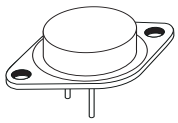
LM138 - LM238 - LM338

Three-terminal 5 A adjustable voltage regulators

Features

- Guaranteed 7 A peak output current
- Guaranteed 5 A output current
- Adjustable output down to 1.2 V
- Line regulation typically 0.005 %/V
- Load regulation typically 0.1 %
- Guaranteed thermal regulation
- Current limit constant with temperature
- Standard 3-lead transistor package



TO-3

Description

The LM138, LM238, LM338 are adjustable 3-terminal positive voltage regulators capable of supplying in excess of 5 A over a 1.2 V to 32 V output range. They are exceptionally easy to use and require only 2 resistors to set the output voltage. Careful circuit design has resulted in outstanding load and line regulation comparable to many commercial power supplies. The LM138 family is supplied in a standard 3-lead transistor package.

A unique feature of the LM138 family is time-dependent current limiting. The current limit circuitry allows peak currents of up to 12 A to be drawn from the regulator for short periods of time. This allows the LM138 to be used with heavy transient loads and speeds start-up under full-load conditions. Under sustained loading conditions, the current limit decreases to a safe value protecting the regulator. Also included on the chip are thermal overload protection and safe area protection for the power transistor. Overload protection remains functional even if the adjustment pin is accidentally disconnected.

Normally, no capacitors are needed unless the device is situated far from the input filter capacitors in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. The adjustment terminal can be bypassed to achieve.very high ripple rejection ratios which are difficult to achieve with standard 3-terminal regulators.

Besides replacing fixed regulators or discrete designs, the LM238 is useful in a wide variety of other applications. Since the regulator is "floating" and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input to input differential is not exceeded.

The LM138, LM238, LM338 are packaged in standard steel TO-3 transistor package. The LM138 is rated for operation from - 55 °C to 150 °C, the LM238 from - 25 °C to 150 °C and the LM338 from 0 °C to 125 °C.

Table 1. Device summary

Part numbers	Order codes	Temperature range
LM138	LM138K	-55 °C to 150 °C
LM238	LM238K	-25 °C to 150 °C
LM338	LM338K	0 °C to 125 °C

3 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter		Value	Unit
$V_I - V_O$	Input-output voltage differential		35	V
P_D	Power dissipation		Internally limited	
T_{STG}	Storage temperature range		-65 to 150	°C
T_{LEAD}	Lead temperature (Soldering, 10 seconds)		300	°C
T_{OP}	Operating junction temperature range	LM138	-55 to 150	°C
		LM238	-25 to 125	
		LM338	0 to 125	

Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thJC}	Thermal resistance junction-case	1.4	°C/W
R_{thJA}	Thermal resistance junction-ambient	35	°C/W

Table 5. Electrical characteristics for LM338 (1)

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
K_{VI}	Line regulation (2)	T_A = 25°C, V_I - V_O = 3 to 35 V			0.005	0.03	%/V
K_{VO}	Load regulation (2)	T_A = 25°C I_O = 10 mA to 5 A	$V_O \leq 5$ V		5	25	mV
			$V_O \geq 5$ V		0.1	0.5	%
	Thermal regulation	Pulse = 20 ms			0.002	0.02	%/W
I_{ADJ}	Adjustment pin current				45	100	µA
ΔI_{ADJ}	Adjustment pin current change	I_L = 10 mA to 5 A, V_I - V_O = 3 to 35 V			0.2	5	µA
V_{REF}	Reference voltage	V_I - V_O = 3 to 35 V, I_O = 10 mA to 5 A P ≤ 50 W		1.19	1.24	1.29	V
K_{VI}	Line regulation (2)	V_I - V_O = 3 to 35 V			0.02	0.06	%/V
K_{VO}	Load regulation (2)	I_O = 10 mA to 5 A	$V_O \leq 5$ V		20	50	mV
			$V_O \geq 5$ V		0.3	1	%
K_{VT}	Temperature stability	$T_J = T_{MIN}$ to T_{MAX}			1		%
$I_{O(MIN)}$	Minimum load current	V_I - $V_O \leq 35$ V			3.5	10	mA
$I_{O(MAX)}$	Current limit	V_I - $V_O \leq 10$ V	DC	5	8		A
			0.5 ms Peak	7	12		
			V_I - V_O = 30 V		1		
V_{NO}	RMS output noise (% of V_O)	T_a = 25°C, f = 10 Hz to 10 kHz				0.003	%
R_{VF}	Ripple rejection ratio	V_O = 10 V, f = 120 Hz			60		dB
		C_{ADJ} = 10 µF		60	75		
K_{VH}	Long term stability	T_A = 125°C			0.3	1	%

1. (T_J = 0 to150 °C, V_I - V_O = 5 V, I_O = 2.5 A. Although power dissipation is internally limited, these specifications apply to power dissipation up to 50 W, unless otherwise specified)
2. Regulation is measured at constant junction temperature. Changes in output voltage due to heating effects are taken into account separately by thermal rejection.

TO-3 mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		11.85			0.466	
B	0.96	1.05	1.10	0.037	0.041	0.043
C			1.70			0.066
D			8.7			0.342
E			20.0			0.787
G		10.9			0.429	
N		16.9			0.665	
P			26.2			1.031
R	3.88		4.09	0.152		0.161
U			39.5			1.555
V		30.10			1.185