Instruction Booklet
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This instruction manual contains the information necessary to properly install, operate, test, and maintain the Microshield O/C relay. Although every effort was made to do so, this instruction manual does not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in conjunction with installation, operation, testing, and maintenance. Should particular problems arise which are not sufficiently covered for the user's purposes, please contact ABB Automation Inc.

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Section 1 - Product Overview

The Microshield O/C is an advanced microprocessor based unit that was designed to provide high value three phase and ground overcurrent protection and optional circuit breaker auto-reclosing, voltage inputs, power metering, and remote communications. Its applications include distribution feeders, transformers, line protection back up, motor protection and other features. The Microshield O/C provides protection as well as monitoring, metering, and fault recording capabilities.

The full drawout design allows for quick removal without the need for removal of hardware. The microprocessor based logic along with the power supply, VTs and CTs can be totally withdrawn from the case and interchanged with other cases without the need for calibration. CT shorting bars are an integral part of the unit case. All connections to the Microshield O/C are made at terminals on the rear of the unit.

The unit is packaged in a steel case for transient immunity and structural integrity that is suitable for conventional panel flush mounting. It can also be semiflush mounted by the use of available case spacers where unit depth is a concern. Available bezels make retrofit of older electromechanical and solid state relays possible without any panel cutting or drilling.

The Microshield O/C can be applied with voltage transformers (VTs) connected for operation at 69 or 120 volts AC phase-to-ground (Wye), 120 volts AC phase-to-phase (Delta or Open Delta with B phase grounded) or 208 volts AC phase-to-phase (Delta).

Because of its microprocessor base, the Microshield O/C provides the following features in one integrated package:

- Full featured three phase and ground time and instantaneous overcurrent protection
- Password protected settings and operations
- Easy to use Man-Machine-Interface (MMI) with 2 line by 16 character display
- Intelligent menu system for ease of programming
- Programmable inputs and outputs
- Calendar and real time clock keeps time even when control power is lost
- Settings, fault and event records are held in non-volatile memory
- Selection of ANSI or IEC time curves
- Multiple resident communications protocols provided including ASCII and Modbus®
- Targets for Status, Pickup, Time Trip, and Instantaneous Trip
- Faulted Phase and Magnitude in Fault Records
- Continuous self testing
- Full drawout design
- Events Records
- Fault Records
- Optional Voltage Inputs with Complete Power System Metering Package
- Optional four shot recloser with Zone Sequence Coordination
- Optional isolated rear RS-485 communications port
- Optional front RS-232 communications port

The Microshield O/C contains multiple current input ranges for both phase and ground. This creates a more versatile system especially in applications where a more sensitive neutral is required. The ranges are listed below in Table 1-1.

Table 1-1. Current Ranges

Catalog Digit # 5	Phase Range	Phase Nominal	Neutral Range	Neutral Nominal
0	1.5 - 12 A	5 A	1.5 - 12 A	5 A
1	1.5 - 12 A	5 A	0.5 - 4.0 A	1.67
2	1.5 - 12 A	5 A	0.1 - 0.8 A	0.33 A
4	0.3 - 2.4 A	1 A	0.3 - 2.4 A	1 A
5	0.3 - 2.4 A	1 A	0.1 - 0.8 A	0.33
6	0.1 - 0.8 A	0.33 A	0.1 - 0.8 A	0.33A
7	1.5 - 12 A	5 A	0.3 - 2.4 A	1A

Protection Fundamentals

The Microshield O/C relay uses an 8 samples per cycle RMS measurement algorithm (square root of the sum of the squares) that also skews consecutive samples by 1/16 cycle to better measure repetitive current data. It detects time overcurrent faults (51LT, 51P, 51N) and is sensitive to the fundamental, second, third, and part of the fourth harmonics in the current waveform. The measurements in the instananteous element (50P, 50N) are based on a peak detection algorithm where the largest peak value over the previous two (2) cycles is used. Both RMS and Peak Detection are subject to over-reach due to the effects of DC offset during a fault. This effect must be considered when setting the Microshield Overcurrent elements.

Additional Information Available on Request

- Microshield Automation Technical Guide - (part number TG-7.2.1.7-16)
- FAXBACK System - Domestic (Toll Free) 877-395-0721 and International 610-395-7333, Ext. 806 and 807 to access customer oriented information available on the system
- Transparent Curve Set (consult factory for availability)
- Customer Technical Assistance

  Tel: 800-634-6005 or 610-395-7333

  Fax: 610-395-1055

Section 2 - Getting Started

Warnings

- Do not install a Microshield O/C relay NOT configured for voltage transformer (VT) inputs into a relay case wired for VT inputs. The VT's will be shorted undesirably (as well as the relay output contacts) upon output contact activation thus causing excessive currents to flow from the VT's to the relay.

- Incorrect wiring may cause personal injury and damage the wiring sticker on the relay case, to the unit. Be sure the wiring agrees with the connection diagram in the Drawings Section of this manual or standard industry practice.

- Removal of the Microshield O/C from its case exposes the user to dangerous voltages. Use extreme care. Do not place hands or other objects into the Microshield O/C case.

Precautions

- Before energizing, check the Microshield O/C relay's Catalog Number against Section 17 - Ordering Selection Guide information to ensure the features and ratings of the relay in hand are acceptable for the installation.

- Apply only the rated control voltage as marked on the unit. See the "Ordering Information" Section for model number descriptions.

- High potential tests are not recommended. If control wire insulation tests are to be performed, remove the Microshield O/C from its case before testing and perform only a DC high potential test.

- Use caution when operating relay test equipment. Only qualified technicians or engineers should perform the tests outlined in this manual.

- The relay case screws are non-captive and should be carefully removed and retained appropriately until the relay internal card cage is reinstalled for service.

- When handling a circuit board contained in the Microshield O/C, proper Electrostatic Discharge (ESD) avoidance procedures must be used. Damage to the unit may occur otherwise.

- Immediately replace or repair the Microshield O/C if the status LED is red and/or the self check alarm has operated. Loss of protection and relay shut down occurs when the relay detects a self test failure. See the Maintenance Section of this manual for more details.

Note: Upgrading a unit from previous software version to a new software version WILL RESULT IN ALL SETTINGS BEING RESET TO FACTORY DEFAULTS. A backup copy of in-service settings should be made before installing new software.

Microshield O/C - Quick Start

The purpose of this section is to provide an engineer or technician with all of the necessary information on how to test trip and reclose (optional) a new Microshield O/C relay. It will answer all of the questions most frequently asked by users who are not familiar with the relay. It is recommended that the initial tests be performed according to the Acceptance Test procedure in this instruction manual before attempting to test with operational settings. These tests are performed on the factory default settings. See Section 11 for more information on the Acceptance Test procedure.

Initial Tripping

When shipped from the factory, mostly all of the protection functions in the Microshield O/C are enabled in the Primary Protective Settings. Only the recloser function is disabled. The Time Overcurrent elements are set to pickup at (1.2 x Inominal) and the Instantaneous to trip at 2 times this setting. See Table 1-1 for nominal current ratings.

The enabled settings must also be enabled in the Recloser Trip Functions settings 79-1, 79-2, 79-3, 79-4, and 79-5. Only the functions that are enabled (or set to lockout) can trip the relay during a specific recloser cycle. That is, only functions enabled (set to enable or lockout) in 79-1 can trip the relay before it's first reclose, only the functions enabled in 79-2 can trip between the first and second reclose, and so on. Elements that are selected "Disable" in any reclose sequence will not operate. From the factory, all protective elements are enabled at each step of the reclose sequence.

Alternatively, the protection functions can be disabled (torque controlled) by mapping a protective elements supervisory input to one of the programmable physical

inputs. This is performed in the “Inputs” Menu using the front panel Man-Machine-Interface or the optional communications interface. By mapping a logical input to a physical input (or combination) the element associated with that logical input will be “torque controlled”. In this case power must be applied to the associated physical input before the “torque controlled” element will operate. As shipped from the factory, no tripping functions are disabled in this way. The only functions that are mapped to physical inputs are the 52A and 52B functions which are mapped to IN-1 and IN-2 respectively. Changes in 52A and 52B contact wiring will also require appropriate internal mapping changes in the relay settings to avoid a locked out TRIP contact in the closed position if test current duration exceeds Trip Fail Timer setting. Note that breaker open position is also determined by current level falling below 5% of nominal current.

Yet another way that a function can be disabled, is by de-selecting it from the factory programmed Output Contact, “TRIP”. The Microshield O/C allows the user to choose which element(s) will activate any of the physical output contacts. From the factory, all protective elements are mapped to the “TRIP” contact. The “CLOSE” output contact is factory mapped to OUT 1. See the Rear Terminal Description drawing in the Drawings Section for the contact locations.

Reclosing

When the Microshield O/C with factory settings is first powered up, the reclosing function is disabled. There are a few different ways that reclosing is defeated in the factory settings. Any one of them is capable of disabling the recloser by itself and must each be taken into account. They are listed here:

1. The 43A function is mapped to a physical input. Enable the recloser by connecting control voltage to the input or by unmapping the 43A input.

2. The **79-1 Open Time** setting is initially set to “Lockout”. Change this setting to some time interval.

3. The function that causes the trip is set to send the relay into “Lockout” within the **79-x Select** setting.

Additionally, the relay will not reclose regardless of what the settings are if the unit is not tested properly. When the relay is tripped, the breaker status 52A and 52B contacts must change state and the fault current must drop to 5% of the neutral Inominal current value within the **Trip Failure Time** setting or the relay will proceed to Lockout and issue a breaker failure alarm. **The 52A and/or 52B inputs MUST be mapped for the recloser to operate.**

To stop the fault current, the current source should be configured to turn off when it senses that the trip contact has closed, or, the current could be wired through an A-contact controlled by the breaker. If the current cannot be turned off quickly enough, the **Trip Failure Time** setting (in the Configuration Settings group) can be increased up to 1 second (60 cycles).

Review

The protective elements are factory default mapped to TRIP or terminals 19 and 20.

The Close output is factory default mapped to OUT 1 or terminals 17 and 18.

The relay password is four spaces.

The recloser is disabled (set to lockout).

The Front Port is disabled (see Communications Section).

Section 3 - Man-Machine Interface

Overview

The Microshield O/C contains a Man-Machine Interface (MMI) as a standard. The MMI is used for local viewing and changing of settings, record retrieval, and metering. It contains a 2 row by 16 character backlit liquid crystal display (LCD). Six keys: "C" (clear) "E" (enter), "↑" (scroll up or increase value), "↓" (scroll down or decrease value), "←" (move cursor left) and, "→" (move cursor right) are used for all MMI operations. The "↑" and "↓" keys are used to scroll and to change numerical values. The "←" and "→" keys are used to move the cursor, select between options (such as time overcurrent curves) or to change between <Yes> or <No>.

An easy to follow smart menu system is used for all MMI functions. If a menu item is entered and no other key is pressed within 2 minutes, the display will return to the main menu. Pressing the "C" key will always back up one menu step. If a setting is changed, the Microshield O/C will ask "Save Settings?". Use the "←" and "→" keys to select <Yes> or <No>.

Note: The Microshield O/C has been designed so that relay reset can be achieved by pressing the "C", "E", and "↑" keys at the same time.

Changing Settings

Press "E" to enter the menu system from the default current display. See Figure 1 for menu structure. Press "E" on "Change Settings" and use the "↑" and "↓" keys to select the desired setting. When the desired setting is displayed, press "E" to get to the "Changing" screen. This is where a new value can be entered. Use the "←" and "→" keys to select the desired change. Note that an "∗" will appear next to the current setting. A new setting can be selected by pressing "E". The "∗" will move to this new setting. The "∗" will also appear next to a setting associated with the change just made. For example; the 51P curve is changed from very inverse to definite time. In this case the time delay setting associated with the definite time setting now changes to time dial. The time dial setting will also show an "∗" to indicate that the parameter has changed. Press "C" to back out of the "Changing" screen. Now note that an "∗" appears next to any changed element to indicate that a change was made. Press "C" again and the display will prompt "Save Settings? <No>. Use the "←" or "→" key to change the selection to <Yes>. Press "E" to save the settings to memory or "C" to escape without saving. Note that the Microshield O/C will not actually recognize a new setting until all of these steps are completed.

LCD Display

The MMI LCD is a 2 line by 16 character backlit Liquid Crystal Display (LCD). It continuously displays system currents Ia, Ib, Ic, and In until "E" is pressed at which time the Main Menu will be displayed. Note that at temperatures below 0 degrees C, the LCD contrast may be impeded.

There is not an LCD display contrast setting in the Microshield O/C relay. The LCD display viewing angle is adjusted in the factory to maximize clarity when looking directly even at the display. To adjust the LCD viewing angle:

1) Remove the inner card cage from the case. Inspect the MSOC to see which type of potentiometer is included in the particular relay. The potentiometers are typically blue in color, cubical in shape, and located just to the right of the LCD display behind the relay faceplate.

2) If the potentiometer is vertically mounted, adjust the potentiometer, reinsert the card cage into the case to check the improvement in viewing from bleow.

3) If the potentiometer is mounted horizontally, adjustment involves disassembling the front plate and using a screwdrive in a horizontal direction. This procedure is not normally recommended for field adjustments.

Clearing Targets

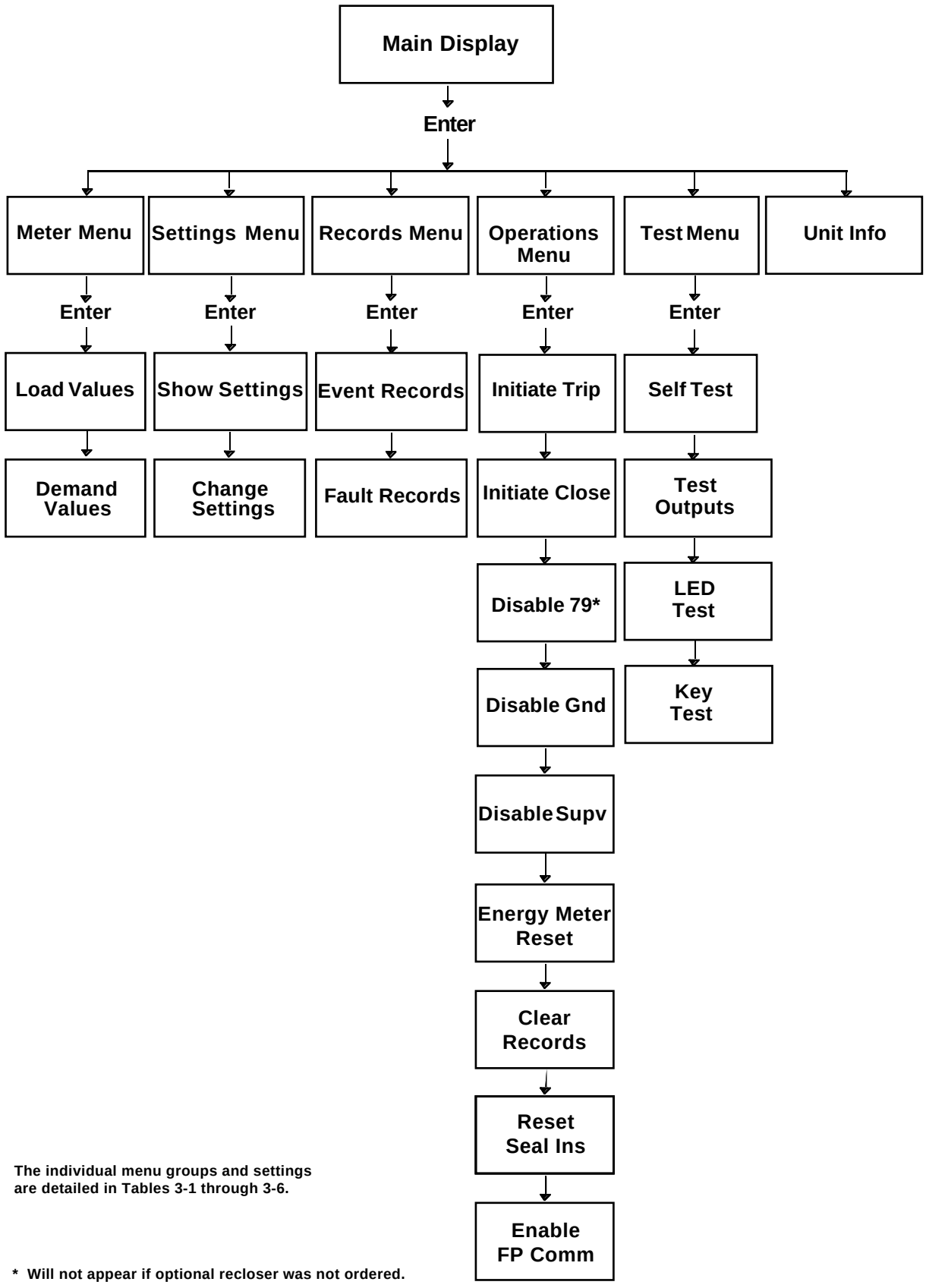
After a Microshield O/C trip operation has occurred, it may be desired to clear the sealed in targets (see the Targets Section of this manual for details). The display will show "Press <C> to Clear Targets". Press "C" again and the display will show "Clearing Targets". The sealed in target LEDs should extinguish at this time.

Using the Operations Menu

The Operations Menu was created for substation operators. This menu contains the normal switching conditions performed by operations personnel.

These include: Trip Initiate, Close Initiate, Recloser Disable, Ground Element Disable, Supervisory (SCADA) Disable, Reset Energy Meters, Clear Records, Reset Reclose Counter, and Front Communications Port Enable. A password is required for all operations.

When the recloser, ground elements, or supervisory functions are disabled, the LCD display will alternate from the main current display to "Elements Disabled" in one second intervals.



The individual menu groups and settings are detailed in Tables 3-1 through 3-6.

*** Will not appear if optional recloser was not ordered.**

Figure 1. Man-Machine Interface Menu Structure

Table 3-1. Meter Menu

Meter Menu	View real time and demand metering values.
Load Values:	The real time system values.
Ia:	The current level seen on phase A.
Ib:	The current level seen on phase B.
Ic:	The current level seen on phase C.
In:	The current level seen on the neutral.
kVan or KVab:	The voltage level seen on phase a (or from a-b for delta VT's.
kVbn or kVbc:	The voltage level seen on phase b (or from b-c for delta VT's.
kVcn or kVca:	The voltage level seen on phase c (or from c-a for delta VT's.
kW3p:	The 3 phase kilowatts.
kVAr3p:	The 3 phase kiloVArs.
Kwhr3p:	The 3 phase kilowatt hours.
KVAr3p:	3-phase KVAr Hrs.
Frequency:	The system frequency.
PF:	Power Factor.
Demand Values:	The demand values accumulated over time.
Ia:	The current level seen on phase A.
Ib:	The current level seen on phase B.
Ic:	The current level seen on phase C.
In:	The current level seen on the neutral.
kW3p:	The 3 phase kilowatts.
kVAr3p:	The 3 phase kiloVArs.

Table 3-2. Records Menu

Records Menu	**View Event and Fault Records**
Event Records	View any operation of the Microshield O/C. Press "E" then press ↑ or ↓ arrow keys to view individual events.
Fault Records	View any fault data stored in the Microshield O/C. Press "E" then press ↑ or ↓ arrow keys to view individual faults. Use the ← or → keys to view the details of a particular fault.

Table 3-3. Settings Menu

Settings Menu	View or Change the relay settings.
Show Settings:	Press "E" then ↑ or ↓ arrow keys to view a group of settings.
Primary:	Press "E" then ↑ or ↓ arrow keys to view the Protective settings.
Config:	Press "E" then ↑ or ↓ arrow keys to view the Configuration settings.
Inputs:	Press "E" then ↑ or ↓ arrow keys to view the Logical Input mapping.
Outputs:	Press "E" then ↑ or ↓ arrow keys to view the Logical Output mapping.
Seal Ins:	Press "E" then ↑ or ↓ arrow keys to view the Seal Ins.
Mstr. Trip:	Press "E" then ↑ or ↓ arrow keys to view the Master Trip mapping.
Comm:	Press "E" then ↑ or ↓ arrow keys to view the Communication settings.
Clock:	Press "E" then ↑ or ↓ arrow keys to view the Clock.
Reclosr:	Press "E" then ↑ or ↓ arrow keys to view the Recloser settings.
Counters:	Press "E" then ↑ or ↓ arrow keys to view the Counters setttings.
Change Settings:	Press "E" then ↑ or ↓ arrow keys to change a group of settings.
Primary:	Press "E" then ↑ or ↓ to make selection. Use the ← , or → keys to modify the value. Press "C" when complete and <Yes> to "Save Settings".
Config:	Press "E" then ↑ or ↓ to make selection. Use the ← , or → keys to modify the value. Press "C" when complete and <Yes> to "Save Settings".
Inputs:	Press "E" then ↑ or ↓ to make selection. Use the ← , or → keys to modify the value. Press "C" when complete and <Yes> to "Save Settings".
Outputs:	Press "E" then ↑ or ↓ to make selection. Use the ← , or → keys to modify the value. Press "C" when complete and <Yes> to "Save Settings".
Seal Ins:	Press "E" then ↑ or ↓ to make selection. Use the ← , or → keys to modify the value. Press "C" when complete and <Yes> to "Save Settings".
Mstr. Trip:	Press "E" then ↑ or ↓ to make selection. Use the ← , or → keys to modify the value. Press "C" when complete and <Yes> to "Save Settings".
Comm:	Press "E" then ↑ or ↓ to make selection. Use the ← , or → keys to modify the value. Press "C" when complete and <Yes> to "Save Settings".
Clock:	Press "E" then ↑ or ↓ to make selection. Use the ← , or → keys to modify the value. Press "C" when complete and <Yes> to "Save Settings".
Reclosr:	Press "E" then ↑ or ↓ to make selection. Use the ← , or → keys to modify the value. Press "C" when complete and <Yes> to "Save Settings". No settings will be available from this item if the optional recloser was not ordered.
Counters:	Press "E" then ↑ or ↓ to make selection. Use the ← , or → keys to modify the value. Press "C" when complete and <Yes> to "Save Settings".

Table 3-4. Operations Menu

Operations Menu	Operate Trip, Close and various supervisory functions
Initiate Trip:	Press “E” and follow the instructions to operate the TRIP contact. The contact will close until a breaker change of state is seen. A password is required for operation. If the 52a or 52b inputs are not mapped to a physical input, the Microsheild O/C cannot determine the breaker state and will not allow this operation. It will return “invalid CB State” on the LCD display.
Initiate Close:	Press “E” and follow the instructions to operate the CLOSE logical output. The contact will close until a breaker change of state is seen or the Close Fail Timer expires. The CLOSE logical output must be assigned to a physical output. A password is required for operation. If the 52a or 52b inputs are not mapped to a physical input, the Michroshield O/C
Disable 79:	Press “E” and follow the instructions to disable the recloser. A password is required for this operation. The LCD display will flash “79 Disabled” when “Yes” is selected to alert the user of this temporary condition. It is recommended that this item be used for temporary outages only. If control power is lost to the Microshield O/C, the 79 Disable will revert to the disable state. The 43A logical input will be ignored when “79 Disable” is set to “Yes.” This menu item will not appear if the optional recloser function was not ordered.
Disable Gnd:	Press “E” and follow the instructions to disable the 51N, 50N protective elements. a password is required for this operation. The LCD display will flash “Gnd. Disabled” when “Yes” is selected to alert the user of this temporary condition. It is recommended that this item be used for temporary outages only. If control power is lost to the Microshield O/C, the Gnd Disable will revert to the disable state. The 51N and 50N supervisory logical inputs will be ignored when the “GND Disable” is set to “Yes.”
Disable Supv:	Press “E” and follow the instructions to disable any remote communications command writes (I.E. from a SCADA master). The unit will still respond to any read or change settings requests but will ignore any Trip, Close, Operations, and Test Outputs commands. A password is required for this operation. The LCD will flash “Supv. Disabled” when “Yes” is selected to alert the user of this temporary condition. It is recommended that this item be used for temporary outages only. If control power is lost to the Microshield O/C, the Supv Disable will revert to the disable state.
Enrgy Mtrs Rst:	Press “E” to reset the Energy Meters (kiloWatt-Hours, kiloVar-Hours) to 0. A password is required for this operation.
Clear Records:	Press “E” to clear the fault and event records.
Reset Seal Ins:	Press “E” then ← or → keys to reset the Seal Ins. A password is required for this operation.
Reclosr:	Press “E” to reset the reclose count to 0. A password is required for this operation. This menu will not appear if the optional recloser function was not ordered.
Enable FP Comm:	Press “E” to enable front port communications. The front port will be shut down after one hour if no activity has been detected. The rear RS-485 communications port is disabled while the front port is enabled. A password is not required for this operation. If control power is lost to the Microshield O/C while the front port is enabled, after re-power, the front port will be disabled and the rear port enabled. This item applies only to units with the communication option.

Table 3-5. Test Menu

Test Menu	Operate contacts, self test, and LED’s
Self Test:	Press “E: to display the relay self test status.
Test Outputs:	Press “E” and select the output contact or contacts to be tested. Once activated, the contact or contacts will activate for 1 second. A password is required for this operation.
LED Test:	Press “E” to test all front panel LED’s. The test will light all LED’s then pulse each LED for 1 second starting with the Status LED, PU, TIME, and finally INST.
Key Test:	Press “E” to test the front panel keys. As each key is depressed, the related character will appear on the display. Press the “C: button twice to exit this test.

Table 3-6. Unit Info

Unit Info.	Displays all Microshield O/C Information: Catalog Number, Serial Number, CPU rev., Comm rev.

Section 4 - Settings

Primary Protective Elements

Tables 4-1 outline the protective elements, ranges, and factory default settings contained in the Microshield O/C relay. These settings are located in the "Primary" Section of the "Change Settings" or "Show Settings" Menu. A more detailed description follows the table. ANSI and IEC Time Curve settings can be accessed and changed via the front panel MMI or via the optional communications port. When sending a relay setting to the relay via a communications port, it is recommended to read the setting back to ensure the transaction was completed. In some circumstances, environmental noise incident on the network cable can result in some message transactions not getting through. Automatic time-out / re-send are not part of the basic MSOC relay setting tool.

Phase Time Overcurrent Element 51P

The phase time overcurrent element, 51P, contained in the Microshield O/C is set based on CT secondary current as connected to the phase current inputs. See Figure 11 in the Connection and Outline Drawings Section of this manual for a typical connections drawing. Multiple time curves and time dials are available (see Table 4-1) to closely coordinate with other devices in the system. The "Overcurrent Calculations and Curves" Section contains the time-current curves included in the Microshield O/C. The 51P pickup, curve type, and time dial are all set in the protective settings menu of the front panel MMI. For the 51P element to operate a contact, it must be mapped to a physical output contact (see "Programmable Outputs" Section). 51P is factory default to operate the "TRIP" contact.

The 51P element can be supervised ("torque controlled") by mapping the 51P logical input to a physical input for external supervision. See the "Programmable Inputs" Section for programming instructions.

There are two selectable reset modes available under "Config" Settings for the 51P element. The instantaneous mode is used to coordinate with other instantaneous reset devices such as solid state or microprocessor based relays. In the instantaneous mode the 51P will reset when the current drops below the pickup setting for one half cycle. The delayed mode simulates the action of an electromechanical induction disk relay. In this mode the 51P reset follows a slow reset characteristic that depends upon the duration of the overcurrent condition and the amount of load current flowing after the event. The reset mode when set applies to all time overcurrent elements in the Microshield O/C. This setting is made in the "Configurations Menu" of the front panel MMI.

Table 4-1. ANSI and IEC Protective Settings

Setting Name	Setting Range	Increment	Factory Default
51LT	Disable	-	-
	Long Time Extremely Inverse	-	-
	Long Time Very Inverse	-	-
	Long Time Inverse	-	Long Time Inverse
	Very Long Time Extremely Inverse	-	-
	Very Long Time Very Inverse	-	-
	Very Long Time Inverse	-	-
	Long Definite Time	-	-
	IEC Long Time Inverse	-	-
51LT Pickup*	1.5 - 12 Amperes	0.25	6 Amperes
	0.3 - 2.4 Amperes	0.05	1.2 Amperes
51LT Time Dial	1 to 10	0.1	1.0
51LT Time Delay	100 - 1200 Seconds	10.0	100
51P	Extremely Inverse	-	-
	Very Inverse	-	-
	Inverse	-	-
	Short Time Inverse	-	-
	Long Time Extremely Inverse	-	-
	Long Time Very Inverse	-	-
	Long Time Inverse	-	Long Time Inverse
	Definite	-	-
	Definite 2	-	-
	IEC Extremely Inverse	-	-
	IEC Very Inverse	-	-
	IEC Inverse	-	-
	IEC Long Time Inverse	-	-
51P Pickup*	1.5 - 12 Amperes	0.25	6 Amperes
	0.3 - 2.4 Amperes	0.05	1.2 Amperes
	0.1 - 0.8 Amperes	0.01	0.4 Amperes
51P Time Dial	1 to 10	0.1	1.0
51P Time Delay Definite	0 - 30 Seconds	0.1	1.0
51P Time Delay Definite 2	0 - 3 Seconds	0.01	1.0
50P	Disable	-	-
	Short Time Inverse	-	-
	Standard (no delay)	-	-
	Definite	-	Definite Time
	Definite 2	-	-

*** See Table 1-1 in Section 1 for nominal current ranges.**

Table 4-1. ANSI and IEC Protective Settings (Cont'd)

Setting Name	Setting Range	Increment	Factory Default
50P Pickup	1.0 - 20 x 51P Pickup setting	0.1	2
50P Time Dial	1 to 10	0.1	1.0
50P Time Delay Definite	0 - 30 Seconds	0.1	1.0
50P Time Delay Definite 2	0 - 3 Seconds	0.01	1.0
51N	Disable	-	-
	Extremely Inverse	-	-
	Very Inverse	-	-
	Inverse	-	-
	Short Time Inverse	-	-
	Long Time Extremely Inverse	-	-
	Long Time Very Inverse	-	-
	Long Time Inverse	-	Long Time Inverse
	Definite	-	-
	Definite 2	-	-
	IEC Extremely Inverse	-	-
	IEC Very Inverse	-	-
	IEC Inverse	-	-
	IEC Long Time Inverse	-	-
51N Pickup*	1.5 - 12 Amperes	0.25	2.0 Amperes
	0.5 - 4.0 Amperes	0.1	2.0 Amperes
	0.3 - 2.4 Amperes	0.05	0.4 Amperes
	0.1 - 0.8 Amperes	0.01	0.4 Amperes
51N Time Dial	1 to 10	0.1	1.0
51N Time Delay Definite	0 - 30 Seconds	0.1	1.0
51N Time Delay Definite 2	0 - 3 Seconds	0.01	1.0
50N	Disable	-	-
	Short Time Inverse	-	-
	Standard (no delay)	-	-
	Definite	-	Definite Time
	Definite 2	-	-
50N Pickup	1.0 - 20 x 51N Pickup setting	0.1	2
50N Time Dial	1 to 10	0.1	1.0
50N Time Delay Definite	0 - 30 Seconds	0.1	1.0
50N Time Delay Definite 2	0 - 3 Seconds	0.01	1.0

*** See Table 1-1 in Section 1 for nominal current ranges.**

Phase Time Overcurrent Element 51LT

The phase time overcurrent element, 51LT, contained in the Microshield O/C is identical in operation to the 51P element. The difference is in the available time overcurrent curves available to the 51LT element. The 51LT was included in the Microshield O/C design to emulate the operation of the ABB IMPRS overcurrent relay. See the 51P description for operation of the 51LT along with Table 4-1 to reference the available Time Overcurrent Curves.

The 51LT element can be supervised ("torque controlled") by mapping the "51LT" logical input to a physical input for external supervision. See the "Programmable Inputs" Section for programming instructions.

For the 51LT element to operate a contact, it must be mapped to a physical output contact (see "Programmable Outputs" Section). 51LT is factory default to operate the "TRIP" contact.

Ground Time Overcurrent Element 51N

The ground time overcurrent element, 51N, contained in the Microshield O/C is set based on CT secondary current as connected to the neutral current input. See Figure 11 in the Connection and Outline Drawings Section of this manual for a typical connections drawing. Multiple time curves and time dials are available (see Table 4-1) to closely coordinate with other devices in the system. The "Overcurrent Calculations and Curves" Section contains the time-current curves included in the Microshield O/C. The 51N pickup, curve type, and time dial are all set in the Protective Settings Menu of the front panel MMI. For the 51N element to operate a contact, it must be mapped to a physical output contact (see "Programmable Outputs" Section). 51N is factory default to operate the "TRIP" contact.

The 51N element can be supervised ("torque controlled") by mapping the "51N" logical input to a physical input for external supervision. See the "Programmable Inputs" Section for programming instructions. When the "GND Disable" function of the Operations Menu is set to "Yes", the 51N element will not operate and the 51N logical input will be ignored.

There are two selectable reset modes available for the 51N element. The instantaneous mode is used to coordinate with other instantaneous reset devices such as solid state or microprocessor based relays. In the instantaneous mode the 51N will reset when the current drops below the pickup setting for one half cycle. The delayed mode simulates the action of an electromechanical induction disk relay. In this mode the 51N reset follows a slow reset characteristic that depends upon the duration of the overcurrent condition and the amount of load current flowing after the event. The

reset mode when set applies to all time overcurrent elements in the Microshield O/C. This setting is made in the "Configurations Menu" of the front panel MMI.

Phase Instantaneous Overcurrent Element 50P

The 50P function operates when the level of any phase current exceeds the pickup level. It is enabled where phase instantaneous tripping is desired. It is typically set at a higher pickup level than the phase time overcurrent pickup. The pickup level of 50P is set as a multiple of the 51P pickup. The timing of the 50P element varies depending upon which curve is selected (see Table 4-1). The 50P pickup, curve type, and time dial are all set in the Protective Settings Menu of the front panel MMI. For the 50P element to operate a contact, it must be mapped to a physical output contact (see "Programmable Outputs" Section). 50P is factory default to operate the "TRIP" contact.

50P can be supervised ("torque controlled") by mapping the "50P" logical input to a physical input for external supervision or Logical Output for internal supervision. See the "Logical Inputs" Section for programming instructions.

When the circuit breaker is closed by an external source such as a control switch or SCADA, the 50P can be disabled from tripping for a "Cold Load Time". See the "Cold Load Time" Section for more details.

Ground Instantaneous Overcurrent Element 50N

The 50N function operates when the level of neutral current exceeds the pickup level. It is enabled where ground instantaneous tripping is desired. It is typically set at a higher pickup level than the ground time overcurrent pickup. The pickup level of 50N is set as a multiple of the 51N pickup. The timing of the 50N element varies depending upon which curve is selected (see Table 4-1). The 50N pickup, curve type, and time dial are all set in the protective settings menu of the front panel MMI. For the 50N element to operate a contact, it must be mapped to a physical output contact (see "Programmable Outputs" Section). 50N is factory default to operate the "TRIP" contact.

50N can be supervised ("torque controlled") by mapping the "50N" logical input to a physical input for external supervision or Logical Output for internal supervision. See the "Logical Inputs" Section for programming instructions. When the "GND Disable" function of the Operations Menu is set to "Yes", the 50N element will not operate and the 50N logical input will be ignored.

When the circuit breaker is closed by an external source such as a control switch or SCADA, the 50N can be disabled from tripping for a "Cold Load Time". See the "Cold Load Time" Section for more details.

Relay Configuration Settings

Table 4-2 outlines the relay configuration settings, ranges, and factory default settings contained in the Microshield O/C relay. These settings are located in the "Config" Section of the "Change Settings" or "Show Settings" Menu. A more detailed description follows the table.

Table 4-2. Configurations Settings

Setting Name	Setting Range	Increment	Factory Default
Phase CT Ratio:	**1 - 2000:1**	1	100:1
Neutral CT Ratio:	**1 - 2000:1**	1	100:1
VT Ratio:	**1 - 1000:1**	1	100:1
VT Connection:	**Wye, Delta**	-	Delta
Trip Fail Time:	**5 - 60 Cycles**	1	18 Cycles
Demand Constant:	**15, 30, or 60 Minutes**	-	30 Minutes
Reset Mode:	**Delayed or Instantaneous**	-	Instantaneous
Voltage Display	**Line-Neutral, Line-Line**	-	Line-Line
Password:	**An 4 Alphanumeric Characters**	-	Four Spaces
Cold Load Time Mode:	**Seconds, Minutes Disable**	-	Seconds
Cold Load Time:	**1-255 Seconds/ Minutes**	1	Disable
Close Fail Time:	**5-999 Cycles**	1	18 Cycles

***** No settings will be available from this item if the optional recloser was not ordered.

Trip Fail Timer (Trip Fail)

The Microshield O/C determines a successful trip by the state of the 52a and 52b breaker contacts (when mapped, not required) and the level of input current. The 52a and 52b contacts must indicate an open breaker and the current must have dropped to below 5% of the neutral nominal current rating for the Microshield O/C to recognize a cleared breaker. Although it is recommended that the 52a and 52b

contacts be used, the Microshield O/C does not require them. Either 52a or 52b can be used. If neither are used, the Microshield O/C determines the breaker state by the level of current only. In this case a closed breaker is determined when the input current is above 5% of the neutral nominal current rating. See the Product Overview for nominal current ratings. A cleared breaker is determined when current is below 5%. It should be noted that when using the optional reclose, 52a , 52b, or both, must be used.

At the time that the relay issues a trip, it also starts a "Trip Fail Timer". This timer is used to determine a failed or slow breaker. It is set in the Configuration Setting and is selectable for 5 to 60 cycles in 1 cycle steps. If the timer expires before the Microshield O/C determines an open breaker (either or both conditions stated above are met), a Breaker Failure Alarm, CBFAIL, logical output is asserted. If the Microshield O/C determines an open breaker within the Trip Fail Time setting, it will reset and re-enable when the breaker is reclosed. The Trip Fail Timer is factory default to 18 cycles.

Demand Time Constant (Dmd Const)

The demand time constant is the time interval in which the demand meters will take a "snapshot" of the load. These values are taken and averaged every time the demand constant timer expires. See the Metering Section of this manual for more details on Demand Metering.

Reset Mode (Reset)

The Microshield O/C has the capability to instantaneously reset after a time overcurrent operation or to emulate the operation of an electromechanical induction disk relay. The delayed reset mode can be used where reset coordination is desired with other electromechanical devices on the system. If no coordination is needed the instantaneous setting should be used. The delayed reset mode conforms to the IEEE C37.112 standard. See the Overcurrent Calculations and Curves Section for details on calculating reset times.

Note: When a definite time is selected in the 51P/51N/ 51LT settings, the reset mode will always be instantaneous.

Voltage Display Mode (V Display)

This setting defines how the voltage metering will be displayed on the Microshield O/C LCD display. In the case where the actual VTs are connected in delta but a Line to Neutral display is selected, the Microshield O/C will assume a balanced system and no V_0. This setting does not affect how the voltages are logged in the fault records. There are no voltage protection functions or settings in the relay.

Change Password

The Microshield O/C factory default password is four spaces. This selection is used to enter a different user defined alphanumeric password. This password is used anytime a setting is changed or operation performed.

Cold Load Time Mode (CLT Mode)

This setting switches the cold load timer as described in the configuration settings to seconds or minutes. A selection of "Disable" is also available in cases where cold load instantaneous disable is not desired (see below).

Cold Load Timer (Cold Load)

The Cold Load Timer is used to block undesired instantaneous unit (50P/50N) tripping due to inrush currents seen by the Microshield O/C after a manual breaker close and feeder re-energization. The timer is set from 1 to 255 seconds with a resolution of 1 second. It can also be set from 1 to 255 minutes by setting the Cold Load Time Mode" to minutes. During the cold load time delay period, a logical output, CLTA, is asserted. This logical output can be mapped to a physical output for alarm and control purposes (see "Programmable Outputs" Section). The cold load timer is operational only after a manual breaker close and does not function during an automatic reclose sequence. The 52a and/or the 52b contact must be mapped to a physical input for the cold load function to operate.

When the 52a and/or 52b contact indicate a circuit breaker transition from open to close, the cold load timer, when enabled, will begin to decrement. When the timer reaches zero the instantaneous elements (50P/50N) will be enabled. While the cold load timer is in operation, the torque control inputs "50P" and "50N" will be forced to zero, or disable. The cold load timer will be set to zero if the circuit breaker state is lost during the cold load timer decrementation. The timer is again preset when the 52a and/or 52b contact indicate a circuit breaker transition from close to open.

This function is useful where undesired tripping may occur due to high current demand when a breaker is closed after an extended outage. Loads such as motors, HVAC systems, and residential electric heat can cause this undesired tripping to occur.

Zone Sequence (79 ZSC)

See the Recloser Section of this manual.

Close Fail Time (Close Fail)

See the Recloser Section of this manual.

Real Time Clock

The Microshield contains a real time clock and calendar that will remain active even upon loss of control power. From the factory, the time and date are set to 00:00:00 and 00/00/00 respectively. These settings effectively disable the clock and calendar and reduce the drain on the internal NiCad battery. To set the clock and calendar select the "Clock" from the "Change Settings" Menu. See the Maintenance Section for more details on the battery backup feature.

Note: The real time clock and calendar will reset to 0 if the Microshield O/C is disassembled or new CPU firmware is installed. See the Maintenance Section for details on installing new firmware.

Breaker Counters

The Microshield O/C contains several counters to provide critical information which can be used to schedule breaker maintenance. Any counter can be set using the Settings Menu through the front panel MMI or using ASCII commands through a communication port. Settings can be created using either Menu ASCII or Fast ASCII. See Section 10, Table 10-23 for the Fast ASCII command structure.

Table 4-3. Breaker Counter Settings

Counters Menu	Setting Range	Increment	Default
Breaker Operations	0 - 9999	1	0
KSIA Kilo – Amp summation, A phase	0 - 9999	1	0
KSIB Kilo – Amp summation, B phase	0 - 9999	1	0
KSIC Kilo – Amp summation, C phase	0 - 9999	1	0
79 – 1 Operations	0 - 9999	1	0
79 – 2 Operations	0 - 9999	1	0
79 – 3 Operations	0 - 9999	1	0
79 – 4 Operations	0 - 9999	1	0
Total Recloser Operations	0 - 9999	1	0
Total Overcurrent Trips	0 - 9999	1	0
Successful Recloser Operations	0 - 9999	1	0

Section 5 - Recloser

The Microshield O/C recloser contains the following reclosing functions:

- Four Shots: 79-1, 79-2, 79-3, 79-4 (79-5 lockout) with selectable instantaneous overcurrent cutout and programmable open times.
- Reset Timer (RESET TM)
- Cutout Timer (CO TM)
- Maximum Recovery Timer (RECOV TM)
- Recovery Limit Count (LIMIT CNT)
- Recloser Limit Timer (LIMIT TM)
- Maximum Reclosures to Lockout (R TO LKO)
- Zone Sequence Coordination (ZSC)
- External Reclose Initiate (EXTRI)
- Internal and External Reclose Enable (43a)
- Close Fail Timer

Table 5-1 outlines the recloser settings, the ranges, and the factory default settings. These settings are located in the "Recloser" Section of the "Change Settings" Menu only if the optional recloser function is included. A more detailed description follows the table.

Note: The 52a and/or 52b contact is required as input to the Microshield O/C for the Recloser to function. If neither of these is provided, the recloser will not operate.

The recloser function, 79, provides automatic reclosing of the circuit breaker after the Microshield O/C has tripped due to a fault. The circuit breaker will close after a preprogrammed time delay called "Open Time". Zero to four recloser steps can be selected and each has its own separate "Open Time" and selection of protective elements. The steps as labeled in the Microshield O/C are 79-1 (step 1), 79-2 (step 2), 79-3, (step 3), and 79-4 (step 4). A 79-5 step is provided only as a lockout path after the first four steps. It has no open time setting. A logical output Reclose In Progress (RIP) is asserted during the entire reclose sequence.

At each point in the reclose steps the protective elements 50P, 50N, 51LT, and 51N can be enabled or disabled from

Table 5-1. Recloser Settings

Setting Name	Setting Range	Increment	Factory Default
79-1 Select	50P, 50N, 51N, 51LT	-	All Enabled
	Enable, Disable, Lockout		
51P Lockout	Yes, No	-	No
79-1 Open Time	0.1 - 200 seconds, Lockout	0.1	Lockout
79-2 Select	50P, 50N, 51N, 51LT	-	All Enabled
	Enable, Disable, Lockout		
51P Lockout	Yes, No	-	No
79-2 Open Time	0.1 - 200 seconds, Lockout	0.1	Lockout
79-3 Select	50P, 50N, 51N, 51LT	-	All Enabled
	Enable, Disable, Lockout		
51P Lockout	Yes, No	-	No
79-3 Open Time	0.1 - 200 seconds, Lockout	0.1	Lockout
79-4 Select	50P, 50N, 51N, 51LT	-	All Enabled
	Enable, Disable, Lockout		
51P Lockout	Yes, No	-	No
79-4 Open Time	0.1 - 200 seconds, Lockout	0.1	Lockout
79-5 Select	50P, 50N, 51N, 51LT	-	All Lockout
79 Reset Time	3 - 200 seconds	1	10
79-Cutout Time	Disable, 1 - 200 seconds	1	Disable
79 Recovery Time	Disable 1 - 9999 seconds	1	Disable
Recovery Limit Count	1 - 99	1	10
79 Limit Time	1 - 9999 seconds	1	100
79 Reclose to Lockout	Disable 1 - 9999 counts	1	Disable

tripping. They can also be set such that if they operate the reclose sequence will be halted and "locked out". Lockout is a point at which the circuit breaker will remain open after a fault and must be manually closed. The 51P time overcurrent element is always enabled in every reclose step but can be programmed to lockout for cases where 51P is used as line overload tripping. These steps can be used to provide high speed reclosing for the first trip and delayed reclosing thereafter. A reset timer runs after a successful circuit breaker reclose (whether automatic or manual) and is used to reset the reclose sequence to 79-1 after its time period expires. If the Microshield O/C trips the circuit breaker again before the expiration of the reset time, the reclose sequence will increment one step; i.e. 79-1 to 79-2. The settings as programmed in the 79-2 step then become active. This incremental stepping occurs until the recloser locks out. At this point the circuit breaker must be manually closed. The LCD display on the front of the Microshield O/C will alternate "Recloser Lockout" with the main display.

The logical input, 43A is used to remotely enable or disable the recloser (i.e. via control switch). If this logical input is not mapped to a physical input (see "Programmable Inputs" Section), the recloser is defaulted to enabled. If the recloser is in the middle of a sequence and the 43A logical input is made inactive the recloser will stop operation. When 43A is returned to the active state, the recloser will be reset to step 79-1. The recloser function can also be disabled by setting 79-1 to lockout. A separate "79 Enable" function is contained in the Operations Menu and is used to emulate a control switch. This function is password protected.

Close Fail Timer (Close Fail)

The Microshield O/C determines a successful close by the state of the 52a and/or 52b breaker contacts.

At the time that the Microshield O/C issues a close, it also starts a "Close Fail Timer". This timer is used to determine a failed or slow breaker. It is set in the Configuration Setting and is selectable for 5 to 999 cycles in 1 cycle steps. If the timer expires before the Microshield O/C determines a closed breaker (condition stated above is met), it will halt automatic reclose or manual close operation and wait for the proper state to appear (a manual close occurs). A logical output called "CB Fail" will assert at this time. If the close failure occurred while the recloser was at a certain reclose step, i.e. 79-3, the MSOC will stay at that step until the breaker is finally closed back in. When this occurs, the reset timer will run and the reclose sequence will pickup where it left off. The "CB Fail logical output will de-assert when the breaker is closed manually. If the MSOC determines a closed breaker within the Close Fail Time setting, it will reset and re-enable when the breaker is opened. The Close Fail Timer is factory default to 18 cycles.

Lockout

The Microshield O/C recloser will lockout reclosing if any one of the following conditions are true:

- A fault persists for the entire reclose sequence
- The breaker is manually closed and a fault occurs before the reset time expires
- A Trip output occurs and the fault current is not removed and/or the 52a/52b contacts did not change state before expiration of the Trip Fail Timer (5 to 60 cycles).
- The reclose function is set to lockout after a 51P, 50P, 50N, 51N, 51LT overcurrent trip.
- The Maximum Recovery Count was reached within the Maximum recovery Time.
- The Maximum Reclose to Lockout Count was reached.

A Lockout condition is alternately displayed on the LCD display as "Recl Lockout". A logical output, RLA is also asserted for a lockout condition. The lockout state is cleared when the Microshield O/C senses a manual breaker close by the state of the 52a and/or 52b contacts and the reset timer expires.

Cutout Timer (79 Cutout)

The recloser contains a function that reverts the protective settings back to the 79-1 setting before the reset timer expires. This is called "Cutout Time". If the cutout timer is disabled, the 79-1 settings will enable after the reset time expires. This function is only valid when more than one shot of reclosing is used and it is set shorter than the reset timer. If the recloser is at step 79-2 and has successfully reclosed the circuit breaker, the reset timer and cutout timer begin to decrement. When the cutout timer reaches 0 it will place the 79-1 protective elements into service even though the unit is still at 79-2. This will occur until the reset timer expires at which point the recloser resets to step 79-1.

External Reclose Initiate

The EXTRI logical input is used to initiate multiple shots of reclosing when the circuit breaker is opened by an external source. Logical input EXTRI must be mapped to a physical input contact for activation by an external device (see programmable inputs section). The 43A (recloser enable) logical input must also be active for the EXTRI function to operate. If 43A is not mapped to a physical input it defaults to enable. The EXTRI operates as follows:

If the breaker is opened by an external source and the EXTRI logical input is active, the circuit breaker will close in the 79-1 open time. If the circuit breaker is opened again by an external source, the reset time has not expired, and EXTRI is made active, the recloser will step to 79-2 and the circuit breaker will close (or lockout depending upon the 79-2 programming) in 79-2 time. If the breaker continues to open before the reset time expires, the recloser will continue to increment steps until it reaches the step that locks out. At this point no further reclosing will take place and the circuit breaker must be closed manually.

If the breaker is opened by an external source and the EXTRI logical input is not active but is made active after the circuit breaker is opened, the circuit breaker will close in the 79-1 open time. If the circuit breaker is opened again by an external source, the reset time has not expired, and EXTRI is made active, the recloser will step to 79-2 and the circuit breaker will close (or lockout depending upon the 79-2 programming) in 79-2 time. If the breaker continues to open before the reset time expires, the recloser will continue to increment steps until it reaches the step that locks out. At this point no further reclosing will take place and the circuit breaker must be closed manually.

Note 1: The internal Microshield O/C logic only checks the status of the EXTRI logical input when it detects that the circuit breaker has opened. Once it has determined that EXTRI is active, it will initiate the reclose sequence. Once the input is made active, the reclose sequence starts.

Note 2: If the multi-shot recloser is in the middle of a sequence and the 43A logical input is made inactive, the recloser will stop operation. When 43A is returned to the active state the recloser will be reset and at step 79-1.

Limit Timer, Recovery Timer, and Limit Count

This feature is useful during severe storms where multiple trip and reclose operations can exceed the thermal capacity of a circuit breaker or recloser. The function will reset when the breaker is closed manually, or the Recovery Timer times out.

Limit Count: This is the total number of reclose operations that has occurred during the present Limit Timer interval. The count is reset to zero at the end of each Limit Timer interval. If the count exceeds the programmed maximum, a **"Max Recv Exceed"** event is logged, and subsequent over current trips will cause the recloser to lock out.

Limit Timer: This timer begins to run at the start of a reclose sequence. It must be set longer than the accumulative 79 open interval timers of all enabled reclose steps. During this time, total reclose operations are counted (see Recover Limit Count). At the end of the timed interval, the Limit Timer is reset to zero. It will start timing again at the start of the next reclose operation if the Recovery Limit Count was not exceeded during the previous timed interval. If the Recovery Limit Count was exceeded during the timed period, the Limit Timer will re-start at the next reclose operation after the expiration of the Recovery Timer.

Recovery Timer: This timer starts when the Limit Count exceeds the programmed maximum count during any Limit Timer interval. The timer continues to run until it times out or the breaker is closed manually. During this time, no other reclose operations will be allowed.

Setting Example:

Three shots of reclosing is desired.

- 79-1 = 0.3 seconds
- 79-2 = 5 seconds
- 79-3 = 15 seconds
- Reset Time = 30 seconds

Program the Limit Timer to at least 0.3 + 5 + 15 = 21 seconds. The actual setting depends upon the available fault current and the thermal limit of the interrupting device.

- Limit Time = 300 seconds

The Limit count setting, like the Limit Timer, will depend on available fault current and the thermal limit of the interrupting device.

- Limit Count = 5
- Recovery Time = 1000 seconds

At the start of an event, the Limit Count, Recovery Time, and Limit Time will all equal zero. Assume a series of events that causes repeated trips and reclosures on a particular feeder, such as a severe wind and rain storm. As a tree branch contacts the line, the DPU2000R trips off line, causing the 79-1 Timer to start. After the first open interval and subsequent reclose attempt, the Limit Timer starts and the Limit Counter increments from zero to one (the Limit Counter will continue to increment with each reclose attempt). Assume that the fault was temporary and that the reclose was successful. Forty five seconds later, another event causes the breaker to trip open, but this time two reclose attempts occur, the second one being successful. At this point, the Limit Timer is at approximately 50 seconds, and the Limit count is at three. Sixty seconds later yet another event causes the breaker to trip open, and two more reclose events are logged. At this point, the Limit Timer is at approximately 125 seconds, and the Limit count is at five. At this point the Limit Count has reached its maximum with the Limit Timer not yet timed out (the setting is 300 seconds) . A **"Max Recv Exceed"** event is now logged, and the Recovery Timer is started. A**ny subsequent overcurrent trips will cause the recloser to be locked out.** The Recovery Timer will reset when the programmed time delay expires, or the breaker is closed manually through the MMI, remote terminal, or external control switch. When the Recovery Timer is reset, a **"Rcl Recover"** event is logged.

Maximum Reclosures to Lockout (79 RTL)

This function counts the maximum number of reclose operations and will unconditionally lockout any reclosing after the count has been reached. No more reclosures will be allowed as long as the Maximum Reclose Counter is equal to this setting. To reset the function, either increase the Maximum Reclosures to Lockout setting or reset the Total Reclose Operations counter. When this function is active, a **Max Recl Exceed** event will be logged. Also the Recloser Max Alarm will be asserted, as well as the Recloser Lockout Alarm.

Zone Sequence Coordination (79 ZSC)

This function allows a downstream recloser to operate without the problem of upstream tripping for multiple faults and reclose attempts. The Zone Sequence Function "keeps step" with the down stream recloser by incrementing the reclose steps based on current above pickup but no local trip. If the local relay sees fault current but the current is cleared before a local trip occurs and ZSC is enabled, the Microshield O/C will increment to 79-2 and begin reset time when the current drops below pickup. The setting is made either "Enabled" or "Disabled" in the Programmable Input Settings. See Section 6 for Mapping Instructions.

Internal and External Reclose Disable

The 43A logical input is required as input to Enable the Microshield O/C reclosing function if the 43A logical input is assigned to a physical input. If the 43A logical input is not mapped to a physical input, it defaults to enable. The programmable logical input, 43A, provides external enabling while an MMI Operations Menu item (password protected) "79 Enable" will provide internal enabling. If the internal recloser "79 Disable" is turned to "Yes", the green status LED will flash reminding the user to re-enable it or permanently disable it in the relay settings. If "79 Disable" is set to "Yes", the 43A input will have no affect on recloser operation.

Section 6 - Programmable Inputs and Outputs

Programmable Inputs

The Microshield O/C contains two physical inputs named "IN1" and "IN2". These physical inputs are where external connections are made such as circuit breaker auxiliary inputs, control switch inputs, and SCADA inputs. Mapping of the logical function internal to the Microshield O/C to physical inputs is necessary for operation of the various Microshield O/C input functions. The logical inputs can be mapped to physical inputs by accessing the "Change Settings" Menu then the "Inputs" Menu from the front MMI of the Microshield O/C. They can also be programmed by using the optional communications port (see Communication Section for details). In the Inputs Menu, assign a logical input to a physical input by selecting it. A selection of "Unmapped", "IN1 & IN2" (AND condition), or "IN1 + IN2" (OR condition) can be made. The symbol "&" represents an AND condition of the physical inputs. The symbol "+" represents an OR condition of the physical inputs. A list of logical inputs and the factory default mapping are shown in Table 6-1. For a rear terminal connection diagram see Figure 16 in Section 16.

Table 6-1. Logical Inputs

Logical Input	Description	Factory Default Physical Input
51LT	51LT Torque Control	-
51P	51P Torque Control	-
50P	50P Torque Control	-
51N	51N Torque Control	-
50N	50N Torque Control	-
52A	52A Input	IN1
52B	52B Input	IN2
TRIP	Trip Input	-
CLOSE	Close Input	-
43A*	Recloser Enable Input	-
EXTRI*	External Reclose Initiate	-
ZSC	Zone Sequence Coordination	-
DTL	Drive to Lockout	-
RSI	Reset Seal In	-

* With reclosing option.

Note 1: Both physical inputs, IN1 and IN2, have a preset two cycle debounce time. Any signal to these inputs must be present longer than this time for the Microshield O/C logic to function properly.

Note 2: The minimum input operate voltages are dependent upon the control power range ordered. The minimum input operate voltages are as follows:

Control Power Range	Catalog Digit #6	Minimum Input Operate Voltages
18 - 60	3	12 Volts DC ± 20%
60 - 150	4	55 Volts DC ± 15%
150 - 500	5	110 Volts DC ± 10%

(The input maximum voltage is the same as the maximum control power rating.)

Programmable Outputs

The Microshield O/C contains three or five normally open physical outputs depending on the catalog number ordered. If the unit was ordered with the optional VT inputs, three physical outputs are present. If the unit was ordered without the optional VT inputs, five physical outputs are present. The outputs are named "TRIP", "OUT1", and "OUT2". MSOC's are shipped with output #2 (OUT2) configured as a diagnostic output as a factory default. When the MSOC is operating properly, this output will be ON. If any of the internal diagnostic routines detect an internal problem (e.g. checksum error, memory failure, time-out, etc.), this output will turn OFF. If no VT inputs are present, "OUT3" and "OUT4" are included. These physical outputs are where external connections are made such as circuit breaker trip and close, alarm outputs, and SCADA outputs. Mapping of the logical functions internal to the Microshield O/C to physical outputs is necessary for operation of the various Microshield O/C output functions. The logical outputs can be mapped to physical outputs by accessing the "Change Settings" then the "Outputs" Menu from the front MMI of the Microshield O/C. They can also be programmed by using the optional communications port (see "Communication" Section for details). In the Programmable Outputs Menu, assign a logical output to a physical output by selecting it. A selection of "Unmapped", "OUT1", "OUT2" can be made and in the case of no VT inputs "OUT3" and "OUT4". If more than one logical output is assigned to a physical output, an OR condition will exist for that contact. A list of logical outputs and the factory default mapping are shown in Table 6-2. For a rear terminal connection diagram see Figure 16 in Section 16.

Table 6-2. Logical Outputs

Logical Output	Description	Factory Default Physical Output
51LT	51LT Output	-
51P	51P Output	-
50P	50P Output	-
51N	51N Output	-
50N	50N Output	-
PUA	Pickup Alarm Output	-
FAIL	Relay Fail Alarm	OUT2 *
CB FAIL	CB Fail Alarm	-
TRIP	OR of all protective elements	-
CLOSE	Close CB Output	OUT1
RIP (1)	Reclose in Progress	-
RLA (1)	Recloser Lockout Alarm	-
RDA	Recloser Disable Alarm	-
RMAX	Recloser Max	

(1) With reclosing option.

*The FAIL output will be energized when the relay is functioning normally and will drop out if a failure occurs.

Programmable Master Trip Contact

The master trip contact is the physical contact to which all the protective elements are mapped and the recloser state machine based. The Microshield O/C has the ability to include or exclude any protective elements from the master trip contact. This is useful where it may be desired to operate a lockout relay when an instantaneous trip (50P) occurs but reclose for a timed trip (51P). In this case the 50P element would be disabled from the master trip contact and re-mapped to one of the programmable output contacts.

Note: Any element disabled from the master trip contact will not initiate reclosing and will not be recorded in the Fault records but the Events records only. The Master Trip contact mapping can be performed in the "Change Settings" "Mstr Trip" Menu. Assign or disable each protective element to the master trip contact. All elements are assigned to the Master Trip contact as default from the factory.

Seal In Outputs

The Microshield O/C is equipped with a number of special Logical Outputs called Seal-in Outputs. A **Seal-In Outputs** becomes asserted when its associated Logical Output condition (51P for example) is true. It remains asserted until cleared by the **"Reset Seal-Ins"** command in the Operations Menu on the front panel interface. It can also be cleared by using the fast ASCII command "xrtsi" through a terminal emulator. See Section 10 for more on fast ASCII communications.

A selection can be made under " Settings" to map the relaying functions 51LT, 51P, 51N, 50P, and 50N to OUT1 or OUT2 to provide a Seal In (contact remains closed until cleared via a specific "Reset Seal In Alarms" command).

Note: The loss of DC power supply and resetting the Microshield relay will also reset the Seal In Alarm contacts.

Section 7 - Targets

Four Light Emitting Diodes (LED's) called "targets" are provided on the front panel of the Microshield O/C for indication of relay health, overcurrent pickup (current exceeds setting), and fault type. Two types of targets are provided, sealed in and non sealed in. Sealed in targets will remain on even after the condition that has turned them on has extinguished. These type of targets can be reset by depressing the "C" key on the Man-Machine Interface (MMI). The sealed in targets are designed to accumulate. This means that all target information is stored on top of all preceding data. Non sealed in targets remain lit only for the time when the condition is present. The targets and their functionality are listed below.

Status: When GREEN, indicates that the Microshield O/C is in a normal operating state. If the internal relay firmware detects an internal failure the LED will turn RED and the relay will not operate. A logical output "Fail" will also energize at this time (See Programmable Outputs Section for details on programming). The Status LED is a non sealed in target.

PU (Pickup): The LED will light for a condition where the input current has exceeded the pickup setting of any of the overcurrent elements (51P, 51N, 51LT, 50P, or 50N). The Pickup LED is a red non sealed in target.

Time: Indicates that a time overcurrent trip has occurred. The time overcurrent elements 51P, 51N, and 51LT when tripped will activate the Time target. The Time LED is a red sealed in target.

Inst. (Instantaneous): Indicates that an instantaneous overcurrent trip has occurred. The instantaneous overcurrent elements 50P, and 50N when tripped will activate the Instantaneous target. The Instantaneous LED is a red sealed in target.

Note: Faulted phase(s) are not indicated by LED targets on the front of the relay. For determination of faulted phase(s) and magnitudes of fault current, access data in the fault records portion of the relay MMI. A rough estimate of the fault location can be developed from the faul current values.

Section 8 - Metering

With Optional VT Inputs

The Microshield O/C contains a complete voltage and current metering package. It also calculates real and reactive power flow, power factor, Watt and VAr Hours, and demand values. The proper setting of the Voltage Transformer (VT) and Current Transformer (CT) configurations and ratios is extremely important to proper metering operation. The VT and CT configuration (Wye or delta) and ratio settings are contained in the "Configuration" Menu (see "Man-Machine Interface" Section). Load magnitudes for phase currents are displayed as default on the LCD display. The voltage values displayed are phase to neutral for Wye connected VT's and phase to phase for delta connected VT's. The metering screen can be used to verify proper and healthy connections to the voltage and current input sensors of the Microshield O/C.

Without Optional VT Inputs

The Microshield O/C measures phase and neutral currents in this metering package. It also calculates current demand values. The proper setting of the Current Transformer ratios is extremely important to proper metering operation. The CT ratio settings are contained in the "Configuration Menu" (see "Man-Machine Interface" Section). Load magnitudes for phase currents are displayed by default on the LCD display. The metering screen can be used to verify proper and healthy connections to the current input sensors of the Microshield O/C.

Accuracy for measured values (voltage and current) is $\pm$ 1% of nominal.

Note: The load current must be above 10% of the nominal current rating to obtain the $\pm$ 1% accuracy. The load meter is accurate up to two times the nominal current rating. See the Product Overview Section of this manual for nominal current ratings. Accuracy for calculated values (power) is $\pm$ 2%.

The Load Metering Section, is a description of all the Microshield O/C metering features.

Load Metering

The following load values are contained in the Microshield O/C and are accessible via the MMI or external communications.

Phase Currents:
Magnitude (Wye or delta connections).

Ground Current:
Magnitude (Wye or delta connections).

Kilovolts:
Magnitude (Wye or delta connections). (Requires optional VT inputs).

Kilowatts:
Three Phase for Wye VT's and Three Phase for Delta VT's. (Requires optional VT inputs).

KiloVArs:
Three Phase for Wye VT's and Three Phase for Delta VT's. (Requires optional VT inputs).

Kilowatt-hours:
Three Phase for Wye VT's and Three Phase for Delta VT's. (Requires optional VT inputs).

KiloVAr-hours:
Three Phase for Wye VT's and Three Phase for Delta VT's. (Requires optional VT inputs).

Power Factor
Wye connected VT's only. (Requires optional VT inputs).

Frequency
Requires optional VT inputs.

The Watt-hour and VAr-hour Energy meters are set to display Kilowatt-hours. A periodic rollover of the energy meters will be seen. The time period of this depends on the magnitude of the power flow seen by the Microshield O/C and the time between meter readings as defined by the "Demand Constant" setting (Relay Configurations Settings Section). Meter rollover is the point at which the watt-hour (or VAr-Hour) meter has reached its maximum count and returns to zero to begin incrementing again. The roll over point for the energy meters is 9,999,999 kilowatt-hours (kiloVAr-hours).

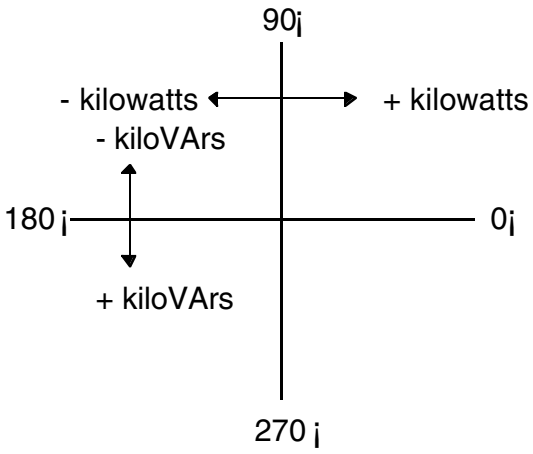


Figure 2. Microshield O/C Metering Conventions

The energy meters are capable of reading negative power. If the magnitudes are positive, the meters will increment, if negative they will decrement. The rollover point in the case of negative power will be 0 at which time the meters will change to 9,999,999. Figure 2 outlines the metering conventions used in the Microshield O/C.

Note: The energy meters will be reset to 0 if the Microshield O/C is disassembled or new CPU firmware is installed. See the Maintenance Section for details on installing new firmware.

The update rate of the energy meters is based on the "Demand Constant" setting (see "Demand Meter" Section) as set in the "Configurations" settings. The meters will update every 1/15 of the Demand Constant. For example: if the Demand Constant is set to 15 minutes the energy meters will update every 1 minute (15min x 1/15 = 1 min). The watt-hour and VAr-hour meters can be reset to 0 by the local Man Machine Interface (MMI) or the optional communications ports. "Rst Enrgy Mtrs" is found in the "Operations" Menu of the MMI.

Demand Metering

The demand meter takes a snapshot of the load every Demand Constant and averages the values of current, Kilowatts, and KiloVArs. It is typically used for analysis of equipment loading and system planning. The demand values in the Microshield O/C are accessible via the MMI or external communications. The following are the measurements taken by the demand meter:

Phase Currents:
Magnitude (Wye or delta connections)

Ground Current:
Magnitude (Wye or delta connections)

Kilowatts:
Three Phase for Wye VT's and Three Phase for Delta VT's (requires optional VT inputs)

KiloVArs:
Three Phase for Wye VT's and Three Phase for Delta VT's (requires optional VT inputs)

The demand currents are calculated using a $\log_{10}$ function to replicate thermal demand meters. The demand kilowatts and kiloVArs are averaged values that are calculated by sampling the kilowatt-hours and kiloVAr-hours every "Demand Constant" interval. The Demand Constant interval is a setting made in the "Config Menu" settings and is the time period between demand meter updates. Current utility or industrial practice usually dictates the setting of the demand constant interval.

Section 9 - Records

The Microshield O/C contains both fault and events recording capability. A summary of fault and events records is listed below. The records can be accessed via the front panel MMI or optional communications port.

- Recording of 128 events stored in battery backed memory
- Events are time tagged to facilitate sequence of event analysis
- Recording of 32 faults stored in battery backed memory
- Record number, time, single phase current values, and single phase voltage values (phase to phase if delta PT's) included in each record
- Record clearing capability

It is possible to clear the event and fault records in the Microshield O/C. This is especially useful when testing the relay and it is desired to clear all of the test records before placing the unit into service. This is accomplished by accessing the "Operations" Menu then the "Clear Records" item.

Note: All Event and Fault records will be lost if the Microshield O/C is disassembled or new CPU firmware is installed. See the Maintenance Section for details on installing new firmware.

Event Records

An Event Record is a stored block of data containing information on a relay or external operation. Any operation of a relay element or change in relay state will cause an event record to be stored. These records are numbered (in descending order i.e.; record 1 is oldest, record >1 is latest) and time tagged for a sequence of events reference. To access the Events Records, use the front panel MMI and access the "Records" then "Events" Menu items. Use the "→" key to access previous events (descending order). Use the "←" key to access most recent events (ascending order). Use the "↑" and "↓" keys to access details on a particular event. The protective events can be defined as follows:

Pickup: The protective element has gone above pickup.

Drop: The protective element has gone below 98% of pickup.

Clear: The protective element has gone below 98% of pickup after the unit has issued a trip.

Reset: The protective element is on a delayed reset and the unit has done so.

Trip: Self evident.

A sample set of events records along with access instructions is shown in Figure 3.

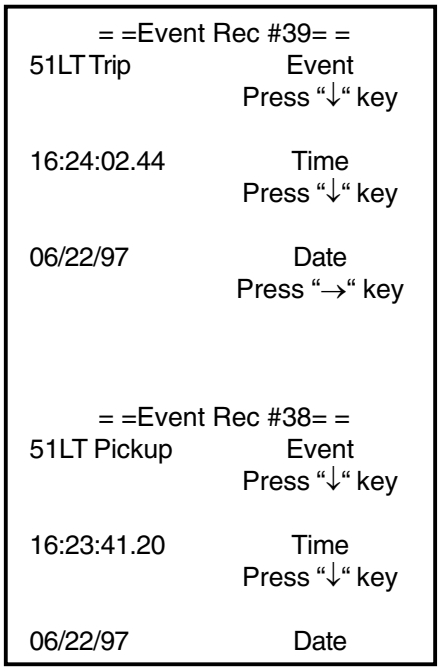


Figure 3. Sample Event Records

Table 9-1 lists all the possible events records and their definitions. The Microshield O/C firmware is continually enhanced. In a case where an event is seen but not defined here, please contact ABB Technical Support at 1-800-634-6005

Table 9-1. Event Records

Event	Description
CB Closed	Indicates that the 52a and/or 52b contacts logged a CB Closed condition (52a = 1, 52b = 0). If 52a or 52b are not mapped to physical input contacts, the Microshield determines a circuit breaker closed state when the input current is above 5% of the nominal current for phase and neutral. Check the catalog number and the Product Overview Section to determine nominal current ratings for phase and neutral inputs.
CB Open	Indicates that the 52a and/or 52b contacts logged a CB Open condition (52a = 0, 52b = 1). If 52a or 52b are not mapped to physical input contacts, the Microshield determines a circuit breaker open state when the input current is below 5% of the nominal current for phase and neutral. Check the catalog number and the Product Overview Section to determine nominal current ratings for phase and neutral inputs.
CB Ste Unknw	Indicates that the 52a and 52b inputs were assigned to physical inputs but that an invalid condition was logged (52a = 1, 52b = 1 or 52a = 0, 52b = 0).
CB Trip Fail	Indicates the Trip Fail Timer has expired. See Trip Fail Timer in the Relay Configurations Settings Section for more details.
CB Close Fail	Indicates the Close Fail Timer has expired. See Close Fail Timer in the Recloser Section for more details.
CB Pop Open	Indicates that the circuit breaker has opened after a CB fail to trip state has occurred. This open state could have occurred when the breaker finally opened (slow breaker) or when manually opened.
CB Pop Closed	Indicates that the circuit breaker has closed after a CB fail to close state has occurred. This could have occurred external to the Microshield O/C or a “Close” command issued via the MMI or communications interface. It could also have occurred when the breaker finally closed (slow breaker) after the close fail timer expired.
RTC	Indicates that the Real time Clock has failed. Contact the ABB Technical Support Department at 1-800-634-6005 for assistance in this case.
Editor Access	Indicates that a setting has been changed.
Watchdog Rst.	Indicates that an internal software timeout has occurred. If this record appears with “Power Up” and “Manual Reset,” a Manual Reset has occurred. See “Manual Reset.”
Manual Reset	Indicates that a manual reset occurred. This is accomplished by pressing the “C”, “E” and “↑” keys on the front panel MMI at the same time.
EEP Failure	Indicates that an Electronically Erasable PROM has failed in the self test diagnostic routine. Contact ABB Technical Support at 1-800-634-6005 for assistance.
Power Up	Indicates that control power was applied to the unit.
RAM Failure	Indicates that the Microshield O/C self test feature determined that a Random Access Memory (RAM) failure occurred. Contact the ABB Technical Support Department at 1-800-634-6005 for assistance in this case.
Ext. Trip	Indicates that the Microshield O/C saw the breaker open via the 52a and 52b programmable logic inputs, but the relay did not cause the breaker to open.
Ext. Close	Indicates that the Microshield O/C saw the breaker close via the 52a and 52b programmable logic inputs, but the relay did not cause the breaker to close.
Analog Failure	Indicates that the Microshield O/C self test feature determined that an Analog circuit or calibration failure occurred. Contact the ABB Technical Support Department at 1-800-634-6005 for assistance in this case.

Table 9-1. Event Records (Cont.)

51LT Disabled	Indicates that the "51LT" programmable input was de-asserted and the active 51LT time overcurrent element was disabled. The "51LT" programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the "51LT" input only. This log will appear even if the 51LT element is disabled in the primary settings.
51LT Enabled	Indicates that the "51LT" programmable input was asserted and the 51LT time overcurrent element was enabled. The "51LT" programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the "51LT" input only. This log will appear even if the 51LT element is disabled in the primary settings.
51P Disabled	Indicates that the "51P" programmable input was de-asserted and the active 51P time overcurrent element was disabled. The "51P" programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the "51P" input only. This log will appear even if the 51P element is disabled in the primary settings.
51P Enabled	Indicates that the "51P" programmable input was asserted and the 51P time overcurrent element was enabled. The "51P" programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the "51P" input only. This log will appear even if the 51P element is disabled in the primary settings.
50P Disabled	Indicates that the "50P" programmable input was de-asserted and the active 50P instantaneous overcurrent element was disabled. The "50P" programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the "50P" input only. This log will appear even if the 50P element is disabled in the primary settings.
50P Enabled	Indicates that the "50P" programmable input was asserted and the 50P instantaneous overcurrent element was enabled. The "50P" programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the "50P" input only. This log will appear even if the 50P element is disabled in the primary settings.
51N Disabled	Indicates that the "51N" programmable input was de-asserted and the active 51N time overcurrent element was disabled. The "51N" programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the "51N" input only. This log will appear even if the 51N element is disabled in the primary settings.
51N Enabled	Indicates that the "51N" programmable input was asserted and the 51N time overcurrent element was enabled. The "51N" programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the "51N" input only. This log will appear even if the 51N element is disabled in the primary settings.
50N Disabled	Indicates that the "50N" programmable input was de-asserted and the active 50N instantaneous overcurrent element was disabled. The "50N" programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the "50N" input only. This log will appear even if the 50N element is disabled in the primary settings.
50N Enabled	Indicates that the "50N" programmable input was asserted and the 50N instantaneous overcurrent element was enabled. The "50N" programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the "50N" input only. This log will appear even if the 50N element is disabled in the primary settings.
52a Opened	Indicates the state of the programmable logic input "52a". This record indicates the state of the programmable input "52a" only. It does not imply an actual breaker state. The "52a Opened" states that the "52a" logical input transitioned from a logical 1 to a logical 0 at the time of the logging.

Table 9-1. Event Records (Cont.)

52a Closed	Indicates the state of the programmable logic input "52a". This record indicates the state of the programmable input "52a" only. It does not imply an actual breaker state. The "52a Closed" states that the "52a" logical input transitioned from a logical 0 to a logical 1 at the time of the logging.
52b Opened	Indicates the state of the programmable logic input "52b". This record indicates the state of the programmable input "52b" only. It does not imply an actual breaker state. The "52b Opened" states that the "52b" logical input transitioned from a logical 1 to a logical 0 at the time of the logging.
52b Closed	Indicates the state of the programmable logic input "52b". This record indicates the state of the programmable input "52b" only. It does not imply an actual breaker state. The "52b Closed" states that the "52b" logical input transitioned from a logical 0 to a logical 1 at the time of the logging.
Direct Trip	Indicates that the logical input "Trip" was asserted.
Direct Close	Indicates that the logical input "Close" was asserted.
51LT Pickup	Indicates that the phase input current has exceeded the phase time overcurrent element, 51LT, pickup setting. This does not indicate an actual trip.
51LT Trip	Indicates that the phase time overcurrent element, 51LT has timed out and operated. It is possible that this may not have been the actual tripping element.
51LT Drop	Indicates that the phase input current has exceeded the phase time overcurrent element, 51LT, pickup setting and then gone below 98% of the setting. This record will appear regardless of the 51LT element actually timing out and tripping.
51LT Clear	Indicates that the phase time overcurrent element, 51LT, has timed out and operated after which the phase input current dropped to 98% of the 51LT pickup setting.
51LT Reset	Indicates that the 51LT phase time overcurrent element has tripped, cleared and the delayed reset has timed out. This log will only appear when the Reset Mode is set to Delayed. See the Relay Configurations Settings Section for more details on delayed reset.
51P Pickup	Indicates that the phase input current has exceeded the phase time overcurrent element, 51P, pickup setting. This does not indicate an actual trip.
51P Trip	Indicates that the phase time overcurrent element, 51P has timed out and operated. It is possible that this may not have been the actual tripping element.
51P Drop	Indicates that the phase input current has exceeded the phase time overcurrent element, 51P, pickup setting and then gone below 98% of the setting. This record will appear regardless of the 51P element actually timing out and tripping.
51P Clear	Indicates that the phase time overcurrent element, 51P, has timed out and operated after which the phase input current dropped to 98% of the 51P pickup setting.
51P Reset	Indicates that the phase time overcurrent element, 51P, has tripped, cleared and the delayed reset has timed out. This log will only appear when the Reset Mode is set to Delayed. See the Relay Configurations Settings Section for more details on delayed reset.
50P Pickup	Indicates that the phase input current has exceeded the phase instantaneous overcurrent element, 50P, pickup setting. This does not indicate an actual trip.
50P Trip	Indicates that the phase instantaneous overcurrent element, 50P has timed out and operated. It is possible that this may not have been the actual tripping element.
50P Drop	Indicates that the phase input current has exceeded the phase instantaneous overcurrent element, 50P, pickup setting and then gone below 98% of the setting. This record will appear regardless of the 50P element actually timing out and tripping.

Table 9-1. Event Records (Cont.)

50P Clear	Indicates that the phase instantaneous overcurrent element, 50P, has timed out and operated after which the phase input current dropped to 98% of the 50P pickup setting.
50P Reset	Indicates that the phase instantaneous overcurrent element, 50P, has tripped, cleared and the delayed reset has timed out. This log will only appear when the Reset Mode is set to Delayed. See the Relay Configurations Settings Section for more details on delayed reset.
51N Pickup	Indicates that the neutral input current has exceeded the neutral time overcurrent element, 51N, pickup setting. This does not indicate an actual trip.
51N Trip	Indicates that the neutral time overcurrent element, 51N has timed out and operated. It is possible that this may not have been the actual tripping element.
51N Drop	Indicates that the neutral input current has exceeded the neutral time overcurrent element, 51N, pickup setting and then gone below 98% of the setting. This record will appear regardless of the 51N element actually timing out and tripping.
51N Clear	Indicates that the neutral time overcurrent element, 51N, has timed out and operated after which the neutral input current dropped to 98% of the 51N pickup setting.
51N Reset	Indicates that the neutral time overcurrent element, 51N, has tripped, cleared and the delayed reset has timed out. This log will only appear when the Reset Mode is set to Delayed. See the Relay Configurations Settings Section for more details on delayed reset.
50N Pickup	Indicates that the neutral input current has exceeded the neutral instantaneous overcurrent element, 50N, pickup setting. This does not indicate an actual trip.
50N Trip	Indicates that the neutral instantaneous overcurrent element, 50N has timed out and operated. It is possible that this may not have been the actual tripping element.
50N Drop	Indicates that the neutral input current has exceeded the neutral instantaneous overcurrent element, 50N, pickup setting and then gone below 98% of the setting. This record will appear regardless of the 50N element actually timing out and tripping.
50N Clear	Indicates that the neutral instantaneous overcurrent element, 50N, has timed out and operated after which the neutral current dropped to 98% of the 50N pickup setting.
50N Reset	Indicates that the neutral instantaneous overcurrent element, 50N, has tripped, cleared and the delayed reset has timed out. This log will only appear when the Reset Mode is set to Delayed. See the Relay Configurations Settings Section for more details on delayed reset.
Com Init Fail	Indicates that the communications option is contained within the Microshield O/C but that the main processor could not initialize communications. Contact the ABB Technical Support Department at 1-800-634-6005 for assistance in this case.
Param Update	Indicates that a communications setting was changed.
Int Tx Failure	Indicates an internal error sending data from the main processor to the communication processor. Contact the ABB Technical Support Department at 1-800-634-6005 for assistance in this case.
Invalid Blk	Indicates that an invalid Modbus command was sent to the Microshield O/C.
Int Rx Failure	Indicates an internal error receiving data from the communication processor.
Recloser Rst	Indicates that the internal reclose feature of the Microshield O/C has performed a successful reclose operation and the reclose reset timer has expired. See the Recloser Section of this manual for more details on recloser reset.
Reclsr Lockout	Indicates that the internal reclose feature has reached the lockout stage. See the Recloser Section of this manual for more details on recloser lockout.

Table 9-1. Event Records (Cont.)

Max Recl Cnt — Indicates that the number of successful reclosures has reached the Maximum Reclose Counter setting. See the Recloser Section for more details on this function.

Recloser Out of Sequence — Indicates some external action has caused a circuit breaker Close during a valid reclose sequence. This can be caused by closing the breaker via a control switch or front panel interface command while the relay is in the midst of a reclose.

Zone Step — Indicates that a Zone Sequence step has occurred. See Section 5 under Zone Sequence Coordination for more information.

Recloser Error — Indicates that an internal problem occurred in the MSOC during a reclose sequence. Contact ABB Technical Support at 1-800-634-6005 for assistance.

Reclose Initiate — Indicates that the conditions for breaker reclose have been met, and a close command sent to the CLOSE output. See Section 5 for more information on MSOC recloser operations.

Recloser Recover — Indicates that the Recovery Timer has expired and that the MSOC is ready for additional reclose operations. See Section 5 under Limit Timer, Recovery Timer, and Limit Count for more information.

Max Recov Cnt — Indicates that the number of successful reclosures has exceeded the 79 Recovery counter within the Maximum Recovery time setting. See the Recloser Section for more details on this function.

Enrgy Mtrs Rst — Indicates that the watt-hour and Var hour meters have been reset to 0. See the Metering Section for more details on energy meters.

Reset Seal-Ins — Indicates that the Seal-In Alarms have been reset through either a communication command or the front panel interface. See Section 6 under Seal In Outputs for more information.

Rcrds Cleared — Indicates that the Fault and Event records have been cleared by the Operations menu item “Clear Records”. This will be the first event log after the clear operation has been completed.

Event Code Err — Indicates that the main processor tried to write an invalid event record number. Contact the ABB Technical Support Department at 1-800-634-6005 for assistance in this case.

Batt. Low — Indicates that the internal Lithium battery is low.

Recl in Prog — Indicates that the reclosing function was activated.

43a Enabled — Indicates that the “43a” programmable input was asserted. This will enable the optional reclosing feature. The “43a” programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the “43a” logical input only. This log will appear even if the optional reclosing feature is disabled in the primary settings.

43a Disabled — Indicates that the “43a” programmable input was de-asserted. This will disable the optional reclosing feature. The “43a” programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the “43a” logical input only. This log will appear even if the optional reclosing feature is disabled in the primary settings.

Ext RCL Init — Indicates that the “EXTRI” (External Reclose Initiate) programmable input was asserted. This will cause the recloser to operate as defined in the Recloser Section of this manual. The “EXTRI” programmable input must be assigned to a physical input for this record to appear. This record indicates the state of the “EXTRI” logical input only and does not imply a successful reclose. This log will appear even if the optional reclosing feature is disabled in the primary settings.

Max Rcl Reset — Indicates that the reclose counter has been reset to 0. See the Recloser Section for more details on this function.

Fault Records

A Fault Record is a stored block of data containing information directly related to an internal Microshield O/C protective element operation. Any operation of a relay element will cause a Fault Record to be stored only if that element is assigned to the master trip contact. If an element is not assigned to the master trip contact but trips the circuit breaker through a programmable output, it will log only an event record. The fault records contain information on the fault such as:

- Record number in descending order (ie; record 1 is oldest, record >1 is latest)
- Which element operated
- Time and Date
- The magnitudes of all phase currents and neutral current
- The magnitudes of the voltages (units with optional VT inputs)
- How long the element took to operate
- How long it took the breaker to operate once the Microshield O/C close the trip contact

To access the Fault Records, use the front panel MMI and access the "Records" then the "Fault Records" MMI Menu items. Use the "→" key to access previous faults (descending order). Use the "←" key to access most recent faults (ascending order). Use the "↑" and "↓" keys to access details on a particular fault. A sample set of fault records along with access instructions is shown in Figure 4.

The value of current stored in the fault records for both time (51LT, 51P, 51N) and instantaneous (50P, 50N) faults is the RMS value present when the Microshield O/C issued the trip signal to the circuit breaker. This is done to represent, as accurately as possible, the circuit breaker interrupt current.

= =Fault Record #7 =

Type: 51P	Tripping Element Press "↓" key
14:54:02.49	Time Press "↓" key
06/06/97	Date Press "↓" key
Ia: 31466	Magnitude of A phase current Press "↓" key
Ib: 31564	Magnitude of B phase current Press "↓" key
Ic: 9863	Magnitude of C phase current Press "↓" key
In: 56	Magnitude of neutral current Press "↓" key
kVan: 12123	Magnitude of A phase voltage * Press "↓" key
kVbn: 12087	Magnitude of B phase voltage * Press "↓" key
kVcn: 11994	Magnitude of C phase voltage * Press "↓" key
Trip Time: 4.64	Time for element to trip Press "↓" key
Clr. Time: 0.92	Time for current to drop to 98% of element pickup setting and/or 52a and/or 52b to indicate open breaker. Press "→" key to access previous record or "←" key for more recent record.

* Logs phase to neutral when a Wye connection is set in Configuration Settings. Logs phase when a delta connection is specified.

Figure 4. Sample Fault Record

Section 10 - Communications

Initial Note: The front panel communications port is normally disabled. If desired, activate the port by entering the "Operations" Menu then "Enable FP Comm" and enable "Yes," otherwise the front port will not operate.

The Microshield O/C has the optional capability to communicate over an RS-232 or RS-485 communication link. One front RS-232 and one rear RS-485 communications port is provided on the unit when ordered with the communications option. The front port, when included, is configured as Data Terminal Equipment or "DTE".

Front and Rear communications port hardware is included in the Microshield relay when the Comm Option is not ordered. However, if communications will be desired from the relay in the future, it is recommended that the Comm Option be chosen at ordert ime to install the chips and software needed up fron tso that comm installation will be easier later. If not, the relay will have to be returned to the factory to add the Comm Option.

The factory default communications settings for the Microshield O/C are listed in Table 10-1. A complete settings list is shown in Table 10-2.

Table 10-1. Factory Default Communication Parameters

Parameter	Rear RS-485 Port	Front RS-232 Port
Port Address	1	N/A
Port Protocol	MSOC ASCII	MSOC ASCII
Port Speed	9600	9600
Port Framing	8, None, 1	8, None, 1
Port Echo	N/A	OFF
Tx Delay Time	0 {disable}	0 {disable}

The Microshield O/C internal communications hardware contains a single serial port designed to be switched from the front RS-232 connector to the rear RS-485 terminations and back. The serial port will normally operate from the rear RS-485 port until it detects that a switch has occurred. This is accomplished by entering the "Operations" the "Enable FP Comm" MMI Menu items. Set the "Enable FP Comm" to <Yes>. At this time the rear RS-485 terminal will become inactive until the "Front Port" switch is turned off or the Microshield O/C detects no activity on the front port for one hour. At this time, rear RS-485 communications will resume.

Both communications ports can be configured independently of one another. This means that the Protocol, Baud Rate, and Frame are set separately. Access the communication settings through the "Show Settings" or Change Settings" then "Comm" MMI Menu selections. All settings relating to the front port will be preceded by "FP:" and all rear port settings will be preceded by "RP:". Both ports support the same settings features except the address. The Address setting although not preceded by "RP:" or "FP:" applies only to the rear port for both ASCII and Modbus modes and the front port for the Modbus mode only.

The Microshield O/C communication support baud rates from 1200 to 19,200 baud. The frame can be set in formats shown in Table 10-2.

Table 10-2. Communication Parameters

Setting Name	Range
Address	1 - 255 Decimal
FP Baud	1200 - 19200
FP Frame	O,7,1 O,7,2 E,7,1 E,7,2 N,8,1
FP Protocol	Modbus, ASCII
FP Local Echo	ON, OFF
RP Baud	1200 - 19200
RP Frame	O,7,1 O,7,2 E,7,1 E,7,2 N,8,1
Protocol	Modbus, ASCII
Tx Delay	0 - 200

Both **ASCII** and **Modbus® ASCII** protocols reside in the Microshield O/C as standard. These two protocols are selectable at both front and rear ports. The front communications port is non-addressable for the MSOC ASCII mode while the rear does have addressing capability in both MSOC ASCII and Modbus ASCII modes. Only one port can be operational at any given time. To set the communications protocol type, simply select the Communication Menu from the front panel MMI and select the option for each port. The rear port addressing capability lends itself to multiple device networks. If a star connected RS-232 network is used, an RS-232 to RS-485 converter must be installed on the Microshield O/C. **See Figure 24 for RS-232 and RS-485 connection diagrams. For a MSOC Automation Technical Guide, please contact the ABB Technical Support department, 1-800-634-6005 or visit our website.**

MSOC ASCII Commands

The MSOC ASCII protocol contained the Microshield O/C was designed to be used in two modes.

1. A menu system is used to be user friendly for walk up type connections. A user is not required to carry a protocol document or instruction manual to set and retrieve relay data.

2. "Fast" commands can be used for automated raw data retrieval without the unnecessary pretext characters.

Modbus Mode

The Modbus protocol in the Microshield O/C was designed to support systems utilizing Modbus ASCII protocol. Modbus RTU mode is not supported. For a Modbus protocol document, please contact Technical Support at 1-800-634-6005.

MSOC ASCII Menu System

The following is a description of the MSOC ASCII Menu system. A terminal emulator program, an IBM PC or compatible computer, and a null modem cable (RS-232 cable with null modem adapter) are required to communicate with the Microshield O/C. Note that RS-232 communications are only available through the front port and only when the communication option is purchased.

Connect the computer RS-232 port to the Microshield O/C through the null modem cable and start the terminal emulation program. Set up the PC port to match the baud rate and frame set in the Microshield O/C.

Note: It is necessary that the terminal emulator program be set to VT-100 emulation, Outbound CR/LF, and Local Echo On. Set the Microshield O/C "Local Echo" setting to "Off" (factory default).

Press the Enter key on the PC and the Microshield O/C will respond with the address, catalog number, serial number, CPU code version, and Comm code version. The format will be as follows:

Microshield O/C 0001,474M04216000,973251,1.00,1.00
Type "menu" to enter menu mode

Type "menu" (must be lower case) and the Microshield O/C will follow with the Main Menu. The menu structure is shown in Figure 5.

Enter the desired menu selection at the > prompt. The selections are made by typing the letter shown in brackets [ ] and pressing the Enter key. The Microshield O/C will prompt when input is required. Entries within the menu system can be upper or lower case. Any invalid characters will return an "invalid character" response. Invalid entries (function not included) will return "N/A". This menu system matches, as closely as possible, the front panel MMI menu system.

It is possible to enter a ">" symbol to jump from one setting category to the next. For example: If it is desired to change a 50N setting (end of list). Enter ">" at the change settings prompt to skip undesired categories (51LT, 51P, 50P, 51N). A total of five ">" symbol entries will be necessary to jump to the 51N category. It is also possible to end a Change Settings routine early by entering an "=" symbol at the "Change to:" prompt.

Note: The [C]hange settings and [O]perations Menu selections will require entering of the relay password before any changes will take affect. The factory default password is four spaces.

Discrete ASCII Commands

The following is a list of ASCII commands that were designed to be used with data acquisition and automation systems. All commands must be followed by a carriage return (CR) and line feed (LF).

"Fast ASCII" provides a fixed command set that is defined to allow the user to develop a simple program to communicate with the Microshield O/C. These commands are documented in this section.

Overview

The default state for the ASCII Mode communications is FAST mode. If the User desires to communicate via the Menu mode, you must type "menu" (must be lower case) <CR><LF> after being first connected to the unit in order to activate this mode.

If the Rear port is configured for ASCII Protocol communications, then in order to communicate with the unit, the user must first address the unit since the rear port is the network port and it is assumed that other units are connected and communicating at the same time. To address the Microshield O/C in this fashion, the user must type ADDR <xxxx> <CR><LF>, where xxxx is the unit's configured network address. NOTE: The "ADDR" CAN BE upper or lower case. The front port, requires just a <CR><LF> for a terminal to become "connected" to the unit.

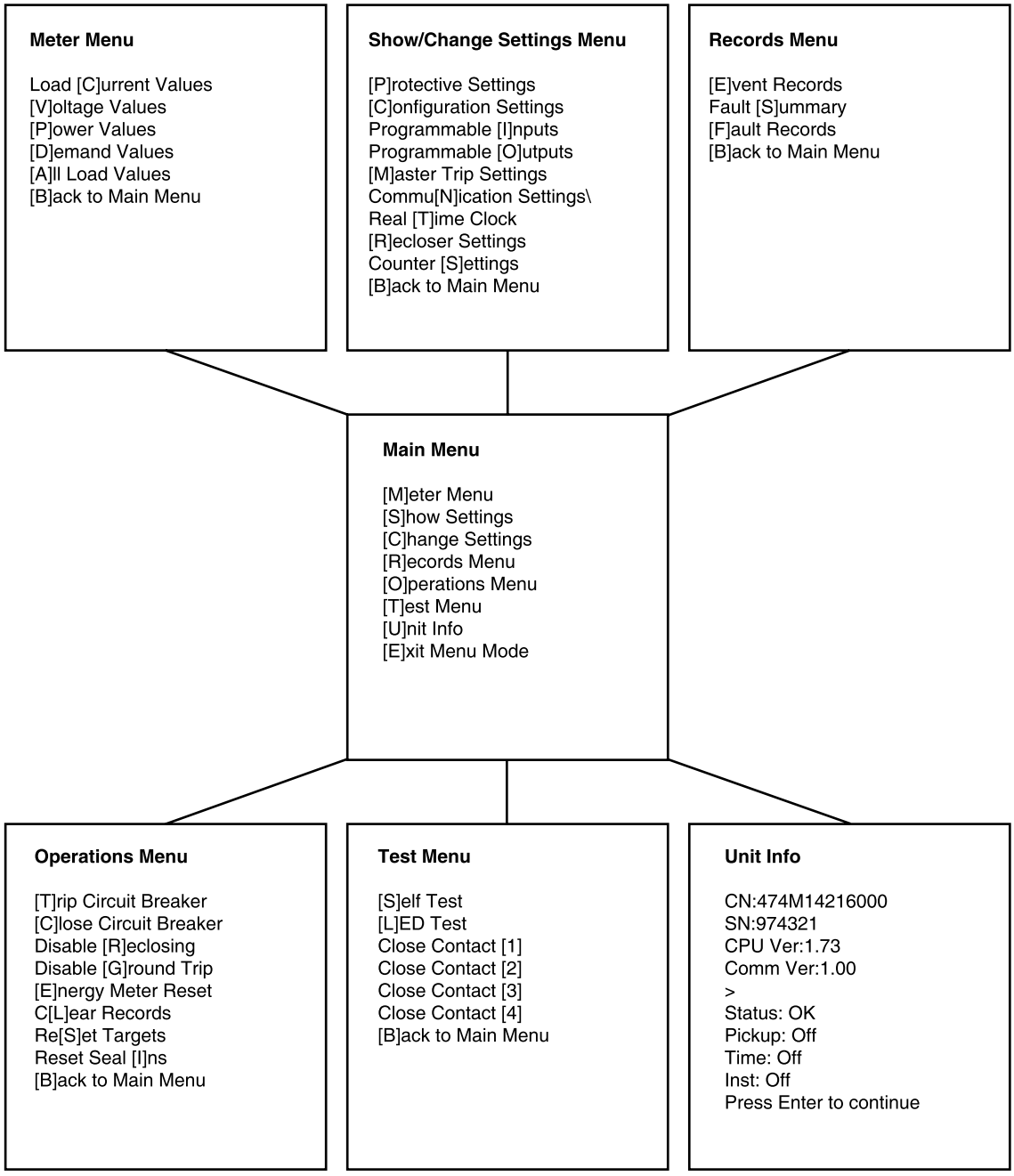


Figure 5. ASCII Menu System

The Echo/No Echo parameter is to disable echoing any received characters. This is useful for automated, fast mode operation, where an intelligent host will issue a command and the unit will then just send back the response, without echoing the received command. The echo is primarily used for the interactive, menu mode.

The input commands from the user to the unit are limited to 8 characters each and MUST BE lowercase. Each response line is limited to an 80 character text string. This reflects some limits that exist within the unit, as well as practical limits for the user.

Each command must be terminated with a <CR><LF> combination. A plain <CR> will NOT work. See your terminal emulator documentation on enabling CR-LF Outbound conversions.

Upon first connecting to the unit, through either port, the following banner will be issued to the user:

Microshield O/C, 0010,474M04116000,974677,1.00,1.00
Type "menu" for menu mode

Where:

0010	is the Unit's address, for verification of the connection
474M. . .	is the Unit's Catalog Number
9746. . .	is the Unit's Serial Number
1.00	is the Software Version for the Main CPU
1.00	is the Software Version for the Comm CPU, if Present, else blank.

Sending Commands

Commands cannot be grouped together, only 1 command per line will be recognized. To simplify the decoding of received commands, each command type will begin with a unique character heading. These command types are organized logically so that commands can be remembered. For example, m is for all Load Meter Values; d is for all Demand Meter Values, and so on. In some cases, the first two characters are significant, such as for Physical Outputs (or Terminal Outputs). Table 10-3 depicts the currently defined command types for the Microshield O/C.

Table 10-3. Command Prefixes

Command Type	1st Characters
Read Commands	
Load Values	m
Demand Values	d
Event Records	e
Fault Records	f
Logical Input States	li
Logical Output States	lo
Seal-In States	si
Physical Inputs	ti
Physical Outputs	to
Misc. Information and Commands	x
Read/Write Commands	
Protective Settings	p
Recloser Settings	r
Configuration Settings	c
Prog. Input Settings	i
Prog. Output Settings	o
Seal-In Output Settings	so
Comm. Settings	n
Clock Settings	k
Master Trip Output Settings	q
Breaker Counters	b

A command that does not begin with any of the prefixes above will return an **02: Invld Cmnd Recvd** error message. All error messages are listed at the end of this document.

For the Read and Read/Write commands defined above, the following format is required to READ data from the unit:

{Command}<CR><LF>

When the User desires to write a setting to the Unit, the following format is required:

{Command}, value, password<CR><LF>

Where:

The value parameter entered must have the same format as described in the Response column of the corresponding table. {See the Response table notes below}. If the received string is not understood, a **"03: Invld Cmnd Syntx"** response will be returned. When a setting is changed successfully, a **"01: OK"** response will be returned.

Receiving Commands

When the unit receives a valid command, it is processed and an ASCII Text String is returned to the User. When numeric values are to be returned, they may or may not be formatted with a decimal point. The following notation is used in the tables defined below:

DP: Decimal Places, e.g. 2DP is 2 Decimal Places
LDP: Decimal Point all the way to the Left
RDP: Decimal Point all the way to the Right

For Example:

min 12345 5 digits, RDP Load IN

defines the Load Meter Neutral Current, IN to be a 5 digit number, with the decimal point to the right.

In another example:

mvan 657.80 5 digits, 2DP VA Magnitude

defines the Load Meter Voltage of VA to N Magnitude to be a 5 digit number with 2 decimal places.

These decimal points are returned in the response. The number of digits shown in each response will be the number of digits returned (In text form). If a field underflows, there will be preceding zero's to make the field size fixed. When writing to the unit, as noted above, the following rules apply:

If a decimal point is required, and none is provided, then the decimal point is assumed to be at the end and the number ends with ".00". If too many decimal places are provided, the number is truncated.

Numbers are rounded down to their next lowest step value. For example, if the step size on a parameter is .25 and the user enters a number .45, then the number stored will be .25. On reads, if the number only has 1 decimal place of significance, it is returned as 2 decimal places, with the last place being 0.

The following are tables, reflect the currently defined FAST mode commands, and their responses.

Table 10-4. Load Metering Commands

Command	Response	Format	Description
mia	12345	5 digits, RDP	Load IA
mib	12345	5 digits, RDP	Load IB
mic	12345	5 digits, RDP	Load IC
min	12345	5 digits, RDP	Load IN
milst	{Note 1}		All Current Load Meter Values
mvan	657.80	5 digits, 2DP	VA Magnitude (line-neutral)
mvbn	658.70	5 digits, 2DP	VB Magnitude (line-neutral)
mvcn	659.80	5 digits, 2DP	VC Magnitude (line-neutral)
mvab	657.80	5 digits, 2DP	VAB Magnitude (line-line)
mvbc	658.70	5 digits, 2DP	VBC Magnitude (line-line)
mvca	659.80	5 digits, 2DP	VCA Magnitude (line-line)
mkw	4332.80	7 digits, RDP	3 Phase Kwatts
mkvar	3432.90	7 digits, RDP	3 Phase KVAr
mkwh	63210.00	7 digits, 2DP	3 Phase Kwatt Hours
mkvarh	54689.10	7 digits, 2DP	3 Phase KVAr Hours
mfq	60.00	4 digits, 2DP	Line Frequency
mpfv	0.22	4 digits, 2DP	Power Factor Value
mpfd	1,0	1 digit, RDP	Power Factor Direction
mvlst	{Note 2, 3}		All Voltage Load Meter Values

Notes:

1. Returns a comma separated list of each of the Load Current Values in the following order:
   mia,mib,mic,min
   If no VT's are present, any command below milst in the table will return a "**03: Invld Cmnd Syntx**" response.

2. Returns a comma separated list of each of the Load Voltage Values, if the VT's are present, in the following order:
   mva-,mvb-,mvc-,mkw,mkvar,mkwh,mkvarh,mfq,mpfv,mpfd

   The voltages will be displayed once either line-neutral (i.e., mvan) or line-line (ie, mvab) depending on the Voltage Display Mode setting, cvdmd, in the Configuration Settings Menu.

3. If the notes MSOC Native ASCII commands are sent to a unit with current inputs only, the issuance of the noted commands will result in an error "**03: Invld Cmnd Syntx**" response.

Table 10-5. Demand Metering Commands

Command	Response	Format	Description
dia	12345	5 digits, RDP	Demand IA
dib	12345	5 digits, RDP	Demand IB
dic	12345	5 digits, RDP	Demand IC
din	12345	5 digits, RDP	Demand IN
dilst	{Note 1}		All Current Demand Status
dkw	4332.80 {Note 3}	7 digits, RDP	3 Phase Kwatts
dkvar	3432.90 {Note 3}	7 digits, RDP	3 Phase KVAR
dplst	{Note 2, 3}		All Power Demand Status

Notes:

1. Returns a comma separated list of each of the Current Demand Values in the following order:
   dia,dib,dic,din
   If no VT's are present, any command below dilst in the table will return a "**03: Invld Cmnd Syntx**" response.

2. Returns a comma separated list of each of the Power Demand Values in the following order:
   dkw,dkvar

3. If no VT's are present, the MSOC will return a "**03: Invld Cmnd Syntx**" response.

Event and Fault Records

This section details the Reading of the Event and Fault Records. In this mode, we will output the entire record requested, as stored in the unit. No summary information (all records) is provided.

Table 10-6. Event and Fault Records Commands

Command	Response	Format	Description
ecurevt	{Note 1}		Current Event (newest)
enxtevt	{Note 1}		Next Event
fcurflt	{Note 2}		Current Fault (newest)
fnxtflt	{Note 2}		Next Fault
fclr	{Note 3}	{Note 3}	Clear all Records
ecurev2k	{Note 4}		Current Event (newest) Year 2000 Compliant
enxtev2k	{Note 4}		Next Event Year 2000 Compliant
fnxtft2k	{Note 5}		Next Fault Year 2000 Compliant
fcurft2k	{Note 5}		Current Fault (newest) Year 2000 Compliant

Notes:

1. Returns a comma separated list of the Event Record values in the following order:
   event number, event code, time, date.

Parameter	Format
Event Number	3 digits, RDP
Event Code	3 digits, RDP
Time	01:23:45.64
Date	01/23/97

   A list of Event Codes is provided at the end of this section. The date will be formatted as 97/01/23 when unit is in IEC mode. If there are no event records, a "**07: No Records Avail**" response is returned.

2. Returns a comma separated list of the Fault Record values in the following order:
   fault number, fault code, recloser sequence number, time, date, mia, mib, mic, min, mvan, mvbn, mvcn

Parameter	Format
Fault Number	3 digits, RDP
Fault Code	Text String, 4 chrs.
Time	01:23:45.64
Date	01/23/97

   The date will be formatted as 97/01/23 when unit is in IEC mode. The load values will have the same format described previously. If there are no fault records, a "**07: No Records Avail**" response is returned

3. fclr requires a password as is done when changing settings, e.g.:
   fclr, password<CR><LF>

4. Returns a comma separated list of the Event Record values in the following order:
   event number, event code, time, date

5. Returns a comma separated list of the Fault Record values in the following order:
   fault number, fault code, time, date, mia, mib, mic, min, mvan, mvbn, mvcn

Logical I/O States

This section details the Reading of Inputs and Output status from the Microshield O/C. All Logical Input State commands begin with the 'li' characters. All Logical Output State commands begin with the 'lo' character and all seal-in outputs begin with "si". The li43a, liextrii, lizsc, lidtl, lorip, lolkoa, lorda, lorma commands are available as of V1.50. All previous versions will return a **03: Invalid Cmnd Syntax response.**

Table 10-7. Logical Input States

Command	Response	Format	Description
li51lt	actv, inac	Text String, 4 chrs.	51LT Logical In
li51p	actv, inac	Text String, 4 chrs.	51P Logical In
li50p	actv, inac	Text String, 4 chrs.	50P Logical In
li51n	actv, inac	Text String, 4 chrs.	51N Logical In
li50n	actv, inac	Text String, 4 chrs.	50N Logical In
li52a	actv, inac	Text String, 4 chrs.	52a Logical In
li52b	actv, inac	Text String, 4 chrs.	52b Logical In
litrip	actv, inac	Text String, 4 chrs.	Ext. Trip Logical In
licls	actv, inac	Text String, 4 chrs.	Ext. Close Logical In
li43a	actv, inac	Text String, 4 chrs.	43a Logical In
liextrii	actv, inac	Text String, 4 chrs.	Ext. Recl. Initiate
lizsc	actv, inac	Text String, 4 chrs.	Zone Seq. Enable
lirsi	actv, inac	Text String, 4 chrs.	Reset Seal-Ins
lidtl	actv, inac	Text String, 4 chrs.	Drive to Lockout

Table 10-8. Logical Output States

Command	Response	Format	Description
lo51lt	actv, inac	Text String, 4 chrs.	51LT Logical Out
lo51p	actv, inac	Text String, 4 chrs.	51P Logical Out
lo50p	actv, inac	Text String, 4 chrs.	50P Logical Out
lo51n	actv, inac	Text String, 4 chrs.	51N Logical Out
lo50n	actv, inac	Text String, 4 chrs.	50N Logical Out
lopua	actv, inac	Text String, 4 chrs.	Pickup Alarm Logical Out
lofail	actv, inac	Text String, 4 chrs.	Relay Fail Alarm Logical Out
locbfl	actv, inac	Text String, 4 chrs.	CB Fail Alarm Logical Out
lotrp	actv, inac	Text String, 4 chrs.	Trip Logical Out
locls	actv, inac	Text String, 4 chrs.	Close Logical Out
lorip	actv, inac	Text String, 4 chrs.	Reclose In Prog. Logical Out
lolkoa	actv, inac	Text String, 4 chrs.	Recloser Lockout Alarm LO
lormax	actv, inac	Text String, 4 chrs.	Recloser Max Reclose Alarm
lorda	actv, inac	Text String, 4 chrs.	Recloser Disable Alarm

Table 10-9. Seal-In Output States

Command	Response	Format	Description
si51lt	actv, inac	Text String, 4 chrs.	51LT Logical Out
si51p	actv, inac	Text String, 4 chrs.	51P Logical Out
si50p	actv, inac	Text String, 4 chrs.	50P Logical Out
si51n	actv, inac	Text String, 4 chrs.	51N Logical Out
si50n	actv, inac	Text String, 4 chrs.	50N Logical Out
sipua	actv, inac	Text String, 4 chrs.	Pickup Alarm Logical Out
sifail	actv, inac	Text String, 4 chrs.	Relay Fail Alarm Logical Out
sicbfl	actv, inac	Text String, 4 chrs.	CB Fail Alarm Logical Out
sitrp	actv, inac	Text String, 4 chrs.	Trip Logical Out
sicls	actv, inac	Text String, 4 chrs.	Close Logical Out
sirip	actv, inac	Text String, 4 chrs.	Reclose In Prog. Logical Out
silkoa	actv, inac	Text String, 4 chrs.	Recloser Lockout Alarm LO
sirmax	actv, inac	Text String, 4 chrs.	Recloser Max Reclose Alarm
sirda	actv, inac	Text String, 4 chrs.	Recloser Disable Alarm

Physical I/O States

This section details the Reading of the Physical Inputs and Output status from the Microshield O/C. All Physical Input State commands begin with the 'ti' characters. All Physical Output State commands begin with the 'to' characters. These functions allow for determining the state of the I/O without having to know what logicals are assigned to them.

Table 10-10. Physical Input States

Command	Response	Format	Description
ti1	actv, inac	Text String, 4 chrs.	IN 1 State
ti 2	actv, inac	Text String, 4 chrs.	IN 2 State

Table 10-11. Physical Output States

Command	Response	Format	Description
to1	open, clse	Text String, 4 chrs.	OUT 1 State
to2	open, clse	Text String, 4 chrs.	OUT 2 State
to3	open, clse	Text String, 4 chrs.	OUT 3 State {Note 1}
to4	open, clse	Text String, 4 chrs.	OUT 4 State {Note 1}

Notes:

1. Commands to3 and to4 will return a **02: Invld Cmnd Recvd** if the unit has voltage inputs.

Clock Commands

This section details the Reading of the Real Time Clock. All Real Time Clock Settings begin with the 'k' character. The Y2K Compliant versions of these commands are available as of V1.50. All previous versions will return a **03: Invalid Cmnd Syntax response.**

Table 10-12. Clock Commands

Command	Response	Format	Description
kdate	01/23/97	Text String, 8 chrs.	Date
ktime	01:23:45	Text String, 12 chrs.	Time
kts	01/23/97, 01:23:45	Text String, 21 chrs.	Time Stamp, both together
kts2k	01/23/1997, 01:23:45	Text String, 23 chrs.	Time Stamp, both together Y2K compliant
kdate2k	01/23/1997	Text String, 10 chrs.	Date, Y2K compliant

Notes:

1. Fractional seconds are not displayed and cannot be set by the user. When setting the time, they are automatically set to 00. It is assumed that this level of time accuracy is not relevant in ASCII communications. Hundredth of seconds are returned in the time stamp of Fault and Event records.

2. Date and time can be formatted differently for IEC enabled units.

3. When the clock is disabled, all digits will be '0.' The clock is disabled by entering '00' for the month value.

4. The commands kts and kts2k are read-only commands, used to read the unit's timestamp.

Miscellaneous Commands

This section details the reading of other miscellaneous information from the unit and the sending of other miscellaneous commands to the unit. All of the Miscellaneous commands begin with the 'x' character.

Table 10-13. Miscellaneous Information

Command	Response	Format	Description
xrdtrg	{Note 1}		Read Targets (LEDÕs)
xinfo	Banner, w/o name	see pg. 10-4	Unit Information
xustat	{Note 2}		Relay Status

Table 10-14. Miscellaneous Commands

Command	Response	Format	Description
xtrip	{Note 3}	{Note 6}	Operate Trip Output
xcls	{Note 3}	{Note 6}	Operate Close Output
x79	{Note 4}	{Note 6}	Enable/Disable 79 Function on a temporary basis
xgnd	{Note 4}	{Note 6}	Enable/Disable Gnd
xrsrec	{Note 5}	{Note 6}	Clear All Records
xrsemtr	{Note 5}	{Note 6}	Reset Energy Meters
xoc1	{Note 5}	{Note 6}	Pulse OUT1 for 1 Second
xoc2	{Note 5}	{Note 6}	Pulse OUT2 for 1 Second
xoc3	{Note 5}	{Note 6}	Pulse OUT3 for 1 Second
xoc4	{Note 5}	{Note 6}	Pulse OUT4 for 1 Second
xrstrg	{Note 5}		Reset Targets
xslftst	pass, fail	{Note 8}	Status of Self Test Commands
xledtst	{Note 5}		Visual test of LEDs
xkeytst	{Note 7}		Visual test of Front Panel keys
xrtsi	{Note 5}	{Note 6}	Reset All Seal-Ins
xexit	impossible		Disabled Comm Port

Notes:

1. Targets will return a comma separated list of each target name followed by its' status. The Status target can have values of "ok" or "fail." The others can have values of "on" or "off." Example:
   stat: ok, pu: off, time: on, inst: off

2. xustat will return a 16 bit word (non-ascii) with the relay status encoded. It is up to the user to extract each individual status bit. See the end of this document for the encoding format.

3. xtrip and xcls will return a **09: Operation Failed** response if the action was not performed and a **01: OK** response if it was performed.

4. x79, xgnd, and xsupv are toggled on and off by this command. The response is as follows:

   10: Disabled if the command leaves the function disabled.
   11: Enabled if the command leaves the function enabled.

5. xrstrg, xledtst, xrsrec, xrsemtr, and xoc1 thru xoc4 will return a **01: OK** response when completed.

6. xtrip, xcls, x79, xgnd, xsupv, xrsrec, xrsemtr, and xoc1 thru xoc4, require a password as is done when changing settings, e.g.:
   xtrip, password<CR><LF>

7. The user will determine the response to the xkeytst command by pressing the E or C key when prompted. If the C key is pressed, the Unit will return a **01: OK** message. If the E key is pressed, the unit will return a **06: Test Failed** message.

8. Self Test will return a comma separated list of each test name followed by its' status. Each can have a value of "pass" or "fail." Example:
   ram: pass,prom:pass,nvrm:fail,eprm:pass,anlg:pass

Protective Settings

This section details the Protective Settings in the Microshield O/C. All of the Protective Setting commands begin with the 'p' character. In specifying these commands, the following abbreviations are used:

cv: Curve
pu: Pickup
td: Time Dial or Delay

Table 10-15 defines the Protective Settings. The NOTES Section provides details on the different curve types defined for the different functions.

Table 10-15. Protective Settings

Command	Response	Format	Description
pcv51lt	{Note 1}	Text String, 4 chrs.	Curve for 51LT function.
ppu51lt	11.75	4 digits, 2DP	PickUp Amps for 51LT
ptd51lt	05.40	4 digits, 2DP	Time Dial/Delay for 51LT
pcv51p	{Note 2}	Text String, 4 chrs.	Curve for 51P function.
ppu51p	11.75	4 digits, 2DP	PickUp Amps for 51P
ptd51p	05.40	4 digits, 2DP	Time Dial/Delay for 51P
pcv50p	{Note 3}	Text String, 4 chrs.	Curve for 50P function.
ppu50p	19.90	4 digits, 2DP	PickUp X for 50P
ptd50p	09.90	4 digits, 2DP	Time Dial/Delay for 50P
pcv51n	{Note 2}	Text String, 4 chrs.	Curve for 51N function.
ppu51n	11.75	4 digits, 2DP	PickUp Amps for 51N
ptd51n	09.90	4 digits, 2DP	Time Dial/Delay for 51N
pcv50n	{Note 3}	Text String, 4 chrs.	Curve for 50N function.
ppu50n	19.90	4 digits, 2DP	PickUp X for 50N
ptd50n	09.90	4 digits, 2DP	Time Dial/Delay for 50N

Notes:

1. Choices for 51LT curve types are as follows:

dis	Disabled
ldef	Long Definite Time
lx	Long Time Extremely Inverse
lv	Long Time Very Inverse
ln	Long Time Inverse
vlx	Very Long Time Extremely Inverse
vlv	Very Long Time Very Inverse
vln	Very Long Time Inverse
iln	IEC Long Time Inverse

2. Choices for 51P and 51N curve are as follows:

dis	Disabled (not for 51P)
def	Definite Time
x	Extremely Inverse
v	Very Inverse
n	Inverse
sn	Short Time Inverse
lx	Long Time Extremely Inverse
lv	Long Time Very Inverse
ln	Long Time Inverse
ix	IEC Extremely Inverse
iv	IEC Very Inverse
in	IEC Inverse
iln	IEC Long Time Inverse
def2	Definite Time 2

3. Choices for 50P and 50N curves are as follows:

dis	Disabled
def	Definite Time
sn	Short Time Inverse
std	Standard (no delay)
def2	Definite Time 2

Recloser Settings

This section details the Reading of Recloser Settings from the Microshield O/C. All of the Recloser Settings commands begin with the 'r' character. The following abbreviations are used:

ot:	Open Time
s:	Selected Functions
791:	1st Reclose
792:	2nd Reclose
793:	3rd Reclose
794:	4th Reclose
795:	5th Reclose

Table 10-16 defines the Recloser Settings. The Notes Section provides details on the different response types defined for the different functions.

Table 10-16. Recloser Settings

Command	Response	Format	Description
rot791	199.90	5 digits, 2DP	Open Timer 79-1
rs79150p	{Note 1}	Text String, 4 chrs.	Selection for 50P Trip.
rs79150n	{Note 1}	Text String, 4 chrs.	Selection for 50N Trip.
rs79151n	{Note 1}	Text String, 4 chrs.	Selection for 51N Trip.
rs79151l	{Note 1}	Text String, 4 chrs.	Selection for 50LT Trip.
rs79151p	{Note 2}	Text String, 4 chrs.	Selection for 50P Lockout.
rot792	199.90	5 digits, 2DP	Open Timer 79-2
rs79250p	{Note 1}	Text String, 4 chrs.	Selection for 50P Trip.
rs79250n	{Note 1}	Text String, 4 chrs.	Selection for 50N Trip.
rs79251n	{Note 1}	Text String, 4 chrs.	Selection for 51N Trip.
rs79251l	{Note 1}	Text String, 4 chrs.	Selection for 50LT Trip.
rs79251p	{Note 2}	Text String, 4 chrs.	Selection for 50P Lockout.
rot793	199.90	5 digits, 2DP	Open Timer 79-3
rs79350p	{Note 1}	Text String, 4 chrs.	Selection for 50P Trip.
rs79350n	{Note 1}	Text String, 4 chrs.	Selection for 50N Trip.
rs79351n	{Note 1}	Text String, 4 chrs.	Selection for 51N Trip.
rs79351l	{Note 1}	Text String, 4 chrs.	Selection for 50LT Trip.
rs79351p	{Note 2}	Text String, 4 chrs.	Selection for 50P Lockout.
rot794	199.90	5 digits, 2DP	Open Timer 79-4
rs79450p	{Note 1}	Text String, 4 chrs.	Selection for 50P Trip.
rs79450n	{Note 1}	Text String, 4 chrs.	Selection for 50N Trip.

Table 10-16. Recloser Settings (Cont).

Command	Response	Format	Description
rs79451n	{Note 1}	Text String, 4 chrs.	Selection for 51N Trip.
rs79451l	{Note 1}	Text String, 4 chrs.	Selection for 50LT Trip.
rs79451p	{Note 2}	Text String, 4 chrs.	Selection for 50P Lockout.
rs79550p	{Note 1}	Text String, 4 chrs.	Selection for 50P Trip.
rs79550n	{Note 1}	Text String, 4 chrs.	Selection for 50N Trip.
rs79551n	{Note 1}	Text String, 4 chrs.	Selection for 51N Trip.
rs79551l	{Note 1}	Text String, 4 chrs.	Selection for 50LT Trip.
rrt79	200	3 digits, RDP	Reset Time
rcot79	200, dis {Note 3}	3 digits, RDP	Cutout Time
rrect79	9999, dis {Note 3}	4 digits, RDP	Recovery Time
rlim79	9999	4 digits, RDP	Limit Time
rrtl79	9999, dis {Note 3}	4 digits, RDP	Recloses to Lockout
rlimc79	99	2 digits, RDP	Recovery Count

Notes:

1. Choices for Selection for Trip are as follows:

enb	Function Enabled
dis	Function Disabled
lko	Sends to Lockout (same as enb for 795)

2. Choices for 51P Lockout are as follows:

eo	Enabled Function
lko	Sends to Lockout

3. rcot79, rrect79, rrtl79 parameters have disable functions.

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Configuration Settings

This section details the Reading of Configuration Settings from the Microshield O/C. All of the Configuration Settings commands begin with the 'c' character.

Table 10-17. Configuration Settings

Command	Response	Format	Description
cpctr	2000	4 digits, RDP	Phase CT Ratio
cnctr	2000	4 digits, RDP	Neutral CT Ratio
cvtr	1000	4 digits, RDP	VT Ratio
cvtcon	Wye, delt	Text String, 4 chrs.	VT Connection type
ctft	60	2 digits, RDP	Trip Fail Time
cdtc	15	2 digits, RDP	Demand Time Constant
crstmd	dly, ins	Text String, 3 chrs.	51 Reset mode
cvdmd	ln, ll	Text String, 2 chrs.	V Display Mode
cclmd	sec, min, dis	Text String, 3 chrs.	Cold Load Time Mode
cclt	254	3 digits, RDP	Cold Load Time
cclft	123	3 digits, RDP	Close Fail Time

Notes:

1. There is no method supported for changing the password.

2. If cclmd is set to dis, then cclt will respond with "**08: Setting not available".**

Programmable Logic Settings

This section details the Reading the Programmable Input and Output Settings from the Microshield O/C. All Programmable Input Settings begin with the 'i' character. All Programmable Output Settings begin with the 'o' character. All seal-in output settings begin with "so".The i43a, iextri, izsc, idtl, orip, olkoa, orda, and orma commands are available as of V1.50. All previous versions will return a **08: Setting Not Avail response.**

Table 10-18. Programmable Input Settings

Command	Response	Format	Description
i51lt	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	51LT Logical In Mapping
i51p	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	51P Logical In Mapping
i50p	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	50P Logical In Mapping
i51n	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	51N Logical In Mapping
i50n	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	50N Logical In Mapping
i52a	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	52a Logical In Mapping
i52b	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	52b Logical In Mapping
itrip	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	Ext. Trip Logical In Mapping
icls	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	Ext. Close Logical In Mapping
i43a	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	43a Logical In Mapping
iextrii	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	EXTRI Logical In Mapping
izsc	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	ZSC Logical In Mapping
idtl	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	DTL Logical In Mapping
irsi	in1,in2,1/or 2,1ad2,nm	Text String, 4 chrs.	RSI Logical In Mapping

Notes:

nm	Not mapped
in1	Physical Input 1
in2	Physical Input 2
1 ad 2	Input 1 AND Input 2
1 or 2	Input 1 OR Input 2

Table 10-19. Programmable Output Settings

Command	Response	Format	Description
o51lt	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	51LT Logical Out Mapping
o51p	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	51P Logical Out Mapping
o50p	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	50P Logical Out Mapping
o51n	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	51N Logical Out Mapping
o50n	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	50N Logical Out Mapping
opua	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	Pickup Alarm Log. Out Mapping
ofail	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	Relay Fail Alarm Log. Out Mapping
ocbfl	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	CB Fail Alarm Log. Out Mapping
otrp	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	Trip Logical Out Mapping
ocls	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	Close Logical Out Mapping
orip	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	Reclose in Progress
olkoa	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	Recloser Lockout Alarm
orda	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	Recloser Diabled Alarm Mapping
ormax	o1,o2,o3, o4,tr,nm	Text String, 2 chrs.	Recloser Max Reclose Alarm

Table 10-20. Programmable Seal-In Output Settings

Command	Response	Format	Description
so51lt	o1,o2,o3,o4,nm	Text String, 2 chrs.	51LT Logical Out Mapping
so51p	o1,o2,o3,o4,nm	Text String, 2 chrs.	51P Logical Out Mapping
so50p	o1,o2,o3,o4,nm	Text String, 2 chrs.	50P Logical Out Mapping
so51n	o1,o2,o3,o4,nm	Text String, 2 chrs.	51N Logical Out Mapping
so50n	o1,o2,o3,o4,nm	Text String, 2 chrs.	50N Logical Out Mapping
sopua	o1,o2,o3,o4,nm	Text String, 2 chrs.	Pickup Alarm Log. Out Mapping
sofail	o1,o2,o3,o4,nm	Text String, 2 chrs.	Relay Fail Alarm Log. Out Mapping
socbfl	o1,o2,o3,o4,nm	Text String, 2 chrs.	CB Fail Alarm Log. Out Mapping
sotrp	o1,o2,o3,o4,nm	Text String, 2 chrs.	Trip Logical Out Mapping
socls	o1,o2,o3,o4,nm	Text String, 2 chrs.	Close Logical Out Mapping
sorip	o1,o2,o3,o4,nm	Text String, 2 chrs.	Reclose in Progress
solkoa	o1,o2,o3,o4,nm	Text String, 2 chrs.	Recloser Lockout Alarm
sorda	o1,o2,o3,o4,nm	Text String, 2 chrs.	Recloser Disabled Alarm Mapping
sormax	o1,o2,o3,o4,nm	Text String 2 chrs.	Recloser Max Reclose Alarm

Notes:

o1	Output 1
o2	Output 2
o3	Output 3
o4	Output 4
nm	Not Mapped

Master Trip Output Settings

This section details the Master Trip Output settings from the MicroShield. All Master Trip Output Settings begin with the 'q' character.

Table 10-21. Master Trip Output Settings

Command	Response	Format	Description
qmt51lt	off, on	Text String, 2 chrs.	51LT to Trip Output
qmt51p	off, on	Text String, 2 chrs.	51P to Trip Output
qmt50p	off, on	Text String, 2 chrs.	50P to Trip Output
qmt51n	off, on	Text String, 2 chrs.	51N to Trip Output
qmt50n	off, on	Text String, 2 chrs.	50N to Trip Output

Communications Settings & Information

This section details the Reading of Communications Settings and Information. All Communications Commands begin with the 'n' character.

Table 10-22. Communications Settings and Information

Command	Response	Format	Description
naddr	1234	4 digits, RDP	Network Address
nfprot	asci, mdbs	Text String, 4 chrs.	Front Port Protocol
nfbaud	{Note 1}	4 digits, RDP	Baud Rate, Front Port
nffrm	{Note 2}	Text String, 3 chrs.	Framing, Front Port
nfech	on, off	Text String, 1 chrs.	Front Port Echo
nrprot	asci, mdbs	Text String, 4 chrs.	Rear Port Protocol
nrbaud	{Note 1}	4 digits, RDP	Baud Rate, Rear Port
nrfrm	{Note 2}	Text String, 3 chrs.	Framing, Rear Port
ntxdly	123 {Note 2}	4 digits, RDP	Transmit Delay Time

Breaker Counter Settings

This section details the breaker counter for the MicroShield. All breaker counters begin with a 'b' prefix. These commands are available as of V1.50. All previous versions will return a **08: Setting Not Avail** response.

Table 10-23. Breaker Counter Settings

Command	Response	Format	Description
bcops	12345	5 digits, RDP	Total Breaker Operations
bcksia	12345	5 digits, RDP	KSIA
bcksib	12345	5 digits, RDP	KSIB
bcksic	12345	5 digits, RDP	KSIC
bc791	12345	5 digits, RDP	First Reclose Counter
bc792	12345	5 digits, RDP	Second Reclose Counter
bc793	12345	5 digits, RDP	Third Reclose Counter
bc794	12345	5 digits, RDP	Fourth Reclose Counter
bctrcl	12345	5 digits, RDP	Total Recloser Counter
bcoctrp	12345	5 digits, RDP	Overcurrent Trip Counter
bcrclok	12345	5 digits, RDP	Successful Reclose Counter

Notes:

1. Possible choices for baud rate are: 1200, 2400, 4800, 9600, 19200

2. Possible choices for framing are: o71, e71, n81, o72, e72

3. Range is 0 to 200 in increments of 5. Any value not divisible by 5 will be rounded down.

Error Codes

This section describes the small but growing list of error codes returned from the unit. Each code is preceded by a number so the code can be quickly determined by an automated system.

The current list of codes is:

00: Invld Err Code This error is used by us as a check on the error code transmission software. The user should never see this once we debug the code.

01: OK Returned when a setting has been changed or action has been performed successfully.

02: Invld Cmnd Recvd Returned when the prefix of the command received does not match any in the table.

03: Invld Cmnd Syntx Returned if the received command does not match any in the list for that category.

04: Invld Pswrd Returned when the password included **07: No Records Avail** Returned when a fault or event record is requested and none are currently logged.

08: Setting Not Avail This setting is currently unavailable to the user.

09: Operation Failed Returned when trip and fail commands are not performed, probably because breaker state is unknown.

10: Disabled Returned when the function was left disabled.

11: Enabled Returned when the function was left enabled.

Event Codes

This section describes the correspondence between the numeric event codes and the text for that code. Each table is defined for each different "group" of error codes generated by the Microshield O/C.

Table 10-24. Circuit Breaker Events

Code	Text
000	CB Closed
001	CB Open
002	CB State Unknown
003	CB Failed to Trip
004	CB Failed to Close
005	CB Pop Open
006	CB Pop Closed
007	Ext. Trip
008	Ext Close
009	Event #10 (Spare)

Table 10-25. Self Test Events

Code	Text
010	RAM 1 Failure
011	RAM 2 Failure
012	RTC Failure
013	EEP Primary Failure
014	EEP Config Failure
015	EEP Output Failure
016	EEP Input Failure
017	EEP Comm Failure
018	EEP Recloser Failure
019	EEP Master Trip Failure
020	EEP PROM Checksum Fail.
021	Analog Failure
022	Editor Access
023	Battery Low
024	Watchdog Reset
025	Power On Reset
026	EEP Seal In Failure
027	Diag 18 (Spare)
028	Diag 19 (Spare)
029	Diag 20 (Spare)
030	Diag 21 (Spare)
031	Diag 22 (Spare)
032	Diag 23 (Spare)
033	Diag 24 (Spare)
034	Diag 25 (Spare)
035	Diag 26 (Spare)
036	Diag 27 (Spare)
037	Diag 28 (Spare)
038	Diag 29 (Spare)
039	Diag 30 (Spare)

Table 10-26. Input Events

Code	Text
040	51LT Disabled
041	51LT Enabled
042	51P Disabled
043	51P Enabled
044	50P Disabled
045	50P Enabled
046	51N Disabled
047	51N Enabled
048	50N Disabled
049	50N Enabled
050	52a Opened
051	52a Closed
052	52b Opened
053	52b Closed
054	Direct Trip
055	Direct Close
056	RCL 43a Enabled
057	RCL 43a Disabled
058	Ext RCL Init
059	Manual Reset
060	Input #21 (Spare)
061	Input #22 (Spare)
062	Input #23 (Spare)
063	Input #24 (Spare)
064	Input #25 (Spare)
065	Input #26 (Spare)
066	Input #27 (Spare)
067	Input #28 (Spare)
068	Input #29 (Spare)
069	Input #30 (Spare)

Table 10-27. Output Events

Code	Text
070	51LT Trip
071	51LT Pickup
072	51LT Drop
073	51P Trip
074	51P Pickup
075	51P Drop
076	50P Trip
077	50P Pickup
078	50P Drop
079	51N Trip
080	51N Pickup
081	51N Drop
082	50N Trip
083	50N Pickup
084	50N Drop
085	51LT Clear
086	51P Clear
087	50P Clear
088	51N Clear
089	50N Clear
090	51LT Reset
091	51P Reset
092	50P Reset
093	51N Reset
094	50N Reset
095	Recloser Enabled
096	Recloser Diasbled
097	Output #28 (Spare)
098	Output #29 (Spare)
099	Output #30 (Spare)

Table 10-28. Communication Events

Code	Text
100	QSI Init Fail
101	Com Init Fail
102	Param Update
103	Int. Tx Failure
104	Wrong (Modbus) Blk Rec'd
105	NW Param Upd
106	Int. Rx Failure
107	Spare Comm #8
108	Spare Comm #9
109	Spare Comm #10

Table 10-29. Operation Events

Code	Text
110	Rst Enrgy Mtrs
111	Records Cleared
112	Reset Seal Ins
113	Spare Ops #4
114	Spare Ops #5
115	Spare Ops #6
116	Spare Ops #7
117	Spare Ops #8
118	Spare Ops #9
119	Spare Ops #10

Table 10-30. Operations Events

Code	Text
120	Recloser 43a Enabled
121	Recloser 43a Disabled
122	Recloser Enabled
123	Recloser Disabled
124	Recl In Prog
125	External Recloser Initiated
126	Recloser Lockout
127	Recloser Reset
128	Recloser Out of Sequence
129	Max Recover Exceeded
130	Recloser Recover
131	Max Recloses Exceeded
132	Max Recloser Resets
133	Zone Step
134	Recloser Error
135	Recloser Init
136	Spare Recloser #17
137	Spare Recloser #18
138	Spare Recloser #19
139	Spare Recloser #20

Misc. Events

Table 10-31. Misc. Event Codes

Code	Text
140	Illegal Event
141	Event Code Error

Fault Codes

This section describes the correspondence between the numeric Fault codes and the text for that code.

Table 10-32. Fault Codes

Code	Text
001	51LT - LO
002	51P - LO
003	50P - LO
004	51N - LO
005	50N - LO
006	Fault Code Error
101	51LT - Reclose Step 1
102	51P - Reclose Step 1
103	50P - Reclose Step 1
104	51N - Reclose Step 1
105	50N - Reclose Step 1
201	51LT - Reclose Step 2
202	51P - Reclose Step 2
203	50P - Reclose Step 2
204	51N - Reclose Step 2
205	50N - Reclose Step 2
301	51LT - Reclose Step 3
302	51P - Reclose Step 3
303	50P - Reclose Step 3
304	51N - Reclose Step 3
305	50N - Reclose Step 3
401	51LT - Reclose Step 4
402	51P - Reclose Step 4
403	50P - Reclose Step 4
404	51N - Reclose Step 4
405	50N - Reclose Step 4

Status Word Decode

This section describes the correspondence between each bit in the return Status word and its' meaning. A '1' means the status is active a '0' means inactive.

Table 10-33. Status Codes

Bit	Text
0	Self Test {1 = fail}
1	Physical Input Setting Change
2	New Event Record
3	New Fault Record
4	Unit Power Cycled
5	Recloser Disabled
6	Ground Trip Disabled
7	Supervisory Control Disabled
8	Battery Failed
9	New Minimum Demand Value
10	New Peak Demand Value
11	Front Port Comm Enabled
12	Local Settings Changed
13 - 15	Reserved, Future Use

Physical Input Setting Change, New Event Record, New Fault Record, Unit Power Cycle, Processor Exception , New Minimum Demand Value, and New Peak Demand are cleared after they are read.

Section 11 - Acceptance Tests

Required Equipment

- Active three phase voltage source and single phase current source with timer.

Settings

The following tests were written to verify proper relay operation after it is received from the factory. They are assumed to be performed on the factory default settings. Tables 4-1, 4-2, and 5-1 list the factory default settings to be tested. Some settings in the Microshield will not be listed in this text and do not affect the test. The values shown in parentheses (x.xx) are the values for 1 ampere rated units.

Factory Default Settings

Verify or change the Microshield O/C settings to match the factory default settings as outlined in Tables 4-1, 4-2, and 5-1.

Testing

All terminal references can be found on Figure 16 in the Drawings Section of this manual.

1. Testing the 51P Phase Time Overcurrent Unit:

Change the following PRIMARY settings for this test:

51LT Selection 51LT = DIS
50P Selection 50P = DIS

Connect a single phase current source to terminals 21 and 22 (Ia). Set the current source to 12.0 (2.4) amperes RMS (2 x pickup). Set up a timer to start upon application of current and stop upon operation of the trip contact at terminal 19 and 20.

Apply the current. The 51P unit should trip in 6.37 seconds $\pm$ 7%. The TIME target should light.

Repeat the test for all of the phase pairs listed in Figure 16.

CAUTION: Do not allow high currents to persist. If tripping is not obtained within the specified time, shut off the current and review your set up.

2. Testing the 51LT Phase Time Overcurrent Unit:

Change the following PRIMARY settings for this test:

51LT Selection 51LT = LT Inv
51P Pickup 51P = 12 (2.4)
50P Selection 50P = DIS

Connect a single phase current source to terminals 21 and 22 (Ia). Set the current source to 12.0 (2.0) amperes RMS (2 x pickup). Set up a timer to start upon application of current and stop upon operation of the trip contact at terminal 19 and 20.

Apply the current. The 51LT unit should trip in 6.37 seconds $\pm$ 7%. The TIME target should light.

Repeat the test for all of the phase pairs listed in Figure 16.

CAUTION: Do not allow high currents to persist. If tripping is not obtained within the specified time, shut off the current and review your set up.

3. Testing the 50P Instantaneous Overcurrent Unit:

Verify or change the following PRIMARY settings for this test:

51P Pickup 51P PU = 6.0 (2.4)
50P Selection 50P = 2.0
50P Pickup 50P PUx = 2.0

Connect a single phase current source to terminals 21 and 22 (Ia). Set the current source to 13.0 (2.60) amperes RMS. Set up a timer to start upon application of current and stop upon operation of the trip contact at terminal 19 and 20.

Apply the current. The 50P unit should trip in 1.0 seconds $\pm$ 7%. The INST target should light.

Repeat the test for all of the phase pairs listed in Figure 16.

CAUTION: Do not allow high currents to persist. If tripping is not obtained within the specified time, shut off the current and review your set up.

4. Testing the 51N Ground Time Overcurrent Unit:

Change the following PRIMARY settings for this test:

50N Selection 50N = DIS

Connect a single phase current source to terminals 27 and 28 (In). Set the current source to 12.0 (2.0) amperes RMS (2 x pickup). Set up a timer to start upon application of current and stop upon operation of the trip contact at terminal 19 and 20.

Apply the current. The 51N unit should trip in 6.37 seconds $\pm$ 7%. The TIME target should light.

Repeat the test for all of the phase pairs listed in Figure 16.

CAUTION: Do not allow high currents to persist. If tripping is not obtained within the specified time, shut off the current and review your set up.

5. Testing the 50N Phase Instantaneous Overcurrent Unit:

Verify or change the following PRIMARY settings for this test:

50N Selection 50N = DEF
50N Pickup 50N = 2.0

Connect a single phase current source to terminals 27 and 28 (In). Set the current source to 13.0 (2.60) amperes RMS. Set up a timer to start upon application of current and stop upon operation of the trip contact at terminal 19 and 20.

Apply the current. The 50N unit should trip in 1.0 seconds $\pm$ 7%. The INST target should light.

Repeat the test for all of the phase pairs listed in Figure 16.

CAUTION: Do not allow high currents to persist. If tripping is not obtained within the specified time, shut off the current and review your set up.

6. Recloser:

Verify or change the following PRIMARY settings for this test:

79-1 Open Time = 5 seconds
79-2 Open Time = 10 seconds
50P Pickup = 3.0

Connect a single phase current source to terminals 21 and 22 (Ia). Set the current source to 12.0 (4.0) amperes RMS. Set the timer to start upon application of current and stop upon operation of the trip contact at terminal 19 and 20.

Use a circuit breaker simulator for this test ABB part number 200S4000 (125 volt model) or equivalent.

Connect the TRIP contact at terminal 19 and 20 to the circuit breaker simulator trip input and the CLOSE contact at terminals 17 and 18 to the circuit breaker simulator close input. Apply the current. The 51P unit should trip in 6.37 seconds and the LCD display should show the 79-1 open time (5 seconds initially). When the open time reaches 0.00, the simulator should close. Apply the fault again within 10 seconds and the 51P unit should trip in 6.37 seconds. The LCD display should show the 79-2 open time (10 seconds initially). When the open time reaches 0.00, the simulator should close. Apply the fault again within 10 seconds and the 51P unit should trip in 6.37 seconds. The LCD display should show the “Recloser Lockout”. At this point the simulator will need to be closed manually.

CAUTION: Do not allow high currents to persist. If tripping is not obtained within the specified time, shut off the current and review your set up.

7. Metering:

Set the current source to 1.00 amperes RMS. Apply the current to each current input (as shown in Figure 10) on the Microshield O/C and watch the metering on the front panel display. The values seen should be 100 $\pm$ 5 amperes.

For units with optional VT inputs:

Apply a three phase voltage source to the voltage inputs as shown in Figure 10 for the metering test connections. Set Va, Vb, and Vc to 70 volts rms. Apply the voltage. Using the front MMI, access the load metering screen and verify the following:

kVan: 7.0 $\pm$ 1%

kVbn: 7.0 $\pm$ 1%

kVcn: 7.0 $\pm$ 1%

Section 12 - Maintenance

The Microshield O/C provides a self test and monitoring feature that virtually eliminates the need for periodic testing. It is recommended that an external connection periodic test be performed to verify proper operation of the Microshield O/C digital inputs and contact outputs since these are not included in the self testing feature. This test will also verify the integrity of the field wiring.

Test Menu

It is possible to energize the contact outputs using the Microshield O/C Test Menu. Access the "Test" then "Outputs" Menu from the front panel MMI. Any one of the output contacts can be tested. A one second pulse is issued from any contact selected for testing.

Self testing status can be displayed by accessing the "Self Test" Menu. This displays the status of all the continual Microshield O/C self tests.

An LED test can be performed by accessing the "LED Test" Menu item.

These functions can also be performed from the optional communications ports.

Relay Failure

If the Microshield should fail self testing for any reason, the self check logical output will change from a logical "1" to a logical "0" and the front panel Status LED will turn red. MSOC's are shipped with output #2 (OUT2) configured as a self check diagnostic output as a factory default. Please contact the ABB Substation Automation and Protection Division Customer Support Department for assistance at 1-800-634-6005. Due to the density and complexity of the Microshield O/C Circuitry, it is not recommended that field service be performed.

Battery Replacement

The long-life battery is a "Lithium" type (not a NiCad). When the Microshield O/C is operating on a source of control power, the drain on the internal battery is essentially 0. The shelf life of the internal battery is approximately 10 years when the Microshield O/C is not running on control power. It can be assumed then that under normal conditions the internal battery will last through the life of the relay. If the battery should fail, an event "Batt. Low" will be generated. DO NOT attempt replacement of the battery due to the density and complexity of the MSOC relay circuitry. Please contact the SAPD factory Customer Support Department at 1-800-634-6005 for assistance.

NOTE: It is recommended that regular checks of events records be performed to detect potential problems like "Batt. Low" to prevent loss of DC power causing a loss of event records data.

Changing EPROMS

All Microshield O/C relays that ship from the factory contain PLCC EPROMS which can be replaced but require a special tool and knowledge of the relay assembly. If it is necessary that EPROM replacement is required, please contact Customer Support at 1-800-634-6005.

Flash EEPROM Programming

It is possible by the use of flash EEPROM to replace the Microshield O/C firmware without the need to replace the physical integrated circuit (IC). The following procedure is required to perform this operation. Note that all relay settings will be lost upon installation of new relay firmware. **BE SURE TO BACKUP YOUR RELAY PRIMARY, CONFIGURATION, AND PROGRAMMABLE INPUTS AND OUTPUTS BEFORE PROCEEDING.**

At the time that this manual was composed, the flash EEPROM interface design was not complete. The next revision to this manual will contain the specific programming instructions. Contact the ABB Substation Automation and Protection Division Technical Support Department for availability. The phone number is 1-800-634-6005.

Communicating with ABB Technical Support

Phone: 1-800-634-6005 or 610-395-7333

Fax: 610-395-1055

If it is deemed necessary to contact the technical support department please have the following information available if possible:

1. Unit catalog number
2. Unit serial number
3. CPU version
4. Comm version

Obtain this information from the MMI Main Menu item "Unit Info". A sample format is shown on the next page.

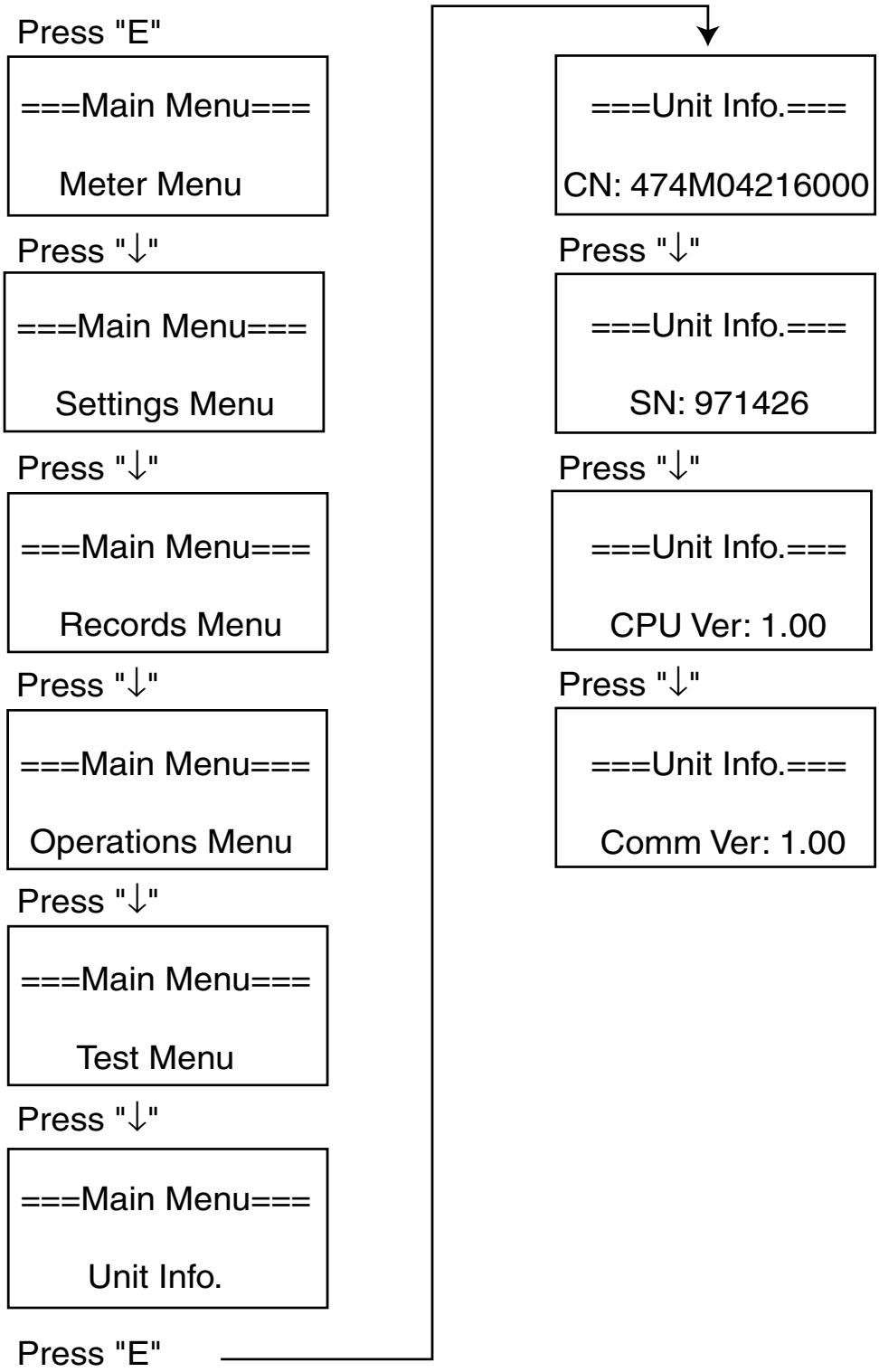


Figure 6. Unit Information

Section 13 - Specifications

Current Input Circuit Ratings (50 or 60 Hertz)

Setting Range	Burden	Max. Continuous	One Second	I nom Metering
1.5 - 12 A	0.0004 VA @ 5 A	15 A	450 A	5 A
0.5 - 4 A	0.0008 VA @ 5 A	15 A	450 A	1.67 A
0.3 - 2.4 A	0.0001 VA @ 1 A	3 A	100 A	1 A
0.1 - 0.8 A	0.0002 VA @ 1 A	3 A	100 A	0.33 A

AC Voltage Input Circuit Ratings (50 or 60 Hertz)

- Burden: 0.04 VA for V-n at 120 Vac

Input Ratings

- Wye Connection: 160 Vac Continuous, 480 Vac for 10 sec
- Delta Connection: 260 Vac Continuous, 480 Vac for 10 sec

Contact Input Circuit Burdens (at terminals 5 and 6)

- 18 - 60 Vdc rated unit: 0.08 VA maximum
- 60 - 150 Vdc rated unit: 0.52 VA maximum
- 150 - 300 Vdc rated unit: 2.1 VA maximum

Output Contact Ratings (all contacts)

- 30 amperes tripping
- 5 amperes continuous
- 0.25 ampere inductive break @ 125 Vdc or 0.1 ampere inductive break @ 250 Vdc

DC Control Power Requirements

Available Ranges	Max. Continuous Drain	Initial Startup Current
18 - 60 Vdc	5 VA	Consult Factory
60 - 150 Vdc	5 VA	0.1 ampere per volt max. over range*
150 - 300 Vdc	5 VA	Consult Factory.

*** Decay to nominal in 0.8 seconds.**

Time-Overcurrent Pickup

Setting Range	Setting Increment
1.5 - 12 A	0.25 A
0.5 - 4 A	0.10 A
0.3 - 2.4 A	0.05 A
0.1 - 0.8 A	0.01 A

Time-Dial Setting

Setting Range	Increment
1-10	0.1

Time-Current Characteristic Curves

- Equations for curves given in the instruction book.
- Transparent curves to be available— consult factory.

Instantaneous Overcurrent Pickup

Setting Range	Increment
1-20X of Time-Overcurrent Pickup	0.1X

Sampling Rate

- 8 samples per cycle per analog input.

SWC and Fast Transient

- Per ANSI C37.90.1 and IEC 255-22-1 class III and 255-22-4 class IV for all connections except communications.

Impulse

- Per IEC 255-5 for all connections except communications.

Dielectric

- 3150 Vdc for 1 second, all circuits to ground except communications ports per IEC 255-5. 2333 Vdc for 1 second, for rear port only.

Radio Frequency Interference

- Per ANSI C37.90.2-1995 (35V/M complete sweep).

Temperature

- -40 to +85 degrees C (operating temperatures below 0 degrees C may impede the LCD display contrast)

Humidity

- Per ANSI C37.90. Up to 95% non-condensing

Metering Tolerances (temperature range of -20 to +55° C)

Function	Tolerance
Ammeter	±1% of Inom (for I from 10% to 2x Inom)
Voltmeter	±1% of full scale (120 Vac)
Wattmeter	±2% of IxV (for I from 10% to 2x Inom)
VAr Meter	±2% of IxV (for I from 10% to 2x Inom)
Energy Meters (WattHr, VArHr)	±2% of IxV (for I from 10% to 2x Inom)
Frequency Meter	±0.05 Hertz

Nominal Metering Current

Input Rating	Inom
1.5 - 12A	5A
0.5 - 4A	1.67A
0.3 - 2.4A	1A
0.1 - 0.8A	0.33A

Protection Tolerances

Function	Pickup	Dropout	Timing (Whichever is greater)
51LT/51P/51N	±5% of setting	98% of setting	±7%, or ±1 cycle
50P/50N	±10% of setting	98% of setting	±7%, or ±1 cycle

Weight

- Unboxed: 7.5 lbs (3.4kg)
- Boxed for shipping: 10 lbs (4.6kg)

Additional Information Available on Request

MSOC Automation Technical Guide TG 7.2.1.7-16
Technical Support: Tel 800-634-6005 or 610-395-7333
Fax 610-395-1055
Faxback System: Domestic (Toll-free) 877-395-0721
International 610-395-7333 x5806

Section 14 - Overcurrent Calculations and Curves

ANSI Curves and Equations

Starting with Firmware Version 1.69, the set of time-current characteristics provdied in the Microshield O/c relay has been expanded to include curves with IEC characteristics. Therefore catalog numbers of format **474Mxxxx-x0xx** have both ANSI style and IEC style curves built in.

The user has complete flexibility in applying both ANSI and IEC curves simultaneously should this be an advantage in the application. For example: the phase-time-overcurrent element (51P) could be set to use the IEC Inverse curve while the phase-instanteous (50P) element is set to use ANSI Short-time Inverse curve.

Table 14-1 along with the associated equations can be used as a reference in determining exact time overcurrent element timing. The operations and reset times are defined as follows:

Trip Time = $\{ [A/(M^P - C) + B] \times [(14n - 5)/9]$
Reset Time = $t_r (M^2-1)$
M = Multiples of pickup current
n = Time Dial Setting (range 1 to 10 in steps of 0.1)

Table 14-1. ANSI Curve Coefficients

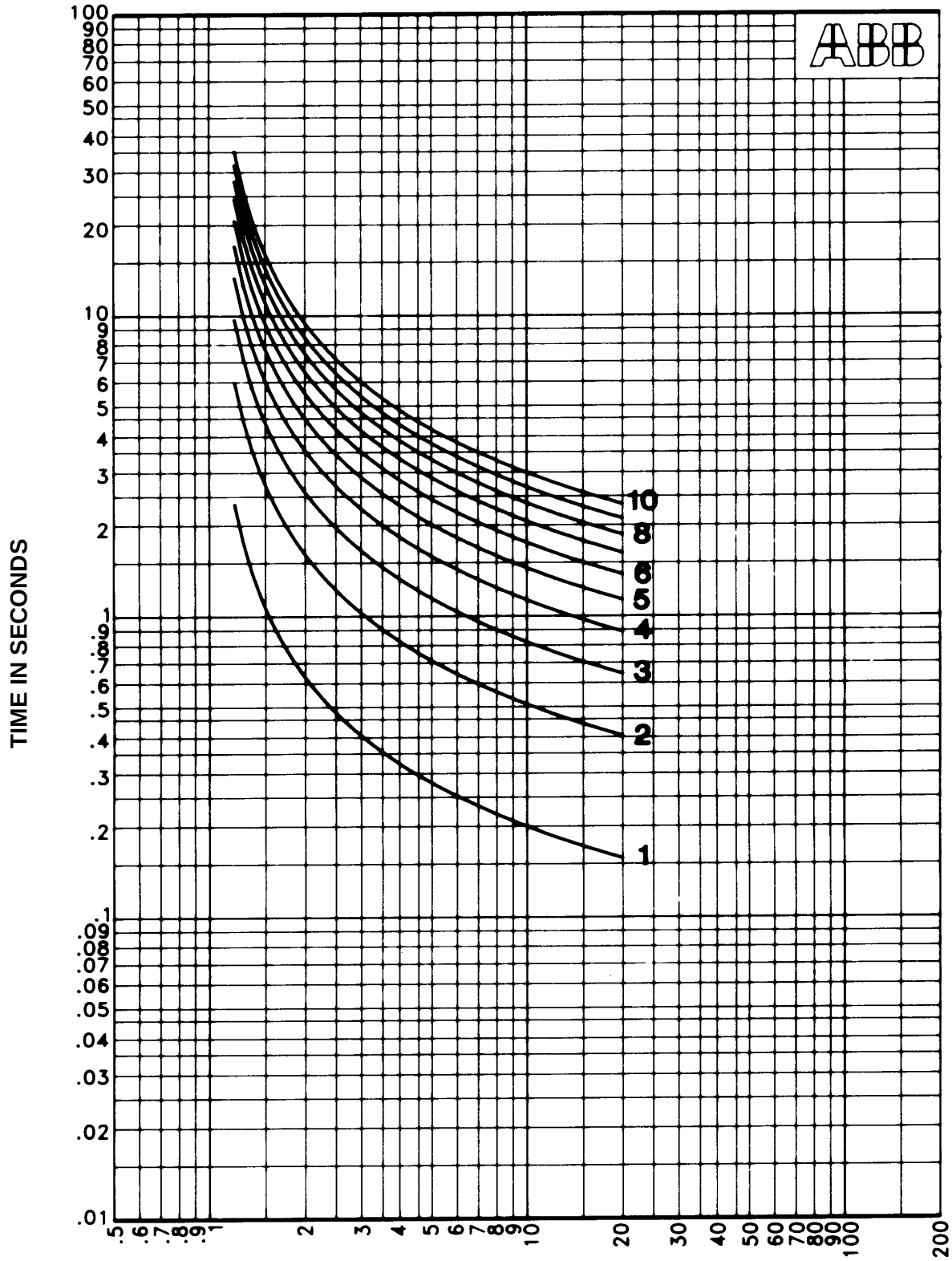
Curve	A	B	C	P	t_r
Extremely Inverse	6.407	0.025	1	2.0	6.285
Very Inverse	2.855	0.0712	1	2.0	3.18
Inverse	0.0086	0.0185	1	0.02	0.798
Short Time Inverse	0.00172	0.0037	1	0.02	0.160
Long Time Extremely Inverse	64.07	0.250	1	2.0	62.85
Long Time Very Inverse	28.55	0.712	1	2.0	31.8
Long Time Inverse	0.086	0.185	1	0.02	7.98
Very Long Time Extremely Inv.	640.7	2.500	1	2.0	628.5
Very Long Time Very Inverse	285.5	7.120	1	2.0	310.8
Very Long Time Inverse	0.860	1.859	1	0.02	79.8

The trip curves and reset times conform to IEEE C37.112.

Notes:

- Only the Inverse, Very Inverse, and Extremely Inverse curves are shown in this section on paes 14-2 through 14-4.
- When a curve is defined as “Short Time”, ie: short time inverse, multiply the times shown on the curves by 0.2.
- When a curve is defined as “Long Time”, ie: long time inverse, multiply the times shown on the curves by 10.
- If a curve is defined as “Very Long Time”, ie: very long time inverse, multiply the times shown on the curves by 100.
- For the ANSI curves the Time Dial is an “identifier” not a multiplier and has a range of 1-10 in steps of 0.1

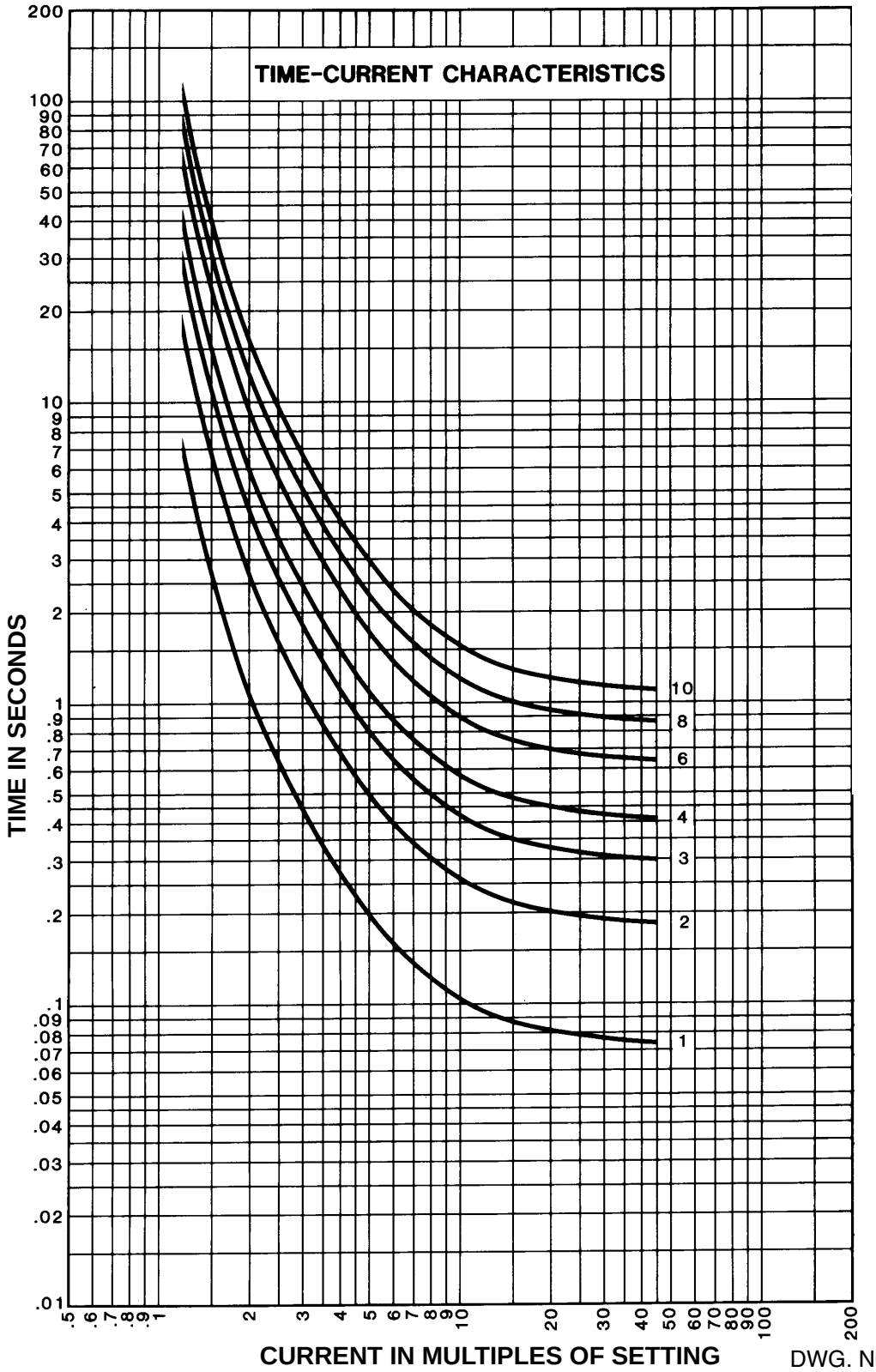
Consult Factory For Curve - 1-800-634-6005 Order Curve Number: 605854



DWG. NO. 605854 Rev. 0

Figure 7. Inverse Curve

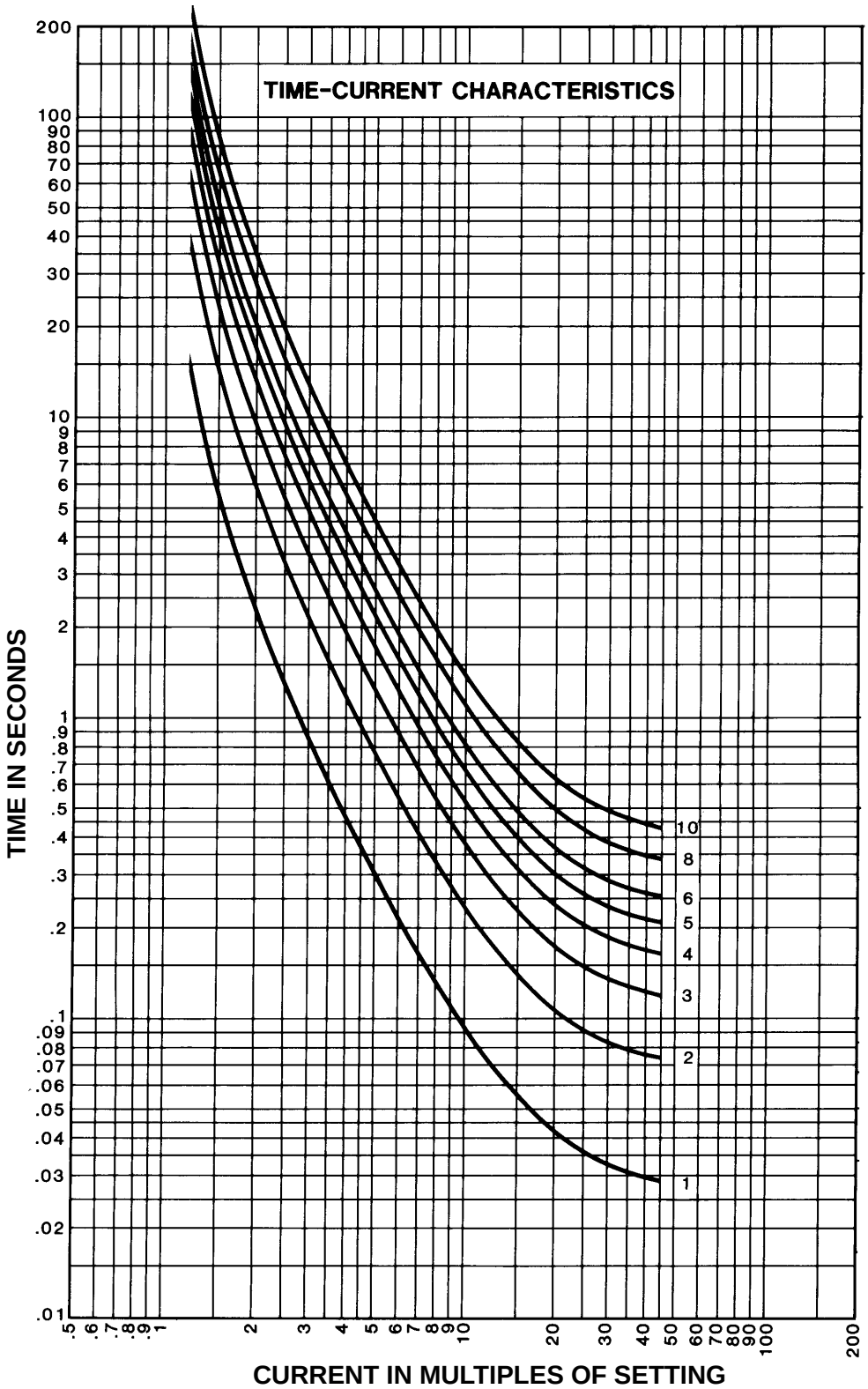
Consult Factory For Curve - 1-800-634-6005 Order Curve Number: 605841



DWG. NO. 605841 Rev. 2

Figure 8. Very Inverse Curve

Consult Factory For Curve - 1-800-634-6005 Order Curve Number: 605842



DWG. NO. 605842 Rev. 2

Figure 9. Extremely Inverse Curve

IEC Curves and Equations

Table 14-2 along with the associated equations can be used as a reference in determining exact time overcurrent element timing. The operations and reset times are defined as follows:

$$\text{Trip Time} = [K/((M^a) - 1)] \times \text{TDM where}$$

K and a are constants,
M = applied current in multiples of the pickup setting
TDM = Time Dial Setting (range 0.05 to 1.0 in steps of 0.05)

Table 14-2. IEC Curve Coefficients

Curve	K	a
Extremely Inverse	80	2.0
Very Inverse	13.5	1.0
Inverse	0.14	0.02
Long Time Inverse	120	1.0

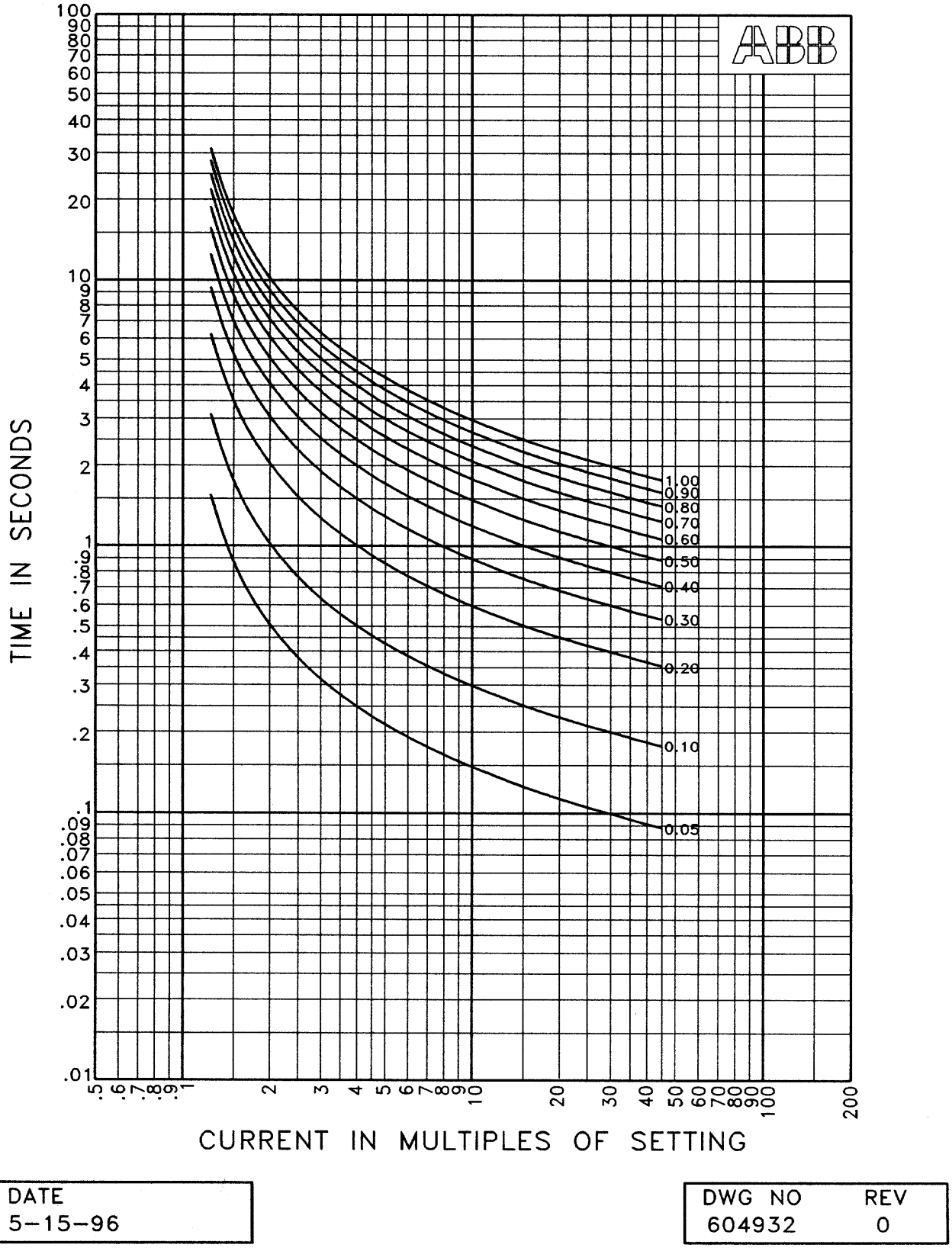


Figure 10. IEC Inverse Curve

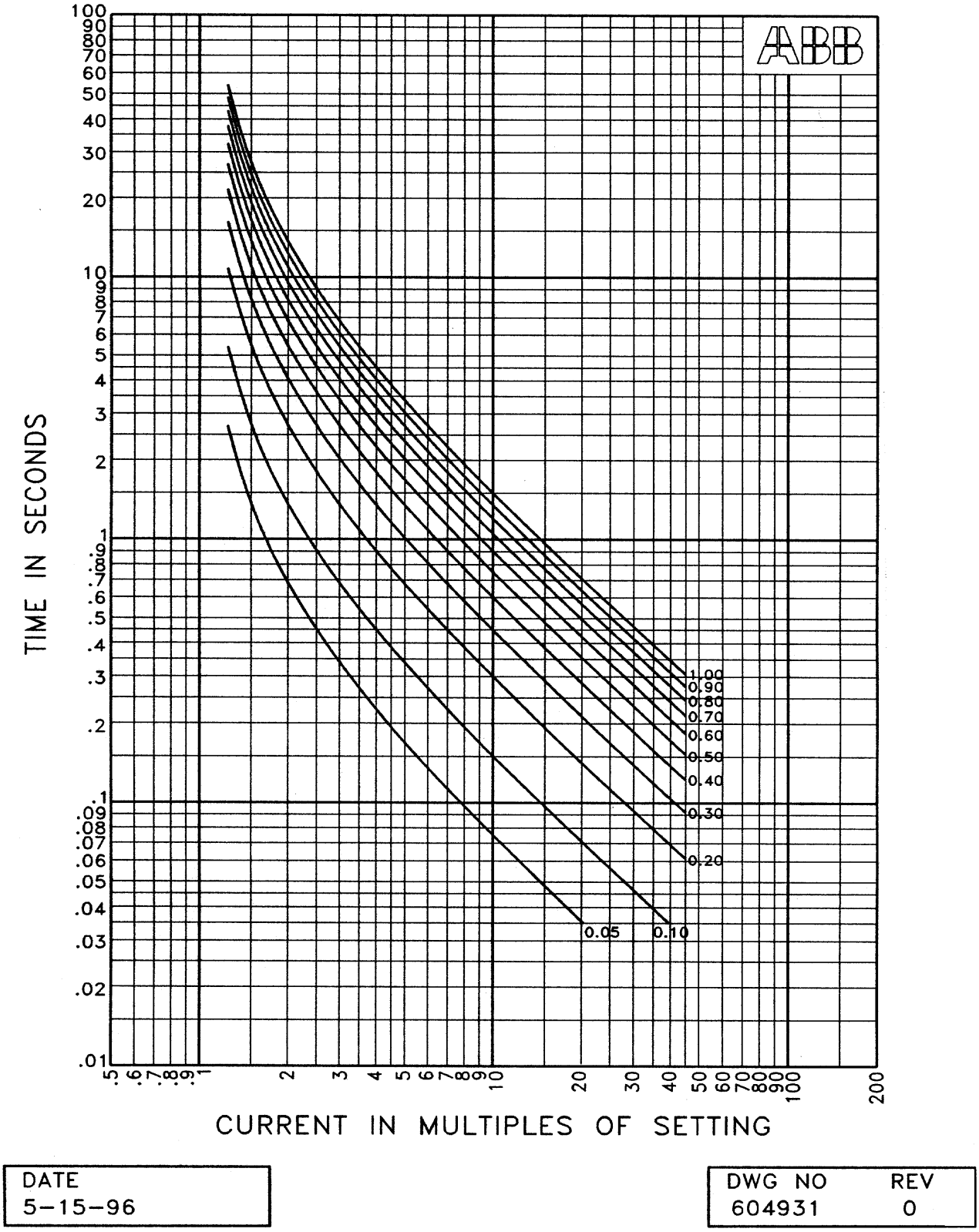


Figure 11. IEC Very Inverse Curve

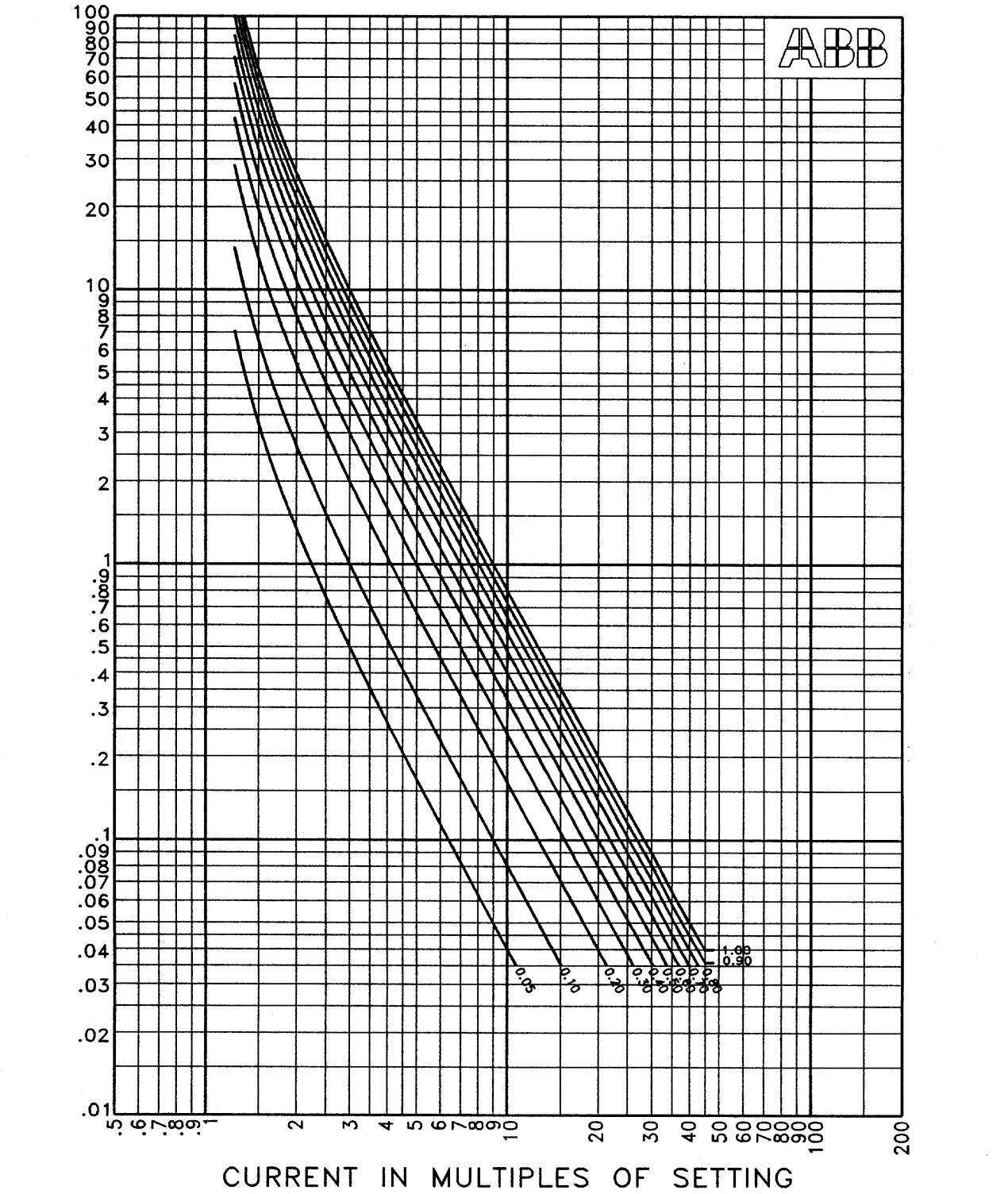


Figure 12. IEC Extremely Inverse Curve

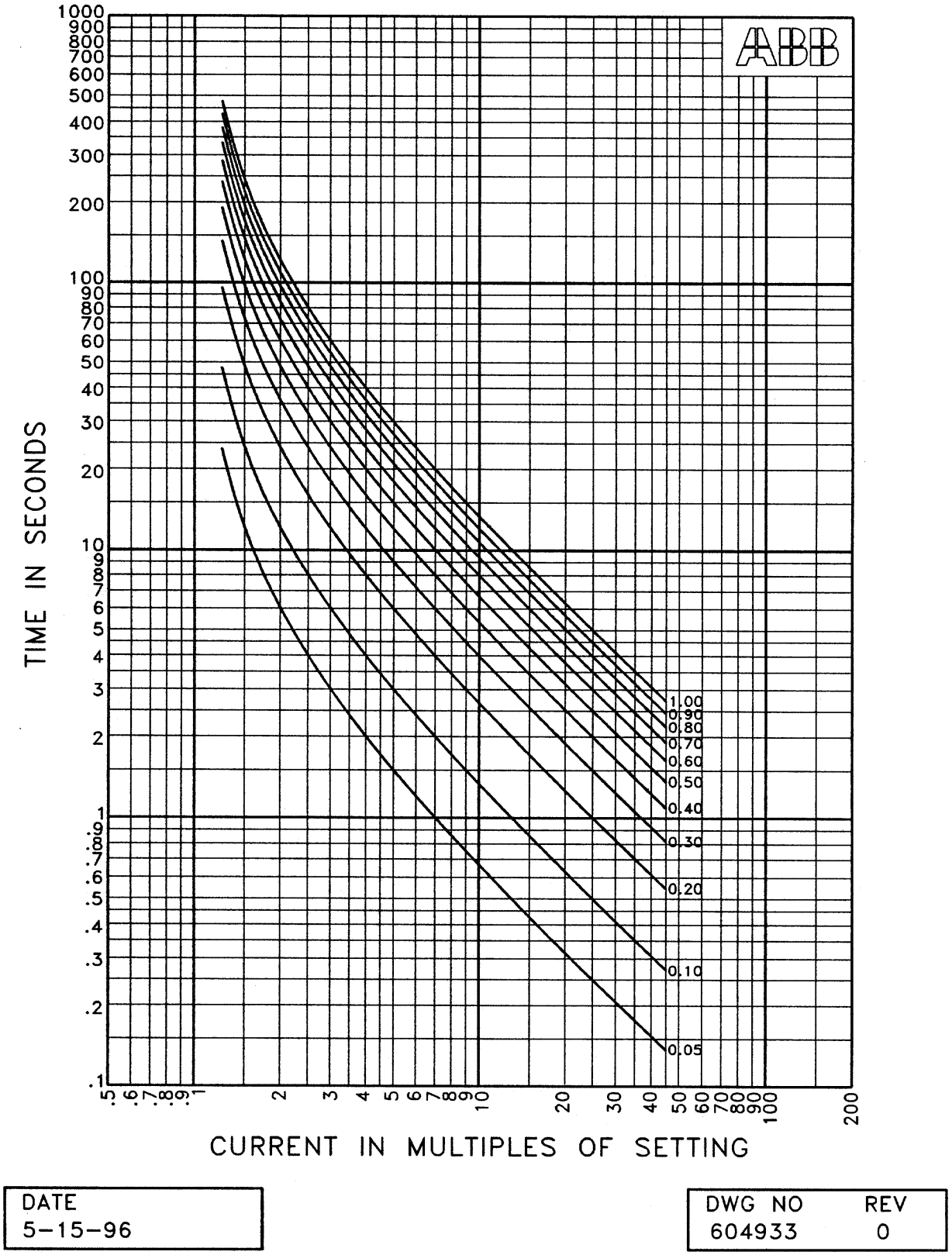


Figure 13. IEC Long Time Inverse Curve

Section 15 - Casing and Optional Accessories

The Microshield O/C relay is packaged in a steel case and provides:

Fully drawout construction with automatic CT secondary shorting.
Standard screw terminals suitable for ring lugs.

The relay outline drawing is shown in Figure 15. For applications where the depth behind the panel is limited, a semiflush mounting kit is available which provides a 0.75-inch- [19 mm] thick spacer. This kit is shown in Figure 18.

The panel drilling and cutout is shown in Figure 14 and the rear terminal block arrangement in Figure 17.

A dust and mist proofing kit consisting of a gasketed clear plastic front cover and a panel gasket is available. This kit is shown in Figure 19 and is suitable for use with or without the semi-flush mounting kit.

For retrofit applications, accessory mounting kits are available. These kits provide an adaptrr plate and hardware to allow mounting the Microshield O/C in an existing panel cutout for an electromechanical unit without any panel cutting or drilling. The available kits are as follows:

1. **Semi-Flush Mounting Kit: 613649-T15**

   Should depth behind the panel be a problem, this kit contains a spacer that is 0.75 [19mm] thick. The spacer is the same size as the front panel of the relay so the overall height and width does not change. Reference Figure 18.

2. **Dust and Mist Proofing Kit: 613649-T13**

   This kit consists of a gasketed plastic cover that fits on the front of the unit, and a gasket that is placed between the unit and the users panel. Reference Figure 19.

3. **CO - FT11 Case Adapter Kit: 613649-T14**

   This kit includes a spacer, adapter plate and associated hardware to allow retrofitting the Microshield O/C relay in a panel cutout originally made for a CO-type electromechanical overcurrent relay. Reference Figure 20.

4. **CO - FT21/22 Case Adapter Kit: 613649-T17**

   This kit includes a spacer, adaptor plate and associated hardware to allow retrofitting the Microshield O/C relay in a panel cutout originally made for a CO-type electromechanical overcurrent relay. Reference Figure 21.

5. **IAC - S1 Case Adapter Kit: 613649-T12**

   This kit includes a spacer, adapter plate and associated hardware to allow retrofitting the Microshield O/C relay in a panel cutout originally made for an IAC-type electromechanical overcurrent relay. Reference Figure 22.

6. **MSOC Projection Mounting Kit: 613649-T18**

   This kit provides box case, standoffs, and associate hardware to install the relay in a projection mount configuration to match e/m relays. Reference Figure 23.

Section 16 - Connection and Outline Drawings

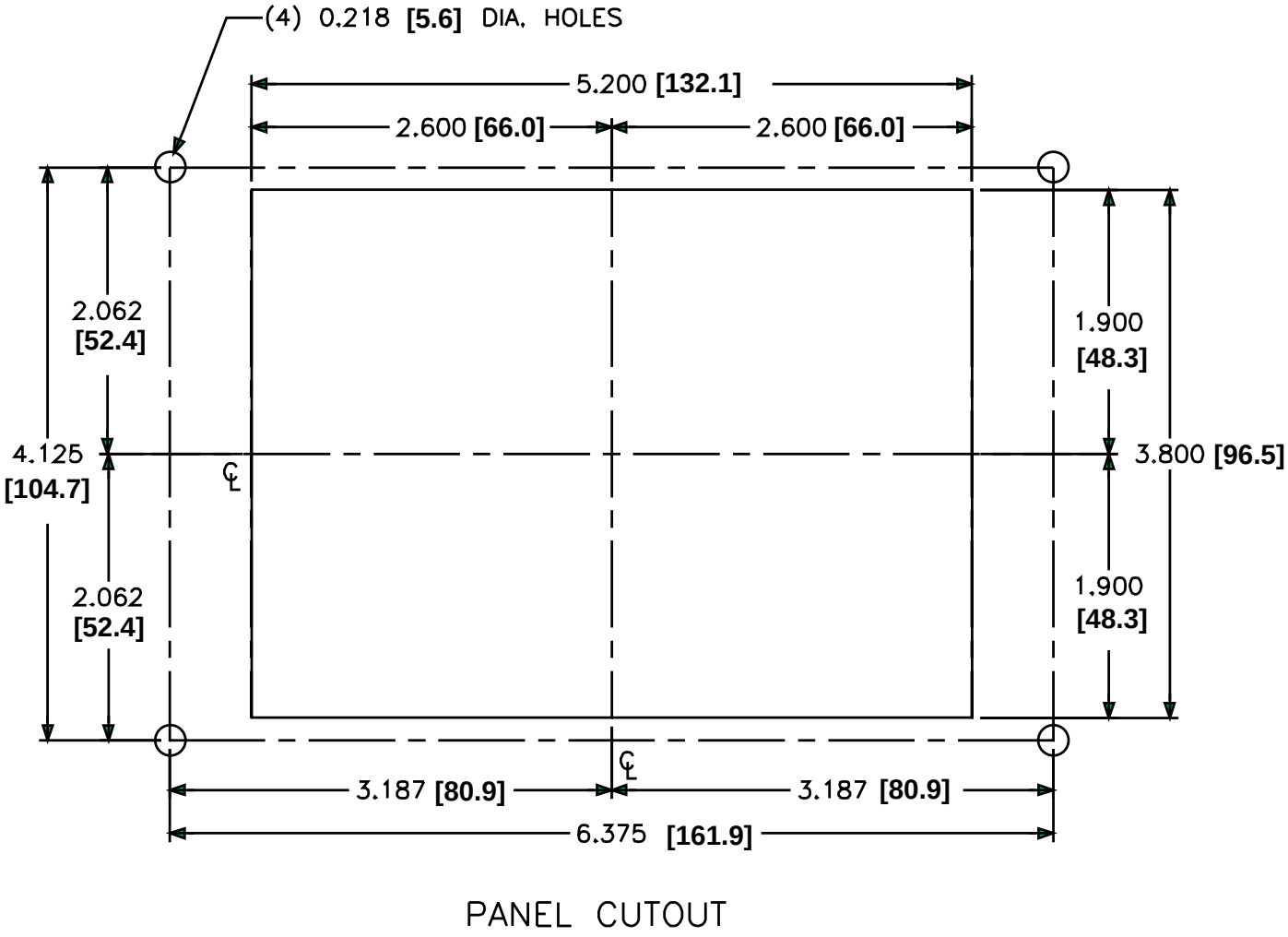
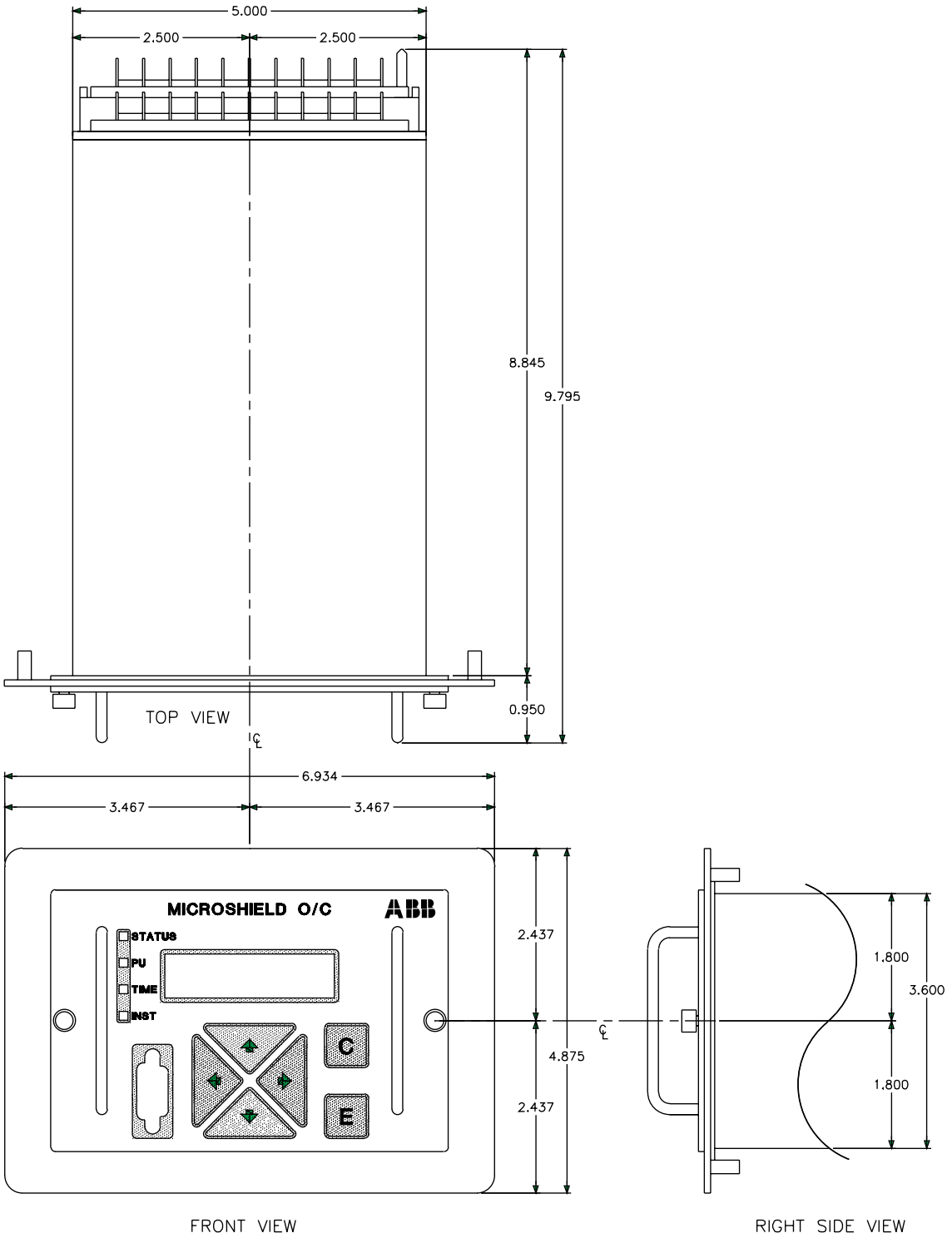


Figure 14. Panel Cutout (Circuit-Shield Style Bezel)



DIMENSIONS IN INCHES

Figure 15. Case Outline

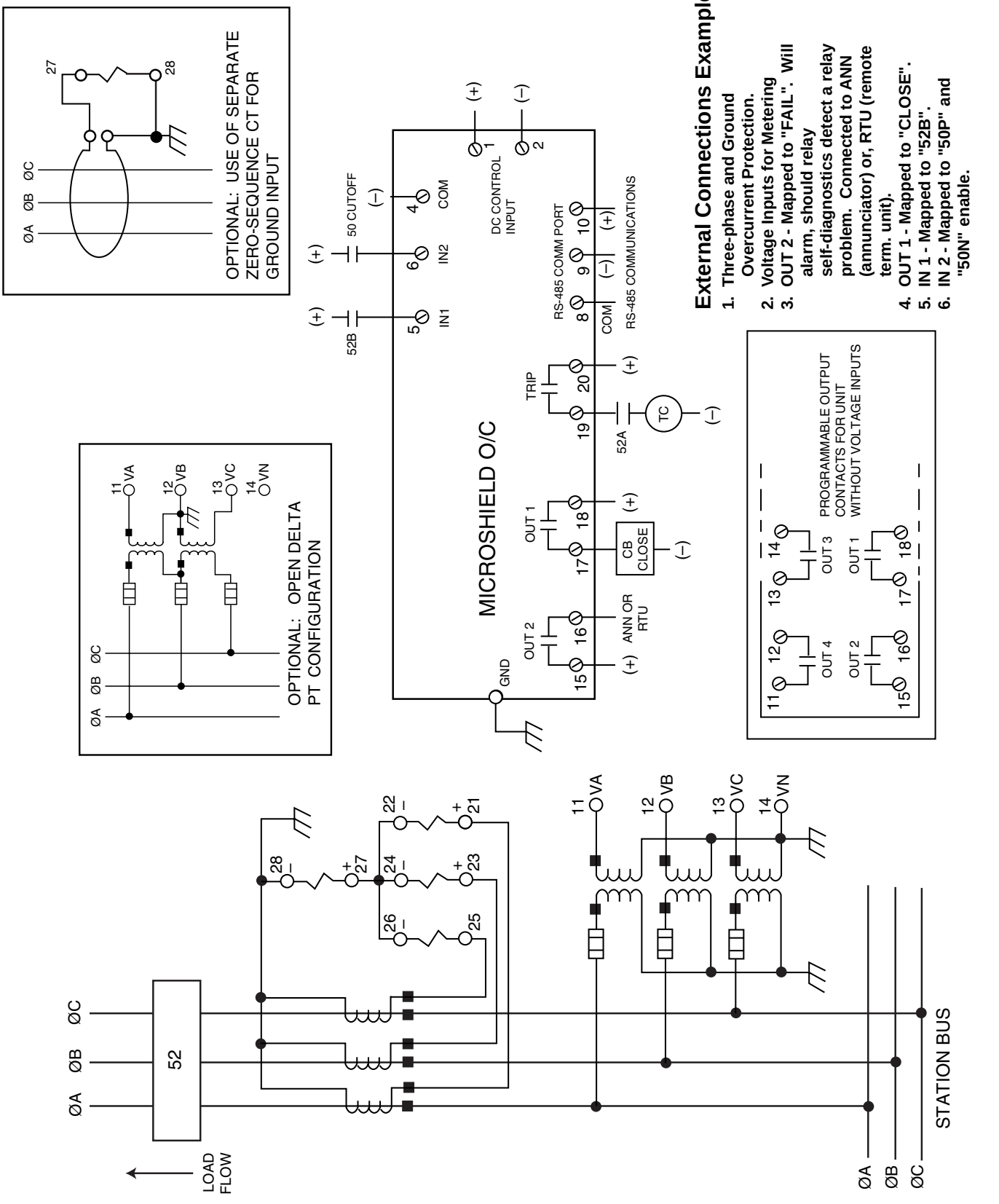
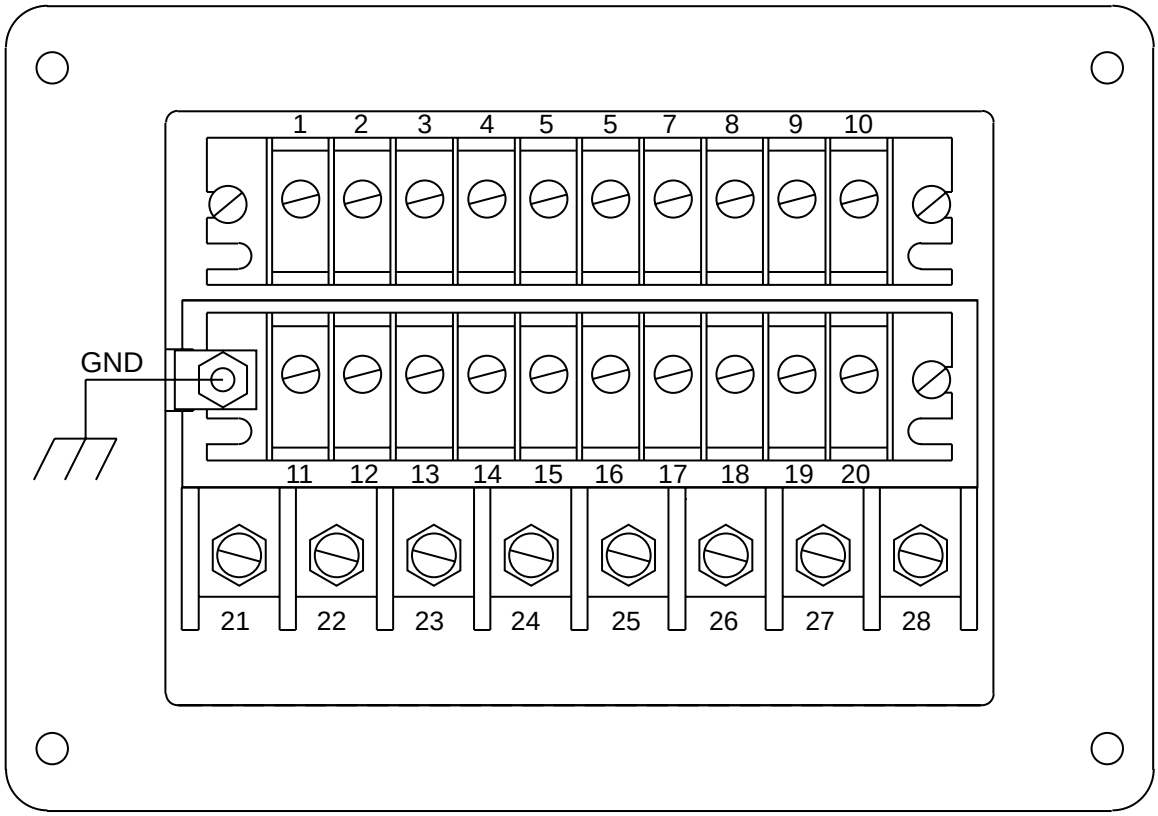


Figure 16. Typical Connections



REAR VIEW

REAR TERMINAL BLOCK CONNECTIONS

	474MXX1X–XXXX	474MXX2M–XXXX
1	+ CONTROL POWER	+ CONTROL POWER
2	– CONTROL POWER	– CONTROL POWER
3	NO CONNECTION	NO CONNECTION
4	– IN	– IN
5	+ IN1	+ IN1
6	+ IN2	+ IN2
7	NO CONNECTION	NO CONNECTION
8	RS–485 COMMON	RS–485 COMMON
9	RS– 485 –	RS–485 –
10	RS–485 +	RS–485 +
11	**OUT4 N.O.**	**VOLTAGE ØA**
12	**OUT4 N.O.**	**VOLTAGE ØB**
13	**OUT3 N.O.**	**VOLTAGE ØC**
14	**OUT3 N.O.**	**VOLTAGE N**
15	OUT2 N.O.	OUT2 N.O.
16	OUT2 N.O.	OUT2 N.O.
17	OUT1 N.O.	OUT1 N.O.
18	OUT1 N.O.	OUT1 N.O.
19	TRIP N.O.	TRIP N.O.
20	TRIP N.O.	TRIP N.O.
21	+Ia	+Ia
22	–Ia	–Ia
23	+Ib	+Ib
24	–Ib	–Ib
25	+Ic	+Ic
26	–Ic	–Ic
27	+In	+In
28	–In	–In

NOTE: The terminal wiring label below is applied to the relay case for field wiring of terminations and terminal block screw torque requirements.

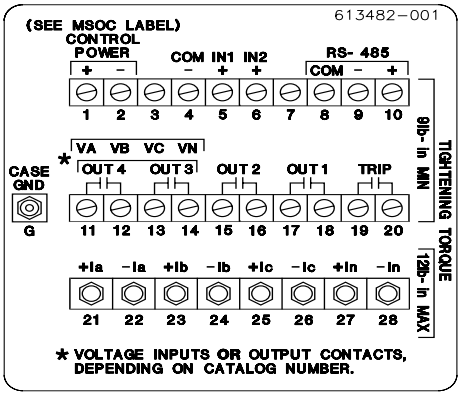


Figure 17. Rear Terminal Description

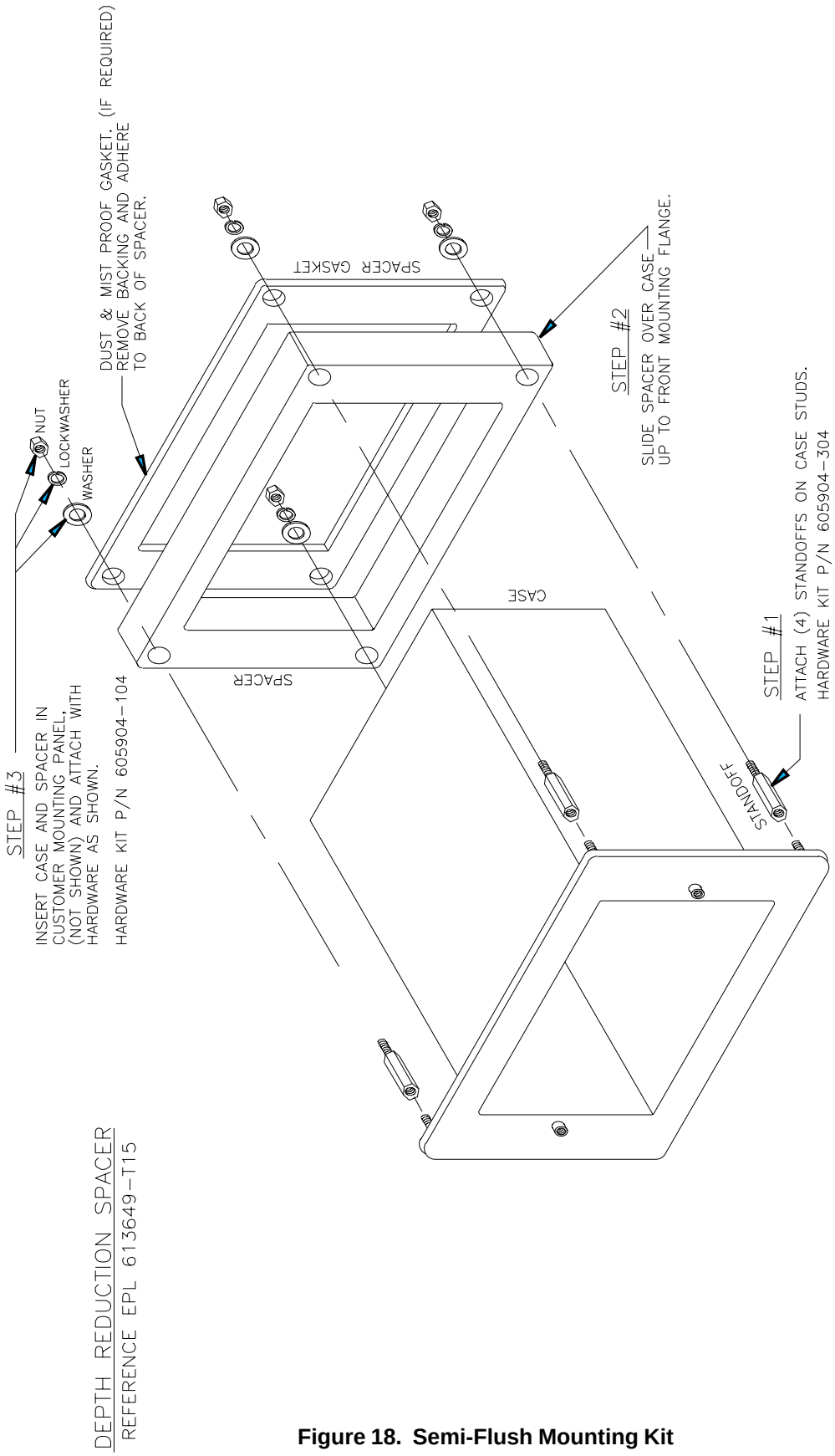


Figure 18. Semi-Flush Mounting Kit

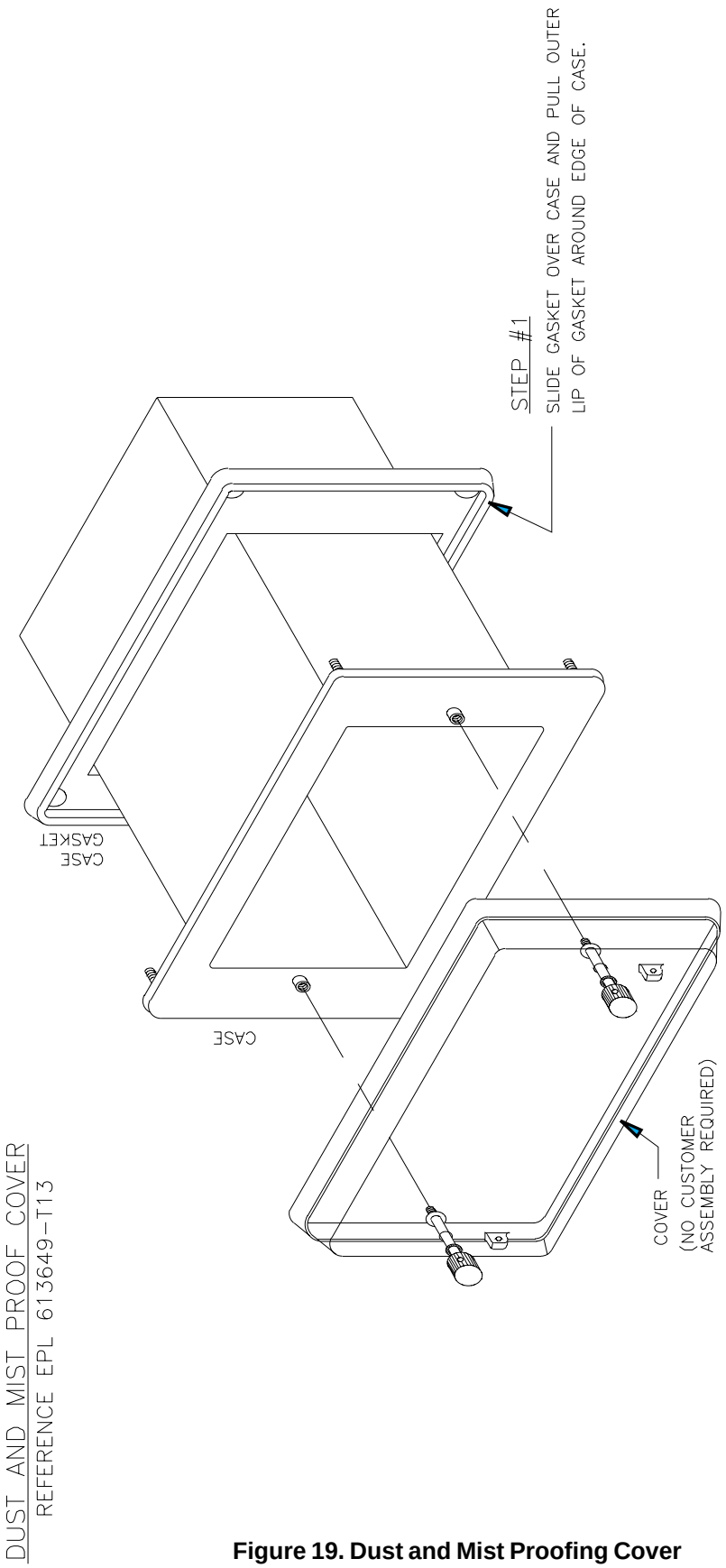


Figure 19. Dust and Mist Proofing Cover

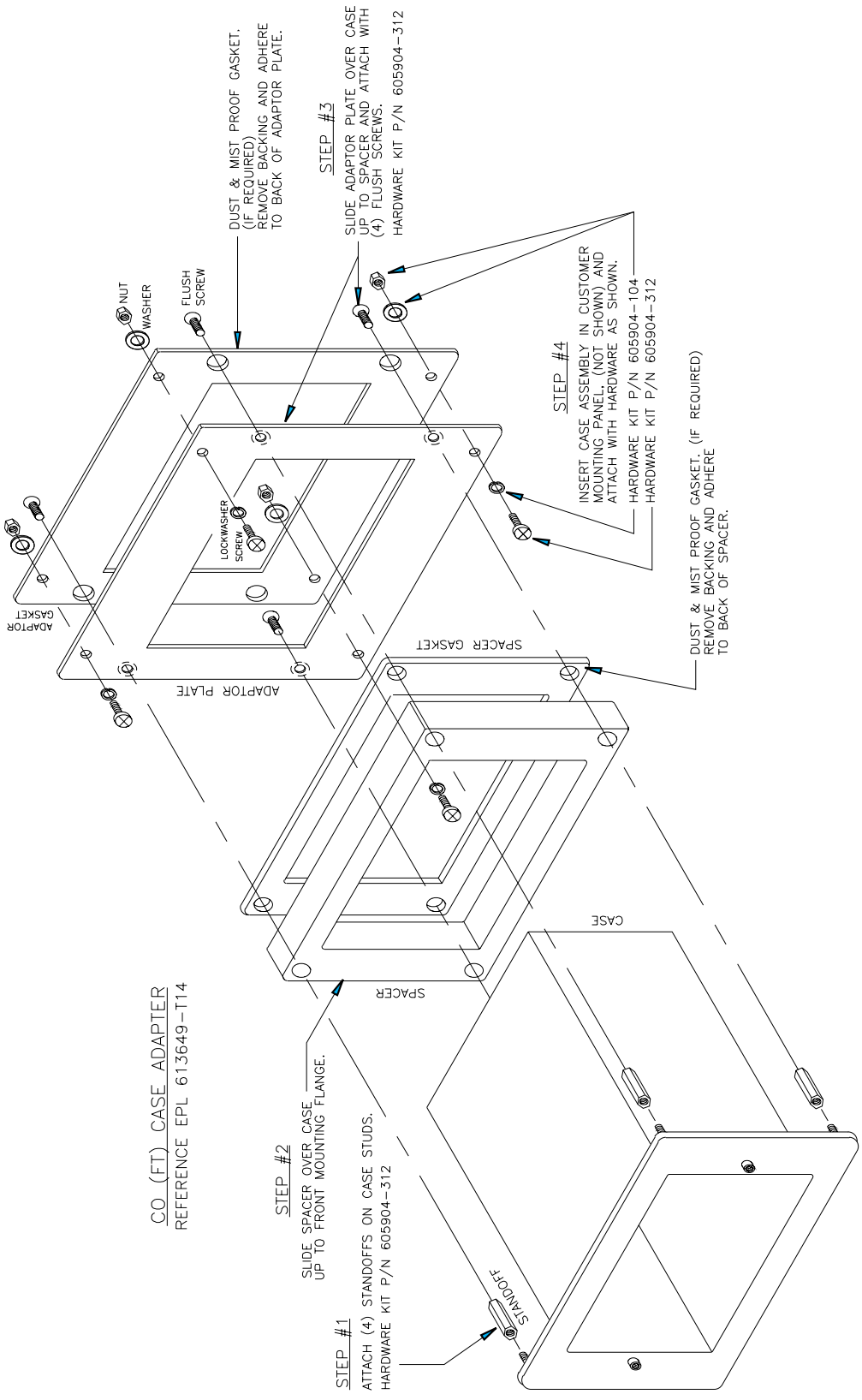


Figure 20. CO - FT11 Case Adapter Kit

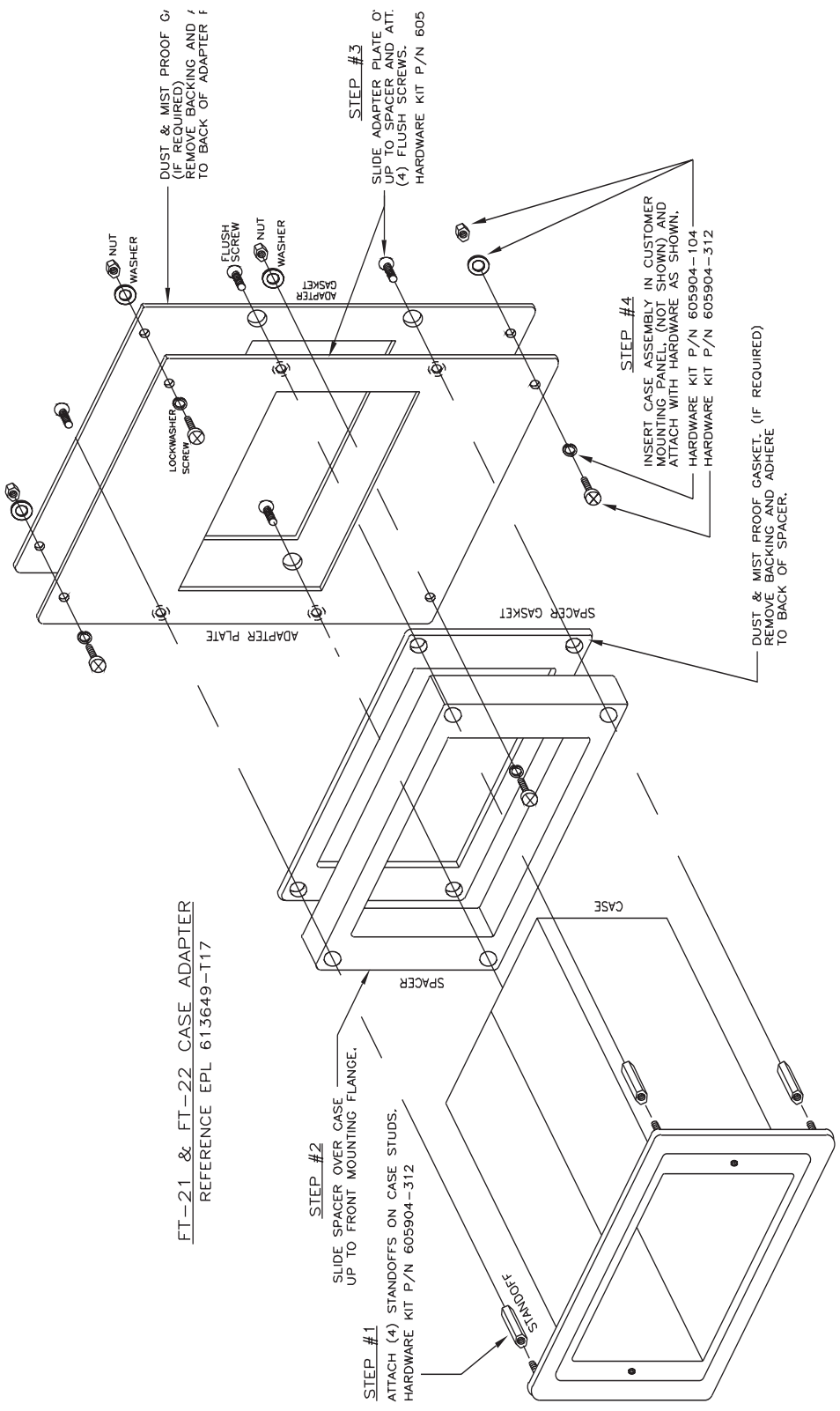


Figure 21. CO FT-21/22 Case Adapter Kit

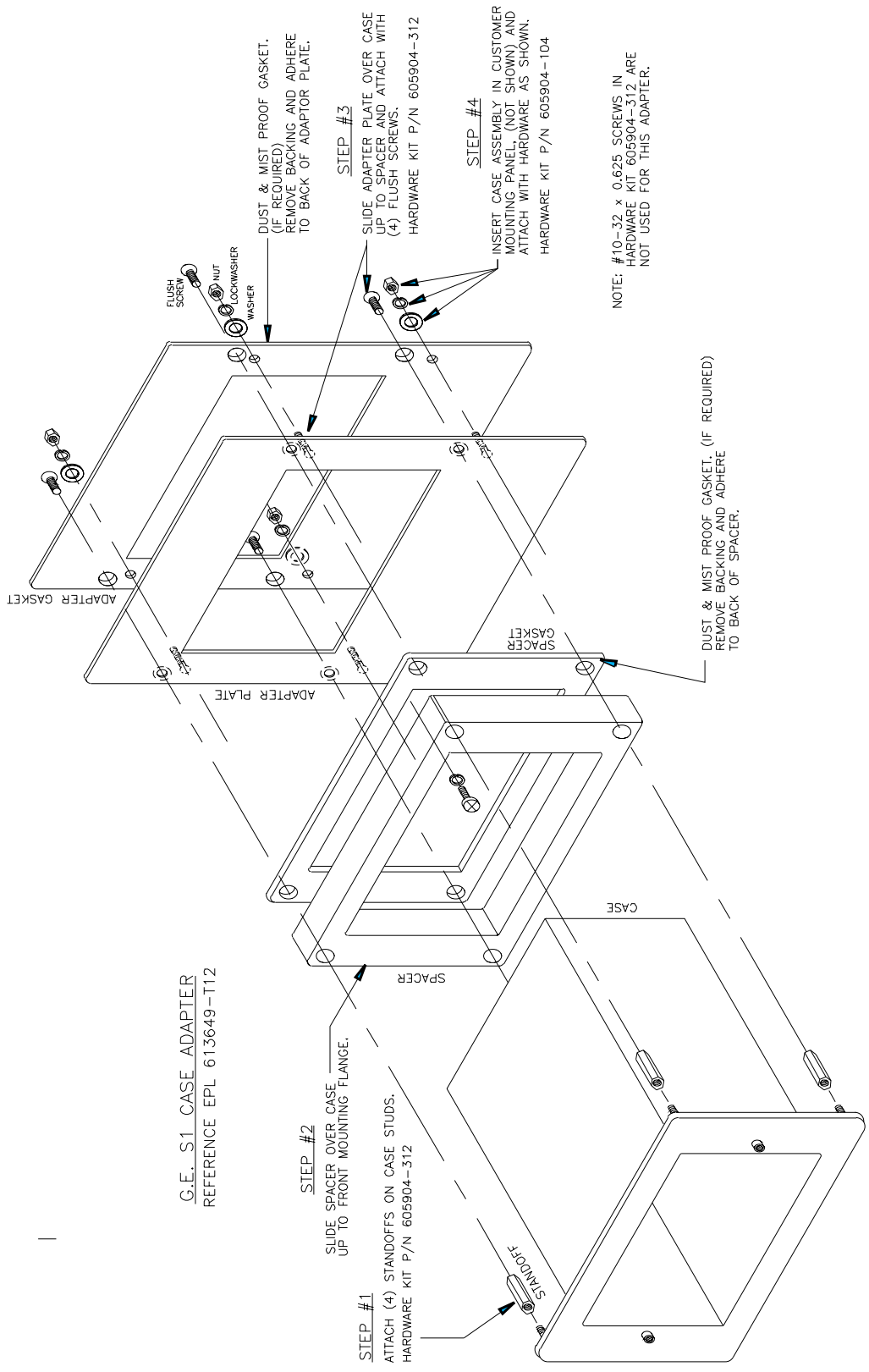


Figure 22. IAC - S1 Case Adapter Kit

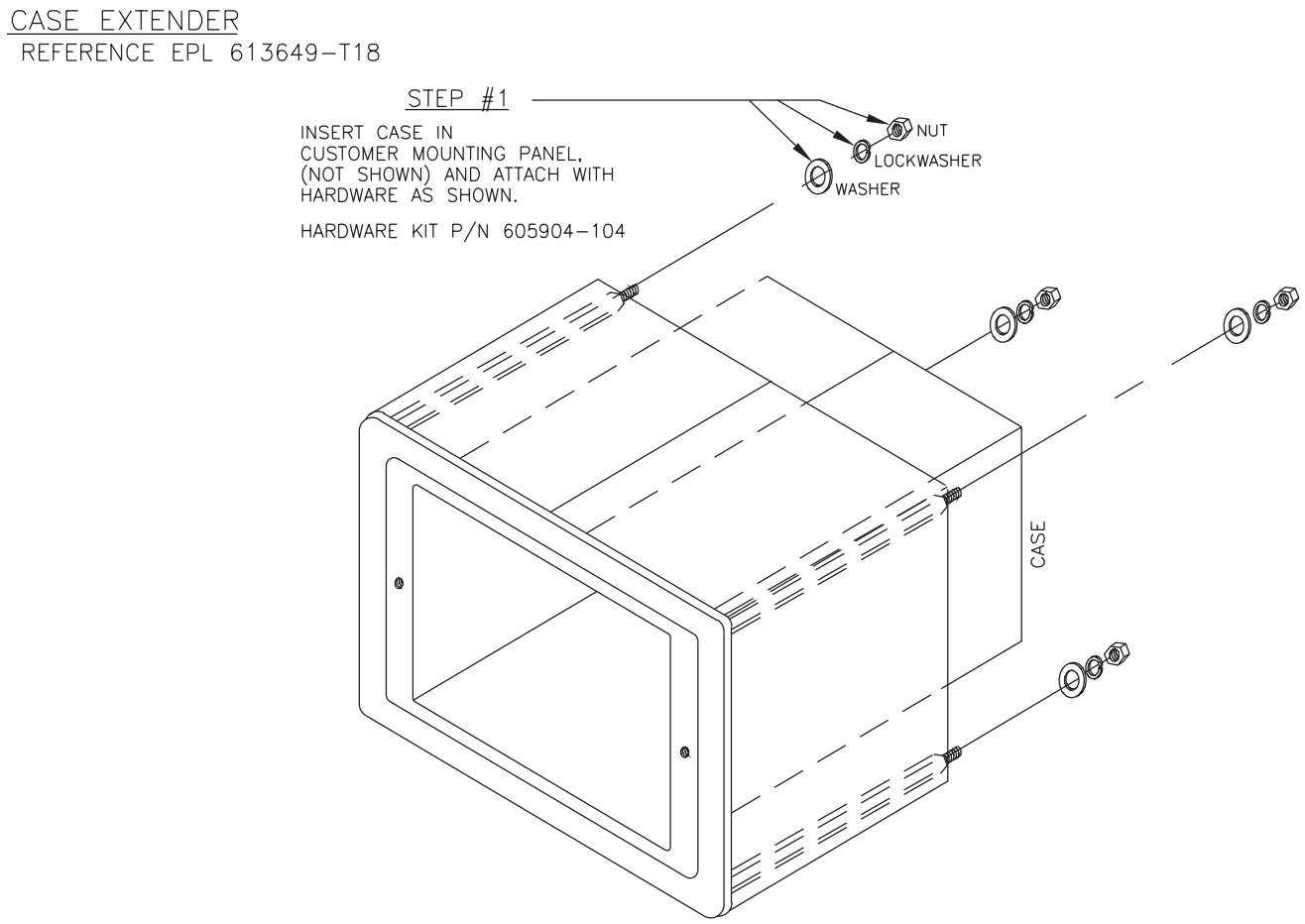


Figure 23. MSOC Projection Mounting Kit

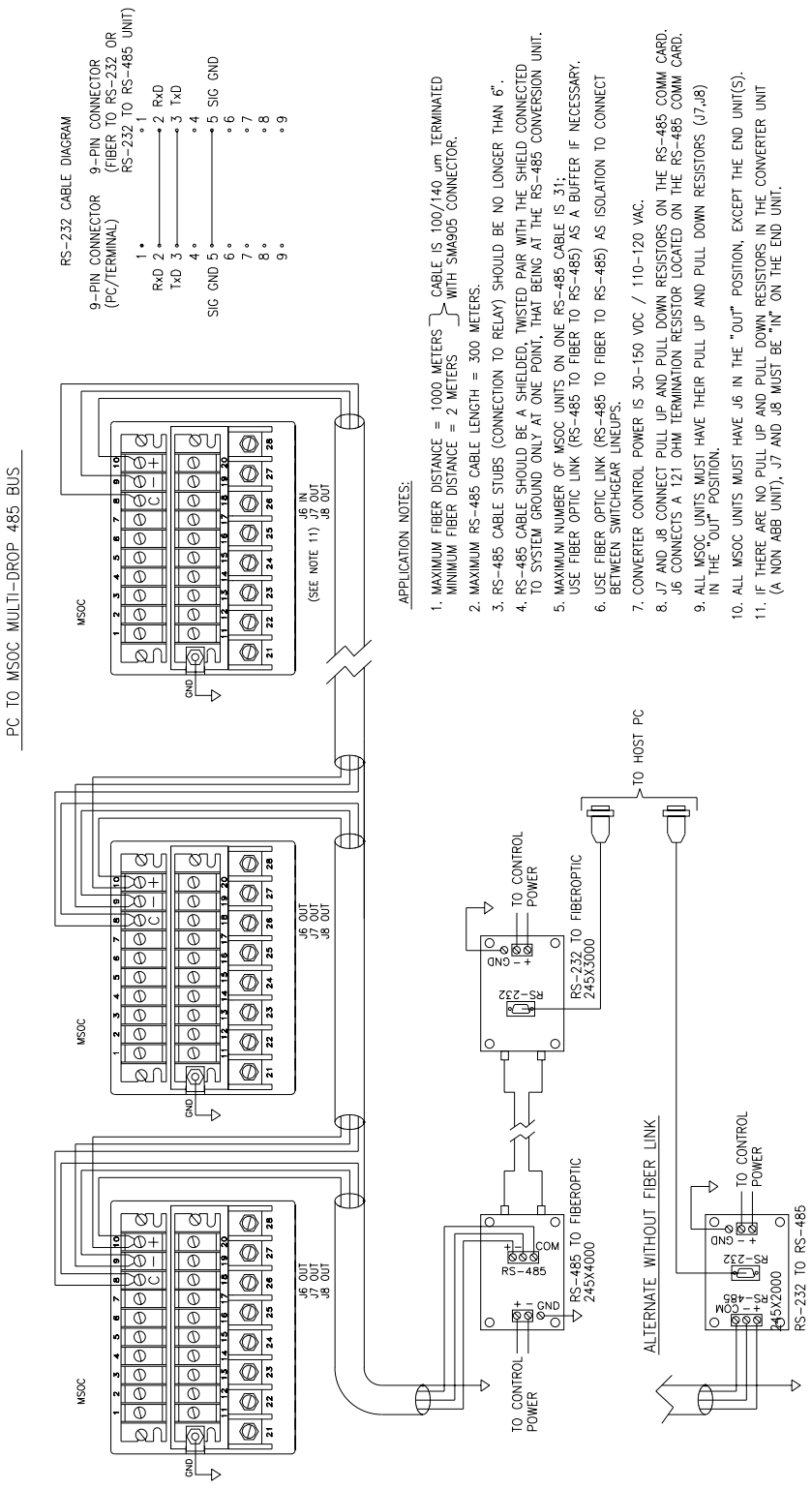


Figure 24. RS-232 and RS-485 Connections

Section 17 - Ordering Selection Guide

Ordering Selection Guide

Catalog Number **474 M 0 4 1 1 - 6 0 0 0**

Enclosure
Circuit Shield™ Style . . . . . M

Current Ranges

Phase	Neutral	
1.5-12.0 A	1.5-12.0 A.	0
1.5-12.0 A	0.5-4.0 A	1
1.5-12.0 A	0.1-0.8 A	2
0.3-2.4 A	0.3-2.4 A	4
0.3-2.4 A	0.1-0.8 A	5
0.1-0.8 A	0.1-0.8 A	6
1.5-12.0 A	0.3-2.4 A	7

DC Control Voltage Ranges
18 - 60 Vdc 3
60 - 150 Vdc 4
150 - 300 Vdc 5

Configuration
1 Trip and 4 programmable output contacts 1
1 Trip, 2 programmable output contacts, voltage inputs 2

Communications Port
None 0
Front RS-232 Port/Rear RS-485 Port 1

Frequency in Hertz
50 5
60 6

Time Curve Type
ANSI and IEC (curves only) 0
IEC (curves and nomenclature)*. 1

Recloser
Without Recloser 0
With Recloser. 1

Protocol
ASCII & Modbus®(available at front and rear ports) 0

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