Data Sheet
August 1993

AT&T Microelectronics

MW005AJ, MW005AJ4 Power Modules: 36 Vdc to 72 Vdc Input; 5 W

The MW005AJ-Series Power Modules use advanced, surface-mount technology and deliver high-quality, compact, dc-dc conversion at an economical price.

Features

- Small size: 2.00 in. x 1.10 in. x 0.46 in.
- Output current limiting, unlimited duration
- Output overvoltage clamp
- Input-to-output isolation
- Operating ambient temperature range: –40 °C to 85 °C
- High reliability
- Within FCC and VDE Class A Radiated Limits
- UL and CSA recognized

Options

- Metal case with ground pin
- Tighter regulation for 5 V output voltage
- Long pins: 0.230 in. ±0.020 in. (5.84 mm ±0.51 mm)

Applications

- Distributed power architectures
- Telecommunications
- Private branch exchange (PBX)

Description

The MW005AJ and MW005AJ4 Power Modules are dc-dc converters which operate over an input-voltage range of 36 Vdc to 72 Vdc and provide precisely regulated dc outputs. The outputs are isolated from the input, and the module has a maximum power rating of 5 W at a typical full-load efficiency of 78% for MW005AJ and 76% for MW005AJ4.

The modules are encapsulated in a nonconductive case which mounts on PC boards. In a natural convection environment, the modules are rated to operate at full load at 85 °C with no heat sinking or external filtering.

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	—	75	Vdc
I/O Isolation Voltage	—	—	500	V
Operating Ambient Temperature (60 ft./min. natural convection)	T_A	–40	85	°C
Storage Temperature	T_{stg}	–40	100	°C

Electrical Specifications

Unless otherwise indicated, specifications apply 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	72	Vdc
Maximum Input Current (V_I = 0 V to 72 V; I_O = $I_{O,max.}$; see Figure 1)	$I_{I,max}$	—	—	600	mA
Inrush Transient	i^2t	—	0.1	0.2	A^2s
Input Reflected-ripple Current, Peak-to-peak (5 Hz to 20 MHz, 12 µH source impedance; T_A = 25 °C; see Figure 11 and Design Considerations section.)	—	—	20	—	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 *Underwriters Laboratories Conditions of Acceptability* requires a normal-blow, dc fuse. A dc fuse with a maximum rating of 5 A is recommended. 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 2–4.)	MW005AJ	V_{O1} V_{O2}	4.70 −4.70	— —	5.30 −5.30	Vdc Vdc
	MW005AJ4	V_{O1} V_{O2}	4.80 −4.70	— —	5.25 −5.80	Vdc Vdc
Output Voltage Set Point (V_I = 48 V; I_{O1}, I_{O2} = 50% $I_{O, max}$; T_A = 25 °C)	MW005AJ	$V_{O1, set}$ $V_{O2, set}$	4.85 −4.85	5.00 −5.00	5.15 −5.15	Vdc Vdc
	MW005AJ4	$V_{O1, set}$ $V_{O2, set}$	4.90 −5.00	5.00 −5.20	5.10 −5.40	Vdc Vdc
Output Regulation: Temperature (T_A = –40 °C to 85 °C; see Figure 5.)	All	—	—	25	—	mV
Output Ripple and Noise: RMS Peak-to-peak (5 Hz to 20 MHz) (See Output Ripple in the Design Considerations section for lower output noise.)	All All	— —	— —	25 120	120 500	mV rms mV p-p
Output Current (At $I_O < I_{O, min}$, the modules may exceed output ripple specifications.)	MW005AJ	I_{O1} I_{O2}	0.1 0.1	— —	0.5 0.5	A A
	MW005AJ4	I_{O1} I_{O2}	0.1 0.05	— —	0.8 0.2	A A
Output Current-limit Inception (V_O = 90% of $V_{O, nom}$; see Figures 6–9.)	All	$I_{O1,2}$	—	1.6	2.5	A
Output Short-circuit Current ($V_{O1, 2}$ = 250 mV; see Figures 6–9.)	All	$I_{O1,2}$	—	1.8	2.8	A
Efficiency (V_I = 48 Vdc; I_O = $I_{O, max}$; T_A = 25 °C; see Figures 10 and 13.)	MW005AJ MW005AJ4	η η	75 74	78 77	— —	% %
Dynamic Response (Applies to V_{O1} and V_{O2} at full load, $\Delta I_O/\Delta t$ = 1 A/10 µs, V_I = 48 V, T_A = 25 °C): Load Change from I_O = 50% to 75% of $I_{O, max}$: Peak Deviation Settling Time (V_O < 10% peak deviation) Load Change from I_O = 50% to 25% of $I_{O, max}$: Peak Deviation Settling Time (V_O < 10% peak deviation)	All All All All	— —	— —	80 5.0	— —	mV ms
		— —	— —	80 5.0	— —	mV ms

Electrical Specifications (continued)

Table 3. Isolation Specifications

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

General Specifications

Table 4. General Specifications

Parameter	Min	Typ	Max	Unit
Calculated MTBF (I_O = 80% of $I_{O,max}$; T_C = 40 °C)		1,900, 000		hours
Weight	—	—	1.00 (28)	oz. (g)

Feature Specifications

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

Table 5. Feature Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Overvoltage Clamp	MW005AJ	$V_{O1, clamp}$	—	—	7.0	V
		$V_{O2, clamp}$	—	—	–7.0	V
	MW005AJ4	$V_{O1, clamp}$	—	—	7.0	V
		$V_{O2, clamp}$	—	—	–8.0	V

Characteristic Curves

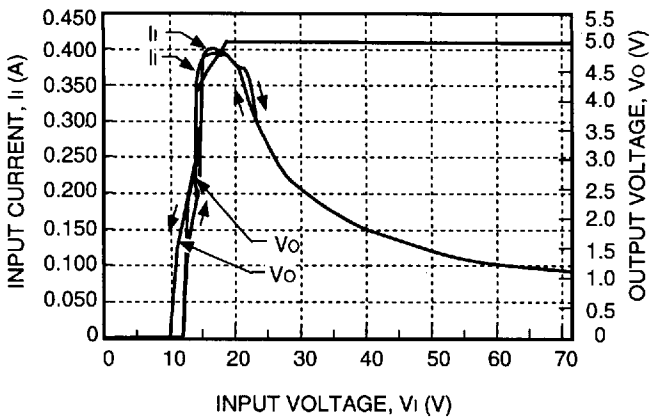


Figure 1. MW005AJ and MW005AJ4 Input Current and Output Voltage vs. Input Voltage at T_A = 25 °C and Full Load

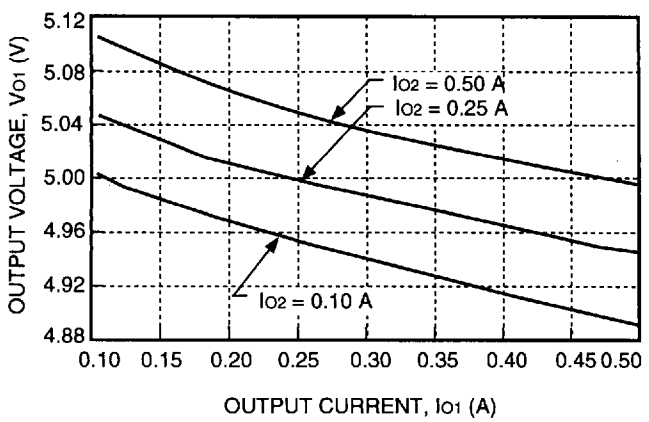


Figure 2. MW005AJ Typical V_{O1} vs. I_{O1} Regulation (V_{IN} = 48 V and T_A = 25 °C)

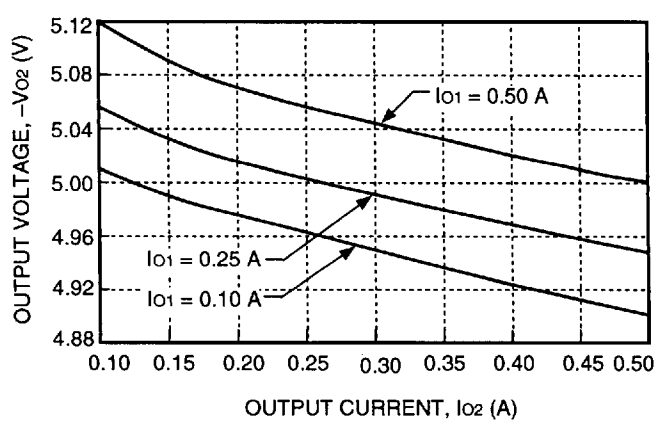


Figure 3. MW005AJ Typical V_{O2} vs. I_{O2} Regulation (V_I = 48 V and T_A = 25 °C)

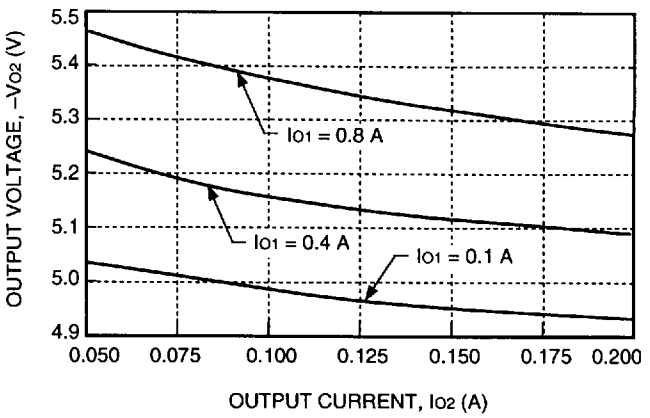


Figure 4. MW005AJ4 Typical V_{O2} vs. I_{O2} Regulation (V_I = 48 V and T_A = 25 °C)

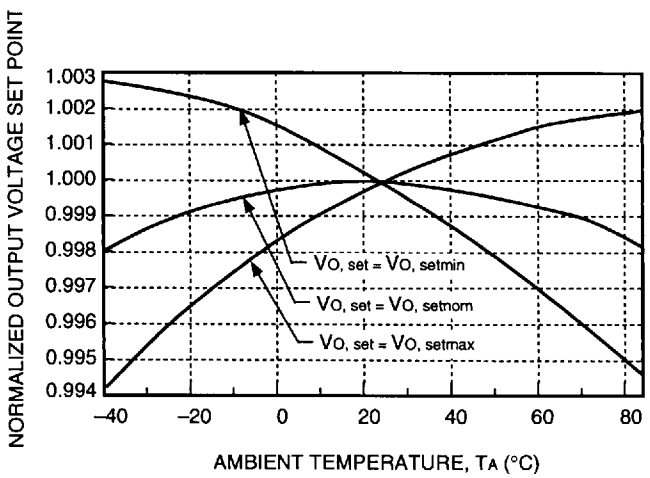


Figure 5. MW005AJ and MW005AJ4 Output Voltage Set Point vs. Ambient Temperature (V_I = 48 V and Full Load)

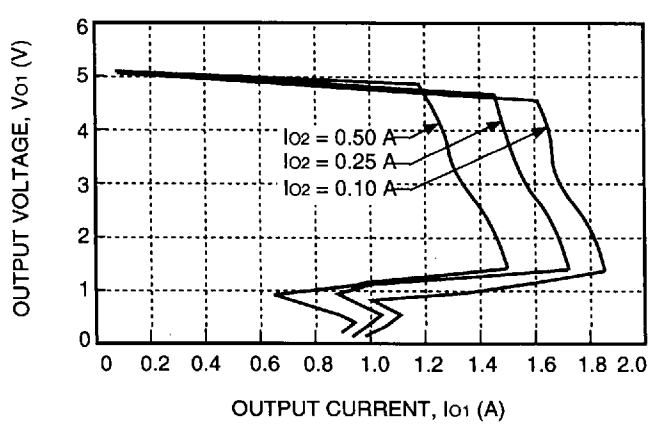


Figure 6. MW005AJ Typical V_{O1} vs. I_{O1} Output Characteristics (V_I = 48 V and T_A = 25 °C)

Characteristic Curves (continued)

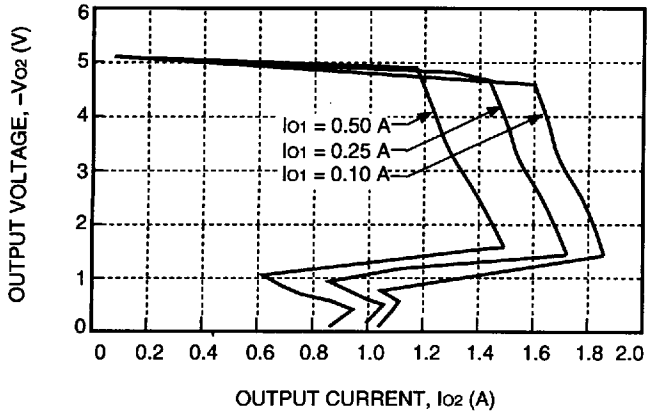


Figure 7. MW005AJ Typical $-V_{O2}$ vs. I_{O2} Output Characteristics (V_I = 48 V and T_A = 25 °C)

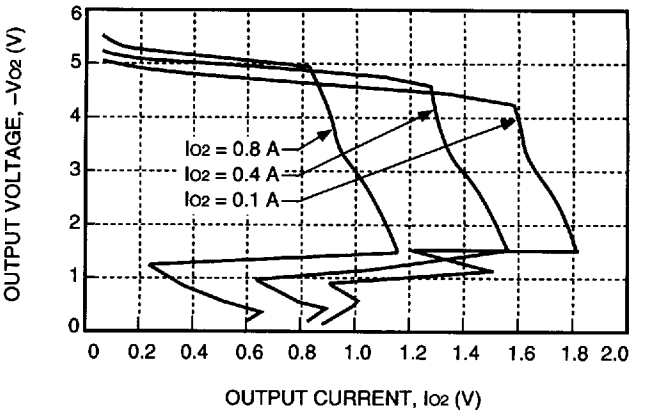


Figure 9. MW005AJ4 Typical $-V_{O2}$ vs. I_{O2} Output Characteristics (V_I = 48 V and T_A = 25 °C)

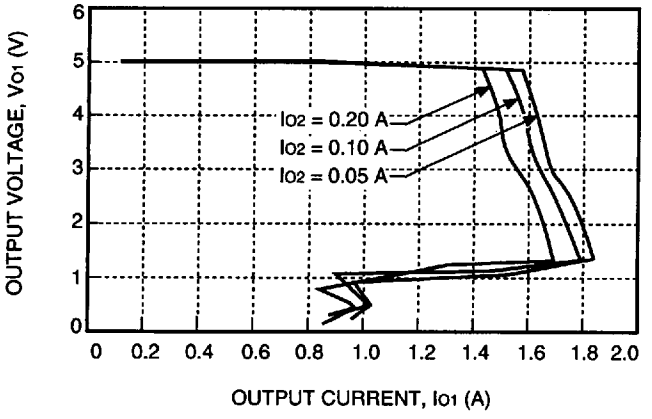


Figure 8. MW005AJ4 Typical V_{O1} vs. I_{O1} Output Characteristics (V_I = 48 V and T_A = 25 °C)

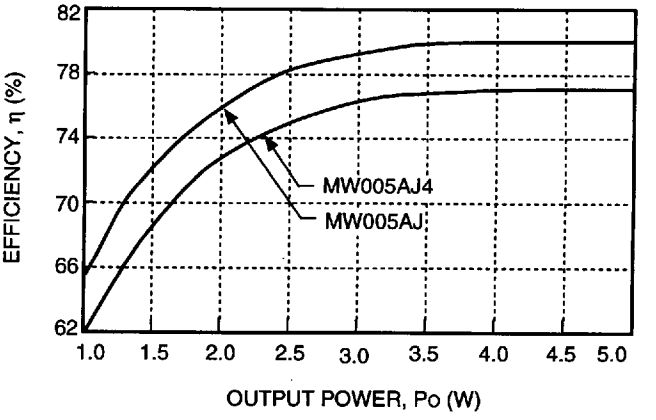
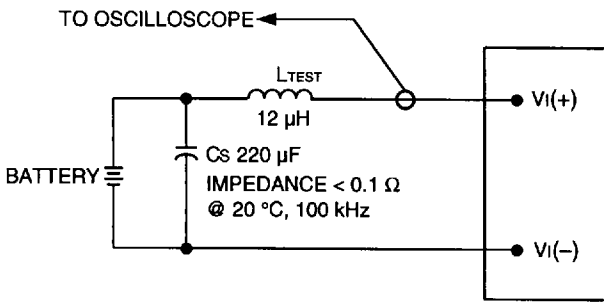


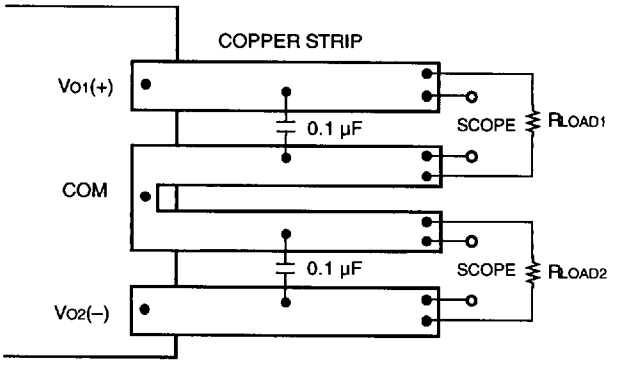
Figure 10. MW005AJ and MW005AJ4 Typical Efficiency vs. Output Power (V_I = 48 V and T_A = 25 °C)

Test Configurations



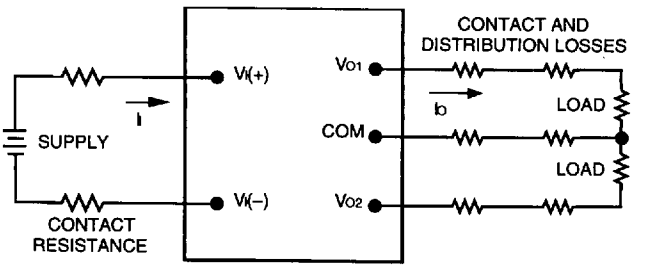
Note: Input reflected-ripple current is measured with a simulated source impedance (LTEST) of 12 µH. Capacitor CS offsets possible battery impedance. Current is measured at the input of the module.

Figure 11. Input Reflected-Ripple Test Setup



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

Figure 12. 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.

$$\eta = \frac{\sum_{j=1}^{2} \left| [V_{oj}(+) - V_{com}]\, I_{oj} \right|}{[V_I(+) + (-V_I(-))]\, I_I} \times 100$$

Figure 13. Output Voltage and Efficiency Measurement Test Setup

Design Considerations

Output Ripple

If lower output ripples are needed, external L-C filters across the module output terminals are recommended. A 3.9 μH, 50 mΩ inductor and a 47 μF capacitor with its impedance less than 1.5 Ω at 100 kHz will reduce the output ripple by at least 50%.

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 22.2-950, EN 60 950.

For the converter output to meet 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 (with the converters)

The power module has extra low voltage (ELV) outputs when all inputs are ELV.

Feature Descriptions

Output Overvoltage Clamp

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 Table 5). 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.

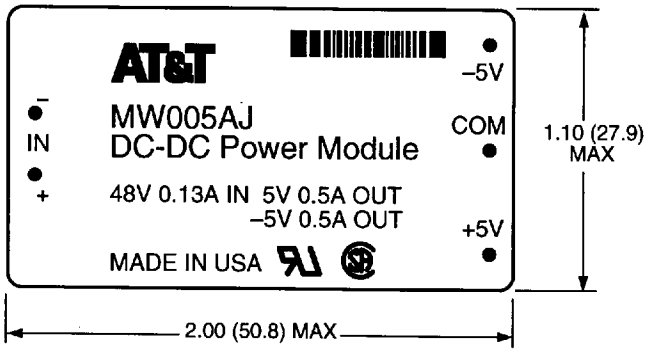
Outline Diagram

Dimensions are in inches and (millimeters).

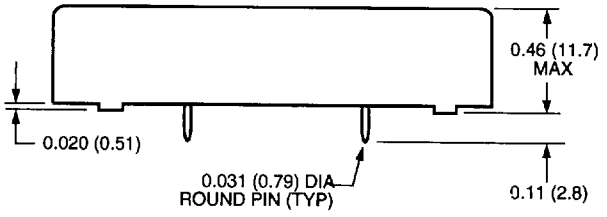
Copper paths must not be routed beneath the power module standoffs.

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

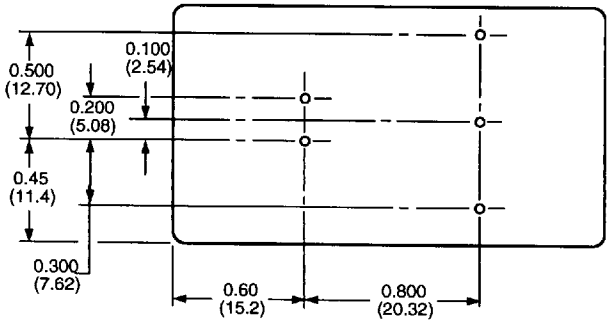
Top View



Side View



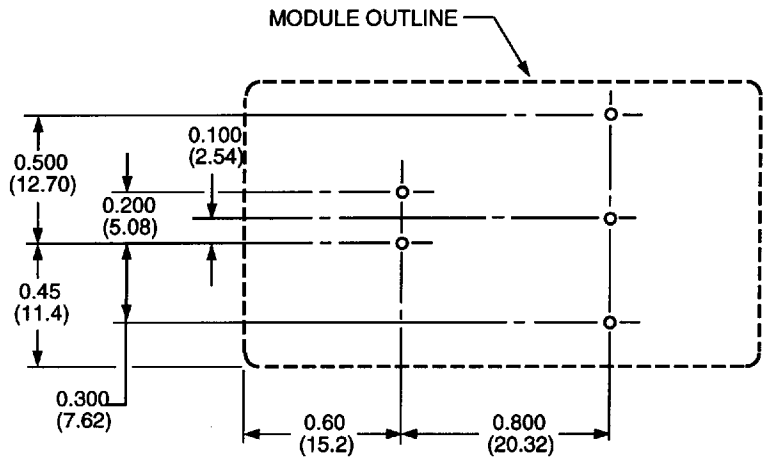
Bottom View



Recommended Hole Pattern

Component-side footprint.

Dimensions are in inches and (millimeters).



Ordering Information

Tighter regulation for 5 V output voltage is optional and is designated by the suffix "4" in the device code name.

Input Voltage	Output Voltage	Output Power	Device Code	Comcode
36 V to 72 V	±5.0 V	5 W	MW005AJ	106778558
36 V to 72 V	+5.0 V, –5.2 V	5 W	MW005AJ4	107003329