TC1054/TC1055/TC1186

50 mA, 100 mA and 150 mA CMOS LDOs with Shutdown and ERROR Output

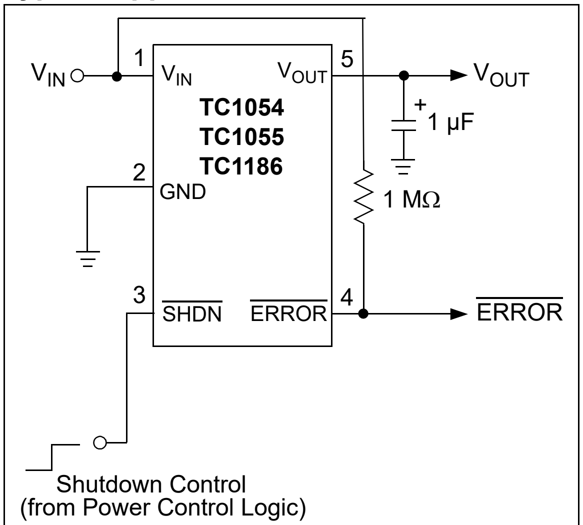
Features

- AEC-Q100 Automotive Qualified, See **Product Identification System**
- Low Ground Current for Longer Battery Life
- Low Dropout Voltage
- Choice of 50 mA (TC1054), 100 mA (TC1055) and 150 mA (TC1186) Output
- High Output Voltage Accuracy
- Standard or Custom Output Voltages:
  - 1.8V, 2.5V, 2.6V, 2.7V, 2.8V, 2.85V, 3.0V, 3.3V, 3.6V, 4.0V, 5.0V
- Power-Saving Shutdown Mode
- $\overline{\text{ERROR}}$ Output Can Be Used as a Low-Battery Detector or Microcontroller-Reset Generator
- Overcurrent and Overtemperature Protection
- 5-Pin SOT-23 Package
- Pin-Compatible Upgrades for Bipolar Regulators

Applications

- Battery Operated Systems
- Portable Computers
- Medical Instruments
- Instrumentation
- Cellular/GSM/PHS Phones
- Linear Post-Regulators for SMPS
- Pagers

Typical Application



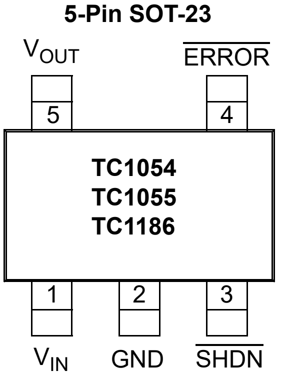
General Description

The TC1054, TC1055 and TC1186 are high accuracy (typically ±0.5%) CMOS upgrades for older (bipolar) low dropout regulators. Designed specifically for battery-operated systems, the devices' CMOS construction minimizes ground current, extending battery life. Total supply current is typically 50 µA at full load (20 to 60 times lower than in bipolar regulators).

The devices' key features include low noise operation, low dropout voltage – typically 85 mV (TC1054), 180 mV (TC1055) and 270 mV (TC1186) at full load — and fast response to step changes in load. An error output ($\overline{\text{ERROR}}$) is asserted when the devices are out-of-regulation (due to a low input voltage or excessive output current). $\overline{\text{ERROR}}$ can be used as a low battery warning or as a processor $\overline{\text{RESET}}$ signal (with the addition of an external RC network). Supply current is reduced to 0.5 µA (maximum), with both V_{OUT} and $\overline{\text{ERROR}}$ disabled when the shutdown input is low. The devices incorporate both overtemperature and overcurrent protection.

The TC1054, TC1055 and TC1186 are stable with an output capacitor of only 1 µF, and have a maximum output current of 50 mA, 100 mA and 150 mA, respectively. For higher output current regulators, please refer to the TC1173 (I_{OUT} = 300 mA) data sheet (DS20001632).

Package Type



Note: 5-Pin SOT-23 is equivalent to the EIAJ (SC-74A)

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Input Voltage 6.75V
Output Voltage .... (-0.3V) to (V_{IN} + 0.3V)
Power Dissipation.. Internally Limited (**Note 6**)
Maximum Voltage on Any Pin .... V_{IN} +0.3V to -0.3V
Operating Junction Temperature Range .... -40°C < T_J < +125°C
Storage Temperature.. -65°C to +150°C
ESD Ratings[(1)]:
Human Body Model .... ±2 kV
Machine Model .... ±200V
Charged Device Model .... ±2 kV

† **Notice:** 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.

Note 1: Testing was performed per AEC-Q100 Standard. ESD CDM was tested on the 5L SOT-23 package. For additional information please contact your local Microchip sales office.

DC CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, $V_{IN} = V_{OUT}$ + 1V, I_L = 100 µA, C_L = 3.3 µF, $\overline{SHDN} > V_{IH}$, T_A = +25°C. **Boldface** type specifications apply for junction temperatures of -40°C to +125°C.

Parameters	Sym	Min	Typ	Max	Units	Conditions
Input Operating Voltage	V_{IN}	**2.7**	—	**6.50**	V	**Note 8**
Maximum Output Current	I_{OUTMAX}	**50**	—	—	mA	**TC1054**
		100	—	—		**TC1055**
		150	—	—		**TC1186**
Output Voltage	V_{OUT}	**V_R – 2.5%**	V_R ± 0.5%	**V_R + 2.5%**	V	**Note 1**

Note 1: V_R is the regulator output voltage setting. For example: V_R = 1.8V, 2.5V, 2.7V, 2.85V, 3.0V, 3.3V, 3.6V, 4.0V, 5.0V.

2: $TC\ V_{OUT} = \dfrac{(V_{OUTMAX} - V_{OUTMIN}) \times 10^6}{V_{OUT} \times \Delta T}$

3: Regulation is measured at a constant junction temperature using low duty cycle pulse testing. Load regulation is tested over a load range from 0.1 mA to the maximum specified output current. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

4: Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value.

5: Thermal Regulation is defined as the change in output voltage at a time T after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a current pulse equal to I_{LMAX} at V_{IN} = 6V for T = 10 ms.

6: The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction-to-air (i.e., T_A, T_J, θ_{JA}). Exceeding the maximum allowable power dissipation causes the device to initiate thermal shutdown. See **5.0 "Thermal Considerations"** for more details.

7: Hysteresis voltage is referenced by V_R.

8: The minimum V_{IN} has to justify the conditions: $V_{IN} \geq V_R + V_{DROPOUT}$ and $V_{IN} \geq$ 2.7V for I_L = 0.1 mA to I_{OUTMAX}.

9: Apply for junction temperatures of -40°C to +85°C.

DC CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise noted, $V_{IN} = V_{OUT} + 1V$, $I_L = 100\ \mu A$, $C_L = 3.3\ \mu F$, $\overline{SHDN} > V_{IH}$, $T_A = +25°C$. **Boldface** type specifications apply for junction temperatures of -40°C to +125°C.

Parameters	Sym	Min	Typ	Max	Units	Conditions
V_{OUT} Temperature Coefficient	TCV_{OUT}	—	20	—	ppm/°C	Note 2
		—	**40**	—		
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	—	0.05	**0.35**	%	$(V_R + 1V) \le V_{IN} \le 6V$
Load Regulation						
TC1054; TC1055	$\Delta V_{OUT}/V_{OUT}$	—	0.5	**2**	%	(Note 3) I_L = 0.1 mA to I_{OUTMAX}
TC1186		—	0.5	**3**		
Dropout Voltage	$V_{IN} - V_{OUT}$	—	2	—	mV	I_L = 100 µA
		—	65	—		I_L = 20 mA
		—	85	**120**		I_L = 50 mA
TC1055; TC1186		—	180	**250**		I_L = 100 mA
TC1186		—	270	**400**		I_L = 150 mA (**Note 4**)
Supply Current	I_{IN}	—	50	**80**	µA	$\overline{SHDN} = V_{IH}$, I_L = 0 µA (**Note 9**)
Shutdown Supply Current	I_{INSD}	—	0.05	0.5	µA	$\overline{SHDN}$ = 0V
Power Supply Rejection Ratio	PSRR	—	64	—	dB	f ≤ 1 kHz
Output Short Circuit Current	I_{OUTSC}	—	300	450	mA	V_{OUT} = 0V
Thermal Regulation	$\Delta V_{OUT}/\Delta P_D$	—	0.04	—	V/W	**Notes 5, 6**
Thermal Shutdown Die Temperature	T_{SD}	—	160	—	°C	
Thermal Shutdown Hysteresis	ΔT_{SD}	—	10	—	°C	
Output Noise	eN	—	260	—	nV/√Hz	$I_L = I_{OUTMAX}$
$\overline{SHDN}$ Input						
SHDN Input High Threshold	V_{IH}	45	—	—	$\%V_{IN}$	V_{IN} = 2.5V to 6.5V
SHDN Input Low Threshold	V_{IL}	—	—	15	$\%V_{IN}$	V_{IN} = 2.5V to 6.5V
$\overline{ERROR}$ Output						
Minimum VIN Operating Voltage	V_{INMIN}	1.0	—	—	V	

Note 1: V_R is the regulator output voltage setting. For example: V_R = 1.8V, 2.5V, 2.7V, 2.85V, 3.0V, 3.3V, 3.6V, 4.0V, 5.0V.

2: $TC\ V_{OUT} = \dfrac{(V_{OUTMAX} - V_{OUTMIN}) \times 10^6}{V_{OUT} \times \Delta T}$

3: Regulation is measured at a constant junction temperature using low duty cycle pulse testing. Load regulation is tested over a load range from 0.1 mA to the maximum specified output current. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

4: Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value.

5: Thermal Regulation is defined as the change in output voltage at a time T after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a current pulse equal to I_{LMAX} at V_{IN} = 6V for T = 10 ms.

6: The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction-to-air (i.e., T_A, T_J, θ_{JA}). Exceeding the maximum allowable power dissipation causes the device to initiate thermal shutdown. See **5.0 "Thermal Considerations"** for more details.

7: Hysteresis voltage is referenced by V_R.

8: The minimum V_{IN} has to justify the conditions: $V_{IN} \ge V_R + V_{DROPOUT}$ and $V_{IN} \ge 2.7V$ for I_L = 0.1 mA to I_{OUTMAX}.

9: Apply for junction temperatures of -40°C to +85°C.

DC CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise noted, $V_{IN} = V_{OUT} + 1V$, $I_L = 100\ \mu A$, $C_L = 3.3\ \mu F$, $\overline{SHDN} > V_{IH}$, $T_A = +25°C$. **Boldface** type specifications apply for junction temperatures of -40°C to +125°C.

Parameters	Sym	Min	Typ	Max	Units	Conditions
Output Logic Low Voltage	V_{OL}	—	—	400	mV	1 mA Flows to $\overline{ERROR}$
ERROR Threshold Voltage	V_{TH}	—	0.95 x V_R	—	V	See Figure 4-2
ERROR Positive Hysteresis	V_{HYS}	—	50	—	mV	**Note 7**
V_{OUT} to $\overline{ERROR}$ Delay	t_{DELAY}	—	2.5	—	ms	V_{OUT} falling from V_R to V_R – 10%

Note 1: V_R is the regulator output voltage setting. For example: V_R = 1.8V, 2.5V, 2.7V, 2.85V, 3.0V, 3.3V, 3.6V, 4.0V, 5.0V.

2: $TC\ V_{OUT} = \frac{(V_{OUTMAX} - V_{OUTMIN}) \times 10^6}{V_{OUT} \times \Delta T}$

3: Regulation is measured at a constant junction temperature using low duty cycle pulse testing. Load regulation is tested over a load range from 0.1 mA to the maximum specified output current. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

4: Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value.

5: Thermal Regulation is defined as the change in output voltage at a time T after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a current pulse equal to I_{LMAX} at V_{IN} = 6V for T = 10 ms.

6: The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction-to-air (i.e., T_A, T_J, θ_{JA}). Exceeding the maximum allowable power dissipation causes the device to initiate thermal shutdown. See **5.0 "Thermal Considerations"** for more details.

7: Hysteresis voltage is referenced by V_R.

8: The minimum V_{IN} has to justify the conditions: $V_{IN} \geq V_R + V_{DROPOUT}$ and $V_{IN} \geq 2.7V$ for I_L = 0.1 mA to I_{OUTMAX}.

9: Apply for junction temperatures of -40°C to +85°C.

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.

Note: Unless otherwise indicated, $V_{IN} = V_{OUT} + 1V$, $I_L = 100\ \mu A$, $C_L = 3.3\ \mu F$, $\overline{SHDN} > V_{IH}$, $T_A = +25°C$.

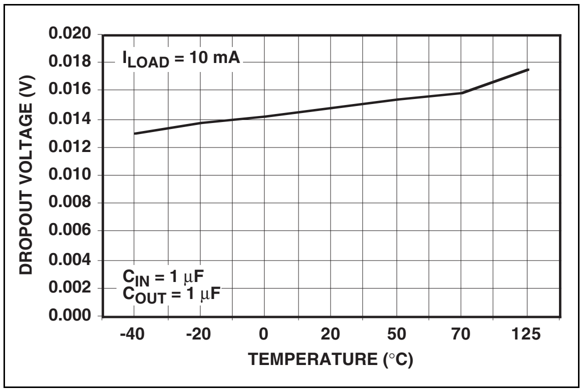


FIGURE 2-1: Dropout Voltage vs. Temperature (I_{LOAD} = 10 mA).

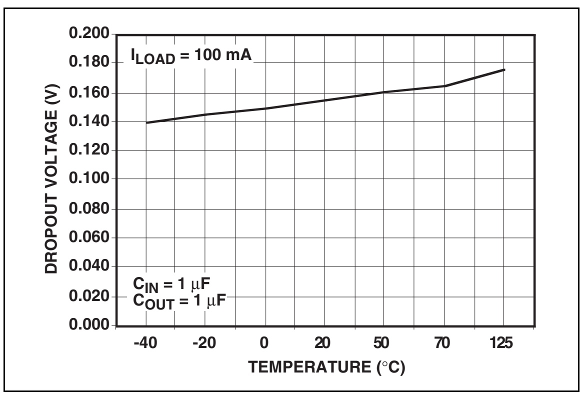


FIGURE 2-2: Dropout Voltage vs. Temperature (I_{LOAD} = 100 mA).

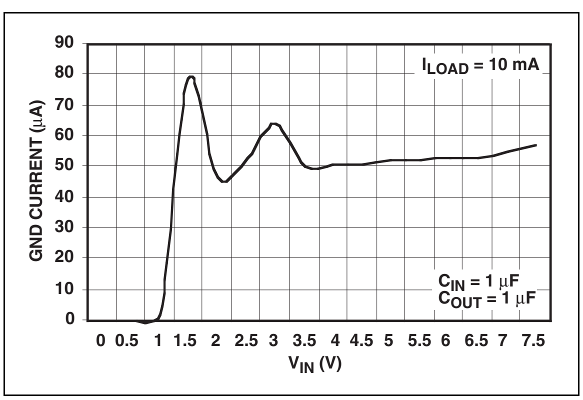


FIGURE 2-3: Ground Current vs. V_{IN} (I_{LOAD} = 10 mA).

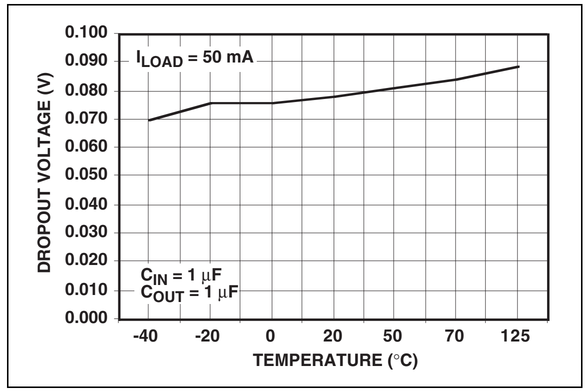


FIGURE 2-4: Dropout Voltage vs. Temperature (I_{LOAD} = 50 mA).

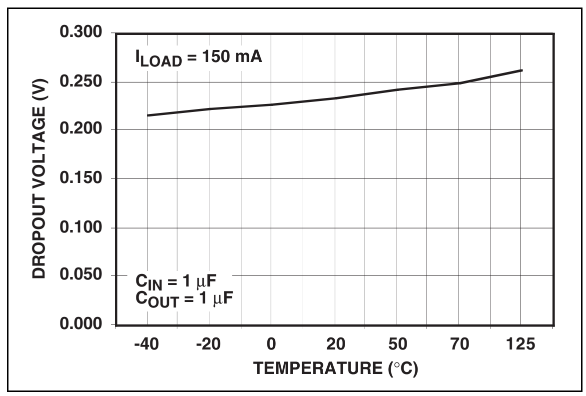


FIGURE 2-5: Dropout Voltage vs. Temperature (I_{LOAD} = 150 mA).

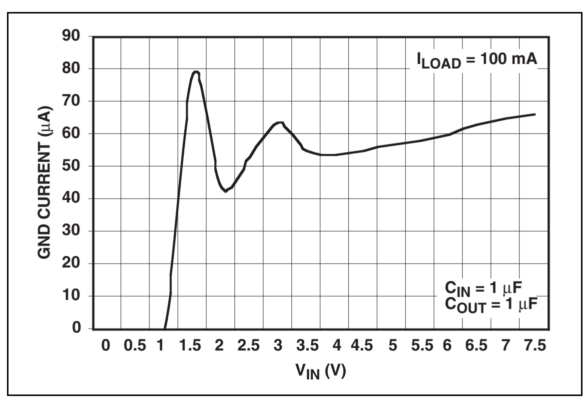


FIGURE 2-6: Ground Current vs. V_{IN} (I_{LOAD} = 100 mA).

Note: Unless otherwise indicated, $V_{IN} = V_{OUT} + 1V$, $I_L = 100\ \mu A$, $C_L = 3.3\ \mu F$, $\overline{SHDN} > V_{IH}$, $T_A = +25°C$.

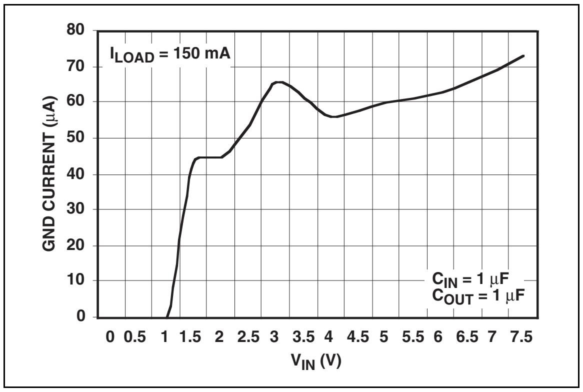


FIGURE 2-7: *Ground Current vs. V_{IN} (I_{LOAD} = 150 mA).*

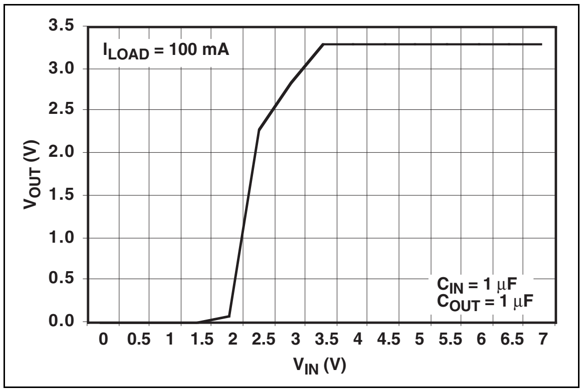


FIGURE 2-8: *V_{OUT} vs. V_{IN} (I_{LOAD} = 100 mA).*

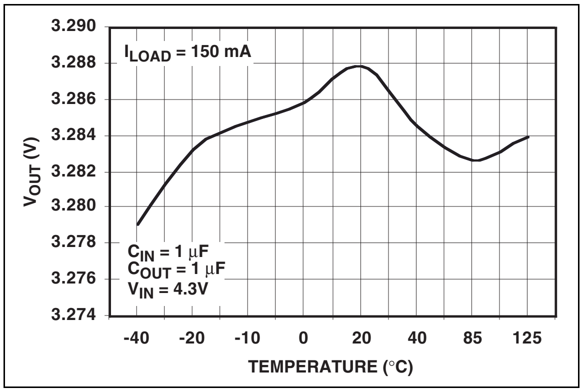


FIGURE 2-9: *V_{OUT} vs. V_{IN} (I_{LOAD} = 150 mA).*

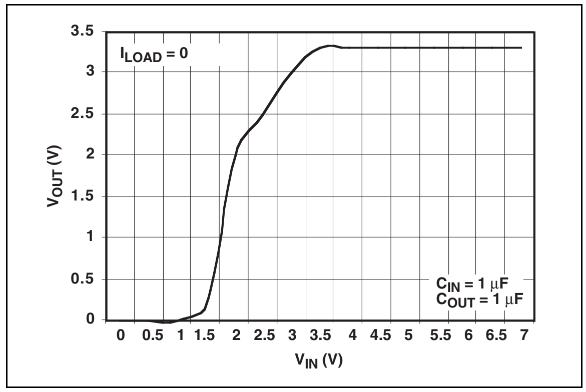


FIGURE 2-10: *V_{OUT} vs. V_{IN} (I_{LOAD} = 0 mA).*

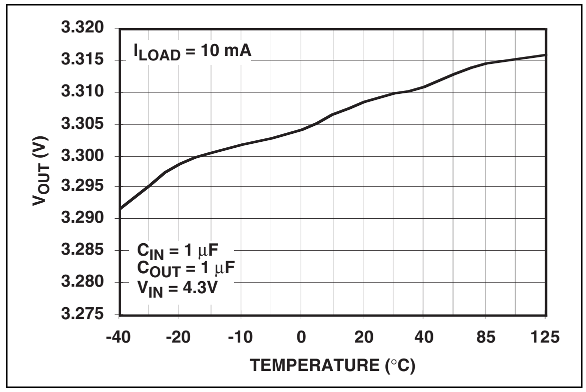


FIGURE 2-11: *Output Voltage (3.3V) vs. Temperature (I_{LOAD} = 10 mA).*

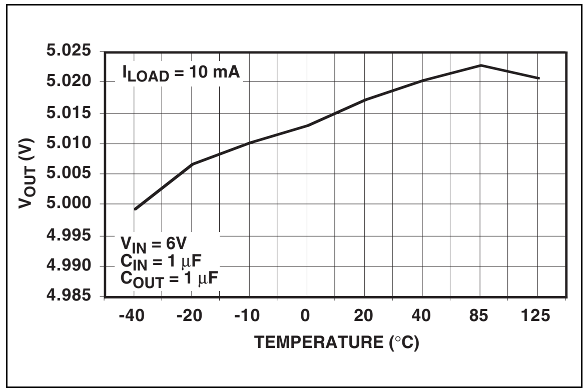


FIGURE 2-12: *Output Voltage (5V) vs. Temperature (I_{LOAD} = 10 mA).*

Note: Unless otherwise indicated, $V_{IN} = V_{OUT} + 1V$, $I_L = 100\ \mu A$, $C_L = 3.3\ \mu F$, $\overline{SHDN} > V_{IH}$, $T_A = +25°C$.

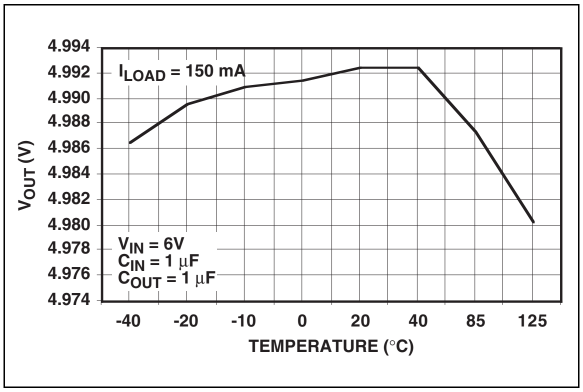


FIGURE 2-13: *Output Voltage (5V) vs. Temperature (I_{LOAD} = 10 mA).*

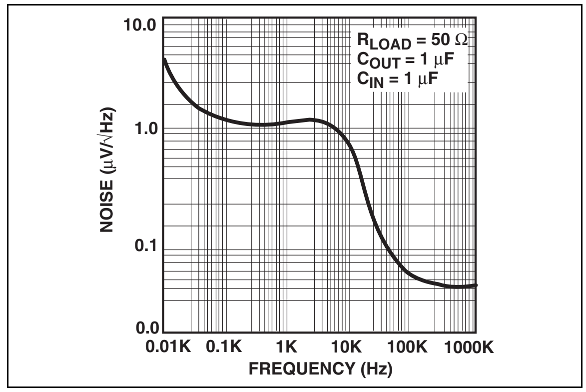


FIGURE 2-16: *Output Noise vs. Frequency.*

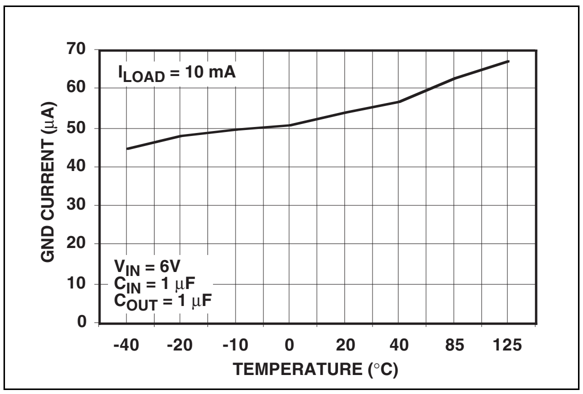


FIGURE 2-14: *GND Current vs. Temperature (I_{LOAD} = 10 mA).*

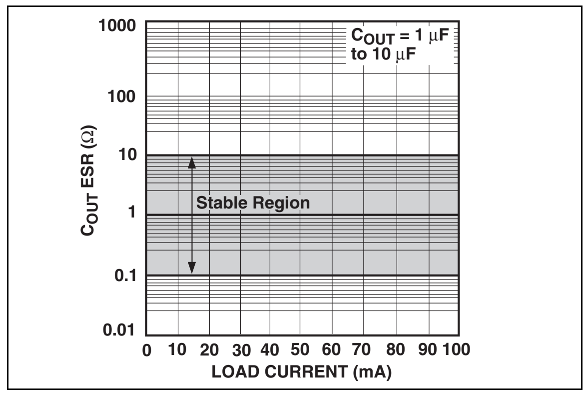


FIGURE 2-17: *Stability Region vs. Load Current.*

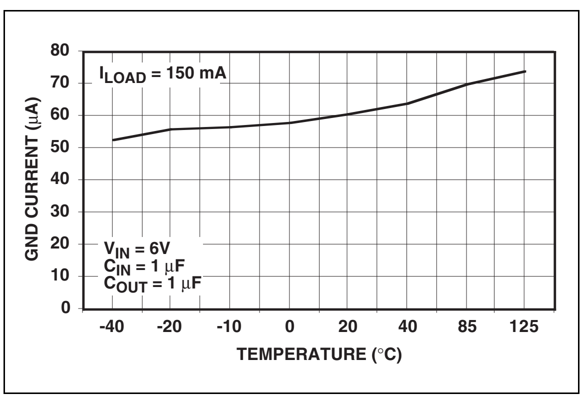
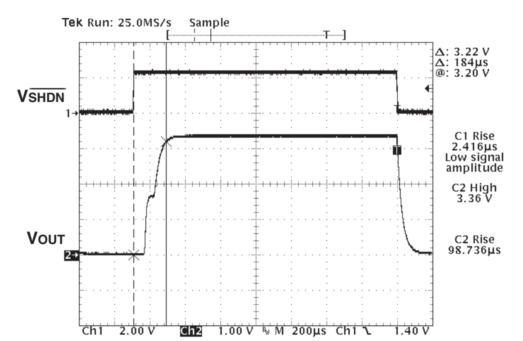


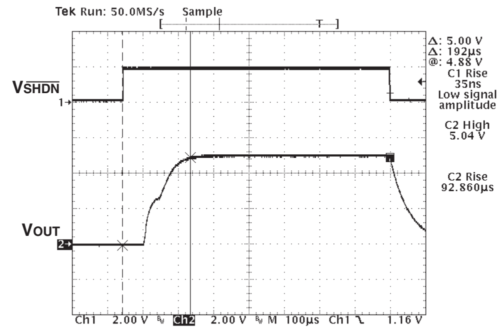
FIGURE 2-15: *GND Current vs. Temperature (I_{LOAD} = 150 mA).*



Conditions: C_{IN} = 1 µF, C_{OUT} = 1 µF, I_{LOAD} = 100 mA, V_{IN} = 4.3V, Temperature = +25°C, Fall Time = 184 µs

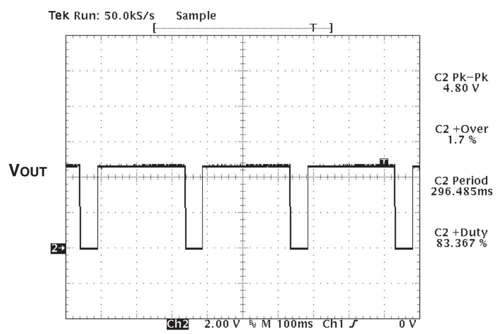
FIGURE 2-18: *Measure Rise Time of 3.3V LDO.*

Note: Unless otherwise indicated, $V_{IN} = V_{OUT} + 1V$, $I_L = 100\ \mu A$, $C_L = 3.3\ \mu F$, $\overline{SHDN} > V_{IH}$, $T_A = +25°C$.



Conditions: $C_{IN} = 1\ \mu F$, $C_{OUT} = 1\ \mu F$, $I_{LOAD} = 100\ mA$, $V_{IN} = 6V$, Temperature = +25°C, Fall Time = 192 µs

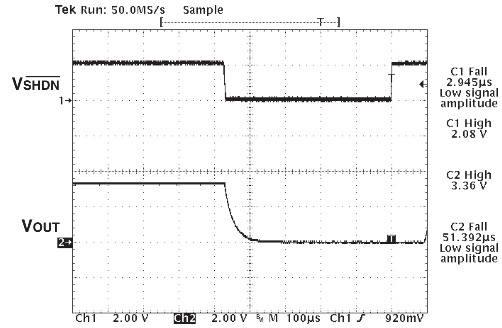
FIGURE 2-19: *Measure Rise Time of 5.0V LDO.*



Conditions: $V_{IN} = 6V$, $C_{IN} = 0\ \mu F$, $C_{OUT} = 1\ \mu F$

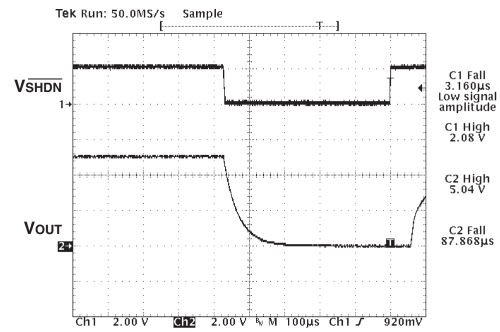
I_{LOAD} was increased until temperature of die reached about +160°C, at which time integrated thermal protection circuitry shuts the regulator off when die temperature exceeds approximately +160°C. The regulator remains off until die temperature drops to approximately +150°C.

FIGURE 2-20: *Thermal Shutdown Response of 5.0V LDO.*



Conditions: $C_{IN} = 1\ \mu F$, $C_{OUT} = 1\ \mu F$, $I_{LOAD} = 100\ mA$, $V_{IN} = 4.3V$, Temperature = +25°C, Fall Time = 52 µs

FIGURE 2-21: *Measure Fall Time of 3.3V LDO.*



Conditions: $C_{IN} = 1\ \mu F$, $C_{OUT} = 1\ \mu F$, $I_{LOAD} = 100\ mA$, $V_{IN} = 6V$, Temperature = +25°C, Fall Time = 88 µs

FIGURE 2-22: *Measure Fall Time of 5.0V LDO.*

3.0 PIN DESCRIPTIONS

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

TABLE 3-1: PIN FUNCTION TABLE

Pin No. SOT-23	Symbol	Description
1	V_{IN}	Unregulated supply input
2	GND	Ground terminal
3	$\overline{SHDN}$	Shutdown control input
4	$\overline{ERROR}$	Out-of-Regulation Flag (Open-drain output)
5	V_{OUT}	Regulated voltage output

3.1 Unregulated Supply Input (V_{IN})

Connect unregulated input supply to the V_{IN} pin. If there is a large distance between the input supply and the LDO regulator, some input capacitance is necessary for proper operation. A 1 µF capacitor connected from V_{IN} to ground is recommended for most applications.

3.2 Ground Terminal (GND)

Connect the unregulated input supply ground return to GND. Also connect the negative side of the 1 µF typical input decoupling capacitor close to GND and the negative side of the output capacitor C_{OUT} to GND.

3.3 Shutdown Control Input ($\overline{SHDN}$)

The regulator is fully enabled when a logic high is applied to $\overline{SHDN}$. The regulator enters shutdown when a logic low is applied to $\overline{SHDN}$. During shutdown, output voltage falls to zero, $\overline{ERROR}$ is open-circuited and supply current is reduced to 0.5 µA (maximum).

3.4 Out Of Regulation Flag ($\overline{ERROR}$)

$\overline{ERROR}$ goes low when V_{OUT} is out-of-tolerance by approximately -5%.

3.5 Regulated Voltage Output (V_{OUT})

Connect the output load to V_{OUT} of the LDO. Also connect the positive side of the LDO output capacitor as close as possible to the V_{OUT} pin.

4.0 DETAILED DESCRIPTION

The TC1054, TC1055 and TC1186 are precision fixed output voltage regulators (If an adjustable version is desired, please see the TC1070/TC1071/TC1187 data sheet (DS20001353)). Unlike bipolar regulators, the TC1054, TC1055 and TC1186 supply current does not increase with load current.

Figure 4-1 shows a typical application circuit, where the regulator is enabled any time the shutdown input (SHDN) is at or above V_{IH}, and shutdown (disabled) when SHDN is at or below V_{IL}. SHDN may be controlled by a CMOS logic gate or I/O port of a microcontroller. If the SHDN input is not required, it should be connected directly to the input supply. While in Shutdown, supply current decreases to 0.05 µA (typical), V_{OUT} falls to zero volts, and ERROR is open-circuited.

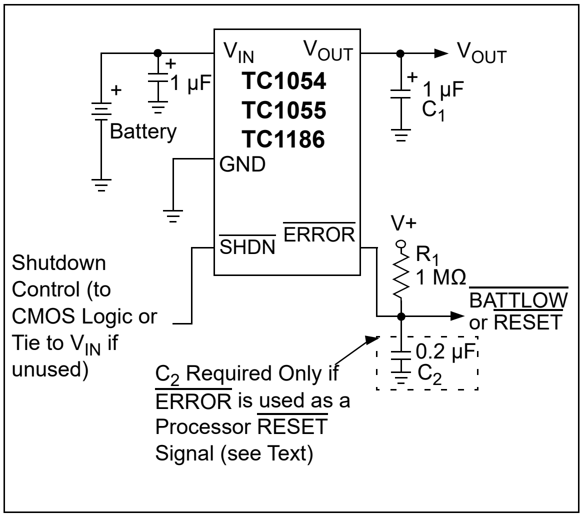


FIGURE 4-1: *Typical Application Circuit.*

4.1 ERROR Open-Drain Output

ERROR is driven low whenever V_{OUT} falls out of regulation by more than -5% (typical). This condition may be caused by low input voltage, output current limiting or thermal limiting. The ERROR threshold is 5% below rated V_{OUT}, regardless of the programmed output voltage value (e.g. ERROR = V_{OL} at 4.75V (typical) for a 5.0V regulator and 2.85V (typical) for a 3.0V regulator). ERROR output operation is shown in Figure 4-2.

Note that ERROR is active when V_{OUT} falls to V_{TH} and inactive when V_{OUT} rises above V_{TH} by V_{HYS}.

As shown in Figure 4-1, ERROR can be used either as a battery low flag or as a processor RESET signal (with the addition of timing capacitor C_2). R_1 x C_2 should be chosen to maintain ERROR below V_{IH} of the processor RESET input for at least 200 ms to allow time for the system to stabilize. Pull-up resistor R_1 can be tied to V_{OUT}, V_{IN} or any other voltage less than (V_{IN} + 0.3V).

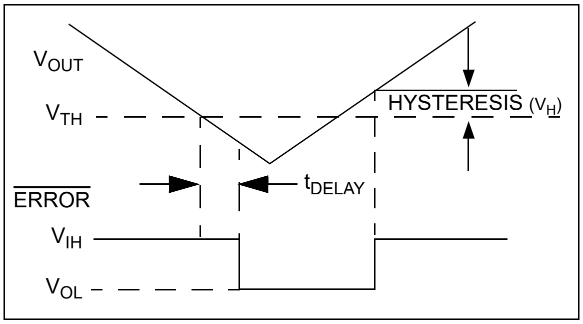


FIGURE 4-2: *Error Output Operation.*

4.2 Output Capacitor

A 1 µF (minimum) capacitor from V_{OUT} to ground is recommended. The output capacitor should have an effective series resistance greater than 0.1Ω and less than 10.0Ω, with a resonant frequency above 1 MHz. A 1 µF capacitor should be connected from V_{IN} to GND if there is more than 10 inches of wire between the regulator and the AC filter capacitor, or if a battery is used as the power source. Aluminum electrolytic or tantalum capacitor types can be used (since many aluminum electrolytic capacitors freeze at approximately -30°C, solid tantalums are recommended for applications operating below -25°C). When operating from sources other than batteries, supply-noise rejection and transient response can be improved by increasing the value of the input and output capacitors and employing passive filtering techniques.

5.0 THERMAL CONSIDERATIONS

5.1 Thermal Shutdown

Integrated thermal protection circuitry shuts the regulator off when die temperature exceeds +160°C. The regulator remains off until the die temperature drops to approximately +150°C.

5.2 Power Dissipation

The amount of power the regulator dissipates is primarily a function of input voltage, output voltage and output current. The following equation is used to calculate worst-case actual power dissipation:

EQUATION 5-1:

$$P_D \approx (V_{INMAX} - V_{OUTMIN}) I_{LOADMAX}$$

Where:

P_D = Worst-case actual power dissipation

V_{INmax} = Maximum voltage on V_{IN}

V_{OUTmin} = Minimum regulator output voltage

$I_{LOADmax}$ = Maximum output (load) current

The maximum allowable power dissipation (Equation 5-2) is a function of the maximum ambient temperature (T_{AMAX}), the maximum allowable die temperature (T_{JMAX}) and the thermal resistance from junction-to-air (θ_{JA}). The 5-Pin SOT-23 package has a θ_{JA} of approximately 220°C/Watt.

EQUATION 5-2:

$$P_{DMAX} = \frac{(T_{JMAX} - T_{AMAX})}{\theta_{JA}}$$

Where all terms are previously defined.

Equation 5-1 can be used in conjunction with Equation 5-2 to ensure regulator thermal operation is within limits.

For example:

Given:

V_{INMAX} = 3.0V + 5%

V_{OUTMIN} = 2.7V – 2.5%

$I_{LOADMAX}$ = 40 mA

T_{JMAX} = +125°C

T_{AMAX} = +55°C

Find:
1. Actual power dissipation
2. Maximum allowable dissipation

Actual power dissipation:

$$P_D \approx (V_{INMAX} - V_{OUTMIN}) I_{LOADMAX}$$
$$= [(3.0 \times 1.05) - (2.7 \times 0.975)] 40 \times 10^{-3}$$
$$= 20.7 mW$$

Maximum allowable power dissipation:

$$P_{DMAX} = \frac{(T_{JMAX} - T_{AMAX})}{\theta_{JA}}$$
$$= \frac{(125 - 55)}{220}$$
$$= 318 mW$$

In this example, the TC1054 dissipates a maximum of 20.7 mW; below the allowable limit of 318 mW. In a similar manner, Equation 5-1 and Equation 5-2 can be used to calculate maximum current and/or input voltage limits.

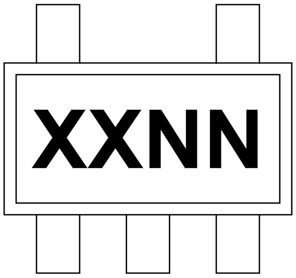
5.3 Layout Considerations

The primary path of heat conduction out of the package is via the package leads. Layouts having a ground plane, wide traces at the pads and wide power supply bus lines, combine to lower θJA and increase the maximum allowable power dissipation limit.

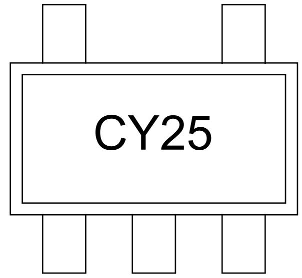
6.0 PACKAGING INFORMATION

6.1 Package Marking Information

5-Lead SOT-23



Example



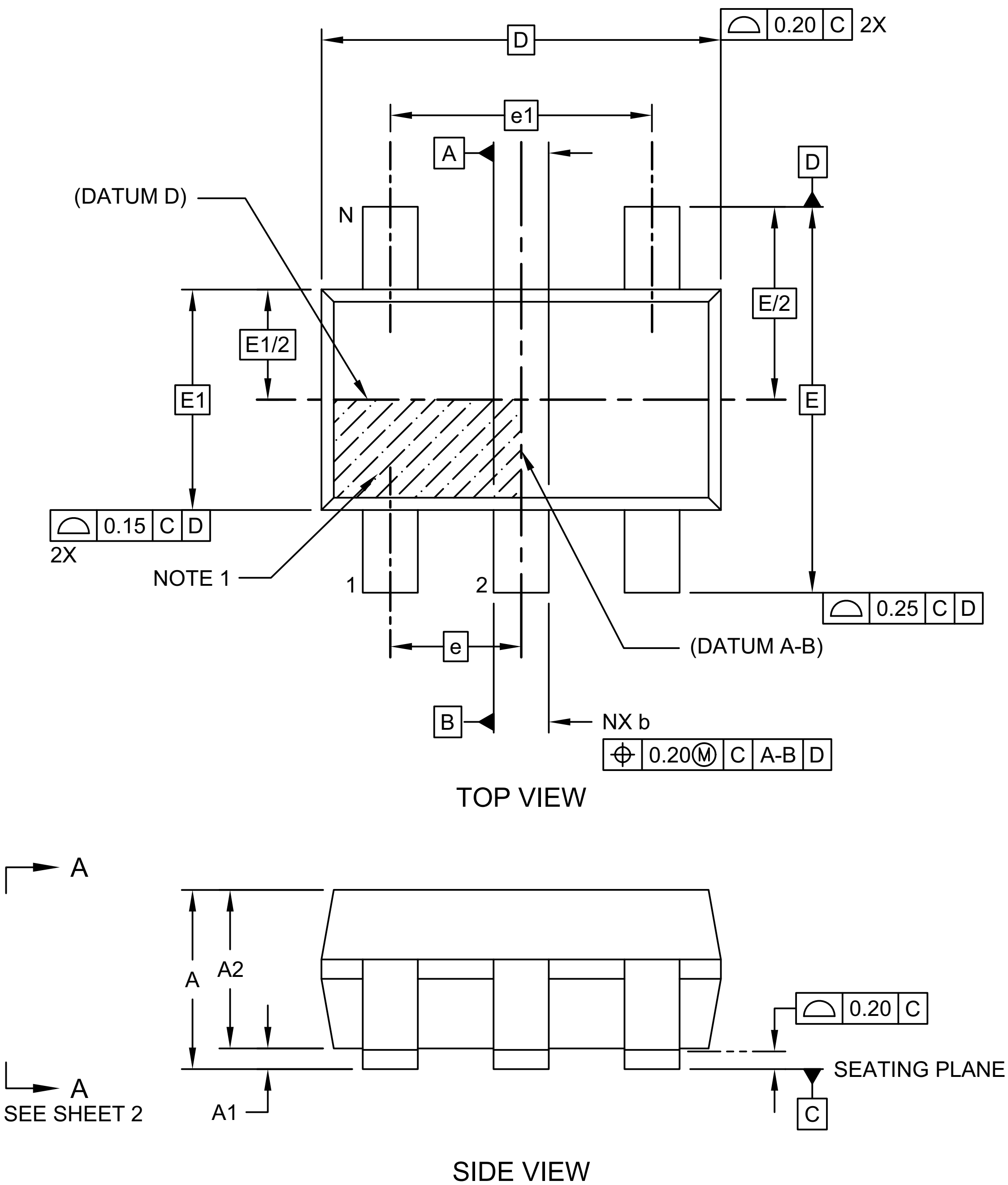
Voltage	TC1054 Code	TC1055 Code	TC1186 Code
1.8	CY	DY	PY
2.5	C1	D1	P1
2.6	CT	DT	PV
2.7	C2	D2	P2
2.8	CZ	DZ	PZ
2.85	C8	D8	P8
3.0	C3	D3	P3
3.3	C4	D4	P5
3.6	C9	D9	P9
4.0	C0	D0	P0
5.0	C6	D6	P7

Legend:		
	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	e3	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.

Note: In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

5-Lead Plastic Small Outline Transistor (C7X) [SOT-23]

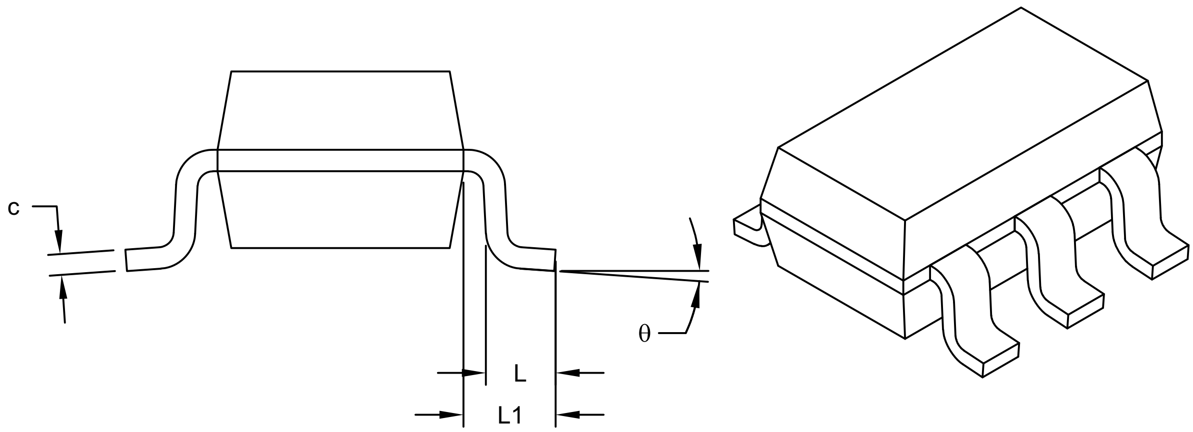
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Microchip Technology Drawing C04-091-C7X Rev H Sheet 1 of 2

5-Lead Plastic Small Outline Transistor (C7X) [SOT-23]

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



VIEW A-A
SHEET 1

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		5	
Pitch	e		0.95 BSC	
Outside lead pitch	e1		1.90 BSC	
Overall Height	A	0.90	-	1.45
Molded Package Thickness	A2	0.89	-	1.30
Standoff	A1	-	-	0.15
Overall Width	E		2.80 BSC	
Molded Package Width	E1		1.60 BSC	
Overall Length	D		2.90 BSC	
Foot Length	L	0.30	-	0.60
Footprint	L1		0.60 REF	
Foot Angle	θ	0°	-	10°
Lead Thickness	c	0.08	-	0.26
Lead Width	b	0.20	-	0.51

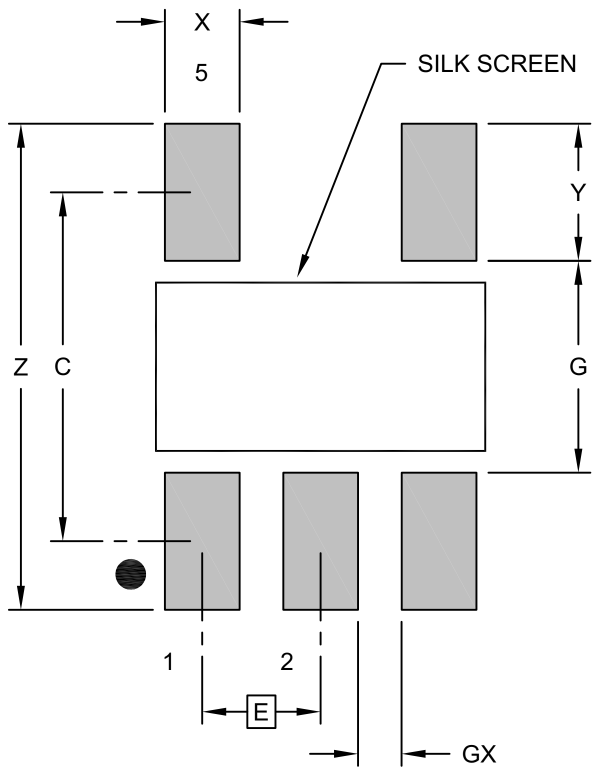
Notes:

1. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M
   BSC: Basic Dimension. Theoretically exact value shown without tolerances.
   REF: Reference Dimension, usually without tolerance, for information purposes only.

Microchip Technology Drawing C04-091-C7X Rev H Sheet 2 of 2

5-Lead Plastic Small Outline Transistor (C7X) [SOT-23]

Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



RECOMMENDED LAND PATTERN

	Units	MILLIMETERS		
	Dimension Limits	MIN	NOM	MAX
Contact Pitch	E	0.95 BSC		
Contact Pad Spacing	C		2.80	
Contact Pad Width (X5)	X			0.60
Contact Pad Length (X5)	Y			1.10
Distance Between Pads	G	1.70		
Distance Between Pads	GX	0.35		
Overall Width	Z			3.90

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

   BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing No. C04-2091-C7X Rev H

NOTES:

APPENDIX A: REVISION HISTORY

Revision F (August 2023)

- Added automotive qualification to **Features** and examples to **Product Identification System**.
- Added values for ESD protection to **Absolute Maximum Ratings**.
- Updated **Section 6.0, "Packaging Information"**.
- Made minor text and format changes throughout the document.

Revision E (December 2012)

- Updated the Input Voltage value in **Absolute Maximum Ratings** section.
- Updated **Section 6.0, "Packaging Information"**.
- Updated **Product Identification System**.

Revision D (February 2007)

- Corrected standard output voltages on page 1 and in **Product Identification System**.
- Added T_{DELAY} parameter in DC Characteristics table in **Section 1.0, "Electrical Characteristics"**.
- Changes to Figure 4-2.
- **Section 6.0, "Packaging Information"**: Corrected SOT-23 Packaging Information.

Revision C (March 2003)

- Undocumented changes.

Revision B (May 2002)

- Undocumented changes.

Revision A (March 2002)

- Original Release of this Document.

NOTES:

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.	-X.X	X	XXXXX	-XXX
Device	Output Voltage	Temperature Range	Package	Qualification

Device:	TC1054: 50 mA LDO with Shutdown and $\overline{\text{ERROR}}$ output TC1055: 100 mA LDO with Shutdown and $\overline{\text{ERROR}}$ output TC1186: 150 mA LDO with Shutdown and ERROR output
Output Voltage *:	1.8 = 1.8V "Standard" 2.5 = 2.5V "Standard" 2.6 = 2.6V "Standard" 2.7 = 2.7V "Standard" 2.8 = 2.8V "Standard" 2.85 = 2.85V "Standard" 3.0 = 3.0V "Standard" 3.3 = 3.3V "Standard" 3.6 = 3.6V "Standard" 4.0 = 4.0V "Standard" 5.0 = 5.0V "Standard" *Contact factory for other output voltage options.
Temperature Range:	V = -40°C to +125°C (Various)
Package:	CT713 = Plastic Small Outline Transistor (SOT-23), Tape and Reel
Qualification*:	(Blank) = Standard Qualification VAO = AEC-Q100 Automotive Qualified * Contact your local Microchip sales office to request automotive qualified part variants.

Examples:

a) TC1054-1.8VCT713: 1.8V LDO Regulator, Various temp., 5LD SOT-23 package
b) TC1054-2.5VCT713: 2.5V LDO Regulator, Various temp., Various Temp., 5LD SOT-23 package
c) TC1054-2.6VCT713: 2.6V LDO Regulator, Various temp., 5LD SOT-23 package
d) TC1054-2.7VCT713: 2.7V LDO Regulator, Various temp., 5LD SOT-23 package
e) TC1054-2.85VCT713: 2.85V LDO Regulator, Various temp., 5LD SOT-23 package
f) TC1054-3.3VCT713: 3.3V LDO Regulator, Various temp., 5LD SOT-23 package
g) TC1054-4.0VCT713: 4.0V LDO Regulator, Various temp., 5LD SOT-23 package
h) TC1054-5.0VCT713: 5.0V LDO Regulator, Various temp., 5LD SOT-23 package

a) TC1055-1.8VCT713: 1.8V LDO Regulator, Various temp., 5LD SOT-23 package
b) TC1055-2.5VCT713: 2.5V LDO Regulator, Various temp., 5LD SOT-23 package
c) TC1055-2.6VCT713: 2.6V LDO Regulator, Various temp., 5LD SOT-23 package
d) TC1055-2.7VCT713: 2.7V LDO Regulator, Various temp., 5LD SOT-23 package
e) TC1055-2.8VCT713: 2.8V LDO Regulator, Various temp., 5LD SOT-23 package
f) TC1055-3.0VCT713: 3.0V LDO Regulator, Various temp., 5LD SOT-23 package
g) TC1055-3.6VCT713: 3.6V LDO Regulator, Various temp., 5LD SOT-23 package
h) TC1055-5.0VCT713: 5.0V LDO Regulator, Various temp., 5LD SOT-23 package

a) TC1186-1.8VCT713: 1.8V LDO Regulator, Various temp., 5LD SOT-23 package
b) TC1186-2.6VCT713: 2.6V LDO Regulator, Various temp., 5LD SOT-23 package
c) TC1186-2.7VCT713: 2.7V LDO Regulator, Various temp., 5LD SOT-23 package
d) TC1186-2.8VCT713: 2.8V LDO Regulator, Various temp., 5LD SOT-23 package
e) TC1186-3.3VCT713: 3.3V LDO Regulator, Various temp., 5LD SOT-23 package
f) TC1186-3.6VCT713: 3.6V LDO Regulator, Various temp., 5LD SOT-23 package
g) TC1186-4.0VCT713: 4.0V LDO Regulator, Various temp., 5LD SOT-23 package
h) TC1186-5.0VCT713: 5.0V LDO Regulator, Various temp., 5LD SOT-23 package

a) TC1186-5.0VCT713-VAO**: 5.0V LDO Regulator, Various Temp., 5LD SOT-23 package, AEC-Q100 Automotive Qualified
a) TC1186-4.0VCT713-VAO**: 4.0V LDO Regulator, Various Temp., 5LD SOT-23 package, AEC-Q100 Automotive Qualified
a) TC1186-3.3VCT713-VAO**: 3.3V LDO Regulator, Various Temp., 5LD SOT-23 package, AEC-Q100 Automotive Qualified

** Example of automotive part variant that can be set up.

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