

Features

- High efficiency and excellent thermal performance
- Output remote sense
- Input under-voltage, output over-voltage, over-current, short-circuit and over-temperature protections
- Basic insulation, 3,000Vac input to output isolation
- UL 62368-1 2nd edition recognized
- Compliance with EN50155
- Wide operating temperature range from -40°C to +100°C

Part Numbering System

QYR	6A	□□□	□	□□□	□	□	□	(□)	-	□
Series Name	**Input Voltage**	**Output Voltage**	**Enabling Logic**	**Rated Output Current**	**Pin Length**	**Options 1**	**Options 2**	**Suffix**	**-**	**Operating Temperature Grade (°C)****
	6A: 34-160V	**Example:** **120:** 12V	**P:** Positive **N:** Negative	**Example:** **010:** 10A	**N:** 0.130" **R:** 0.165" **J:** 0.220"	**0:** Latch off **2:** Auto-restart	**P:** W/O flange **F:** With flange	**R:** Alternative Pin*		**C:** -20 to +100 **H:** -40 to +100

**The details of the alternative pin R is illustrated on page 11.*
***Operating temperature is the temperature measured at the center of the baseplate.*

Available Codes:

Output Voltage	5V	12V	24V	48V
Output Current	24A	5A, 10A	3A*, 5A	2.5A, 3.2A

** Designed to meet UL62368-1 2nd edition.*

Absolute Maximum Rating

Excessive stresses over these absolute maximum ratings can cause permanent damage to the converter. Operation should be limited to the conditions outlined under the Electrical Specification section.

Parameter	Min	Max	Unit
Input Voltage (continuous operating)	-0.5	160	V
Input Voltage (continuous, non-operating)	-	200	V
Input Voltage (<100ms, operating)	-	200	V
Storage Temperature	-55	125	˚C

Electrical Specifications

These specifications are valid over the converter's full range of input voltage, resistive load, and temperature unless noted otherwise.

Input Specifications

Parameter	Min	Typical	Max	Unit
Input Voltage	34	90	160	V
Input Turn-on Voltage Threshold	31	32	33	V
Input Turn-off Voltage Threshold	28	29	30	V

For 12V/5A output module, the (Min, Typical, Max) value of "Input Turn-on Voltage Threshold" is (27.5, 28.0, 28.5)V, and the (Min, Typical, Max) value of "Input Turn-off Voltage Threshold" is (26.0, 26.5, 27.0)V.

Output Specifications

Parameter	Min	Typical	Max	Unit
Output Voltage Set Point Accuracy (typical Vin, full load, Ta = 25°C)	-1.5	-	+1.5	%Vo
Output Voltage Set Point Accuracy (over all conditions)	-3.0	-	+3.0	%Vo
Output Regulation: Line Regulation (full range input voltage, 1/2 full load) Load Regulation(full range load, typical Vin) Temperature (Ta = -40°C to 85 °C)	 - - -	 0.2 0.2 0.1	 0.5 0.5 -	%Vo
Output Trim Range in % of typical Vo	80	-	110	%

General Specifications

Parameter		Min	Typical	Max	Unit
Remote Enable Logic Low: ION/OFF = 1.0mA VON/OFF = 0.0V Logic High: ION/OFF = 0.0μA Leakage Current		 0 - 3.5 -	 - - - -	 1.2 1.0 15 50	 V mA V μA
Isolation Voltage	Input-Output	-	-	3,000	Vac
	Input-Baseplate	-	-	3,000	Vdc
	Output-Baseplate	-	-	1,000	Vdc
Isolation Capacitance		-	2,350	-	pF
Insulation Resistance		10	-	-	MΩ

Module Specific Specifications

5V/24A Module (QYR6A050x024xxx(x)-x)

Parameter	Min	Typical	Max	Unit
Input Current	-	-	5	A
Quiescent Input Current (typical Vin)	-	60	70	mA
Standby Input Current	-	5	8	mA
Efficiency (typical Vin, full load, Ta = 25ºC)	-	89.5	-	%
Output Voltage Set Point	-	5.0	-	V
Output Power	0	-	120	W
Output Over Current Protection Set Point	105	125	140	%
Output Over Voltage Protection Set Point	115	125	140	%
Output Ripple Frequency	140	160	180	kHz
Output Ripple and Noise Voltage RMS Peak-to-peak (5Hz to 20MHz bandwidth, typical Vin)	 - -	 45 100	 100 130	 mVrms mVp-p
External Load Capacitance	-	-	8,000	µF

12V/5A Module (QYR6A120x005xxx(x)-x)

Parameter	Min	Typical	Max	Unit
Input Current	-	-	3	A
Quiescent Input Current (typical Vin)	-	30	45	mA
Standby Input Current	-	5	8	mA
Efficiency (typical Vin, full load, Ta = 25ºC)	-	91.0	-	%
Output Voltage Set Point	-	12.0	-	V
Output Power	0	-	60	W
Output Over Current Protection Set Point	104	135	150	%
Output Over Voltage Protection Set Point	115	125	140	%
Output Ripple Frequency	140	160	180	kHz
Output Ripple and Noise Voltage RMS Peak-to-peak (5Hz to 20MHz bandwidth, typical Vin)	 - -	 10 60	 20 80	 mVrms mVp-p
External Load Capacitance	-	-	3,000	µF

12V/10A Module (QYR6A120x010xxx(x)-x)

Parameter	Min	Typical	Max	Unit
Input Current	-	-	5	A
Quiescent Input Current (typical Vin)	-	45	60	mA
Standby Input Current	-	5	8	mA
Efficiency (typical Vin, full load, Ta = 25ºC)	-	90.5	-	%
Output Voltage Set Point	-	12.0	-	V
Output Power	0	-	120	W
Output Over Current Protection Set Point	104	125	140	%
Output Over Voltage Protection Set Point	115	125	140	%
Output Ripple Frequency	140	160	180	kHz
Output Ripple and Noise Voltage RMS Peak-to-peak (5Hz to 20MHz bandwidth, typical Vin)	 - -	 20 100	 35 120	 mVrms mVp-p
External Load Capacitance	-	-	3,000	µF

24V/3A Module (QYR6A240x003xxx(x)-x)

Parameter	Min	Typical	Max	Unit
Input Current	-	-	4	A
Quiescent Input Current (typical Vin)	-	45	55	mA
Standby Input Current	-	5	8	mA
Efficiency (typical Vin, full load, Ta = 25ºC)	-	90.0	-	%
Output Voltage Set Point	-	24.0	-	V
Output Power	0	-	72	W
Output Over Current Protection Set Point	104	125	150	%
Output Over Voltage Protection Set Point	115	125	150	%
Output Ripple Frequency	140	160	180	kHz
Output Ripple and Noise Voltage RMS Peak-to-peak (5Hz to 20MHz bandwidth, typical Vin)	 - -	 50 220	 100 300	 mVrms mVp-p
External Load Capacitance	-	-	1,500	µF

24V/5A Module (QYR6A240x005xxx(x)-x)

Parameter	Min	Typical	Max	Unit
Input Current	-	-	5	A
Quiescent Input Current (typical Vin)	-	45	55	mA
Standby Input Current	-	5	8	mA
Efficiency (typical Vin, full load, Ta = 25ºC)	-	90.0	-	%
Output Voltage Set Point	-	24.0	-	V
Output Power	0	-	120	W
Output Over Current Protection Set Point	104	125	145	%
Output Over Voltage Protection Set Point	115	125	135	%
Output Ripple Frequency	140	160	180	kHz
Output Ripple and Noise Voltage RMS Peak-to-peak (5Hz to 20MHz bandwidth, typical Vin)	 - -	 50 220	 100 300	 mVrms mVp-p
External Load Capacitance	-	-	1,500	µF

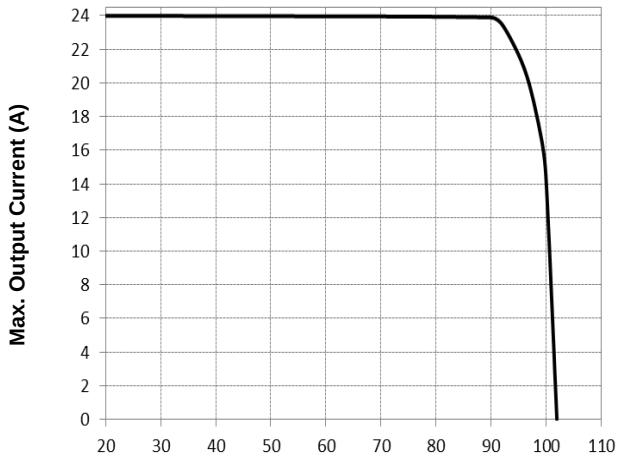
48V/2.5A Module (QYR6A480x2A5xxx(x)-x)

Parameter	Min	Typical	Max	Unit
Input Current	-	-	5	A
Quiescent Input Current (typical Vin)	-	50	70	mA
Standby Input Current	-	5	8	mA
Efficiency (typical Vin, full load, Ta = 25ºC)	-	91.0	-	%
Output Voltage Set Point	-	48.0	-	V
Output Power	0	-	120	W
Output Over Current Protection Set Point	104	125	150	%
Output Over Voltage Protection Set Point	115	125	135	%
Output Ripple Frequency	140	160	180	kHz
Output Ripple and Noise Voltage RMS Peak-to-peak (5Hz to 20MHz bandwidth, typical Vin)	 - -	 50 220	 100 300	 mVrms mVp-p
External Load Capacitance	-	-	150	µF

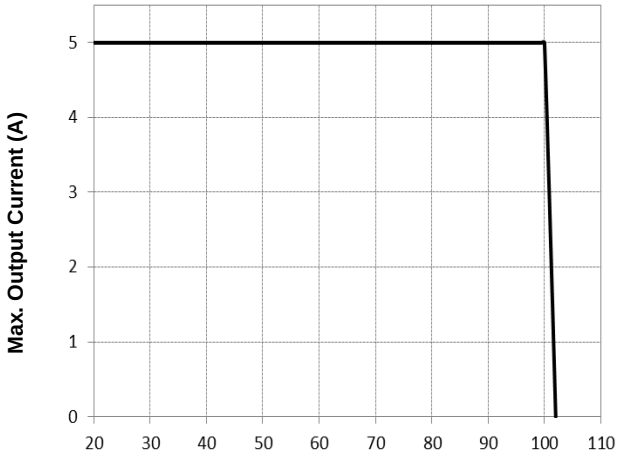
48V/3.2A Module (QYR6A480x3A2xxx(x)-x)

Parameter	Min	Typical	Max	Unit
Input Current	-	-	6	A
Quiescent Input Current (typical Vin)	-	75	100	mA
Standby Input Current	-	5	8	mA
Efficiency (typical Vin, full load, Ta = 25ºC)	-	91.5	-	%
Output Voltage Set Point	-	48.0	-	V
Output Power	0	-	153.6	W
Output Over Current Protection Set Point	104	125	140	%
Output Over Voltage Protection Set Point	115	125	135	%
Output Ripple Frequency	140	160	180	kHz
Output Ripple and Noise Voltage RMS Peak-to-peak (5Hz to 20MHz bandwidth, typical Vin)	 - -	 60 200	 100 300	 mVrms mVp-p
External Load Capacitance	-	-	150	µF

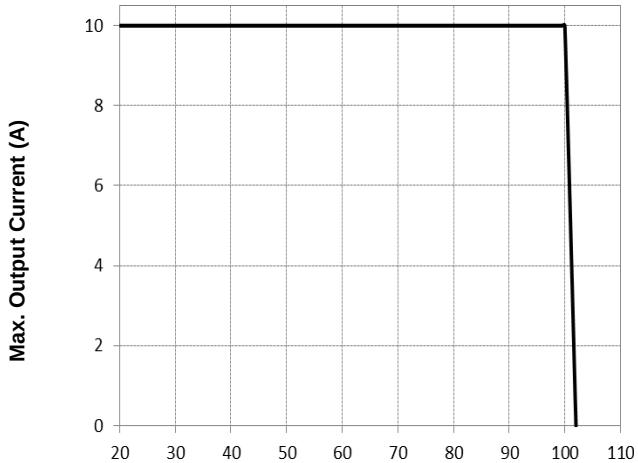
Derating Curves



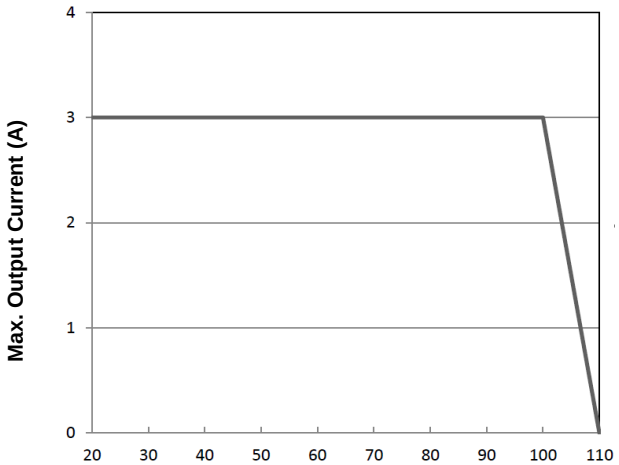
QYR6A050x024xxx(x)-x (Vin=90V)



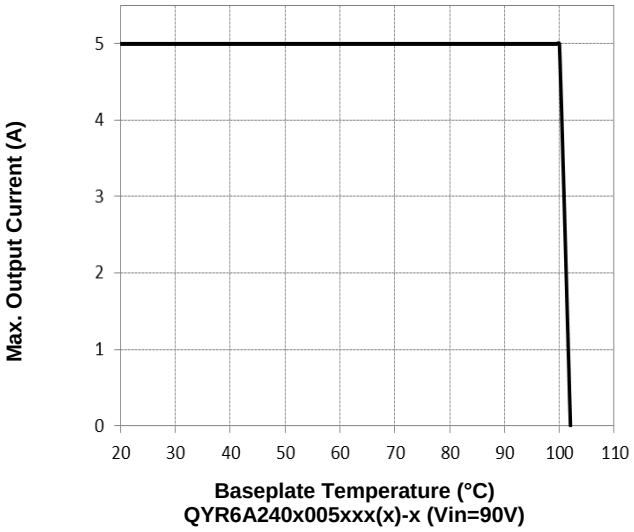
QYR6A120x005xxx(x)-x (Vin=90V)



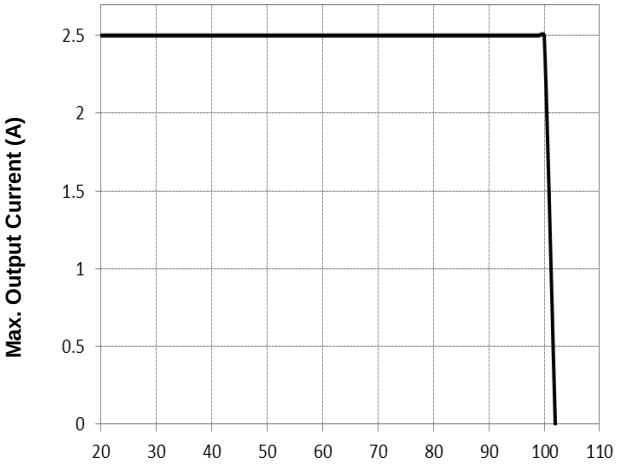
QYR6A120x010xxx(x)-x (Vin=90V)



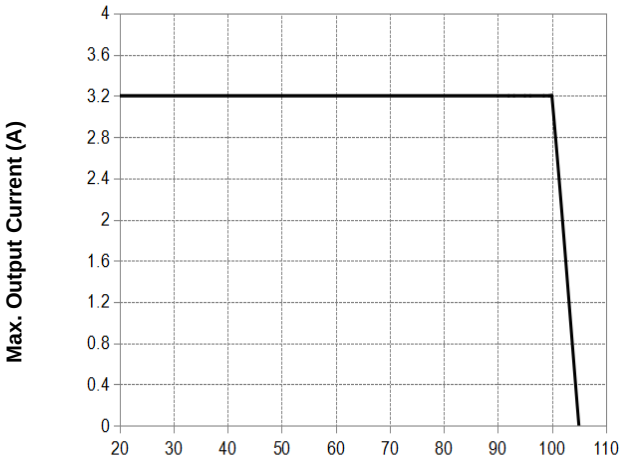
QYR6A240x003xxx(x)-x (Vin=90V)



QYR6A240x005xxx(x)-x (Vin=90V)



QYR6A480x2A5xxx(x)-x (Vin=90V)



QYR6A480x3A2xxx(x)-x (Vin=90V)

Feature Descriptions

Remote ON/OFF

The converter can be turned on and off by changing the voltage between the ON/OFF pin and Vin(-). The QYR6A Series of converters is available with factory selectable positive logic and negative logic.

For the negative control logic, the converter is ON when the ON/OFF pin is at a logic low level and OFF when the ON/OFF pin is at a logic high level. For the positive control logic, the converter is ON when the ON/OFF pin is at a logic high level and OFF when the ON/OFF pin is at a logic low level.

With the internal pull-up circuitry, a simple external switch between the ON/OFF pin and Vin(-) can control the converter. A few example circuits for controlling the ON/OFF pin are shown in Figures 1, 2 and 3.

The logic low level is from 0V to 1.2V and the maximum sink current during logic low is 1mA. The external switch must be capable of maintaining a logic-low level while sinking up to this current. The logic high level is from 3.5V to 15V. The converter has an internal pull-up circuit that ensures the ON/OFF pin at a high logic level when the leakage current at ON/OFF pin is no greater than 50μA.

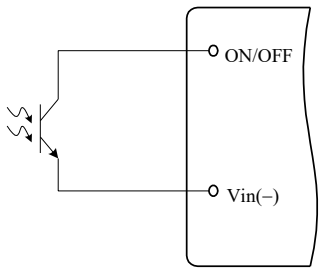


Figure 1. Opto Coupler Enable Circuit

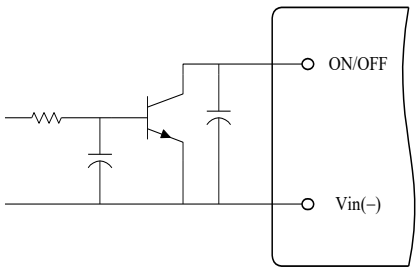


Figure 2. Open Collector Enable Circuit

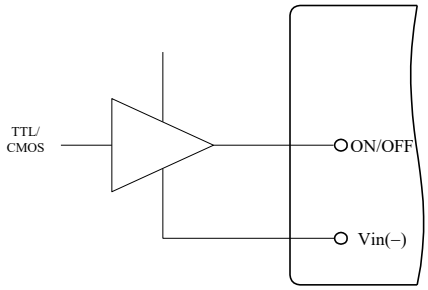


Figure 3. Direct Logic Drive

Remote SENSE

The remote SENSE pins are used to sense the voltage at the load point to accurately regulate the load voltage and eliminate the impact of the voltage drop in the power distribution path.

SENSE (+) and SENSE (-) pins should be connected between the points where voltage regulation is desired. The voltage between the SENSE pins and the output pins must not exceed the smaller of 0.5V or 10% of typical output voltage.

[Vout (+) - Vout (-)] - [SENSE (+) - SENSE (-)] <MIN {0.5V, 10%Vo}

When remote sense is not used, the SENSE pins should be connected to their corresponding output pins. If the SENSE pins are left floating, the converter will deliver an output voltage slightly higher than its specified typical output voltage.

Output Voltage Adjustment (Trim)

The trim pin allows the user to adjust the output voltage set point. To increase the output voltage, an external resistor is connected between the TRIM pin and SENSE(+). To decrease the output voltage, an external resistor is connected between the TRIM pin and SENSE(-). The output voltage trim range is 80% to 110% of the specified typical output voltage.

The circuit configuration for trim down operation is shown in Figure 4. To decrease the output voltage, the value of the external resistor should be

$$Rdown = (\frac{511}{\Delta} - 10.22)(k\Omega)$$

Where

$$\Delta = (\frac{|Vnom - Vadj|}{Vnom}) \times 100$$

And

V_{nom} = Typical Output Voltage
V_{adj} = Adjusted Output Voltage

The circuit configuration for trim up operation is shown in Figure 5. To increase the output voltage, the value of the resistor should be

$$Rup = (\frac{5.11Vo(100+\Delta)}{1.225\Delta} - \frac{511}{\Delta} - 10.22)(k\Omega)$$

Where

V_o = Typical Output Voltage

As the output voltage at the converter output terminals are higher than the specified typical level when using the trim up and/or remote sense functions, it is important to make sure that the voltage at the output terminals does not exceed the maximum power rating of the converter as given in the specifications table.

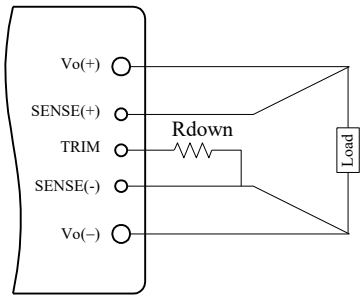


Figure 4. Circuit to Decrease Output Voltage

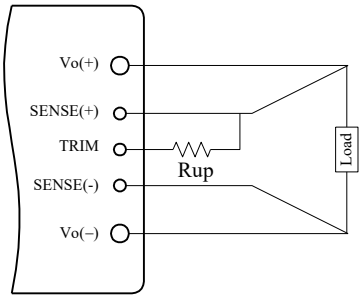


Figure 5. Circuit to Increase Output Voltage

Input Under-Voltage Lockout

This feature prevents the converter from starting until the input voltage reaches the turn-on voltage threshold, and keeps the converter running until the input voltage falls below the turn-off voltage threshold. Both turn-on and turn-off voltage thresholds are defined in the Input Specifications table.

Output Over-Current Protection (OCP)

This converter can be ordered in either latch-off or auto-restart version upon OCP, OVP, and OTP.

With the latch-off version, the converter will latch off when the load current exceeds the limit. The converter can be restarted by toggling the ON/OFF switch or recycling the input voltage.

With the auto-restart version, the converter will operate in a hiccup mode (repeatedly try to restart) until the cause of the over-current condition is cleared.

Output Over-Voltage Protection (OVP)

With the latch-off version, the converter will latch off when the output voltage exceeds the limit. The converter can be restarted by toggling the ON/OFF switch or recycling the input voltage.

With the auto-restart version, the converter will operate in a hiccup mode (repeatedly try to restart) until the cause of the over-voltage condition is cleared.

Over Temperature Protection (OTP)

With the latch-off version, the converter will shut down and latch off if an over-temperature condition is detected. The converter has a temperature sensor located at a carefully selected position, which represents the thermal condition of key components of the converter. The thermal shutdown circuit is designed to turn the converter off when the temperature at the sensor reaches 120°C. The module can be restarted by toggling the ON/OFF switch or recycling the input voltage.

With the auto-restart version, the converter will resume operation after the converter cools down.

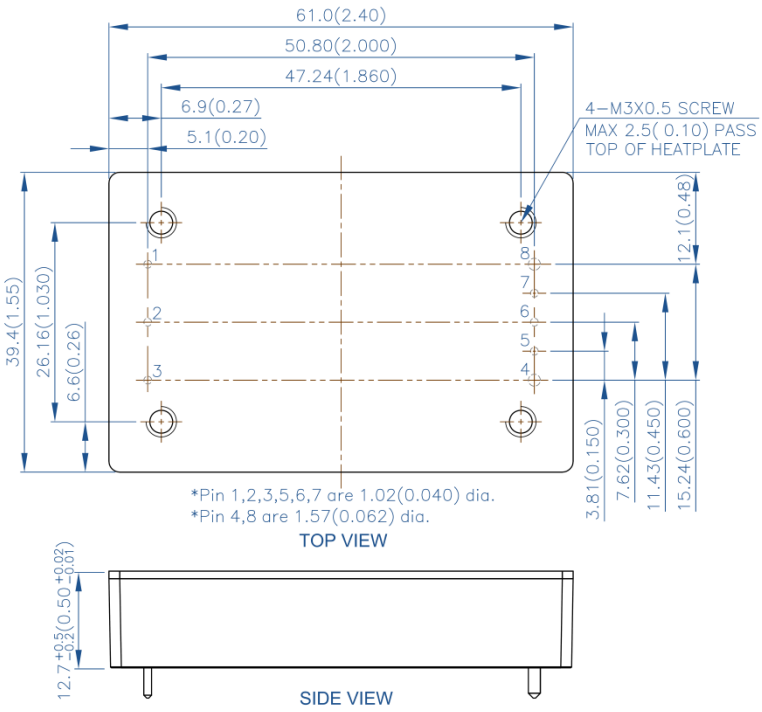
Design Considerations

As with any DC-DC converter, the stability of the QYR6A converter may be compromised if the source impedance is too high or inductive. It's desirable to keep the input source ac-impedance as low as possible. Although the converters are designed to be stable without adding external input capacitors for typical source impedance, it is recommended to add 100μF low ESR electrolytic capacitors at the input of the converter for each 100W output power, which reduces the potential negative impact of the source impedance on the converter stability. These electrolytic capacitors should have sufficient RMS current rating over the operating temperature range.

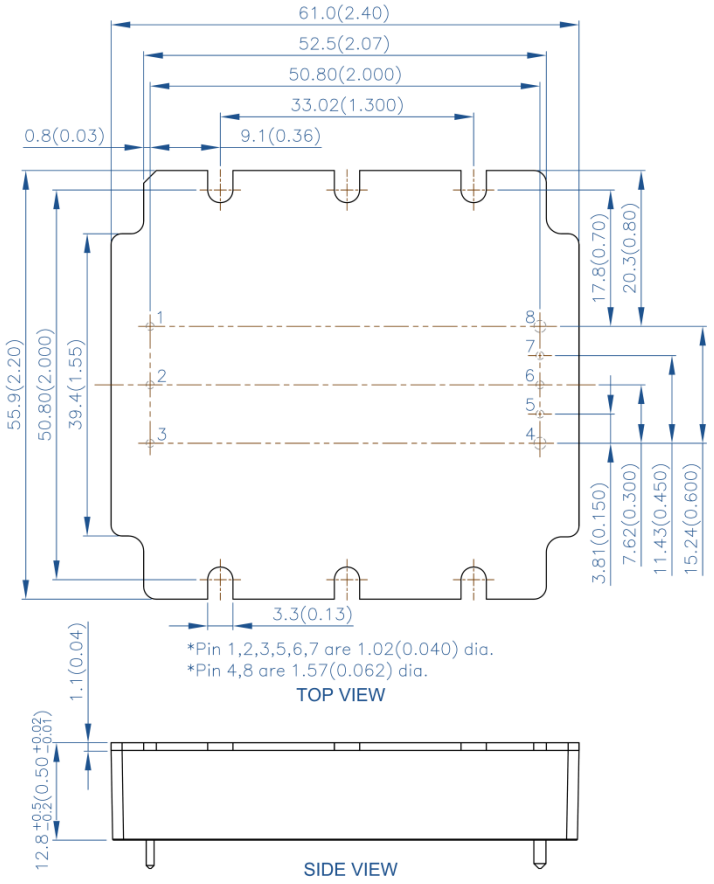
The converter is designed to be stable without additional output capacitors. To further reduce the output voltage ripple or improve the transient response, additional output capacitors are often used in applications. When additional output capacitors are used, a combination of ceramic capacitors and tantalum/polymer capacitors shall be used to provide good filtering while assuring the stability of the converter.

Mechanical Drawing

Without flange



With flange



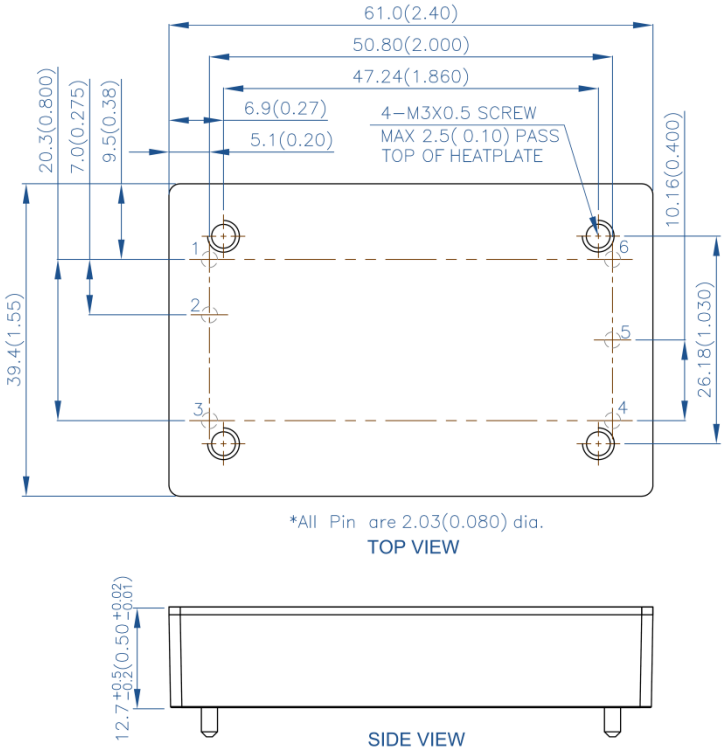
Pin	Name	Function
1	Vin(+)	Positive input voltage
2	ON/OFF	Remote control
3	Vin(-)	Negative input voltage
4	Vout(-)	Negative output voltage
5	SENSE(-)	Negative remote sense
6	TRIM	Output voltage adjustment
7	SENSE(+)	Positive remote sense
8	Vout(+)	Positive output voltage

Notes:

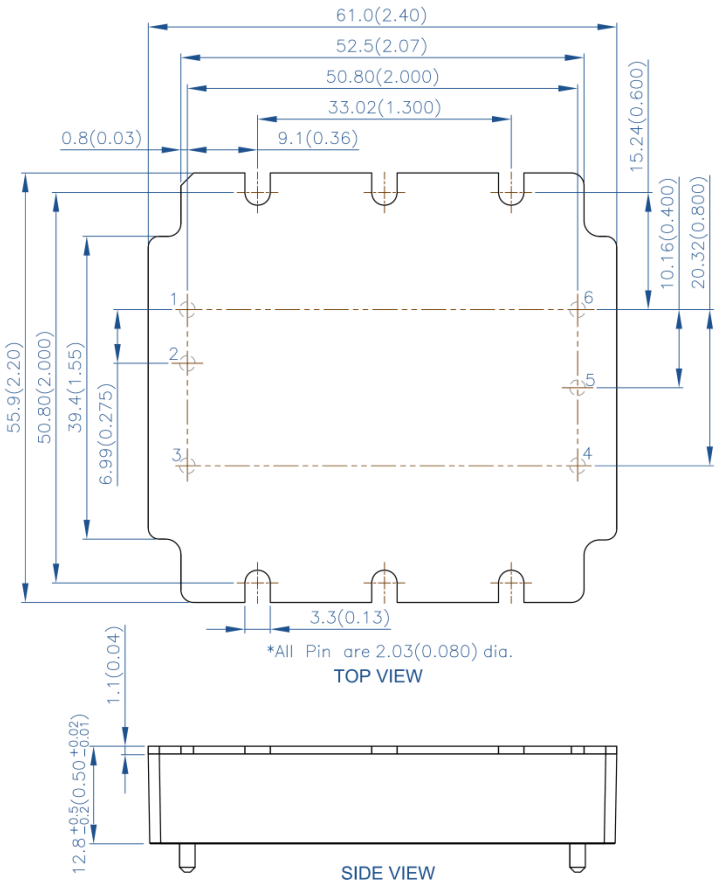
1) All dimensions in mm (inches)
   Tolerances: .x ± .5 (.xx ± 0.02)
   .xx ± .25 (.xxx ± 0.010)
2) Input and function pins are 1.02mm (0.040") dia. with +/- 0.10mm (0.004") tolerance. The recommended diameter of the receiving hole is 1.42mm (0.056").
3) Output pins are 1.57mm (0.062") dia. with +/- 0.10mm (0.004") tolerance. The recommended diameter of the receiving hole is 1.98mm (0.078").
4) All pins are Copper Alloy, Matte Tin finish with Nickel under plating.
5) Workmanship meets or exceeds IPC-A-610 Class II.
6) Torque applied on screw should not exceed 6in-lb. (0.7 Nm).
7) Baseplate flatness tolerance is 0.10mm (0.004") TIR for surface.
8) If M3 screws are used to attach a heatsink to the baseplate, the screw length from the top surface of baseplate going down should not exceed 2.5mm (0.10") max.

Alternative Pin

Without flange



With flange



Pin	Name	Function
1	Vin(+)	Positive input voltage
2	ON/OFF	Remote control
3	Vin(-)	Negative input voltage
4	Vout(-)	Negative output voltage
5	TRIM	Output voltage adjustment
6	Vout(+)	Positive output voltage

Notes:

1) All dimensions in mm (inches)
   Tolerances: .x ± .5 (.xx ± 0.02)
   .xx ± .25 (.xxx ± 0.010)
2) All pins are 2.03mm (0.080") dia. with +/- 0.10mm (0.004") tolerance. The recommended diameter of the receiving hole is 2.44mm (0.096").
3) All pins are Copper Alloy, Matte Tin finish with Nickel under plating.
4) Workmanship meets or exceeds IPC-A-610 Class II.
5) Torque applied on screw should not exceed 6in-lb. (0.7 Nm).
6) Baseplate flatness tolerance is 0.10mm (0.004") TIR for surface.
7) If M3 screws are used to attach a heatsink to the baseplate, the screw length from the top surface of baseplate going down should not exceed 2.5mm (0.10") max.