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Series QP

50W Isolated Regulated High Power DC-DC Converter

PICO Electronics, Inc.

PRODUCT OVERVIEW

The QP series are isolated DC-DC converters with a wide selection of input voltage ranges from 4.5V to 475V while maintaining tight output regulation, low ripple and noise. These modules have trim capability, shutdown and internal reference voltage. Protections include input over/undervoltage, output short-circuit, output overvoltage and over temperature. For increased reliability, the feedback loop does not use an optocoupler.

The 2.5" x 1.55" x 0.5" case size has threaded inserts to mount securely for high vibration and shock applications. Conduction cooling is available through the baseplate or compatible heat sink.



FEATURES

- 4.75V to 475V input range models
- 5 to 500V output models
- Up to 50W output
- Input/output isolation
- Protected against input over/undervoltage, output short-circuit overcurrent (HiQP) and over temperature
- Does not use optocoupler in feedback loop
- External bias for capacitor charging applications (QP)
- Load Share Parallel operation (HiQP)
- Industrial temperature option -40°C (HiQP)
- Military temperature option -55°C (HiQP)
- Input LC filter for soft start and low reflected current ripple (HiQP)

Contact Pico for part number of available options:

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

Hi	QP	24	-M
INPUT VOLTAGE RANGE	SERIES NAME	NOM. OUTPUT VOLTAGE	TEMPERATURE
6 = 4.75 - 9V **12** = 9 - 18V **24** = 18 - 36V **48** = 36 - 72V	**QP**	**5** = 5V **12** = 12V **15** = 15V **24** = 24V **48** = 48V **100** = 100V **200** = 200V **300** = 300V **400** = 400V **500** = 500V	Blank = 0°C to +85°C
Hi = 125 - 475V	**QP**	**24** = 24V **48** = 48V **100** = 100V **200** = 200V	Blank = 0°C to +70°C **-I** = -40°C to +95°C **-M** = -55°C to +95°C

MODEL LIST

Pico Part Number	Output Voltage [VDC]	Output Current Min. [mA]	Output Current Max. [mA]	Output Power [W]	Efficiency [2] [%] typ.	Line Regulation [%] max	Load Regulation 10-100% [1] [%] max	Output Ripple @ 1MHz BW [mVp-p] max
6QP5.0	5	400	4000	20	73	4	2	50
6QP12	12	167	1667	20	82	2	1.5	40
6QP15	15	167	1667	25	82	2	1.5	40
6QP24	24	104	1042	25	81	1.5	1	20
6QP28	28	89	893	25	81	1.5	1	20
6QP48	48	52	521	25	80	2	1.5	30
6QP100	100	25	250	25	82	3	2	20
6QP200	200	13	125	25	77	3	2	150
6QP300	300	7	67 [3]	20 [3]	80	2.5	2	100
6QP400	400	5	50 [3]	20 [3]	79	2.5	2	200
6QP500	500	4	40 [3]	20 [3]	76	2	1.5	200
12QP5.0	5	800	8000	40	78	3	3	50
12QP12	12	333	3333	40	85	1.5	2	40
12QP15	15	333	3333	50	85	1.5	2	40
12QP24	24	208	2083	50	85	1	1.5	20
12QP28	28	179	1786	50	85	1	1.5	20
12QP48	48	104	1042	50	85	1	1.5	30
12QP100	100	50	500	50	86	1	1.5	20
12QP200	200	25	250	50	85	1.5	2	150
12QP300	300	13	133 [4]	40 [4]	87	1	1	100
12QP400	400	10	100 [4]	40 [4]	87	1	1	200
12QP500	500	8	80 [4]	40 [4]	86	1	1	200
24QP5.0	5	800	8000	40	79	3	2	50
24QP12	12	333	3333	40	88	1	1.5	40
24QP15	15	333	3333	50	88	1	1.5	40
24QP24	24	208	2083	50	87	1	1	20
24QP28	28	179	1786	50	87	1	1	20
24QP48	48	104	1042	50	87	1	1	30
24QP100	100	50	500	50	88	1	1	20
24QP200	200	25	250	50	87	1	1.5	150
24QP300	300	13	133	40	90	0.5	1	100
24QP400	400	10	100	40	89	0.5	0.5	200
24QP500	500	8	80	40	89	1	1	200

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: Below 5.5V input, derate linearly 7.5W per input voltage.
Note 4: Below 10.5V input, derate linearly 6.7W per input voltage.

MODEL LIST

Pico Part Number	Output Voltage [VDC]	Output Current Min. [mA]	Output Current Max. [mA]	Output Power [W]	Efficiency [2] [%] typ.	Line Regulation [%] max	Load Regulation 10-100% [5] [%] max	Output Ripple @ 1MHz BW [mVp-p] max
48QP5.0	5	800	8000	40	81	2	2	30
48QP12	12	417	4167	50	83	1	1	20
48QP15	15	333	3333	50	84	1	1	30
48QP24	24	208	2083	50	88	1	1	20
48QP28	28	179	1786	50	88	1	1	20
48QP48	48	104	1042	50	89	1	1	30
48QP100	100	50	500	50	89	1	1	50
48QP200	200	25	250	50	89	1	1.5	250
48QP300	300	13	133	40	90	0.5	1	200
48QP400	400	10	100	40	87	0.5	1	200
48QP500	500	8	80	40	89	1	1.5	200
HiQP24	24	104	2083	50	86	0.25	1.25	350
HiQP24-I								
HiQP24-M								
HiQP28	28	89	1786		86	0.25	1.25	375
HiQP28-I								
HiQP28-M								
HiQP48	48	52	1042		85	0.25	1.75	400
HiQP48-I								
HiQP48-M								
HiQP100	100	25	500		88	0.3	1.6	600
HiQP100-I								
HiQP100-M								
HiQP200	200	13	250		89	0.1	1.5	750
HiQP200-I								
HiQP200-M								

Note 5: For 6QP, 12QP, 24QP & 48QP models, maintain minimum 10% of rated load to prevent a voltage surge.
For HiQP models, maintain minimum 5% of rated load to prevent >2% voltage overshoot.

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	6V input models		4.5	6	9	VDC
	12V input models		9	12	18	
	24V input models		18	24	36	
	48V input models		36	48	72	
	HiQP models		125	250	475	
Input Filter	HiQP models		LC filter			
Input Current	HiQP models	Short-circuit condition	-	-	8	mA
		Shutdown mode	-	-	0.5	
Input Reflected Ripple Current	HiQP models	20MHz, Full Load	-	10	-	%

OUTPUT

Parameter	Condition		Min.	Typ.	Max.	Units
Output Voltage Tolerance	Nominal V_{IN}, Full Load	QP models	-	-	0.5	%
		HiQP models	-	-	1	

ENVIRONMENTAL

Parameter	Condition		Min.	Typ.	Max.	Units
Operating Temperature Range	Baseplate	QP models	0	-	+85	°C
		HiQP models	0	-	+70	
		HiQP -I models	-40	-	+95	
		HiQP -M models	-55	-	+95	
Storage Temperature Range			-55	-	+125	°C
Cooling	Conduction through baseplate					

GENERAL

Parameter	Condition		Min.	Typ.	Max.	Units
Operating Frequency	QP models, Fixed frequency	≤200V output models	-	200	-	kHz
		≥300V output models	-	150	-	
	HiQP models, Variable frequency		80	-	110	
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		2.5 x 1.55 x 0.5 (76.2 x 39.37 x 12.7)			inches (mm)
Weight			-	75	-	grams
Case	Aluminum baseplate and Glass Reinforced Polymer					
Potting	Vacuum Impregnated Epoxy					
Tube Packaging (W x H x L)	2.595 x 1.135 x 20 (65.913 x 28.829 x 101.6)					inches (mm)

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

PROTECTIONS & FEATURES

Parameter	Condition			Min.	Typ.	Max.	Units
Short circuit or Overload	Hiccup mode, self-recovery			-	130	-	%
Overtemperature	Baseplate, self-recovery	All other models	Shutdown	-	95	-	°C
			Restart	-	50	-	
		HiQP -I & -M models	Shutdown	-	110	-	
			Restart	-	100	-	
Output Overvoltage	Zener diode clamp			-	120	-	%
Input Under Voltage	Non-latched shutdown Self-recovery	6V input models	Shutdown	-	3.6	-	VDC
			Restart	-	4.25	-	
		12V input models	Shutdown	-	7.1	-	
			Restart	-	7.6	-	
		24V input models	Shutdown	-	14.6	-	
			Restart	-	15.6	-	
		48V input models	Shutdown	-	31.2	-	
			Restart	-	31.8	-	
		HiQP models	Shutdown	-	60	-	
			Restart	-	107	-	
Input Over Voltage	Non-latched shutdown Self-recovery	6V input models	Shutdown	-	11	-	VDC
			Restart	-	10.8	-	
		12V input models	Shutdown	-	20	-	
			Restart	-	19.5	-	
		24V input models	Shutdown	-	41	-	
			Restart	-	40	-	
		48V input models	Shutdown	-	82	-	
			Restart	-	81.5	-	
		HiQP models	Shutdown	-	560	-	
			Restart	-	500	-	
Shutdown (SHDN)	Non-latched shutdown, Self-recovery			-	-	0.4	VDC
	Note 1: Shutdown will shut down the unit when the pin is pulled below 0.4V. For 6QP, 12QP, 24QP & 48QP models, the voltage of the open shutdown pin is equal to the input voltage. All external components must be rated to at least the input voltage.						
Output Voltage Trim (TRIM)	QP models			-5	0	-	%
	HiQP models			-15	0	15	
	Note 2: Output Voltage Trim can adjust the output voltage through a resistor to -IN or VREF pins.						
Voltage Reference (VREF)	Voltage	QP models		2.8	3	3.2	VDC
		HiQP models		2.94	3	3.06	
	Current			0	-	10	mA
	Note 3: Voltage Reference can be used for Output Voltage Trim. Voltage is typically 3V and current is <10mA. Units can be trimmed down with a resistor to Output Voltage Trim.						
External Bias (EX. B)	QP models	Voltage		17	-	20	VDC
		Current		-	20	-	mA
		Note 4: External Bias should be used in an application which requires a large startup current such as capacitor charging. This will disable and prevent the overload or short-circuit protections. After the output has reached 90-95% nominal value, internal bias should be used so normal operations and protections can be restored. External bias should not be connected when not in use.					
Load Share (LDSH)	HiQP models	Note 5: Load Share allows units to operate the outputs in parallel to share load, increase total power or allow for N+1 redundancy. Connect directly to the load share pin of Pico's HiQP converters. -IN terminals must be connected directly.					

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	-40°C to +85°C (Series QP)	

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*

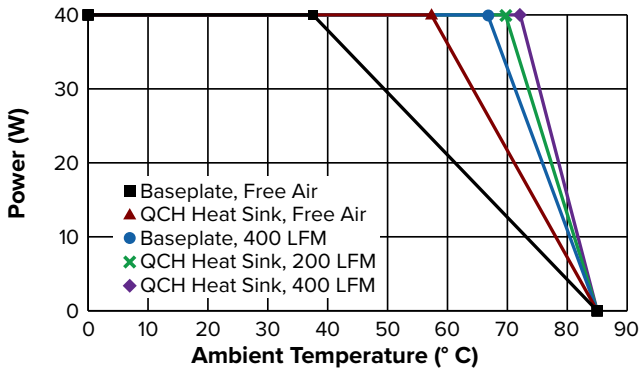
T_{RCA} = *Thermal resistance of case to air in °C / W*

Thermal resistance of case (T_{RCA})

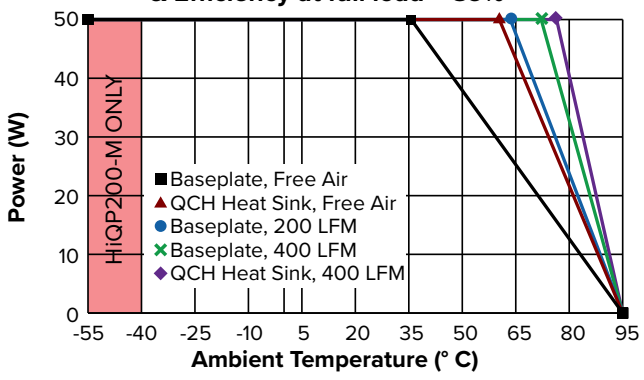
Air Flow	Baseplate only	QCH Heat Sink	Units
Free Air	9.6	5.6	°C / W
200 LFM	5.1	3.0	
400 LFM	3.7	2.2	
600 LFM	3.1	1.8	
800 LFM	2.6	1.5	
1000 LFM	2.2	1.3	

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

Models with Max. Output Power =40W & Efficiency at full load = 89%



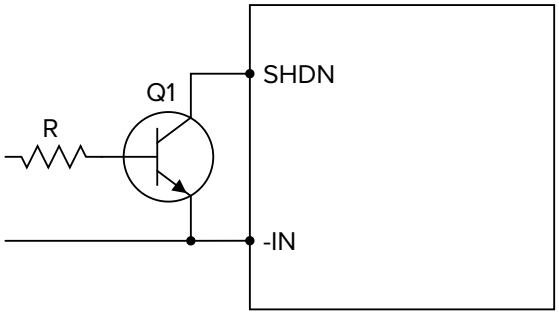
P/N HiQP200-I & HiQP200-M Max. Output Power = 50W & Efficiency at full load = 89%



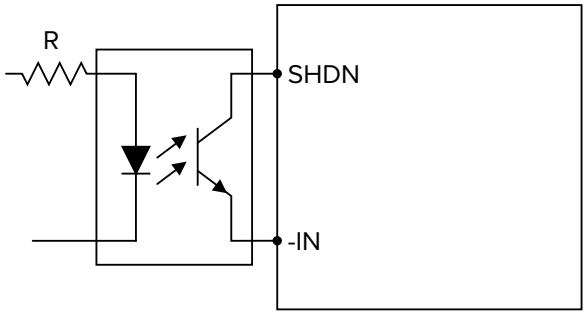
TYPICAL CONNECTION CIRCUIT

SHUTDOWN

NON-ISOLATED



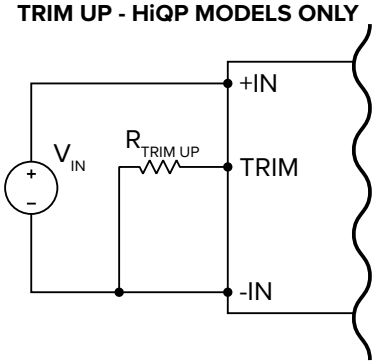
ISOLATED



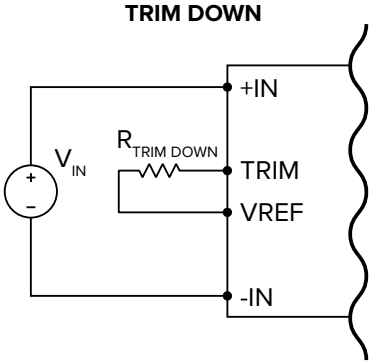
Note 1: Shutdown will shut down the unit when the pin is pulled below 0.4V. For 6QP, 12QP, 24QP & 48QP models, the voltage of the open shutdown pin is equal to the input voltage. All external components must be rated to at least the input voltage.

TRIM

TRIM UP - HiQP MODELS ONLY



TRIM DOWN



6QP, 12QP, 24QP & 48QP MODELS

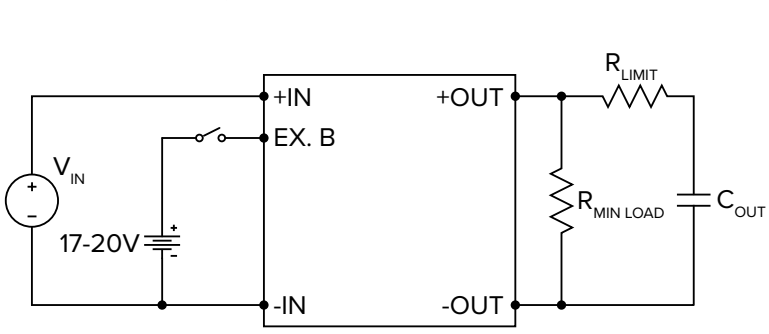
Resistance	Open	374	162	91	33	kΩ typ.
Trim Up	Not available					
Trim Down	0	-1	-2	-3	-5	V_{OUT} %

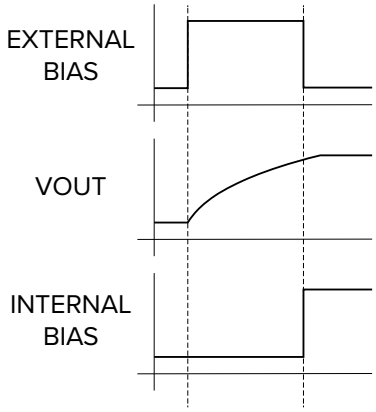
HiQP MODELS

Resistance	Open	1000	470	100	47	10	1	0 (Short)	kΩ typ.
Trim Up	0	0.5	1	4	7	14	16	17	V_{OUT} %
Trim Down	0	-1	-3	-7	-9	-13	-15	-16	

Note 2: Output Voltage Trim (TRIM) can adjust the output voltage through a resistor to -IN or VREF pins.
Note 3: Voltage Reference (VREF) can be used for Output Voltage Trim. Voltage is typically 3V and current is <10mA. Units can be trimmed down with a resistor to Output Voltage Trim.

EXTERNAL BIAS - SERIES QP

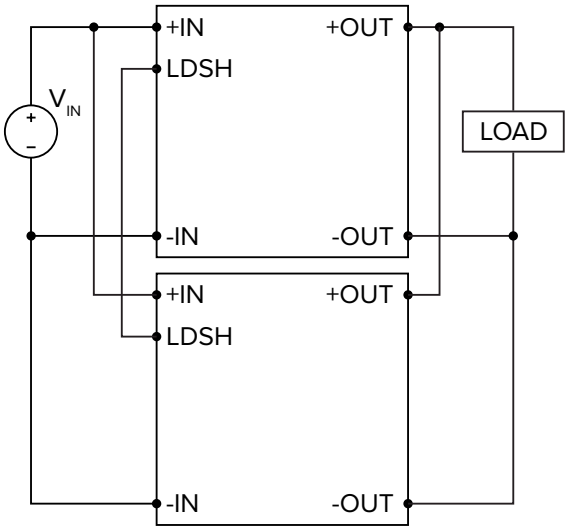




Note 4: External Bias (EX. B) should be used in an application which requires a large startup current such as capacitor charging. This will disable and prevent the overload or short-circuit protections. After the output has reached 90-95% nominal value, internal bias should be used so normal operations and protections can be restored. External bias should not be connected when not in use.

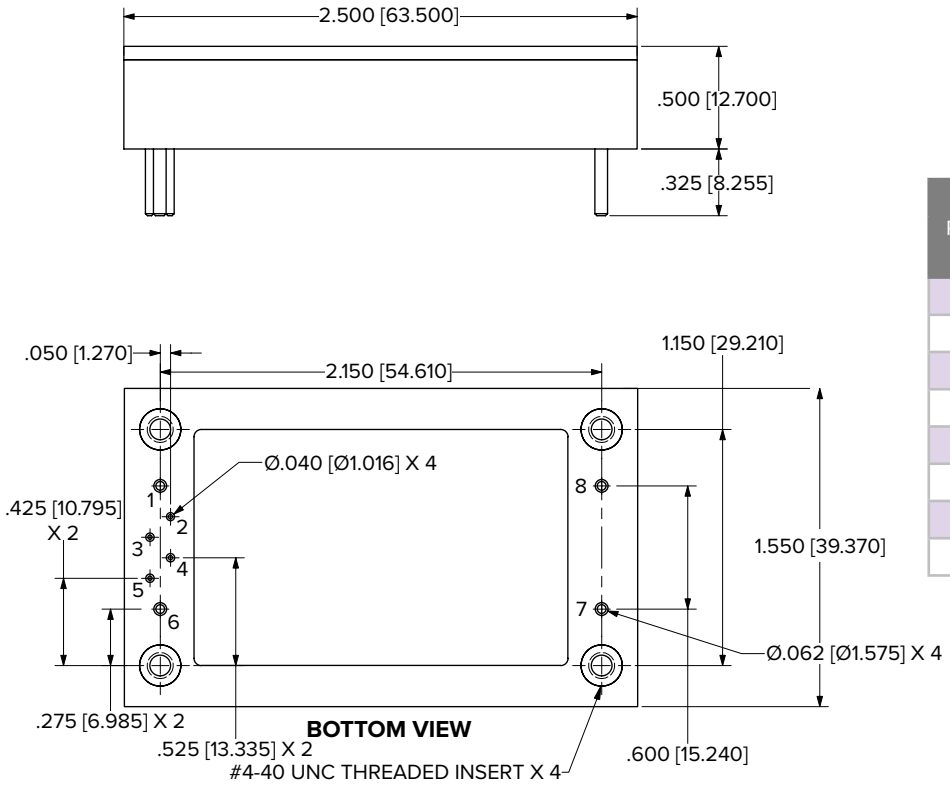
TYPICAL CONNECTION CIRCUIT

LOAD SHARE - HiQP MODELS



Note 5: Load Share (LDSH) allows units to operate the outputs in parallel to share load, increase total power or allow for N+1 redundancy. Connect directly to the load share pin of Pico's HiQP converters. -IN terminals must be connected directly.

MECHANICAL DRAWINGS

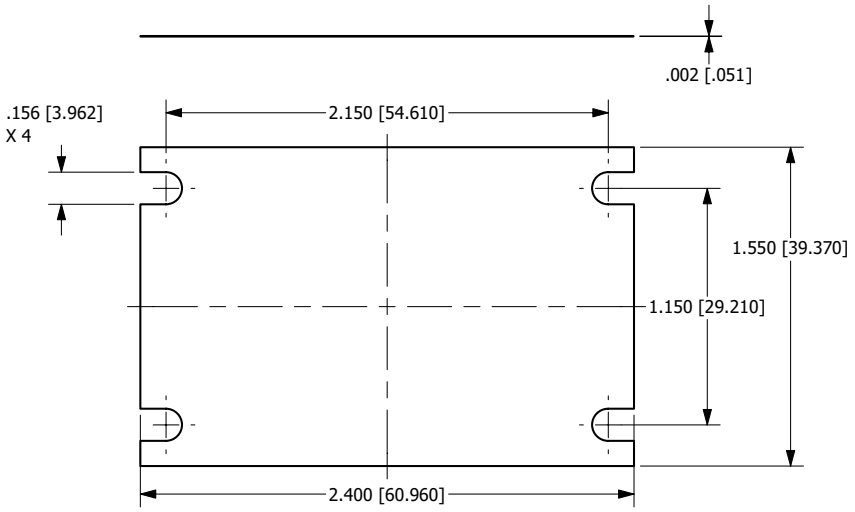


PIN	FUNCTION		PIN DIAMETER
	QP MODELS	HIQP MODELS	
1	-IN		.062 [1.575]
2	SHDN		.040 [1.016]
3	VREF		.040 [1.016]
4	TRIM		.040 [1.016]
5	EX. B	LDSH	.040 [1.016]
6	+IN		.062 [1.575]
7	+OUT		.062 [1.575]
8	-OUT		.062 [1.575]

NOTES
a. ALL DIMENSIONS ARE IN INCHES, [ ] = MM
b. RECOMMENDED TORQUE FOR MOUNTING SCREWS: 3-5 INCH-LBS

MECHANICAL DRAWINGS

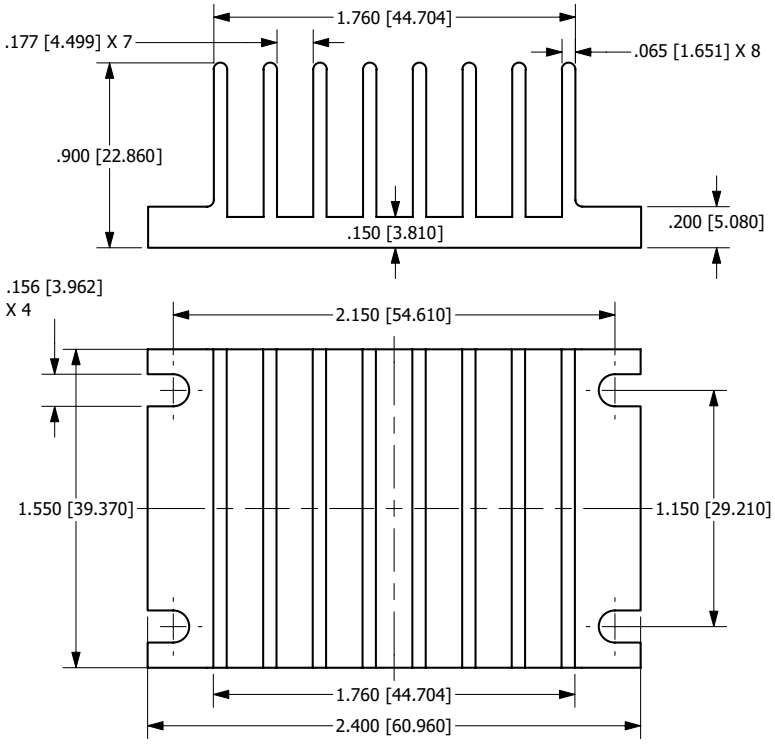
QTI - THERMAL INTERFACE



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

QCH - HEAT SINK

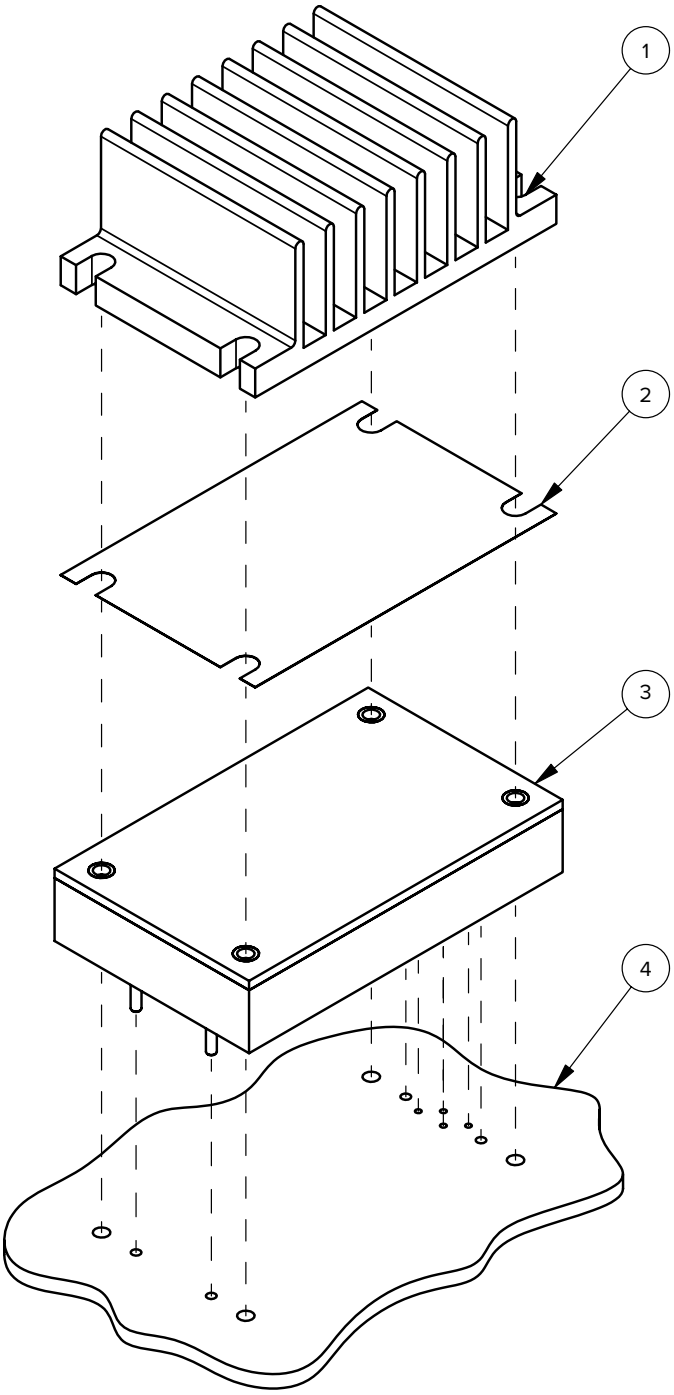


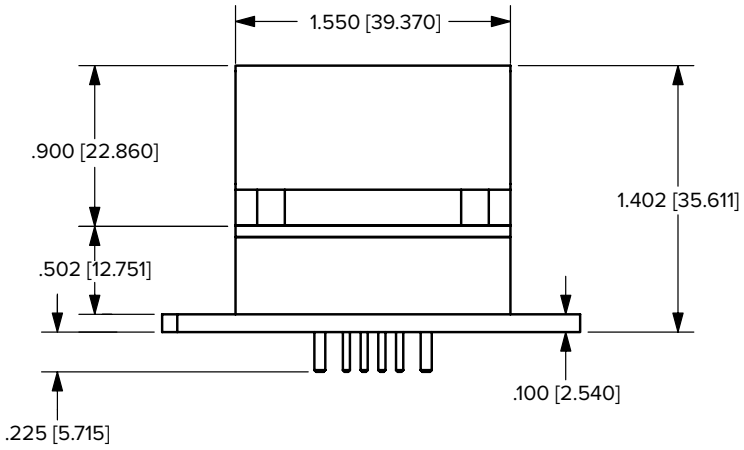
TOP VIEW

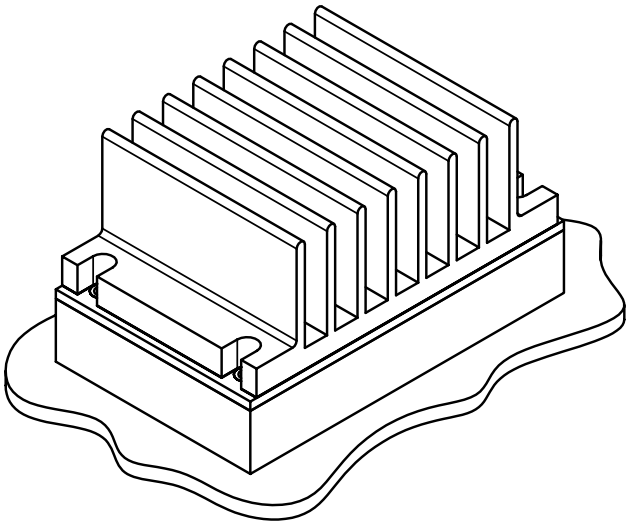
Weight: 51.3 grams typical

MECHANICAL DRAWINGS

HEAT SINK ASSEMBLY

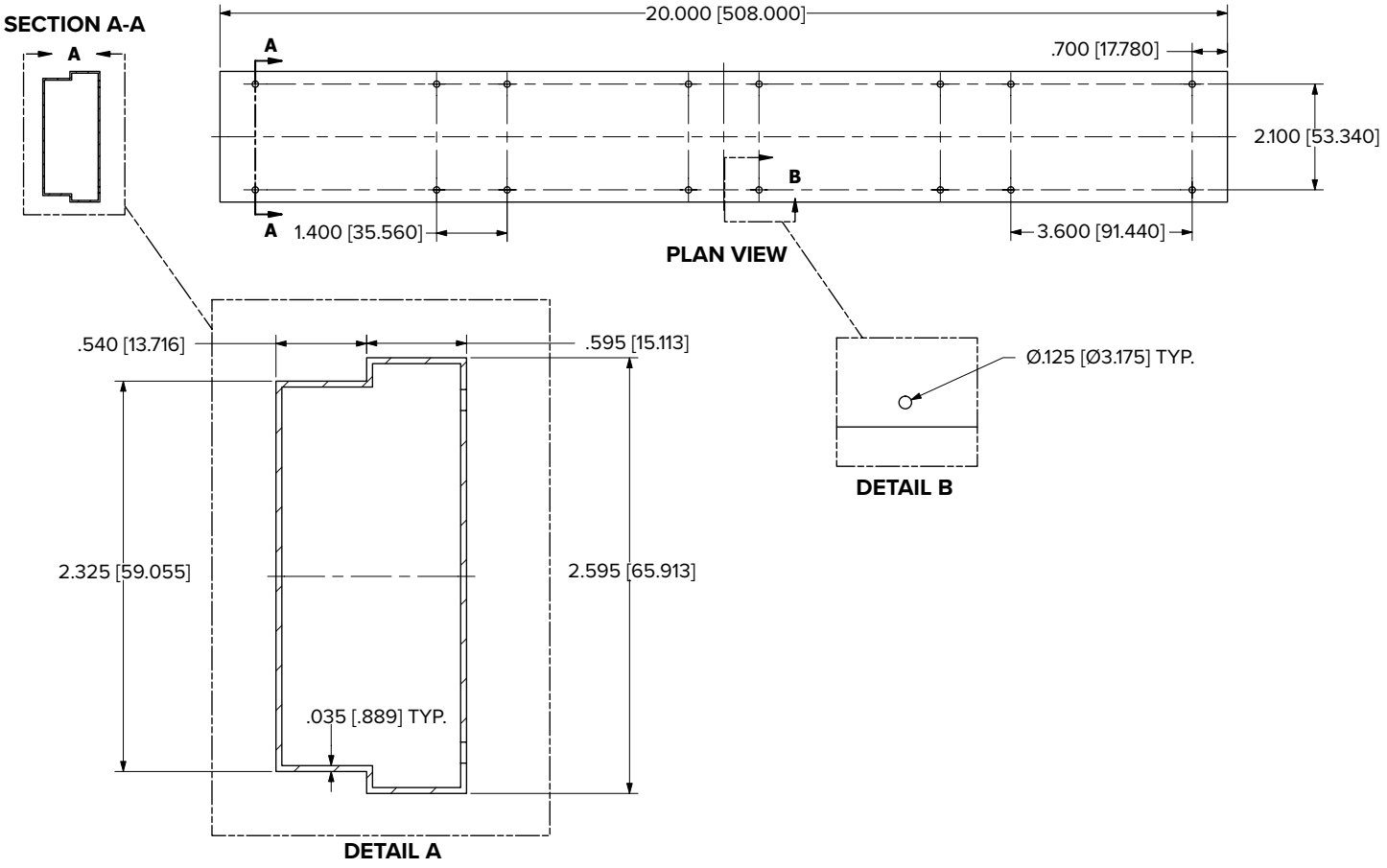




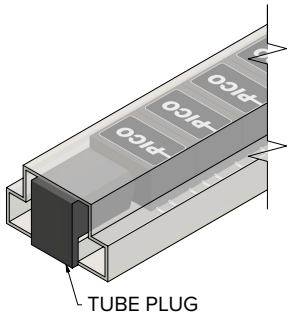


ITEM	QTY	DESCRIPTION
1	1	QCH HEAT SINK
2	1	QTI THERMAL INTERFACE
3	1	QP MODULE
4	1	PCB

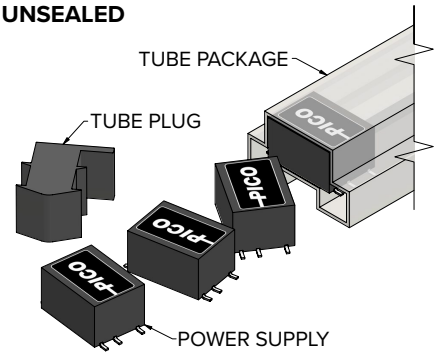
TUBE PACKAGING

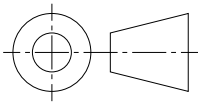


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