Advance Data Sheet
November 17, 2011

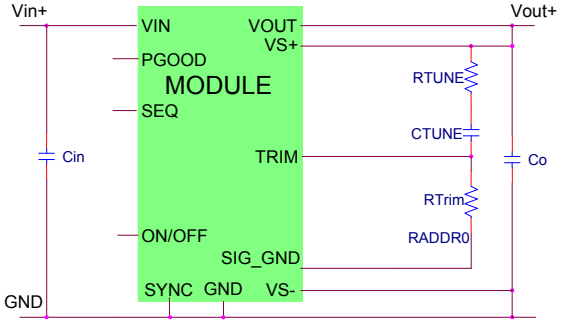
40A Analog Mega DLynx™: Non-Isolated DC-DC Power Modules
4.5Vdc –14.4Vdc input; 0.6Vdc to 2.0Vdc output; 40A Output Current

TUNABLE LOOP™
A LINEAGE POWER TRADEMARK

RoHS Compliant

Applications

- Distributed power architectures
- Intermediate bus voltage applications
- Telecommunications equipment
- Servers and storage applications
- Networking equipment
- Industrial equipment



Features

- Compliant to RoHS EU Directive 2002/95/EC (Z versions)
- Compatible in a Pb-free or SnPb reflow environment (Z versions)`+
- Wide Input voltage range (4.5Vdc-14.4Vdc)
- Output voltage programmable from 0.6Vdc to 2.0Vdc via external resistor
- Tunable Loop™ to optimize dynamic output voltage response
- Power Good signal
- Fixed switching frequency with capability of external synchronization
- Output overcurrent protection (non-latching)
- Overtemperature protection
- Remote On/Off
- Ability to sink and source current
- Cost efficient open frame design
- Small size: 33.02 mm x 13.46 mm x 10.9 mm (1.3 in x 0.53 in x 0.429 in)
- Wide operating temperature range [-40°C to 105°C]
- Ruggedized (-D) version able to withstand high levels of shock and vibration
- *UL** 60950-1 2nd Ed. Recognized, *CSA*† C22.2 No. 60950-1-07 Certified, and *VDE*‡ (EN60950-1 2nd Ed.) Licensed
- ISO** 9001 and ISO 14001 certified manufacturing facilities

Description

The 40A Analog Mega DLynx™ power modules are non-isolated dc-dc converters that can deliver up to 40A of output current. These modules operate over a wide range of input voltage (V_{IN} = 4.5Vdc-14.4Vdc) and provide a precisely regulated output voltage from 0.6Vdc to 2.0Vdc, programmable via an external resistor. Features include remote On/Off, adjustable output voltage, over current and overtemperature protection. The module also includes the Tunable Loop™ feature that allows the user to optimize the dynamic response of the converter to match the load with reduced amount of output capacitance leading to savings on cost and PWB area.

*UL is a registered trademark of Underwriters Laboratories, Inc.
†CSA is a registered trademark of Canadian Standards Association.
‡ VDE is a trademark of Verband Deutscher Elektrotechniker e.V.
** ISO is a registered trademark of the International Organization of Standards

Document No: DS11-016 ver. 0.2
PDF name: MVT040A0X.pdf

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only, functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect the device reliability.

Parameter	Device	Symbol	Min	Max	Unit
Input Voltage Continuous	All	V_{IN}	-0.3	15	Vdc
Operating Ambient Temperature (see Thermal Considerations section)	All	T_A	-40	105	°C
Storage Temperature	All	T_{stg}	-55	125	°C

Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions.

Parameter	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	All	V_{IN}	4.5	—	14.4	Vdc
Maximum Input Current (V_{IN}=4.5V to 14V, I_O=$I_{O,max}$)	All	$I_{IN,max}$			TBD	Adc
Input No Load Current (V_{IN} = 12.0Vdc, I_O = 0, module enabled)	$V_{O,set}$ = 0.6 Vdc	$I_{IN,No\ load}$		TBD		mA
	$V_{O,set}$ = 2Vdc	$I_{IN,No\ load}$		TBD		mA
Input Stand-by Current (V_{IN} = 12.0Vdc, module disabled)	All	$I_{IN,stand-by}$		TBD		mA
Inrush Transient	All	I^2t			1	A^2s
Input Reflected Ripple Current, peak-to-peak (5Hz to 20MHz, 1µH source impedance; V_{IN} =0 to 14V, I_O= I_{Omax} ; See Test Configurations)	All			TBD		mAp-p
Input Ripple Rejection (120Hz)	All			TBD		dB

Electrical Specifications (continued)

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Voltage Set-point (with 0.1% tolerance for external resistor used to set output voltage)	All	$V_{O, set}$	-1.0		+1.0	% $V_{O, set}$
Output Voltage (Over all operating input voltage, resistive load, and temperature conditions until end of life)	All	$V_{O, set}$	-3.0	—	+3.0	% $V_{O, set}$
Adjustment Range (selected by an external resistor) (Some output voltages may not be possible depending on the input voltage – see Feature Descriptions Section)	All	V_O	0.6		2.0	Vdc
Remote Sense Range	All				0.5	Vdc
Output Regulation						
Line (V_{IN}=$V_{IN, min}$ to $V_{IN, max}$)	All			—	5	mV
Load (I_O=$I_{O, min}$ to $I_{O, max}$)	All			—	10	mV
Temperature (T_{ref}=$T_{A, min}$ to $T_{A, max}$)	All			—	0.4	% $V_{O, set}$
Output Ripple and Noise on nominal output (V_{IN}=$V_{IN, nom}$ and I_O=$I_{O, min}$ to $I_{O, max}$ Co = 0.1µF // 22 µF ceramic capacitors)						
Peak-to-Peak (5Hz to 20MHz bandwidth)	All			—	50	100	mV_{pk-pk}
RMS (5Hz to 20MHz bandwidth)	All				20	38	mV_{rms}
External Capacitance[1]						
Without the Tunable Loop™						
ESR ≥ 1 mΩ	All	$C_{O, max}$	0	—	TBD	µF
With the Tunable Loop™						
ESR ≥0.15 mΩ	All	$C_{O, max}$	0	—	TBD	µF
ESR ≥ 10 mΩ	All	$C_{O, max}$	0	—	TBD	µF
Output Current (in either sink or source mode)	All	I_o	0		40	Adc
Output Current Limit Inception (Hiccup Mode) (current limit does not operate in sink mode)	All	$I_{O, lim}$		TBD		% $I_{o,max}$
Output Short-Circuit Current (V_O≤250mV) (Hiccup Mode)	All	$I_{O, s/c}$		TBD		mA
Efficiency	$V_{O,set}$ = 0.6Vdc	η		TBD		%
V_{IN}= 12Vdc, T_A=25°C	$V_{O,set}$ = 1.2Vdc	η		TBD		%
I_O=$I_{O, max}$, V_O= $V_{O,set}$	$V_{O,set}$ = 1.8Vdc	η		TBD		%
Switching Frequency	All	f_{sw}	—	TBD	—	kHz
Frequency Synchronization	All					
Synchronization Frequency Range	All		510		720	kHz
High-Level Input Voltage	All	V_{IH}	2.0			V
Low-Level Input Voltage	All	V_{IL}			0.4	V
Input Current, SYNC	All	I_{SYNC}			100	nA
Minimum Pulse Width, SYNC	All	t_{SYNC}	100			ns
Maximum SYNC rise time	All	t_{SYNC_SH}	100			ns

External capacitors may require using the new Tunable Loop™ feature to ensure that the module is stable as well as getting the best transient response. See the Tunable Loop™ section for details.

General Specifications

Parameter	Device	Min	Typ	Max	Unit
Calculated MTBF (I_O=0.8$I_{O, max}$, T_A=40°C) Telecordia Issue 2 Method 1 Case 3	All		TBD		Hours
Weight		—	TBD	—	g (oz.)

Feature Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions. See Feature Descriptions for additional information.

Parameter	Device	Symbol	Min	Typ	Max	Unit
On/Off Signal Interface						
(V_{IN}=$V_{IN, min}$ to $V_{IN, max}$; open collector or equivalent,						
Signal referenced to GND)						
Device is with suffix "4" – Positive Logic (See Ordering Information)						
Logic High (Module ON)						
Input High Current	All	I_{IH}		—	TBD	µA
Input High Voltage	All	V_{IH}	TBD	—	$V_{IN,max}$	V
Logic Low (Module OFF)						
Input Low Current	All	I_{IL}	—	—	TBD	mA
Input Low Voltage	All	V_{IL}	-0.3	—	TBD	V
Device Code with no suffix – Negative Logic (See Ordering Information)						
(On/OFF pin is open collector/drain logic input with						
external pull-up resistor; signal referenced to GND)						
Logic High (Module OFF)						
Input High Current	All	I_{IH}	—	—	TBD	mA
Input High Voltage	All	V_{IH}	TBD	—	$V_{IN, max}$	Vdc
Logic Low (Module ON)						
Input low Current	All	I_{IL}	—	—	TBD	µA
Input Low Voltage	All	V_{IL}	-0.2	—	TBD	Vdc
Turn-On Delay and Rise Times						
(V_{IN}=$V_{IN, nom}$, I_O=$I_{O, max}$, V_O to within ±1% of steady state)						
Case 1: On/Off input is enabled and then input power is applied (delay from instant at which V_{IN} = $V_{IN, min}$ until V_o = 10% of $V_{o, set}$)	All	Tdelay	—	1.1	—	msec
Case 2: Input power is applied for at least one second and then the On/Off input is enabled (delay from instant at which Von/Off is enabled until V_o = 10% of $V_{o, set}$)	All	Tdelay	—	700	—	µsec
Output voltage Rise time (time for V_o to rise from 10% of Vo, set to 90% of Vo, set)	All	Trise	—	3.1	—	msec
Output voltage overshoot (T_A = 25°C V_{IN}= $V_{IN, min}$ to $V_{IN, max}$, I_O = $I_{O, min}$ to $I_{O, max}$) With or without maximum external capacitance					3.0	% $V_{O, set}$
Output voltage overshoot (T_A = 25°C V_{IN}= $V_{IN, min}$ to $V_{IN, max}$, I_O = $I_{O, min}$ to $I_{O, max}$) With or without maximum external capacitance					3.0	% $V_{O, set}$
Over Temperature Protection (See Thermal Considerations section)	All	T_{ref}		145		°C

Feature Specifications (cont.)

Parameter	Device	Symbol	Min	Typ	Max	Units
Tracking Accuracy (Power-Up: 2V/ms)	All	$V_{SEQ} - V_o$			100	mV
(Power-Down: 2V/ms)	All	$V_{SEQ} - V_o$			100	mV
($V_{IN, min}$ to $V_{IN, max}$; $I_{O, min}$ to $I_{O, max}$ $V_{SEQ} < V_o$)						
Input Undervoltage Lockout						
Turn-on Threshold	All		2.475		3.025	Vdc
Turn-off Threshold	All		2.25		2.75	Vdc
Hysteresis	All		0.25			Vdc
PGOOD (Power Good)						
Signal Interface Open Drain, $V_{supply} \leq$ 5VDC						
Overvoltage threshold for PGOOD ON				108		$\%V_{O, set}$
Overvoltage threshold for PGOOD OFF				105		$\%V_{O, set}$
Undervoltage threshold for PGOOD ON				110		$\%V_{O, set}$
Undervoltage threshold for PGOOD OFF				90		$\%V_{O, set}$
Pulldown resistance of PGOOD pin	All				50	Ω

Design Considerations

Input Filtering

The 40A Analog Mega DLynx™ module should be connected to a low ac-impedance source. A highly inductive source can affect the stability of the module. An input capacitance must be placed directly adjacent to the input pin of the module, to minimize input ripple voltage and ensure module stability.

To minimize input voltage ripple, ceramic capacitors are recommended at the input of the module. Figure 1 shows the input ripple voltage for various output voltages at 40A of load current with TBD µF or TBD µF ceramic capacitors and an input of 12V.

TBD

Figure 1. Input ripple voltage for various output voltages with TBD µF or TBD µF ceramic capacitors at the input (40A load). Input voltage is 12V.

Output Filtering

These modules are designed for low output ripple voltage and will meet the maximum output ripple specification with 0.1 µF ceramic and TBD µF ceramic capacitors at the output of the module. However, additional output filtering may be required by the system designer for a number of reasons. First, there may be a need to further reduce the output ripple and noise of the module. Second, the dynamic response characteristics may need to be customized to a particular load step change.

To reduce the output ripple and improve the dynamic response to a step load change, additional capacitance at the output can be used. Low ESR polymer and ceramic capacitors are recommended to improve the dynamic response of the module. Figure 2 provides output ripple information for different external capacitance values at various Vo and a full load current of 40A. For stable operation of the module, limit the capacitance to less than the maximum output capacitance as specified in the electrical specification table. Optimal performance of the module can be achieved by using the Tunable Loop™ feature described later in this data sheet.

TBD

Figure 2. Output ripple voltage for various output voltages with external TBD ceramic capacitors at the output (40A load). Input voltage is 12V.

Safety Considerations

For safety agency approval the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standards, i.e., UL 60950-1 2nd, CSA C22.2 No. 60950-1-07, DIN EN 60950-1:2006 + A11 (VDE0805 Teil 1 + A11):2009-11; EN 60950-1:2006 + A11:2009-03.

For the converter output to be considered meeting the requirements of safety extra-low voltage (SELV), the input must meet SELV requirements. The power module has extra-low voltage (ELV) outputs when all inputs are ELV.

The input to these units is to be provided with a fast-acting fuse with a maximum rating of TBD A in the positive input lead.

Feature Descriptions

Remote On/Off

The 40A Analog Mega DLynx™ power modules feature an On/Off pin for remote On/Off operation. Two On/Off logic options are available. In the Positive Logic On/Off option, (device code suffix "4" – see Ordering Information), the module turns ON during a logic High on the On/Off pin and turns OFF during a logic Low. With the Negative Logic On/Off option, (no device code suffix, see Ordering Information), the module turns OFF during logic High and ON during logic Low. The On/Off signal should be always referenced to ground. For either On/Off logic option, leaving the On/Off pin disconnected will turn the module ON when input voltage is present.

Monotonic Start-up and Shutdown

The module has monotonic start-up and shutdown behavior for any combination of rated input voltage, output current and operating temperature range.

Startup into Pre-biased Output

The module can start into a prebiased output as long as the prebias voltage is 0.5V less than the set output voltage.

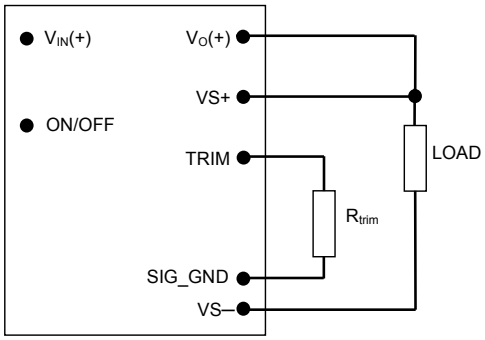
Output Voltage Programming

The output voltage of the module is programmable to any voltage from 0.6dc to 2Vdc by connecting a resistor between the Trim and SIG_GND pins of the module. Without an external resistor between Trim and SIG_GND pins, the output of the module will be 0.6Vdc. To calculate the value of the trim resistor, *Rtrim* for a desired output voltage, should be as per the following equation:

$$Rtrim = \left[\frac{12}{(Vo - 0.6)}\right] k\Omega$$

Rtrim is the external resistor in kΩ

Vo is the desired output voltage. Table 1 provides Rtrim values required for some common output voltages.



Caution *– Do not connect SIG_GND to GND elsewhere in the layout*

Figure 3. Circuit configuration for programming output voltage using an external resistor.

Table 1

$V_{O, set}$ (V)	*Rtrim* (KΩ)
0.6	Open
0.9	40
1.0	30
1.2	20
1.5	13.33
1.8	10

Remote Sense

The power module has a Remote Sense feature to minimize the effects of distribution losses by regulating the voltage at the SENSE pin. The voltage between the SENSE pin and VOUT pin should not exceed 0.5V.

Voltage Margining

Output voltage margining can be implemented in the module by connecting a resistor, $R_{margin\text{-}up}$, from the Trim pin to the ground pin for margining-up the output voltage and by connecting a resistor, $R_{margin\text{-}down}$, from the Trim pin to output pin for margining-down. Figure 4 shows the circuit configuration for output voltage margining

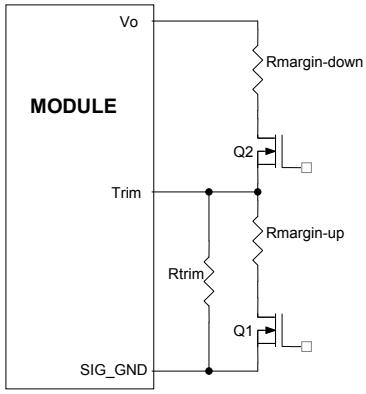


Figure 4. Circuit Configuration for margining Output voltage.

Output Voltage Sequencing

The power module includes a sequencing feature, EZ-SEQUENCE that enables users to implement various types of output voltage sequencing in their applications. This is accomplished via an additional sequencing pin. When not using the sequencing feature, leave it unconnected.

The voltage applied to the SEQ pin should be scaled down by the same ratio as used to scale the output voltage down to the reference voltage of the module. This is accomplished by an external resistive divider

connected across the sequencing voltage before it is fed to the SEQ pin as shown in Fig. 5.

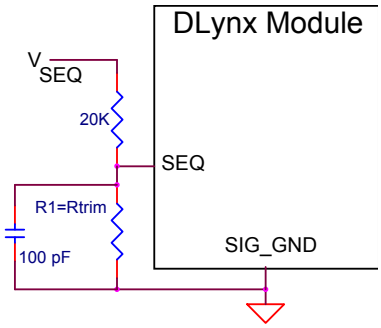


Figure 5. Circuit showing connection of the sequencing signal to the SEQ pin.

When the scaled down sequencing voltage is applied to the SEQ pin, the output voltage tracks this voltage until the output reaches the set-point voltage. The final value of the sequencing voltage must be set higher than the set-point voltage of the module. The output voltage follows the sequencing voltage on a one-to-one basis. By connecting multiple modules together, multiple modules can track their output voltages to the voltage applied on the SEQ pin.

To initiate simultaneous shutdown of the modules, the SEQ pin voltage is lowered in a controlled manner. The output voltage of the modules tracks the voltages below their set-point voltages on a one-to-one basis. A valid input voltage must be maintained until the tracking and output voltages reach ground potential.

Overcurrent Protection

To provide protection in a fault (output overload) condition, the unit is equipped with internal current-limiting circuitry and can endure current limiting continuously. At the point of current-limit inception, the unit enters hiccup mode. The unit operates normally once the output current is brought back into its specified range.

Overtemperature Protection

To provide protection in a fault condition, the unit is equipped with a thermal shutdown circuit. The unit will shut down if the overtemperature threshold of TBD°C(typ) is exceeded at the thermal reference point T_{ref} .Once the unit goes into thermal shutdown it will then wait to cool before attempting to restart.

Input Undervoltage Lockout

At input voltages below the input undervoltage lockout limit, the module operation is disabled. The module will begin to operate at an input voltage above the undervoltage lockout turn-on threshold.

Synchronization

The module switching frequency can be synchronized to a signal with an external frequency within a specified range. Synchronization can be done by using the external signal applied to the SYNC pin of the module as shown in Fig. 6, with the converter being synchronized by the rising edge of the external signal. The Electrical Specifications table specifies the requirements of the external SYNC signal. If the SYNC pin is not used, the module should free run at the default switching frequency. If synchronization is not being used, connect the SYNC pin to GND.

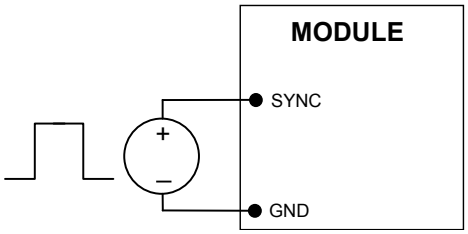


Figure 6. External source connections to synchronize switching frequency of the module.

Dual Layout

Identical dimensions and pin layout of Analog and Digital Mega DLynx modules permit migration from one to the other without needing to change the layout. In both cases the trim resistor is connected between trim and signal ground.

Power Good

The module provides a Power Good (PGOOD) signal that is implemented with an open-drain output to indicate that the output voltage is within the regulation limits of the power module. The PGOOD signal will be de-asserted to a low state if any condition such as overtemperature, overcurrent or loss of regulation occurs that would result in the output voltage going ±10% outside the setpoint value. The PGOOD terminal can be connected through a pullup resistor (suggested value 100KΩ) to a source of 5VDC or lower.

Tunable Loop™

The module has a feature that optimizes transient response of the module called Tunable Loop™.

External capacitors are usually added to the output of the module for two reasons: to reduce output ripple and noise and to reduce output voltage deviations from the steady-state value in the presence of dynamic load current changes. Adding external capacitance however affects the voltage control loop of the module, typically causing the loop to slow down with sluggish response. Larger values of external capacitance could also cause the module to become unstable.

The Tunable Loop™ allows the user to externally adjust the voltage control loop to match the filter network connected to the output of the module. The Tunable Loop™ is implemented by connecting a series R-C between the VS+ and TRIM pins of the module, as shown in Fig. 7. This R-C allows the user to

externally adjust the voltage loop feedback compensation of the module.

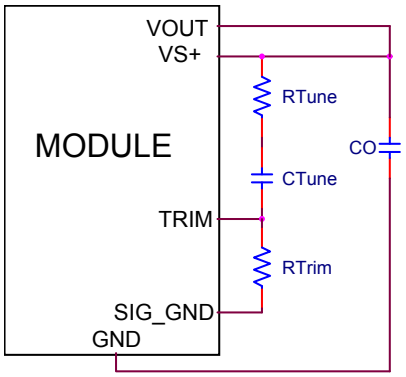


Figure. 7. Circuit diagram showing connection of R_{TUME} and C_{TUNE} to tune the control loop of the module.

Table 2. General recommended values of of R_{TUNE} and C_{TUNE} for Vin=12V and various external ceramic capacitor combinations.

TBD

Table 3. Recommended values of R_{TUNE} and C_{TUNE} to obtain transient deviation of 2% of Vout for a 20A step load with Vin=12V.

TBD

Thermal Considerations

Power modules operate in a variety of thermal environments; however, sufficient cooling should always be provided to help ensure reliable operation.

Considerations include ambient temperature, airflow, module power dissipation, and the need for increased reliability. A reduction in the operating temperature of the module will result in an increase in reliability. The thermal data presented here is based on physical measurements taken in a wind tunnel. The test set-up is shown in Figure 8. The preferred airflow direction for the module is in Figure 9.

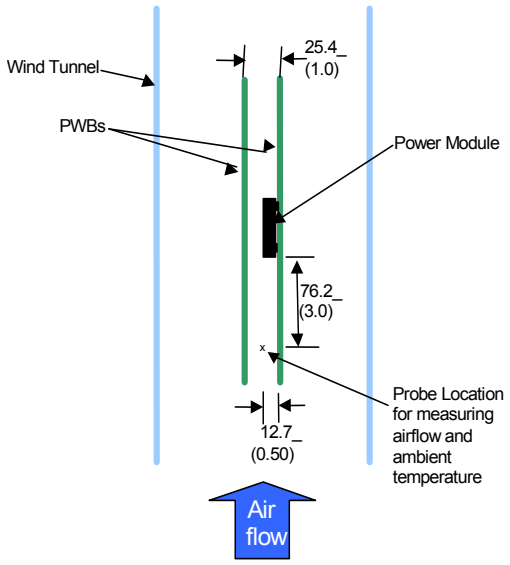


Figure 8. Thermal Test Setup.

The thermal reference points, T_{ref} used in the specifications are also shown in Figure 9. For reliable operation the temperatures at these points should not exceed 120°C. The output power of the module should not exceed the rated power of the module (Vo,set x Io,max).

Please refer to the Application Note "Thermal Characterization Process For Open-Frame Board-Mounted Power Modules" for a detailed discussion of thermal aspects including maximum device temperatures.

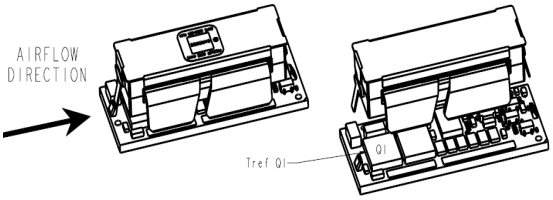
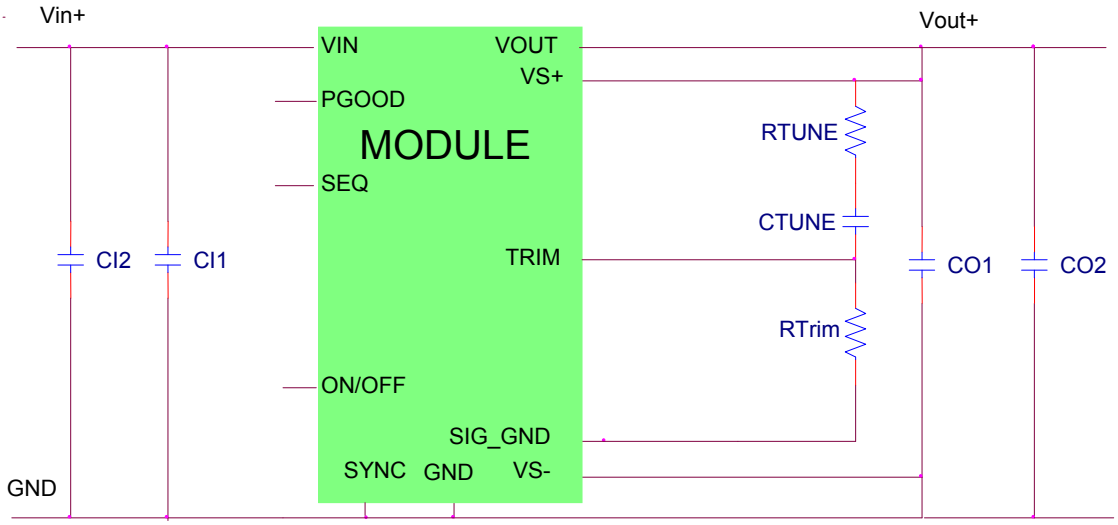


Figure 9. Preferred airflow direction and location of hot-spot of the module (Tref).

Example Application Circuit

Requirements:

Vin:	**12V**
Vout:	**1.8V**
Iout:	**30A max., worst case load transient is from 20A to 30A**
ΔVout:	**1.5% of Vout (27mV) for worst case load transient**
Vin, ripple	**1.5% of Vin (180mV, p-p)**



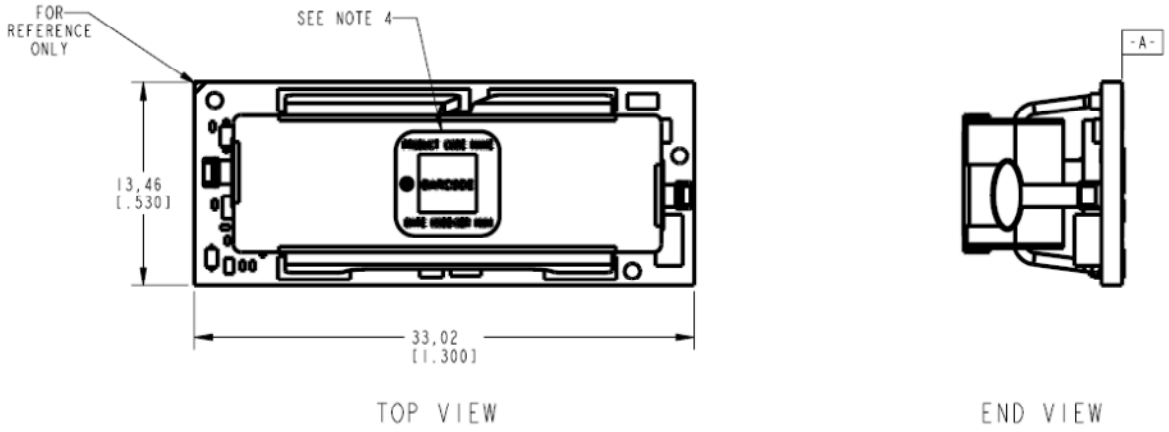
CI1	TBD
CI2	TBD
CO1	TBD
CO2	TBD
CTune	TBD
RTune	TBD
RTrim	10kΩ SMT resistor (can be 1206, 0805 or 0603 size, recommended tolerance of 0.1%)

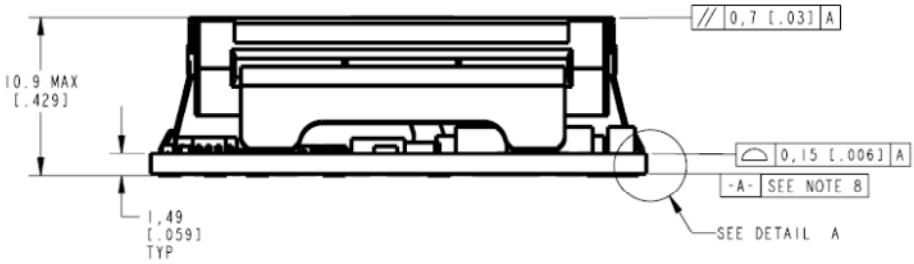
Mechanical Outline

Dimensions are in millimeters and (inches).

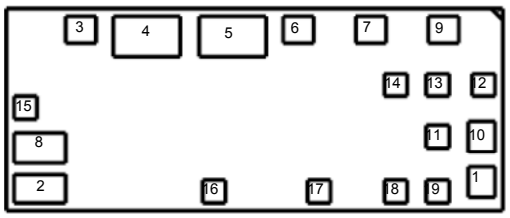
Tolerances: x.x mm ± 0.5 mm (x.xx in. ± 0.02 in.) [unless otherwise indicated]

x.xx mm ± 0.25 mm (x.xxx in ± 0.010 in.)



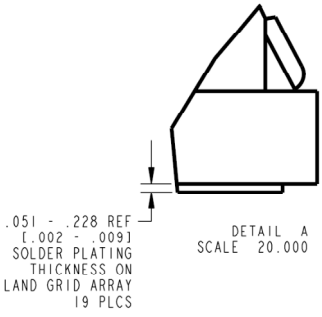


SIDE VIEW



BOTTOM VIEW

PIN	FUNCTION	PIN	FUNCTION
1	ON/OFF	11	SIG_GND
2	VIN	12	VS-
3	SEQ	13	NC
4	GND	14	NC
5	VOUT	15	SYNC
6	TRIM	16	PG
7	VS+	17	NC
8	GND	18	NC
9	SHARE	19	NC
10	GND		

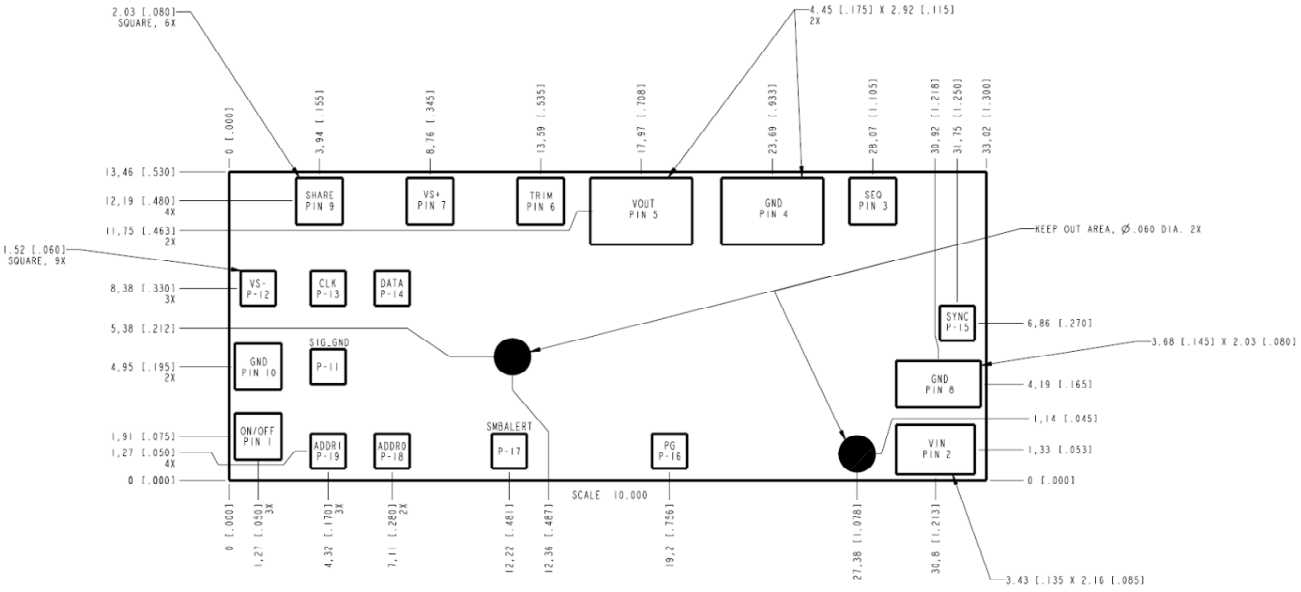


Recommended Pad Layout

Dimensions are in millimeters and (inches).

Tolerances: x.x mm ± 0.5 mm (x.xx in. ± 0.02 in.) [unless otherwise indicated]

x.xx mm ± 0.25 mm (x.xxx in ± 0.010 in.)



NC

PIN	FUNCTION	PIN	FUNCTION
1	ON/OFF	11	SIG_GND
2	VIN	12	VS-
3	SEQ	13	NC
4	GND	14	NC
5	VOUT	15	SYNC
6	TRIM	16	PG
7	VS+	17	NC
8	GND	18	NC
9	SHARE	19	NC
10	GND		

Ordering Information

Please contact your Lineage Power Sales Representative for pricing, availability and optional features.

Table 6. Device Codes

Device Code	Input Voltage Range	Output Voltage	Output Current	On/Off Logic	Sequencing	Comcodes
MVT040A0X3-SRPHZ	4.5 – 14.4Vdc	0.6 – 2.0Vdc	40A	Negative	Yes	CC109159785
MVT040A0X43 -SRPHZ	4.5 – 14.4Vdc	0.6 – 2.0Vdc	40A	Positive	Yes	CC109159793

-Z refers to RoHS compliant parts

Table 7. Device Codes

Package Identifier	Family	Input voltage range	Output current	Output voltage	On/Off logic	Options			ROHS Compliance
M	V	T	040A0	X	4	-SR	-P	-H	Z
P=Pico U=Micro M=Mega G=Giga	D=DIynx Digital V=DLynx Analog.	T=with EZ_Sequence X=without sequencing	40A	X = programmable output	4 = positive No entry = negative	S = Surface Mount R = Tape & Reel	Paralleling	2 Extra Ground Pins	Z = ROHS6

LINEAGE POWER®

World Wide Headquarters
Lineage Power Corporation
601 Shiloh Road, Plano, TX 75074, USA
+1-888-LINEAGE(546-3243)
(Outside U.S.A.: **+1-972-244-WATT(9288)**)
www.lineagepower.com
e-mail: techsupport1@lineagepower.com

Asia-Pacific Headquarters
Tel: +86.021.54279977*808

Europe, Middle-East and Africa Headquarters
Tel: +49.89.878067-280

India Headquarters
Tel: +91.80.28411633