TOSHIBA TPD2002F

TOSHIBA INTELLIGENT POWER DEVICE SILICON MONOLITHIC POWER MOS INTEGRATED CIRCUIT

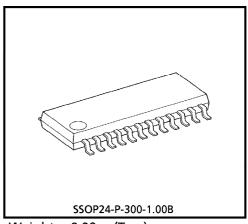
TPD2002F

2-CHANNEL SQUIB DRIVER for AIR BAG

TPD2002F is an intelligent power device for a 2-channel squib driver for use with SRS electronic air bags. The device is based on the Bi-CMOS-DMOS process.

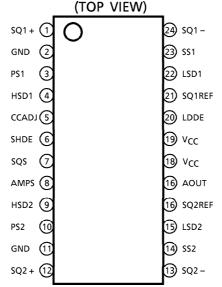
FEATURES

- Four independent inputs control two high-side switches and two low-side switches, directly driving two squibs.
- The following diagnosis functions (analog multiplexer output) are built in:
 - Squib short-to-battery diagnosis
 - Squib short-to-ground diagnosis
 - Squib open diagnosis
 - Safing sensor on diagnosis
 - Squib short diagnosis
 - Squib driver MOS FET diagnosis
- Built-in protection for overheating.
- 24-pin SSOP for surface mounting.
- Embossed taping supported.



Weight: 0.29 g (Typ.)

PIN ASSIGNMENT



(Note): That because of its MOS structure, this product is sensitive to static electricity.

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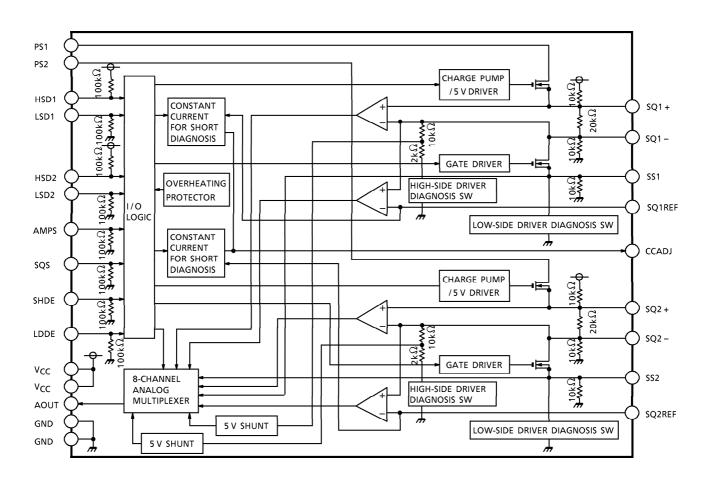
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BLOCK DIAGRAM



PIN DESCRIPTION

PIN No.	SYMBOL	FUNCTION
3	PS1	Squib 1 backup power input pin (24 V)
10	PS2	Squib 2 backup power input pin (24 V)
18, 19	Vcc	5V power input pins (2 pins for redundancy)
2, 11	GND	Ground pins (2 pins for redundancy)
4	HSD1	Squib 1 high-side driver control input pin (pulled up)
22	LSD1	Squib 1 low-side driver control input pin (pulled down)
9	HSD2	Squib 2 high-side driver control input pin (pulled up)
15	LSD2	Squib 2 low-side driver control input pin (pulled down)
6	SHDE	Control input pin at squib short diagnosis (pulled down)
20	LDDE	Control input pin at high-side driver diagnosis (pulled down)
7	sQs	Squib switching control input pin at squib diagnosis (pulled down)
8	AMPS	Amp switching control input pin at squib short diagnosis (pulled down)
17	AOUT	Analog multiplexer output pin
1	SQ1 +	Squib 1 + output pin
24	SQ1 –	Squib 1 – output pin (also used as reference resistance pin for short diagnosis)
21	SQ1REF	Reference resistance pin for squib 1 short diagnosis
23	SS1	Squib 1 safing sensor pin
12	SQ2 +	Squib 2 + output pin
13	SQ2 –	Squib 2 – output pin (also used as reference resistance pin for short diagnosis)
16	SQ2REF	Reference resistance pin for squib 2 short diagnosis
14	SS2	Squib 2 safing sensor pin
5	CCADJ	Constant current source setting pin for short diagnosis (Connect reference resistor between this pin and GND.)

TRUTH TABLE

SQUIB 1

MODE	HSD1	LSD1	SHDE	LDDE	AMPS	sQs
Fire	L	Н	L	L	L	L
Short-to-battery , short-to-ground, or open diagnosis	Н	L	L	L	L	L
Safing sensor diagnosis	Н	L	L	L	Н	L
Short diagnosis	Н	L	Н	L	L/H	L
High-side driver diagnosis	L	L	L	L	L	L
Low-side driver diagnosis	Н	Н	L	Н	Ĺ	L

SQUIB 2

MODE	HSD2	LSD2	SHDE	LDDE	AMPS	sQs
Fire	L	Н	L	L	L	L
Short-to-battery, short-to-ground, or open diagnosis	Н	L	L	L	L	Н
Safing sensor diagnosis	Н	L	L	L	Н	Н
Short diagnosis	Н	L	Н	L	L/H	Н
High-side driver diagnosis	L	L	L	L	L	Н
Low-side driver diagnosis	Н	Н	L	Н	L	Н

*: L/H: Switching

*: When overheating, cuts off all squib driver MOS FETs.

*: When the Vps line voltage exceeds 16 V, the device may be damaged due to a dead short in high-side driver only short-to-ground mode, or in low-side driver only short-to-battery mode. However, in other than the above modes, the device will not be damaged for up to 10ms due to the overheating protection.

OPERATION

(1) Squib on mode

When 1.5 V or more is applied to the HSD pin or 3.5 V or more is applied to the LSD pin, the MOS FETs for the high-side and low-side squib drivers are turned on, entering squib on mode.

(2) Squib short-to-battery, short-to-ground, or open diagnosis/safing sensor on diagnosis

When squib is normal, outputs the voltage divided by the built-in diagnosis resistance ratio.

Since the voltage is output via an analog multiplexer, squib short-to-battery, short-to-ground, open safing sensor are diagnosed using a microcontroller. When the squib is short-to-battery, a built-in shunt circuit prevents the analog multiplexer from damage.

(3) Squib short diagnosis

Outputs current from the built-in constant current source for diagnosis to the squib and the reference resistance, amplifies the voltage drop using an amp with the same gain, outputs the result via the analog multiplexer, enabling the squib resistance to be diagnosed using the microcontroller. The relative error of the output voltage is guaranteed as $\pm 10\%$. The constant current source for diagnosis can be varied using an external resistance. Even if the setting pin is shorted, the current is limited to a maximum of 100 mA by the current limit function.

(4) Squib driver MOS FET diagnosis

When the squib driver is turned on with the safing sensor in normal status, the MOS FET drain voltages for the high-side and low-side drivers are output via the analog multiplexer. Thus, the MOS FETs are diagnosed using the microcontroller. Diagnosis switches are set to much lower than the fire energy required.

(5) Overheating protection

When firing takes place with the squib shorted, protects the output using an overheating protection (output cutoff) circuit. (When wires are shorted, protection is not possible due to too large an output device loss.)

MAXIMUM RATINGS (Ta = $-40 \sim 85$ °C)

CHARACTERISTIC	SYMBOL	RATING	UNIT	
Supply Voltage	V _{PS}	30	\ \	
Supply Voltage	V _C C	7		
Input Voltage (for control)	VIN	-0.5~7	V	
Amp Differential Input	V5	5	V	
vVltage for Short Diagnosis	V _{DEF}	3	"	
Backup Capacitance	CM	1500 (25 V)	μF	
Squib On Time	toN	30	ms	
Power Dissipation	PD	0.8	W	
Operating Temperature	T _{opr}	- 40∼85	°C	
Junction Temperature	Тј	150	°C	
Storage Temperature	T _{stg}	- 55∼150	°C	

(Note) : The breakdown voltage between drain and source output for the power MOS FETs must be 30 V or higher.

ELECTRICAL CHARACTERISTICS (V_{PS} = $6\sim25$ V, V_{CC} = 5 ± 0.25 V, Ta = $-40\sim85$ °C)

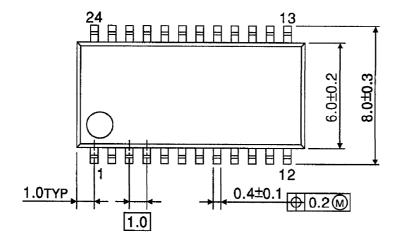
CHARACTERISTIC	SYMBOL	TEST CIR-	TEST CONDITION	MIN	TYP.	MAX	UNIT
	V _P S	CUIT —	_			25	
Operating Voltage	VPS		_	6 4.75		5.25	V
		_	$V_{PS} = 25 \text{ V}, V_{CC} = 5.25 \text{ V},$ at diagnosis	-	_	100	
C man of Bining time	IPS	_	$V_{PS} = 25 \text{ V}, V_{CC} = 5.25 \text{ V},$ at non-diagnosis	_	_	2	A
Current Dissipation	lee	_	$V_{PS} = 25 V$, $V_{CC} = 5.25 V$, at diagnosis			10	mA
	lcc	_	$V_{PS} = 25 V$, $V_{CC} = 5.25 V$, at non-diagnosis			10	
Input Voltage	V _{IL}		INPUT "L"	_	_	1.5	l _v l
input voitage	V _{IH}	_	INPUT "H"	3.5	_	_	Ů
Input Current	IIL	_	V _{IN} = V _{CC} (Pulled-up pin) V _{IN} = 0 V (Pulled-down pin)			± 10	μΑ
·	lін	- V _{IN} = 0 V (Pulled-up pin) V _{IN} = V _{CC} (Pulled-down pin)			50	200	μν.
High-side Driver On	Rpc (ON) Hc		$V_{PS} = 20 \text{ V}, V_{CC} = 4.75 \text{V}, I_{D} = 1 \text{ A}$	_	_	1	Ω
Resistance	Rds (on) hs		$V_{PS} = 20 \text{ V}, V_{CC} = 4.75 \text{ V}, I_{D} = 3 \text{ A}$	_	_	1.2	
Low-side Driver On	R _{DS} (ON) LS		$V_{PS} = 20 \text{ V}, V_{CC} = 4.75 \text{ V}, I_{D} = 1 \text{ A}$	_	_	1	
Resistance			$p_S = 20 \text{ V}, \text{ V}_{CC} = 4.75 \text{ V}, \text{ I}_D = 3 \text{ A} - \frac{1}{2}$		_	1.2	Ω
		_	$V_{PS} = 6 \text{ V}, V_{CC} = 4.75 \text{ V}, I_{D} = 1 \text{ A}$	_	_	1.5	
High-side Driver Output leakage current	lolh	_	V _{OUT} = 25 V	_	_	100	μΑ
Low-side Driver Output Leakage Current	loll		V _{OUT} = 25 V	_	1	100	μΑ
Short Diagnosis Output	VDIAGSQ		$V_{PS} = 8 \sim 25 \text{ V}, \text{ RCCADJ} = 18 \text{ k}\Omega$	900	1400	1800	mV
Voltage	VDIAGREF	_	RSQ = RREF = 2 Ω , IAO = 5 μ A	900	1400	1800	
Diagnosis Output Relative Deviation	VDIAGDEV	_	$V_{PS} = 8 \sim 25 \text{ V}, \text{ RCCADJ} = 18 \text{ k}\Omega$ RSQ = RREF = 2 Ω, IAO = 5 μA $V_{DIAGDEV} = \{V_{DIAGSQ} / (V_{DIAGREF} - V_{DIAGSO})\} \times 100$	- 10	0	10	%
Amp Saturation Voltage	VAMPSAT	_	$V_{CC} = 4.75 \text{ V}, \text{ IAO} = 5 \mu \text{A}$	3.75		_	V
Overheating Protection Level	T _{SD}	_	_		170	200	°C
Switching Time (High-side	T _{PLH}	_		_	100	200	
driver)	T _{PHL}	_	$V_{PS} = 25 \text{ V}, V_{CC} = 4.75 \text{ V}, R \text{ load},$	_	10	50	μ s
Switching Time (Low-side	T _{PLH}		$R = 2 \Omega$		10	50	,
driver)	T _{PHL}				10	50	μ s
High-side Driver			V 25 V V 475 V D I-6 I	_		500	
Diagnosis	TDHL	_	$V_{PS} = 25 V$, $V_{CC} = 4.75 V$, R load, $R = 2 Ω$	_	_	500	
Diagnosis Low-side Driver	TDLH		$A_{OUT} = 1000 \text{pF}$	-		200	,,,
Time Diagnosis	TDHL		$SQ + = 0.01 \mu F$			500	μ s
Other Diagnosis	Tour		$SQ - = 0.01 \mu\text{F}$	_	_	200	_
Other Diagnosis	T _{DHL}			_	_	500	

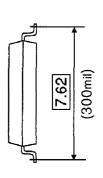
(Note): When the CCADJ pin is short-to-ground, the maximum constant current must be 100 mA (at all temperatures).

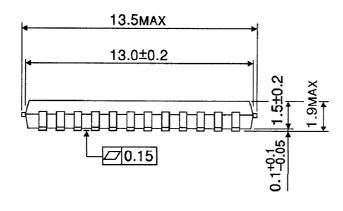
Unit: mm

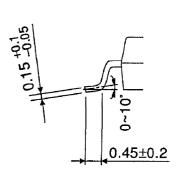
OUTLINE DRAWING

SSOP24-P-300-1.00B









Weight: 0.29 g (Typ.)