User's Manual

Precision Current Regulator Controller/Sorensen SGX Series
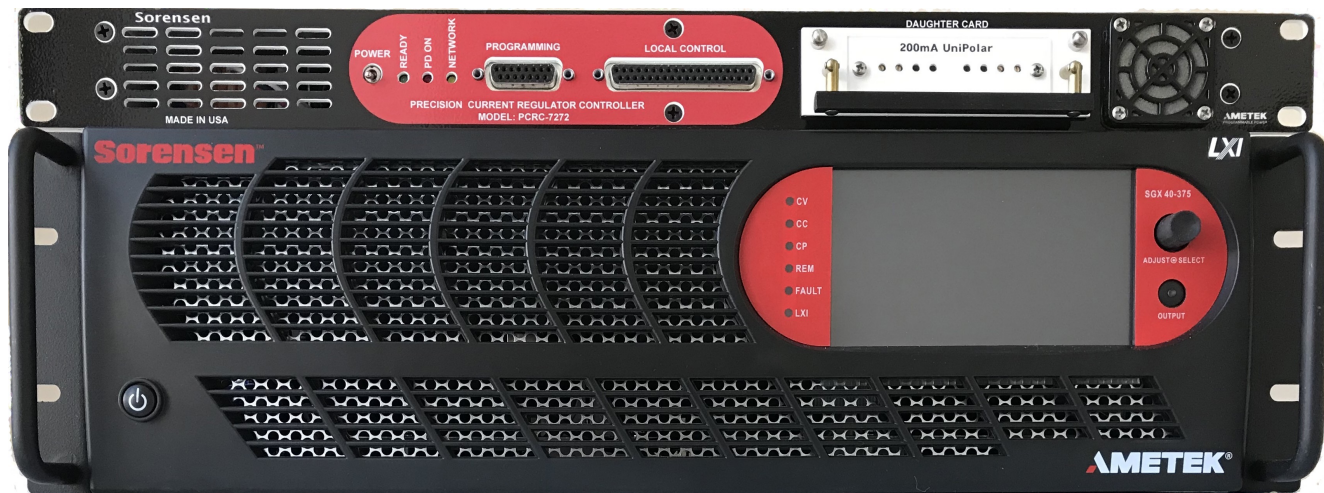
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1.0 Introduction and General Overview

The BiRa Systems Precision Current Regulator Controller, (PCRC) was designed to be used with a commercial power supply and DCCT (Direct Current Current Transformer) to enhance the constant current stability and resolution of the Power Supply. The PCRC uses an Ethernet port for remote control of the Power Supply and a serial port for remote programming of the daughtercard, which resides in the PCRC. The PCRC receives input (current) from the DCCT and provides feedback to the Power Supply for control of the Power Supply. See the Block Diagram below for a general overview.

1.1 System Block Diagram
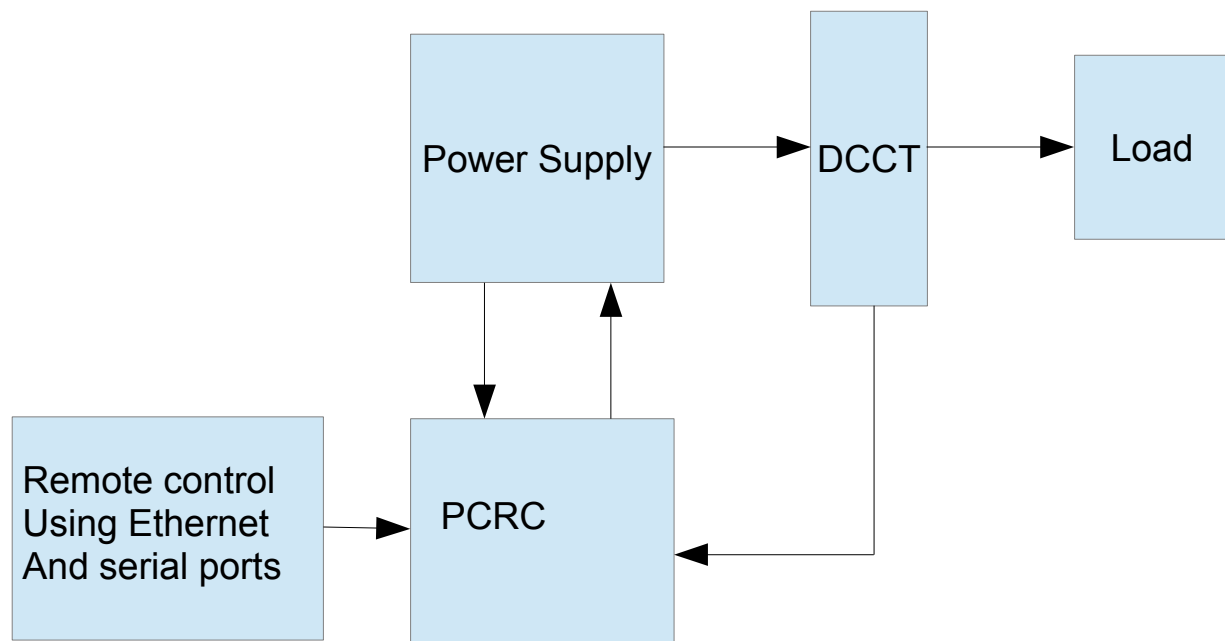
Figure 1: System Block Diagram

1.2 General Information

Front and rear panel connections of the PCRC are shown below.
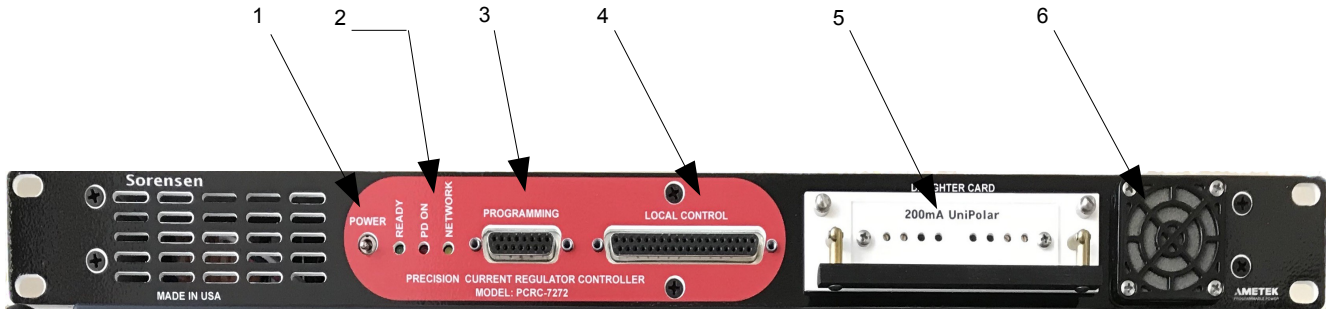
Figure 2- PCRC Front Panel
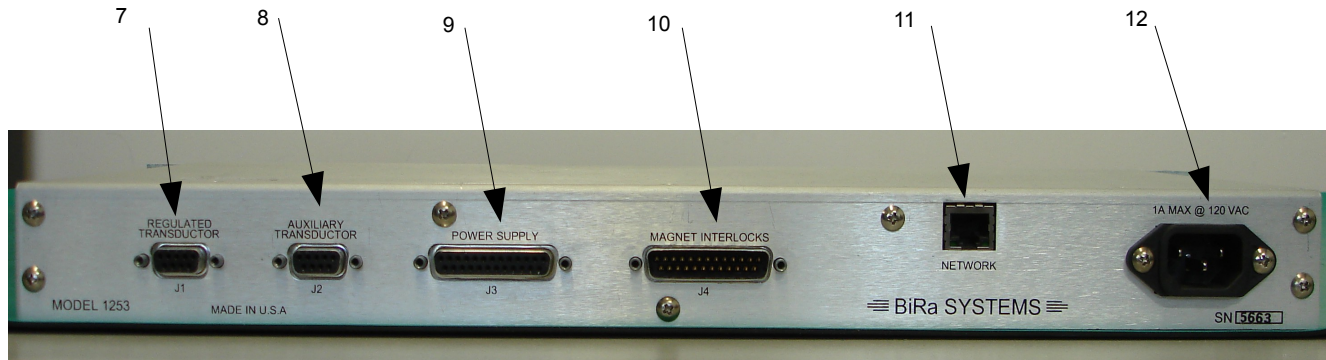
Figure 3- PCRC Rear Panel

1. On/Off Power Switch
2. Front Panel Status LEDs (see Table 1)
3. Serial Programming Port
4. Local Control interface
5. Daughtercard connection port
6. Variable Speed Fan
7. Regulated Transductor interface
8. Auxiliary Transductor interface
9. Power Supply interface
10. Magnet Interlock interface
11. Ethernet Port
12. 120/230 Vac 50/60hz power input receptacle

2.0 System Configuration

Figure 4 below is a block diagram of a typical setup configuration. The setup shown is for reference purposes only. Individual user setups may not appear as shown in figure 4.

The example shown in figure 4 uses a computer for remote programming of the daughtercard using the serial 'Programming' port and a terminal emulator. The daughtercard is discussed in further detail in section 3.4. The Ethernet programming port of the PCRC is used to program the power supply and can also be used for power supply and PCRC status information. UDPWin.exe is an example of a software utility that can be used for programming purposes. UDPWin may be provided by BiRa Systems if requested. Appendix B of this document provides detailed instructions for using UDPWin with the PCRC.

The Power Supply does require an interface adapter (as shown in the block diagram) before programming of the power supply with the PCRC can be accomplished. The interface adapter is discussed in further detail in Section 3 below.

The ±15VDC required by the DCCT (Direct Current Current Transformer) to operate is supplied by the Regulated and Aux outputs of the PCRC. See Table 2 and 3 below for pin-out connections of the PCRC Regulated Transductor connector (J1) to DCCT, and Auxiliary Transductor (J2) to DCCT. The DCCT outputs are fed back to the PCRC as Daughtercard inputs to the Regulated and Aux circuits. The Regulated inputs are used by the PCRC to regulate and control the power supply current while the Aux is used typically as a monitor and is optional (not required to control the power supply).

The 'Magnet Interlocks' connector (J4) is used as a means of monitoring various interlocks. Magnet Interlocks 0,1,2 and 3 must be configured correctly for proper operation. The correct configuration for these four interlocks would be a closed switch across pins 3 and 16 (Magnet Interlock 0), pins 4 and 17 (Magnet Interlock 1), pins 5 and 18 (Magnet Interlock 2) , and pins 6 and 19 (Magnet Interlock 3). Tables 2-8 below show the pin-out of all the PCRC connectors.

The front panel LEDs may be used to indicate status of the PCRC or for troubleshooting purposes. See Table 1 below for status indication (note that 'X' indicates don't care).

Table 1 -Front Panel LED status information

Green	Red	Yellow	Status/Indication
On	Off	X	Standby
Off	On	X	Power Supply On
On	On	X	Power Supply Ramping
X	X	Flash	Network traffic (.2sec/message)
Off	Off	Off	No power or hardware fault
On	On	On	Hardware fault or self test in progress
1Hz	Off	X	Power Supply Off, Hardware fault
Off	1Hz	X	Power Supply On, Hardware fault
2Hz	Off	X	Power Supply Off, Ethernet link down
Off	2Hz	X	Power Supply On, Ethernet link down

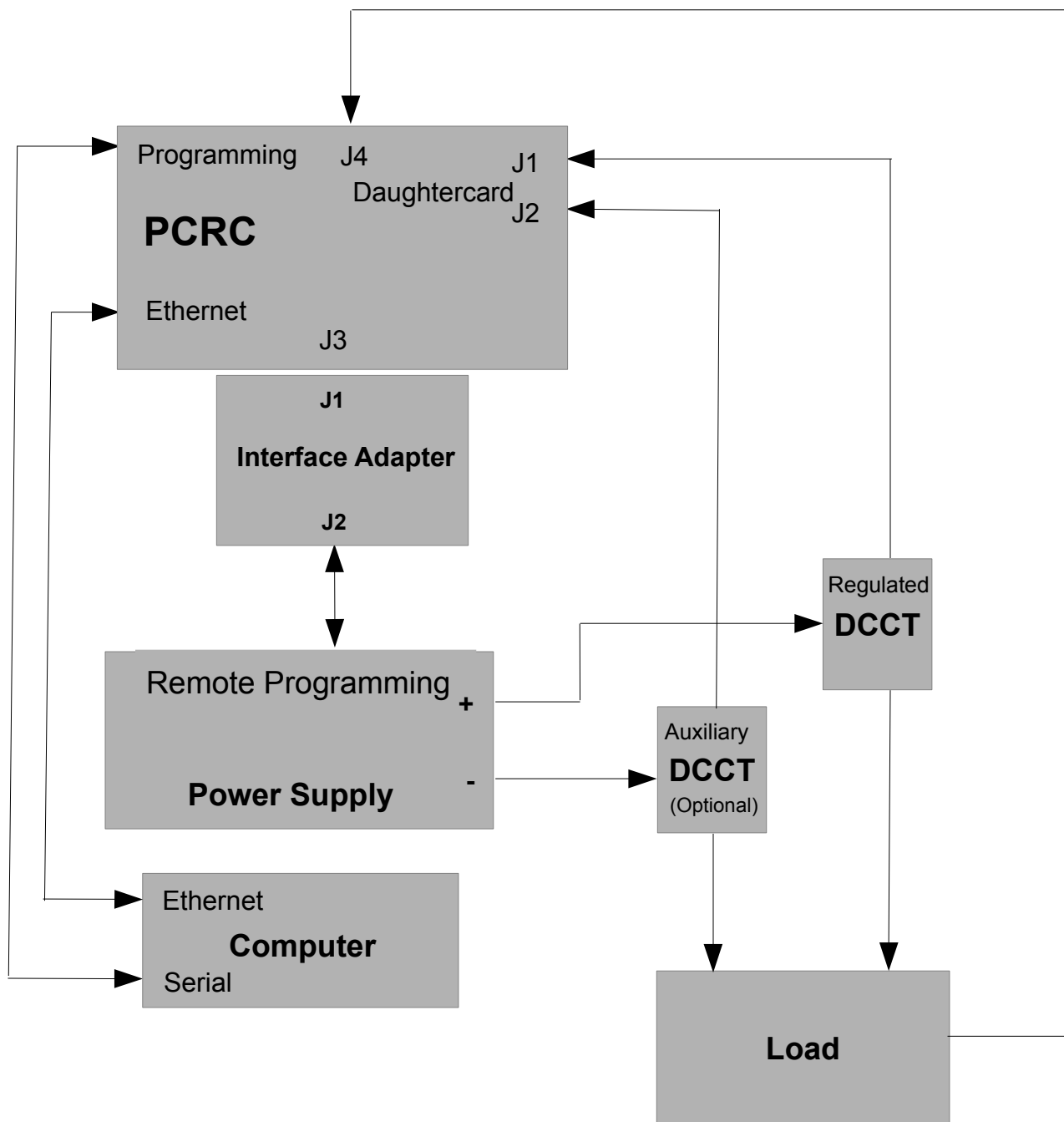## 2.1 Detailed System Diagram

Figure 4- Typical System Block Diagram

2.2 PCRC Connector Pin-Outs

Table 2- J1 Regulated Transductor Connections

Pin	Signal Name	Function
1	N/C	No Connection
6	XDUCT +OUT	Input from DCCT to daughtercard input amplifier (Regulated)
2	XDUCT -OUT	No Connection
7	NC	No Connection
3	GND	GND (Return) connection for DCCT input to daughtercard input amplifier (Regulated)
8	XDUCT OK	Logic input for DCCT status
4	GND	GND (Return) connection
9	+15VDC	+15VDC for DCCT supply
5	-15VDC	-15VDC for DCCT supply

Table 3- J2 Auxiliary Transductor Connections

Pin	Signal Name	Function
1	N/C	No Connection
6	XDUCT +OUT	Input from DCCT to daughtercard input amplifier (Auxiliary)
2	XDUCT -OUT	No Connection
7	NC	No Connection
3	GND	GND (Return) connection for DCCT input to daughtercard input amplifier (Auxiliary)
8	XDUCT OK	Logic input for DCCT status
4	GND	GND (Return) connection
9	+15VDC	+15VDC for DCCT supply
5	-15VDC	-15VDC for DCCT supply

Table 4- J3 Power Supply Connections

Pin	Signal Name	Function
1	PS REF +	0-5V Voltage Programming Output from PCRC (+)
14	PS REF -	0-5V Voltage Programming Output from PCRC (-)
2	PS VOLTS +	0-10V Voltage Monitor Input from Power Supply (+)
15	PS VOLTS -	0-10V Voltage Monitor Input from Power Supply (-)
3	GND CUR +	Ground current monitor input (+)
16	GND CUR -	Ground current monitor input (-)
4	PS READY STATUS	N/C
17	GND	Return connection of PCRC
5	PS ON STATUS	Power Supply On Status monitor input
18	GND	Return connection of PCRC
6	PS STATUS 0	N/C
19	PS STATUS 1	N/C
7	PS STATUS 2	N/C
20	GND	Return connection of PCRC
8	INTERLOCK RESET Out	Interlocks Reset Output
21	INTERLOCKS READY OUT	N/C
9	PS ON OUT	PCRC output for PS Output Control
22	REV POL OUT	N/C
10	GND	Return connection of PCRC
23	PS STATUS 3	N/C
11	NC	N/C
24	NC	N/C
12	+5V POWER	N/C
25	GND	Return connection of PCRC
13	GND	Return connection of PCRC

Table 5- J4 Magnet Interlocks Connections

Pin	Signal Name	Function
1	KLIXON INTERLOCK 0 (+)	Klixon Interlock Input (+)
14	KLIXON INTERLOCK 0 (-)	Klixon Interlock Input (-)
2	KLIXON INTERLOCK 1 (+)	Klixon Interlock Input (+)
15	KLIXON INTERLOCK 1 (-)	Klixon Interlock Input (-)
3	MAGNET INTERLOCK 0 (+)	Magnet Interlock Input (+)
16	MAGNET INTERLOCK 0 (-)	Magnet Interlock Input (-)
4	MAGNET INTERLOCK 1 (+)	Magnet Interlock Input (+)
17	MAGNET INTERLOCK 1 (-)	Magnet Interlock Input (-)
5	MAGNET INTERLOCK 2 (+)	Magnet Interlock Input (+)
18	MAGNET INTERLOCK 2 (-)	Magnet Interlock Input (-)
6	MAGNET INTERLOCK 3 (+)	Magnet Interlock Input (+)
19	MAGNET INTERLOCK 3 (-)	Magnet Interlock Input (-)
7	INTERLOCKS READY OUT	Interlocks Ready Output
20	PS ON OUT	PS On Output
8	INTERLOCK RESET OUT	Interlock Reset Output
21	GND	Return Connection
9	RS485 GLOBAL RAMP (+)	Ramp Input (+)
22	RS485 GLOBAL RAMP (-)	Ramp Input (-)
10	RS485 GLOBAL HOLD (+)	Hold Input (+)
23	RS485 GLOBAL HOLD (-)	Hold Input (-)
11	GROUND CURRENT OUT (+)	Ground current Output (+)
24	GROUND CURRENT OUT (-)	Ground current Output (-)
12	SPARE ADC INPUT (+)	Spare ADC Input (+)
25	SPARE ADC INPUT (-)	Spare ADC Input (-)
13	NC	N/C

Table 6- J5 Daughtercard Connections

Pin	Signal Name	Function
1	GND	Daughtercard chassis ground
14	GND	Daughtercard chassis ground
2	+5V	Daughtercard +5V supply
15	EEPROM_CS1	Daughtercard EEPROM CS Input
3	EEPROM_CLK	Daughtercard EEPROM SCLK Input
16	EEPROM_DIN	Daughtercard EEPROM SD Input
4	EEPROM_DOUT	Daughtercard EEPROM SD Output
17	EN_ERR_AMP	Daughtercard Enable Input
5	GND_TRIP_REF	Voltage Ref output to PCRC
18	N/C	No Connection
6	AUX_XDUCT_IN+	Input to Aux Input Amp
19	AUX_XDUCT_IN-	Not used
7	AUX_XDUCT_OUT	Output of Aux Input Amp
20	COM	Daughtercard GND
8	REG_XDUCT_IN+	Input to Reg Input Amp
21	REG_XDUCT_IN-	Not used
9	REG_XDUCT_OUT	Output of Reg Input Amp
22	COM	Daughtercard GND
10	ERR AMP REFERENCE	Input from PCRC
23	COM	Daughtercard GND
11	ERR AMP OUT	Output to PCRC
24	N/C	No Connection
12	V15P	Daughtercard +15V Supply
25	COM	Daughtercard GND
13	V15N	Daughtercard -15V Supply

Table 7- J6 Local Connections used with a Local Control module (not provided) for local control

Pin	Signal Name	Function
1	GND	Digital Gnd
20	+5V VDD	Digital 5V
2	REGULATED +15V	15V Positive (regulated)
21	REGULATED-15V	15V Negative (regulated)
3	UNREGULATED+15V	15V Positive (unregulated)
22	UNREGULATED -15V	15V negative (unregulated)
4	LOCAL CONTROL REF	Local Reference Voltage
23	REFERENCE GROUND	Return for local Reference
5	AUX TRANSDUCTOR	AUX Transductor Out
24	REG TRANSDUCTOR	REG Transductor Out
6	N/C	No Connection
25	DAC	DAC Output
7	RIPPLE (X100)	Reg XDUCT Out Ripple X100
26	ABSOLUTE RIPPLE	Reg XDUCT Out Absolute Ripple Current
8	ISOLATION AMP INPUT	Iso Amp In
27	ANALOG GROUND	Analog Ground connection
9	TEMPERATURE	Chassis Temperature
28	ABSOLUTE GND CURRENT	Absolute Value of Ground Current
10	GND TRIP REF	Trip point for ground current fault (2.5V)
29	GND CURRENT	Buf_Gnd_Cur
11	PS VOLTS	Buffered Power Supply Voltage monitor
30	REFERENCE CON	ADC Ref gnd
12	REFERENCE REF	ADC Voltage Ref (7.025V)
31	ENABLE LOCAL	Select Local Reference or DAC
13	PS OFF	Local_PS_Off
32	PS ON	Local_PS_On
14	RESET	Processor_Local_Reset
33	VOLTAGE MODE	Loc_Volt_Mode
15	REV POLARITY	Loc_Rev_Pol
34	LOCAL CNTL UART RXD	EXT_URXD2
16	LOCAL CNTL UART TXD	EXT_UTXD2
35	LD	BUF_LOC_LED_LD
17	SERIAL LED DATA CLK	BUF_LOC_LED_CLK
36	SERIAL LED DATA DIN	BUF_LOC_LED_DAT
18	+5V POWER	VDD
37	GND	GND Connection
19	GND	GND Connection

Table 8- J7 Programming Connections

Pin	Signal Name	Function
1	URXD0	UART0 URXD0
9	UTXD0	UART0 UTXD0
2	UCTS0	UART0 UCTS0
10	URTS0	UART0 URTS0
3	URXD1	UART1 URXD1
11	UTXD1	UART1 UTXD1
4	UCTS1	UART1 UCTS1
12	URTS1	UART1 URTS1
5	GND	GND
13	V2D5	JTAG V2D5
6	TDI	JTAG TDI
14	TCK	JTAG TCK
7	TMS	JTAG TMS
15	TD0	JTAG TD0
8	GND	GND

Please note that a special cable is required to connect from a standard 9 pin serial port to the PCRC 15 pin 'Programming' connector as shown in Table 8 above. The pin-out of the cable (required connections) is shown below:

Table 9- DSUB-9 pin connector to DSUB-15 pin connector

Signal	9 pin connector	15 pin connector
TX	2	9
RX	3	1
GND	5	5
RTS	6	10
CTS	7	2

All unspecified pins should be open.

3.0- Interface Card General Information
An interface adapter is necessary for power supply control using the PCRC with the Ametek/Sorensen SGX power supply. Interface adapter PCRC-7274-INT is the correct interface adapter for use with the SGX series power supplies, and is shown in Figure 5 below. A connection Diagram showing how the PCRC-7274-INT connects to the PCRC and power supply, is shown in Figure 6.
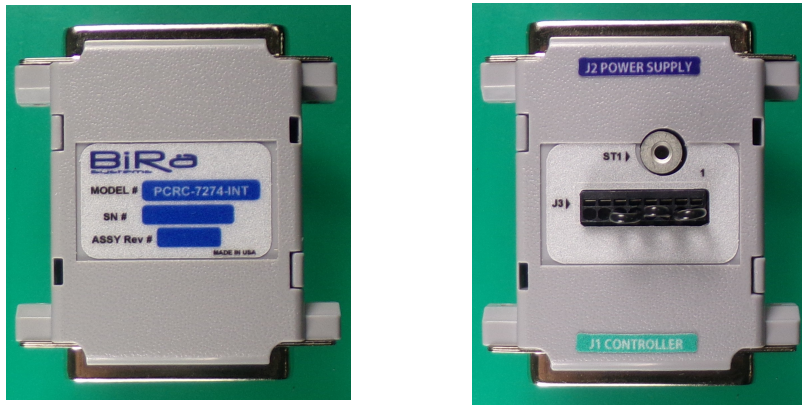
Figure 5- Front and back photos of the PCRC-7274-INT Interface Module

The following discussion involves the PCRC 7274-INT Interface module connections to the Sorensen SGX series Power Supplies and the PCRC. Consult the applicable revision operations manual of the power supply in use for additional information.
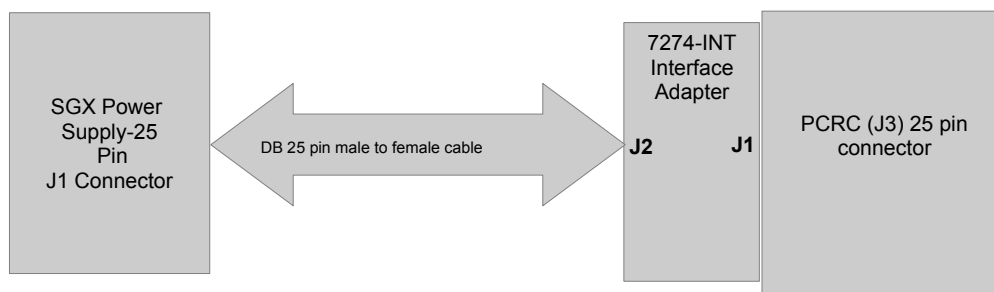

Figure 6 -Interface Adapter Connection Diagram

3.1 Sorensen SGX Series Interface Adapter Information

For a Sorensen SGX series supply, a DB25 male to female cable will be required to connect from J2 of the Interface Adapter to Analog Control Connector (J1) on the back of the Sorensen SGX series supply. The J1 connector on the Interface Adapter connects directly to the 25 pin (J3) connector on the back of the PCRC.

Note: The power supply requires some initial settings before programming and control with the PCRC can occur. These steps are detailed below in section 3.2., and should be performed prior to setting up the complete system.

Remote Output programming of the power supply with the PCRC is accomplished by using the Analog Control connector (J1) on the back of the power supply. Note that Sorensen supplies an optional feature which will allow an isolated (isolated from the negative output terminal of the supply) programming return. The isolated analog option should be used in systems where high electrical noise is present or when excessive ground loop currents are present. The user must determine whether the isolated analog option is necessary or not. Regardless of whether the option is installed or not, the connection to the PCRC is the same. Refer to the Sorensen operation manual for additional information regarding the Isolated Analog option.

Power Supply Configuration Switch

The Configuration switch on the power supply rear panel should be configured as shown below. All switches should be in the down (Off) position for the PCRC to properly control the supply.
Note that the DIP switch appearance may vary depending on what options the Sorensen SGX is equipped with.

Figure 7- Rear Panel 4 position DIP Switch

Ground Current Monitoring

J3 of the Interface Adapter is used for ground current monitoring.
The ground current is monitored using a 100Ω, 1%, 25W resistor connected between the power supply common and earth ground. This is accomplished by placing jumpers on J2 pins 1 to 2, 3 to 4 and 5 to 6.
The ground current may be used to generate a Ground Fault. The trip point (GND TRIP REFERENCE) is 2.5V which corresponds to a 25mA current (2.5V / 100Ω = .025A). If the current flowing between earth ground and the Sorensen supply COM is 25mA or greater, an active high Ground Fault will be generated, disabling the output of the supply.

Interface Card Connections

Please reference Tables 10-12 below for a pin-out of all PCRC 7274-INT interface connections.

Table 10- *Interface Adapter Pin-Out Connections (J1Controller Side)*

Pin	Signal Name	Function
1	PS_REF_+	0-5V Voltage Programming Output from PCRC (+)
14	PS_REF_-	0-5V Voltage Programming Output from PCRC (-)
2	PS_VOLTS_+	0-10V Voltage Monitor Input from Power Supply (+)
15	PS_VOLTS_-	0-10V Voltage Monitor Input from Power Supply (-)
3	GND_CUR_+	Gnd current monitor input + to PCRC
16	GND_CUR_-	Gnd current monitor input - to PCRC
4	PS_READY_STATUS	Status input to PCRC
17	GND	PCRC GND connection
5	PS_ON_STATUS	Status input to PCRC
18	GND	PCRC GND connection
6	N/C	No connection
19	N/C	No connection
7	N/C	No connection
20	GND	PCRC GND connection
8	Interlocks_Reset_Out	Reset Output signal from PCRC
21	N/C	No connection
9	PS_ON_OUT	Signal output from PCRC
22	REV_POL_OUT	Signal output from PCRC
10	GND	PCRC GND connection
23	N/C	No connection
11	N/C	No connection
24	N/C	No connection
12	+5V	+5 Volts
25	GND	PCRC GND connection
13	GND	PCRC GND connection

Table 11- *Interface Adapter Pin-Out Connections (J2 Power Supply Side)*

Pin	Signal Name	Function
1	N/C	No Connection
14	N/C	No Connection
2	N/C	No Connection
15	N/C	No Connection
3	N/C	No Connection
16	N/C	No Connection
4	N/C	No Connection
17	Fault	PS Ready Status to PCRC
5	On/Off	Input to enable supply output
18	S/D Fault	PS On status output
6	PS Common	Common for On/Off
19	VMON	Output for monitoring the PS output voltage
7	N/C	No Connection
20	PS Common	Common for On/Off
8	N/C	No Connection
21	N/C	No Connection
9	VP 5V	Voltage Programming (0-5VDC input)
22	N/C	No Connection
10	N/C	No Connection
23	N/C	No Connection
11	N/C	No Connection
24	COM	Common connection for VMON, IMON,CV/CC
12	N/C	No Connection
25	N/C	No Connection
13	N/C	No Connection

Table 12- *Interface Adapter Pin-Out Connections J3*

Pin	Signal Name	Function
1	GND_CUR_-	Gnd current monitor - input (common with pin 5)
2	100 ohms to EARTH GND	Gnd current sense resistor
3	GND_CUR_+	Gnd current monitor + input
4	EARTH GND	Earth ground
5	GND_CUR_-	Gnd current monitor - input (common with pin 1)
6	IPGM_RTN	PS current monitor return
7	330 ohms to REV_POL_OUT	Reverse polarity output from PS
8	GNDD	Digital GND connection

3.2 Sorensen Power Supply Setup Instructions

The Power Supply must be properly configured before remote control and programming with the PCRC can be accomplished. Use the following instructions to configure the Power Supply. Consult the Sorensen user manual for information on connecting AC power to the supply. For configuring the supply for use with the PCRC it is not necessary to make any external connections to the supply other than the DB 25 connector attaching to J1 which jumpers pins 5 and 6. For safety reasons it is recommended that AC input power is disconnected (after the supply has been configured) while all external connections to the supply are being made. Make certain before AC power is applied that the supply On/Off switch is in the Off position.

Once the power supply has been properly configured, use figures 4 and 6 of this document as needed when configuring the system. Review paragraph 2.0 for important information regarding the magnet interlocks before attempting to control with the PCRC.

Note that remote sensing must be configured before the power supply can be used under normal conditions, but does not have to be connected during the configuration setup process. The 'Sense' connector is located on the rear panel of the Power Supply. Configure the remote sensing as described in the Power Supply User's Manual with the sense leads connected either at the load or attached to the power supply output terminals using the proper polarity. The configuration of the 'Sense' connector is dependent upon the output voltage capability of the power supply. A twisted/ shielded connection is recommended.

Prior to setting up the supply, the SGX Operations Manual should be reviewed so that the user is familiar with the different screens available and understands how to make any required changes to the configuration. The following instructions should be used to configure the power supply for use with the PCRC.

With the power supply front panel power switch in the 'Off' position, install a DB25 connector with pins 5 and 6 shorted, to the 'Analog Control' (J1) connector on the back of the power supply. No other connections should be made to the supply at this time (except for the AC input connections) during this setup process. Note that without pins 5 and 6 of J1 shorted, it will not be possible to enable the output of the supply.

Turn the supply on using the front panel On/Off switch. The default settings of the supply are set so that the output of the supply will be enabled once the power on sequence has completed. Once the power on sequence has completed, confirm that the voltage setting of the supply indicates that 0V is being output and that the supply output is enabled (output switch green lamp is lit). Note that these are the default settings. If the output is not enabled after the power up sequence, access the **PONS** settings (from the 'Home' menu select Configuration and then PONS). Observe that the screen appears as shown in screen shot 1 below.

Screen Shot 1

Confirm that the Output indicates 'On' in green and that the Voltage setting is at 0V as shown. If not, make the changes and save them using the Save option. The user may also choose to set the 'OVP' (over voltage protection) setting to a desired level.

When any setting changes have been saved, check to confirm that the supply is set to the 'Constant Voltage' setting, which is the required setting for the PCRC to control the supply. Note that the 'CV' LED to the left of the display is lit (screen shot 2).
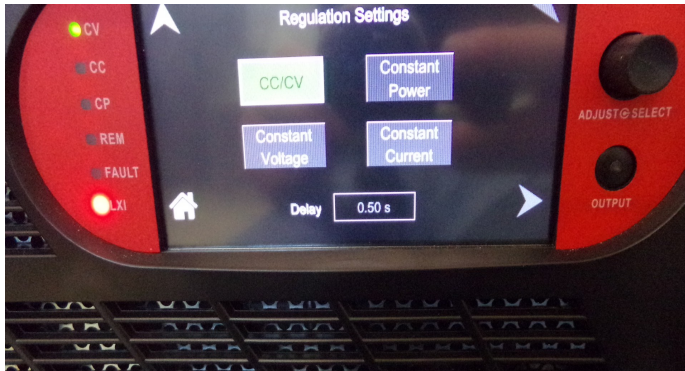
Screen Shot 2

When all settings are as described, disable the output of the supply by pressing the Output button on the front panel, and ensuring that the lamp is extinguished (output disabled). The supply is now properly configured for controlling with the PCRC. Turn the supply off by pushing the On/Off switch. Disconnect the AC input from the supply before attempting to connect the supply to the load and DCCT (s). It is advisable to use a meter to determine that no voltage is present on the output terminals after AC power is disconnected.

With the power supply properly configured for use with the PCRC, use figures 4 and 6 as necessary to configure the system (a short summary of system setup requirements is provided in paragraph 3.5). A properly configured system will include everything necessary for the controller to control the power supply, which includes the Power Supply, PCRC with Daughtercard, DCCT (s), Interface Adapter, PC, and all of the necessary connection cables. An ethernet connection to the PCRC and computer will be required. If it is desired to use UDPWin as the controlling software, Appendix B of this document provides the necessary instructions.
Daughtercard programming (if necessary) is discussed in paragraph 3.4 of this document.

3.3- Typical DCCT to PCRC connections
Caution: It is strongly recommended that no current be applied through the DCCT until the DCCT is powered up, otherwise damage to the DCCT may occur.

Table 13 below shows the connections between the J1 and J2 PCRC connections and a typical DCCT. This pin-out allows the use of a straight through D-Sub9 cable (male to female). The DCCT pin-out is fairly standard, but the specific DCCT user's manual should be referenced to verify the pin-out prior to making this connection. A typical DCCT is shown below in Figure 8.
Note: The 'Current output' connection of the DCCT uses Pin 3 (GND) of the PCRC for return.

Table 13- *Typical DCCT to PCRC Connections*

DCCT Pin	Signal/ Function	PCRC Corresponding J1 Pin	Signal/Function
1	Not used	1	N/C
2	Not used	2	Reg XDUCT – In (not used)
3	Normal Operation Status	3	GND
4	GND	4	GND
5	-15V Supply	5	-15V DC output
6	Current Output	6	Reg XDUCT + In (current input from DCCT)
7	N/C	7	N/C
8	Normal Operation Status	8	Reg XDUCT input status
9	+15V Supply	9	+15V DC output
DCCT Pin	**Signal/Function**	**PCRC Corresponding J2 Pin**	**Signal/Function**
1	Not used	1	N/C
2	Not used	2	Aux XDUCT – In (not used)
3	Normal Operation Status	3	GND
4	GND	4	GND
5	-15V Supply	5	-15V DC output
6	Current Output	6	Aux XDUCT In (current input from DCCT)
7	N/C	7	N/C
8	Normal Operation Status	8	Aux XDUCT input status
9	+15V Supply	9	+15V DC output

Figure 8*: Photo of a typical DCCT*

3.4 Daughtercard Programming and general information

There are 4 types of daughtercards available:

200mA Unipolar
200mA Bipolar
400mA Unipolar
400mA Bipolar

In most cases, a unipolar daughtercard will be used. The bipolar daughtercard is used in systems with a reversing switch, which is used to generate a bipolar output.

The current rating (200mA or 400mA) is the maximum allowable input current to the daughtercard. The input current is the secondary current of the DCCT.

As shown in figure 4 (section 2.1), 2 DCCTs may be used in a system. J1 is associated with the Regulated Transductor, which is a required part of the control loop. J2 is associated with the Auxiliary Transductor, which is an optional independent measurement channel. Each transductor has an Amps/Volt coefficient programmed into the daughtercard. This setting is determined by the maximum system current and the DCCT turns ratio.

The first step is to choose a DCCT. The maximum system current (I_{MAX}) must be less than or equal to the DCCT nominal primary DC current rating (I_{PN}).
$$I_{MAX} \leq I_{PN}$$

Next, the daughtercard is selected. The DCCT secondary current (I_{SEC}) is the maximum system current (I_{MAX}) divided by the DCCT turns ratio (N). The DCCT secondary current must be less than or equal to the daughtercard current rating (I_D).
$$I_{SEC} = I_{MAX} / N$$
$$I_{SEC} \leq I_D$$

Finally, the Amps/Volt (I_{VA}) coefficient is determined by the DCCT turns ratio (N) divided by a constant (K). K=50 for the 200mA daughtercard, K=25 for the 400mA daughtercard.
$$I_{VA} = N/K$$

Example 1:
$I_{MAX} = 100A$
The DS200ID DCCT is selected with $I_{PN} = 300A$ and $N = 500$.
$I_{SEC} = I_{MAX} / N = 100A/500 = 200mA$
The 200mA daughtercard is selected, $K = 50$
$I_{VA} = N/K = 500/50 = 10$
The daughtercard is programmed with $I_{VA} = 10$.

Example 2:
$I_{MAX} = 600A$
The DS400ID DCCT is selected with $I_{PN} = 600A$ and $N = 2000$.
$I_{SEC} = I_{MAX} / N = 600A/2000 = 300mA$

The 400mA daughtercard is selected, K = 25
$I_{VA} = N/K = 2000/25 = 80$
The daughtercard is programmed with $I_{VA} = 80$.

The instructions for programming the Amps/Volt coefficient into the daughtercard are given in **Appendix A** below.

3.5 System Setup Connection Summary
Refer to Figures 4 and 6 for the following information.
1. Ensure that the power supply is setup (configured) as instructed in Paragraph 3.2.

2. Verify AC input power is disconnected from the supply and connect the load and DCCT (s) to the output of the supply as shown in Figure 4. Route the cable attached to the positive (**+**) output terminal of the supply through the DCCT (use the arrow on the DCCT to determine the direction of current) and to the load. Use a 9 pin DB male to female cable to attach the power connections of the DCCT to the PCRC J1 (Regulated Transductance) connector. Route the power supply negative (**-**) terminal through the optional DCCT (again using the arrow on the DCCT to determine the direction of current flow) and to the load. The power connection on the DCCT should be attached to the PCRC J2 (Auxiliary Transductance) connector using a DB9 male to female cable.

3. Connect the PCRC 7274-INT interface adapter to the PCRC and the power supply using the instructions in paragraph 3.0 and figure 6. The J1 connector of the Interface Adapter connects directly to the PCRC J3 connector and a DB 25 male to female cable is used to connect J2 of the Interface adapter to the power supply Analog Control connector.

4. With the DCCT (s) and the Interface Adapter connected, the PCRC can now be powered up. Observe that the green LEDs on the DCCT (s) are lit (power on). The DCCT (s) must be powered up before any current is allowed to pass through them or damage to the DCCT may occur.
With all connections to the load made, AC input power to the power supply can now be made. Be sure to consult the operations manual for information on how the connection should be made. When AC power is properly connected, power up the supply and observe that the output of the supply is off and is in the Constant Voltage (CV) mode. The supply is now ready to be controlled using the PCRC. If using UDPwin as the controlling software use the instructions contained in **Appendix B** after the daughtercard is programmed. See **Appendix A** for information on daughtercard programming.

Appendix A- Using MTTTY for Daughtercard Programming

Programming of the daughtercard is performed by using a terminal emulator (such as MTTTY) and using the 'Programming' connector on the PCRC front panel. A special cable provided by BiRa Systems must be used to connect to a serial port connection on the PC or terminal used. Refer to Table 9 in this document for details regarding the programming cable. Connect the cable between the serial port on the PC or terminal device and the PCRC 'Programming' connector on the front panel.

It may not be necessary to program daughtercard settings, however the instructions below should be used in the event new settings on the daughtercard are required, or if it is desired to check the existing settings. When configuring the programming utility, use the following settings:
- Baud rate to '115200'
- Parity to 'None'
- Data bits to '8'
- Stop Bits to '1'

After the above settings have been made, perform a carriage return and observe that the display is similar to the screen shot below, which will be considered the **'Top'** menu option.
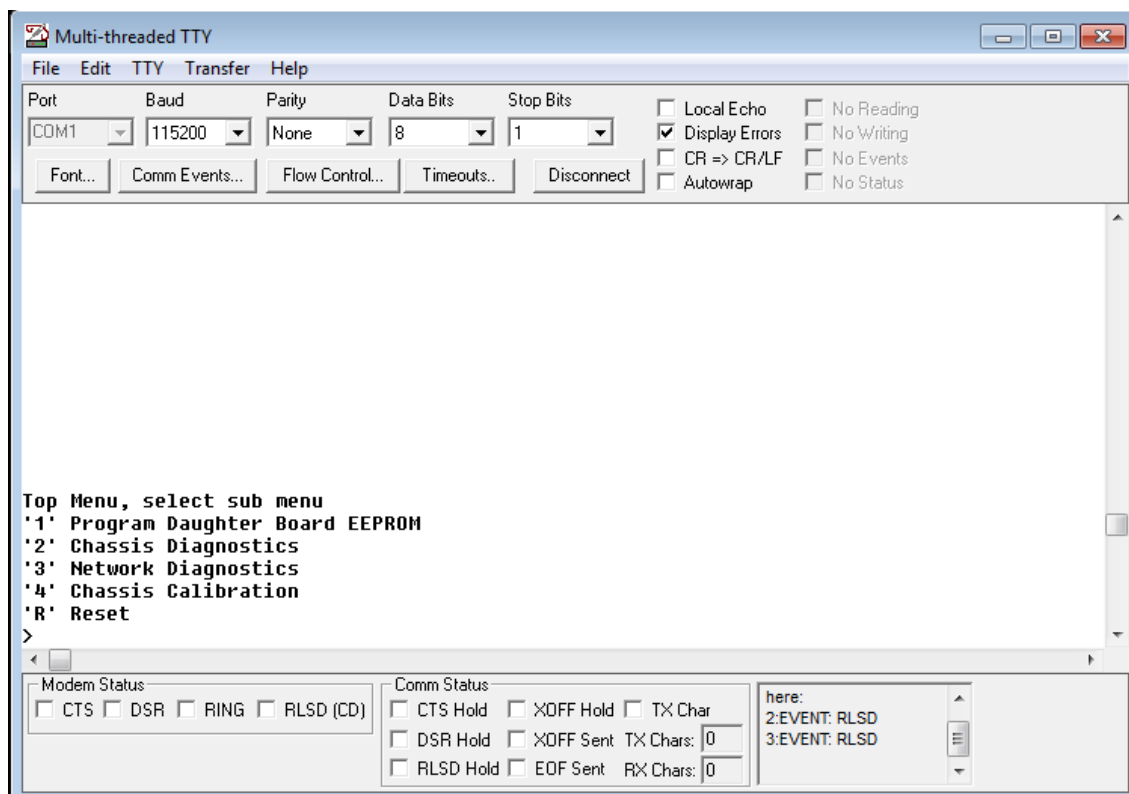
Screen Shot 1

To execute a check of the existing **Amps/Volt** settings on the daughtercard, perform the following:

Enter <**'2' Chassis Diagnostics**> and a carriage return and observe the following display.
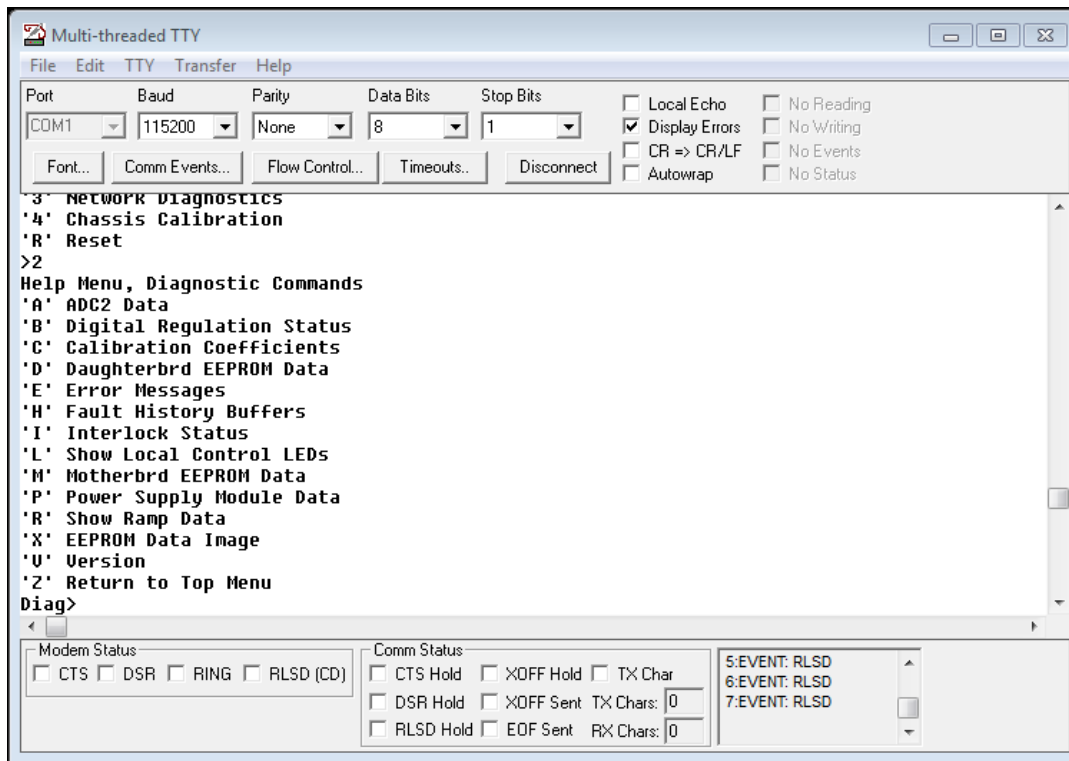
Screen Shot 2

Type <**'D' Daughterbrd EEPROM Data>**, and a carriage return and observe the following display.
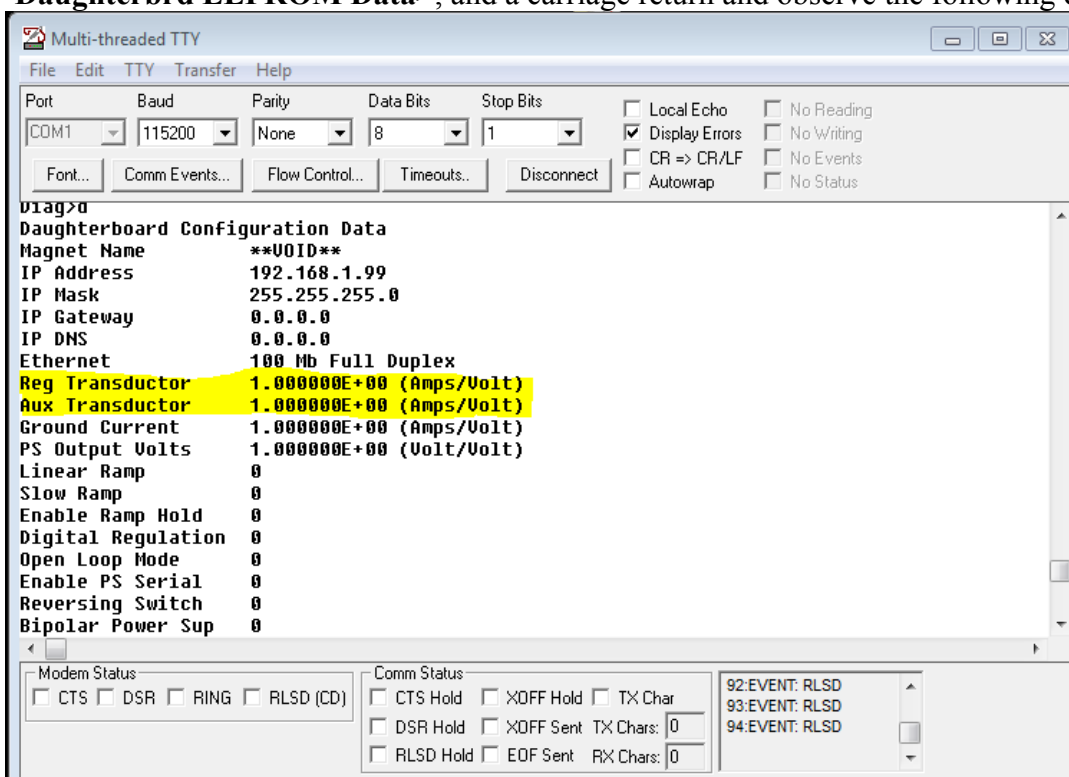
Screen Shot 3

Observe the Amps/Volt settings show in highlight. Note that in the '**Chassis Diagnostics**' mode it is not possible to make changes to the settings- it is just to observe that the settings are as desired. To actually make changes to the daughtercard, perform the following:

Go back to the '**Top**' menu by typing 'Z' and return. (the '**Top**' menu is shown above in screen shot 1).
Type <'**1**' **Program Daughter Board EEPROM**> and then hit return. Observe the screen shown below.
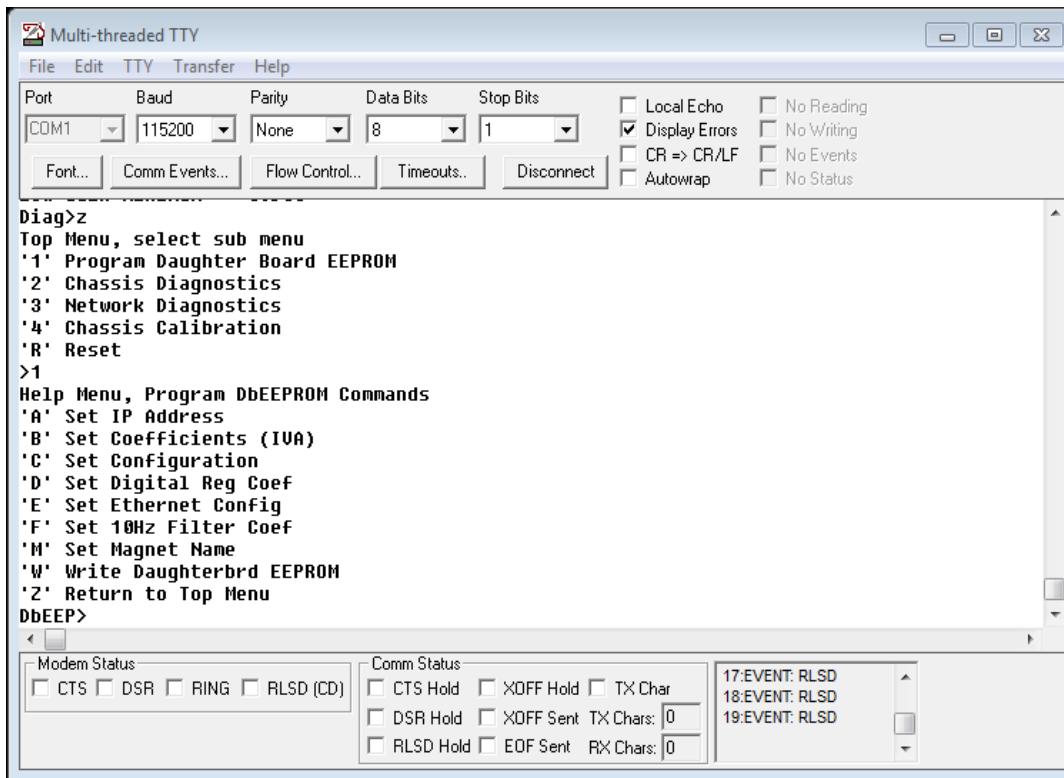
Screen Shot 4

Next type <'**B**' **Set Coefficients (IVA)**> and hit return (it is only necessary to type the letter 'B' in upper or lower case). This will give you the following screen and allow you to make Amps/Volt setting changes.
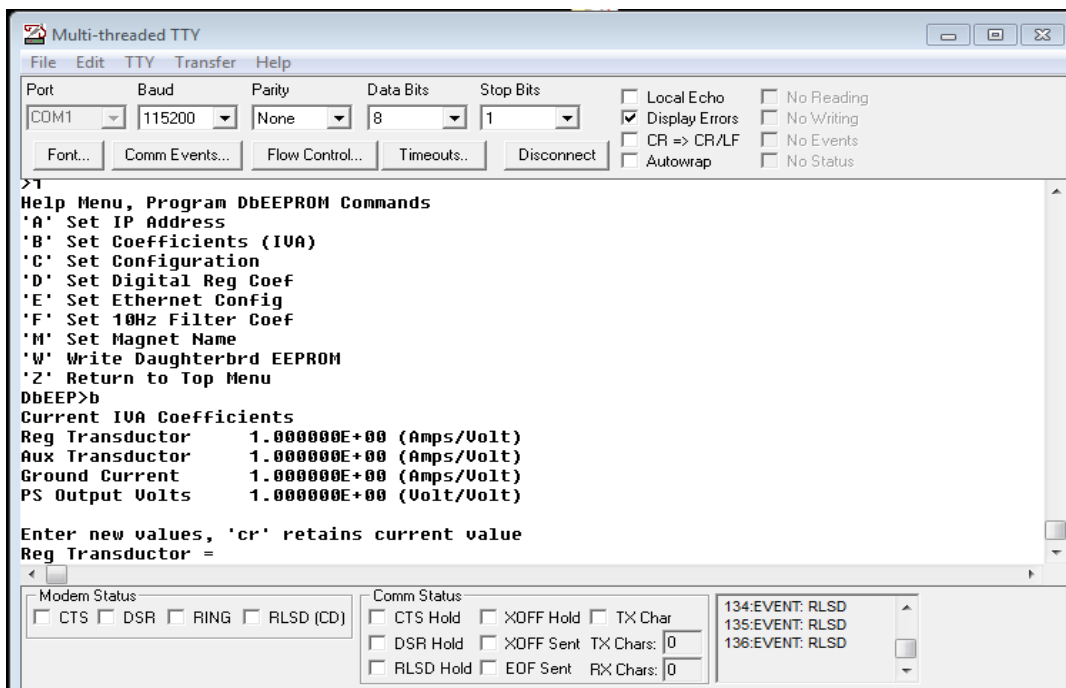
Screen Shot 5

To make **Reg and Aux Transductor Amps/Volt** setting changes, begin making the new entry at the '='
sign. As each entry is made and a carriage return is executed, the next item in the list will appear with
an '=' sign. It is only necessary to make an entry if the setting needs to be changed. If the setting does
not need to be changed, just typing a carriage return will ensure that the setting remains the same. So
assuming that the 'Reg Transductor' and 'Aux Transductor' only need to be changed (and not 'Ground
Current' and 'PS Output Volts') then make entries for 'Reg Transductor' and 'Aux Transductor' and
simply hit Return for 'Ground Current' and 'PS Output Volts' . The Ground Current should be set to
.01 Amps/Volt, and the PS Output Volts should be set to the power supply rated output (volts) divided
by 10. If these values are not set when the daughtercard is received, make them when setting the Reg
and Aux Transductor settings. Once the entries have been made, it is necessary to save the settings by
typing a **'W'** and then carriage return at the 'Dbeep' prompt as shown on screen shot 6 below. After
typing a 'W' the screen will ask you if you want to save the changes. Type 'Y' or 'N', depending on
whether the changes should be saved or not.
Next it is necessary to type '**Z**' to return to the Top menu, Type '**R**' to reset, and then type '**S**' to perform
a Soft Reset. Once the Soft Reset (or Hard Reset) has been performed, the changes have been saved.

It is advisable to go back and confirm that the settings were changed correctly once the changes have
been saved. Perform the instructions under screen shot 1 as necessary to accomplish the confirmation.
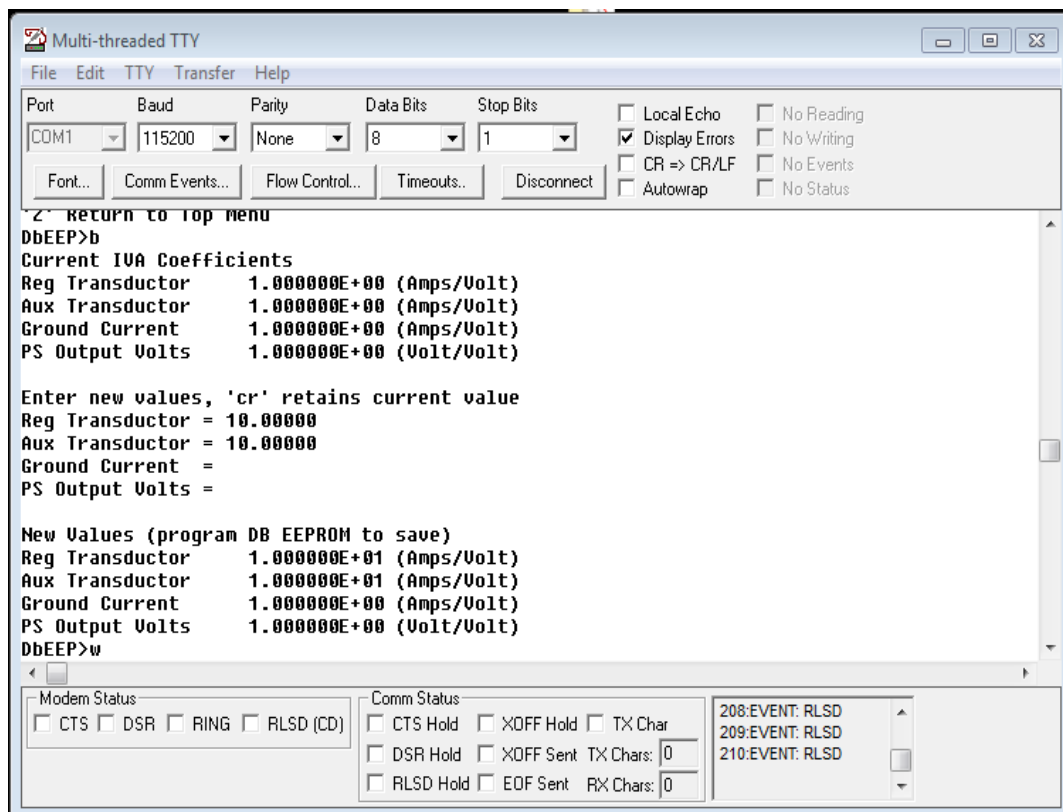
Screen shot 6
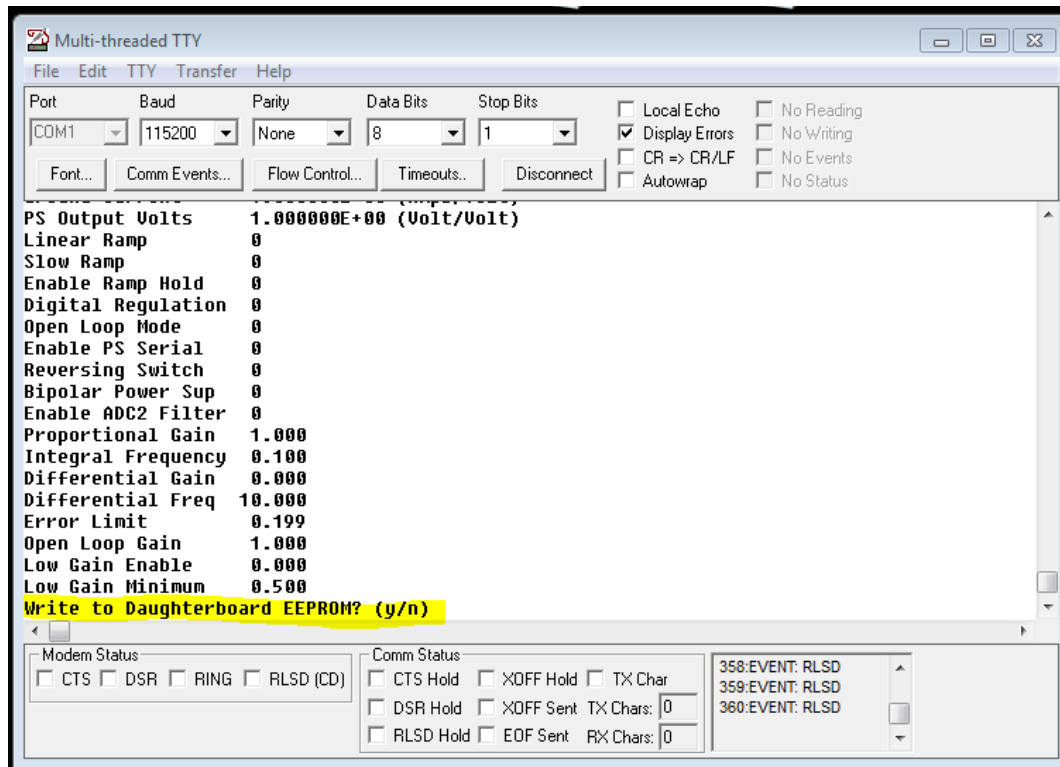
Screen shot 7

Changing the Daughtercard IP Address

It is possible that the IP address of the daughtercard would need to be changed. In order to perform this function, follow the steps listed below after having made the serial cable connection as described above and powering the PCRC on.

Establish that the connection to the PCRC has been made by performing a carriage return and confirming the screen below, which is the 'Top' menu display.
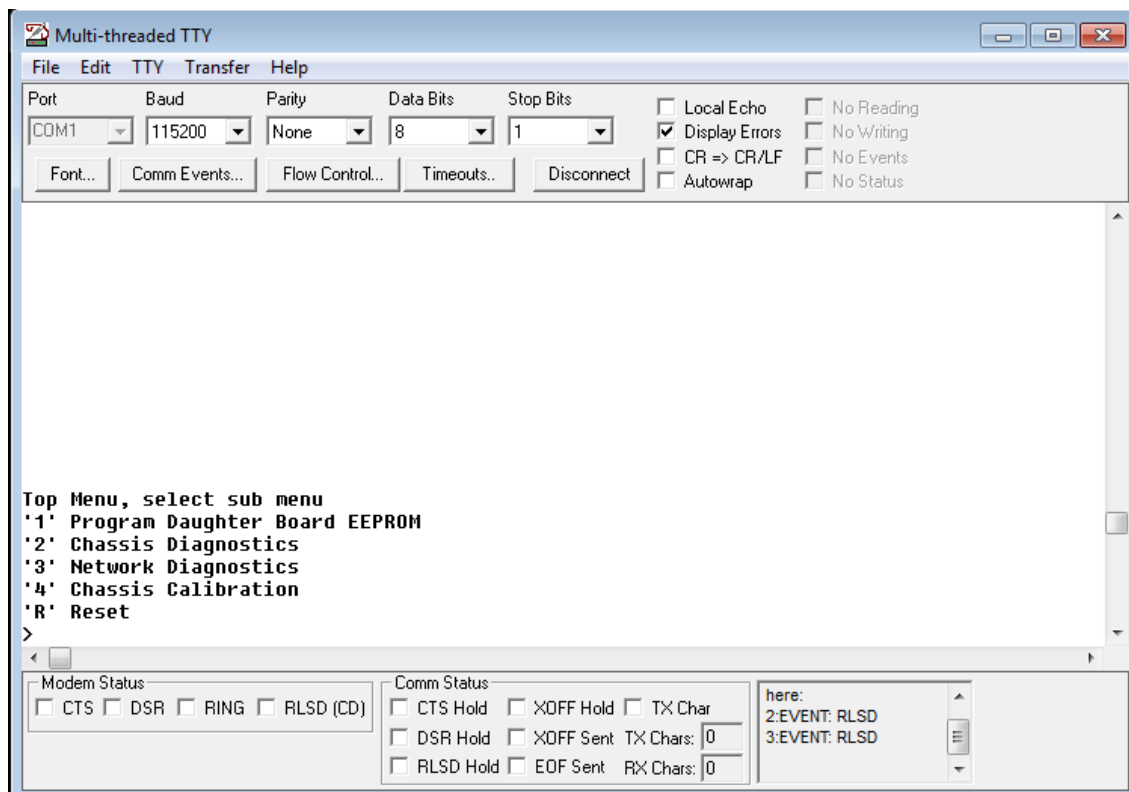
Screen shot 8

From the 'Top' menu type <**'1' Program Daughter Board EEPROM'>** and return. Then type <**'A' Set IP Address**> and observe that the screen shown below appears.
Enter the new IP address at the prompt and hit return. If necessary also enter the new **IP Mask** setting, the **IP Gateway** setting, and the **IP DNS** setting. If it is not necessary to enter any new values other than the **IP Address**, simply hit return at the prompt and the existing settings will be maintained. Once a carriage return has been entered for all four of the settings, type a **'W'** to write the settings, and at the prompt type either a **'Y' or 'N'** depending on whether the settings should be saved or not. Type **'Z'**, then **'R'** for Reset, and then either an **'S' or 'H'** to complete the process.
Once the reset process has completed, it is advisable to go back and confirm that the new settings were

made as expected.
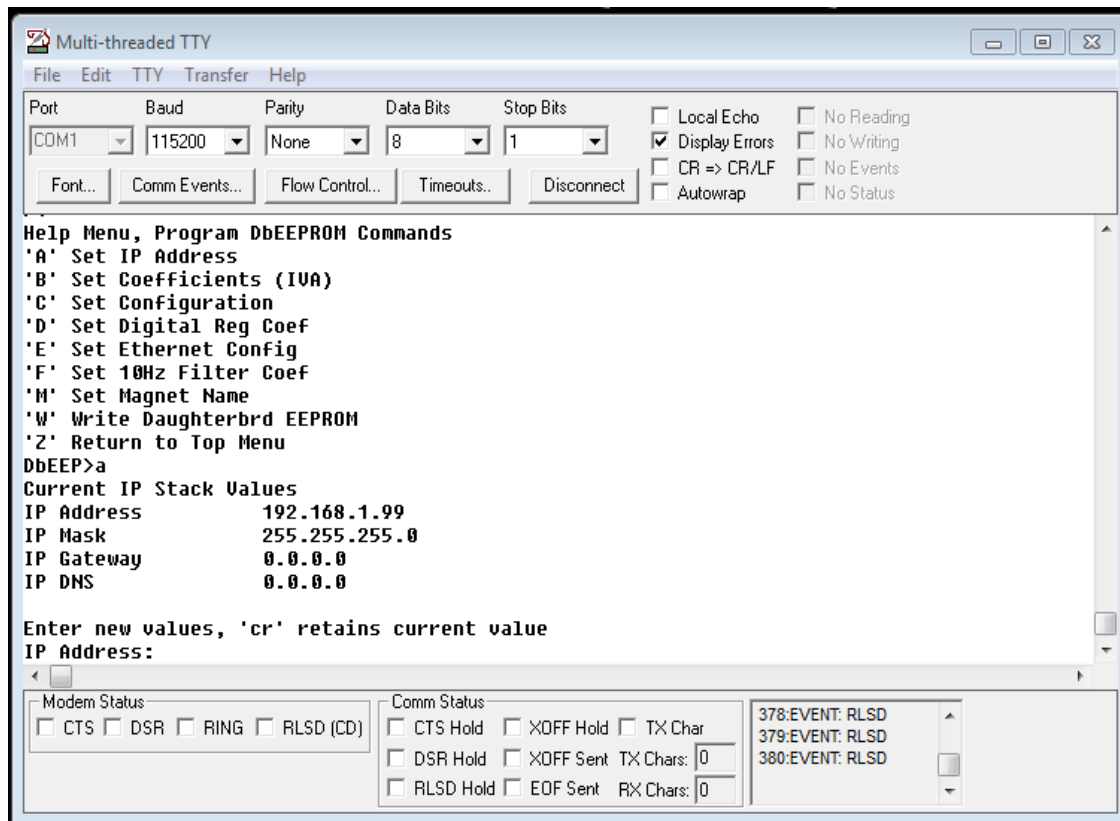
Screen Shot 9

Appendix B- Using UDPwin to control the PCRC

UDPWin.exe is a program that may be used with any PC with an Ethernet port to control the PCRC. With this program (available from BiRa Systems), the supply can be remotely turned on/off, current levels set based on a ramp time, status and error messages displayed. This section gives detailed instructions on how to use this program with the PCRC.
Before the program can be used the PC must be set up or configured with the correct IP address to communicate with the PCRC.
The default IP address of the PCRC is **192.168.1.99**. This IP address may be changed if necessary by following the instructions in Appendix A (Changing the daughtercard IP Address). It should be understood that the IP address of the PC and the IP address of the PCRC cannot be the same. It should also be understood that if more than one PCRC is on the same network, each PCRC must have its own unique IP address. If the PCRC IP address has been changed from the default address, see instructions at the bottom of this Appendix, 'What to do if the PCRC IP address has changed'.
If it is not necessary to change the IP address of the PCRC, continue following the instructions below to configure the PC to communicate with the PCRC. It may be useful to consult with IT before proceeding.

Instructions shown here to change the local IP address are based on a Windows 7 operating system and may need to be adjusted depending on the OS of the computer used.

Navigate to the 'Local Area Connection Properties' display panel and select 'Internet Protocol Version 4 (TCP/IPv4)' as shown in the screen shot below.
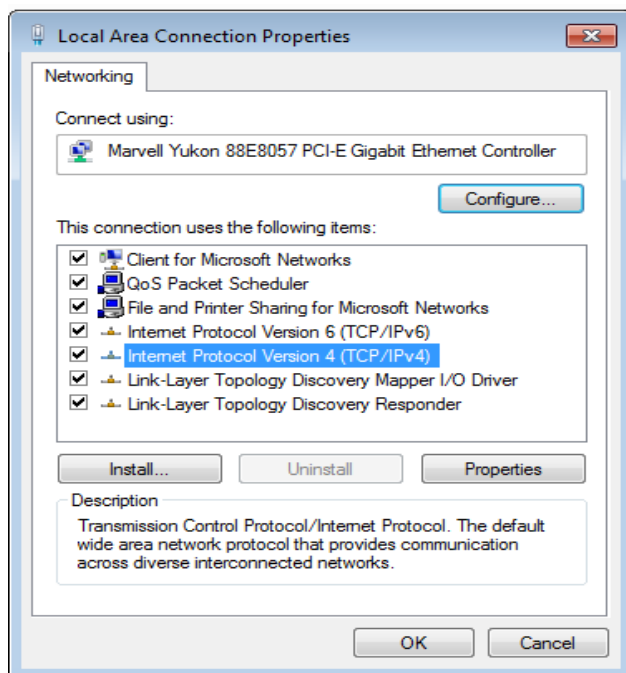
Screen shot 1

Click on the 'Properties' tab and observe the following display panel (Screen Shot 2), which is typical. It will be necessary to enter the actual IP address, Subnet mask, and Default Gateway that the LAN has provided into the display by using the 'Use the following IP address' display. One way to find out those IP values (assuming they are not already known) is to open up a Windows command window and use the command 'ipconfig'. Using the ipconfig command will display the actual IP values of the PC so that they can be entered. Screen shot 3 is an example of what the display will look like when the 'ipconfig' command has been entered. Note that the IPv4 Address, Subnet Mask, and Default Gateway values are shown and will be entered into the display shown in Screen shot 2 once the 'Use the following IP address' selection has been made. When those values have been entered, click on the 'Advanced..." button and follow the instructions below.
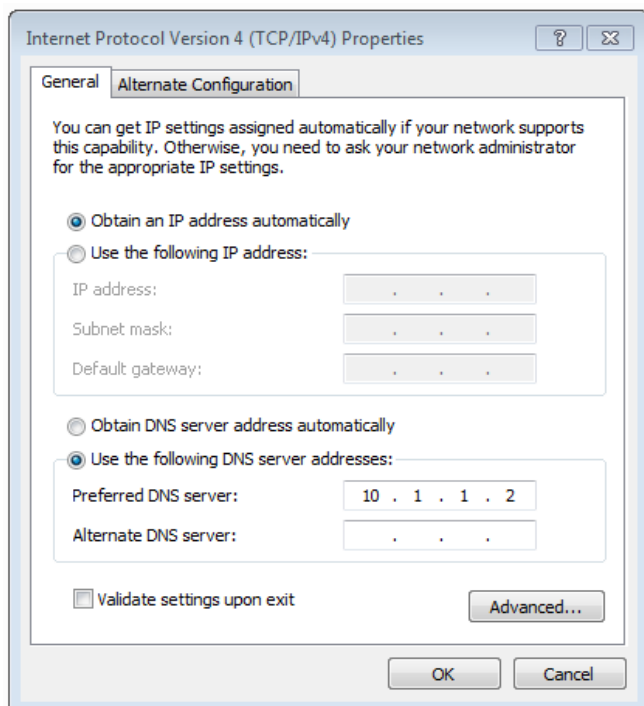
Screen shot 2
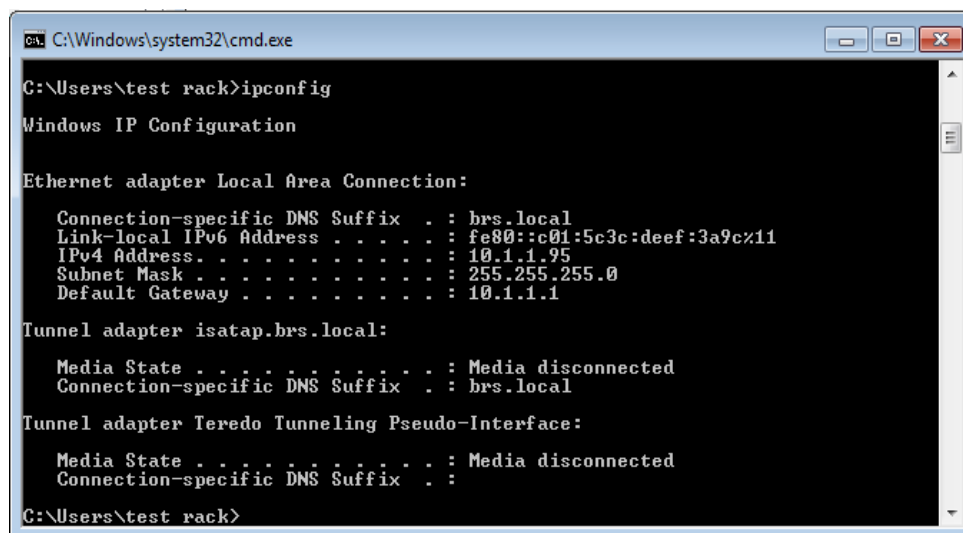
Screen Shot 3- Windows command window after the ipconfig command has been entered.

In the 'Advanced' tab window, click on the 'Add' button, and enter in the IP address window the following as shown in screen shot 4 below. IP address- **192.168.1.100**
Subnet mask- **255.255.255.0**

When done click the 'Add' button, then 'OK' and then 'OK' again to exit the display panel.
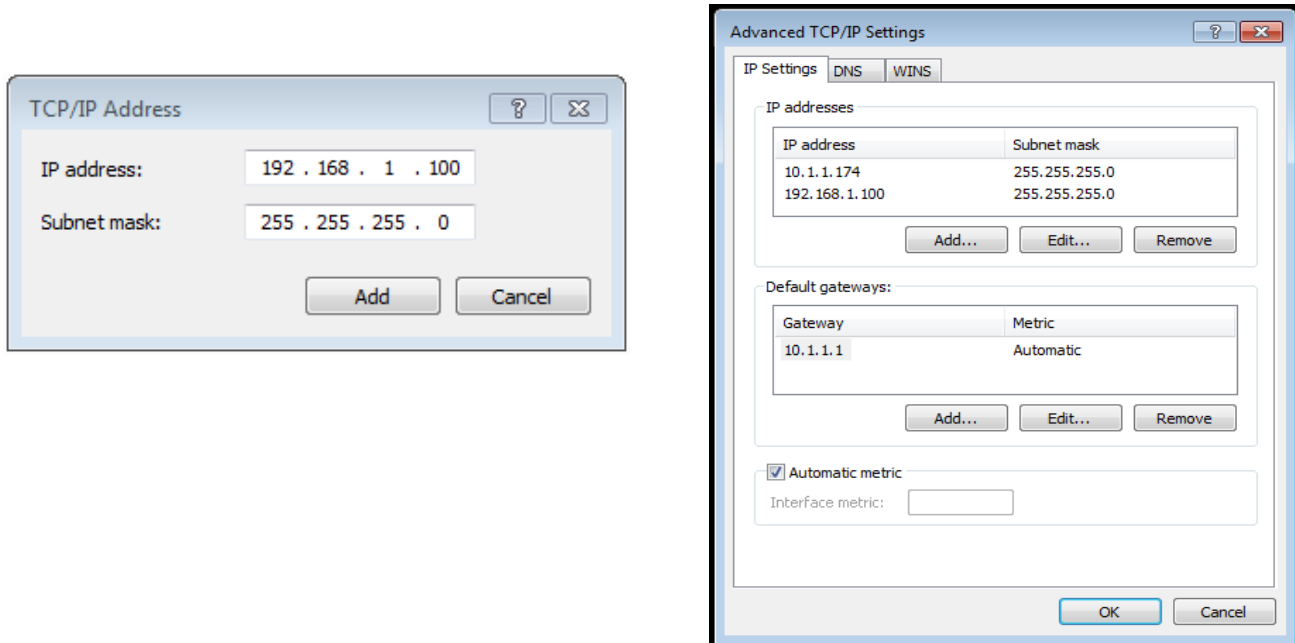
Screen shot 4-IP Address and Subnet mask entry panel, and 'Advanced' screen after entries were made.

Once these entries have been made, communication between the PC and the PCRC can now be established. Use the instructions immediately below if it is desired to use a PC not on a LAN to control the PCRC. Otherwise, proceed with the instructions below '**Using UDPwin to control**'.

If the PC used in not on a LAN and is connected directly to the PCRC with an Ethernet cable, enter the IP address and Subnet mask information shown above, directly into the 'Internet Protocol Version 4' panel (screen shot 2) after clicking on the 'Use the following IP address' button. It is not necessary to enter any information into the 'Preferred DNS Server' window if the connection is direct from the controlling PC to the PCRC.
When the IP address and Subnet mask information have been entered correctly the following commands will be used to program the power supply:

Precision Current Regulator Controller (PCRC) Command Summary
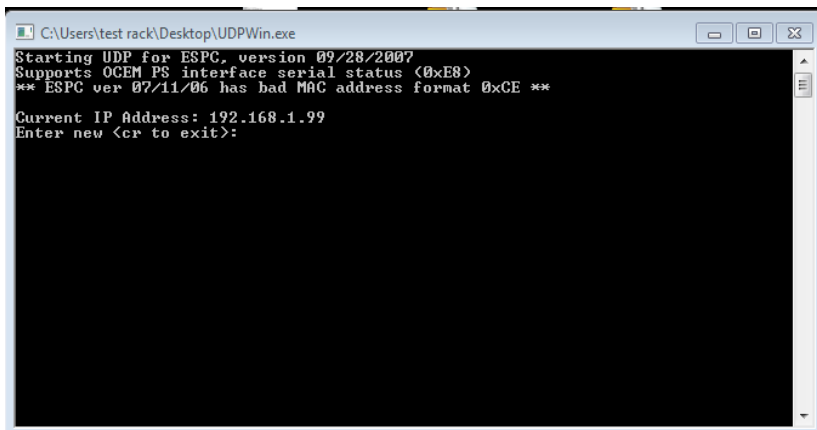
0xC0 Short Status check (wait for current data from ADC)
0xC1 Set Power Supply Current with unsynchronized ramp
0xC2 Set Power Supply Current with synchronized ramp
0xC3 Read ramp setpoints and Times
0xC4 Reset Interlocks
0xC5 Turn OFF Power Supply
0xC6 Turn ON Power Supply
0xC7 Turn ON Power Supply, reverse polarity

0xC8 Read Analog (reads 8 different ADC inputs)
0xC9 Read Error Message
0xCA Diagnostic Message 1
0xCB Diagnostic Message 2
0xCC Diagnostic Message 3
0xCD   Short Status check (same as 0xC0 except uses stored ADC data)
0xCE Configuration Summary (new message with all configuration data)
0xCF Dynamic Data Message (new message with all configuration data)
0xE1 Communications Check Message (echo)
0xE3 Reset PCRC
0xE8 PS Serial Status (07-31-07 and later, for OCEM ATF2 modular PS)

Using UDPwin to Control
After ensuring that all connections between the PCRC, Power Supply, DCCT and Load are as described above, power on the PCRC and supply and confirm that the power on LED on the DCCT is lit. Proceed with the instructions below.

Open the **UDPWin.exe** application and observe the screen shown below.

Screen Shot 5- UDPwin Initial Display

Note that the IP Address of the PCRC is displayed and that it is different than the IP Address that was entered in the instructions above for the 'Advanced' tab.

Hit the Return button on the computer keyboard and observe the 'Enter Bitbus command' prompt. Note that the 'Ready' LED lamp on the PCRC front panel is solid lit and not flashing whenever an Ethernet connection on the PCRC has been installed. Note also that each time that a UDPwin command is given that the 'Network' LED lamp on the PCRC front panel will flash briefly (assuming that proper communication has been established between the PC and PCRC).
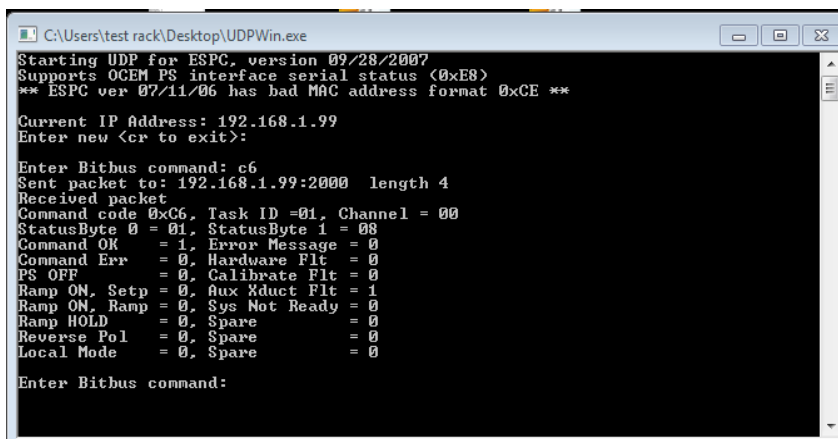
Screen Shot 6- Bitbus command prompt

The power supply output can be turned on by entering the command C6 as shown in the screen shot below.

Screen Shot 7- Using the 'C6' command to turn the supply on

The display indicates the command was successful. The 'Output' LED on the front panel of the supply should be lit, and the 'PS On' LED on the PCRC should also be lit. Observe that the display shows "PS OFF   = 0", which indicates that the output of the supply is On.

Turn the power supply output off by entering C5 at the command prompt as shown below.

Screen Shot 8- Using the 'C5' command to turn the supply off

The power supply output is now turned off. Observe that the display indicates "PS OFF   = 1" indicating that the output of the supply is off. Note that simply turning the supply output on does not mean there is any output current. The output must first be turned on (by using the C6 command) before the command to set current can be delivered as shown below. First, enter the C6 command, ensure that the output of the supply is on, and then type in the C1 command as seen in screen shot 9. Observe the display is asking for number of setpoints to enter from 1 to 5.

Screen Shot 9- Using the 'C1' command

Enter 1 and hit return. At the prompt shown below enter the level of current desired, and then at the next prompt, the desired time the supply will take to reach the current setpoint. No current will be output until the time to setpoint value has been entered. It is recommended that a reasonable amount of time be allowed for the supply to reach the current output setpoint. 1Amp/second is a reasonable value to start with. For example, if 50 Amps is the current setpoint, then an entry of 50 for the setpoint time would result in the supply reaching 50 Amps in 50 seconds, or 1 Amp/second. An entry of 25 as the setpoint time would result in the output reaching 50 amps in 25 seconds, or 2 Amps/second.

Screen Shot 10- 'C1' command to set the output to 1 Amp

The screen shot above highlights the number of setpoints (1), current setpoint (1 Amp), and the time that the supply took to reach 1 Amp (1 second). Once the supply has reached 1 Amp it will remain there until the next command is given. Note that the power supply front panel current display should indicate 1 Amp. Return the supply to 0 Amps by again entering the C1 command as shown below.

Screen Shot 11- 'C1' command to return the supply to 0 Amps
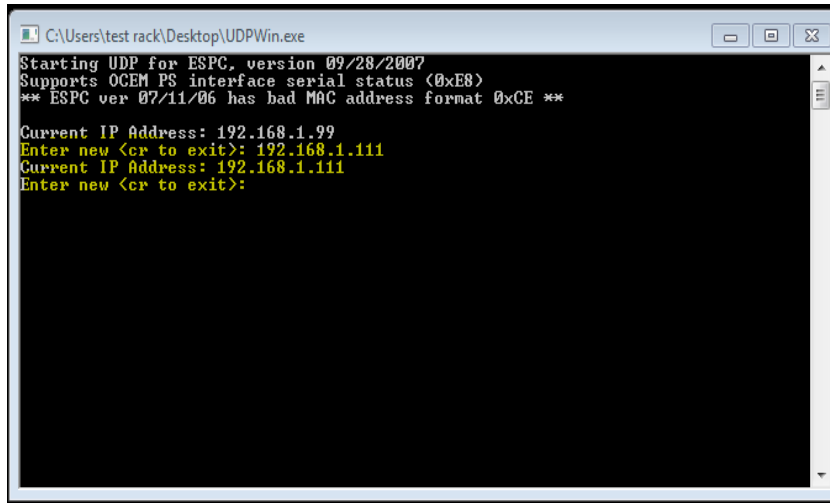
After the C1 command is entered, the highlighted portion above shows 1 setpoint was entered, 0 Amps as the setpoint, and 1 second to return to 0 Amps. Once the supply has been returned to 0 Amps the output can be turned off. Never attempt to turn the supply output off when current is being output. Always return the supply to 0 Amps and then turn the output off.

What to do if the PCRC IP address has been changed
Follow these instructions in the event that a PCRC has had it's IP address changed:
Appendix A has instructions for changing the daughtercard PCRC IP address when that process

becomes necessary, such as if there are two or more PCRCs on the same network. If using UDPWin to communicate with the PCRC, you must change the IP address in UDPWin each time that the application is reopened. Screen Shot 12 shows the application when it is initially opened, and shows the default IP Address (192.168.1.99), not the actual IP address if it was changed. In order to communicate with the PCRC, you must enter the actual IP address at the prompt 'Enter new <cr to exit>:' and then hit the Return button. In the example below the IP address was changed from 192.168.1.99 to 192.168.1.111 as seen in the highlighted portion.

If the IP address has not been changed since the application was last opened, simply hit Return at the prompt.

Screen Shot 12