National Semiconductor

LM125/LM325/LM325A, LM126/LM326 Voltage Regulators

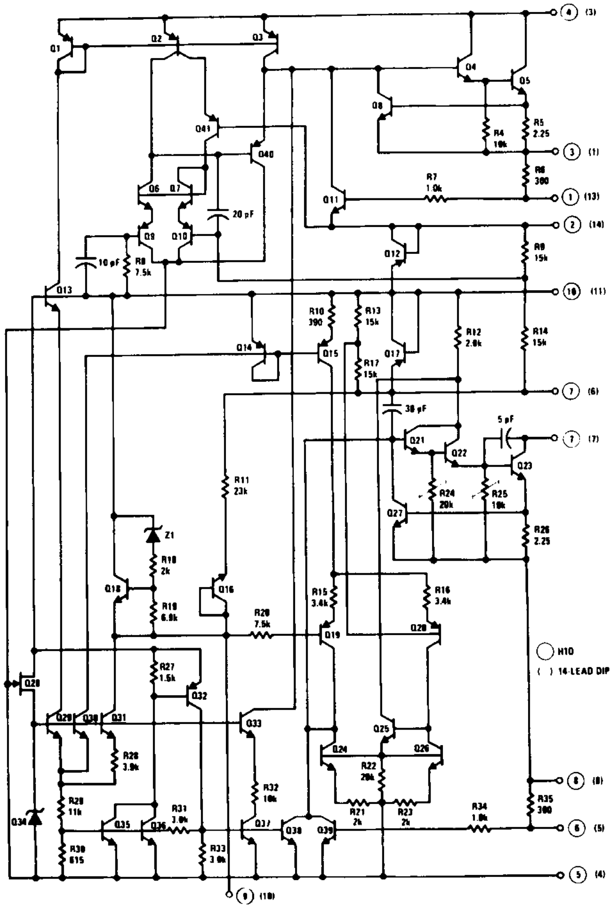
General Description

These are dual polarity tracking regulators designed to provide balanced positive and negative output voltages at current up to 100 mA, the devices are set for ±15V and ±12V outputs respectively. Input voltages up to ±30V can be used and there is provision for adjustable current limiting. These devices are available in two package types to accommodate various power requirements and temperature ranges.

Features

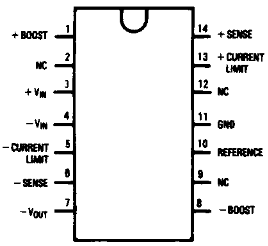
- ±15V and ±12V tracking outputs
- Output current to 100 mA
- Output voltage balanced to within 1% (LM125, LM126, LM325A)
- Line and load regulation of 0.06%
- Internal thermal overload protection
- Standby current drain of 3 mA
- Externally adjustable current limit
- Internal current limit

Schematic and Connection Diagrams



TL/H/7776-1

Dual-In-Line Package

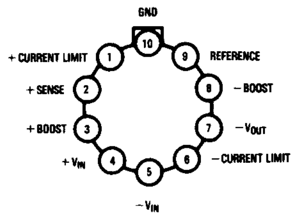


TL/H/7776-2

Top View

Order Number LM325AN, LM325N or LM326N
See NS Package Number N14A

Metal Can Package



Case connected to $-V_{IN}$ TL/H/7776-3

Top View

Order Number LM125H, LM325H, LM126H or LM326H
See NS Package Number H10C

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications. (Note 5)

Input Voltage	±30V
Forced $V_O{}^+$ (Min) (Note 1)	−0.5V
Forced $V_O{}^-$ (Max) (Note 1)	+0.5V
Power Dissipation (Note 2)	P_{MAX}
Output Short-Circuit Duration (Note 3)	Continuous

Operating Conditions

Operating Free Temperature Range	
LM125	−55°C to +125°C
LM325, LM325A	0°C to +70°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	300°C

Electrical Characteristics LM125/LM325/LM325A (Note 2)

Parameter	Conditions	Min	Typ	Max	Units
Output Voltage	T_j = 25°C				
LM125/LM325A		14.8	15	15.2	V
LM325		14.5	15	15.5	V
Input-Output Differential		2.0			V
Line Regulation	V_{IN} = 18V to 30V, I_L = 20 mA, T_j = 25°C		2.0	10	mV
Line Regulation Over Temperature Range	V_{IN} = 18V to 30V, I_L = 20 mA,		2.0	20	mV
Load Regulation	I_L = 0 to 50 mA, V_{IN} = ±30V, T_j = 25°C				
$V_O{}^+$			3.0	10	mV
$V_O{}^-$			5.0	10	mV
Load Regulation Over Temperature Range	I_L = 0 to 50 mA, V_{IN} = ±30V				
$V_O{}^+$			4.0	20	mV
$V_O{}^-$			7.0	20	mV
Output Voltage Balance	T_j = 25°C				
LM125, LM325A				±150	mV
LM325				±300	mV
Output Voltage Over Temperature Range	$P \leq P_{MAX}$, $0 \leq I_O \leq 50$ mA, $18V \leq \lvert V_{IN} \rvert \leq 30$				
LM125, LM325A		14.65		15.35	V
LM325		14.27		15.73	V
Temperature Stability of V_O			±0.3		%
Short Circuit Current Limit	T_j = 25°C		260		mA
Output Noise Voltage	T_j = 25°C, BW = 100 − 10 kHz		150		μVrms
Positive Standby Current	T_j = 25°C		1.75	3.0	mA
Negative Standby Current	T_j = 25°C		3.1	5.0	mA
Long Term Stability			0.2		%/kHr
Thermal Resistance Junction to Case (Note 4)					
LM125H, LM325H			20		°C/W
Junction to Ambient	(Still Air)		215		°C/W
Junction to Ambient	(400 Lf/min Air Flow)		82		°C/W
Junction to Ambient LM325AN, LM325N	(Still Air)		90		°C/W

Note 1: That voltage to which the output may be forced without damage to the device.

Note 2: Unless otherwise specified these specifications apply for T_j = 55°C to +150°C on LM125, T_j = 0°C to +125°C on LM325A, T_j = 0°C to +125°C on LM325, V_{IN} = ±20V, I_L = 0 mA, I_{MAX} = 100 mA, P_{MAX} = 2.0W for the H10 Package. I_{MAX} = 100 mA. I_{MAX} = 100 mA, P_{MAX} = 1.0W for the DIP N Package.

Note 3: If the junction temperature exceeds 150°C, the output short circuit duration is 60 seconds.

Note 4: Without a heat sink, the thermal resistance junction to ambient of the H10 Package is about 155°C/W. With a heat sink, the effective thermal resistance can only approach the junction to case values specified, depending on the efficiency of the sink.

Note 5: Refer to RETS125X drawing for military specification of LM125.

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications. (Note 5)

Input Voltage	±30V
Forced V_O^+ (Min) (Note 1)	−0.5V
Forced V_O^- (Max) (Note 1)	+0.5V
Power Dissipation (Note 2)	Internally Limited
Output Short-Circuit Duration (Note 3)	Continuous

Operating Conditions

Operating Free Temperature Range	
LM126	−55°C to +125°C
LM326	0°C to +70°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec.)	300°C

Electrical Characteristics LM126/LM326 (Note 2)

Parameter	Conditions	Min	Typ	Max	Units
Output Voltage	T_j = 25°C				
LM126/LM326		11.8	12	12.2	V
		11.5		12.5	V
Input-Output Differential		2.0			V
Line Regulation	V_{IN} = 15V to 30V I_L = 20 mA, T_j = 25°C		2.0	10	mV
Line Regulation Over Temperature Range	V_{IN} = 15V to 30V, I_L = 20 mA		2.0	20	mV
Load Regulation	I_L = 0 to 50 mA, V_{IN} = ±30V,				
V_O^+	T_j = 25°C		3.0	10	mV
V_O^-			5.0	10	mV
Load Regulation Over Temperature Range	I_L = 0 to 50 mA, V_{IN} = ±30V				
V_O^+			4.0	20	mV
V_O^-			7.0	20	mV
Output Voltage Balance	T_j = 25°C				
LM126, LM326				±125	mV
				±250	mV
Output Voltage Over Temperature Range	$P \le P_{MAX}$, $0 \le I_O \le 50$ mA,				
LM126	$15V \le \lvert V_{IN} \rvert \le 30$	11.68		12.32	V
LM326		11.32		12.68	V
Temperature Stability of V_O			±0.3		%
Short Circuit Current Limit	T_j = 25°C		260		mA
Output Noise Voltage	T_j = 25°C, BW = 100 − 10 kHz		100		μVrms
Positive Standby Current	T_j = 25°C, I_L = 0		1.75	3.0	mA
Negative Standby Current	T_j = 25°C, I_L = 0		3.1	5.0	mA
Long Term Stability			0.2		%/kHr
Thermal Resistance Junction to Case (Note 4)					
LM126H, LM326H			20		°C/W
Junction to Ambient	(Still Air)		155		°C/W
Junction to Ambient	(400 Lf/min Air Flow)		62		°C/W
Junction to Ambient LM326N			150		°C/W

Note 1: That voltage to which the output may be forced without damage to the device.

Note 2: Unless otherwise specified these specifications apply for T_j = 55°C to +150°C on LM126, T_j = 0°C to +125°C on LM326, V_{IN} = ±20V, I_L = 0 mA, I_{MAX} = 100 mA, P_{MAX} = 2.0W for the H10 Package. I_{MAX} = 100 mA. I_{MAX} = 100 mA, P_{MAX} = 1.0W for the DIP N Package.

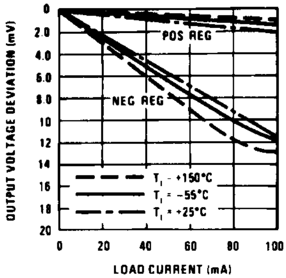
Note 3: If the junction temperature exceeds 150°C, the output short circuit duration is 60 seconds.

Note 4: Without a heat sink, the thermal resistance junction to ambient of the H10 Package is about 155°C/W. With a heat sink, the effective thermal resistance can only approach the junction to case values specified, depending on the efficiency of the sink.

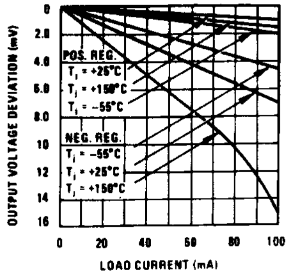
Note 5: Refer to RETS126X drawing for military specification of LM126.

Typical Performance Characteristics

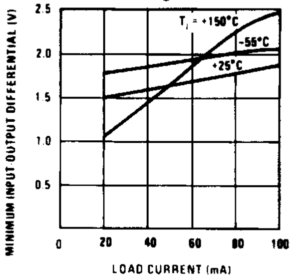
LM125 Load Regulation



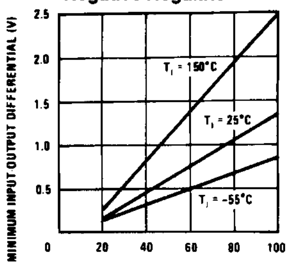
LM126 Load Regulation



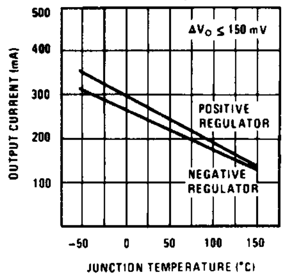
LM125/126 Regulator Dropout Voltage for Positive Regulator



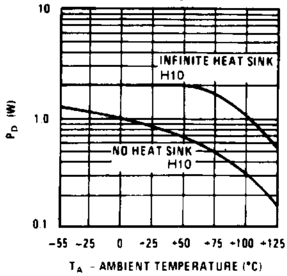
LM125/126 Regulator Dropout Voltage for Negative Regulator



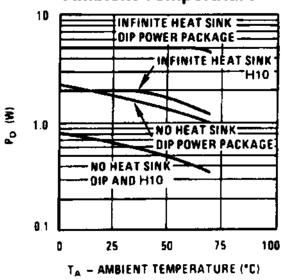
LM125/126 Peak Output Current vs Junction Temperature



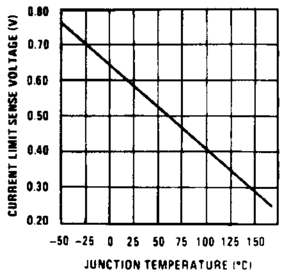
LM125/126 Maximum Average Power Dissipation vs Ambient Temperature



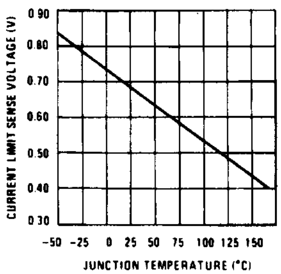
LM325/326 Maximum Average Power Dissipation vs Ambient Temperature



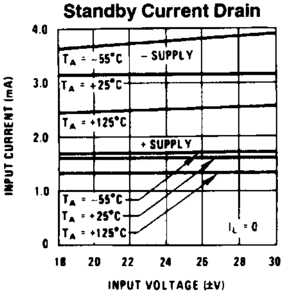
LM125/126 Current Limit Sense Voltage vs Temperature for Negative Regulator



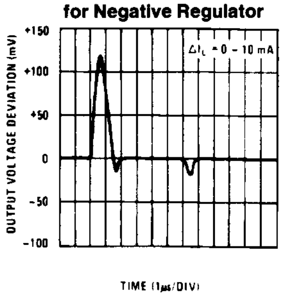
LM125/126 Current Limit Sense Voltage vs Temperature for Positive Regulator



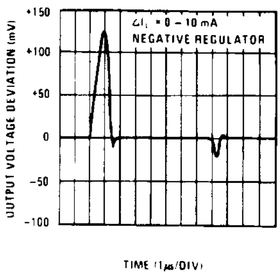
LM125/126 Standby Current Drain



LM125 Load Transient Response for Negative Regulator



LM126 Load Transient Response



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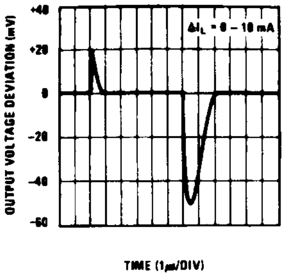
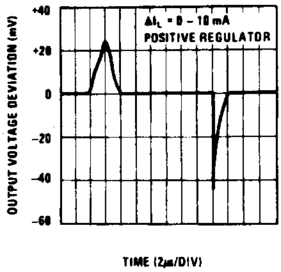
Typical Performance Characteristics (Continued)

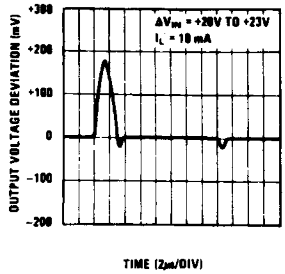
LM125
Load Transient Response
for Positive Regulator



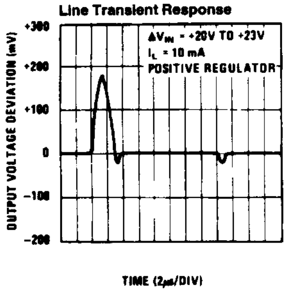
LM126
Load Transient Response



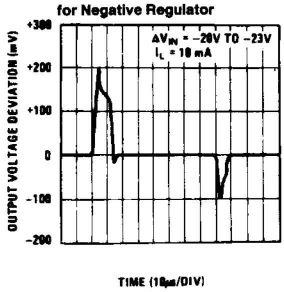
LM125
Line Transient Response
for Positive Regulator



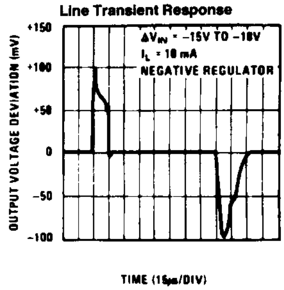
LM126
Line Transient Response



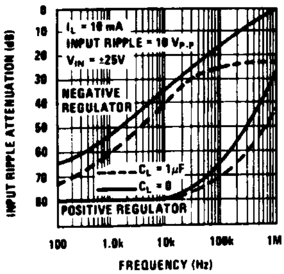
LM125
Line Transient Response
for Negative Regulator



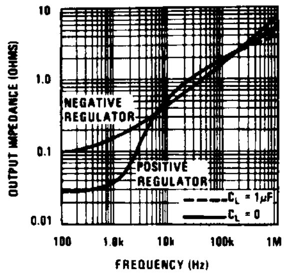
LM126
Line Transient Response



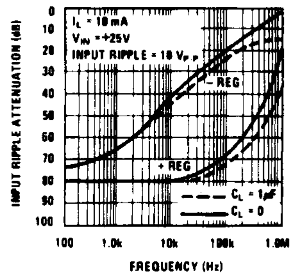
LM125
Ripple Rejection



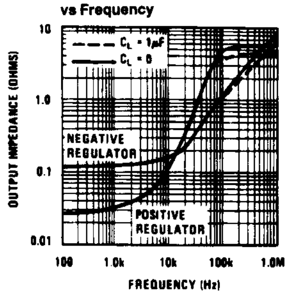
LM125
Output Impedance
vs Frequency



LM126
Ripple Rejection



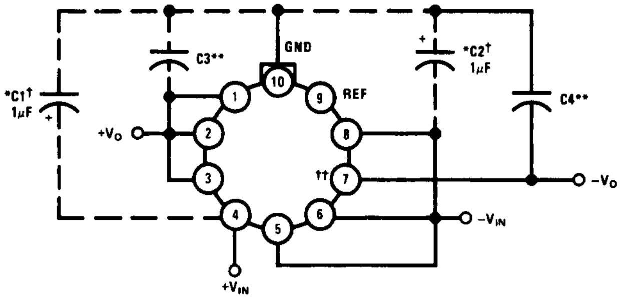
LM126
Output Impedance
vs Frequency



TL/H/7776–5

Typical Applications

Basic Regulator†††



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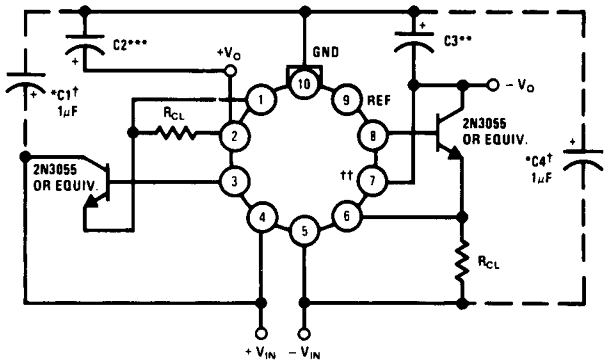
2.0 Amp Boosted Regulator With Current Limit



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Note: Metal can (H) packages shown.

$$I_{CL} = \frac{\text{Current Limit Sense Voltage (See Curve)}}{R_{CL}}$$

†Solid tantalum

††Short pins 6 and 7 on dip

†††R_{CL} can be added to the basic regulator between pins 6 and 5, 1 and 2 to reduce current limit.

*Required if regulator is located an appreciable distance from power supply filter.

**Although no capacitor is needed for stability, it does help transient response. (If needed use 1 μF electrolytic).

***Although no capacitor is needed for stability, it does help transient response. (If needed use 10 μF electrolytic).

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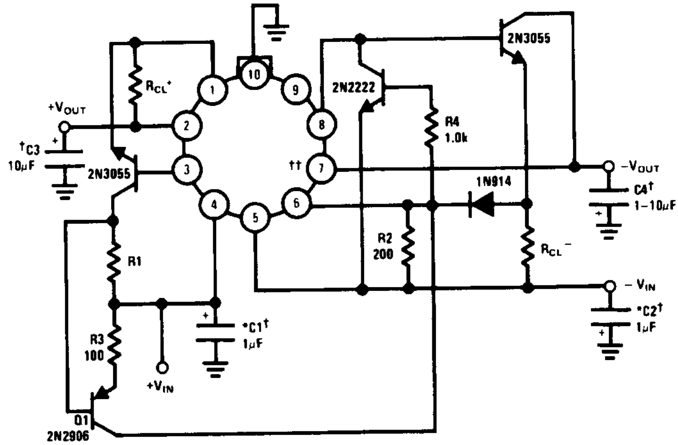
Typical Applications (Continued)

Positive Current Dependent Simultaneous Current Limiting



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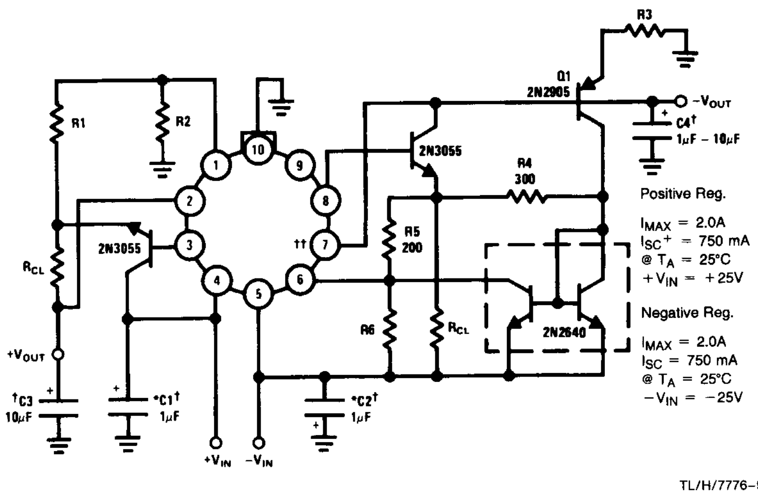
$$I_{CL}^{+} = \frac{\frac{V_{SENSE\,NEG}}{2} + V_{BEQ1}}{R1}$$

$$I_{CL}^{+} = \frac{V_{SENSE\,NEG} + V_{DIODE}}{R_{CL}^{-}}$$

$$R_{CL}^{+} = \frac{V_{SENSE}^{+}}{1.1\,I_{CL}^{+}}$$

I_{CL}^{+} Controls Both Sides of the Regulator.

Boosted Regulator With Foldback Current Limit



Positive Reg.

I_{MAX} = 2.0A
I_{SC}^{+} = 750 mA
@ T_A = 25°C
$+V_{IN}$ = +25V

Negative Reg.

I_{MAX} = 2.0A
I_{SC} = 750 mA
@ T_A = 25°C
$-V_{IN}$ = −25V

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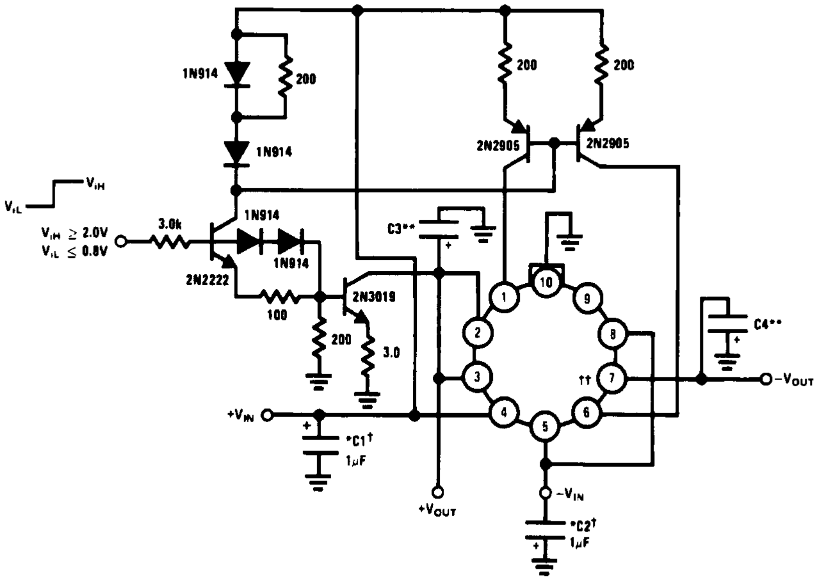
Resistor Values

	125	126
R1	18	20
R2	310	180
R3	2.4k	1.35k
R6	300	290
R_{CL}	0.7	0.9

Typical Applications (Continued)

Electric Shutdown



TL/H/7776-10

†Solid tantalum

††Short pins 6 and 7 on dip

*Required if regulator is located an appreciable distance from power supply filter.

**Although no capacitor is needed for stability, it does help transient response. (If needed use 1 µF electrolytic).

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