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July 2015

# MC78LXXA / LM78LXXA

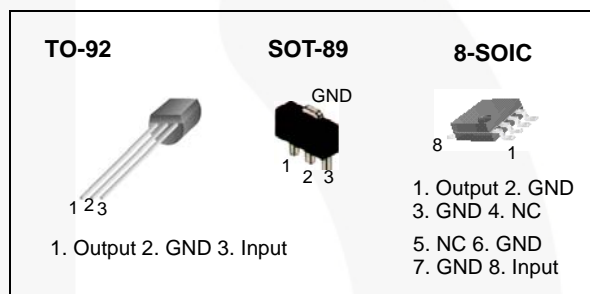
## 3-Terminal 0.1 A Positive Voltage Regulator

### Features

- Maximum Output Current of 100 mA
- Output Voltage of 5 V, 6 V, 8 V, 12 V, and 15 V
- Thermal Overload Protection
- Short-Circuit Current Limiting
- Output Voltage Offered in  $\pm 5\%$  Tolerance

### Description

The MC78LXXA / LM78LXXA series of fixed-voltage monolithic integrated circuit voltage regulators are suitable for applications that required supply current up to 100 mA.



### Ordering Information

Product Number	Package	Packing Method	Output Voltage Tolerance	Operating Temperature
LM78L05ACZ	TO-92	Bulk	$\pm 5\%$	-40 to +125°C
LM78L05ACZX		Tape & Reel		
LM78L05ACZXAX		Ammo		
LM78L12ACZ		Bulk		
LM78L12ACZX		Tape & Reel		
MC78L05ACP		Bulk		
MC78L05ACPXAX		Ammo		
MC78L06ACP		Bulk		
MC78L08ACP		Bulk		
MC78L15ACP		Bulk		
MC78L15ACPXAX		Ammo		
MC78L05ACD	8-SOIC	Rail		
MC78L05ACDX		Tape & Reel		
MC78L05ACHX	SOT-89	Tape & Reel		
MC78L08ACHX		Tape & Reel		

## Block Diagram

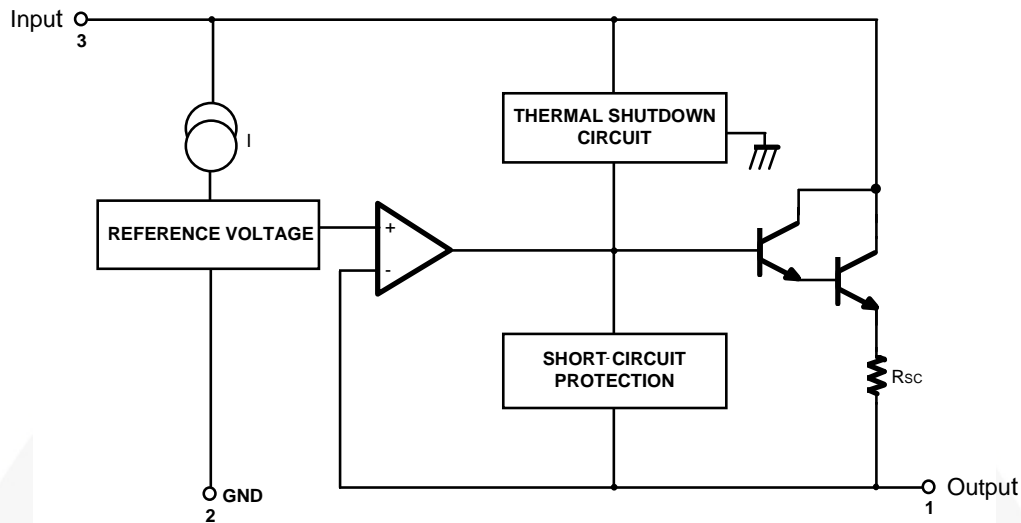


Figure 1. Block Diagram

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only. Values are at  $T_A = 25^\circ\text{C}$  unless otherwise noted.

Symbol	Parameter		Value	Unit
$V_I$	Input Voltage	$V_O = 5\text{ V to }8\text{ V}$	30	V
		$V_O = 12\text{ V to }15\text{ V}$	35	V
$T_{\text{OPR}}$	Operating Temperature Range		-40 to +125°C	°C
$T_{\text{J(MAX)}}$	Maximum Junction Temperature		150	°C
$T_{\text{STG}}$	Storage Temperature Range		-65 to +150	°C
$R_{\theta\text{JC}}$	Thermal Resistance, Junction-Case	TO-92	50	°C/W
$R_{\theta\text{JA}}$	Thermal Resistance, Junction-Air	TO-92	150	°C/W
		SOT-89	225	°C/W
		8-SOIC	160	°C/W

**Electrical Characteristics (MC78L05A / LM78L05A)**

$V_I = 10\text{ V}$ ,  $I_O = 40\text{ mA}$ ,  $-40^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter		Conditions		Min.	Typ.	Max.	Unit
V <sub>O</sub>	Output Voltage		T <sub>J</sub> = 25°C		4.8	5.0	5.2	V
ΔV <sub>O</sub>	Line Regulation <sup>(1)</sup>		T <sub>J</sub> = 25°C	7 V ≤ V <sub>I</sub> ≤ 20 V		8	150	mV
				8 V ≤ V <sub>I</sub> ≤ 20 V		6	100	mV
ΔV <sub>O</sub>	Load Regulation <sup>(1)</sup>		T <sub>J</sub> = 25°C	1 mA ≤ I <sub>O</sub> ≤ 100 mA		11	60	mV
				1 mA ≤ I <sub>O</sub> ≤ 40 mA		5.0	30.0	mV
V <sub>O</sub>	Output Voltage		7 V ≤ V <sub>I</sub> ≤ 20 V	1 mA ≤ I <sub>O</sub> ≤ 40 mA			5.25	V
			7 V ≤ V <sub>I</sub> ≤ V <sub>MAX</sub> <sup>(2)</sup>	1 mA ≤ I <sub>O</sub> ≤ 70 mA	4.75		5.25	V
I <sub>Q</sub>	Quiescent Current		T <sub>J</sub> = 25°C			2.0	5.5	mA
ΔI <sub>Q</sub>	Quiescent Current Change	With Line	8 V ≤ V <sub>I</sub> ≤ 20 V				1.5	mA
ΔI <sub>Q</sub>		With Load	1 mA ≤ I <sub>O</sub> ≤ 40 mA				0.1	mA
V <sub>N</sub>	Output Noise Voltage		T <sub>A</sub> = 25°C, 10 Hz ≤ f ≤ 100 kHz			40		μV/V <sub>O</sub>
ΔV <sub>O</sub> /ΔT	Temperature Coefficient of V <sub>O</sub>		I <sub>O</sub> = 5 mA			-0.65		mV/°C
RR	Ripple Rejection		f = 120 Hz, 8 V ≤ V <sub>I</sub> ≤ 18 V, T <sub>J</sub> = 25°C		41	80		dB
V <sub>D</sub>	Dropout Voltage		T <sub>J</sub> = 25°C			1.7		V

**Notes:**

1. The maximum steady-state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represents pulse test conditions with junction temperature as indicated at the initiation of tests.
2. Power dissipation  $P_D \leq 0.75\text{ W}$ .

**Electrical Characteristics (MC78L06A)**

$V_I = 12\text{ V}$ ,  $I_O = 40\text{ mA}$ ,  $-40^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter		Conditions	Min.	Typ.	Max.	Unit
$V_O$	Output Voltage		$T_J = 25^\circ\text{C}$	5.75	6.0	6.25	V
$\Delta V_O$	Line Regulation <sup>(3)</sup>		$T_J = 25^\circ\text{C}$				
			$8.5\text{ V} \leq V_I \leq 20\text{ V}$		64	175	mV
			$9\text{ V} \leq V_I \leq 20\text{ V}$		54	125	mV
$\Delta V_O$	Load Regulation <sup>(3)</sup>		$T_J = 25^\circ\text{C}$				
			$1\text{ mA} \leq I_O \leq 100\text{ mA}$		12.8	80.0	mV
			$1\text{ mA} \leq I_O \leq 70\text{ mA}$		5.8	40.0	mV
$V_O$	Output Voltage		$8.5\text{ V} \leq V_I \leq 20\text{ V}$ , $1\text{ mA} \leq I_O \leq 40\text{ mA}$	5.7		6.3	V
			$8.5\text{ V} \leq V_I \leq V_{\text{MAX}}^{(4)}$ , $1\text{ mA} \leq I_O \leq 70\text{ mA}$	5.7		6.3	V
$I_Q$	Quiescent Current		$T_J = 25^\circ\text{C}$			5.5	mA
			$T_J = 125^\circ\text{C}$		3.9	6.0	mA
$\Delta I_Q$	Quiescent Current Change	With Line	$9\text{ V} \leq V_I \leq 20\text{ V}$			1.5	mA
$\Delta I_Q$		With Load	$1\text{ mA} \leq I_O \leq 40\text{ mA}$			0.1	mA
$V_N$	Output Noise Voltage		$T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$		40		$\mu\text{V}/V_O$
$\Delta V_O/\Delta T$	Temperature Coefficient of $V_O$		$I_O = 5\text{ mA}$		0.75		$\text{mV}/^\circ\text{C}$
RR	Ripple Rejection		$f = 120\text{ Hz}$ , $10\text{ V} \leq V_I \leq 20\text{ V}$ , $T_J = 25^\circ\text{C}$	40	46		dB
$V_D$	Dropout Voltage		$T_J = 25^\circ\text{C}$		1.7		V

**Notes:**

- The maximum steady-state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represents pulse test conditions with junction temperature as indicated at the initiation of tests.
- Power dissipation  $P_D \leq 0.75\text{ W}$ .

**Electrical Characteristics (MC78L08A)**

$V_I = 14\text{ V}$ ,  $I_O = 40\text{ mA}$ ,  $-40^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$V_O$	Output Voltage	$T_J = 25^\circ\text{C}$	7.7	8.0	8.3	V
$\Delta V_O$	Line Regulation <sup>(5)</sup>	$T_J = 25^\circ\text{C}$		10	175	mV
		$10.5\text{ V} \leq V_I \leq 23\text{ V}$		8	125	mV
$\Delta V_O$	Load Regulation <sup>(5)</sup>	$T_J = 25^\circ\text{C}$		15	80	mV
		$1\text{ mA} \leq I_O \leq 40\text{ mA}$		8	40	mV
$V_O$	Output Voltage	$10.5\text{ V} \leq V_I \leq 23\text{ V}$	7.6		8.4	V
		$10.5\text{ V} \leq V_I \leq V_{\text{MAX}}^{(6)}$	7.6		8.4	V
$I_Q$	Quiescent Current	$T_J = 25^\circ\text{C}$		2.0	5.5	mA
$\Delta I_Q$	Quiescent Current Change	With Line			1.5	mA
$\Delta I_Q$		With Load			0.1	mA
$V_N$	Output Noise Voltage	$T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$		60		$\mu\text{V}/V_O$
$\Delta V_O/\Delta T$	Temperature Coefficient of $V_O$	$I_O = 5\text{ mA}$		-0.8		mV/ $^\circ\text{C}$
RR	Ripple Rejection	$f = 120\text{ Hz}$ , $11\text{ V} \leq V_I \leq 21\text{ V}$ , $T_J = 25^\circ\text{C}$	39	70		dB
$V_D$	Dropout Voltage	$T_J = 25^\circ\text{C}$		1.7		V

**Notes:**

- The maximum steady-state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represents pulse test conditions with junction temperature as indicated at the initiation of tests.
- Power dissipation  $P_D \leq 0.75\text{ W}$ .

**Electrical Characteristics (MC78L12A / LM78L12A)**

$V_I = 19\text{ V}$ ,  $I_O = 40\text{ mA}$ ,  $-40^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter		Conditions		Min.	Typ.	Max.	Unit
V <sub>O</sub>	Output Voltage		T <sub>J</sub> = 25°C		11.5	12.0	12.5	V
ΔV <sub>O</sub>	Line Regulation <sup>(7)</sup>		T <sub>J</sub> = 25°C	14.5 V ≤ V <sub>I</sub> ≤ 27 V		20	250	mV
				16 V ≤ V <sub>I</sub> ≤ 27 V		15	200	mV
ΔV <sub>O</sub>	Load Regulation <sup>(7)</sup>		T <sub>J</sub> = 25°C	1 mA ≤ I <sub>O</sub> ≤ 100 mA		20	100	mV
				1 mA ≤ I <sub>O</sub> ≤ 40 mA		10	50	mV
V <sub>O</sub>	Output Voltage		14.5 V ≤ V <sub>I</sub> ≤ 27 V	1 mA ≤ I <sub>O</sub> ≤ 40 mA	11.4		12.6	V
			14.5 V ≤ V <sub>I</sub> ≤ V <sub>MAX</sub> <sup>(8)</sup>	1 mA ≤ I <sub>O</sub> ≤ 70 mA	11.4		12.6	V
I <sub>Q</sub>	Quiescent Current		T <sub>J</sub> = 25°C			2.1	6.0	mA
ΔI <sub>Q</sub>	Quiescent Current Change	With Line	16 V ≤ V <sub>I</sub> ≤ 27 V				1.5	mA
ΔI <sub>Q</sub>		With Load	1 mA ≤ I <sub>O</sub> ≤ 40 mA				0.1	mA
V <sub>N</sub>	Output Noise Voltage		T <sub>A</sub> = 25°C, 10 Hz ≤ f ≤ 100 kHz			80		μV/V <sub>O</sub>
ΔV <sub>O</sub> /ΔT	Temperature Coefficient of V <sub>O</sub>		I <sub>O</sub> = 5 mA			-1.0		mV/°C
RR	Ripple Rejection		f = 120 Hz, 15 V ≤ V <sub>I</sub> ≤ 25 V, T <sub>J</sub> = 25°C		37	65		dB
V <sub>D</sub>	Dropout Voltage		T <sub>J</sub> = 25°C			1.7		V

**Notes:**

- The maximum steady-state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represents pulse test conditions with junction temperature as indicated at the initiation of tests.
- Power dissipation  $P_D \leq 0.75\text{ W}$ .

**Electrical Characteristics (MC78L15A)**

$V_I = 23\text{ V}$ ,  $I_O = 40\text{ mA}$ ,  $-40^\circ\text{C} \leq T_J \leq 125^\circ\text{C}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$ , unless otherwise specified.

Symbol	Parameter		Conditions	Min.	Typ.	Max.	Unit
$V_O$	Output Voltage		$T_J = 25^\circ\text{C}$	14.4	15.0	15.6	V
$\Delta V_O$	Line Regulation <sup>(9)</sup>		$T_J = 25^\circ\text{C}$		25	300	mV
			$17.5\text{ V} \leq V_I \leq 30\text{ V}$		20	250	mV
$\Delta V_O$	Load Regulation <sup>(9)</sup>		$T_J = 25^\circ\text{C}$		25	150	mV
			$1\text{ mA} \leq I_O \leq 100\text{ mA}$		12	75	mV
$V_O$	Output Voltage		$17.5\text{ V} \leq V_I \leq 30\text{ V}$	$1\text{ mA} \leq I_O \leq 40\text{ mA}$	14.25	15.75	V
			$17.5\text{ V} \leq V_I \leq V_{\text{MAX}}^{(10)}$	$1\text{ mA} \leq I_O \leq 70\text{ mA}$	14.25	15.75	V
$I_Q$	Quiescent Current		$T_J = 25^\circ\text{C}$		2.1	6.0	mA
$\Delta I_Q$	Quiescent Current Change	With Line	$20\text{ V} \leq V_I \leq 30\text{ V}$			1.5	mA
$\Delta I_Q$		With Load	$1\text{ mA} \leq I_O \leq 40\text{ mA}$			0.1	mA
$V_N$	Output Noise Voltage		$T_A = 25^\circ\text{C}$ , $10\text{ Hz} \leq f \leq 100\text{ kHz}$		90		$\mu\text{V}/V_O$
$\Delta V_O/\Delta T$	Temperature Coefficient of $V_O$		$I_O = 5\text{ mA}$		-1.3		$\text{mV}/^\circ\text{C}$
RR	Ripple Rejection		$f = 120\text{ Hz}$ , $18.5\text{ V} \leq V_I \leq 28.5\text{ V}$ , $T_J = 25^\circ\text{C}$	34	60		dB
$V_D$	Dropout Voltage		$T_J = 25^\circ\text{C}$		1.7		V

**Notes:**

9. The maximum steady-state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represents pulse test conditions with junction temperature as indicated at the initiation of tests.

10. Power dissipation  $P_D \leq 0.75\text{ W}$ .



## Typical Application

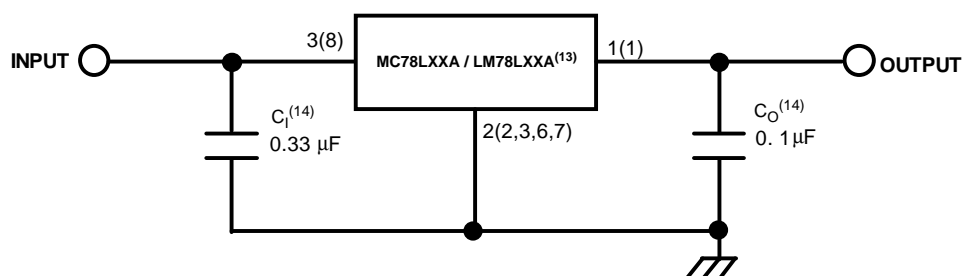
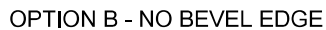
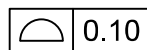
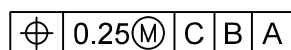


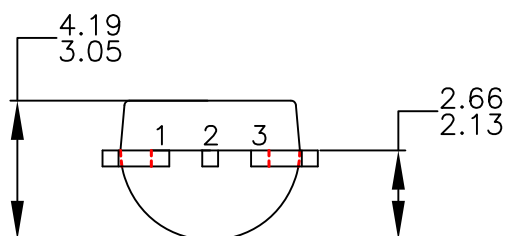
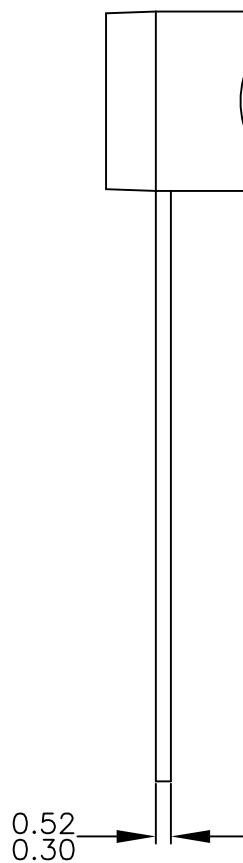
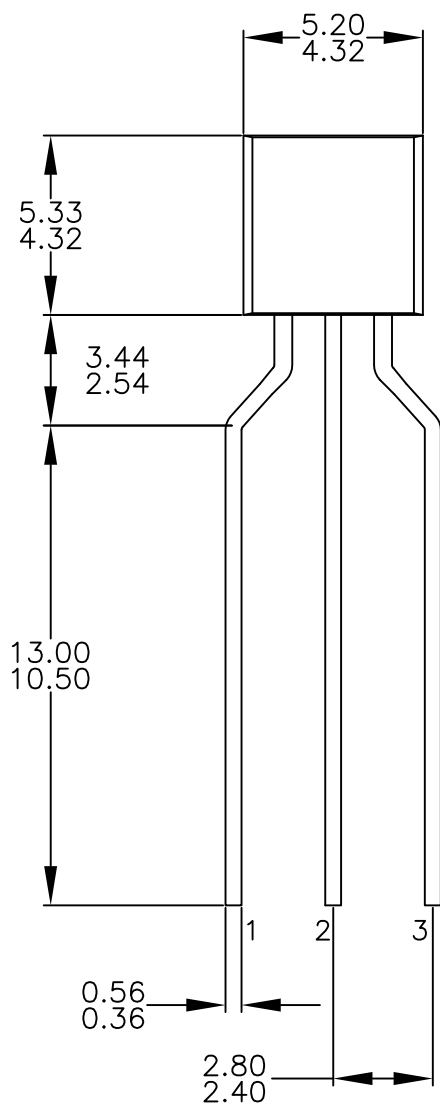
Figure 2. Typical Application

### Notes:

13. To specify an output voltage, substitute voltage value for "XX".
14.  $C_1$  is required if the regulator is located an appreciable distance from the power supply filter. Though  $C_0$  is not needed for stability, it improves transient response. Bypass capacitors are recommended for optimum stability and transient response and should be located as close as possible to the regulator.

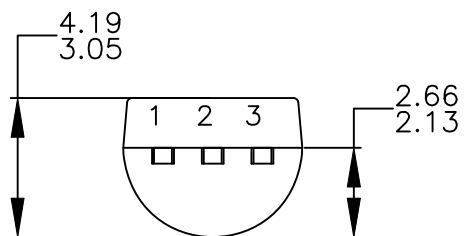
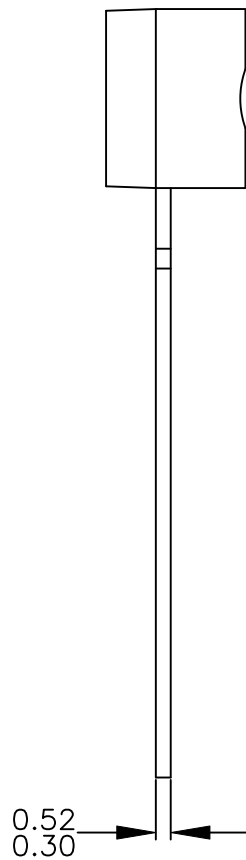
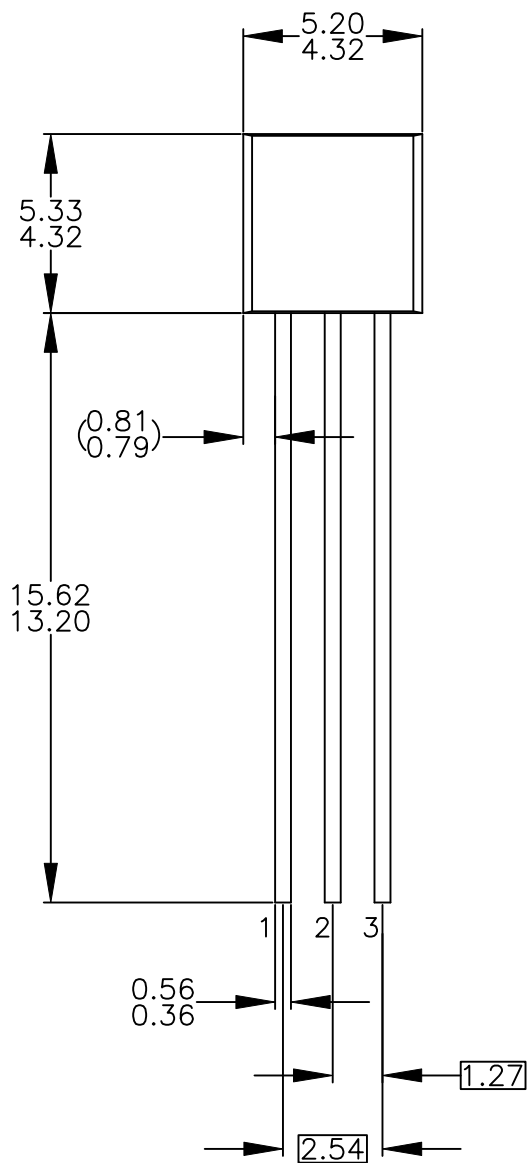


- A) THIS PACKAGE CONFORMS TO JEDEC MS-012, VARIATION AA.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
- D) LANDPATTERN STANDARD: SOIC127P600X175-8M
- E) DRAWING FILENAME: M08Arev16



NOTES: UNLESS OTHERWISE SPECIFIED

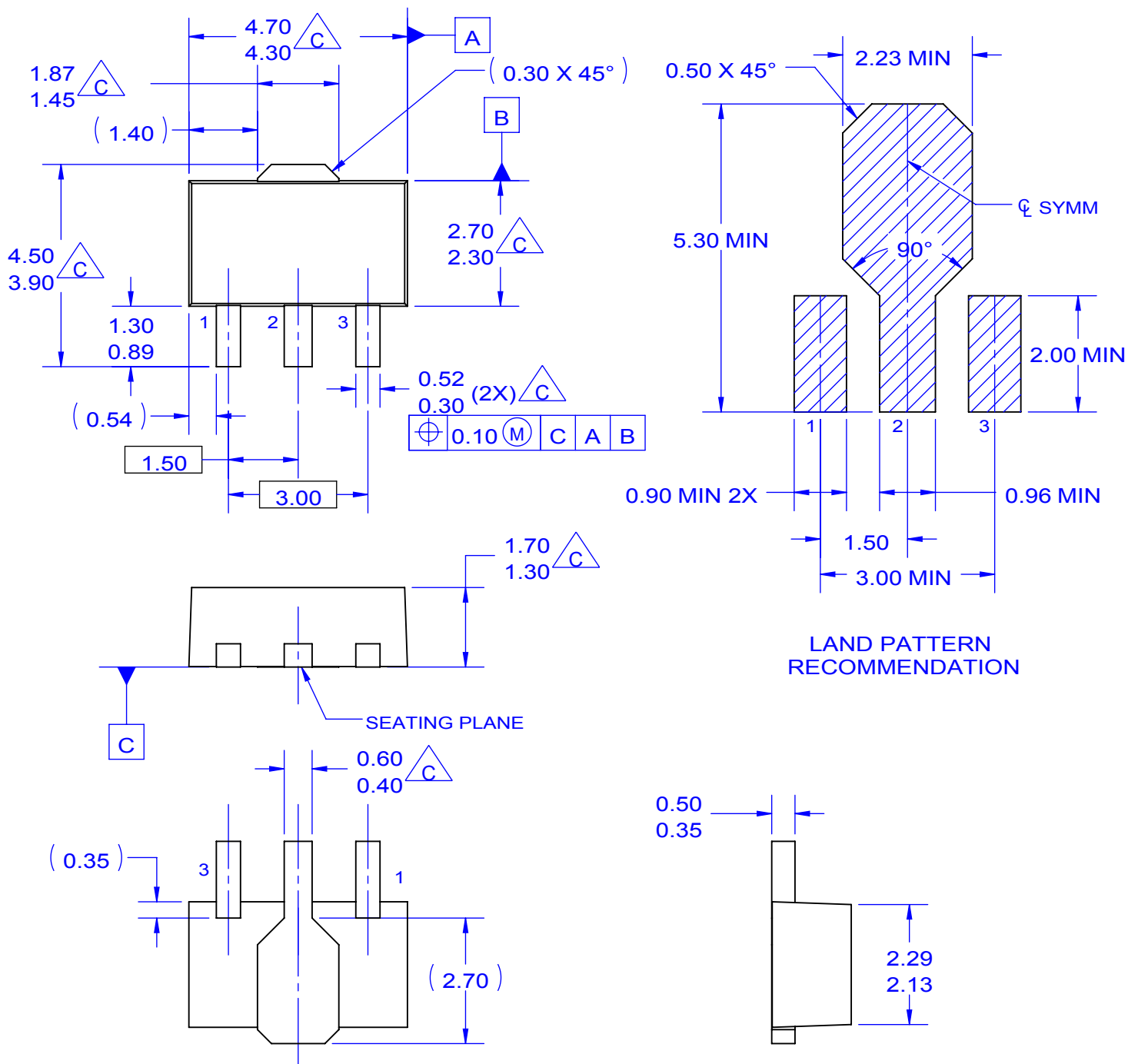
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(C) DOES NOT COMPLY JEDEC STANDARD VALUE.  
D. DIMENSIONS ARE EXCLUSIVE OF BURRS,  
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