DATA SHEET
22 DECEMBER 2003

No. 00009
REV 1-03

REPLACEMENT
of **LT1117**
RC1117
EZ1117

MIK1117

800 mA LOW DROPOUT POSITIVE VOLTAGE REGULATOR

GENERAL DESCRIPTION

The MIK1117 is a positive low dropout regulator designed to provide up to 800mA of output current. The device is available in an adjustable version and fixed output voltages of 1.8V, 2.5V, 3.0V and 3.3V. All internal circuitry is designed to operate down to 1V input to output differential. Dropout voltage is guaranteed at a maximum of 1.3V at 800mA, decreasing at lower load currents. On chip trimming adjusts the reference/output voltage to within ±1%.

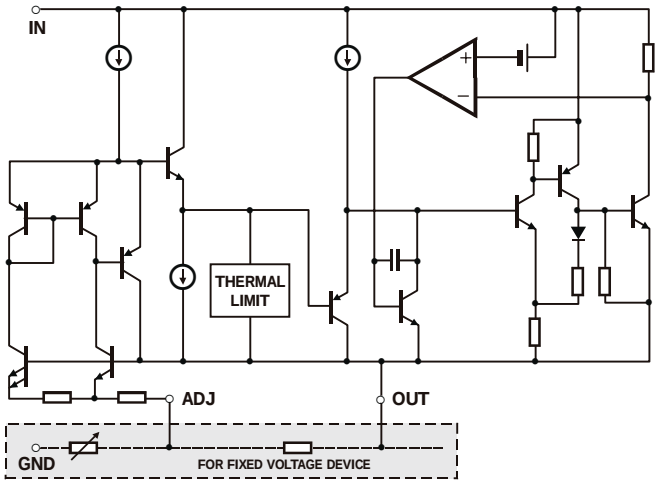
The low profile surface mount SOT-223 package allows the device to be used in applications where space is limited. The MIK1117 requires a minimum of 22µF of output capacitance for stability. Output capacitors of this size or larger are normally included in most regulator designs.

Unlike PNP type regulators where up to 10% of the output current is wasted as quiescent current, the quiescent current of the MIK1117 flows into the load, increasing efficiency.

FEATURES

- Adjustable or Fixed Output
- Output Current of 800mA
- Low Dropout, 1.15V at 800mA Output Current
- 0.04% Line Regulation
- 0.08% Load Regulation
- 100% Thermal Limit Burn-In
- Fast Transient Response

BLOCK DIAGRAM



PIN DESCRIPTION

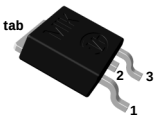
MIK1117**D**, MIK1117-xx**D**

SOT-223-3

1 – **ADJ/GND**
2 – V_{OUT}
3 – **IN**
tab – V_{OUT}

MIK1117**DT**, MIK1117-xx**DT**

TO-252-2



1 – **ADJ/GND**
2 – idle pin
3 – **IN**
tab – V_{OUT}

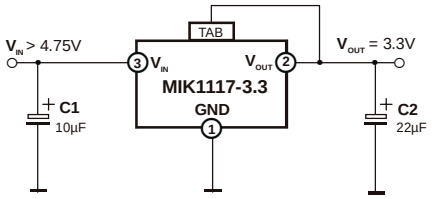
ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	MAXIMUM	UNIT
P_D	Power Dissipation	Internally Limited	W
V_{IN}	Input Voltage	7	V
T_J	Operating Junction Temperature Range		
	Control Section	0 to 125	°C
	Power Transistor	0 to 150	
T_{STG}	Storage Temperature	-65 to 150	°C
T_{LEAD}	Lead Temperature (Soldering, 10 sec)	300	°C

NOTE:
Stresses above those listed under «Absolute Maximum Ratings» may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied.
Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

TYPICAL APPLICATION CIRCUIT

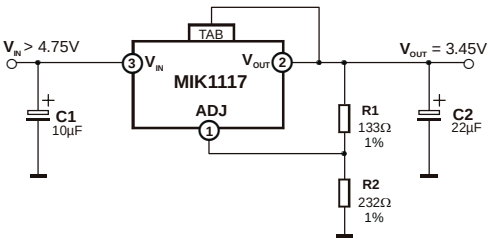
FIXED VOLTAGE REGULATOR



NOTES:

- C1 needed if device is far from filter capacitors
- C2 minimum value required for stability

ADJUSTABLE VOLTAGE REGULATOR



$$V_{OUT} = V_{REF} \times \left(1 + \frac{R2}{R1}\right) + I_{ADJ} \times R2$$

ELECTRICAL CHARACTERISTICS

Electrical Characteristics at I_{LOAD} = 0 mA and T_J = +25°C unless otherwise specified.

PARAMETER	DEVICE	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Reference Voltage (Note 1)	MIK1117	V_{IN} = 2.75V, I_{LOAD} = 10mA V_{IN} = 2.7V to 7V, I_{LOAD} = 10mA to 800mA	• •	1.238 1.230	1.250 1.250	1.262 1.270	V
Output Voltage	MIK1117-1.8	V_{IN} = 4.3V V_{IN} = 3.3V, I_{LOAD} = 0mA to 800mA	• •	1.782 1.771	1.800 1.800	1.818 1.829	V
	MIK1117-2.5	V_{IN} = 5.0V V_{IN} = 4.0V, I_{LOAD} = 0mA to 800mA	• •	2.475 2.460	2.500 2.500	2.525 2.540	V
	MIK1117-3.0	V_{IN} = 5.5V V_{IN} = 4.5V, I_{LOAD} = 0mA to 800mA	• •	2.970 2.950	3.000 3.000	0.030 0.050	V
	MIK1117-3.3	V_{IN} = 5.8V V_{IN} = 4.8V, I_{LOAD} = 0mA to 800mA	• •	3.267 3.247	3.300 3.300	3.333 3.353	V
Line Regulation (Note 1)	All	I_{LOAD} = 10mA, (1.5V+ V_{OUT}) ≤ V_{IN} ≤ 7V	•		0.04	0.2	%
Load Regulation (Note 1)	All	V_{IN} = V_{OUT} +2.5V, I_{LOAD} = 10mA to 800mA	•		0.08	0.4	%
Minimum Load Current (Note 1, 2)	MIK1117	V_{IN} = 5V	•		1.7	5.0	mA
Ground Pin Current	MIK1117-1.8; 2.5; 3.0; 3.3	V_{IN} = V_{OUT} +2.5V I_{LOAD} = 10mA to 800mA	•		6	10	mA
Adjust Pin Current (Note 1)	MIK1117	V_{IN} = 2.75V, I_{LOAD} = 10mA	•		50	120	µA
Current Limit (Note 1)	All	(V_{IN} - V_{OUT}) = 3V	•	0.8	1.1		A
Ripple Rejection (Note 1)	All	V_{IN} = V_{OUT} + 2.5V, I_{LOAD} = 400mA		60	75		dB
Thermal Regulation (Note 1)	MIK1117	T_A = 25°C, 30 ms pulse			0.003		%/W
Dropout Voltage (Note 1, 3)	All	I_{LOAD} = 10mA I_{LOAD} = 800mA	•		1.00 1.15	1.15 1.30	V

The • denotes the specifications which apply over the full temperature range.

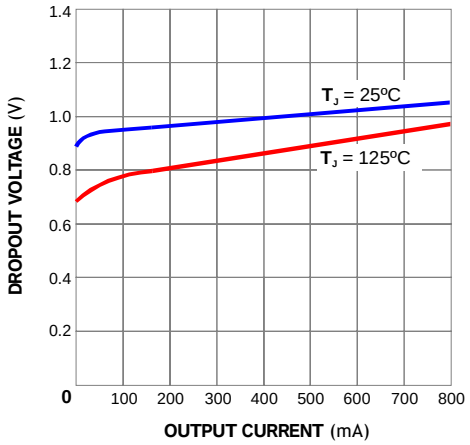
Note 1: For MIK1117 (adjustable) **Vadj** = 0V

Note 2: For the adjustable device the minimum load current is the minimum current required to maintain regulation. Normally the current in the resistor divider used to set the output voltage is selected to meet the minimum load current requirement.

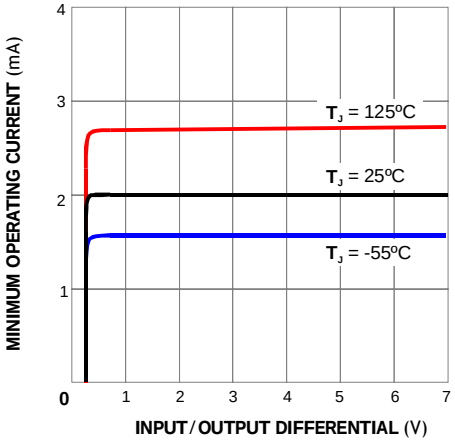
Note 3: The specification represent the minimum input/output voltage required to maintain 1% regulation.

TYPICAL CHARACTERISTICS

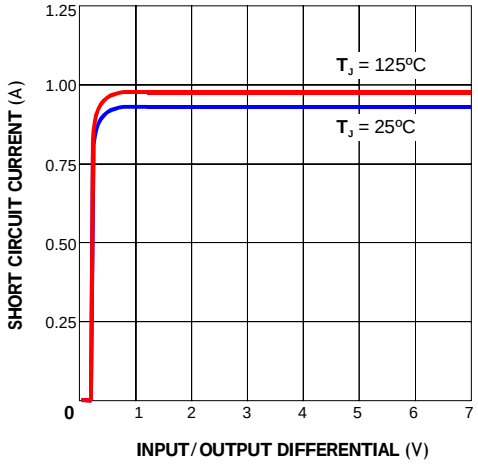
DROPOUT VOLTAGE (V_{IN} - V_{OUT})



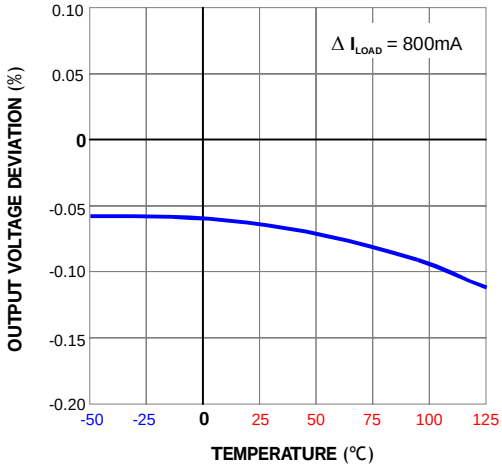
MINIMUM OPERATING CURRENT (ADJUSTABLE DEVICE)



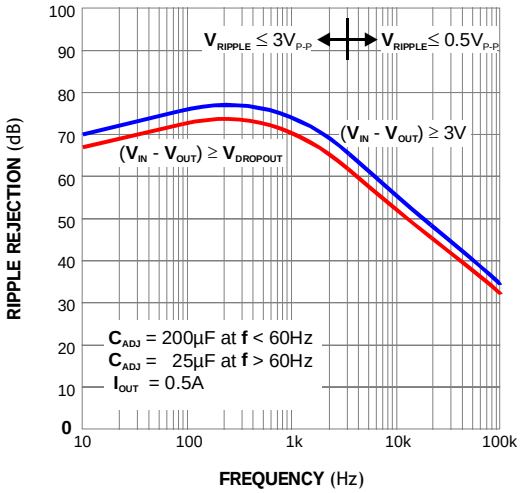
SHORT-CIRCUIT CURRENT



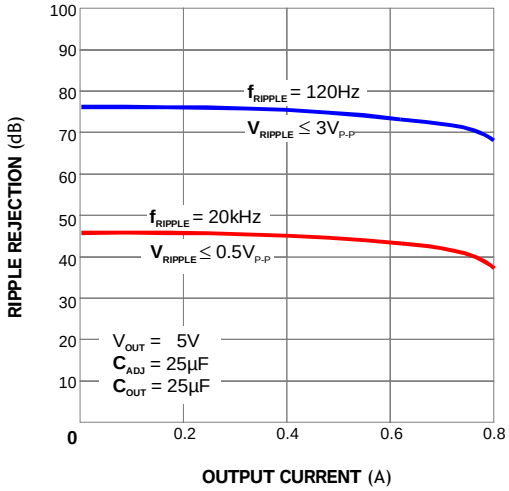
LOAD REGULATION



MIK1117 RIPPLE REJECTION

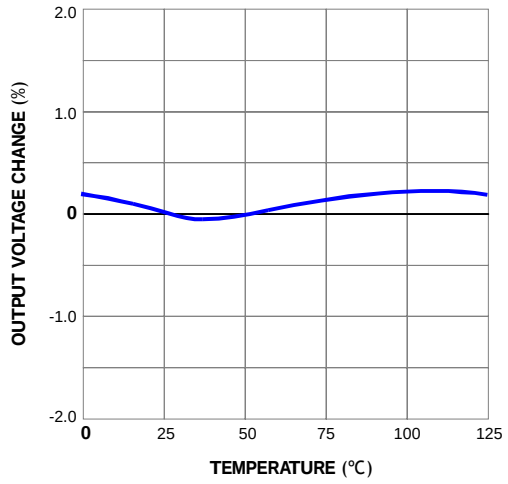


MIK1117 RIPPLE REJECTION versus CURRENT

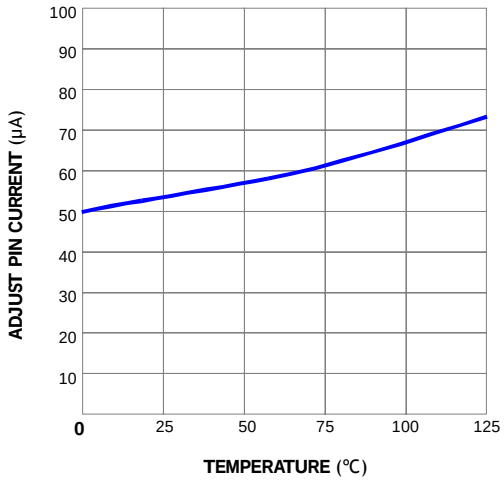


TYPICAL CHARACTERISTICS (CONTINUED)

TEMPERATURE STABILITY

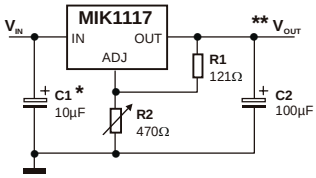


ADJUST PIN CURRENT



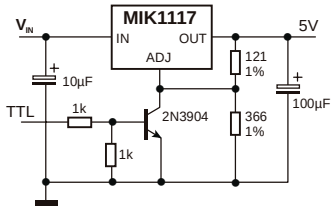
TYPICAL APPLICATIONS

1.2V to 5.5V ADJUSTABLE REGULATOR

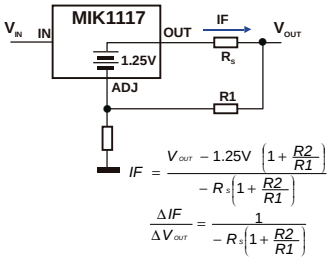


* Needed if device is far from filter capacitor
** V_{OUT} = 1.25 x (1 + (R2/R1))

5V REGULATOR WITH SHUTDOWN



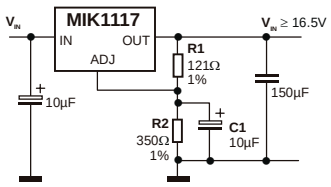
BATTERY CHARCHER



$$IF = \frac{V_{OUT} - 1.25V\left(1 + \frac{R2}{R1}\right)}{-R_S\left(1 + \frac{R2}{R1}\right)}$$

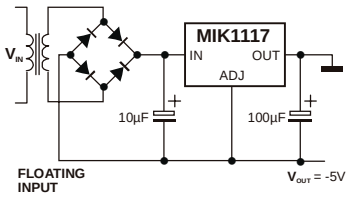
$$\frac{\Delta IF}{\Delta V_{OUT}} = \frac{1}{-R_S\left(1 + \frac{R2}{R1}\right)}$$

IMPROVING RIPPLE REJECTION

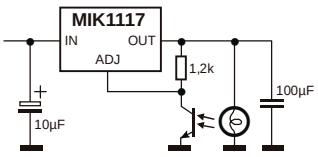


*C1 IMPROVES RIPPLE REJECTION. X_C SHOULD BE ≈R1 AT RIPPLE FREQUENCY

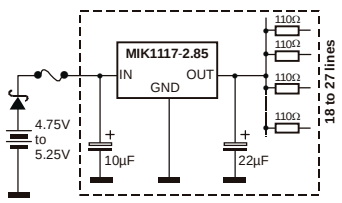
LOW DROPOUT NEGATIVE SUPPLY



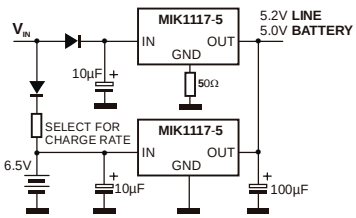
AUTOMATIC LIGHT CONTROL



ACTIVE TERMINATOR FOR SCSI-2 BUS

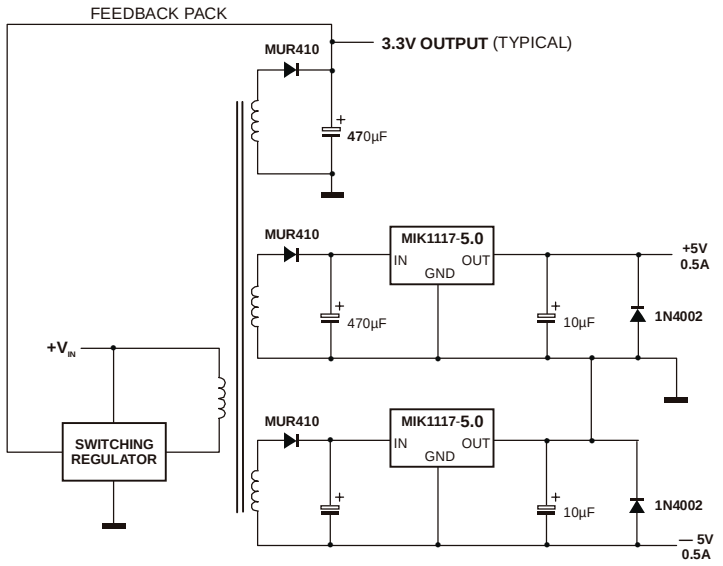


BATTERY BACKED UP REGULATED SUPPLY

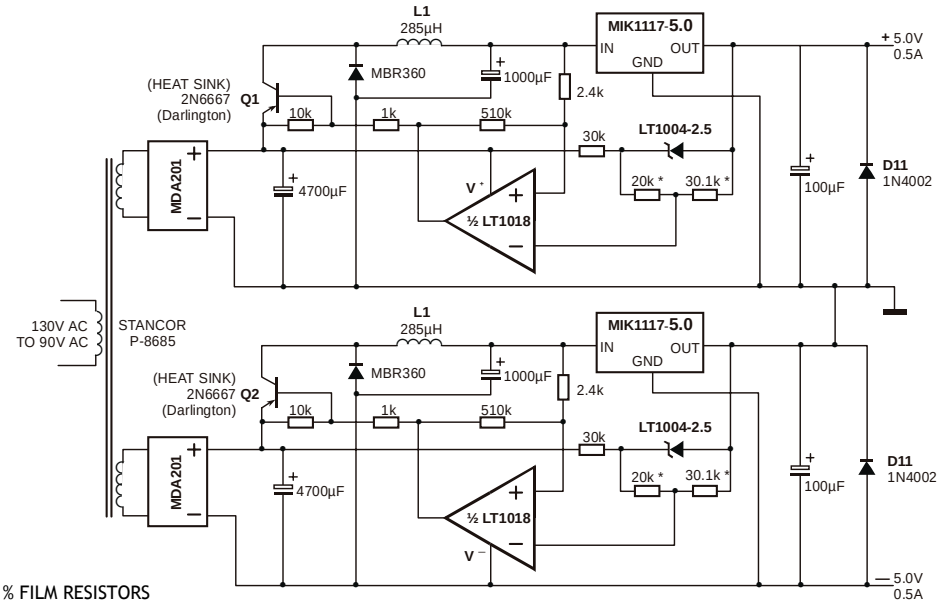


TYPICAL APPLICATIONS (CONTINUED)

HIGH EFFICIENCY DUAL SUPPLY

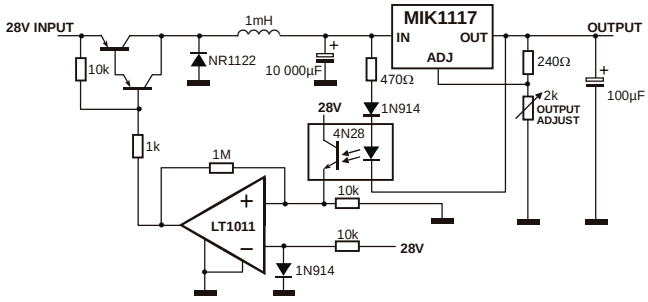


HIGH EFFICIENCY DUAL LINEAR SUPPLY



* = 1 % FILM RESISTORS
MDA = MOTOROLA
L1 = PULSE ENGINEERING, INC. #PE-92106

HIGH EFFICIENCY REGULATOR



APPLICATION INFORMATION

The MIK1117 family of 3-terminal regulators are easy to use. They are protected against short circuit and thermal overloads. Thermal protection circuitry will shut down the regulator should the junction temperature exceed 170°C at the sense point. These regulators are pin compatible with older 3-terminal adjustable regulators, offer lower dropout voltage and more precise reference tolerance. Reference stability over temperature is improved over older types of regulators.

STABILITY

The MIK1117 family of regulators requires an output capacitor as part of the device frequency compensation. A minimum of 22mF of tantalum or 50mF of aluminum electrolytic is required. The ESR of the output capacitor should be less than 0.5Ω.

When using the MIK1117 adjustable device the adjust terminal can be bypassed to improve ripple rejection. When the adjust terminal is bypassed the required value of the output capacitor increases. The device will require an output capacitor of 22mF tantalum or 150mF aluminum electrolytic when the adjust pin is bypassed.
Normally, capacitor values on the order of 100mF are used in the output of many regulators to ensure good load transient response with large load current changes. Output capacitance can be increased without limit and larger values of output capacitance further improve stability and transient response.

PROTECTION DIODES

Diodes between input and output are not usually needed. Only with extremely large output capacitors, such as 1000mF and larger, and with the input pin instantaneously shorted to ground can damage occur. A crowbar circuit at the input of the MIK1117 in combination with a large output capacitor could generate currents large enough to cause damage. In this case a diode from output to input is recommended, as shown in Figure 1.

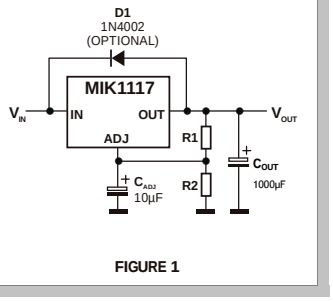


FIGURE 1

OUTPUT VOLTAGE

The MIK1117 develops a 1.25V reference voltage between the output and the adjust terminal (see Figure 2). By placing a resistor between these two terminals, a constant current is caused to flow through R1 and down through R2 to set the overall output voltage. Normally this current is chosen to be the specified minimum load current of 10mA. Because IADJ is very small and constant when compared to the current through R1, it represents a small error and can usually be ignored. For fixed voltage devices R1 and R2 are included in the device.

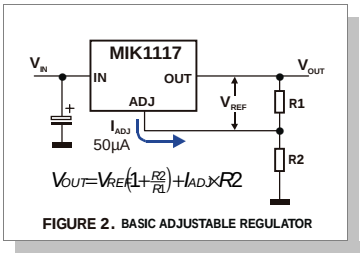


FIGURE 2. BASIC ADJUSTABLE REGULATOR

LOAD REGULATION

Because the MIK1117 is a 3-terminal device, it is not possible to provide true remote load sensing. Load regulation will be limited by the resistance of the wire connecting the regulator to the load. The data sheet specification for load regulation is measured at the output pin of the device. Negative side sensing is a true Kelvin connection, with the bottom of the output divider returned to the negative side of the load. Although it may not be immediately obvious, best load regulation is obtained when the top of the resistor divider (R1) is returned directly to the output pin of the device, not to the load. This is illustrated in Figure 3. Connected as shown, RP is not multiplied by the divider ratio. If R1 were connected to the load, the effective resistance between the regulator and the load would be:

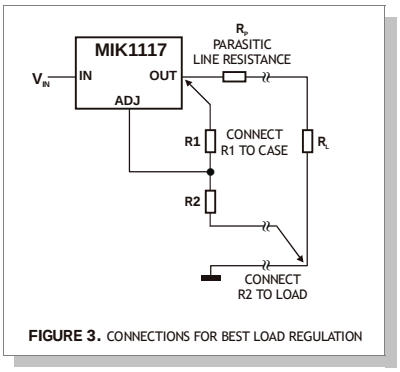


FIGURE 3. CONNECTIONS FOR BEST LOAD REGULATION

$$R_P \frac{R2 + R1}{R1}$$ R_P = Parasitic Line Resistance

For fixed voltage devices the top of R1 is internally Kelvin connected, and the ground pin can be used for negative side sensing.

THERMAL CONSIDERATIONS

MIK1117 series regulators have internal thermal limiting circuitry designed to protect the device during overload conditions. For continuous normal load conditions however, the maximum junction temperature rating of 125°C must not be exceeded.

It is important to give careful consideration to all sources of thermal resistance from junction to ambient. For the SOT-223 package, which is designed to be surface mounted, additional heat sources mounted near the device must also be considered. Heat sinking is accomplished using the heat spreading capability of the PC board and its copper traces. The thermal resistance of the MIK1117 is 15°C/W from the junction to the tab. Thermal resistances from tab to ambient can be as low as 30°C/W. The total thermal resistance from junction to ambient can be as low as 45°C/W.

The power dissipation of the MIK1117 is equal to:

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$$

Maximum junction temperature will be equal to:

$$T_J = T_{A(MAX)} + P_D \text{ (Thermal Resistance (junction-to-ambient))}$$

Maximum junction temperature must not exceed 125°C.

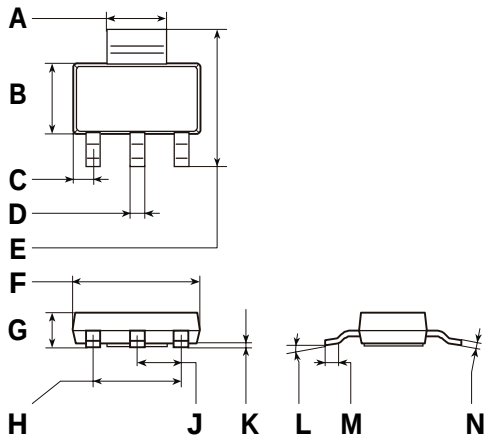
RIPPLE REJECTION

The curves for Ripple Rejection were generated using an adjustable device with the adjust pin bypassed. These curves will hold true for all values of output voltage. For proper bypassing, and ripple rejection approaching the values shown, the impedance of the adjust pin capacitor, at the ripple frequency, should be < R1. R1 is normally in the range of 100Ω to 200Ω. The size of the required adjust pin capacitor is a function of the input ripple frequency. At 120Hz, with R1 = 100Ω, the adjust pin capacitor should be >13μF. At 10kHz only 0.16μF is needed.

For fixed voltage devices, and adjustable devices without an adjust pin capacitor, the output ripple will increase as the ratio of the output voltage to the reference voltage (V_{OUT}/V_{REF}). For example, with the output voltage equal to 5V, the output ripple will be increased by the ratio of 5V/1.25V. It will increase by a factor of four. Ripple rejection will be degraded by 12dB from the value shown on the curve.

PHYSICAL DIMENSIONS AND MARKING DIAGRAMS

SOT-223-3 PACKAGE



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.90	3.15	0.114	0.124
B	3.30	3.71	0.130	0.146
C	0.84	1.04	0.033	0.041
D	0.64	0.84	0.025	0.033
E	6.71	7.29	0.264	0.287
F	6.30	6.71	0.248	0.264
G	–	1.80	–	0.071
H	4.80		0.181	
J	2.29		0.091	
K	0.0203	0.1018	0.0008	0.0040
L	0°	10°	0°	10°
M	0.31	–	0.012	–
N	0.25	0.36	0.010	0.014

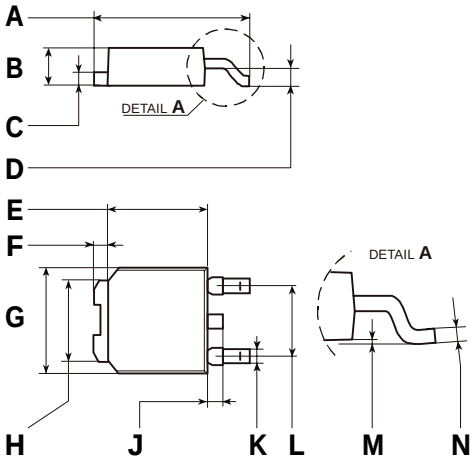
SOT-223-3

MARKING DIAGRAM

Y – Year
WW – Work Week
n – assembly location

XX	OUTPUT VOLTAGE
blank	Adjustable
18	1.8 V
25	2.5 V
30	3.0 V
33	3.3 V

TO-252-2 PACKAGE



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.35	1.01	0.368	0.397
B	2.20	2.40	0.086	0.094
C	0.48	0.60	0.019	0.023
D	0.90	1.10	0.035	0.043
E	6.00	6.20	0.236	0.244
F	0.80		0.031	
G	6.40	6.60	0.252	0.260
H	5.20	5.40	0.204	0.212
J	0.60	1.00	0.023	0.039
K	0.64	0.90	0.025	0.035
L	4.40	4.60	0.173	0.181
M	0.03	0.23	0.001	0.009
N	0.45	0.60	0.017	0.023

TO-252-2

MARKING DIAGRAM

YY – Year
WW – Work Week
n – assembly location

XX	OUTPUT VOLTAGE
blank	Adjustable
18	1.8 V
25	2.5 V
30	3.0 V
33	3.3 V

ORDERING INFORMATION

DEVICE	OUTPUT VOLTAGE	PACKAGE	OPERATING TEMPERATURE	SHIPPING
MIK 1117**D**	Adjustable	SOT-223-3	0°C to +70°C	Rail & Reel
MIK 1117-1.8**D**	1.8 V			
MIK 1117-2.5**D**	2.5 V			
MIK 1117-3.0**D**	3.0 V			
MIK 1117-3.3**D**	3.3 V			
MIK 1117**DT**	Adjustable	TO-252-2	0°C to +70°C	Rail & Reel
MIK 1117-1.8**DT**	1.8 V			
MIK 1117-2.5**DT**	2.5 V			
MIK 1117-3.0**DT**	3.0 V			
MIK 1117-3.3**DT**	3.3 V			

NOTE: The form of packing is stipulated in the contract.

MIKRON JSC Head Office

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