DCX1000S AC/DC CONVERTER MODULE ELECTRICAL INTERFACE DATASHEET

(BEHLMAN PART NUMBER 94056)

1. SCOPE

This document describes the functionality of the electrical interface of DCX1000S power converter.

2. APPLICABLE DOCUMENTS

ASELSAN DWG No: 10051109 Product specification for 1000W AC/DC converter module, 3 phase 400Hz, 115Vac input, 60Vdc output

BEHLMAN SCH74198 Schematic, 1000W, 60VDC OUT, DCX1000S

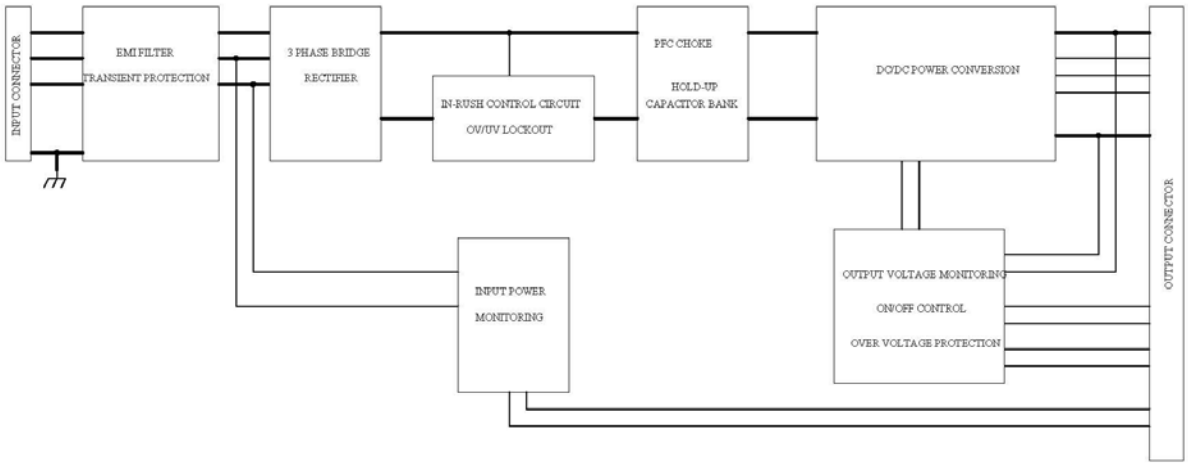
BEHLMAN DWG23094 Outline & connection drawing, 1000W AC/DC converter module, DCX1000S

3. GENERAL DESCRIPTION

DCX1000S power supply is AC/DC converter providing 1000W of output power at 60V nominal output voltage and 16.67A nominal output current. The output voltage can be adjusted from -80% to +110% of the nominal output voltage with external resistor.
The power converter requires 3-phase 400Hz, 115Vrms line to neutral input voltage in compliance with MIL-STD-704.

4. BLOCK DIAGRAM

Fig.1



5. INPUT / OUTPUT PIN CONFIGURATION AND FUNCTION DESCRIPTION

DCX1000S power converter has input connector (J1) and output connector (J2) located on the top, at the opposite ends of the unit. The three phase input power is supplied through the pins of the input

connector (J1). The output connector (J2), has a combination of high current pins (A1 to A4) to supply the output power to the load and also has signal pins (1 to 17) for monitoring and control of the unit. Following is a functional description of each J1 and J2 pin.

5.1 INPUT CONNECTOR – J1

DESCRIPTION: Combo D connector, 5W5 style (5 power pins), plug
MANUFACTURER: ITT CANNON
PART NUMBER: DBM5W5PK127
Table 1

PIN No.	SIGNAL	DESCRIPTION
1	PHASE A	Input power, Phase A, 115/200VAC, 400Hz
2	PHASE B	Input power, Phase B, 115/200VAC, 400Hz
3	PHASE C	Input power, Phase C, 115/200VAC, 400Hz
4	NEUTRAL	Input power, Neutral, Not Used
5	CHASSIS GND	Chassis / Input Ground connection

5.2 OUTPUT CONNECTOR – J2

DESCRIPTION: Combo D connector, 21W4 style (4 power pins and 17 signal pins), socket
MANUFACTURER: ITT CANNON
PART NUMBER: DCM21WA4SK126
Table 2

PIN No.	SIGNAL	DESCRIPTION
		POWER PINS
A1	+60V OUT	Output power, positive terminal, 60Vdc nominal voltage ref. to +60V RTN, pins A3 and A4
A2	+60V OUT	Output power, positive terminal, 60Vdc nominal voltage ref. to +60V RTN, pins A3 and A4
A3	+60V RTN	Output power ground/return, negative terminal
A4	+60V RTN	Output power ground/return, negative terminal
		SIGNAL PINS
1	+SENSE	Positive output voltage remote sense terminal. Connect to +60V OUT at the load for better load regulation.
2	REM ON/OFF	Connect this pin to REM ON/OFF RTN (pin 11) to inhibit the output of the unit (output shutdown).
PIN No.	**SIGNAL**	**DESCRIPTION**
3	OUTPUT PG	An open collector monitoring output with active low state (referenced to pin 12). It provides information about over voltage, over current, short circuit, out of regulation conditions at the output of the power supply. When low, output voltage is within 10% of the nominally set output voltage. Max voltage: 40V, max sink current: 2mA.
4	OVER TEMP	Contact closure output, referenced to pin 12. Monitors base plate temperature. Open, when temperature is less

		than 85ºC, closed when temperature is higher. Max voltage: 50V, max current: 500mA. Minimum closed-open differential is 6ºC.
5	INPUT PG	An open collector monitoring output with active low state (referenced to pin 12). It provides information about input power voltage and frequency. When low, input line to neutral voltage is between 100Vrms and 126Vrms and frequency is between 360Hz and 440Hz. Max voltage: 40V, max sink current: 2mA.
6	TRIM UP	Control pin, used to set the output voltage higher than nominal 60V. Use with pin 7 (TRIM) and pin 8 (TRIM DOWN) to set a voltage different than the nominal 60V.
7	TRIM	Control pin, used to set the output voltage other than the nominal 60V. Use with pin 6 (TRIM UP) and/or pin 8 (TRIM DOWN).
8	TRIM DOWN	Control pin, used to set the output voltage lower than the nominal 60V. Use with pin 7 (TRIM) and pin 6 (TRIM UP) to set a voltage different than the nominal 60V.
9	-SENSE	Negative (return) output voltage remote sense terminal. Connect to +60V RTN at the load for better regulation.
10	+60V OUT	Positive output voltage signal pin. Used when two or more power supplies are connected in parallel array. On each Slave unit, use a short wire jumper to connect this pin to pin1 (+SENSE). Not connected in single unit operation or on Master unit in parallel array. DO NOT USE AS A POWER CONNECTION!
11	REM ON/OFF RTN	A return pin for REM ON/OFF, pin 2. Connected internally to output power ground/return.
12	FAULT SIGNALS COMMON	A return pin for the monitoring/alarm signals: OUTPUT PG (pin 3), INPUT PG (pin 5) and OVER TEMP (pin 4). This pin is floating and could be connected to an external reference ground or to the output power ground/return.
13	SYNC	Synchronization Bus pin, used in pair with SYNC RTN (pin 14), to distribute synchronization pulses to all power supplies used in a parallel array.
14	SYNC RTN	Synchronization Bus pin, used in pair with SYNC (pin 13), to distribute synchronization pulses to all power supplies used in a parallel array.
PIN No.	**SIGNAL**	**DESCRIPTION**
15	SPARE	This pin is not used in the current revision of the unit.
16	SEC CTRL	Control pin, used to set a power supply unit in a parallel array as a Slave, by connecting it to +60V RTN (output ground), pin 17. Not connected in single unit operation or on Master unit in parallel array. The nominal voltage on this pin is 1.23V referenced to DO NOT APPLY ANY EXTERNAL VOLTAGE TO THIS PIN!
17	+60V RTN	Output power ground/return signal pin. Connect to SEC CTRL, pin 16, to set a unit in a parallel array as a slave. Not connected in single unit operation or on a Master unit in a parallel array. DO NOT USE AS A POWER CONNECTION!

6. INPUT POWER SPECIFICATIONS

The power supply, DCX1000S, is compatible with three phase 115/200VAC, 400Hz airborne power as per MIL-STD-704F.

Table 3

#	CHARACTERISTIC	MIN LIMIT	MAX LIMIT	NOTE
6.1	**Specified input voltage range**	**100VAC**	**126VAC**	Line to Neutral
6.2	Operational input voltage range	80VAC*	135VAC	Line to Neutral *When initially applying input power, the input voltage must be higher than 100VAC to turn on the power supply.
6.3	Low input voltage alarm level	95VAC	100VAC	
6.4	High input voltage alarm level	125VAC	130VAC	
6.5	**Specified input frequency range**	**360Hz**	**440Hz**	
6.6	Operational frequency range	360Hz	800Hz	
6.7	Low frequency alarm level	340Hz	360Hz	
6.8	High frequency alarm level	440Hz	460Hz	
6.9	Power Factor @ 115V/400Hz, 25% to 100% load	0.9	-	
6.10	Inrush current	-	10A	Maximum peak current, measured on any input power phase
6.11	**Efficiency, full load**	**-**	**-**	**85% typical**
6.12	Active input power in shutdown mode	-	10W	400mArms max per phase
6.13	Hold-up time, full load, nominal input voltage	50ms	-	

- Specified range – power supply will meet specified requirements.
- Operational range – power supply will operate but not necessarily meeting the specified requirements.
- Input Power Good signal is active when input voltage and frequency are above min alarm level and bellow max alarm level.
- Even if INPUT PG signal is not active, the power supply will operate within its operational range.

7. OUTPUT POWER SPECIFICATIONS

DCX1000S delivers 1000W of output power at the nominal output voltage of 60VDC. This output voltage is adjustable from 48V to 66V through externally connected resistor. The nominal output current is 16.67A and does not change when the output voltage is set to different than the nominal output voltage.

A Power Good signal (OUTPUT PG) provides information about output voltage status.

The output has over voltage, overcurrent, short circuit and over temperature protection.

7.1 MAIN OUTPUT SPECIFICATIONS

Table 4

#	CHARACTERISTIC	MIN LIMIT	MAX LIMIT	NOTE
7.1.1	Nominal output power	-	1000W	
7.1.2	Nominal output voltage	59.4V	60.6V	Typical output voltage accuracy is 1%
7.1.3	Adjustable output voltage range	-20% 48V	+10% 66V	
7.1.4	Nominal output current	-	16.67A	
7.1.5	Output voltage regulation (Line+Load+Temperature)	-1%	+1%	Output voltage measured at Remote Sense connections
7.1.6	Ripple&Noise	-	250mVpp	Measured at full load, BW=20MHz
7.1.7	Output over voltage protection level	68V	70V	Approx. 115% of nominal output voltage
7.1.8	Over current protection – current limit	17A	21A	Approx. 120% of nominal output current

7.2 ADJUSTABLE OUTPUT VOLTAGE FUNCTION – TRIM FUNCTION

The output voltage of the power supply can be adjusted in the range of -20% (48V) to +10% (66) from the nominal 60V. This is achieved by utilizing the following output connector pins:

J2-6 - TRIM UP

J2-7 - TRIM

J2-8 - TRIM DOWN

7.2.1 Setting a fixed, lower than nominal output voltage

To adjust the output voltage to lower than the nominal 60V, connect a resistor (Rd) between TRIM (pin 7) and TRIM DOWN (pin 8). To calculate the value, use the formula:

$$Rd = \frac{1000 * Uout}{Unom - Uout} - 3830, \Omega$$

Where Unom=60V and Uout is the lower output voltage to be achieved.

All the resistors used to adjust the output voltage should be 1% or better, 1/4W, stable over time and temperature change.

For example, to set the output voltage to 48V, a 170Ω resistor should be connected between TRIM and TRIM DOWN. Due to the tolerance of the internal reference and tolerances of the internally connected components, the calculated resistor value is approximate and could be some deviation between the calculated and actual output voltage, Uout.

7.2.2 Setting a fixed, higher than nominal output voltage

To adjust the output voltage to higher than the nominal 60V, connect a resistor (Ru) between TRIM (pin 7) and TRIM UP (pin 6). To calculate the value, use the formula:

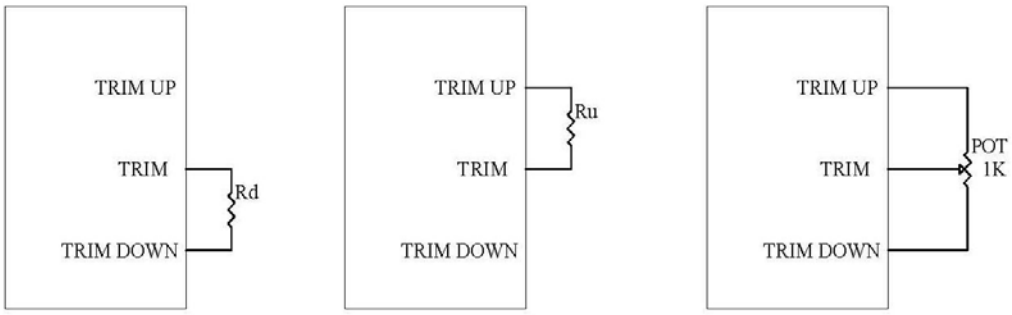
$$Ru = \frac{(Uout - 1.23) * Unom}{1.23 * (Uout - Unom)} - 37.23, k\Omega$$

Where Unom=60V and Uout is the higher output voltage to be achieved.
For example, to set the output voltage to 66V, a 489.3kΩ resistor should be connected between TRIM and TRIM UP.
CAUTION!
Verify the value of the resistor before connecting it. If too low of a resistance (less than 400kΩ approximately) is connected between TRIM and TRIM UP, the output of the unit could go into over voltage situation and it could shutdown.

7.2.3 Continuously adjustable output voltage

The output voltage could be adjusted over the full output voltage range continuously. To achieve that, use a 1kΩ potentiometer and connect the two end terminals to TRIM UP and TRIM DOWN pins, and connect the wiper terminal to the TRIM pin. This set up will provide continuously adjustable output voltage from 48V to 66V.

7.2.4 Trimming connections diagrams, Fig.2



7.2.1 SET TO LOWER VOLTAGE 7.2.2 SET TO HIGHER VOLTAGE 7.2.3 CONTINUOUSLY ADJUSTABLE

7.3 REMOTE ON/OFF FUNCTION
After applying input power, the output of the power supply could be turned on or off by means of connecting REM ON/OFF (pin 2) to REM ON/OFF RTN (pin 11) through low impedance (contact closure). Following is part of the internal ON/OFF circuit, Fig.3:

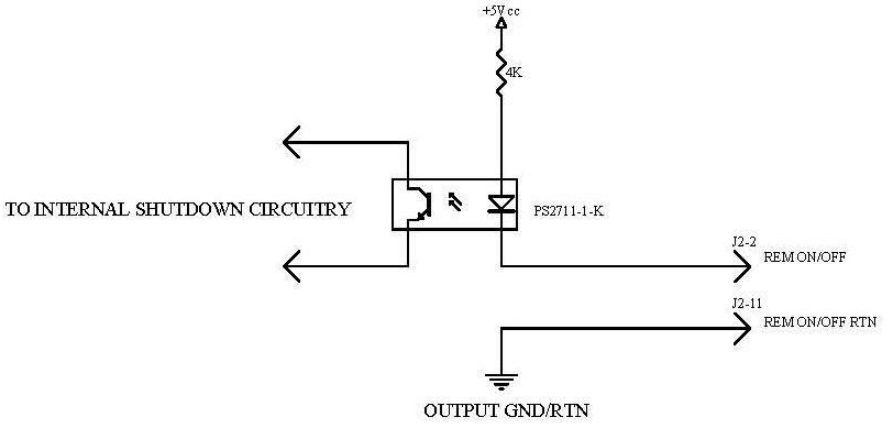


Fig.3: ON/OFF circuitry

When REM ON/OFF pin is left floating, the unit is operating and the output is on. If pins 2 and 11 are shorted, the output of the unit is off.
There are different circuits that could be used to provide connection between the two pins: a switch, relay contact, open collector or open drain type of circuit. The closing contact should have less than 0.5V drop at current higher than 1mA. The open circuit voltage is 5V.

7.4 REMOTE VOLTAGE SENSE FUNCTION
The power supply has capabilities to sense and regulate the output voltage at the point where the load is connected by compensating for the voltage drop along the connecting wires. This compensation is limited to 0.5V on each, the positive and negative connecting wires.
If remote voltage sense is not needed (the load can operate with a wider input voltage range), it is suggested to connect –SENSE (pin 9) to output return, +60V RTN (pin 17) and connect +SENSE (pin 1) to positive output terminal +60V OUT (pin 10). To eliminate noise pick-up and instability, these connections are recommended to be done at the output connector. If +SENSE and –SENSE pins are left floating, the unit will operate but its output voltage regulation might increase and instability is possible.
When power supplies are used in a parallel array, only the Master unit's +SENSE and –SENSE lines are used to regulate the output voltage at the load. On each Slave unit, the +SENSE pin (pin 1) is connected to the positive output (pin 10) and –SENSE pin (pin 9) is connected to the negative output (pin 17).

7.5 ALARM SIGNALS
DCX1000S provides three alarm signals to monitor the status of input power, output power and base plate temperature.

7.5.1 INPUT POWER GOOD signal (INPUT PG, pin 5)
This signal provides information about the RMS value of the input voltage and its frequency. An open collector type of circuit is used with an active low state, Fig.4:

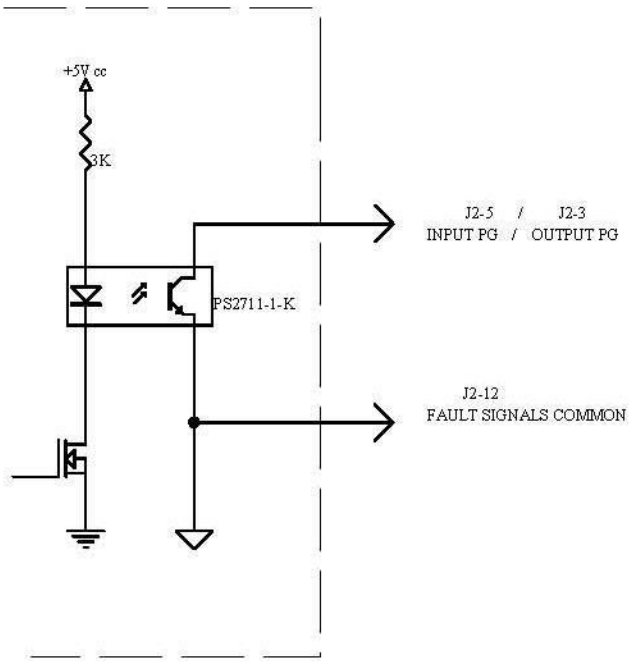


Fig. 4 INPUT PG AND OUTPUT PG INTERNAL CIRCUITRY

When the RMS value of the input line to neutral voltage is between 100V and 126V, and the frequency of the input voltage is between 360Hz and 440Hz, the LED of the optical coupler is energized and the transistor conducts, providing low impedance between INPUT PG pin and the FAULT SIGNALS COMMON. If external current is provided, the status of the INPUT PG signal is logic LOW. Providing the INPUT PG pin sink current is below 2mA, the voltage level at the pin, reference to FAULT SIGNALS COMMON, will be less than 0.6V. When not conducting, the INPUT PG pin can withstand up to 40V reference to the FAULT SIGNALS COMMON pin. The common for the FAULT signals (pin 12) is floating and could be connected to output ground/return or to a different reference ground.
If the input voltage or frequency, change beyond the specified range, the INPUT PG status changes to high impedance reference to pin 12. This should be read as logic HIGH and is considered inactive state of this signal.

7.5.2 OUTPUT POWER GOOD signal (OUTPUT PG, pin 3)
This signal provides information about the status of the output of the power supply. It is an open collector output and uses the same circuit as INPUT PG signal, shown on Fig.4. When the output voltage is within 10% of the set value, the OUTPUT PG signal is in its active state – low impedance between OUTPUT PG (pin 3) and FAULT SIGNALS COMMON (pin 12). When external current is provided, the status of the pin is logic LOW. If the OUTPUT PG pin sink current is less than 2mA, the voltage level of the pin reference to pin 12 is less than 0.6V.
In case of over current situation or short circuit, when the output voltage drops below the nominally set voltage, the OUTPUT PG changes its state to high impedance reference to pin 12. In this case the pin can withstand up to 40V reference to pin 12. This is the inactive state of the signal. Over voltage situation at the output or simply shutting down the output by using REM ON/OFF pin, will force OUTPUT PG pin into inactive state.
As mentioned before, the reference pin FAULT SIGNALS COMMON is floating and could be tied to output ground/return or to other reference point.

7.5.3 OVER TEMPERATURE SIGNAL (pin 4)

This signal is a contact closure type, reference to FAULT SIGNALS COMMON (pin 12), and is open when the base plate temperature of the unit is below 85ºC +/-5ºC. Once the base plate temperature increases above 85ºC, the contact closes. That will not disable the output of the unit, which has a separate thermal shutdown at 90ºC. The OVER TEMP signal does not need power to operate.

7.6 OUTPUT OVER VOLTAGE PROTECTION

Voltage higher than 69V +/-1V on the output of the power supply, would cause a latched shutdown and the unit would stay in this mode until REM ON/OFF control is re-cycled (disable and enable the output) or input power is re-cycled. Then the output voltage would recover.

The over voltage trigger level is fixed and does not depend on the output voltage setting.

7.7 OUTPUT OVER CURRENT AND SHORT CIRCUIT PROTECTION

The power supply has non-latching over current and short circuit protection. When the output current exceeds the nominal value of 16.67A and reaches approx 19A, the output voltage will start to drop from the nominal set value. If the load impedance is further decreased, the current will stay approximately the same, while the output voltage will continue decrease. In a case of short circuit, the output current is limited to 17A.

If the over current or short circuit situation is removed, output voltage will recover automatically. It is not recommended prolonged over current operation, where the total output power exceeds the specified max power of 1000W.

8. PARALLEL OPERATION

Two or more DCX1000S power supplies can operate in a parallel array, when larger loads need to be powered. The parallel array has a designated MASTER power module and one or more SLAVE modules.

The following Fig. 5 shows a typical parallel array and the interconnections at the outputs of the power supplies used.

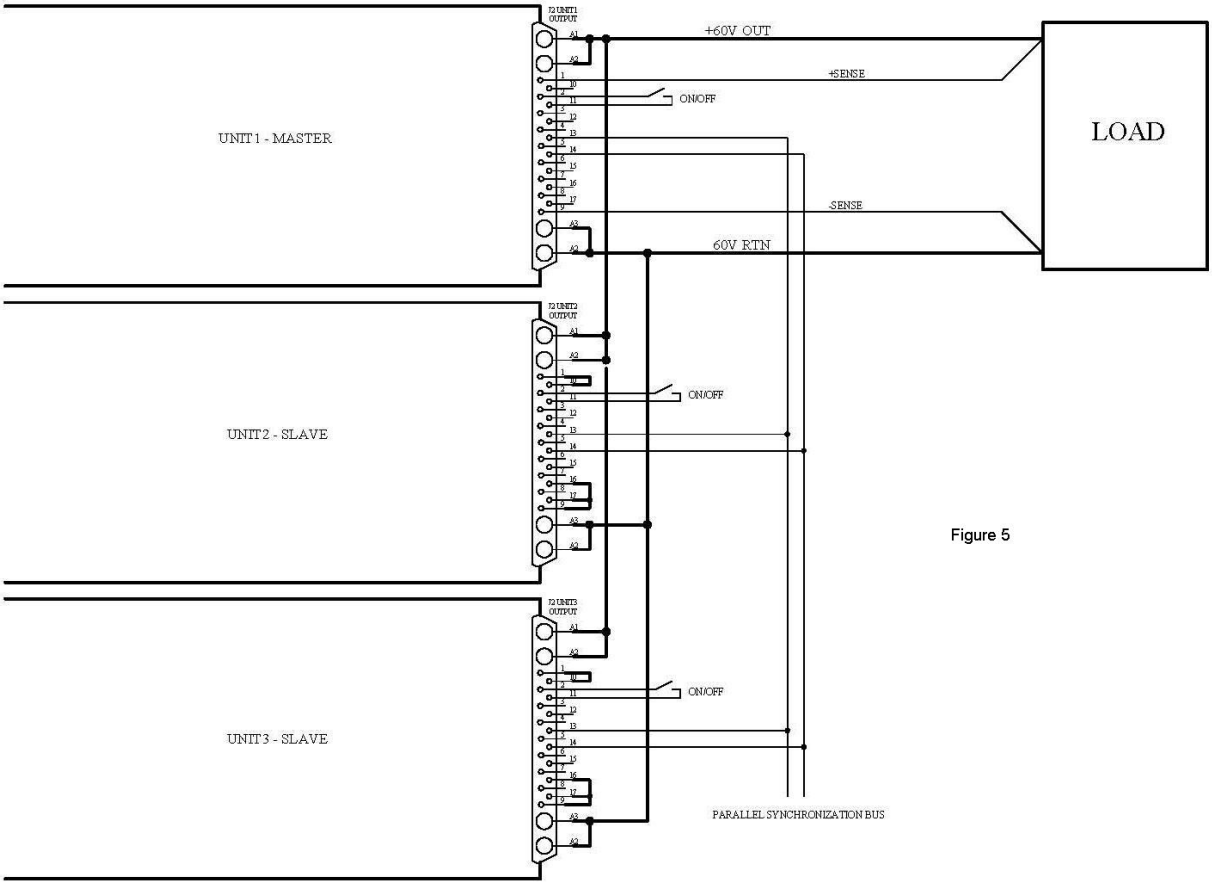


Figure 5

Only one power supply is designated as MASTER, the rest are set as SLAVES. Each power supply has its own ON/OFF circuit (shown as switch). The slave modules could be switched off if the extra power is not needed, providing the master module is on. The output voltage of the array could be adjusted by adjusting the output voltage of the master module by using the TRIM pins (6,7,8). The slave modules follow the voltage set by the master. The remote output voltage sense is provided by the +/- SENSE connections of the master module. For all slave modules, the remote sense lines are terminated to its respective outputs at the output connectors.

A slave module is configured by shorting SEC CTRL, pin 16 to –SENSE, pin 9 and connecting both to the output voltage return,+60V RTN, pin17. On the positive output, +SENSE, pin 1 is connected to the positive output, +60V OUT, pin 10.

In the parallel array, all positive and all negative power outputs are tied together crating a common positive output bus and common negative output bus.

The above described parallel array with a master/slave configuration will operate properly and share the load equally only if synchronization signal is distributed between the power supplies. The master power module generates synchronization pulses and via Parallel Distribution Bus, each of the power modules in the array receives the signal. The frequency of the sync pulses is dependent on the output power being delivered to the load. In general, the frequency changes from 20kHz at no load to 300kHz at full load.

A shielded twisted pair should be used to distribute the SYNC signal (pins 13 and 14). The shield is to be connected to a common point for all units. All SYNC pins (13) of the units must be tied together and all SYNC RTN pins (14) must be tied together. On the input side, all power supplies should use the same three phase source.

9. MECHANICAL INTERFACE

DCX1000S is a base plate cooled type of power supply. It has to be mounted onto a cooling surface able to dissipate at least 200W at 85ºC. There are four mounting points intended for four 8-32 screws. The following Fig.6 shows the basic dimensions and mounting holes for the unit.

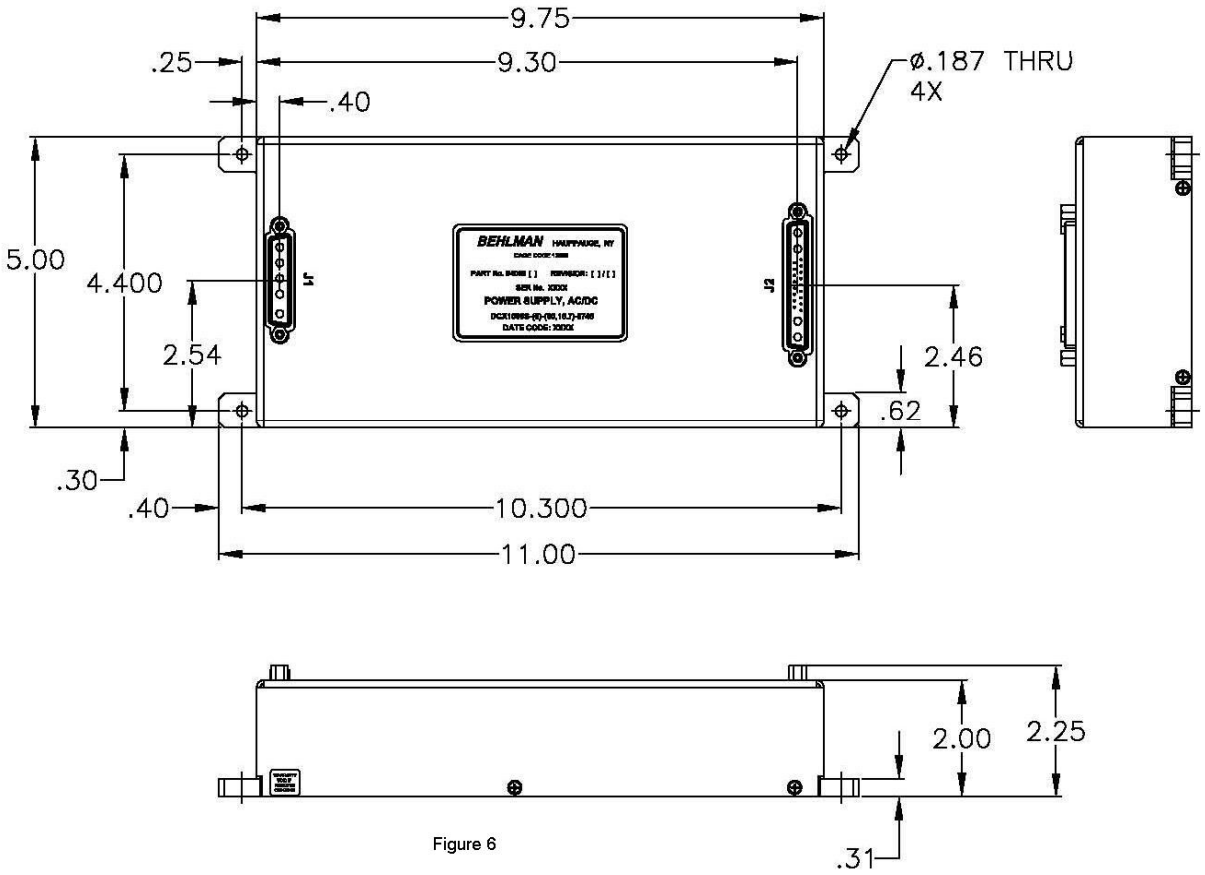


Figure 6

The power supply has a thermal pad attached to the mounting surface for a better heat transfer. After mounting the mating connectors to J1 and J2, proper mechanical hardware should be used to provide secure connection.

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