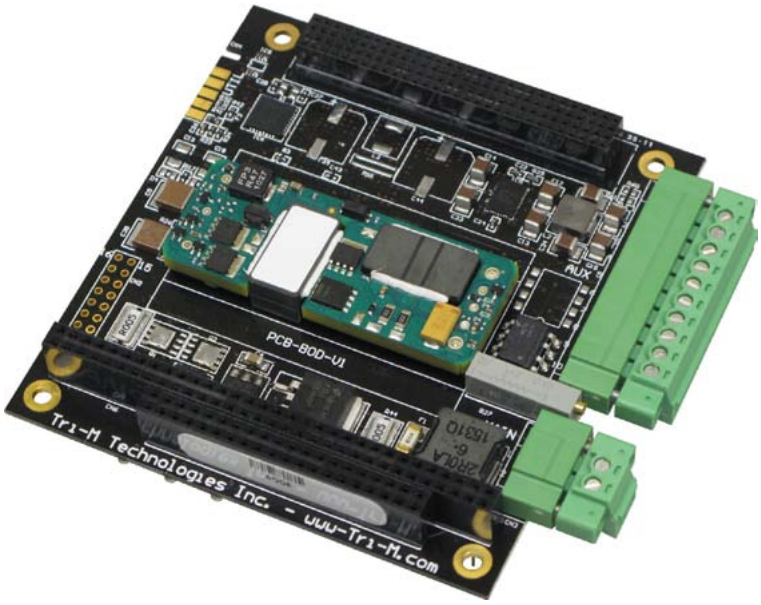
TPSi1075
User Guide



Isolated 75 Watt Power Solution

Rev 10/11a

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Important Notes

This manual is intended for integrators of embedded system applications. It contains detailed information on hardware and software requirements to interconnect to other embedded devices. Carefully read this user guide before you begin installation.

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Tri-M Technologies Inc. specializes in embedded computing for rugged environments. Tri-M's innovative solutions are the premiere choice for off-highway vehicles, industrial controls, robotics, military equipment, aerospace technologies, undersea and advanced security products. We offer a wide range of DC-to-DC converters, CPU boards, hardened enclosures, I/O modules, wireless communication devices, and customized systems. With over 28 years of industry experience, Tri-M is your embedded systems specialist.

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Overview

Tri-M's TPSi1075 is an isolated PC/104-*Plus* power solution offering 2250V input/output isolation, 6000W transient protection, active input voltage clamping, wide input ranges of +9V to +33V DC, and maximum power efficiency 88%. This rugged design operates in an extended temperature range from -40°C to +85°C (-40°F to +185°F), and features quick-disconnect terminal socket plugs for simple installation.

Galvanically isolated and short circuit protected, the TPSi1075 offers two standard outputs of +3.3V @ 8A max. and +5V @15A max. with total combined power of 75W. This isolated power solution also provides remote shutdown functionality, power failure signaling and three dual colour LED status indicators. For PC/104-Plus connectivity, there are 8bit, 16bit, and PCI headers with passthrough/non-passthrough bus and non-bus versions available.

For applications requiring a clean isolated power, the TPSi1075 is the perfect solution. This high density and small form factor optimizes SWaP (size, weight, and performance) requirements and is ideal for aerospace, transportation, military, and industrial applications. To learn more and take advantage of this rugged and innovative design, please contact us at +1.604.945.9565 or visit us at http://www.tri-m.com/products/trim/tpsi1075.html.

Key Features & Benefits

- High voltage isolation (2250V) with active input voltage clamping and transient suppression for enhanced system protection in any harsh environment
- Wide input range of +9V to +33V DC with reverse polarity protection for worry-free installation
- High efficiency maximum 88% for optimized power performance
- Quick-disconnect terminal socket plugs for ease of installation
- Extended operating temperature to perform in even the most extreme environments

Optional Items

Tri-M offers the following options. For more information please visit us www.tri-m.com or call +1.604.945.9565.

- **Conformal Coating**
  Ruggedized protection for temperature, fungal resistance, and humidity and chemical elements
- **Design Build (Non-Stack through/Stack through and/or no bus)**
  Can be built with and without PCI and ISA non-stack throughs, and/or bus configurations

Specifications

Electrical Specifications

Input Voltage Range	+9V to +33V DC
+3.3V Output	8A Max.
+5V Output	15A Max.
Maximum Combined Power	75W Total*
Efficiency	Maximum 88%*
Isolation Voltage	2250V Max.
Transient Suppression	6000W Total
Output Ripple/Noise (5V Output)	80mVp-p to 125mVp-p
Line Regulation (5V Output)	±0.25% Max.
Load Regulation (5V Output)	±0.125% Max.
Switching Frequency (5V Output)	215kHz to 250kHz
Current Limiting Fuse (Onboard)	15A
Quiescent Current (LED's & Outputs Off)	48mA

Environment Specifications

Operating Temperature (with derating)	-40°C to +85°C (-40°F to +185°F)
Thermal Protection/Shutdown	+120°C (248°F)

Mechanical

Dimensions	PC/104 compliant, 90mm x 96mm x 15mm (3.55" x 3.775" x 0.6")
Weight	83g (3oz) no plugs / 90g (3.2oz) with plugs

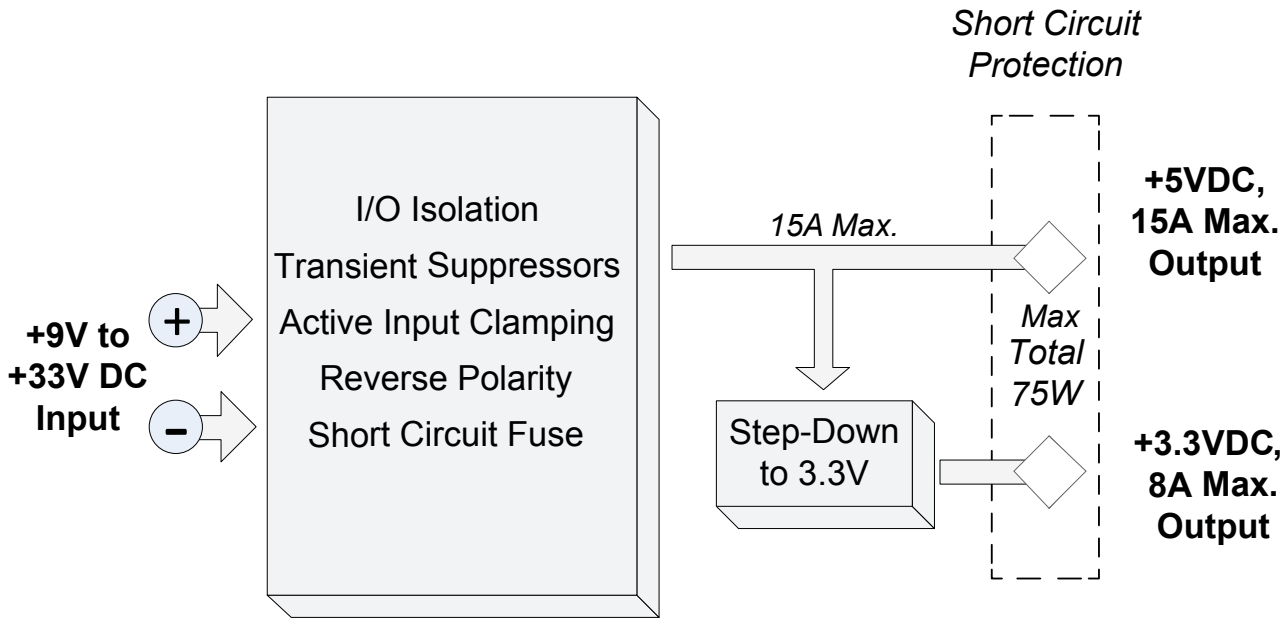
Certifications

RoHS compliant

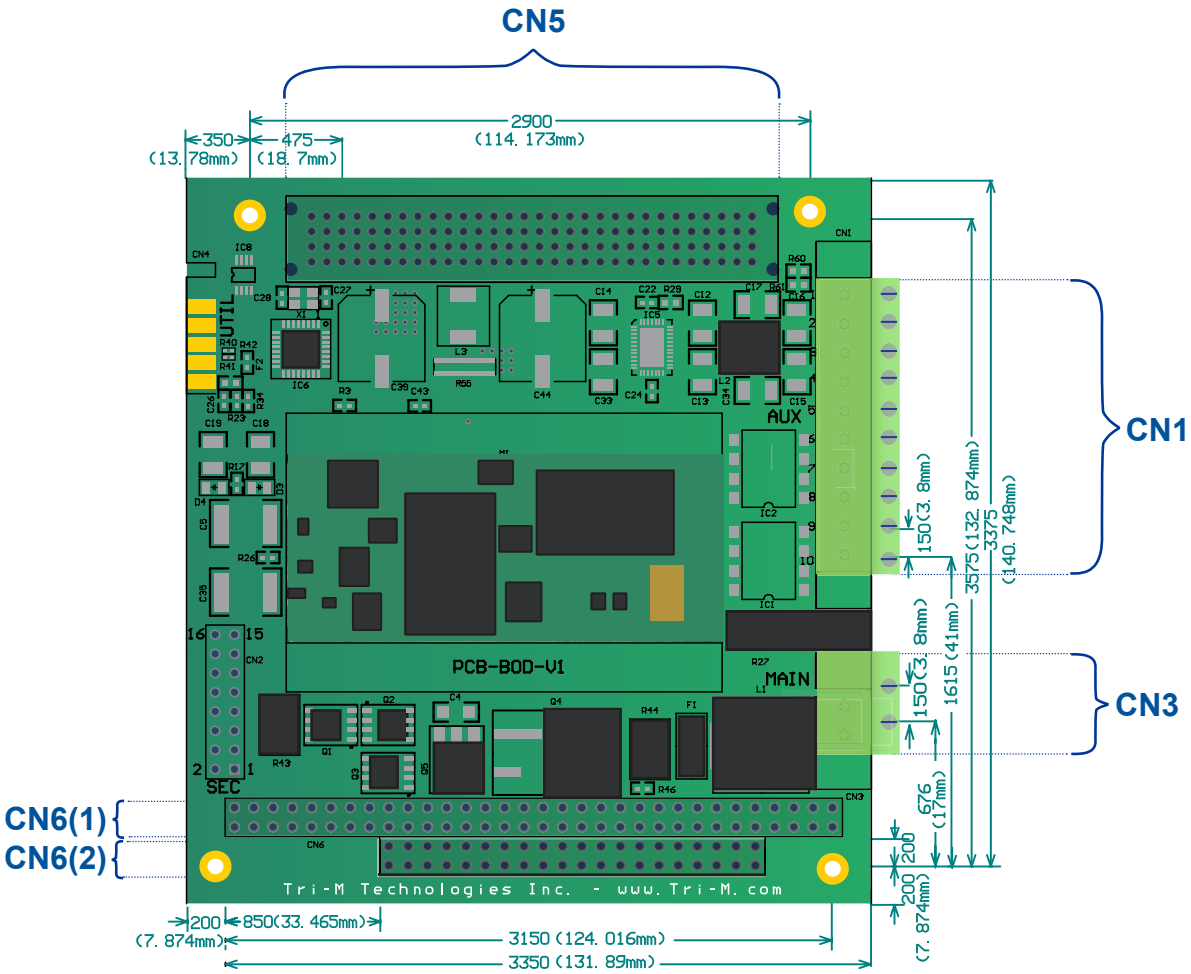
Manufactured in **ISO 9001:2008**, **ISO 14001:2004** & **ANSI/ESD S20.20** Environments

* Maximum power may be derated due to temperature which effects the efficiency. Please see the Technical Notes section for more on efficiency and temperature derating.

Block Diagram



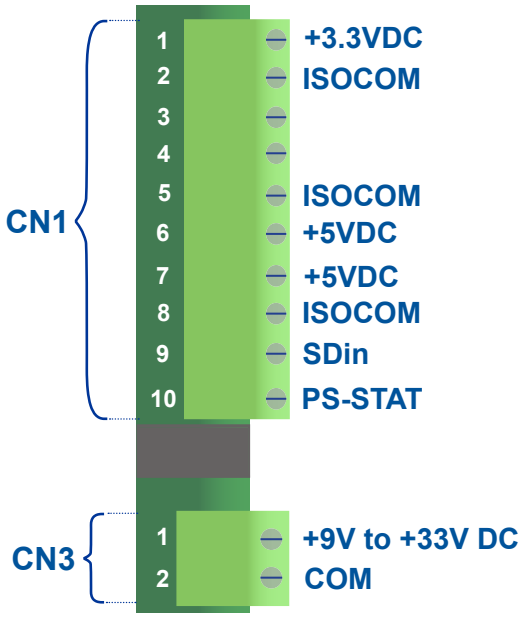
Dimensions



Label	Description	Mechanical Specifications
CN1	Isolated Outputs (+3.3V and +5V DC), Power Status (PS-STAT) signal, and Shutdown (SDin) input	10 position socket, 3.81mm, Phoenix 1803358 mates with screw terminal block Phoenix 1827787
CN3	Main Input Power, +9V to +33V DC	2 position socket, 5.08mm, Phoenix 1879285 mates with screw terminal block Phoenix 1827703
CN5	PC/104-*Plus* PCI Connector	4x40 press-fit header
CN6(1)	PC/104 8-bit Bus PC104 Connector	2x32 press-fit header
CN6(2)	PC/104,16-bit ISA PC104 Connector	2x20 press-fit header

Connectors

There are two main connectors on the TPSi1075, CN1 and CN3. They provide terminal socket connections for the input and output voltages, and signals. The following sections describe the mechanical and pinout specifications.



Outputs & Signals (CN1)	
Pin	**Signal**
CN1-1	+3.3VDC
CN1-2	ISOCOM
CN1-3	(Future Use)
CN1-4	(Future Use)
CN1-5	ISOCOM
CN1-6	+5VDC
CN1-7	+5VDC
CN1-8	ISOCOM
CN1-9	SDin
CN1-10	PS-STAT

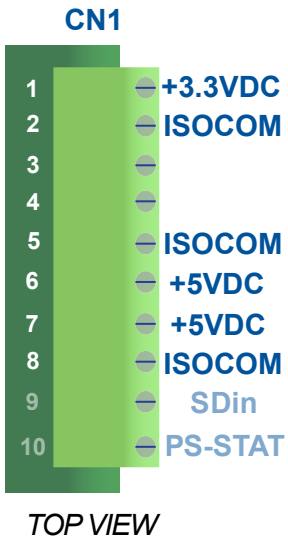
Input Power (CN3)	
Pin	**Signal**
CN3-1	+9V to +33V DC
CN3-2	COM (Non-Isolated)

Note

ISOCOM (CN1-2, CN1-5, & CN1-8) refers to the isolated output commons. CN1-9 (SDin) and CN1-10 (PS-STAT) are referenced to COM (CN3-2), the non-isolated input common.

OUTPUTS (CN1)

CN1 contains the output connectors. Note that CN1-3 and CN1-4 are for future use. The galvanically isolated outputs offer +3.3VDC @ 8A maximum and +5VDC @ 15A maximum. The combined total power for both outputs is 75W. Please see the Technical Notes section for more information. The quick-disconnect screw terminal blocks are intended for 28 to 16 AWG wires.

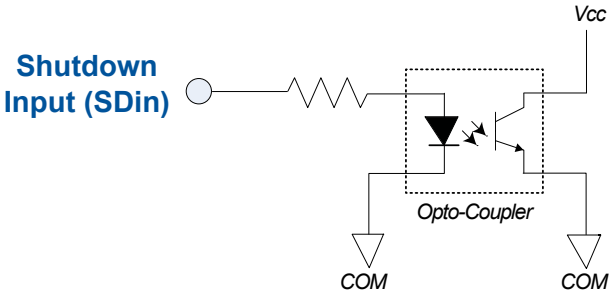


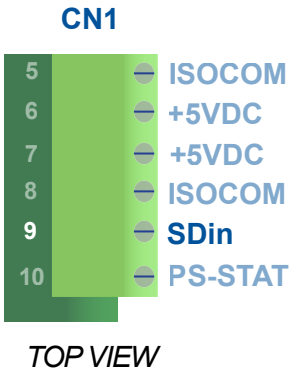
Note
The terminal socket is Phoenix 1803358 which mates with screw terminal block plugs, Phoenix 1827787

CAUTION
There is an additional +5VDC and ISOCOM connector to adequately distribute the current if a heavy load requires more than 8A (max. rating of terminal block)

SHUTDOWN INPUT (CN1-9)

The Shutdown (SDin) input is an active high opto-coupled input which remotely controls the output on/off operation. It acts like an ignition input for vehicle applications. The input range is +9V to +33V DC. The quick-disconnect screw terminal block is intended for 28 to 16 AWG wires.



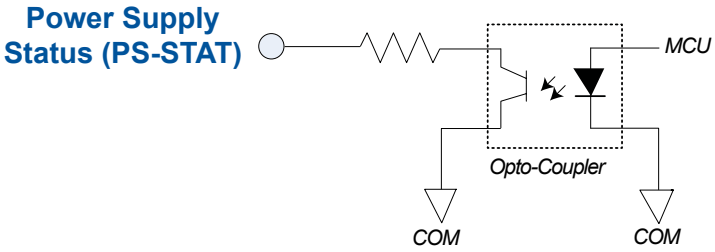


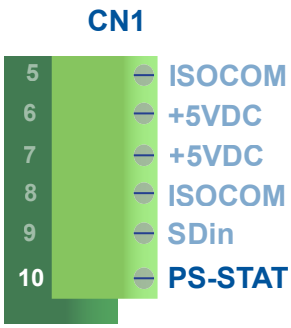
Note
SDin (CN1-9) is referenced to the input COM (CN3-2)

CAUTION
If the remote shutdown control is not used, SDin (CN1-9) MUST be connected to the input power (CN3-1)

POWER SUPPLY STATUS (CN1-10)

The Power Supply Status (PS-STAT) output sends an active low signal when the input voltage is outside of the range, +9V to +33V DC, and when the outputs are turned off. Once the input voltage returns within the range and the power outputs turn on, the PS-STAT signal will turn off. The quick-disconnect screw terminal block is intended for 28 to 16 AWG wires.



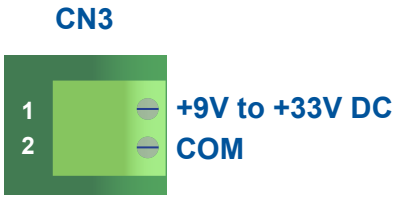


TOP VIEW

Note
PS-STAT (CN1-10) is referenced to the input COM (CN3-2)

INPUT POWER (CN3)

CN3 is the input power connector. The input range is +9V to +33V DC. For enhanced protection, the TPSi1075 provides active input clamping, transient suppressors, current limiting, and reverse polarity protection. See the Protection Features section for more information. The quick-disconnect screw terminal block is intended for 28 to 16 AWG wires.



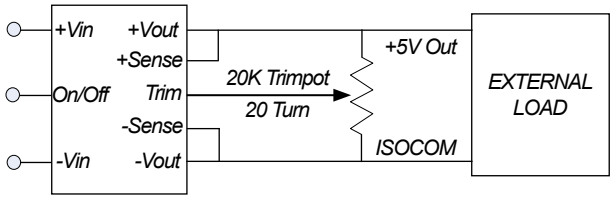
TOP VIEW

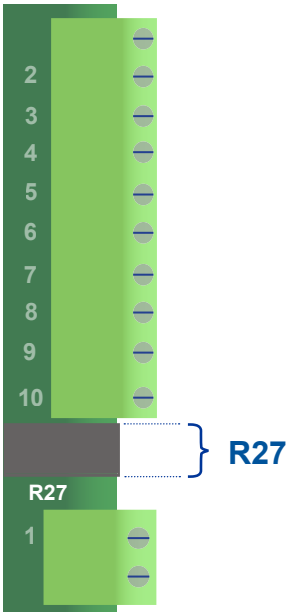
Note
The terminal socket is Phoenix 1879285 which mates with screw terminal block plugs, Phoenix 1827703

CAUTION
Although the TPSi1075 has reverse polarity protection, please ensure that the polarities are correct in order to avoid damaging the input power supply. Supply must be correctly fused.

5V Adjustment (R27)

In-between CN1 and CN3 is R27, the 5V adjustment. It is a 20K 20 turn trimpot with an adjustment range of -10% to +10% of V_{nom}. It is factory set for optimal system performance.





CAUTION

Although the TPSi1075 has a 20K trimpot, it is factory set and adjusting it may cause damage to the connected equipment

Status LED's

There are three dual red/green status LED's located on the bottom side of the board. They provide signal activity for the power failure, micro-controller (MCU) heartbeat, and output power status.

BOTTOM VIEW

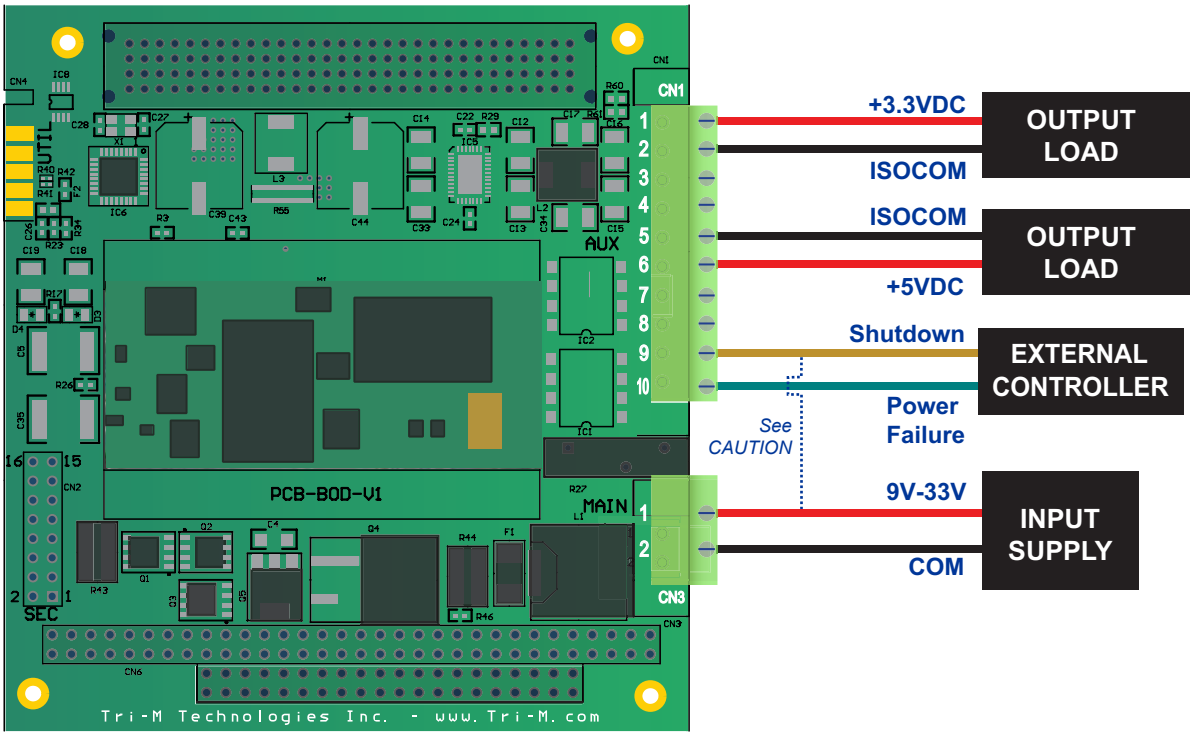
LED SIGNAL	COLOUR	DESCRIPTION
LED1 - Output Status		Outputs are ON
		Outputs are OFF, but should be ON
	OFF	Outputs are OFF, and should be OFF
LED2 - MCU Heartbeat		MCU is operating, blinking every second (1 Hz)
	OFF	Power is OFF
LED3 - Power Failure		Input Voltage is within range (+9V to +33V DC)
		Input Voltage is out of range

Installation

The TPSi1075 features quick-disconnect socket terminals for easy installation. The screw terminal plugs for CN1 and CN3 accept 28 to 16 AWG wires.

Connection Diagram

The power outputs are isolated from the input supply up to 2250V.



CAUTION

If the remote shutdown control is not used, SDin (CN1-9) MUST be connected to the input power (CN3-1)

CAUTION

There is an additional +5VDC and ISOCOM connector to adequately distribute the current if a heavy load requires more than 8A (max. rating of terminal block)

Note

ISOCOM (CN1-2, CN1-5, & CN1-8) refers to the isolated output commons. CN1-9 (SDin) and CN1-10 (PS-STAT) are referenced to COM (CN3-2), the non-isolated input common

Technical Notes

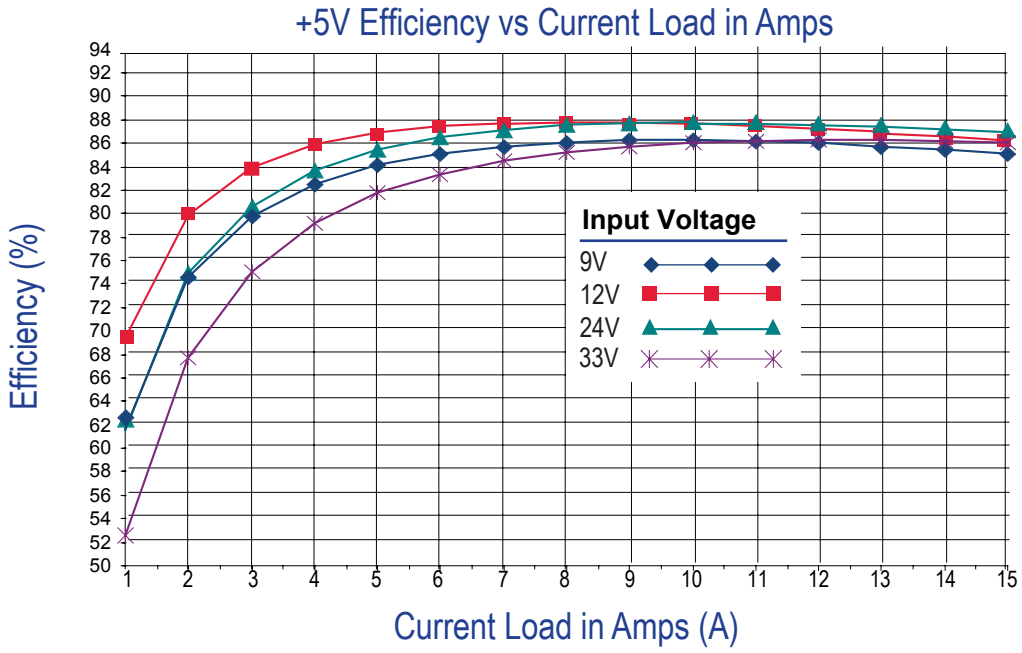
The TPSi1075 is designed to operate in rugged environments. The following sections describe the efficiency and temperature derating values, given the current output, input voltage, and ambient temperature.

Efficiency

The approximate efficiency for the +3.3V output is 94% and the +5V output is 88%. The tables below specify the measured values. The detailed graph illustrates the +5V output efficiency.

+3.3V Output Efficiency					
Input	**Current**	**3.3V Output**	**3.3V Current**	**Ripple**	**Efficiency**
5V	1.13A	3.33V	1.59A	<20mV	94%
5V	2.22A	3.31V	3.09A	<20mV	92%
5V	4.27A	3.29V	5.71A	<20mV	88%
5V	5.48A	3.27V	7.12A	<20mV	85%

+5V Output Efficiency					
Input	**Current**	**5V Output**	**5V Current**	**Ripple**	**Efficiency**
12V	4.03A	5.05V	8.43A	60mV	88%
17V	2.84A	5.05V	8.42A	100mV	88%
23V	2.13A	5.05V	8.43A	140mV	87%
30V	1.65A	5.05V	8.42A	170mV	86%



Note

The graph represents efficiency at 25°C. See the Temperature Derating section for more information

Power Considerations

The maximum current for the +5V output is 15A. The maximum current for the +3.3V output is 8A. To calculate the usable current given a specific load, use the following formula:

$$\text{Usable Current}_{3.3V} = [\text{Output Current}_{MAX} - \text{Current}_{5V}] \bullet [(\text{Efficiency}_{3.3V})(\text{Power Conversion}_{5V/3.3V})]$$

For instance, given 10A on the 5V output, operating at 25°C (77°F) with 0.9 efficiency on the 3.3V output, the usable current for the 3.3V operation is as follows:

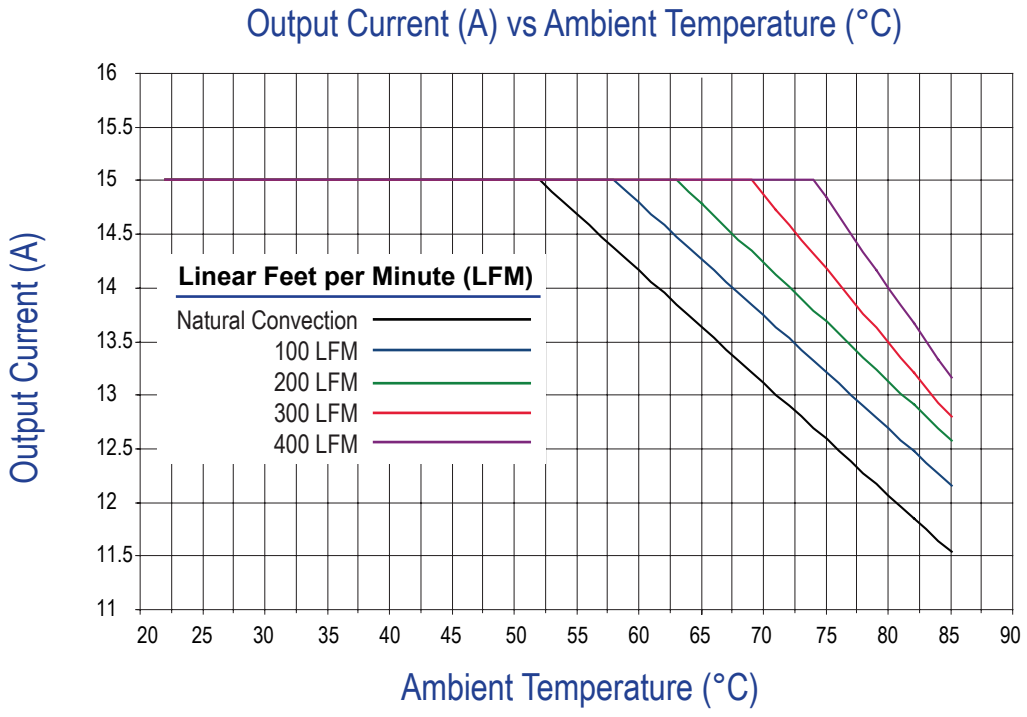
$$\text{Usable Current}_{3.3V} = (15 - 10) \bullet [(0.9)(1.5)]$$

$$\text{Usable Current}_{3.3V} = 6.75A$$

Temperature Deration (52°C to 85°C)

The TPSi1075 operates at an extended temperature, up to 85°C (185°F). If the ambient temperature rises above 52°C (126°F), the TPSi1075 will experience temperature derating. To calculate the maximum output current when the ambient temperature is within 52°C and 85°, simply locate the ambient temperature and intersect of the appropriate slope using the graph below.

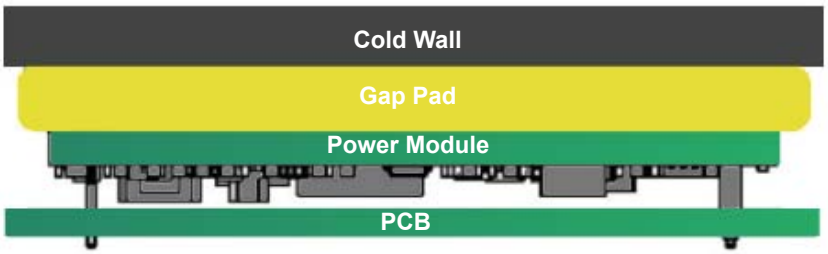
For instance, at 75°C the maximum 5V current with natural convection is 12.6A. This value would then be used for the Output Current$_{MAX}$ in the above formula.



Note
Calculations were measured with a 12V input with transverse airflow

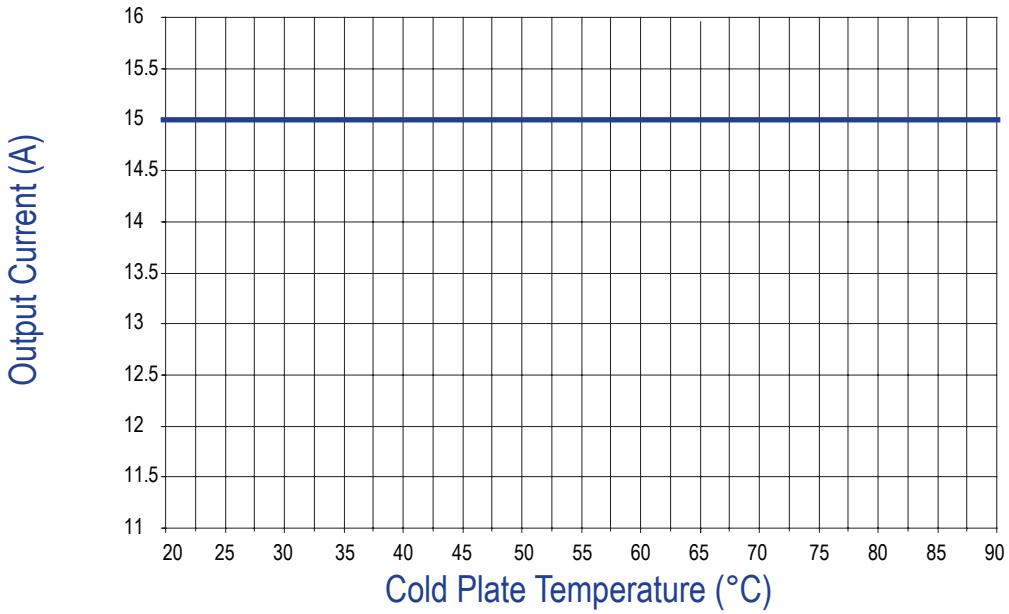
Cold Wall Conduction

To increase the performance of the TPSi1075 and minimize temperature deration, a sealed cold wall and gap pad can be applied to the top surface of the power module. This significantly optimizes the TPSi1075's performance when experiencing extreme temperatures as seen by the graph below. For more information on how to implement this effective cooling solution, please contact our Professional Services Team at +1.604.945.9565 or visit http://www.tri-m.com/support/proservices.html.



TPSi1075 Side View with Cold Wall Mounting

Output Current (A) vs Cold Plate Temperature (°C)
with Cold Wall Mounting



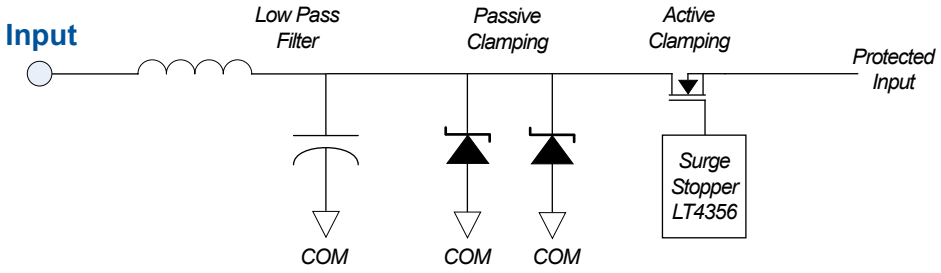
Note
Calculations are estimates with a 12V input and transverse airflow

Protection Features

The TPSi1075 has a number of enhanced protection features, such as three stage transient protection, galvanic isolation, thermal shutdown, and short circuit prevention.

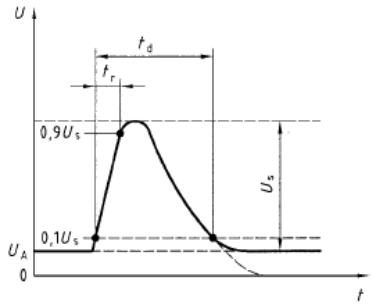
Three Stage Transient Protection

The TPSi1075 is designed to meet ISO ISO7637-2:2011 pulse 5 load dump standards, which specifies the electrical transient protection of equipment installed on passenger cars and commercial vehicles fitted with 12V or 24V electrical systems. The TPSi1075 offers a three stage transient protection process: low-pass filtering, passive clamping, and active clamping.



The first stage is a waveform modification which employs a low pass filter. This elimates unwanted high frequencies from entering the system. The second stage incorporates two high power 3000W transorbs in parallel, rated at 36V. This provides passive clamping by diverting high power spikes to the common ground (COM). The final transient protection stage involves active clamping with a voltage surge stopper (LT4356). This regulates the output to a maximum of 33V during a transient event. By controlling the gate of a clamping N-channel MOSFET (TO263 size, 75V, 120A rated), the output is limited to a safe value thereby allowing the TPSi1075 to continue regulating. By controlling the LT4356 timer, it starts and times inversely proportional to the clamping MOSFET stress. If the timer expires the clamping MOSFET is turned off and the TPSi1075 outputs fail and remain off. After a cool down period, the LT4356 re-enables the clamping MOSFET and operation of the TPSi1075 restarts.

Below is a “typical” load dump transient and detailed pulse 5 waveform as defined by ISO ISO7637-2:2011.



Pulse 5 Waveform

Unsuppressed Load Dump Pulse		
Parameter	**12V System**	**24V System**
U_s	65V to 87V	123V to 174V
R_i	0.5Ω to 4Ω	1Ω to 8Ω
t_d	40ms to 400ms	100ms to 350ms
t_r	$(10^{\ 0}_{-5})$ms	

Galvanic Isolation

The TPSi1075 features galvanic isolation up to 2250V. This insulates high voltages and isolates unwanted high currents between the power solution and the embedded system by providing isolated grounds. This enhances the system protection when servicing and installing the equipment. This is a key advantage since most embedded power solutions only have a common ground.

Thermal Shutdown

In the event that the environmental conditions raise the internal temperature above the extended operating temperature, the TPSi1075 will automatically shutdown until the internal temperature returns to a safe temperature.

Short Circuit

If a short circuit condition exists, the system will shutdown for a specific time-out period until the short-circuit condition is removed. This prevents the internal temperature from rising to excessive levels while maintaining system integrity for an indefinite short circuit output condition.