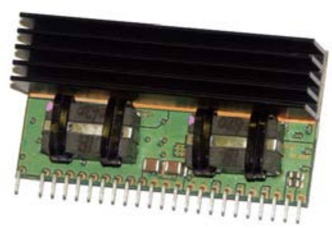
Technical Reference Note

Embedded Power for
Business-Critical Continuity

SIL/SMT80C2
80 Amp

Total Power: **400 W**
Input Voltage: **4.7 - 13.8 VDC**
# of Outputs: **Single**



RoHS 2002/95/EC

Product Family: **SIL/SMT80C2 Series**
Function: **Single In-Line Power**
Usage: **LEDs, ASIC, Memory, FPGAs, Telecom and Networking Equipment, Servers, Industrial Equipment, POL Regulation**

Special Features

- 80 A current rating
- Input voltage range: 4.7-13.8 V
- Output voltage: 0.8375-5.1 V
- Current sharing
- Industry leading value
- Cost optimized design
- Excellent transient response
- Output voltage adjustability
- Pathway for future upgrades
- Supports silicon voltage migration
- Reduced design-in and qualification time
- Over-temperature protection
- RoHS compliant

Definition:
The SIL/SMT80C2 is a new high density open frame non-isolated converter series for space-sensitive applications. Each model has a wide input voltage range (4.7 - 13.8 V) and offers a wide 0.8375 - 5.1 V output voltage range with a 80 A load. An external resistor adjusts the output voltage from its pre-set value of 0.8375 V to any value up to the maximum allowed value for that model. The SIL/SMT80C2 offers remote ON/OFF and over-current protection as standard.

Safety

Designed to meet:

- UL, cUL 60950-1
- (EN60950)

EMERSON
Network Power

General Description

Electrical Description

The SIL/SMT80C2 is implemented using a multi-phase synchronous buck topology. A block diagram of the converter is shown in Figure 1.

The output is adjustable over a range of 0.8375-5.1 V by using a resistor from the trim pin to -trim pin, or by driving the TRIM pin with a voltage.

The converter can be shut down via the enable pin. This input is run with positive logic that is compatible with popular logic devices. Positive logic implies that the converter is enabled if the input is high (or floating), and disabled if it is low.

Output is monitored for overcurrent and short-circuit conditions. When the PWM controller detects an overcurrent condition, it forces the module into hiccup mode.

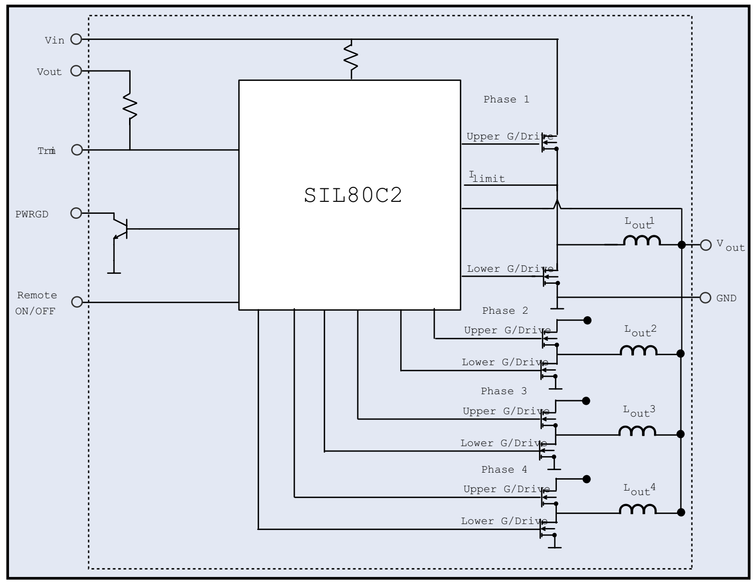


Figure 1 - Electrical Block Diagram

A typical application is shown in Figure 2.

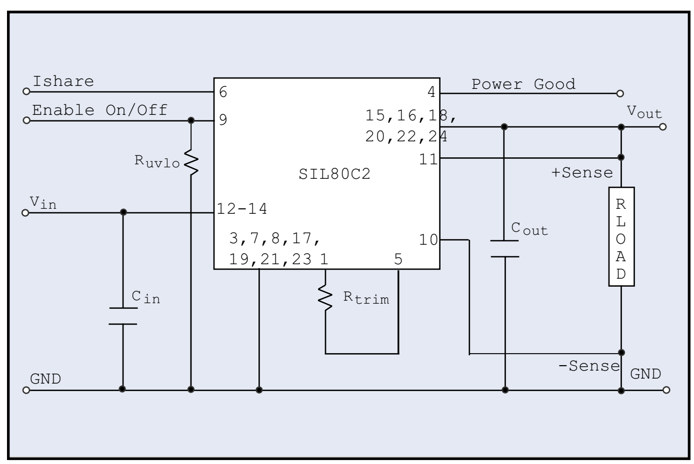


Figure 2 - Standard Application Drawing

Wide Operating Temperature Range

The SIL/SMT80C2's ability to accommodate a wide range of ambient temperatures is the result of its extremely high power conversion efficiency and resultant low power dissipation, combined with the excellent thermal performance of the PCB substrate. Maximum output power that the module can deliver depends on a number of parameters, primarily:

- Input voltage range
- Output load current
- Air velocity (forced or natural convection)
- Mounting orientation of target application PCB, i.e., vertical/horizontal mount, or mechanically tied down (especially important in natural convection conditions).
- Target application PCB design, especially ground planes. These can be effective heatsinks for the converter.

The SIL/SMT80C2 module has an operating temperature range of 0 °C to 85 °C with suitable derating and/or forced air cooling.

Features and Functions

Output Voltage Adjustment

The output voltage on all models is adjustable from 0.8375-5.1 V.

Undervoltage Lockout

The default undervoltage lockout is set at 4.7 V.

Current Limit and Short-Circuit Protection

The SIL/SMT80C2 model has a built-in non-latching current limit function and continuous short-circuit protection. When an overcurrent condition occurs, the module goes into hiccup mode, where it attempts to power up periodically to determine if the problem persists.

Note that none of the module specifications are guaranteed when the unit is operated in an overcurrent condition.

Enable

The enable pin allows external circuitry to put the SIL/SMT80C2 converter into a low dissipation standby mode. Positive logic enable pin is available as standard.

The unit is turned on if the enable pin is high (or floating). Pulling the pin low will disable the unit. To guarantee turn-on, the enable voltage must be above 1.25 V. To disable, the enable voltage must be pulled below 0.7 V.

Figures 3 and 4 show various circuits for driving the Enable feature. The Enable input can be driven through a discrete device (i.e. a bipolar signal transistor) or directly from a logic gate output. The output of the logic gate may be an open-collector (or open-drain) device.

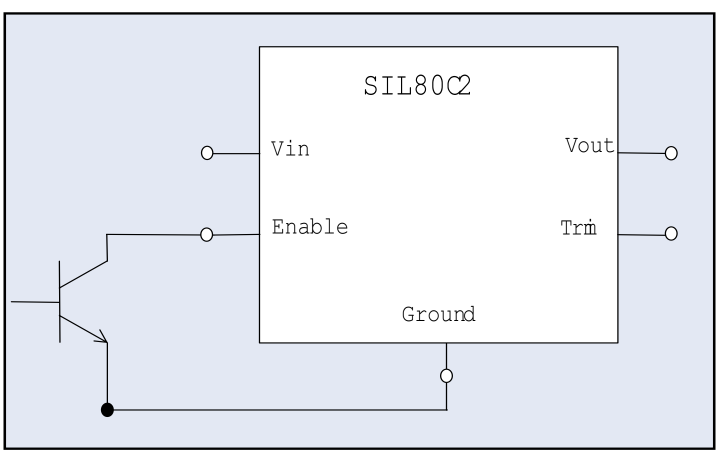


Figure 3 - Enable Input Drive Circuit for Non-Isolated Biopolar

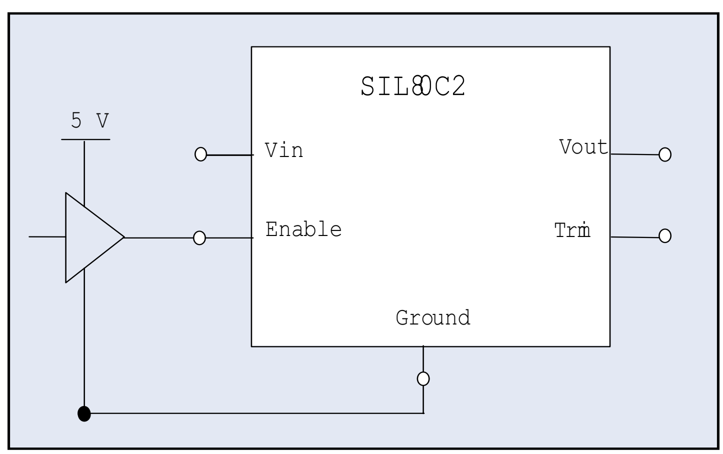


Figure 4 - Enable Input Drive Circuit for Logic Driver

Features and Functions

Power Good

The SIL/SMT80C2 modules have a power good indicator output. This output pin uses positive logic and is open collector. Also, the power good output is able to sink 1 mA. The power good signal should not be pulled any higher than 5.1 V.

When the output of the module is within ±10% of the nominal set point, the power good pin can be pulled high.

Overtemperature Protection (OTP)

The SIL/SMT80C2 is equipped with non-latching overtemperature protection. A temperature sensor monitors the temperature of the PCB near one the main FETs. If the temperature exceeds a threshold of 150 °C (typical) the converter will shut down, disabling the output. When the substrate temperature has decreased by 10 °C the converter will automatically restart.

The converter might experience overtemperature conditions during a persistent overload on the output. Overload conditions can be caused by external faults. OTP might also be entered due to a loss of control of the environmental conditions (e.g. an increase in the converter's ambient temperature due to a failing fan).

Application

Output Voltage Adjustment

The output of the module can be adjusted, or trimmed, from 0.8375 V to 5.1 V. This is accomplished by connecting an external resistor between the Trim pin and -Trim as shown in Figure 5 or with a voltage as shown in Figure 6. Extremely high accuracy setpoints can be achieved with the use of a potentiometer as shown in Figure 7.

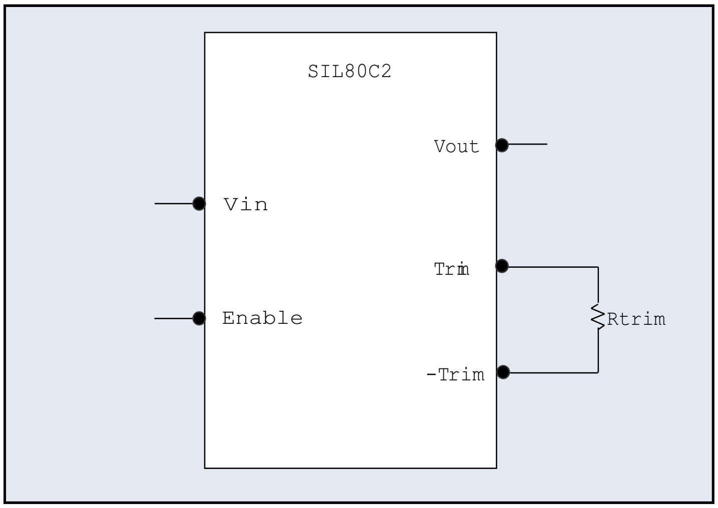


Figure 5 - Output Voltage Trim

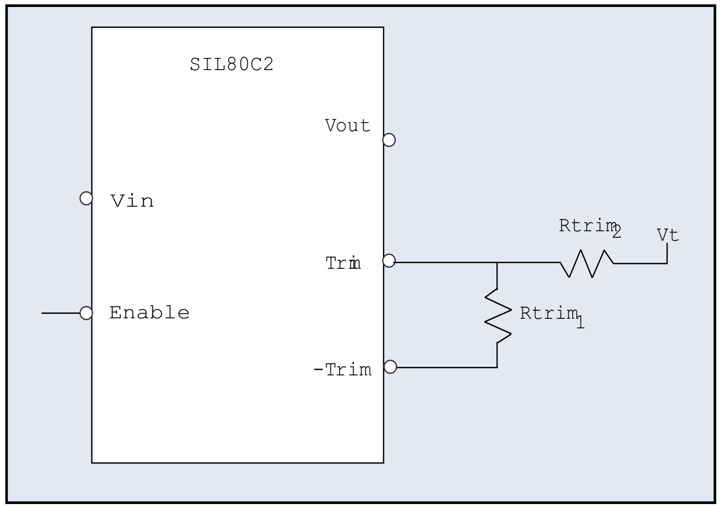


Figure 6 - Output Votlage Trim - with Voltage Source

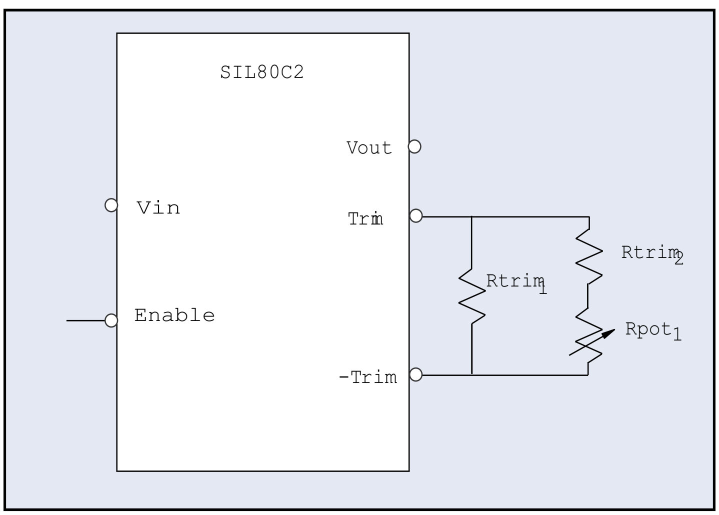


Figure 7 - Output Voltage - with Potentiometer

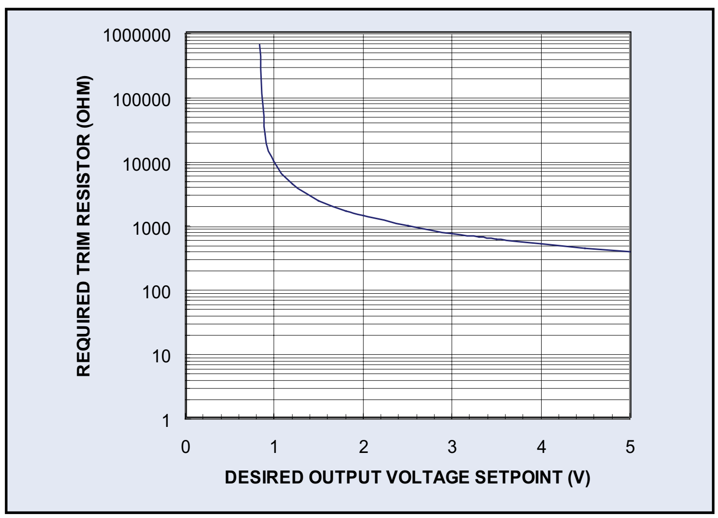


Figure 8 - Typical Trim Curves

Application (cont'd)

Output Voltage Adjustment (cont'd)

The trim equation for the basic configuration shown in Figure 5 is:

$$R_{trim}(k\Omega) = \frac{1.675}{V_{out} - 0.8375}$$

Where Vout is the desired output voltage, Rtrim is the resistance required between Trim and -Trim.

The trim equation for the external voltage configuration shown Figure 6 is:

$$R_{trim2}(k\Omega) = \frac{R_{trim1}\,(1.2 - 2Vt)}{R_{trim1}\,(Vout - 0.8375) - 1.675}$$

Where Vout is the desired output voltage, Rtrim1 and Rtrim2 are the resistors in Figure 6 and Vt is the applied external voltage.

The trim equation for the potentiometer configurations shown in Figure 7 is:

$$Vout = \frac{0.8375}{(R_{trim2} + Rpot)R_{trim1}} \;X\; (2R_{trim2} + 2R_{pot} + R_{trim1}R_{trim2} + R_{trim1}R_{pot} + 2R_{trim1})$$

Where Vout is the desired output voltage, Rtrim1 and Rtrim2 are the resistors in Figure 7 and Rpot is the resistance of the potentiometer.

Undervoltage Lockout

The SIL/SMT80C2 has built-in undervoltage lockout to ensure reliable output power. The lockout prevents the unit from operating when the input voltage is too low. The UVLO for the SIL/SMT80C2 can be adjusted with the following equation:

The trim equation for the undervoltage lockout is:

$$R_{uvlo}\;(k\Omega) = \frac{124.8 + V_{turn\_on}}{10\,V_{turn\_on} - 42.06}$$

Application (cont'd)

Remote Sense Compensation

The remote sense compensation feature minimizes the effect of resistance in the distribution system and facilitates accurate voltage regulation at the load terminals or another selected point. The remote sense lines will carry very little current and hence do not require a large cross-sectional area. However, if the sense lines are routed on a PCB, they should be located close to a ground plane in order to minimize any noise coupled onto the lines that might impair control loop stability. The module will compensate for a maximum drop of 400 mV. Remember that when using remote sense compensation all the resistance, parasitic inductance and capacitance of the distribution system are incorporated into the feedback loop of the power module. This can have an effect on the modules compensation capabilities, affecting its stability and dynamic response.

Parallel Operation

Parallel operation of multiple converters is available since the SIL/SMT80C2 has a current sharing option. The converter will share to within ±10% of full load. To current share, Pin 6 of each module should be connected. Also, the remote sense lines should be connected at the same point. Figure 9 shows the typical current sharing application.

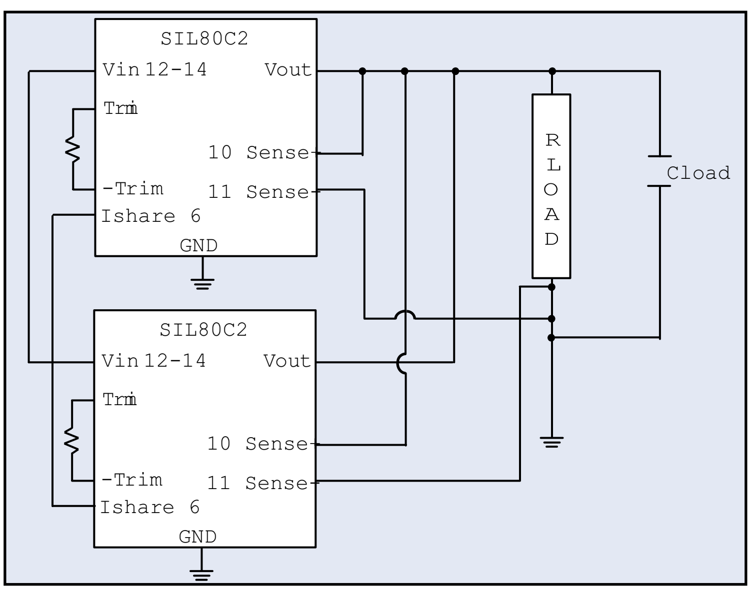


Figure 9 - Parallel Application

Application (cont'd)

Output Capacitance

The SIL/SMT80C2 has output capacitors inside the converter. No output capacitance is required for stable operation. When powering loads with large dynamic current requirements, improved voltage regulation is obtained by inserting low ESR capacitors as close as possible to the load. Low ESR ceramic capacitors will handle the short duration high frequency components of the dynamic current requirement. In addition, higher values of electrolytic capacitors should be used to handle the mid-frequency components.

It is equally important to use good design practices when configuring the dc distribution system. Low resistance and low inductance PCB layout traces should be utilized, particularly in the high current output section. Remember that the capacitance of the distribution system and the associated ESR are within the feedback loop of the power capabilities, thus affecting the stability and dynamic response of the module. Note that the maximum rated value of output capacitance varies between models and for each output voltage setpoint. A stability vs. Load Capacitance calculator, (see your sales representative), details how an external load capacitance influences the gain and phase margins of the SIL/SMT80C2.

SMT Reflow Guidelines

For a SnPb process: Pads should be above 183C (liquidus) for 90 seconds max (60-75 seconds typical) with a peak temperature of 225C. For a leadfree SAC305 process: pads should be above 217C (liquidus) for 90 seconds max (60-75 seconds typical) with a peak temperature of 250C.

Water Washing

Not recommended.

Parameter	Test Conditions	Min	Typ	Max	Units
Absolute Maximums					
Input Voltage		0		13.8	V
Enable Voltage		0		5	V
Operating Ambient Temperature		0		85	˚C
Non-Operating Ambient Temperature		-40		125	˚C
Input Specifications					
Input Voltage		4.7		13.8	Vdc
Input Current (No Load)	Vin(min) - Vin(max), enabled		500		mA
Input Current (quiescent)	Converter disabled		10		mA
Input Capacitance (Internal)	Internal to converter		176		uF
Input Capacitance (External)	Recommend customer added capacitance		47		uF
Output Specifications					
Ouput Voltage		0.8375		5.0	V
Output Setpoint Accuracy		-1.0		+1.0	%
Output Regulation (Line)		-0.2		+0.2	%
Output Regulation (Load)		-0.5		+0.5	%
Output Current (continuous)		0		80	A
Output Current (short circuit)	0.9, 2.5, 5.1 Vout	130		140	A
Output Capacitance (Internal)			500		uF
Output Capacitance (External)	12 Vin, 0.9 Vout (Startup capacitance)	0		63,000	uF
	12 Vin, 2.5 Vout (Startup capacitance)	0		30,000	uF
	12 Vin, 5 Vout (Startup capacitance)	0		11,000	uF
Output Ripple/Noise (Peak/Peak)	5 Vin, 0.9 Vout, 0 uF Cout		20		mV
	12 Vin, 2.5 Vout, 0 uF Cout		20		mV
	12 Vin, 5 Vout, 0 uF Cout		20		mV
Efficiency	5.1 Vin, 0.9 Vout, 80 Aout		82.2		%
	12 Vin, 2.5 Vout, 80 Aout		89.1		%
	12 Vin, 5 Vout, 80 Aout		93.3		%
Dynamic Load Response (Peak Deviation)	12 Vin, 0.9 Vout, 50-75% load at 10 A/us		95		mV
Dynamic Load Response (Setting Time)	12 Vin, 0.9 Vout, 50-75% load at 10 A/us		30		us
Dynamic Load Response (Peak Deviation)	12 Vin, 2.5 Vout, 50-75% load at 10 A/us		150		mV
Dynamic Load Response (Setting Time)	12 Vin, 2.5 Vout, 50-75% load at 10 A/us		30		us
Dynamic Load Response (Peak Deviation)	12 Vin, 5 Vout, 50-75% load at 10 A/us		150		mV
Dynamic Load Response (Setting Time)	12 Vin, 5 Vout, 50-75% load at 10 A/us		30		us

Parameter	Test Conditions	Min	Typ	Max	Units
Turn On Specifications					
Turn On Delay (with Vin)			2.7	3	ms
Turn On Delay (with Enable)			3	12	ms
Output Rise TIme	10% - 90%		1.8	2	ms
Enable Specifications					
Signal Low (Unit Off)		0		0.7	V
Signal Low Current	12 V_{in}	0	1.2		mA
Signal High (Unit On)	12 V_{in}		3.4		V
Signal High Current			1.0		μA
Protection Specifications					
Over Current Protection	Hiccup Mode		108		A
Input Under Voltage (Rising)			4.7		V
Input Under Voltage (Falling)			4.0		V
General Specifications					
MTBF	Telcorida SR-332		3.7		MHrs
Weight			45.36		g
Switching Frequency	Per Phase		500		kHz
Coplanarity					TBD
Material Ratings					
Flammability			UL94V-0		
Material Type			FR4 PCB		

0.9 V Setpoint

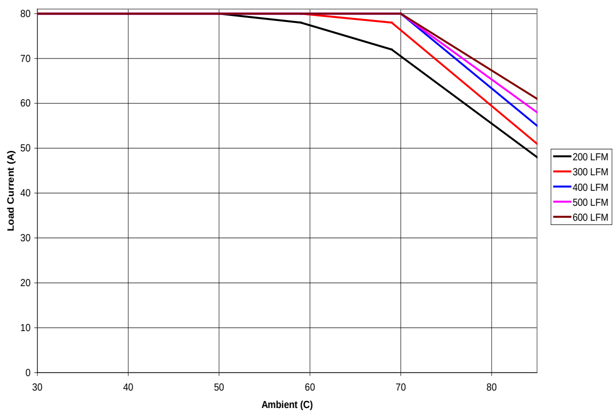


Figure 10: Thermal Derating Curve 5.5 Vin

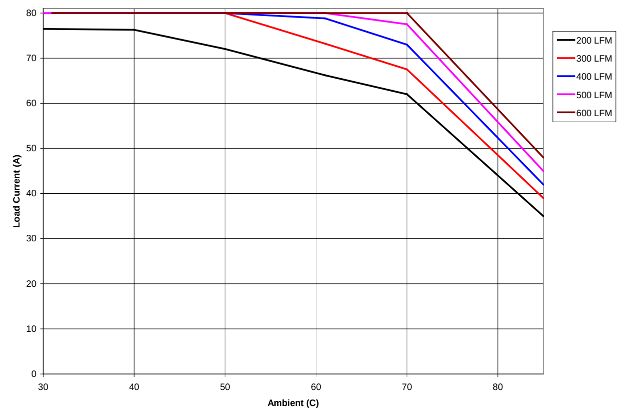


Figure 11: Thermal Derating Curve 12 Vin

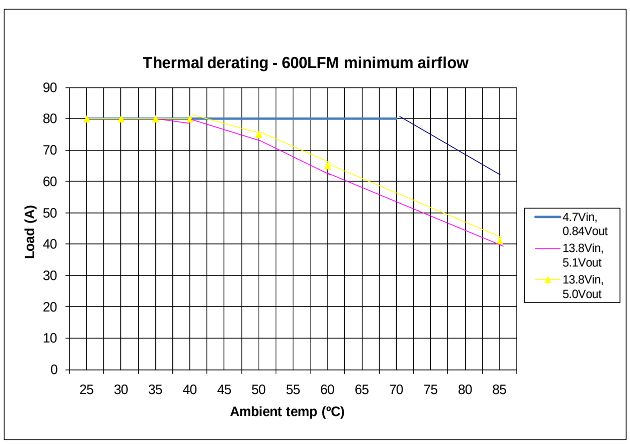


Figure 11A: Thermal derating curve 4.7Vin and 13.8Vin

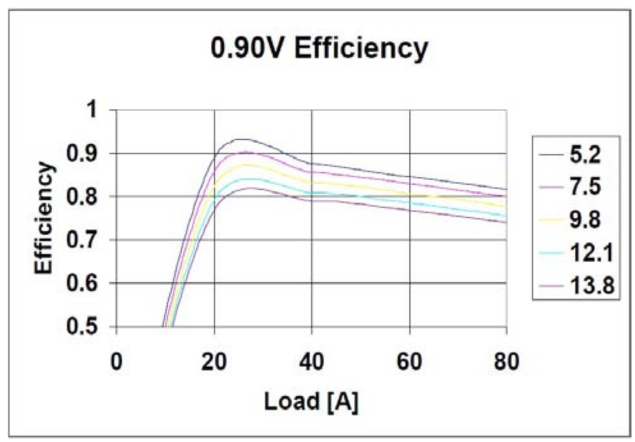


Figure 12: Effiiciency 0.9 V

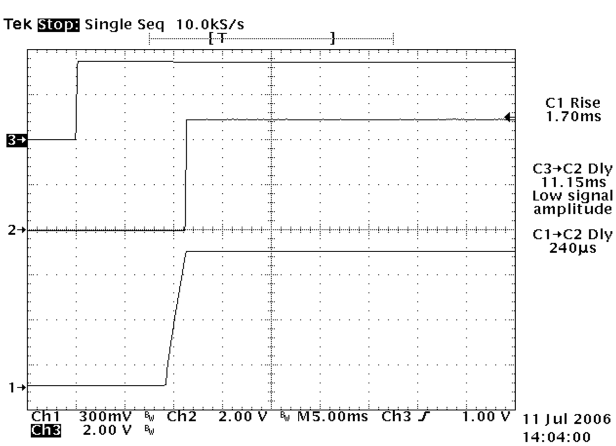


Figure 13: Control On/Off
(Channel 1: Output Voltage, Channel 3: Enable)

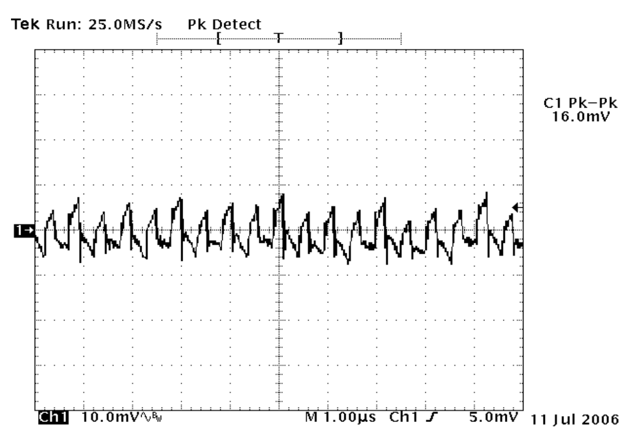


Figure 14: Typical Ripple Output

0.9 V Setpoint

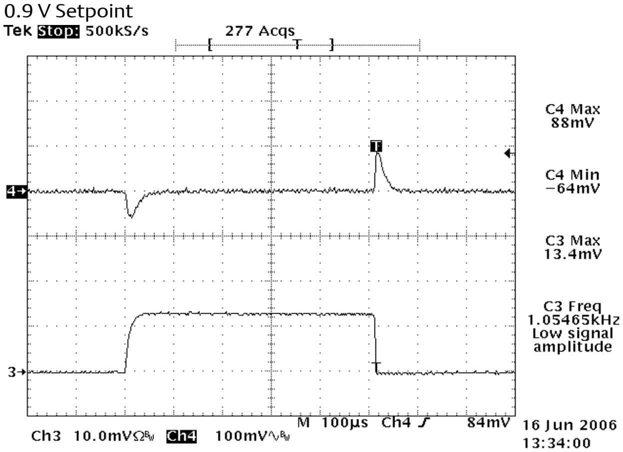


Figure 15: Transient Response 75% - 100%
(Channel 3: Current Step at 10 A/div,
Channel 4: Output Voltage Deviation)

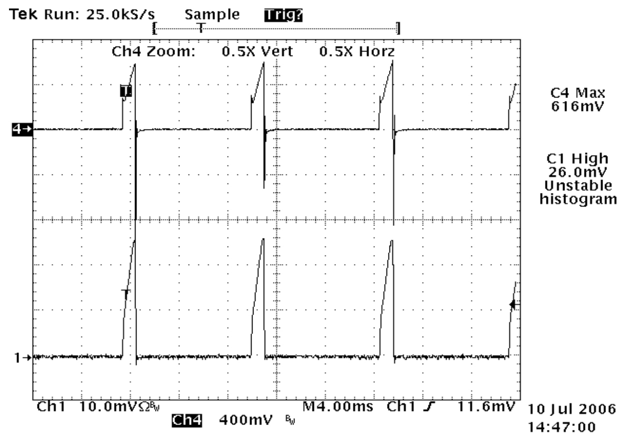


Figure 16: Short Circuit Characteristic
(Channel 1: Output Current at 50 A/div,
Channel 4: Output Voltage)

2.5 V Setpoint

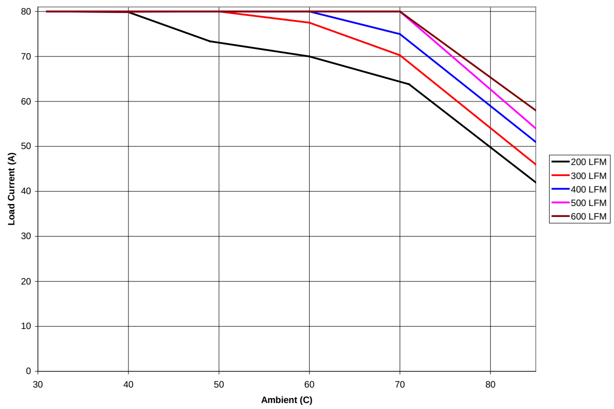


Figure 17: Thermal Derating Curve 5.1 Vin

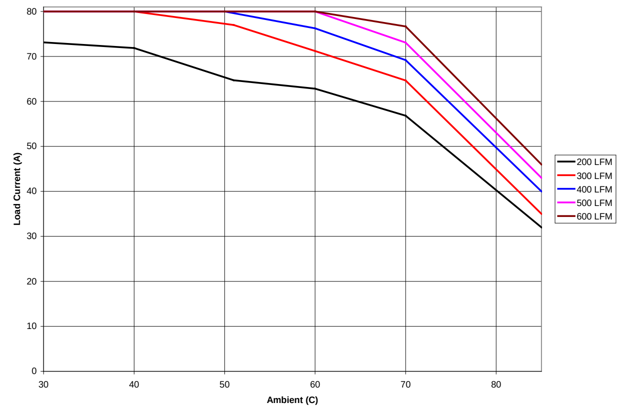


Figure18: Thermal Derating Curve 12 Vin

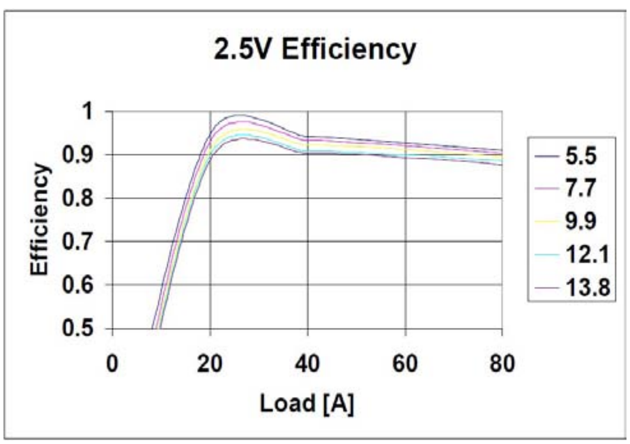


Figure 19: Efficiency 2.5 V

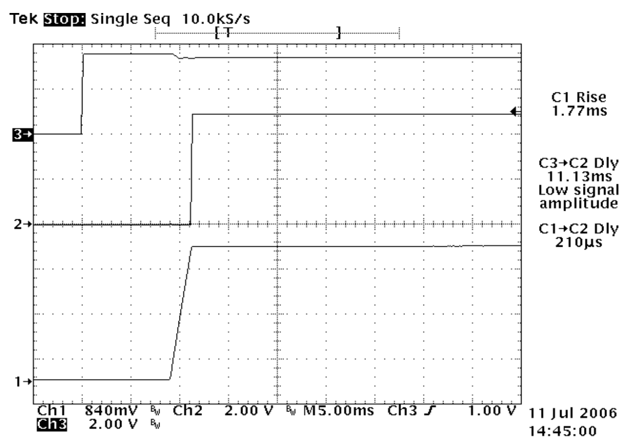


Figure 20: Control On/Off
(Channel 1: Output Voltage, Channel 3: Enable)

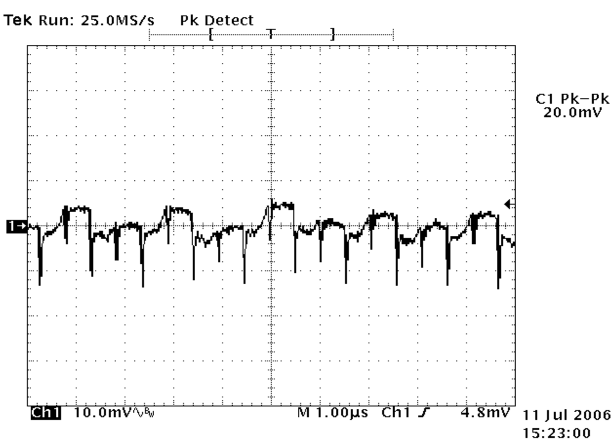


Figure 21: Typical Ripple Output

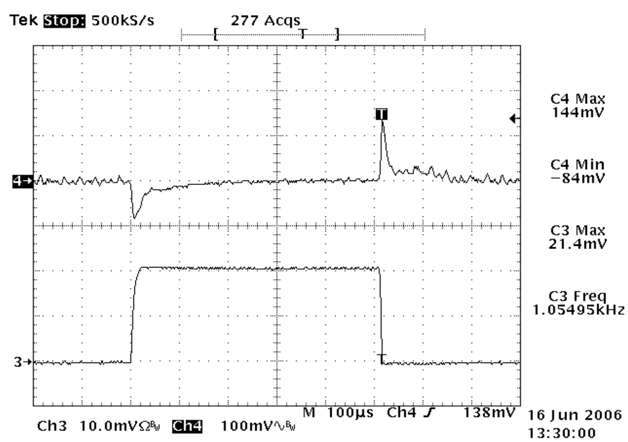


Figure 22: Transient Response 75% - 100%
(Channel 3: Current Step at 10 A/div,
Channel 4: Output Voltage Deviation)

2.5 V Setpoint

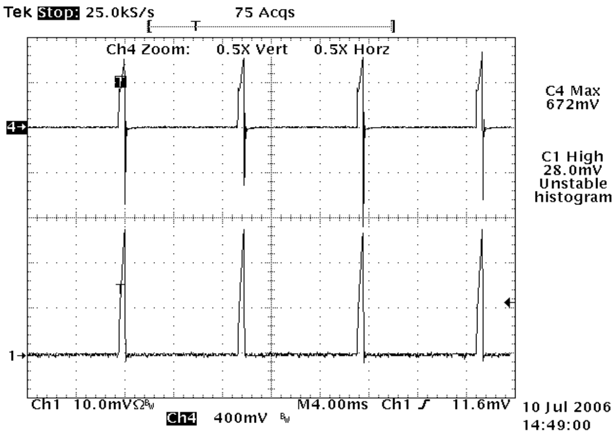


Figure 23: Short Circuit Characteristic
(Channel 1: Output Current at 50 A/div,
Channel 4: Output Voltage)

5.0 V Setpoint

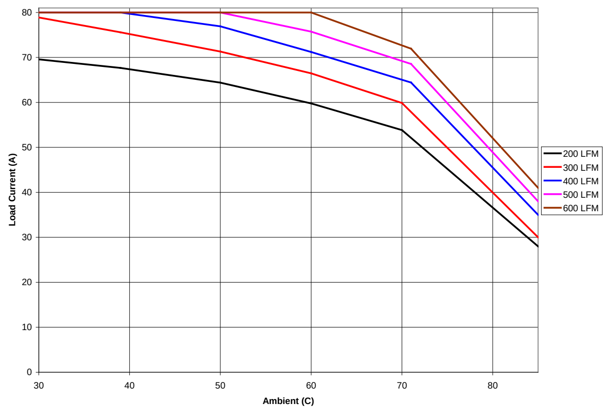


Figure 24: Thermal Derating Curve 12 Vin

Figure 25: Efficiency 5.0 V

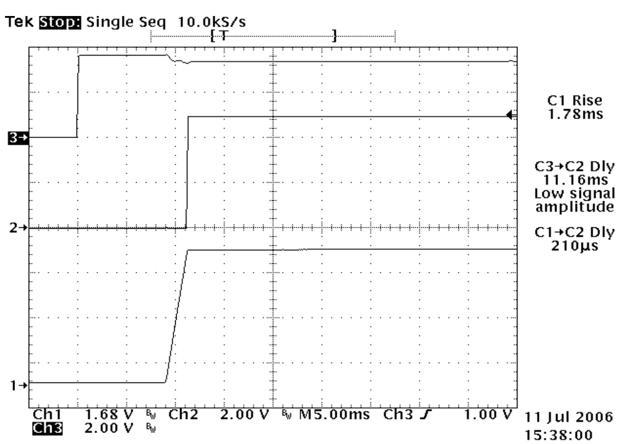


Figure 26: Control On/Off
(Channel 1: Output Voltage, Channel 3: Enable)

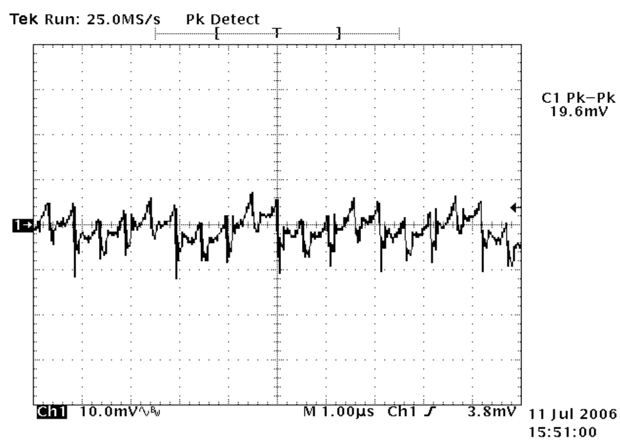


Figure 27: Typical Output Ripple - ADD TEST CONDITIONS

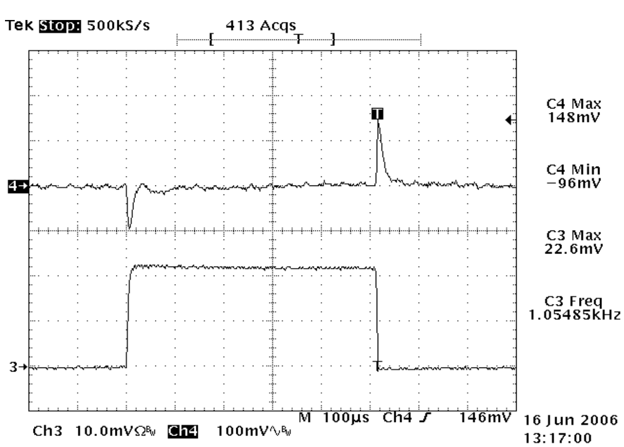


Figure 28: Transient Response 75% - 100%
(Channel 3: Current Step at 10 A/div,
Channel 4: Output Voltage Deviation)

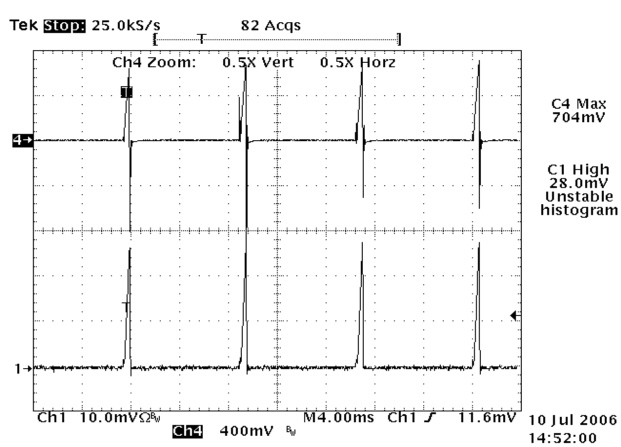
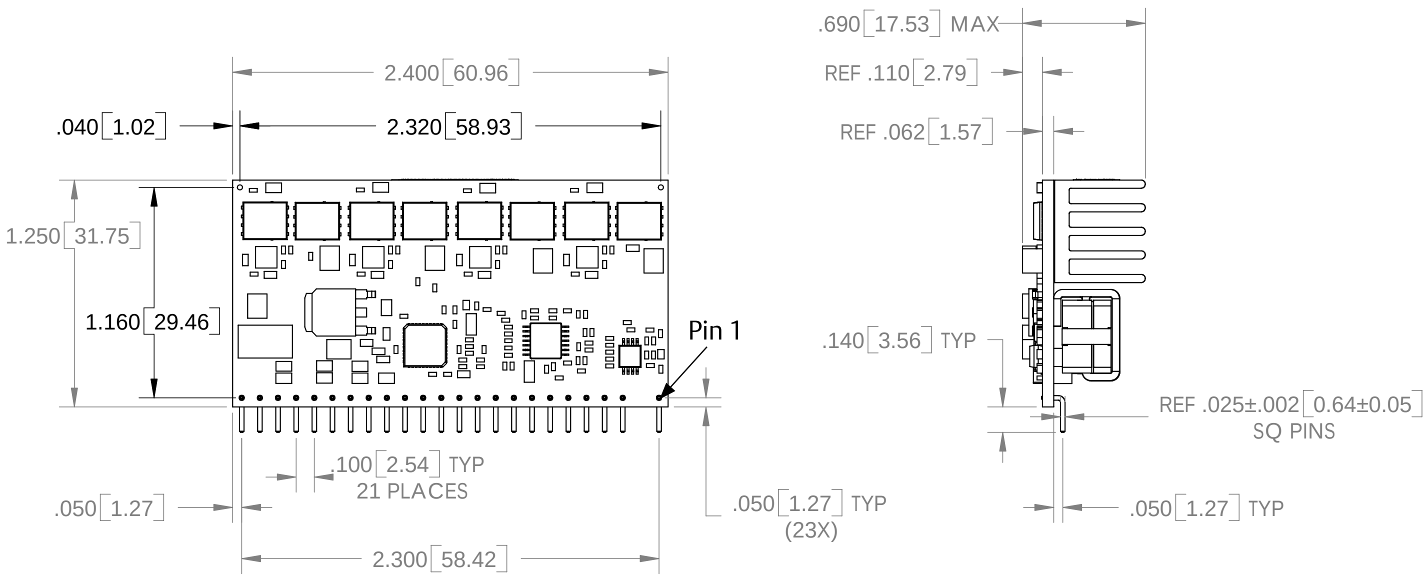


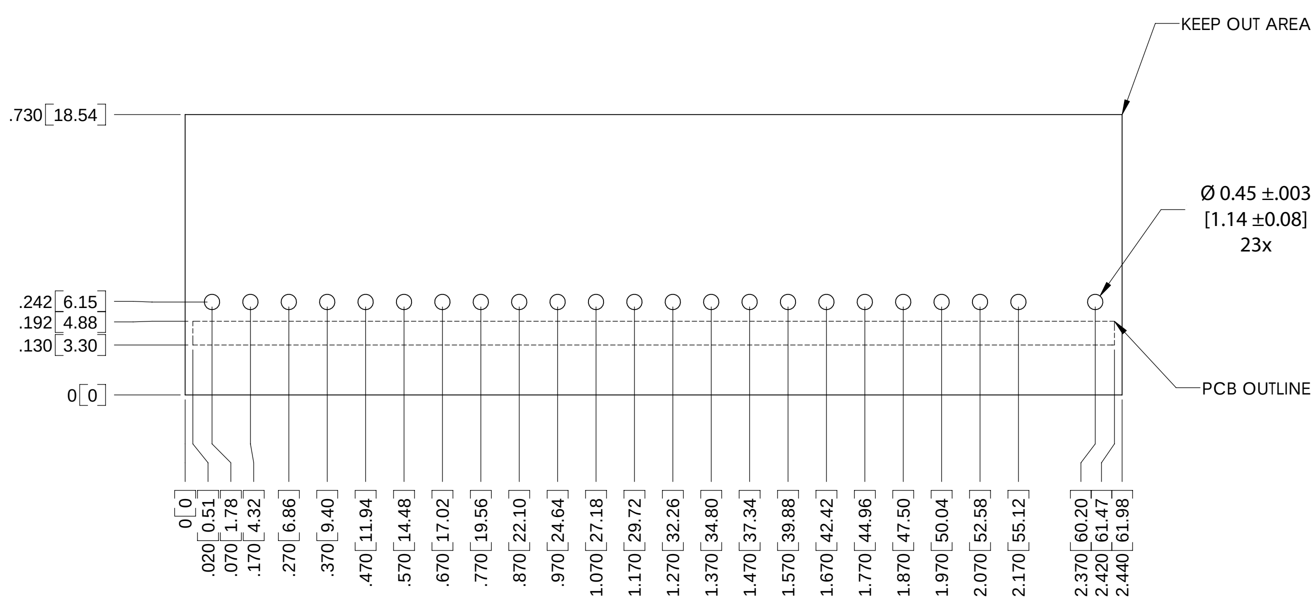
Figure 29: Short Circuit Characteristic
(Channel 1: Output Current at 50 A/div,
Channel 4: Output Voltage)

Mechanical Drawings

SIL80C-00SADJ-VJ

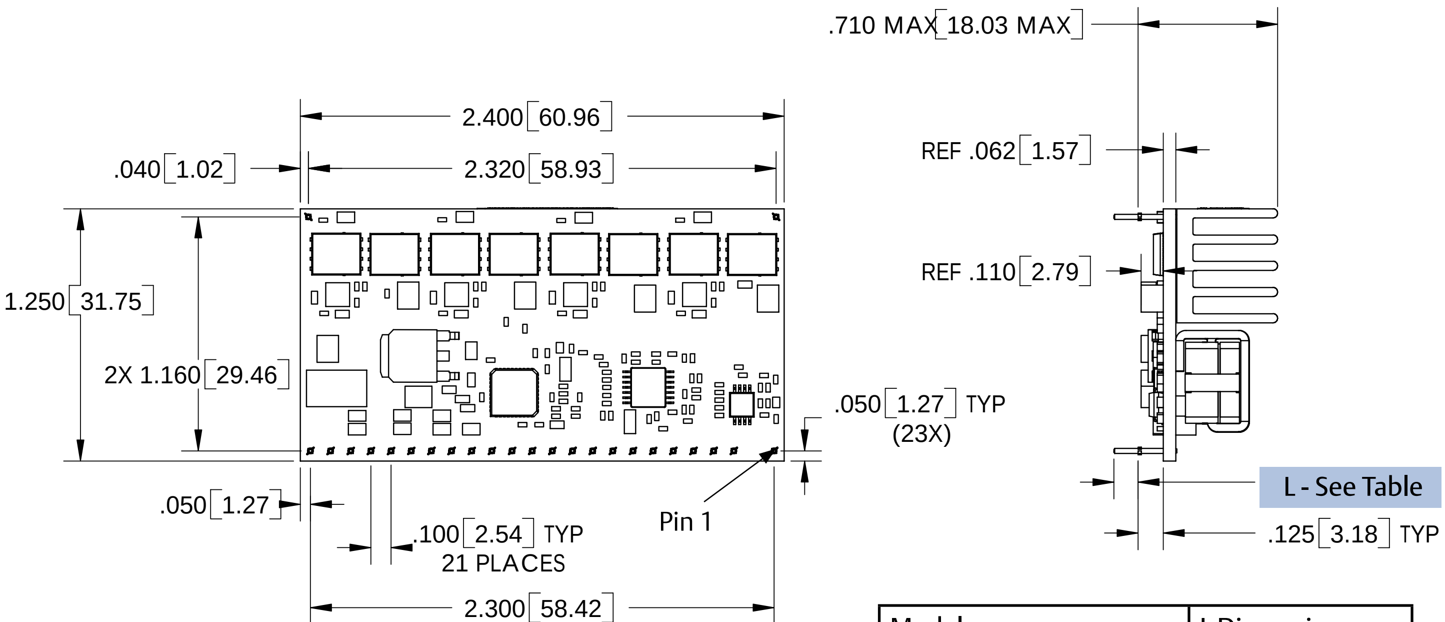


Footprint



Mechanical Drawings

SIL/SMT80C2-00SADJ-HJ/H3J



Model	L Dimension
SIL80C2-00SADJ	REF .120 [3.05]
SIL80C2-00SADJ-H3J	REF .138 [3.50]

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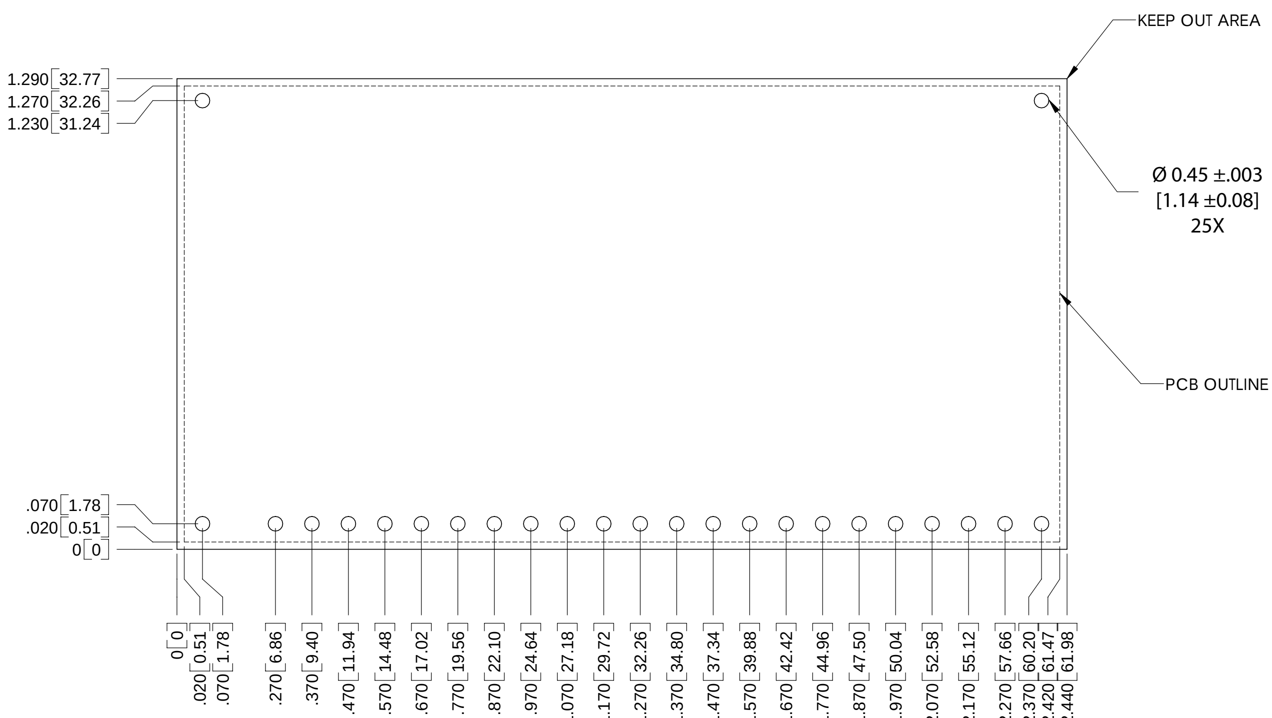
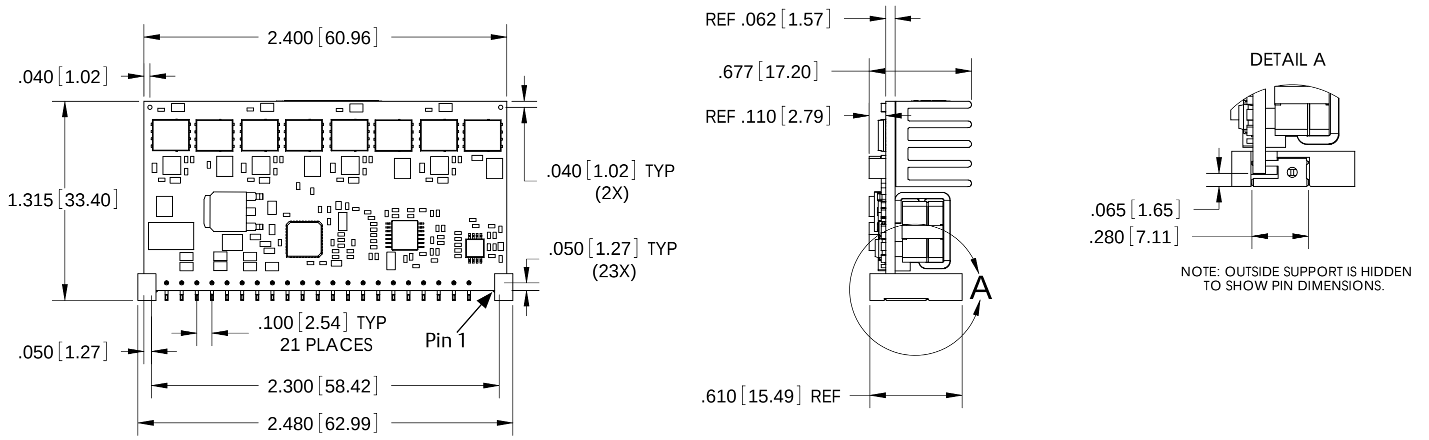


Mechanical Drawings

SMT80C-00SADJ-VJ



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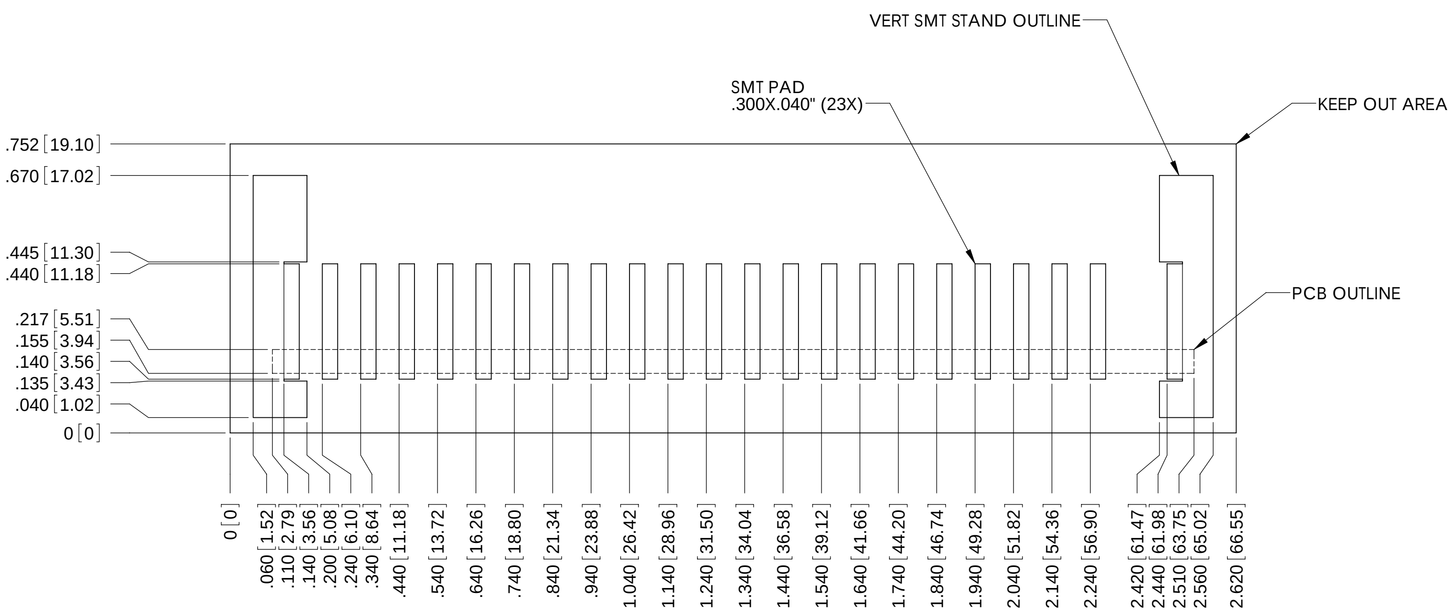
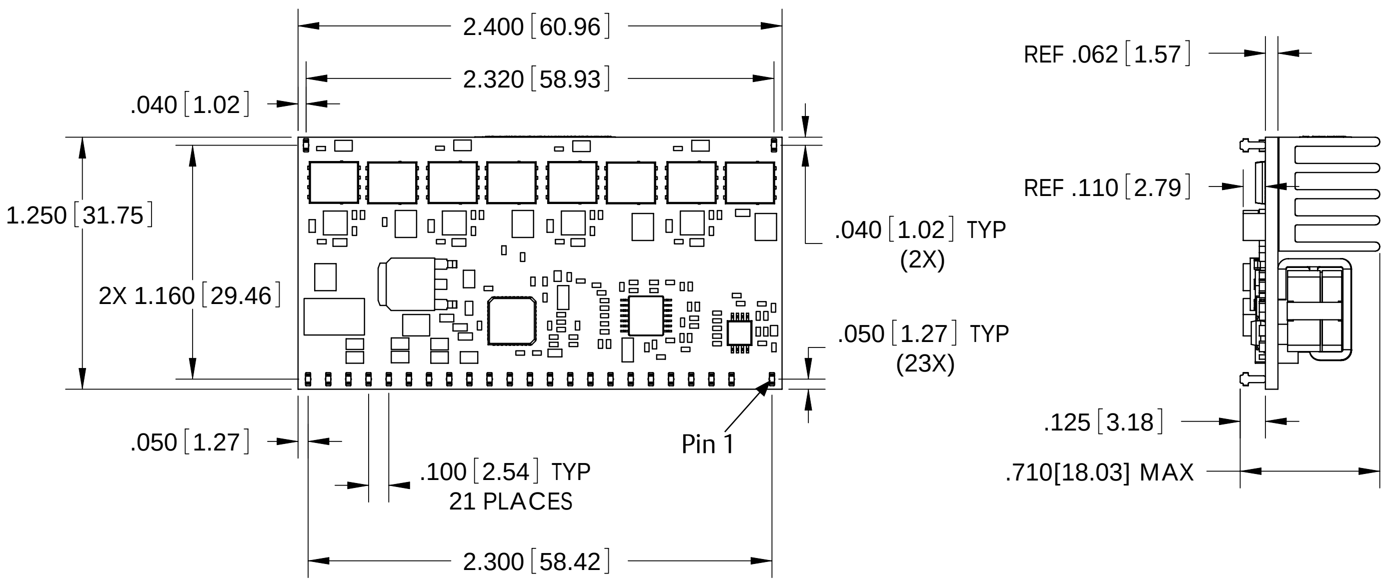
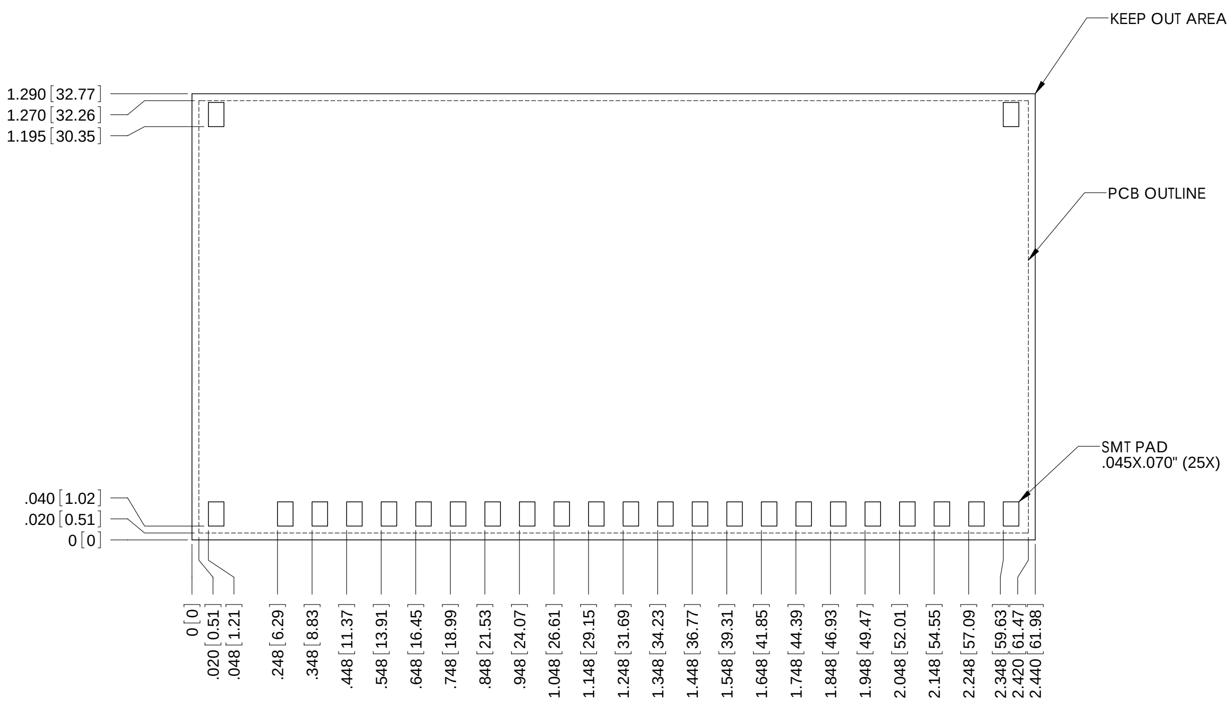


Mechanical Drawings (cont'd)

SMT80C2-00SADJ-J



Footprint



Pin Chart

Pin Assignments		Pin Assignments	
Single Output		Single Output	
1	Trim	14	Vin
2	No Pin	15	Vout
3	Ground	16	Vout
4	Power Good	17	Ground
5	(-) Trim	18	Vout
6	Ishare	19	Ground
7	Ground	20	Vout
8	Ground	21	Ground
9	Enable	22	Vout
10	Rem Sense (-)	23	Ground
11	Rem Sense (+)	24	Vout
12	Vin	25	*Mech Support
13	Vin	26	*Mech Support

*Horizontal version only

Ordering Information

Product Family	Rated Output Current	Performance	Generation		Input Voltage	Output Voltage		Mounting Option	Custom Options	RoHs Compliance[9]
SIL	**80**	**C**	**2**	**-**	**00**	**SADJ**	**-**	**X**	**X**	**J**
Product Family SIL = Single In Line	**Rated Output Current** 80 = 80 A	**Performance** C = Cost Optimized	**Generation** 2 = Increased Current Density		**Input Voltage** 00 = 4.7-13.8 V	**Output Voltage** Single Adjustable Output		**Mounting Option** Blank = Horizontal V = Vertical	**Custom Options** Blank = 3.05 mm pin 3 = 3.50 mm pin	**RoHS Compliance** J = Pb-free (RoHS 6/6 compliant)

Product Family	Rated Output Current	Performance	Generation		Input Voltage	Output Voltage		Mounting Option	Custom Options	RoHs Compliance[9]
SMT	**80**	**C**	**2**	**-**	**00**	**SADJ**	**-**	**X**	**X**	**J**
Product Family SMT = Surface Mount	**Rated Output Current** 80 = 80 A	**Performance** C = Cost Optimized	**Generation** 2 = Increased Current Density		**Input Voltage** 00 = 4.7-13.8 V	**Output Voltage** Single Adjustable Output		**Mounting Option** Blank = Horizontal V = Vertical	**Custom Options** Blank = 3.05 mm pin 3 = 3.50 mm pin	**RoHS Compliance** J = Pb-free (RoHS 6/6 compliant)

This is a preliminary datasheet. Emerson Network Power reserves the right to make changes to the information contained herein without notice and assumes no liability as a result of its use or application.

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