OPERATIONS & MAINTENANCE MANUAL

Revision 1

FARWEST CORROSION CONTROL COMPANY

DCPro Model FSMA 50-50
50V-50A Air Cooled, Switch Mode
Cathodic Protection Power Supply

Version 1.0

FARWEST CORROSION CONTROL COMPANY
(310) 532-9524 • FarwestCorrosion.com

Headquarters: 12029 Regentview Ave. Downey, California 90241 - USA

Los Angeles • Bakersfield • San Francisco • Seattle • Denver • Tulsa • Houston • Chicago • Philadelphia

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DCPro INTRODUCTION

The DCPro Cathodic Protection Power Supply changes the landscape of the traditional rectifier power supply. This advanced rectifier is a durable, switch-mode power supply that provides clean, efficient DC power using state-of-the-art technology. The "constant current" design allows simple current output control in 0.1 amp increments and, once set, the DCPro will hold the desired current output.

Unlike other switch-mode power supplies, there are no confusing menus and no need for a computer interface. The DCPro is designed to look like a conventional rectifier yet offers many more features. The bright color display, readable in direct sunlight, presents both analog and digital output voltage and current readings. Additional status information is available in this same display.

The DCPro model FSMA 50-50 can be configured to operate as two, independently controlled 50 volt, 25 amp power supplies. The operator can provide precise amounts of CP current to two separate structures.

With the DCPro, the desired output current level is maintained the first time and every time.

DCPro FEATURES

Superior Technology

- Fully solid-state "switch-mode" operation
- 80 to 90% efficient power conversion
- Output adjustments in 0.1 amp increments
- Rejects induced AC for accurate "off" readings
- Over-temperature protection
- Provides pure DC power without AC ripple issues
- Standard AC & DC surge protection
- 12-volt power supply for RMU and interrupter (included) operation provided
- Dead-front and side safety panel
- Dual output configuration to provide controlled current to two separate structures

Constant Current Output

- Maintains desired DC current output
- Output voltage adjusts automatically
- Circuit resistance variations will not affect current output
- DC output current remains constant despite AC power fluctuations
- Analog and digital output readings

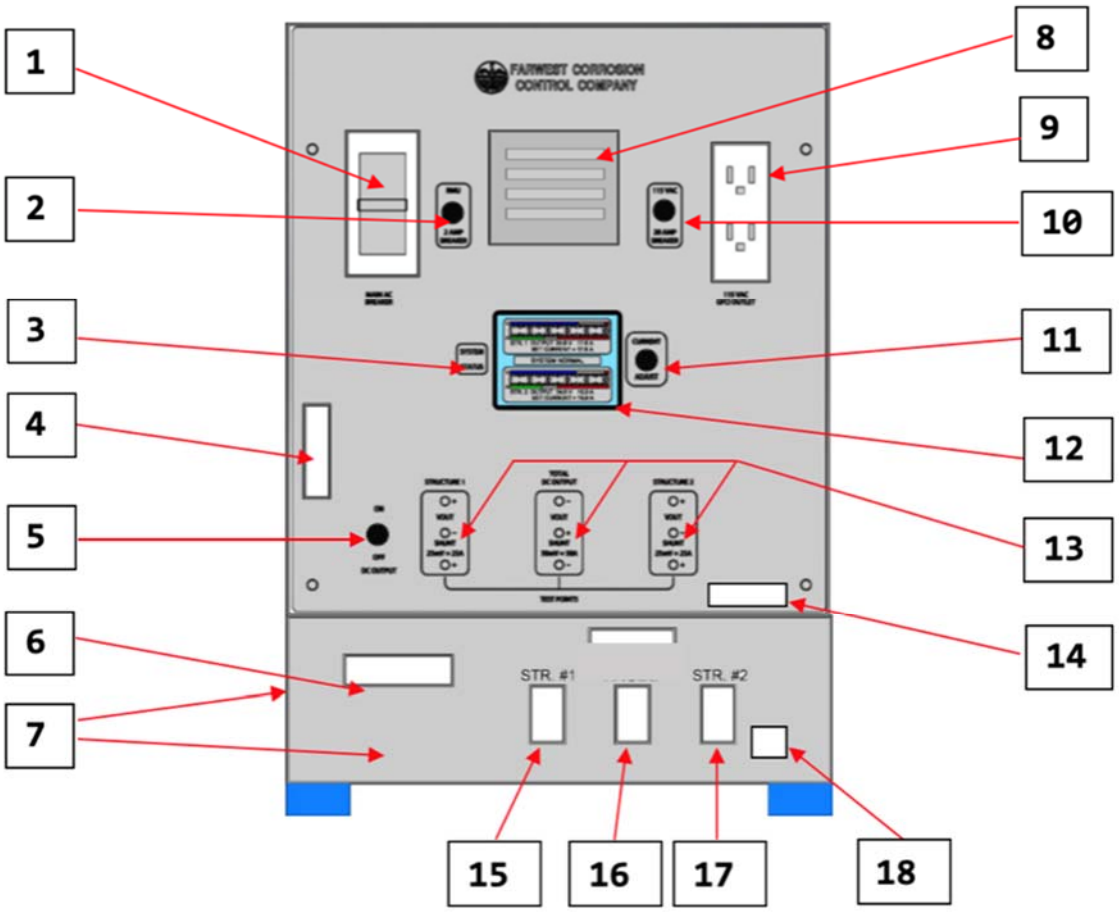
Simple to Operate

- Adjust DC current output with a single knob
- No tap changes required
- Operates on any single-phase power from 115 to 240 VAC
- Easily connects to an RMU with terminal strip (included)
- Connect a portable interrupter (interface included)
- Cross-check meter accuracy with panel test points

Certifications & Warranty

- ETL certified
- 3-year warranty

FIGURE 1 - COMPONENT LOCATONS & IDENTIFICATION



1. Main AC Input Circuit Breaker
2. AC input circuit breaker for 12-volt DC power supply to power RMU and customer supplied portable interrupter
3. Multi-color LED system status indicator light
4. RMU interface terminal block (behind main panel board)
5. DC Output ON-OFF switch
6. Interrupter interface terminal block (behind removable safety panel)
7. Removable dead front and side safety panels
8. Power supply information placard
9. Convenience outlet rated for 20 amps AC
10. AC input circuit breaker for convenience outlet
11. Output current control knob. Press to turn on display; Rotate to adjust current output.
12. TFT color graphics display; Displays output voltage and current in analog and digital format, as well as providing system status messages.
13. Test points to cross check digital and analog volt and ammeter
14. Unit Serial Number Placard
15. STRUCTURE #1 (Negative) DC Output Terminal behind removable safety panel
16. ANODE (Positive) DC Output Terminal behind removable safety panel.
17. STRUCTURE #2 (Negative) DC Output Terminal behind removable safety panel
18. Single structure or two structure configuration buss (See Instructions)

INSTALLATION CONSIDERATIONS

WARNING!

This equipment poses an electrical shock hazard. Any manipulation or maintenance actions should be performed by qualified personnel only.

It is strongly recommended that the installation technician familiarize themselves with the main features and locations for the interface hardware as shown on Figure 1.

1. The DCPro power supply can be provided with an industry-standard, air-cooled, NEMA 3R aluminum (3 door) enclosure that can be pole or wall mounted. Suitable mounting hardware should be used to install the cabinet to the appropriate pole or wall surface.

2. As an option, the DCPro's aluminum chassis is suitable for "slide-in" installation into many existing industry-standard, air-cooled rectifier enclosures. Check with Farwest Corrosion for installation details.

3. The DCPro DOES NOT require any manual AC input configuration. The DCPro units self-configures and can accept any single-phase voltage between 110 to 240-volts AC and 48 to 63 Hz.

4. AC input power should be supplied from a local disconnect circuit breaker (safety switch) or branch circuit breaker. This will allow the DCPro power supply to be disconnected from all power sources to provide a positive lock out/tag out condition during any maintenance on the DCPro power supply.

5. If the front panel AC convenience outlet is to be enabled, it should be provided with a separate AC line source (See FIGURE 1 Item 9). ***ONLY 115-volts AC should be wired to this device. It is recommended that a dedicated 115/1/60 (20 A) service be installed to operate this option.*** (If wired in the recommended configuration, this AC outlet can then be utilized even when the main, front panel mounted, AC input circuit breaker is in the "OFF" position.)

6. The AC input wire size, type and configuration must comply with the National Electrical Code (NEC).

7. **It is imperative that the power supply unit and enclosure be properly grounded.** A dedicated ground terminal is provided on the power supply chassis adjacent to the AC input terminal block in addition to a ground terminal on the cabinet's external mounting channel.

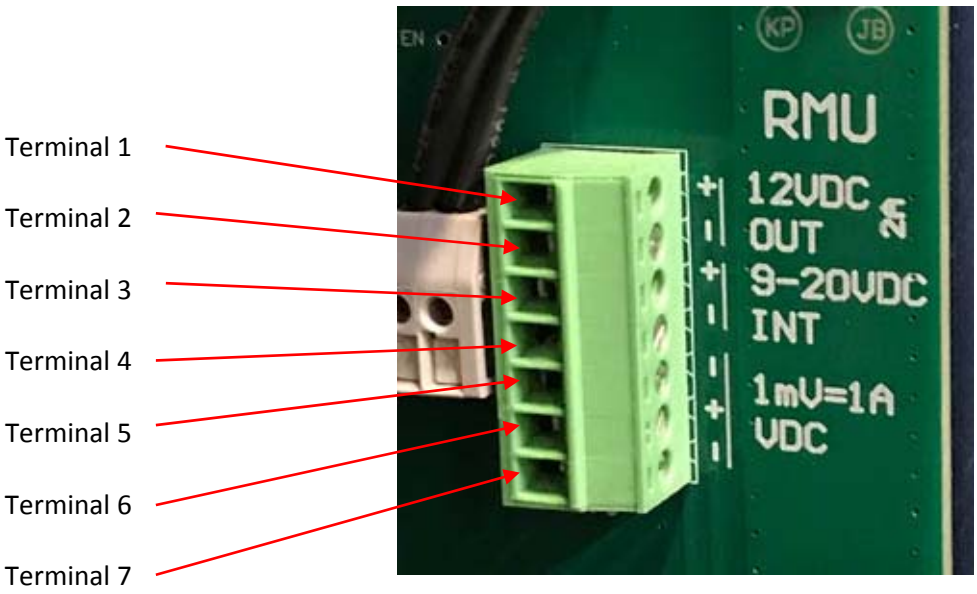
8. DC output cables shall be properly sized for connection to the DC output cable terminals.

9. Always connect the Structure to be protected to the NEGATIVE output lug. Anode shall be connected to the POSITIVE output lug.

10. The DCPro model FSMA 50-50 can provide precise, regulated DC to a single structure or to two separate structures depending on the needs of the operator.

REMOTE MONITORING INTERCONNECT

There is a 7-position terminal block located behind the left side of the main panel. This terminal block provides a convenient interface connection to customer supplied Remote Monitoring Unit (RMU). See Figure 1, Item 4).



Terminals **1 & 2** are 12-volt DC output power from the DCPro onboard supplemental DC power supply to provide power to operate the RMU. Maximum continuous current is 2.0 amps DC.

- **Terminal 1** = Voltage Positive
- **Terminal 2** = Voltage Negative

Terminals **3 & 4** are DC inputs (9 to 20 volts DC) from the RMU to electronically interrupt the DC output of the DCPro power supply.

- **Terminal 3** = Voltage Positive
- **Terminal 4** = Voltage Negative

Terminals **5 & 6** are connected across an internal 0.001-ohm shunt that is in series with the positive DC output terminal. This allows accurate measurement of the total DC output current.

- **Terminal 5** = Shunt Negative
- **Terminal 6** = Shunt Positive (common positive) See NOTE

Terminals **6 & 7** are connected to the DC output of the power supply.

- **Terminal 6** = Voltage Positive (Common Positive) See NOTE
- **Terminal 7** = Voltage Negative
    - **NOTE:** Two POSITIVE wires will be installed on Terminal 6.

SINGLE STRUCTURE CONFIGURATION

The DCPro is shipped in a default "Single Structure" configuration.

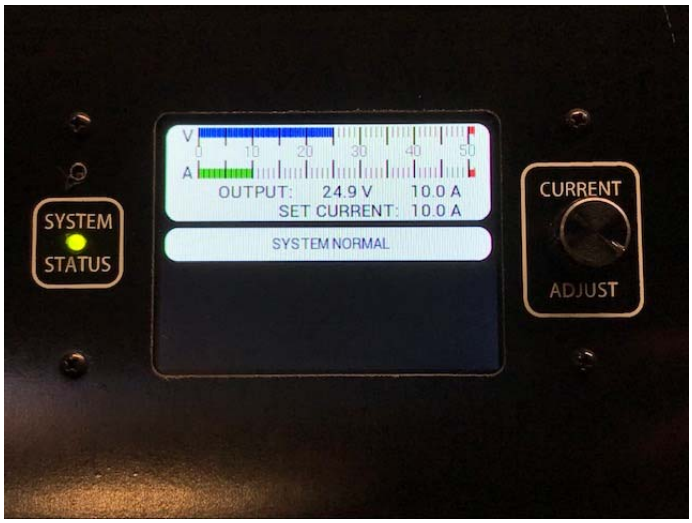
1. Unlike a conventional cathodic protection rectifier (CPR), the AC input power to the DCPro does **NOT** require any configuration of any AC input taps. The DCPro self-configures input voltage between 120 to 240 VAC (47 to 63 Hz).
2. If the use of the 115 VAC convenience outlet is to be enabled, refer to Item 5 in the above "INSTALLATION CONSIDERATIONS".
3. Always connect the POSITIVE anode cable to the center output lug labeled "ANODE".
4. Connect the NEGATIVE structure cable to either the STRUCTURE #1 **or** STRUCTURE #2 terminals. Both lugs are electrically common in the default "Single Structure Configuration".
5. Ensure that both the main DCPro chassis and enclosure are properly grounded per NEC requirements.

TWO STRUCTURE CONFIGURATION

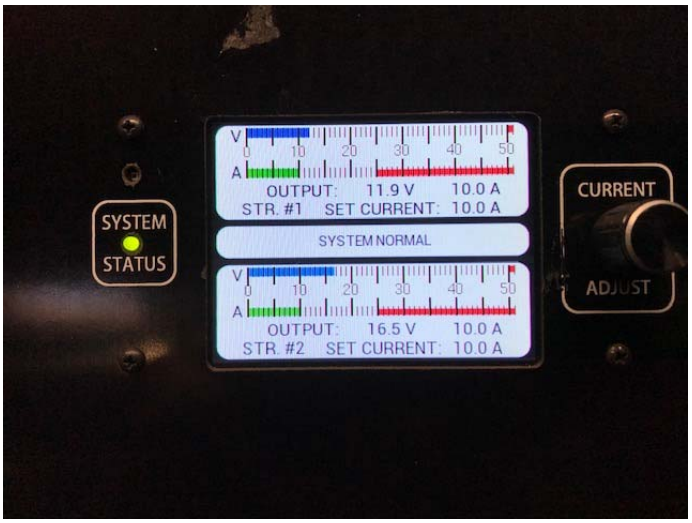
The power supply must be reconfigured for this operating mode as follows:

1. Remove the lower dead front safety panel. (Figure 1 Item 7)
2. Find the 1/4" diameter brass bolt labeled "STR #1 & 2 Shunt" (located to the right of the Structure 2 output lug).
3. Loosen and remove the Bolt, nut and the four washers. The unit is now in the dual structure mode.
4. Store the bolt, nut and washers to be available to reconfigure the unit to a single structure mode.
5. To configure the TFT display from single to dual output mode, press and hold the control knob for approximately 2 seconds. To then change between the "single display" or "dual display" mode, press the knob one time for each change.

SINGLE STRUCTURE DISPLAY



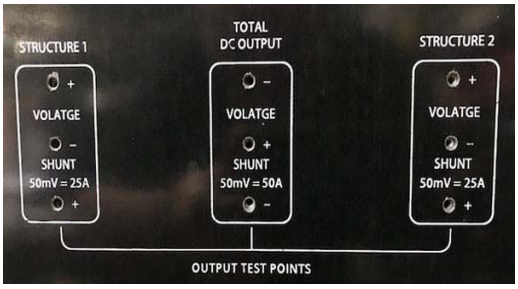
TWO STRUCTURE DISPLAY



SYSTEM START-UP AND ADJUSTMENT

Once the DCPro is properly installed and all cable attachments have been made, it is strongly recommended that a qualified corrosion professional be consulted for start-up and commissioning of the DCPro and the CP system. It is also very important to check the security and polarity of all the cables connected to the DCPro prior to start-up.

1. Verify that AC input power is available and properly installed. Do this by measuring the AC voltage at the input terminal blocks. **Note that extreme care shall be taken to avoid electrical shock.**
2. To energize the DCPro unit, simply "close" the main AC input circuit breaker (Figure 1, Item 1) to the "ON" position. The graphics display will automatically start and display the Farwest logo, hardware and software versions.
3. Ensure that the DC output switch (Figure 1, Item 5) is in the ON position.
4. The DCPro is shipped with the output control set to zero. To set the desired DC output current, press the control knob (Figure 1, Item 11) once to enter the "Set Current" mode. The message "Set Current" will be blinking on the display. Turn the output current adjust knob clockwise to increase the DC output current. Each click of the knob will increase (or decrease when turned counterclockwise) the current output by 0.100 amps.
   NOTE: If the DCPro is in the Two Structure Configuration, while the knob is being adjusted, the TFT display will show the flashing message "CURRENT SET" for Structure 1. To adjust the output of Structure 2, press the knob once and the Structure 2 "SET CURRENT" message will be flashing. Turn the knob to adjust the Structure 2 output. Press the knob again to revert to display operating voltage and current levels.
5. Once the DCPro is adjusted to the desired DC current output, the analog bar graphs and the digital display should indicate the same values. In low light conditions the display backlight can be switched on by pressing the current adjustment knob one time.
   NOTE: The display will "time-out" and go dark after approximately 15 minutes of non-use. To turn the digital display back on, either press the output current control knob (Figure 1, Item 11) one time or turn the knob one click in either direction.
6. Cross check the accuracy of both the digital and an analog meter by using the front panel test (probe) points.
   There are three test point groups shown in the image to the right
   "STRUCTURE 1" (left)
   "STRUCTURE 2" (right)
   "TOTAL DC OUPUT" (center)
   This measures the total DC current output to the anode.



Using a calibrated multimeter, the technician can measure the actual output voltage and current. The voltage is measured between the "+" & "-" "VOLTAGE" test points. Current output is confirmed by measuring the DC millivolt drop between the "-" & "+" "SHUNT" test points.

NOTE: When operating in the Single structure mode, use only the center "TOTAL DC OUTPUT". In this mode current indicated on Structure 1 and Structure 2 test points equal half the total.

NORMAL OPERATIONS

The DCPro power supply is a "constant current" design allowing the operator to set the desired DC current output for the CP system. The DCPro will maintain the DC output current level. Therefore, if the anode-to-earth resistance (load circuit resistance) changes for any reason, such as seasonal moisture changes, anode deterioration, or similar, the DCPro will sense the resistance change and increase or decrease the voltage output to maintain the desired DC output or "SET" current.

The DCPro is rated to operate continuously up to a maximum of 50 volts @ 50 amperes. Therefore, the DCPro can operate at full output rating on systems with anode-to-structure circuit resistance up to 1.0 total ohms. In the single structure mode, any anode-to-earth resistance values above 1.0 ohms will limit the output current to whatever level can be produced with the maximum rated 50 volt output.

SYSTEM STATUS LED

The following are the color code descriptions, which will be displayed by the LED status indicator. (Figure 1, Item 12)

FLASHING GREEN – "SYSTEM NORMAL" message will show in the TFT display as well.

FLASHING ORANGE – A system issue has been detected. Check the display message.

FLASHING RED – The DC output is switched "OFF" via the DC output ON-OFF switch and/or the unit is in "Interrupt mode" via an input from an RMU. In the event of a broken anode and or structure cable, the LED will flash red and the message "ZERO CURRENT OUTPUT" will appear on the display.

GRAPHICS DISPLAY - INFORMATION AND MESSAGES

The color graphics display provides real-time DC output voltage and current values in both analog "Bar Graph" and Digital display.

When in the manual current adjustment mode, the message "SET CURRENT" will blink. Once the desired current is set, "SET CURRENT" level will be stored and displayed below the actual current output values. After approximately 15 minutes, the blinking SET CURRENT message will revert to solid on display.

Additional messages (below) are presented in the middle portion of the display screen.

NOTE: To clear any message, press the adjustment knob one click.

"SYSTEM NORMAL" – The DCPro is in normal operation mode operating at the assigned "SET CURRENT" and is within normal DC output voltage and current ratings. The LED will provide a flashing green system status light.

"MAXIMUM CURRENT" - Either the "SET CURRENT" is at 50 DC amps (25 DC amps in the dual mode) or the DCPro is operating at maximum rated 50 volts. Note that the current output level may be less than 50 DC amps (25 DC amps in the dual mode) when the anode-to-earth circuit resistance is greater than 1.0 ohms.

"MAXIMUM VOLTAGE" - System is operating at maximum rated voltage of 50 volts. Under this condition, the desired "SET CURRENT" may not be possible if the anode-to-earth resistance is greater than 1.0 ohms.

"MINIMUM VOLTAGE – DC output voltage adjustment is set to minimum (zero) volts.

"VOLTAGE DRIFT" - Once the current level is set to the appropriate value, the DCPro stores the assigned set current and the voltage values. If the voltage changes more than 15% since the last set current event, a "VOLTAGE DRIFT" message will be displayed. Additionally, the system status LED will flash yellow. This indicates a change in the output circuit resistance. This message can be cleared by depressing the output current adjust knob twice.

Note: The DC output of a CP system will normally remain stable. Seasonal changes in the anode-to-earth resistance can be the result of moisture variations and/or the anode system approaching the end of its service life. Further investigation is advised as to the root cause of the circuit resistance change.

"INTERRUPT MODE" - The DC ON/OFF switch has been turned off. This same message will also appear during timed interrupt cycles when a customer supplied interrupter is connected to the power supply interrupt terminal block. In the interrupted ("OFF") mode, the system status LED will flash red.

"ZERO CURRENT OUT" – When there is an open circuit in the DC anode or negative cable system (such as a failed anode or structure cable), the message "ZERO CURRENT OUT" will be displayed. The system status LED will flash red.

"OVER TEMPERATURE" – The DCPro has multiple internal temperature sensors. The sensors continuously monitor internal equipment system temperatures.

If there is a high temperature event with internal system temperature of greater than 158 Deg. F, the DCPro will initiate a 10% reduction in output current to reduce stress on the electronics. Concurrently the message "OVER TEMPERATURE EVENT NOW" will be displayed. If the temperature has not returned to a safe operating condition within 30 minutes, the unit will initiate an additional reduction in output current.

When the temperature reduces to a safe level, the system will return to the assigned current set level. The message "OVER TEMPERATURE EVENT OCCURRED – NOW NORMAL" will appear on the display. Again, the message can be cleared by depressing the output current adjust knob twice.

INTERRUPTER FEATURES & INTERCONNECT

The DCPro power supply has three options available to interrupt the DC output of the unit electronically **without disconnecting either of the DC output cables**.

Any of the following options are preferred over disconnecting the DC cables.

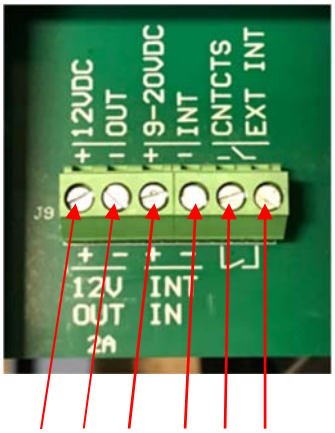
Interrupt Option 1 – The operator can interrupt the power supply (manually) with the DC output ON-OFF toggle switch located on the front panel (Figure 1 Item 5). This switch will turn ON and OFF all DC output current *without* the need to switch off the main AC input circuit breaker or disconnect the DC cables.

Interrupt Option 2 - Portable interrupter units that, can drive a separate DC relay, can be configured to interrupt the DCPro by connecting the DC output of the portable interrupter to terminals 3 & 4. This will electronically interrupt the DCPro.

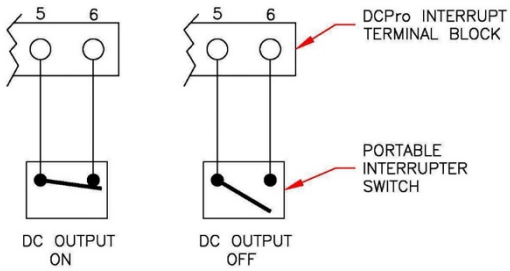
Interrupt Option 3 - Use a customer supplied, portable interrupter with *mechanical contacts*. Interconnect the interrupter to the pre-wired terminal block (Figure 1 Item 6) located behind the removable, lower front safety panel. For this purpose, use Terminals 5 & 6.

Note: Some solid-state relays may not function in this mode.

Important: To enable option 2 or 3, the front panel DC output ON-OFF toggle switch must be in the "OFF" position.



TERMINALS **1 2 3 4 5 6**



MECHANICAL CONTACT SCHEMATIC

Note: The DCPro has a built-in supplemental 12-volt DC power supply to power the customer supplied interrupter at terminals 1 & 2. By using the 12-volt output from terminals 1 & 2 to power the portable interrupter and connecting the DC output of the Interrupter to terminals 3 & 4, the DCPro can be electronically interrupted without the need for supplemental AC or DC power to operate the interrupter and eliminate external portable relay.

NOTE: The DCPro series power supply can be interrupted electronically on structures that have induced AC present. Conventional rectifiers that have induced AC on them "half wave" the AC resulting in a low-level DC on the output even with the input AC power switched off. The DCPro will reject the AC present on the DC cables and when interrupted electronically will result in a true OFF condition.

TROUBLESHOOTING

A basic wiring diagram is provided for troubleshooting use. **This should only be attempted by qualified personnel experienced in electrical troubleshooting and/or repairs.** Basic technical issues may be located and remedied as follows:

ISSUE	CHECK / ACTION REQUIRED
No DC current or voltage output	Check the AC voltage available at AC input terminal block. If no AC power is available, determine the source of AC and attempt to re-establish.
AC power is confirmed but no DC output is detected	Turn the output current control knob clockwise. The DCPro power supply is shipped with the current control setting at zero. If still no output current, check the power supply for loose connections on the DC output lugs. If no DC voltage or current is indicated at that point, there could be an issue with the Main Power Module. See "Repairs" section of this document.
DC voltage output but no (zero) current indicated	The message ZERO CURRENT OUTPUT will appear in the display. The problem is likely an open circuit in either the anode or structure cable. Check DC output cables (anode and structure) for electrical continuity.
Maximum DC current cannot be attained	Check the anode-to-earth (load) resistance of external DC circuit. A maximum of 1.0 ohms is allowable and if that value is exceeded, a MAXIMUM VOLTAGE message will appear in the display.
Main circuit breaker trips	Reset the breaker and retry. If the breaker continues to trip, then it is likely a problem with the Main Power Module. See "Repairs" section of this document.

If the above actions do not correct the observed problem, the technician should call Farwest Corrosion Control's technical advisor at (888) 532-7937 for further assistance.

FIELD REPAIRS

The following procedures should only be attempted by qualified personnel experienced in electrical troubleshooting and/or repairs of electronic equipment.

95% of the electronic components are built into the Main Power Module (MPM). If it is determined that the MPM may be the source of the issue, the DCPro power module is designed for easy field removal and replacement.

NOTE: There are four, silver MPMs in the DCPro FWMA 50-50 assembly. In an operating DCPro that appears to have a problem, isolating the defective MPM can usually be accomplished by measuring the case temperature of the four MPMs. This can be done with an infrared thermometer while the unit is in operation or ***(with the power off)*** *by carefully touching each module. Usually the module that is the coldest is the suspect unit.*

Hint: Best access to the MPMs for temperature check can best be accomplished by opening the right enclosure door.

Once the suspect MPM is identified, it can be removed and replaced as follows:

VERY IMPORTANT SAFETY MESSAGE. Confirm that the AC power supplied to the unit is switched off and locked out.

Note: It will be necessary to remove the chassis from the enclosure for this effort.

1. Mark and disconnect the wires from the AC input terminal block.
2. Mark and disconnect the cables from the DC output terminal lugs.
3. Mark and disconnect any wires connected to the RMU input terminal block.
4. Remove the two security bolts on the bottom front of the power supply chassis rails. Slide the entire DCPro chassis out from the enclosure and set it on a stable work platform.
5. Locate and unplug the four cable connectors on the affected silver main power module (MPM). Care should be taken to remove the connectors as there is a detent mechanism securing the connectors to the main circuit board.
6. Unscrew the two (2) captive thumb screws on the back of the affected (MPM).
7. Remove the affected MPM from the power supply chassis.
8. Reinstall a known functional MPM in reverse order of above.
9. Reinstall the DCPro power supply chassis into enclosure.
10. Reinstall all wires to the AC Input, DC output and RMU terminal block. Be careful to replace the wires in the exact position as marked.

Re-start the DCPro power supply per the *System Start-up and Adjustment* section of this manual.

If this procedure does not correct the issue, contact a technical representative at Farwest Corrosion Control Company for assistance and authorization to return the DCPro. If it is determined that the DCPro is to be returned for repair, the power supply chassis (not the enclosure) should be shipped to Farwest.

If return of the DCPro is required, a Return Authorization number and shipping instructions MUST BE obtained from a Farwest Corrosion representative.

THREE (3) YEAR LIMITED FOR DCPro SWITCHMODE POWER SUPPLY

Non-Transferrable Limited Warranty
This Warranty, for the DCPro air-cooled switch mode power supply, manufactured by Farwest Corrosion Control Company (Farwest), is effective for a period of three (3) years from the original date of purchase from Farwest.

What is Covered
Except as specified below, the Farwest Limited Warranty covers all defects in materials and workmanship for the DCPro power supply and related components within the first three (3) years of ownership from date of purchase.

This Limited Warranty does not cover any of the following occurrences:

1) Damage, deterioration or malfunction resulting from:
   a) Accident, act of nature, abuse, misuse, neglect, unauthorized product repair, or failure to follow instructions supplied with the product.
   b) Repair or attempted repair by anyone not authorized by Farwest.
   c) Any damage of the product as a result during shipment or transportation from Farwest. Such damage must be presented to the freight carrier in the form of a damage claim.
   d) Periodic maintenance, check-ups or evaluation tests.

2) Any installation, removal, labor or other charges, costs or expenses resulting from product failure or inability to perform.

Warranty Coverage
If, during the applicable warranty period, the DCPro or supplied components are found to be defective, Farwest will replace defective parts or if required, make necessary repairs ,without charge for parts and/or repair labor.

How to Obtain Warranty Performance
Contact Farwest at (888) 532-7939. Farwest will instruct you on how and what to return. The following procedures apply when transporting the DCPro for warranty service:

- Return Authorization number and return shipping instructions must be obtained from a Farwest representative prior to return. During the call, you will be required to provide company name, contact name, shipping address, phone numbers and a description of the technical problem. DCPro test results will be discussed during the call.

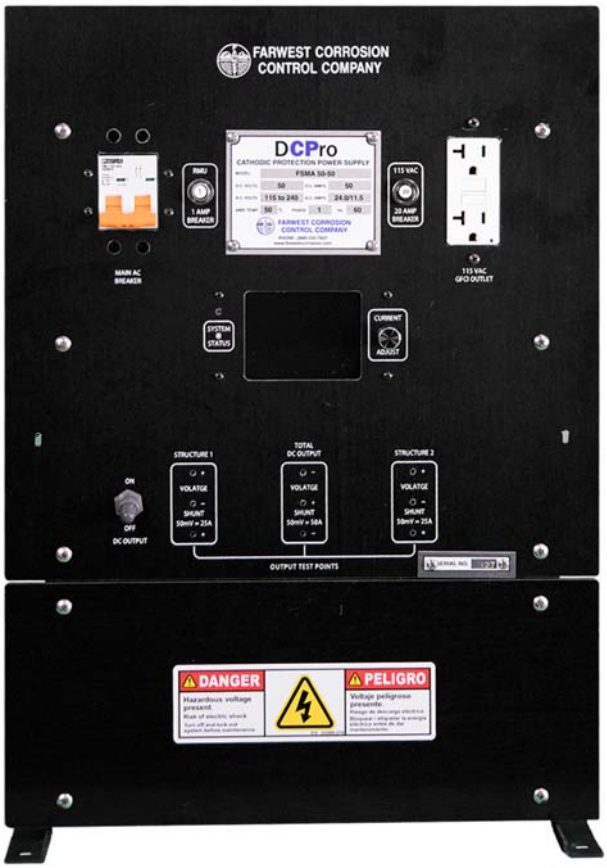
- It is the responsibility of the shipper to arrange for and safely transport the DCPro to a Farwest-designated location. The shipper is responsible for all shipping charges. Farwest will cover return shipping charges if the repairs are covered by the Warranty.

FARWEST LIABILITY IS LIMITED TO THE REPAIR OR REPLACEMENT, AT OUR DISCRETION, OF ANY DEFECTIVE PRODUCT AND SHALL IN NO EVENT INCLUDE INCIDENTAL OR CONSEQUENTIAL COMMERCIAL OR PROPERTY DAMAGES OF ANY KIND. FARWEST IS NOT RESPONSIBLE FOR PRODUCTS LOST, STOLEN AND/OR DAMAGED DURING SHIPPING.

ABOUT FARWEST CORROSION CONTROL COMPANY

Farwest Corrosion Control Company is an industry pioneer and leader in comprehensive cathodic protection and corrosion control services and related products. Cathodic protection and corrosion control services include engineering, technical consultation and cathodic protection installation. The firm also distributes and manufactures products for cathodic protection and corrosion control.

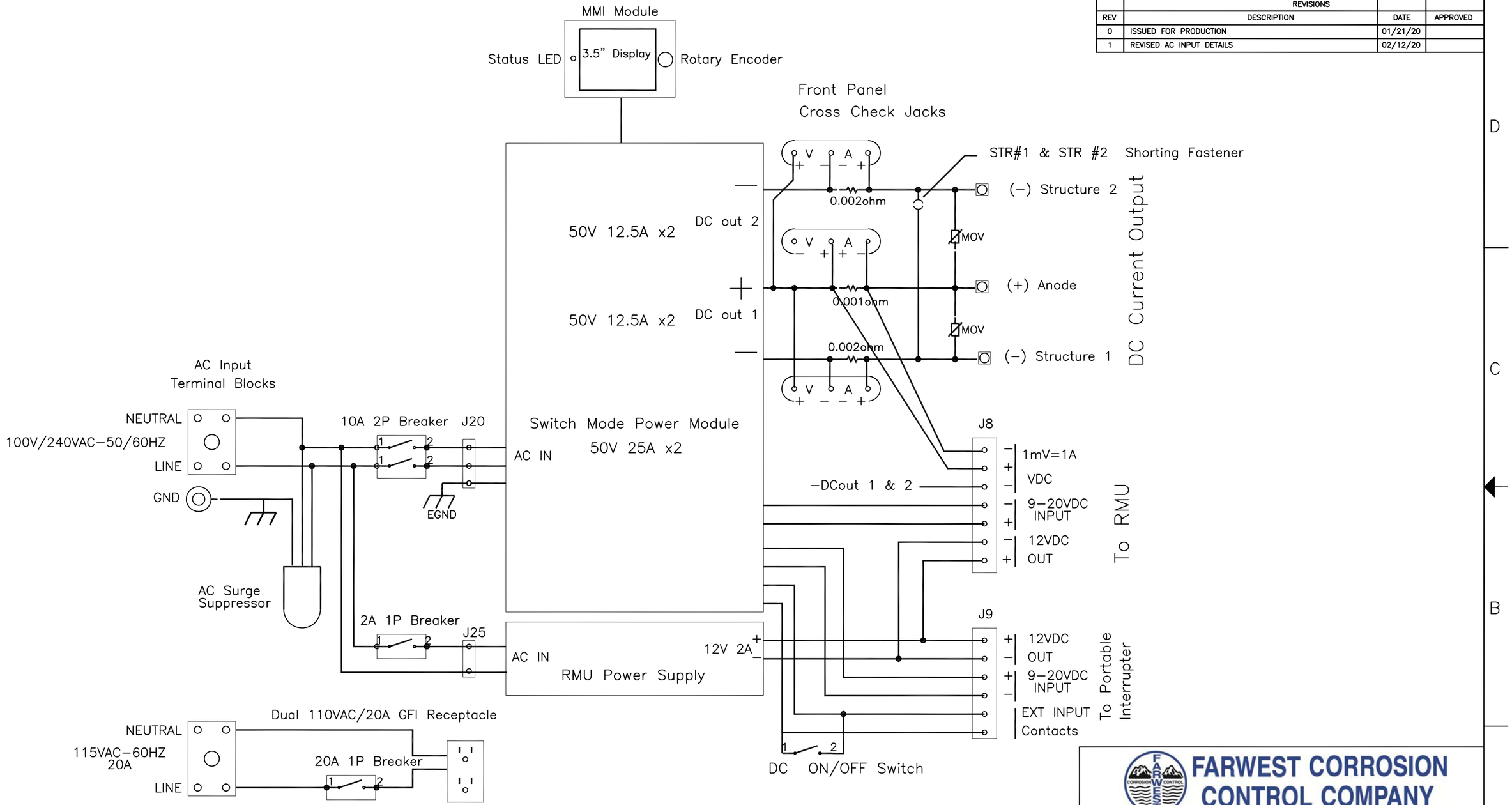
Founded in 1956, the firm remains privately held and family owned and is a Certified Woman Owned Business. The firm is headquartered in Downey, California, has eight regional operations and over 175 employees nationwide.



FARWEST CORROSION CONTROL COMPANY

(310) 532-9524 • FarwestCorrosion.com
Headquarters: 12029 Regentview Ave. Downey, California 90241 - USA
Los Angeles • Bakersfield • San Francisco • Seattle • Denver • Tulsa • Houston • Chicago • Philadelphia

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
0	ISSUED FOR PRODUCTION	01/21/20	
1	REVISED AC INPUT DETAILS	02/12/20	



FSMA 50−50 Basic Schematic

FARWEST CORROSION CONTROL COMPANY
12029 REGENTVIEW AVE. DOWNEY, CALIFORNIA

DRAWN BY N.P.H.	FSMA 50−50 BASIC SCHEMATIC
ENGINEER J.C.B.	
CHECKED BY: J.C.B.	
SIZE B	SCH−FSMA 50−50
DWG NO.	17−65150−1
FILE 17−65150−1.1	SCALE AS NOTED
DATE 02/12/20	REV 1
SHEET 1 of 1	