DATA SHEET
16 JUNE 2003

No. 00011
REV 1-03

MIK78xx series

POSITIVE-VOLTAGE REGULATORS

REPLACEMENT of:
µA78XX
KA78XX
LM78XX
MC78XX

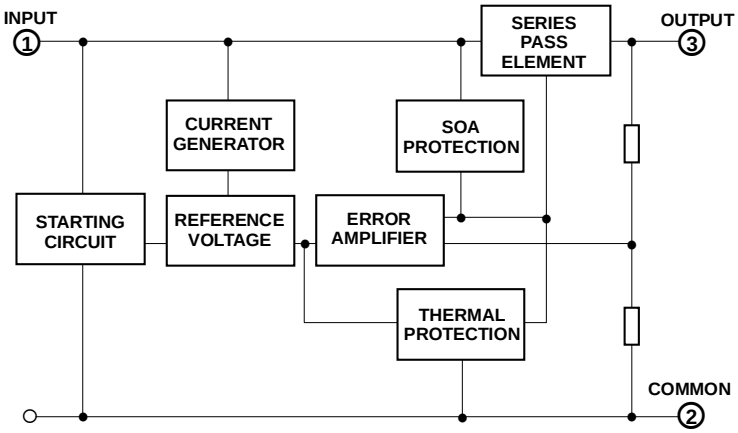
GENERAL DESCRIPTION

This series of fixed-voltage monolithic integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. In addition, they can be used with power-pass elements to make high-current voltage regulators. Each of these regulators can deliver up to 1.5 A of output current. The internal limiting and thermal shutdown features of these regulators make them essentially immune to overload.

FEATURES

- 3-Terminal Regulators
- Output Current Up to 1.5 A
- No External Components
- Internal Thermal Overload Protection
- High Power Dissipation Capability
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation

INTERNAL BLOCK DIAGRAM



PIN DESCRIPTION

MIK78-xx**CT**

TO-220-3

1 — INPUT
2 — COMMON
3 — OUTPUT
TAB — COMMON

MIK78-xx**CD2T**

TO-263-3

1 — INPUT
2 — COMMON
3 — OUTPUT
TAB — COMMON

ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature range, unless otherwise noted.

SYMBOL	PARAMETER		MAXIMUM	UNIT
V_{IN}	Input voltage	MIK78**24**	40	V
		All others	35	
P_D	Continuous total dissipation at 25 °C free-air temperature		2	W
P_D	Continuous total dissipation at (or below) 25 °C case temperature		15	
T_A	Operating free-air temperature range		0 to 150	°C
T_C	Operating case temperature range			
T_J	Operating virtual junctions temperature range			
T_{STG}	Storage temperature range		-65 to 150	
T_L	Lead temperature 1.6 mm (1/16 inch) from case for 10 seconds		260	

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.

NOTE: For operation above 25°C free-air or 90°C case temperature, refer to Figures 1 and 2. To avoid exceeding the design maximum virtual junction temperature, these ratings should not be exceeded. The built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.

FREE-AIR TEMPERATURE DISSIPATION DERATING CURVE

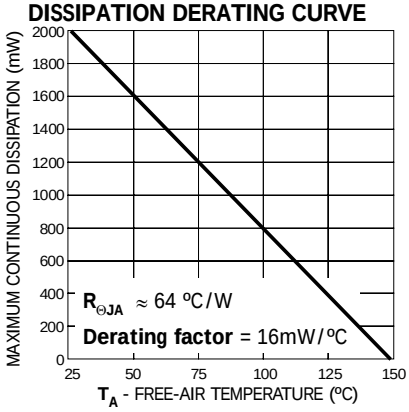


Fig. 1

CASE TEMPERATURE DISSIPATION DERATING CURVE

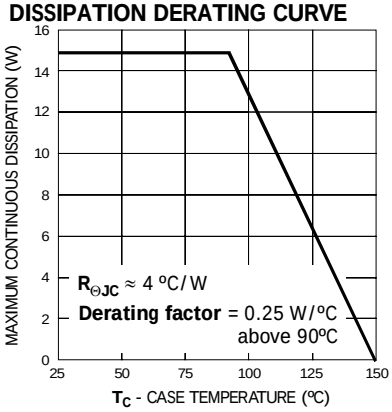


Fig. 2

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER		MIN	MAX	UNIT
V_{IN}	Input voltage	MIK78**05**	7.0	25.0	V
		MIK78**06**	8.0	25.0	
		MIK78**08**	10.5	25.0	
		MIK78**09**	11.5	27.0	
		MIK78**10**	12.5	28.0	
		MIK78**12**	14.5	30.0	
		MIK78**15**	17.5	30.0	
		MIK78**18**	21.0	33.0	
		MIK78**24**	27.0	38.0	
I_{OUT}	Output current			1.5	A
T_J	Operating virtual junction temperature		0	125	°C

ELECTRICAL CHARACTERISTICS MIK78**05**

Electrical characteristics at specified virtual junction temperature, V_{IN} = 10V, I_{OUT} = 500mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		MIN	TYP	MAX	UNIT
Output voltage**		25°C	4.8	5	5.2	V
	I_{OUT} = 5mA to 1A, V_{IN} = 7V to 20V, **P**≤15W	0°C to 125°C	4.75	5	5.25	
Input regulation	V_{IN} = 7V to 25V	25°C		3	100	mV
	V_{IN} = 8V to 12V			1	50	
Ripple rejection	V_{IN} = 8V to 18V, **f** = 120Hz	0°C to 125°C	62	78		dB
Output regulation	I_{OUT} = 5mA to 1.5A	25°C		15	100	mV
	I_{OUT} = 250mA to 750mA			5	50	
Output resistance	**f** = 1KHz	0°C to 125°C		0.017		Ω
Temperature coefficient of output voltage	I_{OUT} = 5mA	0°C to 125°C		-1.1		mV/°C
Output noise voltage	**f** = 10 Hz to 100 KHz	25°C		40		µV
Dropout voltage	I_{OUT} = 1A	25°C		2.0		V
Bias current		25°C		4.2	8	mA
Bias current change	V_{IN} = 7V to 25V	0°C to 125°C			1.3	
	I_{OUT} = 5mA to 1A				0.5	
Short-circuit output current		25°C		750		
Peak output current		25°C		2.2		A

* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.

** This specification applies only for dc power dissipation permitted by absolute maximum ratings.

ELECTRICAL CHARACTERISTICS MIK78**06**

Electrical characteristics at specified virtual junction temperature, V_{IN} = 11V, I_{OUT} = 500mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		MIN	TYP	MAX	UNIT
Output voltage**		25°C	5.75	6	6.25	V
	I_{OUT} = 5mA to 1A, V_{IN} = 8V to 21V, **P**≤15W	0°C to 125°C	5.7	6	6.3	
Input regulation	V_{IN} = 8V to 25V	25°C		5	120	mV
	V_{IN} = 9V to 13V			1.5	60	
Ripple rejection	V_{IN} = 9V to 19V, **f** = 120Hz	0°C to 125°C	59	75		dB
Output regulation	I_{OUT} = 5mA to 1.5A	25°C		14	120	mV
	I_{OUT} = 250mA to 750mA			4	60	
Output resistance	**f** = 1KHz	0°C to 125°C		0.019		Ω
Temperature coefficient of output voltage	I_{OUT} = 5mA	0°C to 125°C		-0.8		mV/°C
Output noise voltage	**f** = 10 Hz to 100 KHz	25°C		45		µV
Dropout voltage	I_{OUT} = 1A	25°C		2.0		V
Bias current		25°C		4.3	8	mA
Bias current change	V_{IN} = 8V to 25V	0°C to 125°C			1.3	
	I_{OUT} = 5mA to 1A				0.5	
Short-circuit output current		25°C		550		
Peak output current		25°C		2.2		A

ELECTRICAL CHARACTERISTICS MIK78**08**

Electrical characteristics at specified virtual junction temperature, V_{IN}= 14V, I_{OUT} = 500mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		MIN	TYP	MAX	UNIT
Output voltage**		25°C	7.7	8	8.3	V
	I_{OUT} = 5mA to 1A, V_{IN} = 10.5V to 23V, **P**≤15W	0°C to 125°C	7.6	8	8.4	
Input regulation	V_{IN} = 10.5V to 25V	25°C		6	160	mV
	V_{IN} = 11V to 17V			2	80	
Ripple rejection	V_{IN} = 11.5V to 21.5V, **f** = 120Hz	0°C to 125°C	55	72		dB
Output regulation	I_{OUT} = 5mA to 1.5A	25°C		12	160	mV
	I_{OUT} = 250mA to 750mA			4	80	
Output resistance	**f** = 1KHz	0°C to 125°C		0.016		Ω
Temperature coefficient of output voltage	I_{OUT} = 5mA	0°C to 125°C		-0.8		mV/°C
Output noise voltage	**f** = 10 Hz to 100 KHz	25°C		52		µV
Dropout voltage	I_{OUT} = 1A	25°C		2.0		V
Bias current		25°C		4.3	8	mA
Bias current change	V_{IN} = 10.5V to 25V	0°C to 125°C			1	
	I_{OUT} = 5mA to 1A				0.5	
Short-circuit output current		25°C		450		
Peak output current		25°C		2.2		A

* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.

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ELECTRICAL CHARACTERISTICS MIK78**09**

Electrical characteristics at specified virtual junction temperature, V_{IN}= 16V, I_{OUT} = 500mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		MIN	TYP	MAX	UNIT
Output voltage**		25°C	8.65	9	9.35	V
	I_{OUT} = 5mA to 1A, V_{IN} = 11.5V to 24V, **P**≤15W	0°C to 125°C	8.55	9	9.45	
Input regulation	V_{IN} = 11.5V to 27V	25°C		7	180	mV
	V_{IN} = 13V to 19V			2	90	
Ripple rejection	V_{IN} = 12V to 22V, **f**= 120Hz	0°C to 125°C	55	70		dB
Output regulation	I_{OUT} = 5mA to 1.5A	25°C		12	180	mV
	I_O= 250mA to 750mA			4	90	
Output resistance	**f**= 1KHz	0°C to 125°C		0.018		Ω
Temperature coefficient of output voltage	I_{OUT} = 5mA	0°C to 125°C		-1.0		mV/°C
Output noise voltage	**f**= 10 Hz to 100 KHz	25°C		60		µV
Dropout voltage	I_{OUT} = 1A	25°C		2.0		V
Bias current		25°C		4.3	8	mA
Bias current change	V_{IN} = 11.5V to 27V	0°C to 125°C			1	
	I_{OUT} = 5mA to 1A				0.5	
Short-circuit output current		25°C		400		
Peak output current		25°C		2.2		A

ELECTRICAL CHARACTERISTICS MIK78**10**

Electrical characteristics at specified virtual junction temperature, V_{IN}= 17V, I_{OUT} = 500mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		MIN	TYP	MAX	UNIT
Output voltage**		25°C	9.6	10	10.4	V
	I_{OUT} = 5mA to 1A, V_{IN} = 12.5V to 25V, **P**≤15W	0°C to 125°C	9.5	10	10.5	
Input regulation	V_{IN} = 12.5V to 28V	25°C		7	200	mV
	V_{IN} = 14V to 20V			2	100	
Ripple rejection	V_{IN} = 13V to 23V, **f** = 120Hz	0°C to 125°C	55	71		dB
Output regulation	I_{OUT} = 5mA to 1.5A	25°C		12	200	mV
	I_{OUT} = 250mA to 750mA			4	100	
Output resistance	**f** = 1KHz	0°C to 125°C		0.018		Ω
Temperature coefficient of output voltage	I_{OUT} = 5mA	0°C to 125°C		-1.0		mV/°C
Output noise voltage	**f** = 10 Hz to 100 KHz	25°C		70		µV
Dropout voltage	I_{OUT} = 1A	25°C		2.0		V
Bias current		25°C		4.3	8	mA
Bias current change	V_{IN} = 12.5V to 28V	0°C to 125°C			1	
	I_{OUT} = 5mA to 1A				0.5	
Short-circuit output current		25°C		400		
Peak output current		25°C		2.2		A

* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.

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ELECTRICAL CHARACTERISTICS MIK78**12**

Electrical characteristics at specified virtual junction temperature, V_{IN}= 19V, I_{OUT} = 500mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		MIN	TYP	MAX	UNIT
Output voltage**		25°C	11.5	12	12.5	V
	I_{OUT} = 5mA to 1A, V_{IN} = 14.5V to 27V, **P**≤15W	0°C to 125°C	11.4	12	12.6	
Input regulation	V_{IN} = 14.5V to 30V	25°C		10	240	mV
	V_{IN} = 16V to 22V			3	120	
Ripple rejection	V_{IN} = 15V to 25V, **f** = 120Hz	0°C to 125°C	55	71		dB
Output regulation	I_{OUT} = 5mA to 1.5A	25°C		12	240	mV
	I_{OUT} = 250mA to 750mA			4	120	
Output resistance	**f** = 1KHz	0°C to 125°C		0.018		Ω
Temperature coefficient of output voltage	I_{OUT} = 5mA	0°C to 125°C		-1.0		mV/°C
Output noise voltage	**f** = 10 Hz to 100 KHz	25°C		75		µV
Dropout voltage	I_{OUT} = 1A	25°C		2.0		V
Bias current		25°C		4.3	8	mA
Bias current change	V_{IN} = 14.5V to 30V	0°C to 125°C			1	
	I_{OUT} = 5mA to 1A				0.5	
Short-circuit output current		25°C		350		
Peak output current		25°C		2.2		A

ELECTRICAL CHARACTERISTICS MIK78**15**

Electrical characteristics at specified virtual junction temperature, V_{IN}= 23V, I_{OUT} = 500mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		MIN	TYP	MAX	UNIT
Output voltage**		25°C	14.4	15	15.6	V
	I_{OUT} = 5mA to 1A, V_{IN} = 17.5V to 30V, **P**≤15W	0°C to 125°C	14.25	15	15.75	
Input regulation	V_{IN} = 17.5V to 30V	25°C		12	300	mV
	V_{IN} = 20V to 26V			3	150	
Ripple rejection	V_{IN} = 18.5V to 28.5V, **f** = 120Hz	0°C to 125°C	54	70		dB
Output regulation	I_{OUT} = 5mA to 1.5A	25°C		12	300	mV
	I_{OUT} = 250mA to 750mA			4	150	
Output resistance	**f** = 1KHz	0°C to 125°C		0.019		Ω
Temperature coefficient of output voltage	I_{OUT} = 5mA	0°C to 125°C		-1.0		mV/°C
Output noise voltage	**f** = 10 Hz to 100 KHz	25°C		90		µV
Dropout voltage	I_{OUT} = 1A	25°C		2.0		V
Bias current		25°C		4.3	8	mA
Bias current change	V_{IN} = 17.5V to 30V	0°C to 125°C			1	
	I_{OUT} = 5mA to 1A				0.5	
Short-circuit output current		25°C		230		
Peak output current		25°C		2.1		A

* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.

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ELECTRICAL CHARACTERISTICS MIK78**18**

Electrical characteristics at specified virtual junction temperature, V_{IN}= 27V, I_{OUT} = 500mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		MIN	TYP	MAX	UNIT
Output voltage**		25°C	17.3	18	18.7	V
	I_{OUT} = 5mA to 1A, V_{IN} = 21V to 33V, **P**≤15W	0°C to 125°C	17.1	18	18.9	
Input regulation	V_{IN} = 21V to 33V	25°C		15	360	mV
	V_{IN} = 24V to 30V			5	180	
Ripple rejection	V_{IN} = 22V to 32V, **f** = 120Hz	0°C to 125°C	53	69		dB
Output regulation	I_{OUT} = 5mA to 1.5A	25°C		12	360	mV
	I_{OUT} = 250mA to 750mA			4	180	
Output resistance	**f** = 1KHz	0°C to 125°C		0.022		Ω
Temperature coefficient of output voltage	I_{OUT} = 5mA	0°C to 125°C		-1.0		mV/°C
Output noise voltage	**f** = 10 Hz to 100 KHz	25°C		110		µV
Dropout voltage	I_{OUT} = 1A	25°C		2.0		V
Bias current		25°C		4.5	8	mA
Bias current change	V_{IN} = 21V to 33V	0°C to 125°C			1	
	I_{OUT} = 5mA to 1A				0.5	
Short-circuit output current		25°C		200		
Peak output current		25°C		2.1		A

ELECTRICAL CHARACTERISTICS MIK78**24**

Electrical characteristics at specified virtual junction temperature, V_{IN}= 33V, I_{OUT} = 500mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS*		MIN	TYP	MAX	UNIT
Output voltage**		25°C	23	24	25	V
	I_{OUT} = 5mA to 1A, V_{IN} = 27V to 38V, **P**≤15W	0°C to 125°C	22.8	24	25.2	
Input regulation	V_{IN} = 27V to 38V	25°C		18	480	mV
	V_{IN} = 30V to 36V			6	240	
Ripple rejection	V_{IN} = 28V to 38V, **f** = 120Hz	0°C to 125°C	50	66		dB
Output regulation	I_{OUT} = 5mA to 1.5A	25°C		12	480	mV
	I_{OUT} = 250mA to 750mA			4	240	
Output resistance	**f** = 1KHz	0°C to 125°C		0.028		Ω
Temperature coefficient of output voltage	I_{OUT} = 5mA	0°C to 125°C		-1.5		mV/°C
Output noise voltage	**f** = 10 Hz to 100 KHz	25°C		170		µV
Dropout voltage	I_{OUT} = 1A	25°C		2.0		V
Bias current		25°C		4.6	8	mA
Bias current change	V_{IN} = 27V to 38V	0°C to 125°C			1	
	I_{OUT} = 5mA to 1A				0.5	
Short-circuit output current		25°C		150		
Peak output current		25°C		2.1		A

* Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.

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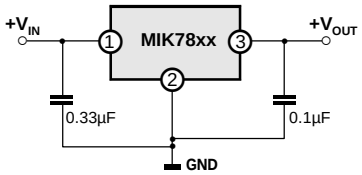
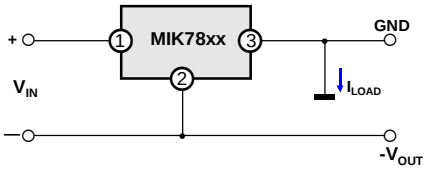
TYPICAL APPLICATIONS

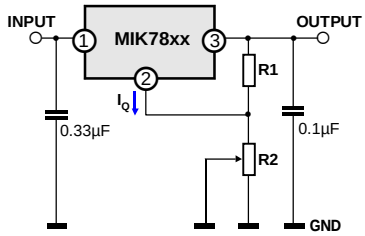
FIXED-OUTPUT REGULATOR



POSITIVE REGULATOR IN NEGATIVE CONFIGURATION
(V_{IN} MUST FLOAT)



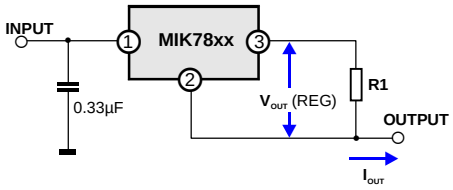
ADJUSTABLE-OUTPUT REGULATOR



$V_{OUT} = V_{XX} + (V_{XX}/R1 + I_Q) \times R2$

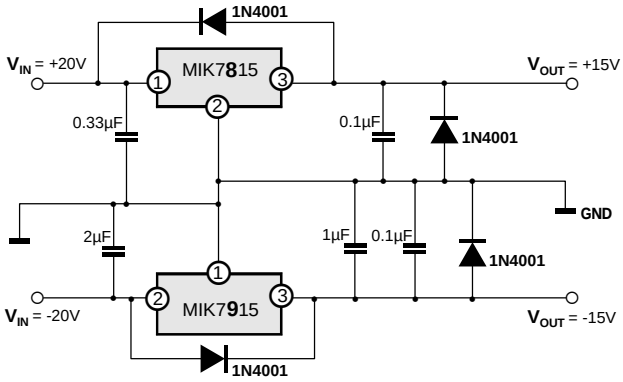
Vxx is the nominal output voltage of the fixed regulator

CURRENT REGULATOR

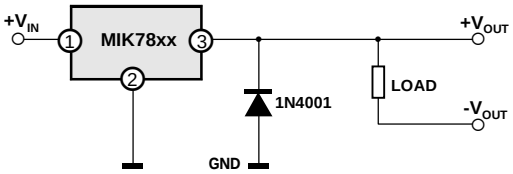


$I_O = (V_{OUT}/R1) + I_{OUT}$ BIAS CURRENT

REGULATED DUAL SUPPLY

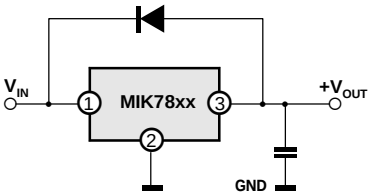


OUTPUT POLARITY-REVERSAL-PROTECTION CIRCUIT



In many cases, a regulator powers a load that is not connected to ground but, instead, is connected to a voltage source of opposite. In these cases, a clamp diode should be connected to the regulator output as shown in this figure. This protects the regulator from output polarity reversals during startup and short-circuit operation.

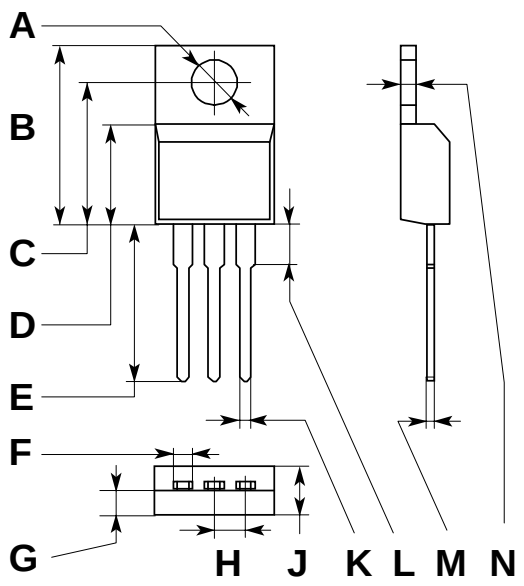
REVERSE-BIAS-PROTECTION CIRCUIT



Occasionally, the input voltage to the regulator can collapse faster than the output voltage. This can occur when the input supply is crowbarred during an output overvoltage condition. If the output voltage is greater than approximately 7 V, the emitter-base junction of the series-pass element could break down. To prevent this, a diode shunt can be used as shown in this figure.

PHYSICAL DIMENSIONS AND MARKING DIAGRAMS

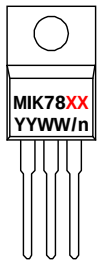
TO-220-3 PACKAGE



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	3.75	3.85	0.147	0.151
B	15.24	15.75	0.600	0.620
C	12.47	12.9	0.491	0.508
D	9.05	9.15	0.356	0.360
E	13.00	14.00	0.511	0.551
F	1.14	1.70	0.044	0.067
G	2.40	2.72	0.094	0.107
H	2.40	2.70	0.094	0.106
J	4.40	4.60	0.173	0.181
K	0.61	0.88	0.024	0.034
L	3.50	3.93	0.137	0.154
M	0.49	0.70	0.019	0.027
N	1.23	1.32	0.048	0.051

TO-220-3

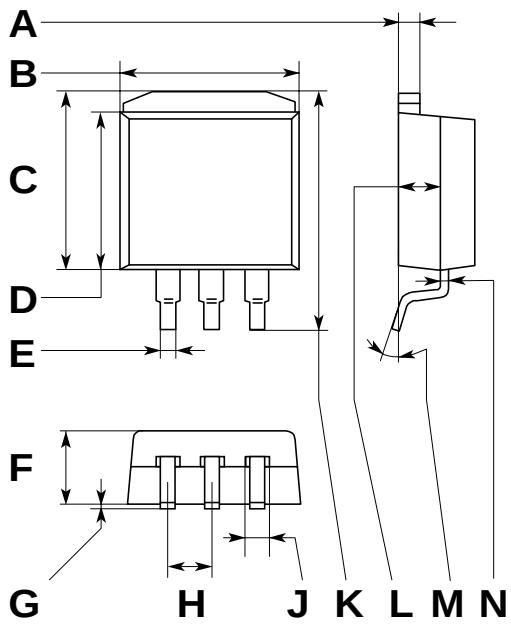
MARKING DIAGRAM



XX — output voltage (see table below)
YY — Year
WW — Work Week
n — assembly location

XX	OUTPUT VOLTAGE	XX	OUTPUT VOLTAGE
05	5.0	12	12.0
06	6.0	15	15.0
08	8.0	18	18.0
09	9.0	24	24.0
10	10.0		

TO-263-3 PACKAGE



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.143	1.397	0.045	0.055
B	9.804	10.236	0.386	0.403
C	11.074	11.506	0.406	0.418
D	9.042	9.347	0.356	0.368
E	0.660	0.914	0.026	0.036
F	4.318	4.572	0.170	0.180
G	0.000	0.254	0.000	0.010
H	2.540 BSC		0.100 BSC	
J	1.295 REF		0.051 REF	
K	13.691	14.707	0.539	0.579
L	0.457	0.660	0.018	0.026
M	5° REF		5° REF	
N	2.235	2.591	0.088	0.102

TO-263-3

MARKING DIAGRAM

XX — output voltage (see table below)
Y — Year
WW — Work Week
n — assembly location

XX	OUTPUT VOLTAGE	XX	OUTPUT VOLTAGE
05	5.0	12	12.0
06	6.0	15	15.0
08	8.0	18	18.0
09	9.0	24	24.0
10	10.0		

ORDERING INFORMATION

(THE FORM OF PACKING IS STIPULATED IN THE CONTRACT)

ORDERING NUMBER	OUTPUT VOLTAGE (V)	OPERATING TEMPERATURE (ºC)	PACKAGE	SHIPPING
MIK 78**05**CT	5.0	0 ÷ 70	TO-220	50 Units/Rail
MIK 78**06**CT	6.0			
MIK 78**08**CT	8.0			
MIK 78**09**CT	9.0			
MIK 78**10**CT	10.0			
MIK 78**12**CT	12.0			
MIK 78**15**CT	15.0			
MIK 78**18**CT	18.0			
MIK 78**24**CT	24.0			
MIK 78**05**CD2T	5.0	0 ÷ 70	TO-263	50 Units/Rail, 800 Units/Reel
MIK 78**06** CD2T	6.0			
MIK 78**08** CD2T	8.0			
MIK 78**09** CD2T	9.0			
MIK 78**10** CD2T	10.0			
MIK 78**12** CD2T	12.0			
MIK 78**15** CD2T	15.0			
MIK 78**18** CD2T	18.0			
MIK 78**24** CD2T	24.0			

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