

# KA78MXX

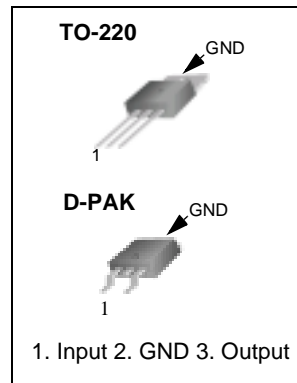
## 3-Terminal 0.5A Positive Voltage Regulator

### Features

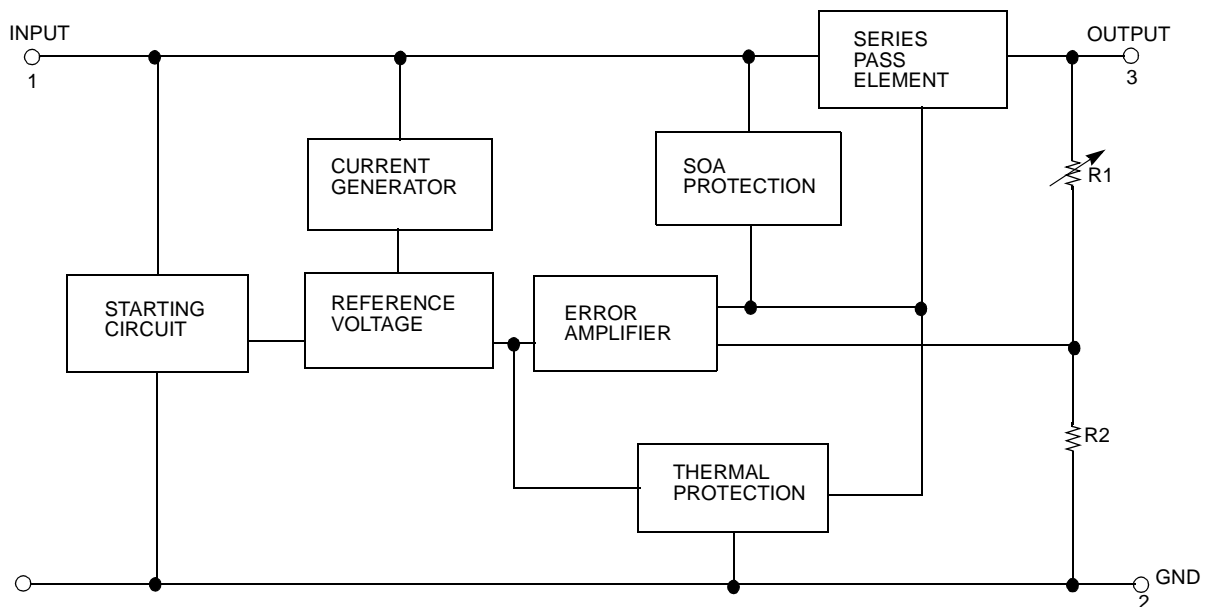
- Output Current up to 0.5A
- Output Voltages of 5, 6, 8, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area (SOA) Protection

### Description

The KA78MXX 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 $V_O = 24V$ )	$V_I$ $V_I$	35 40	V V
Thermal Resistance Junction-Cases (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	$T_{OPR}$	0 ~ +150	$^\circ C$
Storage Temperature Range	$T_{STG}$	-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 (KA78M05/KA78M05R)

(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
		$I_O = 5$ to $350mA$ $V_I = 7$ to $20V$	4.75	5	5.25	
Line Regulation (Note3)	$\Delta V_O$	$I_O = 200mA$ $T_J = +25^\circ C$	-	-	100	mV
		$V_I = 7$ to $25V$ $V_I = 8$ 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
		$I_O = 200mA$ $V_I = 8$ 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	$f = 120Hz$ , $I_O = 300mA$ $V_I = 8$ 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	$I_{SC}$	$T_J = +25^\circ C$ , $V_I = 35V$	-	300	-	mA
Peak Current	$I_{PK}$	$T_J = +25^\circ C$	-	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 (KA78M06/KA78M06R)** (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
		$I_O = 5 \text{ to } 350\text{mA}$ $V_I = 8 \text{ to } 21\text{V}$	5.7	6	6.3	
Line Regulation (Note1)	$\Delta V_O$	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	100	mV
		$V_I = 8 \text{ to } 25\text{V}$ $V_I = 9 \text{ to } 25\text{V}$	-	-	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
		$I_O = 200\text{mA}$ $V_I = 9 \text{ to } 25\text{V}$	-	-	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	$f = 120\text{Hz}$ , $I_O = 300\text{mA}$ $V_I = 9 \text{ to } 19\text{V}$ , $T_J = +25^\circ\text{C}$	-	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 (KA78M08/KA78M08R)** (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	
		$I_O = 5$ to $350\text{mA}$ $V_I = 10.5$ to $23\text{V}$	7.6	8	8.4		
Line Regulation (Note1)	$\Delta V_O$	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	$V_I = 10.5$ to $25\text{V}$	-	-	100	mV
			$V_I = 11$ 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
		$I_O = 200\text{mA}$ $V_I = 10.5$ to $25\text{V}$		-	-	0.8	
Output Voltage Drift	RR	$I_O = 5\text{mA}$ $T_J = 0$ 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	$f = 120\text{Hz}$ , $I_O = 300\text{mA}$ $V_I = 11.5$ 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 (KA78M12/KA78M12R)** (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	
		$I_O = 5$ to $350\text{mA}$ $V_I = 14.5$ to $27\text{V}$	11.4	12	12.6		
Line Regulation (Note1)	$\Delta V_O$	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	$V_I = 14.5$ to $30\text{V}$	-	-	100	mV
			$V_I = 16$ 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	
		$I_O = 200\text{mA}$ $V_I = 14.5$ to $30\text{V}$	-	-	0.8		
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$ $T_J = 0$ 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	$f = 120\text{Hz}$ , $I_O = 300\text{mA}$ $V_I = 15$ 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 (KA78M15)** (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
		$I_O = 5 \text{ to } 350\text{mA}$ $V_I = 17.5 \text{ to } 30\text{V}$	14.25	15	15.75	
Line Regulation (Note1)	$\Delta V_O$	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	-	-	100	mV
		$V_I = 17.5 \text{ to } 30\text{V}$ $V_I = 20 \text{ to } 30\text{V}$	-	-	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
		$I_O = 200\text{mA}$ $V_I = 17.5 \text{ to } 30\text{V}$	-	-	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/ $^\circ\text{C}$
Output Noise Voltage	$V_N$	$f = 10\text{Hz to } 100\text{kHz}$	-	100	-	$\mu\text{V}/V_O$
Ripple Rejection	RR	$f = 120\text{Hz}$ , $I_O = 300\text{mA}$ $V_I = 18.5 \text{ to } 28.5\text{V}$ , $T_J = +25^\circ\text{C}$	-	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 (KA78M18)** (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
		$I_O = 5$ to $350\text{mA}$ $V_I = 20.5$ 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
		$V_I = 21$ to $33\text{V}$ $V_I = 24$ 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
		$I_O = 200\text{mA}$ $V_I = 21$ to $33\text{V}$	-	-	0.8	
Output Voltage Drift	$\Delta V/\Delta T$	$I_O = 5\text{mA}$ , $T_J = 0$ 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	$f = 120\text{Hz}$ , $I_O=300\text{mA}$ , $V_I=22$ 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 (KA78M24)** (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	
		$I_O = 5 \text{ to } 350\text{mA}$ $V_I = 27 \text{ to } 38\text{V}$	22.8	24	25.2		
Line Regulation	$\Delta V_O$	$I_O = 200\text{mA}$ $T_J = +25^\circ\text{C}$	$V_I = 27 \text{ to } 38\text{V}$	-	-	100	mV
			$V_I = 28 \text{ to } 38\text{V}$	-	-	50	
Load Regulation	$\Delta V_O$	$I_O = 5\text{mA} \text{ to } 0.5\text{A}$ , $T_J = +25^\circ\text{C}$	-	-	480	mV	
		$I_O = 5\text{mA} \text{ to } 200\text{mA}$ , $T_J = +25^\circ\text{C}$	-	-	240		
Quiescent Current	$I_Q$	$T_J = +25^\circ\text{C}$	-	4.2	6	mA	
Quiescent Current Change	$\Delta I_Q$	$I_O = 5\text{mA} \text{ to } 350\text{mA}$	-	-	0.5	mA	
		$I_O = 200\text{mA}$ $V_I = 27 \text{ to } 38\text{V}$	-	-	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	$V_N$	$f = 10\text{Hz} \text{ to } 100\text{kHz}$	-	170	-	$\mu\text{V}$	
Ripple Rejection	RR	$f = 120\text{Hz}$ , $I_O = 300\text{mA}$ $V_I = 28 \text{ to } 38\text{V}$ , $T_J = +25^\circ\text{C}$	-	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

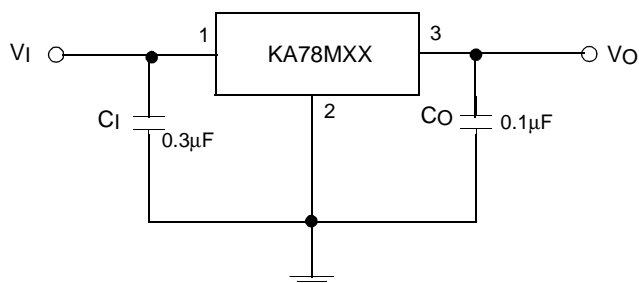


Figure 1. Fixed Output Regulator

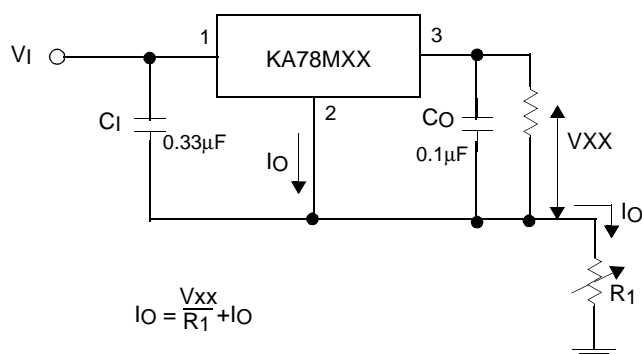


Figure 2. Constant Current Regulator

### 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. Required if regulator is located an appreciable distance from power Supply filter

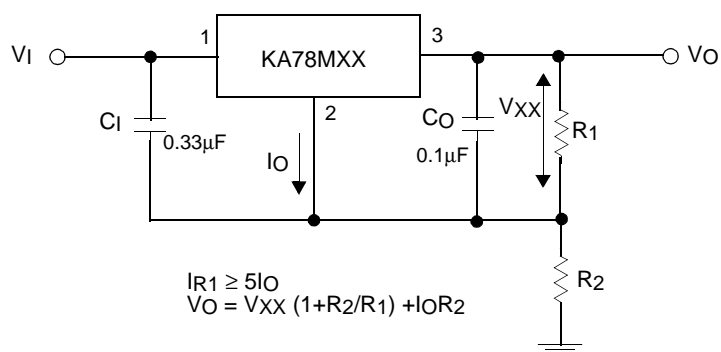


Figure 3. Circuit for Increasing Output Voltage

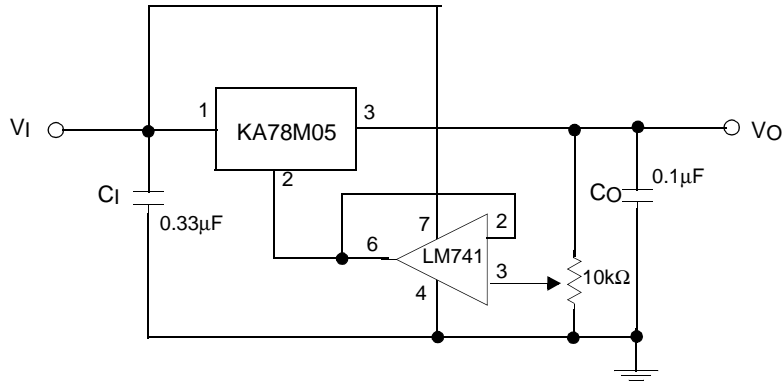


Figure 4. Adjustable Output Regulator (7 to 30V)

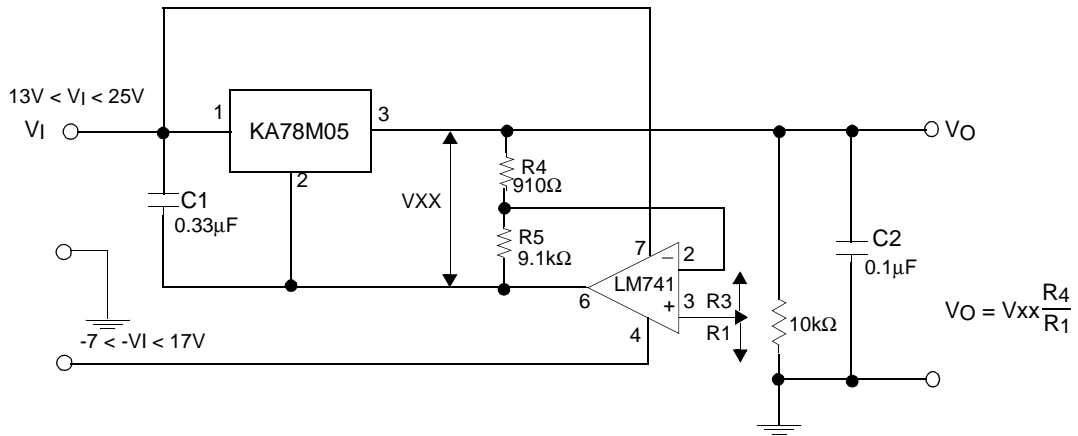


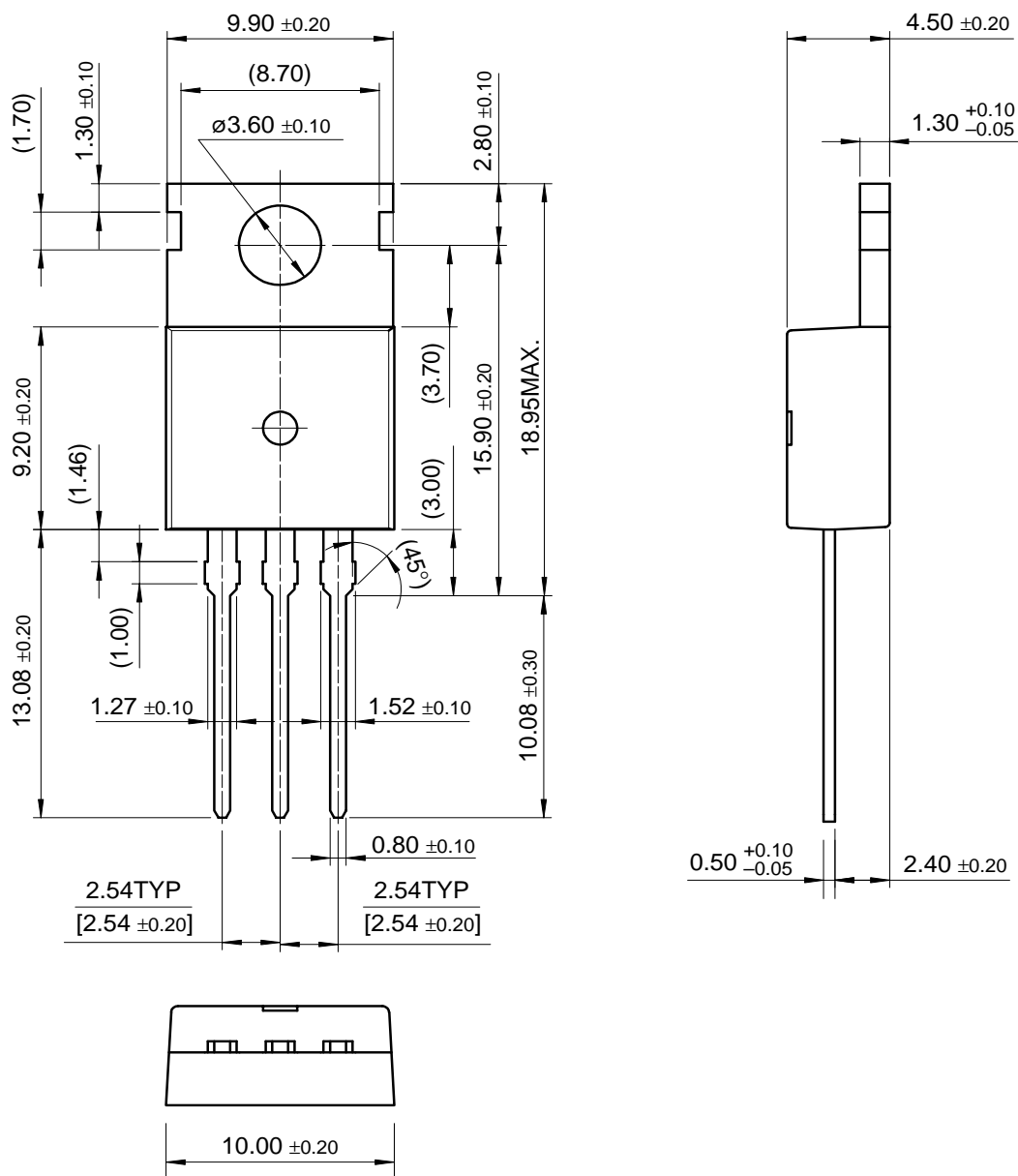
Figure 5. 0.5 to 10V Regulator

# Mechanical Dimensions

## Package

Dimensions in millimeters

### TO-220

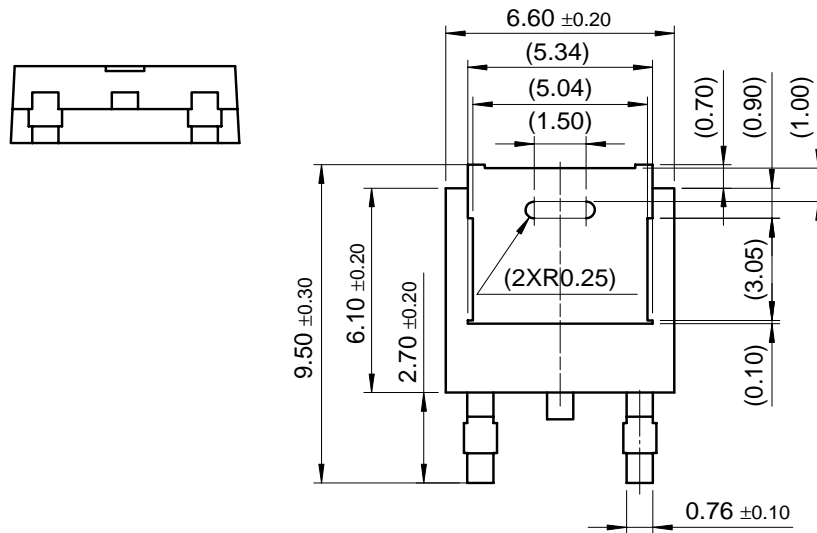
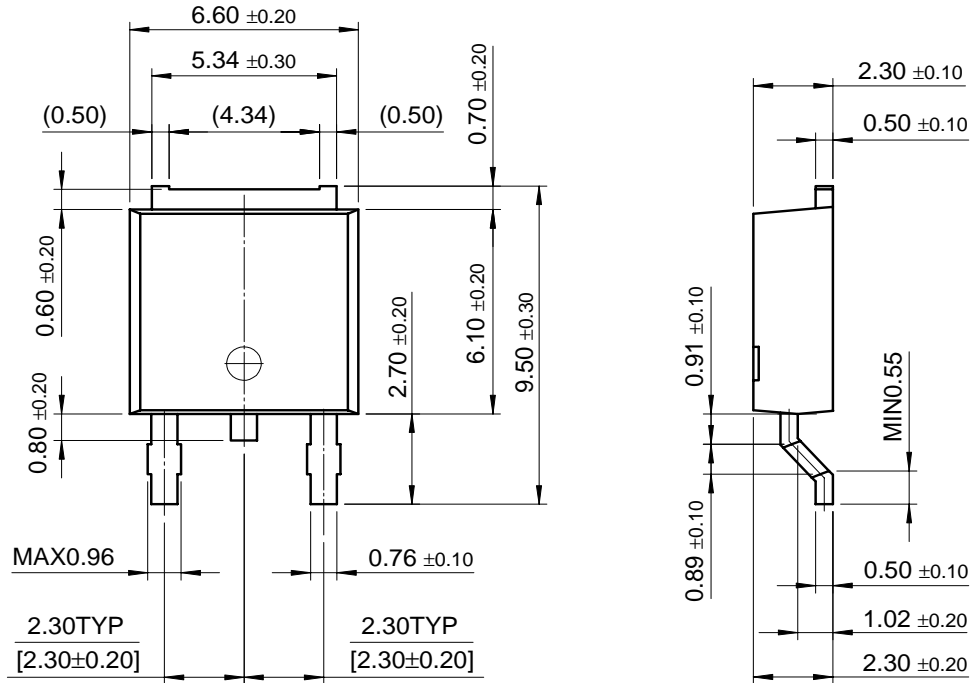


**Mechanical Dimensions** (Continued)

**Package**

Dimensions in millimeters

**D-PAK**



## Ordering Information

Product Number	Package	Operating Temperature
KA78M05	TO-220	0 ~ +125°C
KA78M06		
KA78M08		
KA78M12		
KA78M15		
KA78M18		
KA78M24		
KA78M05R	D-PAK	
KA78M06R		
KA78M08R		
KA78M12R		

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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 (c) 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 of the user.
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.