

TOSHIBA Bipolar Linear Integrated Circuit Silicon Monolithic

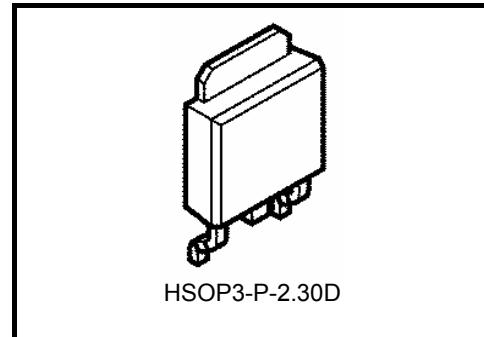
# TA78M05F, TA78M06F, TA78M08F, TA78M09F, TA78M10F TA78M12F, TA78M15F, TA78M18F, TA78M20F, TA78M24F

Output Current of 0.5 A, Three-Terminal Positive Voltage Regulators

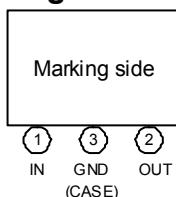
5 V, 6 V, 8 V, 9 V, 10 V, 12 V, 15 V, 18 V, 20 V, 24 V

## Features

- Suitable for CMOS, TTL and the power supply of the other digital ICs
- Internal overheating protection.
- Internal overcurrent protection.
- Maximum output current of 0.5 A.
- Packaged in New PW-Mold (Surface-mount type).

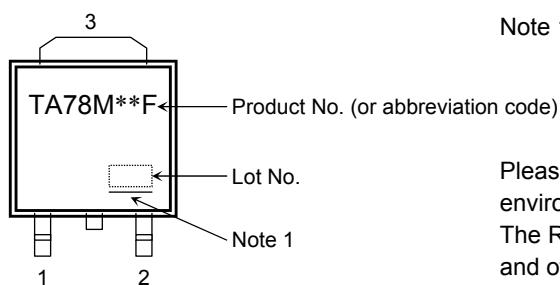


## Pin Assignment



Weight  
HSOP3-P-2.30D: 0.36 g (typ.)

## Marking



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

Not underlined: [[Pb]]/INCLUDES > MCV

Underlined: [[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.

Note 2: The “\*\*” part of each product number varies according to the output voltage of the product.

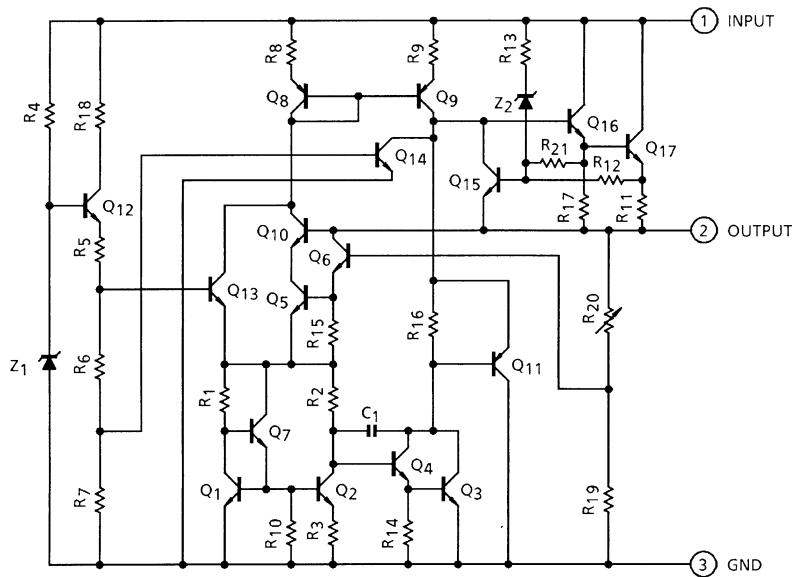
## Ordering Method

Product Name	Package (Lead Type)	Packing Form
TA78M**F (TE16L1, NQ)	New PW-Mold: Surface-mount	Tape (2000 pcs./reel)

Note: The “\*\*” in each pro-forma product name is replaced with the output voltage of each product.

The product(s) in this document (“Product”) contain functions intended to protect the Product from temporary small overloads such as minor short-term overcurrent 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.

## Equivalent Circuit

Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

Characteristics		Symbol	Rating	Unit	
Input voltage	TA78M05F	$V_{IN}$	35	V	
	TA78M06F				
	TA78M08F				
	TA78M09F				
	TA78M10F				
	TA78M12F		40		
	TA78M15F				
	TA78M18F				
	TA78M20F				
	TA78M24F				
Output current		$I_{OUT}$	0.5	A	
Power dissipation	( $T_a = 25^\circ\text{C}$ )	$P_D$	1	W	
	( $T_c = 25^\circ\text{C}$ )		10		
Operating junction temperature		$T_{Jopr}$	-30 to 150	°C	
Storage temperature		$T_{stg}$	-55 to 150	°C	
Junction temperature		$T_j$	150	°C	
Thermal resistance		$R_{th} (j-c)$	12.5	°C/W	
		$R_{th} (j-a)$	125		

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.).

## TA78M05F

## Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 10$  V,  $I_{OUT} = 350$  mA,  $0^\circ C \leq T_j \leq 125^\circ C$ ,  $C_{IN} = 0.33$   $\mu F$ ,  $C_{OUT} = 0.1$   $\mu F$ )

Characteristics	Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage	$V_{OUT}$	1	$T_j = 25^\circ C$		4.8	5.0	5.2	V
Line regulation	Reg-line	1	$T_j = 25^\circ C$	7 V $\leq V_{IN} \leq 25$ V, $I_{OUT} = 200$ mA	—	4	100	mV
				8 V $\leq V_{IN} \leq 25$ V, $I_{OUT} = 200$ mA	—	2	50	
Load regulation	Reg-load	1	$T_j = 25^\circ C$	5 mA $\leq I_{OUT} \leq 500$ mA	—	25	100	mV
				5 mA $\leq I_{OUT} \leq 200$ mA	—	10	50	
Output voltage	$V_{OUT}$	1	$T_j = 25^\circ C$	7 V $\leq V_{IN} \leq 20$ V, 5 mA $\leq I_{OUT} \leq 350$ mA	4.75	—	5.25	V
Quiescent current	$I_B$	1	$T_j = 25^\circ C$		—	4.5	8.0	mA
Quiescent current change	Line	$\Delta I_{BL}$	1 $T_j = 25^\circ C$	8.5 V $\leq V_{IN} \leq 25.5$ V, $I_{OUT} = 200$ mA	—	—	0.8	mA
	Load	$\Delta I_{BO}$		5 mA $\leq I_{OUT} \leq 350$ mA	—	—	0.5	
Output noise voltage	$V_{NO}$	2	$T_j = 25^\circ C$ , 10 Hz $\leq f \leq 100$ kHz		—	50	200	$\mu V_{rms}$
Ripple rejection	R.R.	3	$f = 120$ Hz, $I_{OUT} = 100$ mA, 8 V $\leq V_{IN} \leq 18$ V, $T_j = 25^\circ C$		60	67	—	dB
Short circuit current limit	$I_{SC}$	1	$T_j = 25^\circ C$		—	960	—	mA
Dropout voltage	$V_D$	1	$T_j = 25^\circ C$		—	1.7	—	V
Average temperature coefficient of output voltage	$T_{CVO}$	1	$I_{OUT} = 5$ mA		—	-0.6	—	$mV/^\circ C$

## TA78M06F

## Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 11$  V,  $I_{OUT} = 350$  mA,  $0^\circ C \leq T_j \leq 125^\circ C$ ,  $C_{IN} = 0.33$   $\mu F$ ,  $C_{OUT} = 0.1$   $\mu F$ )

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$		5.75	6.0	6.25	V
Line regulation	Reg-line	1	$T_j = 25^\circ C$	$8 V \leq V_{IN} \leq 25$ V, $I_{OUT} = 200$ mA	—	4	100	mV	
				$9 V \leq V_{IN} \leq 25$ V, $I_{OUT} = 200$ mA	—	2	50		
Load regulation	Reg-load	1	$T_j = 25^\circ C$	$5$ mA $\leq I_{OUT} \leq 500$ mA	—	25	120	mV	
				$5$ mA $\leq I_{OUT} \leq 200$ mA	—	10	60		
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$	$8 V \leq V_{IN} \leq 21$ V, $5$ mA $\leq I_{OUT} \leq 350$ mA	5.7	—	6.3	V
Quiescent current		$I_B$	1	$T_j = 25^\circ C$	—	4.5	8.0	mA	
Quiescent current change	Line	$\Delta I_{BL}$	1	$T_j = 25^\circ C$	$9.5 V \leq V_{IN} \leq 25.5$ V, $I_{OUT} = 200$ mA	—	—	0.8	mA
	Load	$\Delta I_{BO}$	1		$5$ mA $\leq I_{OUT} \leq 350$ mA	—	—	0.5	
Output noise voltage		$V_{NO}$	2	$T_j = 25^\circ C$ , $10$ Hz $\leq f \leq 100$ kHz		—	55	220	$\mu V_{rms}$
Ripple rejection		R.R.	3	$f = 120$ Hz, $I_{OUT} = 100$ mA, $9$ V $\leq V_{IN} \leq 19$ V, $T_j = 25^\circ C$		58	65	—	dB
Short circuit current limit		$I_{SC}$	1	$T_j = 25^\circ C$		—	960	—	mA
Dropout voltage		$V_D$	1	$T_j = 25^\circ C$		—	1.7	—	V
Average temperature coefficient of output voltage		$T_{CVO}$	1	$I_{OUT} = 5$ mA		—	-0.7	—	$mV/^\circ C$

## TA78M08F

## Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 14$  V,  $I_{OUT} = 350$  mA,  $0^\circ C \leq T_j \leq 125^\circ C$ ,  $C_{IN} = 0.33$   $\mu F$ ,  $C_{OUT} = 0.1$   $\mu F$ )

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit	
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$		7.7	8.0	8.3	V	
Line regulation	Reg-line	1	$T_j = 25^\circ C$	10.5 V $\leq V_{IN} \leq$ 25 V, $I_{OUT} = 200$ mA	—	5	100	mV		
				11 V $\leq V_{IN} \leq$ 25 V, $I_{OUT} = 200$ mA	—	3	50			
Load regulation	Reg-load	1	$T_j = 25^\circ C$	5 mA $\leq I_{OUT} \leq$ 500 mA	—	26	160	mV		
				5 mA $\leq I_{OUT} \leq$ 200 mA	—	10	80			
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$	10.5 V $\leq V_{IN} \leq$ 23 V, 5 mA $\leq I_{OUT} \leq$ 350 mA	7.6	—	8.4	V	
Quiescent current		$I_B$	1	$T_j = 25^\circ C$		—	4.6	8.0	mA	
Quiescent current change	Line	$\Delta I_{BL}$	1	$T_j = 25^\circ C$	11 V $\leq V_{IN} \leq$ 25.5 V, $I_{OUT} = 200$ mA	—	—	0.8	mA	
	Load	$\Delta I_{BO}$	1		5 mA $\leq I_{OUT} \leq$ 350 mA	—	—	0.5		
Output noise voltage		$V_{NO}$	2	$T_j = 25^\circ C$ , 10 Hz $\leq f \leq$ 100 kHz		—	60	250	$\mu V_{rms}$	
Ripple rejection		R.R.	3	$f = 120$ Hz, $I_{OUT} = 100$ mA, 11.5 V $\leq V_{IN} \leq$ 21.5 V, $T_j = 25^\circ C$		55	62	—	dB	
Short circuit current limit		$I_{SC}$	1	$T_j = 25^\circ C$		—	960	—	mA	
Dropout voltage		$V_D$	1	$T_j = 25^\circ C$		—	1.7	—	V	
Average temperature coefficient of output voltage		$T_{CVO}$	1	$I_{OUT} = 5$ mA		—	-1.0	—	$mV/^\circ C$	

## TA78M09F

## Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 15 \text{ V}$ ,  $I_{OUT} = 350 \text{ mA}$ ,  $0^\circ\text{C} \leq T_j \leq 125^\circ\text{C}$ ,  $C_{IN} = 0.33 \mu\text{F}$ ,  $C_{OUT} = 0.1 \mu\text{F}$ )

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit	
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ\text{C}$		8.64	9.0	9.36	V	
Line regulation	Reg-line	1	$T_j = 25^\circ\text{C}$	11.5 V $\leq V_{IN} \leq 26 \text{ V}$ , $I_{OUT} = 200 \text{ mA}$	—	5	100	mV		
				13 V $\leq V_{IN} \leq 26 \text{ V}$ , $I_{OUT} = 200 \text{ mA}$	—	3	50			
Load regulation	Reg-load	1	$T_j = 25^\circ\text{C}$	5 mA $\leq I_{OUT} \leq 500 \text{ mA}$	—	26	180	mV		
				5 mA $\leq I_{OUT} \leq 200 \text{ mA}$	—	10	90			
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ\text{C}$	11.5 V $\leq V_{IN} \leq 24 \text{ V}$ , 5 mA $\leq I_{OUT} \leq 350 \text{ mA}$	8.55	—	9.45	V	
Quiescent current		$I_B$	1	$T_j = 25^\circ\text{C}$		—	4.6	8.0	mA	
Quiescent current change	Line	$\Delta I_{BL}$	1	$T_j = 25^\circ\text{C}$	12 V $\leq V_{IN} \leq 26.5 \text{ V}$ , $I_{OUT} = 200 \text{ mA}$	—	—	0.8	mA	
	Load	$\Delta I_{BO}$	1		5 mA $\leq I_{OUT} \leq 350 \text{ mA}$	—	—	0.5		
Output noise voltage		$V_{NO}$	2	$T_j = 25^\circ\text{C}$ , 10 Hz $\leq f \leq 100 \text{ kHz}$		—	60	270	$\mu\text{V}_{\text{rms}}$	
Ripple rejection		R.R.	3	$f = 120 \text{ Hz}$ , $I_{OUT} = 100 \text{ mA}$ , 12.5 V $\leq V_{IN} \leq 22.5 \text{ V}$ , $T_j = 25^\circ\text{C}$		54	61	—	dB	
Short circuit current limit		$I_{SC}$	1	$T_j = 25^\circ\text{C}$		—	960	—	mA	
Dropout voltage		$V_D$	1	$T_j = 25^\circ\text{C}$		—	1.7	—	V	
Average temperature coefficient of output voltage		$T_{CVO}$	1	$I_{OUT} = 5 \text{ mA}$		—	-1.1	—	$\text{mV/}^\circ\text{C}$	

## TA78M10F

## Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 16$  V,  $I_{OUT} = 350$  mA,  $0^\circ C \leq T_j \leq 125^\circ C$ ,  $C_{IN} = 0.33$   $\mu F$ ,  $C_{OUT} = 0.1$   $\mu F$ )

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit	
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$		9.6	10.0	10.4	V	
Line regulation	Reg-line	1	$T_j = 25^\circ C$	12.5 V $\leq V_{IN} \leq$ 26 V, $I_{OUT} = 200$ mA	—	6	100	mV		
				14 V $\leq V_{IN} \leq$ 26 V, $I_{OUT} = 200$ mA	—	3	50			
Load regulation	Reg-load	1	$T_j = 25^\circ C$	5 mA $\leq I_{OUT} \leq$ 500 mA	—	26	200	mV		
				5 mA $\leq I_{OUT} \leq$ 200 mA	—	10	100			
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$	12.5 V $\leq V_{IN} \leq$ 25 V, 5 mA $\leq I_{OUT} \leq$ 350 mA	9.5	—	10.5	V	
Quiescent current		$I_B$	1	$T_j = 25^\circ C$		—	4.7	8.0	mA	
Quiescent current change	Line	$\Delta I_{BL}$	1	$T_j = 25^\circ C$	13 V $\leq V_{IN} \leq$ 26.5 V, $I_{OUT} = 200$ mA	—	—	0.8	mA	
	Load	$\Delta I_{BO}$	1		5 mA $\leq I_{OUT} \leq$ 350 mA	—	—	0.5		
Output noise voltage		$V_{NO}$	2	$T_j = 25^\circ C$ , 10 Hz $\leq f \leq$ 100 kHz		—	65	280	$\mu V_{rms}$	
Ripple rejection		R.R.	3	$f = 120$ Hz, $I_{OUT} = 100$ mA, 13.5 V $\leq V_{IN} \leq$ 23.5 V, $T_j = 25^\circ C$		52	59	—	dB	
Short circuit current limit		$I_{SC}$	1	$T_j = 25^\circ C$		—	960	—	mA	
Dropout voltage		$V_D$	1	$T_j = 25^\circ C$		—	1.7	—	V	
Average temperature coefficient of output voltage		$T_{CVO}$	1	$I_{OUT} = 5$ mA		—	-1.3	—	$mV/^\circ C$	

## TA78M12F

## Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 19$  V,  $I_{OUT} = 350$  mA,  $0^\circ C \leq T_j \leq 125^\circ C$ ,  $C_{IN} = 0.33$   $\mu F$ ,  $C_{OUT} = 0.1$   $\mu F$ )

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit	
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$		11.5	12.0	12.5	V	
Line regulation	Reg-line	1	$T_j = 25^\circ C$	14.5 V $\leq V_{IN} \leq$ 30 V, $I_{OUT} = 200$ mA	—	7	100	mV		
				16 V $\leq V_{IN} \leq$ 30 V, $I_{OUT} = 200$ mA	—	3	50			
Load regulation	Reg-load	1	$T_j = 25^\circ C$	5 mA $\leq I_{OUT} \leq$ 500 mA	—	27	240	mV		
				5 mA $\leq I_{OUT} \leq$ 200 mA	—	10	120			
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$	14.5 V $\leq V_{IN} \leq$ 27 V, 5 mA $\leq I_{OUT} \leq$ 350 mA	11.4	—	12.6	V	
Quiescent current		$I_B$	1	$T_j = 25^\circ C$		—	4.8	8.0	mA	
Quiescent current change	Line	$\Delta I_{BL}$	1	$T_j = 25^\circ C$	15 V $\leq V_{IN} \leq$ 30.5 V, $I_{OUT} = 200$ mA	—	—	0.8	mA	
	Load	$\Delta I_{BO}$	1		5 mA $\leq I_{OUT} \leq$ 350 mA	—	—	0.5		
Output noise voltage		$V_{NO}$	2	$T_j = 25^\circ C$ , 10 Hz $\leq f \leq$ 100 kHz		—	70	300	$\mu V_{rms}$	
Ripple rejection		R.R.	3	$f = 120$ Hz, $I_{OUT} = 100$ mA, 15 V $\leq V_{IN} \leq$ 25 V, $T_j = 25^\circ C$		50	57	—	dB	
Short circuit current limit		$I_{SC}$	1	$T_j = 25^\circ C$		—	960	—	mA	
Dropout voltage		$V_D$	1	$T_j = 25^\circ C$		—	1.7	—	V	
Average temperature coefficient of output voltage		$T_{CVO}$	1	$I_{OUT} = 5$ mA		—	-1.6	—	$mV/^\circ C$	

## TA78M15F

## Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 23$  V,  $I_{OUT} = 350$  mA,  $0^\circ C \leq T_j \leq 125^\circ C$ ,  $C_{IN} = 0.33$   $\mu F$ ,  $C_{OUT} = 0.1$   $\mu F$ )

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit	
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$		14.4	15.0	15.6	V	
Line regulation	Reg-line	1	$T_j = 25^\circ C$	17.5 V $\leq V_{IN} \leq$ 30 V, $I_{OUT} = 200$ mA	—	8	100	mV		
				20 V $\leq V_{IN} \leq$ 30 V, $I_{OUT} = 200$ mA	—	4	50			
Load regulation	Reg-load	1	$T_j = 25^\circ C$	5 mA $\leq I_{OUT} \leq$ 500 mA	—	27	300	mV		
				5 mA $\leq I_{OUT} \leq$ 200 mA	—	10	150			
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$	17.5 V $\leq V_{IN} \leq$ 30 V, 5 mA $\leq I_{OUT} \leq$ 350 mA	14.25	—	15.75	V	
Quiescent current		$I_B$	1	$T_j = 25^\circ C$		—	4.8	8.0	mA	
Quiescent current change	Line	$\Delta I_{BL}$	1	$T_j = 25^\circ C$	18 V $\leq V_{IN} \leq$ 30.5 V, $I_{OUT} = 200$ mA	—	—	0.8	mA	
	Load	$\Delta I_{BO}$	1		5 mA $\leq I_{OUT} \leq$ 350 mA	—	—	0.5		
Output noise voltage		$V_{NO}$	2	$T_j = 25^\circ C$ , 10 Hz $\leq f \leq$ 100 kHz		—	80	450	$\mu V_{rms}$	
Ripple rejection		R.R.	3	$f = 120$ Hz, $I_{OUT} = 100$ mA, 18.5 V $\leq V_{IN} \leq$ 28.5 V, $T_j = 25^\circ C$		48	55	—	dB	
Short circuit current limit		$I_{SC}$	1	$T_j = 25^\circ C$		—	960	—	mA	
Dropout voltage		$V_D$	1	$T_j = 25^\circ C$		—	1.7	—	V	
Average temperature coefficient of output voltage		$T_{CVO}$	1	$I_{OUT} = 5$ mA		—	-2.0	—	$mV/^\circ C$	

## TA78M18F

## Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 27$  V,  $I_{OUT} = 350$  mA,  $0^\circ C \leq T_j \leq 125^\circ C$ ,  $C_{IN} = 0.33$   $\mu F$ ,  $C_{OUT} = 0.1$   $\mu F$ )

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit	
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$		17.3	18.0	18.7	V	
Line regulation	Reg-line	1	$T_j = 25^\circ C$	$21 V \leq V_{IN} \leq 33 V$ , $I_{OUT} = 200$ mA	—	9	100	mV		
				$24 V \leq V_{IN} \leq 33 V$ , $I_{OUT} = 200$ mA	—	5	50			
Load regulation	Reg-load	1	$T_j = 25^\circ C$	$5$ mA $\leq I_{OUT} \leq 500$ mA	—	28	360	mV		
				$5$ mA $\leq I_{OUT} \leq 200$ mA	—	10	180			
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$	$21 V \leq V_{IN} \leq 33 V$ , $5$ mA $\leq I_{OUT} \leq 350$ mA	17.1	—	18.9	V	
Quiescent current		$I_B$	1	$T_j = 25^\circ C$		—	4.8	8.0	mA	
Quiescent current change	Line	$\Delta I_{BL}$	1	$T_j = 25^\circ C$	$21.5 V \leq V_{IN} \leq 33.5 V$ , $I_{OUT} = 200$ mA	—	—	0.8	mA	
	Load	$\Delta I_{BO}$	1		$5$ mA $\leq I_{OUT} \leq 350$ mA	—	—	0.5		
Output noise voltage		$V_{NO}$	2	$T_j = 25^\circ C$ , $10$ Hz $\leq f \leq 100$ kHz		—	90	490	$\mu V_{rms}$	
Ripple rejection		R.R.	3	$f = 120$ Hz, $I_{OUT} = 100$ mA, $22 V \leq V_{IN} \leq 32$ V, $T_j = 25^\circ C$		46	53	—	dB	
Short circuit current limit		$I_{SC}$	1	$T_j = 25^\circ C$		—	960	—	mA	
Dropout voltage		$V_D$	1	$T_j = 25^\circ C$		—	1.7	—	V	
Average temperature coefficient of output voltage		$T_{CVO}$	1	$I_{OUT} = 5$ mA		—	-2.5	—	$mV/^\circ C$	

## TA78M20F

## Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 29$  V,  $I_{OUT} = 350$  mA,  $0^\circ C \leq T_j \leq 125^\circ C$ ,  $C_{IN} = 0.33$   $\mu F$ ,  $C_{OUT} = 0.1$   $\mu F$ )

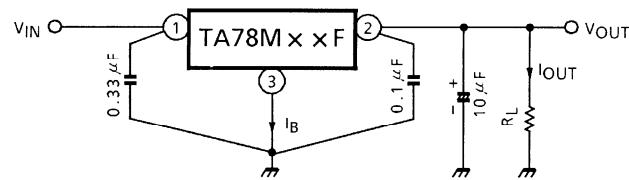
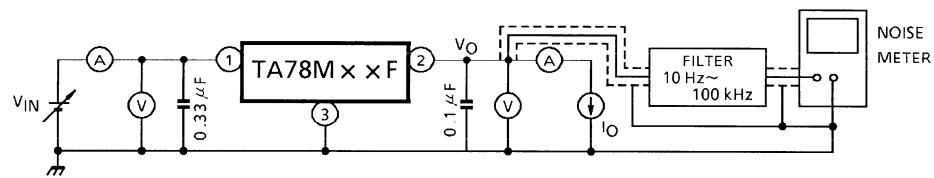
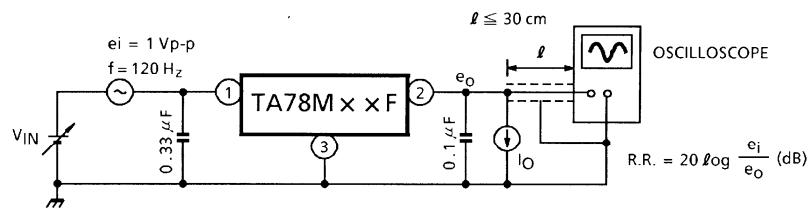
Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit	
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$		19.2	20.0	20.8	V	
Line regulation	Reg-line	1	$T_j = 25^\circ C$	$23 V \leq V_{IN} \leq 35 V$ , $I_{OUT} = 200$ mA	—	10	100	mV		
				$24 V \leq V_{IN} \leq 35 V$ , $I_{OUT} = 200$ mA	—	6	50			
Load regulation	Reg-load	1	$T_j = 25^\circ C$	$5$ mA $\leq I_{OUT} \leq 500$ mA	—	28	400	mV		
				$5$ mA $\leq I_{OUT} \leq 200$ mA	—	10	200			
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$	$23 V \leq V_{IN} \leq 35 V$ , $5$ mA $\leq I_{OUT} \leq 350$ mA	19.0	—	21.0	V	
Quiescent current		$I_B$	1	$T_j = 25^\circ C$		—	4.9	8.0	mA	
Quiescent current change	Line	$\Delta I_{BL}$	1	$T_j = 25^\circ C$	$23.5 V \leq V_{IN} \leq 35.5 V$ , $I_{OUT} = 200$ mA	—	—	0.8	mA	
	Load	$\Delta I_{BO}$	1		$5$ mA $\leq I_{OUT} \leq 350$ mA	—	—	0.5		
Output noise voltage		$V_{NO}$	2	$T_j = 25^\circ C$ , $10$ Hz $\leq f \leq 100$ kHz		—	95	540	$\mu V_{rms}$	
Ripple rejection		R.R.	3	$f = 120$ Hz, $I_{OUT} = 100$ mA, $24 V \leq V_{IN} \leq 34$ V, $T_j = 25^\circ C$		46	53	—	dB	
Short circuit current limit		$I_{SC}$	1	$T_j = 25^\circ C$		—	960	—	mA	
Dropout voltage		$V_D$	1	$T_j = 25^\circ C$		—	1.7	—	V	
Average temperature coefficient of output voltage		$T_{CVO}$	1	$I_{OUT} = 5$ mA		—	-3.0	—	$mV/^\circ C$	

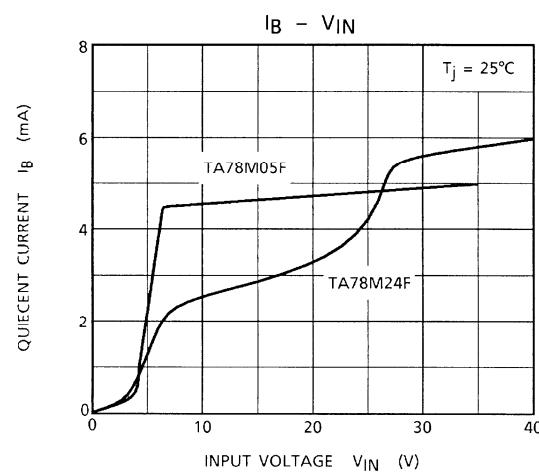
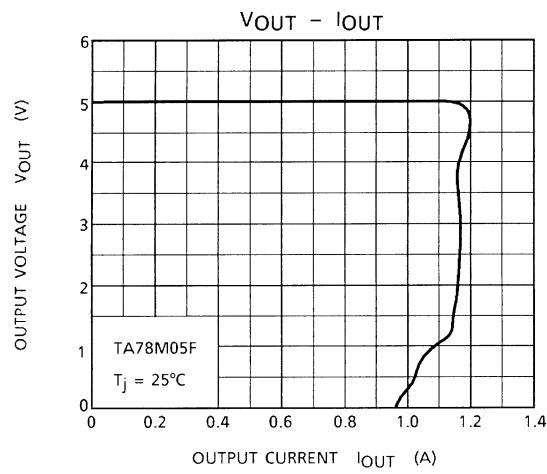
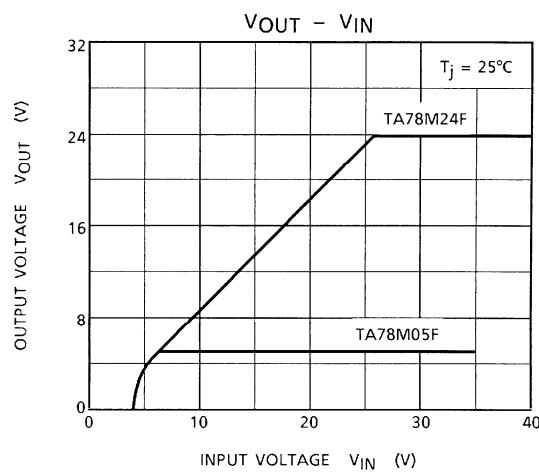
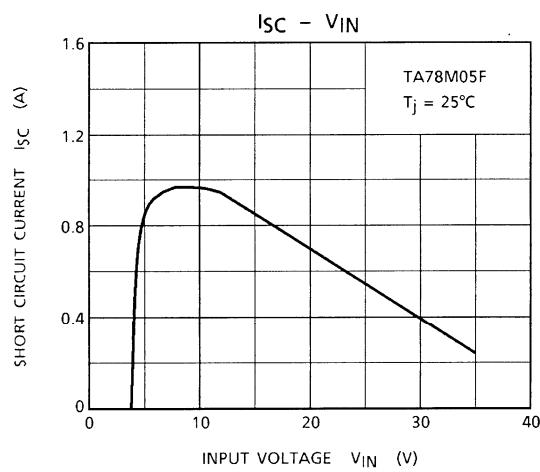
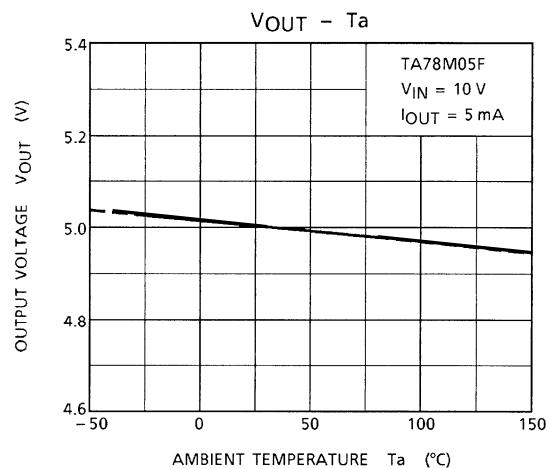
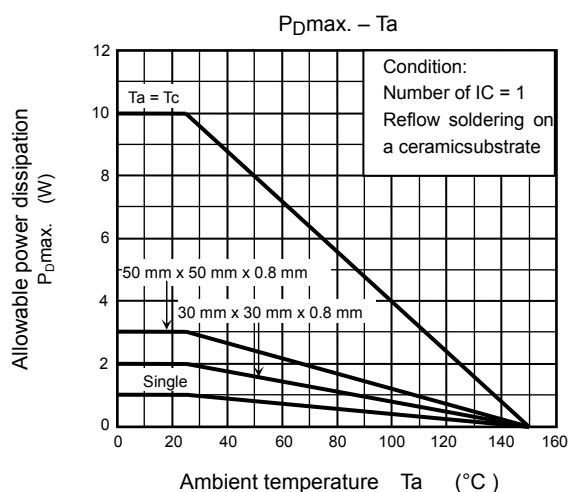
## TA78M24F

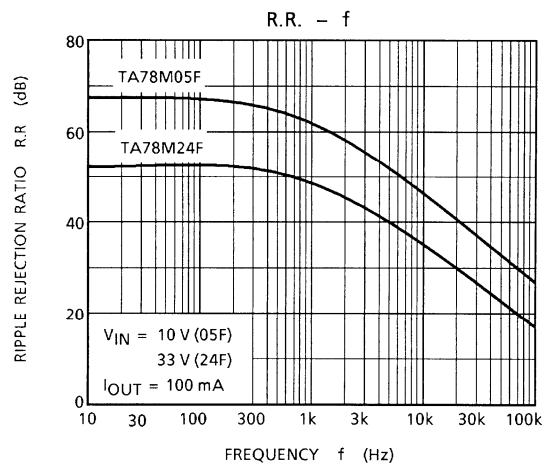
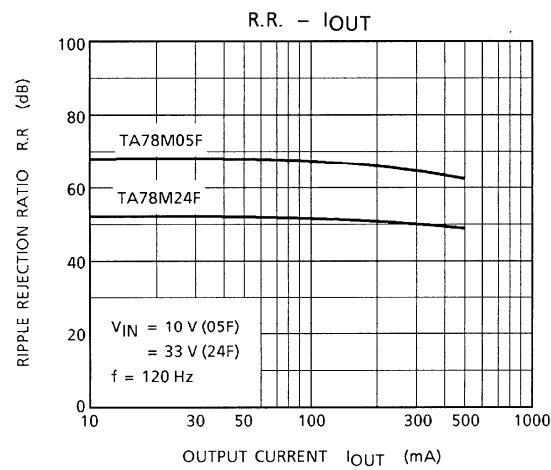
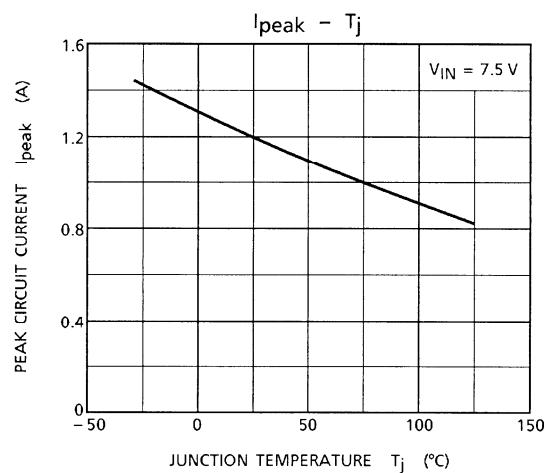
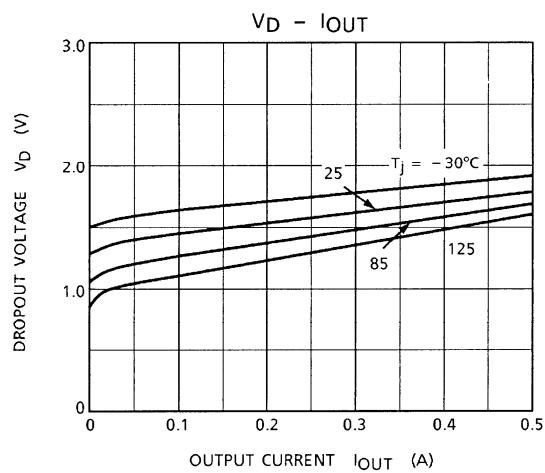
## Electrical Characteristics

(Unless otherwise specified,  $V_{IN} = 33$  V,  $I_{OUT} = 350$  mA,  $0^\circ C \leq T_j \leq 125^\circ C$ ,  $C_{IN} = 0.33$   $\mu F$ ,  $C_{OUT} = 0.1$   $\mu F$ )

Characteristics		Symbol	Test Circuit	Test Condition		Min	Typ.	Max	Unit
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$		23.0	24.0	25.0	V
Line regulation	Reg-line	1	$T_j = 25^\circ C$	$27 V \leq V_{IN} \leq 38$ V, $I_{OUT} = 200$ mA	—	12	100	mV	
				$28 V \leq V_{IN} \leq 38$ V, $I_{OUT} = 200$ mA	—	7	50		
Load regulation	Reg-load	1	$T_j = 25^\circ C$	$5$ mA $\leq I_{OUT} \leq 500$ mA	—	30	480	mV	
				$5$ mA $\leq I_{OUT} \leq 200$ mA	—	10	240		
Output voltage		$V_{OUT}$	1	$T_j = 25^\circ C$	$27 V \leq V_{IN} \leq 38$ V, $5$ mA $\leq I_{OUT} \leq 350$ mA	22.8	—	25.2	V
Quiescent current		$I_B$	1	$T_j = 25^\circ C$	—	5.0	8.0	mA	
Quiescent current change	Line	$\Delta I_{BL}$	1	$T_j = 25^\circ C$	$27.5 V \leq V_{IN} \leq 38.5$ V, $I_{OUT} = 200$ mA	—	—	0.8	mA
	Load	$\Delta I_{BO}$	1		$5$ mA $\leq I_{OUT} \leq 350$ mA	—	—	0.5	
Output noise voltage		$V_{NO}$	2	$T_j = 25^\circ C$ , $10$ Hz $\leq f \leq 100$ kHz		—	115	650	$\mu V_{rms}$
Ripple rejection		R.R.	3	$f = 120$ Hz, $I_{OUT} = 100$ mA, $28 V \leq V_{IN} \leq 38$ V, $T_j = 25^\circ C$		46	53	—	dB
Short circuit current limit		$I_{SC}$	1	$T_j = 25^\circ C$	—	960	—	mA	
Dropout voltage		$V_D$	1	$T_j = 25^\circ C$	—	1.7	—	V	
Average temperature coefficient of output voltage		$T_{CVO}$	1	$I_{OUT} = 5$ mA		—	-3.5	—	$mV/^\circ C$

**Test Circuit 1 / Standard Application**

**Test Circuit 2**
**V<sub>NO</sub>**

**Test Circuit 3**
**R.R.**






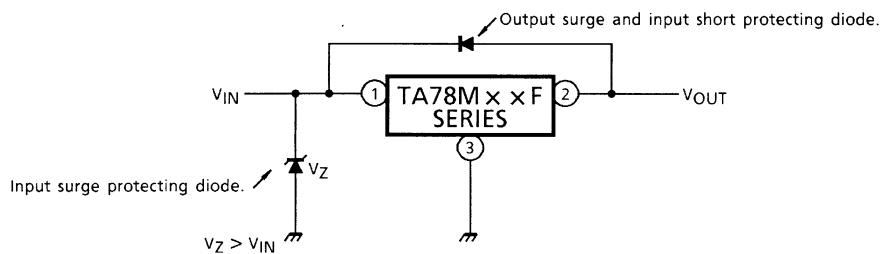
## Usage Precautions

- (1) In regard to GND, be careful not to apply a negative voltage to the input/output terminal.
- (2) If a surge voltage exceeding the absolute maximum rating is applied to the input terminal or if a voltage in excess of the input terminal voltage is applied to the output terminal, the circuit may be destroyed.

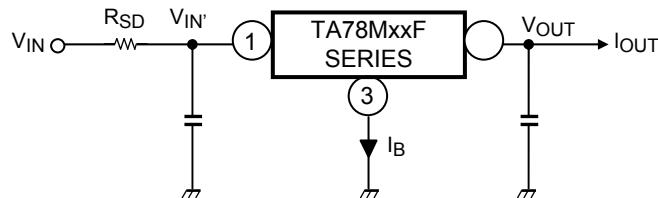
Particular care is necessary in the case of the latter.

Circuit destruction may also occur if the input terminal shorts to GND in a state of normal operation, causing the output terminal voltage to exceed the input voltage (GND potential) and the electrical charge of the chemical capacitor connected to the output terminal to flow into the input side.

Where these risks exist, take steps such as connecting Zener and general silicon diodes to the circuit, as shown in the figure below.



- (3) When the input voltage is too high, the power dissipation of the three-terminal regulator, which is a series regulator, increases, causing the junction temperature to rise. In such a case, it is recommended to reduce the power dissipation, and hence the junction temperature, by inserting a power-limiting resistor  $R_{SD}$  in the input terminal.



The power dissipation  $P_D$  of the IC is expressed in the following equation.

$$P_D = (V_{IN'} - V_{OUT}) \cdot I_{OUT} + V_{IN'} \cdot I_B$$

Reducing  $V_{IN'}$  below the lowest voltage necessary for the IC will cause ripple, deterioration in output regulation and, in certain circumstances, parasitic oscillation.

To determine the resistance value of  $R_{SD}$ , design with a margin, referring to the following equation.

$$R_{SD} < \frac{V_{IN} - V_{IN'}}{I_{OUT} + I_B}$$

- (4) Be sure to connect a capacitor near the input terminal and output terminal between both terminals and GND. The capacitances should be determined experimentally because they depend on printed circuit board patterns. In particular, adequate investigation should be made to ensure there is no problem even in high or low temperatures.
- (5) The molded plastic portion of this unit, measuring 5.5 mm (L) by 6.5 mm (W) by 2.3 mm (T), is more compact compared to its equivalent TO-220. The collector fin extends directly out of the main body and can be soldered directly to the ceramic circuit board for significant increase in collector power dissipation. To obtain high reliability on the heat sink design of a regulator IC, it is generally required to derate more than 20% of maximum junction temperature ( $T_j$  max). Further, full consideration should be given to the installation of the IC on a heat sink.

- **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.

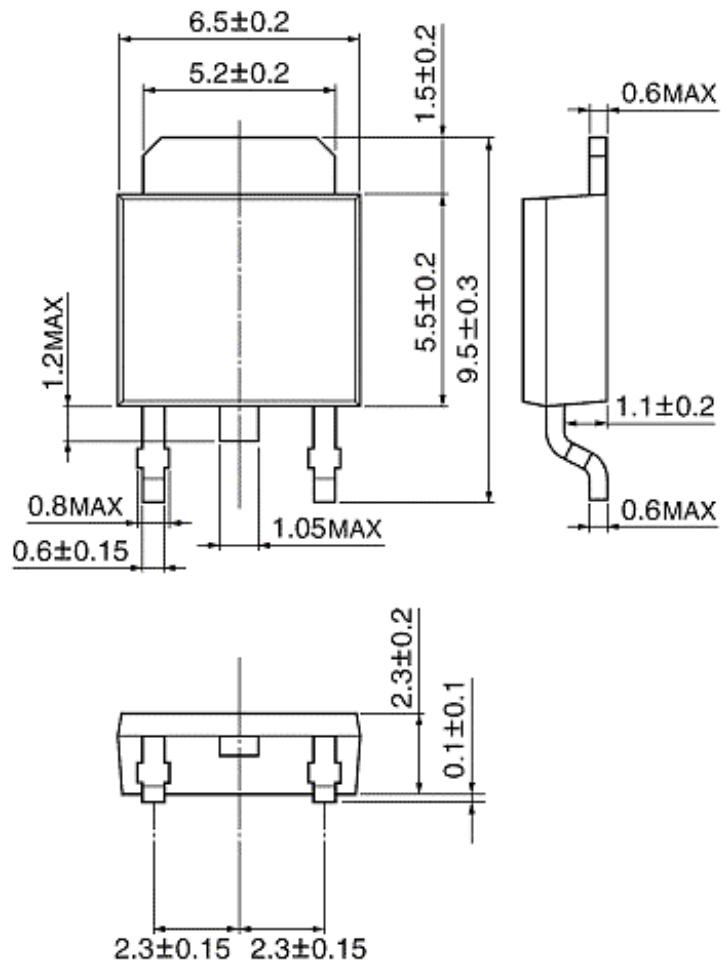
- **Overheating Protection**

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.

**Package Dimensions**

HSOP3-P-2.30D

Unit: mm



Weight: 0.36 g (typ.)

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