Data Sheet
June 2001

LAW005-Series Power Modules; dc-dc Converters: 36 Vdc to 75 Vdc Input; 5 W

The LAW005-Series Power Modules use advanced, surface-mount technology and deliver high-quality, compact, dc-dc conversion at an economical price.

Applications

- Communication equipment
- Computer equipment

Features

- Small footprint: 32 mm x 20 mm (1.25 in. x 0.8 in.)
- Low profile: 10.7 mm (0.42 in.)
- Wide input voltage range: 36 Vdc to 75 Vdc
- Input-to-output isolation: 1500 Vdc
- Operating ambient temperature range: –25 °C to +71 °C with no derating
- 12.5 W per cubic inch
- Metal case
- Burn in 4 hours @ 50 °C, full load
- Output overcurrent protection, unlimited duration
- Output overvoltage protection
- *UL** 60950 Recognized, *CSA*† C22.2 No. 60950-00 Certified, *VDE*‡ 0805 (IEC60950) Licensed
- CE mark meets 73/23/EEC and 93/68/EEC directives§
- Within FCC Class A radiated limits

Options

- Short pins: 2.8 mm ± 0.25 mm (0.110 in. ± 0.010 in.)

Description

The LAW005-Series Power Modules are low-profile dc-dc converters that operate over an input voltage range of 36 Vdc to 75 Vdc and provide precisely regulated single or dual outputs. The –25 °C to +71 °C operating temperature range makes it ideal for electronic data processing applications. The outputs are isolated from the inputs, allowing versatile polarity configurations and grounding connections. The modules have a maximum power rating of 5 W and a typical full-load efficiency of 80%. Built-in filtering for both input and output minimizes the need for external filtering.

* *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 the required procedures for CE marking of end-use equipment should be followed. (The CE mark is placed on selected products.)

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 device reliability.

Parameter	Symbol	Min	Max	Unit
Input Voltage: Continuous Transient (100 ms)	 V_I $V_{I, trans}$	 0 0	 80 100	 Vdc V
Operating Ambient Temperature* (natural convection)	T_A	–25	71	°C
Storage Temperature	T_{stg}	–55	105	°C
I/O Isolation Voltage	—	—	1500	Vdc

* At $I_O = I_{O, max}$, derate linearly to 0 W at 100 °C. Unit guaranteed to start at –40 °C. All parameters will be within specification at T_A = –25 °C.

Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage and resistive load from –25 °C to +71 °C.

Table 1. Input Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	V_I	36	48	75	Vdc
Input Current (V_I = 0 V to $V_{I, max}$; $I_O = I_{O, max}$)	$I_{I, max}$	—	250	—	mA
Inrush Transient	i^2t	—	0.008	—	A^2s
Input Reflected-ripple Current (See Figure 1.)	I_I	—	5	—	mAp-p

Fusing Considerations

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

This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone 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 normal-blow 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 for further information.

Electrical Specifications (continued)

Table 2. Output Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Voltage Set Point (V_I = 48 V; I_O = $I_{O, max}$; T_A = 25 °C)	LAW005F	$V_{O, set}$	3.26	3.3	3.33	Vdc
	LAW005A	$V_{O, set}$	4.95	5.00	5.05	Vdc
	LAW005B	$V_{O, set}$	11.88	12.00	12.12	Vdc
	LAW005C	$V_{O, set}$	14.85	15.00	15.15	Vdc
	LAW005BK	$V_{O1, set}$	11.88	12.00	12.12	Vdc
		$V_{O2, set}$	11.88	12.00	12.12	Vdc
	LAW005CL	$V_{O1, set}$	14.85	15.00	15.15	Vdc
		$V_{O2, set}$	14.85	15.00	15.15	Vdc
Output Voltage (Over all line, load, and temperature conditions until end of life; see Figure 3.)	LAW005F	V_O	3.17	—	3.43	Vdc
	LAW005A	V_O	4.80	—	5.20	Vdc
	LAW005B	V_O	11.52	—	12.48	Vdc
	LAW005C	V_O	14.40	—	15.60	Vdc
	LAW005BK	V_{O1}	11.52	—	12.48	Vdc
		V_{O2}	–11.52	—	–12.48	Vdc
	LAW005CL	V_{O1}	14.40	—	15.60	Vdc
		V_{O2}	–14.40	—	–15.60	Vdc
Output Regulation:						
Line (V_I = 36 V to 75 V)	All	—	—	—	0.2	%V_O
Load (I_O = 25% $I_{O, max}$)	LAW005F	—	—	—	0.5	%V_O
	LAW005A	—	—	—	0.5	%V_O
	LAW005B	—	—	—	0.5	%V_O
	LAW005C	—	—	—	0.5	%V_O
Load (I_O = 50% $I_{O, max}$ to $I_{O, max}$)	LAW005BK	—	—	—	1.0	%V_O
	LAW005CL	—	—	—	1.0	%V_O
Temperature (T_A = –25 °C to +71 °C)	All	—	—	—	0.2	%V_O
Output Ripple and Noise Voltage (see Figure 2.):						
RMS	All	—	—	—	10	mVrms
Peak-to-peak (5 Hz to 20 MHz)	All	—	—	—	75	mVp-p
External Load Capacitance	LAW005F	—	—	—	1000	µF
	LAW005A	—	—	—	1000	µF
	LAW005B	—	—	—	220	µF
	LAW005C	—	—	—	150	µF
	LAW005BK	—	—	—	47	µF
	LAW005CL	—	—	—	47	µF
Output Current (At I_O < $I_{O, min}$, the modules may exceed output ripple specifications.)	LAW005F	I_O	0.050	—	1.0	A
	LAW005A	I_O	0.050	—	1.0	A
	LAW005B	I_O	0.024	—	0.47	A
	LAW005C	I_O	0.020	—	0.40	A
	LAW005BK	I_{O1}	0.012	—	0.23	A
		I_{O2}	0.012	—	0.23	A
	LAW005CL	I_{O1}	0.010	—	0.19	A
		I_{O2}	0.010	—	0.19	A
Output Current-limit Inception (V_O = 90% x $V_{O, set}$)	All	I_O	—	165	—	%$I_{O, max}$
Output Short-circuit Current (duration typ. 8 ms before shutdown; $V_O \leq$ 60% $V_{O, nom}$)	All	I_O	—	300	—	%$I_{O, max}$

Electrical Specifications (continued)

Table 2. Output Specifications (continued)

Parameter	Device	Symbol	Min	Typ	Max	Unit
Efficiency ($V_{I, nom}$; $I_O = I_{O, max}$; T_A = 25 °C; see Figure 3.)	LAW005F	η	71	73	—	%
	LAW005A	η	74	78	—	%
	LAW005B	η	77	80	—	%
	LAW005C	η	78	82	—	%
	LAW005BK	η	77	80	—	%
	LAW005CL	η	78	80	—	%
Dynamic Response ($\dot{y}I_O/\dot{y}t$ = 1 A/10 µs, $V_I = V_{I, nom}$, T_A = 25 °C):						
Load Change from I_O = 50% to 75% of $I_{O, max}$:						
Peak Deviation	All	—	—	1	—	$\%V_{O, set}$
Settling Time (V_O < 10% peak deviation)	All	—	—	0.15	—	ms
Load Change from I_O = 50% to 25% of $I_{O, max}$:						
Peak Deviation	All	—	—	1	—	$\%V_{O, set}$
Settling Time (V_O < 10% peak deviation)	All	—	—	0.15	—	ms

Table 3. Isolation Specifications

Parameter	Min	Typ	Max	Unit
Isolation Capacitance	—	1000	—	pF
Isolation Resistance	100	—	—	M¾

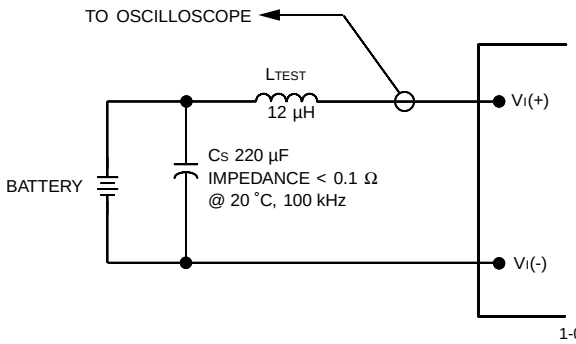
Table 4. General Specifications

Parameter	Min	Typ	Max	Unit
Weight	—	18 (0.64)	20 (0.71)	g (oz.)

Table 5. Feature Specifications

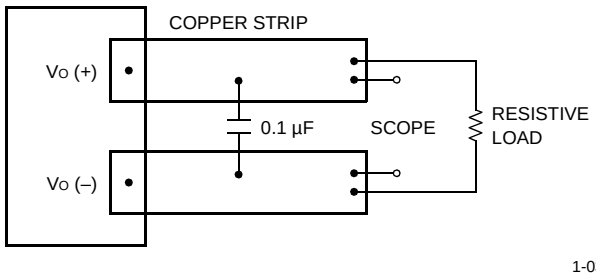
Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Overvoltage Protection (clamp)	LAW005F	$V_{O,CLAMP}$	4.0	4.3	4.6	V
Output Overvoltage Protection (clamp)	LAW005A	$V_{O,CLAMP}$	6.4	6.8	7.2	V
Output Overvoltage Protection (clamp)	LAW005B	$V_{O,CLAMP}$	13.8	15	15.6	V
Output Overvoltage Protection (clamp)	LAW005C	$V_{O,CLAMP}$	16.8	18	19.1	V
Output Overvoltage Protection (clamp)	LAW005BK	$V_{O,CLAMP}$	—	—	—	V
Output Overvoltage Protection (clamp)	LAW005CL	$V_{O,CLAMP}$	—	—	—	V

Test Configurations



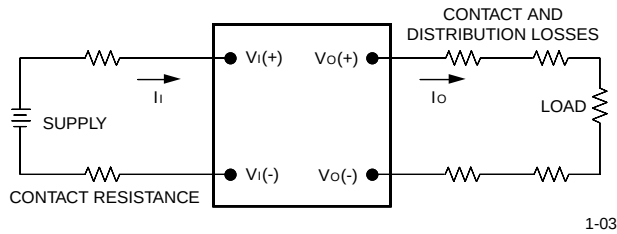
Note: Input reflected-ripple current is measured with a simulated source impedance of 12 µH. Capacitor Cs offsets possible battery impedance. Current is measured at the input of the module.

Figure 1. Input Reflected-Ripple Test Setup



Note: Use a 0.1 µF ceramic capacitor. Scope measurement should be made using a BNC socket. Position the load between 50.8 mm and 76.2 mm (2 in. and 3 in.) from the module.

Figure 2. Peak-to-Peak Output Noise Measurement Test Setup



Note: All measurements are taken at the module terminals. When socketing, place Kelvin connections at module terminals to avoid measurement errors due to socket contact resistance.

$$\eta = \left(\frac{[V_O(+) - V_O(-)]I_O}{[V_I(+) - V_I(-)]I_I}\right) \times 100 \qquad \%$$

Figure 3. Output Voltage and Efficiency Measurement Test Setup

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, *CSA* C22.2 No. 60950-00, and *VDE* 0805 (IEC60950).

If the input source is non-SELV (ELV or a hazardous voltage greater than 60 Vdc and less than or equal to 75 Vdc), for the module's output to be considered meeting the requirements of 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_I pin and one V_O 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, as required by the safety agencies, on the combination of supply source and the subject module 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.

The input to these units is to be provided with a maximum 5 A normal-blow fuse in the ungrounded lead.

Feature Description

Output Overvoltage Protection (single output modules only)

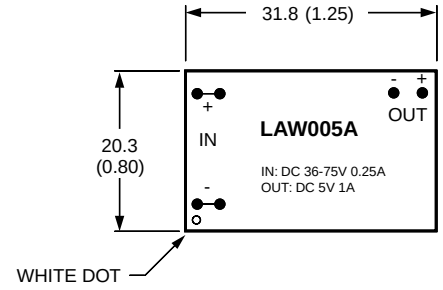
Output overvoltage protection is not a feature on dual output modules. For single output modules, the output overvoltage protection consists of a Transient Voltage Suppressor (TVS) diode across the output terminals. During an ouput overvoltage fault condition, this diode protection clamps the output within the voltages shown in Table 5

Outline Diagram

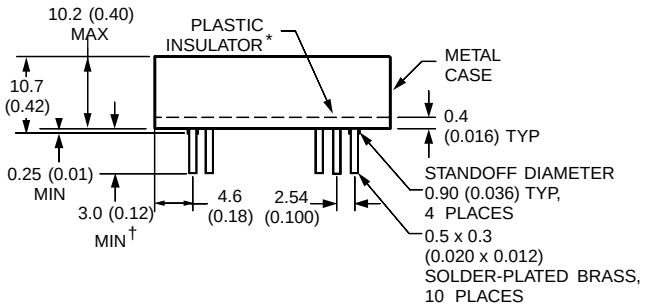
Dimensions are in millimeters and (inches).

Tolerances: x.x mm ± 0.5 mm (x.xx in. ± 0.02 in.)
x.xx mm ± 0.25 mm (x.xxx in. ± 0.010 in.)

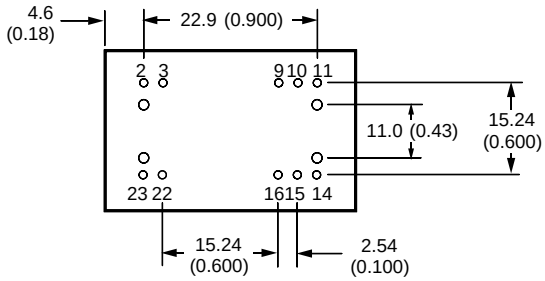
Top View



Side View



Bottom View



Pin	Single	Duals
2	$V_I(-)$	$V_I(-)$
3	$V_I(-)$	$V_I(-)$
9	NC†	Common
10	NC†	NC†
11	NC†	$V_O(-)$
14	$V_O(+)$	$V_O(+)$
15	NC†	NC†
16	$V_O(-)$	Common
22	$V_I(+)$	$V_I(+)$
23	$V_I(+)$	$V_I(+)$

† No connection.

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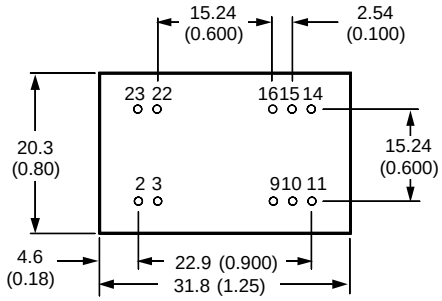
Note: Pinouts are numbered to fit in a standard 24-pin DIP footprint.

* Note insulation thickness when considering clearance from the PWB traces to the metal case.
† Lead trim option: 2.8 mm ± 0.25 mm (0.110 in. ± 0.010 in.).

Recommended Hole Pattern

Component-side footprint.

Dimensions are in millimeters and (inches).



1-0310

Ordering Information

Table 6. Device Codes

Input Voltage	Output Voltage	Output Power	Device Code	Comcode
48 Vdc	3.3 Vdc	3.3 W	LAW005F	108070749
48 Vdc	5 Vdc	5 W	LAW005A	108070715
48 Vdc	12 Vdc	5 W	LAW005B	108070723
48 Vdc	15 Vdc	5 W	LAW005C	108070731
48 Vdc	±12 Vdc	5 W	LAW005BK	108070756
48 Vdc	±15 Vdc	5 W	LAW005CL	108070764

Optional features may be ordered using the device code suffixes shown below. The feature suffixes are listed numerically in descending order. Please contact your Tyco Electronics' Account Manager or Field Application Engineer for pricing and availability.

Table 7. Device Options

Option	Device Code Suffix
Short pins: 2.8 mm ± 0.25 mm (0.110 in. ± 0.010 in.)	8

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