

TPIC2404 INTELLIGENT-POWER QUAD LOW-SIDE SWITCH

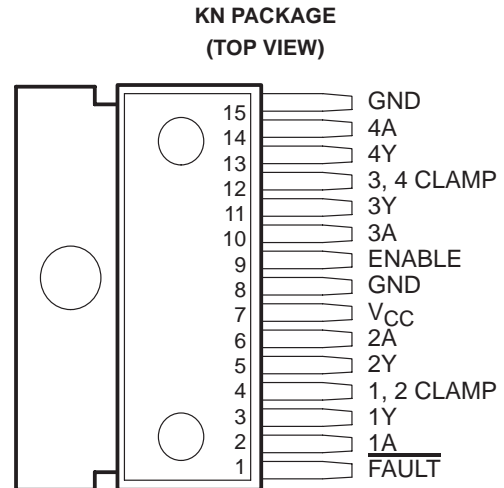
SLIS007A – D3299, AUGUST 1989 – REVISED MAY 1993

- 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

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 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.



The tab is electrically connected to the GND pins.

FUNCTION TABLE

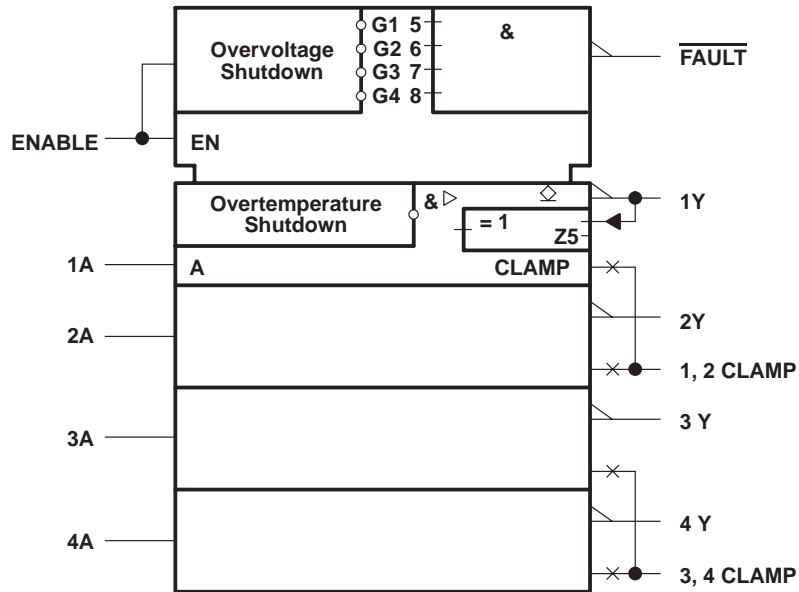
	INPUTS		OUTPUTS	
	ENABLE	A	Y	FAULT
Normal operation	H	H	L	H
	H	L	H	H
	L	X	H	H
Open load	H	L	L	L
	H	H	L	H
Short to GND	H	L	L	L
	H	H	L	H
Overvoltage shutdown	H	H	H	L
	H	L	H	H
Thermal shutdown	H	H	H	L
	H	L	H	H
Short to V_{CC}	H	H	H	L
	H	L	H	H

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

TPIC2404 INTELLIGENT-POWER QUAD LOW-SIDE SWITCH

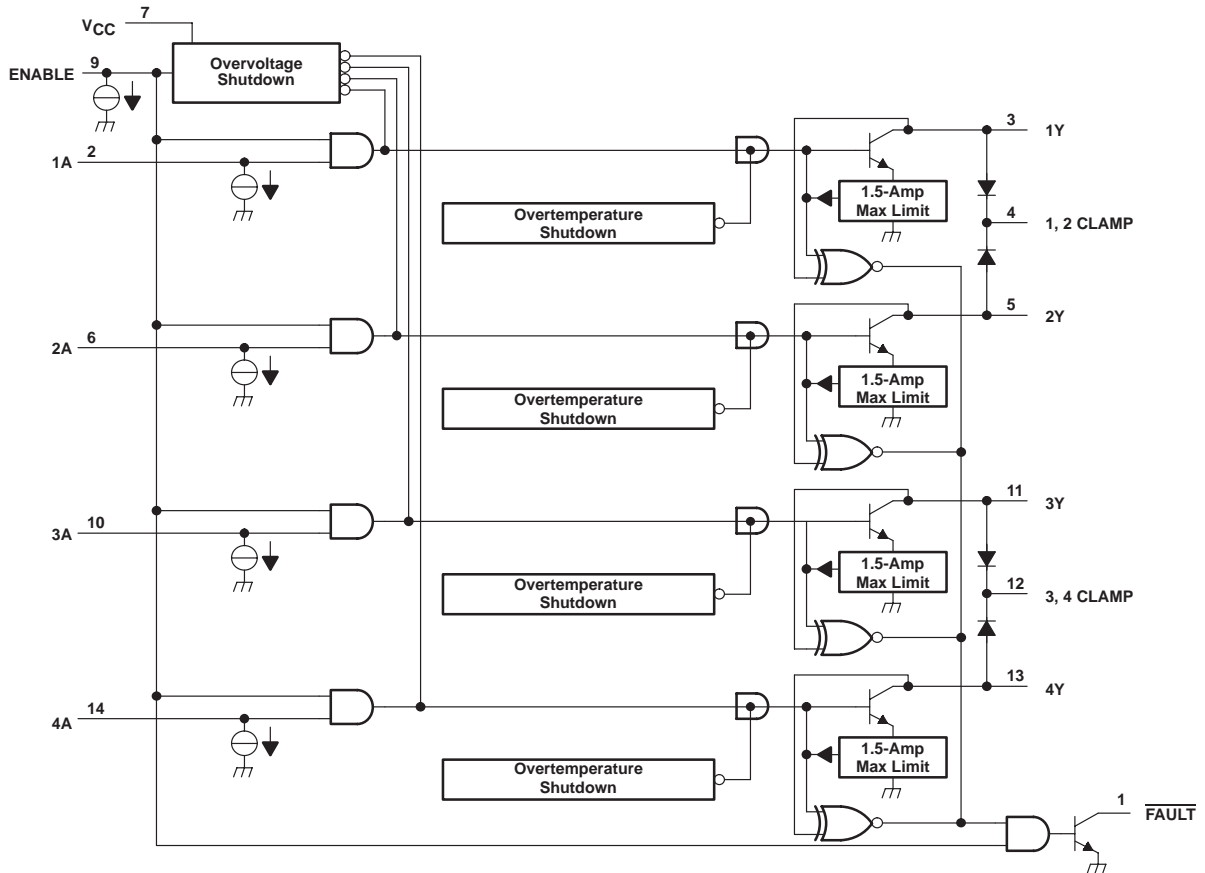
SLIS007A – D3299, AUGUST 1989 – REVISED MAY 1993

logic symbol†

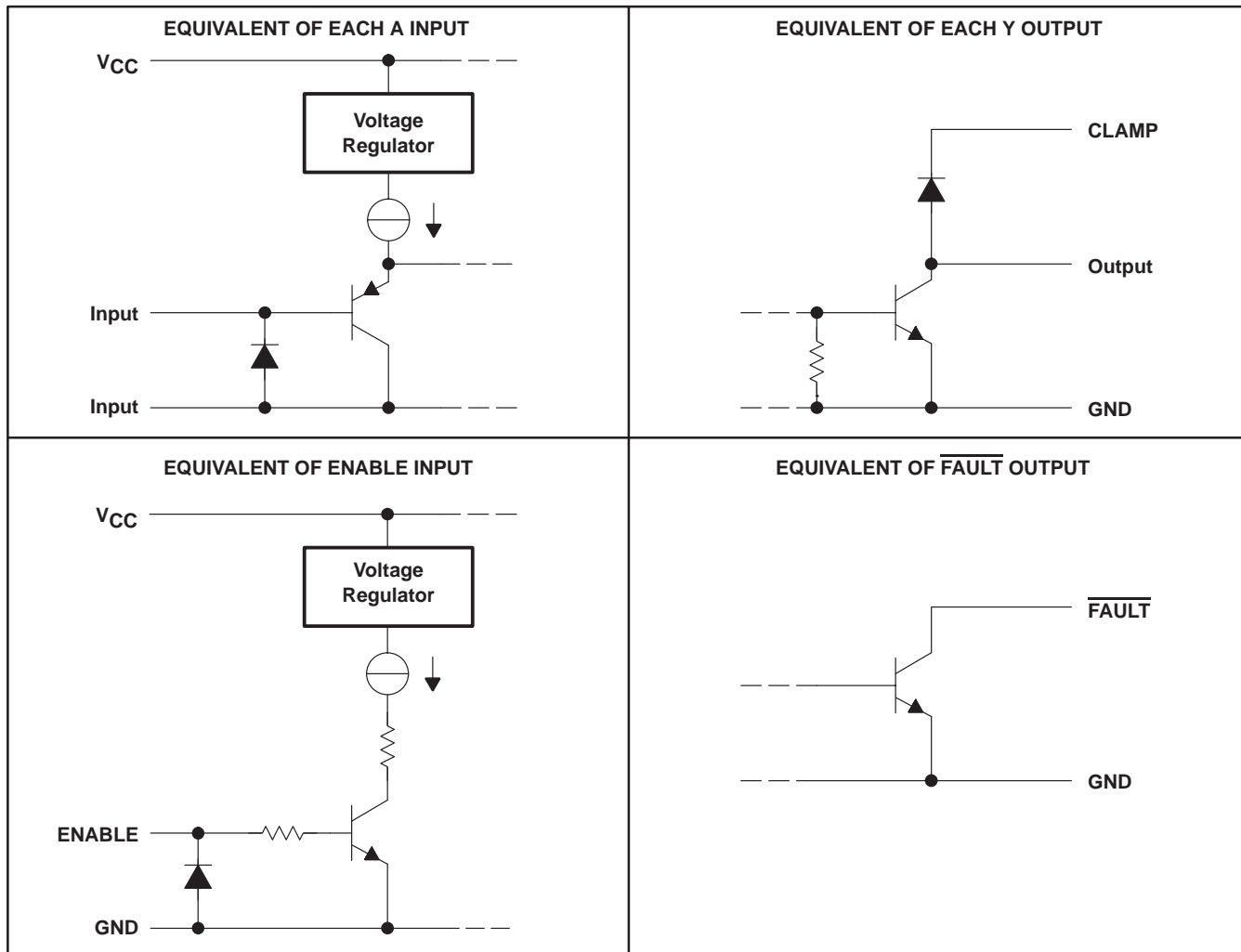


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



schematics of inputs and outputs



TPIC2404 INTELLIGENT-POWER QUAD LOW-SIDE SWITCH

SLIS007A – D3299, AUGUST 1989 – REVISED MAY 1993

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.

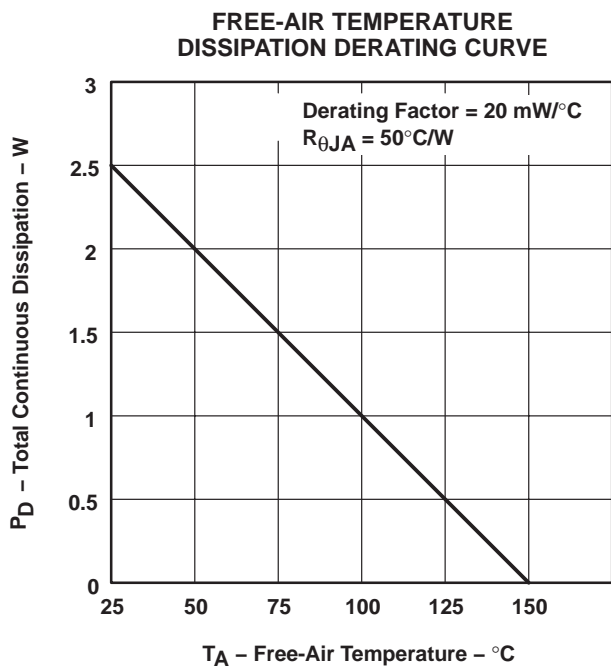


Figure 1

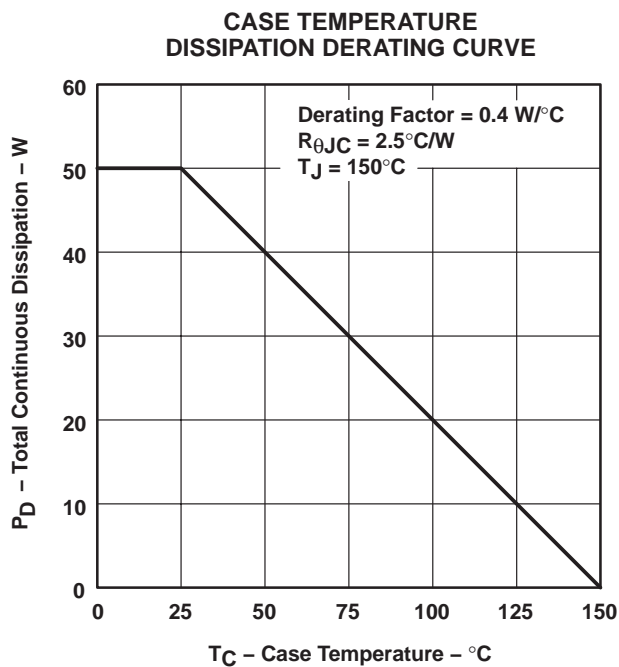


Figure 2

TPIC2404 INTELLIGENT-POWER QUAD LOW-SIDE SWITCH

SLIS007A – D3299, AUGUST 1989 – REVISED MAY 1993

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	$^{\circ}\text{C}$

† 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
$I_{O(\text{off})}$	Off-state output current	$V_O = 12\text{ V}$, ENABLE low		15	100	μA
		$V_O = 45\text{ V}$, ENABLE high		0.6	2	mA
		$V_O = 12\text{ V}$, ENABLE high	200	400	600	μA
I_{IL}	Low-level input current	$V_I = 0\text{ to }0.8\text{ V}$	-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	$I_{OL} = 100\text{ mA}$		0.1	0.15	V
		$I_{OL} = 500\text{ mA}$		0.3	0.55	
		$I_{OL} = 1\text{ A}$		0.8	1.3	
		$\overline{\text{FAULT}}$ output, $I_{OL} = 30\text{ }\mu\text{A}$		0.2	0.4	
I_{OL}	Low-level output current	$\overline{\text{FAULT}}$ output, $V_{OL} = 1\text{ V to }5.5\text{ V}$	50	90	125	μA
$I_{R(K)}$	Clamp-diode reverse current	$V_r = 50\text{ V}$, $V_O = 0$			100	μA
$V_{F(K)}$	Clamp-diode forward voltage	$I_f = 1\text{ A}$			2	V
		$I_f = 1.5\text{ A}$			2.5	
I_{CC}	Supply current	Outputs off, ENABLE low			0.25	mA
		Outputs on, $T_A = -40^{\circ}\text{C}$			120	
		Outputs on, $T_A = 25^{\circ}\text{C to }125^{\circ}\text{C}$			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
Overshoot shutdown		25.5		31	V
Overshoot shutdown hysteresis			0.25		V
Overcurrent limiting	$T_A = -40^{\circ}\text{C}$			1.85	A
	$T_A = 25^{\circ}\text{C to }125^{\circ}\text{C}$		1.2	1.5	
Thermal shutdown			155		$^{\circ}\text{C}$
Thermal shutdown hysteresis			15		$^{\circ}\text{C}$
Turn-on time			8		μs
Turn-off time			8		μs

‡ All typical values are at $V_{CC} = 12\text{ V}$, $T_A = 25^{\circ}\text{C}$.



IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

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

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2008, Texas Instruments Incorporated