corTalk® by MOBILTEX® DATA LTD

# Installation and Operating Instructions

FOR

# SPI1 corTalk® Portable & Stationary Interrupters



Portable




Stationary

Print Date:
January 17, 2019

| MOBILTEX® DATA LTD.<br>Calgary, Alberta | TITLE: Installation and Operating Instructions | | |
|---|---|---|---|
| | DOCUMENT NO.: SPI1-MAN-001 | SHEET: 1 of 57 | REV: 1.14 |

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# CURRENT REVISION APPROVALS (Revision 1.14)

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# REVISION HISTORY

| Rev | Start Date | Approval Date | Description | Prepared By |
|---|---|---|---|---|
| 1.00 | Oct 26, 2006 | Oct 27, 2006 | Original Release | Tony da Costa |
| 1.01 | Nov 10, 2006 | Nov 14, 2006 | Added information on synchronization when used with other manufacturers' interrupters. Added SPI1Config utility information. Fixed 'Timing accuracy (AC line sync enabled)' spec. | Tony da Costa |
| 1.02 | Jan 30, 2007 | Jan 30, 2007 | Added descriptions for datalogger digital filter additions. Added descriptions for datalogger media format menu. | Tony da Costa |
| 1.03 | June 4, 2007 | June 4, 2007 | Added stationary interruption information. | Tony da Costa |
| 1.04 | Aug 28, 2007 | Aug 28, 2007 | Added de-polarization mode information. Changed datalogger high range to 150V from 75V. | Tony da Costa |
| 1.05 | Sept 20, 2007 | Sept 20, 2007 | Added information on reverting to factory defaults. Added information on new backlight parameter for v1.09 code. Changed information on menu key operation for v1.09 code. | Tony da Costa |
| 1.06 | Dec 5, 2007 | Dec 5, 2007 | Added information on properly locking the four circular connectors. Added cable color code information on ring lug version of SSR1. | Tony da Costa |
| 1.07 | April 15, 2008 | April 15, 2008 | V1.14 firmware changes. Added config menu page 1 and 2 changes. Added description of new NO-GPS operation mode. Added schematic diagram of SSR1. Updated relay type table. Updated MSR2 picture to latest production model. | Tony da Costa |
| 1.08 | Jan 5, 2009 | Jan 5, 2009 | Updated with new stationary SPI1 form factor and mounting brackets. | Tony da Costa |
| 1.09 | Jan 30, 2009 | Jan 30, 2009 | Reviewed and updated Mobiltex part numbers. Added HPR information. | Tony da Costa |
| 1.10 | Feb 4, 2009 | Feb 4, 2009 | Corrected HPR1/2 option supply connection description. | Tony da Costa |
| 1.11 | March 19, 2009 | March 20, 2009 | Added information on interruption cycle on-first parameter available in v1.20 code. | Tony da Costa |
| 1.12 | Aug 12, 2014 | Aug 12, 2014 | Updated power on/off section for newer stationary SPI1 units. Added GPS Sync Once parameter information. | Tony da Costa |
| 1.13 | Sept 30, 2016 | Sept 30, 2016 | Added half-hour time zone information. | Tony da Costaa |
| 1.14 | January 17, 2019 | January 17, 2019 | Updated for v1.28 firmware. | Tony da Costa |

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# 1 Introduction

The SPI1 is a powerful interruption controller for use with cathodic protection rectifiers. Precise timing accuracy and repeatability is attained with GPS and microprocessor technology. A small physical size and wide operating temperature range make this device ideally suited for use in portable applications.

Features:

- Interactive detailed plain English menus provide easy and intuitive operation.
- Bright backlit alphanumeric display provides detailed presentation of all important parameters.
- Large dedicated function keys with audible annunciation facilitate accurate data entry.
- Color coded bright LED indicators focus the user's attention to important status conditions.
- A resolution of 1ms and maximum range of 60,000ms for OFF and Cycle Times provides the user with very fine timing selection.
- Excellent timing accuracy is attained with a 20 channel GPS receiver and a temperature compensated high stability crystal oscillator.
- Field programmable parameters allow device customization for use with a wide range of relays.
- Can immediately operate in manual mode or be programmed with up to 7 predefined schedules.
- Device configuration parameters and schedule are permanently stored in non-volatile memory with auto-resume after a power disruption.
- A wide -30°C to +70°C operating temperature range allows installation in extreme environments.
- Internal AC line synchronization provides rectifier switching at zero primary current conditions.
- The front keypad and display are fully sealed and waterproof for maximum reliability.
- GPS satellite and internal diagnostic self test routines assure proper operation.
- Holds rectifier power on when not interrupting.
- Software can be field upgraded using RS-232.
- Can include or be upgraded to include a data logger.
- Low current solid state components provide maximum reliability.
- Available in AC/DC/battery powered portable or AC powered battery backed stationary fixed mount configurations.

This document details the installation and operation of the Mobiltex® SPI1 Portable & Stationary Interrupter products. This document version applies to SPI1 devices that are equipped with version 1.27 firmware or higher. If your SPI1 has firmware with a lower version, some menu items and features may differ. Please contact Mobiltex® for firmware updates.

# 2 Component Identification and Descriptions

Figure 1 shows the top front view of the SPI1 Portable Interrupter. To access the keypad and LCD display, the lid latches must be popped open and the lid lifted. The SPI1 may be secured by installing pad locks (not provided) through the two sets of lock loops.




**Figure 1 Top Front View of SPI1 Portable Interrupter**

Figure 2 shows the front and back views of the SPI1 Stationary Interrupter configuration. The SPI1Stationary Interrupter is designed to be mounted inside a rectifier cabinet for permanent installations.




**Figure 2 Front and Back Views of SPI1 Stationary Interrupter**

Figure 3 shows the locations of the connectors and mounting studs on the back of the SPI1 Stationary Interrupter. These dimensions are necessary in preparing a flat mounting surface for attachment of the SPI1 Stationary Interrupter.

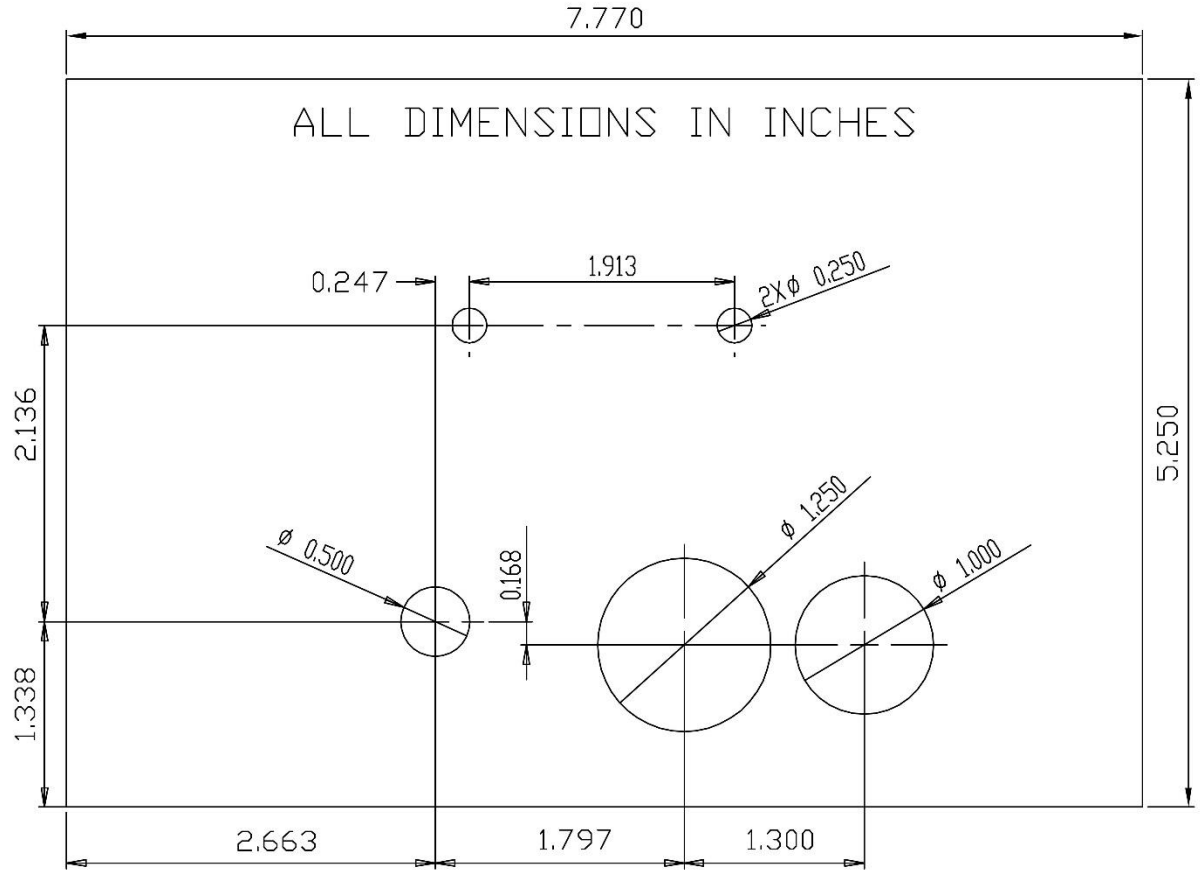



**Figure 3 SPI1 Stationary Interrupter Mounting Area Dimensions**

Figure 4 shows the dimensions of the mounting bracket provided with the SPI1 Stationary Interrupter. The plate may be attached to the SPI1 in either a top or bottom mount configuration.

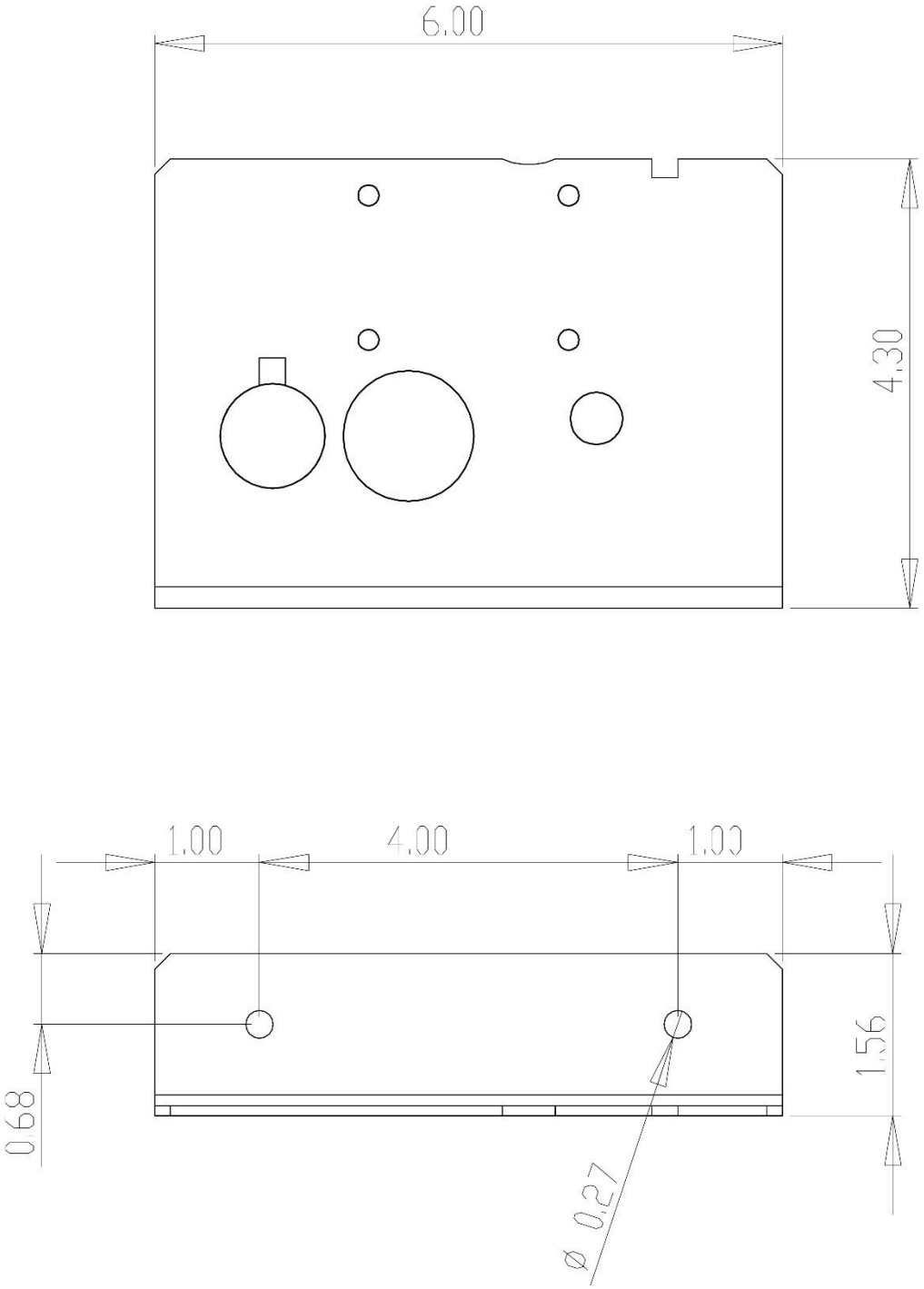



**Figure 4 SPI1 Stationary Interrupter Mounting Bracket Dimensions**

Additional accessories are available for alternate mounting applications. Figure 5 shows the SPI1 Stationary Interrupter fitted with an optional RAM mount (Mobiltex P/N H16550B101U).




**Figure 5 SPI1 Stationary Interrupter Optional RAM Mount**

Figure 6 shows the keypad and LCD. Below the LCD display are three LED indicators marked CHARGE, INTERRUPT, AND UNLOCKED.

The yellow CHARGE LED lights when power is applied to the AC+/- pins on any one of the 6 pin circular connectors (A, B (portable-only), or C (portable-only)) on the side of the unit (see Figure 10) using one of the SPI1 charge cables, or another suitably configured connection.

The green INTERRUPT LED will light when the rectifier circuit is being interrupted, i.e. no current flowing.

The orange UNLOCKED LED will light when the unit does not have a valid GPS time lock thus not allowing synchronized interruption. The UNLOCKED LED will initially light when the unit is turned on and remain on until enough satellites have been acquired to obtain a time lock. This initial satellite lock may take up to 13 minutes when the unit is in good satellite coverage. If the unit has been listening to the GPS datastream within the prior two week period, then the lock time will be substantially less than this. The LED will also light if GPS acquisition is lost for over 5 minutes during an interruption cycle. Interruption is always disabled if the UNLOCKED light is lit. An interruption cycle that has been interrupted by loss of GPS lock will auto-resume upon re-acquisition of the GPS signal.




**Figure 6 SPI1 Keypad and LCD**

Figure 7 shows the left side view of SPI1 Portable Interrupter. Figure 8 shows the back view of the SPI1 Stationary Interrupter. Visible are the protection caps which guard against dust and moisture entering the SPI1 external connectors when the unit is not in use. For easy reference, the connectors are labelled A through E.




**Figure 7 Side View of SPI1 Portable Interrupter**

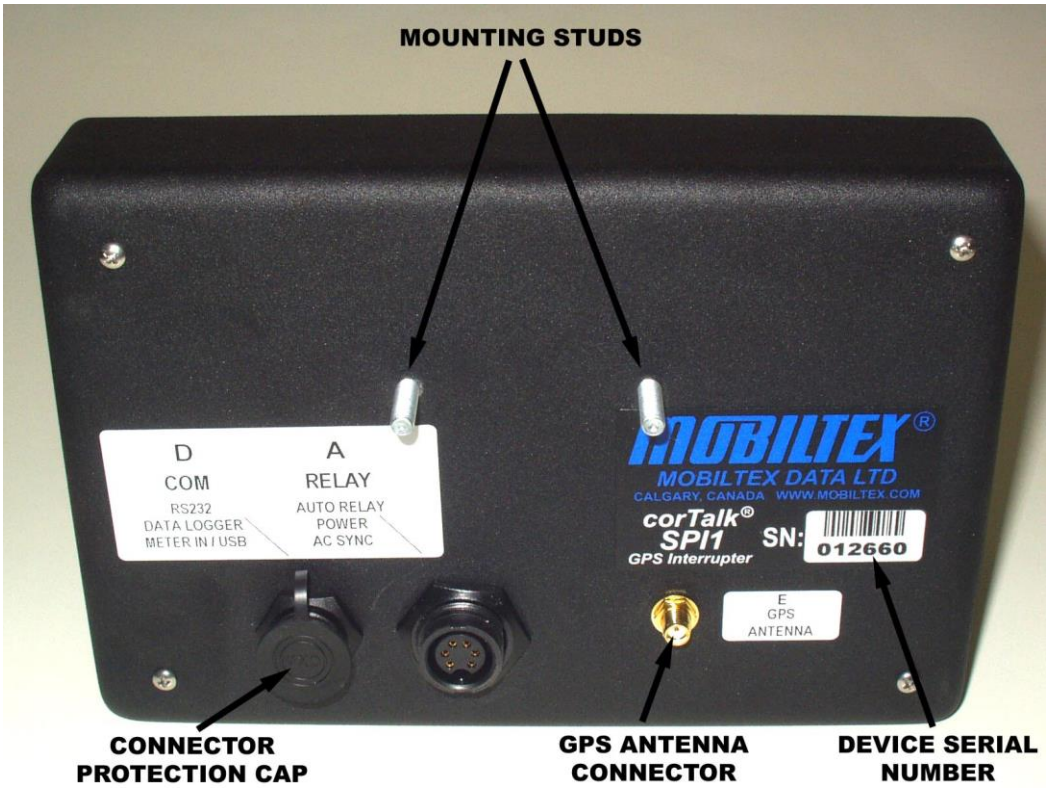



**Figure 8 Back View of SPI1 Stationary Interrupter**

*****Important Note On Proper Installation Of Circular Connector Cable Ends*****

The four circular multi-conductor connectors (A, B, C and D) on the SPI1 are waterproof when the mating cable end is properly installed. For a waterproof connection, the mating connectors must be fully engaged. Turn the connector wing nut ¼" past the first feel of resistance, until a definitive click is felt. Failure to fully engage the connector will result in corrosion of the connector pins as moisture enters the contact areas.

Figure 9 shows the mating connector position at the initial resistance point, and in the fully locked position.

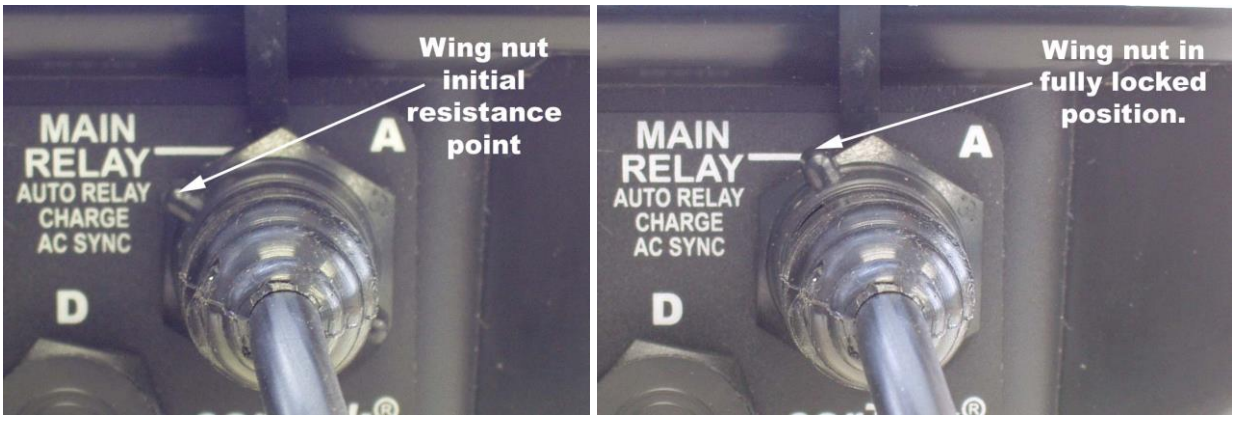



**Figure 9 Proper Installation of Cable Ends On Circular Connectors**

Figure 10 shows a close up view of the GPS antenna connector (E), the communications/datalogger connector (D) and the power/relay connectors (A,B,C). The SPI1 Stationary Interrupter only has connectors A, D and E available—the pin outs are identical to SPI1 Portable Interrupter. The pinout of the communications connector (D) is shown in Table 1. Table 2 shows the pinout of the relay connectors (A, B, C).

| Pin # | Label | Description |
|---|---|---|
| 1 | AIN+ | Datalogger Analog Input + |
| 2 | USBD- | Datalogger USB Port D- |
| 3 | USBD+ | Datalogger USB Port D+ |
| 4 | USB+5V | Datalogger USB Port +5V |
| 5 | GND | Ground (Common for Datalogger USB port and SPI1 programming port) |
| 6 | TXD | SPI1 Programming port, TXD line (DCE) |
| 7 | RXD | SPI1 Programming port, RXD line (DCE) |
| 8 | AIN- | Datalogger Analog Input - |

**Table 1 SPI1 Communications/Datalogger Connector Pinout**

| Pin # | Label | Description |
|---|---|---|
| 1 | INT+ | Relay Drive Positive Voltage (+6V or 12V) |
| 2 | INT- | Relay Drive Switched Negative |
| 3 | GND | Ground (Do not connect this to Earth ground! Only used for powering certain types of Mobiltex relays) |
| 4 | AC+ | Charger/60Hz Reference AC Input (Reference Capability On Port A Only) |
| 5 | AC- | Charger/60Hz Reference AC Input (Reference Capability On Port A Only) |
| 6 | RELAYSNS | Relay Type Detect Line (For Use With Mobiltex® Provided Relays) |

**Table 2 SPI1 Relay Connector Pinout**

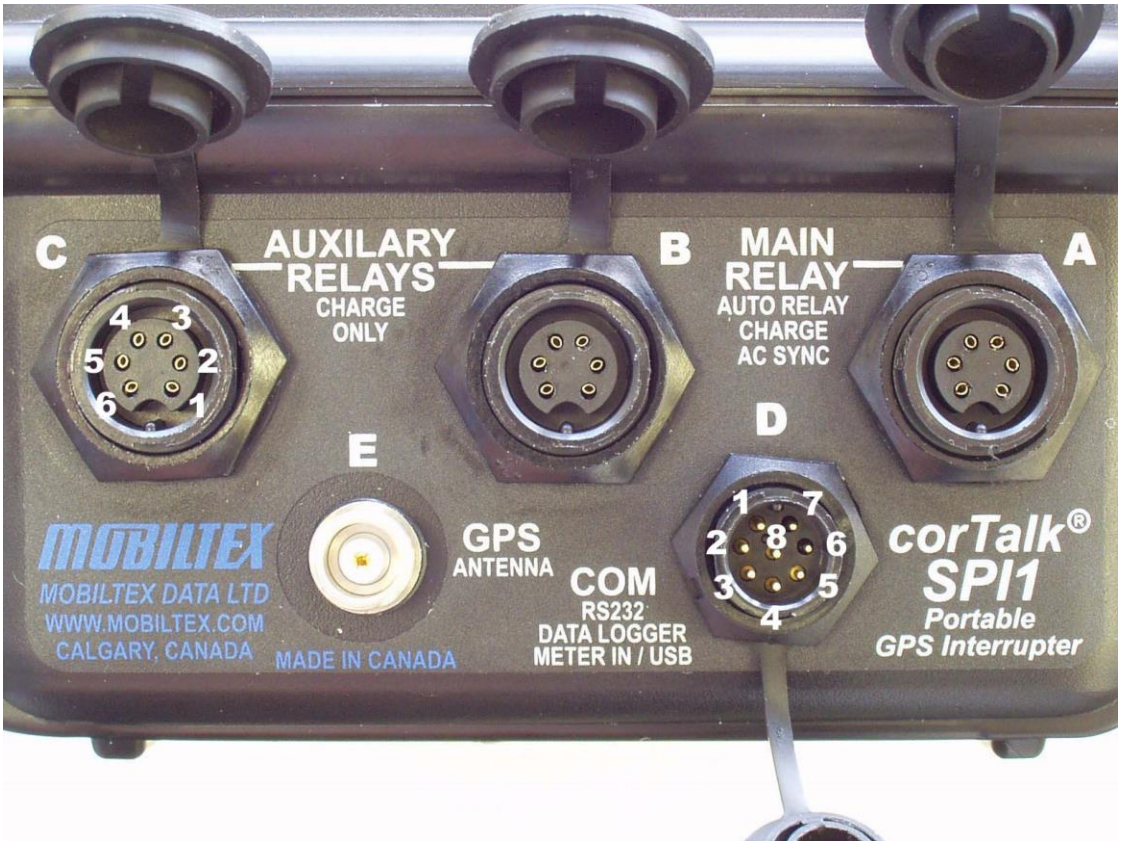



**Figure 10 SPI1 External Connectors**

Figure 11 and Figure 12 show the charging cables for the SPI1 Portable Interrupter. These cables are used to recharge the SPI1 Portable Interrupter integral battery from AC mains or from a vehicle cigarette lighter socket.




**Figure 11 SPI1 AC Charge Cable**




**Figure 12 SPI1 DC Charge Cable**

Figure 13 shows the serial programming cable (P/N W16400CPI06) for the SPI1 Portable or Stationary Interrupters. The cable may be used to load new firmware into the SPI1 by attaching the DE-9S connector to the serial port on a PC and using the 'SPI1Loader.exe' application. This cable may also be used for configuration of general parameters and schedules using the PC-based utility 'SPI1Config.exe'.




**Figure 13 SPI1 Programming Cable**

Figure 14 shows the GPS antenna supplied with the SPI1 Portable Interrupter. The antenna has a 3 meter cable attached that is terminated in a TNC connector. The TNC connector must be threaded onto the GPS antenna port on the SPI1 Portable Interrupter during operation. The antenna top face must be oriented as shown.

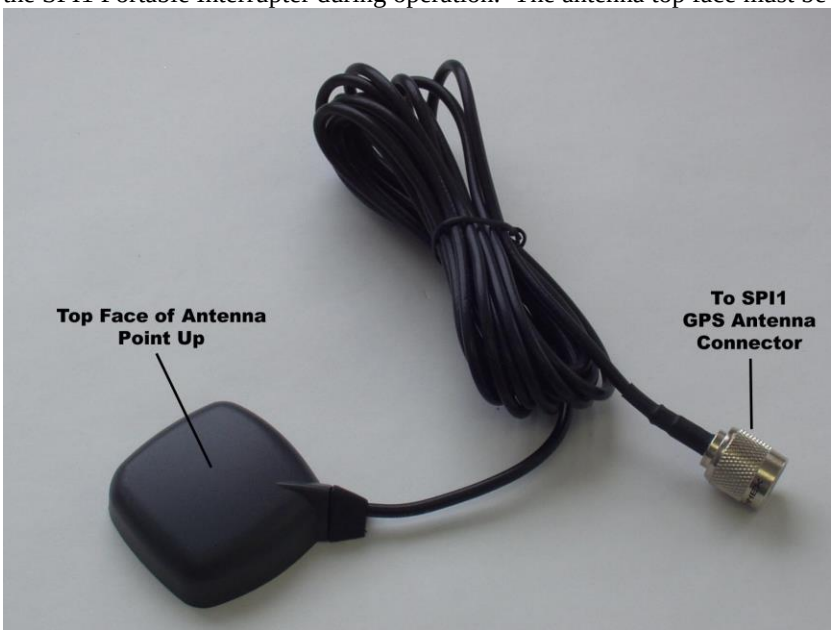



**Figure 14 SPI1 Portable Interrupter GPS Antenna**

Figure 15 shows the GPS antenna used with the SPI1 Stationary Interrupter. The antenna has a 3 meter cable attached that is terminated with an SMA connection. The SMA connector must be threaded on the GPS antenna port on the rear of the SPI1 Stationary Interrupter.

Installation of the antenna requires that a 0.75" round hole be punched through the mounting surface to allow the antenna cable to enter. The antenna must be mounted on the outside of the rectifier cabinet. An integral sealing gasket is present to prevent water entry into the rectifier cabinet. The top face must be oriented skyward.

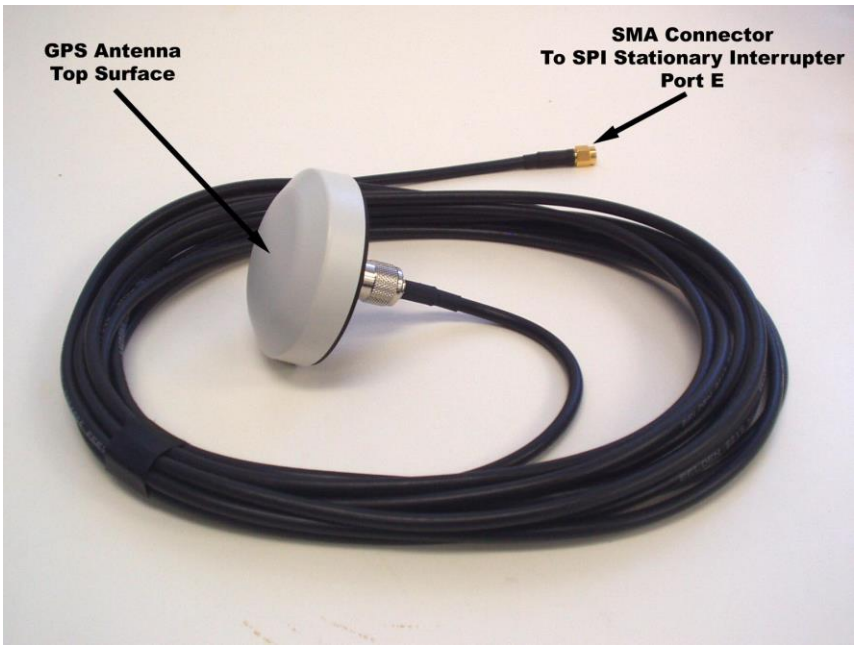



**Figure 15 SPI1 Stationary Interrupter GPS Antenna**

Figure 16 shows the 3 meter long cable (Mobiltex® P/N W16400CPI03) used to connect the SPI1 Portable Interrupter to the MSR2 relay or directly to a rectifier with a Mobiltex® interruption port already hardwired in. The cable is symmetric, so either end can be plugged into the SPI1 or the MSR2. The connectors on the cable and SPI1/MSR2 form a waterproof connection when mated.




**Figure 16 SPI1 Portable Interrupter to MSR2/Rectifier Cable**

Figure 17 shows the MSR2 (P/N A15060201B2) mechanical relay assembly. The relay portion of the MSR2 is rated at 8A at 250VAC/150VDC max. The MSR2 is internally protected with a 10 Amp slow blow 5mm x 20mm fuse. Replacement fuses are available from Mobiltex® as part number F0131110A00 (Littelfuse part number 218010HXP). The MSR2 is connected to the device requiring interruption through two clip-on leads.




**Figure 17 MSR2 External Connectors**

Figure 18 shows the SSR1 solid state relay (P/N A15000SPI01). This relay is capable of interrupting up to 100A on a 120/240VAC circuit. The relay is attached to the device requiring interruption via a Hubbell CS-6365C circular power connector. Ground is attached to the green terminal, neutral is attached to the white terminal, incoming power is attached to the XXX terminal, and switched power is available on the YYY terminal. The SSR1 provides charging current and an AC synchronization signal to the SPI1.

Extreme caution must be taken when handling the relay after it has been in use. The unit will get extremely hot during normal operation when a large load is being controlled. After interruption is complete and the relay connector is disconnected from the load, the relay should be left to cool for 1 hour before the unit is handled with bare hands.

During operation, ensure that the heatsink fins on the bottom of the relay are exposed to adequate air flow, otherwise the relay may overheat. If the relay does overheat, an internal thermal cut off will turn off the relay until the internal temperature returns to an acceptable level.

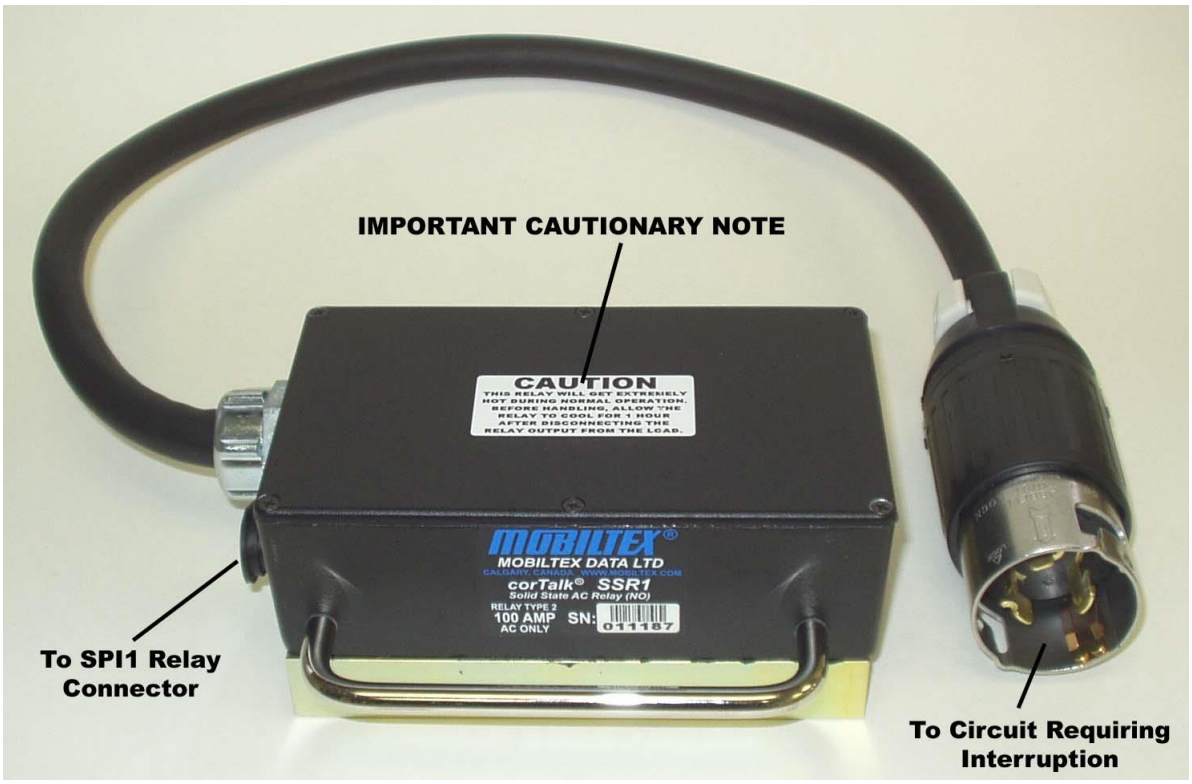



**Figure 18 Solid State Relay (SSR1) Connections**

The SSR1 relay is also available with ring lugs terminating the individual conductor wires (P/N A15000SPI07), instead of the circular power connector. Table 3 describes the function of each wire. A simplified schematic of the relay may be found in Appendix B.

| Wire Color | Label | Description |
|---|---|---|
| Green | Earth Ground | This wire should be connected to a proper earth ground point for safe operation. |
| White | Neutral (N) | Optionally connected to power system neutral. When connected, the SPI1 will charge from the line power source. Only connect if the voltage between N and L1 is 120VAC +/- 20V. |
| Red | Line In (L1) | Line power input connected to relay contacts. |
| Black | Line Out (L1 Switched) | Switched line power output from relay contacts. |

**Table 3 SSR1 Ring Lug Circuits**

Figure 19 shows the 1.5 meter (10 feet) long cable (Mobiltex® P/N W16400CPI10) used to connect the SPI1 Stationary Interrupter to a rectifier. The connections to the rectifier are provided as bare, un-terminated wires.

The following connections are available at the end of the cable:

| SPI Pin # | Label | Wire Color | Description |
|---|---|---|---|
| 1 | INT+ | Red | Relay Drive Positive Voltage (+6V or 12V) |
| 2 | INT- | Green | Relay Drive Switched Negative |
| 3 | GND | Black | Ground (Do not connect this to Earth ground! Only used for powering certain types of Mobiltex relays) |
| 4 | AC+ | Orange | Power/60Hz Reference AC Input |
| 5 | AC- | White | Power/60Hz Reference AC Input |

**Table 4 SPI1 Stationary Interrupter Power/Relay Control Cable Pinout**

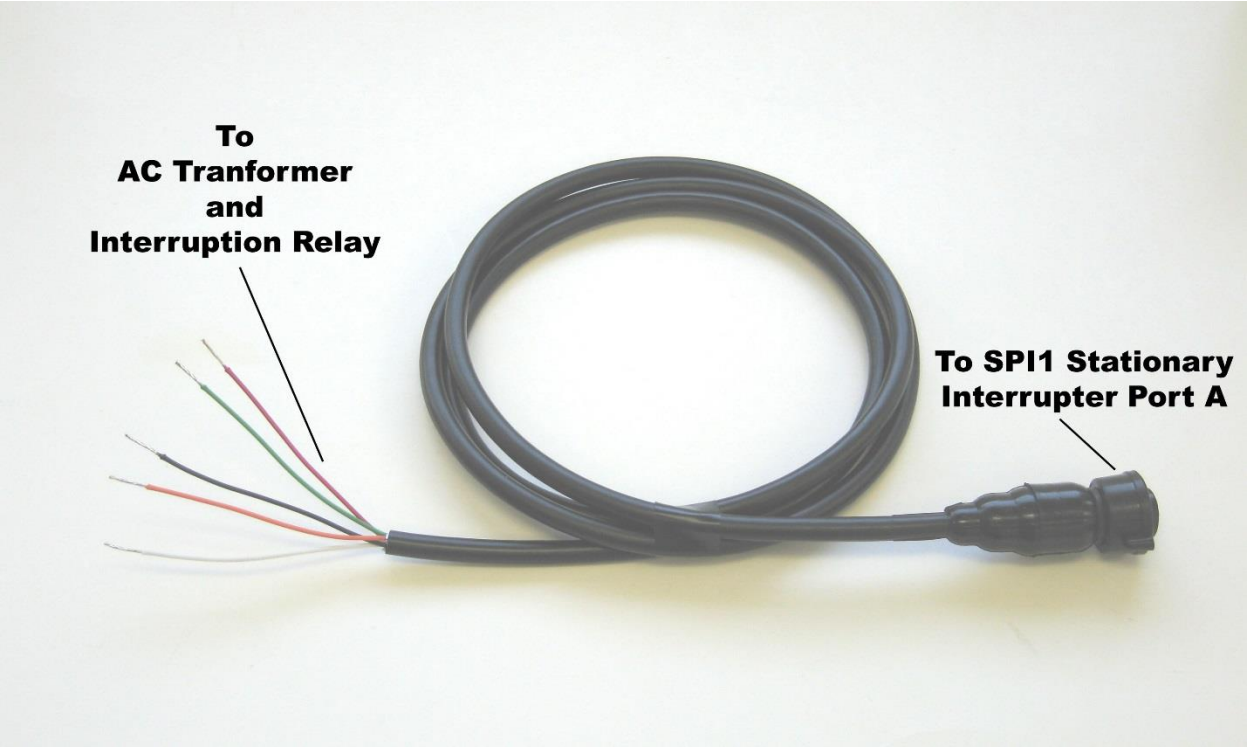



**Figure 19 SPI1 Stationary Interrupter Power and Relay Control Cable**

Figure 20, Figure 21, and Figure 22 show the contents of the HPR2 DC-only 100A high power relay package (A15000SPI05). This relay is capable of switching DC loads of up to 100 Amps at 350 Volts. Over-current and Reverse-polarity indications are provided by both visual indicators and a loud buzzer.

The relay is provided with two color-coded heavy duty cables (A02100HPR02 and A02100HPR03) that are used to connect the relay contacts to the source being interrupted. The red cable must be attached to the highest potential side of the circuit, i.e. conventional current must enter the red terminal and exit through the black terminal. If this connection is made incorrectly, the reverse polarity indicator will light and a buzzer will sound.

When in use, the 5/16" bronze chassis stud should be connected to an adequate Earth ground point for safety reasons. Installation of the relay must comply with all applicable safety standards for the particular installation.

The HPR2 also has the ability to provide power to the SPI1, if the optional power banana jack is connected. This eliminates the need for the attachment of a charging adapter during extended survey operations. The blue connection should be attached to source being interrupted. For example, if the negative leg of the rectified DC output on a rectifier is being interrupted, the supplied blue clip lead would be attached to the '+' output of the rectifier, the black relay contact cable would be attached to the '-' output of the rectifier, and the red relay contact would be attached to the load. Under this situation, if the rectifier output is higher than approximately 10V, the SPI1 will be powered from the HPR2.

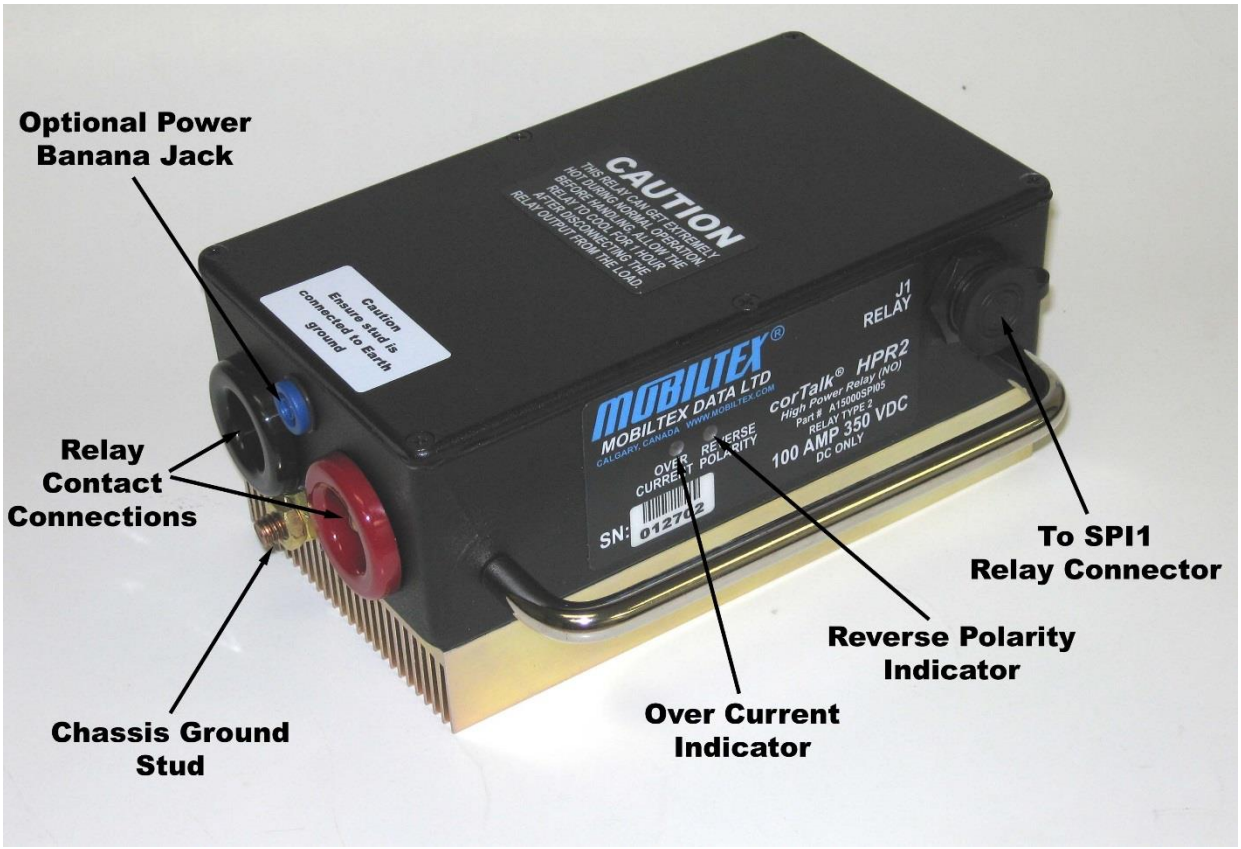



**Figure 20 HPR2 DC-Only 100A High Power Relay**



**Figure 21 HPR2 Attachment Cables**



**Figure 22 HPR1/2 Optional Power Connection Cable**

Figure 23, Figure 24, and Figure 22 show the contents of the HPR1 AC/DC 50A high power relay package (A15000SPI05). This relay is capable of switching AC loads of up to 50 Amps at 250 Volts, or DC loads of up to 50 Amps at 350 Volts. Over-current indication is provided by both a visual indicator and a loud buzzer.

The relay is provided with two heavy duty cables (A02100HPR01) that are used to connect the relay contacts to the source being interrupted. The relay contacts are not polarity sensitive.

When in use, the 5/16" bronze chassis stud should be connected to an adequate Earth ground point for safety reasons. Installation of the relay must comply with all applicable safety standards for the particular installation.

The HPR1 also has the ability to provide power to the SPI1, if the optional power banana jack is connected. This eliminates the need for the attachment of a charging adapter during extended survey operations. The blue banana jack connection should be attached to source being interrupted. For example, if the negative leg of the DC output on a

rectifier is being interrupted, the supplied blue clip lead would be attached to the '+' output of the rectifier, one of the blue relay contact cables would be attached to the '-' output of the rectifier, and the second blue relay contact would be attached to the load. Under this situation, if the rectifier output is higher than approximately 10V, the SPI1 will be powered from the HPR1.

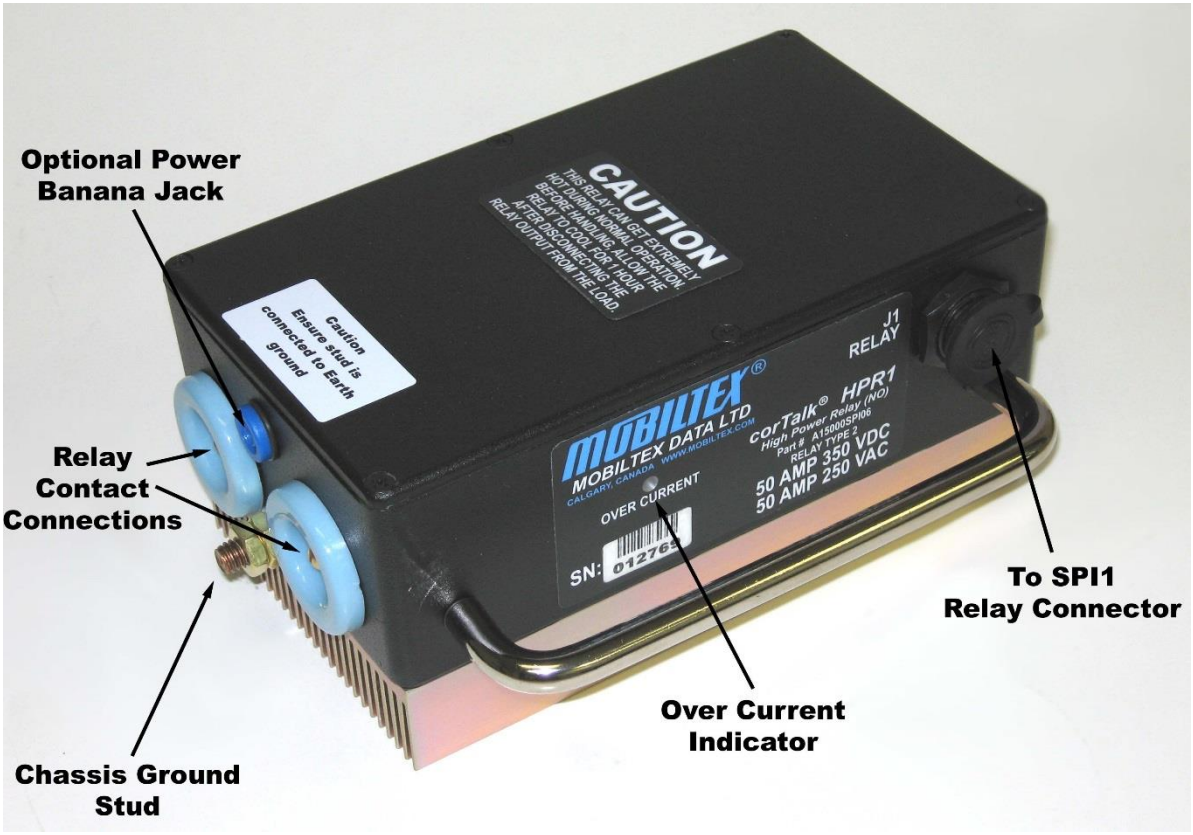
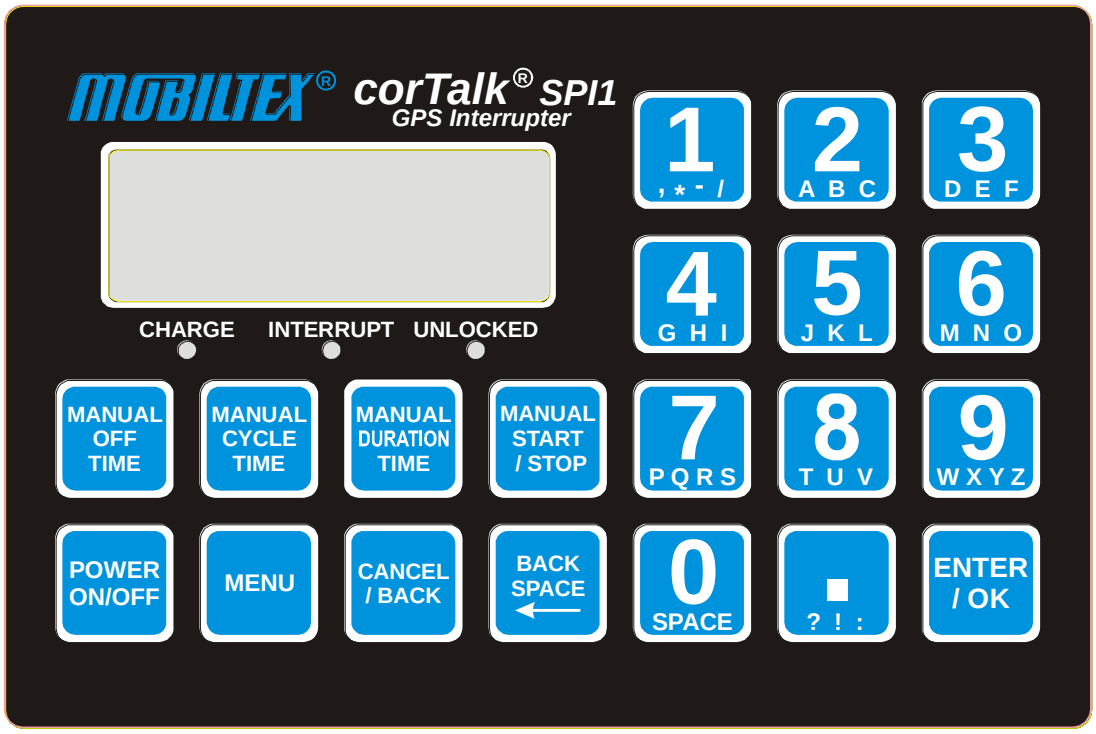



**Figure 23 HPR1 AC/DC 50A High Power Relay**



**Figure 24 HPR1 Attachment Cables**

# 3 User Interface Summary




POWER ON/OFF

```
03/03 11:33:50  100%
MODE: IDLE* SAT: 06*
CYC TIME(s): 00.000
OFF TIME(s): 00.000
```

Power On and Display Main Status Screen

Top Line Indicates Local Time On Left, Battery Charge Level On Right

Mode Indicates The Currently Active Schedule (*=AC Sync Active). Sat Indicates The Number Of Satellites Being Received By The GPS Receiver (*=Time Lock).

Cyc Time Indicates The Cycle Time Of The Currently Active Schedule.

Off Time Indicates The Off Time Of The Currently Active Schedule.

MANUAL OFF TIME

```
OFF TIME (ms)
500
```

Manual Interruption Off Time

(1ms Steps, Range 1 To Cycle Time)

MANUAL CYCLE TIME

```
CYCLE TIME (ms)
6000
```

Manual Interruption Cycle Time

(1ms Steps, Range 1 To 60000)

MANUAL DURATION TIME

```
DURATION (minutes)
1440
```

Manual Interruption Duration

(1 minute Steps, Range 1 to 9999)

MANUAL START / STOP

Manual Interruption Cycle Start/Stop

MENU

```
MAIN MENU
[1]STATUS
[2]SCHEDULER
[3]CONFIGURATION
```

Enter Main Menu From Main Status

With version 1.09 or higher firmware, the menu key can be pressed from any screen to return to the main menu. Pressing the menu key while in the main menu reverts to the main status screen.

CANCEL / BACK

Return To Previous Menu/
Cancel Current Edit Field

BACK SPACE ←

Backspace In Current Edit Field

ENTER / OK

Complete/Accept Current Edit Field

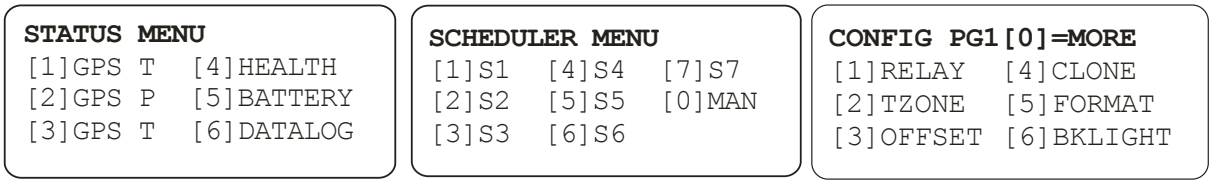



...



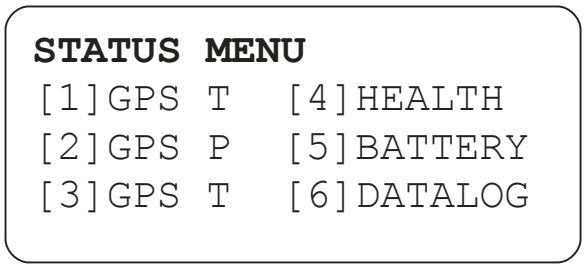

Numeric/Text Entry Keys

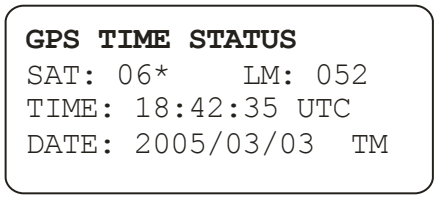
**Figure 25 corTalk® Portable Interrupter Menus**




Continue to page 28. Continue to page 29. Continue to page 34.

**Figure 26 corTalk® Portable Interrupter Status Menu**



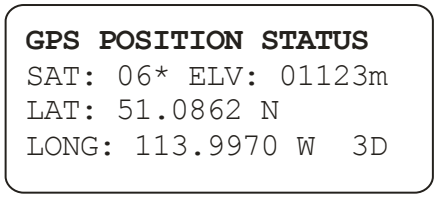




SAT field indicates the number of satellites currently locked onto. An asterisk next to the satellite count indicates that a valid time lock exists.

The LM field is a diagnostic field, the value of which may be request by Mobiltex® technical support.

The TIME and DATE fields indicate the current UTC time as received from the GPS system.

A two letter field after the date indicates the type of solution on the GPS receiver. TM=time only, 2D=3 satellite position fix, 3D=4+ satellite position fix.



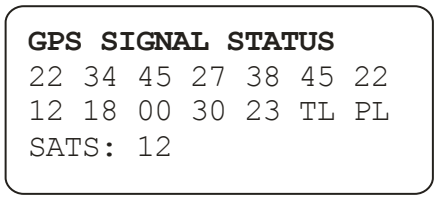

SAT field indicates the number of satellites currently locked onto. An asterisk next to the satellite count indicates that a valid position lock exists.

ELV field indicates the current altitude in meters.

LAT field indicates the current latitude in degrees North or South.

LONG field indicates the current longitude in degrees East or West.

A two letter field after the date indicates the type of solution on the GPS receiver. TM=time only, 2D=3 satellite position fix, 3D=4+ satellite position fix.

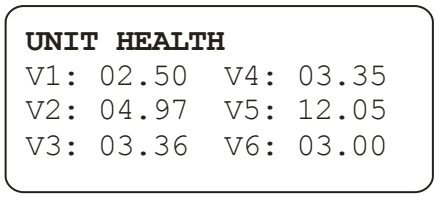



SATS field indicates the number of satellites currently locked onto.

12 two digit fields indicate the C/No (signal to noise ratio) values for each satellite channel in dB.

If TL follows the C/No values, a valid time lock exists.

if PL follows the C/No values, a valid position fix exists.




V1= smart relay detect voltage (varies from 0 to 2.5V depending on relay)

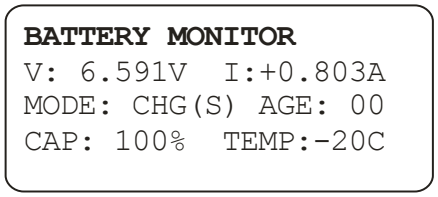
V2= +5V internal supply

V3= +3.3V internal supply

V4= GPS power supply, nominally 3.3V

V5= relay drive voltage, nominally 6V or 12V

V6 = GPS antenna voltage, nominally 3V




V field indicates the internal battery voltage.

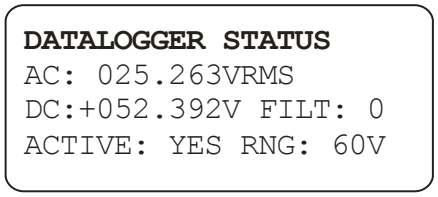
I field indicates the current flowing to/from the battery. Negative indicates discharge.

STATUS field indicates charging/discharging. Letter in parenthesis indicates fast (F) or slow (S) charge.

CAP field indicates current charge level in battery.

TEMP field shows the current temperature inside the SPI1.

AGE indicates how long the SPI1 internal battery has been in service.




AC field indicates the last measured AC voltage level on the datalogger. Measurements are taken only when a datalogger schedule is active.

DC field indicates the last measured DC voltage level on the datalogger.

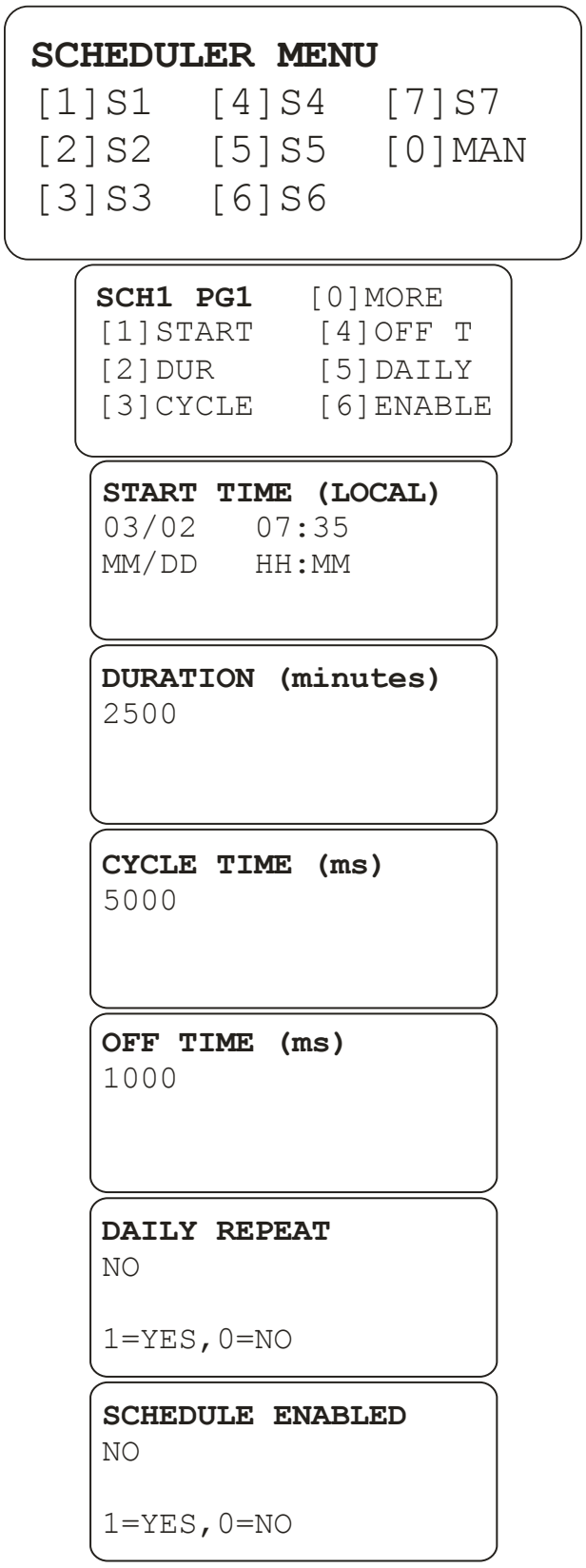
The FILT field indicates whether the datalogger digital 60Hz suppression filter is active or not. A one in the field indicates that the filter is active.

ACTIVE field indicates whether the datalogger is currently taking measurements.

RNG field shows the current meter range for the datalogger input.

***Datalogger Status screen only available on SDL1 equipped devices.**

**Figure 27 corTalk® Portable Interrupter Scheduler Menu Page 1**




Start time for currently selected schedule in local time.

Month and day are ignored if schedule is set for daily repeat.

Run time for currently selected schedule in minutes.

1 minute steps with a range from 1 to 9999.

Cycle time for currently selected schedule in milliseconds.

1 ms steps with a range from 1 to 60000.

Off time for currently selected schedule in milliseconds.

1 ms steps with a range from 1 to cycle time.

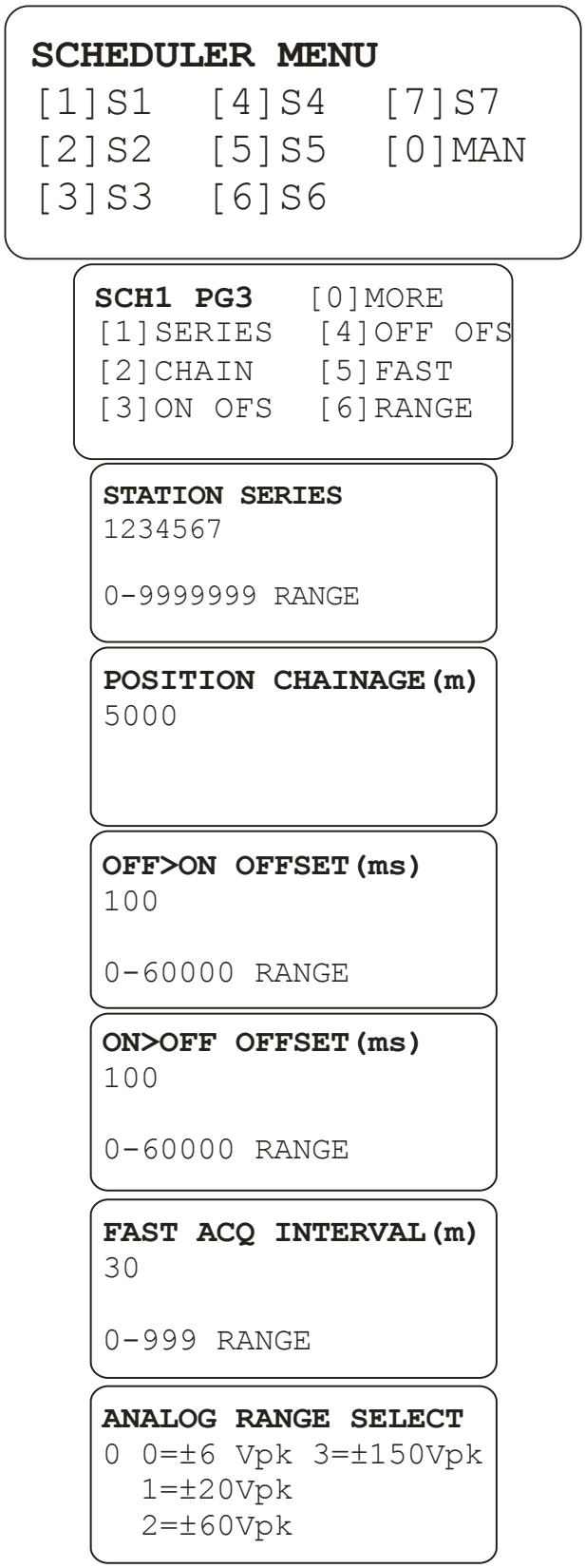
When set, makes the currently selected schedule repeat every day starting at start time HH:MM.

Enables/disables current schedule.

**Figure 28 corTalk® Portable Interrupter Scheduler Menu Page 2**

| | |
|---|---|
| **SCHEDULER MENU**<br>[1]S1 [4]S4 [7]S7<br>[2]S2 [5]S5 [0]MAN<br>[3]S3 [6]S6 | |
| **SCH1 PG2** [0]MORE<br>[1] ON 1ST | |
| **CYCLE STARTS WITH ON**<br>YES<br><br>1=YES,0=NO | Sets the order for an interruption cycle. If the parameter is set to no, the rectifier will turn off at 0s into the minute for a duration of 'off time', then be followed by the on portion of the cycle. If the parameter is set to yes, at 0s into the minute, the rectifier will turn back on for a duration of 'cycle time – off time', then be followed by the off portion of the cycle. |

**Figure 29 corTalk® Portable Interrupter Scheduler Menu Page 3**




***Schedule page 3 options only available on SDL1 equipped devices.**

Station series. Typically, this number would identify rectifier station on the pipeline. This field can be set to any number from 0 to 9999999. Entry is optional, however it is stored in the resultant data file.

Position Chainage. Typically, this would be the number of meters from a reference mark on the pipeline. This field can be set to any number from 0 to 999999. Entry is optional, however it is stored in the resultant data file.

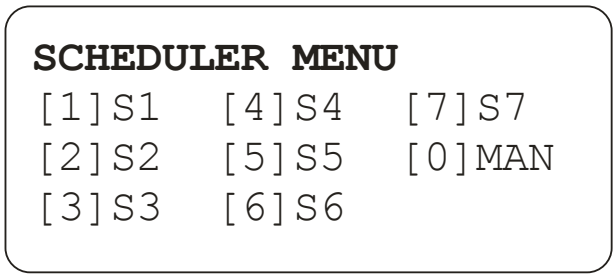
The number of milliseconds that the datalogger will wait before taking a reading after the rectifier has transitioned from an off to an on state. This parameter can be set in 1ms increments in a range from 0 to cycle on-time (ms).

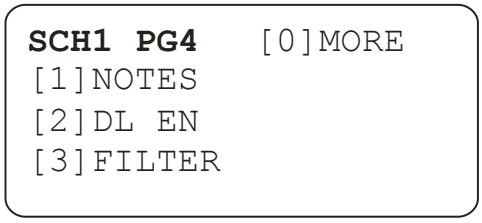
The number of milliseconds that the datalogger will wait before taking a reading after the rectifier has transitioned from an on to an off state. This parameter can be set in 1ms increments in a range from 0 to cycle off-time (ms).

The SDL1 will perform fast acquisition cycles (waveform capture) on a periodic basis determined by the value in the fast acquisition interval. A fast acquisition cycle lasts 1 minute, during which samples are taken every 50ms. By default, this field is set to 30 minutes. Range is from 0 to 999 minutes.

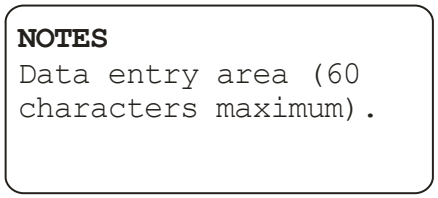
The analog meter range parameter sets the maximum voltage recordable by the datalogger. This parameter can be set to 0 for +/-6Vpeak, 1 for +/-20Vpeak, 2 for +/-60Vpeak, and 3 for +/-75Vpeak.

**Figure 30 corTalk® Portable Interrupter Scheduler Menu Page 4**

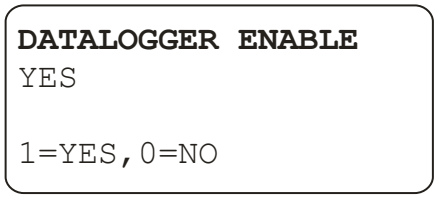


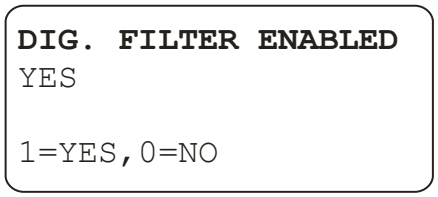

***Schedule page 4 options only available on SDL1 equipped devices.**




Free form notes entry parameter. Parameter does not affect operation, but is stored in the resultant data file. Alphabet characters are entered using the numeric keypad in a manner similar to the text messaging entry commonly available on many cell phones.




Enable/disable datalogger operation on current schedule.




Enable/disable a 60Hz digital filter on the current schedule. The digital filter in the datalogger will suppress 60Hz noise by an additional 27dB over the hardware filtering (54dB).

**Figure 31 corTalk® Portable Interrupter Configuration Menu Page 1**

```
CONFIG PG1[0]=MORE
[1]RELAY   [4]CLONE
[2]TZONE   [5]FORMAT
[3]OFFSET  [6]BKLIGHT
```

```
RELAY TYPE
3
```

The SPI1 must be programmed with a relay type that encodes the necessary information to drive a particular relay in the correct manner. All Mobiltex® provided relays will have a relay type printed on the label.

For relays not provided by Mobiltex®, please see Appendix A for information on computing the correct relay type number. Setting this value incorrectly may cause erratic operation of the interruption relay.

Entry range is 0 to 999.

```
TIME ZONE OFFSET
-7:00  -4=AST  -7=MST
0=-    -5=EST  -8=PST
1=+    -6=CST
```

Offset from UTC to local time in hours. The SPI1 does not perform automatic daylight savings time compensation so the offset must be changed manually when daylight saving time changes occur. Common offset values are shown on the SPI1 when changing the time zone field. Fractional hour entries with 0, 15, 30 and 45 minute offsets are allowed.

```
OFFSET (ms)
1000

0-5000 RANGE
```

Interruption offset parameter that allows the interruption cycle to be skewed by several seconds with a 1ms granularity. To align exactly to UTC time, this parameter should be set to **2000ms**.

```
CLONE SCHEDULES/PARM

ENTER/OK TO START
CANCEL/BACK TO ABORT
```

Selecting this item allows the SPI1 to clone its entire configuration including schedules, relay type, time zone, and offset to a second SPI1. A cloning cable must be attached between the two SPI1 communications ports.

```
FORMAT DATALOGGER

ENTER/OK TO START
CANCEL/BACK TO ABORT
```

Selecting this item will format the storage media on the SDL1 datalogger unit. All data files on the datalogger are wiped out if this item is confirmed with the [ENTER/OK] key. This item is only visible on the menu if the SDL1 datalogger option board is installed.

```
BACKLIGHT ALWAYS ON
WITH EXTERNAL POWER
YES
1=YES,0=NO
```

When this parameter is set to 'yes', the LCD backlight will always be on when the SPI1 is power through an external power source. When set to 'no', the backlight will turn off after a timeout period. This parameter has no effect on operation of the backlight when the SPI1 is running on internal batteries. (Firmware v1.09 or higher)

**Figure 32 corTalk® Portable Interrupter Configuration Menu Page 2**

```
CONFIG PG2[0]=MORE
[1]NO GPS INTERRUPT
[2]GPS SYNC ONCE
[3]FACTORY DEFAULTS
```

```
NO GPS INTERRUPTION
YES

1=YES,0=NO
```

Normally, the SPI1 will require GPS time lock to operate the interruption control signal. This parameter allows the unit to operate without GPS time lock. When this mode is activated, the interruption control signal can not be synchronized to other interruption equipment. If the datalogger subsystem is activated on a schedule while this mode is active, the resultant time stamp accuracy can not be guaranteed. (Firmware 1.21 or higher)

This mode is reset to a disabled state each time the SPI1 is powered up.

```
GPS SYNC ONCE ONLY
YES

1=YES,0=NO
```

As with the prior option, normally the SPI1 will require GPS time lock to operate the interruption control signal. This parameter allows the unit to operate after an initial GPS time synchronization has been achieved. When this mode is activated, the interruption control signal will initially be synchronized to other interruption equipment, but will diverge over time.

This mode is reset to a disabled state each time the SPI1 is powered up.

```
FACTORY DEFAULTS

ENTER/OK TO CONTINUE
CANCEL/BACK TO ABORT
```

Reverts all configuration and scheduler parameters back to factory default values.

# 4 Basic Operation

## 4.1 Charging

Prior to use, the internal battery of the SPI1 must be charged. This is accomplished by attaching the unit to a power source via one of the relay ports A, B or C on the side of the box. Use cigarette lighter adapter cable W16400CPI07 when charging from a vehicle cigarette lighter socket. Use 120VAC charger adapter cable W16400CPI08 when charging from AC mains. The unit may also be charged when connected to an appropriately equipped rectifier. If the unit is to be attached to AC power while an interruption operation is occurring, then it is favoured that port A be used for the power source. This will allow the SPI1 to synchronize relay switching to the AC waveform.

The current charge level of the battery is indicated on the top right side of the main status screen. Continue charging until this value is greater than 98%. Leaving the charging source attached to the SPI1 will **not** damage the internal battery. More detailed information on the current charge state of the battery may be found in the battery status screen by pressing [MENU][1][5] while the main status screen is showing.

When the SPI1 Portable Interrupter is fully charged and a solid state relay is used for interruption, approximately 7 days of run time can be expected when operating on internal battery. The SPI1 Stationary Interrupter internal battery will provide approximately 8 hours of back up power in the event of main power failure.

## 4.2 Power Up and Power Down

The SPI1 Portable Interrupter and post mid-September 2013 SPI1 Stationary Interrupters can be powered up in one of two ways, by pressing the Power On/Off key or by plugging in a charging power source on one of the relay drive ports A, B or C. SPI1 Stationary Interrupters produced prior to mid-September 2013 can only be powered up by using the Power On/Off key.

The SPI1 can be powered down by pressing the Power On/Off key. The SPI1 will display a message indicating that it is shutting down. With version 1.12 or higher firmware, a double beep will sound as the unit powering down. While the unit is powered down, the relay drive is left in a state that will keep the cathodic rectifier in an on state, delivering current to the pipeline.

Note that the SPI1 Portable Interrupter and post mid-September 2013 SPI1 Stationary Interrupters cannot be turned off while a charging power source is attached.

## 4.3 Configuration

Three items must be configured in the SPI1 prior to operation, these are relay type, time zone, and offset. The configuration menu is entered by pressing [MENU][3] from the main status screen. There are seven options that can be adjusted from that menu. The menu is split between two page displays, where the next page may be selected by pressing [0].

### 4.3.1 Relay Type

The SPI1 has been designed to be extremely versatile in its capability to drive many types of relay devices used to interrupt rectifier current. To allow for this, the SPI1 must be programmed with a relay type that encodes the necessary information to drive a particular relay in the correct manner. All Mobiltex® provided relays will have a relay type printed on the label.

For relays not provided by Mobiltex®, please see Appendix A for information on computing the correct relay type number. Setting this value incorrectly may cause erratic operation of the interruption relay.

### 4.3.2 Time Zone

All scheduling and time display on the SPI1 is performed using local time. The GPS receiver on the unit retrieves time in UTC (GMT) format. This requires that the SPI1 be programming with the offset from UTC to local time, in hours. The SPI1 does not perform automatic daylight savings time compensation, the offset must be changed manually when daylight saving time changes occur. Common offset values are shown on the SPI1 when changing the time zone field.

### 4.3.3 Offset

The SPI1 contains an offset parameter that allows the interruption cycle to be skewed by several seconds with a 1ms granularity. This would be used to align the relay output control to another manufacturer's interruption device if there are slight timing differences. To align exactly to UTC time, this parameter should be set to **2000ms**. Setting the value lower than 2000ms causes interruption cycles to start sooner than top of the minute. Setting the value higher than 2000ms causes interruption cycles to start later than top of the minute. Interruption cycles are aligned with the on-to-off transition at the top of the minute.

### 4.3.4 Cloning Schedules and Parameters

The SPI1 allows the schedules and parameters in one unit to be transferred to a second unit via a cloning cable (P/N W16400CPI09) connection. The cloning cable is attached to the communications port (D) on each unit. On the master unit, select option '[4]CLONE' from the configuration menu. After the cloning cable is attached to both units, press 'ENTER/OK' to initiate the data transfer. The master unit will indicate the progress of the transfer on the LCD display. Upon completion of the cloning procedure, the slave unit will reboot. Detach the cloning cable after completing the process.

### 4.3.5 Datalogger Media Format

Selecting the '[5]FORMAT' item from the configuration menu allows the storage media on the optional SDL1 datalogger unit to be formatted. All information on the datalogger is wiped out if this menu item is confirmed with [ENTER/OK]. This menu item only appears if the SDL1 option board is installed.

### 4.3.6 Backlight Mode

The SPI1 LCD display backlight is normally only on for a certain duration after a key is pressed. This is done to save power and to increase life on the LCD backlight. It is possible to override this time out and keep the backlight on if the SPI1 is being powered by an external power connection. Set this option to 'yes' if it is desirable to keep the backlight always on when external power is present.

### 4.3.7 No GPS Interruption

Normally, the SPI1 will require GPS satellite signal and time lock to operate the interruption control signal. This parameter allows the unit to operate without GPS time lock. A GPS antenna does not have to be attached to the SPI1 when operating in this mode. The main status screen will show "DIS" in the "SAT" field when this mode is active.

When this mode is activated, the interruption control signal can not be synchronized to other interruption equipment. If the datalogger subsystem is activated on a schedule while this mode is active, the resultant data point time stamp accuracy can not be guaranteed.

To prevent accidental use of this mode, this parameter is reset to a disabled state each time the SPI1 is powered up.

### 4.3.8 Reverting to Factory Defaults

It is possible to revert the SPI1 to factory default settings by pressing the [2] key while in the configuration page 2 menu. A confirmation prompt is presented. If [ENTER/OK] is pressed at this point, all configuration values are reverted to factory defaults. If instead, [CANCEL/BACK] is pressed, no changes occur to the configuration values.

## 4.4 Attachment

Verify that the GPS antenna has been attached to the SPI1 and the connector tightened properly. Place the antenna so that is has a clear view of the sky. Make sure that the magnetic base of the antenna is facing down for optimum signal reception.

The SPI1 must be attached to an interruption relay or a rectifier equipped with a low voltage interruption port. Up to three interruption relays of the same type may be driven by the SPI1 through relay ports A, B, and C on the side of the unit. Attach cable W16400CPI01, W16400CPI02, or W16400CPI03 between one of the relay ports on the SPI1 and the matching port on the interruption relay or rectifier. If attaching to a rectifier that is equipped to provide 12VAC

power to the SPI1, favour using relay port A for that particular connection so that the SPI1 can synchronize interruption to the AC waveform.

Once connected to the relay device, connect the relay device to the rectifier as needed to stop current flow during interruption. Ensure that relay power limits are adequate for the particular rectifier that is being interrupted.

**Install all electrical equipment in accordance with locally applicable electrical and safety codes.**

## 4.5 Manual Interruption

Prior to the start of interruption, ensure that the SPI1 has locked to the GPS satellite time source. This can be determined by observing the main status screen 'SAT:' field value. If an asterisk (*) follows the number of satellites, then the SPI1 has a valid time lock. The 'UNLOCKED' LED indicator may also be observed to determine the same information—the LED will turn off once the SPI1 has a valid time lock. This initial satellite lock may take up to 13 minutes when the unit is in good satellite coverage. If the unit has been listening to the GPS data stream within the prior two week period, then the lock time will be substantially less than this (typically less than 2 minutes).

This most basic way to start interrupting with the SPI1 is to use the manual interruption mode. Three pieces of information must be entered—cycle time, off time, and duration. Separate keys are provided on the SPI1 keypad to allow quick entry of these parameters. Cycle time is the number of milliseconds that comprise the total of the on and off times for interruption. Off time is the number of milliseconds that the rectifier is interrupted during each cycle. Duration is the number of minutes that the SPI1 will continue performing interruption cycles after the operation is initiated. Enter all three parameters as required for the current pipeline survey.

*****Important Notice*****

**If the SPI1 is being used in conjunction with other manufacturers' interrupters, it is important that the cycle time selected be evenly divisible into 60s, otherwise synchronized interruption may not occur. Some manufacturers' interrupters re-synchronize at the top of the minute, top of the hour or top of the day. The SPI1 re-synchronizes at the top of the minute. As long as the cycle time is evenly divisible into 60s, synchronization is assured among different manufacturers' interrupters. Example cycle times that meet this criteria: 100ms, 200ms, 250ms, 500ms, 1000ms, 2000ms, 3000ms, 4000ms, 5000ms, 6000ms, 10000ms, 12000ms, 15000ms, 20000ms, 30000ms, 60000ms. Also, some manufacturers start an interruption cycle at the reference point with the rectifier on-time occurring before the rectifier off-time—in this case, set the 'ON 1ST' parameter in the manual schedule ([MENU][2][0]).**

To start interruption once the parameters have been entered, press the [MANUAL START/STOP] key. The 'MODE:' field on the main status screen should change to 'MAN', indicating that the manual schedule is active. The 'INTERRUPT' LED should light during the off portions of the interruption cycles.

To stop manual interruption early, press the [MANUAL START/STOP] key. The 'MODE:' field should return to 'IDLE'.

## 4.6 Scheduled Interruption

The SPI1 includes a scheduler system to allow more flexible field use. The SPI1 can be programmed with up to seven separate schedules, each with independent cycle, off, and duration times. Each schedule may also be set to repeat daily.

Schedules are configured by entering the schedule configuration menu. From the main status screen, press [MENU][2] followed the schedule identifier number. A menu will be presented with the options for the schedule being changed. The first parameter is the start time for the schedule; this is entered as month/day/hour/minute. The next three parameters are the same as those available in manual mode, duration, cycle time and off time. The next parameter is the daily repeat—when this parameter is set, the month and day portion of the start time are ignored, causing the schedule entry to start operation every day at the set time. The final parameter is the schedule enable—when set, the schedule is placed in an operational state. If the schedule enable is set to no, then the schedule is ignored.

*****Important Notice*****

**If the SPI1 is being used in conjunction with other manufacturers' interrupters, it is important that the cycle time selected be evenly divisible into 60s, otherwise synchronized interruption may not occur. Some manufacturers' interrupters re-synchronize at the top of the minute, top of the hour or top of the day. The**

**SPI1 re-synchronizes at the top of the minute. As long as the cycle time is evenly divisible into 60s, synchronization is assured among different manufacturers' interrupters. Example cycle times that meet this criteria: 100ms, 200ms, 250ms, 500ms, 1000ms, 2000ms, 3000ms, 4000ms, 5000ms, 6000ms, 10000ms, 12000ms, 15000ms, 20000ms, 30000ms, 60000ms. Also, some manufacturers start an interruption cycle at the reference point with the rectifier on-time occurring before the rectifier off-time—in this case, set the 'ON 1ST' parameter in the schedule that will be used.**

When a schedule is active, i.e. interruption is in progress, the 'MODE:' field will show 'SCHx', where 'x' is the identifier number of the active schedule.

Note that schedules are prioritized with the lower number schedule having higher priority. If two schedules overlap in time, the lower numbered schedule will continue operating until the overlap ends.

## 4.7 De-polarization Operation

The SPI1 may be used for shutting off the rectifier output during pipeline de-polarization procedures. This operation may be performed using manual mode, or any of the seven scheduler entries. To activate this mode, select a schedule and set the off time equal to the cycle time. The rectifier will remain off for the time set in the duration time entry for the selected schedule. At the end of the interruption duration period, the rectifier output will be re-activated.

## 4.8 SPI1Config Utility

A Mobiltex® provided utility, SPI1Config.exe, may be used to configure the SPI1 from a PC (must be running Microsoft Windows 2000/XP/2003/Vista operating system and have an unused RS-232 serial port). SPI1Config presents a graphical user interface (GUI) that simplifies the entry of parameters into the SPI1. Figure 33 shows the main screen:

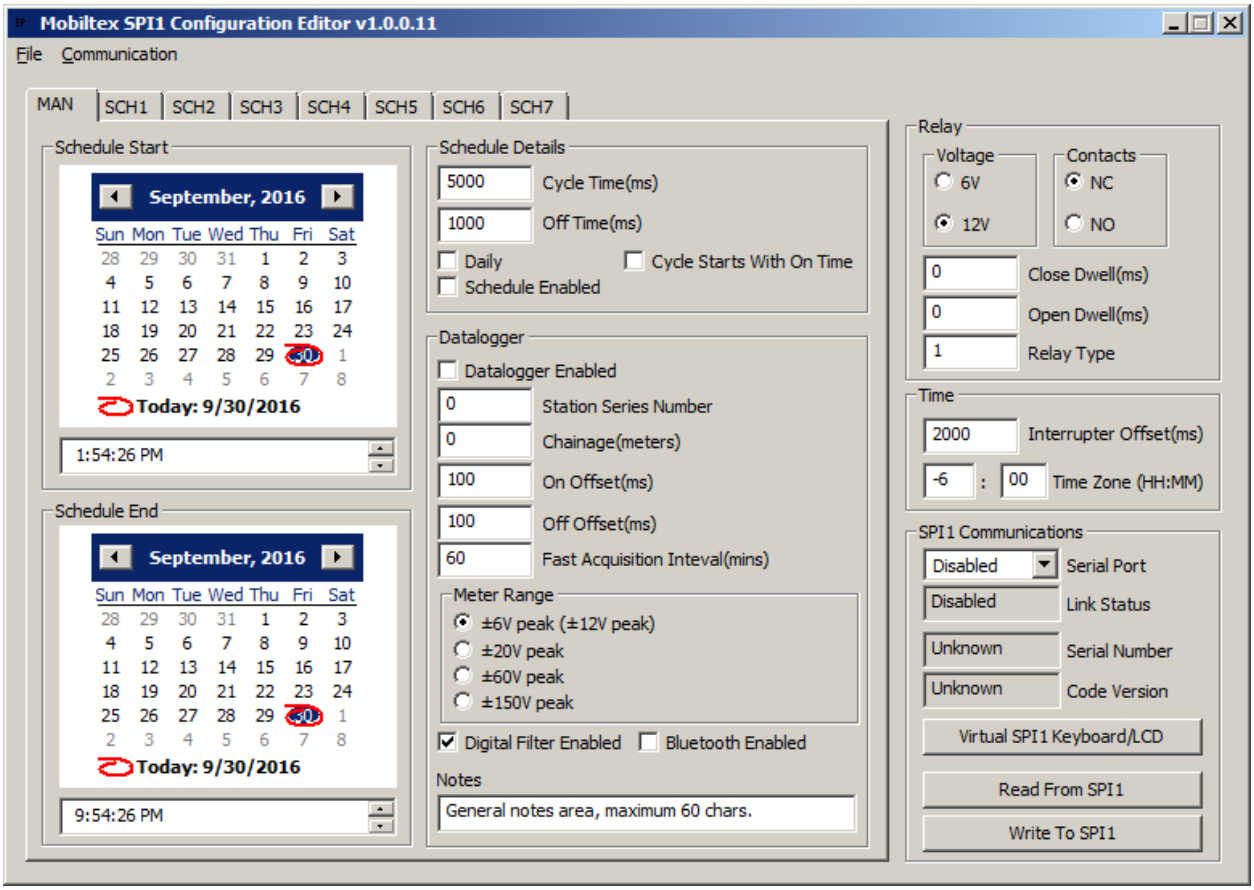



**Figure 33 SPI1Config Screen Shot**

To use the application, first run the provided executable SPIConfig.exe. Next, select the serial port, from the drop down box, that will be used to connect the PC to the SPI1. After the selection, the Link Status box will change from 'Disabled' to 'Idle' if the serial port opens successfully.

Next, attach the SPI1 serial cable (P/N W16400CPI06) between the PC serial port and the SPI1 communications port (D). It is important that this step follows the serial port selection, as the SPI1 may be held in reset or turn off if the cable is attached before the serial port is selected.

If changes are to be made to the SPI1's existing schedule/parameter, click the 'Read From SPI1' button to retrieve the SPI1's current schedules and parameters into the application. The Link Status will change to 'Busy' while the information is being transferred, and back to 'Idle' on completion. After a successful transfer, the serial number and firmware code version of the SPI1 are shown in the 'SPI1 Communications' area.

The parameters shown on the GUI match the parameters that can be edited via the SPI1 menus. Edit the values as needed. Individual schedules are chosen by selecting the appropriate tab in the GUI.

The relay information may be changed in one of two ways. First, the relay type, as stamped on Mobiltex® provided relays, can be entered directly into the 'Relay Type' field. When a different field is selected, the 'Voltage', 'Contacts', 'Close Dwell', and 'Open Dwell' fields will be updated from the information in the 'Relay Type' field. The second method of entry is to enter the information in the 'Voltage', 'Contacts', 'Close Dwell', and 'Open Dwell' fields. When another field, other than 'Relay Type' is selected, the 'Relay Type' field is updated with the information from the other fields. The second entry method allows a generic relay, where the individual relay parameters are known, to be used with SPI1.

After completing the information editing, the information may be stored on the PC hard drive for later retrieval. Select the 'File' menu item and then select 'Save As'. Select the location and filename, then click 'Save'. The file may be retrieved later by using the 'File->Open' menu item.

To save the information to the SPI1, click the 'Write To SPI1' button. The Link Status will change to 'Busy' while the information is being transferred, and back to 'Idle' on completion. Data transfer may take 10 seconds to complete.

After transferring the information to the SPI1, remove the serial cable from the SPI1 communications port (D). The PC application may be shutdown by clicking the 'X' in the upper right corner, or by selecting the 'File->Close' menu item.

## 4.9 Firmware Updates

The firmware in the SPI1 can be updated in the field by using a PC with a serial port connection. Cable W16400CPI06 is used to attach the PC serial port to the SPI1 COM port D. Instructions on how to perform the firmware update will be provided in a separate document included with the firmware update software.

The current version numbers of the firmware for the SPI1 and the SDL1(if so equipped), can be displayed by entering the main menu on the SPI1 with the [MENU] key, then pressing [1] followed by [0]. Also displayed is the serial number of the SPI1 and the GPS module type identifier (G2, G3, or G5).

# 5 Optional Datalogger Operation

An SDL1 datalogger option board equipped SPI1 is able to capture voltage information during interruption. The SDL1 is able to capture AC and DC voltage level information in one of four ranges, +/-6Vpeak, +/-20Vpeak, +/-60Vpeak, or +/-150Vpeak.

When an SDL1 datalogger option board is installed in an SPI1, additional configuration and status menu options are present. An SDL1 equipped SPI1 unit can be identified by the label above the LCD display which will read "Datalogger Equipped".

## 5.1 Configuration

The SDL1 datalogger option board adds eight new configuration parameters to a schedule. These new parameters are accessed by pressing the [0] key to scroll between configuration pages on the schedule configuration menu. The new parameters that relate to the SDL1 datalogger are: station series, chainage, on offset, off offset, fast acquisition interval, meter range, notes, and datalogger enable.

### 5.1.1 Station Series

The station series parameter is placed in the datalogger data file header to provide information on where the data was acquired. Typically, this number would identify rectifier station on the pipeline. This field can be set to any number from 0 to 9999999. This entry does not affect datalogger operation, but is including in the resultant data file.

### 5.1.2 Position Chainage

The position chainage parameter is placed in the datalogger data file header to provide information on where the data was acquired. Typically, this would be the number of meters from a reference mark on the pipeline. This field can be set to any number from 0 to 999999. This entry does not affect datalogger operation, but is including in the resultant data file.

### 5.1.3 On Offset

The on offset parameter sets the number of milliseconds that the datalogger will wait before taking a reading after the rectifier has transitioned back to an on state. This field should be set to at least 100ms to ensure that voltages have settled after the transition. This parameter can be set in 1ms increments in a range from 0 to 60000ms. The SDL1 will limit this parameter to be 1ms less than the on portion of the interruption cycle.

### 5.1.4 Off Offset

The on offset parameter sets the number of milliseconds that the datalogger will wait before taking a reading after the rectifier has transitioned back to an off state. This field should be set to at least 100ms to ensure that voltages have settled after the transition. This parameter can be set in 1ms increments in a range from 0 to 60000ms. The SDL1 will limit this parameter to be 1ms less than the off portion of the interruption cycle.

### 5.1.5 Fast Acquisition Interval

The SDL1 will perform fast acquisition cycles (waveform capture) on a periodic basis determined by the value in the fast acquisition interval. A fast acquisition cycle lasts 1 minute, during which samples are taken every 50ms. By default, this field is set to 30 minutes. The interval must be set with care due to the amount of storage space consumed by fast acquisition cycles. Fast acquisition data is used to determine whether there are interrupters present during a survey that are not synchronized or operating correctly. Range is from 0 to 999.

### 5.1.6 Meter Range

The meter range parameter sets the maximum voltage recordable by the datalogger. This parameter must be set according to what is expected to be the signal source maximum voltage. Setting the range too high results in poor resolution. Setting the range too low results in over ranging the input analog to digital converter. This parameter can be set to 0 for +/-6Vpeak, 1 for +/-20Vpeak, 2 for +/-60Vpeak, and 3 for +/-150Vpeak.

### 5.1.7 Text Notes

The text notes parameter is a free form text comment entry. The parameter is stored in the datalogger data file for later use during analysis.

Up to 60 characters may be stored in the text notes parameter. Entry is performed in a manner similar to how some cell phones allow text messaging entry. Each of the numeric keys has several alphabet letters or punctuation characters associated with it. Pressing the same key multiple times rapidly scrolls through the characters associated with that key. After a time out, the parameter entry moves to the next character position. If another numeric key is pressed prior to the key time out, the parameter entry moves to the next character position immediately. The [BACK SPACE] key may be used to clear out the field or to fix entry errors; this key operates in a destructive manner. Press [ENTER/OK] when finished entering text.

### 5.1.8 Datalogger Enable

The datalogger enable parameter, when set to 'yes', enables datalogger operation when the schedule is active. If set to 'no', the datalogger board will remain powered down during an active schedule and no data will be collected. If datalogging operation is not required during a particular interruption session, this parameter should be set to 'no' to conserve battery power.

### 5.1.9 Digital Filter Enable

The digital filter enable parameter, when set to 'yes', enables a digital software filter in the datalogger which provides additional attenuation to 60Hz signals that may be superimposed on DC signals that are being measured. The digital filter reduces 60Hz noise by an additional 27dB when enabled. The disadvantage of using the digital filter is that battery life of the SPI1/SDL1 is reduced slightly while data acquisition is active.

## 5.2 Attachment

Attach cable W16400CPI12 between the SPI1 COM port D and the target measurement connection. Start interruption operation to initiate logging. The values being collected by the datalogger can be observed in the datalogger status screen by pressing [MENU][1][6] from the main status screen. This allows validation of the connection between the target measurement connection and the SPI1.

## 5.3 Retrieving Files

After datalogging has completed, data from the SDL1 datalogger option board can be retrieved by attaching cable W16400CPI04 between the SPI1 COM port D connector and the USB port on a PC running the Microsoft Windows XP Operating System (or newer). The SDL1 datalogger identifies itself to the PC as a USB Mass Storage device, allowing it to be accessed as a removable drive.

Data files are stored in subdirectories starting with the letter 'S' followed by a seven digit number. This seven digit number matches the seven digits of the station series parameter configured in the scheduler. Data files all have an extension of '.sdl'.

Use Windows Explorer to retrieve the data from the SDL1 datalogger—delete the source files from the SDL1 each time the data is retrieved to avoid filling the SDL1 data drive. Delete empty directories as well to make it easier to navigate the directory structure.

A Mobiltex® provided utility, 'sdl1util.exe' may also be used to retrieve the data and optionally convert the data to a format compatible with most spreadsheet applications. This utility automatically takes care of deleting source files and directories. On retrieving the data files, it will rename them to more descript filenames based on the information entered in the scheduler configuration.

****Important****, after completing data retrieval, remove the USB cable from the SPI1. The SDL1 will **not** perform any logging operations while the USB cable is attached to the PC.

# 6 Maintenance

## 6.1 Cleaning

The SPI1 should be wiped inside and out with a lint-free cloth dampened with domestic glass cleaner. Ensure that the cloth is free of dust and other debris when cleaning the LCD and keypad area to prevent scratching the overlay.

If any of the external connectors become contaminated, attempt to vacuum out the debris. Use canned compressed air to remove any remaining debris. To prevent connector contamination, make sure that protective connector caps are used at all times when a cable is not installed in a particular connector.

## 6.2 Battery Life

The internal sealed lead acid battery of SPI1 Portable Interrupter should have a useful service life of approximately 3 to 5 years with average usage. The internal sealed lead acid battery of SPI1 Stationary Interrupter should have a useful service life of approximately 5 to 8 years with average usage. An age counter is present in battery status screen. This counter increments by 1 each time the battery has been used the equivalent of approximately 40 full discharge/charge cycles. After the counter exceeds a value of 12, the capacity of the battery may be lowered to the point where it may need to be replaced. The SPI1 should be returned to Mobiltex® for servicing if battery replacement is necessary.

SPI1 units that are not used on a regular basis should have the batteries recharged at least every three months. Sealed lead acid batteries have a high rate of self-discharge and can be damaged if a proper charge level is not maintained on the battery.

## 6.3 Servicing

There are no user serviceable parts inside the SPI1. If any malfunction is detected in the unit, it should be returned to Mobiltex® for servicing.

# A. Relay Type Encoding

The SPI1 controls relays differently depending on the relay code that is programmed in through the configuration menu. A three digit number is used to identify a particular type of relay. Table 5 shows how bits are binary encoded to produce the relay code type. To compute a value for the relay type, sum the weight values for each bit that has a value of 1. The dwell values may be used to initiate openings and closures earlier to compensate for activation lag times in mechanical relays.

| Bit | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|
| Weight | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| Label | Disable AC Sync | Close Dwell | | | Open Dwell | | | NC/NO | Voltage |
| Values | 0=enable AC sync<br>1=disable AC sync | 000=0 ms<br>001=5 ms<br>010=10 ms<br>011=15 ms<br>100=20 ms<br>101=30 ms<br>110=50 ms<br>111=80 ms | | | 000=0 ms<br>001=5 ms<br>010=10 ms<br>011=15 ms<br>100=20 ms<br>101=30 ms<br>110=50 ms<br>111=80 ms | | | 1=Normally Open, 0=Normally Closed | 1=12V,<br>0=6V |

**Table 5 Relay Type Encoding Bits**

Examples:

NO, 6V, 0ms open, 0ms close => 2

NO, 12V, 0ms open, 0ms close => 3

NC, 6V, 0ms open, 0ms close => 0

NC, 12V, 0ms open, 0ms close => 1

NC, 12V, 20ms open, 10ms close => 81

NO, 12V, 15ms open, 0ms close => 15

Mobiltex® MSR2 Mechanical Relay (P/N A15060201B1) => 141

Mobiltex® MSR2 Mechanical Relay (P/N A15060201B2) => 141

Mobiltex® AC Solid State Relay (P/N A15000SPI01) => 2

Mobiltex® AC Solid State Relay (P/N A15000SPI02) => 2

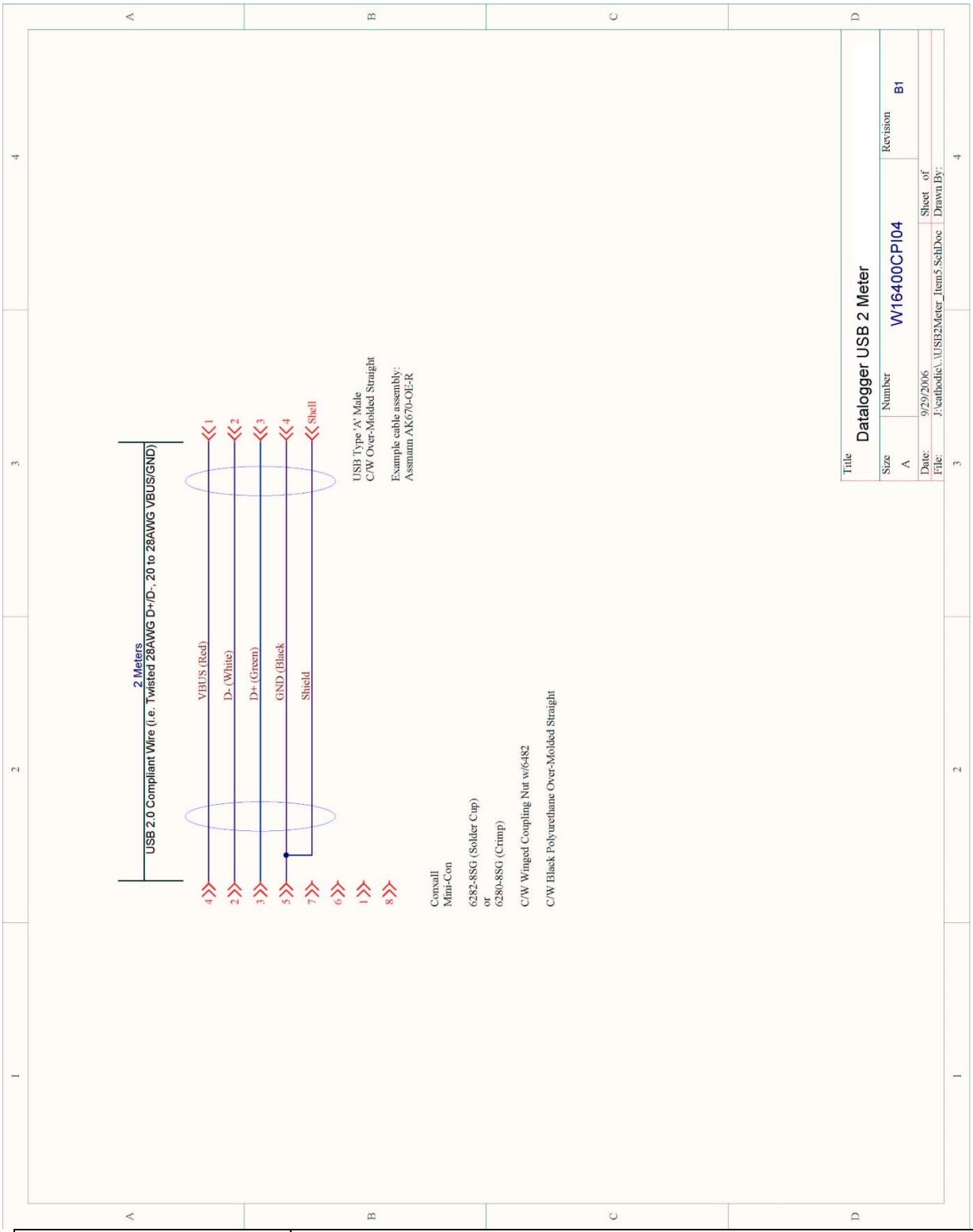
Mobiltex® AC Solid State Relay (P/N A15000SPI07) => 2

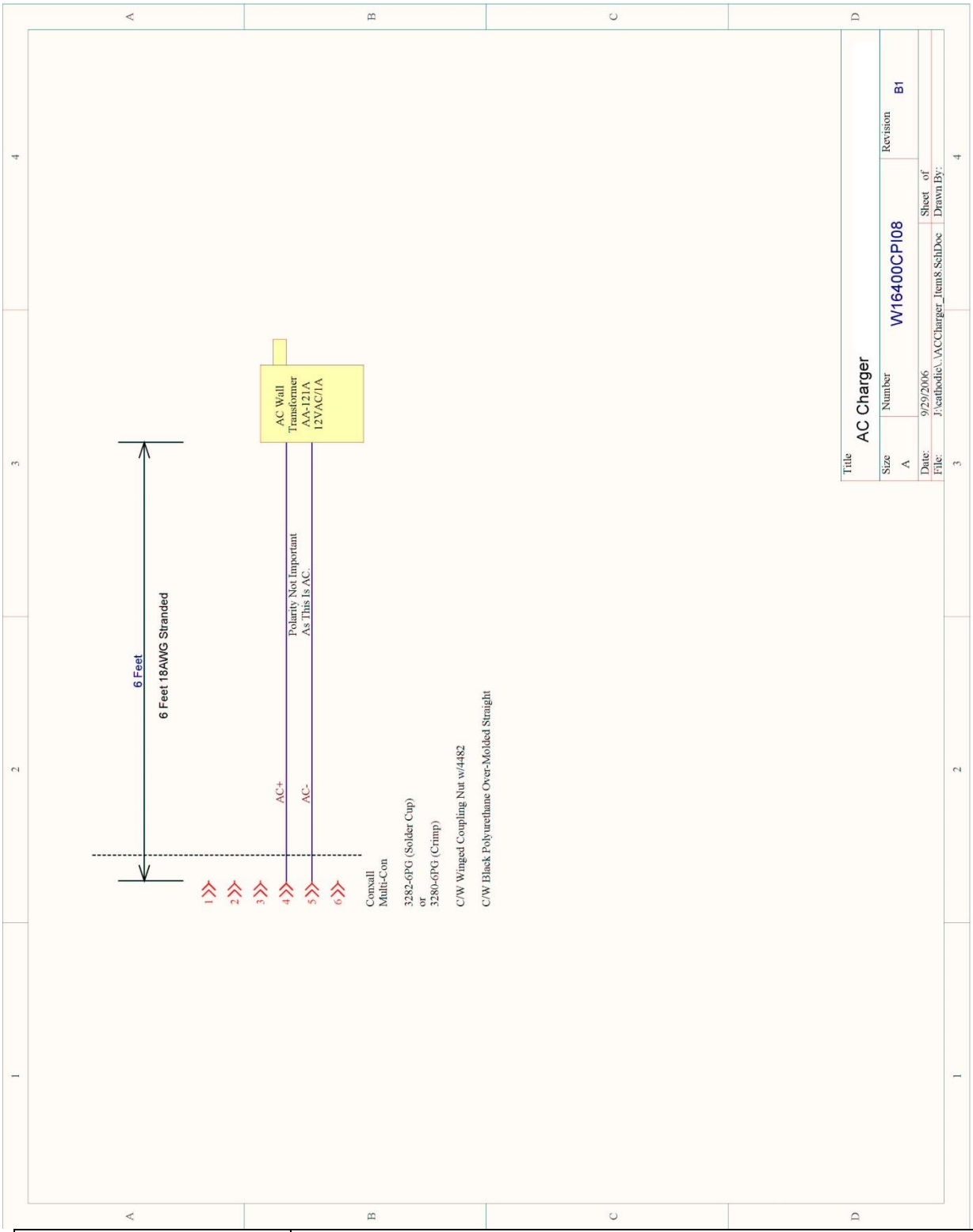
Mobiltex® 50A Three phase AC Solid State Relay (P/N K05232R5016) => 258 (AC sync disabled)

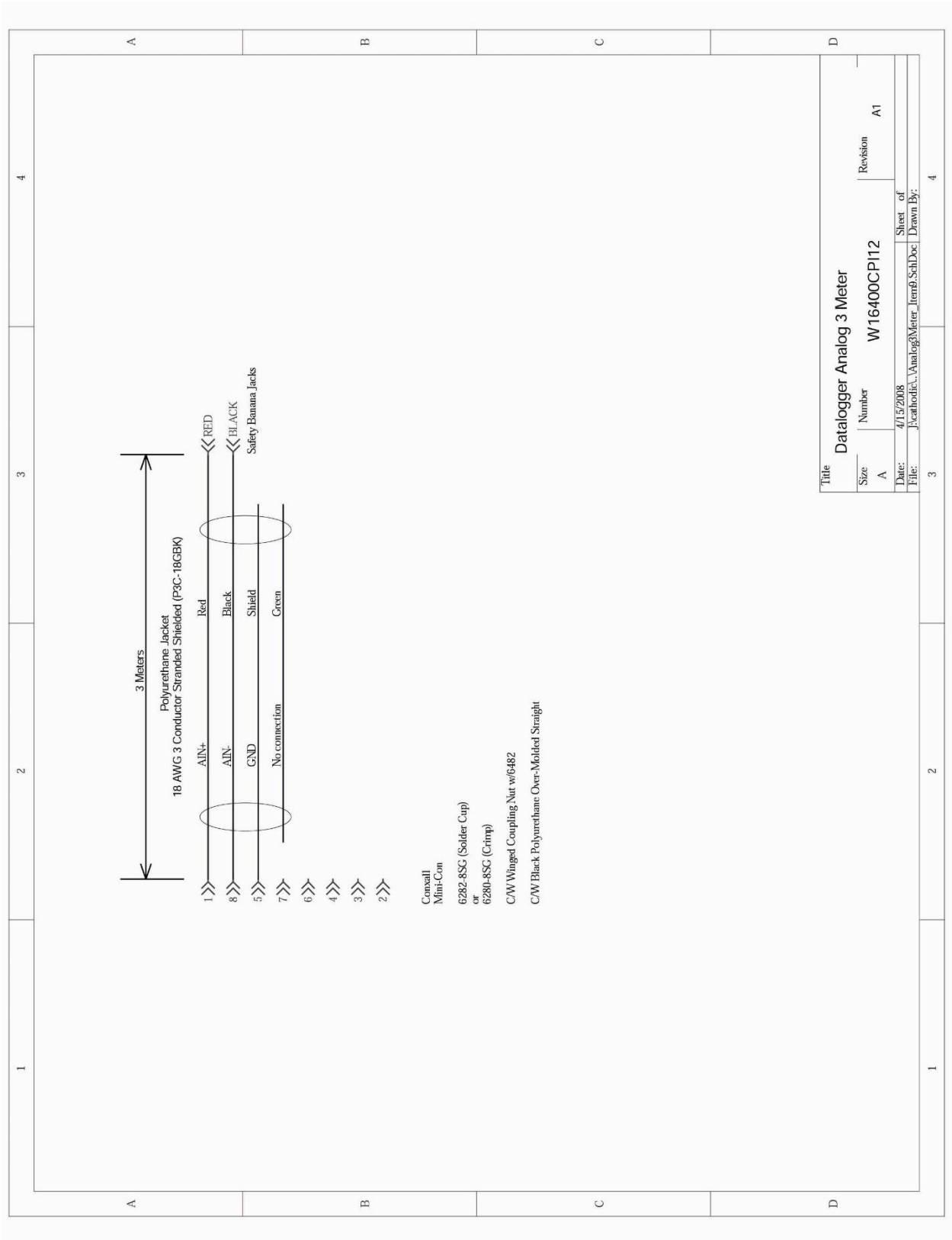
Mobiltex® 50A AC/DC High Power Relay (P/N A15000SPI06) => 2

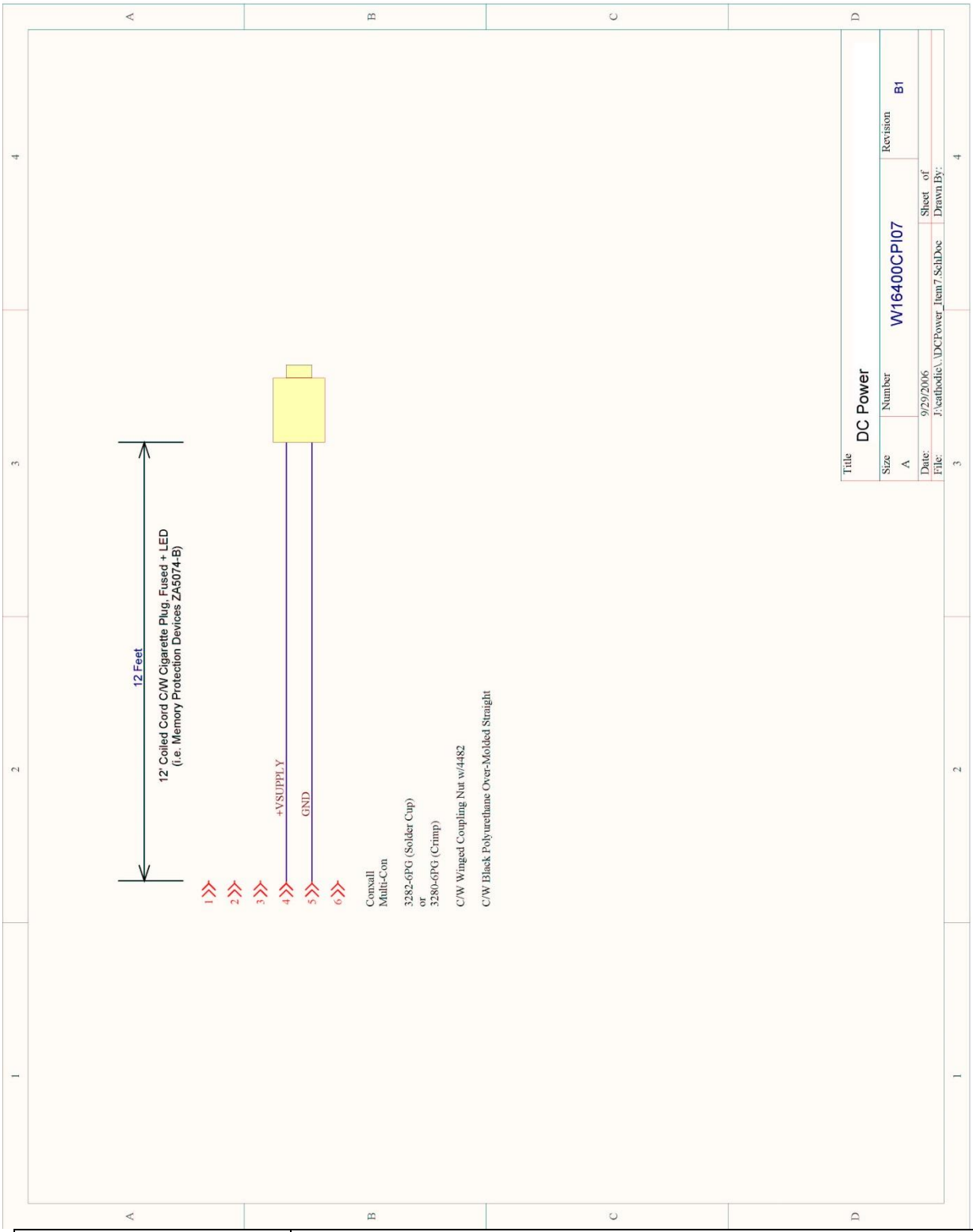
Mobiltex® 100A DC High Power Relay (P/N A15000SPI05) => 2

# B. Cable Diagrams

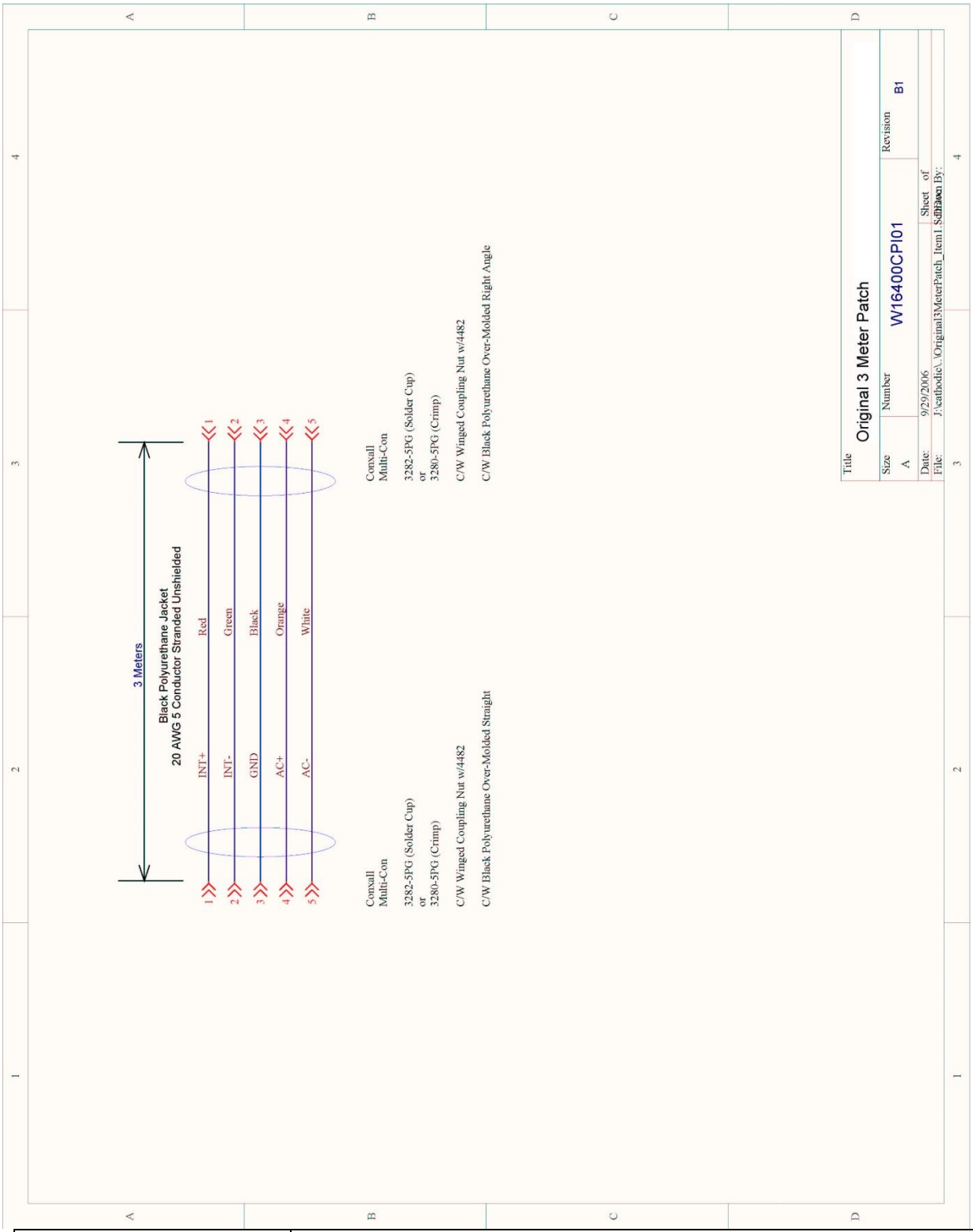

2 Meters
USB 2.0 Compliant Wire (i.e. Twisted 28AWG D+/D-, 20 to 28AWG VBUS/GND)
VBUS (Red)
D- (White)
D+ (Green)
GND (Black
Shield
Shell
USB Type 'A' Male
C/W Over-Molded Straight
Example cable assembly:
Assmann AK670-OE-R
Conxall
Mini-Con
6282-8SG (Solder Cup)
or
6280-8SG (Crimp)
C/W Winged Coupling Nut w/6482
C/W Black Polyurethane Over-Molded Straight
Title
Datalogger USB 2 Meter
Size
A
Number
W16400CPI04
Revision
B1
Date:
9/29/2006
Sheet of
File:
J:\cathode\..\USB2Meter_Item5.SchDoc
Drawn By:

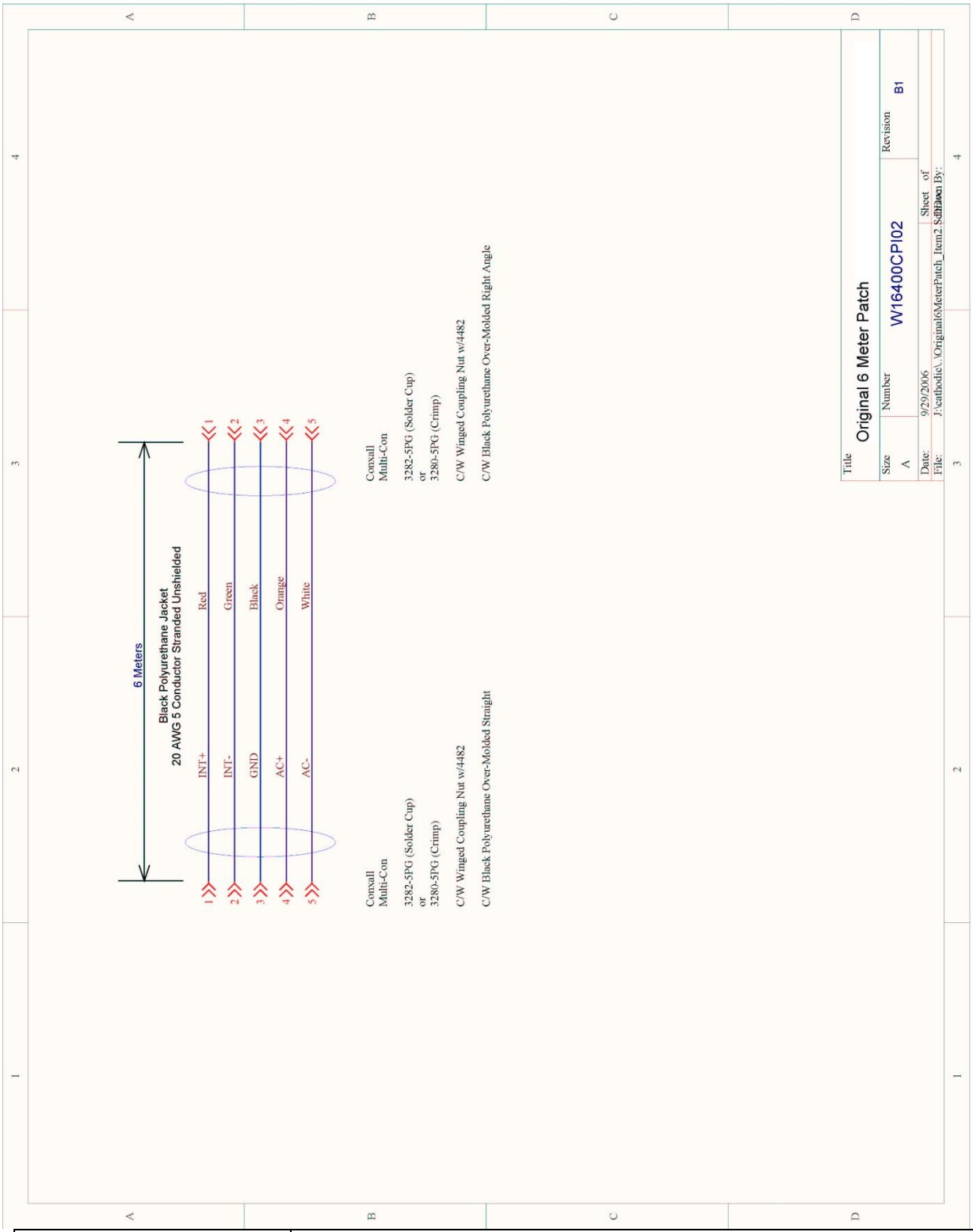

AC Wall
Transformer
AA-121A
12VAC/1A
Polarity Not Important
As This is AC.
AC+
AC-
6 Feet
6 Feet 18AWG Stranded
1
2
3
4
5
6
Conxall
Multi-Con
3282-6PG (Solder Cup)
or
3280-6PG (Crimp)
C/W Winged Coupling Nut w/4482
C/W Black Polyurethane Over-Molded Straight
Title
AC Charger
Size
A
Number
W16400CPI08
Revision
B1
Date:
9/29/2006
File:
J:\cathode\..\ACCharger_Item8.SchDoc
Sheet of
Drawn By:

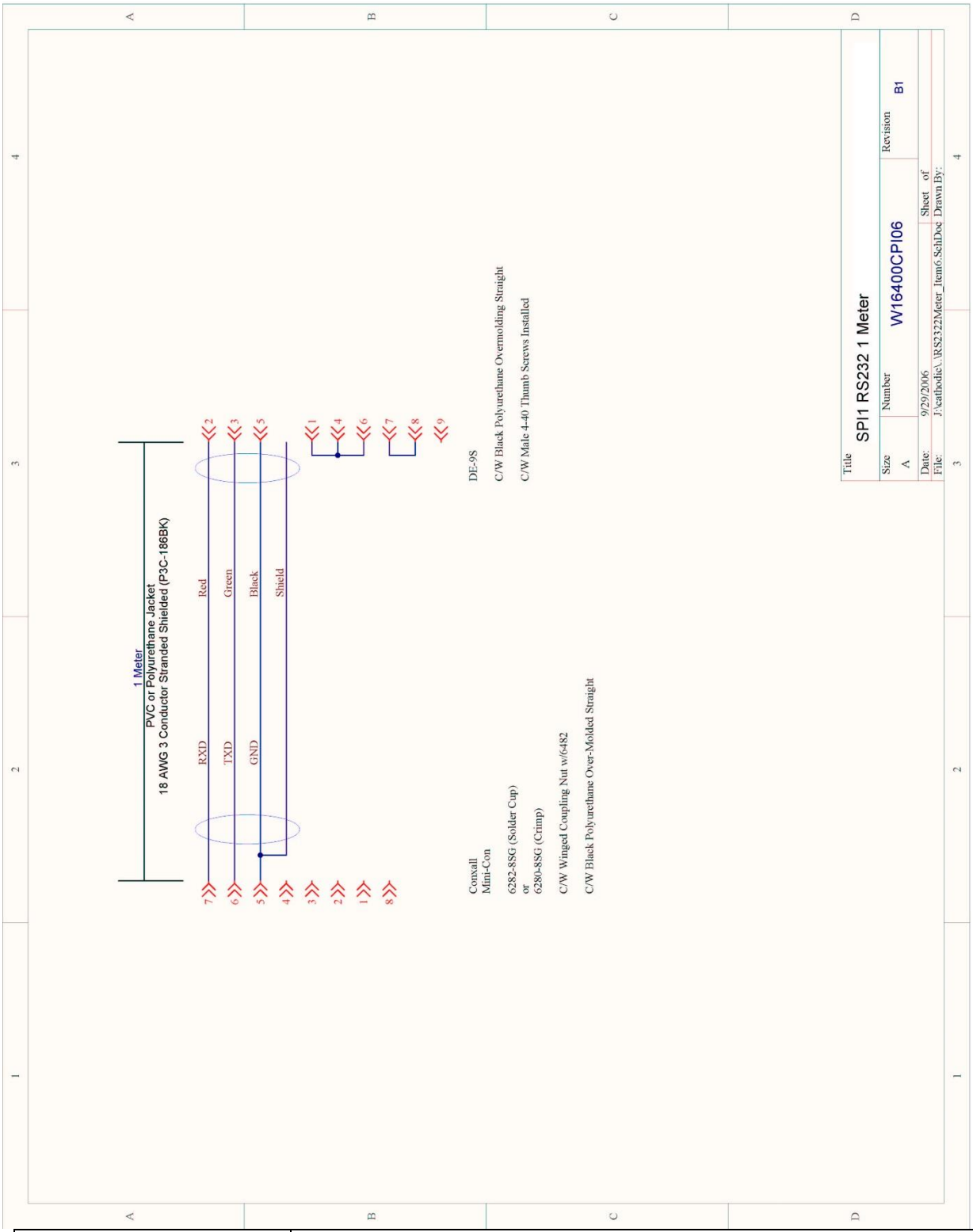

3 Meters
Polyurethane Jacket
18 AWG 3 Conductor Stranded Shielded (P3C-18GBK)
AIN+
AIN-
GND
No connection
Red
Black
Shield
Green
RED
BLACK
Safety Banana Jacks
1
8
5
7
6
4
3
2
Conxall
Mini-Con
6282-8SG (Solder Cup)
or
6280-8SG (Crimp)
C/W Winged Coupling Nut w/6482
C/W Black Polyurethane Over-Molded Straight
Title
Datalogger Analog 3 Meter
Size
A
Number
W16400CPI12
Revision
A1
Date:
4/15/2008
Sheet of
File:
J:\cathodic\..\Analog3Meter_Item0.SchDoc
Drawn By:

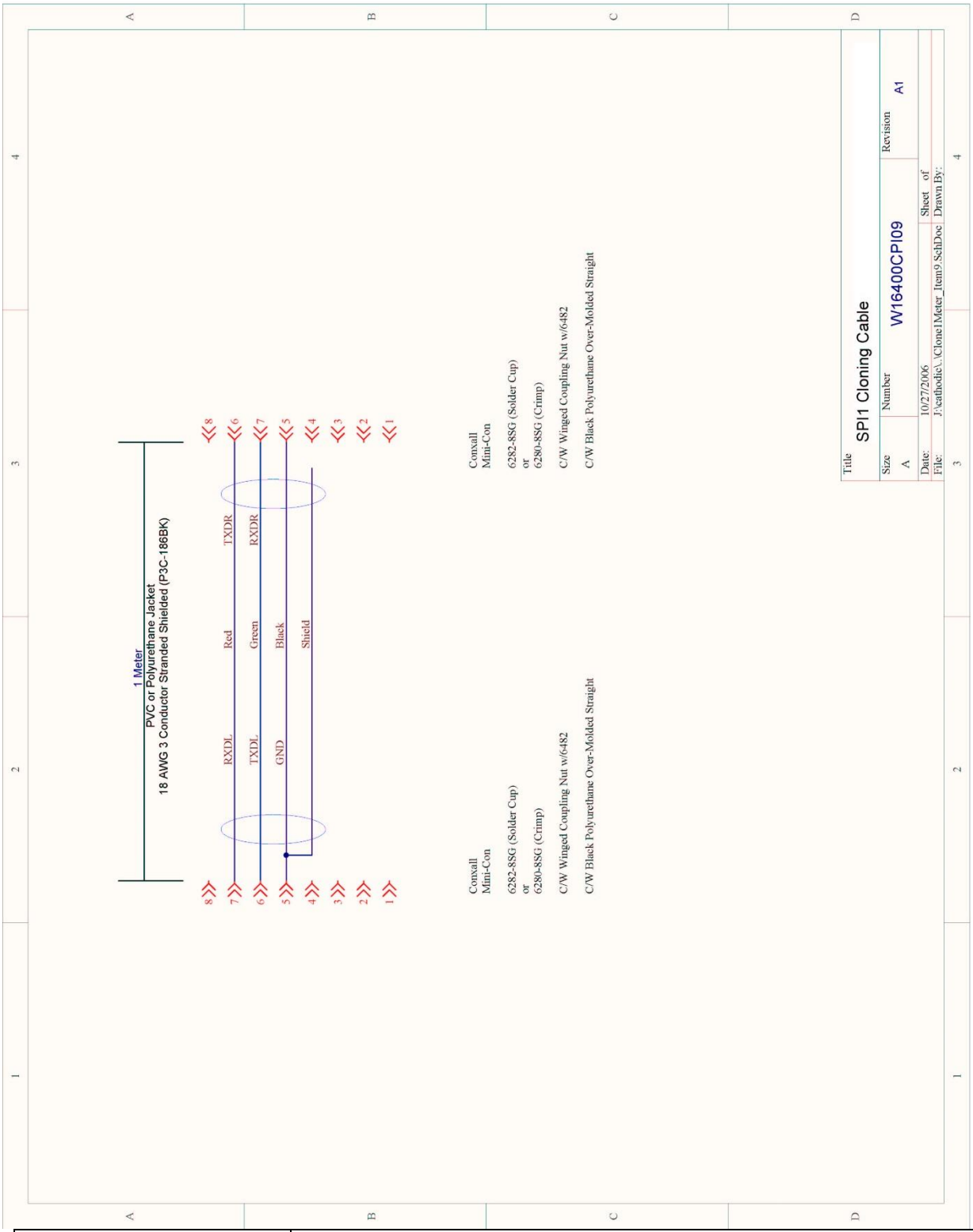

12 Feet
12' Coiled Cord C/W Cigarette Plug, Fused + LED
(i.e. Memory Protection Devices ZA5074-B)
+VSUPPLY
GND
1
2
3
4
5
6
Conxall
Multi-Con
3282-6PG (Solder Cup)
or
3280-6PG (Crimp)
C/W Winged Coupling Nut w/4482
C/W Black Polyurethane Over-Molded Straight
Title
DC Power
Size
A
Number
W16400CPI07
Revision
B1
Date:
9/29/2006
File:
J:\cathodie\..\DCPower_Item7.SchDoc
Sheet of
Drawn By:

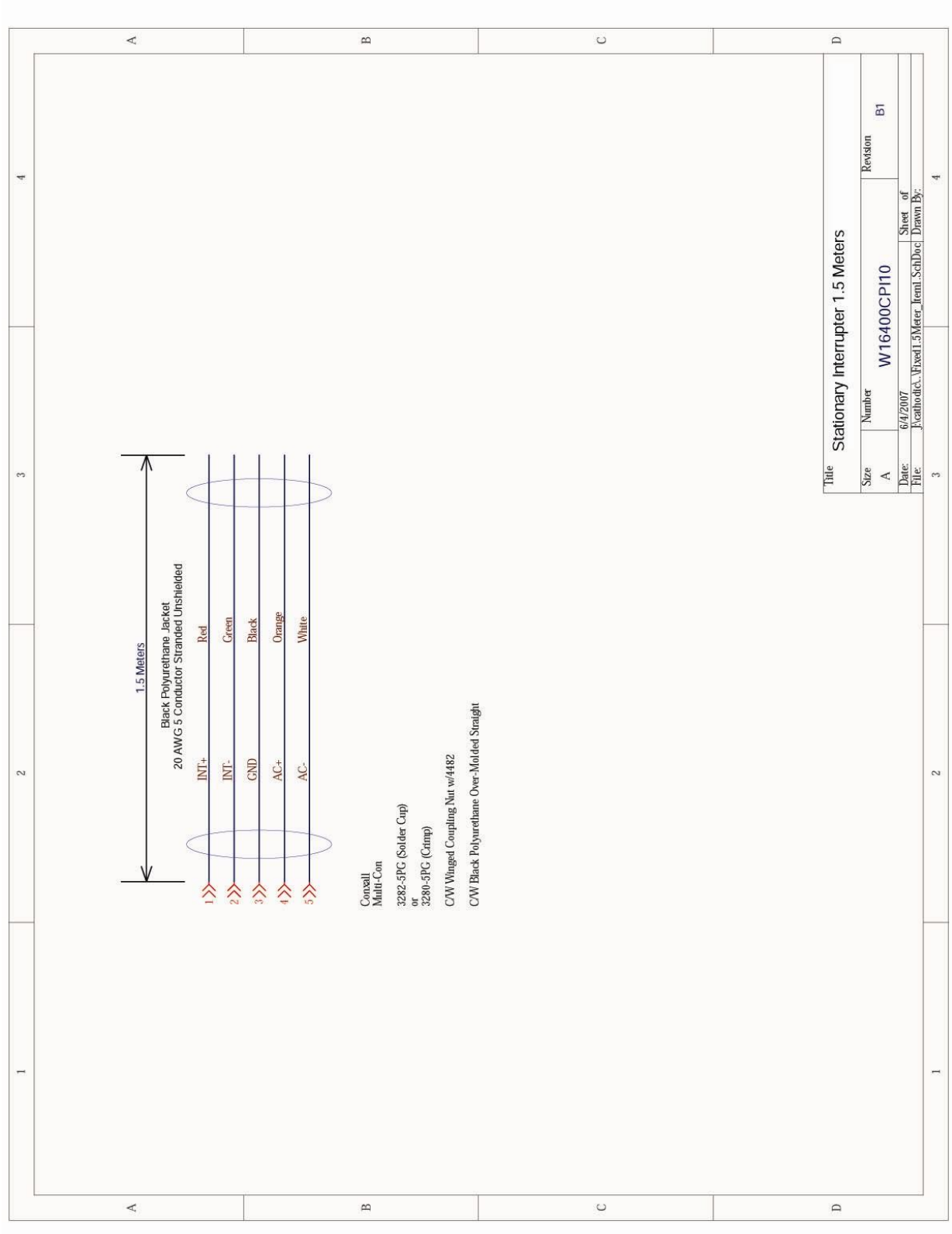
3 Meters
Black Polyurethane Jacket
22 AWG 6 Conductor Stranded Shielded
INT+
INT-
AC+
AC-
RELAYSNS
GND
SHIELD
Red
Green
Orange
White
Blue
Black
Shield
1
2
4
5
6
3
Conxall
Multi-Con
3282-6PG (Solder Cup)
or
3280-6PG (Crimp)
C/W Winged Coupling Nut w/4482
C/W Black Polyurethane Over-Molded Straight
Conxall
Multi-Con
3282-6PG (Solder Cup)
or
3280-6PG (Crimp)
C/W Winged Coupling Nut w/4482
C/W Black Polyurethane Over-Molded Straight
Title
Enhanced 3 Meter Patch
Size
A
Number
W16400CPI03
Revision
C1
Date:
9/29/2006
Sheet of
File:
J:\cathodie\...\Enhanced3MeterPatch_Item3...
Drawn By:

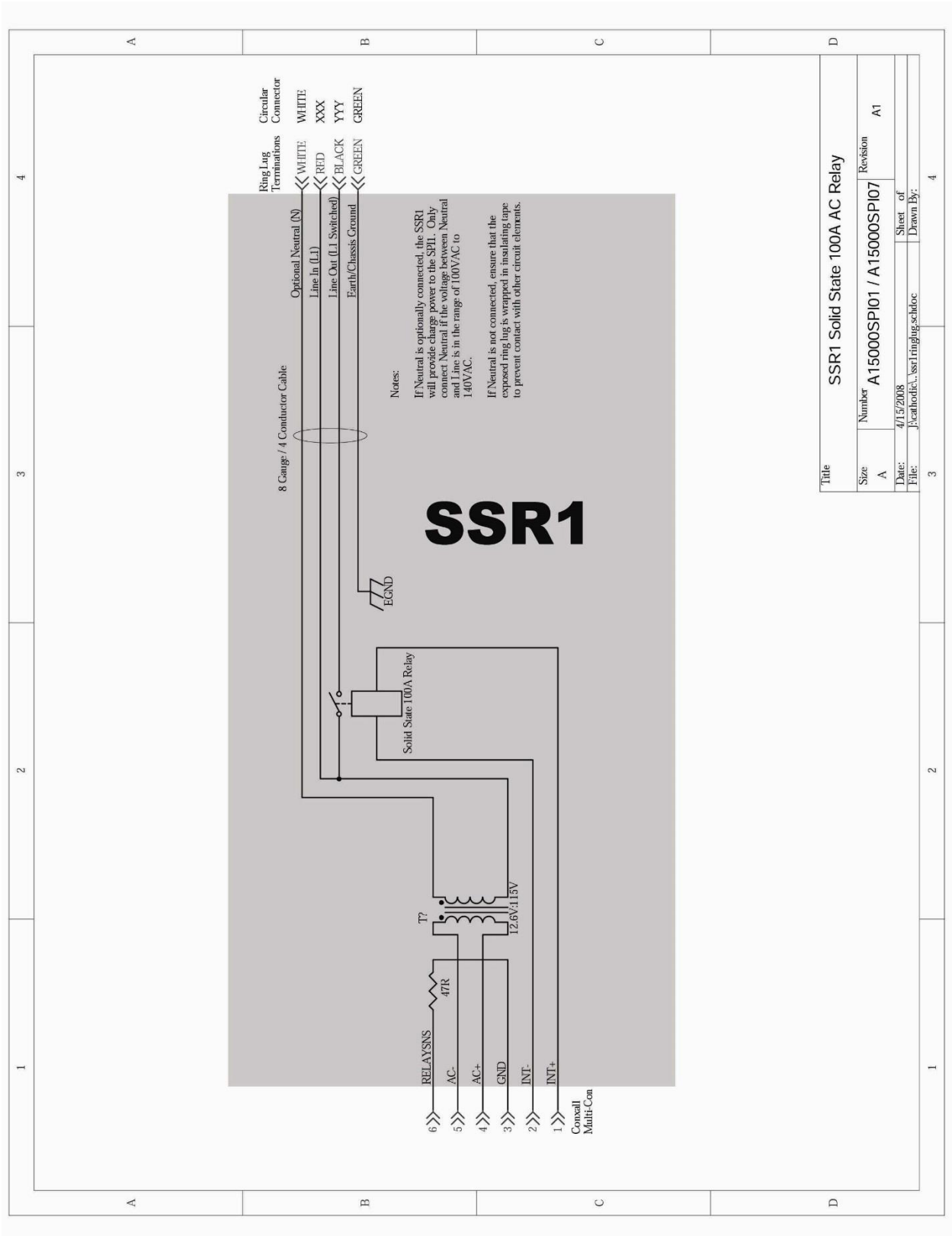

3 Meters
Black Polyurethane Jacket
20 AWG 5 Conductor Stranded Unshielded
INT+
INT-
GND
AC+
AC-
Red
Green
Black
Orange
White
1
2
3
4
5
Conxall
Multi-Con
3282-5PG (Solder Cup)
or
3280-5PG (Crimp)
C/W Winged Coupling Nut w/4482
C/W Black Polyurethane Over-Molded Straight
Conxall
Multi-Con
3282-5PG (Solder Cup)
or
3280-5PG (Crimp)
C/W Winged Coupling Nut w/4482
C/W Black Polyurethane Over-Molded Right Angle
Title
Original 3 Meter Patch
Size
A
Number
W16400CPI01
Revision
B1
Date:
9/29/2006
Sheet of
File:
J:\cathodie\...\Original3MeterPatch_Item1.SLDDRW
Drawn By:


6 Meters
Black Polyurethane Jacket
20 AWG 5 Conductor Stranded Unshielded
INT+
INT-
GND
AC+
AC-
Red
Green
Black
Orange
White
1
2
3
4
5
Conxall
Multi-Con
3282-5PG (Solder Cup)
or
3280-5PG (Crimp)
C/W Winged Coupling Nut w/4482
C/W Black Polyurethane Over-Molded Right Angle
Conxall
Multi-Con
3282-5PG (Solder Cup)
or
3280-5PG (Crimp)
C/W Winged Coupling Nut w/4482
C/W Black Polyurethane Over-Molded Straight
Title
Original 6 Meter Patch
Size
A
Number
W16400CPI02
Revision
B1
Date:
9/29/2006
Sheet of
File:
J:\cathodie\...\Original6MeterPatch_Item2.SLDDRW
Drawn By:


1 Meter
PVC or Polyurethane Jacket
18 AWG 3 Conductor Stranded Shielded (P3C-186BK)
RXD
TXD
GND
Red
Green
Black
Shield
DE-9S
C/W Black Polyurethane Overmolding Straight
C/W Male 4-40 Thumb Screws Installed
Conxall
Mini-Con
6282-8SG (Solder Cup)
or
6280-8SG (Crimp)
C/W Winged Coupling Nut w/6482
C/W Black Polyurethane Over-Molded Straight
Title
SPI1 RS232 1 Meter
Size
A
Number
W16400CPI06
Revision
B1
Date:
9/29/2006
Sheet of
File:
J:\cathodie\..\RS232Meter_Item6.SchDoc
Drawn By:


1 Meter
PVC or Polyurethane Jacket
18 AWG 3 Conductor Stranded Shielded (P3C-186BK)
RXDL
TXDL
GND
Red
Green
Black
Shield
TXDR
RXDR
Conxall
Mini-Con
6282-8SG (Solder Cup)
or
6280-8SG (Crimp)
C/W Winged Coupling Nut w/6482
C/W Black Polyurethane Over-Molded Straight
Conxall
Mini-Con
6282-8SG (Solder Cup)
or
6280-8SG (Crimp)
C/W Winged Coupling Nut w/6482
C/W Black Polyurethane Over-Molded Straight
Title
SPI1 Cloning Cable
Size
A
Number
W16400CPI09
Revision
A1
Date:
10/27/2006
Sheet of
File:
J:\cathode\...\Clone1Meter_Item9.SchDoc
Drawn By:


1.5 Meters
Black Polyurethane Jacket
20 AWG 5 Conductor Stranded Unshielded
INT+
INT-
GND
AC+
AC-
Red
Green
Black
Orange
White
1
2
3
4
5
Conxall
Multi-Con
3282-5PG (Solder Cup)
or
3280-5PG (Crimp)
C/W Winged Coupling Nut w/4482
C/W Black Polyurethane Over-Molded Straight
Title
Stationary Interrupter 1.5 Meters
Size
A
Number
W16400CPI10
Revision
B1
Date:
6/4/2007
Sheet of
File:
J:\catholdc\..\Fixed\1.5Meter_Item1.SchDoc
Drawn By:


SSR1
Ring Lug Terminations
Circular Connector
WHITE
RED
BLACK
GREEN
XXX
YYY
8 Gauge / 4 Conductor Cable
Optional Neutral (N)
Line In (L1)
Line Out (L1 Switched)
Earth/Chassis Ground
EGND
Notes:
If Neutral is optionally connected, the SSR1 will provide charge power to the SPI1. Only connect Neutral if the voltage between Neutral and Line is in the range of 100VAC to 140VAC.
If Neutral is not connected, ensure that the exposed ring lug is wrapped in insulating tape to prevent contact with other circuit elements.
Solid State 100A Relay
T?
12.6V/1.15V
47R
RELAYSNS
AC-
AC+
GND
INT-
INT+
Conxall Multi-Con
Title
SSR1 Solid State 100A AC Relay
Size
A
Number
A15000SPI01 / A15000SPI07
Revision
A1
Date:
4/15/2008
Sheet of
File:
J:\cathodic\...\ssr1ringlug.schdoc
Drawn By:

# C. Specifications

**SPI1:**

| | |
|---|---|
| Operating temperature range: | -30 to +70 C (-22 to 158F) |
| Operating voltage range: | 10 to 18 Volts AC or DC |
| Power (less relay drive power): | 2 watts maximum |
| Supplied transformer: | Portable: 120VAC Class II 12 VAC<br>Stationary: installation dependent |
| Physical size: | Portable: 225 x 190 x 95 mm (8.85" x 7.48" x 3.74")<br>Stationary: 196 x 134 x 50mm (7.70" x 5.25" x 1.97") |
| Device weight: | Portable: 2.6 kgs (5.72 lbs)<br>Stationary: 0.75 kgs (1.65 lbs) |
| Display: | 4 line by 20 character backlit LCD |
| Keypad : | 20 key sealed membrane with annunciation |
| Enclosure: | High-impact plastic waterproof case (portable)<br>Painted (powder coat) aluminum waterproof case (stationary) |
| Timing accuracy (AC line sync disabled): | +/-0.5 ms |
| Timing accuracy (AC line sync enabled): | +8.8/-0.5 ms |
| Relay drive voltage: | 6 or 12 volts DC |
| Relay drive current: | 1 Amp maximum (portable)<br>0.4 Amps @ 12V maximum (stationary)<br>0.8 Amps @ 6V maximum (stationary) |
| Relay contact close dwell: | 0-80 ms |
| Relay contact open dwell: | 0-80 ms |
| Relay contact type: | NO or NC |
| Relay type: | Solid state or mechanical |
| Off Time: | 1 – 60,000ms in 1ms steps |
| Cycle Time: | 2 – 60,000ms in 1ms steps |
| Cycle Order: | Programmable (off first, or on first) |
| Interruption schedules (date and time): | 7 automatic (daily repeat optional) + 1 manual |
| Interruption & schedule memory: | Non-volatile EEPROM |
| GPS Receiver: | Internal 12 channel |
| GPS Antenna: | Low current magnetic mount with TNC (portable)<br>Low current fixed mount with SMA (stationary) |
| GMT Time-zone offset: | +/- 12 hours |
| Reference offset adjustment: | 5000ms in 1ms steps |
| PC Connection: | RS-232 |

**SDL1 Option Board:**

| | |
|---|---|
| Operating temperature range: | -30 to +70 C (-22 to 158F) |
| Installation: | Factory only |
| Channels: | 1 (Separate AC and DC measurements are simultaneously performed) |
| Input Ranges: | +/-6Vpeak, +/-20Vpeak, +/-60Vpeak, +/-150Vpeak |
| AC Measurement: | True RMS |
| Analog to Digital Conversion | |
| Resolution: | 16-bit |
| Maximum sampling rate: | 100ksps |
| Storage Memory Type: | Integral microSD card |
| Storage Memory Size: | Approx. 1GB (1GB=1,000,000,000 bytes) |
| PC Connection: | USB 2.0 Full-Speed (Appears as a Mass Storage Device to the PC) |
| File Format: | Mobiltex® binary proprietary. Conversion utility to spreadsheet CSV format is provided. Detailed binary file format specification (document SDL1-SDD-001) is available. |