Data Sheet
December 1999

Lucent Technologies
Bell Labs Innovations

912A Power Module: dc-dc Converter; 48 Vdc Input, 12 Vdc Output, 12 W

The 912A Power Module uses advanced, surface-mount technology.

Features

- Small size: 56.9 mm x 77.2 mm x 17.8 mm
  (2.2 in. x 3.0 in. x 0.7 in.)
- Output overvoltage protection: V_O < 16 V
- Short-circuit protection
- Input-to-output isolation
- No external filtering required
- Remote on/off
- No heat sink required
- PC-board mountable
- Operating ambient temperature range:
  0 °C to 70 °C with no derating
- *UL** 1950 Recognized, *CSA*† C22.2 No. 950-95 Certified, *VDE*‡ 0805 (EN60950, IEC950) Licensed
- Meets FCC EMI Class A limits

Applications

- Communications equipment 48 V systems
- Computer equipment
- Local power distribution
- Digital circuits
- Distributed power architectures

Description

The 912A Power Module is a dc-dc converter that is suitable for a wide variety of applications. The module converts 48 Vdc to 12 Vdc and delivers up to 12 W of power at a minimum full-load efficiency of 78%. The precisely regulated output is fully isolated from the input, allowing versatile polarity configurations and grounding connections.

The module is potted in a nonconductive case that mounts on a PC board. No external filtering components are required. No heat sink is required, and the module is rated to full load at 70 °C in a natural convection environment.

* *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.

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	V_I	—	60	Vdc
I/O Isolation Voltage	—	—	500	Vdc
Operating Ambient Temperature (natural convection)	T_A	0	70	°C
Storage Temperature	T_{stg}	–40	100	°C

Electrical Specifications

Unless otherwise indicated, specifications apply to the module with the recommended input filter and layout configuration over all operating input voltage, resistive load, and temperature conditions.

Table 1. Input Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	V_I	39.5	48.0	60.0	Vdc
Maximum Input Current (V_I = 0 to 60 V; see Figure 1.)	$I_{I,\ max}$	—	—	675	mA
Inrush Transient	i^2t	—	—	0.54	A^2s
Input Reflected-ripple Current (5 Hz to 20 MHz, 12 µH source impedance, full load; see Figure 8.)	I_I	—	17	—	mAp-p
Input Ripple Rejection (120 Hz)	—	—	75	—	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 fuse with a maximum rating of 5 A in series with the input (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	Symbol	Min	Typ	Max	Unit
Output Voltage Set Point (V_I = 48 V; $I_O = I_{O,\,max}$; T_A = 25 °C)	$V_{O,\,set}$	11.55	12.00	12.45	Vdc
Output Voltage (Over all operating input voltage, resistive load, and temperature conditions until end of life)	V_O	11.4	—	12.6	Vdc
Output Regulation:					
Line (V_I = 39.5 V to 60 V)	—	—	0.025	0.05	%V_O
Load ($I_O = I_{O,\,min}$ to $I_{O,\,max}$)	—	—	0.075	0.25	%V_O
Temperature (T_A = 0 °C to 70 °C; see Figure 2)	—	—	—	100	mV
Output Ripple and Noise Voltage:					
RMS	—	—	9	25	mVrms
Peak-to-peak (5 Hz to 20 MHz)	—	—	50	100	mVp-p
Output Current	I_O	0.150	—	1.0	A
Output Current-limit Inception (V_O = 10.8 V; see Figure 3)	I_O	—	1.3	—	A
Output Current Limit (V_I = 60 V; V_O = 1.0 V; see Figure 3)	—	1.5	1.95	3.5	A
Output Short-circuit Current (V_O = 250 mV; see Figure 3)	—	—	2.45	—	A
Efficiency (V_I = 48 V; $I_O = I_{O,\,max}$; T_A = 25 °C; see Figure 4)	η	78	81	—	%
Dynamic Response ($\Delta I_O/\Delta t$ = 1 A/10 µs, V_I = 48 V, T_A = 25 °C):					
Load Change from I_O = 50% to 75% of $I_{O,\,max}$ (see Figure 5):					
Peak Deviation	—	—	80	—	mV
Settling Time (V_O < 10% peak deviation)	—	—	3	—	ms
Load Change from I_O = 50% to 25% of $I_{O,\,max}$ (see Figure 6):					
Peak Deviation	—	—	80	—	mV
Settling Time (V_O < 10% peak deviation)	—	—	3	—	ms

Table 3. Isolation Specifications

Parameter	Min	Typ	Max	Unit
Isolation Capacitance	—	1265	—	pF
Isolation Resistance	10	—	—	MΩ

General Specifications

Parameter	Min	Typ	Max	Unit
Calculated MTBF (At 80% of full load; T_C = 40 °C, natural convection)		760,000		hours
Weight	—	—	4.5	oz.

Feature Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions.

Parameter	Symbol	Min	Typ	Max	Unit
Remote On/Off (0 V < V_I < 60 V; switch controlled; $V_{on/off}$ referenced between V_I(–) and on/off terminals; see Feature Descriptions section):					
Switch Open—Module Off					
Switch Closed—Module On					
Module Specifications:					
On/Off Current—Switch Closed	$I_{on/off}$	0.25	—	0.61	mA
On/Off Voltage:					
Switch Closed	$V_{on/off}$	0	—	2.0	V
Switch Open ($I_{on/off}$ = 0)	$V_{on/off}$	—	—	60	V
Switch Specifications:					
Leakage Current—Switch Open ($V_{on/off}$ = 60 V)	$I_{on/off}$	—	—	70	µA
Output Low Voltage—Switch Closed ($I_{on/off}$ = 0.61 mA)	$V_{on/off}$	—	—	2.0	V
Turn-on Time (At V_I = 48 V, T_A = 25 °C; 80% of full load, V_O within ±1% of steady state; see Figure 7)	—	—	12	87	ms
Output Overvoltage Protection (clamp)	$V_{O,\ clamp}$	13.0	14.5	16.0	V

Characteristic Curves

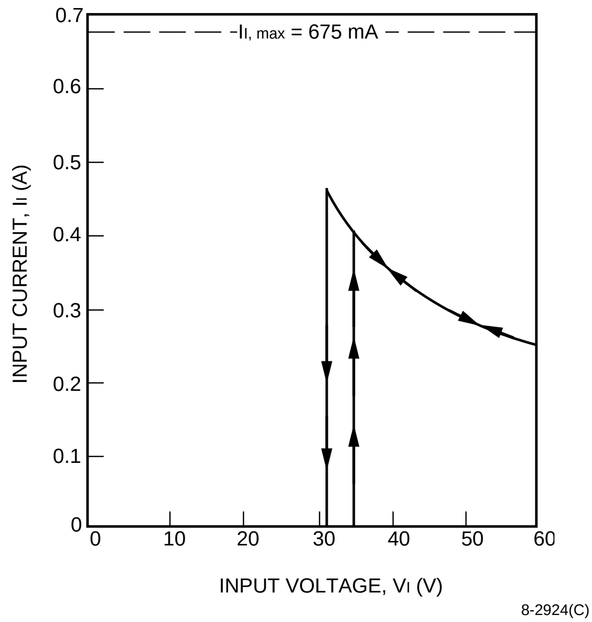


Figure 1. Typical Input Characteristic with a Load of I_O = 1.0 A, T_A = 25 °C (Arrows Indicate Hysteresis)

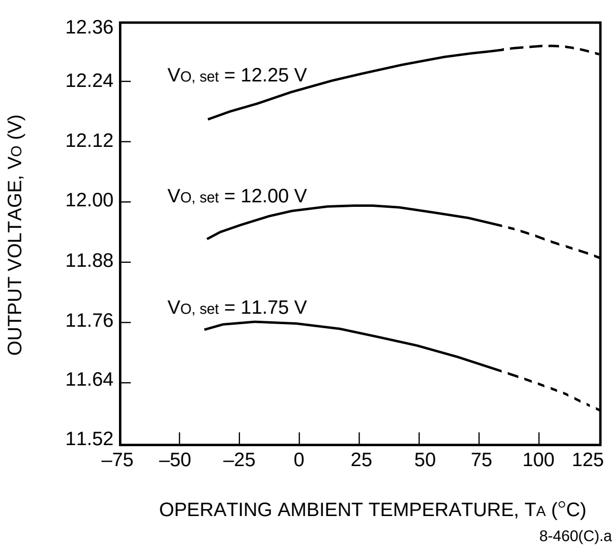


Figure 2. Typical Output Voltage Variation Over Operating Ambient Temperature Range at Full Load and V_I = 48 V

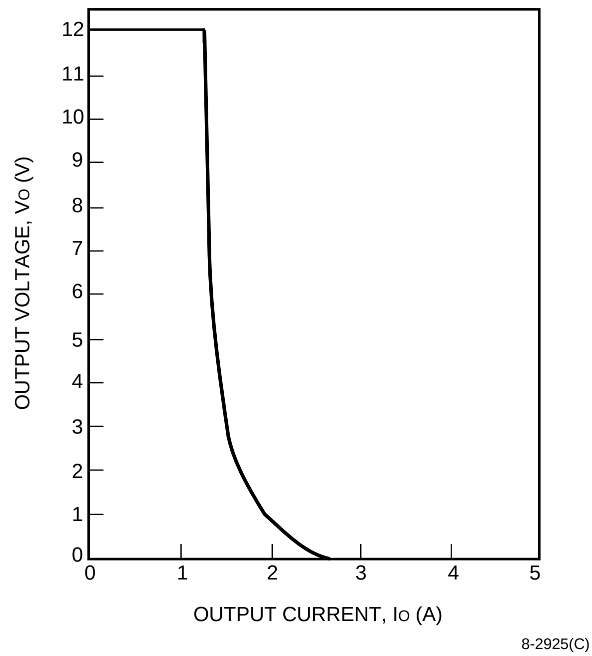


Figure 3. Typical Output Characteristic at V_I = 48 V and T_A = 25 °C

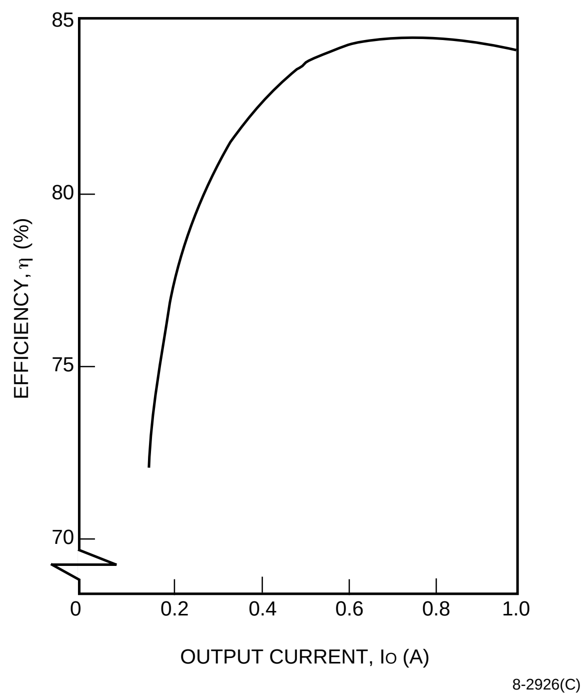


Figure 4. Typical Converter Efficiency as a Function of Output Current; V_I = 48 V; T_A = 25 °C

Characteristic Curves (continued)

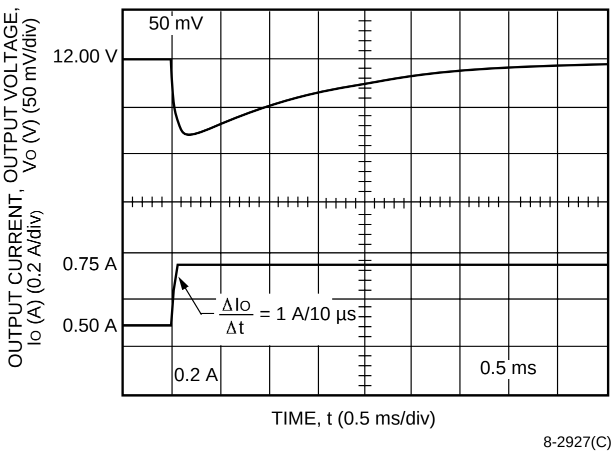


Figure 5. Typical Output Voltage Waveform for a Step Load Change from 50% to 75% of Full Output Power, V_I = 48 V, T_A = 25 °C

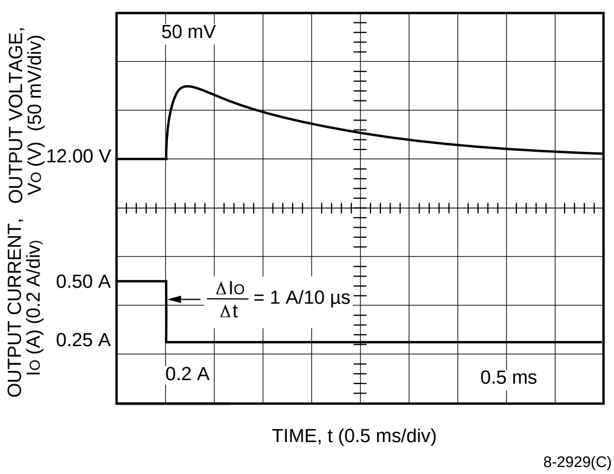


Figure 6. Typical Output Voltage Waveform for a Step Load Change from 50% to 25% of $I_{O,\,max}$; V_I = 48 V; T_A = 25 °C

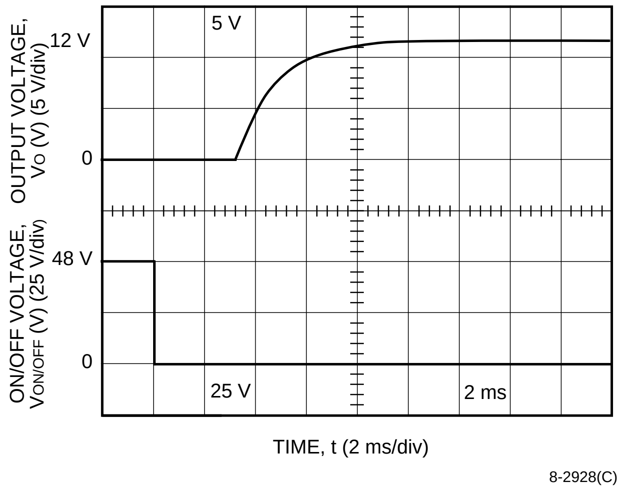
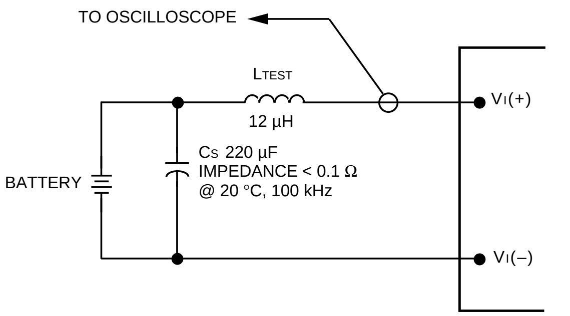


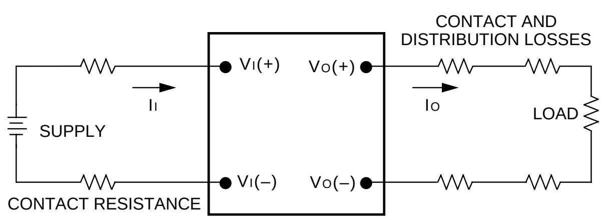
Figure 7. Typical Output Voltage Start-up Waveform Once Remote On/Off is Removed at I_O = 800 mA, V_I = 48 V, T_A = 25 °C

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 8. Input Reflected-Ripple Test Setup



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

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

Figure 9. 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* 1950, *CSA* C22.2 No. 950-95, and *VDE* 0805 (EN60950, IEC950).

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 Descriptions

Output Overvoltage Protection

The output overvoltage clamp consists of control circuitry, which is independent of the primary regulation loop, that monitors the voltage on the output terminals. The control loop of the clamp has a higher voltage set point than the primary loop (see Feature Specifications table). This provides a redundant voltage control that reduces the risk of output overvoltage.

Overcurrent Protection

To provide protection in a fault condition, the unit is equipped with internal current-limiting 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. The unit operates normally once the output current is brought back into its specified range.

Feature Descriptions (continued)

Remote On/Off

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 ($V_{on/off}$). See Figure 10. The switch must have both a high-impedance or open state, and a low-impedance or closed state. When the switch is open, $I_{on/off} < 70\ \mu A$, and the module is off. When the switch is closed, $V_{on/off} \leq 2.0$ V, and the module is on. For the module to remain on, $0.25\ mA \leq I_{on/off} \leq 0.61\ mA$.

Note: A PWB trace between $V_I(+)$ and the on/off terminals can be used to override the remote on/off.

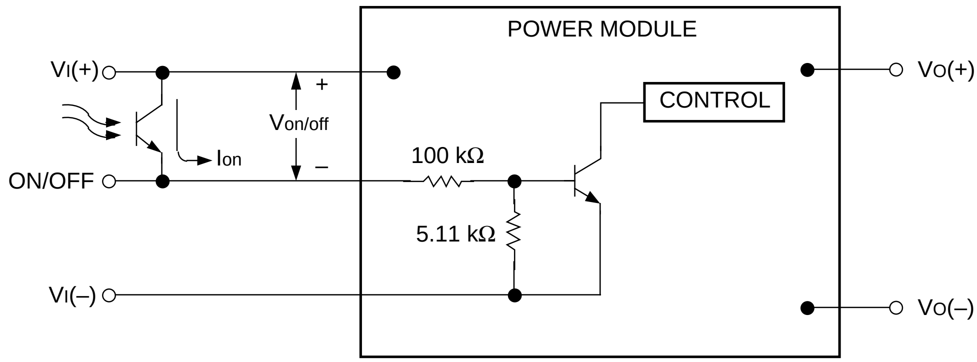


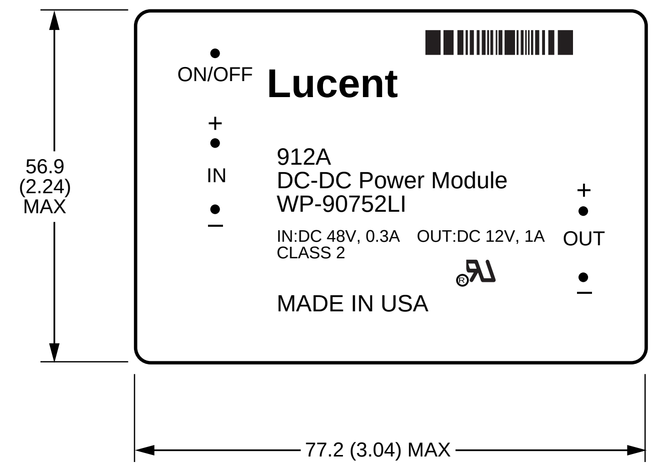
Figure 10. Typical Remote On/Off Implementation

Outline Diagram

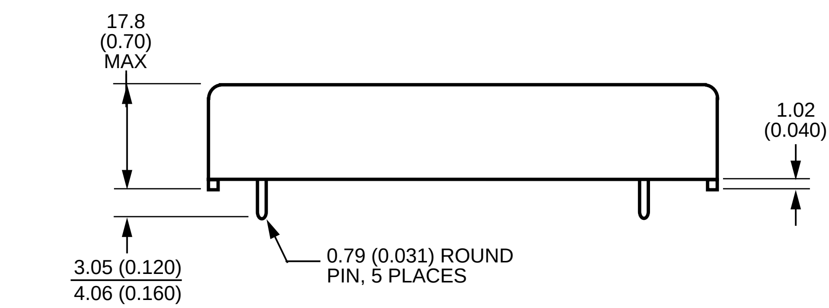
Dimensions are in millimeters and (inches).

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

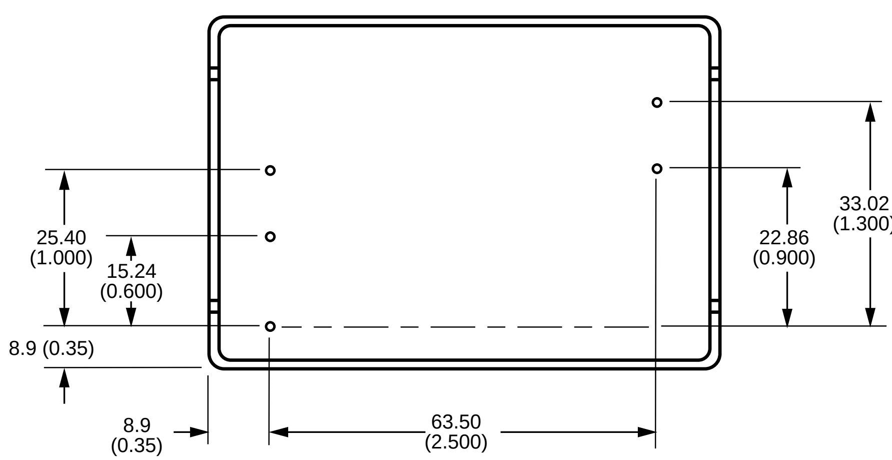
Top View



Side View



Bottom View

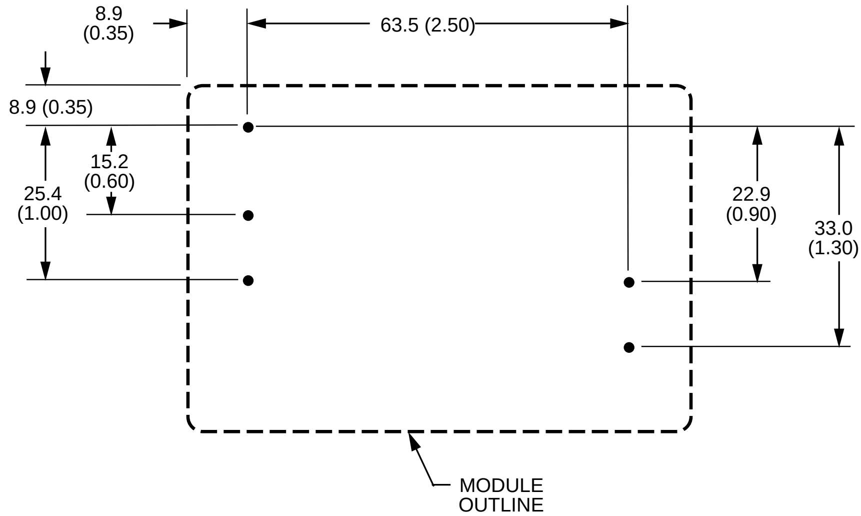


8-2930(C)

Recommended Hole Pattern

Component-side footprint.

Dimensions are in millimeters and (inches).



8-2930(C)

Ordering Information

Input Voltage	Output Voltage	Output Power	Device Code	Comcode
48 Vdc	12 Vdc	12 W	912A	104386131

Notes

For additional information, contact your Lucent Technologies Account Manager or the following:
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E-MAIL: **techsupport@lucent.com**
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