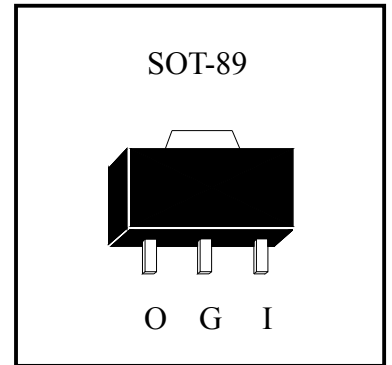


# Low Current Positive Voltage Regulator

## LM78LXXM3



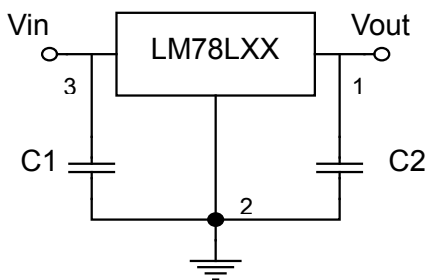
### Description

The LM78LXXM3 series of positive regulators are available in the SOT-89 package and with 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V and 24V fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. Each type employs internal current limiting, thermal shut-down and safe operating area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 100mA output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents. LM78LXXM3 is characterized for operation from -40°C to +125°C.

### Features:

- Internal Short-Circuit Current Limiting
- Internal Thermal Overload Protection
- No External Components Required
- Pb-free lead plating and halogen-free package

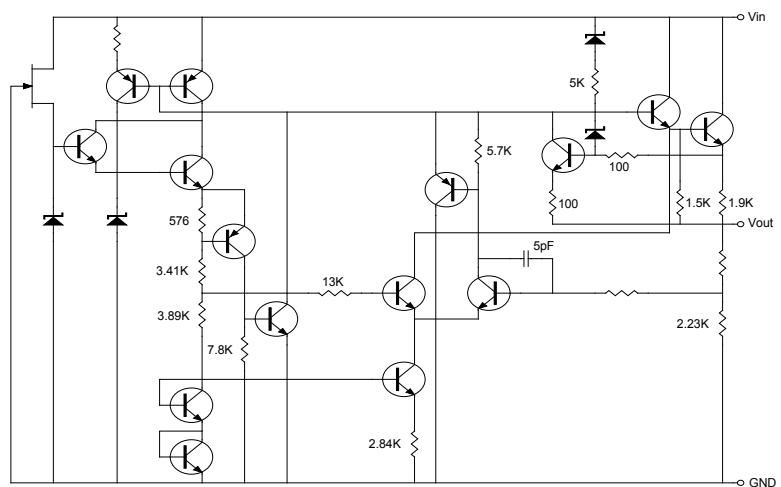
#### Typical Application



A common ground is required between the input and the output voltages. The input voltage must remain typically 2.0V above the output voltage even during the low point on the input ripple voltage.

Note : C1 and C2 are required if regulator is located far from power supply filter and load, or oscillation may induced on the loop.

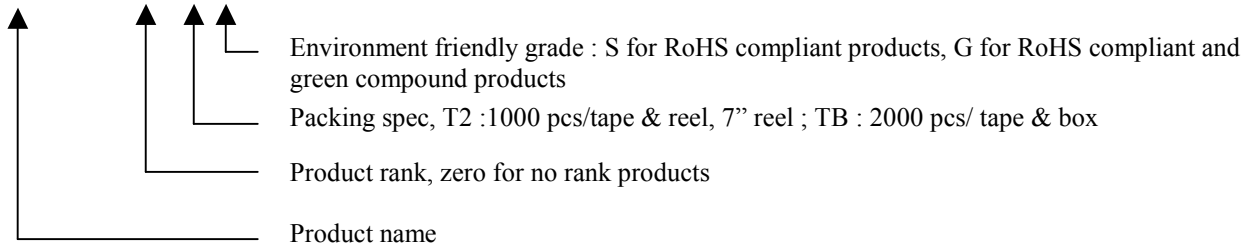
#### Schematic Diagram





**Ordering Information**

Device	Output Voltage Tolerance	Package	Shipping
LM78LXXM3-A-T2-G	±3%	SOT-89 (Pb-free lead plating and halogen-free package)	1000 pcs / Tape & Reel
LM78LXXM3-B-T2-G	±5%		



**Absolute Maximum Ratings**

Parameter	Ratings	Unit
Input Voltage	LM78L05 ~ 10	30
	LM78L12 ~18	35
	LM78L24	40
Output Current	100	mA
Operating Junction Temperature Range	-40 ~ +125	°C
Storage Temperature Range	-65 ~ +150	°C
Power Dissipation	500 (Note)	mW

Note : When mounted on minimum pad size and tested in free air condition, without heat sinking.

**Electrical Characteristics**

**LM78L05** (Vin=10V, Io=40mA, Tj=25°C, Cin=0.33uF, Cout=0.1uF ,unless otherwise noted) (Note 1)

Symbol	Parameter	Min	Typ	Max	Conditions	Units
Vo	Output Voltage	4.85	5	5.15	Vin=10V, Io=40mA, Tj=25°C 7V≤Vin≤20V, 1mA≤Io≤40mA	V
		4.75	-	5.25	Vin=10V, 1mA≤Io≤70mA (Note 2)	
ΔVo	Line Regulation	-	32	150	7V≤Vin≤20V	mV
		-	26	100	8V≤Vin≤20V	
ΔVo	Load Regulation	-	15	60	1mA≤Io≤100mA	mV
		-	8	30	1mA≤Io≤40mA	
IQ	Quiescent Current	-	2.6	6	Tj=25°C, Vin=10V, Io=40mA	mA
ΔIQ	Quiescent Current Change	-	-	1.5	8V≤Vin≤20V	mA
		-	-	0.1	1mA≤Io≤40mA	
Vn	Output Noise Voltage	-	42	-	10Hz≤f≤100KHz	μV
ΔVin / ΔVout	Ripple Rejection	41	49	-	8V≤Vin≤18V, f=120Hz	dB
ΔVo/ΔTj	Temperature Stability	-	-0.65	-	Io=5mA, 0°C ≤Tj≤125°C	mV/°C
VD	Dropout Voltage	-	1.7	-	Io=40mA	V



**LM78L06** ( $V_{in}=12V$ ,  $I_o=40mA$ ,  $T_j=25^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ , unless otherwise noted) (Note 1)

Symbol	Parameter	Min	Typ	Max	Conditions	Units	
Vo	A-rank(3%)	Output Voltage	5.82	6	6.18	$V_{in}=12V$ , $I_o=40mA$ , $T_j=25^{\circ}C$ $8V \leq V_{in} \leq 20V$ , $1mA \leq I_o \leq 40mA$ $V_{in}=11V$ , $1mA \leq I_o \leq 70mA$ (Note 2)	V
	B-rank(5%)		5.70	-	6.30		
$\Delta V_o$	Line Regulation	-	35	175	$8V \leq V_{in} \leq 20V$	mV	
		-	29	125	$9V \leq V_{in} \leq 20V$		
$\Delta V_o$	Load Regulation	-	16	80	$1mA \leq I_o \leq 100mA$	mV	
		-	9	40	$1mA \leq I_o \leq 40mA$		
IQ	Quiescent Current	-	2.7	6	$T_j=25^{\circ}C$ , $V_{in}=12V$ , $I_o=40mA$	mA	
$\Delta IQ$	Quiescent Current Change	-	-	1.5	$9V \leq V_{in} \leq 20V$	mA	
		-	-	0.1	$1mA \leq I_o \leq 40mA$		
Vn	Output Noise Voltage	-	46	-	$10Hz \leq f \leq 100KHz$	$\mu V$	
$\Delta V_{in} / \Delta V_{out}$	Ripple Rejection	40	48	-	$9V \leq V_{in} \leq 19V$ , $f=120Hz$	dB	
$\Delta V_o / \Delta T_j$	Temperature Stability	-	0.75	-	$I_o=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	$mV/^{\circ}C$	
VD	Dropout Voltage	-	1.7	-	$I_o=40mA$	V	

**LM78L08** ( $V_{in}=14V$ ,  $I_o=40mA$ ,  $T_j=25^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ , unless otherwise noted) (Note 1)

Symbol	Parameter	Min	Typ	Max	Conditions	Units	
Vo	A-rank(3%)	Output Voltage	7.76	8	8.24	$V_{in}=14V$ , $I_o=40mA$ , $T_j=25^{\circ}C$ $10.5V \leq V_{in} \leq 23V$ , $1mA \leq I_o \leq 40mA$ $V_{in}=14V$ , $1mA \leq I_o \leq 70mA$ (Note 2)	V
	B-rank(5%)		7.60	-	8.40		
$\Delta V_o$	Line Regulation	-	42	175	$10.5V \leq V_{in} \leq 23V$	mV	
		-	36	125	$11V \leq V_{in} \leq 23V$		
$\Delta V_o$	Load Regulation	-	18	80	$1mA \leq I_o \leq 100mA$	mV	
		-	10	40	$1mA \leq I_o \leq 40mA$		
IQ	Quiescent Current	-	2.8	6	$T_j=25^{\circ}C$ , $V_{in}=14V$ , $I_o=40mA$	mA	
$\Delta IQ$	Quiescent Current Change	-	-	1.5	$11V \leq V_{in} \leq 23V$	mA	
		-	-	0.1	$1mA \leq I_o \leq 40mA$		
Vn	Output Noise Voltage	-	54	-	$10Hz \leq f \leq 100KHz$	$\mu V$	
$\Delta V_{in} / \Delta V_{out}$	Ripple Rejection	37	46	-	$11V \leq V_{in} \leq 21V$ , $f=120Hz$	dB	
$\Delta V_o / \Delta T_j$	Temperature Stability	-	0.75	-	$I_o=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	$mV/^{\circ}C$	
VD	Dropout Voltage	-	1.7	-	$I_o=40mA$	V	



**LM78L09** ( $V_{in}=16V, I_o=40mA, T_j=25^{\circ}C, C_{in}=0.33\mu F, C_{out}=0.1\mu F$ , unless otherwise noted) (Note 1)

Symbol	Parameter	Min	Typ	Max	Conditions	Units
Vo	A-rank(3%)	8.73	9	9.27	Vin=16V, Io=40mA, Tj=25°C 12V≤Vin≤24V, 1mA≤Io≤40mA Vin=12V, 1mA≤Io≤70mA (Note 2)	V
	B-rank(5%)		-	9.45		
ΔVo	Line Regulation	-	45	175	12V≤Vin≤24V	mV
		-	40	125	13V≤Vin≤24V	
ΔVo	Load Regulation	-	19	90	1mA≤Io≤100mA	mV
		-	11	40	1mA≤Io≤40mA	
IQ	Quiescent Current	-	2.9	6	Tj=25°C, Vin=16V, Io=40mA	mA
ΔIQ	Quiescent Current Change	-	-	1.5	13V≤Vin≤24V	mA
		-	-	0.1	1mA≤Io≤40mA	
Vn	Output Noise Voltage	-	58	-	10Hz≤f≤100KHz	μV
ΔVin / ΔVout	Ripple Rejection	38	45	-	15V≤Vin≤25V, f=120Hz	dB
ΔVo/ΔTj	Temperature Stability	-	0.75	-	Io=5mA, 0°C ≤Tj≤125°C	mV/°C
VD	Dropout Voltage	-	1.7	-	Io=40mA	V

**LM78L10** ( $V_{in}=17V, I_o=40mA, T_j=25^{\circ}C, C_{in}=0.33\mu F, C_{out}=0.1\mu F$ , unless otherwise noted) (Note 1)

Symbol	Parameter	Min	Typ	Max	Conditions	Units
Vo	A-rank(3%)	9.70	10	10.30	Vin=17V, Io=40mA, Tj=25°C 13V≤Vin≤25V, 1mA≤Io≤40mA Vin=17V, 1mA≤Io≤70mA (Note 2)	V
	B-rank(5%)		-	10.50		
ΔVo	Line Regulation	-	51	175	13V≤Vin≤25V	mV
		-	42	125	14V≤Vin≤25V	
ΔVo	Load Regulation	-	20	90	1mA≤Io≤100mA	mV
		-	11	40	1mA≤Io≤40mA	
IQ	Quiescent Current	-	3	6	Tj=25°C, Vin=17V, Io=40mA	mA
ΔIQ	Quiescent Current Change	-	-	1.5	14V≤Vin≤25V	mA
		-	-	0.1	1mA≤Io≤40mA	
Vn	Output Noise Voltage	-	62	-	10Hz≤f≤100KHz	μV
ΔVin / ΔVout	Ripple Rejection	37	44	-	15V≤Vin≤25V, f=120Hz	dB
ΔVo/ΔTj	Temperature Stability	-	0.75	-	Io=5mA, 0°C ≤Tj≤125°C	mV/°C
VD	Dropout Voltage	-	1.7	-	Io=40mA	V



**LM78L12** ( $V_{in}=19V, I_o=40mA, T_j=25^{\circ}C, C_{in}=0.33\mu F, C_{out}=0.1\mu F$ , unless otherwise noted) (Note 1)

Symbol	Parameter	Min	Typ	Max	Conditions	Units	
Vo	A-rank(3%)	Output Voltage	11.64	12	12.36	$V_{in}=19V, I_o=40mA, T_j=25^{\circ}C$ $14V \leq V_{in} \leq 27V, 1mA \leq I_o \leq 40mA$ $V_{in}=19V, 1mA \leq I_o \leq 70mA$ (Note 2)	V
	B-rank(5%)		11.40	-	12.60		
$\Delta V_o$	Line Regulation	-	55	250	$14V \leq V_{in} \leq 27V$	mV	
		-	49	200	$16V \leq V_{in} \leq 27V$		
$\Delta V_o$	Load Regulation	-	22	100	$1mA \leq I_o \leq 100mA$	mV	
		-	13	50	$1mA \leq I_o \leq 40mA$		
IQ	Quiescent Current	-	3.1	6.5	$T_j=25^{\circ}C, V_{in}=19V, I_o=40mA$	mA	
$\Delta IQ$	Quiescent Current Change	-	-	1.5	$16V \leq V_{in} \leq 27V$	mA	
		-	-	0.1	$1mA \leq I_o \leq 40mA$		
Vn	Output Noise Voltage	-	70	-	$10Hz \leq f \leq 100KHz$	$\mu V$	
$\Delta V_{in} / \Delta V_{out}$	Ripple Rejection	37	42	-	$15V \leq V_{in} \leq 25V, f=120Hz$	dB	
$\Delta V_o / \Delta T_j$	Temperature Stability	-	-1.0	-	$I_o=5mA, 0^{\circ}C \leq T_j \leq 125^{\circ}C$	$mV/^{\circ}C$	
VD	Dropout Voltage	-	1.7	-	$I_o=40mA$	V	

**LM78L15** ( $V_{in}=23V, I_o=40mA, T_j=25^{\circ}C, C_{in}=0.33\mu F, C_{out}=0.1\mu F$ , unless otherwise noted) (Note 1)

Symbol	Parameter	Min	Typ	Max	Conditions	Units	
Vo	A-rank(3%)	Output Voltage	14.55	15	15.45	$V_{in}=23V, I_o=40mA, T_j=25^{\circ}C$ $17.5V \leq V_{in} \leq 30V, 1mA \leq I_o \leq 40mA$ $V_{in}=23V, 1mA \leq I_o \leq 70mA$ (Note 2)	V
	B-rank(5%)		14.25	-	15.75		
$\Delta V_o$	Line Regulation	-	25	150	$17.5V \leq V_{in} \leq 30V$	mV	
		-	15	75	$19V \leq V_{in} \leq 30V$		
$\Delta V_o$	Load Regulation	-	20	150	$1mA \leq I_o \leq 100mA$	mV	
		-	25	150	$1mA \leq I_o \leq 40mA$		
IQ	Quiescent Current	-	2.2	6.5	$T_j=25^{\circ}C, V_{in}=23V, I_o=40mA$	mA	
$\Delta IQ$	Quiescent Current Change	-	-	1.5	$19V \leq V_{in} \leq 30V$	mA	
		-	-	0.1	$1mA \leq I_o \leq 40mA$		
Vn	Output Noise Voltage	-	90	-	$10Hz \leq f \leq 100KHz$	$\mu V$	
$\Delta V_{in} / \Delta V_{out}$	Ripple Rejection	34	63	-	$18.5V \leq V_{in} \leq 28.5V, f=120Hz$	dB	
$\Delta V_o / \Delta T_j$	Temperature Stability	-	-1.3	-	$I_o=5mA, 0^{\circ}C \leq T_j \leq 125^{\circ}C$	$mV/^{\circ}C$	
VD	Dropout Voltage	-	1.7	-	$I_o=40mA$	V	



**LM78L18** ( $V_{in}=26V$ ,  $I_o=40mA$ ,  $T_j=25^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ , unless otherwise noted) (Note 1)

Symbol	Parameter	Min	Typ	Max	Conditions	Units
Vo	Output Voltage	17.46	18	18.54	$V_{in}=26V$ , $I_o=40mA$ , $T_j=25^{\circ}C$ $21V \leq V_{in} \leq 33V$ , $1mA \leq I_o \leq 40mA$ $V_{in}=26V$ , $1mA \leq I_o \leq 70mA$ (Note 2)	V
		17.10	-	18.90		
$\Delta V_o$	Line Regulation	-	70	360	$20.5V \leq V_{in} \leq 33V$	mV
		-	64	300	$22V \leq V_{in} \leq 33V$	
$\Delta V_o$	Load Regulation	-	27	180	$1mA \leq I_o \leq 100mA$	mV
		-	19	90	$1mA \leq I_o \leq 40mA$	
IQ	Quiescent Current	-	3.5	6.5	$T_j=25^{\circ}C$ , $V_{in}=26V$ , $I_o=40mA$	mA
$\Delta IQ$	Quiescent Current Change	-	-	1.5	$21V \leq V_{in} \leq 33V$	mA
		-	-	0.1	$1mA \leq I_o \leq 40mA$	
Vn	Output Noise Voltage	-	89	-	$10Hz \leq f \leq 100KHz$	$\mu V$
$\Delta V_{in} / \Delta V_{out}$	Ripple Rejection	32	36	-	$21.5V \leq V_{in} \leq 31.5V$ , $f=120Hz$	dB
$\Delta V_o / \Delta T_j$	Temperature Stability	-	-1.8	-	$I_o=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	$mV/^{\circ}C$
VD	Dropout Voltage	-	1.7	-	$I_o=40mA$	V

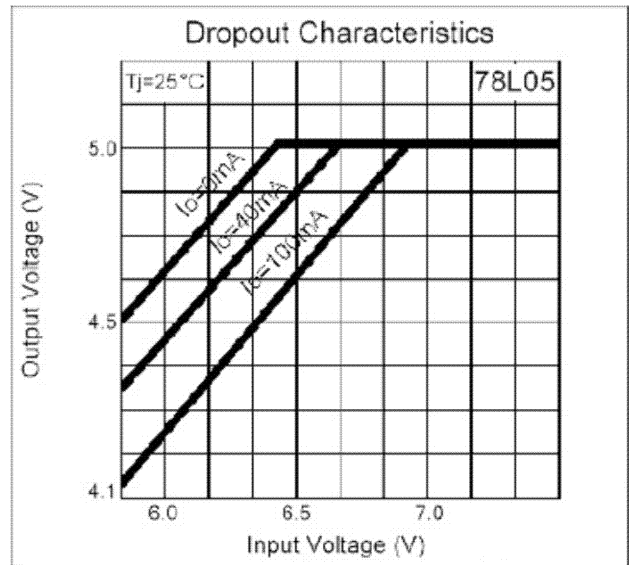
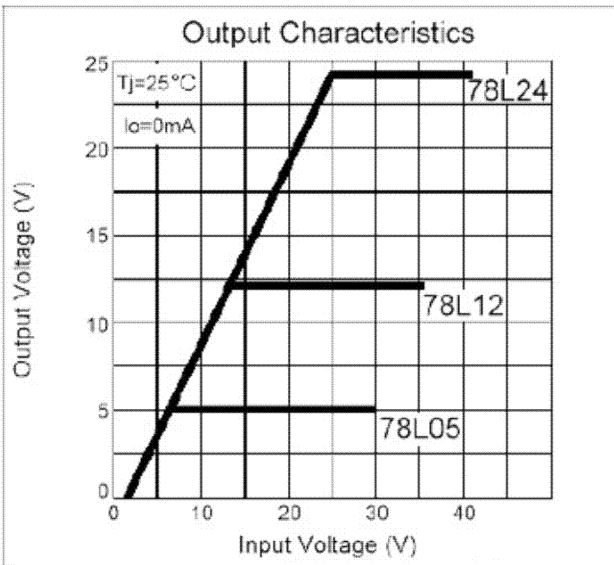
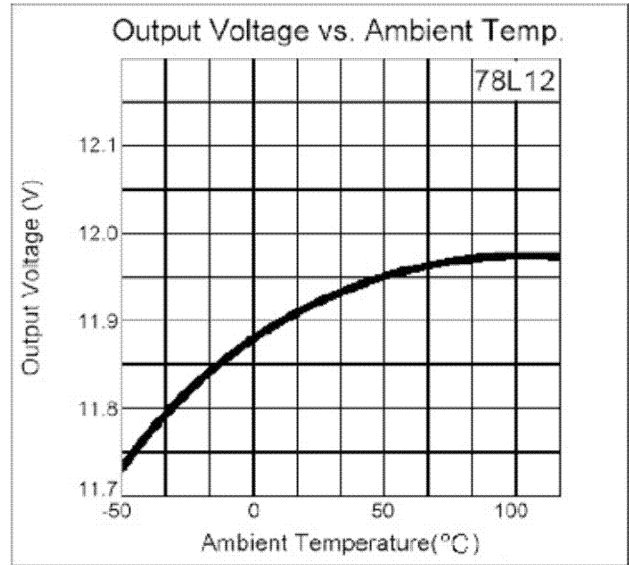
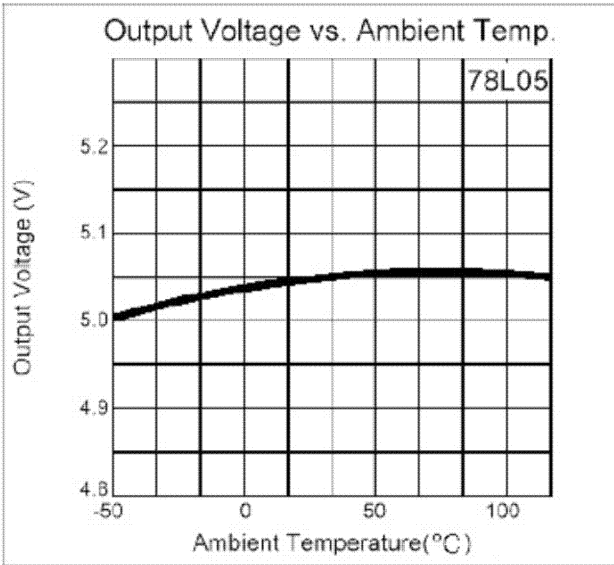
**LM78L24** ( $V_{in}=32V$ ,  $I_o=40mA$ ,  $T_j=25^{\circ}C$ ,  $C_{in}=0.33\mu F$ ,  $C_{out}=0.1\mu F$ , unless otherwise noted) (Note 1)

Symbol	Parameter	Min	Typ	Max	Conditions	Units
Vo	Output Voltage	23.28	24	24.72	$V_{in}=32V$ , $I_o=40mA$ , $T_j=25^{\circ}C$ $27V \leq V_{in} \leq 38V$ , $1mA \leq I_o \leq 40mA$ $V_{in}=32V$ , $1mA \leq I_o \leq 70mA$ (Note 2)	V
		22.80	24	25.20		
$\Delta V_o$	Line Regulation	-	95	480	$26.5V \leq V_{in} \leq 39V$	mV
		-	78	400	$29V \leq V_{in} \leq 39V$	
$\Delta V_o$	Load Regulation	-	41	240	$1mA \leq I_o \leq 100mA$	mV
		-	28	120	$1mA \leq I_o \leq 40mA$	
IQ	Quiescent Current	-	3.6	6.5	$T_j=25^{\circ}C$ , $V_{in}=32V$ , $I_o=40mA$	mA
$\Delta IQ$	Quiescent Current Change	-	-	1.5	$28V \leq V_{in} \leq 39V$	mA
		-	-	0.1	$1mA \leq I_o \leq 40mA$	
Vn	Output Noise Voltage	-	97	-	$10Hz \leq f \leq 100KHz$	$\mu V$
$\Delta V_{in} / \Delta V_{out}$	Ripple Rejection	30	33	-	$27.5V \leq V_{in} \leq 37.5V$ , $f=120Hz$	dB
$\Delta V_o / \Delta T_j$	Temperature Stability	-	-2.0	-	$I_o=5mA$ , $0^{\circ}C \leq T_j \leq 125^{\circ}C$	$mV/^{\circ}C$
VD	Dropout Voltage	-	1.7	-	$I_o=40mA$	V

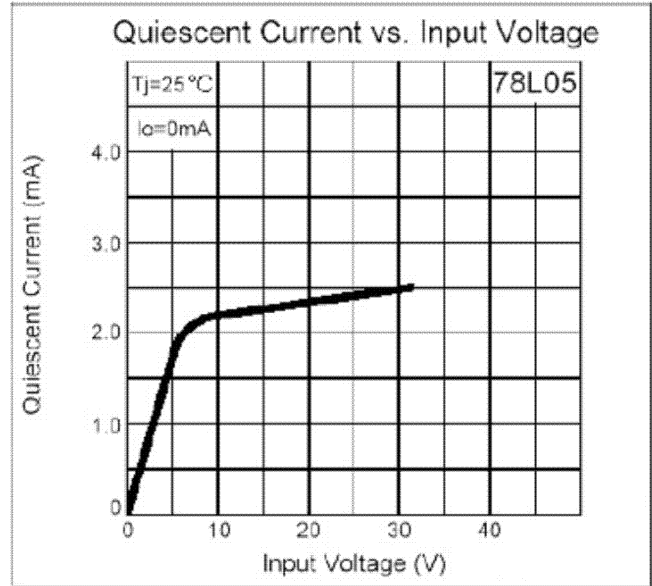
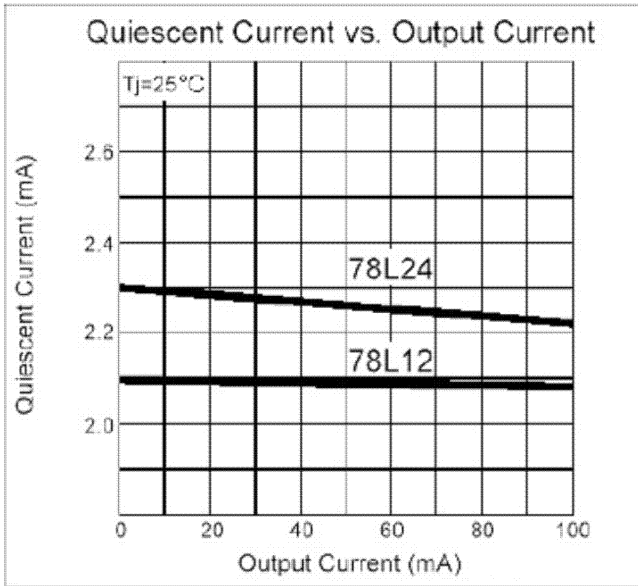
Note : 1. The maximum steady state usable output current is dependent on input voltage, heat sinking, lead length of the package and copper of PCB. The data above represent pulse test conditions with junction temperatures specified at the initial of test.

2. Power dissipation  $< 0.5W$

**Characteristic Curves**

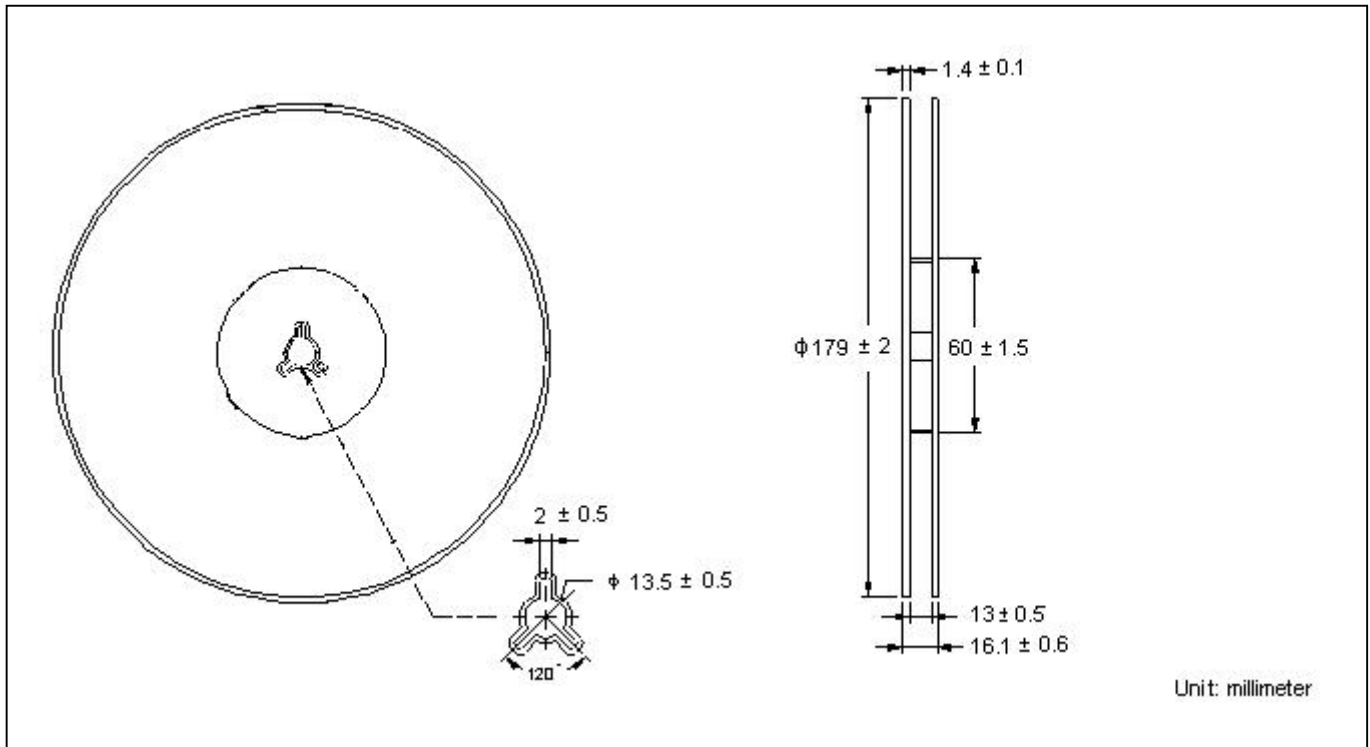


**Characteristic Curves(Cont.)**

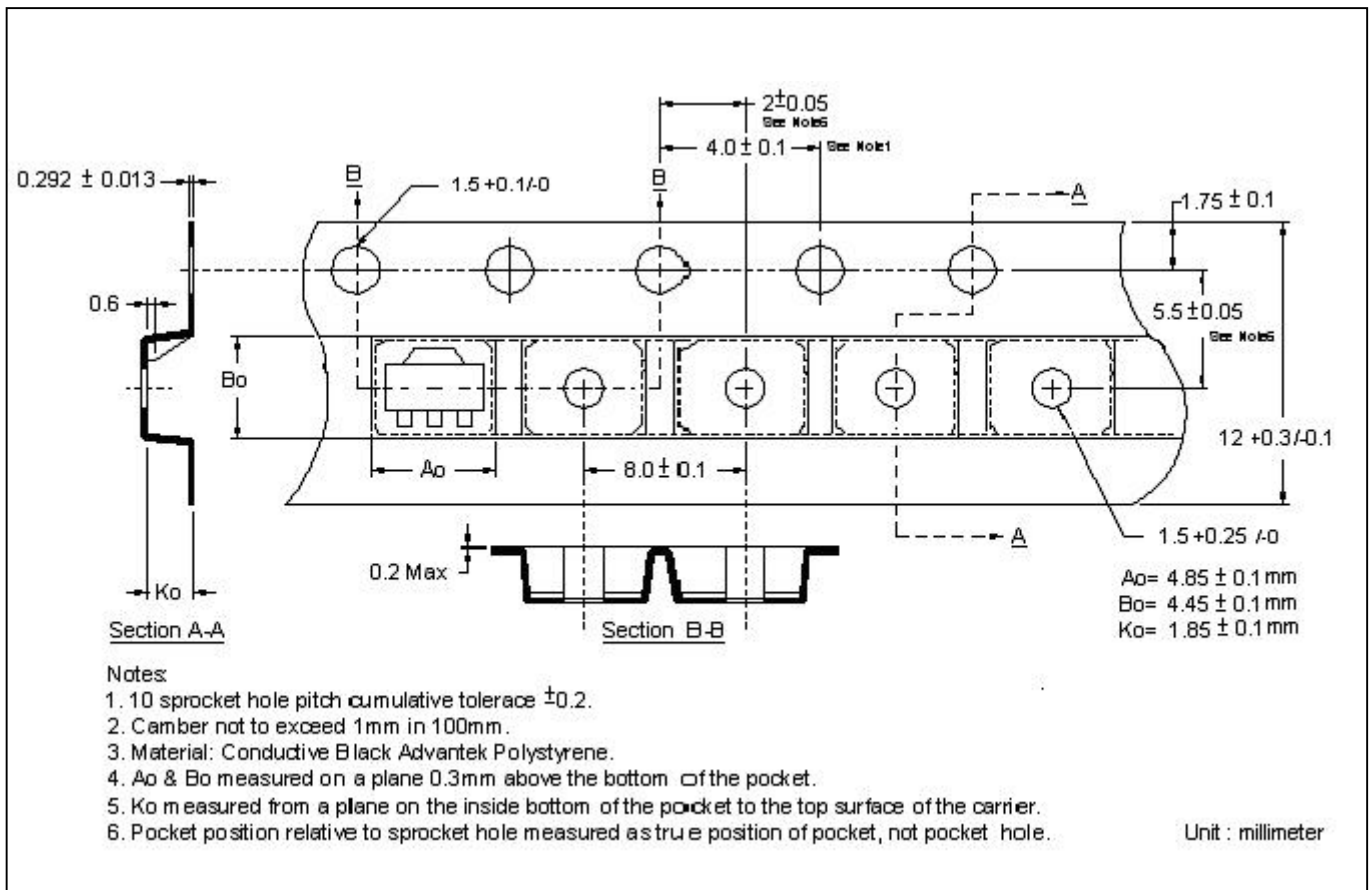




**Reel Dimension**



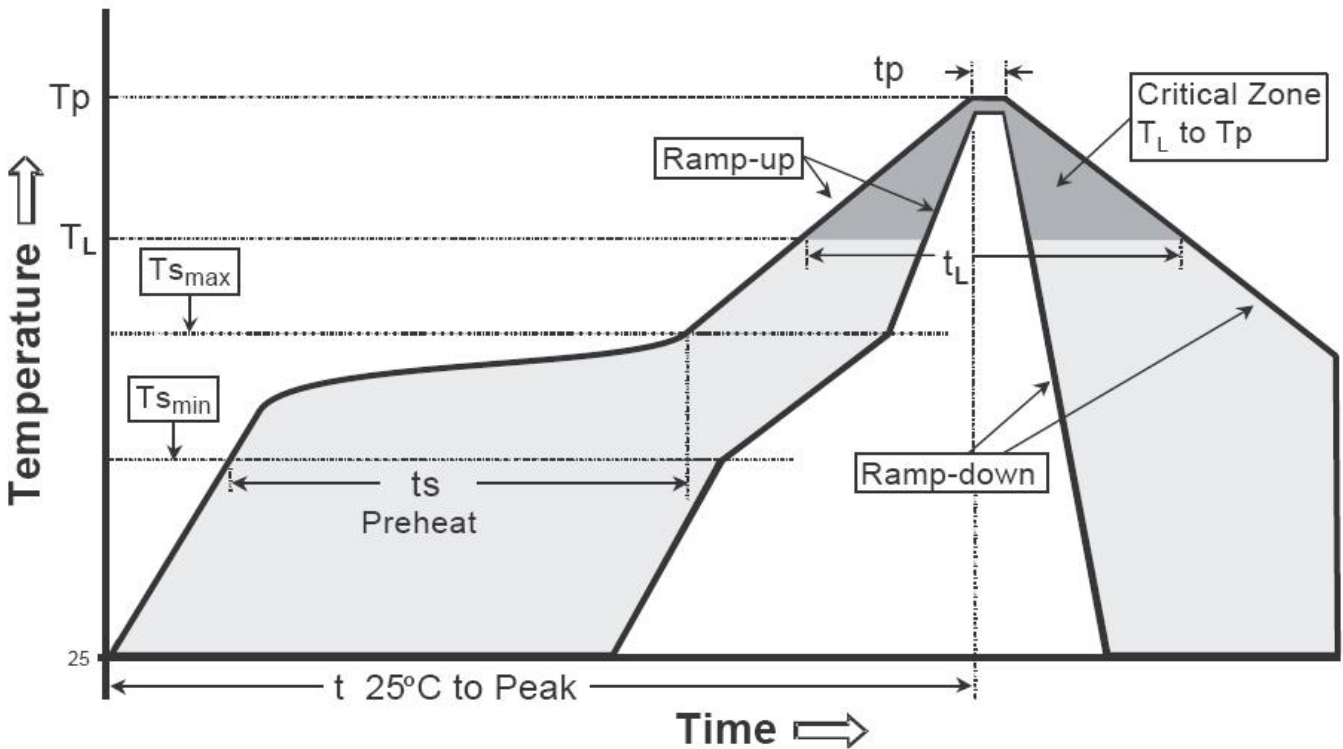
**Carrier Tape Dimension**



**Recommended wave soldering condition**

Product	Peak Temperature	Soldering Time
Pb-free devices	260 +0/-5 °C	5 +1/-1 seconds

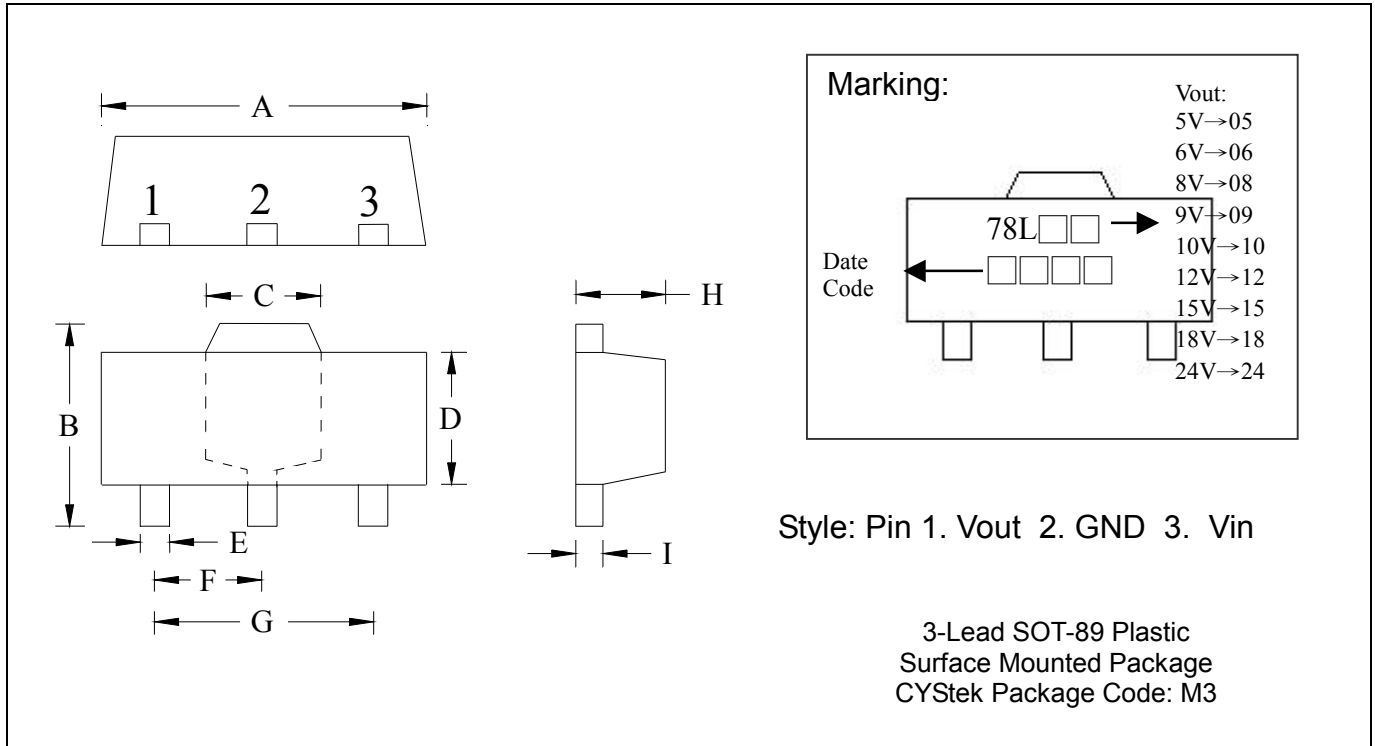
**Recommended temperature profile for IR reflow**



Profile feature	Sn-Pb eutectic Assembly	Pb-free Assembly
Average ramp-up rate (Tsmax to Tp)	3°C/second max.	3°C/second max.
Preheat		
-Temperature Min(Ts min)	100°C	150°C
-Temperature Max(Ts max)	150°C	200°C
-Time(ts min to ts max)	60-120 seconds	60-180 seconds
Time maintained above:		
-Temperature (Tl)	183°C	217°C
- Time (tl)	60-150 seconds	60-150 seconds
Peak Temperature(Tp)	240 +0/-5 °C	260 +0/-5 °C
Time within 5°C of actual peak temperature(tp)	10-30 seconds	20-40 seconds
Ramp down rate	6°C/second max.	6°C/second max.
Time 25 °C to peak temperature	6 minutes max.	8 minutes max.

Note : All temperatures refer to topside of the package, measured on the package body surface.

**SOT-89 Dimension**



\*: Typical

DIM	Inches		Millimeters		DIM	Inches		Millimeters	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	0.1732	0.1811	4.40	4.60	F	0.0591	TYP	1.50	TYP
B	0.1551	0.1673	3.94	4.25	G	0.1181	TYP	3.00	TYP
C	0.0610	REF	1.55	REF	H	0.0551	0.0630	1.40	1.60
D	0.0906	0.1024	2.30	2.60	I	0.0138	0.0173	0.35	0.44
E	0.0126	0.0205	0.32	0.52					

Notes: 1.Controlling dimension: millimeters.  
 2.Maximum lead thickness includes lead finish thickness, and minimum lead thickness is the minimum thickness of base material.  
 3.If there is any question with packing specification or packing method, please contact your local CYStek sales office.

**Material:**

- Lead: Pure tin plated.
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0.

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