

# COUPP Acoustic Breakout Box

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## Preliminary Conceptual Design Report

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*2/15/2010*

*This document is a conceptual design report for the breakout box for the acoustic detector signals for the COUPP-60kg chamber MINOS commissioning run. Each acoustic sensor is serviced by a 3-twisted pair cable which carries bias voltages and returns plus a single twisted pair for the signal output. The acoustic breakout box is an 8-channel device servicing 8 separate acoustic transducers. It provides termination for the primary 3-pair cable. It supplies the biasing voltages for the pre-amplifiers and extracts the acoustic signals which are presented to the front panel for digitization. This box is essentially a clone of the device used on the COUPP-2L bubble chamber, but with 8 channels instead of 4.*

## Introduction

The acoustic breakout box for the COUPP-2L chamber was constructed on the basis of specifications for the COUPP-2L preamps. The box supplied +5 Volts, -5 volts, and ground for the voltage bias, and signal+ and signal- for the output signals. In the assignment of pins and cable pairs, we chose a 6-pin military spec connector and 3-twisted-pair cables. We chose to pair +5 and +5 return, -5 and -5 return, and signal+/signal-. Since the detector itself has only five wires (+5, -5, ground, signal+, signal-,) we connected both power return wires together and to the sensor ground wire in the wiring internal to the chamber. I treated the signal ground as being distinct from the power ground, although I believe that these signals are actually connected inside the sensor packaging. The front panel of the device preserves the ground separation, using isolated-ground BNC cables. When the signals are ultimately received on the digitizer, they are treated as differential signals. A schematic of one channel of the COUPP-2L breakout box is shown in Figure 1.

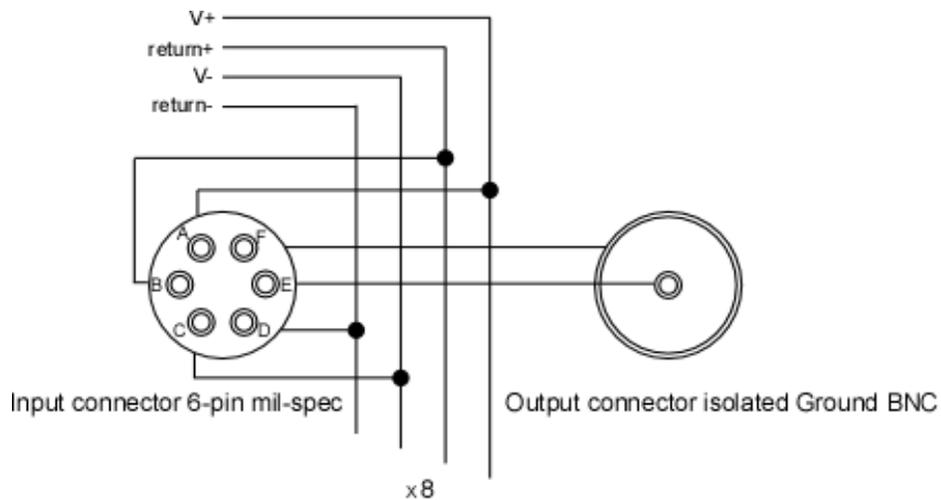


Figure 1: Schematic of a typical Acoustic Breakout Box channel. The input pin assignments are indicated. At the breakout box, V+ and return+ are paired as are V- and return-. The power grounds are also kept separate from the signal ground.

## **The COUPP-2L Implementation**

For COUPP-2L, we constructed a simple 4-channel box. The box is shown in detail in Figure 2. The box uses two Polytron linear encapsulated power supply modules to supply the plus and minus 5 Volt bias voltages. The specification sheet for the Polytron linear power supplies is included as Appendix I. Each of the supplies is floated, and each is simply connected to the parallel combination of the bias voltage pins for each of the four channels. For better or for worse, there is no bypassing or other isolation separating the individual channels within the box. The box is equipped with an integrated power cord / fuse holder to provide appropriately protected AC to the Polytron supplies. The front panel is provided with a power switch and indicator LEDs for the two voltages. Connections from the acoustic sensors arrive at the back of the module via 6-pin mil- spec connectors. The signal and signal ground pins from the sensor are passed across the breakout box to the front panel isolated ground BNC connectors.

## **Specifications for the COUPP-2L Module**

- 1) Number of channels = 4
- 2) Bias Power Supply Specifications
  - a. Power + = +5 volts, Power - = -5 volts. 1000 ma supply capability.
  - b. Encapsulated linear power supply
  - c. Ripple <1mV rms
- 3) Rear panel connector specification – AMPHENOL 0722 MS3120E-10-6S
  - a. Pin assignments
    - i. Pin A = power +
    - ii. Pin B = return +
    - iii. Pin C = power –
    - iv. Pin D = return –
    - v. Pin E = signal +
    - vi. Pin F = signal –
- 4) Four (4) isolated ground BNC front panel outputs
- 5) Integrated AC cord / fuse holder assembly.
  - a. 1/8 amp slow blow fuse
- 6) Front Panel LEDs for plus and minus voltages.



Figure 2: The COUPP-2L breakout box. Top is a view looking down into the open 1-U chassis. Next image is the front panel showing the isolated ground BNC outputs, power switch, and front-panel LEDs. Next is the back panel showing the integrated fuse holder/AC cord connector and the 6-pin mil-spec inputs connectors. The bottom image is a detail of the input connectors.

## The COUPP-60kg Implementation

- 1) For COUPP-60kg, we need an eight-channel box. The box should be largely similar to the COUPP-2L unit shown in Figure 2 except for the channel count. The choices of input and output connectors, AC cord, fuse holder, and power switch have proved acceptable in the 2L implementation. These should be kept the same. *The indicator LEDs as delivered were too bright and were modified in the field. This should be corrected in the 60kg unit.*
- 2) *The choice of the Polytron linear encapsulated power supply modules to supply the bias voltages should be revisited.* An assessment of the voltage, current, and ripple requirements should be made based on the pre-amplifier design and channel count.
- 3) The basic architecture should be kept the same. Each supply should be floated, and each should be simply connected to the parallel combination of the bias voltage pins for each of the eight channels. *The question of bypassing and or channel-to-channel power isolation should be revisited.*

## Specifications for the COUPP-2L Module

- 1) Number of Channels = 8
- 2) Power Supply Specifications
  - a. Power + = +10 volts, Power - = -10 volts. [1000 ma supply capability.]
  - b. Encapsulated linear power supply
  - c. [Ripple <1mV rms ]
- 3) Rear panel connector specification – AMPHENOL 0722 MS3120E-10-6S
  - a. Pin assignments
    - i. Pin A = power +
    - ii. Pin B = return +
    - iii. Pin C = power –
    - iv. Pin D = return –
    - v. Pin E = signal +
    - vi. Pin F = signal –
- 4) Eight (8) isolated ground BNC front panel outputs
- 5) Integrated AC cord / fuse holder assembly.
  - a. [1/8 amp slow blow fuse (or other as appropriate for Power supply choice)]
- 6) Front Panel LEDs for plus and minus voltages.

### **Project Details, Specific Deliverables:**

- 1) The first bureaucratic step in this effort is for the COUPP project manager to approve this conceptual design report.
- 2) The second bureaucratic step in this effort is for the assigned electrical Engineer to review this document and to provide an assessment of the engineering time and effort required to complete item (4) below.
- 3) The third bureaucratic step in this effort is for the COUPP project manager to approve the engineering effort assessment in (2)
- 4) The first technical step in the project is an engineering assessment of the power supply requirements based on the details of the pre-amplifier design. The specific deliverable here is a set of detailed specifications for the COUPP-60kg acoustic breakout box. These specifications should include
  - a. A schematic for the circuitry
  - b. Drawings for the mechanical aspects of the box including mounting, front and rear panels, etc.
  - c. A parts list.
- 5) A final design report should be produced. This report should include
  - a. An overview of the design considerations and the choices that were made.
  - b. Details of any relevant engineering calculations
  - c. The specifications for the module
  - d. Cost estimates derived from the parts list
  - e. An assessment of the effort required for procurement and assembly
  - f. A schedule for the completion of the module, based on estimated parts delivery and time required for assembly of the module.
- 6) The final design report along with all procurement materials (purchase requisitions, sole source, etc) should be provided to the COUPP project manager for approval.
- 7) The final deliverable, obviously, is the Box. Assembled, tested, certified.

## Appendix I: Polytron Linear Encapsulated Power Module Data Sheet



POLYTRON DEVICES, Inc.

# LINEAR ENCAPSULATED POWER MODULES

**REGULATED 5Vdc-250Vdc  
P.C. CARD OR CHASSIS MOUNTING**



### FEATURES

- **UL, CE & CSA  
Approved (All Models)**
- **Regulation Line &  
Load 0.2% to 0.02%**
- **P.C. Card/Chassis  
Mounting**
- **High Isolation Voltage  
Available**
- **Short Circuit  
Protection**
- **Single, Dual & Triple  
Outputs**
- **Finger Safe Terminal  
Available**

P3, P5 Series

### Specifications

115 Vac, 50 to 400 Hz @ 25°C

#### INPUT

Voltage Range.....105-125 Vac, 50-60 Hz  
.....400Hz available

#### OUTPUT

Voltage Accuracy @ FL for Singles, .....±1.0%  
Line Regulation:     Single Output.....±0.2%  
Load Regulation:     Single Output.....±0.2%  
Temperature Coefficient.....±0.02%/°C typ.

#### GENERAL

Isolation Resistance.....50MOhms  
Protection.....Short Circuit Protection

#### ENVIRONMENTAL

Operating Temperature Range.....-25 to +71°C  
.....-40 to +85°C Optional  
Storage Temperature Range.....-25 to +85°C  
Cooling.....Free Air Convection

#### PHYSICAL

Dimensions.....See Chart and Diagrams

1. Case style ending with letter "T"(Chassis mounted units with terminal barrier strip) are designated by the suffix "T". Case styles A,B,G,D,G and E (P.C card mounting) do not require suffixing.
2. **Most competitors pinouts available--contact factory.**
3. For 400HZ, use suffix "04" after model number.
4. For wide operating temperature range, use "W" suffix after model number.

**FAST DELIVERY**

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**Selection Guide**

(Continued)

Output (Vdc)	Output Current (mA)	Regulation		Ripple & (mV rms)	Case	Model Number	Slow Blow (A)
		Line	Load				
5	200	0.20%	0.20%	1.0	G, 1GT	P34-5SM	1/32
	500	0.20%	0.20%	0.5	A, 1AT	P37	1/16
	500	0.02%	0.05%	0.5	A, 1AT	P37-1	1/16
	1000	0.20%	0.20%	1.0	B, 1BT	P38	1/8
	1000	0.02%	0.05%	1.0	B, 1BT	P38-1	1/8
	1000	0.02%	0.05%	0.5	C, 1CT	P38/1.56	1/8
	2000	0.02%	0.10%	1.0	C, 1CT	P39	1/4
	3000	0.02%	0.15%	1.0	D, 1DT	P39-3	3/8
	120	0.10%	0.10%	1.0	E, 1ET	P33-10SM	1/32
	150	0.10%	0.10%	1.0	A, 1AT	P33-10S	1/16
10	250	0.10%	0.10%	1.0	B, 1BT	P34-10S	1/16
	500	0.02%	0.05%	0.5	C, 1CT	P37-10S	1/8
	1000	0.02%	0.05%	0.5	D, 1DT	P38-10S	3/8
	1500	0.02%	0.05%	0.5	D, 1DT	P38-10SA	1/4
	100	0.10%	0.10%	1.0	E, 1ET	P32-12SM	1/32
	120	0.02%	0.10%	1.0	A, 1AT	P33-12S	1/16
12	200	0.10%	0.10%	1.0	B, 1BT	P34-12S	1/16
	500	0.02%	0.10%	0.5	C, 1CT	P37-12S	1/5
	1000	0.10%	0.10%	1.0	D, 1DT	P38-12S	3/10
	80	0.10%	0.10%	1.0	E, 1ET	P33-15SM	1/32
15	120	0.02%	0.10%	1.0	A, 1AT	P33-12S	1/16
	200	0.10%	0.10%	1.0	B, 1BT	P34-15S	1/10
	300	0.10%	0.10%	1.0	C, 1CT	P35-15S	1/8
	500	0.02%	0.10%	0.5	C, 1CT	P37-15S	1/5
	800	0.02%	0.10%	1.0	D, 1DT	P38-15S	3/10
	50	0.10%	0.10%	1.0	E, 1ET	P32-18SM	1/32
18	50	0.02%	0.05%	1.0	A, 1AT	P32-18S	1/32
	100	0.02%	0.05%	1.0	B, 1BT	P33-18S	1/16
	50	0.10%	0.10%	1.0	E, 1ET	P32-24SM	1/32
24	100	0.10%	0.10%	1.0	A, 1AT	P33-24S	1/16
	200	0.10%	0.10%	1.0	B, 1BT	P34-24S	1/8
	300	0.10%	0.10%	1.0	C, 1CT	P35-24S	1/5
	500	0.10%	0.10%	1.0	D, 1DT	P37-24S	1/4
	800	0.10%	0.10%	1.0	H, 1HT	P38-24S	3/8
	1000	0.10%	0.10%	1.0	H, 1HT	P39-24S	1/2
	50	0.20%	0.20%	2.0	B, 1BT	P32-48S	1/16
48	100	0.20%	0.20%	2.0	B, 1BT	P33-48S	1/8
	200	0.20%	0.20%	2.0	C, 1CT	P34-48S	1/4
	50	0.05%	0.20%	2.0	B, 1BT	P32-50S	1/16
50	100	0.05%	0.20%	2.0	B, 1BT	P33-50S	1/8
	200	0.05%	0.20%	2.0	C, 1CT	P34-50S	1/4
	300	0.20%	0.20%	3.0	D, 1DT	P35-50S	3/8
	35	0.05%	0.20%	2.0	B, 1BT	P32-75S	1/10
75	70	0.05%	0.20%	2.0	B, 1BT	P33-75S	1/5
	150	0.05%	0.20%	2.0	C, 1CT	P34-75S	3/10
	200	0.10%	0.20%	3.0	D, 1DT	P35-75S	3/8
	25	0.05%	0.20%	2.0	B, 1BT	P32-100S	1/16
100	50	0.05%	0.20%	2.0	B, 1BT	P33-100S	1/8
	100	0.05%	0.20%	3.0	C, 1CT	P34-100S	1/4
	150	0.10%	0.20%	3.0	D, 3DT	P35-100S	3/8

1. Case style ending with letter "T"(Chassis mounted units with terminal barrier strip) are designated by the suffix "T". Case styles A,B,C,D,G and E (PC card mounting) do not require suffixing.
2. Most competitors pinouts available--contact factory.
3. For 400HZ, use suffix "04" after model number.
4. For wide operating temperature range, use "W" suffix after model number.



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Selection Guide

(Continued)

	Output (Vdc)	Output Current (mA)	Regulation		Ripple & (mV rms)	Case	Model Number	Slow Blow (A)
			Line	Load				
SINGLE OUTPUT	150	17	0.05%	0.20%	2.0	A,1A1	P32-150S	1/16
		35	0.05%	0.20%	3.0	B,1B1	P33-150S	2/10
		70	0.05%	0.20%	3.0	C,1C1	P34-150S	1/4
		100	0.20%	0.20%	3.0	D,1D1	P35-150S	3/8
	180	15	0.05%	0.20%	3.0	B,1B1	P32-180S	1/16
		30	0.05%	0.20%	3.0	B,1B1	P33-180S	1/5
		55	0.05%	0.20%	3.0	C,1C1	P34-180S	1/4
		80	0.10%	0.20%	3.0	D,1D1	P35-180S	3/8
	200	12	0.05%	0.20%	3.0	B,1B1	P32-200S	1/16
		25	0.05%	0.20%	3.0	B,1B1	P33-200S	1/8
		50	0.05%	0.20%	3.0	C,1C1	P34-200S	1/4
	250	75	0.10%	0.20%	3.0	D,1D1	P35-200S	3/8
		10	0.05%	0.20%	3.0	B,1B1	P32-250S	1/16
		20	0.05%	0.20%	3.0	B,1B1	P33-250S	1/8
		40	0.05%	0.20%	3.0	C,1C1	P34-250S	1/4
	60	0.10%	0.20%	3.0	D,1D1	P35-250S	3/8	
DUAL OUTPUTS	±5	±50	0.02%	0.02%	1.0	A,2A1	P32-5	1/32
		±100	0.10%	0.10%	1.0	A,2A1	P33-5	1/32
		±200	0.10%	0.10%	1.0	B,2B1	P34-5	1/16
		±300	0.02%	0.05%	0.5	C,2C1	P35-5	1/10
		±500	0.02%	0.05%	0.5	C,2C1	P37-5	1/8
		±1000	0.01%	0.10%	1.0	D,2D1	P38-5	1/4
	±8	±500	0.10%	0.10%	82.0	D,2D1	P37-8	1/5
	±10	±100	0.02%	0.05%	82.0	A,2A1	P33-10	1/16
		±25	0.10%	0.10%	2.0	G,1G1	P31-12M	1/32
	±12	±25	0.02%	0.05%	5.0	A,2A1	P31-12	1/32
		±50	0.02%	0.05%	5.0	A,2A1	P32-12	1/32
		±100	0.10%	0.10%	1.0	A,2A1	P33-12	1/16
		±200	0.10%	0.10%	1.0	B,2B1	P34-12	1/8
		±300	0.10%	0.10%	1.0	C,2C1	P35-12	1/5
		±500	0.10%	0.10%	1.0	D,2D1	P37-12	3/10
		±800	0.10%	0.10%	1.0	D,2D1	P38-12	2/5
		±25	0.10%	0.10%	2.0	G,1G1	P31-M	1/32
		±25	0.20%	0.20%	1.0	A,2A1	P31	1/32
		±25	0.02%	0.02%	0.5	A,2A1	P31-1	1/32
	±15	±50	0.20%	0.20%	1.0	A,2A1	P32	1/16
		±50	0.02%	0.02%	0.5	A,2A1	P32-1	1/16
		±100	0.20%	0.20%	1.0	A,2A1	P33	1/10
		±100	0.02%	0.02%	1.0	A,2A1	P33-1	1/10
		±200	0.20%	0.20%	1.0	B,2B1	P34	1/5
		±200	0.02%	0.05%	1.0	B,2B1	P34-1	1/5
		±350	0.20%	0.20%	1.0	C,2C1	P35	1/4
		±350	0.02%	0.05%	1.0	C,2C1	P35-1	1/4
		±500	0.10%	0.10%	1.0	D,2D1	P37-15	3/8
		±800	0.10%	0.10%	1.0	D,2D1	P38-15	1/2
	±18	±50	0.10%	0.10%	1.0	A,2A1	P32-18	1/16
±100		0.10%	0.10%	1.0	B,2B1	P33-18	1/10	
±24	±50	0.10%	0.10%	1.0	B,2B1	P32-24	1/16	
	±100	0.10%	0.20%	1.0	B,2B1	P33-24	1/8	
	±200	0.10%	0.20%	1.0	C,2C1	P34-24	1/4	
TRIPLE VOLTAGE	5/±12	250/±60	0.02%	0.10%	1.0	C,3C1	P51-12	1/10
		250/±120	0.02%	0.10%	1.0	C,3C1	P52-12	1/10
		300/±180	0.02%	0.10%	1.0	C,3C1	P53-12L	1/5
		500/±120	0.02%	0.10%	1.0	C,3C1	P53-12	1/5
	5/±15	1000/±150	0.02%	0.10%	1.0	D,3D1	P53-1280	1/4
		250/±50	0.02%	0.10%	1.0	C,3C1	P51-15	1/10
		250/±100	0.02%	0.10%	1.0	C,3C1	P52-15	1/10
		300/±150	0.02%	0.10%	1.0	C,3C1	P53-15L	1/5
		500/±100	0.02%	0.10%	1.0	C,3C1	P53-15	1/5
		1000/±150	0.02%	0.10%	1.0	D,3D1	P53-1580	1/4

1. Case style ending with letter "T" (Chassis mounted units with terminal barrier strip) are designated by the suffix "T".

Case styles A,B,C,D,G and E (PC card mounting) do not require suffixing.

2. Most competitors pinouts available--contact factory.

3. For 400HZ, use suffix "04" after model number.

4. For wide operating temperature range, use "W" suffix after model number.



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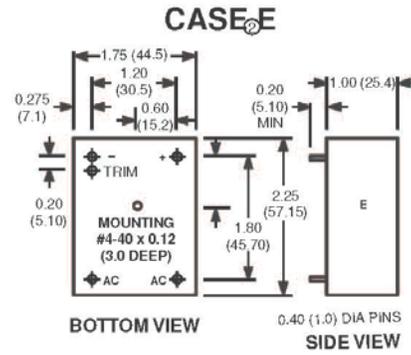
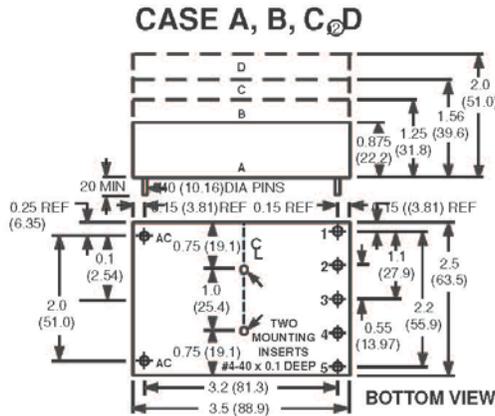
**Mechanical Specification**

I/O Connections			
Pin	SINGLE	DUAL	TRIPLE
1	-Vdc*	-Vdc*	Com (5)
2	No Pin	No Pin	+5Vdc
3	Com*	Com*	-12 / -15
4	No Pin	No Pin	CMN (12/15)
5	+Vdc	+Vdc	+12 / +15

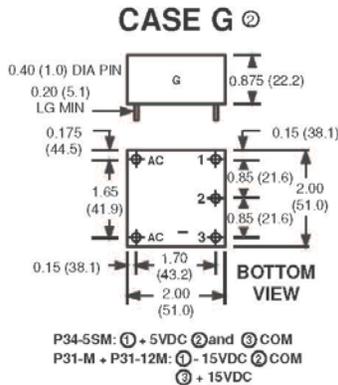
\* -Vdc Internally connected to COM for single output units.

OPTIONS AVAILABLE	SUFFIX	
220Vac	X	
230Vac	XA	
240Vac	XE	
100Vac	Q	
115/220	AX	
Alternate Pin-Out	22	
Chassis mounting with terminal barrier strip (case styles ending with letter "T")	T	
Finger Safe Chassis Mount Terminal Barrier Strip	FST	
Wide Oper. Temp. Range	W	
400Hz	04	

② Most competitors pinouts available--contact factory.



All Dimensions are in inches (mm)



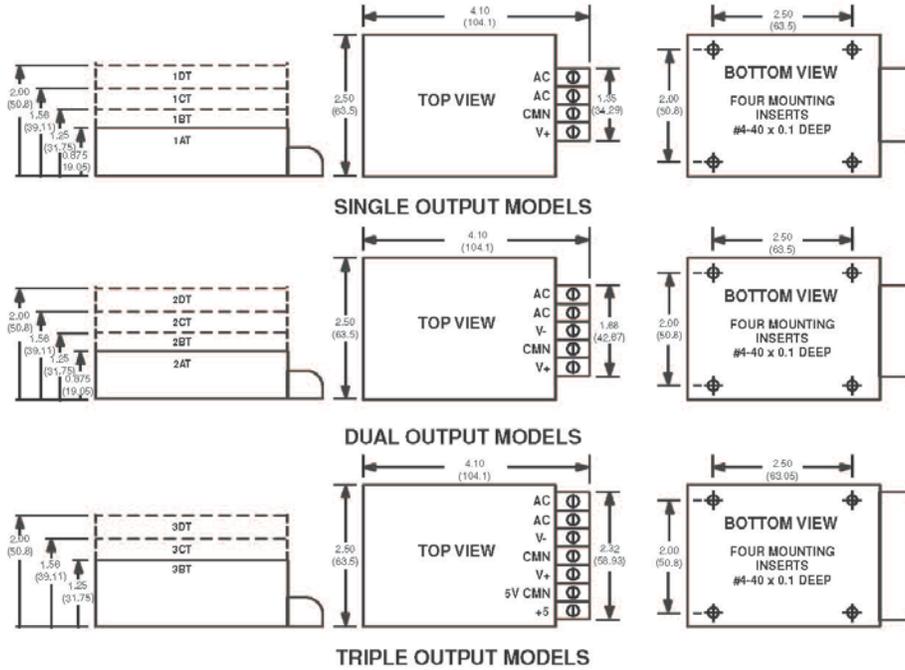
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Power Supply Options

(Continued)

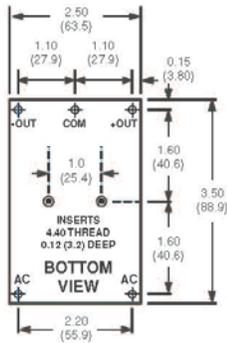
CHASSIS MOUNTED UNITS



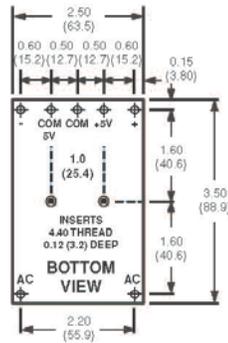
All Dimensions are in inches (mm)

ALTERNATE PIN-OUT

SINGLE & DUAL OUTPUT MODELS

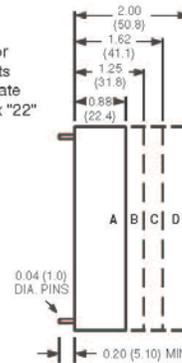


TRIPLE OUTPUT MODELS



Note:  
 \* No connection for single output units  
 \* To specify alternate pin-out use suffix "22"

SIDE VIEW



All Dimensions are in inches (mm)

POLYTRON DEVICES, Inc.



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