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LW030-Series Power Modules: 36 Vdc to 75 Vdc Inputs; 19.8 W to 30 W

The LW030-Series Power Modules use advanced, surface-mount technology and deliver high-quality, compact, dc-dc conversion at an economical price.

Applications

- Communication equipment
- Distributed power architectures
- Computer equipment

Options

- Negative remote on/off logic
- Case ground pin
- Tight tolerance
- Synchronization
- Short pins: 2.79 mm ± 0.25 mm (0.110 in. ± 0.010 in.)
- Short pins: 3.68 mm ± 0.25 mm (0.145 in. ± 0.010 in.)

* *UL* is a registered trademark of Underwriters Laboratories, Inc.
† *CSA* is a registered trademark of Canadian Standards Association.
‡ *VDE* is a trademark of Verband Deutscher Elektrotechniker e.V.
§ This product is intended for integration into end-use equipment. All the required procedures for CE marking of end-use equipment should be followed. (The CE mark is placed on selected products.)

Features

- Low profile and small size: 61.0 mm x 71.1 mm x 9.53 mm (2.40 in. x 2.80 in. x 0.375 in.)
- Wide input voltage range: 36 Vdc to 75 Vdc
- Input-to-output isolation
- Operating case temperature range: –40 °C to +100 °C
- Metal case
- Output overcurrent protection, unlimited duration
- Positive remote on/off logic and output voltage remote sense
- Output voltage adjust: 90% to 110% of $V_{O,\ nom}$
- Output overvoltage protection
- *UL** 1950 Recognized, *CSA*† C22.2 No. 950-95 Certified, *VDE*‡ 0805 (EN60950, IEC950) Licensed
- CE mark meets 73/23/EEC and 93/68/EEC directives§
- Within FCC Class A radiated limits

Description

The LW030-Series Power Modules are low-profile dc-dc converters that operate over an input voltage range of 36 Vdc to 75 Vdc and provide precisely regulated outputs. The output is isolated from the input, allowing versatile polarity configurations and grounding connections. The modules have a maximum power rating up to 30 W at a typical full-load efficiency of up to 79%.

The power modules feature remote on/off, output voltage remote sense (both negative and positive leads), and output voltage adjustment. Built-in filtering for both input and output minimizes the need for external filtering. The modules are PC-board mountable and encapsulated in metal cases.

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	0	80	Vdc
Operating Case Temperature (see Thermal Considerations section.)	T_C	–40	100	°C
Storage Temperature	T_{stg}	–40	120	°C
I/O Isolation Voltage	—	—	1050	Vdc

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	36	48	75	Vdc
Maximum Input Current (V_I = 0 V to $V_{I, max}$; I_O = $I_{O, max}$; see Figures 1 and 2.)	$I_{I, max}$	—	—	1.6	A
Inrush Transient	i^2t	—	—	1	A^2s
Input Reflected-ripple Current (See Figure 11.)	I_I	—	25	—	mAp-p
Input Ripple Rejection (100 Hz—120 Hz)	—	—	60	—	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 safety agencies require a normal-blow fuse with a maximum rating of 5 A (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. Refer to the fuse manufacturer's data for further information.

Electrical Specifications (continued)

Table 2. Output Specifications

Parameter	Device Suffix	Symbol	Min	Typ	Max	Unit
Output Voltage Set Point (V_I = 48 V; $I_O = I_{O,\,max}$; T_C = 25 °C)	F A	$V_{O,\,set}$ $V_{O,\,set}$	3.24 4.92	3.30 5.00	3.37 5.08	Vdc Vdc
Output Voltage (Over all line, load, and temperature conditions until end of life; see Figure 13.)	F A	V_O V_O	3.15 4.80	— —	3.45 5.2	Vdc Vdc
Output Regulation:						
Line (V_I = 36 V to 75 V)	F A	— —	— —	0.03 0.01	0.25 0.1	$\%V_O$ $\%V_O$
Load ($I_O = I_{O,\,min}$ to $I_{O,\,max}$)	F A	— —	— —	0.03 0.05	0.25 0.2	$\%V_O$ $\%V_O$
Temperature (T_C = –40 °C to +100 °C)	F A	— —	— —	0.75 0.5	1.5 1.5	$\%V_O$ $\%V_O$
Output Ripple and Noise Voltage (See Figure 12.):						
RMS	All	—	—	—	20	mVrms
Peak-to-peak (5 Hz to 20 MHz)	All	—	—	—	75	mVp-p
Output Current (At $I_O < I_{O,\,min}$, the modules may exceed output ripple specifications.)	All	I_O	0.6	—	6.0	A
Output Current-limit Inception (V_O = 90% x $V_{O,\,set}$)	All	I_O	—	6.9	—	A
Output Short-circuit Current (V_O = 250 mV)	F A	I_O I_O	— —	8.0 8.0	10.5 9.5	A A
Efficiency ($V_{I,\,nom}$; $I_O = I_{O,\,max}$; T_C = 25 °C)	F A	η η	72 79	73.5 81	— —	% %
Switching Frequency	All	—	—	250	—	kHz
Dynamic Response (ýI_O/ýt = 1 A/10 µs, $V_I = V_{I,\,nom}$, T_C = 25 °C):						
Load Change from I_O = 50% to 75% of $I_{O,\,max}$:						
Peak Deviation	All	—	—	2	—	$\%V_{O,\,set}$
Settling Time (V_O < 10% peak deviation)	All	—	—	5.0	—	ms
Load Change from I_O = 50% to 25% of $I_{O,\,max}$:						
Peak Deviation	All	—	—	2	—	$\%V_{O,\,set}$
Settling Time (V_O < 10% peak deviation)	All	—	—	5.0	—	ms

Table 3. Isolation Specifications

Parameter	Min	Typ	Max	Unit
Isolation Capacitance	—	0.02	—	µF
Isolation Resistance	10	—	—	M¾

General Specifications

Parameter	Min	Typ	Max	Unit
Calculated MTBF (I_O = 80% of $I_{O,\,max}$; T_C = 40 °C)		3,500,000		hours
Weight	—	—	113 (4.0)	g (oz.)

Feature Specifications

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

Parameter	Device Suffix	Symbol	Min	Typ	Max	Unit
Remote On/Off Signal Interface (V_I = 0 V to 75 V; open collector or equivalent compatible; signal referenced to V_I(–) terminal. See Figures 9, 10, 14, and Feature Descriptions.):						
LW030x Positive Logic:						
Logic Low—Module Off						
Logic High—Module On						
LW030x1 Negative Logic:						
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	$V_{on/off}$	–0.7	—	1.2	V
Logic High ($I_{on/off}$ = 0 µA)	All	$V_{on/off}$	—	—	6.0	V
Open Collector Switch Specifications:						
Leakage Current During Logic High ($V_{on/off}$ = 6.0 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_C = 25 °C; V_O within ±1% of steady state)	All	—	—	—	5.0	ms
Output Voltage Overshoot	All	—	—	0	5.0	%
Output Voltage Sense Range	All	—	—	—	10	%$V_{O,\,nom}$
Output Voltage Set-point Adjustment Range	F	—	80	—	110	%$V_{O,\,nom}$
	A	—	90	—	110	%$V_{O,\,nom}$
Output Overvoltage Protection (clamp)	F	$V_{O,\,clamp}$	4.0	—	5.7	V
	A	$V_{O,\,clamp}$	5.6	—	7.0	V

Characteristic Curves

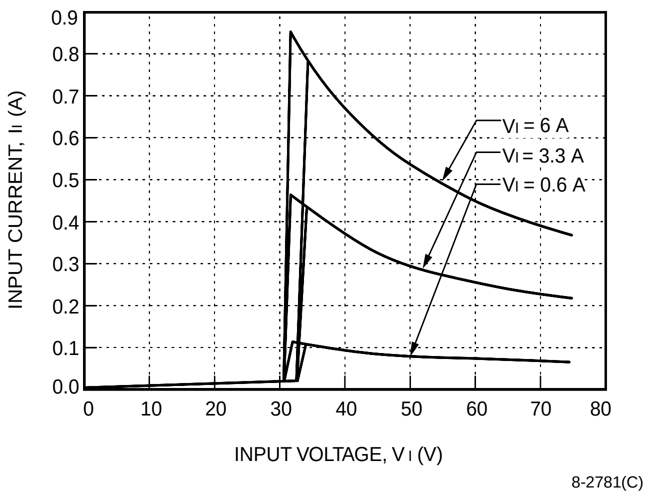


Figure 1. LW030F871 Typical Input Characteristics

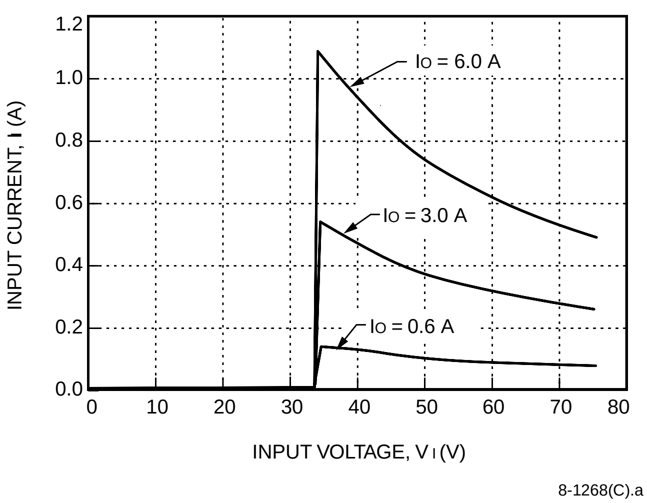


Figure 2. LW030A Typical Input Characteristics

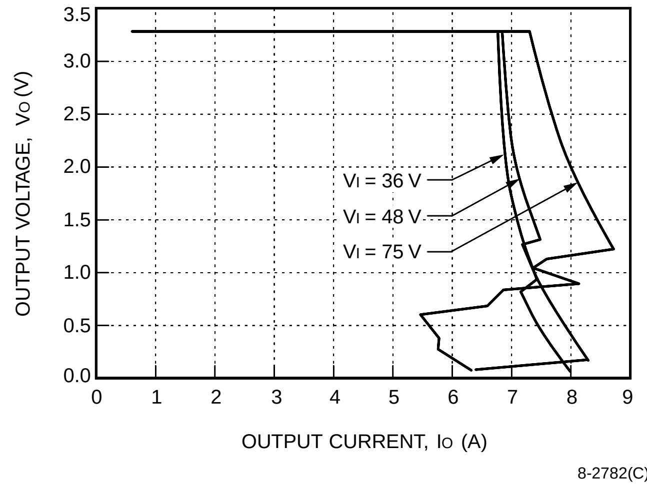


Figure 3. LW030F871 Typical Output Characteristics

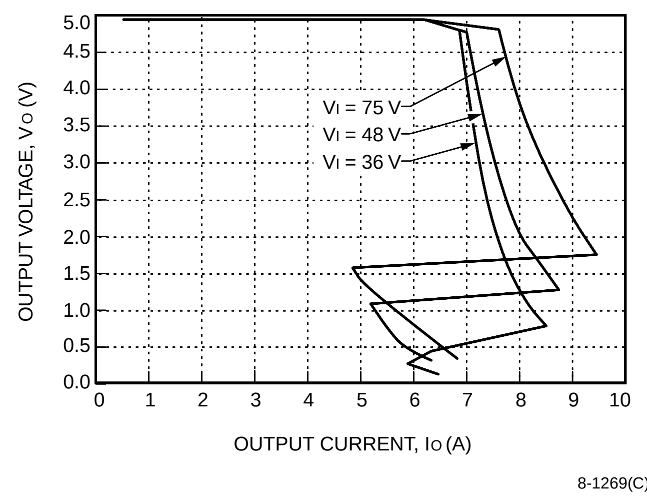


Figure 4. LW030A Typical Output Characteristics

Characteristic Curves (continued)

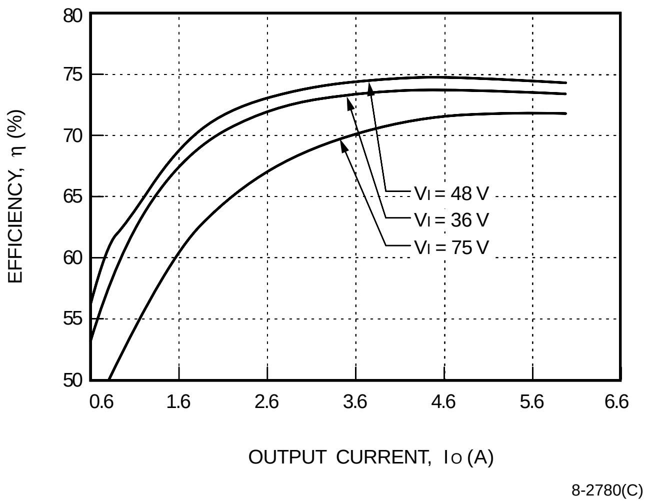


Figure 5. LW030F871 Typical Converter Efficiency vs. Output Current

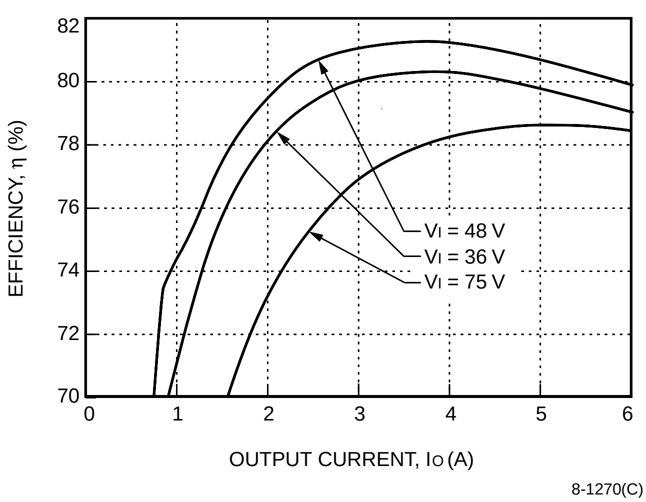


Figure 6. LW030A Typical Converter Efficiency vs. Output Current

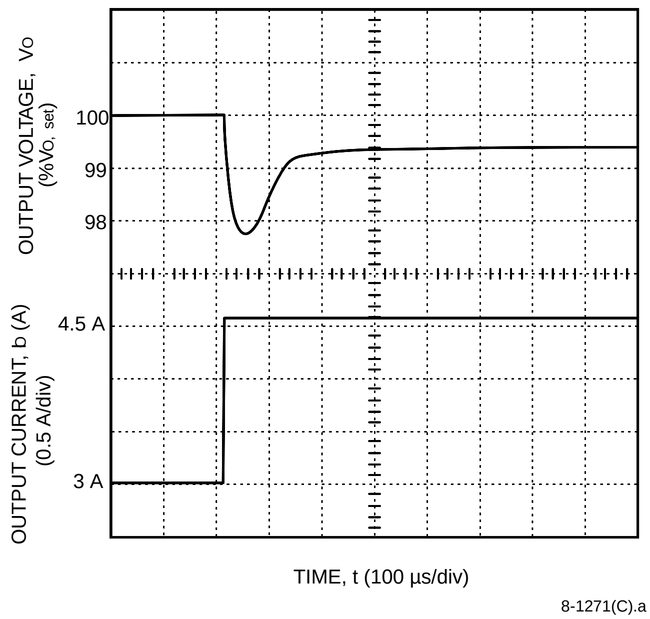


Figure 7. LW030 Typical Output Voltage for a Step Load Change from 50% to 75%

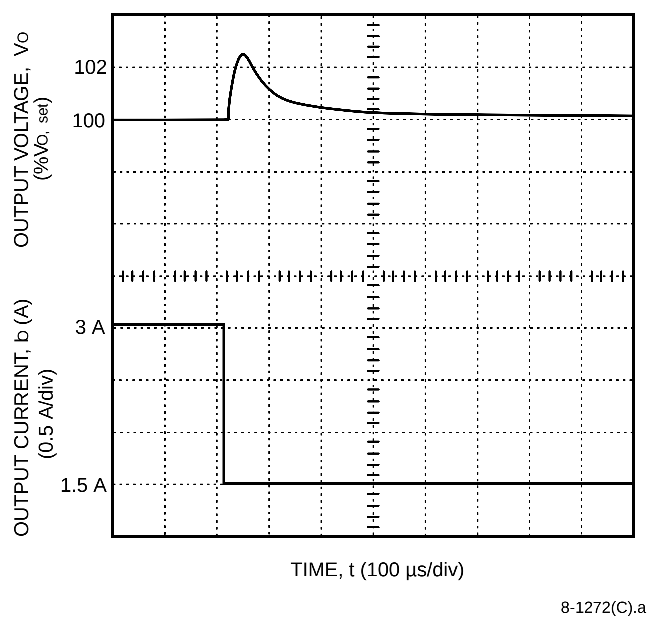


Figure 8. LW030 Typical Output Voltage for a Step Load Change from 50% to 25%

Characteristic Curves (continued)

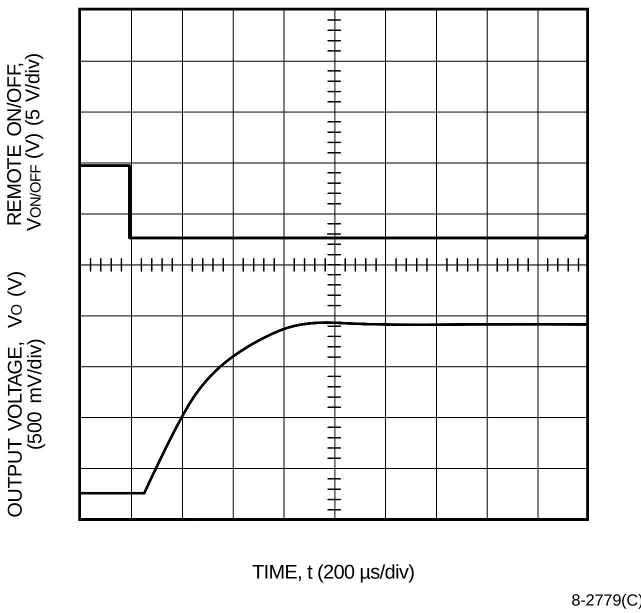


Figure 9. LW030F871 Typical Output Voltage Start-Up when Signal Applied to Remote On/Off

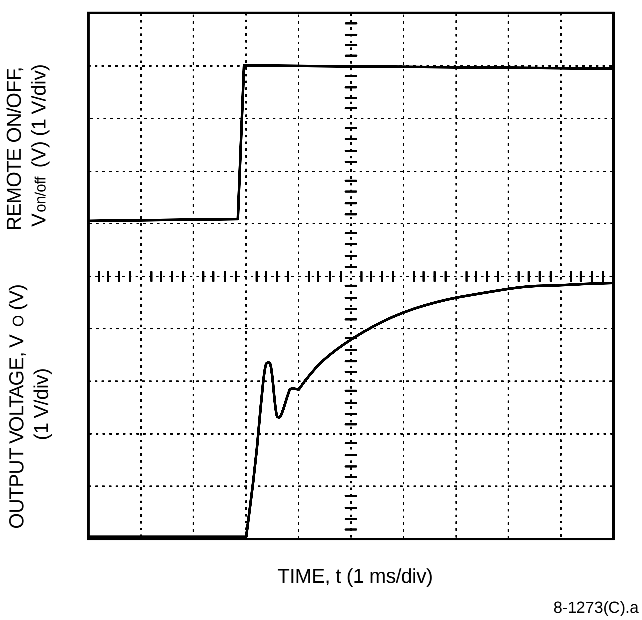
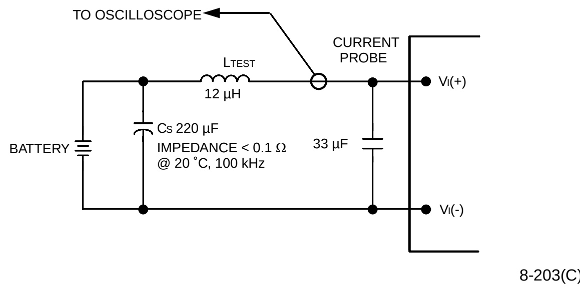


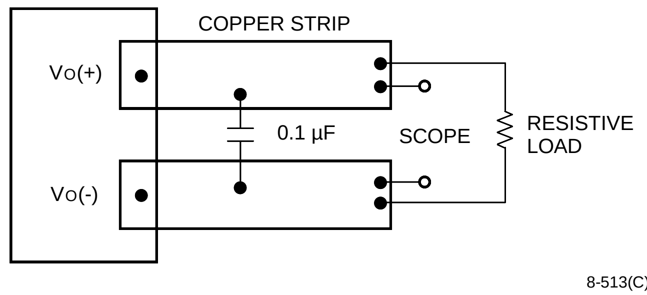
Figure 10. LW030A Typical Output Voltage Start-Up when Signal Applied to Remote On/Off

Test Configurations



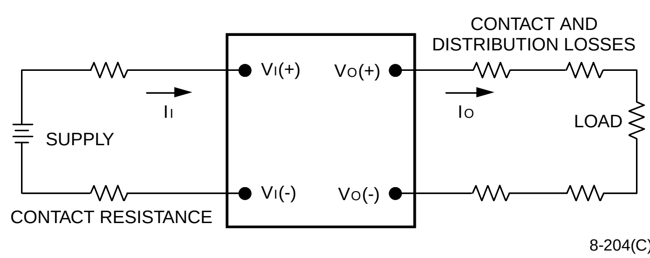
Note: Input reflected-ripple current is measured with a simulated source impedance of 12 µH. Capacitor Cs offsets possible battery impedance. Current is measured at the input of the module.

Figure 11. 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 12. 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.

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

Figure 13. Output Voltage and Efficiency Measurement Test Setup

Design Considerations

Grounding Considerations

For modules without the isolated case ground pin option, the case is internally connected to the $V_I(+)$ pin. For modules with the isolated case ground pin option, device code suffix “7,” the case is not connected internally allowing the user flexibility in grounding.

Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. For the test configuration in Figure 11, a 33 µF electrolytic capacitor (ESR < 0.7 ¾ at 100 kHz) mounted close to the power module helps ensure stability of the unit. For other highly inductive source impedances, consult the factory for further application guidelines.

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).

If the input source is non-SELV (ELV or a hazardous voltage greater than 60 Vdc and less than or equal to 75 Vdc), for the module's output to be considered meeting the requirements of safety extra-low voltage (SELV), all of the following must be true:

- The input source is to be provided with reinforced insulation from any other hazardous voltages, including the ac mains.
- One V_I pin and one V_O pin are to be grounded or both the input and output pins are to be kept floating.
- The input pins of the module are not operator accessible.
- Another SELV reliability test is conducted on the whole system, as required by the safety agencies, on the combination of supply source and the subject module to verify that under a single fault, hazardous voltages do not appear at the module's output.

Note: Do not ground either of the input pins of the module without grounding one of the output pins. This may allow a non-SELV voltage to appear between the output pins and ground.

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 circuitry 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

Two remote on/off options are available. Positive logic remote on/off turns the module on during a logic-high voltage on the remote ON/OFF pin, and off during a logic low. Negative logic remote on/off, device code suffix “1,” turns the module off during a logic high and on during a logic low.

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 14). A logic low is $V_{on/off}$ = –0.7 V to 1.2 V. 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 6 V. The maximum allowable leakage current of the switch at $V_{on/off}$ = 6 V is 50 µA.

The module has internal capacitance to reduce noise at the ON/OFF pin. Additional capacitance is not generally needed and may degrade the start-up characteristics of the module.

Feature Descriptions (continued)

Remote On/Off (continued)

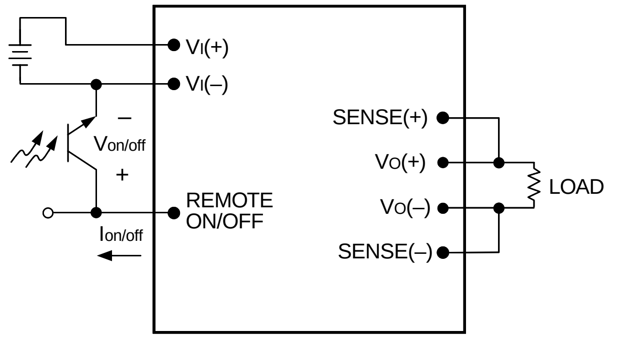


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Figure 14. Remote On/Off Implementation

Remote Sense

Remote sense minimizes the effects of distribution losses by regulating the voltage at the remote-sense connections. The voltage between the remote-sense pins and the output terminals must not exceed the output voltage sense range given in the Feature Specifications table, i.e.:

[VO(+) – VO(–)] – [SENSE(+) – SENSE(–)] ð 10%$V_{O,\ nom}$

The voltage between the VO(+) and VO(–) terminals must not exceed the minimum output overvoltage shutdown voltage as indicated in the Feature Specifications table. This limit includes any increase in voltage due to remote-sense compensation and output voltage set-point adjustment (trim). See Figure 15.

If not using the remote-sense feature to regulate the output at the point of load, then connect SENSE(+) to VO(+) and SENSE(–) to VO(–) at the module.

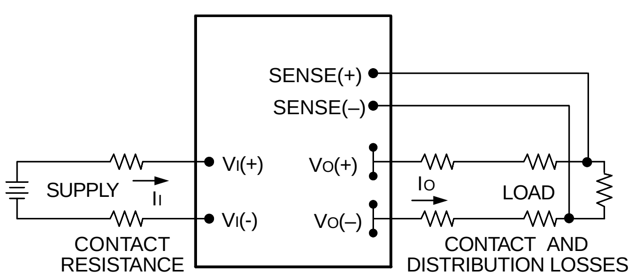

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Figure 15. Effective Circuit Configuration for Single-Module Remote-Sense Operation

Output Voltage Adjustment

Output voltage trim allows the user to increase or decrease the output voltage set point of a module. This is accomplished by connecting an external resistor between the TRIM pin and either the VO(+) or VO(–) pins. With an external resistor between the TRIM and VO(+) pins ($R_{adj\text{-}down}$), the output voltage set point ($V_{O,\ adj}$) decreases. The following equations determine the required external resistor value to obtain an output voltage change of ý%.

For the LW030F:

$$R_{adj\text{-}down} = \left(\frac{(V_{O,adj} - 1.23) \times 28.47}{V_{O,\ nom} - V_{O,\ adj}}\right) k\Omega$$

For the LW030A:

$$R_{adj\text{-}down} = \left[\frac{8.47}{\Delta\%} - 16.94\right] k\Omega$$

where $R_{adj\text{-}down}$ is the resistance value connected between TRIM and VO (+).

For example, to lower the output voltage of the LW030A by 10%, the external resistor value must be:

$R_{adj\text{-}down}$ = 67.8 k¾

With an external resistor connected between the TRIM and VO(–) pins ($R_{adj\text{-}up}$), the output voltage set point ($V_{O,\ adj}$) increases. The following equations determine the required external resistor value to obtain an output voltage change of ý%.

For the LW030F:

$$R_{adj\text{-}up} = \left[\frac{10.62}{\Delta\%}\right] k\Omega$$

For the LW030A:

$$R_{adj\text{-}up} = \left[\frac{8.47}{\Delta\%}\right] k\Omega$$

where $R_{adj\text{-}up}$ is the resistance value connected between TRIM and VO(–).

For example, to increase the output voltage of the LW030A by 10%, the external resistor value must be:

$R_{adj\text{-}up}$ = 84.7 k¾

Feature Descriptions (continued)

Output Voltage Adjustment (continued)

The combination of the output voltage adjustment and sense range and the output voltage given in the Feature Specifications table cannot exceed 110% of the nominal output voltage between the $V_O(+)$ and $V_O(-)$ terminals.

The LW030-Series Power Modules have fixed current-limit set points. Therefore, as the output voltage is adjusted down, the available output power is reduced. In addition, the minimum output current is a function of the output voltage. As the output voltage is adjusted down, the minimum required output current can increase.

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 protection circuit has a higher voltage set point than the primary loop (see Feature Specifications table). In a fault condition, the overvoltage clamp ensures that the output voltage does not exceed $V_{O,\ clamp,\ max}$. This provides a redundant voltage-control that reduces the risk of output overvoltage.

Synchronization (Optional)

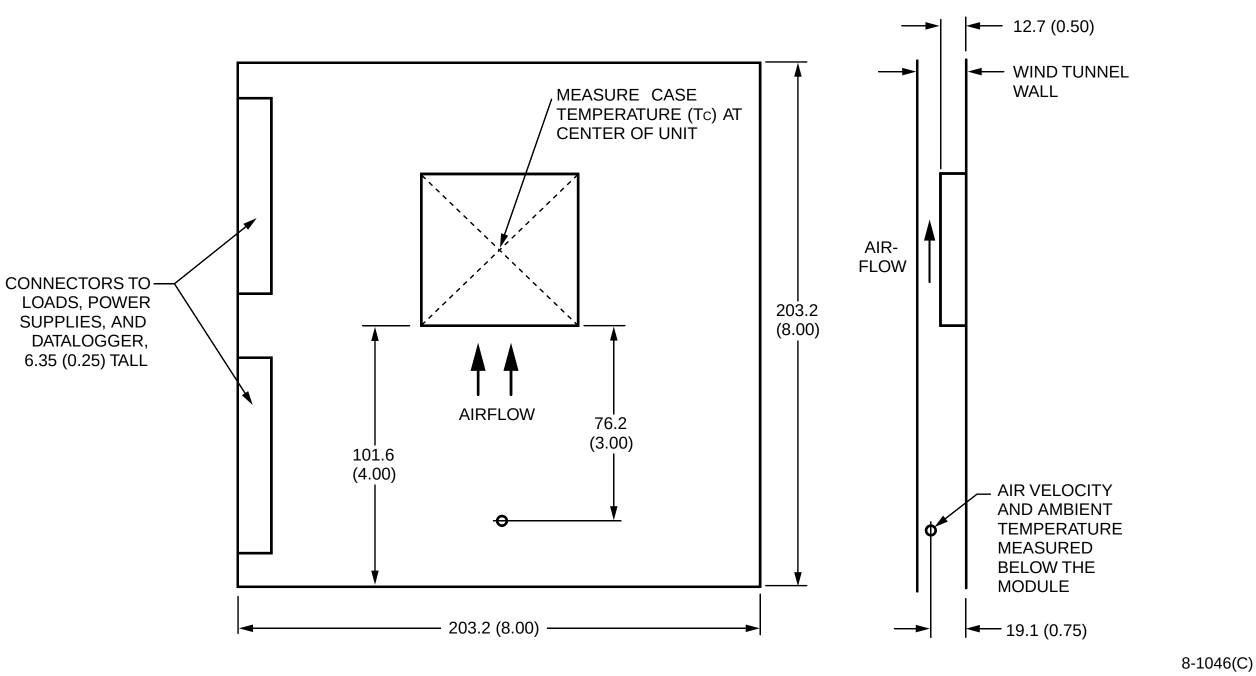
The unit is capable of external synchronization from an independent time base with a switching rate between 290 kHz and 310 kHz. The amplitude of the synchronizing pulse train is TTL compatible, and the duty cycle ranges between 40% and 60%. Synchronization is referenced to the primary.

Thermal Considerations

Introduction

The LW030-Series Power Modules operate in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat-dissipating components inside the unit are thermally coupled to the case. Heat is removed by conduction, convection, and radiation to the surrounding environment. Proper cooling can be verified by measuring the case temperature. Peak temperature (T_C) occurs at the position indicated in Figure 16.

The temperature at this location should not exceed 100 °C. The output power of the module should not exceed the rated power for the module as listed in the Ordering Information table.



Note: Dimensions are in millimeters and (inches). Drawing is not to scale.

Figure 16. Thermal Test Setup

Thermal Considerations (continued)

Heat Transfer Without Heat Sinks

The thermal data presented in this section is based on measurements taken in a wind tunnel. The test setup shown in Figure 16 was used to collect data for Figure 17.

Increasing airflow over the module enhances the heat transfer via convection. Figure 17 shows the maximum power that can be dissipated by the modules without exceeding the maximum case temperature versus local ambient temperature (T_A) for natural convection through 3.05 ms^{-1} (600 ft./min.)

Note that the natural convection condition was measured at 0.05 ms^{-1} to 0.1 ms^{-1} (10 ft./min. to 20 ft./min.); however, systems in which these power modules may be used typically generate natural convection airflow rates of 0.3 ms^{-1} (60 ft./min.) due to other heat-dissipating components in the system. Use of Figure 17 is shown in the following example.

Example

What is the minimum airflow necessary for a LW030A operating at V_I = 56 V, I_O = 5.0 A, and a maximum ambient temperature of 80 °C?

Solution:

Given: V_I = 56 V, I_O = 5.0 A, T_A = 80 °C
Determine P_D (Figure 19): P_D = 6.0 W
Determine airflow (Figure 17): v = 1.02 ms^{-1}
(200 ft./min.)

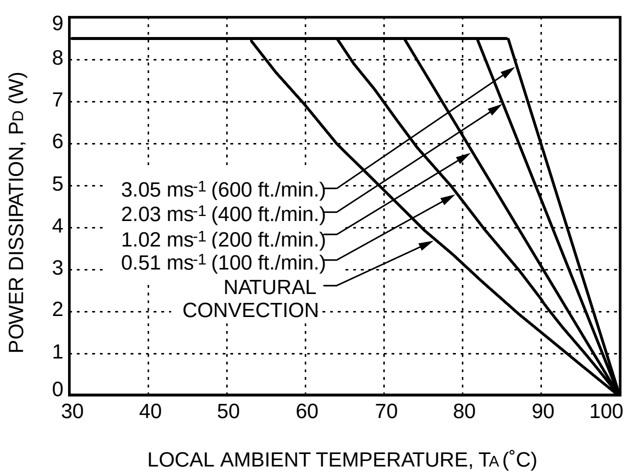


Figure 17. LW030A and LW030F Convection Derating Power Derating with No Heat Sink; Either Orientation

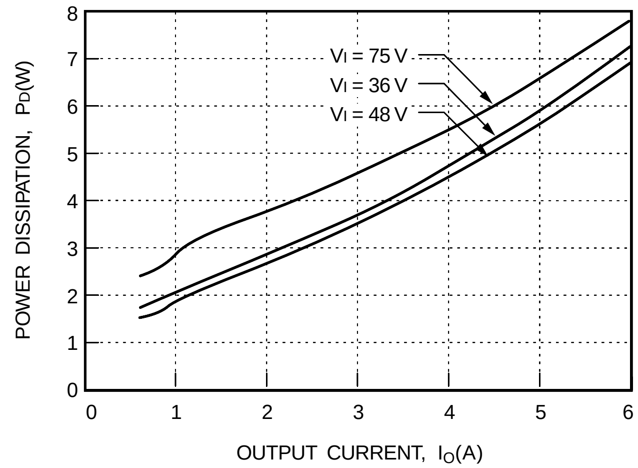


Figure 18. LW030F871 Power Dissipation vs. Output Current

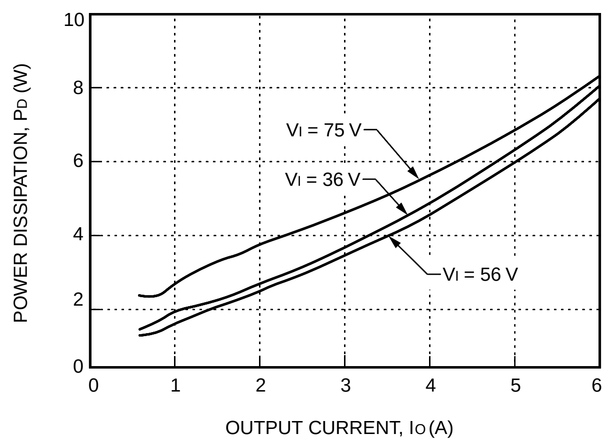


Figure 19. LW030A Power Dissipation vs. Output Current

Thermal Considerations (continued)

Heat Transfer with Heat Sinks

The LW030-Series Power Modules include four through-threaded M3 x 0.5 mounting holes, which allow heat sinks or cold plates to be attached from either side of the module. The mounting torque must not exceed 0.56 N-m (5 in.-lb.).

Thermal derating with heat sinks is expressed through use of the overall thermal resistance of the module. Total module thermal resistance (θ_{CA}) is defined as the maximum case temperature rise (ý$T_{C,\ max}$) divided by the module power dissipation (P_D):

$$\theta_{CA} = ýT_{C,\ max}/P_D = (T_C - T_A)/P_D$$

The location of the case temperature (T_C) is defined in Figure 16. The case-to-ambient thermal resistance vs. airflow for various heat sink configurations is given in Figure 20. This set of curves was obtained by experimental testing of heat sinks, which are offered in the product catalog.

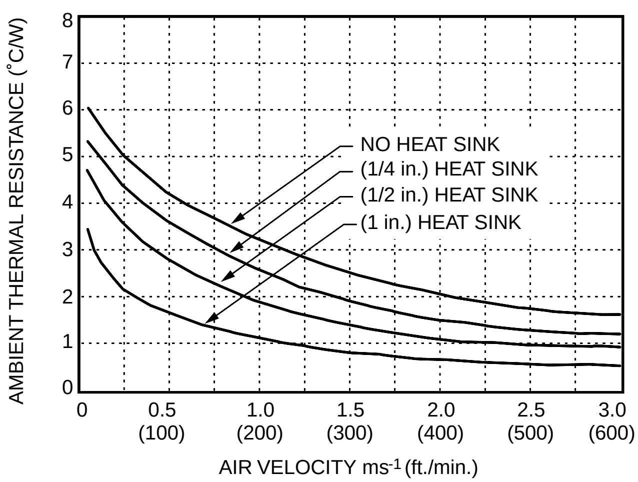


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Figure 20. LW030A and LW030F Case-to-Ambient Thermal Resistance vs. Air Velocity Curves; Either Orientation

These measured resistances are for heat transfer from the sides and bottom of the module as well as the top side with the attached heat sink; therefore, the case-to-ambient thermal resistance shown is generally lower than the resistance of the heat sink by itself. The module used to collect the data in Figure 20 had a thermally conductive dry pad between the case and the heat sink to minimize contact resistance. Use of Figure 20 is shown in the following example.

Example

Although the maximum case temperature for the LW030A is 100 °C, one may want to limit the maximum case temperature to a lower value for extremely high reliability. If a 90 °C case temperature is desired, what is the allowable minimum airflow necessary for an LW030A operating at V_I = 56 V and I_O = 6 A with a maximum ambient of 75 °C and a 1/2 in. heat sink?

Solution:

Given: V_I = 56 V, I_O = 6 A, T_A = 75 °C, sink = 1/2 in.
Determine P_D (Figure 19): P_D = 7.7 W
$\theta ca = (T_C - T_A)/P_D$
$= (90 - 75)/7.7$
$= 1.95$ °C/W

Use Figure 20 to determine air velocity (1/2 in. heat sink): v = 0.97 ms^{-1} (190 ft./min.)

Custom Heat Sinks

A more detailed model can be used to determine the required thermal resistance of a heat sink to provide necessary cooling. The total module resistance can be separated into a resistance from case-to-sink (θcs) and sink-to-sink ambient (θsa). This model is shown below.

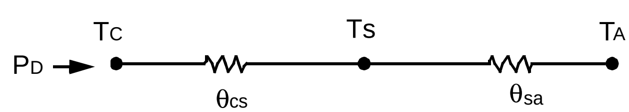


Figure 21. Resistance from Case-to-Sink and Sink-to-Ambient

For a managed interface using thermal grease or foils, a value of θcs = 0.1 °C/W – 0.3 °C/W is typical. Solution for the heat sink resistance is:

$$\theta sa = [(Tc - T_A)/P_D] - \theta cs$$

Note that this equation assumes that all dissipated power must be shed by the heat sink. Depending on the user-defined application environment, a more accurate model including heat transfer from the sides and bottom of the module can be used. This equation provides a conservative estimate in such instances.

Layout Considerations

Copper paths must not be routed beneath the power module standoffs.

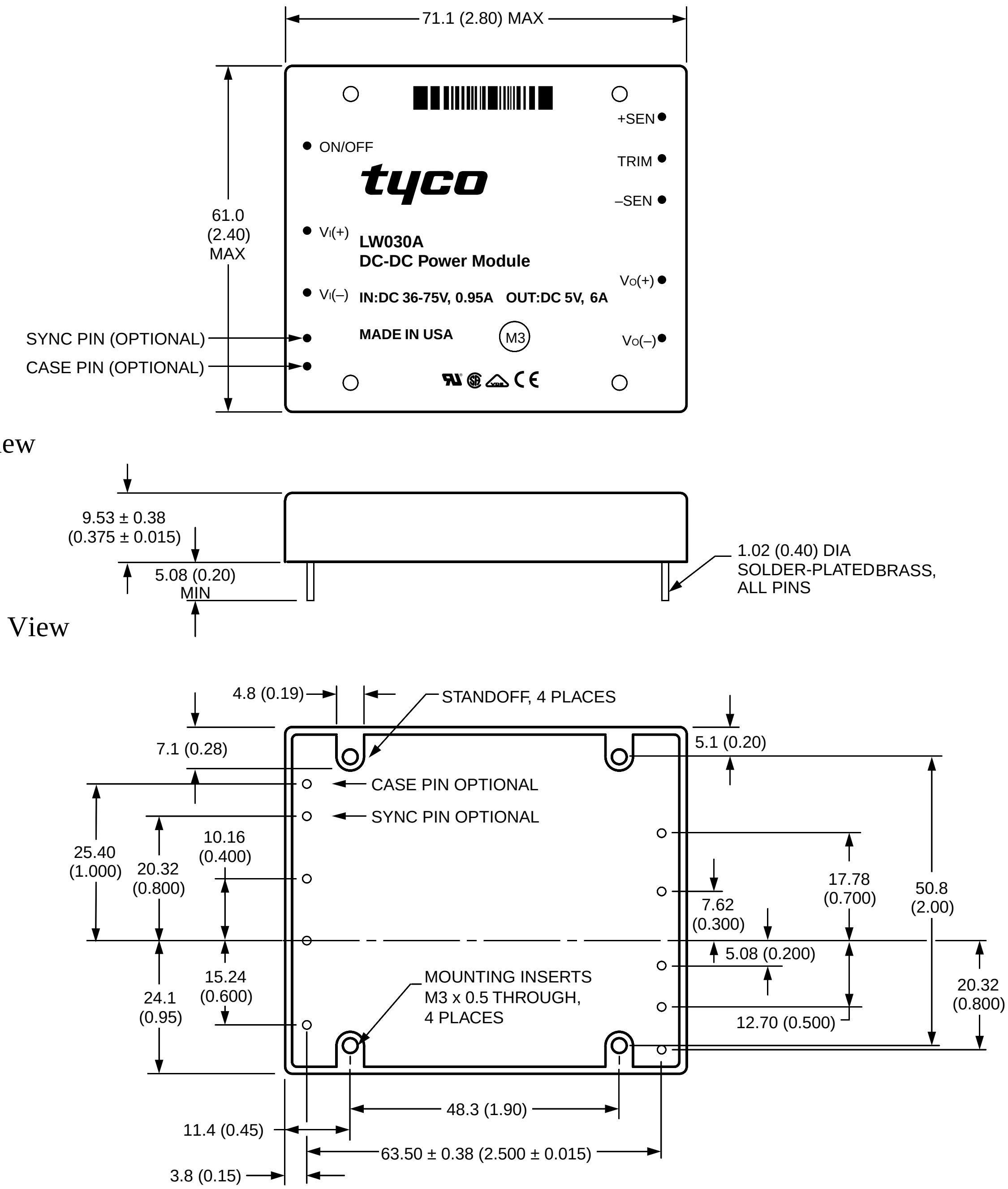
Outline Diagram

Dimensions are in millimeters and (inches).

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

Note: For standard modules, $V_I(+)$ is internally connected to the case.

Top View

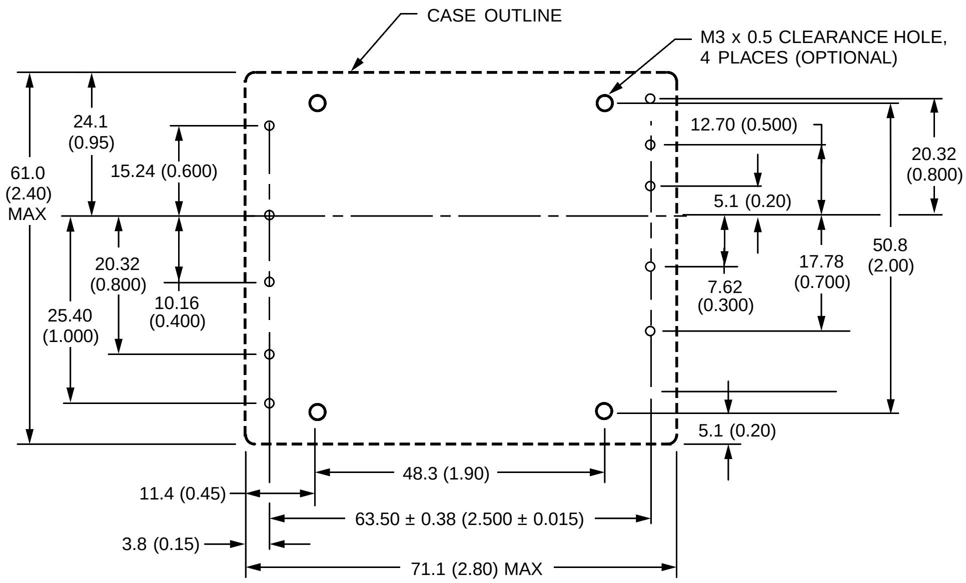


8-1177(C).c

Recommended Hole Pattern

Component-side footprint.

Dimensions are in millimeters and (inches).



8-1177(C).d

Ordering Information

Table 4. Device Codes

Input Voltage	Output Voltage	Output Power	Device Code	Comcode
48 V	3.3 V	19.8 W	LW030F81	108058702
48 V	5 V	30 W	LW030A	107314296

Optional features may be ordered using the device code suffixes shown below. To order more than one option, list suffixes in numerically descending order. Please contact your Tyco Electronics' Account Manager or Field Application Engineer for pricing and availability.

Table 5. Device Options

Option	Device Code Suffix
Short Pins: 2.79 mm ± 0.25 mm (0.110 in. ± 0.010 in.)	8
Case Ground Pin	7
Short Pins: 3.68 mm ± 0.25 mm (0.145 in. ± 0.010 in.)	6
Synchronization	3
Negative Logic Remote On/Off	1

Ordering Information (continued)

Table 6. Device Accessories

Accessory	Comcode
1/4 in. transverse kit (heat sink, thermal pad, and screws)	407244763
1/4 in. longitudinal kit (heat sink, thermal pad, and screws)	407244771
1/2 in. transverse kit (heat sink, thermal pad, and screws)	407244789
1/2 in. longitudinal kit (heat sink, thermal pad, and screws)	407244797
1 in. transverse kit (heat sink, thermal pad, and screws)	407244805
1 in. longitudinal kit (heat sink, thermal pad, and screws)	407244813
1 1/2 in. transverse kit (heat sink, thermal pad, and screws)	407244821
1 1/2 in. longitudinal kit (heat sink, thermal pad, and screws)	407244839

Note: Dimensions are in millimeters and (inches).

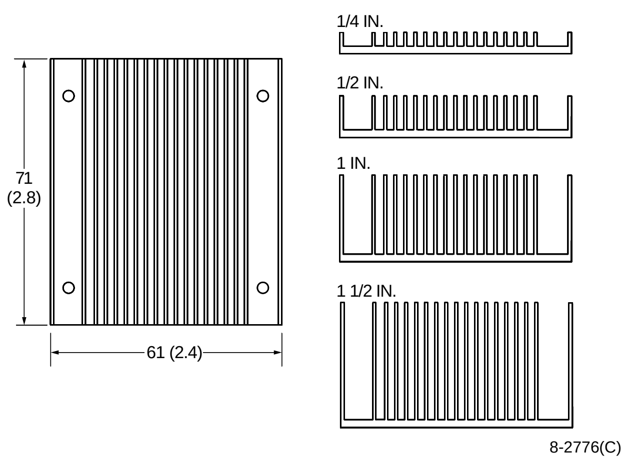


Figure 22. Longitudinal Heat Sink

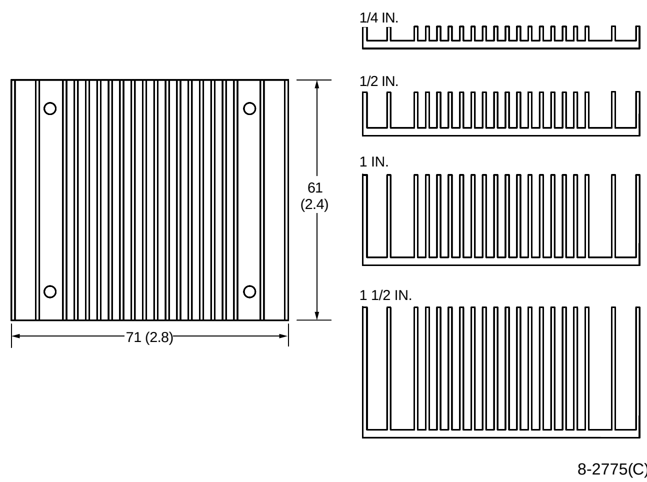


Figure 23. Transverse Heat Sink

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