MCP1825/MCP1825S

500 mA, Low Voltage, Low Quiescent Current LDO Regulator

Features

- 500 mA Output Current Capability
- Input Operating Voltage Range: 2.1V to 6.0V
- Adjustable Output Voltage Range: 0.8V to 5.0V (MCP1825 only)
- Standard Fixed Output Voltages:
  - 0.8V, 1.2V, 1.8V, 2.5V, 3.0V, 3.3V, 5.0V
- Other Fixed Output Voltage Options Available Upon Request
- Low Dropout Voltage: 210 mV Typical at 500 mA
- Typical Output Voltage Tolerance: 0.5%
- Stable with 1.0 µF Ceramic Output Capacitor
- Fast response to Load Transients
- Low Supply Current: 120 µA (typical)
- Low Shutdown Supply Current: 0.1 µA (typical) (MCP1825 only)
- Fixed Delay on Power Good Output (MCP1825 only)
- Short Circuit Current Limiting and Overtemperature Protection
- TO-263-5 (DDPAK-5), TO-220-5, SOT-223-5 Package Options (MCP1825).
- TO-263-3 (DDPAK-3), TO-220-3, SOT-223-3 Package Options (MCP1825S).

Applications

- High-Speed Driver Chipset Power
- Networking Backplane Cards
- Notebook Computers
- Network Interface Cards
- Palmtop Computers
- 2.5V to 1.XV Regulators

Description

The MCP1825/MCP1825S is a 500 mA Low Dropout (LDO) linear regulator that provides high current and low output voltages. The MCP1825 comes in a fixed or adjustable output voltage version, with an output voltage range of 0.8V to 5.0V. The 500 mA output current capability, combined with the low output voltage capability, make the MCP1825 a good choice for new sub-1.8V output voltage LDO applications that have high current demands. The MCP1825S is a 3-pin fixed voltage version.

The MCP1825/MCP1825S is stable using ceramic output capacitors that inherently provide lower output noise and reduce the size and cost of the entire regulator solution. Only 1 µF of output capacitance is needed to stabilize the LDO.

Using CMOS construction, the quiescent current consumed by the MCP1825/MCP1825S is typically less than 120 µA over the entire input voltage range, making it attractive for portable computing applications that demand high output current. The MCP1825 versions have a Shutdown ($\overline{SHDN}$) pin. When shut down, the quiescent current is reduced to less than 0.1 µA.

On the MCP1825 fixed output versions, the scaled-down output voltage is internally monitored and a power good (PWRGD) output is provided when the output is within 92% of regulation (typical). The PWRGD delay is internally fixed at 110 µs (typical).

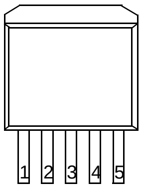
The overtemperature and short circuit current-limiting provide additional protection for the LDO during system fault conditions.

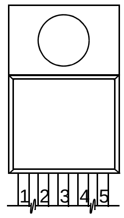
Package Types

MCP1825

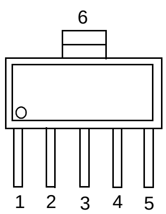
DDPAK-5 **TO-220-5**

Fixed/Adjustable





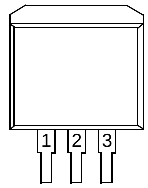
SOT-223-5

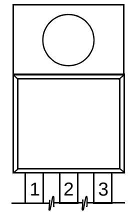


Pin	Fixed	Adjustable
1	$\overline{SHDN}$	$\overline{SHDN}$
2	V_{IN}	V_{IN}
3	GND (TAB)	GND (TAB)
4	V_{OUT}	V_{OUT}
5	PWRGD	ADJ
6	GND (TAB)	GND (TAB)

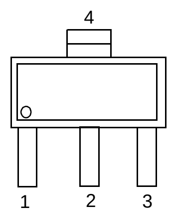
MCP1825S

DDPAK-3 **TO-220-3**





SOT-223-3



Pin	
1	V_{IN}
2	GND (TAB)
3	V_{OUT}
4	GND (TAB)

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

V_{IN} 6.5V

Maximum Voltage on Any Pin .. (GND – 0.3V) to (V_{DD} + 0.3)V

Maximum Power Dissipation......... Internally-Limited (**Note 6**)

Output Short Circuit Duration................................Continuous

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

Maximum Junction Temperature, T_J ....+150°C

ESD protection on all pins (HBM/MM) .... ≥ 4 kV; ≥ 300V

† 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.

AC/DC CHARACTERISTICS

Electrical Specifications: Unless otherwise noted, $V_{IN} = V_{OUT(MAX)} + V_{DROPOUT(MAX)}$, **Note 1**, V_R = 1.8V for Adjustable Output, I_{OUT} = 1 mA, $C_{IN} = C_{OUT}$ = 4.7 µF (X7R Ceramic), T_A = +25°C.
Boldface type applies for junction temperatures, T_J (**Note 7**) of **-40°C to +125°C**

Parameters	Sym	Min	Typ	Max	Units	Conditions
Input Operating Voltage	V_{IN}	**2.1**		**6.0**	V	**Note 1**
Input Quiescent Current	I_q	—	120	**220**	µA	I_L = 0 mA, V_{OUT} = 0.8V to 5.0V
Input Quiescent Current for $\overline{SHDN}$ Mode	$I_{\overline{SHDN}}$	—	0.1	**3**	µA	$\overline{SHDN}$ = GND
Maximum Output Current	I_{OUT}	**500**	—	—	mA	V_{IN} = 2.1V to 6.0V V_R = 0.8V to 5.0V, **Note 1**
Line Regulation	$\Delta V_{OUT}/(V_{OUT} \times \Delta V_{IN})$	—	±0.05	±0.**16**	%/V	**(Note 1)** ≤ V_{IN} ≤ 6V
Load Regulation	$\Delta V_{OUT}/V_{OUT}$	**-1.0**	±0.5	**1.0**	%	I_{OUT} = 1 mA to 500 mA, (**Note 4**)
Output Short Circuit Current	I_{OUT_SC}	—	1.2	—	A	R_{LOAD} < 0.1Ω, Peak Current
Adjust Pin Characteristics (Adjustable Output Only)						
Adjust Pin Reference Voltage	V_{ADJ}	**0.402**	0.410	**0.418**	V	V_{IN} = 2.1V to V_{IN} = 6.0V, I_{OUT} = 1 mA
Adjust Pin Leakage Current	I_{ADJ}	-10	±0.01	+10	nA	V_{IN} = 6.0V, V_{ADJ} = 0V to 6V
Adjust Temperature Coefficient	TCV_{OUT}	—	40	—	ppm/°C	**Note 3**
Fixed-Output Characteristics (Fixed Output Only)						
Voltage Regulation	V_{OUT}	**V_R - 2.5%**	V_R ±0.5%	**V_R + 2.5%**	V	**Note 2**

Note 1: The minimum V_{IN} must meet two conditions: V_{IN} ≥ 2.1V and $V_{IN} \geq V_{OUT(MAX)} + V_{DROPOUT(MAX)}$.

2: V_R is the nominal regulator output voltage for the fixed cases. V_R = 1.2V, 1.8V, etc. V_R is the desired set point output voltage for the adjustable cases. $V_R = V_{ADJ} * ((R_1/R_2)+1)$. Figure 4-1.

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

4: Load regulation is measured at a constant junction temperature using low duty-cycle pulse testing. Load regulation is tested over a load range from 1 mA to the maximum specified output current.

5: Dropout voltage is defined as the input-to-output voltage differential at which the output voltage drops 2% below its nominal value that was measured with an input voltage of $V_{IN} = V_{OUT(MAX)} + V_{DROPOUT(MAX)}$.

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 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.

AC/DC CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise noted, $V_{IN} = V_{OUT(MAX)} + V_{DROPOUT(MAX)}$, **Note 1**, V_R = 1.8V for Adjustable Output, I_{OUT} = 1 mA, $C_{IN} = C_{OUT}$ = 4.7 µF (X7R Ceramic), T_A = +25°C.
Boldface type applies for junction temperatures, T_J (**Note 7**) of **-40°C to +125°C**

Parameters	Sym	Min	Typ	Max	Units	Conditions
Dropout Characteristics						
Dropout Voltage	$V_{DROPOUT}$	—	210	**350**	mV	**Note 5**, I_{OUT} = 500 mA, $V_{IN(MIN)}$ = 2.1V
Power Good Characteristics						
PWRGD Input Voltage Operating Range	V_{PWRGD_VIN}	1.0	—	6.0	V	T_A = +25°C
		1.2	—	**6.0**		T_A = -40°C to +125°C
						For V_{IN} < 2.1V, I_{SINK} = 100 µA
PWRGD Threshold Voltage (Referenced to V_{OUT})	V_{PWRGD_TH}				$\%V_{OUT}$	Falling Edge
		89	92	**95**		V_{OUT} < 2.5V Fixed, V_{OUT} = Adj.
		90	92	**94**		V_{OUT} >= 2.5V Fixed
PWRGD Threshold Hysteresis	V_{PWRGD_HYS}	**1.0**	2.0	**3.0**	$\%V_{OUT}$	
PWRGD Output Voltage Low	V_{PWRGD_L}	—	0.2	**0.4**	V	$I_{PWRGD\ SINK}$ = 1.2 mA, ADJ = 0V
PWRGD Leakage	P_{WRGD_LK}	—	1	—	nA	$V_{PWRGD} = V_{IN}$ = 6.0V
PWRGD Time Delay	T_{PG}	—	110	—	µs	Rising Edge R_{PULLUP} = 10 kΩ
Detect Threshold to PWRGD Active Time Delay	$T_{VDET\text{-}PWRGD}$	—	200	—	µs	$V_{OUT} = V_{PWRGD\_TH}$ + 20 mV to V_{PWRGD_TH} - 20 mV
Shutdown Input						
Logic High Input	$V_{SHDN\text{-}HIGH}$	**45**	—	—	$\%V_{IN}$	V_{IN} = 2.1V to 6.0V
Logic Low Input	$V_{SHDN\text{-}LOW}$	—	—	**15**	$\%V_{IN}$	V_{IN} = 2.1V to 6.0V
$\overline{SHDN}$ Input Leakage Current	$\overline{SHDN}_{ILK}$	**-0.1**	±0.001	**+0.1**	µA	V_{IN} = 6V, $\overline{SHDN}$ = V_{IN}, $\overline{SHDN}$ = GND
AC Performance						
Output Delay From $\overline{SHDN}$	T_{OR}	—	100	—	µs	$\overline{SHDN}$ = GND to V_{IN}, V_{OUT} = GND to 95% V_R
Output Noise	e_N	—	2.0	—	µV/√Hz	I_{OUT} = 200 mA, f = 1 kHz, C_{OUT} = 10 µF (X7R Ceramic), V_{OUT} = 2.5V

Note 1: The minimum V_{IN} must meet two conditions: $V_{IN} \geq 2.1V$ and $V_{IN} \geq V_{OUT(MAX)} + V_{DROPOUT(MAX)}$.

2: V_R is the nominal regulator output voltage for the fixed cases. V_R = 1.2V, 1.8V, etc. V_R is the desired set point output voltage for the adjustable cases. $V_R = V_{ADJ} * ((R_1/R_2)+1)$. Figure 4-1.

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

4: Load regulation is measured at a constant junction temperature using low duty-cycle pulse testing. Load regulation is tested over a load range from 1 mA to the maximum specified output current.

5: Dropout voltage is defined as the input-to-output voltage differential at which the output voltage drops 2% below its nominal value that was measured with an input voltage of $V_{IN} = V_{OUT(MAX)} + V_{DROPOUT(MAX)}$.

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 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.

AC/DC CHARACTERISTICS (CONTINUED)

Electrical Specifications: Unless otherwise noted, $V_{IN} = V_{OUT(MAX)} + V_{DROPOUT(MAX)}$, **Note 1**, V_R = 1.8V for Adjustable Output, I_{OUT} = 1 mA, $C_{IN} = C_{OUT}$ = 4.7 µF (X7R Ceramic), T_A = +25°C.
Boldface type applies for junction temperatures, T_J (**Note 7**) of **-40°C to +125°C**

Parameters	Sym	Min	Typ	Max	Units	Conditions
Power Supply Ripple Rejection Ratio	PSRR	—	60	—	dB	f = 100 Hz, C_{OUT} = 4.7 µF, I_{OUT} = 100 µA, V_{INAC} = 100 mV pk-pk, C_{IN} = 0 µF
Thermal Shutdown Temperature	T_{SD}	—	150	—	°C	I_{OUT} = 100 µA, V_{OUT} = 1.8V, V_{IN} = 2.8V
Thermal Shutdown Hysteresis	ΔT_{SD}	—	10	—	°C	I_{OUT} = 100 µA, V_{OUT} = 1.8V, V_{IN} = 2.8V

Note 1: The minimum V_{IN} must meet two conditions: $V_{IN} \geq 2.1V$ and $V_{IN} \geq V_{OUT(MAX)} + V_{DROPOUT(MAX)}$.

2: V_R is the nominal regulator output voltage for the fixed cases. V_R = 1.2V, 1.8V, etc. V_R is the desired set point output voltage for the adjustable cases. $V_R = V_{ADJ} * ((R_1/R_2)+1)$. Figure 4-1.

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

4: Load regulation is measured at a constant junction temperature using low duty-cycle pulse testing. Load regulation is tested over a load range from 1 mA to the maximum specified output current.

5: Dropout voltage is defined as the input-to-output voltage differential at which the output voltage drops 2% below its nominal value that was measured with an input voltage of $V_{IN} = V_{OUT(MAX)} + V_{DROPOUT(MAX)}$.

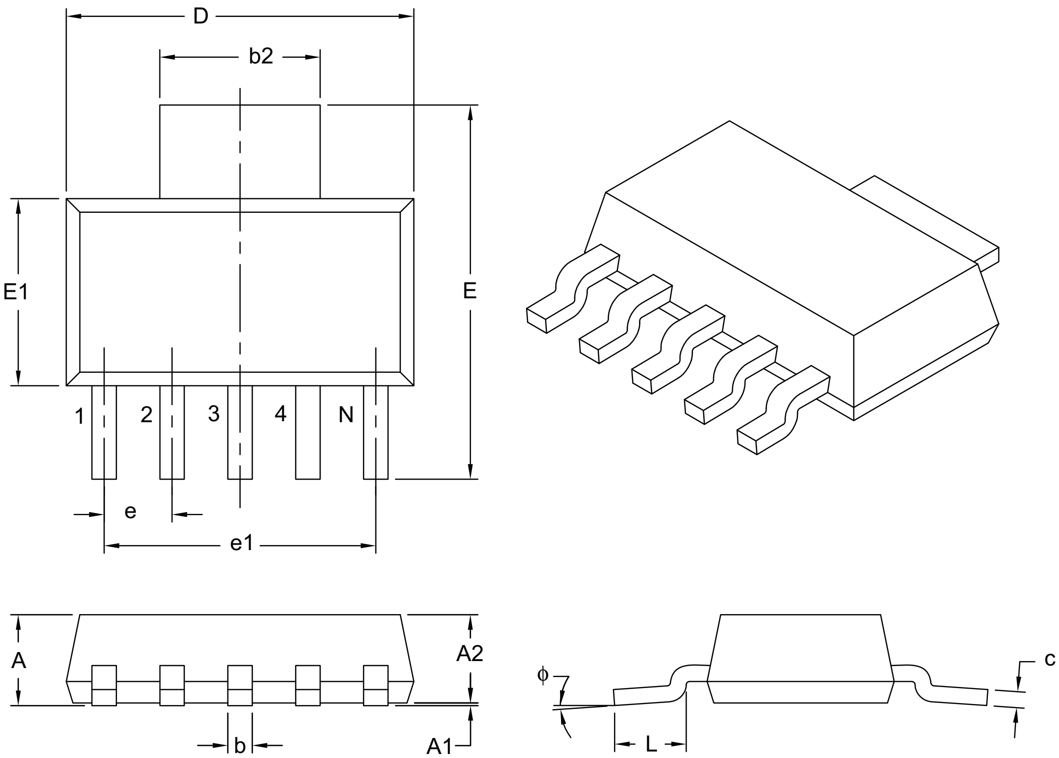
6: The maximum allowable power dissipation is a function of ambient temperature, the maximum allowable junction temperature and the thermal resistance from junction to air. (i.e., T_A, T_J, θ_{JA}). Exceeding the maximum allowable power dissipation will cause the device operating junction temperature to exceed the maximum +150°C rating. Sustained junction temperatures above 150°C can impact 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						
Operating Junction Temperature Range	T_J	-40	—	+125	°C	Steady State
Maximum Junction Temperature	T_J	—	—	+150	°C	Transient
Storage Temperature Range	T_A	-65	—	+150	°C	
Thermal Package Resistances						
Thermal Resistance, 3LD DDPAK	θ_{JA}	—	31.4	—	°C/W	4-Layer JC51 Standard Board
	θ_{JC}	—	3.0	—		
Thermal Resistance, 3LD TO-220	θ_{JA}	—	29.4	—	°C/W	4-Layer JC51 Standard Board
	θ_{JC}	—	2.0	—		
Thermal Resistance, 3LD SOT-223	θ_{JA}	—	62	—	°C/W	EIA/JEDEC JESD51-751-7 4 Layer Board
	θ_{JC}	—	15.0	—		
Thermal Resistance, 5LD DDPAK	θ_{JA}	—	31.2	—	°C/W	4-Layer JC51 Standard Board
	θ_{JC}	—	3.0	—		
Thermal Resistance, 5LD TO-220	θ_{JA}	—	29.3	—	°C/W	4-Layer JC51 Standard Board
	θ_{JC}	—	2.0	—		
Thermal Resistance, 5LD SOT-223	θ_{JA}	—	62	—	°C/W	EIA/JEDEC JESD51-751-7 4 Layer Board
	θ_{JC}	—	15.0	—		

5-Lead Plastic Small Outline Transistor (DC) [SOT-223]



		Units	MILLIMETERS		
		Dimension Limits	MIN	NOM	MAX
Number of Leads	N		5		
Lead Pitch	e		1.27 BSC		
Outside Lead Pitch	e1		5.08 BSC		
Overall Height	A		–	–	1.80
Standoff	A1		0.02	0.06	0.10
Molded Package Height	A2		1.55	1.60	1.65
Overall Width	E		6.86	7.00	7.26
Molded Package Width	E1		3.45	3.50	3.55
Overall Length	D		6.45	6.50	6.55
Lead Thickness	c		0.24	0.28	0.32
Lead Width	b		0.41	0.457	0.51
Tab Lead Width	b2		2.95	3.00	3.05
Foot Length	L		0.91	–	1.14
Lead Angle	ϕ		0°	4°	8°

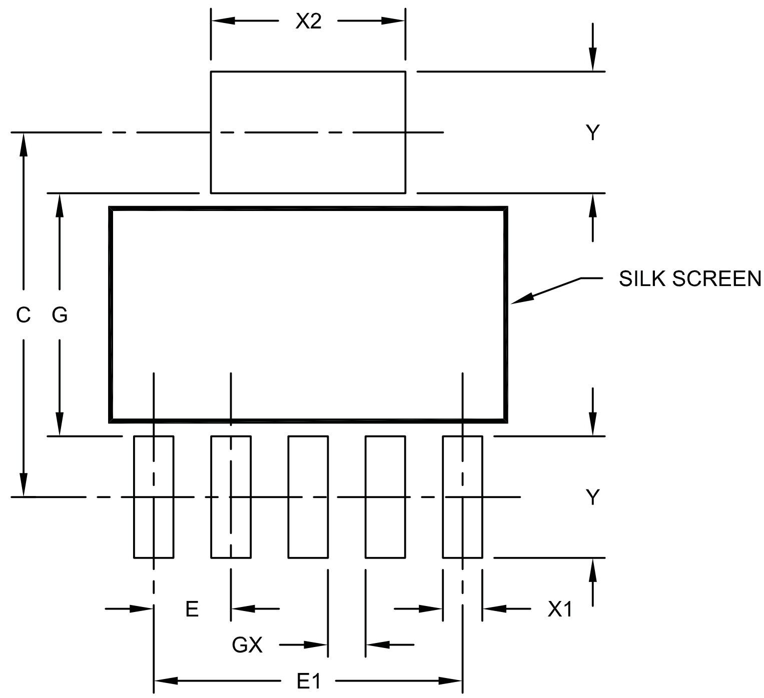
Notes:

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 C04-137B

5-Lead Plastic Small Outline Transistor (DC) [SOT-223]



RECOMMENDED LAND PATTERN

Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Pad Pitch	E	1.27 BSC		
Overall Pad Pitch	E1	5.08 BSC		
Pad Spacing	C		6.00	
Pad Width	X1			0.65
Pad Width	X2			3.20
Pad Length	Y			2.00
Distance Between Pads	G	4.00		
Distance Between Pads	GX	0.62		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2137A

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
Device	Output Voltage	Feature Code	Tolerance	Temp.	Package

Device:	MCP1825:	500 mA Low Dropout Regulator
	MCP1825T:	500 mA Low Dropout Regulator Tape and Reel
	MCP1825S:	500 mA Low Dropout Regulator
	MCP1825ST:	500 mA Low Dropout Regulator Tape and Reel
Output Voltage *:	08	= 0.8V “Standard”
	12	= 1.2V “Standard”
	18	= 1.8V “Standard”
	25	= 2.5V “Standard”
	30	= 3.0V “Standard”
	33	= 3.3V “Standard”
	50	= 5.0V “Standard”
	ADJ	= Adjustable Output Voltage ** (MCP1825 Only)
Extra Feature Code:	0	= Fixed
Tolerance:	2	= 2.5% (Standard)
Temperature:	E	= -40°C to +125°C
Package Type:	AB	= Plastic Transistor Outline, TO-220, 3-lead
	AT	= Plastic Transistor Outline, TO-220, 5-lead
	EB	= Plastic, DDPAK, 3-lead
	ET	= Plastic, DDPAK, 5-lead
	DB	= Plastic Small Transistor Outline, SOT-223, 3-lead
	DC	= Plastic Small Transistor Outline, SOT-223, 5-lead

*Contact factory for other output voltage options
** When ADJ is used, the “extra feature code” and “tolerance” columns do not apply. Refer to examples.

Note: ADJ (Adjustable) only available in 5-lead version.

Examples:

a) MCP1825-0802E/XX: 0.8V LDO Regulator
b) MCP1825-1202E/XX: 1.2V LDO Regulator
c) MCP1825-1802E/XX: 1.8V LDO Regulator
d) MCP1825-2502E/XX: 2.5V LDO Regulator
e) MCP1825-3002E/XX: 3.0V LDO Regulator
f) MCP1825-3302E/XX: 3.3V LDO Regulator
g) MCP1825-5002E/XX: 5.0V LDO Regulator
h) MCP1825-ADJE/XX: ADJ LDO Regulator

a) MCP1825S-0802E/YY: 0.8V LDO Regulator
b) MCP1825S-1202E/YY: 1.2V LDO Regulator
c) MCP1825S-1802E/YY: 1.8V LDO Regulator
d) MCP1825S-2502E/YY: 2.5V LDO Regulator
e) MCP1825S-2502E/YY: 3.0V LDO Regulator
f) MCP1825S-3302E/YY: 3.3V LDO Regulator
g) MCP1825S-5002E/YY: 5.0V LDO Regulator

XX = AT for 5LD TO-220 package
= DC for 5LD SOT-223 package
= ET for 5LD DDPAK package

YY = AB for 3LD TO-220 package
= DB for 3LD SOT-223 package
= EB for 3LD DDPAK package