

VRNE-40E1A0

Non-Isolated DC-DC Converter VRM Series

The VRNE-40E1A0 is a single non-isolated step-down DC/DC converter providing up to 40 A of output current and designed to be compatible with the Intel VRM12.5 memory requirements. Standard features include remote on/off, over current protection, remote sense, VR_Hot# signal and a power good signal. This product also makes use of adaptive positioning to improve transient response performance.

These products may be used almost anywhere low-voltage silicon is being employed and a nominal 12 VDC source is available.

Typical applications include file servers, work stations and other computing applications.



Key Features & Benefits

- 7.5 VDC – 13.5 VDC Input
- 0 VDC – 2.3 VDC / 40 A Single Output
- High Efficiency and Power Density
- Output Current Monitor
- Input Under-Voltage Lockout
- Input Over Current Protection
- Output Overvoltage Protection
- Power Management Bus Communication Protocol
- Thermal Warning
- Remote ON/OFF
- 2-Wire Remote Sense
- OCP/SCP
- SVID
- VR12.5 Compliant
- Class 2, Category 2, Non-Isolated DC/DC Converter (refer to IPC-9592B)

Applications

- Networking
- Computers and peripherals
- Telecommunications

1. MODEL SELECTION

PART NUMBER ACTIVE HIGH	OUTPUT VOLTAGE	INPUT VOLTAGE	MAX. OUTPUT CURRENT	MAX. OUTPUT POWER	TYPICAL EFFICIENCY
VRNE-40E1A0	0 VDC – 2.3 VDC	7.5 VDC – 13.5 VDC	40 A	92 W	83.6%

NOTE: Add “G” suffix at the end of the model number to indicate Tray Packaging.

PART NUMBER EXPLANATION

V	R	NE	-	40	E	1A	x	x
Mount Type	RoHS	Series Name		Output Current	Input Range	Output Voltage	Suffix	Package
Vertical Mount	RoHS 6 Compliant			40 A	7.5 –13.5 VDC	0 – 2.3 VDC	0 – Active High	G – Tray Packaging

2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNITS
Continuous non-operating Input Voltage		-0.3	-	13.5	V
Input Transient Voltage	100 ms maximum	-	-	15	V
Remote On/Off		-0.3	-	5.25	V
Ambient Temperature		-40	-	85	°C
Storage Temperature		-40	-	125	°C
Altitude		-	-	2000	m

NOTE: Ratings used beyond the maximum ratings may cause a reliability degradation of the converter or may permanently damage the device.

3. INPUT SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Operating Input Voltage		7.5	12	13.5	V
Input Current	Vin = 12 V, Vo = 1.2 V, Io = 46 A	-	-	5.6	A
	Vin = 12 V, PS = 00 h, Vo = 1.2 V	-	220	300	mA
No Load Input Current	Vin = 12 V, PS = 01 h, Vo = 1.2 V	-	220	300	mA
	Vin = 12 V, PS = 10 h or 11 h, Vo = 1.2 V	-	150	200	mA
Remoted Off Input Current		-	38	50	mA
Input Reflected Ripple Current (RMS)	With 1uH inductor. Use a 180/16V Os-Con cap with ESR=22 mΩ, a 470/16V Aluminum Cap with ESR = 160mΩ and 2×22 μF / 25 V Ceramic caps.	-	4	5	mA
Input Reflected Ripple Current (Pk-Pk)		-	25	35	mA
Turn-on Voltage Threshold		6.9	7.2	7.45	V
Turn-off Voltage Threshold		6.1	6.6	6.8	V

NOTE: All specifications are typical at 25 °C unless otherwise stated.

4. OUTPUT SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Output Voltage Set Point	Vin = 12 V, Io = 50% load	0	1.2	2.3	V
Load Regulation	Vin = 12 V, Io = 0-full load	-	0.1	0.2	%
Line Regulation	Vin = 7.5-13.5 V, Io = full load	-	0.05	0.1	%
Regulation Over Temperature	Working ambient temperature range is 0°C to 60°C .	-	4	8	mV
Output Ripple and Noise (pk-pk)	Vin = 12 V, PS = 00 h, Vo = 1.2 V, 0-20 MHz BW, with 8×22 µF/4V GRM21BC80G226M ceramic caps, 12×10 µF/10V GRM188C81A106M ceramic caps, 6×560 µF /2.0V 4.5 mOhms EEFSX0D561E4 caps at output.	-	25	50	mV
Output Ripple and Noise (rms)		-	5	10	mV
Output Current Range		0	-	40	A
		0	-	46	A
Output DC Current Limit		54	60	68	A
Rise time		-	350	400	µs
Turn-on Time	Enable from Vin	This time is tested when the boot voltage is set higher than 0 V.	4	5	ms
	Enable from ON/OFF		4	5	ms
Overshoot at Turn-on	Boot Voltage is 1.2 V	-	-	8.3	%
Output Capacitance	Recommended: 22 µF / 4 V, X6S, 0805 GRM21BC80G226M×8, 10 µF / 10 V, X6S, 0603 GRM188C81A106M×12 , 560 µF / 2.0 V, 4.5 mOhms, 7343 EEFSX0D561E4 ×6	-	3656	-	µF

NOTE: All specifications are typical at nominal input, full load at 25°C unless otherwise stated.

5. GENERAL SPECIFICATIONS

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Efficiency (Vin = 12 V; Io = Io, max)	Measured at Vin = 12 V, Vo = 1.2 V, Io = 46 A	80	83.6		%
Over Temperature Warning	Only the VR_HOT# is asserted, the power stage is not protected by the VRM controller.	-	115	-	°C
Switching Frequency	Single phase frequency.	-	370	-	kHz
MTBF	Calculated Per Telcordia SR-332, Issue2 (Vin=12 V, Vo=1.2 V, Io=40 A, Ta = 25°C , FIT=109/MTBF)		3 million		h
Weight		-	27.5	-	g
Dimensions (L × W ×H)			2.00 x 0.75 x 1.10		in
			50.80 x 19.05 x 27.94		mm

NOTE: All specifications are typical at 25 °C unless otherwise stated.

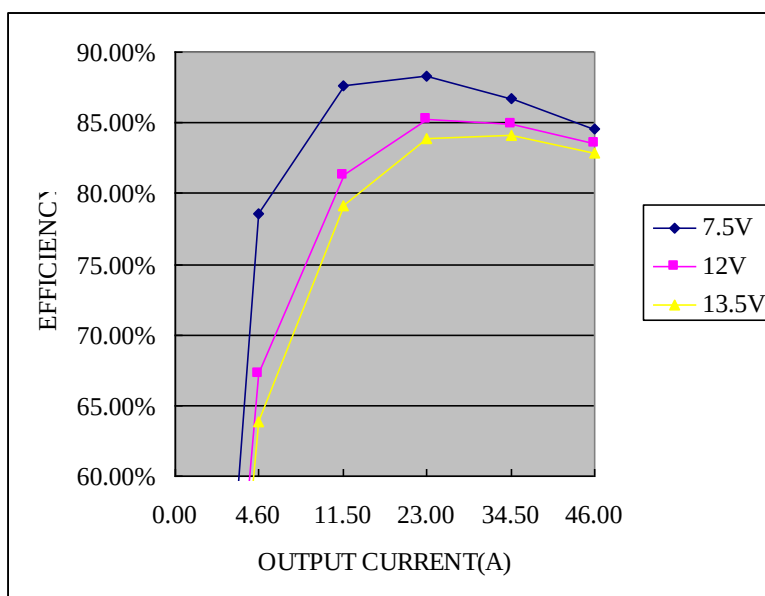
6. REMOTE ON/OFF

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Signal Low (Unit Off)	Active High Remote on/off pin is open, the module Unit off.	-0.3	-	0.65	V
Signal High (Unit On)		1.15	-	5	V
Current Sink		0	-	1	mA

7. Vc5

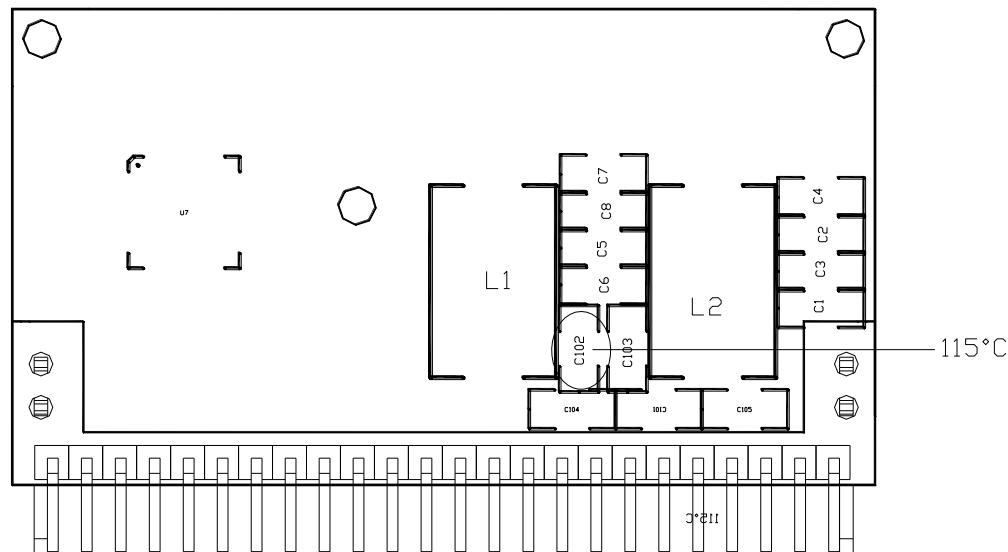
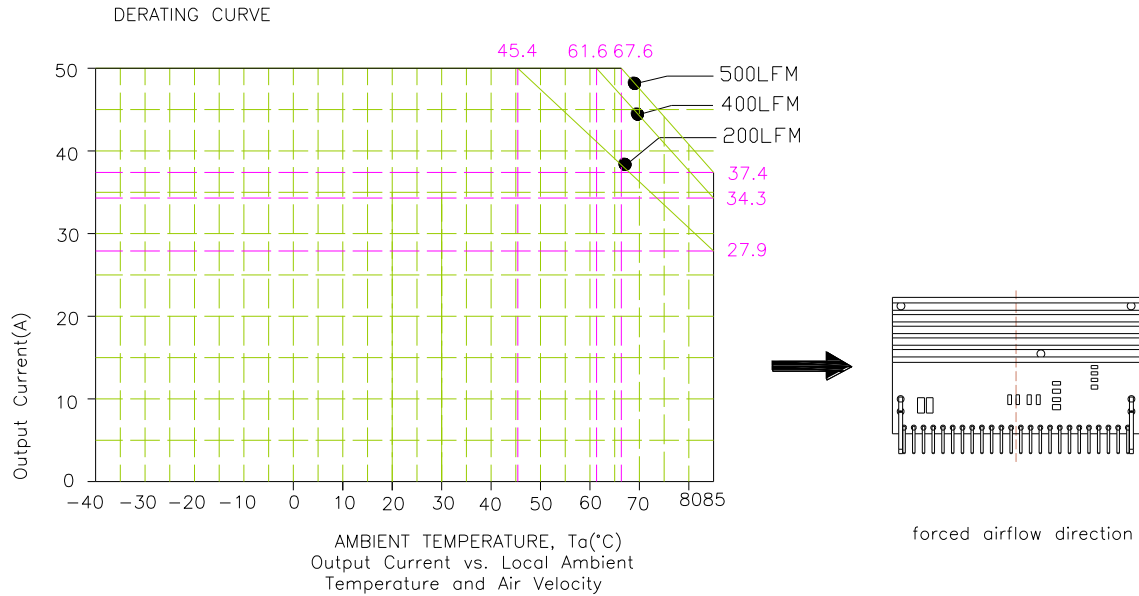
PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Output Voltage Setpoint		4.96	4.98	5	V
Output Current		-	-	5	mA
Output Voltage Regulation (Total Output Voltage Range)		4.78	-	5.13	V
Vout Temperature Coefficient		-	50	150	ppm/C
Line Regulation		-0.02	-	0.02	V
Load Regulation		-0.13	-	0.13	V
Output Noise	20 MHz bandwidth, pk-pk,	-	15	25	mV

8. EFFICIENCY DATA



9. THERMAL DERATING CURVE

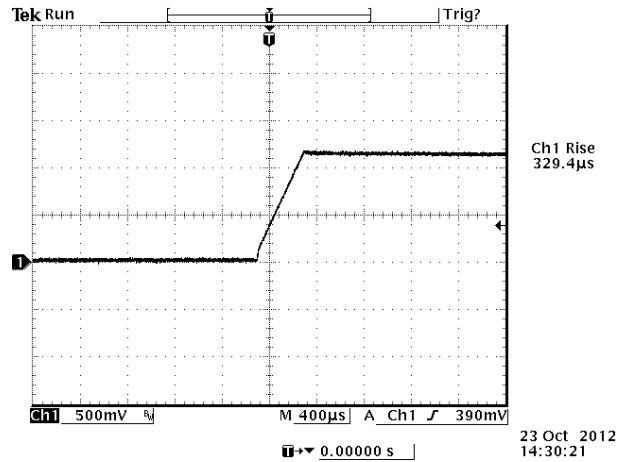
Maximum junction temperature of semiconductors derated to 120 °C



The over temperature warning is sensed by NTC and The VR_HOT# signal will be pulled down when the component C102 reaches its temperature to 115°C, Then VR_HOT# signal informs the system should reduce its power consumption. It will recover automatically when the temperature of C102 falls down to 105°C. The Warning point will be varied a little under different conditions (air flow, ambient temperature, input voltage, load and so on)

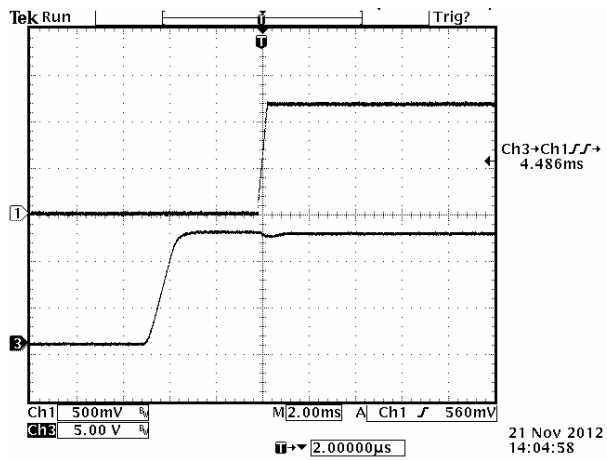
10. STARTUP

Rise Time

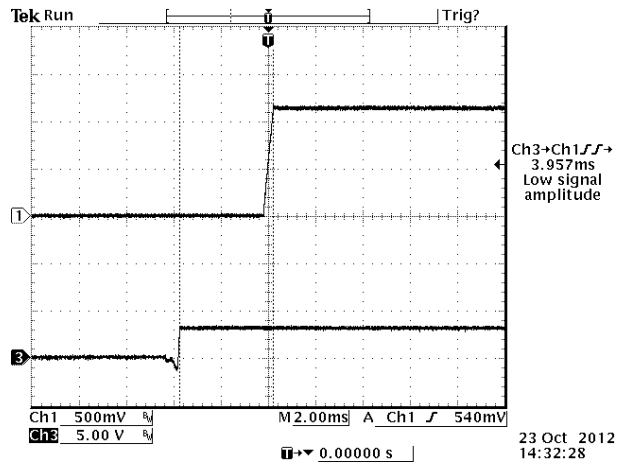


$V_{in}=12V$, $V_o=1.2V$, $I_o=40A$

Startup time



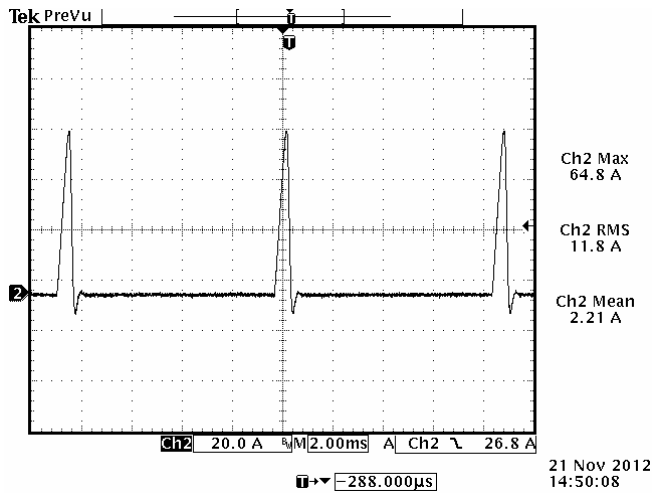
Startup from V_{in}
 Ch1: V_o
 Ch3: V_{in}
 $V_{in}=12V$, $V_o=1.2V$, $I_o=40A$



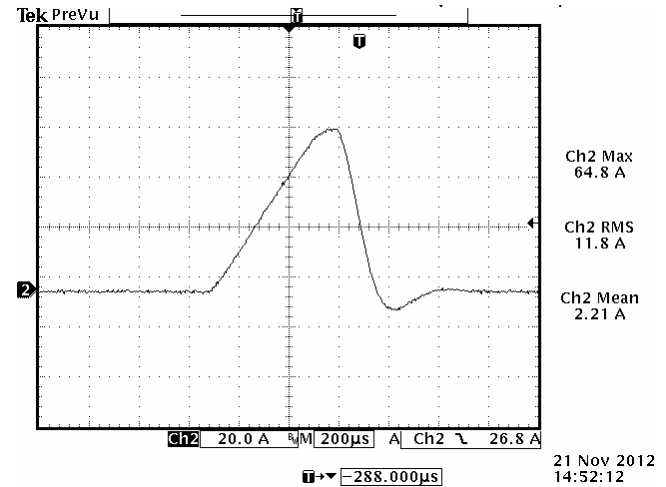
Startup from on/off
 Ch1: V_o
 Ch3: on/off
 $V_{in}=12V$, $V_o=1.2V$, $I_o=40A$

11. OVER CURRENT PROTECTION

To provide protection in a fault output overload condition, the module is equipped with internal current-limiting circuitry and can endure current limiting for a few milliseconds. If the overcurrent condition persists beyond a few milliseconds, the module will shut down into hiccup mode and restart once every 8Ms. The module operates normally when the output current goes into specified range. The typical average output current is 2.21A during hiccup.

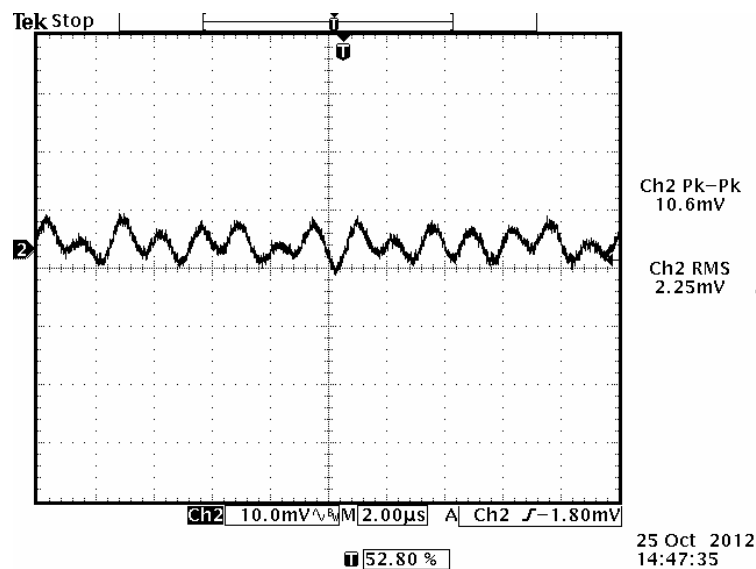


CH2: Output current waveform
Test condition: $V_{in}=12V$, $V_{out}=1.2V$, $T_a=25^{\circ}C$



CH2: Output current waveform
Expansion of on time portion of above figure

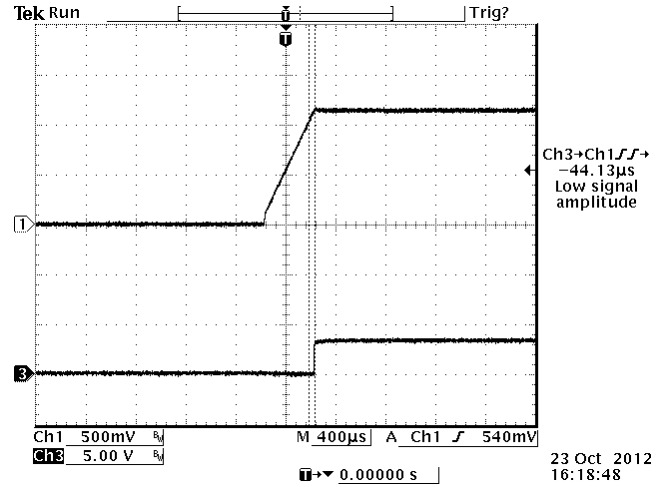
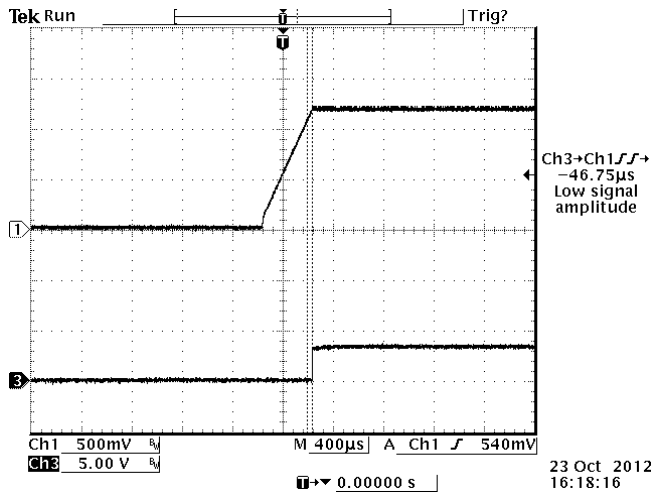
12. RIPPLE AND NOISE WAVEFORM



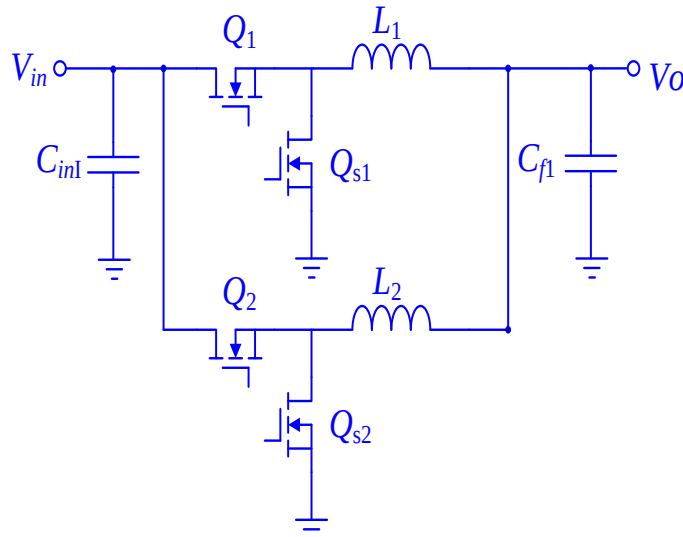
Ripple and noise at 12 VDC input, 1.2 VDC/40 A output and $T_a=25^{\circ}C$, and with $8 \times 22 \mu F/4V$ GRM21BC80G226M ceramic caps, $12 \times 10 \mu F/10V$ GRM188C81A106M, ceramic caps, $6 \times 560 \mu F/2.0V$ 4.5 mOhms EEFSX0D561E4 caps at output.

13. POWER GOOD

1. This module has one power good indicator output. Power good pin used positive logic and is open collector.
2. The maximum voltage pulled up externally on Power Good pin should not exceed 5 V.
3. When the output reaches 90% of the nominal set-point, the power good pin will be pulled high.

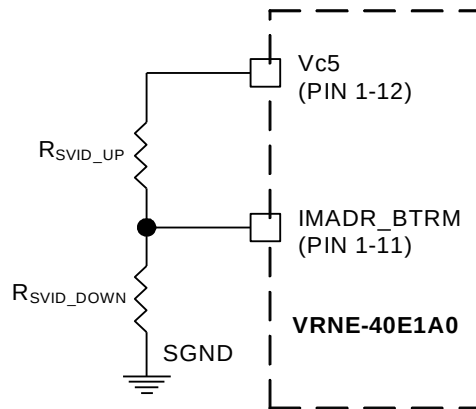


14. FUNDAMENTAL CIRCUIT DIAGRAM



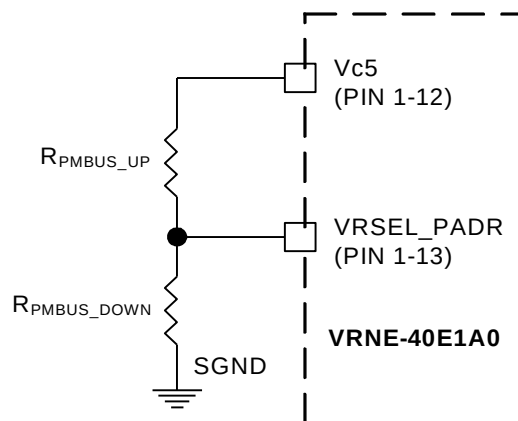
15. ADDRESS SELECTION

Two voltage dividers set the SVID and Power Management Bus addresses for this module. The resistors for these dividers are external to the module and need to be placed on the customer board. Below are the available addresses for the module and their associated resistor values, along with a diagram showing how the voltage dividers should be connected to the module. If Power Management Bus is not needed, then RPOWER MANAGEMENT BUS-UP can be left open and RPOWER MANAGEMENT BUS-DOWN set to 10kΩ (VRSEL_PADR should not be left unconnected).



Voltage divider on IMADR_BTRM pin to select SVID address

SVID Address (Hex)	R _{SVID-UP} (kΩ)	R _{SVID-DOWN} (kΩ)
02	82.5	28.7
04	52.3	37.4
06	37.4	49.9
08	29.4	78.7



Voltage divider on VRSEL_PADR pin to select Power Management Bus address

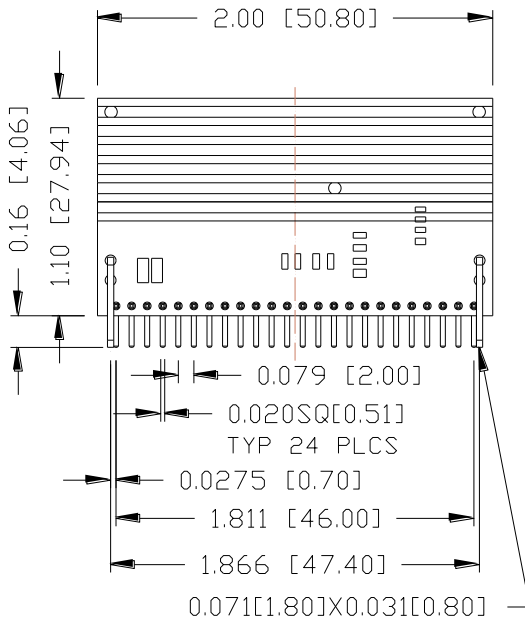
Power Management Bus Address (Hex)	R _{POWER MANAGEMENT BUS-UP} (kΩ)	R _{POWER MANAGEMENT BUS-DOWN} (kΩ)
88	19.6	20
8A	18.7	22.1
8C	16.9	23.7
8E	16.2	26.1
E0	OPEN	10
E2	44.2	13
E4	37.4	13.7
E6	33.2	14.3
E8	28.7	15
EA	26.1	16.2
EC	23.7	17.8
EE	21.5	18.7
C8	15	29.4
CA	14.3	33.2
CC	13.7	37.4

Note:

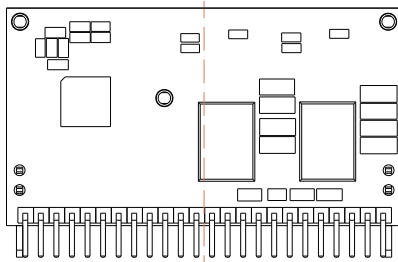
- For the external divider, it's recommended to use 1%, 100ppm/k or better resistors, and same type are preferred for all resistors. Do not use any RC decoupling network on the resistor divider.

2. The resistor value in above table is only for the specific boot voltage and output current which are presented in the output specification. If a different output voltage / current setting is used, please contact Bel Power Application Support for SVID / Power Management Bus address setting.

16. MECHANICAL OUTLINE

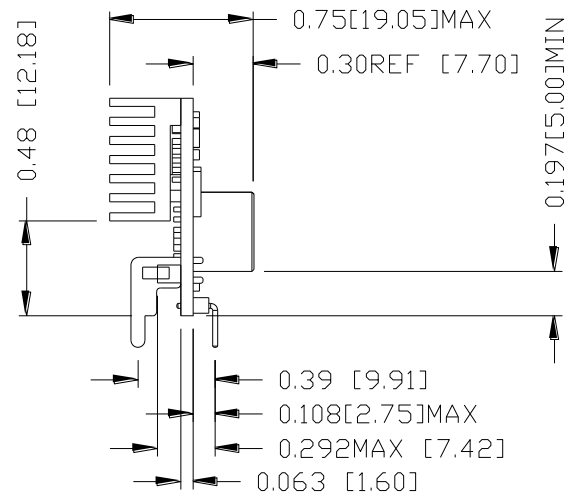


23 EQUAL SPACE @ $0.079(2.00) = 1.811(46.00)$
TOLERANCE NON-ACCUMULATING
TOP VIEW

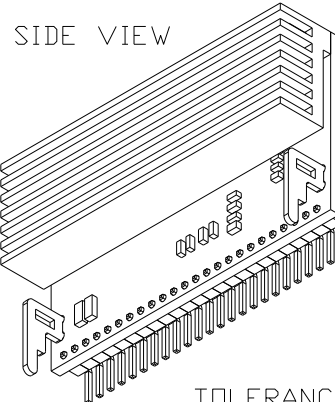


BOTTOM VIEW

UNIT: INCH [MM]



THE SEATING PLANE OF THE SUPPORT PIN IS CO-PLANAR WITH THE SEATING EDGE OF THE BOARD ± 0.010



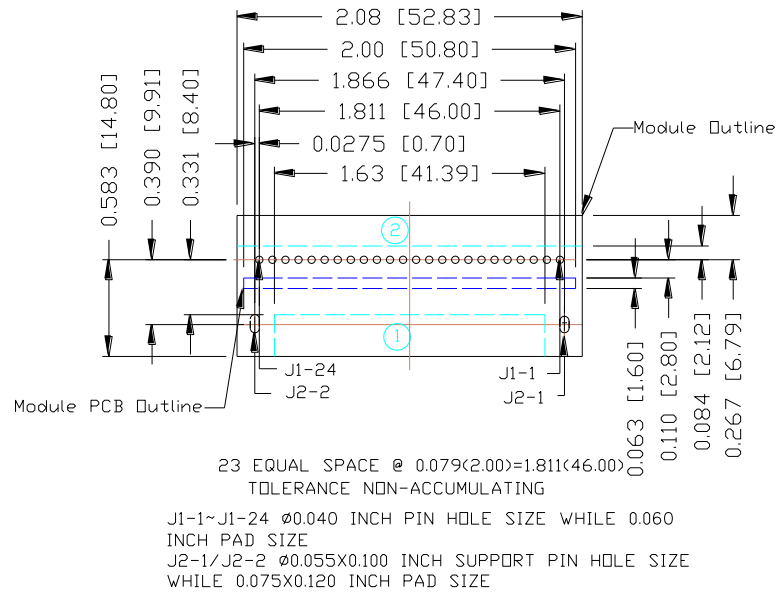
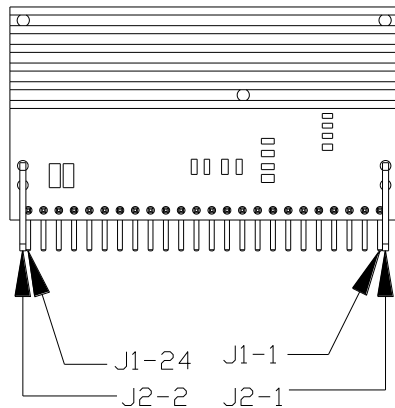
SIDE VIEW

TOLERANCE:

.XX: ± 0.020 [0.51]

.XXX: ± 0.010 [0.25]

.XXXX: ± 0.010 [0.25]



Pin	Function	Pin	Function
2-1	SGND	1-13	VRSEL_PADR
1-1	SVID_DATA	1-14	Vsense-
1-2	SVID_ALERT#	1-15	Vsense+
1-3	SVID_CLK	1-16	VOUT+
1-4	VR_HOT#	1-17	VOUT+
1-5	VR_FAULT#	1-18	GND
1-6	VR_READY	1-19	GND
1-7	ENABLE	1-20	VOUT+
1-8	Power Management Bus_DATA	1-21	VOUT+
1-9	Power Management Bus_ALERT#	1-22	GND
1-10	Power Management Bus_CLK	1-23	GND
1-11	IMADR_BTRM	1-24	Vin+
1-12	Vc5	2-2	Vin+

NOTES:

Components may be placed in the areas marked as ① and ②. Components in these areas may be shadowed by the module. The height of the components in area ① is limited to 0.452 [11.50] max. The height of the components in area ② is limited to 0.157 [4.00] max. The remaining keep out area should not contain any components.

NOTES:

- 1) All Pins: Material – Copper Alloy; Finish –3 micro inches Gold over 40 micro inches minimum Nickel plating.
- 2) Undimensioned components are shown for visual reference only.

17. REVISION HISTORY

DATE	REVISION	CHANGES DETAIL	APPROVAL
2012-8-30	PA	First release.	Jessica Yan
2012-11-22	PB	Update Cover, Input specs, Output specs, General, Efficiency data, NR, Startup & Shutdown, Remote on/off, OCP, PG and MD.	Jessica Yan
2013-04-15	PC	Update Output specs, TD, NR.	Jessica Yan
2013-04-24	PD	Update Output specs and MD.	Jessica Yan
2013-07-15	E	Update Abs Max# and TD	Jessica Yan
2014-3-25	F	Update All TBD, Remote on/off.	Jessica Yan
2014-7-29	G	Update TD	Jessica Yan
2015-3-27	H	Update description, MD, SVID/Power Management Bus address setting	Jessica Yan
2015-6-18	I	Add Vc5 specification	Jessica Yan
2019-01-11	J	Disclaimer added: Disclaimer: Power Management Bus is a registered trademark of SMIF, Inc.	Jessica Yan

For more information on these products consult: tech.support@psbel.com

NUCLEAR AND MEDICAL APPLICATIONS - Products are not designed or intended for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems.

TECHNICAL REVISIONS - The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.



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