Obsolete Device

TC55

1 µA Low Dropout Positive Voltage Regulator

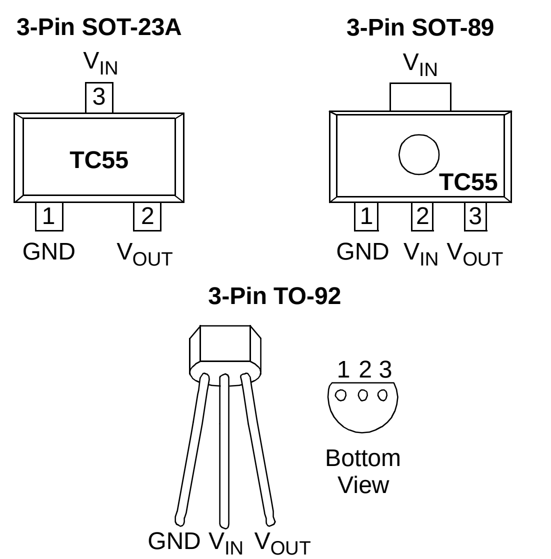
Features

- Low Dropout Voltage: 120 mV (typ) at 100 mA, 380 mV (typ) at 200 mA
- High Output Current: 250 mA (V_{OUT} = 5.0V)
- High Accuracy Output Voltage: ±2% (max) (±1% Semi-Custom Version)
- Low Power Consumption: 1.1 µA (typ)
- Low Temperature Drift: ±100 ppm/°C (typ)
- Excellent Line Regulation: 0.2%/V (typ)
- Package Options: 3-Pin SOT-23A, 3-Pin SOT-89 and 3-Pin TO-92
- Short-Circuit Protection
- Standard Output Voltage Options: 1.2V, 1.8V, 2.5V, 3.0V, 3.3V, 5.0V

Applications

- Battery-Powered Devices
- Cameras and Portable Video Equipment
- Pagers and Cellular Phones
- Solar Powered Instruments
- Consumer Products

Package Types



Note: 3-Pin SOT-23A is equivalent to the EIAJ SC-59.

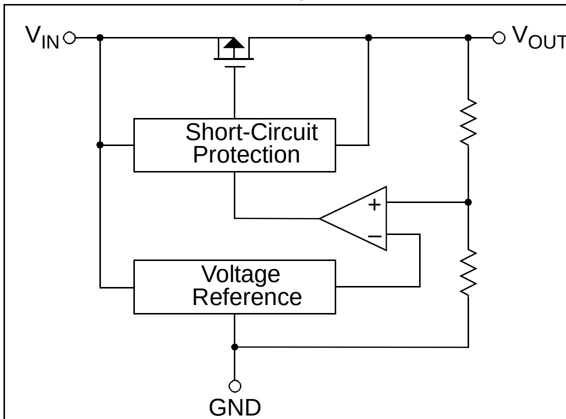
General Description

The TC55 Series is a collection of CMOS low dropout, positive voltage regulators that can source up to 250 mA of current, with an extremely low input-output voltage differential of 380 mV (typ) at 200 mA.

The TC55's low dropout voltage, combined with the low current consumption of only 1.1 µA (typ), makes it ideal for battery operation. The low voltage differential (dropout voltage) extends the battery operating lifetime. It also permits high currents in small packages when operated with minimum $V_{IN} – V_{OUT}$ differentials.

The circuit also incorporates short-circuit protection to ensure maximum reliability.

Functional Block Diagram



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

Input Voltage ....+12V
Output Current (Continuous)......... $P_D/(V_{IN} – V_{OUT})$mA
Output Current (peak) .... 500 mA
Output Voltage.................. $(V_{SS} – 0.3V)$ to $(V_{IN} + 0.3V)$
Continuous Power Dissipation:
 3-Pin SOT-23A ....240 mW
 3-Pin SOT-89 ....500 mW
 3-Pin TO-92..440 mW

† Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

PIN FUNCTION TABLE

Symbol	Description
GND	Ground Terminal
V_{OUT}	Regulated Voltage Output
V_{IN}	Unregulated Supply Input

TC55RP50: ELECTRICAL CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, $V_{OUT}(S) = 5.0V$, $T_A = +25°C$ (see **Note 1**).

Parameters	Sym	Min	Typ	Max	Units	Conditions
Output Voltage	$V_{OUT}(A)$	— 4.90	— 5.0	— 5.10	V	$I_{OUT} = 40$ mA $V_{IN} = 6.0V$
Maximum Output Current	I_{OUTMAX}	250	—	—	mA	$V_{IN} = 6.0V$, $V_{OUT}(A) \geq 4.5V$
Load Regulation	ΔV_{OUT}	—	40	80	mV	$V_{IN} = 6.0V$, 1 mA $\leq I_{OUT} \leq$ 100 mA
I/O Voltage Difference	V_{DIF}	— —	120 380	300 600	mV	$I_{OUT} = 100$ mA $I_{OUT} = 200$ mA
Current Consumption	I_{SS}	—	1.1	3.0	µA	$V_{IN} = 6.0V$
Voltage Regulation	$\frac{V_{OUT}(A) \cdot 100}{\Delta V_{IN} \cdot V_{OUT}(S)}$	—	0.2	0.3	%/V	$I_{OUT} = 40$ mA, $6.0V \leq V_{IN} \leq 10.0V$
Input Voltage	V_{IN}	—	—	10	V	
Temperature Coefficient of Output Voltage	$\frac{\Delta V_{OUT}(A) \cdot 10^6}{V_{OUT}(S) \cdot \Delta T_A}$	—	±100	—	ppm/°C	$I_{OUT} = 40$ mA, $-40°C \leq T_A \leq +85°C$
Long-Term Stability		—	0.5	—	%	$T_A = +125°C$, 1000 Hours

Note 1: $V_{OUT}(S)$: Preset value of output voltage; $V_{OUT}(A)$: Actual value of output voltage; V_{DIF}: Definition of I/O voltage difference = $\{V_{IN}1 – V_{OUT}(A)\}$; $V_{OUT}(A)$: Output voltage when I_{OUT} is fixed and $V_{IN} = V_{OUT}(S) + 1.0V$; $V_{IN}1$: Input voltage when the output voltage is 98% $V_{OUT}(A)$.

TC55RP40: ELECTRICAL CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, $V_{OUT}(S) = 4.0V$, $T_A = +25°C$ (see **Note 1**).

Parameters	Sym	Min	Typ	Max	Units	Conditions
Output Voltage	$V_{OUT}(A)$	— 3.92	— 4.0	— 4.08	V	$I_{OUT} = 40$ mA $V_{IN} = 5.0V$
Maximum Output Current	I_{OUTMAX}	200	—	—	mA	$V_{IN} = 5.0V$, $V_{OUT}(A) \geq 3.6V$
Load Regulation	ΔV_{OUT}	—	45	90	mV	$V_{IN} = 5.0V$, 1 mA $\leq I_{OUT} \leq$ 100 mA
I/O Voltage Difference	V_{DIF}	— —	170 400	330 630	mV	$I_{OUT} = 100$ mA $I_{OUT} = 200$ mA
Current Consumption	I_{SS}	—	1.0	2.9	µA	$V_{IN} = 5.0V$
Voltage Regulation	$\frac{V_{OUT}(A) \cdot 100}{\Delta V_{IN} \cdot V_{OUT}(S)}$	—	0.2	0.3	%/V	$I_{OUT} = 40$ mA, $5.0V \leq V_{IN} \leq 10.0V$
Input Voltage	V_{IN}	—	—	10	V	
Temperature Coefficient of Output Voltage	$\frac{\Delta V_{OUT}(A) \cdot 10^6}{V_{OUT}(S) \cdot \Delta T_A}$	—	±100	—	ppm/°C	$I_{OUT} = 40$ mA, $-40°C \leq T_A \leq +85°C$
Long-Term Stability		—	0.5	—	%	$T_A = +125°C$, 1000 Hours

Note 1: $V_{OUT}(S)$: Preset value of output voltage; $V_{OUT}(A)$: Actual value of output voltage; V_{DIF}: Definition of I/O voltage difference = $\{V_{IN}1 – V_{OUT}(A)\}$; $V_{OUT}(A)$: Output voltage when I_{OUT} is fixed and $V_{IN} = V_{OUT}(S) + 1.0V$; $V_{IN}1$: Input voltage when the output voltage is 98% $V_{OUT}(A)$.

TC55RP33: ELECTRICAL CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, $V_{OUT}(S) = 3.3V$, $T_A = +25°C$ (see **Note 1**).

Parameters	Sym	Min	Typ	Max	Units	Conditions
Output Voltage	$V_{OUT}(A)$	— 3.23	— 3.30	— 3.37	V	$I_{OUT} = 40$ mA $V_{IN} = 4.3V$
Maximum Output Current	I_{OUTMAX}	150	—	—	mA	$V_{IN} = 4.3V$, $V_{OUT}(A) \geq 3.0V$
Load Regulation	ΔV_{OUT}	—	45	90	mV	$V_{IN} = 4.3V$, $1\text{ mA} \leq I_{OUT} \leq 80\text{ mA}$
I/O Voltage Difference	V_{DIF}	— —	180 400	360 700	mV	$I_{OUT} = 80$ mA $I_{OUT} = 160$ mA
Current Consumption	I_{SS}	—	1.0	2.9	µA	$V_{IN} = 4.3V$
Voltage Regulation	$\frac{V_{OUT}(A)\bullet 100}{\Delta V_{IN}\bullet V_{OUT}(S)}$	—	0.2	0.3	%/V	$I_{OUT} = 40$ mA, $4.3V \leq I_{OUT} \leq 10.0V$
Input Voltage	V_{IN}	—	—	10	V	
Temperature Coefficient of Output Voltage	$\frac{\Delta V_{OUT}(A)\bullet 10^6}{V_{OUT}(S)\bullet \Delta T_A}$	—	±100	—	ppm/°C	$I_{OUT} = 40$ mA, $-40°C \leq T_A \leq +85°C$
Long-Term Stability		—	0.5	—	%	$T_A = +125°C$, 1,000 Hours

Note 1: $V_{OUT}(S)$: Preset value of output voltage; $V_{OUT}(A)$: Actual value of output voltage; V_{DIF}: Definition of I/O voltage difference = $\{V_{IN}1 - V_{OUT}(A)\}$; $V_{OUT}(A)$: Output voltage when I_{OUT} is fixed and $V_{IN} = V_{OUT}(S) + 1.0V$; $V_{IN}1$: Input voltage when the output voltage is 98% $V_{OUT}(A)$.

TC55RP30: ELECTRICAL CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, $V_{OUT}(S) = 3.0V$, $T_A = +25°C$ (see **Note 1**).

Parameters	Sym	Min	Typ	Max	Units	Conditions
Output Voltage	$V_{OUT}(A)$	— 2.94	— 3.0	— 3.06	V	$I_{OUT} = 40$ mA $V_{IN} = 4.0V$
Maximum Output Current	I_{OUTMAX}	150	—	—	mA	$V_{IN} = 4.0V$, $V_{OUT}(A) \geq 2.7V$
Load Regulation	ΔV_{OUT}	—	45	90	mV	$V_{IN} = 4.0V$, $1\text{ mA} \leq I_{OUT} \leq 80\text{ mA}$
I/O Voltage Difference	V_{DIF}	— —	180 400	360 700	mV	$I_{OUT} = 80$ mA $I_{OUT} = 160$ mA
Current Consumption	I_{SS}	—	0.9	2.8	µA	$V_{IN} = 4.0V$
Voltage Regulation	$\frac{V_{OUT}(A)\bullet 100}{\Delta V_{IN}\bullet V_{OUT}(S)}$	—	0.2	0.3	%/V	$I_{OUT} = 40$ mA, $4.0V \leq V_{IN} \leq 10.0V$
Input Voltage	V_{IN}	—	—	10	V	
Temperature Coefficient of Output Voltage	$\frac{\Delta V_{OUT}(A)\bullet 10^6}{V_{OUT}(S)\bullet \Delta T_A}$	—	±100	—	ppm/°C	$I_{OUT} = 40$ mA, $-40°C \leq T_A \leq +85°C$
Long-Term Stability		—	0.5	—	%	$T_A = +125°C$, 1000 Hours

Note 1: $V_{OUT}(S)$: Preset value of output voltage; $V_{OUT}(A)$: Actual value of output voltage; V_{DIF}: Definition of I/O voltage difference = $\{V_{IN}1 - V_{OUT}(A)\}$; $V_{OUT}(A)$: Output voltage when I_{OUT} is fixed and $V_{IN} = V_{OUT}(S) + 1.0V$; $V_{IN}1$: Input voltage when the output voltage is 98% $V_{OUT}(A)$.

TC55RP25: ELECTRICAL CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, $V_{OUT}(S) = 2.5V$, $T_A = +25°C$ (see **Note 1**).

Parameters	Sym	Min	Typ	Max	Units	Conditions
Output Voltage	$V_{OUT}(A)$	— 2.45	— 2.5	— 2.55	V	I_{OUT} = 40 mA V_{IN} = 3.5V
Maximum Output Current	I_{OUTMAX}	125	—	—	mA	V_{IN} = 3.5V, $V_{OUT}(A) \geq 2.25V$
Load Regulation	ΔV_{OUT}	—	45	90	mV	V_{IN} = 3.5V, 1 mA ≤ I_{OUT} ≤ 60 mA
I/O Voltage Difference	V_{DIF}	—	180 400	360 700	mV	I_{OUT} = 60 mA I_{OUT} = 120 mA
Current Consumption	I_{SS}	—	1.0	2.8	µA	V_{IN} = 3.5V
Voltage Regulation	$\frac{V_{OUT}(A) \cdot 100}{\Delta V_{IN} \cdot V_{OUT}(S)}$	—	0.2	0.3	%/V	I_{OUT} = 40 mA, 3.5V ≤ I_{OUT} ≤ 10.0V
Input Voltage	V_{IN}	—	—	10	V	
Temperature Coefficient of Output Voltage	$\frac{\Delta V_{OUT}(A) \cdot 10^6}{V_{OUT}(S) \cdot \Delta T_A}$	—	±100	—	ppm/°C	I_{OUT} = 40 mA, -30°C ≤ T_A ≤ +80°C
Long-Term Stability		—	0.5	—	%	T_A = +125°C, 1,000 Hours

Note 1: $V_{OUT}(S)$: Preset value of output voltage; $V_{OUT}(A)$: Actual value of output voltage; V_{DIF}: Definition of I/O voltage difference = $\{V_{IN}1 – V_{OUT}(A)\}$; $V_{OUT}(A)$: Output voltage when I_{OUT} is fixed and $V_{IN} = V_{OUT}(S) + 1.0V$; $V_{IN}1$: Input voltage when the output voltage is 98% $V_{OUT}(A)$.

TC55RP18: ELECTRICAL CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, $V_{OUT}(S) = 1.8V$, $T_A = +25°C$ (see **Note 1**).

Parameters	Sym	Min	Typ	Max	Units	Conditions
Output Voltage	$V_{OUT}(A)$	— 1.764	— 1.8	— 1.836	V	I_{OUT} = 0.5 mA V_{IN} = 2.8V
Maximum Output Current	I_{OUTMAX}	110	—	—	mA	V_{IN} = 2.8V, $V_{OUT}(A) \geq 1.62V$
Load Regulation	ΔV_{OUT}	—	—	30	mV	V_{IN} = 2.8V, 1 mA ≤ I_{OUT} ≤ 30 mA
I/O Voltage Difference	V_{DIF}	—	—	300	mV	I_{OUT} = 0.5 mA
Current Consumption	I_{SS}	—	—	3.0	µA	V_{IN} = 2.8V
Voltage Regulation	$\frac{V_{OUT}(A) \cdot 100}{\Delta V_{IN} \cdot V_{OUT}(S)}$	—	—	0.25	%/V	I_{OUT} = 0.5 mA, 2.8V ≤ I_{OUT} ≤ 10.0V
Input Voltage	V_{IN}	—	—	6.0	V	
Temperature Coefficient of Output Voltage	$\frac{\Delta V_{OUT}(A) \cdot 10^6}{V_{OUT}(S) \cdot \Delta T_A}$	—	±100	—	ppm/°C	I_{OUT} = 0.5 mA, -30°C ≤ T_A ≤ +80°C
Long-Term Stability		—	0.5	—	%	T_A = +125°C, 1,000 Hours

Note 1: $V_{OUT}(S)$: Preset value of output voltage; $V_{OUT}(A)$: Actual value of output voltage; V_{DIF}: Definition of I/O voltage difference = $\{V_{IN}1 – V_{OUT}(A)\}$; $V_{OUT}(A)$: Output voltage when I_{OUT} is fixed and $V_{IN} = V_{OUT}(S) + 1.0V$; $V_{IN}1$: Input voltage when the output voltage is 98% $V_{OUT}(A)$.

TC55RP12: ELECTRICAL CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, $V_{OUT}(S)$ = 1.2V, T_A = +25°C (see **Note 1**).						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Output Voltage	$V_{OUT}(A)$	— 1.176	— 1.200	— 1.224	V	I_{OUT} = 0.5 mA V_{IN} = 2.2V
Maximum Output Current	I_{OUTMAX}	50	—	—	mA	V_{IN} = 2.2V, $V_{OUT}(A) \geq$ 1.08V
Load Regulation	ΔV_{OUT}	—	—	30	mV	V_{IN} = 2.2V, 1 mA $\leq I_{OUT} \leq$ 30 mA
I/O Voltage Difference	V_{DIF}	—	—	300	mV	I_{OUT} = 0.5 mA
Current Consumption	I_{SS}	—	—	3.0	µA	V_{IN} = 2.2V
Voltage Regulation	$\frac{V_{OUT}(A) \bullet 100}{\Delta V_{IN} \bullet V_{OUT}(S)}$	—	—	0.25	%/V	I_{OUT} = 0.5 , 2.2V $\leq$ $I_{OUT} \leq$ 10.0V
Input Voltage	V_{IN}	—	—	6.0	V	
Temperature Coefficient of Output Voltage	$\frac{\Delta V_{OUT}(A) \bullet 10^6}{V_{OUT}(S) \bullet \Delta T_A}$	—	±100	—	ppm/°C	I_{OUT} = 0.5 mA, -30°C $\leq T_A \leq$ +80°C
Long-Term Stability		—	0.5	—	%	T_A = +125°C, 1,000 Hours

Note 1: $V_{OUT}(S)$: Preset value of output voltage; $V_{OUT}(A)$: Actual value of output voltage; V_{DIF}: Definition of I/O voltage difference = $\{V_{IN}1 - V_{OUT}(A)\}$; $V_{OUT}(A)$: Output voltage when I_{OUT} is fixed and $V_{IN} = V_{OUT}(S)$ + 1.0V; $V_{IN}1$: Input voltage when the output voltage is 98% $V_{OUT}(A)$.

TEMPERATURE CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, $V_{OUT}(S)$ = 5.0V, T_A = +25°C.						
Parameters	**Sym**	**Min**	**Typ**	**Max**	**Units**	**Conditions**
Temperature Ranges						
Specified Temperature Range (E)	T_A	-40	—	+85	ºC	
Storage Temperature Range	T_A	-65	—	+150	ºC	
Package Thermal Resistances						
Thermal Resistance, 3L-SOT-23A	θ_{JA}	—	359	—	ºC/W	
Thermal Resistance, 3L-SOT-89	θ_{JA}	—	110	—	ºC/W	When mounted on 1 square inch of copper
Thermal Resistance, 3L-TO-92	θ_{JA}	—	131.9	—	ºC/W	

2.0 TYPICAL PERFORMANCE CURVES

Note:	The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.

Notes: Unless otherwise specified, $V_{OUT}(S)$ = 3.0V, 5.0V, T_A = +25°C, C_{IN} = 1 µF Tantalum, C_{OUT} = 1 µF Tantalum.

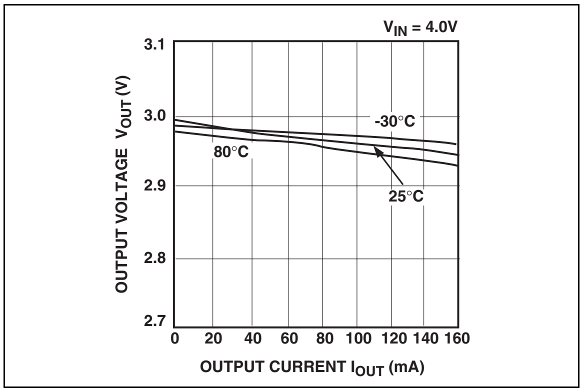


FIGURE 2-1: Output Voltage vs. Output Current (TC55RP3002).

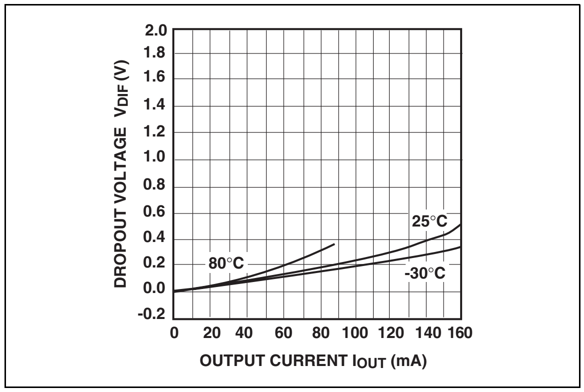


FIGURE 2-4: Dropout Voltage vs. Output Current (TC55RP3002).

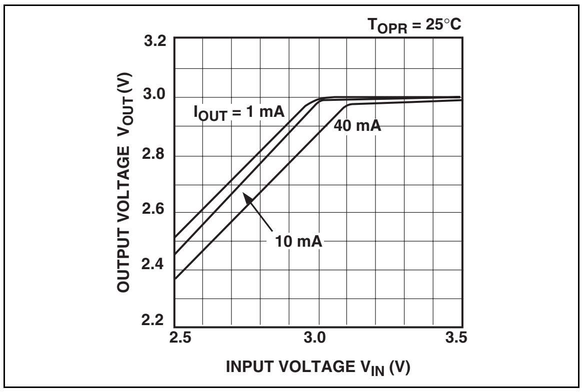


FIGURE 2-2: Output Voltage vs. Input Voltage (TC55RP3002).

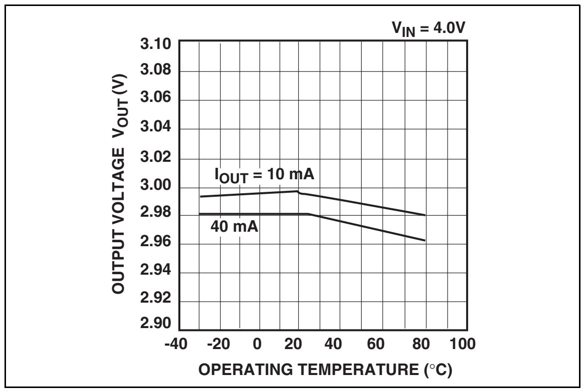


FIGURE 2-5: Output Voltage vs. Operating Temperature (TC55RP3002).

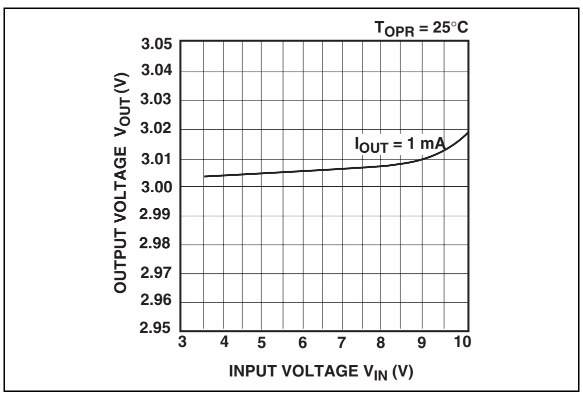


FIGURE 2-3: Output Voltage vs. Input Voltage (TC55RP3002).

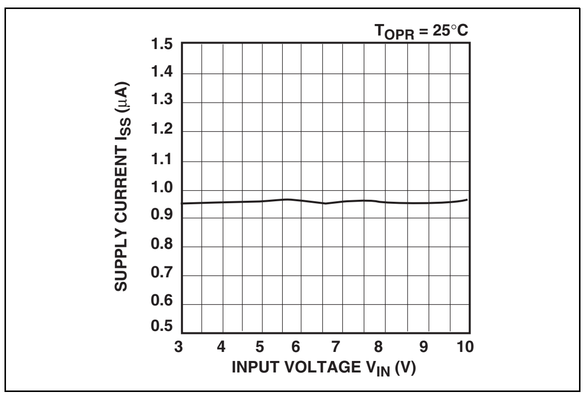


FIGURE 2-6: Supply Current vs. Input Voltage (TC55RP3002).

Note: Unless otherwise indicated, $V_{OUT}(S)$ = 3.0V, 5.0V, T_A = +25°C, C_{IN} = 1 µF Tantalum, C_{OUT} = 1 µF Tantalum.

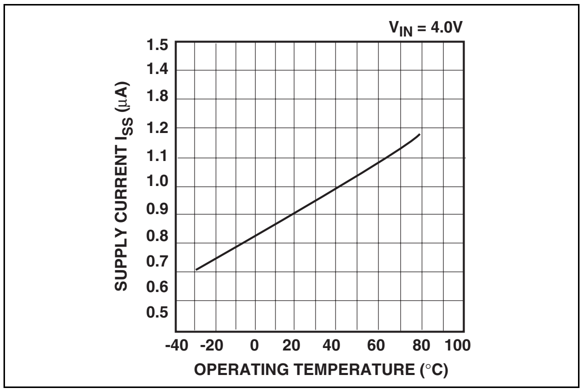


FIGURE 2-7: *Supply Current vs. Operating Temperature (TC55RP3002).*

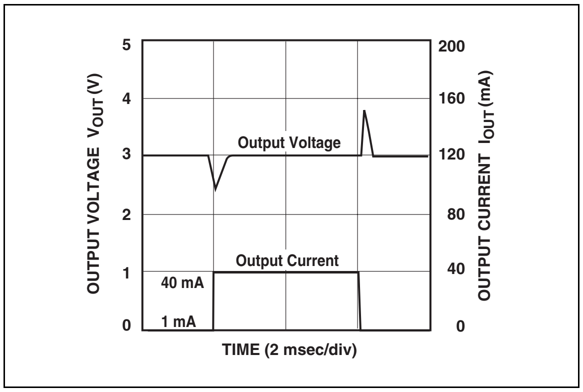


FIGURE 2-8: *Load Transient Response (TC55RP3002).*

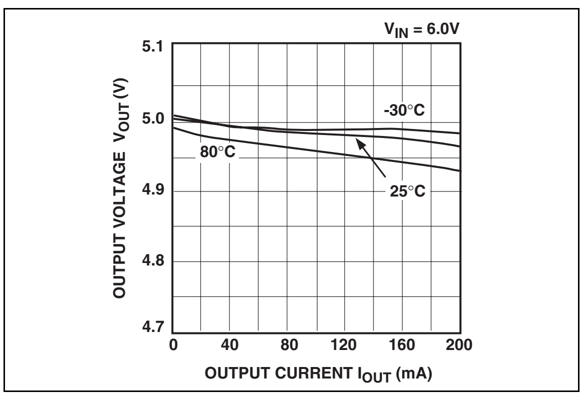


FIGURE 2-9: *Output Voltage vs. Output Current (TC55RP5002).*

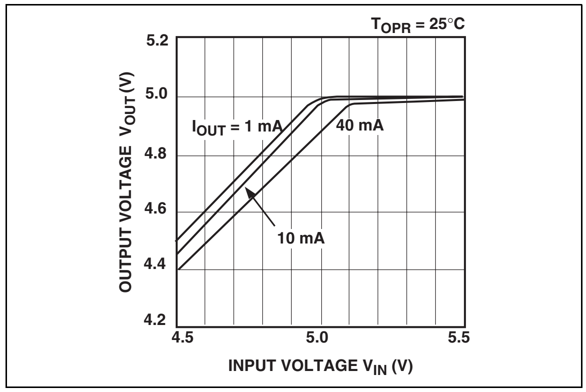


FIGURE 2-10: *Output Voltage vs. Input Voltage (TC55RP5002).*

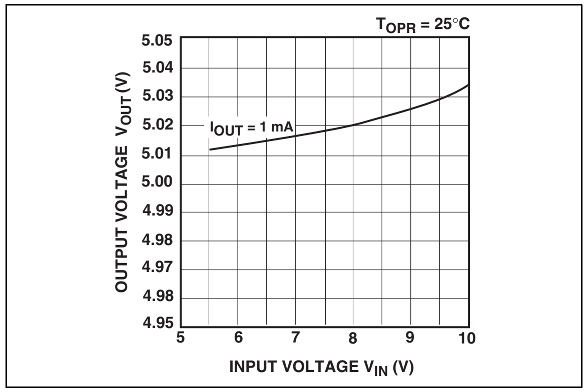


FIGURE 2-11: *Output Voltage vs. Input Voltage (TC55RP5002).*

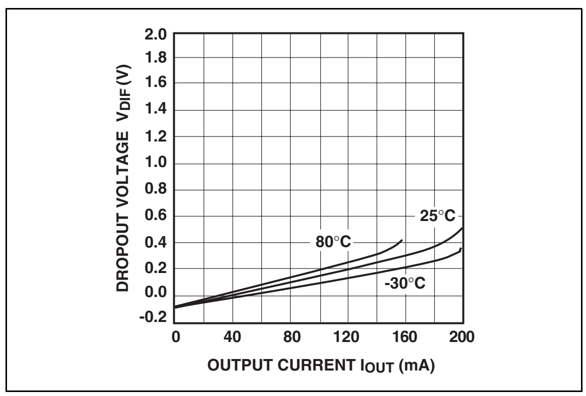


FIGURE 2-12: *Dropout Voltage vs. Output Current (TC55RP5002).*

Note: Unless otherwise indicated, $V_{OUT}(S)$ = 3.0V, 5.0V, T_A = +25°C, C_{IN} = 1 µF Tantalum, C_{OUT} = 1 µF Tantalum.

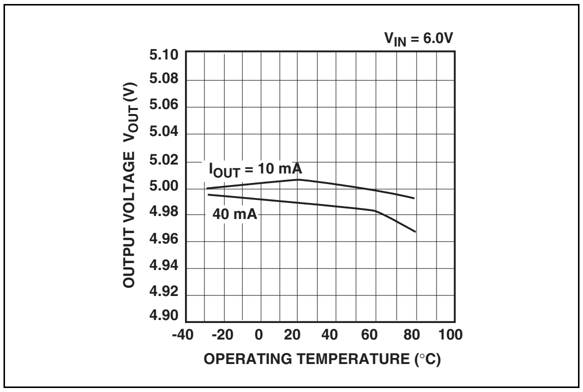


FIGURE 2-13: *Output Voltage vs. Operating Temperature (TC55RP5002).*

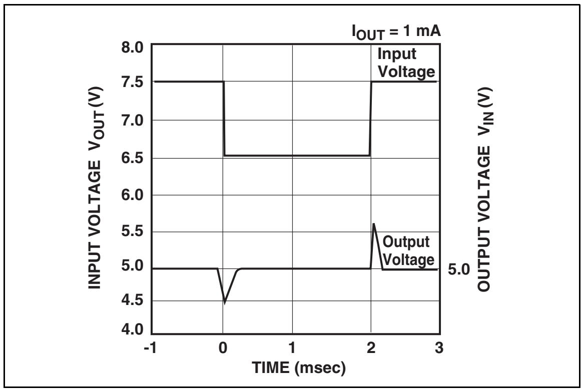


FIGURE 2-16: *Input Transient Response, 1 mA (TC55RP5002).*

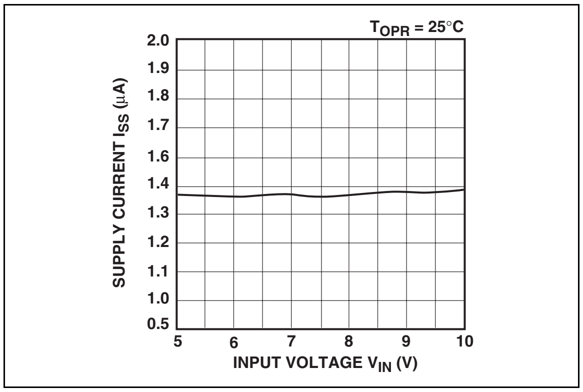


FIGURE 2-14: *Supply Current vs. Input Voltage (TC55RP5002).*

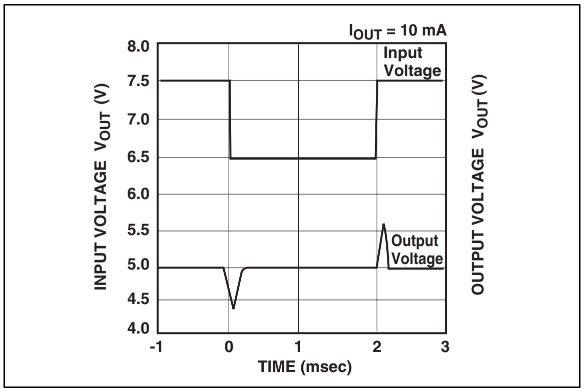


FIGURE 2-17: *Input Transient Response, 10 mA (TC55RP5002).*

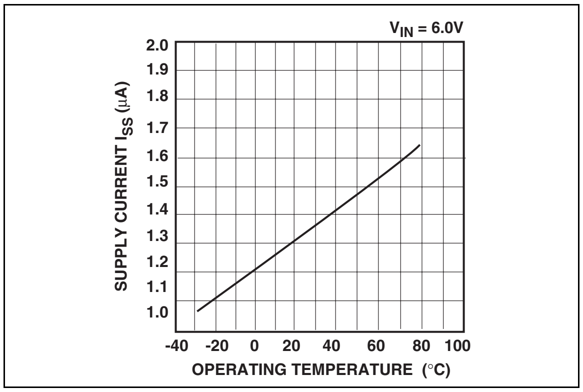


FIGURE 2-15: *Supply Current vs. Operating Temperature (TC55RP5002).*

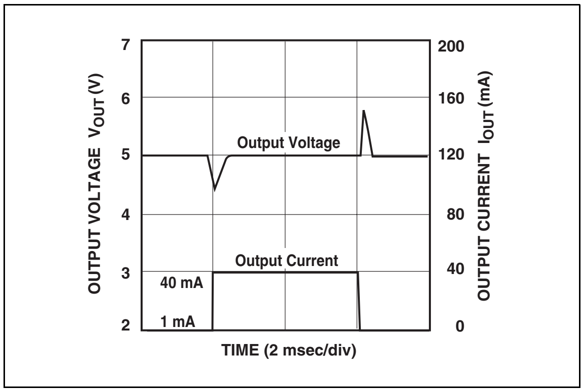


FIGURE 2-18: *Load Transient Response (TC55RP5002).*

3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE

Pin No.	Symbol	Description
1	GND	Ground Terminal
2	V_{OUT}	Regulated Voltage Output
3	V_{IN}	Unregulated Supply Input

3.1 Ground Terminal (GND)

Regulator ground. Tie GND to the negative side of the output and the negative side of the input capacitor. Only the LDO bias current (1 µA typical) flows out of this pin, there is no high current. The LDO output regulation is referenced to this pin. Minimize voltage drops between this pin and the minus side of the load.

3.2 Regulated Voltage Output (V_{OUT})

Connect V_{OUT} to the positive side of the load and the positive terminal of the output capacitor. The positive side of the output capacitor should be physically located as close to the LDO V_{OUT} pin as is practical. The current flowing out of this pin is equal to the DC load current.

3.3 Unregulated Supply Input (V_{IN})

Connect the input supply voltage and the positive side of the input capacitor to V_{IN}. The input capacitor should be physically located as close as is practical to V_{IN}. The current flow into this pin is equal to the DC load current, plus the LDO bias current (1 µA typical.)

4.0 DETAILED DESCRIPTION

The TC55 is a low quiescent current, precision, fixed-output voltage LDO. Unlike bipolar regulators, the TC55 supply current does not increase proportionally with load current.

4.1 Output Capacitor

A minimum of 1 µF output capacitor is required. The output capacitor should have an effective series resistance (esr) greater than 0.1Ω and less than 5Ω, plus a resonant frequency above 1 MHz. Larger output capacitors can be used to improve supply noise rejection and transient response. Care should be taken when increasing C_{OUT} to ensure that the input impedance is not high enough to cause high input impedance oscillation.

4.2 Input Capacitor

A 1 µF input capacitor is recommended for most applications when the input impedance is on the order of 10Ω. Larger input capacitance may be required for stability when operating off of a battery input, or if there is a large distance from the input source to the LDO. When large values of output capacitance are used, the input capacitance should be increased to prevent high source impedance oscillations.

5.0 THERMAL CONSIDERATIONS

5.1 Power Dissipation

The amount of power dissipated internal to the low dropout linear regulator is the sum of the power dissipation within the linear pass device (P-Channel MOSFET) and the quiescent current required to bias the internal reference and error amplifier. The internal linear pass device power dissipation is calculated by multiplying the voltage across the linear device by the current through the device.

EQUATION

$$P_D \text{ (Pass Device)} = (V_{IN} - V_{OUT}) \times I_{OUT}$$

The internal power dissipation, as a result of the bias current for the LDO internal reference and error amplifier, is calculated by multiplying the ground or quiescent current by the input voltage.

EQUATION

$$P_D \text{ (Bias)} = V_{IN} \times I_{GND}$$

The total internal power dissipation is the sum of P_D (Pass Device) and P_D (Bias).

EQUATION

$$P_{TOTAL} = P_D \text{ (Pass Device)} + P_D \text{ (Bias)}$$

For the TC55, the internal quiescent bias current is so low (1 µA typical) that the P_D (Bias) term of the power dissipation equation can be ignored. The maximum power dissipation can be estimated by using the maximum input voltage and the minimum output voltage to obtain a maximum voltage differential between input and output. The next step would be to multiply the maximum voltage differential by the maximum output current.

EQUATION

$$P_D = (V_{INMAX} - V_{OUTMIN}) \times I_{OUTMAX}$$

Given:

V_{IN} = 3.3V to 4.1V

V_{OUT} = 3.0 V ± 2%

I_{OUT} = 1 mA to 100 mA

T_{AMAX} = 55°C

P_{MAX} = (4.1V – (3.0V x 0.98)) x 100 mA

P_{MAX} = 116.0 milliwatts

To determine the junction temperature of the device, the thermal resistance from junction-to-ambient must be known. The 3-pin SOT-23 thermal resistance from junction-to-air ($R_{\theta JA}$) is estimated to be approximately 359°C/W. The SOT-89 $R_{\theta JA}$ is estimated to be approximately 110°C/W when mounted on 1 square inch of copper. The TO-92 $R_{\theta JA}$ is estimated to be 131.9°C/W. The $R_{\theta JA}$ will vary with physical layout, airflow and other application-specific conditions.

The device junction temperature is determined by calculating the junction temperature rise above ambient, then adding the rise to the ambient temperature.

EQUATION

Junction Temperature

SOT-23 Example:

$T_J = P_{DMAX} \times R_{\theta JA} + T_A$

T_J = 116.0 milliwatts x 359°C/W + 55°C

T_J = 96.6°C

SOT-89 Example:

T_J = 116.0 milliwatts x 110°C/W + 55°C

T_J = 67.8°C

TO-92 Example:

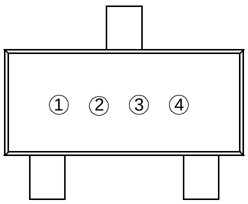
T_J = 116.0 milliwatts x 131.9°C/W + 55°C

T_J = 70.3°C

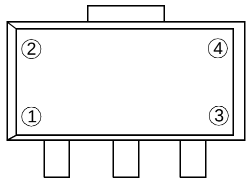
6.0 PACKAGING INFORMATION

6.1 Package Marking Information

3-Pin SOT-23A



3-Pin SOT-89



① represents first voltage digit
2V, 3V, 4V, 5V, 6V

Ex: 3.xV = ③ ◯ ◯ ◯

② represents first decimal place voltage (x.0 - x.9)

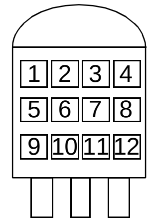
Ex: 3.4V = ③ Ⓔ ◯ ◯

Symbol	Voltage	Symbol	Voltage
A	x.0	F	x.5
B	x.1	H	x.6
C	x.2	K	x.7
D	x.3	L	x.8
E	x.4	M	x.9

③ represents polarity
0 = Positive (fixed)

④ represents assembly lot number

3-Pin TO-92



①, ②, ③ & ④ = 55RP (fixed)

⑤ represents first voltage digit (2-6)

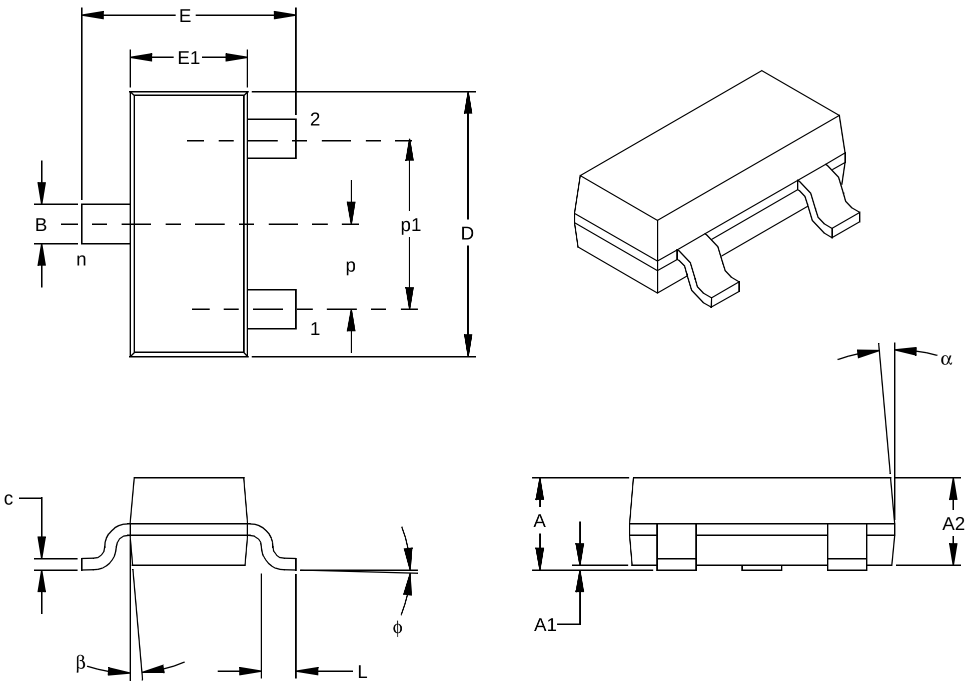
⑥ represents first voltage decimal (0-9)

⑦ represents extra feature code: fixed: 0

⑧ represents regulation accuracy
1 = ±1.0% (custom), 2 = ±2.0% (standard)

⑨, ⑩, ⑪ & ⑫ represents assembly lot number

3-Lead Plastic Small Outline Transistor (CB) (SOT23)

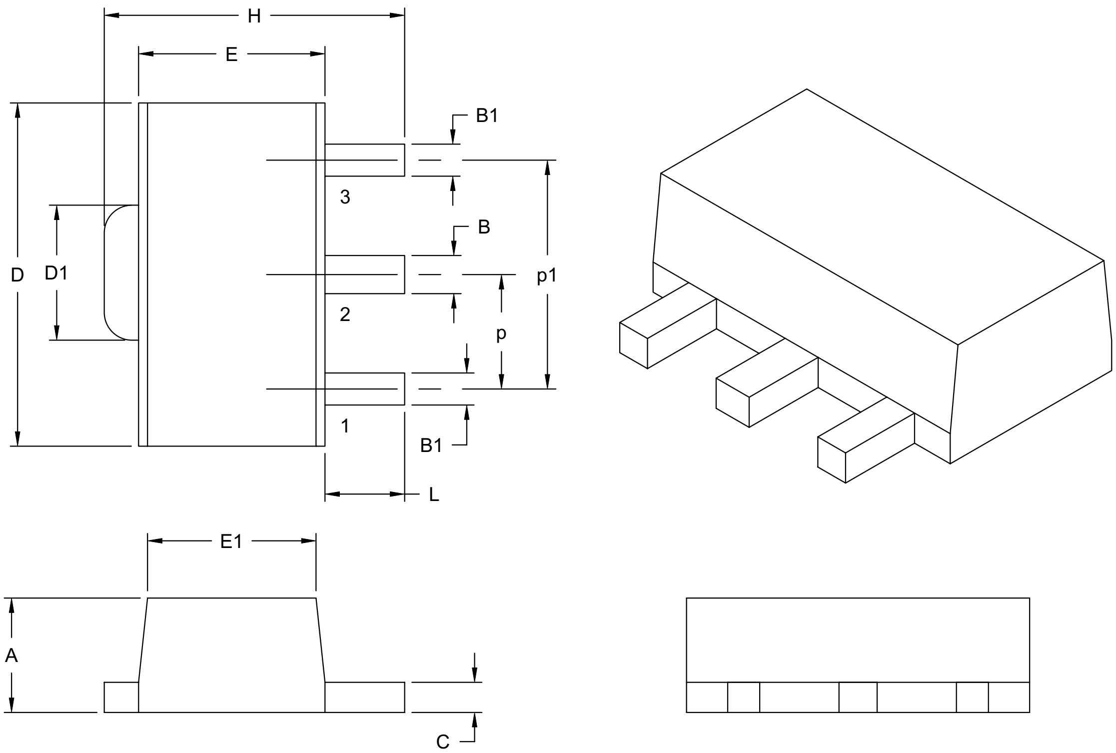


Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		3			3	
Pitch	p		.038			0.96	
Outside lead pitch (basic)	p1		.076			1.92	
Overall Height	A	.035	.040	.044	0.89	1.01	1.12
Molded Package Thickness	A2	.035	.037	.040	0.88	0.95	1.02
Standoff §	A1	.000	.002	.004	0.01	0.06	0.10
Overall Width	E	.083	.093	.104	2.10	2.37	2.64
Molded Package Width	E1	.047	.051	.055	1.20	1.30	1.40
Overall Length	D	.110	.115	.120	2.80	2.92	3.04
Foot Length	L	.014	.018	.022	0.35	0.45	0.55
Foot Angle	φ	0	5	10	0	5	10
Lead Thickness	c	.004	.006	.007	0.09	0.14	0.18
Lead Width	B	.015	.017	.020	0.37	0.44	0.51
Mold Draft Angle Top	α	0	5	10	0	5	10
Mold Draft Angle Bottom	β	0	5	10	0	5	10

* Controlling Parameter
§ Significant Characteristic

Notes:
Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010” (0.254mm) per side.
JEDEC Equivalent: TO-236
Drawing No. C04-104

3-Lead Plastic Small Outline Transistor (MB) (SOT89)



Units		INCHES		MILLIMETERS*	
Dimension Limits		MIN	MAX	MIN	MAX
Pitch	p	.059 BSC		1.50 BSC	
Outside lead pitch (basic)	p1	.118 BSC		3.00 BSC	
Overall Height	A	.055	.063	1.40	1.60
Overall Width	H	.155	.167	3.94	4.25
Molded Package Width at Base	E	.090	.102	2.29	2.60
Molded Package Width at Top	E1	.084	.090	2.13	2.29
Overall Length	D	.173	.181	4.40	4.60
Tab Length	D1	.064	.072	1.62	1.83
Foot Length	L	.035	.047	0.89	1.20
Lead Thickness	c	.014	.017	0.35	0.44
Lead 2 Width	B	.017	.022	0.44	0.56
Leads 1 & 3 Width	B1	.014	.019	0.36	0.48

*Controlling Parameter

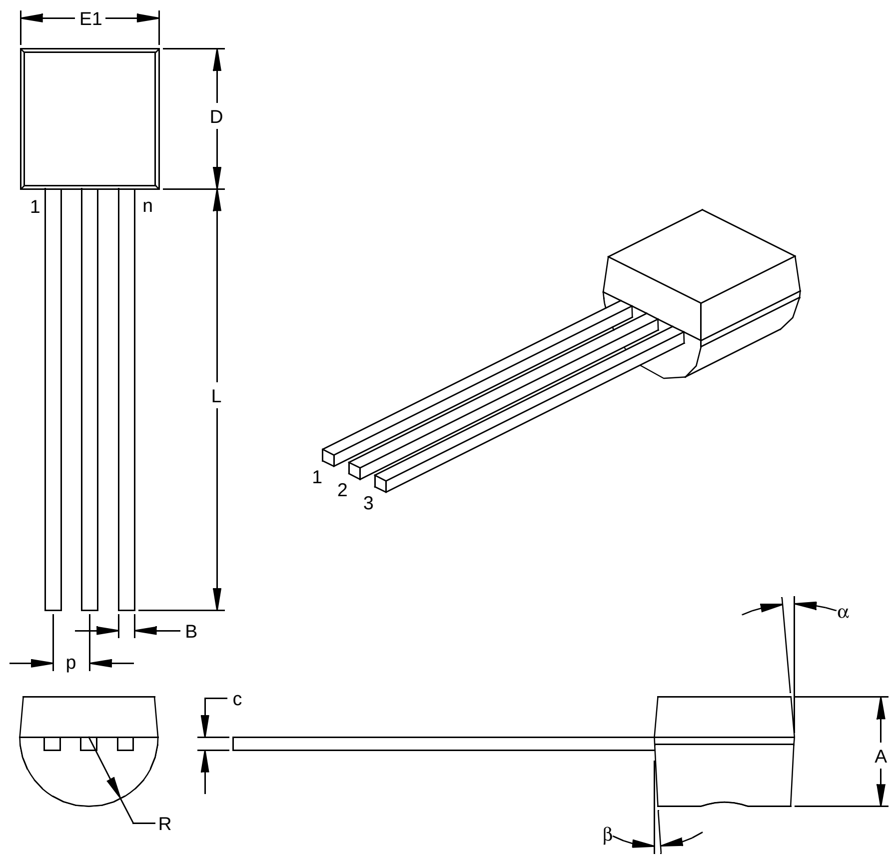
Notes:

Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" (0.127mm) per side.

JEDEC Equivalent: TO-243

Drawing No. C04-29

3-Lead Plastic Transistor Outline (ZB) (TO-92)



Units		INCHES*			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		3			3	
Pitch	p		.050			1.27	
Bottom to Package Flat	A	.130	.143	.155	3.30	3.62	3.94
Overall Width	E1	.175	.186	.195	4.45	4.71	4.95
Overall Length	D	.170	.183	.195	4.32	4.64	4.95
Molded Package Radius	R	.085	.090	.095	2.16	2.29	2.41
Tip to Seating Plane	L	.500	.555	.610	12.70	14.10	15.49
Lead Thickness	c	.014	.017	.020	0.36	0.43	0.51
Lead Width	B	.016	.019	.022	0.41	0.48	0.56
Mold Draft Angle Top	α	4	5	6	4	5	6
Mold Draft Angle Bottom	β	2	3	4	2	3	4

*Controlling Parameter

Notes:

Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010” (0.254mm) per side.

JEDEC Equivalent: TO-92

Drawing No. C04-101

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

PART NO.	XX	X	X	X	XX	XX
Device	Output Voltage	Feature Code	Tolerance	Temp.	Package	Taping Direction

Device:	TC55:	1 µA Low Dropout Positive Voltage Regulator
Output Voltage:	12	= 1.2V "Standard"
	18	= 1.8V "Standard"
	25	= 2.5V "Standard"
	30	= 3.0V "Standard"
	33	= 3.3V "Standard"
	50	= 5.0V "Standard"
Extra Feature Code:	0	= Fixed
Tolerance:	1	= 1.0% (Custom)
	2	= 2.0% (Standard)
Temperature:	E	= -40°C to +85°C
Package Type:	CB	= 3-Pin SOT-23A (equivalent to EIAJ SC-59)
	MB	= 3-Pin SOT-89
	ZB	= 3-Pin TO-92
Taping Direction:	TR	= Standard
	713	= Standard

Examples:

a) TC55RP1802ECB713: 1.8V LDO Positive Voltage Regulator, 2% Tolerance SOT23-A-3 package.

b) TC55RP2502EMB713: 1.8V LDO Positive Voltage Regulator, 2% Tolerance. SOT89-3 package.

c) TC55RP2502ECB713: 2.5V LDO Positive Voltage Regulator, 2% Tolerance. SOT23-A-3 package.

d) TC55RP3002ECB713: 3.0V LDO Positive Voltage Regulator, 2% Tolerance. SOT23-A-3 package.

e) TC55RP3002EMB713: 3.0V LDO Positive Voltage Regulator, 2% Tolerance. SOT89-3 package.

f) TC55RP3302ECB713: 3.3V LDO Positive Voltage Regulator, 2% Tolerance. SOT23-A-3 package.

g) TC55RP3302EMB713: 3.3V LDO Positive Voltage Regulator, 2% Tolerance. SOT89-3 package.

h) TC55RP5002ECB713: 5.0V LDO Positive Voltage Regulator, 2% Tolerance. SOT23-A-3 package.

i) TC55RP5002EMB713: 5.0V LDO Positive Voltage Regulator, 2% Tolerance. SOT89-3 package.

Sales and Support

Data Sheets
Products supported by a preliminary Data Sheet may have an errata sheet describing minor operational differences and recommended workarounds. To determine if an errata sheet exists for a particular device, please contact one of the following:

1. Your local Microchip sales office
2. The Microchip Corporate Literature Center U.S. FAX: (480) 792-7277
3. The Microchip Worldwide Site (www.microchip.com)

Please specify which device, revision of silicon and Data Sheet (include Literature #) you are using.

Customer Notification System
Register on our web site (www.microchip.com/cn) to receive the most current information on our products.

NOTES:

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Printed on recycled paper.

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO/TS 16949:2002

Microchip received ISO/TS-16949:2002 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona and Mountain View, California in October 2003. The Company's quality system processes and procedures are for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://support.microchip.com
Web Address:
www.microchip.com

Atlanta
Alpharetta, GA
Tel: 770-640-0034
Fax: 770-640-0307

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

San Jose
Mountain View, CA
Tel: 650-215-1444
Fax: 650-961-0286

Toronto
Mississauga, Ontario,
Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8676-6200
Fax: 86-28-8676-6599

China - Fuzhou
Tel: 86-591-8750-3506
Fax: 86-591-8750-3521

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Shunde
Tel: 86-757-2839-5507
Fax: 86-757-2839-5571

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xian
Tel: 86-29-8833-7250
Fax: 86-29-8833-7256

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-2229-0061
Fax: 91-80-2229-0062

India - New Delhi
Tel: 91-11-5160-8631
Fax: 91-11-5160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Yokohama
Tel: 81-45-471- 6166
Fax: 81-45-471-6122

Korea - Gumi
Tel: 82-54-473-4301
Fax: 82-54-473-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Penang
Tel: 60-4-646-8870
Fax: 60-4-646-5086

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-572-9526
Fax: 886-3-572-6459

Taiwan - Kaohsiung
Tel: 886-7-536-4818
Fax: 886-7-536-4803

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-399
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

10/31/05