Data Sheet
December 1999

MC010-Series Power Modules: 18 Vdc to 36 Vdc Input; 10 W

The MC010-Series Power Modules use advanced, surface-mount technology and deliver high-quality, compact, dc-dc conversion at an economical price.

Features

- Small size: 50.8 mm x 40.6 mm x 12.7 mm (2.00 in. x 1.60 in. x 0.50 in.)
- Wide input voltage range: 18 Vdc to 36 Vdc
- Operating ambient temperature range: –40 °C to +85 °C
- High reliability
- Input-to-output isolation
- No external filtering required
- Load regulation: 0.15% max (MC010A, B, C)
- Line regulation: 0.10% max (MC010A, B, C)
- Overcurrent protection
- Output overvoltage protection
- Input undervoltage lockout
- PC board mountable
- *UL** 1950 Recognized, *CSA*† C22.2 No. 950-95 Certified
- Within FCC Class A requirements

* *UL* is a registered trademark of Underwriters Laboratories, Inc.
† *CSA* is a registered trademark of Canadian Standards Association.

Applications

- Communication equipment
- Computer equipment
- Distributed power architectures

Options

- Remote on/off

Description

The MC010-Series Power Modules are dc-dc converters that operate over a wide input voltage range of 18 Vdc to 36 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 10 W at typical full-load efficiencies of 80% to 83%.

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

For applications requiring remote on/off, the MC010A1, B1, C1, BK1, and CL1 Power Modules are available. These modules are equivalent to the previously described modules, except for the addition of the remote on/off and associated terminal.

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 (≤1 second)	 All All	 V_I $V_{I, trans}$	 — —	 36 47	 Vdc V
Operating Ambient Temperature (At 0.3 ms^{-1} (60 ft./min.) natural convection; see Thermal Considerations section.)	All	T_A	–40	85	°C
Storage Temperature	All	T_{stg}	–40	100	°C
I/O Isolation Voltage (1 minute)	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	18	28	36	Vdc
Maximum Input Current (V_I = 0 V to 36 V; I_O = $I_{O, max}$)	$I_{I, max}$	—	—	1.20	A
Inrush Transient	i^2t	—	0.1	0.4	A^2s
Input Reflected-ripple Current, Peak-to-peak (5 Hz to 20 MHz, 12 µH source impedance; T_A = 25 °C; see Figure 1 and Design Considerations section.)	I_I	—	25	—	mAp-p
Input Ripple Rejection (120 Hz)	—	—	44	—	dB
Input Inductance (see Design Considerations section.)	—	—	—	12	µH

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. However, for *UL* recognition, the dc rating of the fuse must not exceed 5 A. 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 = 28 V; $I_O = I_{O, max}$; T_A = 25 °C)	MC010A	$V_{O, set}$	4.85	5.0	5.20	Vdc
	MC010B	$V_{O, set}$	11.52	12.0	12.48	Vdc
	MC010C	$V_{O, set}$	14.4	15.0	15.6	Vdc
	MC010BK	$V_{O1, set}$	11.4	12.0	12.6	Vdc
		$V_{O2, set}$	–11.4	–12.0	–12.6	Vdc
	MC010CL	$V_{O1, set}$	14.25	15.0	15.75	Vdc
		$V_{O2, set}$	–14.25	–15.0	–15.75	Vdc
Output Voltage (Over all operating input voltage, resistive load, and temperature conditions until end of life. See Figures 3 and 4.)	MC010A	V_O	4.80	—	5.25	Vdc
	MC010B	V_O	11.4	—	12.6	Vdc
	MC010C	V_O	14.25	—	15.75	Vdc
	MC010BK	V_{O1}	10.08	—	13.2	Vdc
		V_{O2}	–10.08	—	–13.2	Vdc
	MC010CL	V_{O1}	13.5	—	16.5	Vdc
		V_{O2}	–13.5	—	–16.5	Vdc
Output Regulation:						
Line (V_I = 18 Vdc to 36 Vdc)	MC010A, B, C	—	—	0.02	0.10	%V_O
Load ($I_O = I_{O, min}$ to $I_{O, max}$)	MC010A, B, C	—	—	0.05	0.15	%V_O
Temperature	MC010A	—	—	15	70	mV
(T_A = –40 °C to +85 °C)	MC010B	—	—	35	150	mV
	MC010C	—	—	45	190	mV
Output Ripple and Noise Voltage (With 0.1 µF ceramic bypass capacitor on output; see Figure 2.):						
RMS	MC010A	—	—	—	10	mVrms
	MC010B, C	—	—	—	15	mVrms
	MC010BK, CL	—	—	—	20	mVrms
Peak-to-peak (5 Hz to 20 MHz)	MC010A	—	—	—	70	mVp-p
	MC010B, C	—	—	—	100	mVp-p
	MC010BK, CL	—	—	—	100	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.)	MC010A	I_O	0.1	—	2.0	A
	MC010B	I_O	0.04	—	0.83	A
	MC010C	I_O	0.03	—	0.67	A
	MC010BK	I_{O1}	0.04	—	0.42	A
		I_{O2}	0.04	—	0.42	A
	MC010CL	I_{O1}	0.03	—	0.33	A
		I_{O2}	0.03	—	0.33	A
Output Current-limit Inception:						
V_O = 4.5 V	MC010A	I_O	—	3.7	5.5	A
V_O = 10.8 V	MC010B	I_O	—	1.5	2.5	A
V_O = 13.5 V	MC010C	I_O	—	1.3	2.4	A
V_{O1} or V_{O2} = 10.2 V	MC010BK	I_O	—	1.4	2.5	A
V_{O1} or V_{O2} = 12.75 V	MC010CL	I_O	—	1.3	2.4	A
Output Current Limit:						
V_O = 1.0 V	MC010A	—	—	—	6.3	A
V_O = 1.0 V	MC010B, C	—	—	—	3.0	A
V_{O1} or V_{O2} = 1.0 V	MC010BK, CL	—	—	—	3.0	A

Electrical Specifications (continued)

Table 2. Output Specifications (continued)

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Short-circuit Current (V_O = 250 mV)	MC010A MC010B, C, BK, CL	— —	— —	3.5 1.0	— —	A A
Efficiency (V_I = 28 V; $I_O = I_{O, max}$; T_A = 25 °C; see Figures 3 and 4.)	MC010A MC010B, C, BK, CL	η η	77 80	80 83	— —	% %
Dynamic Response ($\Delta I_O/\Delta t$ = 1 A/10 µs, V_I = 28 V, T_A = 25 °C; for MC010BK and CL, applies to V_{O1} and V_{O2} at $I_O = I_{O, max}$): Load Change from I_O = 50% to 75% of $I_{O, max}$: Peak Deviation	MC010A MC010B, BK MC010C, CL	— — —	— — —	140 200 180	— — —	mV mV mV
Settling Time (V_O < 10% peak deviation)	All	—	—	3.0	—	ms
Load Change from I_O = 50% to 25% of $I_{O, max}$: Peak Deviation	MC010A MC010B, BK MC010C, CL	— — —	— — —	140 200 180	— — —	mV mV mV
Settling Time (V_O < 10% of peak deviation)	All	—	—	3.0	—	ms

Table 3. Isolation Specifications

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

General Specifications

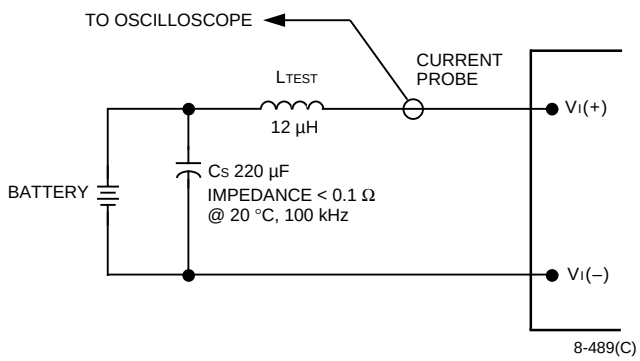
Parameter	Device	Min	Typ	Max	Unit
Calculated MTBF (I_O = 80% of $I_{O, max}$; T_C = 40 °C)	All		8,000,000		hours
Weight	All	—	—	45.4 (1.60)	g (oz.)

Feature Specifications

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

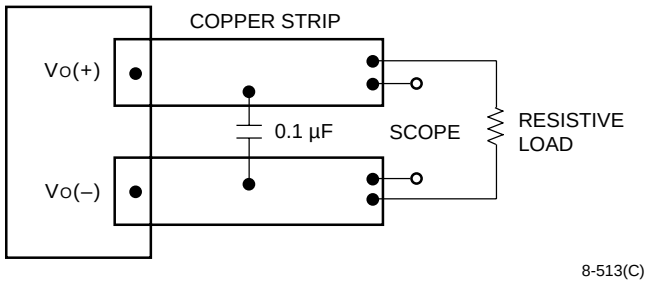
Parameter	Device	Symbol	Min	Typ	Max	Unit
Remote On/Off (MC010A1, B1, C1, BK1, CL1 only; V_I = 0 V to 36 V; open collector or equivalent compatible; signal referenced to V_I(–) terminal. See Figure 5 and Feature Descriptions section.):						
Logic Low—Module On						
Logic High—Module Off						
Module Specifications:						
On/Off Current—Logic Low	All	$I_{on/off}$	—	—	1.0	mA
On/Off Voltage:						
Logic Low	All	$V_{on/off}$	0	—	1.2	V
Logic High ($I_{on/off}$ = 0)	All	$V_{on/off}$	—	—	18	V
Open Collector Switch Specifications:						
Leakage Current During Logic High ($V_{on/off}$ = 18 V)	All	$I_{on/off}$	—	—	50	µA
Output Low Voltage During Logic Low ($I_{on/off}$ = 1 mA)	All	$V_{on/off}$	—	—	1.2	V
Turn-on Time (@ 80% of $I_{O, max}$; T_A = 25 °C; V_O within ±1% of steady state)	All	—	—	5	—	ms
Output Overvoltage Protection (clamp)	MC010A	$V_{O, clamp}$	—	6	7	V
	MC010B	$V_{O, clamp}$	—	14	16	V
	MC010C	$V_{O, clamp}$	—	17	19	V
	MC010BK	$V_{O1, clamp}$	—	16	18	V
		$V_{O2, clamp}$	—	–16	–18	V
	MC010CL	$V_{O1, clamp}$	—	19	21	V
		$V_{O2, clamp}$	—	–19	–21	V
Input Undervoltage Lockout:						
Module On	All	V_{UVLO}	—	16	18	V
Module Off	All	V_{UVLO}	12.0	15.5	—	V

Test Configurations



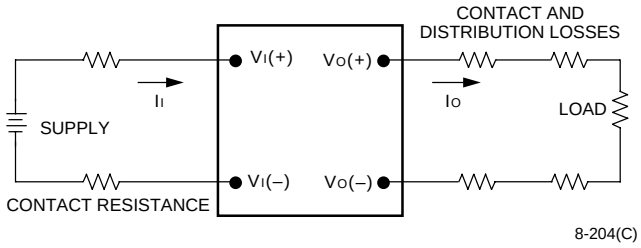
Note: Input reflected-ripple current is measured with a simulated source impedance of 12 µH. Capacitor CS offsets possible battery impedance. Current is measured at the input of the module.

Figure 1. Input Reflected-Ripple Test Setup



Note: Use 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.

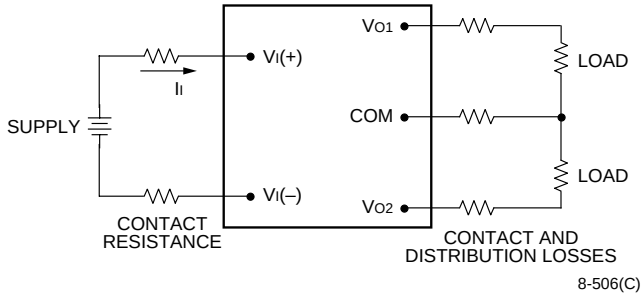
Figure 2. Peak-to-Peak Output Noise Measurement Test Setup



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.

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

Figure 3. MC010A, 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.

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

Figure 4. MC010BK, CL 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. Source impedances greater than 12 µH can affect the stability of the power module. When the source impedance exceeds 12 µH, mount a 33 µF electrolytic capacitor (ESR < 0.7 Ω at 100 kHz) close to the module input pins. This is also recommended to minimize reflected-ripple current as well as conducted and radiated electromagnetic interference (EMI).

Output Voltage Reversal

CAUTION: Applying a reverse voltage across the module output forward biases an internal diode. Attempting to start the module under this condition 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).

For the converter output to be considered meeting the requirements of safety extra-low voltage (SELV), the input must meet SELV requirements.

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.

Remote On/Off

(MC010A1, B1, C1, BK1, and CL1 only)

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 can be an open collector or equivalent (see Figure 5). A logic low is $V_{on/off}$ = 0 V to 1.2 V, during which the module is on. The maximum Ion/off during a logic low is 1 mA. The switch should maintain a logic-low voltage while sinking 1 mA.

During a logic high, the maximum $V_{on/off}$ generated by the power module is 18 V. The maximum allowable leakage current of the switch at $V_{on/off}$ = 18 V is 50 µA.

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

Either the user-supplied switch or the override jumper should be wired into the circuit via individual traces not common with the $V_I(-)$ power current path. Connect the switch or jumper at the power module terminals (see Figure 5). Configuring the switch connection in this way prevents noise from falsely triggering the remote on/off.

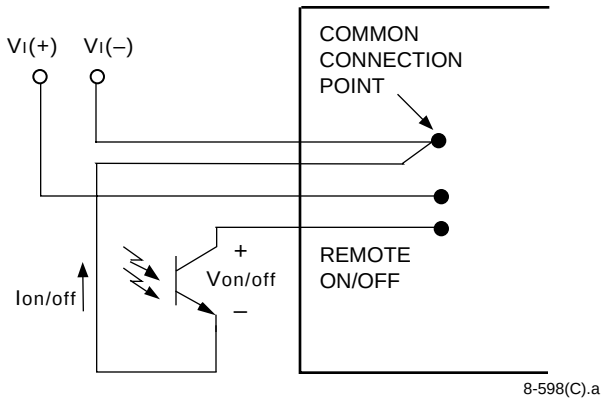


Figure 5. Remote On/Off Wiring Configuration, Top View

Feature Descriptions (continued)

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

Although the power module is designed for an 85 °C maximum operating ambient temperature, the characterization of the local thermal environment becomes more critical as temperatures exceed 70 °C. The maximum operating ambient temperature for the module is based on the maximum safe operating temperature of the devices contained inside it. Variations in local temperature and airflow, as well as the methods and location of measurement for these parameters, can affect the resulting internal temperature rises for a given ambient temperature. For ambient temperatures exceeding 70 °C, call technical support for application assistance.

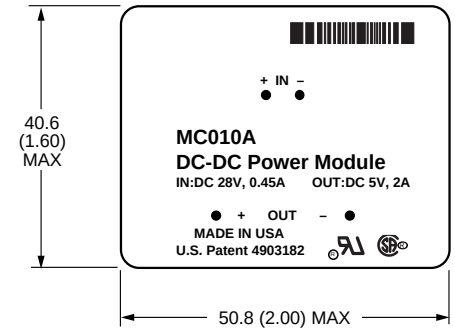
Outline Diagrams

Dimensions are in millimeters and (inches).

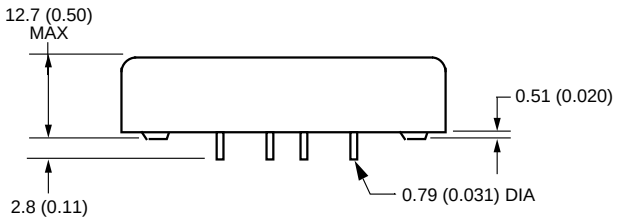
Module tolerances, unless otherwise indicated: x.x ± 0.5 mm (0.02 in.), x.xx ± 0.25 mm (0.010 in.).

Single-Output Module

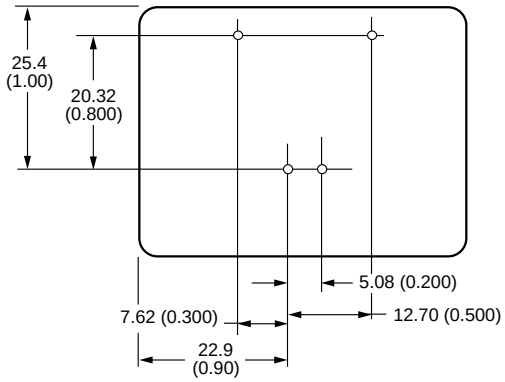
Top View



Side View



Bottom View



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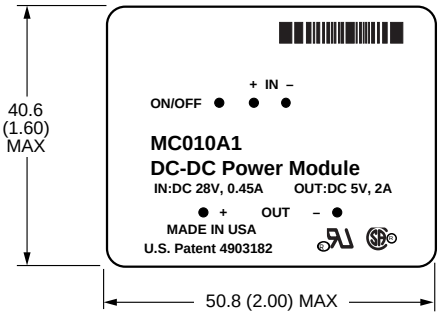
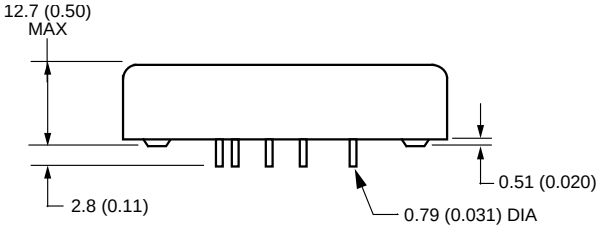
Single-Output Module with Remote On/Off

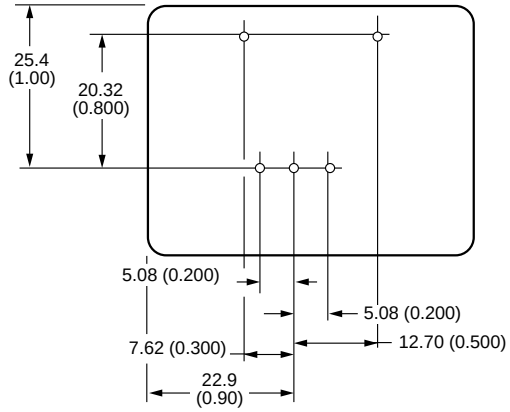
Top View



Side View



Bottom View



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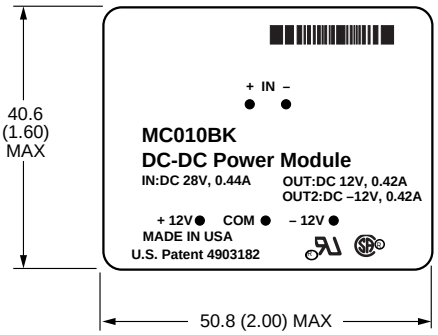
Outline Diagrams (continued)

Dimensions are in millimeters and (inches).

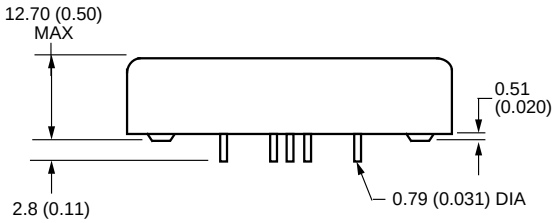
Module tolerances, unless otherwise indicated: x.x ± 0.5 mm (0.02 in.), x.xx ± 0.25 mm (0.010 in.).

Dual-Output Module

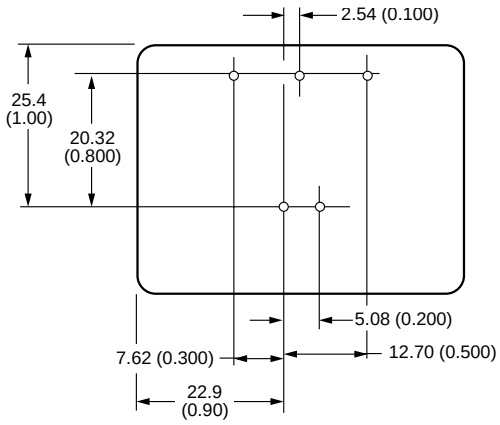
Top View



Side View



Bottom View



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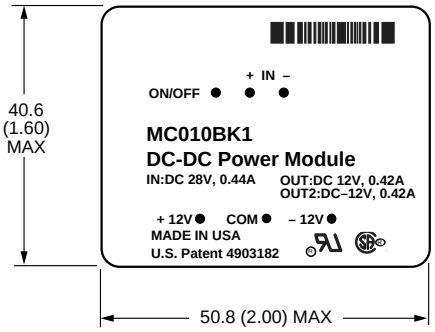
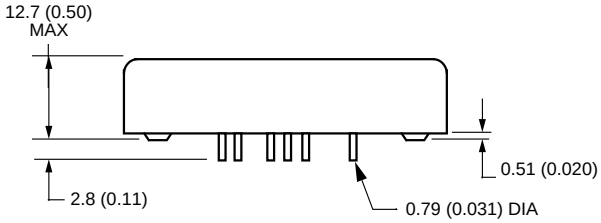
Dual-Output Module with Remote On/Off

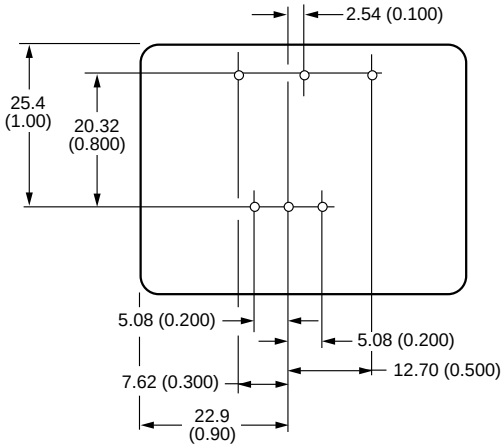
Top View



Side View



Bottom View



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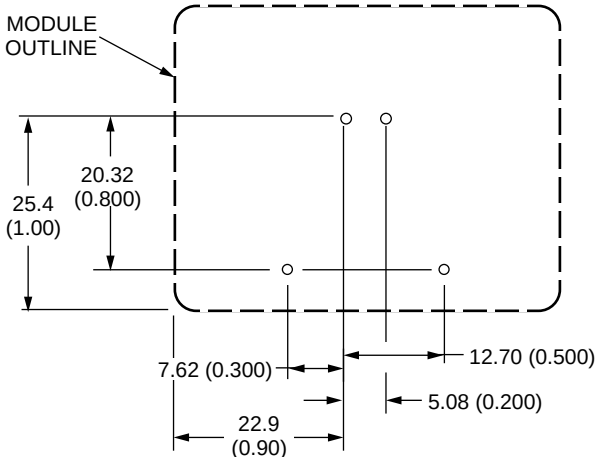
Recommended Hole Patterns

Component-side footprint.

Dimensions are in millimeters and (inches).

Single-Output Module



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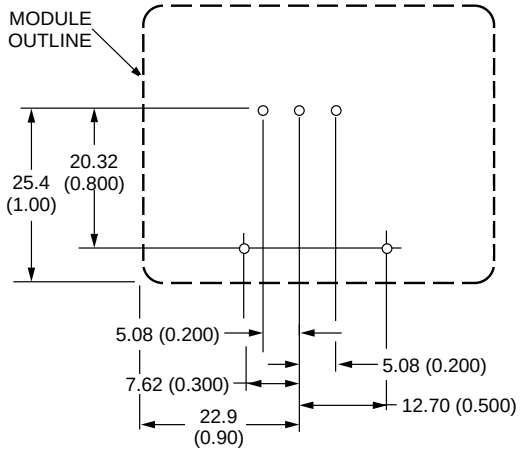
Single-Output Module with Remote On/Off



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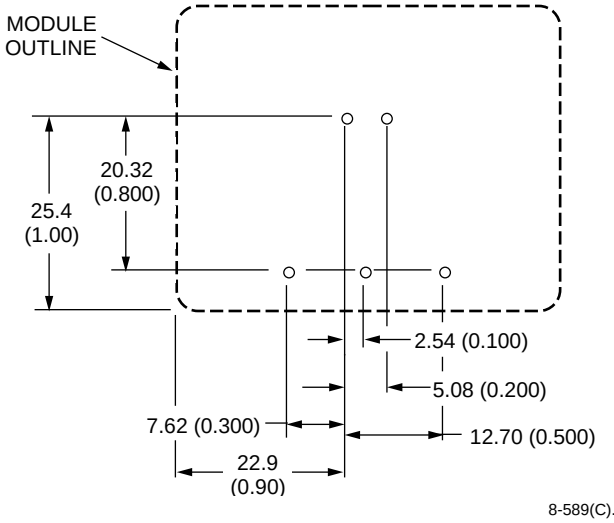
Dual-Output Module



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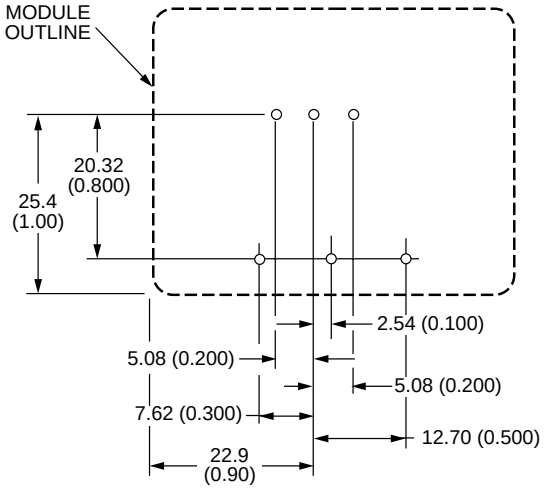
Dual-Output Module with Remote On/Off



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Ordering Information

Input Voltage	Output Voltage	Output Power	Remote On/Off Logic	Device Code	Comcode
18 V—36 V	5 V	10 W	No	MC010A	106464159
18 V—36 V	5 V	10 W	Yes	MC010A1	106464209
18 V—36 V	12 V	10 W	No	MC010B	106464167
18 V—36 V	12 V	10 W	Yes	MC010B1	106464217
18 V—36 V	15 V	10 W	No	MC010C	106464175
18 V—36 V	15 V	10 W	Yes	MC010C1	106464282
18 V—36 V	+12 V, –12 V	10 W	No	MC010BK	106464316
18 V—36 V	+12 V, –12 V	10 W	Yes	MC010BK1	106464399
18 V—36 V	+15 V, –15 V	10 W	No	MC010CL	106464365
18 V—36 V	+15 V, –15 V	10 W	Yes	MC010CL1	106464407

tyco Electronics

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December 1999
DS98-304EPS (Replaces DS91-197EPS)

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Recycled Paper