18-36V Input, 15V/6A Output Sixteenth Brick

Features

- **Wide input voltage range: 18 – 36V**
- **High Efficiency: 91% at 15V/6A output**
- **Optimal thermal performance**
- **Remote sense, On/Off control,**
- **Over-voltage, over-current, short-circuit, and over temperature protection**
- **Monotonic start-up into pre-biased load**
- **1,500V isolation voltage**

For High Reliability Applications

Options

- **Open-frame, Baseplate, or Encapsulated**
- **Auto-restart or lock-up protection mode**
- **Negative / Positive enable logic**

Part Numbering System

SA	24	X	150	X	006	X	X	X	X
Series Name	Nominal Input Voltage	Temperature Grade（Baseplate Temperature）	Output Voltage	Enabling Logic	Rated Output Current	Pin Length	Electrical Options	Mechanical Options	Lead-free, ROHS Compliant
SA	24: 18-36V	C: -40C--80 ˚C H: -40C--100 ˚C M: -55C--100 ˚C	Unit:0.1V 150: 15.0V	P: Positive N: Negative	Unit: A 006: 6A	R: 0.180"	0: Lock-up 2: Auto-restart	0: Open-frame 1: Baseplate 2: Encapsulated 3: With mounting holes	G: Lead-free

General Specification

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	Symbol	Min	Max	Unit
Input Voltage (continuous)	Vi	-0.5	40	Vdc
Transient Input Voltage (<100ms continuous operating)	$V_{i,trans}$	-	50	Vdc
I/O Isolation Voltage (for 1 minute)		-	1,500	Vdc
Operating Ambient Temperature	To			
"C" Temperature grade		-40	80	˚C
"H" Temperature grade		-40	100	˚C
"M" Temperature grade		-55	100	˚C
Storage Temperature	Tstg	-55	125	˚C

Electrical Specifications

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

Input Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Input Voltage	Vi	18	24	36	Vdc
Input Current	$I_{i,max}$	-	-	8	A
Quiescent Input Current (Vin = 24V)	$I_{i,Qsnt}$	-	90	130	mA
Standby Input Current	$I_{i,stdby}$	-	4	6	mA
Inrush Transient	I^2t	-	-	1.0	A^2s
Input Reflected-ripple Current, Peak-to-peak (5 Hz to 20 MHz, 12 µH source impedance)	-	-	20	-	mA
Input Ripple Rejection (120 Hz)	-	-	60	-	dB
Input Turn-on Voltage Threshold	-	16.5	17	18	V
Input Turn-off Voltage Threshold	-	15.5	16.0	17	V
Input Voltage ON/OFF Hysteresis	-		1		V

Output Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Output Voltage Set Point	-		15.0		Vdc
Output Voltage Set Point Accuracy (Vi = 24 V; Io = Io_max; Ta = 25°C)	-	-2		+2	%Vo
Output Voltage Set Point Accuracy (over all conditions)	-	-3		+3	%Vo
Output Regulation:					
Line Regulation (Vi = 18V to 36V, Io = 1/2 of load)	-	-	0.2	0.6	%Vo
Load Regulation (Io = Io,min to Io,max, Vi = 24V)	-	-	0.2	0.6	%Vo
Temperature (Ta = -55°C to 100 °C)	-	-	0.1		%Vo
Output Current	Io	0	-	6	A
Output Power	Po	0	-	90	W
Efficiency (Vi = 24 Io = Iomax, T_A = 25ºC)	η	89	91	-	%
Output Ripple and Noise Voltage (full load)					
RMS	-	-	23	53	mVrms
Peak-to-peak (5 Hz to 20 MHz bandwidth, Vin = 24V)	-	-	98	180	mVp-p
External Load Capacitance	-	-	-	1,500	µF

Output Specifications (continued)

Parameter	Symbol	Min	Typ	Max	Unit
Output Over Current Protection Set Point / Io_max		105	125	150	%
Output Over Voltage Protection Set Point / Vo_typical		115	125	150	%
Switching frequency	-	280	300	320	kHz
Dynamic Response (Vi = 24V Ta = 25°C; Load transient 0.1A/μs) Load step from 50% to 75% of full load: Peak deviation Settling time (within 10% band of Vo deviation) Load step from 50% to 25% of full load Peak deviation Settling time (within 10% band of Vo deviation)			 5 2 5 2		 %Vo ms %Vo ms

General Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Remote Enable Negative Logic: Logic Low – Module On Logic High – Module Off Positive Logic: Logic High – Module On Logic Low – Module Off	-	-	-	-	-
Logic Low: $I_{ON/OFF}$ = 1.0mA $V_{ON/OFF}$ = 0.0V Logic High: $I_{ON/OFF}$ = 0.0μA Leakage Current	 $V_{ON/OFF}$ $I_{ON/OFF}$ $V_{ON/OFF}$ $I_{ON/OFF}$	 - - - -	 - - - -	 1.2 1.0 15 50	 V mA V μA
Turn-on Time (Io = full load, Vo within 1% of setpoint)		-	10	14	ms
Output Voltage Trim Range	-	80	-	110	%Vo
Output Voltage Remote-sense Range	-	-	-	0.5	V
Over-temperature Protection Set Point	To	-	120	-	°C
Isolation Capacitance	-	-	1200	-	pF
Isolation Resistance	-	10	-	-	MΩ
Calculated MTBF (Bellcore TR-332)			3.2		10^6 -hour

Feature Descriptions

The converter can be turned on and off by changing the voltage between the ON/OFF pin and Vin(-). The SA24 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 Fig. 1,2and 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.

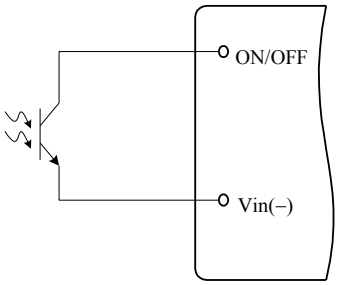


Fig. 1 Opto Coupler Enable Circuit

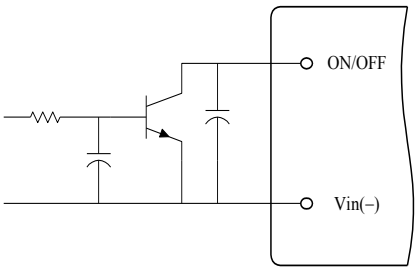


Fig. 2 Open Collector Enable Circuit

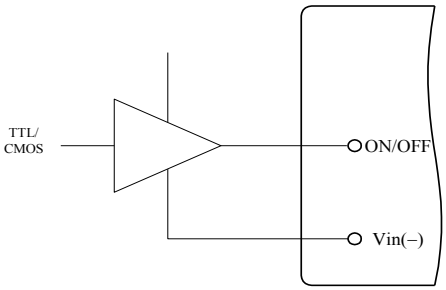


Fig. 3 Direct Logic Drive

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 its specified nominal output voltage. The circuit configuration for trim down operation is shown in Fig.4.

To increase the output voltage, the value of the 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 Voltage

The circuit configuration for trim up operation is shown in Fig.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

Vo = Typical Output Voltage

This equation applies to typical output voltage of 1.5V or higher.

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

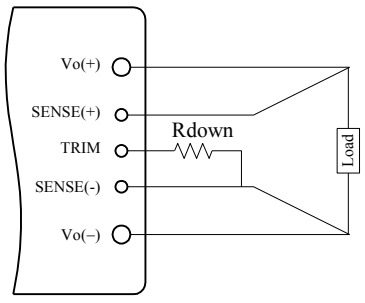


Fig. 4 Circuit to Decrease Output Voltage

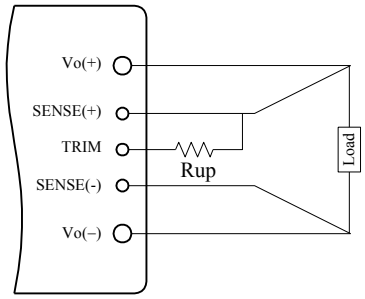


Fig. 5 Circuit to Increase Output Voltage

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. The hysteresis prevents oscillations.

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 shut down and latch off if an over-temperature condition is detected. The converter has a temperature sensor located at a carefully selected position in the converter circuit board, 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

Input Source Impedance

As with any DC/DC converter, the stability of the SA24 converters 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 100 μF 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.

Safety Considerations

The SA24 Series of converters are designed in accordance with EN 60950 Safety of Information Technology Equipment Including Electrical Equipment. The converters are recognized by UL in both USA and Canada to meet the requirements in UL 60950, Safety of Information Technology Equipment and applicable Canadian Safety Requirement, and ULc 60950. Flammability ratings of the PWB and plastic components in the converter meet 94V-0.

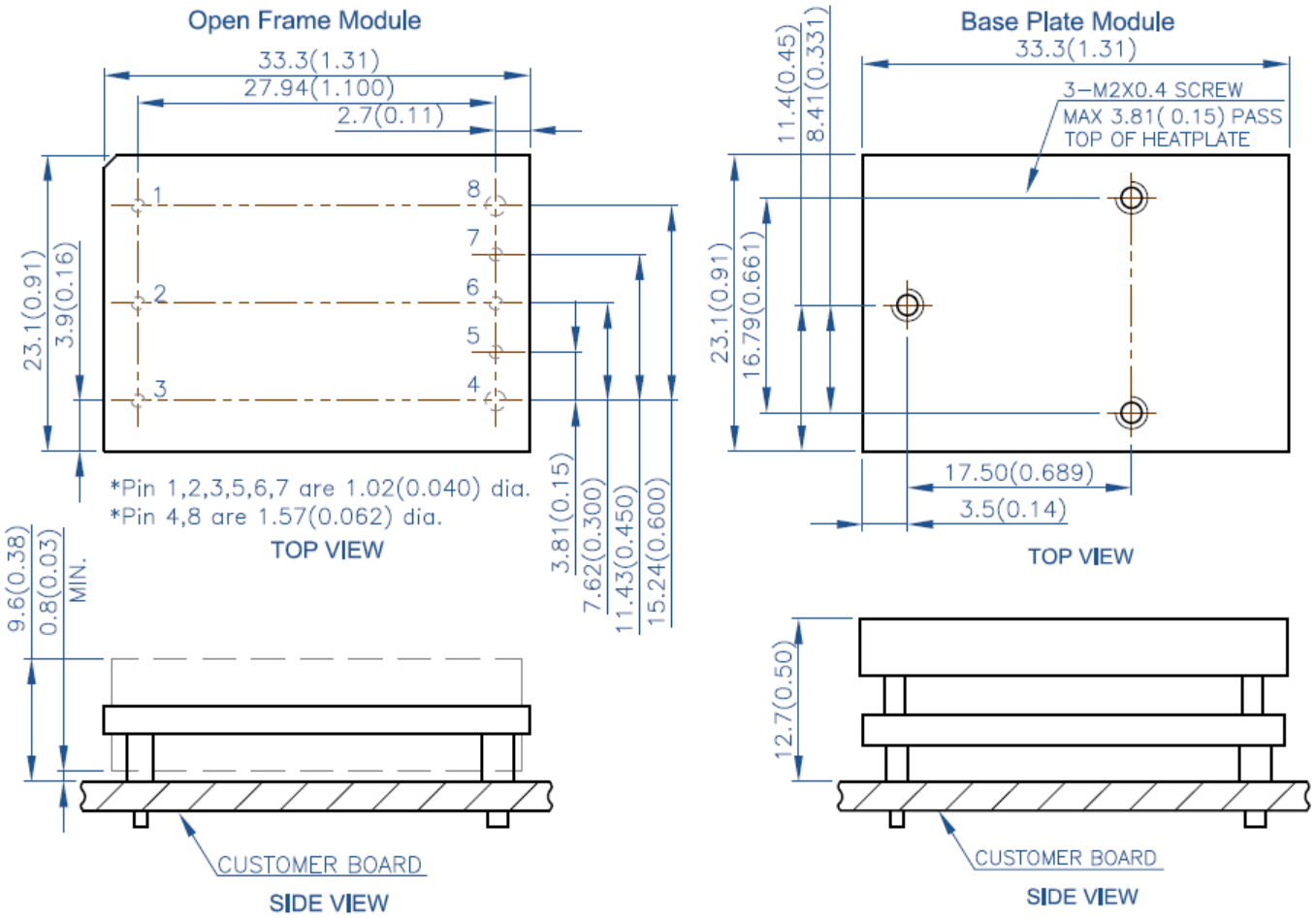
To protect the converter and the system, an input line fuse is highly recommended on the un-grounded input end.

Thermal Considerations

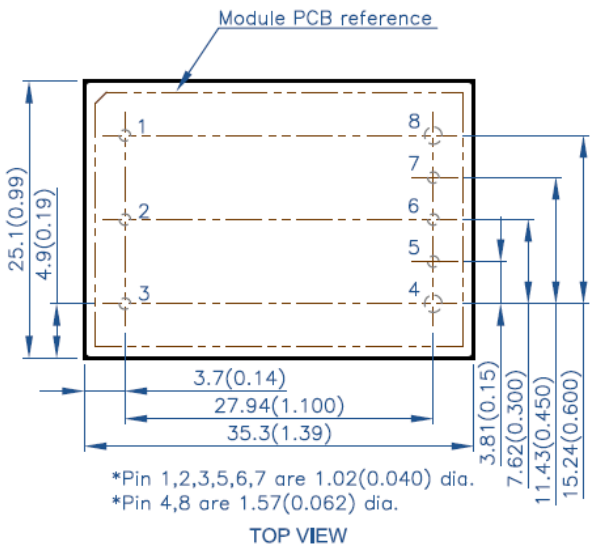
The SA Series of converters can operate in various thermal environments. Due to the high efficiency and optimal heat distribution, these converters exhibit excellent thermal performance.

The maximum allowable output power of any power converter is usually determined by the electrical design and the maximum operating temperature of its components.

Mechanical Diagrams



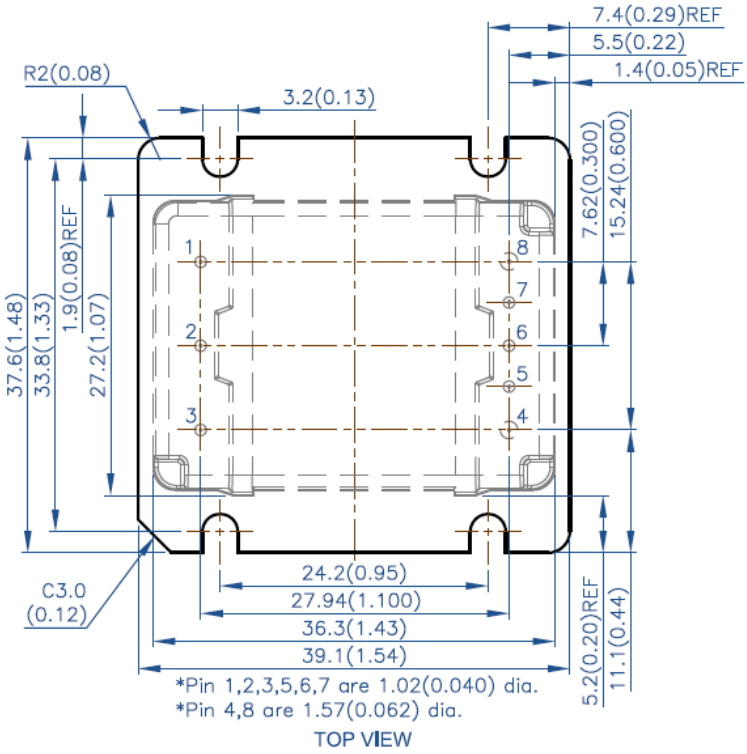
Encapsulated Type-I
(without mounting holes)



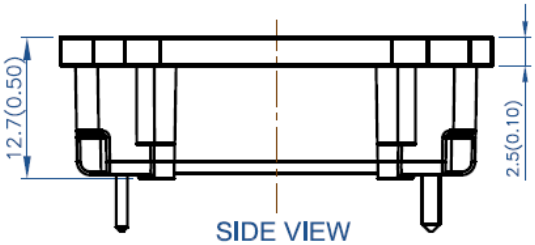
TOP VIEW

SIDE VIEW

Encapsulated Type-II
(with mounting holes)



TOP VIEW



SIDE VIEW

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 adjust
7	SENSE(+)	Positive remote sense
8	Vout(+)	Positive output voltage

Notes:

All dimensions in mm (inches)
Tolerances: x ± .5 (.xx ± 0.02)
.xx ± .25 (.xxx ± 0.010)

For more information, please contact
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Warranty

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