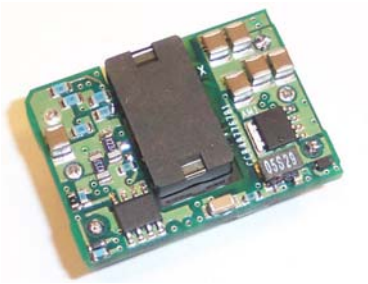
Data Sheet
October 2, 2009

CPKW002A0C1 Power Module; dc-dc Converter
36-75 Vdc Input; 15.0Vdc 2.0A Output



RoHS Compliant

Applications

- Distributed power architectures
- Wireless Networks
- Access and Optical Network Equipment

Options

- Remote On/Off logic (positive or negative)

Features

- Compliant to RoHS EU Directive 2002/95/EC (-Z versions)
- Delivers up to 30W of output power: 15V (2A)
- Small size: 33.0 mm x 24.0 mm x 8.5max mm
  (1.30 x 0.945 x 0.335 in)
- Through-hole (TH) mounting
- Sixteenth-Brick compatible footprint
- Cost efficient open frame design
- Single tightly regulated output
- Remote On/Off
- Output overcurrent protection
- Output overvoltage protection
- Over temperature protection
- Output voltage adjustment trim -20% to +10%
- Wide operating temperature range (-40°C to +85°C)
- UL* 60950-1 Recognized, CSA† C22.2 No. 60950-1-03 Certified, and VDE‡ 0805 (IEC60950, 3rd Edition) Licensed
- CE mark meets 2006/95/EC directives§
- ISO** 9001 and ISO 14001 certified manufacturing facilities

Description

The CPKW002A0C1 power module is an isolated dc-dc converter that operates over a wide input voltage range of 36 to 75 Vdc and provides a single precisely regulated output. This module is a low cost, smaller size alternative to the existing QW030C1. The output is fully isolated from the input, allowing versatile polarity configurations and grounding connections. The module exhibit high efficiency, typical 90% for 15V at 2A. Built-in filtering for both input and output minimizes the need for external filtering. These open frame modules are available in through-hole (TH) form. Standard features include Remote On/Off, output voltage adjust, overvoltage, overcurrent and overtemperature protection.

* *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.
§ This product is intended for integration into end-use equipment. All of the required procedures of end-use equipment should be followed.
** ISO is a registered trademark of the International Organization of Standards

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 Transient (100ms)	All All	V_{IN} $V_{IN, trans}$	-0.3 -0.3	80 100	Vdc Vdc
Operating Ambient Temperature (see Thermal Considerations section)	All	T_A	-40	90	°C
Storage Temperature	All	T_{stg}	-55	125	°C
I/O Isolation Voltage	All	—	—	500	Vdc

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}	36	54	75	Vdc
Maximum Input Current (V_{IN}=0V to 75V, I_O=$I_{O, max}$)	All	$I_{IN,max}$			1.5	Adc
Inrush Transient	All	I^2t			0.06	A^2s
Input Reflected Ripple Current, peak-to-peak (5Hz to 20MHz, 12µH source impedance; V_{IN}=0V to 75V, I_O= I_{Omax} ; see Figure 9)	All			30		mAp-p
Input Ripple Rejection (120Hz)	All			50		dB
EMC, EN55022		See EMC Considerations section				

CAUTION: This power module is not internally fused. An input line fuse must always be used.

This power module can be used in a wide variety of applications, ranging from simple standalone operation to an integrated part of sophisticated power architectures. To preserve maximum flexibility, internal fusing is not included, however, to achieve maximum safety and system protection, always use an input line fuse. The safety agencies require a fast-acting fuse with a maximum rating of 3A (see Safety Considerations section). Based on the information provided in this data sheet on inrush energy and maximum dc input current, the same type of fuse with a lower rating can be used. Refer to the fuse manufacturer's data sheet for further information.

Electrical Specifications (continued)

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Voltage Set-point ($V_{IN}=V_{IN, nom}$ $I_O=I_{O, max}$ $T_A=25°C$)	All	$V_{O, set}$	-1.5	—	+1.5	% $V_{O, nom}$
Output Voltage (Over all operating input voltage, resistive load, and temperature conditions until end of life)	All	V_O	-3.0	—	+3.0	% $V_{O, nom}$
Adjustment Range Selected by external resistor	All	$V_{O, adj}$	-20.0		+10.0	% $V_{O, nom}$
Output Regulation						
Line ($V_{IN}=V_{IN, min}$ to $V_{IN, max}$)	All		—	0.05	0.2	% $V_{O, set}$
Load ($I_O=I_{O, min}$ to $I_{O, max}$)	All		—	0.05	0.2	% $V_{O, set}$
Temperature ($T_{ref}=T_{A, min}$ to $T_{A, max}$)	All		—	—	1.00	% $V_{O, set}$
Output Ripple and Noise on nominal output Measured with 10uF Tantalum and 1uF ceramic						
($V_{IN}=V_{IN, nom}$ $I_O=80\%$ $I_{O, max}$ $T_A=25°C$)	15V		—	—	50	mV_{rms}
RMS (5Hz to 20MHz bandwidth)			—	—	150	mV_{pk-pk}
Peak-to-Peak (5Hz to 20MHz bandwidth)						
External Capacitance (min ESR = 10mΩ)	15V	$C_{O, max}$	0	—	470	µF
Output Current	15V	I_o	0	—	2.0	Adc
Output Current Limit Inception (Hiccup Mode)	15V	$I_{O, lim}$	105	—	250	% $I_{O, max}$
Output Short-Circuit Current (RMS) (V_O≤250mV) (Hiccup Mode)	15V	$I_{O, s/c}$	—	—	3.0	A rms

Electrical Specifications (continued)

Parameter	Device	Symbol	Min	Typ	Max	Unit
Efficiency						
$V_{IN}=V_{IN,nom}$, I_O=80% $I_{O,max}$, $V_O=V_{O,set}$, T_A=75°C	15V	η	88	90.0	—	%
$V_{IN}=V_{IN,nom}$, I_O=50% $I_{O,max}$, $V_O=V_{O,set}$, T_A=75°C	15V	η	86	88.0	—	%
Switching Frequency (Variable with Line & Load)						
$V_{IN}=V_{IN,nom}$ and $I_O=I_{O,max}$	All	f_{sw}	—	250	—	kHz
$V_{IN}=V_{IN,nom}$ and I_O= 50% $I_{O,max}$	All	f_{sw}	—	420	—	kHz
Dynamic Load Response ($\Delta Io/\Delta t$=0.1A/µs, $V_{IN}=V_{IN,nom}$, T_A=25°C) Load Change from Io= 50% to 75% or 25% to 50% of Io,max:						
Peak Deviation	15V	V_{pk}	—	1.0	—	% $V_{O,set}$
Settling Time (Vo<10% peak deviation)	15V	t_s	—	800	—	µs

Isolation Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Isolation Capacitance	C_{iso}	—	33	—	nF
Isolation Resistance	R_{iso}	10	—	—	MΩ
I/O Isolation Voltage	All	—	—	500	Vdc

General Specifications

Parameter	Min	Typ	Max	Unit
Calculated MTBF (I_O=80% of $I_{O,max}$, T_A=40°C, airflow=1m/s) Telcordia SR-332 Issue 1: Method 1 Case 3		6,206,856		Hours
Weight	—	11.6 (0.41)	—	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
Remote On/Off Signal Interface (V_{IN}=$V_{IN, min}$ to $V_{IN, max}$; open collector or equivalent, Signal referenced to V_{IN-} terminal) Negative Logic: device code suffix "1" Logic Low = module On, Logic High = module Off Positive Logic: No device code suffix required Logic Low = module Off, Logic High = module On						
Logic Low - Remote On/Off Current	All	$I_{on/off}$	—	—	1.0	mA
Logic Low - On/Off Voltage	All	$V_{on/off}$	-0.7	—	1.2	V
Logic High Voltage – (Typ = Open Collector)	All	$V_{on/off}$	—	5.0	15	V
Logic High maximum allowable leakage current	All	$I_{on/off}$	—	—	50	µA
Turn-On Delay and Rise Times (I_O=80% of $I_{O, max}$, T_A=25°C)						
Case 1: On/Off input is set ON and then input power is applied (T_{delay} = from instant at which V_{IN}=$V_{IN, min}$ until V_O = 10% of $V_{O, set}$).	All	T_{delay} Case1	—	60	100	ms
Case 2: Input power is applied for at least 1 second and then On/Off input is set from OFF to ON (T_{delay} = from instant at which V_{IN}=$V_{IN, min}$ until V_O = 10% of $V_{O, set}$).	All	T_{delay} Case2	—	60	100	ms
T_{rise} = time for V_O to rise from 10% of $V_{O, set}$ to 90% of $V_{O, set}$.	All	T_{rise}	—	0.2	1	ms
T_{rise} = time for V_O to rise from 10% of $V_{O, set}$ to 90% of $V_{O, set}$ with max ext capacitance	All	T_{rise}	—	2.0	—	ms
Output Overvoltage Protection	15V	$V_{O, limit}$	16.6	—	21.0	V
Overtemperature Protection (See Feature Descriptions)	All	T_{ref}	—	130	—	°C
Input Undervoltage Lockout						
Turn-on Threshold	All	$V_{uv/on}$	—	32	35	V
Turn-off Threshold	All	$V_{uv/off}$	—	28	30	V
Hysterisis	All	V_{hyst}	—	4	—	V

Characteristic Curves

The following figures provide typical characteristics for the CPKW002A0C1 (15.0V, 2.0A) at 25°C.

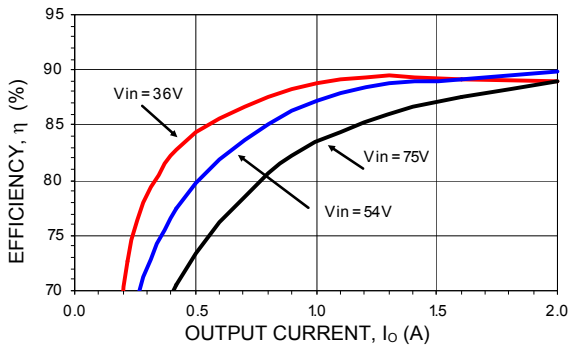


Figure 1. Converter Efficiency versus Output Current

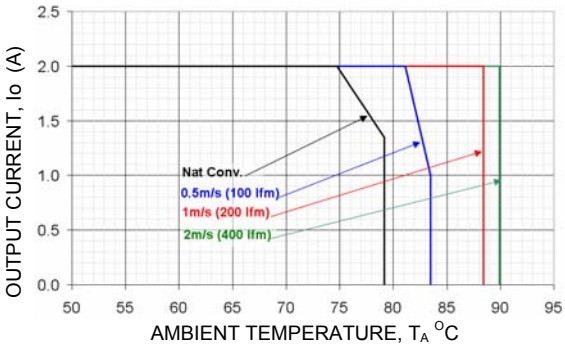


Figure 2. Derating Output Current versus Local Ambient Temperature and Airflow

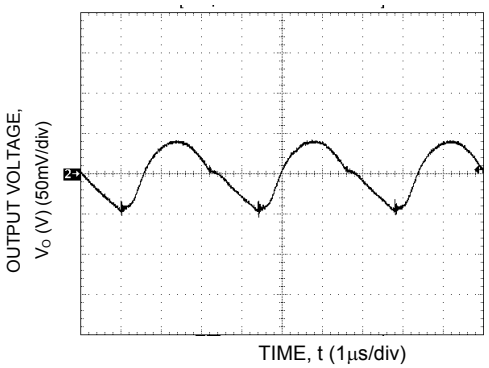


Figure 3. Typical Output Ripple and Noise, @ 80% Full Load.

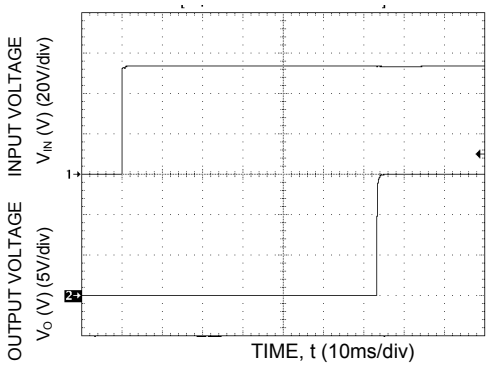
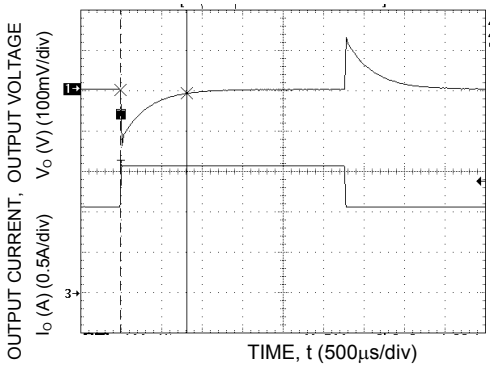


Figure 4. Typical Start-Up with application of Vin.



igure 5. Transient Response to Dynamic Load Change from 50% to 75% to 50% of full load.

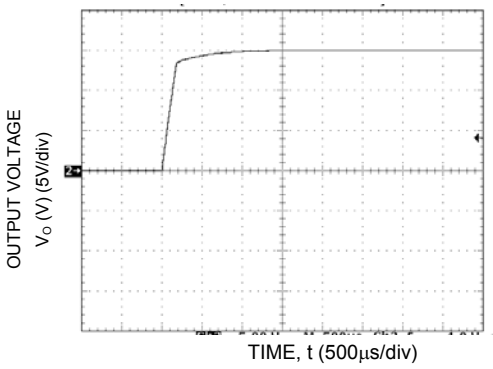
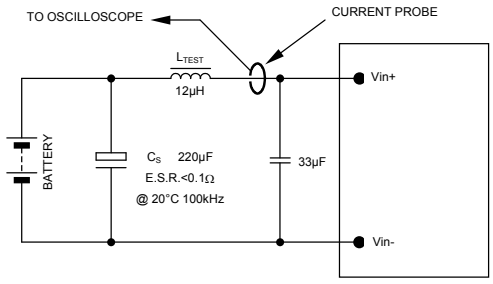


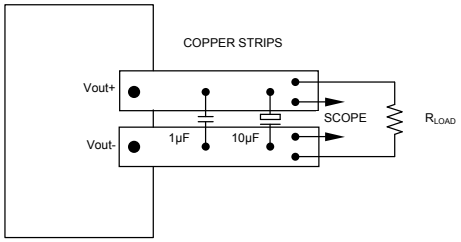
Figure 6. Typical Output Rise Characteristic, without external capacitance fitted.

Test Configurations



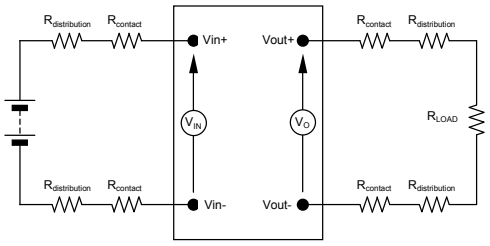
NOTE: Measure input reflected ripple current with a simulated source inductance (L_{TEST}) of 12µH. Capacitor C_S offsets possible battery impedance. Measure current as shown above.

Figure 7. Input Reflected Ripple Current Test Setup



NOTE: Use a 1µF ceramic capacitor and a 10µF aluminium or tantalum capacitor. The scope measurement should be made using a BNC socket. Position the load 50mm to 75mm (2" to 3") from the module.

Figure 8. Output Ripple and Noise Test Setup



NOTE: All voltage measurements to be taken at the module terminals, as shown above. If sockets are used then Kelvin connections are required at the module terminals to avoid measurement errors due to socket contact resistance.

Figure 9. Output Voltage and Efficiency Test Setup

$$Efficiency\ (\eta) = \left[\frac{V_O \times I_O}{V_{IN} \times I_{IN}}\right] \times 100\ (\%)$$

Design Considerations

Input Source Impedance

The power module should be connected to a low ac-impedance source. Highly inductive source impedance can affect the stability of the power module. For the test configuration in Figure 7 a 33µF electrolytic capacitor (ESR<0.7Ω at 100kHz), mounted close to the power module helps ensure the stability of the unit. Consult the factory for further application guidelines.

Safety Considerations

For safety-agency approval of the system in which the power module is used, the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standard, i.e., UL 60950-1, CSA C22.2 No. 60950-1-03, and VDE 0805 (IEC60950, 3rd Edition).

The modules spacing (creepages and clearances) have been designed to meet Functional Insulation.

If the input source is non-SELV (ELV or a hazardous voltage greater than 60 Vdc and less than or equal to 75Vdc), for the module's output to be considered as meeting the requirements for safety extra-low voltage (SELV), all of the following must be true:

- The input source is to be provided with reinforced insulation from any other hazardous voltages, including the ac mains.
- If the output pins are accessible to the end user, then to maintain the output voltage to ground (earth) within ELV or SELV limits, Vin(+) pin of the input and Vout (-) pin of the output must be reliably grounded (earthed) in the end application.
- The input pins of the module are not operator accessible.
- Another SELV reliability test is conducted on the whole system (combination of supply source and subject module), as required by the safety agencies, to verify that under a single fault, hazardous voltages do not appear at the module's output.

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 maximum 3A fast-acting fuse in the ungrounded lead.

Feature Descriptions

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. The average output current during hiccup is 10% $I_{O, max}$.

Remote On/Off

Two remote on/off options are available. Positive logic turns the module on during a logic high voltage on the ON/OFF pin, and off during a logic low. Negative logic remote On/Off, device code suffix “1”, turns the module off during a logic high and on during a logic low.

To maintain compatibility with LW series power modules the Remote On/Off pin is optional for the TH (through hole) version. Standard TH modules have no On/Off pin fitted. TH modules ordered with device code suffix “1” are negative logic with the On/Off pin fitted.

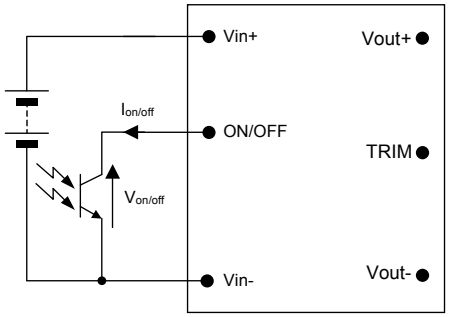


Figure 10. Remote On/Off Implementation

To turn the power module on and off, the user must supply a switch (open collector or equivalent) to control the voltage ($V_{on/off}$) between the ON/OFF terminal and the $V_{IN}(-)$ terminal. Logic low is $0V \le V_{on/off} \le 1.2V$. The maximum $I_{on/off}$ during a logic low is 1mA, the switch should be maintain a logic low level whilst sinking this current.

During a logic high, the typical $V_{on/off}$ generated by the module is 5.0V, and the maximum allowable leakage current at $V_{on/off}$ = 5.0V is 50µA.

If not using the remote on/off feature:

For positive logic, leave the ON/OFF pin open.

For negative logic, short the ON/OFF pin to $V_{IN}(-)$.

Input Undervoltage Lockout

At input voltages below the input undervoltage lockout limit, the module operation is disabled. The module will only begin to operate once the input voltage is raised above the undervoltage lockout turn-on threshold, $V_{UV/ON}$.

Once operating, the module will continue to operate until the input voltage is taken below the undervoltage turn-off threshold, $V_{UV/OFF}$.

Output Overvoltage Protection

The output overvoltage protection consists of circuitry that internally clamps the output voltage. If a more accurate output overvoltage protection scheme is required then this should be implemented externally via use of the remote on/off pin.

Overtemperature Protection

These modules feature an overtemperature protection circuit to safeguard against thermal damage. The circuit shuts down the module if the temperature measured at the thermal reference point Tref exceeds maximum limits. The module will automatically restart if the temperature at Tref has reduced sufficiently. The module can continue in this mode until the overtemperature condition is cleared.

Feature Descriptions (continued)

Output Voltage Set-Point Adjustment (Optional pin on TH version)

Trimming allows the user to increase or decrease the output voltage set point of the module. This is accomplished by connecting an external resistor between the TRIM pin and either the Vout+ pin or the Vout- pin.

Trim Down – Decrease Output Voltage

By connecting an external resistor between the TRIM pin and Vout+ pin (Radj-down), the output voltage set point decreases (see figure 11). The following equation determines the external resistor value to obtain an output voltage change from Vo, nom to the desired Vo, adj:

$$R_{adj-down} = \left[\frac{(V_{o,adj} - L) \times G}{(V_{o,nom} - V_{o,adj})} - H \right] \Omega$$

Note: Values for G, H, L and K are defined for each module version in the following table 1 .

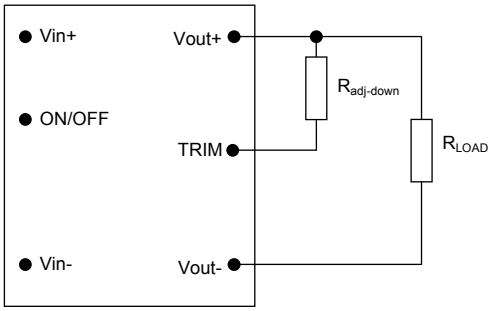


Figure 11. Circuit Configuration to Decrease Output Voltage

Trim Up – Increase Output Voltage

By connecting an external resistor between the TRIM pin and Vout- pin (Radj-up), the output voltage set point increases (see figure 12). The following equation determines the external resistor value to obtain an output voltage change from Vo, nom to the desired Vo, adj:

$$R_{adj-up} = \left[\frac{(G \times L)}{(V_{o,adj} - L - K)} - H \right] \Omega$$

Note: Values for G, H, L and K are defined for each module version in the following table 1 .

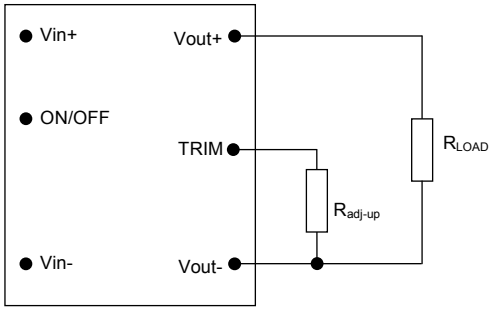


Figure 12. Circuit Configuration to Increase Output Voltage

Module	G	H	K	L
CPKW002A0C1	10,000	5110	12.5	2.5

Table 1 . Trim Constants CPKW002A0C1

The combination of the output voltage adjustment and the output voltage initial tolerance must not exceed the allowable trim range of 90% to 110% of the nominal output voltage as measured between the Vout+ and Vout- pins.

The CPKW002A0C1 power modules have a fixed current-limit set point. Therefore, as the output voltage is adjusted down, the available output power is reduced.

Trim Examples

For CPKW002A0C1, nominal 15.0V module. To trim module up to 15.5V (see figure 12):

$$R_{adj-up} = \left[\frac{(10{,}000 \times 2.5)}{(15.5 - 2.5 - 12.5)} - 5110 \right] \Omega$$

$$R_{adj-up} = 44{,}890\ \Omega$$

Feature Descriptions (continued)

Thermal Considerations

The power module operates in a variety of thermal environments; however, sufficient cooling should 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 thermal reference point, T_{ref} used in the specifications is shown in Figure 13. For reliable operation this temperature should not exceed 110°C.

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.

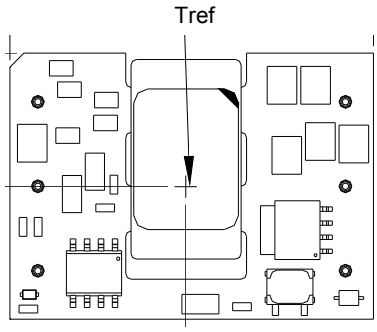


Figure 13. T_{ref} Temperature Measurement Location

Heat Transfer via Convection

Increased airflow over the module enhances the heat transfer via convection. Derating figures showing the maximum output current that can be delivered by each module versus local ambient temperature (T_A) for natural convection and up to 2m/s (400 ft./min) are shown in the respective Characteristics Curves section.

EMC Considerations

The figure 14 shows a suggested configuration to meet the conducted emission limits of EN55022 Class B in an application that only requires 500Vdc operational isolation between input and output.

Component Values:
C1, C2 = 1500nF low impedance SMT ceramic
C3 = 220uF low impedance electrolytic
C4 = 1000nF low impedance SMT ceramic
C5 = 220nF low impedance SMT ceramic
L1 = Common Mode inductor, Pulse Engineering type P0420 1.32mH.
L2 = 10uH differential inductor

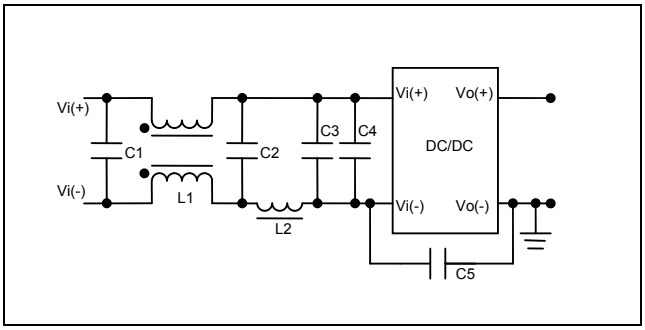


Figure 14. Suggested Configuration for EN55022 Class B

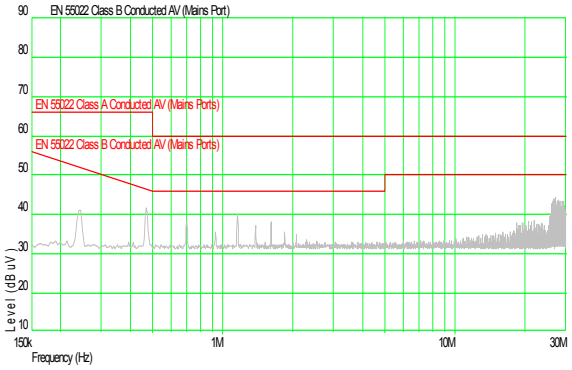


Figure 15. EMC signature using above filter.

Layout Considerations

The CPKW002A0C1 power module is a low profile in order to be used in fine pitch system card architectures. As such, component clearance between the bottom of the power module and the mounting board is limited. Avoid placing copper areas on the outer layer directly underneath the power module. Also avoid placing via interconnects underneath the power module.

For additional layout guide-lines, refer to FLTR100V10 data sheet.

Post Solder Cleaning and Drying Considerations

Post solder cleaning is usually the final circuit-board assembly process prior to electrical board testing. The result of inadequate cleaning and drying can affect both the reliability of a power module and the testability of the finished circuit-board assembly. For guidance on appropriate soldering, cleaning and drying procedures, refer to Lineage Power *Board Mounted Power Modules: Soldering and Cleaning* Application Note (AP01-056EPS).

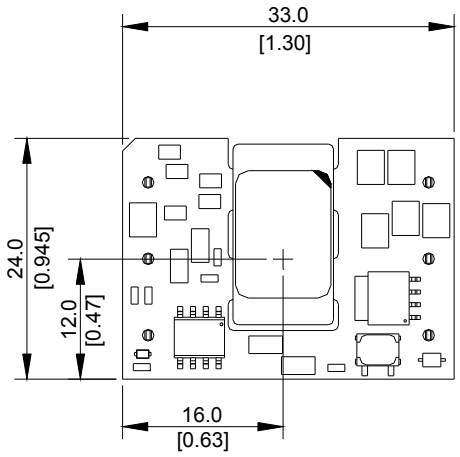
Mechanical Outline for CPKW002A0C1 Through-Hole Module

Dimensions are in millimeters and [inches].

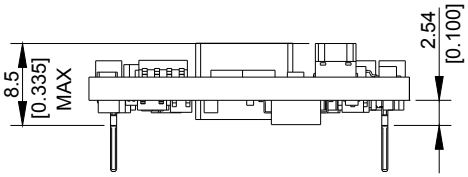
Tolerances: x.x mm ± 0.5 mm [x.xx in. ± 0.02 in.] (Unless otherwise indicated)

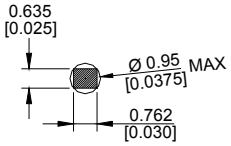
x.xx mm ± 0.25 mm [x.xxx in ± 0.010 in.]

Top View



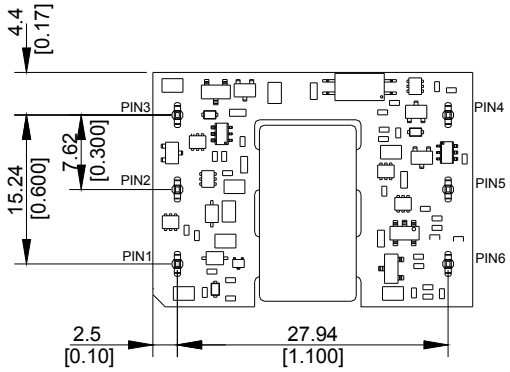
Side View





Pin Cross Section

Bottom View



Pin	Function
1	Vin+
2	ON/OFF
3	Vin-
4	VO-
5	TRIM
6	VO+

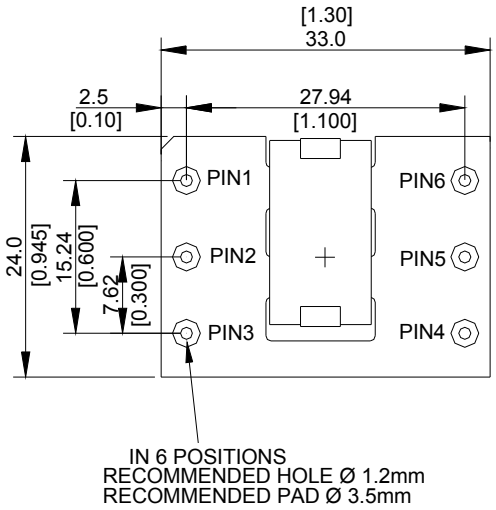
Recommended Pad Layout for Through-Hole Module

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.]

Pin	Function
1	Vin+
2	ON/OFF
3	Vin-
4	VO-
5	TRIM
6	VO+



Through-Hole Pad Layout – Component side view

Ordering Information

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

Table 2. Device Codes

Input Voltage	Output Voltage	Output Current	Remote On/Off Logic	Connector Type	Product codes	Comcodes
48 Vdc	15.0V	2.0A	Negative	TH	CPKW002A0C1Z	CC109127602
48 Vdc	15.0V	2.0A	Negative	TH	CPKW002A0C81Z	CC109141066

Table 3. Device Options

Option	Suffix
Negative remote on/off logic	1
Pin Length: 2.79 mm ± 0.25 mm, (0.110 in. ± 0.010 in.)	8
RoHS Compliant (6 of 6)	Z

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