Preliminary Data Sheet

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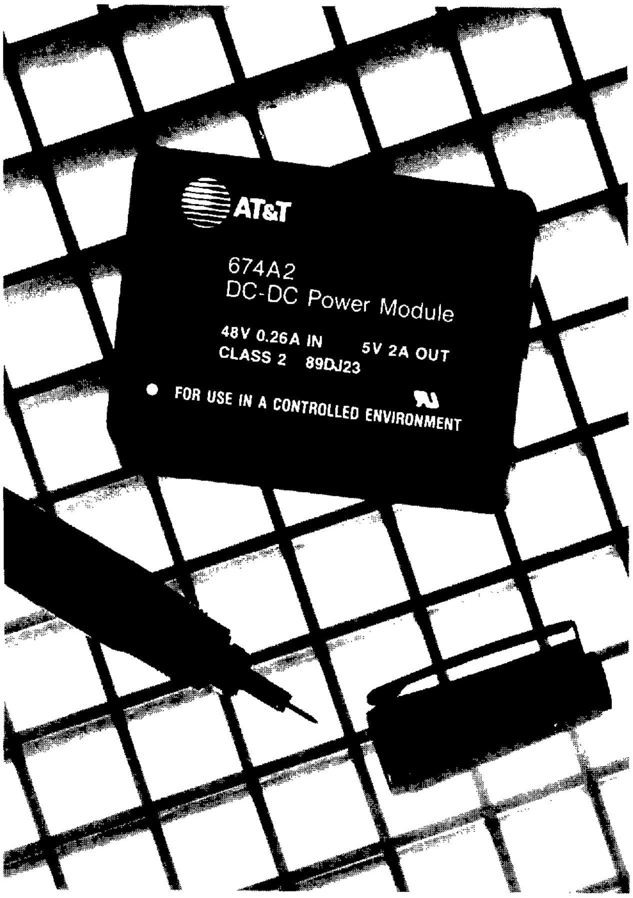
T-57-11

674A2 Power Module: DC-DC Converter; 48 Vdc Input, 5 Vdc Output, 10 W

10-15 WATTS



The 674A2 Power Module uses advanced surface-mount technology and delivers high-quality, compact dc-dc conversion over a wide temperature range.

Features

- Small size: 2.2" x 1.6" x 0.5"
- Wide operating temperature range: −40°C to +70°C
- No heat sink required
- Initial output voltage precision: ± 1%
- Output overvoltage clamp: V_O < 7 V
- Short-circuit protection
- Input-to-output isolation
- Output voltage adjust
- Inherent adaptive start-up
- Remote on/off

Applications

- Telecommunications 48 V systems
- Local power distribution
- Digital circuits
- Distributed power architectures

Description

The 674A2 Power Module is a 10 W, isolated, dc-dc converter that converts a nominal 48 Vdc input to a regulated 5 Vdc output. This power module incorporates pulse-width modulated control circuitry and a power train that combines high-efficiency power conditioning with a well-regulated output voltage.

State-of-the-art packaging techniques are combined with high-frequency switching technology to produce a low-profile, high power-density power unit. The 674A2 Power Module is 2.2″ long, 1.6″ wide, 0.5″ high, and is intended for mounting on a printed circuit board.

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Absolute Ratings

Exceeding these values can damage the module.

Parameter	Symbol	Min	Max	Unit
Input Voltage	V_I	—	60	V
I/O Isolation Voltage		—	500	Vdc
Ambient Operating Temperature (natural convection)	T_A	- 40	+70	°C
Storage Temperature		- 40	+100	°C

Electrical Specifications

Unless otherwise indicated, specifications apply to the module with the recommended input filter and layout configuration over all operating input voltage, resistive load, and temperature conditions.

Parameter	Symbol	Min	Typ	Max	Unit
Input					
Operating Input Voltage	V_I	40	48	60	V
Maximum Input Current (V_I = 0 V to 60 V) (see Figure 1)	$I_{I,\ max}$	—	—	500	mA
Inrush Transient	i^2t	—	—	0.7	A^2s
Input Reflected Ripple Current, Peak-to-Peak (5 Hz to 20 MHz, 12 μH source impedance) (see Figure 9)		—	5	—	mA p-p
Input Ripple Rejection (120 Hz)		—	55	—	dB
Recommended Values For Required Input Filter (see Figure 14): Inductance	L_I	20 ± 10%			μH
Inductor dc Resistance	DCR	—	—	0.3	Ω
Capacitance	C_I	120 +100, - 10%			μF
Capacitor Equivalent Series Resistance (at 100 kHz and T_A > 0°C)	ESR (C_I)	—	—	0.24	Ω

Fusing Considerations

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 comply with UL Conditions of Acceptability and to achieve maximum safety and system protection, an input line fuse should always be used. This data sheet provides information on inrush energy, maximum dc input current, and the fuse type and rating specified in the UL report. The same type of fuse with a lower rating may be used, but under no circumstances should the dc rating of the fuse exceed the maximum value stated in the "Conditions of Acceptability" for UL recognition. Refer to the fuse manufacturer's data for further information.

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Parameter	Symbol	Min	Typ	Max	Unit
Output					
Output Voltage (Over all operating input voltage, resistive load, and temperature conditions until end of life)	V_O	4.8	—	5.2	Vdc
Initial Output Voltage Set Point (V_I = 48 V, I_O at full load, and T_A = 25°C)	$V_{O,\ set}$	4.95	5.00	5.05	Vdc
Output Regulation:					
Line (V_I = 40 V to 60 V)		—	0.01	0.1	%
Load (I_O = 0.1 A to 2.0 A)		—	0.02	0.2	%
Temperature (T_A = – 40°C to +70°C) (see Figure 3)		—	—	50	mV
Output Ripple and Noise:					
RMS		—	—	10	mV rms
Peak-to-Peak (5 Hz to 20 MHz)		—	—	50	mV p-p
Output Current	I_O	0.1	—	2	A
Output Current Limit Inception (V_I = 48 V, V_O = 4.5 V) (see Figure 4)		—	2.8	—	A
Output Current Limit (V_I = 60 V, V_O = 1.0 V) (see Figure 4)		2.2	—	4.5	A
Output Short-Circuit Current (V_I = 48 V, V_O = 250 mV) (see Figure 4)		—	4.5	—	A
Efficiency (V_I = 48 V, I_O at full load, and T_A = 25 °C) (see Figures 5 and 10)	η	77	80	—	%
Dynamic Response ($\Delta I_O/\Delta t$ = 1 A/ 10μs, V_I = 48 V, and T_A = 25°C):					
Load Change from I_O = 1.0 A to 1.5 A:					
Peak Deviation		—	40	—	mV
Settling Time (V_O < 10% of peak deviation) (see Figure 6)		—	100	—	μs
Load Change from I_O = 1.0 A to 0.5 A:					
Peak Deviation		—	40	—	mV
Settling Time (V_O < 10% of peak deviation) (see Figure 7)		—	100	—	μs
Isolation					
Isolation Capacitance		—	1200	—	pF
Isolation Resistance		10	—	—	MΩ

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General Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Calculated MTBF (80% full load, T_A = 40°C, and natural convection)			1,200,000		hours
Weight		—	1.5	—	oz.

Feature Specifications

See Feature Descriptions section for further information.

Parameter	Symbol	Min	Typ	Max	Unit
Remote On/Off (40 V < V_I < 60 V) (see Figure 11):					
Switch Specifications:					
Switch Open — Unit On:					
Withstand Voltage		—	—	10	V
Leakage Current		—	—	50	μA
Switch Closed — Unit Off:					
Contact Voltage		—	—	1.2	V
Current Sink		—	—	750	μA
Turn-On Time (V_I = 48 V, T_A = 25°C, 80% full load, and V_O within ±1% of steady state) (see Figure 8)		—	0.8	2.0	ms
Output Voltage Overshoot		—	—	2	%
Output Voltage Set Point Adjustment Range (see Figures 12 and 13)		−4	—	+4	%
Output Overvoltage Clamp		5.3	6.1	7.0	V

Characteristics

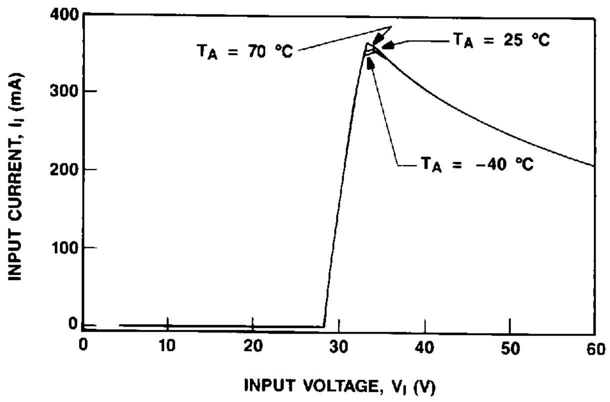


Figure 1. Typical Input Characteristic With a Load of I_O = 2.0 A and T_A = − 40°C to +70°C

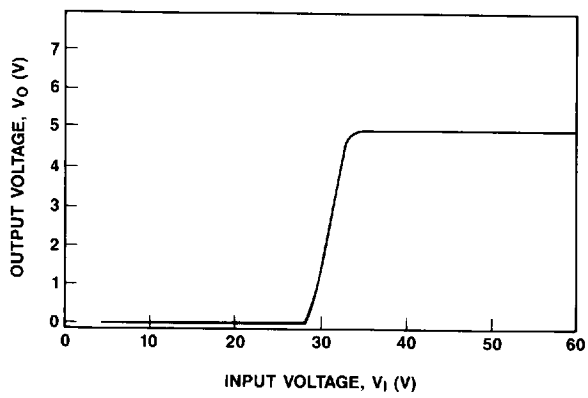


Figure 2. Typical Output Voltage vs Input Voltage With a Load of I_O = 2.0 A and T_A = − 40°C to +70°C

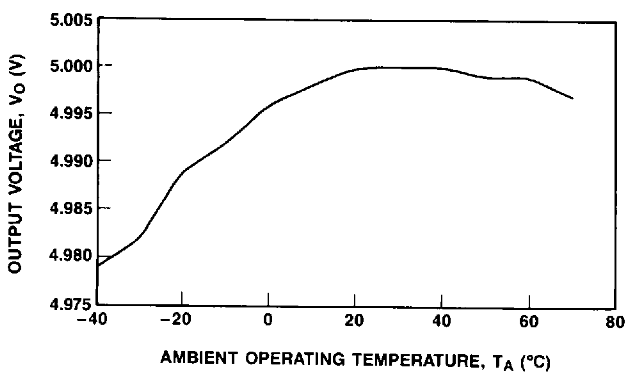


Figure 3. Typical Output Voltage Variation Over Ambient Operating Temperature Range at 80% Load and With V_I = 48 V

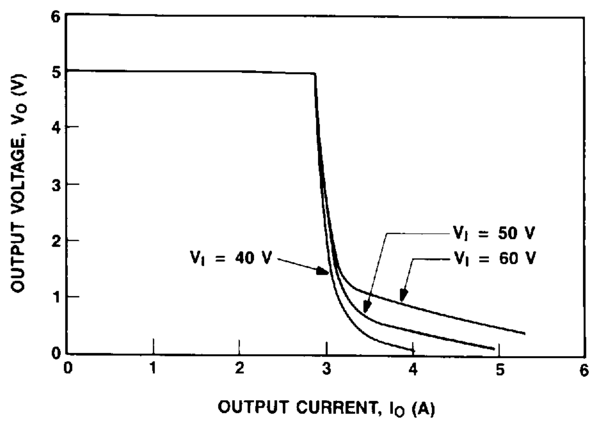


Figure 4. Typical Output Characteristic With V_I = 40 V to 60 V and T_A = 25°C

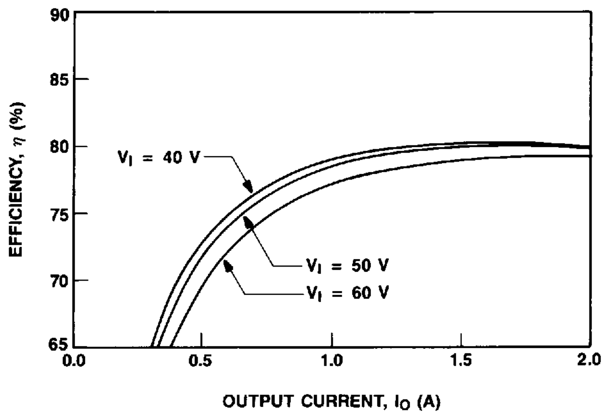


Figure 5. Typical Converter Efficiency as a Function of Output Current With V_I = 40 V to 60 V and T_A = 25°C

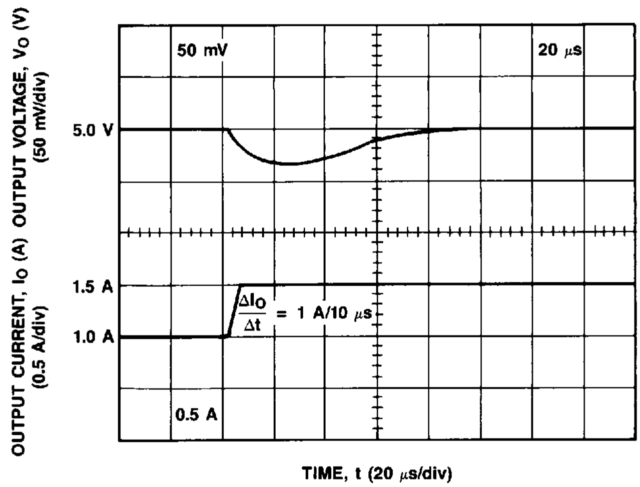


Figure 6. Typical Output Voltage Waveform for a Step Load Change from 50% to 75% of Full Output Power, V_I = 48 V, and T_A = 25°C

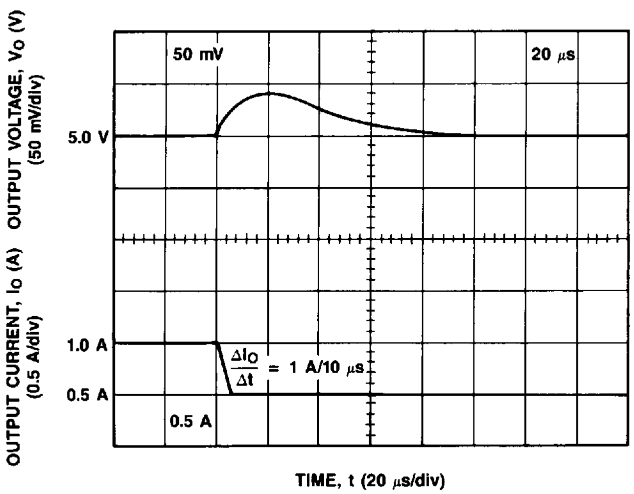


Figure 7. Typical Output Voltage Waveform for a Step Load Change from 50% to 25% of Full Output Power, V_I = 48 V, and T_A = 25°C

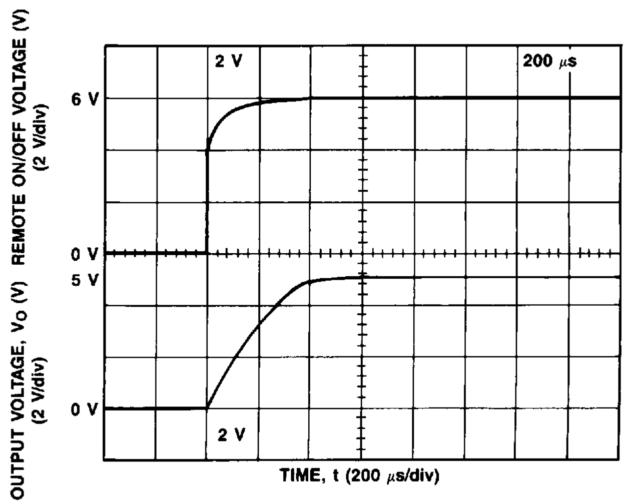
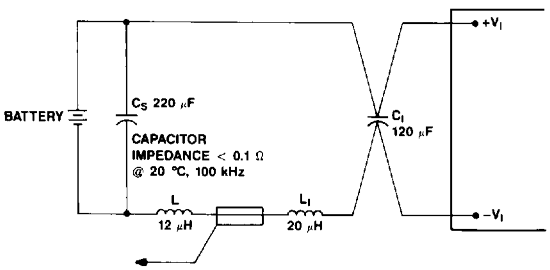


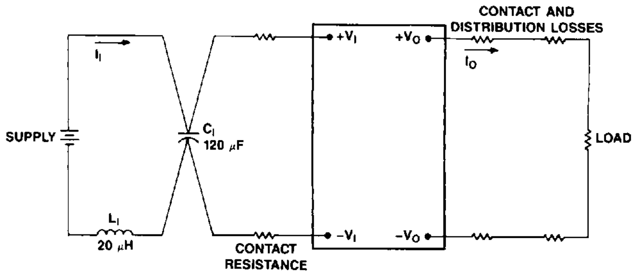
Figure 8. Typical Output Voltage Start-Up Waveform Once Remote On/Off Is Removed at V_I = 48 V, I_O = 80% of Full Load, and T_A = 25°C

Test Configurations



Note: Input reflected ripple current is measured with a simulated source impedance of 12 μH. Capacitor C_S will offset possible battery impedance. Current is measured in series with the recommended input filter inductor.

Figure 9. Input Reflected Ripple Test Set-Up



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 10. Output Voltage and Efficiency Measurement Test Set-Up

Feature Descriptions

Remote On/Off

A switch must be supplied by the user to control the voltage between terminals 25 and 33 in order to turn the module on and off. This function requires a switch with high-impedance and low-impedance states as specified in this data sheet. When the switch is in the high-impedance state, the module will be on. In this state, a positive voltage of between 2.5 V to 10 V will appear at terminal 25 with respect to terminal 33. No more than 50 μA of leakage current is permitted. To turn the module off, the switch must be in the low-impedance state, where it must maintain a voltage of 1.2 V or less while sinking a maximum current of 750 μA. In addition, turn-off is guaranteed for a current of 230 μA or greater. **Note:** No connection to terminal 25 is required if the remote on/off feature is not used.

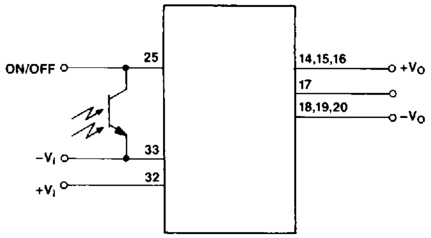


Figure 11. Typical Remote On/Off Implementation

Output Overvoltage Clamp

The output overvoltage clamp consists of control circuitry that monitors the voltage on the output terminals, independent of the primary regulation loop. The control loop for the clamp has a higher set point of nominally 6.1 V. This feature provides a redundant voltage-control capability that reduces the risk of damage due to output overvoltage.

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Current Limit

To provide protection in a fault condition, each module is equipped with internal current-limiting that will operate for an unlimited duration. The module will operate normally once the output current is brought into its specified range.

Output Voltage Adjust

The output voltage may be adjusted to within ± 4% of the typical output voltage set point. Figures 12 and 13 illustrate the typical output voltage set point with various external resistor values connected between the voltage adjust terminal 17 and either terminal 16 or 18. **Note:** No connections between terminals 17 and 16, or 18 are needed for nominal output voltage.

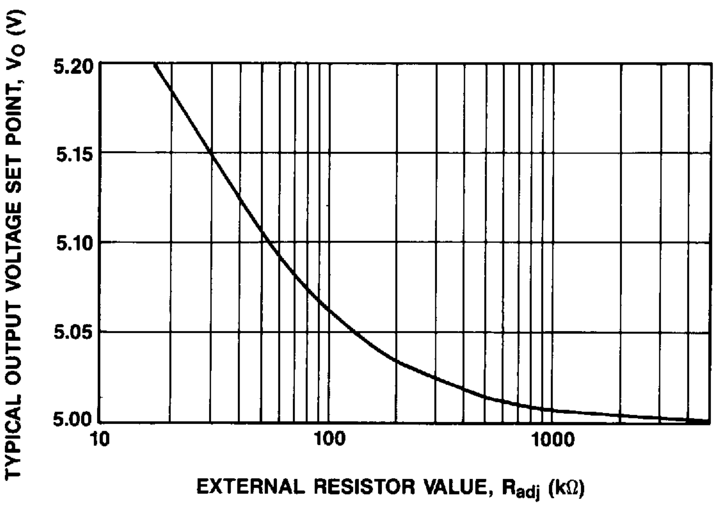

Figure 12. Typical Output Voltage Set Points When Connecting an External Resistor Between Pins 17 and 18

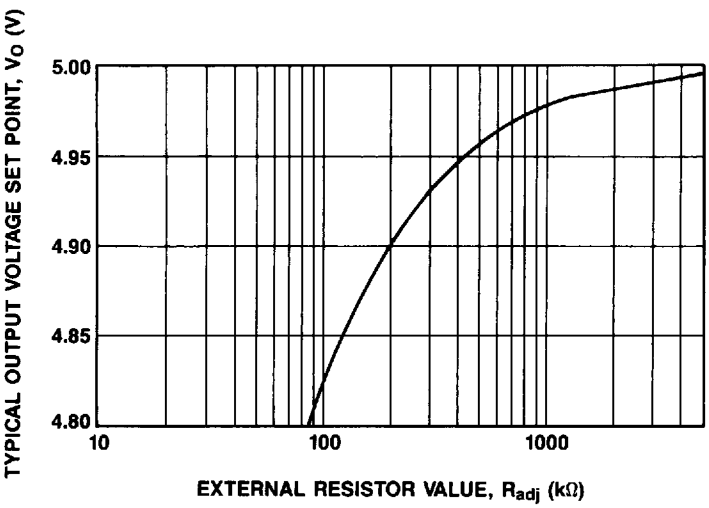

Figure 13. Typical Output Voltage Set Points When Connecting an External Resistor Between Pins 16 and 17

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Note for UL Application

The Underwriters Laboratories Conditions of Acceptability for using the 674A2 Power Module as a UL-recognized component require the positive input to be grounded and a 5 A, normal blow, dc fuse placed in series with the input filter.

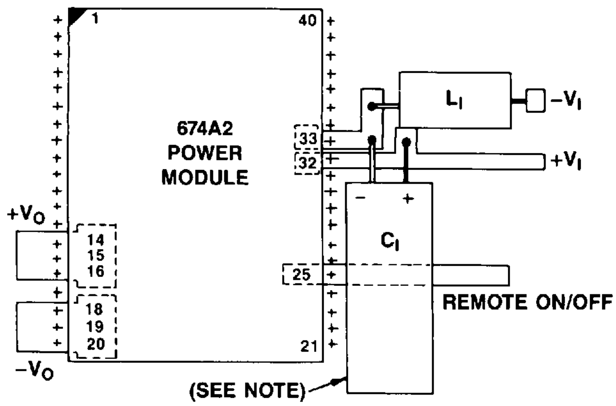
Layout Considerations

When routing power paths, it is beneficial to orient the positive and negative paths in parallel, one on top of the other (on opposite sides of the circuit board), so as to minimize the effective inductance and maximize capacitive coupling. Conductor paths from the battery to the power module input filter typically carry 250 mA of dc current while the module is in full load operation, and therefore adequate copper should be provided. The switching current from the input capacitor (C_I) to the power module is typically 550 mA. During actual switching transients, high-frequency current spikes between C_I and the power module can be higher than 550 mA. To minimize this current on the user's circuit board, a high-frequency capacitor has been built into the module.

Proper operation of the module is dependent upon the input filter layout configuration. It is recommended that the input filter components C_I and L_I be located adjacent to pins 32 and 33 of the module, as shown in Figure 14, to guarantee proper operation. Failure to maintain a low impedance between C_I and the power module could result in poor noise performance.

Input Filter Components:

L_I:	20 μH	KS-20927,L5 or equivalent Gowanda 24M202K-1 or equivalent
C_I:	120 μF	KS-21860,L9 or equivalent Sprague 672D127H060DS5C or equivalent



Note: Input filter components should be placed as close as possible to the module leads. To further enhance the filtering capabilities of the filter capacitor, connect the module leads directly to the capacitor terminals.

Figure 14. Recommended Input Filter Layout Configuration

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Thermal Management

The 674A2 Power Module is designed for natural convection cooling. Figure 15 shows the output power derating curves for modules mounted on 0.75" spaced, vertically oriented boards, under natural convection and 200 fpm forced air conditions. Air velocity is measured with a hot wire anemometer placed 0.5" above the edge of the module and level with its top surface, as shown in Figure 16.

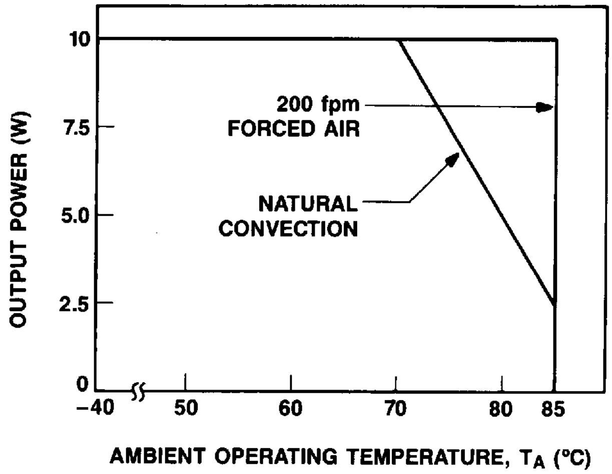
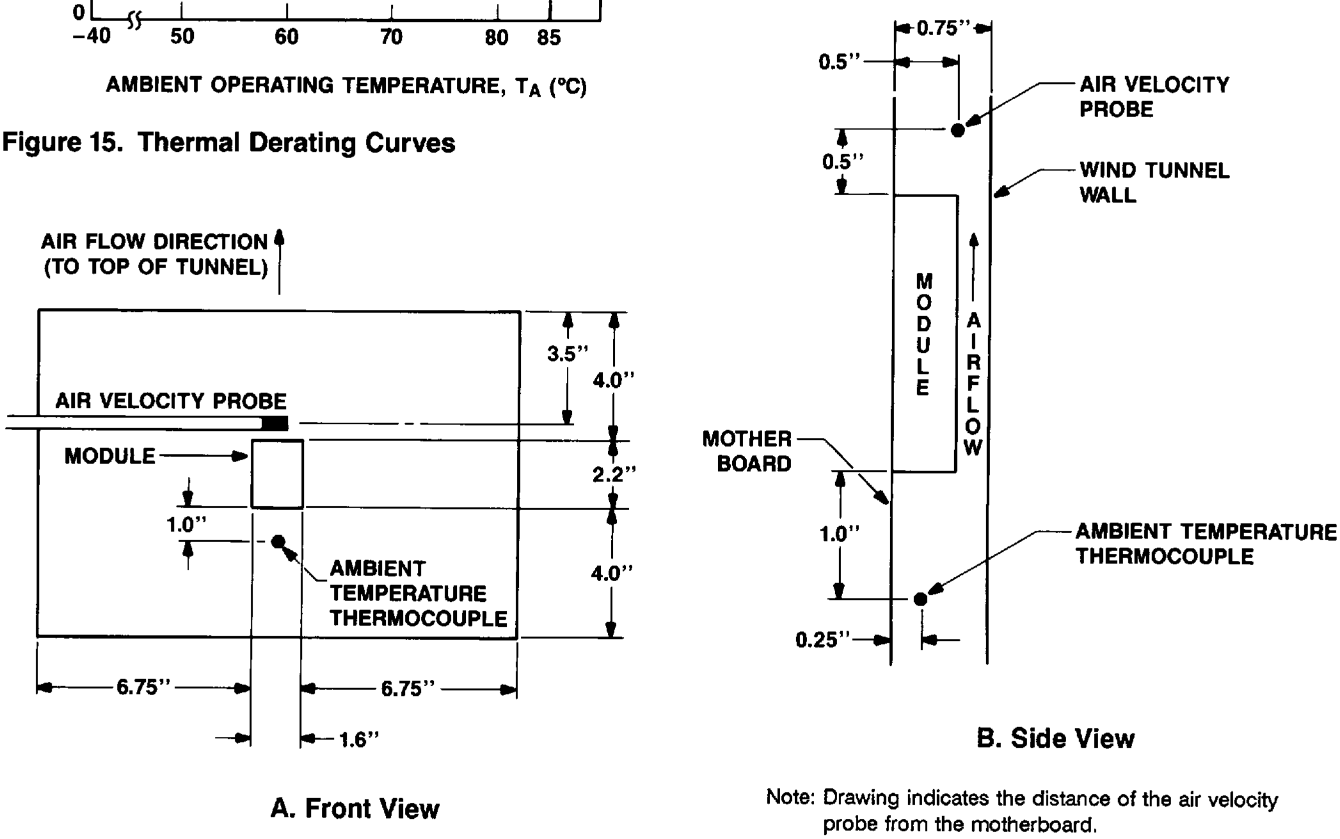


Figure 15. Thermal Derating Curves



Note: Position and orientation of the power module under test as it was mounted on the motherboard. The location of the air velocity probe and ambient temperature thermocouple are also shown.

Note: Drawing indicates the distance of the air velocity probe from the motherboard.

Figure 16. Positioning For Thermal Testing

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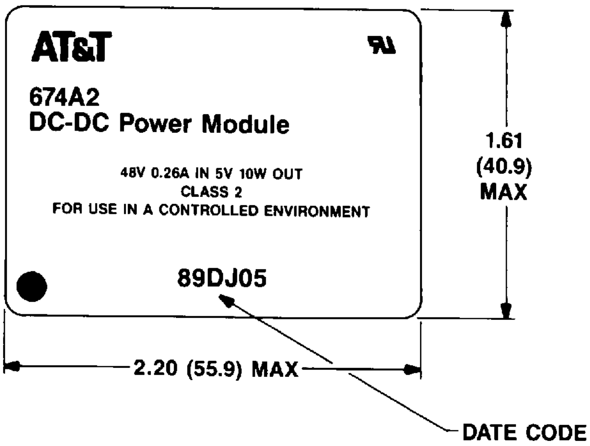
Module Dimensions

Dimensions are in inches and (millimeters).
Tolerances: x.xx ± 0.02 inch (0.5 mm), x.xxx ± 0.010 inch (0.25 mm)

Top View



Pin(s)	Description
1—13	No Connection
14—16	+5 V Output
17	Output Voltage Adjust
18—20	– 5 V Output
21—24	No Connection
25	Remote On/Off
26—31	No Connection
32	+48 V Input
33	– 48 V Input
34—40	No Connection

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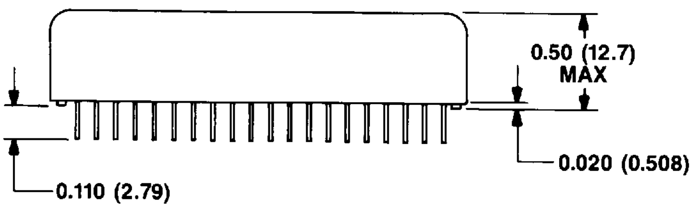
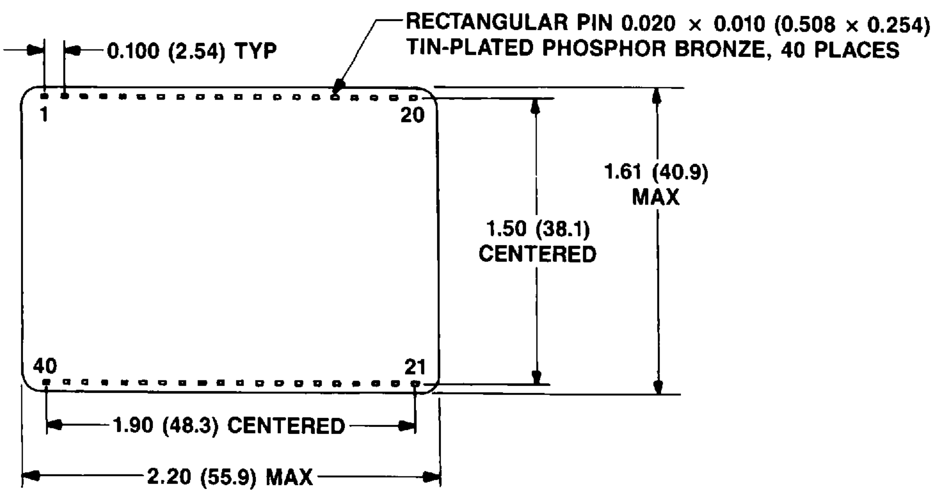
Side View



Bottom View



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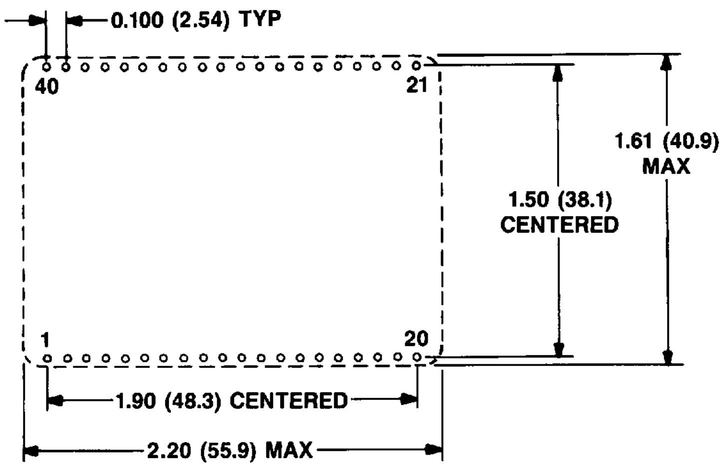
Recommended Hole-Pattern (Component-Side Footprint)

Dimensions are in inches and (millimeters).



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