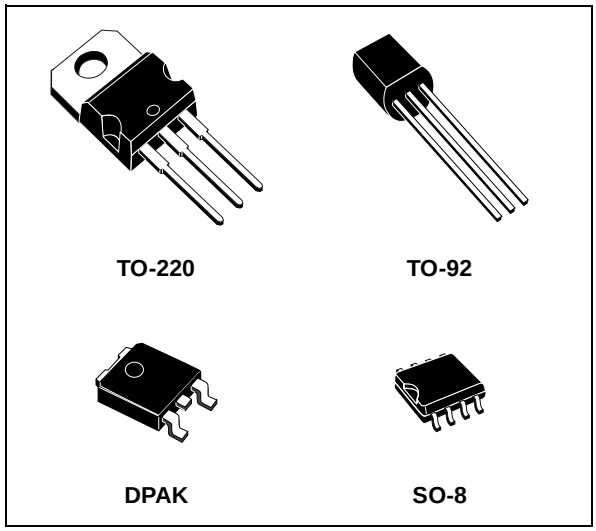
LM2931 SERIES

VERY LOW DROP VOLTAGE REGULATORS WITH INHIBIT FUNCTION

- VERY LOW DROPOUT VOLTAGE (0.15V TYP. AT 10mA LOAD)
- LOW QUIESCENT CURRENT (TYP. 2.5mA, AT 100mA LOAD)
- OUTPUT CURRENT UP TO 100mA
- ADJUSTABLE (FROM V_{OUT} = 2.5V ONLY SO-8) AND FIXED (3.3V & 5V) OUTPUT VOLTAGE VERSION
- INTERNAL CURRENT AND THERMAL LIMIT
- LOAD DUMP PROTECTION UP TO 60V
- REVERSE TRANSIENT PROTECTION UP TO -50V
- TEMPERATURE RANGE: -40 TO 125°C
- PACKAGE AVAILABLE: TO-92, DPAK, TO-220, SO-8 (WITH INHIBIT CONTROL)

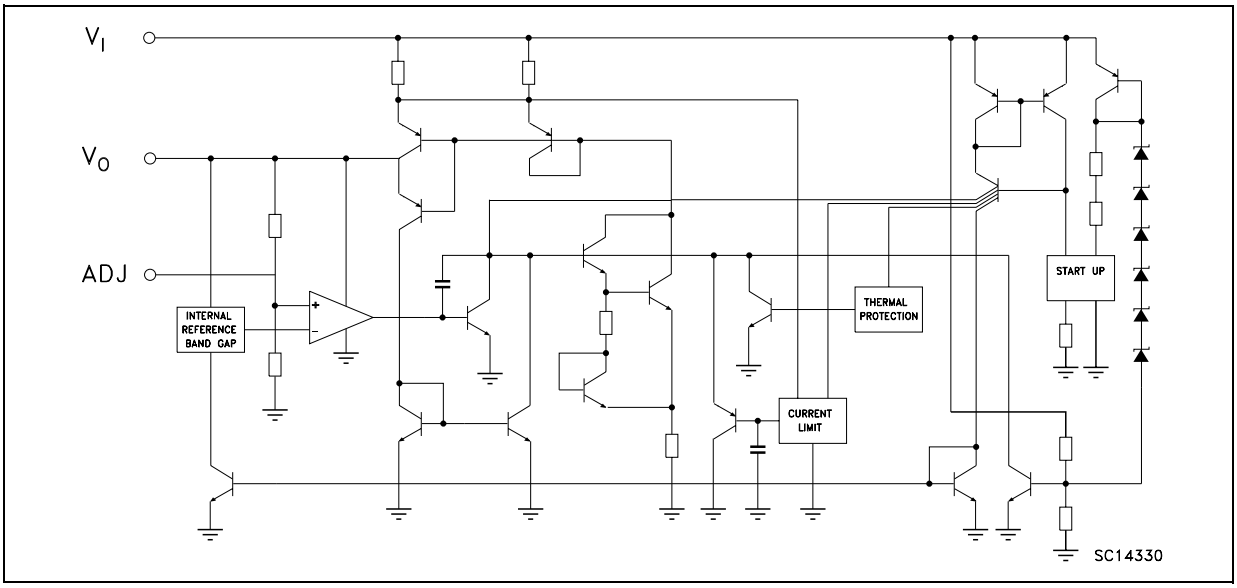


DESCRIPTION

The LM2931 series are very low drop regulators. The very low drop voltage and the low quiescent current make them particular suitable for low noise, low power applications and in battery powered systems. In the 8 pin configuration (SO-8), fully compatible to the older L78L00 family, a shut down Logic Control function is available.

This means that when the device is used as a local regulator is possible to put a part of the board in stand-by decreasing the total power consumption. Ideal for automotive application the LM2931 is protected from reverse battery installations or 2 battery jumps. During the transient, such as a a load dump (60V) when the input voltage can exceed the specified maximum operating input voltage (26V), the regulator will automatically shut down to protect both internal circuit and the load.

SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_I	DC Positive Input Voltage	40	V
V_I	DC Reverse Input Voltage	-15	V
V_I	Transient Input Voltage (τ < 100ms)	60	V
V_I	Transient Reverse Input Voltage (τ < 100ms)	-50	V
V_{INH}	Inhibit Input Voltage	40	V
I_O	Output Current	Internally Limited	
T_{stg}	Storage Temperature Range	-65 to 150	°C
T_{op}	Operating Junction Temperature Range	-40 to 125	°C

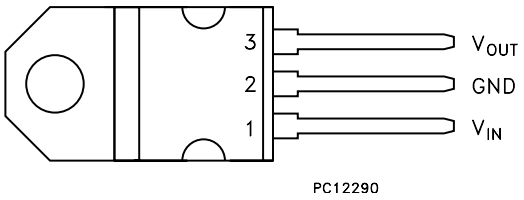
Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

THERMAL DATA

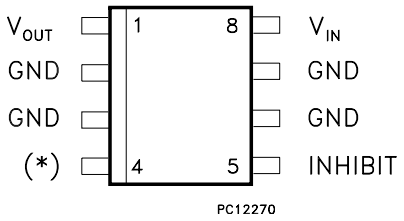
Symbol	Parameter	TO-220	SO-8	DPAK	TO-92	Unit
$R_{thj\text{-}case}$	Thermal Resistance Junction-case	3	20	8		°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient	50	55(*)	100	200	°C/W

(*) Considering 6 cm^2 of copper board heat-sink

CONNECTION DIAGRAM (top view)



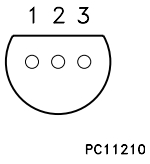
TO-220



(*) = N.C. for FIXED and ADJ for ADJUSTABLE

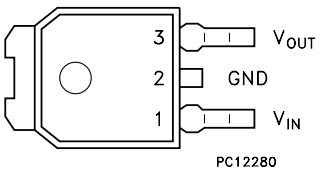
SO-8

PIN 1 = V_{OUT}
PIN 2 = GND
PIN 3 = V_{IN}



BOTTOM VIEW

TO-92



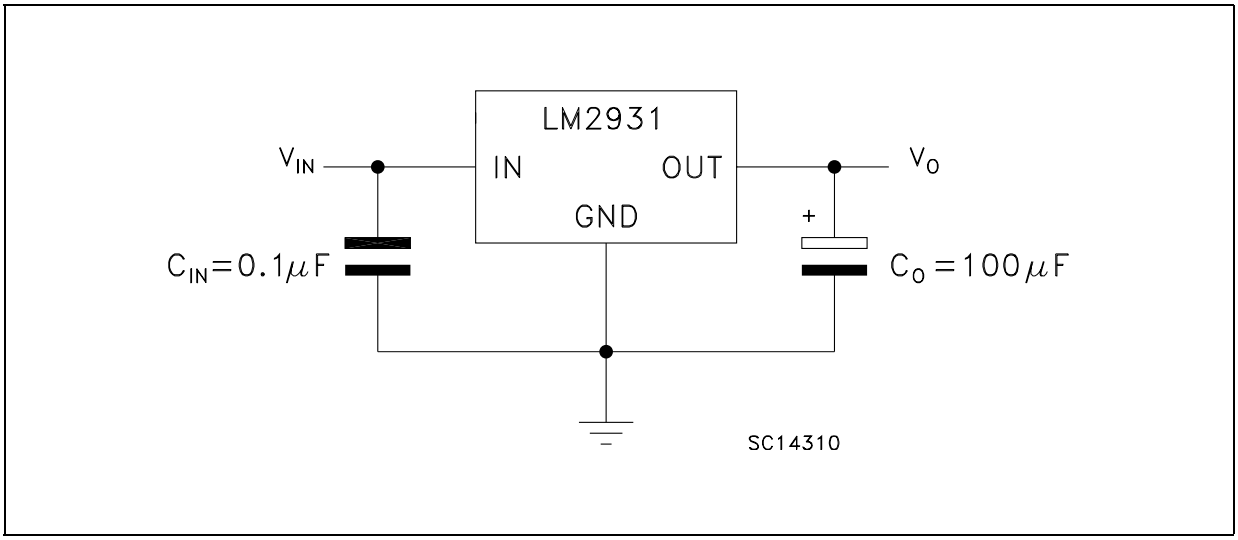
DPAK

ORDERING CODES

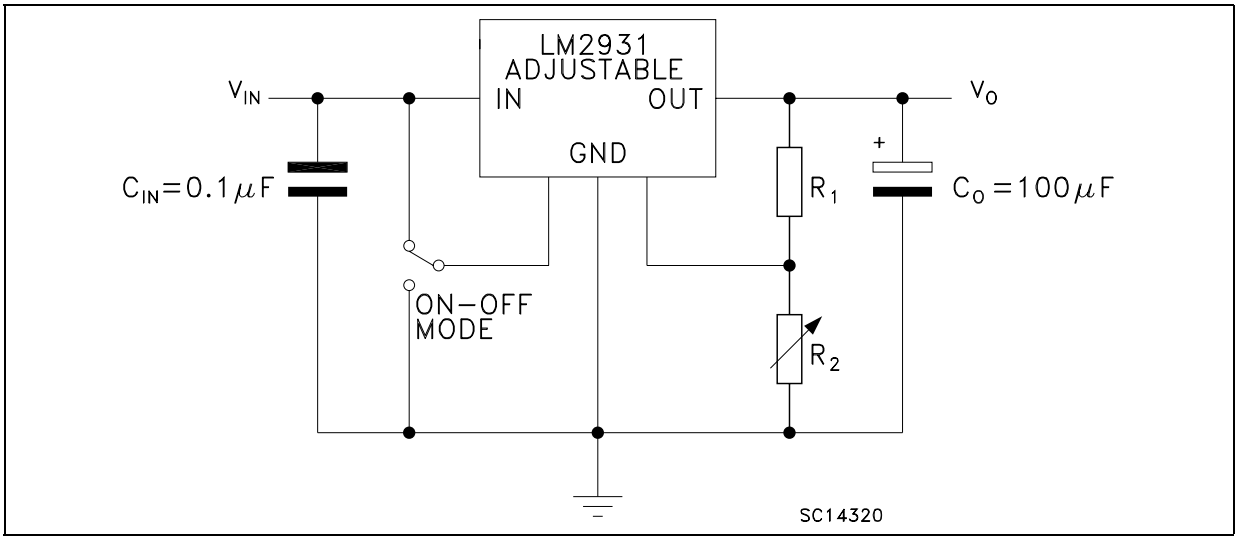
TO-220	DPAK (*)	TO-92 (*)	SO-8 (*)	OUTPUT VOLTAGE
LM2931AV33	LM2931ADT33	LM2931AZ33	LM2931AD33	3.3 V
LM2931BV33	LM2931BDT33	LM2931BZ33	LM2931BD33	3.3 V
LM2931AV50	LM2931ADT50	LM2931AZ50	LM2931AD50	5.0 V
LM2931BV50	LM2931BDT50	LM2931BZ50	LM2931BD50	5.0 V
			LM2931D	2.5 to 26 V

(*) Available in Tape & Reel with the suffix "R" for fixed version and "-R" for adjustable version.

APPLICATION CIRCUIT FOR FIXED OUTPUT



APPLICATION CIRCUIT FOR ADJUSTABLE OUTPUT



R_1 suggested Value = 27KΩ
$V_O = V_{REF}\ (R_1 + R_2)/R_1$.

ELECTRICAL CHARACTERISTICS OF LM2931A 3.3V (refer to the test circuits, T_J = 25°C, C_I = 0.1 µF, C_O = 100 µF, V_I = 14V, I_O = 10mA, V_{INH} = 0V, unless otherwise specified).

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_I	Maximum Operating Input Voltage	I_O = 10 mA T_J = -40 to 125°C	26	37		V
V_O	Output Voltage		3.135	3.3	3.425	V
V_O	Output Voltage	I_O = 100 mA V_I = 6 to 26 V T_J = -40 to 125°C	3.135	3.3	3.465	V
ΔV_O	Line Regulation	V_I = 9 to 16 V		2	10	mV
		V_I = 6 to 26 V		4	33	
ΔV_O	Load Regulation	I_O = 5 to 100 mA		10	33	mV
V_d	Dropout Voltage (Note 1, 2)	I_O = 10 mA		90	250	mV
		I_O = 100 mA		250	600	
I_d	Quiescent Current ON MODE	I_O = 100 mA		2.5	30	mA
	OFF MODE	V_{INH} = 2.5 V R_{LOAD} = 330 Ω		0.3	1	mA
I_{SC}	Short Circuit Current		100	300		mA
SVR	Supply Voltage Rejection	I_O = 100 mA, V_I = 14 ± 2 V f = 120 Hz, T_J = -40 to 125°C	55	78		dB
V_{IL}	Control Input Voltage Low	T_J = -40 to 125°C		2	1.2	V
V_{IH}	Control Input Voltage High	T_J = -40 to 125°C	3.25	2		V
I_{INH}	Inhibit Input Current	V_{INH} = 2.5 V		22	50	µA
V_I	Transient Input Voltage	R_{LOAD} = 330 Ω τ < 100ms	60	70		V
V_I	Reverse Polarity Input Voltage	V_O = ± 0.3 V R_{LOAD} = 330 Ω	-15	-50		V
V_I	Reverse Polarity Input Voltage Transient	R_{LOAD} = 330 Ω τ < 100ms	-50			V
eN	Output Noise Voltage	B =10 Hz to 100 KHz		330		μV_{RMS}

Note 1: Reference Voltage is measured from V_{OUT} to ADJ pin.
Note 2: V_d measured when the output voltage has dropped 100mV from the nominal value obtained at 14V.

ELECTRICAL CHARACTERISTICS OF LM2931B 3.3V (refer to the test circuits, T_J = 25°C, C_I = 0.1 µF, C_O = 100 µF, V_I = 14V, I_O = 10mA, V_{INH} = 0V, unless otherwise specified).

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_I	Maximum Operating Input Voltage	I_O = 10 mA T_J = -40 to 125°C	26	37		V
V_O	Output Voltage		3.135	3.3	3.465	V
V_O	Output Voltage	I_O = 100 mA V_I = 6 to 26 V T_J = -40 to 125°C	2.97	3.3	3.63	V
ΔV_O	Line Regulation	V_I = 9 to 16 V		2	10	mV
		V_I = 6 to 26 V		4	33	
ΔV_O	Load Regulation	I_O = 5 to 100 mA		10	33	mV
V_d	Dropout Voltage (Note 1, 2)	I_O = 10 mA		90	200	mV
		I_O = 100 mA		250	600	
I_d	Quiescent Current ON MODE	I_O = 100 mA		2.5	30	mA
	OFF MODE	V_{INH} = 2.5 V R_{LOAD} = 330 Ω		0.3	1	mA
I_{SC}	Short Circuit Current		100	300		mA
SVR	Supply Voltage Rejection	I_O = 100 mA, V_I = 14 ± 2 V f = 120 Hz, T_J = -40 to 125°C	55	78		dB
V_{IL}	Control Input Voltage Low	T_J = -40 to 125°C		2	1.2	V
V_{IH}	Control Input Voltage High	T_J = -40 to 125°C	3.25	2		V
I_{INH}	Inhibit Input Current	V_{INH} = 2.5 V		22	50	µA
V_I	Transient Input Voltage	R_{LOAD} = 330 Ω τ < 100ms	60	70		V
V_I	Reverse Polarity Input Voltage	V_O = ± 0.3 V R_{LOAD} = 330 Ω	-15	-50		V
V_I	Reverse Polarity Input Voltage Transient	R_{LOAD} = 330 Ω τ < 100ms	-50			V
eN	Output Noise Voltage	B =10 Hz to 100 KHz		330		μV_{RMS}

Note 1: Reference Voltage is measured from V_{OUT} to ADJ pin.
Note 2: V_d measured when the output voltage has dropped 100mV from the nominal value obtained at 14V.

ELECTRICAL CHARACTERISTICS OF LM2931A 5V (refer to the test circuits, T_J = 25°C, C_I = 0.1 µF, C_O = 100 µF, V_I = 14V, I_O = 10mA, V_{INH} = 0V, unless otherwise specified).

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_I	Maximum Operating Input Voltage	I_O = 10 mA T_J = -40 to 125°C	26	37		V
V_O	Output Voltage		4.81	5	5.19	V
V_O	Output Voltage	I_O = 100 mA V_I = 6 to 26 V T_J = -40 to 125°C	4.75	5	5.25	V
ΔV_O	Line Regulation	V_I = 9 to 16 V		2	10	mV
		V_I = 6 to 26 V		4	30	
ΔV_O	Load Regulation	I_O = 5 to 100 mA		15	50	mV
V_d	Dropout Voltage (Note 1, 2)	I_O = 10 mA		90	200	mV
		I_O = 100 mA		250	600	
I_d	Quiescent Current ON MODE	I_O = 100 mA		2.5	30	mA
	OFF MODE	V_{INH} = 2.5 V R_{LOAD} = 500 Ω		0.3	1	mA
I_{SC}	Short Circuit Current		100	300		mA
SVR	Supply Voltage Rejection	I_O = 100 mA, V_I = 14 ± 2 V f = 120 Hz, T_J = -40 to 125°C	55	75		dB
V_{IL}	Control Input Voltage Low	T_J = -40 to 125°C		2	1.2	V
V_{IH}	Control Input Voltage High	T_J = -40 to 125°C	3.25	2		V
I_{INH}	Inhibit Input Current	V_{INH} = 2.5 V		22	50	µA
V_I	Transient Input Voltage	R_{LOAD} = 500 Ω τ < 100ms	60	70		V
V_I	Reverse Polarity Input Voltage	V_O = ± 0.3 V R_{LOAD} = 500 Ω	-15	-50		V
V_I	Reverse Polarity Input Voltage Transient	R_{LOAD} = 500 Ω τ < 100ms	-50			V
eN	Output Noise Voltage	B =10 Hz to 100 KHz		500		μV_{RMS}

Note 1: Reference Voltage is measured from V_{OUT} to ADJ pin.
Note 2: V_d measured when the output voltage has dropped 100mV from the nominal value obtained at 14V.

ELECTRICAL CHARACTERISTICS OF LM2931B 5V (refer to the test circuits, T_J = 25°C, C_I = 0.1 µF, C_O = 100 µF, V_I = 14V, I_O = 10mA, V_{INH} = 0V, unless otherwise specified).

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_I	Maximum Operating Input Voltage	I_O = 10 mA T_J = -40 to 125°C	26	37		V
V_O	Output Voltage		4.75	5	5.25	V
V_O	Output Voltage	I_O = 100 mA V_I = 6 to 26 V T_J = -40 to 125°C	4.5	5	5.5	V
ΔV_O	Line Regulation	V_I = 9 to 16 V		2	10	mV
		V_I = 6 to 26 V		4	30	
ΔV_O	Load Regulation	I_O = 5 to 100 mA		15	50	mV
V_d	Dropout Voltage (Note 1, 2)	I_O = 10 mA		90	200	mV
		I_O = 100 mA		250	600	
I_d	Quiescent Current ON MODE	I_O = 100 mA		2.5	30	mA
	OFF MODE	V_{INH} = 2.5 V R_{LOAD} = 500 Ω		0.3	1	mA
I_{SC}	Short Circuit Current		100	300		mA
SVR	Supply Voltage Rejection	I_O = 100 mA, V_I = 14 ± 2 V f = 120 Hz, T_J = -40 to 125°C	55	75		dB
V_{IL}	Control Input Voltage Low	T_J = -40 to 125°C		2	1.2	V
V_{IH}	Control Input Voltage High	T_J = -40 to 125°C	3.25	2		V
I_{INH}	Inhibit Input Current	V_{INH} = 2.5 V		22	50	µA
V_I	Transient Input Voltage	R_{LOAD} = 500 Ω τ < 100ms	60	70		V
V_I	Reverse Polarity Input Voltage	V_O = ± 0.3 V R_{LOAD} = 500 Ω	-15	-50		V
V_I	Reverse Polarity Input Voltage Transient	R_{LOAD} = 500 Ω τ < 100ms	-50			V
eN	Output Noise Voltage	B =10 Hz to 100 KHz		500		μV_{RMS}

Note 1: Reference Voltage is measured from V_{OUT} to ADJ pin.
Note 2: V_d measured when the output voltage has dropped 100mV from the nominal value obtained at 14V.

ELECTRICAL CHARACTERISTICS OF LM2931ADJ (refer to the test circuits figure 2 with R_1 = 27KΩ and R_2 = 40.5KΩ, T_J = 25°C, C_I = 0.1 µF, C_O = 100 µF, V_I = 14V, I_O = 10mA, V_{INH} = 0V, unless otherwise specified).

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
V_I	Maximum Operating Input Voltage	I_O = 10 mA	T_J = -40 to 125°C	26	37		V
V_{REF}	Reference Voltage (Note 1)			1.14	1.2	1.26	V
V_{REF}	Reference Voltage (Note 1)	I_O = 100 mA	T_J = -40 to 125°C	1.08	1.2	1.32	V
ΔV_O	Line Regulation	V_I = 3.6 to 26 V			0.6	4.5	mV
ΔV_O	Load Regulation	I_O = 5 to 100 mA			9	30	mV
V_d	Dropout Voltage (Note 1, 2)	I_O = 10 mA			90	200	mV
		I_O = 100 mA			250	600	
I_d	Quiescent Current ON MODE	I_O = 100 mA			2.5	30	mA
	OFF MODE	V_{INH} = 2.5 V	R_{LOAD} = 300 Ω		0.3	1	mA
I_{SC}	Short Circuit Current			100	300		mA
SVR	Supply Voltage Rejection	I_O = 100 mA f = 120 Hz	V_I = 14 ± 2 V T_J = -40 to 125°C	55	80		dB
V_{IL}	Control Input Voltage Low	T_J = -40 to 125°C			2	1.2	V
V_{IH}	Control Input Voltage High	T_J = -40 to 125°C		3.25	2		V
I_{INH}	Inhibit Input Current	V_{INH} = 2.5 V			22	50	µA
V_I	Transient Input Voltage	R_{LOAD} = 300 Ω	τ < 100ms	60	70		V
V_I	Reverse Polarity Input Voltage	V_O = ± 0.3 V	R_{LOAD} = 300 Ω	-15	-50		V
V_I	Reverse Polarity Input Voltage Transient	R_{LOAD} = 300 Ω	τ < 100ms	-50			V
eN	Output Noise Voltage	B =10 Hz to 100 KHz			330		μV_{RMS}

Note 1: Reference Voltage is measured from V_{OUT} to ADJ pin.
Note 2: V_d measured when the output voltage has dropped 100mV from the nominal value obtained at 14V.

TYPICAL CHARACTERISTICS (unless otherwise specified C_I = 0.1 µF, C_O = 100 µF).

Figure 1 : Output Voltage vs Temperature

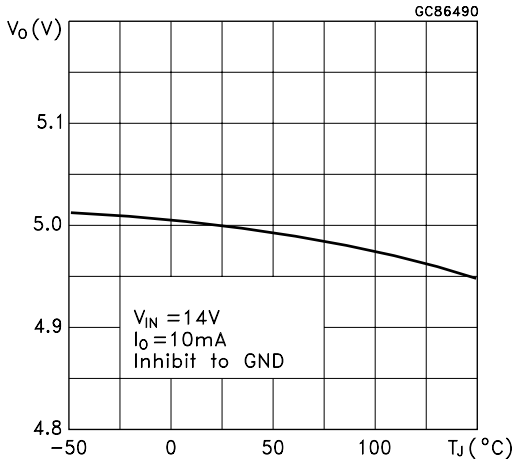


Figure 2 : Output Voltage vs Temperature

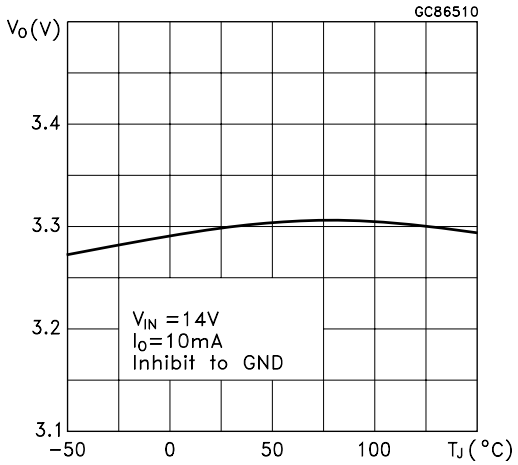


Figure 3 : Reference Voltage vs Temperature

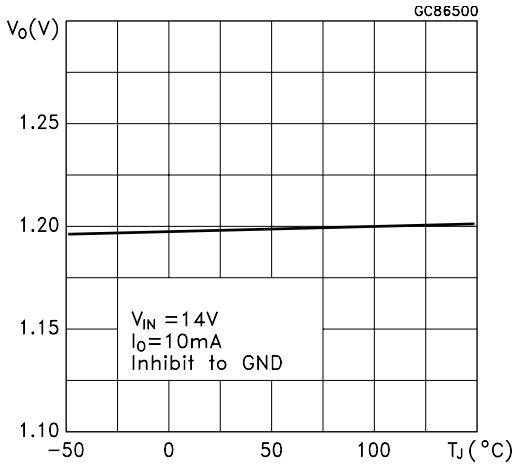


Figure 4 : Line Regulation vs Temperature

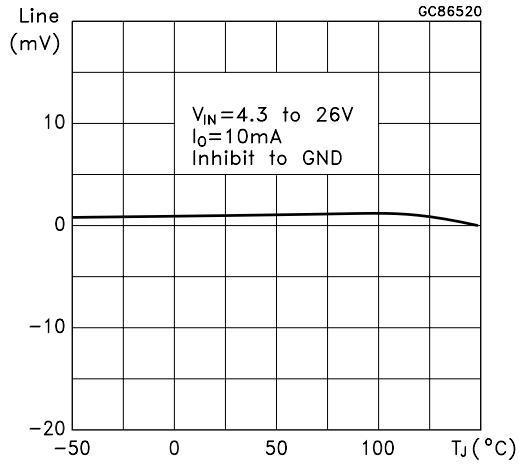


Figure 5 : Load Regulation vs Temperature

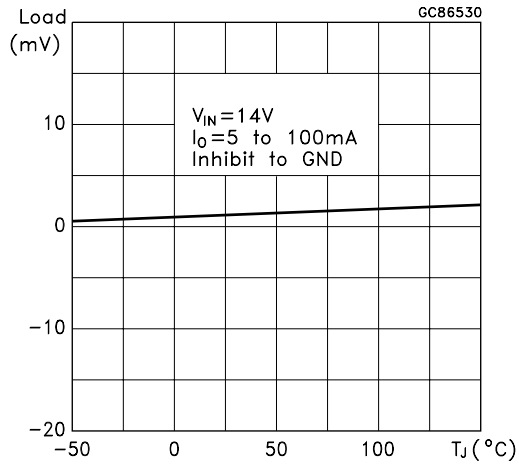


Figure 6 : Dropout Voltage vs Temperature

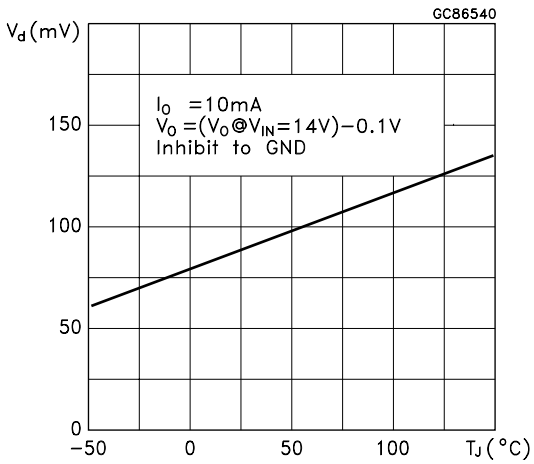


Figure 7 : Dropout Voltage vs Temperature

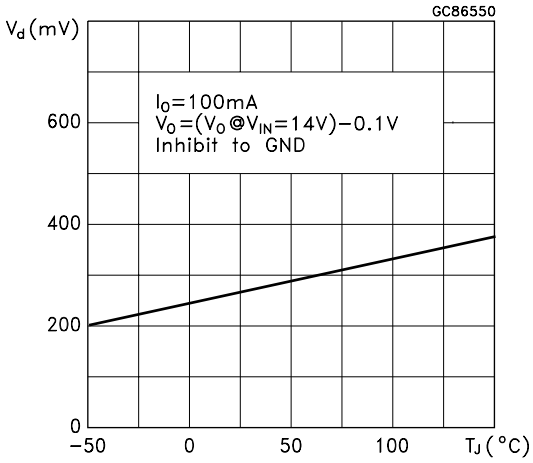


Figure 8 : Dropout Voltage vs Output Current

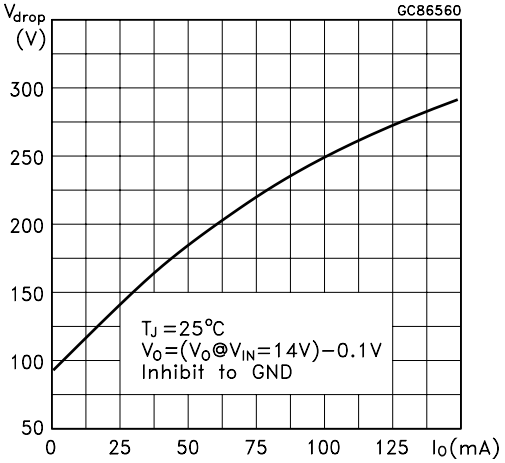


Figure 9 : Output Voltage vs Input Voltage

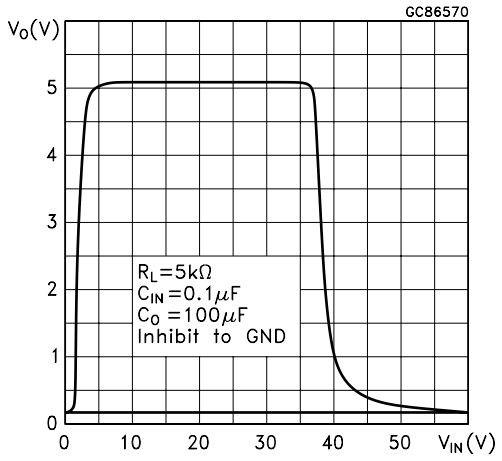


Figure 10 : Short Circuit Current vs Drop Voltage

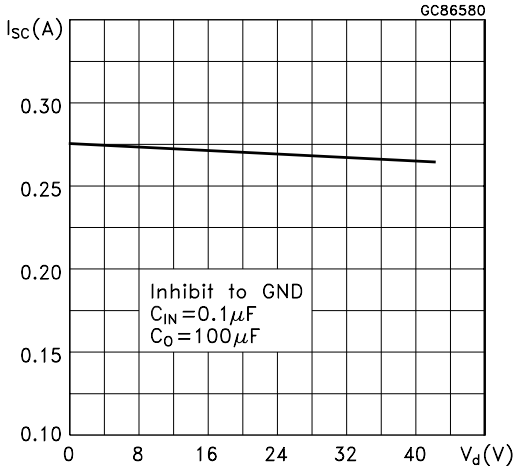


Figure 11 : Quiescent Current vs Temperature

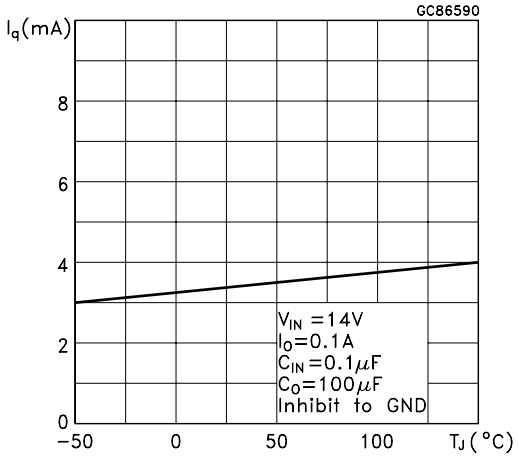


Figure 12 : Quiescent Current vs Input Voltage

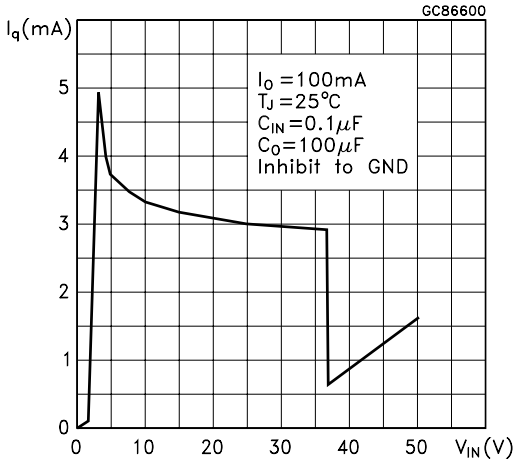


Figure 13 : Quiescent Current vs Output Current

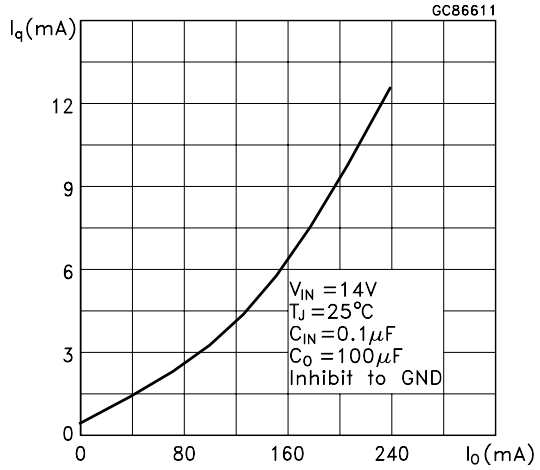


Figure 14 : Supply Voltage Rejection vs Temperature

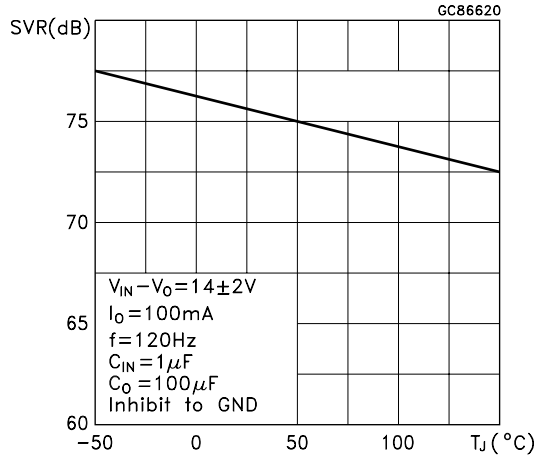


Figure 15 : Supply Voltage Rejection vs Frequency

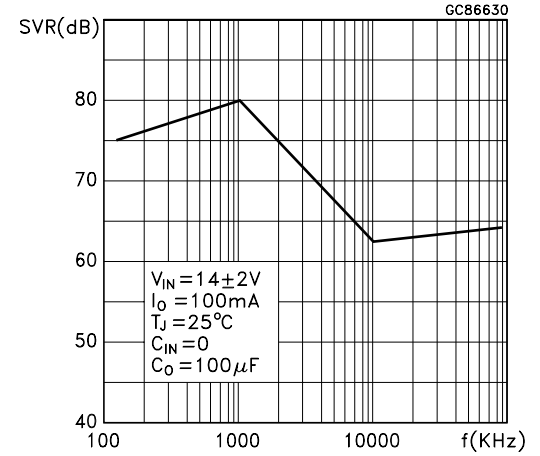


Figure 16 : Supply Voltage Rejection vs Output Current

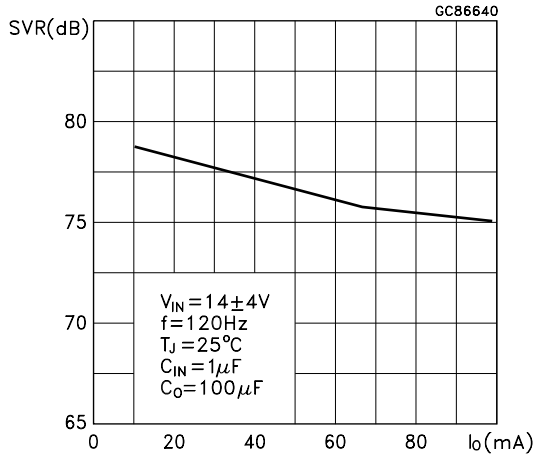


Figure 17 : Stability vs C_O

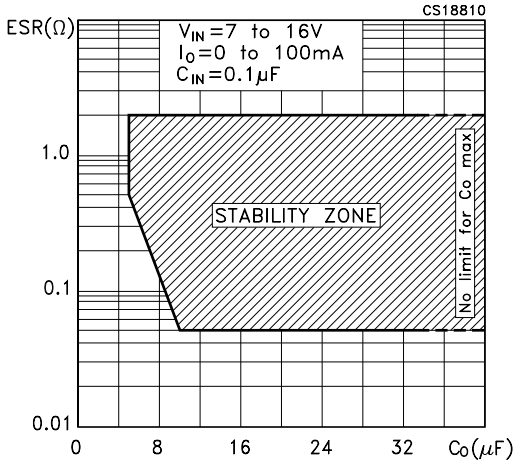
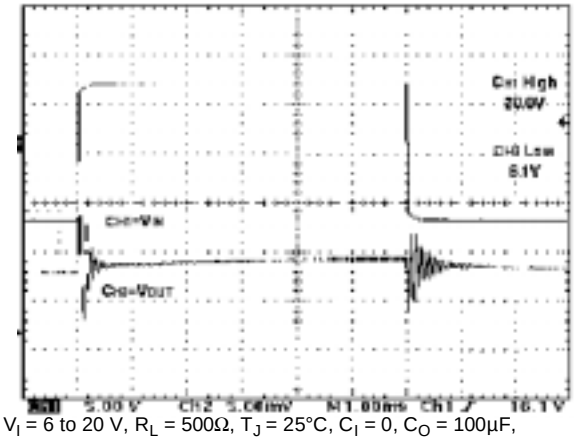
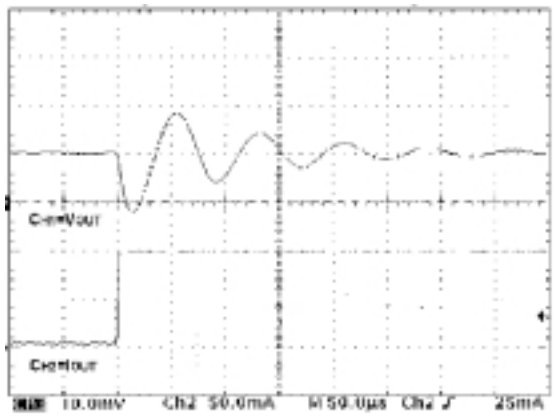


Figure 18 : Line Transient



V_I = 6 to 20 V, R_L = 500Ω, T_J = 25°C, C_I = 0, C_O = 100µF, Rise Fall-Time = 200 ns

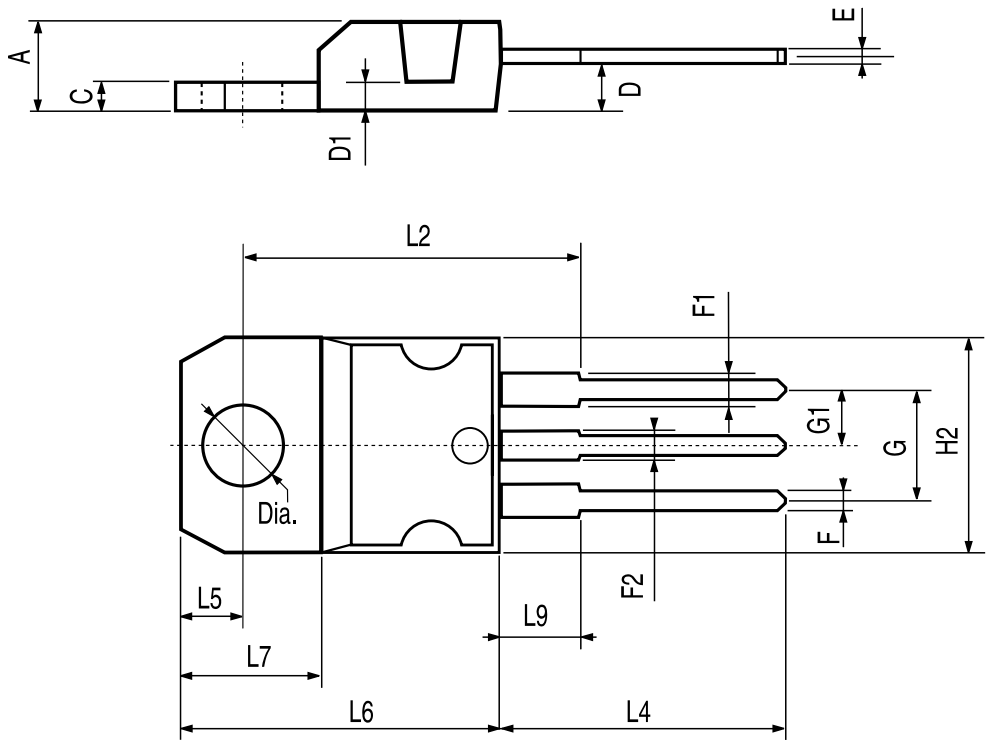
Figure 19 : Load Transient



V_I = 14 V, I_O = 100mA, T_J = 25°C, C_I = 0.1µF, C_O = 100µF,
Rise Time = 500ns, Fall-Time = 1µs

TO-220 MECHANICAL DATA

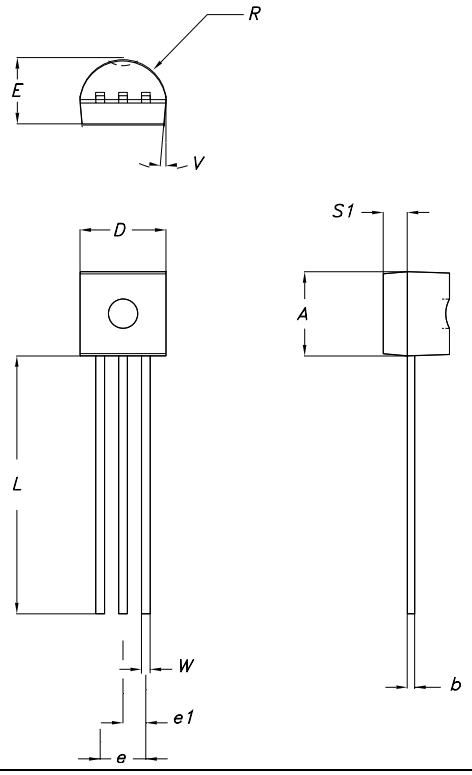
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



P011C

TO-92 MECHANICA DATA

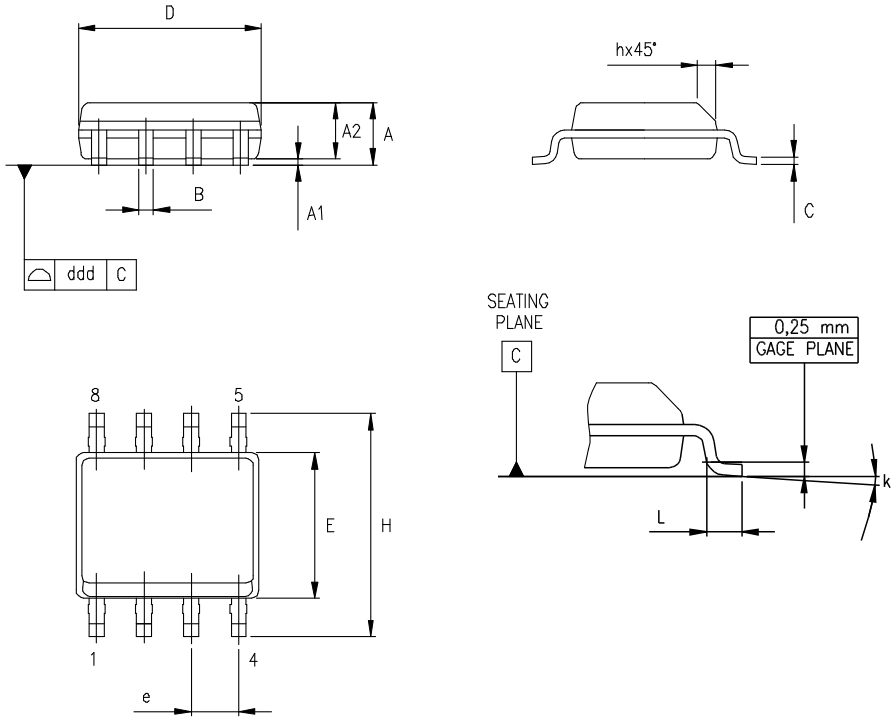
DIM.	mm.			mils		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.32		4.95	170.1		194.9
b	0.36		0.51	14.2		20.1
D	4.45		4.95	175.2		194.9
E	3.30		3.94	129.9		155.1
e	2.41		2.67	94.9		105.1
e1	1.14		1.40	44.9		55.1
L	12.7		15.49	500.0		609.8
R	2.16		2.41	85.0		94.9
S1	0.92		1.52	36.2		59.8
W	0.41		0.56	16.1		22.0



0102782/C

SO-8 MECHANICAL DATA

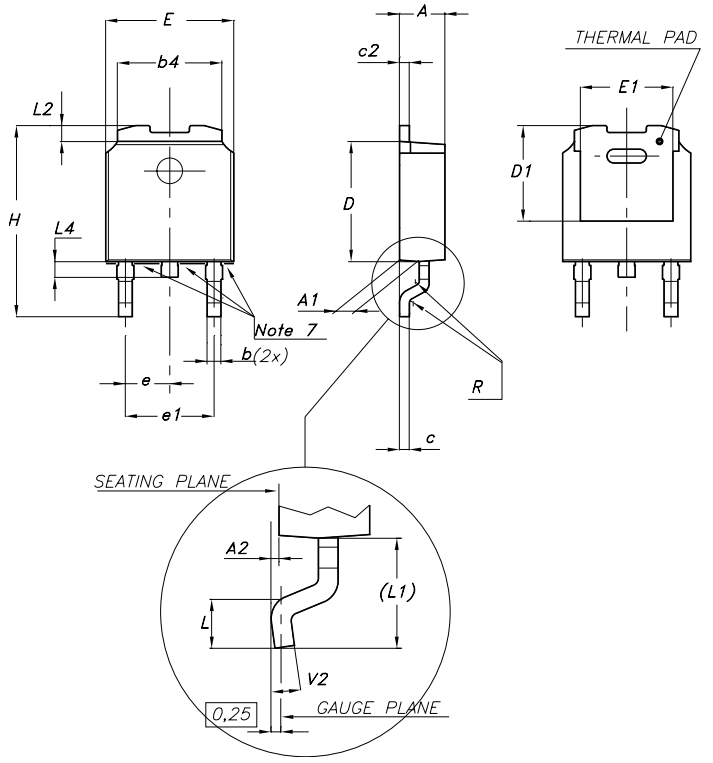
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	8° (max.)					
ddd			0.1			0.04



0016023/C

DPAK MECHANICAL DATA

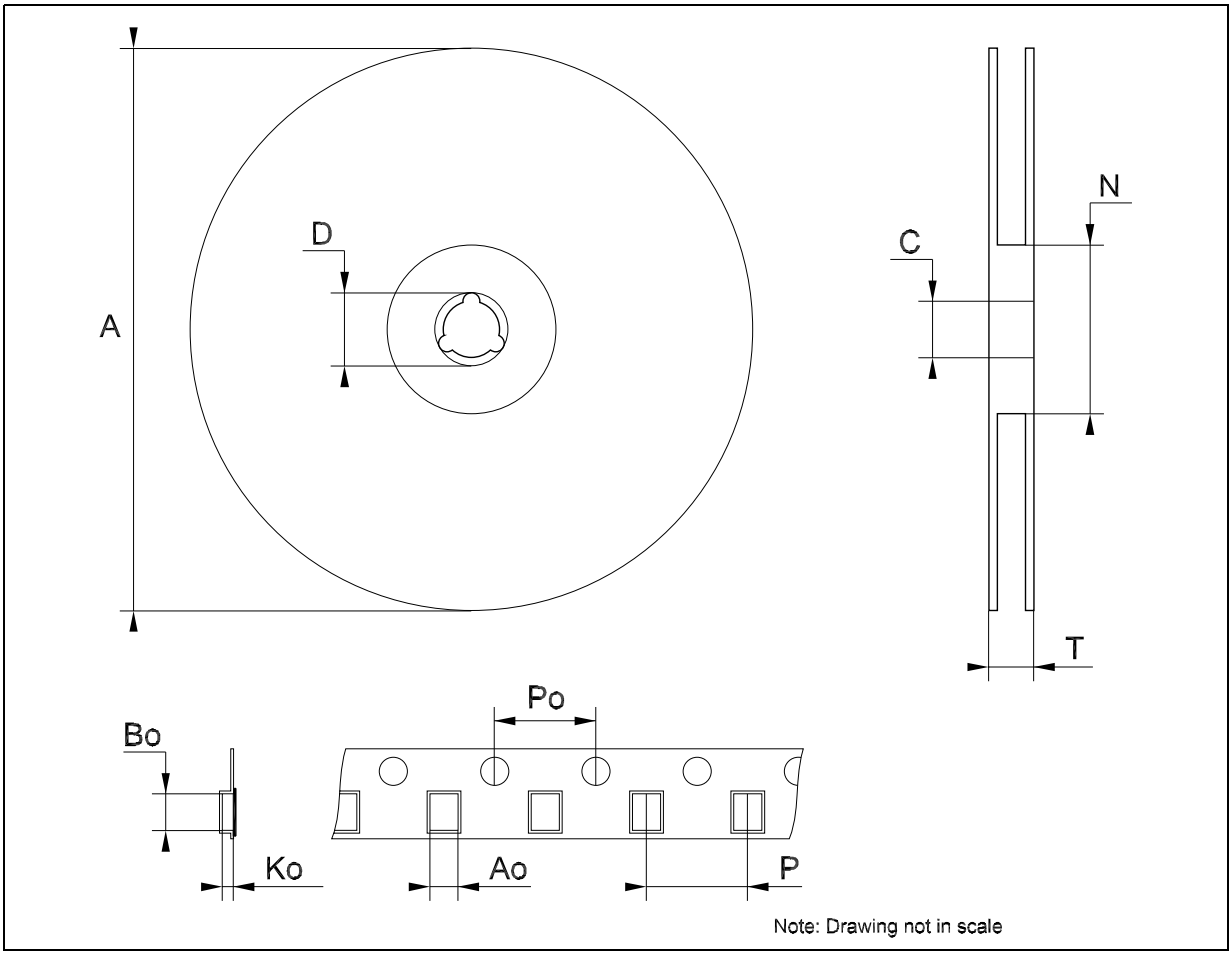
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.9	0.025		0.035
B2	5.2		5.4	0.204		0.212
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
D1		5.1			0.200	
E	6.4		6.6	0.252		0.260
E1		4.7			0.185	
e		2.28			0.090	
e1	4.4		4.6	0.173		0.181
H	9.35		10.1	0.368		0.397
L		1			0.039	
(L1)		2.8			0.110	
L2		0.8			0.031	
L4	0.6		1	0.023		0.039



0068772-F

Tape & Reel DPAK-PPAK MECHANICAL DATA

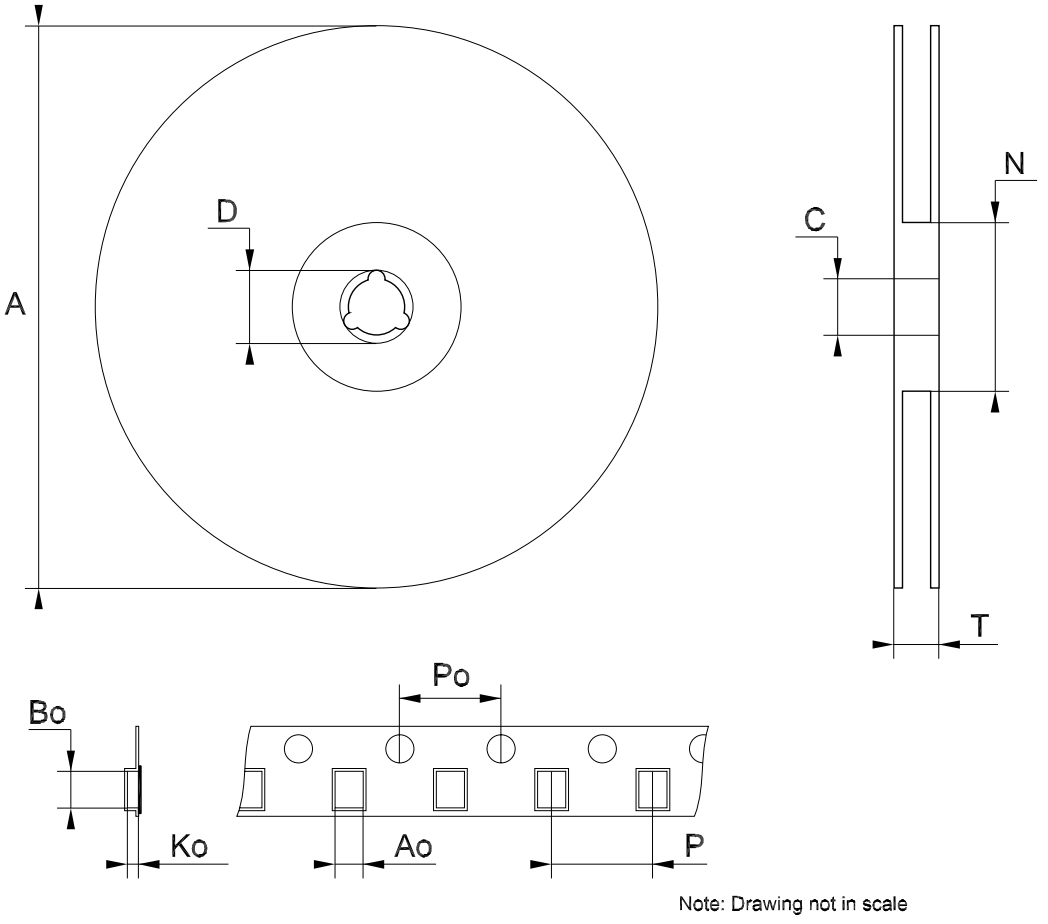
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8	13.0	13.2	0.504	0.512	0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.80	6.90	7.00	0.268	0.272	0.2.76
Bo	10.40	10.50	10.60	0.409	0.413	0.417
Ko	2.55	2.65	2.75	0.100	0.104	0.105
Po	3.9	4.0	4.1	0.153	0.157	0.161
P	7.9	8.0	8.1	0.311	0.315	0.319



Note: Drawing not in scale

Tape & Reel SO-8 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	8.1		8.5	0.319		0.335
Bo	5.5		5.9	0.216		0.232
Ko	2.1		2.3	0.082		0.090
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



Note: Drawing not in scale

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a registered trademark of STMicroelectronics

All other names are the property of their respective owners

© 2004 STMicroelectronics - All Rights Reserved

STMicroelectronics GROUP OF COMPANIES

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States.

http://www.st.com