Analog Inputs
- ±10 Vdc current reference
- Peak, continuous current & peak-time set

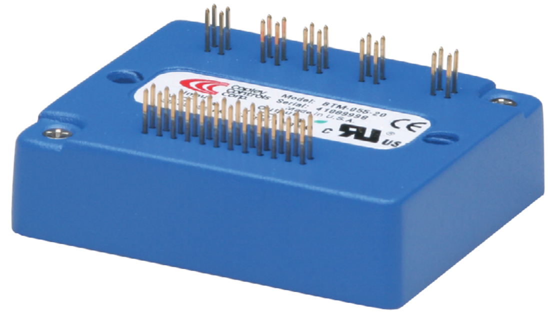
Analog Outputs
- Current monitor
- Current reference

Digital Inputs
- Amp Enable
- Fwd/Rev Enable (limit switches)
- Hi/Lo load inductance

Digital Outputs
- Amp OK
- Regen control
- Brake control

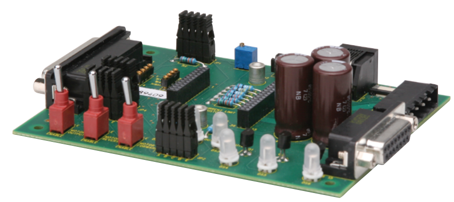
Feedback
- Digital Halls from brushless motors

Dimensions
- 53.3 x 45.7 x 15.2 mm
- 2.1 x 1.8 x 0.6 in



Actual Size

Model	Vdc	Ic	Ip
BTM-055-20	12~55	10	20
BTM-090-10	20~90	5	10



DEVELOPMENT KIT

DESCRIPTION

Bantam is a compact, DC powered analog current amplifier for torque control of DC brush or brushless motors. It operates as a stand-alone driver taking a ±10V input from an external controller. Mounting to a PC board with solderless connectors facilitates low-cost, multi-axis designs.

The Amp Enable input interfaces to active LO signals up to 24 Vdc. Another digital input switches the current-loop gain from a high to low for load inductance compensation. Forward and Reverse Enable inputs are provided for limit switches.

A digital output for Amp-OK indicates the amplifier’s status. There are two other digital outputs one of which can activate an external regenerative energy dissipator circuit and another for motor brake control.

Digital Hall feedback enables trapezoidal drive of DC brushless motors. For driving DC brush motors, these inputs are left unconnected and the motor connected between the U & V outputs.

Protections include I2T current limiting for peak and continuous current as well as peak time. Short circuits between outputs or to ground and amplifier over-temperature produce latching faults.

A Development Kit is available that provides mounting and easy connectivity for the Bantam.

GENERAL SPECIFICATIONS

Test conditions: Load = Wye connected load: 2 mH + 2 Ω line-line. Ambient temperature = 25°C, +HV = HV_{max}

MODEL	BTM-055-20	BTM-090-10	
OUTPUT POWER			
Peak Current	20	10	Adc, ±5%
Peak time	1	1	Sec
Continuous current	10	5	Adc, ±5%
Peak Output Power	1045	855	W
Continuous Output Power	523	427	W
Output resistance	0.075	0.075	Rout (Ω)
Maximum Output Voltage	Vout = HV*0.97 - Rout*Iout		
INPUT POWER			
HV_{min} to HV_{max}	+12 to +55	+20 to +90	Vdc, Transformer-isolated
Ipeak	20	10	Adc (1 sec) peak
Icont	10	5	Adc continuous (Note 1)
PWM OUTPUTS			
Type	3-phase MOSFET, 33 kHz		
Commutation	Trapezoidal using digital Hall feedback		

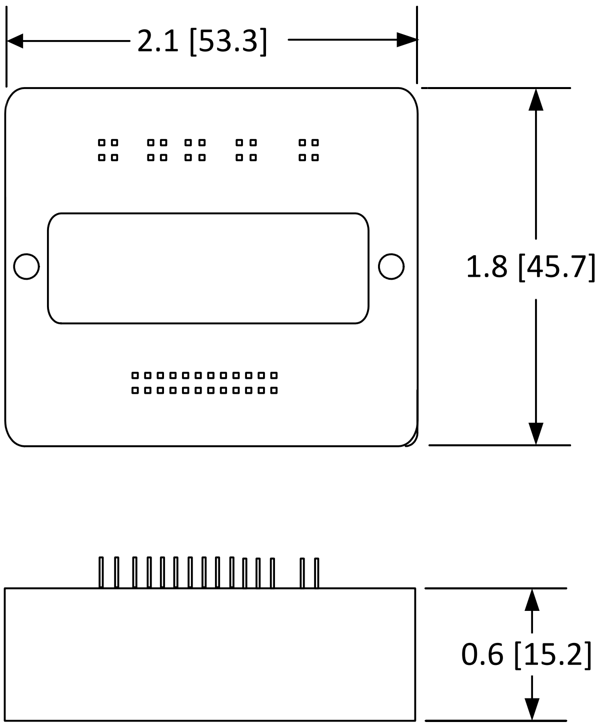
CONTROL	
Analog Reference Input	±10 Vdc, 100 kΩ differential input impedance
Bandwidths	Current loop: 2.5 kHz typical, bandwidth will vary with tuning & load inductance
Minimum load inductance	200 µH line-line
FEEDBACK	
Digital Halls	3, non-isolated, for brushless motor commutation 10 kΩ to +5 Vdc pull-up with 33 µs RC filter to 74HC14 Schmitt trigger
Power	+5 Vdc @ 250 mA max. (J1-21, 22) to power Hall sensors or commutating encoder
DIGITAL INPUTS	
Number	4
[IN1] /Enable	Amplifier enable, LO active, HI disables
/PosEnab, /NegEnab	Forward and reverse direction limit switch/enable inputs: HI will disable output current in direction
Type	74HC14 Schmitt trigger operating from +5 Vdc with RC filter on input Vin-LO < 1.35 Vdc, Vin-HI >3.65 Vdc, input voltage range 0 to +24 Vdc 10 kΩ to +5 Vdc pull-up, 74HC14 Schmitt trigger operating from +5 Vdc with RC filter on input 74HCT, Vil = 0.8 Vdc max, Vih = 2.0 Vdc min, input voltage range 0 to +24 Vdc
[LoInd] Low Inductance	HI or open: for higher inductance loads, LO or grounded: for lower inductance loads
ANALOG INPUTS	
Number	5
Ref(+), Ref(-)	Command input for output current demand, ±10 Vdc
Peak Current Limit	0.5 to 4.80 Vdc sets peak current limit from 10~100% of rated peak current
Continuous Current Limit	0.5 to 4.87 Vdc sets continuous current limit from 10~100% of rated continuous current
I2T Limit	0.5 to 5.00 Vdc sets 10~100% of I2T time
Balance	±2.5 Vdc from the 2.5 Vdc quiescent state will adjust output current ±1% of peak rated current
DIGITAL OUTPUTS	
Number: type	3: N-channel MOSFET, open-drain, 30 Vdc max, 100 mA max for [AOK] and [OUT1], 1000 mA for [OUT2]
[AOK]	Amp OK: active LO when amplifier has no faults and will operate when enabled
[OUT1]	Configured as external regen switch controller: will be LO to turn on regen switch
[OUT2]	Brake control (external flyback diode required): will be LO when AOK and is enabled to release brake
ANALOG OUTPUT	
Current Monitor	±3.0 Vdc @ ±Ipeak
Current Ref	Monitor for current-loop command: ±3.0 Vdc = ±100% of rated peak current

NOTES

1) Heatsink is required for continuous current rating.

MOTOR CONNECTIONS	
Phase U, V, W	PWM outputs to 3-phase ungrounded Wye or delta wound brushless motors, or DC brush motors (U-V)
Hall U, V, W	Digital Hall signals, single-ended
Hall power	+5 Vdc ±2% @ 250 mAdc max
PROTECTIONS	
HV Overvoltage	+HV > HV_{max}, Amplifier outputs turn off until +HV < HV_{max} (See Input Power for HV)
HV Undervoltage	BTM-090-10: +HV < +20 Vdc, Amplifier outputs turn off until +HV > +20 Vdc
	BTM-055-20: +HV < +12 Vdc, Amplifier outputs turn off until +HV > +12 Vdc
Amplifier over temperature	Heat plate > 70°C
Short circuits	Output to output, output to ground, internal PWM bridge faults
I^2T Current limiting	Programmable: continuous current, peak current, peak time
MECHANICAL & ENVIRONMENTAL	
Size	2.1 x 1.8 x 0.6 [53.3 x 45.7 x 15.2] in [mm]
Weight	Amplifier: 0.082 lb [0.037 kg], heatsink 0.113 lb [.051 kg]
Ambient temperature	0 to +45 °C operating, -40 to +85 °C storage
Humidity	0 to 95%, non-condensing
Contaminants	Pollution degree 2
Environment	IEC68-2: 1990
Cooling	Conduction through heatplate on amplifier chassis, or convection

AMPLIFIER DIMENSIONS

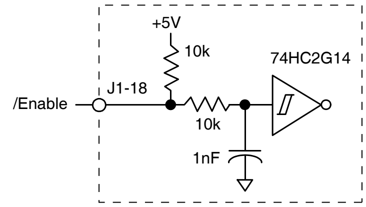


Dimensions in inches [mm]

CONTROL INPUTS AND OUTPUTS

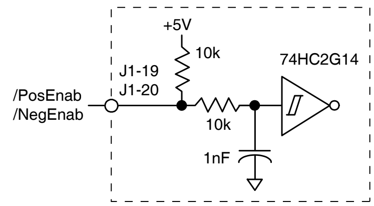
ENABLE INPUT

The Enable input [IN1] is LO-active and pulled up to +5V by an internal 10k resistor. This provides fail-safe operation by disabling the amplifier if the Enable input is open, or a wire from the controller should break.



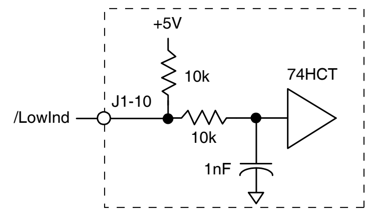
FWD/REV ENABLE INPUTS

Two inputs are provided for limit switches.
These should be LO for normal operation, and open or HI to inhibit current of positive or negative polarity.



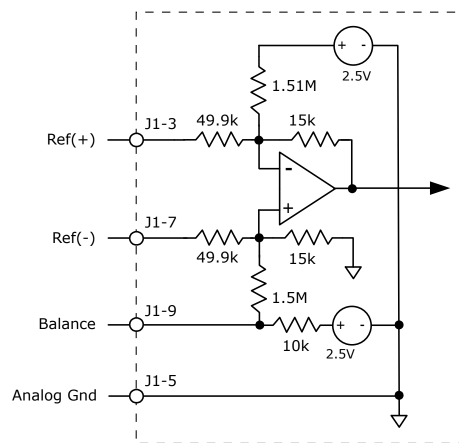
LOAD INDUCTANCE INPUT

The /LowInd input controls the gain of the current error amplifier to compensate the amplifier for lower or higher inductance loads. With the input open, the bandwidth will be ~2.5 kHz for a 2 mH (line-line) load. Grounding the input reduces the gain to 1/10 of the input-open gain for the same bandwidth with 200 µH loads.



ANALOG REFERENCE INPUT

The amplitude and polarity of the amplifier output current is controlled by a ±10V analog signal from an external controller.



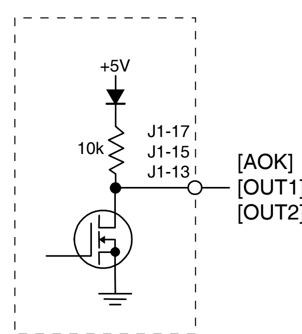
BALANCE INPUT

The output current of the amplifier can be adjusted to 0 Adc by connecting the balance input to a potentiometer with an adjustment range of 0 to +5 Vdc. This will produce an offset adjustment range of ±0.8% of the Ipeak rating of the amplifier. The table below shows the offset adjustment range in mA.

Model	±Ioffset (mA)
BTM-055-20	160
BTM-090-10	80

DIGITAL OUTPUTS

Three N-channel MOSFETs sink current from loads connecting to +30 Vdc maximum. Outputs [AOK] and [OUT1] can sink 100 mA maximum. The brake output [OUT2] can sink 1000 mA. An external flyback diode is required with driving inductive loads like a brake, or relays.



MOTOR CONNECTIONS

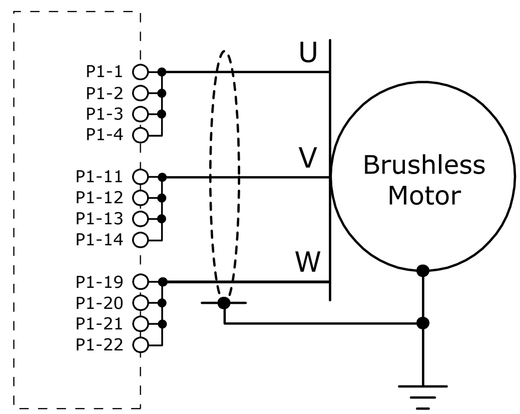
Motor connections are of two types for brushless motors: phases and Halls. For brush motors, only the armature connections are needed. The phase or armature connections carry the amplifier output currents that drive the motor to produce motion. The Hall signals are three digital signals used for commutating a brushless motor. When using a brush motor the Hall inputs should be unconnected and the motor armature connections made between the U & V phase outputs.

MOTOR PHASING: BRUSHLESS

Phasing can be done simply by connecting the motor Halls and phase wires to the BTM based on their signal names. Then, enable the amp and use the Offset adjust pot as a reference source by removing JP1-A. There are six possible combinations of the UVW phase wires and only one will produce torque correctly. If the UVW motor phase connection doesn't work, the other five combinations can be found easily by swapping two wires at a time: swap UV, swap VW, swap WU, swap UV, swap VW. Only one combination will produce smooth torque equally in both directions of rotation. Once the correct connection is found, check the direction of rotation. If it's desireable to reverse the direction of rotation, swap the U & W Halls, and swap the U & W motor phases.

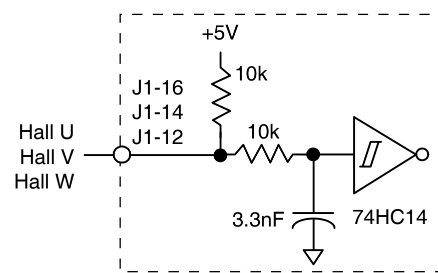
MOTOR PHASE CONNECTIONS: BRUSHLESS

The amplifier output is a three-phase PWM inverter that converts the DC buss voltage (+HV) into DC voltage waveforms that drive two motor phase-coils at a time (trapezoidal commutation). Cable should be sized for the continuous current rating of the amplifier. Motor cabling should use twisted, shielded conductors for CE compliance, and to minimize PWM noise coupling into other circuits. The motor cable shield should connect to motor frame and the equipment frame ground for best results.



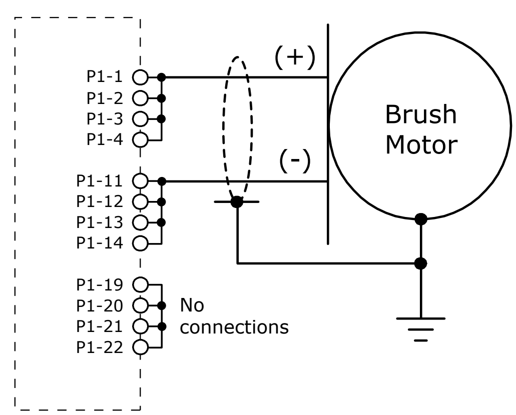
MOTOR HALL SIGNALS: BRUSHLESS

Hall signals are single-ended signals that provide absolute feedback within one electrical cycle of the motor. There are three of them (U, V, & W) and they may be sourced by magnetic sensors in the motor, or by encoders that have Hall tracks as part of the encoder disc. They typically operate at much lower frequencies than the motor encoder signals, and are used for commutation. When driving DC brush motors, the Hall inputs should be left unconnected.



MOTOR PHASE CONNECTIONS: BRUSH

The amplifier output is an H-bridge PWM inverter that converts the DC bus voltage (+HV) into a DC voltage waveform that drives the motor armature. Cable should be sized for the continuous current rating of the amplifier. Motor cabling should use twisted, shielded conductors for CE compliance, and to minimize PWM noise coupling into other circuits. The motor cable shield should connect to motor frame and the equipment frame ground for best results.



CURRENT LIMIT INPUTS

Two inputs are provided for setting the peak and continuous current limits. The I-Peak and I-Cont inputs each have equivalent circuits shown below. Limits can be set either by applying a voltage (Vset) to the input or by connecting a resistor (Rset) between input and signal ground. The tables below show values for Rset and Vset that give 10~100% of the rated peak and continuous current ratings.

AMPLIFIER MODELS AND RATINGS

Model	I-Peak	I-Cont	T-Peak	I2T
BTM-055-20	20	10	1	300
BTM-090-10	10	5		75

Note: I2T = $(\text{Ipeak}^2 - \text{Icont}^2) * \text{T-peak}$

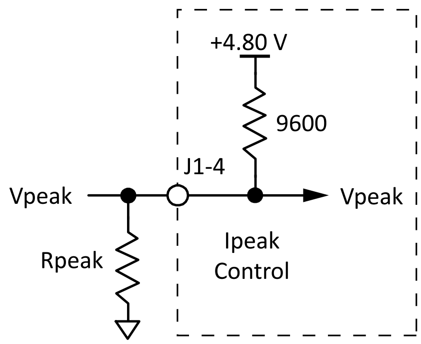
PEAK CURRENT LIMIT SETTINGS

%	Vpeak	Rpeak
100	4.80	<OUT>
90	4.32	86400
80	3.84	38400
70	3.36	22400
60	2.88	14400
50	2.4	9600
40	1.92	6400
30	1.44	4114
20	0.96	2400
10	0.48	1067

To use the table, find the % value as follows:

$$\% = \frac{\text{NewPeakCurrent} * 100}{\text{AmpPeak Current}}$$

EQUIVALENT CIRCUIT



EXAMPLE I-Peak SETTING

If a voltage Vpeak is used to control the peak-limit current, it can be found like this:

$$\text{Vpeak} = \frac{4.80 * \text{NewPeakCurrent}}{\text{AmpPeakCurrent}}$$

Example: find Vpeak for a 6 A NewPeakCurrent using a BTM-090-10:

$$\text{Vpeak} = \frac{4.80 * 6}{10} = 2.88 \text{ V}$$

To use a resistor for setting Peak-Limit current, calculate the value as follows:

$$\text{Rpeak} = \frac{9600 * \text{NewPeakCurrent}}{(\text{AmpPeakCurrent} - \text{NewPeakCurrent})}$$

Example: find Rpeak for a 6 A PeakLimitCurrent:

$$\text{Rpeak} = \frac{9600 * 6}{(10 - 6)} = 14{,}400 \text{ ohms}$$

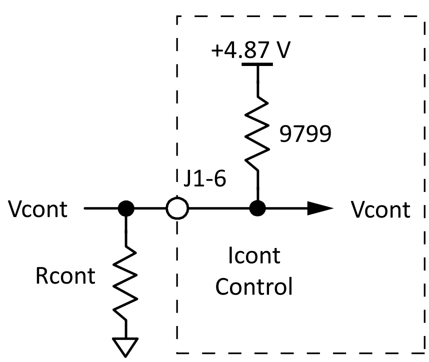
CONTINUOUS CURRENT LIMIT SETTINGS

%	Vcont	Rcont
100	4.87	<OUT>
90	4.38	88189
80	3.90	39195
70	3.41	22864
60	2.92	14698
50	2.44	9799
40	1.95	6533
30	1.46	4199
20	0.97	2450
10	0.49	1089

To use the table, find the % value as follows:

$$\% = \frac{\text{NewContCurrent} * 100}{\text{AmpContCurrent}}$$

EQUIVALENT CIRCUIT



EXAMPLE Icont SETTING

If a voltage Vcont is used to control the peak-limit current, it can be found like this:

$$\text{Vcont} = \frac{4.87 * \text{NewContCurrent}}{\text{AmpContCurrent}}$$

Example: find Vcont for a 3 A NewContCurrent using a BTM-090-10:

$$\text{Vcont} = \frac{4.87 * 3}{5} = 2.92 \text{ V}$$

To use a resistor for setting Cont-Limit current, calculate the value as follows:

$$\text{Rcont} = \frac{9799 * \text{NewContCurrent}}{(\text{AmpContCurrent} - \text{NewContCurrent})}$$

Example: find Rcont for a 2 A NewContCurrent:

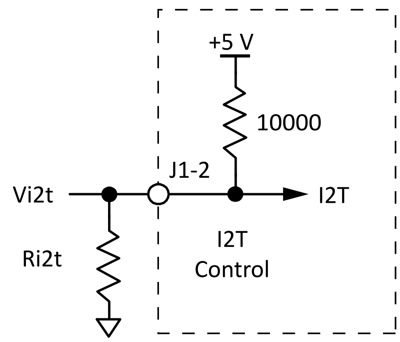
$$\text{Rcont} = \frac{9799 * 2}{(5 - 2)} = 6{,}533 \text{ ohms}$$

PWM LIMITING INPUT

I2T LIMIT SETTINGS

%	Vi2t	Ri2t
100	5.0	<OUT>
90	4.50	90000
80	4.00	40000
70	3.50	23333
60	3.00	15000
50	2.50	10000
40	2.00	6667
30	1.50	4286
20	1.00	2500
10	0.50	1111

EQUIVALENT CIRCUIT



I2T LIMITS ($AMP^2 \cdot SECS$) OF AMPLIFIERS

I2T Limit = (Ipeak^2 - Icont^2) * 1 sec

Model	I2T Limit
BTM-055-20	300
BTM-090-10	75

EXAMPLES OF I2T SETTINGS

I2T Limit settings should be made after the peak and continuous current limits have been set. The time that the peak current can be maintained is then calculated based on the amplifier model and the new peak/continuous current limit settings. If a shorter peak time is desired, a new I2T Limit can be produced with an external voltage or resistor as described below.

Example 1: Find a the I2T limit for a BTM-055-20 with peak/continuous currents set to 12 & 9 A and a new peak time of 0.5 s

1) I2T Limit for BTM-055-20 = Amp I2T $A^2 \cdot s$ = $(20^2 - 10^2)A^2 * 1$ sec = 300 $A^2 \cdot s$
2) Find new I2T A^2 for 12/9 limits = $(12^2 - 9^2)A^2$ = 63 A^2
3) Find new peak time = Amp I2T $A^2 \cdot s$ / New I2T A^2, or 300 / 63 = 4.76 s

Example 2: Select an external resistor to shorten the peak I2T time for the peak/continuous current limits in Example 1 using the pre-set peak/cont current limits and a new desired peak time of 0.5 secs.

1) Calculate the new I2T Limit in $A^2 \cdot s$ = $(12^2 - 6^2)$ * 0.5 sec = 54 $A^2 \cdot s$
2) Find the ratio of the new I2T Limit to the amplifier I2T limit: (54 / 300) = 0.18, or 18%
3) Using the table above, find the nearest entry to 18% and install an external Ri2t with the table value
   18% is close to 20%, and the table gives a value of 2500 ohms (2.5k) for this.
4) Or, calculate a resistor value that gives the exact new peak time desired:
   Ri2t = 10000 * X / (1-X) where X = ratio of the new I2T Limit to the amplifier I2T limit (54 / 300)
   Ri2t = 10000 * 0.18 / (1-0.18) = 2195 ohm. A 2.2k, 1% resistor is close to this value.
5) To find a voltage that can be applied to J1-2 to produce the same effect, multiply 5.0V X the ratio of I2T limits (54 / 300)
   5.0 X (54 / 300) = 0.90 Vdc.

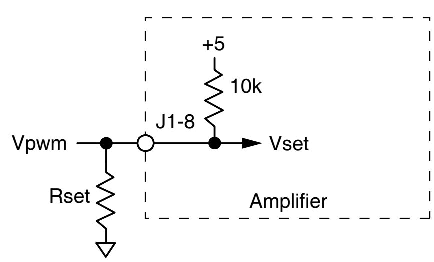
ABOUT PWM LIMITING

PWM limiting sets a maximum value for the on vs. off time of the outputs of the amplifier. While the peak voltage seen by the load remains about the same as the supply voltage (HV), the average voltage seen by the motor can be limited.
A common use of this is to limit the maximum RPM of a motor even though it's operating in torque mode.

PWM LIMIT SETTINGS

%	Rset (K)	Vset
97	<OUT>	4.95
78	42	4.00
70	30	3.71
68	25	3.54
62	20	3.3
57	15	2.97
45	10	2.48
38	7.5	2.12
28	5	1.65
25	2.5	0.99
25	0	0

EQUIVALENT CIRCUIT



EXAMPLE PWM SETTING

The table shows duty cycles measured with some choices of Rset for the PWM limits.

PC BOARD DESIGN

Printed circuit board layouts for Bantam amplifiers should follow some simple rules:

1. Install a low-ESR electrolytic capacitor not more than 12 inches from the drive. PWM amplifiers produce ripple currents in their DC supply conductors. Bantam amplifiers do not use internal electrolytic capacitors as these can be easily supplied by the printed circuit board. In order to provide a good, low-impedance path for these currents a low-ESR capacitor should be mounted as close to the drive as possible. 330 µF is a minimum value, with a voltage rating appropriate to the drive model and power supply.

2. Connect P1 signals (U,V,W outputs, +HV, and +HV Common) in pin-groups for current-sharing. The signals on P1 are all high-current types (with the exception of the +24 Vdc Aux HV supply). To carry these high currents (up to 20 Adc peak) the pins of P1 must be used in multiples to divide the current and keep the current carrying capacity of the connectors within specification. The diagram on page 9 shows the pin groups that must be inter-connected to act as a single connection point for pc board traces.

3. Follow IPC-2221 rules for conductor thickness and minimum trace width of P1 signals. The width and plating should depend on the model of drive used, the maximum voltage, and maximum current expected to be used for that model. Power supply traces (+HV, +HV Common) should be routed close to each other to minimize the area of the loop enclosed by the drive DC power. Noise emission or effects on nearby circuitry are proportional to the area of this loop, so minimizing it is good layout practice. Motor signals (U,V,W) should also be routed close together. All the motor currents sum to zero, and while the instantaneous value in a given phase will change, the sum of currents will be zero. So, keeping these traces as closely placed as possible will again minimize noise radiation due to motor phase currents.

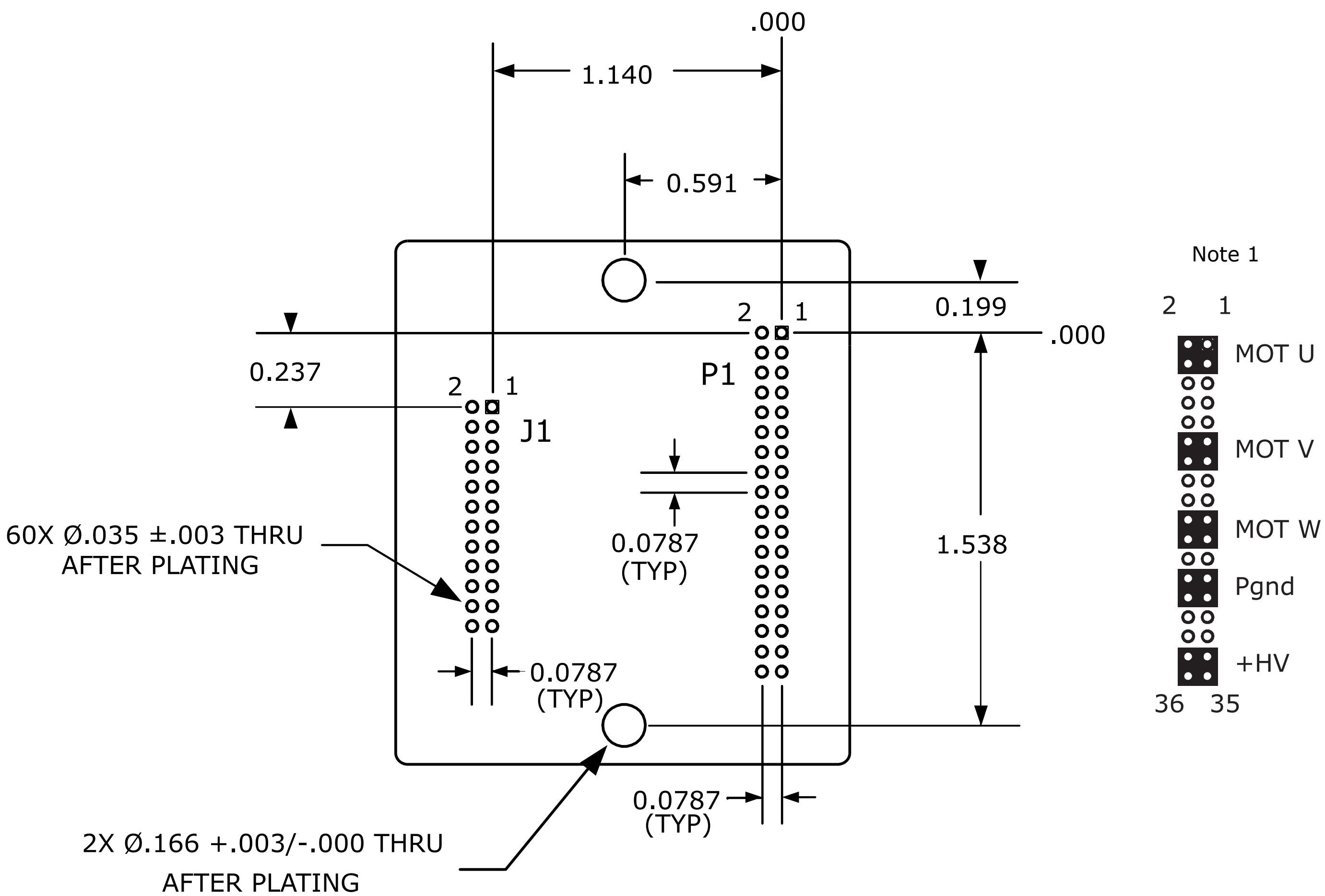
Bantam circuit grounds are electrically common, and connect internally. However, the P1 signals carry high currents while the grounds on J1 (signal ground) carry low currents. So, J1 signals should be routed away from, and never parallel to the signals on P1. Encoder signal pairs (A, /A, B, /B, and X, /X) should be routed close together for good transmission-line effect to reduce reflections and noise.

The amplifier heatplate is electrically isolated from all drive circuits. For best noise-immunity it is recommended to connect the standoffs to frame ground and to use metal mounting screws to maintain continuity between heatplate and standoffs.

PC BOARD MOUNTING FOOTPRINT

Top View

Dimensions in inches



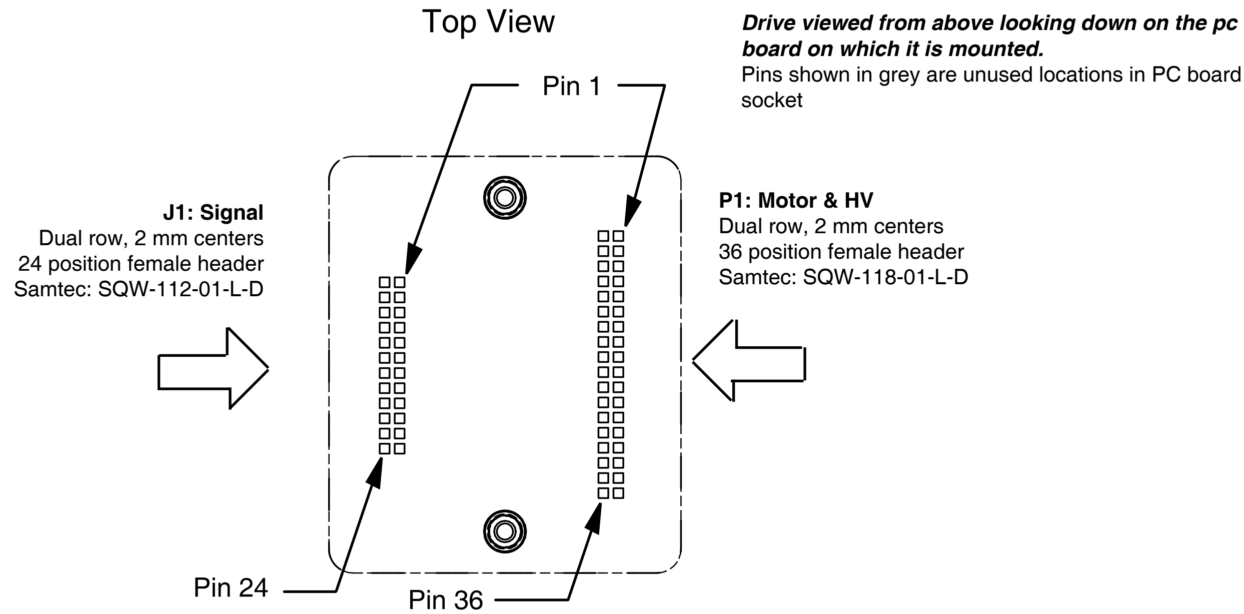
Accelnet Mounting Hardware:

Qty	Description	Mfgr	Part Number	Remarks
1	Socket Strip	Samtec	SQW-112-01-L-D	J1
1	Socket Strip	Samtec	SQW-118-01-L-D	P1

Notes

1. P1 signals must be connected for current-sharing.
2. To determine copper width and thickness for P1 signals refer to specification IPC-2221.
   (Association Connecting Electronic Industries, http://www.ipc.org)
3. Standoffs should be connected to etches on pc board that connect to frame ground for maximum noise suppression and immunity.

AMPLIFIER PC BOARD CONNECTORS



J1 SIGNALS & PINS

Signal	Pin		Signal
I2T Time	2	1	Current Ref
Peak Curr Limit	4	3	Ref(+)
Cont Curr Limit	6	5	Agnd
PWM Limit	8	7	Ref(-)
/LowInd	10	9	Balance
Hall W	12	11	Current Monitor
Hall V	14	13	[OUT2]
Hall U	16	15	[OUT1]
/Enable	18	17	[AOK]
/NegEnab	20	19	/PosEnab
Hall +5V	22	21	Hall +5V
Pgnd	24	23	Pgnd

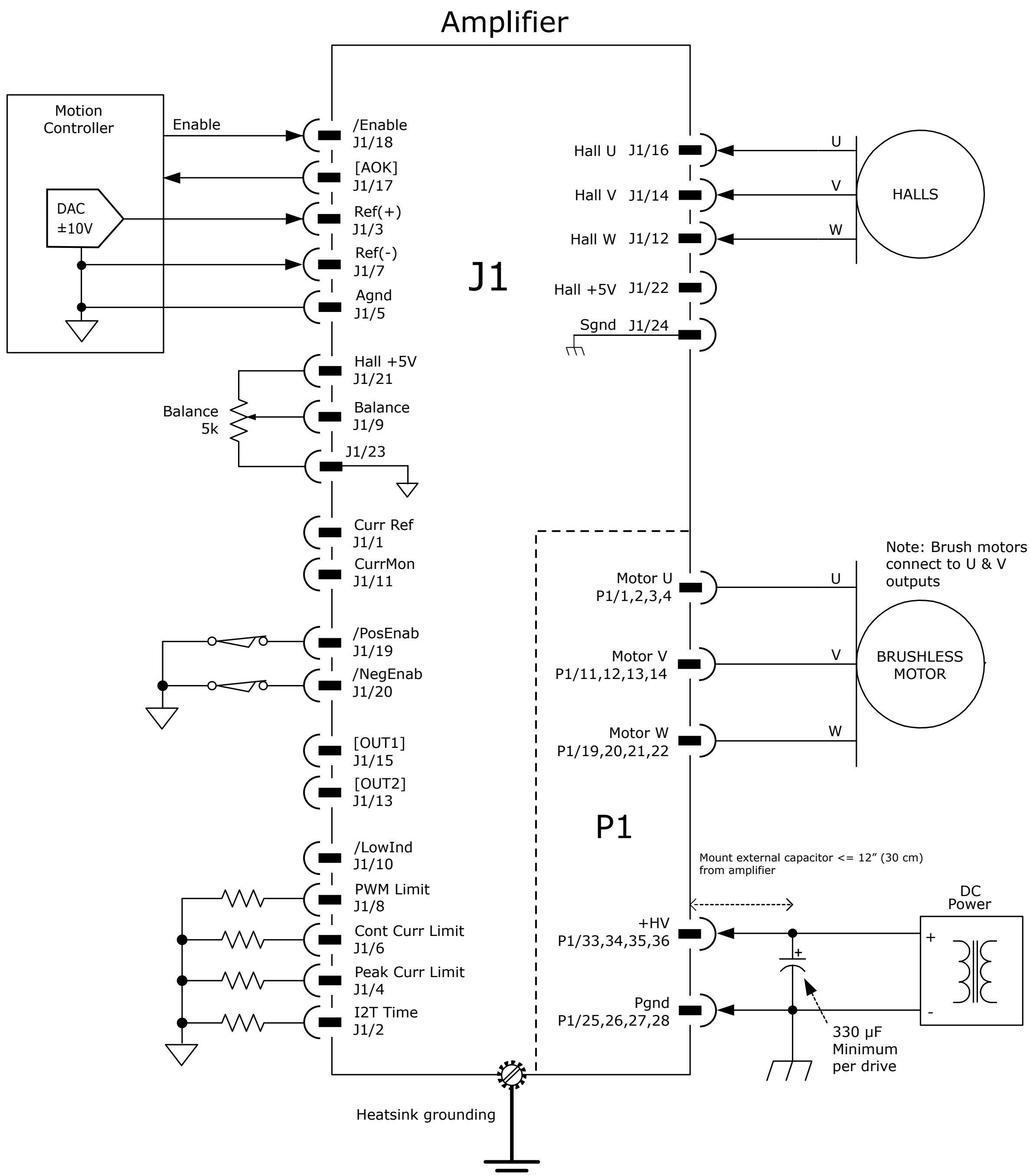
P1 SIGNALS & PINS

Signal	Pin		Signal
Motor U	2	1	Motor U
Motor U	4	3	Motor U
N/C	6	5	N/C
N/C	8	7	N/C
N/C	10	9	N/C
Motor V	12	11	Motor V
Motor V	14	13	Motor V
N/C	16	15	N/C
N/C	18	17	N/C
Motor W	20	19	Motor W
Motor W	22	21	Motor W
N/C	24	23	N/C
Pgnd	26	25	Pgnd
Pgnd	28	27	Pgnd
N/C	30	29	N/C
N/C	32	31	N/C
+HV	34	33	+HV
+HV	36	35	+HV

NOTES

1. Grey-shaded signal are N.C. (No Connection)
2. Signals are grouped for current-sharing on the power connector. When laying out pc board art-works, all pins in groups having the same signal name must be connected.
3. Total output current from +5V pins (J1-21,22) cannot exceed 250 mA.

AMPLIFIER CONNECTIONS



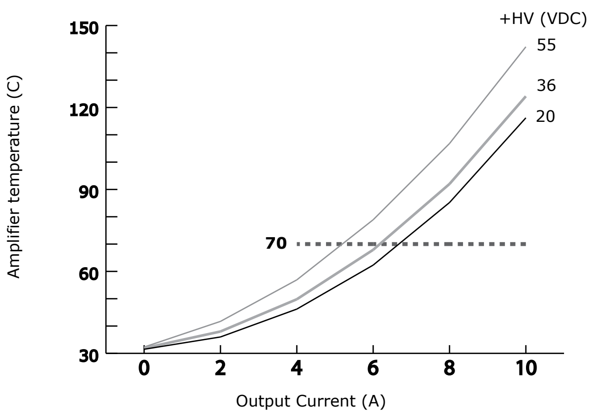
NOTES

1. Total output current from +5V pins (J1-21,22) cannot exceed 250 mA.
2. When Balance potentiometer is used, it should connect to amplifier +5V and ground for best stability.

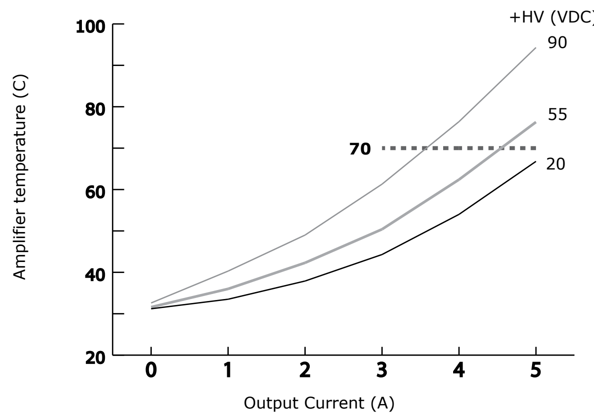
AMPLIFIER TEMPERATURE VS OUTPUT CURRENT AND HV AT 25C AMBIENT

The curves below use the amplifier power dissipation information and the thermal resistance of 12 ºC/W without any heatsink or forced-air cooling to show quickly if a heatsink or forced-air cooling will be required.
When output current is known, draw a vertical line to the curve of the supply voltage (HV) that's closes to the HV in use and mark the spot where they intersect. If the point is above the 70C line on the chart, then either a heatsink or forced-air cooling will be required. If this is the case, then use the following curves for power dissipation and thermal resistance to determine what combination of heatsinking and/or cooling would be required.

BTM-055-20



BTM-090-10

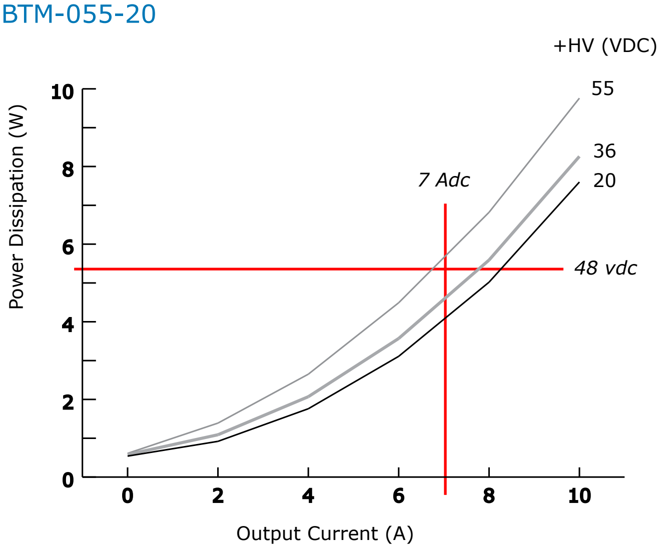


HEATSINK AND FORCED-AIR COOLING: HOW TO FIND OUT IF THESE ARE REQUIRED

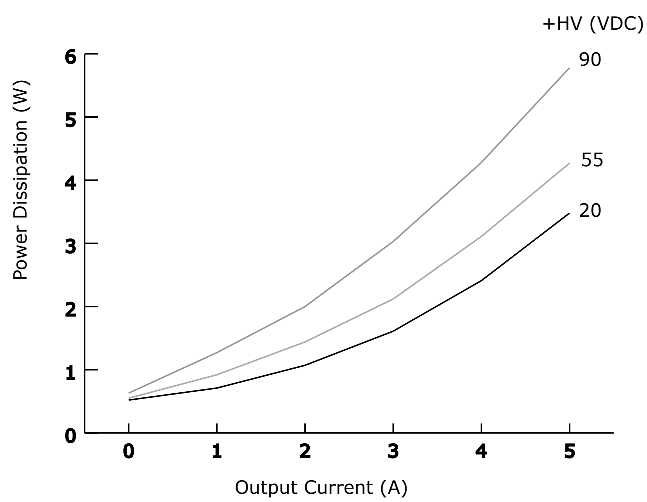
To see if a heatsink or fan-cooling is required, find the temperature rise the drive will experience when it's installed. For example, if the ambient temperature in the drive enclosure is 40 °C, and the heatplate temperature is to be limited to 70° C or less to avoid shutdown, the maximum rise would be 70C - 40C. or 30C. Then find the power dissipation in the charts below. Divide the temperature rise by the power dissipation and the result is thermal resistance in ºC/W. Find this value on the Y-axis of the charts on the following page and draw horizontal lines across the charts to show what combinations of heatsink and air movement will produce this thermal resistance.

POWER DISSIPATION VS. OUTPUT CURRENT AND HV

BTM-055-20



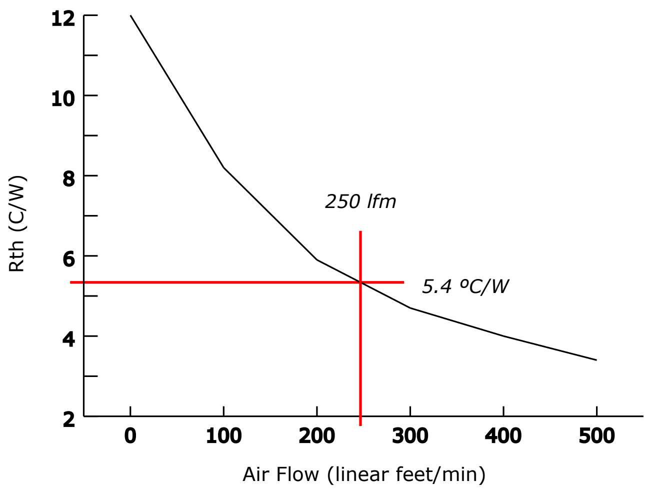
BTM-090-10



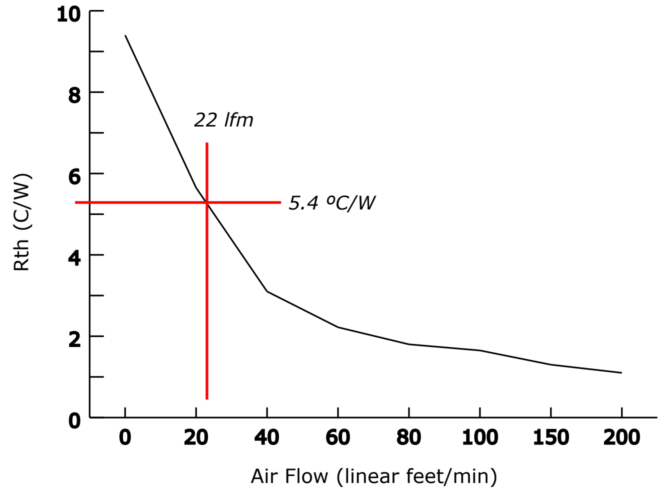
THERMAL RESISTANCE

The temperature rise of the amplifier when operating depends on the power dissipation and the thermal resistance between the amplifier and the environment.

NO HEATSINK



WITH HEATSINK



EXAMPLE

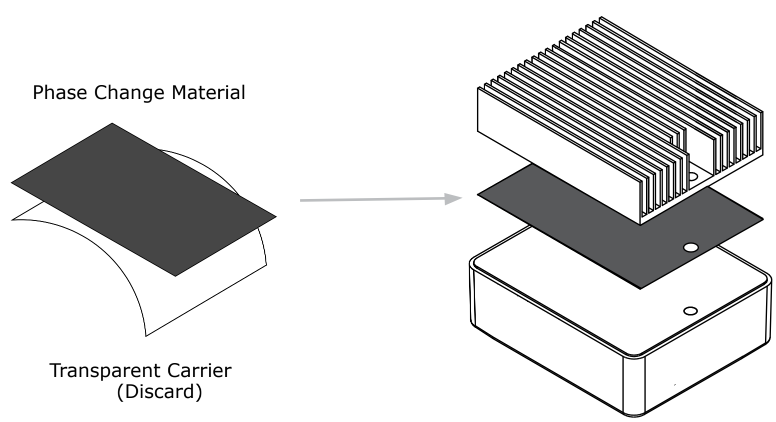
A BTM-055-20 application needs to output 7 Adc while operating from a 48 V power supply. In the chart on p. 10, place a vertical line at the 7 Adc point. Next draw a horizontal line that intersects it at a point 2/3 of the way between the 36 & 55 V curves, estimating a 48 Vdc power supply. This line yields a power dissipation of 5.4 W. Next, draw lines at the 5.4 ºC/W point on the curves above. These show that adding a heatsink reduces the air circulation requirement from 250 lfm to ~25 lfm. This low value can probably be met using a single fan in the enclosure to circulate air where it could cool multiple Bantam amplifiers adequately.

HEATSINK INSTALLATION

If a heatsink is used it is mounted using the same type of screws used to mount the drive without a heatsink but slightly longer. Phase change material (PSM) is used in place of thermal grease. This material comes in sheet form and changes from solid to liquid form as the drive warms up. This forms an excellent thermal path from drive heatplate to heatsink for optimum heat transfer.

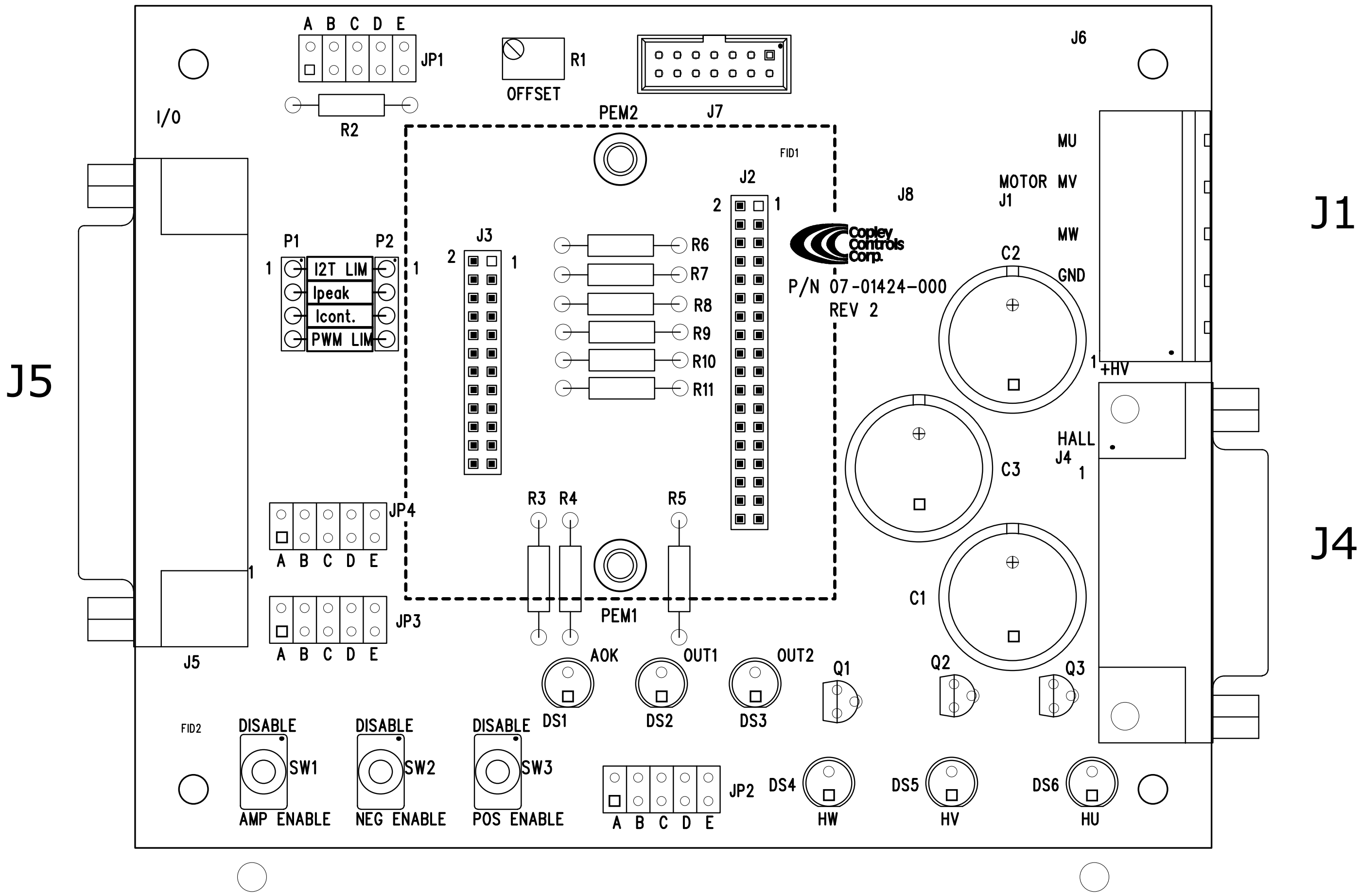
STEPS TO INSTALL

1. Remove the PSM (Phase Change Material) from the clear plastic carrier.
2. Place the PSM on the *Bantam* aluminum heatplate taking care to center the PSM holes over the holes in the drive body.
3. Mount the heatsink onto the PSM again taking care to see that the holes in the heatsink, PSM, and drive all line up.
4. Torque the #4-40 mounting screws to 8~10 lb-in (0.9~1.13 N·m).



DEVELOPMENT KIT TOP VIEW

The graphic below shows the placement of components and connectors on the Development Kit PC board.
The Bantam amplifier is not shown, but mounts in the outline that contains connectors J3 & J2.



SOCKETED COMPONENTS

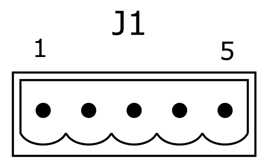
P1/P2	Remarks
1	I2T Time setting resistor
2	Ipeak setting resistor
3	Icont setting resistor
4	No function

CONNECTORS

These charts show the pins and signals for the Development Kit connectors.

J1 MOTOR AND HV POWER

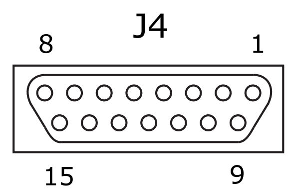
Pin	Signal
5	Mot U
4	Mot V
3	Mot W
2	HV Gnd
1	+HV Input



Euro 5 position

J4 HALLS

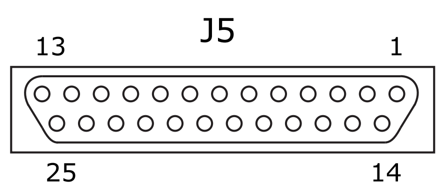
Signal	Pin	Pin	Signal
Sgnd	1	9	n.c.
Hall U	2	10	Sgnd
Hall V	3	11	+5 Vdc output
Hall W	4	12	Sgnd
Sgnd	5	13	n.c.
n.c.	6	14	n.c.
n.c.	7	15	n.c.
n.c.	8		



D-Sub 15 female

J5 CONTROL

Signal	Pin	Pin	Signal
Sgnd	1	14	Ref(-)
Ref(+)	2	15	Sgnd
Ext Balance	3	16	Sgnd
/NegEnab	4	17	/PosEnab
/Enable	5	18	Gain Select
[OUT1]	6	19	Sgnd
Current Cont Limit	7	20	n.c.
Current Ref	8	21	Curr Peak Limit
I2T Time	9	22	[AOK]
Current Monitor	10	23	+5 Vdc Output
[OUT2]	11	24	n.c.
Sgnd	12	25	n.c.
Sgnd	13		



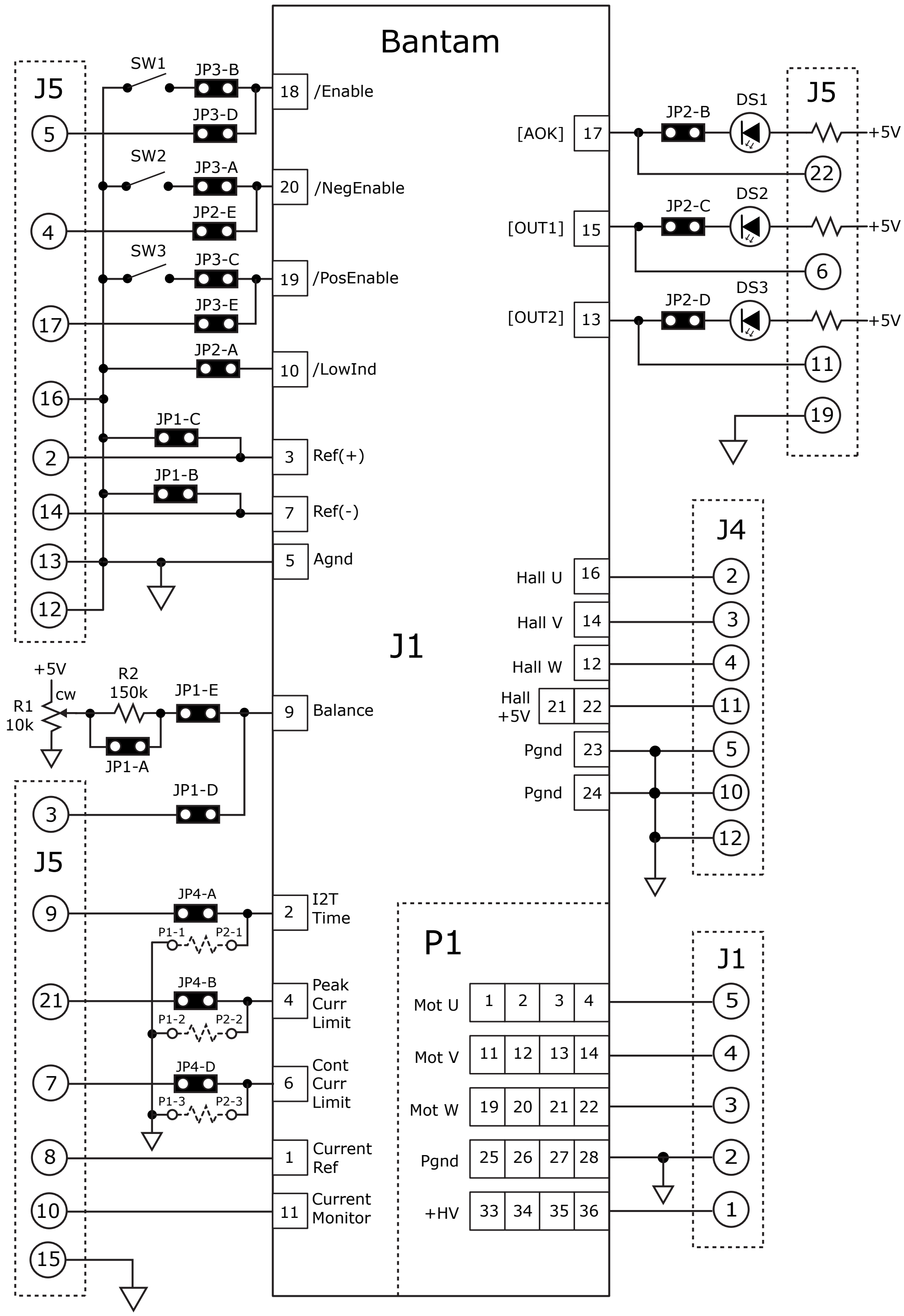
D-Sub 25 female

NOTES

1) The combined current from J4-11 and J5-23 cannot exceed 250 mA.

CONNECTIONS

In the diagram below, connectors inside the Bantam outline are the amplifier connectors, their signal names, and pin numbers. All connectors and components outside of the Bantam are on the Development Kit.



NOTES

1) The combined current from J4-11 and J5-23 cannot exceed 250 mA.

JUMPER FUNCTIONS

The functions shown in the tables below are in effect when the jumper is in place.
When a jumper is removed, the stated function is disabled.
J5 connects to an external controller

JP1

JP1	Remarks
A	Shorts 150k balance scaler
B	Ref(-) input is grounded
C	Ref(+) input is grounded
D	Connects J5-3 to Amp: Balance
E	R1 controls Amp: Balance

JP2

JP2	Remarks
A	Gain Select to Sgnd
B	Amp: [AOK] drives DS1
C	Amp: [OUT1] drives DS2
D	Amp: [OUT2] drives DS3
E	Connects J5-4 to Amp: /NegEnab

JP3

JP3	Remarks
A	Connects SW2 to Amp: /NegEnab
B	Connects SW1 to Amp: /Enable
C	Connects SW3 to Amp: /PosEnab
D	Connects J5-5 to Amp: /Enable
E	Connects J5-17 to Amp: /PosEnab

JP4

JP4	Remarks
A	Connects J5-9 to Amp: I2T Time
B	Connects J5-21 to Amp: Current Peak Limit
C	No connections
D	Connects J5-7 to Amp: Current Cont Limit
E	Connects J5-18 to Amp: Gain Select

MASTER ORDERING GUIDE

BTM-055-20	*Bantam* analog current amplifier, 10/20 Adc
BTM-090-10	*Bantam* analog current amplifier, 5/10 Adc
BDK-090-01	Development kit
BDK-CK	Connector Kit for Development Kit

ORDERING EXAMPLE

Example: Order 1 BTM-055-20 current amplifier and development kit:

Qty	Item	Remarks
1	BTM-055-20	*Bantam* current amplifier
1	BDK-090-01	Development Kit for Bantam amplifier
1	BDK-CK	Connector Kit for Development Kit

ACCESSORIES

ORDER NUMBER	Qty	Ref	DESCRIPTION
BDK-CK Connector kit for BDK-090-01 Development Kit (includes next 5 items shown below)			
	1	J1	Connector, RoHS, Euro style plug, 5 position, Tyco (AMP) 796635-5
	1	J4	Connector, D-Sub, 15-position, male, RoHS, Tyco (AMP) 5-747908-2
	1	J4	Backshell, D-Sub, RoHS, metallized, 15-position, Norcomp 979-015-020R121
	1	J5	Connector, D-Sub, 25-position, male, RoHS, Tyco (AMP) 5-747912-2
	1	J5	Backshell, D-Sub, RoHS, metallized, 25-position, Norcomp 979-025-020R121

HEATSINK (OPTIONAL)

Heatsink Kit BTM-HK	1	Heatsink kit (for field-installation by customer)
	1	Heatsink Thermal Phase-change Material
	4	Heatsink hardware (#4-40 screws)

Note: Specifications subject to change without notice