Series **F/M**

100W Isolated Regulated High Power DC-DC Converter

PICO Electronics, Inc.

PRODUCT OVERVIEW

The F/M series are isolated DC-DC converters with a wide selection of input voltage ranges from 18V to 380V in a low profile full brick size - 4.6" x 2.5" x 0.5". These modules have trim capability and shutdown features. Protections include input overvoltage, output short-circuit, output overvoltage and over temperature.

The unique case has integrated side heat sink for better thermal dissipation but is capable of conduction cooling through the baseplate or additional top mounted heat sink.

FEATURES

- 18V to 380V input range models
- 3.3V to 350V output models
- Up to 200W output
- Input/output isolation
- Parallel operation option
- Single and dual isolated outputs
- Trim capability
- Remote shutdown feature
- Fixed operating frequency
- No external components required

Contact Pico for part number of available options:

- Expanded operating temperature: -55°C to +85°C
- Select screening per MIL-STD-883:
  - Stabilization Bake
  - Temperature Cycle
  - Burn-In
- Special Input Voltage, Output Voltage, Isolation Voltage or Output Power
- Parallel Operation

M	B	28	S
TEMPERATURE RANGE	INPUT VOLTAGE RANGE	OUTPUT VOLTAGE	NUMBER OF OUTPUTS
F = -40°C to +85°C **M** = -55°C to +85°C	**A** = 18 - 36V **B** = 36 - 72V **C** = 100 - 180V **D** = 200 - 380V	**3.3** = 3.3V **5** = 5V **5.2** = 5.2V **9** = 9V **12** = 12V **15** = 15V **24** = 24V **28** = 28V **48** = 48V **100** = 100V **125** = 125V **150** = 150V **175** = 175V **200** = 200V **225** = 225V **250** = 250V **275** = 275V **300** = 300V **325** = 325V **350** = 350V	**S** = SINGLE **D** = DUAL

MODEL LIST - FA/MA (18-36V INPUT RANGE)

SINGLE OUTPUT

Pico Part Number		Output Voltage	Output Current		Output Power	Efficiency [2]	Line Regulation	Load Regulation [3]	Output Voltage Tolerance [2]
-40°C to +85°C	-55°C to +85°C	[VDC]	Min. [1] [A]	Max. [A]	[W]	[%] typ.	[±%] max	[±%] max	[±%]
FA3.3S	MA3.3S	3.3	1.52	15.15	50	74	1.50	2.00	2.0
FA5S	MA5S	5	1.50	15.00	75	76	1.50	2.00	2.0
FA5.2S	MA5.2S	5.2	1.44	14.42	75	76	1.50	2.00	2.0
FA9S	MA9S	9	1.11	11.11	100	81	1.25	1.50	1.5
FA12S	MA12S	12	0.83	8.33	100	83	1.00	1.25	1.0
FA15S	MA15S	15	0.67	6.67	100	84	0.75	1.00	1.0
FA24S	MA24S	24	0.42	4.17	100	86	0.50	0.75	1.0
FA28S	MA28S	28	0.36	3.57	100	86	0.50	0.50	0.5
FA48S	MA48S	48	0.21	2.08	100	86	0.50	0.50	0.5
FA100S	MA100S	100	0.10	1.00	100	85	0.50	0.50	0.5
FA125S	MA125S	125	0.08	0.80	100	85	0.3	0.5	0.5
FA150S	MA150S	150	0.07	0.67	100	85	0.3	0.5	0.5
FA175S	MA175S	175	0.06	0.57	100	85	0.3	0.5	0.5
FA200S	MA200S	200	0.05	0.50	100	85	0.3	0.5	0.5
FA225S	MA225S	225	0.04	0.44	100	85	0.3	0.5	0.5
FA250S	MA250S	250	0.04	0.40	100	85	0.3	0.5	0.5

DUAL OUTPUT

Pico Part Number		Output Voltage Per Output	Output Current Per Output		Output Power Per Output [4]	Efficiency [2]	Line Regulation	Load Regulation [3]	Output Voltage Tolerance [2]
-40°C to +85°C	-55°C to +85°C	[VDC]	Min. [1] [A]	Max. [A]	[W]	[%] typ.	[±%] max	[±%] max	[±%]
FA5D	MA5D	5	0.75	7.50	37.5	76	1.50	2.00	2.0
FA9D	MA9D	9	0.56	5.56	50	81	1.25	1.50	1.5
FA12D	MA12D	12	0.42	4.17	50	83	1.00	1.25	1.0
FA15D	MA15D	15	0.33	3.33	50	84	0.75	1.00	1.0
FA24D	MA24D	24	0.21	2.08	50	85	0.50	0.75	1.0
FA28D	MA28D	28	0.18	1.79	50	86	0.50	0.50	0.5
FA48D	MA48D	48	0.10	1.04	50	86	0.50	0.50	0.5

Note 1: Maintain minimum 10% of rated load to prevent a voltage surge.
Note 2: Tested at nominal input voltage and full output load.
Note 3: For ≤100V output models, load regulation is specified for 10-100% load. For ≥125V output models, load regulation is specified for 20-100% load.
Note 4: Dual output loads must be balanced.

MODEL LIST - FB/MB (36-72V INPUT RANGE)

SINGLE OUTPUT

Pico Part Number		Output Voltage	Output Current		Output Power	Efficiency [2]	Line Regulation	Load Regulation [3]	Output Voltage Tolerance [2]
-40°C to +85°C	-55°C to +85°C	[VDC]	Min. [1] [A]	Max. [A]	[W]	[%] typ.	[±%] max	[±%] max	[±%]
FB3.3S	MB3.3S	3.3	1.52	15.15	50	76	0.75	1.50	2.0
FB5S	MB5S	5	1.50	15.00	75	78	0.75	1.00	1.5
FB5.2S	MB5.2S	5.2	1.44	14.42	75	78	0.75	1.00	1.5
FB9S	MB9S	9	1.11	11.11	100	82	0.75	1.00	1.0
FB12S	MB12S	12	0.83	8.33	100	84	0.50	0.75	1.0
FB15S	MB15S	15	0.67	6.67	100	85	0.50	0.75	1.0
FB24S	MB24S	24	0.42	4.17	100	87	0.50	0.50	0.5
FB28S	MB28S	28	0.36	3.57	100	87	0.50	0.50	0.5
FB48S	MB48S	48	0.21	2.08	100	88	0.50	0.50	0.5
FB100S	MB100S	100	0.10	1.00	100	87	0.50	0.50	0.5
FB125S	MB125S	125	0.08	0.80	100	85	0.3	0.5	0.5
FB150S	MB150S	150	0.07	0.67	100	85	0.3	0.5	0.5
FB175S	MB175S	175	0.06	0.57	100	85	0.3	0.5	0.5
FB200S	MB200S	200	0.05	0.50	100	85	0.3	0.5	0.5
FB225S	MB225S	225	0.04	0.44	100	85	0.3	0.5	0.5
FB250S	MB250S	250	0.04	0.40	100	85	0.3	0.5	0.5
FB275S	MB275S	275	0.04	0.36	100	85	0.3	0.5	0.5
FB300S	MB300S	300	0.03	0.33	100	85	0.3	0.5	0.5

DUAL OUTPUT

Pico Part Number		Output Voltage Per Output	Output Current Per Output		Output Power Per Output [4]	Efficiency [2]	Line Regulation	Load Regulation [3]	Output Voltage Tolerance [2]
-40°C to +85°C	-55°C to +85°C	[VDC]	Min. [1] [A]	Max. [A]	[W]	[%] typ.	[±%] max	[±%] max	[±%]
FB5D	MB5D	5	0.75	7.50	37.5	78	0.75	1.00	1.5
FB9D	MB9D	9	0.56	5.56	50	82	0.75	1.00	1.0
FB12D	MB12D	12	0.42	4.17	50	84	0.50	0.75	1.0
FB15D	MB15D	15	0.33	3.33	50	85	0.50	0.75	1.0
FB24D	MB24D	24	0.21	2.08	50	87	0.50	0.50	0.5
FB28D	MB28D	28	0.18	1.79	50	87	0.50	0.50	0.5
FB48D	MB48D	48	0.10	1.04	50	88	0.50	0.50	0.5

Note 1: Maintain minimum 10% of rated load to prevent a voltage surge.
Note 2: Tested at nominal input voltage and full output load.
Note 3: For ≤100V output models, load regulation is specified for 10-100% load. For ≥125V output models, load regulation is specified for 20-100% load.
Note 4: Dual output loads must be balanced.

MODEL LIST - FC/MC (100-180V INPUT RANGE)

SINGLE OUTPUT

Pico Part Number		Output Voltage	Output Current		Output Power	Efficiency [2]	Line Regulation	Load Regulation [3]	Output Voltage Tolerance [2]
-40°C to +85°C	-55°C to +85°C	[VDC]	Min. [1] [A]	Max. [A]	[W]	[%] typ.	[±%] max	[±%] max	[±%]
FC3.3S	MC3.3S	3.3	1.52	15.15	50	76	0.75	1.00	2.0
FC5S	MC5S	5	1.50	15.00	75	78	0.75	1.00	1.5
FC5.2S	MC5.2S	5.2	1.44	14.42	75	78	0.75	1.00	1.5
FC9S	MC9S	9	1.11	11.11	100	84	0.50	0.75	1.0
FC12S	MC12S	12	0.83	8.33	100	86	0.50	0.75	1.0
FC15S	MC15S	15	0.67	6.67	100	87	0.50	0.75	1.0
FC24S	MC24S	24	0.42	4.17	100	88	0.30	0.50	0.5
FC28S	MC28S	28	0.36	3.57	100	88	0.20	0.50	0.5
FC48S	MC48S	48	0.21	2.08	100	88	0.20	0.50	0.5
FC100S	MC100S	100	0.10	1.00	100	87	0.30	0.50	0.5
FC125S	MC125S	125	0.08	0.80	100	85	0.3	0.5	0.5
FC150S	MC150S	150	0.07	0.67	100	85	0.3	0.5	0.5
FC175S	MC175S	175	0.06	0.57	100	85	0.3	0.5	0.5
FC200S	MC200S	200	0.05	0.50	100	85	0.3	0.5	0.5
FC225S	MC225S	225	0.04	0.44	100	85	0.3	0.5	0.5
FC250S	MC250S	250	0.04	0.40	100	85	0.3	0.5	0.5
FC275S	MC275S	275	0.04	0.36	100	85	0.3	0.5	0.5
FC300S	MC300S	300	0.03	0.33	100	85	0.3	0.5	0.5

DUAL OUTPUT

Pico Part Number		Output Voltage Per Output	Output Current Per Output		Output Power Per Output [4]	Efficiency [2]	Line Regulation	Load Regulation [3]	Output Voltage Tolerance [2]
-40°C to +85°C	-55°C to +85°C	[VDC]	Min. [1] [A]	Max. [A]	[W]	[%] typ.	[±%] max	[±%] max	[±%]
FC5D	MC5D	5	0.75	7.50	37.5	78	0.75	1.00	1.5
FC9D	MC9D	9	0.56	5.56	50	84	0.50	0.75	1.0
FC12D	MC12D	12	0.42	4.17	50	86	0.50	0.75	1.0
FC15D	MC15D	15	0.33	3.33	50	87	0.50	0.75	1.0
FC24D	MC24D	24	0.21	2.08	50	88	0.30	0.50	0.5
FC28D	MC28D	28	0.18	1.79	50	88	0.20	0.50	0.5
FC48D	MC48D	48	0.10	1.04	50	88	0.20	0.50	0.5

Note 1: Maintain minimum 10% of rated load to prevent a voltage surge.
Note 2: Tested at nominal input voltage and full output load.
Note 3: For ≤100V output models, load regulation is specified for 10-100% load. For ≥125V output models, load regulation is specified for 20-100% load.
Note 4: Dual output loads must be balanced.

MODEL LIST - FD/MD (200-380V INPUT RANGE)

SINGLE OUTPUT

Pico Part Number		Output Voltage	Output Current		Output Power	Efficiency [2]	Line Regulation	Load Regulation [3]	Output Voltage Tolerance [2]
-40°C to +85°C	-55°C to +85°C	[VDC]	Min. [1] [A]	Max. [A]	[W]	[%] typ.	[±%] max	[±%] max	[±%]
FD3.3S	MD3.3S	3.3	1.52	15.15	50	76	1.25	1.50	2.0
FD5S	MD5S	5	1.50	15.00	75	78	1.00	1.25	1.5
FD5.2S	MD5.2S	5.2	1.44	14.42	75	78	1.00	1.25	1.5
FD9S	MD9S	9	1.11	11.11	100	84	1.00	1.25	1.0
FD12S	MD12S	12	0.83	8.33	100	85	0.75	1.00	1.0
FD15S	MD15S	15	0.67	6.67	100	86	0.75	1.00	1.0
FD24S	MD24S	24	0.42	4.17	100	87	0.50	0.75	0.5
FD28S	MD28S	28	0.36	3.57	100	87	0.50	0.50	0.5
FD48S	MD48S	48	0.21	2.08	100	88	0.20	0.50	0.5
FD100S	MD100S	100	0.10	1.00	100	88	0.20	0.50	0.5
FD125S	MD125S	125	0.08	0.80	100	85	0.3	0.5	0.5
FD150S	MD150S	150	0.07	0.67	100	85	0.3	0.5	0.5
FD175S	MD175S	175	0.06	0.57	100	85	0.3	0.5	0.5
FD200S	MD200S	200	0.05	0.50	100	85	0.3	0.5	0.5
FD225S	MD225S	225	0.04	0.44	100	85	0.3	0.5	0.5
FD250S	MD250S	250	0.04	0.40	100	85	0.3	0.5	0.5
FD275S	MD275S	275	0.04	0.36	100	85	0.3	0.5	0.5
FD300S	MD300S	300	0.03	0.33	100	85	0.3	0.5	0.5
FD325S	MD325S	325	0.03	0.31	100	85	0.3	0.5	0.5
FD350S	MD350S	350	0.03	0.29	100	85	0.3	0.5	0.5

DUAL OUTPUT

Pico Part Number		Output Voltage Per Output	Output Current Per Output		Output Power Per Output [4]	Efficiency [2]	Line Regulation	Load Regulation [3]	Output Voltage Tolerance [2]
-40°C to +85°C	-55°C to +85°C	[VDC]	Min. [1] [A]	Max. [A]	[W]	[%] typ.	[±%] max	[±%] max	[±%]
FD5D	MD5D	5	0.75	7.50	37.5	78	1.00	1.25	1.5
FD9D	MD9D	9	0.56	5.56	50	84	1.00	1.25	1.0
FD12D	MD12D	12	0.42	4.17	50	85	0.75	1.00	1.0
FD15D	MD15D	15	0.33	3.33	50	86	0.75	1.00	1.0
FD24D	MD24D	24	0.21	2.08	50	87	0.50	0.75	0.5
FD28D	MD28D	28	0.18	1.79	50	87	0.50	0.50	0.5
FD48D	MD48D	48	0.10	1.04	50	88	0.50	0.50	0.5

Note 1: Maintain minimum 10% of rated load to prevent a voltage surge.
Note 2: Tested at nominal input voltage and full output load.
Note 3: For ≤100V output models, load regulation is specified for 10-100% load. For ≥125V output models, load regulation is specified for 20-100% load.
Note 4: Dual output loads must be balanced.

SPECIFICATIONS (Nominal V_{IN}, Full Load, T_A = +25°C, 1 hour warm up unless otherwise specified)

INPUT

Parameter	Condition	Min.	Typ.	Max.	Units
Input Voltage Range	FA/MA models	18	28	36	VDC
	FB/MB models	36	48	72	
	FC/MC models	100	150	180	
	FD/MD models	200	300	380	

OUTPUT

Parameter	Condition		Min.	Typ.	Max.	Units
Output Ripple	1MHz bandwidth	≤100V output models	-	-	50	mVp-p
		≥125V output models	-	-	1	%

ENVIRONMENTAL

Parameter	Condition		Min.	Typ.	Max.	Units
Operating Temperature Range	Baseplate	F models	-40	-	+85	°C
		M models	-55	-	+85	
Storage Temperature Range			-55	-	+105	°C
Cooling	Conduction through baseplate					

GENERAL

Parameter	Condition	Min.	Typ.	Max.	Units
Operating Frequency		-	100	-	kHz
Isolation Voltage	Input to output	4242	-	-	VDC
	Input to baseplate	2121	-	-	
	Output to baseplate	1000	-	-	
Insulation Resistance		100	-	-	MΩ
Size	L x W x H	4.6 x 2.5 x 0.5 (116.84 x 63.5 x 12.7)			inches (mm)
Weight	≤48V single output models	-	210	-	grams
	≥100V single output models	-	220	-	
	Dual output models	-	235	-	
Case	Aluminum baseplate and Glass Reinforced Polymer				
Potting	Vacuum Impregnated Epoxy				
Tube Packaging (W x H x L)	2.595 x 1.105 x 20 (65.913 x 28.067 x 101.6)				inches (mm)

PROTECTIONS & FEATURES

Parameter	Condition		Min.	Typ.	Max.	Units
Input Over Voltage	FA/MA, FB/MB & FC/MC models		Yes			
Short circuit or Overload	Hiccup mode, self-recovery		120	-	-	%
Overtemperature	Baseplate, self-recovery	Shutdown	-	95	-	°C
		Restart	-	50	-	
Output Overvoltage	Zener diode clamp		-	120	-	%
Shutdown (SHUTDOWN)	Non-latched shutdown, Self-recovery		-	-	0.15	VDC
Output Voltage Trim (TRIM, TRIM UP & TRIM DOWN)	Trim up or trim down		-5	0	5	%
Parallel [3]	P option models		Connect as shown in connection diagram.			

Note 3: The parallel option allows units to operate the outputs in parallel to share load, increase total power or allow for N+1 redundancy.

SPECIFICATIONS (Nominal V_{IN}, Full Load, T_A = +25°C, 1 hour warm up unless otherwise specified)

DESIGNED TO MEET

Test	Referenced Standard	Description
Vibration	MIL-STD-202	Method 204, Vibration, High Frequency, Condition D
Shock	MIL-STD-202	Method 213, Shock (Specified Pulse), Condition I
Humidity	MIL-STD-202	Method 106, Moisture Resistance
Altitude	MIL-STD-202	Method 105, Barometric Pressure (Reduced), Condition D

OPTIONS AVAILABLE – CONTACT PICO FOR PART NUMBER

Parameter	Referenced Standard	Description
Stabilization Bake	MIL-STD-883	Referenced Method 1008 Non-operating maximum storage temperature for 24 hours
Temperature Cycle	MIL-STD-883	Referenced Method 1010 Non-operating at temperature extremes, 15 mins/temp, 10 cycles
Burn-In	MIL-STD-883	Referenced Method 1015 Max operating temperature for 160 hours
Expanded Operating Temperature Range	-55°C to +85°C	

THERMAL RESISTANCE

$$P_{OUT} = \frac{T_C - T_A}{T_{RCA} \times (1 / \eta - 1)}$$

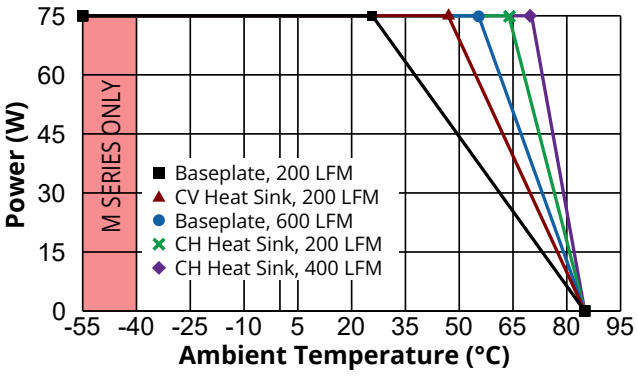
P_{OUT} = Output Power in Watts
η = Efficiency
T_C = Case temperature in °C
T_A = Ambient temperature in °C
T_{RCA} = Thermal resistance of case to air in °C / W

Thermal resistance of case (T_{RCA})

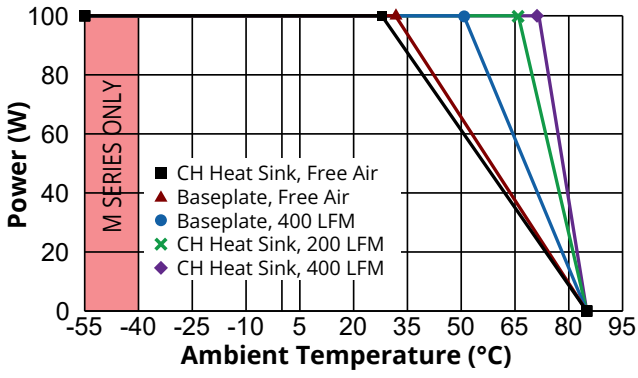
Airflow	Baseplate only	CV Heat Sink	CH Heat Sink	Units
Free Air	5.1	3.5	3.0	°C / W
200 LFM	2.8	1.8	1	
400 LFM	1.8	1.1	0.7	
600 LFM	1.4	0.8	0.55	
800 LFM	1.2	0.65	0.45	
1000 LFM	1	0.55	0.4	

DERATING GRAPHS (Nominal V_{IN}, Full Load, Efficiency @ Full Load)

Models with Max. Output Power = 75W & Efficiency at full load = 78%

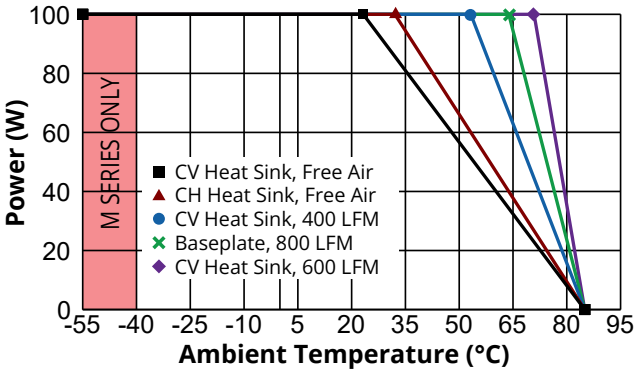


Models with Max. Output Power = 100W & Efficiency at full load = 84%

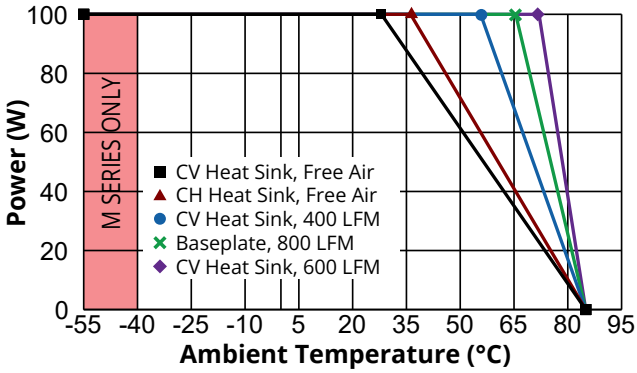


DERATING GRAPHS

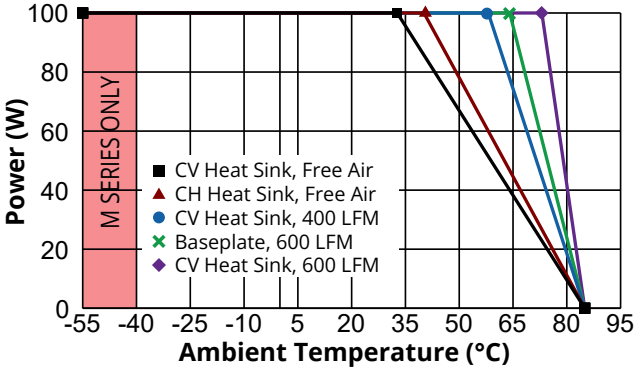
Models with Max. Output Power = 100W & Efficiency at full load = 85%



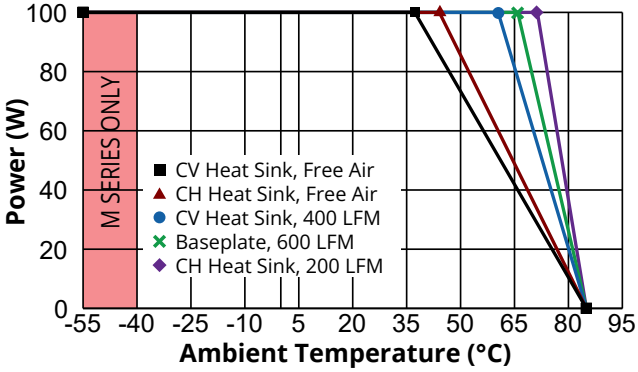
Models with Max. Output Power = 100W & Efficiency at full load = 86%



Models with Max. Output Power = 100W & Efficiency at full load = 87%



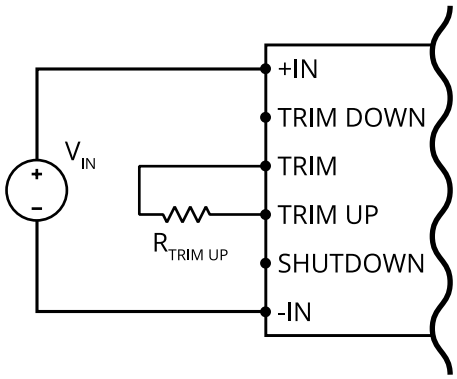
Models with Max. Output Power = 100W & Efficiency at full load = 88%



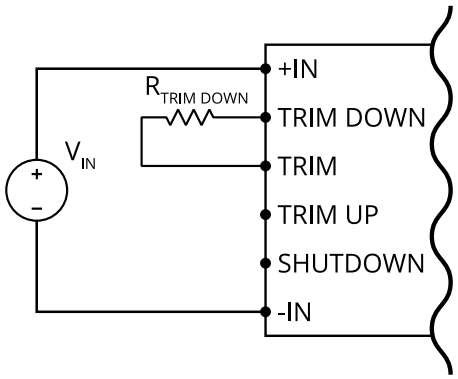
TYPICAL CONNECTION CIRCUIT

TRIM

TRIM UP



TRIM DOWN

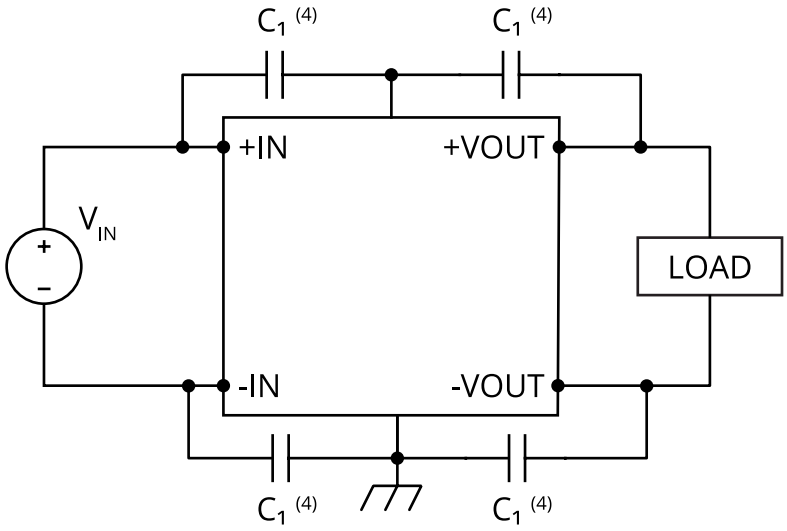


ΔV_{OUT}	0	1	2	3	5	% typ.
Trim Up Resistance	Open	300	150	50	20	kΩ typ.
Trim Down Resistance	Open	1000	500	250	100	

Note: Each individual unit will vary slightly. It is recommended to use a 1MΩ multi-turn trimmer potentiometer to determine resistance value and achieve desired adjustment. Use minimum 1/2W power rating resistor. Keep the trim resistor leads as short as possible to eliminate the stray inductance which will effect the trimming results.

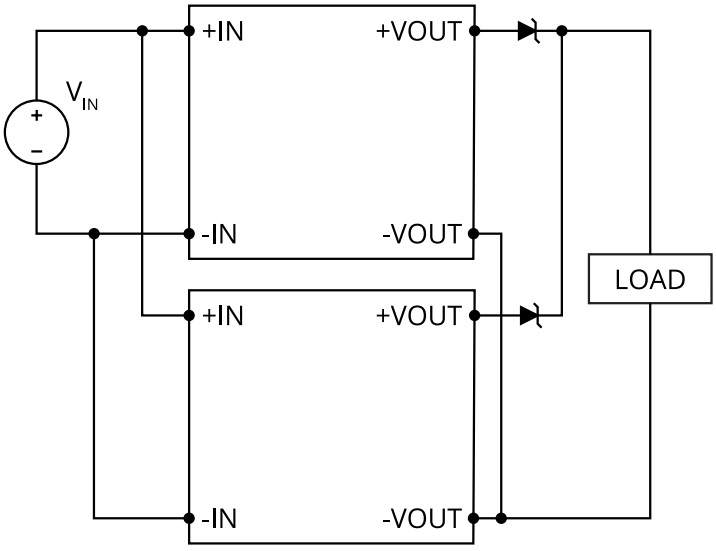
TYPICAL CONNECTION CIRCUIT

NOISE REDUCTION



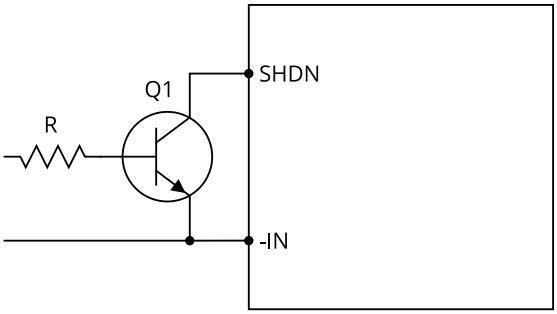
Note 4: C1 filter capacitors may reduce noise further. Please contact Pico for more details.

PARALLEL

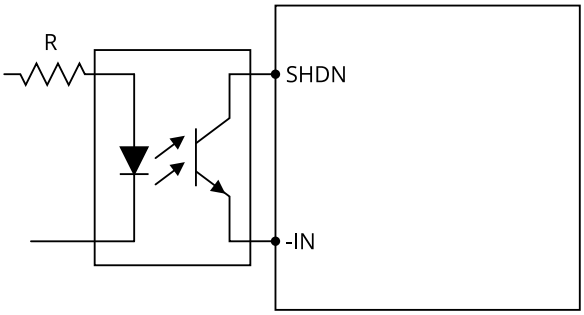


SHUTDOWN

NON-ISOLATED

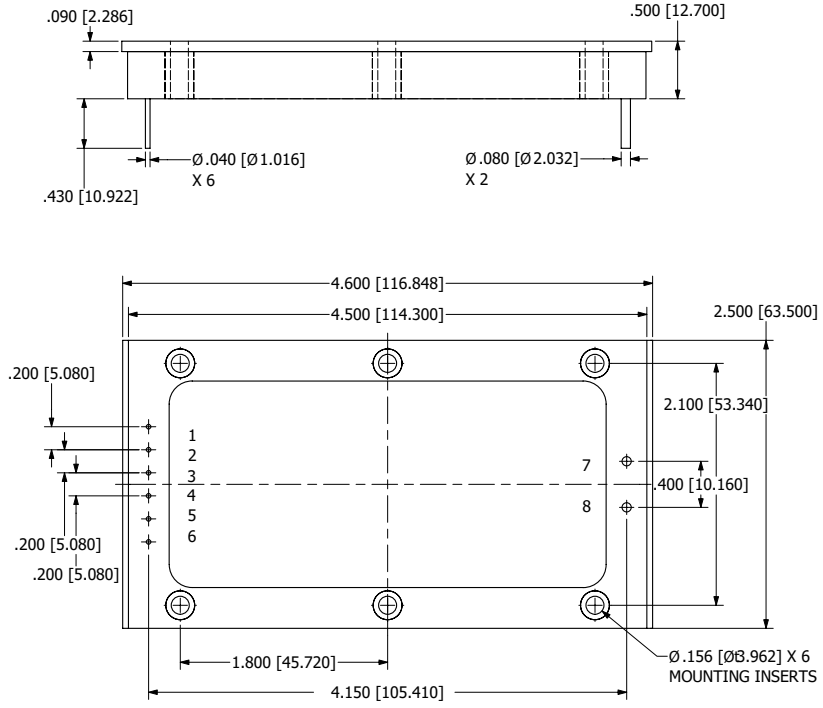


ISOLATED



MECHANICAL DRAWINGS

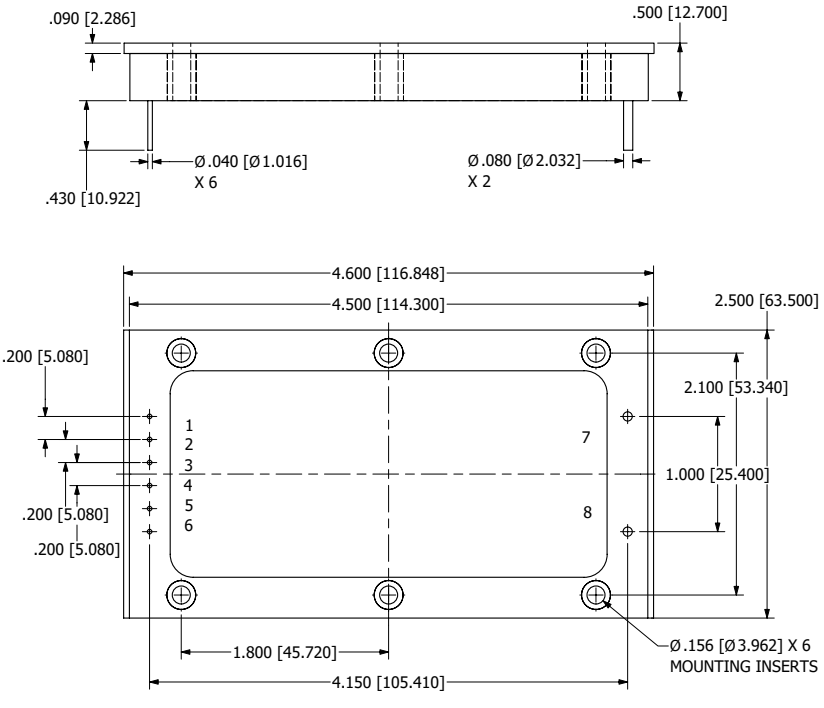
≤48V SINGLE OUTPUT MODELS



BOTTOM VIEW

PIN	FUNCTION	PIN DIAMETER
1	+IN	.040 [1.016]
2	TRIM DOWN	.040 [1.016]
3	TRIM	.040 [1.016]
4	TRIM UP	.040 [1.016]
5	SHUT DOWN	.040 [1.016]
6	-IN	.040 [1.016]
7	-OUT	.080 [2.032]
8	+OUT	.080 [2.032]

≥100V SINGLE OUTPUT MODELS



BOTTOM VIEW

PIN	FUNCTION	PIN DIAMETER
1	+IN	.040 [1.016]
2	TRIM DOWN	.040 [1.016]
3	TRIM	.040 [1.016]
4	TRIM UP	.040 [1.016]
5	SHUT DOWN	.040 [1.016]
6	-IN	.040 [1.016]
7	-OUT	.080 [2.032]
8	+OUT	.080 [2.032]

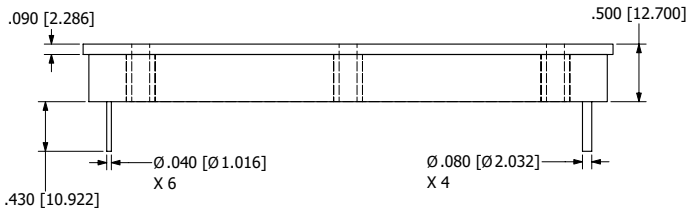
NOTES

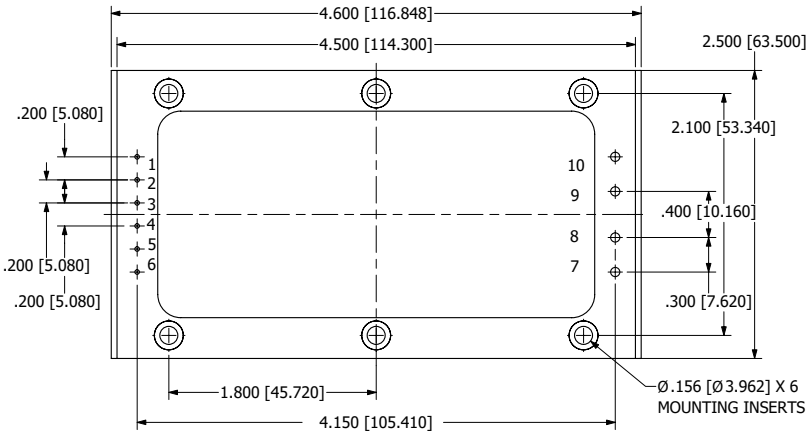
a. ALL DIMENSIONS ARE IN INCHES, [ ] = MM

b. RECOMMENDED TORQUE FOR MOUNTING SCREWS: 6-9 INCH-LBS

MECHANICAL DRAWINGS

DUAL OUTPUT MODELS





BOTTOM VIEW

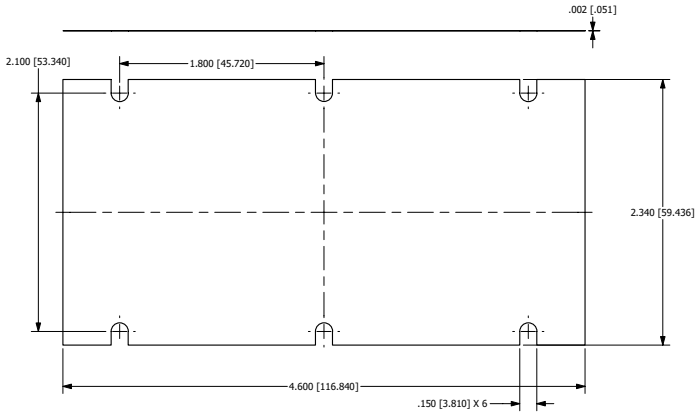
PIN	FUNCTION	PIN DIAMETER
1	+IN	.040 [1.016]
2	TRIM DOWN	.040 [1.016]
3	TRIM	.040 [1.016]
4	TRIM UP	.040 [1.016]
5	SHUT DOWN	.040 [1.016]
6	-IN	.040 [1.016]
7	-OUT1	.080 [2.032]
8	+OUT1	.080 [2.032]
9	-OUT2	.080 [2.032]
10	+OUT2	.080 [2.032]

NOTES
a. ALL DIMENSIONS ARE IN INCHES, [ ] = MM
b. RECOMMENDED TORQUE FOR MOUNTING SCREWS: 6-9 INCH-LBS

MECHANICAL DRAWINGS

THERMAL INTERFACE

TI

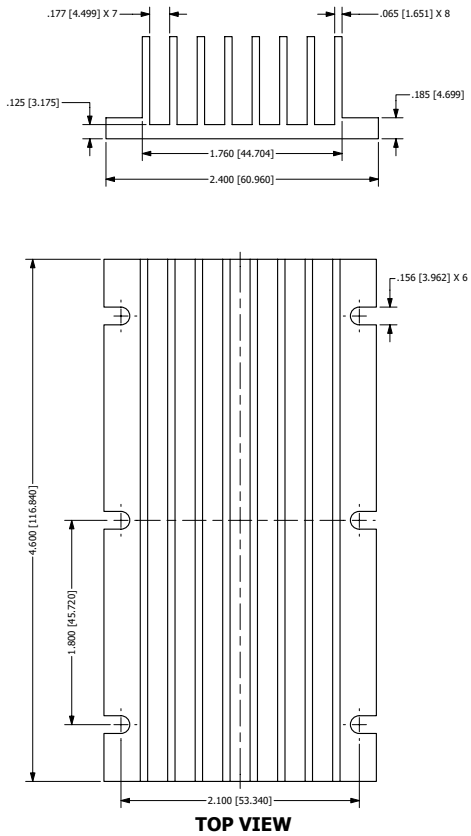


BOTTOM VIEW

Material	Alloy Aluminum Substrate
Thermal Conductivity	1530 BTU-in/hr sq.ft °F
Coefficient of Thermal Expansion, (25-100°C)	13.1 10^{-6} in-in/°F
Brinell Hardness	23 HB
Endurance Limit	5000 PSI
Standard Thickness	0.002 inches

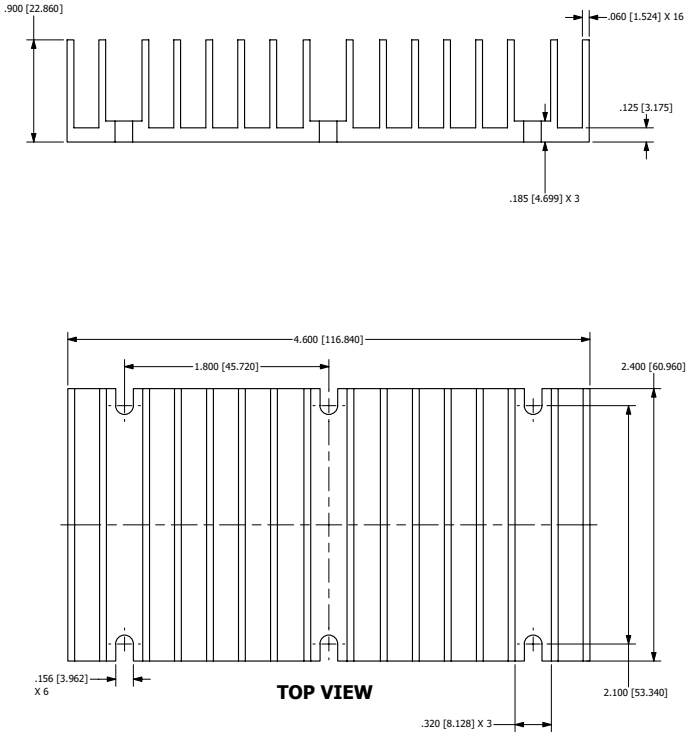
HEAT SINKS

CV

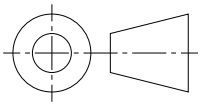


TOP VIEW

CH



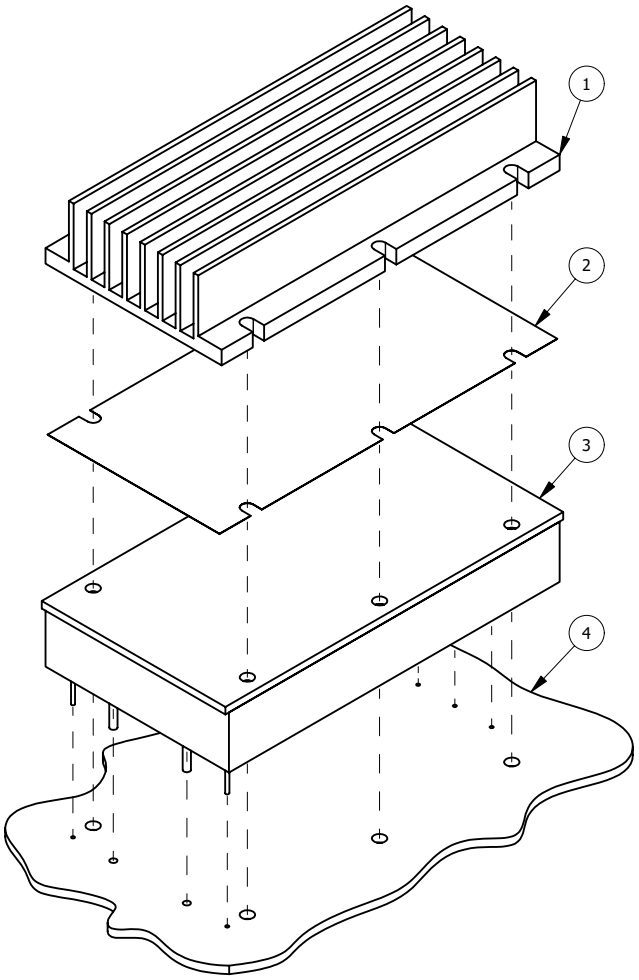
TOP VIEW

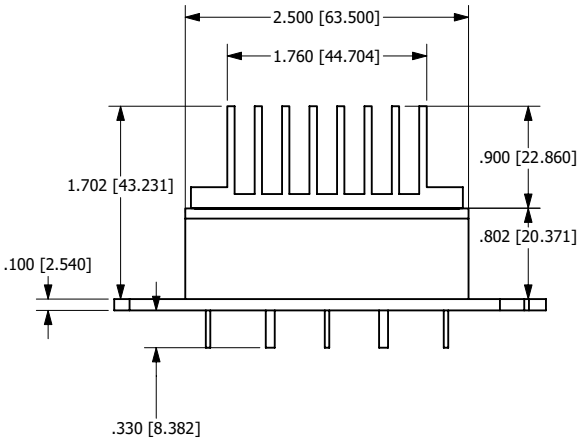


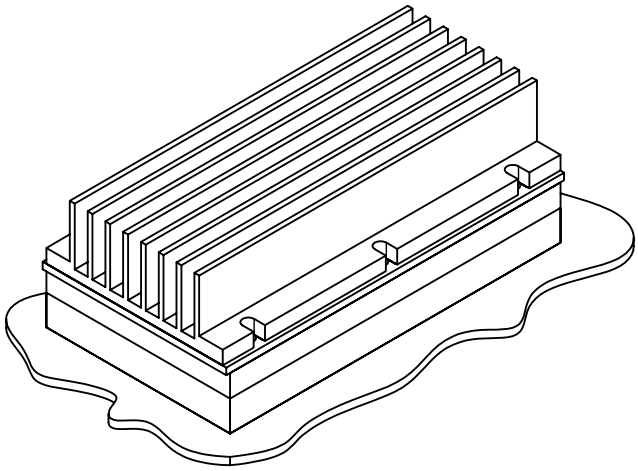
Weight: 145 grams typical

MECHANICAL DRAWINGS

HEAT SINK ASSEMBLY







ITEM	QTY	DESCRIPTION
1	1	CH OR CV HEAT SINK
2	1	TI THERMAL INTERFACE
3	1	F/M MODULE
4	1	PCB

TUBE PACKAGING