

BM78LXX

3-TERMINAL POSITIVE VOLTAGE REGULATORS

Features

- Maximum Output Current of 100mA ($T_c=25^\circ\text{C}$)
- Internal Short-Circuit Current Limiting
- Internal Thermal Overload Protection
- 5% Output Tolerance
- SOP-8 Package

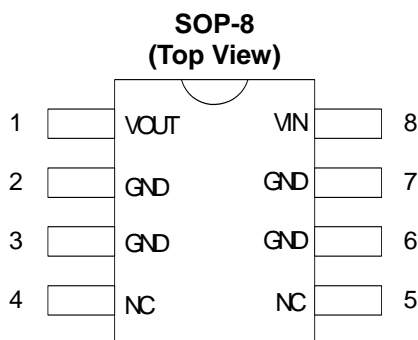
Description

BM78LXX regulators employ internal current-limiting and thermal-shutdown, making them essentially indestructible. They can deliver up to 100mA output current.

Applications

- Bias Supply for Analog Circuit
- Post Regulator for Switching DC-DC Converter

Pin Assignment

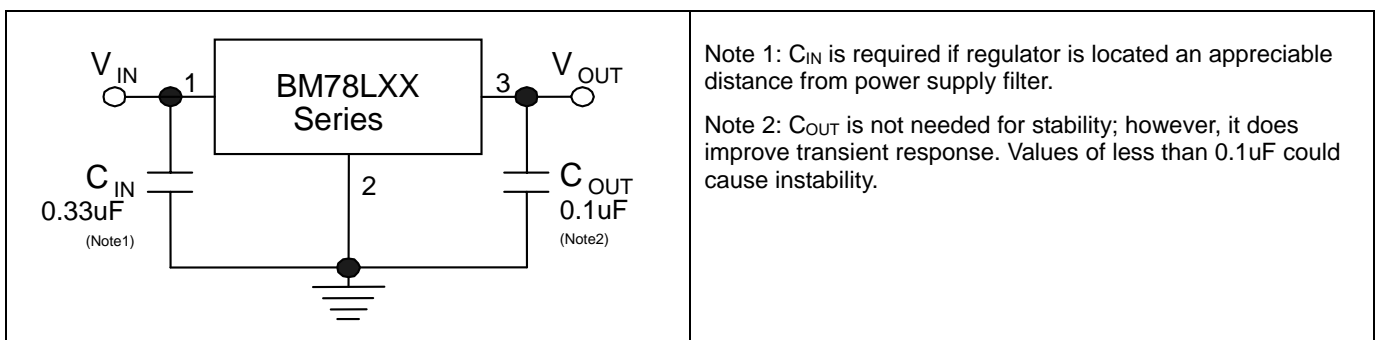


Ordering Information

Part Number	Temperature Range	Package
BM78LXXS	0 ~ +125	SOP-8

Note: XX: Voltage Output. 05(5V); 06(6V), 08(8V), 09(9V), 12(12V)

Typical Application



BM78LXX

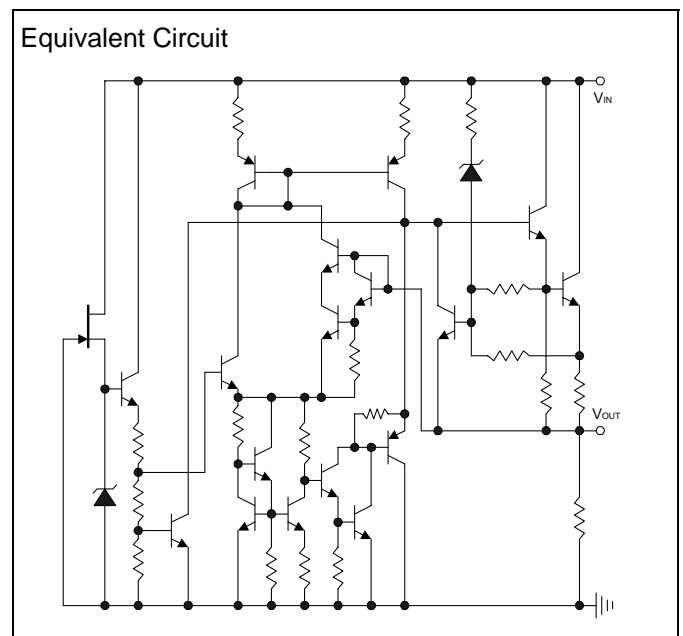
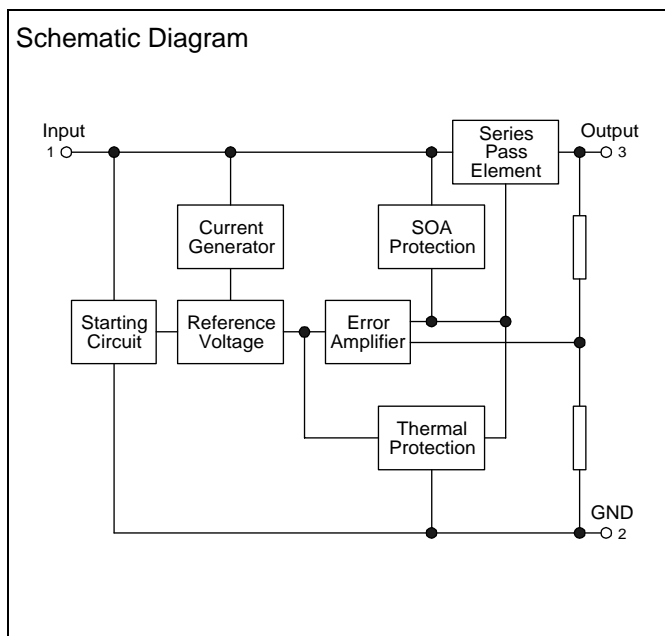
3-TERMINAL POSITIVE VOLTAGE REGULATORS

Absolute Maximum Ratings

($T_a=25^\circ\text{C}$, Unless Otherwise Specified)

Characteristic	Symbol	Rating	Unit
Input Voltage	V_{IN}	40	V
Power Dissipation	P_D	SOP-8 770	mW
Operating Temperature	T_{opr}	-30 to 85	$^\circ\text{C}$
Storage Temperature	T_{stg}	-55 to 150	$^\circ\text{C}$
Junction Temperature	T_j	150	$^\circ\text{C}$
Thermal Resistance	$R_{th(j-a)}$	208	$^\circ\text{C/W}$

Schematic Diagram & Equivalent Circuit



BM78L05 Electrical Characteristics

$V_{IN}=10\text{V}$, $I_{OUT}=40\text{mA}$, $C_{IN}=0.33\mu\text{F}$, $C_{OUT}=0.1\mu\text{F}$, $0^\circ\text{C}\leq T_j\leq 125^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Conditions	BM78L05			Units
			Min	Typ	Max	
V_O	Output Voltage	$T_j=25^\circ\text{C}$	4.75	5	5.25	V
		$1\text{mA}\leq I_{OUT}\leq 70\text{mA}$	4.75	5	5.25	
		$7\text{V}\leq V_{IN}\leq 20\text{V}$, $1\text{mA}\leq I_{OUT}\leq 40\text{mA}$				
Reg_{line}	Line Regulation	$T_j=25^\circ\text{C}$, $7\text{V}\leq V_{IN}\leq 20\text{V}$	-	15	150	mV
		$T_j=25^\circ\text{C}$, $8\text{V}\leq V_{IN}\leq 20\text{V}$	-	15	100	

BM78LXX

3-TERMINAL POSITIVE VOLTAGE REGULATORS

Symbol	Parameter	Conditions	BM78L05			Units
			Min	Typ	Max	
Reg _{load}	Load Regulation	T _j =25°C, 1mA≤I _{OUT} ≤100mA	-	11	60	mV
		T _j =25°C, 1mA≤I _{OUT} ≤40mA	-	5	30	
I _B	Quiescent Current	I _{OUT} =5mA, T _j =25°C	-	3.9	6	mA
ΔI _B	Quiescent Current Change	8V≤V _{IN} ≤20V, T _j =25°C	-	-	1.5	mA
		1mA≤I _{OUT} ≤40mA, T _j =25°C	-	-	0.1	
V _N	Output Noise Voltage	10Hz≤f≤100KHz, T _j =25°C	-	40	-	uVrms
RR	Ripple Rejection	8V≤V _{IN} ≤18V, f=120Hz, T _j =25°C	41	49	-	dB
V _D	Dropout Voltage	T _j =25°C, I _{OUT} =100mA	-	1.7	2.5	V
R _O	Output Resistance	f=1KHz	-	17	-	mΩ
I _{SC}	Short Circuit Current	V _{IN} =10V, T _j =25°C	-	1.5	2	A
T _{CVO}	Average Temperature Coefficient of Output Voltage	I _{OUT} =5mA	-	-	0.6	mV/°C

BM78L06 Electrical Characteristics

V_{IN}=11V, I_{OUT}=40mA, C_{IN}=0.33uF, C_{OUT}=0.1uF, 0°C≤T_j≤125°C (unless otherwise specified)

Symbol	Parameter	Conditions	BM78L06			Units
			Min	Typ	Max	
V _O	Output Voltage	T _j =25°C	5.7	6	6.3	V
		1mA≤I _{OUT} ≤70mA	5.7	6	6.3	
		8V≤V _{IN} ≤22V, 1mA≤I _{OUT} ≤40mA				
Reg _{line}	Line Regulation	T _j =25°C, 8V≤V _{IN} ≤22V	-	15	155	mV
		T _j =25°C, 9V≤V _{IN} ≤12V	-	20	105	
Reg _{load}	Load Regulation	T _j =25°C, 1mA≤I _{OUT} ≤100mA	-	15	70	mV
		T _j =25°C, 1mA≤I _{OUT} ≤40mA	-	5	35	
I _B	Quiescent Current	I _{OUT} =5mA, T _j =25°C	-	3.9	6	mA
ΔI _B	Quiescent Current Change	9V≤V _{IN} ≤22V, T _j =25°C	-	-	1.5	mA
		1mA≤I _{OUT} ≤40mA, T _j =25°C	-	-	0.1	
V _N	Output Noise Voltage	10Hz≤f≤100KHz, T _j =25°C	-	50	-	uVrms
RR	Ripple Rejection	9V≤V _{IN} ≤19V, f=120Hz, T _j =25°C	39	47	-	dB
V _D	Dropout Voltage	T _j =25°C, I _{OUT} =100mA	-	1.7	2.5	V
R _O	Output Resistance	f=1KHz	-	17	-	mΩ
I _{SC}	Short Circuit Current	V _{IN} =10V, T _j =25°C	-	1.5	2	A
T _{CVO}	Average Temperature Coefficient of Output Voltage	I _{OUT} =5mA	-	-	0.7	mV/°C

BM78LXX

3-TERMINAL POSITIVE VOLTAGE REGULATORS

BM78L08 Electrical Characteristics

$V_{IN}=14V$, $I_{OUT}=40mA$, $C_{IN}=0.33\mu F$, $C_{OUT}=0.1\mu F$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$ (unless otherwise specified)

Symbol	Parameter	Conditions	BM78L08			Units
			Min	Typ	Max	
V_O	Output Voltage	$T_j=25^{\circ}C$	7.6	8	8.4	V
		$1mA \leq I_{OUT} \leq 70mA$	7.6	8	8.4	
		$10.5V \leq V_{IN} \leq 23V$, $1mA \leq I_{OUT} \leq 40mA$				
Reg_{line}	Line Regulation	$T_j=25^{\circ}C$, $10.5V \leq V_{IN} \leq 23V$	-	20	175	mV
		$T_j=25^{\circ}C$, $11V \leq V_{IN} \leq 23V$	-	20	125	
Reg_{load}	Load Regulation	$T_j=25^{\circ}C$, $1mA \leq I_{OUT} \leq 100mA$	-	15	80	mV
		$T_j=25^{\circ}C$, $1mA \leq I_{OUT} \leq 40mA$	-	7	40	
I_B	Quiescent Current	$I_{OUT}=5mA$, $T_j=25^{\circ}C$	-	3.9	6	mA
ΔI_B	Quiescent Current Change	$11V \leq V_{IN} \leq 23V$, $T_j=25^{\circ}C$	-	-	1.5	mA
		$1mA \leq I_{OUT} \leq 40mA$, $T_j=25^{\circ}C$	-	-	0.1	
V_N	Output Noise Voltage	$10Hz \leq f \leq 100KHz$, $T_j=25^{\circ}C$	-	60	-	uVrms
RR	Ripple Rejection	$12V \leq V_{IN} \leq 23V$, $f=120Hz$, $T_j=25^{\circ}C$	37	45	-	dB
V_D	Dropout Voltage	$T_j=25^{\circ}C$, $I_{OUT}=100mA$	-	1.7	2.5	V
R_O	Output Resistance	$f=1KHz$	-	17	-	$m\Omega$
I_{SC}	Short Circuit Current	$T_j=25^{\circ}C$	-	1.5	2	A
T_{CVO}	Average Temperature Coefficient of Output Voltage	$I_{OUT}=5mA$	-	-	0.9	$mV/^{\circ}C$

BM78L09 Electrical Characteristics

$V_{IN}=15V$, $I_{OUT}=40mA$, $C_{IN}=0.33\mu F$, $C_{OUT}=0.1\mu F$, $0^{\circ}C \leq T_j \leq 125^{\circ}C$ (unless otherwise specified)

Symbol	Parameter	Conditions	BM78L09			Units
			Min	Typ	Max	
V_O	Output Voltage	$T_j=25^{\circ}C$	8.55	9	9.45	V
		$1mA \leq I_{OUT} \leq 70mA$	8.55	9	9.45	
		$11.4V \leq V_{IN} \leq 24V$, $1mA \leq I_{OUT} \leq 40mA$				
Reg_{line}	Line Regulation	$T_j=25^{\circ}C$, $11.4V \leq V_{IN} \leq 24V$	-	80	200	mV
		$T_j=25^{\circ}C$, $12V \leq V_{IN} \leq 24V$	-	20	160	
Reg_{load}	Load Regulation	$T_j=25^{\circ}C$, $1mA \leq I_{OUT} \leq 100mA$	-	17	90	mV
		$T_j=25^{\circ}C$, $1mA \leq I_{OUT} \leq 40mA$	-	8	45	
I_B	Quiescent Current	$I_{OUT}=5mA$, $T_j=25^{\circ}C$	-	3.9	6	mA
ΔI_B	Quiescent Current Change	$12V \leq V_{IN} \leq 24V$, $T_j=25^{\circ}C$	-	-	1.5	mA
		$1mA \leq I_{OUT} \leq 40mA$, $T_j=25^{\circ}C$	-	-	0.1	
V_N	Output Noise Voltage	$10Hz \leq f \leq 100KHz$, $T_j=25^{\circ}C$	-	65	-	uVrms
RR	Ripple Rejection	$12V \leq V_{IN} \leq 24V$, $f=120Hz$, $T_j=25^{\circ}C$	36	44	-	dB
V_D	Dropout Voltage	$T_j=25^{\circ}C$, $I_{OUT}=100mA$	-	1.7	2.5	V
R_O	Output Resistance	$f=1KHz$	-	17	-	$m\Omega$

BM78LXX

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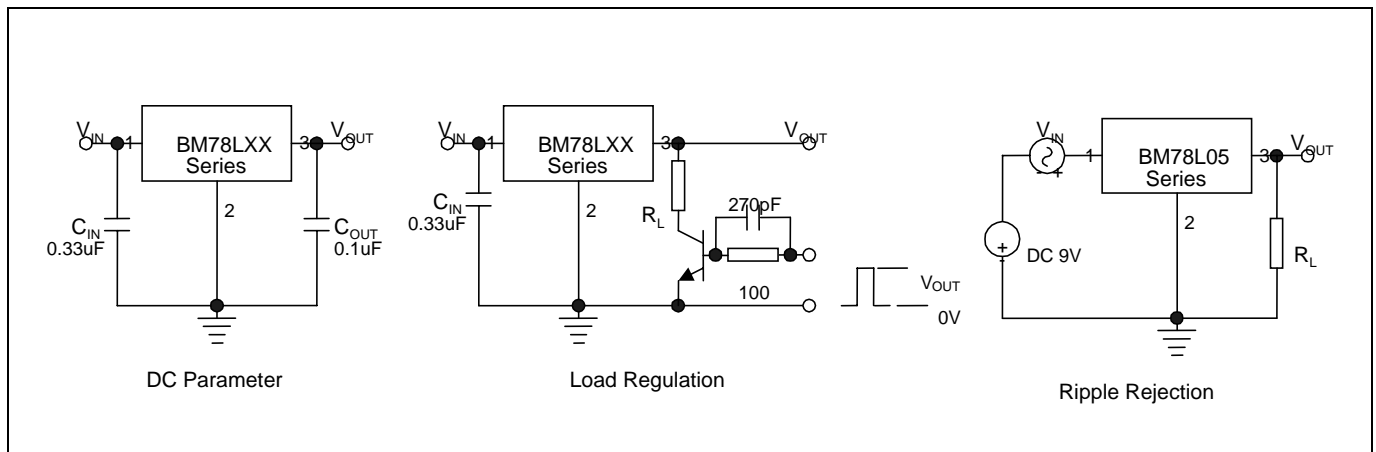
I_{SC}	Short Circuit Current	$T_j=25^\circ\text{C}$	-	1.5	2	A
T_{CVO}	Average Temperature Coefficient of Output Voltage	$I_{OUT}=5\text{mA}$	-	-	1	mV/°C

BM78L12 Electrical Characteristics

$V_{IN}=19\text{V}$, $I_{OUT}=40\text{mA}$, $C_{IN}=0.33\mu\text{F}$, $C_{OUT}=0.1\mu\text{F}$, $0^\circ\text{C}\leq T_j\leq 125^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Conditions	BM78L12			Units
			Min	Typ	Max	
V_O	Output Voltage	$T_j=25^\circ\text{C}$	11.4	12	12.6	V
		$1\text{mA}\leq I_{OUT}\leq 70\text{mA}$	11.4	12	12.6	
		$14.5\text{V}\leq V_{IN}\leq 27\text{V}$, $1\text{mA}\leq I_{OUT}\leq 40\text{mA}$				
Reg_{line}	Line Regulation	$T_j=25^\circ\text{C}$, $14.5\text{V}\leq V_{IN}\leq 27\text{V}$	-	120	250	mV
		$T_j=25^\circ\text{C}$, $16\text{V}\leq V_{IN}\leq 27\text{V}$	-	100	200	
Reg_{load}	Load Regulation	$T_j=25^\circ\text{C}$, $1\text{mA}\leq I_{OUT}\leq 100\text{mA}$	-	20	100	mV
		$T_j=25^\circ\text{C}$, $1\text{mA}\leq I_{OUT}\leq 40\text{mA}$	-	10	50	
I_B	Quiescent Current	$I_{OUT}=5\text{mA}$, $T_j=25^\circ\text{C}$	-	3.9	6	mA
ΔI_B	Quiescent Current Change	$16\text{V}\leq V_{IN}\leq 27\text{V}$, $T_j=25^\circ\text{C}$	-	-	1.5	mA
		$1\text{mA}\leq I_{OUT}\leq 40\text{mA}$, $T_j=25^\circ\text{C}$	-	-	0.1	
V_N	Output Noise Voltage	$10\text{Hz}\leq f\leq 100\text{KHz}$, $T_j=25^\circ\text{C}$	-	80	-	μV_{rms}
RR	Ripple Rejection	$15\text{V}\leq V_{IN}\leq 25\text{V}$, $f=120\text{Hz}$, $T_j=25^\circ\text{C}$	36	41	-	dB
V_D	Dropout Voltage	$T_j=25^\circ\text{C}$, $I_{OUT}=100\text{mA}$	-	1.7	2.5	V
R_O	Output Resistance	$f=1\text{KHz}$	-	17	-	$\text{m}\Omega$
I_{SC}	Short Circuit Current	$T_j=25^\circ\text{C}$	-	1.5	2	A
T_{CVO}	Average Temperature Coefficient of Output Voltage	$I_{OUT}=5\text{mA}$	-	-	1.4	mV/°C

Test Circuits

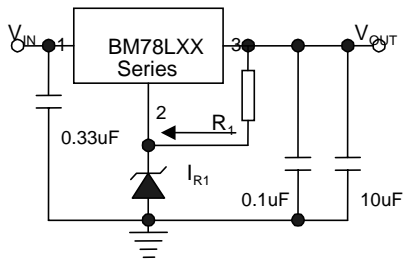


BM78LXX

3-TERMINAL POSITIVE VOLTAGE REGULATORS

Application Circuits

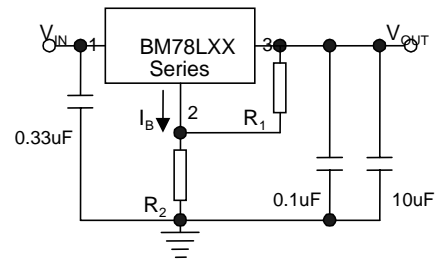
Constant Current Regulator



$$V_{OUT} = V_{OUT(IC)} + V_Z$$

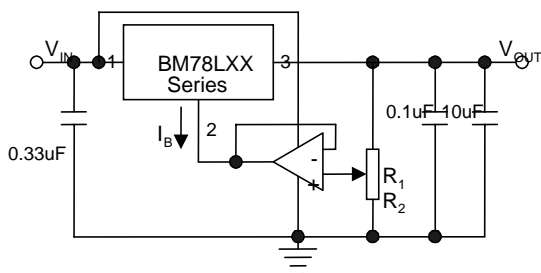
$$I_1 = V_{OUT(IC)} / R_1$$

Circuit for Increasing Output Voltage



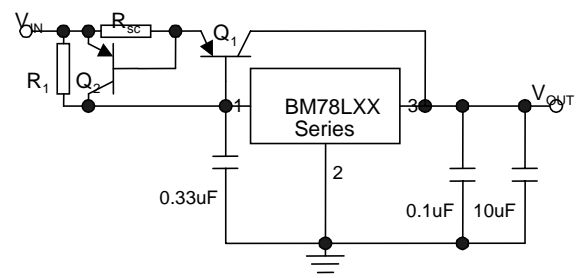
$$V_{OUT} = V_{OUT(IC)}(1 + R_2/R_1) + R_2 * I_B$$

Adjustable Output Regulator



$$V_{OUT} = V_{OUT(IC)}(1 + R_2/R_1)$$

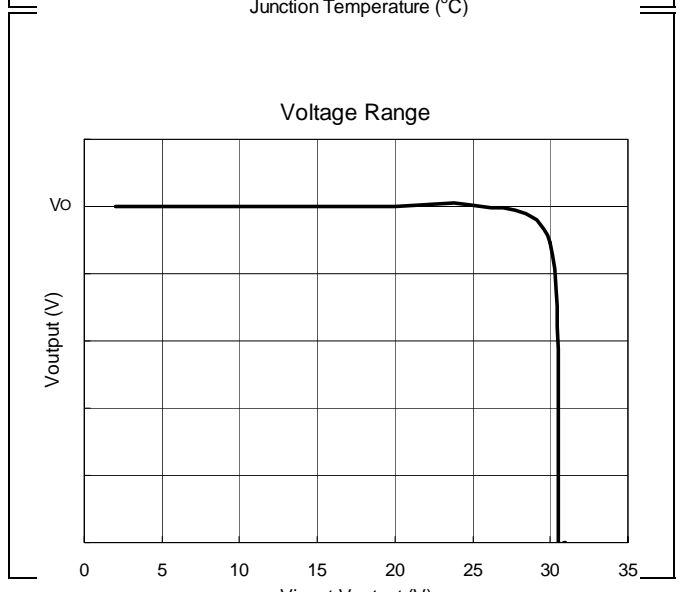
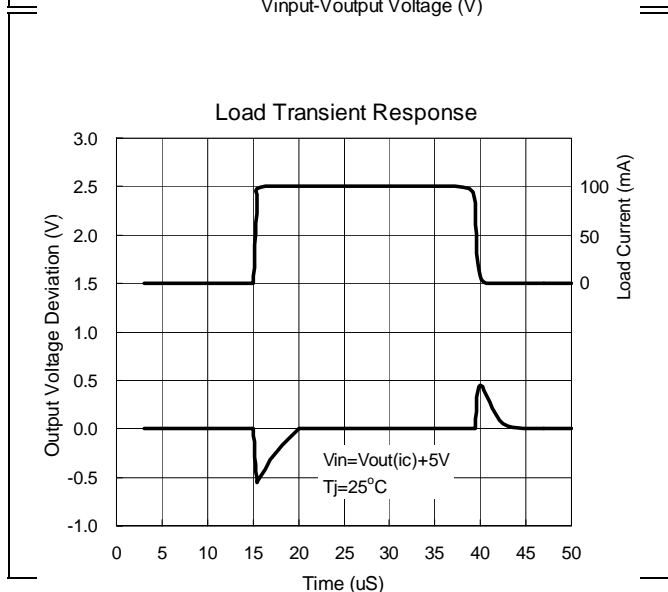
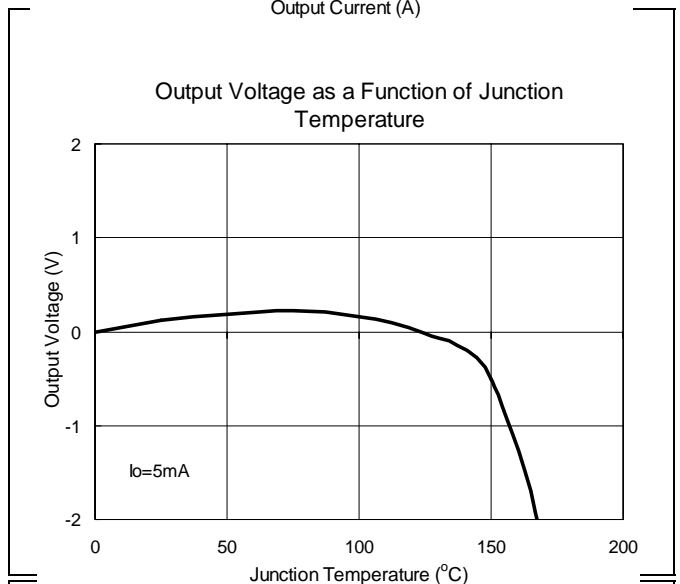
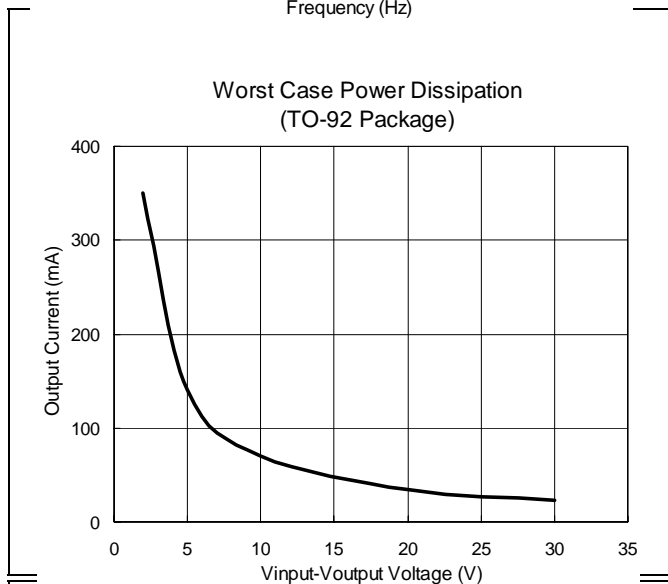
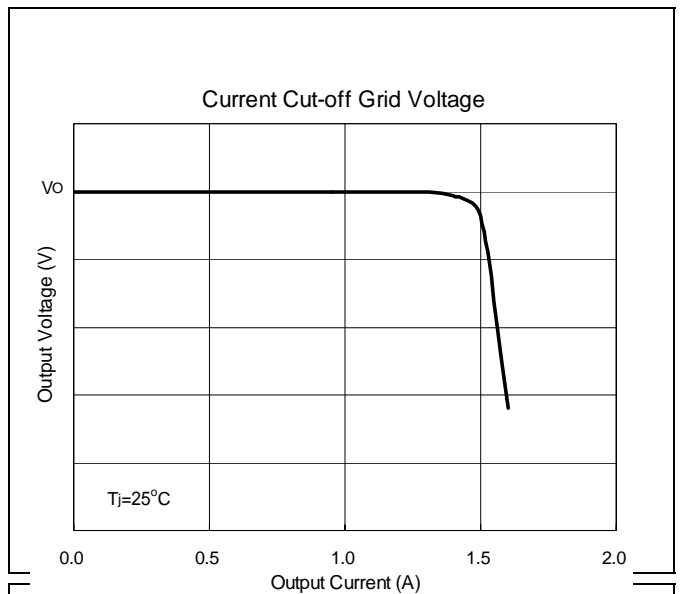
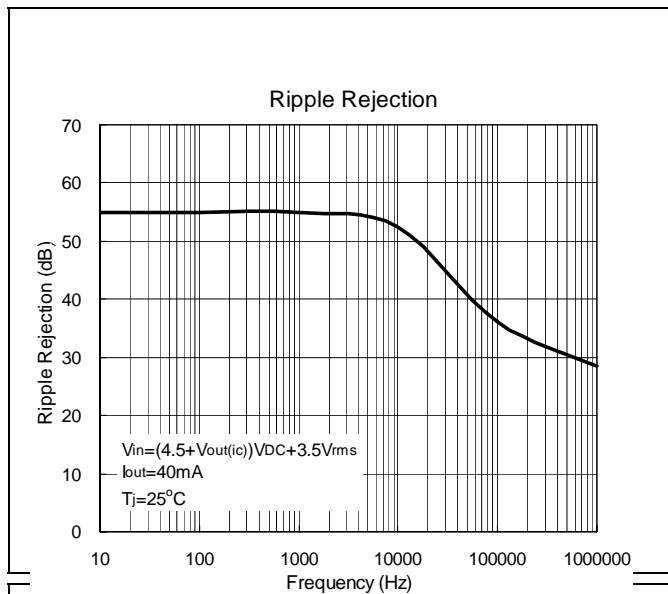
High Output Current with Short-circuit Protection



$$R_1 \leq V_{BE1} / I_{B(max)}$$

$$R_{SC} = V_{BE2} / I_{SC}, \quad I_{SC}: \text{Short-Circuit Current}$$

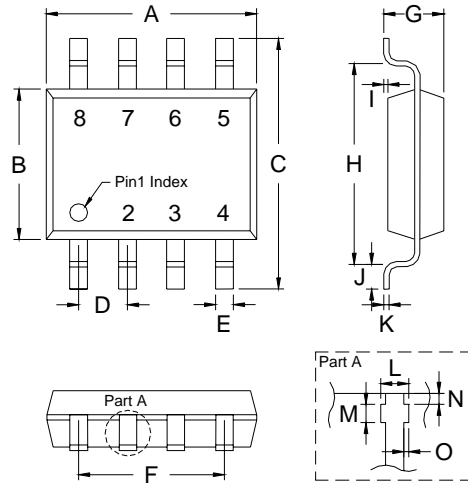
Characteristics Curve



BM78LXX

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SOP-8 (S) Dimension



DIM	Min.	Max.
A	4.85	5.10
B	3.85	3.95
C	5.80	6.20
D	1.22	1.32
E	0.37	0.47
F	3.74	3.88
G	1.45	1.65
H	4.80	5.10
I	0.05	0.20
J	0.30	0.70
K	0.19	0.25
L	0.37	0.52
M	0.23	0.28
N	0.08	0.13
O	0.00	0.15

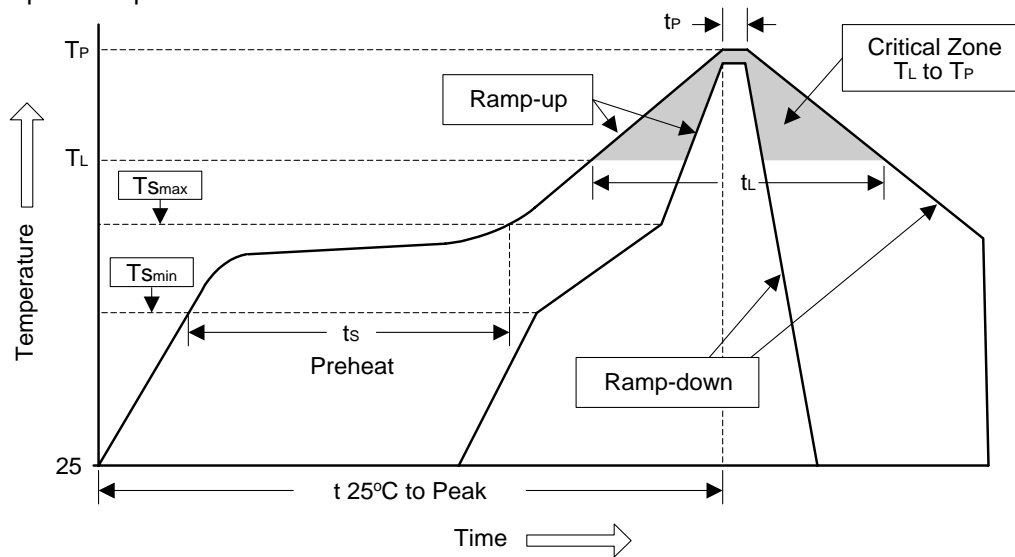
*: Typical, Unit: mm

8-Lead SO-8 Plastic
Surface Mounted Package

Soldering Methods

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%
2. Reflow soldering of surface-mount devices

Figure 1: Temperature profile



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	<3°C/sec	<3°C/sec
Preheat		
- Temperature Min (T_{smin})	100°C	150°C
- Temperature Max (T_{smax})	150°C	200°C
- Time (min to max) (t_s)	60~120 sec	60~180 sec
T_{smax} to T_L		
- Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above:		
- Temperature (T_L)	183°C	217°C
- Time (t_L)	60~150 sec	60~150 sec
Peak Temperature (T_P)	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature (t_p)	10~30 sec	20~40 sec
Ramp-down Rate	<6°C/sec	<6°C/sec
Time 25°C to Peak Temperature	<6 minutes	<8 minutes

3. Flow (wave) soldering (solder dipping)

Products	Peak temperature	Dipping time
Pb devices.	245°C ±5°C	5sec ±1sec
Pb-Free devices.	260°C +0/-5°C	5sec ±1sec