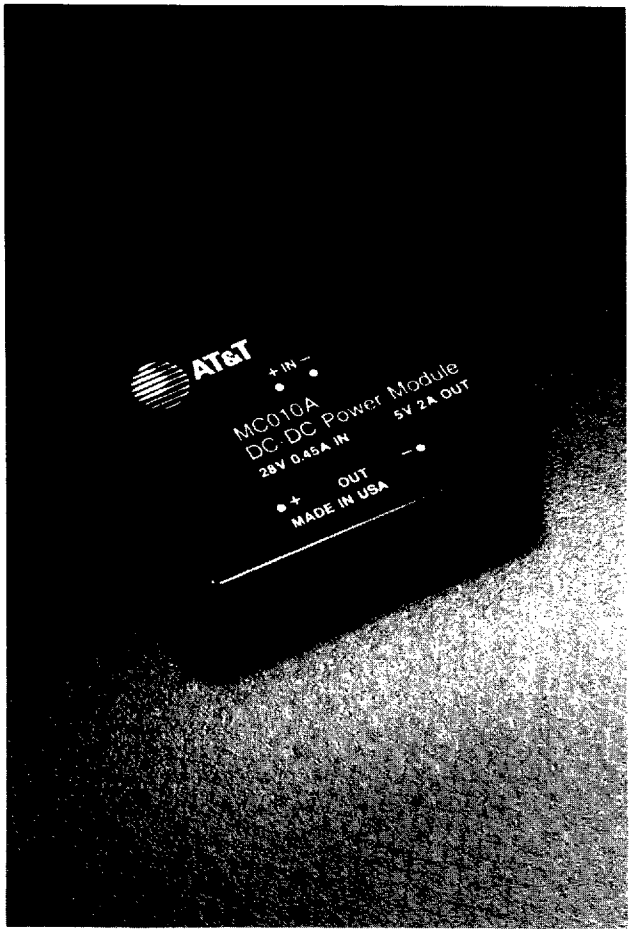
Data Sheet
December 1991

AT&T Microelectronics

MC010-Series Power Modules; 18 Vdc to 36 Vdc Inputs, 10 W



The MC010-Series Power Modules are encapsulated in nonconductive cases measuring 2.00 in. long, 1.60 in. wide, and 0.50 in. high.

Features

- Small size: 2.00 in. x 1.60 in. x 0.50 in.
- Wide input voltage range: 18 Vdc to 36 Vdc
- Output current limiting; unlimited duration
- Output overvoltage clamp
- Load regulation: 0.15% max. (MC010A, B, C)
- Line regulation: 0.10% max. (MC010A, B, C)
- Input undervoltage lockout
- Input-to-output isolation
- No external filtering required
- Operating ambient temperature range: −40 °C to +85 °C
- Remote on/off available
- UL, CSA recognition pending (UL 1950, CSA 22.2-234)
- TUV recognition available
- Meets FCC Class A requirements
- High reliability

Applications

- Telecommunications
- Distributed power architecture

Description

The MC010A, B, C, BK, and CL 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.

Specifications apply to all devices.

Parameter	Symbol	Min	Max	Unit
Input Voltage: Continuous Transient (≤1 s)	 V_I V_I	 — —	 36 47	 Vdc V
I/O Isolation Voltage	—	—	500	Vdc
Operating Ambient Temperature (At 60 ft./min. natural convection) (See Thermal Considerations.)	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	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.)	—	—	25	—	mA p-p
Input Ripple Rejection (120 Hz)	—	—	44	—	dB
Input Inductance (See Design Considerations section.)	—	—	—	12	µH

UL 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 with a maximum rating of 5 A in series with the input. 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	MC010A	V_O	4.80	—	5.25	Vdc
(Over all operating input voltage,	MC010B	V_O	11.4	—	12.6	Vdc
resistive load, and temperature	MC010C	V_O	14.25	—	15.75	Vdc
conditions until end-of-life.)	MC010BK	V_{O1}	10.8	—	13.2	Vdc
		V_{O2}	−10.8	—	−13.2	Vdc
	MC010CL	V_{O1}	13.5	—	16.5	Vdc
		V_{O2}	−13.5	—	−16.5	Vdc
Output Voltage Set Point	MC010A	$V_{O, set}$	4.85	5.0	5.20	Vdc
(V_I = 28 V; I_O = $I_{O, max}$; T_A = 25 °C)	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 Regulation:						
Line (V_I = 18 Vdc to 36 Vdc)	MC010A, B, C	—	—	0.02	0.10	%
Load (I_O = $I_{O, min}$ to $I_{O, max}$)	MC010A, B, C	—	—	0.05	0.15	%
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	mV rms
	MC010B, C	—	—	—	15	mV rms
	MC010BK, CL	—	—	—	20	mV rms
Peak-to-peak (5 Hz to 20 MHz)	MC010A	—	—	—	70	mV p-p
	MC010B, C	—	—	—	100	mV p-p
	MC010BK, CL	—	—	—	100	mV p-p
Output Current	MC010A	I_O	0.1	—	2.0	A
(At I_O < $I_{O, min}$, the modules may	MC010B	I_O	0.04	—	0.83	A
exceed output ripple specifications	MC010C	I_O	0.03	—	0.67	A
and dual-output modules may exceed	MC010BK	I_{O1}	0.04	—	0.42	A
specified output voltages.)		I_{O2}	0.04	—	0.42	A
	MC010CL	I_{O1}	0.03	—	0.33	A
		I_{O2}	0.03	—	0.33	A

Electrical Specifications (continued)

Table 2. Output Specifications (continued)

Parameter	Device	Symbol	Min	Typ	Max	Unit
Output Current-limit Inception:						
V_O = 4.5 V	MC010A	—	—	3.7	5.5	A
V_O = 10.8 V	MC010B	—	—	1.5	2.5	A
V_O = 13.5 V	MC010C	—	—	1.3	2.4	A
V_{O1} or V_{O2} = 10.2 V	MC010BK	—	—	1.4	2.5	A
V_{O1} or V_{O2} = 12.75 V	MC010CL	—	—	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
Output Short-circuit Current	MC010A	—	—	3.5	—	A
(V_O = 250 mV)	MC010B, C, BK, CL	—	—	1.0	—	A
Efficiency (See Figures 3 and 4;	MC010A	η	77	80	—	%
V_I = 28 V, I_O = $I_{O,max}$; T_A = 25 °C)	MC010B, C, BK, CL	η	80	83	—	%
Dynamic Response (For MC010BK and CL, applies to V_{O1} and V_{O2} at full load; $\Delta I_O/\Delta t$ = 1 A/10 µs, V_I = 28 V, T_A = 25 °C):						
Load Change from I_O = 50% to 75% of $I_{O,max}$:						
Peak Deviation	MC010A	—	—	140	—	mV
	MC010B, BK	—	—	200	—	mV
	MC010C, CL	—	—	180	—	mV
Settling Time (V_O < 10% of peak deviation)	all	—	—	3.0	—	ms
Load Change from I_O = 50% to 25% of $I_{O,max}$:						
Peak Deviation	MC010A	—	—	140	—	mV
	MC010B, BK	—	—	200	—	mV
	MC010C, CL	—	—	180	—	mV
Settling Time (V_O < 10% of peak deviation)	all	—	—	3.0	—	ms

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.

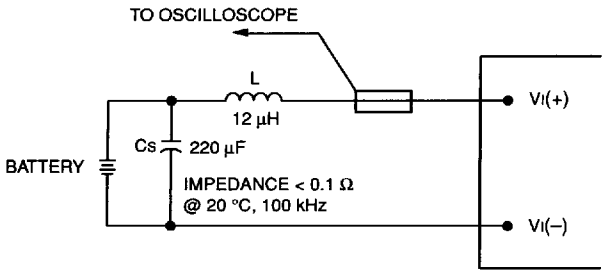
Parameter	Min	Typ	Max	Unit
Calculated MTBF (80% of $I_{O,max}$; T_C = 40 °C)		2,500,000		hours
Weight	—	—	1.60(45.4)	oz.(g)

Feature Specifications

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

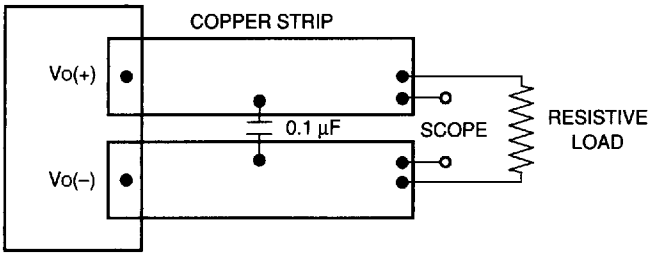
Parameter	Device	Symbol	Min	Typ	Max	Unit
Remote On/Off (MC010A1, B1, C1, BK1, CL1 only; V_I = 0 V to 36 V; open collector or equivalent compatible; signal referenced to V_I(–) terminal; see Figure 5 and Feature Descriptions.):						
Logic Low — Module On						
Logic High — Module Off						
Module Specifications:						
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 full load, T_A = 25 °C, V_O within ±1% of steady state)	all	—	—	5	—	ms
Output Overvoltage Clamp	MC010A	V_O	—	6.0	7.0	V
	MC010B	V_O	—	14	16.0	V
	MC010C	V_O	—	17	19.0	V
	MC010BK	V_{O1}	—	16	18.0	V
		V_{O2}	—	–16	–18.0	V
	MC010CL	V_{O1}	—	19	21.0	V
		V_{O2}	—	–19	–21.0	V
Input Undervoltage Lockout:						
Module On	all	V_{UVLO}	—	16	18	V
Module Off	all	V_{UVLO}	12.0	15.5	—	V

Test Configurations



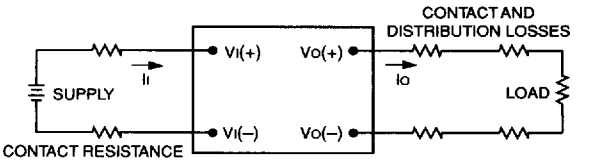
Note: Input reflected-ripple current is measured with a simulated source impedance of 12 µH. Capacitor Cs offsets possible battery impedance. Current is measured at the input of the module.

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 2 in. and 3 in. from the module.

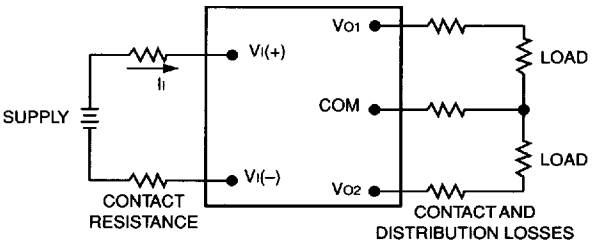
Figure 2. Peak-to-Peak Output Noise Measurement Test Setup



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.

$$\eta = \frac{[V_O(+) - V_O(-)]\, I_O}{[V_I(+) - V_I(-)]\, I_I}$$

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.

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

Figure 4. MC010BK, CL Output Voltage and Efficiency Measurement Test Setup

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 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.

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 $I_{on/off}$ 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.

Design Considerations

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.

Top view.

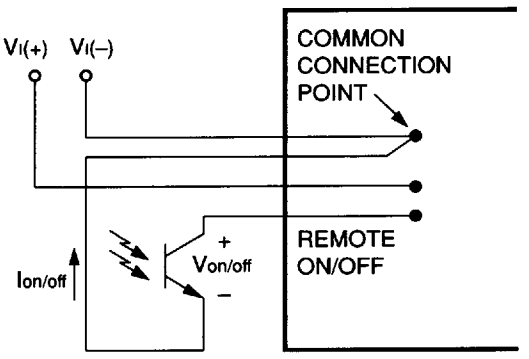


Figure 5. Remote On/Off Wiring Configuration

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).

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 1-800-526-7819 for application assistance.

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.

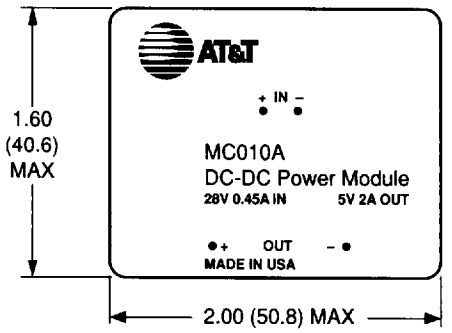
Outline Diagrams

Dimensions are in inches and (millimeters).

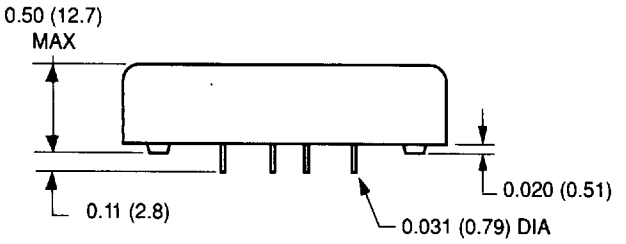
Module tolerances, unless otherwise indicated: x.xx ± 0.02 in. (0.5 mm), x.xxx ± 0.010 in. (0.25 mm).

Single-Output Module

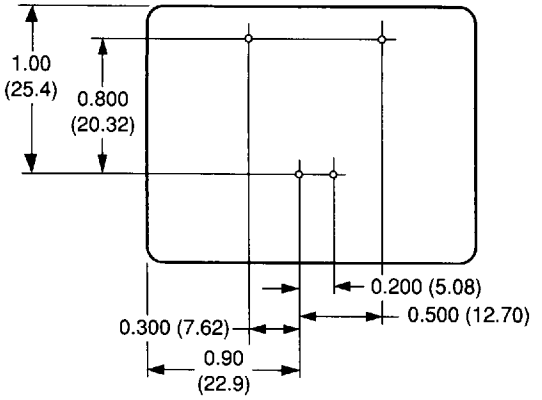
Top View



Side View

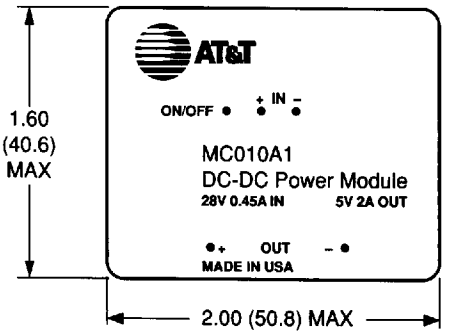


Bottom View

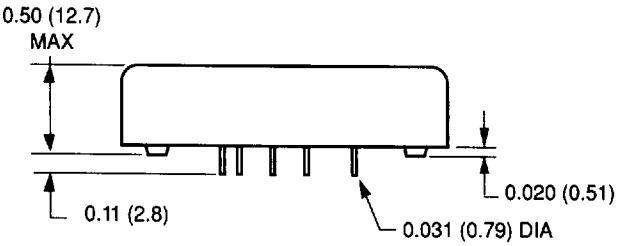


Single-Output Module with Remote On/Off

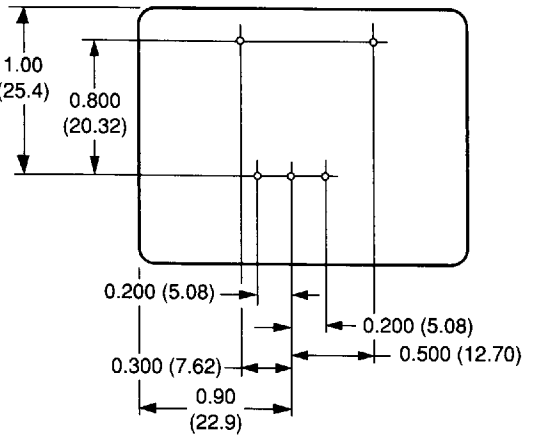
Top View



Side View



Bottom View



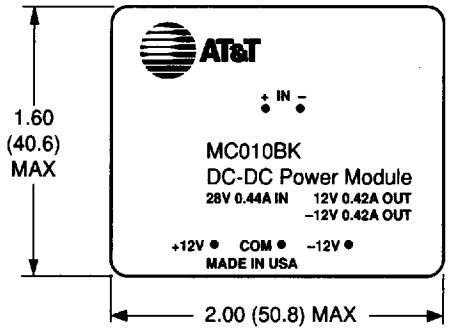
Outline Diagrams (continued)

Dimensions are in inches and (millimeters).

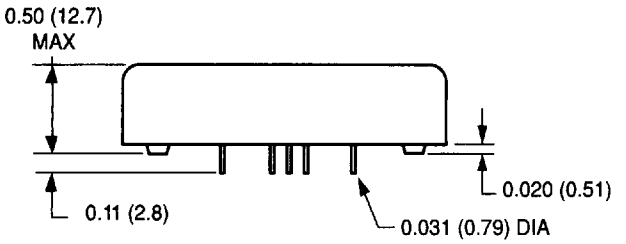
Module tolerances, unless otherwise indicated: x.xx ± 0.02 in. (0.5 mm), x.xxx ± 0.010 in. (0.25 mm).

Dual-Output Module

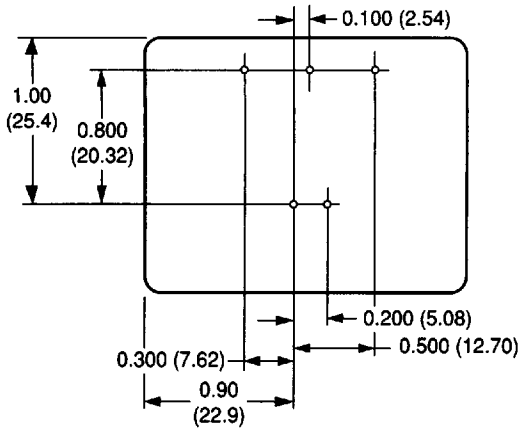
Top View



Side View

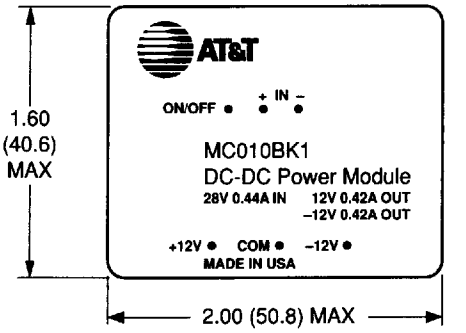


Bottom View

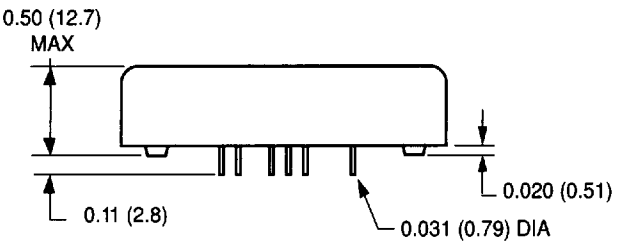


Dual-Output Module with Remote On/Off

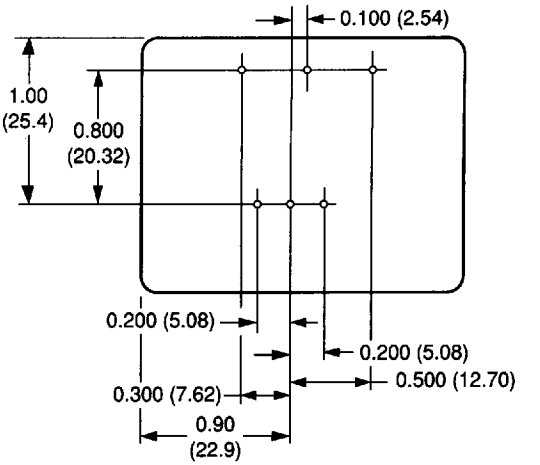
Top View



Side View



Bottom View

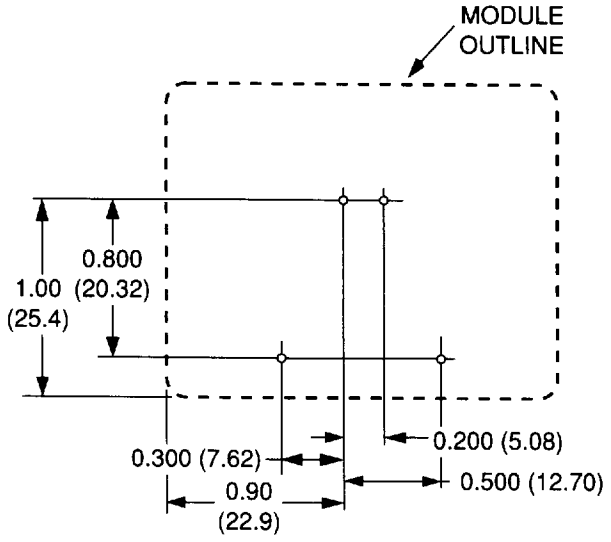


Recommended Hole Patterns

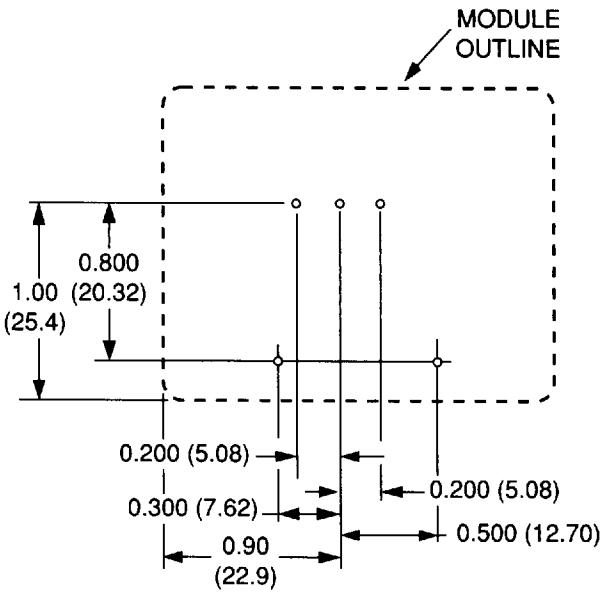
Component-side footprint.

Dimensions are in inches and (millimeters).

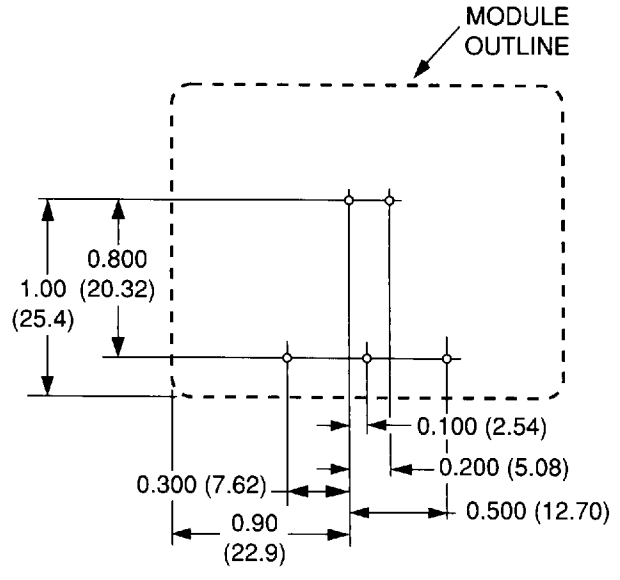
Single-Output Module



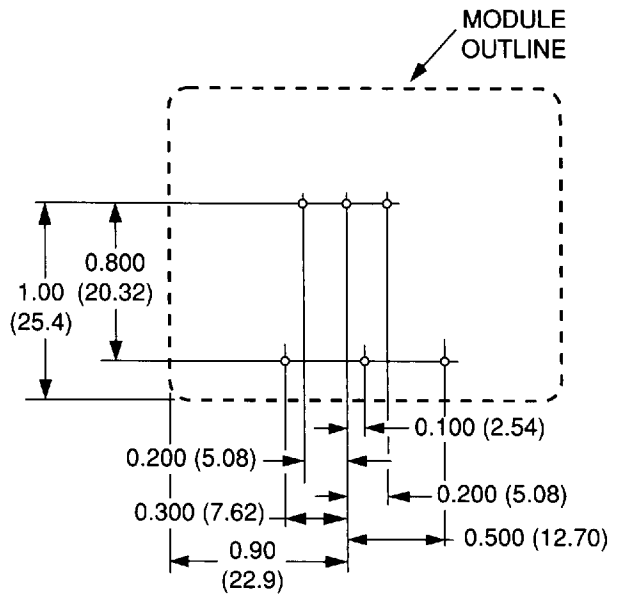
Single-Output Module with Remote On/Off



Dual-Output Module



Dual-Output Module with Remote On/Off



Ordering Information

Power Module Description			Device Code	Comcode
Input Voltage (V)	Output Voltage (V)	Remote On/Off		
18—36	5.0	no	MC010A	106464159
18—36	5.0	yes	MC010A1	106464209
18—36	12.0	no	MC010B	106464167
18—36	12.0	yes	MC010B1	106464217
18—36	15.0	no	MC010C	106464175
18—36	15.0	yes	MC010C1	106464282
18—36	+12.0, −12.0	no	MC010BK	106464316
18—36	+12.0, −12.0	yes	MC010BK1	106464399
18—36	+15.0, −15.0	no	MC010CL	106464365
18—36	+15.0, −15.0	yes	MC010CL1	106464407

For additional information, contact your AT&T Account Manager or the following:
U.S.A.: AT&T Microelectronics, Dept. 52AL040420, 555 Union Boulevard, Allentown, PA 18103
1-800-372-2447, FAX 215-778-4106 (In CANADA: **1-800-553-2448**, FAX 215-778-4106)
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