

TPIC2404 INTELLIGENT-POWER QUAD LOW-SIDE SWITCH

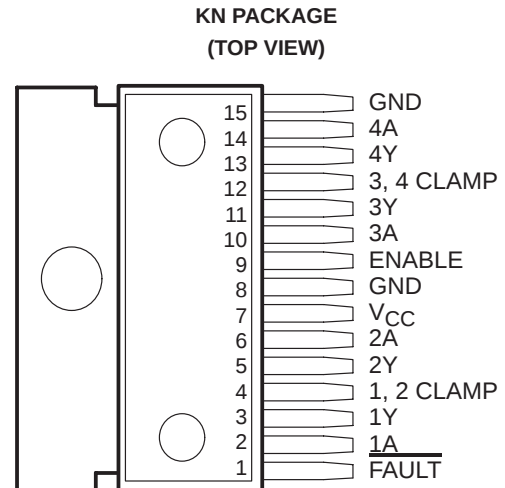
SLIS007A – D3299, AUGUST 1989 – REVISED MAY 1993

- 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 $\overline{\text{FAULT}}$ 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.



The tab is electrically connected to the GND pins.

FUNCTION TABLE

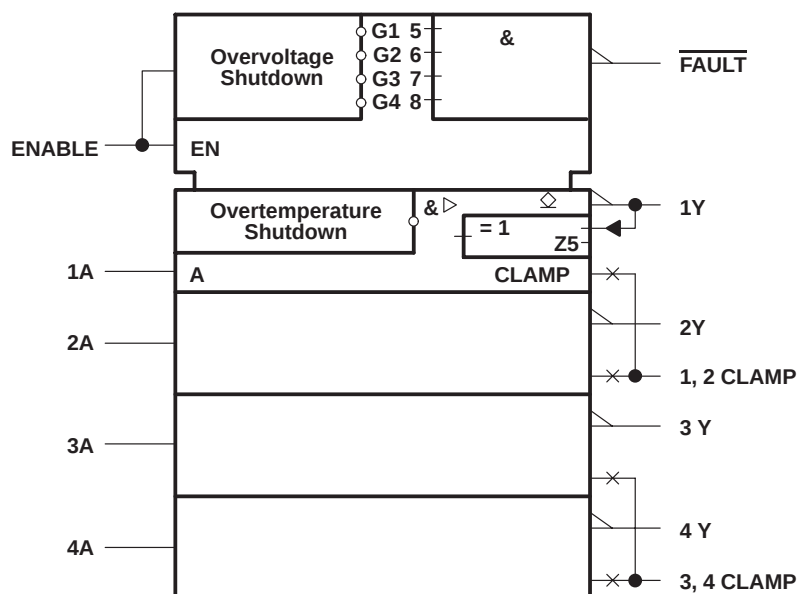
	INPUTS		OUTPUTS	
	ENABLE	A	Y	$\overline{\text{FAULT}}$
Normal operation	H	H	L	H
	H	L	H	H
	L	X	H	H
Open load	H	L	L	L
	H	H	L	H
Short to GND	H	L	L	L
	H	H	L	H
Overvoltage shutdown	H	H	H	L
	H	L	H	H
Thermal shutdown	H	H	H	L
	H	L	H	H
Short to V_{CC}	H	H	H	L
	H	L	H	H

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

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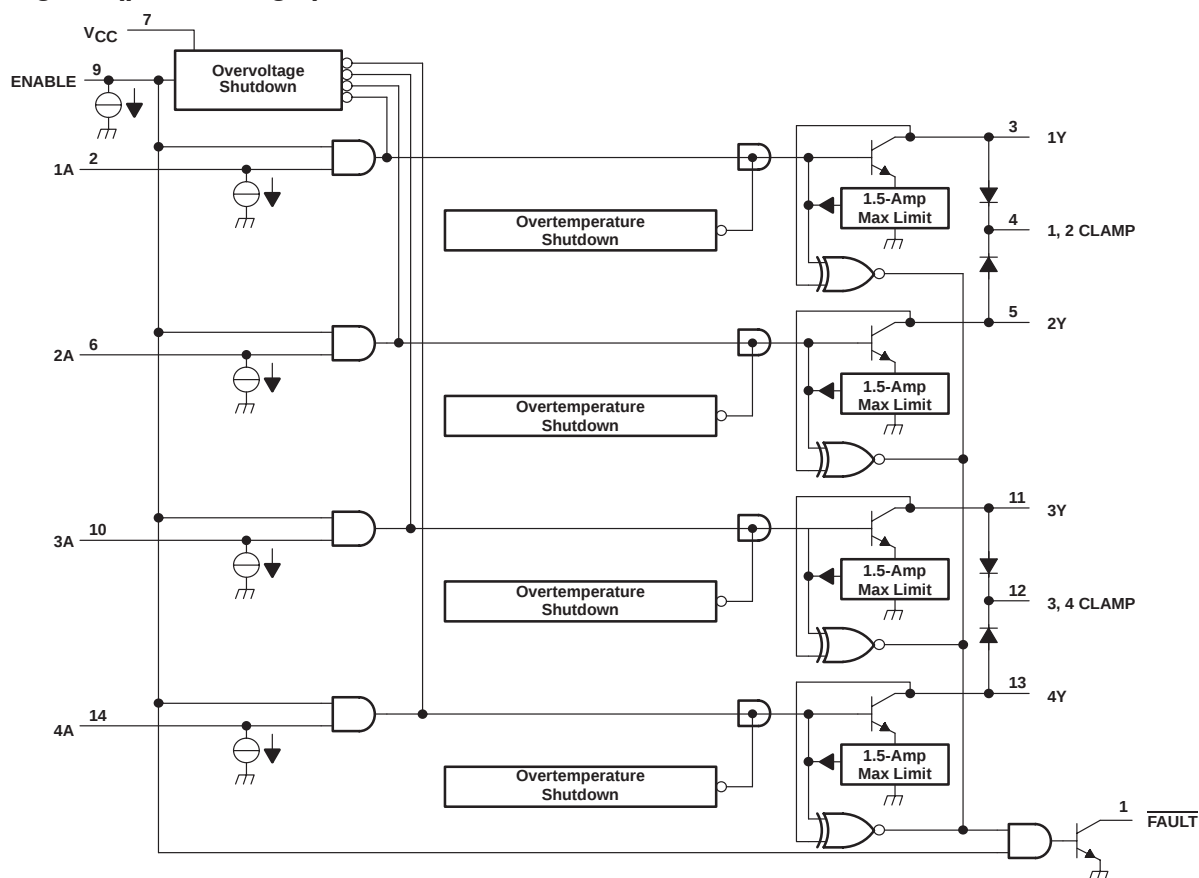
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logic symbol†

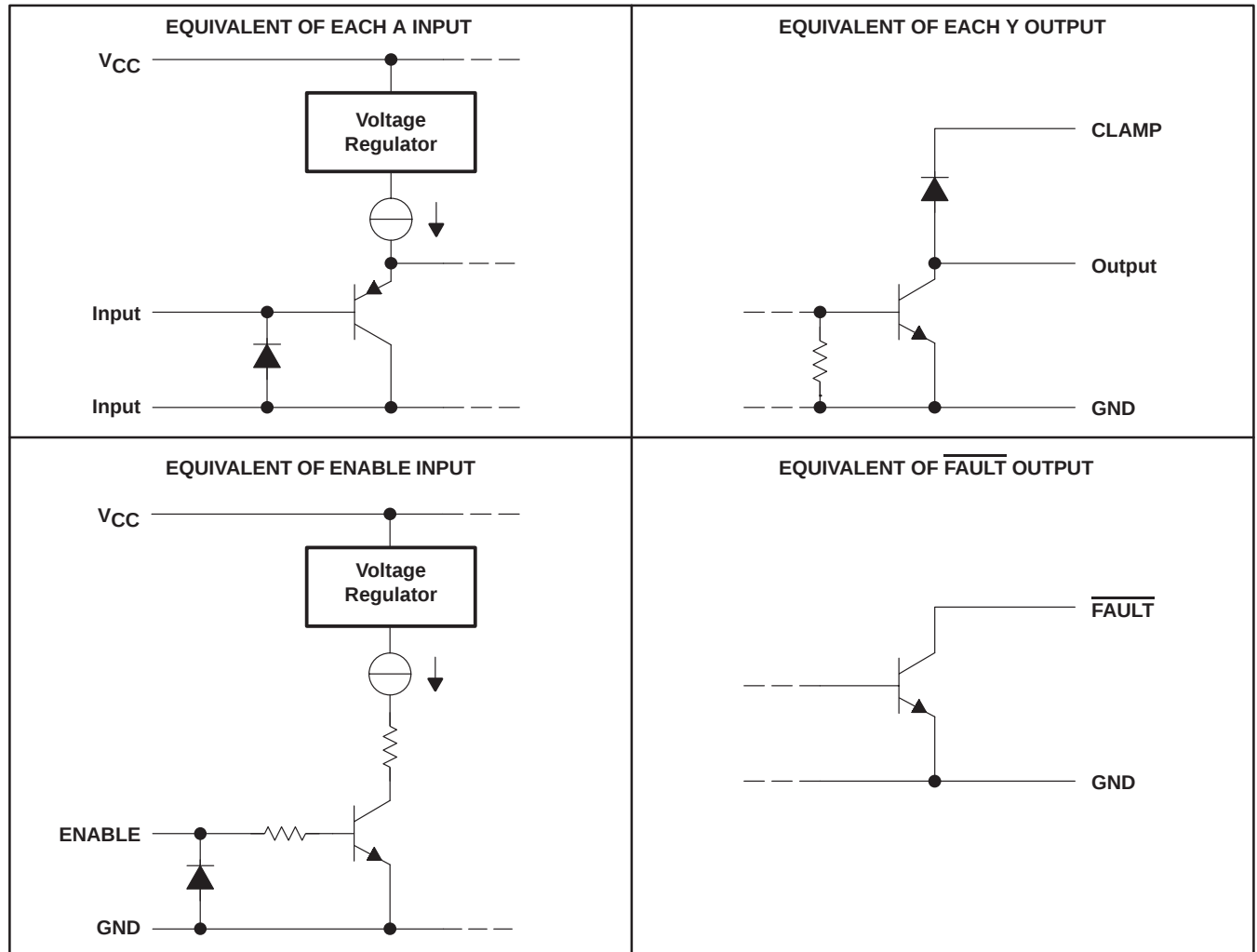


† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

logic diagram (positive logic)



schematics of inputs and outputs



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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.

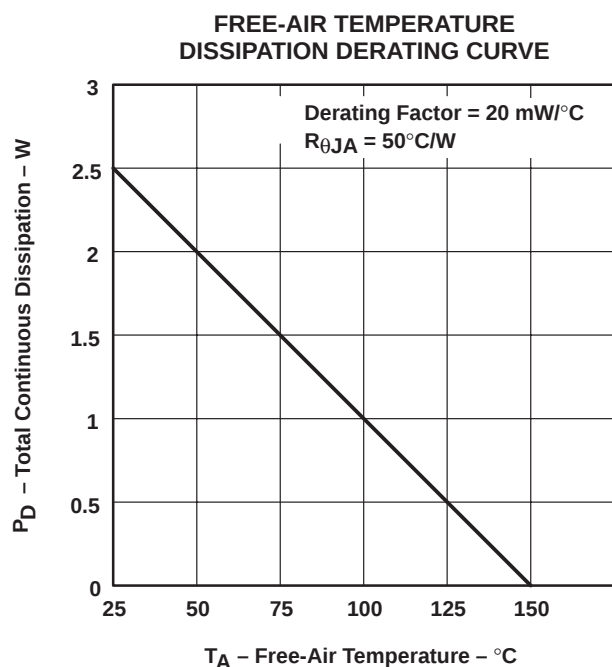


Figure 1

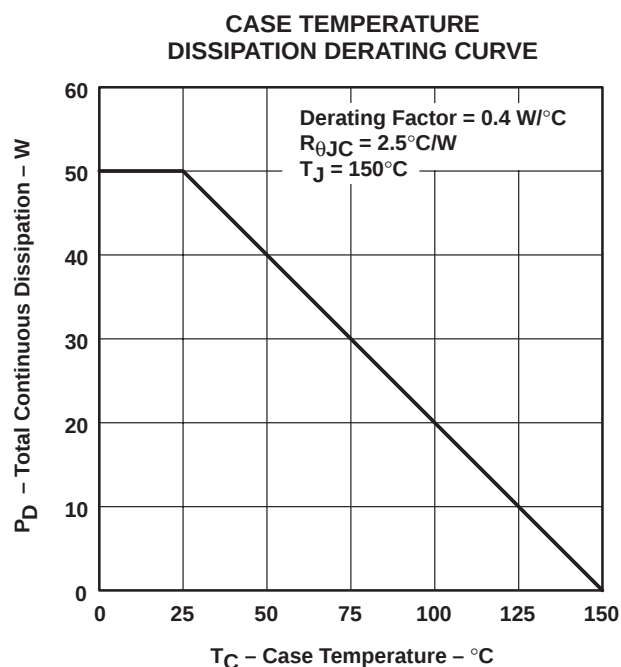


Figure 2

TPIC2404

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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
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	
			FAULT output, $I_{OL} = 30$ μA			0.2	0.4	
I_{OL}	Low-level output current		FAULT output, $V_{OL} = 1$ V to 5.5 V		50	90	125	μA
$I_{R(K)}$	Clamp-diode reverse current		$V_I = 50$ 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, $T_A = -40^\circ\text{C}$				120	
			Outputs on, $T_A = 25^\circ\text{C}$ 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	$T_A = -40^\circ\text{C}$			1.85	A
	$T_A = 25^\circ\text{C}$ 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, $T_A = 25^\circ\text{C}$.



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