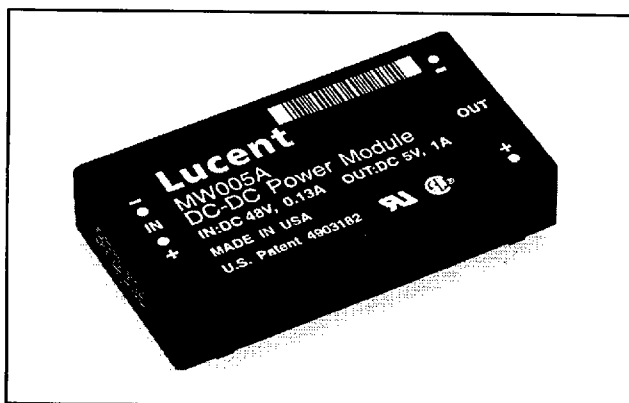




MW005-Series Power Modules: 36 Vdc to 75 Vdc Inputs; 5 W



The MW005-Series Power Modules are encapsulated in nonconductive cases measuring 50.8 mm long, 27.9 mm wide, and 11.7 mm high (2.00 in. x 1.10 in. x 0.46 in.).

Features

- Small size: 50.8 mm x 27.9 mm x 11.7 mm (2.00 in. x 1.10 in. x 0.46 in.)
- Wide input-voltage range: 36 Vdc to 75 Vdc
- Output current limiting, unlimited duration
- Output overvoltage clamp
- Load regulation: 0.15% max (MW005A, B, C)
- Line regulation: 0.05% max (MW005A, B, C)
- Short-circuit protection
- Input-to-output isolation
- No external filtering required
- Operating ambient temperature range: -40 °C to +85 °C
- PC-board mountable
- High reliability
- Meets FCC and VDE Class B limits for radiated emissions
- UL* Recognized, CSA† Certified, and VDE Licensed
- CE mark meets 73/23/EEC and 93/68/EEC directives‡

Applications

- Telecommunications
- Digital circuitry
- Distributed power architecture

Options

- Standard long pin: 5.8 mm ± 0.5 mm (0.230 in. ± 0.020 in.)

Description

The MW005A, B, C, BK, and CL Power Modules are dc-dc converters that operate over a wide input-voltage range of 36 Vdc to 75 Vdc and provide precisely regulated dc outputs. The outputs are fully isolated from the inputs, allowing versatile polarity configurations and grounding connections. The modules have maximum power ratings of 5 W at typical full-load efficiencies of 82% (80% for the MW005A).

The modules are encapsulated in nonconductive cases that mount on printed-circuit boards. In a natural convection environment, the modules are rated to full load at 70 °C with no heat sinking or external filtering. The modules can be used up to 85 °C with derated output power (4.5 W with an external input capacitor; 3.5 W with no external capacitor).

* 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.)

0050026 0028464 753

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.

Ratings apply to all devices.

Parameter	Symbol	Min	Max	Unit
Input Voltage:				
Continuous	V_I	—	80	Vdc
Transient (2 ms)	$V_{I, trans}$	—	100	Vdc
I/O Isolation Voltage	—	—	500	Vdc
Operating Ambient Temperature (0.30 ms ⁻¹ (60 ft./min.) natural convection)	T_A	-40	85	°C
Storage Temperature	T_{stg}	-40	100	°C

Electrical Specifications

Unless otherwise indicated, specifications apply to all devices 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	36	48	75	Vdc
Maximum Input Current ($V_I = 0$ V to 75 V; $I_O = I_{O, max}$; see Figure 1.)	$I_{I, max}$	—	—	600	mA
Inrush Transient	I^2t	—	0.3	1.0	A ² s
Input Reflected-ripple Current, Peak-to-peak (5 Hz to 20 MHz, 12 μ H source impedance, $T_A = 25$ °C, see Figure 24 and Design Considerations section.)	—	—	30	—	mA _{p-p}
Input Ripple Rejection (120 Hz)	—	—	53	—	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 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	Device	Symbol	Min	Typ	Max	Unit
Output Voltage (Over all operating input voltage, resistive load, and temperature conditions until end of life. See Figures 5—8 for cross regulation on dual outputs.)	MW005A	V_O	4.80	—	5.25	Vdc
	MW005B	V_O	11.40	—	12.60	Vdc
	MW005C	V_O	14.25	—	15.75	Vdc
	MW005BK	V_{O1}	10.80	—	13.20	Vdc
		V_{O2}	-10.80	—	-13.20	Vdc
	MW005CL	V_{O1}	13.50	—	16.50	Vdc
		V_{O2}	-13.50	—	-16.50	Vdc
Output Voltage Set Point ($V_I = 48$ V; $I_O = I_{O, \max}$; $T_A = 25$ °C)	MW005A	$V_{O, \text{set}}$	4.85	5.00	5.20	Vdc
	MW005B	$V_{O, \text{set}}$	11.52	12.00	12.48	Vdc
	MW005C	$V_{O, \text{set}}$	14.40	15.00	15.60	Vdc
	MW005BK	$V_{O1, \text{set}}$	11.40	12.00	12.60	Vdc
		$V_{O2, \text{set}}$	-11.40	-12.00	-12.60	Vdc
	MW005CL	$V_{O1, \text{set}}$	14.25	15.00	15.75	Vdc
		$V_{O2, \text{set}}$	-14.25	-15.00	-15.75	Vdc
Output Regulation: Line ($V_I = 36$ Vdc to 75 Vdc) Load ($I_O = I_{O, \min}$ to $I_{O, \max}$) Temperature ($T_A = -40$ °C to +85 °C) (See Figures 2—4.)	MW005A, B, C	—	—	0.01	0.05	%
	MW005A, B, C	—	—	0.05	0.15	%
	MW005A	—	—	15	70	mV
	MW005B	—	—	40	150	mV
	MW005C	—	—	45	190	mV
Output Ripple and Noise Voltage (With 0.1 μ F, ceramic, bypass capacitor on output; see Figure 25.): RMS Peak-to-peak (5 Hz to 20 MHz)	MW005A	—	—	—	15	mVrms
	MW005B, C	—	—	—	25	mVrms
	MW005BK, CL	—	—	—	80	mVrms
	MW005A	—	—	—	50	mVp-p
	MW005B, C	—	—	—	100	mVp-p
	MW005BK, CL	—	—	—	250	mVp-p
Output Current (At $I_O < I_{O, \min}$, the modules may exceed output ripple specifications and dual-output modules may exceed specified output voltages. At $T_A > 70$ °C, see Figure 28 for derating.)	MW005A	I_O	0.1	—	1.0	A
	MW005B	I_O	0.02	—	0.42	A
	MW005C	I_O	0.02	—	0.33	A
	MW005BK	I_{O1}	0.02	—	0.21	A
		I_{O2}	0.02	—	0.21	A
	MW005CL	I_{O1}	0.017	—	0.17	A
		I_{O2}	0.017	—	0.17	A

Electrical Specifications (continued)

Table 2. Output Specifications (continued)

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Current-limit Inception (See Figures 9—15.): Vo = 4.5 V Vo = 10.8 V Vo = 13.5 V Vo1 or Vo2 = 10.2 V Vo1 or Vo2 = 12.75 V	MW005A MW005B MW005C MW005BK MW005CL	— — — — —	— — — — —	1.6 0.8 0.7 0.8 0.7	2.5 1.4 1.3 1.4 1.3	A A A A A
Output Current Limit (See Figures 9—15.): Vo = 1.0 V Vo = 1.0 V Vo1 or Vo2 = 1.0 V	MW005A MW005B, C MW005BK, CL	— — —	— — —	— — —	3.0 2.0 2.0	A A A
Output Short-circuit Current (Vo = 250 mV; see Figures 9—15.)	MW005A MW005B, C, BK, CL	— —	— —	1.5 1.0	— —	A A
Efficiency (Vi = 48 V; Io = Io, max; TA = 25 °C; see Figures 16, 17, 26, and 27.)	MW005A MW005B, C MW005BK, CL	η η η	77 79 78	80 82 81	— — —	% % %
Dynamic Response ($\Delta I_o/\Delta t = 1 \text{ A}/10 \mu\text{s}$, Vi = 48 V, TA = 25 °C) (For MW005BK and CL, applies to Vo1 and Vo2 at full load.): Load Change from Io = 50% to 25% of Io, max (See Figures 18—20.): Peak Deviation	MW005A MW005B MW005C MW005BK, CL	— — — —	— — — —	80 70 60 50	— — — —	mV mV mV mV
Settling Time (Vo < 10% of peak deviation)	MW005A, B, C MW005BK, CL	— —	— —	3.5 5.0	— —	ms ms
Load Change from Io = 50% to 75% of Io, max (See Figures 21—23.): Peak Deviation	MW005A MW005B, C MW005BK, CL	— — —	— — —	80 70 50	— — —	mV mV mV
Settling Time (Vo < 10% of peak deviation)	MW005A, B, C MW005BK, CL	— —	— —	3.5 5.0	— —	ms ms

Electrical Specifications (continued)

Table 3. Isolation Specifications

Specifications apply to all devices.

Parameter	Min	Typ	Max	Unit
Isolation Capacitance	—	1200	—	pF
Isolation Resistance	10	—	—	MΩ

General Specifications

Specifications apply to all devices.

Parameter	Min	Typ	Max	Unit
Calculated MTBF (at 80% of $I_{O, max}$; $T_C = 40^\circ\text{C}$)	1,700,000			hr
Weight	—	—	28 (1.0)	g (oz.)

Cleanliness Requirements

The open frame (no case or potting) power modules meet specification J-STD-001B. These requirements state that solder balls must be attached and their size should not compromise minimum electrical spacing of the power module.

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

Feature Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions. See Feature Descriptions for further information.

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Overvoltage Clamp	MW005A	V_O	—	6.0	7.0	V
	MW005B	V_O	—	14	16	V
	MW005C	V_O	—	17	19	V
	MW005BK	V_{O1}	—	16	18	V
		V_{O2}	—	—16	—18	V
	MW005CL	V_{O1}	—	19	21	V
		V_{O2}	—	—19	—21	V

Characteristic Curves

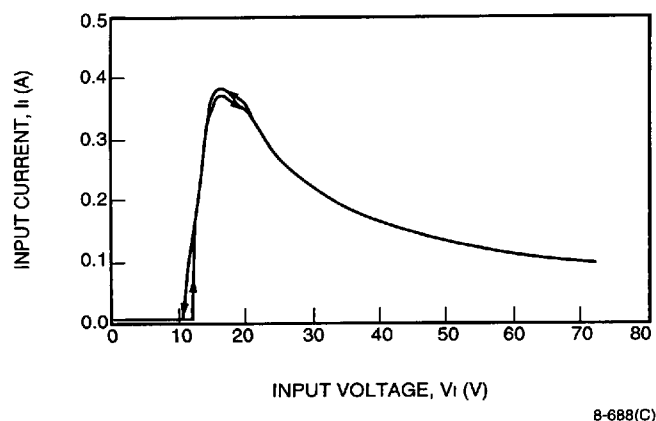


Figure 1. MW005-Series Typical Input Characteristic with $I_o = I_{o, max}$ and $T_A = 25^\circ\text{C}$ (Arrows Indicate Hysteresis)

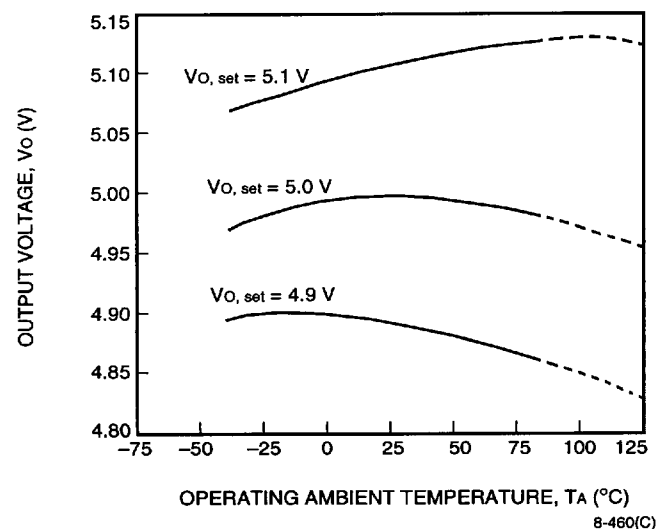


Figure 2. MW005A Typical Output Voltage Variations Over Operating Ambient Temperature Range

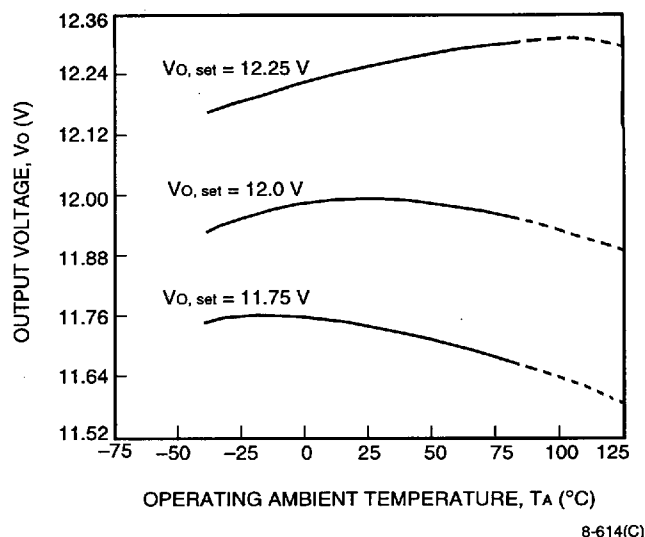


Figure 3. MW005B Typical Output Voltage Variations Over Operating Ambient Temperature Range

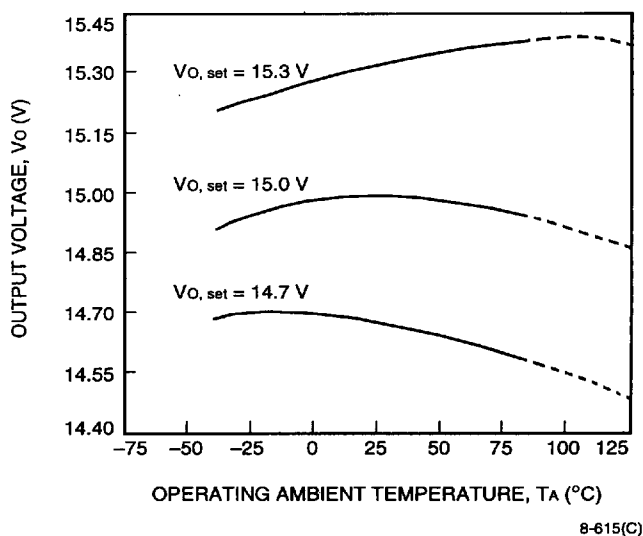


Figure 4. MW005C Typical Output Voltage Variations Over Operating Ambient Temperature Range

Characteristic Curves (continued)

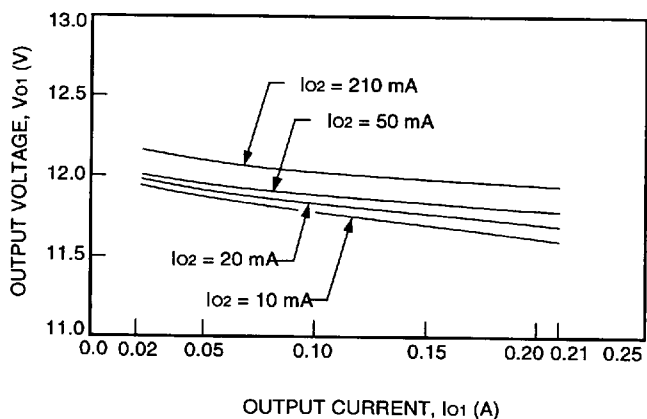


Figure 5. MW005BK Typical V_{o1} vs. I_{o1} Regulation
with $V_i = 48$ V and $T_A = 25$ °C

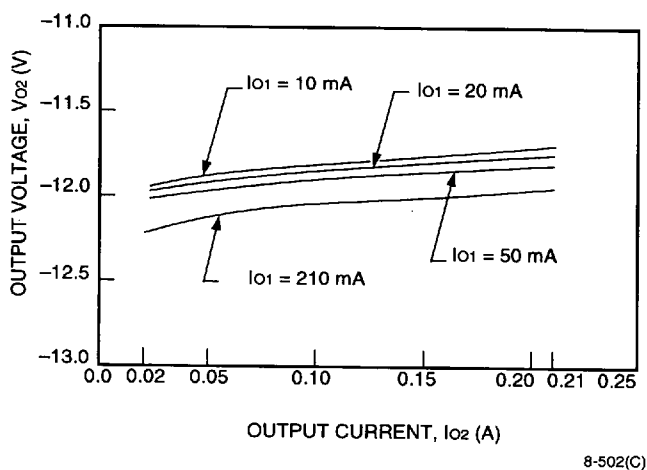


Figure 6. MW005BK Typical V_{o2} vs. I_{o2} Regulation
with $V_i = 48$ V and $T_A = 25$ °C

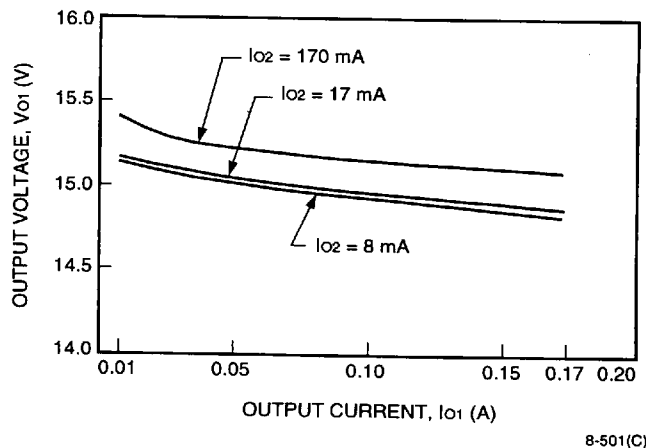


Figure 7. MW005CL Typical V_{o1} vs. I_{o1} Regulation
with $V_i = 48$ V and $T_A = 25$ °C

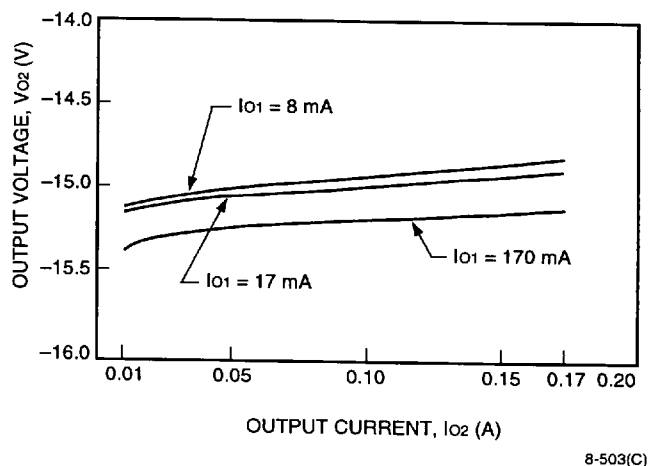


Figure 8. MW005CL Typical V_{o2} vs. I_{o2} Regulation
with $V_i = 48$ V and $T_A = 25$ °C

Characteristic Curves (continued)

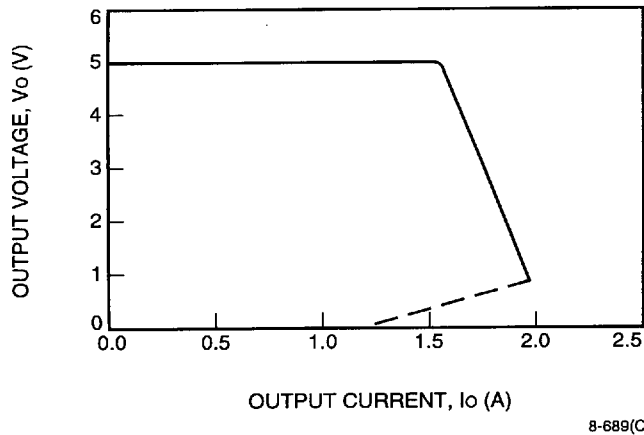


Figure 9. MW005A Typical Output Characteristic
with $V_i = 48$ V and $T_A = 25$ °C

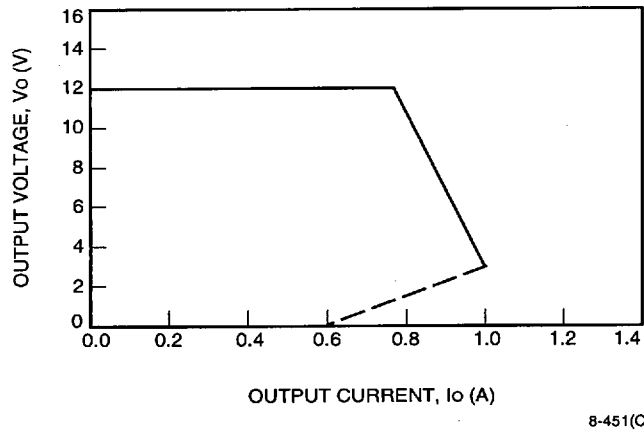


Figure 10. MW005B Typical Output Characteristic
with $V_i = 48$ V and $T_A = 25$ °C

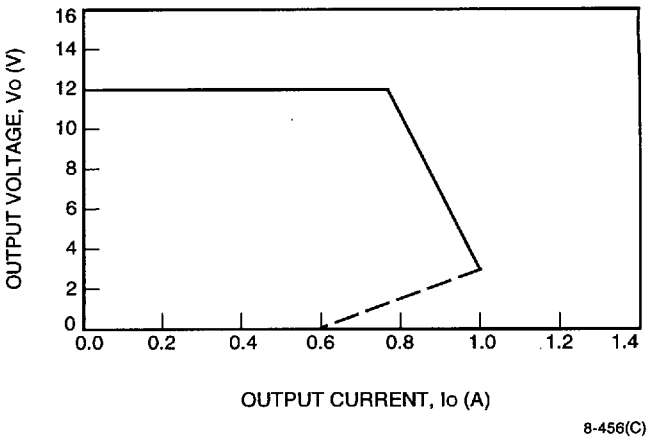


Figure 11. MW005C Typical Output Characteristic
with $V_i = 48$ V and $T_A = 25$ °C

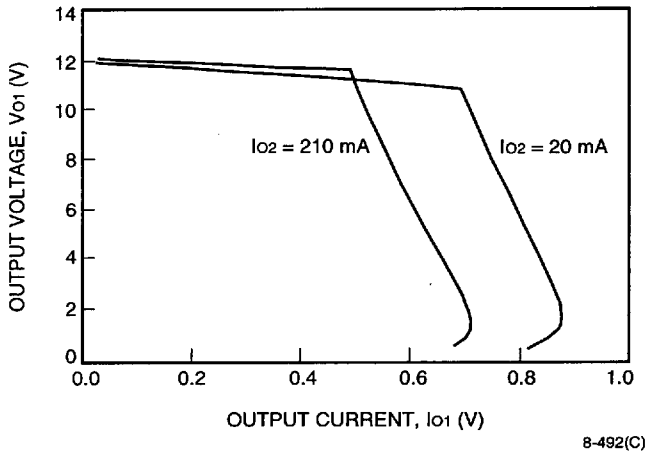
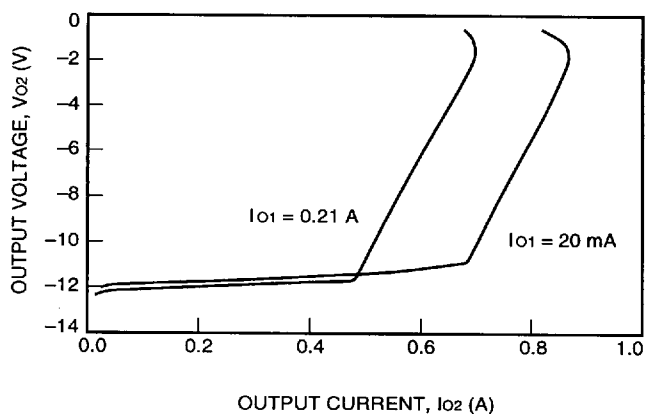


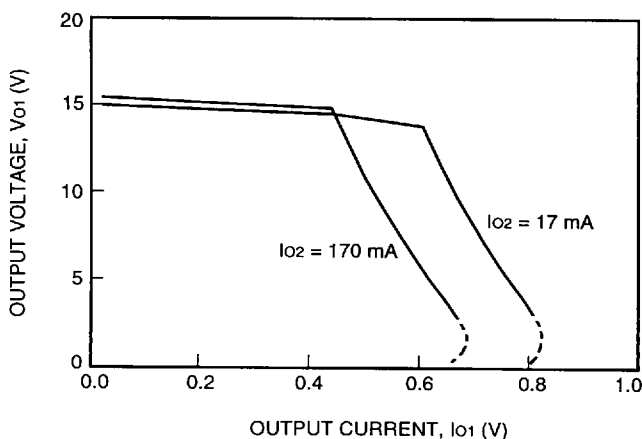
Figure 12. MW005BK Typical Output Characteristics (V_{o1} vs. I_{o1}) with $V_i = 48$ V and $T_A = 25$ °C

Characteristic Curves (continued)



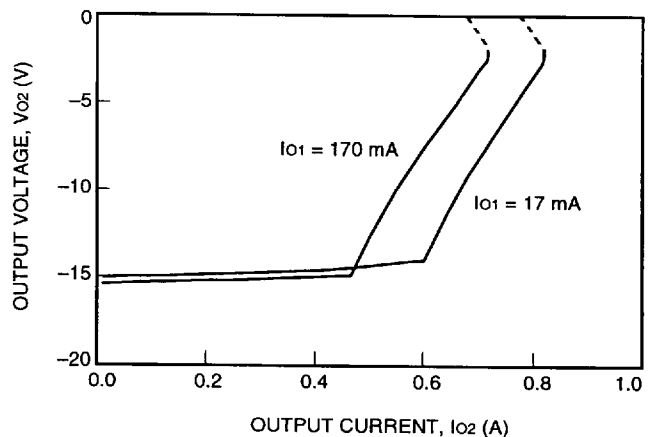
8-494(C)

Figure 13. MW005BK Typical Output Characteristics (V_{O2} vs. I_{O2}) with $V_I = 48$ V and $T_A = 25$ °C



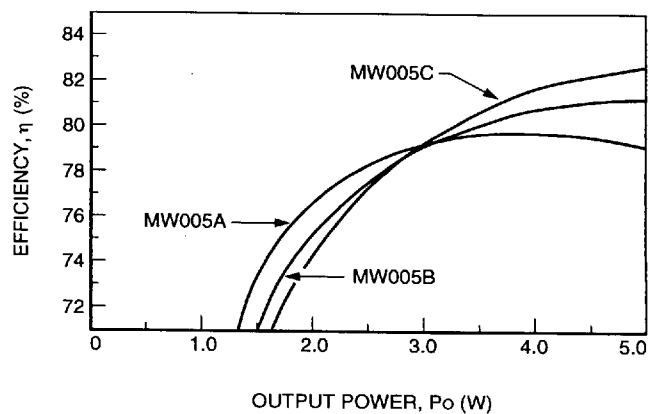
8-493(C)

Figure 14. MW005CL Typical Output Characteristics (V_{O1} vs. I_{O1}) with $V_I = 48$ V and $T_A = 25$ °C



8-495(C)

Figure 15. MW005CL Typical Output Characteristics (V_{O2} vs. I_{O2}) with $V_I = 48$ V and $T_A = 25$ °C



8-687(C)

Figure 16. MW005A, B, C Typical Converter Efficiency as a Function of Output Current with $V_I = 48$ V and $T_A = 25$ °C

Characteristic Curves (continued)

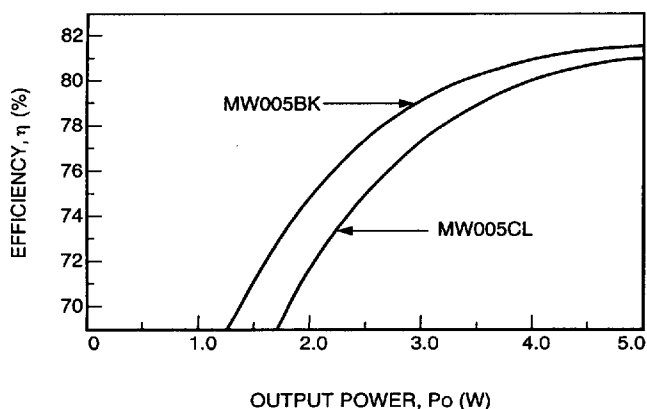


Figure 17. MW005BK, CL Typical Converter Efficiency as a Function of Output Current with $V_i = 48$ V and $T_A = 25$ °C

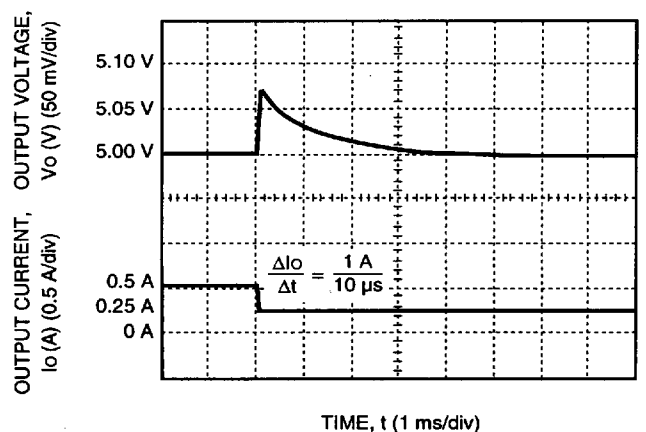


Figure 18. MW005A Typical Output Voltage Waveform for a Step Load Change from 50% to 25% of $I_{o,max}$ with $V_i = 48$ V and $T_A = 25$ °C

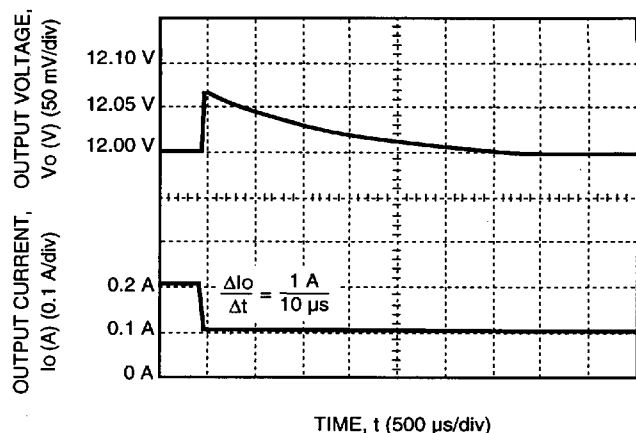


Figure 19. MW005B Typical Output Voltage Waveform for a Step Load Change from 50% to 25% of $I_{o,max}$ with $V_i = 48$ V and $T_A = 25$ °C

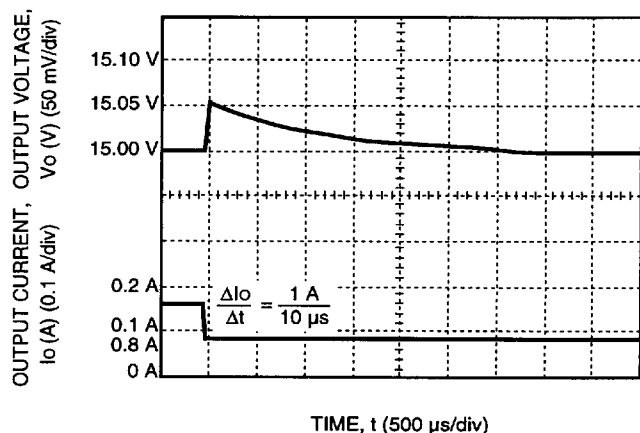


Figure 20. MW005C Typical Output Voltage Waveform for a Step Load Change from 50% to 25% of $I_{o,max}$ with $V_i = 48$ V and $T_A = 25$ °C

Characteristic Curves (continued)

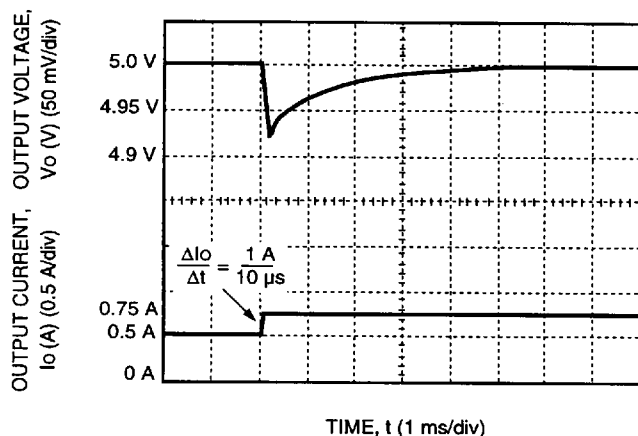


Figure 21. MW005A Typical Output Voltage Waveform for a Step Load Change from 50% to 75% of $I_{o,max}$ with $V_i = 48$ V and $T_A = 25$ °C

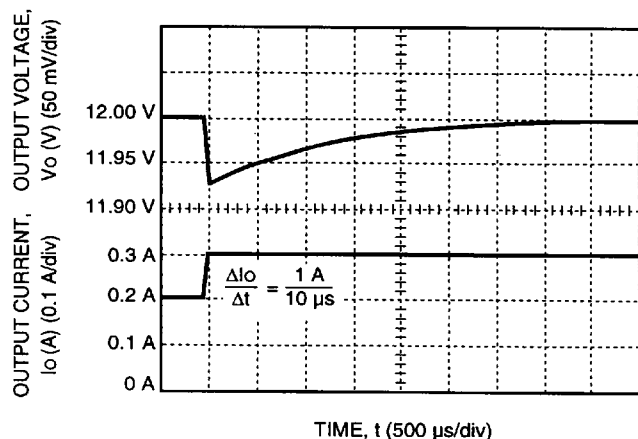


Figure 22. MW005B Typical Output Voltage Waveform for a Step Load Change from 50% to 75% of $I_{o,max}$ with $V_i = 48$ V and $T_A = 25$ °C

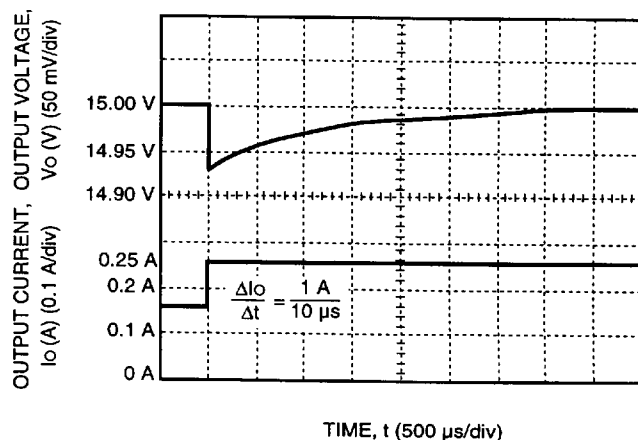
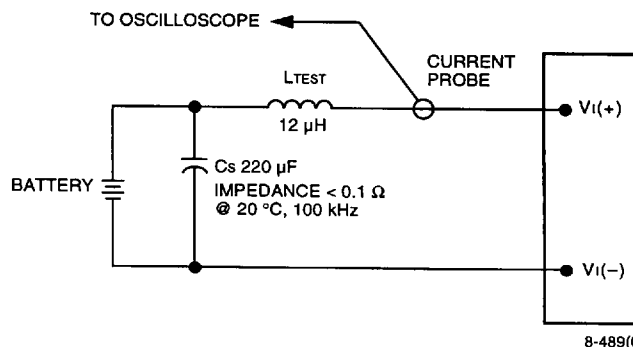


Figure 23. MW005C Typical Output Voltage Waveform for a Step Load Change from 50% to 75% of $I_{o,max}$ with $V_i = 48$ V and $T_A = 25$ °C

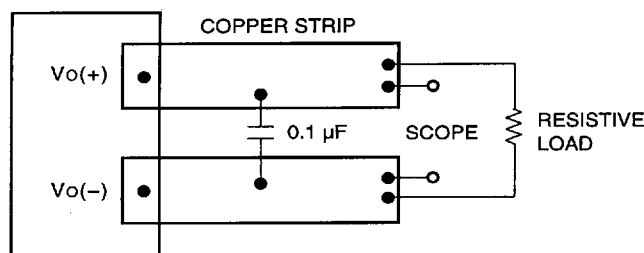
Test Configurations



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

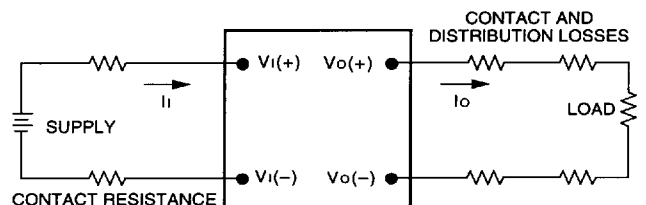
Figure 24. MW005-Series Input Reflected-Ripple Test Setup

Test Configurations (continued)



Note: Use a 0.1 μF ceramic capacitor. Scope measurement should be made using a BNC socket. Position the load between 50 mm (2 in.) and 75 mm (3 in.) from the module.

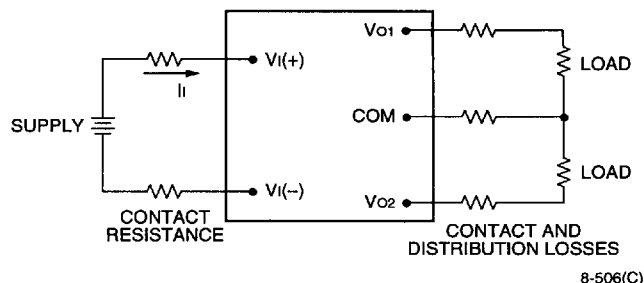
Figure 25. MW005-Series Peak-to-Peak Output Noise Measurement Test Setup



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 26. MW005A, B, C Output Voltage and Efficiency 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.

$$\eta = \frac{\sum_{j=1}^2 |V_{Oj(+)} - V_{COM}| I_{Oj}}{[V_{I(+)} - V_{I(-)}] I_i} \times 100$$

Figure 27. MW005BK, CL Output Voltage and Efficiency Measurement Test Setup

Feature Descriptions

Output Overvoltage Clamp

The output overvoltage clamp consists of control circuitry, 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.

Current Limit

To provide protection in a fault (output overload) 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. 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.

Feature Descriptions (continued)

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 22.2-950*, *EN60950*.

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

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

If the input meets extra-low voltage (ELV) requirements, then the converter's output is considered ELV.

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

Design Considerations

Input Reflected Ripple

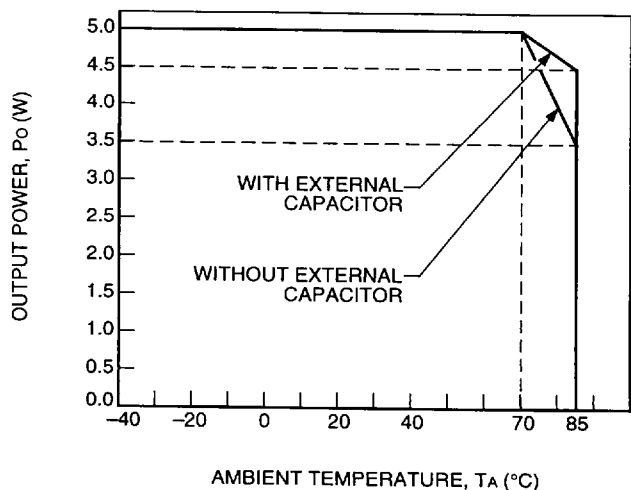
An internal aluminum electrolytic input capacitor is used for filtering; therefore, input ripple increases as temperature decreases. There is approximately two times more ripple at 0 °C than at 25 °C and eight times more ripple at -40 °C than at 25 °C. The power module functions properly down to -40 °C with no additional filtering. If lower ripple comparable to that at 25 °C is needed at low temperatures, an external capacitor across the input with an impedance of 0.5 Ω at 100 kHz over the desired temperature range is recommended.

Input or Output Voltage Reversal

CAUTION: Applying a reverse voltage across the module input or output can damage the module.

Thermal Management

To maintain the full power rating at ambient temperatures above 70 °C ($T_A > 70$ °C), add an external capacitor across the input close to the power module input leads. Use an 80 V capacitor with a minimum ripple current rating of 160 mA rms and maximum impedance of 1.0 Ω at 105 °C and 100 kHz. Otherwise, derate the output power as shown in Figure 28.



8-548(C)

Figure 28. Thermal Derating Curve

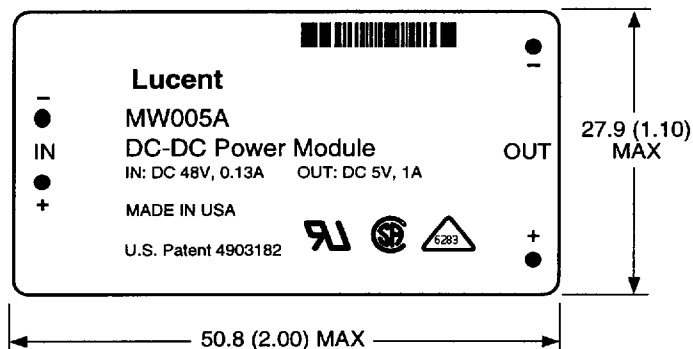
Outline Diagrams

Dimensions are in millimeters and (inches).

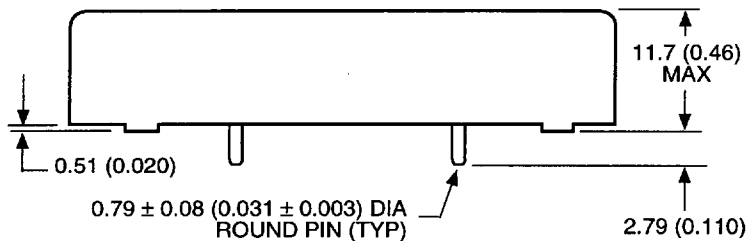
Tolerances, unless otherwise indicated: $x.x \pm 0.5$ mm (0.02 in.), $x.xx \pm 0.25$ mm (0.010 in.)

Single-Output Module

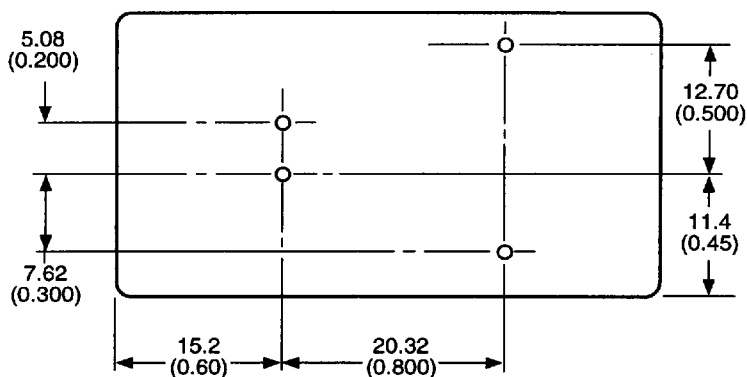
Top View



Side View



Bottom View



8-317(C).c

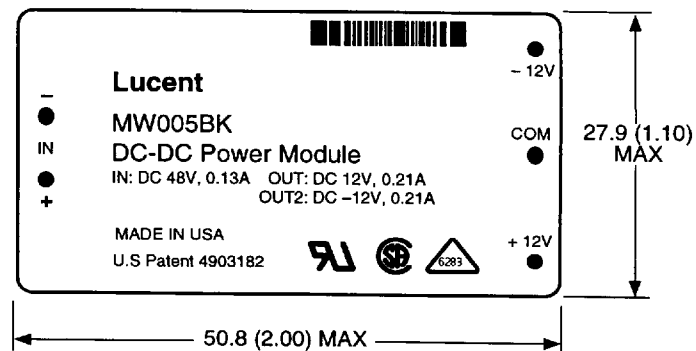
Outline Diagrams (continued)

Dimensions are in millimeters and (inches).

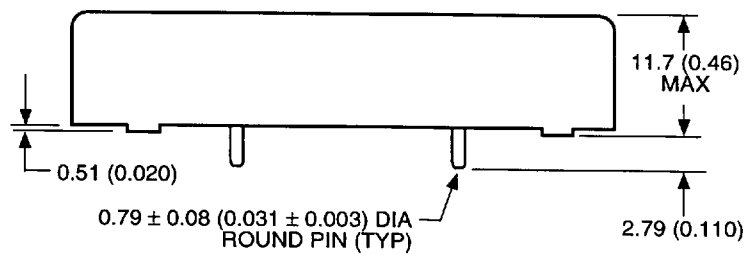
Tolerances, unless otherwise indicated: $x.x \pm 0.5$ mm (0.02 in.), $x.xx \pm 0.25$ mm (0.010 in.)

Dual-Output Module

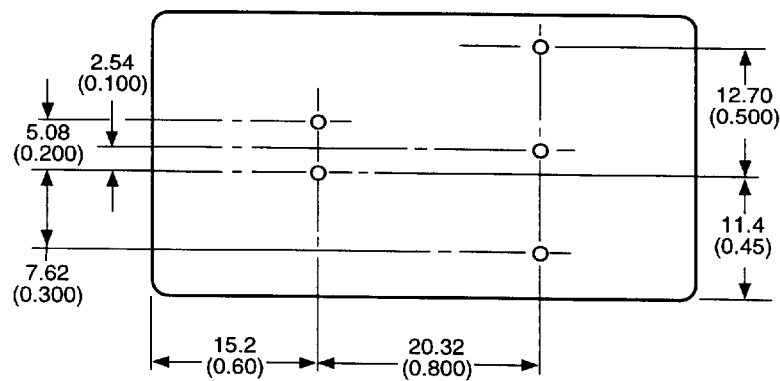
Top View



Side View



Bottom View



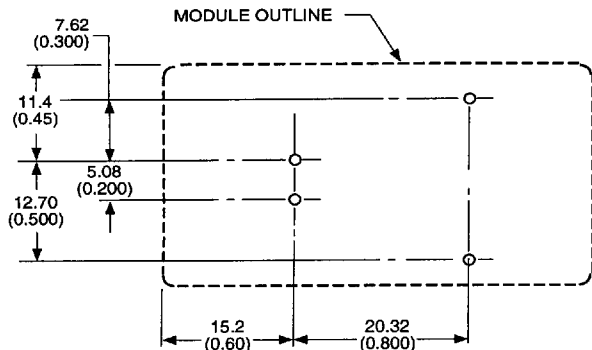
8-356(C)

Recommended Hole Patterns

Component-side footprint.

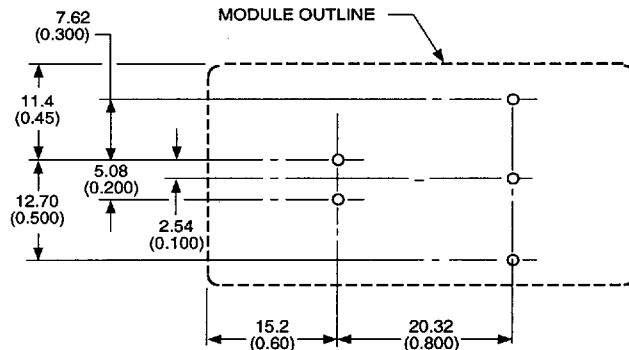
Dimensions are in millimeters and (inches).

Single-Output Module



8-317(C),c

Dual-Output Module



8-356(C)

Ordering Information

Input Voltage (V)	Output Voltage (V)	Device Code	Comcode
36—75	5.0	MW005A	106233901
36—75	12.0	MW005B	106233919
36—75	15.0	MW005C	106233927
36—75	12.0, -12.0	MW005BK	106233935
36—75	15.0, -15.0	MW005CL	106233943

Optional features maybe ordered using device code suffixes shown below. To order more than one option, list suffixes in numerical descending order followed by the -SLP suffix if desired.

Option	Device Code Suffix
Standard Long Pin: 5.84 mm ± 0.51 mm (0.230 in. ± 0.020 in.)	-SLP

Please contact your Microelectronics Group Account Manager or Application Engineer for pricing and availability of options.

For additional information, contact your Microelectronics Group Account Manager or the following:

POWER SYSTEMS UNIT: Microelectronics Group, Lucent Technologies Inc., 3000 Skyline Drive, Mesquite, TX 75149

1-800-526-7819 (Outside U.S.A.: 972-284-2626, FAX 972-329-8202) (product-related questions or technical assistance)

INTERNET: <http://www.lucint.com/micro>

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U.S.A.: Microelectronics Group, Lucent Technologies Inc., 555 Union Boulevard, Room 30L-15P-BA, Allentown, PA 18103

1-800-372-2447, FAX 610-712-4106 (In CANADA: 1-800-553-2448, FAX 610-712-4106)

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