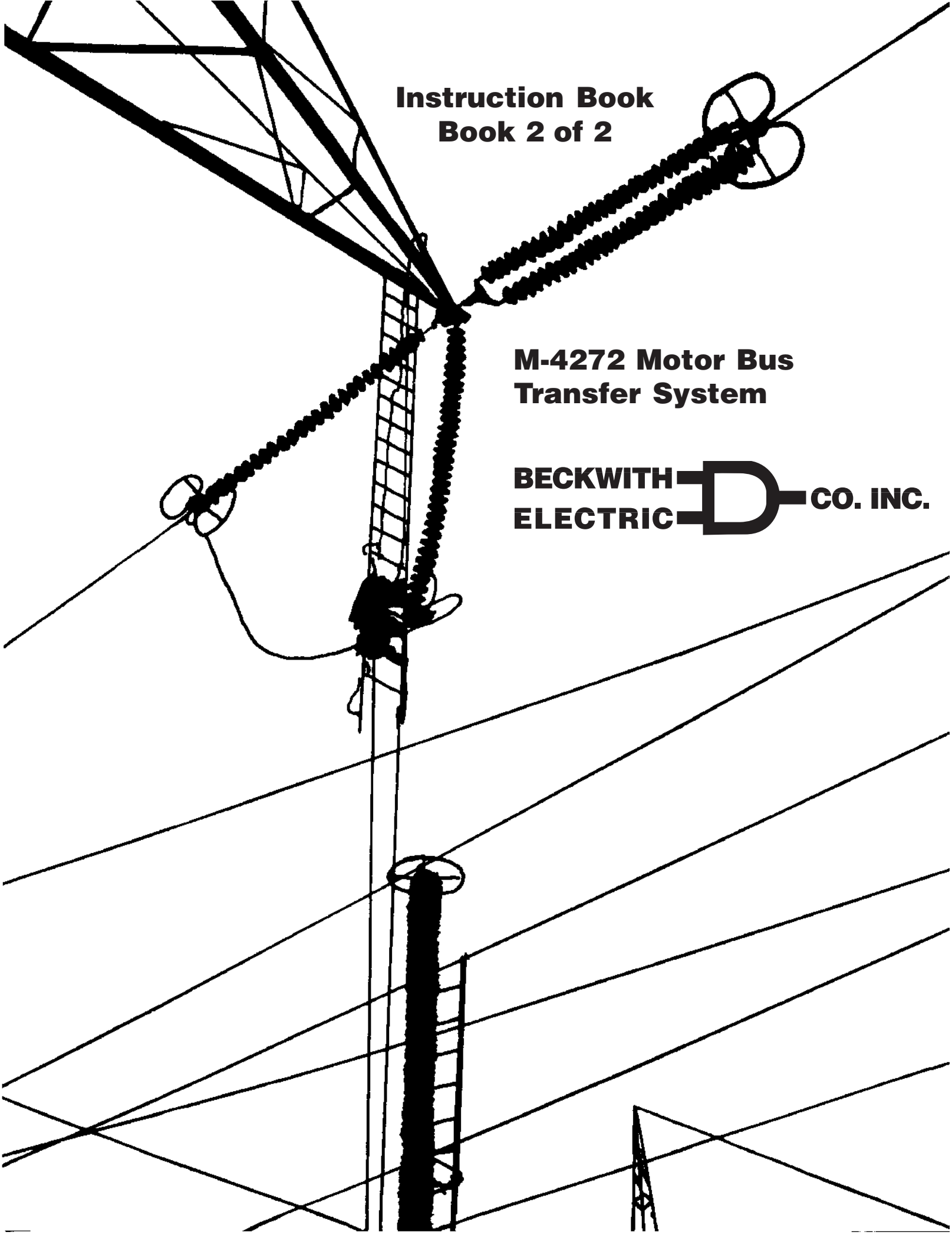

Instruction Book
Book 2 of 2

M-4272 Motor Bus Transfer System

BECKWITH ELECTRIC CO. INC.

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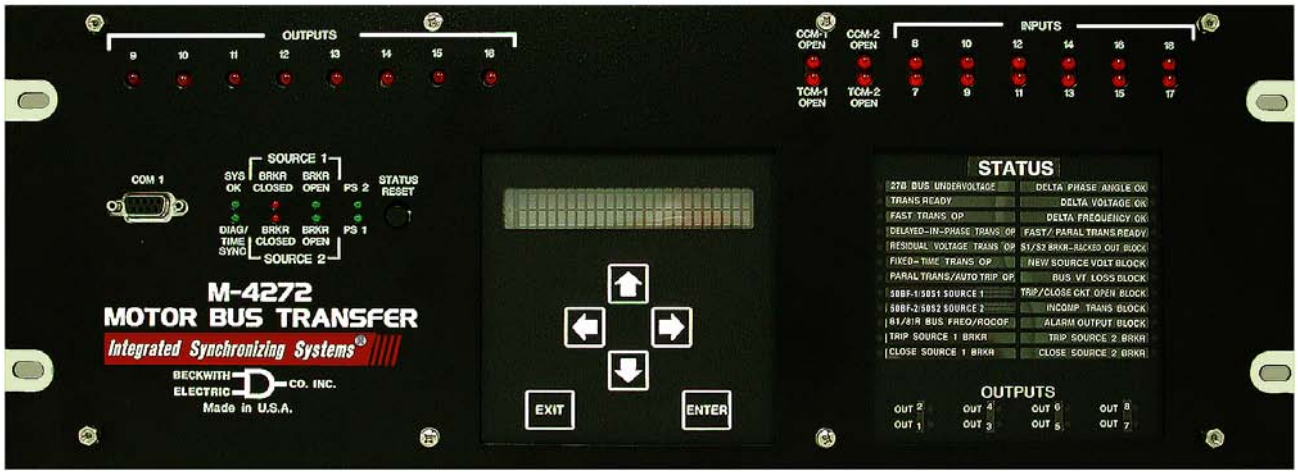
SYNCHRONIZING

Digital Motor Bus Transfer System M-4272

Integrated Synchronizing System®



- Provides Automatic and Manual transfers of motor bus systems in power plants and industrial processing plants to ensure process continuity
- Automatically selects Fast, Delayed In-Phase, Residual Voltage, and Fixed Time motor bus transfers, based on varying system conditions
- Applicable for one way and bi-directional Manual and Automatic transfers
- Can be expanded to accomodate multiple breaker configurations
- Multiple setpoint profiles for various application requirements
- Integrated control, supervisory functions, sequence of events, and oscillograph recording in one device
- Extensive commissioning tools, including ringdown analysis

Standard Features

Automatic Transfer: The digital Motor Bus Transfer System (MBTS) provides the following Automatic Transfer logic and features:

- Transfer initiated by protective relay external to the MBTS
- Automatic Transfer after a loss of the motor bus supply voltage based on the programmable undervoltage element. This provides a selectable backup feature if a manual or protective relay transfer is not initiated.
- Fast Transfer with adjustable phase angle limit
- Delayed In-Phase Transfer at the first phase coincidence if Fast Transfer is not possible
- Residual Voltage Transfer at an adjustable low residual voltage limit if Fast Transfer and Delayed In-Phase Transfer are not possible
- Fixed Time Transfer after an adjustable time delay
- Programmable Load Shedding with no time delay for Fast Transfer
- Programmable load shedding prior to initiating Delayed-in-Phase Transfer, Residual Voltage Transfer, and Fixed Time Transfer
- Adjustable setpoints for delta voltage limit and delta frequency limit
- Verify the new source (the source to which the bus is being transferred) is healthy and within acceptable upper and lower voltage limits

Manual Transfer: When a Manual Transfer is initiated the digital MBTS provides the following:

- Sync check functions with adjustable parameters
- Hot Parallel Transfer if enabled (make-before-break)
- Fast Transfer, Delayed In-Phase Transfer, and Residual Voltage Transfer (if the Hot Parallel Transfer is disabled)
- Programmable Load Shedding with no time delay for Fast Transfer
- Programmable load shedding prior to initiating Delayed In-phase Transfer and Residual Voltage Transfer
- Verify the new source (the source to which the bus is being transferred) is healthy and within acceptable upper and lower voltage limits

Circuit Breaker Control: The digital Motor Bus Transfer System includes the following Circuit Breaker Control features:

- Control of two circuit breakers with two individual programmable breaker closing times
- Three-breaker configuration can be provided by two M-4272 devices
- Breaker status supervision
- Breaker failure monitoring
- Four trip and close circuit monitoring inputs

Additional Standard Features

- Sequential or Simultaneous Transfer Mode
- Bus Phase Undervoltage (27B)
- Frequency (81) and Rate of Change of Frequency (81R) for load shedding
- Instantaneous Phase Overload Detection Source 1 and 2 (50S1) (50S2)
- Breaker Failure (50BF), Source 1 and Source 2
- Bus VT Fuse-Loss Detection (60FL)
- Auto Trip
- Auto Close
- Four dry output contacts (two trip and two close) for Source 1 and Source 2, one lockout/blocking output contact, and 11 programmable output contacts (10 Form 'a' and one Form 'c')
- Six Breaker Status inputs (a, b, and service position) for the Source 1 and Source 2 breakers, twelve programmable digital inputs
- All functions can be enabled or disabled
- Remote/Local control selection
- Device ON/OFF Control Selection
- M-3931 Human-Machine Interface (HMI) Module
- M-3972 Status Module
- IRIG-B time synchronization
- Oscillographic recording
- Two RS-232 ports (front and rear) and one RS-485 port (rear)
- M-3872 ISScom® Communications and Oscillographic Analysis Software

Optional Features

- RJ45 Ethernet Port Utilizing MODBUS over TCP/IP
- 5 A or 1 A models available
- 60 Hz or 50 Hz models available

The M-4272 Digital Motor Bus Transfer System provides Automatic and Manual Transfers. The Fast Transfer, Delayed In-Phase Transfer, and Residual Voltage Transfer methods are activated at the same time, if enabled. If the conditions for the Fast Transfer are not met, then the Delayed In-Phase Transfer or the Residual Voltage Transfer will be attempted. The Fixed Time Transfer is also provided if during a transfer operation, it is not possible to monitor the motor bus voltage (due to Bus VT fuse loss, for example). The Delayed In-Phase Transfer, Residual Voltage Transfer, and Fixed Time Transfer methods can be selectively disabled. The Automatic or Manual Transfer operation can be blocked by control/status input or remote serial communications. See Figure 2 for Typical Application of Motor Bus Transfer Systems.

Automatic Transfer

Automatic Transfer can be initiated by an external protection trip signal (86P) or an external undervoltage function (27) using control/status input to the Motor Bus Transfer System (MBTS) device or triggered by a sudden loss of motor bus supply voltage using the internal bus undervoltage relay (27B Function). Automatic Transfer allows transfer operation in both directions: from Source 1 to Source 2, and vice-versa. The Automatic Transfer provides Fast Transfer, Delayed In-Phase Transfer, Residual Voltage Transfer and Fixed Time Transfer. The Automatic Transfer is blocked when any lockout/blocking condition occurs. The MBTS will not respond to any transfer command and will not send the trip command while in the lockout/blocking condition.

Manual Transfer

Manual transfer can be initiated by using the local Human-Machine Interface (HMI), from a control/status input or through remote serial communications. The Manual Transfer allows transfer operation in either direction: from Source 1 to Source 2, and vice versa. Manual Transfer provides Hot Parallel Transfer or a combination of Fast Transfer, Delayed In-Phase Transfer and Residual Voltage Transfer. The Manual Transfer is blocked when any lockout/blocking condition occurs. The MBTS will not respond to any transfer command and will not send the trip command while in the lockout/blocking condition.

Transfer Modes

There are two transfer modes, Sequential and Simultaneous, in the open transition transfer operation.

Sequential Transfer Mode

Once a transfer is initiated, and if the Sequential Mode is selected, the old source breaker is tripped within 10 ms and closure of the new source* breaker is attempted only upon confirmation by the breaker status contact that the old source breaker has opened. Within 4 ms of receipt of this confirmation, all three methods, Fast, Delayed In-Phase and Residual Voltage Transfer are enabled to supervise closure of the new source* breaker, and the Fixed Time Transfer is enabled 30 cycles later. The new source* breaker is then closed by the Fast Transfer Method if the phase angle between the motor bus and the new source* is within the delta phase angle limit immediately after the old source breaker opens.

If the phase angle between the motor bus and the new source* is not within the delta phase angle limit, the old source breaker is still tripped. When the four methods of transfer are enabled, the new source* breaker then closes either as a result of a subsequent movement into the delta phase angle limit within the Fast Transfer Time Window, a movement through a predicted zero phase coincidence within the Delayed In-Phase Transfer Time Window, or by a drop in the motor bus voltage below the Residual Voltage Transfer limit, or after the fixed time delay of the Fixed Time Transfer. Transfer is completed and the new source* breaker is closed by any of the above methods whose criteria is first satisfied.

Refer to Figure 3 for Timing Sequence of Transfer Logic in Sequential Transfer Mode.

Simultaneous Transfer Mode

Alternatively, once a transfer is initiated, and if the Simultaneous Mode is selected, within 10 ms of transfer initiate, all three methods of transfer, Fast, Delayed In-Phase and Residual Voltage Transfer are immediately enabled to supervise closure of the new source* breaker without waiting for the breaker status contact confirmation that the old source breaker has opened. At the same instant, the commands for the old source breaker and the new source* breaker to trip and close are sent simultaneously if and only if the phase angle between the motor bus and the new source* is within the delta phase angle limit for the Fast Transfer Method immediately upon transfer initiation. However only the Fixed Time Transfer is enabled 30 cycles after the old source breaker has opened.

If the phase angle between the motor bus and the new source* is not within the delta phase angle limit, the old source breaker is still tripped. When the four methods of transfer are enabled, the new source* breaker then

* **NOTE**: The 'new source' is defined as the source to which the bus is being transferred.

closes either as a result of a subsequent movement into the delta phase angle limit within the Fast Transfer Time Window, a movement through a predicted zero phase coincidence within the Delayed In-Phase Transfer Time Window, or by a drop in the motor bus voltage below the Residual Voltage Transfer limit, or after the fixed time delay of the Fixed Time Transfer. Transfer is completed and the new source* breaker is closed by any of the above methods whose criteria is first satisfied.

Refer to Figure 4 for Timing Sequence of Transfer Logic in Simultaneous Transfer Mode.

Bus VT Fuse-Loss Detection (60FL)

A Bus VT Fuse-Loss condition is detected by comparing either the three-phase voltage of the motor bus to the three-phase voltage of the connected source (VT's in three-phase connection) or single phase voltage of the motor bus to a single phase voltages of the connected source (VT's in single phase connection): phase a to phase a, phase b to phase b, and phase c to phase c.

Auto Trip

If an external operation closes the second breaker while leaving the first one closed, and if the Auto Trip feature is enabled, there is a breaker trip option: the MBTS will trip the breaker that was originally closed or the breaker that has just been closed within an adjustable time delay (0 to 50 Cycles in increments of 0.5 Cycle) after the second breaker is closed. This Auto Trip operates to transfer in either direction. The purpose is to allow external parallel transfer but prohibits inadvertent parallel operation. It must be noted that the external operation that closed the second breaker must be supervised by means external to the motor bust transfer system.

Auto Close

If an external operation opens the second breaker while leaving the first one open, and if the Auto Close feature is selected, the MBTS will close the breaker that was originally opened. The originally opened breaker will be closed using the Fast Transfer, Delayed In Phase Transfer, Residual Voltage Transfer or Fixed Time Transfer method depending upon the bus voltage decayed condition. This Auto Close operates to transfer in either direction. The purpose is to permit a transfer when the normally-closed breaker is accidentally/inadvertently tripped resulting in two open breakers. This operation is very similar to the regular transfer process except it does not send out the trip command, since the second breaker is already opened.

Lockout/Blocking

A transfer is blocked when any lockout/blocking condition described below is active:

- Voltage Blocking – If prior to a transfer, the new source* voltage exceeds the Upper or Lower voltage limits, all transfers are blocked as long as the voltage remains outside these limits.
- External Blocking – When this control input contact is closed, all transfers are blocked.
- Incomplete Transfer Lockout – Blocks any transfer initiated by a protective relay initiate or an automatic initiated transfer or manual transfer if the last transfer has not been completed within the time delay. A time delay can be set from 50 to 3000 Cycles. The MBTS remains in the lockout condition until manually reset.
- Bus VT Fuse Loss Blocking – Transfer is blocked if the Bus VT fuse loss is detected and the customer has selected to block transfers when this occurs.
- “Both Breakers Same State” Blocking – If both breaker status contacts are in the open state, due to an external operation that opens the second breaker while leaving the first one open, and if the Auto Close feature is not selected, no transfer sequence is initiated. Furthermore, any subsequent initiation of a transfer sequence while the breakers are in this state is inhibited. Also, if both breaker status contacts are closed due to an external operation that closes the second breaker while leaving the first one closed, and if the auto trip feature is disabled, no transfer sequence is initiated.
- Transfer in Process Blocking – Once a transfer is in process, any other transfer initiate inputs will be ignored until the original transfer is complete.
- Blocking After Transfer – After a transfer has been completed, any additional transfers are blocked for 0 to 8160 cycles, as selected by the user.
- Trip/Close Circuit Open Blocking – Transfer is blocked if the Trip or Close Circuit Open is detected.
- 52a and 52b Position Disagreement Blocking – Transfer is blocked when the 52a and 52b status input positions disagree (applicable when both 52a and 52b status inputs are used).

* **NOTE**: The 'new source' is defined as the source to which the bus is being transferred.

TRANSFER SETTINGS

	Setpoint Ranges	Increment	Accuracy†
Automatic Transfer			
Fast Transfer			
Delta Phase Angle Limit*	0.0 to 90.0 Degrees	0.1 Degree	±0.5 Degree
Delta Voltage Limit	0 to 60 V	1 V	±0.5 V or ±2%
Delta Frequency Limit	0.02 to 2.00 Hz	0.01 Hz	±0.01 Hz or 5%
Time Window**	1 to 10 Cycles	0.5 Cycle	±1 Cycle
Closing Command Time Delay***	0 to 10 Cycles	0.5 Cycle	1 Cycle

** Accuracy defined at a constant frequency with a delta frequency of zero (0).*

*** This timer is used to limit the time window during which a Fast Transfer may be initiated.*

**** This time delay is only used for Fast Transfer in Simultaneous. The trip and close commands are normally issued at the same time. This time delay allows the flexibility to delay the closing command to accomplish the break-before-make mode of operation (open transition).*

Delayed In-Phase Transfer			
Delta Voltage Limit	0 to 120 V	1 V	±0.5 V or ±2%
Delta Frequency Limit*	0.10 to 10.00 Hz	0.05 Hz	±0.02 Hz (±0.1Hz)***
Time Window**	10 to 600 Cycles	1 Cycle	±1 Cycle or ±1%

** The pickup accuracy applies to the 60 Hz model at a range of 57 to 63 Hz, and to the 50 Hz model at a range of 47 to 53 Hz. Beyond these ranges, the accuracy is ±0.1 Hz (3-phase); ±0.4Hz(single phase).*

*** This timer is used to limit the time window during which an in-phase transfer may be initiated.*

**** Value in parenthese applies to single phase unit.*

For Delayed In-Phase Transfer, phase angle accuracy at first phase coincidence is 10.0 degrees with up to 10.0 Hz slip frequency.

Residual Voltage Transfer			
Residual Voltage Limit	5 to 60 V	1 V	±0.5 V or ±2%
Load Shedding Time Delay*	2 to 100 Cycles	1 Cycle	±1 Cycle or ±1%

Enabling the Load Shedding option allows the user to assign an output contact to shed load.

** The load shedding command is issued when bus voltage drops below residual voltage limit. The close command for the Residual Voltage Transfer is sent after the programmed load shedding time delay.*

Fixed Time Transfer			
Fixed Time Delay	30 to 1000 Cycles	1 Cycle	±1 Cycle or ±1%
Load Shedding Time Delay*	2 to 100 Cycles	1 Cycle	±1 Cycle or ±1%

This method is based on time delay only, and does not use the voltage, phase angle, frequency or current to supervise the closing of the new source breaker. The 'new source' is defined as the source to which the bus is being transferred.

Enabling the Load Shedding option allows the user to assign an output contact to shed load.

** The load shedding command is issued when the FixedTime delay has timed out. The Close command for the Fixed Time Transfer is sent after the programmed load shedding time delay.*

†Select the greater of these accuracy values. Accuracy applies to sinusoidal voltage with constant amplitude and frequency.

TRANSFER SETTINGS

	Setpoint Ranges	Increment	Accuracy†
Manual Transfer			
Fast Transfer			
Delta Phase Angle Limit*	0.0 to 90.0 Degrees	0.1 Degree	±0.5 Degree
Delta Voltage Limit	0 to 60 V	1 V	±0.5 V or ±2%
Delta Frequency Limit	0.02 to 2.00 Hz	0.01 Hz	±0.01 Hz or ±5%
Time Window**	1 to 10 Cycles	0.5 Cycle	± 1 Cycle
Closing Command Time Delay***	0 to 10 Cycles	0.5 Cycle	1 Cycle
Delayed In-Phase Transfer			
Delta Voltage Limit	0 to 120 V	1 V	±0.5 V or ±2%
Delta Frequency Limit*	0.10 to 10.00 Hz	0.05 Hz	±0.02 Hz (±0.1Hz)***
Time Window**	10 to 600 Cycles	1 Cycle	±1 Cycle or ±1%
Residual Voltage Transfer			
Residual Voltage Limit	5 to 60 V	1 V	±0.5 V or ±2%
Load Shedding Time Delay*	2 to 100 Cycles	1 Cycle	±1 Cycle or ±1%

* Accuracy defined at a constant frequency with a delta frequency of zero (0).

*** This timer is used to limit the time window during which a Fast Transfer may be initiated.*

**** This time delay is only used for Fast Transfer in Simultaneous mode. The trip and close commands are normally issued at the same time. This time delay allows the flexibility to delay the closing command to accomplish the break-before-make mode of operation (open transition).*

*** The pickup accuracy applies to the 60 Hz model at a range of 57 to 63 Hz, and to the 50 Hz model at a range of 47 to 53 Hz. Beyond these ranges, the accuracy is ±0.1 Hz (3-phase); ±0.4Hz (single phase).*

*** This timer is used to limit the time window during which an in-phase transfer may be initiated.*

**** Value in parenthese applies to single phase unit.*

For Delayed In-Phase Transfer, phase angle accuracy at first phase coincidence is 10.0 degrees with up to 10.0 Hz slip frequency.

*** The load shedding command is issued when bus voltage drops below residual voltage limit. The close command for the Residual Voltage Transfer is sent after the programmed load shedding time delay.*

Enabling load shedding option allows the user to assign an output contact to shed load.

†Select the greater of these accuracy values. Accuracy applies to sinusoidal voltage with constant amplitude and frequency.

TRANSFER SETTINGS

	Setpoint Ranges	Increment	Accuracy†
Manual Transfer (cont.)			
Hot Parallel Transfer			
Delta Phase Angle Limit*	0.0 to 90.0 Degrees	0.1 Degree	±0.5 Degree
Delta Voltage Limit	0 to 60 V	1 V	±0.5 V or ±2%
Delta Frequency Limit	0.02 to 0.50 Hz	0.01 Hz	±0.01 Hz or ±5%
Time Window	1.0 to 50.0 Cycles	0.5 Cycle	±1 Cycle
Tripping Command Time Delay**	0.0 to 30.0 Cycles	0.5 Cycle	1 Cycle
Auto Trip			
Trip Originally Closed Breaker	Enable/Disable	____	____
Trip Breaker Just Closed	Enable/Disable	____	____
Tripping Command Time Delay	0.0 to 50.0 Cycles	0.5 Cycle	1 Cycle

** Accuracy defined at a constant frequency with a delta frequency of zero (0).*

*** This time delay is only used in the Manual Transfer to implement a Hot Parallel Transfer (make-before-break).*

†Select the greater of these accuracy values. Accuracy applies to sinusoidal voltage with constant amplitude and frequency.

TRANSFER SETTINGS

	Setpoint Ranges	Increment	Accuracy†
Common Function Settings			
Upper Voltage Limit New Source	5 to 180 V	1 V	±0.5 V or ±2%
Lower Voltage Limit New Source	5 to 180 V	1 V	±0.5 V or ±2%
Breaker Closing Time #1 (Source 1 Breaker)(1)	0.0 to 12.0 Cycles	0.1 Cycle	0.3 Cycle
Breaker Closing Time #2 (Source 2 Breaker)(1)	0.0 to 12.0 Cycles	0.1 Cycle	0.3 Cycle
Breaker Closing Time Deviation #1 (2)	0.0 to 6.0 Cycles	0.1 Cycle	0.3 Cycle
Breaker Closing Time Deviation #2 (2)	0.0 to 6.0 Cycles	0.1 Cycle	0.3 Cycle
52a and 52b Position Disagreement Pickup Time Delay(3) (Source 1 Breaker)	0 to 30 Cycles	1 Cycle	1 Cycle
Dropout Time Delay(3) (Source 1 Breaker)	0 to 30 Cycles	1 Cycle	1 Cycle
Pickup Time Delay(3) (Source 2 Breaker)	0 to 30 Cycles	1 Cycle	1 Cycle
Dropout Time Delay(3) (Source 2 Breaker)	0 to 30 Cycles	1 Cycle	1 Cycle
Incomplete Transfer Lockout Time(4)	50 to 3000 Cycles	1 Cycle	±1 Cycle or ±1%
Local Manual Transfer Initiate Time Delay(5)	0 to 8160 Cycles	1 Cycle	1 Cycle or 1%
Remote Manual Transfer Initiate Time Delay(7)	0 to 8160 Cycles	1 Cycle	1 Cycle or 1%
Blocking After Transfer Time(6)	0 to 8160 Cycles	1 Cycle	1 Cycle or 1%
Trip Command Pulse Length	15 to 30 Cycles	1 Cycle	±1 Cycle
Close Command Pulse Length	15 to 30 Cycles	1 Cycle	±1 Cycle

(1) This is the time it takes the breaker to close from the issue of a close command to when the breaker status contact closes. The selectable adaptive breaker closing time is also provided.

(2) An alarm is activated if the actual Breaker Closing Time exceeds the programmed closing time by ± this value.

(3) The Time Delays are only applicable when both 52a and 52b Status Inputs of the S1 and S2 breakers are used. The Pickup Time Delay is used to block transfer when the 52a and 52b Status Input positions disagree.

(4) This timer is used for situations where the transfer was not completed. Response to a breaker failure is considered a complete transfer, and resets this timer.

(5) This time delay is only applicable when the manual transfer is initiated from the local front panel via the HMI or Com1 port.

(6) This timer is used to block any additional transfer after a transfer has been completed.

(7) This time delay is only applicable when manual transfer is initiated from the Control/Status input, Com2 Port, Com3 Port or Ethernet Port.

†Select the greater of these accuracy values. Accuracy applies to sinusoidal voltage with constant amplitude and frequency.

FUNCTIONS

		Setpoint Ranges	Increment	Accuracy†
27B Bus Phase Undervoltage				
27B	Pickup #1, #2, #3, #4	5 to 120 V	1 V	±0.5 V or ±2%
	Inhibit Setting**	5 to 120 V	1 V	±0.5 V or ±2%
	Time Delay	1 to 8160 Cycles	1 Cycle	-1 to +3 Cycles or ±0.5%*

** The pickup and time delay accuracies apply to 60 HZ models at a range of 57 to 63 Hz, and to 50 Hz models at a range of 47 to 53 Hz. Beyond these ranges, the time delay accuracy is 6 Cycles or 0.75% for the bus frequency down to 25 Hz. The time delay accuracy is ≦ 20 Cycles or 1% for the bus frequency at a range of 5 to 25 Hz.*

*** The Voltage Inhibit setting can be enabled or disabled.*

27B #1 is the Bus Phase Undervoltage initiate function that is used for Automatic Transfer from S1 to S2 direction.

27B #2 is the Bus Phase Undervoltage initiate function that is used for Automatic Transfer from S2 to S1 direction.

27B #3 can be used for load shedding.

27B #4 can be used for alarm or trip function.

The 27B functions are applicable only when the bus phase voltage input is applied.

50S1 Instantaneous Phase Overload Detection (Source 1)				
50 S1	Pickup #1, #2	1.0 to 100.0 A (0.2 to 20.0 A)*	0.1 A	±0.1 A or ±3% (±0.02 A or ±3%)
	Time Delay	1 to 8160 Cycles	1 Cycle	±2 Cycles or ±1%

** Values in parentheses apply to 1A secondary rating. Since this is only a single phase element, the 50S1 Function can only be used for overload detection and not used for overcurrent protection.*

50S2 Instantaneous Phase Overload Detection (Source 2)				
50 S2	Pickup #1, #2	1.0 to 100.0 A (0.2 to 20.0 A)*	0.1 A	±0.1 A or ±3% (±0.02 A or ±3%)
	Time Delay	1 to 8160 Cycles	1 Cycle	±2 Cycles or ±1%

** Values in parentheses apply to 1A secondary rating. Since this is only a single phase element, the 50S2 Function can only be used for overload detection and not used for overcurrent protection.*

50BF-1 Breaker Failure (Source 1)				
50 BF1	Pickup Current	0.10 to 10.00 A (0.02 to 2.00 A)*	0.01 A	±0.1 A or ±2% (±0.02 A or ±2%)
	Time Delay	1 to 30 Cycles	1 Cycle	±1 Cycle

50BF-1 can be initiated from designated M-4272 output contacts or programmable inputs.

** Value in parentheses apply to 1A Secondary Rating*

50BF-2 Breaker Failure (Source 2)				
50 BF2	Pickup Current	0.10 to 10.00 A (0.02 to 2.00 A)*	0.01 A	±0.1 A or ±2% (±0.02 A or ±2%)
	Time Delay	1 to 30 Cycles	1 Cycle	±1 Cycle

50BF-2 can be initiated from designated M-4272 output contacts or programmable inputs.

** Value in parentheses apply to 1A Secondary Rating*

†Select the greater of these accuracy values. Accuracy applies to sinusoidal voltage with constant amplitude and frequency. Values in parentheses apply to 1 A CT secondary rating.

FUNCTIONS (Cont.)

		Setpoint Ranges	Increment	Accuracy†
Source 1 Breaker Failure (Using breaker status)				
	Time Delay	0 to 30 Cycles	1 Cycle	1 Cycle

The breaker failure time delay is used to monitor breaker failure when using the breaker status inputs only. The breaker is considered failed when the breaker status has not changed state within this programmable time delay after a trip command is issued. A separate time delay is provided for breaker failure function (50BF) when current is present.

Source 2 Breaker Failure (Using breaker status)				
	Time Delay	0 to 30 Cycles	1 Cycle	1 Cycle

The breaker failure time delay is used to monitor breaker failure when using the breaker status inputs only. The breaker is considered failed when the breaker status has not changed state within this programmable time delay after a trip command is issued. A separate time delay is provided for breaker failure function (50BF) when current is present.

81 Frequency (bus voltage)				
81	Pickup #1, #2	50.00 to 67.00 Hz 40.00 to 57.00 Hz*	0.01 Hz	±0.02 Hz (±1.0 Hz)**
	Time Delay #1, #2	5 to 65,500 Cycles	1 Cycle	±3 Cycles or ±1%

The pickup accuracy applies to 60 Hz models at a range of 57 to 63 Hz, and to 50 Hz models at a range of 47 to 53 Hz. Beyond these ranges, the accuracy is ±0.1 Hz (3-phase); ±0.4Hz(single phase).

The 81 #1 Function can be used to initiate Load Shedding. The 81 Function is automatically disabled when the bus phase voltage input is less than 5 to 15 V (Positive Sequence) based on the frequency, or less than 5 V (Single Phase).

** This range applies to 50 Hz nominal frequency model.*

*** Value in parenthese applies to single phase bus voltage frequency.*

81R Rate of Change of Frequency (bus voltage)				
81R	Pickup #1, #2	0.10 to 20.00 Hz/Sec.	0.01 Hz/Sec.	±0.05 Hz/Sec. or ±5%
	Time Delay #1, #2	3 to 8160 Cycles	1 Cycle	+20 Cycles
	Negative Sequence Voltage Inhibit	0 to 99%	1%	±0.5%
	Increasing ROCOF	Enable/Disable		

The 81R #1 Function can be used to initiate Load Shedding. 81R function can only be used when the bus voltage input is three-phase, and for load shedding.

†Select the greater of these accuracy values. Accuracy applies to sinusoidal voltage with constant amplitude and frequency.

FUNCTIONS (Cont.)

		Setpoint Ranges	Increment	Accuracy†
Bus VT Fuse-Loss Detection				
60FL	Delta Pickup*	5 to 25 V	1 V	±.05 V or ±2%
	Time Delay**	1 to 8160 Cycles	1 Cycle	3 Cycles or 1%****
	Blocking Drop Out Time Delay***	1 to 300 Cycles	1 Cycle	3 Cycles or 1%****

** Mismatched voltage of the motor bus in respect to the connected source.*

*** This time delay is for the programmable alarm output.*

**** This is the time it takes to drop out (reset) the block transfer after no Bus VT fuse-loss is detected.*
***** The pickup and time delay accuracies apply to 60 HZ models at a range of 57 to 63 Hz, and to 50 Hz models at a range of 47 to 53 Hz. Beyond these ranges, the time delay accuracy is 6 Cycles or 0.75% for the bus frequency down to 25 Hz. The time delay accuracy is ≤ 20 Cycles or 1% for the bus frequency at a range of 5 to 25 Hz.*

If the bus VT fuse-loss is detected, the user must either select block transfer or initiate the Fixed Time Transfer.

Bus VT fuse-loss output is intiated from internally generated logic.

Trip and Close Circuit Monitor				
	Trip Circuit Monitor			
TCM	TCM-1 Time Delay	1 to 8160 Cycles	1 Cycle	±1 Cycle or ±1%
	TCM-1 Dropout Time Delay	1 to 8160 Cycles	1 Cycle	±1 Cycle or ±1%
	TCM-2 Time Delay	1 to 8160 Cycles	1 Cycle	±1 Cycle or ±1%
	TCM-2 Dropout Time Delay	1 to 8160 Cycles	1 Cycle	±1 Cycle or ±1%
	Close Circuit Monitor			
CCM	CCM-1 Time Delay	1 to 8160 Cycles	1 Cycle	±1 Cycle or ±1%
	CCM-1 Dropout Time Delay	1 to 8160 Cycles	1 Cycle	±1 Cycle or ±1%
	CCM-2 Time Delay	1 to 8160 Cycles	1 Cycle	±1 Cycle or ±1%
	CCM-2 Dropout Time Delay	1 to 8160 Cycles	1 Cycle	±1 Cycle or ±1%

The CCM/TCM inputs are provided for monitoring the continuity of the Source 1 and Source 2 trip and close circuits. The inputs can be used for nominal trip/close coil voltages of 24 V dc – 250 V dc. Trip and closing circuit monitoring are performed in the active breaker status only (trip circuit supervision when breaker is closed and close circuit supervision when breaker is open.) Both the DC supply and continuity for each of the circuits are monitored.

ISSLogic®				
ISSL	ISSLogic uses control/status input status, system status, function status, output contact close signals to develop 6 programmable logic schemes.			
	Time Delay #1-#6	0 to 65500 Cycles	1 Cycle	1 Cycle or 1%
	Dropout/Reset Time Delay #1-#6	0 to 65500 Cycles	1 Cycle	1 Cycle or 1%

†Select the greater of these accuracy values. Accuracy applies to sinusoidal voltage with constant amplitude and frequency.

Multiple Setpoint Profiles (Groups)

The system supports four setpoint profiles. This feature allows multiple setpoint profiles to be defined for the type of transfer initiated (Automatic , Manual or Hot Parallel) and the direction of the next transfer.

Metering

The Digital Motor Bus Transfer System provides metering of voltage and current of the Source 1 and Source 2, and Voltage and Frequency of the Motor Bus.

Metering accuracies are:

Voltage:	±0.5 V or ±0.5%, whichever is greater (from 57 to 63 Hz for 60 Hz models; from 47 to 53 Hz for 50 Hz models) ±1.0 V or ±0.75%, whichever is greater (below 57 Hz or beyond 63 Hz for 60 Hz models; below 47 Hz or beyond 53 Hz for 50 Hz models)
Current:	5 A rating, ±0.1 A or ±3%, whichever is greater 1 A rating, ±0.02 A or ±3%, whichever is greater
Frequency:	±0.02 Hz (from 57 to 63 Hz for 60 Hz models; from 47 to 53 Hz for 50 Hz models) ±0.1 Hz (below 57 Hz or beyond 63 Hz for 60 Hz models; below 47 Hz or beyond 53 Hz for 50 Hz models)
Phase Angle:	±0.5 degree or ±0.5%, whichever is greater

Oscillographic Recorder

The oscillographic recorder provides comprehensive data recording of all monitored waveforms, and status inputs storing up to 248 cycles of data. The total record length is user-configurable from 1 to 16 partitions. The number of samples per cycle used to store the data is user selectable. The number of samples per cycle that can be selected is 16 or 32 (50 or 60 Hz). The number of samples selected effects the length of the data that can be saved and its resolution. The lower the number of samples, the longer the record length that can be stored (but at a lower resolution).

The oscillographic recorder is triggered by a designated control/status input (usually a protective relay initiate input), an automatically initiated signal, a trip output, a manual transfer signal or from serial communications.

When untriggered, the recorder continuously stores waveform data, thereby keeping the most recent data in memory. When triggered, the recorder stores pre-trigger data, then continues to store data in memory for a user-defined, post-trigger delay period. The records may be analyzed using Beckwith Electric ISScom® Communications and Oscillographic Analysis Software, and are also available in COMTRADE file format.

Transfer Event Log

A transfer event log is considered complete when one of following occurs:

1. When the breaker from the old source opens and the breaker to the new source* closes.
2. When a breaker failure occurs.
3. When the incomplete transfer timer times out.

Depending on transfer type, up to four transfers will be stored. When 16 events are stored, any subsequent event will cause the oldest event to be lost. Each Transfer Event Log parameter is time stamped with the date and time in 1 ms increments.

The trigger and complete events are used to define the time frame during which the transfer event log is storing information. A reset feature is provided to clear this log through the serial communications. The Transfer Event Log is available for viewing utilizing the M-3872 ISScom Communications Software.

Sequence of Events Recording

In addition to the Transfer Event Log the Digital Motor Bus Transfer System provides Sequence of Events Recording. The Sequence of Events Recording stores every change in the input status, trip commands, close commands, any signal to initiate a transfer, type of transfer, change in any breaker status, and status reset.

*__NOTE__: The 'new source' is defined as the source to which the bus is being transferred.

Each of these Running Events are time stamped with the date and time in 1 ms increments. The Running Event Log stores the last 512 events, when a new event occurs the oldest event is removed. A reset feature is provided to clear this log through the serial communications. The events and the associated data are available for viewing utilizing the M-3872 ISScom® Communications Software.

Calculations

Current and Voltage Values: The Digital Motor Bus Transfer System uses discrete Fourier Transform (DFT) and RMS calculation algorithm on sampled voltage and current signals to extract fundamental amplitude, phase and frequency for the M-4272.

Power Input Options

Nominal 110/120/230/240 V ac, 50/60 Hz, or nominal 110/125/220/250 V dc. Operates properly from 85 V ac to 265 V ac and from 80 V dc to 312.5 V dc. Withstands 315 V dc or 300 V ac for 1 second. Burden 20 VA at 120 V ac/125 V dc.

Nominal 24/48 V dc, Operates properly from 18 V dc to 56 V dc. Withstands 65 V dc for 1 second. Burden 46 VA at 24 V dc and 30 VA at 48 V dc.

This unit includes two power supplies which are not redundant.

Sensing Inputs

Nine Voltage Inputs – Rated for a nominal voltage of 50 V ac to 140 V ac (user configurable) at 60 Hz or 50 Hz. Will withstand 240 V continuous voltage and 360 V for 10 seconds. Voltage transformer burden is less than 0.2 VA at 120 V. Source voltage may be phase-to ground or phase-to-phase connected. For proper operation of M-4272 MBTS, the connections for the Source 1, Source 2 and Bus voltages must match each other. The unit may have up to three voltage inputs for each of the Source 1, Source 2, and Bus Voltages. Typical connection diagrams are illustrated in Figures 10 through 15.

One Source 1 Current Input – Rated for a current (I_R) of 5.0 A or 1.0 A (optional) at 60 Hz or 50 Hz. Will withstand 4 I_R continuous current and 100 I_R for 1 second. Current transformer burden is less than 0.5 VA at 5 A (5 A option), or 0.3 VA at 1 A (1 A option).

One Source 2 Current Input – Rated for a current (I_R) of 5.0 A or 1.0 A (optional) at 60 Hz or 50 Hz. Will withstand 4 I_R continuous current and 100 I_R for 1 second. Current transformer burden is less than 0.5 VA at 5 A (5 A option), or 0.3 VA at 1 A (1 A option).

Control/Status Inputs

To provide proper operation and breaker status LED indication on the front panel, the INPUT1 through INPUT 6 status inputs must be connected to the 52a, 52b, 52a/b and 52SP (service position) breaker status contacts. The control/status inputs, INPUT7 through INPUT18, can be programmed to initiate the transfer or block the transfer operation, trigger the oscillographic recorder, or to operate one or more outputs. The control/status inputs are designed to be connected to dry contacts and are internally wetted with a 24 V dc power supply.The four Aux Inputs must be connected to the trip and close circuit monitoring.

Output Contacts

Output contacts OUTPUT1 through OUTPUT4 are available to Trip and Close the Source 1 and Source 2 breakers and are closed for a defined pulse length (pulse length can be programmed from 15 to 30 Cycles). The power supply alarm output contact (form 'b') and the self-test alarm output contact (form 'c'), and one output contact for lockout or blocking status (form 'c'). These outputs are pre-defined.

The eleven programmable output contacts (ten form ‘a’ and one form ‘c’), the Lockout/Block alarm output contact (form 'c'), the power supply alarm output contact (form 'b') and the self-test alarm output contact (form ‘c’), are all rated as per ANSI/IEEE C37.90-1989 for tripping. (Make 30 A for 0.2 seconds, carry 8 A, break 6 A @ 120 V ac, break 0.5A @ 48 V dc; 0.3A @ 125 V dc; 0.2A @ 250 V dc with L/R = 40 mSec.)

Any of the MBTS functions can be individually programmed to activate any one or more of the programmable output contacts (Outputs 5 to 16). Any output contact can also be selected as pulsed or latched. ISSLogic can also be used to activate an output contact.

*__NOTE__: The 'new source' is defined as the source to which the bus is being transferred.

Breaker Closing Time and Breaker Failure Monitoring

The Breaker Closing Time Monitoring feature measures the breaker closing time each time a transfer occurs. If this time varies by more than a selectable breaker closing time deviation of the programmed time, an alarm is activated. The breaker closing time is measured from the time the close command is sent until the breaker status indicates that the breaker is closed.

The selectable Adaptive Breaker Closing Time is provided. If it is enabled, a new setpoint of the breaker closing time will be automatically updated to an average value of 8 breaker closing time's measurements; however the setpoints of the breaker closing time are not permitted to write and change unless this feature is disabled.

The breaker status inputs are also monitored for breaker failure. The breaker is considered failed when the breaker status has not changed state within a programmable time after a trip command is issued. When Simultaneous Transfer mode is selected and a breaker failure occurs on the breaker that should have tripped, the breaker that was just closed will be tripped. This prevents the new source* from being continuously connected with the failed breaker, which could have a fault.

In addition to using the breaker status in determining when a breaker has failed, the current through the breaker can also be used to determine if the breaker has operated. The loss of current after a trip can be selected to provide a more positive indication of breaker operation. An instantaneous overcurrent breaker failure element with a time delay (50BF) is provided to minimize breaker failure coordination margins.

Power up Self-Test and Continuous On-Line Testing

The system performs self test verifications when power is first applied to the unit. These include verifying the operation of the multiplexer, programmable gain amplifier, analog to digital converter, DSP chip, Host processor and all RAM chips. After the initial self test is complete and the system is operating normally, continuous self check verification continues to check for correct operation of the system. The continuous self check verification tests are performed in the background and do not effect the response time of the unit to emergency conditions. In addition to the background tests, there are tests that can be performed in the diagnostic mode during periodic off line system testing. These additional tests can exercise the relay outputs, check front panel LED operation, verify input status operation, check pushbutton operation and communication operation.

Target/Status Indicators and Controls

The **SYS OK** LED reveals proper cycling of the microcomputer; it can be programmed to flash or to be illuminated continuously. The **SOURCE 1 BRKR CLOSED** and **SOURCE 2 BRKR CLOSED** red LEDs illuminate when the breaker is closed (when the 52a contact is closed). The **SOURCE 1 BRKR OPEN** and **SOURCE 2 BRKR OPEN** green LEDs illuminate when the breaker is open (when the 52a contact is open). The 52 contact input can be configured for either “a”, “b” or "a/b" inputs. The corresponding **BRKR status** LED will illuminate when any of the conditions, events or unit functions activate.

Pressing and releasing the **STATUS RESET** pushbutton resets the **STATUS** LEDs if the conditions causing the operation have been removed. Pressing and holding the **STATUS RESET** pushbutton will allow conditions, events or functions that are picked up to be displayed. The **PS1** and **PS2** LEDs will remain illuminated as long as power is applied to the unit and the power supply is operating properly. **TIME SYNC** LED illuminates when a valid IRIG-B signal is applied and time synchronization has been established. The **TRIP SOURCE 1, CLOSE SOURCE 1, TRIP SOURCE 2** and **CLOSE SOURCE 2** status indicators are latched due to the pulsed nature of these commands. To provide information about which outputs were operated during the last transfer the appropriate **TRIP SOURCE 1, CLOSE SOURCE 1, TRIP SOURCE 2** or **CLOSE SOURCE 2** LEDs in the **Status** module are latched until reset or the next transfer.

*__NOTE__: The 'new source' is defined as the source to which the bus is being transferred.

Communication

Communication ports include rear RS-232 and RS-485 ports, a front RS-232 port, a rear IRIG-B port, and an Ethernet port (optional). The communications protocol implements serial, byte-oriented, asynchronous communication, providing the following functions when used with the Windows™-compatible M-3872 ISScom® Communications and Oscillographic Analysis Software. MODBUS protocol is supported, providing:

- Interrogation and modification of setpoints and configuration
- Time-stamped status information for the 4 most recent Transfer Event logs
- Time-stamped status information for the 512 most recent events in the Sequence of Events log
- Real-time metering of all measured quantities, control status inputs, and outputs
- Downloading of recorded oscillographic data and Sequence of Events recorder data
- Initiate manual transfer and Sequence of Events recorder

The M-3872 ISScom Communications and Oscillographic Analysis Software enables the plotting and printing of M-4272 waveform data downloaded from the unit to any IBM-PC compatible computer. The ISScom Communications and Oscillograph Analysis Software can also be used to analyze the operation of the system, determine timing of the trip and close commands, breaker times and to evaluate “bus ringdown” test data. The evaluation of “bus ringdown” data eliminates the requirement for separate recording equipment during commissioning.

IRIG-B

The M-4272 accepts either modulated or demodulated IRIG-B time clock synchronization signals. The IRIG-B time synchronization information is used to correct the local calendar/clock and provide greater system wide synchronization for status and oscillograph time tagging.

HMI Module

Local access to the M-4272 is provided through the M-3931 Human-Machine Interface (HMI) Module, allowing for easy-to-use, menu-driven access to all functions using a 6-pushbutton keyboard and a 2-line by 24 character alphanumeric display. The M-3931 module includes the following features:

- User-definable access codes providing three levels of security
- Real-time metering of all measured quantities, control status inputs, and outputs
- Initiate Manual Transfer
- Remote/Local control
- Device On/Off control

Status Module

An M-3972 Status Module provides 24 status and 8 output LEDs. Appropriate status LEDs illuminate when the corresponding M-4272 conditions, event or function activates. The status indicators can be reset with the **STATUS RESET** pushbutton if the activated conditions have been removed. The **OUTPUT** LEDs indicate the status of the programmable output contacts. There are an additional 4 status LEDs, 8 output LEDs and 12 input LEDs located on the front panel.

ISSLogic®

This feature can be programmed utilizing the M-3872 ISScom Communications Software. ISScom takes the control/status input status, system status and function status, and by employing (OR, AND, NOR and NAND) boolean logic and timers, can activate an output, change active setting profiles, initiate transfer, or block transfer.

There are six ISSLogic Functions per setting profile, depending on the number of different MBTS settings defined, the scheme may provide up to 24 different logic schemes. The ISSLogic Function Diagram is illustrated in Figure 1.

*__NOTE__: The 'new source' is defined as the source to which the bus is being transferred.

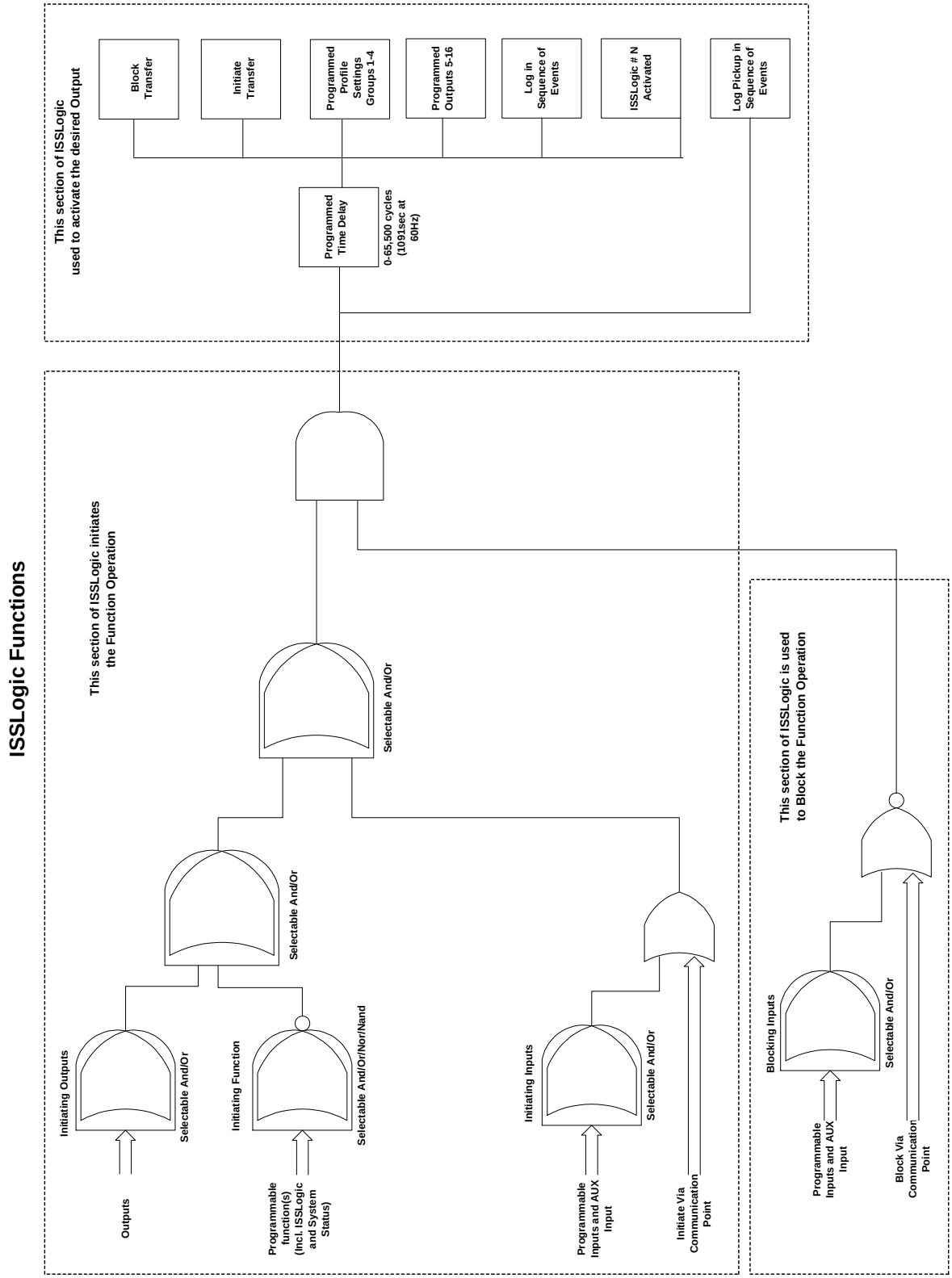


Figure 1 ISSLogic® Function Diagram

Tests and Standards

M-4272 Digital Motor Bus Transfer System complies with the following type tests and standards:

Voltage Withstand

Dielectric Withstand

IEC 60255-5	3,500 V dc for 1 minute applied to each independent circuit to earth
	3,500 V dc for 1 minute applied between each independent circuit
	1,500 V dc for 1 minute applied to IRIG-B circuit to earth
	1,500 V dc for 1 minute applied between IRIG-B to each independent circuit
	1,500 V dc for 1 minute applied between RS-485 to each independent circuit

Impulse Voltage

IEC 60255-5	5,000 V pk, +/- polarity applied to each independent circuit to earth
	5,000 V pk, +/- polarity applied between each independent circuit
	1.2 by 50 μs, 500 ohms impedance, three surges at 1 every 5 seconds
IEC 60255-5	> 100 Megaohms

Electrical Environment

Electrostatic Discharge Test

EN 60255-22-2	Class 4 (8 kV)—point contact discharge
EN 60255-22-2	Class 4 (15kV)–air discharge

Fast Transient Disturbance Test

EN 60255-22-4	Class A (4 kV, 2.5 kHz)

Surge Withstand Capability

ANSI/IEEE C37.90.1-1989	2,500 V pk-pk oscillatory applied to each independent circuit to earth
	2,500 V pk-pk oscillatory applied between each independent circuit
	5,000 V pk Fast Transient applied to each independent circuit to earth
	5,000 V pk Fast Transient applied between each independent circuit
ANSI/IEEE C37.90.1-2002	2,500 V pk-pk oscillatory applied to each independent circuit to earth
	2,500 V pk-pk oscillatory applied between each independent circuit
	4,000 V pk Fast Transient burst applied to each independent circuit to earth
	4,000 V pk Fast Transient burst applied between each independent circuit

■ **NOTE**: The signal is applied to the digital data circuits (RS-232, RS-485, IRIG-B, Ethernet communication port coupling port) through capacitive coupling clamp.

ANSI/IEEE C37.90.2	80-1000 Mhz @ 35 V/m

Output Contacts

ANSI/IEEE C37.90.0	Make 30 A for 0.2 seconds, off for 15 seconds for 2,000 operations, per Section 6.7.1, Tripping Output Performance Requirements

Atmospheric Environment

Temperature

IEC 60068-2-1	Cold, –20° C
IEC 60068-2-2	Dry Heat, +70° C
IEC 60068-2-78	Damp Heat, +40° C @ 93% RH

Mechanical Environment

Vibration

IEC 60255-21-1	Vibration response Class 1, 0.5 g
	Vibration endurance Class 1, 1.0 g
IEC 60255-21-2	Shock Response Class 1, 5.0g
	Shock Withstand Class 1, 15.0g
	Bump Response Class 1, 10.0g

Compliance

cULus-Listed per 508 – Industrial Control Equipment

– Industrial Control Equipment Certified for Canada CAN/CSA C22.2 No. 14-M91

cULus-Listed Component per 508A Table SA1.1 Industrial Control Panels

European Safety - EN 61010-1:2001, CAT II, Pollution Degree 2

Physical

Size: 19.00" wide x 6.96" high x 10.20" deep (48.3 cm x 17.7 cm x 25.9 cm)

Mounting: The unit is a standard 19", semiflush, 4-unit high, rack-mount panel design, conforming to ANSI/EIA RS-310C and DIN 41494 Part 5 specifications. Optional mounting is available.

Approximate Weight: 20 lbs (9.1 kg)

Approximate Shipping Weight: 30 lbs (13.6 kg)

Recommended Storage Parameters

Temperature: 5° C to 40° C

Humidity: Maximum relative humidity 80% for temperatures up to 31° C, decreasing to 31° C linearly to 50% relative humidity at 40° C.

Environment: Storage area to be free of dust, corrosive gases, flammable materials, dew, percolating water, rain and solar radiation.

See M-4272 Instruction Book, Appendix G, Layup and Storage for additional information.

Patent & Warranty

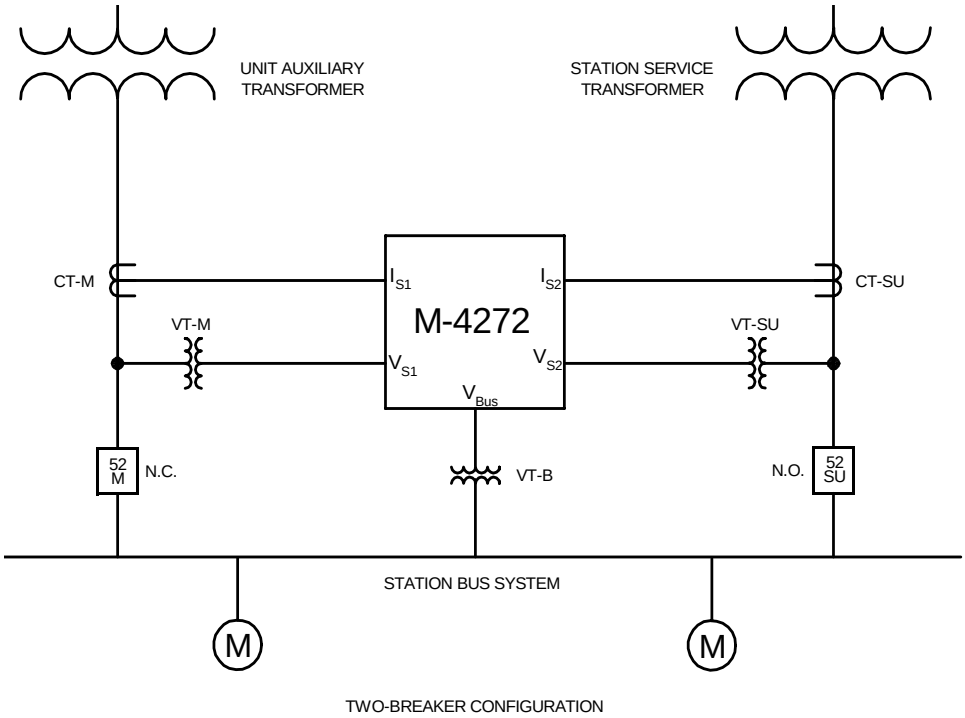
The M-4272 Digital Motor Bus Transfer System has patents pending.

The M-4272 Digital Motor Bus Transfer System is covered by a five year warranty from date of shipment.

External Connections

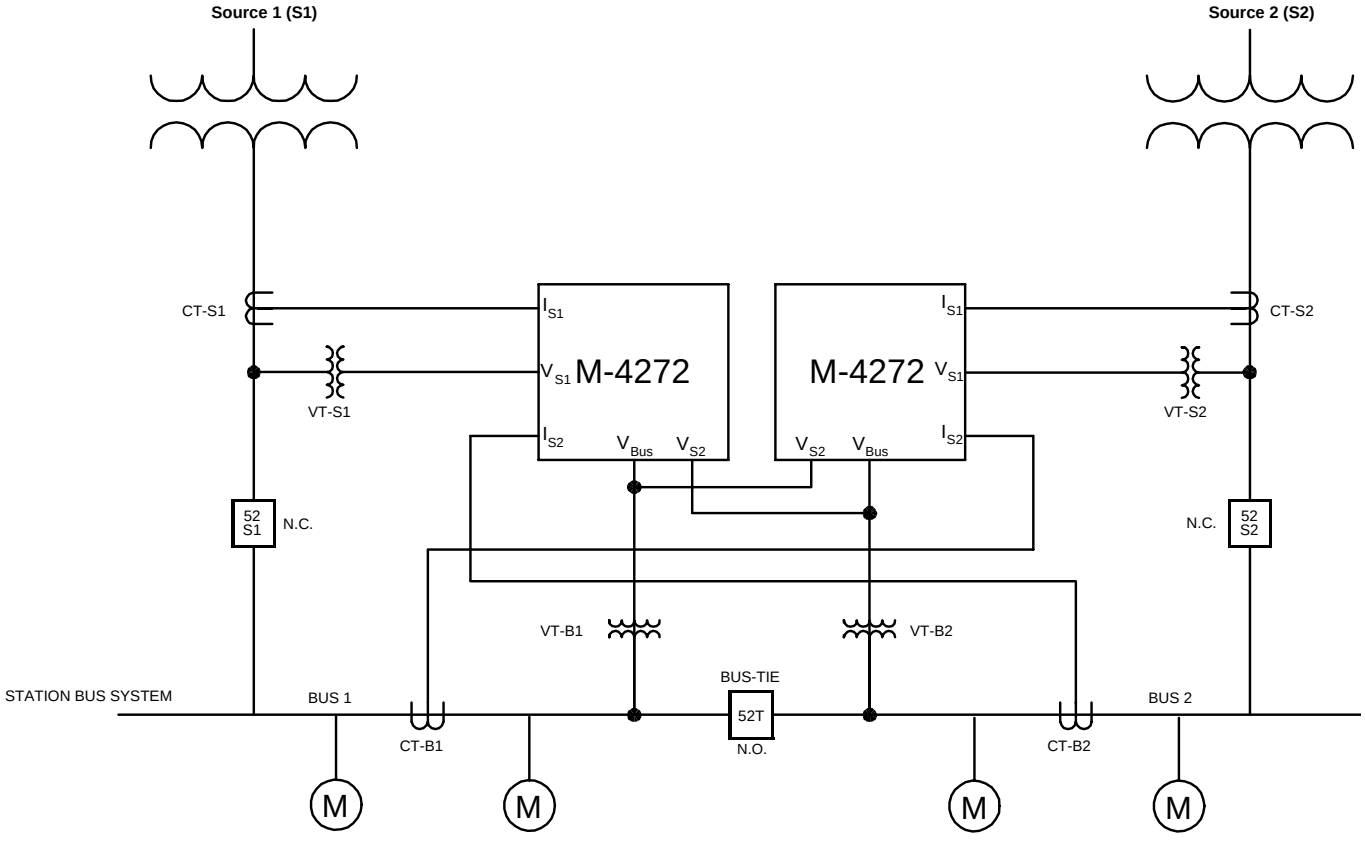
M-4272 external connection points are illustrated in Figure 5, External Connections.

Specification subject to change without notice.



TWO-BREAKER CONFIGURATION

TWO-BREAKER CONFIGURATION



THREE-BREAKER CONFIGURATION

■ **NOTE**: Current Transformers are used for the M-4272, 50BF Function, they are not required for transfer operation.

Figure 2 Typical Applications of Motor Bus Transfer Systems

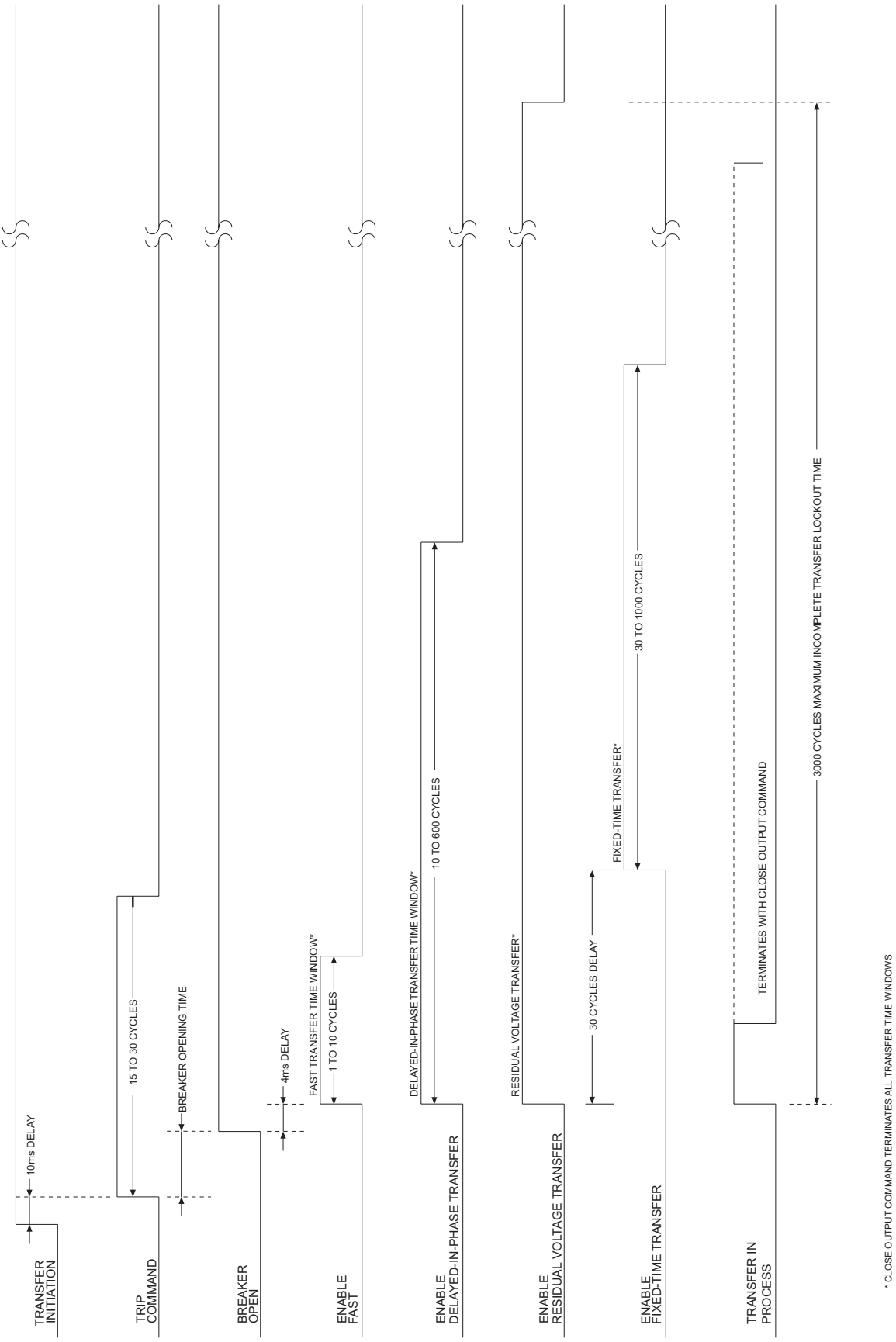


Figure 3 Time Sequence of Transfer Logic in Sequential Transfer Mode

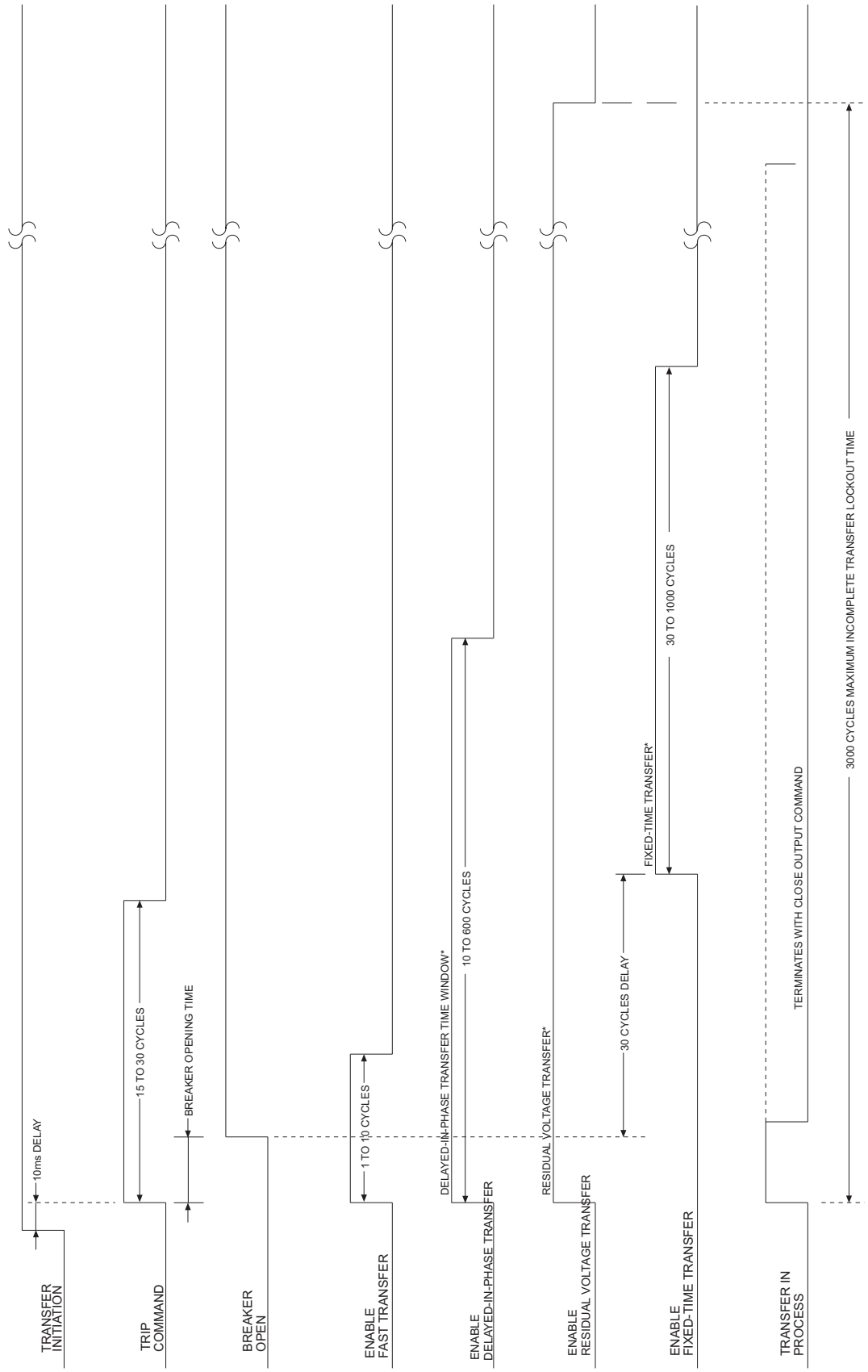


Figure 4 Time Sequence of Transfer Logic in Simultaneous Transfer Mode

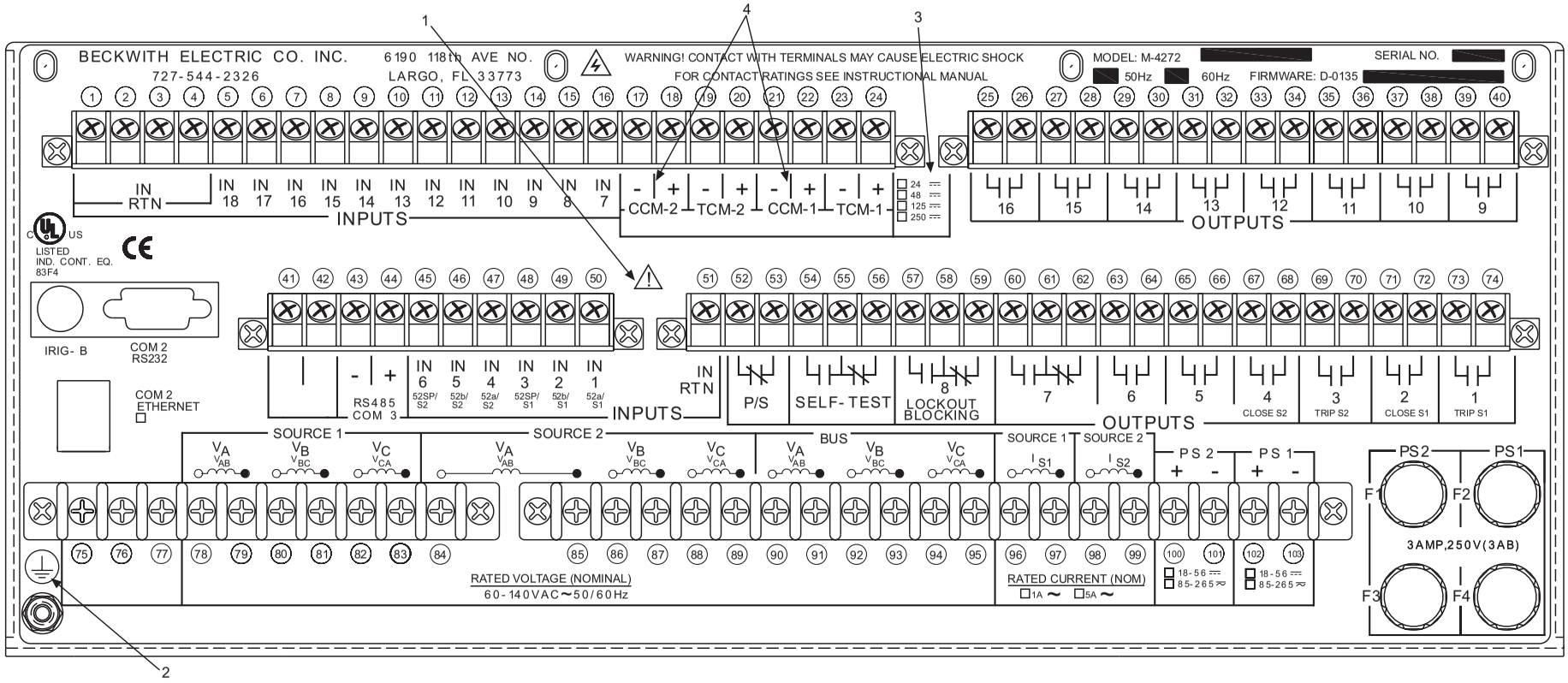


Figure 5 External Connections

1. **WARNING: ONLY DRY CONTACTS must be connected to inputs (terminals 45 through 50 with 51 common and terminals 5 through 16 with 1 through 4 common) because these contact inputs are internally wetted with 24 V dc. Application of external voltage on these inputs may result in damage to the units.**
2. **WARNING: The protective grounding terminal must be connected to an earthed ground any time external connections have been made to the unit.**
3. **▲CAUTION:** Before making connections to the Trip/Close Circuit Monitoring input, see M-4272 Instruction Book Section 5.5, Circuit Board Switches and Jumpers, for the information regarding setting Trip/Close Circuit Monitoring input voltage. Connecting a voltage other than the voltage that the unit is configured to may result in mis-operation or permanent damage to the unit.
4. **▲CAUTION:** Connecting the M-4272 Close Coil Monitor (CCM) in parallel with other relay CCMs in the Close Coil Circuit where the anti-pump "Y" relay is not bypassed may not provide reliable breaker closing operation.

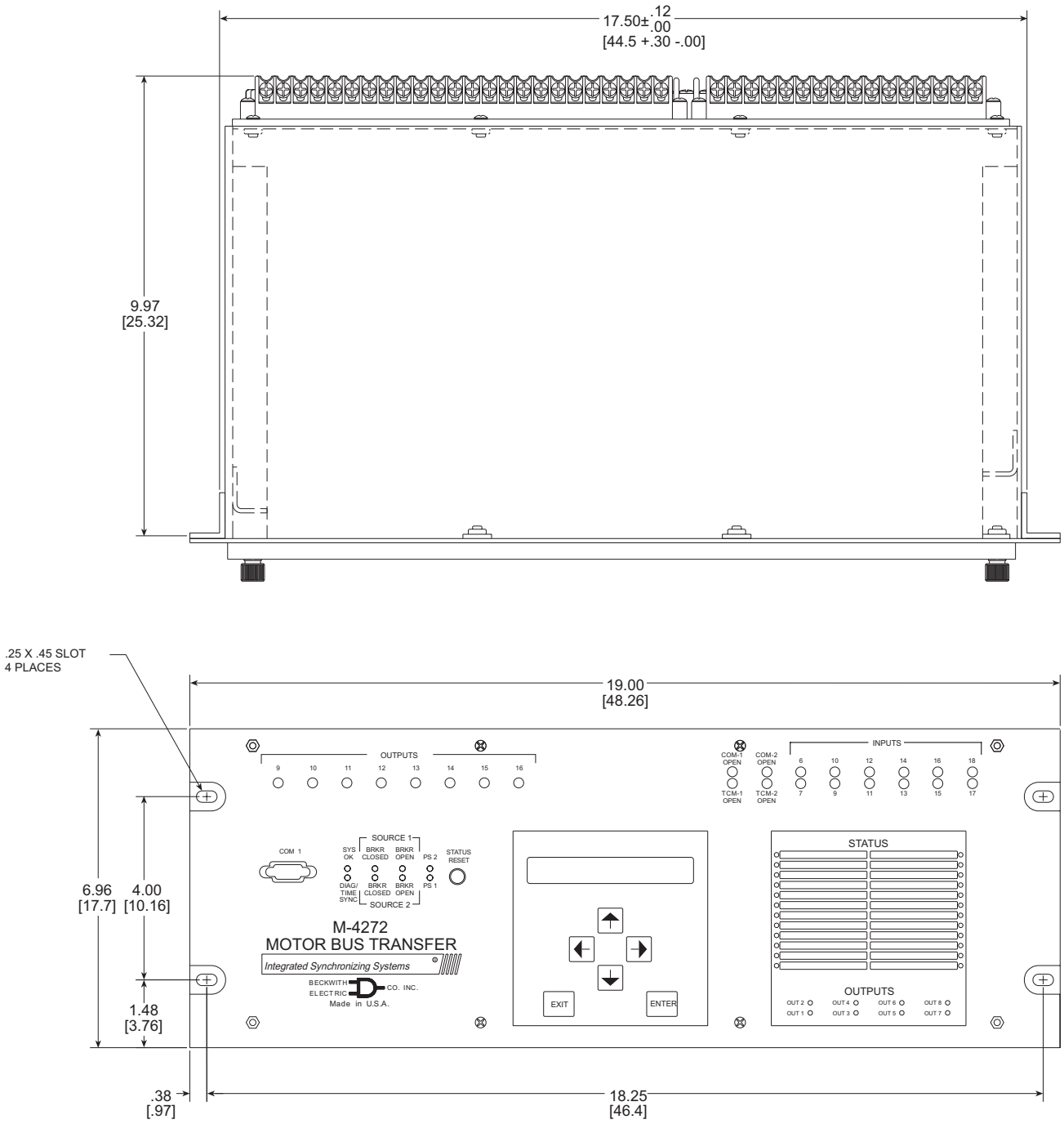


Figure 6 Horizontal Mounting Dimensions

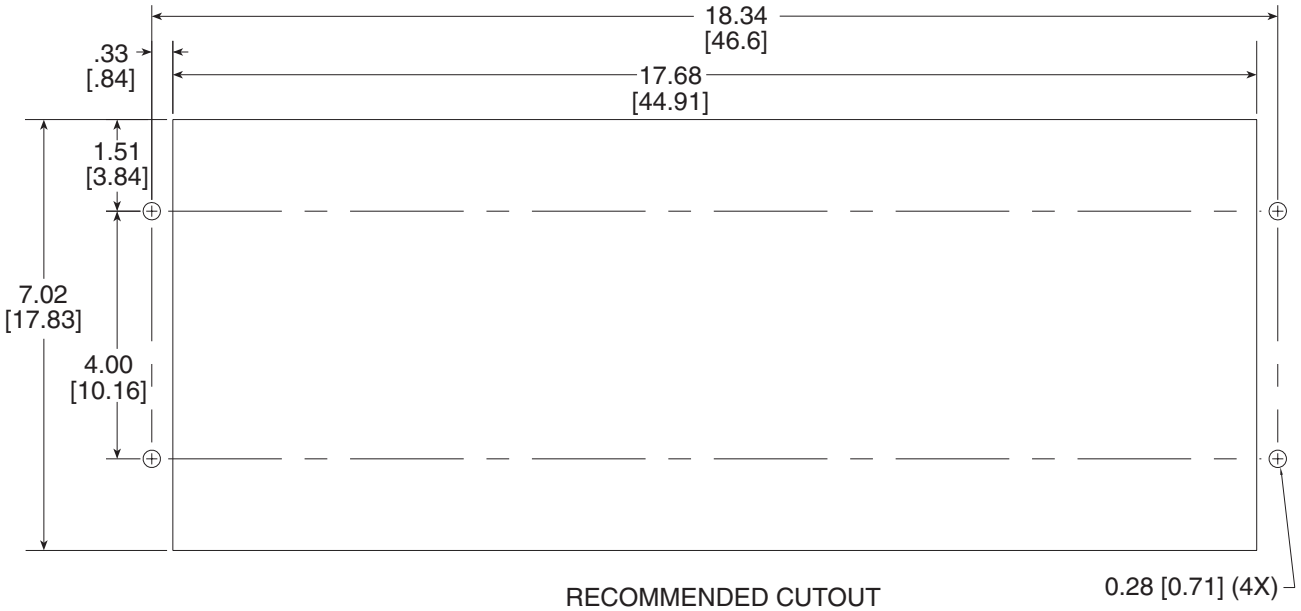


Figure 7 Panel Mount Cutout Dimensions

BECKWITH ELECTRIC CO., INC.
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WARNING

DANGEROUS VOLTAGES, capable of causing death or serious injury, are present on the external terminals and inside the equipment. Use extreme caution and follow all safety rules when handling, testing or adjusting the equipment. However, these internal voltage levels are no greater than the voltages applied to the external terminals.

DANGER! HIGH VOLTAGE

– This sign warns that the area is connected to a dangerous high voltage, and you must never touch it.

PERSONNEL SAFETY PRECAUTIONS

The following general rules and other specific warnings throughout the manual must be followed during application, test or repair of this equipment. Failure to do so will violate standards for safety in the design, manufacture, and intended use of the product. Qualified personnel should be the only ones who operate and maintain this equipment. Beckwith Electric Co., Inc. assumes no liability for the customer's failure to comply with these requirements.

– This sign means that you should refer to the corresponding section of the operation manual for important information before proceeding.

Always Ground the Equipment

To avoid possible shock hazard, the chassis must be connected to an electrical ground. When servicing equipment in a test area, the Protective Earth Terminal must be attached to a separate ground securely by use of a tool, since it is not grounded by external connectors.

Do NOT operate in an explosive environment

Do not operate this equipment in the presence of flammable or explosive gases or fumes. To do so would risk a possible fire or explosion.

Keep away from live circuits

Operating personnel must not remove the cover or expose the printed circuit board while power is applied. In no case may components be replaced with power applied. In some instances, dangerous voltages may exist even when power is disconnected. To avoid electrical shock, always disconnect power and discharge circuits before working on the unit.

Exercise care during installation, operation, & maintenance procedures

The equipment described in this manual contains voltages high enough to cause serious injury or death. Only qualified personnel should install, operate, test, and maintain this equipment. Be sure that all personnel safety procedures are carefully followed. Exercise due care when operating or servicing alone.

Do not modify equipment

Do not perform any unauthorized modifications on this instrument. Return of the unit to a Beckwith Electric repair facility is preferred. If authorized modifications are to be attempted, be sure to follow replacement procedures carefully to assure that safety features are maintained.

PRODUCT CAUTIONS

Before attempting any test, calibration, or maintenance procedure, personnel must be completely familiar with the particular circuitry of this unit, and have an adequate understanding of field effect devices. If a component is found to be defective, always follow replacement procedures carefully to that assure safety features are maintained. Always replace components with those of equal or better quality as shown in the Parts List of the Instruction Book.

Avoid static charge

This unit contains MOS circuitry, which can be damaged by improper test or rework procedures. Care should be taken to avoid static charge on work surfaces and service personnel.

Use caution when measuring resistances

Any attempt to measure resistances between points on the printed circuit board, unless otherwise noted in the Instruction Book, is likely to cause damage to the unit.

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Chapter 4 (cont'd)

Chapter 5

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5 Installation

5.1 General Information

■ **NOTE**: Prior to the installation of the equipment, it is essential to review the contents of this manual to locate data which may be of importance during the installation procedures. The following is a quick review of the contents of this chapter.

The person or group responsible for the installation of the MBTS will find herein all mechanical information required for the physical installation, equipment ratings, and all external connections in this chapter. For reference, the Three-Line Connection Diagrams are repeated from Chapter 4, **System Settings and Setpoints**. Further, a commissioning checkout procedure is outlined using the HMI option to check the external CT and VT connections. Additional tests which may be desirable at the time of installation are described in Chapter 6, **Testing**.

Service Conditions and Conformity to CE Standard

Stating conformance to CE Standard EN 61010-1 2001, operation of this equipment within the following service conditions does not present any known personnel hazards outside of those stated herin:

- 5^0 to 40^0 Centigrade
- Maximum relative humidity 80% for temperatures up to 31^0 C, decreasing in a linear manner to 50% relative humidity at 40^0 C.

This equipment will function properly, and at stated accuracies beyond the limits of this CE Standard, as per the equipment's specifications, stated in this Instruction Book.

It is suggested that the terminal connections illustrated here be transferred to *station* one-line wiring and three-line connection diagrams, *station* panel drawings and *station* DC wiring schematics.

If during the commissioning of the M-4272 Digital Motor Bus Transfer System, additional tests are desired, Chapter 6, **Testing**, may be consulted.

5.2 Mechanical/Physical Dimensions

Figure 5-1 contains the physical dimensions of the MBTS that may be required for mounting the unit on a rack. Figure 5-2 provides panel mounting dimensions.

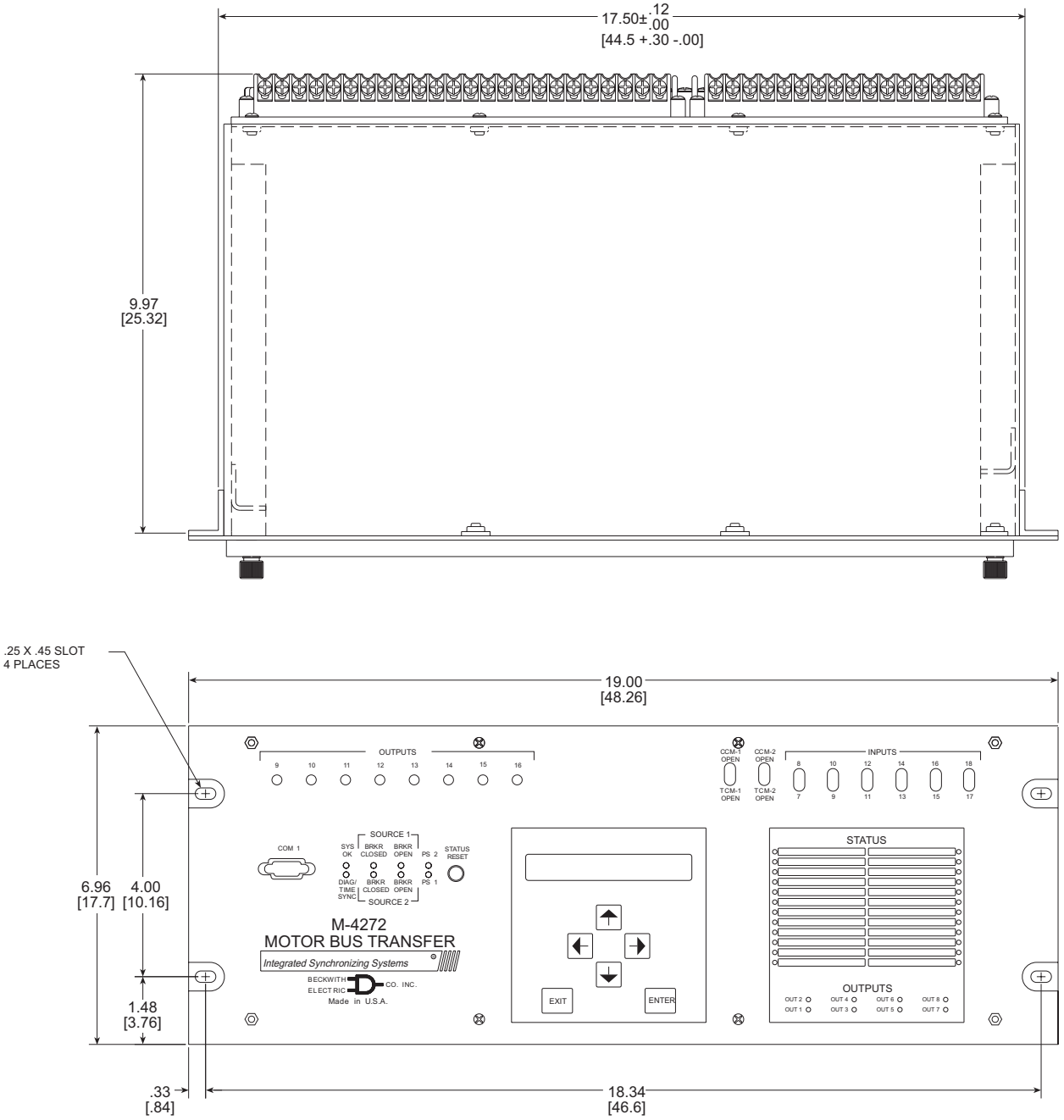


Figure 5-1 Mechanical/Physical Dimensions

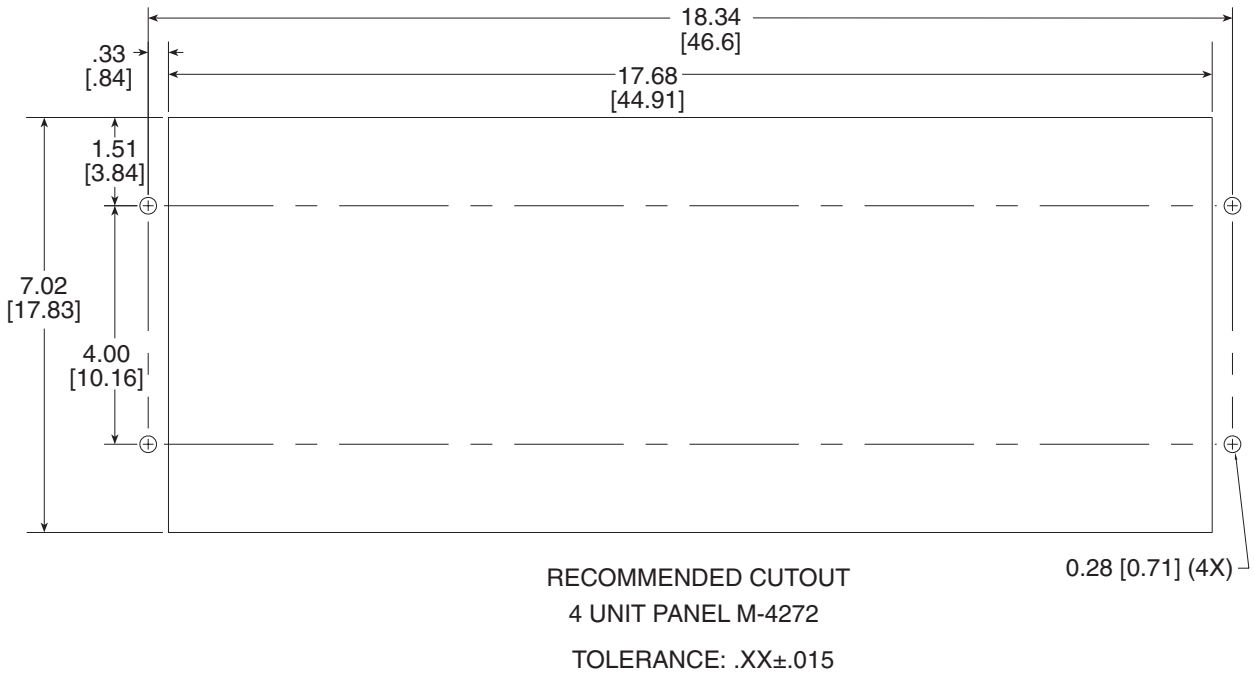


Figure 5-2 Panel Mount Cutout Dimensions

5.3 External Connections

WARNING: The protective grounding terminal must be connected to an earthed ground anytime external connections have been made to the unit.

WARNING: ONLY DRY CONTACTS must be connected to inputs (terminals 45 through 50 with 51 common and terminals 5 through 16 with 1 through 4 common) because these contact inputs are internally wetted. Application of external voltage on these inputs may result in damage to the units.

WARNING: Do not open live CT circuits. Live CT circuits should be shorted prior to disconnecting CT wiring to the M-4272. Death or severe electrical shock may result.

▲ **CAUTION:** Mis-operation or permanent damage may result to the unit if a voltage is applied to Terminals 17 through 24 that does not match the configured Trip and Close Circuit Monitoring input voltage.

To fulfill requirements for UL and CSA listings, terminal block connections must be made with No. 12 AWG solid or stranded copper wire inserted in an AMP #324915 (or equivalent) connector, and wire insulation used must be rated at 60° C minimum.

Power Supply

The M-4272 power supplies (not redundant) must be powered from the same source.

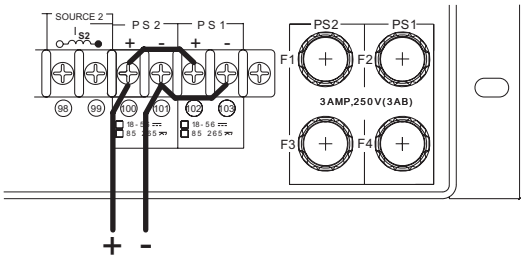


Figure 5-3 Power Supply Connection

Grounding Requirements

The M-4272 is designed to be mounted in an adequately grounded metal panel, using grounding techniques (metal-to-metal mounting) and hardware that assures a low impedance ground.

Unit Isolation

Sensing inputs should be equipped with test switches and shorting devices where necessary to isolate the unit from external potential or current sources.

Insulation Coordination

Sensing Inputs: 60 V to 140 V, Installation Category IV, Transient Voltages not to exceed 5,000 V.

Torque Requirements

- **Terminals 1–74**: 7.5 in-lbs, minimum, and 8.0 in-lbs, maximum
- **Terminals 75–103**: 8.5 in-lbs, minimum, and 9.0 in-lbs, maximum

MBTS Outputs

All outputs are shown in the de-energized state for standard reference. MBTS standard reference is defined as the non-asserted state, or power to the MBTS is removed. Output contacts #1 through #4 and #9 through #16 are high speed operation contacts. The power supply MBTS (P/S) is energized when the power supply is OK. The self-test MBTS is energized when the MBTS has performed all self-tests successfully.

Replacement Fuses

F1–F4 replacement fuses must be fast-acting 3 Amp, 250 V (3AB) Beckwith Electric Part Number 420-00885.

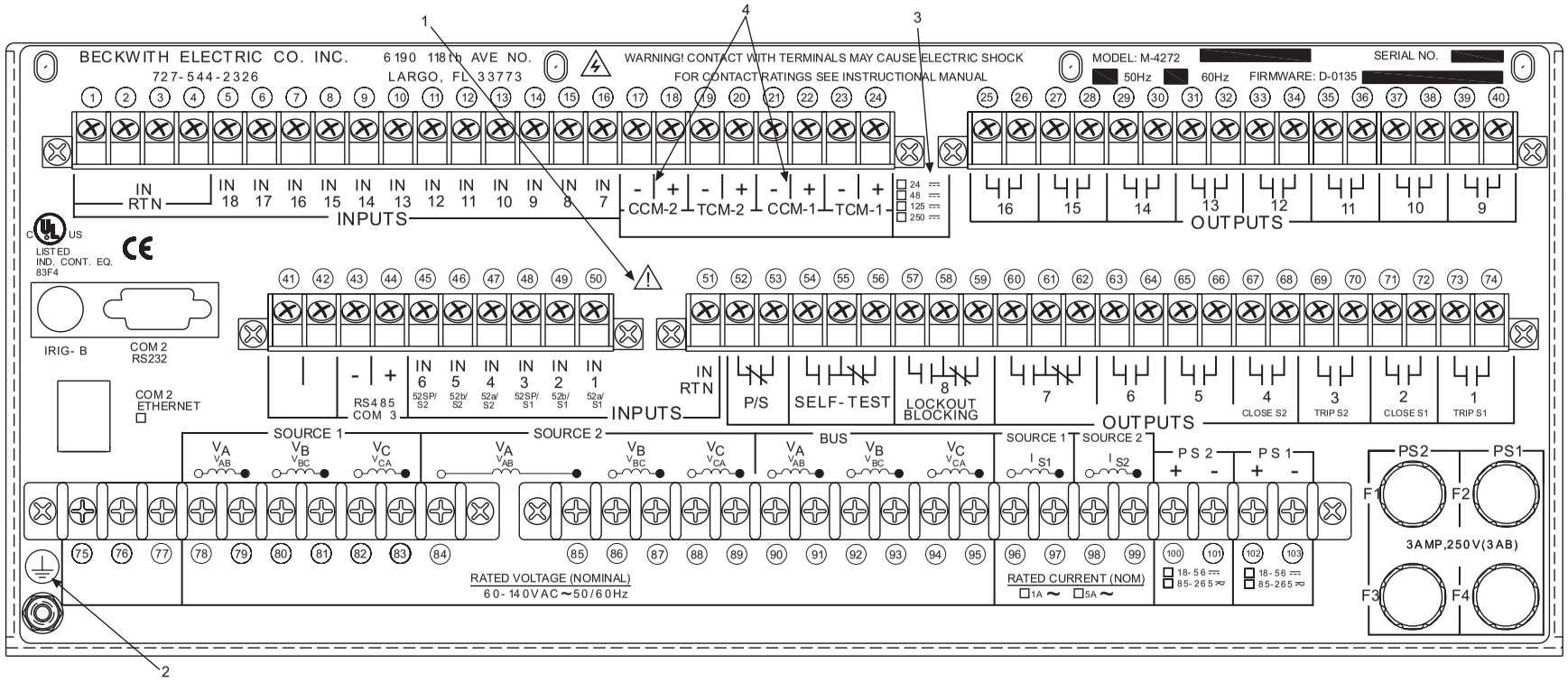
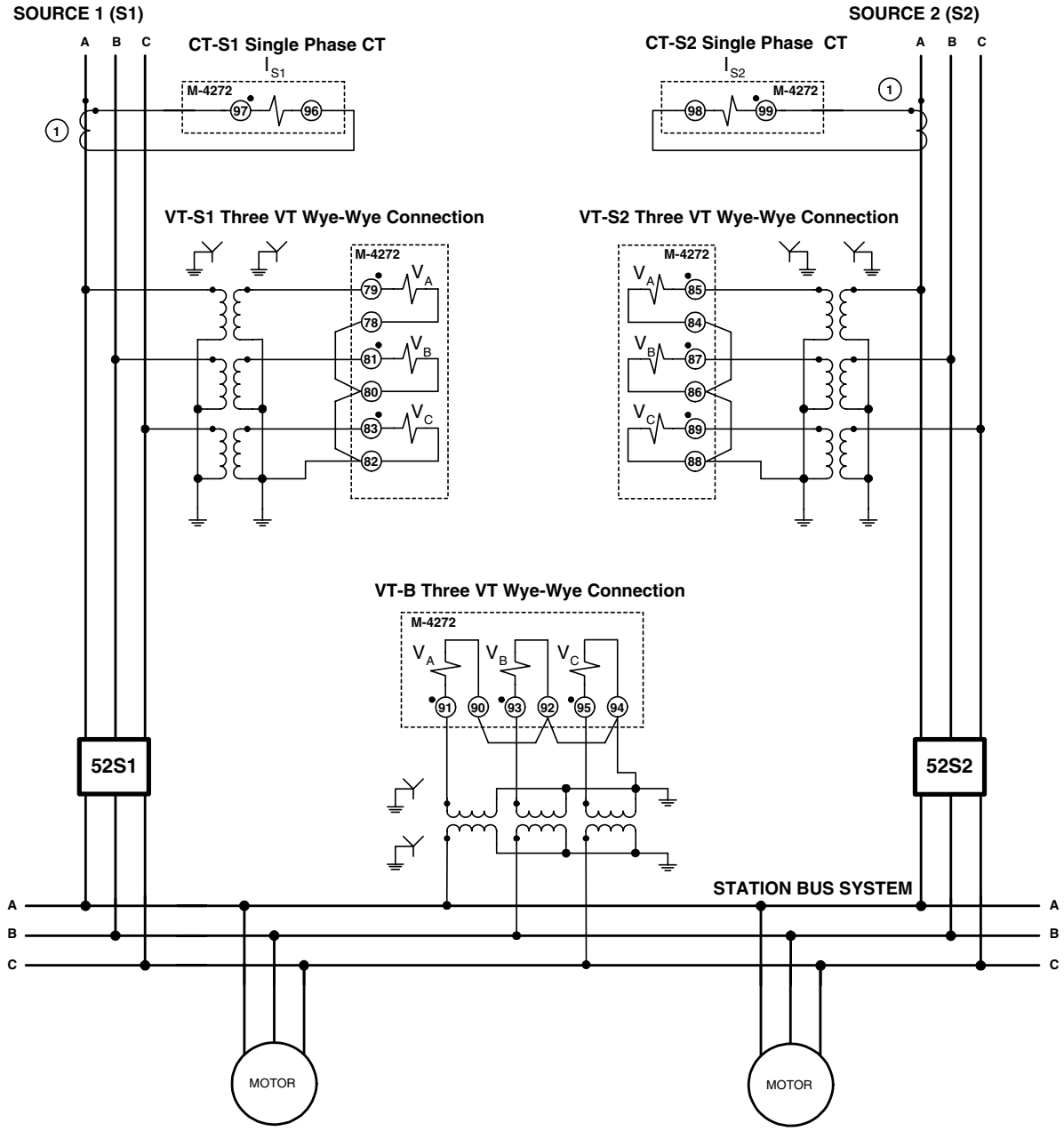


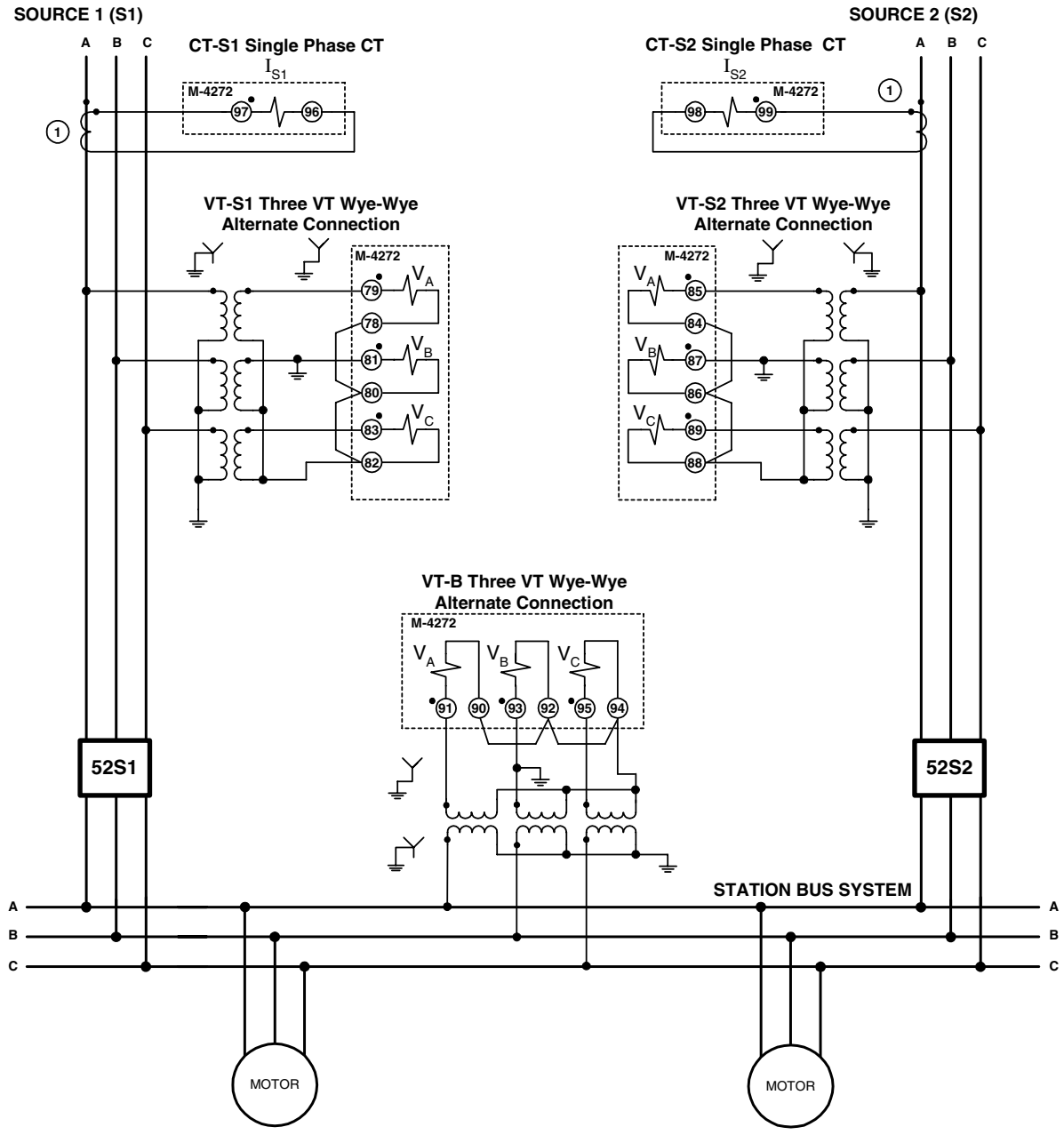
Figure 5-4 External Connections

1. **WARNING: ONLY DRY CONTACTS must be connected to inputs (terminals 45 through 50 with 51 common and terminals 5 through 16 with 1 through 4 common) because these contact inputs are internally wetted with 24 V dc. Application of external voltage on these inputs may result in damage to the units.**
2. **WARNING: The protective grounding terminal must be connected to an earthed ground any time external connections have been made to the unit.**
3. **▲CAUTION:** Before making connections to the Trip/Close Circuit Monitoring input, see M-4272 Instruction Book Section 5.5, Circuit Board Switches and Jumpers, for the information regarding setting Trip/Close Circuit Monitoring input voltage. Connecting a voltage other than the voltage that the unit is configured to may result in mis-operation or permanent damage to the unit.
4. **▲CAUTION:** Connecting the M-4272 Close Coil Monitor (CCM) in parallel with other relay CCMs in the Close Coil Circuit where the anti-pump "Y" relay is not bypassed may not provide reliable breaker closing operation.



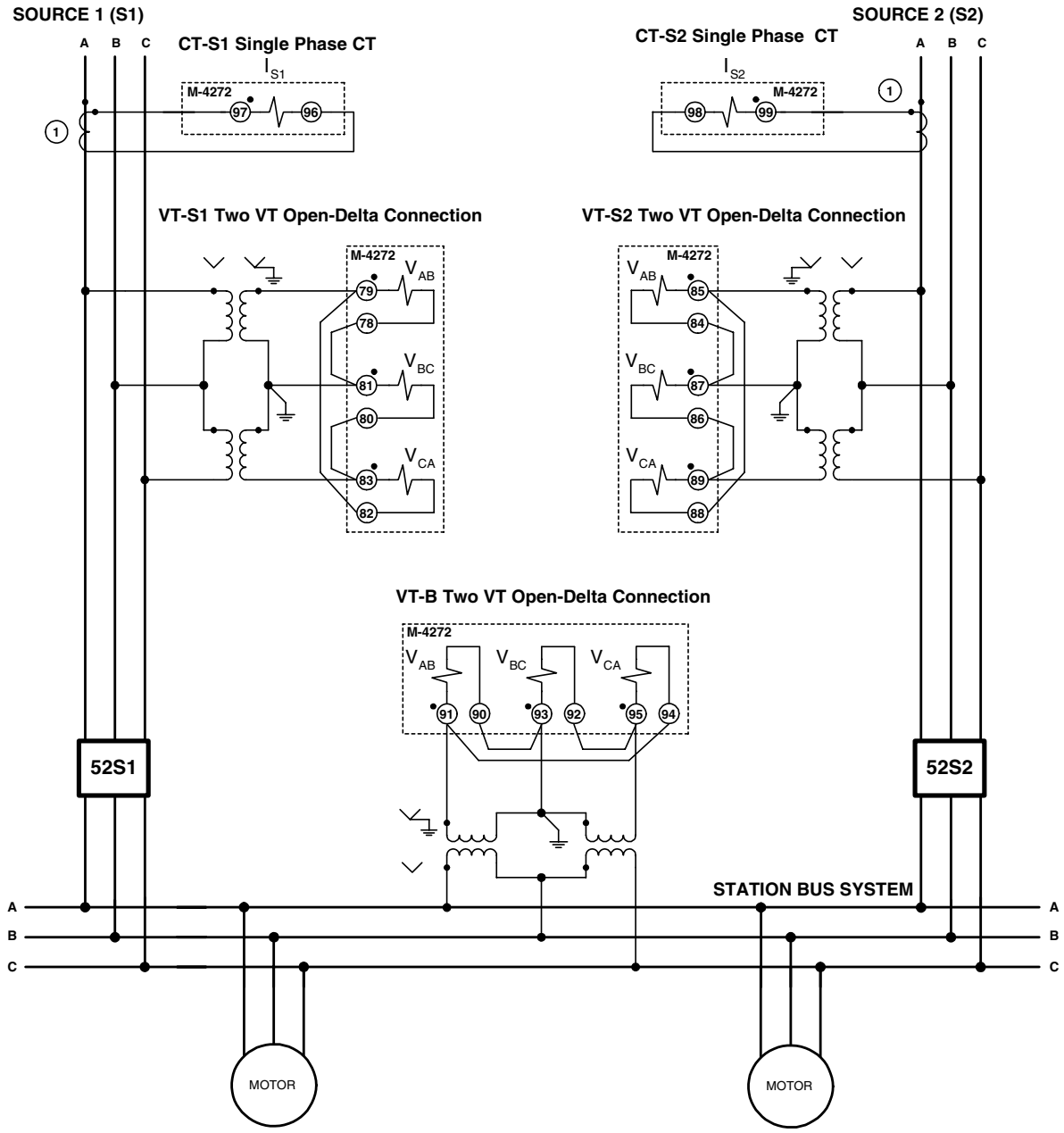
(1) CT-S1 and CT-S2 are single phase CTs. They both must be connected to the same phase, either Phase A, Phase B or Phase C.

Figure 5-5 Three-Phase Wye-Wye VT Three-Line Connection Diagram



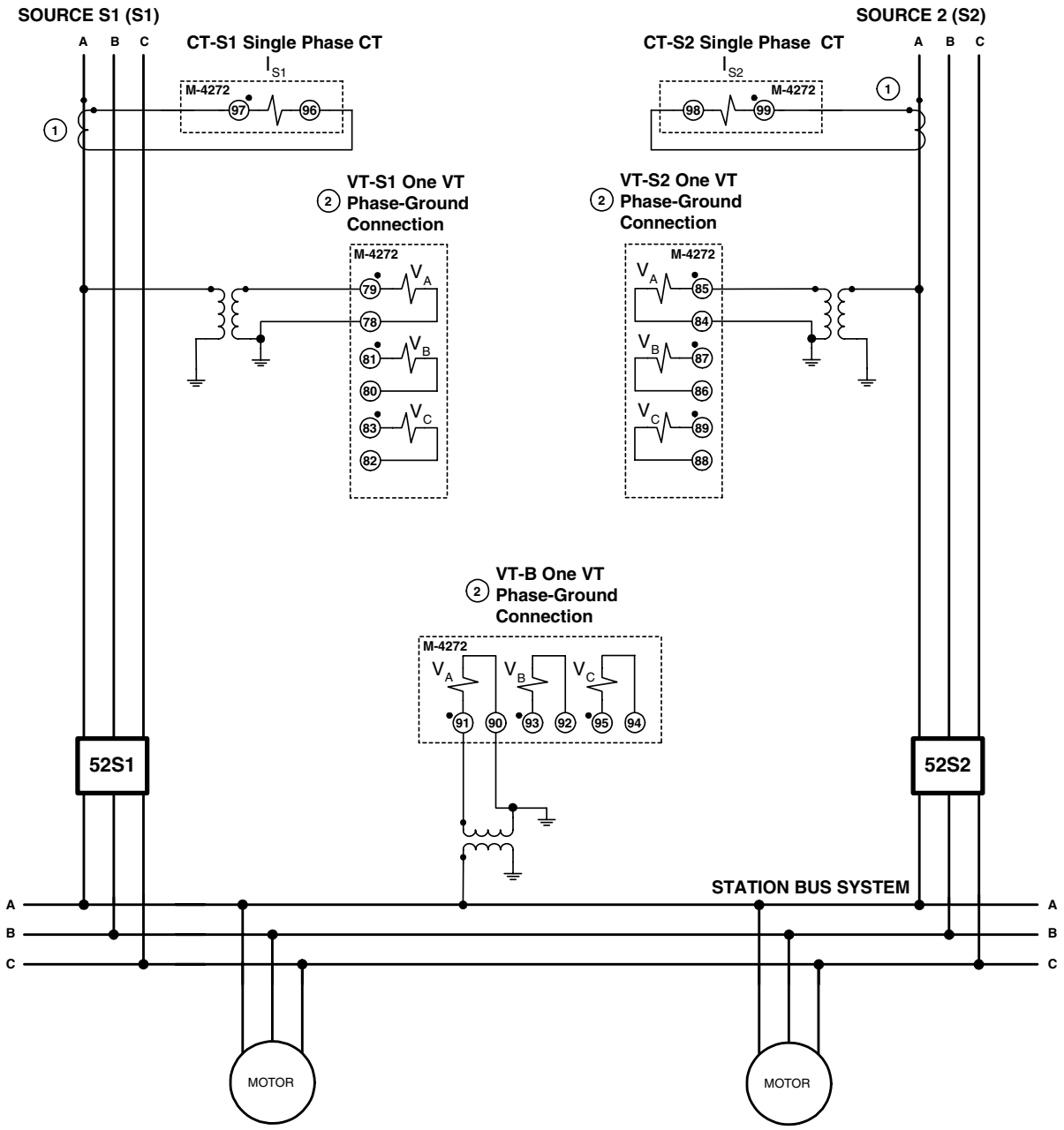
(1) CT-S1 and CT-S2 are single phase CTs. They both must be connected to the same phase, either Phase A, Phase B or Phase C.

Figure 5-6 Three-Phase Wye-Primary/Wye Secondary, One Phase Grounded VT Three-Line Connection Diagram



(1) CT-S1 and CT-S2 are single phase CTs. They both must be connected to the same phase, either Phase A, Phase B or Phase C respectively.

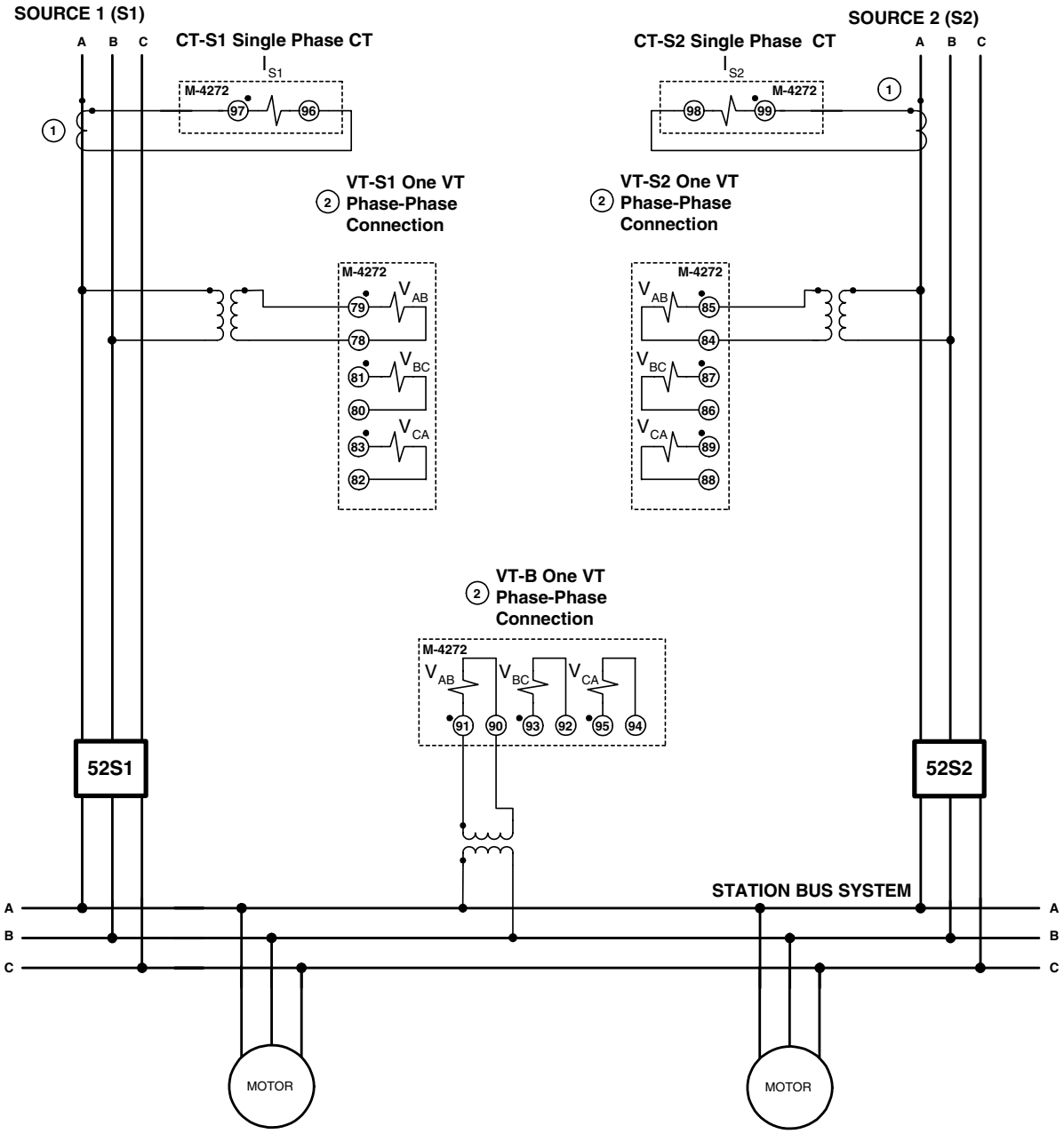
Figure 5-7 Three-Phase Open Delta VT Three-Line Connection Diagram



1 CT-S1 and CT-S2 are single phase CTs. They both must be connected to the same phase, either Phase A, Phase B or Phase C.

2 VT-S1, VT-S2 and VT-B are single phase VTs. They all must be connected to the same phase, either Phase A-To-Ground, Phase B-To-Ground or Phase C-To - Ground.

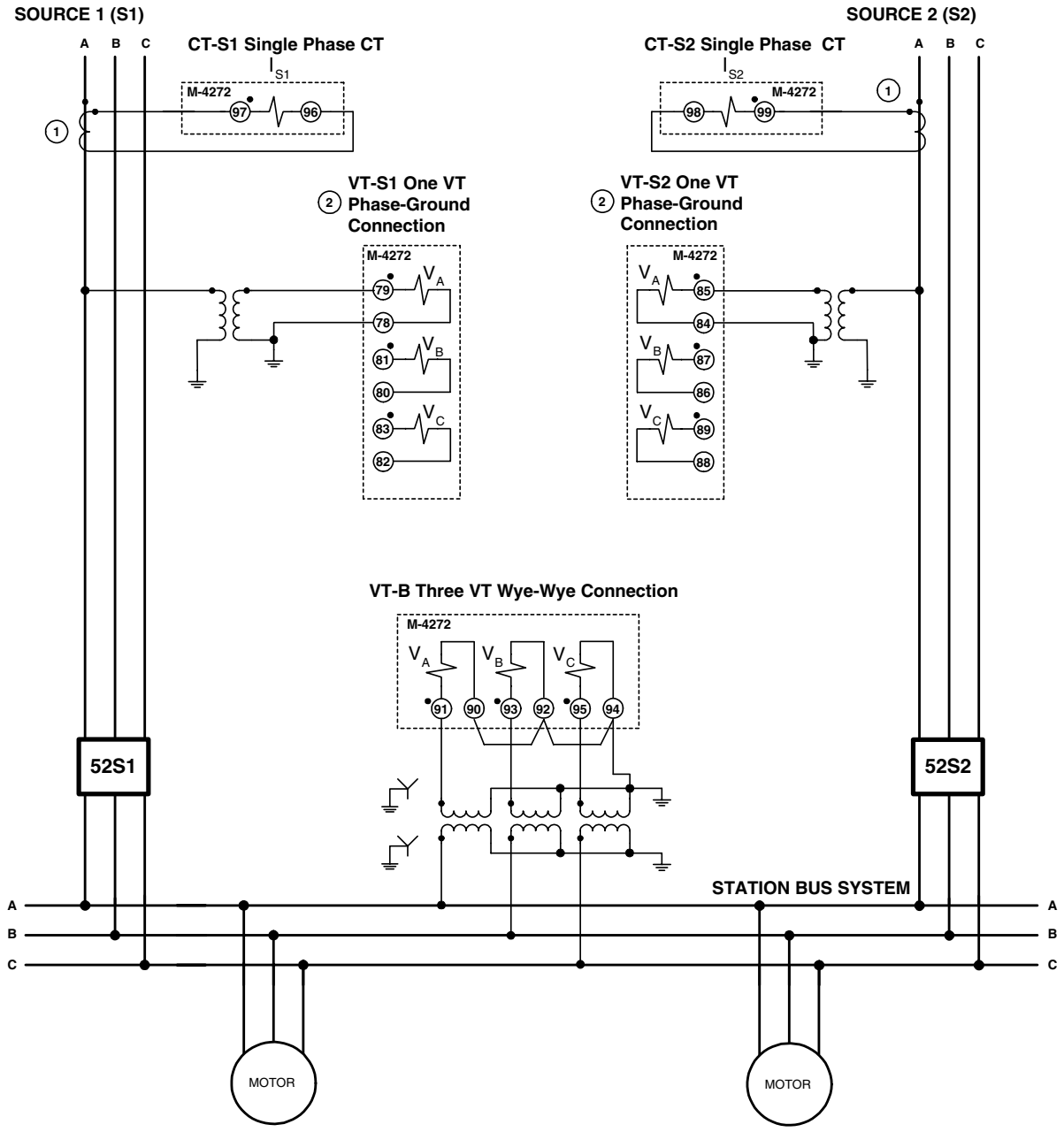
Figure 5-8 Single-Phase, Phase-Ground VT Three-Line Connection Diagram



1 CT-S1 and CT-S2 are single phase CTs. They both must be connected to the same phase, either Phase A, Phase B or Phase C.

2 VT-S1, VT-S2 and VT-B are single phase VTs. They all must be connected to the same phase, either Phase A-To-Phase B, Phase B-To-Phase C or Phase A-To - Phase C.

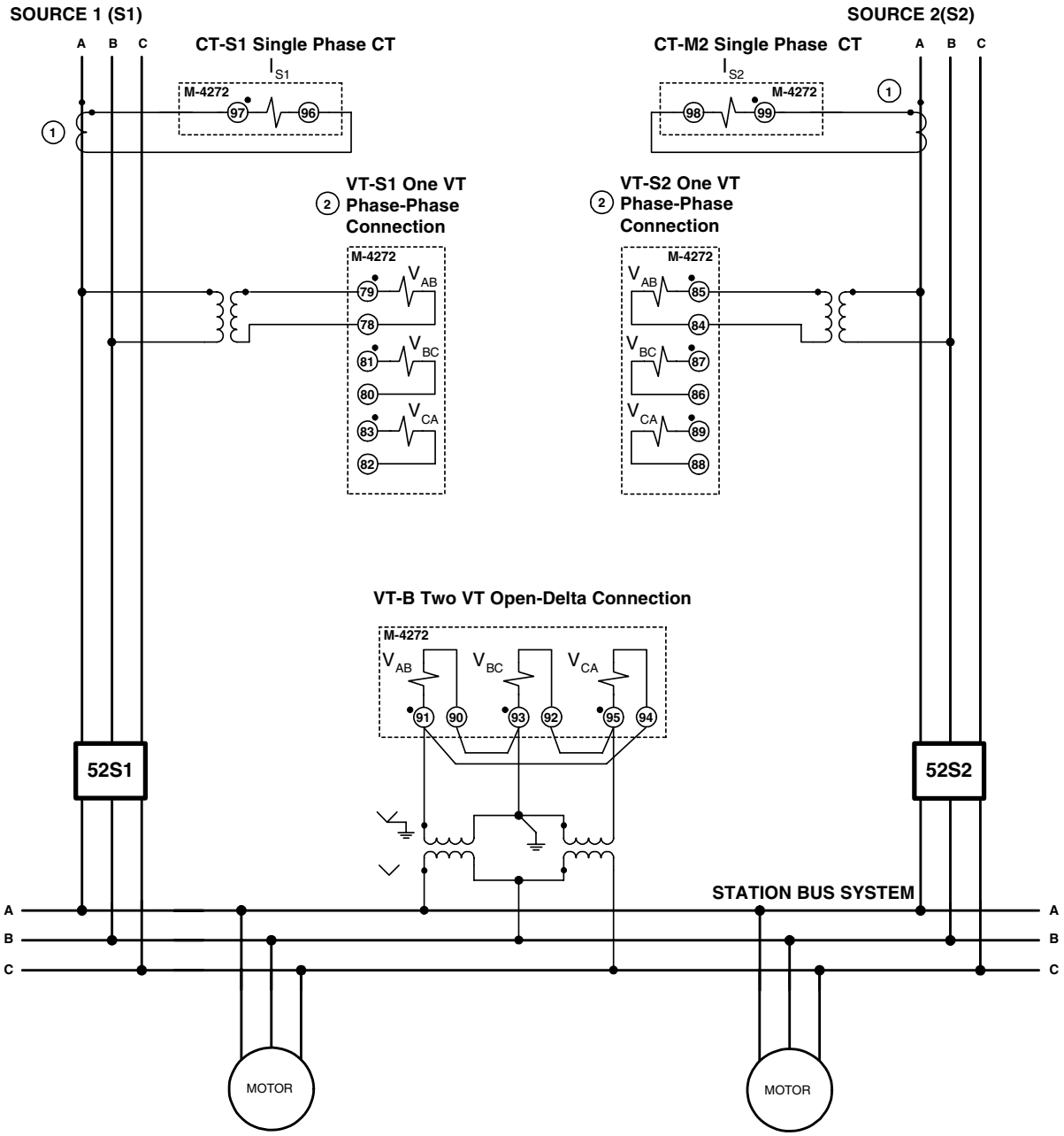
Figure 5-9 Single-Phase, Phase-Phase VT Three-Line Connection Diagram



(1) CT-S1 and CT-S2 are single phase CTs. They both must be connected to the same phase, either Phase A, Phase B or Phase C.

(2) VT-S1 and VT-S2 are single phase VTs. They both must be connected to the same phase, either Phase A-To-Ground, Phase B-To-Ground or Phase C-To - Ground.

Figure 5-10 Single-Phase, Source Side, Phase-Ground, Three-Phase Bus Side, Wye-Wye Three-Line Connection Diagram



(1) CT-S1 and CT-S2 are single phase CTs. They both must be connected to the same phase, either Phase A, Phase B or Phase C.

(2) VT-S1 and VT-S2 are single phase VTs. They both must be connected to the same phase, either Phase A-To-Phase B, Phase B-To-Phase C or Phase A-To -Phase C.

Figure 5-11 Single-Phase, Source Side, Phase-Phase, Three-Phase Bus Side, Open Delta Three-Line Connection Diagram

5.4 Circuit Board Switches and Jumpers

See Figures 5-12 and 5-13 for Circuit Board Jumper and Switch locations.

See Tables 5-1 through 5-6 for Circuit Board Jumper and Switch configuration details.

Accessing Switches and Jumpers

● **WARNING: Operating personnel must not remove the cover or expose the printed circuit board while power is applied. IN NO CASE may the circuit-based jumpers or switches be moved with power applied.**

● **WARNING: The protective grounding terminal must be connected to an earthed ground any time external connections have been made to the unit. See Figure 5-4, Note #3.**

▲ **CAUTION**: This unit contains MOS circuitry, which can be damaged by static discharge. Care should be taken to avoid static discharge on work surfaces and service personnel.

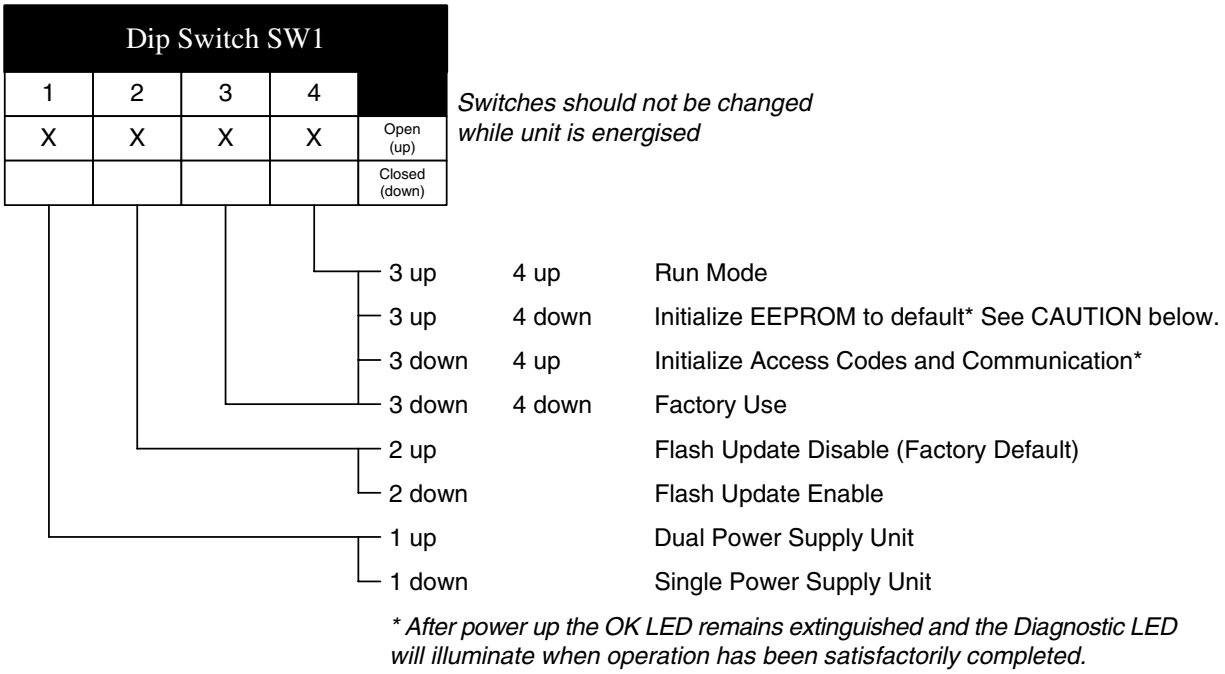
1. De-energize the M-4272.
2. Remove the screws that retain the front cover.
3. Remove the "J" connectors from the corresponding plugs, P1, P2 and P3 from the top board (B-0957).
4. Remove the “J” connectors from the corresponding plugs, P4, 5, 6, 7, 9 and 11 from the bottom board (B-0970).
5. Loosen the two circuit board retention screws (captured) in each board.
6. Remove the circuit boards from the chassis.
7. Jumpers J5, J18, J46, J60, and J61 are now accessible on the bottom board (B-0970). See Figure 5-12, M-4272 Bottom Circuit Board (B-0970) for locations.
8. Jumpers J1, J2, J3, J4, J5, J6, J13, J14, J15, J16, J17 and J18 are now accessible on the top board (B-0957). See Figure 5-13, M-4272 Top Circuit Board for locations.
9. Dipswitch SW1 is now accessible. See Figure 5-12 for location.
10. Insert circuit boards into chassis guides and seat firmly.
11. Tighten circuit board retention screws.
12. Reconnect “J” connectors to corresponding plugs.
13. Reinstall cover plate.

■ **NOTE:** Short circuit protection (100 ma limit) is incorporated on pins 1 and 9 when used for +/- 15V.

JUMPER	POSITION	DESCRIPTION
J5	A to B	Demodulated IRIG-B TTL signal on pin 6 COM2
	B to C	Modulated IRIG-B signal BNC (Default)
J18	A to B	COM3 200 ohm termination resistor inserted
	B to C	COM3 no termination (Default)
J46	A to B	COM3 shares Baud rate with COM1
	B to C	COM3 shares Baud rate with COM2 (Default)
J60	A to B	Connects DCD signal to pin 1 of COM2 (Default)
	A to C	Connects +15V to pin 1 of COM2
J61	B to C	Connects -15V to pin 9 of COM2
	A to B	COM2 pin 9 float (Default)

▲ **CAUTION**: A loss of calibration, setpoints, and configuration will occur when the EEPROM is initialized to default.

Table 5-1 Jumpers



▲ **CAUTION**: A loss of calibration,setpoints and configuration will occur when the EEPROM is initialized to default.

Table 5-2 Dip Switch SW-1

TRIP CIRCUIT MONITOR 1 INPUT VOLTAGE SELECT			
INPUT VOLTAGE	JUMPER J1 POSITION	JUMPER J2 POSITION	JUMPER J3 POSITION
24 V dc	A to B	A to B	A to B
48 V dc	B to C	A to B	A to B
125 V dc	B to C	B to C	A to B
250 V dc*	B to C	B to C	B to C

**Default from Factory*

Table 5-3 Trip Circuit Monitor 1 Input Voltage Select Jumper Configuration

CLOSE CIRCUIT MONITOR 1 INPUT VOLTAGE SELECT			
INPUT VOLTAGE	JUMPER J4 POSITION	JUMPER J5 POSITION	JUMPER J6 POSITION
24 V dc	A to B	A to B	A to B
48 V dc	B to C	A to B	A to B
125 V dc	B to C	B to C	A to B
250 V dc*	B to C	B to C	B to C

**Default from Factory*

Table 5-4 Close Circuit Monitor 1 Input Voltage Select Jumper Configuration

TRIP CIRCUIT MONITOR 2 INPUT VOLTAGE SELECT			
INPUT VOLTAGE	JUMPER J13 POSITION	JUMPER J14 POSITION	JUMPER J15 POSITION
24 V dc	A to B	A to B	A to B
48 V dc	B to C	A to B	A to B
125 V dc	B to C	B to C	A to B
250 V dc*	B to C	B to C	B to C

**Default from Factory*

Table 5-5 Trip Circuit Monitor 2 Input Voltage Select Jumper Configuration

CLOSE CIRCUIT MONITOR 2 INPUT VOLTAGE SELECT			
INPUT VOLTAGE	JUMPER J16 POSITION	JUMPER J17 POSITION	JUMPER J18 POSITION
24 V dc	A to B	A to B	A to B
48 V dc	B to C	A to B	A to B
125 V dc	B to C	B to C	A to B
250 V dc*	B to C	B to C	B to C

**Default from Factory*

Table 5-6 Close Circuit Monitor 2 Input Voltage Select Jumper Configuration

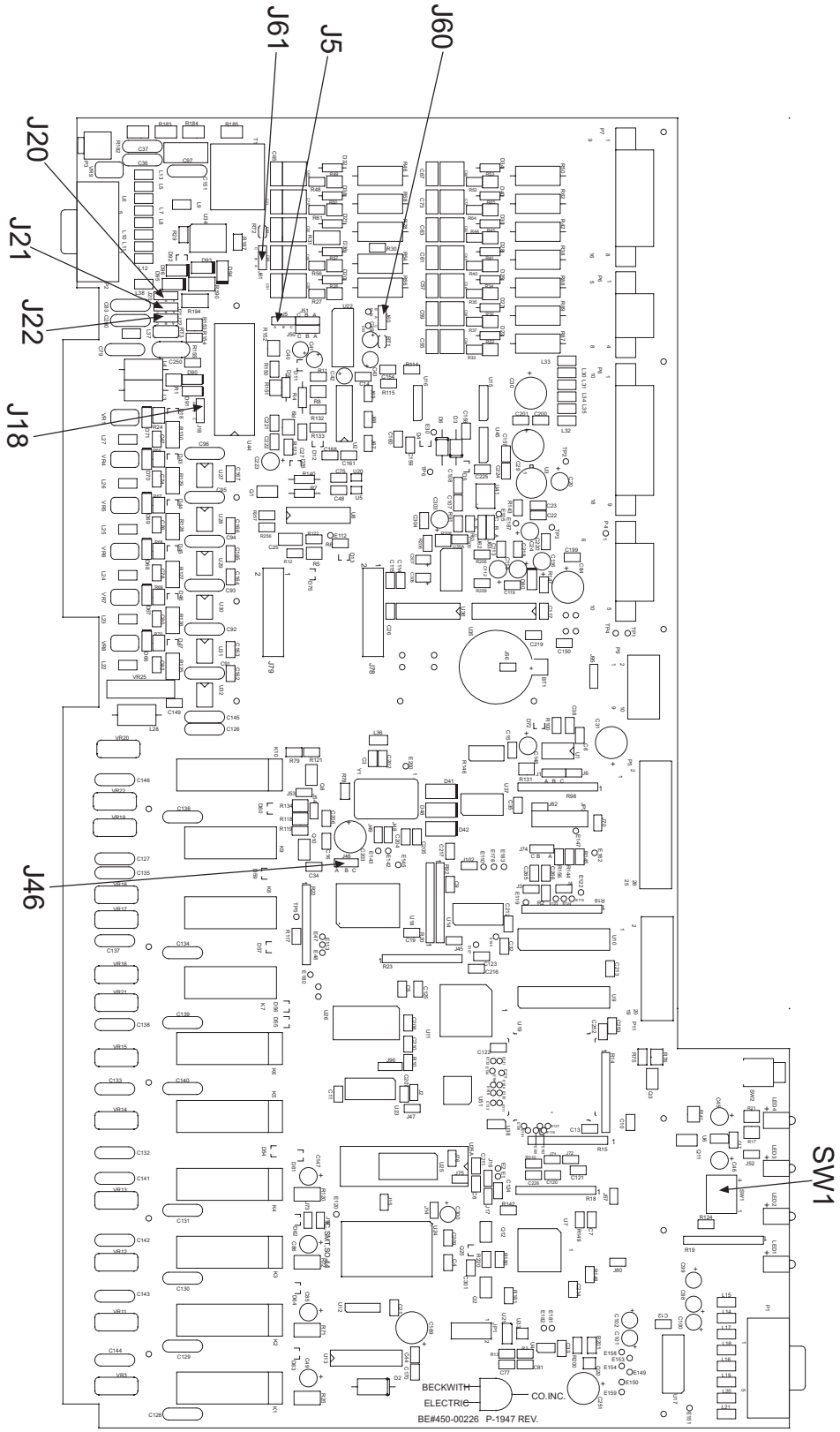


Figure 5-12 M-4272 Bottom Circuit Board (B-0970)

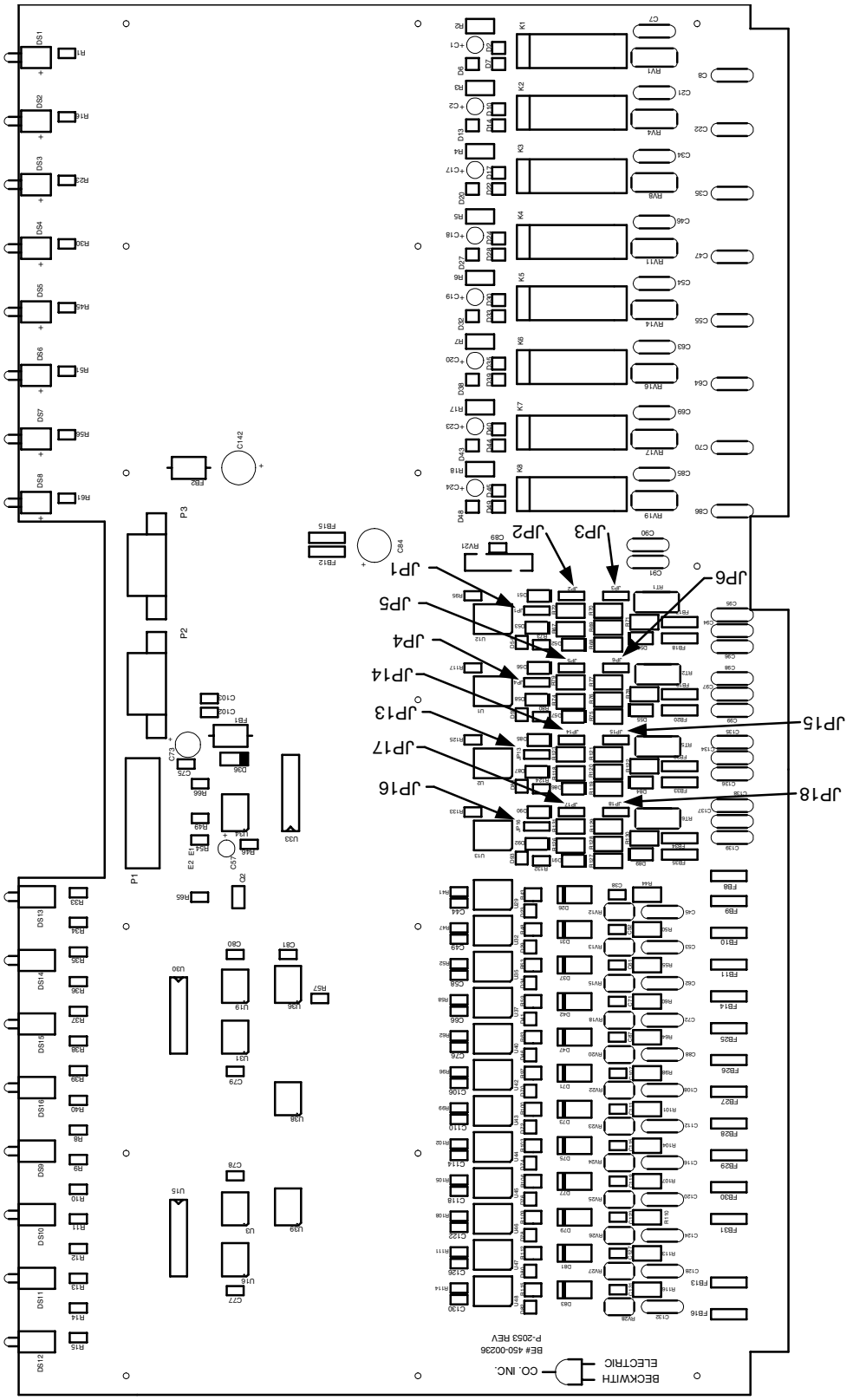


Figure 5-13 M-4272 B-0957 Top Circuit Board

5.5 ISScom® Communications and Analysis Software Installation

ISScom Installation and Setup

ISScom runs with the Microsoft Windows® 98 operating system or later. ISScom only supports communication using the MODBUS protocol.

ISScom is available on CD-ROM, or may be downloaded from our website at www.beckwithelectric.com

The M-3872 ISScom Communications and Analysis Software is not copy-protected. For more information on your specific rights and responsibilities, see the licensing agreement enclosed with your software or contact Beckwith Electric.

Hardware Requirements

ISScom will run on any IBM PC-compatible computer that provides at least the following:

- 8 MB of RAM
- Microsoft Windows 98 or later
- CD-ROM drive
- one serial (RS-232) communication port
- pointing device (mouse)

Installing ISScom

1. Insert software CD-ROM into your drive.

   An Auto-Install program will establish a program folder (Becoware) and subdirectory (ISScom). After installation, the ISScom program item icon (see Figure 5-14) is located in Becoware. The default location for the application files is on drive C:, in the new subdirectory "ISScom" (C:\Becoware\ISScom).

Figure 5-14 ISScom Program Icon

2. If the Auto-Install program does not launch when the CD-ROM is inserted into the drive then proceed as follows:

   a. Select Run from the Start Menu.

   b. In the Run dialog screen, locate the installation file (sfi_m3872Acom_V__.exe) contained on the ISScom installation disk.

   c. Select Run to start the installation process.

5.6 Activating Initial Local Communications

The MBTS and ISScom Communications and Analysis Software are shipped from the factory with the same default communication parameters. Therefore, it may not be necessary to set up communication parameters.

In order for ISScom to communicate with the MBTS using direct serial connection, a serial "null modem" cable is required, with a 9-pin connector (DB9P) for the MBTS, and an applicable connector for the computer (usually DB9S or DB25S). Pin-outs for a null modem adapter are provided in Appendix B, **Communications**.

Activating initial communications using default communication parameters is accomplished as follows:

1. Verify that a direct serial connection between the PC hosting ISScom and the target MBTS COM1 (front) is in place.
2. Select the ISScom icon (Figure 5-14) from the Becoware folder or Desktop. The ISScom **Main Screen** (Figure 3-5) is displayed.
3. Select the **COMM** menu item. ISScom will display the **Communication Dialog Screen** (Figure 3-7).
4. If the computer is connected through either an RS-232 port or RS-485 port perform the following:
   a. Select **Serial COM Port** from the Comm Device selection.
   b. Select the **PC Comm Port** that is connected to the MBTS.
   c. Select **Open Com**. This action attempts to establish communication.
5. If ISScom returns a "COM Opened and Level #(1, 2 or 3) access granted" then communications have been established. Enter any valid ISScom command(s) as desired. To close the communication channel when connected locally, select the **Close COM** button.

6. If ISScom® returns an error message, then determine the MBTS COM1 communication parameters as follows:

   a. From the MBTS Front Panel HMI press **ENTER**. The MBTS will display:

   ```
   INIT TRANSFER
   INIT rmte_lcal  →
   ```

   b. Press the right arrow pushbutton until the MBTS displays:

   ```
   COMMUNICATION
   ←  stat COMM setup  →
   ```

   c. Press **ENTER**. The MBTS will display:

   ```
   COM1 SETUP
   COM1  com2  com3 com_adr →
   ```

   d. Press **ENTER**. The MBTS will display:

   ```
   COM1 BAUD RATE
   ←  baud_4800  baud_9600
   ```

   Record the Baud Rate that is displayed in all Caps: _____

   e. Press **ENTER**. The MBTS will display:

   ```
   COM1 DEAD SYNC TIME
         XX  ms
   ```

   Record the Dead Sync Time that is displayed: _____

   f. Press **ENTER**. The MBTS will display:

   ```
   COM1 PARITY
   none  odd  even
   ```

   Record the Parity that is displayed in all Caps: _____

   g. Press **ENTER**. The MBTS will display:

   ```
   COM1 STOP BITS
         X
   ```

   Record the Stop Bits value that is displayed: _____

   h. Pres **EXIT** as necessary to exit the HMI.

   i. Select the **COMM** menu item. ISScom will display the **Communication Dialog Screen** (Figure 3-7).

   j. Verify the ISScom communication parameters are the same as the MBTS COM1 parameters.

   k. Verify that the **PC Comm Port** that is connected to the MBTS is selected.

   l. Select **Open Com**. This action will attempt to establish communication.

   m. If ISScom returns a "COM Opened and Level #(1, 2 or 3) access granted" then communications have been established. Enter any valid ISScom command(s) as desired.

To close the communication channel when connected locally, select the **Close COM** button.

5.7 Pre-Commissioning Checkout

During field commissioning, check the following parameters to ensure that the CT and VT connections are correct for the application as follows.

1. Determine if ISScom® Communication and Analysis Software is available to communicate with the MBTS and proceed as follows:
2. If ISScom is available, then go to Step 4.
3. If ISScom is not available then:
   a. From the MBTS Front Panel HMI press **ENTER**. The MBTS will display:

   ```
   INIT TRANSFER
   INIT   rmte_lcal  →
   ```

   b. Press the right arrow pushbutton until the MBTS displays:

   ```
   STATUS
   ←  STAT  comm  setup  →
   ```

   c. Press **ENTER**. The MBTS will display:

   ```
   VOLTAGE STATUS
   VOLT  curr  freq  phang  →
   ```

   From this menu the user can access status data that includes Voltage, Current, Frequency, Phase Angle, Inputs, Outputs, Alarm Counter, Time of Last Power Up and Error Codes.

   d. Go to Step 6.
4. Start the ISScom, then establish communication with the MBTS.
5. From the ISScom menu select **System/ Setup/Setup System** to open the Setup System dialog screen.
6. Verify that the S1/S2 VT Configuration and the Bus VT Configuration are configured for the MBTS application.
7. Select **System/Monitor/Secondary Metering and Status** to open the Secondary Metering and Status screen. The Voltage, Positive Sequence and Status information is also available from the MBTS Front Panel HMI.
8. The unit should display either S1 V_A, S1 V_B, S1 V_C and S1 V_{PS} (three phase line-to-ground connections) or S1 V_{AB}, S1 V_{BC}, S1 V_{CA} and S1 V_{PS} (three phase line-to-line connections). The same should be true for the S2 (Source 2) and the Bus.
9. Compare the voltages with actual measurements using a voltmeter. If there is a discrepancy, check for loose connections at the rear terminal block of the unit.
10. The positive sequence voltage should be S1 $V_{PS} \approx$ S1 $V_A \approx$ S1 $V_B \approx$ S1 V_C or S1 $V_{AB} \approx$ S1 $V_{BC} \approx$ S1 V_{CA}. The same should be the true for S2 and the bus
11. If the positive sequence voltage is close to zero, then the phase sequence is incorrect and the proper phases must be reversed to obtain correct phase sequence. If the phase sequence is incorrect, frequency related functions will not operate properly and the **Frequency Status** menu will display **DISABLED**.
12. Compare currents with the measured values using a meter. If there is a discrepancy, check the CT connections at the rear terminal block of the unit.
13. Compare the indicated frequency value to the actual frequency of the bus.
14. Verify Inputs and outputs agree with inputs and outputs.

■ **NOTE:** The CT and VT polarities can be easily verified by looking at the oscillographic waveforms, using M-3872 ISSplot™ Analysis Software.

5.8 Initial Setup Procedure

The M-4272 Motor Bus Transfer System (MTBS) is shipped from the factory with all functions disabled.

The Setup Procedure provided below is a suggested setup procedure for initially entering settings into the device.

Setup Procedure

■ **NOTE**: Setup Record forms are available in Appendix A, **Setup Record Forms**, to record settings for future reference.

1. Enter the Unit Setup data. This is general information required including altering access codes, setting date and time, defining user logos, and other adjustments. See Section 4.1, Unit Setup.
2. Configure the System Setup data. This is the general system and equipment information required for operation, including such items as CT and VT ratios, VT configuration, and Nominal values. See Section 4.2, System Setup.
3. Enter the System Setpoints data. This is the function specific settings for transfers and initiating functions. See Section 4.4, System Setpoints

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6 Testing

Testing Overview

For the purposes of site acceptance and verifying the MBTS hardware is operating properly and is connected correctly, Beckwith Electric recommends the following tests:

- Power on Self Tests
- Diagnostic Tests
- Metering Tests

Section 6.4, **MBTS Function Tests**, is provided for advanced users who wish to test each MTBS feature and function individualy.

6.1 Power On Self Test

Equipment Required

- If the MBTS permanent power supply source is not available, then a portable power supply (>50 W) matched to the installed MBTS power supply (indicated by check box on rear of unit Figure 6-1) will be required.
- Digital Multi Meter

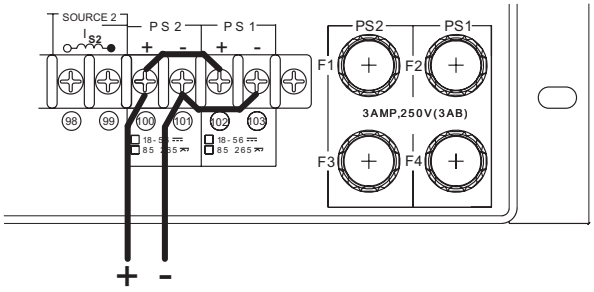

Figure 6-1 Power Supply Connection

To perform the Power On Self Test proceed as follows:

1. Verify the power supply contact is in the normal state. (Closed)
2. Determine if the permanent power supply source is connected and available.

WARNING: Applying power to the MBTS may cause equipment connected to the MBTS to operate.

3. If the permanent power supply source is connected and available, then energize the power supply (The Power On Self Test will automatically begin) and go to Step 5.
4. If the permanent power supply source is not connected or is unavailable, then proceed as follows:
   a. Ensure that the permanent power supply source breaker is open and applicable safety tagging is complete.
   b. Disconnect and tag/identify the permanent power supply source connections (Figure 6-1) from the MBTS (100/102 HOT and 101/103 NEUTRAL).
   c. Connect the portable power supply to terminals (100/102 HOT and 101/103 NEUTRAL).

WARNING: Applying power to the MBTS may cause equipment connected to the MBTS to operate.

   d. Energize the portable power supply. The Power On Self Test will automatically begin.

NOTE: A Power On Self Test failure is indicated by no display or SYSTEM HALT ERROR CODE XX. If a failure occurs, then stop any further testing and contact the factory.

5. The following sequence of actions will take place:
   a. Power supply, **PS1** and **PS2**, LED(s) will illuminate.
   b. The power supply contact will energize (open) (Terminals 52 and 53)
   c. The internal hardware test excecutes.
   d. All LEDs will illuminate for approximately 1 second.
   e. As each Power On Self Test routine is completed satisfactorly the HMI will display an “X”.
6. Upon successful completion of all Power On Self Tests:
   a. The **PS1** and **PS2** LEDs will remain illuminated.
   b. All other LEDs will extinguish.
   c. The diagnostic contact will energize.
   d. The **SYS OK** LED will flash (or remain illuminated as programed in the diagnostic menu).
   e. The unit will display the Model Number, Firmware Version, Current CT Rating, Nominal Frequency Rating and the Serial Number.

f. The **BREAKER CLOSED** and **BREAKER OPEN** LEDs will be illuminated for Source 1 based on the position of the breaker position contacts (52a and/or 52b) connected to the Status Inputs 1, 2, 4 and 5.

6. Verify the power supply contact is energized (open).

7. Restore any connections that may have been disconnected in Step 4.

Torque Requirements

- **Terminals 1–74**: 7.5 in-lbs, minimum, and 8.0 in-lbs, maximum
- **Terminals 75–103**: 8.5 in-lbs, minimum, and 9.0 in-lbs, maximum

6.2 Diagnostic Test Procedures

Overview

The diagnostic test procedures perform basic functional MBTS tests to verify the operation of the front-panel controls, inputs, outputs, and communication ports.

The diagnostic menu includes the following tests:

- OUTPUT (Output Test Relay)
- INPUT (Input Test Status)
- LED (Status LED Test)
- TARGET (Target LED Test)
- BUTTON (Button Test)
- DISP (Display Test)
- COM1 (COM1 Loopback Test)
- COM2 (COM2 Loopback Test)
- COM3 (COM3 Echo Test 2-Wire)

Each test is described individually in this section.

The diagnostic menu also provides access to the following MBTS feature settings:

- CLOCK (Clock On/Off)
- LED (MBTS OK LED Flash/Solid)
- CAL (Auto Calibration)
- FACTORY (Factory Use Only)

Auto Calibration is described in detail in Section 6.5, **Auto Calibration**.

Equipment Required

- If the MBTS permanent power supply source is not available, then a portable power supply (>50 W) matched to the installed MBTS power supply (indicated by check box on rear of unit Figure 6-1) will be required to power the unit.
- 24 to 250 V dc variable supply for Trip Coil and Close Coil Monitor input testing.
- Digital Multi Meter (DMM)

Entering MBTS Diagnostic Mode

WARNING: Entering DIAGNOSTIC MODE disables all transfer, protection and control functionality and, during the output test, any connected equipment will operate

1. Press **ENTER** to access the main menu.
2. Press the right arrow pushbutton until the following is displayed:

```
SETUP UNIT
← SETUP exit
```

3. Press **ENTER,** the following will be displayed:

```
SOFTWARE VERSION
VERS sn access number  →
```

4. Press the right arrow pushbutton until the following is displayed:

```
DIAGNOSTIC MODE
←  time error eth DIAG
```

5. Press **ENTER**, the following warning will be displayed:

```
PROCESSOR WILL RESET!
ENTER KEY TO CONTINUE
```

● **WARNING: Do not enter DIAGNOSTIC MODE when protected equipment is in service. Entering DIAGNOSTIC MODE when protected equipment is in service disables all Transfer, protective, and control functions of the relay.**

6. Press **ENTER**, the MBTS will reset and **DIAGNOSTIC MODE** will be temporarily displayed followed by:

```
OUTPUT TEST (RELAY)
OUTPUT input led module →
← button disp →
← com1 com2 com3 clock →
← led cal factory
```

This marks the beginning of the diagnostic menu. The left arrow and right arrow pushbuttons are used to navigate within the diagnostic menu. Exiting the diagnostic menu is accomplished by pressing **EXIT**, **PRESS EXIT TO EXIT DIAGNOSTIC MODE** is displayed, then pressing **EXIT** a second time.

Output Relay Test (Output Relays 1–16 and 17)

■ **NOTE:** This test does not include testing of Power Supply Relay.

● **WARNING: Performing this test will cause output contacts to change state. Proper steps should be taken to avoid unintended operation of connected equipment.**

1. Ensure the affected equipment is in a configuration/state that can support MBTS output testing.
2. Confirm the positions of the outputs in the normal or **OFF** position. This can be accomplished by connecting the Digital Multimeter (DMM) in continuity test mode across the appropriate contacts and confirming open or closed. The de-energized or **OFF** position for outputs 1 through 17 are listed in Table 6-1.
3. If the MBTS is already in the Diagnostic Mode, then go to Step 4.

   If the MBTS is NOT in the Diagnostic Mode, then enter the MBTS diagnostic mode by performing the steps described in the Entering MBTS Diagnostic Mode section of this chapter, then go to Step 4.
4. Ensure that the Diagnostic Menu is selected to OUTPUT (Upper Case).

```
OUTPUT TEST (RELAY)
OUTPUT input led module →
← button disp →
← com1 com2 com3 clock →
← led cal factory
```

   If OUTPUT is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select OUTPUT.
5. Press **ENTER**, the MBTS will display the following:

```
RELAY NUMBER
      1
```

6. Select the Output Relay (from Table 6-1) to be tested, utilizing the Up/Down arrow pushbuttons.

RELAY OUTPUT NUMBER	NORMALLY OPEN CONTACT	NORMALLY CLOSED CONTACT*
1	73-74	--
2	71-72	--
3	69-70	--
4	67-68	--
5	65-66	--
6	63-64	--
7	60-61	61-62
8	57-58	58-59
9	39-40	--
10	37-38	--
11	35-36	--
12	33-34	--
13	31-32	--
14	29-30	--
15	27-28	--
16	25-26	--
Self-Test (17)	54-55	55-56

* "Normal" position of the contact corresopnds to the OFF (de-engergized) state of the relay.

Table 6-1 Output Contacts

7. Press **ENTER**. The following will be displayed for the selected relay:

```
RELAY NUMBER 1
OFF on
```

8. Select **ON** (Upper Case) utilizing the Right arrow pushbutton, then press **ENTER**. The MBTS will respond as follows:
   - Output relay energizes (On position)
   - Appropriate RED **OUTPUT** LED illuminates.

If testing all output relays, then press **EXIT** to return to the output relay selection menu, then repeat Steps 6, 7 and 8 for each output relay.

9. The DMM can now be used to verify that the output relay contact is in the operated or **ON** position. The readings should be the opposite of the initial reading determined in Step 2.
10. When output relay testing is complete, then restore all output relays to their de-energized or **OFF** positions listed in Table 6-1 and press **EXIT** to return to the Diagnostic Menu.
11. If all Diagnostic Testing is complete, then exit the diagnostic menu by pressing **EXIT**, **PRESS EXIT TO EXIT DIAGNOSTIC MODE** is displayed, then press **EXIT** a second time.

Input Test (Control/Status) Inputs 1–18

The **INPUT TEST** menu enables the user to determine the status of the individual control/status inputs . Individual inputs can be selected by number using the up and down arrow pushbuttons. The status of the input will then be displayed.

1. Ensure the protected equipment is in a configuration/state that can support MBTS input testing.
2. If the MBTS is already in the Diagnostic Mode, then go to Step 3.

   If the MBTS is NOT in the Diagnostic Mode, then enter the MBTS diagnostic mode by performing the steps described in the Entering MBTS Diagnostic Mode section of this chapter, then go to Step 3.
3. Ensure that the Diagnostic Menu is selected to **INPUT** (Upper Case).

```
INPUT TEST (RELAY)
output INPUT led module →
← button disp →
← com1 com2 com3 clock →
← led cal factory
```

   If INPUT is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select INPUT.
4. Press **ENTER**. The following is displayed:

```
INPUT NUMBER
      1
```

5. Select the MBTS Input (from Table 6-2) to be tested utilizing the Up/Down arrow pushbuttons.
6. Press **ENTER**. The following is displayed for the selected input:

```
INPUT NUMBER 1
CIRCUIT OPEN
```

7. If no external control/status inputs are connected to the MBTS, then place a jumper between the **IN RTN** terminal (Terminal #51 for Inputs 1–6, and either Terminal #1, 2, 3 or 4 for Inputs 7–18). See Table 6-2 for terminals for inputs.

   Alternatively, if this specific input is being used in this application and the external wiring is complete, the actual external control/status input contact can be manually closed. This will test the input contact operation *and* the external wiring to the input contacts.

   The corresponding Input LED will illuminate and the following wiil be immediately displayed:

```
INPUT NUMBER 1
CIRCUIT CLOSED
```

8. Remove the jumper between the **IN RTN** terminal (Terminal #51 for Inputs 1–6, and either Terminal #1, 2, 3 or 4 for Inputs 7–18).

   The input LED will extinguish and the following will be immediately displayed:

```
INPUT NUMBER 1
CIRCUIT OPEN
```

9. If testing all inputs, press **EXIT** to return to the input selection menu, then repeat Steps 5, 6, 7 and 8 for each input except inputs 19–22.

INPUT NUMBER	COMMON TERMINAL	TERMINAL
1 (52a/S1)	51	50
2 (52b/S1)	51	49
3 (52sp/S1)	51	48
4 (52a/S2)	51	47
5 (52b/S2)	51	46
6 (52sp/S2)	51	45
7	1,2,3,4	16
8	1,2,3,4	15
9	1,2,3,4	14
10	1,2,3,4	13
11	1,2,3,4	12
12	1,2,3,4	11
13	1,2,3,4	10
14	1,2,3,4	9
15	1,2,3,4	8
16	1,2,3,4	7
17	1,2,3,4	6
18	1,2,3,4	5

Table 6-2 Input Contacts

Input Test (Trip Coil, Close Coil) Inputs 19–22

The **INPUT TEST** menu enables the user to determine the status of the individual Trip and/or Close Coil inputs. Individual inputs can be selected by number using the up and down arrow pushbuttons. The status of the input will then be displayed.

1. Ensure any equipment connected to the MBTS is in a configuration/state that can support Trip Coil and/or Close Coil input testing.
2. If there are no connections made to the terminals listed in Table 6-3, then go to Step 4.

TRIP/CLOSE COIL INPUTS		
INPUT NUMBER	COMMON TERMINAL	TERMINAL
19 (TCM #1)	23	24
20 (CCM #1)	22	21
21 (TCM #2)	20	19
22 (CCM #2)	18	17

Table 6-3 Trip Coil and Close Coil Input Contacts

3. If the permanent Trip Coil and/or Close Coil voltage inputs are connected to the MBTS, then proceed as follows:
   a. Ensure that the permanent Trip Coil and/or Close Coil voltage input supply breaker is open and applicable safety tagging is complete.
   b. Disconnect and tag/identify the permanent Trip Coil and/or Close Coil voltage input connections (Figure 6-2).
4. Determine the Trip Coil/Close Coil Monitor Input voltage as identified on the rear of the unit (Figure 6-2).

   See Section 5.4, **Circuit Board Switches and Jumpers**, (Table 5-3 for TCM#1, Table 5-5 for TCM#2, Table 5-4 for CCM #1 and Table 5-6 for CCM#2) for the available trip/close circuit input voltage selections and jumper configurations if the input voltage rating is unknown or has changed.

5. Connect the portable power supply to the Trip Coil and/or Close Coil voltage input terminals to be tested (Figure 6-2).

6. If the MBTS is already in the Diagnostic Mode, then go to Step 7.

   If the MBTS is NOT in the Diagnostic Mode, then enter the MBTS diagnostic mode by performing the steps described in the Entering MBTS Diagnostic Mode section of this chapter, then go to Step 7.

7. Select the MBTS Trip Coil or Close Coil Input (from Table 6-3) to be tested utilizing the Up/Down arrow pushbuttons.

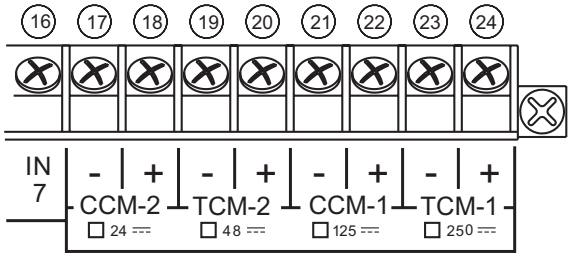

Figure 6-2 MBTS Trip Coil—Close Coil Input Voltage Rating

8. Apply the rated Trip Coil and/or Close Coil voltage (as determined in Step 4) to the terminals indicated in Table 6-3.

9. Press **ENTER**. The TCM/CCM status LED will be extinguished and the following will be displayed for the selected input:

```
INPUT NUMBER 19 TCM #1
CIRCUIT CLOSED
```

10. Remove the voltage source from the Trip Coil/Close Coil input terminals. The TCM/CCM status LED will be illuminated and the following will be displayed for the selected input:

```
INPUT NUMBER 19 TCM #1
CIRCUIT OPEN
```

11. If testing all TCM/CCM inputs, then press **EXIT** to return to the input selection menu, then repeat Steps 8, 9 and 10 for each of the remaining TCM/CCM inputs.

12. When TCM/CCM input testing is complete then insure all voltage sources have been disconected from the MBTS and press **EXIT** to return to the Diagnostic Menu.

11. If all Diagnostic Testing is complete, then exit the diagnostic menu by pressing **EXIT**, **PRESS EXIT TO EXIT DIAGNOSTIC MODE** is displayed, then press **EXIT** a second time.

12. Restore any connections that may have been disconnected in Step 3.

Torque Requirements

- **Terminals 1–74**: 7.5 in-lbs, minimum, and 8.0 in-lbs, maximum
- **Terminals 75–103**: 8.5 in-lbs, minimum, and 9.0 in-lbs, maximum

Front Panel Status LED Test

The **Front Panel STATUS LED TEST** menu enables the user to check the front-panel Status LED individually.

1. If the MBTS is already in the Diagnostic Mode, then go to Step 2.

   If the MBTS is NOT in the Diagnostic Mode, then enter the MBTS diagnostic mode by performing the steps described in the Entering MBTS Diagnostic Mode section of this chapter, then go to Step 2.

2. Ensure that the Diagnostic Menu is selected to LED (Upper Case).

```
STATUS LED TEST
output input LED module →
← button disp →
← com1 com2 com3 clock →
← led cal factory
```

   If LED is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select LED.

3. Press **ENTER**. LED #1 (**RELAY OK**) illuminates and the following is displayed:

```
STATUS LED TEST
LED NUMBER 1 = ON
```

4. If testing all Status LEDs, press the right arrow pushbutton to toggle through the remaining LEDs illustrated in Figure 6-3. The **PS1** and **PS2** LEDs are tested in the System Power On Tests.

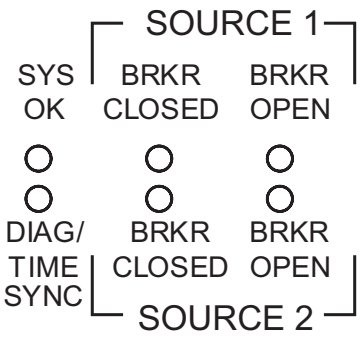

Figure 6-3 Status LED Panel

5. When Status LED testing is complete press **EXIT** to return to the Diagnostic Menu.
6. If all Diagnostic Testing is complete, then exit the diagnostic menu by pressing **EXIT**, **PRESS EXIT TO EXIT DIAGNOSTIC MODE** is displayed, then press **EXIT** a second time.

Module LED Test

The **MODULE LED TEST** menu allows the user to check each M-3972 Module LED individually.

1. If the MBTS is already in the Diagnostic Mode, then go to Step 2.

   If the relay is NOT in the Diagnostic Mode, then enter the MBTS diagnostic mode by performing the steps described in the Entering MBTS Diagnostic Mode section of this chapter, then go to Step 2.
2. Ensure that the Diagnostic Menu is selected to **MODULE** (Upper Case).

```
MODULE LED TEST
output input led MODULE →
← button disp →
← com1 com2 com3 clock →
← led cal factory
```

   If **MODULE** is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select MODULE.
3. Press **ENTER**. MODULE LED #1 lights and the following is displayed:

```
MODULE LED TEST
LED NUMBER 1 = ON
```

4. If testing all MODULE LEDs, press the right arrow pushbutton to toggle through the remaining MODULE LEDs illustrated in Figure 6-4.
5. When Module LED testing is complete press **EXIT** to return to the Diagnostic Menu.
6. If all Diagnostic Testing is complete, then exit the diagnostic menu by pressing **EXIT**, **PRESS EXIT TO EXIT DIAGNOSTIC MODE** is displayed, then press **EXIT** a second time.

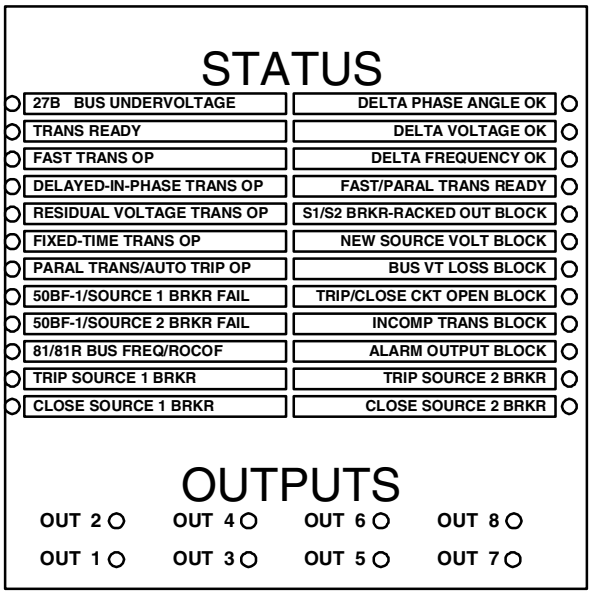

Figure 6-4 Status Module

Button Test

The **BUTTON TEST** menu selection allows the user to check the M-3931 HMI Module buttons and the STATUS RESET pushbutton on the front panel. As each pushbutton is pressed, its name is displayed.

1. If the relay is already in the Diagnostic Mode, then go to Step 2.

   If the relay is NOT in the Diagnostic Mode, then enter the relay diagnostic mode by performing the steps described in the Entering Relay Diagnostic Mode section of this chapter, then go to Step 2.

2. Ensure that the Diagnostic Menu is selected to BUTTON (Upper Case).

```
BUTTON TEST
output input led module →
← BUTTON disp →
← com1 com2 com3 clock →
← led cal factory
```

If BUTTON is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select BUTTON.

3. Press **ENTER**. The following is displayed:

```
BUTTON TEST
      0
```

■ **NOTE:** Pressing the **EXIT** pushbutton will exit from this test, and therefore should be the last pushbutton tested. If it is pushed before this test sequence is completed, the test may be restarted by pressing **ENTER**. Notice that the word **EXIT** is displayed temporarily before the test sequence is exited.

4. Press each pushbutton for test (Figure 6-5). As each pushbutton is pressed, the display will briefly show the name for each key (“RIGHT ARROW”, “UP ARROW”, etc).

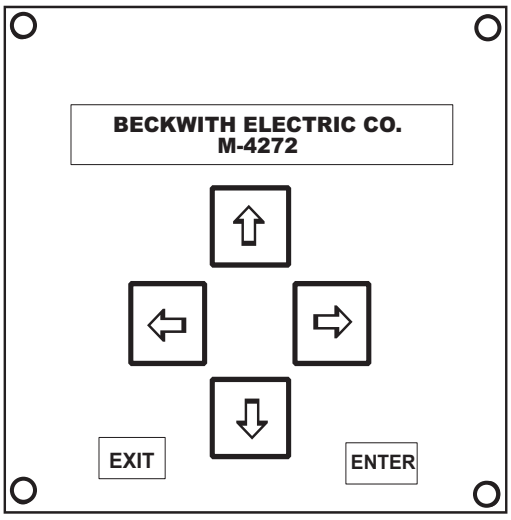

Figure 6-5 M-3931 Human-Machine Interface Module

5. When pushbutton testing is complete press **EXIT** to return to the Diagnostic Menu.

6. If all Diagnostic Testing is complete, then exit the diagnostic menu by pressing **EXIT**, **PRESS EXIT TO EXIT DIAGNOSTIC MODE** is displayed, then press **EXIT** a second time.

Display Test

The **DISPLAY TEST** menu selection enables the user to check the display. This test cycles through varying test patterns until **EXIT** is pressed.

1. If the MBTS is already in the Diagnostic Mode, then go to Step 2.

   If the MBTS is NOT in the Diagnostic Mode, then enter the MBTS diagnostic mode by performing the steps described in the Entering MBTS Diagnostic Mode section of this chapter, then go to Step 2.

2. Ensure that the Diagnostic Menu is selected to DISPLAY TEST (Upper Case).

```
DISPLAY TEST
output input led module →
← button DISP →
← com1 com2 com3 clock →
← led cal factory
```

If DISP is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select DISP.

3. Press **ENTER**, the unit will display a sequence of test characters until **EXIT** is pushed.

4. After the test has cycled through completely, press **EXIT** to return to the Diagnostic Menu.

5. If all Diagnostic Testing is complete, then exit the diagnostic menu by pressing **EXIT**, **PRESS EXIT TO EXIT DIAGNOSTIC MODE** is displayed, then press **EXIT** a second time.

COM1/COM2 Loopback Test

The **COM1 LOOPBACK TEST** menu allows the user to test the front-panel RS-232 port. **COM2 LOOPBACK TEST** menu tests the rear panel RS-232 port.

A loopback plug is required for this test. The required loopback plug consists of a DB9P connector (male) with pin 2 (RX) connected to pin 3 (TX) and pin 7 (RTS) connected to pin 8 (CTS). No other connections are necessary.

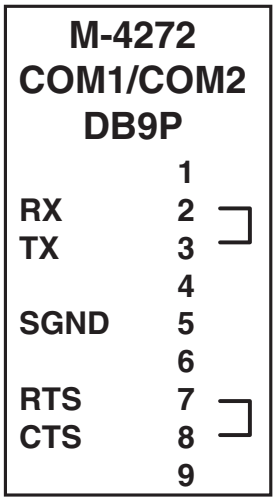

Figure 6-6 COM1/COM2 Loopback Plug

1. If the MBTS is already in the Diagnostic Mode, then go to Step 2.

   If the MBTS is NOT in the Diagnostic Mode, then enter the MBTS diagnostic mode by performing the steps described in the Entering MBTS Diagnostic Mode section of this chapter, then go to Step 2.

2 Ensure that the Diagnostic Menu is selected to COM1 LOOPBACK TEST (Upper Case).

```
COM1 LOOPBACK TEST
output input led module →
← button disp →
← COM1 com2 com3 clock →
← led cal factory
```

   If COM1 is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select COM1.

3. Press **ENTER**. The following is displayed:

```
COM1 LOOPBACK TEST
CONNECT LOOPBACK PLUG
```

4. Connect the loop-back plug to **COM1**, the front-panel RS-232 connector.

5. Press **ENTER**, the relay will initiate the loopback test.

   If the COM Port passes the loopback test the following will be displayed:

```
COM1 LOOPBACK TEST
-DONE-
```

   If the COM Port fails the loopback test the following will be displayed:

```
COM1 LOOPBACK TEST
RX—TX FAIL
```

6. Press **EXIT** to return to the DIAGNOSTIC Menu.

7. If all Diagnostic Testing is complete, then exit the diagnostic menu by pressing **EXIT**, **PRESS EXIT TO EXIT DIAGNOSTIC MODE** is displayed, then press **EXIT** a second time.

8. Ensure that the Diagnostic Menu is selected to COM2 LOOPBACK TEST (Upper Case).

```
COM2 LOOPBACK TEST
output input led module →
← button disp →
← com1 COM2 com3 clock →
← led cal factory
```

   If COM2 is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select COM2.

8. Press **ENTER**, then repeat Steps 3 through 6 for **COM2**.

COM3 Test (2-Wire)

The COM3 Echo Test 2-Wire allows the user to test the RS-485 rear terminal connections for proper operation.

■ **NOTE**: This test requires a PC with an RS-485 converter and terminal emulator software installed.

1. If the MBTS is already in the Diagnostic Mode, then go to Step 2.

   If the MBTS is NOT in the Diagnostic Mode, then enter the MBTS diagnostic mode by performing the steps described in the Entering MBTS Diagnostic Mode section of this chapter, then go to Step 2.

2. Ensure that the Diagnostic Menu is selected to COM3 ECHO TEST 2 WIRE (Upper Case).

```
COM3 ECHO TEST 2 WIRE
output input led module →
←  button disp →
←  com1 com2 COM3 clock →
←  led cal factory
```

   If COM3 is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select COM3.

3. Press **ENTER**. The following is displayed:

```
COM3 ECHO TEST 2WIRE
IDLING...9600, N, 8, 1
```

4. From the rear of the unit, connect a PC to the MBTS at terminals 43(-) and 44(+) using an RS-485 converter set for 2-wire operation. See Figure 6-7 for diagram.

5. Set the following PC communications parameters:

Baud Rate	9600
Parity	None
Data Bits	8
Stop Bits	1
Duplex	Half

6. Open the terminal emulator program on the PC, then open the COM port for the RS-485 converter.

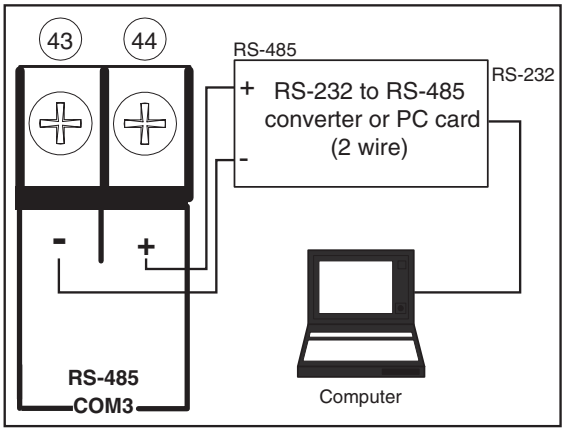

Figure 6-7 RS-485 2-Wire Testing

7. Press a key on the PC keyboard, then verify the following:
   a. The character pressed is displayed temporarily on the relay display.
   b. The character pressed is displayed on the PC monitor.
8. When communication has been verified, press **EXIT**, the following is displayed:

```
COM3 ECHO TEST 2WIRE
-DONE-
```

9. Press **EXIT** to return to the DIAGNOSTIC Menu.
10. Close the COM port on the PC, and exit the terminal program.
11. If all Diagnostic Testing is complete, then exit the diagnostic menu by pressing **EXIT**, **PRESS EXIT TO EXIT DIAGNOSTIC MODE** is displayed, then press **EXIT** a second time.

Clock ON/OFF

This feature provides the user with the ability to either start or stop the clock.

1. If the MBTS is already in the Diagnostic Mode, then go to Step 2.

   If the MBTS is NOT in the Diagnostic Mode, then enter the MBTS diagnostic mode by performing the steps described in the Entering MBTS Diagnostic Mode section of this chapter, then go to Step 2.

2. Ensure that the Diagnostic Menu is selected to CLOCK TEST (Upper Case).

```
CLOCK TEST
output input led module →
←  button disp →
←  com1 com2 com3 CLOCK →
←  led cal factory
```

   If CLOCK is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select CLOCK.

■ **NOTE**: '80' will be displayed in the seconds place when the clock is stopped.

3. Press **ENTER**, the following is displayed:

   a. If the clock is already running the following will be displayed and will continue to update.

```
CLOCK TEST
01-Jan-2003 01:01:01
```

   b. If the clock was NOT running the following will be displayed:

```
CLOCK TEST
01-Jan-2003 01:01:80
```

4. To start or stop the clock press **ENTER**, the following is displayed:

   a. If the clock is already running the following will be displayed:

```
CLOCK TEST
CLOCK STOP
```

```
CLOCK TEST
01-Jan-2003 01:01:80
```

   b. If the clock was NOT running the following will be displayed:

```
CLOCK TEST
CLOCK START
```

```
CLOCK TEST
01-Jan-2003 01:01:01
```

■ **NOTE**: To preserve battery life the clock should be OFF if the unit is to be left de-energized for a long period of time.

5. The clock can be toggled ON or OFF by pressing any arrow pushbutton or **ENTER**.

   To exit the Clock ON/OFF mode press **EXIT**, the following will be displayed:

```
CLOCK TEST
-DONE-
```

6. To exit the CLOCK ON/OFF Diagnostic Menu press **EXIT**.

7. If all Diagnostic Testing is complete, then exit the diagnostic menu by pressing **EXIT**, **PRESS EXIT TO EXIT DIAGNOSTIC MODE** is displayed, then press **EXIT** a second time.

SYS OK LED Flash/Illuminated

This feature provides the user with the ability to set the SYS OK LED to either Flash or be Illuminated when the MBTS is working properly.

1. If the MBTS is already in the Diagnostic Mode, then go to Step 2.

   If the MBTS is NOT in the Diagnostic Mode, then enter the MBTS diagnostic mode by performing the steps described in the Entering MBTS Diagnostic Mode section of this chapter, then go to Step 2.

2. Ensure that the Diagnostic Menu is selected to FLASH SYS OK LED (Upper Case).

```
FLASH SYS OK LED
output input led module →
←  button disp →
←  com1 com2 com3 clock →
← LED cal factory
```

   If LED (to the left of cal) is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select LED.

3. Press **ENTER**, the following will be displayed:

```
FLASH SYS OK LED
OFF on
```

4. Select (upper case) either ON (to flash) or OFF (to Illuminate) by pressing the right/left arrow pushbutton once.
5. Press **ENTER**, the following will be displayed:

```
FLASH SYS OK LED
-DONE-
```

6. To exit the FLASH SYS OK LED Diagnostic Menu press **EXIT**.
7. If all Diagnostic Testing is complete, then exit the diagnostic menu by pressing **EXIT**, **PRESS EXIT TO EXIT DIAGNOSTIC MODE** is displayed, then press **EXIT** a second time.

6.3 Metering Tests

Equipment Required

- If the MBTS permanent power supply source is not available, then a portable power supply (>50 W) matched to the installed MBTS power supply (indicated by check box on rear of unit Figure 6-1) will be required.
- One synchronized voltage source with variable amplitude (0-120 % PT secondary voltage).
- If current inputs to the MBTS are to be used, two single-phase independent current sources (0 to 5 A) to simulate CT inputs are required.
- A PC with an RS-232 port, ISScom Software installed.
- A null modem cable.

Metering Test Setup

1. Connect a null modem cable between the PC RS-232 port and the MBTS COM1 port.
2. Connect the temporary voltage source as follows:
   a. If permanent voltage input connections are present, then disconnect and tag/identify the permanent voltage input connections (Figure 6-8).
   b. Connect the temporary voltage source to the Source 1, Source 2 and Bus voltage inputs in parallel as indicated in Figure 6-8.
3. Connect the temporary current source as follows:

WARNING: Do not remove current transformer loads without shorting the current inputs to the MBTS. Death or severe electrical shock can occur.

   a. If permanent current input connections are present, temporarily place a shorting device across each CT secondary, then disconnect and tag/identify the permanent current input connections (Figure 6-9).
   b. Connect the temporary curent source in series to Source 1 and Source 2 current inputs as indicated in Figure 6-9.
4. Determine if the permanent MBTS power supply source is connected and available.

WARNING: Applying power to the MBTS may cause equipment connected to the MBTS to operate.

5. If the permanent power supply source is connected and available, then energize the power supply (The Power On Self Test will automatically begin).
6. If the permanent power supply source is not connected or is unavailable, then proceed as follows:
   a. Ensure that the permanent power supply source breaker is open and applicable safety tagging is complete.
   b. Disconnect and tag/identify the permanent power supply source connections (Figure 6-1) from the MBTS (100/102 HOT and 101/103 NEUTRAL).
   c. Connect the portable power supply to terminals (100/102 HOT and 101/103 NEUTRAL).

WARNING: Applying power to the MBTS may cause equipment connected to the MBTS to operate.

d. Energize the portable power supply. The Power On Self Test will automatically begin.

Voltage/Current Verification

1. Apply nominal voltage and current
2. Using ISScom, open the monitoring screen and verify the following:
   - Verify that the displayed voltages are ± 0.5 V of the applied voltage
   - Verify that the displayed currents are ± 0.1 A of the applied current
3. Remove the applied voltage an currents.
4. Remove all test equipment from voltage and current inputs.
5. Reconnect the permanent voltage and current input wiring.

Torque Requirements

- **Terminals 1–74**: 7.5 in-lbs, minimum, and 8.0 in-lbs, maximum
- **Terminals 75–103**: 8.5 in-lbs, minimum, and 9.0 in-lbs, maximum

6.4 Auto Calibration

NOTE: The M-4272 Motor Bus Transfer System has been fully calibrated at the factory. There is no need to recalibrate the unit prior to initial installation.

1. If the MBTS is already in the Diagnostic Mode, then go to Step 2.

   If the relay is NOT in the Diagnostic Mode, then enter the MBTS diagnostic mode by performing the steps described in the Entering MBTS Diagnostic Mode section of this chapter, then go to Step 2.

2. Ensure that the Diagnostic Menu is selected to CAL (upper case).

```
AUTO CALIBRATION
output input led module →
←  button disp →
←  com1 com2 com3 clock →
← led CAL factory
```

   If CAL is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select CAL.

3. Press **ENTER**, the following will be displayed depending on the frequency rating of the unit:

```
60 HZ CALIBRATION
60_HZ
```

```
50 HZ CALIBRATION
50_HZ
```

4. Ensure that the 60 (50) HZ Calibration Menu is selected to 60_HZ, Upper Case (50_Hz).

   If 60_HZ (50_Hz) is not selected (Upper Case), then use the Right/Left arrow pushbuttons to select 60_HZ (50_Hz).

5. Press **ENTER**, the following will be displayed:

```
CONNECT REFERENCE INPUTS
PRESS ENTER TO CALIBRATE
```

6. Connect $V_A = V_B = V_C = 120.0$ (±0.01) V at 0° phase. (See Figure 6-8.)
7. Connect $I_{S1} = I_{S2} = 5.00$* Amps at 0° (see Figure 6-9).

   * *For a 1 A CT rating, use 1.00 A*

The calibration can be verified by exiting from the Diagnostic menu and reading status:

$V_A = V_B = V_C = 120$ V

$I_{S1} = I_{S2} = 5$ A*

* *For a 1 A CT rating, use 1.00 A*

NOTE: The phase angle difference between voltage and current input source should be 0°, ±0.05°, and an accurate low-distortion source should be used. (THD less than 1%).

8. Press **ENTER**, the following will be displayed while the relay is being calibrated:

```
CALIBRATING
WAIT
```

   When the calibration is complete, the following will be displayed:

```
CALIBRATING
DONE
```

9. Remove the calibration source inputs.

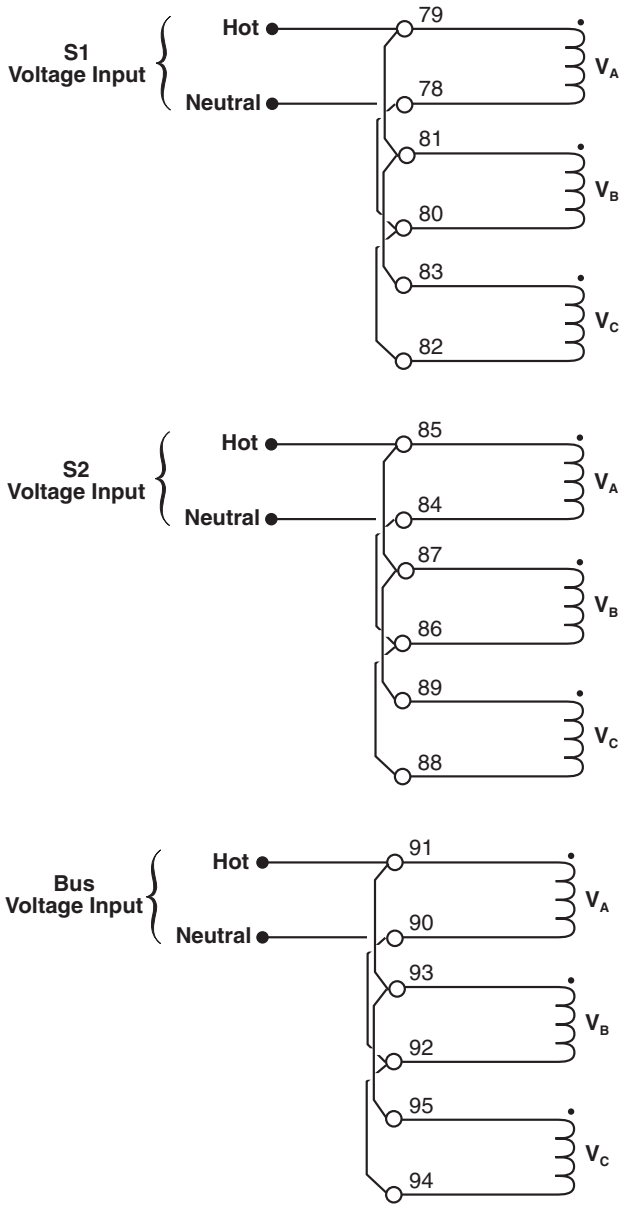

Figure 6-8 Metering Voltage Input Configuration

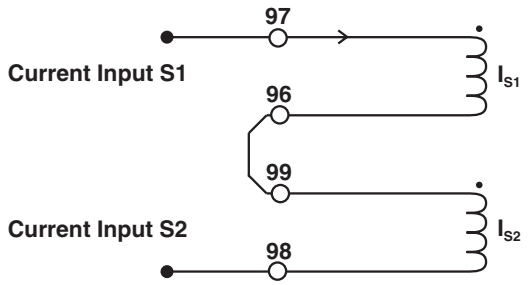

Figure 6-9 Metering Current Input Configuration

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A Configuration Record Forms

This Appendix contains photocopy–ready forms for recording the configuration and setting of the M-4272 Motor Bus Transfer System (MBTS). The forms can be supplied to field service personnel for configuring the MBTS, and kept on file for future reference.

A copy of the **MBTS Configuration Table** (Table A-1) is provided to define and record the blocking inputs and output configuration. For each function; check the **D** (disabled) column or check the output contacts *t*o be operated by the function, and check the inputs designated to block the function operation.

Figure A-1, System Communication Setup Record Form reproduces the System Communication Setup menus. This form records definition of the parameters necessary for communication with the MBTS.

Figure A-2, Setup System Record Form reproduces the Setup System menus. For each function or setpoint, refer to the configuration you have defined using the MBTS Configuration Table, and circle whether it should be enabled or disabled, the output contacts it will activate, and the inputs that will block its operation.

Figure A-3, System Setpoints Transfer Settings Record Form allows recording of the specific values entered for each transfer. The form follows the Transfer Settings section of the System Setpoints dialog screen.

Figure A-4, System Setpoints Function Settings Record Form allows recording of the specific values entered for each function. The form follows the Function Settings section of the System Setpoints dialog screen. If a function is DISABLED, the input/ output screens for that function will not be displayed.

System Communication Setup

Communication Setup

COM 1

Dead Sync Time _____ 2 msec – 3000 msecs

Baud Rate ❑ 1200 ❑ 2400 ❑ 4800 ❑ 9600

Parity ❑ None ❑ Odd ❑ Even

Stop Bits ❑ 1 ❑ 2

System's Communication Address _____

COM 2

Dead Sync Time _____ 2 msec – 3000 msecs

Baud Rate ❑ 1200 ❑ 2400 ❑ 4800 ❑ 9600

Parity ❑ None ❑ Odd ❑ Even

Stop Bits ❑ 1 ❑ 2

System's Communication Address _____

COM 3

Dead Sync Time _____ 2 msec – 3000 msecs

Parity ❑ None ❑ Odd ❑ Even

Stop Bits ❑ 1 ❑ 2

System's Communication Address _____

Figure A-1 System Communication Setup

Setup System 0

Nominal Voltage _____ 50V-140V

Nominal Current _____ 0.50A-6.00A

Phase Rotation

❑ABC ❑ACB

S1/S2 VT Configuration

❑ Phase to Ground (Three Phase)
- ❑ Phase to Ground (Single Phase A)
- ❑ Phase to Ground (Single Phase B)
- ❑ Phase to Ground (Single Phase C)

❑ Phase to Phase (Three Phase)
- ❑ Phase to Phase (Single Phase A)
- ❑ Phase to Phase (Single Phase B)
- ❑ Phase to Phase (Single Phase C)

Bus VT Configuration

❑ Phase to Ground (Three Phase)
- ❑ Phase to Ground (Single Phase A)
- ❑ Phase to Ground (Single Phase B)
- ❑ Phase to Ground (Single Phase C)

❑ Phase to Phase (Three Phase)
- ❑ Phase to Phase (Single Phase A)
- ❑ Phase to Phase (Single Phase B)
- ❑ Phase to Phase (Single Phase C)

S1/S2 CT Configuration

❑ Yes ❑ No S1 and S2 Connected to Rear Terminals

LATCHED OUTPUTS

❑ #5	❑ #6	❑ #7		❑ #9	❑ #10
❑ #11	❑ #12	❑ #13	❑ #14	❑ #15	❑ #16

PULSED OUTPUTS

❑ #5	❑ #6	❑ #7		❑ #9	❑ #10
❑ #11	❑ #12	❑ #13	❑ #14	❑ #15	❑ #16

INPUT ACTIVE STATE

3	❑ Open	❑ Close	6	❑ Open	❑ Close	7	❑ Open	❑ Close	8	❑ Open	❑ Close
9	❑ Open	❑ Close	10	❑ Open	❑ Close	11	❑ Open	❑ Close	12	❑ Open	❑ Close
13	❑ Open	❑ Close	14	❑ Open	❑ Close	15	❑ Open	❑ Close	16	❑ Open	❑ Close
17	❑ Open	❑ Close	18	❑ Open	❑ Close						

Duplicate Outputs Selection

❑ Output 9 Duplicates Output 1(Trip S1)
❑ Output 10 Duplicates Output 2(Close S1)
❑ Output 11 Duplicates Output 3(Trip S2)
❑ Output 12 Duplicates Output 4(Close S2)

Output Seal-in Time

2 – 8160 Cycles

OUT 5: _____ OUT 6: _____ OUT 7: _____ OUT 8: _____ OUT 9: _____ OUT 10: _____
OUT 11: _____ OUT 12: _____ OUT 13: _____ OUT 14: _____ OUT 15: _____ OUT 16: _____

Figure A-2 Setup System

System Setpoints Transfer Settings

Transfer Settings

CS – Common Settings

Common Function Settings

Transfer Mode

❑ Simultaneous ❑ Sequential

Upper Voltage Limit New Source: _____ 5V – 180V

Lower Voltage Limit New Source: _____ 5V – 180V

Breaker Closing Time

S1 Breaker Closing Time: _____ 0 Cycles – 12 Cycles

S1 Breaker Closing Time Deviation: _____ 0 Cycles – 6 Cycles

S2 Breaker Closing Time: _____ 0 Cycles – 12 Cycles

S2 Breaker Closing Time Deviation: _____ 0 Cycles – 6 Cycles

❑ Adaptation Disable ❑ Adaptation Enable

S1 Breaker 52a & 52b Position Disagreement

Pickup Delay: _____ 0 Cycles – 30 Cycles

Dropout Time Delay: _____ 0 Cycles – 30 Cycles

S2 Breaker 52a & 52b Position Disagreement

Pickup Delay: _____ 0 Cycles – 30 Cycles

Dropout Time Delay: _____ 0 Cycles – 30 Cycles

Incomplete Transfer Lockout Time: _____ 50 Cycles – 3000 Cycles

Local Manual Initiate Time Delay: _____ 0 Cycles – 8160 Cycles

Remote Manual Initiate Time Delay: _____ 0 Cycles – 8160 Cycles

Blocking After Transfer Time: _____ 0 Cycles – 8160 Cycles

Trip Command Pulse Length: _____ 15 Cycles – 30 Cycles

Close Command Pulse Length: _____ 15 Cycles – 30 Cycles

Inputs

Breaker Status Inputs

❑ S1 52a (Input 1) ❑ S1 52b (Input 2) ❑ S1 52a & 52b (Inputs 1 & 2)

❑ S2 52a (Input 4) ❑ S2 52b (Input 5) ❑ S2 52a & 52b (Inputs 4 & 5)

External Control Inputs Configuration

Transfer Block #1

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12

❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

Transfer Block #2

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12

❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

Figure A-3 System Setpoints Transfer Settings (page 1 of 7)

System Setpoints Transfer Settings (cont'd)

Transfer Settings

CS – Common Settings

External Control Inputs Configuration (cont'd)

Transfer Block #3

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

External Status Reset

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

Outputs

Auto Fast Transfer Ready Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Manual Fast/Hot Parallel Transfer Ready Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Transfer Ready Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Transfer Completed Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Fast Transfer Load Shedding Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Delayed In-Phase Transfer Load Shedding Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Load Shedding Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Incomplete Transfer Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Load Shedding Function Selection

❑ F27B #3 ❑ F81 #1 ❑ F81R #1
❑ Residual Voltage Transfer ❑ Fixed-Time Transfer

Figure A-3 System Setpoints Transfer Settings (page 2 of 7)

System Setpoints Transfer Settings (cont'd)

Transfer Settings

ATS – Automatic Transfer Settings

Setup

Auto Transfer

❑ Enable ❑ Disable

Both S1 & S2 Breakers Open

❑ Block Transfer ❑ Auto Close

External Control Inputs Configuration

Auto Transfer Block

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

86P-S1 Initiate (S1 to S2)

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

86P-S2 Initiate (S2 to S1)

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

27-S1 Initiate (S1 to S2)

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

27-S2 Initiate (S2 to S1)

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

Figure A-3 System Setpoints Transfer Settings (page 3 of 7)

System Setpoints Transfer Settings (cont'd)

Transfer Settings

ATS – Automatic Transfer Settings (cont'd)

Fast Transfer

Delta Phase Angle Limit _____ 0.0 Degrees – 90.0 Degrees

Delta Voltage Limit _____ 0V – 60V

❑ Disable ❑ Enable

Delta Freq. Limit _____ 0.02Hz – 2.00Hz

❑ Disable ❑ Enable

Time Window _____ 1 Cycle – 10 Cycles

Closing Command Time Delay _____ 0 Cycles – 10 Cycles

Blocking Inputs Selection

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12

❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18 ❑ FL

Delayed In-Phase Transfer

Delta Voltage Limit _____ 0V – 120V

❑ Enable ❑ Disable

Delta Freq. Limit _____ 0.10Hz – 10.0Hz

Time Window _____ 10 Cycles – 600 Cycles

Blocking Inputs Selection

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12

❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18 ❑ FL

Residual Voltage Transfer

Residual Voltage Limit _____ 5V – 60V

Load Shedding Time Delay _____ 2 Cycles – 100 Cycles

Blocking Inputs Selection

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12

❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18 ❑ FL

Fixed-Time Transfer

Fixed Time Delay _____ 30 Cycles – 1000 Cycles

Load Shedding Time Delay _____ 2 Cycles – 100 Cycles

Blocking Inputs Selection

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12

❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18 ❑ FL

Figure A-3 System Setpoints Transfer Settings (page 4 of 7)

System Setpoints Transfer Settings (cont'd)

Transfer Settings

MTS – Manual Transfer Settings

Setup

Manual Transfer

❑ Disable ❑ Enable

External Control Inputs Configuration

Manual Transfer Block

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

Manual Transfer Initiate

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

Fast Transfer

Delta Phase Angle Limit _____ 0.0 Degrees – 90.0 Degrees

Delta Voltage Limit _____ 0V – 60V

❑ Disable ❑ Enable

Delta Freq. Limit _____ 0.02Hz – 2.00Hz

❑ Disable ❑ Enable

Time Window _____ 1 Cycle – 10 Cycles

Closing Command Time Delay _____ 0 Cycles – 10 Cycles

Blocking Inputs Selection

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18 ❑ FL

Figure A-3 System Setpoints Transfer Settings (page 5 of 7)

System Setpoints Transfer Settings (cont'd)

Transfer Settings

MTS – Manual Transfer Settings (cont'd)

Delayed In-Phase Transfer

Delta Voltage Limit _____ 0V – 120V

❑ Enable ❑ Disable

Delta Freq. Limit _____ 0.10Hz – 10.00Hz

Time Window _____ 10 Cycles – 600 Cycles

Blocking Inputs Selection

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12

❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18 ❑ FL

Residual Voltage Transfer

Residual Voltage Limit _____ 5V – 60V

Load Shedding Time Delay _____ 2 Cycles – 100 Cycles

Blocking Inputs Selection

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12

❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18 ❑ FL

Hot Parallel Transfer

Delta Phase Angle Limit _____ 0.0 Degrees – 90.0 Degrees

Delta Voltage Limit _____ 0V – 60V

❑ Disable ❑ Enable

Delta Freq. Limit _____ 0.02Hz – 0.50Hz

❑ Disable ❑ Enable

Time Window _____ 1 Cycle – 50 Cycles

Tripping Command Time Delay _____ 0 Cycles – 30 Cycles

Blocking Inputs Selection

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12

❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18 ❑ FL

Figure A-3 System Setpoints Transfer Settings (page 6 of 7)

System Setpoints Transfer Settings (cont'd)

Transfer Settings

AT – Auto Trip

AT

Breaker Trip Option

❑ Trip Originally Closed Breaker ❑ Trip Breaker Just Closed

Tripping Command Time Delay _____ 0 Cycles – 50 Cycles

Blocking Inputs Selection

❑ #7 ❑ #8 ❑ #9 ❑ #10 ❑ #11 ❑ #12

❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18 ❑ FL

Figure A-3 System Setpoints Transfer Settings (page 7 of 7)

System Setpoints Function Settings

Function Settings

27B – Bus Phase Undervoltage

Bus Phase Undervoltage Transfer Initiate (S1 to S2)

27B #1

Pickup _____ 5V – 120V

❑ Disable ❑ Enable Voltage Inhibit _____ 5V – 120V

Time Delay _____ 1 Cycle – 8160 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)

❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

❑ #FL

Bus Phase Undervoltage Transfer Initiate (S2 to S1)

27B #2

Pickup _____ 5V – 120V

❑ Disable ❑ Enable Voltage Inhibit _____ 5V – 120V

Time Delay _____ 1 Cycle – 8160 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)

❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

❑ #FL

Figure A-4 System Setpoints Function Settings (page 1 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

27B – Bus Phase Undervoltage (cont'd)

27B #3

❑ Disable ❑ Enable

Pickup _____ 5V – 120V
Voltage Inhibit _____ 5V – 120V
Time Delay _____ 1 Cycle – 8160 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

27B #4

❑ Disable ❑ Enable

Pickup _____ 5V – 120V
Voltage Inhibit _____ 5V – 120V
Time Delay _____ 1 Cycle – 8160 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

Figure A-4 System Setpoints Function Settings (page 2 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

50BF #1 – Source 1 Breaker Failure

Source 1 Breaker Failure

50BF #1

Pickup Current _____ 0.02A – 2.00A

Time Delay _____ 1 Cycle – 30 Cycles

I/O Selection

Outputs

❑ #3 ❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

I/O Initiate

Outputs Initiate

❑ #1 ❑ #2 ❑ #3 ❑ #4 ❑ #5 ❑ #6 ❑ #7
❑ #9 ❑ #10 ❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Inputs Initiate

❑ #7(86P-S1 Initiate (S1 to S2)) ❑ #8(Manual Transfer Initiate)
❑ #9(Transfer Block 1) ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

Figure A-4 System Setpoints Function Settings (page 3 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

S1 BF – Source 1 Breaker Failure (Breaker Status)

Source 1 Breaker Failure (Using Breaker Status)

S1BF

Time Delay _____ 0 Cycles – 30 Cycles

I/O Selection

Outputs

❑ #3 ❑ #5 ❑ #6 ❑ #7 ❑ #9
❑ #10 ❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

Figure A-4 System Setpoints Function Settings (page 4 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

81 – Bus Voltage Frequency

Bus Voltage Frequency

81 #1

Pickup _____ 50.00Hz – 67.00Hz (40.00 Hz – 57.00 Hz, 50 Hz)

Time Delay _____ 5 Cycles – 65500 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

81 #2

Pickup _____ 50.00Hz – 67.00Hz (40.00 Hz – 57.00 Hz, 50 Hz)

Time Delay _____ 5 Cycles – 65500 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

Figure A-4 System Setpoints Function Settings (page 5 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

TCM – Trip Circuit Monitor

Trip Circuit Monitor

TCM #1 (Source 1 Breaker)

Time Delay _____ 1 Cycle – 8160 Cycles

Dropout Time Delay _____ 1 Cycle – 8160 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

TCM #2 (Source 2 Breaker)

Time Delay _____ 1 Cycle – 8160 Cycles

Dropout Time Delay _____ 1 Cycle – 8160 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP)
❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

Figure A-4 System Setpoints Function Settings (page 6 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

60FL – Bus VT Fuse-Loss

Bus VT Fuse-Loss

60FL

Delta Voltage Pickup _____ 5V – 25V

Time Delay _____ 1 Cycle – 8160 Cycles

Blocking Drop Out Time Delay _____ 1 Cycle – 300 Cycles

Bus VT Fuse Loss Condition

❑ Fixed Time Transfer ❑ Block Transfer

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)

❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

❑ #FL

Figure A-4 System Setpoints Function Settings (page 7 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

50BF #2 – Source 2 Breaker Failure

Source 2 Breaker Failure

50BF #2

Pickup Current _____ 0.10A – 10.00A

Time Delay _____ 1 Cycle – 30 Cycles

I/O Selection

Outputs

❑ #1 ❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

I/O Initiate

Outputs Initiate

❑ #1 ❑ #2 ❑ #3 ❑ #4 ❑ #5 ❑ #6 ❑ #7 ❑ #8
❑ #9 ❑ #10 ❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Inputs Initiate

❑ #7(86P-S1 Initiate (S1 to S2)) ❑ #8(Manual Transfer Initiate)
❑ #9(Transfer Block 1) ❑ #10 ❑ #11 ❑ #12
❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

Figure A-4 System Setpoints Function Settings (page 8 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

S2 BF – Source 2 Breaker Failure (Breaker Status)

Source 2 Breaker Failure (Using Breaker Status)

S2 BF

Time Delay _____ 0 Cycles – 30 Cycles

I/O Selection

Outputs

❑ #1 ❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

Figure A-4 System Setpoints Function Settings (page 9 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

81R – ROCOF (Bus Voltage)

81R #1

Pickup _____ 0.10 Hz/Sec – 20.00Hz/Sec

Time Delay _____ 3 Cycles – 8160 Cycles

Neg. Sequence Voltage Inhibit _____ 0% – 99%

Increasing ROCOF ❑ Enable ❑ Disable

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)

❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

❑ #FL

81R #2

Pickup _____ 0.10 Hz/Sec – 20.00Hz/Sec

Time Delay _____ 3 Cycles – 8160 Cycles

Neg. Sequence Voltage Inhibit _____ 0% – 99%

Increasing ROCOF ❑ Enable ❑ Disable

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)

❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

❑ #FL

Figure A-4 System Setpoints Function Settings (page 10 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

CCM – Close Circuit Monitor

Close Circuit Monitor

CCM #1 (Source 1 Breaker)

Time Delay _____ 1 Cycle – 8160 Cycles

Dropout Time Delay _____ 1 Cycle – 300 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)

❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

❑ #FL

CCM #2 (Source 2 Breaker)

Time Delay _____ 1 Cycle – 8160 Cycles

Dropout Time Delay _____ 1 Cycle – 300 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP)

❑ #6(S2 52SP) ❑ #7 ❑ #8 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

❑ #FL

Figure A-4 System Setpoints Function Settings (page 11 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

ISSL – ISSLogic

ISSLogic

ISSL #1

Initiating Outputs (1-16)

❑ #1 ❑ #2 ❑ #3 ❑ #4 ❑ #5 ❑ #6 ❑ #7 ❑ #8
❑ #9 ❑ #10 ❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Initiating Function Timeout

❑ 27B #1	❑ 27B #2	❑ 27B #3	❑ 27B #4	❑ 50BF #1
❑ 50BF #2	❑ 81 #1	❑ 81 #2	❑ 81R #1	❑ 81R #2
❑ 50S1 #1	❑ 50S1 #2	❑ 50S2 #1	❑ 50S2 #2	
❑ 60FL	❑ ISSL #2	❑ ISSL #3	❑ ISSL #4	❑ ISSL #5
❑ ISSL #6	❑ TCM #1	❑ TCM #2	❑ CCM #1	❑ CCM #2

Initiating Function Pickup

❑ 27B #1	❑ 27B #2	❑ 27B #3	❑ 27B #4	❑ 50BF #1
❑ 50BF #2	❑ 81 #1	❑ 81 #2	❑ 81R #1	❑ 81R #2
❑ 50S1 #1	❑ 50S1 #2	❑ 50S2 #1	❑ 50S2 #2	
❑ 60FL	❑ ISSL #2	❑ ISSL #3	❑ ISSL #4	❑ ISSL #5
❑ ISSL #6	❑ TCM #1	❑ TCM #2	❑ CCM #1	❑ CCM #2

Figure A-4 System Setpoints Function Settings (page 12 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

ISSL – ISSLogic (cont'd)

Initiating System Status

- ❑ Auto Fast Transfer Delta Phase Angle OK
- ❑ Auto Fast Transfer Delta Voltage OK
- ❑ Auto Fast Transfer Delta Frequency OK
- ❑ Auto Delayed In-Phase Transfer Delta Voltage OK
- ❑ Auto Delayed In-Phase Transfer Delta Frequency OK
- ❑ Auto Fast Transfer Ready
- ❑ Transfer Ready
- ❑ Auto Transfer Enabled
- ❑ Auto Transfer Initiated
- ❑ Fixed Time Transfer Selected (60FL Condition)
- ❑ 27B#1 Bus Phase UV Transfer Initiated (S1 to S2)
- ❑ 27B#2 Bus Phase UV Transfer Initiated (S2 to S1)
- ❑ Open Transition Transfer In Process
- ❑ Transfer Completed
- ❑ Fast Transfer Operated
- ❑ Delayed In-Phase Transfer Operated
- ❑ Residual Voltage Transfer Operated
- ❑ Fixed Time Transfer Operated
- ❑ Fast Transfer Load Shedding
- ❑ Delayed In-Phase Transfer Load Shedding
- ❑ Residual Voltage Transfer Load Shedding
- ❑ Fixed Time Transfer Load Shedding
- ❑ Load Shedding (27B#3, 81#1, 81R#1)
- ❑ S1 Breaker Failure
- ❑ S1 Breaker 52a & 52b Position Disagreement
- ❑ S1 Breaker Opened
- ❑ S1 Breaker Closed
- ❑ Trip S1 Breaker Command
- ❑ Close S1 Breaker Command
- ❑ Source 1 (New Source)
- ❑ Manual Fast/Hot Parallel Transfer Delta Phase Angle OK
- ❑ Manual Fast/Hot Parallel Transfer Delta Voltage OK
- ❑ Manual Fast/Hot Parallel Transfer Delta Frequency OK
- ❑ Manual Delayed In-Phase Transfer Delta Voltage OK
- ❑ Manual Delayed In-Phase Transfer Delta Frequency OK
- ❑ Manual Fast/Hot Parallel Transfer Ready
- ❑ Auto Close Initiated
- ❑ Manual Transfer Enabled
- ❑ Manual Transfer Initiated
- ❑ Hot Parallel Transfer In Process
- ❑ Hot Parallel Transfer Operated
- ❑ Auto Trip Enabled
- ❑ Auto Trip Operated
- ❑ S1/S2 Breaker Racked-Out Transfer Blocked
- ❑ New Source Upper Voltage Limit Transfer Blocked
- ❑ New Source Lower Voltage Limit Transfer Blocked
- ❑ Bus VT Fuse-Loss Transfer Blocked
- ❑ Trip/Close Circuit Open Transfer Blocked
- ❑ Both Breakers Open Transfer Blocked
- ❑ Both Breakers Close Transfer Blocked
- ❑ Incomplete Transfer Blocked
- ❑ Blocking After Transfer Alarm
- ❑ S1/S2 Breaker Closing Time Out Of Range
- ❑ S2 Breaker Failure
- ❑ S2 Breaker 52a & 52b Position Disagreement
- ❑ S2 Breaker Opened
- ❑ S2 Breaker Closed
- ❑ Trip S2 Breaker Command
- ❑ Close S2 Breaker Command
- ❑ Source 2 (New Source)
- ❑ Remote Mode

Figure A-4 System Setpoints Function Settings (page 13 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

ISSL – ISSLogic (cont'd)

❑ Initiate via Communication Port

Initiating Inputs (1-18)

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 [86P-S1 Initiate (S1 to S2)]
❑ #8 (Manual Transfer Initiate) ❑ #9 (Transfer Block 1) ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

Blocking Inputs (1-18)

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 [86P-S1 Initiate (S1 to S2)]
❑ #8 (Manual Transfer Initiate) ❑ #9 (Transfer Block 1) ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

Figure A-4 System Setpoints Function Settings (page 14 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

ISSL – ISSLogic (cont'd)

Block System Status

- ❑ Auto Fast Transfer Delta Phase Angle OK
- ❑ Auto Fast Transfer Delta Voltage OK
- ❑ Auto Fast Transfer Delta Frequency OK
- ❑ Auto Delayed In-Phase Transfer Delta Voltage OK
- ❑ Auto Delayed In-Phase Transfer Delta Frequency OK
- ❑ Auto Fast Transfer Ready
- ❑ Transfer Ready
- ❑ Auto Transfer Enabled
- ❑ Auto Transfer Initiated
- ❑ Fixed Time Transfer Selected (60FL Condition)
- ❑ 27B#1 Bus Phase UV Transfer Initiated (S1 to S2)
- ❑ 27B#2 Bus Phase UV Transfer Initiated (S2 to S1)
- ❑ Open Transition Transfer In Process
- ❑ Transfer Completed
- ❑ Fast Transfer Operated
- ❑ Delayed In-Phase Transfer Operated
- ❑ Residual Voltage Transfer Operated
- ❑ Fixed Time Transfer Operated
- ❑ Fast Transfer Load Shedding
- ❑ Delayed In-Phase Transfer Load Shedding
- ❑ Residual Voltage Transfer Load Shedding
- ❑ Fixed Time Transfer Load Shedding
- ❑ Load Shedding (27B#3, 81#1, 81R#1)
- ❑ S1 Breaker Failure
- ❑ S1 Breaker 52a & 52b Position Disagreement
- ❑ S1 Breaker Opened
- ❑ S1 Breaker Closed
- ❑ Trip S1 Breaker Command
- ❑ Close S1 Breaker Command
- ❑ Source 1 (New Source)
- ❑ Manual Fast/Hot Parallel Transfer Delta Phase Angle OK
- ❑ Manual Fast/Hot Parallel Transfer Delta Voltage OK
- ❑ Manual Fast/Hot Parallel Transfer Delta Frequency OK
- ❑ Manual Delayed In-Phase Transfer Delta Voltage OK
- ❑ Manual Delayed In-Phase Transfer Delta Frequency OK
- ❑ Manual Fast/Hot Parallel Transfer Ready
- ❑ Auto Close Initiated
- ❑ Manual Transfer Enabled
- ❑ Manual Transfer Initiated
- ❑ Hot Parallel Transfer In Process
- ❑ Hot Parallel Transfer Operated
- ❑ Auto Trip Enabled
- ❑ Auto Trip Operated
- ❑ S1/S2 Breaker Racked-Out Transfer Blocked
- ❑ New Source Upper Voltage Limit Transfer Blocked
- ❑ New Source Lower Voltage Limit Transfer Blocked
- ❑ Bus VT Fuse-Loss Transfer Blocked
- ❑ Trip/Close Circuit Open Transfer Blocked
- ❑ Both Breakers Open Transfer Blocked
- ❑ Both Breakers Close Transfer Blocked
- ❑ Incomplete Transfer Blocked
- ❑ Blocking After Transfer Alarm
- ❑ S1/S2 Breaker Closing Time Out Of Range
- ❑ S2 Breaker Failure
- ❑ S2 Breaker 52a & 52b Position Disagreement
- ❑ S2 Breaker Opened
- ❑ S2 Breaker Closed
- ❑ Trip S2 Breaker Command
- ❑ Close S2 Breaker Command
- ❑ Source 2 (New Source)
- ❑ Remote Mode

Figure A-4 System Setpoints Function Settings (page 15 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

ISSL – ISSLogic (cont'd)

❑ Block via Communication Port

Delay _____ 0 Cycles – 65500 Cycles

Profile Switch

❑ Not Activated ❑ #1 ❑ #2 ❑ #3 ❑ #4

DO/RST Delay _____ 0 Cycles – 65500 Cycles

❑ Dropout Timer ❑ Reset Timer

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ LCK/BLK (Out 8)

❑ #9 ❑ #10 ❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

❑ No Transfer Initiate

❑ Initiate S1 to S2 Transfer

❑ Initiate S2 to S1 Transfer

❑ Transfer Block

ISSL #2 (See Previous ISSL #1)

ISSL #3 (See Previous ISSL #1)

ISSL #4 (See Previous ISSL #1)

ISSL #5 (See Previous ISSL #1)

ISSL #6 (See Previous ISSL #1)

Figure A-4 System Setpoints Function Settings (page 16 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

50S1 #1 – Source 1 Instantaneous Phase Overload Detection

Source 1 Source 1 Instantaneous Phase Overload Detection

50S1 #1

Pickup Current _____ 1.0A – 100.0A

Time Delay _____ 1 Cycle – 8160 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)

❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 [86P-S1 Initiate (S1 to S2)]

❑ #8 (Manual Transfer Initiate) ❑ #9 (Transfer Block 1) ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

❑ #FL

50S1 #2

Pickup Current _____ 1.0A – 100.0A

Time Delay _____ 1 Cycle – 8160 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)

❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 [86P-S1 Initiate (S1 to S2)]

❑ #8 (Manual Transfer Initiate) ❑ #9 (Transfer Block 1) ❑ #10

❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18

❑ #FL

Figure A-4 System Setpoints Function Settings (page 17 of 18)

System Setpoints Function Settings (cont'd)

Function Settings

50S2 #1 – Source 2 Instantaneous Phase Overload Detection

Source 2 Instantaneous Phase Overload Detection

50S2 #1

Pickup Current _____ 1.0A – 100.0A

Time Delay _____ 1 Cycle – 8160 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 [86P-S1 Initiate (S1 to S2)]
❑ #8 (Manual Transfer Initiate) ❑ #9 (Transfer Block 1) ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

50S2 #2

Pickup Current _____ 1.0A – 100.0A

Time Delay _____ 1 Cycle – 8160 Cycles

I/O Selection

Outputs

❑ #5 ❑ #6 ❑ #7 ❑ #9 ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16

Blocking Inputs

❑ #1(S1 52a) ❑ #2(S1 52b) ❑ #3(S1 52SP) ❑ #4(S2 52a)
❑ #5(S2 52b) ❑ #6(S2 52SP) ❑ #7 [86P-S1 Initiate (S1 to S2)]
❑ #8 (Manual Transfer Initiate) ❑ #9 (Transfer Block 1) ❑ #10
❑ #11 ❑ #12 ❑ #13 ❑ #14 ❑ #15 ❑ #16 ❑ #17 ❑ #18
❑ #FL

Figure A-4 System Setpoints Function Settings (page 18 of 18)

Function		D	OUTPUTS																	BLOCKING INPUTS																			
			16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	FL	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
CS	1																																					
	2																																				
	3																																				
	4																																				
	5																																				
	6																																				
	7																																				
	8																																				
AT																																					
ATS	1																																				
	2																																				
	3																																				
	4																																				
MTS	1																																				
	2																																				
	3																																				
	4																																				
27B	1																																				
	2																																				
	3																																				
	4																																				
50BF #1																																					
50BF #2																																					
50S1 #1																																					
50S1 #2																																					
50S2 #1																																					
50S2 #2																																					
S1 BF																																					
S2 BF																																					
60 FL																																					
81	1																																				
	2																																				
81R	1																																				
	2																																				
TCM	1																																				
	2																																				
CCM	1																																				
	2																																				
ISSL	1																																				
	2																																				
	3																																				
	4																																				
	5																																				
	6																																				

Check each box applicable : ✓ (See page A-1 for information regarding the use of this table.)
D Column = Function Disabled.
OUTPUTS Columns =Designated function output(s)
FL Column = Function blocked by fuse loss.
INPUTS Columns =Designated function blocking input(s)

Table A-1 MBTS Configuration Table

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B Appendix B–Communications

The M-4272 Motor Bus Transfer System (MBTS) incorporates three serial ports and an optional RJ45 Ethernet port for intelligent, digital communication with external devices. Equipment such as RTU's, data concentrators, modems, or computers can be interfaced for direct, on-line, real time data acquisition and control. Generally, all data available to the operator through the front panel of the relay with the M-3931 Human-Machine Interface (HMI) module is accessible remotely through the MODBUS data exchange protocol. The protocol document and the database-specific protocol document are available from the factory or from our website at www.beckwithelectric.com.

The M-3872 ISScom® Communications Software has been supplied for communication to any IBM compatible computer running under Microsoft® Windows™ 98 or higher.

The communication protocol implements serial, byte oriented, asynchronous communication and can be used to fulfill the following communications functions:

- Real time monitoring of line status.
- Interrogation and modification of setpoints.
- Downloading of recorded oscillograph and transfer event log data.
- Reconfiguration of MBTS functions.

■ **NOTE**: The following restrictions apply for MODBUS protocol use:

1. Parity is supported on COM1, COM2 and COM3; valid selections are 8,N,2; 8,O,1; 8,E,1; 8,N,1; 8,O,2 or 8,E,2.
2. ASCII mode is not supported (RTU only).
3. Standard baud rates from 1200 to 9600 are supported.
4. Only the following MODBUS commands are supported:
   a. read holding register (function 03)
   b. read input register (function 04)
   c. force single coil (function 05)
   d. preset single register (function 06)

For detailed information on ISScom communications, refer to Section 4.1, Unit Setup.

Serial Ports

The MBTS includes both front and rear panel RS-232 ports and a rear RS-485 port. The front and rear panel RS-232 ports are 9-pin (DB9S) connector configured as DTE (Data Terminal Equipment) per the EIA-232D standard. Signals are defined in Table B-1, Communication Port Signals .

The 2-wire RS-485 port is assigned to the rear panel terminal block pins 43 (–) and 44 (+).

Each communication port may be configured to operate at any of the standard baud rates (1200, 2400, 4800, and 9600). The RS-485 port shares the same baud rate with COM 2 (for COM1 see Section 5.4, Circuit Board Switches and Jumpers).

A null modem cable is also shown in Figure B-1, Null Modem Cable: M-0423, if direct connection to a PC (personal computer) is desired.

Optional Ethernet Port

The M-4272, when equipped with the optional Ethernet port can be accessed from a local network. When the ethernet port is enabled, the COM2 serial port (RS-232) is unavailable for communication. However, the Demodulated IRIG-B may still be used through the COM2 Port when Ethernet is enabled. When COM2 Port is enabled the Ethernet Port is not available. Although the ethernet connection speed is faster than the RS-232 port (can be up to 10 Mbps), the ethernet module connects internally through the COM2 serial connection and is therefore limited to connection speeds up to 9600 bps.

Either port COM2 (Ethernet) or COM3 may be used to remotely set and interrogate the relay using a local area network, modem or other direct serial connection.

	Signal	COM1	COM2
RX	Receive Data	Pin 2	Pin 2
TX	Transmit Data	Pin 3	Pin 3
RTS	Request to Send	Pin 7	Pin 7
CTS	Clear to Send		Pin 8
DTR	Data Terminal Ready	Pin 4	Pin 4
DCD	Data Carrier Detect		Pin 1*
GND	Signal Ground	Pin 5	Pin 5
+15 V			Pin 1*
-15 V			Pin 9*
	TTL IRIG-B (+)		Pin 6*

** Optional: See Section 5.4, Circuit Board Switches and Jumpers, ±15V (±15%) @100 mA maximum.*

Table B-1 Communication Port Signals

■ **NOTE**: Also see Tables 5-1, 5-2 and Figure 5-8.

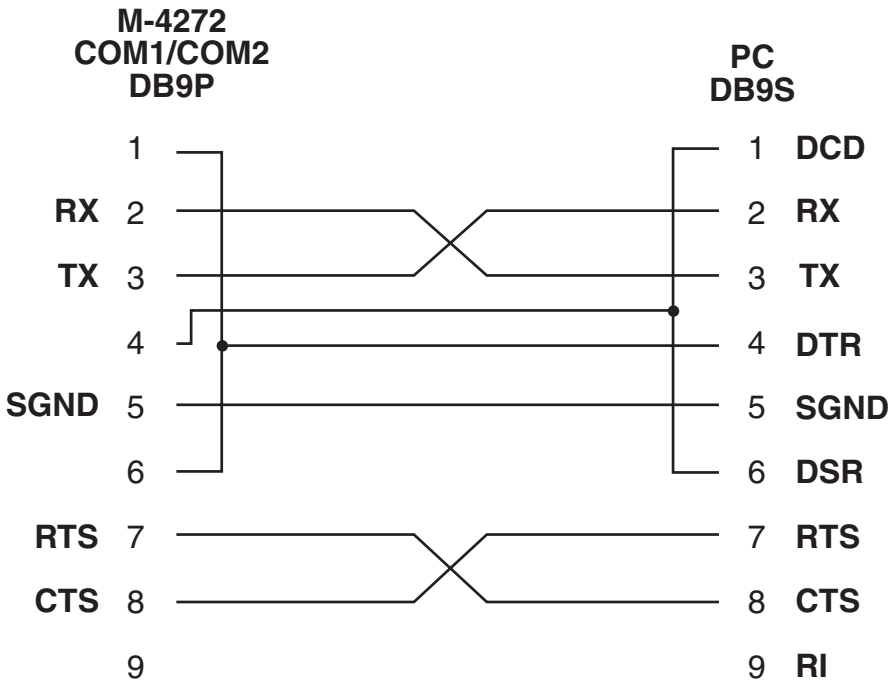


Figure B-1 Null Modem Cable: M-0423

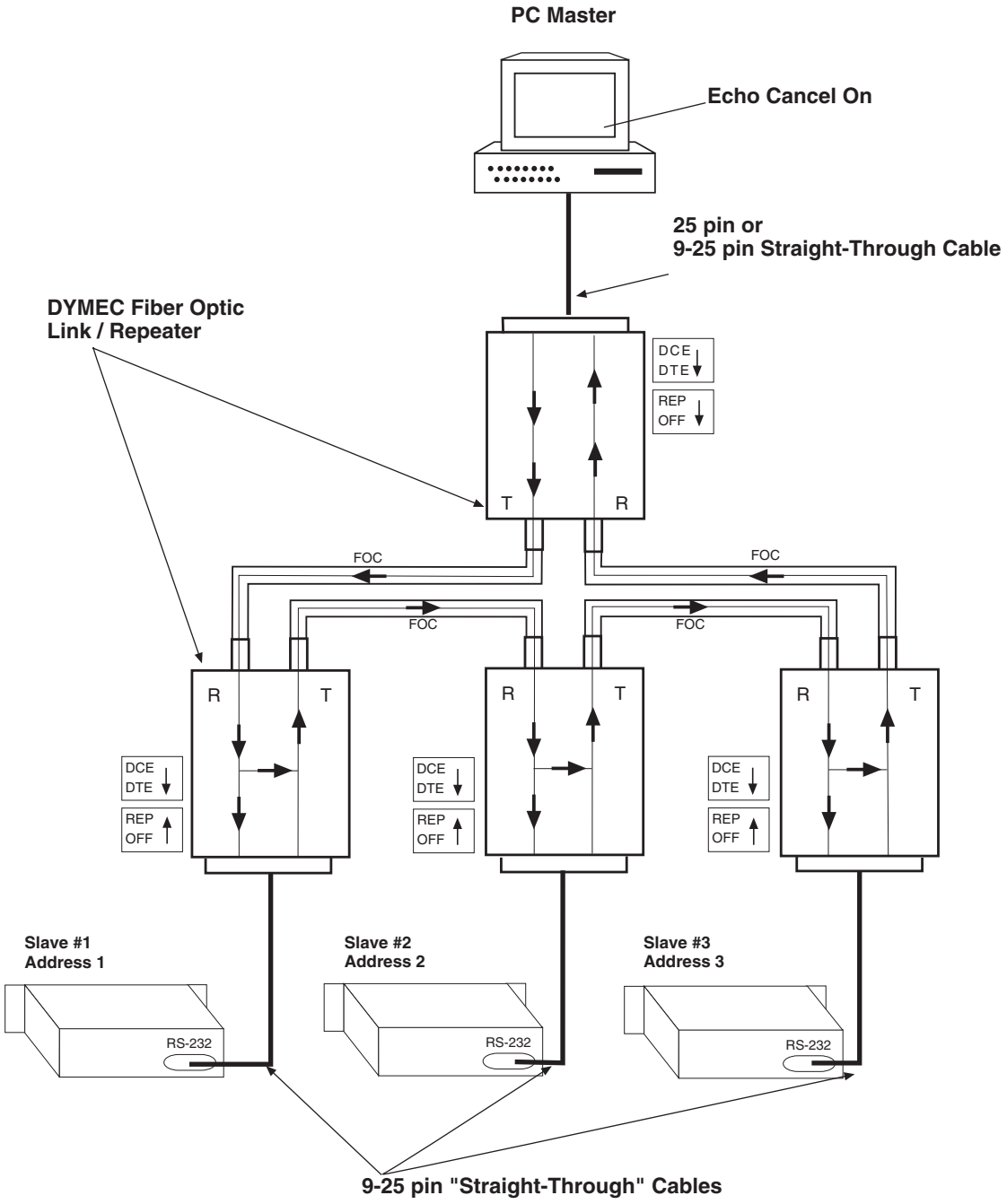
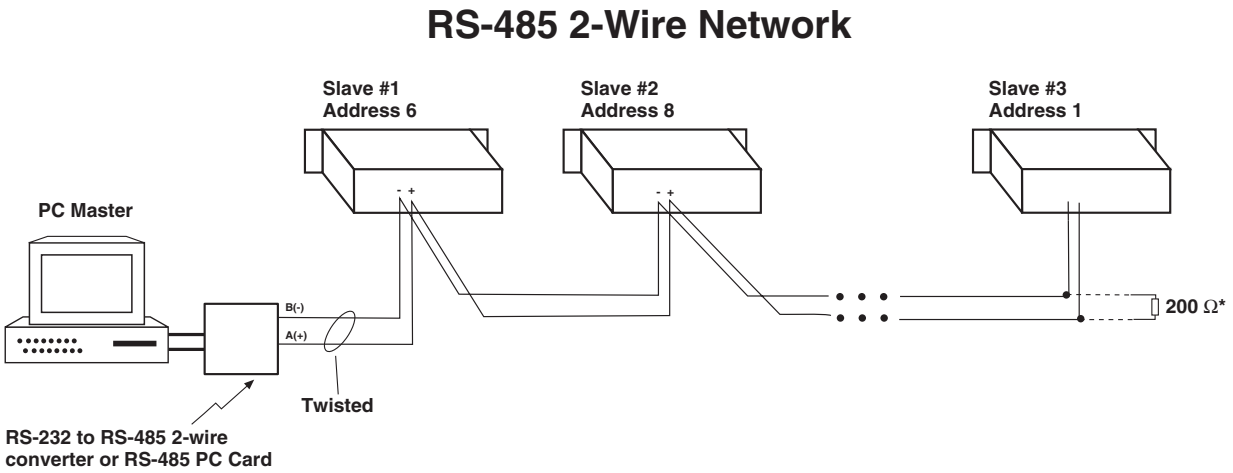


Figure B-2 RS-232 Fiber Optic Network



▲ **CAUTION:** Due to the possibility of ground potential difference between units, all units should be mounted in the same rack. If this is not possible, fiber optics with the appropriate converters should be used for isolation.

■ **NOTE**: Each address on the network must be unique. Only the last physical slave on the network should have the termination resistor installed. This may be completed externally or using a jumper internal to the unit. See Section 5.4, Circuit Board Switches and Jumpers.

Figure B-3 RS-485 Network

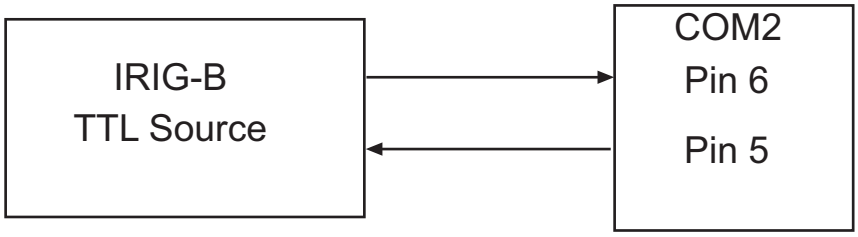


Figure B-4 COM2 Pinout for Demodulated TTL Level Signal

C Appendix C–Self-Test Error Codes

1	
2	Battery backed RAM test fail
3	EEPROM write power-up fail
4	EEPROM read back power-up fail
5	Dual port RAM test fail
6	EEPROM write calibration checksum fail
7	EEPROM write setpoint checksum fail loss of power
8	EEPROM write setpoint checksum fail loss of battery backed RAM
9	DMA checksum/physical block fail
10	Oscillograph Memory Test fail
11	DSP external program RAM fail
12	DSP A/D convert fail
13	DSP ground channel fail
14	DSP reference channel fail
15	DSP PGA gain fail
16	DSP DSP<-> HOST interrupt 1 fail
17	DSP DSP -> HOST interrupt 2 set fail
18	DSP DSP -> HOST interrupt 2 reset fail
19	DSP program load fail
20	DSP not running run mode code
21	DSP not running primary boot code
22	DSP DPRAM pattern test fail
23	EEPROM write verify error
26	WARNING calibration checksum mismatch warning
27*	WARNING setpoint checksum mismatch warning
28	WARNING low battery (BBRAM) warning
29	Supply/mux PGA running test fail

*If a system Setpoint has been changed and power is removed from the MBTS within 5 minutes, an Error Code 27 will be displayed when power is applied to the MBTS. This condition is normal and the Error Code 27 should be reset.

Table C-1 Self-Test Error Codes (1 of 2)

30	External DSP RAM test fail
31	Unrecognized INT1 code
32	Values update watchdog fail
34	Restart Error
35	Interrupt Error
36	Trap Error
37	Calibration running check fail
38	Ethernet Board not running (Warning)
40	Interrupt noise INT2
44	Oscillograph buffer overflow
45	Oscillograph buffer underflow
46	Failure of DSP to calculate calibration phasors
50	Stack Overflow
51	Setpoint Write Overflow

Table C-1 Self-Test Error Codes (2 of 2)

Error Code	Description
Comm Channel Locked	An incorrect communication password supplied to the system will result in this message.
HMI Active	This message indicates that the system is being operated locally and serial communication is suspended.
Echo Timeout	This error results if there are problems with the serial optical fiber communication link or if the echo cancel function is used incorrectly.
Illegal Data Value	This error results if incorrect or out of range data is entered.
Illegal Function	This error results if incorrect function is performed on modbus protocol.
Illegal Data Address	This error results if an incompatible version of ISScom software is used. This is a communication protocol error. Contact a Beckwith Electric Co. factory representative.
Invalid CRC	This error results if there are problems with the communication link or if the echo cancel function is used incorrectly.
Failed to open Comm Port	This error results when there is a mismatch in PC Com Port settings.
Failed to write to Comm Port	This error results when communication with the system is lost while attempting to write data to the system.
Read Timeout	This error results when communication with the system is lost while attempting to read data from the system.

Table C-2 ISScom™ Error Messages

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D Appendix D – Transfer Event Log Samples

This Appendix contains Illustrations of the print-ready screens provided by the ISScom® Transfer Event Log Print Summary and Print Detail features.

Transfer Event Log Recorder

System: M4272
Date: 12/19/2005, 15:45:49

No.	Date & Time	Event Information
1	12/06/2005, 09:18:39.399	S2 Breaker Opened S1 Breaker Closed Trip S1 Breaker Command 27B #1: Pickup/Timeout Input Pickup: 1 3 5 6 Output Pickup: 1
2	12/06/2005, 09:18:39.412	S1 Breaker Opened S2 Breaker Opened Trip S1 Breaker Command Close S2 Breaker Command 27B #1: Pickup/Timeout Input Pickup: 3 5 6 Output Pickup: 1 4
3	12/06/2005, 09:18:39.437	S1 Breaker Opened S2 Breaker Closed Trip S1 Breaker Command Close S2 Breaker Command 27B #1: Pickup/Timeout Input Pickup: 2 3 4 6 Output Pickup: 1 4 Transfer : 1
4	12/06/2005, 10:51:10.862	S1 Breaker Opened S2 Breaker Opened Close S2 Breaker Command Input Pickup: 3 5 6 Output Pickup: 4
5	12/06/2005, 10:51:10.887	S1 Breaker Opened S2 Breaker Closed Close S2 Breaker Command Input Pickup: 2 3 4 6 Output Pickup: 4 Transfer : 2
6	12/06/2005, 11:14:01.870	S1 Breaker Opened S2 Breaker Closed Trip S2 Breaker Command Input Pickup: 2 3 4 6 Output Pickup: 3
7	12/06/2005, 11:14:01.904	S1 Breaker Opened

Figure D-1 Transfer Event Log Summary Printout (page 1 of 2)

No.	Date & Time	Event Information
		S2 Breaker Opened Trip S2 Breaker Command Close S1 Breaker Command Input Pickup: 2 3 5 6 Output Pickup: 2 3
8	12/06/2005, 11:14:01.924	S2 Breaker Opened S1 Breaker Closed Trip S2 Breaker Command Close S1 Breaker Command Input Pickup: 1 3 5 6 Output Pickup: 2 3 Transfer : 3
9	12/06/2005, 11:24:26.104	S2 Breaker Opened S1 Breaker Closed Trip S1 Breaker Command Input Pickup: 1 3 5 6 Output Pickup: 1
10	12/06/2005, 11:24:26.137	S1 Breaker Opened S2 Breaker Opened Trip S1 Breaker Command Close S2 Breaker Command Input Pickup: 2 3 5 6 Output Pickup: 1 4
11	12/06/2005, 11:24:26.162	S1 Breaker Opened S2 Breaker Closed Trip S1 Breaker Command Close S2 Breaker Command Input Pickup: 2 3 4 6 Output Pickup: 1 4 Transfer : 4

Figure D-1 Transfer Event Log Summary Printout (page 2 of 2)

Transfer Event Log Recorder

System: M4272
Date: 12/19/2005, 15:48:16

No.	Date & Time	Event Information
1	12/06/2005, 09:18:39.399	S2 Breaker Opened S1 Breaker Closed Trip S1 Breaker Command 27B #1: Pickup/Timeout Input Pickup: 1 3 5 6 Output Pickup: 1 System Status: Auto Fast Transfer Delta Phase Angle OK, Auto Fast Transfer Delta Voltage OK, Auto Fast Transfer Delta Frequency OK, Auto Delayed In-Phase Transfer Delta Voltage OK, Auto Delayed In-Phase Transfer Delta Frequency OK, Auto Fast Transfer Ready, Transfer Ready, Auto Transfer Enabled, Auto Transfer Initiated, 27B #1 Bus Phase UV Transfer Initiated (S1 to S2), Open Transition Transfer In Process, S1 Breaker Closed, Trip S1 Breaker Command, Device ON, Manual Fast/Hot Parallel Transfer Delta Phase Angle OK, Manual Fast/Hot Parallel Transfer Delta Voltage OK, Manual Fast/Hot Parallel Transfer Delta Frequency OK, Manual Delayed In-Phase Transfer Delta Voltage OK , Manual Delayed In-Phase Transfer Delta Frequency OK, Manual Fast/Hot Parallel Transfer Ready, Manual Transfer Enabled, Auto Trip Enabled, S2 Breaker Opened, Source 2 (New Source), Remote Mode, Transfer Start Signal: Internal 27B1 VPS(S1): VA: 119.9 (V) VB: VC: VPS(S2): VA: 119.9 (V) VB: VC: VPS(Bus): VA: 112.4 (V) VB: VC: VNS(Bus): I(S1): 0.127 (A) I(S2): 0.232 (A) Bus V/Hz: 46.8 % Bus Frequency: 60.00 (Hz) Delta Voltage: -7.5 (V) Delta Phase Angle: 0.0 (°) Delta Frequency: 0.00 (Hz)
2	12/06/2005, 09:18:39.412	S1 Breaker Opened

Figure D-2 Transfer Event Log Detail Printout (page 1 of 3)

No.	Date & Time	Event Information

S2 Breaker Opened
Trip S1 Breaker Command
Close S2 Breaker Command
27B #1: Pickup/Timeout
Input Pickup: 3 5 6
Output Pickup: 1 4
System Status: Auto Fast Transfer Delta Phase Angle OK,
Auto Fast Transfer Delta Voltage OK,
Auto Fast Transfer Delta Frequency OK,
Auto Delayed In-Phase Transfer Delta Voltage OK,
Auto Delayed In-Phase Transfer Delta Frequency OK,
Transfer Ready,
Auto Transfer Enabled,
Auto Transfer Initiated,
27B #1 Bus Phase UV Transfer Initiated (S1 to S2),
Open Transition Transfer In Process,
Fast Transfer Operated,
S1 Breaker Opened,
Trip S1 Breaker Command,
Device ON,
Manual Fast/Hot Parallel Transfer Delta Phase Angle OK,
Manual Fast/Hot Parallel Transfer Delta Voltage OK,
Manual Fast/Hot Parallel Transfer Delta Frequency OK,
Manual Delayed In-Phase Transfer Delta Voltage OK ,
Manual Delayed In-Phase Transfer Delta Frequency OK,
Manual Transfer Enabled,
Auto Trip Enabled,
S2 Breaker Opened,
Close S2 Breaker Command,
Source 2 (New Source),
Remote Mode,

Transfer Start Signal:		Internal 27B1		
VPS(S1):		VA: 119.9 (V)	VB:	VC:
VPS(S2):		VA: 119.9 (V)	VB:	VC:
VPS(Bus):		VA: 112.4 (V)	VB:	VC:
VNS(Bus):				
I(S1):	0.127 (A)	I(S2): 0.233 (A)		
Bus V/Hz:	46.8 %	Bus Frequency: 60.00 (Hz)		
Delta Voltage:		-7.5 (V)		
Delta Phase Angle:		0.0 (°)		
Delta Frequency:		0.00 (Hz)		
Breaker Opening Time :		0.4 (Cycle)		

3 12/06/2005, 09:18:39.437 S1 Breaker Opened
S2 Breaker Closed
Trip S1 Breaker Command
Close S2 Breaker Command

Figure D-2 Transfer Event Log Detail Printout (page 2 of 3)

No.	Date & Time	Event Information

27B #1: Pickup/Timeout
Transfer : 1
Input Pickup: 2 3 4 6
Output Pickup: 1 4
System Status: Auto Fast Transfer Delta Phase Angle OK,
Auto Fast Transfer Delta Voltage OK,
Auto Fast Transfer Delta Frequency OK,
Auto Delayed In-Phase Transfer Delta Voltage OK,
Auto Delayed In-Phase Transfer Delta Frequency OK,
Auto Transfer Enabled,
Auto Transfer Initiated,
27B #1 Bus Phase UV Transfer Initiated (S1 to S2),
Transfer Completed,
Fast Transfer Operated,
S1 Breaker Opened,
Trip S1 Breaker Command,
Device ON,
Manual Fast/Hot Parallel Transfer Delta Phase Angle OK,
Manual Fast/Hot Parallel Transfer Delta Voltage OK,
Manual Fast/Hot Parallel Transfer Delta Frequency OK,
Manual Delayed In-Phase Transfer Delta Voltage OK ,
Manual Delayed In-Phase Transfer Delta Frequency OK,
Manual Transfer Enabled,
Auto Trip Enabled,
Blocking After Transfer Alarm ,
S2 Breaker Closed,
Close S2 Breaker Command,
Source 2 (New Source),
Remote Mode,

Transfer Start Signal:		Internal 27B1		
VPS(S1):		VA: 119.9 (V)	VB:	VC:
VPS(S2):		VA: 119.9 (V)	VB:	VC:
VPS(Bus):		VA: 112.4 (V)	VB:	VC:
VNS(Bus):				
I(S1):	0.127 (A)	I(S2): 0.233 (A)		
Bus V/Hz:	46.8 %	Bus Frequency: 60.00 (Hz)		
Delta Voltage:		-7.5 (V)		
Delta Phase Angle:		0.0 (°)		
Delta Frequency:		0.00 (Hz)		
Breaker Closing Time:		1.1 (Cycles)		
Resultant V/Hz at breaker close:		6.25%		
Open Transition Time(S1 to S2):		1.5 (Cycle)		

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Figure D-2 Transfer Event Log Detail Printout (page 3 of 3)

E Appendix E – Sequence of Events

Sample Printout

This Appendix contains Illustrations of the print-ready screens provided by the ISScom® Sequence of Events Recorder Print Summary and Print Detail features.

Sequence of Event Recorder

System: M4272
Date: 05/23/2006, 15:02:02

No.	Date & Time	Event Information
1	04/12/2006, 13:01:23.991	Input Pickup: 2 4 6 Output Pickup: 8 Input Drop: 5
2	04/12/2006, 13:10:25.245	Input Pickup: 2 4 6 Output Pickup: 8 Input Drop: 5
3	04/12/2006, 13:19:35.349	Input Pickup: 2 4 6 Output Pickup: 8 Input Drop: 5
4	04/12/2006, 13:25:22.103	Input Pickup: 2 4 6 Output Pickup: 8 Input Drop: 5
5	04/12/2006, 13:25:41.658	Input Pickup: 2 4 6 Output Pickup: 8 Input Drop: 5
6	04/12/2006, 13:46:17.491	Input Pickup: 2 4 6 Output Pickup: 8 Input Drop: 5
7	04/12/2006, 13:57:33.949	Input Pickup: 2 4 6 Output Pickup: 8 Input Drop: 5
8	04/20/2006, 08:55:10.403	27B #1: Pickup Input Pickup: 1 3 5 6
9	04/20/2006, 08:55:10.470	27B #1: Pickup/Timeout Input Pickup: 1 3 5 6 Output Pickup: 1
10	04/20/2006, 08:55:10.474	27B #1: Pickup/Timeout Input Pickup: 1 3 5 6 Output Pickup: 1
11	04/20/2006, 08:55:10.520	Fuse Loss: Pickup 27B #1: Drop Input Pickup: 3 5 6 BFL Output Pickup: 1 Input Drop: 1
12	04/20/2006, 08:55:10.524	Fuse Loss: Drop Input Pickup: 2 3 5 6

Page 1

Figure E-1 Sequence of Events Recorder Summary Printout (page 1 of 2)

No.	Date & Time	Event Information
		Output Pickup: 1 Input Drop:
13	04/20/2006, 08:55:10.528	27B #1: Pickup Input Pickup: 2 3 5 6 Output Pickup: 1
14	04/20/2006, 08:55:10.541	27B #1: Pickup Input Pickup: 2 3 5 6 Output Pickup: 1 4
15	04/20/2006, 08:55:10.591	27B #1: Pickup Input Pickup: 2 3 4 6 Output Pickup: 1 4 Input Drop: 5
16	04/20/2006, 08:55:10.595	27B #1: Pickup/Timeout Input Pickup: 2 3 4 6 Output Pickup: 1 4
17	04/20/2006, 08:55:10.603	Fuse Loss: Pickup 27B #1: Drop Input Pickup: 2 3 4 6 BFL Output Pickup: 1 4

Figure E-1 Sequence of Events Recorder Summary Printout (page 2 of 2)

Sequence of Event Recorder

System: M4272
Date: 12/21/2005, 16:39:35

No.	Date & Time	Event Information
1	12/14/2005, 10:11:41.108	27B #1: Pickup Current Profile: 1 Input Pickup: 1 3 6 Output Pickup: Input Drop: Output Drop: System Status: Auto Fast Transfer Delta Phase Angle OK, Auto Fast Transfer Delta Voltage OK, Auto Fast Transfer Delta Frequency OK, Auto Delayed In-Phase Transfer Delta Voltage OK, Auto Delayed In-Phase Transfer Delta Frequency OK, Transfer Ready, Auto Transfer Enabled, S1 Breaker Closed, Device ON, Manual Fast/Hot Parallel Transfer Delta Phase Angle OK, Manual Fast/Hot Parallel Transfer Delta Voltage OK, Manual Fast/Hot Parallel Transfer Delta Frequency OK, Manual Delayed In-Phase Transfer Delta Voltage OK , Manual Delayed In-Phase Transfer Delta Frequency OK, Manual Transfer Enabled, S2 Breaker Opened, Source 2 (New Source), Local Mode, System Start Signal: No Signal VPS(S1): VA: 119.4 (V) VB: VC: VPS(S2): VA: 119.4 (V) VB: VC: VPS(Bus) VA: 118.6 (V) VB: VC: VNS(Bus) I(S1): 0.000 (A) I(S2): 0.000 (A) Bus V/Hz: 98.84 % Bus Frequency: 59.99 (Hz) Delta Voltage: -0.7 (V) Delta Phase Angle: 0.0 (°) Delta Frequency: -0.01 (Hz)
2	12/14/2005, 10:11:41.341	27B #1: Pickup (A)/Timeout Current Profile: 1 Input Pickup: 1 3 6 Output Pickup: 1 5 Input Drop: Output Drop: System Status: Auto Fast Transfer Delta Phase Angle OK,

Figure E-2 Sequence of Events Recorder Detail Printout (page 1 of 4)

No.	Date & Time	Event Information

Auto Fast Transfer Delta Voltage OK,
Auto Fast Transfer Delta Frequency OK,
Auto Delayed In-Phase Transfer Delta Voltage OK,
Auto Delayed In-Phase Transfer Delta Frequency OK,
Transfer Ready,
Auto Transfer Enabled,
Auto Transfer Initiated,
27B #1 Bus Phase UV Transfer Initiated (S1 to S2),
S1 Breaker Closed,
Device ON,
Manual Fast/Hot Parallel Transfer Delta Phase Angle OK,
Manual Fast/Hot Parallel Transfer Delta Voltage OK,
Manual Fast/Hot Parallel Transfer Delta Frequency OK,
Manual Delayed In-Phase Transfer Delta Voltage OK ,
Manual Delayed In-Phase Transfer Delta Frequency OK,
Manual Transfer Enabled,
S2 Breaker Opened,
Source 2 (New Source),
Local Mode,

System Start Signal: Internal 27B1
VPS(S1): VA: 118.6 (V) VB: VC:
VPS(S2): VA: 118.6 (V) VB: VC:
VPS(Bus) VA: 118.6 (V) VB: VC:
VNS(Bus)
I(S1): 0.000 (A) I(S2): 0.000 (A)
Bus V/Hz: 98.84 % Bus Frequency: 60.00 (Hz)
Delta Voltage: 0.0 (V)
Delta Phase Angle: 0.0 (°)
Delta Frequency: 0.00 (Hz)

3 12/14/2005, 10:11:41.399 27B #1: Drop
Current Profile: 1
Input Pickup: 1 3 6
Output Pickup: 1 5
Input Drop:
Output Drop:
System Status: Auto Fast Transfer Delta Phase Angle OK,
Auto Fast Transfer Delta Voltage OK,
Auto Fast Transfer Delta Frequency OK,
Auto Delayed In-Phase Transfer Delta Voltage OK,
Auto Delayed In-Phase Transfer Delta Frequency OK,
Transfer Ready,
Auto Transfer Enabled,
Auto Transfer Initiated,
27B #1 Bus Phase UV Transfer Initiated (S1 to S2),
Open Transition Transfer In Process,
S1 Breaker Closed,

Figure E-2 Sequence of Events Recorder Detail Printout (page 2 of 4)

No.	Date & Time	Event Information

Trip S1 Breaker Command,
Device ON,
Manual Fast/Hot Parallel Transfer Delta Phase Angle OK,
Manual Fast/Hot Parallel Transfer Delta Voltage OK,
Manual Fast/Hot Parallel Transfer Delta Frequency OK,
Manual Delayed In-Phase Transfer Delta Voltage OK ,
Manual Delayed In-Phase Transfer Delta Frequency OK,
Manual Transfer Enabled,
S2 Breaker Opened,
Source 2 (New Source),
Local Mode,

System Start Signal: Internal 27B1
VPS(S1): VA: 119.4 (V) VB: VC:
VPS(S2): VA: 119.4 (V) VB: VC:
VPS(Bus) VA: 119.4 (V) VB: VC:
VNS(Bus)
I(S1): 0.000 (A) I(S2): 0.000 (A)
Bus V/Hz: 99.45 % Bus Frequency: 60.01 (Hz)
Delta Voltage: 0.0 (V)
Delta Phase Angle: 0.0 (°)
Delta Frequency: 0.01 (Hz)

4 12/14/2005, 10:11:41.408

Current Profile: 1
Input Pickup: 1 3 6
Output Pickup: 1
Input Drop:
Output Drop: 5
System Status: Auto Fast Transfer Delta Phase Angle OK,
Auto Fast Transfer Delta Voltage OK,
Auto Fast Transfer Delta Frequency OK,
Auto Delayed In-Phase Transfer Delta Voltage OK,
Auto Delayed In-Phase Transfer Delta Frequency OK,
Transfer Ready,
Auto Transfer Enabled,
Auto Transfer Initiated,
27B #1 Bus Phase UV Transfer Initiated (S1 to S2),
Open Transition Transfer In Process,
S1 Breaker Closed,
Trip S1 Breaker Command,
Device ON,
Manual Fast/Hot Parallel Transfer Delta Phase Angle OK,
Manual Fast/Hot Parallel Transfer Delta Voltage OK,
Manual Fast/Hot Parallel Transfer Delta Frequency OK,
Manual Delayed In-Phase Transfer Delta Voltage OK ,
Manual Delayed In-Phase Transfer Delta Frequency OK,
Manual Transfer Enabled,

Figure E-2 Sequence of Events Recorder Detail Printout (page 3 of 4)

No.	Date & Time	Event Information

S2 Breaker Opened,
Source 2 (New Source),
Local Mode,

System Start Signal:		Internal 27B1		
VPS(S1):		VA: 119.4 (V)	VB:	VC:
VPS(S2):		VA: 119.4 (V)	VB:	VC:
VPS(Bus)		VA: 120.1 (V)	VB:	VC:
VNS(Bus)				
I(S1):	0.000 (A)	I(S2): 0.000 (A)		
Bus V/Hz:	100.05 %	Bus Frequency: 60.01 (Hz)		
Delta Voltage:		0.8 (V)		
Delta Phase Angle:		0.0 (°)		
Delta Frequency:		0.01 (Hz)		

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Figure E-2 Sequence of Events Recorder Detail Printout (page 4 of 4)

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F Appendix F – Transfer Logic Time Sequence

This Appendix contains Illustrations of the Transfer Logic Time Sequence for the Sequential Transfer Mode and the Simultaneous Transfer Mode.

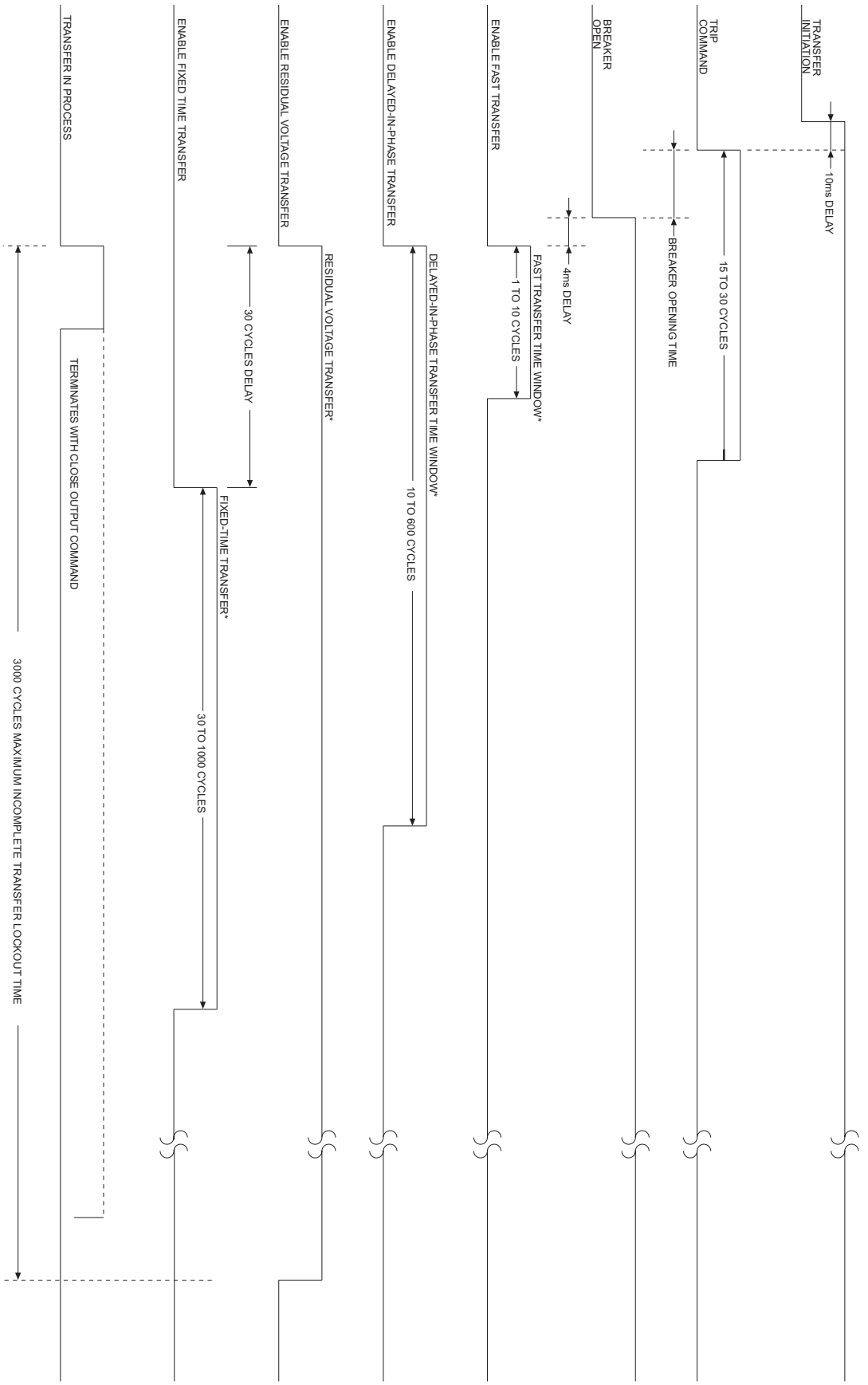

Figure F-1 Time Sequence of Transfer Logic in Sequential Transfer Mode

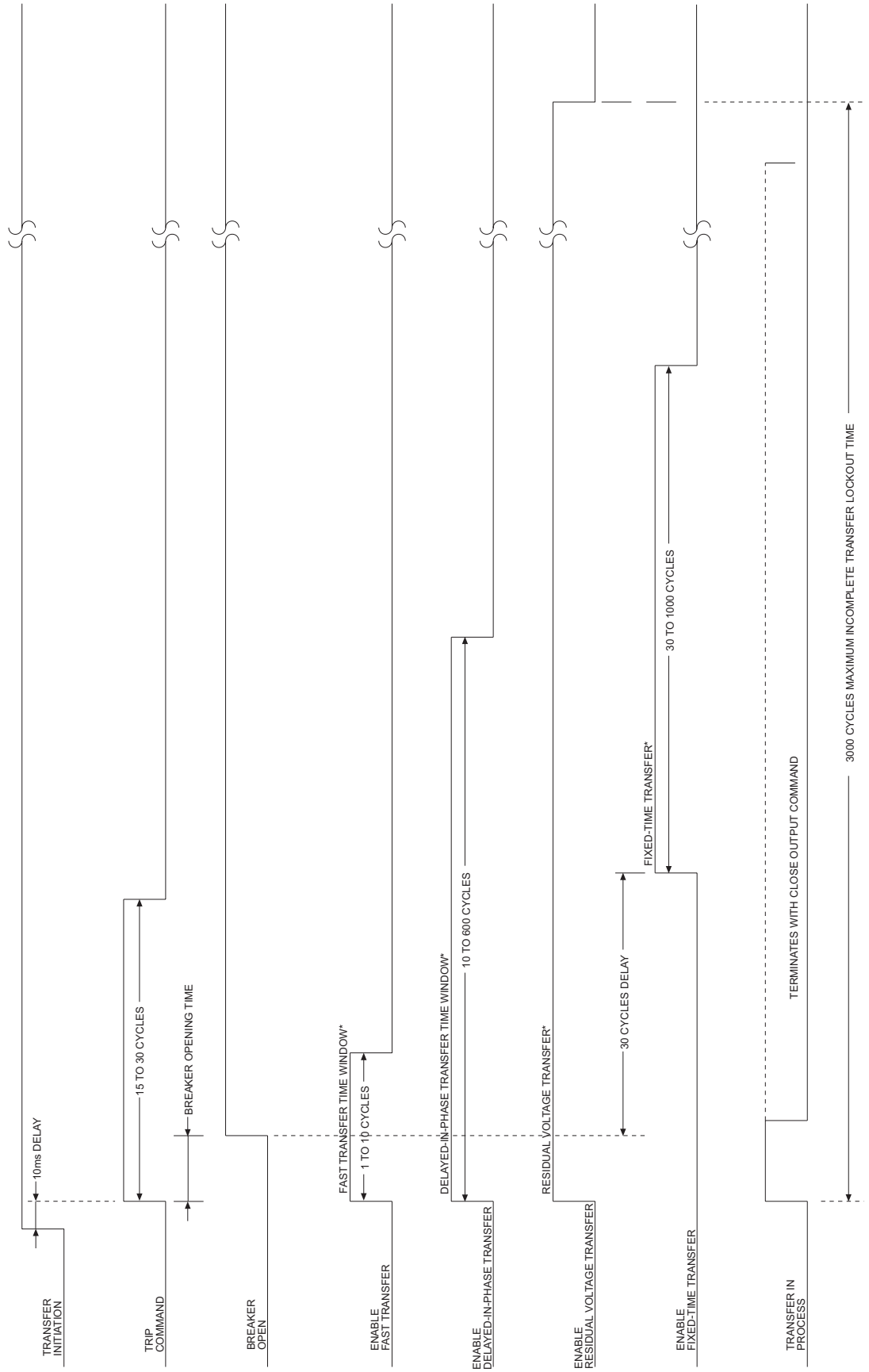

Figure F-2 Time Sequence of Transfer Logic in Simultaneous Transfer Mode

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G Appendix – Layup and Storage

Appendix G includes the recommended storage parameters, periodic surveillance activities and layup configuration for the M-4272 Motor Bus Transfer System.

Storage Requirements (Environment)

The recommended storage environment parameters for the M-4272 are:

- The ambient temperature where the M-4272 is stored is within a range of 5° C to 40° C
- The maximum relative humidity is less than or equal to 80% for temperatures up to 31° C, decreasing to 31° C linearly to 50% for relative humidity at 40° C.
- The storage area environment is free of dust, corrosive gases, flammable materials, dew, percolating water, rain and solar radiation.

Storage Requirements (Periodic Surveillance During Storage)

The M-4272 power supply contains electrolytic capacitors. It is recommended that power be applied to the relay (PS1 and optional PS2 redundant power supply when installed) every three to five years for a period of not less than one hour to help prevent the electrolytic capacitors from drying out.

Layup Configuration

The M-4272 includes a removable lithium battery backed TIMEKEEPER® module (Beckwith Electric component U25, Figure 5-11). The TIMEKEEPER module is the M-4272 real-time clock and also provides power to the unit's nonvolatile memory when power is not applied to the unit.

Layup of the M-4272 requires verifying that the system clock is stopped. The steps necessary to verify system clock status are as follows:

▲ **CAUTION:** Do not use the diagnostic mode in relays that are installed in an active protection scheme.

For units *with* the optional HMI panel:

1. Verify that the Power Supply (PS) fuses are installed.
2. Determine the unit power supply rating by observing the check box below the PS terminals on the rear of the unit.
3. Apply power to the unit consistant with the rating determined in Step 2 (see Section 5.3 , External Connections). The unit will enter the selftest mode.
4. When the selftests are complete, then press **ENTER** to begin main menu.
5. Press the right arrow pushbutton until **SETUP UNIT** is displayed.
6. Press **ENTER** to access the **SETUP UNIT** menu.
7. Press the right arrow pushbutton until **DIAGNOSTIC MODE** is displayed.
8. Press **ENTER**. A reset warning will be displayed:

```
PROCESSOR WILL RESET!
ENTER KEY TO CONTINUE
```

⬣ **WARNING: All relay functions and protection will be inoperative while the relay is in diagnostic mode.**

9. Press **ENTER**. Unit will now reset and **DIAGNOSTIC MODE** will be temporarily displayed, followed by **OUTPUT TEST** (RELAY). This is the beginning of the diagnostic menu.

10. Press the right arrow pushbutton until the following is displayed:

```
CLOCK TEST
← CLOCK led cal factory
```

11. Press **ENTER**. The following is displayed:

```
CLOCK TEST
03-JAN-1998 09:00:00.000
```

12. If the clock is running, press **ENTER** to stop the clock. The following is displayed:

```
CLOCK TEST
-CLOCK STOP-
```

■ **NOTE:** When the relay clock is stopped, the seconds will be displayed as 80.

13. Press **ENTER** and verify the relay clock is stopped. A display similar to the following is shown with the seconds stopped:

```
CLOCK TEST
03-JAN-09:01:80.000
```

14. When the clock has been verified to be stopped, then press **EXIT** until the following message appears:

```
PRESS EXIT TO
EXIT DIAGNOSTIC MODE
```

15. Press **EXIT** again to exit **DIAGNOSTIC MODE**. The relay will reset and normal running mode will resume.

■ **NOTE**: Pressing any button other than **EXIT** will return the user to **DIAGNOSTIC MODE.**

16. Remove power from the unit. The unit can now be placed in storage.

For units *<u>without</u>* the optional HMI panel:

1. Verify that the Power Supply (PS) fuses are installed.
2. Determine the unit power supply rating by observing the check box below the PS terminals on the rear of the unit.
3. Apply power to the unit consistant with the rating determined in Step 2 (see Section 5.3 , External Connections). The unit will enter the selftest mode.
4. Install M-3872 ISScom® Communications and Oscillograph Analysis Software (see Section 5.5, ISSccom Communications and Analysis Software Installation) on a PC that includes the following:
   - Microsoft Windows™ 98 Operating System or above
   - Equipped with a serial port
5. Connect a null modem cable from COM1 of the relay to the PC serial port.
6. Open communications with the relay utilizing Section 5.6, Activating Initial Local Communications.
7. Select **System/Setup/Set Date/Time** from the menu bar. ISScom will display the “Set Date/Time dialog screen Figure 3-15.
8. Verify that “Start Real-Time Clock” is displayed, then proceed as follows:
   a. If “Start Real-Time Clock” is displayed, then select “Save” and go to Step 9.
   b. If “Stop Real-Time Clock” is displayed, then select “Stop Real-Time Clock” and then select “Save”.
9. Close communications with the unit by selecting “Comm” from the menu bar and then select “Exit”.
10. Disconnect the null modem cable and then remove power from the unit. The unit can now be placed in storage.

Storage of the M-4272 greater than five years may require replacement of the lithium battery prior to placing the unit in service. Contact Beckwith Electric Customer Service for replacement procedure.

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Appendix I–Declaration of Conformity

DECLARATION OF CONFORMITY
(in accordance to ISO/IEC 17050-1:2004)

No. M-4272

Manufacturer's Name: ***Beckwith Electric CO, INC.***
Manufacturer's Address: ***6190 118th Avenue North***
Largo, FL 33773-3724

The manufacturer hereby declares under our sole responsibility that the M-4272 product conforms to the following product standard as of July 25th, 2006 in accordance to Directive 2004/108/EC for equipment incorporated into stationary installations:

BS EN 60255-26:2005

Electromagnetic compatibility (EMC)
Requirements for measuring relays and protection equipment

Electromagnetic Emissions: EN 60255-25:2000

***Conducted* 150 kHz to 30MHz**
***Radiated* 30MHz to 1000MHz**
Class A Limits

Electromagnetic Immunity

1 MHz Disturbance
IEC 60255-22-1:2005

Electrostatic Discharge 8kV Contact; 15kV Air
EN 60255-22-2:1997

Radiated RF 80MHz to 1000MHz 10V/m, 80% AM (1kHz)
EN 60255-22-3:2001

Fast Transients 5ns/50ns Bursts @ 5kHz for 15ms 300ms for 1 min.
2kV power supply lines and earth 2kV signal data and control lines
EN 60255-22-4:2002

Surge 1Kv Line to Line coupling, 2Kv Line to Earth coupling power supply lines
IEC 60255-22-5:2002

Conducted RF 150KHz to 80MHz 10V emf
EN 60255-22-6:2001

Power frequency immunity test
Class A 300 Vrms common mode – 150 Vrms differential mode
Class B 300 Vrms common mode – 100 Vrms differential mode
IEC 60255-22-7:2003

DC voltage interruptions
IEC 60255-11:1979

***EN 61010-1: 2001* Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1. General requirements European Safety Directive**

Manufacturers Contact*:*
Manager of Engineering
6190 118th Ave North
Largo, FL 33773-3724
Tel (727) 544-2326

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Legal Information

Patent

The units described in this manual are covered by U.S. Patents, with other patents pending.

Buyer shall hold harmless and indemnify the Seller, its directors, officers, agents, and employees from any and all costs and expense, damage or loss, resulting from any alleged infringementof United States Letters Patent or rights accruing thereform or trademarks, whether federal, state, or common law, arising from the Seller's compliance with Buyer's designs, specifications, or instructions.

Warranty

Seller hereby warrants that the goods which are the subject matter of this contract will be manufactured in a good workmanlike manner and all materials used herein will be new and reasonably suitable for the equipment. Seller warrants that if, during a period of five years from date of shipment of the equipment, the equipment rendered shall be found by the Buyer to be faulty or shall fail to peform in accordance with Seller's specifications of the product, Seller shall at his expense correct the same, provided, however, that Buyers shall ship the equipment prepaid to Seller's facility. The Seller's responsibility hereunder shall be limited to replacement value of the equipment furnished under this contract.

Seller makes no warranties expressed or implied other than those set out above. Seller specifically excludes the implied warranties of merchantibility and fitness for a particular purpose. There are no warranties which extend beyond the description contained herein. In no event shall Seller be liable for consequential, exemplary, or punitive damages of whatever nature.

Any equipment returned for repair must be sent with transportation charges prepaid. The equipment must remain the property of the Buyer. The aforementioned warranties are void if the value of the unit is invoiced to the Seller at the time of return.

Indemnification

The Seller shall not be liable for any property damages whatsoever or for any loss or damage arising out of, connected with, or resulting from this contract, or from the performance or breach thereof, or from all services covered by or furnished under this contract.

In no event shall the Seller be liable for special, incidental, exemplary, or consequential damages, including but not limited to, loss of profits or revenue, loss of use of the equipment or any associated equipment, cost of capital, cost of purchased power, cost of substitute equipment, facilities or services, downtime costs, or claims or damages of customers or employees of the Buyer for such damages, regardless of whether said claim or damages is based on contract, warranty, tort including negligence, or otherwise.

Under no circumstances shall the Seller be liable for any personal injury whatsoever.

It is agreed that when the equipment furnished hereunder are to be used or performed in connection with any nuclear installation, facility, or activity, Seller shall have no liability for any nuclear damage, personal injury, property damage, or nuclear contamination to any property located at or near the site of the nuclear facility. Buyer agrees to indemnify and hold harmless the Seller against any and all liability associated therewith whatsoever whether based on contract, tort, or otherwise. Nuclear installation or facility means any nuclear reactor and includes the site on which any of the foregoing is located, all operations conducted on such site, and all premises used for such operations.

Notice:

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