TOSHIBA TPD2004F

TENTATIVE TOSHIBA INTELLIGENT POWER DEVICE SILICON MONOLITHIC POWER MOS IC

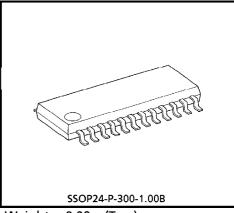
TPD2004F

2-ch SQUIB DRIVER FOR AIR BAGS

Manufactured by the Bi-CMOS-DMOS process, this 2-channel squib drive IPD is designed for use in SRS electronic system air bags.

FEATURES

- Using independent four-channel inputs, this IC controls two high-side and two low-side switches, making it possible to drive two squibs directly.
- Incorporates various diagnostic functions (analog multiplexer outputs) :
 - Squib short-to-battery diagnosis
 - Squib short-to-ground diagnosis
 - Squib open-circuit diagnosis
 - Safing sensor-ON unusual diagnosis
 - High-redundancy, upstream arrangement for safing sensor
 - Squib short diagnosis
 - Squib drive MOSFET diagnosis
- Chip select function allows for multi-channel structure to be materialized using minimum control lines.
- Comes in a 24-pin SSOP surface mount package.
- Supports emboss taping.



Weight: 0.29g (Typ.)

980508EBA1

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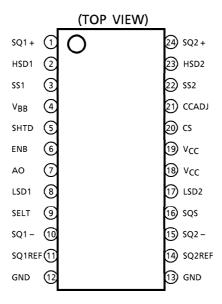
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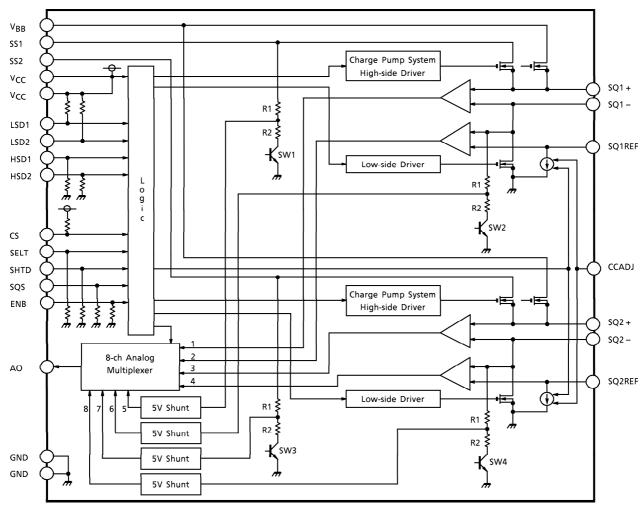
PIN ASSIGNMENT



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

TOSHIBA

BLOCK DIAGRAM



PIN DESCRIPTION

| PIN No. | SYMBOL | PIN DESCRIPTION |
|---------|-----------------|--|
| 1 | SQ1+ | Squib positive (+) side output pin for channel 1 |
| 2 | HSD1 | High-side driver control input pin for Channel 1 (Pull-down) |
| 3 | SS1 | Safing sensor connect pin for channel 1 |
| 4 | V _{BB} | Backup block power supply input pin |
| 5 | SHTD | Control input pin for short diagnosis (Pull-down) |
| 6 | ENB | INHIBIT input pin to inhibit ignition when this input is pulled low. (Pull-down) |
| 7 | AO | Analog multiplexer output pin |
| 8 | LSD1 | Low-side driver control input pin for Channel 1 (Pull-up) |
| 9 | SELT | Control input pin for switching between diagnosis line and analog multiplexer (Pull-down) |
| 10 | SQ1 – | Squid negative (-) side output pin for channel 1 (Shared with reference resistor pin for short diagnosis) |
| 11 | SQ1REF | Shorting diagnosis reference resistor pin for channel 1 |
| 12, 13 | GND | Ground pin (Two pins) |
| 14 | SQ2REF | Shorting diagnosis reference resistor pin for Channel 2 |
| 15 | SQ2 – | Squib negative (-) side output pin for channel 2 (Shared with reference resistor pin shorting diagnosis) |
| 16 | sQs | Squib switchover control input pin during each squib diagnosis. (Pull-down) |
| 17 | LSD2 | Low-side driver control input pin for Channel 2 (Pull-up) |
| 18, 19 | Vcc | 5V block power supply input pin (Two pins) |
| 20 | CS | Chip select control input pin (Pull-up) |
| 21 | CCADJ | Current setup resistor connect pin for short diagnosis constant-current source. (Reference resistor connect pin) |
| 22 | SS2 | Safing sensor connect pin for Channel 2 |
| 23 | HSD2 | High-side driver control input pin for Channel 2 (Pull-down) |
| 24 | SQ2 + | squib positive (+) side output pin for Channel 2 |

TRUTH TABLE

| MODE | SQUIB | HSD1 | HSD2 | LSD1 | LSD2 | SELT | SHTD | sQs | ENB | cs | MULTIPL EXER ch | DIVIDING VOLTAGE SW |
|---|-------|------|------|------|------|------|------|-----|-----|----|-----------------------|---------------------------|
| lamitian | SQ1 | Н | * | L | * | * | * | * | Н | * | _ | _ |
| Ignition | SQ2 | * | Н | * | L | * | * | * | Н | * | _ | _ |
| | SQ1 | L | L | Н | Н | L | Н | L | Н | L | 1 | _ |
| Short Diagnosis | SQ1 | L | L | Н | Н | Н | Н | L | T | L | 2 | _ |
| Short Diagnosis | SQ2 | L | L | Н | Н | L | Н | Н | Н | L | 3 | _ |
| | SQ2 | L | L | Н | Н | Н | Н | Н | Н | L | 4 | _ |
| SS1 Potential Diagnosis (Not Divided) | SQ1 | L | L | Н | Н | Н | L | L | L | L | 5 | _ |
| SS2 Potential Diagnosis (Not Divided) | SQ2 | L | L | Н | Н | Н | L | Н | L | L | 7 | _ |
| SS1 Potential Diagnosis (Divided) | SQ1 | L | L | Н | Н | Н | L | L | Н | L | 5 | SW1 |
| SS2 Potential Diagnosis (Divided) | SQ2 | L | L | Н | Н | Н | L | Н | Н | L | 7 | SW3 |
| SQ-1 Potential Diagnosis (Not Divided) | SQ1 | L | L | Н | Н | L | L | L | Н | L | 6 | _ |
| SQ-2 Potential Diagnosis (Not Divided) | SQ2 | L | L | Н | Н | L | L | Н | Н | L | 8 | _ |
| SQ-1 Potential Diagnosis (Divided) | SQ1 | L | L | Н | Н | L | L | L | L | L | 6 | SW2 |
| SQ-2 Potential Diagnosis (Divided) | SQ2 | L | L | Н | Н | L | L | Н | L | L | 8 | SW4 |
| High-side Driver | SQ1 | Н | L | Н | Н | L | L | L | Н | L | 6 | SW2 |
| Diagnosis | SQ2 | L | Н | Н | Н | L | L | Н | Н | L | 8 | SW4 |
| Low-side Driver | SQ1 | L | L | L | Н | L | L | L | Н | L | 6 | _ |
| Diagnosis | SQ2 | L | L | Н | L | L | L | Ι | Н | L | 8 | _ |

* : Don't Care

(Note) When ENB input is pulled low, ignition is inhibited.

(Note) When CS is high, the diagnostic inputs SELT, SHTD, and SQS are ignored (in logic) and the AO pin is placed in the high-impedance state.

(Note) If ignited under shorted condition, the device may break down.

FUNCTIONAL DESCRIPTION

(1) 2-ch squib drive function

Using independent four-channel inputs, this IC controls two high-side and two low-side switches, making it possible to drive two squibs directly.

(2) Squib line short-to-battery, short-to-groud and open-circuit diagnostic function (diagnostic voltage output)

When the squib is in normal state, by an external diagnostic resistor, the device outputs a voltage derived from V_{CC} by dividing it according to the resistance ratio. Because this voltage is output via the analog multiplexer, it is possible to diagnose short-to-battery, short-to-groud and open-circuit in the squib line by a microcomputer. Also, the device contains a shunt circuit to prevent the analog multiplexer from breaking down when squib is short-to-battery.

(3) Squib short diagnostic function (diagnostic voltage output)

A diagnostic current is flowed from the internal constant-current source to the squib and reference resistor, and a voltage drop in each is amplified by an internal amp whose gain is the same for both. These voltages are output via the analog multiplexer, so that the squib resistance value can be diagnosed by a microcomputer. Also, the relative accuracy of the output voltages is guaranteed to be within $\pm 10\%$.

(4) Squib driver MOSFET diagnostic function (diagnostic voltage output)

When the squib driver is turned on while the safing sensor is in normal state, the MOSFET's drain voltage is output via the analog multiplexer, making it possible to diagnose the MOSFET by a microcomputer.

(5) Diagnostic chip select function

Since the device has a chip select function, the diagnostic control bits can be minimized when the application circuit is configured with multiple chips. Furthermore, since when a chip is not selected, diagnostic output pin AO is placed in the high-impedance state, it is possible to diagnose multiple chips using a 1-ch CPU A/D port. (Ignition operates irrespective of CS.)

(6) Input INHIBIT function

This function is provided to prevent erroneous ignition due to a fault in microcomputer or system power supply. It allows for ignition to be inhibited by pulling the ENB pin low.

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

| CHARACTERISTIC | SYMBOL | RATING | UNIT |
|------------------------------|--------------------|-----------------|------|
| Bower Supply Voltage | V _{BB} | 30 | v |
| Power Supply Voltage | VCC | 10 | |
| Input Voltage | SS | 30 | V |
| imput voitage | VIN | - 0.5~7 | |
| Backup Capacitor Capacitance | CM | 1500 (1ch) | μF |
| Backup Capacitor Charging | cv | 25 | V |
| Voltage | | 23 | V |
| Squib ON-Time | ^t ON | 15 | ms |
| Squib Driver Current | Iso | 10 | Α |
| (channel) | I _{SQ} 10 | | |
| Power Dissipation | PD | 0.8 | W |
| Operating Temperature | T _{ope} | - 40∼8 5 | °C |
| Junction Temperature | Tj | 150 | °C |
| Storage Temperature | T _{stg} | - 55∼150 | °C |

(Note) The squib driver uses a 60V tolerant output device. However, this does not guarantee that the squib tolerates 60V because this varies with the withstand voltages of peripheral circuits.

ELECTRICAL CHARACTERISTICS (Ta = $-40 \sim 85$ °C)

| CHARACTERIS | TIC | SYMBOL | TEST CONDITION | MIN | TYP. | MAX | UNIT | | | |
|---|--------------|------------------|--|-----------------------|------|--|---------|--|--|--|
| On anation Committee Va | la | V _{BB} | _ | 4 | _ | 25 | | | | |
| Operating Supply Vo | itage | V _C C | | 4.75 | _ | 5.25 | V | | | |
| | CCRet = 20kΩ | | 100 | | | | | | | |
| Current Consumption | 1 | I _{BB} | $V_{BB} = 24V$, when not diagnosed | _ | 0.1 | 1 | mA | | | |
| · | | 1 | $V_{CC} = 5.25V$, when diagnosed | _ | 5 | 10 |] | | | |
| | | ^I cc | $V_{CC} = 5.25V$, when not diagnosed | _ | 3 | 6 | | | | |
| Input Voltage | | V _{IL} | INPUT "L" | _ | _ | V _{CC} × 0.3 | - v | | | |
| mput voitage | | V _{IH} | INPUT "H" | V _{CC} × 0.7 | _ | _ | | | | |
| | | 1 | V _{IN} = 0V (Pull-down) | _ | _ | 25 5.25 100 1 10 6 V _{CC} × 0.3 ± 10 - 200 200 ± 10 1 1.2 0.1 0.1 1 22 ± 10 | | | | |
| Input Current | | IIL | $V_{IN} = 0V (Pull-up)$ | | | - 200 |] ,,, | | | |
| Imput Current | | l | $V_{IN} = V_{CC}$ (Pull-down) | _ | 50 | 200 | μA | | | |
| | | ΙΗ | $V_{IN} = V_{CC}$ (Pull-up) | _ | _ | 25 5.25 100 1 10 6 VCC× 0.3 — ±10 -200 200 ±10 1.2 0.1 0.1 1.2 0.1 0.1 | | | | |
| Squib Driver ON Besi | ctanca | Proc (ON) CO | $V_{BB} = 9V$, $V_{CC} = 4.75V$, $I_{D} = 1A$ | _ | 0.6 | 1 | Ω | | | |
| Squib Driver ON-Resi | stance | RDS (ON) SQ | $V_{BB} = 9V$, $V_{CC} = 4.75V$, $I_{D} = 3A$ | - | 0.7 | 1.2 | 77 | | | |
| Squib Driver Output | High Side | IOLSQ (H) | V _{OUT} = 25V | _ | _ | 0.1 | mA | | | |
| Leakage Current | Low Side | IOLSQ (L) | V _{OUT} = V _{CC} | _ | _ | 0.1 | | | | |
| Leakage Current | 5100 | IOLSQ (L) | V _{OUT} = 25V | _ | _ | 1 | | | | |
| Diagnostic Amp Amp Factor | olification | AMPGAIN | $V_{CC} = 4.75V$, $AMPVCOMM = 3V$, $25^{\circ}C$ | 18 | 20 | 22 | | | | |
| Diagnostic Amp Offset Voltage | | AMPOFFSET | $V_{CC} = 4.75V$, $AMPVCOMM = 3V$, $25^{\circ}C$ | _ | _ | ± 10 | mV | | | |
| Diagnostic Amp Diffe Input Voltage Range | | AMPVDEF | $V_{CC} = 4.75V$, ISH = 100mA, AMPVCOMM = 3V, 25°C | 200 | _ | _ | mV | | | |
| Diagnostic Amp In-p Input Voltage Range | | AMPVCOMM | | 3.0 | _ | _ | V | | | |
| Diagnostic Amp Out Saturation Voltage | out | VAMPSAT | | V _{CC} -1 | _ | _ | V | | | |
| Diagnostic Constant- Source | current | ISHDIAGCC | $CCRef = 20k\Omega$ | 28 | 35 | 45 | mA | | | |
| Diamantic Outros V | - 14 | VDIAGSQ | RSQ = 2Ω , ISH = 35 mA, IAO = 5μ A | 900 | 1400 | 1900 | | | | |
| Diagnostic Output V | ortage | VDIAGREF | RREF = 2Ω , ISH = 35 mA, IAO = 5μ A | 900 | 1400 | 1900 | mV | | | |
| Diagnostic Output Ro Accuracy | elative | VDIAGDEV | RSQ = RREF = 2Ω , ISH = 35 mA, IAO = 5μ A | - 10 | 0 | 10 | % | | | |

| CHARACTERISTIC | | SYMBOL | TEST CONDITION | MIN | TYP. | MAX | UNIT | |
|-----------------------------|--------------------|----------|--|------------|------|-------|--------------------|--|
| CHARACTERISTIC | | STIVIBOL | 1231 CONDITION | IVIIIN | IIF. | IVIAA | CIVIT | |
| Diagnostic P | osistanco Valuo | R1 | | 40 | 80 | 280 | $\mathbf{k}\Omega$ | |
| Diagnostic Resistance Value | | R2 | | 10 | 20 | 70 | K77 | |
| Diagnostic V Ratio | oltage Dividing | VDIV | | 0.17 | 0.2 | 0.23 | _ | |
| Diagnostic R Accuracy | esistance Relative | RDEV | (Measured between SS1, SQ1 – , SS2, SQ2 –) | - 5 | 0 | 5 | % | |
| Switching Ti | me | TPLH | <u> </u> | | 200 | | | |
| (High-side SW) | | TPHL | $V_{BB} = 25V$, R load, $I_D = 3A$ | _ | 10 | 50 | μ s | |
| Switching Ti | Switching Time | | | _ | 10 | 50 | | |
| (Low-side SV | V) | TPHL |] | 10 | | 50 | | |
| | High-side Driver | TDLH | $V_{BB} = 25V$, R load, $R = 2\Omega$ | _ | 120 | 250 | | |
| Diamania | Diagnosis | TDHL | | _ | 50 | 100 | | |
| Diagnosis | Low-side Driver | TDLH | | _ | 20 | 80 |] | |
| Switchover Time | Diagnosis | TDHL | $\frac{1}{2}$ ARR = 524, W load, W = 577 | _ | 40 | 100 | μ s | |
| rime | Oth an Diamaraia | TDLH |] | _ | 30 | 60 | | |
| | Other Diagnosis | TDHL |] | _ | 50 | | 1 | |

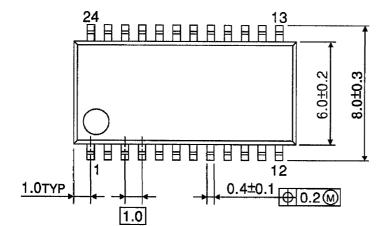
(Note) The short diagnosis monitor current in cases when the CCADJ pin is shorted to GND is 100mA (Max) (at all temperatures).

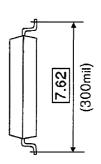
(Note) Short diagnosis must be completed within 15ms.

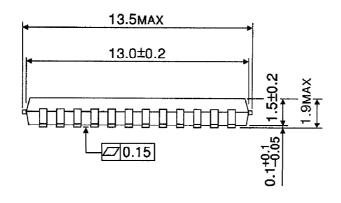
Unit: mm

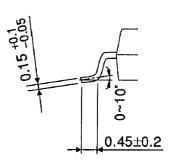
OUTLINE DRAWING

SSOP24-P-300-1.00B









Weight: 0.29g (Typ.)