SIL40C SERIES

Single output

- Wide trim range (0.9 Vdc to 5.0 Vdc)
- Horizontal and vertical models available
- High power density design means reduced board space requirement
- Remote sense
- Power good output signal (open collector)
- Operating ambient temperature to 80 °C with suitable de-rating and forced air cooling
- Remote ON/OFF (active high)
- Overtemperature protection
- 0 A minimum load
- Input undervoltage lockout
- Overcurrent and short-circuit protection
- Current sharing option
- Available RoHS compliant

The SIL40C is a new high density open-frame non-isolated converter series for space sensitive applications. The converter has a wide input range (10.2 Vdc to 13.8 Vdc) and offers a wide 0.9 Vdc to 5 Vdc output voltage range with a 40 A load. An external resistor adjusts the output voltage from its preset value of 0.9 V to any value up to the 5 V maximum. The SIL has a typical efficiency of 92%. The series offers remote ON/OFF, overtemperature protection and overcurrent protection as standard.

Its current share facility supports parallel operation of multiple SIL40C units and the remote sense feature enables the SIL40C compensate for voltage drops between the converters output and the load. With full international safety approvals including EN60950 and UL/cUL60950 the SIL40C reduces compliance costs and time to market.

[2 YEAR WARRANTY]

ARTESYN TECHNOLOGIES

Absolute Maximum Ratings

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input voltage - continuous	$V_{in\ (cont)}$	-0.3		13.8	V DC	$V_{in(+)}$ - $V_{in(-)}$
Operating temperature	T_{op}	0		80	°C	Measured at thermal reference points, see Note 1. Higher ambient operation possible with forced air cooling. See de-rating curves
Power good pull-up voltage				11	V	
Storage temperature	$T_{storage}$	-40		125	°C	
Output current	Iout	0		40	A	

All specifications are typical at nominal input Vin = 12V, full load under any resistive load combination at 25°C unless otherwise stated.

Input Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input voltage - operating	$V_{in\ (oper)}$	10.2	12.0	13.8	V DC	
Input current - no load	I_{in}		290		mADC	$V_{in\ (min)}$ - $V_{in\ (max)}$, enabled
Input current - Quiescent	$I_{in\ (off)}$		30		mADC	Converter disabled
Input voltage variation	dv/dt		1.0		V/ms	Product was tested at 1.2V/ms. Much higher dV/dt is possible (>10V/ms). Consult factory for details

Turn On/Off

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input voltage - turn on	$V_{in\ (on)}$	8.5	9.0	9.5	V DC	
Input voltage - turn off	$V_{in\ (off)}$	7.1	7.6	8.1	V DC	
Turn on delay - enabled, then power applied	T_{delay} (power)			30	msec	With the Remote ON/OFF signal asserted, this is the time from when the input voltage reaches the minimum specified operating voltage until the POWER GOOD is asserted high
Turn on delay - power applied, then Remote ON/OFF asserted	T_{delay} (Remote ON/OFF)			30	msec	V_{in} = $V_{in\ (nom)}$, then Remote ON/OFF asserted. This is the time taken until the POWER GOOD is asserted high
Output to Power Good delay	T_{delay}			8	msec	Output voltage in full regulation to POWER GOOD asserted high
Rise time	T_{rise}		3		msec	From 10% to 90%; full resistive load, 2 x 680µF external capacitance

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Signal Electrical Interface

Characteristic - Signal Name	Symbol	Min	Typ	Max	Units	Notes and Conditions
At remote/control ON/OFF pin Open collector or equivalent compatible						**See Notes 2 and 3** See Application Note 132 for Remote ON/OFF details
Control pin open circuit voltage	V_{ih}		2.27	2.50	V	I_{ih} = 0 µA; open circuit voltage
High level input current	I_{ih}			1	µA	Current flowing into control pin when pin is pulled high (max. at V_{ih} = 13.8V)
High level input voltage	V_{ih}	2.40			Vin	Converter guaranteed on when control pin is greater than V_{ih} (max)
Low level input voltage	V_{il}			0.80	V	Converter guaranteed off when control pin is less than V_{il} (max)
Low level input current	I_{il} (max)			1.3	mA	V_{il} = 0.0 V;

Reliability and Service Life

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Mean time between failure	MTBF	95,418			Hours	MIL-HDBK-217F, V_{in} = $V_{in\ (nom)}$; I_{out} = $I_{out\ (max)}$; ambient 25°C; ground benign environment
Mean time between failure	MTBF	4,585,991			Hours	Telcordia SR-332 Issue 3, ground benign, temp. = 40°C, V_{in} = $V_{in\ (nom)}$, I_{out} = $I_{out\ (max)}$

Other Specifications

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Switching frequency	F_{sw}		300		kHz	Fixed frequency
Weight			28.3		g	

Safety Agency Approvals

Characteristic	
UL/cUL 60950	File No. E139421
TÜV Product Service IEC 60950	Certificate No. B 03 08 19870 219

Material Ratings

Characteristic - Signal Name	Notes and Conditions
Flammability rating	UL94V-0
Material type	FR4 PCB

Model Numbers

Model Number (See Notes below)	Input Voltage	Output Voltage	Output Current (Max.)	Typical Efficiency	Max. Load Regulation
SIL40C-12SADJ-VJ	12VDC	0.9 - 5.0V	40A	92%	±1.5%
SIL40C-12SADJ-VSJ	12VDC	0.9 - 5.0V	40A	92%	±1.5%
SIL40C-12SADJ-HJ	12VDC	0.9 - 5.0V	40A	92%	±1.5%
SIL40C-12SADJ-HSJ	12VDC	0.9 - 5.0V	40A	92%	±1.5%

Suffix Notes:

Suffix '-V' and suffix '-H' are to be used for non-isolated current sharing applications.
Suffix ''-VS' and suffix '-HS' are to be used for isolated current sharing applications.

RoHS Compliance Ordering Information

RoHS
2002/95/EC

The 'J' at the end of the part number indicates that the part is Pb-free (RoHS 6/6 compliant). TSE RoHS 5/6 (non Pb-free) compliant versions may be available on special request, please contact your local sales representative for details.

0.9V Setpoint

Input Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input current - operating	I_{in}		4.40		A DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out}$ (max.)
Reflected ripple current	$I_{in\ (ripple)}$		27 62		mA RMS mA pk-pk	$I_{out} = I_{out\ (max.)}$, measured with external filter. See Application Note 132 for details
Input capacitance - internal filter	C_{input}		18.8		µF	
Input capacitance - external external input	C_{bypass}		270		µF	Recommended customer added capacitance. Maximum ESR = 20mΩ See Application Note 132 for ripple current requirements

0.9V Setpoint

Electrical Characteristics – O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Nominal set-point voltage	Vo (nom)	0.873	0.900	0.927	V DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (NL)}$
Line regulation				0.2	%	$V_{in\ (min)}$ to $V_{in\ (max)}$
Load regulation				1.5	%	$V_{in} = V_{in\ (nom)}$; $I_{out\ (min)}$ to $I_{out\ (max)}$
Output current continuous	Iout	0		40	A DC	
Output current - short circuit	I_{sc}		22.5		A rms	Continuous, unit auto recovers from short, V_o < 100mV
Output voltage - noise	V_{p-p} V_{rms}			40 15	mV pk-pk mV rms	Measurement bandwidth 20 MHz See Application Note 132 for measurement set-up details
Current sharing			±10		%	$I_{out} = I_{out\ (max)}$

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0.9V Setpoint

Electrical Characteristics - O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Load transient response - peak deviation	$V_{dynamic}$		55		mV	Peak deviation for 50% to 75% step load, di/dt = 10A/µsec
Load transient response - recovery	$T_{recovery}$		30		µsec	Settling time to within 1% of output set point voltage for 50% to 75% step load
External load capacitance	C_{ext}		2,040		µF	Maximum capacitor value may vary with load conditions. Consult factory for details Max ESR = 12mΩ See Application Note 132 for output capacitance values vs. stability

0.9V Setpoint

Protection and Control Features

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Overcurrent limit inception	I_{oc}		62		A DC	V_o = 90% of V_o (nom)
Open sense voltage			0.9		V DC	Sense pins not connected

0.9V Setpoint

Efficiency

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Efficiency	η	69.8	71.8		%	I_{out} = 100% Iout (max), V_{in} = V_{in} (nom)
Efficiency	η	75.3	77.3		%	I_{out} = 50% I_{out} (max), V_{in} = V_{in} (nom)

2.5V Setpoint

Input Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input current - operating	I_{in}		9.85		A DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out}$ (max.)
Reflected ripple current	$I_{in\ (ripple)}$		45 105		mA RMS mA pk-pk	$I_{out} = I_{out\ (max.)}$, measured with external filter. See Application Note 132 for details
Input capacitance - internal filter	C_{input}		18.80		µF	
Input capacitance - external external input	C_{bypass}		270		µF	Recommended customer added capacitance. Maximum ESR = 20mΩ See Application Note 132 for ripple current requirements

2.5V Setpoint

Electrical Characteristics – O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Nominal set-point voltage	Vo (nom)	2.425	2.500	2.575	V DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (NL)}$
Line regulation				±0.2	%	V_{in} (min) to V_{in} (max)
Load regulation				±1	%	$V_{in} = V_{in\ (nom)}$; $I_{out\ (min)}$ to I_{out} (max)
Output current continuous	Iout	0		40	A DC	
Output current - short circuit	I_{sc}		23.9		A rms	Continuous, unit auto recovers from short, V_o < 100mV
Output voltage - noise	V_{p-p} V_{rms}			50 15	mV pk-pk mV rms	Measurement bandwidth 20 MHz See Application Note 132 for measurement set-up details
Current sharing			±10		%	$I_{out} = I_{out\ (max)}$

2.5V Setpoint

Electrical Characteristics - O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Load transient response - peak deviation	$V_{dynamic}$		55		mV	Peak deviation for 50% to 75% step load, di/dt = 10A/µsec
Load transient response - recovery	$T_{recovery}$		30		µsec	Settling time to within 1% of output set point voltage for 50% to 75% step load
External load capacitance	C_{ext}		2,040		µF	Maximum capacitor value may vary with load conditions. Consult factory for details Max ESR = 12mΩ See Application Note 132 for output capacitance values vs. stability

2.5V Setpoint

Protection and Control Features

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Overcurrent limit inception	I_{oc}		62		A DC	V_o = 90% of V_o (nom)
Open sense voltage			2.5		V DC	Sense pins not connected

2.5V Setpoint

Efficiency

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Efficiency	η	83.7	85.7		%	I_{out} = 100% Iout (max), V_{in} = V_{in} (nom)
Efficiency	η	87.0	89.0		%	I_{out} = 50% I_{out} (max), V_{in} = V_{in} (nom)

5V Setpoint

Input Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Input current - operating	I_{in}		18.15		A DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out}$ (max.)
Reflected ripple current	$I_{in\ (ripple)}$		41 115		mA RMS mA pk-pk	$I_{out} = I_{out\ (max.)}$, measured with external filter. See Application Note 132 for details
Input capacitance - internal filter	C_{input}		18.8		µF	
Input capacitance - external external input	C_{bypass}		270		µF	Recommended customer added capacitance. Maximum ESR = 20mΩ See Application Note 132 for ripple current requirements

5V Setpoint

Electrical Characteristics – O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Nominal set-point voltage	Vo (nom)	4.85	5.000	5.15	V DC	$V_{in} = V_{in\ (nom)}$; $I_{out} = I_{out\ (NL)}$
Line regulation				±0.2	%	$V_{in\ (min)}$ to $V_{in\ (max)}$
Load regulation				±1	%	$V_{in} = V_{in\ (nom)}$; $I_{out\ (min)}$ to $I_{out\ (max)}$
Output current continuous	Iout	0		40	A DC	
Output current - short circuit	I_{sc}			23.9	A rms	Continuous, unit auto recovers from short, V_o < 100mV
Output voltage - noise	V_{p-p} V_{rms}			50 15	mV pk-pk mV rms	Measurement bandwidth 20 MHz See Application Note 132 for measurement set-up details
Current sharing			±10		%	$I_{out} = I_{out\ (max)}$

5V Setpoint

Electrical Characteristics – O/P

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Load transient response - peak deviation	$V_{dynamic}$		55		mV	Peak deviation for 50% to 75% step load, di/dt = 10A/µsec
Load transient response - recovery	$T_{recovery}$		40		µsec	Settling time to within 1% of output set point voltage for 50% to 75% step load
External load capacitance	C_{ext}		2,040		µF	Maximum capacitor value may vary with load conditions. Consult factory for details Max ESR = 12mΩ See Application Note 132 for output capacitance values vs. stability

5V Setpoint

Protection and Control Features

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Overcurrent limit inception	I_{oc}		62		A DC	V_o = 90% of V_o (nom)
Open sense voltage			5		V DC	Sense pins not connected

5V Setpoint

Efficiency

Characteristic	Symbol	Min	Typ	Max	Units	Notes and Conditions
Efficiency	η	90.2	92.2		%	I_{out} = 100% Iout (max), V_{in} = V_{in} (nom)
Efficiency	η	91.7	93.7		%	I_{out} = 50% I_{out} (max), V_{in} = V_{in} (nom)

0.9V Model

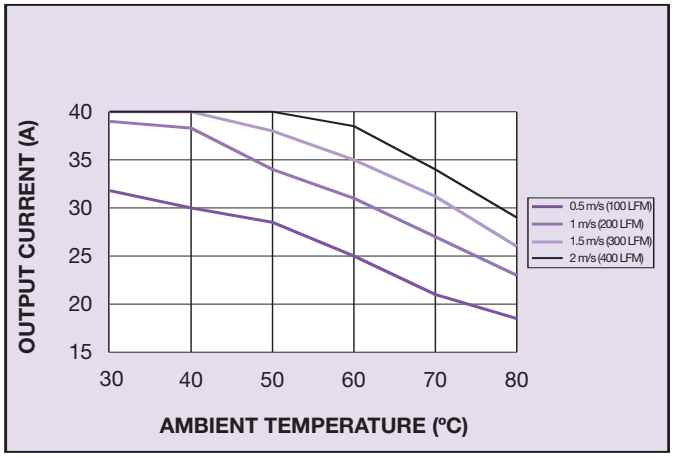

Figure 1: Thermal De-rating Curve

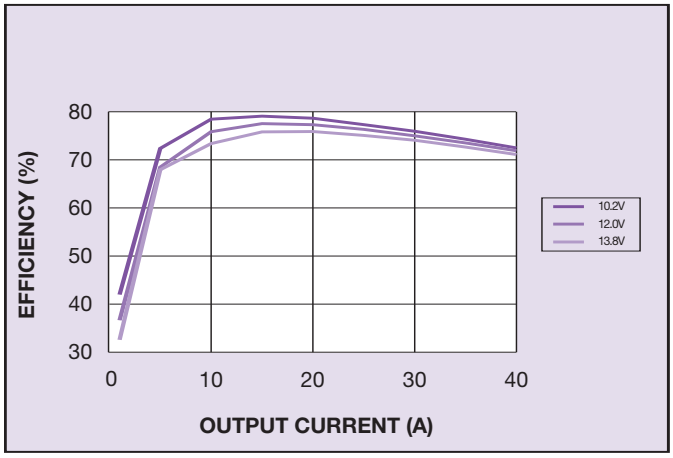

Figure 2: Efficiency vs Load and Line

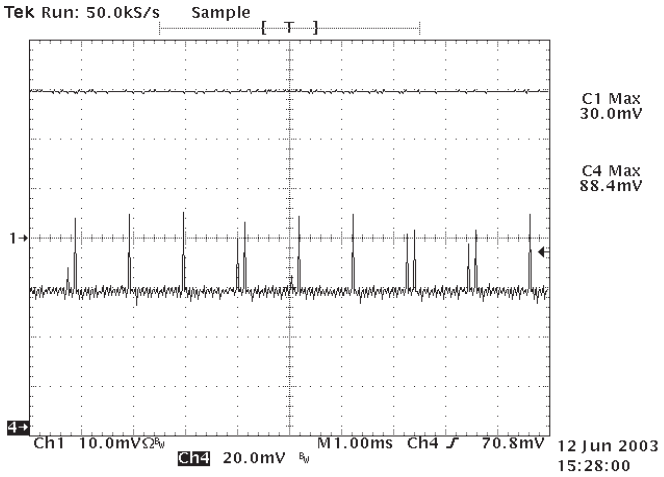

Figure 3: Short Circuit Characteristic (Channel 1: Output Current at 10A/div, Channel 4: Output Voltage)

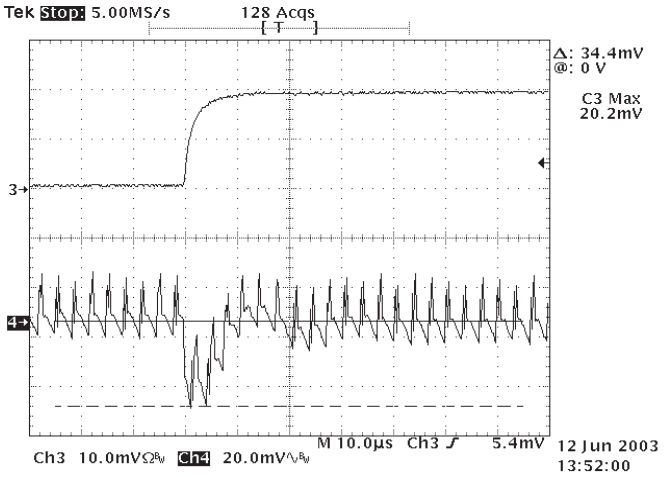

Figure 4: Transient Response 50-75% (Channel 3: Current load step at 5A/div, Channel 4: Output Voltage deviation)

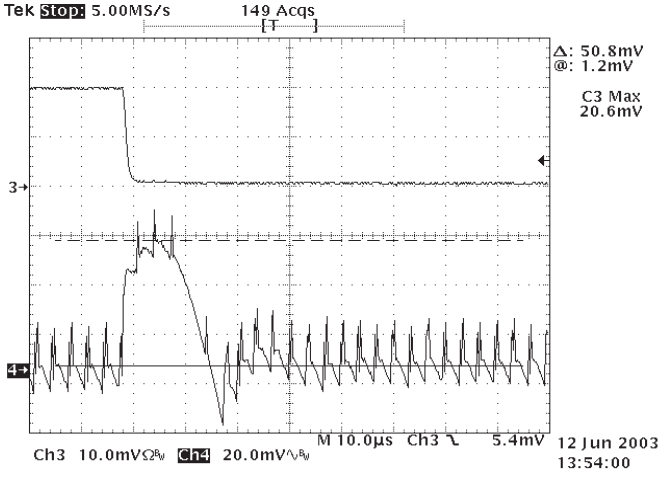

Figure 5: Transient Response 75 - 50% (Channel 3: Current load step at 5A/div, Channel 4: Output Voltage deviation)

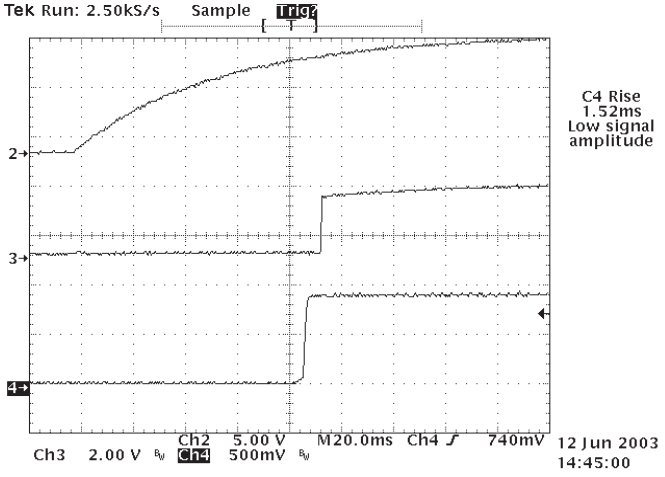

Figure 6: Typical Power Up (Channel 2: DC Input, Channel 3: Power Good Channel 4: Output Voltage)

0.9V Model

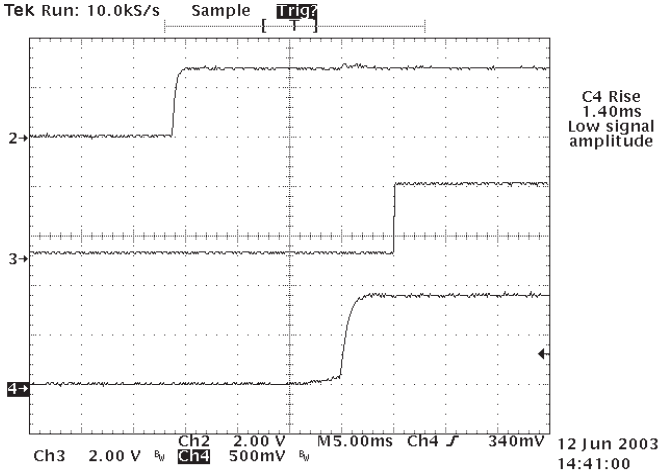

Figure 7: Control On/Off
(Channel 2: Remote ON/OFF, Channel 3: Power Good
Channel 4: Output Voltage)

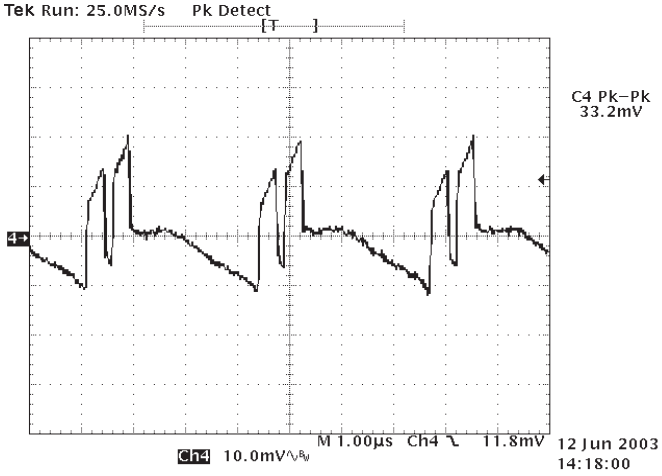

Figure 8: Typical Ripple and Noise

2.5V Model

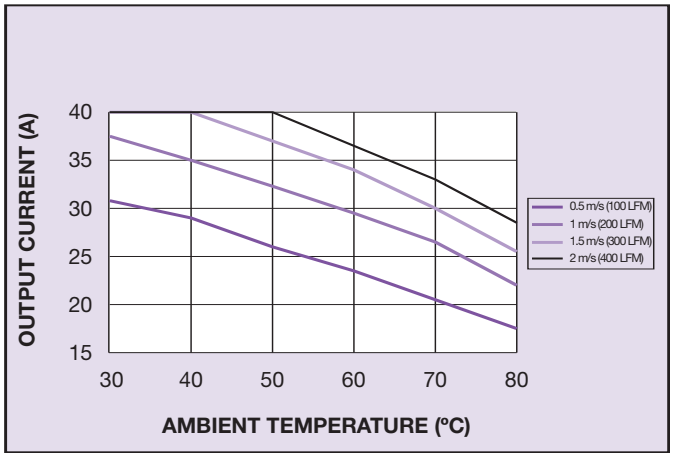

Figure 9: Thermal De-rating Curve

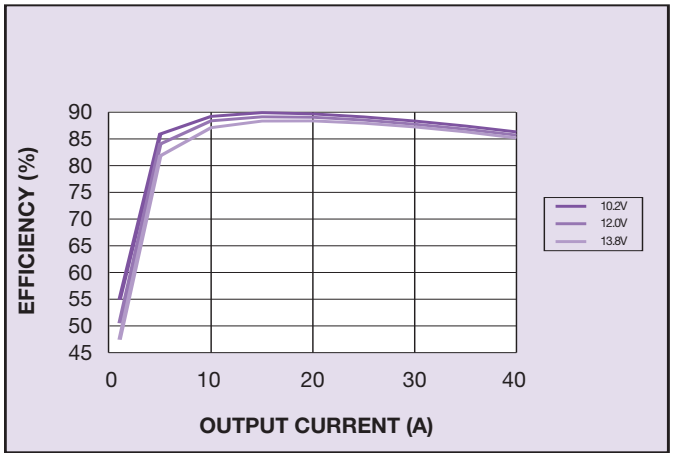

Figure 10: Efficiency vs Load and Line

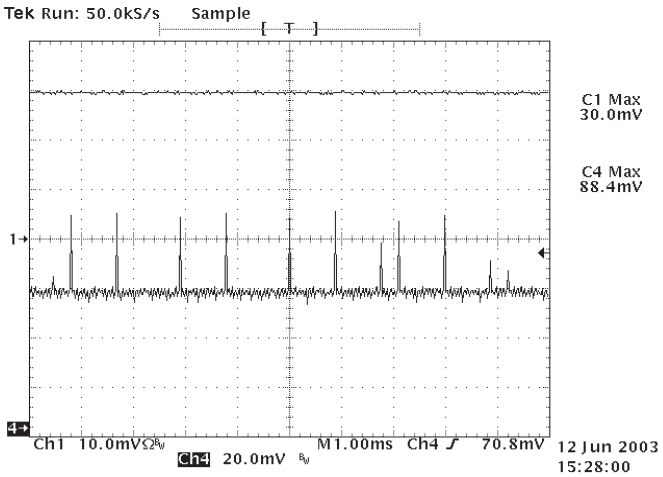

Figure 11: Short Circuit Characteristic
(Channel 1: Output Current at 10A/div,
Channel 4: Output Voltage)

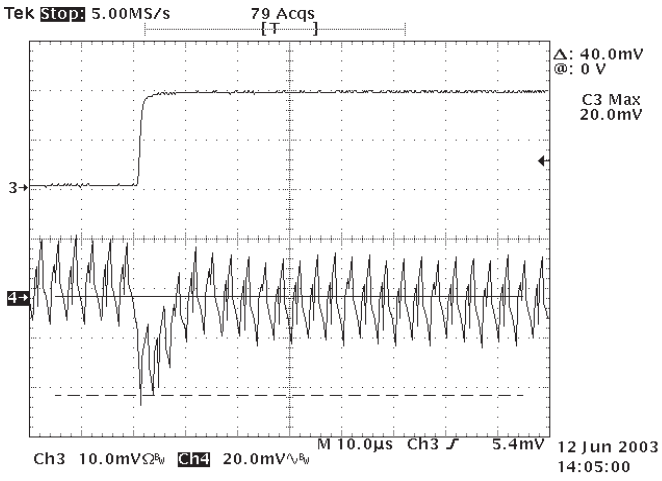

Figure 12: Transient Response 50-75%
(Channel 3: Current load step at 5A/div,
Channel 4: Output Voltage deviation)

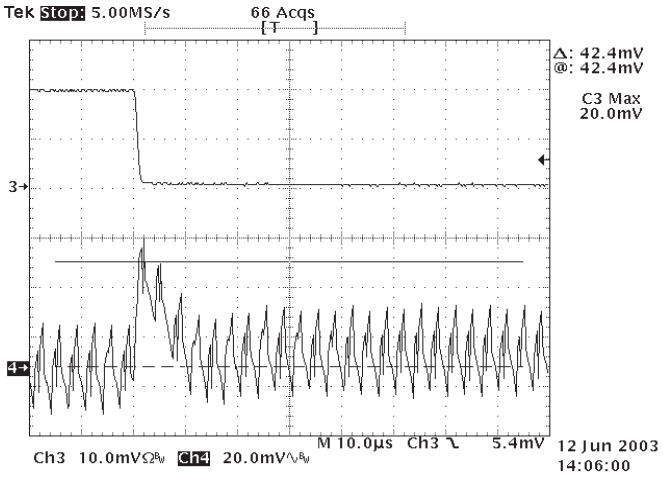

Figure 13: Transient Response 75 - 50%
(Channel 3: Current load step at 5A/div,
Channel 4: Output Voltage deviation)

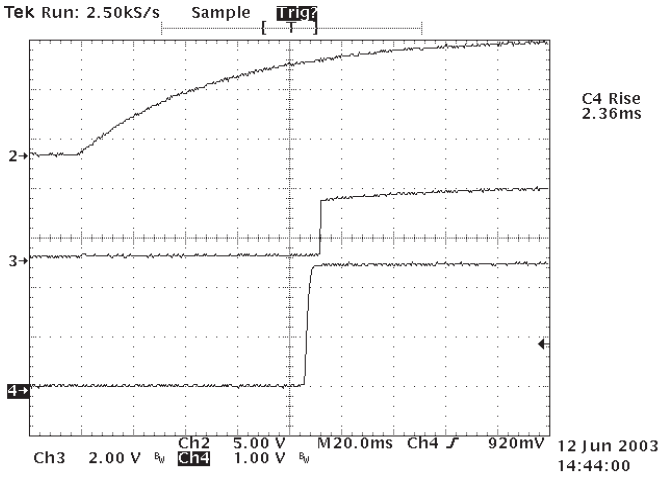

Figure 14: Typical Power Up
(Channel 2: DC Input, Channel 3: Power Good
Channel 4: Output Voltage)

2.5V Model

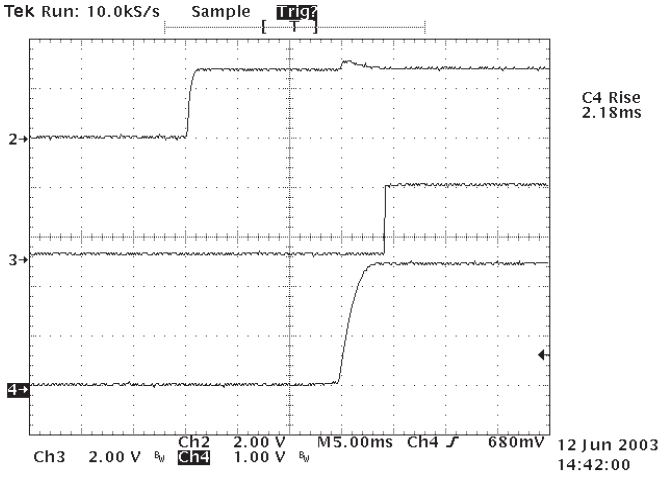

Figure 15: Control On/Off (Channel 2: Remote ON/OFF, Channel 3: Power Good Channel 4: Output Voltage)

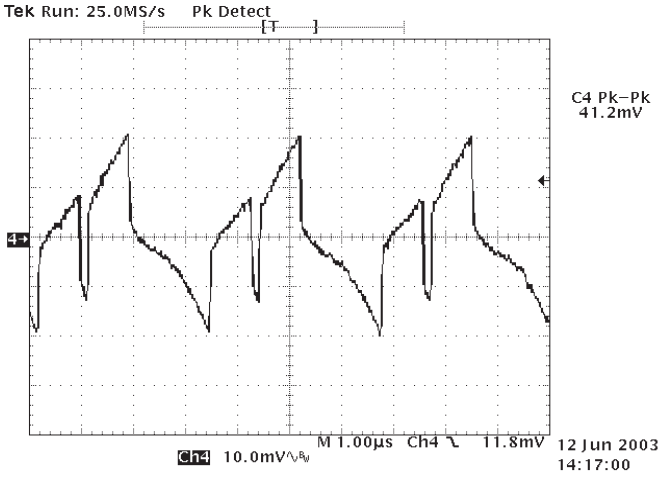

Figure 16: Typical Ripple and Noise

5V Model

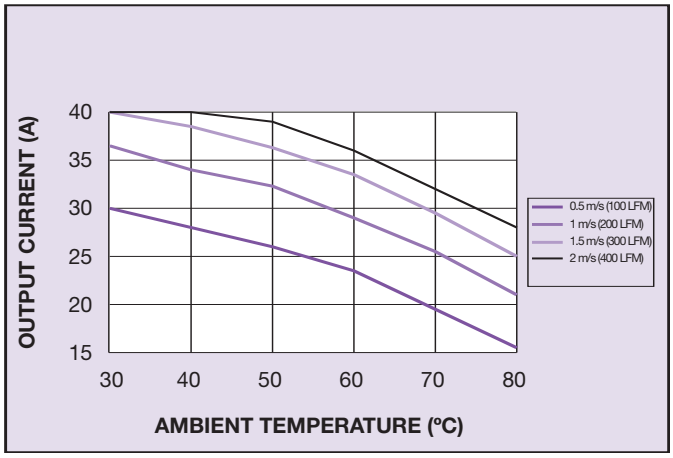

Figure 17: Thermal De-rating Curve

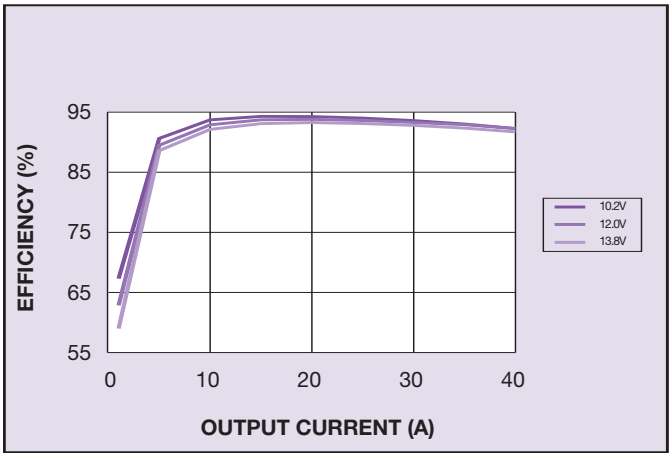

Figure 18: Efficiency vs Load and Line

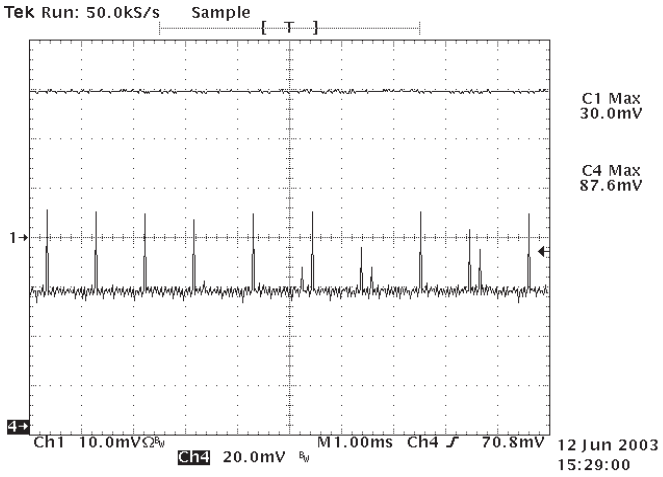

Figure 19: Short Circuit Characteristic (Channel 1: Output Current at 10A/div, Channel 4: Output Voltage)

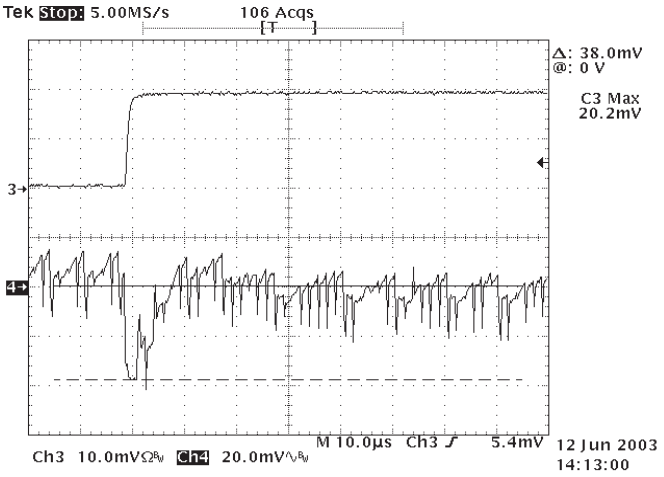

Figure 20: Transient Response 50-75% (Channel 3: Current load step at 5A/div, Channel 4: Output Voltage deviation)

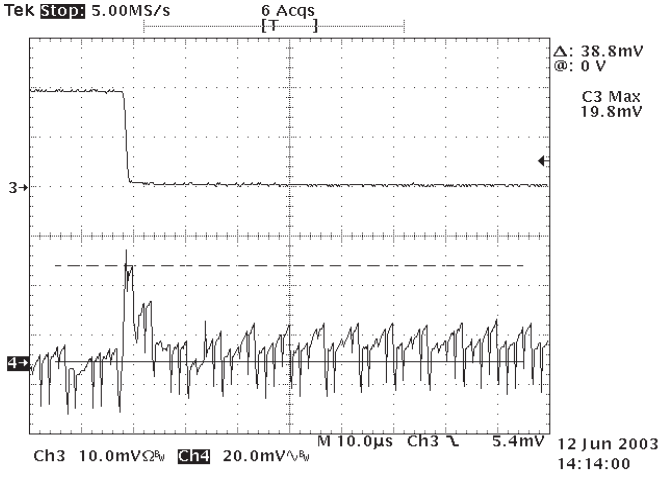

Figure 21: Transient Response 75 - 50% (Channel 3: Current load step at 5A/div, Channel 4: Output Voltage deviation)

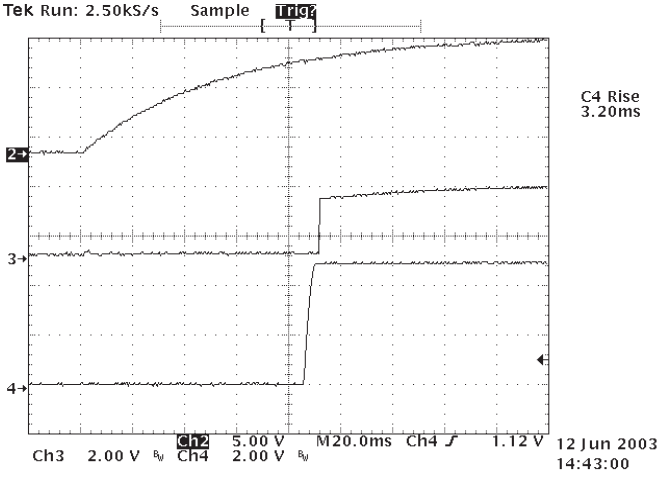

Figure 22: Typical Power Up (Channel 2: DC Input, Channel 3: Power Good Channel 4: Output Voltage)

5V Model

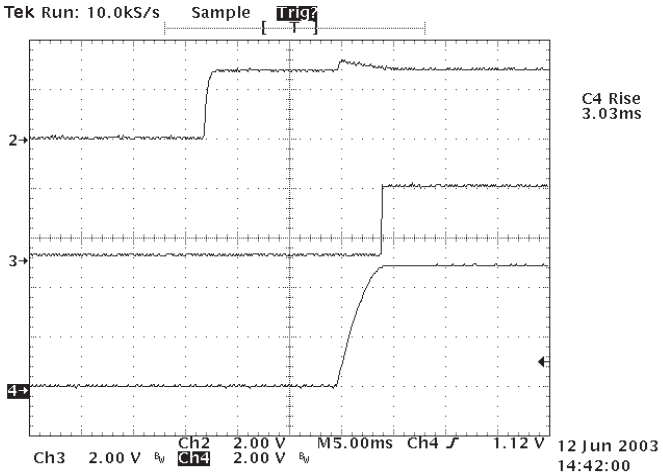

Figure 23: Control On/Off (Channel 2: Remote ON/OFF, Channel 3: Power Good Channel 4: Output Voltage)

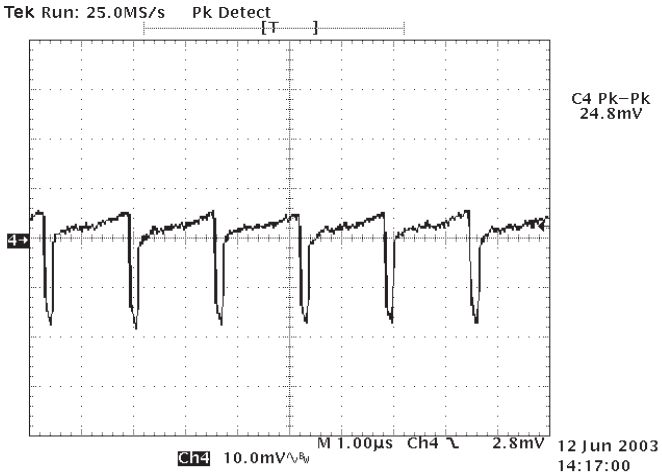

Figure 24: Typical Ripple and Noise

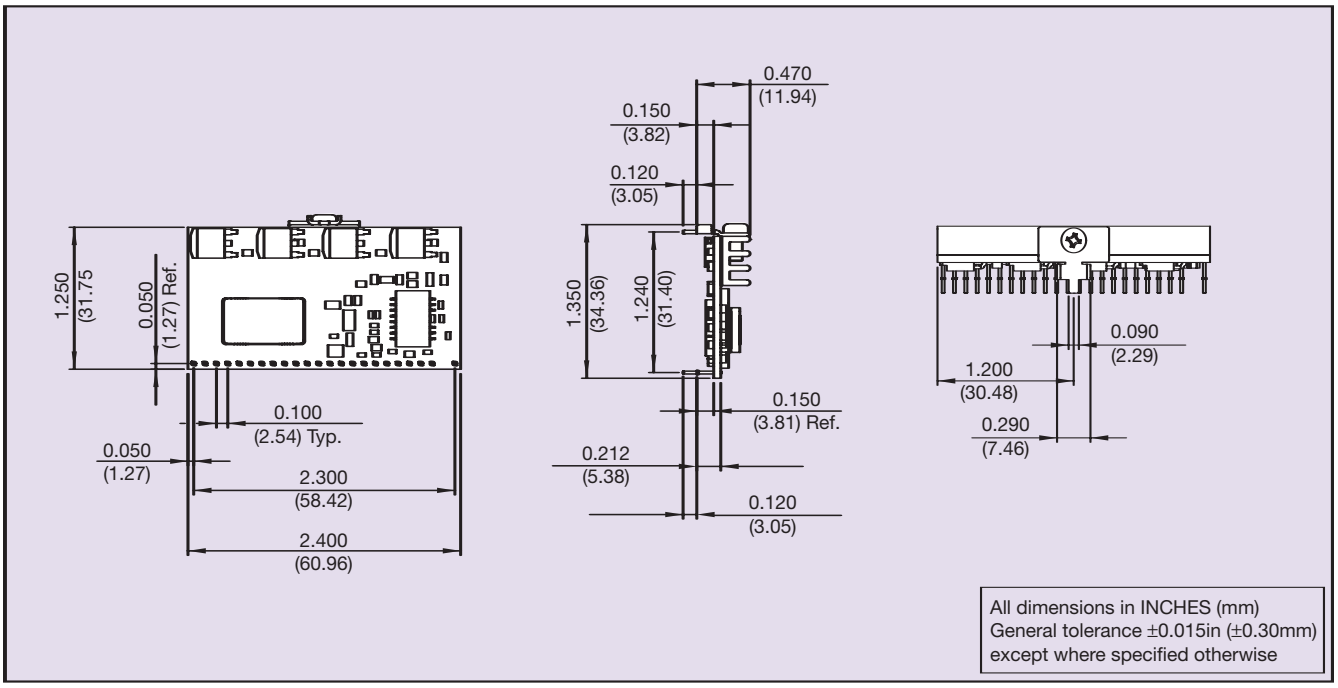

Figure 25: Mechanical Drawing - Horizontal

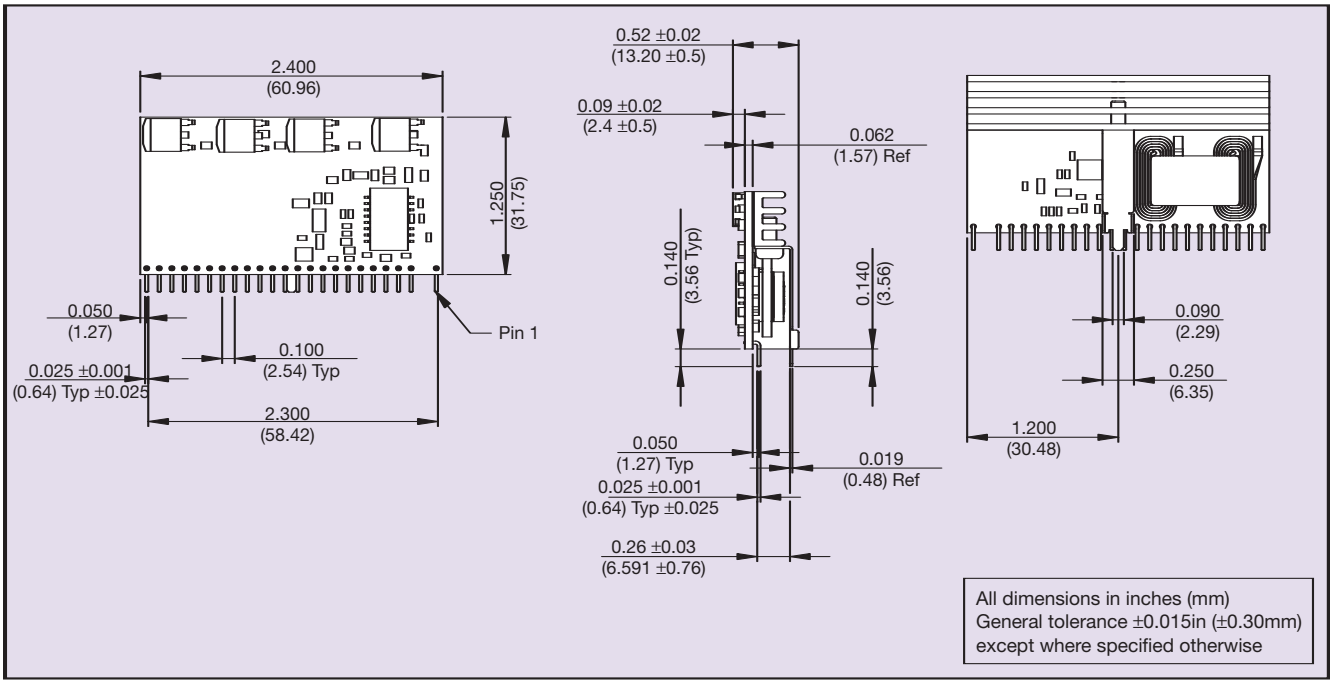

Figure 26: Mechanical Drawing - Vertical

Note 1

Thermal reference point is defined as the highest temperature measured at any one of the specified thermal reference points. See Figure 19: Thermal reference point.

Note 2

The control pin is referenced to Vin-

Note 3

The SIL40C is supplied as standard with active High logic.
Control input pulled low: Unit Disabled
Control input left open: Unit Enabled

Note 4

Thermal reference set up: Unit mounted on an edge card test board 215mm x 115mm. Test board mounted vertically. For test details and recommended set-up see Application Note 132 .

Note 5

3-200Hz, sweep at 1/2 octave/min from low to high frequency, and then from high to low. Thirty minute dwell at all resonant points.

CAUTION: Hazardous internal voltages and high temperatures. Ensure that unit is accessible only to trained personnel. The user must provide the recommended fusing in order to comply with safety approvals.

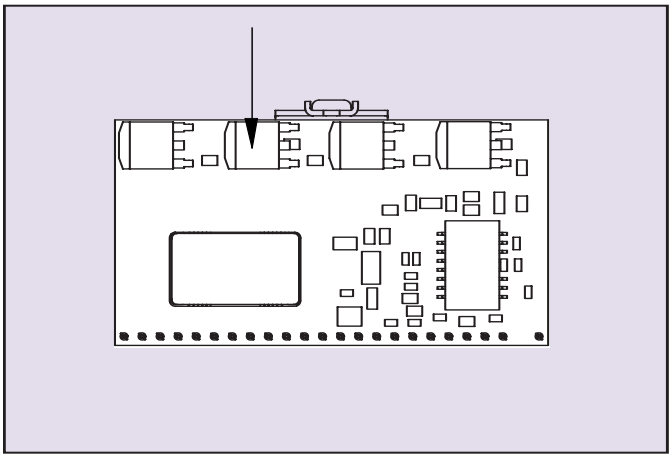

Figure 27: Thermal reference points

Pin Connections

Pin No.	Function
1	TRIM
2	No Pin
3	Ground
4	POWER GOOD
5	Not Connected
6	Current Share
7	Ground
8	Ground
9	Remote ON/OFF
10	Remote Sense (GND)
11	Remote Sense (O/P)
12	Vin
13	Vin
14	Vin
15	Vout
16	Vout
17	Ground
18	Vout
19	Ground
20	Vout
21	Ground
22	Vout
23	Ground
24	Vout

Figure 28: Dimensions and Pinout

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NORTH AMERICA
e-mail: sales.us@artesyn.com

☎ 800 769 7274
☎+508 628 5600

EUROPEAN LOCATIONS
e-mail: sales.europe@artesyn.com

IRELAND
☎+353 24 93130

AUSTRIA
☎+43 1 80150

FAR EAST LOCATIONS
e-mail: sales.asia@artesyn.com

HONG KONG
☎+852 2699 2868

ARTESYN® TECHNOLOGIES