MICROCHIP

MCP1703

250 mA, 16V, Low Quiescent Current LDO Regulator

Features

- 2.0 µA Typical Quiescent Current
- Input Operating Voltage Range: 2.7V to16.0V
- 250 mA Output Current for Output Voltages ≥ 2.5V
- 200 mA Output Current for Output Voltages < 2.5V
- Low Drop Out Voltage, 625 mV typical @ 250 mA for V_R = 2.8V
- 0.4% Typical Output Voltage Tolerance
- Standard Output Voltage Options (1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V, 4.0V, 5.0V)
- Output voltage range 1.2V to 5.5V in 0.1V increments (50 mV increments available upon request)
- Stable with 1.0 µF to 22 µF ceramic output capacitance
- Short-Circuit Protection
- Overtemperature Protection

Applications

- Battery-powered Devices
- Battery-powered Alarm Circuits
- Smoke Detectors
- CO^2 Detectors
- Pagers and Cellular Phones
- Smart Battery Packs
- Low Quiescent Current Voltage Reference
- PDAs
- Digital Cameras
- Microcontroller Power
- Solar-Powered Instruments
- Consumer Products
- Battery Powered Data Loggers

Description

The MCP1703 is a family of CMOS low dropout (LDO) voltage regulators that can deliver up to 250 mA of current while consuming only 2.0 µA of quiescent current (typical). The input operating range is specified from 2.7V to 16.0V, making it an ideal choice for two to six primary cell battery-powered applications, 9V alkaline and one or two cell Li-Ion-powered applications.

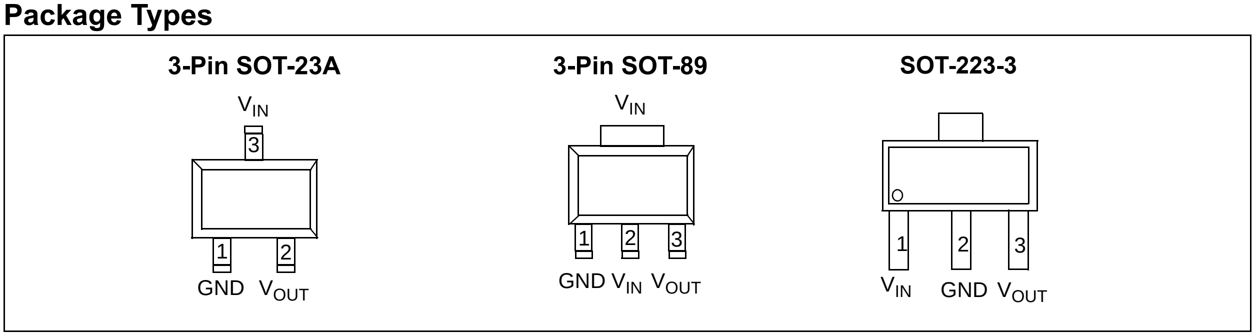
The MCP1703 is capable of delivering 250 mA with only 625 mV (typical) of input to output voltage differential (V_{OUT} = 2.8V). The output voltage tolerance of the MCP1703 is typically ±0.4% at +25°C and ±3% maximum over the operating junction temperature range of -40°C to +125°C. Line regulation is ±0.1% typical at +25°C.

Output voltages available for the MCP1703 range from 1.2V to 5.5V. The LDO output is stable when using only 1 µF of output capacitance. Ceramic, tantalum, or aluminum electrolytic capacitors can all be used for input and output. Overcurrent limit and overtemperature shutdown provide a robust solution for any application. Package options include the SOT-223-3, SOT-23A, and SOT-89-3.

Related Literature

- AN765, "Using Microchip's Micropower LDOs", DS00765, Microchip Technology Inc., 2002
- AN766, "Pin-Compatible CMOS Upgrades to BiPolar LDOs", DS00766, Microchip Technology Inc., 2002
- AN792, "A Method to Determine How Much Power a SOT23 Can Dissipate in an Application", DS00792, Microchip Technology Inc., 2001

Package Types



1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

V_{DD} ....+18V

All inputs and outputs w.r.t. ....(V_{SS}-0.3V) to (V_{IN}+0.3V)

Peak Output Current ....500 mA

Storage temperature ....-65°C to +150°C

Maximum Junction Temperature .... +150°C

Operating Junction Temperature...................-40°C to +125°C

ESD protection on all pins (HBM;MM).............. ≥ 4 kV; ≥ 400V

† Notice: Stresses above those listed under "Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

DC CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, all limits are established for $V_{IN} = V_{OUT(MAX)} + V_{DROPOUT(MAX)}$, **Note 1**, I_{LOAD} = 100 µA, C_{OUT} = 1 µF (X7R), C_{IN} = 1 µF (X7R), T_A = +25°C.
Boldface type applies for junction temperatures, T_J **(Note 7)** of -40°C to +125°C.

Parameters	Symbol	Min	Typ	Max	Units	Conditions
Input / Output Characteristics						
Input Operating Voltage	V_{IN}	**2.7**	—	**16.0**	V	**Note 1**
Input Quiescent Current	I_q	—	2.0	**5**	µA	I_L = 0 mA
Maximum Output Current	I_{OUT_mA}	**250**	—	—	mA	For $V_R \geq 2.5V$
		50	100	—	mA	For V_R < 2.5V, $V_{IN} \geq 2.7V$
		100	130	—	mA	For V_R < 2.5V, $V_{IN} \geq 2.95V$
		150	200	—	mA	For V_R < 2.5V, $V_{IN} \geq 3.2V$
		200	250	—	mA	For V_R < 2.5V, $V_{IN} \geq 3.45V$
Output Short Circuit Current	I_{OUT_SC}	—	400	—	mA	$V_{IN} = V_{IN(MIN)}$ **(Note 1)**, V_{OUT} = GND, Current (average current) measured 10 ms after short is applied.
Output Voltage Regulation	V_{OUT}	**V_R-3.0%** V_R-2.0%	V_R±0.4 %	**V_R+3.0%** V_R+2.0%	V	**Note 2**
V_{OUT} Temperature Coefficient	TCV_{OUT}	—	50	**150**	ppm/°C	**Note 3**
Line Regulation	$\Delta V_{OUT}/(V_{OUT} X \Delta V_{IN})$	**-0.3**	±0.1	**+0.3**	%/V	$(V_{OUT(MAX)} + V_{DROPOUT(MAX)}) \leq V_{IN} \leq 16V$, **Note 1**
Load Regulation	$\Delta V_{OUT}/V_{OUT}$	**-2.5**	±1.0	**+2.5**	%	I_L = 1.0 mA to 250 mA for V_R >= 2.5V I_L = 1.0 mA to 200 mA for V_R < 2.5V V_{IN} = 3.65V, **Note 4**

Note 1: The minimum V_{IN} must meet two conditions: $V_{IN} \geq 2.7V$ and $V_{IN} \geq (V_{OUT(MAX)} + V_{DROPOUT(MAX)})$.

2: V_R is the nominal regulator output voltage. For example: V_R = 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V, 4.0V, or 5.0V. The input voltage $V_{IN} = V_{OUT(MAX)} + V_{DROPOUT(MAX)}$ or Vi_{IN} = 2.7V (whichever is greater); I_{OUT} = 100 µA.

3: $TCV_{OUT} = (V_{OUT-HIGH} - V_{OUT-LOW}) *10^6 / (V_R * \Delta Temperature)$, $V_{OUT-HIGH}$ = highest voltage measured over the temperature range. $V_{OUT-LOW}$ = lowest voltage measured over the temperature range.

4: Load regulation is measured at a constant junction temperature using low duty cycle pulse testing. Changes in output voltage due to heating effects are determined using thermal regulation specification TCV_{OUT}.

5: Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its measured value with an applied input voltage of $V_{OUT(MAX)} + V_{DROPOUT(MAX)}$ or 2.7V, whichever is greater.

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 will cause the device operating junction temperature to exceed the maximum 150°C rating. Sustained junction temperatures above 150°C can impact the device reliability.

7: The junction temperature is approximated by soaking the device under test at an ambient temperature equal to the desired Junction temperature. The test time is small enough such that the rise in the Junction temperature over the ambient temperature is not significant.

DC CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise specified, all limits are established for $V_{IN} = V_{OUT(MAX)} + V_{DROPOUT(MAX)}$, **Note 1**, I_{LOAD} = 100 µA, C_{OUT} = 1 µF (X7R), C_{IN} = 1 µF (X7R), T_A = +25°C.
Boldface type applies for junction temperatures, T_J **(Note 7)** of -40°C to +125°C.

Parameters	Symbol	Min	Typ	Max	Units	Conditions
Dropout Voltage **Note 1**, **Note 5**	$V_{DROPOUT}$	—	330	**650**	mV	I_L = 250 mA, V_R = 5.0V
		—	525	**725**	mV	I_L = 250 mA, 3.3V $\le V_R$ < 5.0V
		—	625	**975**	mV	I_L = 250 mA, 2.8V $\le V_R$ < 3.3V
		—	750	**1100**	mV	I_L = 250 mA, 2.5V $\le V_R$ < 2.8V
		—	—	—	mV	V_R < 2.5V, See Maximum Output Current Parameter
Output Delay Time	T_{DELAY}	—	1000	—	µs	V_{IN} = 0V to 6V, V_{OUT} = 90% V_R, R_L = 50Ω resistive
Output Noise	e_N	—	8		µV/(Hz)$^{1/2}$	I_L = 50 mA, f = 1 kHz, C_{OUT} = 1 µF
Power Supply Ripple Rejection Ratio	PSRR	—	44	—	dB	f = 100 Hz, C_{OUT} = 1 µF, I_L = 100 µA, V_{INAC} = 100 mV pk-pk, C_{IN} = 0 µF, V_R = 1.2V
Thermal Shutdown Protection	T_{SD}	—	150	—	°C	

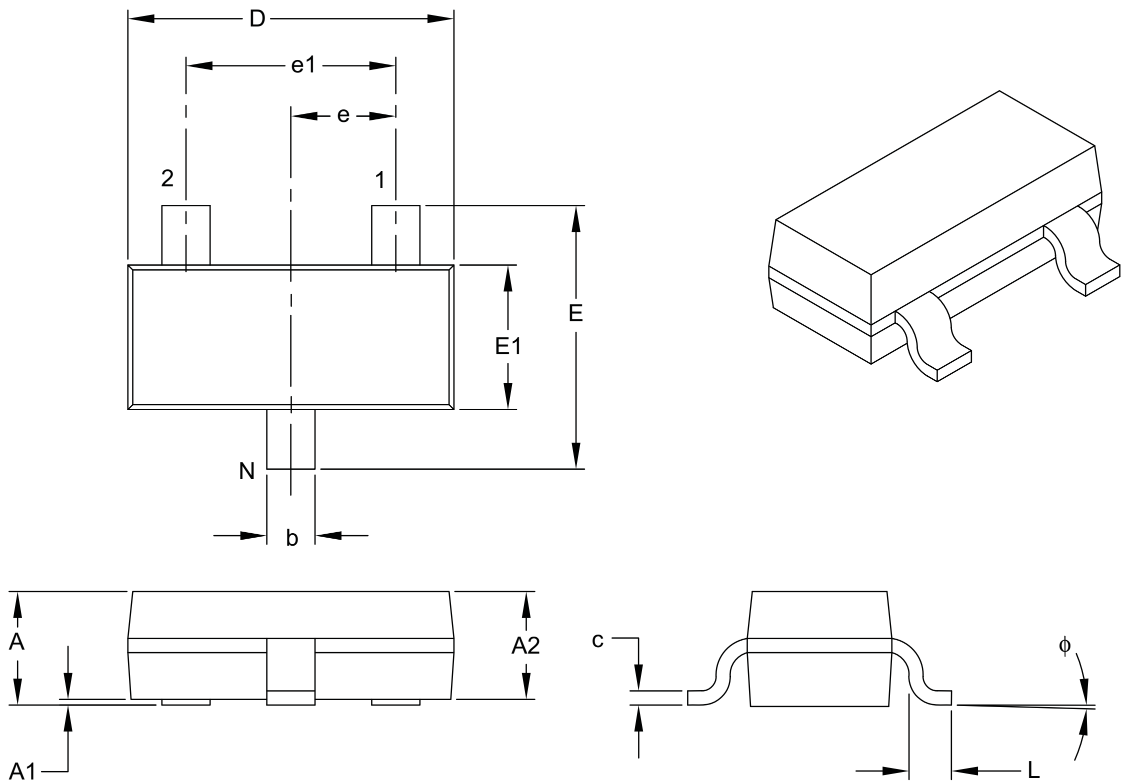
Note 1: The minimum V_{IN} must meet two conditions: $V_{IN} \ge 2.7V$ and $V_{IN} \ge (V_{OUT(MAX)} + V_{DROPOUT(MAX)})$.
2: V_R is the nominal regulator output voltage. For example: V_R = 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V, 4.0V, or 5.0V. The input voltage $V_{IN} = V_{OUT(MAX)} + V_{DROPOUT(MAX)}$ or Vi_{IN} = 2.7V (whichever is greater); I_{OUT} = 100 µA.
3: $TCV_{OUT} = (V_{OUT-HIGH} - V_{OUT-LOW}) * 10^6 / (V_R * \Delta Temperature)$, $V_{OUT-HIGH}$ = highest voltage measured over the temperature range. $V_{OUT-LOW}$ = lowest voltage measured over the temperature range.
4: Load regulation is measured at a constant junction temperature using low duty cycle pulse testing. Changes in output voltage due to heating effects are determined using thermal regulation specification TCV_{OUT}.
5: Dropout voltage is defined as the input to output differential at which the output voltage drops 2% below its measured value with an applied input voltage of $V_{OUT(MAX)} + V_{DROPOUT(MAX)}$ or 2.7V, whichever is greater.
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 will cause the device operating junction temperature to exceed the maximum 150°C rating. Sustained junction temperatures above 150°C can impact the device reliability.
7: The junction temperature is approximated by soaking the device under test at an ambient temperature equal to the desired Junction temperature. The test time is small enough such that the rise in the Junction temperature over the ambient temperature is not significant.

TEMPERATURE SPECIFICATIONS

Parameters	Sym	Min	Typ	Max	Units	Conditions
Temperature Ranges						
Specified 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 Resistance						
Thermal Resistance, 3LD SOT-223	θ_{JA} θ_{JC}	— —	62 15	— —	°C/W	EIA/JEDEC JESD51-7 FR-4 0.063 4-Layer Board
Thermal Resistance, 3LD SOT-23A	θ_{JA} θ_{JC}	— —	336 110	— —	°C/W	EIA/JEDEC JESD51-7 FR-4 0.063 4-Layer Board
Thermal Resistance, 3LD SOT-89	θ_{JA} θ_{JC}	— —	75 10	— —	°C/W	0.300 sq in copper on both sides of 2 sided board, with vias

Note 1: 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 will cause the device operating junction temperature to exceed the maximum 150°C rating. Sustained junction temperatures above 150°C can impact the device reliability.

3-Lead Plastic Small Outline Transistor (CB) [SOT-23A]



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		3	
Lead Pitch	e		0.95 BSC	
Outside Lead Pitch	e1		1.90 BSC	
Overall Height	A	0.89	–	1.45
Molded Package Thickness	A2	0.90	–	1.30
Standoff	A1	0.00	–	0.15
Overall Width	E	2.10	–	3.00
Molded Package Width	E1	1.20	–	1.80
Overall Length	D	2.70	–	3.10
Foot Length	L	0.15	–	0.60
Foot Angle	ϕ	0°	–	30°
Lead Thickness	c	0.09	–	0.26
Lead Width	b	0.30	–	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 C04-130B

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-	XX	X	X	X/	XX
Device	Tape and Reel	Output Voltage	Feature Code	Tolerance	Temp.	Package

Device:	MCP1703: 250 mA, 16V Low Quiescent Current LDO	
Tape and Reel:	T =	Tape and Reel
Output Voltage *:	12 =	1.2V "Standard"
	15 =	1.5V "Standard"
	18 =	1.8V "Standard"
	25 =	2.5V "Standard"
	28 =	2.8V "Standard"
	30 =	3.0V "Standard"
	33 =	3.3V "Standard"
	40 =	4.0V "Standard"
	50 =	5.0V "Standard"
	*Contact factory for other output voltage options.	
Extra Feature Code:	0 =	Fixed
Tolerance:	2 =	2.0% (Standard)
Temperature:	E =	-40°C to +125°C
Package Type:	CB =	Plastic Small Outline Transistor (SOT-23A) 3-lead,
	DB =	Plastic Small Outline Transistor (SOT-223) 3-lead,
	MB =	Plastic Small Outline Transistor (SOT-89) 3-lead,

Examples:

a) MCP1703T-1202E/XX: Tape and Reel, 1.2V

b) MCP1703T-1502E/XX: Tape and Reel, 1.5V

c) MCP1703T-1802E/XX: Tape and Reel, 1.8V

d) MCP1703T-2502E/XX: Tape and Reel, 2.5V

e) MCP1703T-2802E/XX: Tape and Reel, 2.8V

f) MCP1703T-3002E/XX: Tape and Reel, 3.0V

g) MCP1703T-3302E/XX: Tape and Reel, 3.3V

h) MCP1703T-3602E/XX: Tape and Reel, 3.6V

i) MCP1703T-4002E/XX: Tape and Reel, 4.0V

j) MCP1703T-5002E/XX: Tape and Reel, 5.0V

XX = CB for 3LD SOT-23A package
= DB for 3LD SOT-223 package
= MB for 3LD SOT-89 package