



660-Series 2 Power Modules: dc-dc Constant Current Converters; 48 Vdc Inputs



The 660-Series 2 Power Modules supply constant output currents from 48 Vdc inputs while providing high efficiency.

Features

- Input-to-output isolation: 1000 V
- Remote on/off
- Isolated TTL status output
- Foldback voltage limiting
- UL* Recognized
- Operating ambient temperature range: -40 °C to +85 °C
- Pin for pin compatible with original 660 Series

Applications

- Line-feed power

Description

The 660-Series 2 is a redesigned, cost-reduced version of the 660 Series. It meets or exceeds the specifications of the original 660 Series.

The 660A1S2, A3S2, A4S2, and A5S2 Power Modules provide constant output currents from 48 V inputs. The 660A1S2, A3S2, and A5S2 deliver 60 mA up to 8 W, and the 660A4S2 delivers 48 mA up to 6 W. Isolation is provided between the input, output, and status circuitry for protection against lightning surges up to 1000 V. To meet the safety requirements of transmission systems, output is limited to 120 V for the 660A4S2, 140 V for the 660A1S2 and A3S2, and 150 V for the 660A5S2.

The modules are designed for line-feed power applications in telecommunications transmission systems. Advantages of constant-current line-feed power rather than linear regulator power include:

- Greatly simplified power administration and craft interface—no manual adjustment of individual powering circuits is needed to compensate for loop length changes.
- No need for fuses to protect each loop from a large current flow.
- Improved power efficiency.

The 660A1S2 and A4S2 modules are packaged in nonconductive plastic cases. The 660A3S2 and A5S2 are packaged in an aluminum case with a case ground pin.

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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	All	V_I	0	80	Vdc
	All	$V_{I, trans}$	0	100	Vdc
I/O Isolation Voltage	All	—	—	1000	Vdc
Operating Ambient Temperature (natural convection)	All	T_A	-40	85	°C
Storage Temperature	All	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	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	660A1S2, A3S2, A5S2	V_I	40	48	60	Vdc
	660A4S2	V_I	36	48	75	Vdc
Maximum Input Current	All	$I_{I, max}$	—	—	500	mA
Inrush Transient	All	I^2t	—	—	0.2	A ² s
Input Ripple Rejection (100 Hz—120 Hz)	All	—	—	50	—	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* require a normal-blow, dc fuse with a maximum rating of 3 A in a 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 3 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 Current	660A1S2, A3S2, A5S2	I_o	58	60	62	mAdc
	660A4S2	I_o	46	48	50	mAdc
Operating Output Resistance	660A1S2, A3S2	R_o	140	—	2200	Ω
	660A4S2	R_o	220	—	1800	Ω
	660A5S2	R_o	140	—	2310	Ω
Output Voltage Limit ($R_o = 0$ to ∞ and 70 Ω series resistance.)	660A1S2, A3S2	$V_{o, \max}$	—	—	140	Vdc
	660A4S2	$V_{o, \max}$	—	—	120	Vdc
	660A5S2	$V_{o, \max}$	—	—	150	Vdc
Output Ripple and Noise Current (RMS)	All	—	—	—	1.0	mA
Efficiency ($V_i = 48$ V; $R_o = R_{o, \max}$; $T_A = 25$ °C.)	All	η	75	78.5	—	%

Feature Specifications

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

Parameter	Symbol	Min	Typ	Max	Unit
Remote On/Off ($V_i = 0$ V to 60 V for 660A1S2, A3S2, and A5S2; $V_i = 0$ V to 75 V for 660A4S2; open collector or equivalent compatible; signal referenced to $V_i(-)$ terminal; see Figure 2 and Feature Descriptions section.): Logic Low—Module Off Logic High—Module On Module Specifications: On/Off Current—Logic Low On/Off Voltage: Logic Low Logic High ($I_{on/off} = 0$) Open Collector Switch Specifications: Leakage Current During Logic High ($V_{on/off} = 10$ V) Output Low Voltage During Logic Low ($I_{on/off} = 1$ mA)	$I_{on/off}$ $V_{on/off}$ $V_{on/off}$ $I_{on/off}$ $V_{on/off}$	— -0.7 — — -0.70	— — — —	1.0 1.2 10 50 1.2	mA V V μ A V

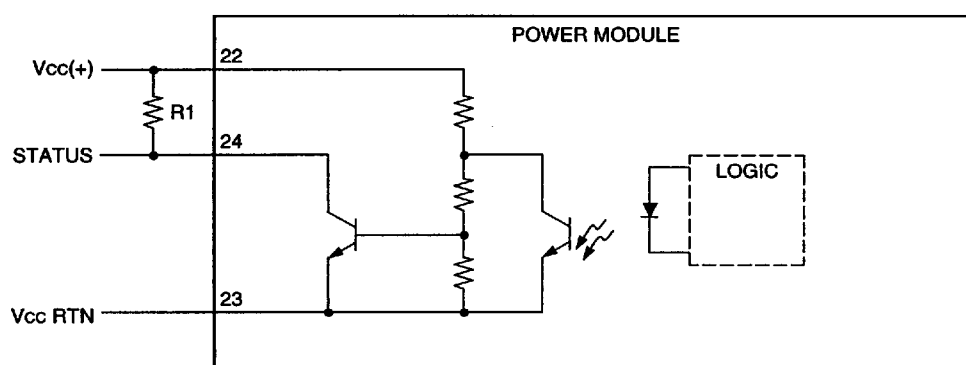
Feature Descriptions

Status Output (Optional)

An on/off status indicator that is open-collector TTL compatible is provided at pin 24. A TTL low indicates that the unit is off. A TTL high indicates that the unit is on. To employ this output, connect a +5 Vdc bias to pin 22 and a +5 Vdc return to pin 23. A pull-up resistor (R1) can be connected between pins 24 and 22.

Table 3. Limits for Proper Operation of Status Output

Parameter	Symbol	Min	Max	Unit
Pull-up Resistor	R1	1	—	k Ω
Supply Voltage	Vcc	4	6	V



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Figure 1. Operation of Status Output

Internal Noise Filtering

660-Series 2 power modules have ceramic (0.1 μ F) capacitors across both the input and output for extra high-frequency noise reduction. This is an improvement over the original 660 Series.

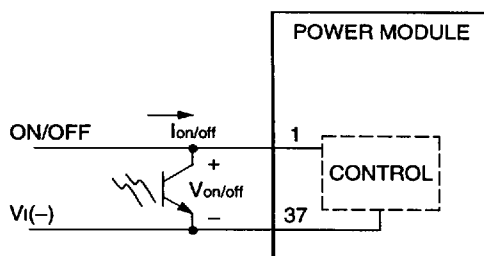
Feature Descriptions (continued)

Remote On/Off

To turn the power 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 open collector or equivalent (see Figure 2.) A logic low is $V_{on/off} = -0.7$ V to 1.2 V, during which the module is off. The maximum $I_{on/off}$ during a logic low is 1 mA. The switch should maintain a logic low voltage with sinking 1 mA.

During a logic high, the maximum $V_{on/off}$ generated by the power module is 10 V. The maximum allowable leakage current of the switch at $V_{on/off} = 10$ V is 50 μ A.

Note: No connection to pin 1 is required for operation without the remote on/off.



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Figure 2. Remote On/Off Circuitry

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*.

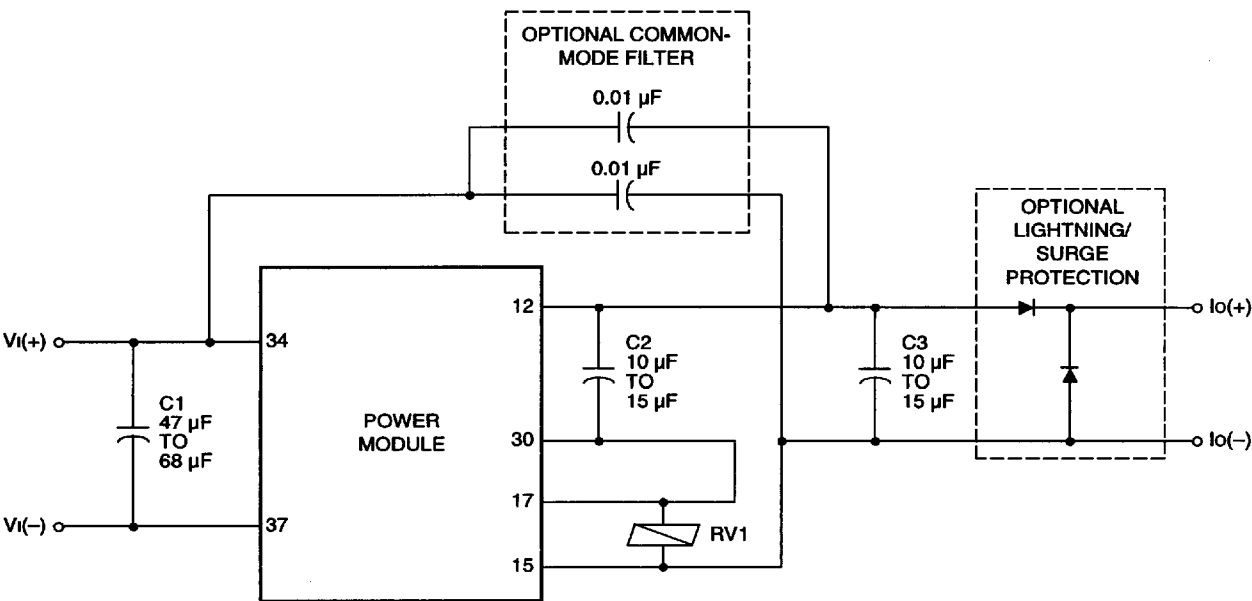
For the converter output to be considered meeting the requirements for safety extra-low voltage (SELV), one of the following must be true:

- All inputs are SELV and floating, with all outputs 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 an SELV reliability test performed on it in combination with the converters. Inputs must meet SELV requirement.

If the input meets extra-low voltage (ELV) requirements, then the converter's output is considered ELV.

The inputs to these units are to be provided with a maximum 3 A normal-blow fuse in the ungrounded lead.

Connection Diagram



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Figure 3. Connection Diagram

Required External Components

We have recommended specific vendors and parts for use with this circuit in Table 3; however, many different vendors and parts could be used. Please follow these guidelines when selecting vendors and parts: C1, C2, and C3 should be aluminum electrolytic capacitors with equivalent series resistances less than 10 Ω over the required temperature range, and with maximum ripple current specified at 105 $^{\circ}\text{C}$ and 100 kHz of greater than 250 mArms for C1, and greater than 120 mArms for C2 and C3. RV1 should be a varistor equivalent to the part recommended in Table 3.

Table 3. Recommended External Components

Reference Designation	Component Type	Suggested Vendor	Vendor Part Number
C1	Capacitor	NICHICON	UPJ1K470MHH
C2	Capacitor	UCC	KS21860L28, 10 μF
C3	Capacitor	UCC	KS21860L28, 10 μF
RV1	Varistor	Microsemi	MSV701A

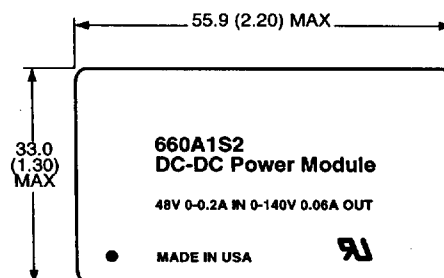
Outline Diagrams

Dimensions are in millimeters and (inches).

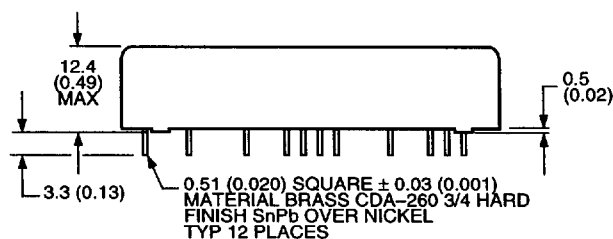
Tolerances: x.x $\pm$ 0.5 mm (0.02 in.), x.xx $\pm$ 0.25 mm (0.010 in.).

660A1S2 and A4S2 Outline Diagram

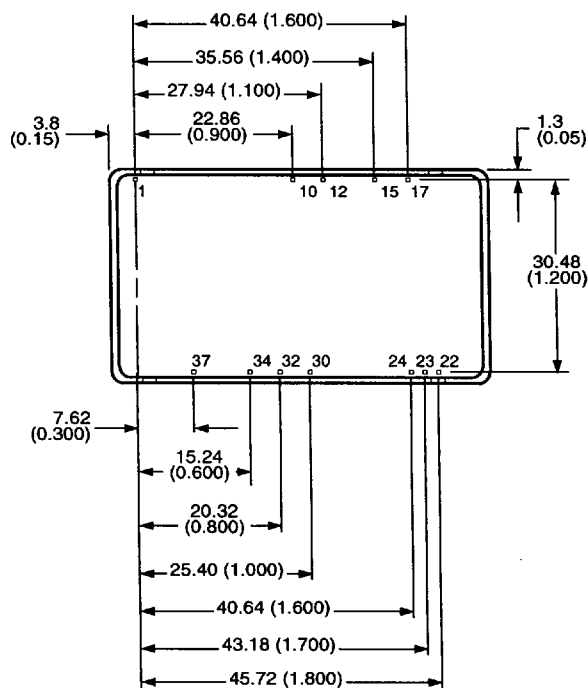
Top View



Side View



Bottom View



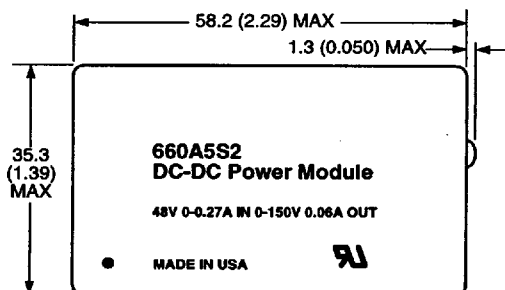
Outline Diagrams (continued)

Dimensions are in millimeters and (inches).

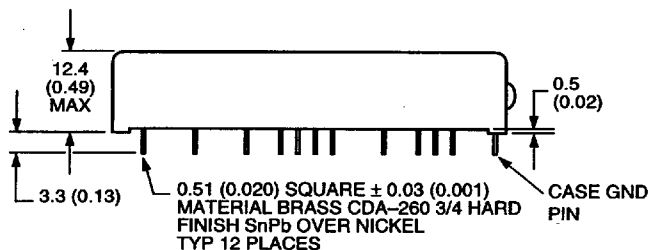
Tolerances: x.x $\pm$ 0.5 mm (0.02 in.), x.xx $\pm$ 0.25 mm (0.010 in.).

660A3S2 and A5S2 Outline Diagram

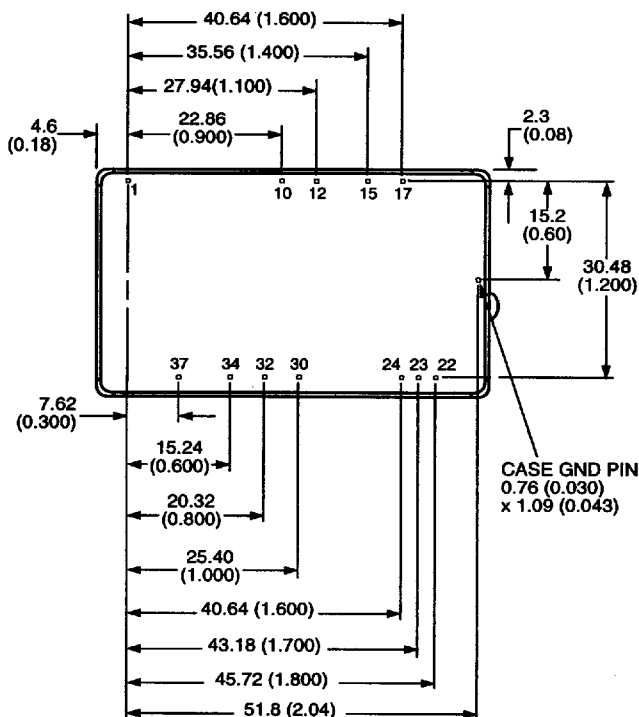
Top View



Side View



Bottom View



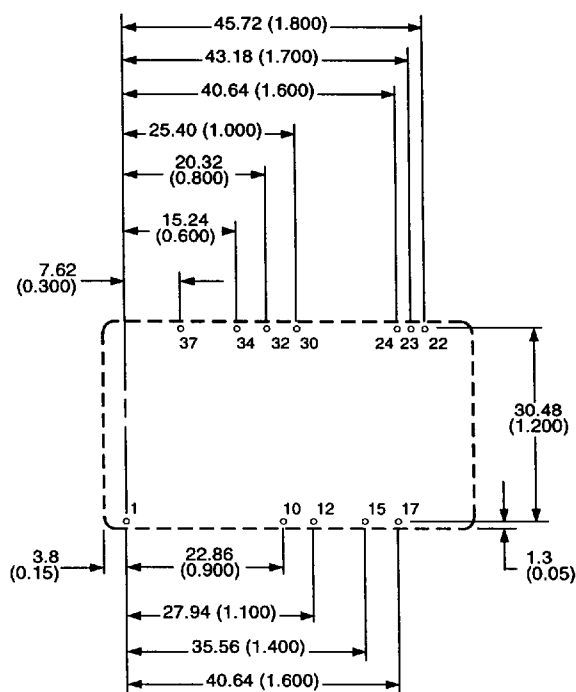
Recommended Hole Patterns

Component-side footprint.

Dimensions are in millimeters and (inches).

Tolerances: x.x $\pm$ 0.5 mm (0.02 in.), x.xx $\pm$ 0.25 mm (0.010 in.).

660A1S2 and 660A4S2 Recommended Hole Pattern



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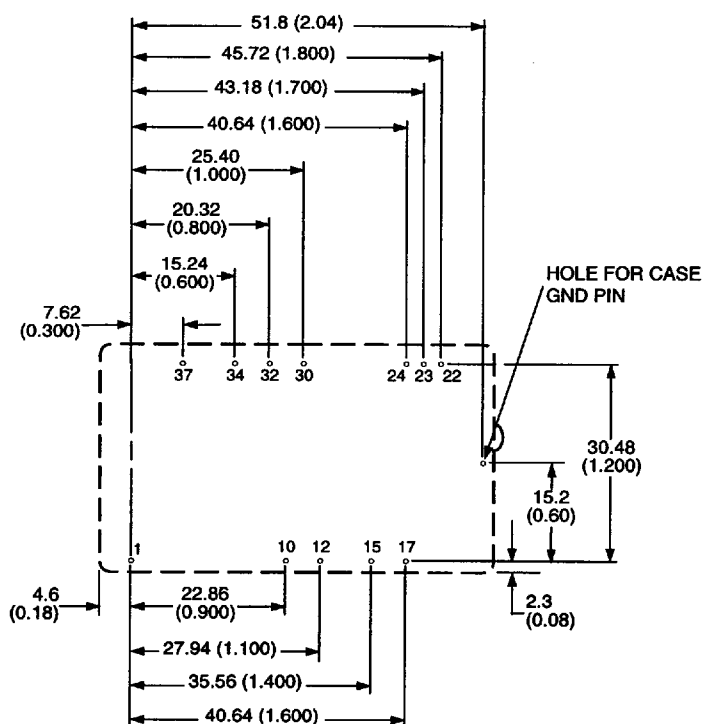
Recommended Hole Patterns (continued)

Component-side footprint.

Dimensions are in millimeters and (inches).

Tolerances: x.x $\pm$ 0.5 mm (0.02 in.), x.xx $\pm$ 0.25 mm (0.010 in.).

660A3S2 and 660A5S2 Recommended Hole Pattern



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Recommended Hole Patterns (continued)

Table 4. Pin Information

Pin	Name
1	ON/OFF
10	NC*
12	Io (+)
15	Io (-)
17	C2 (-)
22	STATUS Vcc
23	STATUS GND
24	STATUS
30	C2 (-)
32	NC*
34	Vi (+)
37	Vi (-)
CASE GND†	GND

* No user connection. Do not connect.

† 660A3S2 and 660A5S2 only.

Ordering Information

Input Voltage	Output Current	Output Power	Package	Device Code	Comcode
48 V (40 V—60 V)	60 mA	8 W	Plastic	660A1S2	107933483
48 V (40 V—60 V)	60 mA	8 W	Metal	660A3S2	107947202
48 V (36 V—75 V)	48 mA	6 W	Plastic	660A4S2	107933491
48 V (40 V—60 V)	60 mA	8 W	Metal	660A5S2	107933509