NON-ISOLATED REGULATED DC-DC Converter Modules

14 Vdc to 60 Vdc Input
From 50 Watts to 500 Watts

FEATURES

- Small Size 2.4" x 2.3" x 0.5"
- Constant Frequency
- Efficiency Up to 96.5%
- Non-isolated
- Remote On/Off (Input Enable)
- Remote Sense
- Output Voltage Adjustment from 60% to 110%
- Load Sharing
- DC Fail Output
- Over-Temp Shutdown (with Auto-Recovery)
- User Selectable Fold-Back or Straight-Line Current Limit
- User Selectable Current Limit Set Point
- Over-Voltage Protection
- Over-Current Protection
- 100°C Base-Plate Operation
- Low Output Noise

APPLICATIONS

- Distributed power architecture
- Telecommunications
- Applications requiring high power in compact space.
- Automotive / Truck
- Personal computers and peripherals
- Industrial control systems
- Battery operated systems

OPTIONS

- Special Output Voltages Available

* *UL* is a registered trademark of the Underwriters Laboratories, Inc.
CSA is a registered trademark of the Canadian Standards Association.
This product is intended for integration into end-use equipment. All the required procedures for CE marking of end-use equipment should be followed. (The CE mark is placed on selected products.)

DESCRIPTION

Core Technology's family of Positive Synchronous Buck Regulator (SBR) Power Modules are DC-DC converters that can operate over an input voltage range of 14 Vdc to 60 Vdc. SBR converters are non-isolated and are particularly known for high efficiency. These power modules provide excellent line and load regulation and are available in a wide range of output voltages. In addition, several user selectable current limit features along with many common features have been designed into this converter to provide the user with maximum flexibility. If isolation is required, the SBR Modules may be combined with Core Technology's CT4XXXE series modules which provide nominal 30 Vdc and nominal 60 Vdc out. The CT4XXXE series modules allow isolation from a PFC output or off-line applications. The SBR converters accept the isolated output from the CT4XXXE series and provide accurate, efficient output power. The SBR Power Modules have a maximum output power rating of up to 500 Watts at 100 °C base-plate temperature with a 2.3" x 2.4" x 0.5" form factor. These modules are best used in applications requiring maximum performance in a small form factor.

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ELECTRICAL SPECIFICATIONS - Output

Parameter	Symbol	Units	CP2BXXCX	CP2CXXCX	CP2DXXCX	CP2FXXCX	CP2GXXCX	CP2HXXCX	CP2JXXCX
Nominal Output Voltage	Vo	Volts	2.5	3.3	5.0	12	15	24	28
Typical Efficiency *1	ηeff	Volts	76	78	85	93	94	95	96
Max Ripple & Noise	Vpp	mV	50	50	50	120	150	200	200
Reflected Ripple Current *1	I_{RR}	ma	200	250	250	300	300	300	300
Output Voltage Accuracy	-	%	≤ 1%						
Voltage Adjustment Range	-	%	60% to 110% of nominal						
Maximum Line Regulation *3	-	%	≤0.1%						
Maximum Load Regulation *2	-	%	≤0.5%						
Current Limit Set Point	-	%	50% to 100% of max output current						
Current Limit Type	-	-	Straight line or foldback						
Over Current Protection	-	%	105% - 125% of output current set point						
Over Voltage Protection	-	%	118% - 125% of nominal output voltage (manual reset)						
Over temperature Shutdown	-	%	105% of Maximum Base-plate temperature (auto-recovering)						
Over temp S-down Hysteresis	-	%	10°C -20°C						

ELECTRICAL SPECIFICATIONS - Input

Parameter	Symbol	Units	CP2BXXCX	CP2CXXCX	CP2DXXCX	CP2FXXCX	CP2GXXCX	CP2HXXCX	CP2JXXCX
Input Voltage Range	Vi	Volts	14-60	14-60	14-60	14-60	17-60	26-60	30-60
Input & Output to Chassis	Vdc	Volts	500	500	500	500	500	500	500
Remote 0n/Off (Enable)	-	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes
120 Hz Ripple Rejection	R_{REJ}	DB	40	40	40	40	40	40	40

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Units	CP2BXXCX	CP2CXXCX	CP2DXXCX	CP2FXXCX	CP2GXXCX	CP2HXXCX	CP2JXXCX
Maximum Output Power	Po	Watts	100	100	150	350	350	500	500
Maximum Output Current	Io	Amps	40	40	40	30	23.35	21	18
Minimum Input Volts	Vi	Volts	14	14	14	14	17	28	30
Maximum Input Volts	Vi	Volts	64						
Input To Output Isolation	-	-	None						
Base Plate Temperature	Tcs	Celsius	-30°C to 100°C						
Storage Temperature	Tst	Celsius	-40°C to 110°C						
Vcc Out Max Current	Is	ma	50						

ENVIRONMENTAL SPECIFICATIONS

Parameter	Symbol	Units	CP2BXXCX	CP2CXXCX	CP2DXXCX	CP2FXXCX	CP2GXXCX	CP2HXXCX	CP2JXXCX
Operating Humidity	RH	-	5% to 95% RH						
Temperature Coefficient	Tco	C	0.02°C						
Cooling	-	-	Chose heatsink based on ambient and airflow						
Base Plate Thermal Resistance	$-R_{TH}$	°C/Watt	0.08°C +/- 0.02°C						
Vibration	-	Grms	25 Grms. three axis random vibration						
Weight	-	gr/oz/lb	93 gr / .40 oz /.205lb						
Size (LxWxD)	-	Inches	2.4” x 2.3” x 0.5”						
MTBF	hrs	Hours	835,911						

*1 @ 24VDC Vin and 75% of Max I Out for 5, 12, 15 volt units and @ 50 Volts Vin and 75% of MAX I out for 24, 28, 50 volt units.
*2 From no-load to Full Load.
*3 From Min input to Max input voltage.

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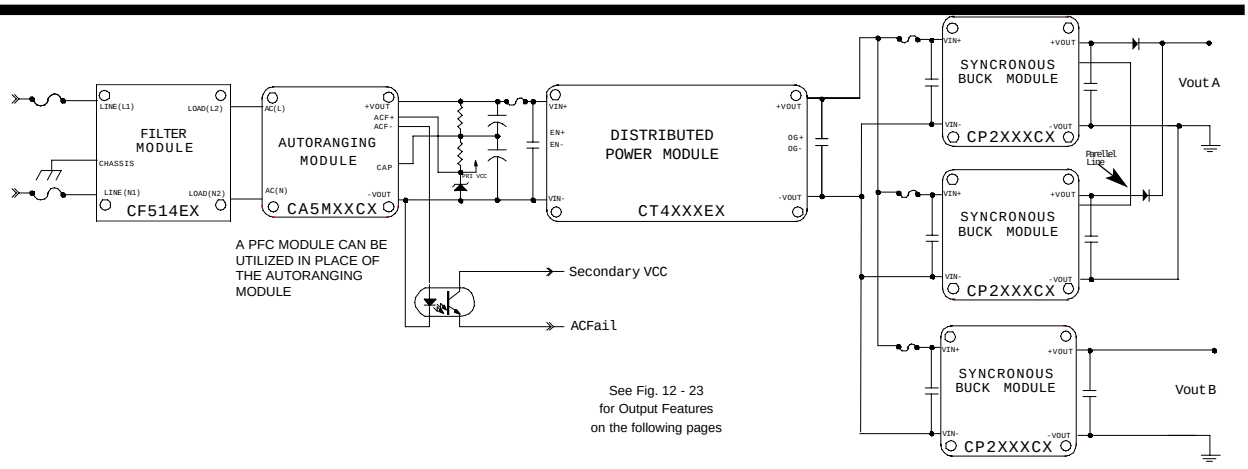
TYPICAL APPLICATION



See Fig. 12 - 23 for Output Features on the following pages

FUSING CONSIDERATIONS

In order to allow maximum flexibility when using these converter modules, an internal fuse is not provided. For module and system protection always provide input fusing based on the particular application requirements.

SAFETY CONSIDERATIONS

In order to insure agency approval in which this power module is utilized, the unit must be used in compliance with the creepage, (spacing and separation) requirements with UL-1950, CSA22.2 - 950 and EN60950.

INPUT SOURCE IMPEDANCE

Core Technology's Synchronous Buck Regulators should interface to a low AC impedance input source. Large inductive source impedance can affect the stability of the converter. A 10UF film capacitor located as close to the input pins as possible will insure stability of the module.

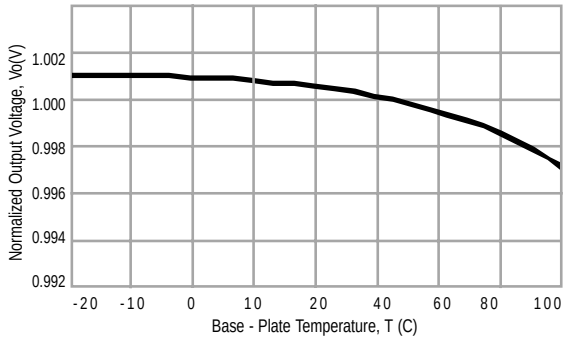
OVER-VOLTAGE PROTECTION

In the event of an over-voltage condition, the SBR module will shut itself down, and will require the removal of input power in order to reset the module into normal operation.

CHARACTERISTIC CURVES

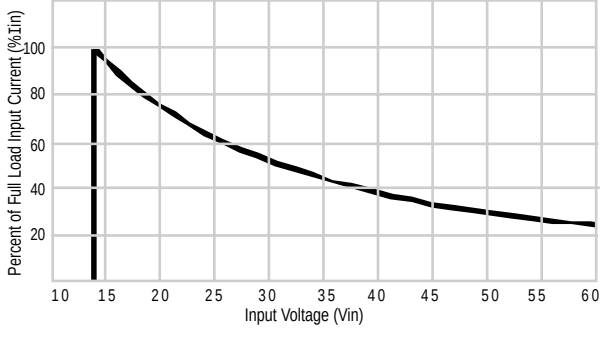
NORMALIZED OUTPUT VOLTAGE VO(V) vs CASE TEMPERATURE SYNCHRONOUS BUCK REGULATOR MODULE

FIGURE 1



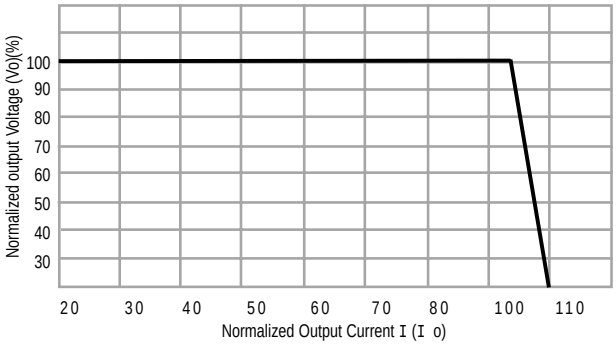
PERCENT OF FULL LOAD INPUT CURRENT vs INPUT VOLTAGE SYNCHRONOUS BUCK REGULATOR MODULE

FIGURE 2



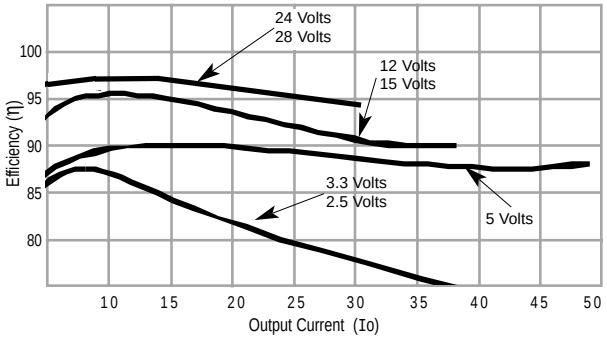
OUTPUT VOLTAGE vs OUTPUT CURRENT SYNCHRONOUS BUCK REGULATOR MODULE

FIGURE 3



EFFICIENCY vs OUTPUT CURRENT SYNCHRONOUS BUCK REGULATOR MODULE

FIGURE 4



CHARACTERISTIC CURVES CONTINUED

FIGURE 5
EFFICIENCY vs INPUT VOLTAGE
SYNCHRONOUS BUCK REGULATOR MODULE

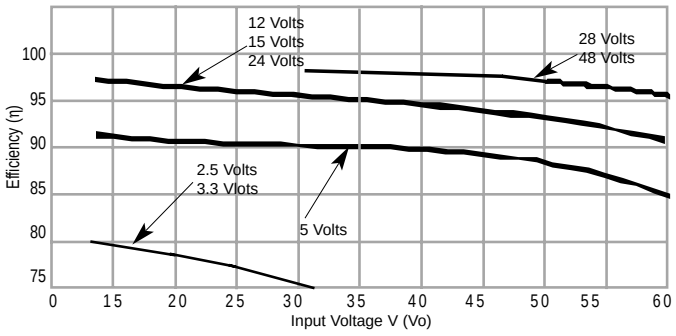
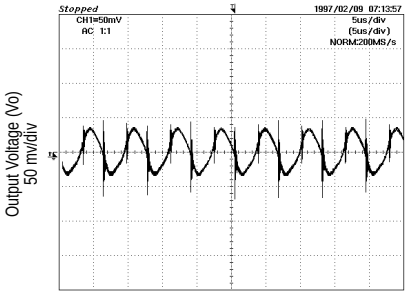
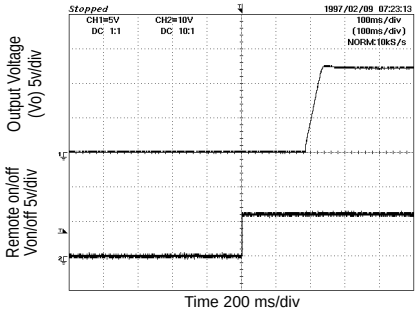


FIGURE 6
OUTPUT NOISE
SYNCHRONOUS BUCK REGULATOR MODULE



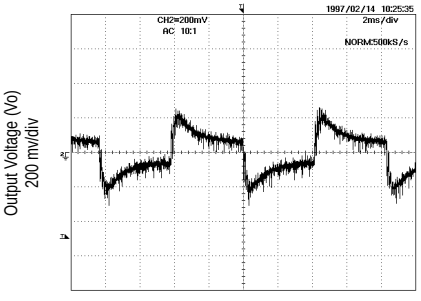
Time 5us/div
(12 Volt unit shown)

FIGURE 7
START - UP TRANSIENT (FROM ENABLE)
SYNCHRONOUS BUCK REGULATOR MODULE



Time 200 ms/div

FIGURE 8
TRANSIENT RESPONSE
SYNCHRONOUS BUCK REGULATOR MODULE



Time 200 ms/div
Load Step Change Form
25% - 50% and 50% - 75% of Full Load
(12 volt unit shown)

TEST CONFIGURATIONS

OUTPUT NOISE MEASUREMENT

NOTE: Measurement taken at 75% load. Coaxial cable with BNC connector must be used. Load should be in close proximity to output and shunted by a 0.01uF ceramic capacitor.

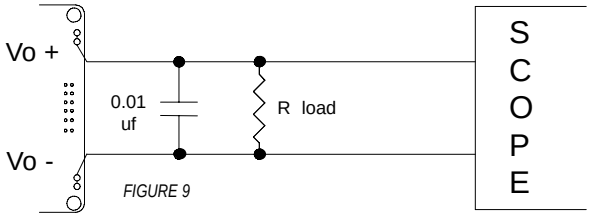


FIGURE 9

EFFICIENCY MEASUREMENT

NOTE: Measurement taken at terminals of module. All connection points must be tight to avoid erroneous readings.

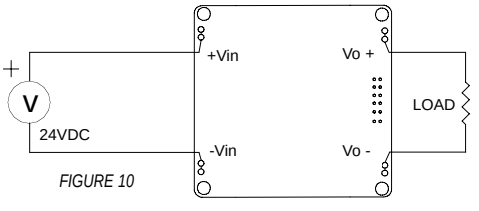


FIGURE 10

REFLECTED RIPPLE CURRENT MEASUREMENT

NOTE: Measurements of Reflected Ripple Currents are taken at input terminals with a simulated supply impedance of 10uH. A low ESR 220uF capacitor connected across the supply is used to suppress any supply impedance deficiencies. Measurements taken, are within 12" of module terminals. All connection points must be tight to avoid erroneous readings.

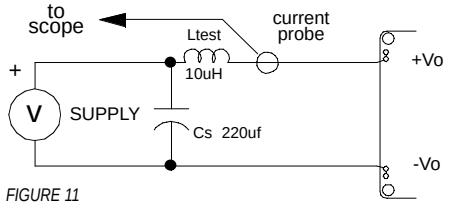


FIGURE 11

REMOTE ON/OFF

This is an input to the SBR converter module and can be used to remotely turn the unit on and off. To enable the power converter, the user must supply a logic high on the "EN" pin (Von ≥ 2.7 Volts)(Max Von = 24VDC).

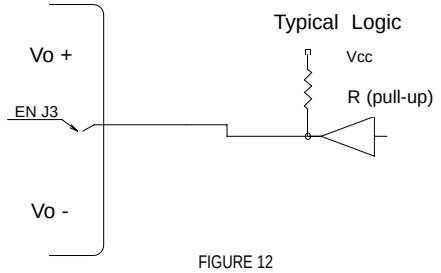


FIGURE 12

EXTERNAL VCC

The SBR converter provides an external VCC supply. This supply can provide the user with 12 volts at a maximum of 50ma.

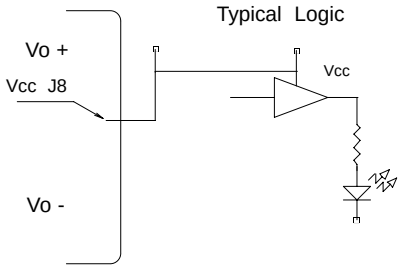


FIGURE 15

DC FAIL

SBR converter modules are equipped with a DC Fail Logic signal. In the event that the output voltage falls below a pre-determined value, the DC Fail Output will be asserted. A logic high ("DC" > 2.7 Volts) on the DC pin indicates that the output voltage is good. A logic low ("DC" < 2.7 Volts) on the DC pin indicates that a failure has occurred.

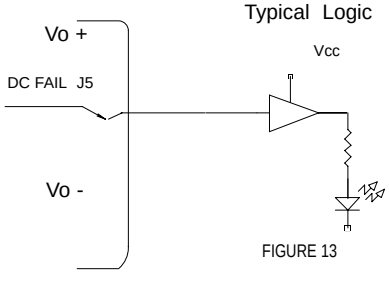


FIGURE 13

REMOTE SENSE

The SBR Sense lines allow the converter module to compensate for a voltage drop in the current carrying conductors. These lines can be attached at some distant point requiring accurate voltage regulation. (Do not exceed a 0.5 volt drop in share lines.)

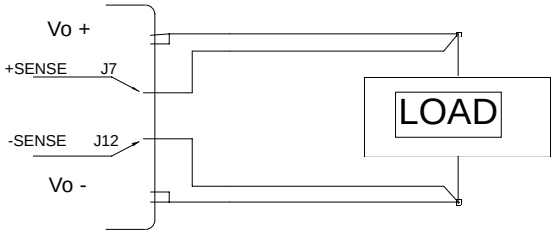


FIGURE 16

OVER-TEMPERATURE SHUTDOWN

The SBR converter modules are equipped with over-temperature protection circuitry, so that the module will not be damaged in an over-temperature condition. The module will auto-restart once the unit is at a safe operating temperature. In addition, a logic output is provided. A logic high ("OT" > 2.7 Volts) indicates there is not an over-temperature condition. A logic low ("OT < 2.7 Volts) indicates when an over-temperature condition exists.

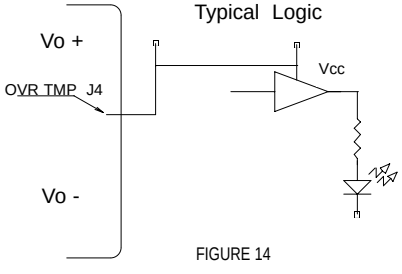


FIGURE 14

LOAD SHARING

The SBR converter modules are equipped with load sharing capability and can be combined or paralleled in order to increase MTBF or output power capability.

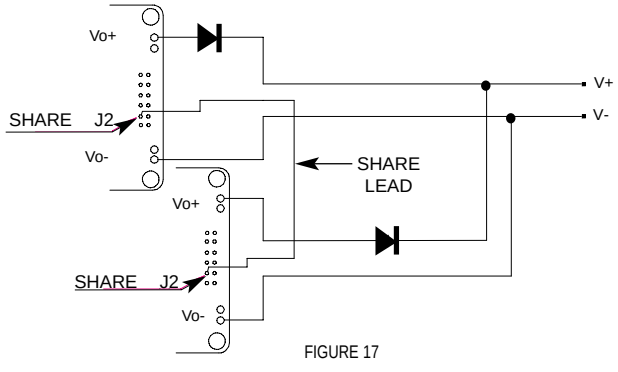


FIGURE 17

OUTPUT VOLTAGE SETTING

OUTPUT VOLTAGE ADJUSTMENTS 60% TO 110%

The trim pin can be utilized to trim the voltage up to 110% of the nominal output voltage or down to 60% of nominal output voltage.

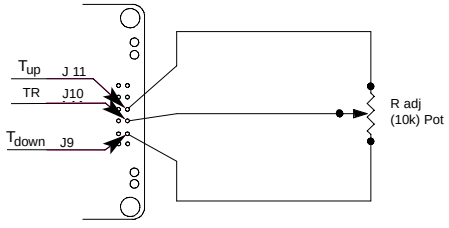


FIGURE 18

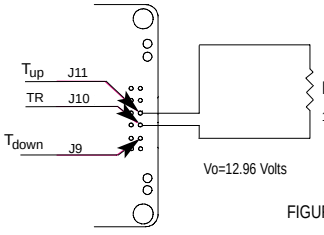
OUTPUT VOLTAGE EXAMPLE

Example: To trim a 12 volt output up 8%, the value of R_{up} =?

Note: R_{up} can be tied between T_R and T_{up} to trim up 8%.

R_{down} can be trim between T_R and T_{down} to trim down 8% (use appropriate equation.)

$$R_{up} = \left[\left(\frac{1}{\triangle}\right)^2 \times 370K\right] + 7K \qquad R_{down} = \left[\frac{40 - \triangle}{\triangle}\right] \times 23K$$



$\triangle\% = (8)$

$R_{up}\left[\left(\frac{1}{8}\right)^2 \times 370000\right] + 7000$ $R_{up} = 12781$ ohms

Where

R_{up} = Resistance between (T_R) and (T_{up}) pins to achieve output voltage change.

$\triangle$ % = Percentage in output voltage change required

FIGURE 19

CURRENT LIMITING

STRAIGHT-LINE CURRENT LIMITING

When utilizing "Straight-Line" current limiting and the maximum output current is exceeded, the output voltage will drop to approximately zero while maintaining the maximum rated output current. Configuring the "FB" pin as shown (open), will enable this feature.

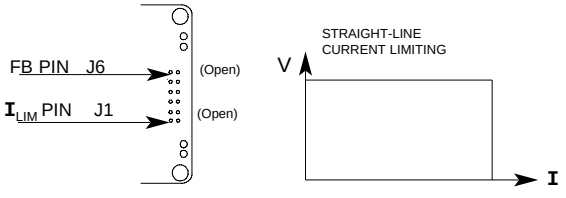


FIGURE 20

FOLD BACK CURRENT LIMITING

When an overload condition exists and "Fold Back" current limiting is being utilized, the output current will be reduced as well as the output voltage. Configuring the "FB" pin as shown, will enable Fold Back current limiting.

$$R_{SLOPE} = \frac{[V_{FB} - 0.5] * 409K}{I\Delta_{(AMP)}} \qquad R_{FB} = \left[\frac{12K}{V_{FB}} - 1K\right]$$

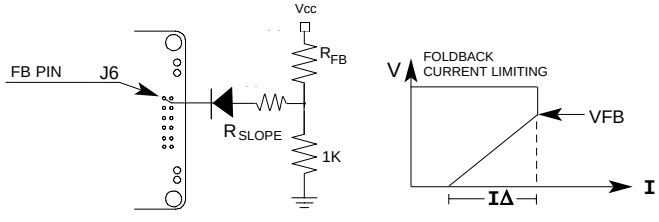


FIGURE 22

ADJUSTABLE CURRENT LIMIT SET POINT

When utilizing "Straight-Line" current limiting, the module can be configured to limit the output current from 50% to 100% of the maximum rated output current of the module. Configuring the"FB" pin as shown, will enable this feature.

$$Radj = \frac{52100}{(100 - \%\ \text{of Maximum } \mathbf{I})}$$

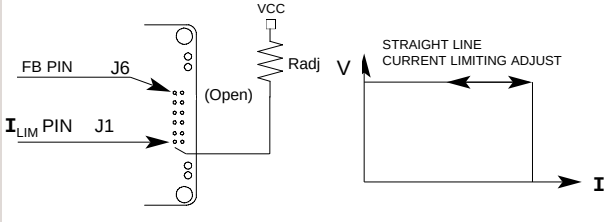


FIGURE 21

ADJ. FOLD BACK CURRENT LIMIT SET POINT

While utilizing "Fold Back" current limiting, the module can be configured to limit the output current from 50% to 100% of the maximum rated output current of the module. Configuring the "$\mathbf{I}_{LIM}$" pin as shown, will enable this feature.

$$Radj = \frac{52100}{(100 - \%\ \text{of Maximum } \mathbf{I})}$$

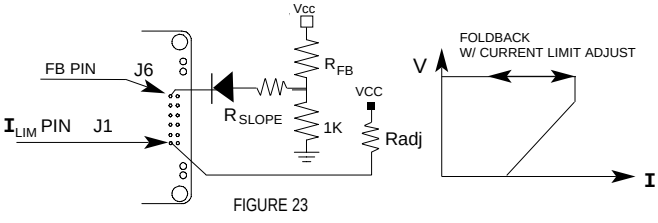
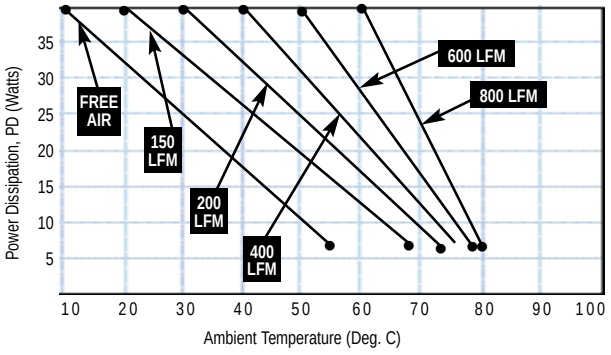


FIGURE 23

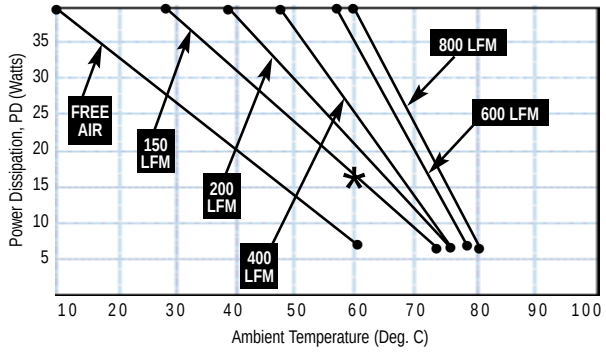
POWER DISSIPATION (PD) vs AMBIENT TEMPERATURE
SYNCHRONOUS BUCK REGULATOR MODULE
NO HEAT SINK

FIGURE 24



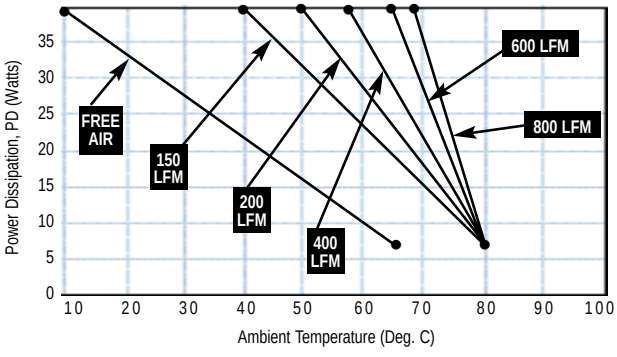
POWER DISSIPATION (PD)vs AMBIENT TEMPERATURE
SYNCHRONOUS BUCK REGULATOR MODULE
1/4" HEAT SINK

FIGURE 25



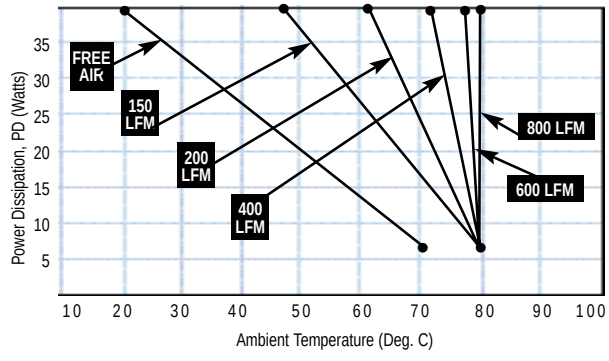
POWER DISSIPATION (PD)vs AMBIENT TEMPERATURE
SYNCHRONOUS BUCK REGULATOR MODULE
1/2" HEAT SINK

FIGURE 26



POWER DISSIPATION (PD)vs AMBIENT TEMPERATURE
SYNCHRONOUS BUCK REGULATOR MODULE
1" HEAT SINK

FIGURE 27



FORCED AIR CONVECTION COOLING

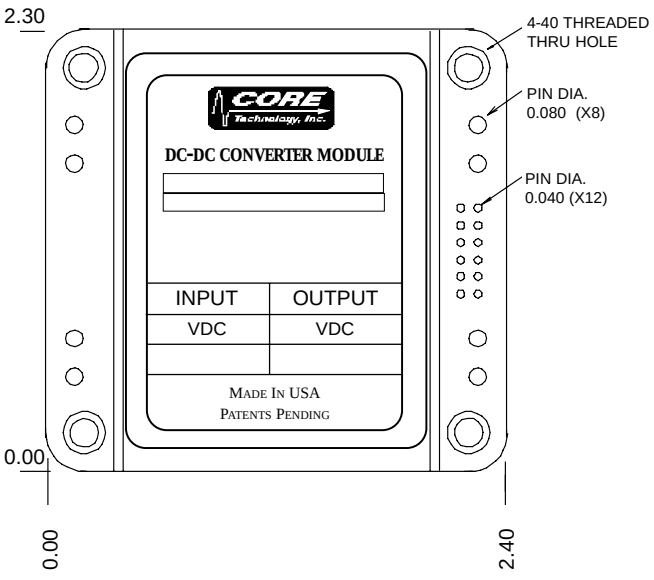
These figures can be utilized to determine if a heat sink and forced air convection cooling will be required in your particular application. Figures 1 through 4 show typical output power vs ambient temperature with various heat sink and air flow conditions. Utilizing these curves, the required cooling for your application can be determined.

* **EXAMPLE:** For your particular application you have determined that you will require 12 volts @ 25 amperes (300 watts of output power). A CP2FJ2CX unit will provide up to 350 watts of output power with a 95% efficiency. Therefore, maximum power dissipation from the module will be 16 watts. By viewing Figure 25, it can be determined that in a 60 °C environment, forced air cooling of 150LFM (MIN.) with a 1/4" heatsink will be required.

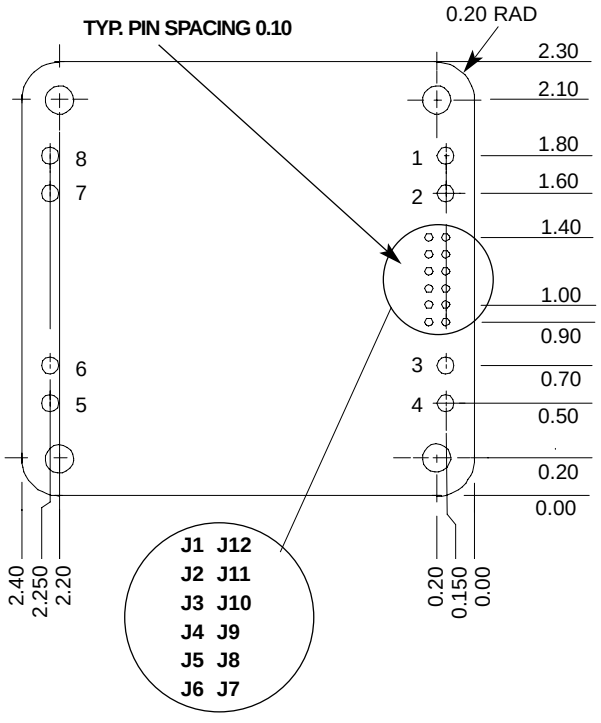
NOTE: By providing 150LFM with a 1/4" heat sink in a 60 °C environment, the base plate of the power module will not exceed 100 °C

Outline Drawing

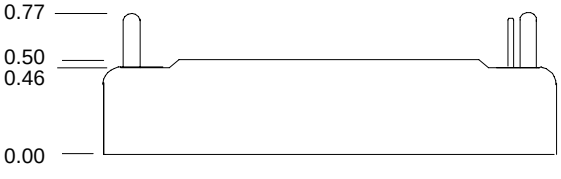
BOTTOM VIEW



PCB PIN LAYOUT
As viewed from top of module



SIDE VIEW



TOLERANCES: - 0.000”
+0.030”

Connector Pin Assignment

1,2	+Vout	J5	DC Fail
3,4	-Vout	J6	Foldback
5,6	-Vin	J7	Vsense-
7,8	+Vin	J8	External VCC
J1	I_{LIM}	J9	T_{up}
J2	Share	J10	Trim
J3	Enable	J11	T_{down}
J4	O Temp	J12	Vsense+

Ordering Information

Part Numbering Scheme for
CP2XXXCX Positive Synchronous Buck

C	*TYPE*	*IN VOLTS*	*OUT-VOLTS*	*POWER LEVEL*	*TEMPERATURE RANGE*	*PACKAGE SIZE*	*HEAT SINK*
C	***P*** = Positive Non- **I**solated Mod	***2*** = 14-60VDC	***B*** = *2.5 VDC* ***C*** = 3.3 VDC ***D*** = 5 VDC ***F*** = 12 VDC ***G*** = 15 VDC ***H*** = 24 VDC ***J*** = 28 VDC	***B*** = 50 Watts ***D*** = 100 Watts ***E*** = 150 Watts ***G*** = 250 Watts ***J*** = 350 Watts ***K*** = 500 Watts	***2*** = -25C to +85C ***3*** = -30C to +100C	***C*** = 1/2 Full Size	***Blank*** = No Heat Sink ***L02*** = 0.25”Longitudinal ***L05*** = 0.50”Longitudinal ***L10*** = 1.0”Longitudinal ***T02*** = 0.25” Transverse ***T05*** = 0.50” Transverse ***T10*** =1.0” Transverse
C	**P**	**2**	**F**	**J**	**2**	**C**	**L10**

EXAMPLE - *To order a Positive Synchronous Buck Regulator module with an input voltage range of 14VDC to 60VDC, output voltage of 12 volts, output power of 350 watts, -25C to +85C operating temperature range and 1” longitudinal heat sink would require the above part number. (CP2FJ2CL10)*