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## HC006/010 Series DC-DC Converter Power Modules: 18-36Vdc Input; 3.3V-5Vdc Output; 6.6A-10A Output Current

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### RoHS Compliant



### Applications

- Wireless Networks
- Distributed power architectures
- Optical and Access Network Equipment
- Enterprise Networks
- Latest generation IC's (DSP, FPGA, ASIC) and Microprocessor powered applications

### Options

- Remote On/Off logic (positive or negative)
- Surface Mount (-S Suffix)
- Trimmed leads

### Description

The HC series power modules are isolated dc-dc converters that operate over a wide input voltage range of 18 to 36 Vdc and provide one precisely regulated output. The output is fully isolated from the input, allowing versatile polarity configurations and grounding connections. The modules exhibit high efficiency, e.g. typical efficiency of 90% 3.3/10A, 91% at 5V/6A. Built-in filtering for both input and output minimizes the need for external filtering. These open frame modules are available either in surface-mount (-S) or in through-hole form.

### Features

- Compliant to RoHS EU Directive 2002/95/EC (-Z versions)
- Compliant to ROHS EU Directive 2002/95/EC with lead solder exemption (non-Z versions)
- Delivers up to 10A Output current  
5V (6.6A), 3.3V (10A)
- High efficiency – 90% at 3.3V full load
- Low Output voltage- supports migration to future IC supply voltages down to 1.0V
- Low output ripple and noise
- Small Size and low profile  
47.2mm x 29.5mm x 8.5mm  
(1.86 x 1.16 x 0.335 in)
- Surface mount or Through hole (TH)
- Remote On/Off
- Output overcurrent/Over voltage protection
- Over temperature protection
- Single Tightly regulated output
- Output voltage adjustment trim  $\pm 10\%$
- Wide operating temperature range (-40°C to 85°C)
- Meets the voltage insulation requirements for ETSI 300-132-2 and complies with and is Licensed for Basic Insulation rating per EN 60950
- CE mark meets 73/23/EEC and 93/68/EEC directives<sup>§</sup>
- *UL*<sup>\*</sup> 60950-1 Recognized, *CSA*<sup>†</sup> C22.2 No. 60950-1-03 Certified, and *VDE*<sup>‡</sup> 0805:2001-12 (EN60950-1) Licensed
- ISO<sup>\*\*</sup> 9001 and ISO 14001 certified manufacturing facilities

\* *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

## 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	All	$V_{IN}$	-0.3	50	Vdc
Operating Ambient Temperature (see Thermal Considerations section)	All	$T_A$	-40	85	°C
Storage Temperature	All	$T_{stg}$	-55	125	°C
I/O Isolation Voltage (100% factory tested)	All	—	—	1500	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	HC	$V_{IN}$	18	24	36	Vdc
Maximum Input Current ( $V_{IN}=0V$ to 75V, $I_O=I_{O,max}$ )	HC	$I_{IN,max}$			3.2	Adc
Inrush Transient	All	$I^2t$			1	A <sup>2</sup> s
Input Reflected Ripple Current, peak-to-peak (5Hz to 20MHz, 12μH source impedance; $V_{IN}=0V$ to 75V, $I_O=I_{O,max}$ ; see Figure 9)	All			3		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 a sophisticated power architecture. 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 5A (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	3.3V	$V_{O, set}$	3.25	3.3	3.35	Vdc
( $V_{IN}=V_{IN, nom}$ , $I_O=I_{O, max}$ , $T_{ref}=25^{\circ}C$ )	5.0V	$V_{O, set}$	4.92	5.0	5.08	Vdc
Output Voltage (Over all operating input voltage, resistive load, and temperature conditions until end of life)	All	$V_O$	-3.0	—	+3.0	% $V_{O, set}$
Adjustment Range Selected by external resistor	All	$V_O$	-10.0		+10.0	% $V_{O, set}$
Output Regulation						
Line ( $V_{IN}=V_{IN, min}$ to $V_{IN, max}$ )	All		—	—	0.1	% $V_{O, set}$
Load ( $I_O=I_{O, min}$ to $I_{O, max}$ )	All		—	—	10	mV
Temperature ( $T_{ref}=T_{A, min}$ to $T_{A, max}$ )	All		—	0.2	—	% $V_{O, set}$
Output Ripple and Noise on nominal output ( $V_{IN}=V_{IN, nom}$ and $I_O=I_{O, min}$ to $I_{O, max}$ )  Measured across 10 $\mu$ F tantalum//1 $\mu$ F ceramic						
RMS (5Hz to 20MHz bandwidth)	All		—	8	20	mV <sub>rms</sub>
Peak-to-Peak (5Hz to 20MHz bandwidth)	All		—	40	75	mV <sub>pk-pk</sub>
External Load Capacitance	3.3V	$C_{O, max}$	0	—	1000	$\mu$ F
	5.0V	$C_{O, max}$	0	—	470	$\mu$ F
Output Current	3.3V	$I_O$	0.05		10	Adc
(At $I_O < I_{O, min}$ the output ripple may exceed the The max specifications. All modules shall Operate at no load without damage and without exceeding 100% of $V_{O, set}$ )	5.0V	$I_O$	0.05		6.6	Adc
Output Current Limit Inception	3.3V	$I_{O, lim}$	—	12	—	Adc
( $V_O = 90\%$ of $V_{O, set}$ )	5.0V	$I_{O, lim}$	—	8	—	Adc
Output Short-Circuit Current	3.3V	$I_{O, s/c}$	—	17	—	Adc
( $V_O \leq 250mV$ )	5.0V	$I_{O, s/c}$	—	13	—	Adc
Efficiency	3.3V	$\eta$	—	90.0	—	%
$V_{IN}=V_{IN, nom}$ , $T_A=25^{\circ}C$	5.0V	$\eta$	—	91.0	—	%
$I_O=I_{O, max}$ , $V_O=V_{O, set}$						

## Electrical Specifications (continued)

Parameter	Device	Symbol	Min	Typ	Max	Unit
Switching Frequency	All	$f_{sw}$	—	285	—	kHz
Dynamic Load Response ( $\Delta I_o/\Delta t=0.1A/\mu s$ ; $V_{in}=V_{in,nom}$ ; $T_A=25^\circ C$ )  Load Change from $I_o=50\%$ to $75\%$ of $I_{o,max}$  Peak Deviation	All	$V_{pk}$	—	200	—	mV
Settling Time ( $V_o<10\%$ peak deviation)		$t_s$	—	200	—	$\mu s$
( $\Delta I_o/\Delta t=0.1A/\mu s$ ; $V_{in}=V_{in,nom}$ ; $T_A=25^\circ C$ ) Load Change from $I_o=75\%$ to $50\%$ of $I_{o,max}$  Peak Deviation		$V_{pk}$	—	200	—	mV
Settling Time ( $V_o<10\%$ peak deviation)		$t_s$	—	200	—	$\mu s$

## Isolation Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Isolation Capacitance	$C_{iso}$	—	1000	—	pF
Isolation Resistance	$R_{iso}$	10	—	—	M $\Omega$

## General Specifications

Parameter	Min	Typ	Max	Unit
Calculated MTBF (for HC010A0F1 in accordance with Lucent RIN: $I_o=80\%$ of $I_{o,max}$ , $T_A=25^\circ C$ , airflow=1m/s)	> TBD			Hours
Weight	—	13 (0.46)	Weight	—

## 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 Specification Remote On/Off Current – Logic Low On/Off Voltage: Logic Low Logic High – (Typ = Open Collector) Logic High maximum allowable leakage current	All	$I_{on/off}$	—	0.15	1.0	mA
	All	$V_{on/off}$	-0.7	—	1.2	V
	All	$V_{on/off}$	—	—	15	V
	All	$I_{on/off}$	—	—	50	$\mu$ A
Turn-On Delay and Rise Times ( $V_{IN}=V_{IN, nom}$ , $I_O=I_{O, max}$ , $V_O$ to within $\pm 1\%$ of steady state) Case 1: On/Off input is set to Logic high and then input power is applied (delay from instant at which $V_I = V_{I, min}$ until $V_O = 10\%$ of $V_O$ , set) Case 2: Input power is applied for at least one second and then the On/Off input is set to logic high (delay from instant at which $V_{on/off} = 0.9V$ until $V_O = 10\%$ of $V_O$ , set) Output voltage Rise time (time for $V_O$ to rise from 10% of $V_O$ , set to 90% of $V_O$ , set)	All	$T_{delay}$	—	20	—	msec
	All	$T_{delay}$	—	12	—	msec
	All	$T_{rise}$	—	5	—	msec
Output voltage overshoot ( $V_{IN}=V_{IN, nom}$ , $I_O = 80\%$ of $I_{O, max}$ , $T_A=25^\circ C$ )	All	—	—	—	5	% $V_{O, set}$
Output Overvoltage Protection	3.3V	$V_{O, limit}$	—	4.0	4.6	V
	5.0V	$V_{O, limit}$	—	6.1	7.0	V
Overtemperature Protection (See Feature Descriptions)	All	$T_{ref}$	—	125	—	$^\circ C$
Input Undervoltage Lockout						
Turn-on Threshold	HC	—	—	16	18	V
Turn-off Threshold	HC	13	14	—	—	V

## Characteristic Curves

The following figures provide typical characteristics for the HC010A0F (3.3V, 10A) at 25°C. The figures are identical for either positive or negative Remote On/Off logic.

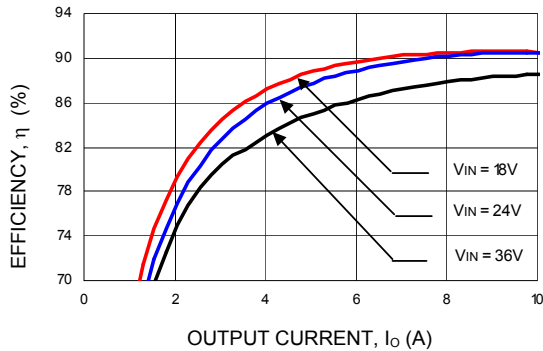


Figure 1. Converter Efficiency versus Output Current

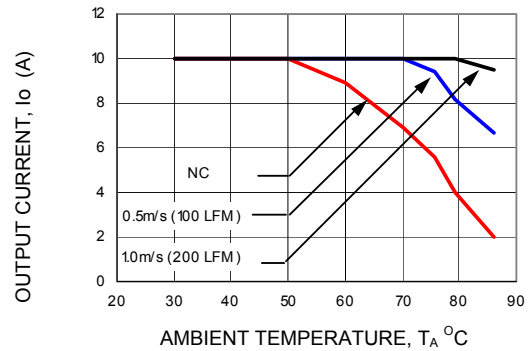


Figure 4. Derating Output Current versus Local Ambient Temperature and Airflow

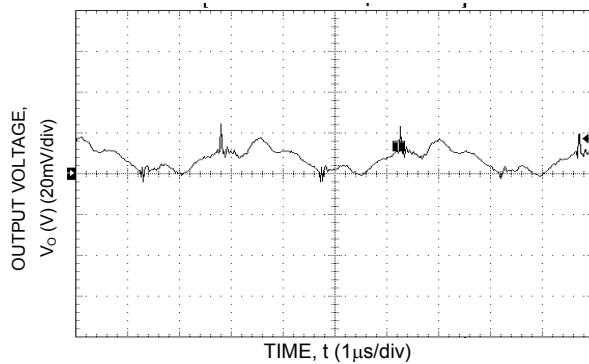


Figure 2. Typical Output Ripple and Noise.

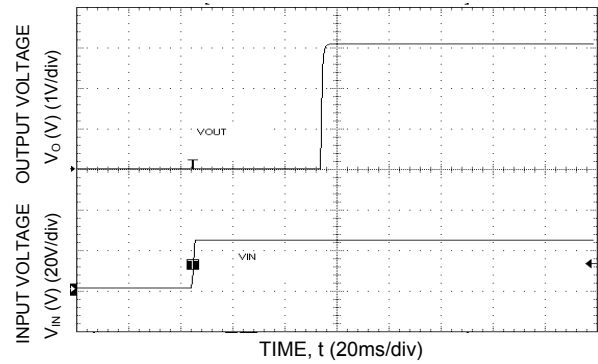


Figure 5. Typical Start-Up with application of  $V_{IN}$  ( $V_{IN} = 24V_{dc}$ ,  $I_o = 10A$ ).

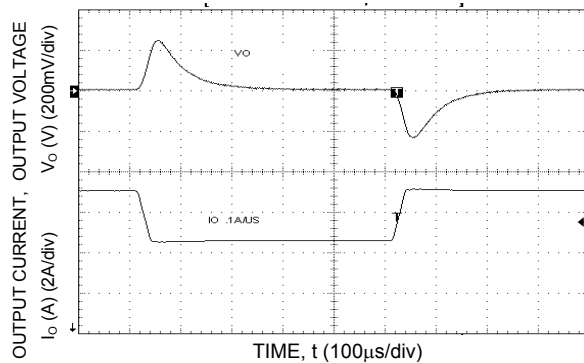


Figure 3. Transient Response to Dynamic Load Change from 50% to 75% to 50% of full load.

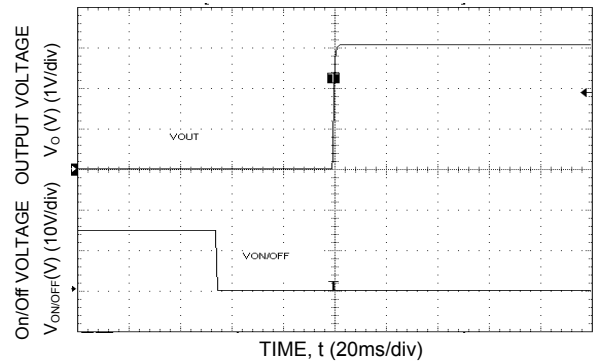


Figure 6. Typical Start-Up Using Remote On/Off, negative logic version shown.

## Characteristic Curves (continued)

The following figures provide typical characteristics for the HC006A6A (5.0V, 6.6A) at 25°C. The figures are identical for either positive or negative Remote On/Off logic.

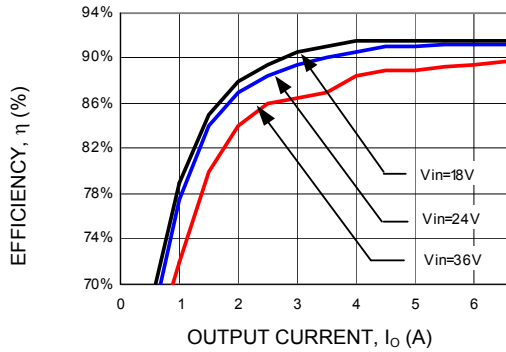


Figure 7. Converter Efficiency versus Output Current

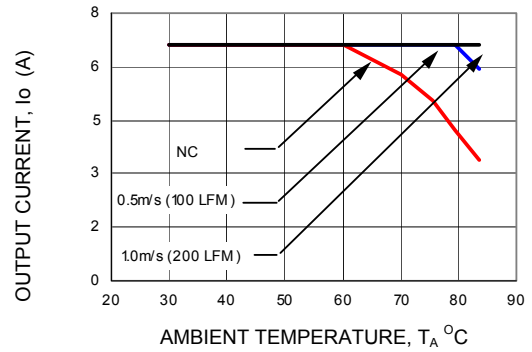


Figure 10. Derating Output Current versus Local Ambient Temperature and Airflow

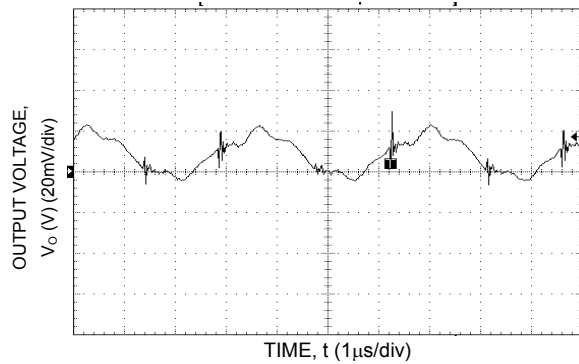


Figure 8. Typical Output Ripple and Noise ( $V_{IN} = 24Vdc$ ,  $I_o = 6.6A$ ).

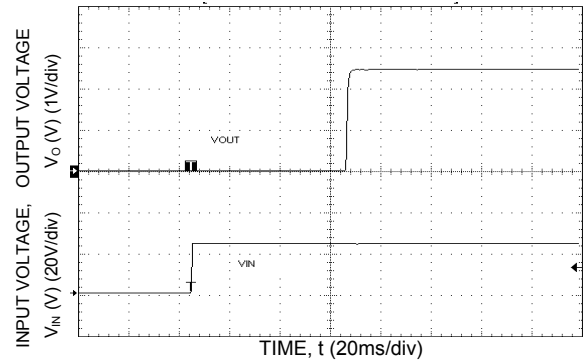


Figure 11. Typical Start-Up with application of  $V_{IN}$  ( $V_{IN} = 48Vdc$ ,  $I_o = 6.6A$ ).

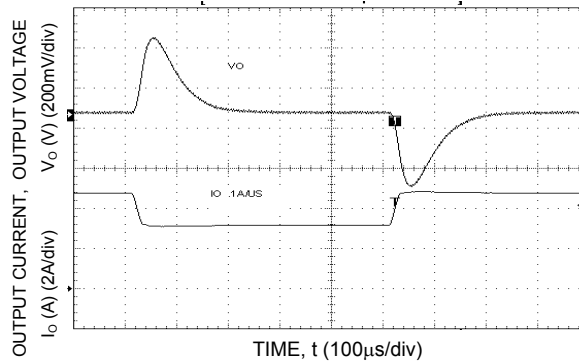


Figure 9. Transient Response to Dynamic Load Change from 50% to 75% to 50% of full load.

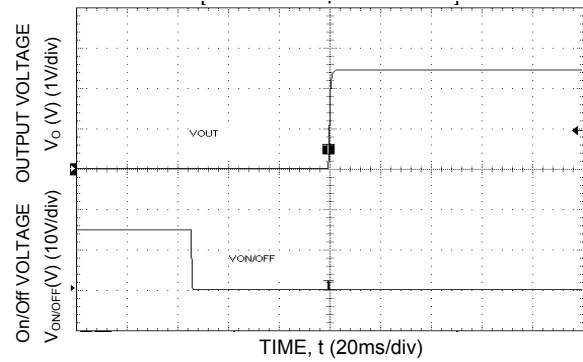
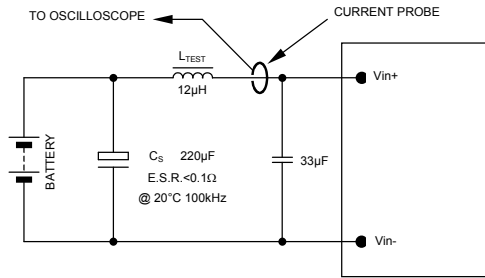


Figure 12. Typical Start-Up Using Remote On/Off, negative logic version shown ( $V_{IN} = 24Vdc$ ,  $I_o = 6.6A$ ).

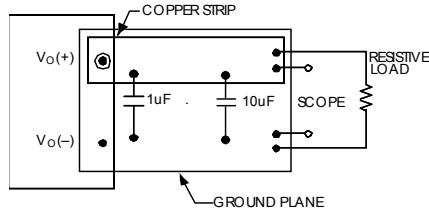


## Test Configurations



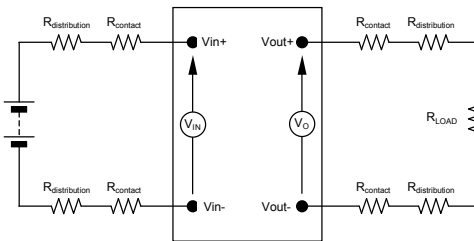
NOTE: Measure input reflected ripple current with a simulated source inductance ( $L_{TEST}$ ) of 12µH. Capacitor  $C_S$  offsets possible battery impedance. Measure current as shown above.

Figure 13. Input Reflected Ripple Current 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 14. 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 15. Output Voltage and Efficiency Test Setup.

$$\text{Efficiency } \eta = \frac{V_O \cdot I_O}{V_{IN} \cdot I_{IN}} \times 100 \%$$

## Design Considerations

### Input Source Impedance

The power module should be connected to a low ac-impedance source. A highly inductive source impedance can affect the stability of the power module. For the test configuration in Figure 13, 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 60950-1-3, CSA C22.2 No. 60950-00, and VDE 0805:2001-12 (IEC60950-1).

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.
- One  $V_{IN}$  pin and one  $V_{OUT}$  pin are to be grounded, or both the input and output pins are to be kept floating.
- 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.

**Note:** Do not ground either of the input pins of the module without grounding one of the output pins. This may allow a non-SELV voltage to appear between the output pins and ground.

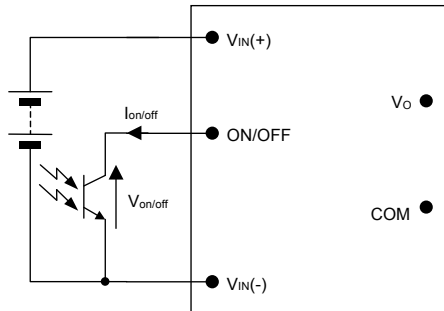
The power module has extra-low voltage (ELV) outputs when all inputs are ELV.

For input voltages exceeding -60 Vdc but less than or equal to -75 Vdc, these converters have been evaluated to the applicable requirements of BASIC INSULATION between secondary DC MAINS DISTRIBUTION input (classified as TNV-2 in Europe) and unearthed SELV outputs. "All flammable materials used in the manufacturing of these modules are rated 94V-0 and UL60950 A.2 for reduced thicknesses. The input to these units is to be provided with a maximum 3A fast-acting fuse in the unearthed lead."

## Feature Description

### 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.



**Figure 16. 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  $-0.7V \leq V_{on/off} \leq 1.2V$ . The maximum  $I_{on/off}$  during a logic low is 1mA, the switch should maintain a logic low level whilst sinking this current.

During a logic high, the maximum  $V_{on/off}$  generated by the module is 15V, and the maximum allowable leakage current at  $V_{on/off} = 15V$  is 50 $\mu$ A.

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  $V_{IN}(-)$ .

### Overcurrent Protection

To provide protection in a fault (output overload) condition, the module is equipped with internal current-limiting circuitry, and can endure current limiting continuously. At the instance of current-limit inception, the output current begins to tail-out. When an overcurrent condition exists beyond a few seconds, the module enters a "hiccup" mode of operation, whereby it shuts down and automatically attempts to restart upon cooling. While the fault condition exists, the module will remain in this hiccup mode, and can remain in this mode until the fault is cleared. The unit operates normally once the output current is reduced back into its specified range.

### 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.

### Over Voltage Protection

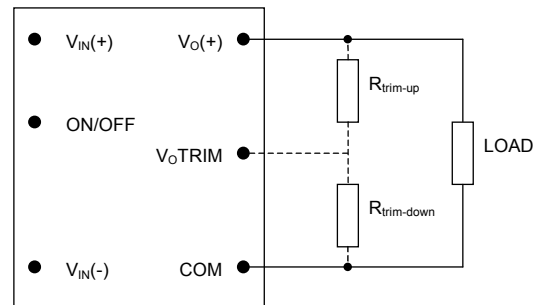
The output overvoltage protection clamp consists of control circuitry, independent of the primary regulation loop, that monitors the voltage on the output terminals. This control loop has a higher voltage set point than the primary loop (See the overvoltage clamp values in the Feature Specifications Table). In a fault condition, the overvoltage clamp ensures that the output voltage does not exceed  $V_{o,ovsd, max}$ . This provides a redundant voltage-control that reduces the risk of output overvoltage.

### Over Temperature Protection

To provide protection in a fault condition, the unit is equipped with a thermal shutdown circuit. The unit will shutdown if the overtemperature threshold of 125°C 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.

### Output Voltage Programming

Trimming allows the output voltage set point to be increased or decreased, this is accomplished by connecting an external resistor between the TRIM pin and either the  $V_O(+)$  pin or the  $V_O(-)$  pin (COM pin).



**Figure 17. Circuit Configuration to Trim Output Voltage.**

Connecting an external resistor ( $R_{trim-down}$ ) between the TRIM pin and the COM pin decreases the output voltage set point. The following equation determines the value of trim-down resistor needed to decrease the output voltage from  $V_{o,set}$  to  $V_o$ :

## Feature Descriptions (continued)

### Output Voltage Programming (continued)

$$R_{trim-down} = \left[ \frac{A}{\Delta\%} - B \right] k\Omega$$

$R_{trim-down}$  is the external resistor in  $k\Omega$

$\Delta\%$  is the % change in output voltage

Values of A & B are provided in Table 1

Table 1

Output Voltage (V)	A	B
3.3V	1690	73.1
5.0V	1690	73.1

Connecting an external resistor ( $R_{trim-up}$ ) between the TRIM pin and the  $V_O(+)$  pin increases the output voltage set point. The relationship between the output voltage and the trim resistor value for a  $\Delta\%$  increase in output voltage is:

$$R_{trim-up} = \left\{ \left[ \frac{A(100 + \Delta\% - B)}{\Delta\%} \right] - C \right\} k\Omega$$

$R_{trim-up}$  is the external resistor in  $k\Omega$

$\Delta\%$  is the % change in output voltage

Values of A, B and C are provided in Table 2

Table 2

Output Voltage (V)	A	B	V
3.3	45.5	1690	73.1
5.0	69.0	1690	73.1

Examples:

To trim down the output of a nominal 5.0V module (HC006A6A) to 4.90V

$\Delta\% = 2$

$$R_{trim-down} = \left[ \frac{1690}{2} - 73.1 \right] k\Omega$$

$$R_{trim-down} = 771.9k\Omega$$

To trim up the output of a nominal 3.3V module (HC010A0F) to 3.63V

$\Delta\% = 10$

$$R_{trim-up} = \left\{ \left[ \frac{45.5(100 + 10) - 1690}{10} \right] - 73.1 \right\} k\Omega$$

$$R_{trim-up} = 258.4k\Omega$$

## Thermal Considerations

The power modules operate 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 18. For reliable operation this temperature should not exceed 110 °C

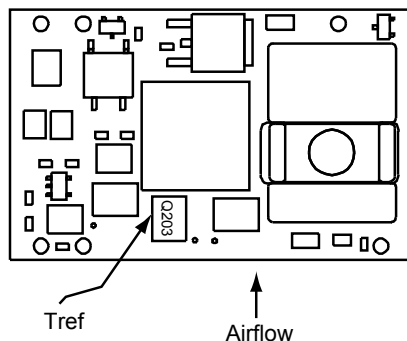


Figure 18.  $T_{ref}$  Temperature Measurement Location.

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.

## 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 3m/s (600 ft./min) are shown in the respective Characteristics Curves section.

## EMC Considerations

The figure 19 shows a suggested configuration to meet the conducted emission limits of EN55022 Class B.

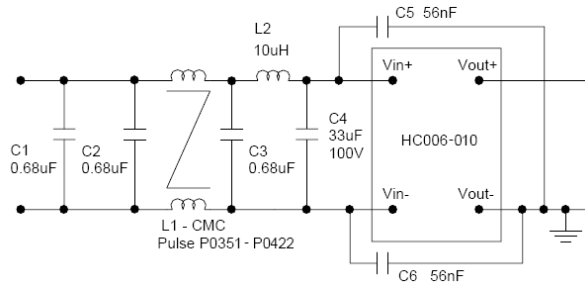


Figure 19. Suggested Configuration for EN55022 Class B.

For further information on designing for EMC compliance, please refer to the FLTR100V10 data sheet (FDS01-043EPS).

## Layout Considerations

The HC power module series are 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.

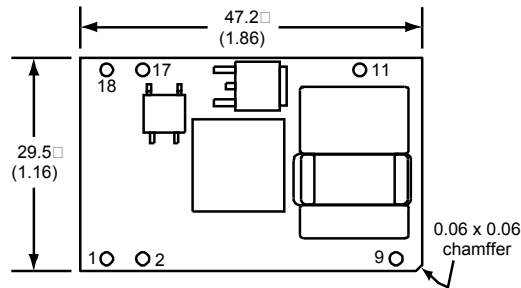
## Mechanical Outline for Surface-Mount Module

Dimensions are in millimeters and (inches).

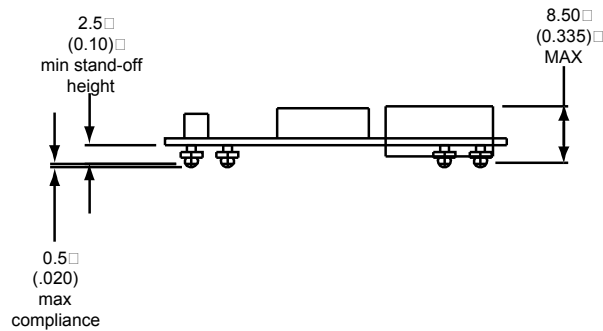
Tolerances:  $x.x \text{ mm} \pm 0.5 \text{ mm}$  ( $x.xx \text{ in.} \pm 0.02 \text{ in.}$ ) [Unless otherwise indicated]

$x.xx \text{ mm} \pm 0.25 \text{ mm}$  ( $x.xxx \text{ in.} \pm 0.010 \text{ in.}$ )

**Top View**

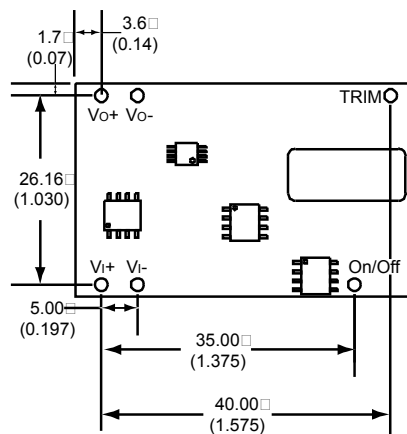


**Side View**



**Bottom View**

Pin	Function
1	Vo(+)
2	Vo(-)
9	Trim
11	On/Off
17	Vin(-)
18	Vin(+)





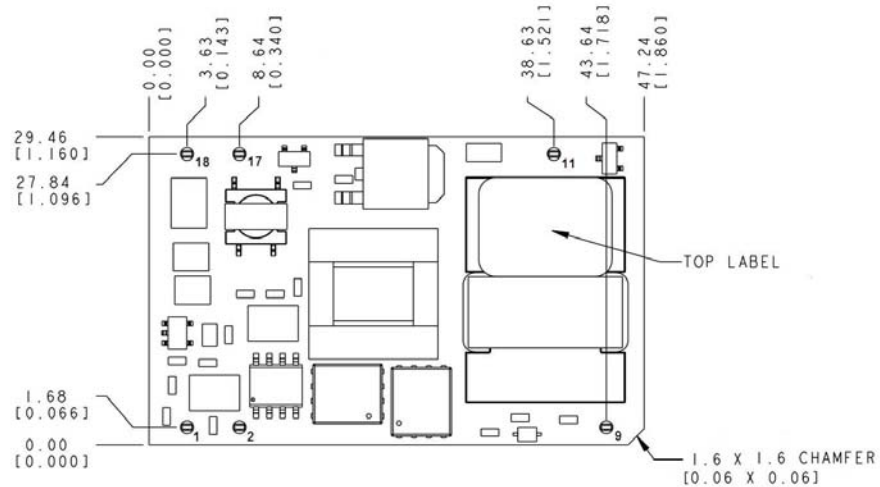
## Mechanical Outline for Through Hole Module

Dimensions are in millimeters and [inches].

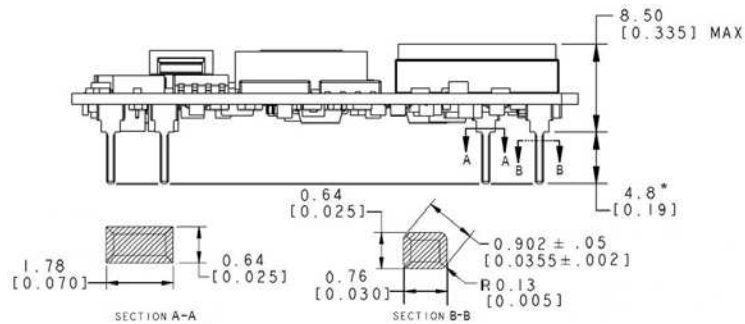
Tolerances: x.x mm  $\pm$  0.5 mm [x.xx in.  $\pm$  0.02 in.] (Unless otherwise indicated)

x.xx mm  $\pm$  0.25 mm [x.xxx in  $\pm$  0.010 in.]

Top View



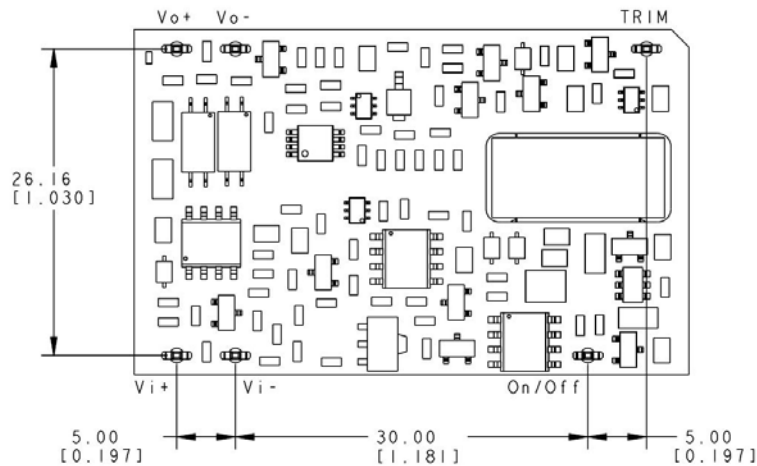
Side View



\* Optional pin lengths shown in Table 2 Device Options

Bottom View

Pin	Function
1	Vo(+)
2	Vo(-)
9	Trim
11	On/Off
17	Vin(-)
18	Vin(+)

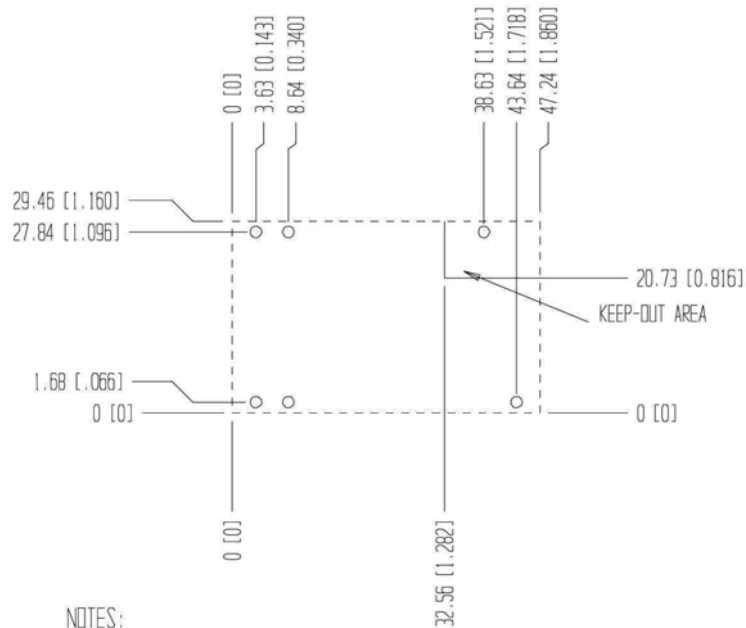


## Recommended Pad Layout for Surface Mount and Through Hole Module

Dimensions are in millimeters and [inches].

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

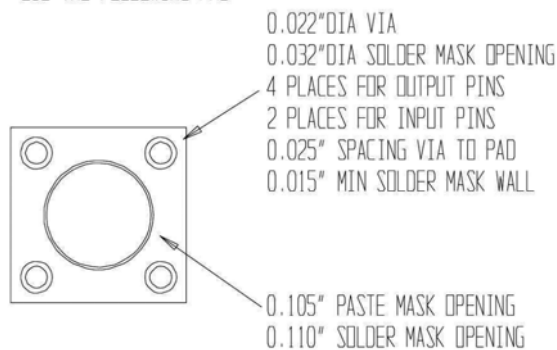
x.xx mm  $\pm$  0.25 mm [x.xxx in  $\pm$  0.010 in.]



### NOTES:

1. FOR 0.025" X 0.035" PIN  
USE 0.045" DIA PLATED THROUGH HOLE

2. FOR CGA SURFACE MOUNT PIN  
USE THE FOLLOWING PAD

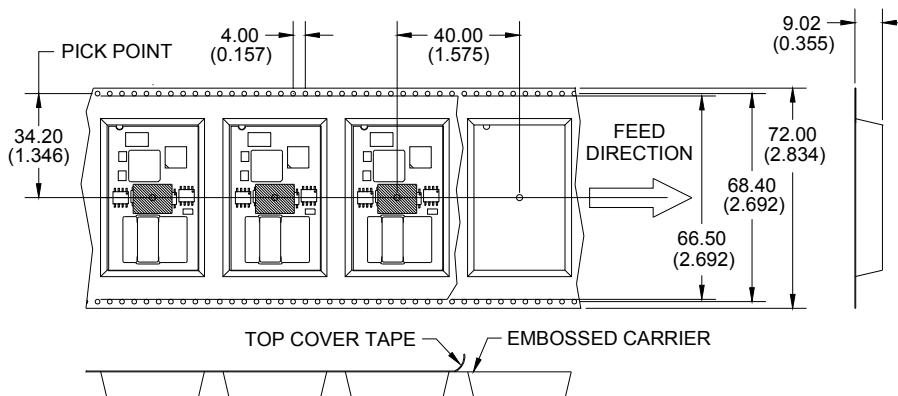


## Packaging Details

The surface mount versions of the HW005 family are also available in tape & reel (suffix –SR) as an option. Detailed of tape dimensions are shown below. Modules are shipped in quantities of 115 per reel.

### Tape Dimensions

Dimensions are in millimeters and (inches).



NOTE: CONFORMS TO EIA-481 REV. A STANDARD

### Reel Dimensions

Outside diameter: 330.2 mm (13.00")  
Inside diameter: 177.8 mm (7.00")  
Tape Width: 72.00 mm (2.834")

### Through-Hole Lead-Free Soldering Information

The RoHS-compliant through-hole products use the SAC (Sn/Ag/Cu) Pb-free solder and RoHS-compliant components. They are designed to be processed through single or dual wave soldering machines. The pins have an RoHS-compliant finish that is compatible with both Pb and Pb-free wave soldering processes. A maximum preheat rate of 3°C/s is suggested. The wave preheat process should be such that the temperature of the power module board is kept below 210°C. For Pb solder, the recommended pot temperature is 260°C, while the Pb-free solder pot is 270°C max. Not all RoHS-compliant through-hole products can be processed with paste-through-hole Pb or Pb-free reflow process. If additional information is needed, please consult with your Lineage Power representative for more details.

### Surface Mount Information

#### Packaging Details

The surface mount versions of the HC family (suffix – S) are supplied as standard in the plastic tray shown in Figure 21. The tray has external dimensions of 136mm (W) x 322.6mm (L) x 18.4mm (H) or 5.35in (W) x 12.7in (L) x 0.72in (H).

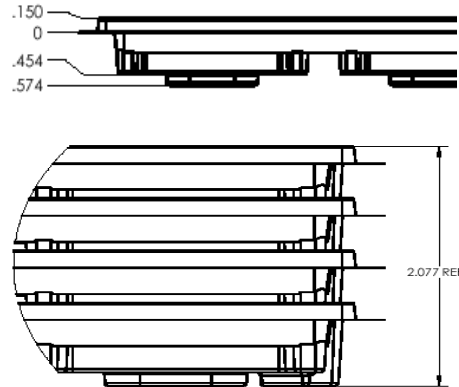
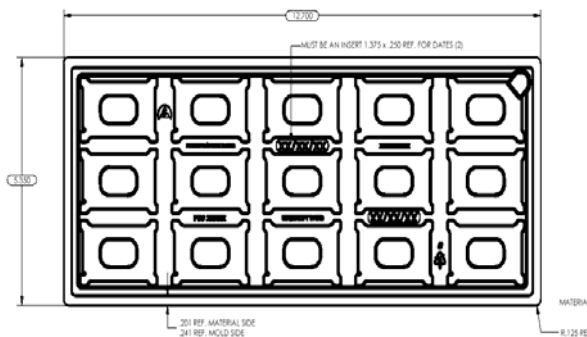


Figure 21. Surface Mount Packaging Tray

#### Tray Specification

Material	Antistatic coated PVC
Max temperature	65°C
Max surface resistivity	$10^{12} \Omega/\text{sq}$
Colour	Clear
Capacity	15 power modules
Min order quantity	45 pcs (1 box of 3 full trays)

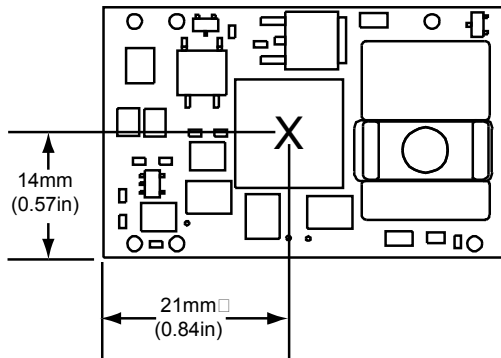
Each tray contains a total of 15 power modules. The trays are self-stacking and each shipping box will contain 3 full trays plus one empty hold down tray giving a total number of 45 power modules.

#### Pick and Place

The HC-S series of DC-to-DC power converters use an open-frame construction and are designed for surface mount assembly within a fully automated manufacturing process.

The HC-S series modules are fitted with a Kapton label designed to provide a large flat surface for pick and placing. The label is located covering the Centre of Gravity of the power module. The label meets all the requirements for surface-mount processing, as well as meeting UL safety agency standards. The label will withstand reflow temperatures up to 300°C. The label also carries product information such as product code, date and location of manufacture.

## Surface Mount Information (continued)



Note: All dimensions in mm.

**Figure 22. Pick and Place Location.**

### Z Plane Height

The 'Z' plane height of the pick and place location is 7.50mm nominal with an RSS tolerance of  $\pm 0.25$  mm.

### Nozzle Recommendations

The module weight has been kept to a minimum by using open frame construction. Even so, they have a relatively large mass when compared with conventional SMT components. Variables such as nozzle size, tip style, vacuum pressure and placement speed should be considered to optimize this process.

The minimum recommended nozzle diameter for reliable operation is 6mm. The maximum nozzle outer diameter, which will safely fit within the allowable component spacing, is 9 mm.

Oblong or oval nozzles up to 11 x 9 mm may also be used within the space available.

For further information please contact your local Lineage Power Technical Sales Representative.

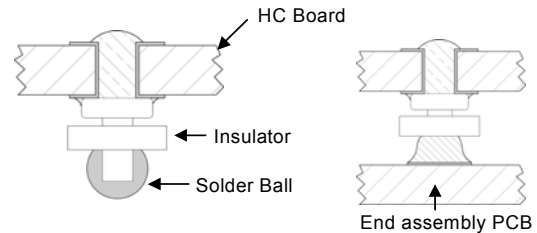
### Reflow Soldering Information

The HC family of power modules is available for either Through-Hole (TH) or Surface Mount (SMT) soldering. These power modules are large mass, low thermal resistance devices and typically heat up slower than other SMT components. It is recommended that the customer review data sheets in order to customize the solder reflow profile for each application board assembly.

The following instructions must be observed when SMT soldering these units. Failure to observe these instructions may result in the failure of or cause

damage to the modules, and can adversely affect long-term reliability.

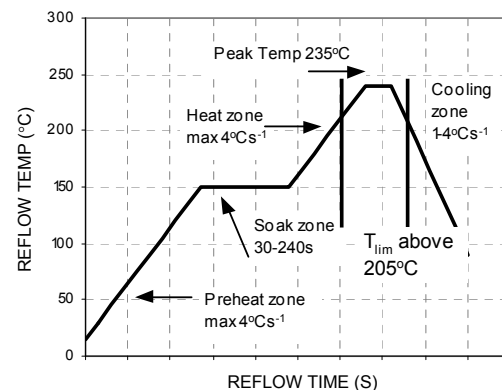
The surface mountable modules in the HC family use our newest SMT technology called "Column Pin" (CP) connectors. Fig 23 shows the new CP connector before and after reflow soldering onto the end-board assembly.



**Figure 23. Column Pin Connector Before and After Reflow Soldering.**

The CP is constructed from a solid copper pin with an integral solder ball attached, which is composed of tin/lead (Sn/Pb) solder. The CP connector design is able to compensate for large amounts of co-planarity and still ensure a reliable SMT solder joint.

Typically, the eutectic solder melts at  $183^{\circ}\text{C}$ , wets the land, and subsequently wicks the device connection. Sufficient time must be allowed to fuse the plating on the connection to ensure a reliable solder joint. There are several types of SMT reflow technologies currently used in the industry. These surface mount power modules can be reliably soldered using natural forced convection, IR (radiant infrared), or a combination of convection/IR. For reliable soldering the solder reflow profile should be established by accurately measuring the modules CP connector temperatures.



**Figure 24. Recommended Reflow Profile**



## Surface Mount Information (continued)

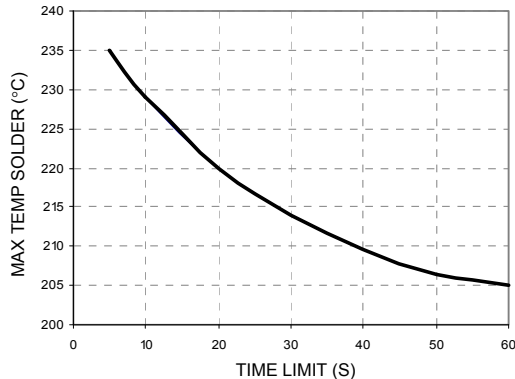


Figure 25. Time Limit Curve Above 205°C Reflow .

## Lead Free Soldering

The SMT modules of the HW/HC series are lead-free (Pb-free) and RoHS compliant and are both forward and backward compatible in a Pb-free and a SnPb soldering process. Failure to observe the instructions below may result in the failure of or cause damage to the modules and can adversely affect long-term reliability.

## Pb-free Reflow Profile

Power Systems will comply with J-STD-020 Rev. C (Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices) for both Pb-free solder profiles and MSL classification procedures. This standard provides a recommended forced-air-convection reflow profile based on the volume and thickness of the package (table 4-2). The suggested Pb-free solder paste is Sn/Ag/Cu (SAC). The recommended linear reflow profile using Sn/Ag/Cu solder is shown in Figure. 26.

## Storage and Handling

The recommended storage environment and handling procedures for moisture-sensitive surface mount packages is detailed in J-STD-033 Rev. A (Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices). Moisture barrier bags (MBB) with desiccant are required for MSL ratings of 2 or greater. These sealed packages should not be broken until time of use. Once the original package is broken, the floor life of the product at conditions of  $\leq 30^{\circ}\text{C}$  and 60% relative humidity varies according to the MSL rating (see J-STD-033A). The shelf life for dry packed SMT packages will be a minimum of 12 months from the bag seal date, when

stored at the following conditions:  $< 40^{\circ}\text{C}$ ,  $< 90\%$  relative humidity.

## MSL Rating

The HW/HC series SMT modules have a MSL rating of 1.

## 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).

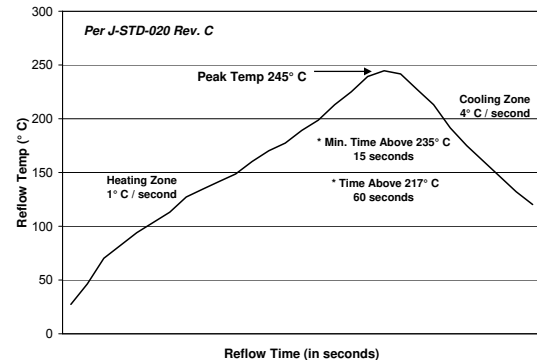


Figure 26. Recommended linear reflow profile using Sn/Ag/Cu solder.

## Solder Ball and Cleanliness Requirements

The open frame (no case or potting) power module will meet the solder ball requirements per J-STD-001B. These requirements state that solder balls must neither be loose nor violate the power module minimum electrical spacing.

The cleanliness designator of the open frame power module is C00 (per J specification).

## Ordering Information

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

**Table 1. Device Codes**

Input Voltage	Output Voltage	Output Current	Remote On/Off Logic	Connector Type	Product codes	Comcodes
24 (18 – 36) Vdc	3.3 V	10A	Negative	SMT	HC010A0F1-S	108975442
24 (18 – 36) Vdc	3.3 V	10A	Negative	SMT	HC010A0F1-SZ	109100220
24 (18 – 36) Vdc	5.0V	6.6A	Negative	SMT	HC006A6A1-S	108975459
24 (18 – 36) Vdc	5.0V	6.6A	Negative	SMT	HC006A6A1-SZ	109100212
24 (18 – 36) Vdc	5.0V	6.6A	Negative	TH	HC006A6A1	108994281
24 (18 – 36) Vdc	5.0V	6.6A	Negative	TH	HC006A6A1Z	CC109107100
24 (18 – 36) Vdc	5.0V	6.6A	Negative	TH	HC006A6A61Z	CC109140266

**Table 2. Device Options**

Option	Suffix
Negative remote on/off logic	1
Short Pins: 3.68 mm ± 0.25 mm (0.145 in ±0.010 in)	6
Short Pins: 2.79 mm ± 0.25 mm (0.110 in ±0.010 in)	8
Tape & Reel	-R
Surface mount connections	-S
RoHS Compliant	-Z



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