

TENTATIVE

TOSHIBA INTELLIGENT POWER DEVICE  
SILICON MONOLITHIC POWER MOS INTEGRATED CIRCUIT

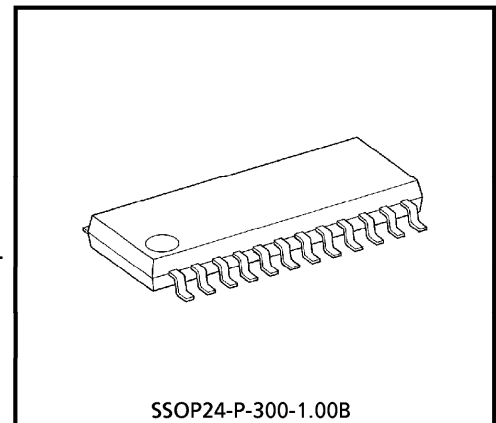
# TPD7100F

## 2ch HIGH-SIDE N-ch POWER MOSFET GATE DRIVER

The TPD7100F is a 2ch High-side N-ch Power MOSFET Gate Driver. This IC contains a power MOSFET driver and power MOSFET protective and diagnostic functions, allowing you to configure a high-side switch for large-current applications easily.

### FEATURES

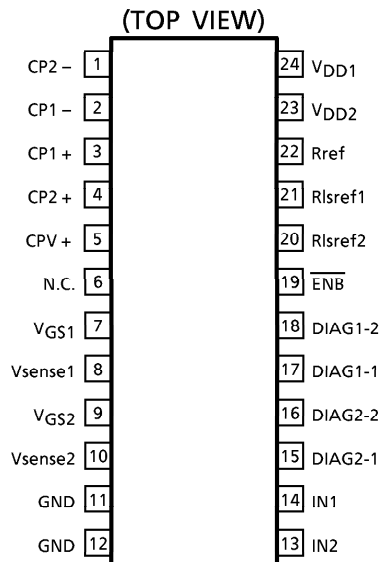
- The large-current charge pump allows for fast switching.
- Power MOSFET protective and diagnostic functions are built-in.  
Protective functions : Overvoltage (internal device protection), overcurrent protection,  $V_{DD}$  voltage drop detection  
\* Overvoltage is internally limited. No detection or shutdown functions are included.  
Diagnostic functions: Overcurrent
- The level of Overcurrent detection can set by external resistor.
- Package : SSOP-24 (300 mil) with embossed-tape packing



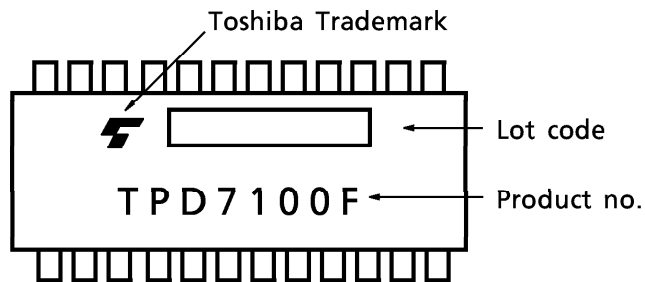
Weight : 0.29 g (Typ.)

Because this product uses MOS structure, must take special care with electrostatic when handling.

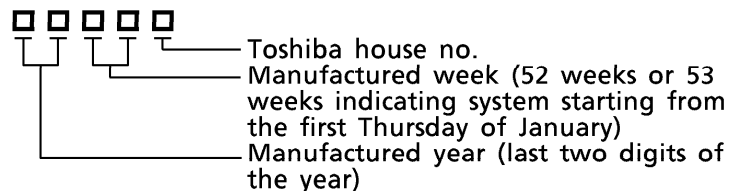
### PIN ASSIGNMENT



### MARKING



#### Lot code naming system

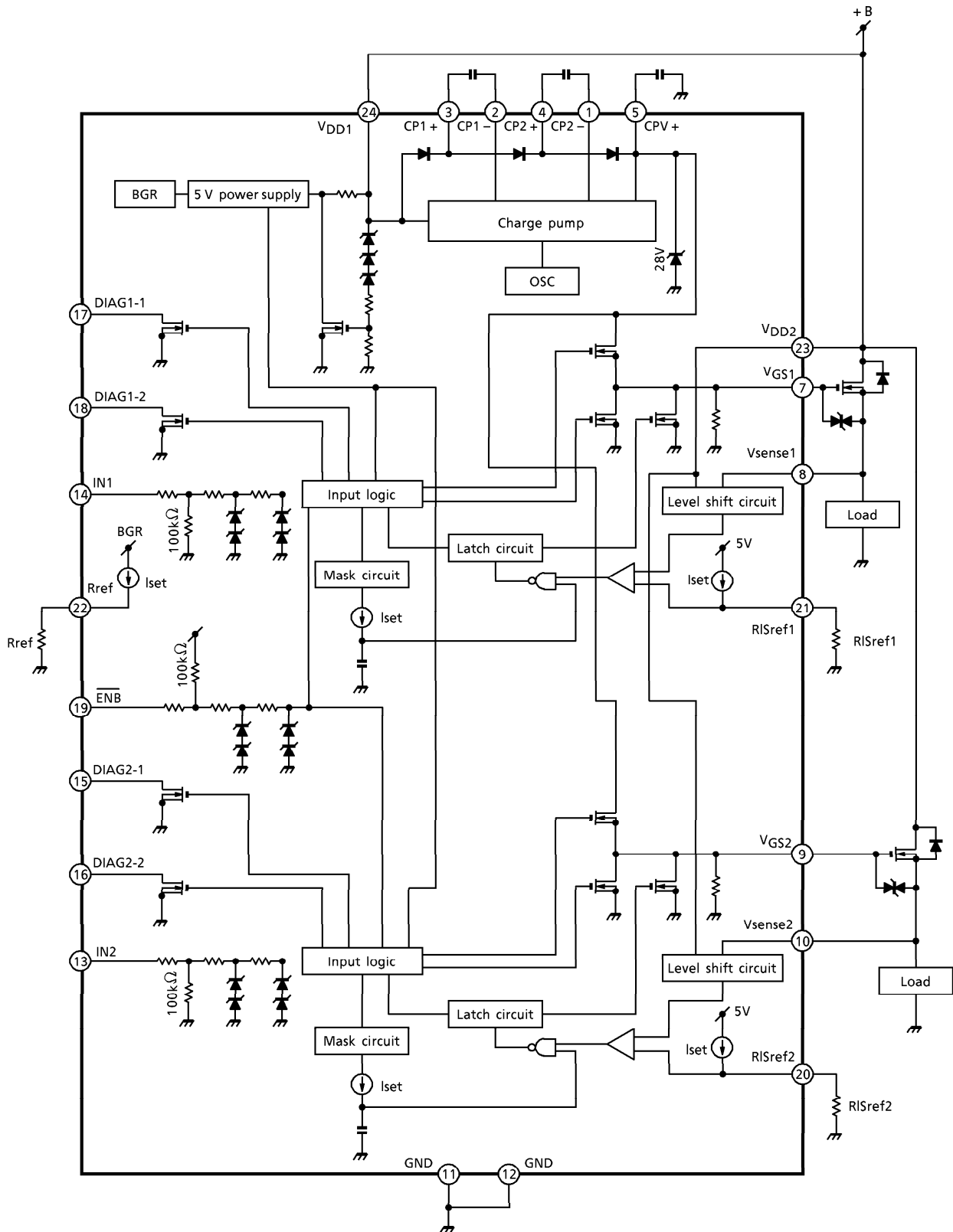


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BLOCK DIAGRAM



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## PIN DESCRIPTION

PIN NO.	SYMBOL	PIN DESCRIPTION
1	CP2 –	Negative side connecting pin for the charge pump's second capacitor.
2	CP1 –	Negative side connecting pin for the charge pump's first capacitor.
3	CP1 +	Positive side connecting pin for the charge pump's first capacitor.
4	CP2 +	Positive side connecting pin for the charge pump's second capacitor.
5	CPV +	Positive side connecting pin for the charge pump's third capacitor. Although about three times the $V_{DD}$ voltage is generated, it is limited about 28 V by a voltage clamping circuit.
6	N.C.	—
7	$V_{GS1}$	External power MOSFET gate drive pin for ch1. This pin controls the external power MOSFET. Also, when overcurrent flows in the external power MOSFET, it shuts down the gate and is latched. It is unlatched by a low on input.
8	$V_{sense1}$	External power MOSFET monitor pin for ch1 : overcurrent is detected by comparing the difference between this and the $V_{DD2}$ pin with the reference voltage.
9	$V_{GS2}$	External power MOSFET gate drive pin for ch2. This pin controls the external power MOSFET. Also, when overcurrent flows in the external power MOSFET, it shuts down the gate and is latched. It is unlatched by a low on input.
10	$V_{sense2}$	External power MOSFET monitor pin for ch2 : overcurrent is detected by comparing the difference between this and the $V_{DD2}$ pin with the reference voltage.
11	GND	Ground pin : shared internally with pin 12.
12	GND	Shared internally with pin 11.
13	IN2	Input pin for ch2 (active high) : This pin has a pull-down resistor (100 k $\Omega$ typ.), so that even when it is open-circuited, output will not turn on inadvertently.
14	IN1	Input pin for ch1 (active high) : This pin has a pull-down resistor (100 k $\Omega$ typ.), so that even when it is open-circuited, output will not turn on inadvertently.
15	DIAG2-1	Diagnostic output pin for ch2 (N-ch open-drain) : when overcurrent condition is detected, its output goes low. Also, when overcurrent is detected, it remains latched until the next rising edge of input.
16	DIAG2-2	Diagnostic output pin for ch2 (N-ch open-drain) : by comparing the voltage between $V_{DD2}$ and $V_{sense2}$ pins with the set overcurrent level, it outputs external power MOSFET on/off state.
17	DIAG1-1	Diagnostic output pin for ch1 (N-ch open-drain) : when overcurrent condition is detected, its output goes low. Also, when overcurrent is detected, it remains latched until the next rising edge of input.
18	DIAG1-2	Diagnostic output pin for ch1 (N-ch open-drain) : by comparing the voltage between $V_{DD2}$ and $V_{sense1}$ pins with the set overcurrent level, it outputs external power MOSFET on/off state.
19	$\overline{ENB}$	Chip inhibit pin (active low) : By driving this pin high, all outputs can be turned off regardless of input signals. This pin has a pull-up resistor (100 k $\Omega$ typ.).

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PIN NO.	SYMBOL	PIN DESCRIPTION
20	RSref2	Overcurrent detection level setup pin for ch2 : the voltage determined by the constant current set by the resistor connected to the Rref pin and the resistance of an external resistor connected to the RSref2 pin is referenced to detect overcurrent.
21	RSref1	Overcurrent detection level setup pin for ch1 : the voltage determined by the constant current set by the resistor connected to the Rref pin and the resistance of an external resistor connected to the RSref1 pin is referenced to detect overcurrent.
22	Rref	Resistor connection pin ; This resistor determines the constant current used for the overcurrent detection circuit. Connect 62 k $\Omega$ (recommended) between this pin and GND.
23	VDD2	External power MOSFET drain voltage detection pin.
24	VDD1	Power supply pin : the internal device is protected when overvoltage is applied.

**MAXIMUM RATING** (Ta = 25°C)

CHARACTERISTICS	SYMBOL	RATING	UNIT
Power Supply Voltage	VDD	30	V
Input Voltage	VIN	0.5~6	V
Diagnosis Output Current	IDIAG	2	mA
Power Dissipation	PD	0.8	W
Operating Temperature	Topr	-40~110	°C
Storage Temperature	Tstg	-55~150	°C

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**ELECTRICAL CHARACTERISTICS** (Unless otherwise specified :  $V_{DD} = 8\sim 18\text{V}$ ,  $T_j = -40\sim 110^\circ\text{C}$ )

CHARACTERISTICS	RATING	PIN NO.	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Supply Voltage	$V_{DD}$	$V_{DD}$	—	8	—	18	V
Supply Current	$I_{DD}$	$V_{DD}$	$V_{DD} = 12\text{V}$ , $V_{IN} = 0\text{V}$ , $CP = 0.01\ \mu\text{F}$	—	—	10	mA
Input Voltage	$V_{IN(1)}$	IN1, IN2	$V_{DD} = 12\text{V}$ , $V_{GS} = \text{“H”}$	3.5	—	—	V
	$V_{IN(2)}$		$V_{DD} = 12\text{V}$ , $V_{GS} = \text{“L”}$	—	—	1.5	
Input Current	$I_{IN(1)}$	IN1, IN2	$V_{DD} = 12\text{V}$ , $V_{IN} = 5\text{V}$	—	—	200	$\mu\text{A}$
	$I_{IN(2)}$		$V_{DD} = 12\text{V}$ , $V_{IN} = 0\text{V}$	-1	—	1	
	$I_{\overline{ENB}(1)}$	$\overline{ENB}$	$V_{DD} = 12\text{V}$ , $V_{\overline{ENB}} = 5\text{V}$	-45	—	—	
	$I_{\overline{ENB}(2)}$		$V_{DD} = 12\text{V}$ , $V_{\overline{ENB}} = 0\text{V}$	-250	—	—	
Output Voltage	$V_{OH}$	$V_{GS1}$ $V_{GS2}$	$V_{DD} = 12\text{V}$ , $V_{IN} = 5\text{V}$	—	$V_{\text{sense}} + 15^*$	$V_{\text{sense}} + 19^*$	V
	$V_{OL}$		$V_{DD} = 12\text{V}$ , $V_{IN} = 0\text{V}$	—	—	0.4	
Output Current	$I_{OH}$		$V_{DD} = 12\text{V}$ , $V_{IN} = 5\text{V}$ , $CP = 0.01\ \mu\text{F}$	—	0.1	—	A
	$I_{OL}$		$V_{DD} = 12\text{V}$ , $V_{IN} = 0\text{V}$ , $CP = 0.01\ \mu\text{F}$	—	0.1	—	
Overcurrent Detection Resistance Setup Range	$R_{ISref}$	$R_{ISref}$	—	10	20	40	$\text{k}\Omega$
Constant Current Source Setup Pin Voltage	$V_{Rref}$	$R_{ref}$	$R_{ref} = 62\ \text{k}\Omega$	1.17	1.30	1.43	V
Overcurrent Detection Voltage	$V_{DS(ON)(1)}$	$V_{DD2}$ $V_{\text{sense}1}$ $V_{\text{sense}2}$	$R_{ref} = 62\ \text{k}\Omega$ , $R_{ISref} = 10\ \text{k}\Omega$	0.16	0.20	0.24	V
	$V_{DS(ON)(2)}$		$R_{ref} = 62\ \text{k}\Omega$ , $R_{ISref} = 20\ \text{k}\Omega$	0.32	0.40	0.48	
	$V_{DS(ON)(3)}$		$R_{ref} = 62\ \text{k}\Omega$ , $R_{ISref} = 40\ \text{k}\Omega$	0.64	0.80	0.96	
Diagnostic Output Current	$I_{DH}$	DIAG1	$V_{DD} = 12\text{V}$ , $V_{DIAG} = 5\text{V}$	—	—	10	$\mu\text{A}$
Diagnostic Output Voltage	$V_{DL}$	DIAG2	$V_{DD} = 12\text{V}$ , $I_{DL} = 1\text{mA}$	—	—	0.6	V
Power Supply Drop Detection Voltage	$V_{DDUV1-}$	$V_{DD}$	—	6.3	6.7	7.3	V
Power Supply Drop Detection Reset Voltage	$V_{DDUV1+}$		—	6.6	7.2	7.8	
Undervoltage Protection	$V_{DDUV2}$		—	—	—	4.5	
Switching Time	$t_{ON}$	$V_{GS1}$	$V_{DD} = 12\text{V}$ , $C = 3000\ \text{pF}$	—	2	5	$\mu\text{s}$
	$t_{OFF}$	$V_{GS2}$		—	2	5	

\* :  $V_{\text{sense}}$  denotes the  $V_{\text{sense}}$  pin voltage.

Equation to calculate overcurrent detection resistance ( $R_{ISref}$ )

$$R_{ISref} = R_{ref} \times R_{DS(ON)} \times I_D / V_{Rref}$$

$$= R_{ref} \times V_{DS(ON)} / V_{Rref}$$

where  $R_{DS(ON)}$  : ON-resistance of external power MOSFET

$I_D$  : drain current of external power MOSFET

$V_{DS(ON)}$  : ON-voltage of external power MOSFET

$R_{ref}$  : external resistor connected to  $R_{ref}$  pin (used to set constant current)

$V_{Rref}$  :  $R_{ref}$  pin voltage

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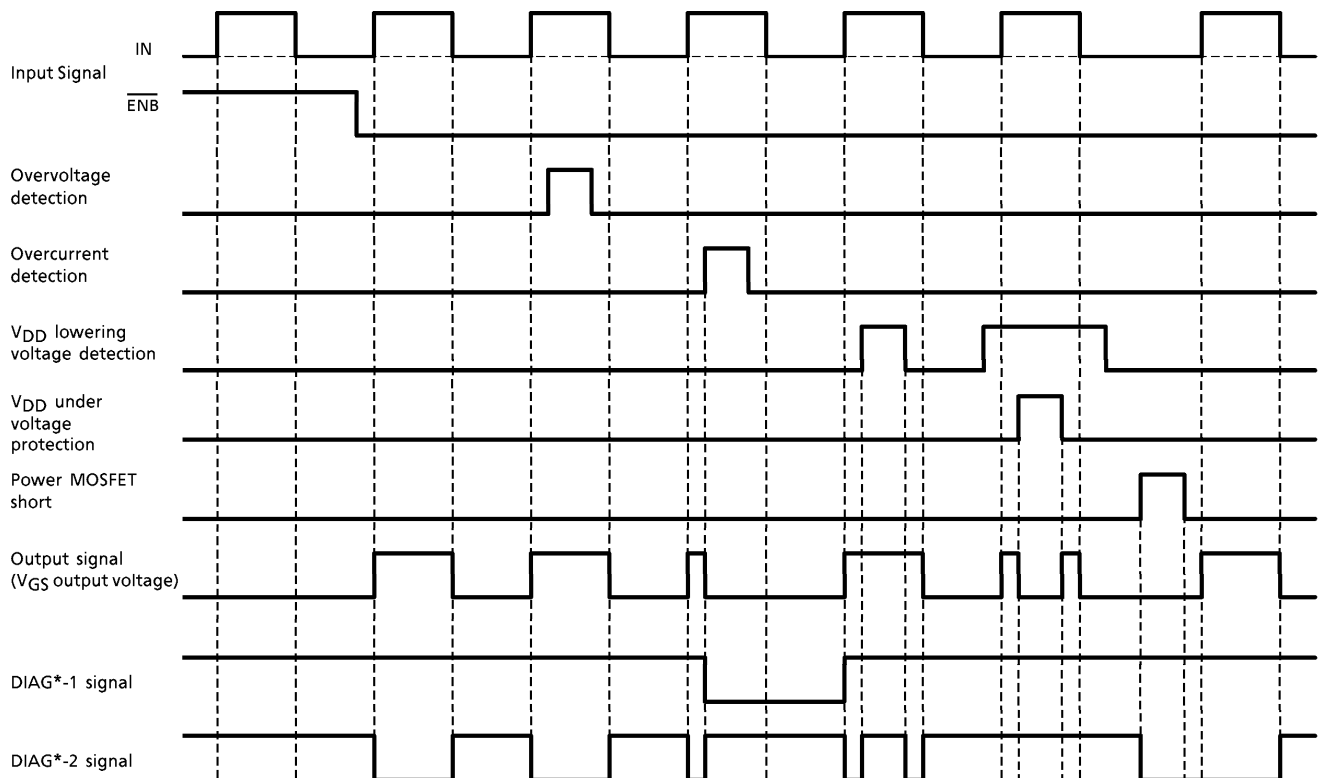
**TRUTH TABLE**

IN	ENB	V <sub>GS</sub>	DIAG*-1	DIAG*-2	MODE
L	H	L	H	H	When normal
H	H	L	H	H	
L	L	L	H	H	
H	L	H	H (Note 1)	L	
L	L	L	H	H	For overvoltage
H	L	H	H (Note 1)	L	
L	L	L	L (Note 1/Note 2)	H	For overcurrent
H	L	L	L (Note 1)	H	
L	L	L	H	H	When supply voltage drop detected
H	L	H	H	H	
L	L	L	H	H	Undervoltage protection
H	L	L	H	H	
L	L	L	H	L	When power MOSFET shorted
H	L	H	H	L	

(Note 1) : Because overcurrent is detected by checking the drain-to-source voltage of the power MOSFET, there is a possibility of detecting overcurrent erratically for a while after input is driven high before the power MOSFET turns on, during which the drain-to-source voltage is high. To prevent this erroneous detection, DIAG detection is disabled for 15  $\mu$ s (typ.) by a mask circuit. This masking time depends on the constant current determined by the internal capacitor and Rref. (The masking time is 15  $\mu$ s when Rref = 62 k $\Omega$ .)

(Note 2) : After overcurrent is detected, DIAG remains latched until the next rising edge of input.

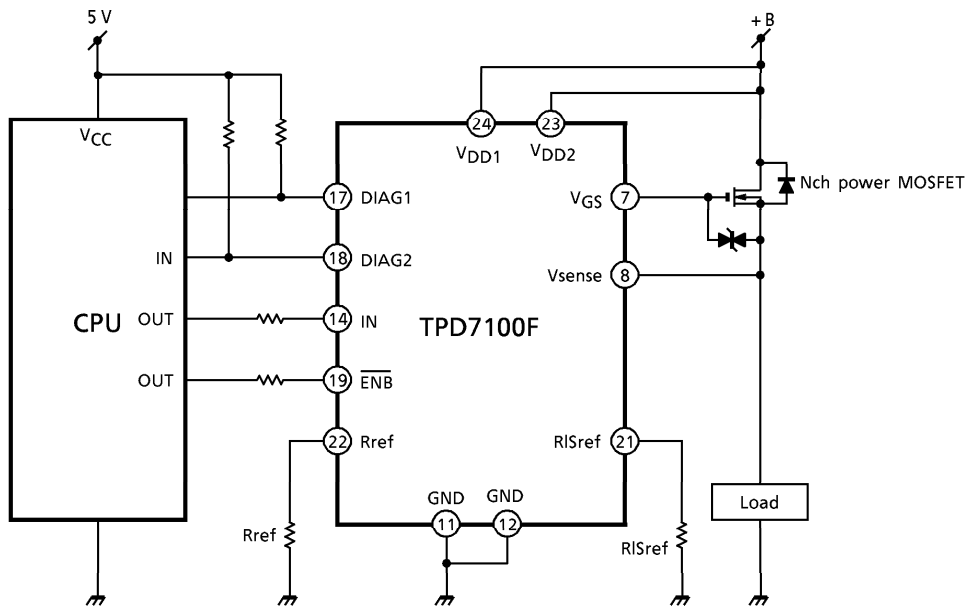
**TIMING CHART**



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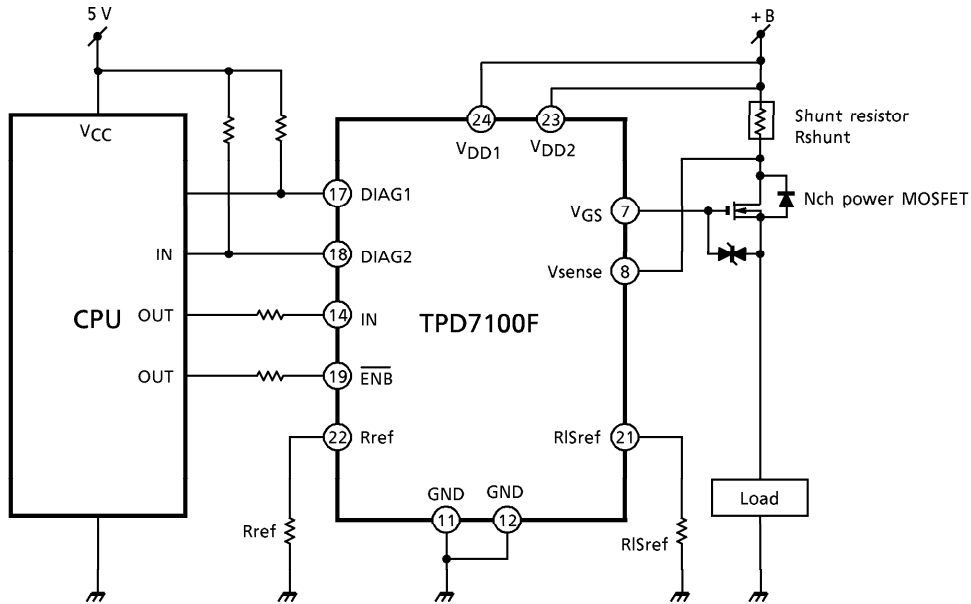
**APPLICATION CIRCUIT 1**

Monitoring Power MOSFET drain-source voltage



**APPLICATION CIRCUIT 2**

Monitoring voltage between shunt resistors (for detecting overcurrent with high accuracy)



**MOISTURE-PROOF PACKING**

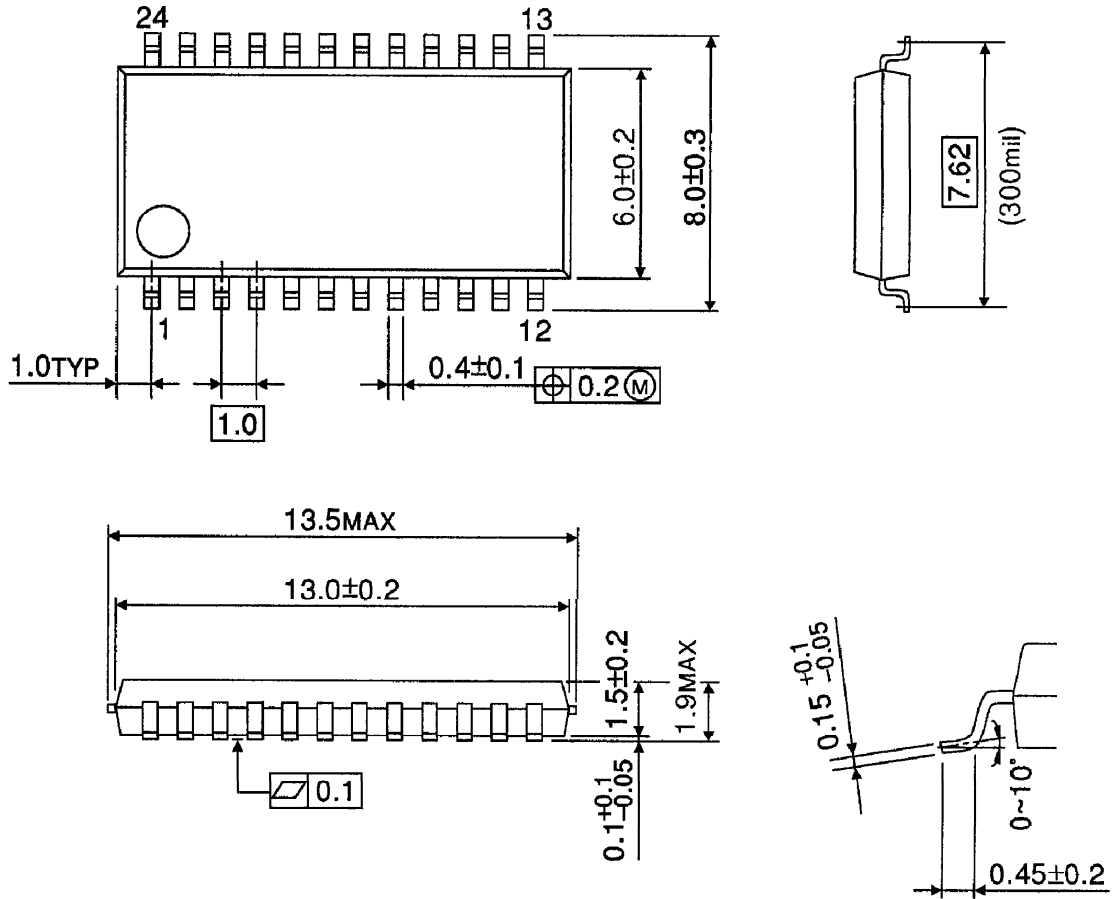
After the pack is opened, use the devices in a 30°C, 60% RH environment, and within the 48 hours. Embossed-tape packing cannot be baked. Devices so packed must be within their allowable time limits after unpacking, as specified on the packing.

Tape packing quantity: 500 devices/reel (EL) or 2000 devices/reel (EL1)

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PACKAGE DIMENSIONS  
SSOP24-P-300-1.00B

Unit : mm



Weight : 0.29 g (Typ.)