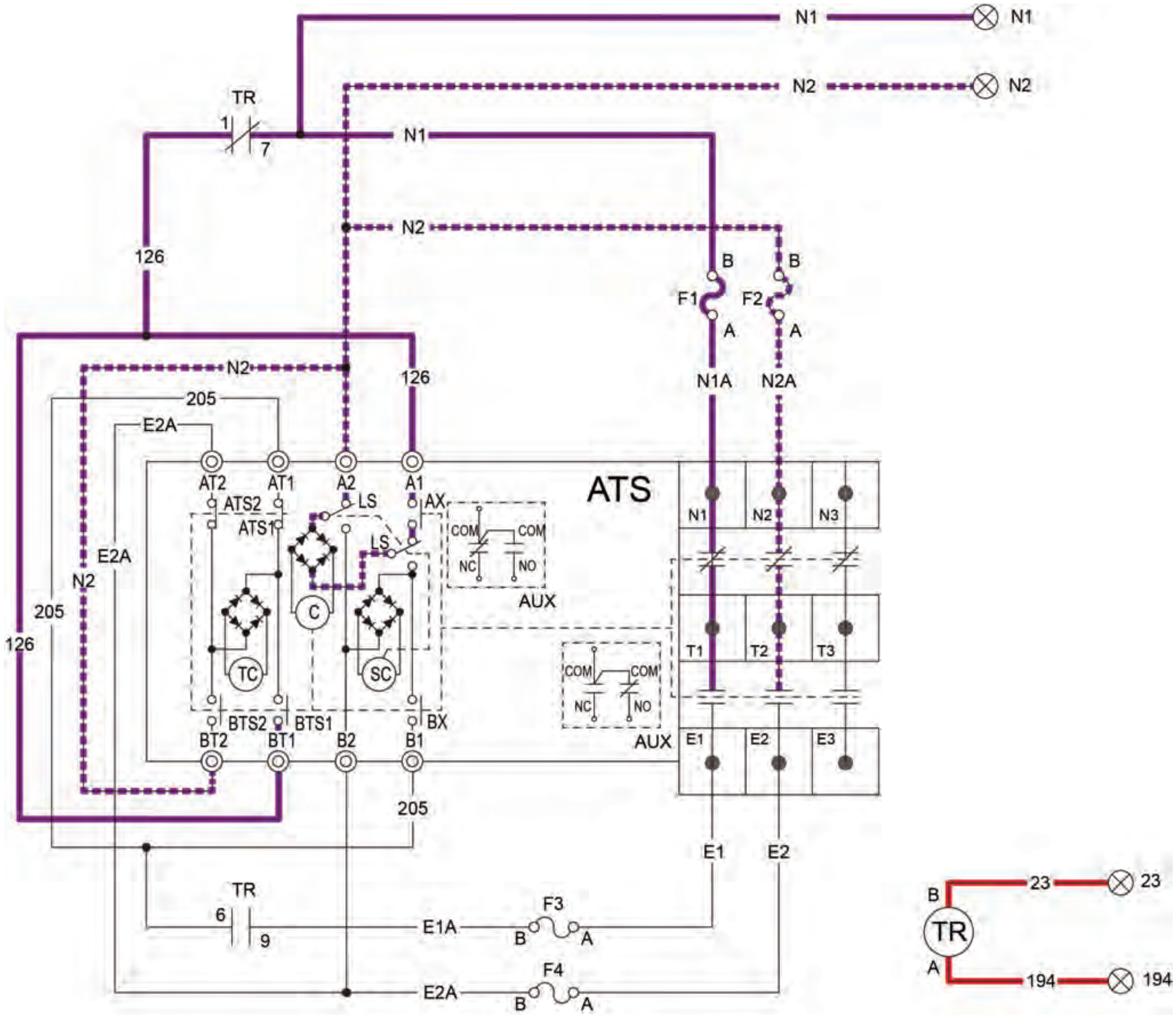
DC VOLTAGE
(PCB) GROUND CONTROL
E1 AND E3 GENERATOR VOLTAGE
E2 GENERATOR VOLTAGE
N1 AND N3 UTILITY VOLTAGE
N2 UTILITY VOLTAGE

REV A
TRANSFERRING TO UTILITY
SCHEMATIC DIAGRAM
208-240 600-800 AMP RTS-WN
0J0912

011187

Figure 1-69. Transferring to Utility

Utility Voltage Available



Limit Switch Positions			
	"Utility"	"Standby"	"Neutral"
ATS1	Closed	Open	Open
ATS2	Closed	Open	Open
BTS1	Open	Closed	Open
BTS2	Open	Closed	Open
AX	Open	Open	Closed
BX	Open	Open	Closed

LEGEND

ATS - TRANSFER SWITCH CONTACTOR
C - CONTACTOR ACTUATING COIL
TR - RELAY, TRANSFER
SC - COIL, SELECTIVE
TC - COIL, TRIP
TS - TERMINAL STRIP (CUSTOMER CONNECTION)
F1,F2 - FUSE 5A SENSING & SWITCH OPERATION
F3,F4 - FUSE 5A SWITCH OPERATION

DC VOLTAGE
(PCB) GROUND CONTROL
E1 AND E3 GENERATOR VOLTAGE
E2 GENERATOR VOLTAGE
N1 AND N3 UTILITY VOLTAGE
N2 UTILITY VOLTAGE

REV A
UTILITY VOLTAGE AVAILABLE
SCHEMATIC DIAGRAM
208-240 600-800 AMP RTS-WN
0J0912

011180

Figure 1-70. Utility Voltage Available

Load Shed Module and Operation OPCB LSM 120 Volt Only

The Load Shed Module is designed to prevent an overload on the generator when it is supplying customer loads. Up to six loads can be managed by the load shed module; 2 air conditioner loads and 4 additional loads. The load shed module manages the loads by "shedding" the connected loads in the event of a drop in generator frequency (overload). Loads to be "shed" are grouped in 4 priority levels on the load shed module.

Priority 1 and 2 each have connections for one air conditioner and one contactor. Both an air conditioner and a contactor can be used at the same time if desired. To control an air conditioner, no additional equipment is required. Internal relays interrupt the thermostat 24 VAC control signal to disable the air conditioner load.

Priority 3 and 4 have connections for one contactor only.

Four LEDs located on the load shed module will indicate when a load priority level is enabled or disabled.

Any load, including a central air conditioner, can be controlled via a contactor that must be purchased separately. Up to four contactors can be controlled by the load shed module.

The LSM (120 volt only) supplies the 120 VAC to energize each contactor coil.

Wire 194 from the HSB controller supplies 12 VDC to the module. Wire 0 provides the ground for the logic side of the module. Wire 23 is monitored by the module to identify when transfer to standby and back to utility has occurred. T1 and Neutral are used to monitor the frequency of the generator for load control.

Test Button

The load shed modules and the OPCB modules have a TEST button which forces the unit to act as if an overload has occurred. This button operates even when the transfer signal is inactive.

Figure 1-71. LSM TEST Button

Load Shed Operation

NOTE: The following sequence is for the LSM 120 volt module ONLY.

The 4 green status LEDs will indicate when a load priority level is enabled or disabled.

All loads are enabled when the transfer signal is off. (ATS in Utility position).

If the transfer signal is pulled low (Active) all loads are enabled until an overload is detected.

When an overload is detected all loads are disabled.

A generator overload condition is determined by generator frequency. Loads are shed when the frequency is <58 Hz for 3 seconds or <50 Hz for ½ Second (For 60Hz).

- Priority 1 loads are enabled after 5 minutes.
- Priority 2 loads are enabled after 30 seconds.
- Priority 3 load is enabled after another 30 seconds.
- Priority 4 load is enabled after another 30 seconds.

If an overload is detected within 30 seconds of a level being enabled, all loads are disabled again and the sequence repeats. However, the level that caused the overload and all levels higher will not be enabled again for 30 minutes. This process of testing will continue every 30 minutes. The faulting priority and all other higher levels will remain locked out until the overload for that priority is lowered, or system is returned to utility, or reset button is pressed.

Figure 1-72 **through** *Figure 1-81* follow the sequence of operation when an overload condition occurs on Priority Circuit 3. After a 30 minute timer expires, Priority 3 is activated. If the frequency is still OK, Priority 4 is enabled after another 30 second timer expires.

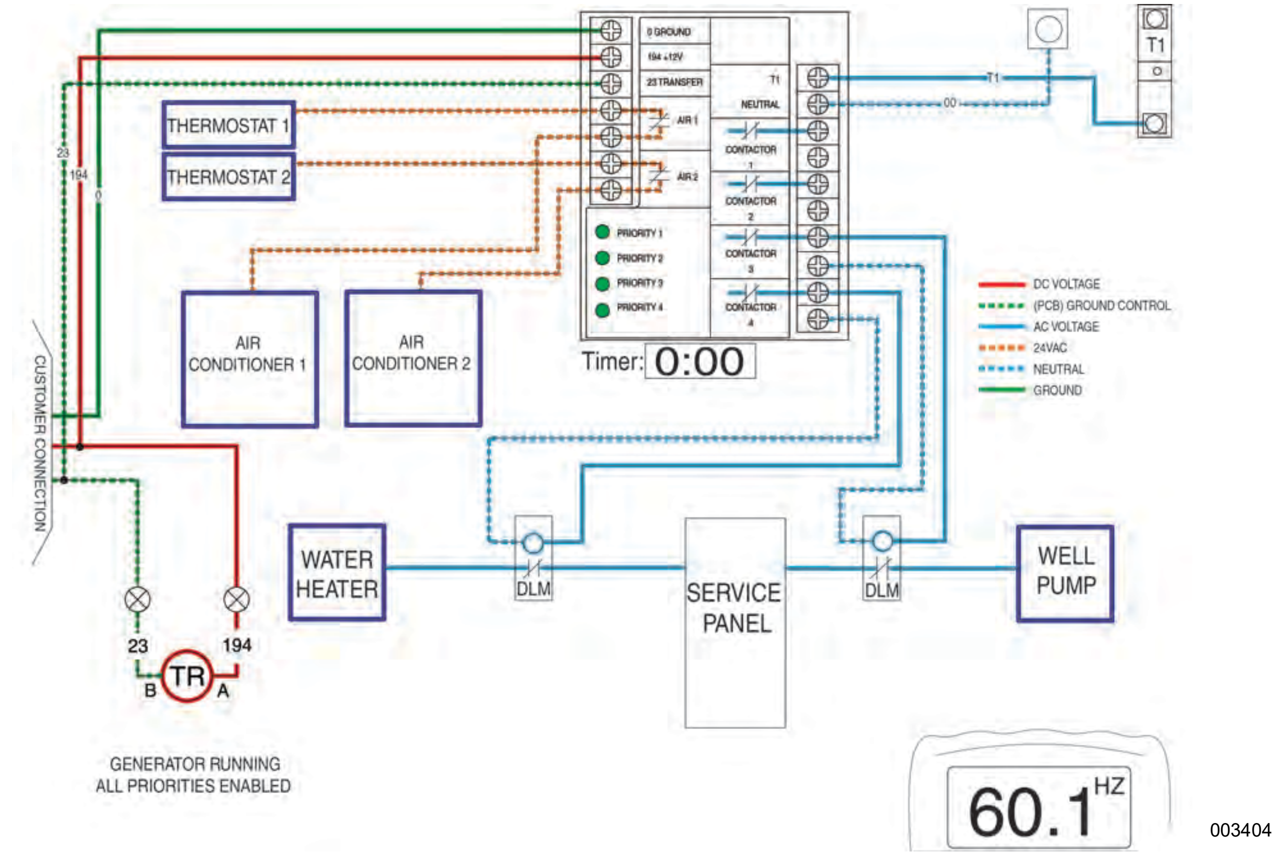


Figure 1-72. Generator Running All Priorities Enabled

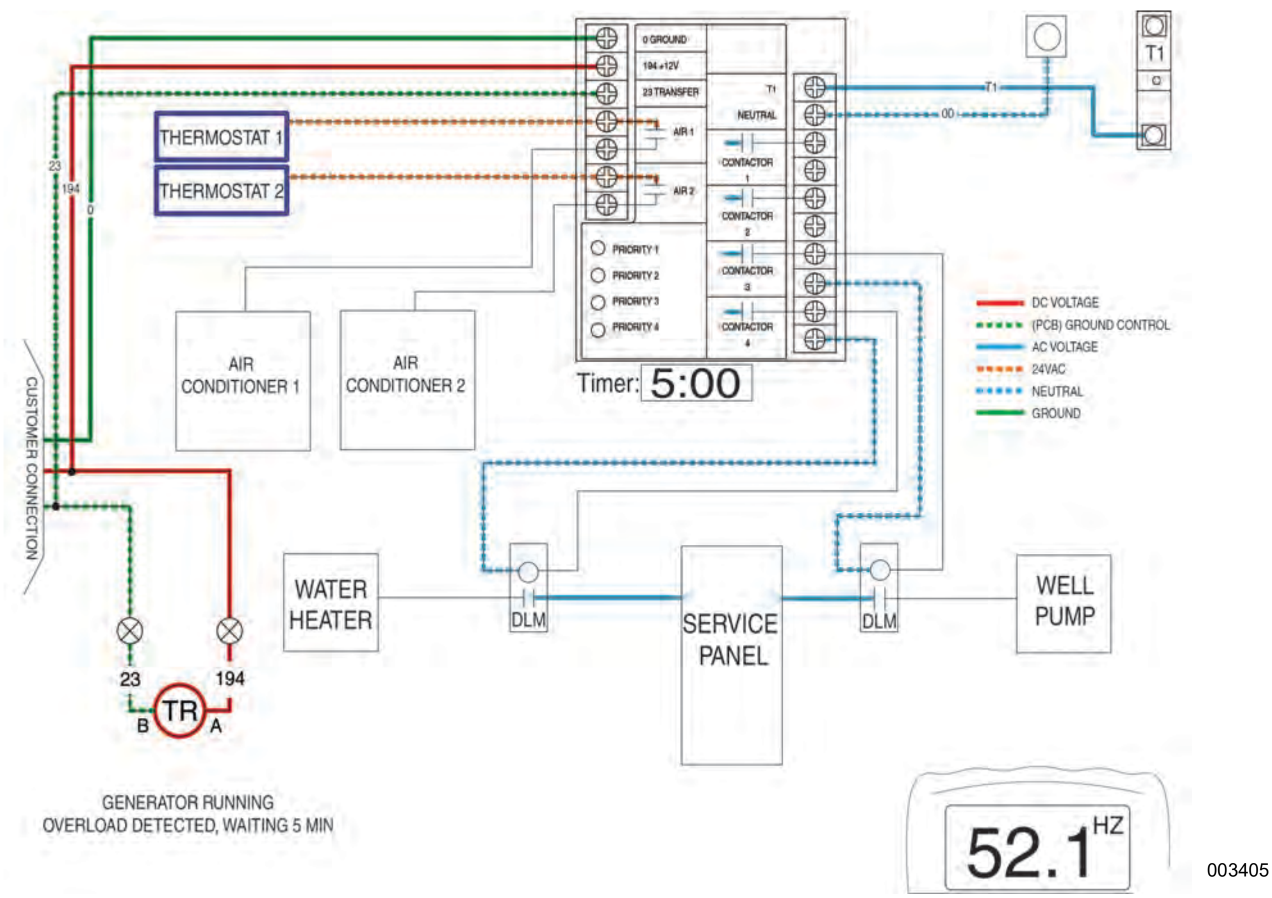


Figure 1-73. Generator Running Overload Detected, Waiting 5 Minutes

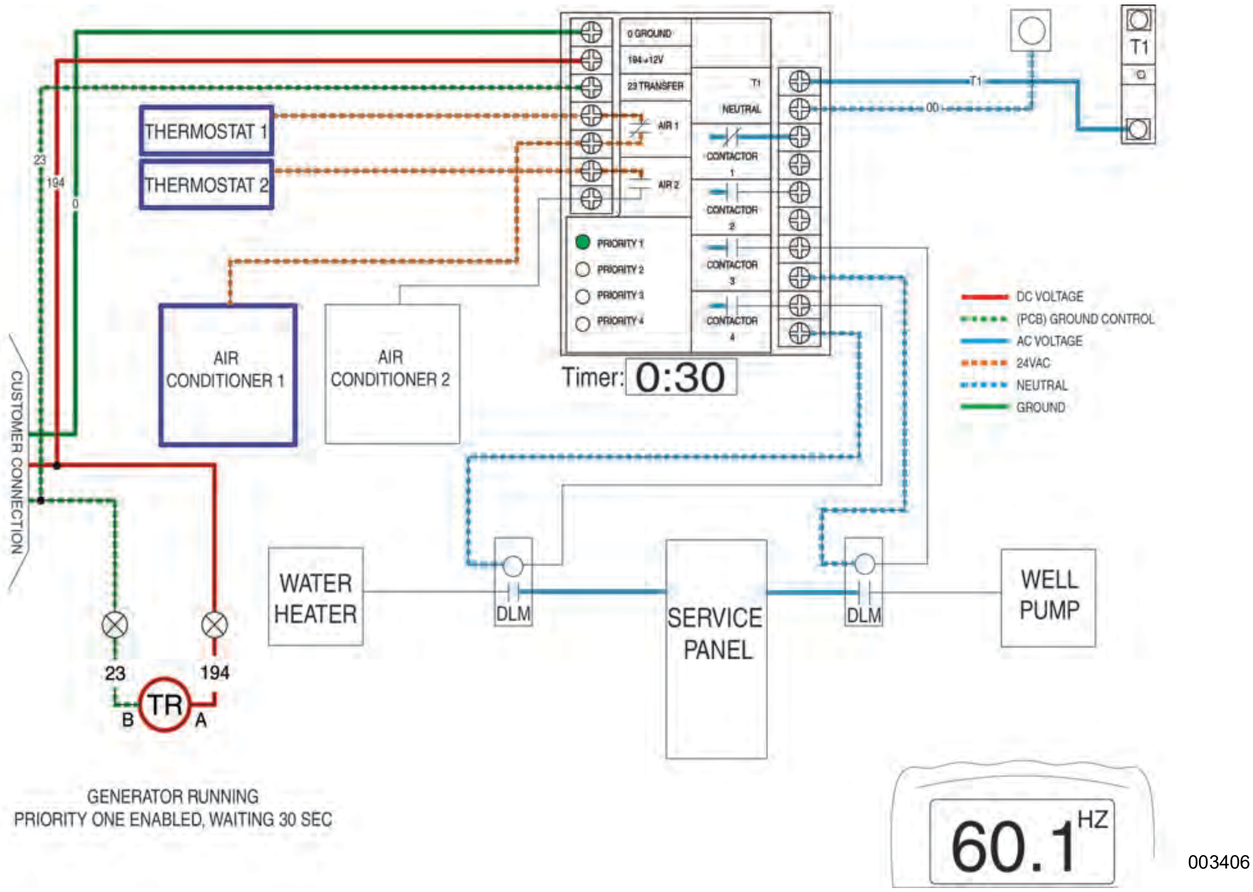


Figure 1-74. LSM 120 Volt Generator Running Priority One Enabled, Waiting 30 Seconds

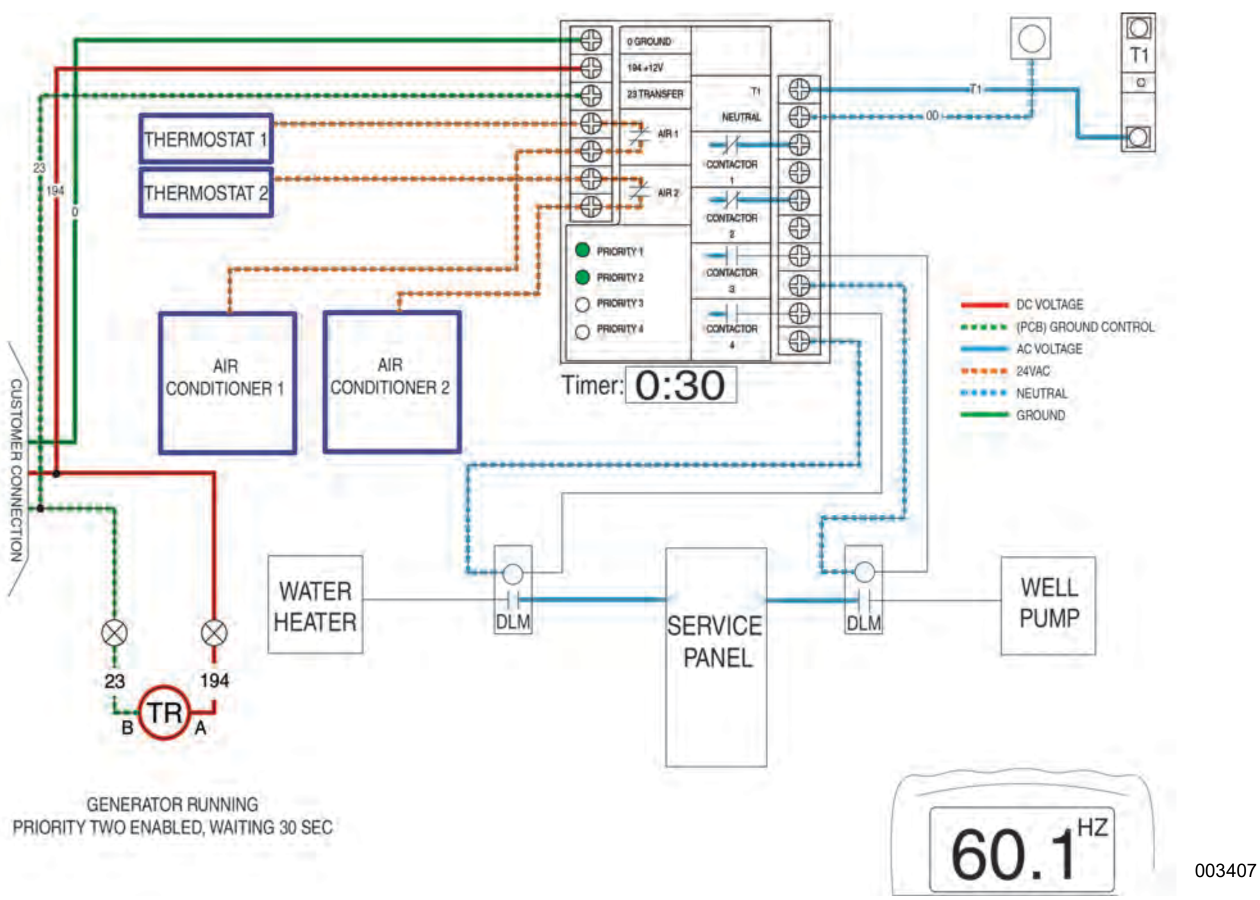


Figure 1-75. LSM 120 Volt Generator Running Priority Two Enabled, Waiting 30 Seconds

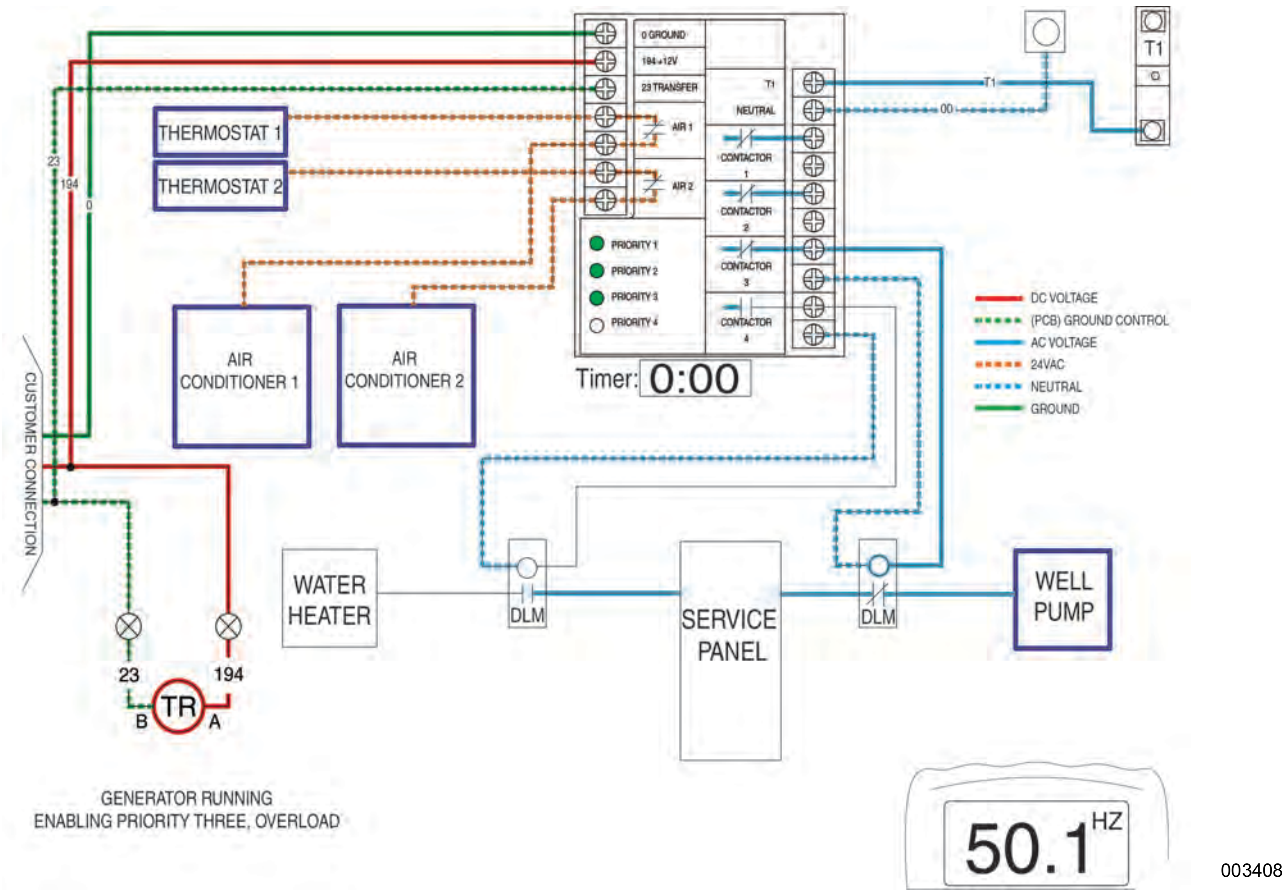


Figure 1-76. LSM 120 Volt Generator Running Enabling Priority Three, Overload

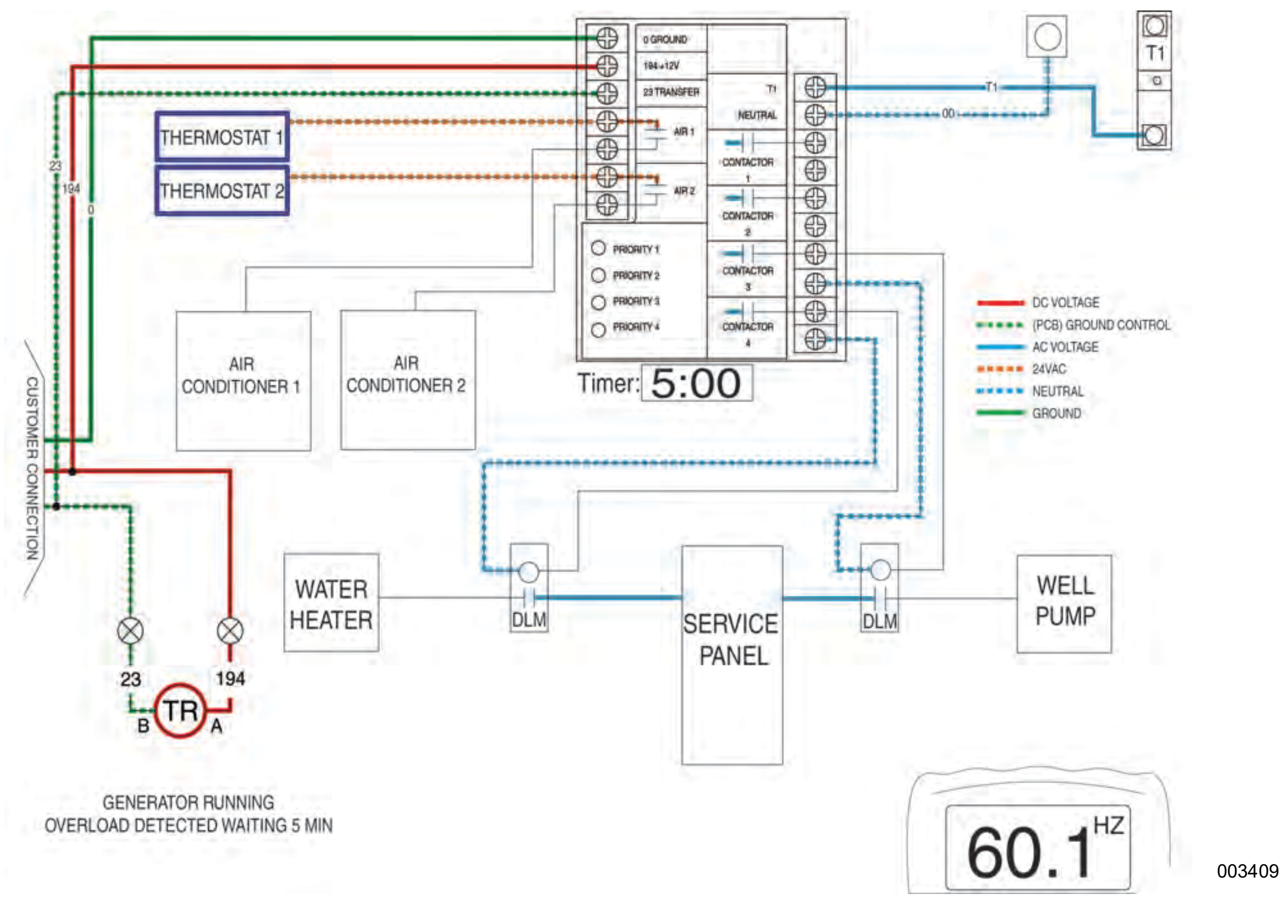


Figure 1-77. LSM 120 Volt Generator Running Overload Detected Waiting 5 Minutes

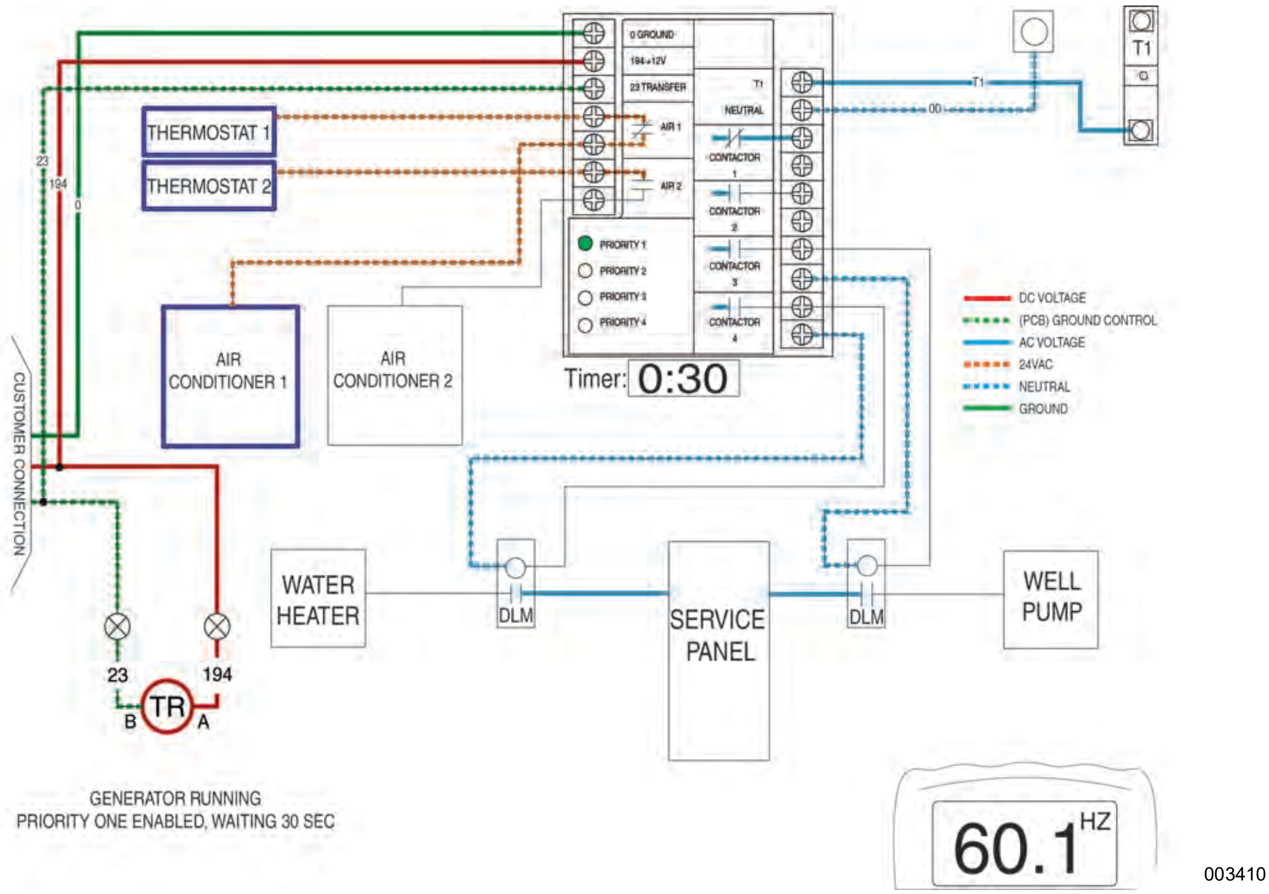


Figure 1-78. LSM 120 Volt Generator Running Priority One Enabled, Waiting 30 Seconds

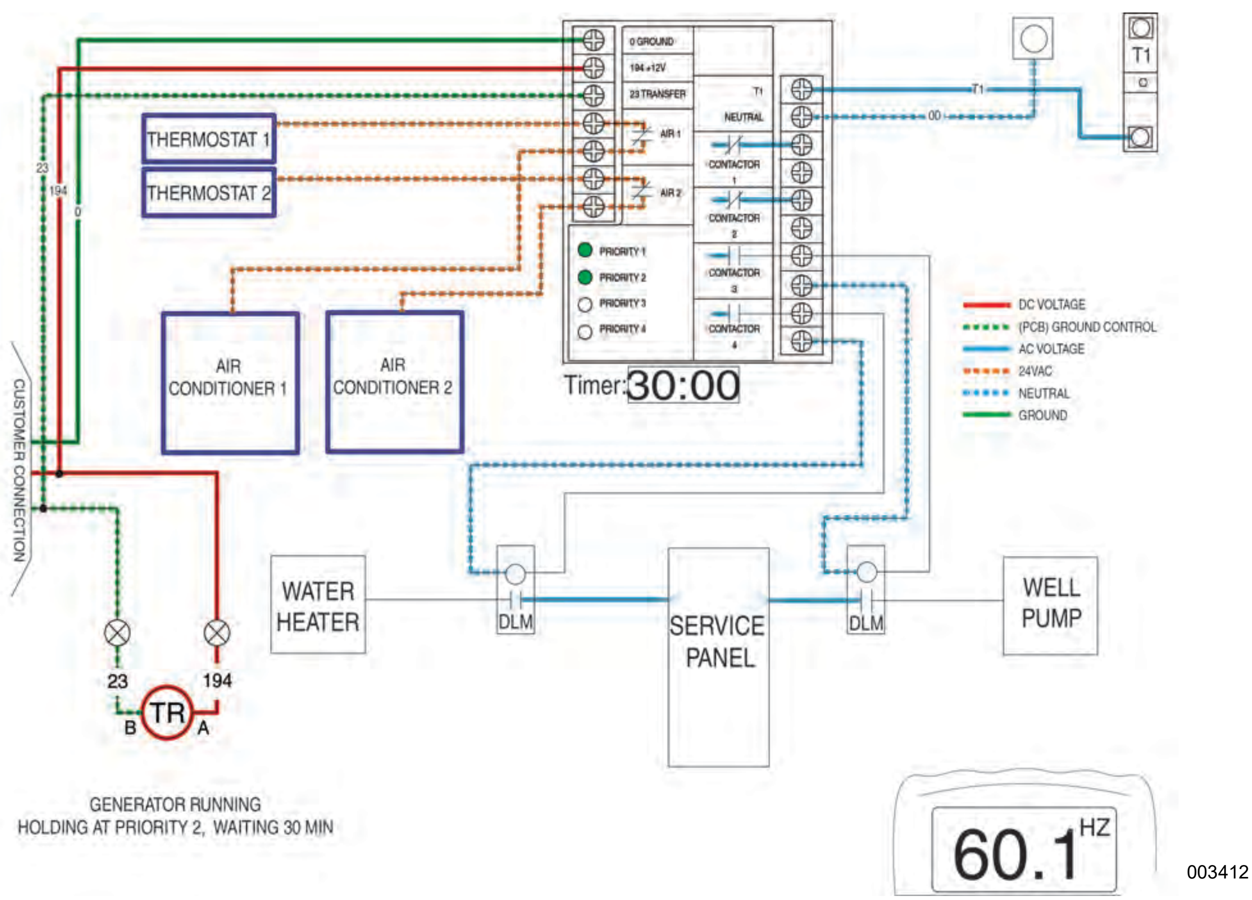
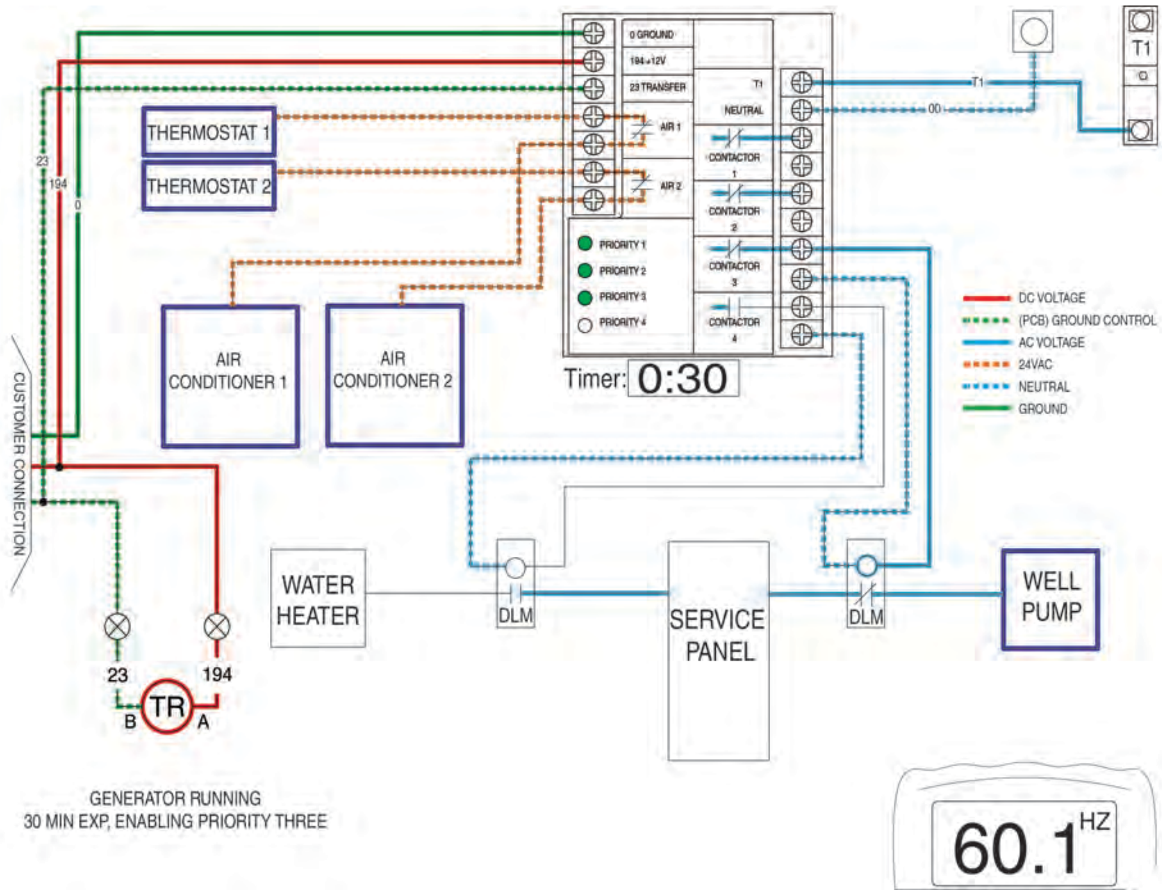
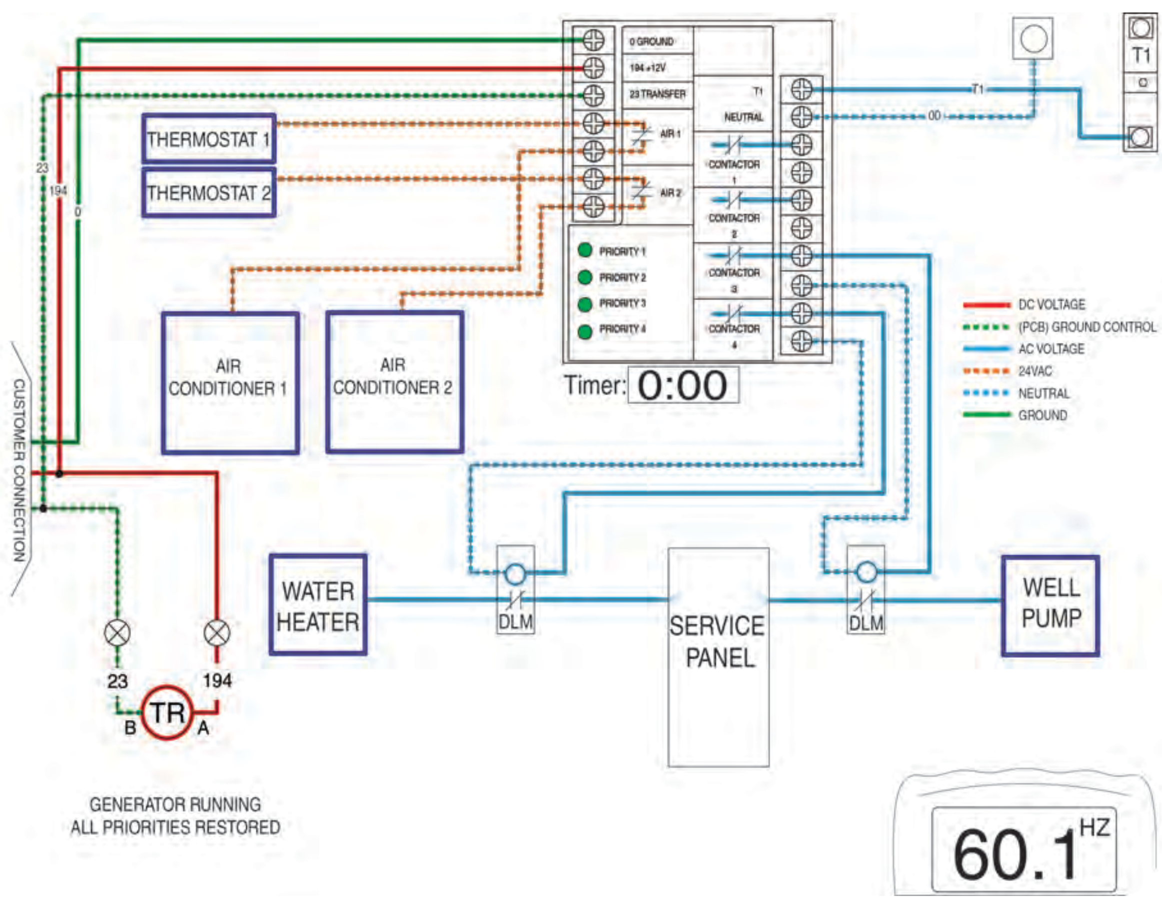


Figure 1-79. LSM 120 Volt Generator Running Holding At Priority 2, Waiting 30 Minutes



003413

Figure 1-80. LSM 120 Volt Generator Running 30 Min Exp, Enabling Priority Three



003414

Figure 1-81. LSM 120 Volt Generator Running All Priorities Restored

Load Shed Module Operation OPCB 24/120 Volt Module

The Overload Prevention Control Board (OPCB) can control an air conditioner (24 VAC) directly or a separate contactor (24 VAC or 120 VAC operating coil) which can control any load connected to it.

The OPCB load contacts can be powered from either a 24 VAC or 120 VAC power supply. The 24 VAC supply is from a Class 2 transformer which can be purchased from the manufacturer.

Wire 194 from the HSB controller supplies 12 VDC to the module. Wire 0 provides the ground for the logic side of the module. Wire 23 is monitored by the module to identify when transfer to standby and back to utility has occurred.T1 and Neutral are used to monitor the frequency of the generator for load control.

NOTE: When utilizing the optional 24 VAC configuration, the power supply transformer (Class 2) must have connections to the LOAD and NEUTRAL connection at the OPCB. Limit each output to 1 Amp.

NOTE: 120 volt contactors cannot be used in conjunction with 24 volt contactors. The OPCB must be wired with one or the other.

A generator overload condition is determined by generator frequency. Loads are shed when the frequency is <58 Hz for 3 seconds or <50 Hz for ½ Second (For 60 Hz).

Smart A/C Module (SACM)

Up to four air conditioner loads can be managed by the Smart A/C Module (SACM). The SACM manages the loads by “shedding” the connected loads in the event of a drop in generator frequency (overload). Loads to be shed are in 4 priority levels on the module.

Priorities A/C 1-4 have connections for an air conditioner. To control an air conditioner, no additional equipment is required. Internal normally closed relays interrupt the 24 VAC thermostat control signal to disable the air conditioner load.

Four LEDs, located on the SACM, illuminate when a load is connected and powered. The SACM has a test button used to simulate an overload condition. This button operates even when the transfer signal is inactive.

A generator overload condition is determined by generator frequency. Loads are shed when the frequency is <58 Hz for 3 seconds or <50 Hz for ½ Second (For 60Hz).

Test Button

The OPCB/SACM load shed module has a TEST button which forces the unit to act as if an overload has occurred. This button operates even when the transfer signal is inactive.

The TEST button will work when the ATS is in the Utility or the Generator position.

1. Turn on the utility supply to the ATS.
2. Press and hold the TEST button on the OPCB for approximately 1 second.
3. Verify that all of the connected loads to be “shed” become disabled. The method of verification will depend on the type of load.
4. After five (5) minutes verify A/C1 (Priority 1) are energized. Status LED AC 1 and Load 1 is ON.
5. After another 15 seconds, verify A/C2 (Priority 2) are energized. Status LED AC 2 and Load 2 are ON.
6. After another 15 seconds, verify A/C3 (Priority 3) is energized. Status Load 3 is ON.
7. After another 15 seconds, verify A/C4 (Priority 4) is energized. Status Load 4 is ON.

Figure 1-1. OPCB TEST Button

Load Shed Operation

NOTE: The following sequence of operation is the same for the SACM and the OPCB 24/120 modules.

The 4 green status LEDs will indicate when a load priority level is enabled or disabled.

All loads are enabled when the transfer signal is off. (ATS in Utility position).

When utility power is interrupted, T1 is de-activated. The module remains powered via Wire 194 (12 VDC) and Wire 0. Wire 23 is not grounded (high, 12 VDC) at this time.

As the generator starts, runs, and transfers, Wire 23 is pulled to ground (low, 0 VDC). Once the transfer switch goes to the standby position, T1 is powered by the generator.

The module senses that the system is on standby and disables all loads. A 5 minute timer is activated.

- A/C1 (Priority 1) load(s) are enabled after 5 minutes.
- A/C2 (Priority 2) load(s) are enabled after 15 seconds.
- A/C3 (Priority 3) load is enabled after another 15 seconds.

- A/C4 (Priority 4) load is enabled after another 15 seconds.

When an overload is detected all loads are disabled.

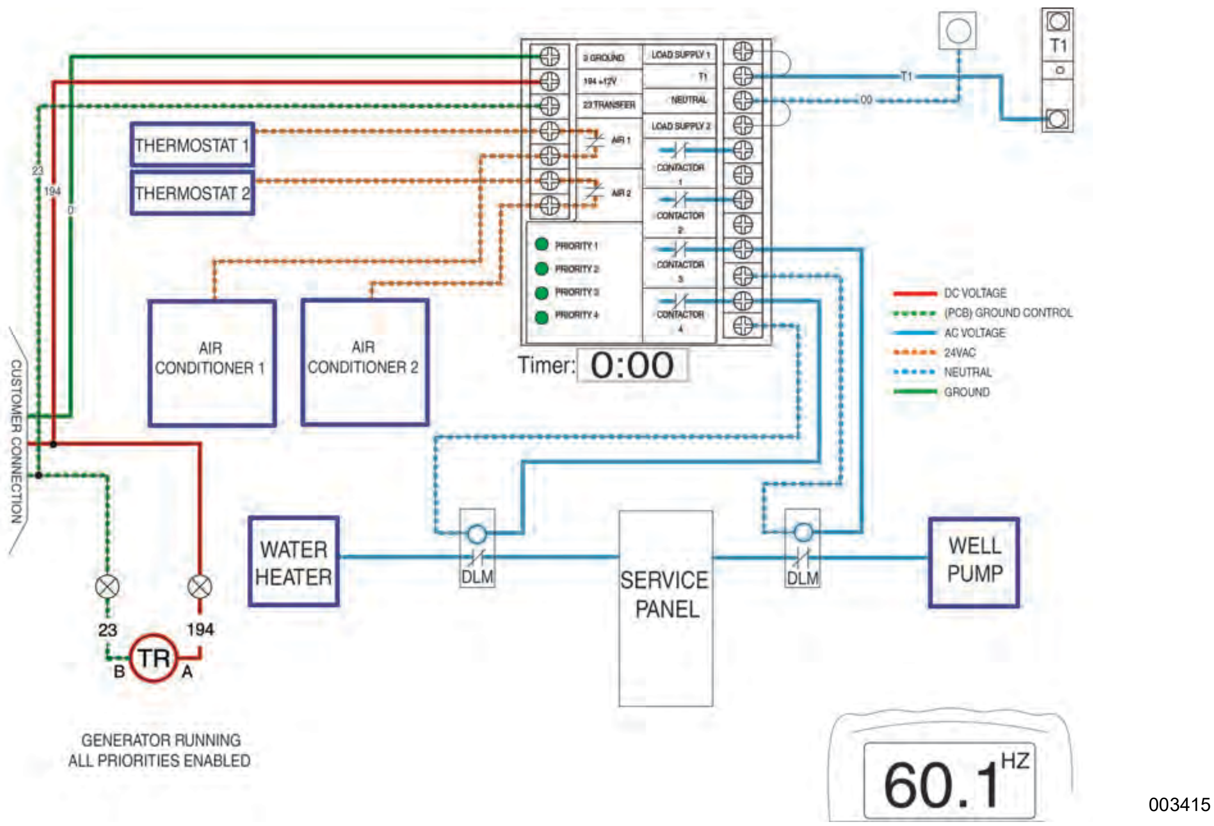
Generator overload condition is determined by generator frequency. Loads are shed when the frequency is <58 Hz for 3 seconds or <50 Hz for ½ second (For 60Hz).

If an overload is detected within 15 seconds of a priority being enabled, that load is then locked out. The sequence will continue until all load levels have been checked (temporarily bypassing the faulting level). The level that caused the overload will not be enabled/tested again for 30 minutes. The OPCB/SACM will attempt to enable the load every 30 minutes. During enabling, if the frequency drops below specifications, the OPCB/SACM will disable again. This will continue until the frequency does not drop when the priority is enabled, the system is returned to utility, or the TEST button is pressed.

When utility voltage returns, Wire 23 is released from ground (back to 12 VDC, high) and the transfer switch returns to the utility position. The OPCB/SACM will disable all loads, time out for 5 minutes and then enable all 4 priorities at the same time.

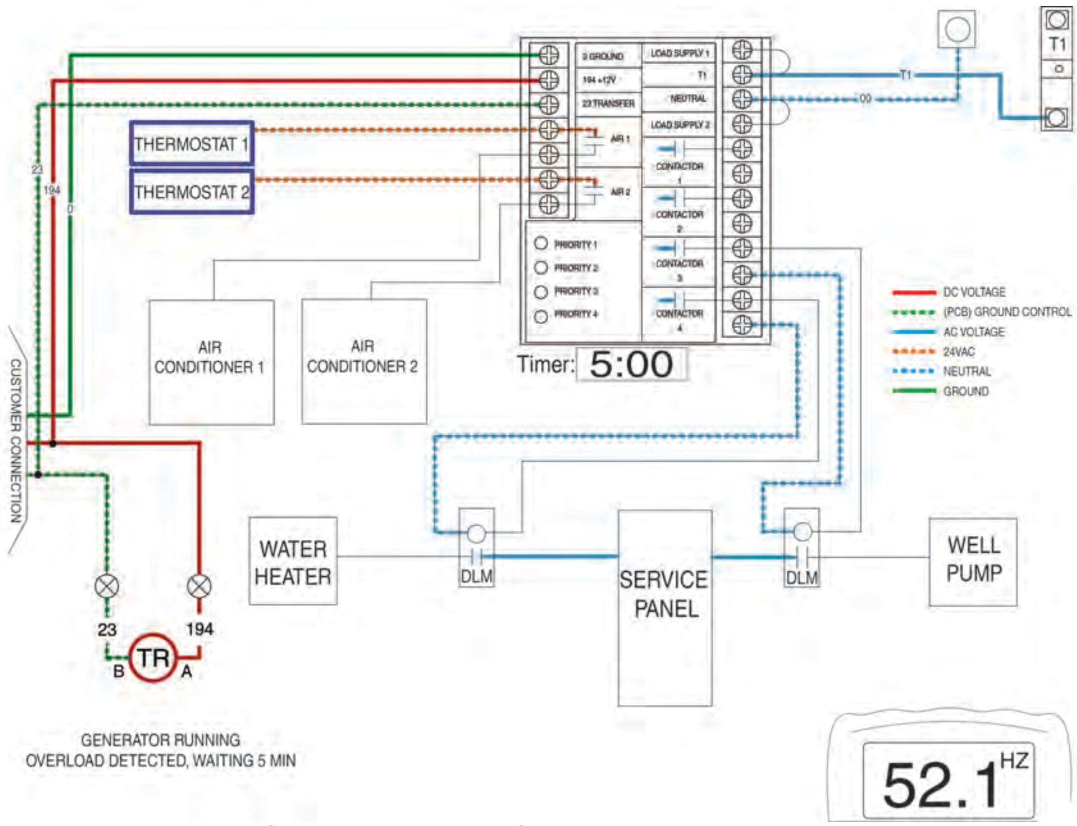
OPCB Module Example

Figure 1-82 **through** ***Figure 1-90*** follow the sequence of operation when an overload condition occurs on example Priority Circuit 3. After a 30 minute timer expires, Priority 3 is activated. If the frequency is still OK then all priorities will remain active.



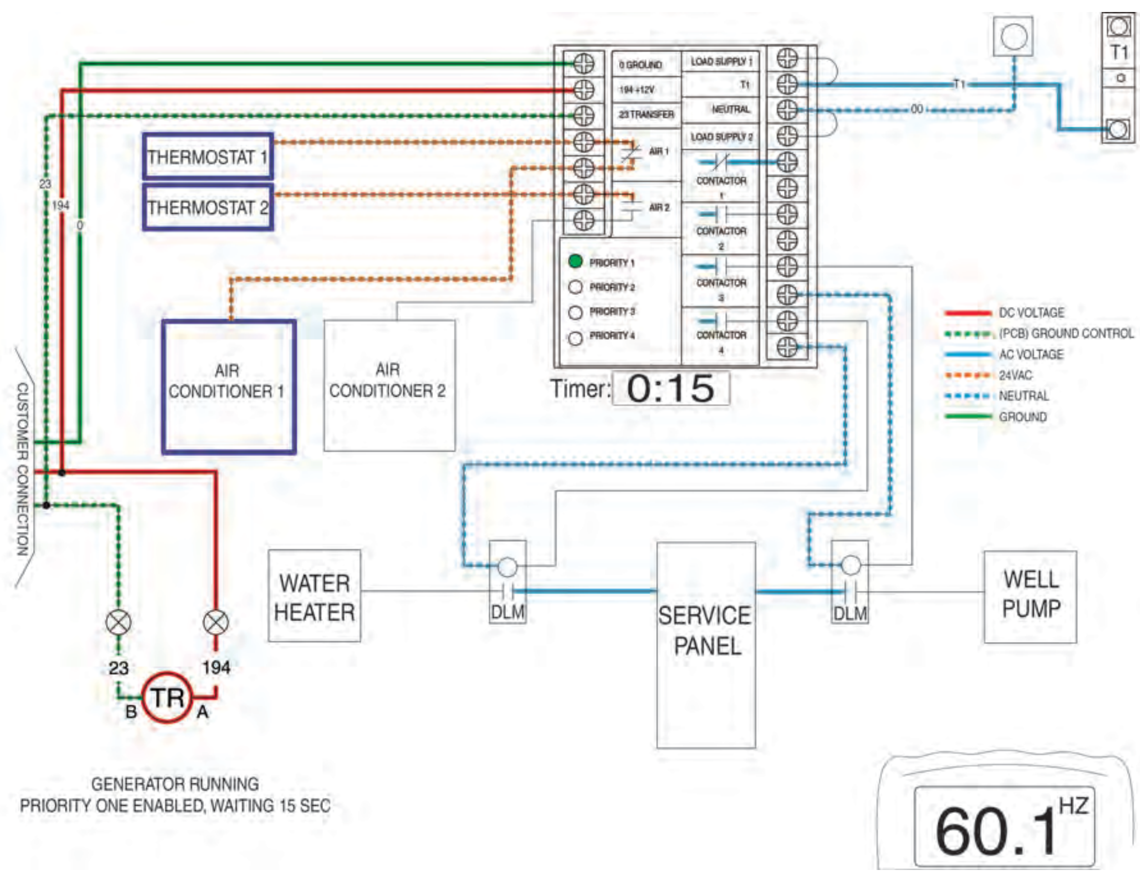
003415

Figure 1-82. Generator Running All Priorities Enabled



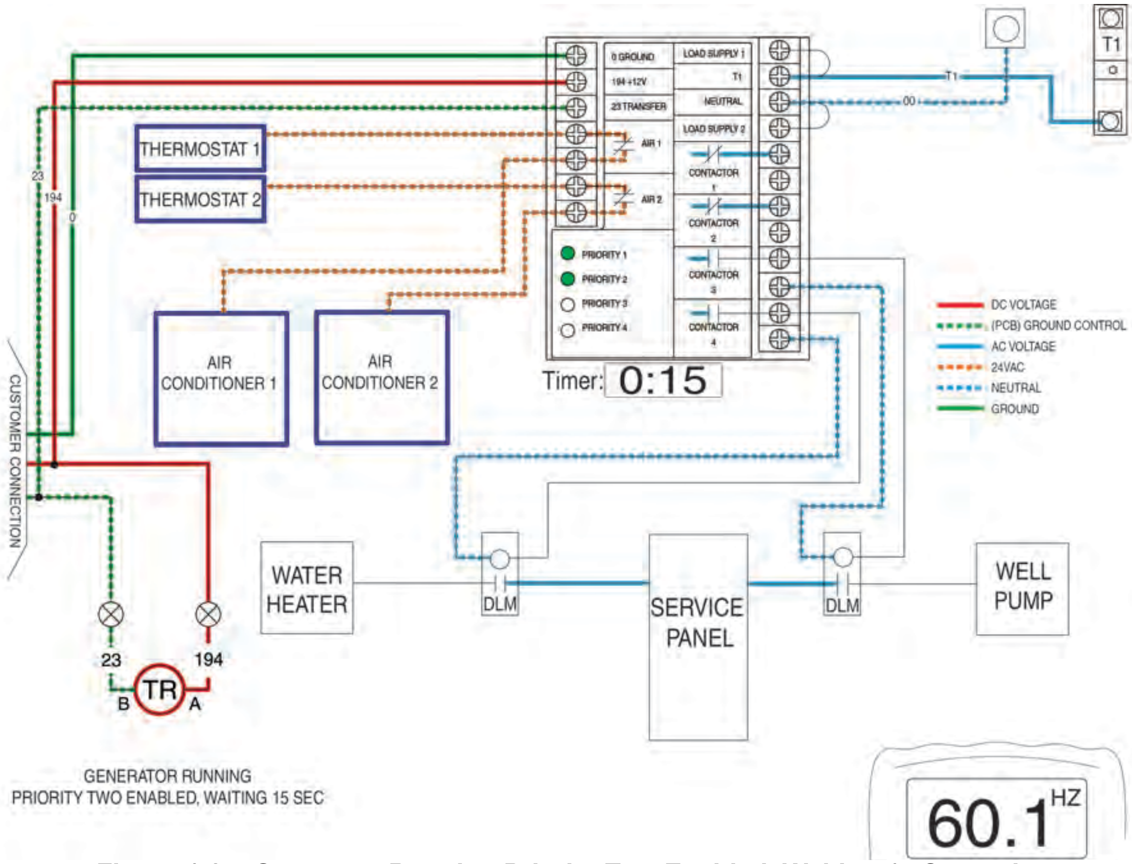
003416

Figure 1-83. Generator Running Overload Detected, Waiting 5 Minutes



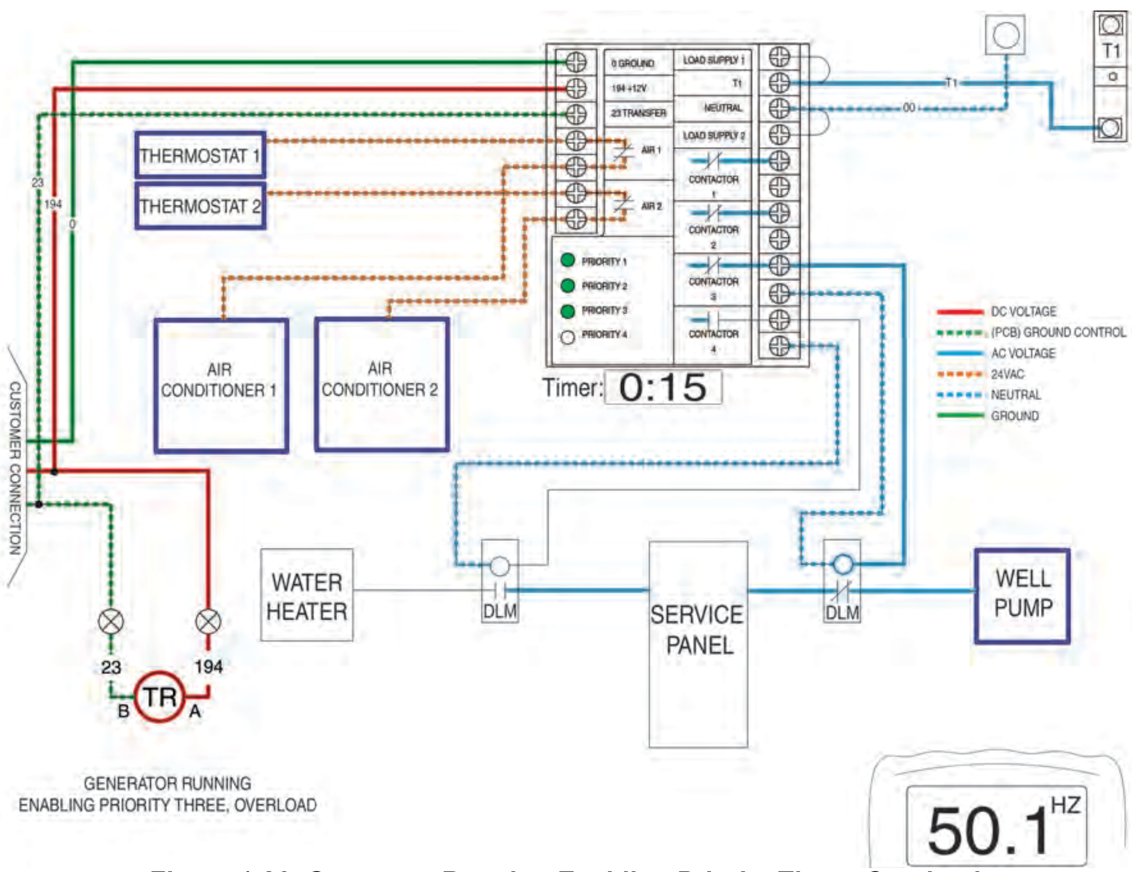
003417

Figure 1-84. Generator Running Priority One Enabled, Waiting 15 Seconds



003418

Figure 1-85. Generator Running Priority Two Enabled, Waiting 15 Seconds



003419

Figure 1-86. Generator Running Enabling Priority Three, Overload

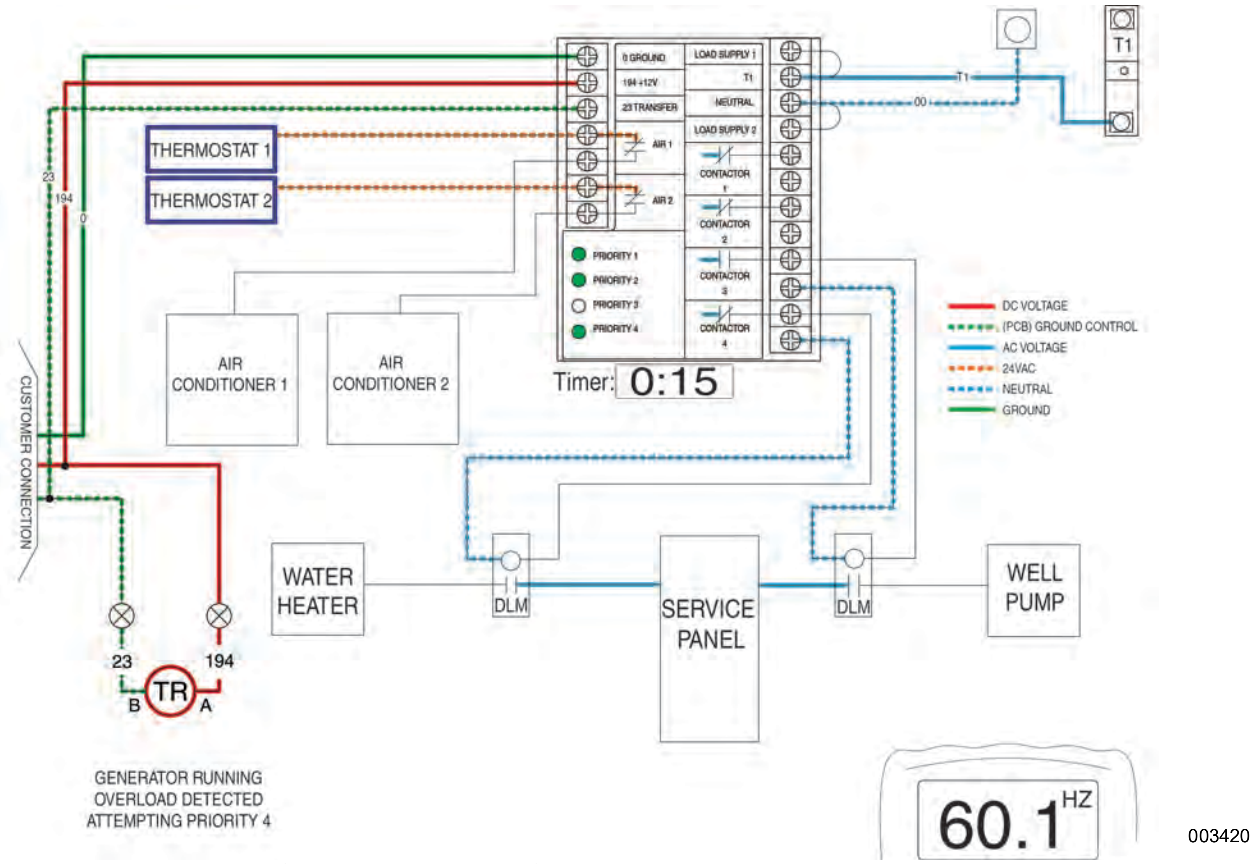


Figure 1-87. Generator Running Overload Detected Attempting Priority 4

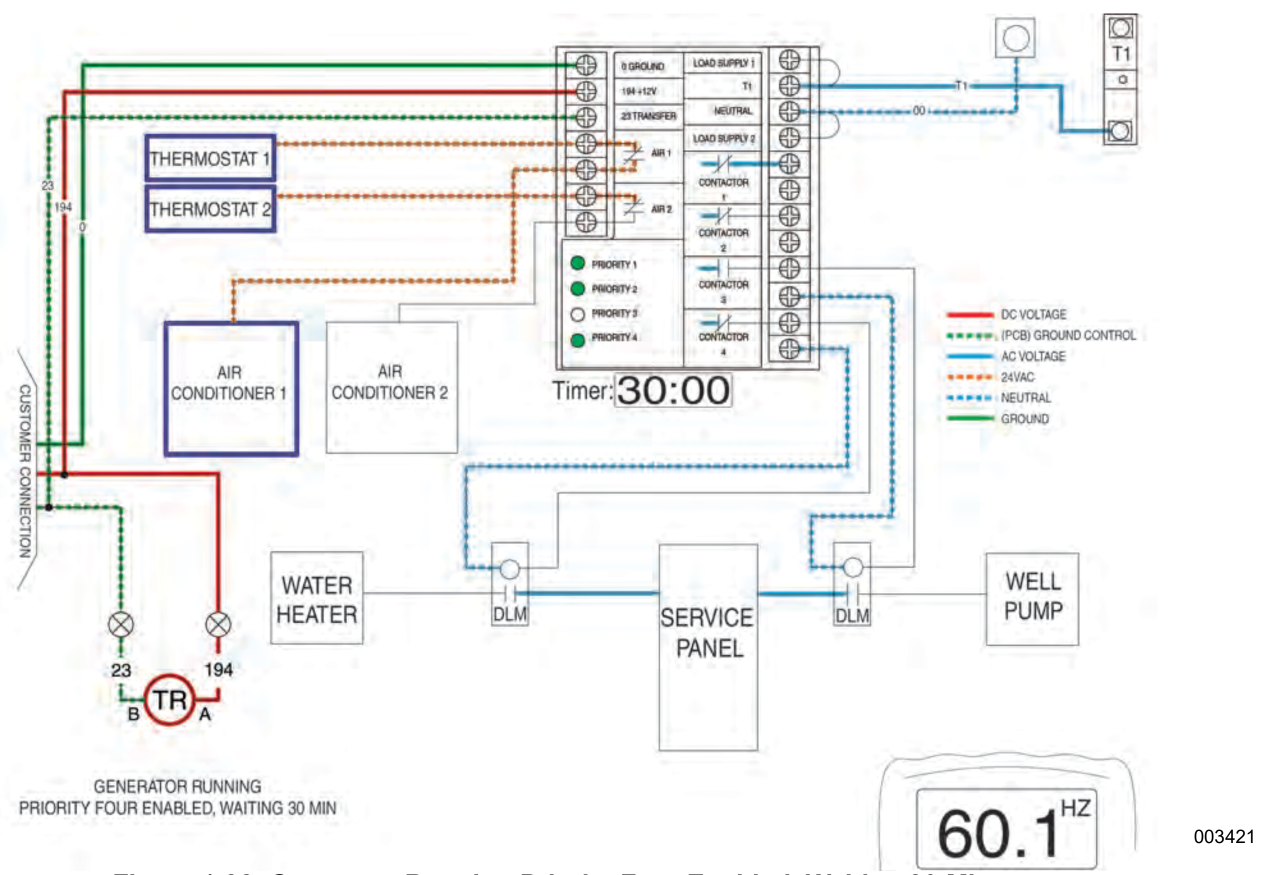


Figure 1-88. Generator Running Priority Four Enabled, Waiting 30 Minutes

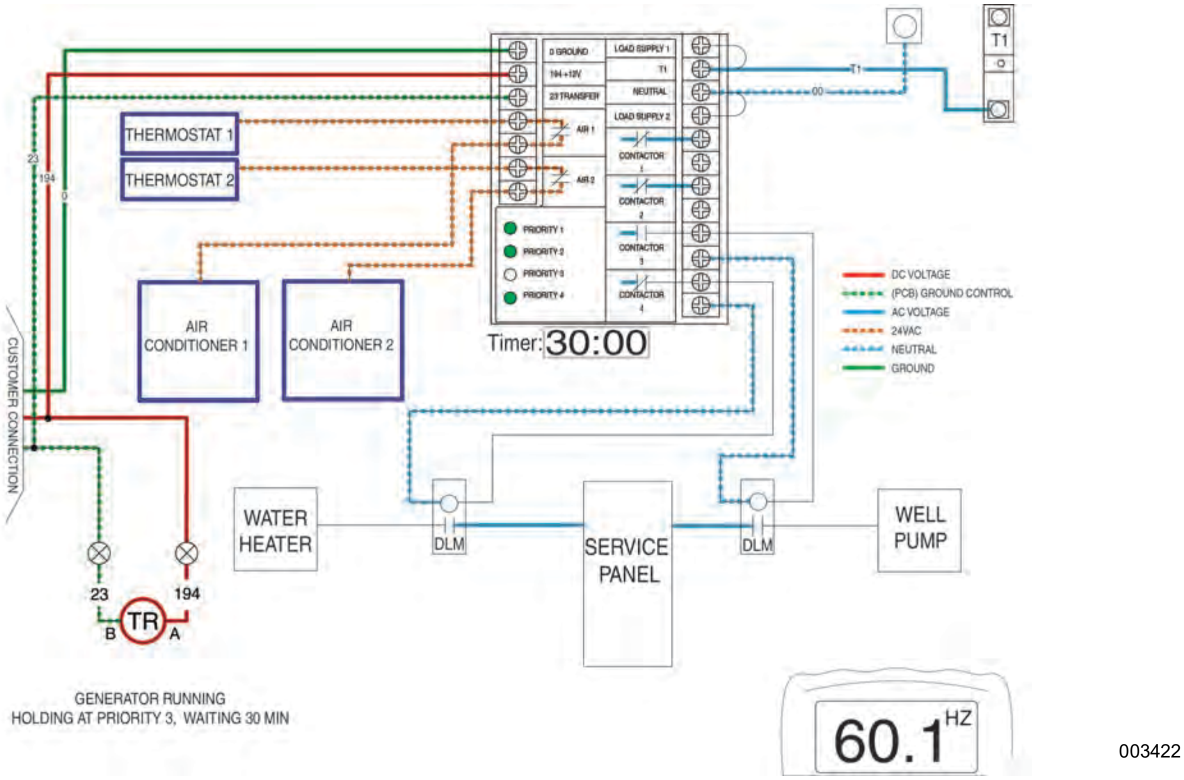


Figure 1-89. Generator Running Holding At Priority 3, Waiting 30 Minutes

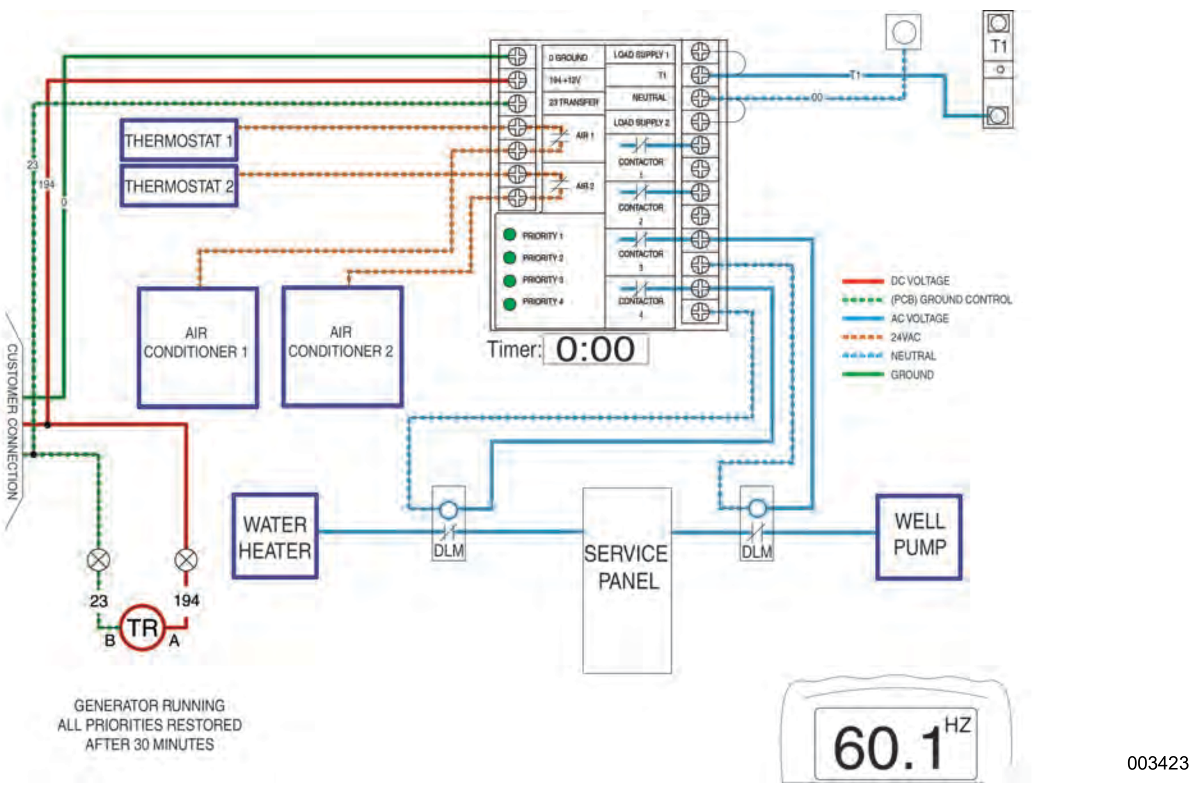


Figure 1-90. Generator Running All Priorities Restored after 30 Minutes

NOTE: After all priorities are enabled and the generator frequency is within limits all priorities will remain on. In this example Priority 3 was the faulty circuit. The controller will lock out the priority for 30 minutes then attempt to enable Priority 3. If not successful, the OPCB module would continue to lock out the faulting priority and continue to attempt to enable it every 30 minutes until utility is restored or until unit is reset. If the unit is reset during generator operation, the testing sequence would begin again.

SACM

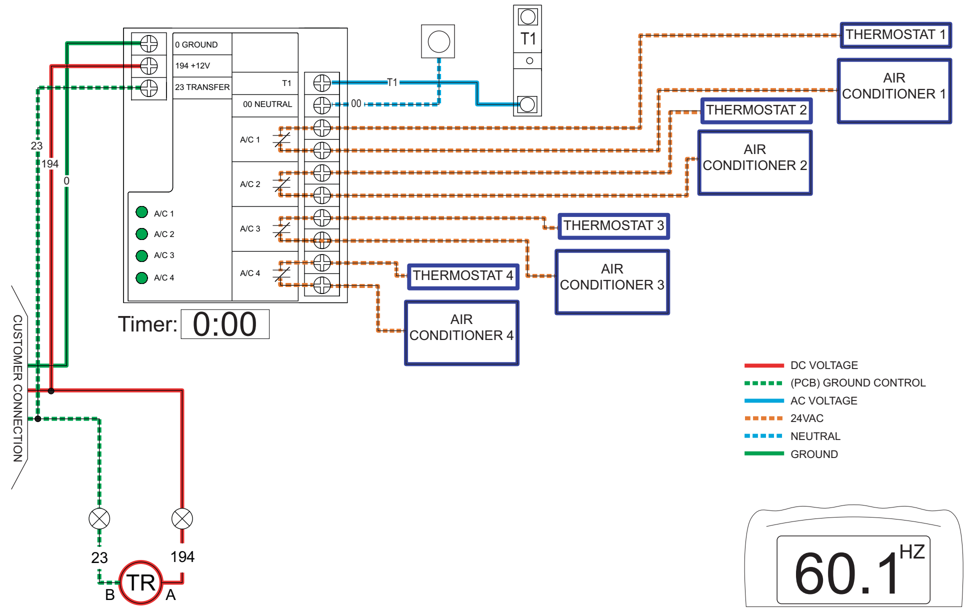


Figure 1-91. SACM

Power Supply Connections for Contactors

The Overload Prevention Control Board (OPCB) can be powered from either a 24 VAC or 120 VAC power supply. The 24 VAC supply is from a class 2 transformer that can be purchased from the manufacturer. Mounting holes are provided in the enclosure subplate for mounting of the transformer. The 120 VAC supply is fused at 5 amps and is factory connected to OPCB terminals labeled “T1” and “Neutral”.

24 VAC Supply

Transformer connections are made as shown in ***Figure 1-92***.

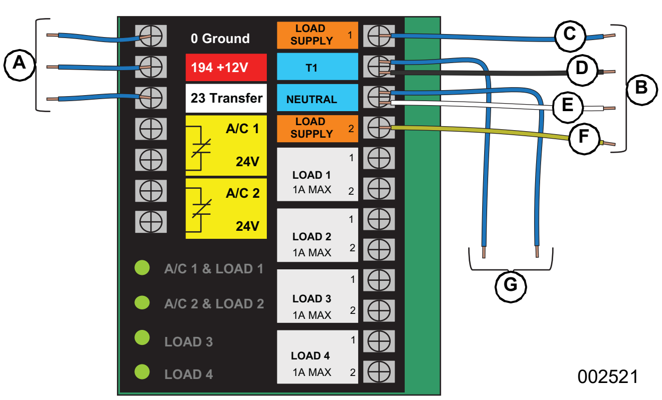


Figure 1-92. 24 VAC Supply Connections

A. Factory wiring
B. Transformer leads Field Installed
C. Blue
D. Black
E. White
F. Yellow
G. Existing wiring

- Blue wire - OPCB “LOAD SUPPLY 1” terminal
- Black wire - OPCB “T1” terminal
- White wire - OPCB “NEUTRAL” terminal
- Yellow wire - OPCB “LOAD SUPPLY 2” terminal

120 VAC Supply

Install the following jumpers on the OPCB as shown in ***Figure 1-93***.

- Load Supply 1 to T1
- Load Supply 2 to Neutral

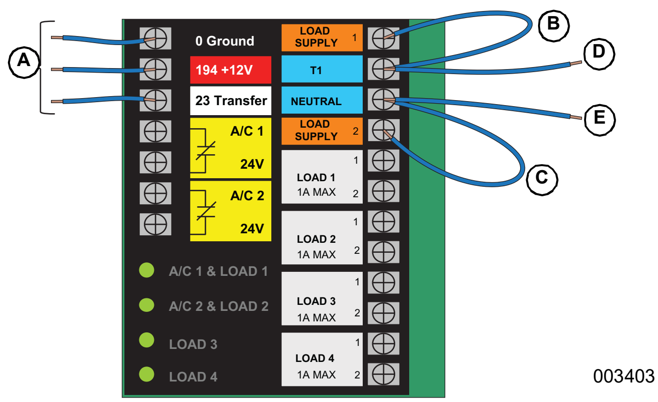


Figure 1-93. 120 VAC Supply Connections

A. Factory wiring
B. Jumper Wire T1 to Load Supply 1
C. Jumper Wire Neutral to Load Supply 2
D. T1 (Factory)
E. 00 (Factory)

Control of a Separate Contactor

A separate contactor relay module can be purchased from the manufacturer. If a different relay is used it must have a 120 VAC coil voltage. The LSM supplies fused (5A) 120 VAC to energize the coils of the relay contactors (contactor 1, 2, 3 or 4).

1. Mount the contactor module and connect the load to the main contacts.
2. Connect the contactor coil to the desired LSM (Contactor 1, 2, 3 or 4) terminals on the terminal strip.
3. Connect additional load shedding contactors in a similar fashion.

Power Management Module (PMM)

The PMM is for use with the Overload Prevention Control Board (OPCB).

The Power Management Module (PPM) 24 VAC contactor is NOT supplied with the transfer switch. It can be purchased separately from the manufacturer.

The OPCB is mounted in the transfer switch. The OPCB provides 24 VAC to the PMM contactor operating coil via the installed 24 VAC transformer. These PMM contactor coil connections are made at the OPCB terminal strip.

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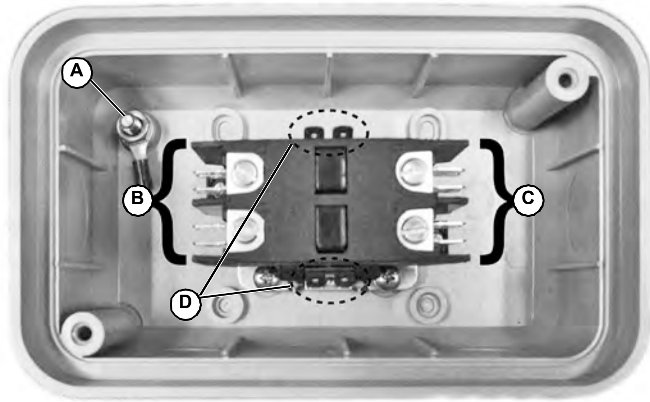
Figure 1-94. Power Management Module



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A. Ground Stud
B. Line Connections Terminals L1 & L2
C. Load Connections Terminals T1 & T2
D. Contactor Control Connections

Figure 1-95. Power Supply Connections

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Figure 1-96. PMM Starter Kit

Smart Management Module (SMM)

Description

The Smart Power Management System is designed to optimize the performance of a standby generator. The system can consist of up to 8 individual Smart Management Modules (SMM). Unlike other load management systems that depend on another control device, SMM modules are actually self-aware and operate autonomously.

An SMM module monitors the frequency (Hz) of the power being produced by a standby generator. If frequency falls below a certain threshold, the module will automatically follow a power management algorithm to ensure that the generator is not overloaded.

Generator overload condition is determined by generator frequency. Loads are shed when the frequency is <58 Hz for 3.5 seconds or <50 Hz for 1 second.

The modules can be set to a load priority from 1 to 8 or be set in a lock out only mode for loads that do not need to run during a power outage, which reduces the necessary size of the generator for a more cost effective solution.

NOTE: PRIORITY MUST BE DIFFERENT for each module in an installation. Priority sets the order in which loads recover from a load shed event. Recovery time from a load shed event is five minutes for Priority 1. Each priority after Priority 1 waits an additional 15 seconds after the initial recovery time. See ***Table 1-7***.

Table 1-7. Priority Settings

Priority	Recovery Time
1	5 minutes
2	5 minutes 15 seconds
3	5 minutes 30 seconds
4	5 minutes 45 seconds
5	6 minutes
6	6 minutes 15 seconds
7	6 minutes 30 seconds
8	6 minutes 45 seconds

SMM Module Identification

Early versions of the SMM (Version 1) use a normally open (N.O.) contactor. Later versions (Version 2) use a normally closed (N.C.) contactor with an added set of mode selector jumper pins on the circuit board.

See ***Figure 1-97***. To determine the version of an SMM, remove the cover. On the underside of the control panel (above the contactor) there is a printed label with the firmware number.

Version 1 uses firmware 1.XX and Version 2 uses firmware 2.XX.

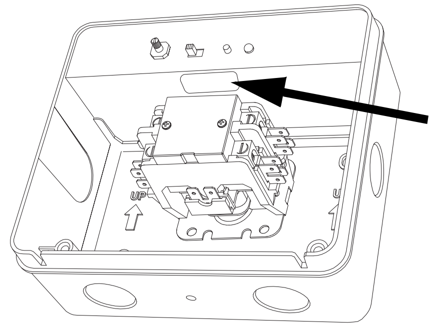

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Figure 1-97. SMM Firmware Label

SMM Version 1—Firmware 1.XX

Version 1 does not have the additional mode selector jumper pins on the circuit board.

With the lockout switch in the enabled position, this version will lockout the load while on generator power and keep the load disconnected until utility power returns.

With the lockout switch in the disabled position, Version 1 will allow the load to connect. When the priority timer expires the SMM will reconnect the load. If the generator subsequently overloads the SMM will drop that load and a 30 minute timer will start. When the 30 minute timer expires it will connect again and if it overloads again another 30 minute timer will start. This cycle will continue until the generator excepts the load OR until utility power is restored.

SMM Version 2—Firmware 2.XX

Version 2 has a 50Hz/60Hz jumper and a Lockout AB jumper on the printed circuit board.

The 50Hz/60Hz jumper switches between 60 Hz or 50 Hz operation. There is no change in operational control of the load as described in Version 1.

The Lockout AB jumper has two selections—A and B.

- With the jumper set to Selection A, SMM operation is identical to Version 1, whether the lockout switch is enabled or disabled.
- With the jumper set to Selection B and the lockout switch disabled, the SMM has a wider frequency response window. All other operation is identical to Version 1.
- With the jumper set to Selection B and the lockout switch enabled, SMM will allow the load to reconnect to the generator after an initial overload (after the priority timer expires). However, upon a subsequent overload the SMM will drop the load and will not allow the load to reconnect until utility power returns.

NOTE: The Test button on Version 2 will reset the SMM to initial settings.

SMM Features and Controls

See *Figure 1-98*.

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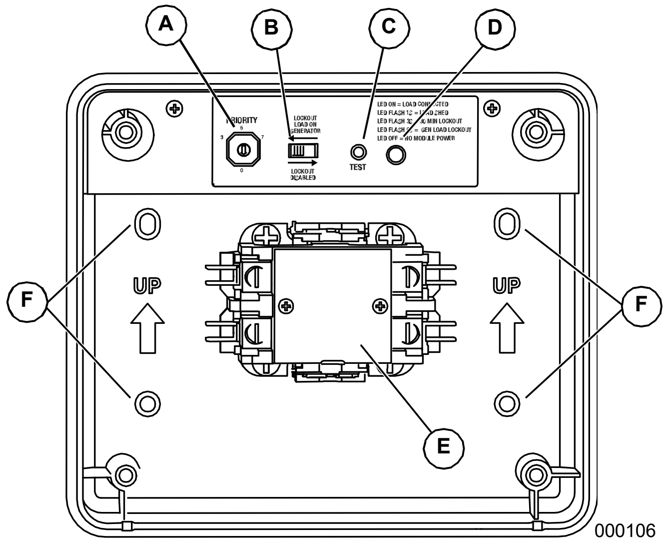


Figure 1-98. SMM Features and Controls

Priority Dial (A) – Sets module priority.

Lockout Switch (B) – Initial switch to generator power will allow load to operate until an overload condition occurs. If overload happens the load will be locked out until utility returns. See *SMM Module Identification*.

NOTE: See *SMM Module Identification*. On Version 1, when lockout switch is engaged and running on generator, module will start in load shed mode. After approximately 1 minute of run time the module will enter lockout mode. When utility returns while in lockout mode, the module will delay for 2 minutes before returning to load shed mode. After a 4 minute timer expires the load will be activated.

Test Button (C) – Disables contactor output for a specified time.

LED (D) – Provides module status. See *Table 1-10*.

Contactor (E) – Controlled by a smart controller in module. Contactor remains CLOSED until generator power is required. Upon generator activation, controller moves to OPEN to handle overload conditions.

NOTE: When the system is on generator power, the contactor is also opened during lockout switch ACTIVE state.

Mounting Holes (F) – Internal enclosure mounting holes provide clean and sturdy mounting.

Recovery time is based on priority dial settings. See *Table 1-7*.

Setting Priorities

High priority 240 VAC loads should be set to the highest priorities so those loads recover first in the event of generator overload.

NOTE: The highest priority, and first load to activate is Priority 1. The last load to activate is Priority 8.

Setting priority determines timing for 3 scenarios:

- Order in which loads recover
- Delay time until power returns during an outage
- Delay time for post load shed recovery

An example configuration is shown below. Configurations will vary depending on customer prioritization of loads.

Priority 1 - Baseboard heat	Priority 5 - Non-essential circuits
Priority 2 - Air conditioner	Priority 6 - Pool pump or hot tub
Priority 3 - Range	Priority 7 - Other circuits
Priority 4 - Clothes Dryer	Priority 8 - Other circuits

1. Set the priority of each SMM module as desired (using the example configuration for reference).
2. Apply priority decal in a suitable location on electrical panel to record chosen priority designations.
3. Record priorities on decal.

Setting Lockout

Version 1, Normally Open Contactor

Most installations will require the lockout switch to be DISABLED. When performing a whole house backup with a generator not sized to manage all household loads, SMM's can be used to disable appliances or circuits during an outage. For non-essential loads that will not be used on generator power, set lockout switch to ENABLED.

Table 1-8. Lockout Switch Settings (Version 1, Normally Open Contactor)

Lockout Switch Position	Mode	Function
ON	Generator	If overloaded, module sheds load until utility returns. Contactor is OPEN.
ON	Utility	Power is available on module output (contactor output). Contactor is CLOSED.
OFF	Generator	Module operates with standard load shed logic. Contactor is OPEN or CLOSED per logic.
OFF	Utility	Power is available on module output (contactor output). Contactor is CLOSED.

NOTE: Version 1: When lockout switch is engaged and running on generator, module will start in load shed mode. After approximately 1 minute of run time the module will enter lockout mode. When utility returns while in lockout mode, the module will delay for 2 minutes before returning to load shed mode. After a 4 minute timer expires the load will be activated.

Setting Lockout

Version 2, Normally Closed Contactor

Two steps are required for setting SMM to enable standard lockout mode:

1. See ***Figure 1-99***. Slide the lockout switch (A) to LOCKOUT LOAD ON GENERATOR.
2. Move the mode selector jumper (B) on the control board as directed in ***Jumper Locations***.

Table 1-9. Lockout Switch Settings (Version 2, Normally Closed Contactor)

Lockout Switch Setting	Mode Selector Jumper Position	Mode	Function
Lockout Load On Generator	A	Generator	Module sheds load and does not reconnect until utility returns. This setting is considered standard for most installations.
Lockout Load On Generator	B	Generator	Module sheds load and does not reconnect until utility returns. This setting is recommended for installations in areas with unstable utility power.
Lockout Load On Generator	A or B	Utility	Power is available on module output.
Lockout Disabled	A or B	Generator	Module operates with standard load shed logic. See ***Table 1-7*** for more information.
Lockout Disabled	A or B	Utility	Power is available on module output.
NOTE: *Duration of Return to Utility timer is longer in Mode B.*			

Jumper Locations

See ***Figure 1-99***. Later SMM control boards (Version 2) are equipped with two movable jumpers. Jumper locations are indicated on the diagram:

- 50 Hz/60 Hz Frequency Jumper (C)
- Mode Selector Jumper (D) [identified on control board as “Lock Out Jumper”].

The frequency jumper is factory set at the 60 Hz position. The mode selector jumper is factory set at position “A” which is considered standard for most installations.

Jumpers should remain in place except when operating the unit under either or both of the following conditions:

- Operating the unit at 50 Hz requires moving frequency jumper to “50 Hz” position.
- For installations in areas with unstable utility power, move mode selector jumper to position “B.”

To move a jumper:

1. Remove power.
2. Grasp jumper and pull straight up until it clears the pins.
3. Move jumper to new location and press it gently onto the pins until seated.

NOTE: To avoid bending or breaking pins, do not rock jumper, use excessive force, or pull sideways to remove it from the SMM control board.

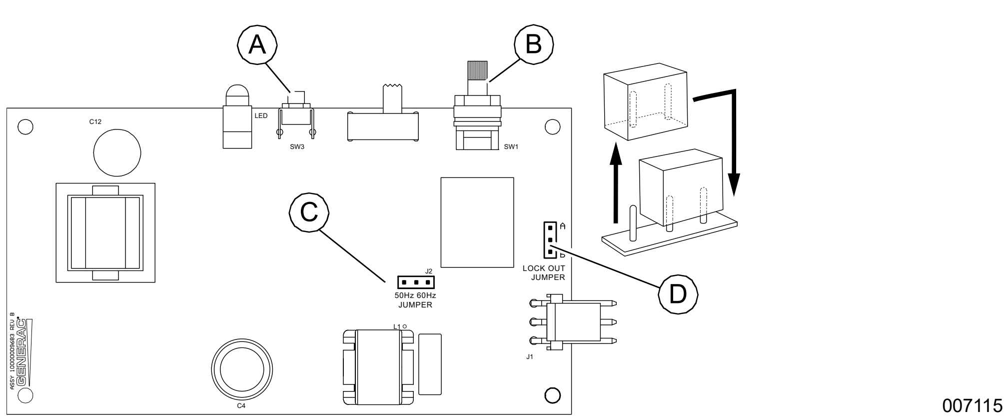


Figure 1-99. Jumper Locations (Version 2, Normally Closed Contactor)

Table 1-10. LED States

State	LED State	Mode	Note
Shed	1 second flash (1 On – 1 Off)	Generator	Module detected an overload and shed its load. This state only occurs in generator mode, or during a first time utility power-up for five minutes of initial operation.
Lockout (30 minutes)	3 second flash (3 On – 3 Off)	Generator	Module detected an overload while trying to recover from a shed situation. Operation is disabled for 30 minutes. This state only occurs in generator mode.
Lockout Switch Active	6 second flash (6 On – 6 Off)	Generator	Module output is disabled and there is no power to the appliance while in generator mode and generator is overloaded. Lockout switch must be ON. See ***Table 1-8***.
Lockout Switch Active	ON	Utility	Lockout switch operates in generator mode only. It has no function in utility mode. LED is solid, indicating the load is connected. Lockout switch must be ON. See ***Table 1-8***.
Normal	ON	Generator or Utility	Indicates the appliance has power. This is the default in utility mode. It is the normal operating state in generator mode when an overload is not detected.
Test	1 second flash	Generator or Utility	Test button triggers a typical shed condition and overrides all other states except generator lockout switch ACTIVE state. **NOTE:** Actual test time varies depending on SMM priority setting. Use the following formula to calculate test time: **Time = (P-1) x 15 seconds, where P represents priority setting.** Example: SMM Priority 6 test time = (6-1) x 15 seconds, or 75 seconds.

Electrical Specifications

Input Voltage	240 VAC
Current Rating	50A resistive, 40A inductive
Locked Rotor Amp Rating	240A
Motor Rating	3 HP
Contactor Coil Voltage	240 VAC

Enclosure Specifications

UL Rating	Type 3R
Temperature	-30 to 50 deg C (-22 to 122 deg F)

Connections

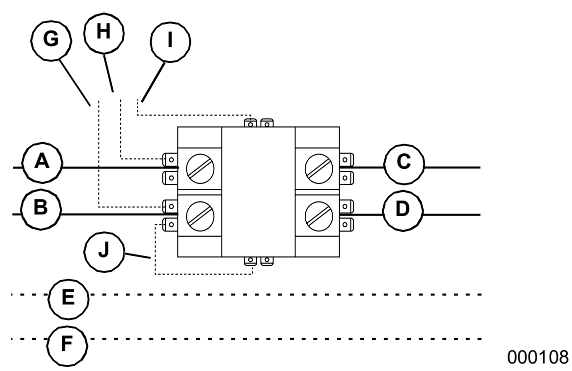


Figure 1-100. Smart Management Module Connections

A	Red (240 VAC - Line)
B	Black (240 VAC - Line)
C	Red (240 VAC - Load)
D	Black (240 VAC - Load)
E	White - Neutral (as required)
F	Green - Ground (as required)
G	Black - Factory (PCB)
H	Red - Factory (PCB)
I	Blue - Factory (PCB)
J	Blue - Factory (Jumper)

Tests

Utility Test

1. Turn utility power ON and enable all module feeding circuits.
2. Verify LED begins to flash at one second intervals.
3. All contactors will close after five minutes. LED will illuminate, and stay ON.
4. Wait 30 seconds after contactor closes, then press TEST button and verify module load shed. LED will flash at one second intervals.
5. Wait five minutes, plus predefined priority set time for module to recover.
6. Contactor will CLOSE and LED will illuminate, and stay ON.

Generator Test

1. Simulate a utility loss by turning main line circuit breaker (MLCB - service disconnect) OFF while generator is in AUTO.
2. All modules will lose power and LEDs will disable.
3. Generator will power on after preset delay.
4. All LEDs will flash when generator transfers.
5. Allow each module to enable output per its priority setting.
6. After predefined priority time elapses, each contactor will CLOSE and LED will illuminate and stay ON.
7. Once LED stays ON, press TEST button and verify load shed occurs.
8. Once load shed occurs, LED will flash at one second intervals.
9. Allow time for each module to enable contactor output per priority setting.
10. After predefined priority set time, each contactor will CLOSE and LED will illuminate and stay ON.

NOTE: Depending on load size, the SMM module may immediately go into load shed mode or lockout during test. In this event, remove one or more higher priority loads to allow testing of each module.

Generator Test with Lockout Switch Enabled (perform if Lockout Switch Enabled on any loads)

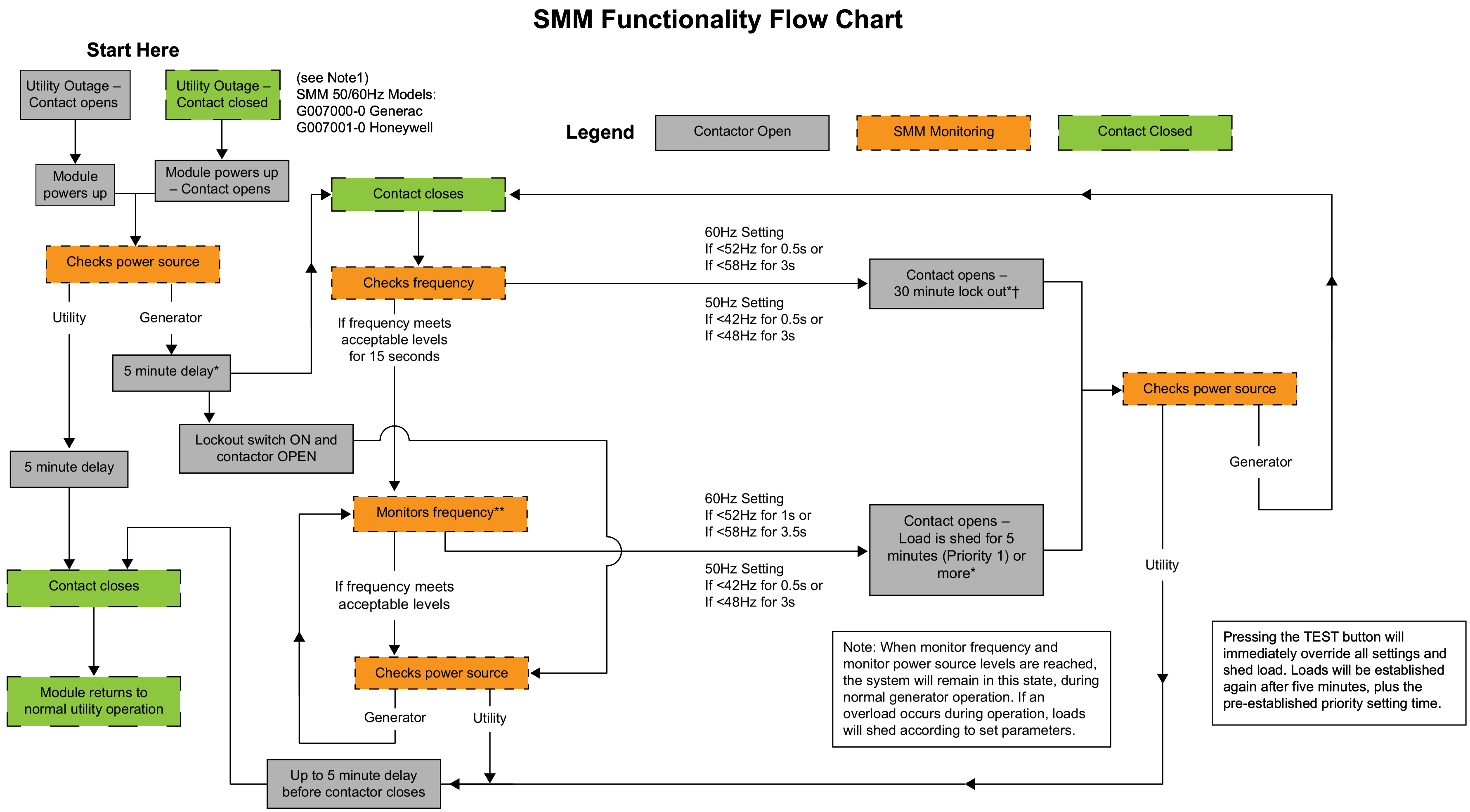
1. Simulate a utility loss by turning MLCB (service disconnect) to OFF while generator is in AUTO.
2. All modules will lose power and LEDs will disable.
3. Generator should power on after preset delay.

NOTE: For modules with lockout switch enabled, LEDs will flash at six second intervals and load will remain disabled while in generator power.

Return to Utility Test

1. Return utility power by setting the MLCB (service disconnect) to ON.

NOTE: All modules should begin flashing at one second intervals. All modules will recover in five minutes (including units with lockout switch enabled).



Note 1: This model has a contactor that is Normally Closed and is energized to open.

Note 2: If the frequency is under 58 Hz when a module attempts to close the contactor after a shed, the module will wait another 5minutes plus Priority delay before attempting to enable.

Note 3: The "Checks power source" block monitors frequency and will change state, Generator or Utility, after it detects 1 minute of stable operation in the new state.

* Each priority setting above Priority 1 will increase delay time in 15 second increments, starting with 15 seconds at Priority 2.

** If the frequency drops below acceptable levels for the pre-determined durations, all modules will shed.

† During lock out, the module will continuously monitor power source. If utility returns before the 30 minute lock out is satisfied, the module will allow five minutes to elapse from utility return time, and then close the contact.

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Figure 1-101. SMM Sequence of Operations

Integrated SACM Module

The Integrated SACM module incorporates the following components in one module:

- N1, N2, T1, 23, 194, and 0 connection points.
- N1, N2, and T1 6.3 amp mini fuse.
- Transfer relay.
- Load shedding SACM that has the same operating parameters as the non-integrated SACM.

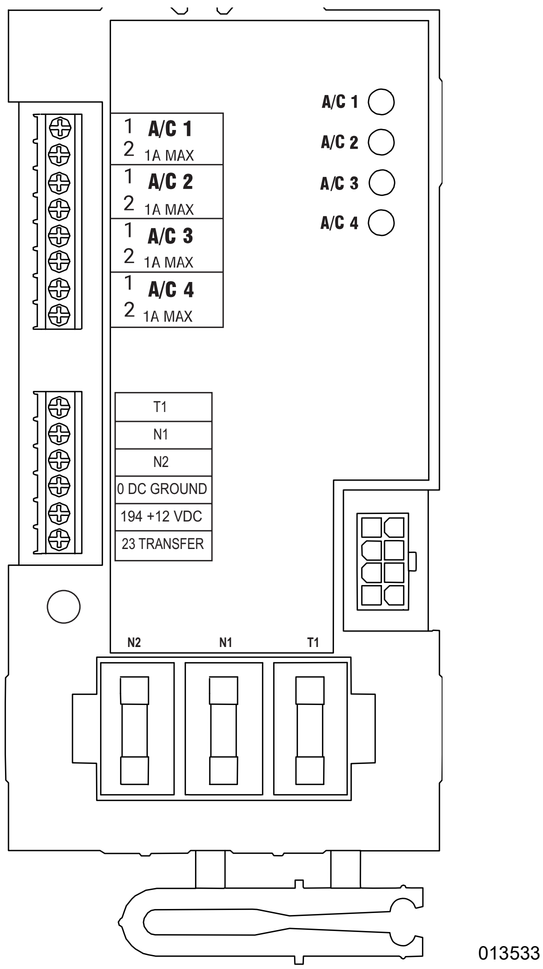
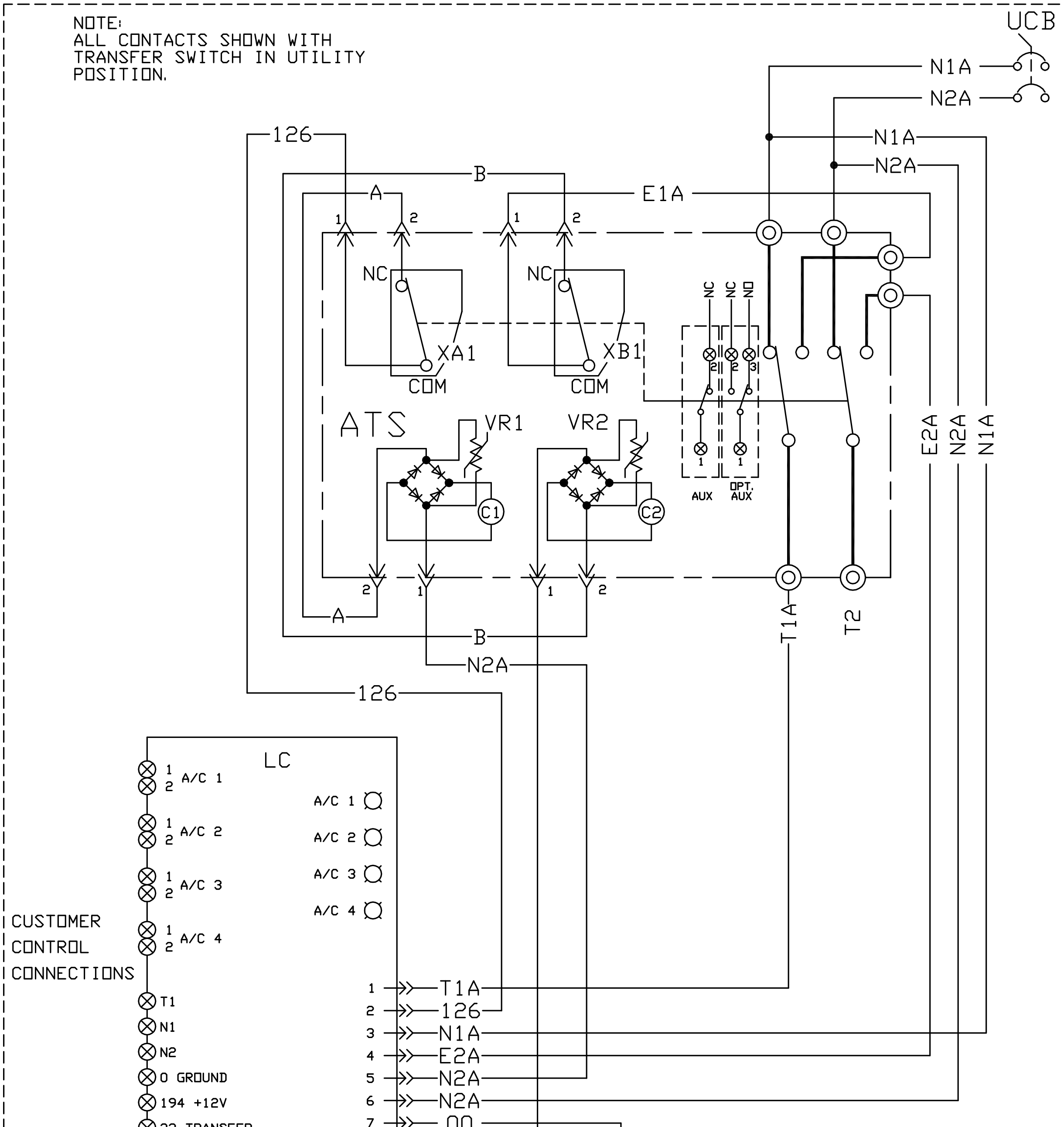


Figure 1-102. Integrated SACM Module

GROUP G



LEGEND	
ATS	TRANSFER SWITCH CONTACTOR
C1	SOLENOID COIL (UTILITY CLOSING)
C2	SOLENOID COIL (STANDBY CLOSING)
LC	SMART AC MODULE
NB	NEUTRAL BLOCK
UCB	UTILITY CIRCUIT BREAKER
VR1, VR2	VARISTOR
XA1, XB1	LIMIT SWITCHES, ACTUATOR

SCHEMATIC - DIAGRAM

REVISION: -A-

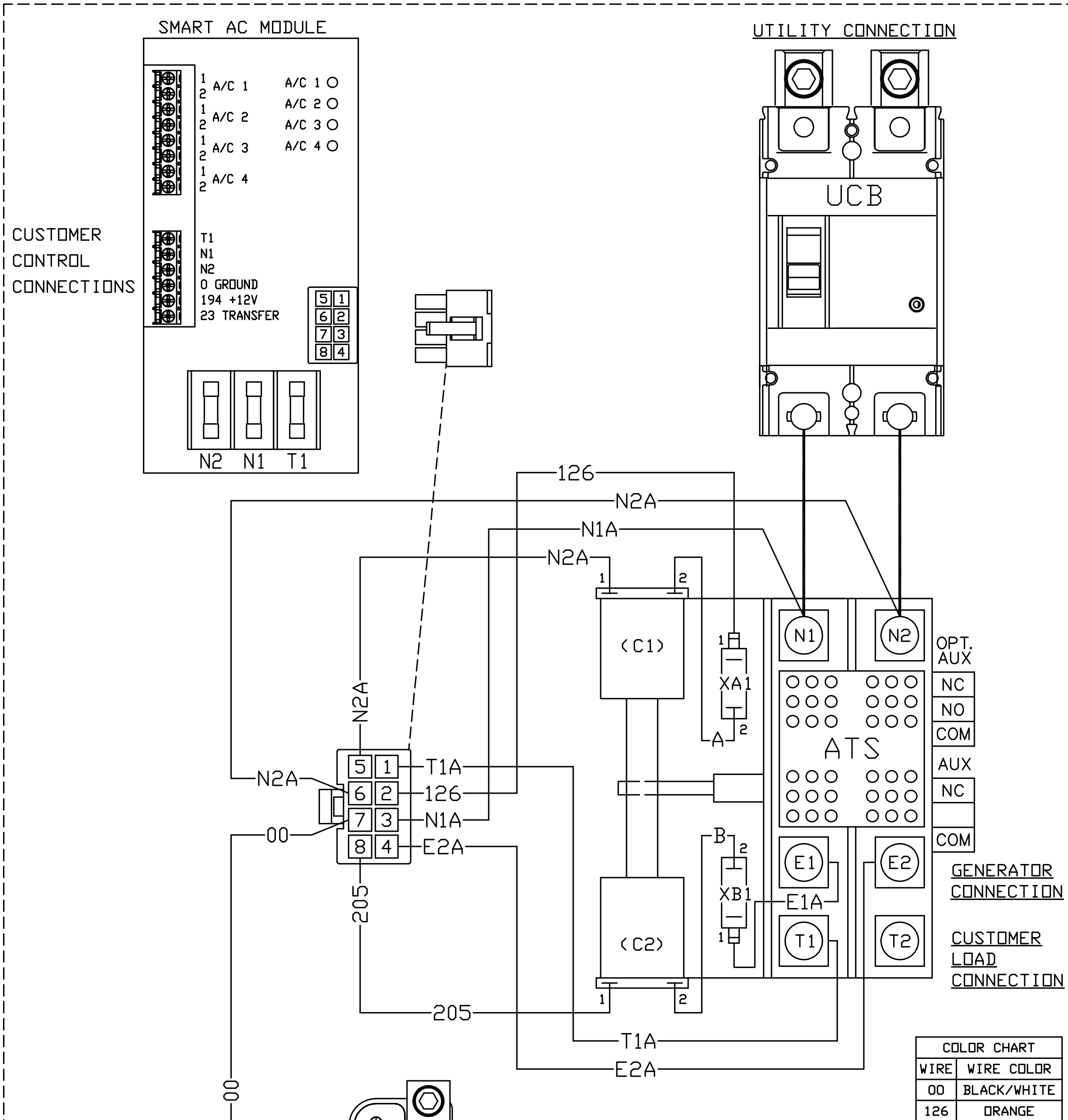
SE TRANSFER SWITCH 100-200A

DATE: 2/13/17

DRAWING #: 10000006038

Figure 1-103.

GROUP G



COLOR CHART	
WIRE	WIRE COLOR
00	BLACK/WHITE
126	ORANGE
205	VIOLET
A	BLACK
B	GRAY
E1A	BROWN
E2A	BROWN/WHITE
N1A	YELLOW
N2A	YELLOW/BLACK
T1A	BLUE

WIRING - DIAGRAM
SE TRANSFER SWITCH 100-200A
DRAWING #: 10000006038

REVISION: -A-
DATE: 4/22/13

Figure 1-104.

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Section 2.1 *Troubleshooting Flowcharts*

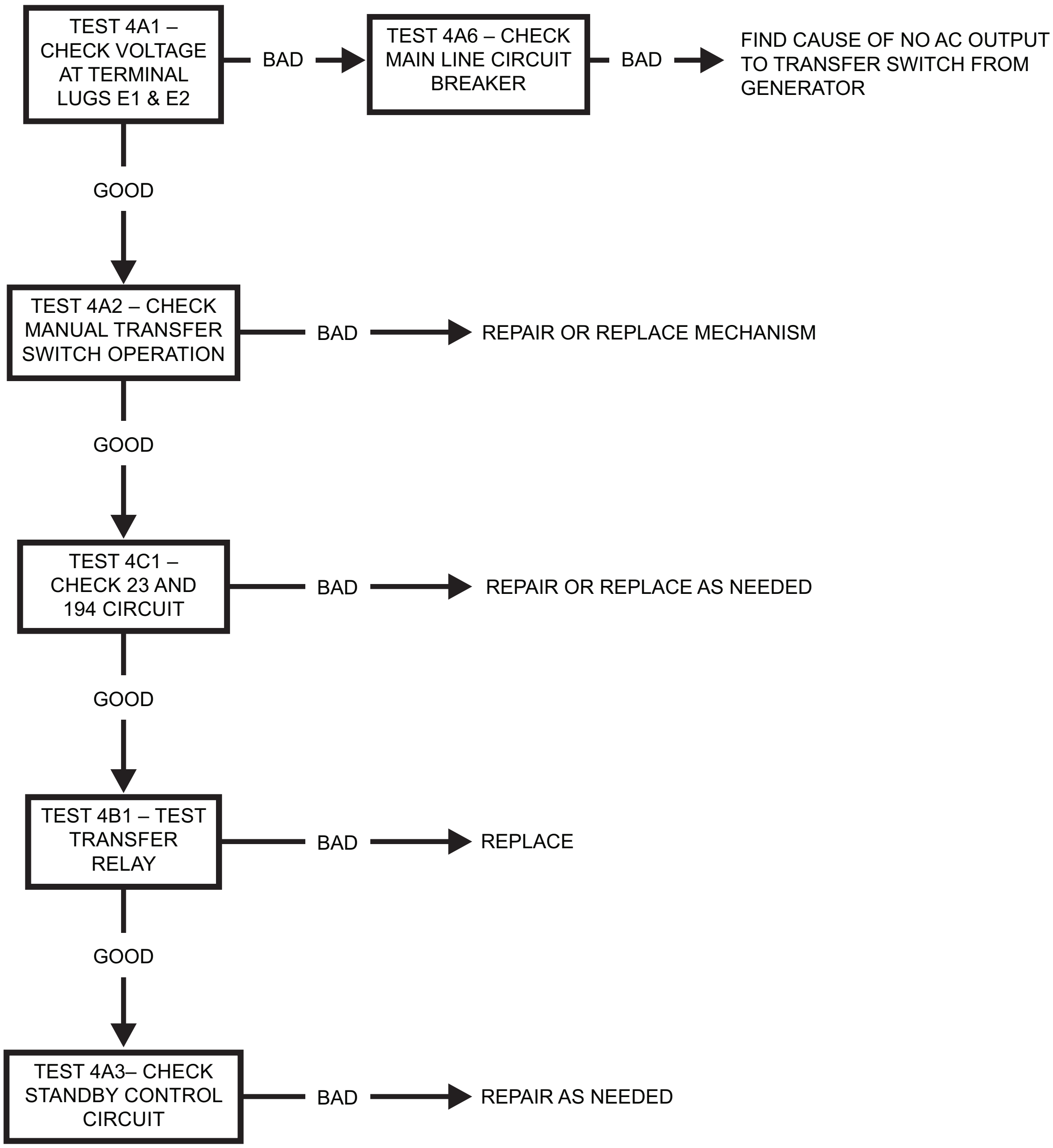
Introduction

Use the “Flow Charts” in conjunction with the detailed instructions that follow. Test numbers used in the flow charts correspond to the numbered tests in ***Section 2.2 – Diagnostic Tests***. The first step in using the flow charts is to identify the correct problem on the following pages. For best results, perform all tests in the exact sequence shown in the flow charts.

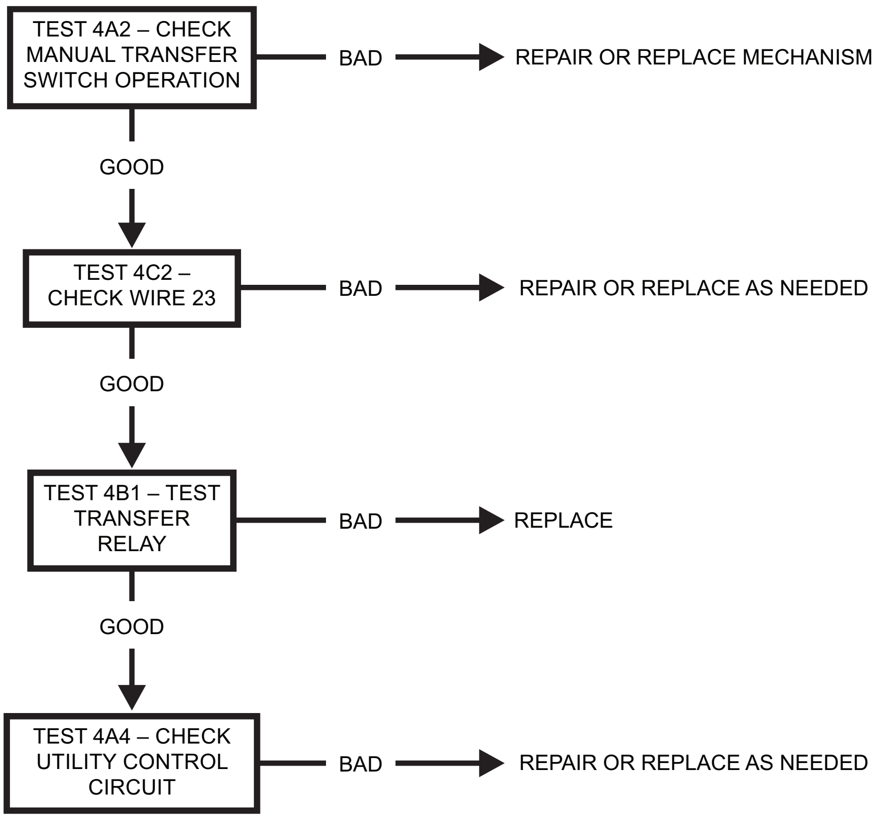
Table 2-1.

Test Number	Test Description
4A1	***Test 4A1 – Check Voltage at Terminal Lugs E1 and E2***
4A2	***Test 4A2 – Check Manual Operation of Transfer Switch***
4A3	***Test 4A3 – Test Standby Control Circuit***
4A4	***Test 4A4 – Test Utility Control Circuit***
4A5	***Test 4A5 – Test Limit Switches***
4A6	***Test 4A6 – Check Main Circuit Breaker***
4B1	***Test 4B1 – Test Transfer Relay***
4B2	***Test 4B2 – Check Fuses F1 (N1) and F2 (N2)***
4B3	***Test 4B3 – Check Fuse F3 (T1)***
4B4	***Integrated SACM Test 4B4 – Generator starts and runs in AUTO with Utility Present***
4B5	***Integrated SACM Test 4B5 – Transfer to Standby Does Not Occur in AUTO***
4B6	***Integrated SACM Test 4B6 – Transfer to Utility Does Not Occur after Utility Returns***
4C1	***Test 4C1 – Check Wire 23 and 194 Circuits***
4C2	***Test 4C2 – Check Wire 23***
4C3	***Test 4C3 – Check N1 and N2 Wiring***
4C4	***Test 4C4 – Check N1 and N2 Voltage***
4C5	***Test 4C5 – Check Utility Sensing Voltage at the Controller***
4C6	***Test 4C6 – Check Utility Sense Voltage***
4C7	***Test 4C7 – Check T1 Wiring***
4D1	***Test 4D1 – Test SMM Contactor Line, Load and Control***

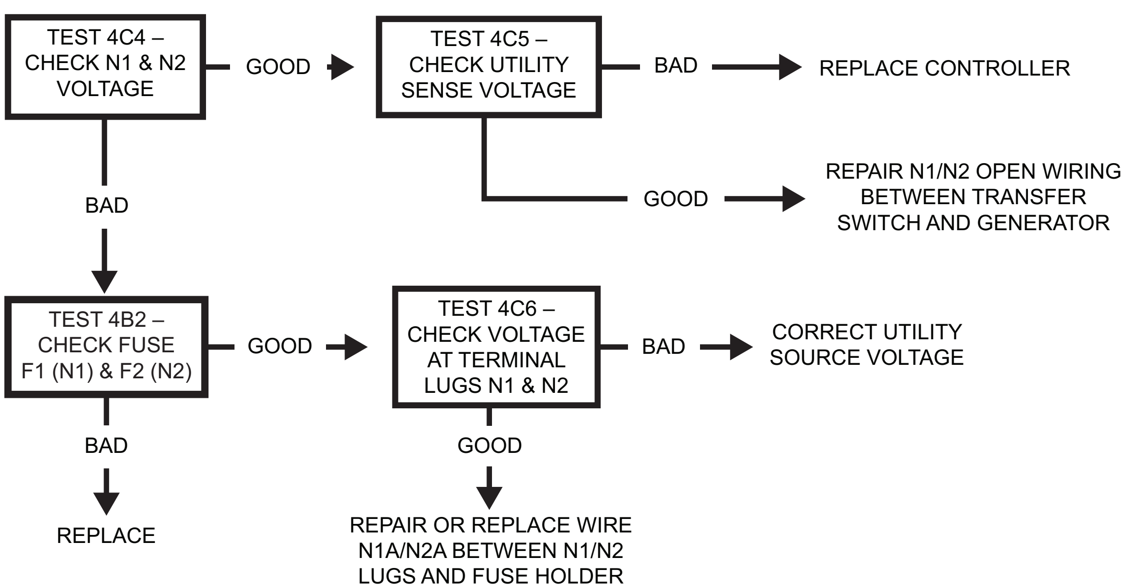
Problem 1 — With Controller in Automatic Mode and Utility Failed, Generator Runs but Transfer to Standby Does Not Occur



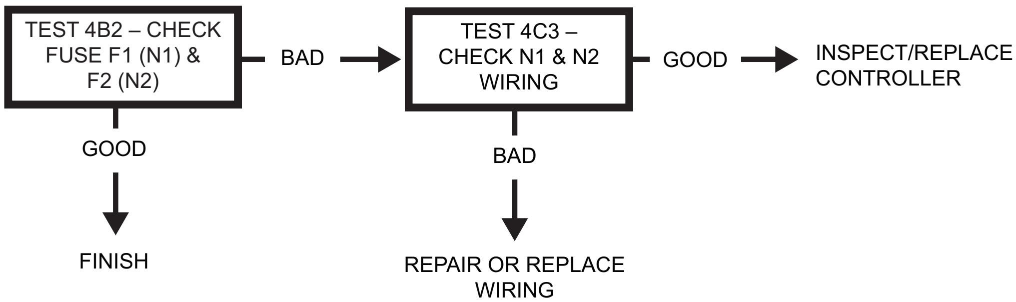
Problem 2 – In Automatic Mode, Generator Starts When Loss of Utility Occurs, Generator Shuts Down When Utility Returns But There is No Re-transfer to Utility Power Or Generator Transfers to Standby During Exercise or in Manual Mode



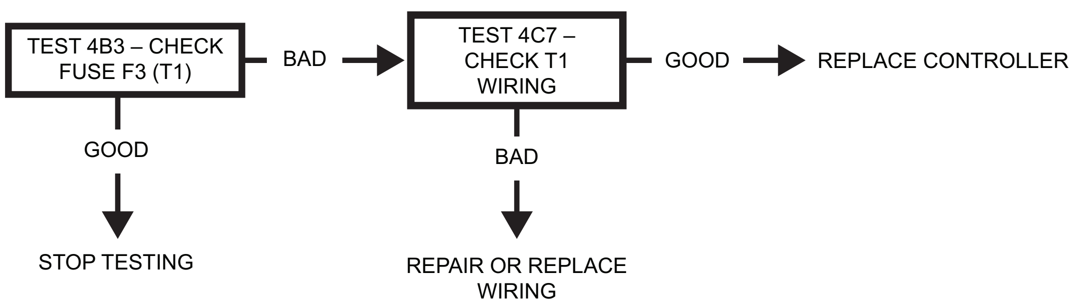
Problem 3 – Unit Starts and May or May Not Transfer When Utility Power is On



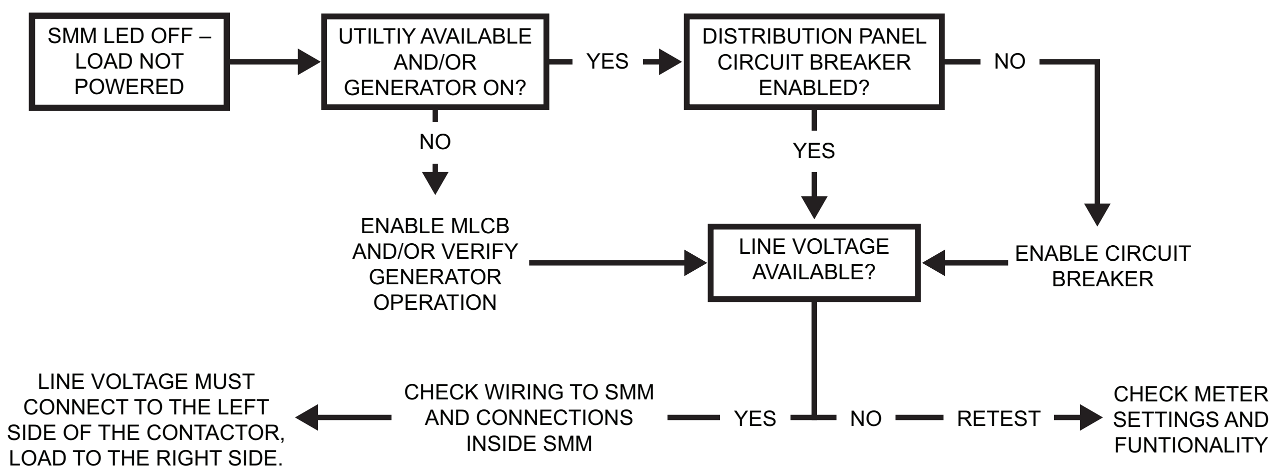
Problem 4 – Blown F1 or F2 Fuse



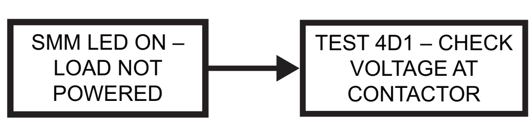
Problem 5 – Blown T1 Fuse



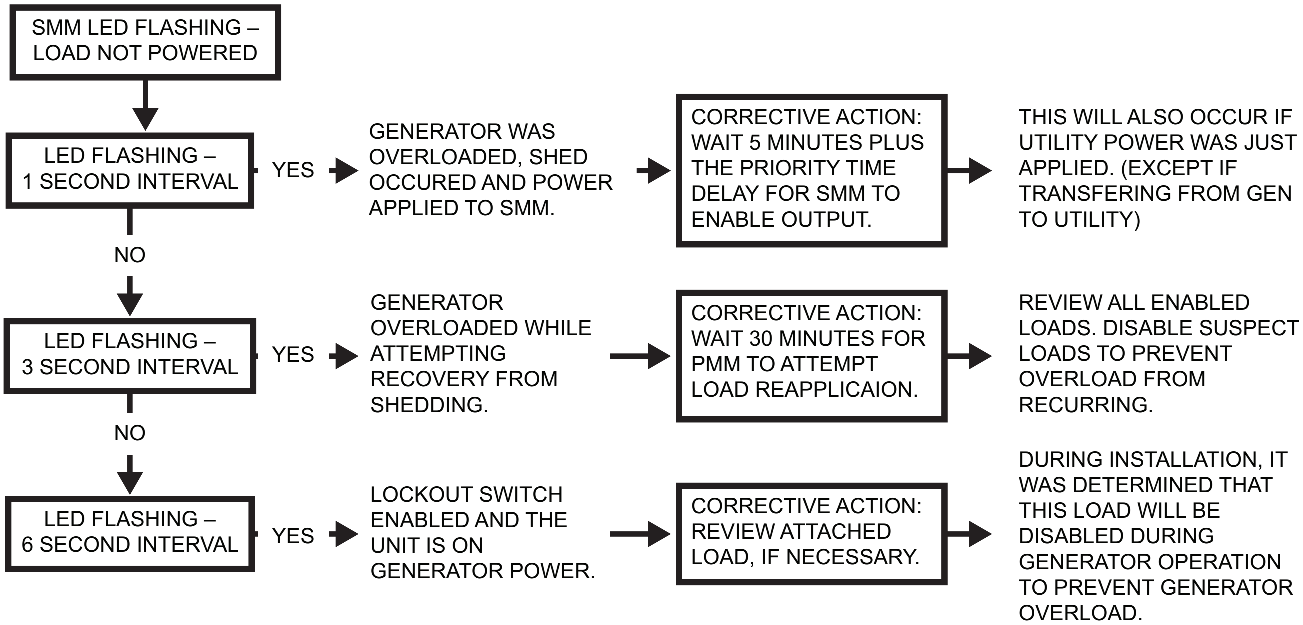
Problem 6 – Load Management Module (SMM) LED is OFF, Load Not Powered



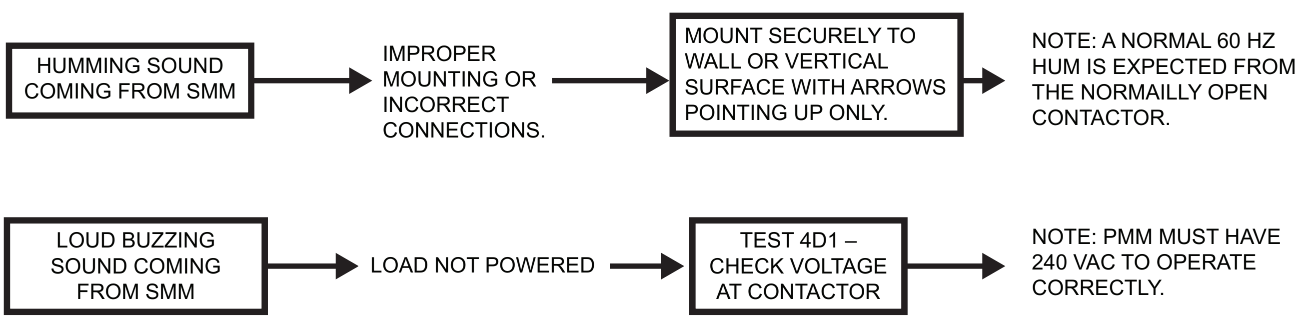
Problem 7 – Load Management Module (SMM) LED is ON, Load Not Powered



Problem 8 – Load Management Module (SMM) LED is Flashing, Load Not Powered



Problem 9 – Load Management Module (SMM) is Humming or Buzzing



Integrated SACM Test 4B4 – Generator starts and runs in AUTO with Utility Present

NOTE: Verify the integrity of all wires and connections relative to the function of the Integrated SACM. Utility Voltage must be available to perform this test.

NOTE: This procedure may require SD/WD 100000060381.

Step	Test Point	AC Voltage Present?	Action
1	Check for AC Voltage on N1 and N2 at the connection deck on the generator.	YES	***Test 4C5 – Check Utility Sensing Voltage at the Controller***
		NO	Go To Next Step
2	Check for AC Voltage on N1 and N2 at the 6 Pin Customer Control Connector.	YES	Repair or Replace N1 and N2 interconnect wires
		NO	Go To Next Step
3	Check for AC Voltage at upper end of N1 and N2 Fuses.	YES	Replace Integrated SACM Board
		NO	Go To Next Step
4	Check for AC Voltage at the lower end of N1 and N2 Fuses.	YES	Replace N1 and N2 fuses
		NO	Go To Next Step
5	Check for AC Voltage at pins 3 and 6 on the white Molex Connector.	YES	Replace Integrated SACM Board
		NO	Go To Next Step
6	Check for AC Voltage on N1 and N2 at the lugs on the contactor.	YES	Check N1A and N2A Wires
		NO	Reset Utility Breaker or Check Utility Service

Integrated SACM Test 4B5 – Transfer to Standby Does Not Occur in AUTO

NOTE: Verify the integrity of all wires and connections relative to the function of the Integrated SACM. Generator voltage must be available to perform this test. DC Voltage value should be at least 9 VDC.

NOTE: This procedure may require SD/WD 100000060381.

Step	Test Point	AC Voltage Present?	Action
1	Check for AC Voltage on E1 and E2 at the connection deck on the generator.	YES	Go To Step 3
		NO	Go To Next Step
2	Check for AC Voltage on Wire 11 and Wire 44 at the MLCB (Generator Circuit Breaker).	YES	Is Breaker Closed? Go To Next Step
		NO	Perform ***Preliminary Output Voltage Test*** from the Air-Cooled Diagnostic Manual (P/N 10000041488)
3	Check for AC Voltage on E1 and E2 at the Transfer Switch Contactor.	YES	Go To Next Step
		NO	Go to Step 1 in this Test
4	Check for DC Voltage across Wire 23 and Wire 194 at the Customer Control Connection on the Integrated SACM board.	YES	Go To Next Step
		NO	Go to ***Test 4C1 – Check Wire 23 and 194 Circuits***
5	Check for AC Voltage at Pin 8 and Pin 4 on the white Molex Connector. **NOTE:** Leave one meter test lead in Pin 8 for remaining Steps 6 and 7.	YES	Go to Step 3 in this Test
		NO	Go To Next Step
6	Check for AC Voltage at Pin 8 of the white Molex Connector and Terminal 2 of the C2 Coil.	YES	Replace C2 Coil
		NO	Go To Next Step
7	Check for AC Voltage on Pin 8 and Terminal 1 of the XB1 Limit Switch.	YES	Replace XB1 Limit Switch
		NO	Go to ***Test 4B1 – Test Transfer Relay***

Integrated SACM Test 4B6 – Transfer to Utility Does Not Occur after Utility Returns

NOTE: Verify the integrity of all wires and connections relative to the function of the Integrated SACM. Utility Voltage must be available to perform this test. DC Voltage value should be at least 9 VDC.

NOTE: This procedure may require SD/WD 100000060381.

Step	Test Point	AC Voltage Present?	Action
1	Check for AC Voltage at the Utility Connection (before Utility Main Circuit Breaker)	YES	Go To Next Step
		NO	Check Utility Mains for AC Voltage
2	Check for AC Voltage on N1 and N2 (after Utility Main Circuit Breaker).	YES	Go To Next Step
		NO	Go To ***Test 4A6 – Check Main Circuit Breaker***
3	Check for DC Voltage across Wire 23 and Wire 194 at the Customer Control Connection on the Integrated SACM board.	YES	Go To ***Test 4C1 – Check Wire 23 and 194 Circuits***
		NO	Go To Next Step
4	Check for AC Voltage at Pin 3 (N1A) and Pin 6 (N2A) on the white Molex Connector. **NOTE:** Leave one meter test lead in Pin 8 for remaining Steps 5–8.	YES	Go To Next Step
		NO	Go to Step 2 in this Test
5	Check for AC Voltage at Pin 3 (N1A) and Pin 5 (N2A) of the white Molex Connector.	YES	Go To Next Step
		NO	Replace Integrated SACM board
6	Check for AC Voltage at Pin 3 (N1A) of the white Molex Connector and Terminal 2 of the C1 Coil.	YES	Go To Next Step
		NO	Replace C1 Utility Coil
7	Check for AC Voltage on Pin 3 (N1A) on the white Molex Connector and Terminal 1 of the XA1 Limit Switch. **NOTE:** Verify the transfer switch actuator lever is in the generator position (down).	YES	Replace the XA1 Limit Switch
		NO	Go To Next Step
8	Check for AC Voltage on Pin 3 (N1A) and Pin 2 (Wire 126) of the white Molex Connector.	YES	Go to ***Test 4B1 – Test Transfer Relay***
		NO	Go Step 3 in this Test

Introduction

This section familiarizes the technician with acceptable procedures for the testing and evaluation of various problems that can occur on RTS transfer switches. The numbered tests in this section correspond with the flow charts in Section 2.1 – ***Troubleshooting Flowcharts***.

Some test procedures in this section may require the use of specialized test equipment, meters or tools. Most tests can be performed with a digital multimeter (DMM). An AC frequency meter is required, where frequency readings must be taken. To measure AC loads it is acceptable to use a clamp-on ammeter.

Testing and troubleshooting methods covered in this section are not exhaustive. No attempt has been made to discuss, evaluate and advise the home standby service trade of all conceivable ways in which service and trouble diagnosis must be performed. Accordingly, anyone who uses a test method not recommended herein must first satisfy himself that the procedure or method he has selected will jeopardize neither his nor the products safety.

Safety

Service personnel who work on this equipment should be aware of the dangers of such equipment. Extremely high and dangerous voltages are present that can kill or cause serious injury. Gaseous fuels are highly explosive and can ignite by the slightest spark. Engine exhaust gases contain deadly carbon monoxide gas that can cause unconsciousness or even death. Contact with moving parts can cause serious injury. The list of hazards is seemingly endless.

When working on this equipment, use common sense and remain alert at all times. Never work on this equipment while physically or mentally fatigued. If you do not understand a component, device or system, do not work on it.

Transfer Switch Troubleshooting

It is always good practice to continue to ask questions during the troubleshooting process. When evaluating the problem, asking some of these questions may help identify the problem more quickly.

- What is the transfer switch doing?
- What was the transfer switch supposed to do?
- Does the transfer switch have the same fault consistently, and when does it occur?
- Who is controlling it?
- Exactly what is occurring?
- When is it happening?
- Why would this happen?
- How would this happen?
- What type of test will either prove or disprove the cause of the fault?

Test 4A1 – Check Voltage at Terminal Lugs E1 and E2

General Theory

While in AUTOMATIC mode, the standby closing coil (C2) energizes utilizing generator output to transfer to the STANDBY position. Transfer to STANDBY cannot occur unless generator voltage is available to the transfer switch.

If the generator is not producing the correct voltage it will shutdown on an under or over-voltage alarm and thus will not be running.

Two procedures have been provided for this test. The first procedure is performed in the event that the generator is already running in a utility failure. The second procedure is performed if the generator has already shutdown. It is not required to complete both procedures.

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: Dangerously high voltages are present at terminal lugs E1 and E2 when the generator is running.

Procedure 1: Generator Running in Utility Failure, Switch did not Transfer

1. Set a digital multimeter (DMM) to measure AC voltage.
2. If the generator engine has started automatically (due to a utility failure) and is running, check the position of the generator main line circuit breaker. The circuit breaker must be set to its “Closed” position. After confirming that the generator main circuit breaker is set to the “Closed” position, verify the voltage at transfer switch contactor terminal lugs E1 and E2 with an accurate AC meter. The meter should indicate generator line-to-line voltage.

Procedure 2: Generator Shutdown

1. Set the controller to OFF.
2. Set DMM to measure AC voltage.
3. Disconnect Utility voltage from the transfer switch.
4. Verify the contactor is in the UTILITY position.
5. Verify the generator main line circuit breaker (MLCB) is in the “Closed” position.
6. Set the controller to MANUAL.

7. If transfer to the STANDBY position does not occur, check the voltage across terminal lugs E1 and E2. The DMM should indicate generator line-line voltage.

Results

1. If normal transfer to the STANDBY position occurs, discontinue testing.
2. If transfer to the STANDBY position did not occur but the Generator continued to run for longer than 10 seconds, and the DMM did not indicate voltage across E1 and E2, perform *Preliminary Output Voltage Test* from the Air-Cooled Diagnostic Manual (P/N 10000041488).
3. If transfer to the STANDBY position did not occur and the DMM indicated proper voltage across E1 and E2 this test is GOOD. Refer to back to flow chart.
4. If transfer to the STANDBY position did not occur and the generator faulted on under-voltage, perform *Preliminary Output Voltage Test* from the Air-Cooled Diagnostic Manual (P/N 10000041488).

Test 4A2 – Check Manual Operation of Transfer Switch

General Theory

In automatic operating mode, when Utility source voltage drops below a preset level, the engine should crank and start. On engine startup, an “engine warm-up timer” on the generator should start timing. After the timer has expired (about 15 seconds), the transfer relay energizes to deliver generator source voltage to the standby closing coil terminals. If generator voltage is available to the standby closing coil terminals, but transfer to STANDBY does not occur, the cause of the failure may be (a) a failed standby closing coil and/or bridge rectifier, or (b) a seized or sticking actuating coil or load contact. This test will help to evaluate whether any sticking or binding is present in the contactor.

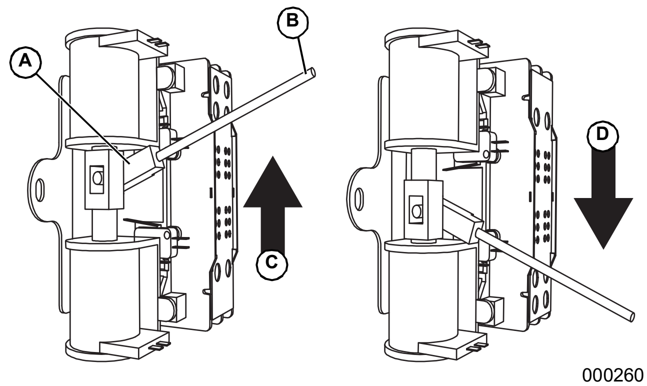
Procedure

1. Set the generator main line circuit breaker (MLCB) to the “Open” position.
2. Set the controller to OFF.
3. Disconnect Utility from the transfer switch.

⚠DANGER

Electrocution. Do not manually transfer under load. Disconnect transfer switch from all power sources prior to manual transfer. Failure to do so will result in death or serious injury, and equipment damage.
(000132)

4. Locate the manual transfer handle inside the switch enclosure.
5. See ***Figure 2-1***. Insert the un-insulated end of the handle over the transfer switch-operating lever.
6. Manually actuate the contactor lever up to the UTILITY position.
7. Actuate the operating lever down to the STANDBY position.
8. Repeat Step 5 several times. When the contactor lever is moved, slight force should be needed until the lever reaches its center position. As the lever moves past its “over center” position, an over-center spring should snap the movable LOAD contacts against the stationary STANDBY or UTILITY contacts.
9. Actuate the contactor to the UTILITY position.



A.Transfer switch-operating lever
B.Manual transfer handle
C.Load connected to utility power source

Figure 2-1. Manual Transfer Switch Operation

Results

1. If there is no evidence of binding, sticking, or excessive force required the test is GOOD. Refer back to the flow chart.
2. If evidence of sticking, binding, excessive force is required to move the contactor, find cause of binding or sticking and repair or replace damaged components.

Test 4C1 – Check Wire 23 and 194 Circuits

General Theory

An OPEN or improperly grounded circuit in either Wire 23 or Wire 194 will prevent a transfer from occurring. This test assumes that battery voltage is sufficient (at least 12.2 VDC).

NOTE: There are four variations of Transfer Relays. See Section 1.3 - ***Transfer Relay*** for pin and terminal identification.

Procedure/Results

1. Check for DC voltage at Wire 194 on the relay in the transfer switch. 10-12 Volts DC is sufficient.
   a. If DC voltage is not present at Wire 194, check for DC Voltage at the terminal block in the transfer switch and at the terminal block in the generator. If not present at either location, continue to Step 2.
   b. If DC voltage is present at Wire 194, proceed to Step 3.
2. Disconnect Wire 194 from the transfer switch side of the terminal block in the generator. Check for DC voltage at this terminal block.
   a. If DC voltage is now present but wasn't before, check for a short to ground between generator and transfer switch.
   b. If DC voltage is not present at the terminal block, verify the presence of DC Voltage at the generator controller and for connector/wire/pin integrity. See ***Appendix A – Controller Identification*** in the Air-Cooled Diagnostic Manual (P/N 10000041488 Rev. C or higher) for specific pin location.
3. With the generator running (MANUAL or AUTO), connect a jumper wire from ground to Wire 23 located at the terminal block in the transfer switch. Listen for the energizing of the relay and for the transfer to standby.
   a. If the relay energized (clicked) and the contactor transferred to the STANDBY position, proceed to ***Test 4C2 – Check Wire 23***.
   b. If the CONTACTOR did not transfer to the STANDBY position and the relay DID or DID NOT energize, proceed to ***Test 4B1 – Test Transfer Relay***.

Test 4B1 – Test Transfer Relay

General Theory

In automatic mode, transfer to standby will not occur until the transfer relay energizes. When the relay energizes, generator source voltage is available to operate the standby closing coil. Without generator source voltage available, the closing coil will remain de-energized and transfer to the STANDBY position will not occur. This test will determine if the relay is functioning normally.

NOTE: There are four variations of Transfer Relays. See Section 1.3 - ***Transfer Relay*** for pin and terminal identification.

Procedure

1. See appropriate figure for the relay being tested.
   a. For an independently mounted relay, disconnect all wires from the relay to prevent interaction.
   b. For the Integrated SACM, disconnect the 8-Pin Molex connector and Wires 194 and 23 to prevent any possible interaction.
2. Set DMM to measure resistance.
3. With wires disconnected, connect the DMM test leads across terminals for Wires 194 and 23. Measure and record the resistance. See appropriate table for proper resistance values.
4. Using jumper wires and a new (fully charged) 9V alkaline all-purpose battery, connect one jumper wire from the positive post of the battery to the relay terminal that had Wire 194 and connect the other jumper wire from the negative post of the battery to the relay terminal that had Wire 23.
5. Set DMM to measure continuity.
6. Based on the relay being tested per ***Table 2-2***, ***Table 2-3***, ***Table 2-4***, and ***Table 2-5***, connect the DMM test leads across the appropriate relay Terminals. Measure and record the resistance while energized and then de-energized.
   a. With the relay energized the DMM should indicate either INFINITY or CONTINUITY according to the appropriate table.
   b. With the relay de-energized the DMM should indicate CONTINUITY or INFINITY according to the appropriate table.

Table 2-2. Clear Transfer Relay (Ice Cube)

Connect DMM Test Leads Across:	Desired Meter Reading	
	Energized	De-Energized
Terminals 6 and 9	Continuity	Infinity
Terminals 1 and 7	Infinity	Continuity
Terminals A and B		120 Ohms

Table 2-3. Clear Transfer Relay (small) OMRON®

Connect DMM Test Leads Across:	Desired Meter Reading	
	Energized	De-Energized
Terminals 4 and 6	Continuity	Infinity
Terminals 1 and 5	Infinity	Continuity
Terminals 7 and 8 (Coil)		160 Ohms

Table 2-4. Yellow Transfer Relay (small) IDEC®

Connect DMM Test Leads Across:	Desired Meter Reading	
	Energized	De-Energized
Terminals 8 and 12	Continuity	Infinity
Terminals 1 and 9	Infinity	Continuity
Terminals 13 and 14 (Coil)		163 Ohms

Table 2-5. Integrated SACM		
Connect DMM Test Leads Across:	Desired Meter Reading	
	Energized	De-Energized
Pins 4 and 8	Continuity	Infinity
Pins 2 and 3	Infinity	Continuity
Wires 23 and 194		335 Ohms ± 10%

Results

1. Compare the results with the appropriate table.
   a. If the relay tests good, refer back to flow chart.
   b. If the relay test bad, replace the relay or appropriate component.

NOTE: The relay is integral to the Integrated SACM and cannot be replaced as a separate component. The complete module would need to be replaced if defective.

Test 4A3 – Test Standby Control Circuit

General Theory

See ***Figure 2-2***. The standby coil (C2) requires 240 VAC to energize. When the transfer relay energizes, 240 VAC is applied to the C2 coil. Once energized, the coil will pull the contactor down to the STANDBY position. Once in the STANDBY position, the limit switch (XB1) will open, removing AC voltage from the C2 coil.

Procedure/Results

1. Set the DMM to measure AC voltage.
2. Measure between the E2 terminal and Terminal 2 of the C2 coil, the DMM should indicate 240 VAC.
   a. If 240 VAC was not measured, continue testing.
   b. If 240 VAC was measured, replace the C2 coil.
3. Verify the contactor is in the UTILITY position.

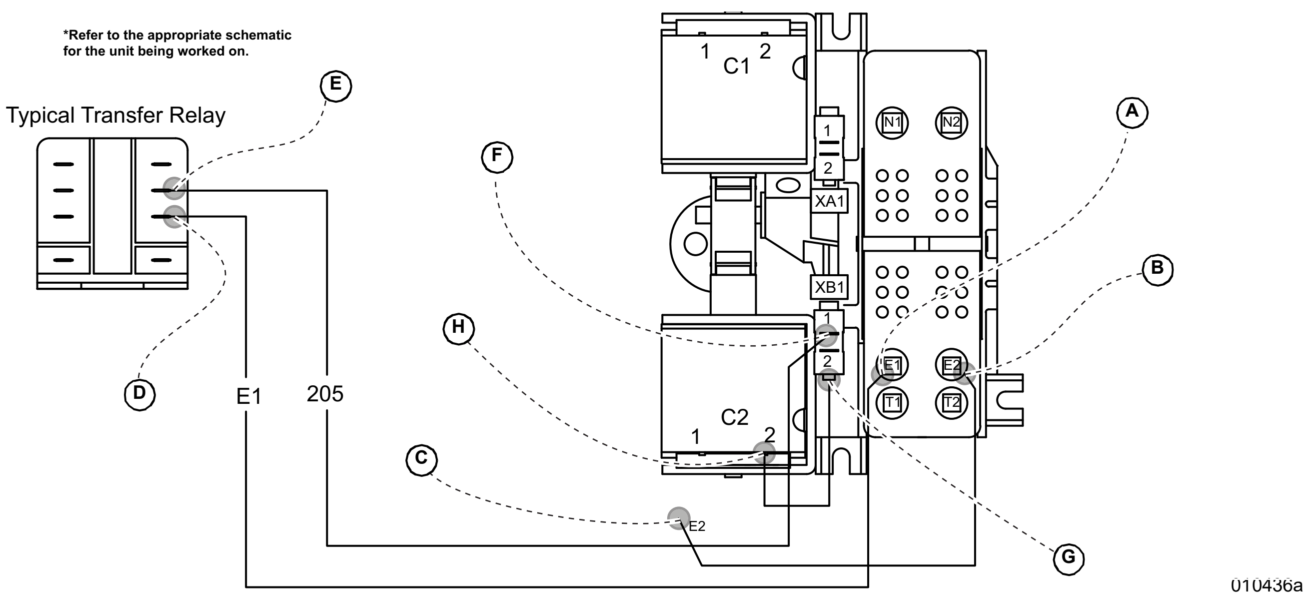


Figure 2-2. Typical Standby Control Circuit Test Points*

4. Remove Wire B from the C2 coil.
5. Set the controller to AUTO mode. Turn off utility power supply to the transfer switch, simulating a utility failure. The generator should start and the transfer relay should energize.
6. Measure across lugs E1 and E2, the DMM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, go back to Test 20.
   b. If 240 VAC was measured, proceed to Step 7.
7. Measure for the voltage on Wire B from the lug to 1 of the C2 coil (Wire B previously removed from the coil) and B, the DMM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, repair or replace Wire E2.
   b. If 240 VAC was measured, proceed to Step 8.
8. Measure between the E2 lug and E1 on the relay (or E1 lug and E2A on the relay) depending on production year. The DMM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, repair or replace Wire E1 or E2A.
   b. If 240 VAC was measured, proceed to Step 8.
9. Measure between Wire E2 (or E2A) and terminal containing Wire 205. The DMM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, replace transfer relay.
   b. If 240 VAC was measured, proceed to Step 10.

10. Measure between the E2 terminal and the top terminal of XB1 the DMM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, repair or replace Wire 205.
    b. If 240 VAC was measured, proceed to Step 11.
11. Measure between the E2 terminal and the bottom terminal of XB1. The DMM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, verify the limit switch (XB1) is wired correctly, proceed to ***Test 4A5 – Test Limit Switches***.
    b. If 240 VAC was measured, proceed to Step 12.
12. Measure between the E2 terminal and terminal 2 of the C2 coil, the DMM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, repair or replace Wire B.
    b. If 240 VAC was measured, replace the C2 coil.

Test 4C2 – Check Wire 23

General Theory

The controller located in the generator is responsible for grounding Wire 23 to initiate a transfer. When Wire 23 closes to ground the transfer relay energizes. To initiate a transfer back to Utility the relay must de-energize. If the relay is staying energized, a faulty Wire 23 could be the cause. This test assumes that battery voltage is sufficient (at least 12.2 VDC).

NOTE: There are several variations of generator connection points. See ***Section 3.1 - Description and Major Components*** in the Air-Cooled Diagnostic Manual (P/N 10000041488) for generator interconnections, pin locations, and terminal identification.

Procedure/Results

1. Set the controller to OFF.
2. Set the DMM to measure DC voltage.
3. Disconnect and isolate Wire 23 from the transfer switch side of the terminal block *in the generator*. Observe the transfer switch.
    a. If the transfer relay DID NOT de-energize and the transfer switch DID NOT return to Utility, proceed to Step 7.
    b. If the transfer relay de-energized and the transfer switch returned to Utility, proceed to the next step.
4. Set the controller to the AUTO mode. Utility voltage must be present. Verify that Utility is present at N1 and N2 Terminal Block in the generator.
5. See ***Figure 2-3***. Using the appropriate menu map, access the OUTPUTS display via the DEALER menu.

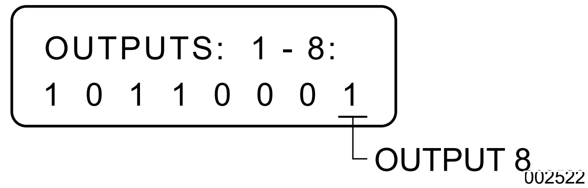


Figure 2-3. The Output Screen – Output 8

6. Digital Output 8 is the Wire 23 output from the controller.
    a. If Output 8 is displaying a “1”, the control board is grounding Wire 23. Replace the controller.
    b. If Output 8 is displaying a “0”, the control board is NOT grounding Wire 23, proceed to the next step.
7. Verify Wire 23 is disconnected from the transfer switch side of the terminal block *in the generator*.
8. Connect the positive meter test lead to Wire 194 at the terminal block *in the generator* and connect the negative meter test lead to the ground lug. Verify that DC Voltage is present.
    a. If DC Voltage was NOT measured, refer back to the flowchart (Test 4C1).
    b. If DC Voltage was measured, proceed to the next step.
9. With Wire 23 removed from the terminal block in the Step 7 (transfer switch side), check the voltage between Wire 23 previously disconnected and ground.
    a. If no DC Voltage was measured, an open exists on Wire 23 between the generator and transfer switch. Repair or replace Wire 23 as needed.
    b. If low DC Voltage was measured (less than ½ volt), a short to ground exists on Wire 23 between the generator and transfer switch. Repair or replace Wire 23 as needed.

Test 4A4 – Test Utility Control Circuit

General Theory

See ***Figure 2-4***. The utility coil (C1) requires 240 VAC to energize. When the transfer relay de-energizes, 240 VAC is applied to the C1 coil. Once energized, the coil will pull the CONTACTOR up to the “Utility” position. Once in the UTILITY position, the limit switch (XA1) will open, removing AC voltage from the C1 coil.

Procedure

1. Set the controller to OFF. Disconnect Wire 194 from the transfer switch terminal strip.
2. Set DMM to measure AC voltage.
3. Disconnect Utility supply voltage from the transfer switch.

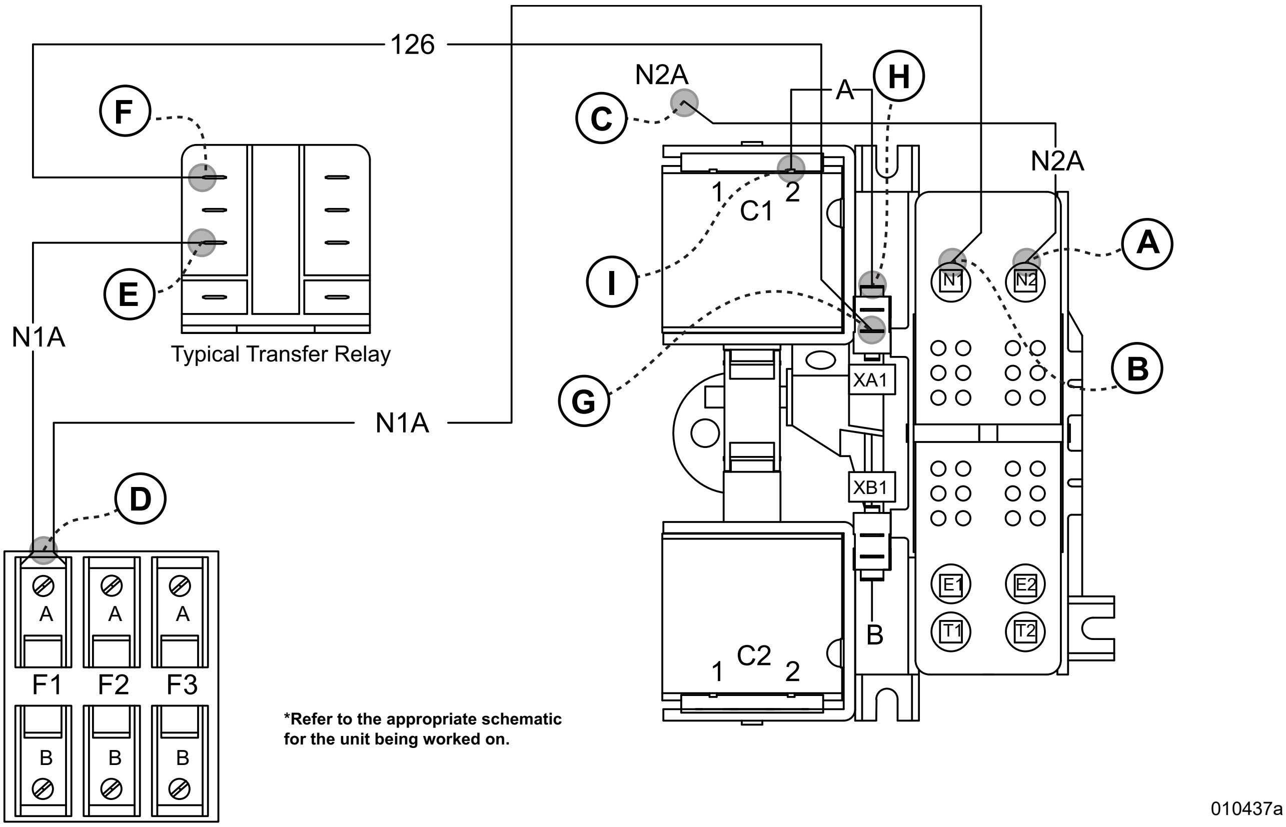


Figure 2-4. Typical Utility Control Circuit Test Points

4. Verify the transfer switch is in the STANDBY position.
5. Turn on Utility supply voltage to the transfer switch.
   a. If transfer to Utility occurs, the transfer relay was energized preventing a re-transfer to Utility. Proceed to ***Test 4C2 – Check Wire 23***.
   b. If transfer to Utility does NOT occur, proceed to Step 7.
6. Remove two wires from the utility coil and check for 240 VAC.
   a. If 240 VAC is measured check utility coil for continuity.
   b. If 240 VAC is not measured proceed to Step 9.
7. Checking coil continuity:
   a. If continuity is measured proceed to Step 8.
   b. If there is no continuity, replace the coil.
8. Measure the voltage across point C (Wire N2A previously removed) and B, the DMM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, repair or replace Wire N2A.
   b. If 240 VAC was measured, proceed to Step 9.
9. Measure for voltage between the N2 lug and the F1 terminal A. The DMM should indicate 240 VAC.
   a. If 240 VAC was NOT measured, repair or replace Wire N1A.
   b. If 240 VAC was measured, proceed to Step 10.
10. Measure for voltage from the N2 lug and the relay terminal where Wire N1A lands. The DMM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, repair or replace Wire N1A.
    b. If 240 VAC was measured, proceed to Step 11.
11. Measure for voltage between the N2 lug and the relay terminal where Wire 126 lands. The DMM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, replace transfer relay.
    b. If 240 VAC was measured, proceed to Step 12.
12. Measure for voltage between the N2 lug and the lower terminal of XA1. The DMM should indicate 240 VAC.
    a. If 240 VAC was NOT measured, repair or replace Wire 126.
    b. If 240 VAC was measured, proceed to Step 13.
13. Measure for voltage between the N2 lug and the upper terminal of XA1. The DMM should indicate 240 VAC.
    a. If 240 VAC was not measured, verify the limit switch (XA1) is wired correctly and proceed to ***Test 4A5 – Test Limit Switches***.
    b. If 240 VAC was measured, proceed to Step 14.

14. Measure for voltage between the N2 lug and terminal 2 of the C1 coil. The DMM should indicate 240 VAC.
    a. If 240 VAC was not measured, repair or replace Wire A.
    b. If 240 VAC was measured, replace the C1 coil.

Test 4A5 – Test Limit Switches

General Theory

Wired to the normally CLOSED contacts, the limit switches provide a means to interrupt the transfer circuits. When the CONTACTOR changes position, the limit switch contacts change state to become OPEN.

Procedure

With the controller set to OFF, the generator main circuit breaker "Open", and Utility Voltage disconnected from the transfer switch, test limit switches XA1 and XB1 as follows.

1. To prevent interaction, disconnect Wire 126 and Wire A from the limit switch (XA1) terminals.
2. Set the DMM to measure resistance.
3. Connect the DMM meter test leads across the two outer terminals on XA1 from which the wires were disconnected.
4. Manually actuate the CONTACTOR to the "Standby" position. Measure and record the resistance.
5. Manually actuate the CONTACTOR to the "Utility" position. Measure and record the resistance.
6. Repeat Step 4 and 5 several times and verify the DMM reading at each switch position.
7. To prevent interaction, disconnect Wire 205 and Wire B from the limit switch (XB1) terminals.
8. Connect the DMM meter test leads across the two outer terminals on XB1 from which the wires were disconnected.
9. Manually actuate the CONTACTOR to the "Standby" position. Measure and record the resistance.
10. Manually actuate the CONTACTOR to the "Utility" position. Measure and record the resistance.
11. Repeat Step 4 and 5 several times and verify the DMM reading at each switch position.

Coil Nominal Resistance: 480-520k ohms

Results

1. If the DMM indicated CONTINUITY in Step 4 and 10 and INFINITY in Step 5 and 9 the limit switches are good. Refer back to flowchart.
2. If DMM did NOT indicate CONTINUITY in Step 4 or 10 and INFINITY in Step 5 or 9 the limit switch(es) are bad. Repair or replace appropriate switch(es).

Test 4B2 – Check Fuses F1 (N1) and F2 (N2)

General Theory

Fuses F1 and F2 are connected in series with the N1 and N2 circuits, respectively. A blown fuse will open the applicable circuit and will result in (a) generator startup and transfer to the "Standby", or (b) failure to re-transfer back to utility source.

Procedure

1. On the generator panel, set the controller to OFF.
2. Disconnect Utility from the transfer switch.
3. See ***Figure 2-5***. Remove fuse F1 (N1) and F2 (N2) from the fuse holder.
4. Inspect and test fuses for an OPEN condition with a DMM set to measure resistance. CONTINUITY should be measured across the fuse.

Results

1. Replace blown fuse(s) as needed.

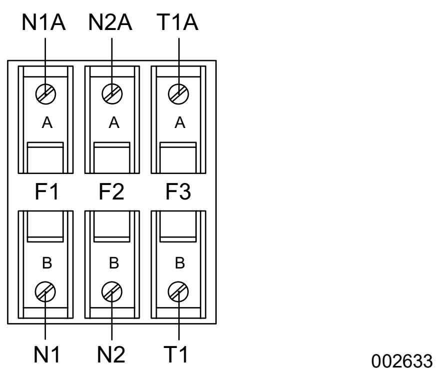


Figure 2-5. Transfer Switch Fuse Block

Test 4B3 – Check Fuse F3 (T1)

General Theory

Connected in series with Load Wire T1, F3 provides 120 VAC to the generator to operate the battery charger. A blown fuse will result in a possible dead battery situation.

Procedure

1. On the generator panel, set the controller to OFF.
2. Disconnect Utility from the transfer switch.
3. Remove fuse F3 (T1) from the fuse holder.
4. Inspect and test fuses for an OPEN condition with a DMM set to measure resistance. CONTINUITY should be measured across the fuse.

Results

1. Replace blown fuse as needed.

Test 4A6 – Check Main Circuit Breaker

General Theory

Often the most obvious cause of a problem is overlooked. If the generator main line circuit breaker (MLCB) is set to “Open”, the electrical loads will not receive power. If the connected loads are not receiving voltage a possible cause could be, the MLCB has failed OPEN.

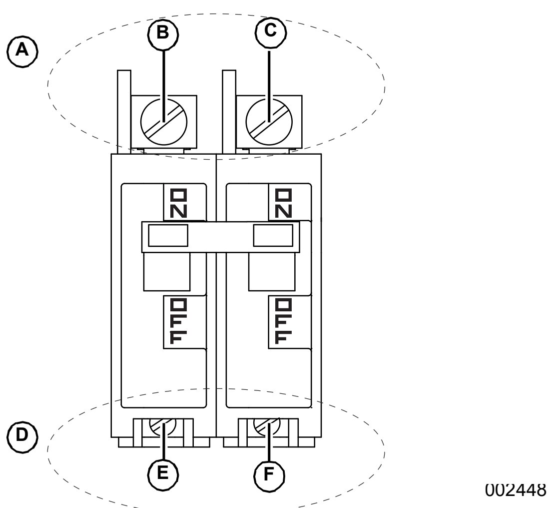
Procedure

The generator main line circuit breaker (MLCB) is located underneath the control panel side cover. If loads are not receiving power, verify the breaker is set to the “Closed” position. If the beaker is suspected to have failed, test it as follows.

1. Set the DMM to measure resistance.
2. With the generator shutdown, disconnect all wires from the MLCB terminals, to prevent interaction.
3. See *Figure 2-6*. Connect one meter test lead to the Wire 11 terminal on the breaker and the other test lead to the E1 terminal.
4. Set the breaker to its “Closed” position; the DMM should indicate CONTINUITY.
5. Set the breaker to its “Open” position; the DMM should indicate INFINITY.
6. Repeat Step 4 and 5 with the DMM meter leads connected across the Wire 44 terminal and the E2 terminal.

Results

1. If the circuit breaker tests good, refer back to the flow chart.
2. If the breaker failed Steps 4 or 5, replace the breaker.



A. Line Side
B. 11
C. 44
D. Load Side
E. E1
F. E2

Figure 2-6. Main Line Circuit Breaker

Test 4C3 – Check N1 and N2 Wiring

General Theory

A shorted Wire N1 or N2 to ground can cause fuse F1 (N1) or F2 (N2) to blow.

Procedure

1. On the generator panel, set the controller to OFF.
2. Turn off the utility power supply to the transfer switch, using whatever means provided.
3. Remove fuses F1 (N1), F2 (N2), and F3 (T1) from the fuse holder.
4. Remove the generator control panel cover. Disconnect the connector that supplies the controller T1 located in the control panel.
5. Set DMM to measure resistance.
6. Connect the positive meter test lead to Wire N1 at the terminal block in the control panel.
   a. Connect the negative meter lead to the ground lug. INFINITY should be measured.
   b. Connect the negative meter lead to Wire 23 at the terminal strip. INFINITY should be measured.
   c. Connect the negative meter lead to Wire 194 at the terminal strip. INFINITY should be measured.
   d. Connect the negative meter lead to Wire 0 at the terminal strip. INFINITY should be measured.
   e. Connect the negative meter lead to Wire N2 at the terminal block. INFINITY should be measured.
   f. Connect the negative meter lead to the neutral connection. INFINITY should be measured.
7. Connect the positive meter test lead to Wire N2 at the terminal block in the control panel.
   a. Connect the negative meter lead to the ground lug. INFINITY should be measured.
   b. Connect the negative meter lead to Wire 23 at the terminal strip. INFINITY should be measured.
   c. Connect the negative meter lead to Wire 194 at the terminal strip. INFINITY should be measured.
   d. Connect the negative meter lead to Wire 0 at the terminal strip. INFINITY should be measured.
   e. Connect the negative meter lead to the neutral connection. INFINITY should be measured.

Results

If a short is indicated in Step 6 or Step 7, repair wiring and repeat test.

Test 4C4 – Check N1 and N2 Voltage

General Theory

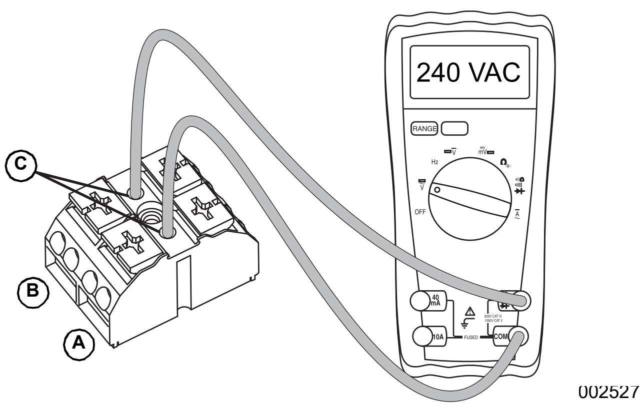
Loss of utility source voltage to the generator will initiate a startup and transfer by the generator. Testing at the control panel terminal block will divide the system in two, thereby reducing troubleshooting time.

Procedure

1. Set the controller to OFF.
2. Set a DMM to measure AC voltage.
3. See ***Figure 2-7***. Connect one test lead to Wire N1 at the terminal block in the generator control panel. Connect the other test lead to Wire N2. Utility line-to-line voltage should be measured.

Results

Refer to **Flow Chart**.



A. N1
B. N2
C. Test Points

Figure 2-7. Terminal Block Test Points

Test 4C5 – Check Utility Sensing Voltage at the Controller

General Theory

If the generator starts and transfer to STANDBY occurs in automatic mode when acceptable UTILITY source voltage is available at the terminal block, the next step is to determine if sensing voltage is reaching the controller.

NOTE: The System Ready LED will flash in AUTO or UTILITY LOST will display on the panel.

Procedure

1. Set the controller to OFF.
2. Disconnect the harness connector containing Wires N1 and N2 from the controller.
3. Set a DMM to measure AC voltage.
4. Connect one meter test lead to Wire N1. Connect the other meter test lead to Wire N2. Approximately 240 VAC should be measured.

Results

1. If voltage was measured in Step 4 and the pin connections are good, replace the circuit board.
2. If voltage was NOT measured in Step 4, repair or replace Wire N1/N2 between connector and terminal block.

Test 4C6 – Check Utility Sense Voltage

The N1 and N2 terminals in the transfer switch deliver utility voltage “sensing” to a circuit board. If voltage at the terminals is zero or low, standby generator startup and transfer to the “Standby” source will occur automatically as controlled by the circuit board. Zero or low voltage at these terminals will also prevent transfer back to the “Utility” source.

Procedure

With utility source voltage available to terminal lugs N1 and N2, use a DMM to test for utility source line-to-line voltage across terminal locations N1 and N2 terminals. Normal line-to-line utility source voltage should be indicated.

Results

1. If voltage reading across the N1 and N2 terminals is zero or low, refer to **Flow Chart**.
2. If voltage reading is good, refer to **Flow Chart**.

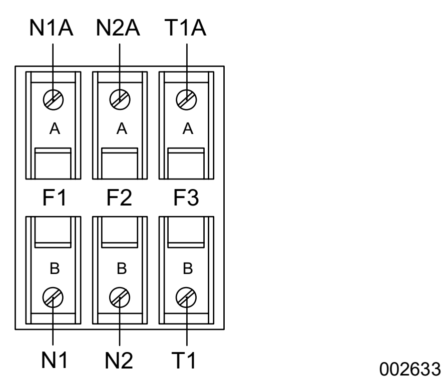


Figure 2-8. Transfer Switch Fuse Block

Test 4C7 – Check T1 Wiring

General Theory

If the T1 wiring is shorted to ground can cause the F3 fuse to blow.

Procedure

1. Set the controller to OFF.
2. Remove F1, F2, and F3 from the fuse holder in the transfer switch.
3. Disconnect the proper controller harness connector that has Wire T1 in it from the controller.
4. Set the DMM to measure resistance.

   a. Connect one meter test lead to T1 on the customer connection in the generator and the other meter lead to ground. Measure and record the resistance.
   b. Connect one meter test lead to T1 on the customer connection in the generator and the other meter test lead to Wire 194. Measure and record the resistance.
   c. Connect one meter test lead to T1 on the customer connection in the generator and the other meter test lead to Wire 23. Measure and record the resistance.
   d. Connect one meter test lead to T1 on the customer connection in the generator and the other meter test lead to Wire N1. Measure and record the resistance.
   e. Connect one meter test lead to T1 on the customer connection in the generator and the other meter test lead to Wire N2. Measure and record the resistance.

Results

1. If the DMM indicated INFINITY in Steps 4a -4e, replace the controller.
2. If the DMM indicated CONTINUITY, repair or replace the wiring in the appropriate circuit.

Test 4D1 – Test SMM Contactor Line, Load and Control

General Theory

The SMM Load Shed Module (integral to load shedding) requires line voltage from either the utility or the generator for it to operate. If line voltage is present, but the SMM is still not operating, this test will confirm the proper operation of the contactor.

Required Tools

- Meter test leads that are capable of measuring voltage.
- Phillips screwdriver.

Procedure

1. Remove the four (4) screws securing the cover to the SMM Load Shed Module.
2. Verify the LED is ON, but not flashing.
   a. If the LED is OFF or flashing in any interval, return to the flowchart.
3. Set the DMM to measure AC volts.
4. Place the meter leads across the line (input) terminals and record the voltage.
5. Place the meter leads across the load (output) terminals and record the voltage.

Results

1. If the meter indicated less than approximately 240 VAC in Step 4, stop testing and check source voltage coming from the circuit breaker.
2. If the meter indicated approximately 240 VAC in Step 4, but not in Step 5, replace the contactor.

Universal Wire 23 and 194 Quick Diagnostic

Generator runs but does not transfer to Standby

1. Verify generator main line circuit breaker (MLCB) is ON (closed).
2. Place controller in MANUAL and allow unit to start and run.
3. Check for rated AC voltage output at generator MLCB. If voltage is below rated output, perform Preliminary Output Voltage Test from the Air-Cooled Diagnostic Manual (P/N 10000041488).
4. Place the utility source breaker (MLCB) in the OFF (open) position.
5. After the Utility Loss Delay timer expires, Wire 23 will close to ground in the controller and the transfer switch should transfer to Standby.

NOTE: If transfer switch did not transfer to the standby position proceed with the next steps.

6. Locate Wire 23 and Wire 194 at the WAGO block (or connection point) in the transfer switch.

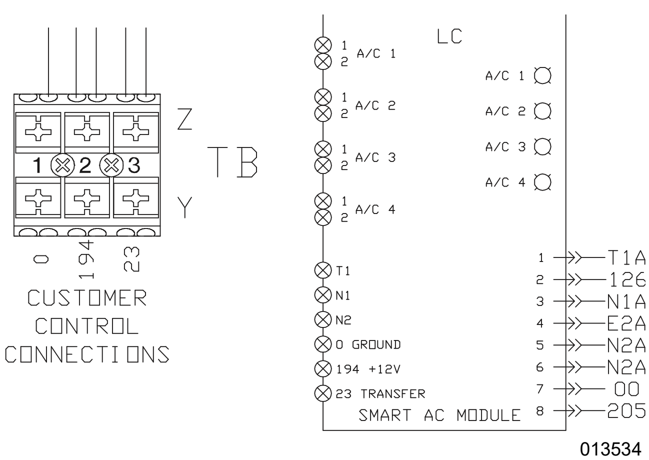


Figure 2-9. Transfer Switch Connections

7. Set a digital multimeter (DMM) to measure DC Voltage. Measure voltage on Wire 194 to ground lug on the transfer switch.
   a. If voltage is present (minimum 10 VDC) go to next step.
   b. If voltage is not present, a problem exists on Wire 194.

NOTE: If voltage is not measured on Wire 194, Wire 194 will need to be traced back to the generator set control board. Perform a continuity test of the circuit or a voltage potential test to ground, looking for the break in the circuit or a faulty control board (no output on Wire 194).

NOTE: Wire 194 is a protected circuit. Voltage on this wire falls to zero a short (to ground) exists.

8. Set DMM to measure DC Voltage. Measure voltage on Wire 23 to ground lug on the transfer switch.
   a. If voltage is present (approximately the same voltage measured on Wire 194), a problem exists on Wire 23.
   b. If voltage is not present, or a very low voltage is measured (0.1 to 0.2 VDC) there is a problem with the coil in the transfer relay, wiring harness in the switch, or the switch mechanism.

NOTE: To test the coil of the relay for resistance, set DMM to measure to resistance. Measure the resistance of the coil. If an open is measured or the coil reads 0 ohms, replace the relay. If the relay tests Good then the problem is in the harness or the mechanism.

NOTE: There are four variations of Transfer Relays. See Section 1.3 – ***Transfer Relay*** for pin and terminal identification.

NOTE: If voltage is measured on Wire 23, Wire 23 will need to be traced back to the generator set control board. Perform a continuity test of the circuit or a voltage potential test to ground, looking for the break in the circuit or a faulty control board (no grounding on Wire 23).

Utility is available but switch does not transfer to Utility.

NOTE: This test is done once the control board has sensed that Utility voltage has returned and the Utility voltage falls within acceptable parameters. Utility voltage can be verified by looking at the input display of the Evolution control board. If Utility voltage is not being displayed on the Control board, the control board is not sensing Utility voltage. The switch will not be allowed to transfer back to the utility position.

1. Set DMM to measure DC Voltage. Measure voltage on Wire 23 to ground lug on the transfer switch.
   a. If voltage is present (approximately the same voltage measured on Wire 194), a problem exists in the transfer relay contacts, wiring harness in the switch or the switch mechanism.
   b. If voltage is not present, or a very low voltage is measured (0.1 to 0.2 VDC) a problem exists on Wire 23 (possible wire shorted to ground).

NOTE: To check Wire 23 for a short to ground, isolate Wire 23 at both ends of the circuit (transfer switch end and generator control board end). Set DMM to measure resistance and measure Wire 23 to ground. If there is continuity to ground then an inspection of Wire 23 will need to be performed. look for the short to ground. Repair or replace as needed. If the wire is open from ground then the control board will need to be checked for a faulty Wire 23.

50 Amp W-Type RTG Transfer Switch – No Transfer to Standby

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Remove all power sources from switch.
2. Set a digital multimeter (DMM) to measure resistance (Ω).
3. Disconnect and measure for resistance between limit switch LS2 and closing coil C1.
4. Disconnect and measure for resistance between main lug E2 and limit switch LS2.

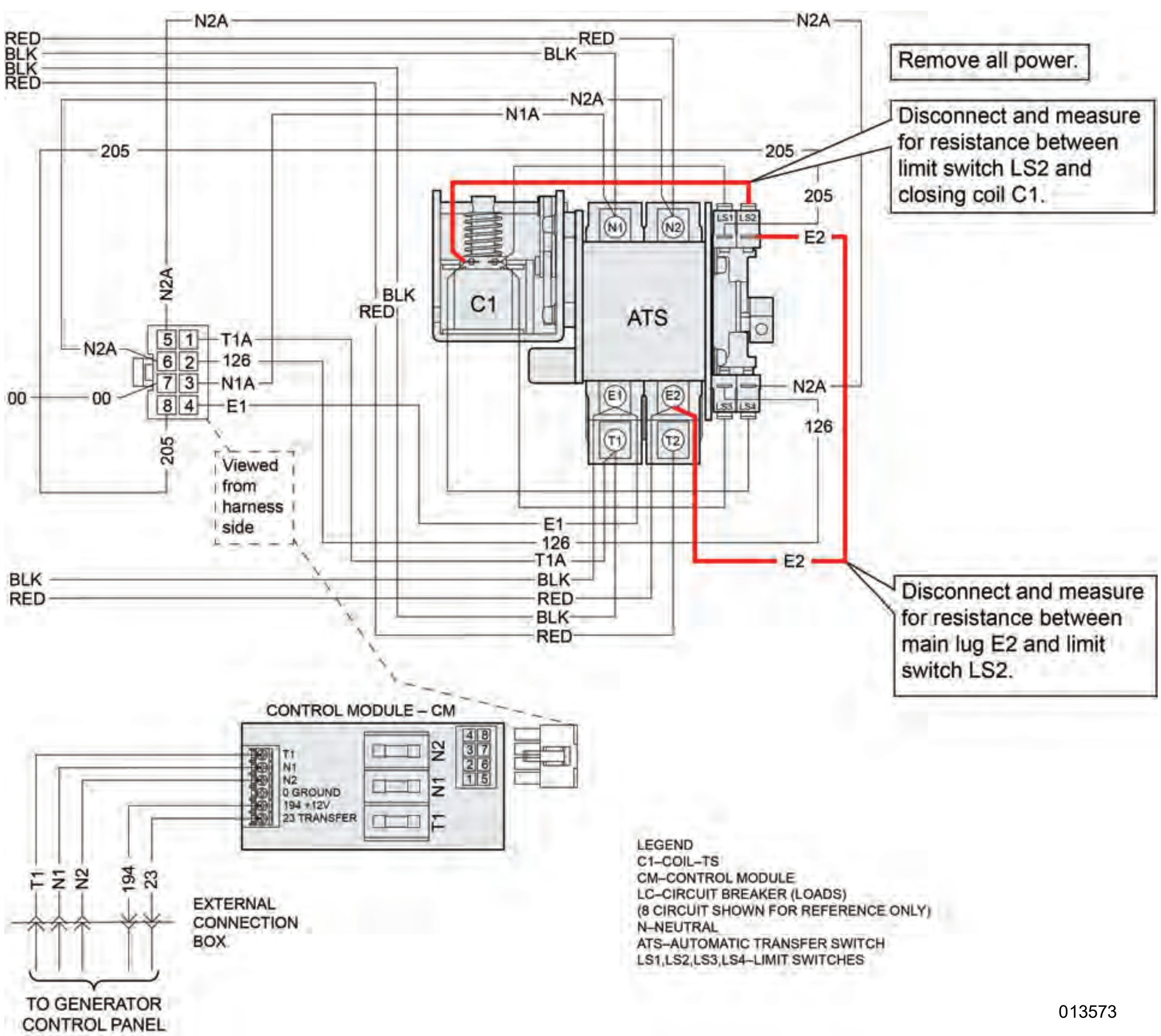


Figure 2-10.

50 Amp W-Type RTG Transfer Switch – No Transfer to Standby

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Set DMM to measure AC voltage.
2. Place the black test lead on main lug E2 of the transfer switch.
3. Measure for AC voltage at C1.
4. Measure for AC voltage at limit switch LS1.
5. Measure for AC voltage on Wire 205 control board pin 8.
6. Measure for AC voltage on Wire E1 control board pin 4.
7. Measure for AC voltage at main lug E1.

NOTE: Transfer switch is live throughout this test.

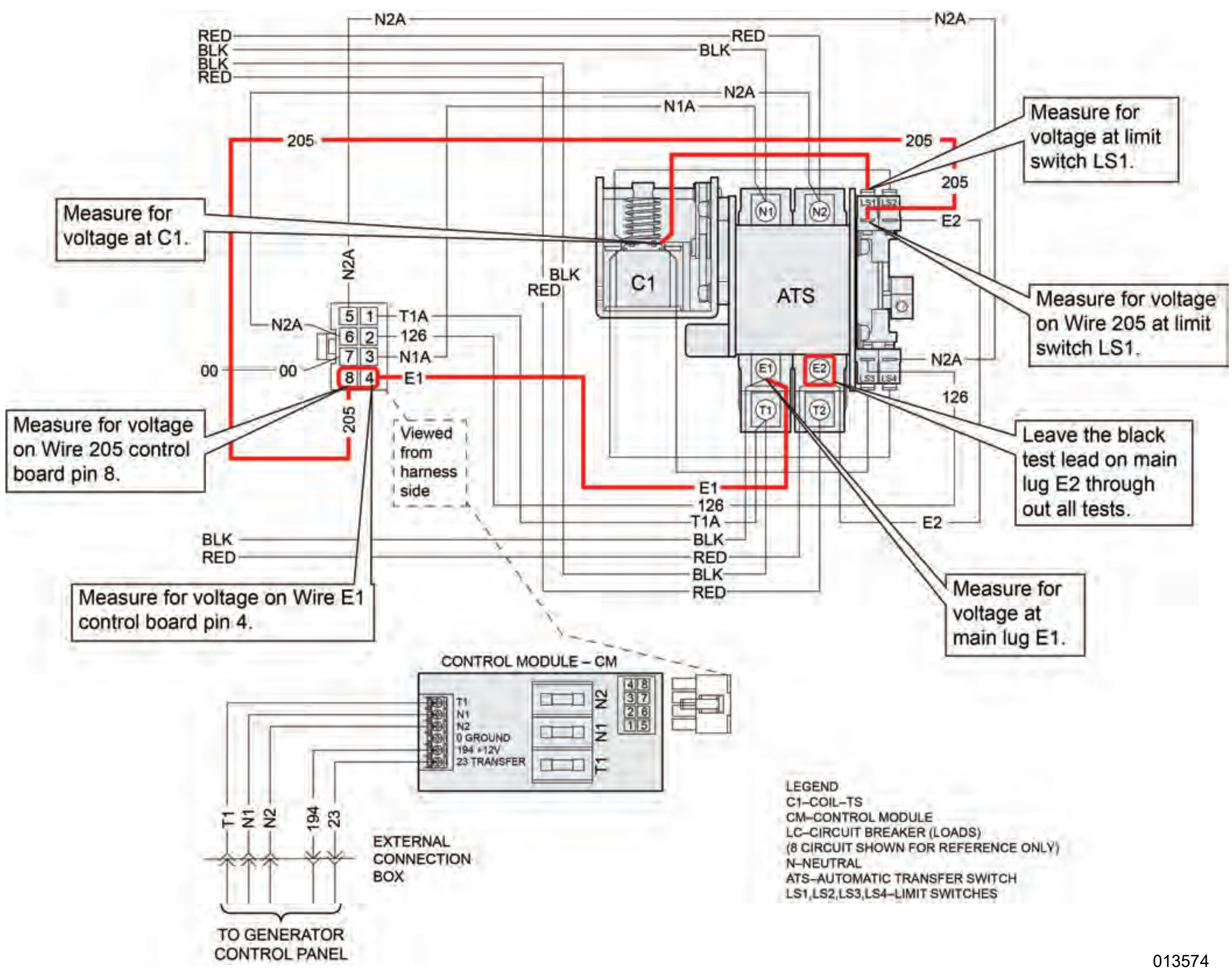


Figure 2-11.

50 Amp W-Type RTG Transfer Switch – No Transfer to Utility

⚠DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Remove all power sources from switch.
2. Set DMM to measure resistance (Ω).
3. Disconnect harness from module.
4. Measure resistance of Pin 5, Wire N2A to limit switch LS4.
5. Measure resistance of Pin 6, Wire N2A to main lug N2.

NOTE: Transfer switch is live throughout this test.

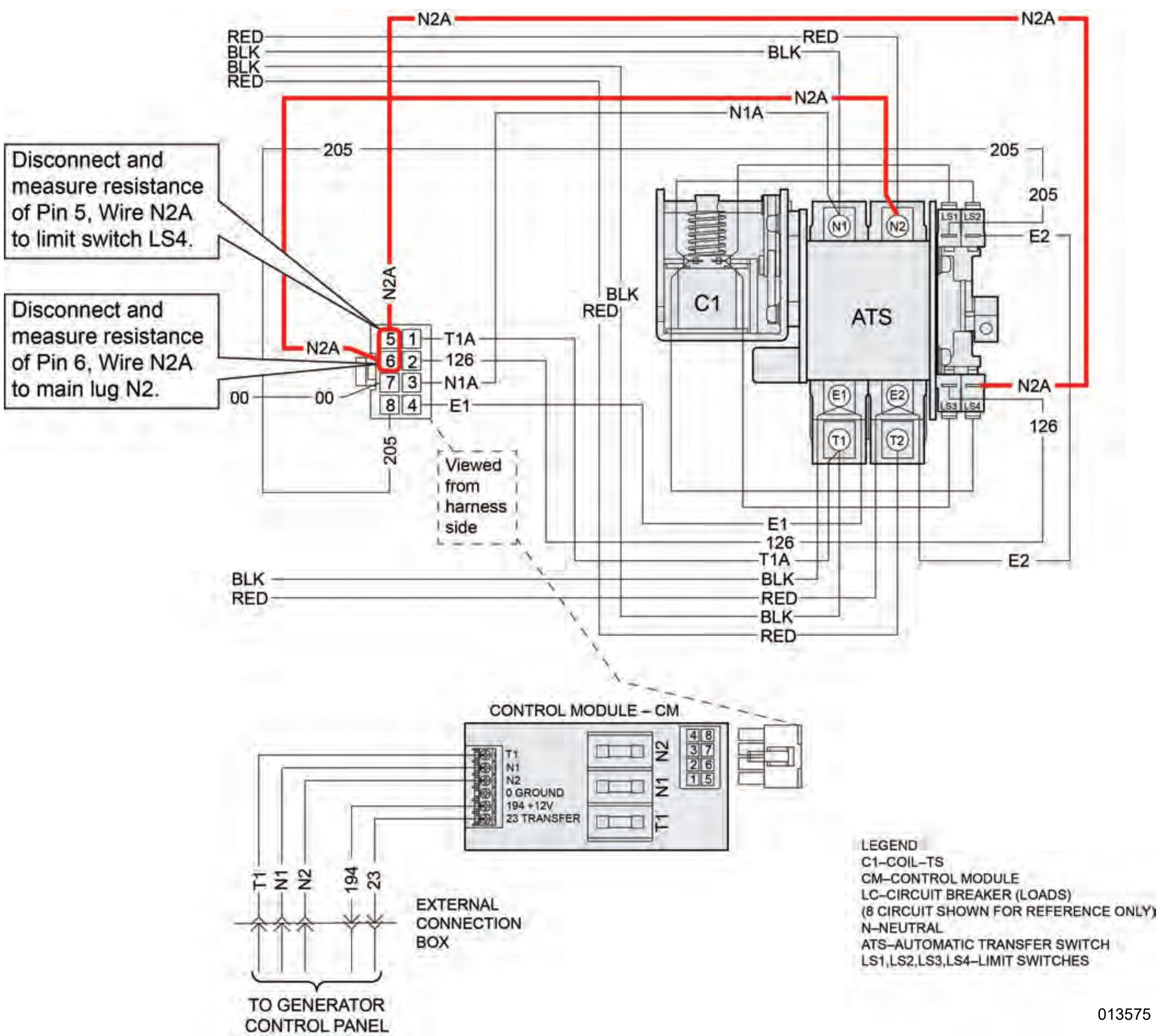


Figure 2-12.

50 Amp W-Type RTG Transfer Switch – No Transfer to Utility

⚠DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Set DMM to measure AC voltage.
2. Place the black test lead on main lug N2 of the transfer switch.
3. Measure for AC voltage at C1.
4. Measure for AC voltage at limit switch LS3.
5. Measure for AC voltage on Wire 126 limit switch LS3.
6. Measure for AC voltage on Wire 126 control board pin 2.
7. Measure for AC voltage on Wire N1A control board pin 3.
8. Measure for AC voltage on Wire N1A at main lug N1.

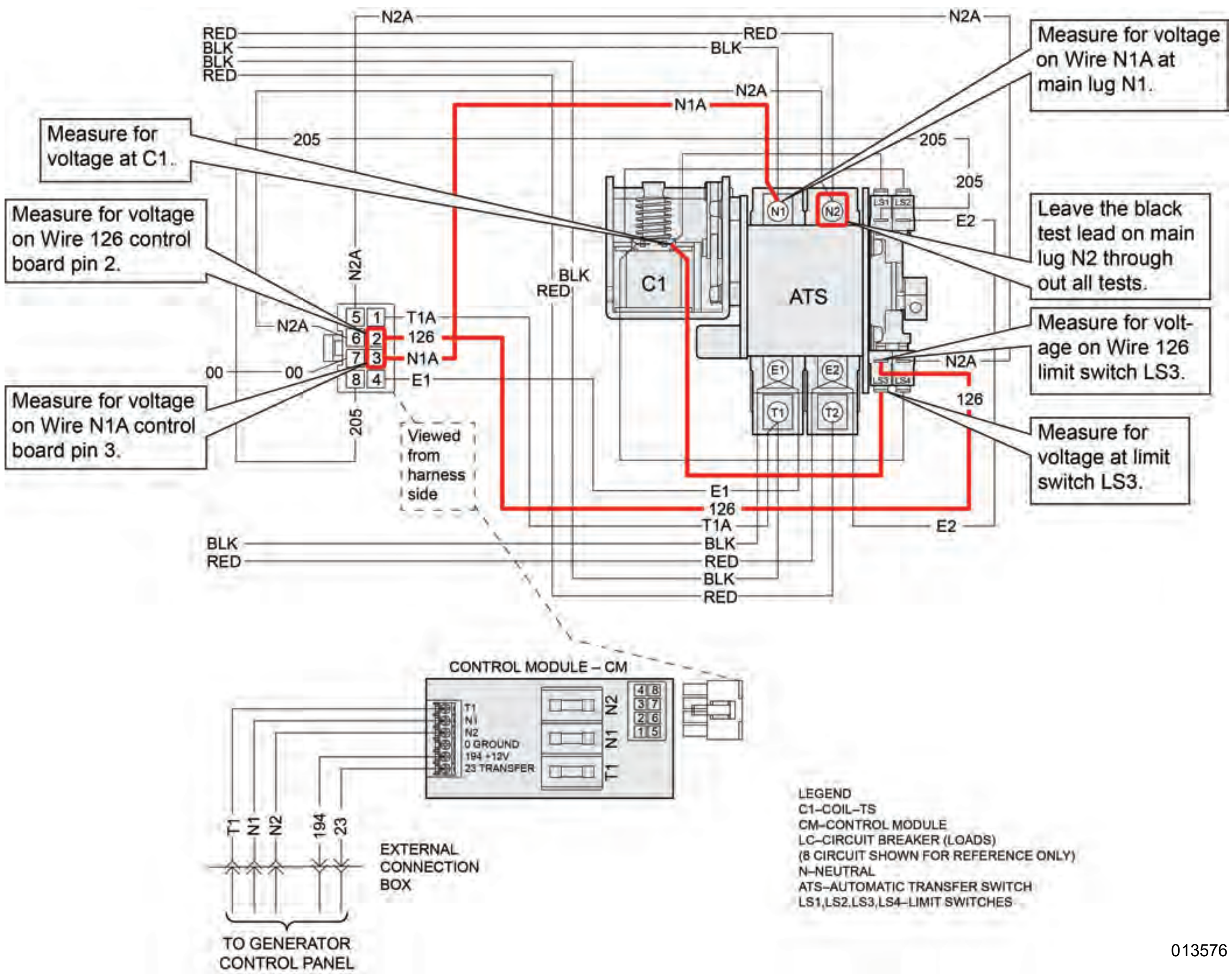


Figure 2-13.

V-Type Transfer Switch with Integrated SACM – Green LED Indicator Quick Diagnostic

Generator runs but does not transfer to Standby

NOTE: This applies to Evolution 1.0 (w/firmware v1.17 and higher) and Evolution 2.0 (all firmware) where the green LED flashes when transferred and is carrying load.

1. Verify generator main line circuit breaker (MLCB) is ON (closed).
2. Place controller in MANUAL and allow unit to start and run.
3. Check for rated AC voltage output at generator MLCB. If voltage is below rated output, stop testing and refer to appropriate test in the diagnostic manual.
4. Place the utility source breaker (MLCB) in the OFF (open) position.
5. After the Utility Loss Delay timer expires, Wire 23 will close to ground in the controller and the transfer switch should transfer to Standby.
   a. If the 3-light annunciator is flashing green, go to the next step.
   b. If the 3-light annunciator is not flashing green, verify Steps 3 and 4 in this procedure have been performed.
   c. If Steps 3 and 4 have been verified and the 3-light annunciator is not flashing green, check to see if Channel 8 on the Output Screen in the Test Menu is displaying a “1”. If so, refer to the appropriate test in the diagnostic manual.
6. Locate Wire 23 and Wire 194 at the WAGO block (or connection point) in the generator.
7. Set the digital multimeter (DMM) to measure DC Volts. Measure voltage on Wire 194 to ground.
   a. If voltage is present, go to next step.
   b. If voltage is not present, a problem exists on Wire 194. See ***Test 4C1 – Check Wire 23 and 194 Circuits***.

NOTE: Wire 194 is a protected circuit. If a short (to ground) exists on this wire, the voltage on this wire falls to zero.

8. Measure voltage across Wires 23 and 194 at the test points on the WAGO block.
   a. If voltage is present, go to next step.
   b. If voltage is not present, a problem in either Wire 23 or 194 exists between the WAGO block and the Evolution controller. See ***Test 4C1 – Check Wire 23 and 194 Circuits***.
9. Locate Wire 23 and Wire 194 at the WAGO block (or the Integrated SACM connection point) in the transfer switch.
10. Set the DMM to measure DC Volts. Measure voltage on Wire 194 to ground.
    a. If voltage is present, go to next step.
    b. If voltage is not present, a problem exists on Wire 194. See ***Test 4C1 – Check Wire 23 and 194 Circuits***.
11. Set the DMM to measure DC Volts. Measure voltage across Wires 23 and 194 at the test points in the transfer switch.
    a. If no voltage is present, an open in either Wire 23 or Wire 194 exists between the WAGO block in the Transfer Switch connection point (or WAGO block) and the WAGO block (connection deck) on the generator.
    b. If voltage is present, a problem exists internal to the transfer switch, for example, the relay or the Integrated SACM or the contactor assembly itself.

V-Type Transfer Switch with Integrated SACM – No Transfer to Standby

⚠DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: The transfer switch mechanism is still in the utility position.

1. Test wire 194 to ground 12 VDC. Minimum acceptable voltage is 10 DCV
   - If minimum voltage is not available there is a problem with the control board or harness.

NOTE: Refer to generator wiring diagram. If no SACM, refer to proper relay terminal.

2. Test wire 23 to ground, 0.1 to 0.9 VDC
   - If 12 VDC is present the problem is with the control board or harness. If 0 VDC measured check coil resistance.

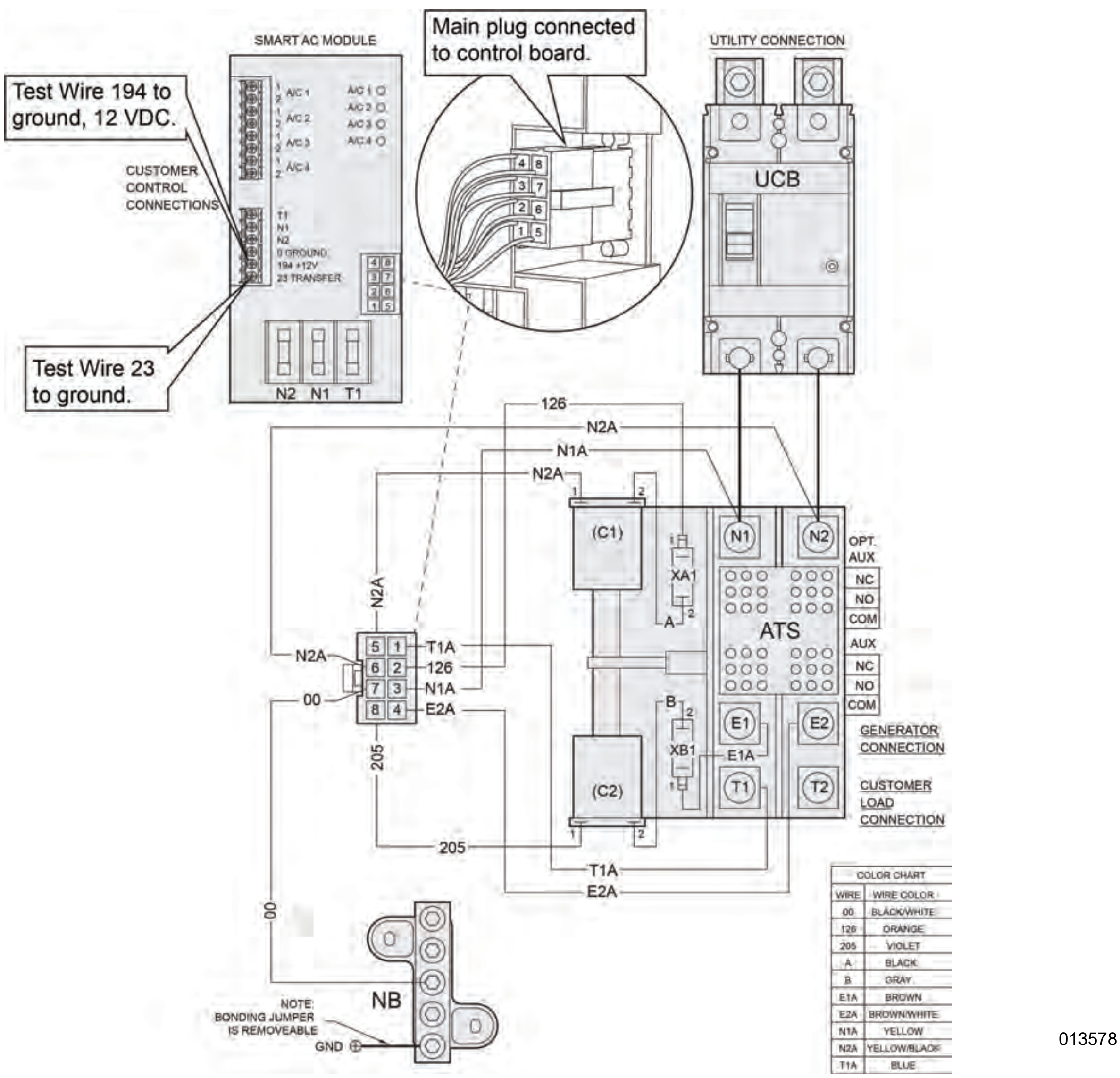


Figure 2-14.

V-Type Transfer Switch with Integrated SACM – No Transfer to Standby

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: The transfer switch mechanism is still in the utility position.

1. Disconnect the main connector on the control board.
2. With the board not energized (Wire 23 NOT grounded) measure resistance between pins 2 and 3, and between pins 5 and 6. Continuity should be measured.
3. With the board not energized (Wire 23 NOT grounded) measure resistance between pins 4 and 8. Open (OL) should be measured.

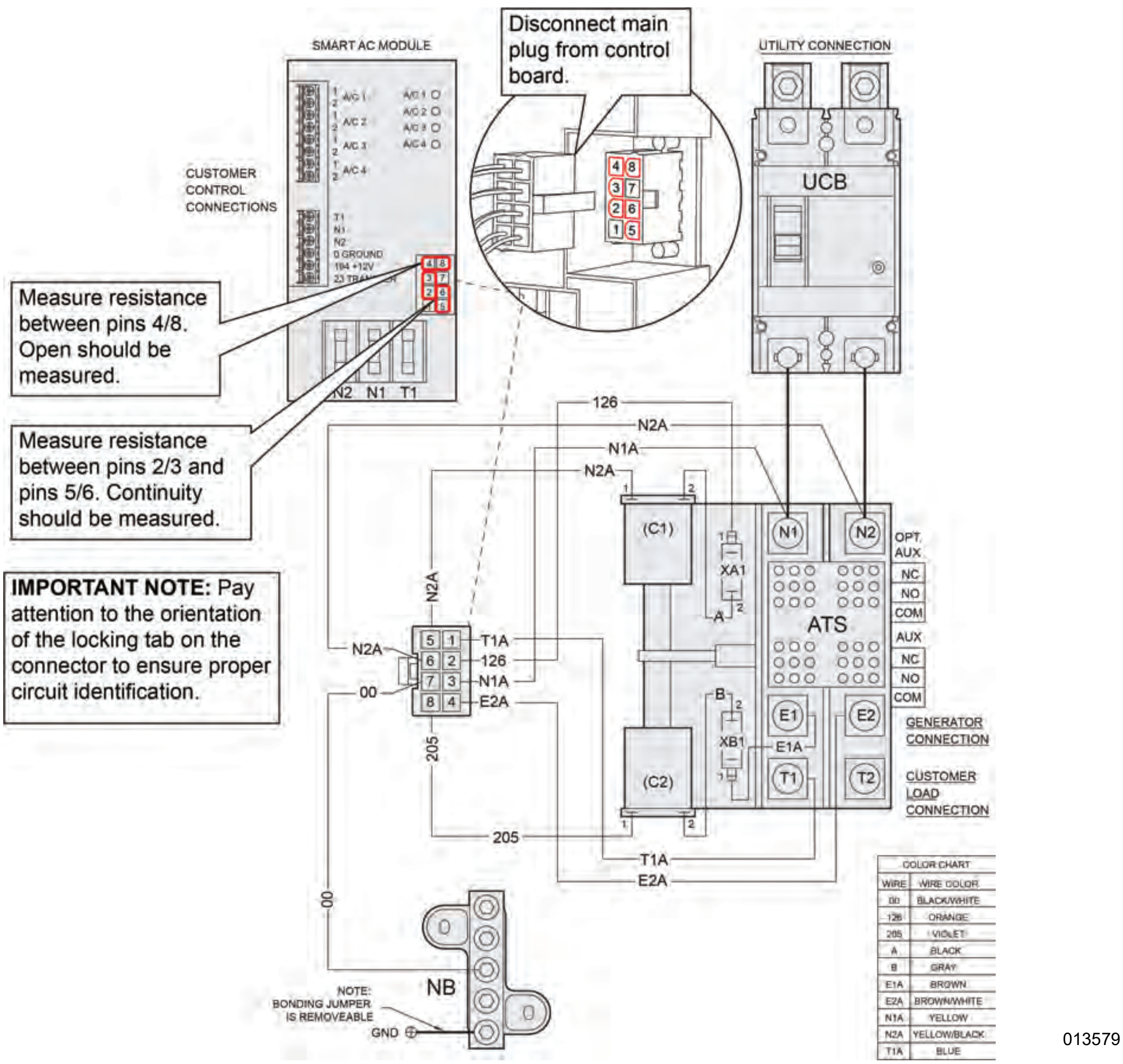


Figure 2-15.

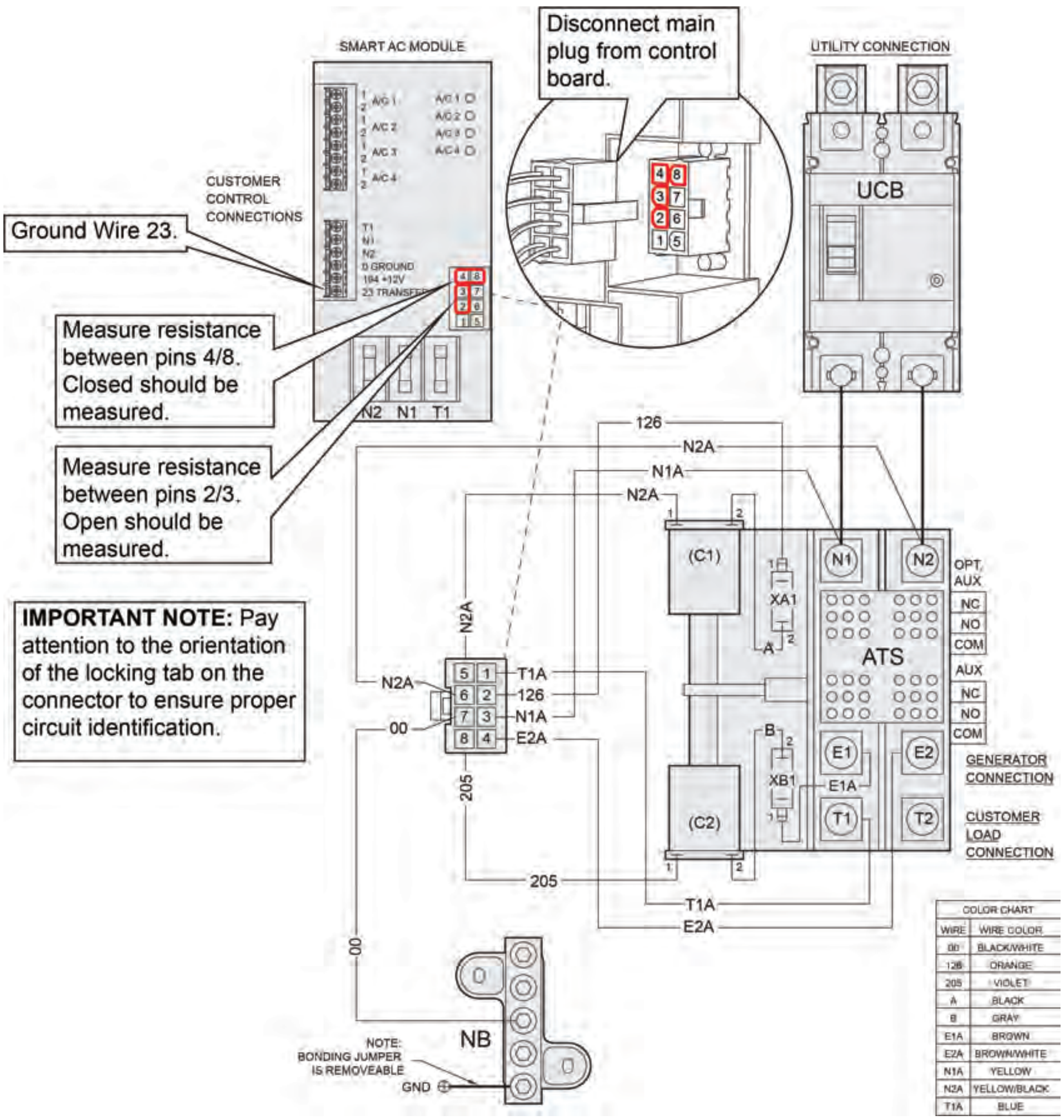
V-Type Transfer Switch with Integrated SACM – Testing Operation of On-board (K5) Relay

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Ground Wire 23.
2. Disconnect the main connector on the control board.
3. With the board energized (Wire 23 grounded) measure resistance between pins 2 and 3. An open should be measured.
4. With the board energized (Wire 23 grounded) measure resistance between pins 4 and 8. Continuity should be measured.



COLOR CHART	
WIRE	WIRE COLOR
00	BLACK/WHITE
126	ORANGE
205	VIOLET
A	BLACK
B	GRAY
E1A	BROWN
E2A	BROWN/WHITE
N1A	YELLOW
N2A	YELLOW/BLACK
T1A	BLUE

013580

Figure 2-16.

V-Type Transfer Switch with Integrated SACM – No Transfer to Standby

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: Generator is running during Step 1.

1. Check for AC generator voltage at B and 205 on the C2 coil.
   - If AC generator voltage is present at B and 205 then the problem is internal to the C2 coil. Test coil for resistance—approximately 30 ohms. Replace if open.
   - If generator voltage is NOT present at B and 205 troubleshoot the wiring harness relay contacts.
2. With generator OFF and utility breaker OPEN, measure the resistance of Wire 205 between pin 8 and C2 coil (disconnect and isolate the wire).
   - Replace wire if open.
   - If continuity is measured proceed to next step (connect).
3. Measure the resistance of Wire E2A between Lug E2 and pin 4 (disconnect and isolate the wire).
   - Replace wire if open.
   - If continuity is measured proceed to next step (connect).

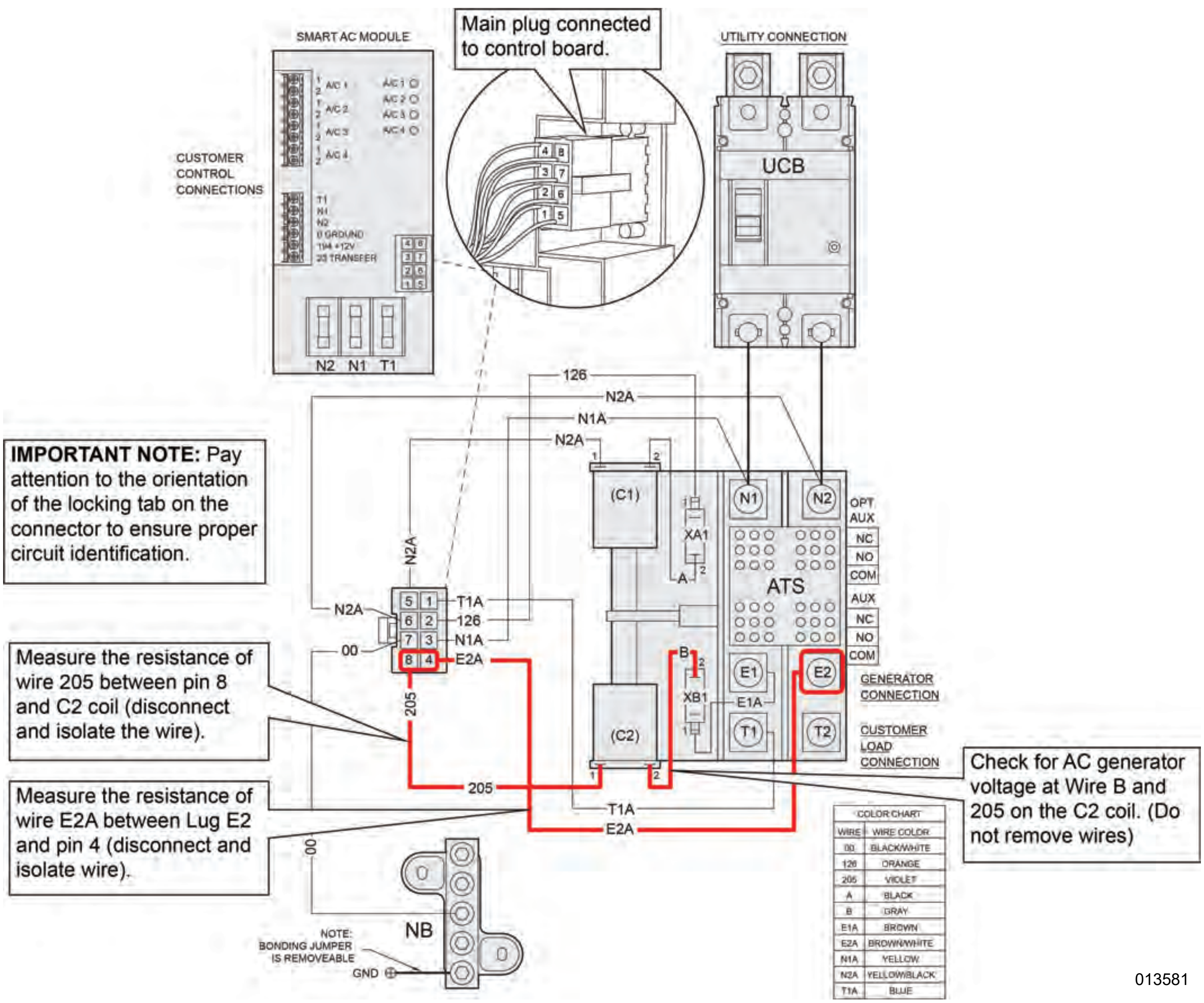


Figure 2-17.

V-Type Transfer Switch with Integrated SACM – No Transfer to Standby

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: Generator voltage must be present at lugs E1 and E2 of the switch and transfer relay must be energized.

1. Set DMM to measure AC volts.
2. Place the black test lead on main lug E2 of the transfer switch.

NOTE: Leave the black test lead on E2 throughout all steps.

3. Use the red test lead to measure for generator voltage on Wire E1A at limit switch XB1.
   - If generator voltage not present replace wire E1A.
   - If generator voltage is present proceed to next step.
4. Remove Wire B from limit switch XB1 terminal. Measure for voltage at limit switch XB1 terminal.
   - If generator voltage is not measured the problem is with the XB1 limit switch. Replace limit switch.
   - If generator voltage is present proceed to next step (do not remove the wire).
5. Measure for voltage at C2 coil Wire B (do not remove the wire).
   - If generator voltage is not measured the problem is with Wire B. Replace Wire B.

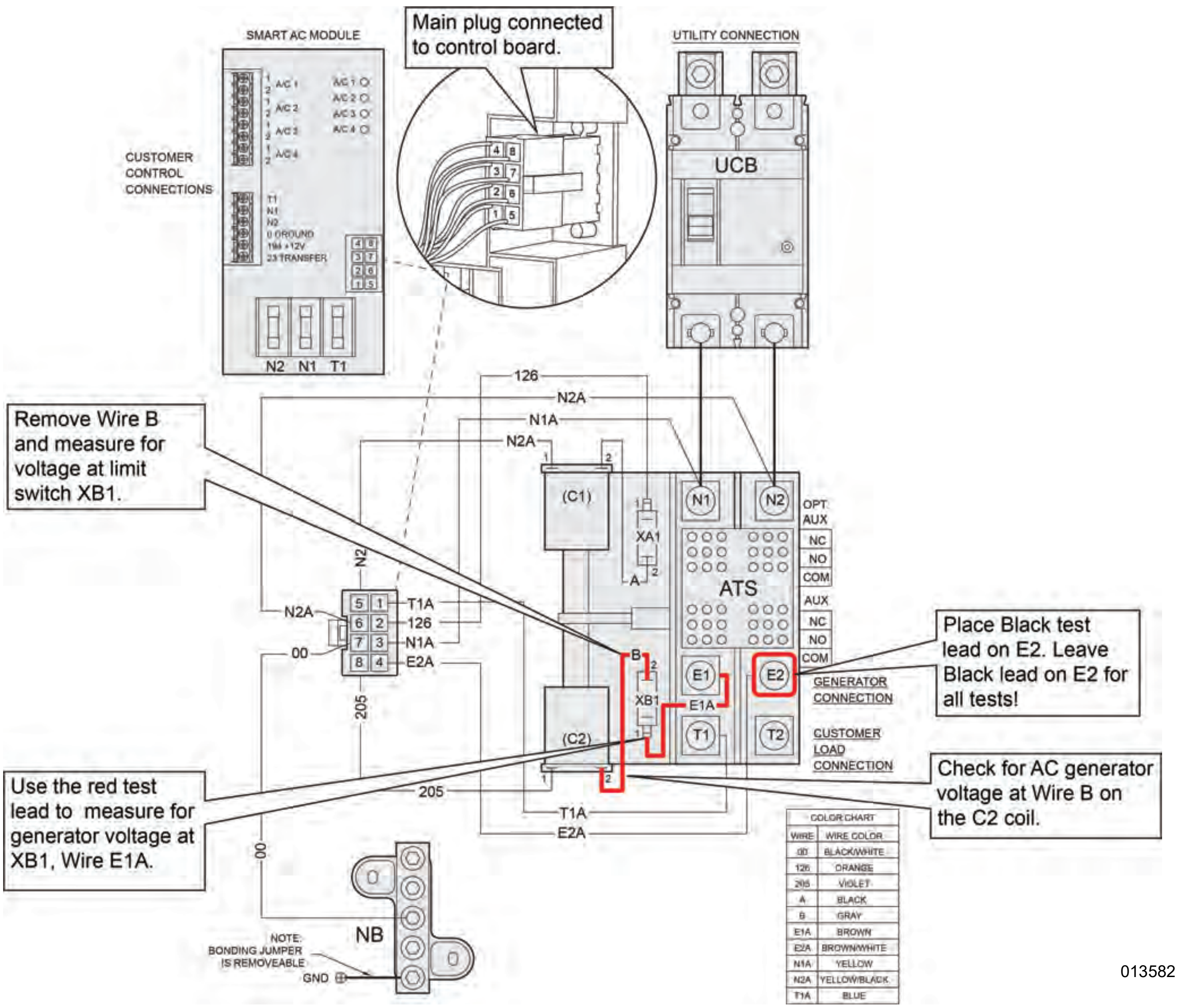


Figure 2-18.

V-Type Transfer Switch with Integrated SACM – No Transfer to Utility

⚠ DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Check for AC utility voltage at A and N2A on the C1 coil.
   - If utility voltage is present at Wire A and Wire N2A the problem is internal to the C1 coil. Test coil for resistance. Approximately 30 ohms should be measured. If open replace coil.

NOTE: Inspect coil for mechanical or thermal damage, replace as necessary.

   - If utility voltage is NOT present at A and N2A troubleshoot the wiring harness relay contacts.
2. Measure the resistance of wire N2A between pin 6 and lug N2 (disconnect and isolate the wire).
   - Replace wire if open.
   - If continuity is measured reconnect the wire and proceed to next step.
3. Measure the resistance of wire N2A between pin 5 and C1 coil (disconnect and isolate the wire).
   - Replace wire if open.
   - If continuity is measured reconnect the wire and proceed to next step.

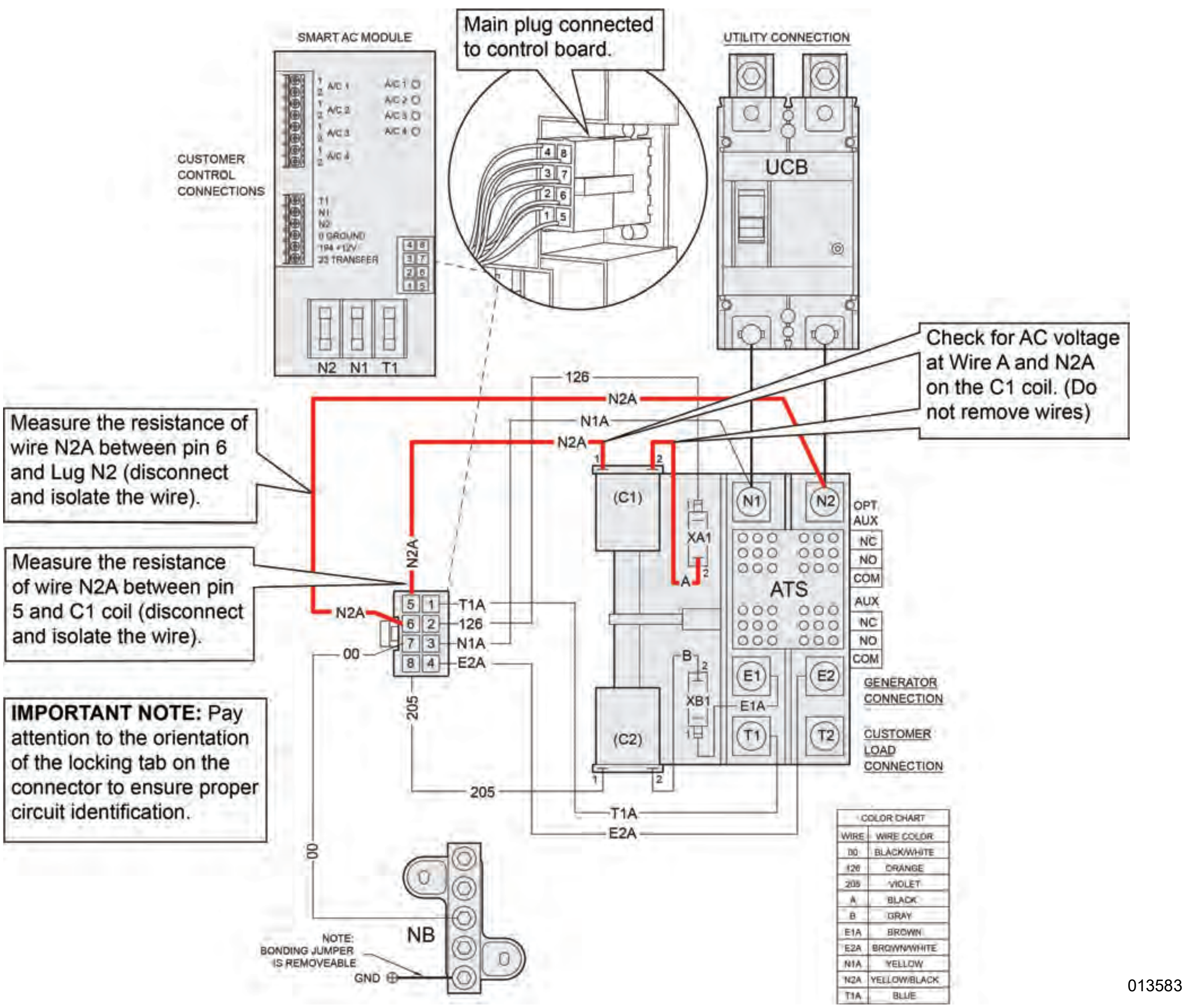


Figure 2-19.

V-Type Transfer Switch with Integrated SACM – No Transfer to Utility

⚠DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: Utility voltage must be present at lugs N1 and N2 of the switch and the transfer relay must NOT be energized.

1. Set DMM to measure AC volts.
2. Place the black test lead on main lug N2 of the transfer switch.

NOTE: Leave the black test lead on N2 throughout all steps.

3. Use the red test lead to measure for utility voltage at pin 3, Wire N1A.
   - If voltage not present replace wire N1A.
   - If voltage is present proceed to next step (do not remove the wire).
4. Measure for voltage at pin 2 Wire 126 (do not remove the wire).
   - If utility voltage is not measured the problem is with the Integrated SACM. Replace the Integrated SACM.
   - If utility voltage is present proceed to next step (do not remove the wire).
5. Measure for voltage at limit switch XA1, Wire 126 (do not remove the wire).
   - If utility voltage is not measured the problem is with Wire 126. Replace Wire 126.
   - If utility voltage is present proceed to next step.
6. Measure for utility voltage at limit switch XA1, Wire A (do not remove the wire).
   - If utility voltage is not measured the problem is with limit switch XA1. Replace limit switch XA1.
   - If utility voltage is present proceed to next step.
7. Measure for voltage at coil C1, Wire A (do not remove the wire).
   - If utility voltage is not measured the problem is with Wire A. Replace Wire A.

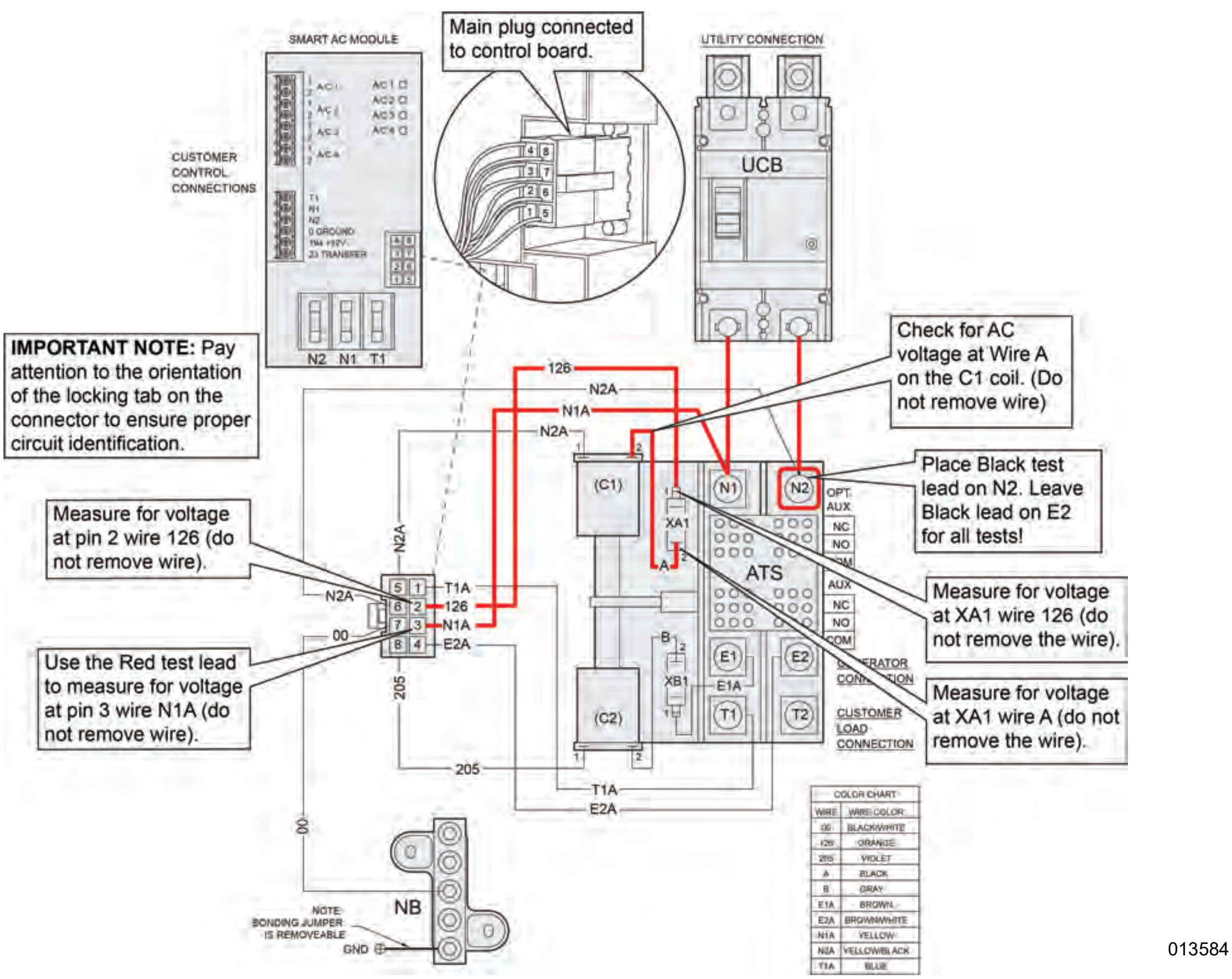


Figure 2-20.

Generator Runs But Does Not Transfer To Standby – Wire 23 and 194 Quick Diagnostic

NOTE: This applies to Evolution 1.0 (firmware v1.17 and higher) and Evolution 2.0 (all firmware) and ALL liquid-cooled units.

1. Verify generator main line circuit breaker (MLCB) is ON (closed).
2. Place the controller in MANUAL and allow the unit to start and run.
3. Check for rated AC voltage output at the generator MLCB. If the voltage is below rated output, stop testing and refer to the appropriate test in the diagnostic manual.
4. Place the utility source breaker (MLCB) in the OFF (open) position.
5. After the Utility Loss Delay timer expires, Wire 23 will close to ground in the controller and the transfer switch should transfer to Standby.
6. Locate Wire 23 and Wire 194 at the transfer relay or Integrated SACM control board in the transfer switch.
7. Set DMM to measure DC Volts.
8. Measure voltage on Wire 194 to ground.
   a. If voltage is present, go to next step (minimum 10 VDC).
   b. If voltage is not present, a problem exists on Wire 194. Test Wire 194 back to the generator control board.

NOTE: Wire 194 is a protected circuit. If a short (to ground) exists on this wire, the voltage on this wire falls to zero.

9. Measure voltage on Wires 23 at the transfer relay or Integrated SACM control board in the transfer switch.
   a. If voltage is between 0.1–0.9 VDC the problem is in the switch mechanism or switch controls/ wiring.
   b. If 0 VDC is measured test the transfer relay coil for resistance. If open replace the device and re-test.

W-Type Transfer Switch – No Transfer to Standby

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Set DMM to measure resistance (Ω).
2. Isolate Wire E2.
3. Check resistance of wire E2 from terminal B2 to Lug E2.
4. If wire is open, replace wire and retest switch.

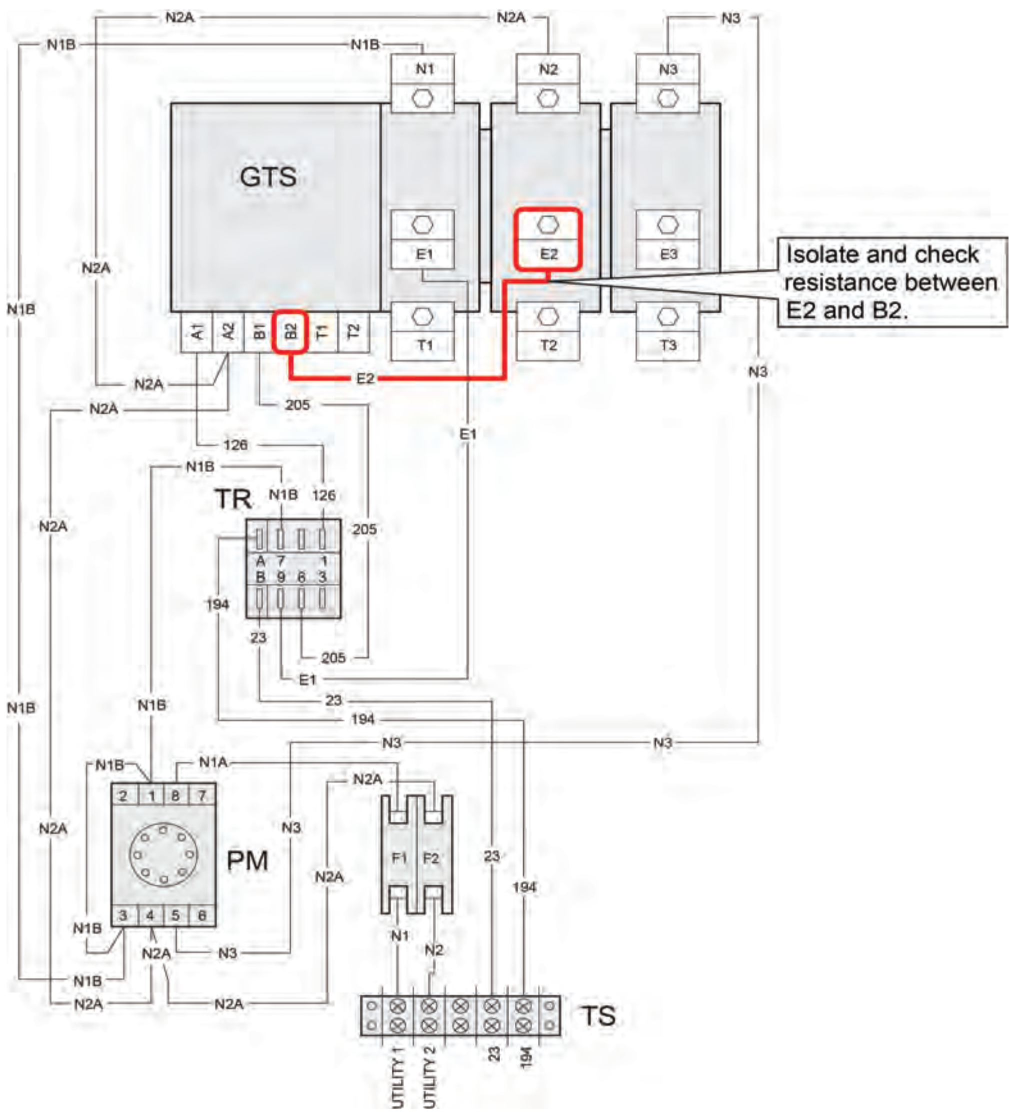


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Figure 2-21.

W-Type Transfer Switch – No Transfer to Standby

⚠DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: Generator voltage must be present at the E1 and E2 lugs of the switch (transfer relay energized).

1. Check for AC generator voltage at B1 and B2 on the transfer switch mechanism terminal strip.
   - If generator voltage is present at B1 and B2, the problem is internal to the mechanism. Consult service for further action.
   - If generator voltage is NOT present at B1 and B2, troubleshoot the wiring and relay contacts.

NOTE: Leave the black test lead on E2 throughout all tests.

2. Set DMM to measure AC volts.
3. Place the black test lead on main lug E2 of the transfer switch.
4. Use the red test lead to measure for generator voltage at B1, Wire 205.
   - If generator voltage is not present proceed to next step (do not remove the wire).

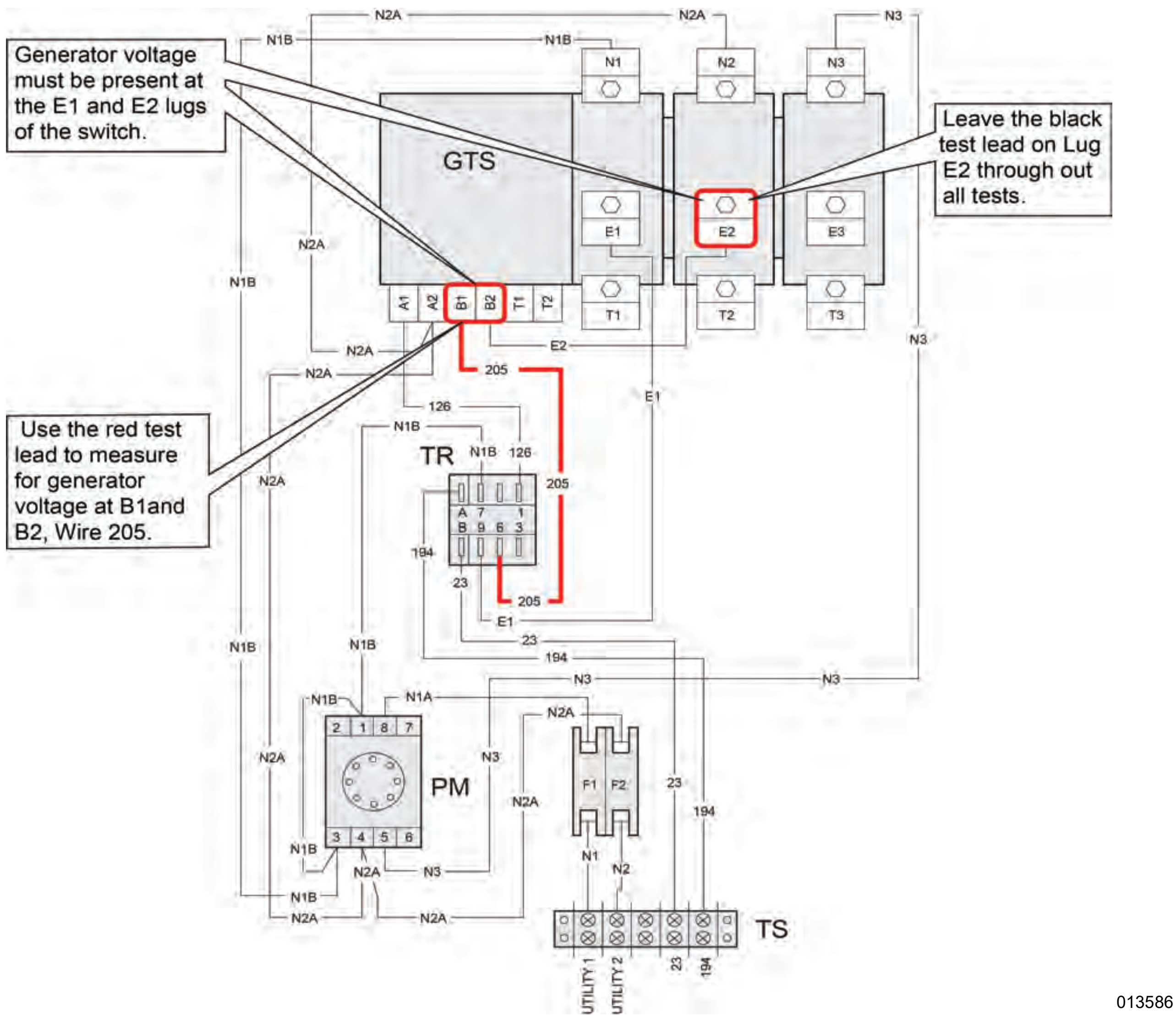


Figure 2-22.

W-Type Transfer Switch – No Transfer to Standby

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Measure for voltage at Terminal 6 Wire 205 on the transfer relay (do not remove the wire).
   - If generator voltage is measured this indicates Wire 205 is open. Test and replace Wire 205.
   - If generator voltage is not measured proceed to next step.
2. Measure for voltage at Terminal 9 Wire E1 on the transfer relay (do not remove the wire).
   - If generator voltage is measured this indicates a problem in the transfer relay normally open contacts. Remove and bench test the relay. Replace if necessary.
   - If generator voltage is not measured proceed to next step.
3. Measure for voltage at E1 main lug of the transfer switch (do not remove the wire).
   - If generator voltage is measured then Wire E1 is open, test and replace Wire E1.
   - If generator voltage is not measured this indicates the problem is not with the switch but with the generator supply voltage. Refer to the diagnostic manual for the generator.

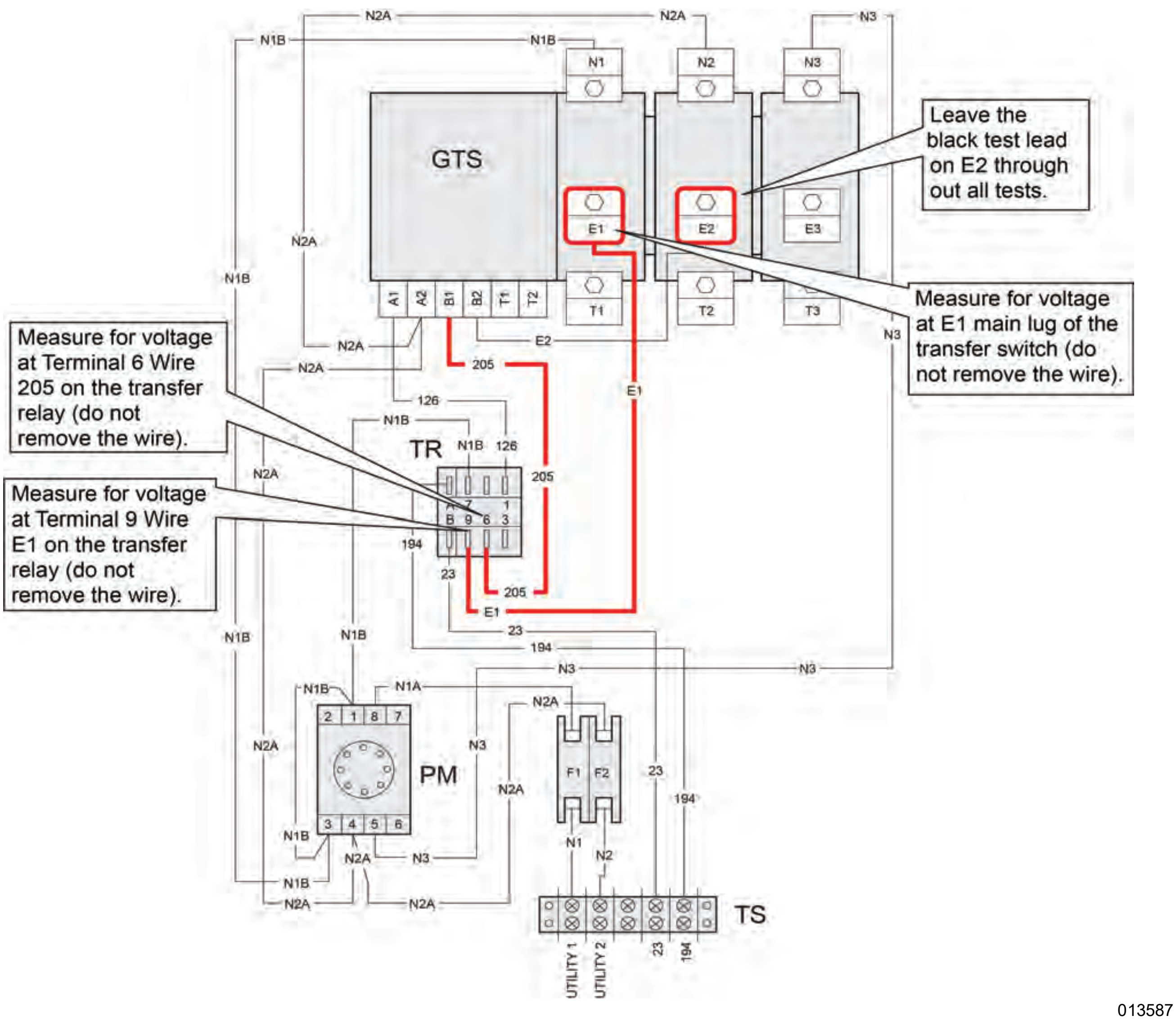


Figure 2-23.

Generator Runs But Does Not Transfer To Utility – Wire 23 and 194 Quick Diagnostic

Utility Returns But Transfer Switch Does Not Re-transfer To Utility

1. Locate Wire 23 and Wire 194 at the transfer relay or Integrated SACM control board in the transfer switch.
2. Measure for voltage to ground on Wires 23 at the transfer relay or Integrated SACM control board in the transfer switch.
    a. If voltage is between 0.1 to 0.9 VDC then the problem is in the wiring between the switch mechanism and the generator controls. Test for possible short to ground or faulty controller.
    a. If voltage is present, there is a problem with switch mechanism or wiring inside the transfer switch.

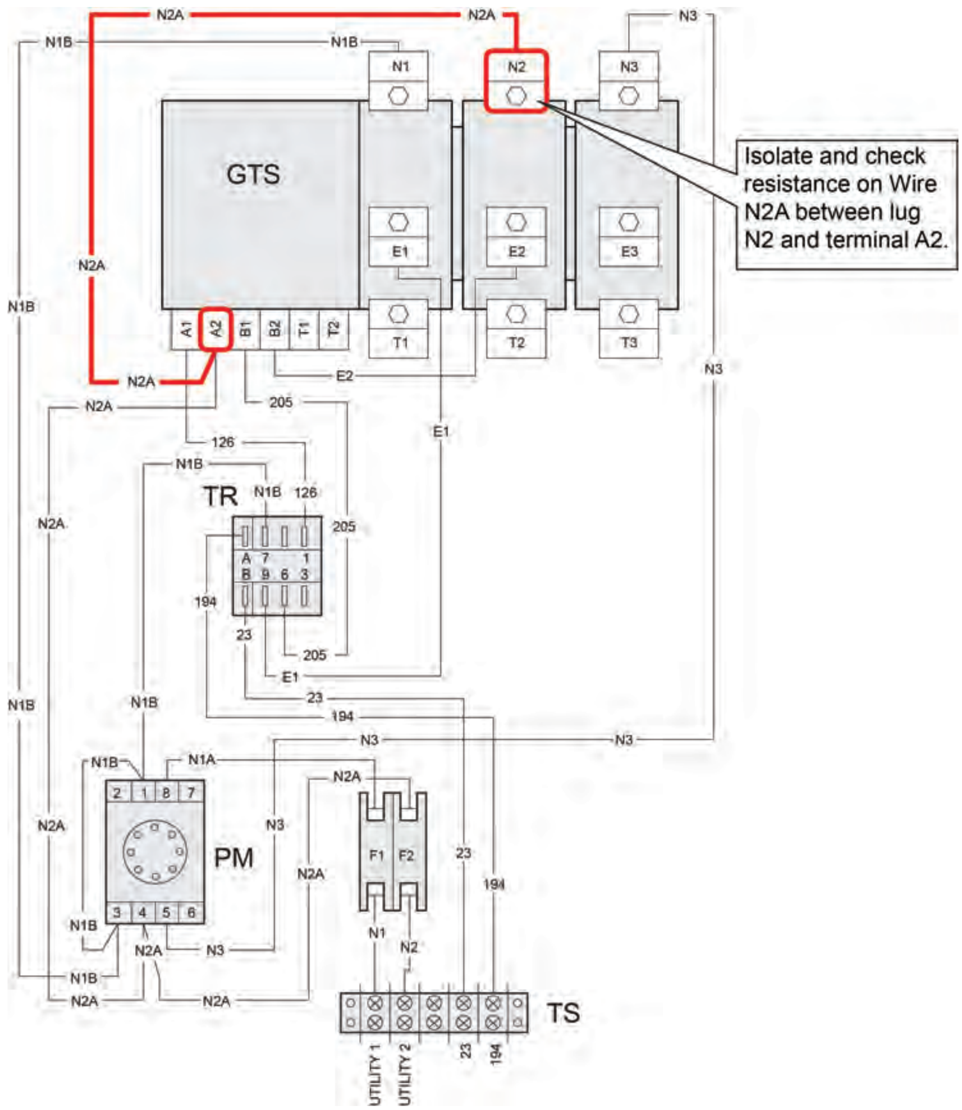
W-Type Transfer Switch – No Transfer to Utility

⚠ DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Set DMM to measure resistance (Ω).
2. Turn OFF Utility breaker.
3. Isolate Wire N2A.
4. Check resistance of wire N2A from terminal A2 to Lug N2.
5. If wire is open, replace and retest the switch.



013588

Figure 2-24.

W-Type Transfer Switch – No Transfer to Utility

DANGER

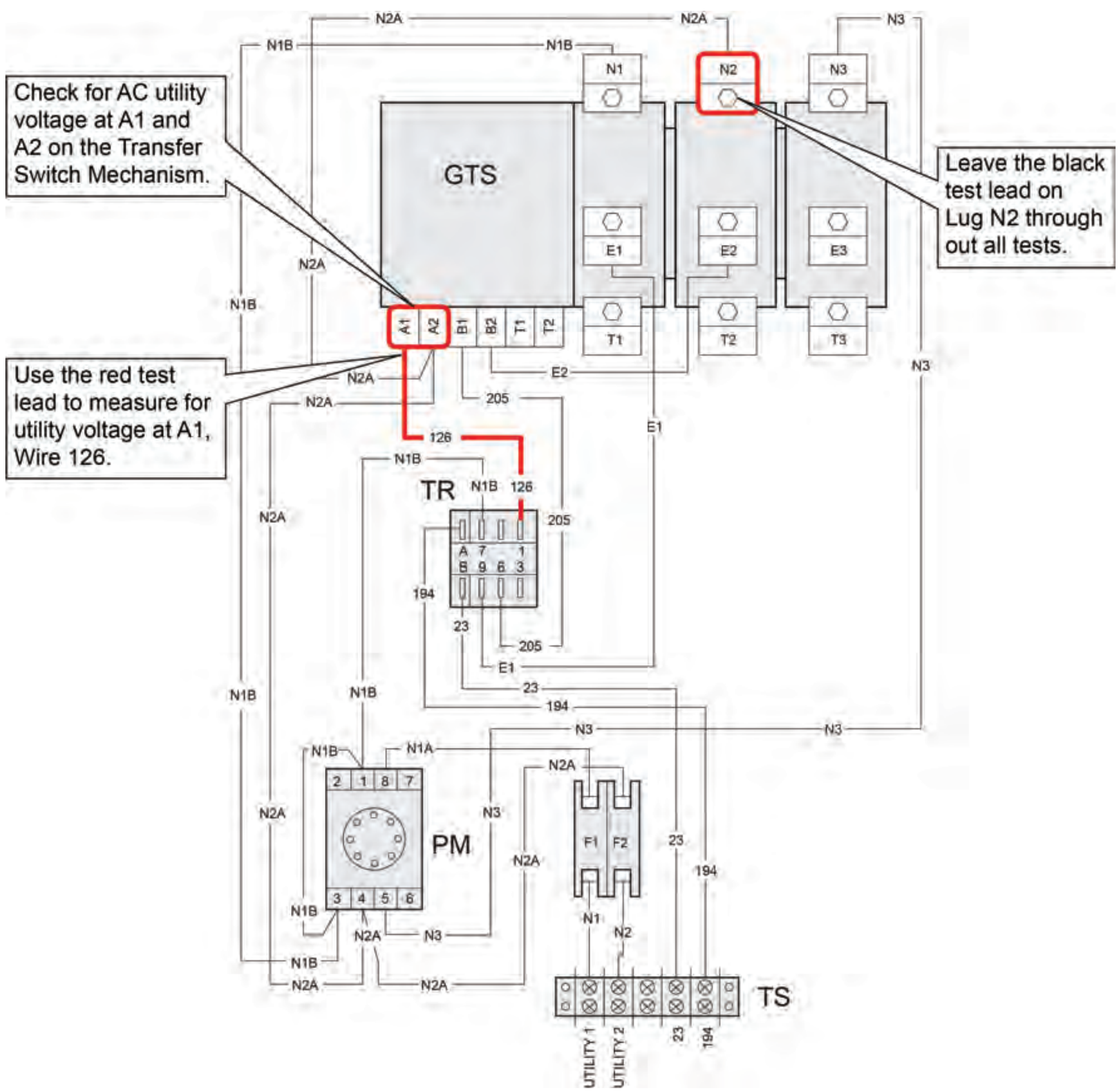
Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Check for AC utility voltage across A1 and A2 on the transfer switch mechanism terminal strip.
    - If AC utility voltage is present at A1 and A2 then the problem is internal to the mechanism. Contact service for further action.
    - If utility voltage is NOT present at A1 and A2, troubleshoot the wiring and relay contacts.

NOTE: Utility voltage must be present at the N1 and N2 lugs of the switch. (Transfer relay must be de-energized!)

2. Place black test lead on N2 for remaining steps.
3. Use the red test lead to measure for utility voltage at A1, Wire 126.
    - If utility voltage not present proceed to next step (do not remove wire).



013589

Figure 2-25.

W-Type Transfer Switch – No Transfer to Utility

⚠DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Place black test lead on N2 for remaining steps.
2. Measure for utility voltage at Terminal 1 Wire 126 on the transfer relay (do not remove the wire).
   - If utility voltage is measured this indicates Wire 126 is open. Test and replace Wire 126.
   - If utility voltage is not measured proceed to next step.
3. Measure for voltage at Terminal 1 Wire N1B on the transfer relay (do not remove the wire).
   - If utility voltage is measured this indicates a problem in the transfer relay normally closed contacts. Remove and bench test transfer relay. Replace if necessary.
   - If utility voltage is not measured proceed to next step.
4. Measure for utility voltage at main lug N1 of the transfer switch (do not remove the wire).
   - If utility voltage is measured then Wire N1B is open, test and replace Wire N1B.
   - If utility voltage is not measured this indicates the problem is not with the switch but with the utility supply voltage.

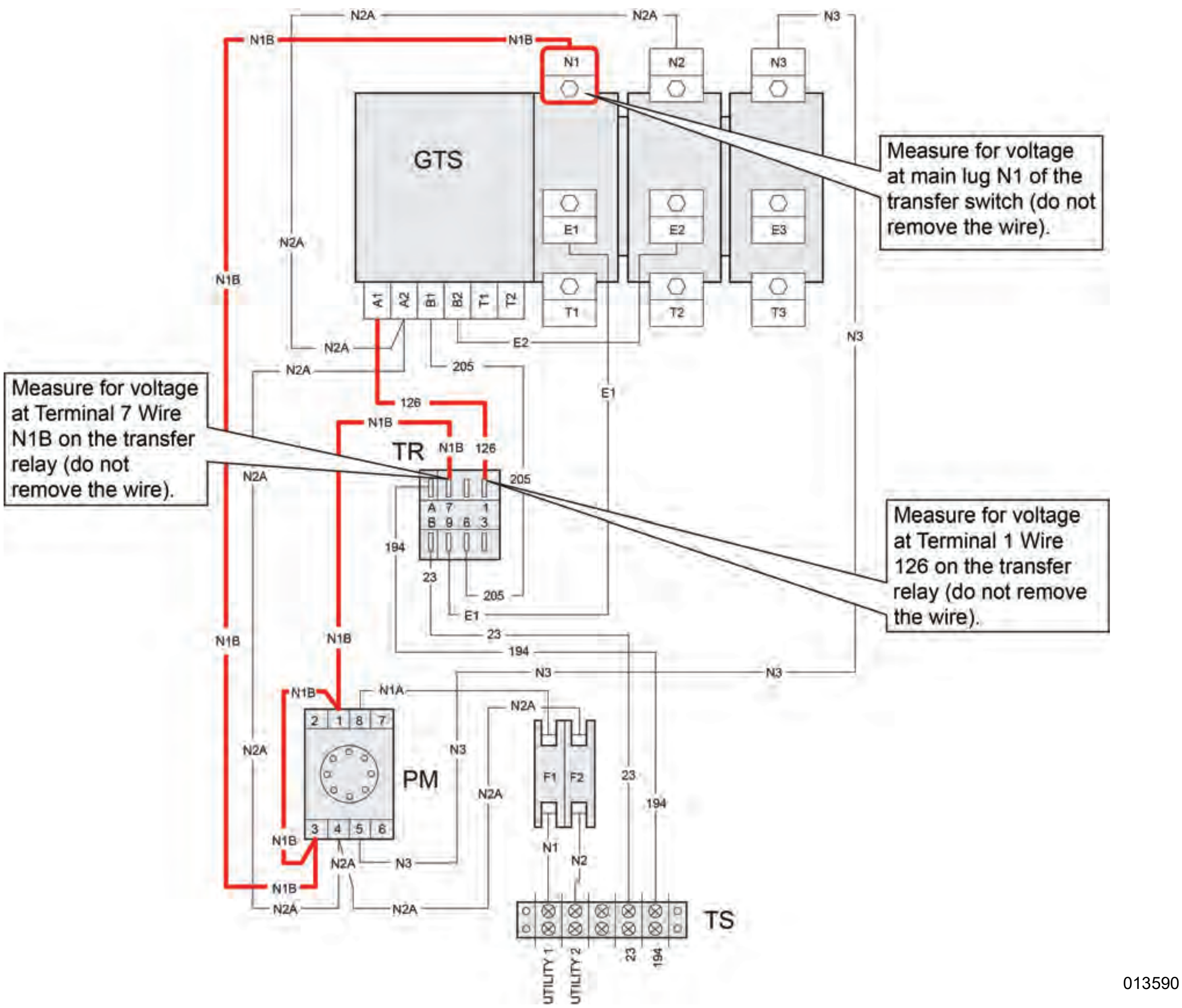


Figure 2-26.

Generator Runs But Does Not Transfer To Standby – Wire 23 and 194 Quick Diagnostic

NOTE: This applies to Evolution 1.0 (firmware v1.17 and higher) and Evolution 2.0 (all firmware) and ALL liquid-cooled units.

1. Verify generator main line circuit breaker (MLCB) is ON (closed).
2. Place the controller in MANUAL and allow the unit to start and run.
3. Check for rated AC voltage output at the generator MLCB. If the voltage is below rated output, stop testing and refer to the appropriate test in the diagnostic manual.
4. Place the utility source breaker (MLCB) in the OFF (open) position.
5. After the Utility Loss Delay timer expires, Wire 23 will close to ground in the controller and the transfer switch should transfer to Standby.
6. Locate Wire 23 and Wire 194 at the transfer relay or Integrated SACM control board in the transfer switch.
7. Set DMM to measure DC Volts.
8. Measure voltage on Wire 194 to ground.
   a. If voltage is present, go to next step (minimum 10 VDC).
   b. If voltage is not present, a problem exists on Wire 194. Test Wire 194 back to the generator control board.

NOTE: Wire 194 is a protected circuit. If a short (to ground) exists on this wire, the voltage on this wire falls to zero.

9. Measure voltage on Wires 23 at the transfer relay or Integrated SACM control board in the transfer switch.
   a. If voltage is between 0.1–0.9 VDC the problem is in the switch mechanism or switch controls/wiring.
   b. If 0 VDC is measured test the transfer relay coil for resistance. If open replace the device and re-test.

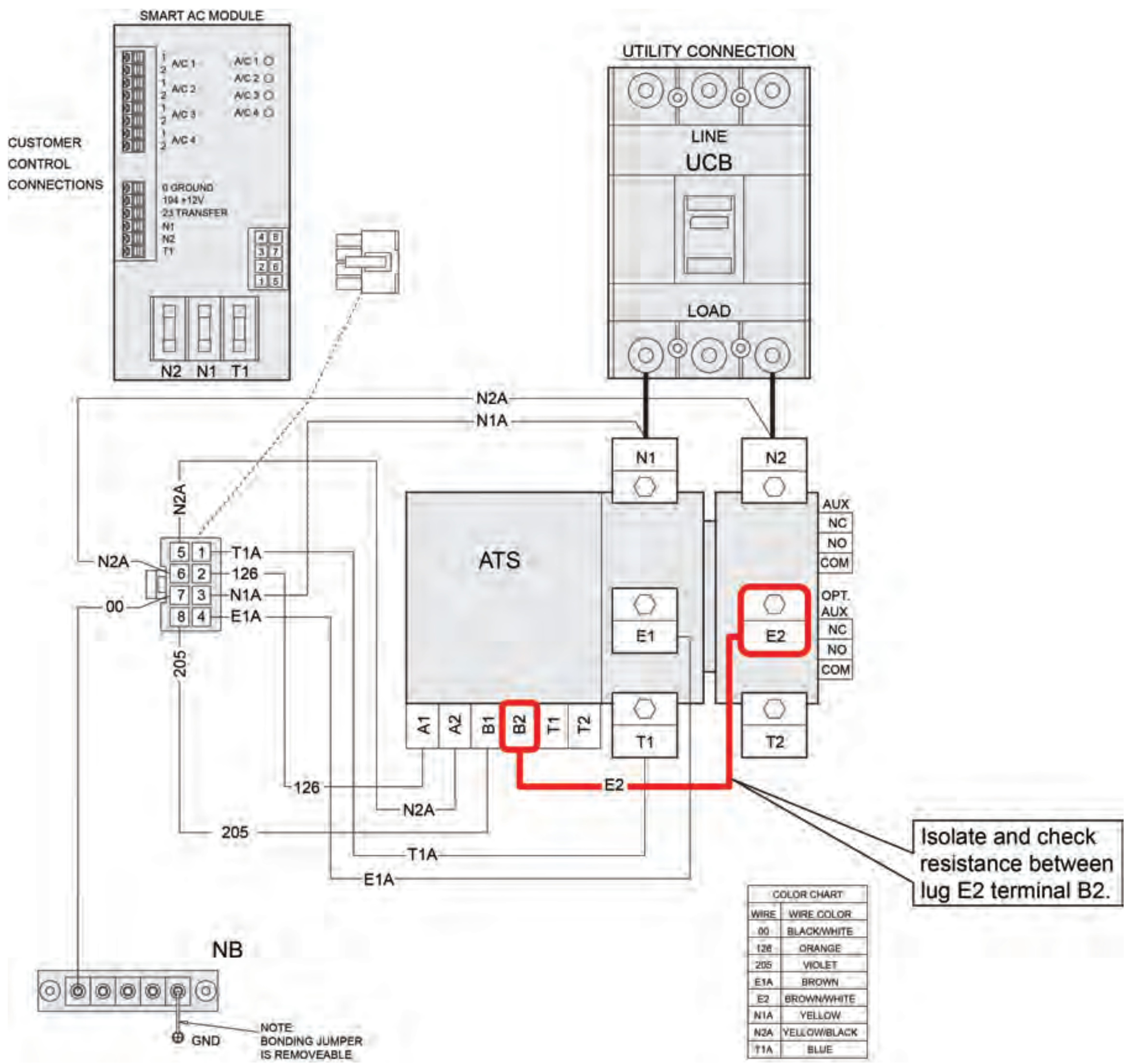
W-Type Transfer Switch with Integrated SACM – No Transfer to Standby

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Set DMM to measure resistance.
2. Turn off generator and open the utility and generator circuit breaker (breakers OFF).
3. Isolate Wire E2.
4. Check resistance of wire E2 from terminal B2 to Lug E2.
5. If wire is open, replace and retest the switch.



013591

Figure 2-27.

W-Type Transfer Switch with Integrated SACM – No Transfer to Standby

⚠DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Set DMM to measure AC volts.
2. Check for AC generator voltage across B1 and B2 on the transfer switch mechanism.
   - If AC generator voltage is present across B1 and B2 then the problem is internal to the mechanism. Consult service for further action.
   - If AC generator voltage is NOT present across B1 and B2 troubleshoot the wiring and relay contacts.

NOTE: Generator voltage must be present at the E1 and E2 lugs of the switch (transfer relay energized).

NOTE: Leave the black test lead on E2 for the remaining steps.

3. Place the black test lead on main lug E2 of the transfer switch.
4. With the red test lead measure for generator voltage at terminal B1, Wire 205.
   - If generator voltage is not present proceed to next step (do not remove the wire).

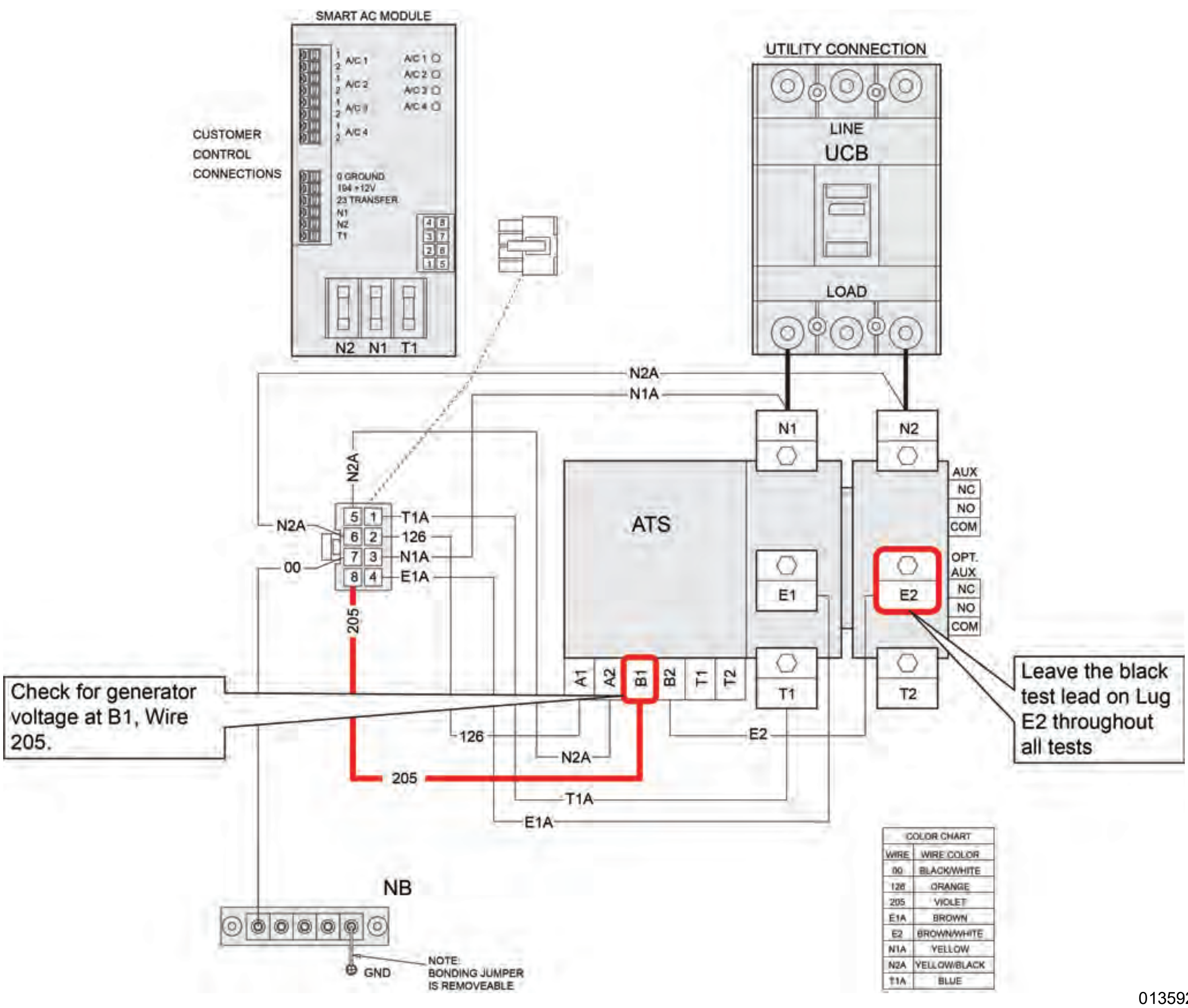


Figure 2-28.

W-Type Transfer Switch with Integrated SACM – No Transfer to Standby

⚠ DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Place the black test lead on main lug E2 of the transfer switch.
2. Measure for AC voltage at pin position 8 Wire 205 on the Integrated SACM board (do not remove the connector).
   - If generator voltage is measured this indicates Wire 205 is open. Test and replace Wire 205.
   - If generator voltage is not measured proceed to next step.
3. Measure for voltage at Pin position 4 Wire E1A on the Integrated SACM board (do not remove the connector).
   - If generator voltage is measured this indicates a problem in the Integrated SACM control board. Remove and bench test. Replace if necessary.
   - If generator voltage is not measured proceed to next step.
4. Measure for voltage at main lug E1 of the transfer switch (do not remove the wire).
   - If generator voltage is measured then wire E1A is open, test and or replace Wire E1A.
   - If generator voltage is not measured this indicates the problem is not with the switch but with the generator supply voltage. Refer to the diagnostic manual for the generator.

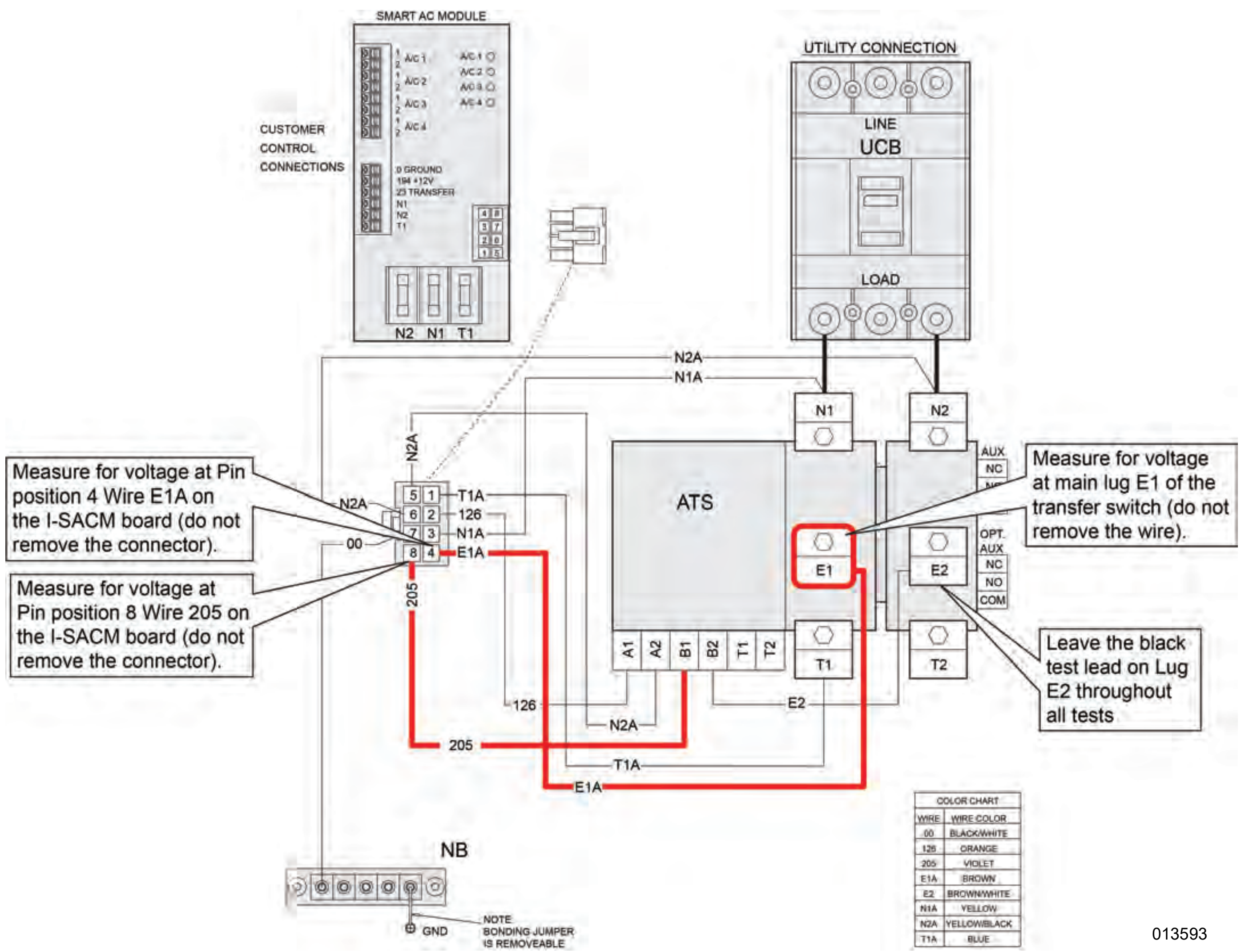


Figure 2-29.

Generator Runs But Does Not Transfer To Utility – Wire 23 and 194 Quick Diagnostic

Utility Returns But Transfer Switch Does Not Re-transfer To Utility

1. Locate Wire 23 and Wire 194 at the transfer relay or Integrated SACM control board in the transfer switch.
2. Measure for voltage to ground on Wires 23 at the transfer relay or Integrated SACM control board in the transfer switch.
   a. If voltage is between 0.1 to 0.9 VDC then the problem is in the wiring between the switch mechanism and the generator controls. Test for possible short to ground or faulty controller.
   a. If voltage is present, there is a problem with switch mechanism or wiring inside the transfer switch.

W-Type Transfer Switch with Integrated SACM – No Transfer to Utility

⚠ DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Isolate Wire N2A.
2. Check the resistance of wire N2A from pin position 6 to Lug N2, and from pin position 5 to terminal A2.
   - If any wire(s) are open, replace wire and retest the switch.

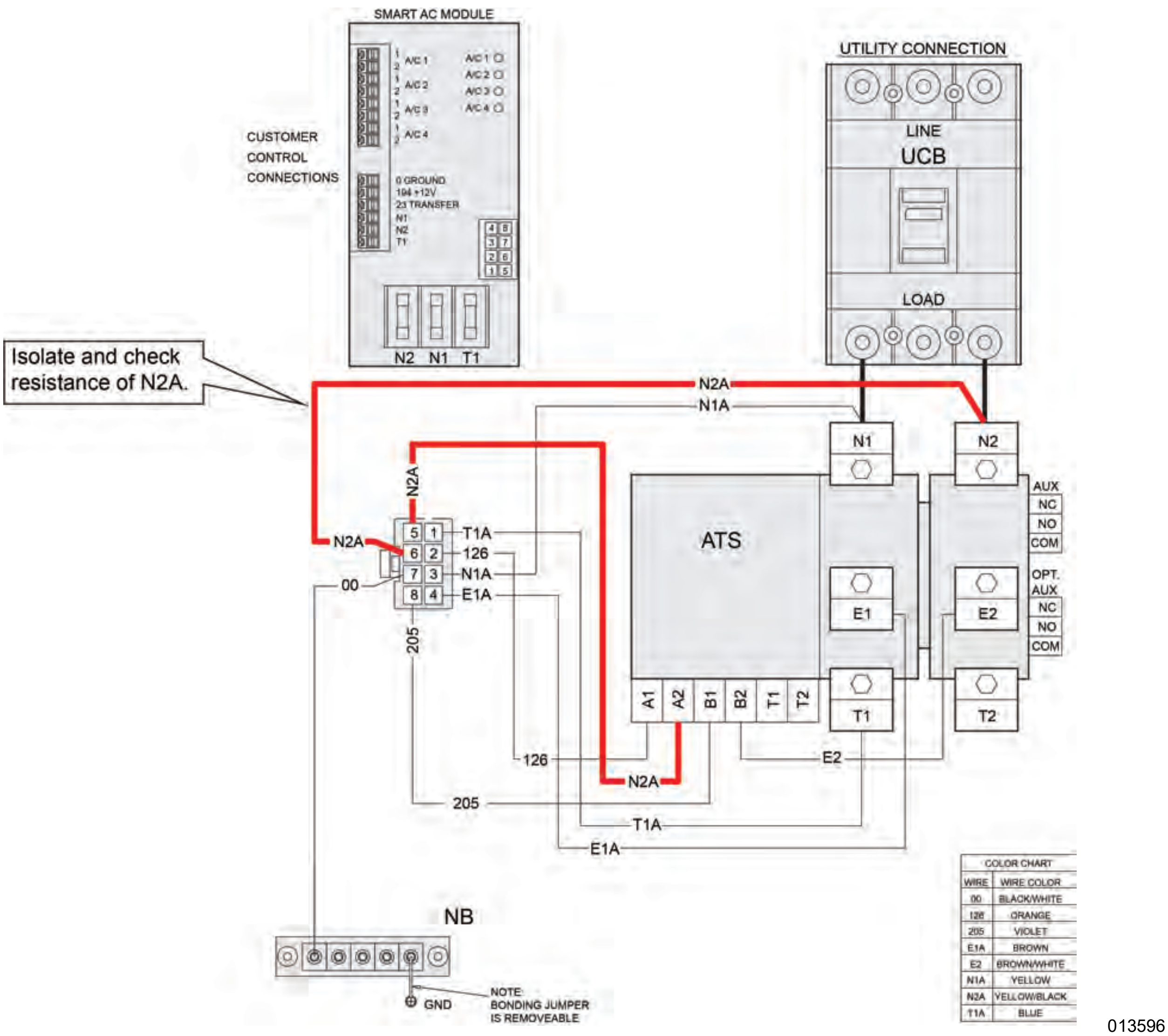


Figure 2-30.

W-Type Transfer Switch with Integrated SACM – No Transfer to Utility

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Set DMM to read AC volts.
2. Check for AC utility voltage across A1 and A2 on the transfer switch mechanism.
   - If AC utility voltage is present at A1 and A2 then the problem is internal to the mechanism. Contact service for further action.
   - If utility voltage is NOT present at A1 and A2, troubleshoot the wiring and relay contacts.

NOTE: Utility voltage must be present at the N1 and N2 lugs of the switch. (Transfer circuit must be de-energized!)

3. Place the black test lead on main lug N2 of the transfer switch.

NOTE: Leave the black test lead on N2 through out all tests.

4. Use the red test lead to measure for utility voltage at terminal A1, Wire 126.
   - If utility voltage is not present proceed to next step (do not remove wire).

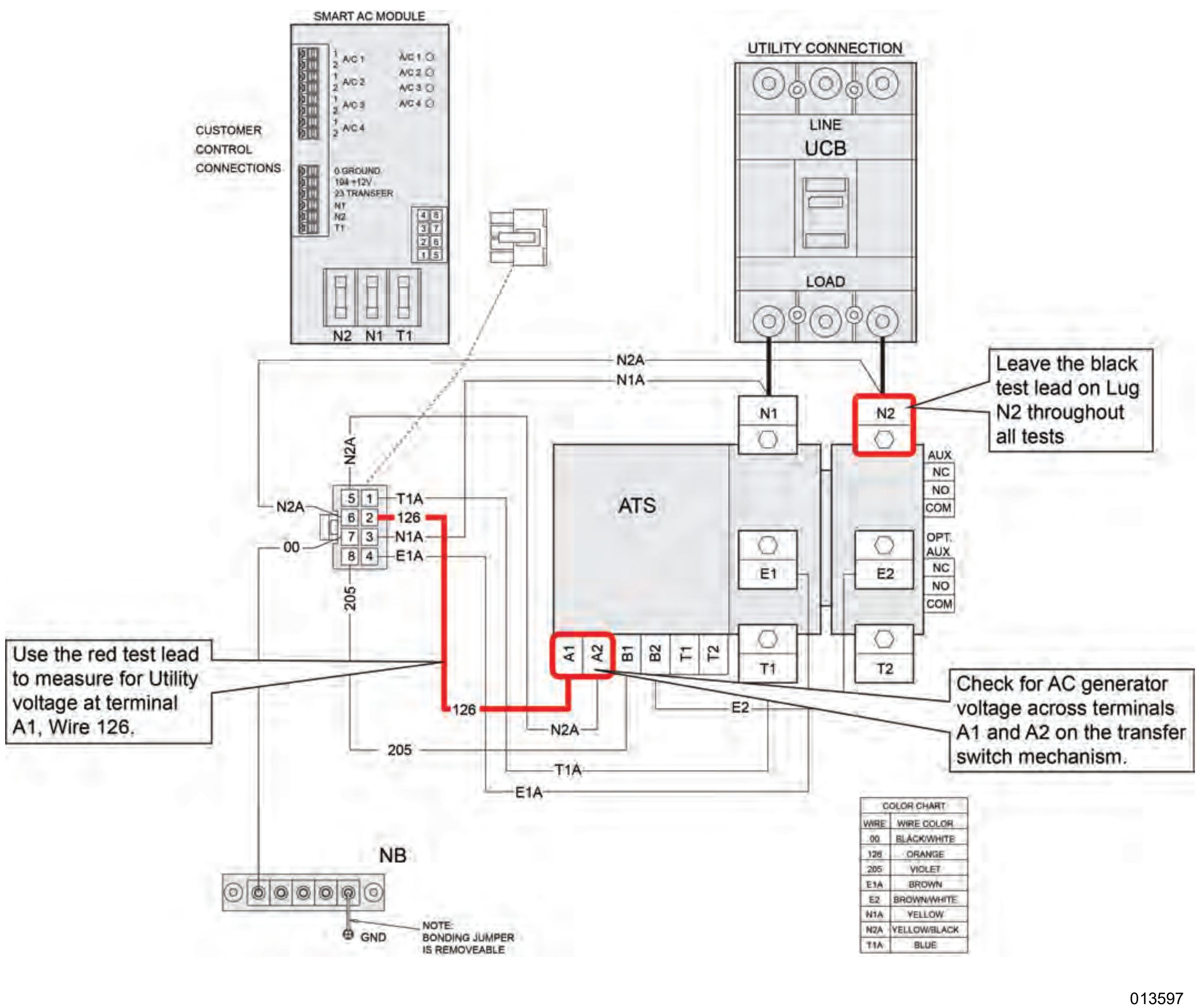


Figure 2-31.

W-Type Transfer Switch with Integrated SACM – No Transfer to Utility

⚠DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Leave the black test lead on N2 through all steps.
2. Measure for utility voltage at pin position 2 Wire 126 on the Integrated SACM board (do not remove the connector).
   - If utility voltage is measured this indicates Wire 126 is open. Test and replace Wire 126.
   - If utility voltage is not measured proceed to next step.
3. Measure for voltage at pin position 3 Wire N1A on the Integrated SACM module (do not remove the connector).
   - If utility voltage is measured this indicates a problem in the Integrated SACM control board. Remove and bench test Integrated SACM module. Replace if necessary.
   - If utility voltage is not measured proceed to next step.
4. Measure for utility voltage at N1 main lug of the transfer switch (do not remove the wire).
   - If utility voltage is measured then Wire N1A is open, test and replace Wire N1A.
   - If utility voltage is not measured this indicates the problem is not with the switch but with the utility supply voltage.

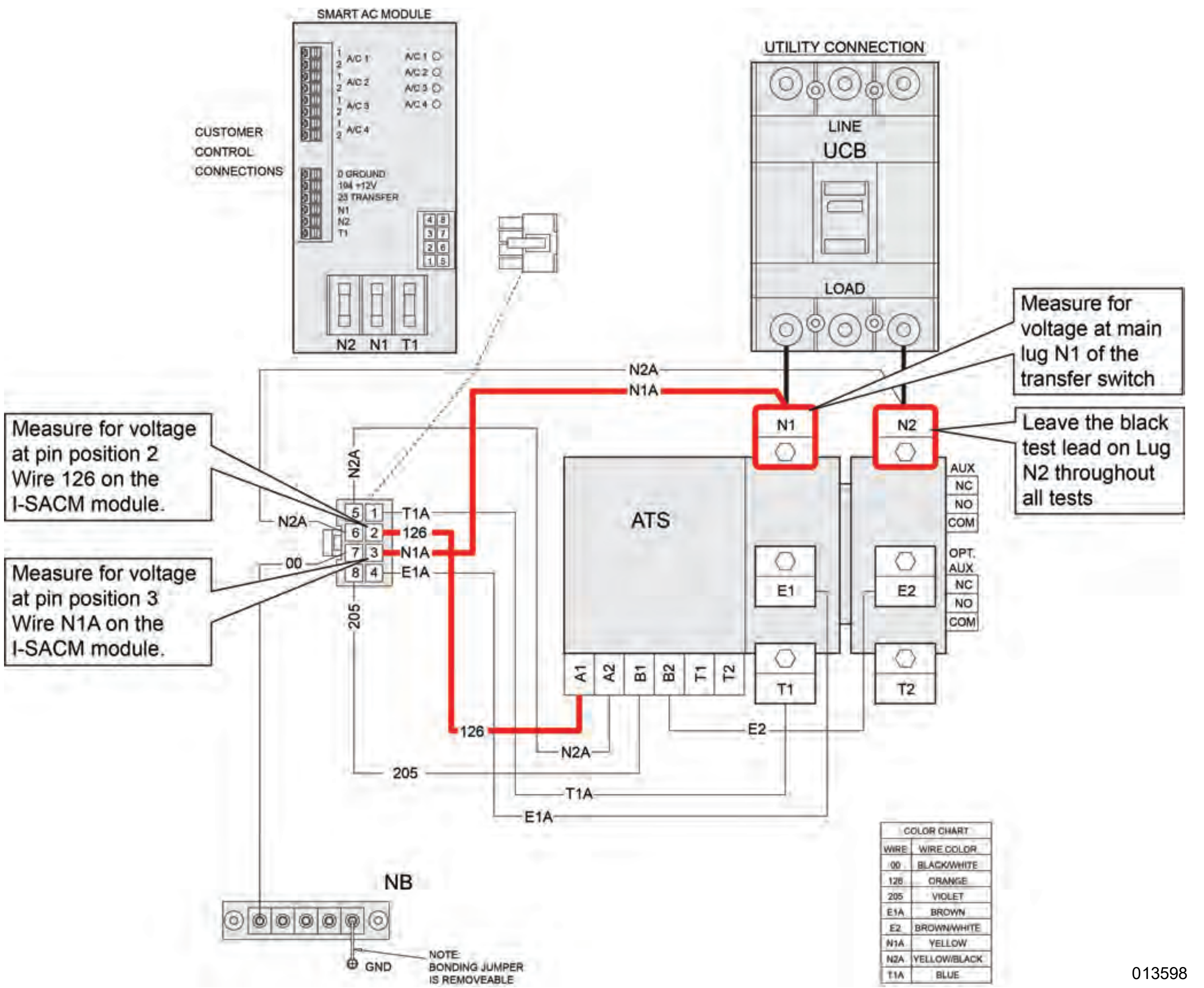


Figure 2-32.

Generator Runs But Does Not Transfer To Standby – Wire 23 and 194 Quick Diagnostic

NOTE: This applies to Evolution 1.0 (firmware v1.17 and higher) and Evolution 2.0 (all firmware) and ALL liquid-cooled units.

1. Verify generator main line circuit breaker (MLCB) is ON (closed).
2. Place the controller in MANUAL and allow the unit to start and run.
3. Check for rated AC voltage output at the generator MLCB. If the voltage is below rated output, stop testing and refer to the appropriate test in the diagnostic manual.
4. Place the utility source breaker (MLCB) in the OFF (open) position.
5. After the Utility Loss Delay timer expires, Wire 23 will close to ground in the controller and the transfer switch should transfer to Standby.
6. Locate Wire 23 and Wire 194 at the transfer relay or Integrated SACM control board in the transfer switch.
7. Set DMM to measure DC Volts.
8. Measure voltage on Wire 194 to ground.
   a. If voltage is present, go to next step (minimum 10 VDC).
   b. If voltage is not present, a problem exists on Wire 194. Test Wire 194 back to the generator control board.

NOTE: Wire 194 is a protected circuit. If a short (to ground) exists on this wire, the voltage on this wire falls to zero.

9. Measure voltage on Wires 23 at the transfer relay or Integrated SACM control board in the transfer switch.
   a. If voltage is between 0.1–0.9 VDC the problem is in the switch mechanism or switch controls/ wiring.
   b. If 0 VDC is measured test the transfer relay coil for resistance. If open replace the device and re-test.

Wn-Type Transfer Switch with Non-Integrated SACM – No Transfer to Standby

⚠DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: Generator voltage must be present at the E1 and E2 lugs of the switch (transfer relay energized).

1. Check for generator voltage (208/240V) at terminals AT1/AT2 and B1/B2 on the transfer switch mechanism.
   - If generator voltage is present at terminals AT1/AT2 and B1/B2 the problem is internal to the mechanism. Contact Generac Service for further action.
   - If generator voltage is NOT present at terminals AT1/AT2 and B1/B2 proceed to troubleshooting the wiring and relay contacts.
2. Check F3 and F4 fuses for continuity.
3. Measure the resistance of wire E2/E2A between terminals B2/AT2 and Lug E2 (disconnect and isolate the wires).
   - Replace wire(s) if open.
   - If continuity is measured go to next step, (reconnect wires).

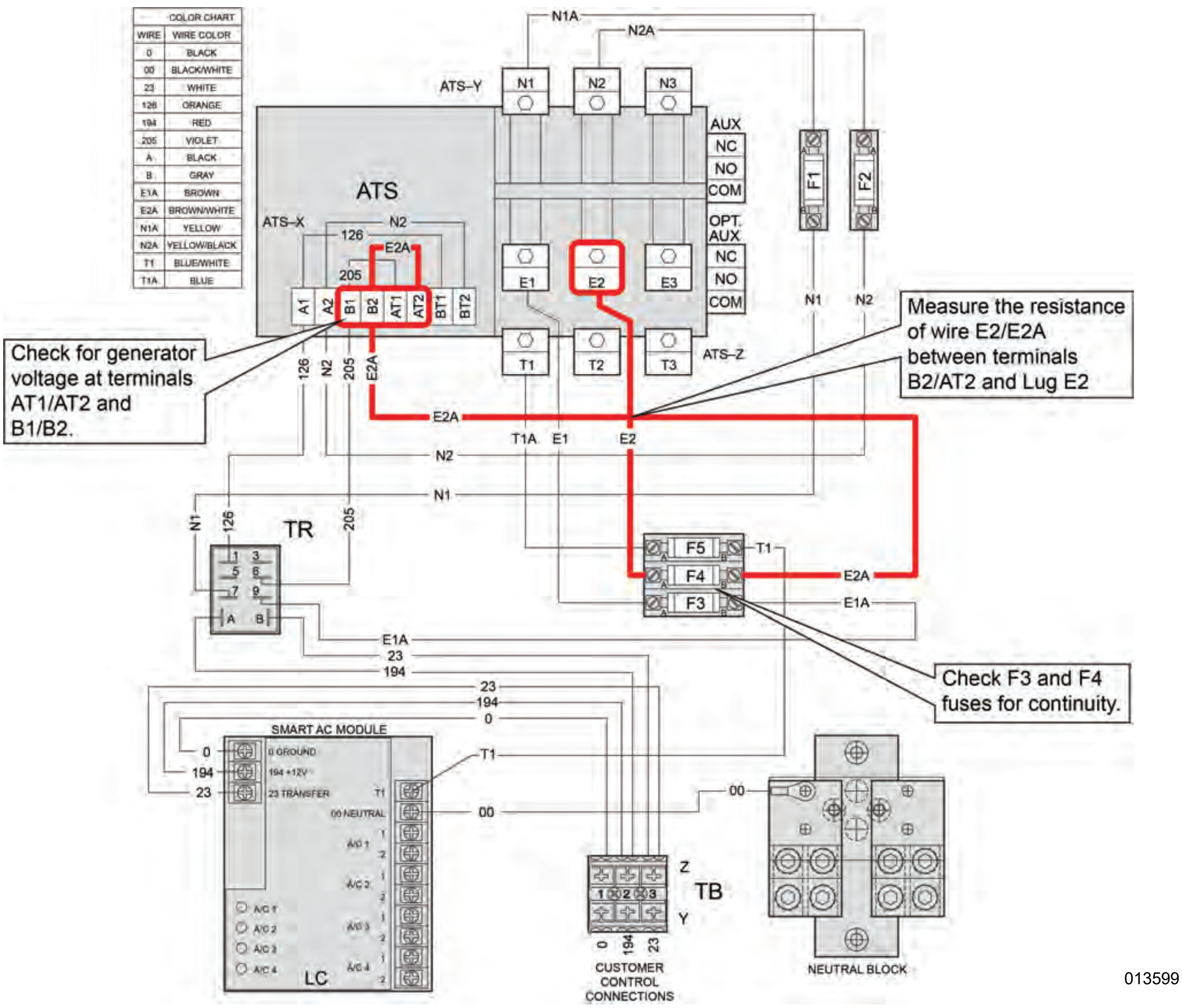


Figure 2-33.

Wn-Type Transfer Switch with Non-Integrated SACM – No Transfer to Standby

⚠ DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: Generator voltage (208/240) must be present at the E1 and E2 lugs of the switch.

1. Set DMM to measure AC volts.
2. Place the black test lead on the E2 main lug of the transfer switch.

NOTE: Leave the black test lead on E2 throughout all tests.

NOTE: Wire 205 goes to 2 locations. It is possible that the wire could be damaged going to either location.

3. Use the red test lead to measure for generator voltage (208/240) at terminal AT1 and terminal B1 Wire 205.
   - If generator voltage is not measured, proceed to the next step. (do not remove the wire)
4. Measure for voltage (208/240) at terminal 6 Wire 205 on the transfer relay. (Do not remove the wire)
   - If generator voltage (208/240) is measured Wire 205 is open. Test and replace Wire 205.
   - If generator voltage is not measured proceed to next step.

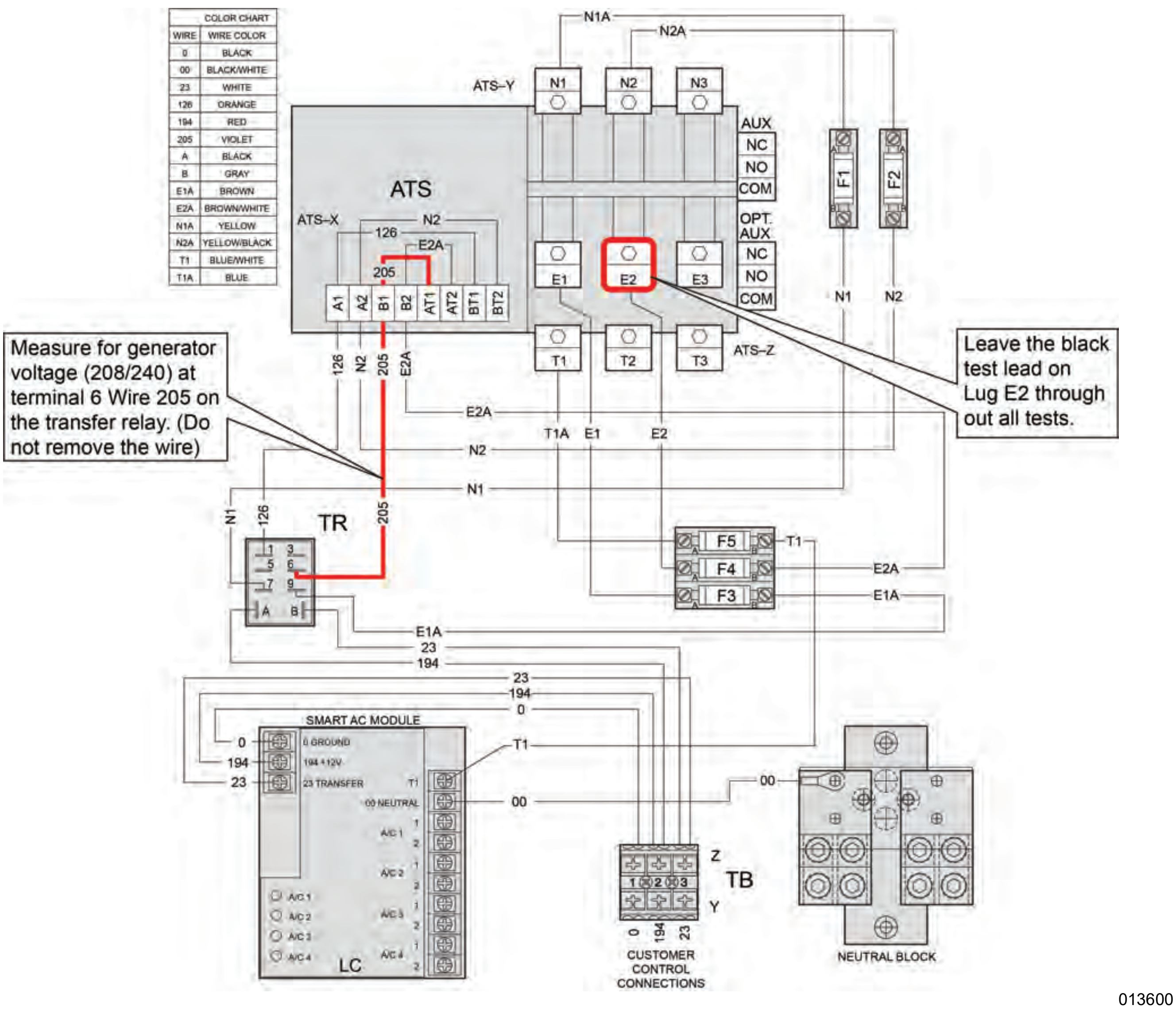


Figure 2-34.

Wn-Type Transfer Switch with Non-Integrated SACM – No Transfer to Standby

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: Leave the black test lead on E2 throughout all tests.

1. Measure for generator voltage (208/240) at terminal 6 Wire 205 on the transfer relay. (Do not remove the wire)
   - If generator voltage (208/240) is measured then Wire 205 is open. Test and replace Wire 205.

NOTE: Wire 205 goes to 2 locations. It is possible that the wire could be damaged going to either location.

   - If generator voltage is not measured then go to next step.

2. Measure for generator voltage (208/240) at terminal 9 Wire E1A on the transfer relay. (Don't remove the wire)
   - If generator voltage (208/240) is measured then there is a problem in the transfer relay normally open contacts; remove and bench test transfer relay.
   - If generator voltage (208/240) is not measured then go to next step.

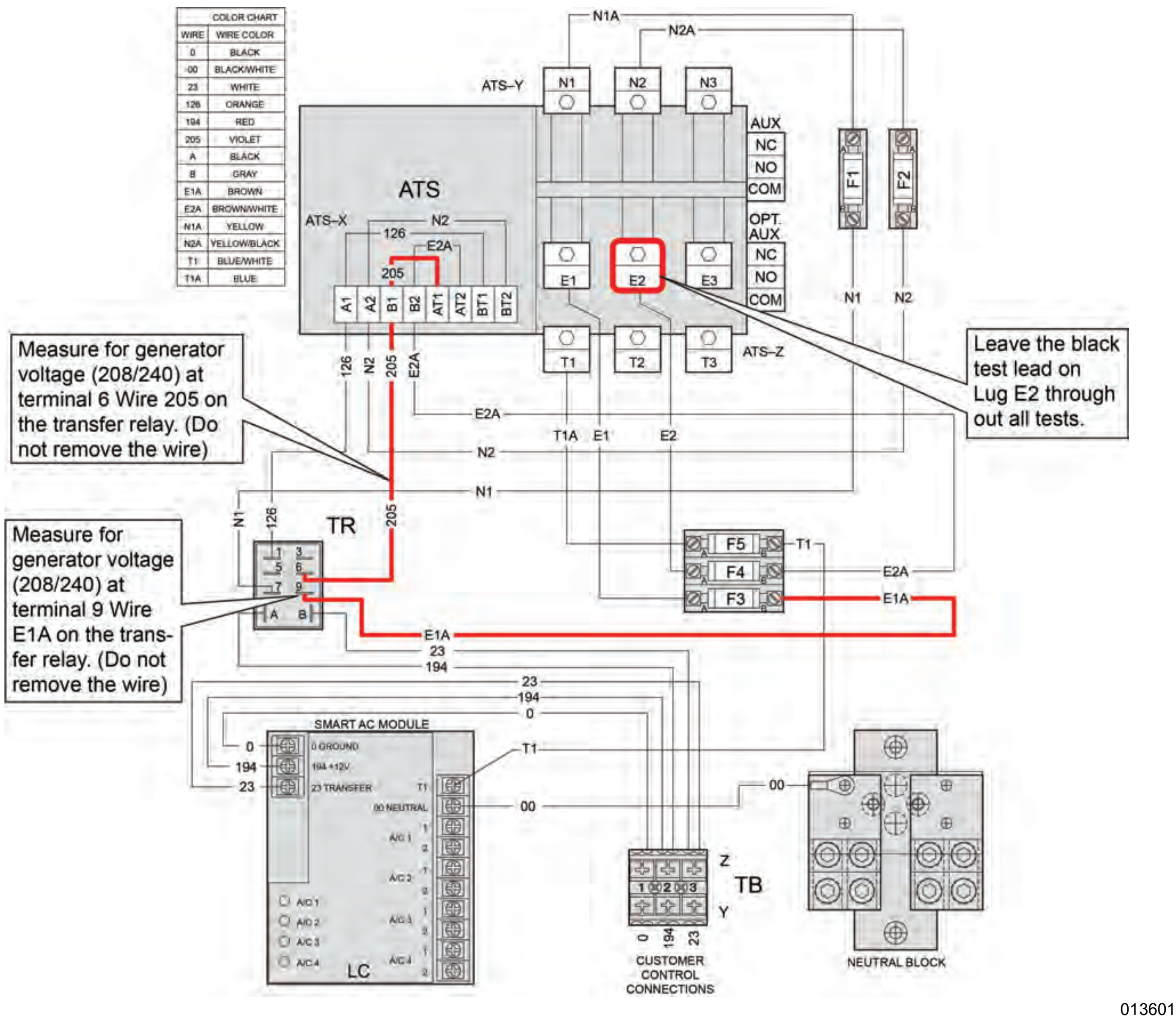


Figure 2-35.

Generator Runs But Does Not Transfer To Utility – Wire 23 and 194 Quick Diagnostic

Utility Returns But Transfer Switch Does Not Re-transfer To Utility

1. Locate Wire 23 and Wire 194 at the transfer relay or Integrated SACM control board in the transfer switch.
2. Measure for voltage to ground on Wires 23 at the transfer relay or Integrated SACM control board in the transfer switch.
   a. If voltage is between 0.1 to 0.9 VDC then the problem is in the wiring between the switch mechanism and the generator controls. Test for possible short to ground or faulty controller.
   a. If voltage is present, there is a problem with switch mechanism or wiring inside the transfer switch.

Wn-Type Transfer Switch with Non-Integrated SACM – No Transfer to Utility

⚠ DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: Utility voltage (208/240) must be present at the N1 and N2 lugs of the switch. (Transfer relay must NOT be energized.

NOTE: De-energize the circuit and then remove F1 and F2 fuse. Check F1 and F2 fuses for continuity.

1. Check for utility voltage (208 / 240) at terminals BT1, BT2 and A1, A2 on the transfer switch mechanism.
   - If AC utility voltage (208/240) is present at terminals BT1/BT2 and A1/A2 the problem is internal to the mechanism. Contact Generac service for further action.
   - If utility voltage (208/240) is NOT present at terminals BT1, BT2 and A1, A2, troubleshoot the wiring and relay contacts.
2. Measure the resistance of wire N2 / N2A between terminals A2 / BT2 and Lug N2 (disconnect and isolate the wires).
   - If wire or wires are open replace wire(s).
   - If continuity is measured then go to the next step (re-connect the wires).

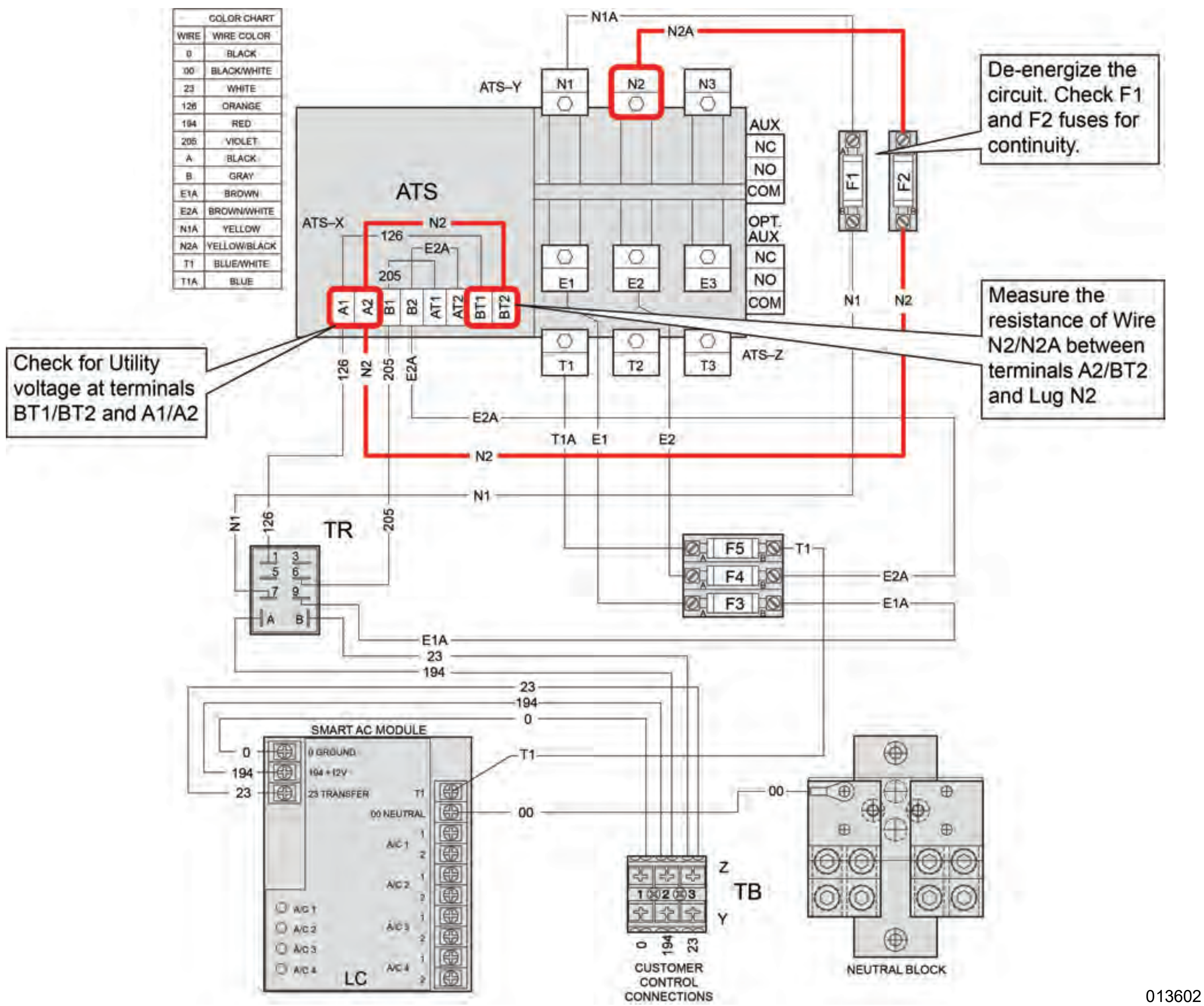


Figure 2-36.

Wn-Type Transfer Switch with Non-Integrated SACM – No Transfer to Utility

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

NOTE: Utility voltage (208/240) must be present at the N1 and N2 lugs of the switch.

1. Set DMM to read AC volts.
2. Measure for utility voltage (208/240) at A1, BT1 Wire 126.
3. Place the black test lead on the N2 main lug of the transfer switch.

NOTE: Leave the black test lead on N2 throughout all tests.

NOTE: Wire 126 goes to 2 locations. It is possible that the wire could be damaged going to either location.

4. Use the red test lead to measure for Utility voltage (208 / 240) at terminals A1, BT1 Wire 126.
   - If utility voltage not present proceed to next step. (Do not remove the wire)
5. Measure for voltage (208/240) at terminal 1 Wire 126 on the transfer relay. (Do not remove the wire)
   - If utility voltage (208/240) is measured then Wire 126 is open. Test and replace Wire 126.
   - If utility voltage is not measured then go to next step.

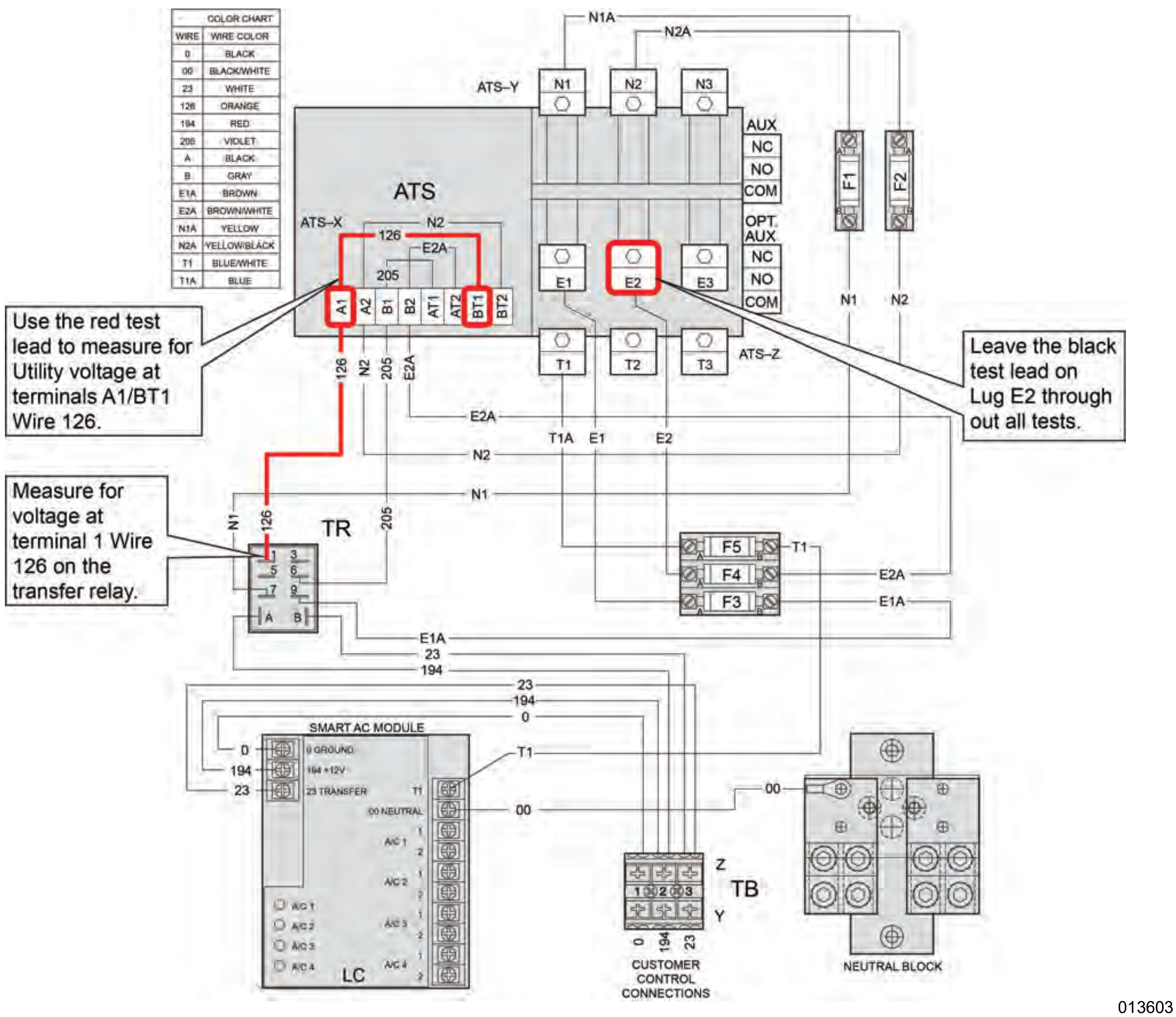


Figure 2-37.

Wn-Type Transfer Switch with Non-Integrated SACM – No Transfer to Utility

DANGER

Electrocution. High voltage is present at transfer switch and terminals. Contact with live terminals will result in death or serious injury.

(000129)

1. Measure for utility voltage (208/240) at terminal 7 Wire N1BA on the transfer relay. (Do not remove the wire)
   - If utility voltage (208/240) is measured, there is a problem in the transfer relay normally closed contacts. Remove and bench test transfer relay.
   - If utility voltage (208/240) is not measured, proceed to next step.
2. Measure for utility voltage (208/240) at N1 main lug of the transfer switch. (Do not remove the wire)
   - If utility voltage (208/240) is measured, Wire N1A/N1B is open. Test and replace Wire N1A/N1B.
   - If utility voltage (208/240) is not measured, the problem is not with the switch but with the utility supply voltage.

NOTE: The Wn switch has a trip coil, a select coil and a closing coil. Each of these coils and their associated limit switches must operate in correctly and in sequence to allow the switch to transfer from either position to neutral, and from neutral to the next position.

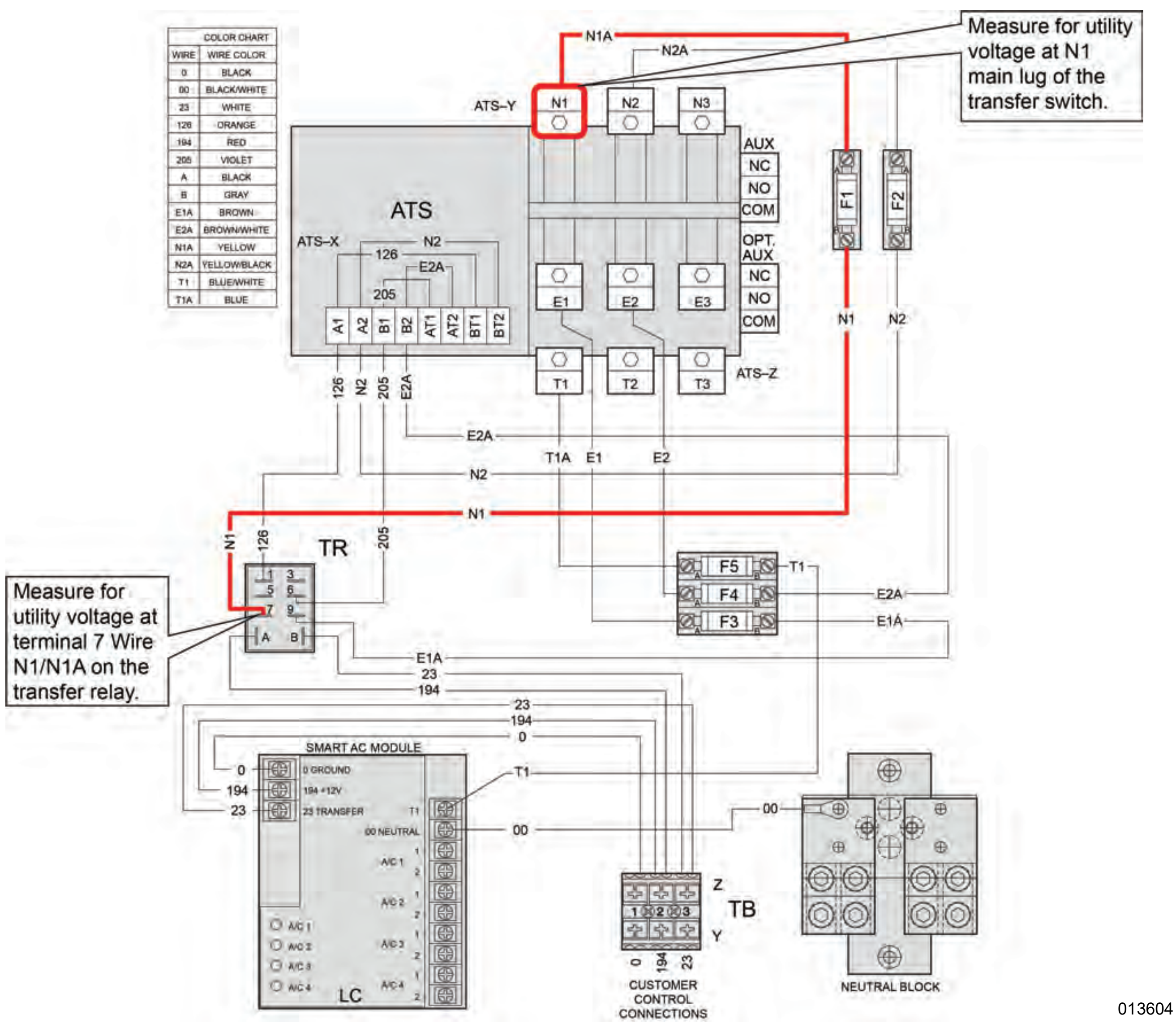


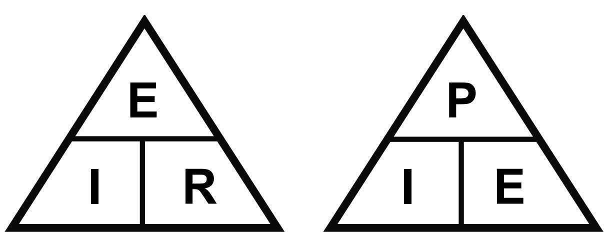
Figure 2-38.

Electrical Formulas

To Find	Known Values	1-phase	3-phase
Kilowatts (kW)	Volts, Current, Power Factor	$\frac{E \times I}{1000}$	$\frac{E \times I \times 1.73 \times PF}{1000}$
KVA	Volts, Current	$\frac{E \times I}{1000}$	$\frac{E \times I \times 1.73}{1000}$
Amperes	kW, Volts, Power Factor	$\frac{kW \times 1000}{E}$	$\frac{kW \times 1000}{E \times 1.73 \times PF}$
Watts	Volts, Amps, Power Factor	Volts x Amps	E x I x 1.73 x PF
No. of Rotor Poles	Frequency, RPM	$\frac{2 \times 60 \times \text{Frequency}}{\text{RPM}}$	$\frac{2 \times 60 \times \text{Frequency}}{\text{RPM}}$
Frequency	RPM, No. of Rotor Poles	$\frac{\text{RPM} \times \text{Poles}}{2 \times 60}$	$\frac{\text{RPM} \times \text{Poles}}{2 \times 60}$
RPM	Frequency, No. of Rotor Poles	$\frac{2 \times 60 \times \text{Frequency}}{\text{Rotor Poles}}$	$\frac{2 \times 60 \times \text{Frequency}}{\text{Rotor Poles}}$
kW (required for Motor)	Motor Horsepower, Efficiency	$\frac{HP \times 0.746}{\text{Efficiency}}$	$\frac{HP \times 0.746}{\text{Efficiency}}$
Resistance	Volts, Amperes	$\frac{E}{I}$	$\frac{E}{I}$
Volts	Ohm, Amperes	I x R	I x R
Amperes	Ohms, Volts	$\frac{E}{R}$	$\frac{E}{R}$

E = Volts   I = Amperes   R = Resistance (Ohms)   PF = Power Factor

Term	Symbol	Measurement
Current	I	Amps
Wattage	P	Watts
Voltage	E	Volts
Resistance	R	Ohms



003003

Constant	Shift		Result	
Voltage E	Resistance Increase	⇧	Current Decrease	⇩
Voltage E	Resistance Decrease	⇩	Current Increase	⇧
Resistance R	Voltage Decrease	⇩	Current Decrease	⇩
Resistance R	Voltage Increase	⇧	Current Increase	⇧
Current I	Resistance Decrease	⇩	Voltage Decrease	⇩
Current I	Resistance Increase	⇧	Voltage Increase	⇧
Power P	Voltage Increase	⇧	Power Increase	⇧
Power P	Voltage Decrease	⇩	Power Decrease	⇩
Power P	Current Increase	⇧	Power Increase	⇧
Power P	Current Decrease	⇩	Power Decrease	⇩

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