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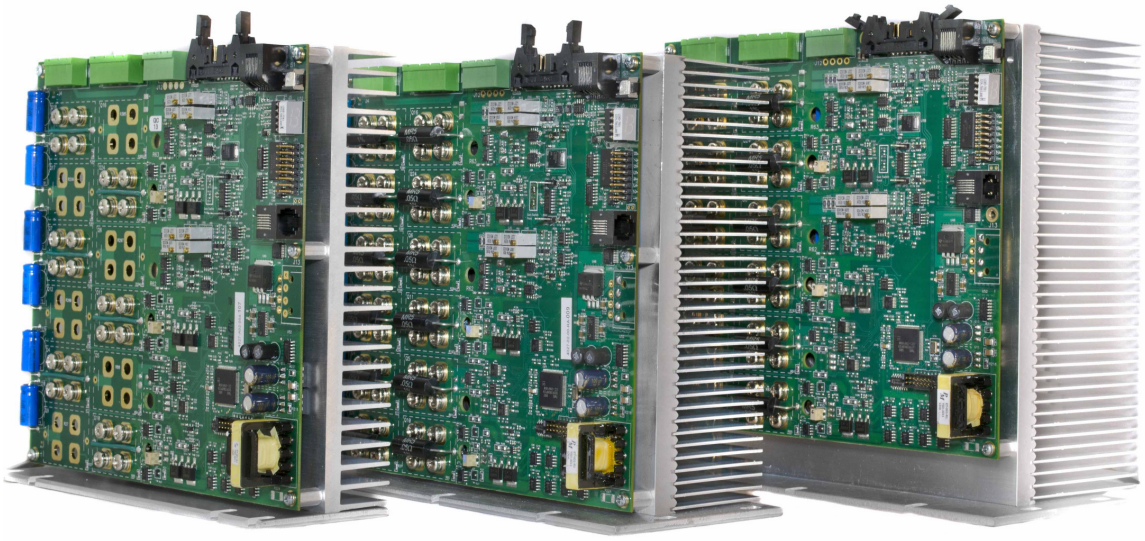

LALD Linear Servo Amplifiers

LALD-500 Series
LALD-800 Series
LALD-1500 Series

Technical Reference Manual

Manual Part Number: 4027-40 Rev. F

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Document Change History

Revision	Description
A	Original release
B	Review 1 changes
C	Review 2 changes
D	Add 15 and 20A versions
E	Change to 500, 800 and 1500 series
F	Add pictures and mechanical drawings

CAUTION! READ THIS SECTION BEFORE PROCEEDING.

- Warning! Potentially lethal voltages exist within the amplifier when power is applied. Never attempt to handle or probe the amplifier with power applied.
- This product contains static sensitive devices and requires proper handling with ESD protection.
- These amplifiers are capable of producing large amounts of energy. Serious injury or death can result from improper motor or load movement. The amplifier requires an external controller for Sinusoidal mode operation to commutate the motor properly.
-
- Do not connect the motor to the system load during initial testing and installation.
- These amplifiers require customer-supplied airflow for proper operation. Operation of the amplifier without proper cooling will void the warranty. Contact the factory for information on adequate airflow for your application.
- Be sure power is off when inserting or removing connectors or connections.
- For motors with a phase to phase inductance of less than 250uH, please consult the factory. A special set of current loop bandwidth components will need to be installed for safe operation of the amplifier.

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1 Introduction

The LALD (linear amplifier low drift) Linear Amplifiers are the next generation in our linear amplifier series. They are the perfect choice for systems requiring low radiated noise, low distortion, and minimal drift from the drive electronics. These high power current mode linear amplifiers are well suited to drive low inductance/resistance loads such as brushless and brush servomotors or voice coils. Commutation options include externally commutated 2-phase sine input, or single-phase control.

With their true class AB linear output stage, their design features pure analog control from input to output. The next generation current sensing method provides for extremely low drift over the operating range of the amplifier. Furthermore, sophisticated circuitry provides gain switching to allow very accurate low-level current (<500mA) control. This new design is inherently balanced and requires no extra setup or adjustment for proper operation.

The LALD amplifiers are both extremely quiet and provide the ultimate in zero crossover distortion for smooth output positioning. The design of these amplifiers includes an on board high speed DSP which monitors all key system functions in real time and provides protection for the outputs by only allowing output power within the “Safe Operating Area” of the output transistors. An intelligent user interface allows setup and storage of all system parameters via the serial interface. Non-volatile memory provides storage of the parameters during power off conditions.

1.1 Safe Operating Area

The LALD amplifiers include a sophisticated algorithm that protects the outputs from over power conditions. This algorithm is matched to the power characteristics of the output transistors in each amplifier model. With linear servo amplifiers (as opposed to PWM amplifiers), it is very important to provide over-power protection (rather than simple over-current protection) due to the linear nature of the output control. In the case of PWM amplifiers, only over-current protection is required since the outputs are operating in saturation mode or “full on mode”. This mode provides very little voltage drop across the output transistors, so simple current monitoring is sufficient to provide protection of the outputs.

With linear servo amplifiers, the outputs are operating in their linear region, so the voltage across the output transistors can be a substantial contribution to the total power dissipated by the device. To properly protect the amplifier from damage, the amplifier must provide protection by monitoring the power (voltage * current) in the output devices. To put this in perspective, the outputs used in our LA-415 (5A continuous, 15A peak) can handle 60A under the proper conditions! It’s the power that has to be kept under control.

The DSP in the LALD series amplifiers monitors the power of each output device in real time as the device is switched on by the control circuitry. This instantaneous power measurement is compared with the transistor manufactures recommended “safe operating area” curve (published in all transistor specifications) stored in the DSP memory. The amplifier is shut down in the event the measured power exceeds the recommended ratings of the output devices.

Our Safe Operating Area (SOA) algorithm has proven to be very effective in protecting the amplifier from damage due to over power conditions. While the user may experience “nuisance” tripping of the SOA protective function during system development and testing, be aware that the conditions that caused the “nuisance” trip may have very well have destroyed an amplifier without this SOA protection.

2 Specifications

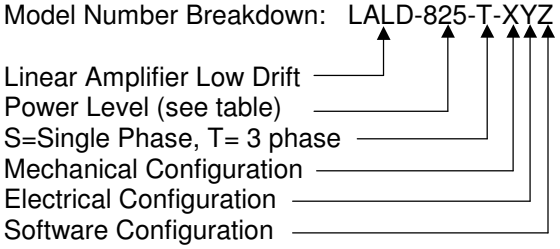
	LALD-525	LALD-540	LALD-825	LALD-840	LALD-1525	LALD-1540
Peak Output Current (A)	25	40	25	40	25	40
Cont. Output Current (A)	15	15	15	15	15	15
Peak Output Power (25°C) W	1900	3800	1900	3800	1900	3800
Continuous Power (25°C) W	500	500	800	800	1500	1500
Weight lbs.	4.25	4.30	4.75	4.80	5.50	5.55
Size - Height (inches)	2.612	2.612	3.871	3.871	4.871	4.871
Size - Length x Width (inches)	9.00 in. x 7.50					
Motor Bus Voltage – Bipolar	+/-12 to +/-150VDC*					
Bias Supply Voltage - Bipolar	+/-14.5 to +/-16.0V (@500mA each)					
Max. Heat Sink Temperature	70°C					
Current Loop Bandwidth*	up to 10kHz*					
Operating Modes	3-Phase using 2-Phase Sine Input or Single-phase					
Absolute Overcurrent Trip Time	50ms					
Command Signal	+/-20V Differential					
Transconductance	2.5Amps/Volt	4 Amps/Volt	2.5Amps/Volt	4 Amps/Volt	2.5Amps/Volt	4 Amps/Volt

*This setting can be customized. Please contact the factory for details.

3 Model Numbering

The LALD Series Linear Amplifier modules are available in various power options and in either single-phase or 3-phase models.

Model Number Breakdown: LALD-825-T-XYZ



4 Protective Features

DSP Fault – Set when the internal DSP checksum fails following reset

NVM Fault – Set when NVM checksum fails following reset. Parameter defaults set.

ABS Overcurrent – Set when instantaneous overcurrent condition is detected

SOA – Set when Safe Operating Area protection detects an over power condition

Bus Over Voltage – Set when Bus voltage is greater than maximum allowed (75 Vdc)

Fatal Error – Set if the DSP encounters an unidentified problem.

Amplifier Over Temp – Set when amplifier heat sink temperature exceeds 70 C.

RMS Overcurrent – Set when amplifier detects a continuous (RMS) overcurrent condition

Bus Under Voltage – Set when Bus voltage is less than the minimum allowed (10 Vdc)

Bias error – Set when Bias voltage input +/-15 is outside allowable range

5V Reference error – Set when internal 5V supply is out of range.

I2C Error - Set when an error is detected in the internal communication bus.

5 Operational Description

Before applying power to the amplifier be sure to read all sections in this document.

Upon power up of the +/- 15V bias supply, the amplifier derives all the necessary internal voltages for operation related to the logic and output drivers. Once the proper levels are achieved, the DSP is released from reset and begins operation. A series of internal checks are done to insure the DSP is operating correctly. The I/O is initialized for operation if these checks pass. The NVM is then read and the stored checksum is verified. The version and revision number for the software is flashed on the display and the serial sign on message is sent.

The initialization process is now complete and the software enters main loop processing.

During main loop processing, the software runs in an endless loop performing the tasks necessary for operation and fault monitoring. Once per pass in the main loop, the 7-segment LED is updated, the inputs are scanned and the protective algorithm calculations are performed. In addition to the main loop processing, interrupts are enabled to handle such actions as A/D processing for all system voltages and currents, and serial communication if used.

If at anytime during operation a fault occurs, the drive will immediately disable the output stage, set the Fault output active and display the fault code on the LED display. A message will also be sent over the serial interface annunciating the fault. .

Note that bias power (+/-15V) is always required for the drive to operate. Bus power is only required if a motor is to be used. This allows the drive to be set up away from the actual system using only the bias supply.

6 User Configurable Settings

6.1 Absolute Over Current Trip Point

This setting determines the instantaneous (<50mS) trip level for current. If any phase current reaches and maintains the set level for more than 50mS, the drive is disabled and the fault is set.
See the ABSLevel command for more information. See Section 2 for ratings.

6.2 RMS Over Current Trip Point

This setting determines the trip point for the continuous or RMS over current trip function. Once the set level is reached by any phase, an internal timer is started and if the current remains at or above the set level for the amount of time set by the RMSTime setting, the drive is disabled and the fault is set. See the RMSLevel command for more information. See Section 2 for ratings.

6.3 RMS Over Current Time

This setting determines trip time for the continuous or RMS over current trip function. Once the set level is reached by any phase, an internal timer is started and if the current remains at or above the set level for the amount of time set by the RMSTime setting, the drive is disabled and the fault is set. See the RMSLevel command for more information. Note that this is an accumulative timer with a 1x accumulation rate and and 2x decay rate. That means that if the current is above the RMSLevel for 2 seconds and the time is set to 4 seconds, it will take a 2*2 or 4 seconds for the timer to clear to 0 before the 4 seconds is reset. This feature is needed to properly simulate the heating effect of the applied current. Whenever the drive is in RMS "pickup" (current is above trip level and timer is running), the "." on the display will be on. the "." will remain on until the timer decays to 0 or the drive trips.

6.4 Enable Level

This setting determines the active state of the hardware enable input. If EnableLevel=1 a high (3-5vdc) is needed at the enable input to enable the drive and a "0" will disable the drive. If EnableLevel=0 a low (0vdc) is needed at the enable input to enable the drive and a "1" will disable the drive. See the EnableLevel command. Note the default hardware configuration has a 10k ohm pullup to +5vdc on Enable.

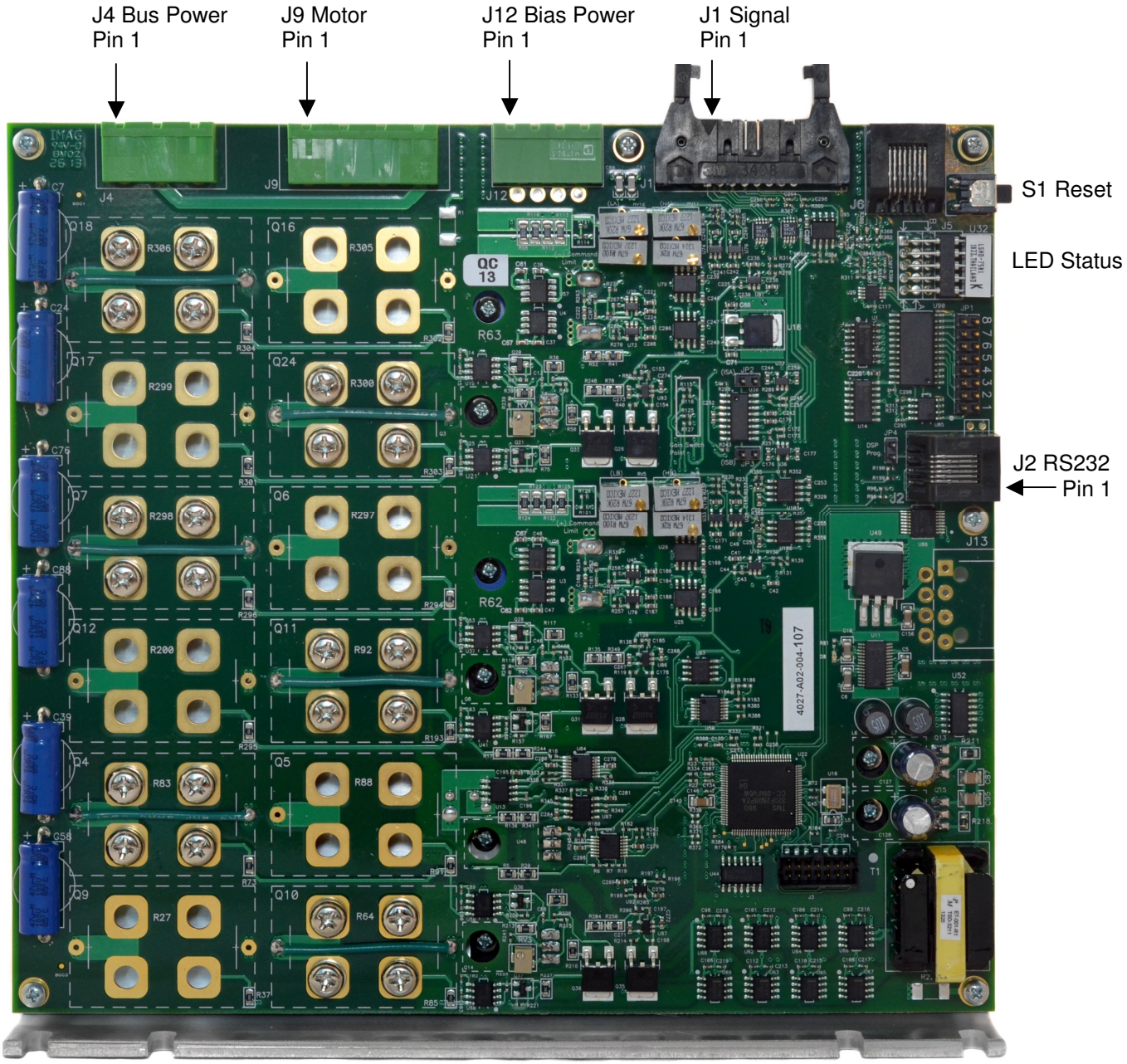
6.5 External Enable

This setting determines the source for the enable. If ExtEnable=1 then the hardware enable input is used to enable and disable the drive (External Enable = true). If ExtEnable=0 then the software command Enable or En is used to enable the drive. If ExtEnable =1 then the EnableLevel setting determines the active level for enable. See the ExtEnable command.

6.6 Fault Level

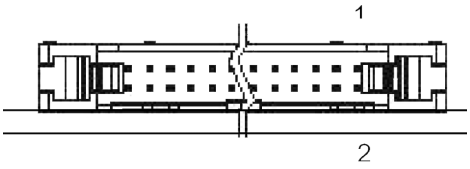
This setting sets the active level for the Fault output. If FaultLevel=1 then the fault output will be active high (5vdc) when a fault is present, and 0 if no faults are present. If FaultLevel=0 then the fault output will be active low when a fault is present and high if no faults are present. See the FaultLevel command.

7 Connector Locations



8 Connector Pin Designations

All views are looking into the connector.



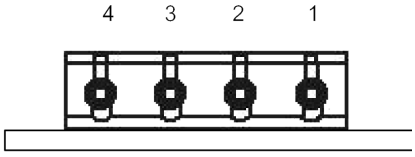
8.1 J1 Signal Connector

Pin	Function
1	Phase A+ Current Command Input. Range is +/-10vdc.
2	Phase A- Current Command Input. Range is +/-10vdc.
3	Phase B+ Current Command Input. Range is +/-10vdc.
4	Phase B- Current Command Input. Range is +/-10vdc.
5	IA Mon – Current A monitor. Output voltage representing: 1V=-4A (LALD-x40), 1V=-2.5A (LALD-x25)
6	Common (Ground)
7	IB Mon – Current B monitor. Output voltage representing: 1V=-1A (LALD-x10), 1V=-2.5A (LALD-x25)
8	Common (Ground)
9	IC Mon – Current B monitor. IC Mon= - (IA Mon + IB Mon)
10	Spare I/O
11	Enable Input – Internally pulled high (5V). Use EnableLevel for active level. Range is 0 to +5vdc
12	Spare I/O
13	Fault Output - Use FaultLevel command to set the active level. Range is 0 to +5vdc (1mA source max)
14	Spare I/O
15	Reset Input– Ground input to reset drive. Internally pulled high (5V).
16	Common (Ground)

Note: Inputs are 0 to 5vdc compatible, pulled high to +5 through 10k ohm resistor.

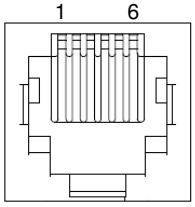
8.2 J12 or J13 Bias Power Connector (Populate option)

Pin	Function
1	+15 Volts DC in
2	Common (Ground)
3	Common (Ground)
4	–15 Volts DC in

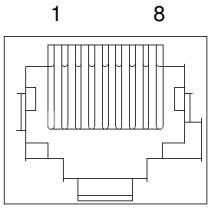


8.3 J2 RS-232 Serial Connector RJ12

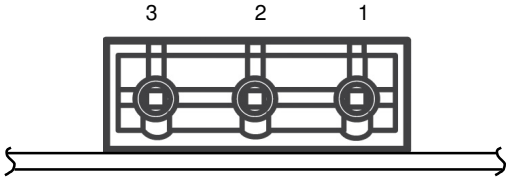
Pin	Function
1	Spare I/O
2	RXD (data into drive out from host)
3	TXD (data out from drive into host)
4	Common (Ground)
5	DSP Program (Leave open normally)
6	Common (Ground)



8.4 J6 Not Used

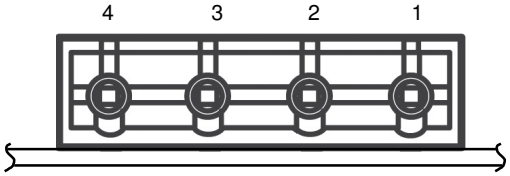


8.5 J4 Bus Power Connector



Pin	Function
1	+Bus Power
2	Bus Common (Ground)
3	–Bus Power

8.6 J9 Motor Phase Connector



Pin	Function
1	Phase A Output
2	Phase B Output
3	Phase C Output
4	Motor Ground (for cable shield and/or FG connection if used) (J9 pin 4 is internally connected to amplifier common or ground)

8.7 Mating Connector Part Numbers

J1 Command
Standard 8x2 0.1in IDC or Crimp (Many options here. These are just examples)
1) TE - 1658622-3 and 499252-8
2) TE - 102387-3 and 6-87523-9

J2 RS232
Standard 6p6c RJ12 (Many options)

J4 Bus
1) Phoenix Contact – 1767012
2) On-Shore Tech - EDZ960/3
3) TE Connectivity - 796981-3
4) Amphenol - ELFP03410

J6
Standard 8p8c RJ45 (Many options)

J9 Motor
1) Phoenix Contact – 1767025
2) On-Shore Tech – EDZ960/4
3) TE Connectivity - 796981-4
4) Amphenol – ELFP04410

J12/J13 Bias
1) Phoenix Contact – 1757035
2) On-Shore Tech - EDZ950/4
3) TE Connectivity - 796634-4
4) FCI - 20020007-H041B01LF

9 User Interfaces

9.1 Push Button

The push button S1 is used for the Reset function. Pressing and releasing this button will reset the drive. The reset function is performed on the release of the button.

The push button can also be used during a power-on-reset to display the full part number of the software. To use this feature, hold the push button in while applying bias power. The display will begin flashing the full part number. Release the button before the part number display completes. See the section on Software Version Display below.

9.2 LED Display

The LED Display indicates the status of the drive. Following a reset or POR, the LED will flash all segments as a check to make sure they are working. The display will blank briefly (1/2 sec.) and the drive status or a system fault will be indicated. The drive is fully functioning when the status is shown (“C” or “0”). When a fault is shown, the drive is disabled and cannot be enabled until the fault is cleared. For most faults, a Reset (software or hardware) or AlarmReset command is needed to reset the fault. A Bus Undervoltage (U) fault will be automatically cleared when the bus is at the proper operating voltage. A Fatal Error (F) can only be cleared by a power on reset of the amplifier.

9.3 Software Version Display

The full part number of the DSP software can be displayed during power-on-reset by holding in the push button and applying bias power. The part number will be displayed in the following format:

Example: 4027-1.01.02

“4027”= Varedan Technologies product code

“1” = Software Version linked to Hardware version

“01” = Major Software Version (major changes to features, change operational behavior)

"02" = Minor Software Version (bug fixes)

.

9.4 L.E.D. Error Codes and Meaning

The following table lists the L.E.D. error codes and their meaning. If multiple errors are present, the display will cycle through all the error codes, displaying each for ½ second.


Amp ok, motor current enabled. This is the “normal” display when enabled.

DSP Fault – Set when the DSP checksum detects an internal fault


NVM Fault – Set when NVM checksum fails following reset. Parameter defaults are set.


I^2C Fault – Set when I^2C interface detects a fault.


Undefined Fault - Contact factory.


ABS Overcurrent – Set when instantaneous overcurrent condition is detected


SOA – Set when Safe Operating Area protection detects over power


+5 VDC Reference error – Set when internal +5 reference supply is out of range


Bus Over Voltage – Set when Bus voltage is greater than the programmed trip level. (Note: Each leg (+ and -) is checked against this value.)


Amp ok, not enabled (Output is Clamped off). This is the normal display when the amplifier is not enabled.


Fatal Error – Set if the DSP encounters an unidentified problem.


Amp Over Temp – Set when the heat sink temperature is above 70 C.


Overcurrent – Set when amplifier detects an overcurrent condition (“L”ow speed circuit breaker)


Bus Under Voltage – Set when the Bus voltage is less than +/-9 Vdc. (Note: Each leg (+ and -) is checked against this value.)


Bias error – Set when Bias voltage input +/-15 is outside allowable range. Note: The tolerance of this supply must be within +/-1.00vdc on each leg of the bias input (+14 to 16vdc and –14 to –16vdc)

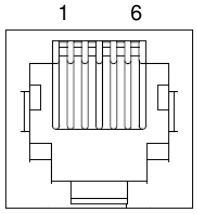

(Decimal point on) Indicates an Overcurrent trip pending

9.5 Serial Port

J2 is the RS232 communication port. A built in operating system in the DSP allows setting and viewing of all parameters and switch settings via a dumb terminal interface such as Windows Hyper Terminal. An on board NVM chip stores the serial parameter settings for recall on next power up of following a reset.

The communication settings are 38.4 Kbaud, 8 data, 1 stop, no parity, no handshake. The pin out for the cable to connect to a standard PC serial port as a DTE device is as follows.

J2 Pin		DB9-F Pin
2	←	3 RXD (data into LALD amplifier out from host)
3	→	2 TXD (data out from LALD amplifier into host)
4		5 Common (Ground)



J2 RJ12

9.5.1 Serial Commands

The following commands are supported over the serial port communications interface. Commands are shown in bold. All commands entries are terminated with a Carriage return character <Cr> (<Enter> on most keyboards). Commands are not case sensitive and can be a mix of upper and lower case.
For commands with a data field, the data is entered after either a ":" or "=" followed by the numerical data.
Example: ExtEnable:1 <Enter> or ExtEnable=1 <Enter>

ABSLevel:nn Sets the absolute over current circuit breaker. The range for nn is 0 to the peak current rating of the amplifier model. This is an instant trip function. See Section 2 for ratings. For 25A models, max nn=25. For 40A models, max nn=40.

.

AlarmReset This command resets the alarm status. Note: When an alarm is detected the drive is immediately disabled.

Defaults ⚠ Caution: This command will reset all internal parameters to factory defaults. This will erase amplifier specific settings and can result in undesired behavior. Do not use this command unless instructed to do so by an applications engineer.

Dis or **Disable** Disables the amplifier.

En or **Enable** This command is used to enable the drive (current to motor) when ExtEnable is 0. The LED display should display "0" after entering this command unless an error is present.

EnableLevel: n This command sets the active level for the hardware enable input. Entering 0 sets the level to active low. Entering 1 sets the level to active high.

ExtEnable: n Sets the enable source to external (1) or internal software (0).

Faults? Show any faults present.

FaultLevel :n This command sets the active level for the Fault output. Entering 0 sets the active Fault output to low for a fault condition. Entering 1 sets the active Fault output high for a fault condition.

Help This command lists a summary of commands.

List This command lists all the user settable parameters and system readings to the display. The enable and alarm status are also shown.

Reset This command causes the drive to perform a power on reset.

RMSLevel:nn Sets the low speed circuit breaker trip level in amps. The range of nn is 0 to the continuous current rating of the amplifier model. See Section 2 for ratings.

RMSTime:nn Sets the trip time, in seconds, for the low speed circuit breaker. When the timer is running (current above the RMSLevel), the decimal point on the LED display is on. Maximum value for nn is 10.

ShowTrip This command displays the last saved SOA trip information from NVM. In the event of an SOA trip, all the system parameters related to the trip are stored. This information is useful to the factory for troubleshooting SOA events.

Write This command saves the user selectable parameters to NVM.

9.5.2 Example Serial Interface Communication

A ">" character will be shown when the amplifier is ready to receive a command. This is our prompt character. When the amplifier is first powered on, or following a reset, the sign-on message is displayed, similar to the following, followed by the prompt. When the <Enter> key is hit, a new prompt appears on the next line.

```
Varedan Technologies 4027-2.01.00
>
```

Commands can now be entered. The amplifier will echo all typed characters. Example, to set the enable level to 0, type the following as shown. The amplifier will return a ">" prompt when the command has been processed and is ready for the next command.

```
Varedan Technologies 4027-2.01.00
>
>EnableLevel:0
>
```

The active enable level is now set to 0.

Example, to set the fault level to 1, type the following:

```
Varedan Technologies 4027-2.01.00
>
>EnableLevel:0
>FaultLevel:1
>
```

The fault level is now active high.

When a fault occurs, a message will be displayed as well as an error code shown on the LED display. An example fault message is shown below:

```
Varedan Technologies 4027-2.01.00
>
>EnableLevel:0
>FaultLevel:1
>SOA Fault
>
```

Use the alarmreset command to clear a fault condition:

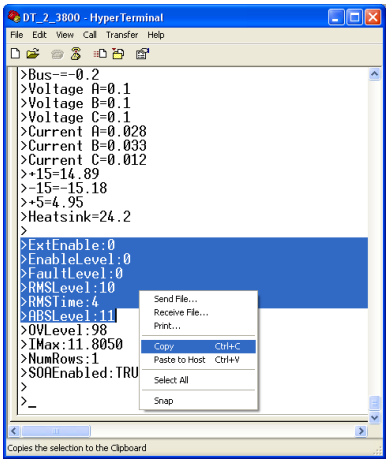
```
Varedan Technologies 4027-2.01.00
>
>EnableLevel:0
>FaultLevel:1
>
>SOA Fault
>AlarmReset
>
```

If the fault is no longer present, the amplifier can be enabled again.

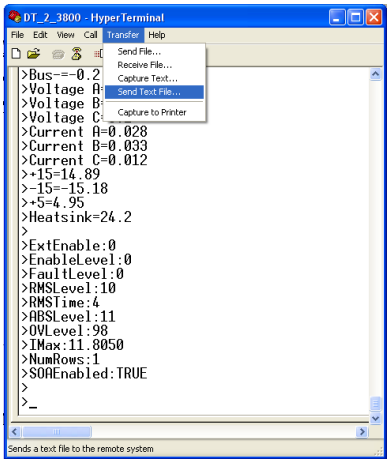
An example of the List command output is shown below. All voltages, currents and user settings are shown in the listing.

```
>LIST
>Version:2.01.00
>Bus+=0.4
>Bus-=-0.2
>Voltage A=-0.0
>Voltage B=-0.0
>Voltage C=-0.0
>Current A=0.040
>Current B=0.044
>Current C=0.005
>+15=14.88
>-15=-15.17
>+5=4.96
>Heatsink=22.0
>
>ExtEnable:0
>EnableLevel:0
>FaultLevel:0
>RMSLevel:10
>RMSTime:4
>ABSLevel:11
>OVLevel:98
>IMax:11.8050
>NumRows:1
>SOAEnabled:TRUE
```

A feature of the serial port List command is the ability to store the settings in a text file for use in another amplifier or to save a particular setup. From the List output on your dumb terminal interface, highlight the lower section starting with ExtEnable:0 down through ABSLevel (the remaining settings are factory locked). Once higlighted, right click on the section and select "Copy". The open a text file and paste the settings into that file and save it. To download these settings to another amplifier, use the text transfer utility for the dumb terminal program you are using. For example, Hyperterminal, select "Transfer" from the top menu, then select "Send Text File". Navigate to the file with the desired settings and click "Ok". The file should be sent directly to the amplifier. Be sure to issue a Write command to save the settings. Alternatively, the Write command can be added to the end of the text file so it would be sent following the settings.



Highlight and Copy the settings to a file



Transfer saved settings from a file

10 Mechanical Dimensions

Figure 1. LALD 525, 540 Dimensions

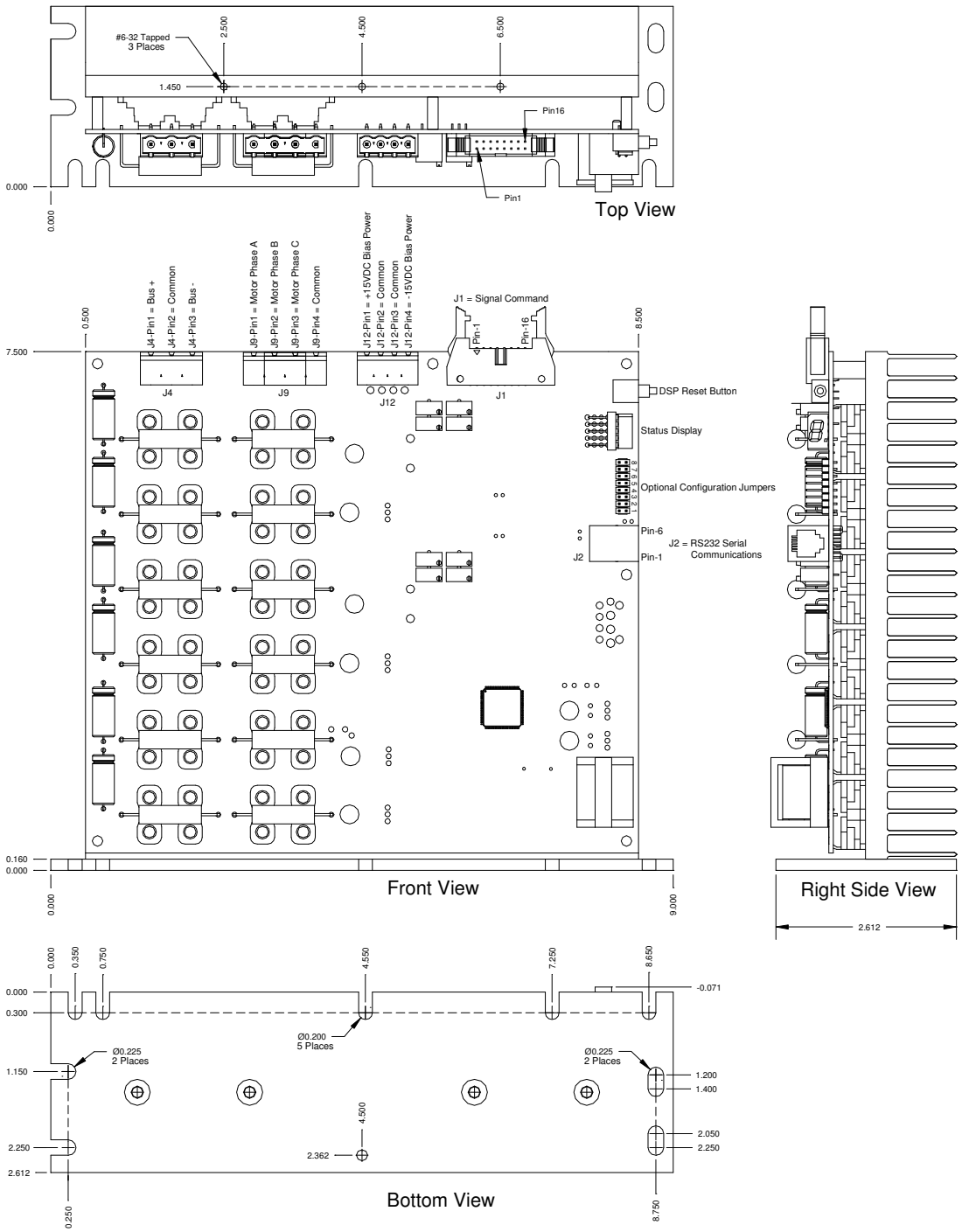


Figure 2. LALD 825, 840 Dimensions

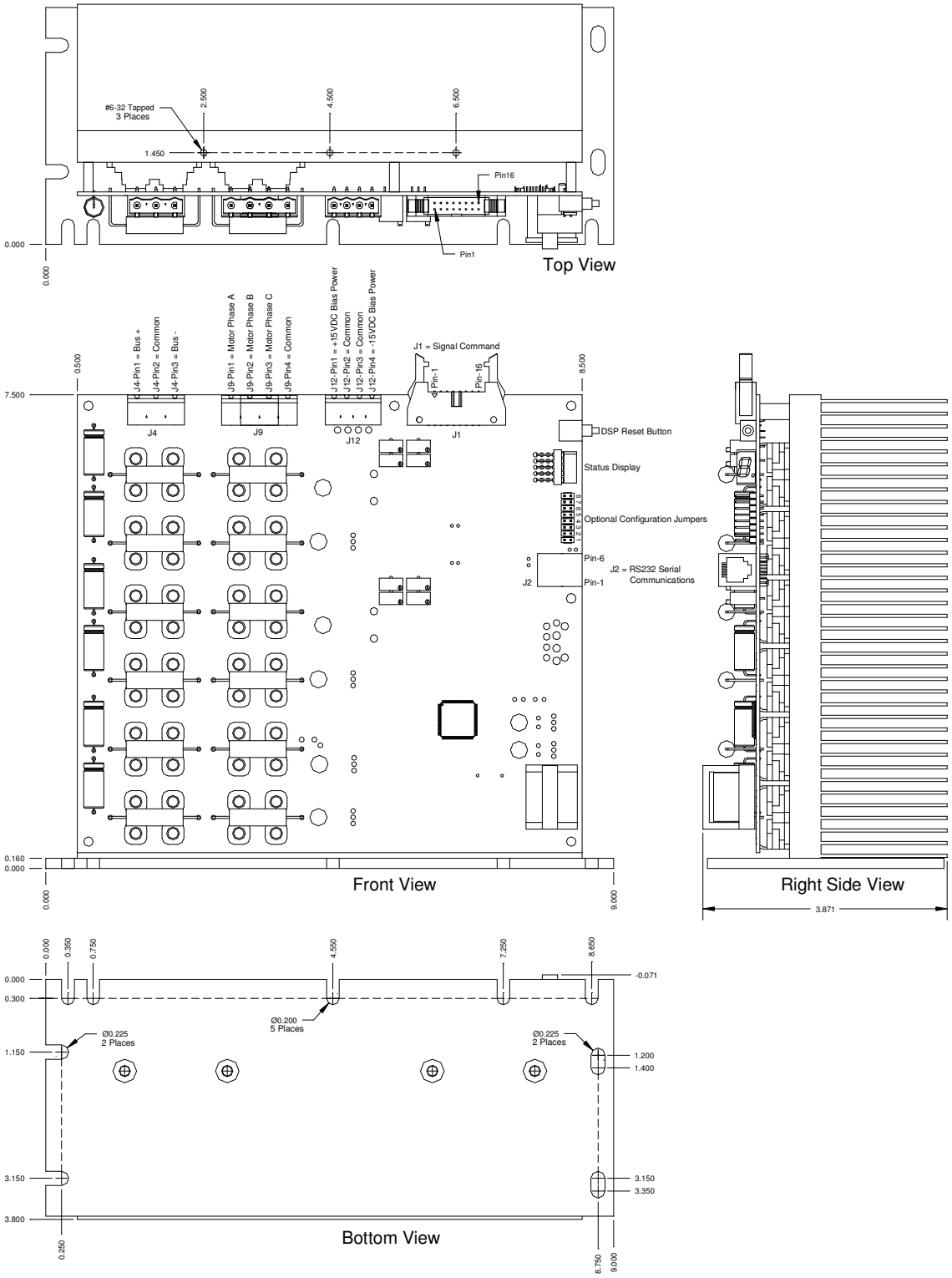
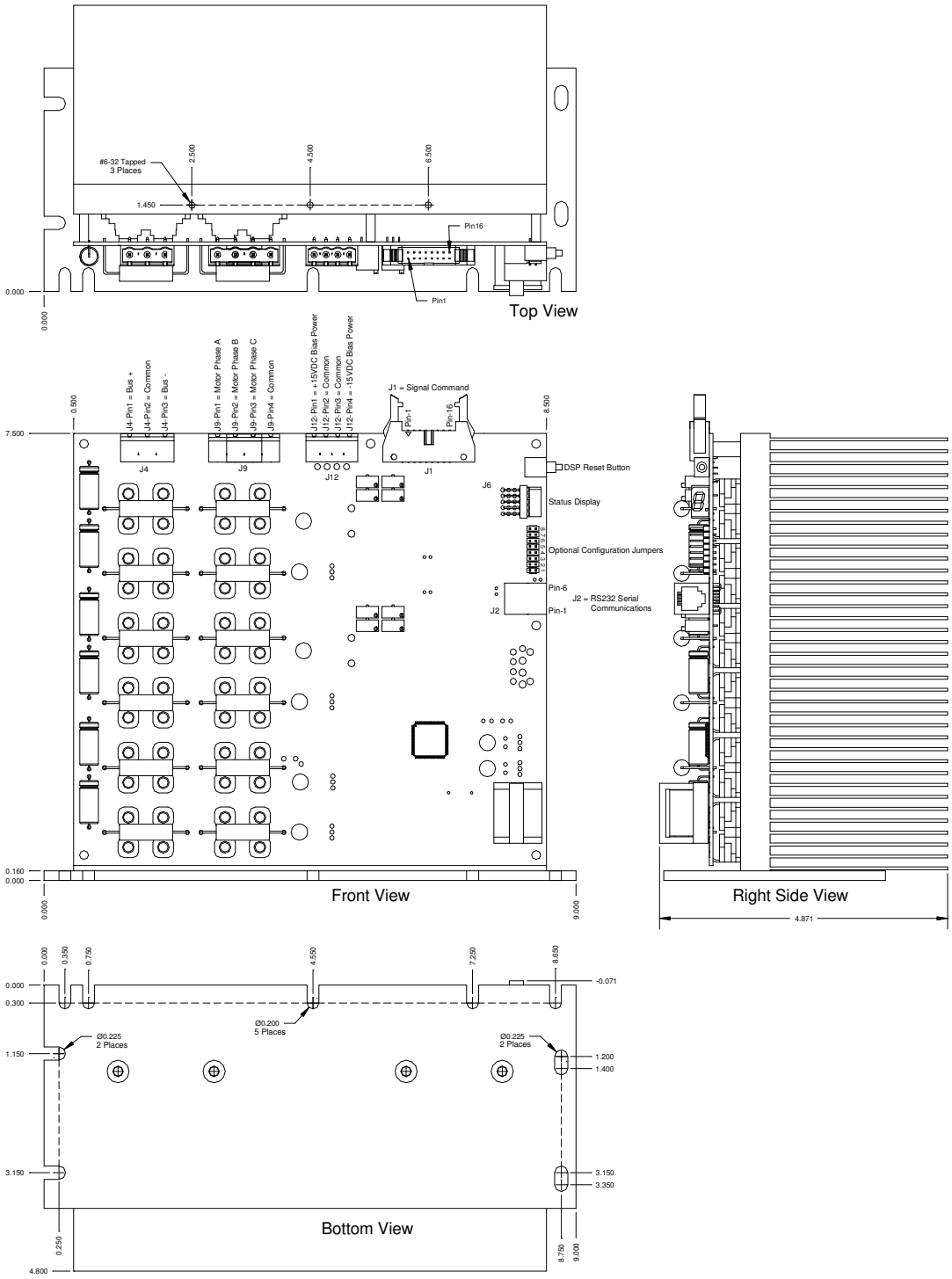


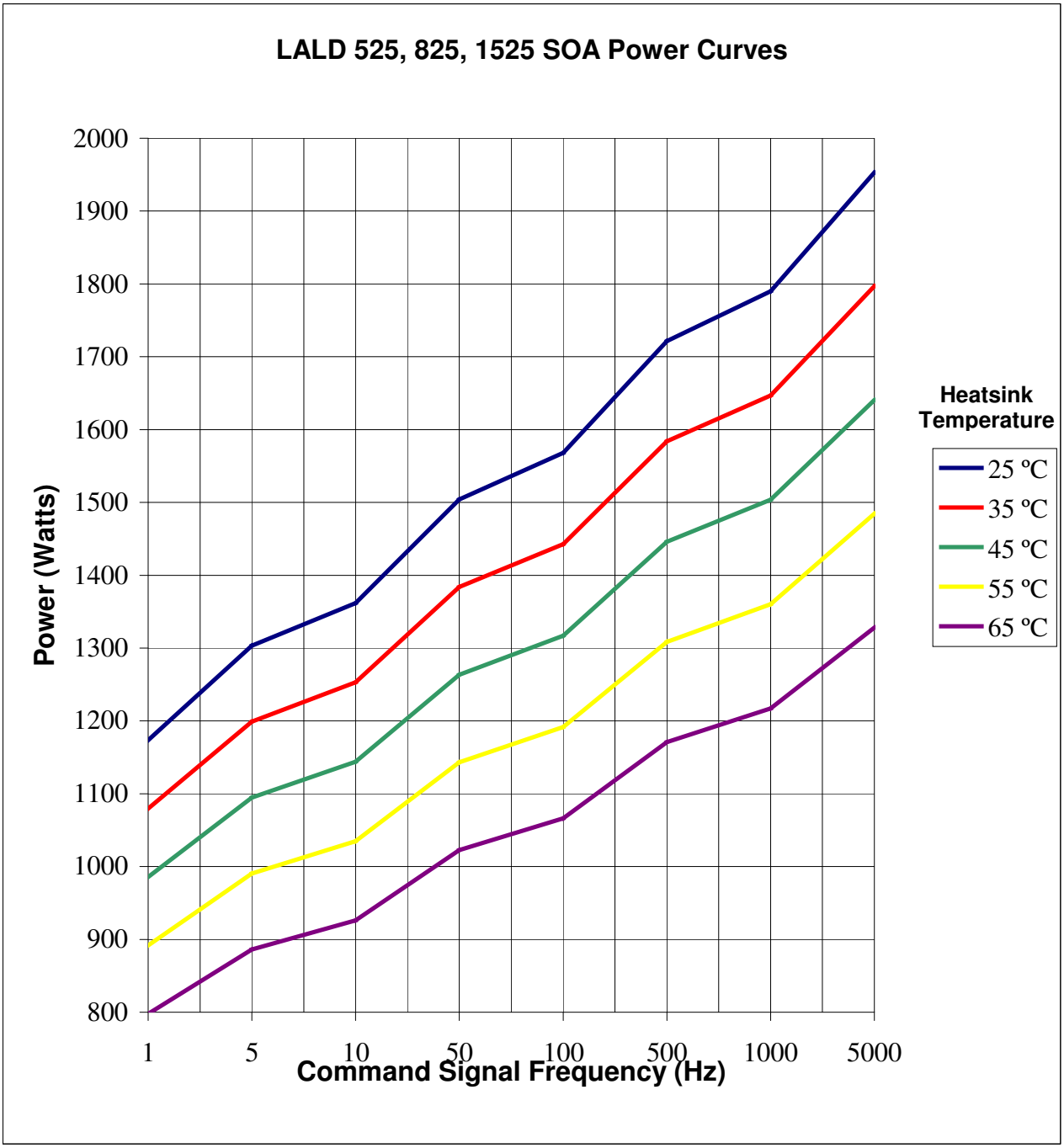
Figure 3. LALD 1525, 1540 Dimensions



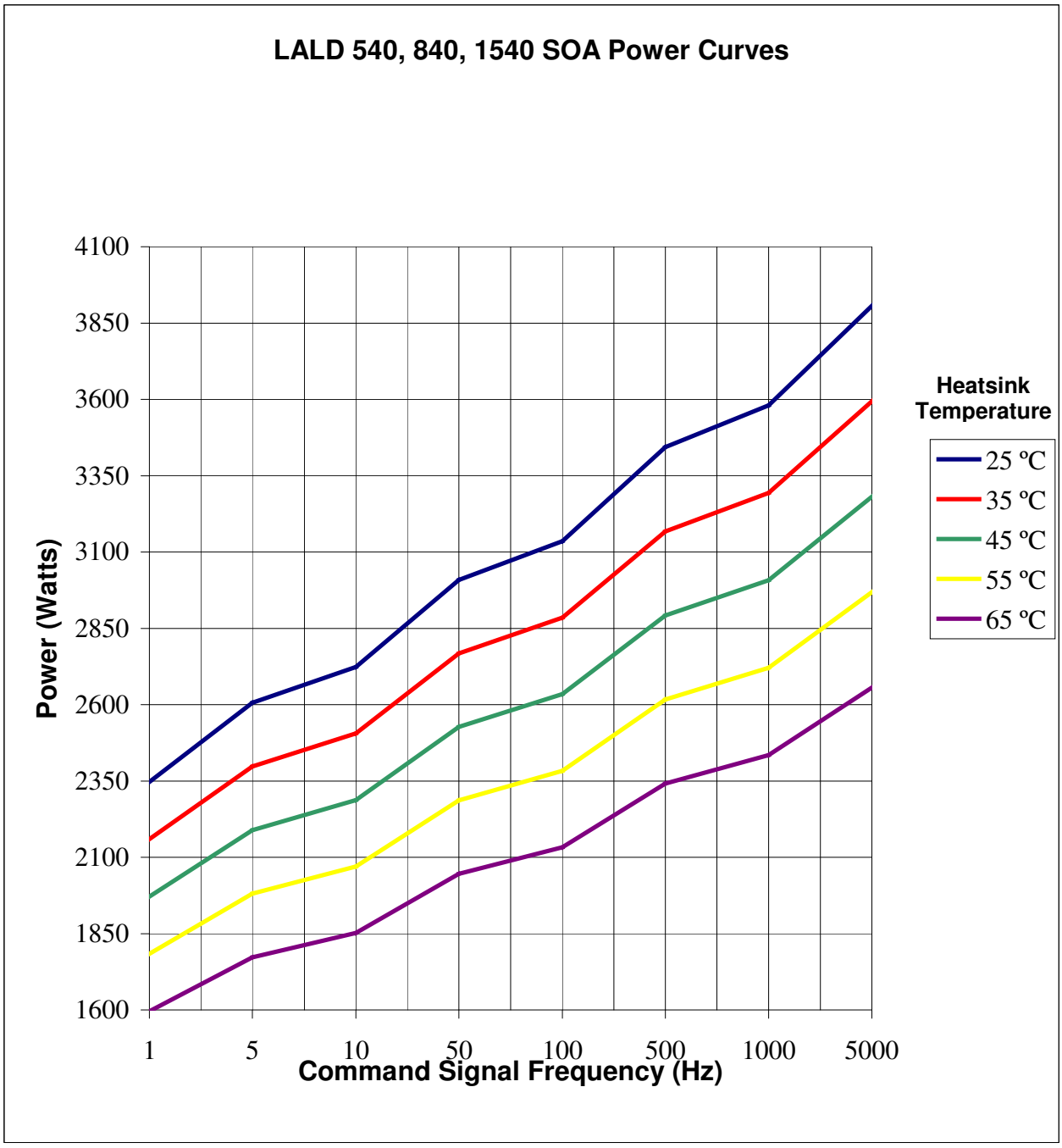
11 SOA Power Curves

The following charts show the allowable peak SOA power based on input signal frequency and heatsink temperature.

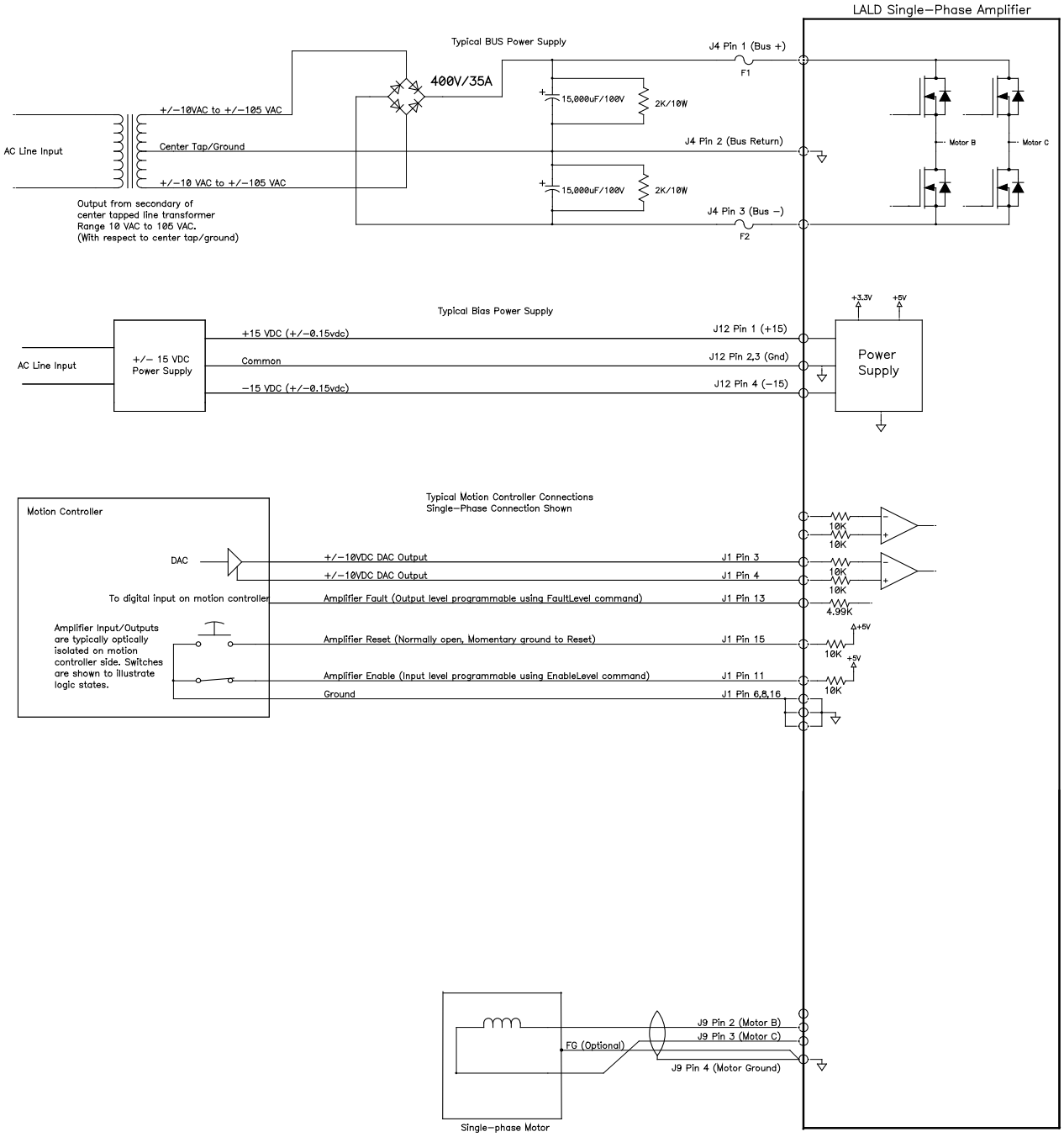
11.1 LALD 525, 825, 1525 SOA Power Curves



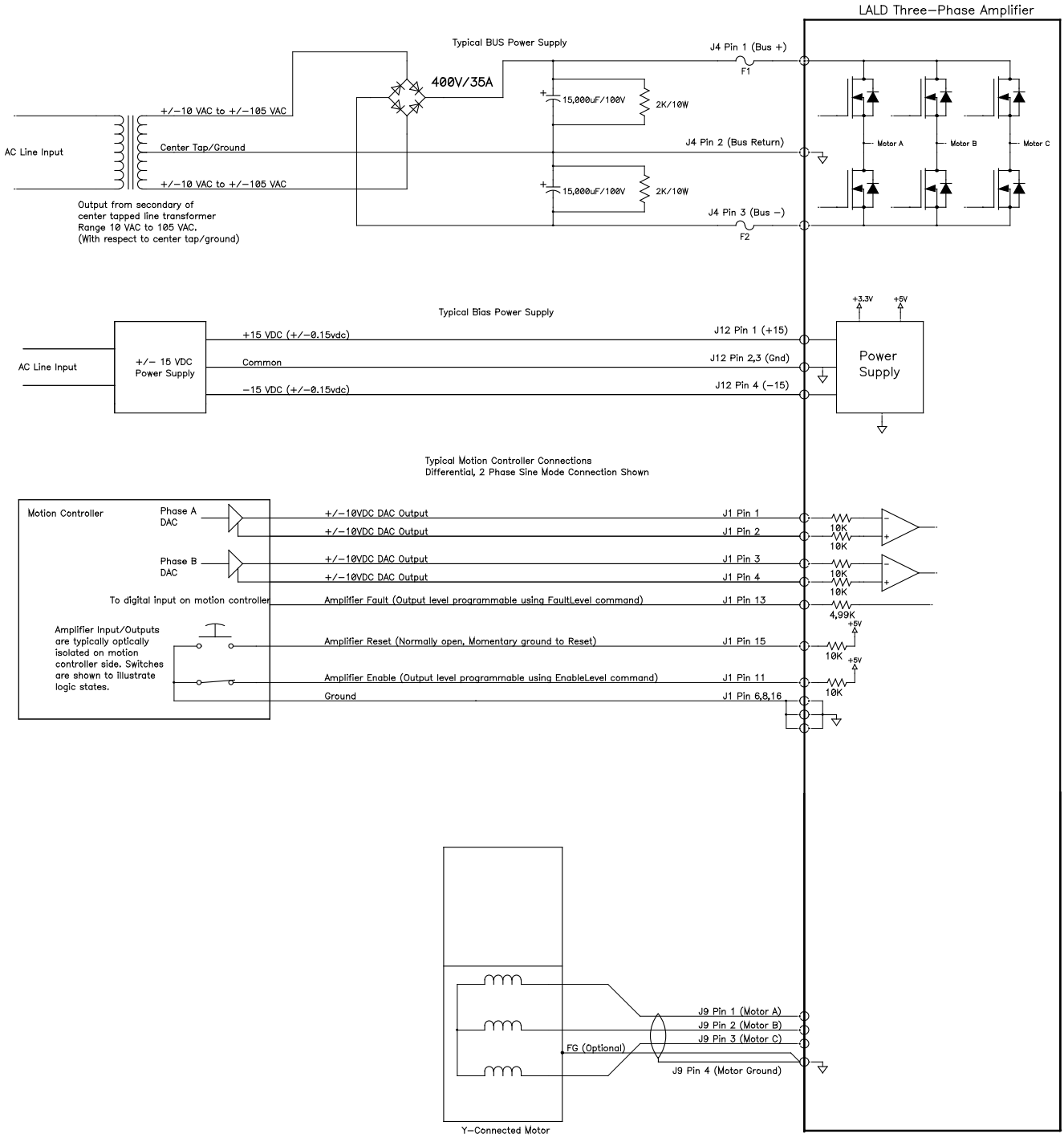
11.2 LALD 540, 840, 1540 SOA Power Curves



12 Typical Single-Phase Connections



13 Typical 3-Phase Connections



14 Warranty & Contact Information

Varedan Technologies warrants this product to be free of manufacturing defects for a period of 1 year.
If your product requires service, please contact our factory for troubleshooting information and if needed, return material authorization (RMA) information.

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