MIL-PRF-38534 CERTIFIED



DUAL +/-VOLTAGE REGULATOR

5211 SERIES

(315) 701-6751

M.S.KENNEDY CORP.

4707 Dey Road Liverpool, N.Y. 13088

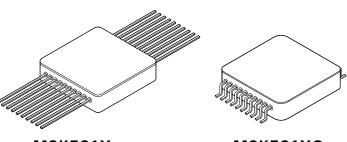
FEATURES:

- Internal Thermal Overload Protection
- Output Current to 1.5 Amps
- Output Voltage Internally Trimmed to $\pm 1\%$ Accuracy
- Electrically Isolated Case
- · Lead Form Options: Straight and Gull Wing
- Alternate Voltage Combinations Available
- Contact MSK for MIL-PRF-38534 Qualification Status

DESCRIPTION:

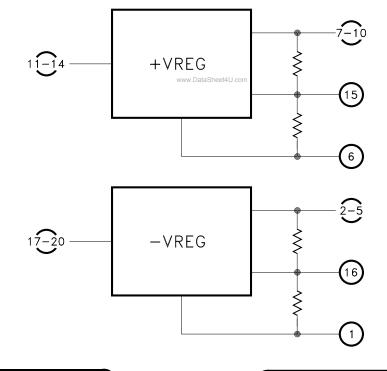
The MSK 5211 series are dual +/- voltage regulators offering excellent output accuracy to $\pm 1\%$ maximum. Excellent line and load regulation characteristics ensure highly accurate performance. The MSK 5211 series regulators are equipped with internal thermal overload protection. The devices are packaged in a space efficient 20 pin flatpack with two lead form options, straight and gull wing.

EQUIVALENT SCHEMATIC



MSK521X

MSK521XG



TYPICAL APPLICATIONS

- Switching Power Supply Post Regulators
- Constant Voltage/Current Regulators
- High Efficiency Linear Regulators
- System Power Supplies

Ρ	IN-OUT II	NFORMA	TION	
1	-VRTN	20	-VIN	
2	-VOUT	19	-VIN	
3	-VOUT	18	-VIN	
4	-VOUT	17	-VIN	
5	-VOUT	16	-Ccomp	
6	+ VRTN	15	+ Ccomp	
7	+ VOUT	14	+ VIN	
8	+ VOUT	13	+ VIN	
9	+ VOUT	12	+ VIN	
10	+VOUT	11	+ VIN	
4 5 6 7 8 9	-VOUT -VOUT + VRTN + VOUT + VOUT + VOUT	17 16 15 14 13 12	-VIN -Ccomp + Ccomp + VIN + VIN + VIN	

ABSOLUTE MAXIMUM RATINGS

$+V_{IN}$	+ Input Voltage (VIN-VOUT)	+ 40VDC
-Vin	-Input Voltage (VIN-VOUT)	
PD	Power Dissipation	Internally Limited
+ І оит	+ Output Current	1.5 A
-lout	-Output Current	1.5 A
TJ	Junction Temperature	+150°C

- Tst Storage Temperature Range -65°C to +150°C
- (10 Seconds)
- Tc Case Operating Temperature MSK 5211-5214(H/E) -55°C to +125°C

ELECTRICAL SPECIFICATIONS

	Test Osnilitions	Group A	MSK 521X H/E		MSK 521X				
Parameter	Test Conditions	Subgroup	Min.	Typ.	Max.	Min.	Typ.	Max.	Units
POSITIVE OUTPUT REGULATO	RS:								
Output Voltage Tolerance	IOUT = 10mA; VIN = VOUT + 3V	1	-	±0.2	±1.0	-	±0.2	±1.5	%
		2,3	-	±0.8	±3.0	-	-	-	%
Dropout Voltage	Ιουτ=0.5Α; ΔVουτ=1%	1	-	1.6	3.0	-	1.6	3.5	V
		2,3	-	1.9	3.0	-	-	-	V
Load Regulation	10mA≤louт≤0.5A	1	-	±0.2	±2.0	-	±0.2	± 2.5	%
	$V_{IN} = V_{OUT} + 3V$	2,3	-	±0.4	±2.5	-	-	-	%
Line Regulation	Iout = 10mA	1	-	±0.6	±1.5	-	±0.6	±2.0	%
	$VOUT + 3V \le VIN \le 35V$	2,3	-	±1.0	±2.5	-	-	-	%
Thermal Resistance $\textcircled{1}$	JUNCTION TO CASE @ 125°C	-	-	12.5	13.5	-	12.5	14.0	°C/W
NEGATIVE OUTPUT REGULATO	DRS:								
Output Voltage Tolerance	IOUT = 10mA; VIN = VOUT -3V	1	-	±0.2	±1.0	-	±0.2	±1.5	%
		2,3	-	±0.8	±3.0	-	-	-	%
Dropout Voltage	Iout = 0.5A; ΔVout = 1%	1	-	1.9	3.0	-	1.9	3.0	V
		2,3	-	1.5	3.0	-	-	-	V
Load Regulation	10mA≤louт≤0.5A	1	-	±0.2	±2.0	-	±0.2	±2.5	%
	VIN = VOUT -3V	2,3	-	±0.4	±2.5	-	-	-	%
Line Regulation	Iout = 10mA	1	-	±0.1	±1.5	-	±0.1	±2.0	%
	-35V≤Vin≤Vout-3V	2,3	-	±0.2	±2.5	-	-	-	%
Thermal Resistance $①$	JUNCTION TO CASE @ 125°C	-	-	13.5	14.5	-	13.5	15.0	°C/W

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NOTES:

- ① Guaranteed by design but not tested. Typical parameters are representative of actual device performance but are for reference only.
- 2 3 4 Industrial grade and "E" suffix devices shall be tested to subgroup 1 unless otherwise specified.
- Military grade devices shall be 100% tested to subgroups 1,2 and 3.
- Subgroup 1 $T_A = T_C = +25 \,^{\circ}C$
- Subgroup 2 $T_A = T_C = +125 \text{ °C}$ Subgroup 3 $T_A = T_C = -55 \text{ °C}$
- Please consult the factory if alternate output voltages are required.
- 6 For positive regulator, output decoupled to ground using 1μ F minimum tantalum capacitor unless otherwise specified. For negative regulator, output decoupled to ground using 1µF minimum tantanlum capacitor.
- (7)Continuous operation at or above absolute maximum ratings may adversly effect the device performance and/or life cycle.

PART 5	OUTPUT VOLTAGES		
NUMBER	POSITIVE	NEGATIVE	
MSK5211	5.0	5.0	
MSK5212	10.0	10.0	
MSK5213	12.0	12.0	
MSK5214	15.0	15.0	

APPLICATION NOTES

TYPICAL APPLICATION CIRCUIT

CAPACITOR SELECTION

POSITIVE REGULATOR

INPUT CAPACITOR:

An input bypass capacitor is recommenced when using the MSK 5211 series regulators. This is especially true if the regulator is located farther than 6 inches from the power supply filter capacitors. For most applications a 1μ F solid tantalum capacitor will be suitable.

OUTPUT CAPACITOR:

A minimum of a 1μ F solid tantalum capacitor should also be used at the output to insure stability. Any increase of this output capacitor larger than 10μ F will only improve output impedance.

+ CCOMP CAPACITOR:

For improved ripple rejection, + Ccomp can be bypassed to ground with a 10μ F tantalum capacitor. This bypass capacitor will provide 80dB ripple rejection. Increased capacitance above 10μ F does not improve the ripple rejection at frequencies above 120Hz. If the Ccomp bypass capacitor is used, it may be necessary to add a protection diode to protect the regulator from capacitor discharge damage. See Typical Applications Circuit for clarification. If the bypass capacitor is not used, it should be left open since it is internally connected to the regulator.

NEGATIVE REGULATOR

INPUT CAPACITOR:

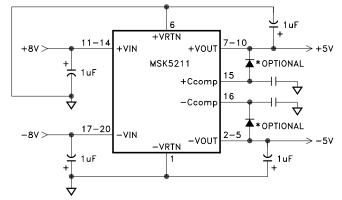
Once again, if the regulator will be farther than 6 inches from power supply filter capacitors, then an input capacitor will be required on the negative regulator. It is recommended that a 1μ F solid tantalum capacitor be used.

OUTPUT CAPACITOR:

A minimum of a 1μ F solid tantalum capacitor should also be used at the output to insure stability. Any increase of this output capacitor larger than 10μ F will only improve output impedance.

-CCOMP CAPACITOR:

For improved ripple rejection, -Ccomp can be bypassed to ground with a 10μ F tantalum capacitor. This bypass capacitor will provide 66dB ripple rejection. Increased capacitance above 10μ F does not improve the ripple rejection at frequencies above 120Hz. If the Ccomp bypass capacitor is used, it may be necessary to add a protection diode to protect the regulator from capacitor discharge damage. See Typical Applications Circuit for clarification. If the bypass capacitor is not used, it should be left open since it is internally connected to the regulator.



LOAD REGULATION

It is important to keep the output connection between the regulator and the load as short as possible since this directly affects the load regulation. For example, if 20 gauge wire were used which has a resistance of about 0.008 ohms per foot, this would result in a drop of 8mV/ft at 1Amp of load current. It is also important to follow the capacitor selection guidelines to achieve best performance.

HEAT SINKING

To determine if a heat sink is required for your application and if so, what type, refer to the thermal model and governing equation below.

Governing Equation: $Tj = Pd x (R_{\theta}jc + R_{\theta}cs + R_{\theta}sa) + Ta$

WHERE

- Tj = Junction Temperature
- Pd = Total Power Dissipation
- R₀jc = Junction to Case Thermal Resistance
- Recs = Case to Heat Sink Thermal Resistance
- Resa = Heat Sink to Ambient Thermal Resistance
- Tc = Case Temperature
- Ta = Ambient Temperature
- Ts = Heat Sink Temperature

EXAMPLE:

This example demonstrates an analysis where the output currents are at 0.5 amp each and both inputs are 8V.

Conditions for MSK 5211:

+ Vin = + 8.0V; lout = 0.5A Positive Regulator

1.) Assume 45° heat spreading model.

2.) Find positive regulator power dissipation:

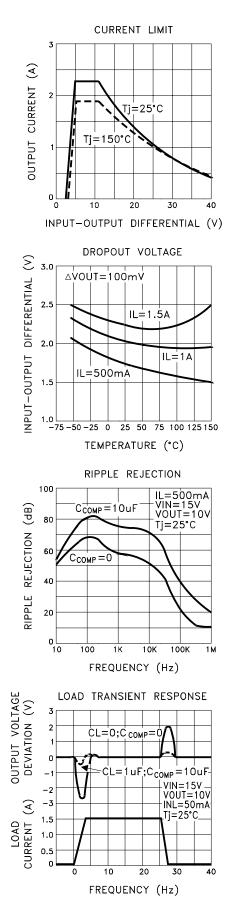
Pd = (Vin - Vout)(lout)Pd = (+8V-5V)(0.5A)Pd = 1.5W

- 3.) For conservative design, set Tj = +125 °C Max.
- 4.) For this example, worst case $Ta = +85^{\circ}C$.
- 5.) $R_{\theta jc} = 10.5 \,^{\circ}C/W$ from the Electrical Specification Table.
- 6.) $R_{\theta}cs = 0.15^{\circ}C/W$ for most thermal greases.
- 7.) Rearrange governing equation to solve for Resa:
 - $R_{\theta}sa = ((Tj Ta)/Pd) (R_{\theta}jc) (R_{\theta}cs)$
 - $= (125^{\circ}C-85^{\circ}C)/1.5W 13.5^{\circ}C/W 0.15^{\circ}C/W$
 - $= 13.0^{\circ}C/W$

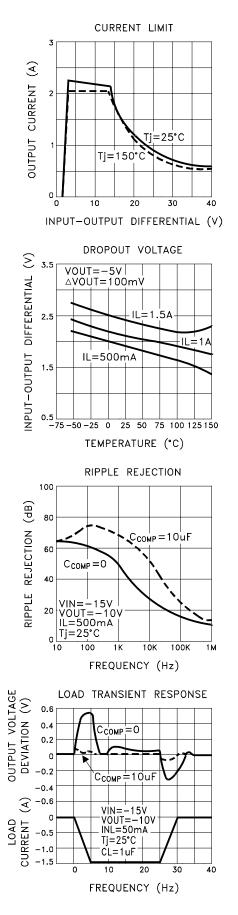
The same exercise must be performed for the negative regulator.

TYPICAL PERFORMANCE CURVES

POSITIVE REGULATOR

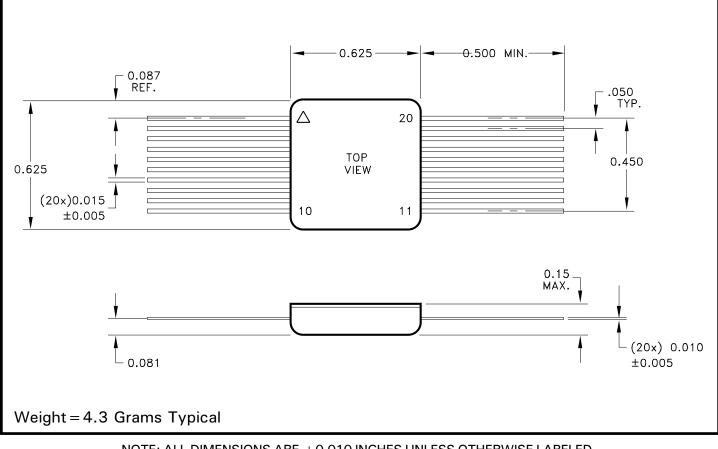


NEGATIVE REGULATOR



MECHANICAL SPECIFICATIONS

MSK521X



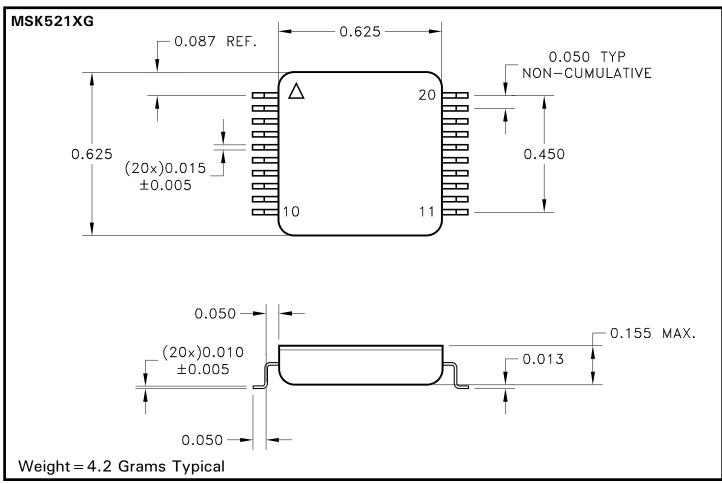
NOTE: ALL DIMENSIONS ARE \pm 0.010 INCHES UNLESS OTHERWISE LABELED. ESD Triangle indicates pin 1.

ORDERING INFORMATION

Part Number	Screening Level
MSK521X	Industrial
MSK521XH	MIL-PRF-38534 CLASS H
MSK521XE	EXTENDED RELIABILITY

X - Designates voltage selection (MSK 5211-5214)

MECHANICAL SPECIFICATIONS CONTINUED



NOTE: ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED. ESD Triangle indicates pin 1.

ORDERING INFORMATION

Part Number	Screening Level		
MSK521XG	Industrial		
MSK521XHG	MIL-PRF-38534 CLASS H		
MSK521XEG	EXTENDED RELIABILITY		

X - Designates voltage selection (MSK 5211-5214)

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