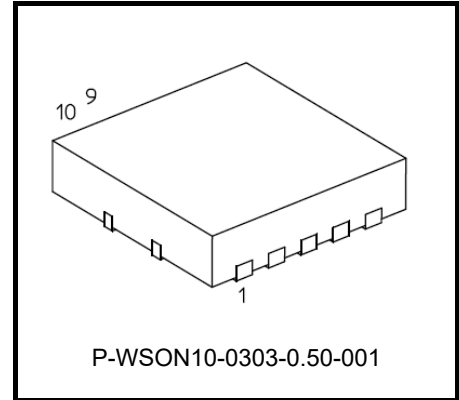


Toshiba Intelligent Power Device Silicon Monolithic Power MOS Integrated Circuit

## TPD1055FA

For Motor, Solenoid and Lamp  
High side power switch

TPD1055FA is a High-side switch of a P channel DMOS output. It is monolithic power IC that can be driven directly from a CMOS or TTL logic circuit (MPU etc.), and was equipped with the intelligent function of protection and diagnosis.

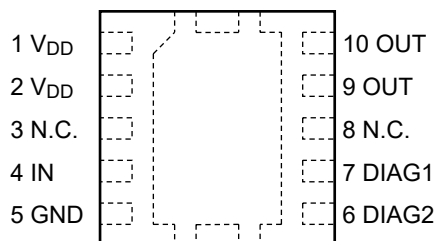


Weight:0.02g(typ.)

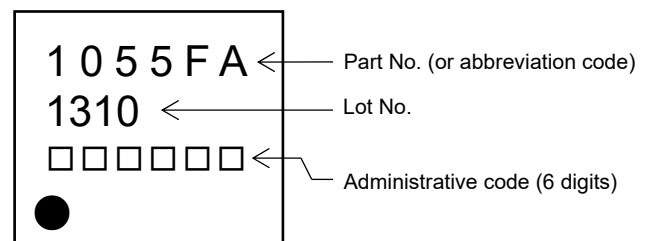
### Features

- A monolithic power IC with a structure combining a control block and a power MOSFET (D-MOS) on single chip.
- One side of load can be grounded to a high-side switch.
- AEC-Q100 qualified.
- Can directly drive a power load from CMOS or TTL logic.
- Built-in protection circuits against over temperature, over current.
- Incorporates a diagnosis function that allows diagnosis output to be read externally at battery short, load short-circuiting, opening, or over temperature.
- Up to  $V_{DD} - 40V$  (Min) of counter electromotive force from an inductance load can be applied.
- Low on-resistance:  $R_{DS(ON)}=0.12\Omega(\text{Max})$  (@  $V_{DD} = 12V$ ,  $T_{ch} = 25^\circ\text{C}$ ,  $I_o = -2A$ )
- WSON10 package for surface mounting that is packed in embossed tape.

### Pin Assignment (top view)



### Marking

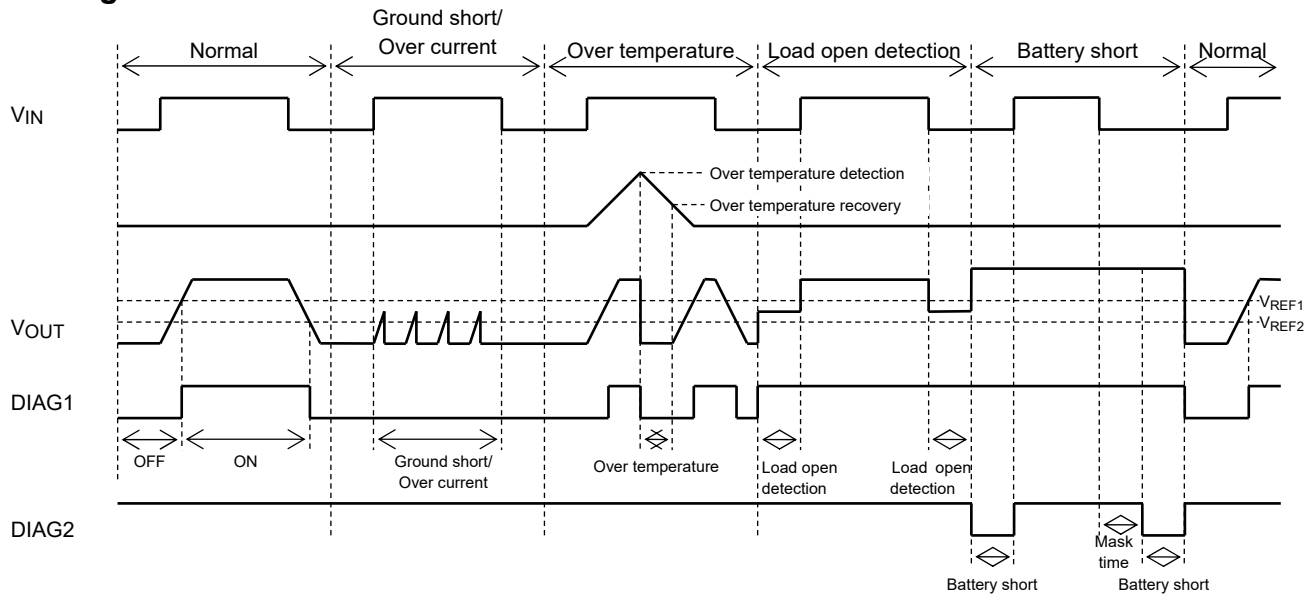


Due to its MOS structure, this product is sensitive to static electricity.

Start of commercial production  
2013-12



### Timing Chart



### Truth Table

Input signal VIN	Output voltage VOUT	Output state	Operating state
L	L	Off	Normal
H	H	On	
L	H(Note 1)	Off	Load open detection
H	H	On	
L	H	Off	Battery short
H	H	On	
L	L	Off	Ground short / Over current
H	L	Current limit (Switching)	
L	L	Off	Over temperature
H	L	Off	

Note 1: Internal voltage in TPD1055FA and external voltage decide this output voltage.

Input signal VIN	Output voltage VOUT	Diagnosis state			
		VDIAG1	State	VDIAG2	state
L	$V_{OUT} < V_{REF2}$	L	Normally off	H	-
	$V_{REF2} \leq V_{OUT} < V_{REF1}$	H	Load open detection	H	-
	$V_{REF1} \leq V_{OUT}$	H	-	L	Battery short
H	$V_{REF1} \leq V_{OUT}$	H	Normally on	H	-
	$V_{OUT} < V_{REF1}$	L	Over current(Load short)/ Over temperature	H	-

$V_{REF2}$ :  $V_{IH}=1.8V(Typ.) / V_{IL}=1.6V(Typ.)$  \* Hysteresis 0.2V

$V_{REF1}$ :  $V_{IH}=V_{DD}-1.0V(Typ.) / V_{IL}=V_{DD}-1.5V(Typ.)$  \* Hysteresis 0.5V

## Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit	Note
Drain-source voltage	V <sub>DS</sub>	40.0	V	P channel
Supply voltage	DC	V <sub>DD(1)</sub>	-0.3 to 25.0	-
	Pulse	V <sub>DD(2)</sub>	40.0	Range exceeding 25.0V is within 0.3s.
Input voltage	V <sub>IN</sub>	-0.3 to 6.0	V	-
Diagnosis output voltage	V <sub>DIAG</sub>	-0.3 to 6.0	V	-
Output voltage	V <sub>OUT</sub>	(V <sub>DD</sub> -40.0) to (V <sub>DD</sub> +0.3)	V	-
Output current	I <sub>O</sub>	Internally Limited	A	-
Diagnosis current	I <sub>DIAG</sub>	5	mA	-
Power dissipation	P <sub>D</sub>	1.84	W	Note2
Operating temperature	T <sub>opr</sub>	-40 to 125	°C	-
Channel temperature	T <sub>ch</sub>	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).

## Thermal Resistance

Characteristic	Symbol	Rating	Unit
Channel to ambient thermal resistance	R <sub>th(ch-a)</sub>	67.6	°C /W

### Test conditions

#### Note 2:

- Glass epoxy board
- Material: FR-4(4 layer)
- Size: 76.2mm \* 114.3mm \* 1.6mm
- Via: ø0.3mm (2 points)

### Electrical Characteristics

(Unless otherwise specified,  $T_{ch} = -40$  to  $125\text{ }^{\circ}\text{C}$ ,  $V_{DD} = 5$  to  $18\text{ V}$ )

Characteristics	Symbol	Test circuit	Test condition	Min	Typ.	Max	Unit
Operating supply voltage	$V_{DD(opr)}$	-	-	5	-	18	V
Negative output voltage that can be applied to output	$V_{OUT(neg)}$	-	$V_{IN}=0\text{V}$	$V_{DD}-40$	-	-	V
Supply current	$I_{DD(off)}$	-	$V_{IN}=0\text{V}$ , Output open	-	1.0	2.5	mA
	$I_{DD(on)}$	-	$V_{IN}=5\text{V}$ , Output open	-	1.2	3.0	mA
Input voltage	$V_{IH}$	-	-	2.0	-	-	V
	$V_{IL}$	-	-	-	-	0.8	V
Input current	$I_{IN(1)}$	-	$V_{IN}=5\text{V}$	-	15	50	$\mu\text{A}$
	$I_{IN(2)}$	-	$V_{IN}=0\text{V}$	-1	-	1	$\mu\text{A}$
On resistance	$R_{DS(ON)}$	-	$V_{DD}=8$ to $18\text{V}$ , $I_O=-2\text{A}$ , $T_{ch}=25\text{ }^{\circ}\text{C}$	-	0.08	0.12	$\Omega$
Output leakage current	$I_{OL}$	-	$V_{IN}=0\text{V}$ , $V_{OUT}=0\text{V}$	-500	-120	-	$\mu\text{A}$
Diagnosis output voltage	"L"-level $V_{DL}$	-	$I_{DIAG}=1\text{mA}$	-	0.15	0.40	V
Diagnosis output current	"H"-level $I_{DH}$	-	$V_{DIAG}=5\text{V}$	-	-	10	$\mu\text{A}$
Over current detection	$I_{OC}$	-	-	-9	-5	-3	A
Over current off time	Short-Toff	-	$V_{DD}=12\text{V}$ , $R_L=0.1\Omega$ , $T_{ch}=25\text{ }^{\circ}\text{C}$	3.3	8.0	15.0	ms
Over temperature detection	Temperature $T_{OT}$	-	-	150	170	200	$^{\circ}\text{C}$
	Hysteresis $\Delta T_{OT}$	-	-	-	5	-	$^{\circ}\text{C}$
Load open detection resistance	$R_{OP}$	-	$V_{IN}=0\text{V}$	1	20	200	$\text{k}\Omega$
Load open detection voltage	$V_{OUT(OP)}$	-	$V_{IN}=0\text{V}$	-	$0.6 \cdot V_{DD}$	$0.7 \cdot V_{DD}$	V
Battery short detection voltage	Temperature $V_{REF1}$	-	$V_{IN}=0\text{V}$ , $V_{OUT}=L$ to $H$	$V_{DD}-1.5$	$V_{DD}-1.0$	$V_{DD}-0.7$	V
	Hysteresis $\Delta V_{REF1}$	-	-	-	0.5	-	V
Battery short detection mask time	$T_{mask}$	-	$V_{OUT}=V_{DD}$ , $V_{IN} \downarrow$ to $DIAG2 \downarrow$	50	110	200	$\mu\text{s}$
Switching time	$t_{on}$	1	$V_{DD}=12\text{V}$ , $R_L=10\Omega$ , $T_{ch}=25\text{ }^{\circ}\text{C}$	-	20	50	$\mu\text{s}$
	$t_{off}$			-	20	50	$\mu\text{s}$

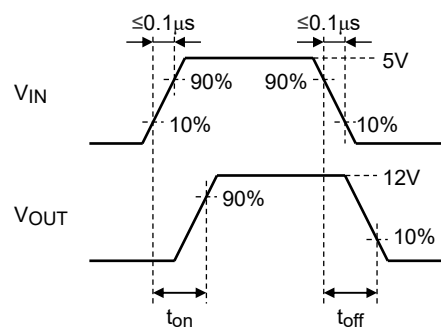
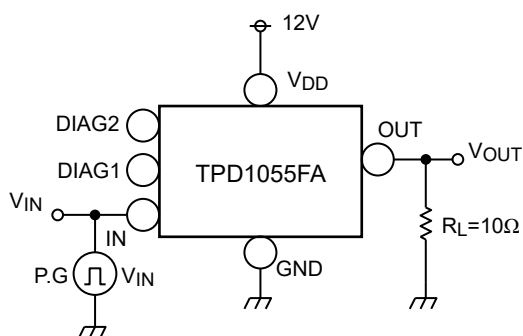
\*Typical characteristic conditions are  $V_{DD}=12\text{V}$ ,  $T_{ch}=25\text{ }^{\circ}\text{C}$ .

\*Sink current to this IC is expressed by "+", source current from this IC is expressed by "-".

\*The voltage range that can detect difference between Load open and battery short is  $V_{DD} \geq 7\text{V}$ .

### Test Circuit 1

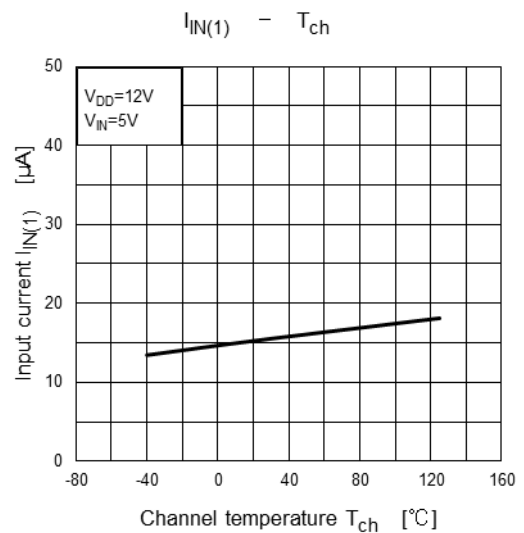
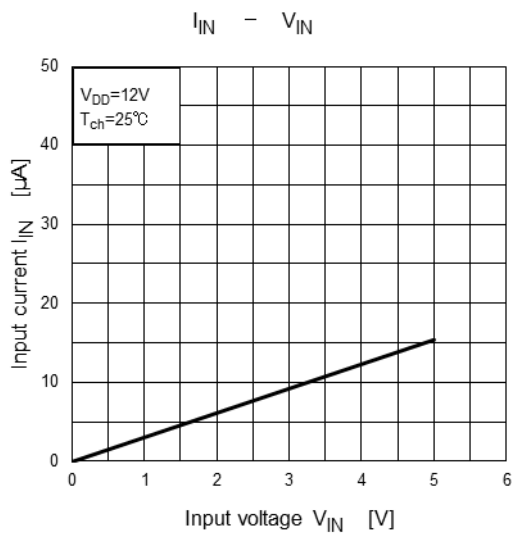
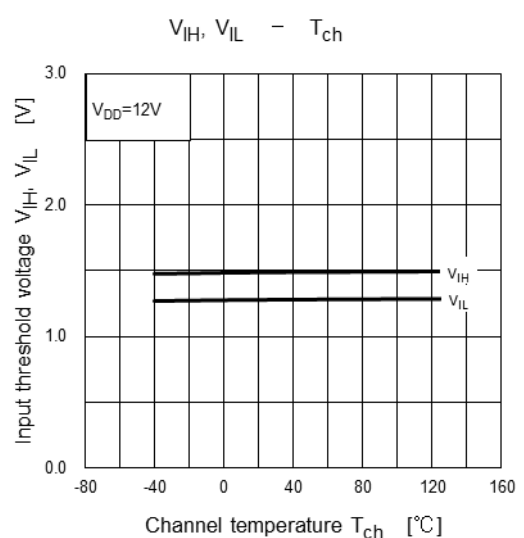
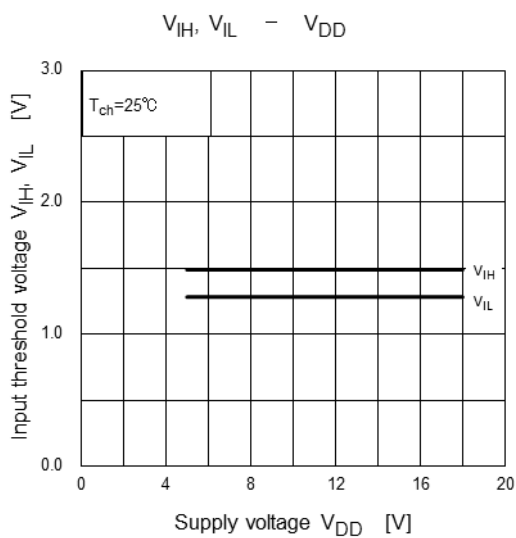
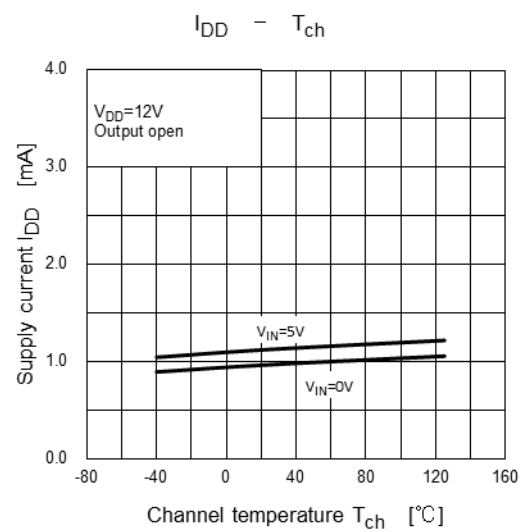
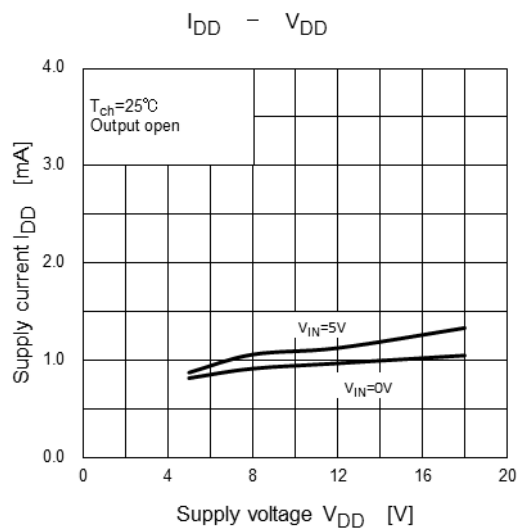
Switching times  $t_{on}$ ,  $t_{off}$

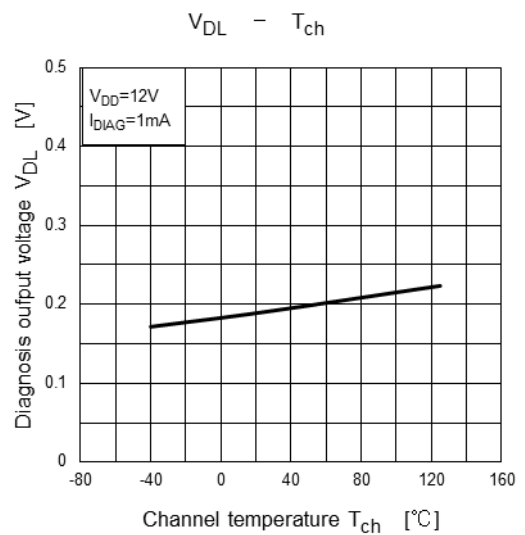
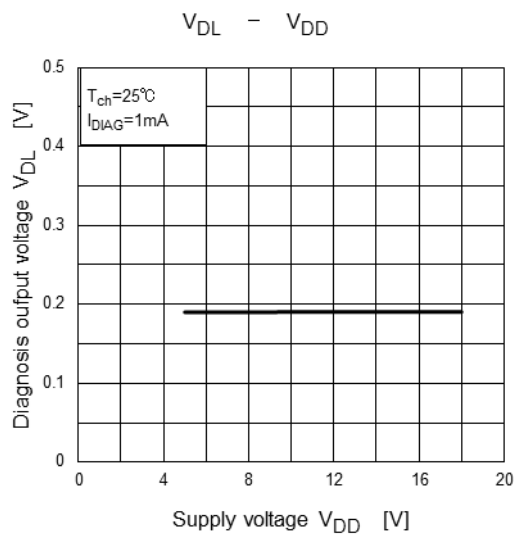
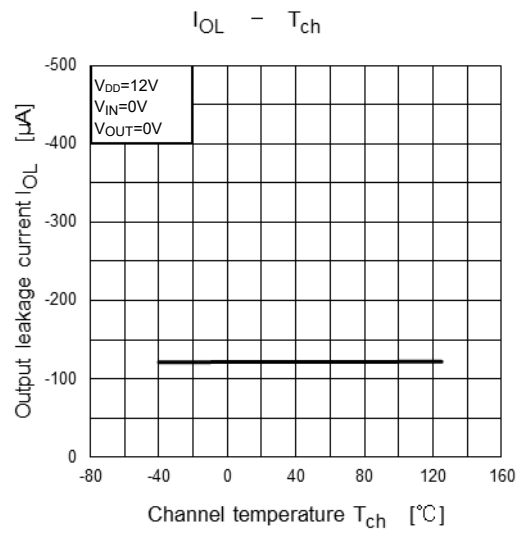
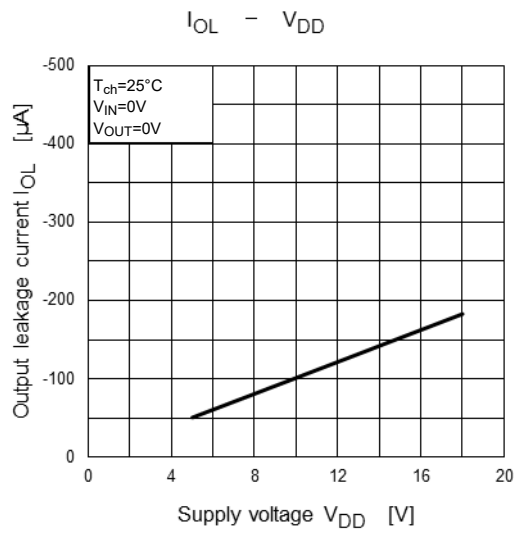
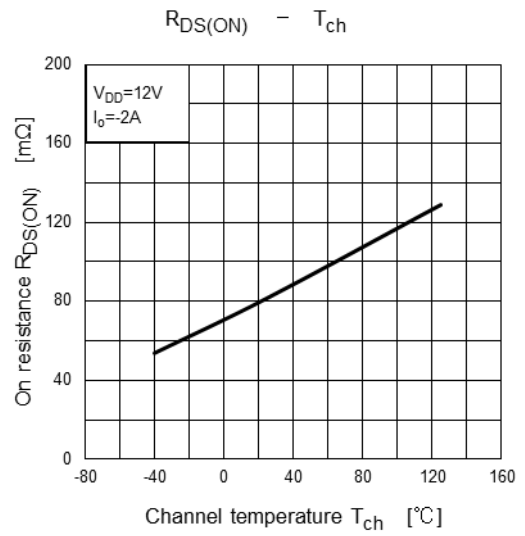
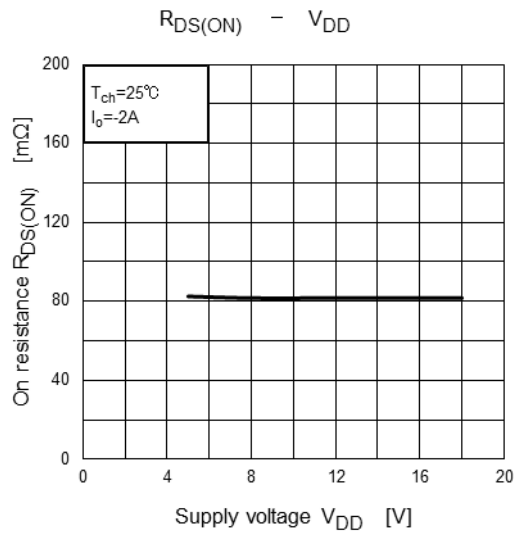


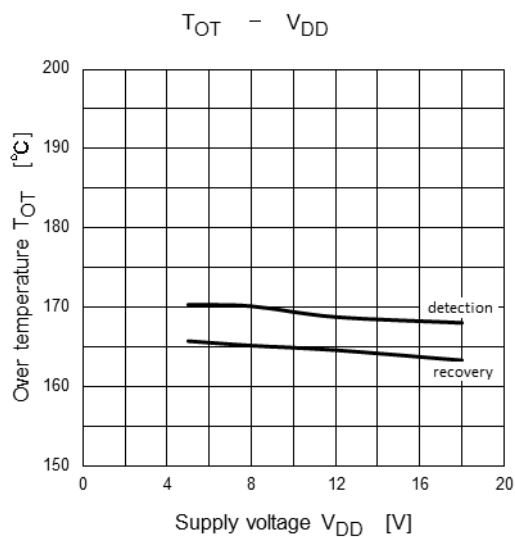
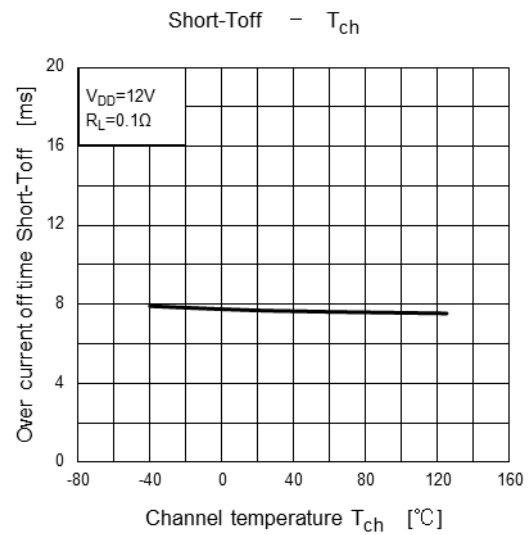
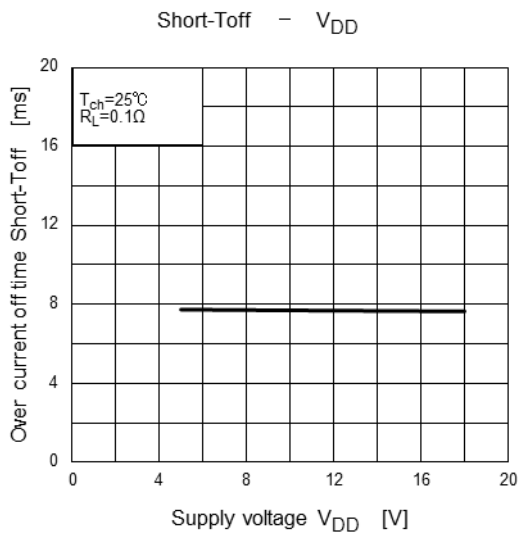
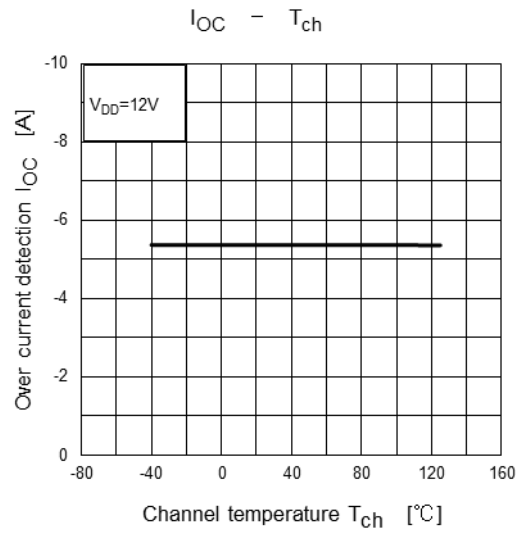
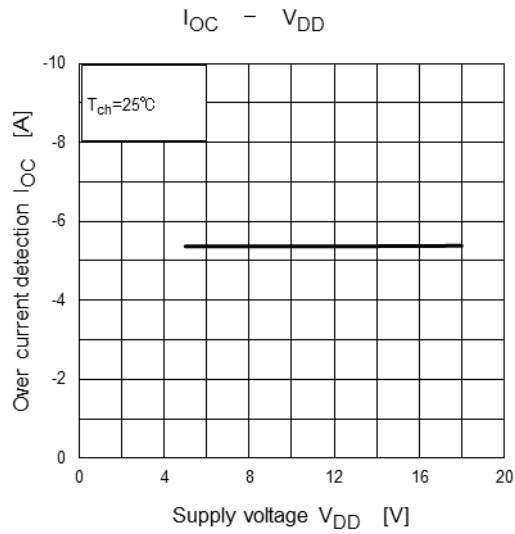
\*Because TPD1055FA does not have output clamp circuit, in the case of inductance load, connect flywheel diode.

### Characteristic curves

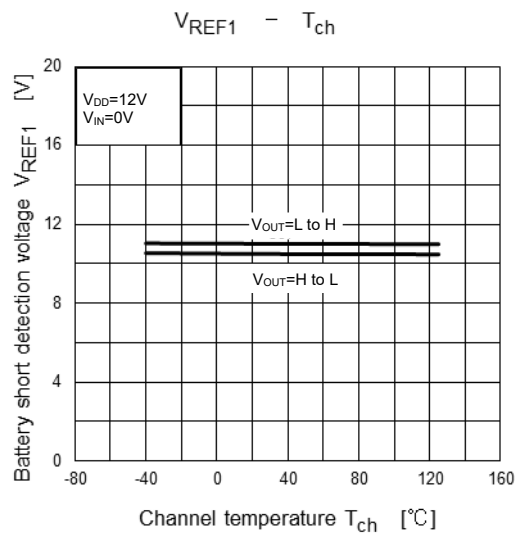
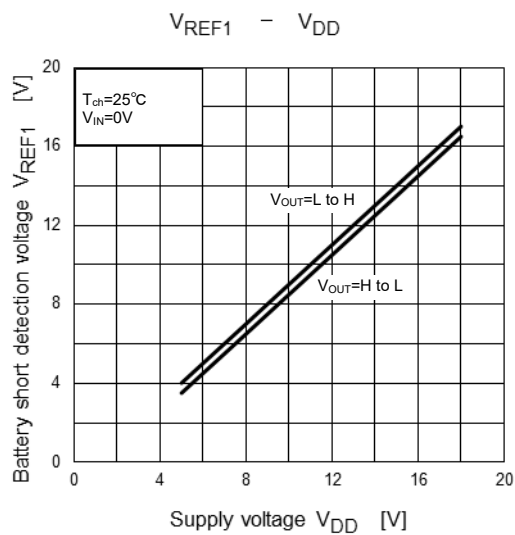
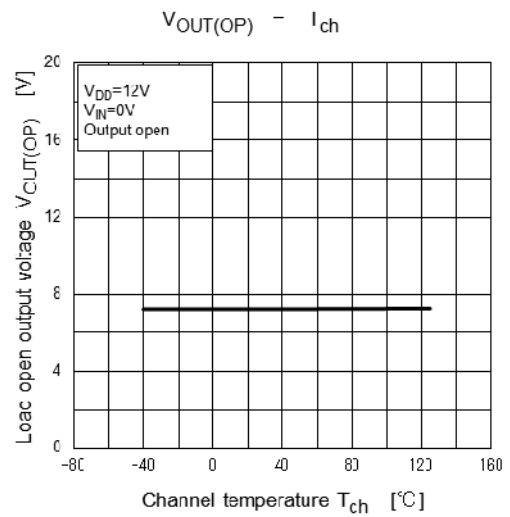
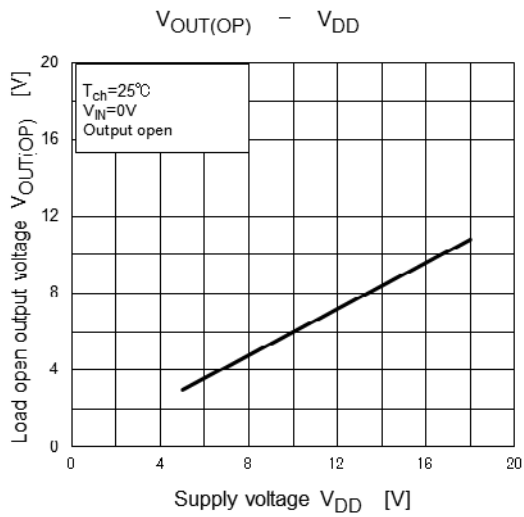
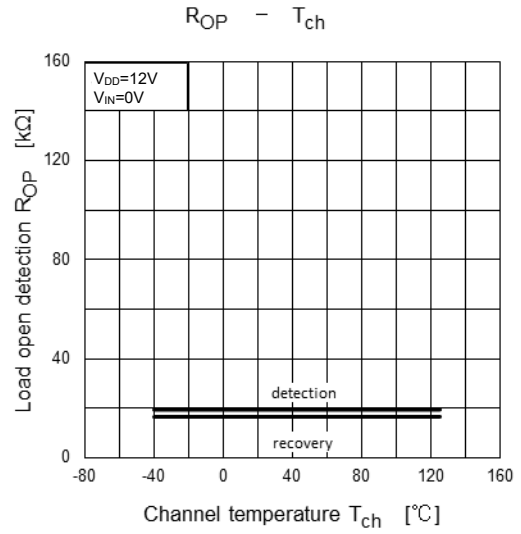
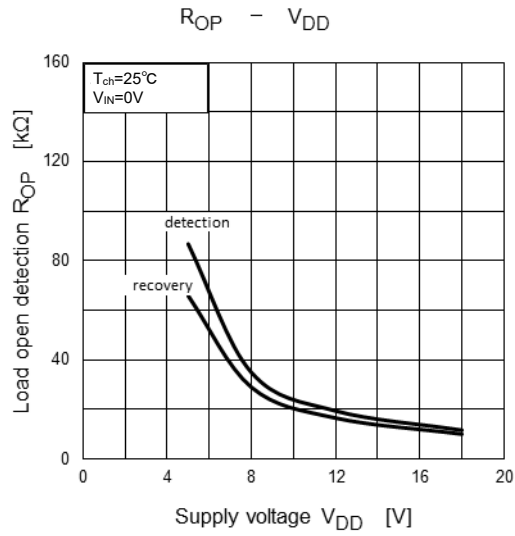
The below characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

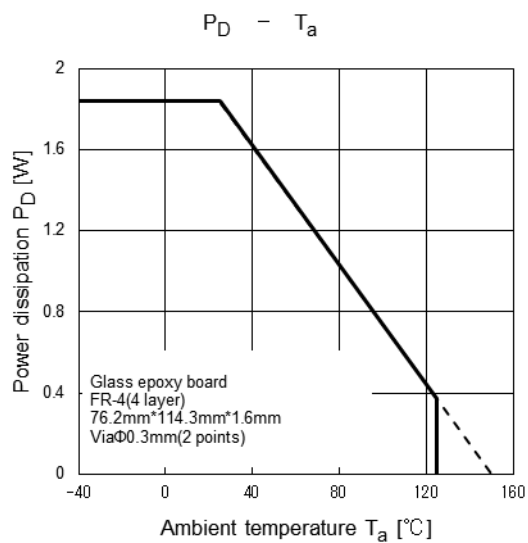
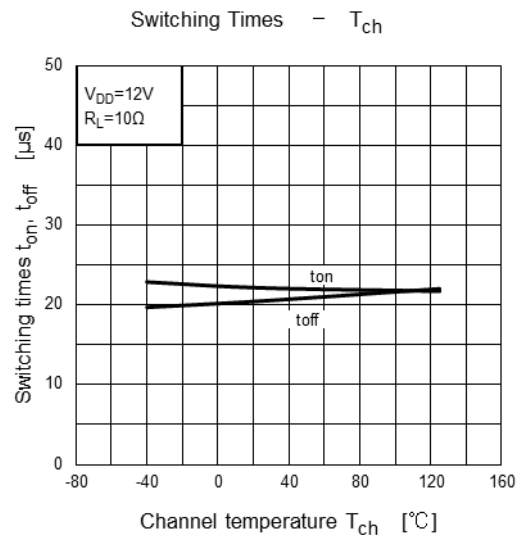
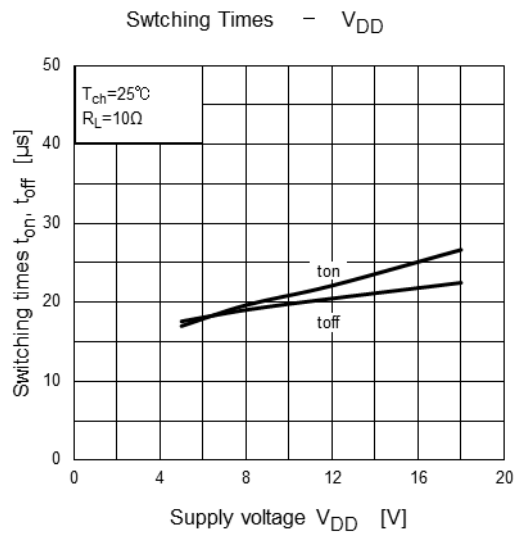
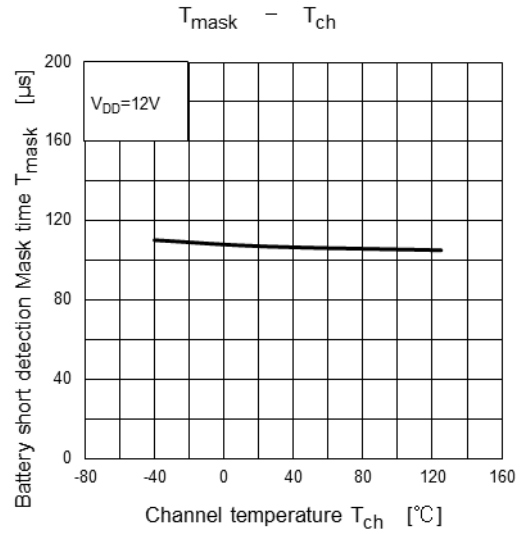
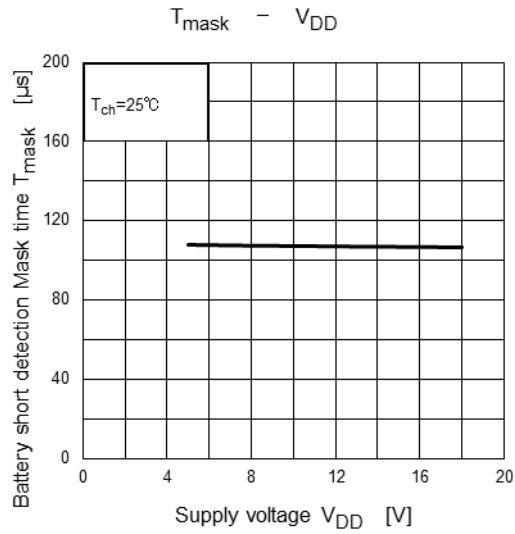






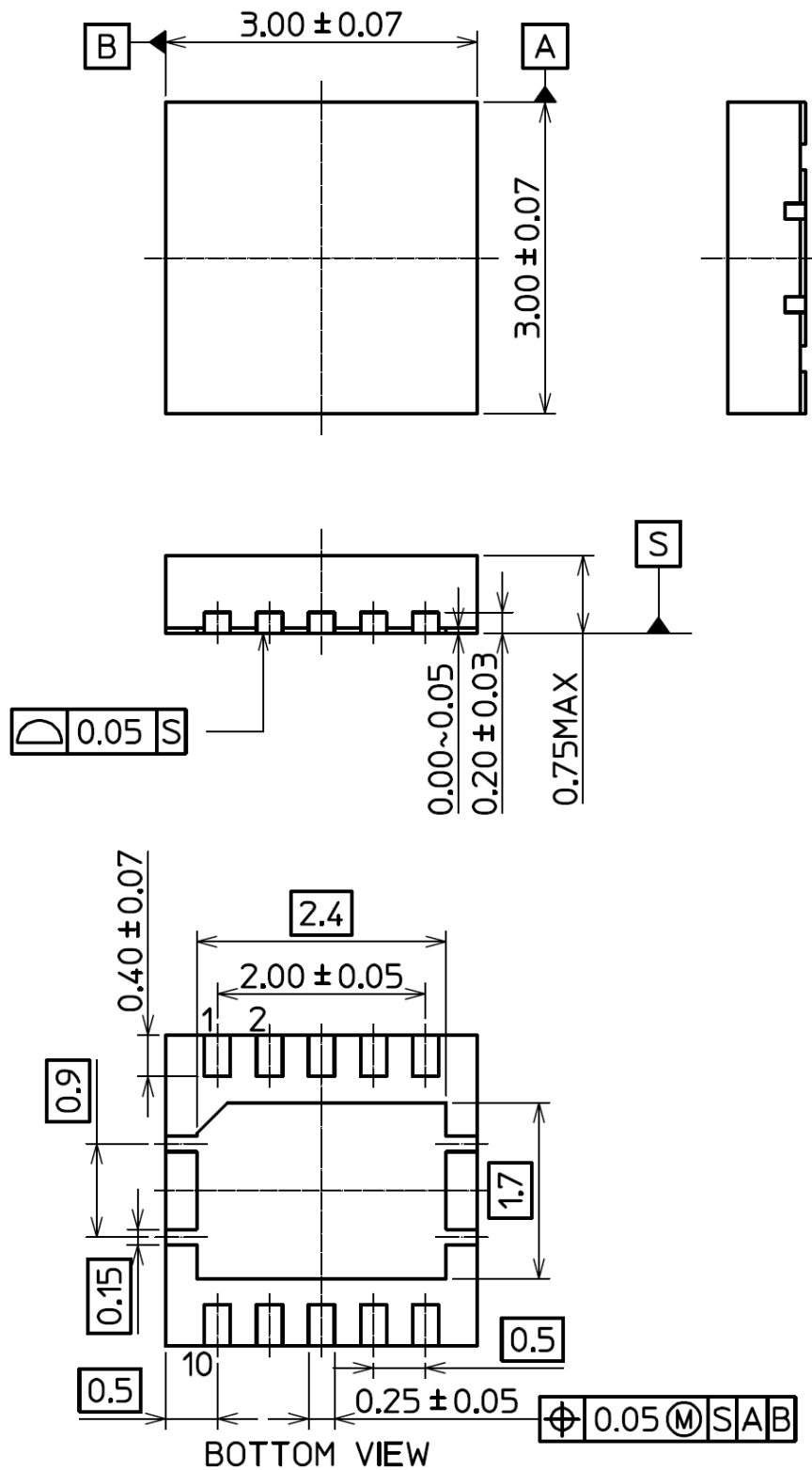






## Package Dimensions

Unit: mm



Weight: 0.02g(typ.)

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