

LM78LXX Series 3-Terminal Positive Regulators

Check for Samples: [LM78L05](#), [LM78L09](#), [LM78L12](#), [LM78L15](#), [LM78L62](#), [LM78L82](#)

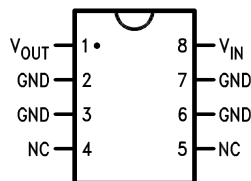
FEATURES

- LM78L05 in DSBGA Package
- Output Voltage Tolerances of $\pm 5\%$ Over the Temperature Range
- Output Current of 100mA
- Internal Thermal Overload Protection
- Output Transistor Safe Area Protection
- Internal Short Circuit Current Limit
- Available in TO-92 and SOIC-8 Low Profile Packages
- No External Components
- Output Voltages of 5.0V, 6.2V, 8.2V, 9.0V, 12V, 15V
- See AN-1112 ([SNVA009](#)) for DSBGA Considerations

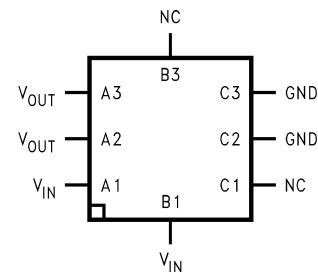
DESCRIPTION

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.

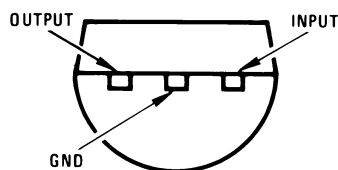
Connection Diagram



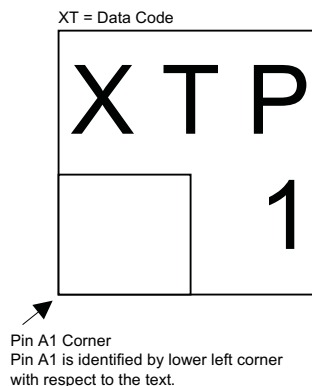
**Figure 1. SOIC-8 (D)
(Top View, Narrow Body)**



**Figure 2. 8-Bump DSBGA
(Top View, Bump Side Down)**



**Figure 3. TO-92 Package (LP)
(Bottom View)**



**Figure 4. DSBGA Marking Orientation
(Top View)**



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These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

DESCRIPTION (CONTINUED)

The LM78LXX is available in the plastic TO-92 (LP) package, the SOIC-8 (D) package and a chip sized package (8-Bump DSBGA) using TI's DSBGA package technology. With adequate heat sinking the regulator can deliver 100mA 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.

Absolute Maximum Ratings⁽¹⁾⁽²⁾

Power Dissipation ⁽³⁾	Internally Limited
Input Voltage	35V
Storage Temperature	-65°C to +150°C
ESD Susceptibility ⁽⁴⁾	1kV
Operating Junction Temperature	
LM78LxxACZ, TO-92	0°C to 125°C
LM78LxxACM, SOIC-8	0°C to 125°C
LM78LxxAIM, SOIC-8	-40°C to 125°C
LM78LxxIBPX, DSBGA	-40°C to 85°C
LM78LxxITP, Thin DSBGA	-40°C to 85°C
Soldering Information	
Infrared or Convection (20 sec.)	235°C
Wave Soldering (10 sec.)	260°C (lead time)

- (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.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
- (3) Typical thermal resistance values for the packages are:
LP Package: $\theta_{JC} = 60^\circ\text{C/W}$, $\theta_{JA} = 230^\circ\text{C/W}$
D Package: $\theta_{JA} = 180^\circ\text{C/W}$
DSBGA Package: $\theta_{JA} = 230.9^\circ\text{C/W}$
- (4) Human body model, 1.5 k Ω in series with 100pF.

LM78LXX Electrical Characteristics LM78L05AC / LM78L05I

Limits in standard typeface are for $T_J = 25^\circ\text{C}$, **Bold typeface applies over the entire operating temperature range of the indicated package.** Limits are ensured by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods. Unless otherwise specified: $I_O = 40\text{mA}$, $C_I = 0.33\mu\text{F}$, $C_O = 0.1\mu\text{F}$.

Unless otherwise specified, $V_{IN} = 10\text{V}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		4.8	5	5.2	V
		$7\text{V} \leq V_{IN} \leq 20\text{V}$ $1\text{mA} \leq I_O \leq 40\text{mA}$ (1)	4.75		5.25	
		$1\text{mA} \leq I_O \leq 70\text{mA}$ (1)	4.75		5.25	
ΔV_O	Line Regulation	$7\text{V} \leq V_{IN} \leq 20\text{V}$		18	75	mV
		$8\text{V} \leq V_{IN} \leq 20\text{V}$		10	54	
ΔV_O	Load Regulation	$1\text{mA} \leq I_O \leq 100\text{mA}$		20	60	
		$1\text{mA} \leq I_O \leq 40\text{mA}$		5	30	

(1) Power dissipation $\leq 0.75\text{W}$.

LM78LXX Electrical Characteristics LM78L05AC / LM78L05I (continued)

Limits in standard typeface are for $T_J = 25^\circ\text{C}$, **Bold typeface applies over the entire operating temperature range of the indicated package.** Limits are ensured by production testing or correlation techniques using standard Statistical Quality Control (SQC) methods. Unless otherwise specified: $I_O = 40\text{mA}$, $C_I = 0.33\mu\text{F}$, $C_O = 0.1\mu\text{F}$.

Unless otherwise specified, $V_{IN} = 10\text{V}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
I_Q	Quiescent Current			3	5	mA
ΔI_Q	Quiescent Current Change	$8\text{V} \leq V_{IN} \leq 20\text{V}$			1.0	
		$1\text{mA} \leq I_O \leq 40\text{mA}$			0.1	
V_n	Output Noise Voltage	$f = 10\text{ Hz to } 100\text{ kHz}^{(2)}$		40		μV
$\Delta V_{IN}/\Delta V_{OUT}$	Ripple Rejection	$f = 120\text{ Hz}$ $8\text{V} \leq V_{IN} \leq 16\text{V}$	47	62		dB
I_{PK}	Peak Output Current			140		mA
$\Delta V_O/\Delta T$	Average Output Voltage Tempco	$I_O = 5\text{mA}$		-0.65		$\text{mV}/^\circ\text{C}$
$V_{IN}(\text{Min})$	Minimum Value of Input Voltage Required to Maintain Line Regulation			6.7	7	V
θ_{JA}	Thermal Resistance (8-Bump micro SMD)			230.9		$^\circ\text{C}/\text{W}$

(2) Recommended minimum load capacitance of $0.01\mu\text{F}$ to limit high frequency noise.

LM78LXX Electrical Characteristics LM78L62AC

Unless otherwise specified, $V_{IN} = 12\text{V}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		5.95	6.2	6.45	V
		$8.5\text{V} \leq V_{IN} \leq 20\text{V}$ $1\text{mA} \leq I_O \leq 40\text{mA}$ (1)	5.9		6.5	
		$1\text{mA} \leq I_O \leq 70\text{mA}$ (1)	5.9		6.5	
ΔV_O	Line Regulation	$8.5\text{V} \leq V_{IN} \leq 20\text{V}$		65	175	mV
		$9\text{V} \leq V_{IN} \leq 20\text{V}$		55	125	
ΔV_O	Load Regulation	$1\text{mA} \leq I_O \leq 100\text{mA}$		13	80	
		$1\text{mA} \leq I_O \leq 40\text{mA}$		6	40	
I_Q	Quiescent Current			2	5.5	mA
ΔI_Q	Quiescent Current Change	$8\text{V} \leq V_{IN} \leq 20\text{V}$			1.5	
		$1\text{mA} \leq I_O \leq 40\text{mA}$			0.1	
V_n	Output Noise Voltage	$f = 10\text{ Hz to } 100\text{ kHz}$ (2)		50		μV
$\Delta V_{IN}/\Delta V_{OUT}$	Ripple Rejection	$f = 120\text{ Hz}$ $10\text{V} \leq V_{IN} \leq 20\text{V}$	40	46		dB
I_{PK}	Peak Output Current			140		mA
$\Delta V_O/\Delta T$	Average Output Voltage Tempco	$I_O = 5\text{mA}$		-0.75		$\text{mV}/^\circ\text{C}$
$V_{IN}(\text{Min})$	Minimum Value of Input Voltage Required to Maintain Line Regulation			7.9		V

(1) Power dissipation $\leq 0.75\text{W}$.

(2) Recommended minimum load capacitance of $0.01\mu\text{F}$ to limit high frequency noise.

LM78LXX Electrical Characteristics LM78L82ACUnless otherwise specified, $V_{IN} = 14V$

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

(1) Power dissipation $\leq 0.75W$.(2) Recommended minimum load capacitance of $0.01\mu F$ to limit high frequency noise.**LM78LXX Electrical Characteristics LM78L09AC / LM78L09I**Unless otherwise specified, $V_{IN} = 15V$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_O	Output Voltage		8.64	9.0	9.36	V
		$11.5V \leq V_{IN} \leq 24V$ $1mA \leq I_O \leq 40mA$ (1)	8.55		9.45	
		$1mA \leq I_O \leq 70mA$ (1)	8.55		9.45	
ΔV_O	Line Regulation	$11.5V \leq V_{IN} \leq 24V$		100	200	mV
		$13V \leq V_{IN} \leq 24V$		90	150	
ΔV_O	Load Regulation	$1mA \leq I_O \leq 100mA$		20	90	
		$1mA \leq I_O \leq 40mA$		10	45	
I_Q	Quiescent Current			2	5.5	mA
ΔI_Q	Quiescent Current Change	$11.5V \leq V_{IN} \leq 24V$			1.5	
		$1mA \leq I_O \leq 40mA$			0.1	
V_n	Output Noise Voltage			70		μV
$\Delta V_{IN}/\Delta V_{OUT}$	Ripple Rejection	$f = 120 \text{ Hz}$ $15V \leq V_{IN} \leq 25V$	38	44		dB
I_{PK}	Peak Output Current			140		mA
$\Delta V_O/\Delta T$	Average Output Voltage Tempco	$I_O = 5mA$		-0.9		$mV/^\circ C$
$V_{IN} \text{ (Min)}$	Minimum Value of Input Voltage Required to Maintain Line Regulation			10.7		V

(1) Power dissipation $\leq 0.75W$.

LM78LXX Electrical Characteristics LM78L12AC

 Unless otherwise specified, $V_{IN} = 19V$

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

 (1) Power dissipation $\leq 0.75W$.

LM78LXX Electrical Characteristics 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
		$17.5V \leq V_{IN} \leq 30V$ $1mA \leq I_O \leq 40mA$ (1)	14.25		15.75	
		$1mA \leq I_O \leq 70mA$ (1)	14.25		15.75	
ΔV_O	Line Regulation	$17.5V \leq V_{IN} \leq 30V$		37	250	mV
		$20V \leq V_{IN} \leq 30V$		25	140	
ΔV_O	Load Regulation	$1mA \leq I_O \leq 100mA$		35	150	
		$1mA \leq I_O \leq 40mA$		12	75	
I_Q	Quiescent Current			3	5	mA
ΔI_Q	Quiescent Current Change	$20V \leq V_{IN} \leq 30V$			1	
		$1mA \leq I_O \leq 40mA$			0.1	
V_n	Output Noise Voltage			90		μV
$\Delta V_{IN}/\Delta V_{OUT}$	Ripple Rejection	$f = 120 \text{ Hz}$ $18.5V \leq V_{IN} \leq 28.5V$	37	51		dB
I_{PK}	Peak Output Current			140		mA
$\Delta V_O/\Delta T$	Average Output Voltage Tempco	$I_O = 5mA$		-1.3		mV/°C
$V_{IN} \text{ (Min)}$	Minimum Value of Input Voltage Required to Maintain Line Regulation			16.7	17.5	V

 (1) Power dissipation $\leq 0.75W$.

Typical Performance Characteristics

Maximum Average Power Dissipation (LP Package)

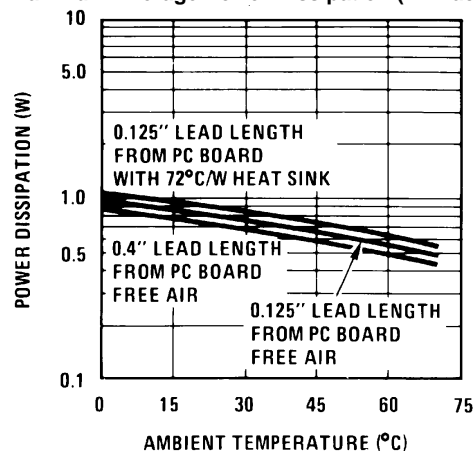


Figure 5.

Peak Output Current

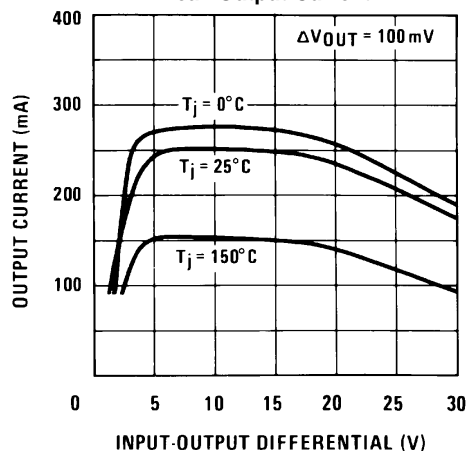


Figure 6.

Dropout Voltage

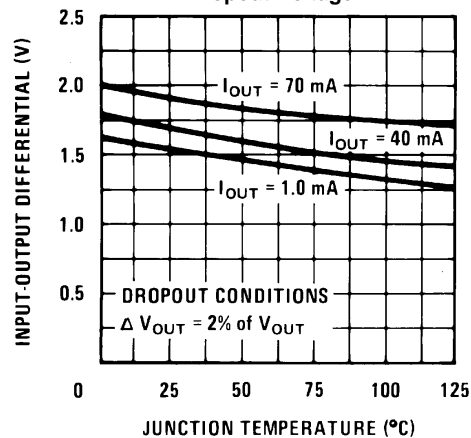


Figure 7.

Ripple Rejection

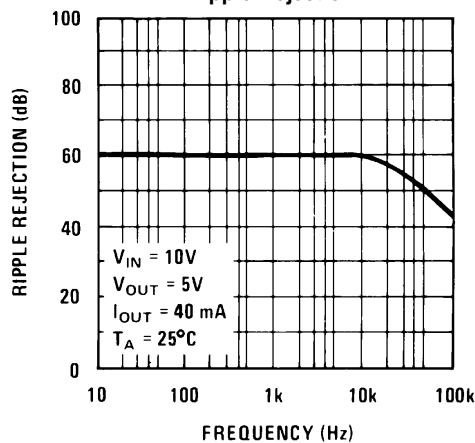


Figure 8.

Output Impedance

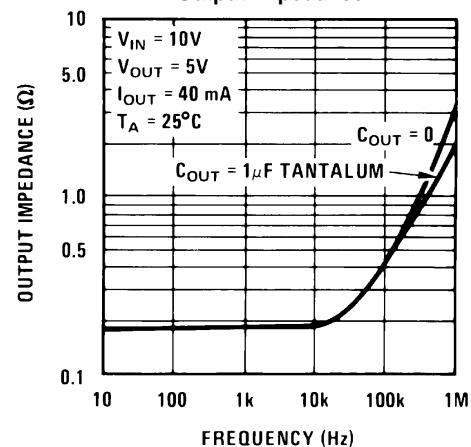


Figure 9.

Quiescent Current

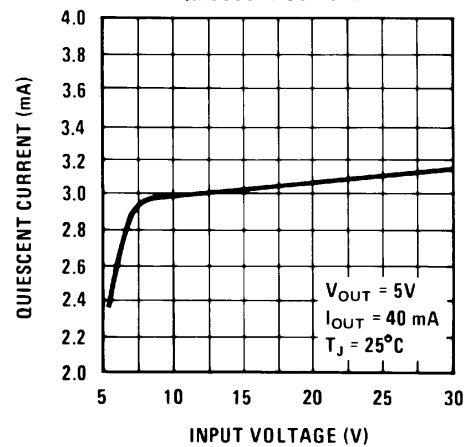


Figure 10.

Typical Performance Characteristics (continued)

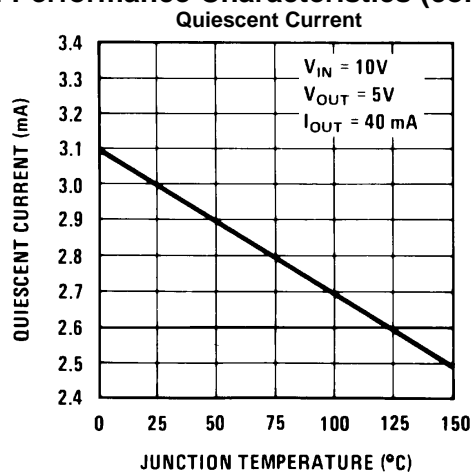
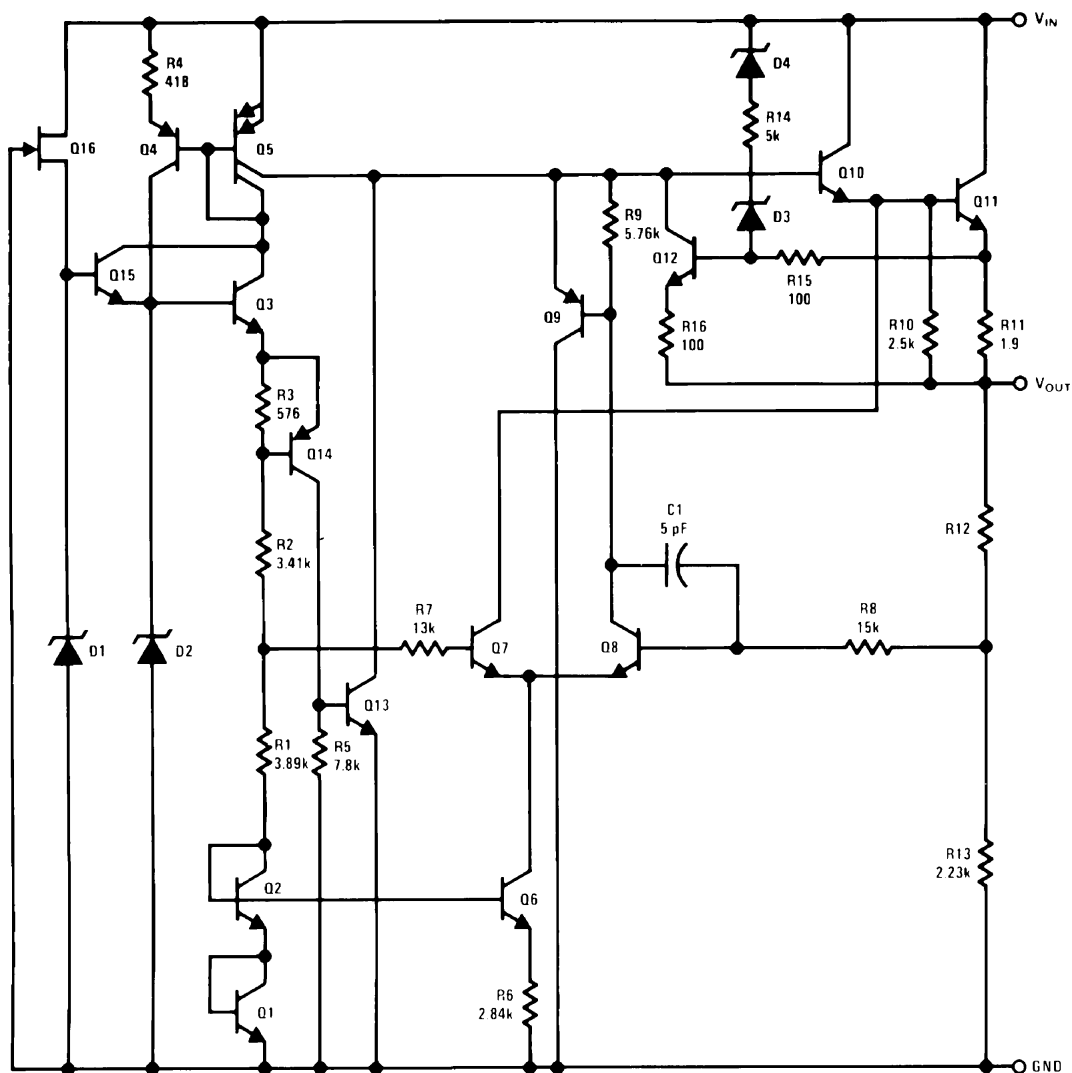
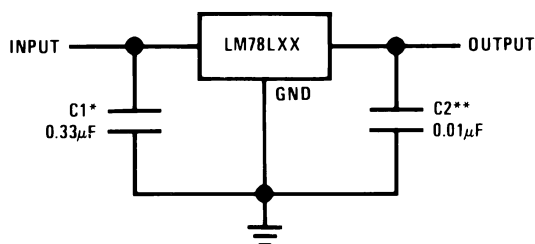


Figure 11.

EQUIVALENT CIRCUIT**Figure 12. LM78LXX**

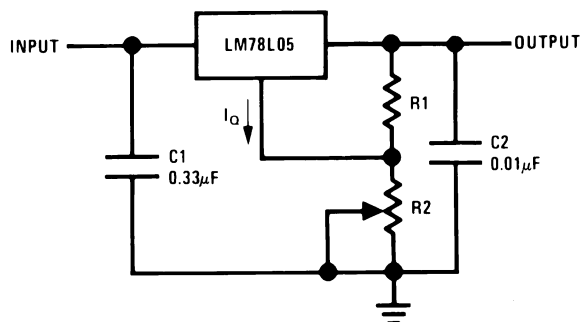
Typical Applications



*Required if the regulator is located more than 3" from the power supply filter.

**See (1) in the electrical characteristics table.

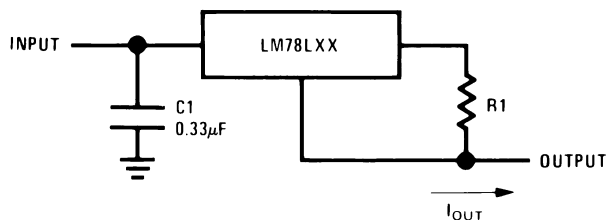
Figure 13. Fixed Output Regulator



$$V_{OUT} = 5V + (5V/R1 + I_Q) R2$$

$$5V/R1 > 3 I_Q, \text{ load regulation } (L_r) \approx [(R1 + R2)/R1] (L_r \text{ of LM78L05})$$

Figure 14. Adjustable Output Regulator

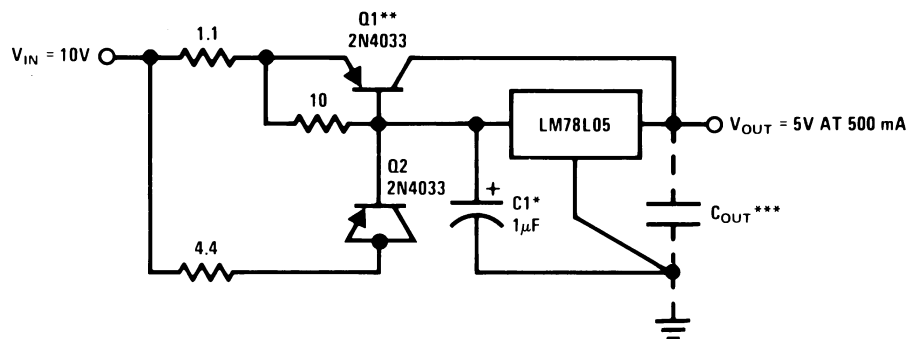


$$I_{OUT} = (V_{OUT}/R1) + I_Q$$

$$>I_Q = 1.5\text{mA over line and load changes}$$

Figure 15. Current Regulator

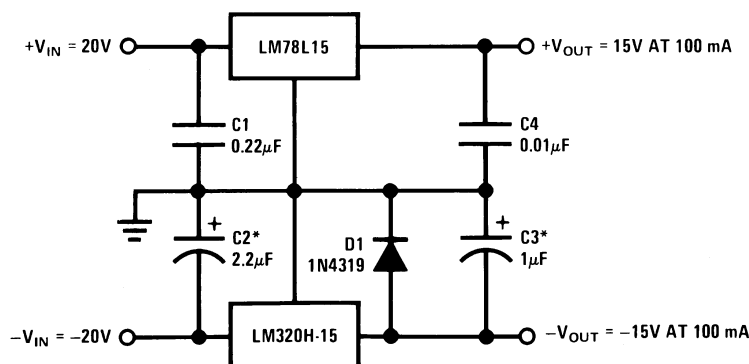
(1) Recommended minimum load capacitance of 0.01µF to limit high frequency noise.



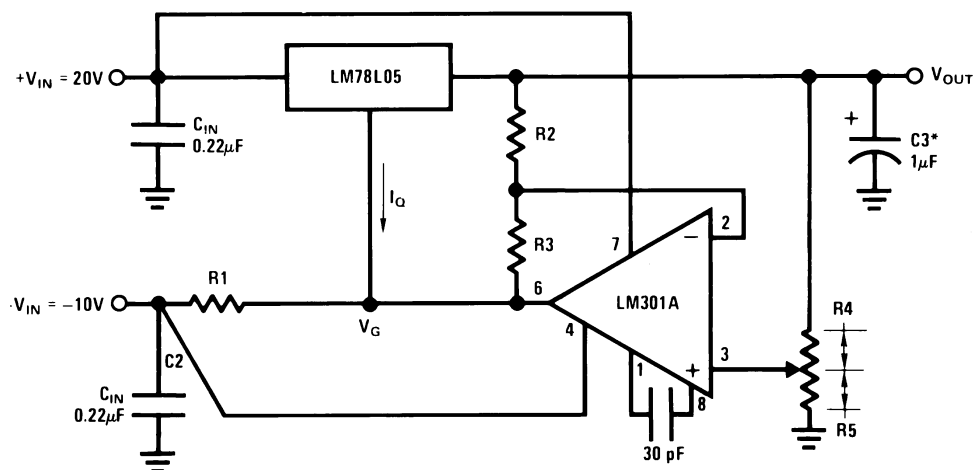
*Solid tantalum.

**Heat sink Q1.

***Optional: Improves ripple rejection and transient response.

Load Regulation: 0.6% $0 \leq I_L \leq 250\text{mA}$ pulsed with $t_{ON} = 50\text{ms}$.**Figure 16. 5V, 500mA Regulator with Short Circuit Protection**

*Solid tantalum.

Figure 17. ±15V, 100mA Dual Power Supply

*Solid tantalum.

 $V_{OUT} = V_G + 5V$, $R1 = (-V_{IN}/I_Q \text{ LM78L05})$ $V_{OUT} = 5V (R2/R4)$ for $(R2 + R3) = (R4 + R5)$ A 0.5V output will correspond to $(R2/R4) = 0.1$ $(R3/R4) = 0.9$ **Figure 18. Variable Output Regulator 0.5V-18V**

REVISION HISTORY

Changes from Revision H (April 2013) to Revision I	Page
• Changed layout of National Data Sheet to TI format	10

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LM78L05ACM	ACTIVE	SOIC	D	8	95	TBD	Call TI	Call TI	-40 to 85	LM78L 05ACM	Samples
LM78L05ACM/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	LM78L 05ACM	Samples
LM78L05ACMX	ACTIVE	SOIC	D	8	2500	TBD	Call TI	Call TI	-40 to 85	LM78L 05ACM	Samples
LM78L05ACMX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	LM78L 05ACM	Samples
LM78L05ACZ/LFT1	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM		LM78L 05ACZ	Samples
LM78L05ACZ/LFT3	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM		LM78L 05ACZ	Samples
LM78L05ACZ/LFT4	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM		LM78L 05ACZ	Samples
LM78L05ACZ/LFT7	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM		LM78L 05ACZ	Samples
LM78L05ACZ/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM	-40 to 85	LM78L 05ACZ	Samples
LM78L05AIM/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM		LM78L 05AM	Samples
LM78L05AIMX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM		LM78L 05AM	Samples
LM78L05ITP/NOPB	ACTIVE	DSBGA	YPB	8	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM		P 03	Samples
LM78L05ITPX/NOPB	ACTIVE	DSBGA	YPB	8	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM		P 03	Samples
LM78L09ITPX/NOPB	ACTIVE	DSBGA	YPB	8	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM		P 02	Samples
LM78L12ACM	ACTIVE	SOIC	D	8	95	TBD	Call TI	Call TI	-40 to 85	LM78L 12ACM	Samples
LM78L12ACM/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	LM78L 12ACM	Samples
LM78L12ACMX	ACTIVE	SOIC	D	8	2500	TBD	Call TI	Call TI	-40 to 85	LM78L 12ACM	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LM78L12ACMX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	LM78L 12ACM	Samples
LM78L12ACZ/LFT3	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM		LM78L 12ACZ	Samples
LM78L12ACZ/LFT4	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM		LM78L 12ACZ	Samples
LM78L12ACZ/LFT7	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM		LM78L 12ACZ	Samples
LM78L12ACZ/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM	-40 to 85	LM78L 12ACZ	Samples
LM78L15ACM	ACTIVE	SOIC	D	8	95	TBD	Call TI	Call TI	-40 to 85	LM78L 15ACM	Samples
LM78L15ACM/NOPB	ACTIVE	SOIC	D	8	95	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	LM78L 15ACM	Samples
LM78L15ACMX	ACTIVE	SOIC	D	8	2500	TBD	Call TI	Call TI	-40 to 85	LM78L 15ACM	Samples
LM78L15ACMX/NOPB	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-40 to 85	LM78L 15ACM	Samples
LM78L15ACZ/LFT4	ACTIVE	TO-92	LP	3	2000	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM		LM78L 15ACZ	Samples
LM78L15ACZ/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM	-40 to 85	LM78L 15ACZ	Samples
LM78L62ACZ/NOPB	ACTIVE	TO-92	LP	3	1800	Green (RoHS & no Sb/Br)	SNCU	Level-1-NA-UNLIM	-40 to 85	LM78L 62ACZ	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBsolete: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

⁽⁴⁾ Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

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D (R-PDSO-G8)

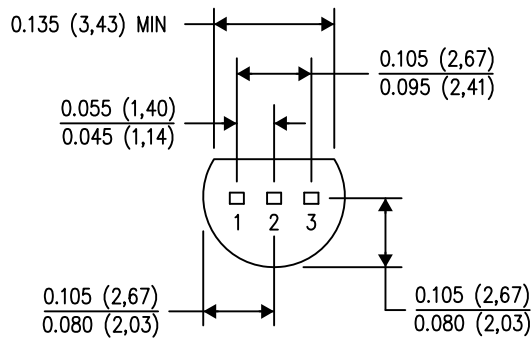
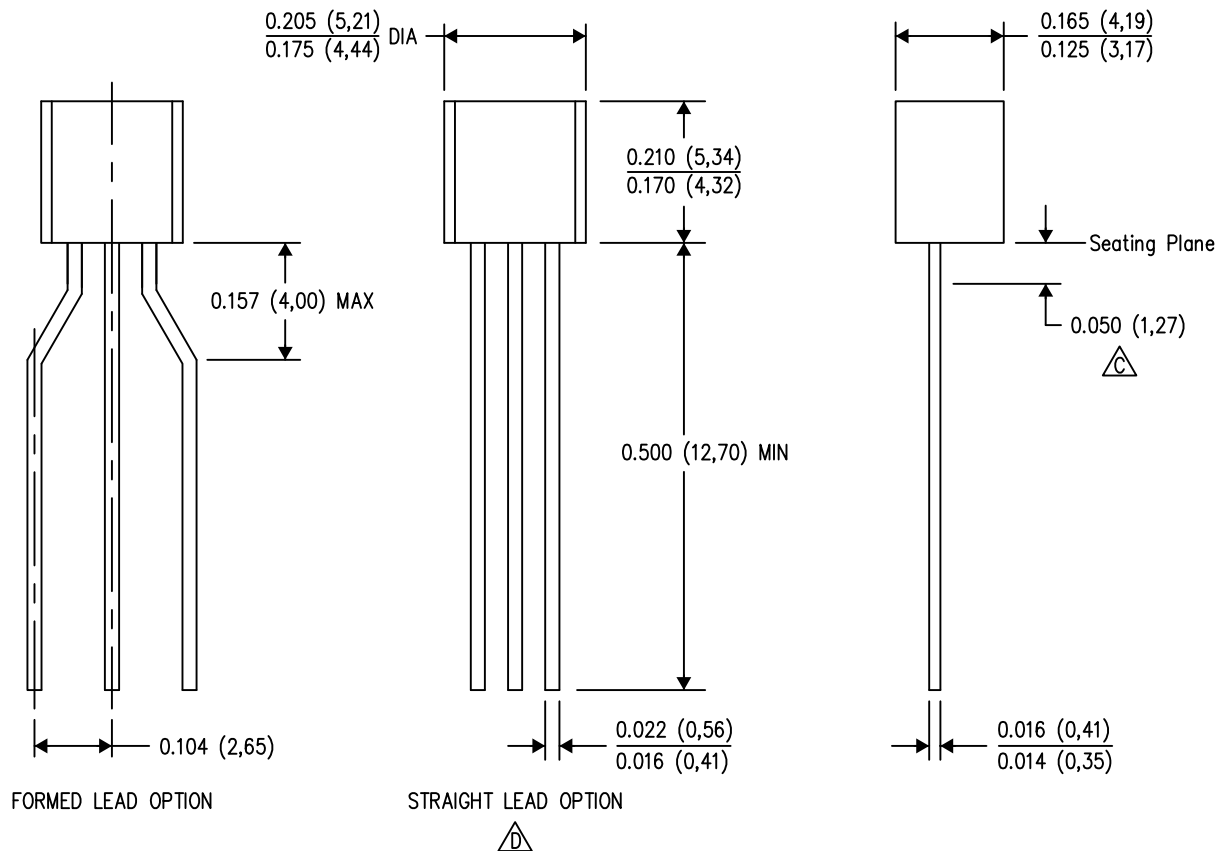
PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - $\triangle D$ Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AA.

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE

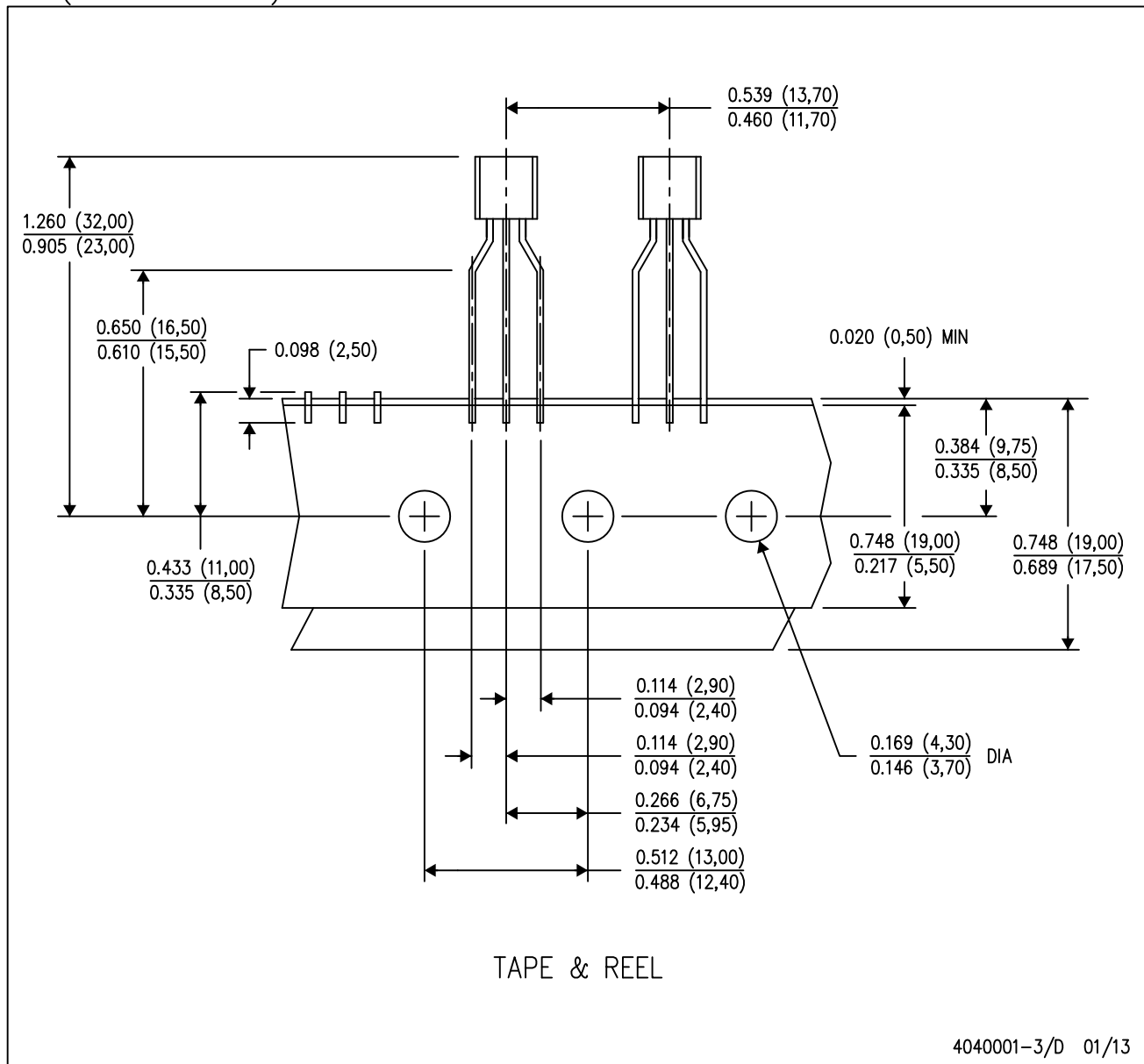


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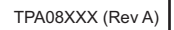
- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - Lead dimensions are not controlled within this area.
 - Falls within JEDEC TO-226 Variation AA (TO-226 replaces TO-92).
 - Shipping Method:
 - Straight lead option available in either bulk pack or tape & reel.
 - Formed lead option available in tape & reel or ammo pack.
 - Specific products can be offered in limited combinations of shipping mediums and lead options.
 - Consult product folder for more information on available options.

LP (O-PBCY-W3)

PLASTIC CYLINDRICAL PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Tape and Reel information for the Formed Lead Option package.



NOTES: A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
B. This drawing is subject to change without notice.

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