

# TPIC2404 INTELLIGENT-POWER QUAD LOW-SIDE SWITCH

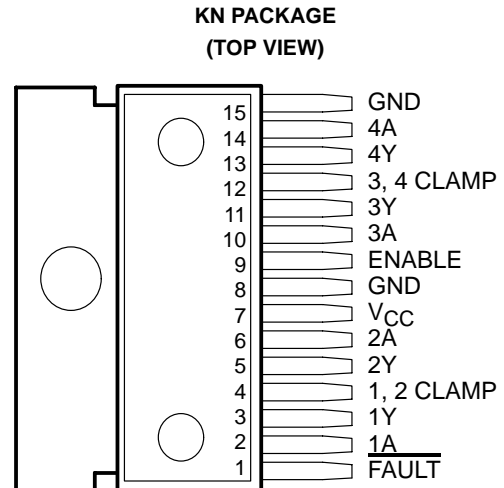
SLIS007A – D3299, AUGUST 1989 – REVISED MAY 1993

- 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  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$

## 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  $\overline{\text{FAULT}}$  output goes to a low state. In addition, the device features on-board  $V_{\text{CC}}$  overvoltage and thermal overload protection circuits, and the outputs are current limit protected.



The tab is electrically connected to the GND pins.

**FUNCTION TABLE**

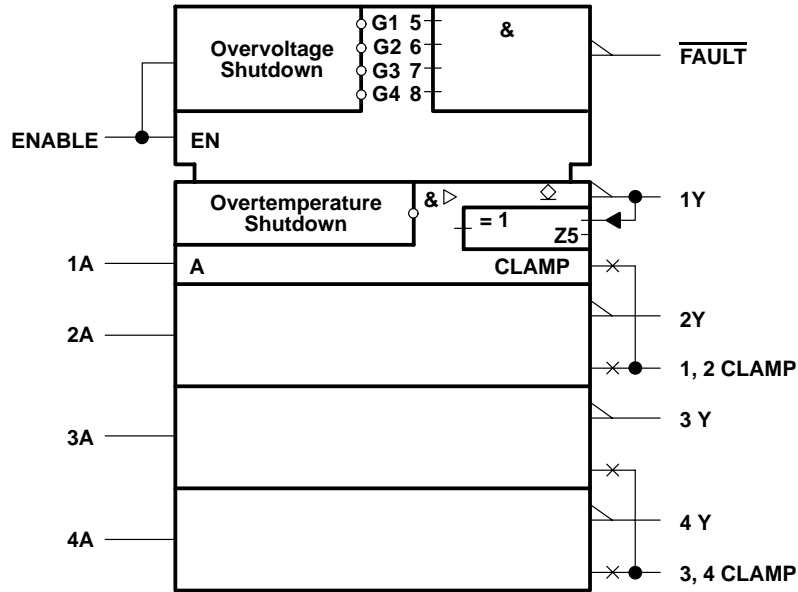
	INPUTS		OUTPUTS	
	ENABLE	A	Y	$\overline{\text{FAULT}}$
Normal operation	H	H	L	H
	H	L	H	H
	L	X	H	H
Open load	H	L	L	L
	H	H	L	H
Short to GND	H	L	L	L
	H	H	L	H
Overvoltage shutdown	H	H	H	L
	H	L	H	H
Thermal shutdown	H	H	H	L
	H	L	H	H
Short to $V_{\text{CC}}$	H	H	H	L
	H	L	H	H

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

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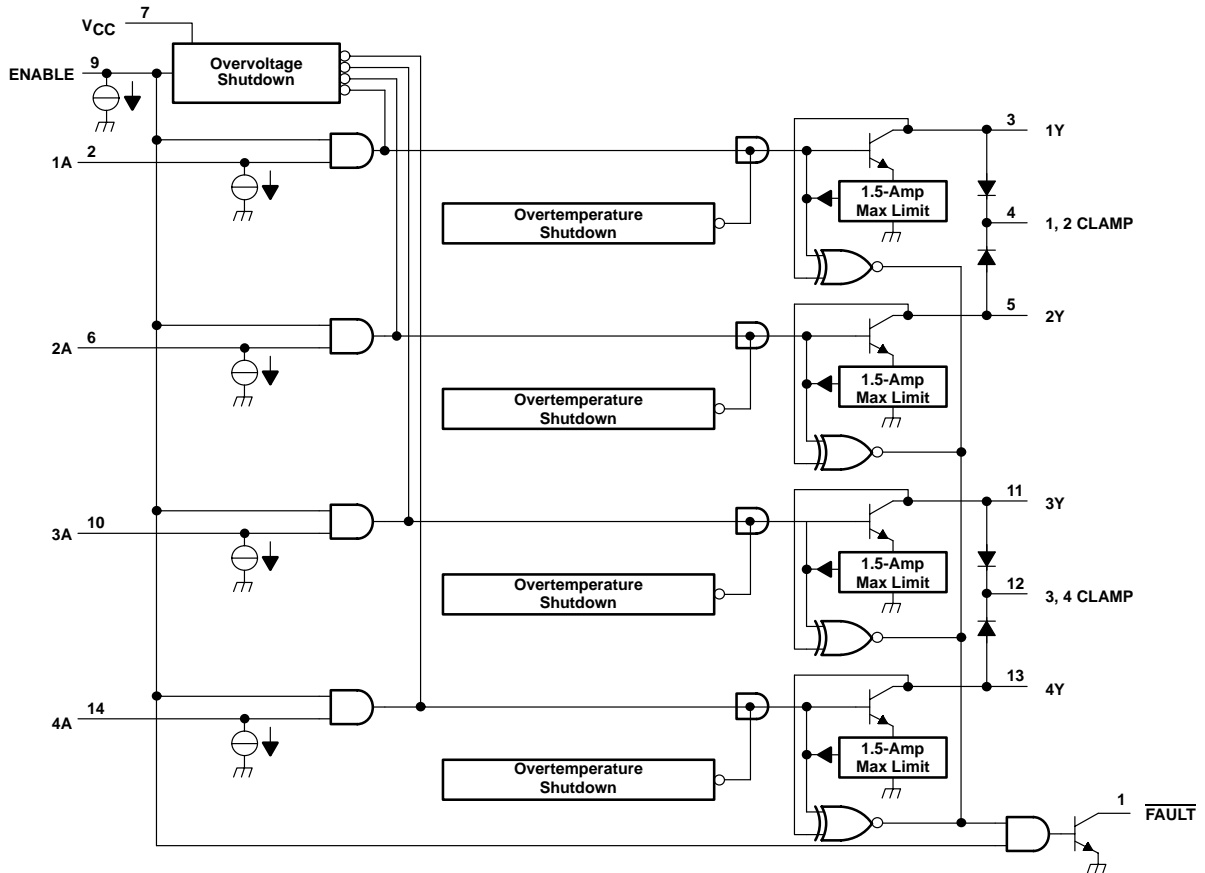
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## logic symbol†

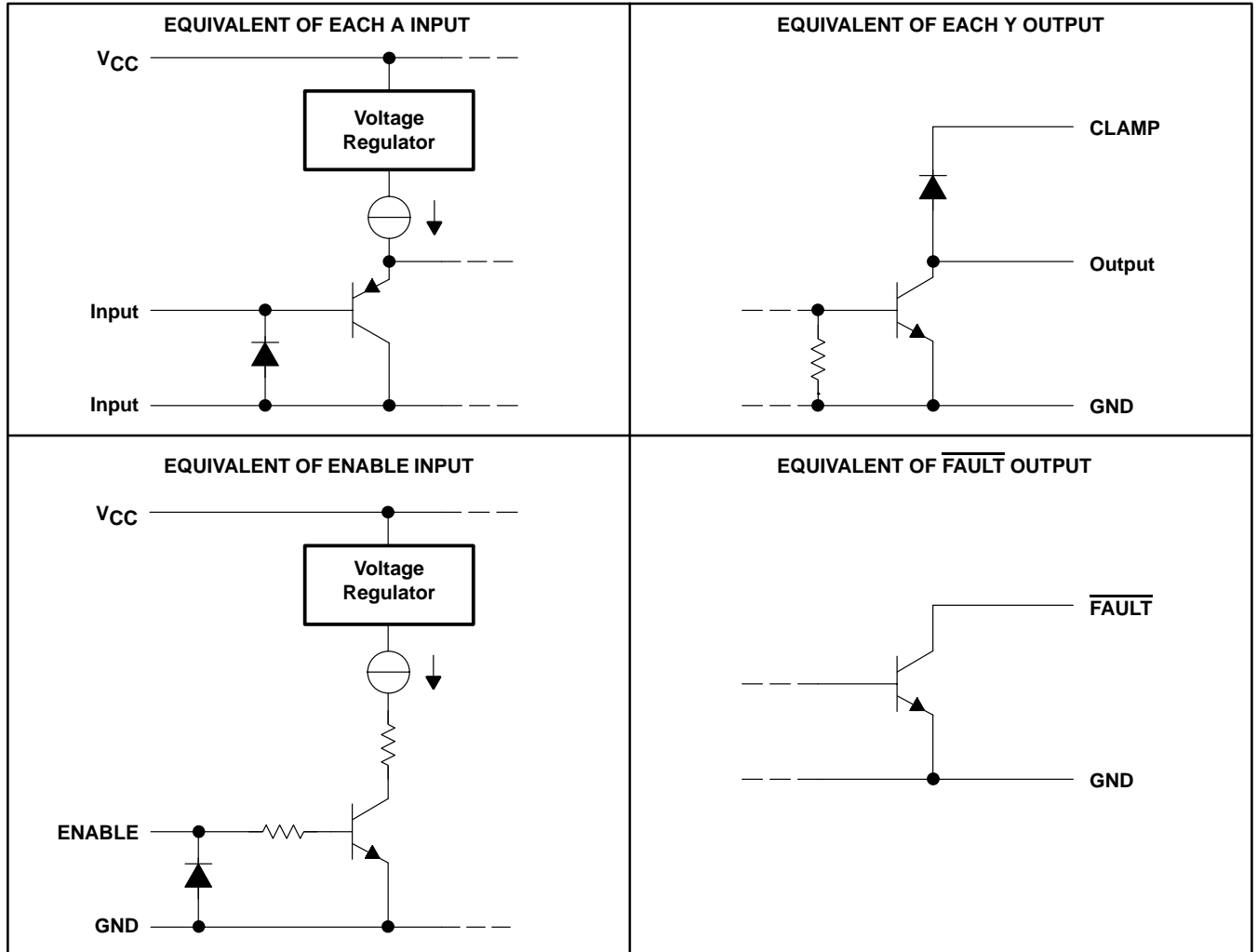


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

## logic diagram (positive logic)



**schematics of inputs and outputs**



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## 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.

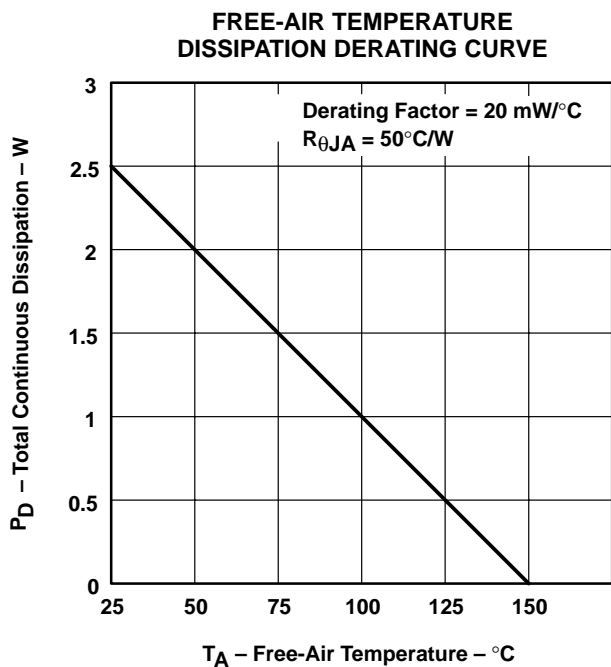


Figure 1

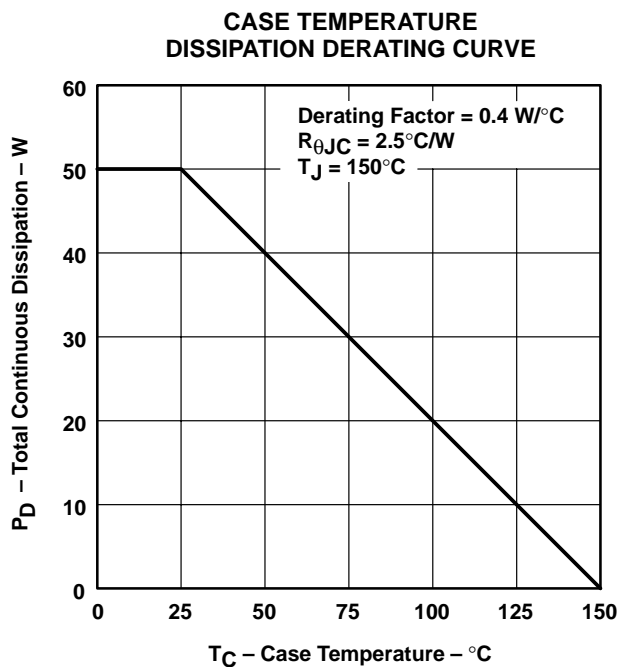


Figure 2

# TPIC2404

## INTELLIGENT-POWER QUAD LOW-SIDE SWITCH

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### 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 <sup>†</sup>		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	$\mu\text{A}$
Operating free-air temperature, $T_A$	-40		125	$^{\circ}\text{C}$

<sup>†</sup> 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 <sup>‡</sup>	MAX	UNIT
$I_{O(\text{off})}$	Off-state output current	$V_O = 12\text{ V}$ , ENABLE low		15	100	$\mu\text{A}$
		$V_O = 45\text{ V}$ , ENABLE high		0.6	2	mA
		$V_O = 12\text{ V}$ , ENABLE high	200	400	600	$\mu\text{A}$
$I_{IL}$	Low-level input current	$V_I = 0\text{ to }0.8\text{ V}$	-10	25	40	$\mu\text{A}$
$I_{IH}$	High-level input current	A inputs	10	25	60	$\mu\text{A}$
		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	$\mu\text{A}$
$I_{R(K)}$	Clamp-diode reverse current	$V_T = 50\text{ V}$ , $V_O = 0$			100	$\mu\text{A}$
$V_{F(K)}$	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 <sup>‡</sup>	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	$T_A = -40^{\circ}\text{C}$			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		$\mu\text{s}$
Turn-off time			8		$\mu\text{s}$

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





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