THOMSON TECHNOLOGY
POWER & CONTROL
A REGAL-BELOIT COMPANY

SUGGESTED SPECIFICATION

CLOSED TRANSITION (Soft Load) AUTOMATIC TRANSFER SWITCHES

TS 880 SERIES 800A-4000A

Specification No. ES022 - TS 880

ES022 Rev 0 05//07/26

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1. SCOPE

Specification writer's notes:

a) This suggested specification is intended for typical automatic transfer switches consisting of the following main characteristics:

- Soft Load closed transition (i.e. make-before-break) transfer logic between two available sources.
- Maximum voltage rating of 600VAC, 50/60Hz
- Amperage rating of 800 - 4000Amps utilizing insulated case power switching devices
- Standard or Service Entrance Rated Automatic Transfer Switches

For automatic transfer switches of different rating, equipment types or operation modes, contact Thomson Technology for alternate sample specifications as available.

b) Included in this suggested specification are sections identified as **"Alternates"**. These sections provide the specifying engineer many design options, which allow for system customizing.

Note:
The following information is provided by Thomson Technology as a guide only for use by specifying engineers in designing automatic transfer switch systems. All system designs and installations must be done in accordance with all applicable electrical regulation codes and practices as required. Please contact Thomson Technology for any additional information.

1.1. AUTOMATIC TRANSFER SWITCH

1.1.1. This Specification covers the supply of a complete operational automatic transfer switch rated ____Amps, ____Volts, ___Phase, and ___Hz, _ Pole, for installation by others.

Specification writer's note: For *Service Entrance Rated* automatic transfer switch applications use "Alternate" as required.

"Alternate" This Specification covers the supply of a complete operational service entrance rated automatic transfer switch rated ____Amps, ____Volts, ___Phase, and ___Hz, _ Pole, for installation by others.

2. GENERAL REQUIREMENTS

2.1. GENERAL

2.1.1. The unit shall be manufactured in accordance with this specification and applicable UL, CSA, IEC, NEMA, and ANSI standards.

2.1.2. The unit shall be manufactured in a facility, which is registered to an ISO 9001:2000 quality system.

2.1.3. Supplier shall be responsible for ensuring the compatibility of all components of the unit.

2.1.4. The unit shall be free of defects in material and workmanship.

2.1.5. The unit shall be supplied with a 5-year warranty from the manufacturer at no additional cost.

2.2. RELATED INDUSTRY STANDARDS

2.2.1. **UL 1008**	Automatic Transfer Switches for Use in Emergency Systems
2.2.2. **UL 508**	Industrial control Equipment
2.2.3. **NEMA No. ICS 10**	Industrial Control and Systems AC Transfer Switch Equipment

2.3. ENGINEERING SUBMITTALS

The following documentation shall be made available for submission to the project engineer for review/approval purposes on the automatic transfer switch:

- Physical Layout Drawing
  -Outline dimensions, cable entry/exit locations, interior/exterior component layouts, connection data
- Electrical Schematic
  -Internal wiring, customer connection terminals, optional components, controller settings
- Product Data Sheets
  -Equipment Ratings

2.4. ENVIRONMENTAL CONDITIONS

2.4.1. The unit shall be installed with ambient temperatures between 5° and 122° Fahrenheit (-15°and +50°Celsius), relative humidity from 0-95% non-condensing.

3. RATINGS & CONSTRUCTION

3.1. AUTOMATIC TRANSFER SWITCH

3.1.1. Rating of the automatic transfer switch shall be _____AMP, _____VAC, ___Hz, __ PHASE, __WIRE.

3.1.2. The transfer switch shall comprise of ___ switching poles plus a solid neutral.

Specification writer's note: Delete reference to neutral if all poles are switching. (Note: A switched neutral pole is typically only required if ground fault protection is provided on both sources.)

3.1.3. The automatic transfer switch assembly shall be rated for 100% continuous load without de-rating. The current rating shall be based on all classes of load including resistive, and motor loads.

Specification writer's note: For *Service Entrance Rated* automatic transfer switches sized using an over current protection device on the utility supply, use "**Alternate**".

"Alternate" The automatic transfer switch shall be rated for Service Entrance applications and shall contain a ____Amp standard or 100% rated over current device for the utility power switching device as indicated on the drawings. The generator power switching device shall be rated for 100% continuous load without de-rating. The current rating shall be based on all classes of load including resistive, and motor loads. Fault withstand current rating of the complete assembly shall be ____Kamps RMS. The interrupting and closing rating shall be equal to or exceed the required withstand rating. This rating shall be obtained with standard upstream over current protection devices.

3.1.4. The automatic transfer switch mechanism must be listed or certified to "UL 1008 Automatic Transfer Switches For Use in Emergency Systems" safety standard.

3.1.5. Enclosure: NEMA 1 (IP23) rated, 14 gauge (minimum) steel of adequate strength and rigidity necessary to resist all conditions of use to which it may be subjected and to support all equipment contained therein.

Specification writer's note: For NEMA 2/NEMA 3R rated enclosure applications use "Alternate" as required.

"Alternate" The completed assembly shall be mounted in a NEMA 2 enclosure complete with door gasketting and drip hood.

"Alternate" The completed assembly shall be mounted in a NEMA 3R enclosure suitable for outdoor application with controls mounted on an interior door. Exterior door shall provide additional protection against outside environment and vandalism.

3.1.6. Finish: All steel parts shall be cleaned, sealed and painted with one coat rust resistant primer and two coats of ASA #61 gray enamel or polyester powder coat finish inside and out.

Specification writer's note: Specifiers to provide details of special finishing as required.

3.1.7. Dimensions: Overall height, maximum 91 5/8" (2330mm) (including base channels). Transfer switches with fix mounted power switching devices shall consist of two vertical sections (i.e. power switching cubicle and control cubicle) and shall have the following maximum dimensions:

Specification writer's note: Specifiers to select only the transfer switch dimensions as per the required amperage size for the application.

- 800A-1600A Overall maximum width of 62" (1575mm) which shall be comprised of a power switching cubicle (36" (915mm) W x 42" (1067mm) D) and a control cubicle (26" (660mm) W x 18" (457mm) D).
- 2000A Overall maximum width of 62" (1575mm) which shall be comprised of a power switching cubicle (36" (915mm) W x 48" (1219mm) D) and a control cubicle (26" (660mm) W x 18" (457mm) D).
- 2500-3000A Overall maximum width of 62" (1575mm) which shall be comprised of a power switching cubicle (36" (915mm) W x 60" (1524mm) D) and a control cubicle (26" (660mm) W x 18" (457mm) D).
- 4000A Overall maximum width of 74" (1879mm) which shall be comprised of a power switching cubicle (48" (1219mm) W x 72" (1829mm) D) and a control cubicle (26" (660mm) W x 18" (457mm) D).

Specification writer's note: For applications requiring optional insulated case power switching units with Draw-out (DO) option use "**Alternate**" as required.".

"Alternate" Dimensions: Overall height, maximum 91 5/8" (2330mm) (including base channels). Transfer switches with draw-out power switching devices shall consist of two vertical sections (i.e. power switching cubicle and control cubicle) and shall have the following maximum dimensions:

Specification writer's note: Specifiers to select only the transfer switch dimensions as per the required amperage size for the application.

- 800A-1600A Overall maximum width of 62" (1575mm) which shall be comprised of a power switching cubicle (36" (915mm) W x 48" (1219mm) D) and a control cubicle (26" (660mm) W x 18" (457mm) D).
- 2000A Overall maximum width of 62" (1575mm) which shall be comprised of a power switching cubicle (36" (915mm) W x 54" (1372mm) D) and a control cubicle (26" (660mm) W x 18" (457mm) D).
- 2500-3000A Overall maximum width of 62" (1575mm) which shall be comprised of a power switching cubicle (36" (915mm) W x 60" (1524mm) D) and a control cubicle (26" (660mm) W x 18" (457mm) D).
- 4000A Overall maximum width of 74" (1879mm) which shall be comprised of a power switching cubicle (48" (1219mm) W x 72" (1829mm) D) and a control cubicle (26" (660mm) W x 18" (457mm) D).

3.1.8. The rear section shall contain bussing and provisions for customer incoming and outgoing line and load cables. Access shall be from the rear by removable rear covers.

3.1.9. Ground Lugs/Bus: Adequate size and quantity of ground lugs shall be provided and shall conform to NEC/CEC guidelines. The ground bus shall be a full length copper bonded to the frame with adequate size and quantity of ground lugs and shall conform to NEC/CEC guidelines.

3.1.10. Busbars: Load bus bars shall be tin plated round-edge high conductivity copper and be sized for 100% continuous load rating of the transfer switch, in accordance with NEMA, CSA and UL guidelines. The short circuit withstand rating of the completed bus assembly shall be not less than the short circuit fault current of the system.

3.1.11. Cable Connections: Provision shall be made to terminate all incoming and outgoing power cables and grounding conductors. Connections shall be via screw type cable lugs.

Specification writer's note: Alternate or special connection requirements shall be detailed by the specifier.

3.1.12. The automatic transfer switch shall be constructed to accommodate top (Alternate: bottom) entry of incoming generator power cables, incoming utility power cables and top (Alternate: bottom) exit of outgoing load cables. Cable type shall be _____.

Specification writer's note: Specifiers to provide details of incoming and outgoing power cabling. For applications requiring bus-duct entry or exit of the utility/generator or load, specify details as required.

3.1.13. The power switching units shall be fix-mounted, utilize fully enclosed contacts and their withstand and closing rating shall be equal to or exceed the required withstand rating of the complete mechanism.

Specification writer's note: For applications requiring optional insulated case power switching units with Draw-out (DO) option use "Alternate" as required.

"Alternate" The power switching units shall be of draw-out construction, utilize fully enclosed contacts and their withstand and closing rating shall be equal to or exceed the required withstand rating of the complete mechanism.

3.1.14. All materials and parts used in the unit shall be new, of current manufacture, of best industrial grade, and free from defects and imperfections.

3.1.15. The transfer switch mechanism shall provide a simple means of manual operation using only components, which are permanently affixed, in the operating position.

3.1.16. The unit shall permit manual operation of the transfer switch while the system is energized and carrying rated load.

3.1.17. All internal control devices used in the automatic transfer switch shall be cable of being de-energized and isolated from the system by use of an accessible isolation plug for servicing procedures as required.

3.1.18. The automatic transfer switch design shall provide front accessible components and wiring for easy serviceability. Power or control connections, which are not readily serviceable while the transfer

switch is mounted in its enclosure, are not acceptable.

3.1.19. All power contacts used shall be stored energy type and shall operate in a quick-make / quick-break manner, the speed of which shall be independent of supply voltage and / or speed of operation by manual means.

4. FUNCTIONAL REQUIREMENTS

4.1. GENERAL DESCRIPTION

The automatic transfer switch shall be capable of either open or closed transition operation as selected by door mounted control switch. The general description of the two operating modes is as follows:

4.1.1. **Closed Transition**: The transfer switch shall automatically transfer the connected load to the generator supply in the event of a utility supply failure or when a “load test” mode is activated. The connected load shall automatically re-transfer back to the utility supply when utility power is restored or when a “load test” mode is terminated. All power transfers shall utilize closed transition (i.e. “make-before-break”) switching logic with automatic soft load ramping when both sources of power are available. When only one source of power is available (e.g. during a utility power failure condition), the transfer control logic shall automatically revert to open transition (i.e. “break-before-make”) operation.

4.1.2. **Open Transition**: The transfer switch shall automatically transfer the connected load to the generator supply in the event of a utility supply failure or when a “load test” mode is activated. The connected load shall automatically re-transfer back to the utility supply when utility power is restored or when a “load test” mode is terminated. All power transfers shall utilize an open transition (i.e. “break-before-make”) switching logic. The power switching devices shall be electrically interlocked to prevent the utility and generator supplies from being interconnected.

4.1.3. **Manual**: The transfer power switching devices are not automatically operated. They may be tripped via the built-in trip pushbuttons and closed via the close pushbuttons. In manual mode, the close pushbuttons are electrically interlocked to prevent accidental paralleling of the generator and utility supplies.

Specification writer’s note: For *Service Entrance Rated* automatic transfer switch applications use “Alternate” as required.

"Alternate" The service entrance rated automatic transfer switch shall automatically transfer the connected load to the generator supply in the event of a utility supply failure or when a "load test" mode is activated. The connected load shall automatically re-transfer back to the utility supply when utility power is restored or when a "load test" mode is terminated. The transfer switch shall incorporate an isolating mechanism and over current protection on the utility supply to allow operation as the main service disconnect in accordance with NEC requirements. The transfer switch power switching devices shall be electrically interlocked to prevent the utility and generator supplies from being interconnected.

4.2. AUTOMATIC SEQUENCE OF OPERATION-CLOSED TRANSITION

A detailed description of the automatic sequence of operation for the closed operation modes is as follows:

Note: For specific device settings refer to section 4.5 "STANDARD CONTROL FEATURES."

4.2.1. Utility Power Fail & Restoration Condition

4.2.1.1. When the voltage on any phase of the utility supply is below preset levels of rated voltage and/or is outside nominal phase balance limits for a preset time delay, as per transfer controller setpoints, a contact shall close to initiate starting of the generator set.

4.2.1.2. Once the generator attains nominal voltage and frequency levels a warm-up time delay period shall be initiated. Following expiry of the warm-up delay timer, the utility transfer power switching device is tripped open. The generator transfer power switching device is then closed. A neutral delay timer is initiated when the load bus is de-energized and provides a minimum neutral position delay before closing the opposite source power switching device when open transition transferring between two live sources.

4.2.1.3. If the generator fails while operating on load, the load shall immediately open transition transfer to the utility supply if the utility supply is within normal operating limits.

4.2.1.4. Once the utility supply is restored to above preset levels of rated voltage on all phases and phase balance is normal, the transfer controller utility return delay timer shall be initiated.

4.2.1.5. Once the utility return time delay period expires, automatic

synchronizing of the generator to the utility source shall be initiated. Once the generator speed and phase is matched to that of the utility, the utility transfer power switching device shall be closed. The generator's kW load is then unloaded at a controlled ramp rate and the generator power switching device shall be tripped open to complete the soft-load transfer.

4.2.1.6. Once the generator is transferred off load a cooldown delay time period shall be initiated, and once it expires, the engine start contact is opened allowing the generator to shut off.

4.2.1.7. The load shall immediately retransfer to the utility supply (if within acceptable limits) should the generator supply fail prior to expiry of the utility return delay timer.

4.2.2. On Load Test Mode Condition

Load test may be initiated at the transfer switch, or remotely via optional communication link to the transfer controller.

4.2.2.1. When an on-load test mode is activated by system operator or from an automatic on-load exercise mode, a contact shall close to initiate starting of the generator set.

4.2.2.2. Once the generator attains nominal voltage and frequency levels a warm-up time delay period shall be initiated. Following expiry of the warm-up delay timer, automatic synchronizing of the generator to the utility source shall be initiated.

4.2.2.3. Once the generator's speed and phase is matched to that of the utility supply, the generator transfer power switching device shall be closed. The generator's kW load is then increased at a controlled ramp rate. Once the utility supply has been unloaded, the utility power switching device shall be tripped open. The generator shall operate on load until the load test is terminated.

4.2.2.4. If the generator fails during load testing, an open transition transfer to the utility supply shall immediately be initiated.

4.2.2.5. When the load test is terminated, automatic synchronizing shall be initiated. Once the generator speed and phase is matched to that of the utility, the utility transfer power

switching device is closed. The generator's kW load is then unloaded at a controlled ramp rate and the generator power switching device is tripped open to complete the soft-load transfer.

4.2.2.6. The generator set shall continue to operate following a load transfer for a cooldown delay period, and then a contact shall open to stop the generator set.

4.2.3. Closed Transition Operation Failure Condition

4.2.3.1. If the generator fails to unload 30 seconds after the utility power switching device closes, the generator transfer power switching device shall be tripped open to complete the transfer to the utility source.

4.2.3.2. If the utility supply fails to unload 30 seconds after the generator power switching device closes, the utility transfer power switching device shall be tripped open to complete the transfer to the generator source.

4.2.3.3. If the transfer switch was transferring power from the generator source to the utility source and the generator switching device failed to open, an auxiliary trip relay shall trip open the utility power switching device to immediately separate the two power sources.

4.2.3.4. If the transfer switch was transferring power from the utility source to the generator source and the utility switching device failed to open, an auxiliary trip relay shall trip open the generator power switching device to immediately separate the two power sources.

4.2.3.5. The original source (i.e. prior to the transfer sequence) shall remain on load, separated from the other source. An alarm light and transfer controller shall indicate a failure condition which must be manually reset before the transfer switch shall re-attempt subsequent transfers.

4.2.3.6. Should a power switching device fail to close for any reason within a 5 minute time period, an alarm light and alarm relay contact shall be activated.

4.3. AUTOMATIC SEQUENCE OF OPERATION-OPEN TRANSITION

A detailed description of the automatic sequence of operation for the open operation modes is as follows:

Note: For specific device settings refer to section 4.5 “STANDARD CONTROL FEATURES."

4.3.1. Utility Power Fail & Restoration Condition

4.3.1.1. When the voltage on any phase of the utility supply is below preset levels of rated voltage and/or is outside nominal phase balance limits for a preset time delay, a contact shall close to initiate starting of the generator set.

4.3.1.2. The utility transfer power switching device shall open and then the generator transfer power switching device shall close to transfer the load to the generator supply when the generator voltage and frequency have reached acceptable preset levels and the warm-up time delay has expired.

4.3.1.3. Once the utility supply is restored to above preset levels of rated voltage on all phases and phase balance is normal, the utility return delay timer shall be initiated.

4.3.1.4. Once the transfer mechanism operates and opens the generator power switching device, the transfer mechanism shall stop in the neutral position (i.e. with both power switching devices open) for the duration of the neutral delay timer setting to allow load voltage to decay prior to re-connecting the utility supply.

4.3.1.5. The load shall be re-connected to the utility supply once the neutral delay timer expires and the transfer mechanism continues operation and closes the utility power switching device.

4.3.1.6. The load shall immediately retransfer to the utility supply (if within acceptable limits) should the generator supply fail prior to expiry of the utility transfer delay.

4.3.1.7. The generator set shall continue to operate following a load transfer for a cooldown delay period, and then a contact shall open to stop the generator set.

4.3.1.8. An “on load” test mode may be initiated which shall cause a simulated utility failure condition and transfer the load to the generator set. The transfer sequence shall be the same as for

a utility power failure except a neutral delay sequence shall occur when transferring from utility to the generator source.

4.4. MANUAL OPERATION

4.4.1.1. The transfer switch controller shall continue to monitor both sources, but the automatic transfer circuitry shall be disabled. The system may only be open transition transferred in the manual mode utilizing the operation pushbuttons provided for each power switching device.

4.5. STANDARD CONTROL FEATURES

4.5.1. The transfer switch shall be rated for use on multiple system voltages. The transfer switch shall be field configurable to operate on the following nominal system voltages; 208V, 240V, 380V, 480V, 600V.

4.5.2. A control circuit isolation plug shall be provided to isolate all control circuitry inside the transfer switch to facilitate maintenance procedures. When isolated, there shall be no voltage present on the control circuitry.

4.5.3. The transfer switch controller shall be microprocessor based and shall contain voltage and frequency sensing, timing functions, and metering.

4.5.4. The transfer switch controller software program shall include a three (3) level security password system for access to all programming functions. Specific password levels shall be provided for “read only”, “read/write” and “master”. Transfer switch controller programming setpoints for voltage, frequency and time delays shall be software programmable from the front panel mounted keypad, and parameters shall be displayed in alpha numeric format.

4.5.5. The transfer switch controller shall include an operator interface liquid crystal display (LCD) which is door mounted. The LCD shall have an automatic scrolling display feature for all main system information. The following information shall be displayed:

System Time
Transfer switch position
Utility supply metering – 3 phase voltage and frequency
Generator supply metering – 3 phase voltage and frequency
Timer countdown display

Test mode operation indication
Data Logging of Events

Specification writer's note: For applications requiring optional extended temperature range transfer switch controller display (VFD option), use "Alternate" as required.

"Alternate" The transfer switch controller shall include an operator interface vacuum florescent display (VFD) for extended temperature range application which is door mounted. The VFD shall the display the following information:

System Time
Transfer Switch position
Utility supply metering – 3 phase voltage and frequency
Generator supply metering – 3 phase voltage and frequency
Timer countdown display
Test mode operation indication
Data Logging of Events

4.5.6. Digital metering provided by the transfer switch controller shall have an accuracy of +-0.5% for all voltage and frequency readings. Frequency shall be displayed to at least one decimal. Three phase line to line voltages shall be displayed for both generator and utility supplies.

4.5.7. The transfer controller shall provide data logging and shall store the data in non-volatile EEPROM memory. The following events shall be recorded:

- Total Number of Transfers
- Total Number of Transfers due to source failure
- Number of Hours Controller is energized
- Number of Hours Load is on Utility
- Number of Hours Load is on Generator

4.5.8. Three phase under voltage sensing shall be provided for the utility supply. The under voltage sensor shall be user adjustable from 70-100% of nominal and shall be based on a falling (i.e. drop-out) voltage. The under voltage sensor shall be factory set at 80% nominal voltage. The under voltage sensor shall reset (i.e. pick-up) 10% above the dropout setting and shall be adjustable. The under voltage sensor shall include a transient time delay feature set at 1 second.

4.5.9. Three phase over voltage sensing shall be provided for both utility and generator supplies. The voltage sensing function shall be programmable as follows:

–over voltage pickup 100–130% of nominal, factory set at 110%.
–over voltage dropout 100–130% of nominal, factory set at 108%.
–over voltage time delay 0–10 seconds, factory set at 5 seconds.

4.5.10. Three phase under voltage sensing shall be provided for the generator supply. The under voltage sensor shall be user adjustable from 70 -100% of nominal and shall be based on a falling (i.e. drop-out) voltage. The under voltage sensor shall be factory set at 80% nominal voltage. The under voltage sensor shall reset (i.e. pick-up) 10% above the dropout setting and shall be user adjustable. The under voltage sensor shall include a transient time delay feature set at 5 seconds.

4.5.11. Voltage phase balance sensing shall be provided for the generator and utility supplies. The voltage phase balance sensor shall be user adjustable from 3-30% of nominal and shall be factory set at 6% nominal voltage. Activation of an abnormal utility phase balance condition shall cause the generator to start and to transfer on load. The voltage phase balance sensor shall include a transient time delay feature set at 10 seconds.

4.5.12. Frequency sensing shall be provided for the utility supply to permit load transfer to the utility supply if within nominal limits. The utility frequency sensing function shall be programmable as follows:

–under frequency 40.0–60.0Hz, factory set at 59.0Hz
–under frequency time delay 0–10 seconds, factory set at 10 seconds.
–over frequency 50.0–70.0Hz, factory set at 61.0Hz
–over frequency time delay 0–10 seconds, factory set at 5 seconds.

4.5.13. Frequency sensing shall be provided for the generator supply to permit load transfer to the generator supply if within nominal limits. The generator frequency sensing function shall be programmable as follows:

–under frequency 40.0–60.0Hz, factory set at 57.0Hz
–under frequency time delay 0–10 seconds, factory set at 5 seconds.
–over frequency 50.0–70.0Hz, factory set at 63.0Hz
–over frequency time delay 0–10 seconds, factory set at 5 seconds.

4.5.14. An engine start contact shall be provided which shall close to initiate starting of the engine. The engine start contact shall be rated 5A, 120/240VAC, 5A, 28Vdc resistive. The contacts shall be wired to terminal blocks for customer use.

The following time delay functions shall be provided:

4.5.14.1. Engine Start - A time delay on engine start shall be provided to delay the engine start signal after failure of the utility source. The time delay shall be user adjustable 0 - 60 seconds, factory set at two (2) seconds.

4.5.14.2. Engine Warm-up - A time delay for engine warmup shall be provided which permits transfer to the generator supply after generator voltage and frequency exceed acceptable limits. The time delay shall be user adjustable 0 - 60 minutes, factory set at two (2) seconds.

4.5.14.3. Utility Return - A time delay for return to utility shall be provided which permits transfer to the utility supply only after stable voltage conditions exist for the specified time period. The time delay shall be user adjustable 0 - 60 minutes, factory set at two (2) minutes.

4.5.14.4. Engine Cooldown - A time delay for engine cooldown shall be provided which delays the engine stop signal after load has retransferred to the utility source until the time delay period expires. The time delay shall be user adjustable 0 - 60 minutes, factory set at two (2) minutes.

4.5.14.5. Neutral Delay - A time delay for neutral position shall be provided in the open transition mode to minimize the effect of out-of-phase transfer due to connected motor load. The time delay shall be user adjustable 0 - 120 seconds, factory set at three (3) seconds.

4.5.15. The transfer controller shall provide a timer bypass function to automatically bypass unwanted delays during testing or maintenance procedures. The timers shall automatically reset on the next operation sequence to their original setting. The following time delays shall have a user initiated bypass feature:

- Engine Warmup Delay
- Utility Return Timer
- Engine Cooldown Timer
- Neutral Delay Timer

4.5.16. The utility re-transfer operation shall be user selectable for Automatic, or Manual re-transfer operation. When Manual re-transfer mode is selected, the user can initiate when the re-transfer

to utility power shall occur.

4.5.17. Provision for operator-initiated system test modes shall be provided. Test modes shall be programmable for “off load” testing (load does not transfer to generator) or “on load” testing (load does transfer to generator).

4.5.18. All test modes shall have provisions to enable a programmable security access with password protection if required. A master level password shall be required to change user access passwords.

4.5.19. Automatic timed test modes shall be provided to allow for tests to be manually initiated and automatically terminated. Timed test modes shall be user adjustable (0-240 minutes). The load shall automatically re-transfer back to the utility supply should the generator fail on load.

4.5.20. An automatic exercise time function shall be provided for generator testing. A 7/14/21/28 day, programmable time clock shall be provided. The timer shall be fully programmable for; day, week, time of day, duration of the test and type of test mode (i.e. On-Load or Off-Load). The exercise timer shall utilize the transfer controller’s internal time clock for referencing all timing functions. The time clock shall have a ten (10) minute power reserve feature to retain correct time settings during short duration utility power failures. The transfer switch shall automatically re-transfer back to the utility supply if the generator set fails during an exercise period.

4.5.21. Control logic shall be provided for immediate transfer to the utility supply (if within acceptable limits) should the generator set fail during any activated test mode.

4.5.22. A two position “Transfer Control” selector switch shall be provided on the door of the transfer switch to select either “Open” or “Closed” transition operation. The selector switch shall be keyed and the key shall be removable in either position.

4.5.23. All power transfers in the closed transition mode shall utilize a zero power transfer set point to provide a "soft" power transfer.

4.5.24. A protective relay shall be provided for the utility supply to satisfy all applicable utility company interconnect regulations. These protective relays shall ensure the generator separates from the utility supply during a failure of either source. As a minimum, the following protective functions shall be provided:

- 3 Phase under/over voltage/negative sequence relay

(47/27/59)
- under/over frequency relay (81-O/U)
- 3 phase utility reverse power relay (32)
- Synchronizing check relay (25)

4.5.25. Generator protective relays shall be provided for safe parallel operation. As a minimum, the following protective relays shall be provided:
- Synchronizing check relay (25)
- Generator reverse power relay (32)

4.5.26. A voltage and speed matching Automatic Synchronizer compatible with the engine's electronic governor and generators automatic voltage regulator shall be provided. It shall monitor the voltage, frequency and phase angle of the incoming generator to the load bus, and provide automatic power switching device closure signal when in synchronism. The automatic synchronizer shall have adjustable gain and stability for optimal synchronizing speed. The automatic synchronizer shall be provided with voltage matching control outputs for interface to the generators voltage regulator.

4.5.27. Customer supplied engine generator set shall be capable of the following performance criteria to ensure proper of operation of the closed transition transfer sequence:
- Engine Governor: Engine speed (i.e. frequency) to be set at 100% nominal operating frequency with +-0.25% steady state regulation performance from no-load to full load operation and shall accept a remote speed signal bias input for synchronizing and load control.
- Generator Automatic Voltage Regulator: Generator voltage to be set at 100% nominal operating voltage with +-0.5% steady state regulation performance no-load to full load operation and shall accept a remote voltage signal bias input for synchronizing and load control.

4.5.28. Independent control logic shall be provided to detect if a power switching device fails to open during a normal closed transition operating sequence. Should the closed transition loading and unloading operation time exceed 30 seconds (i.e. both power switching devices remain closed for more than 30 seconds), an auxiliary trip relay shall be activated which shall immediately trip open the original power source transfer device to separate the two supplies. An alarm light and two alarm contacts shall be provided to alert site operators of abnormal operation. The contacts shall be wired to terminal block for customer use to remotely trip open upstream devices should an abnormal condition persist.

4.5.29. Control logic shall be provided to detect if a power switching device fails to close during a normal closed transition operating sequence. Should a power switching device fail to close for any reason within a 5 minute time period (adjustable), an alarm light and alarm relay contact shall be activated. The alarm contact shall be wired to terminal blocks for customer use.

4.5.30. Control logic shall be provided for sensing a transfer switch failure in the open transition mode, and if the alarm condition is activated, the transfer controller shall automatically force a transfer to the alternate source if available.

4.5.31. Programmable control logic shall be provided to select desired point at which a "commit to transfer" to the generator supply shall be given to prevent nuisance starts due to a fluctuating utility supply. The "commit to transfer" point shall be user selected as follows: following expiry of the engine start delay period or following expiry of the warmup delay period.

4.5.32. Pilot lights shall be provided to indicate load on utility status (green) and load on generator status (red). Pilot lights to be long life LED type.

4.5.33. The transfer switch controller shall provide a lamp test function to test all LED lights.

4.5.34. Utility Supply Auxiliary Contact (AUX-U)

Three (3) auxiliary contacts shall be provided which operate when the utility source is on load. The auxiliary contacts shall be supplied with a rating of 10A, 120/240VAC, 5A, 28Vdc resistive, Form C. The contacts shall be wired to terminal blocks for customer use.

4.5.35. Generator Supply Auxiliary Contact (AUX-G)

Three (3) auxiliary contacts shall be provided which operate when the generator is on load. The auxiliary contacts shall be supplied with a rating of 10A, 120/240VAC, 5A, 28Vdc resistive, Form C. The contacts shall be wired to terminal blocks for customer use.

4.6. OPTIONAL CONTROL FEATURES

Specification writer's note: Select the following *optional* control features as required for the specific application:

4.6.1. Utility Supply Auxiliary Contacts (AUX-U)

Additional auxiliary contacts shall be provided which operate when

the utility source is on load. A maximum of three (3) additional auxiliary contacts shall be supplied with a rating of 10A, 120VAC 5A, 28Vdc resistive Form C.

4.6.2. Generator Supply Auxiliary Contacts (AUX-G)

Additional auxiliary contacts shall be provided which operate when the generator is on load. A maximum of three (3) additional auxiliary contacts shall be supplied with a rating of 10A, 120VAC 5A, 28Vdc resistive Form C.

4.6.3. Utility Available Light (UAL)

A pilot light shall be provided to indicate the availability of the utility supply condition. Pilot light is to be green, LED type.

4.6.4. Generator Available Light (GAL)

A pilot light shall be provided to indicate the availability of the generator supply condition. Pilot light is to be green, LED type.

4.6.5. Utility Power Available Contacts (UPA)

Auxiliary contacts shall be provided which operate when utility power is available. A quantity of __ auxiliary contacts shall be supplied with a rating of 10A, 120VAC resistive Form C.

4.6.6. Generator Power Available Contacts (GPA)

Auxiliary contacts shall be provided which operate when generator power is available. A quantity of __ auxiliary contacts shall be supplied with a rating of 10A, 120VAC 5A, 28Vdc resistive Form C.

4.6.7. Load Disconnect Contact (LDC)

Control logic shall be provided to signal an external load (e.g. elevator) of an impending transfer to and from the generator supply. A single Form A output contact shall be supplied and shall be rated 10A, 120VAC 5A, 28Vdc resistive. The contact, shall close prior to a transfer and remain closed until the transfer is completed and the post transfer delay time has expired. A pre-transfer delay function shall be provided, programmable 0 - 30 seconds, factory set at 10 seconds. A post transfer delay function shall be provided, programmable 0 - 30 seconds, factory set at 10 seconds.

4.6.8. Enclosure Strip Heater c/w Thermostat (TS-H1)

An enclosure strip heater shall be supplied inside the Transfer Switch enclosure and shall be controlled by an adjustable thermostat. An external power source rated 120VAC, single phase, 15A over current protected branch circuit is to be supplied by others.

4.6.9. Enclosure Strip Heater c/w Thermostat (TS-H2)

An enclosure strip heater shall be supplied inside the Transfer Switch enclosure and shall be controlled by an adjustable thermostat. Power for the strip heater is to be connected to the transfer switch load bus via suitably sized power transfer.

4.6.10. Shunt Trip Generator Switch (TS-STG)

A shunt trip device shall be provided in the Generator transfer power switching device to provide remote tripping capability for load shedding or load dumping purposes. Shunt trip device shall be rated for 24Vdc 10A control power, which is to be supplied by an external source with required logic and over current protection.

4.6.11. Shunt Trip Utility Switch (TS-STU)

A shunt trip device shall be provided in the Utility transfer power-switching device to provide remote tripping capability for immediate load dumping purposes. Shunt trip device shall be rated for 24Vdc 10A control power, which is to be supplied by an external source with required logic and over current protection.

4.6.12. Remote Communication Module (CIM)

A remote communication module shall be provided to remotely monitor and control the transfer switch with direct telephone system interconnection via internal modem or to communicate remotely via RS232 or RS 485 type signal. Communication module is to be provided with remote communication software operable on current version of Windows™ software. Communication module shall provide Modbus™ protocol for interface with external communication systems of same type.

5. EXECUTION

5.1. FACTORY TESTING

The automatic transfer switch shall be factory tested prior to delivery to the purchaser. The following tests shall be conducted by qualified factory personnel:

5.1.1. Visual Inspection: Electrical and mechanical inspections to verify installed components are of correct ratings; meet the requirements of the project specifications and to ensure regulatory and quality requirements are met.

5.1.2. Mechanical Tests: As a minimum, the following mechanical tests shall be performed on the transfer switch:

5.1.2.1. Power conductor torque verification

5.1.2.2. Manual ATS mechanism operation/adjustment

5.1.2.3. All mechanical fasteners/wire connections tight

5.1.3. Electrical Tests: As a minimum, the following electrical tests shall be performed on the transfer switch:

5.1.3.1. Adjustment/setting all timers & voltage sensors

5.1.3.2. Adjustment/setting of sync check relay

5.1.3.3. Verification of electrical interlock

5.1.3.4. Function test-normal operation- three (3) complete cycles (closed transition and open transition)

5.1.3.5. Mechanism adjustment

5.1.3.6. Dielectric test

5.1.4. Final Inspection: As a minimum, the following final inspection tasks shall be performed on the transfer switch:

5.1.4.1. Calibration label/equipment labels installed and correct

5.1.4.2. All safety/warning labels attached

5.1.4.3. All wiring straight, neatly bundled and adequately protected.

5.1.4.4. All options supplied as specified

5.1.4.5. Enclosure is clean, no paint imperfections

5.1.4.6. Final documentation is enclosed (Drawing, O&M Manual)

5.1.5. The transfer switch manufacturer shall provide upon request of the project engineer, four (4) copies of certified Factory Test Reports for the transfer switch supplied.

5.2. FIELD TESTING/COMMISSIONING

The automatic transfer switch shall be tested once installed at the project site to confirm proper operation of the system. Schedule and witness testing activities shall be coordinated with the project engineer, site contractor, and owner as required in advance of the testing. Qualified local factory-trained field service representatives shall conduct the following tests:

5.2.1. Visual Inspection: Electrical and Mechanical inspection to verify the installation is correct as recommended by the transfer switch manufacturer and as per NEC/CEC requirements.

5.2.2. Mechanical Tests: As a minimum, the following mechanical tests

shall be performed on the transfer switch:

5.2.2.1. Power conductor torque verification

5.2.2.2. Manual ATS mechanism operation

5.2.2.3. All mechanical fasteners/wire connections tight

5.2.2.4. Confirmation of correct transfer switch voltage, current and withstand ratings as is required for the application.

5.2.3. Electrical Tests: As a minimum, the following electrical tests shall be performed on the transfer switch:

5.2.3.1. Meggar testing the power cabling to the transfer switch.

5.2.3.2. Verification of correct power cabling phasing and phase rotation, prior to energization.

5.2.3.3. Confirmation of settings for all timers and voltage sensors.

5.2.3.4. Full function test - normal operation (Closed Transition) – three (3) complete cycles of failing the utility supply, and transfer load to/from the generator set.

5.2.3.5. Verification of all test modes operates correctly.

5.2.4. Qualified factory-trained field service personnel shall provide upon request of the project engineer four (4) copies of field test reports noting any deficiencies that require corrective action.

Acceptable model shall be a ***Thomson Technology TS 880*** series automatic transfer switch with soft-load closed transition feature.

Specification writer's note: For *Service Entrance Rated* automatic transfer switch applications use "Alternate" as required.

"Alternate" Acceptable model shall be a ***Thomson Technology TS 880*** series service entrance rated automatic transfer switch with soft-load closed transition feature.