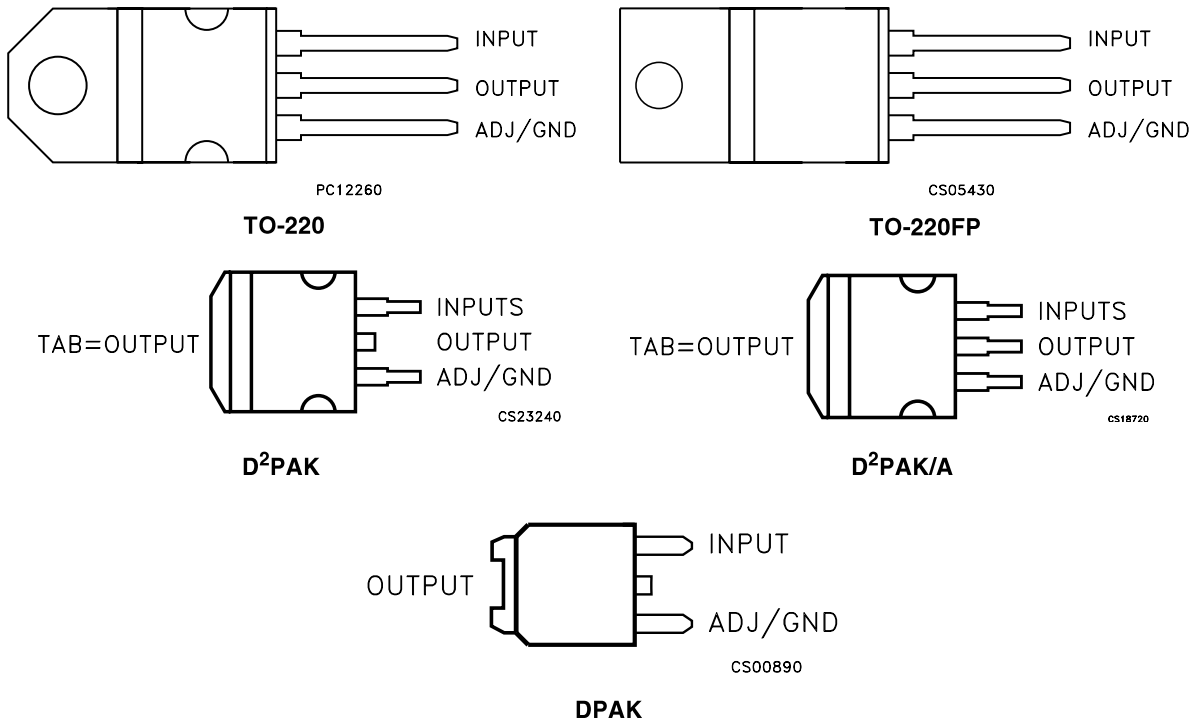
1 Pin configuration

Figure 1. Pin connections (top view)

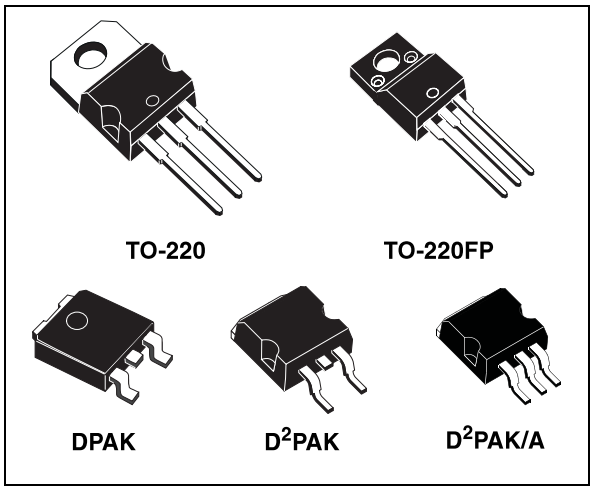


LD1085xx

3 A low drop positive voltage regulator adjustable and fixed

Features

- Typical dropout 1.3 V (at 3 A)
- Three terminal adjustable or fixed output voltage 1.5 V, 1.8 V, 2.5 V, 3.3 V, 5 V, 12 V.
- Automotive grade product: adjustable V_{OUT} only in TO-220 full pack package
- Guaranteed output current up to 3 A
- Output tolerance ± 1 % at 25°C and ± 2 % in full temperature range
- Internal power and thermal limit
- Wide operating temperature range -40 °C to 125 °C
- Package available: TO-220, TO-220FP, DPAK, D^2PAK, D^2PAK/A
- Pinout compatibility with standard adjustable VREG



Description

The LD1085xx is a low drop voltage regulator able to provide up to 3 A of output current. Dropout is guaranteed at a maximum of 1.2 V at the maximum output current, decreasing at lower loads. The LD1085xx is pin to pin compatible with the older 3-terminal adjustable regulators, but has better performances in term of drop and output tolerance.

A 2.85 V output version is suitable for SCSI-2 active termination. Unlike PNP regulators, where a part of the output current is wasted as quiescent current, the LD1085xx quiescent current flows into the load, so increase efficiency. Only a 10 µF minimum capacitor is need for stability.

The device is supplied in TO-220, TO-220FP, DPAK, D^2PAK and D^2PAK/A. On chip trimming allows the regulator to reach a very tight output voltage tolerance, within ± 1 % at 25 °C.

The LD1085xx is available as automotive grade in TO-220FP package only, for the option of adjustable output voltage whose commercial part number is shown in the *Table 11: Order codes*. This device is qualified according to the specification AEC-Q100 of the automotive market, in the temperature range -40 °C to 125 °C, and the statistical tests PAT, SYL, SBL are performed.

Table 1. Device summary

Part numbers	
LD1085XX	LD1085XX25
LD1085XX15	LD1085XX33
LD1085XX18	LD1085XX50

National Semiconductor

January 1995

LM123/LM323A/LM323
3-Amp, 5-Volt Positive Regulator

General Description

The LM123 is a three-terminal positive regulator with a preset 5V output and a load driving capability of 3 amps. New circuit design and processing techniques are used to provide the high output current without sacrificing the regulation characteristics of lower current devices.

The LM323A offers improved precision over the standard LM323. Parameters with tightened specifications include output voltage tolerance, line regulation, and load regulation.

The 3 amp regulator is virtually blowout proof. Current limiting, power limiting, and thermal shutdown provide the same high level of reliability obtained with these techniques in the LM109 1 amp regulator.

No external components are required for operation of the LM123. If the device is more than 4 inches from the filter capacitor, however, a 1 μF solid tantalum capacitor should be used on the input. A 0.1 μF or larger capacitor may be used on the output to reduce load transient spikes created by fast switching digital logic, or to swamp out stray load capacitance.

An overall worst case specification for the combined effects of input voltage, load currents, ambient temperature, and power dissipation ensure that the LM123 will perform satisfactorily as a system element.

For applications requiring other voltages, see LM150 series adjustable regulator data sheet.

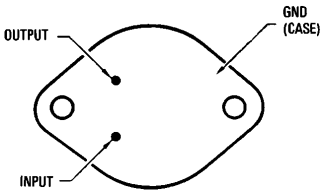
Operation is guaranteed over the junction temperature range −55°C to +150°C for LM123, −40°C to +125°C for LM323A, and 0°C to +125°C for LM323. A hermetic TO-3 package is used for high reliability and low thermal resistance.

Features

- Guaranteed 1% initial accuracy (A version)
- 3 amp output current
- Internal current and thermal limiting
- 0.01Ω typical output impedance
- 7.5V minimum input voltage
- 30W power dissipation
- P+ Product Enhancement tested

Connection Diagram

Metal Can Package



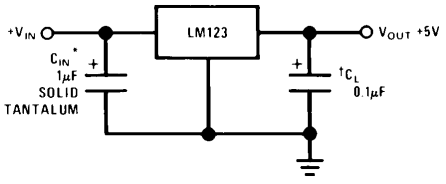
TL/H/7771–2

Order Number LM123K STEEL, LM323AK STEEL or LM323K STEEL
See NS Package Number K02A

Order Number LM123K/883
See NS Package Number K02C

Typical Applications

Basic 3 Amp Regulator



TL/H/7771–3

*Required if LM123 is more than 4″ from filter capacitor.

†Regulator is stable with no load capacitor into resistive loads.

National Semiconductor

February 29, 2008

LM2673
SIMPLE SWITCHER® 3A Step-Down Voltage Regulator with Adjustable Current Limit

General Description

The LM2673 series of regulators are monolithic integrated circuits which provide all of the active functions for a step-down (buck) switching regulator capable of driving up to 3A loads with excellent line and load regulation characteristics. High efficiency (>90%) is obtained through the use of a low ON-resistance DMOS power switch. The series consists of fixed output voltages of 3.3V, 5V and 12V and an adjustable output version.

The SIMPLE SWITCHER concept provides for a complete design using a minimum number of external components. A high fixed frequency oscillator (260KHz) allows the use of physically smaller sized components. A family of standard inductors for use with the LM2673 are available from several manufacturers to greatly simplify the design process.

Other features include the ability to reduce the input surge current at power-ON by adding a softstart timing capacitor to gradually turn on the regulator. The LM2673 series also has built in thermal shutdown and resistor programmable current limit of the power MOSFET switch to protect the device and load circuitry under fault conditions. The output voltage is guaranteed to a ±2% tolerance. The clock frequency is controlled to within a ±11% tolerance.

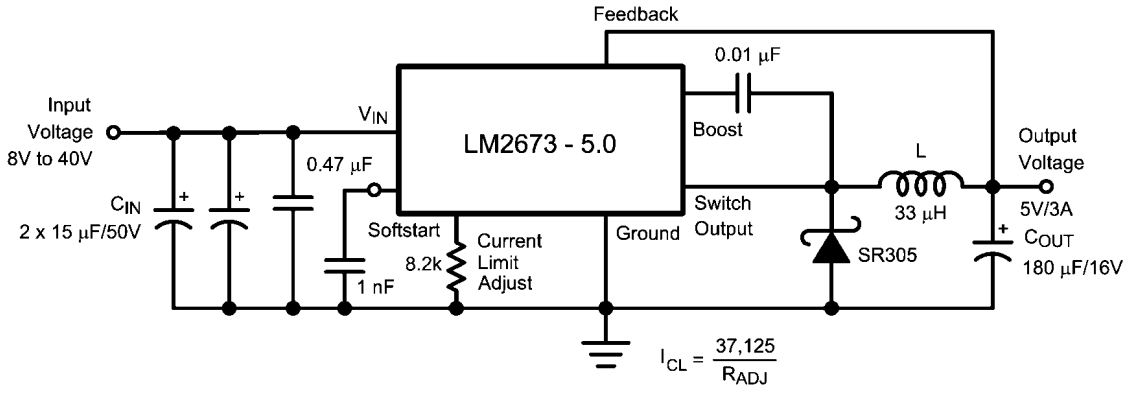
Features

- Efficiency up to 94%
- Simple and easy to design with (using off-the-shelf external components)
- Resistor programmable peak current limit over a range of 2A to 5A.
- 150 mΩ DMOS output switch
- 3.3V, 5V and 12V fixed output and adjustable (1.2V to 37V) versions
- ±2%maximum output tolerance over full line and load conditions
- Wide input voltage range: 8V to 40V
- 260 KHz fixed frequency internal oscillator
- Softstart capability
- −40 to +125°C operating junction temperature range

Applications

- Simple to design, high efficiency (>90%) step-down switching regulators
- Efficient system pre-regulator for linear voltage regulators
- Battery chargers

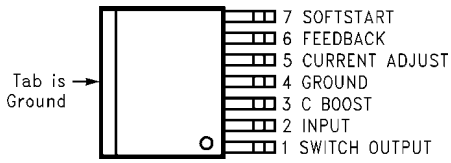
Typical Application



SIMPLE SWITCHER® is a registered trademark of National Semiconductor Corporation

Connection Diagrams and Ordering Information

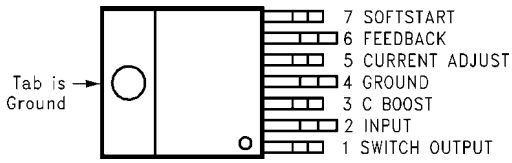
TO-263 Package
Top View



10091301

Order Number
LM2673S-3.3, LM2673S-5.0,
LM2673S-12 or LM2673S-ADJ
See NSC Package Number TS7B

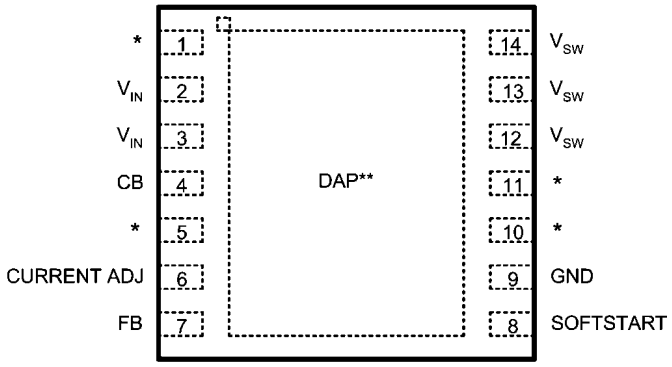
TO-220 Package
Top View



10091302

Order Number
LM2673T-3.3, LM2673T-5.0,
LM2673T-12 or LM2673T-ADJ
See NSC Package Number TA07B

Top View



* No Connections

** Connect to Pin 9 on PCB

10091335

LLP-14
See NS package Number SRC14A

Ordering Information for LLP Package

Output Voltage	Order Information	Package Marking	Supplied As
12	LM2673SD-12	S0002SB	250 Units on Tape and Reel
12	LM2673SDX-12	S0002SB	2500 Units on Tape and Reel
3.3	LM2673SD-3.3	S0002TB	250 Units on Tape and Reel
3.3	LM2673SDX-3.3	S0002TB	2500 Units on Tape and Reel
5.0	LM2673SD-5.0	S0002UB	250 Units on Tape and Reel
5.0	LM2673SDX-5.0	S0002UB	2500 Units on Tape and Reel
ADJ	LM2673SD-ADJ	S0002VB	250 Units on Tape and Reel
ADJ	LM2673SDX-ADJ	S0002VB	2500 Units on Tape and Reel

LM317, NCV317

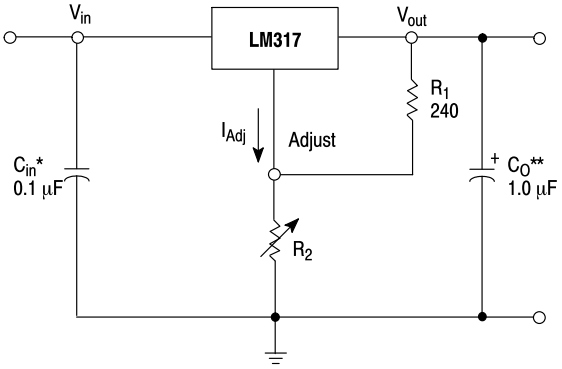
1.5 A Adjustable Output, Positive Voltage Regulator

The LM317 is an adjustable 3−terminal positive voltage regulator capable of supplying in excess of 1.5 A over an output voltage range of 1.2 V to 37 V. This voltage regulator is exceptionally easy to use and requires only two external resistors to set the output voltage. Further, it employs internal current limiting, thermal shutdown and safe area compensation, making it essentially blow−out proof.

The LM317 serves a wide variety of applications including local, on card regulation. This device can also be used to make a programmable output regulator, or by connecting a fixed resistor between the adjustment and output, the LM317 can be used as a precision current regulator.

Features

- Output Current in Excess of 1.5 A
- Output Adjustable between 1.2 V and 37 V
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting Constant with Temperature
- Output Transistor Safe−Area Compensation
- Floating Operation for High Voltage Applications
- Available in Surface Mount D^2PAK−3, and Standard 3−Lead Transistor Package
- Eliminates Stocking many Fixed Voltages
- Pb−Free Packages are Available



* C_{in} is required if regulator is located an appreciable distance from power supply filter.
** C_O is not needed for stability, however, it does improve transient response.

$$V_{out} = 1.25\,V\left(1 + \frac{R_2}{R_1}\right) + I_{Adj}R_2$$

Since I_{Adj} is controlled to less than 100 μA, the error associated with this term is negligible in most applications.

Figure 1. Standard Application

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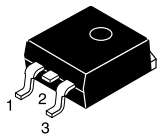
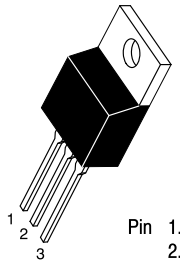
http://onsemi.com



D^2PAK−3
D2T SUFFIX
CASE 936

Heatsink surface (shown as terminal 4 in case outline drawing) is connected to Pin 2.



TO−220
T SUFFIX
CASE 221AB

Pin 1. Adjust
2. V_{out}
3. V_{in}

Heatsink surface connected to Pin 2.

ORDERING INFORMATION

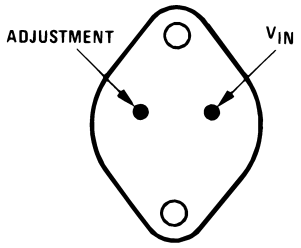
See detailed ordering and shipping information in the package dimensions section on page 10 of this data sheet.

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 10 of this data sheet.

Connection Diagrams

(TO-3)
Metal Can Package

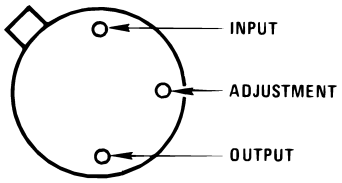


00906330

CASE IS OUTPUT

Bottom View
Steel Package
NS Package Number K02A or K02C

(TO-39)
Metal Can Package

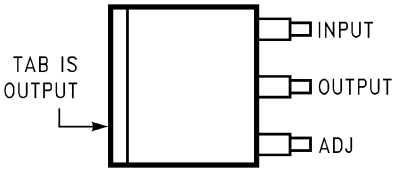


00906331

CASE IS OUTPUT

Bottom View
NS Package Number H03A

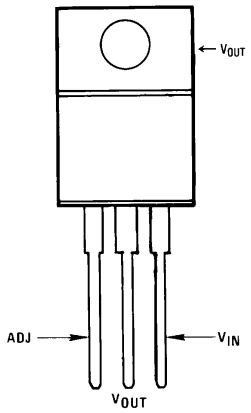
(TO-263) Surface-Mount Package



00906335

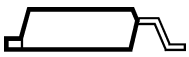
Top View

(TO-220)
Plastic Package



00906332

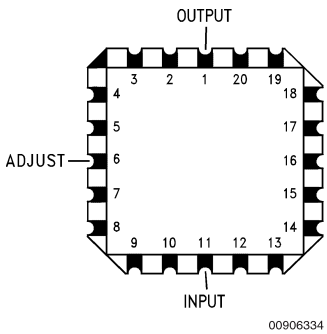
Front View
NS Package Number T03B



00906336

Side View
NS Package Number TS3B

Ceramic Leadless
Chip Carrier

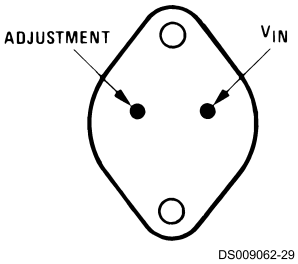


00906334

Top View
NS Package Number E20A

Connection Diagrams (See Physical Dimension section for further information)

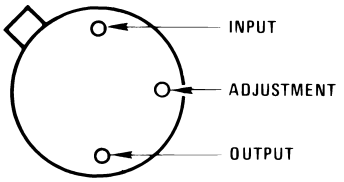
(TO-3)
Metal Can Package



DS009062-29

Case is Output
Bottom View
Order Number LM117HVKSTL/883
See NS Package Number K02C
Order Number LM317HVK STEEL
See NS Package Number K02A

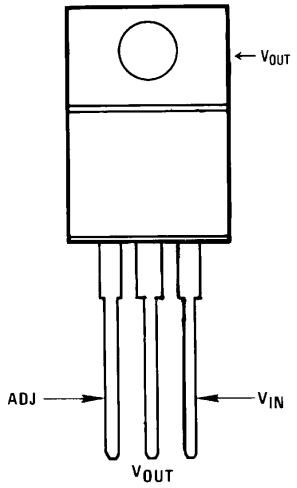
(TO-39)
Metal Can Package



DS009062-30

Case is Output
Bottom View
Order Number LM117HVH,
LM117HVH/883
or LM317HVH
See NS Package Number H03A

(TO-220)
Plastic Package



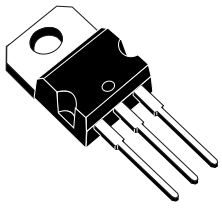
DS009062-31

Front View
Order Number LM317HVT
See NS Package Number T03B

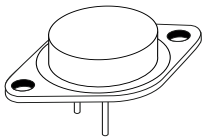
LM123/LM223
LM323

THREE-TERMINAL 3A-5V POSITIVE VOLTAGE REGULATORS

- OUTPUT CURRENT: 3A
- INTERNAL CURRENT AND THERMAL LIMITING
- TYPICAL OUTPUT IMPEDANCE: 0.01Ω
- MINIMUM INPUT VOLTAGE: 7.5V
- POWER DISSIPATION: 30W



TO-220



TO-3

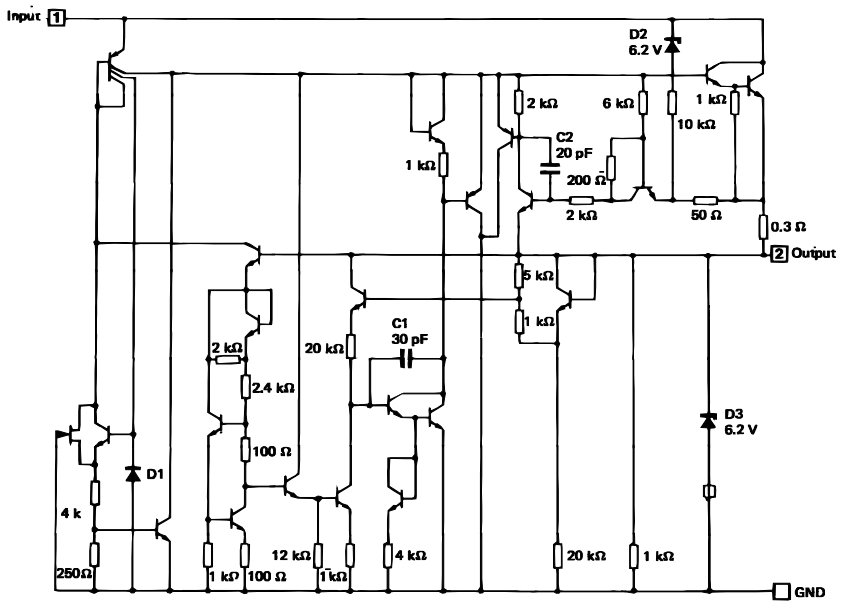
DESCRIPTION

The LM123, LM223, LM323 are three-terminal positive voltage regulators with a preset 5V output and a load driving capability of 3A. New circuit design and processing techniques are used to provide the high output current without sacrificing the regulation characteristics of lower current devices.

The 3A regulator is virtually blowout proof.

Current limiting, power limiting and thermal shut-down provide the same high level of reliability obtained with these techniques in the LM209, 1A regulator. An overall worst case specification for the combined effects of input voltage, load current, ambient temperature, and power dissipation ensure that the LM123, LM223, LM323 will perform satisfactorily as a system element.

SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

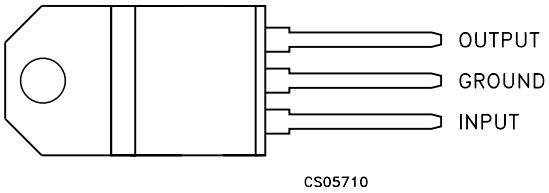
Symbol	Parameter[2]		Value	Unit
V_I	Input Voltage		20	V
I_O	Output Current		Internally Limited	
P_{tot}	Power Dissipation		Internally Limited	
T_{stg}	Storage Temperature Range		-65 to 150	°C
T_{oper}	Operating Junction Temperature Range	LM123	-55 to 150	°C
		LM223	-25 to 125	
		LM323	0 to 125	

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

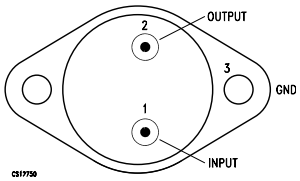
THERMAL DATA

Symbol	Parameter	TO-220	TO-3	Unit
$R_{thj\text{-}case}$	Thermal Resistance Junction-case Max	3	2	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient Max	50	35	°C/W

CONNECTION DIAGRAM (top view)



TO-220



TO-3

ORDERING CODES

TYPE	TO-220	TO-3	TEMPERATURE RANGE
LM123		LM123K	-55°C to 150°C
LM223		LM223K	-25°C to 150°C
LM323	LM323T	LM323K	0°C to 125°C

LM337

1.5 A, Adjustable Output, Negative Voltage Regulator

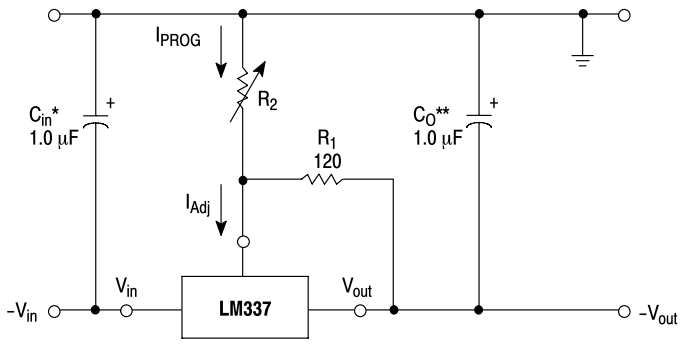
The LM337 is an adjustable 3−terminal negative voltage regulator capable of supplying in excess of 1.5 A over an output voltage range of −1.2 V to −37 V. This voltage regulator is exceptionally easy to use and requires only two external resistors to set the output voltage. Further, it employs internal current limiting, thermal shutdown and safe area compensation, making it essentially blow−out proof.

The LM337 serves a wide variety of applications including local, on card regulation. This device can also be used to make a programmable output regulator, or by connecting a fixed resistor between the adjustment and output, the LM337 can be used as a precision current regulator.

Features

- Output Current in Excess of 1.5 A
- Output Adjustable between −1.2 V and −37 V
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting Constant with Temperature
- Output Transistor Safe−Area Compensation
- Floating Operation for High Voltage Applications
- Eliminates Stocking many Fixed Voltages
- Available in Surface Mount D^2PAK and Standard 3−Lead Transistor Package
- Pb−Free Packages are Available

Standard Application



*C_{in} is required if regulator is located more than 4 inches from power supply filter. A 1.0 μF solid tantalum or 10 μF aluminum electrolytic is recommended.

**C_O is necessary for stability. A 1.0 μF solid tantalum or 10 μF aluminum electrolytic is recommended.

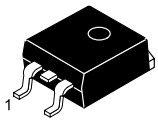
$$V_{out} = -1.25\ V\left(1 + \frac{R_2}{R_1}\right)$$

ON Semiconductor®

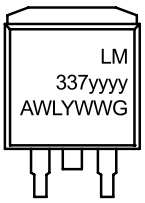
http://onsemi.com

THREE−TERMINAL ADJUSTABLE NEGATIVE VOLTAGE REGULATOR

MARKING DIAGRAMS

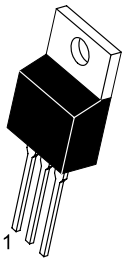


D^2PAK
D2T SUFFIX
CASE 936



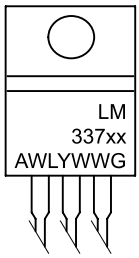
Heatsink surface (shown as terminal 4 in case outline drawing) is connected to Pin 2.

Pin 1. Adjust
2. V_{in}
3. V_{out}



TO−220AB
T SUFFIX
CASE 221AB

Heatsink surface connected to Pin 2.



xx = BT, T
yyyy = BD2T, D2T
A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week
G = Pb−Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

National Semiconductor

November 2004

LM137/LM337
3-Terminal Adjustable Negative Regulators

General Description

The LM137/LM337 are adjustable 3-terminal negative voltage regulators capable of supplying in excess of −1.5A over an output voltage range of −1.2V to −37V. These regulators are exceptionally easy to apply, requiring only 2 external resistors to set the output voltage and 1 output capacitor for frequency compensation. The circuit design has been optimized for excellent regulation and low thermal transients. Further, the LM137 series features internal current limiting, thermal shutdown and safe-area compensation, making them virtually blowout-proof against overloads.

The LM137/LM337 serve a wide variety of applications including local on-card regulation, programmable-output voltage regulation or precision current regulation. The LM137/LM337 are ideal complements to the LM117/LM317 adjustable positive regulators.

Features

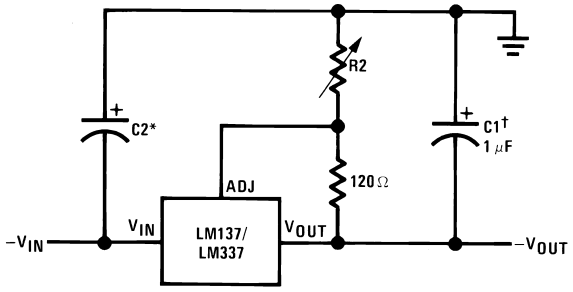
- Output voltage adjustable from −1.2V to −37V
- 1.5A output current guaranteed, −55˚C to +150˚C
- Line regulation typically 0.01%/V
- Load regulation typically 0.3%
- Excellent thermal regulation, 0.002%/W
- 77 dB ripple rejection
- Excellent rejection of thermal transients
- 50 ppm/˚C temperature coefficient
- Temperature-independent current limit
- Internal thermal overload protection
- P+ Product Enhancement tested
- Standard 3-lead transistor package
- Output is short circuit protected

LM137 Series Packages and Power Capability

Device	Package	Rated Power Dissipation	Design Load Current
LM137/337	TO-3 (K)	20W	1.5A
	TO-39 (H)	2W	0.5A
LM337	TO-220 (T)	15W	1.5A
LM337	SOT-223 (MP)	2W	1A

Typical Applications

Adjustable Negative Voltage Regulator



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Full output current not available at high input-output voltages

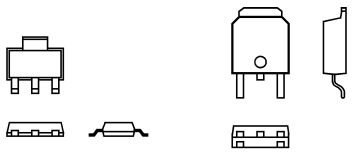
$$-V_{OUT} = -1.25V\left(1 + \frac{R2}{120}\right) + \left(-I_{ADJ} \times R2\right)$$

†C1 = 1 µF solid tantalum or 10 µF aluminum electrolytic required for stability

*C2 = 1 µF solid tantalum is required only if regulator is more than 4" from power-supply filter capacitor

Output capacitors in the range of 1 µF to 1000 µF of aluminum or tantalum electrolytic are commonly used to provide improved output impedance and rejection of transients

Comparison between SOT-223 and D-Pak (TO-252) Packages



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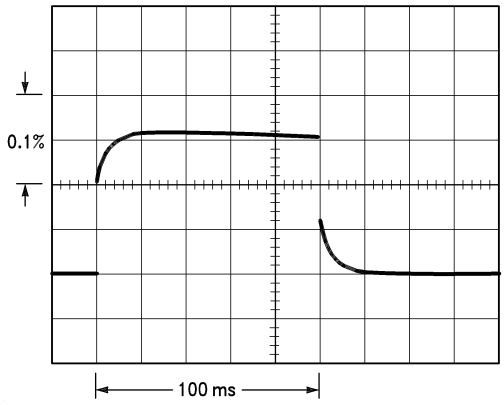
Scale 1:1

Thermal Regulation (Continued)

In *Figure 1*, a typical LM137's output drifts only 3 mV (or 0.03% of V_{OUT} = −10V) when a 10W pulse is applied for 10 ms. This performance is thus well inside the specification limit of 0.02%/W x 10W = 0.2% max. When the 10W pulse is ended, the thermal regulation again shows a 3 mV step at the LM137 chip cools off. Note that the load regulation error of about 8 mV (0.08%) is additional to the thermal regulation error. In *Figure 2*, when the 10W pulse is applied for 100 ms, the output drifts only slightly beyond the drift in the first 10 ms, and the thermal error stays well within 0.1% (10 mV).

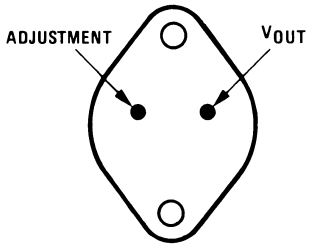


LM137, V_{OUT} = −10V
$V_{IN} - V_{OUT}$ = −40V
I_L = 0A → 0.25A → 0A
Horizontal sensitivity, 20 ms/div

FIGURE 2.

Connection Diagrams

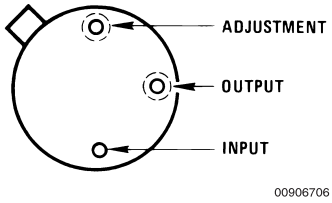
TO-3
Metal Can Package



Case is Input

Bottom View
Order Number LM137K/883
LM137KPQML and LM137KPQMLV(Note 5)
See NS Package Number K02C
Order Number LM337K STEEL
See NS Package Number K02A

TO-39
Metal Can Package



Case Is Input

Note 5: See STD Mil DWG 5962P99517 for Radiation Tolerant Devices

Bottom View
Order Number LM137H, LM137H/883 or LM337H
LM137HPQML and LM137HPQMLV(Note 5)
See NS Package Number H03A

LM350

3-Terminal 3A Positive Adjustable Voltage Regulator

Features

- Output Adjustable Between 1.2V and 33V
- Guaranteed 3A Output Current
- Internal Thermal Overload Protection
- Load Regulation (Typ: 0.1%)
- Line Regulation (Typ: 0.015%/V)
- Internal Short Circuit Current Limit
- Output Transistor Safe-Area Compensation

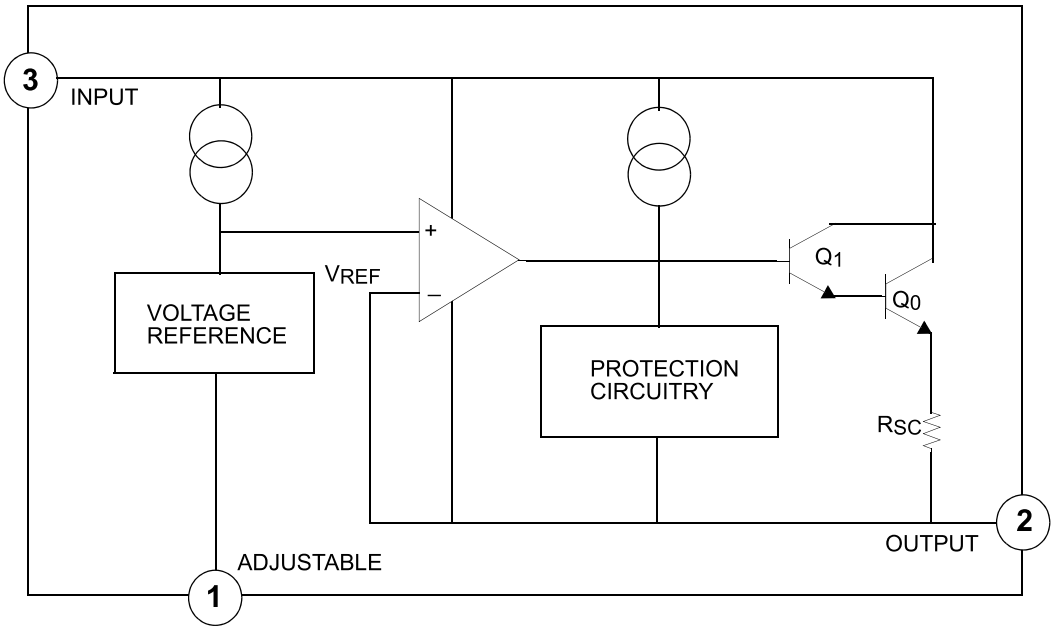
Description

The LM350 is an adjustable 3-terminal positive voltage regulator capable of supplying in excess of 3.0A over an output voltage range of 1.2V to 33V

TO-220

1. Adj 2. Output 3. Input

Internal Block Diagram



National Semiconductor

September 2001

LM79XX Series
3-Terminal Negative Regulators

General Description

The LM79XX series of 3-terminal regulators is available with fixed output voltages of −5V, −12V, and −15V. These devices need only one external component — a compensation capacitor at the output. The LM79XX series is packaged in the TO-220 power package and is capable of supplying 1.5A of output current.

These regulators employ internal current limiting safe area protection and thermal shutdown for protection against virtually all overload conditions.

Low ground pin current of the LM79XX series allows output voltage to be easily boosted above the preset value with a resistor divider. The low quiescent current drain of these devices with a specified maximum change with line and load ensures good regulation in the voltage boosted mode.

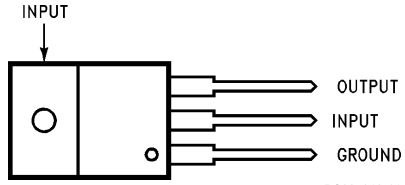
For applications requiring other voltages, see LM137 datasheet.

Features

- Thermal, short circuit and safe area protection
- High ripple rejection
- 1.5A output current
- 4% tolerance on preset output voltage

Connection Diagrams

TO-220 Package



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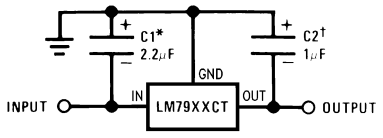
Front View
Order Number LM7905CT, LM7912CT or LM7915CT
See NS Package Number TO3B

Typical Applications

Fixed Regulator



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*Required if regulator is separated from filter capacitor by more than 3". For value given, capacitor must be solid tantalum. 25μF aluminum electrolytic may be substituted.

†Required for stability. For value given, capacitor must be solid tantalum. 25μF aluminum electrolytic may be substituted. Values given may be increased without limit.

For output capacitance in excess of 100μF, a high current diode from input to output (1N4001, etc.) will protect the regulator from momentary input shorts.

