

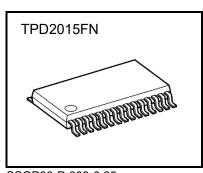
Toshiba Intelligent Power Device Silicon Monolithic MOS Integrated Circuit

# **TPD2015FN**

High side switch (8-channels) for motors, solenoids, lamp drives

## 1. Description

TPD2015FN is a high-side switch (8-channels) with MOSFET outputs. This is the monolithic power IC that can be driven directly from CMOS, TTL logic circuitry (MCU, etc.) and have over current and over temperature protection features.



SSOP30-P-300-0.65 Weight: 0.176 g (Typ.)

## 2. Applications

- Programmable logic controller for Industrial Use.
- Driving resistant load and inductive load

#### 3. Features

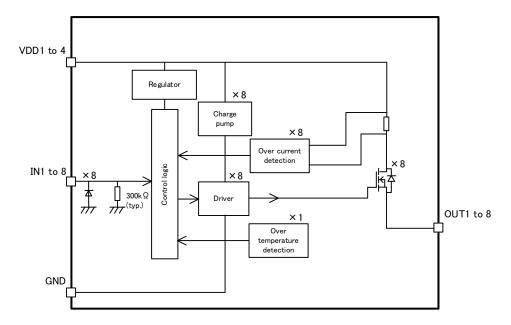
- 8-channels of N-channel MOSFET and charge pump are built-in.
- This IC can drive the power load directly.
- Built-in protection against over temperature and over current.
- 8-channels access enables space-saving design.
- High voltage operation is possible: 40 V
- Low on resistance :  $0.55\Omega$  (max) @ V<sub>DD</sub> = 12V, I<sub>OUT</sub> = 0.5A, T<sub>j</sub> = 25°C (per channel)
- Parallel operation is possible.
- Package is SSOP30 (300 mil) and packing form is embossed taping.

Note: This product has a MOS structure and is sensitive to electrostatic discharge.

Start of commercial production 2022-05



# 4. Block Diagram



Note: Some of the functional blocks, circuits, constants, etc. in the block diagram are omitted or simplified.

Figure 4.1 Block Diagram



# 5. Pin Assignments

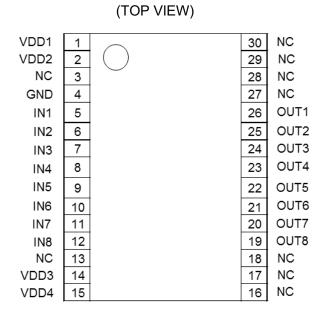


Figure 5.1 Pin Assignments



# 6. Pin Description

Table 6.1 Pin Description

Pin No.	Symbol	I/O	Pin Description
1	VDD1	-	Power supply pin.
2	VDD2	-	Power supply pin.
3	NC	-	No-Connect pin.
4	GND	-	GND pin.
5	IN1	IN	Input pin for channel 1. Built in pull down resistor (300kΩ typ.).
6	IN2	IN	Input pin for channel 2. Built in pull down resistor (300kΩ typ.).
7	IN3	IN	Input pin for channel 3. Built in pull down resistor (300kΩ typ.).
8	IN4	IN	Input pin for channel 4. Built in pull down resistor (300kΩ typ.).
9	IN5	IN	Input pin for channel 5. Built in pull down resistor (300kΩ typ.).
10	IN6	IN	Input pin for channel 6. Built in pull down resistor (300kΩ typ.).
11	IN7	IN	Input pin for channel 7. Built in pull down resistor (300kΩ typ.).
12	IN8	IN	Input pin for channel 8. Built in pull down resistor (300kΩ typ.).
13	NC	-	No-Connect pin.
14	VDD3	-	Power supply pin.
15	VDD4	-	Power supply pin.
16	NC	-	No-Connect pin.
17	NC	-	No-Connect pin.
18	NC	-	No-Connect pin.
19	OUT8	OUT	Output pin of channel 8.
20	OUT7	OUT	Output pin of channel 7.
21	OUT6	OUT	Output pin of channel 6.
22	OUT5	OUT	Output pin of channel 5.
23	OUT4	OUT	Output pin of channel 4.
24	OUT3	OUT	Output pin of channel 3.
25	OUT2	OUT	Output pin of channel 2.
26	OUT1	OUT	Output pin of channel 1.
27	NC	-	No-Connect pin.
28	NC	-	No-Connect pin.
29	NC	-	No-Connect pin.
30	NC	-	No-Connect pin.



## 7. Operational Description

### 7.1. Over temperature protection

To prevent damage due to temperature rise, this product is equipped with one channel of a built-in over temperature detection circuit that turns off all outputs when the junction temperature exceeds the over temperature detection (Tsd). If the junction temperature falls below the hysteresis set temperature (Tsd- $\Delta$ Tsd), the product will return to normal operation.

### 7.2. Over current protection

Each output has a built-in over current protection circuit. If the output current exceeds the over current detection value (I<sub>OC</sub>) due to a load short, etc., the output is turned off during the over current protection operating time (t<sub>OFF-DUTY</sub>). After that, the output returns, if the over current condition continues, the output will again be turned off for the over current protection operating time (t<sub>OFF-DUTY</sub>).

### 7.3. Timing chart

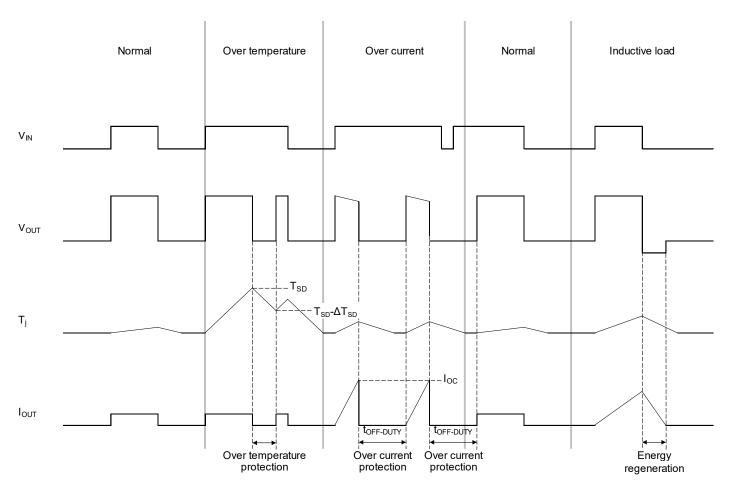


Figure 7.1 Timing chart



### 7.4. Truth table

Table 7.1 Truth table

Input	Output	Operating state
L	L	Normal
Н	Н	Nomai
L	L	Over current protection
Н	Switching	( Load short circuit )
L	L	Over temperature
Н	L	protection



## 8. Absolute Maximum Ratings

Table 8.1 Absolute Maximum Ratings (Note)

(Ta = 25°C unless otherwise specified)

Characteristics	Symbol	Rating	Unit
Supply voltage	V <sub>DD</sub>	-0.3 to 40.0	V
Input voltage	V <sub>IN</sub>	-0.3 to 6.0	V
VDDx - OUTx withstand voltage	V <sub>DSS</sub>	50.0 <sup>(Note 1)</sup>	V
Output current	Іоит	Internally limited	Α
Power dissipation	P <sub>D</sub>	1.8	W
Operating temperature	T <sub>opr</sub>	-40 to 110	°C
Junction temperature	Tj	150	°C
Storage temperature	T <sub>stg</sub>	-55 to 150	°C

Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: Not subject to production test.

#### 8.1. Thermal Resistance

Table 8.2 Thermal resistance

Characteristics	Symbol	Rating	Unit
Thermal resistance (junction-to-ambient)	R <sub>th (j–a)</sub>	70	°C/W

Note: JEDEC Standard.

> Glass epoxy board Material: FR-4(4 layer)

Board size: 76.2mm x 114.3mm x 1.6mm



# 9. Operating Ranges

**Table 9.1 Operating supply voltage** 

Characteristics	Symbol	Condition	Min	Тур.	Max	Unit
Operating supply voltage	$V_{DD(opr)}$	T <sub>j</sub> = 25°C	8	1	40	٧

## 10. Electrical Characteristics

#### **Table 10.1 Electrical Characteristics**

 $(T_j = 25^{\circ}C, V_{DD} = 8 \text{ to } 40V \text{ unless otherwise specified})$ 

Characteristics		Symbol	Note or Test Condition	Min	Тур.	Max	Unit
Supply current		I <sub>DD(OFF)</sub>	V <sub>DD</sub> =24V, V <sub>IN</sub> = 0V	-	1.9	2.6	mA
		I <sub>DD(ON)</sub>	V <sub>DD</sub> =24V, V <sub>IN</sub> = 5V, All outputs open	-	3.1	4.2	mA
lanut valtaga	"L" level	V <sub>IL</sub>	-	-	-	8.0	V
Input voltage	"H" level	V <sub>IH</sub>	-	2.0	-	-	
Inner comment		lıL	V <sub>IN</sub> = 0V	-1	-	1	
Input current		l <sub>IH</sub>	V <sub>IN</sub> = 5V	-	16	23	μA
On resistance		R <sub>DS(ON)</sub>	V <sub>DD</sub> = 12V, V <sub>IN</sub> = 5V, I <sub>OUT</sub> = 0.5A	-	0.40	0.55	Ω
Output leakage current		I <sub>OL</sub>	V <sub>DD</sub> = 40V, V <sub>IN</sub> = 0V, Per output	-	-	1	μA
Over current pr	otection	loc	-	1.0	1.8	2.8	Α
Over current protection operating time		toff-duty	-	1.5	3.0	4.5	ms
Over	Temperature	T <sub>SD</sub>	-	150	175	200	°C
temperature detection	Hysteresis	ΔT <sub>SD</sub>	-	10	20	30	
Switching time		ton	Refer to test circuit 1	5	10	15	μs
		toff		3	6	9	
Single pulse avalanche energy		E <sub>S</sub>	T <sub>a</sub> = 25°C, I <sub>OUT</sub> = 0.75A (1-channel operation)	30	150 <sup>(Note 2)</sup>	-	mJ

Note 2: Not subject to production test.



## 11. Test circuit

### 11.1. Test circuit 1

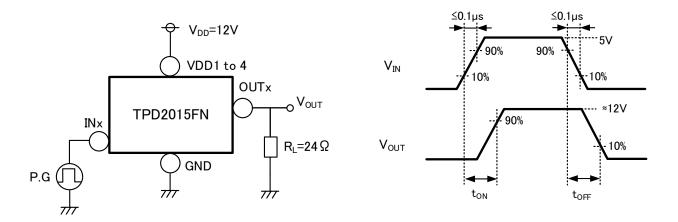
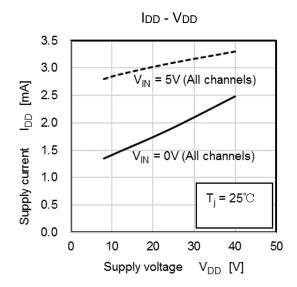


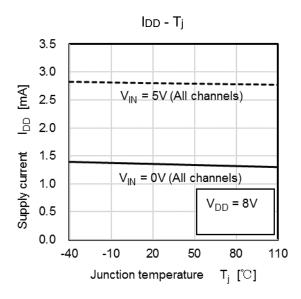
Figure 11.1 Switching time measurement circuit

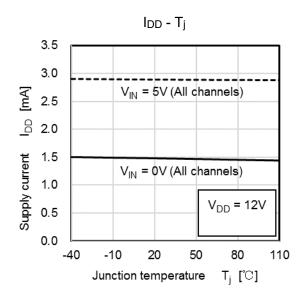


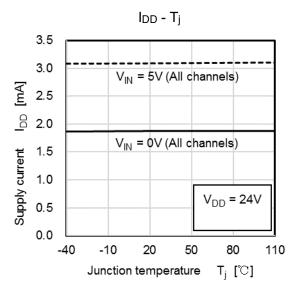
#### 12. Characteristic curves

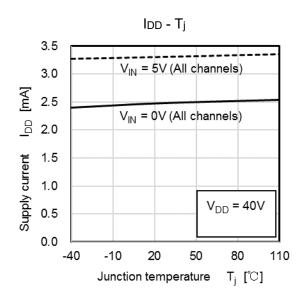
The below characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.



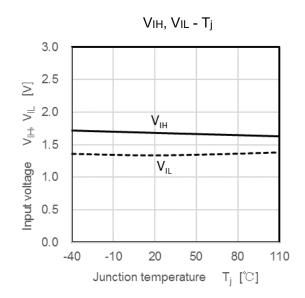


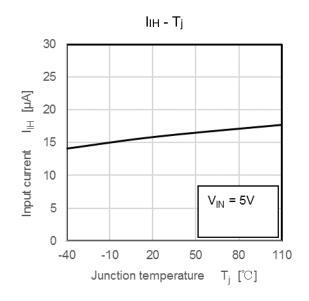


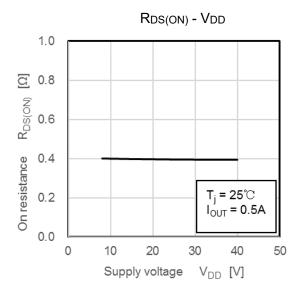


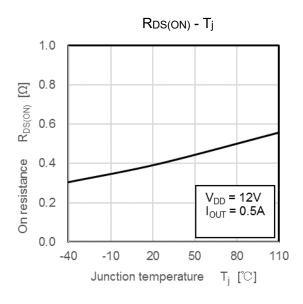


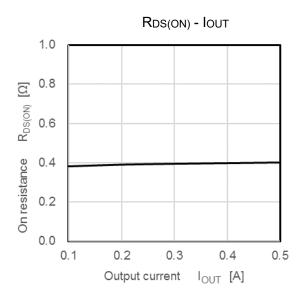


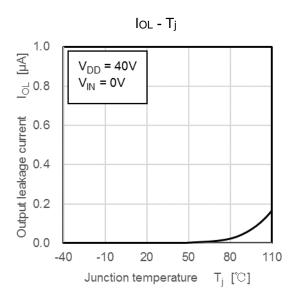




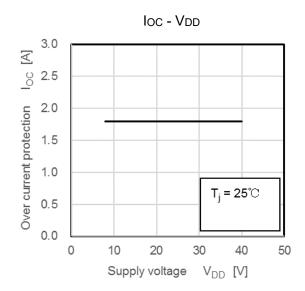


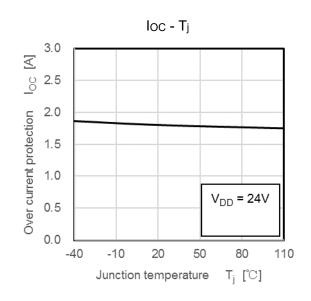


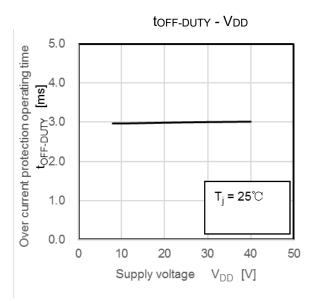


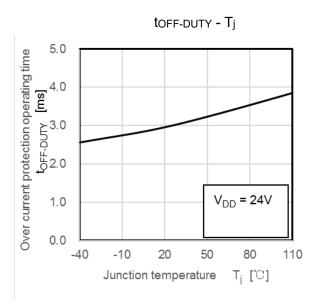


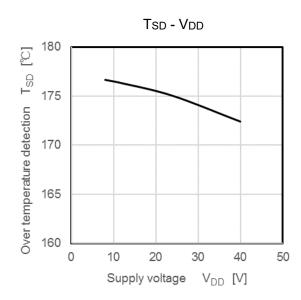


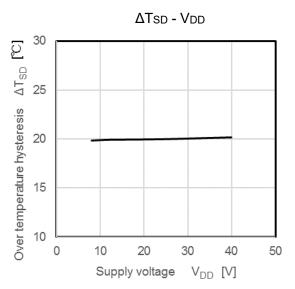




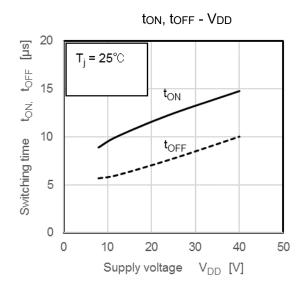


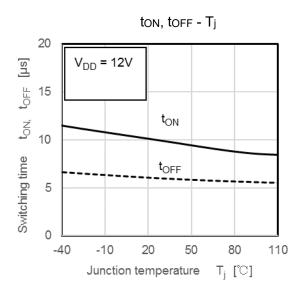


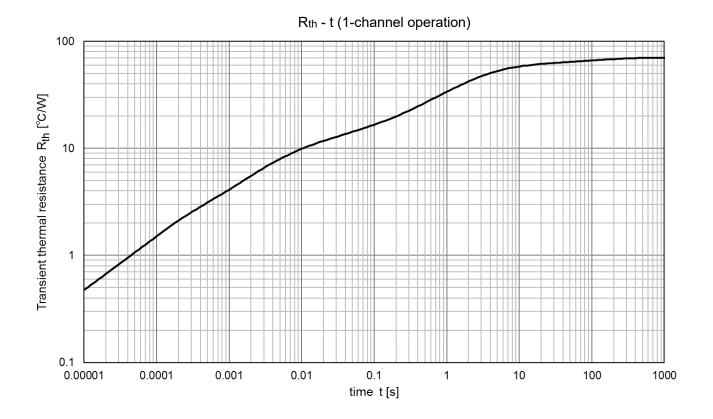












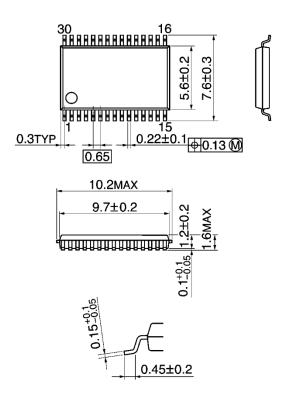
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# 13. Package Information

## 13.1. Package Dimensions

Unit: mm



Weight: 0.176 g (Typ.)

Figure 13.1 Package Dimensions



## 13.2. Marking

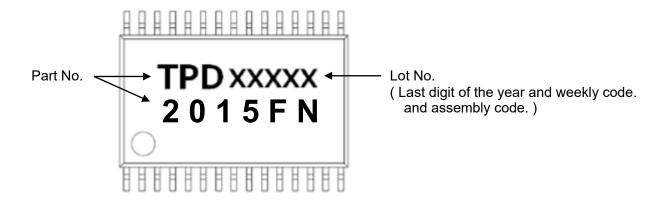


Figure 13.2 Marking

## 13.3. Land Pattern Dimensions for Reference only

\$\$SOP30-P-300-0.65

"Unit: mm"

Figure 13.3 Land Pattern Dimensions for Reference only



## 14. IC Usage Considerations

### 14.1. Notes on handling of ICs

The absolute maximum ratings of a semiconductor device are a set of ratings that must not be exceeded, even for a moment.

### 14.2. Notes on moisture-proof packaging

After opening the moisture-proof package, mount it within 168 hours in an environment of 30 °C and RH 60% or less.

Since it cannot be baked due to embossing, be sure to use it within the permissible range after opening the moisture-proof packaging.

The standard packing quantity for taping is 2000 pieces / reel.



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