Data Sheet
October 5, 2009

KW006-010 Series (Sixteenth-Brick) DC-DC Converter Power Modules: 36–75Vdc Input; 3.3Vdc to 5.0Vdc Output; 6A to 10A Output Current

RoHS Compliant

Applications

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

Options

- Negative Remote On/Off logic

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 33W output power: 3.3V(10A), 5.0V(6A)
- Small size and low profile: 33.0 mm x 22.9 mm x 8.75 mm (1.30 in x 0.9 in x 0.344 in)
- Industry standard DOSA footprint
- Output voltage adjustment trim (-20%, +10%)
- Remote On/Off, Positive logic
- Remote Sense
- Over-temperature protection (non-latching)
- Output over-current protection (non-latching)
- Output over-voltage protection (latching)
- Wide operating temperature range (-40°C to 85°C)
- Meets the voltage isolation requirements for ETSI 300-132-2 and complies with and is licensed for Basic Insulation rating per EN60950-1
- CE mark meets the 2006/95/EC directive§
- *UL** 60950-1Recognized, *CSA*† C22.2 No. 60950-1-03 Certified, and *VDE*‡ 0805 (EN60950 3rd Edition) Licensed
- ISO** 9001 and ISO 14001 certified manufacturing facilities
- Surface Mount (Tape and Reel, -SR Suffix)

Description

The KW (Sixteenth-brick) series power modules are isolated dc-dc converters that operate over a wide input voltage range of 36 to 75Vdc and provide a single precisely regulated output. The output is fully isolated from the input, allowing versatile polarity configurations and grounding connections. The modules exhibit high efficiency, typical efficiency of 87% for 3.3V/10A. These open frame modules are available in surface-mount (-SR) form.

* *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-user equipment. All of the required procedures of end-user 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	All	V_{IN}	-0.3	80	V_{dc}
Transient (100 ms)	All	$V_{IN,trans}$	-0.3	100	V_{dc}
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	V_{dc}

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	48	75	V_{dc}
Maximum Input Current (V_{IN}= $V_{IN, min}$ to $V_{IN, max}$, I_O=$I_{O, max}$)	All	$I_{IN,max}$			1.5	A_{dc}
Input No Load Current (V_{IN} = $V_{IN, nom}$, I_O = 0, module enabled)	All	$I_{IN,No\ load}$		40	75	mA
Input Stand-by Current (V_{IN} = $V_{IN, nom}$, module disabled)	All	$I_{IN,stand\text{-}by}$		3	5	mA
Inrush Transient	All	I^2t			0.1	A^2s
Input Reflected Ripple Current, peak-to-peak (5Hz to 20MHz, 1μH source impedance; $V_{IN, min}$ to $V_{IN, max}$, I_O= I_{Omax} ; See Test configuration section)	All			30		$mA_{p\text{-}p}$
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 time-delay fuse with a maximum rating of 5 A (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 ($V_{IN}=V_{IN, min}$, $I_O=I_{O, max}$, T_A=25°C)	All	$V_{O, set}$	-1.5	—	+1.5	% $V_{O, set}$
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 an external resistor	All	$V_{O,adj}$	-20.0		+10.0	V_{dc}
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		—	—	5	mV
Temperature ($T_{ref}=T_{A, min}$ to $T_{A, max}$)	All		—	—	±1.0	% $V_{O, set}$
Output Ripple and Noise on nominal output ($V_{IN}=V_{IN, nom}$,I_O= $I_{O, max}$, $T_A=T_{A, min}$ to $T_{A, max}$) (see Figure 14 for test conditions)						
RMS (5Hz to 20MHz bandwidth)	F		—	—	20	mV_{rms}
Peak-to-Peak (5Hz to 20MHz bandwidth)	F		—	—	60	mV_{pk-pk}
RMS (5Hz to 20MHz bandwidth)	A		—	—	25	mV_{rms}
Peak-to-Peak (5Hz to 20MHz bandwidth)	A		—	—	75	mV_{pk-pk}
External Capacitance	F	$C_{O, max}$	0*	—	5,000	µF
	A	$C_{O, max}$	0*	—	2,000	µF
Output Current	A	I_o	0	—	6	A_{dc}
	F	I_o	0	—	10	A_{dc}
Output Current Limit Inception (Hiccup Mode) (V_O= 90% of $V_{O, set}$)	All	$I_{O, lim}$	101		130	% I_o
Output Short-Circuit Current (V_O≤250mV) (Hiccup Mode)	All	$I_{O, s/c}$	—	1	—	A_{rms}
Efficiency V_{IN}= $V_{IN, nom}$, T_A=25°C $I_O=I_{O, max}$, V_O= $V_{O,set}$	All	η		87.0		%
Switching Frequency	All	f_{sw}		300		kHz
Dynamic Load Response (dIo/dt=1.0A/µs; V_{IN} = $V_{IN, nom}$; T_A=25°C) Load Change from Io= 50% to 75% or 25% to 50% of Io,max; 470µF external capacitance (ESR_{max}< 20 mΩ)						
Peak Deviation	All	V_{pk}	—	3	—	% $V_{O, set}$
Settling Time (Vo<10% peak deviation)	All	t_s	—	200	—	µs

(* See Output Overvoltage Protection Information in the Feature Specifications and Feature Descriptions for advise on minimum output capacitance)

Isolation Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Isolation Capacitance	All	C_{iso}	—	120	—	pF
Isolation Resistance	All	R_{iso}	10	—	—	MΩ
I/O Isolation Voltage	All	All	—	—	1500	V_{dc}

General Specifications

Parameter	Device	Min	Typ	Max	Unit
Calculated MTBF Based upon Telcordia SR-332 Issue 2: Method 1 Case 3, 90% confidence (I_O=80%$I_{O, max}$, T_A=40°C, Airflow = 200 lfm)	F		3,765,608		Hours
Powered Random Vibration (V_{IN}=$V_{IN, min}$, I_O=$I_{O, max}$, T_A=25°C, 0 to 5000Hz, 10Grms)	All		90		Minutes
Weight	All	—	10 (0.35)	—	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	$I_{on/off}$	—	0.37	1.0	mA
Logic Low - On/Off Voltage	All	$V_{on/off}$	-0.7	—	1.2	V
Logic Threshold – change of state	All	$V_{on/off}$		2.4		V
Logic High Voltage – (Typ = Open Collector)	All	$V_{on/off}$	3	3.4	5	V
Logic High maximum allowable leakage current (current flow sourced from the unit)	All	$I_{on/off}$	—	—	10	μA
External voltage allowed on on/off pin					15	V
Turn-On Delay and Rise Times (I_O=$I_{O, max}$, V_{IN}=$V_{IN, nom}$, T_A = 25 °C)						
Case 1: On/Off input is set to Logic Low (Module ON) and then input power is applied (delay from instant at which V_{IN} = $V_{IN, min}$ until Vo=10% of Vo,set)	All	T_{delay}	—	2	5	msec
Case 2: Input power is applied for at least 1 second and then the 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}	—	2	5	msec
Output voltage Rise time (time for Vo to rise from 10% of $V_{o,set}$ to 90% of $V_{o, set}$, with 0 to max ext capacitance)	All	T_{rise}	—	8	12	msec
Output voltage overshoot – Startup I_O= $I_{O, max}$; V_{IN}=$V_{IN, min}$ to $V_{IN, max}$, T_A = 25 °C		All		—	3	% $V_{O, set}$
Remote Sense Range	All	All			10	% $V_{O, set}$
Output Overvoltage Protection (requires 660 μF output capacitance to meet limits, when Output Overvoltage is caused by internal module failure; see Feature Descriptions for further detail)	A	$V_{O, limit}$	5.75	—	7	V_{dc}
	F	$V_{O, limit}$	3.8	—	4.6	V_{dc}
Input Undervoltage Lockout						
Turn-on Threshold	All	$V_{uv/on}$	—	34	36	V_{dc}
Turn-off Threshold	All	$V_{uv/off}$	24	27	—	V_{dc}
Hysterisis	All	V_{hyst}	—	6	—	V_{dc}

Characteristic Curves

The following figures provide typical characteristics for the KW010A0F (3.3V, 10A) at 25°C. The figures are identical for either positive or negative remote On/Off logic.

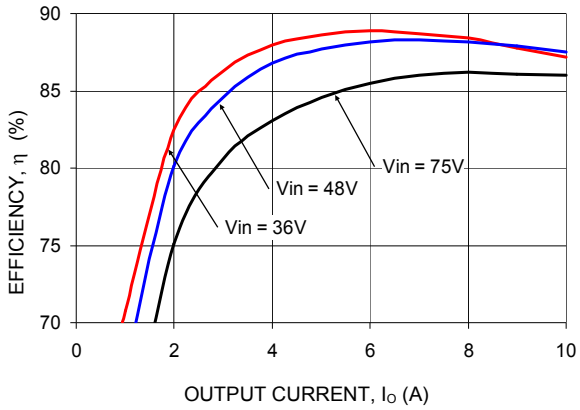


Figure 1. Converter Efficiency versus Output Current.

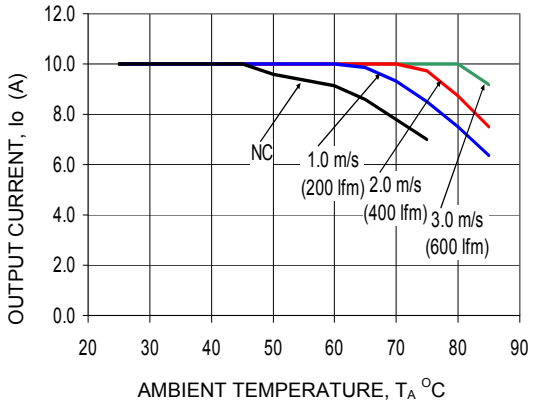


Figure 4. Derating Output Current versus Local Ambient Temperature and Airflow.

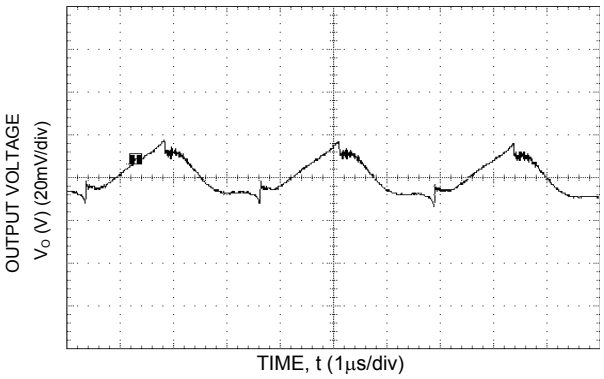


Figure 2. Typical output ripple and noise ($V_{IN} = V_{IN,NOM}$, $I_o = I_{o,max}$).

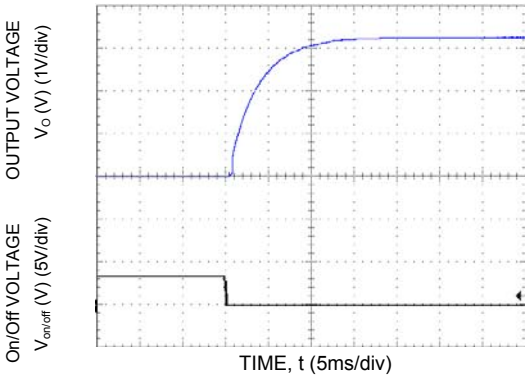


Figure 5. Typical Start-up Using Remote On/Off, negative logic version shown ($V_{IN} = V_{IN,NOM}$, $I_o = I_{o,max}$).

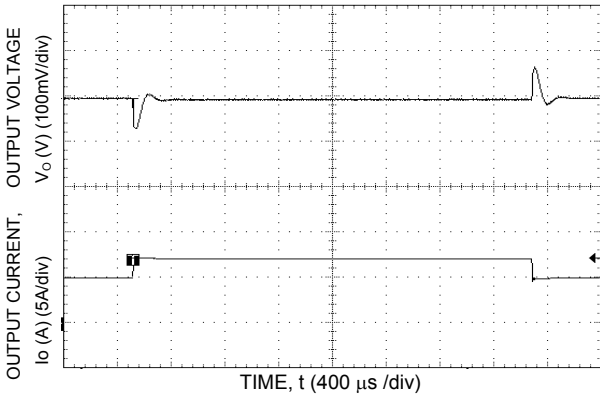


Figure 3. Transient Response to Dynamic Load Change from 75% to 50% to 75% of full load with an external 470uF tantalum capacitor (dI/dt =1.0A/µs).

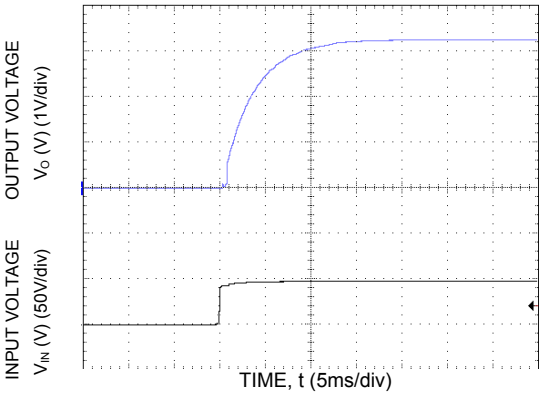


Figure 6. Typical Start-up Using Input Voltage ($V_{IN} = V_{IN,NOM}$, $I_o = I_{o,max}$).

Characteristic Curves (continued)

The following figures provide typical characteristics for the KW006A0A (5.0V, 6A) at 25°C. The figures are identical for either positive or negative remote On/Off logic.

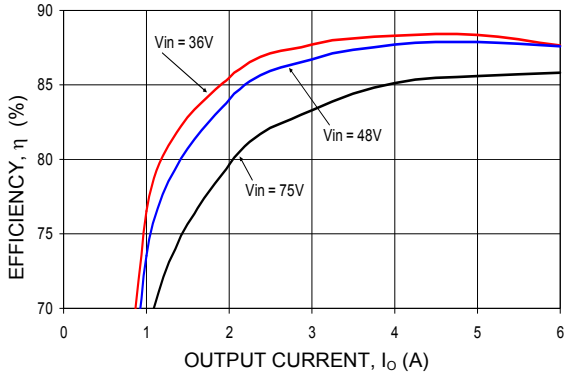


Figure 7. Converter Efficiency versus Output Current.

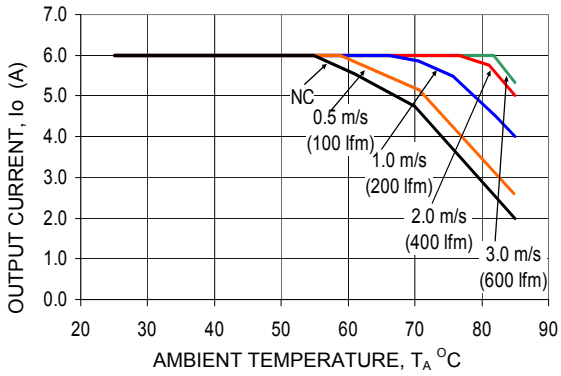


Figure 10. Derating Output Current versus Local Ambient Temperature and Airflow.

Figure 8. Typical output ripple and noise ($V_{IN} = V_{IN,NOM}$, $I_o = I_{o,max}$).

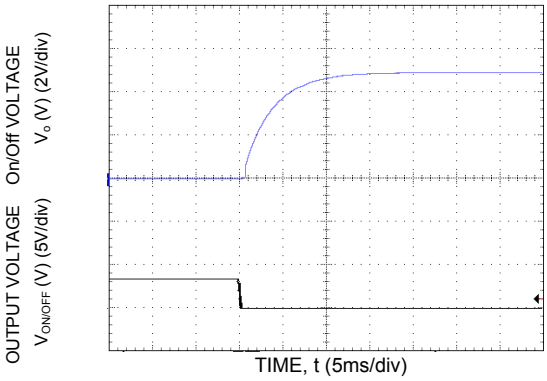


Figure 11. Typical Start-up Using Remote On/Off, negative logic version shown ($V_{IN} = V_{IN,NOM}$, $I_o = I_{o,max}$).

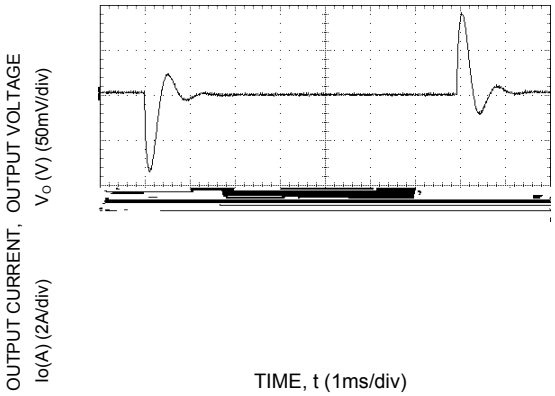


Figure 9. Transient Response to Dynamic Load Change from 50% to 75% to 50% of full load with an external 470uF tantalum capacitor (dI/dt =1.0A/μs).

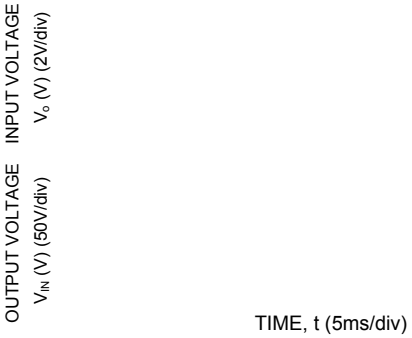


Figure 12. Typical Start-up Using Input Voltage ($V_{IN} = V_{IN,NOM}$, $I_o = I_{o,max}$).

Surface Mount Information

Pick and Place

The KW006/010 modules use an open frame construction and are designed for a fully automated assembly process. The pick and place location on the module is the larger magnetic core as shown in Figure 23. The modules are fitted with a label which meets all the requirements for surface mount processing, as well as safety standards, and is able to withstand reflow temperatures of up to 300°C. The label also carries product information such as product code, serial number and the location of manufacture.

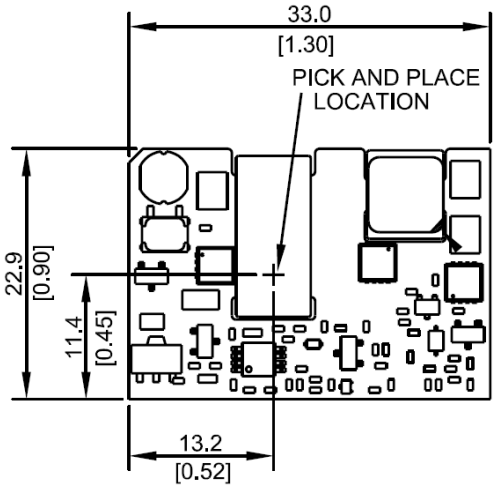


Figure 23. Pick and Place Location.

Nozzle Recommendations

The module weight has been kept to a minimum by using open frame construction. Even so, these modules have a relatively large mass when compared to conventional SMT components. Variables such as nozzle size, tip style, vacuum pressure and placement speed should be considered to optimize this process. The recommended nozzle diameter for reliable operation is 6mm. Oblong or oval nozzles up to 11 x 6 mm may also be used within the space available.

Tin Lead Soldering

The KW006/010 power modules (both non-Z and –Z codes) can be soldered either in a conventional Tin/Lead (Sn/Pb) process. The non-Z version of the KW006/010 modules are RoHS compliant with the lead exception. Lead based solder paste is used in the soldering process during the manufacturing of these modules. These modules can only be soldered in conventional Tin/lead (Sn/Pb) process. 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 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.

In a conventional Tin/Lead (Sn/Pb) solder process peak reflow temperatures are limited to less than 235°C. Typically, the eutectic solder melts at 183°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.

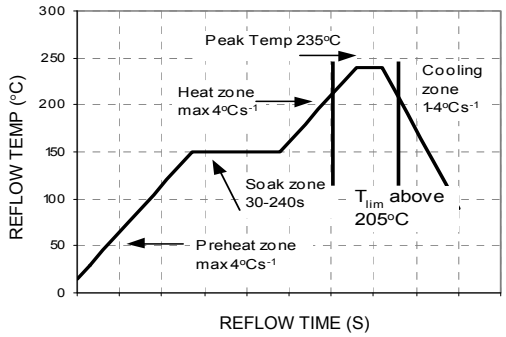


Figure 24. Reflow Profile for Tin/Lead (Sn/Pb) process

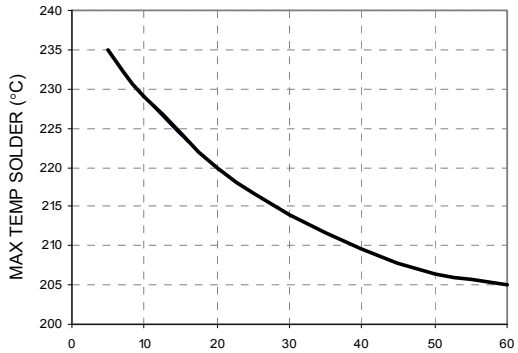


Figure 25. Time Limit Curve Above 205°C for Tin/Lead (Sn/Pb) process

Lead Free Soldering

The –Z version of the KW006/010 modules are lead-free (Pb-free) and RoHS compliant and are both forward and backward compatible in a Pb-free and a SnPb soldering process. The non-Z version of the KW006/010 modules are RoHS compliant with the lead exception. Lead based solder paste is used in the soldering process during the manufacturing of these modules. These modules can only be soldered in

Surface Mount Information (continued)

conventional Tin/lead (Sn/Pb) 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 Non-hermetic 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.

MSL Rating

The KW006/010 modules have a MSL rating of 2.

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 ≤ 30°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° C, < 90% relative humidity.

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 (AN04-001).

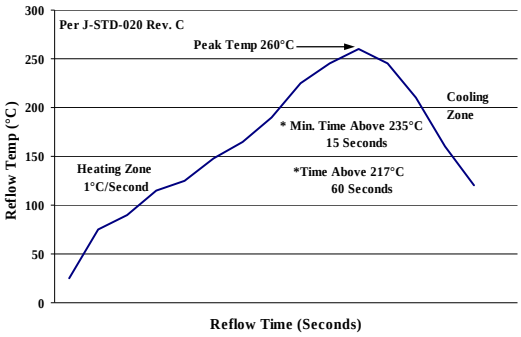


Figure 26. Recommended linear reflow profile using Sn/Ag/Cu solder.

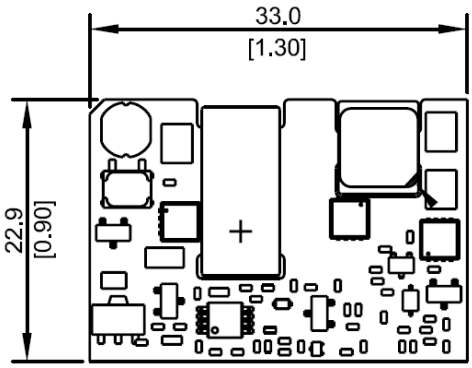
Mechanical Outline for Surface Mount Module

Dimensions are in millimeters and [inches].

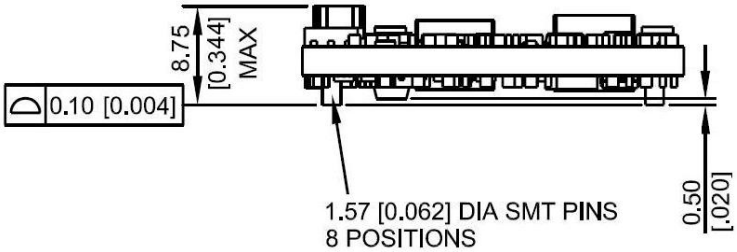
Tolerances: x.x mm ± 0.5 mm [x.xx in. ± 0.02 in.] (unless otherwise indicated)

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

Top View

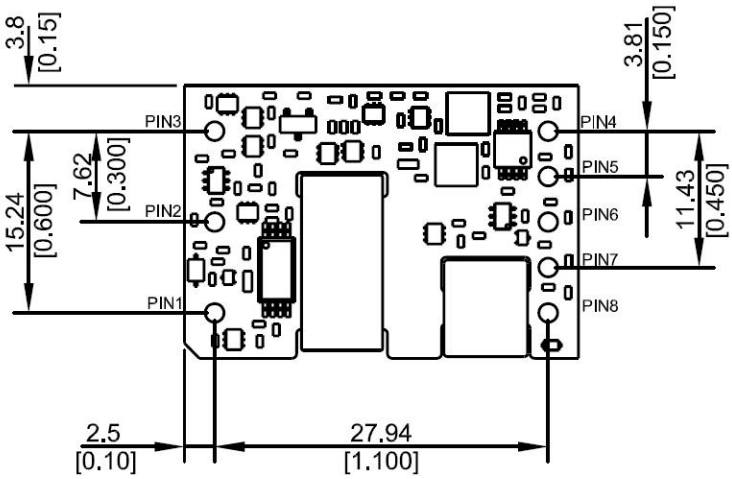


Side View



Bottom View

PIN	FUNCTION
1	$V_{IN}(+)$
2	On/Off
3	$V_{IN}(-)$
4	$V_o(-)$
5	Sense(-)
6	Trim
7	Sense(+)
8	$V_o(+)$

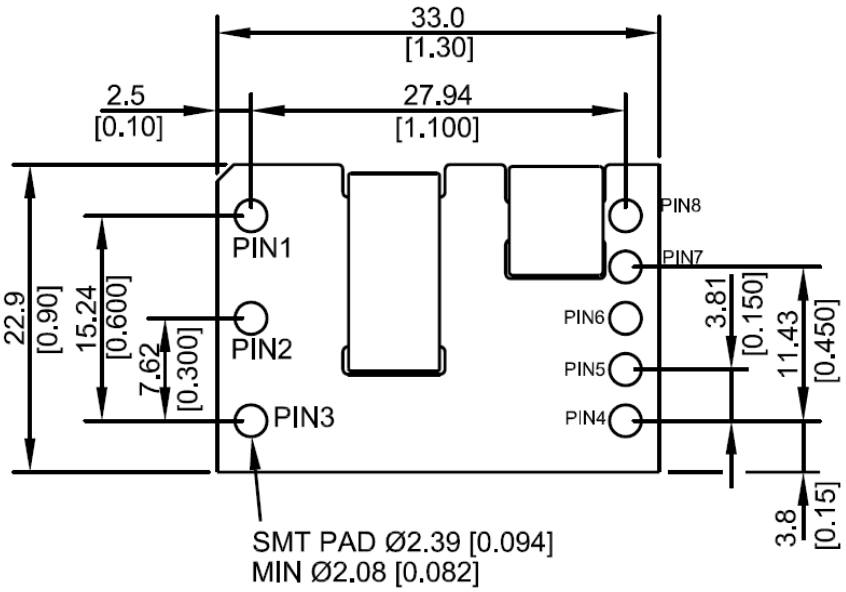


Recommended Pad Layout

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.]



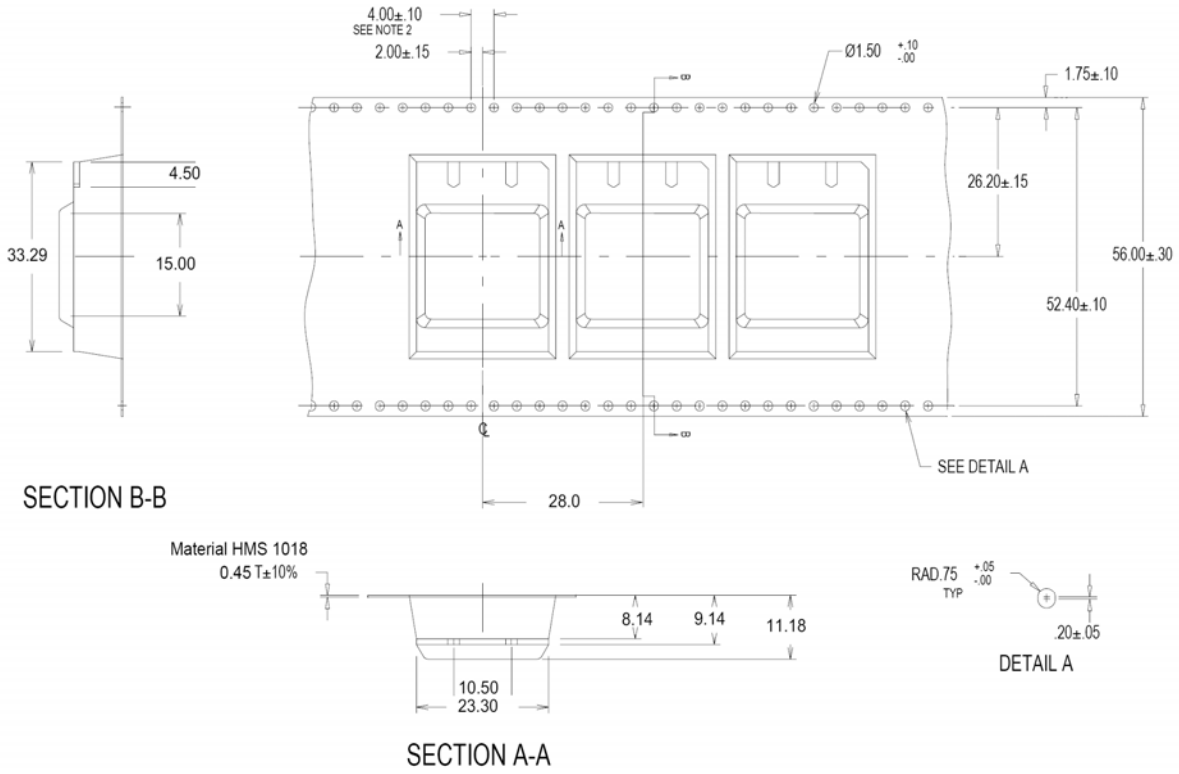
SMT Recommended Pad Layout (Component Side View)

Packaging Details

The Sixteenth-brick SMT versions are supplied in tape & reel as standard. Details of tape dimensions are shown below. Modules are shipped in quantities of 140 modules per reel.

Tape Dimensions

Dimensions are in millimeters.



Ordering Information

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

Table 1. Device Code

Product Codes	Input Voltage	Output Voltage	Output Current	On/Off Logic	Connector Type	Comcode
KW010A0F41-SR	48V (36-75Vdc)	3.3V	10A	Negative	Surface mount	108996360
KW010A0F41-SRZ	48V (36-75Vdc)	3.3V	10A	Negative	Surface mount	CC109114113
KW006A0A41-SR	48V (36-75Vdc)	5V	6A	Negative	Surface mount	108996385
KW006A0A41-SRZ	48V (36-75Vdc)	5V	6A	Negative	Surface mount	CC109128798

-Z Indicated RoHS Compliant Modules

Table 2. Device Options

Option*	Suffix**
Negative remote on/off logic	1
Over-Current (auto-restart)/ Over-Temp Protection(auto-restart) /Over-Voltage (latching)	4 (must be ordered)
Surface mount connections (Tape & Reel)	-SR (must be ordered)

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