SGS-THOMSON MICROELECTRONICS

L4918

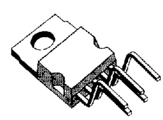
VOLTAGE REGULATOR PLUS FILTER

- FIXED OUTPUT VOLTAGE 8.5V
- 250mA OUTPUT CURRENT
- HIGH RIPPLE REJECTION
- HIGH LOAD REGULATION
- HIGH LINE REGULATION
- SHORT CIRCUIT PROTECTION
- THERMAL SHUT DOWN WITH HYSTERESIS
- DUMP PROTECTION

The L4918 combines both a filter and a voltage regulator in order to provide a high ripple rejection over a wider input voltage range.

A supervisor low-pass loop of the element prevents the output transistor from saturation at low input voltages.

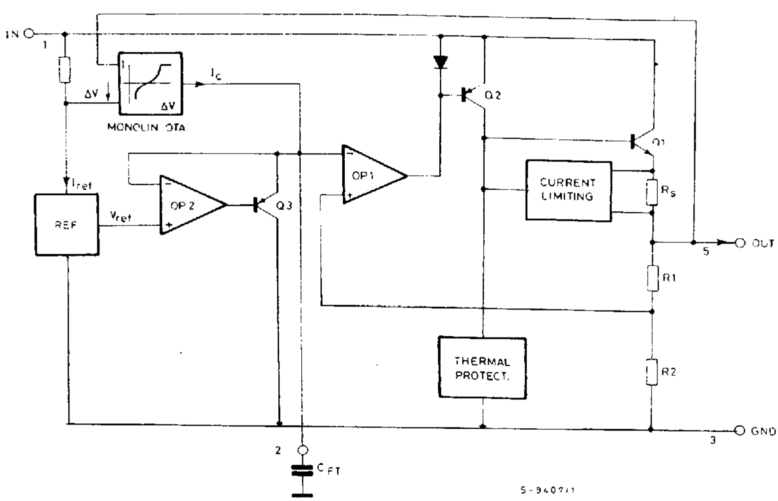
The non linear behaviour of this control circuitry allows a fast setting of the filter.



Pentawatt

ORDERING NUMBER: L4918

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

V_s	Peak input voltage (300ms)	40	V
V_s	DC voltage	28	V
I_o	Output current	internally limited	
P_{tot}	Power dissipation	internally limited	
T_{stg}, T_j	Storage and junction temperature	-40 to 150	°C

CONNECTION DIAGRAM
(Top view)

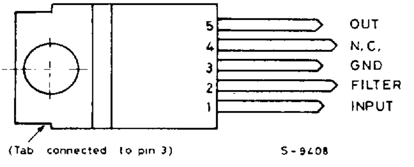
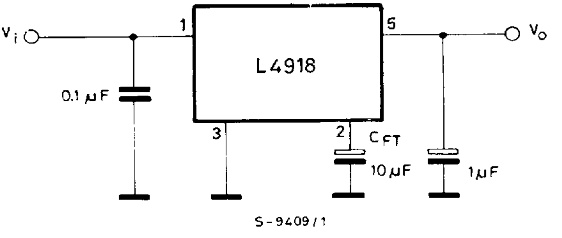


Fig. 1 - Application and test circuit



THERMAL DATA

$R_{th\ j\text{-}case}$	Thermal resistance junction-case	max	4	°C/W

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, V_i = 13.5V unless otherwise specified)

	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_i	Input voltage				20	V
V_o	Output voltage	V_i = 12 to 18V I_o = 5 to 150mA	8.1	8.5	8.9	V
$\Delta V_{I/O}$	Controlled input-output dropout voltage	V_i = 5 to 10V I_o = 5 to 150mA		1.6	2.1	V
ΔV_o	Line regulation	V_i = 12 to 18V I_o = 10mA		1	20	mV
ΔV_o	Load regulation	I_o = 5 to 250mA t_{on} = 30μs t_{off} = ≥ 1ms			100	mV
ΔV_o	Load regulation	V_i = 8.5V I_o = 5 to 150mA t_{on} = 30μs t_{off} = ≥ 1ms		100	250	mV
I_q	Quiescent current	I_o = 5mA		1.0	2	mA
ΔI_q	Quiescent current change	V_i = 6 to 18V I_o = 5 to 150mA		0.05		mA
$\frac{\Delta V_o}{\Delta T}$	Output voltage drift	I_o = 10mA		1.2		mV/°C
SVR	Supply voltage rejection	$\dot{V}_{iac}$ = 1V_{rms} f = 100Hz I_o = 150mA V_{IDC} = 12 to 18V V_{IDC} = 6 to 11V		 71 35 (*)		 dB dB
I_{SC}	Short circuit current		250	300		mA
t_{on}	Switch on time	I_o = 150mA V_i = 5 to 11V V_i = 11 to 18V		 500 (*) 300		 ms ms
T_{JSD}	Thermal shut down			150		°C

(*) Depending of the C_{FT} capacitor

PRINCIPLE OF OPERATION

During normal operation (input voltage upper than $V_{I\,MIN} = V_{OUT\,NOM} + \Delta V_{I/O}$). The device works as a normal voltage regulator built around the OP1 of the block diagram.
The series pass element use a PNP-NPN connection to reduce the dropout. The reference voltage of the OP1 is derived from a REF through the OP2 and Q3, acting as an active zener diode of value V_{REF}.
In this condition the device works in the range (1) of the characteristic of the non linear drop control unit (see fig. 2)
The output voltage is fixed to its nominal value:

$$V_{OUT\,NOM} = V_{REF}\,(1 + \frac{R1}{R2}) = V_{CFT}\,(1 + \frac{R1}{R2})$$

$\frac{R1}{R2}$ = INTERNALLY FIXED RATIO = 2.4

The ripple rejection is quite high (71 dB) and independent from C_{FT} value.
On the usual voltage regulators, when the input voltage goes below the nominal value, the regulation transistors (series element) saturate bringing the system out of regulation making it very sensible to every variation of the input voltage. On the contrary, a control loop on the L4918 consents to avoid the saturation of the series element by regulating the value of the reference voltage (pin 2). In fact, whenever the input voltage decreases below $V_{I\,MIN}$ the supervisor loop, utilizing a non linear OTA, forces the reference voltage at pin 2 to decrease by discharging C_{FT}. So, during the static mode, when the input voltage goes below V_{MIN} the drop out is kept fixed to about 1.6V. In this condition the device works as a low pass filter in the range (2) of the OTA characteristic. The ripple rejection is externally adjustable acting on C_{FT} as follows:

$$SVR\,(jw) = \left| \frac{V_I\,(jw)}{V_{out}\,(jw)} \right| = \left| 1 + \frac{10^{-6}}{\frac{gm}{jwC_{FT}}\,(1 + \frac{R1}{R2})} \right|$$

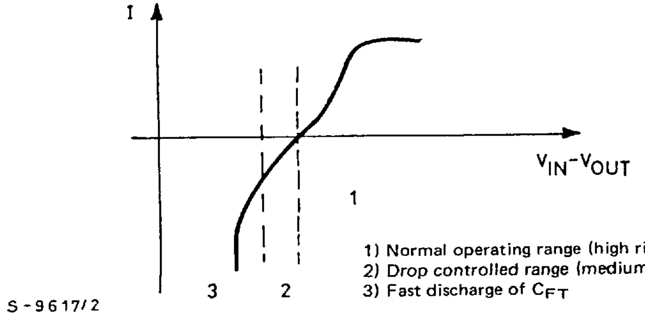
Where:
$gm = 2 \cdot 10^{-5}\ \Omega^{-1}$ = OTA'S typical transconductance value on linear region

$\frac{R1}{R2}$ = fixed ratio

C_{FT} = value of capacitor in μF

The reaction time of the supervisor loop is given by the tranconductance of the OTA and by C_{FT}. When the value of the ripple voltage is so high and its negative peak is fast/enough to determine an istantaneous decrease of the dropout till 1.2V, the OTA works in a higher transconductance condition [range (3) of the characteristic] and discharge the capacitor rapidously.
If the ripple frequency is high enough the capacitor won't charge itself completely, and the output voltage reaches a small value allowing a better ripple rejection; the device's again working as a filter (fast transient range).
With C_{FT}= 10 μF; f = 100 Hz a SVR of 35 is obtained.

Fig. 2 - Nonliner transfer characteristic of the drop control unit



1) Normal operating range (high ripple rejection)
2) Drop controlled range (medium ripple rejection)
3) Fast discharge of C_{FT}

Fig. 3 - Supply voltage rejection vs. frequency

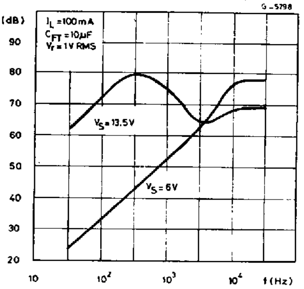


Fig. 4 - Supply voltage rejection vs. input voltage

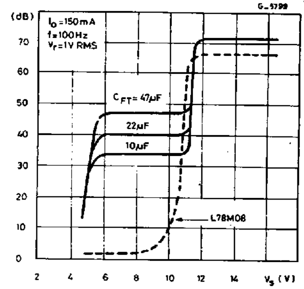


Fig. 5 - Output voltage vs input voltage