

# LM78MXX

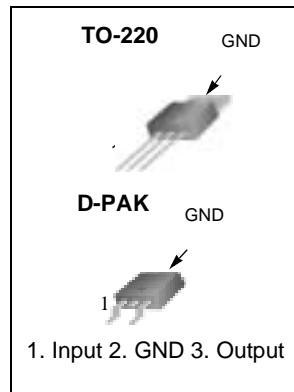
## 3-Terminal 0.5A Positive Voltage Regulator

### Features

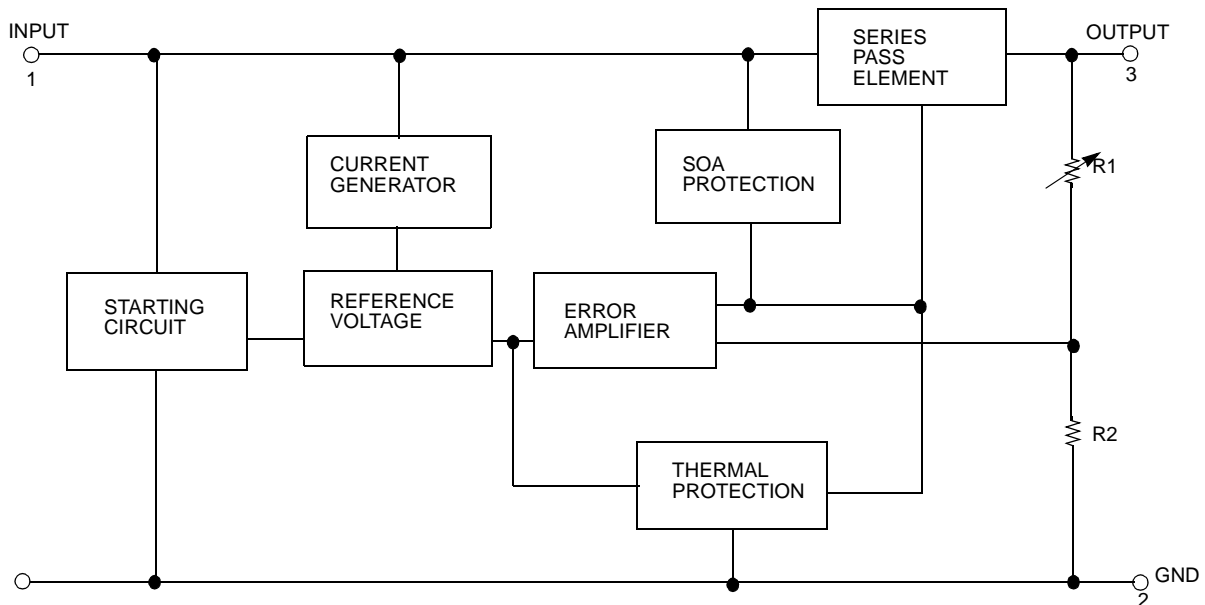
- Output Current up to 0.5A
- Output Voltages of 5, 6, 8, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area (SOA) Protection

### Description

The LM78MXX series of three-terminal positive regulators are available in the TO-220/D-PAK package with several fixed output voltages making it useful in a wide range of applications.



### Internal Block Diagram



## Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Input Voltage (for $V_O = 5V$ to $18V$ ) (for $V_O = 24V$ )	$V_I$	35	V
	$V_I$	40	V
Thermal Resistance Junction-Case (Note1) TO-220 ( $T_c = +25^\circ C$ )	$R_{\theta JC}$	2.5	$^\circ C/W$
Thermal Resistance Junction-Air (Note1, 2) TO-220 ( $T_a = +25^\circ C$ ) D-PAK ( $T_a = +25^\circ C$ )	$R_{\theta JA}$	66 92	$^\circ C/W$
Operating Junction Temperature Range	TOPR	0 ~ +150	$^\circ C$
Storage Temperature Range	TSTG	-65 ~ +150	$^\circ C$

### Note:

- Thermal resistance test board  
Size: 76.2mm \* 114.3mm \* 1.6mm(1S0P)  
JEDEC standard: JESD51-3, JESD51-7
- Assume no ambient airflow

## Electrical Characteristics (LM78M05)

(Refer to the test circuits,  $0 \leq T_J \leq +125^\circ C$ ,  $I_O = 350mA$ ,  $V_I = 10V$ , unless otherwise specified,  $C_I = 0.33\mu F$ ,  $C_O = 0.1\mu F$ )

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	$V_O$	$T_J = +25^\circ C$	4.8	5	5.2	V
		$I_O = 5mA$ to $350mA$ $V_I = 7V$ to $20V$	4.75	5	5.25	
Line Regulation (Note3)	$\Delta V_O$	$I_O = 200mA$ $T_J = +25^\circ C$	-	-	100	mV
		$V_I = 7V$ to $25V$ $V_I = 8V$ to $25V$	-	-	50	
Load Regulation (Note3)	$\Delta V_O$	$I_O = 5mA$ to $0.5A$ , $T_J = +25^\circ C$	-	-	100	mV
		$I_O = 5mA$ to $200mA$ , $T_J = +25^\circ C$	-	-	50	
Quiescent Current	$I_Q$	$T_J = +25^\circ C$	-	4.0	6.0	mA
Quiescent Current Change	$\Delta I_Q$	$I_O = 5mA$ to $350mA$	-	-	0.5	mA
		$I_O = 200mA$ $V_I = 8V$ to $25V$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5mA$ $T_J = 0$ to $+125^\circ C$	-	-0.5	-	mV/ $^\circ C$
Output Noise Voltage	$V_N$	$f = 10Hz$ to $100kHz$	-	40	-	$\mu V/V_O$
Ripple Rejection	RR	$f = 120Hz$ , $I_O = 300mA$ $V_I = 8V$ to $18V$ , $T_J = +25^\circ C$	-	80	-	dB
Dropout Voltage	$V_D$	$T_J = +25^\circ C$ , $I_O = 500mA$	-	2	-	V
Short Circuit Current	ISC	$T_J = +25^\circ C$ , $V_I = 35V$	-	300	-	mA
Peak Current	IPK	$T_J = +25^\circ C$	-	700	-	mA

### Note:

- Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

**Electrical Characteristics (LM78M06)** (Continued)(Refer to the test circuits,  $0 \leq T_J \leq +125^\circ\text{C}$ ,  $I_O=350\text{mA}$ ,  $V_I=11\text{V}$ , unless otherwise specified,  $C_I=0.33\mu\text{F}$ ,  $C_O=0.1\mu\text{F}$ )

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
Output Voltage	$V_O$	$T_J = +25^\circ\text{C}$	5.75	6	6.25	V	
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 8\text{V to } 21\text{V}$	5.7	6	6.3		
Line Regulation (Note1)	$\Delta V_O$	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	$V_I = 8\text{V to } 25\text{V}$	-	-	100	mV
			$V_I = 9\text{V to } 25\text{V}$	-	-	50	
Load Regulation (Note1)	$\Delta V_O$	$I_O = 5\text{mA to } 0.5\text{A}$ , $T_J = +25^\circ\text{C}$	-	-	120	mV	
		$I_O = 5\text{mA to } 200\text{mA}$ , $T_J = +25^\circ\text{C}$	-	-	60		
Quiescent Current	$I_Q$	$T_J = +25^\circ\text{C}$	-	4.0	6.0	mA	
Quiescent Current Change	$\Delta I_Q$	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA	
		$I_O = 200\text{mA}$ $V_I = 9\text{V to } 25\text{V}$	-	-	0.8		
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$ $T_J = 0 \text{ to } +125^\circ\text{C}$	-	-0.5	-	mV/ $^\circ\text{C}$	
Output Noise Voltage	$V_N$	$f = 10\text{Hz to } 100\text{kHz}$	-	45	-	$\mu\text{V}/V_O$	
Ripple Rejection	RR	$f = 120\text{Hz}$ , $I_O = 300\text{mA}$ $V_I = 9\text{V to } 19\text{V}$ , $T_J = +25^\circ\text{C}$	-	80	-	dB	
Dropout Voltage	$V_D$	$T_J = +25^\circ\text{C}$ , $I_O = 500\text{mA}$	-	2	-	V	
Short Circuit Current	ISC	$T_J = +25^\circ\text{C}$ , $V_I = 35\text{V}$	-	300	-	mA	
Peak Current	IPK	$T_J = +25^\circ\text{C}$	-	700	-	mA	

**Note:**

1. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

**Electrical Characteristics (LM78M08)** (Continued)

(Refer to the test circuits,  $0 \leq T_J \leq +125^\circ\text{C}$ ,  $I_O=350\text{mA}$ ,  $V_I=14\text{V}$ , unless otherwise specified,  $C_I = 0.33\mu\text{F}$ ,  $C_O=0.1\mu\text{F}$ )

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
Output Voltage	$V_O$	$T_J = +25^\circ\text{C}$	7.7	8	8.3	V	
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 10.5\text{V to } 23\text{V}$	7.6	8	8.4		
Line Regulation (Note1)	$\Delta V_O$	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	$V_I = 10.5\text{V to } 25\text{V}$	-	-	100	mV
			$V_I = 11\text{V to } 25\text{V}$	-	-	50	
Load Regulation (Note1)	$\Delta V_O$	$I_O = 5\text{mA to } 0.5\text{A}$ , $T_J = +25^\circ\text{C}$		-	-	160	mV
		$I_O = 5\text{mA to } 200\text{mA}$ , $T_J = +25^\circ\text{C}$		-	-	80	
Quiescent Current	$I_Q$	$T_J = +25^\circ\text{C}$	-	4.0	6.0	mA	
Quiescent Current Change	$\Delta I_Q$	$I_O = 5\text{mA to } 350\text{mA}$		-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 10.5\text{V to } 25\text{V}$		-	-	0.8	
Output Voltage Drift	RR	$I_O = 5\text{mA}$ $T_J = 0 \text{ to } +125^\circ\text{C}$	-	-0.5	-	mV/ $^\circ\text{C}$	
Output Noise Voltage	$V_N$	$f = 10\text{Hz to } 100\text{kHz}$	-	52	-	$\mu\text{V}/V_O$	
Ripple Rejection	RR	$f = 120\text{Hz}$ , $I_O = 300\text{mA}$ $V_I = 11.5\text{V to } 21.5\text{V}$ , $T_J = +25^\circ\text{C}$	-	80	-	dB	
Dropout Voltage	$V_D$	$T_J = +25^\circ\text{C}$ , $I_O = 500\text{mA}$	-	2	-	V	
Short Circuit Current	ISC	$T_J = +25^\circ\text{C}$ , $V_I = 35\text{V}$	-	300	-	mA	
Peak Current	IPK	$T_J = +25^\circ\text{C}$	-	700	-	mA	

**Note:**

1. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

**Electrical Characteristics (LM78M12)** (Continued)

(Refer to the test circuits,  $0 \leq T_J \leq +125^\circ\text{C}$ ,  $I_O=350\text{mA}$ ,  $V_I=19\text{V}$ , unless otherwise specified,  $C_I=0.33\mu\text{F}$ ,  $C_O=0.1\mu\text{F}$ )

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	$V_O$	$T_J = +25^\circ\text{C}$	11.5	12	12.5	V
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 14.5\text{V to } 27\text{V}$	11.4	12	12.6	
Line Regulation (Note1)	$\Delta V_O$	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	100	mV
		$V_I = 14.5\text{V to } 30\text{V}$ $V_I = 16\text{V to } 30\text{V}$	-	-	50	
Load Regulation (Note1)	$\Delta V_O$	$I_O = 5\text{mA to } 0.5\text{A}$ , $T_J = +25^\circ\text{C}$	-	-	240	mV
		$I_O = 5\text{mA to } 200\text{mA}$ , $T_J = +25^\circ\text{C}$	-	-	120	
Quiescent Current	$I_Q$	$T_J = +25^\circ\text{C}$	-	4.1	6.0	mA
Quiescent Current Change	$\Delta I_Q$	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 14.5\text{V to } 30\text{V}$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$ $T_J = 0 \text{ to } +125^\circ\text{C}$	-	-0.5	-	mV/ $^\circ\text{C}$
Output Noise Voltage	$V_N$	$f = 10\text{Hz to } 100\text{kHz}$	-	75	-	$\mu\text{V}/V_O$
Ripple Rejection	RR	$f = 120\text{Hz}$ , $I_O = 300\text{mA}$ $V_I = 15\text{V to } 25\text{V}$ , $T_J = +25^\circ\text{C}$	-	80	-	dB
Dropout Voltage	$V_D$	$T_J = +25^\circ\text{C}$ , $I_O = 500\text{mA}$	-	2	-	V
Short Circuit Current	$I_{SC}$	$T_J = +25^\circ\text{C}$ , $V_I = 35\text{V}$	-	300	-	mA
Peak Current	$I_{PK}$	$T_J = +25^\circ\text{C}$	-	700	-	mA

**Note:**

1. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

**Electrical Characteristics (LM78M15)** (Continued)

(Refer to the test circuits,  $0 \leq T_J \leq +125^\circ\text{C}$ ,  $I_O=350\text{mA}$ ,  $V_I=23\text{V}$ , unless otherwise specified,  $C_I=0.33\mu\text{F}$ ,  $C_O=0.1\mu\text{F}$ )

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	$V_O$	$T_J = +25^\circ\text{C}$	14.4	15	15.6	V
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 17.5\text{V to } 30\text{V}$	14.25	15	15.75	
Line Regulation (Note1)	$\Delta V_O$	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	100	mV
		$V_I = 17.5\text{V to } 30\text{V}$ $V_I = 20\text{V to } 30\text{V}$	-	-	50	
Load Regulation (Note1)	$\Delta V_O$	$I_O = 5\text{mA to } 0.5\text{A}$ , $T_J = +25^\circ\text{C}$	-	-	300	mV
		$I_O = 5\text{mA to } 200\text{mA}$ , $T_J = +25^\circ\text{C}$	-	-	150	
Quiescent Current	$I_Q$	$T_J = +25^\circ\text{C}$	-	4.1	6.0	mA
Quiescent Current Change	$\Delta I_Q$	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 17.5\text{V to } 30\text{V}$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$ $T_J = 0 \text{ to } +125^\circ\text{C}$	-	-1	-	mV/°C
Output Noise Voltage	$V_N$	$f = 10\text{Hz to } 100\text{kHz}$	-	100	-	$\mu\text{V}/V_o$
Ripple Rejection	RR	$f = 120\text{Hz}$ , $I_O = 300\text{mA}$ $V_I = 18.5\text{V to } 28.5\text{V}$ , $T_J = +25^\circ\text{C}$	-	70	-	dB
Dropout Voltage	$V_D$	$T_J = +25^\circ\text{C}$ , $I_O = 500\text{mA}$	-	2	-	V
Short Circuit Current	$I_{SC}$	$T_J = +25^\circ\text{C}$ , $V_I = 35\text{V}$	-	300	-	mA
Peak Current	$I_{PK}$	$T_J = +25^\circ\text{C}$	-	700	-	mA

**Note:**

1. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

**Electrical Characteristics (LM78M18)** (Continued)(Refer to the test circuits,  $0 \leq T_J \leq +125^\circ\text{C}$ ,  $I_O=350\text{mA}$ ,  $V_I=26\text{V}$ , unless otherwise specified,  $C_I=0.33\mu\text{F}$ ,  $C_O=0.1\mu\text{F}$ )

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	$V_O$	$T_J = +25^\circ\text{C}$	17.3	18	18.7	V
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 20.5\text{V to } 33\text{V}$	17.1	18	18.9	
Line Regulation (Note1)	$\Delta V_O$	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	100	mV
		$V_I = 21\text{V to } 33\text{V}$ $V_I = 24\text{V to } 33\text{V}$	-	-	50	
Load Regulation (Note1)	$\Delta V_O$	$I_O = 5\text{mA to } 0.5\text{A}$ , $T_J = +25^\circ\text{C}$	-	-	360	mV
		$I_O = 5\text{mA to } 200\text{mA}$ , $T_J = +25^\circ\text{C}$	-	-	180	
Quiescent Current	$I_Q$	$T_J = +25^\circ\text{C}$	-	4.2	6.0	mA
Quiescent Current Change	$\Delta I_Q$	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 21\text{V to } 33\text{V}$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$ , $T_J = 0 \text{ to } 125^\circ\text{C}$	-	-1.1	-	mV/ $^\circ\text{C}$
Output Noise Voltage	$V_N$	$f = 10\text{Hz to } 100\text{kHz}$	-	100	-	$\mu\text{V}/V_O$
Ripple Rejection	RR	$f = 120\text{Hz}$ , $I_O = 300\text{mA}$ , $V_I = 22\text{V to } 32\text{V}$ $T_J = +25^\circ\text{C}$	-	70	-	dB
Dropout Voltage	$V_D$	$T_J = +25^\circ\text{C}$ , $I_O = 500\text{mA}$	-	2	-	V
Short Circuit Current	$I_{SC}$	$T_J = +25^\circ\text{C}$ , $V_I = 35\text{V}$	-	300	-	mA
Peak Current	$I_{PK}$	$T_J = +25^\circ\text{C}$	-	700	-	mA

**Note:**

1. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.

**Electrical Characteristics (LM78M24)** (Continued)

(Refer to the test circuits,  $0 \leq T_J \leq +125^\circ\text{C}$ ,  $I_O=350\text{mA}$ ,  $V_I=33\text{V}$ , unless otherwise specified,  $C_I=0.33\mu\text{F}$ ,  $C_O=0.1\mu\text{F}$ )

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output Voltage	$V_O$	$T_J = +25^\circ\text{C}$	23	24	25	V
		$I_O = 5\text{mA to } 350\text{mA}$ $V_I = 27\text{V to } 38\text{V}$	22.8	24	25.2	
Line Regulation (Note1)	$\Delta V_O$	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	100	mV
		$V_I = 27\text{V to } 38\text{V}$ $V_I = 28\text{V to } 38\text{V}$	-	-	50	
Load Regulation (Note1)	$\Delta V_O$	$I_O = 5\text{mA to } 0.5\text{A}$ , $T_J = +25^\circ\text{C}$	-	-	480	mV
		$I_O = 5\text{mA to } 200\text{mA}$ , $T_J = +25^\circ\text{C}$	-	-	240	
Quiescent Current	$I_Q$	$T_J = +25^\circ\text{C}$	-	4.2	6.0	mA
Quiescent Current Change	$\Delta I_Q$	$I_O = 5\text{mA to } 350\text{mA}$	-	-	0.5	mA
		$I_O = 200\text{mA}$ $V_I = 27\text{V to } 38\text{V}$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$ $T_J = 0 \text{ to } +125^\circ\text{C}$	-	-1.2	-	mV/ $^\circ\text{C}$
Output Noise Voltage	$V_N$	$f = 10\text{Hz to } 100\text{kHz}$	-	170	-	$\mu\text{V}/V_O$
Ripple Rejection	RR	$f = 120\text{Hz}$ , $I_O = 300\text{mA}$ $V_I = 28\text{V to } 38\text{V}$ , $T_J = +25^\circ\text{C}$	-	70	-	dB
Dropout Voltage	$V_D$	$T_J = +25^\circ\text{C}$ , $I_O = 500\text{mA}$	-	2	-	V
Short Circuit Current	ISC	$T_J = +25^\circ\text{C}$ , $V_I = 35\text{V}$	-	300	-	mA
Peak Current	IPK	$T_J = +25^\circ\text{C}$	-	700	-	mA

**Note:**

1. Load and line regulation are specified at constant junction temperature. Change in  $V_O$  due to heating effects must be taken into account separately. Pulse testing with low duty is used.



## Typical Applications

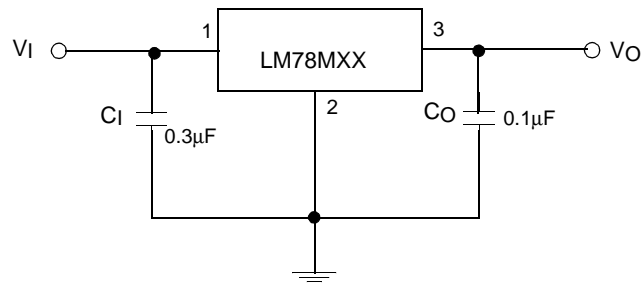


Figure 1. Fixed Output Regulator

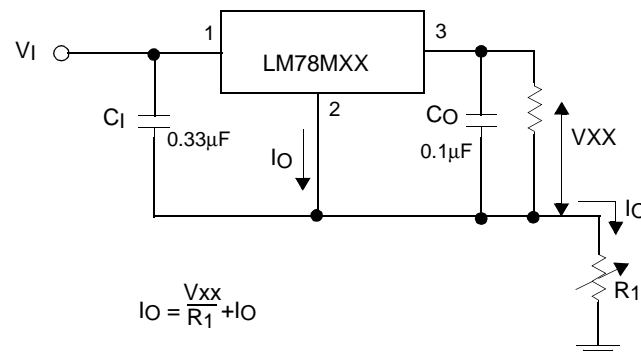


Figure 2. Constant Current Regulator

### Notes:

1. To specify an output voltage, substitute voltage value for "XX"
2. Although no output capacitor is needed for stability, it does improve transient response.
3.  $C_1$  is required if regulator is located an appreciable distance from power Supply filter

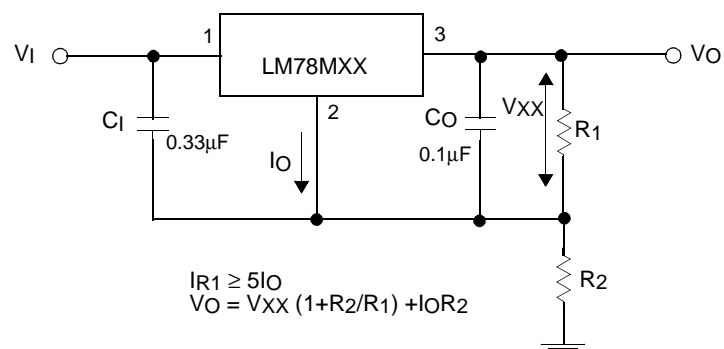


Figure 3. Circuit for Increasing Output Voltage

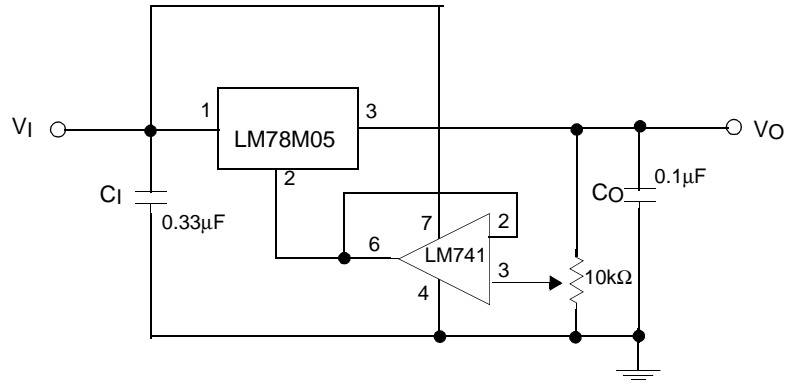


Figure 4. Adjustable Output Regulator (7 to 30V)

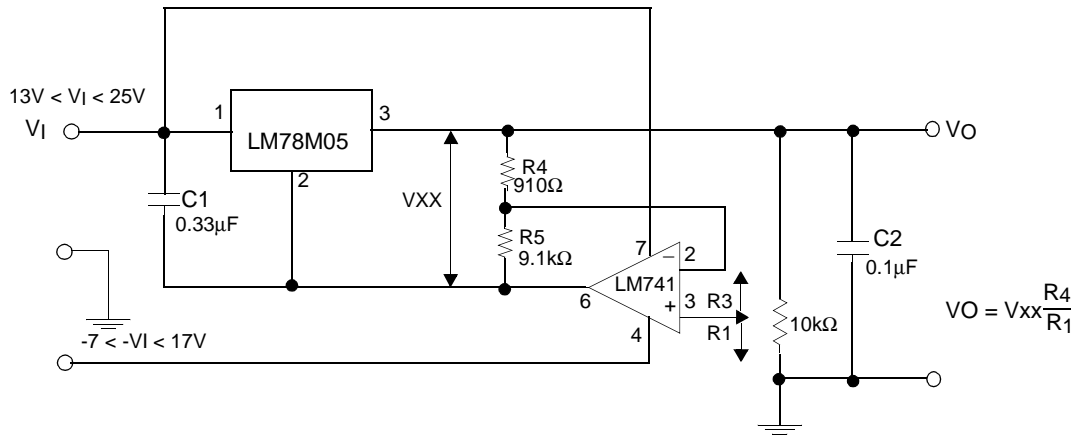


Figure 5. 0.5 to 10V Regulator

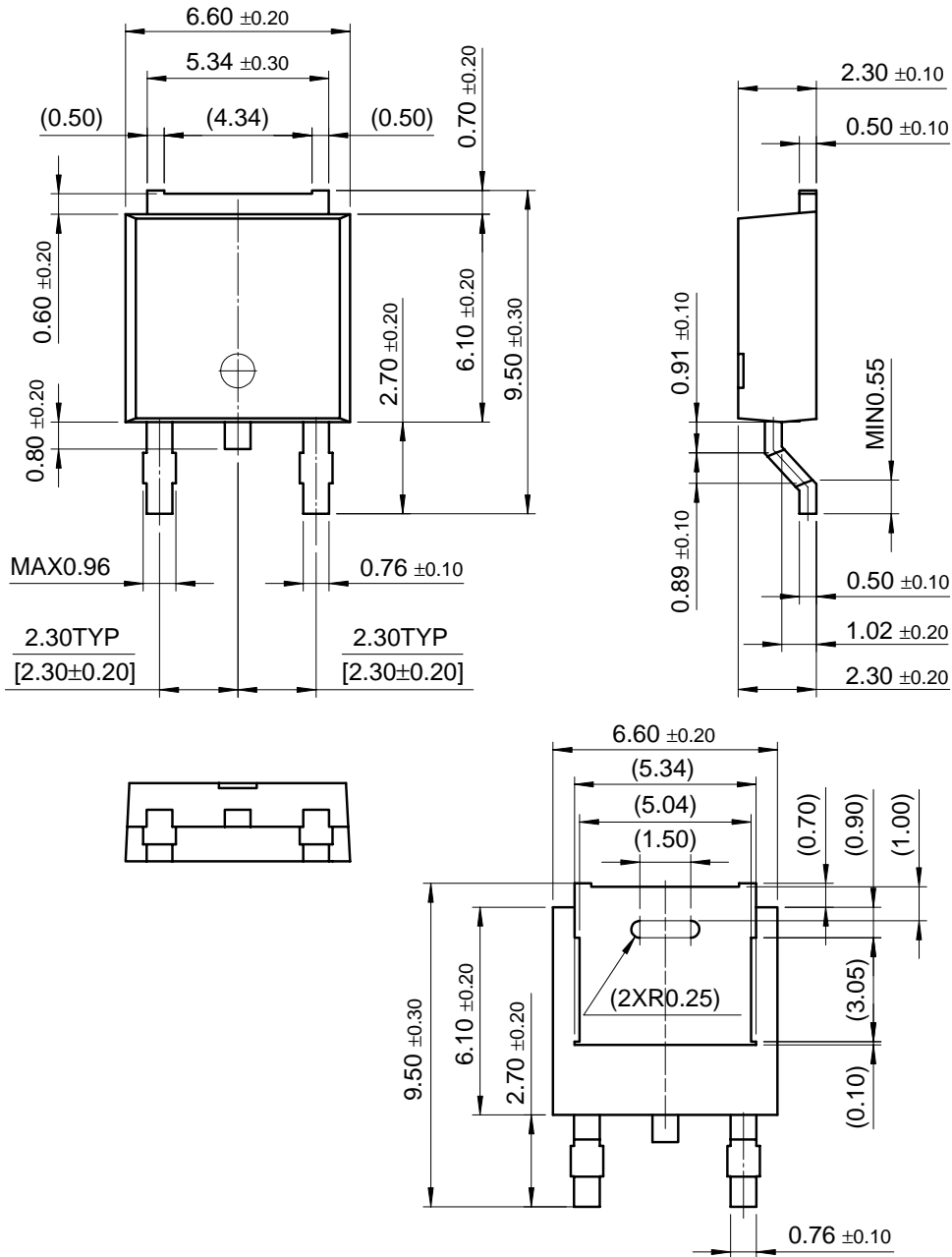


**Mechanical Dimensions** (Continued)

**Package**

Dimensions in millimeters

**D-PAK**



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**Ordering Information**

Product Number	Package	Operating Temperature
LM78M05CT	TO-220	0 ~ +125°C <sub>L</sub>
LM78M06CT		
LM78M08CT		
LM78M12CT		
LM78M15CT		
LM78M18CT		
LM78M24CT		
LM78M05CDT	D-PAK	
LM78M06CDT		
LM78M08CDT		
LM78M12CDT		

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2. A critical component in 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.