Low Current Positive Voltage Regulator

LM78LXX Series

Description

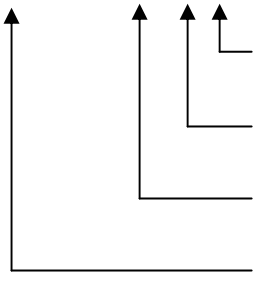
The LM78LXX series of positive regulators are available in the TO-92 and SOT-89 package and with 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V and 24V fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems 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 200mA output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents. LM78LXX series is characterized for operation from -40℃ to 125℃.

Features:

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

Ordering Information

Device	Output Voltage Tolerance	Package	Shipping
LM78LXXA3-A-TB-G	±3%	TO-92 (Pb-free lead plating and halogen-free package)	2000 pcs / Tape & Box
LM78LXXA3-B-TB-G	±5%		
LM78LXXA3-A-BK-G	±3%		1000 pcs/ bag, 10 bags/ box 10boxes/carton
LM78LXXA3-B-BK-G	±5%		
LM78LXXM3-A-T2-G	±3%	SOT-89 (Pb-free lead plating and halogen-free package)	1000 pcs / Tape & Reel
LM78LXXM3-B-T2-G	±5%		



Environment friendly grade : S for RoHS compliant products, G for RoHS compliant and green compound products

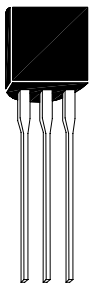
Packing spec, T2 :1000 pcs/tape & reel, 7" reel ; TB : 2000 pcs/ tape & box ;
BK: 1000 pcs/bag, 10 bags/box, 10 boxes/carton

Product rank, zero for no rank products

Product name

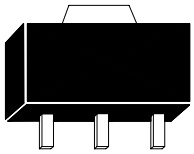
Outlines

TO-92



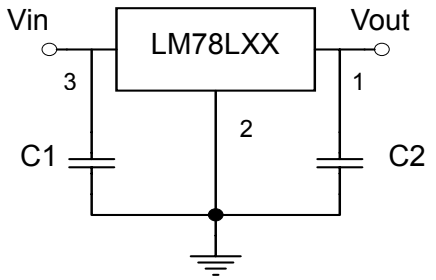
O G I

SOT-89



O G I

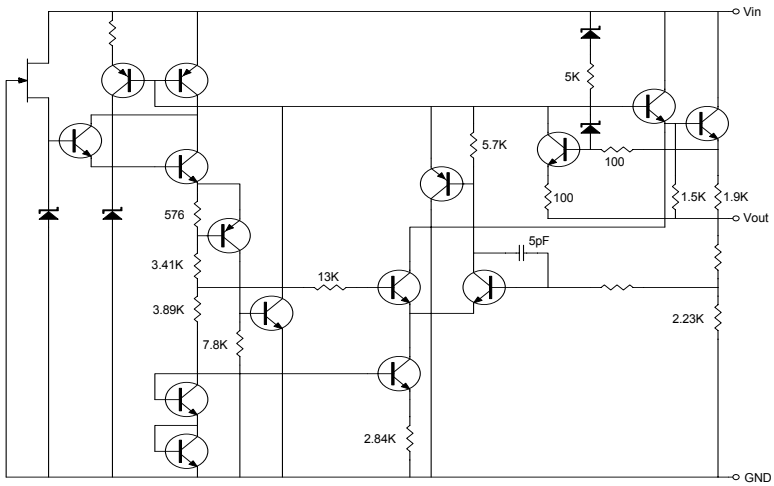
Typical Application



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



Absolute Maximum Ratings

Parameter		Ratings	Unit
Input Voltage	LM78L05 ~ 10	30	V
	LM78L12 ~18	35	
	LM78L24	40	
Output Current		200	mA
Operating Junction Temperature Range		-40 ~ +125	℃
Storage Temperature Range		-65 ~ +150	℃
Power Dissipation	TO-92	625 (Note)	mW
	SOT-89	500 (Note)	

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

Electrical Characteristics

LM78L05 (Vin=10V, Io=80mA, Tj=25°C, Cin=0.33uF, Cout=0.1uF ,unless otherwise noted) (Note 1)

Symbol		Parameter	Min	Typ	Max	Conditions	Units
Vo	A-rank(3%)	Output Voltage	4.85	5	5.15	Vin=10V, Io=80mA,Tj=25°C 7V≤Vin≤20V, 1mA≤Io≤80mA Vin=10V, 1mA≤Io≤140mA (Note 2)	V
	B-rank(5%)		4.75	-	5.25		
ΔVo		Line Regulation	-	32	150	7V≤Vin≤20V	mV
			-	26	100	8V≤Vin≤20V	
ΔVo		Load Regulation	-	15	60	1mA≤Io≤200mA	mV
			-	8	30	1mA≤Io≤80mA	
IQ		Quiescent Current	-	2.6	6	Tj=25°C, Vin=10V, Io=80mA	mA
ΔIQ		Quiescent Current Change	-	-	1.5	8V≤Vin≤20V	mA
			-	-	0.1	1mA≤Io≤80mA	
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/℃
VD		Dropout Voltage	-	1.7	-	Io=80mA	V

LM78L06 (Vin=12V, Io=80mA, Tj=25°C, Cin=0.33uF, Cout=0.1uF, unless otherwise noted) (Note 1)

Symbol		Parameter	Min	Typ	Max	Conditions	Units
Vo	A-rank(3%)	Output Voltage	5.82	6	6.18	Vin=12V, Io=80mA,Tj=25°C 8V≤Vin≤20V, 1mA≤Io≤80mA Vin=11V, 1mA≤Io≤140mA (Note 2)	V
	B-rank(5%)		5.70	-	6.30		
ΔVo		Line Regulation	-	35	175	8V≤Vin≤20V	mV
			-	29	125	9V≤Vin≤20V	
ΔVo		Load Regulation	-	16	80	1mA≤Io≤200mA	mV
			-	9	40	1mA≤Io≤80mA	
IQ		Quiescent Current	-	2.7	6	Tj=25°C, Vin=12V, Io=80mA	mA
ΔIQ		Quiescent Current Change	-	-	1.5	9V≤Vin≤20V	mA
			-	-	0.1	1mA≤Io≤80mA	
Vn		Output Noise Voltage	-	46	-	10Hz≤f≤100KHz	μV
ΔVin / ΔVout		Ripple Rejection	40	48	-	9V≤Vin≤19V, f=120Hz	dB
ΔVo/ΔTj		Temperature Stability	-	0.75	-	Io=5mA, 0°C ≤Tj≤125°C	mV/℃
VD		Dropout Voltage	-	1.7	-	Io=80mA	V

LM78L08(Vin=14V, Io=80mA, Tj=25°C, Cin=0.33uF, Cout=0.1uF, unless otherwise noted) (Note 1)

Symbol		Parameter	Min	Typ	Max	Conditions	Units
Vo	A-rank(3%)	Output Voltage	7.76	8	8.24	Vin=14V, Io=80mA,Tj=25°C 10.5V≤Vin≤23V, 1mA≤Io≤80mA Vin=14V,1mA≤Io≤140mA (Note 2)	V
	B-rank(5%)		7.60	-	8.40		
ΔVo		Line Regulation	-	42	175	10.5V≤Vin≤23V	mV
			-	36	125	11V≤Vin≤23V	
ΔVo		Load Regulation	-	18	80	1mA≤Io≤200mA	mV
			-	10	40	1mA≤Io≤80mA	
IQ		Quiescent Current	-	2.8	6	Tj=25°C, Vin=14V, Io=80mA	mA
ΔIQ		Quiescent Current Change	-	-	1.5	11V≤Vin≤23V	mA
			-	-	0.1	1mA≤Io≤80mA	
Vn		Output Noise Voltage	-	54	-	10Hz≤f≤100KHz	μV
ΔVin / ΔVout		Ripple Rejection	37	46	-	11V≤Vin≤21V, f=120Hz	dB
ΔVo/ΔTj		Temperature Stability	-	0.75	-	Io=5mA, 0°C ≤Tj≤125°C	mV/℃
VD		Dropout Voltage	-	1.7	-	Io=80mA	V

LM78L09 (Vin=16V, Io=80mA, Tj=25°C, Cin=0.33uF, Cout=0.1uF, unless otherwise noted) (Note 1)

Symbol		Parameter	Min	Typ	Max	Conditions	Units
Vo	A-rank(3%)	Output Voltage	8.73	9	9.27	Vin=16V, Io=80mA,Tj=25°C 12V≤Vin≤24V, 1mA≤Io≤80mA Vin=12V,1mA≤Io≤140mA (Note 2)	V
	B-rank(5%)		8.55	-	9.45		
ΔVo		Line Regulation	-	45	175	12V≤Vin≤24V	mV
			-	40	125	13V≤Vin≤24V	
ΔVo		Load Regulation	-	19	90	1mA≤Io≤200mA	mV
			-	11	40	1mA≤Io≤80mA	
IQ		Quiescent Current	-	2.9	6	Tj=25°C, Vin=16V, Io=80mA	mA
ΔIQ		Quiescent Current Change	-	-	1.5	13V≤Vin≤24V	mA
			-	-	0.1	1mA≤Io≤80mA	
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/℃
VD		Dropout Voltage	-	1.7	-	Io=80mA	V

LM78L10(Vin=17V, Io=80mA, Tj=25°C, Cin=0.33uF, Cout=0.1uF, unless otherwise noted) (Note 1)

Symbol		Parameter	Min	Typ	Max	Conditions	Units
Vo	A-rank(3%)	Output Voltage	9.70	10	10.30	Vin=17V, Io=80mA,Tj=25°C 13V≤Vin≤25V, 1mA≤Io≤80mA Vin=17V,1mA≤Io≤140mA (Note 2)	V
	B-rank(5%)		9.50	-	10.50		
ΔVo		Line Regulation	-	51	175	13V≤Vin≤25V	mV
			-	42	125	14V≤Vin≤25V	
ΔVo		Load Regulation	-	20	90	1mA≤Io≤200mA	mV
			-	11	40	1mA≤Io≤80mA	
IQ		Quiescent Current	-	3	6	Tj=25°C, Vin=17V, Io=80mA	mA
ΔIQ		Quiescent Current Change	-	-	1.5	14V≤Vin≤25V	mA
			-	-	0.1	1mA≤Io≤80mA	
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/℃
VD		Dropout Voltage	-	1.7	-	Io=80mA	V

LM78L12 (Vin=19V, Io=80mA, Tj=25°C, Cin=0.33uF, Cout=0.1uF, unless otherwise noted) (Note 1)

Symbol		Parameter	Min	Typ	Max	Conditions	Units
Vo	A-rank(3%)	Output Voltage	11.64	12	12.36	Vin=19V, Io=80mA,Tj=25°C 14V≤Vin≤27V, 1mA≤Io≤80mA Vin=19V,1mA≤Io≤140mA (Note 2)	V
	B-rank(5%)		11.40	-	12.60		
ΔVo		Line Regulation	-	55	250	14V≤Vin≤27V	mV
			-	49	200	16V≤Vin≤27V	
ΔVo		Load Regulation	-	22	100	1mA≤Io≤200mA	mV
			-	13	50	1mA≤Io≤80mA	
IQ		Quiescent Current	-	3.1	6.5	Tj=25°C, Vin=19V, Io=80mA	mA
ΔIQ		Quiescent Current Change	-	-	1.5	16V≤Vin≤27V	mA
			-	-	0.1	1mA≤Io≤80mA	
Vn		Output Noise Voltage	-	70	-	10Hz≤f≤100KHz	μV
ΔVin / ΔVout		Ripple Rejection	37	42	-	15V≤Vin≤25V, f=120Hz	dB
ΔVo/ΔTj		Temperature Stability	-	-1.0	-	Io=5mA, 0°C ≤Tj≤125°C	mV/℃
VD		Dropout Voltage	-	1.7	-	Io=80mA	V

LM78L15 (Vin=23V, Io=80mA, Tj=25°C, Cin=0.33uF, Cout=0.1uF, unless otherwise noted) (Note 1)

Symbol		Parameter	Min	Typ	Max	Conditions	Units
Vo	A-rank(3%)	Output Voltage	14.55	15	15.45	Vin=23V, Io=80mA,Tj=25°C 17.5V≤Vin≤30V, 1mA≤Io≤80mA Vin=23V,1mA≤Io≤140mA (Note 2)	V
	B-rank(5%)		14.25	-	15.75		
ΔVo		Line Regulation	-	25	150	17.5V≤Vin≤30V	mV
			-	15	75	19V≤Vin≤30V	
ΔVo		Load Regulation	-	20	150	1mA≤Io≤200mA	mV
			-	25	150	1mA≤Io≤80mA	
IQ		Quiescent Current	-	2.2	6.5	Tj=25°C, Vin=23V, Io=80mA	mA
ΔIQ		Quiescent Current Change	-	-	1.5	19V≤Vin≤30V	mA
			-	-	0.1	1mA≤Io≤80mA	
Vn		Output Noise Voltage	-	90	-	10Hz≤f≤100KHz	μV
ΔVin / ΔVout		Ripple Rejection	34	63	-	18.5V≤Vin≤28.5V, f=120Hz	dB
ΔVo/ΔTj		Temperature Stability	-	-1.3	-	Io=5mA, 0°C ≤Tj≤125°C	mV/℃
VD		Dropout Voltage	-	1.7	-	Io=80mA	V

LM78L18 (Vin=26V, Io=80mA, Tj=25°C, Cin=0.33uF, Cout=0.1uF, unless otherwise noted) (Note 1)

Symbol		Parameter	Min	Typ	Max	Conditions	Units
Vo	A-rank(3%)	Output Voltage	17.46	18	18.54	Vin=26V, Io=80mA,Tj=25°C 21V≤Vin≤33V, 1mA≤Io≤80mA Vin=26V,1mA≤Io≤140mA (Note 2)	V
	B-rank(5%)		17.10	-	18.90		
ΔVo		Line Regulation	-	70	360	20.5V≤Vin≤33V	mV
			-	64	300	22V≤Vin≤33V	
ΔVo		Load Regulation	-	27	180	1mA≤Io≤200mA	mV
			-	19	90	1mA≤Io≤80mA	
IQ		Quiescent Current	-	3.5	6.5	Tj=25°C, Vin=26V, Io=80mA	mA
ΔIQ		Quiescent Current Change	-	-	1.5	21V≤Vin≤33V	mA
			-	-	0.1	1mA≤Io≤80mA	
Vn		Output Noise Voltage	-	89	-	10Hz≤f≤100KHz	μV
ΔVin / ΔVout		Ripple Rejection	32	36	-	21.5V≤Vin≤31.5V, f=120Hz	dB
ΔVo/ΔTj		Temperature Stability	-	-1.8	-	Io=5mA, 0°C ≤Tj≤125°C	mV/℃
VD		Dropout Voltage	-	1.7	-	Io=80mA	V

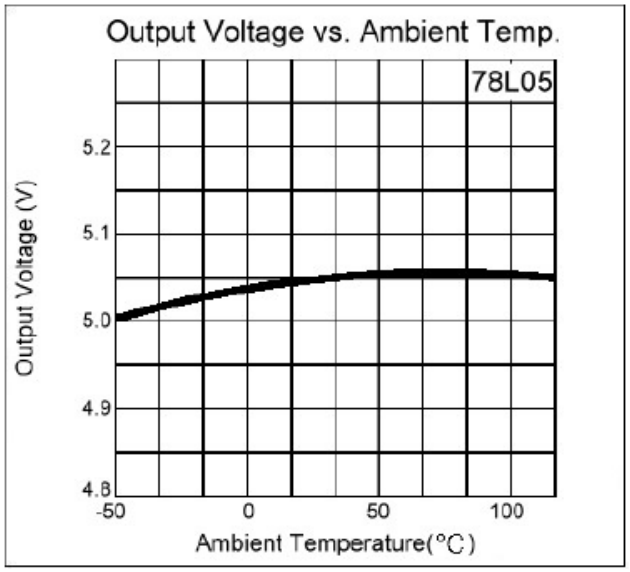
LM78L24 (Vin=32V, Io=80mA, Tj=25°C, Cin=0.33uF, Cout=0.1uF, unless otherwise noted) (Note 1)

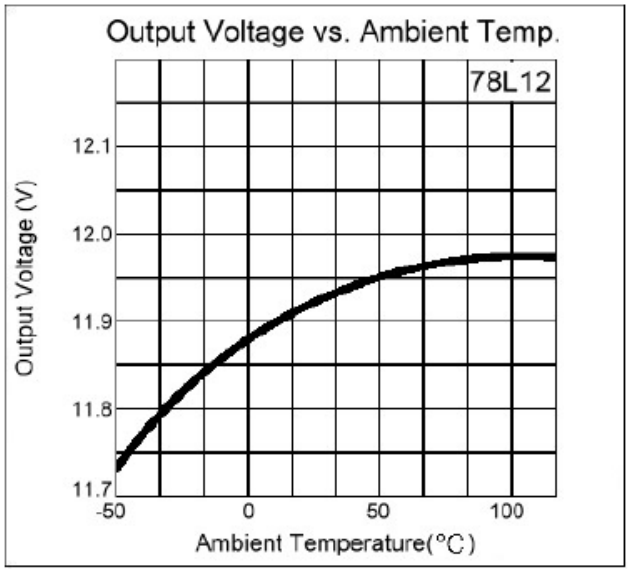
Symbol		Parameter	Min	Typ	Max	Conditions	Units
Vo	A-rank(3%)	Output Voltage	23.28	24	24.72	Vin=32V, Io=80mA,Tj=25°C 27V≤Vin≤38V, 1mA≤Io≤80mA Vin=32V,1mA≤Io≤140mA (Note 2)	V
	B-rank(5%)		22.80	24	25.20		
ΔVo		Line Regulation	-	95	480	26.5V≤Vin≤39V	mV
			-	78	400	29V≤Vin≤39V	
ΔVo		Load Regulation	-	41	240	1mA≤Io≤200mA	mV
			-	28	120	1mA≤Io≤80mA	
IQ		Quiescent Current	-	3.6	6.5	Tj=25°C, Vin=32V, Io=80mA	mA
ΔIQ		Quiescent Current Change	-	-	1.5	28V≤Vin≤39V	mA
			-	-	0.1	1mA≤Io≤80mA	
Vn		Output Noise Voltage	-	97	-	10Hz≤f≤100KHz	μV
ΔVin / ΔVout		Ripple Rejection	30	33	-	27.5V≤Vin≤37.5V, f=120Hz	dB
ΔVo/ΔTj		Temperature Stability	-	-2.0	-	Io=5mA, 0°C ≤Tj≤125°C	mV/℃
VD		Dropout Voltage	-	1.7	-	Io=80mA	V

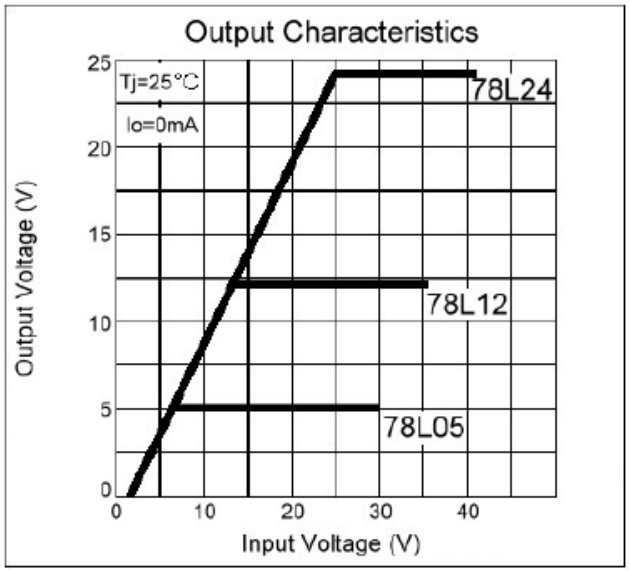
Note : 1. The maximum steady state usable output current is dependent on input voltage, heat sinking, lead length of the package and copper of PCB. The data above represent pulse test conditions with junction temperatures specified at the initial of test.

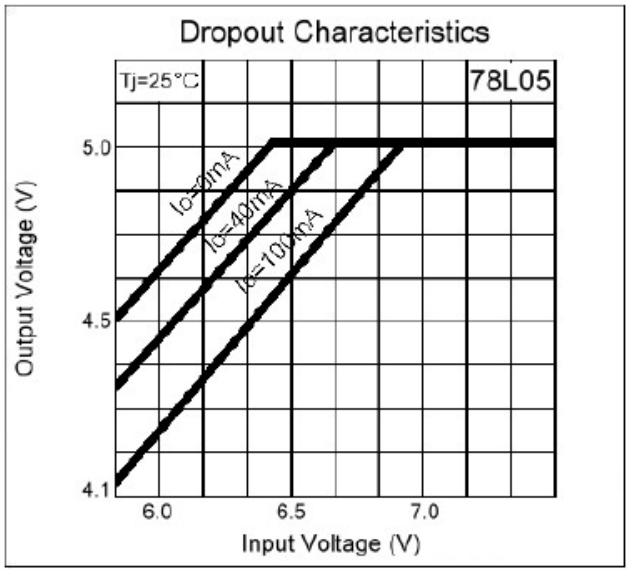
2. Power dissipation<0.625W for TO-92, <0.5W for SOT-89.

Characteristic Curves

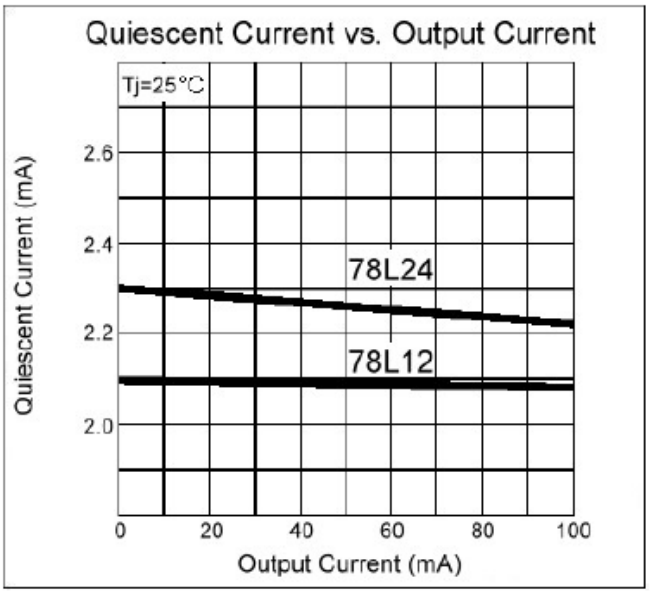


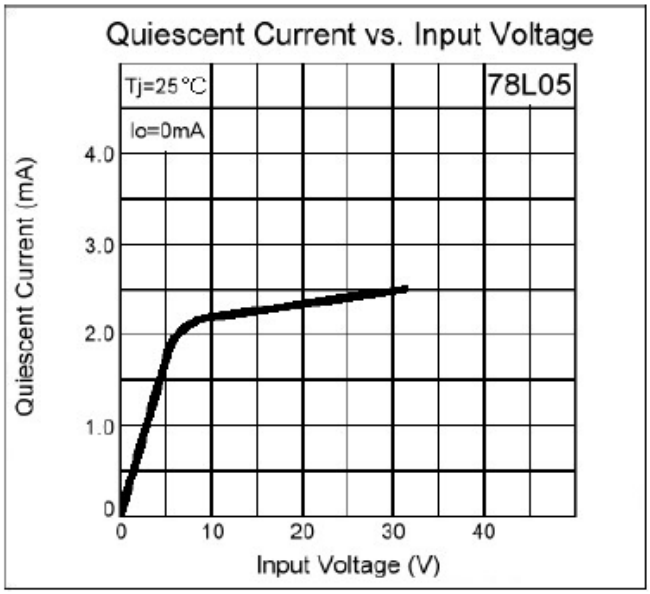




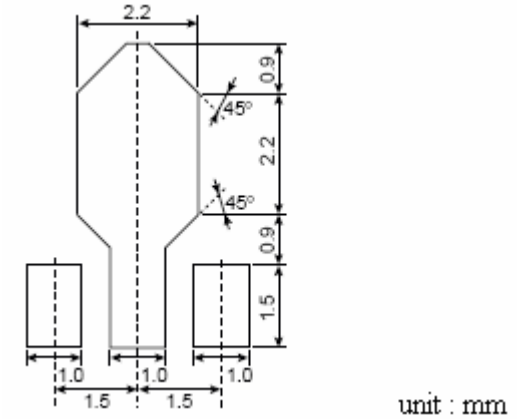


Characteristic Curves(Cont.)

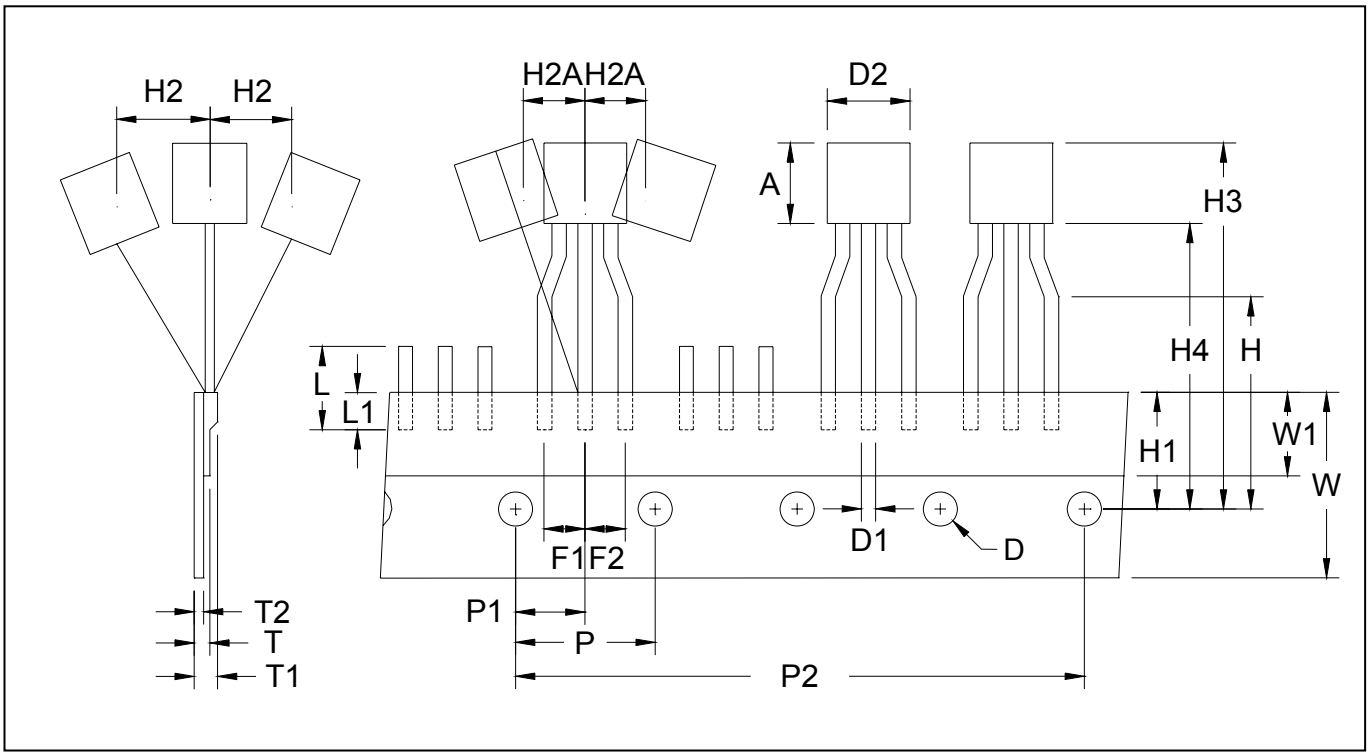




Recommended soldering footprint for SOT-89 package

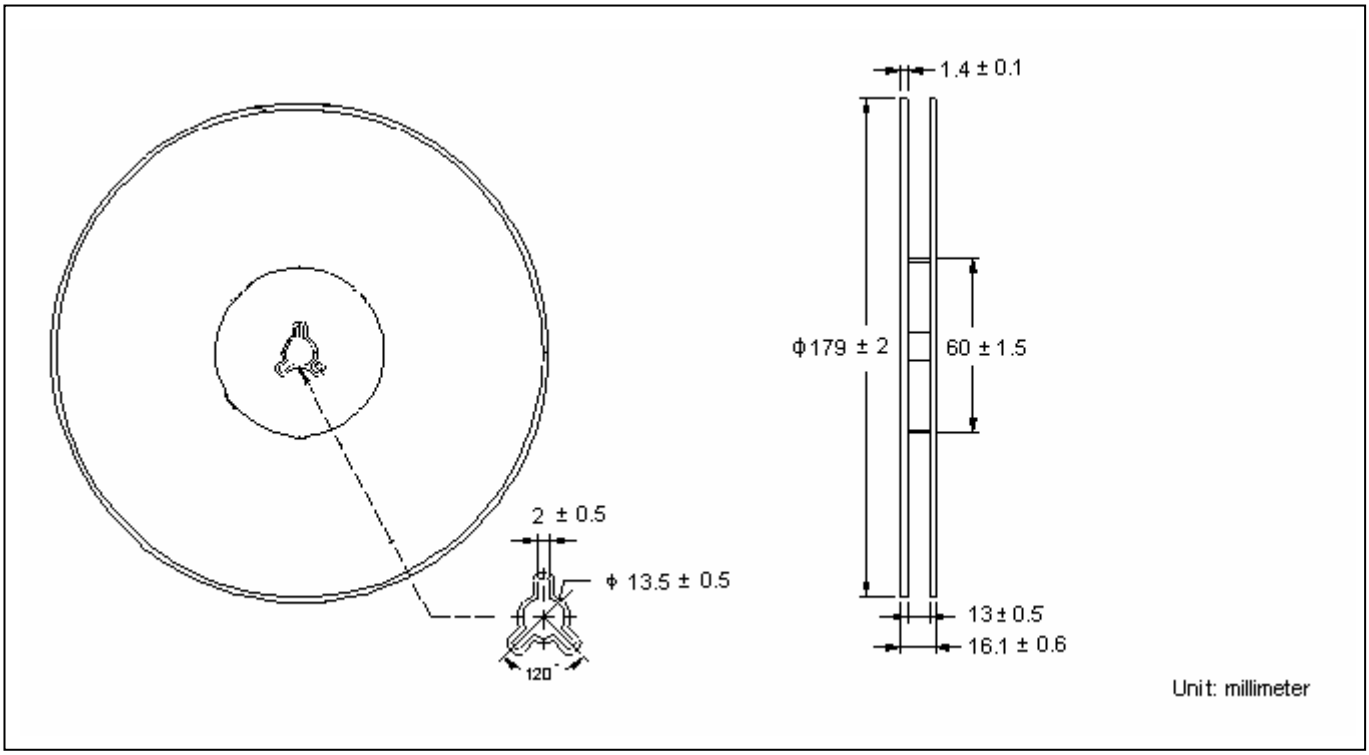


TO-92 Taping Outline

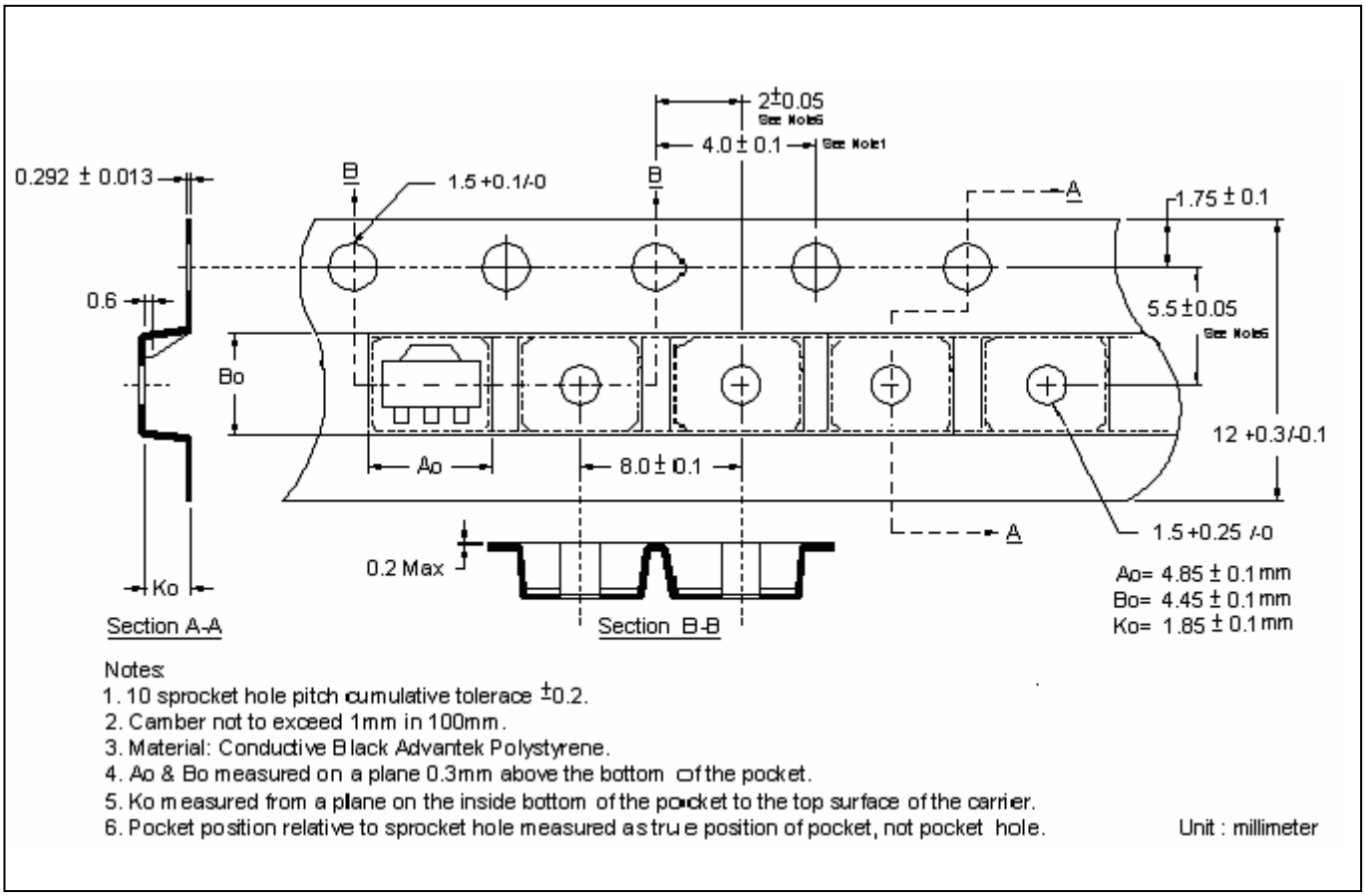


DIM	Item	Millimeters	
		Min.	Max.
A	Component body height	4.33	4.83
D	Tape Feed Diameter	3.80	4.20
D1	Lead Diameter	0.36	0.53
D2	Component Body Diameter	4.33	4.83
F1,F2	Component Lead Pitch	2.40	2.90
F1,F2	F1-F2	-	±0.3
H	Height Of Seating Plane	15.50	16.50
H1	Feed Hole Location	8.50	9.50
H2	Front To Rear Deflection	-	1
H2A	Deflection Left Or Right	-	1
H3	Component Height	-	27
H4	Feed Hole To Bottom Of Component	-	21
L	Lead Length After Component Removal	-	11
L1	Lead Wire Enclosure	2.50	-
P	Feed Hole Pitch	12.50	12.90
P1	Center Of Seating Plane Location	5.95	6.75
P2	4 Feed Hole Pitch	50.30	51.30
T	Over All Tape Thickness	-	0.55
T1	Total Taped Package Thickness	-	1.42
T2	Carrier Tape Thickness	0.36	0.68
W	Tape Width	17.50	19.00
W1	Adhesive Tape Width	5.00	7.00
-	20 pcs Pitch	253	255

Reel Dimension



Carrier Tape Dimension



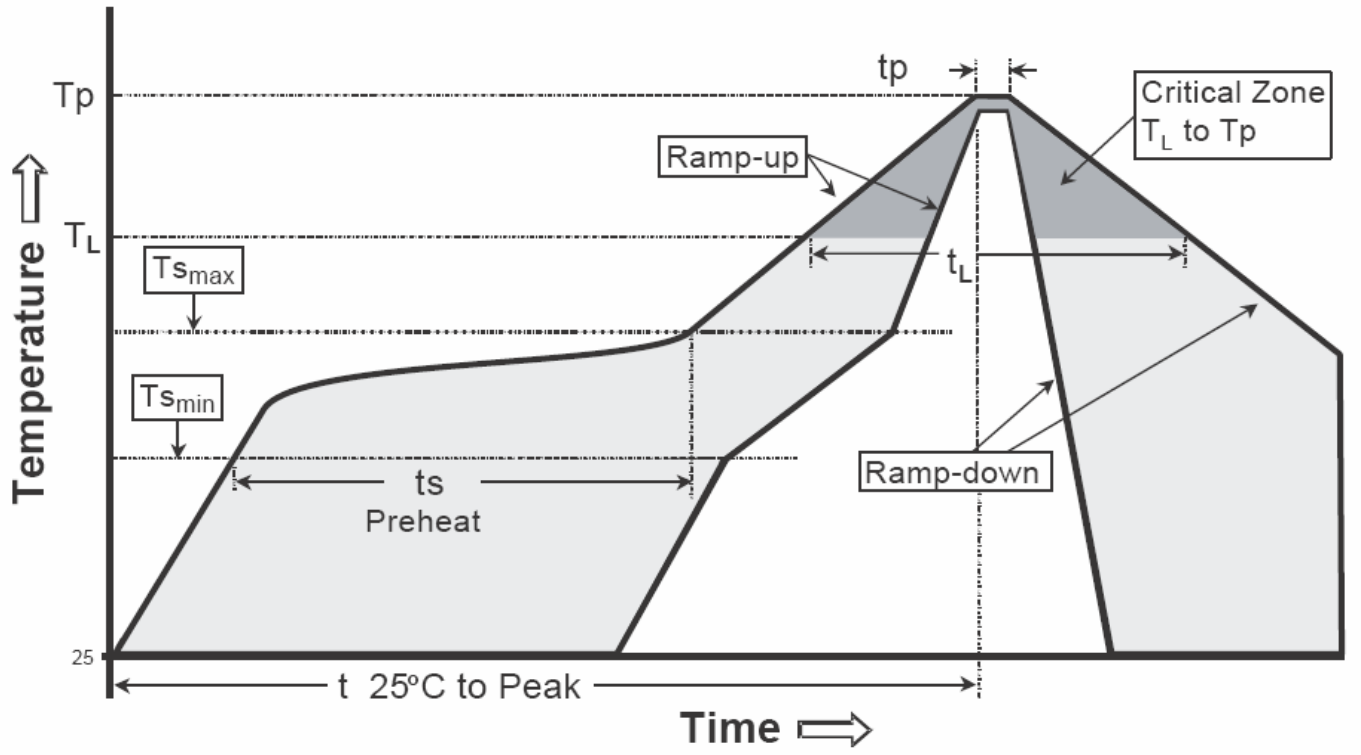
Notes:
1. 10 sprocket hole pitch cumulative tolerace ±0.2.
2. Camber not to exceed 1mm in 100mm.
3. Material: Conductive Black Advantek Polystyrene.
4. Ao & Bo measured on a plane 0.3mm above the bottom of the pocket.
5. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

Unit : millimeter

Recommended wave soldering condition

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

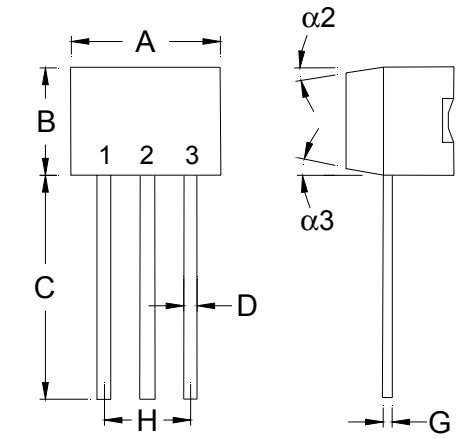
Recommended temperature profile for IR reflow

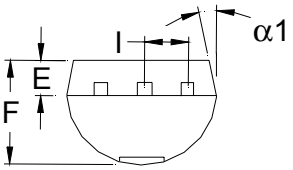


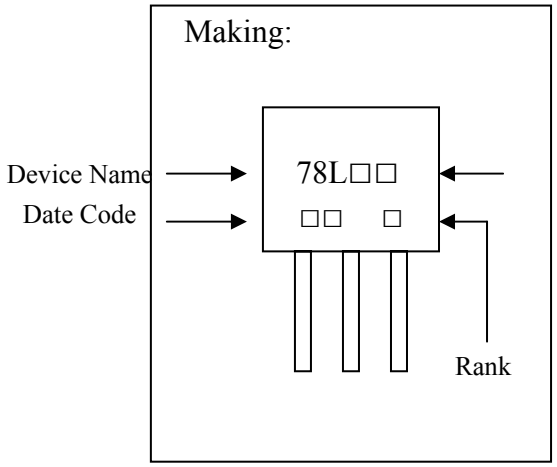
Profile feature	Sn-Pb eutectic Assembly	Pb-free Assembly
Average ramp-up rate (Tsmax to Tp)	3°C/second max.	3°C/second max.
Preheat −Temperature Min(Ts min) −Temperature Max(Ts max) −Time(ts min to ts max)	 100°C 150°C 60-120 seconds	 150°C 200°C 60-180 seconds
Time maintained above: −Temperature (TL) − Time (tL)	 183°C 60-150 seconds	 217°C 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.

TO-92 Dimension







Style: Pin 1.Vout 2.GND 3.Vin

3-Lead TO-92 Plastic Package
CYStek Package Code: A3

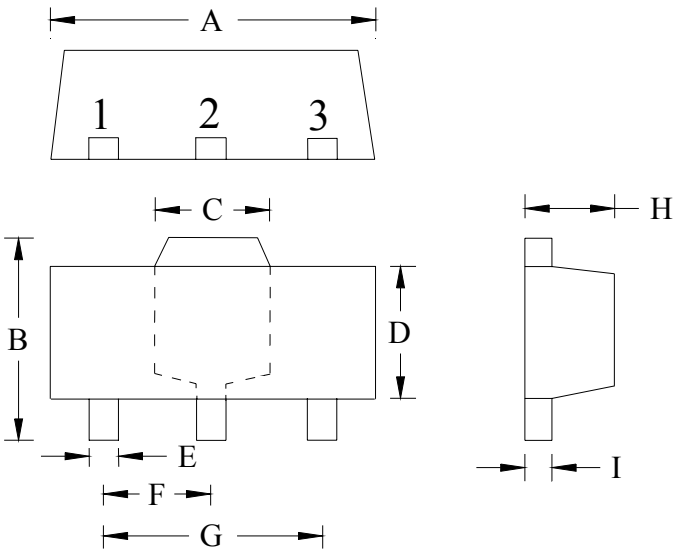
*: Typical

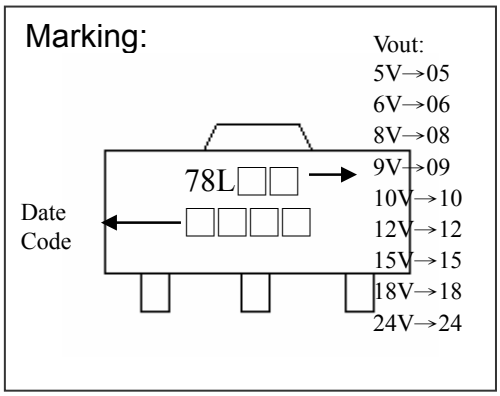
DIM	Inches		Millimeters		DIM	Inches		Millimeters	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	0.1704	0.1902	4.33	4.83	G	0.0142	0.0220	0.36	0.56
B	0.1704	0.1902	4.33	4.83	H	-	*0.1000	-	*2.54
C	0.5000	-	12.70	-	I	-	*0.0500	-	*1.27
D	0.0142	0.0220	0.36	0.56	α1	-	*5°	-	*5°
E	-	*0.0500	-	*1.27	α2	-	*2°	-	*2°
F	0.1323	0.1480	3.36	3.76	α3	-	*2°	-	*2°

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:
• Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

SOT-89 Dimension





Style: Pin 1. Vout 2. GND 3. Vin

3-Lead SOT-89 Plastic
Surface Mounted Package
CYStek Package Code: M3

*: 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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