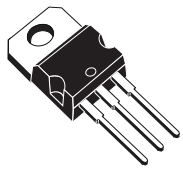
LM217M
LM317M

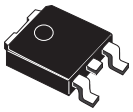
Medium current 1.2 to 37V adjustable voltage regulator

Feature summary

- Output voltage range: 1.2 to 37V
- Output current in excess of 500 mA
- Line regulation typ. 0.01%
- Load regulation typ. 0.1%
- Thermal overload protection
- Short circuit protection
- Output transition safe area compensation
- Floating operation for high voltage applications



TO-220



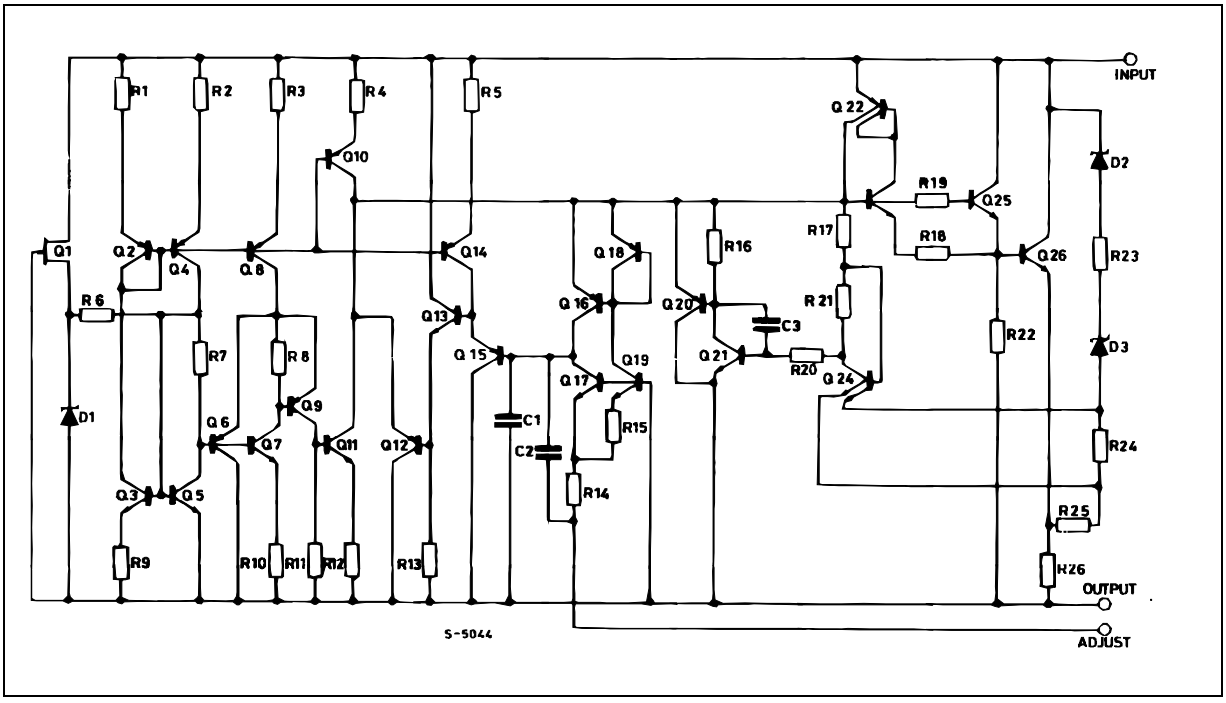
DPAK

Description

The LM217M/LM317M are monolithic integrated circuits in TO-220 and DPAK packages intended for use as positive adjustable voltage regulators. They are designed to supply until 500 mA of load current with an output voltage adjustable over a 1.2 to 37V range.

The nominal output voltage is selected by means of only a resistive divider, making the device exceptionally easy to use and eliminating the stocking of many fixed regulators.

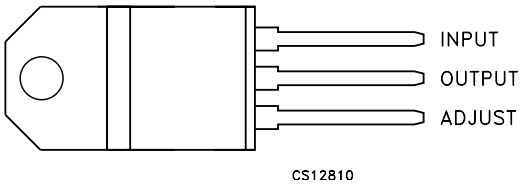
Schematic diagram



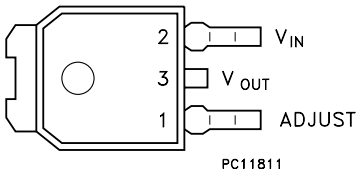
Contents

1 Pin configuration

Figure 1. Pin connections (top view)



TO-220



DPAK

2 Maximum ratings

Table 1. Absolute maximum ratings

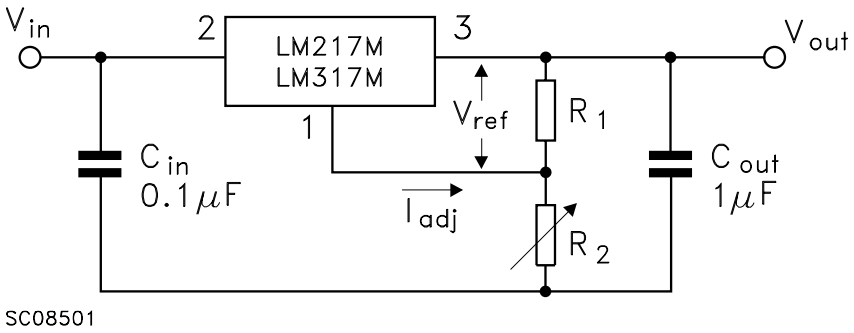
Symbol	Parameter		Value	Unit
V_I-V_O	Input-Output differential voltage		40	V
P_D	Power dissipation		Internally Limited	mW
T_{OP}	Operating junction temperature range (1)	for LM217M	-40 to 125	°C
		for LM317M	0 to 125	
T_{STG}	Storage temperature range		-55 to 150	°C

1. Re-Boot is not guaranteed for $T_J \geq 85°C$.

Table 2. Thermal data

Symbol	Parameter	TO-220	DPAK	Unit
R_{thJC}	Thermal resistance junction-case	3	8	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	100	°C/W

Figure 2. Test circuit



3 Electrical characteristics

Table 3. Electrical characteristics of LM217M (refer to the test circuits, T_J = - 40 to 125°C, V_I - V_O = 5 V, I_O = 100 mA, P_D ≤7.5 W, unless otherwise specified)

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
ΔV_O	Line regulation	V_I - V_O = 3 to 40 V	T_J = 25°C		0.01	0.02	%/V
					0.02	0.05	
ΔV_O	Load regulation	V_O ≤5 V I_O = 10 to 500mA	T_J = 25°C		5	15	mV
					20	50	
		V_O ≥ 5 V I_O = 10 to 500mA	T_J = 25°C		0.1	0.3	%/V_O
					0.3	1	
I_{ADJ}	Adjustment pin current				50	100	µA
ΔI_{ADJ}	Adjustment pin current	V_I - V_O = 3 to 40 V, I_O = 10 to 500 mA			0.2	5	µA
V_{REF}	Reference voltage	V_I - V_O = 3 to 40 V, I_O = 10 to 500 mA		1.2	1.25	1.3	V
$\Delta V_O/V_O$	Output voltage temperature stability				0.7		%
$I_{O(min)}$	Minimum load current	V_I - V_O = 40 V			3.5	5	mA
$I_{O(max)}$	Maximum output current	V_I - V_O ≤15 V		500	1000		mA
		V_I - V_O = 40 V, $P_d < P_{DMAX}$, T_J = 25°C			200		
eN	Output noise voltage (percentage of V_O)	B = 10 Hz to 100 KHz, T_J = 25°C			0.003		%
SVR	Supply voltage rejection (1)	T_J = 25°C f = 120 Hz	C_{ADJ} = 0		65		dB
			C_{ADJ} = 10 µF	66	80		

1. C_{ADJ} is connected between Adjust pin and Ground.

Table 4. Electrical characteristics of LM317M (refer to the test circuits, T_J = 0 to 125°C, V_I - V_O = 5 V, I_O = 100 mA, P_D ≤7.5 W, unless otherwise specified)

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
ΔV_O	Line regulation	V_I - V_O = 3 to 40 V	T_J = 25°C		0.01	0.04	%/V
					0.02	0.07	
ΔV_O	Load regulation	V_O ≤5 V I_O = 10 to 500mA	T_J = 25°C		5	25	mV
					20	70	
		V_O ≥ 5 V I_O = 10 to 500mA	T_J = 25°C		0.1	0.5	%/V_O
					0.3	1.5	
I_{ADJ}	Adjustment pin current				50	100	µA
ΔI_{ADJ}	Adjustment pin current	V_I - V_O = 3 to 40 V, I_O = 10 to 500 mA			0.2	5	µA
V_{REF}	Reference voltage	V_I - V_O = 3 to 40 V, I_O = 10 to 500 mA		1.2	1.25	1.3	V
$\Delta V_O/V_O$	Output voltage temperature stability				0.7		%
$I_{O(min)}$	Minimum load current	V_I - V_O = 40 V			3.5	10	mA
$I_{O(max)}$	Maximum output current	V_I - V_O ≤15 V		500	1000		mA
		V_I - V_O = 40 V, $P_d < P_{DMAX}$, T_J = 25°C			200		
eN	Output noise voltage (percentage of V_O)	B = 10 Hz to 100 KHz, T_J = 25°C			0.003		%
SVR	Supply voltage rejection (1)	T_J = 25°C f = 120 Hz	C_{ADJ} = 0		65		dB
			C_{ADJ} = 10 µF	66	80		

1. C_{ADJ} is connected between Adjust pin and Ground.

4 Typical performance

Figure 3. Current limit

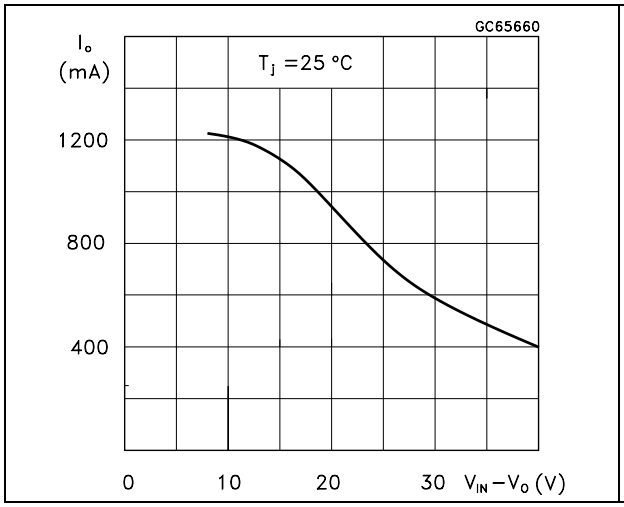


Figure 4. Minimum operating current

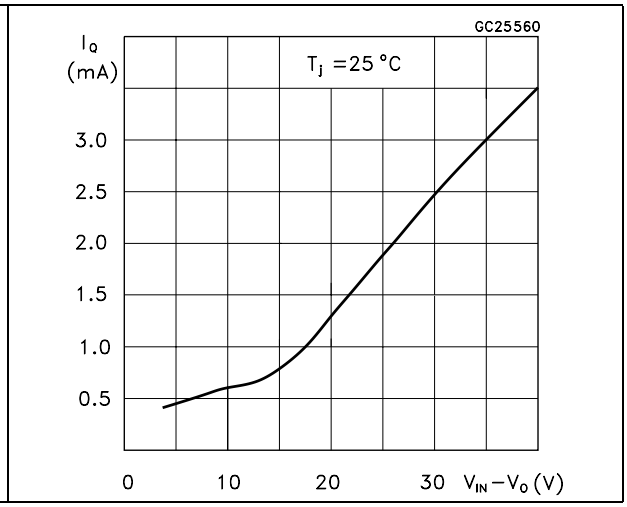


Figure 5. Basic adjustable regulator

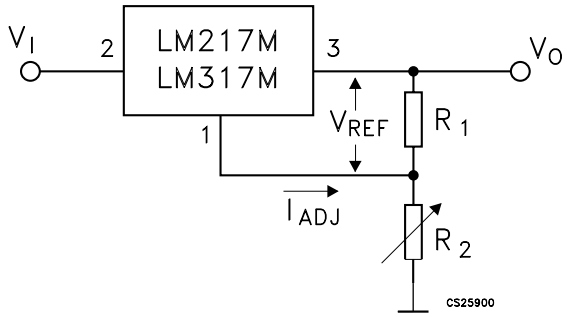
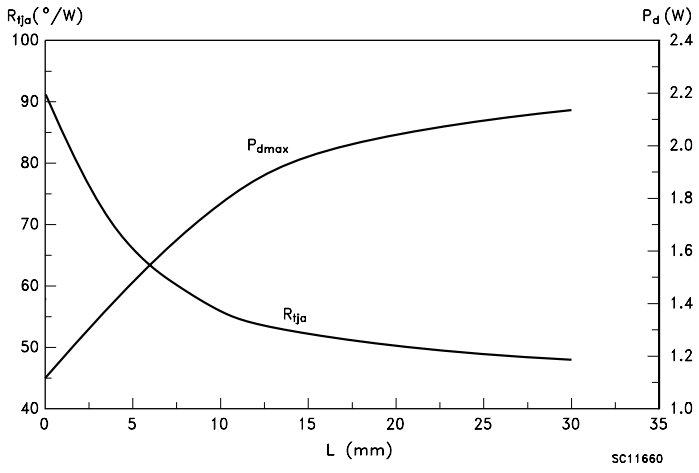


Figure 6. Thermal resistance & maximum power dissipation vs P.C.B. copper length for DPAK



1. P_{dmax} calculated for T_a = 50°C.

5 Application information

The LM217M/LM317M provide an internal reference voltage of 1.25V between the output and adjustment terminals. These devices are used to set a constant current flow across an external resistor divider (see *Figure 5.*), giving an output voltage V_O of: $V_O = V_{REF} (1 + R_2 / R_1) + I_{ADJ} R_2$.
The devices were designed to minimize the term I_{ADJ} (100µA max) and to maintain it very constant in line and load changes. Usually, the error term $I_{ADJ} \times R_2$ can be neglected. To obtain the previous requirement, all the regulator quiescent current is returned to the output terminal, imposing a minimum load current condition. If the load is insufficient, the output voltage will rise.
Since the LM217M/LM317M devices are floating regulators and "see" only the input-to-output differential voltage, supplies of very high voltage with respect to ground can be regulated as long as the maximum input-to-output differential is not exceeded. Furthermore, programmable regulators are easily obtained and, by connecting a fixed resistor between the adjustment and output, the devices can be used as a precision current regulator. In order to optimize the load regulation, the current set resistor R_1 (see *Figure 5.*) should be tied as close as possible to the regulator, while the ground terminal of R_2 should be near the ground of the load to provide remote ground sensing.

5.1 External capacitors (*Figure 7.*)

Normally no capacitors are needed unless the devices are situated far from the input filter capacitors; in which case an input bypass is needed.
A 0.1µF disc or 1µF tantalum input bypass capacitor (C_I) is recommended to reduce the sensitivity to input line impedance.
The adjustment terminal may be bypassed to ground to improve ripple rejection. This capacitor (C_{ADJ}) prevents ripple from being amplified as the output voltage is increased. A 10µF capacitor should improve ripple rejection of about 80dB at 120Hz in a 10V application.
Although the LM217M/LM317M devices are stable with no output capacitance like any feedback circuit, certain values of external capacitance can cause excessive ringing. An output capacitance (C_O) in the form of a 1µF tantalum or 25µF aluminium electrolytic capacitor on the output swamps this effect and insures stability.

5.2 Protection diodes (*Figure 7.*)

When external capacitors are used with any IC regulator it is sometimes necessary to add protection diodes to prevent the capacitors from discharging through low current points into the regulator.
Figure 5. shows the LM217M/LM317M with the recommended protection diodes for output voltages in excess of 25V or high capacitance values ($C_3 > 25µF$, $C_2 > 10µF$). Diode D1 prevents C_3 from discharging through the IC during an input short-circuit. The combination of diodes D1 and D2 prevents C_2 from discharging through the regulator during an input or output short-circuit.

5.3 Start-up block

It's not guaranteed the Re-Boot of the device when the junction temperature is over 85°C.

6 Application circuits

Figure 7. Voltage regulator with protection diodes

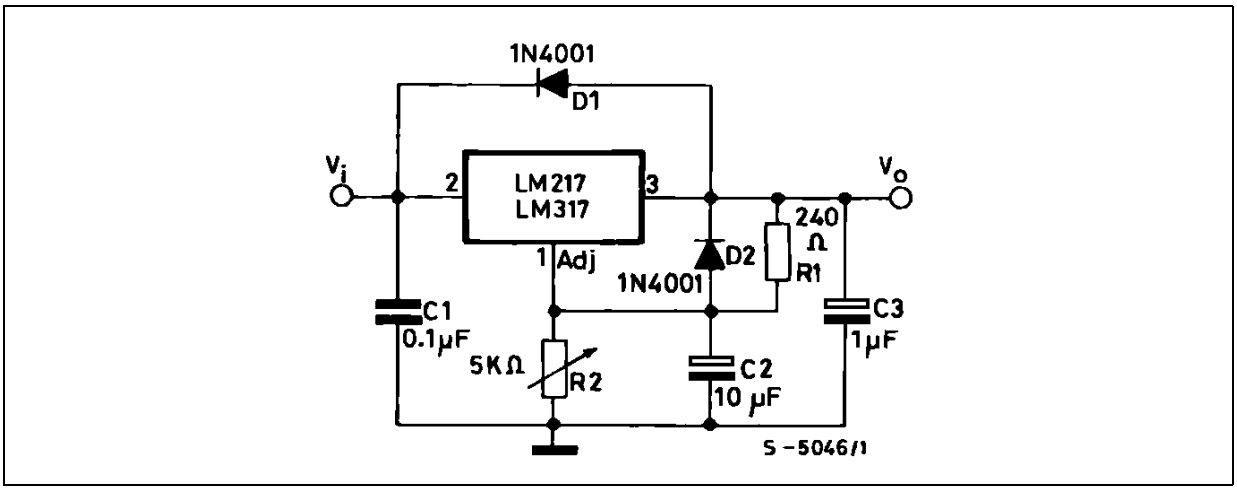


Figure 8. Slow Turn-on 15V Regulator

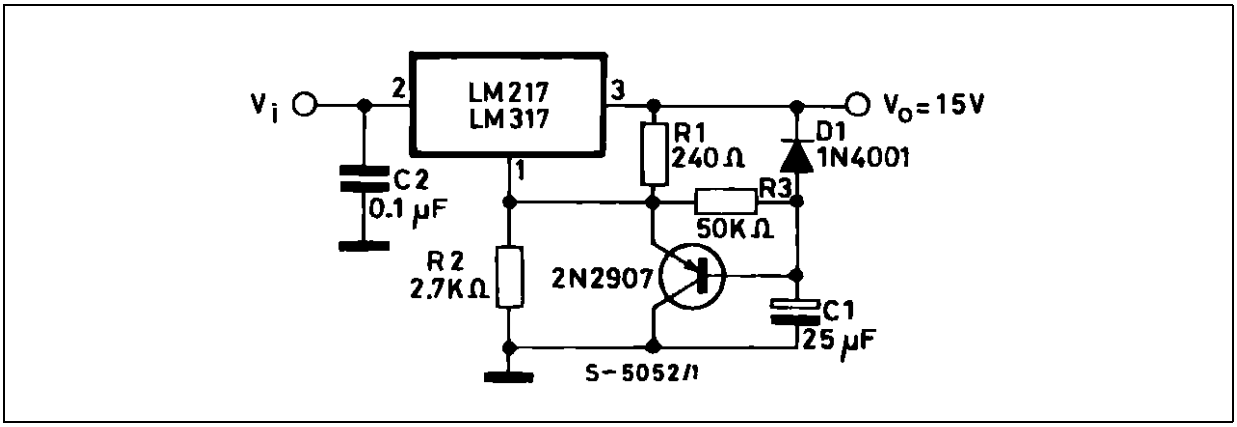


Figure 9. Current Regulator

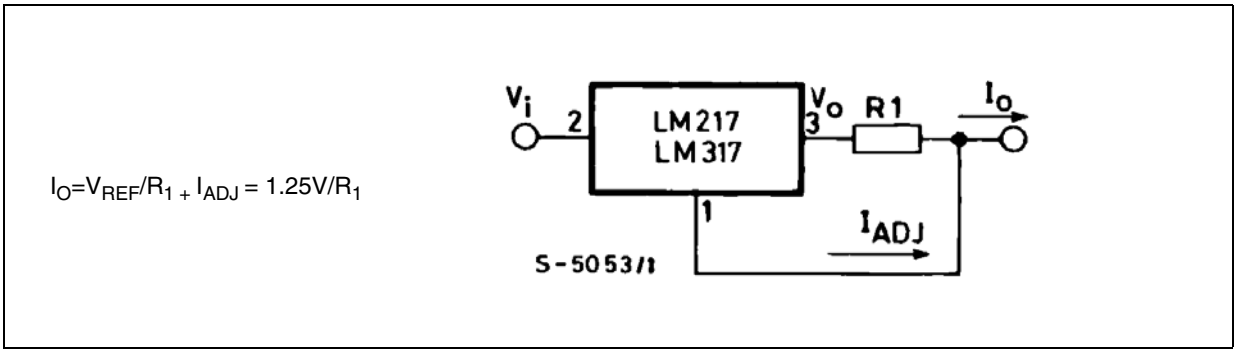


Figure 10. 5V Electronic shut-down regulator

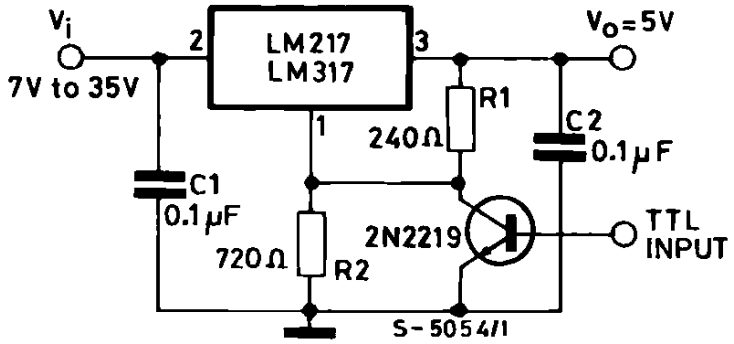
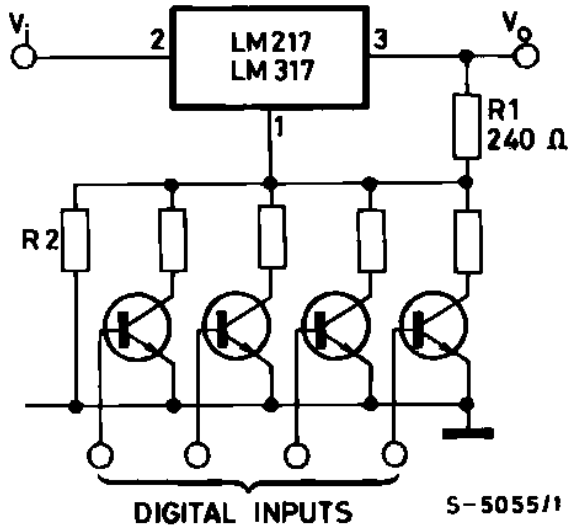


Figure 11. Digitally selected outputs



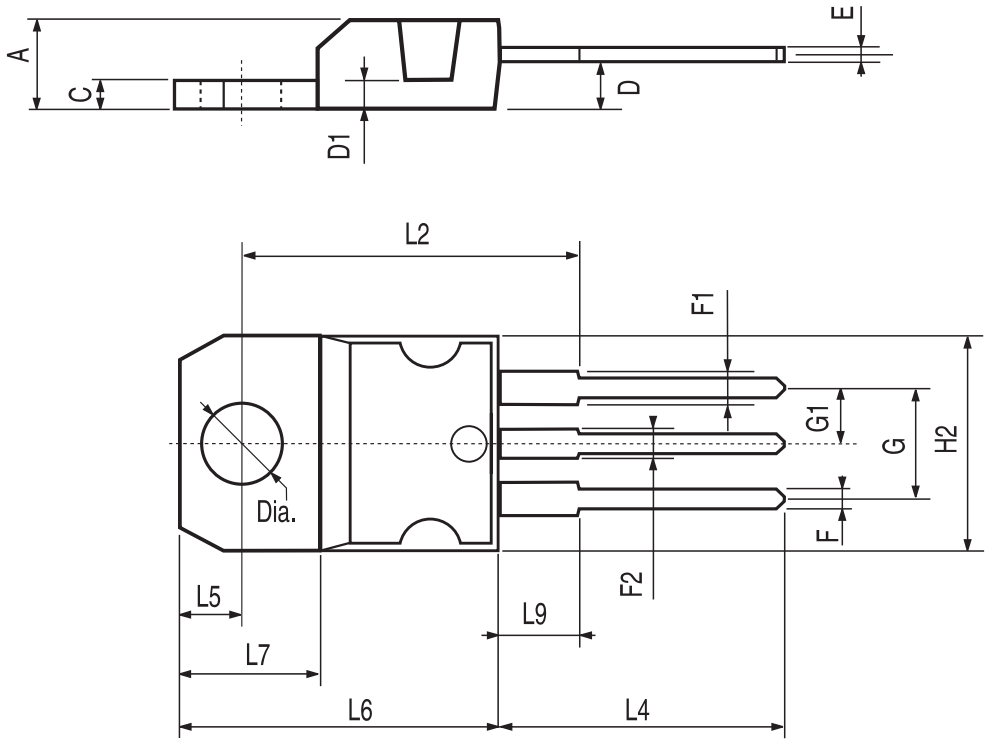
(R_2 = sets maximum V_O)

7 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second Level Interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com.

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

Figure 12. DRAWING DIMENSION DPAK (TYPE STD-ST)

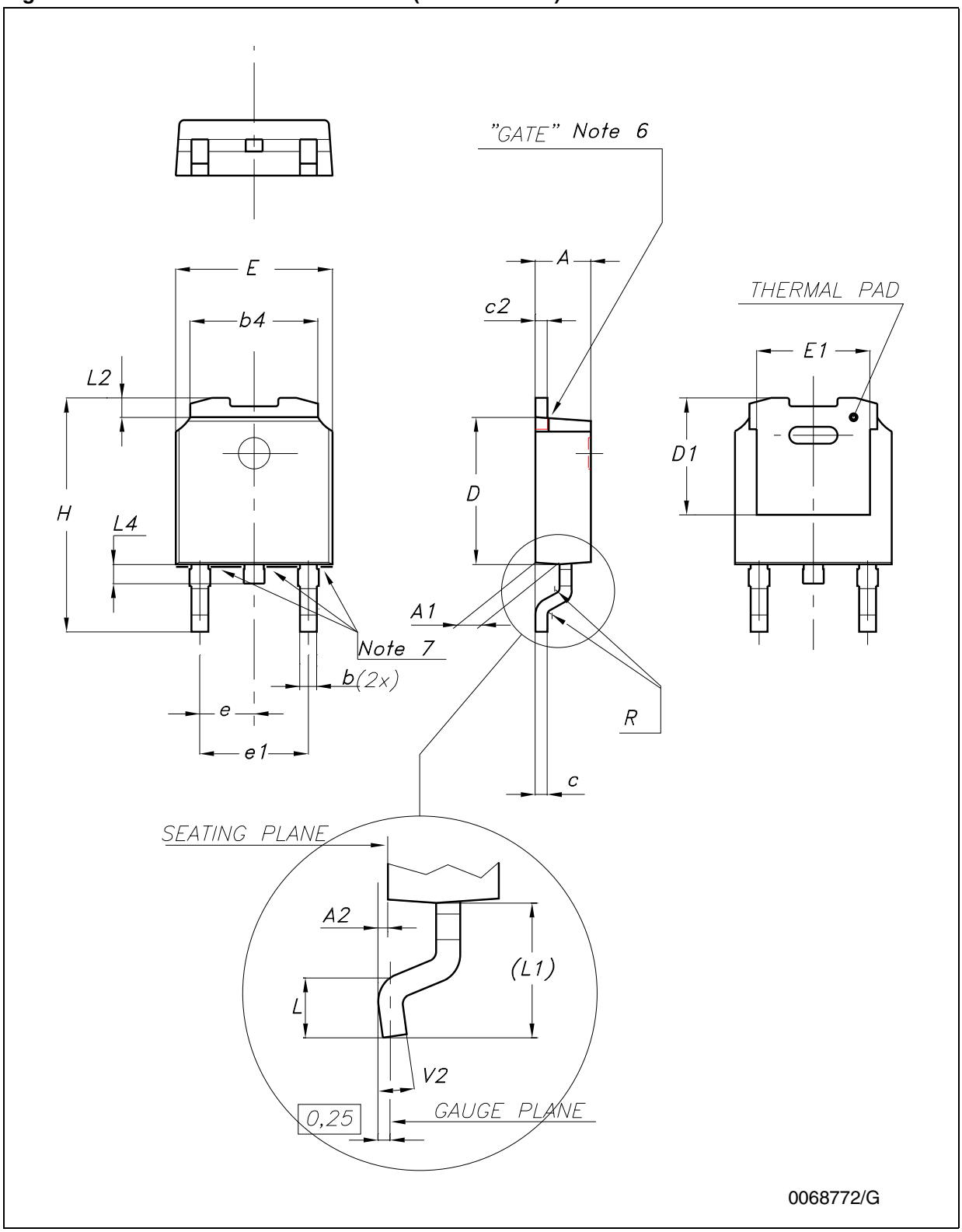


Figure 13. DRAWING DIMENSION DPAK (TYPE FUJITSU-SUBCON.)

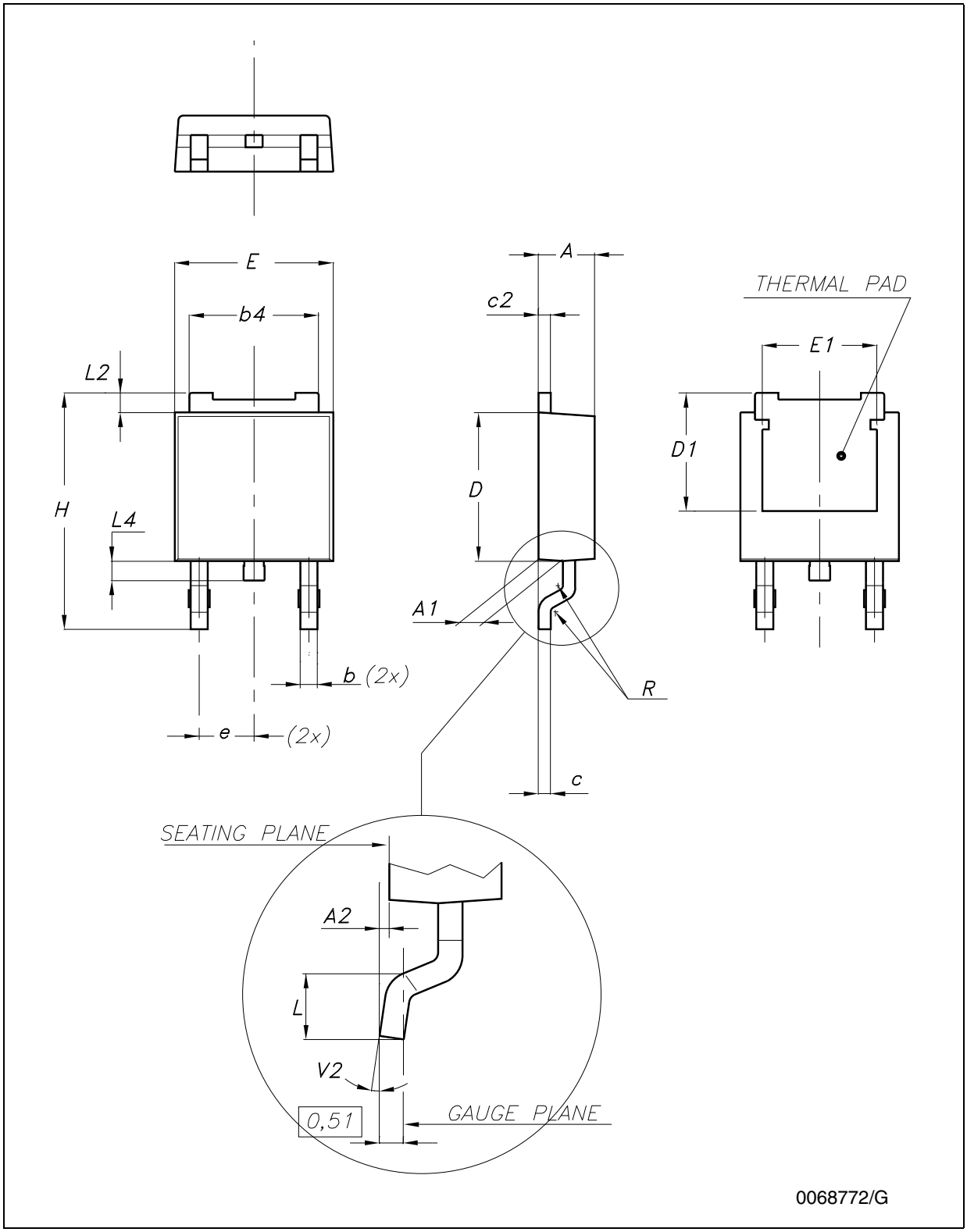


Figure 14. DRAWING DIMENSION DPAK (TYPE IDS-SUBCON.)

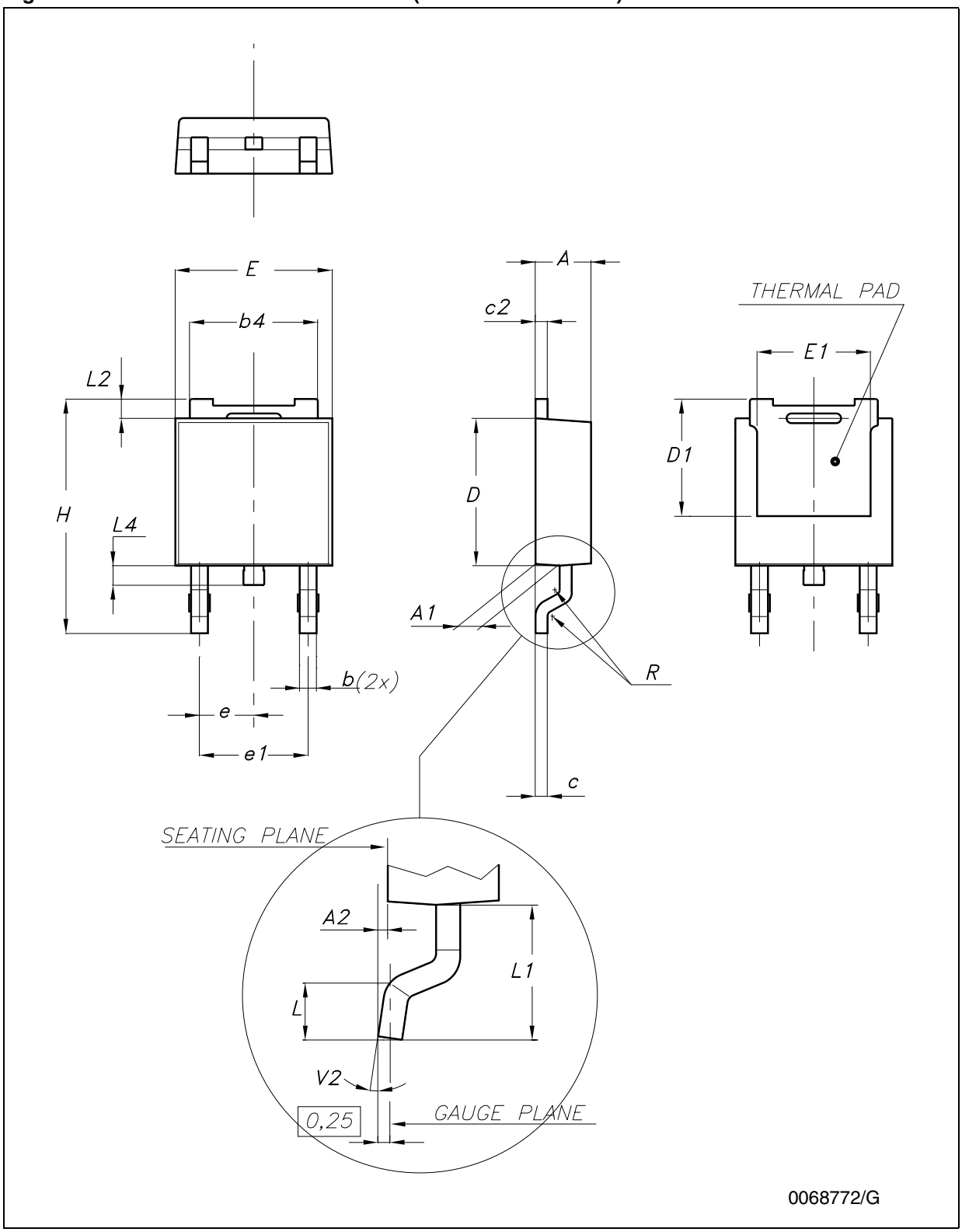


Table 5. DPAK MECHANICAL DATA

DIM.	TYPE STD-ST			TYPE FUJITSU-SUBCON.			TYPE IDS-SUBCON		
	mm.			mm.			mm.		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.20		2.40	2.25	2.30	2.35	2.19		2.38
A1	0.90		1.10	0.96		1.06	0.89		1.14
A2	0.03		0.23	0		0.10	0.03		0.23
b	0.64		0.90	0.76		0.86	0.64		0.88
b4	5.20		5.40	5.28		5.38	5.21		5.46
c	0.45		0.60	0.46		0.56	0.46		0.58
c2	0.48		0.60	0.46		0.56	0.46		0.58
D	6.00		6.20	6.05		6.15	5.97		6.22
D1		5.10		5.27		5.47		5.20	
E	6.40		6.60	6.55	6.60	6.65	6.35		6.73
E1		4.70			4.77			4.70	
e		2.28		2.23	2.28	2.33		2.28	
e1	4.40		4.60				4.51		4.61
H	9.35		10.10	9.90		10.30	9.40		10.42
L	1.00			1.40		1.60	0.90		
L1		2.80					2.50		2.65
L2		0.80		1.03		1.13	0.89		1.27
L4	0.60		1.00	0.70		0.90	0.64		1.02
R		0.20			0.40			0.20	
V2	0°		8°	0°		8°	0°		8°

Note: The DPAK package coming from the two subcontractors (Fujitsu and IDS) are fully compatible with the ST's package suggested footprint.

Figure 15. DPAK FOOTPRINT RECOMMENDED DATA

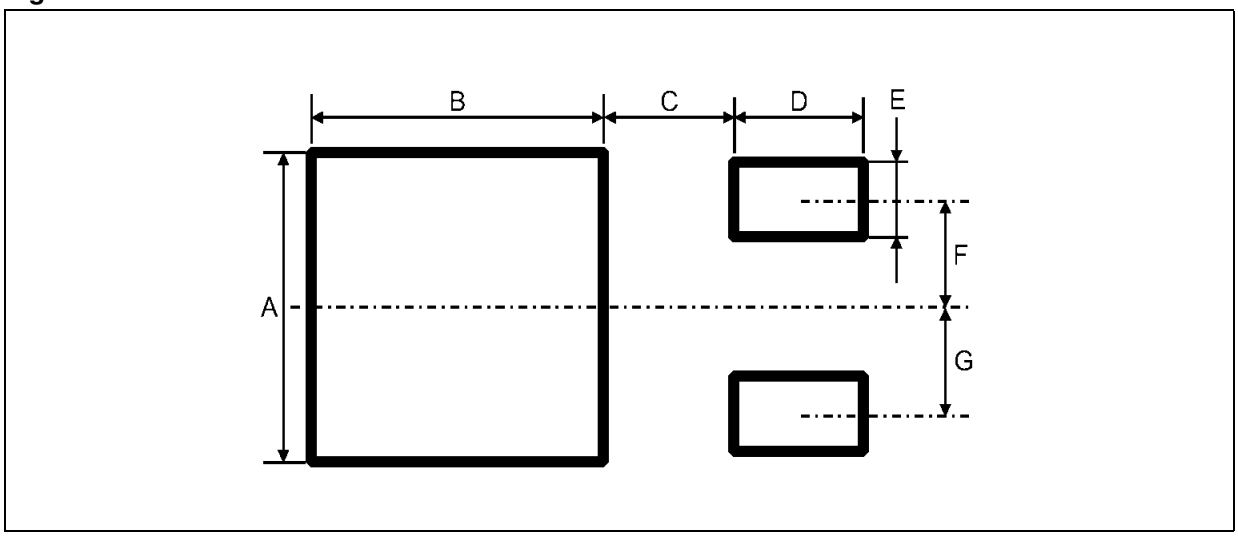
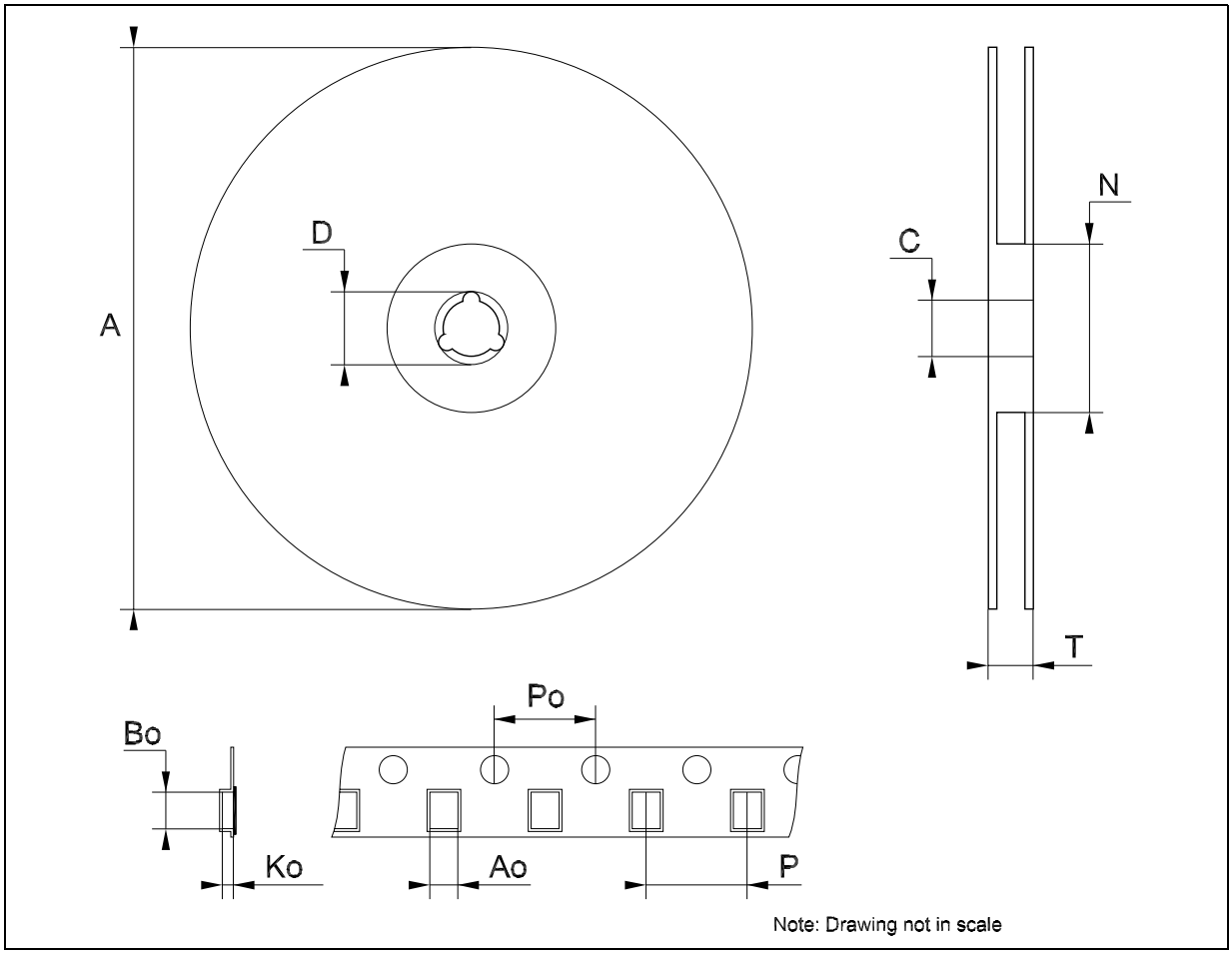


Table 6. FOOTPRINT DATA

VALUES		
	mm.	**inch.**
A	6.70	0.264
B	6.70	0.64
C	1.8	0.070
D	3.0	0.118
E	1.60	0.063
F	2.30	0.091
G	2.30	0.091

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

8 Order code

Table 7. Order code

Part numbers	Packaging	
	TO-220	DPAK (T&R)
LM217M	LM217MT	LM217MDT-TR
LM317M	LM317MT	LM317MDT-TR

9 Revision history

Table 8. Revision history

Date	Revision	Changes
21-Jun-2004	5	The document has been reformatted.
06-Dec-2006	6	DPAK mechanical data has been updated, add footprint data and new template

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