Advance Data Sheet
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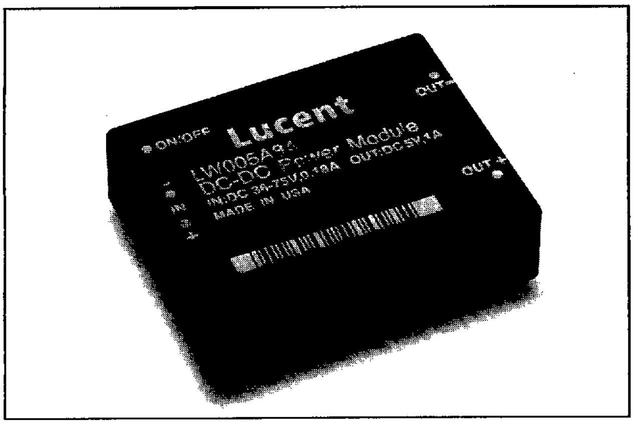
Lucent Technologies
Bell Labs Innovations

LC/LW005 Series Power Modules: 18 Vdc to 36 Vdc or 36 Vdc to 75 Vdc Inputs, 5 W



The LC/LW005 Series Power Modules use advanced, surface-mount technology and deliver high-quality, compact, dc-dc conversion at an economical price.

Applications

- Telecommunications
- Distributed power architectures

Options

- Remote on-off (positive logic)
- Short pin: 2.8 mm ± 0.25 mm (0.110 in. ± 0.010 in.)
- Synchronization (cannot be ordered on units with remote on/off)
- Tight output voltage tolerance

Features

- Low profile: 10.2 mm x 25 mm x 32 mm (0.40 in. x 1 in. x 1.26 in.) with standoffs (9.8 mm (0.385 in.) with standoffs recessed).
- Wide input voltage range: 18 Vdc to 36 Vdc or 36 Vdc to 75 Vdc
- Output current limiting, unlimited duration
- Output overvoltage clamp
- Input-to-output isolation up to 1500 V
- Operating case temperature range: –40 °C to +105 °C
- *UL*1950* Recognized, *CSA*† C22.2 No. 950-95 Certified, IEC950, and VDE0805 Licensed
- CE mark meets 73/23/EEC and 93/68/EEC directives‡
- Within FCC and VDE Class A radiated limits

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

Description

The L-Series Power Modules are low-profile, dc-dc converters that operate over an input voltage range of 18 Vdc to 36 Vdc or 36 Vdc to 75 Vdc and provide a precisely regulated output. The output is isolated from the input, allowing versatile polarity configurations and grounding connections. The modules have a maximum power rating of 5 W and efficiencies greater than 75%. Built-in filtering for both input and output minimizes the need for external filtering.

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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	Device	Min	Typ	Max	Unit
Input Voltage:						
Continuous	V_I	LC	0	—	50	Vdc
	V_I	LW	0	—	80	Vdc
100 ms Transient	$V_{I, trans}$	LW	0	—	100	V
Operating Case Temperature	T_C	All	–40	—	105	°C
Operating Ambient Temperature in Natural Convection (See Thermal Considerations section.)	T_A	All	–40	—	85	°C
Storage Temperature	T_{stg}	All	–55	—	125	°C
I/O Isolation	—	All	—	—	1500	Vdc

Electrical Specifications

Table 1. Input Specifications

Parameter	Symbol	Device	Min	Typ	Max	Unit
Operating Input Voltage	V_I	LC	18	24	36	Vdc
	V_I	LW	36	48	75	Vdc
Maximum Input Current (V_I = 0 to $V_{I, max}$; $I_O = I_{O, max}$)	$I_{I, max}$	LC	—	—	0.6	A
	$I_{I, max}$	LW	—	—	0.3	A
Inrush Transient	I^2t	All	—	—	0.2	A^2s
Input Reflected-ripple Current (5 Hz to 20 MHz; 12 µH source impedance; T_A = 25 °C; see Figure 1.)	I_I	All	—	5	—	mAp-p
Input Ripple Rejection (100 Hz—120 Hz)	—	All	—	45	—	dB

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, dc 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 Code or Suffix	Symbol	Min	Typ	Max	Unit
Output Voltage (Over all line, load, and temperature conditions until end of life; see Figure 3.)	A	V_O	4.80	—	5.25	Vdc
	B	V_O	11.40	—	12.60	Vdc
	C	V_O	14.25	—	15.75	Vdc
	F	V_O	3.13	—	3.47	Vdc
Output Voltage Set Point ($V_I = V_{I,\,nom}$; $I_O = I_{O,\,max}$; T_A = 25 °C)	A	$V_{O,\,set}$	4.85	—	5.20	Vdc
	B	$V_{O,\,set}$	11.52	—	12.48	Vdc
	C	$V_{O,\,set}$	14.40	—	15.60	Vdc
	F	$V_{O,\,set}$	3.17	—	3.43	Vdc
Output Regulation: Line ($V_I = V_{I,\,min}$ to $V_{I,\,max}$)	A, F	—	—	—	5	mV
	B, C	—	—	0.01	0.1	%V_O
Load ($I_O = I_{O,\,min}$ to $I_{O,\,max}$)	A, F	—	—	—	10	mV
	B, C	—	—	0.1	0.2	%V_O
Temperature (T_C = –40 °C to +85 °C)	A, F	—	—	25	100	mV
	B, C	—	—	0.5	2.0	%V_O
External Load Capacitance	A, F	—	—	—	470	µF
	B, C	—	—	—	100	µF
Output Ripple and Noise: With an External 0.1 µF Ceramic Output Capacitor (See Figure 2.): RMS	All	—	—	—	35	mVrms
Peak-to-peak (5 Hz to 20 MHz)	All	—	—	—	150	mVp-p
With an External 3.3 µF Ceramic Output Capacitor: RMS	A, F	—	—	—	30	mVrms
Peak-to-peak (5 Hz to 20 MHz)	A, F	—	—	—	100	mVp-p
Output Current (At $I_O < I_{O,\,min}$, the modules may exceed output ripple specifications, but operation is guaranteed.)	A	I_O	0.1	—	1.0	A
	B	I_O	0.08	—	0.42	A
	C	I_O	0.06	—	0.33	A
	F	I_O	0.12	—	1.21	A
Output Current-limit Inception (V_O = 90% $V_{O,\,set}$)	A	I_O	—	1.4	2	A
	B, C	I_O	—	0.6	0.9	A
	F	I_O	—	1.7	3.0	A
Output Short-circuit Current (V_O = 0.25 V)	A	I_O	—	2.0	4.0	A
	B, C	I_O	—	1.0	2.5	A
	F	I_O	—	2.4	4.5	A
Efficiency ($V_I = V_{I,\,nom}$; $I_O = I_{O,\,max}$; T_A = 25 °C, see Figure 3.)	LC005A	η	73	76	—	%
	LC005B, C	η	71	74	—	%
	LC005F	η	69	72	—	%
	LW005A, B, C	η	75	78	—	%
	LW005F	η	71	74	—	%

Electrical Specifications (continued)

Table 2. Output Specifications (continued)

Parameter	Device Code or Suffix	Symbol	Min	Typ	Max	Unit
Dynamic Response ($\Delta I_O/\Delta t$ = 1A/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	—	—	1.5	—	$\%V_{O, set}$
Settling Time (V_O < 10% of peak deviation)	All	—	—	0.8	—	ms
Load Change from I_O = 50% to 25% of $I_{O, max}$:						
Peak Deviation	All	—	—	1.5	—	$\%V_{O, set}$
Settling Time (V_O < 10% of peak deviation)	All	—	—	0.8	—	ms

Table 3. Isolation Specifications

Parameter	Min	Typ	Max	Unit
Isolation Capacitance	—	2300	—	pF
Isolation Resistance	10	—	—	MΩ

Table 4. General Specifications

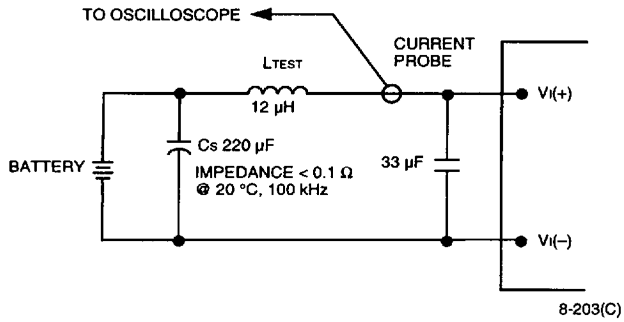
Parameter	Min	Typ	Max	Unit
Calculated MTBF (I_O = 80% of $I_{O, max}$; T_C = 40 °C)	—	8,400,000	—	hours
Weight	—	—	17 (0.6)	g (oz.)
Hand Soldering (soldering iron 3 mm (0.125 in.) tip, 425 °C)	—	—	12	s

Electrical Specifications (continued)

Table 5. Feature Specifications

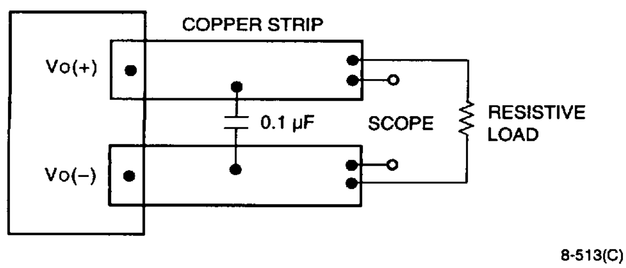
Parameter	Device Code Suffix	Symbol	Min	Typ	Max	Unit
Remote On/Off Signal Interface (optional) (V_I = 0 V to $V_{I, max}$; open collector or equivalent compatible; signal referenced to $V_I(-)$ terminal. See Feature Descriptions section.):						
Positive Logic—Code Suffix 4:						
Logic Low—Module Off						
Logic High—Module On						
Module Specifications:						
On/Off Current—Logic Low	All	$I_{on/off}$	—	5.0	10	mA
On/Off Voltage:						
Logic Low	All	$V_{on/off}$	0	—	1.2	V
Logic High ($I_{on/off}$ = 0)	All	$V_{on/off}$	—	—	15	V
Open Collector Switch Specifications:						
Leakage Current During Logic High ($V_{on/off}$ = 15 V)	All	$I_{on/off}$	—	—	50	µA
Output Low Voltage During Logic Low ($I_{on/off}$ = 10 mA)	All	$V_{on/off}$	—	—	1.2	V
Turn-on Delay and Rise Times (at 80% of $I_{O, max}$; T_A = 25 °C):						
Case 1: On/Off Input Is Set for Unit On and then Input Power Is Applied (delay from point at which $V_I = V_{I, min}$ until V_O = 10% of $V_{O, nom}$).	All	T_{delay}	—	5	20	ms
Case 2: Input Power Is Applied for at Least One Second, and then the On/Off Input Is Set to Turn the Module On (delay from point at which on/off input is toggled until V_O = 10% of $V_{O, nom}$).	All	T_{delay}	—	2	10	ms
Output Voltage Rise Time (time for V_O to rise from 10% of $V_{O, nom}$ to 90% of $V_{O, nom}$)	All	T_{rise}	—	0.3	5	ms
Output Voltage Overshoot (at 80% of $I_{O, max}$; T_A = 25 °C)	All	—	—	0	5	%
Output Overvoltage Clamp	A	$V_{O, clamp}$	5.4	—	7.0	V
	B	$V_{O, clamp}$	12.7	—	16.0	V
	C	$V_{O, clamp}$	15.8	—	21.0	V
	F	$V_{O, clamp}$	3.5	—	6.2	V
Under Voltage Lockout	LCxxx	V_{uvlo}	11	14	—	V
	LWxxx	V_{uvlo}	20	27	—	V

Test Configurations



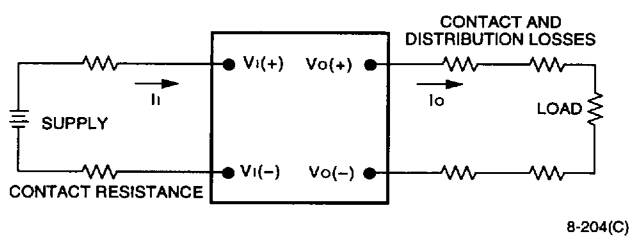
Note: Input reflected-ripple current is measured with a simulated source impedance of 12 µH. Capacitor Cs offsets possible battery impedance. Current is measured at the input of the module.

Figure 1. Input Reflected-Ripple Test Setup



Note: Use one external 0.1 µF ceramic capacitor. Scope measurement should be made using a BNC socket. Position the load between 50 mm and 75 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.

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

Figure 3. Output Voltage and Efficiency Measurement Test Setup

Design Considerations

Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. If the source inductance exceeds 5 µH, a 33 µF electrolytic capacitor (ESR < 0.7 Ω at 100 kHz) mounted close to the power module helps ensure stability of the unit.

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*1950, *CSA* C22.2 No. 950-95, EN60950.

For the converter output to be considered meeting the requirements of safety extra-low voltage (SELV), one of the following must be true of the dc input:

- All inputs are SELV and floating, with the output also floating.
- All inputs are SELV and grounded, with the output also grounded.
- Any non-SELV input must be provided with reinforced insulation from any other hazardous voltages, including the ac mains, and must have a SELV reliability test performed on it in combination with the converters.

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 Descriptions

Output Overvoltage Clamp

The output overvoltage clamp consists of control circuitry, almost entirely independent of the secondary regulation circuitry, that monitors the voltage on the output terminals. This control loop has a higher voltage set point than the primary loop (see Feature Specifications table). In a fault condition, the overvoltage clamp ensures that the output voltage does not exceed $V_{O,\,clamp,\,max}$. This provides a redundant voltage-control that reduces the risk of output overvoltage.

Current Limit

To provide protection in a fault (output overload) condition, the unit is equipped with internal current-limiting circuitry and can endure current limiting for an unlimited duration. At the point of current-limit inception, the unit shifts from voltage control to current control. If the output voltage is pulled very low during a severe fault, the current-limit circuit can exhibit either foldback or tailout characteristics (output-current decrease or increase). The unit operates normally once the output current is brought back into its specified range.

Remote On/Off (Optional)

Positive logic (code suffix 4) remote on/off turns the module on during a logic high voltage on the REMOTE ON/OFF pin, and off during a logic low.

To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the $V_I(-)$ terminal ($V_{on/off}$). The switch may be an open collector or equivalent (see Figure 4). A logic low is $V_{on/off}$ = 0 V to 1.2 V. The maximum $I_{on/off}$ during a logic low is 10 mA. The switch should maintain a logic-low voltage while sinking 10 mA.

During a logic high, the maximum $V_{on/off}$ generated by the power module is 15 V. The maximum allowable leakage current of the switch at $V_{on/off}$ = 15 V is 50 μA.

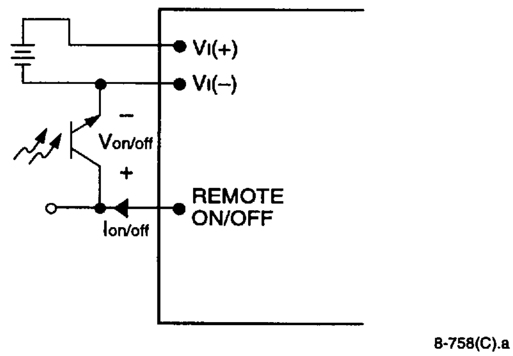


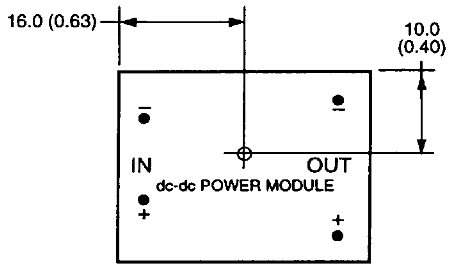
Figure 4. Remote On/Off Implementation

Synchronization (Optional)

With external circuitry, the unit is capable of synchronization from an independent time base with a switching rate of 300 kHz. Other frequencies may be available; please consult the factory for application guidelines and/or a description of the external circuit needed to use this feature.

Thermal Considerations

Sufficient cooling should be provided to help ensure reliable operation of the power module. Heat-dissipating components inside the unit are thermally coupled to the case. Heat is removed by conduction, convection, and radiation to the surrounding environment. Proper cooling can be verified by measuring the case temperature. The case temperature (Tc) should be measured at the position indicated in Figure 5.



Note: Dimensions are in millimeters and (inches).

Figure 5. Case Temperature Measurement Location

Note that the view in Figure 5 is of the surface of the module—the pin locations shown are for reference. The temperature at this location should not exceed a maximum case temperature of 105 °C. The output power of the module should not exceed the rated power for the module as listed in the Ordering Information table.

The Lx005 series operates at full load in an 85 °C ambient temperature with 0.25 ms^{-1} (50 ft./min.) airflow. This airflow is present in a typical circuit pack environment in a natural cooled equipment rack, with other components causing airflow through the chimney effect. Note that these are approximations and that actual case temperature measurements in the equipment rack should be taken to verify the case temperature does not exceed 105 °C.

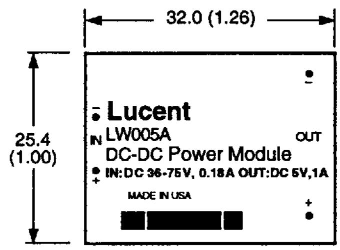
Outline Diagram

Dimensions are in millimeters and (inches).

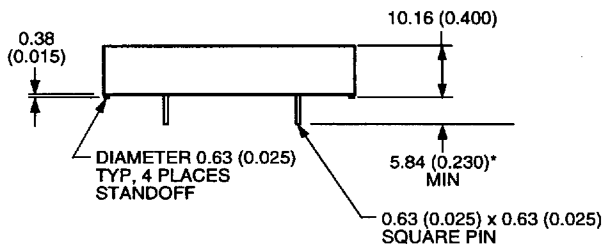
Tolerance: x.x ± 0.5 mm (0.020 in.); x.xx ± 0.38 mm (0.015 in.).

If slightly lower height is needed, the four standoffs can be dropped through holes on the user's PWB. By dropping the standoffs through the PWB, the module height will be decreased to 9.8 mm (0.385 in.) typical height.

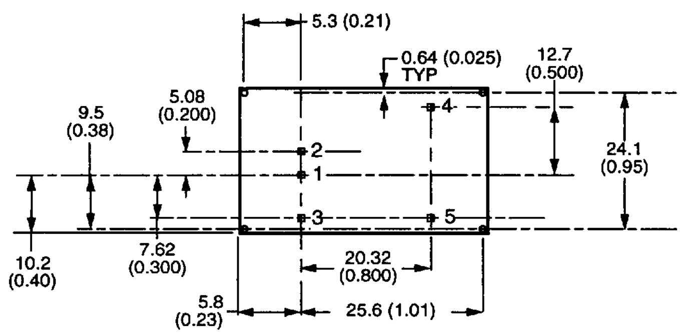
Top View



Side View



Bottom View



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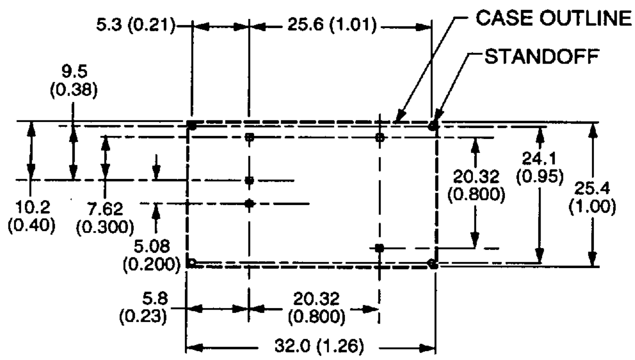
* An optional short pin dimension is 2.8 mm ± 0.25 mm (0.110 in. ± 0.010 in.).

Pin	Function
1	VI(−)
2	VI(+)
3	ON/OFF or SYNC (optional) Pin is not present unless one of these options is specified.
4	VO(+)
5	VO(−)

Recommended Hole Pattern

Component-side footprint.

Dimensions are in millimeters and (inches).



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Ordering Information

Table 6. Ordering Information

Device Code	Input Voltage	Output Voltage	Output Power	Comcode
LC005A	18 V—36 V	5 V	5 W	108122185
LC005B	18 V—36 V	12 V	5 W	108122193
LC005C	18 V—36 V	15 V	5 W	TBD*
LC005F	18 V—36 V	3.3 V	4 W	108122201
LW005A	36 V—75 V	5 V	5 W	108122136
LW005B	36 V—75 V	12 V	5 W	108122169
LW005C	36 V—75 V	15 V	5 W	TBD*
LW005F	36 V—75 V	3.3 V	4 W	108122177

* Please contact your Lucent Technologies Account Manager or the factory for availability.

Optional features may be ordered using the device code suffixes shown below. The feature suffixes are listed numerically in descending order.

Table 7. Optional Features

Option	Device Code Suffix
Short pin: 2.8 mm ± 0.25 mm (0.110 in. ± 0.010 in.)	8
Positive logic remote on/off	4
Synchronization	3

Please contact your Lucent Technologies Account Manager or Application Engineer for pricing and availability of options.