Data Sheet

AT&T Microelectronics

FE008-Series Power Modules: dc-dc Converters; 48 Vdc Inputs, ±5 Vdc Outputs, 8 W

The FE008-Series Power Modules use advanced surface-mount technology and deliver high-quality, compact, dc-dc conversion at an economical price.

Features

- Small case, low profile: 2.00 in. x 2.00 in. x 0.50 in.
- Output current limiting: unlimited duration
- Output overvoltage clamp: $V_{O1} < 7$ V
- Line and load regulation: <0.2% maximum
- Short-circuit protection
- Remote on/off (FE008AJ1 only)
- Undervoltage lockout
- Input-to-output isolation
- No external filtering required
- Operating ambient temperature range: 0 °C to 70 °C
- Meets FCC EMI Class A limits
- UL recognized
- Synchronization (FE008AJ3 only)

Applications

- Telecommunications networks with 48 Vdc inputs
- Digital circuits
- Distributed power architectures

Description

The FE008AJ, AJ1, and AJ3 Power Modules are dc-dc converters that operate from nominal 48 Vdc inputs and provide precisely regulated +5 Vdc and –5 Vdc outputs. The outputs are fully isolated from the inputs, allowing versatile polarity configurations and grounding connections. Each unit provides up to 8 W of output power, with up to 2 W from the –5 V output.

Each device is encapsulated in a nonconductive case, 2.00 in. long, 2.00 in. wide, and 0.50 in. high, that mounts on a PC board.

The FE008AJ1 is identical to the FE008AJ except that it has a remote on/off control. The FE008AJ3 is identical to the FE008AJ except that it can be synchronized to an external 256 kHz clock by use of a logic signal.

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:				
Continuous	V_I	—	60	V
Transient (<1 s)	$V_{I, trans}$	—	63	V
I/O Isolation Voltage	—	—	500	V
Synchronization Voltage	V_{sync}	—	5.5	V
Operating Ambient Temperature (60 ft./min. natural convection)	T_A	0	70	°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	39.5	48	60	V
Maximum Input Current (V_I = 0 V to 60 V; $I_O = I_{O, max}$)	$I_{I, max}$	—	—	550	mA
Inrush Transient	i^2t	—	—	0.1	A^2s
Input Reflected-ripple Current, Peak-to-peak (5 Hz to 20 MHz, 12 µH source impedance) (See Figure 1 and Design Considerations.)	—	—	50	—	mA p-p
Input Inductance (See Design Considerations.)	—	—	—	12	µH
Input Ripple Rejection (120 Hz)	—	—	58	—	dB

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	Symbol	Min	Typ	Max	Unit
Output Voltage (Over all operating input voltage, resistive load, and temperature conditions until end-of-life.)	V_{O1} V_{O2}	4.80 –4.80	— —	5.25 –5.25	V V
Initial Output Voltage Set Point (V_I = 48 V, I_O at full load, T_A = 25 °C)	$V_{O1, set}$ $V_{O2, set}$	4.85 –4.85	5.00 –5.0	5.20 –5.20	V V
Output Regulation (V_{O1}, V_{O2}): Line (V_I = 39.5 V to 60 V) Load (I_O = $I_{O, min}$ to $I_{O, max}$) Temperature (T_C = 0 °C to 70 °C)	 — — —	 — — —	 0.001 0.05 15	 0.1 0.2 70	 % % mV
Output Ripple and Noise Voltage (With 0.1 µF, ceramic, bypass capacitor on each output.): RMS Peak-to-peak (5 Hz to 20 MHz)	 — —	 — —	 — —	 10 50	 mV rms mV p-p
Output Current: Output 1 Output 2 Total of Outputs 1 and 2	 I_{O1} I_{O2} $I_{O1} + I_{O2}$	 0.1 0.01 —	 — — —	 1.6 0.40 1.60	 A A A
Output Current-limit Inception: V_{O1} = 4.5 V V_{O2} = –4.5 V	 I_{O1} I_{O2}	 — —	 2.5 0.7	 3.8 1.1	 A A
Output Short-circuit Current: V_{O1} = 250 mV V_{O2} = –250 mV	 I_{O1} I_{O2}	 — —	 4.6 0.6	 6.3 1.1	 A A
Efficiency (V_I = 48 V, I_O at full load, T_A = 25 °C) (See Figure 2.)	η	70	74	—	%
Dynamic Response ($\Delta I_O/\Delta t$ = 1 A/10 µs, V_I = 48 V, T_C = 25 °C): Load Change from I_O = 50% to 75% of $I_{O, max}$: Peak Deviation: V_{O1} V_{O2} Settling Time (V_O < 10% of peak deviation): V_{O1} V_{O2} Load Change from I_O = 50% to 25% of $I_{O, max}$: Peak Deviation: V_{O1} V_{O2} Settling Time (V_O < 10% of peak deviation): V_{O1} V_{O2}	 — — — — — — — —	 — — — — — — — —	 90 60 1.5 1 90 50 1 1	 — — — — — — — —	 mV mV ms ms mV mV ms ms

Electrical Specifications (continued)

Table 3. Isolation Specifications

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

Feature Specifications

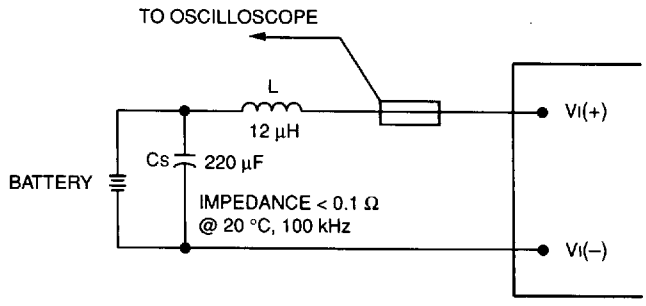
Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions.

Parameter	Symbol	Min	Typ	Max	Unit
Remote On/Off (FE008AJ1 only)					
(0 V < V_I < 60 V; open collector or equivalent compatible; signal referenced to $V_I(-)$ terminal; see Feature Descriptions section.):					
Logic Low — Module On					
Logic High — Module Off					
Module Specifications:					
On/Off Current — Logic Low	$I_{on/off}$	—	—	1.0	mA
On/Off Voltage:					
Logic Low	$V_{on/off}$	0	—	1.2	V
Logic High ($I_{on/off}$ = 0)	$V_{on/off}$	—	—	18	V
Open Collector Switch Specifications:					
Leakage Current during Logic High ($V_{on/off}$ = 18 V)	$I_{on/off}$	—	—	50	µA
Output Low Voltage during Logic Low ($I_{on/off}$ = 1 mA)	$V_{on/off}$	—	—	1.2	V
Turn-on Time (At 80% of full load, V_O within ±1% of steady state.)	—	—	3	—	ms
Output Undervoltage Lockout:					
Unit On	—	—	34	38	V
Unit Off	—	23	28	—	V
Output Overvoltage Clamp	$V_{O1, clamp}$	—	6.1	7.0	V
	$V_{O2, clamp}$	—	–7.5	—	V
Synchronization Signal Specifications (FE008AJ3 only) (Referenced to $V_I(+)$ terminal.):					
Frequency	—	255	256	257	kHz
Logic-High State Voltage (Sourcing 1 mA.)	—	2.4	—	—	V
Logic-Low State Voltage (Sinking 1.6 mA.)	—	—	—	0.4	V
Rise/Fall Time	—	—	—	0.1	µs
Duty Cycle	—	45	—	55	%

General Specifications

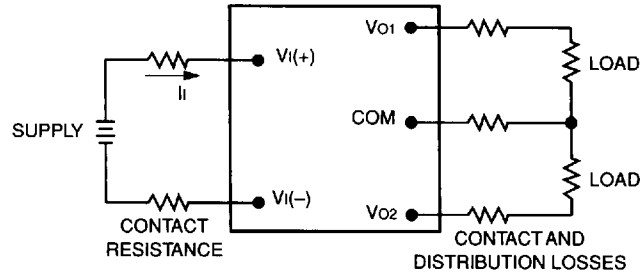
Parameter	Min	Typ	Max	Unit
Calculated MTBF (At I_O = 80% of $I_{O,max}$; T_C = 40 °C)		1,200,000		hours
Weight	—	—	1.9(54)	oz.(g)

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: 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 2. 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 set point that is higher than the set point of 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 tailout characteristics (output-current increase). The unit operates normally once the output current is brought back into its specified range.

FE008AJ1 Remote On/Off

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 3). 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.

FE008AJ3 Synchronization

The switching frequency of the FE008AJ3 can be synchronized to an external clock signal as specified in the Feature Specifications table. The signal is referenced to the positive side of the input bus. To minimize noise, the clock signal ground should be run separately from the power ground. With no signal applied, the module switches at a frequency lower than the specified synchronization frequency, but is not guaranteed to meet all specifications.

Design Considerations

FE008AJ1 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 3). Configuring the switch connection in this way prevents noise from falsely triggering the remote on/off.

Top view.

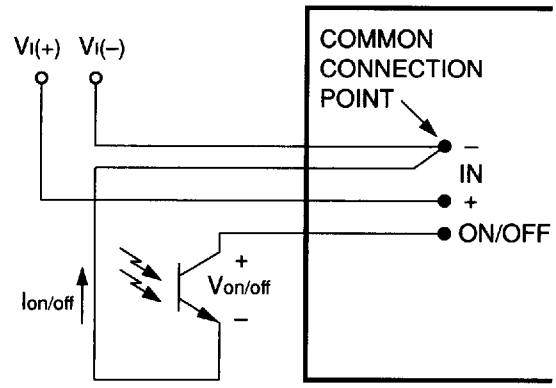


Figure 3. Remote On/Off Wiring Configuration

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).

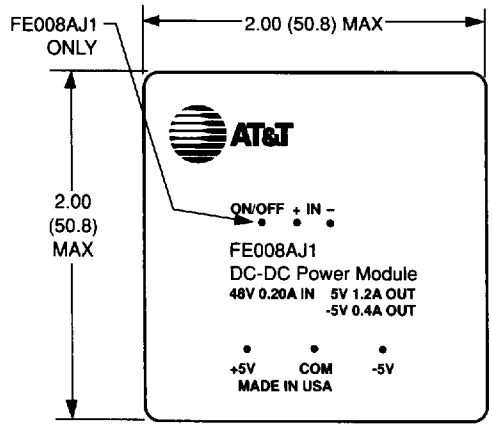
Outline Diagrams

Dimensions are in inches and (millimeters).

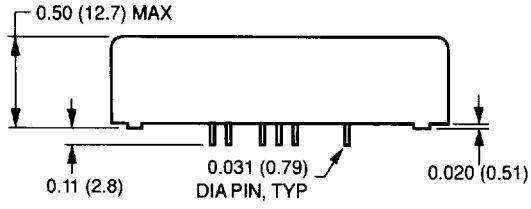
Tolerances: x.xx ± 0.02 in. (0.5 mm), x.xxx ± 0.010 in. (0.25 mm)

FE008AJ and FE008AJ1 Power Modules

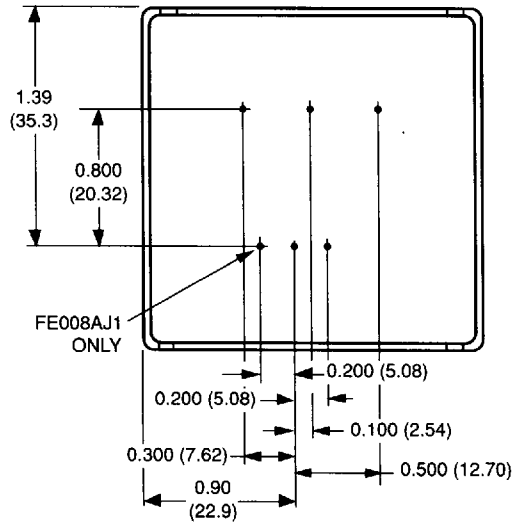
Top View



Side View

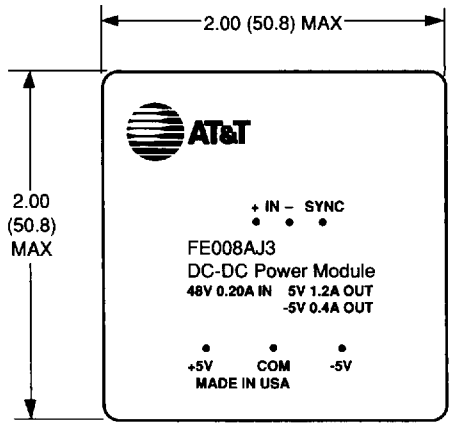


Bottom View

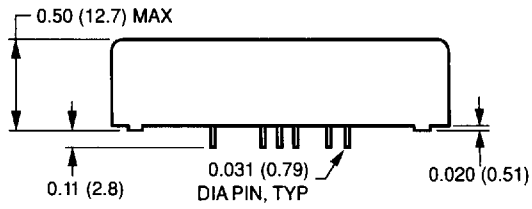


FE008AJ3 Power Module

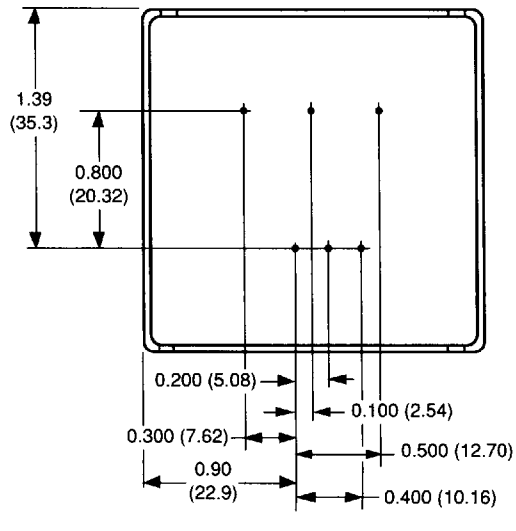
Top View



Side View



Bottom View

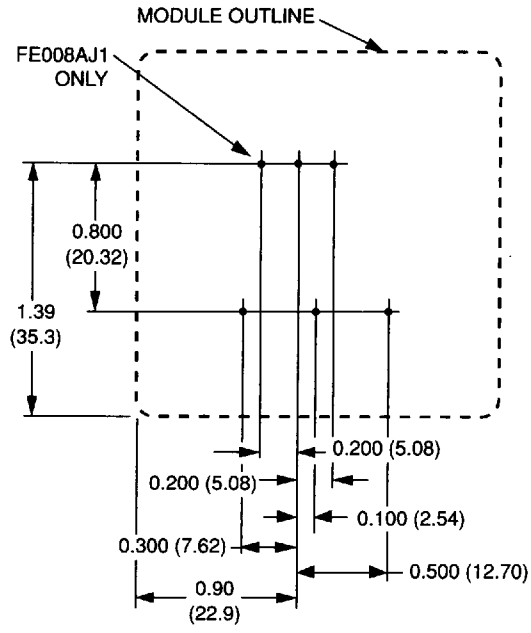


Recommended Hole Patterns

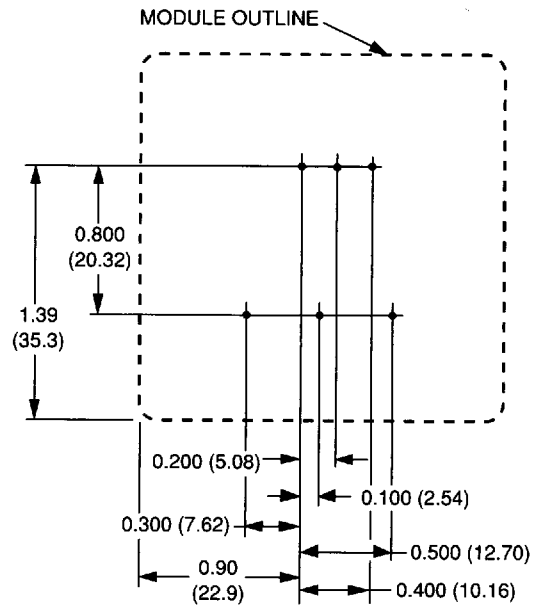
Component-side footprint.

Dimensions are in inches and (millimeters).

FE008AJ and FE008AJ1 Power Modules



FE008AJ3 Power Module



Ordering Information

Input Voltage	Output Voltage	Output Power	Remote On/Off	Synchronization	Device Code	Comcode
48 V	±5 V	8 W	no	no	FE008AJ	106391816
48 V	±5 V	8 W	yes	no	FE008AJ1	106391824
48 V	±5 V	8 W	no	yes	FE008AJ3	106358948

For additional information, contact your AT&T Account Manager or the following:
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