Three-Terminal Low Current Positive Voltage Regulators
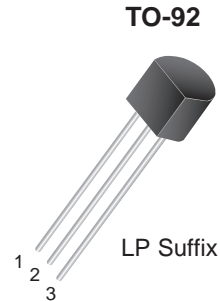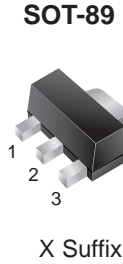
SOP-8

SOT-89

TO-92

S Suffix

X Suffix

LP Suffix
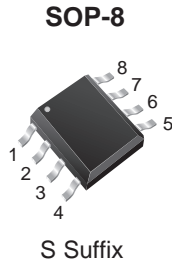
Features

- Wide selection of available fixed output voltages
- Available in space saving SOT-89 package
- Low cost
- Internal short circuit current limiting
- Internal thermal overload protection
- No external components required
- Complementary negative voltage regulators also available (MC79L00)
- Accurate, ± 2% output voltage tolerance

Standard Application Circuit
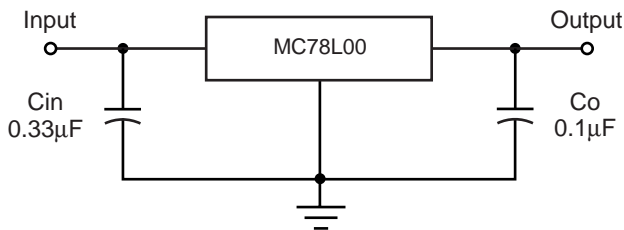
Internal Block Diagram
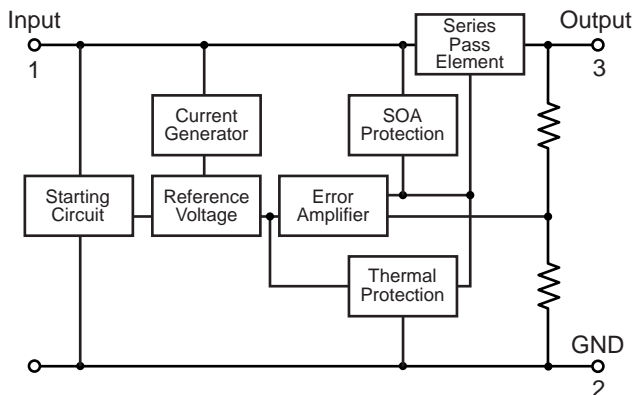
Description

The MC78L00 series of positive voltage regulators are designed to provide a range of regulated power supply voltages for low current applications of up to 100mA.

They are low cost, rugged, easy to use, three terminal devices with internal current limiting and thermal shut-down protection and are the low current members of the popular MC78M00 and MC7800 family..

No external components are required with the MC78L00 in most applications.

These products offer an improved replacement for the traditional zener-resistor combination, providing better output impedance, lower internal power dissipation and lower quiescent current.

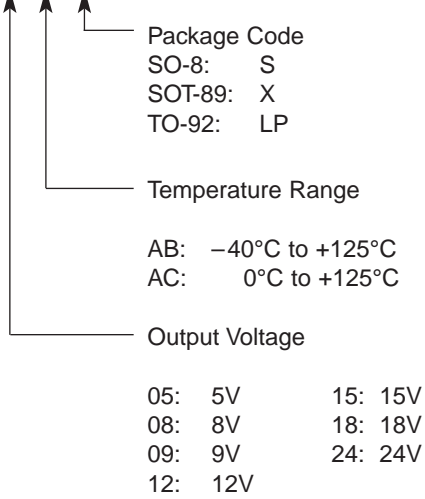## Mechanical Data

Case: SO-8, SOT-89, TO-92
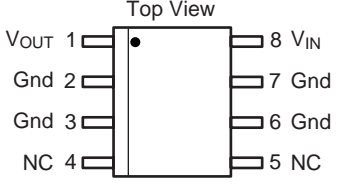
High temperature soldering guaranteed:
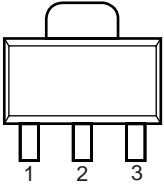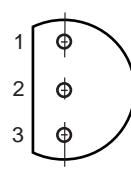
260°C/10 seconds at terminals

Case outlines are on the back pages

MC78L00

Vishay
formerly General Semiconductor

Ordering Information

MC78Lxx xx xx

Package Code
SO-8: S
SOT-89: X
TO-92: LP

Temperature Range

AB: −40°C to +125°C
AC: 0°C to +125°C

Output Voltage

05: 5V   15: 15V
08: 8V   18: 18V
09: 9V   24: 24V
12: 12V

SO-8

Top View

V_{OUT} 1	8 V_{IN}
Gnd 2	7 Gnd
Gnd 3	6 Gnd
NC 4	5 NC

SOT-89

Top View
1. V_{OUT}
2. Gnd (tab)
3. V_{IN}

1 2 3

TO-92

Top View
1. V_{OUT}
2. Gnd
3. V_{IN}

1
2
3

Marking Information

SOT-89

Marking	Part Number
BAxxxx	MC78L05AB
BBxxxx	MC78L05AC
BDxxxx	MC78L08AB
BExxxx	MC78L08AC
BGxxxx	MC78L09AB
BHxxxx	MC78L09AC
BIxxxx	MC78L12AB
BKxxxx	MC78L12AC
BLxxxx	MC78L15AB
BMxxxx	MC78L15AC
BNxxxx	MC78L18AB
BOxxxx	MC78L18AC
BPxxxx	MC78L24AB
BRxxxx	MC78L24AC

The 5th character is the year code
The 6th character is the week code

Maximum Ratings T_A = 25°C unless otherwise noted.

Parameter		Symbol	Value	Unit
Input Voltage		$V_i{}^{(1)}$	30	V
Input Voltage		$V_i{}^{(2)}$	40	V
Storage Junction Temperature Range		T_{stg}	−65 to +150	°C
Operating Junction Temperature Range	AB AC	T_j	−40 to +150 0 to +150	°C
Thermal Resistance, Junction to Case	SO-8 SOT-89	$R_{\theta JC}$	20 15	°C/W
Thermal Resistance, Junction to Ambient (3 CM^2 of Copper)	SO-8 TO-92 SOT-89	$R_{\theta JA}$	55 115 200	°C/W

Notes: (1) MC78L05 to MC78L18
(2) MC78L24

• To maintain the specified junction temperature, low duty cycle pulse testing is required for most parameters. All characteristics are measured with a 0.33μF capacitor across the input and a 0.1μF capacitor across the output.

MC78L05 AB/AC Electrical Characteristics

V_i = 10V, I_O = 40mA, C_i = 0.33μF, C_O = 0.1μF, −40°C < T_J < 125°C (MC78L05AB), 0°C < T_J < 125°C (MC78L05AC) unless otherwise noted.

Parameter		Symbol	Min	Typ	Max	Unit
Output Voltage (T_J = 25°C)		V_O	4.9	5.0	5.1	Vdc
Line Regulation (T_J = 25°C, I_O = 40mA)	7.0V ≤ V_i ≤ 20V 8.0V ≤ V_i ≤ 20V	REGline		32 26	150 100	mV
Load Regulation (T_J = 25°C)	1.0mA ≤ I_O ≤ 100mA 1.0mA ≤ I_O ≤ 40mA	REGload		15 8	60 30	mV
Output Voltage 7.0V ≤ V_i ≤ 20V, 1.0mA ≤ I_O ≤ 40mA V_i = 10V, 1.0mA ≤ I_O ≤ 70mA		V_O	4.8 (4.75)* 4.8 (4.75)*		5.2 (5.25)* 5.2 (5.25)*	V
Quiescent Current	T_J = 25°C T_J = 125°C	I_Q		3.8	6.0 5.5	mA
Quiescent Current Change	8.0V ≤ V_i ≤ 20V 1.0mA ≤ I_O ≤ 40mA	ΔI_Q			1.5 0.1	mA
Output Noise Voltage (T_A = 25°C, 10Hz ≤ f ≤ 100KHz)		V_n		40		μV
Ripple Rejection (I_O = 40mA, f = 120Hz, 8.0V ≤ V_i ≤ 18V, T_J = 25°C)		RR		40		dB
Dropout Voltage		V_{drop}		1.7		Vdc

* Limits in parenthesis apply for MC78L05AB

MC78L00

Vishay
formerly General Semiconductor

MC78L08 AB/AC Electrical Characteristics

Vi = 14V, I_O = 40mA, Ci = 0.33µF, C_O = 0.1µF, −40°C < T_J < 125°C (MC78L08AB), 0°C < T_J < 125°C (MC78L08AC) unless otherwise noted..

Parameter		Symbol	Min	Typ	Max	Unit
Output Voltage (T_J = 25°C)		V_O	7.8	8.0	8.2	Vdc
Line Regulation (T_J = 25°C, I_O = 40mA)	10.5V ≤ Vi ≤ 23V 11V ≤ Vi ≤ 23V	REGline		42 36	175 125	mV
Load Regulation (T_J = 25°C)	1.0mA ≤ I_O ≤ 100mA 1.0mA ≤ I_O ≤ 40mA	REGload		18 10	80 40	mV
Output Voltage 10.5V ≤ Vi ≤ 23V, 1.0mA ≤ I_O ≤ 40mA Vi = 14V, 1.0mA ≤ I_O ≤ 70mA		V_O	7.65 (7.6)* 7.65 (7.6)*		8.3 (8.4)* 8.3 (8.4)*	V
Quiescent Current	T_J = 25°C T_J = 125°C	I_Q		3.0	6.0 5.5	mA
Quiescent Current Change	11V ≤ Vi ≤ 23V 1.0mA ≤ I_O ≤ 40mA	ΔI_Q			1.5 0.2	mA
Output Noise Voltage (T_A = 25°C, 10Hz ≤ f ≤ 100KHz)		Vn		54		µV
Ripple Rejection (I_O = 40mA, f = 120Hz, 12V ≤ Vi ≤ 23V, T_J = 25°C)		RR	36	45		dB
Dropout Voltage (T_J = 25°C)		V_{drop}		1.7		Vdc

* Limits in parenthesis apply for MC78L08AB

MC78L09 AB/AC Electrical Characteristics

Vi = 16V, I_O = 40mA, Ci = 0.33µF, C_O = 0.1µF, −40°C < T_J < 125°C (MC78L09AB), 0°C < T_J < 125°C (MC78L09AC) unless otherwise noted..

Parameter		Symbol	Min	Typ	Max	Unit
Output Voltage (T_J = 25°C)		V_O	8.8	9.0	9.2	Vdc
Line Regulation (T_J = 25°C, I_O = 40mA)	11.5V ≤ Vi ≤ 24V 12V ≤ Vi ≤ 24V	REGline		45 40	175 125	mV
Load Regulation (T_J = 25°C)	1.0mA ≤ I_O ≤ 100mA 1.0mA ≤ I_O ≤ 40mA	REGload		19 11	90 40	mV
Output Voltage 11.5V ≤ Vi ≤ 24V, 1.0mA ≤ I_O ≤ 40mA Vi = 15V, 1.0mA ≤ I_O ≤ 70mA		V_O	8.6 (8.5)* 8.6 (8.5)*		9.4 (9.5)* 9.4 (9.5)*	Vdc
Quiescent Current	T_J = 25°C T_J = 125°C	I_Q		3.0	6.0 5.5	mA
Quiescent Current Change	11V ≤ Vi ≤ 23V 1.0mA ≤ I_O ≤ 40mA	ΔI_Q			1.5 0.1	mA
Output Noise Voltage (T_A = 25°C, 10Hz ≤ f ≤ 100KHz)		Vn		58		µV
Ripple Rejection (I_O = 40mA, f = 120Hz, 12V ≤ Vi ≤ 23V, T_J = 25°C)		RR	37	45		dB
Dropout Voltage		V_{drop}		1.7		Vdc

* Limits in parenthesis apply for MC78L09AB

MC78L12 AB/AC Electrical Characteristics

Vi = 19V, I_O = 40mA, Ci = 0.33μF, C_O = 0.1μF, −40°C < T_J < 125°C (MC78L08AB), 0°C < T_J < 125°C (MC78L08AC) unless otherwise noted.

Parameter		Symbol	Min	Typ	Max	Unit
Output Voltage (T_J = 25°C)		V_O	11.75	12	12.25	Vdc
Line Regulation (T_J = 25°C, I_O = 40mA)	14.5V ≤ Vi ≤ 27V 16V ≤ Vi ≤ 27V	REGline		55 49	250 200	mV
Load Regulation (T_J = 25°C)	1.0mA ≤ I_O ≤ 100mA 1.0mA ≤ I_O ≤ 40mA	REGload		22 13	100 50	mV
Output Voltage 14.5V ≤ Vi ≤ 27V, 1.0mA ≤ I_O ≤ 40mA Vi = 19V, 1.0mA ≤ I_O ≤ 70mA		V_O	11.5 (11.4)* 11.5 (11.4)*		12.5 (12.6)* 12.5 (12.6)*	V
Quiescent Current	T_J = 25°C T_J = 125°C	I_Q		42	6.5 6.0	mA
Quiescent Current Change	16V ≤ Vi ≤ 27V 1.0mA ≤ I_O ≤ 40mA	ΔI_Q			1.5 0.2	mA
Output Noise Voltage (T_A = 25°C, 10Hz ≤ f ≤ 100KHz)		Vn		70		μV
Ripple Rejection (I_O = 40mA, f = 120Hz, 15V ≤ Vi ≤ 25V, T_J = 25°C)		RR	36	42		dB
Dropout Voltage (T_J = 25°C)		V_drop		1.7		Vdc

* Limits in parenthesis apply for MC78L12AB

MC78L15 AB/AC Electrical Characteristics

Vi = 23V, I_O = 40mA, Ci = 0.33μF, C_O = 0.1μF, −40°C < T_J < 125°C (MC78L09AB), 0°C < T_J < 125°C (MC78L09AC) unless otherwise noted.

Parameter		Symbol	Min	Typ	Max	Unit
Output Voltage (T_J = 25°C)		V_O	14.7	15	15.3	Vdc
Line Regulation (T_J = 25°C, I_O = 40mA)	17.5V ≤ Vi ≤ 30V 20V ≤ Vi ≤ 30V	REGline		65 58	300 250	mV
Load Regulation (T_J = 25°C)	1.0mA ≤ I_O ≤ 100mA 1.0mA ≤ I_O ≤ 40mA	REGload		25 12	150 75	mV
Output Voltage 17.5V ≤ Vi ≤ 30V, 1.0mA ≤ I_O ≤ 40mA Vi = 23V, 1.0mA ≤ I_O ≤ 70mA		V_O	14.40 (14.25)* 14.40 (14.25)*		15.60 (15.75)* 15.60 (15.75)*	Vdc
Quiescent Current	T_J = 25°C T_J = 125°C	I_Q		4.4	6.5 6.0	mA
Quiescent Current Change	20V ≤ Vi ≤ 30V 1.0mA ≤ I_O ≤ 40mA	ΔI_Q			1.5 0.2	mA
Output Noise Voltage (T_A = 25°C, 10Hz ≤ f ≤ 100KHz)		Vn		82		μV
Ripple Rejection (I_O = 40mA, f = 120Hz, 18.5V ≤ Vi ≤ 28.5V, T_J = 25°C)		RR	33	39		dB
Dropout Voltage		V_drop		1.7		Vdc

* Limits in parenthesis apply for MC78L15AB

MC78L18 AC Electrical Characteristics

$V_i = 27V$, $I_O = 40mA$, $C_i = 0.33\mu F$, $C_O = 0.1\mu F$, $0°C < T_J < 125°C$ unless otherwise noted.

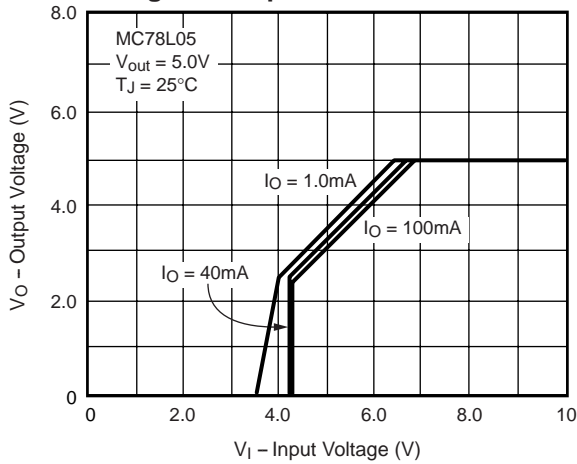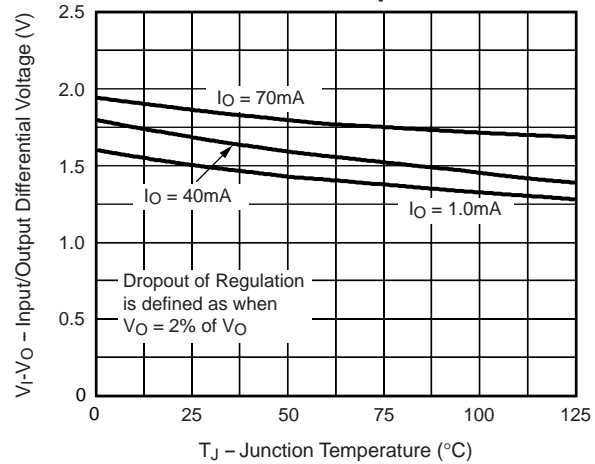| Parameter		Symbol	Min	Typ	Max	Unit
Output Voltage (T_J = 25°C)		V_O	17.64	18	18.36	Vdc
Line Regulation (T_J = 25°C, I_O = 40mA)	$20.7V \leq V_i \leq 33V$ $22V \leq V_i \leq 33V$	REGline		70 64	325 275	mV
Load Regulation (T_J = 25°C)	$1.0mA \leq I_O \leq 100mA$ $1.0mA \leq I_O \leq 40mA$	REGload		30 15	170 85	mV
Output Voltage	$20.7V \leq V_i \leq 33V$, $1.0mA \leq I_O \leq 40mA$ $V_i = 27V$, $1.0mA \leq I_O \leq 70mA$	V_O	17.4 17.4		18.6 18.6	V
Quiescent Current	T_J = 25°C T_J = 125°C	I_Q		3.1	6.5 6.0	mA
Quiescent Current Change	$22V \leq V_i \leq 33V$ $1.0mA \leq I_O \leq 40mA$	ΔI_Q			1.5 0.2	mA
Output Noise Voltage (T_A = 25°C, $10Hz \leq f \leq 100KHz$)		V_n		150		μV
Ripple Rejection (I_O = 40mA, f = 120Hz, $23V \leq V_i \leq 33V$, T_J = 25°C)		RR	32	46		dB
Dropout Voltage (T_J = 25°C)		V_{drop}		1.7		Vdc

MC78L24 AC Electrical Characteristics

$V_i = 33V$, $I_O = 40mA$, $C_i = 0.33\mu F$, $C_O = 0.1\mu F$, $0°C < T_J < 125°C$ unless otherwise noted.

Parameter		Symbol	Min	Typ	Max	Unit
Output Voltage (T_J = 25°C)		V_O	23.5	24	24.5	Vdc
Line Regulation (T_J = 25°C, I_O = 40mA)	$27.0V \leq V_i \leq 38V$ $28V \leq V_i \leq 38V$	REGline		35 30	350 300	mV
Load Regulation (T_J = 25°C)	$1.0mA \leq I_O \leq 100mA$ $1.0mA \leq I_O \leq 40mA$	REGload		40 20	200 100	mV
Output Voltage	$27V \leq V_i \leq 38V$, $1.0mA \leq I_O \leq 40mA$ $V_i = 33V$, $1.0mA \leq I_O \leq 70mA$	V_O	23.3 23.3		24.7 24.7	Vdc
Quiescent Current	T_J = 25°C T_J = 125°C	I_Q		3.1	6.5 6.0	mA
Quiescent Current Change	$28V \leq V_i \leq 38V$ $1.0mA \leq I_O \leq 40mA$	ΔI_Q			1.5 0.2	mA
Output Noise Voltage (T_A = 25°C, $10Hz \leq f \leq 100KHz$)		V_n		200		μV
Ripple Rejection (I_O = 40mA, f = 120Hz, $29V \leq V_i \leq 35V$, T_J = 25°C)		RR	30	43		dB
Dropout Voltage		V_{drop}		1.7		Vdc

Ratings and
Characteristic Curves (T$_A$ = 25°C unless otherwise noted)

Fig. 1 – Dropout Characteristics

MC78L05
V$_{out}$ = 5.0V
T$_J$ = 25°C

I$_O$ = 1.0mA
I$_O$ = 100mA
I$_O$ = 40mA

V$_O$ – Output Voltage (V)
V$_I$ – Input Voltage (V)

Fig. 2 – Dropout Voltage vs. Junction Temperature

I$_O$ = 70mA
I$_O$ = 40mA
I$_O$ = 1.0mA

Dropout of Regulation is defined as when V$_O$ = 2% of V$_O$

V$_I$-V$_O$ – Input/Output Differential Voltage (V)
T$_J$ – Junction Temperature (°C)

Fig. 3 – Input Bias Current vs. Ambient Temperature

MC78L05
V$_I$ = 10V
V$_O$ = 5.0V
I$_O$ = 40mA

I$_{IB}$ – Input Bias Current (mA)
T$_A$ – Ambient Temperature (°C)
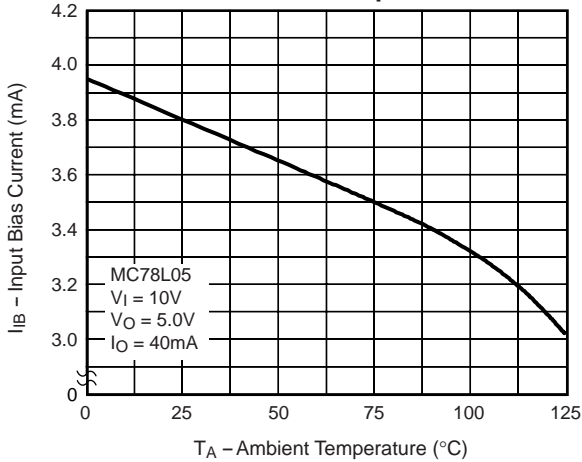
Fig. 4 – Input Bias Current vs. Input Voltage

MC78L05
V$_{out}$ = 5.0V
I$_O$ = 40mA
T$_J$ = 25°C

I$_{IB}$ – Input Bias Current (mA)
V$_I$ – Input Voltage (V)
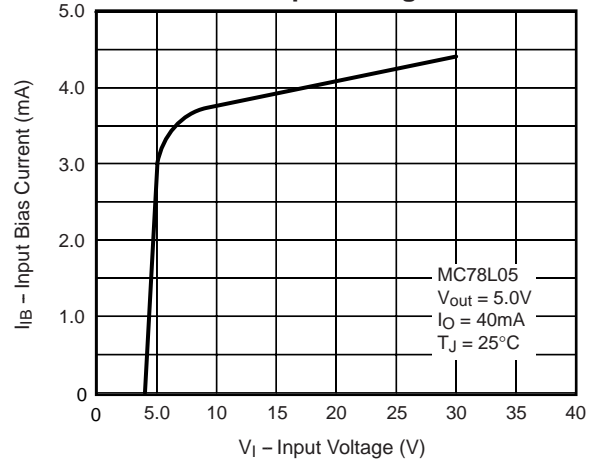
Fig. 5 – Max. Average Power Dissipation vs. Ambient Temperature – TO-92

No Heatsink

R$_{θJA}$ = 200°C/W
P$_{D(max)}$ to 25°C = 625mW

P$_D$ – Power Dissipation (mW)
T$_A$ – Ambient Temperature (°C)
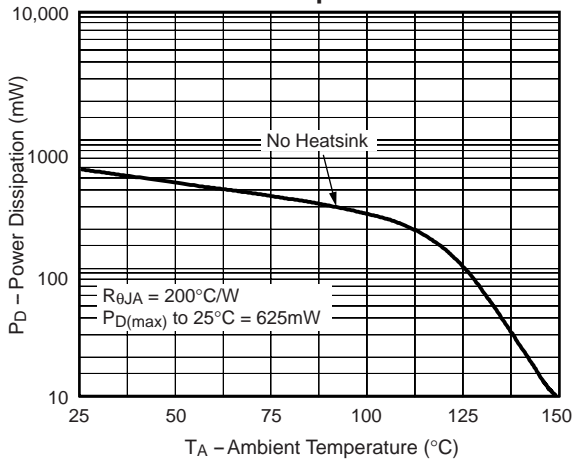
Fig. 6 – SOP-8 Thermal Resistance & Max. Power Dissipation vs. P.C.B.Copper Length

P$_{D(max)}$ for T$_A$ = 50°C
R$_{θJA}$

2.0 oz Copper
L
L
3.0 mm

R$_{θJA}$ – Thermal Resistance Junction-to-Air (°C/W)
L – Length of Copper (mm)

MC78L00

Vishay
formerly General Semiconductor

Case Outlines

SOT-89

Top View

4.5±0.1

1.6±0.1

2.45 ±0.15   4.15±0.1

1.045± 0.155

1   2   3

1.50 (Typ.)

0.46±0.06

3.00 (Typ.)

1.5±0.1

0.395±0.045

Dimensions in millimeters

TO-92

0.25±0.31

0.4±0.025

3.5±0.2

2.54±0.12

4.5±0.2

4.5±0.2

14.3 (Typ.)

0.46±0.025

Dimensions in millimeters

SOP-8

5.00 / 4.80

8   7   6   5

4.00 / 3.80

6.20 / 5.80

Dimensions in millimeters

1   2   3   4

0.49 / 0.35

1.27 (Typ.)

1.75 / 1.35

0.25 / 0.10

0.50 / 0.25

0.25 / 0.19

1.25 / 0.40