

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

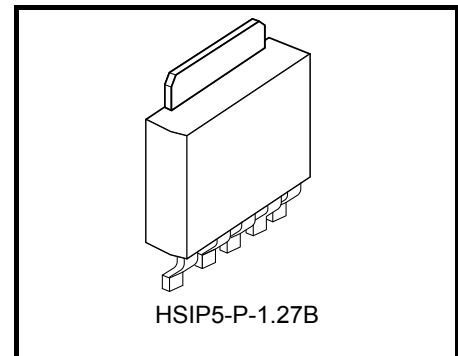
# TA58MS00F

## 500-mA Adjustable-Output Voltage Regulator with On/Off Switch

The TA58MS00F is a small surface-mount low-dropout voltage regulator that provides up to 500 mA of output current and an on/off switch. The output voltage can be freely programmed with external resistors, making the TA58MS00F suitable for a wide range of applications. The EN input can be used to turn on and off the device as necessary and thus helps save system power. The TA58MS00F is an ideal solution for power supply applications for audiovisual systems, office equipment and other digital electronics with a standby function, as well as for battery-operated portable devices.

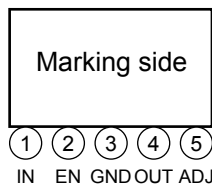
### Features

- Active-High on/off switch
- Up to 500-mA output current
- Output voltage ( $V_{OUT}$ ) adjustable from 2.475 V to 24 V
- Reference voltage accuracy:  $V_{REF} \pm 3.0\%$  ( $T_j = 25^\circ\text{C}$ )
- Low quiescent current: 2.2 mA typ. ( $@V_{IN} = 4.5\text{ V}, I_{OUT} = 0\text{ A}$ )
- Low standby current (Off mode): 1.0  $\mu\text{A}$  (max)
- Overcurrent protection / thermal shutdown / 60-V load dump protection / overvoltage protection
- Package: 5-pin New PW-Mold (surface-mount)

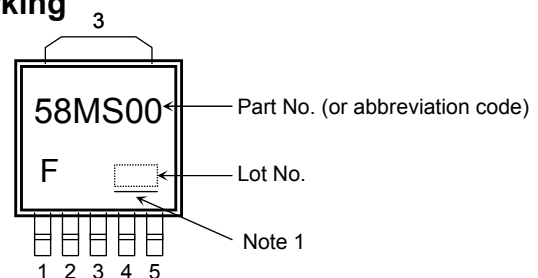


Weight : 0.36 g (Typ.)

### Pin Assignment



### Marking



Note 1: A line under a Lot No. identifies the indication of product Labels.

[[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is the Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

The product(s) in this document ("Product") contain functions intended to protect the Product from temporary small overloads such as minor short-term overcurrent, overvoltage, or overheating. The protective functions do not necessarily protect Product under all circumstances. When incorporating Product into your system, please design the system (1) to avoid such overloads upon the Product, and (2) to shut down or otherwise relieve the Product of such overload conditions immediately upon occurrence. For details, please refer to the notes appearing below in this document and other documents referenced in this document.

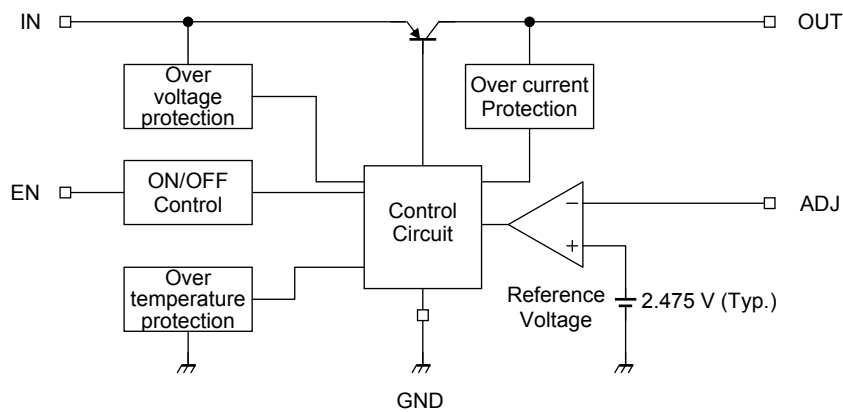
## Pin Description

Pin No.	Symbol	Description
1	IN	Input voltage source. Connect a capacitor ( $C_{IN}$ ) from this pin to ground.
2	EN	Output on/off control. The output turns on when EN is set High and turns off when it is open (undriven) or set Low.
3	GND	Ground
4	OUT	Output voltage. Connect a capacitor(s) ( $C_{OUT}$ ) from this pin to ground.
5	ADJ	Output voltage feedback input. It is connected on-chip to an error amplifier with a typical reference voltage ( $V_{REF}$ ) of 2.475 V.

## How to Order

Part Number	Package	Shipping
TA58MS00F (T6L1,Q)	5-pin New PW-Mold (surface-mount)	Tape (2000 pcs/reel)

## Block Diagram



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

Characteristic		Symbol	Rating	Unit
Input voltage	DC	V <sub>IN</sub> (DC)	29	V
	Pulse	V <sub>IN</sub> (Pulse)	60 (τ = 200 ms, once)	
EN input voltage		V <sub>EN</sub>	V <sub>IN</sub> (DC)	V
Output current		I <sub>OUT</sub>	500	mA
Operating junction temperature		T <sub>jopr</sub>	-40 to 150	°C
Junction temperature		T <sub>j</sub>	150	°C
Storage temperature		T <sub>stg</sub>	-55 to 150	°C
Power dissipation	Ta = 25°C	P <sub>D</sub>	1	W
	Tc = 25°C		10	

Note 2: 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 Characteristics

Characteristic	Symbol	Max	Unit
Thermal resistance, junction to ambient	R <sub>th(j-a)</sub>	125	°C/W
Thermal resistance, junction to case	R <sub>th(j-c)</sub>	12.5	°C/W

## Operating Input Voltage Range

Characteristic	Symbol	Min	Typ.	Max	Unit
Input voltage	V <sub>IN</sub>	5.0 (Note 3)	—	29	V

Note 3: This is the voltage at which the IC begins operating at T<sub>j</sub> = -40°C. Dropout voltage, V<sub>D</sub>, must be considered when determining the best input voltage for the application.

## Output Voltage Range

Characteristic	Symbol	Min	Typ.	Max	Unit
Output voltage	V <sub>OUT</sub>	2.475	—	24	V

## Protection Function (Reference)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Thermal shutdown	T <sub>SD</sub>	V <sub>IN</sub> = 14 V, I <sub>OUT</sub> = 5 mA	—	175	—	°C
Peak output current	I <sub>PEAK</sub>	V <sub>IN</sub> = 14 V, T <sub>j</sub> = 25°C	—	1	—	A
Short-circuit current	I <sub>SC</sub>	V <sub>IN</sub> = 14 V, T <sub>j</sub> = 25°C	—	0.1	—	A
Overvoltage protection (Note 5)	V <sub>OV</sub>	T <sub>j</sub> = 25°C	29	45	—	V

Note 4: Protection features do not guarantee that the device will be kept below the maximum rated conditions. Ensure that the device will not be exposed to conditions exceeding the maximum ratings.

Note 5: The overvoltage protection circuit shuts down the voltage output.

## TA58MS00F

## Electrical Characteristics

(unless otherwise specified,  $V_{EN} = 10V$ ,  $V_{OUT} = 2.5 V$ ,  $C_{IN} = 1.0 \mu F$ ,  $C_{OUT} = 10 \mu F$ ,  $ESR = 1\Omega$ ,  $T_j = 25^\circ C$ )

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Reference voltage	$V_{REF}$	$V_{IN} = 14 V$ , $V_{REF} = V_{OUT}$	2.40	2.475	2.55	V
Line regulation	Reg·line	$4.5 V \leq V_{IN} \leq 26 V$ , $I_{OUT} = 10 mA$	—	—	20	mV
Load regulation	Reg·load	$V_{IN} = 14 V$ , $5 mA \leq I_{OUT} \leq 500 mA$	—	—	30	mV
Quiescent current	$I_B$	$4.5 V \leq V_{IN} \leq 26 V$ , $I_{OUT} = 0 A$	—	2.2	5.0	mA
		$4.5 V \leq V_{IN} \leq 26 V$ , $I_{OUT} = 500 mA$	—	30	50	
Quiescent current (OFF mode)	$I_{B(OFF)}$	$4.5 V \leq V_{IN} \leq 26 V$ , $V_{EN} = 0.4 V$	—	0.1	1.0	$\mu A$
Starting quiescent current	$I_{Bstart}$	$V_{IN} = 3.8 V$ , $I_{OUT} = 0 A$	—	1.75	4.5	mA
		$V_{IN} = 3.8 V$ , $I_{OUT} = 500 mA$	—	28.9	55	
Output noise voltage	$V_{NO}$	$V_{IN} = 14 V$ , $I_{OUT} = 50 mA$ , $10 Hz \leq f \leq 100 kHz$	—	37	—	$\mu V_{rms}$
Ripple rejection	R.R.	$V_{IN} = 14 V$ , $I_{OUT} = 50 mA$ , $f = 120 Hz$	—	78	—	dB
Dropout voltage	$V_D$	$I_{OUT} = 250 mA$	—	—	2	V
		$I_{OUT} = 500 mA$	—	—	2	
Output control voltage (ON)	$V_{EN(ON)}$	—	2	—	—	V
Output control voltage (OFF)	$V_{EN(OFF)}$	—	—	—	0.8	V
Output control current (ON)	$I_{EN(ON)}$	$V_{IN} = 14 V$ , $V_{EN} = 5 V$	—	125	175	$\mu A$
Average temperature coefficient of output voltage	$T_{CVO}$	$V_{IN} = 14 V$ , $I_{OUT} = 5 mA$ , $-40^\circ C \leq T_j \leq 105^\circ C$	—	(Note 6)	—	$mV/^\circ C$

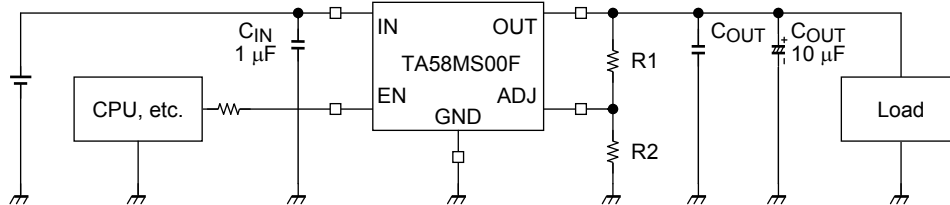
Note 6:  $T_j = -40$  to  $25^\circ C$ :  $\pm 0.385 mV/^\circ C$  $T_j = 25$  to  $105^\circ C$ :  $\pm 0.312 mV/^\circ C$

**Note on Electrical Characteristics**

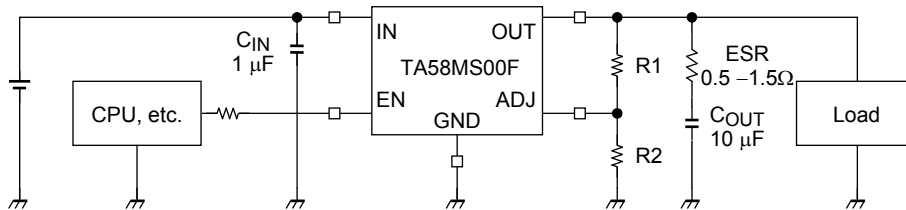
- The test condition  $T_j = 25^\circ\text{C}$  means a state where any drifts in electrical characteristics incurred by an increase in the chip's junction temperature can be ignored during pulse testing.

**Standard Application Circuits**

<Example using an electrolytic capacitor for C<sub>OUT</sub>>



<Example using only a single ceramic capacitor for C<sub>OUT</sub>>



- Connect input and output capacitors (C<sub>IN</sub> and C<sub>OUT</sub>) from the IN and OUT pins to ground respectively. Place these capacitors as close as possible to the device pins. C<sub>OUT</sub> is used to prevent output oscillation and stabilize operation over load variations. However, in a cold environment, the output might oscillate due to a decrease in its capacitance and/or an increase in ESR (equivalent series resistance). It is therefore recommended to use a capacitor whose capacitance and ESR values do not vary greatly with environmental conditions or hours of use. A ceramic capacitor with very small ESR might cause output oscillation if used alone, depending on usage conditions. To reduce the risk of oscillation, electrolytic and ceramic capacitors should be connected in parallel, or a resistor equivalent to the ESR should be connected in series with a ceramic capacitor, as shown above. The output might still oscillate, depending on external conditions such as the capacitor and ESR values, input voltage, output current, temperature and so on. Therefore, appropriate capacitor(s) and resistor should be selected through experimentation using an actual board in which the TA58MS00F will be used.

**Setting the Output Voltage**

- The output voltage can be calculated as follows. A handy guide for R<sub>2</sub> is 5 kΩ, and the output voltage should be adjusted with R<sub>1</sub>. R<sub>1</sub> and R<sub>2</sub> should be placed as close as possible to the device to minimize the length of board traces to the ADJ pin.

$$V_{\text{OUT}} = V_{\text{REF}} \times \left( 1 + \frac{R_1}{R_2} \right) + I_{\text{ADJ}} \times R_1$$

where  $I_{\text{ADJ}} = 1.2 \mu\text{A}$

**Precautions for use**

- Note that, depending on the load conditions, an abrupt change in the input voltage (V<sub>IN</sub>) may cause a transient rise in output voltage (V<sub>OUT</sub>) even if the EN (enable) pin is Low.

- Low voltage

Do not apply voltage to the Product that is lower than the minimum operating voltage, or the Product's protective functions will not operate properly and the Product may be permanently damaged.

- Overcurrent Protection

The overcurrent protection circuits in the Product are designed to temporarily protect Product from minor overcurrent of brief duration. When the overcurrent protective function in the Product activates, immediately cease application of overcurrent to Product. Improper usage of Product, such as application of current to Product exceeding the absolute maximum ratings, could cause the overcurrent protection circuit not to operate properly and/or damage Product permanently even before the protection circuit starts to operate.

- Overheating Protection

The thermal shutdown circuits in the Product are designed to temporarily protect Product from minor overheating of brief duration. When the overheating protective function in the Product activates, immediately correct the overheating situation. Improper usage of Product, such as the application of heat to Product exceeding the absolute maximum ratings, could cause the overheating protection circuit not to operate properly and/or damage Product permanently even before the protection circuit starts to operate.

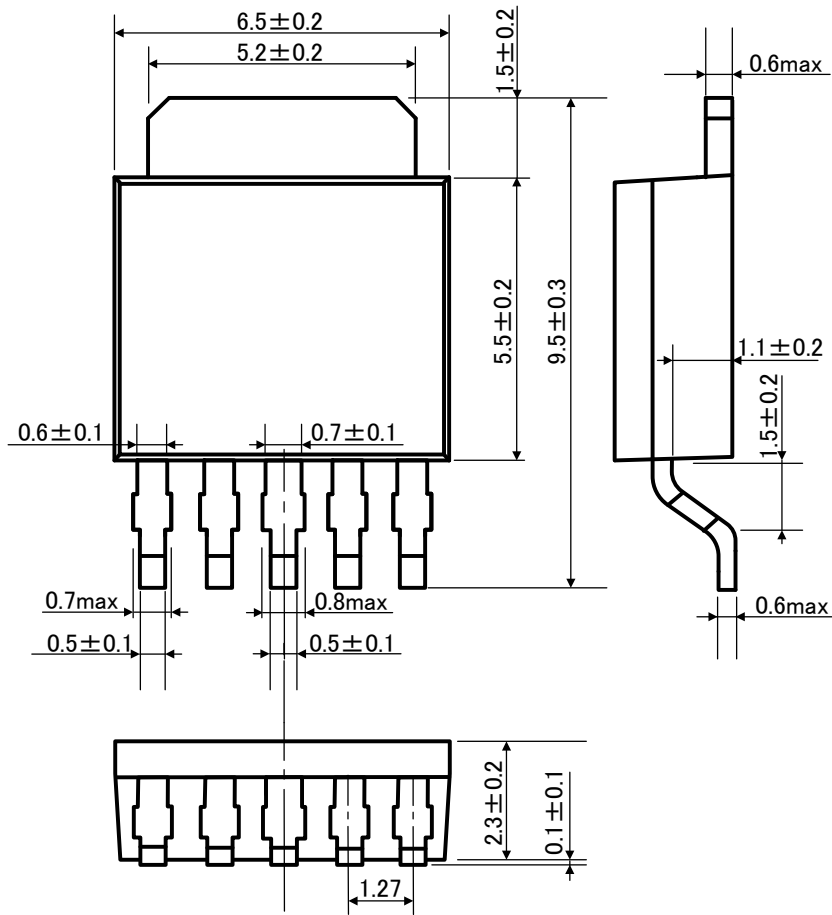
- Overvoltage Protection

The overvoltage protection circuits in the Product are designed to temporarily protect Product from minor overvoltage of brief duration. When the overvoltage protective function in the Product activates, immediately cease application of over voltage to Product. Improper usage of Product, such as application of voltage to Product exceeding the absolute maximum ratings, could cause the overvoltage protection circuit not to operate properly and/or damage Product permanently even before the protection circuit starts to operate.

## Package Dimensions

HSIP5-P-1.27B

Unit: mm



Weight: 0.36 g (Typ.)

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