Data Sheet
April 1999

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

The MW005-Series Power Modules use advanced surface-mount technology and deliver high-quality, efficient, and compact dc-dc conversion in a nonconductive case.

Applications

- Telecommunications
- Digital circuitry
- Distributed power architecture

Options

- Standard long pins: 5.84 mm ± 0.51 mm (0.230 in. ± 0.020 in.)
- Pin lengths: 3.68 mm ± 0.25 mm (0.145 in. ± 0.010 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
- Load regulation: 0.15% max (MW005A, B, C)
- Line regulation: 0.05% max (MW005A, B, C)
- Input-to-output isolation
- No external filtering required
- Operating ambient temperature range: –40 °C to +85 °C
- PC-board mountable
- High reliability
- Overcurrent protection, unlimited duration
- Output overvoltage protection
- *UL** 1950 Recognized, *CSA*† C22.2 No. 950-95 Certified, VDE 0805 (EN60950, IEC950) Licensed
- CE mark meets 73/23/EEC and 93/68/EEC directives‡
- Meets FCC and VDE Class B limits for radiated emissions

* *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 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).

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

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^2s
Input Reflected-ripple Current, Peak-to-peak (5 Hz to 20 MHz, 12 µH source impedance, T_A = 25 °C, see Figure 24 and Design Considerations section.)	I_I	—	30	—	mAp-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 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 Set Point (V_I = 48 V; I_O = $I_{O, max}$; T_A = 25 °C)	MW005A	$V_{O, set}$	4.85	5.00	5.20	Vdc
	MW005B	$V_{O, set}$	11.52	12.00	12.48	Vdc
	MW005C	$V_{O, set}$	14.40	15.00	15.60	Vdc
	MW005BK	$V_{O1, set}$	11.40	12.00	12.60	Vdc
		$V_{O2, set}$	–11.40	–12.00	–12.60	Vdc
	MW005CL	$V_{O1, set}$	14.25	15.00	15.75	Vdc
		$V_{O2, set}$	–14.25	–15.00	–15.75	Vdc
Output Voltage (Over all operating input voltage, resistive load, and temperature conditions until end of life. See Figures 26 and 27. 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 Regulation:						
Line (V_I = 36 Vdc to 75 Vdc)	MW005A, B, C	—	—	0.01	0.05	%V_O
Load (I_O = $I_{O, min}$ to $I_{O, max}$)	MW005A, B, C	—	—	0.05	0.15	%V_O
Temperature (T_A = –40 °C to +85 °C)	MW005A	—	—	15	70	mV
(See Figures 2—4.)	MW005B	—	—	40	150	mV
	MW005C	—	—	45	190	mV
Output Ripple and Noise Voltage (With 0.1 µF, ceramic, bypass capacitor on output; see Figure 25.):						
RMS	MW005A	—	—	—	15	mVrms
	MW005B, C	—	—	—	25	mVrms
	MW005BK, CL	—	—	—	80	mVrms
Peak-to-peak (5 Hz to 20 MHz)	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.):						
V_O = 4.5 V	MW005A	—	—	1.6	2.5	A
V_O = 10.8 V	MW005B	—	—	0.8	1.4	A
V_O = 13.5 V	MW005C	—	—	0.7	1.3	A
V_{O1} or V_{O2} = 10.2 V	MW005BK	—	—	0.8	1.4	A
V_{O1} or V_{O2} = 12.75 V	MW005CL	—	—	0.7	1.3	A
Output Current Limit (See Figures 9—15.):						
V_O = 1.0 V	MW005A	—	—	—	3.0	A
V_O = 1.0 V	MW005B, C	—	—	—	2.0	A
V_{O1} or V_{O2} = 1.0 V	MW005BK, CL	—	—	—	2.0	A
Output Short-circuit Current	MW005A	—	—	1.5	—	A
(V_O = 250 mV; see Figures 9—15.)	MW005B, C, BK, CL	—	—	1.0	—	A
Efficiency	MW005A	η	77	80	—	%
(V_I = 48 V; I_O = $I_{O, max}$; T_A = 25 °C;	MW005B, C	η	79	82	—	%
see Figures 16, 17, 26, and 27.)	MW005BK, CL	η	78	81	—	%
Dynamic Response ($\Delta I_O/\Delta t$ = 1 A/10 µs, V_I = 48 V, T_A = 25 °C; for MW005BK and CL, applies to V_{O1} and V_{O2} at I_O = $I_{O, max}$.):						
Load Change from I_O = 50% to 25% of $I_{O, max}$ (See Figures 18—20.):						
Peak Deviation	MW005A	—	—	80	—	mV
	MW005B	—	—	70	—	mV
	MW005C	—	—	60	—	mV
	MW005BK, CL	—	—	50	—	mV
Settling Time (V_O < 10% of peak deviation)	MW005A, B, C	—	—	3.5	—	ms
	MW005BK, CL	—	—	5.0	—	ms
Load Change from I_O = 50% to 75% of $I_{O, max}$ (See Figures 21—23.):						
Peak Deviation	MW005A	—	—	80	—	mV
	MW005B, C	—	—	70	—	mV
	MW005BK, CL	—	—	50	—	mV
Settling Time (V_O < 10% of peak deviation)	MW005A, B, C	—	—	3.5	—	ms
	MW005BK, CL	—	—	5.0	—	ms

Electrical Specifications (continued)

Table 3. Isolation Specifications

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

General Specifications

Parameter	Device	Min	Typ	Max	Unit
Calculated MTBF (at 80% of $I_{O, max}$; T_C = 40 °C)	All		8,800,000		hours
Weight	All	—	—	28 (1.0)	g (oz.)

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 Protection (clamp)	MW005A	$V_{O, clamp}$	—	6.0	7.0	V
	MW005B	$V_{O, clamp}$	—	14	16	V
	MW005C	$V_{O, clamp}$	—	17	19	V
	MW005BK	$V_{O1, clamp}$	—	16	18	V
		$V_{O2, clamp}$	—	–16	–18	V
	MW005CL	$V_{O1, clamp}$	—	19	21	V
		$V_{O2, clamp}$	—	–19	–21	V

Characteristic Curves

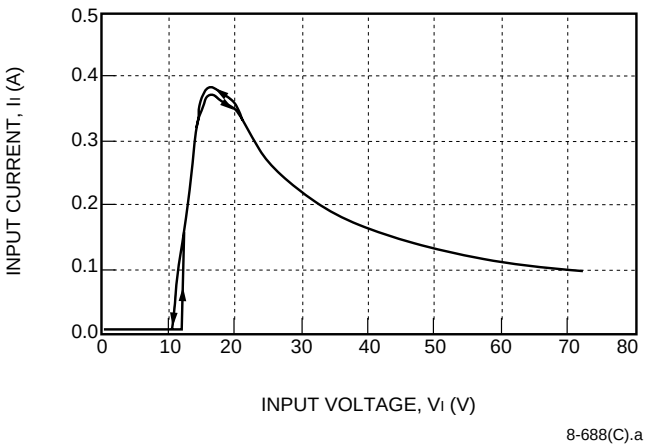


Figure 1. MW005-Series Typical Input Characteristic with $I_O = I_{O,max}$ and T_A = 25 °C (Arrows Indicate Hysteresis)

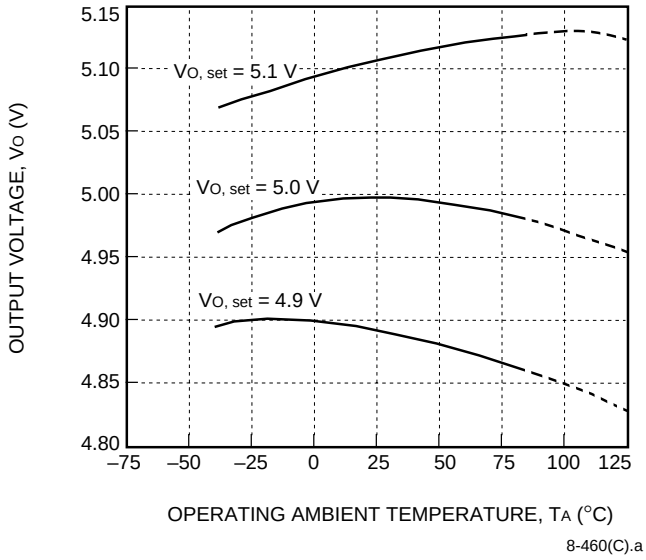


Figure 2. MW005A Typical Output Voltage Variations Over Operating Ambient Temperature Range

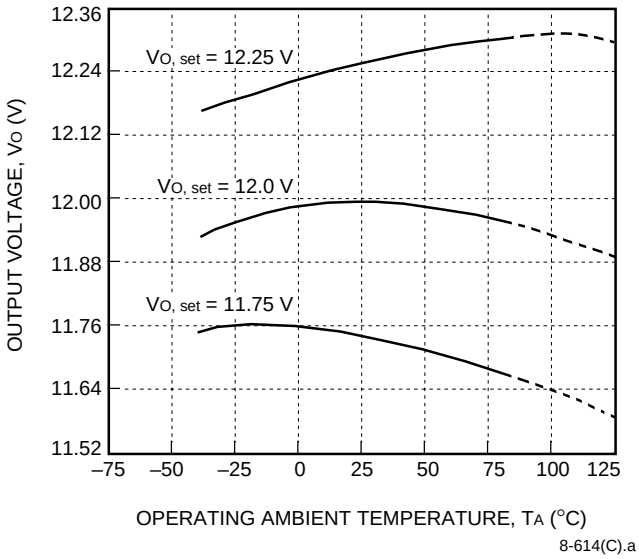


Figure 3. MW005B Typical Output Voltage Variations Over Operating Ambient Temperature Range

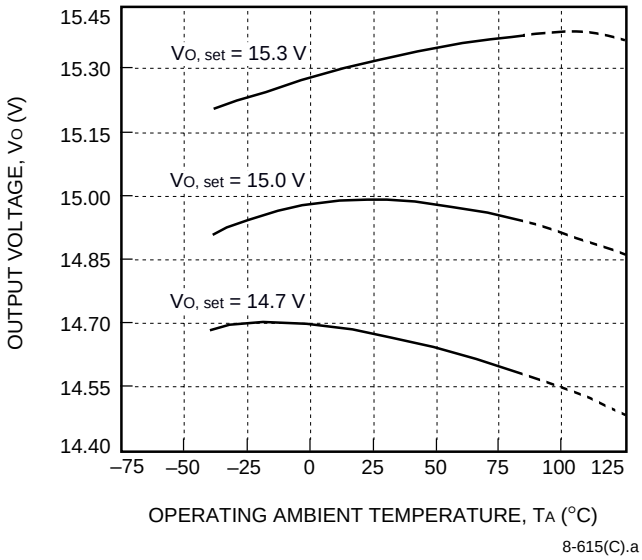


Figure 4. MW005C Typical Output Voltage Variations Over Operating Ambient Temperature Range

Characteristic Curves (continued)

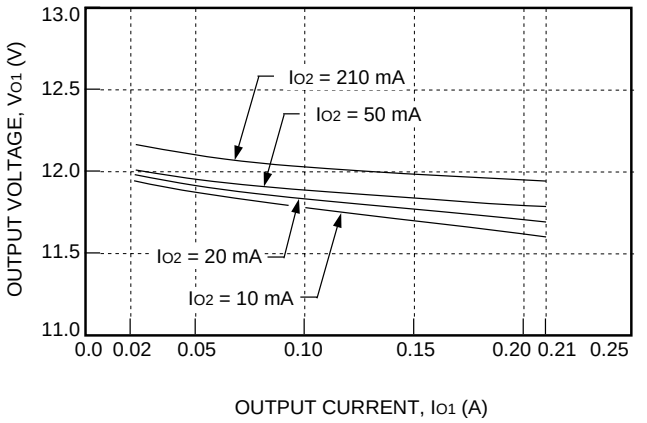


Figure 5. MW005BK Typical V_{O1} vs. I_{O1} Regulation with V_I = 48 V and T_A = 25 °C

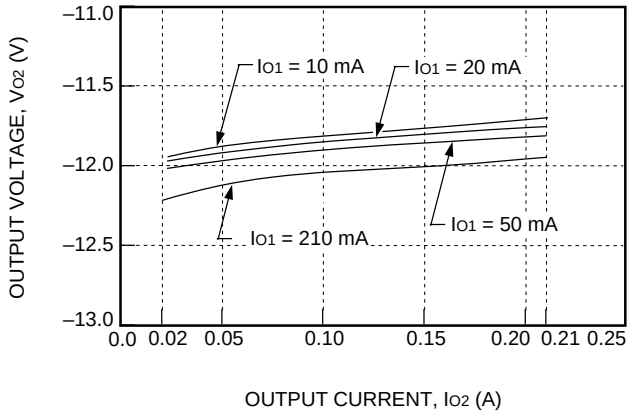


Figure 6. MW005BK Typical V_{O2} vs. I_{O2} Regulation with V_I = 48 V and T_A = 25 °C

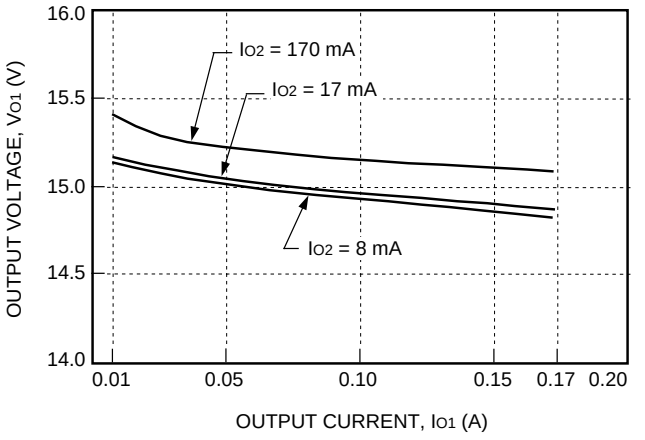


Figure 7. MW005CL Typical V_{O1} vs. I_{O1} Regulation with V_I = 48 V and T_A = 25 °C

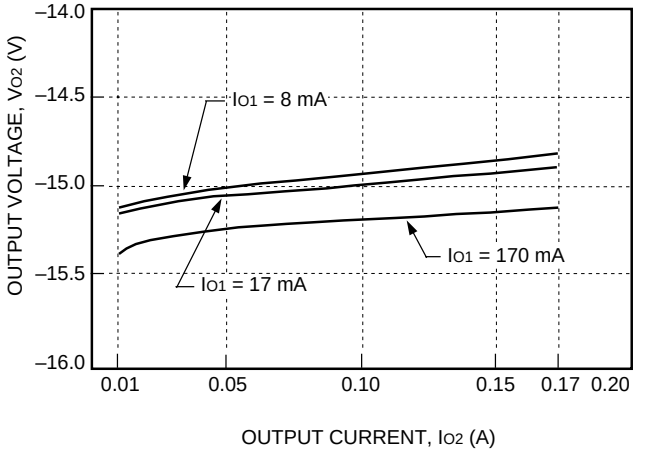


Figure 8. MW005CL Typical V_{O2} vs. I_{O2} Regulation with V_I = 48 V and T_A = 25 °C

Characteristic Curves (continued)

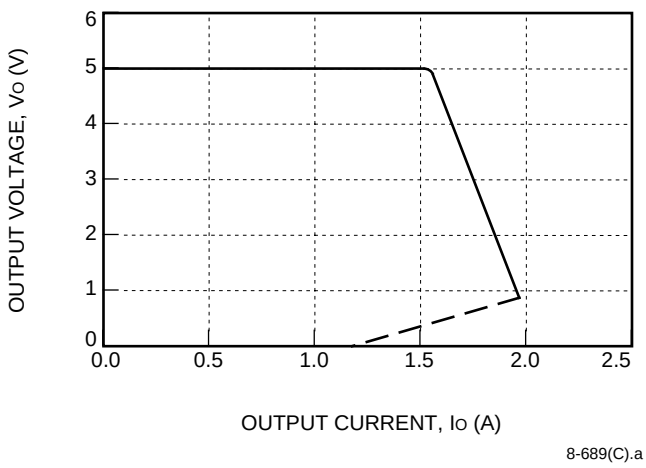


Figure 9. MW005A Typical Output Characteristic with V_I = 48 V and T_A = 25 °C

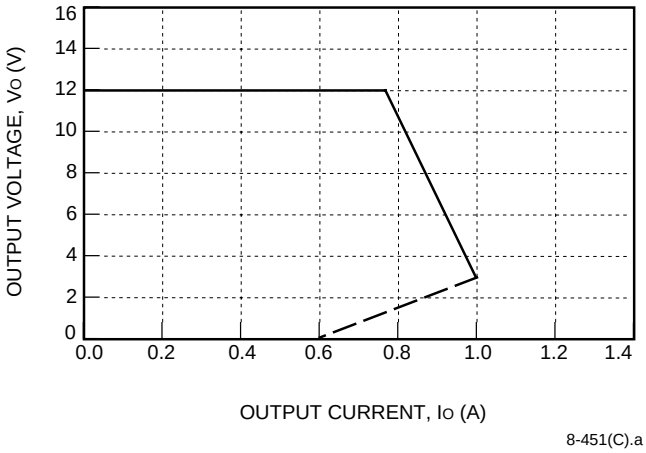


Figure 10. MW005B Typical Output Characteristic with V_I = 48 V and T_A = 25 °C

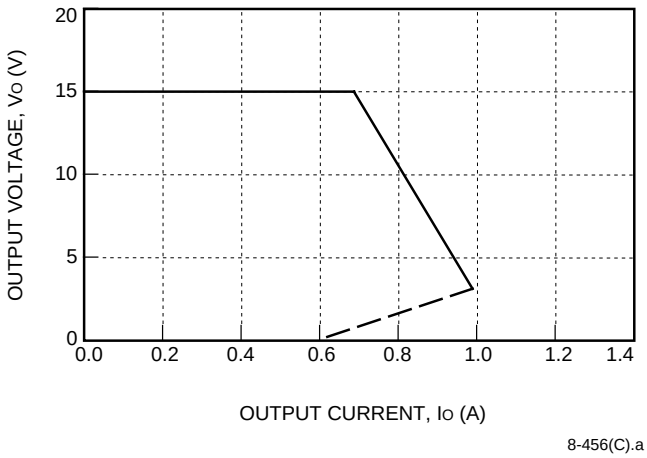


Figure 11. MW005C Typical Output Characteristic with V_I = 48 V and T_A = 25 °C

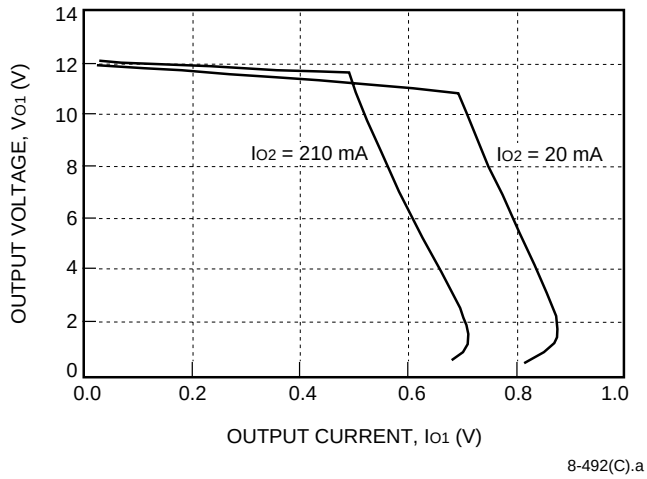


Figure 12. MW005BK Typical Output Characteristics (V_{O1} vs. I_{O1}) with V_I = 48 V and T_A = 25 °C

Characteristic Curves (continued)

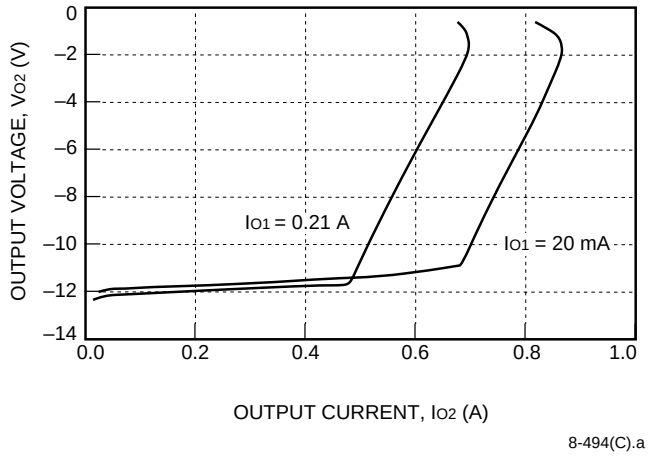


Figure 13. MW005BK Typical Output Characteristics (V_{O2} vs. I_{O2}) with V_I = 48 V and T_A = 25 °C

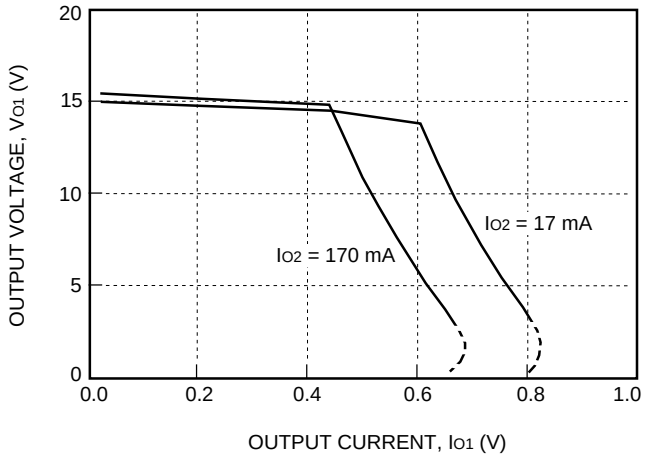


Figure 14. MW005CL Typical Output Characteristics (V_{O1} vs. I_{O1}) with V_I = 48 V and T_A = 25 °C

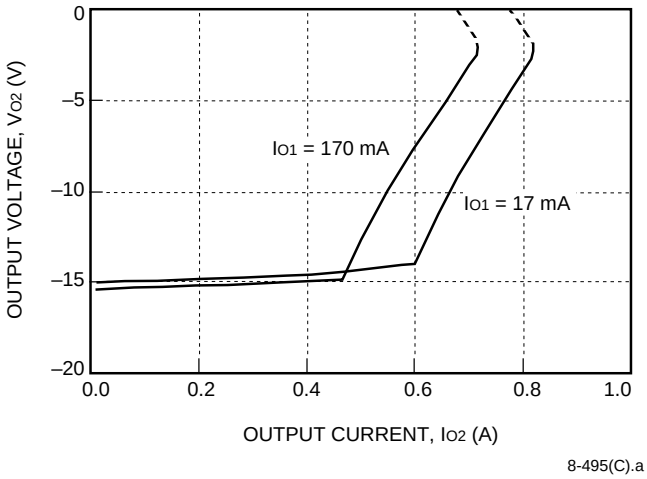


Figure 15. MW005CL Typical Output Characteristics (V_{O2} vs. I_{O2}) with V_I = 48 V and T_A = 25 °C

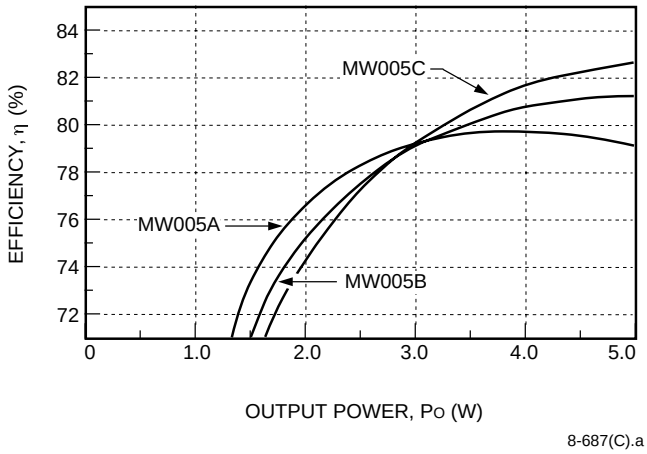


Figure 16. MW005A, B, C Typical Converter Efficiency as a Function of Output Current with V_I = 48 V and T_A = 25 °C

Characteristic Curves (continued)

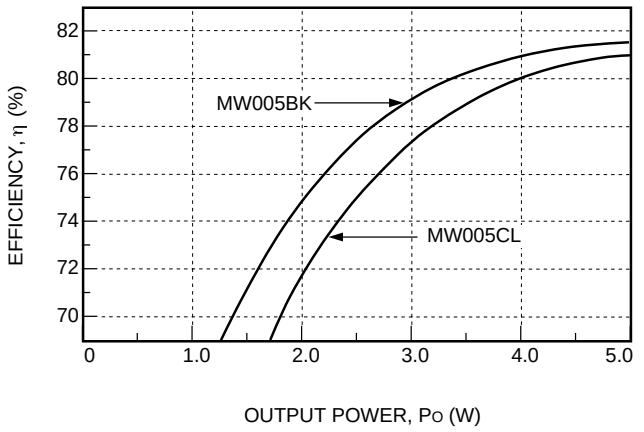


Figure 17. MW005BK, CL Typical Converter Efficiency as a Function of Output Current with V_I = 48 V and T_A = 25 °C

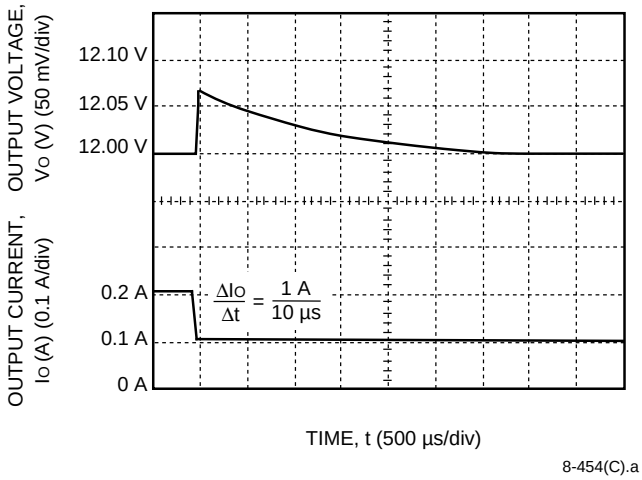


Figure 19. MW005B Typical Output Voltage Waveform for a Step Load Change from 50% to 25% of $I_{O, max}$ with V_I = 48 V and T_A = 25 °C

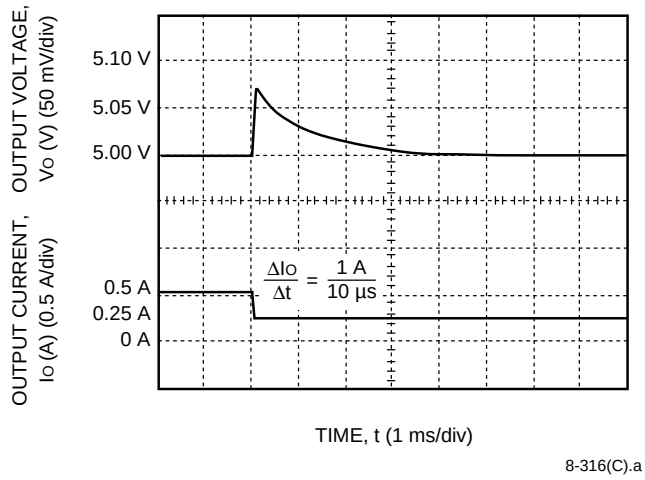


Figure 18. MW005A Typical Output Voltage Waveform for a Step Load Change from 50% to 25% of $I_{O, max}$ with V_I = 48 V and T_A = 25 °C

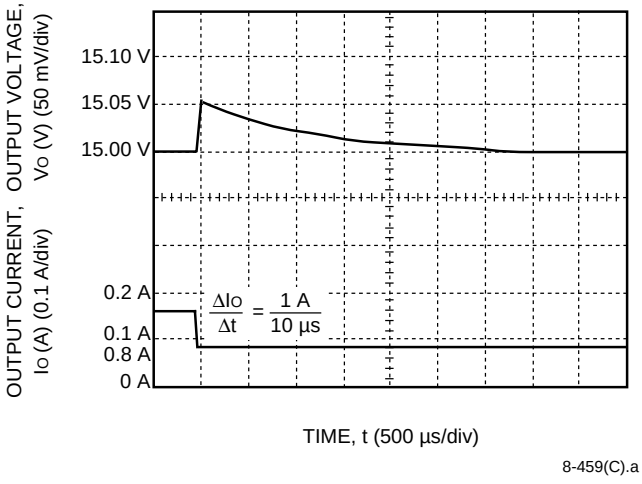


Figure 20. MW005C Typical Output Voltage Waveform for a Step Load Change from 50% to 25% of $I_{O, max}$ with V_I = 48 V and T_A = 25 °C

Characteristic Curves (continued)

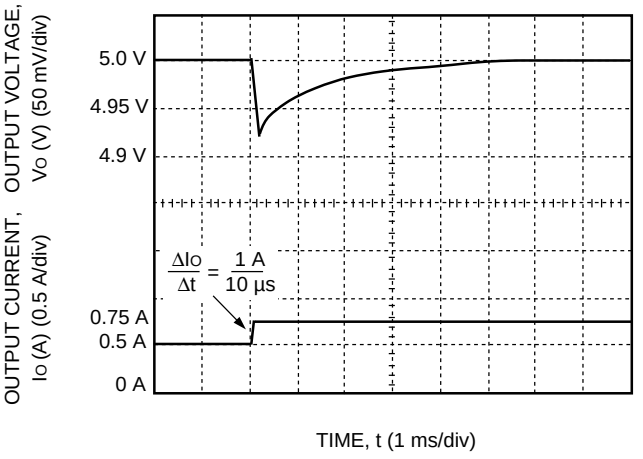


Figure 21. MW005A Typical Output Voltage Waveform for a Step Load Change from 50% to 75% of $I_{o,max}$ with V_I = 48 V and T_A = 25 °C

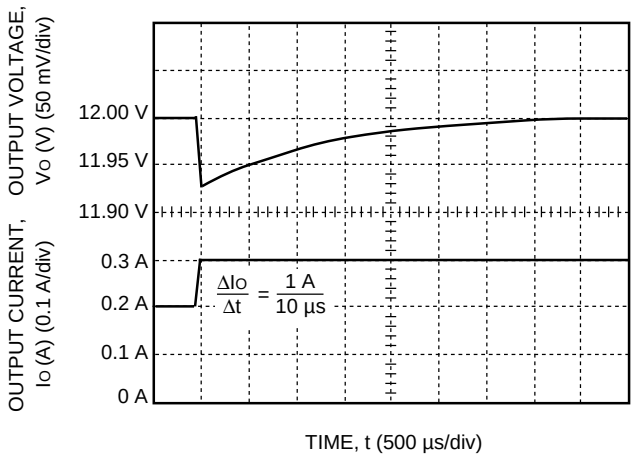


Figure 22. MW005B Typical Output Voltage Waveform for a Step Load Change from 50% to 75% of $I_{o,max}$ with V_I = 48 V and T_A = 25 °C

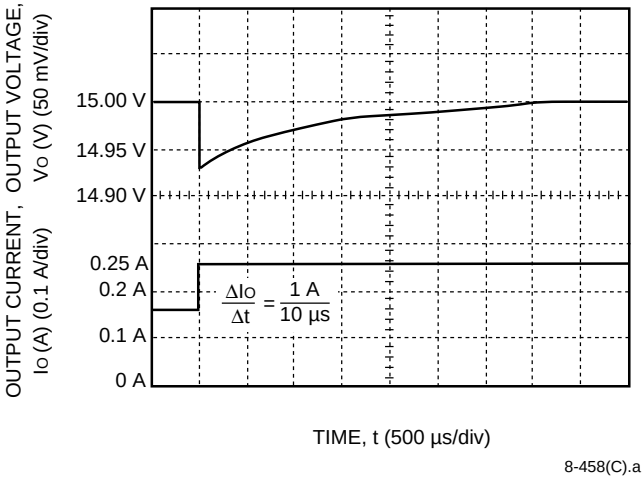
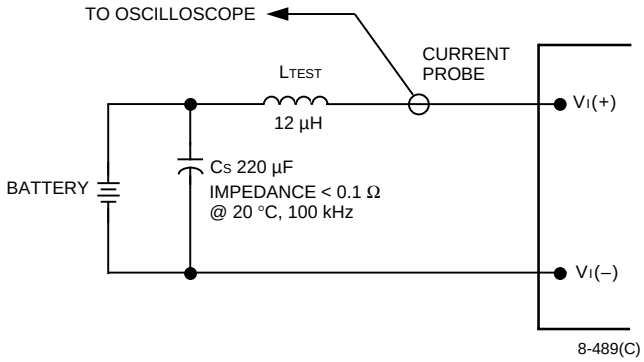


Figure 23. MW005C Typical Output Voltage Waveform for a Step Load Change from 50% to 75% of $I_{o,max}$ with V_I = 48 V and T_A = 25 °C

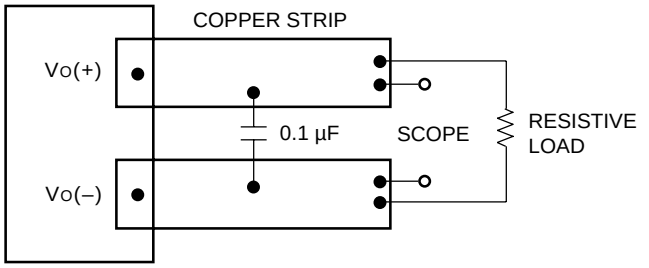
Test Configurations



Note: Input reflected-ripple current is measured with a simulated source impedance of 12 µH. 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

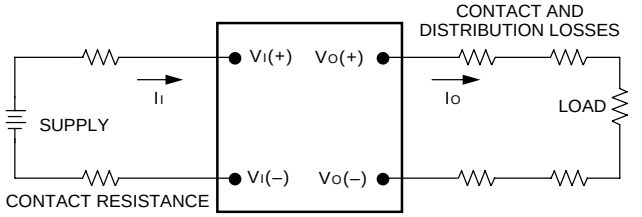
Test Configurations (continued)



8-513(C)

Note: Use a 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 25. MW005-Series Peak-to-Peak Output Noise Measurement Test Setup

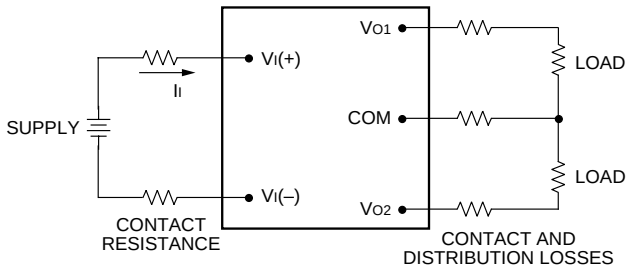


8-204(C)

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 26. MW005A, B, C Output Voltage and Efficiency Measurement Test Setup



8-506(C)

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.

$$\eta = \frac{\sum_{J=1}^{2} |[V_{OJ(+)} - V_{COM}]I_{OJ}|}{[V_{I(+)} - V_{I(-)}]I_I} \times 100 \qquad \%$$

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

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. See Figure 24 for the test setup.

Input or Output Voltage Reversal

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

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; and
- 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; and
- The input pins of the module are not operator accessible; and
- 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

Overcurrent Protection

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.

Output Overvoltage Protection

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.

Thermal Considerations

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 mArms and maximum impedance of 1.0 Ω at 105 °C and 100 kHz. Otherwise, derate the output power as shown in Figure 28.

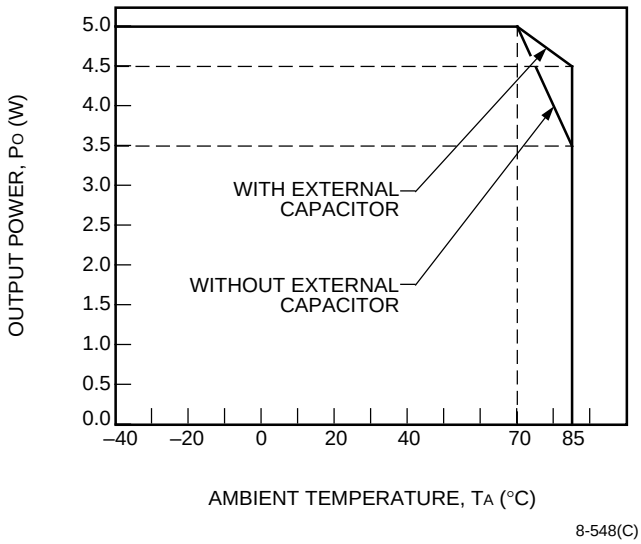


Figure 28. Thermal Derating Curve

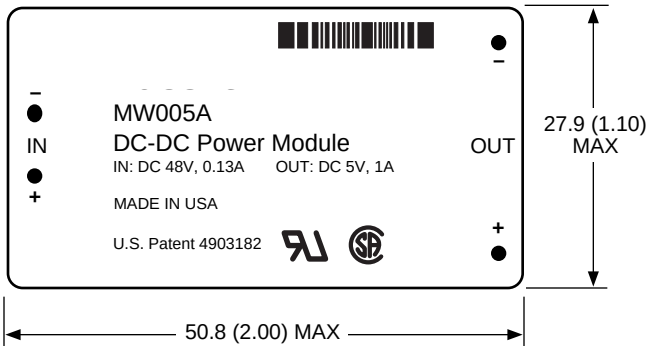
Outline Diagrams

Dimensions are in millimeters and (inches).

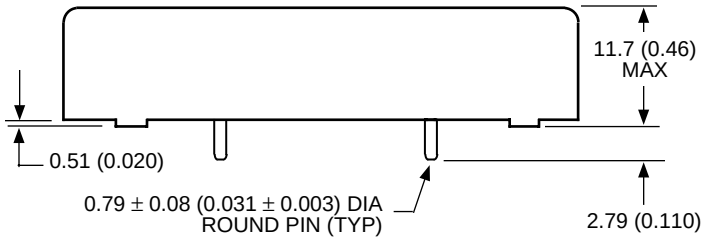
Tolerances, unless otherwise indicated: x.x ± 0.5 mm (0.02 in.), x.xx ± 0.25 mm (0.010 in.)

Single-Output Module

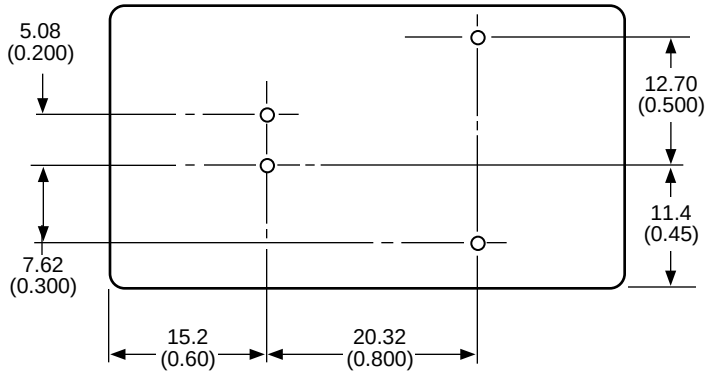
Top View



Side View



Bottom View



8-317(C).c

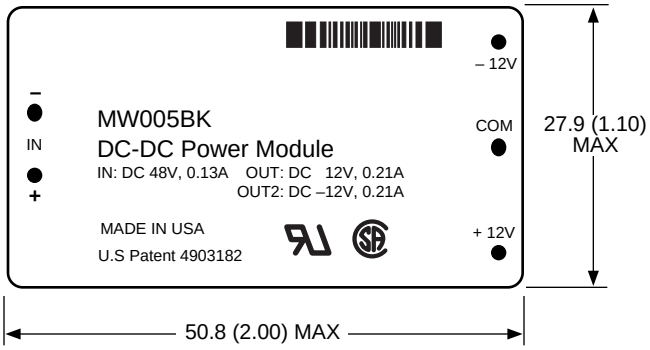
Outline Diagrams (continued)

Dimensions are in millimeters and (inches).

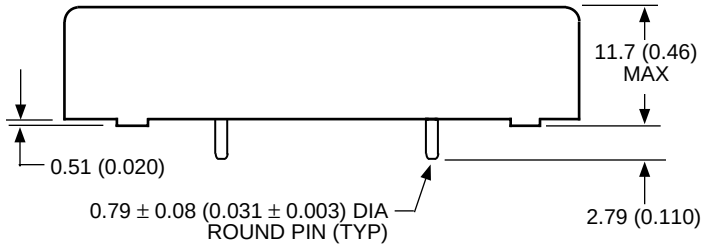
Tolerances, unless otherwise indicated: x.x ± 0.5 mm (0.02 in.), x.xx ± 0.25 mm (0.010 in.)

Dual-Output Module

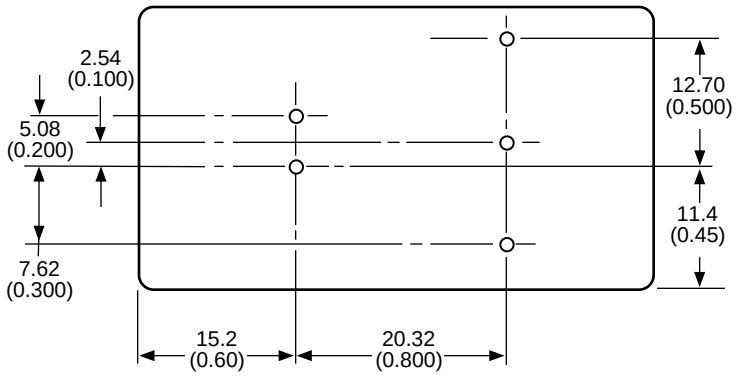
Top View



Side View



Bottom View



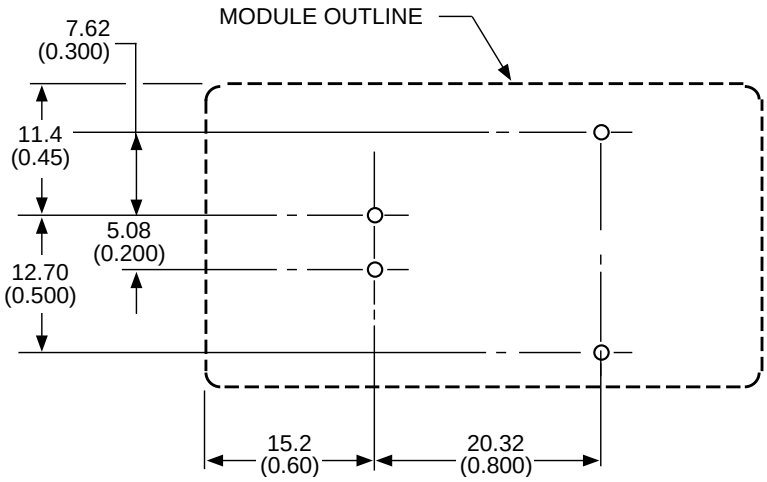
8-356(C)

Recommended Hole Patterns

Component-side footprint.

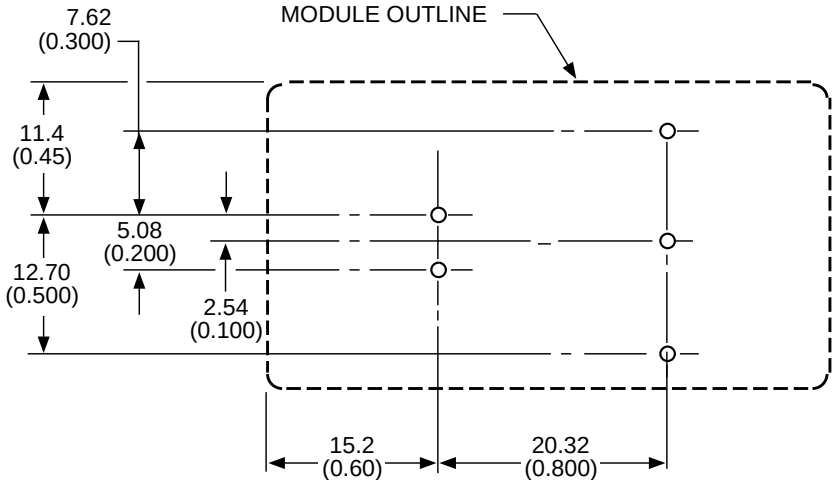
Dimensions are in millimeters and (inches).

Single-Output Module



8-317(C).c

Dual-Output Module



8-356(C)

Ordering Information

Table 4. Device Codes

Input Voltage	Output Voltage	Output Power	Device Code	Comcode
36 V—75 V	5 V	5 W	MW005A	106233901
36 V—75 V	12 V	5 W	MW005B	106233919
36 V—75 V	15 V	5 W	MW005C	106233927
36 V—75 V	±12 V	5 W	MW005BK	106233935
36 V—75 V	±15 V	5 W	MW005CL	106233943

Optional features maybe ordered using device code suffixes shown below.

Table 5. Device Options

Option	Device Code Suffix
Standard long pins: 5.84 mm ± 0.51 mm (0.230 in. ± 0.020 in.)	–SLP
Pin lengths: 3.68 mm ± 0.25 mm (0.145 in. ± 0.010 in.)	6

Notes

Notes

Tyco Electronics Power Systems, Inc.
3000 Skyline Drive, Mesquite, TX 75149, USA
+1-800-526-7819 FAX: +1-888-315-5182
(Outside U.S.A.: **+1-972-284-2626**, FAX: +1-972-284-2900)
http://power.tycoelectronics.com

April 1999
DS99-115EPS (Replaces DS96-213EPS)

Printed on
Recycled Paper