3-Terminal 1.5A Adjustable Voltage Regulator LM317

FEATURES

- 1.5A Output Current
- Input-Output Differential up to 40V
- Output Voltage Range Adjustable from 1.25V to 37V
- Typical 0.01%/V Line Regulation
- Typical 0.1% Load Regulation
- Current Limit Constant with Temperature
- Short-Circuit Protected Output
- Internal Short-Circuit Current Limiting
- Thermal Overload Protection

APPLICATIONS

- Post Regulation for Switching Supplies
- Constant Current Regulator
- Digital Signage
- Ethernet Switches
- Motor Controls
- Power Line Communication Modems
- Refrigerators
- Signal or Waveform Generators
- Washing Machines

DESCRIPTION

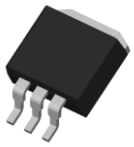
The LM317 device is an adjustable three-terminal positive-voltage regulator capable of supplying 1.5A over a 1.25V to 37V output range.

It requires only two external resistors to set the output voltage. The device features a typical line regulation of 0.01% and typical load regulation of 0.1%. It includes current limiting, thermal overload protection, and safe operating area protection. Overload protection circuity remains fully functional even if the ADJ terminal is disconnected.

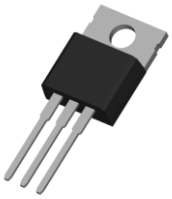
SOT-223-3L

TO-252-3L

TO-263-2L



TO-263-3L



TO-220-3L

DEVICE INFORMATION

Device	Package
LM317S	SOT-223-3L
LM317RS	TO-252-3L
LM317R2	TO-263-2L
LM317R	TO-263-3L
LM317T	TO-220-3L

ABSOLUTE MAXIMUM RATINGS (Note 1)

CHARACTERISTIC	SYMBOL	MIN	MAX	UNIT
Input-to-Output Differential Voltage	$V_{IN} - V_{OUT}$	−0.3	40	V
Power Dissipation	P_D		Limited	
Operating Virtual Junction Temperature	T_J	−40	125	°C
Storage Temperature	T_{STG}	−65	150	°C

Note 1. Stresses beyond 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 beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING RATINGS (Note 2)

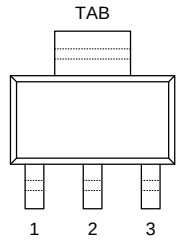
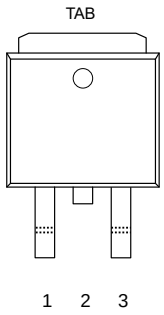
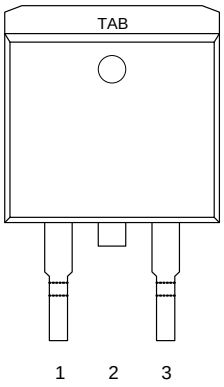
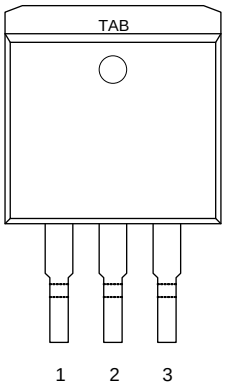
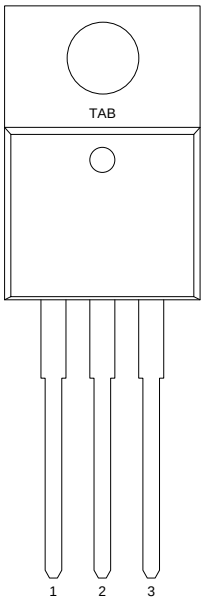
CHARACTERISTIC	SYMBOL	MIN	MAX	UNIT
Supply Voltage (Note 2)	$V_{IN} - V_{OUT}$	3.0	40	V
Output Current	I_O	0.01	1.5	A
Operating Virtual Junction Temperature	T_J	−40	125	°C

Note 2. The device is not guaranteed to function outside its operating ratings.

ORDERING INFORMATION

VOUT	Package	Order No.	Description	Supplied As	Status
ADJ	SOT-223-3L	LM317S	1.5A, Adjustable	Tape & Reel	Active
	TO-252-3L	LM317RS	1.5A, Adjustable	Tape & Reel	Active
	TO-263-2L	LM317R2	1.5A, Adjustable	Tape & Reel	Active
	TO-263-3L	LM317R	1.5A, Adjustable	Tape & Reel	Active
	TO-220-3L	LM317T	1.5A, Adjustable	Tube	Active

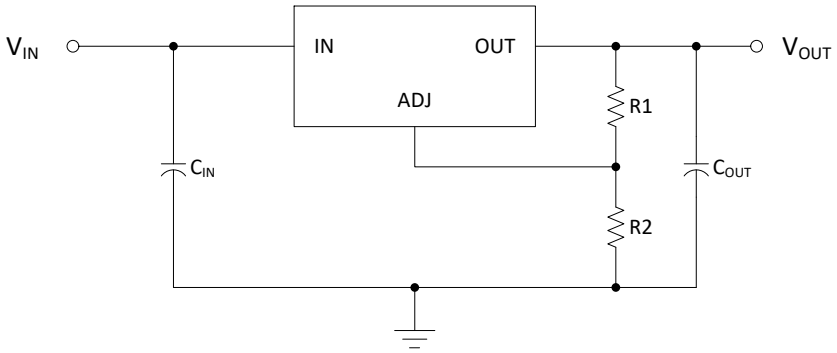
PIN CONFIGURATIONS

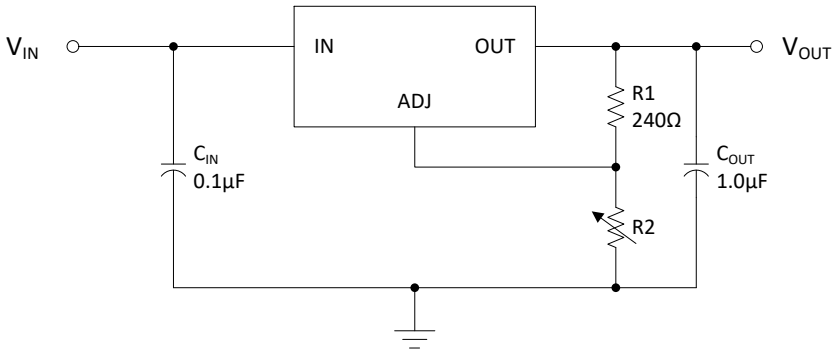
				
SOT-223	TO-252-3	TO-263-2	TO-263-3	TO-220

PIN DESCRIPTION

Pin No.				Pin Name	Pin Function
SOT-223	TO-252	TO-263	TO-220		
1	1	1	1	ADJ	Output Voltage Adjustment.
2	2	2	2	OUT	Output Voltage.
3	3	3	3	IN	Input Voltage.
TAB	TAB	TAB	TAB	TAB	Connect to OUT. Attached to heatsink for thermal relief for TO-220 package or put a copper plane connected to this pin as a thermal relief for TO-263/TO-252 package.

TYPICAL APPLICATION CIRCUITS





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

* C_{IN} required if the device is more than 6 inches from filter capacitors. Value given may be increased.

** C_{OUT} optional to improve transient response. Value given may be increased up to 1000µF.

ELECTRICAL CHARACTERISTICS (Note 3)

Specifications apply over full operating virtual junction temperature range as noted. Unless otherwise noted, $V_{IN} - V_{OUT} = 5.0$ V, $I_{OUT} = 10$ mA, $C_{IN} = 0.1$ µF, $C_{OUT} = 1.0$ µF.

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNIT
Reference Voltage	V_{REF}	3.0 V ≤ ($V_{IN} - V_{OUT}$) ≤ 40 V, 10 mA ≤ I_{OUT} ≤ 1.5 A (Note 4)		1.20	1.25	1.30	V
Line Regulation	LNR	3.0 V ≤ ($V_{IN} - V_{OUT}$) ≤ 40 V	T_J = 25°C	-	0.01	0.04	%/V
			T_{MIN} to T_{MAX}	-	0.02	0.07	
Load Regulation	LDR	10 mA ≤ I_{OUT} ≤ 1.5 A (Note 4), V_{OUT} ≤ 5.0 V	T_J = 25°C	-	5.0	25	mV
			T_{MIN} to T_{MAX}	-	20	70	mV
		10 mA ≤ I_{OUT} ≤ 1.5 A (Note 4), V_{OUT} > 5.0 V	T_J = 25°C	-	0.1	0.5	%
			T_{MIN} to T_{MAX}	-	0.3	1.5	%
ADJ Pin Current	I_{ADJ}			-	50	100	µA
ADJ Pin Current Change	ΔI_{ADJ}	2.5 V ≤ ($V_{IN} - V_{OUT}$) ≤ 40 V, 10 mA ≤ I_{OUT} ≤ 1.5 A (Note 4)		-	0.2	5.0	µA
Output Voltage Temperature Stability	ΔV_{OUT}			-	1.0	-	%
RMS Output Noise		10 Hz ≤ f ≤ 10 kHz, T_J = 25°C		-	0.003	-	$\%V_{OUT}$
Minimum Load Current	I_{MIN}	($V_{IN} - V_{OUT}$) = 40 V		-	3.5	10	mA
Maximum Output Current	$I_{O.MAX}$	($V_{IN} - V_{OUT}$) ≤ 15 V, $P_D < P_{MAX}$		1.5	2.2	-	A
		($V_{IN} - V_{OUT}$) = 40 V, T_J = 25°C, $P_D < P_{D.MAX}$		0.15	0.4	-	
Ripple Rejection Ratio	PSRR	V_{OUT} = 10 V, f = 120 Hz		-	65	-	dB
		V_{OUT} = 10 V, f = 120 Hz, C_{ADJ} = 10 µF (Note 5)		66	80	-	
Long-term Stability (Note 6)		T_J = 25°C, 1000 hrs		-	0.3	1.0	%

Note 3. Low duty cycle pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible.

Note 4. Device power dissipation (P_D) is limited by ambient temperature (T_A), device maximum junction temperature (T_J), and package thermal resistance (θ_{JA}). The maximum allowable power dissipation at any temperature is: $P_{D.MAX} = ((T_{J.MAX} - T_A) / \theta_{JA})$.

Note 5. C_{ADJ} is connected between the ADJ pin and GND.

Note 6. Since long-term stability cannot be measured on the individual devices prior to shipment, this specification is not intended to be a guarantee or warranty. It is an engineering estimate of the average drift to be expected from lot to lot.

TYPICAL OPERATING CHARACTERISTICS

T.B.D.

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Site Web : www.es-france.com

APPLICATION INFORMATION

The LM317 device is an adjustable three-terminal positive-voltage regulator capable of supplying 1.5A over a 1.25V to 37V output range.
Typically, no capacitors are needed unless the device is suited more than 6 inches 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 ADJ terminal can be bypassed to achieve very high ripple rejection ratios.
The primary applications of each of these regulators is that of a programmable output regulator, but by connecting a fixed resistor between adjustment terminal and the output terminal, each device can be used as a precision current regulator. Even though the regulator is floating and sees only the input-to-output differential voltage, use of these devices to regulate output voltages that would cause the maximum-rated differential voltage to be exceeded if the output became shorted to ground is not recommended.

THERMAL PROTECTION

Device operational range is limited by the maximum junction temperature (T_J). The junction temperature is influenced by the ambient temperature (T_A), package selection, input voltage (V_{IN}), and the output load current. When operating with maximum load currents the input voltage and/or ambient temperature will be limited.
Even though the LM317 is equipped with circuitry to protect itself from excessive thermal dissipation, it is not recommended that the LM317 be operated at, or near, the maximum recommended die junction temperature (T_J) as this may impair long term device reliability.
The thermal protection circuitry monitors the temperature at the die level. When the die temperature exceeds typically 160°C the voltage regulator output will be switched off.

MAXIMUM OUTPUT CURRENT CAPABILITY

The LM317 can deliver a continuous current of 1.0A over the full operating temperature range. However, the output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of application. With respect to the applied package, the maximum output current of 1A may be still undeliverable due to the restriction of the power dissipation of LM317. Under all possible conditions, the junction temperature must be within the range specified under operating conditions. The temperatures over the device are given by:

$$T_C = T_A + P_D \times \theta_{CA} \quad / \quad T_J = T_C + P_D \times \theta_{JC} \quad / \quad T_J = T_A + P_D \times \theta_{JA}$$

where T_J is the junction temperature, T_C is the case temperature, T_A is the ambient temperature, P_D is the total power dissipation of the device, θ_{CA} is the thermal resistance of case-to-ambient, θ_{JC} is the thermal resistance of junction-to-case, and θ_{JA} is the thermal resistance of junction to ambient. The total power dissipation of the device is given by:

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

where I_{GND} is the operating ground current of the device which is specified at the Electrical Characteristics. The maximum allowable temperature rise (T_{Rmax}) depends on the maximum ambient temperature (T_{Amax}) of the application, and the maximum allowable junction temperature (T_{Jmax}):

$$T_{Rmax} = T_{Jmax} - T_{Amax}$$

The maximum allowable value for junction-to-ambient thermal resistance, θ_{JA}, can be calculated using the formula:

$\theta_{CA} = T_{Rmax} / P_D = (T_{Jmax} - T_{Amax}) / P_D$

The thermal resistance depends on amount of copper area or heat sink, and on air flow. If the maximum allowable value of θ_{JA} calculated above is over its rating of a package, no heat sink is needed since the package can dissipate enough heat to satisfy these requirements. If the value for allowable θ_{JA} falls near or below these limits, a heat sink or proper area of copper plane is required. The absolute maximum ratings of thermal resistances are as follow:

CHARACTERISTICS	SYMBOL	RATING	UNIT
Thermal Resistance Junction-To-Ambient / SOT-223-3L	$\theta_{JA\text{-}SOT\text{-}223\text{-}3L}$	137	°C/W
Thermal Resistance Junction-To-Ambient / TO-220-3L	$\theta_{JA\text{-}TO\text{-}220\text{-}3L}$	70	°C/W

No heat sink / No air flow / No adjacent heat source / T_A=25°C

REVISION NOTICE

The description in this datasheet is subject to change without any notice to describe its electrical characteristics properly.

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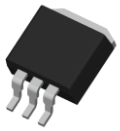
3-Terminal 1.5A Positive Voltage Regulator LM78xx

FEATURES

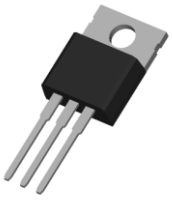
- Output Current up to 1.5A
- Internal Thermal Overload Protection
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation
- Output Voltage of 5V, 6V, 8V, 9V, 12V, 15V, 18V, 20V, and 24V
- Available in SOT-223, TO-252, TO-263, TO-220 and TO-220F Packages

SOT-223-3

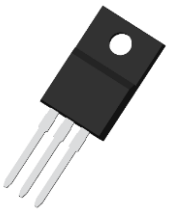
TO-252-3



TO-263-3



TO-220-3



TO-220F-3

DESCRIPTION

The series of fixed-Positive voltage monolithic integrated circuit voltage regulator is designed to complement LM78xx series in a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation.

Each of these regulators can deliver up to 1.5A of output current. The internal limiting and thermal shutdown features of these regulators make them essentially immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and current and also as the power pass element in precision regulators.

ORDERING INFORMATION

Device	Package
LM78xxS	SOT-223-3L
LM78xxRS	TO-252-3L
LM78xxR	TO-263-3L
LM78xxT	TO-220-3L
LM78xxTP	TO-220F-3L

xx: Output Voltage

ABSOLUTE MAXIMUM RATINGS (Note 1)

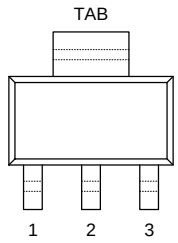
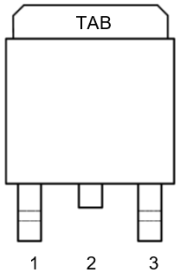
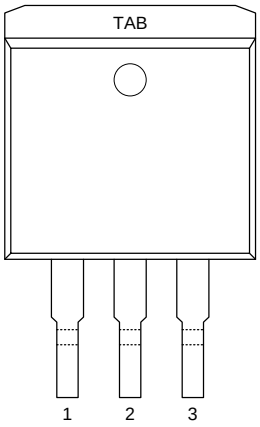
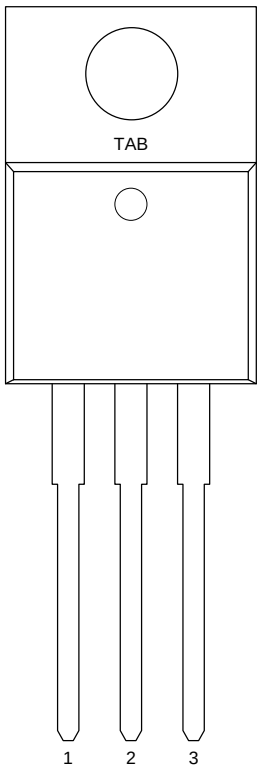
CHARACTERISTIC		SYMBOL	MIN	MAX	UNIT
Input Voltage	V_{OUT} = 5V to 18V	V_{IN}	-	35	V
	V_{OUT} = 20V and 24V		-	40	
Maximum Junction Temperature		T_J	−40	125	°C
Storage Temperature		T_{STG}	−65	150	°C

Note 1. Stresses beyond 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 beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

ORDERING INFORMATION

VOUT	Package	Order No.	Description	Supplied As	Status
5.0V	SOT-223-3L	LM7805S	1.5A, Fixed	Tape & Reel	Active
	TO-252-3L	LM7805RS	1.5A, Fixed	Tape & Reel	Active
	TO-263-3L	LM7805R	1.5A, Fixed	Tape & Reel	Active
	TO-220-3L	LM7805T	1.5A, Fixed	Tube	Active
	TO-220F-3L	LM7805TP	1.5A, Fixed	Tube	Active
6.0V	TO-252-3L	LM7806RS	1.5A, Fixed	Tape & Reel	Contact us
	TO-263-3L	LM7806R	1.5A, Fixed	Tape & Reel	Contact us
	TO-220-3L	LM7806T	1.5A, Fixed	Tube	Active
	TO-220F-3L	LM7806TP	1.5A, Fixed	Tube	Contact us
8.0V	TO-252-3L	LM7808RS	1.5A, Fixed	Tape & Reel	Contact us
	TO-263-3L	LM7808R	1.5A, Fixed	Tape & Reel	Contact us
	TO-220-3L	LM7808T	1.5A, Fixed	Tube	Contact us
	TO-220F-3L	LM7808TP	1.5A, Fixed	Tube	Contact us
9.0V	TO-252-3L	LM7809RS	1.5A, Fixed	Tape & Reel	Contact us
	TO-263-3L	LM7809R	1.5A, Fixed	Tape & Reel	Contact us
	TO-220-3L	LM7809T	1.5A, Fixed	Tube	Active
	TO-220F-3L	LM7809TP	1.5A, Fixed	Tube	Contact us
12V	TO-252-3L	LM7812RS	1.5A, Fixed	Tape & Reel	Contact us
	TO-263-3L	LM7812R	1.5A, Fixed	Tape & Reel	Contact us
	TO-220-3L	LM7812T	1.5A, Fixed	Tube	Active
	TO-220F-3L	LM7812TP	1.5A, Fixed	Tube	Active
15V	TO-252-3L	LM7815RS	1.5A, Fixed	Tape & Reel	Contact us
	TO-263-3L	LM7815R	1.5A, Fixed	Tape & Reel	Contact us
	TO-220-3L	LM7815T	1.5A, Fixed	Tube	Active
	TO-220F-3L	LM7815TP	1.5A, Fixed	Tube	Contact us
18V	TO-252-3L	LM7818RS	1.5A, Fixed	Tape & Reel	Contact us
	TO-263-3L	LM7818R	1.5A, Fixed	Tape & Reel	Contact us
	TO-220-3L	LM7818T	1.5A, Fixed	Tube	Contact us
	TO-220F-3L	LM7818TP	1.5A, Fixed	Tube	Contact us
20V	TO-252-3L	LM7820RS	1.5A, Fixed	Tape & Reel	Contact us
	TO-263-3L	LM7820R	1.5A, Fixed	Tape & Reel	Contact us
	TO-220-3L	LM7820T	1.5A, Fixed	Tube	Contact us
	TO-220F-3L	LM7820TP	1.5A, Fixed	Tube	Contact us
24V	TO-252-3L	LM7824RS	1.5A, Fixed	Tape & Reel	Contact us
	TO-263-3L	LM7824R	1.5A, Fixed	Tape & Reel	Contact us
	TO-220-3L	LM7824T	1.5A, Fixed	Tube	Active
	TO-220F-3L	LM7824TP	1.5A, Fixed	Tube	Contact us

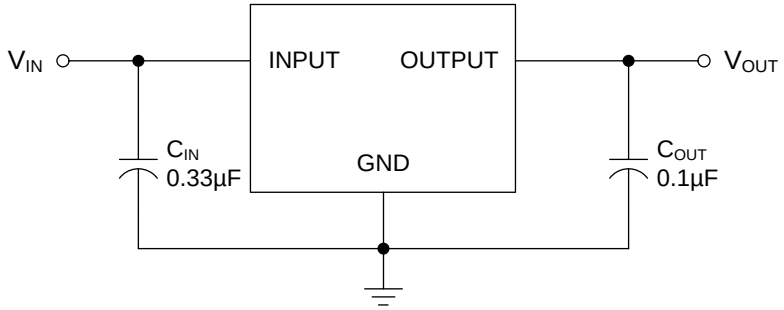
PIN CONFIGURATION

			
SOT-223	TO-252	TO-263	TO-220 / TO-220F

PIN DESCRIPTION

Pin No.				Pin Name	Pin Function
TO-252	TO-263	TO-220	TO-220F		
1	1	1	1	INPUT	Input Voltage
2	2	2	2	GND	Ground (Common)
3	3	3	3	OUTPUT	Output Voltage
TAB	TAB	TAB	TAB	TAB	Connect to GND. Attached to heatsink for thermal relief for TO-220 package or put a copper plane connected to this pin as a thermal relief for TO-263 package.
					No Connection, Electrically Isolated for TO-220F Package

TYPICAL APPLICATION CIRCUITS



* C_{IN} required for stability. Value given may be increased.

** C_{OUT} may be used to improve the transient response of the regulator. It should be located as close as possible tor the regulator. Value given may be increased.

ELECTRICAL CHARACTERISTICS: LM7805

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over T_J = 0°C to 125°C. Conditions are V_{IN} = 10V, I_{OUT} = 500mA, C_{IN} = 0.33µF, C_{OUT} = 0.1µF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		4.80	5.0	5.20	V
		7V ≤ V_{IN} ≤ 20V, 5.0mA ≤ I_{OUT} ≤ 1.0A	**4.75**	**5.0**	**5.25**	
Line Regulation	ΔV_{LINE}	7V ≤ V_{IN} ≤ 25V	-	-	100	mV
		8.0V ≤ V_{IN} ≤ 12V	-	-	50	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	-	100	mV
		0.25A ≤ I_{OUT} ≤ 0.75A	-	-	50	
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	2.0	-	V
Bias Current	I_B		-	-	8.0	mA
Bias Current Change	ΔI_B	7V ≤ V_{IN} ≤ 25V	-	-	1.3	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	-	0.5	

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by the *Absolute Maximum Ratings*.

ELECTRICAL CHARACTERISTICS: LM7806

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over T_J = 0°C to 125°C. Conditions are V_{IN} = 11V, I_{OUT} = 500mA, C_{IN} = 0.33µF, C_{OUT} = 0.1µF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		5.76	6.0	6.24	V
		8V ≤ V_{IN} ≤ 21V, 5.0mA ≤ I_{OUT} ≤ 1.0A	**5.70**	**6.0**	**6.30**	
Line Regulation	ΔV_{LINE}	8V ≤ V_{IN} ≤ 25V	-	-	120	mV
		9V ≤ V_{IN} ≤ 13V	-	-	60	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	-	120	mV
		0.25A ≤ I_{OUT} ≤ 0.75A	-	-	60	
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	2.0	-	V
Bias Current	I_B		-	-	8.0	mA
Bias Current Change	ΔI_B	8.0V ≤ V_{IN} ≤ 25V	-	-	1.3	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	-	0.5	

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by the *Absolute Maximum Ratings*.

ELECTRICAL CHARACTERISTICS: LM7809

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over T_J = 0°C to 125°C. Conditions are V_{IN} = 15V, I_{OUT} = 500mA, C_{IN} = 0.33µF, C_{OUT} = 0.1µF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		8.64	9.0	9.36	V
		11.5V ≤ V_{IN} ≤ 24V, 5.0mA ≤ I_{OUT} ≤ 1.0A	**8.55**	**9.0**	**9.45**	
Line Regulation	ΔV_{LINE}	11.5V ≤ V_{IN} ≤ 26V	-	-	180	mV
		11.5V ≤ V_{IN} ≤ 17V	-	-	90	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	-	180	mV
		0.25A ≤ I_{OUT} ≤ 0.75A	-	-	90	
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	2.0	-	V
Bias Current	I_B		-	-	8.0	mA
Bias Current Change	ΔI_B	11.5V ≤ V_{IN} ≤ 26V	-	-	1.3	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	-	0.5	

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by the *Absolute Maximum Ratings*.

ELECTRICAL CHARACTERISTICS: LM7812

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over T_J = 0°C to 125°C. Conditions are V_{IN} = 19V, I_{OUT} = 500mA, C_{IN} = 0.33µF, C_{OUT} = 0.1µF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		11.5	12	12.5	V
		14.5V ≤ V_{IN} ≤ 27V, 5.0mA ≤ I_{OUT} ≤ 1.0A	**11.4**	**12**	**12.6**	
Line Regulation	ΔV_{LINE}	14.5V ≤ V_{IN} ≤ 30V	-	-	240	mV
		16V ≤ V_{IN} ≤ 22V	-	-	120	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	-	240	mV
		0.25A ≤ I_{OUT} ≤ 0.75A	-	-	120	
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	2.0	-	V
Bias Current	I_B		-	-	8.0	mA
Bias Current Change	ΔI_B	14.5V ≤ V_{IN} ≤ 30V	-	-	1.3	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	-	0.5	

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by the *Absolute Maximum Ratings*.

ELECTRICAL CHARACTERISTICS: LM7815

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over T_J = 0°C to 125°C. Conditions are V_{IN} = 23V, I_{OUT} = 500mA, C_{IN} = 0.33µF, C_{OUT} = 0.1µF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		14.4	15	15.6	V
		17.5V ≤ V_{IN} ≤ 30V, 5.0mA ≤ I_{OUT} ≤ 1.0A	**14.25**	**15**	**15.75**	
Line Regulation	ΔV_{LINE}	17.5V ≤ V_{IN} ≤ 30V	-	-	300	mV
		20V ≤ V_{IN} ≤ 26V	-	-	150	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	-	300	mV
		0.25A ≤ I_{OUT} ≤ 0.75A	-	-	150	
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	2.0	-	V
Bias Current	I_B		-	-	8.0	mA
Bias Current Change	ΔI_B	17.5V ≤ V_{IN} ≤ 30V	-	-	1.3	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	-	0.5	

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by the *Absolute Maximum Ratings*.

ELECTRICAL CHARACTERISTICS: LM7824

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over T_J = 0°C to 125°C. Conditions are V_{IN} = 33V, I_{OUT} = 500mA, C_{IN} = 0.33µF, C_{OUT} = 0.1µF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		23	24	25	V
		27V ≤ V_{IN} ≤ 38V, 5.0mA ≤ I_{OUT} ≤ 1.0A	**22.8**	**24**	**25.2**	
Line Regulation	ΔV_{LINE}	27V ≤ V_{IN} ≤ 38V	-	-	480	mV
		30V ≤ V_{IN} ≤ 36V	-	-	240	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	-	480	mV
		0.25A ≤ I_{OUT} ≤ 0.75A	-	-	240	
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	2.0	-	V
Bias Current	I_B		-	-	8.0	mA
Bias Current Change	ΔI_B	27V ≤ V_{IN} ≤ 38V	-	-	1.3	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	-	0.5	

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by the *Absolute Maximum Ratings*.

Maximum Output Current Capability

The LM78xx can deliver a continuous current of 3.0A over the full operating junction temperature range. However, the output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of application. With respect to the applied package, the maximum output current of 3.0A may be still undeliverable due to the restriction of the power dissipation of LM78xx. Under all possible conditions, the junction temperature must be within the range specified under operating conditions.
The temperatures over the device are given by:

$$T_C = T_A + P_D \times \theta_{CA} \quad / \quad T_J = T_C + P_D \times \theta_{JC} \; / \quad T_J = T_A + P_D \times \theta_{JA}$$

where T_J is the junction temperature, T_C is the case temperature, T_A is the ambient temperature, P_D is the total power dissipation of the device, θ_{CA} is the thermal resistance of case-to-ambient, θ_{JC} is the thermal resistance of junction-to-case, and θ_{JA} is the thermal resistance of junction to ambient.
The total power dissipation of the device is given by:

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

where I_{GND} is the operating ground current of the device which is specified at the Electrical Characteristics. The maximum allowable temperature rise (T_{Rmax}) depends on the maximum ambient temperature (T_{Amax}) of the application, and the maximum allowable junction temperature (T_{Jmax}):

$$\mathbf{T_{Rmax} = T_{Jmax} - T_{Amax}}$$

The maximum allowable value for junction-to-ambient thermal resistance, θ_{JA}, can be calculated using the formula:

$$\mathbf{\theta_{JA} = T_{Rmax} / P_D = (T_{Jmax} - T_{Amax}) / P_D}$$

LM78xx is available in SOP8, SOP8-PP, TO225, TO263 and TO220/TO220F packages. The thermal resistance depends on amount of copper area or heat sink, and on air flow. If the maximum allowable value of θ_{JA} calculated above is over 165°C/W for SOP8 package, over 175°C/W for SOP8-PP package, over 105 °C/W for TO252 package, over 80 °C/W for TO263 package, over 70 °C/W for TO220 package, no heat sink is needed since the package can dissipate enough heat to satisfy these requirements. If the value for allowable θ_{JA} falls near or below these limits, a heat sink or proper area of copper plane is required.
In summary, the absolute maximum ratings of thermal resistances are as follow:

Absolute Maximum Ratings of Thermal Resistance
No heat sink / No air flow / No adjacent heat source / T_A = 25°C

Characteristic	Symbol	Rating	Unit
Thermal Resistance Junction-To-Ambient / TO252	$\theta_{JA\text{-}SOT223}$	137	°C/W
Thermal Resistance Junction-To-Ambient / TO252	$\theta_{JA\text{-}TO252}$	105	°C/W
Thermal Resistance Junction-To-Ambient / TO263	$\theta_{JA\text{-}TO263}$	80	°C/W
Thermal Resistance Junction-To-Ambient / TO220	$\theta_{JA\text{-}TO220}$	70	°C/W
Thermal Resistance Junction-To-Ambient / TO220F	$\theta_{JA\text{-}TO220F}$	T.B.D	°C/W

In case that there is no cooling solution and no heat sink / copper plane area for heat sink, the maximum allowable power dissipation of each package is as follow;

Characteristic	Symbol	Rating	Unit
Maximum Allowable Power Dissipation at T_A=25°C / SOT223	$P_{DMax\text{-}SOT223}$	0.729	W
Maximum Allowable Power Dissipation at T_A=25°C / TO252	$P_{DMax\text{-}TO252}$	0.952	W
Maximum Allowable Power Dissipation at T_A=25°C / TO263	$P_{DMax\text{-}TO263}$	1.250	W
Maximum Allowable Power Dissipation at T_A=25°C / TO220	$P_{DMax\text{-}TO220}$	1.429	W
Maximum Allowable Power Dissipation at T_A=25°C / TO220F	$P_{DMax\text{-}TO220F}$	T.B.D	W

- Please note that above maximum allowable power dissipation is based on the minimum copper plane area which does not exceed the proper footprint of the package. And the ambient temperature is 25°C.

If proper cooling solution such as heat sink, copper plane area, air flow is applied, the maximum allowable power dissipation could be increased. However, if the ambient temperature is increased, the allowable power dissipation would be decreased.

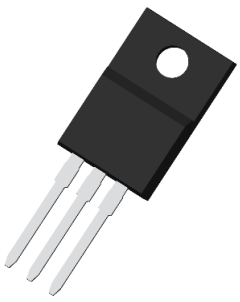
REVISION NOTICE

The description in this datasheet is subject to change without any notice to describe its electrical characteristics properly.

3-Terminal 1.5A Negative Voltage Regulator LM79xxTP

FEATURES

- Output Current Up to 1.5A
- Internal Thermal Overload Protection
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation
- Output Voltage of −5V, −6V, −8V, −9V, −12V, −15V, −18V, −20V, and −24V



TO-220F-3

DESCRIPTION

This series of fixed-negative voltage monolithic integrated circuit voltage regulator is designed to complement LM79xxTP series in a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation.

Each of these regulators can deliver up to 1.5A of output current. The internal limiting and thermal shutdown features of these regulators make them essentially immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and current and also as the power pass element in precision regulators.

ORDERING INFORMATION

Device	Package
LM79xxTP	TO-220F-3L

xx: Output Voltage

ABSOLUTE MAXIMUM RATINGS (Note 1)

CHARACTERISTIC		SYMBOL	MIN	MAX	UNIT
Input Voltage	All (except V_{OUT} = −24V)	V_{IN}	-	−35	V
	V_{OUT} = −24V		-	−40	
Maximum Junction Temperature		T_J	0	150	°C
Storage Temperature		T_{STG}	−65	150	°C

Note 1. Stresses beyond 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 beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING RATINGS (Note 2)

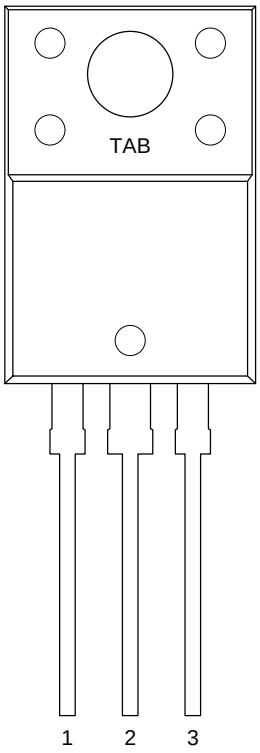
CHARACTERISTIC		SYMBOL	MIN	MAX	UNIT
Input Voltage	V_{OUT} = −5.0V	V_{IN}	−7.0	−25	V
	V_{OUT} = −6.0V		−8.0	−25	
	V_{OUT} = −8.0V		−10.5	−25	
	V_{OUT} = −9.0V		−11.5	−25	
	V_{OUT} = −12V		−14.5	−30	
	V_{OUT} = −15V		−17.5	−30	
	V_{OUT} = −18V		−21	−33	
	V_{OUT} = −20V		−23	−34	
	V_{OUT} = −24V		−27	−38	
Output Current		I_{OUT}	0	1.5	A
Operating Junction Temperature Range		T_J	0	125	°C

Note 2. The device is not guaranteed to function outside its operating ratings.

ORDERING INFORMATION

VOUT	Package	Order No.	Description	Supplied As	Status
−5.0V	TO-220F-3L	LM7905TP	1.5A, FullPAK	Tube	Contact us
−6.0V	TO-220F-3L	LM7906TP	1.5A, FullPAK	Tube	Contact us
−8.0V	TO-220F-3L	LM7908TP	1.5A, FullPAK	Tube	Contact us
−9.0V	TO-220F-3L	LM7909TP	1.5A, FullPAK	Tube	Contact us
−12V	TO-220F-3L	LM7912TP	1.5A, FullPAK	Tube	Contact us
−15V	TO-220F-3L	LM7915TP	1.5A, FullPAK	Tube	Contact us
−18V	TO-220F-3L	LM7918TP	1.5A, FullPAK	Tube	Active
−20V	TO-220F-3L	LM7920TP	1.5A, FullPAK	Tube	Contact us
−24V	TO-220F-3L	LM7924TP	1.5A, FullPAK	Tube	Active

PIN CONFIGURATION

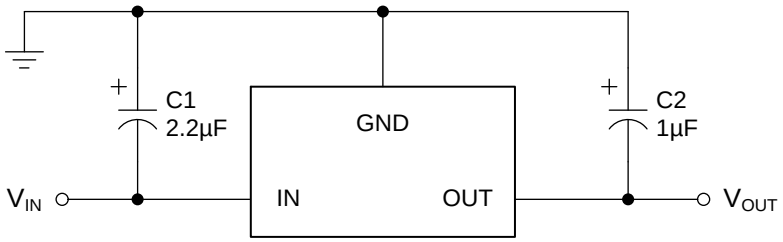


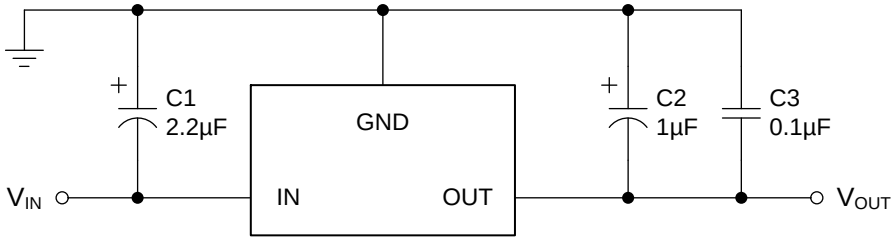
TO-220F (FullPAK)

PIN DESCRIPTION

Pin No.	Pin Name	Pin Function
1	GND	Ground
2	IN	Input Voltage
3	OUT	Output Voltage
TAB	TAB	No Connection. Electrically Isolated.

TYPICAL APPLICATION CIRCUITS





* C1 required for stability. Value given may be increased.

** C2 required for stability. Value given may be increased.

*** C3 considered improving the transient response.

ELECTRICAL CHARACTERISTICS: LM7905

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full operating temperature range In the *Recommended Operating Ratings*. Conditions are V_{IN} = −10V, I_{OUT} = 500mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		−4.80	−5.0	−5.20	V
		−20V ≤ V_{IN} ≤ −7.0V, 5.0mA ≤ I_{OUT} ≤ 1.0A, P_D ≤ 15W	**−4.75**	**−5.0**	**−5.25**	
Line Regulation	ΔV_{LINE}	−25V ≤ V_{IN} ≤ −7.0V	-	12.5	50	mV
		−12V ≤ V_{IN} ≤ −8.0V	-	4.0	15	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	15	100	mV
		250mA ≤ I_{OUT} ≤ 750mA	-	5.0	50	
Temperature Coefficient of Output Voltage	$\Delta V_{OUT}/\Delta T$	I_{OUT} = 5.0mA	-	**−0.4**	-	mV/°C
Output Noise Voltage	V_n	10Hz ≤ f ≤ 100kHz	-	125	-	μV
Ripple Rejection	P_{RR}	−18V ≤ V_{IN} ≤ −8.0V, f = 120Hz	**54**	**60**	-	dB
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	1.6	-	V
Bias Current	I_B		-	1.5	2.0	mA
Bias Current Change	ΔI_B	−25V ≤ V_{IN} ≤ −7.0V	-	**0.15**	**0.5**	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	**0.08**	**0.5**	
Peak Output Current	I_{OMAX}		-	2.1	-	A

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

ELECTRICAL CHARACTERISTICS: LM7906

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full operating temperature range In the *Recommended Operating Ratings*. Conditions are V_{IN} = −11V, I_{OUT} = 500mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		−5.75	−6.0	−6.25	V
		−21V ≤ V_{IN} ≤ −8.0V, 5.0mA ≤ I_{OUT} ≤ 1.0A, P_D ≤ 15W	**−5.70**	**−6.0**	**−6.30**	
Line Regulation	ΔV_{LINE}	−25V ≤ V_{IN} ≤ −8.0V	-	12.5	120	mV
		−13V ≤ V_{IN} ≤ −9.0V	-	4.0	60	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	15	120	mV
		250mA ≤ I_{OUT} ≤ 750mA	-	5.0	60	
Temperature Coefficient of Output Voltage	$\Delta V_{OUT}/\Delta T$	I_{OUT} = 5.0mA	-	**−0.4**	-	mV/°C
Output Noise Voltage	V_n	10Hz ≤ f ≤ 100kHz	-	150	-	μV
Ripple Rejection	P_{RR}	−19V ≤ V_{IN} ≤ −9.0V, f = 120Hz	**54**	**60**	-	dB
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	1.6	-	V
Bias Current	I_B		-	1.5	2.0	mA
Bias Current Change	ΔI_B	−25V ≤ V_{IN} ≤ −8.0V	-	**0.15**	**1.3**	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	**0.08**	**0.5**	
Peak Output Current	I_{OMAX}		-	2.1	-	A

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

ELECTRICAL CHARACTERISTICS: LM7908

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full operating temperature range In the *Recommended Operating Ratings*. Conditions are V_{IN} = −14V, I_{OUT} = 500mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		−7.70	−8.0	−8.30	V
		−23V ≤ V_{IN} ≤ −10.5V, 5.0mA ≤ I_{OUT} ≤ 1.0A, P_D ≤ 15W	**−7.60**	**−8.0**	**−8.40**	
Line Regulation	ΔV_{LINE}	−25V ≤ V_{IN} ≤ −10.5V	-	12.5	160	mV
		−17V ≤ V_{IN} ≤ −11V	-	4.0	80	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	15	160	mV
		250mA ≤ I_{OUT} ≤ 750mA	-	5.0	80	
Temperature Coefficient of Output Voltage	$\Delta V_{OUT}/\Delta T$	I_{OUT} = 5.0mA	-	**−0.6**	-	mV/°C
Output Noise Voltage	V_n	10Hz ≤ f ≤ 100kHz	-	200	-	μV
Ripple Rejection	P_{RR}	−21.5V ≤ V_{IN} ≤ −11.5V, f = 120Hz	**54**	**60**	-	dB
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	1.6	-	V
Bias Current	I_B		-	1.5	2.0	mA
Bias Current Change	ΔI_B	−25V ≤ V_{IN} ≤ −10.5V	-	**0.15**	**1.0**	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	**0.08**	**0.5**	
Peak Output Current	I_{OMAX}		-	2.1	-	A

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

ELECTRICAL CHARACTERISTICS: LM7909

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full operating temperature range In the *Recommended Operating Ratings*. Conditions are V_{IN} = −15V, I_{OUT} = 500mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		−8.64	−9.0	−9.36	V
		−25V ≤ V_{IN} ≤ −11.5V, 5.0mA ≤ I_{OUT} ≤ 1.0A, P_D ≤ 15W	**−8.55**	**−9.0**	**−9.45**	
Line Regulation	ΔV_{LINE}	−25V ≤ V_{IN} ≤ −11.5V	-	12.5	180	mV
		−22V ≤ V_{IN} ≤ −14.5V	-	4.0	90	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	15	180	mV
		250mA ≤ I_{OUT} ≤ 750mA	-	5.0	90	
Temperature Coefficient of Output Voltage	$\Delta V_{OUT}/\Delta T$	I_{OUT} = 5.0mA	-	**−1.0**	-	mV/°C
Output Noise Voltage	V_n	10Hz ≤ f ≤ 100kHz	-	225	-	μV
Ripple Rejection	P_{RR}	−24V ≤ V_{IN} ≤ −12.5V, f = 120Hz	**54**	**60**	-	dB
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	1.6	-	V
Bias Current	I_B		-	1.5	2.0	mA
Bias Current Change	ΔI_B	−25V ≤ V_{IN} ≤ −11.5V	-	**0.15**	**1.0**	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	**0.08**	**0.5**	
Peak Output Current	I_{OMAX}		-	2.1	-	A

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

ELECTRICAL CHARACTERISTICS: LM7912

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full operating temperature range In the *Recommended Operating Ratings*. Conditions are V_{IN} = −19V, I_{OUT} = 500mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		−11.5	−12	−12.5	V
		−27V ≤ V_{IN} ≤ −14.5V, 5.0mA ≤ I_{OUT} ≤ 1.0A, P_D ≤ 15W	**−11.4**	**−12**	**−12.6**	
Line Regulation	ΔV_{LINE}	−30V ≤ V_{IN} ≤ −14.5V	-	5.0	80	mV
		−22V ≤ V_{IN} ≤ −16V	-	3.0	30	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	15	200	mV
		250mA ≤ I_{OUT} ≤ 750mA	-	5.0	75	
Temperature Coefficient of Output Voltage	$\Delta V_{OUT}/\Delta T$	I_{OUT} = 5.0mA	-	**−0.8**	-	mV/°C
Output Noise Voltage	V_n	10Hz ≤ f ≤ 100kHz	-	300	-	μV
Ripple Rejection	P_{RR}	−25V ≤ V_{IN} ≤ −15V, f = 120Hz	**54**	**60**	-	dB
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	1.6	-	V
Bias Current	I_B		-	2.0	3.0	mA
Bias Current Change	ΔI_B	−30V ≤ V_{IN} ≤ −14.5V	-	**0.04**	**0.5**	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	**0.06**	**0.5**	
Peak Output Current	I_{OMAX}		-	2.1	-	A

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

ELECTRICAL CHARACTERISTICS: LM7915

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full operating temperature range In the *Recommended Operating Ratings*. Conditions are V_{IN} = −23V, I_{OUT} = 500mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		−14.4	−15	−15.6	V
		−30V ≤ V_{IN} ≤ −17.5V, 5.0mA ≤ I_{OUT} ≤ 1.0A, P_D ≤ 15W	**−14.25**	**−15**	**−15.75**	
Line Regulation	ΔV_{LINE}	−30V ≤ V_{IN} ≤ −17.5V	-	5.0	100	mV
		−26V ≤ V_{IN} ≤ −20V	-	3.0	50	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	15	200	mV
		250mA ≤ I_{OUT} ≤ 750mA	-	5.0	75	
Temperature Coefficient of Output Voltage	$\Delta V_{OUT}/\Delta T$	I_{OUT} = 5.0mA	-	**−1.0**	-	mV/°C
Output Noise Voltage	V_n	10Hz ≤ f ≤ 100kHz	-	375	-	μV
Ripple Rejection	P_{RR}	−28.5V ≤ V_{IN} ≤ −18.5V, f = 120Hz	**54**	**60**	-	dB
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	1.6	-	V
Bias Current	I_B		-	2.0	3.0	mA
Bias Current Change	ΔI_B	−30V ≤ V_{IN} ≤ −17.5V	-	**0.04**	**0.5**	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	**0.06**	**0.5**	
Peak Output Current	I_{OMAX}		-	2.1	-	A

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

ELECTRICAL CHARACTERISTICS: LM7918

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full operating temperature range In the *Recommended Operating Ratings*. Conditions are V_{IN} = −27V, I_{OUT} = 500mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		−17.3	−18	−18.7	V
		−33V ≤ V_{IN} ≤ −21V, 5.0mA ≤ I_{OUT} ≤ 1.0A, P_D ≤ 15W	**−17.1**	**−18**	**−18.9**	
Line Regulation	ΔV_{LINE}	−33V ≤ V_{IN} ≤ −21V	-	5.0	360	mV
		−30V ≤ V_{IN} ≤ −24V	-	3.0	180	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	30	360	mV
		250mA ≤ I_{OUT} ≤ 750mA	-	10	180	
Temperature Coefficient of Output Voltage	$\Delta V_{OUT}/\Delta T$	I_{OUT} = 5.0mA	-	**−1.0**	-	mV/°C
Output Noise Voltage	V_n	10Hz ≤ f ≤ 100kHz	-	450	-	μV
Ripple Rejection	P_{RR}	−32V ≤ V_{IN} ≤ −22V, f = 120Hz	**54**	**60**	-	dB
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	1.6	-	V
Bias Current	I_B		-	2.0	3.0	mA
Bias Current Change	ΔI_B	−33V ≤ V_{IN} ≤ −21V	-	**0.04**	**1.0**	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	**0.06**	**0.5**	
Peak Output Current	I_{OMAX}		-	2.1	-	A

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

ELECTRICAL CHARACTERISTICS: LM7920

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full operating temperature range In the *Recommended Operating Ratings*. Conditions are V_{IN} = −31V, I_{OUT} = 500mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		−19.2	−20	−20.8	V
		−34V ≤ V_{IN} ≤ −23V, 5.0mA ≤ I_{OUT} ≤ 1.0A, P_D ≤ 15W	**−19.0**	**−20**	**−21.0**	
Line Regulation	ΔV_{LINE}	−34V ≤ V_{IN} ≤ −23V	-	5.0	400	mV
		−31V ≤ V_{IN} ≤ −26V	-	3.0	200	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	50	400	mV
		250mA ≤ I_{OUT} ≤ 750mA	-	15	120	
Temperature Coefficient of Output Voltage	$\Delta V_{OUT}/\Delta T$	I_{OUT} = 5.0mA	-	**−1.0**	-	mV/°C
Output Noise Voltage	V_n	10Hz ≤ f ≤ 100kHz	-	500	-	μV
Ripple Rejection	P_{RR}	−33V ≤ V_{IN} ≤ −24V, f = 120Hz	**54**	**60**	-	dB
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	1.6	-	V
Bias Current	I_B		-	2.0	3.0	mA
Bias Current Change	ΔI_B	−34V ≤ V_{IN} ≤ −23V	-	**0.04**	**1.0**	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	**0.06**	**0.5**	
Peak Output Current	I_{OMAX}		-	2.1	-	A

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

ELECTRICAL CHARACTERISTICS: LM7924

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full operating temperature range In the *Recommended Operating Ratings*. Conditions are V_{IN} = −33V, I_{OUT} = 500mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		−23.0	−24	−25.0	V
		−38V ≤ V_{IN} ≤ −27V, 5.0mA ≤ I_{OUT} ≤ 1.0A, P_D ≤ 15W	**−22.8**	**−24**	**−25.2**	
Line Regulation	ΔV_{LINE}	−38V ≤ V_{IN} ≤ −27V	-	5.0	480	mV
		−36V ≤ V_{IN} ≤ −30V	-	3.0	240	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	85	480	mV
		250mA ≤ I_{OUT} ≤ 750mA	-	25	240	
Temperature Coefficient of Output Voltage	$\Delta V_{OUT}/\Delta T$	I_{OUT} = 5.0mA	-	**−1.0**	-	mV/°C
Output Noise Voltage	V_n	10Hz ≤ f ≤ 100kHz	-	600	-	μV
Ripple Rejection	P_{RR}	−38V ≤ V_{IN} ≤ −28V, f = 120Hz	**54**	**60**	-	dB
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	1.6	-	V
Bias Current	I_B		-	2.0	3.0	mA
Bias Current Change	ΔI_B	−38V ≤ V_{IN} ≤ −27V	-	**0.04**	**1.0**	mA
		5.0mA ≤ I_{OUT} ≤ 1.0A	-	**0.06**	**0.5**	
Peak Output Current	I_{OMAX}		-	2.1	-	A

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

TYPICAL OPERATING CHARACTERISTICS

T.B.D.

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APPLICATION INFORMATION

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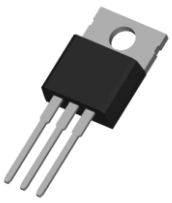
3-Terminal 1.5A Negative Voltage Regulator LM79xx

FEATURES

- Output Current Up to 1.5A
- Internal Thermal Overload Protection
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation
- Output Voltage of −5V, −12V



TO-220-3

DESCRIPTION

This LM7905 series of fixed-negative voltage monolithic integrated circuit voltage regulator is designed to complement LM7805 series in a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation.

Each of these regulators can deliver up to 1.5A of output current. The internal limiting and thermal shutdown features of these regulators make them essentially immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and current and also as the power pass element in precision regulators.

ORDERING INFORMATION

Device	Package
LM79xxT	TO-220-3L

xx: Output Voltage

ABSOLUTE MAXIMUM RATINGS (Note 1)

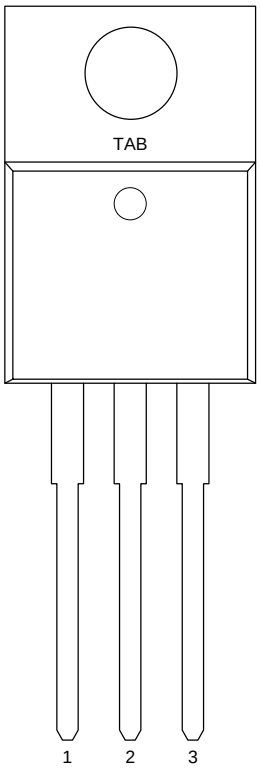
CHARACTERISTIC	SYMBOL	MIN	MAX	UNIT
Input Voltage	V_{IN}	-	−35	V
Maximum Operating Junction Temperature	T_J	−40	125	°C
Storage Temperature	T_{STG}	−65	150	°C

Note 1. Stresses beyond 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 beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

ORDERING INFORMATION

VOUT	Package	Order No.	Description	Supplied As	Status
−5.0V	TO-220-3L	LM7905T	1.5A, Fixed	Tube	Active
−12V	TO-220-3L	LM7912T	1.5A, Fixed	Tube	Active

PIN CONFIGURATION

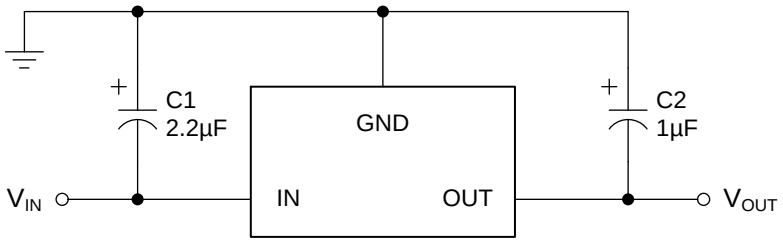


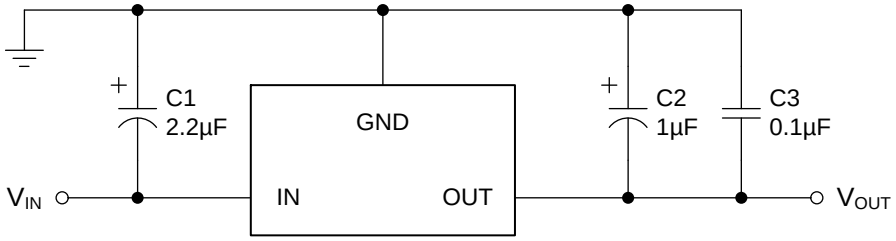
TO-220

PIN DESCRIPTION

Pin No.	Pin Name	Pin Function
1	GND	Ground
2	IN	Input Voltage
3	OUT	Output Voltage
TAB	TAB	Input Voltage

TYPICAL APPLICATION CIRCUITS





* C1 required for stability. Value given may be increased.

** C2 required for stability. Value given may be increased.

*** C3 considered improving the transient response.

ELECTRICAL CHARACTERISTICS: LM7905

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full operating temperature range In the *Recommended Operating Ratings*. Conditions are V_{IN} = −10V, I_{OUT} = 500mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		−4.80	−5.0	−5.20	V
		−20V ≤ V_{IN} ≤ −7.0V, 5.0mA ≤ I_{OUT} ≤ 1.0A	**−4.75**	**−5.0**	**−5.25**	
Line Regulation	ΔV_{LINE}	−25V ≤ V_{IN} ≤ −7.0V, I_{OUT} = 100mA	-	-	47.5	mV
		−12V ≤ V_{IN} ≤ −8.0V, I_{OUT} = 100mA	-	-	23.5	
		−25V ≤ V_{IN} ≤ −7.0V, I_{OUT} = 500mA	-	-	95.0	
		−12V ≤ V_{IN} ≤ −8.0V, I_{OUT} = 500mA	-	-	47.5	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	-	95	mV
		250mA ≤ I_{OUT} ≤ 750mA	-	-	47.5	
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	2.0	-	V
Bias Current	I_B		-	-	7.8	mA
Bias Current Change	ΔI_B	−25V ≤ V_{IN} ≤ −7.0V	-	-	1.25	mA
		5.0mA ≤ I_{OUT} ≤ 1.5A	-	-	0.48	
Peak Output Current	I_{OMAX}		-	2.2	-	A
Ripple Rejection	RR	I_{OUT} = 0.2A, Frequency = 100Hz -8.0V ≤ V_{IN} ≤ -18.0V	-	70	-	dB

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

ELECTRICAL CHARACTERISTICS: LM7912

Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full operating temperature range In the *Recommended Operating Ratings*. Conditions are V_{IN} = −19V, I_{OUT} = 500mA, C_{IN} = 2.2μF, C_{OUT} = 1μF, unless otherwise noted.

PARAMETER	SYMBOL	TEST CONDITIONS (Note 3)	MIN	TYP	MAX	UNIT
Output Voltage (Note 4)	V_{OUT}		−11.52	−12.0	−12.48	V
		−20V ≤ V_{IN} ≤ −7.0V, 5.0mA ≤ I_{OUT} ≤ 1.0A	**−11.4**	**−12.0**	**−12.6**	
Line Regulation	ΔV_{LINE}	−30V ≤ V_{IN} ≤ −14.5V, I_{OUT} = 100mA	-	-	114	mV
		−22V ≤ V_{IN} ≤ −16V, I_{OUT} = 100mA	-	-	58.5	
		−30V ≤ V_{IN} ≤ −14.5V, I_{OUT} = 500mA	-	-	228	
		−22V ≤ V_{IN} ≤ −16V, I_{OUT} = 500mA	-	-	114	
Load Regulation	ΔV_{LOAD}	5.0mA ≤ I_{OUT} ≤ 1.5A	-	-	228	mV
		250mA ≤ I_{OUT} ≤ 750mA	-	-	114	
Dropout Voltage	V_D	I_{OUT} = 1.0A	-	2.0	-	V
Bias Current	I_B		-	-	7.8	mA
Bias Current Change	ΔI_B	−25V ≤ V_{IN} ≤ −7.0V	-	-	1.25	mA
		5.0mA ≤ I_{OUT} ≤ 1.5A	-	-	0.48	
Peak Output Current	I_{OMAX}		-	2.2	-	A
Ripple Rejection	RR	I_{OUT} = 0.2A, Frequency = 100Hz -8.0V ≤ V_{IN} ≤ -18.0V	-	70	-	dB

Note 3. 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.

Note 4. This specification applies only for DC power dissipation permitted by absolute maximum ratings.

TYPICAL OPERATING CHARACTERISTICS

T.B.D.

APPLICATION INFORMATION

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