National Semiconductor

March 2002

LM78LXX Series
3-Terminal Positive Regulators

General Description

The LM78LXX series of three terminal positive regulators is available with several fixed output voltages making them useful in a wide range of applications. When used as a zener diode/resistor combination replacement, the LM78LXX usually results in an effective output impedance improvement of two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow the LM78LXX to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment.

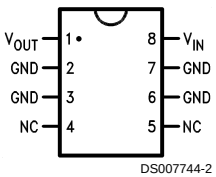
The LM78LXX is available in the plastic TO-92 (Z) package, the plastic SO-8 (M) package and a chip sized package (8-Bump micro SMD) using National's micro SMD package technology. With adequate heat sinking the regulator can deliver 100 mA output current. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistors is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

Features

- LM78L05 in micro SMD package
- Output voltage tolerances of ±5% over the temperature range
- Output current of 100 mA
- Internal thermal overload protection
- Output transistor safe area protection
- Internal short circuit current limit
- Available in plastic TO-92 and plastic SO-8 low profile packages
- No external components
- Output voltages of 5.0V, 6.2V, 8.2V, 9.0V, 12V, 15V
- See AN-1112 for micro SMD considerations

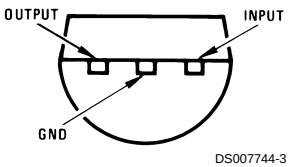
Connection Diagrams

SO-8 Plastic (M)
(Narrow Body)



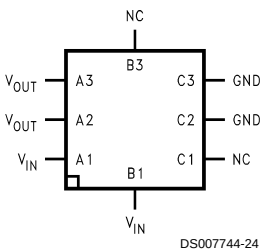
Top View

(TO-92)
Plastic Package (Z)



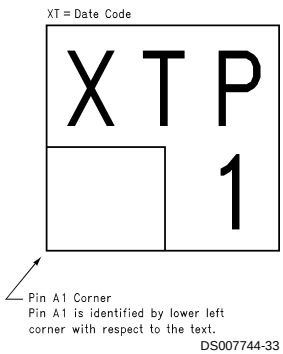
Bottom View

8-Bump micro SMD



Top View
(Bump Side Down)

micro SMD Marking Orientation



Top View

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Power Dissipation (Note 5)	Internally Limited
Input Voltage	35V
Storage Temperature	−65˚C to +150˚C
Operating Junction Temperature	
SO-8	0˚C to 125˚C
micro SMD	−40˚C to 85˚C
Soldering Information	
Infrared or Convection (20 sec.)	235˚C
Wave Soldering (10 sec.)	260˚C (lead time)
ESD Susceptibility (Note 2)	1kV

LM78LXX Electrical Characteristics

Limits in standard typeface are for T_J = 25˚C, **Bold typeface applies over 0˚C to 125˚C for SO-8 package and −40˚C to 85˚C for micro SMD package.** Limits are guaranteed by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods. Unless otherwise specified: I_O = 40 mA, C_I = 0.33 µF, C_O = 0.1 µF.

LM78L05

Unless otherwise specified, V_{IN} = 10V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		4.8	5	5.2	V
		7V ≤ V_{IN} ≤ 20V 1 mA ≤ I_O ≤ 40 mA (Note 3)	**4.75**		**5.25**	
		1 mA ≤ I_O ≤ 70 mA (Note 3)	**4.75**		**5.25**	
ΔV_O	Line Regulation	7V ≤ V_{IN} ≤ 20V		18	75	mV
		8V ≤ V_{IN} ≤ 20V		10	54	
ΔV_O	Load Regulation	1 mA ≤ I_O ≤ 100 mA		20	60	
		1 mA ≤ I_O ≤ 40 mA		5	30	
I_Q	Quiescent Current			3	5	mA
ΔI_Q	Quiescent Current Change	8V ≤ V_{IN} ≤ 20V			**1.0**	
		1 mA ≤ I_O ≤ 40 mA			**0.1**	
V_n	Output Noise Voltage	f = 10 Hz to 100 kHz (Note 4)		40		µV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz 8V ≤ V_{IN} ≤ 16V	47	62		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	I_O = 5 mA		−0.65		mV/˚C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			6.7	7	V
θ_{JA}	Thermal Resistance (8-Bump micro SMD)			230.9		˚C/W

LM78L62AC

Unless otherwise specified, V_{IN} = 12V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		5.95	6.2	6.45	V
		8.5V ≤ V_{IN} ≤ 20V 1 mA ≤ I_O ≤ 40 mA (Note 3)	**5.9**		**6.5**	
		1 mA ≤ I_O ≤ 70 mA (Note 3)	**5.9**		**6.5**	
ΔV_O	Line Regulation	8.5V ≤ V_{IN} ≤ 20V		65	175	mV
		9V ≤ V_{IN} ≤ 20V		55	125	
ΔV_O	Load Regulation	1 mA ≤ I_O ≤ 100 mA		13	80	
		1 mA ≤ I_O ≤ 40 mA		6	40	

LM78L62AC (Continued)

Unless otherwise specified, V_{IN} = 12V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
I_Q	Quiescent Current			2	5.5	mA
ΔI_Q	Quiescent Current Change	8V ≤ V_{IN} ≤ 20V			**1.5**	mA
		1 mA ≤ I_O ≤ 40 mA			**0.1**	
V_n	Output Noise Voltage	f = 10 Hz to 100 kHz (Note 4)		50		µV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz 10V ≤ V_{IN} ≤ 20V	40	46		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	I_O = 5 mA		−0.75		mV/˚C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			7.9		V

LM78L82AC

Unless otherwise specified, V_{IN} = 14V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		7.87	8.2	8.53	V
		11V ≤ V_{IN} ≤ 23V 1 mA ≤ I_O ≤ 40 mA (Note 3)	**7.8**		**8.6**	
		1 mA ≤ I_O ≤ 70 mA (Note 3)	**7.8**		**8.6**	
ΔV_O	Line Regulation	11V ≤ V_{IN} ≤ 23V		80	175	mV
		12V ≤ V_{IN} ≤ 23V		70	125	
ΔV_O	Load Regulation	1 mA ≤ I_O ≤ 100 mA		15	80	
		1 mA ≤ I_O ≤ 40 mA		8	40	
I_Q	Quiescent Current			2	5.5	mA
ΔI_Q	Quiescent Current Change	12V ≤ V_{IN} ≤ 23V			**1.5**	
		1 mA ≤ I_O ≤ 40 mA			**0.1**	
V_n	Output Noise Voltage	f = 10 Hz to 100 kHz (Note 4)		60		µV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz 12V ≤ V_{IN} ≤ 22V	39	45		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	I_O = 5 mA		−0.8		mV/˚C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			9.9		V

LM78L09AC

Unless otherwise specified, V_{IN} = 15V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		8.64	9.0	9.36	V
		11.5V ≤ V_{IN} ≤ 24V 1 mA ≤ I_O ≤ 40 mA (Note 3)	**8.55**		**9.45**	
		1 mA ≤ I_O ≤ 70 mA (Note 3)	**8.55**		**9.45**	

LM78L09AC (Continued)

Unless otherwise specified, V_{IN} = 15V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
ΔV_O	Line Regulation	11.5V ≤ V_{IN} ≤ 24V		100	200	mV
		13V ≤ V_{IN} ≤ 24V		90	150	
ΔV_O	Load Regulation	1 mA ≤ I_O ≤ 100 mA		20	90	
		1 mA ≤ I_O ≤ 40 mA		10	45	
I_Q	Quiescent Current			2	5.5	mA
ΔI_Q	Quiescent Current Change	11.5V ≤ V_{IN} ≤ 24V			**1.5**	
		1 mA ≤ I_O ≤ 40 mA			**0.1**	
V_n	Output Noise Voltage			70		µV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz 15V ≤ V_{IN} ≤ 25V	38	44		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	I_O = 5 mA		−0.9		mV/˚C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			10.7		V

LM78L12AC

Unless otherwise specified, V_{IN} = 19V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		11.5	12	12.5	V
		14.5V ≤ V_{IN} ≤ 27V 1 mA ≤ I_O ≤ 40 mA (Note 3)	**11.4**		**12.6**	
		1 mA ≤ I_O ≤ 70 mA (Note 3)	**11.4**		**12.6**	
ΔV_O	Line Regulation	14.5V ≤ V_{IN} ≤ 27V		30	180	mV
		16V ≤ V_{IN} ≤ 27V		20	110	
ΔV_O	Load Regulation	1 mA ≤ I_O ≤ 100 mA		30	100	
		1 mA ≤ I_O ≤ 40 mA		10	50	
I_Q	Quiescent Current			3	5	mA
ΔI_Q	Quiescent Current Change	16V ≤ V_{IN} ≤ 27V			**1**	
		1 mA ≤ I_O ≤ 40 mA			**0.1**	
V_n	Output Noise Voltage			80		µV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz 15V ≤ V_{IN} ≤ 25	40	54		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	I_O = 5 mA		−1.0		mV/˚C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			13.7	14.5	V

LM78L15AC

Unless otherwise specified, V_{IN} = 23V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		14.4	15.0	15.6	V
		17.5V ≤ V_{IN} ≤ 30V 1 mA ≤ I_O ≤ 40 mA (Note 3)	**14.25**		**15.75**	
		1 mA ≤ I_O ≤ 70 mA (Note 3)	**14.25**		**15.75**	
ΔV_O	Line Regulation	17.5V ≤ V_{IN} ≤ 30V		37	250	mV
		20V ≤ V_{IN} ≤ 30V		25	140	
ΔV_O	Load Regulation	1 mA ≤ I_O ≤ 100 mA		35	150	
		1 mA ≤ I_O ≤ 40 mA		12	75	
I_Q	Quiescent Current			3	5	mA
ΔI_Q	Quiescent Current Change	20V ≤ V_{IN} ≤ 30V			**1**	
		1 mA ≤ I_O ≤ 40 mA			**0.1**	
V_n	Output Noise Voltage			90		µV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz 18.5V ≤ V_{IN} ≤ 28.5V	37	51		dB
I_{PK}	Peak Output Current			140		mA
$\frac{\Delta V_O}{\Delta T}$	Average Output Voltage Tempco	I_O = 5 mA		−1.3		mV/˚C
V_{IN} (Min)	Minimum Value of Input Voltage Required to Maintain Line Regulation			16.7	17.5	V

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Electrical specifications do not apply when operating the device outside of its stated operating conditions.

Note 2: Human body model, 1.5 kΩ in series with 100 pF.

Note 3: Power dissipation ≤ 0.75W.

Note 4: Recommended minimum load capacitance of 0.01 µF to limit high frequency noise.

Note 5: Typical thermal resistance values for the packages are:

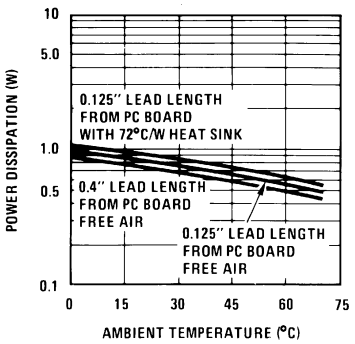
Z Package: θ_{JC} = 60 ˚C/W, = θ_{JA} = 230 ˚C/W

M Package: θ_{JA} = 180 ˚C/W

micro SMD Package: θ_{JA} = 230.9˚C/W

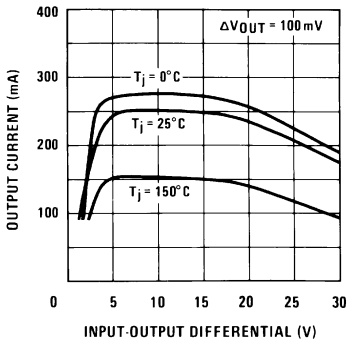
Typical Performance Characteristics

Maximum Average Power Dissipation (Z Package)



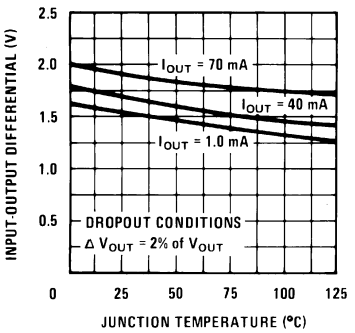
DS007744-14

Peak Output Current



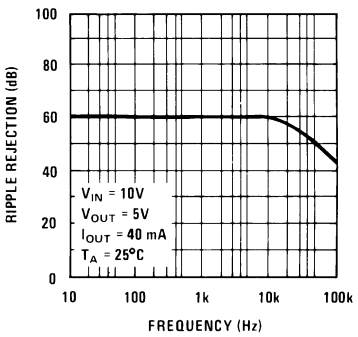
DS007744-16

Dropout Voltage



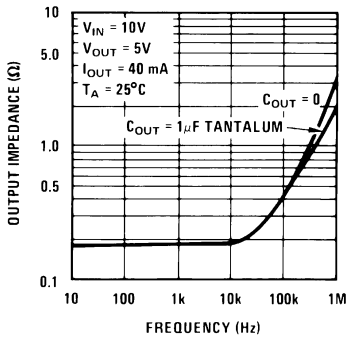
DS007744-17

Ripple Rejection



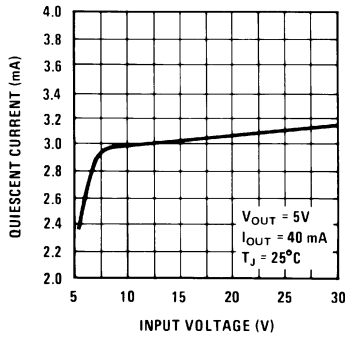
DS007744-18

Output Impedance



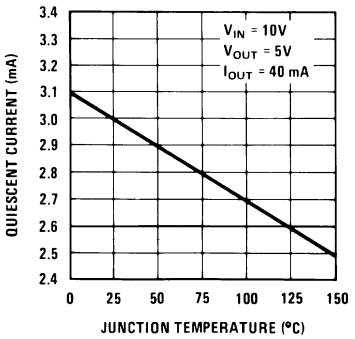
DS007744-19

Quiescent Current



DS007744-20

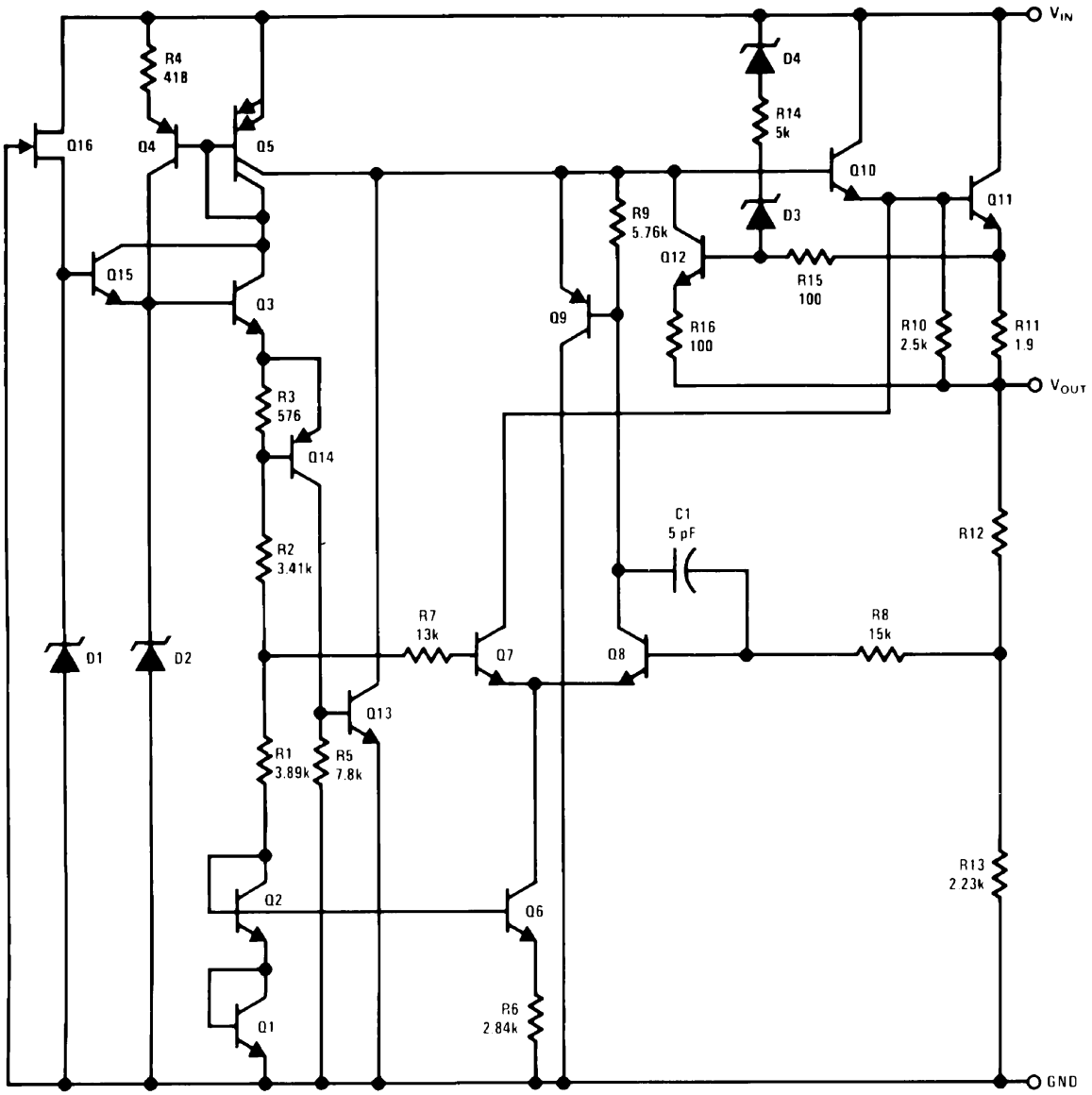
Quiescent Current



DS007744-21

Equivalent Circuit

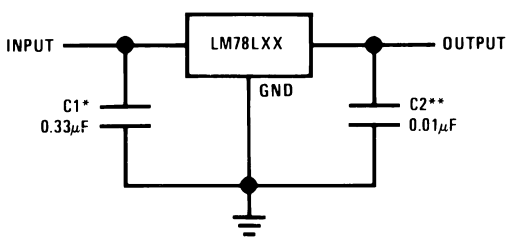
LM78LXX



DS007744-7

Typical Applications

Fixed Output Regulator

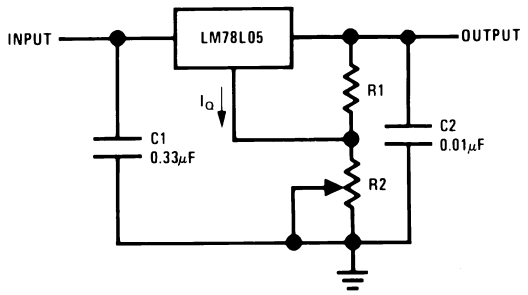


DS007744-8

*Required if the regulator is located more than 3" from the power supply filter.
**See (Note 4) in the electrical characteristics table.

Typical Applications (Continued)

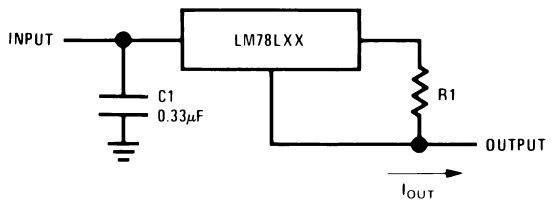
Adjustable Output Regulator



DS007744-9

V_{OUT} = 5V + (5V/R1 + I_Q) R2
5V/R1 > 3 I_Q, load regulation (L_r) ≈ [(R1 + R2)/R1] (L_r of LM78L05)

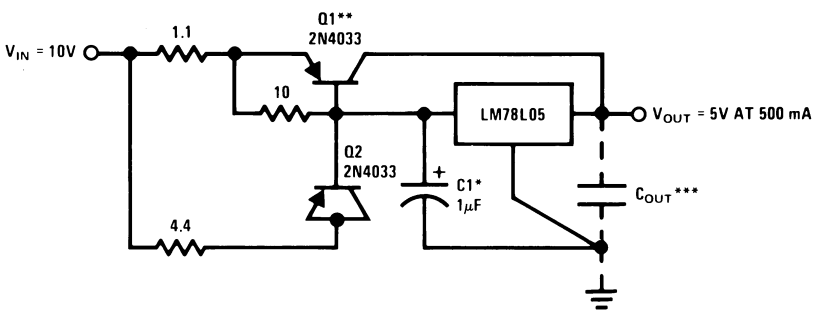
Current Regulator



DS007744-10

I_{OUT} = (V_{OUT}/R1) + I_Q
>I_Q = 1.5 mA over line and load changes

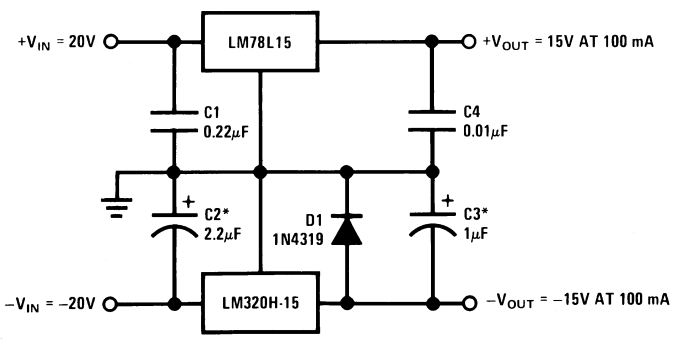
5V, 500 mA Regulator with Short Circuit Protection



DS007744-11

*Solid tantalum.
**Heat sink Q1.
***Optional: Improves ripple rejection and transient response.
Load Regulation: 0.6% 0 ≤ I_L ≤ 250 mA pulsed with t_{ON} = 50 ms.

±15V, 100 mA Dual Power Supply

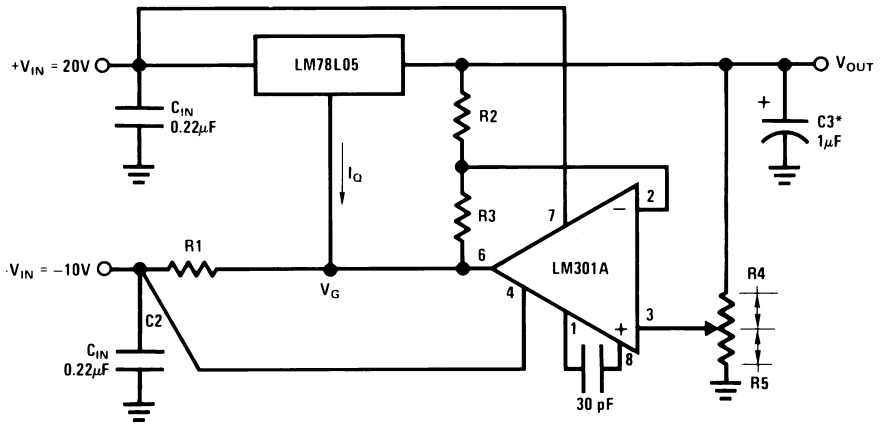


DS007744-12

*Solid tantalum.

Typical Applications (Continued)

Variable Output Regulator 0.5V-18V



DS007744-13

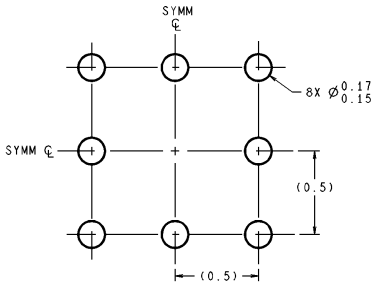
*Solid tantalum.

$V_{OUT} = V_G + 5V$, $R1 = (-V_{IN}/I_{Q\ LM78L05})$

$V_{OUT} = 5V\ (R2/R4)$ for $(R2 + R3) = (R4 + R5)$

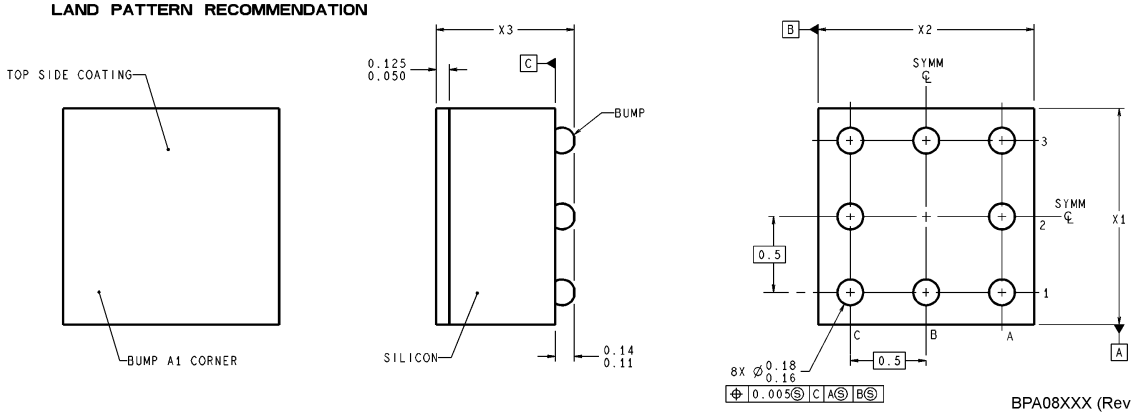
A 0.5V output will correspond to $(R2/R4) = 0.1\ (R3/R4) = 0.9$

Physical Dimensions inches (millimeters) unless otherwise noted



DIMENSIONS ARE IN MILLIMETERS

LAND PATTERN RECOMMENDATION



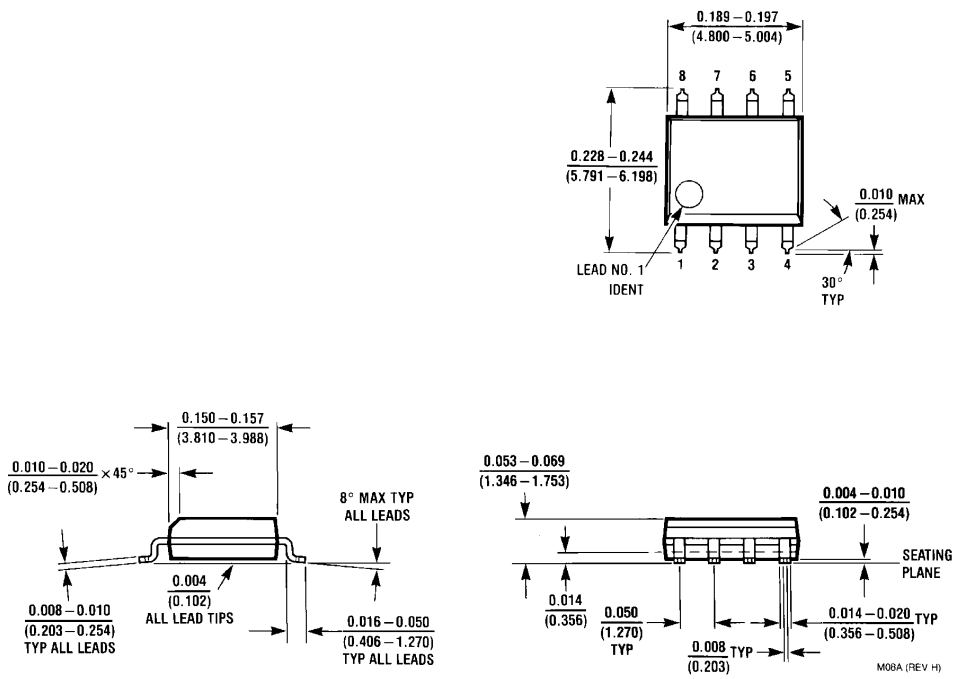
BPA08XXX (Rev C)

NOTES: UNLESS OTHERWISE SPECIFIED

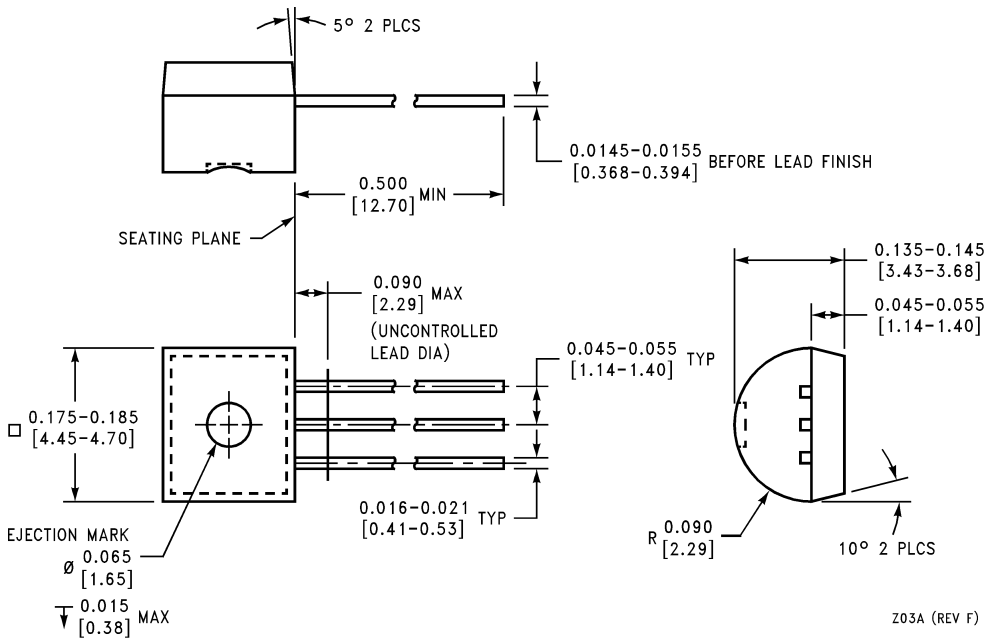
1. EPOXY COATING
2. 63Sn/37Pb EUTECTIC BUMP
3. RECOMMEND NON-SOLDER MASK DEFINED LANDING PAD.
4. PIN A1 IS ESTABLISHED BY LOWER LEFT CORNER WITH RESPECT TO TEXT ORIENTATION. REMAINING PINS ARE NUMBERED COUNTERCLOCKWISE.
5. XXX IN DRAWING NUMBER REPRESENTS PACKAGE SIZE VARIATION WHERE X_1 IS PACKAGE WIDTH, X_2 IS PACKAGE LENGTH AND X_3 IS PACKAGE HEIGHT.
6. REFERENCE JEDEC REGISTRATION MO-211, VARIATION BC.

8-Bump micro SMD
Order Number LM78L05IBP or LM78L05IBPX
NS Package Number BPA08AAB
X_1 = 1.285 X_2 = 1.285 X_3 = 0.850

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



S.O. Package (M)
Order Number LM78L05ACM, LM78L12ACM or LM78L15ACM
NS Package Number M08A



Molded Offset TO-92 (Z)
Order Number LM78L05ACZ, LM78L09ACZ, LM78L12ACZ,
LM78L15ACZ, LM78L62ACZ or LM78L82ACZ
NS Package Number Z03A

Notes

LIFE SUPPORT POLICY

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1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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LM78L05 Product Folder

3-Terminal Positive Regulators

See Also: LM3480 - better line/load/dropout voltage

General Description | Features | Datasheet | Package & Models | Samples & Pricing | Design Tools | Application Notes

Parametric Table

Multiple Output Capability	No
On/Off Pin	No
Error Flag	-
Input Voltage, min (Volt)	6.70

Parametric Table

Input Voltage, max (Volt)	35
Output Current, max	100 mA
Watchdog	-
Output Voltage (Volt)	5

Datasheet

Title	Size in Kbytes	Date	View Online	Download	Receive via Email
LM78LXX Series 3-Terminal Positive Regulators	198 Kbytes	5-Mar-02	View Online	Download	Receive via Email

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Package Availability, Models, Samples & Pricing

Part Number	Package			Status	Models		Samples & Electronic Orders	Budgetary Pricing		Std Pack Size	Package Marking
	Type	Pins	MSL		SPICE	IBIS		Qty	$US each		
LM78L05IBP	microSMD	8	MSL	Full production	N/A	N/A	Samples / Buy Now	1K+	$0.1500	reel of 250	¢1¢IP $I 1
LM78L05IBPX	microSMD	8	MSL	Full production	N/A	N/A		1K+	$0.1500	reel of 3000	¢1¢IP $I 1
LM78L05ACM	SOIC NARROW	8	MSL	Full production	N/A	N/A	24 Hour / Buy Now	1K+	$0.1100	rail of 95	[logo]¢2¢T LM78L 05ACM

LM78L05ACMX	SOIC NARROW	8	MSL	Full production	N/A	N/A	Buy Now	1K+	$0.1100	reel of 2500	[logo]¢2¢T LM78L 05ACM
LM78L05ACZ	TO 92	3	MSL	Full production	N/A	N/A	Buy Now	1K+	$0.0960	box of 1800	[logo]¢2¢T LM78L 05ACZ
LM78L05 MDC	Die			Full production	N/A	N/A	Samples			tray of N/A	-
LM78L05 MWC	Wafer			Full production	N/A	N/A				wafer jar of N/A	-

General Description

The LM78LXX series of three terminal positive regulators is available with several fixed output voltages making them useful in a wide range of applications. When used as a zener diode/resistor combination replacement, the LM78LXX usually results in an effective output impedance improvement of two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow the LM78LXX to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment.

The LM78LXX is available in the plastic TO-92 (Z) package, the plastic SO-8 (M) package and a chip sized package (8-Bump micro SMD) using National's micro SMD package technology. With adequate heat sinking the regulator can deliver 100 mA output current. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistors is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

Features

- LM78L05 in micro SMD package
- Output voltage tolerances of ±5% over the temperature range
- Output current of 100 mA
- Internal thermal overload protection
- Output transistor safe area protection
- Internal short circuit current limit
- Available in plastic TO-92 and plastic SO-8 low profile packages
- No external components
- Output voltages of 5.0V, 6.2V, 8.2V, 9.0V, 12V, 15V
- See AN-1112 for micro SMD considerations

Design Tools

Title	Size in Kbytes	Date	View Online	Download	Receive via Email
LM78L05IBP Micro SMD Qualification Package	4172 Kbytes	17-Apr-2000	View Online	Download	Receive via Email

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Application Notes

Title	Size in Kbytes	Date	View Online	Download	Receive via Email
AN-1081: Application Note 1081 A Low Cost, Low Parts-Count DC/DC Converter With Multiple Outputs	45 Kbytes	2-Mar-99	View Online	Download	Receive via Email
AN-1112: Application Note 1112 Micro SMD Wafer Level Chip Scale Package	620 Kbytes	27-Mar-02	View Online	Download	Receive via Email
Application Note 1112 Micro SMD Wafer Level Chip Scale Package (**JAPANESE**)	171 Kbytes		View Online	Download	Receive via

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[Information as of 5-Aug-2002]

LM78L15 Product Folder

3-Terminal Positive Regulators

See Also: LM3480 - better line/load/dropout voltage

General Description | Features | Datasheet | Package & Models | Samples & Pricing

Parametric Table

Multiple Output Capability	No
On/Off Pin	No
Error Flag	-
Input Voltage, min (Volt)	16.70

Parametric Table

Input Voltage, max (Volt)	35
Output Current, max	100 mA
Watchdog	-
Output Voltage (Volt)	15

Datasheet

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Package Availability, Models, Samples & Pricing

Part Number	Package			Status	Models		Samples & Electronic Orders	Budgetary Pricing		Std Pack Size	Package Marking
	Type	Pins	MSL		SPICE	IBIS		Qty	$US each		
LM78L15ACM	SOIC NARROW	8	MSL	Full production	N/A	N/A	Buy Now	1K+	$0.0960	rail of 95	[logo]¢2¢T LM78L 15ACM
LM78L15ACMX	SOIC NARROW	8	MSL	Full production	N/A	N/A	Buy Now	1K+	$0.0960	reel of 2500	[logo]¢2¢T LM78L 15ACM
LM78L15ACZ	TO 92	3	MSL	Full production	N/A	N/A	Buy Now	1K+	$0.0960	box of 1800	[logo]¢2¢T LM78L 15ACZ
LM78L15AC MDC	Die			Full production	N/A	N/A	Samples			tray of N/A	-

LM78L15AC MWC	Wafer	Full production	N/A	N/A				wafer jar of N/A	-

General Description

The LM78LXX series of three terminal positive regulators is available with several fixed output voltages making them useful in a wide range of applications. When used as a zener diode/resistor combination replacement, the LM78LXX usually results in an effective output impedance improvement of two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow the LM78LXX to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment.

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[Information as of 5-Aug-2002]