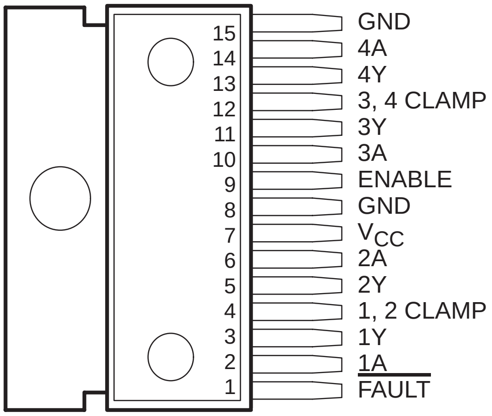
- **1-A Current Capability Per Channel**
- **45-V Inductive Switching Voltage Capability**
- **Current Sink Inputs Compatible With TTL or CMOS Devices**
- **Output Clamp Diodes for Inductive Transient Protection**
- **Independent Thermal Shutdown Protection**
- **Overvoltage Shutdown Protection**
- **Independent Channel Current Limit**
- **Error Sensing**
- **Extended Temperature Range of –40°C to 125°C**

KN PACKAGE
(TOP VIEW)



The tab is electrically connected to the GND pins.

description

The TPIC2404 is a monolithic high-voltage high-current quadruple low-side switch especially designed for driving from low-level logic to peripheral loads such as relays, solenoids, motors, lamps, and other high-voltage high-current loads. The high-efficiency power switch is optimized for applications where a very rugged power switch is required. The device tolerates power supply transients and reverse battery conditions up to 13 V.

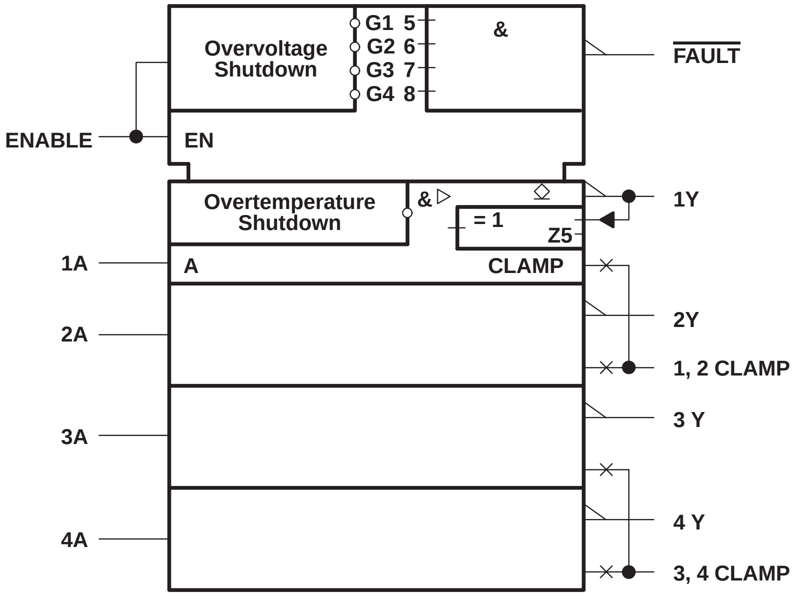
The TPIC2404 features four inverting open-collector outputs controlled by a common-enable input. When ENABLE is low, the outputs are disabled. An error-sensing circuit monitors load and device faults. When an error is sensed, the $\overline{\text{FAULT}}$ output goes to a low state. In addition, the device features on-board V_{CC} overvoltage and thermal overload protection circuits, and the outputs are current limit protected.

FUNCTION TABLE

	INPUTS		OUTPUTS	
	ENABLE	**A**	**Y**	**$\overline{\text{FAULT}}$**
Normal operation	H	H	L	H
	H	L	H	H
	L	X	H	H
Open load	H	L	L	L
	H	H	L	H
Short to GND	H	L	L	L
	H	H	L	H
Overvoltage shutdown	H	H	H	L
	H	L	H	H
Thermal shutdown	H	H	H	L
	H	L	H	H
Short to V_{CC}	H	H	H	L
	H	L	H	H

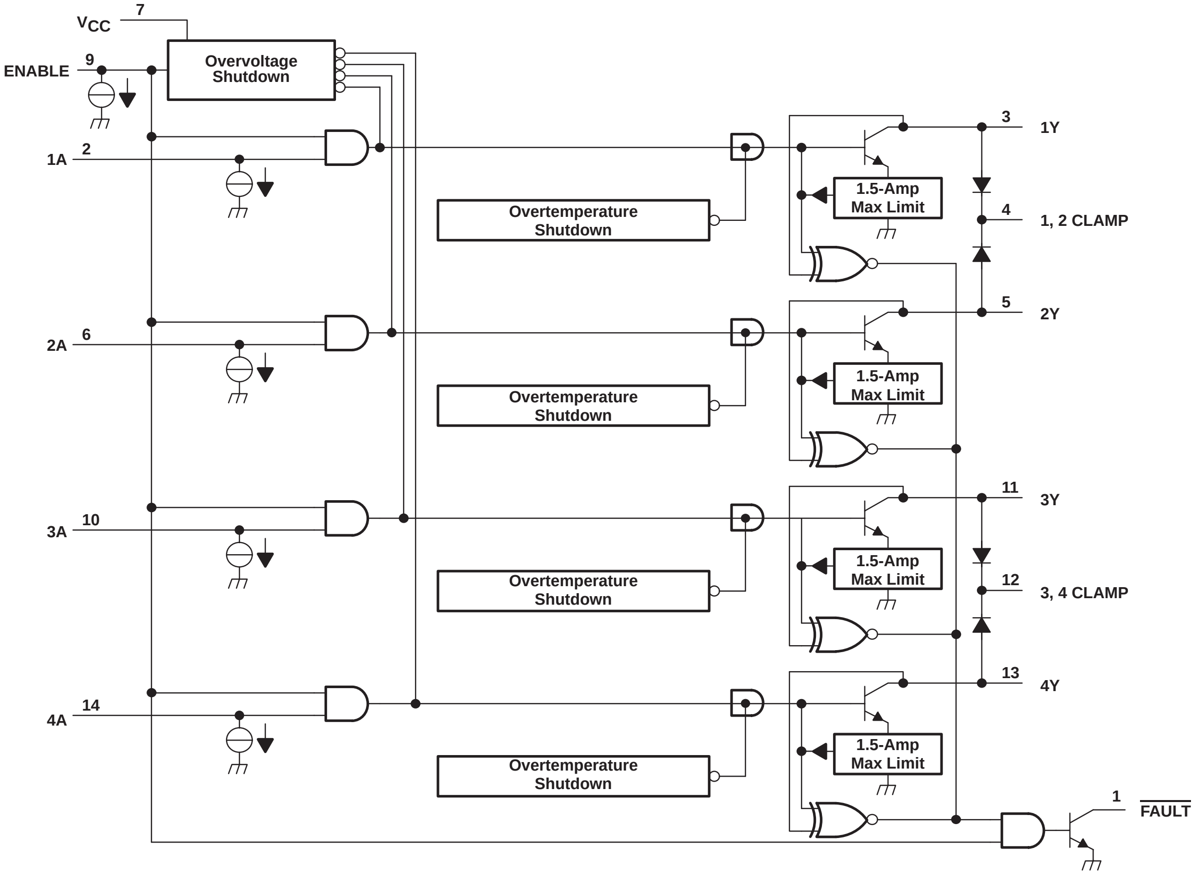
H = high level, L = low level, X = irrelevant

logic symbol†



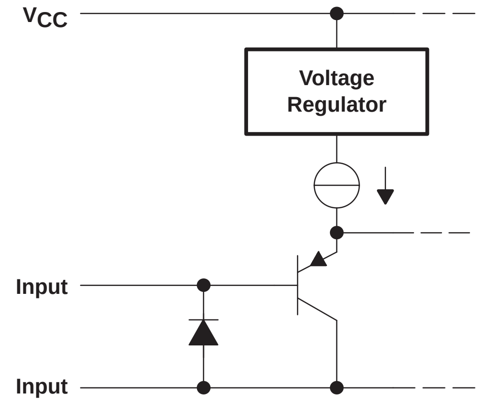
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)

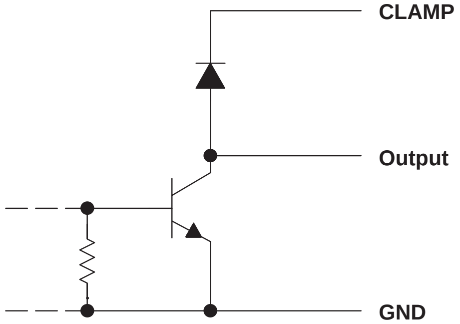


schematics of inputs and outputs

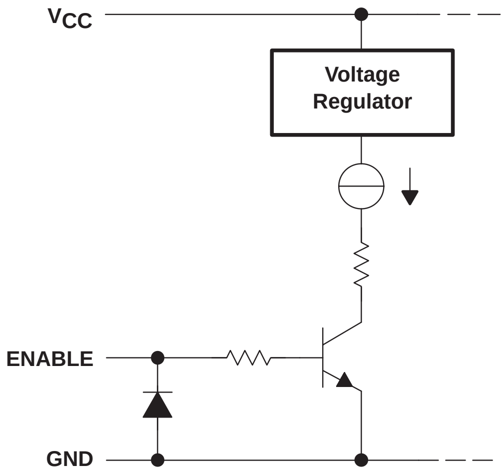
EQUIVALENT OF EACH A INPUT



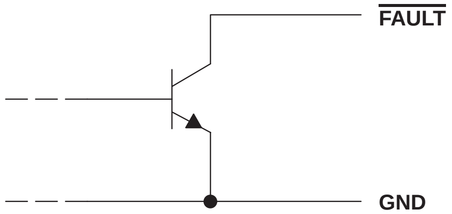
EQUIVALENT OF EACH Y OUTPUT



EQUIVALENT OF ENABLE INPUT



EQUIVALENT OF $\overline{\text{FAULT}}$ OUTPUT



absolute maximum ratings over operating temperature range (unless otherwise noted)

Supply voltage range, V_{CC} (see Note 1)	–13 V to 24 V
Input voltage range, V_I	–0.6 V to 7 V
Output voltage range, V_O (see Note 2)	–0.6 V to 45 V
Output sustaining voltage, $V_{O(sust)}$	45 V
Continuous output sink current (repetitive, t_w < 8 ms), I_{OL} (see Note 3)	1.5 A
Output clamp-diode voltage, V_{OK}	45 V
Continuous total dissipation at (or below) 25°C case temperature (see Note 4)	50 W
Operating case or virtual junction temperature range	–55°C to 150°C
Storage temperature range	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

NOTES: 1. All voltage values are with respect to network GND.
2. For a fault condition to be valid, the output voltage needs to be a minimum of 7 V.
3. Output sink current is limited by the overcurrent limit.
4. For operation above 25°C free-air or case temperature, refer to Figures 1 and 2. To avoid exceeding the design maximum virtual junction temperature, these ratings should not be exceeded. Due to variations in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection can be activated at power levels slightly above or below rated dissipation.

FREE-AIR TEMPERATURE
DISSIPATION DERATING CURVE

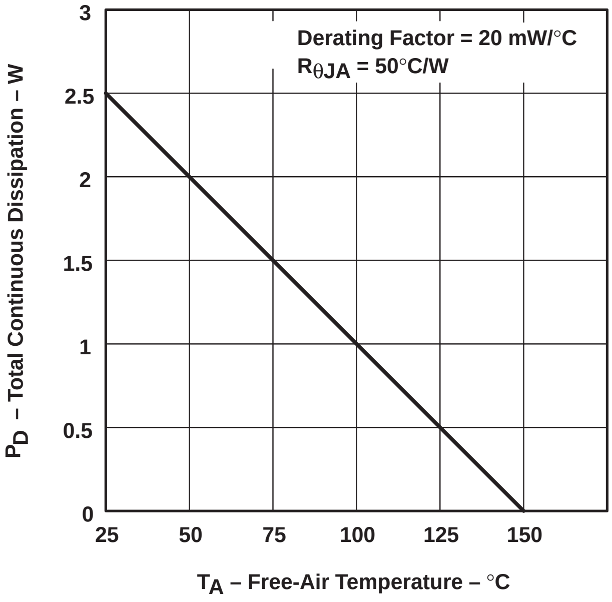


Figure 1

CASE TEMPERATURE
DISSIPATION DERATING CURVE

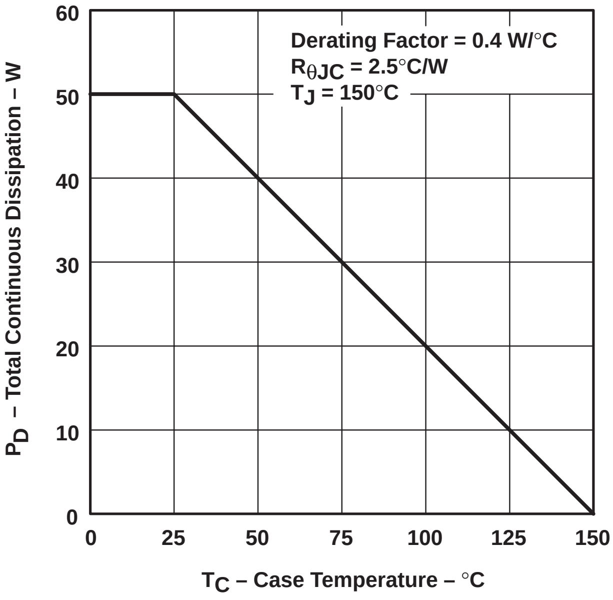


Figure 2

recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}	9	12	16	V
High-level input voltage, V_{IH}	2		5.5	V
Low-level input voltage, V_{IL}	–0.3[†]		0.8	V
Peak output voltage from external inductive kickback			45	V
Continuous output sink current			1	A
$\overline{\text{FAULT}}$ output sink current			75	μA
Operating free-air temperature, T_A	–40		125	°C

[†] The algebraic convention, in which the least positive (most negative) value is designated as minimum, is used in this data sheet for logic voltage levels.

electrical characteristics over recommended ranges of operating free-air temperature and supply voltages (unless otherwise noted)

PARAMETER			TEST CONDITIONS		MIN	TYP[‡]	MAX	UNIT
$I_{O(off)}$	Off-state output current		V_O = 12 V,	ENABLE low		15	100	μA
			V_O = 45 V,	ENABLE high		0.6	2	mA
			V_O = 12 V,	ENABLE high	200	400	600	μA
I_{IL}	Low-level input current		V_I = 0 to 0.8 V		–10	25	40	μA
I_{IH}	High-level input current	A inputs			10	25	60	μA
		ENABLE				0.2	1	mA
V_{OL}	Low-level output voltage		I_{OL} = 100 mA			0.1	0.15	V
			I_{OL} = 500 mA			0.3	0.55	
			I_{OL} = 1 A			0.8	1.3	
			$\overline{\text{FAULT}}$ output,	I_{OL} = 30 μA		0.2	0.4	
I_{OL}	Low-level output current		$\overline{\text{FAULT}}$ output,	V_{OL} = 1 V to 5.5 V	50	90	125	μA
$I_{R(K)}$	Clamp-diode reverse current		V_r = 50 V,	V_O = 0			100	μA
$V_{F(K)}$	Clamp-diode forward voltage		I_f = 1 A				2	V
			I_f = 1.5 A				2.5	
I_{CC}	Supply current		Outputs off,	ENABLE low			0.25	mA
			Outputs on,	T_A = –40°C			120	
			Outputs on,	T_A = 25°C to 125°C			100	

operating characteristics over recommended operating free-air temperature and supply voltages (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP[‡]	MAX	UNIT
High-level output sense voltage threshold				7	V
Low-level output sense voltage threshold		3			V
Overvoltage shutdown		25.5		31	V
Overvoltage shutdown hysteresis			0.25		V
Overcurrent limiting	T_A = –40°C			1.85	A
	T_A = 25°C to 125°C		1.2	1.5	
Thermal shutdown			155		°C
Thermal shutdown hysteresis			15		°C
Turn-on time			8		μs
Turn-off time			8		μs

[‡] All typical values are at V_{CC} = 12 V, T_A = 25°C.

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.

Copyright © 1998, Texas Instruments Incorporated