TC1014/TC1015/TC1185

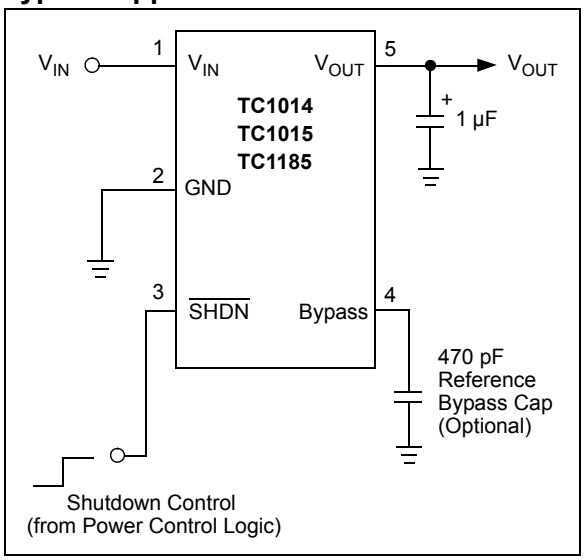
50 mA, 100 mA and 150 mA CMOS LDOs with Shutdown and Reference Bypass

- Low Supply Current (50 µA, typical)
- Low Dropout Voltage
- Choice of 50 mA (TC1014), 100 mA (TC1015) and 150 mA (TC1185) Output
- High Output Voltage Accuracy
- Standard or Custom Output Voltages
- Power-Saving Shutdown Mode
- Reference Bypass Input for Ultra Low-Noise Operation
- Overcurrent and Overtemperature Protection
- Space-Saving 5-Pin SOT-23 Package
- Pin-Compatible Upgrades for Bipolar Regulators
- Standard Output Voltage Options:
  - 1.8V, 2.5V, 2.6V, 2.7V, 2.8V, 2.85V, 3.0V, 3.3V, 3.6V, 4.0V, 5.0V

Applications:

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

Typical Application



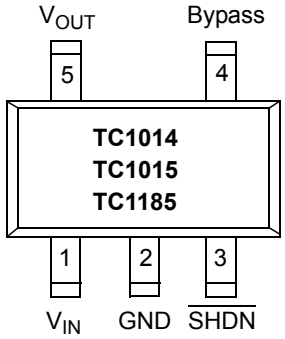
The TC1014/TC1015/TC1185 are high accuracy (typically ±0.5%) CMOS upgrades for older (bipolar) Low Dropout Regulators (LDOs) such as the LP2980. Designed specifically for battery-operated systems, the devices' CMOS construction eliminates wasted ground current, significantly extending battery life. Total supply current is typically 50 µA at full load (20 to 60 times lower than in bipolar regulators).

The devices' key features include ultra low-noise operation (plus optional Bypass input), fast response to step changes in load, and very low dropout voltage, typically 85 mV (TC1014), 180 mV (TC1015), and 270 mV (TC1185) at full-load. Supply current is reduced to 0.5 µA (max) and V_{OUT} falls to zero when the shutdown input is low. The devices incorporate both overtemperature and overcurrent protection.

The TC1014/TC1015/TC1185 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 see the TC1107 (DS21356), TC1108 (DS21357), TC1173 (DS21362) (I_{OUT} = 300 mA) data sheets.

Package Type

5-Pin SOT-23



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings†

Input Voltage 6.5V
Output Voltage..... (-0.3V) to (V_{IN} + 0.3V)
Power Dissipation.....Internally Limited **(Note 7)**
Maximum Voltage on Any Pin .....V_{IN} +0.3V to -0.3V
Operating Temperature Range..... -40°C < T_J < 125°C
Storage Temperature.....-65°C to +150°C

† **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.

TC1014/TC1015/TC1185 ELECTRICAL SPECIFICATIONS

Electrical Specifications: V_{IN} = V_R + 1V, I_L = 100 µA, C_L = 1.0 µF, $\overline{SHDN}$ > V_{IH}, T_A = +25°C, unless otherwise noted. Boldface type specifications apply for junction temperatures of -40°C to +125°C.

Parameter	Symbol	Min	Typ	Max	Units	Device	Test Conditions
Input Operating Voltage	V_{IN}	**2.7**	—	**6.0**	V	—	**Note 1**
Maximum Output Current	I_{OUTMAX}	**50** **100** **150**	— — —	— — —	mA	TC1014 TC1015 TC1185	
Output Voltage	V_{OUT}	**V_R – 2.5%**	V_R ±0.5%	**V_R + 2.5%**	V	—	**Note 2**
V_{OUT} Temperature Coefficient	TCV_{OUT}	— —	20 **40**	— —	ppm/°C	—	**Note 3**
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	—	0.05	**0c.35**	%	—	(V_R + 1V) ≤ V_{IN} ≤ 6V
Load Regulation	$\Delta V_{OUT}/V_{OUT}$	— —	0.5 0.5	**2** **3**	%	TC1014; TC1015 TC1185	I_L = 0.1 mA to I_{OUTMAX} I_L = 0.1 mA to I_{OUTMAX} **(Note 4)**
Dropout Voltage	V_{IN}-V_{OUT}	— — — — —	2 65 85 180 270	— — **120** **250** **400**	mV	— — — TC1015; TC1185 TC1185	I_L = 100 µA I_L = 20 mA I_L = 50 mA I_L = 100 mA I_L = 150 mA **(Note 5)**
Supply Current **(Note 8)**	I_{IN}	—	50	**80**	µA	—	$\overline{SHDN}$ = V_{IH}, I_L = 0
Shutdown Supply Current	I_{INSD}	—	0.05	0.5	µA	—	$\overline{SHDN}$ = 0V
Power Supply Rejection Ratio	PSRR	—	64	—	dB	—	F_{RE} ≤ 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 6, 7**
Thermal Shutdown Die Temperature	T_{SD}	—	160	—	°C	—	
Thermal Shutdown Hysteresis	ΔT_{SD}	—	10	—	°C	—	

Note 1: The minimum V_{IN} has to meet two conditions: $V_{IN} \geq 2.7V$ and $V_{IN} \geq V_R + V_{DROPOUT}$.

2: V_R is the regulator output voltage setting. For example: V_R = 1.8V, 2.5V, 2.6V, 2.7V, 2.8V, 2.85V, 3.0V, 3.3V, 3.6V, 4.0V, 5.0V.

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

4: Regulation is measured at a constant junction temperature using low duty cycle pulse testing. Load regulation is tested over a load range from 1.0 mA to the maximum specified output current. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

5: Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value at a 1V differential.

6: 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.

7: 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. Please see **Section 5.0 "Thermal Considerations"** for more details.

8: Apply for Junction Temperatures of -40°C to +85°C.

TC1014/TC1015/TC1185 ELECTRICAL SPECIFICATIONS (CONTINUED)

Electrical Specifications: $V_{IN} = V_R + 1V$, I_L = 100 µA, C_L = 1.0 µF, $\overline{SHDN} > V_{IH}$, T_A = +25°C, unless otherwise noted. Boldface type specifications apply for junction temperatures of -40°C to +125°C.

Parameter	Symbol	Min	Typ	Max	Units	Device	Test Conditions
Output Noise	eN	—	600	—	nV/√Hz	—	$I_L = I_{OUTMAX}$, F = 10 kHz 470 pF from Bypass to GND
$\overline{SHDN}$ Input High Threshold	V_{IH}	45	—	—	%V_{IN}	—	V_{IN} = 2.5V to 6.5V
$\overline{SHDN}$ Input Low Threshold	V_{IL}	—	—	15	%V_{IN}	—	V_{IN} = 2.5V to 6.5V

Note 1: The minimum V_{IN} has to meet two conditions: $V_{IN} \geq 2.7V$ and $V_{IN} \geq V_R + V_{DROPOUT}$.

2: V_R is the regulator output voltage setting. For example: V_R = 1.8V, 2.5V, 2.6V, 2.7V, 2.8V, 2.85V, 3.0V, 3.3V, 3.6V, 4.0V, 5.0V.

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

4: Regulation is measured at a constant junction temperature using low duty cycle pulse testing. Load regulation is tested over a load range from 1.0 mA to the maximum specified output current. Changes in output voltage due to heating effects are covered by the thermal regulation specification.

5: Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its nominal value at a 1V differential.

6: 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.

7: 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. Please see **Section 5.0 "Thermal Considerations"** for more details.

8: Apply for Junction Temperatures of -40°C to +85°C.

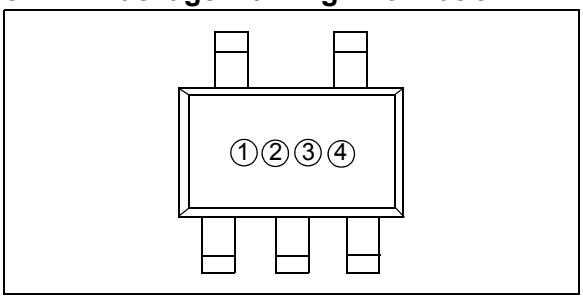
TEMPERATURE CHARACTERISTICS

Electrical Specifications: $V_{IN} = V_R + 1V$, I_L = 100 µA, C_L = 1.0 µF, $\overline{SHDN} > V_{IH}$, T_A = +25°C, unless otherwise noted. Boldface type specifications apply for junction temperatures of -40°C to +125°C.

Parameters	Sym	Min	Typ	Max	Units	Conditions
Temperature Ranges:						
Extended Temperature Range	T_A	-40	—	+125	°C	
Operating Temperature Range	T_A	-40	—	+125	°C	
Storage Temperature Range	T_A	-65	—	+150	°C	
Thermal Package Resistances:						
Thermal Resistance, 5L-SOT-23	θ_{JA}	—	256	—	°C/W	

6.0 PACKAGING INFORMATION

6.1 Package Marking Information



①&② represents part number code + temperature range and voltage

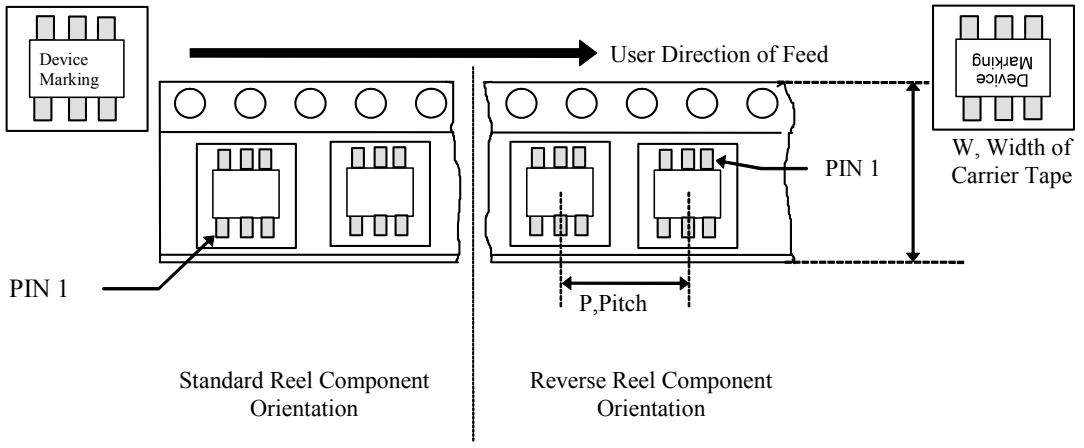
③ represents year and 2-month period code

④ represents lot ID number

TABLE 6-1: PART NUMBER CODE AND TEMPERATURE RANGE

(V)	TC1014 Code	TC1015 Code	TC1185 Code
1.8	AY	BY	NY
2.5	A1	B1	N1
2.6	NB	BT	NT
2.7	A2	B2	N2
2.8	AZ	BZ	NZ
2.85	A8	B8	N8
3.0	A3	B3	N3
3.3	A5	B5	N5
3.6	A9	B9	N9
4.0	A0	B0	N0
5.0	A7	B7	N7

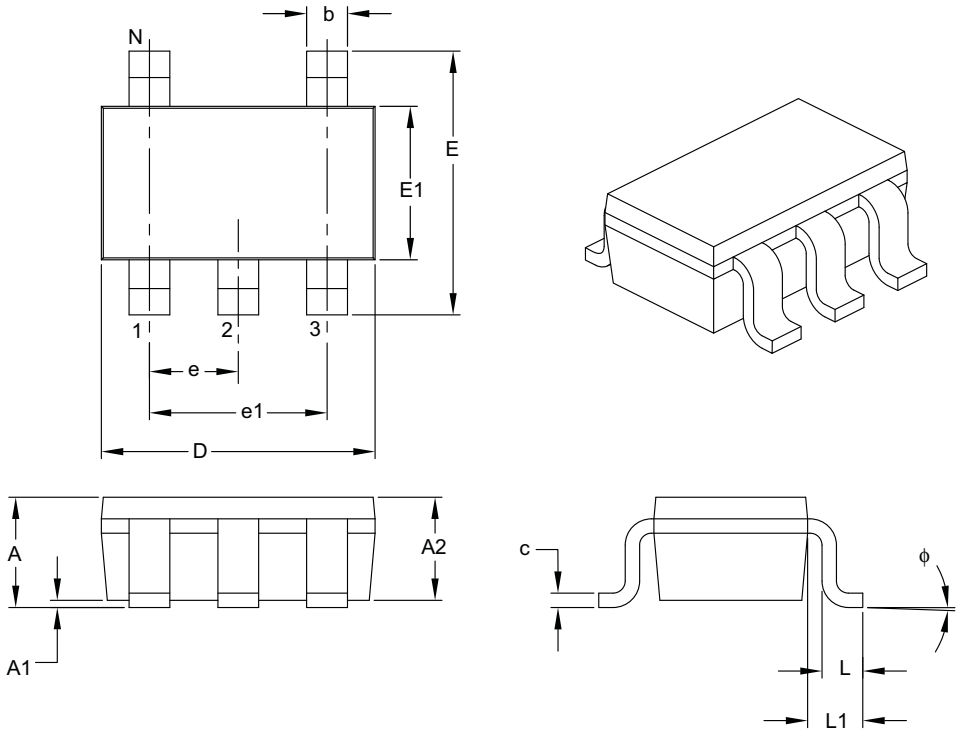
6.2 Taping Form



Carrier Tape, Number of Components per Reel and Reel Size

Package	Carrier Width (W)	Pitch (P)	Part Per Full Reel	Reel Size
5-Pin SOT-23	8 mm	4 mm	3000	7 in

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



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		5	
Lead 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	0.00	–	0.15
Overall Width	E	2.20	–	3.20
Molded Package Width	E1	1.30	–	1.80
Overall Length	D	2.70	–	3.10
Foot Length	L	0.10	–	0.60
Footprint	L1	0.35	–	0.80
Foot Angle	ϕ	0°	–	30°
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 0.127 mm per side.
2. Dimensioning and tolerancing per ASME Y14.5M.

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

Microchip Technology Drawing C04-091B

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
Device	Output Voltage	Temperature Range	Package

Device:	TC1014:	50 mA LDO with Shutdown and V_{REF} Bypass
	TC1015:	100 mA LDO with Shutdown and V_{REF} Bypass
	TC1185:	150 mA LDO with Shutdown and V_{REF} Bypass
Output Voltage:	1.8 =	1.8V
	2.5 =	2.5V
	2.6 =	2.6V
	2.7 =	2.7V
	2.8 =	2.8V
	2.85 =	2.85V
	3.0 =	3.0V
	3.3 =	3.3V
	3.6 =	3.6V
	4.0 =	4.0V
	5.0 =	5.0V
Temperature Range:	V =	-40° C to +125° C
Package:	CT713 =	Plastic Small Outline Transistor (SOT-23), 5-lead, Tape and Reel

Examples:

a) TC1014-1.8VCT713: 1.8V, 5LD SOT-23, Tape and Reel.

b) TC1014-2.85VCT713: 2.85V, 5LD SOT-23, Tape and Reel.

c) TC1014-3.3VCT713: 3.3V, 5LD SOT-23, Tape and Reel.

a) TC1015-1.8VCT713: 1.8V, 5LD SOT-23, Tape and Reel.

b) TC1015-2.85VCT713: 2.85V, 5LD SOT-23, Tape and Reel.

c) TC1015-3.0VCT713: 3.0V, 5LD SOT-23, Tape and Reel.

a) TC1185-1.8VCT713: 1.8V, 5LD SOT-23, Tape and Reel.

b) TC1185-2.8VCT713: 2.8V, 5LD SOT-23, Tape and Reel.