Sarel Electronics Ltd.

Power Electronic, Controls and More

Solid State Transition Transfer Switch (SSTTS):

Mission Critical Load Switching

Operator's Manual

Version: 2 (Proposal for new manual) : Revision: 1 : Pre-Beta. For Web and Pre-Sale Review Only
Email ben@sarelelectronics.com if you spot errors or have suggestions

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PRE-RELEASE MANUAL NOTES:

A 2nd Revision of a Manual?

You read right, that is what this is. The SSTTS has evolved both in technical specification and in marketing and branding semantics. Sarel Electronics, as a professional company has also evolved. We are more than a simple engineering company today, one of our main goals is improving the lackluster communication that is the norm in the technological world. This miscommunication is responsible for technician errors, a barrier between business decision makers and the technological tools they need to decide on, and ultimately, inefficiency and break-down of core business tasks. Putting a manual through the test paces of hardware and software ensures a better final product. The ideal Systems Development Life Cycle is one that is continuous evolving, this cycle should include all of the technology and the supporting items.

UTS, SSTS, SSTTS, Static? Solid State? Uninterruptible? Open Transition?

The Solid State Transition Transfer Switch is relatively unique in the power management world. It is an add-on board that allow uninterruptible transfer from one power source to another. Uninterrupted transfers require specialized components and logic that allow "instant" action thereby not interrupting the computers and industrial equipment attached to the sources. "Instant" components are bundled into various terms : "Uninterruptible" (as in Uninterruptible Power Supply (ups)), "Solid State" (as in Solid State Relays) and "Static" (as in Static Transfer Switch (sts)). At various time in its production history the SSTTS and various derived configurations of the product were sold as the "Uninterruptible Transfer Switch" (uts), the "Solid State Transfer Switch" (ssts) or simply as a type of "Static Transfer Technology" (similar to the sts). If we were to literally name the product it would be called:

Automatic/Manual Solid State Open Transition Transfer Switch

Thus, we settled on the name

Solid State Transition Transfer Switch.

NOTE: The OPEN TRANSITION part is of vital importance. It is important to note that the SSTTS is an OPEN TRANSITION switch or a "Break Before Make" switch. This is important as Closed Transition Switches are undesirable in many circumstances, not the least of which are laws regulating the use of these.

What does this have to do with the manual?

Though the SSTTS evolved in name and functionality, the manuals and support did not. This document is to be the unison of all of the documentation and support material we have compiled and unified into one document.

SECTION 1
Introduction

1.1 SCOPE

This manual contains information on the operation and maintenance of the load Solid State Transition Transfer Switch (SSTTS). Complete Step by step operating instructions, maintenance procedures, safety concerns and basic fault finding techniques are included. Applicable block diagrams are provided to assist the reader. A complete set of technical drawings is also included. The entire manual should be read prior to installation or operation of the equipment.

1.2 DESCRIPTION

The SSTTS is a solid state device designed to transfer critical loads from a primary power source to an alternate power source without paralleling or affecting the load.

The SSTTS is designed to be retrofitted to most automatic transfer switch (ATS) installations, without modification to the standard operation of the ATS.

The devices comprising the SSTTS are housed in a freestanding or wall mounted NEMA-1 enclosure. Enclosures and subassembly layouts are chosen to match site space requirements.

The SSTTS is connected between the primary and alternate power sources across the poles of the existing or new ATS. Power to the critical load is furnished through the ATS at all times. The SSTTS is in circuit only when an uninterrupted transfer is initiated manually or by external signal input. The SSTTS is intended for manual or controlled transfer only where both of the power sources are available at the time of transfer. Figure 1-2 shows the single line diagram of the SSTTS connection to a typical ATS.

The SSTTS offers the following benefits:

1. Provides load uninterrupted transfer capability to most standard ATS configurations.
2. Designed for retrofit to most existing ATS installations without interruption to standard ATS Operation..
3. All SSTTS models are manufactured to customer's specifications and / or site space requirements.
4. Highly reliable, energy efficient, technology due to extremely short duty cycle (less than 500ms).
5. Mechanical design provides for front only access for infrared scanning and ease of maintenance.
6. Available in any size or rating both single phase and three phase configurations

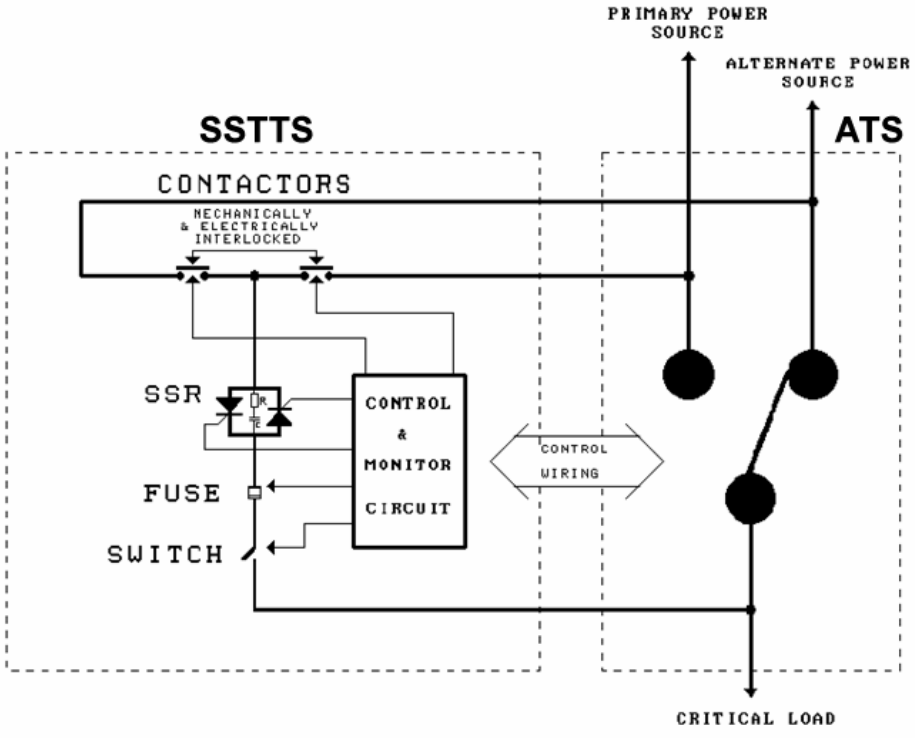

Figure 1-2 SSTTS / ATS Single Line

1.3 DRAWINGS

A complete drawing package to be used in conjunction with this manual has been included. All drawings are titled and indicate the applicable model number in the SSTTS suffix. If the drawing is universal to all SSTTS models no suffix number will appear after the "SSTTS" designation in the title.
Drawing numbers are shown on all drawings. Refer to the table of drawings in section six for a description of each drawing listed in numeric order. All drawing numbers that contain a "SSTTS" prefix are universal to all models.

The following drawings may be included in the package:

- Electrical Single line
- Installation Drawing Wiring Diagram
- Electromechanical Assembly
- Component Layout Drawing
- System Interconnection Diagram
- System Schematic Diagram
- Mimic and Control Diagram
- PCB Schematic Diagram(s)
- Option Table
- Spare Parts List

1.4 INSTALLATION

The SSTTS is to be installed in accordance with the latest National Electrical Code and all Municipal, Provincial (or State) Codes and Regulations.
The SSTTS is to be installed in accordance with the included installation drawing and the following procedures. Any discrepancies between drawings and specifications leaving in doubt the intent of work should be brought to the attention of the manufacturer's local representative immediately. Where the drawings differ from what is required by governing Codes and Regulations the Codes and Regulations shall prevail.

After the installation is complete, contact the **Sarel Electronics** for inspection and startup assistance.

1.4.1 Initial Inspection

- Verify that all items ordered have been received. Any shortages or overages should be reported immediately.

- Visually inspect the unit for shipping damage internally and externally immediately upon receipt. The units are shipped F.O.B. Factory and if shipping damage has occurred the purchaser should promptly notify the carrier and file a claim with the carrier. If damage has occurred, keep the shipping cartons and packing materials for the carrier or distributor. If you discover shipping damage after acceptance, file a claim for concealed damages. **Sarel Electronics and the applicable shipping company** should be notified if the damages may impair the operation of the unit.

- When unpacking take care to avoid damaging painted surfaces, switches and instruments.

- Check all mechanical connections for unsecured components within the SSTTS system.

- Check all electrical connections and tighten any connections that may have come loose due to vibration during shipping.

- Check for any unsafe feature that may be a potential safety hazard.

1.4.2 Storage

If you do not install the equipment immediately;

- Keep it in the original packing material (after inspection).

- Store it in temperatures between 0°C (32°F) and 70°C (158°F).

- Always protect it from moisture. Store in relative humidity of 0 to 95% non-condensing.

1.4.3 Location

The SSTTS should be placed as close as possible to the existing ATS.

- Maintain clearance on all sides as needed for servicing and as required by local codes and regulations.

- Verify that there is adequate clearance for cabinet doors to fully open. See installation drawing and local codes (1.2 meters or 4 feet is recommended).

- Avoid temperature and humidity extremes.

- Provide shelter from the elements (especially moisture).

- Maintain 6 inches of clearance from top of unit.

1.4.4 Interconnect Wiring

WARNING

ELECTRICAL SHOCK HAZARD. ALL POWER TO THE AUTOMATIC TRANSFER SWITCH (ATS) AND THE SSTTS SHOULD BE SHUT OFF BEFORE ANY CABLES OR CONTROL WIRES ARE INSTALLED AND CONNECTED. THE SSTTS AND THE SSTTS OPTIONS SHOULD BE INSTALLED BY **QUALIFIED ELECTRICIANS, TECHNICIANS, OR OTHER QUALIFIED PERSONNEL**.

- Power and control wiring must be separated. Power wiring must run in individual separate conduit or cable tray. Control wiring must be run in individual separate ferrous conduit.

- The SSTTS is to be installed in accordance with the latest National Electrical Code and all Municipal, Provincial (or State) Codes and Regulations.

- A safety ground wire must be run from the ground connection within the SSTTS to the ground connection in the ATS. Refer to the applicable electrical code for wire size.

- Always observe proper phase rotation of all power wiring entering and / or leaving the ATS and the SSTTS.

- Verify that the cable termination lugs of the ATS load, normal and emergency poles are suitable for multiple cable use. If the termination points in the ATS cannot accept the additional power conductors from the SSTTS, contact the ATS supplier for a suitable provision for cable connection. Be prepared to furnish cable sizes and number of conductors per phase when calling the ATS supplier.

- Be sure to use copper conductors.

- Refer to installation and interconnect drawings included in this manual to locate the SSTTS terminal blocks. Refer to these drawings for details on routing power and control wiring and their respective termination points in the ATS.

1.4.5 Verification of Interconnect Wiring

CAUTION

Do not energize any of the Power Inputs or Outputs to the ATS or the SSTTS after installation. An authorized **Sarel Electronics** Service Representative must be present to perform the initial Start-up procedures.

CAUTION

Do not energize any of the Power Inputs or Outputs without first verifying that the following connections have been made.

.1 AC power cables from the SSTTS - SW1 terminals to the ATS - LOAD terminals. (Observe phase rotation.)

.2 AC power cables from the SSTTS - CON1 terminals to the ATS - NORMAL terminals. (Observe phase rotation.)

.3 AC power cables from the SSTTS - CON2 terminals to the ATS - EMERGENCY terminals. (Observe phase rotation.)

.4 AC Ground cable from the SSTTS - GROUND terminal to the ATS - GROUND terminal. (Observe phase rotation.)

.5 Control Wiring from the SSTTS - TB1 terminal block to the ATS Controller user interface.

1.4.6 Start-Up

After the installation is complete, contact the **Sarel Electronics** for inspection and startup assistance.

WARNING

UNDER NO CIRCUMSTANCES SHOULD POWER BE APPLIED to the Automatic Transfer Switch (ATS) or the Solid State Transition Transfer Switch (SSTTS) before all equipment has been thoroughly checked by a factory trained representative of **Sarel Electronics.**

1.5 OPTIONS

Contact your local **Sarel Electronics** distributor for separately printed descriptive literature on available SSTTS options. All options included with your equipment purchase are documented in section six of this manual. A brief description of the most frequently requested options follows.

1. Custom Mimic and Control

   The SSTTS mimic and control panel located on the front side of door contains the normal operating controls, and status indicators on a graphic mimic bus diagram depicting the overall SSTTS power flow.

   The standard mimic and control panel, suitable for most applications, can be designed to suit the specific requirements of the owner. Silk screened descriptions on graphic mimic bus, color and placement of indicators and control push buttons can be designed to suit the owner's needs. Digital metering of load bus current or voltage and / or a synchronizing meter can also be incorporated.

2. Remote Mimic and Control

   All the features of the mimic and control panel, both standard and custom versions, are duplicated in a remote mimic and control panel. The remote unit can be wall mounted or incorporated into the owner's fixtures.

3. External Control Signals

   The SSTTS can be equipped to accept any external control signal voltage to initiate an automatic transfer operation. The external control signal could originate from the owners Computerized Building Management and Control System, Energy Management System or any Alarm Monitoring Device.

4. Customer Interface

   The SSTTS Customer Interface provides alarm and status indications through dry contacts. It is equipped with a terminal block for a convenient termination point for external wiring.

1.6 GENERAL SAFETY

Electrical shock hazard. All power to the automatic transfer switch (ATS) and the SSTTS should be shut off before any cables or control wires are installed and connected. These connections may contain HIGH VOLTAGES which can injure or kill personnel, and damage equipment. The SSTTS and the SSTTS options should be installed by qualified electricians, technicians, or other qualified personnel.

Under no circumstances should power be applied to the Automatic Transfer Switch (ATS) or the Solid State Transition Transfer Switch (SSTTS) before all equipment has been thoroughly checked by a factory trained representative of **Sarel Electronics Limited (Ltd.)**

Always ensure that maintenance and servicing is performed by qualified factory trained electricians or technicians. **Sarel Electronics** has a highly qualified customer service staff to assist and train customers with installation, maintenance, and repair of SSTTS equipment.

Never rely on any electrical or mechanical lockouts that form part of the ATS or SSTTS to remove power from any component of the SSTTS. Always use up stream or down stream isolating devices such as disconnects to safely remove power from the ATS and the SSTTS equipment.

Use only test equipment designed and rated for use with this type of electrical / electronic equipment. Exercise caution when utilizing tools such as an oscilloscope. Always check with an AC voltmeter to ensure safety before making contact.

Never work alone unless all power is removed from equipment. Always wear safety glasses and apparel in accordance with your company's safety procedures and the local health and safety regulations. Use

rubber mats when performing maintenance or service on the equipment.

Always keep the area around the equipment free of debris and obstructions.

In case of fire involving electrical equipment use only fire extinguishers approved for use in electrical fire fighting.

Under normal operation the SSTTS with its doors closed requires no special safety procedures. Only normal safety precautions are required. Special safety precautions are required when performing maintenance or service on the equipment.

2.1 ELECTRICAL CHARACTERISTICS

The Amperes and Voltage rating of the SSTTS are provided on the nameplate and the single line diagram. These ratings are also expressed as part of the model number. The nominal operating voltage immediately follows the SSTTS designation with the rated current as the next portion of the SSTTS model number suffix.

Figure 2-1 below illustrates the Model Numbering System.

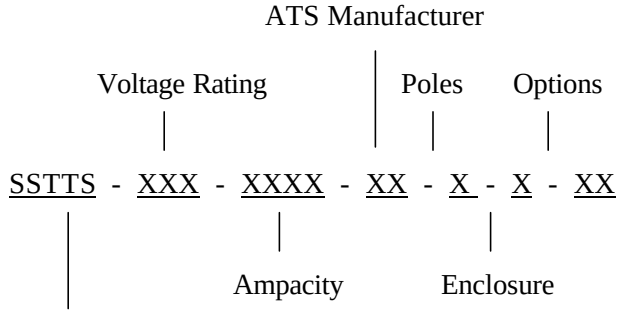

Figure 2-1 Model Numbering

- **Source Voltages:** 600 volts AC +/- 10%, 3 phases, 3 wires, 3 poles (480 or 208 volt, 1 or 3 phase as specified on drawings).
- **Source Frequencies:** 60Hz +/- 5%
- **Rating:** As defined on drawings, nameplate and model number. Amperes at Nominal Voltage.
- **Load Power Factor:** Unity to .80 lagging or leading.
- **Overload Rating:** 500% for one half cycles.
- **Harmonic Current Feedback:** Harmonic current feedback from the load is unlimited.
- **Source Harmonic Voltage Content:**
  Maximum 5% total harmonics or as acceptable to the load.
  Maximum 3% single harmonics or as acceptable to the load.
- **Voltage Transient Withstand:** Voltage Transient Withstand, without failure or mis-operation, present on the line (applicable during transfer operation only) is up to 2kV (2000 volt spike), per IEEE 587 standards.
- **Electromagnetic Interference:** Not susceptible to mis-operation due to EMI or RFI generated by a hand held general radio service transmitter from a distance of 24 inches in front of unit, with door closed.
- **Shorted SCR Protection:** The SCR's are protected by appropriate fuses complete with fuse monitoring circuits. A shorted SCR will clear the fuse and sensing circuits will inhibit transfer operation.
- **Interface Connection:** The unit is equipped with summary alarm N.O. contacts (SPDT) rated at 250 volts AC - 10 amp, or 24 volts DC - 5 amp.

2.2 ENVIRONMENTAL CONDITIONS

The SSTTS is convection cooled and capable of withstanding any combination of the following environmental conditions:

- Operating ambient environment of 0 to 40 C

- Non operating ambient environment of 0 to 70 C
- Relative Humidity: 0 to 95% non-condensing
- Barometric Pressure: At elevations up to 6000 feet above sea level
- Equipment shall be designated for indoor use in a clean (dust free) temperature and humidity controlled environment.

2.3 ADJUSTMENTS

Adjustments are located behind lockable door to ensure only authorized staff can make such adjustments. All adjustments have been factory set and normally do not have to be field readjusted.

- Acceptable voltage limits on both the primary and the alternate sources are individually adjustable by an operator with the ability to set the UV (under voltage) from 5% to 30% of nominal.
- The Unit is equipped with an adjustment for phase angle difference (10° to 20°). This adjustment is set in the factory prior to shipment, and located such that only qualified personnel have access to it. The SSTTS is able to transfer with any number of degrees difference between the sources if the owner so specifies ahead of time prior to manufacture.

2.4 PROTECTION

- SCR Isolation Breaker / Switch
- SCR Fuses
- Fuse Monitoring Circuits
- Fuse Blown Transfer Lockout
- Mechanical & Electrical Contactor Interlocks
- Phase Angle Transfer lockout
- Under Voltage Lockout

2.5 ENCLOSURE

The SSTTS is constructed in subassembly configuration for maximum ease of maintenance. Assemblies are installed in NEMA Type-1 metal enclosures. The enclosure is designed for indoor use only.

Individual enclosures have only front access for operational maintenance. Power and control cabling is through the bottom, top or side as defined by the owner prior to order. All circuit breaker handles are accessible from the front of the unit (after opening lockable door).

SECTION 3
Theory and Functional Description

3.1 THEORY OF OPERATION

The SSTTS is a Solid State device designed to provide the standard open transition ATS with uninterrupted transfer capability of critical loads from a *primary power source* to an *alternate power source*, without paralleling or affecting the load. Either power source (*Normal or Emergency*) can be designated as the primary source by the owner at the time of transfer. The SSTTS is intended for manual or controlled transfer only where both of the power sources are available at the time transfer is requested.

The SSTTS is designed to be retrofitted to most existing automatic transfer switch (ATS) installations. No modifications to the operation of the ATS, (wherein transfers between two power sources are open transition), are required. All logic and control interface between the SSTTS and the existing ATS are through standard ATS customer contact options. Each input power source (*Normal or Emergency*) is electrically and mechanically interlocked within the SSTTS.

The Static Transfer Section provides a current path from the alternate power source to the load during the time required for the ATS to complete its transfer cycle. (*The alternate power source is the desired power source to which the operator wishes to transfer the critical load and could be Normal or Emergency ATS sources depending on present position of the ATS*.) The static transfer section can be electrically isolated from the load and all external power, through operation of a built in disconnecting device, to provide the means for safe servicing and / or maintenance.

The SSTTS consists of three pairs of Silicon Controlled Rectifiers (SCR's) connected in an AC switch configuration. These momentary rated and operated SCR's are rated to carry the full 100% load for a period of 500ms, approximately 10 times the closing time of an ATS.

Refer to flow chart "Sequence of Operation" figure 3.1.2, page 3.2, depicting a typical transfer from the Primary to an Alternate power source.

Normal operation is for power to pass to the critical load through the preferred side (*usually the Normal position*) of the ATS. When transfer is initiated, via external automatic signal or manually by owner's operator, the mechanical isolation device (contactor) connected to the alternate source will close connecting it to the static switch. On the 2nd available zero crossing (after contactor closure) of the two power sources the ATS is activated disconnecting the critical load from the preferred (*usually the Normal position*) power source. At this moment the SSTTS critical bus monitoring will detect the resulting under voltage condition and instantaneously activate the static switch.

The power flow is now from the alternate power source to the critical load via the static switch SCR's, while the ATS is completing its mechanical transfer. The gate signal to the SCR's will be maintained for an additional 500ms after the ATS has completed its transfer to the alternate source.

Power now passes to the critical load through the alternate side of the ATS (*usually the Emergency position*). The SSTTS isolation contactor connected to the alternate source is disengaged. The SSTTS is returned to its normal off line state ready to complete the next transfer upon request.

Refer to figure 3.1.1, Transfer Timing Diagram, below for an illustration of the sequence of transfer operation.

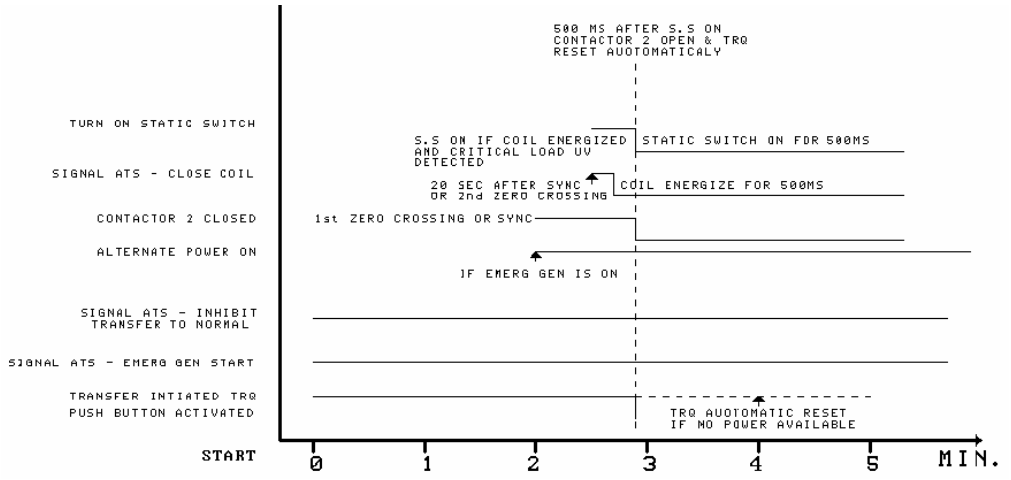

Figure 3.1.1 Transfer Timing

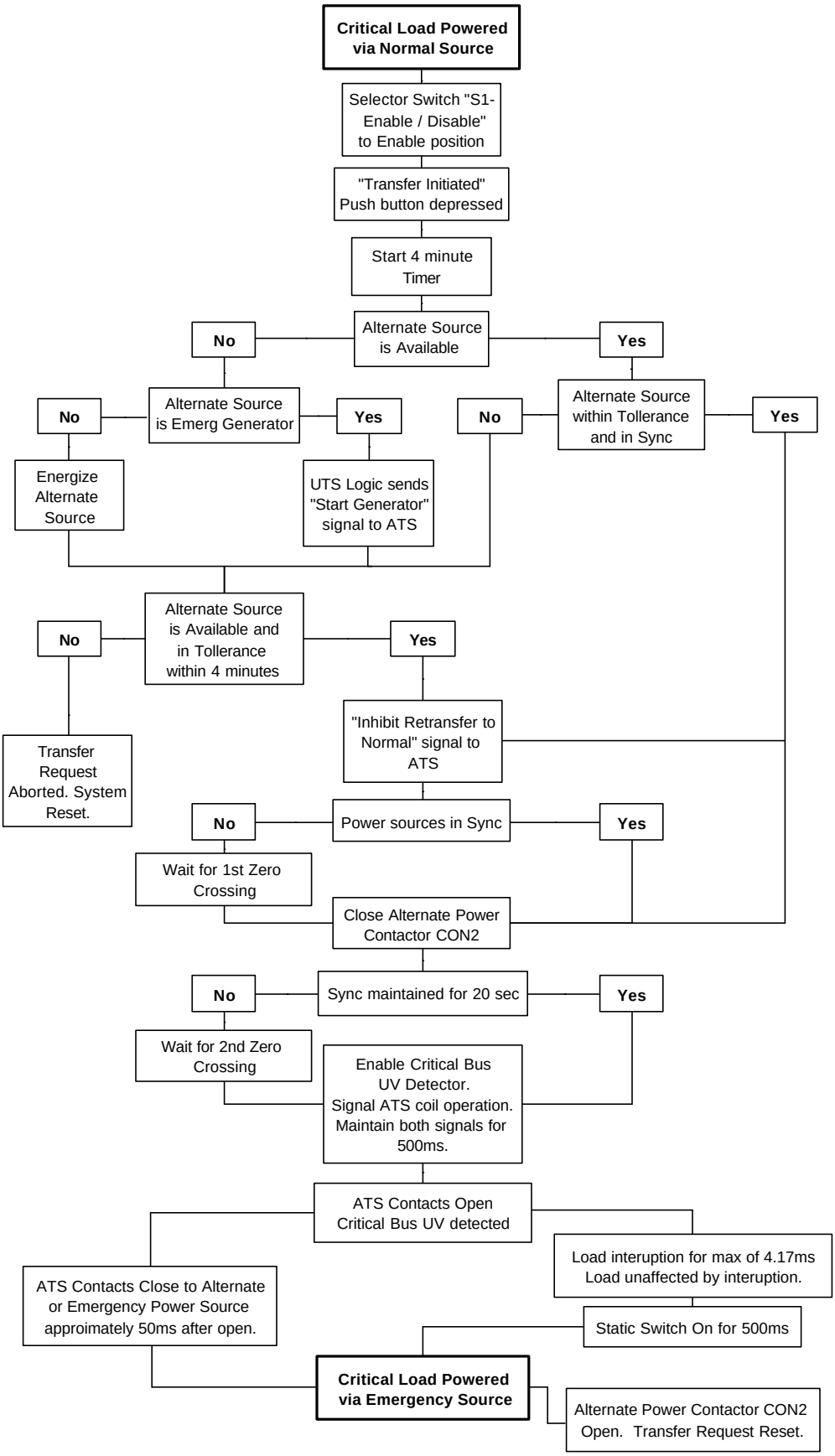

Figure 3.1.2 Sequence of Operation

3.2 COMPONENT DESCRIPTION

A System Schematic diagram, Figure 3.2, is included to assist in understanding the interaction of the various components comprising the SSTTS. The Power components and paths are shown in bold lines. The Control and Logic components are shown in light lines.

Functional descriptions of the components are provided in the succeeding text. Physical location, or layout, of these components is provided in the Drawing Section 6 of this manual. Location of components depends on enclosure size selected to meet the owner's site space requirements.

3.2.1 Power

.a CON1 - Contactor 1 (CON1) is the AC connection point for power wiring from the *Normal or Primary* power source in the ATS. CON1 connects the power source to the Static Switch when initiating a transfer from the *alternate source to the primary source*. With the contactor closed and SW1 closed, power is available to both sides of the open or off static switch. It is electromechanical interlocked with CON2.

.b CON2 - Contactor 2 (CON2) is the AC connection point for power wiring from the *Emergency or Alternate* power source in the ATS. CON2 connects the power source to the Static Switch when initiating a transfer from the *primary source to the alternate source*. With the contactor closed and SW1 closed, power is available to both sides of the open or off static switch. It is electromechanical interlocked with CON1.

.c SW1 - Switch 1 (circuit breaker) is the AC connection point for power wiring from the *Load* terminals of the ATS. SW1 connects the critical load to the opposite side of the static switch from the power source input. Opening SW1, CB3 and CB4 will isolate the static switch and fuse sections from the load, primary and alternate power respectively.

.d F1, F2 and F3 - Fuses F1 to F3 inclusive serve to protect the static switch section from over current. The fuses will clear should on over current, shorted SCR(s) or load current is sustained through the static switch (due to malfunction) for longer than the allowable 1 second duty cycle.

.e SSR1, SSR2 and SSR3 - comprise the Static Switch section of the SSTTS. The Static Switch Section provides a current path from the desired power source to the load during the time required for the ATS to complete its open transition transfer cycle.

3.2.2 Control

.a CB1 - Fuse monitor for static switch fuses F1-F3. On detection of blown fuse CB1 will open disabling transfer activation.

.b CB2 - Protection for Critical Bus Voltage Sensing feedback circuit. Sensing circuit originates from load side of SW1 through CB1 to control transformers T1, T2 and T3.

.c CB3 - Protection for primary power source, (*ATS Normal source*), Sensing Circuit. Taps from line side of contactor 1 are routed through CB3 to control transformers T4 and T6. Opening CB3 will isolate *Normal Power* from the static transfer section by dis-engaging the CON1 contactor.

.d CB4 - Protection for alternate power source, (*ATS Emergency source*), Sensing Circuit. Taps from line side of contactor 2 are routed through CB4 to control transformers T5 and T7. Opening CB4 will isolate *Emergency Power* from the static transfer section by dis-engaging the CON2 contactor.

.e T1, T2 and T3 - Control transformers for Critical Bus Sensing. Steps down from Line voltage to 24 VAC for input to main Printed Circuit Board (PCB) - C3D via CONV1.

.f T4 - Control transformer for primary power source (*ATS Normal source*), Sensing Circuit. Steps down from Line voltage to 24 VAC for input to main PCB - C3D via CONV1.

.g T5 - Control transformer for alternate power source (*ATS Emergency source*), Sensing Circuit. Steps down from Line voltage to 24 VAC for input to main PCB - C3D via CONV1

.h T6 - Step down (to 120 Vac) control transformer for primary power source - Power Supply PS1

and contactor CON1 coil power via relay board REL-BD and electrical interlock circuit.

.i T7 - Step down (to 120 Vac) control transformer for alternate power source - Power Supply PS2 and contactor CON2 coil power via relay board REL-BD and electrical interlock circuit.

.k PS2 - 24 volt, 0.6 - 2.1 amp, regulated switching power supply for main PCB - C3D. Power supply source is from alternate *(emergency)* power bus. Operates in parallel to PS1 when transfer is initiated to provide redundancy in power supplies.

.l SSR4 - Solid state relay to interface with ATS operating coil. Activates the ATS coil when both the SSTTS and the ATS synchronizing circuits allow transfer.

.m REL-BD - Provides isolation between low and high voltage control and signal circuits. Is comprised of 8 individual low current relays.

.1 2 relays to interface between the main PCB - C3D low voltage outputs and the contactor coil control circuits.

.2 3 relays to interface with the ATS logic.

.3 1 relay to interface with the SSTTS enable / disable circuitry.

.4 1 relay to interface with synchronizing feedback circuits.

.5 1 relay provides for summary alarm customer interface.

.n RL1 - Nominal line voltage contactor in parallel with SSR to disable or enable SSTTS transfer functions.

.o CONV1 & CONV2 - Terminal block to 10 pin ribbon interface or converter. Used as I/O for main PCB - C3D.

.p TB1 - Interface between relay board and ATS logic. Customer connection point for control wiring between the ATS and the SSTTS.

.q TB2 - Customer connection point for Summary Alarm.

.j PS1 - 24 volt, 0.6 - 2.1 amp, regulated switching power supply for main PCB- C3D. Power supply source is from primary *(normal)* power bus. Operates in parallel to PS2 when transfer is initiated to provide redundancy in power supplies.

.r TRQ - Initiate Transfer Request push-button. See table 3.1 “Mimic and Control Panel” for description.

.s ENABLE / DISABLE - Selector switch used to set the SSTTS operating mode. See table 3.1 “Mimic and Control Panel” for description.

.t SSD - Static Switch Driver, printed circuit board, generates a 15 - 17 kHz carrier (rectified to 1.2 - 1.8 volts DC) gate signal to SSR1, SSR2 AND SSR3.

3.2.3 Logic

All control logic functions originate from a single main printed circuit board (PCB) - C3D mounted on the rear of the mimic panel.

- Monitors status of CON1 and CON2.
- Monitors status of SW1, CB1 and CB2
- Primary and Alternate power bus voltage monitoring.
- Primary and Alternate power bus voltage tolerance (+/- 5% of nominal)
- Critical Load Bus undervoltage monitoring.
- Monitors Synchronization status between critical load and desired power source.
- Driver for Mimic Panel LED.
- Generates signals for contactor control.
- Generates signals to SSD for static switch control.
- Generates signals to interface with ATS logic via relay board.

- Generates signal to activate ATS transfer via SSR.

- Generates signal for ATS Coil Bypass Relay RL1.

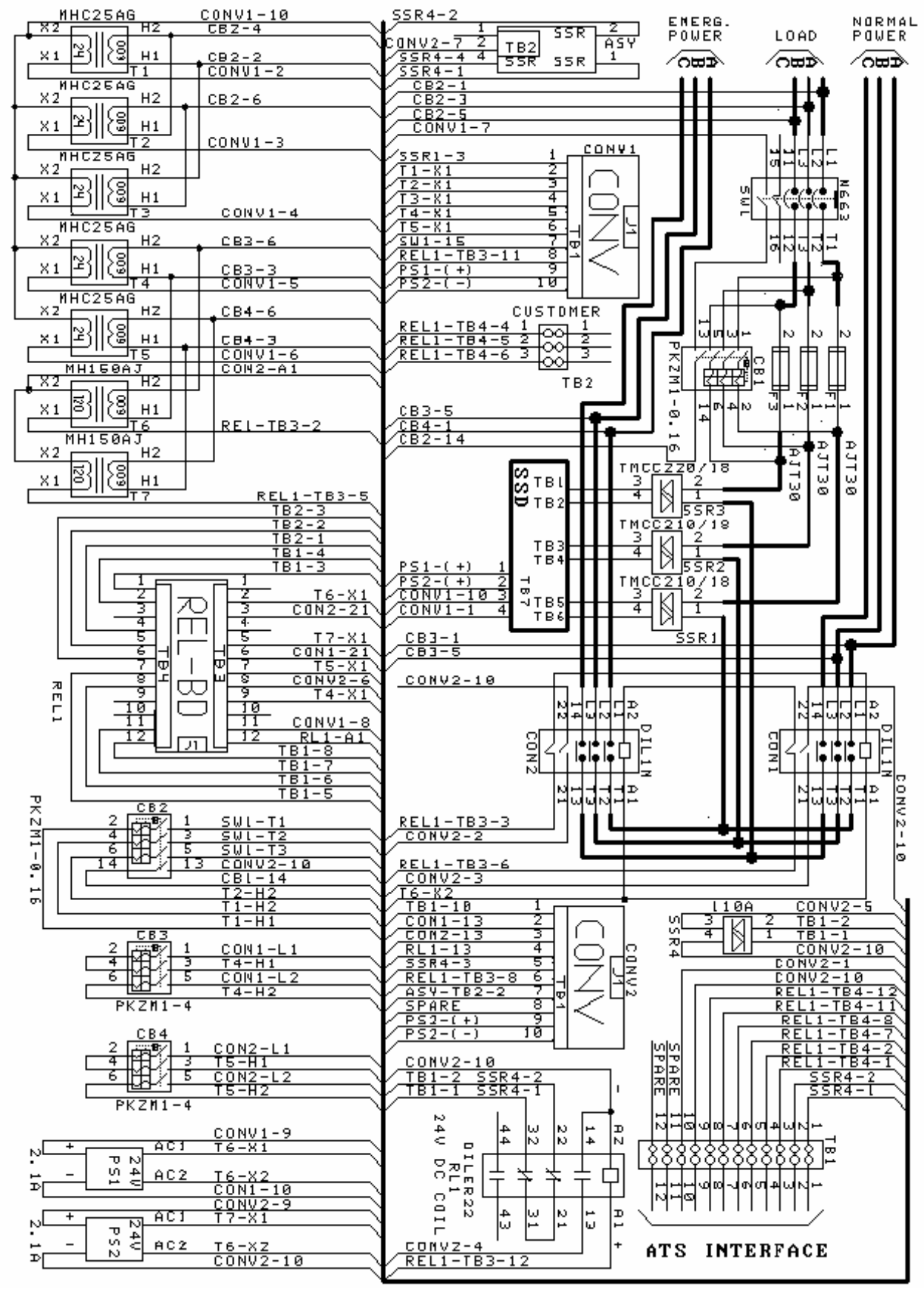

Figure 3.2 System Schematic Diagram

3.3 MIMIC AND CONTROL

The detail of the “Standard” Mimic and Control Panel is shown in figure 3.3 . Table 3.1 provides the descriptions for all of the items on the Mimic and Control Panel.

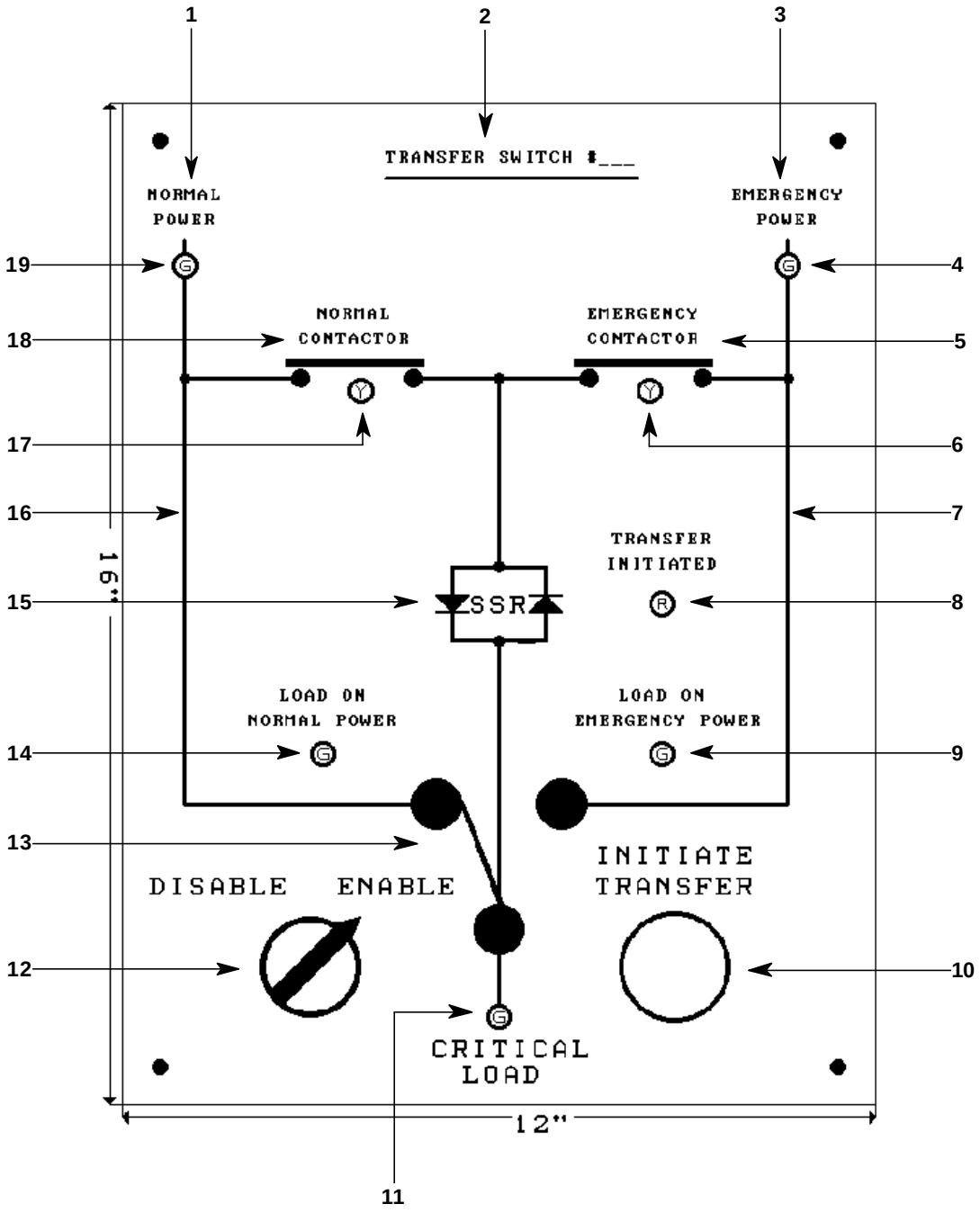

Figure 3.3 Mimic and Control

Table 3.1 Mimic and Control Panel Detail

INDEX NO.	CONTROL OR INDICATOR	FUNCTION
1	Normal Power	Designation for Normal or Primary power from ATS. On custom units this designation is per owner's requirements and will match that of item 14 and 18.
2	Transfer Switch #	Includes the ATS number designation per owner's requirements. Refers to the ATS to which the SSTTS is fitted to.
3	Emergency Power	Designation for Emergency or Alternate power from ATS. On custom units this designation is per owner's requirements and will match that of item 5 and 9.
4	Green LED	LED is ON any time Emergency or Alternate power from ATS is available.
5	Emergency Contactor	Depicts the Emergency or Alternate contactor. On custom units this designation is per owner's requirements and will match that of item 3 and 9.
6	Yellow LED	LED is ON only when Emergency or Alternate power contactor is closed.
7	Emergency Power Bus	Depicts the Emergency or Alternate Power Bus.
8	Transfer Initiated Red LED	LED Flashes from the time the Transfer Initiate Push button (Item 10) is depressed until transfer has been completed or transfer is aborted.
9	Load on Emergency Power Green LED	Led is on when the critical load is powered from the Emergency or Alternate source. On custom units this designation is per owner's requirements and will match that of item 3 and 5.
10	Initiate Transfer Push Button	Momentary Push Button used to initiate manual transfer operation. Has no effect if the Enable / Disable selector switch (Item 12) is in the disable position.
11	Critical Load Green LED	LED is ON any time there is power to the Critical Load.
12	Operating Mode Selector Switch "Disable / Enable"	Disable: Disables all SSTTS functions, except LED indicators. The ATS will function as designed independent from the SSTTS. Any transfer requests, manual or automatic will be open transition. Critical load will not be maintained during transfer operation. Enable: Enables all SSTTS functions. Any transfer requests, manual or automatic, will be completed by the SSTTS and the ATS , controlled by the SSTTS. Provided both power sources are available and synchronized the Critical load will be maintained during transfer operation. Select Enable position prior to operating the Initiate Transfer (Item 10) push button. NOTE: With the Selector switch left in the Enable position the SSTTS maintains control of all ATS transfer operations. Any transfer requests issued by the ATS or by external signal to the ATS will be ignored if SSTTS conditions are not satisfied.
13	Transfer Switch Silk Screen	Depicts the ATS. Shown with ATS in Normal position.
14	Load on Normal Power Green LED	Led is on when the critical load is powered from the Normal or Primary source. On custom units this designation is per owner's requirements and will match that of item 1 and 18.

INDEX NO.	CONTROL OR INDICATOR	FUNCTION

Table 3.1 Mimic and Control Panel Detail

INDEX NO.	CONTROL OR INDICATOR	FUNCTION
15	SSR	Depicts the Static Switch or Solid State Relay.
16	Normal Power Bus	Depicts the Normal or Primary Power Bus.
17	Yellow LED	LED is ON only when Normal or Primary power contactor is closed.
18	Normal Contactor	Depicts the Normal or Primary contactor. On custom units this designation is per owners requirements and will match that of items 1 and 14.
19	Green LED	LED is ON any time Normal or Primary power from ATS is available.

3.4 CONTROL LOGIC

All the Control Logic is contained on one main printed circuit board (PCB) designated as C3D. The C3D PCB is located on the rear of the door containing the mimic panel. (For physical location of C3D see the component layout Drawing in Section 6 of this manual.)

Adjustments are located behind lockable door to ensure only authorized staff can make such adjustments. All adjustments have been factory set and normally do not have to be field readjusted.

A brief description of the logic indicators, test points and adjustments is provided in Table 3.2. Component location is provided in Figure 3.4 "C3D - PCB Component Layout".

Table 3.2 Adjustments

ITEM	DESCRIPTION
TP1	Test Point One, Critical Load Feedback (LDFB) - Un-filtered rectified representation of 3 phase load bus voltage. Used to set U/V threshold.
TP2	Test Point Two, Under Voltage Reference (UREF) - DC U/V Reference Voltage set with Potentiometer P1.
TP3	Test Point Three, Under Voltage (U/V) - DC signal. High if undervoltage on critical load bus.
TP4	Test Point Four, Primary or Normal Supply Voltage in Tolerance, (OKM) - DC signal, high when Primary voltage is within +/-5% of nominal.
TP5	Test Point Five, Alternate or Emergency Supply Voltage in Tolerance, (OKG) - DC signal, high when Alternate voltage is within +/-5% of nominal.
TP6	Test Point Six, Synchronized (SYNC) - DC signal. High if the critical load bus is in sync with the desired power source.
TP7	Test Point Seven, 24 Volt DC Control Voltage (24V) - Representation of +24 Volt DC Control Voltage.
TP8	Test Point Eight, +15 Volt DC Control Voltage (+15V) - Representation of +15 Volt DC Control Voltage.
TP9	Test Point Nine, Common (COM) - Power Supply Common. Linked to TP10.
TP10	Test Point Ten, Common (COM) - Power Supply Common. Linked to TP9.
TP11	Test Point Eleven, -15 Volt DC Control Voltage (-15V) - Representation of -15 Volt DC Control Voltage.
TP12	Test Point Twelve, Transfer Signal to ATS, (ATST) - 500ms pulse from SSTTS logic to ATS via SSR4.
TP13	Test Point Thirteen, Static Switch On (SSON) - 500ms pulse to Static Switch SCR's.
TP14	Test Point Fourteen, Source Under Voltage Reference (SUVR) - DC Reference Voltage set with potentiometer P2.
TP15	Test Point Fifteen, Source Over Voltage Reference (SOVR) -DC Reference Voltage set with potentiometer P3.
ITEM	DESCRIPTION (continued)
P1	Potentiometer One - Sets DC U/V Reference Voltage available at test point 2.

P2	Potentiometer Two - Sets Source U/V Reference Voltage available at test point 14.
P3	Potentiometer Three - Sets Source O/V Reference Voltage available at test point 15.
P4	Potentiometer Four - Sets the Synchronization Window one.
P5	Potentiometer Five - Sets the Synchronization Window two.
S1	Push button, Reset ATS Time Delay - Optional cancellation of ATS delay on re-transfer. Used for test only.

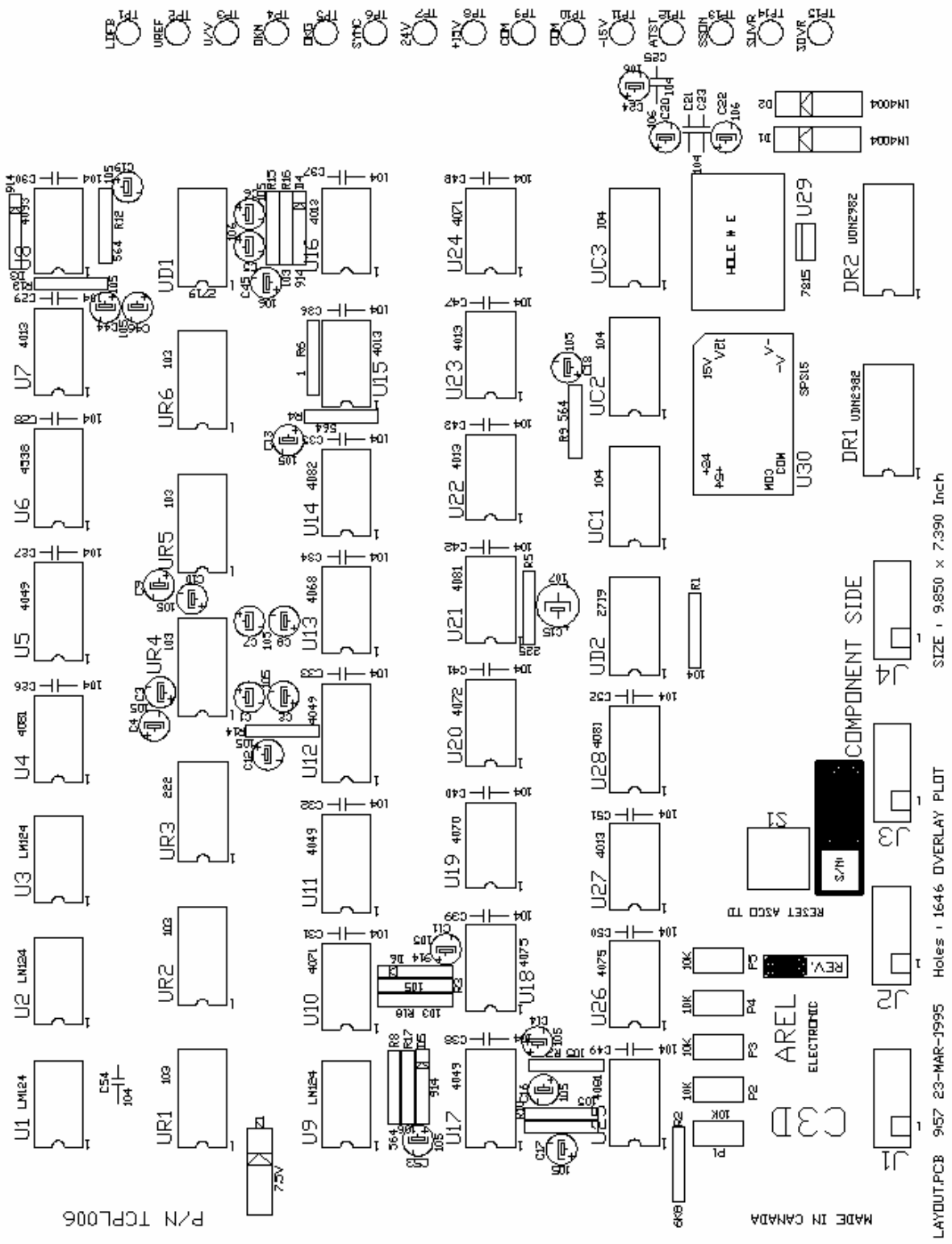

Figure 3.4 C3D - PCB Component Layout

3.5 PROTECTION

The location of the Power and Control fuses and circuit breakers is shown in the component layout Drawing in Section 6 of this manual. The description and rating of the devices is shown in Table 3.3.

Table 3.3 Protective Devices

LOCATION	PART NUMBER	VALUE (AMPS)	DESIGNATOR
Power Section	Gould: A4J30	30	F1, F2, F3
Power Section	KM: PKZM1-0.16	0.1 - 0.16 Adjustable	CB1
Power Section	KM: PKZM1-0.16	0.1 - 0.16 Adjustable	CB2
Power Section	KM: NZM-63-CNA	0 (Switch only)	SW1
Control Section	KM: PKZM1-4	2.4 - 4.0 Adjustable	CB3
Control Section	KM: PKZM1-4	2.4 - 4.0 Adjustable	CB4

SECTION 4
Operation

4.1 GENERAL

This section describes the operating modes, transfer procedures, start-up and shutdown procedures and information relating to the operation of the SSTTS.

The operating procedures outlined assume that the SSTTS has been installed and verified in accordance with the installation procedures within this manual.

4.2 START-UP

The following sequence should be performed only on initial startup or if the SSTTS has been shut down and isolated from the ATS in accordance with the shutdown procedures contained within.

Use the component layout drawing in Section 6 to locate the devices referred to in the following instructions.

CAUTION

If the ATS is energized and / or supplying power to the critical load, while starting up the SSTTS, the following points may have line voltage present with all SSTTS internal disconnecting devices open.

⇒ Line side of Contactors CON1 and CON2
⇒ Line side of Switch SW1
⇒ Line side of Circuit Breaker CB2
⇒ Line side of Circuit Breaker CB3
⇒ Line side of Circuit Breaker CB4
⇒ Relay RL1
⇒ Terminal Block TB1

1. Set Operating Mode Selector Switch on Mimic and Control panel to the Disable position.

2. Set Circuit Breaker CB1 to the closed position

3. Set Circuit Breaker CB2 to the closed position.

4. Set Circuit Breaker CB3 to the closed position.

5. Set Circuit Breaker CB4 to the closed position.

6. Set Switch SW1 to the closed position.

7. Supply power to the ATS.

WARNING

When the ATS supply power is turned on the ATS will automatically close supplying power to the Critical Load.

8. With the ATS energized the SSTTS Mimic and Control panel LED indicators should be functional. The following indicators should be ON. (Applicable to Standard Mimic as per figure 3.3 “Mimic and Control”. For Custom Mimic, refer to Section 6 “Mimic and Control”.)

- Normal Power LED 1 if normal power is present in ATS.

- Emergency Power LED 3 if emergency power is present in ATS.

- Critical Load LED 11 if the ATS is closed connecting one of the power sources to the load.

- Load on Normal Power LED 14 or Load on Emergency Power LED 9 depending on which source the critical load is connected to through the ATS.

9. Set the desired SSTTS operating mode with the “Enable / Disable” switch on the Mimic and Control panel.

- DISABLE POSITION - Disables all SSTTS functions except LED indicators. The ATS will function as designed independent from the SSTTS. Any transfer requests, manual or automatic will be open transition. Critical load will not be maintained during transfer operation.

- ENABLE POSITION - Enables all SSTTS functions. Any transfer requests, manual or automatic will be completed by the SSTTS and the ATS, provided both power sources are available. Transfer control is maintained by the SSTTS. Critical load will be maintained during transfer operation. Select Enable position prior to operating the Initiate Transfer (Item 10) push button.

4.3 SHUTDOWN

SECTION 4
Operation

The SSTTS once connected to an ATS becomes an extension of the ATS itself, therefore the same procedures used to electrically isolate the ATS must be applied to completely electrically isolate the SSTTS.

WARNING

To completely electrically isolate the SSTTS, all sources of power must be removed from the ATS. The disconnecting devices within the SSTTS enclosure are to be used to electrically isolate individual components or subassemblies, for service and maintenance, in strict compliance with the procedures contained in Section 5 of this manual. Opening of these devices does not remove all power sources from within the enclosure.

- To disable all SSTTS functions, excepting monitoring and indication, move Operating Mode Selector Switch to the Disable position as per item 1 of the following sequence. No further steps are required.

- To disable all SSTTS functions, including monitoring and indication, and further isolate SSTTS components from electrical power perform steps 1 through 6 of the following sequence.

- To completely isolate power sources from the SSTTS perform steps 1 and 7 of the following sequence.

1. Set Operating Mode Selector Switch on Mimic and Control panel to the Disable position.
2. Set Switch SW1 to the open or off position.
3. Set Circuit Breaker CB4 to the open or off position.
4. Set Circuit Breaker CB3 to the open or off position.
5. Set Circuit Breaker CB2 to the open or off position.
6. Set Circuit Breaker CB1 to the open or off position.

If the ATS is to be shutdown or electrically isolated, for maintenance or other purposes, the SSTTS should be placed in the "Disabled mode" using the selector switch on the Mimic and Control panel. No other steps are required. The SSTTS will be completely de-energized when the ATS has been electrically isolated from its power sources.

7. Remove all power sources to the ATS.

CAUTION

Never rely on electrical or mechanical interlocks or locking devices incorporated into the ATS to safely remove a power source from the ATS or the SSTTS. Always open isolating devices upstream and downstream from the ATS and lock in the off position.

4.4 SSTTS - MANUAL TRANSFER FROM NORMAL *(PRIMARY)* TO EMERGENCY *(ALTERNATE)*

The following procedure assumes the ATS operating mode is set to "Auto".

The following sequence is used to manually transfer the critical load, from the ATS Normal Supply to the ATS Emergency Supply under SSTTS control.

.1 Verify that the Critical Load is connected to the Normal *(Primary*) power source;

- The following LED's should be "ON"
  LED 1 Normal Power (green)
  LED 11 Critical Load (green)
  LED 14 Load on Normal Power (green)

.2 Verify that the Emergency or Alternate power source is available;

- The following additional LED should be "ON"
  LED 3 Emergency Power (green)

NOTE:

If the Alternate or Emergency source is supplied from an Emergency Generator, and the ATS is equipped with a "Start Emergency Generator" option, LED 3 may be "OFF". Continue with step 3 as the SSTTS will issue a start Generator command to the ATS further in the sequence. If the ATS is not equipped with the start option the generator must be started and LED 3 must be "ON" prior to proceeding.

.3 Select the "ENABLE" position using the Operating Mode Selector Switch on the face of the Mimic and Control panel.

.4 Depress the "Initiate Transfer" push-button on the face of the Mimic and Control panel.

.5 Verify that the Critical Load is connected to the Emergency or *(Alternate)* power source;

- The following LED's should be "ON"
  LED 3 Emergency Power (green)
  LED 11 Critical Load (green)
  LED 9 Load on Emergency Power (green)

.6 Return the Operating Mode Selector Switch on the face of the Mimic and Control panel to the "DISABLE" position.

4.5 SSTTS - MANUAL TRANSFER FROM EMERGENCY *(ALTERNATE)* TO NORMAL *(PRIMARY)*

The following procedure assumes the ATS operating mode is set to "Auto".

The following sequence is used to manually transfer the critical load, from the ATS Emergency Supply to the ATS Normal Supply under SSTTS control.

.1 Verify that the Critical Load is connected to the Emergency *(Alternate*) power source;

- The following LED's should be "ON"
  LED 3 Emergency Power (green)
  LED 11 Critical Load (green)
  LED 9 Load on Emergency Power (green)

.2 Verify that the Normal or Primary power source is available;

- LED 8 - Transfer Initiated (red) flashes until the transfer has been completed or aborted.

- The SSTTS issues the "Start Emergency Generator" command to the ATS and starts a 4 minute timer. The Alternate source must be available, indicated by LED 3 - Emergency Power (green) "ON" within 4 minutes or the transfer request will be aborted and reset.

- Emergency Contactor will close, indicated by yellow LED 6 "ON", when the two power sources are synchronized.

- The Transfer command is issued to the ATS if synchronization is maintained for 20 seconds. If synchronization is not maintained during this 20 second period the SSTTS will wait for an available momentary sync window before issuing the transfer command.

- The following additional LED should be "ON"
  LED 19 Normal Power (green)

- The Normal or Primary power source must be available prior to proceeding with the following sequence in order for transfer to occur.

.3 Select the "ENABLE" position using the Operating Mode Selector Switch on the face of the Mimic and Control panel.

.4 Depress the "Initiate Transfer" push-button on the face of the Mimic and Control panel.

- LED 8 - Transfer Initiated (red) flashes until the transfer has been completed or aborted.

- Normal Contactor will close, indicated by yellow LED 17 "ON", when the two power sources are synchronized.

- The Transfer command is issued to the ATS if synchronization is maintained for 20 seconds. If synchronization is not maintained during this 20 second period the SSTTS will wait for an available momentary sync window before issuing the transfer command.

.5 Verify that the Critical Load is connected to the Normal or *(Primary)* power source;

- The following LED's should be "ON"
  LED 1 Normal Power (green)
  LED 11 Critical Load (green)
  LED 14 Load on Normal Power (green)

.6 Return the Operating Mode Selector Switch on the face of the Mimic and Control panel to the "DISABLE" position.

4.6 AUTOMATIC TRANSFERS

Automatic transfer of the critical load between the two sources will only occur if the Operating Mode Selector Switch, "Enable / Disable", is left in the Enable position.

The following conditions or occurrences will initiate an automatic transfer under SSTTS control;

- Manual command of ATS through available ATS operator controls.
- External command direct to the ATS.
- External command direct to the SSTTS.

CAUTION
With the Selector switch left in the Enable position the SSTTS maintains control of all ATS transfer operations. Any transfer requests issued by the ATS or by external signal to the ATS will be ignored if SSTTS conditions are not satisfied.

Sequence of automatic transfer operation is identical to that of a manually initiated transfer. Refer to the appropriate section 4.4 or 4.5 ignoring references to manual actions.

NOTE:

The type of ATS and the owner's requirements may require Operation Procedures that differ from the standard procedures outlined in section 4 of this manual.. Any operating instructions contained in the *"Operation Supplement"* will always supersede the standard procedures and will always appear immediately following this notice in front of the procedures.

The supplemental procedures that differ from those of the standard procedures have been designated by letters subsequent to the item number as shown in the following example;

Standard Procedure: 4.2 Startup

SECTION 4
Operation

Supplemental Procedure: 4.2a Startup

OPERATION
Supplemental

4.4a MANUAL TRANSFER FROM LIGHTING BUS *(ATS NORMAL)* TO UPS *(ATS EMERGENCY)*

The following procedure assumes the ATS operating mode is set to "Manual".

The following sequence is used to manually transfer the critical load, from the ATS Normal Supply *(Lighting Bus)* to the ATS Emergency Supply *(UPS)* under SSTTS control.

.1 Verify that the Critical Load is connected to the ATS Normal *(Lighting Bus*) power source;

- The following LED's should be "ON"
  LED 3 LIGHTING BUS (green)
  LED 11 CRITICAL LOAD (green)
  LED 9 LOAD ON LIGHTING BUS (green)

.2 Verify that the ATS Emergency or *(UPS)* power source is available;

- The following additional LED should be "ON"
  LED 1 UPS (green)

NOTE:

The UPS or ATS Emergency source must be supplied from the Emergency Diesel Generator prior to initiating a transfer. LED 1 (UPS) may be "ON" even though the UPS power source is not Diesel Generator. If the UPS power source is not Emergency Diesel Generator the SSTTS will not allow a transfer operation.

.3 Select the "ENABLE" position using the Operating Mode Selector Switch on the face of the Mimic and Control panel.

CAUTION

Failure to select the "ENABLE" position will result in an interrupted transfer resulting in a loss of power to the computer load

.4 Select the UPS position with the ATS selector switch on the face of the ATS.

- LED 8 - Transfer Initiated (red) flashes until the transfer has been completed or aborted.

- The SSTTS starts a 4 minute timer. The UPS source must be available, indicated by LED 1 - UPS (green) "ON" within 4 minutes or the transfer request will be aborted and reset.

- UPS Contactor, (18), will close, indicated by yellow LED 17 "ON", when the two power sources are synchronized. It may take several seconds or minutes for the contactor to close.

- The SSTTS will wait for the next available momentary sync window before issuing the transfer command to the ATS. It may take several seconds or minutes for the transfer to occur.

.5 Once transfer has been completed the Transfer Initiated LED 8 (red) will shut off. The following LED's should be "ON"
  LED 1 UPS (green)
  LED 3 LIGHTING BUS (green)
  LED 14 LOAD ON UPS (green)

NOTE

The SSTTS Operating Mode Selector Switch on the face of the Mimic and Control panel should remain in the "ENABLE" position to prevent an interrupted transfer through manual operation of the ATS.

4.5a MANUAL TRANSFER FROM UPS *(ATS EMERGENCY)* TO LIGHTING BUS *(ATS NORMAL)*

The following procedure assumes the ATS operating mode is set to "Manual".

The following sequence is used to manually transfer the critical load, from the ATS Emergency Supply *(UPS)* to the ATS Normal Supply *(Lighting Bus)* under SSTTS control.

.1 Verify that the Critical Load is connected to the ATS Emergency Supply *(UPS)* power source;

- The following LED's should be "ON"
  LED 1 UPS (green)
  LED 11 CRITICAL LOAD (green)
  LED 14 LOAD ON UPS (green)

.2 Verify that the ATS Normal or *(Lighting Bus)* power source is available;

- The following additional LED should be "ON"
  LED 3 LIGHTING BUS (green)

NOTE:

The UPS or ATS Emergency source must be supplied from the Emergency Diesel Generator prior to initiating a transfer. LED 1 (UPS) may be "ON" even though the UPS power source is not Diesel Generator. If the UPS power source is not Emergency Diesel Generator the SSTTS will not allow a transfer operation.

.3 Select the "ENABLE" position using the Operating Mode Selector Switch on the face of the Mimic and Control panel.

CAUTION

Failure to select the "ENABLE" position will result in an interrupted transfer resulting in a loss of power to the computer load

.4 Select the Lighting Bus position with the ATS selector switch on the face of the ATS.

- LED 8 - Transfer Initiated (red) flashes until the transfer has been completed or aborted.

- The SSTTS starts a 4 minute timer. The Lighting Bus source must be available, indicated by LED 3 - LIGHTING BUS (green) "ON" within 4 minutes or the transfer request will be aborted and reset.

- LIGHTING BUS Contactor, (5), will close, indicated by yellow LED 6 "ON", when the two power sources are synchronized. It may take several seconds or minutes for the contactor to close.

- The SSTTS will wait for the next available momentary sync window before issuing the transfer command to the ATS. It may take several seconds or minutes for the transfer to occur.

.5 Once transfer has been completed the Transfer Initiated LED 8 (red) will shut off. The following LED's should be "ON"
LED 1 UPS (green)
LED 3 LIGHTING BUS (green)
LED 9 LOAD ON LIGHTING BUS (green)

NOTE

The SSTTS Operating Mode Selector Switch on the face of the Mimic and Control panel should remain in the "ENABLE" position to prevent an interrupted transfer through manual operation of the ATS.

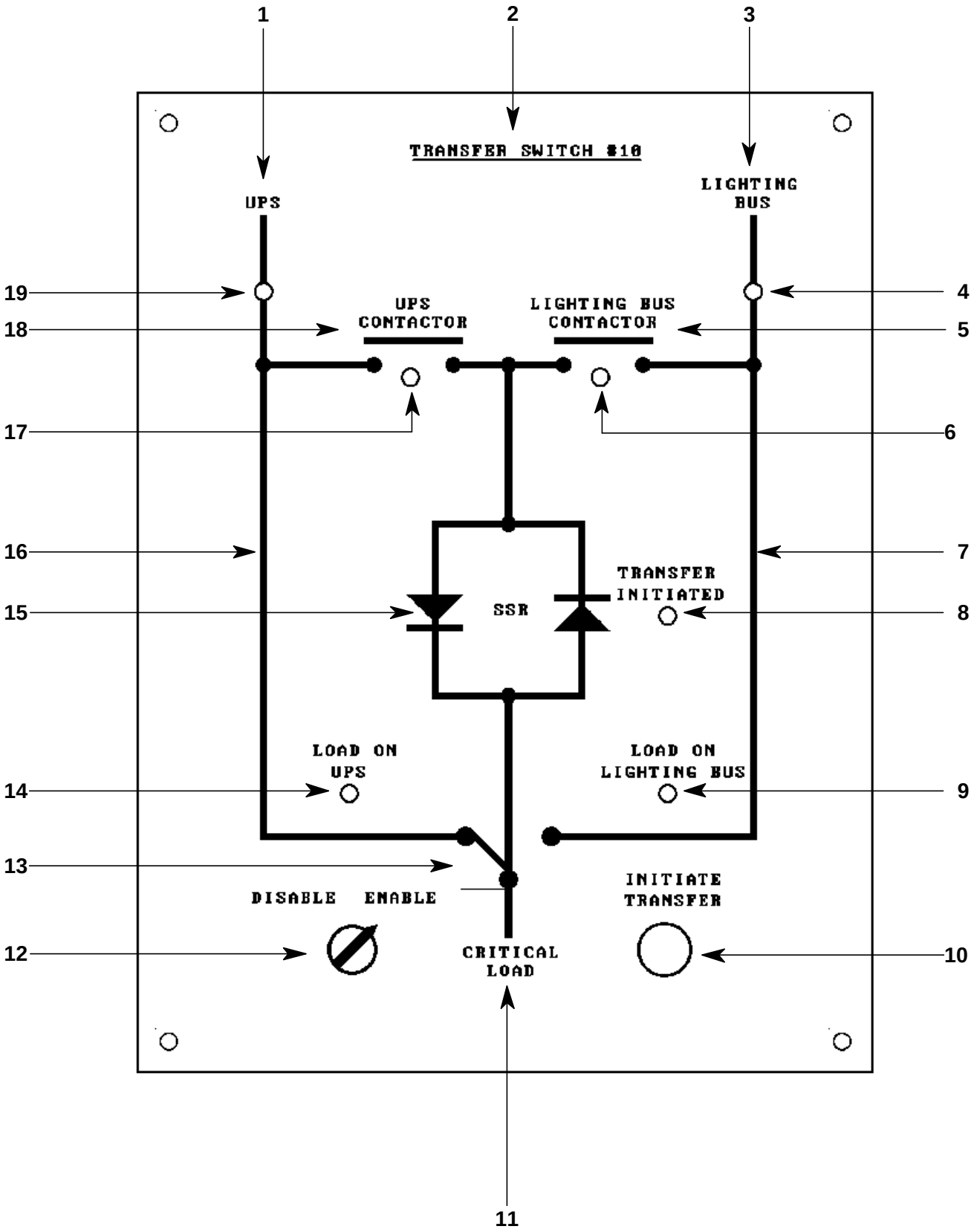

FIGURE 4.0 MIMIC AND CONTROL PANEL LAYOUT