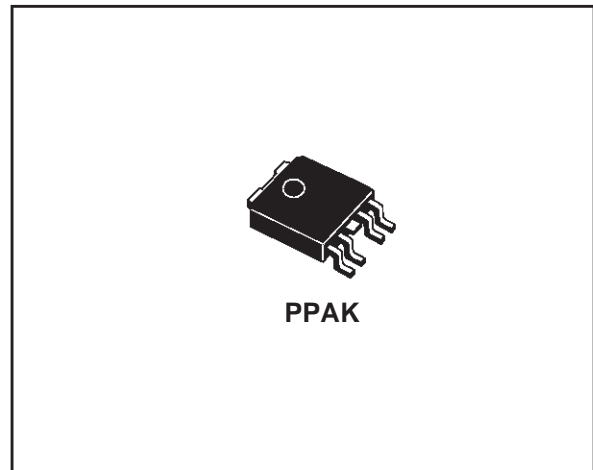




# L4987 SERIES

## VERY LOW DROP VOLTAGE REGULATORS WITH INHIBIT AND DROPOUT CONTROL FLAG

- VERY LOW DROPOUT VOLTAGE (0.25V TYP.)
- DROPOUT CONTROL FLAG
- VERY LOW QUIESCENT CURRENT (TYP. 90  $\mu$ A IN OFF MODE, 500 $\mu$ A IN ON MODE)
- OUTPUT CURRENT UP TO 200 mA
- LOGIC-CONTROLLED ELECTRONIC SHUTDOWN
- OUTPUT VOLTAGES OF 3V, 5V 8.7V 12V
- INTERNAL CURRENT AND THERMAL LIMIT
- ONLY 2.2 $\mu$ F FOR STABILITY
- AVAILABLE IN  $\pm$  2% SELECTION AT 25  $^{\circ}$ C
- SUPPLY VOLTAGE REJECTION: 70 dB (TYP.)

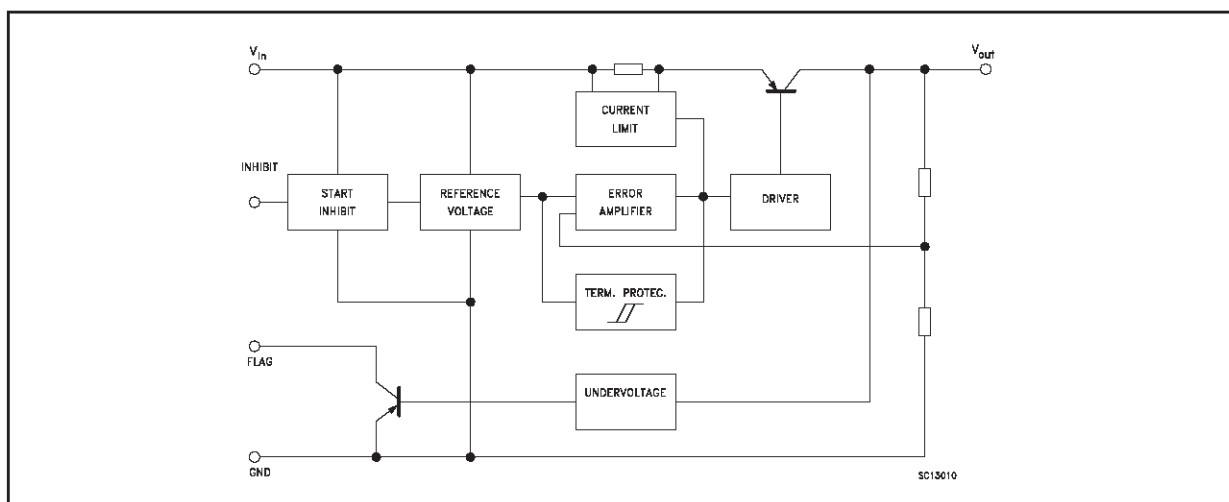


### DESCRIPTION

The L4987 is a very low drop regulator available in PPAK. The very low drop-voltage (0.5V Max at 200 mA) and the very low quiescent current make it particularly suitable for low noise, low power applications, and in battery powered systems. The input dump protection up to 40V makes it ideal for automotive applications. a shutdown Logic Control function is available (pin2, TTL compatible). This means that when the device is used as a local regulator, it is possible to put a

part of the board in standby, decreasing the total power consumption. The regulator employs an output pin (open collector) providing a logic signal when the pass transistor is in saturation at low input voltage, this signal can be used to prevent the pop-up phenomenon in the car radio. In battery powered systems (the cellular phone, notebook) it is possible to use the flag to monitor the battery charge status through the dropout of the regulator.

### SCHEMATIC DIAGRAM



## L4987 SERIES

### ABSOLUTE MAXIMUM RATINGS

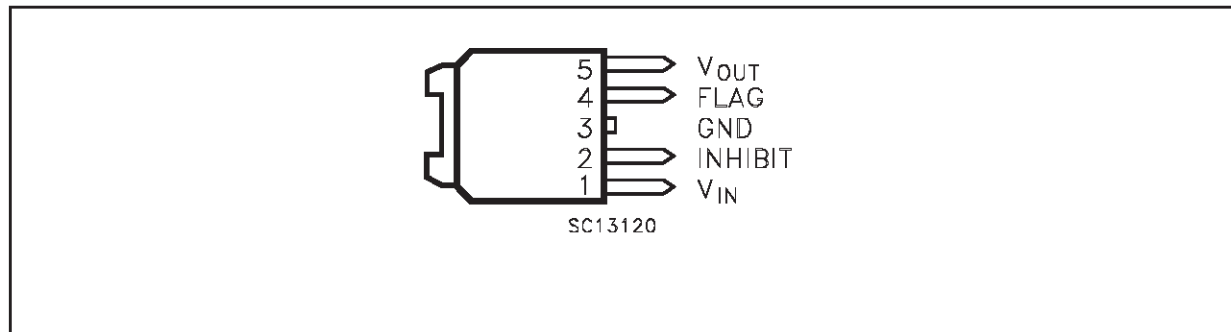
Symbol	Parameter	Value	Unit
$V_i$	DC Input Voltage	40	V
$I_o$	Output Current	Internally limited	mA
$P_{tot}$	Power Dissipation	Internally limited	mW
$T_{stg}$	Storage Temperature Range	- 40 to 150	°C
$T_{op}$	Operating Junction Temperature Range	- 40 to 125	°C

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

### THERMAL DATA

Symbol	Parameter	DPAK/PPAK	Unit
$R_{thj-case}$	Thermal Resistance Junction-case	8	°C/W
$R_{thj-amb}$	Thermal Resistance Junction-ambient	100	°C/W

### CONNECTION DIAGRAM (top view)



### ORDERING NUMBERS

Type	Output Voltage
L4987CPT30 (*)	3 V
L4987CPT50 (*)	5 V
L4987CPT87 (*)	8.7 V
L4987CPT120 (*)	12 V

(\*) Available even in tape & reel

**ELECTRICAL CHARACTERISTICS FOR L4987CPT30** (refer to the test circuits,  $V_i = 6\text{ V}$ ,  $I_{OUT} = 5\text{ mA}$ ,  $T_j = 25\text{ }^\circ\text{C}$ ,  $C_i = 0.1\text{ }\mu\text{F}$ ,  $C_o = 2.2\text{ }\mu\text{F}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_o$	Output Voltage	$I_o = 200\text{ mA}$ , $V_i = 6\text{ V}$	2.94	3	3.06	V
		$I_o = 200\text{ mA}$ , $V_i = 6\text{ V}$ $-40 < T_j < 125\text{ }^\circ\text{C}$	2.88		3.12	V
$V_i$	Operating Input Voltage	$I_o = 200\text{ mA}$	3.62		18	V
$I_{out}$	Output Current Limit		250			A
$\Delta V_o$	Line Regulation	$V_i = 4.3\text{ to }18\text{ V}$ , $I_o = 0.5\text{ mA}$		2.4	14	mV
$\Delta V_o$	Load Regulation	$V_i = 4.1\text{ V}$ $I_o = 0.5\text{ to }200\text{ mA}$		3	20	mV
$I_d$	Quiescent Current	ON MODE				
		$V_i = 4.3\text{ to }18\text{ V}$ $I_o = 0\text{ mA}$		0.7	1	mA
		$V_i = 4.3\text{ to }18\text{ V}$ $I_o = 200\text{ mA}$		1.5	6	mA
		OFF MODE $V_i = 12\text{ V}$		90	180	$\mu\text{A}$
SVR	Supply Voltage Rejection	$I_o = 5\text{ mA}$ $V_i = 5.3\text{ V} \pm 1\text{ V}$				
		$f = 120\text{ Hz}$		80		dB
		$f = 1\text{ KHz}$		75		dB
		$f = 10\text{ KHz}$		60		dB
$V_d$	Dropout Voltage	$I_o = 200\text{ mA}$		0.25	0.5	V
		$I_o = 200\text{ mA}$ $-40 < T_j < 125\text{ }^\circ\text{C}$			0.7	V
$V_{il}$	Control Input Logic Low	$-40 < T_j < 125\text{ }^\circ\text{C}$			0.8	V
$V_{ih}$	Control Input Logic High	$-40 < T_j < 125\text{ }^\circ\text{C}$	2			V
$I_i$	Control Input Current			10		$\mu\text{A}$
$C_o$	Output Bypass Capacitance	ESR = 0.5 to 10 $\Omega$ $I_o = 0\text{ to }200\text{ mA}$ $-40 < T_j < 125\text{ }^\circ\text{C}$	2	10		$\mu\text{F}$
$V_{fl}$	Control Flag Output Low	$V_i - V_o < V_{cesat\ power}$ , $I_{fi} = 6\text{ mA}$ $I_o = 200\text{ mA}$			0.5	V
$I_{fh}$	Control Flag Output High Leakage Current	$V_i > 3.62\text{ V}$ $V_{oh} = 15\text{ V}$			10	$\mu\text{A}$

## L4987 SERIES

**ELECTRICAL CHARACTERISTICS FOR L4987CPT50** (refer to the test circuits,  $V_i = 8\text{ V}$ ,  $I_{OUT} = 5\text{ mA}$ ,  $T_j = 25\text{ }^\circ\text{C}$ ,  $C_i = 0.1\text{ }\mu\text{F}$ ,  $C_o = 2.2\text{ }\mu\text{F}$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_o$	Output Voltage	$I_o = 200\text{ mA}$ , $V_i = 8\text{ V}$	4.9	5	5.1	V
		$I_o = 200\text{ mA}$ , $V_i = 8\text{ V}$ $-40 < T_j < 125\text{ }^\circ\text{C}$	4.8		5.2	V
$V_i$	Operating Input Voltage	$I_o = 200\text{ mA}$	5.7		18	V
$I_{out}$	Output Current Limit		250			A
$\Delta V_o$	Line Regulation	$V_i = 6.3\text{ to }18\text{ V}$ , $I_o = 0.5\text{ mA}$		3	20	mV
$\Delta V_o$	Load Regulation	$V_i = 3.6\text{ V}$ $I_o = 0.5\text{ to }200\text{ mA}$		3	20	mV
$I_d$	Quiescent Current	ON MODE				
		$V_i = 6.3\text{ to }18\text{ V}$ $I_o = 0\text{ mA}$		0.7	1	mA
		$V_i = 6.3\text{ to }18\text{ V}$ $I_o = 200\text{ mA}$		1.5	6	mA
		OFF MODE $V_i = 12\text{ V}$		90	180	$\mu\text{A}$
SVR	Supply Voltage Rejection	$I_o = 5\text{ mA}$ $V_i = 7.3\text{ V} \pm 1\text{ V}$				
		$f = 120\text{ Hz}$		76		dB
		$f = 1\text{ KHz}$		71		dB
		$f = 10\text{ KHz}$		58		dB
$V_d$	Dropout Voltage	$I_o = 200\text{ mA}$		0.3	0.5	V
		$I_o = 200\text{ mA}$ $-40 < T_j < 125\text{ }^\circ\text{C}$			0.7	V
$V_{il}$	Control Input Logic Low	$-40 < T_j < 125\text{ }^\circ\text{C}$			0.8	V
$V_{ih}$	Control Input Logic High	$-40 < T_j < 125\text{ }^\circ\text{C}$	2			V
$I_i$	Control Input Current			10		$\mu\text{A}$
$C_o$	Output Bypass Capacitance	ESR = 0.5 to 10 $\Omega$ $I_o = 0\text{ to }200\text{ mA}$ $-40 < T_j < 125\text{ }^\circ\text{C}$	2	10		$\mu\text{F}$
$V_{fl}$	Control Flag Output Low	$V_i - V_o < V_{cesat\ power}$ , $I_{fi} = 6\text{ mA}$ $I_o = 200\text{ mA}$			0.5	V
$I_{fh}$	Control Flag Output High Leakage Current	$V_i > 5.85\text{ V}$ $V_{oh} = 15\text{ V}$			10	$\mu\text{A}$

**ELECTRICAL CHARACTERISTICS FOR L4987CPT87** (refer to the test circuits,  $V_i = 11.7V$ ,  $I_{OUT} = 5mA$ ,  $T_j = 25^\circ C$ ,  $C_i = 0.1 \mu F$ ,  $C_o = 2.2 \mu F$  unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_o$	Output Voltage	$I_o = 200 \text{ mA}$ , $V_i = 11.7 \text{ V}$	8.526	8.7	8.874	V
		$I_o = 200 \text{ mA}$ , $V_i = 11.7 \text{ V}$ $-40 < T_j < 125^\circ C$	8.35			9.05
$V_i$	Operating Input Voltage	$I_o = 200 \text{ mA}$	9.55		18	V
$I_{out}$	Output Current Limit		250			A
$\Delta V_o$	Line Regulation	$V_i = 10 \text{ to } 18 \text{ V}$ , $I_o = 0.5 \text{ mA}$		4	24	mV
$\Delta V_o$	Load Regulation	$V_i = 10 \text{ V}$ $I_o = 0.5 \text{ to } 200 \text{ mA}$		3	20	mV
$I_d$	Quiescent Current	ON MODE				
		$V_i = 10 \text{ to } 18 \text{ V}$ $I_o = 0 \text{ mA}$		0.5	1	mA
		$V_i = 10 \text{ to } 18 \text{ V}$ $I_o = 200 \text{ mA}$		3	6	mA
		OFF MODE $V_i = 12 \text{ V}$		90	180	$\mu A$
SVR	Supply Voltage Rejection	$I_o = 5 \text{ mA}$ $V_i = 11 \text{ V} \pm 1V$		71		dB
		$f = 120 \text{ Hz}$		68		dB
		$f = 1 \text{ KHz}$		55		dB
$V_d$	Dropout Voltage	$I_o = 200 \text{ mA}$		0.3	0.5	V
		$I_o = 200 \text{ mA}$ $-40 < T_j < 125^\circ C$			0.7	V
$V_{il}$	Control Input Logic Low	$-40 < T_j < 125^\circ C$			0.8	V
$V_{ih}$	Control Input Logic High	$-40 < T_j < 125^\circ C$	2			V
$I_i$	Control Input Current			10		$\mu A$
$C_o$	Output Bypass Capacitance	ESR = 0.5 to 10 $\Omega$ $I_o = 0 \text{ to } 200 \text{ mA}$ $-40 < T_j < 125^\circ C$	2	10		$\mu F$
$V_{fl}$	Control Flag Output Low	$V_i - V_o < V_{cesat \text{ power}}$ , $I_{fi} = 6 \text{ mA}$ $I_o = 200 \text{ mA}$			0.5	V
$I_{fh}$	Control Flag Output High Leakage Current	$V_i > 9.55 \text{ V}$ $V_{oh} = 15 \text{ V}$			10	$\mu A$

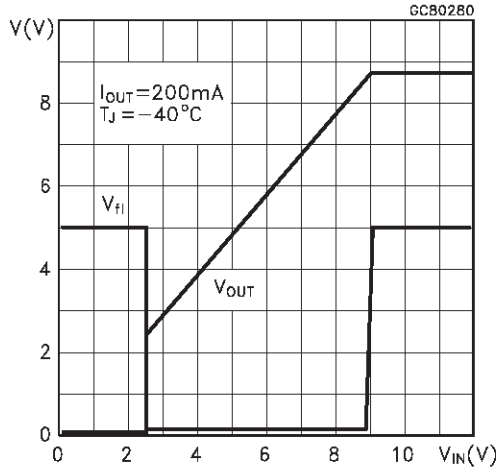
## L4987 SERIES

**ELECTRICAL CHARACTERISTICS FOR L4987CPT120** (refer to the test circuits,  $V_i = 15V$ ,  $I_{OUT} = 5mA$ ,  $T_j = 25^\circ C$ ,  $C_i = 0.1 \mu F$ ,  $C_o = 2.2 \mu F$  unless otherwise specified)

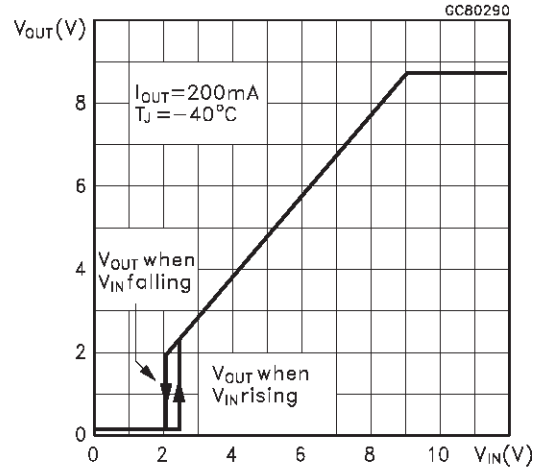
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_o$	Output Voltage	$I_o = 200 \text{ mA}$ , $V_i = 15 \text{ V}$	11.76	12	8.874	V
		$I_o = 200 \text{ mA}$ , $V_i = 15 \text{ V}$ $-40 < T_j < 125^\circ C$	11.52		9.05	V
$V_i$	Operating Input Voltage	$I_o = 200 \text{ mA}$	12.75		18	V
$I_{out}$	Output Current Limit		250			A
$\Delta V_o$	Line Regulation	$V_i = 13.5 \text{ to } 18 \text{ V}$ , $I_o = 0.5 \text{ mA}$		5	30	mV
$\Delta V_o$	Load Regulation	$V_i = 13.5 \text{ V}$ $I_o = 0.5 \text{ to } 200 \text{ mA}$		3	20	mV
$I_d$	Quiescent Current	ON MODE				
		$V_i = 13.5 \text{ to } 18 \text{ V}$ $I_o = 0 \text{ mA}$		0.5	1	mA
		$V_i = 13.5 \text{ to } 18 \text{ V}$ $I_o = 200 \text{ mA}$		3	6	mA
		OFF MODE $V_i = 12 \text{ V}$		90	180	$\mu A$
SVR	Supply Voltage Rejection	$I_o = 5 \text{ mA}$ $V_i = 14.5 \text{ V} \pm 1 \text{ V}$				
		$f = 120 \text{ Hz}$		67		dB
		$f = 1 \text{ KHz}$		64		dB
		$f = 10 \text{ KHz}$		51		dB
$V_d$	Dropout Voltage	$I_o = 200 \text{ mA}$		0.3	0.5	V
		$I_o = 200 \text{ mA}$ $-40 < T_j < 125^\circ C$			0.7	V
$V_{il}$	Control Input Logic Low	$-40 < T_j < 125^\circ C$			0.8	V
$V_{ih}$	Control Input Logic High	$-40 < T_j < 125^\circ C$	2			V
$I_i$	Control Input Current			10		$\mu A$
$C_o$	Output Bypass Capacitance	ESR = 0.5 to 10 $\Omega$ $I_o = 0 \text{ to } 200 \text{ mA}$ $-40 < T_j < 125^\circ C$	2	10		$\mu F$
$V_{fl}$	Control Flag Output Low	$V_i - V_o < V_{cesat \text{ power}}$ , $I_{fl} = 6 \text{ mA}$ $I_o = 200 \text{ mA}$			0.5	V
$I_{fh}$	Control Flag Output High Leakage Current	$V_i > 12.75 \text{ V}$ $V_{oh} = 15 \text{ V}$			10	$\mu A$

**TYPICAL PERFORMANCE CHARACTERISTICS** (unless otherwise specified  $T_J=25^\circ\text{C}$ ,  $C_{IN}=C_{OUT}=1\mu\text{F}$ )

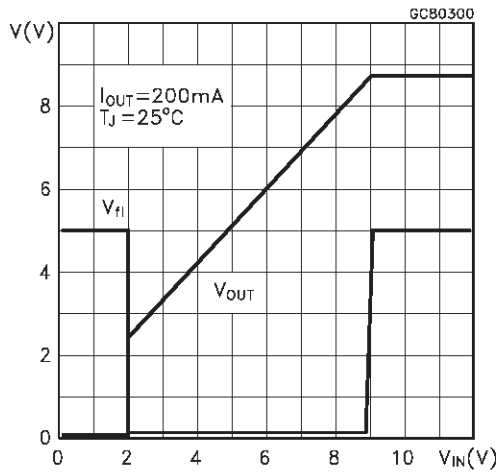
Output and Flag Voltage vs Input Voltage



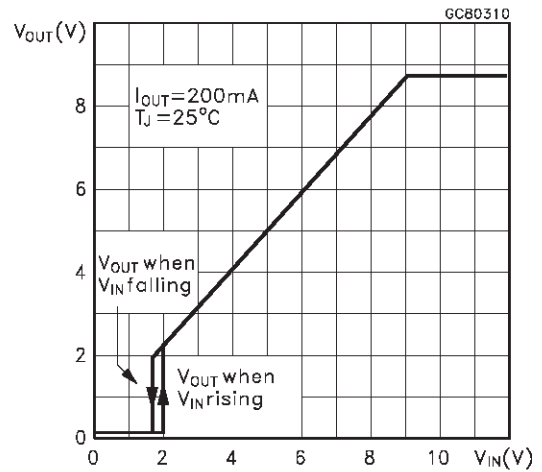
Output Voltage vs Input Voltage



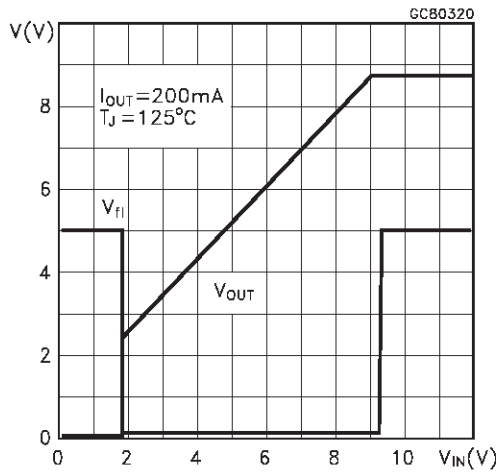
Output and Flag Voltage vs Input Voltage



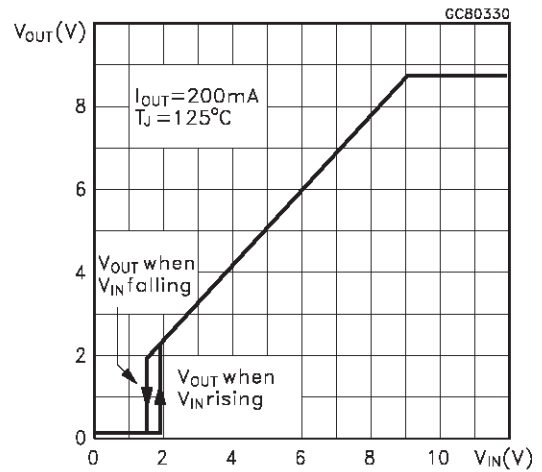
Output Voltage vs Input Voltage



Output and Flag Voltage vs Input Voltage



Output Voltage vs Input Voltage



**APPLICATION HINT OF L4987CPT30**

**How to use the control flag**

The flag produces a logic "low" whenever the output fall out of regulation. An "out of regulation condition can result from:

- 1) Low Input Voltage ( $V_{IN} \leq V_{OUT} + V_{DROP}$ )
- 2) Current Limiting
- 3) Thermal Limiting

Figure 1 to 2 show the typical behaviour of the output voltage and the control flag versus the input voltage and the temperature. No hysteresis is implemented; so the response of  $V_{OUT}$  and  $V_{FLAG}$  are the same either when the  $V_{IN}$  ramps up or down.

The control flag is an open collector which requires an external pull-up resistor. This may be connected to the regulator output (Figure 3) or some other supply voltage (Figure 4).

Using the regulator output prevents an invalid "high" on the flag which occurs if it is pulled up to an external voltage while the regulator input voltage is reduced below about 2V (Figure 5).

Concerning the pull-up resistor its value must be properly chosen as suggested below. When "low" as it is possible to see in figure 6 the control flag voltage is:

$$V_{FLAG(LOW)} = V_{CE} = 0.5 = V_{SUPPLY} - R_{PULL} \times I_{FL}$$

$V_{SUPPLY}$  is chosen by design and, thus is known, while  $I_{FL}$  must be at maximum 10mA. Then

$$0.5V \geq V_{SUPPLY} - R_{PULL} \times 10mA$$

The minimum value of  $R_{PULL}$ , is, so, determined by the following equation:

$$R_{PULL(min)} \geq V_{SUPPLY} - \frac{0.5}{10 \text{ mA}}$$

Regarding the maximum value of  $R_{PULL}$  note that its value depends of the type of logic used (CMOS, TTL etc.), the transistor leakage current and the presence or not of a load on  $V_{FLAG}$ .

The following example shows how to determine the  $R_{PULL}$  max in the case of CMOS logic, no load and 10µA (for L4978 it is the maximum value of  $I_{FH}$ ) of control flag leakage current.

Because of CMOS logic:

$$V_{FLAG(HIGH)} \geq \frac{2}{3} V_{SUPPLY}$$

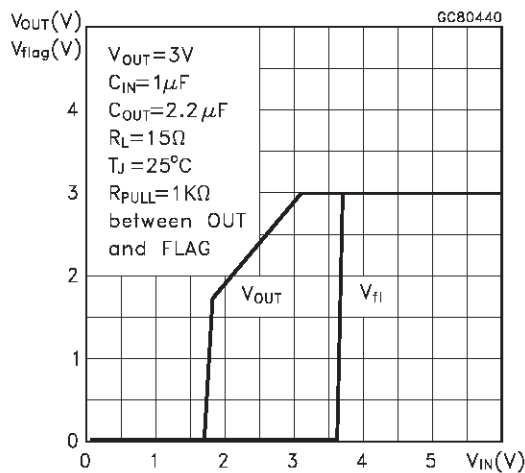
But:

$$V_{FLAG(HIGH)} = V_{SUPPLY} - R_{PULL} \times I_{FH} \geq \frac{2}{3} V_{SUPPLY}$$

so, the maximum value is determined by the following equation:

$$R_{PULL(MAX)} \leq \frac{\frac{1}{3} V_{SUPPLY}}{10 \text{ A}}$$

**Figure 1: Output and Flag Voltage vs Input**



**Figure 2: Flag Voltage vs Input**

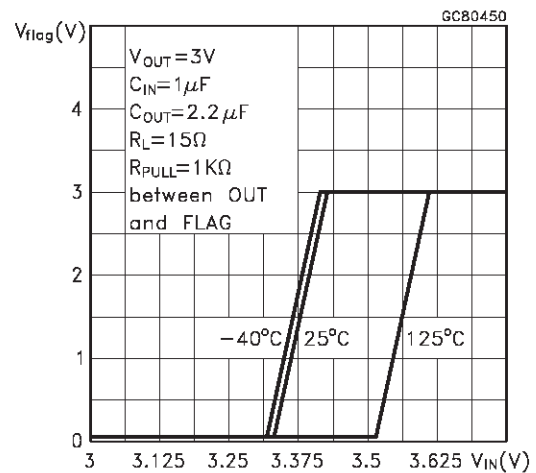




Figure 3: Test Circuit

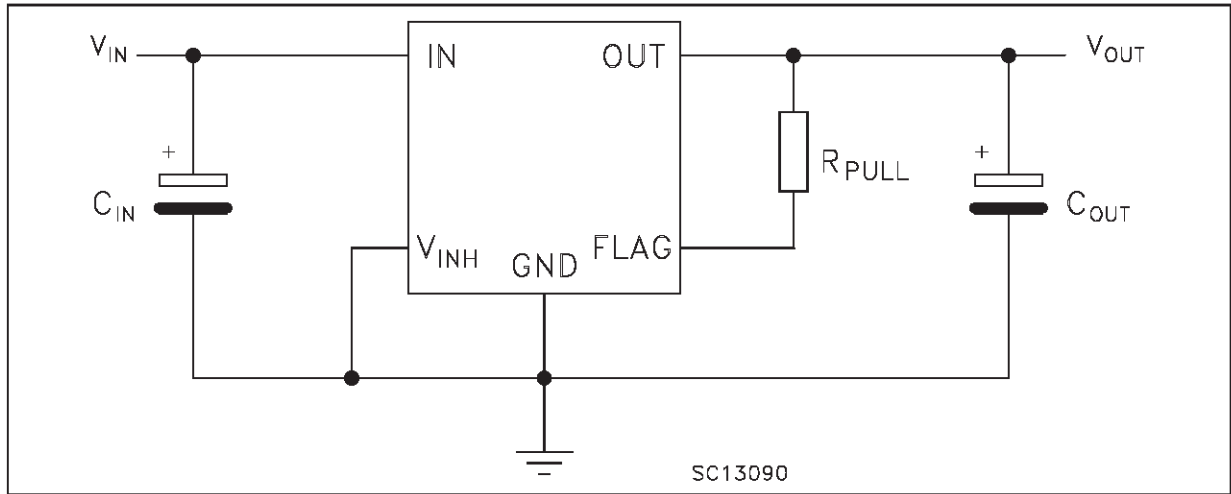


Figure 4: Test Circuit

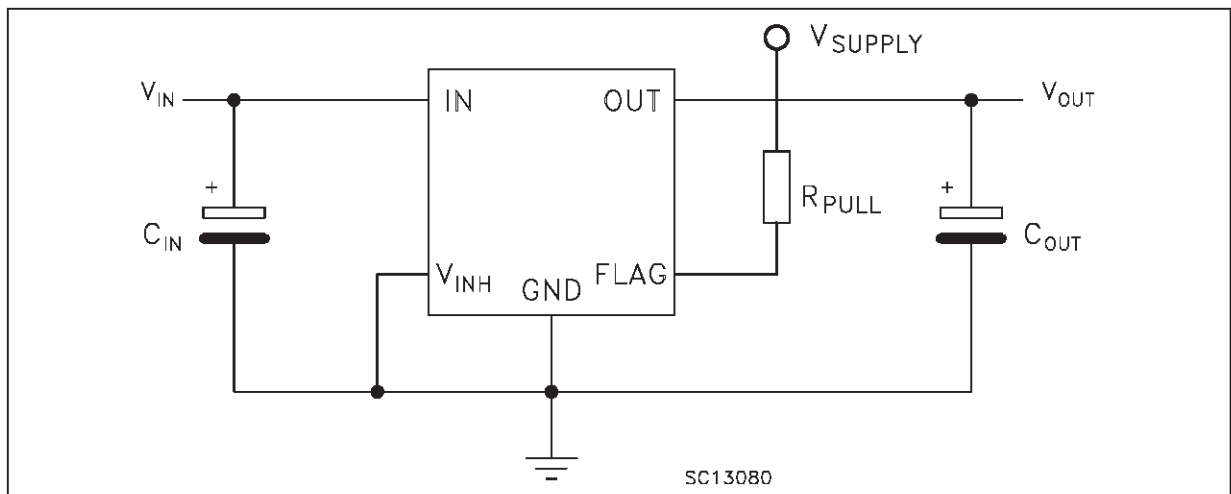


Figure 5: Output and Flag Voltage vs Input

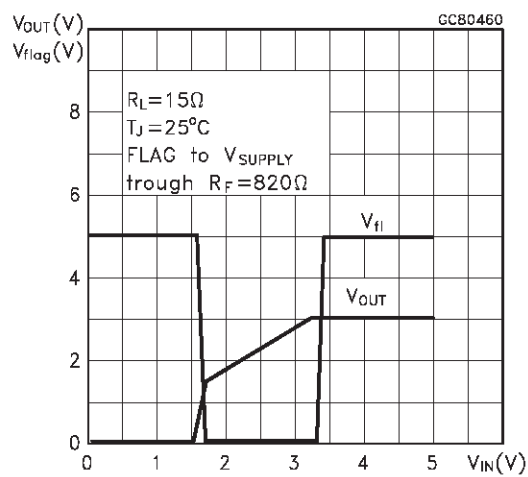
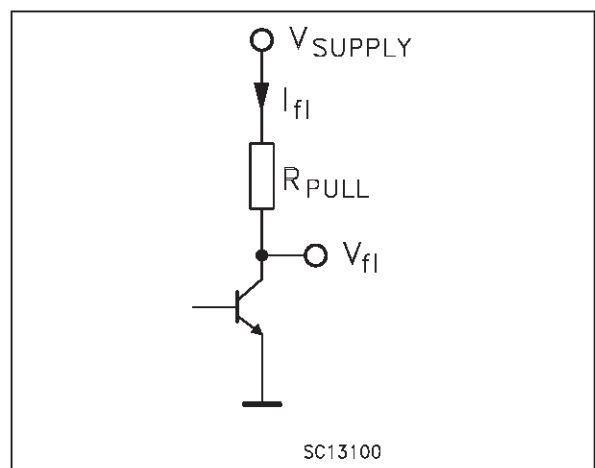
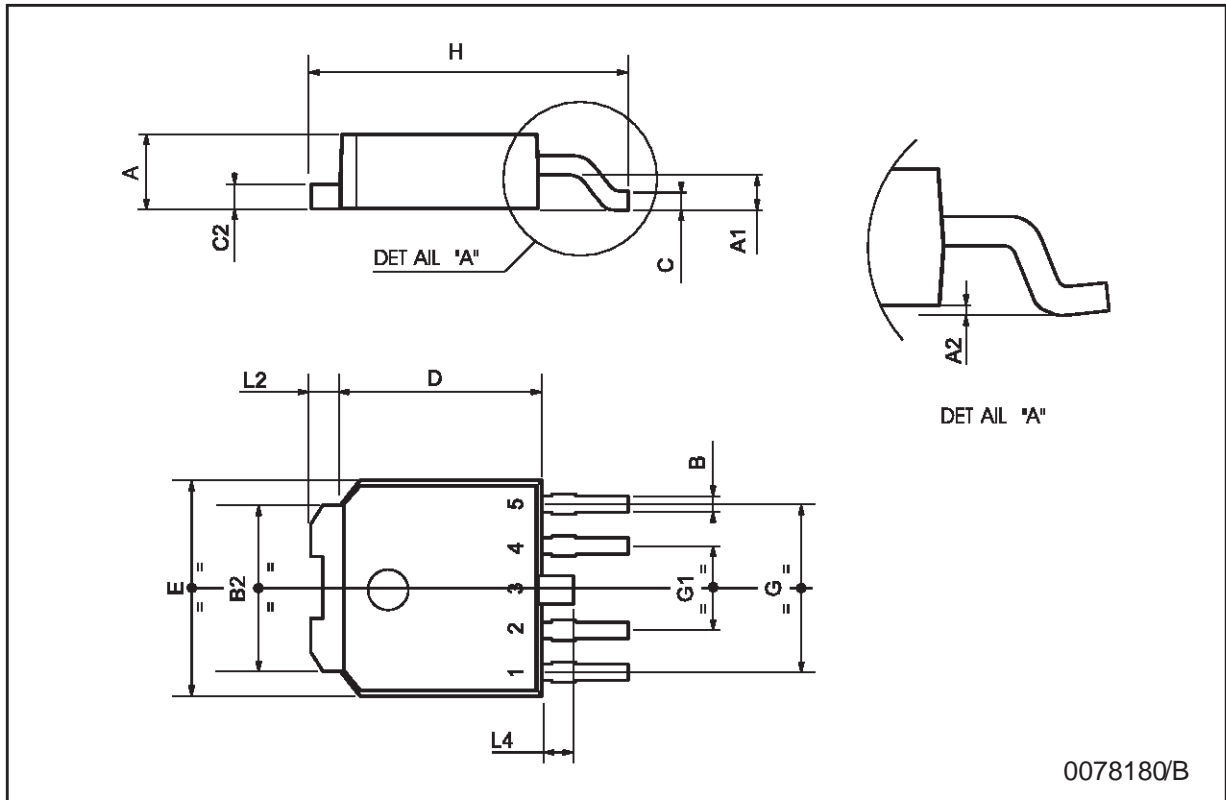


Figure 6: Equivalent Output Circuit



**PPAK MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.4		0.6	0.015		0.023
B2	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.9		5.25	0.193		0.206
G1	2.38		2.7	0.093		0.106
H	9.35		10.1	0.368		0.397
L2		0.8	1		0.031	0.039
L4	0.6		1	0.023		0.039



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