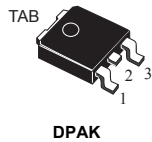


## Medium current 1.2 to 37 V adjustable voltage regulator



### Features

- Output voltage range: 1.2 to 37 V
- 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

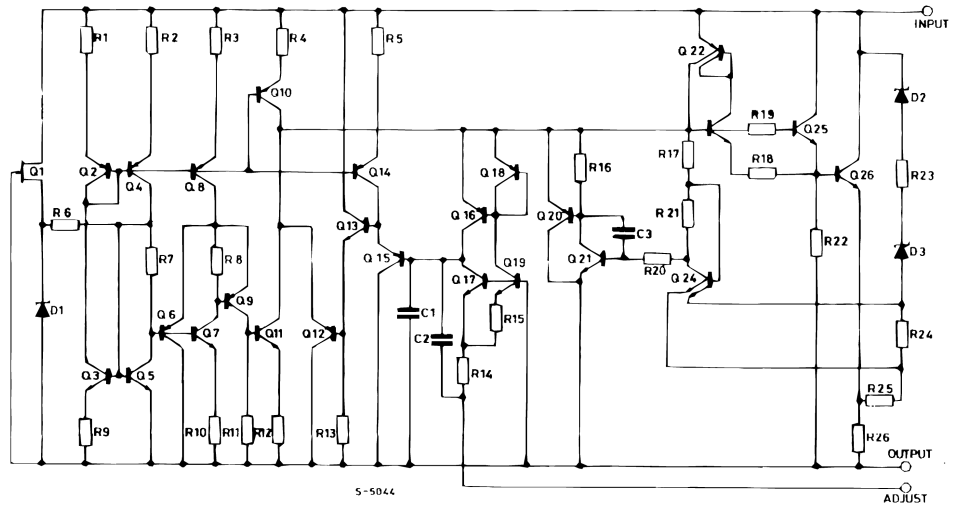
### Description

The [LM217M](#) and [LM317M](#) are monolithic integrated circuits in DPAK package used 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 37 V range. The nominal output voltage is selected by one resistive divider only, making the device exceptionally easy to configure and avoiding the use of several fixed regulators.

| Product status link    |
|------------------------|
| <a href="#">LM217M</a> |
| <a href="#">LM317M</a> |

1 Diagram

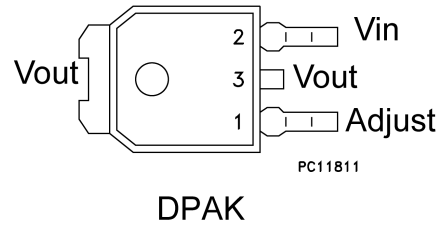
Figure 1. Schematic diagram



GIPG250220151152

## 2 Pin configuration

Figure 2. Pin connections (top view)



GIPG200220151157MT

### 3 Maximum ratings

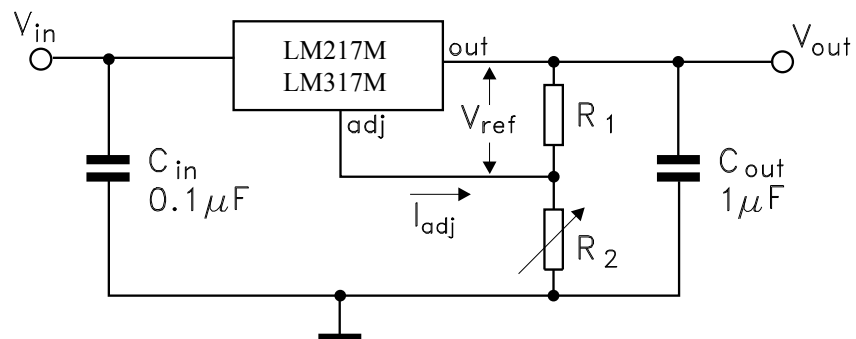
**Table 1. Absolute maximum ratings**

| Symbol    | Parameter   | Value              | Unit       |
|-----------|---|--------------------|------------|
| $V_I-V_O$ | Input-to-output differential voltage                | 40                 | V          |
| $P_D$     | Power dissipation                                   | Internally limited | mW         |
| $T_{OP}$  | Operating junction temperature range <sup>(1)</sup> | LM217M             | -40 to 125 |
|           |   | LM317M             | 0 to 125   |
| $T_{STG}$ | Storage temperature range                           | -55 to 150         | °C         |

1. Reboot is not guaranteed for  $T_J \geq 85$  °C.

**Table 2. Thermal data**

| Symbol     | Parameter                           | DPAK | Unit |
|------------|-------------------------------------|------|------|
| $R_{thJC}$ | Thermal resistance junction-case    | 8    | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient | 100  | °C/W |

**Figure 3. Test circuit**


## 4 Electrical characteristics

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

| Symbol           | Parameter                                   | Test conditions   |                   | Min. | Typ.  | Max. | Unit            |
|------------------|---|---|-------------------|------|-------|------|-----------------|
| $\Delta V_O$     | Line regulation                             | $V_I - V_O = 3$ to $40$ V                               | $T_J = 25$ °C     |      | 0.01  | 0.02 | %V              |
|                  |   |   |                   |      | 0.02  | 0.05 |                 |
| $\Delta V_O$     | Load regulation                             | $V_O \leq 5$ V<br>$I_O = 10$ to $500$ mA                | $T_J = 25$ °C     |      | 5     | 15   | mV              |
|                  |   |   |                   |      | 20    | 50   |                 |
|                  |   | $V_O \geq 5$ V<br>$I_O = 10$ to $500$ mA                | $T_J = 25$ °C     |      | 0.1   | 0.3  | %V <sub>O</sub> |
|                  |   |   |                   |      | 0.3   | 1    |                 |
| $I_{ADJ}$        | Adjustment pin current                      |   |                   |      | 50    | 100  | μA              |
| $\Delta I_{ADJ}$ | 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                      | $V_I - V_O \leq 15$ V                                   |                   | 500  | 1000  |      | mA              |
|                  |   | $V_I - V_O = 40$ V, $P_d < P_{DMAX}$ ,<br>$T_J = 25$ °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 <sup>(1)</sup>     | $T_J = 25$ °C<br>$f = 120$ Hz                           | $C_{ADJ} = 0$     |      | 65    |      | dB              |
|                  |   |   | $C_{ADJ} = 10$ μF | 66   | 80    |      |                 |

1.  $C_{ADJ}$  is connected between the adjustment pin and ground.

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

| Symbol           | Parameter                                | Test conditions                                   |   | Min. | Typ.  | Max.    | Unit            |
|------------------|--|---|---|------|-------|---------|-----------------|
| $\Delta V_O$     | Line regulation                          | $V_I - V_O = 3$ to $40$ V                         | $T_J = 25$ °C   |      | 0.01  | 0.04    | %V              |
|                  |  |   |   |      | 0.02  | 0.07    |                 |
| $\Delta V_O$     | Load regulation                          | $V_O \leq 5$ V<br>$I_O = 10$ to $500$ mA          | $T_J = 25$ °C   |      | 5     | 25      | mV              |
|                  |  |   |   |      | 20    | 70      |                 |
|                  |  | $V_O \geq 5$ V<br>$I_O = 10$ to $500$ mA          | $T_J = 25$ °C   |      | 0.1   | 0.5     | %V <sub>O</sub> |
|                  |  |   |   |      | 0.3   | 1.5     |                 |
| $I_{ADJ}$        | Adjustment pin current                   |   |   | 50   | 100   | $\mu$ A |                 |
| $\Delta I_{ADJ}$ | Adjustment pin current                   | $V_I - V_O = 3$ to $40$ V, $I_O = 10$ to $500$ mA |   |      | 0.2   | 5       | $\mu$ A         |
| $V_{REF}$        | 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                   | $V_I - V_O \leq 15$ V                             |   | 500  | 1000  |         | mA              |
|                  |  |   | $V_I - V_O = 40$ V, $P_d < P_{DMAX}$ ,<br>$T_J = 25$ °C |      |       | 200     |                 |
| eN               | Output noise voltage ( $V_O$ percentage) | $B = 10$ Hz to $100$ kHz, $T_J = 25$ °C           |   |      | 0.003 |         | %               |
| SVR              | Supply voltage rejection <sup>(1)</sup>  | $T_J = 25$ °C<br>$f = 120$ Hz                     | $C_{ADJ} = 0$   |      | 65    |         | dB              |
|                  |  |   | $C_{ADJ} = 10$ $\mu$ F                                  | 66   | 80    |         |                 |

1.  $C_{ADJ}$  is connected between the adjustment pin and ground.

## 5 Typical performance

Figure 4. Current limit

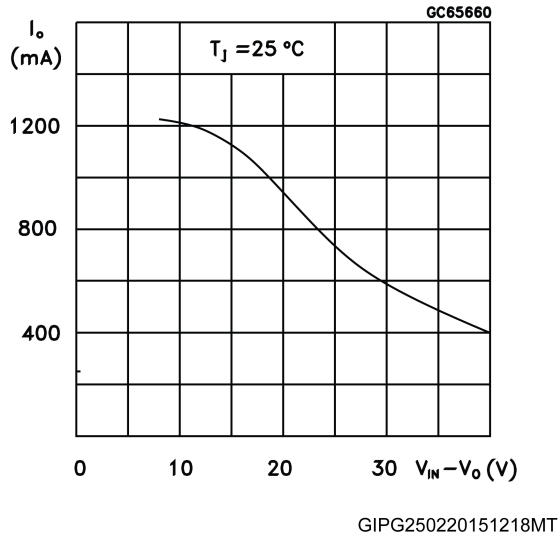


Figure 5. Minimum operating current

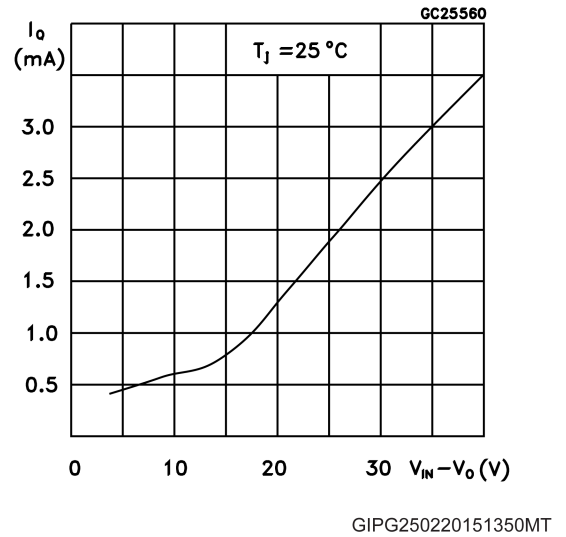
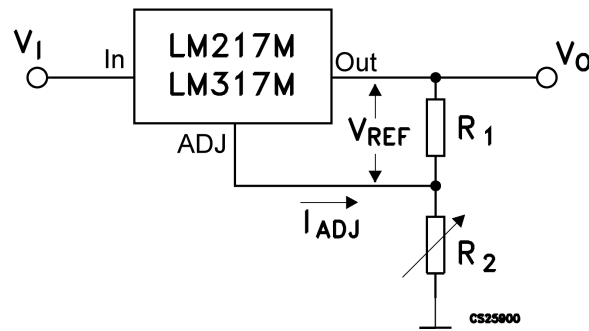
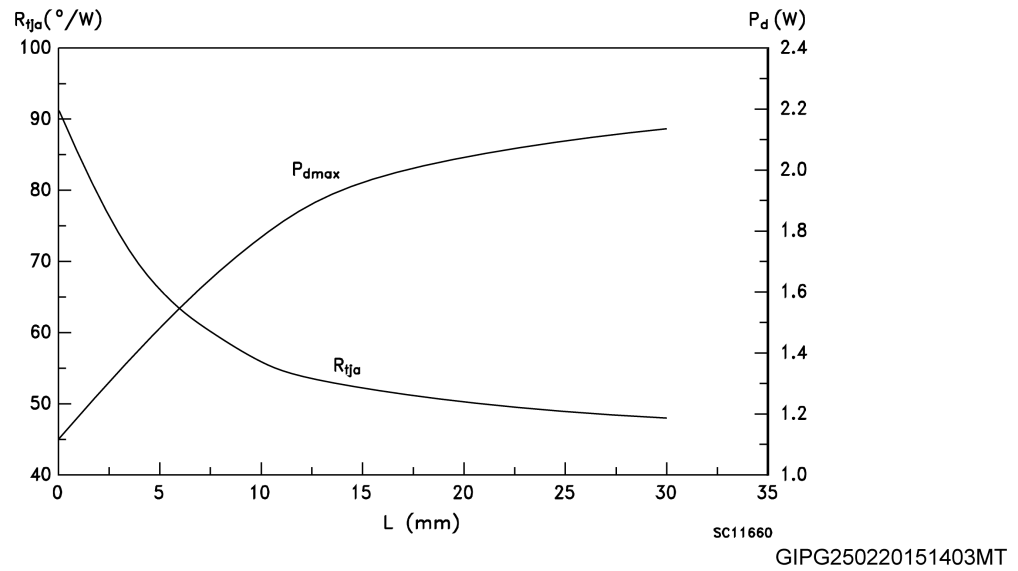


Figure 6. Basic adjustable regulator



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Figure 7. Thermal resistance and maximum power dissipation vs. PCB copper length for DPAK



Note:  $P_{dmax}$  calculated for  $T_a = 50\text{ }^{\circ}\text{C}$ .



## 6 Application information

The LM217M and LM317M provide an internal reference voltage (1.25 V) between the output and adjustment terminals. These devices set a constant current flow across an external resistor divider (see [Figure 6. Basic adjustable regulator](#)), giving the following output voltage:

### Equation 1

$$V_O = V_{REF} (1 + R_2 / R_1) + I_{ADJ} R_2$$

These devices minimize the term  $I_{ADJ}$  (100  $\mu$ A max.) and keep it constant with line and load changes. Usually, the error terms:  $I_{ADJ} \times R_2$  can be neglected. To obtain the previous requirement, the regulator quiescent current is returned to the output terminal, imposing a minimum load current condition. If the load is insufficient, the output voltage rises.

Since the LM217M and LM317M devices are floating regulators and only “see” the input-to-output differential voltage, high voltage supplies 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 precision current regulators. In order to optimize the load regulation,  $R_1$ , the current set resistor (see [Figure 6. Basic adjustable regulator](#)) should be as close as possible to the regulator, while  $R_2$ , the ground terminal should be near the ground of the load to provide remote ground sensing.

### 6.1 External capacitors

Usually, capacitors are not necessary unless the devices are far from the input filter capacitors; in this case an input bypass is needed.

To reduce the sensitivity to input line impedance, a 0.1  $\mu$ F disc or 1  $\mu$ F tantalum input bypass capacitor ( $C_I$ ) is recommended.

The adjustment terminal may be bypassed to ground to improve ripple rejection. This capacitor ( $C_{ADJ}$ ) avoids the amplification of ripple as the output voltage rises. A 10  $\mu$ F capacitor should improve ripple rejection about 80 dB at 120 Hz in a 10 V application.

Although the devices are stable without any output capacitors, some external capacitance values can cause excessive ringing. A 1  $\mu$ F solid tantalum or 25  $\mu$ F aluminum electrolytic output capacitor swamps this effect and assures stability.

### 6.2 Protection diodes

When external capacitors are used with any IC regulator, sometimes some protection diodes have to be added to prevent the capacitors from discharging through low current points into the regulator.

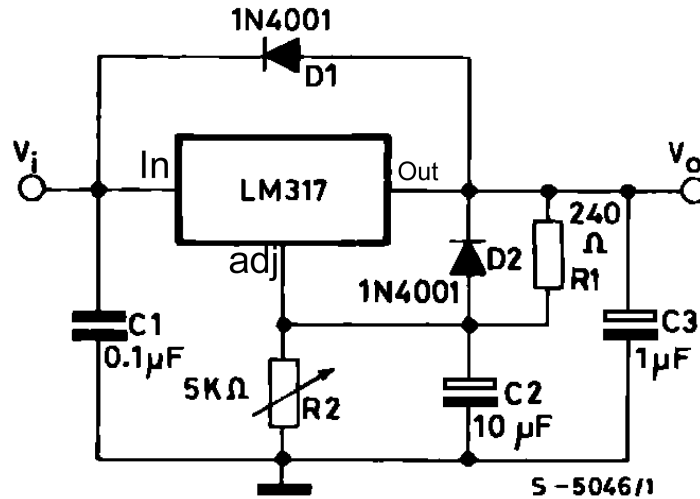
[Figure 8. Voltage regulator with protection diodes](#) shows the devices with the recommended protection diodes for output voltages in excess of 25 V or high capacitance values ( $C_3 > 25 \mu$ F,  $C_2 > 10 \mu$ F). Diode D1 prevents  $C_3$  from discharging through the IC during an input short-circuit. The combination of diodes D1 and D2 prevents  $C_2$  from discharging through the regulator during an input or output short-circuit.

### 6.3 Start-up block

Reboot of the device is not guaranteed when the junction temperature is over 85 °C.

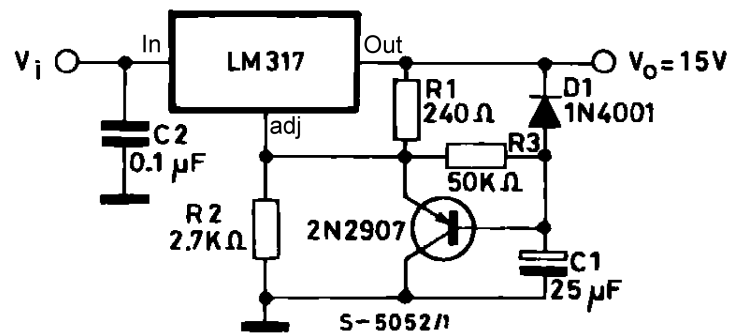
## 7 Application circuits

Figure 8. Voltage regulator with protection diodes



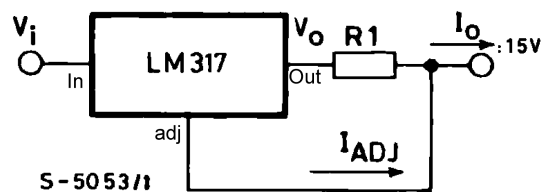
GIPG250220151410MT

Figure 9. Slow turn-on 15 V regulator



GIPG250220151414MT

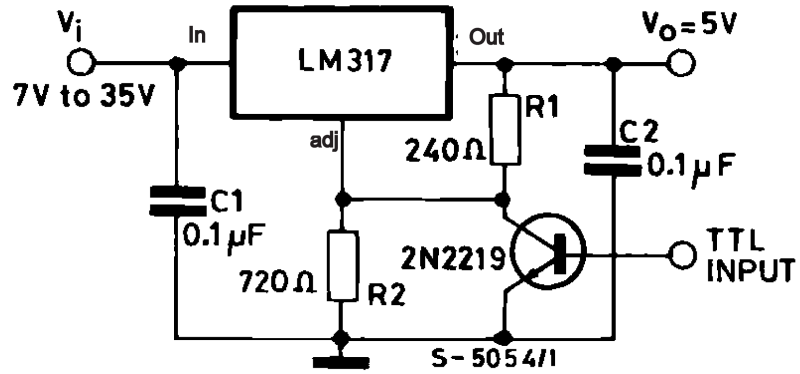
Figure 10. Current regulator



$$I_o = V_{REF}/R_1 + I_{ADJ} = 1.25 \text{ V} / R_1$$

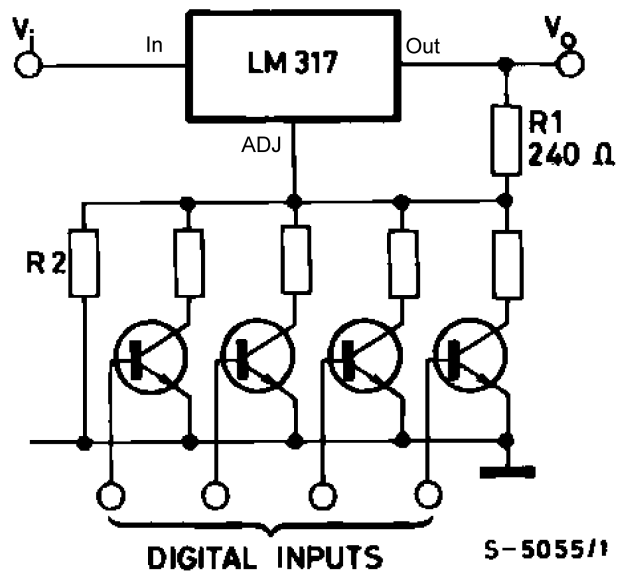
GIPG250220151417MT

Figure 11. 5 V electronic shutdown regulator



GIPG250220151421MT

Figure 12. Digitally selected outputs



(R2 sets maximum  $V_o$ )

GIPG250220151429MT

## 8 Device summary

Table 5. Device summary

| Order code  | Packing       |
|-------------|---------------|
| LM217MDT-TR | Tape and reel |
| LM317MDT-TR |               |

## 9 Package information

In order to meet environmental requirements, ST offers these devices in different grades of **ECOPACK** packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK is an ST trademark.

### 9.1 DPAK (TO-252) package information

**Table 6. DPAK (TO-252) mechanical data (type A)**

| Dim. | mm    |       |       |
|------|-------|-------|-------|
|      | Min.  | Typ.  | Max.  |
| A    | 2.20  |       | 2.40  |
| A1   | 0.90  |       | 1.10  |
| A2   | 0.03  |       | 0.23  |
| b    | 0.64  |       | 0.90  |
| b4   | 5.20  |       | 5.40  |
| c    | 0.45  |       | 0.60  |
| c2   | 0.48  |       | 0.60  |
| D    | 6.00  |       | 6.20  |
| D1   | 4.95  | 5.10  | 5.25  |
| E    | 6.40  |       | 6.60  |
| E1   | 4.60  | 4.70  | 4.80  |
| e    | 2.159 | 2.286 | 2.143 |
| e1   | 4.445 | 4.572 | 4.699 |
| H    | 9.35  |       | 10.10 |
| L    | 1.00  |       | 1.50  |
| L1   | 2.60  | 2.80  | 1.50  |
| L2   |       |       | 3.00  |
| L4   | 0.60  |       | 1.00  |
| R    |       | 0.20  |       |
| V2   | 0°    |       | 8°    |

Figure 13. DPAK (TO-252) package outline A

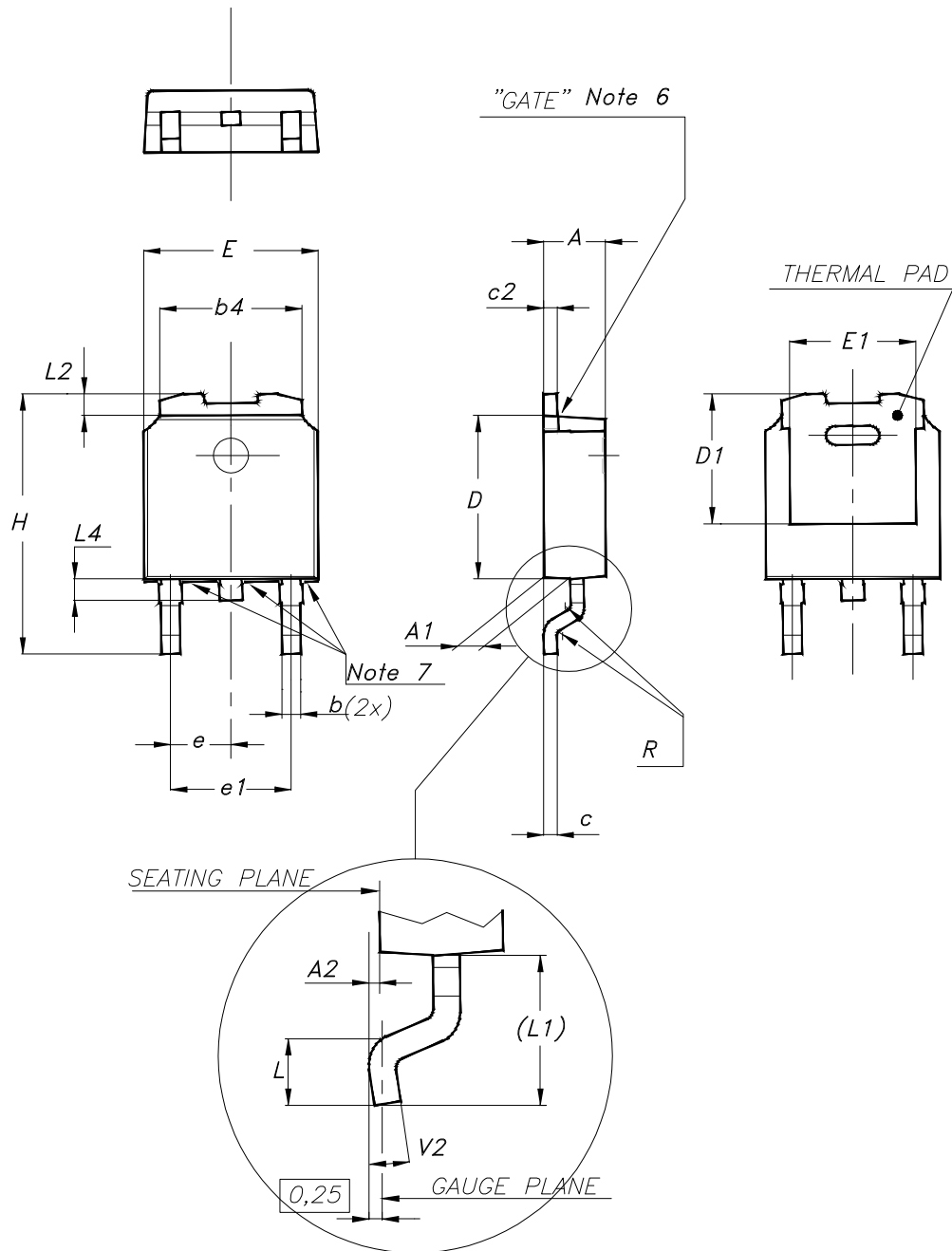
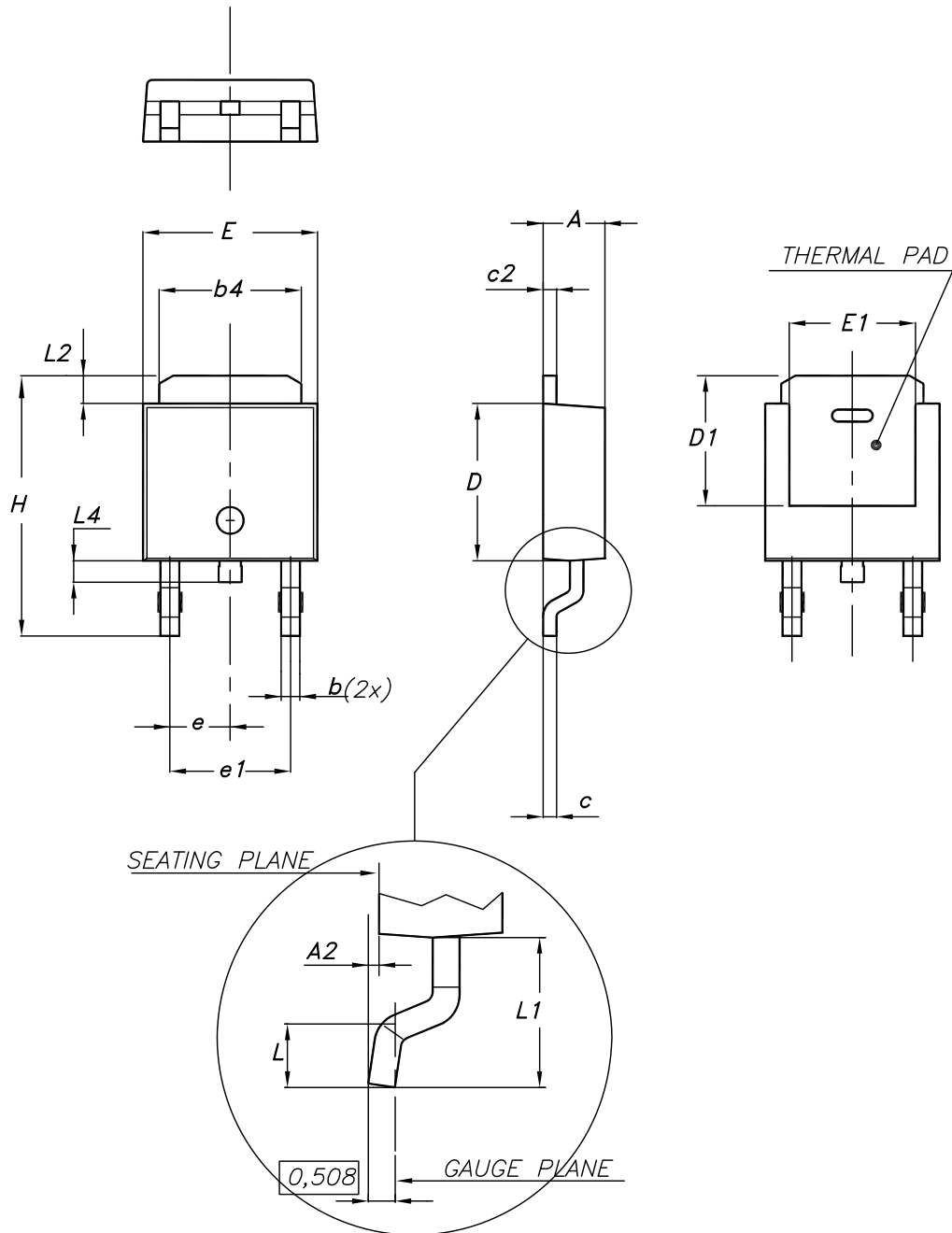


Table 7. DPAK(TO-252) mechanical data (type E)

| Dim. | mm   |       |       |
|------|------|-------|-------|
|      | Min. | Typ.  | Max.  |
| A    | 2.18 |       | 2.39  |
| A2   |      |       | 0.13  |
| b    | 0.65 |       | 0.884 |
| b4   | 4.95 |       | 5.46  |
| c    | 0.46 |       | 0.61  |
| c2   | 0.46 |       | 0.60  |
| D    | 5.97 |       | 6.22  |
| D1   | 5.21 |       |       |
| E    | 6.35 |       | 6.73  |
| E1   | 4.32 |       |       |
| e    |      | 2.286 |       |
| e1   |      | 4.572 |       |
| H    | 9.94 |       | 10.34 |
| L    | 1.50 |       | 1.78  |
| L1   |      | 2.74  |       |
| L2   | 0.89 |       | 1.27  |
| L4   |      |       | 1.02  |

Figure 14. DPAK (TO-252) package outline E





**Table 8. DPAK (TO-252) mechanical data type I**

| Dim. | mm        |       |       |
|------|-----------|-------|-------|
|      | Min.      | Typ.  | Max.  |
| A    | 2.20      | 2.30  | 2.38  |
| A1   | 0.90      | 1.01  | 1.10  |
| A2   | 0.00      | -     | 0.10  |
| b    | 0.77      | -     | 0.89  |
| b1   | 0.76      | 0.81  | 0.86  |
| b2   | 0.77      | -     | 1.10  |
| b3   | 5.23      | 5.33  | 5.43  |
| c    | 0.47      | -     | 0.60  |
| c1   | 0.46      | 0.51  | 0.56  |
| c2   | 0.47      | -     | 0.60  |
| D    | 6.00      | 6.10  | 6.20  |
| D1   | 5.25      | 5.40  | 5.60  |
| E    | 6.50      | 6.60  | 6.70  |
| E1   | 4.70      | 4.85  | 5.00  |
| e    | 2.286 BSC |       |       |
| H    | 9.80      | 10.10 | 10.40 |
| L    | 1.40      | 1.50  | 1.70  |
| L1   | 2.90 REF  |       |       |
| L2   | 0.90      | -     | 1.25  |
| L3   | 0.51 BSC  |       |       |
| L4   | 0.60      | 0.80  | 1.00  |
| L5   | 0.90      | -     | 1.50  |
| L6   | 1.80 BSC  |       |       |
| Θ    | 0°        | -     | 8°    |
| Θ1   | 3°        | 5°    | 7°    |
| Θ2   | 1°        | 3°    | 5°    |

Figure 15. DPAK (TO-252) package outline I

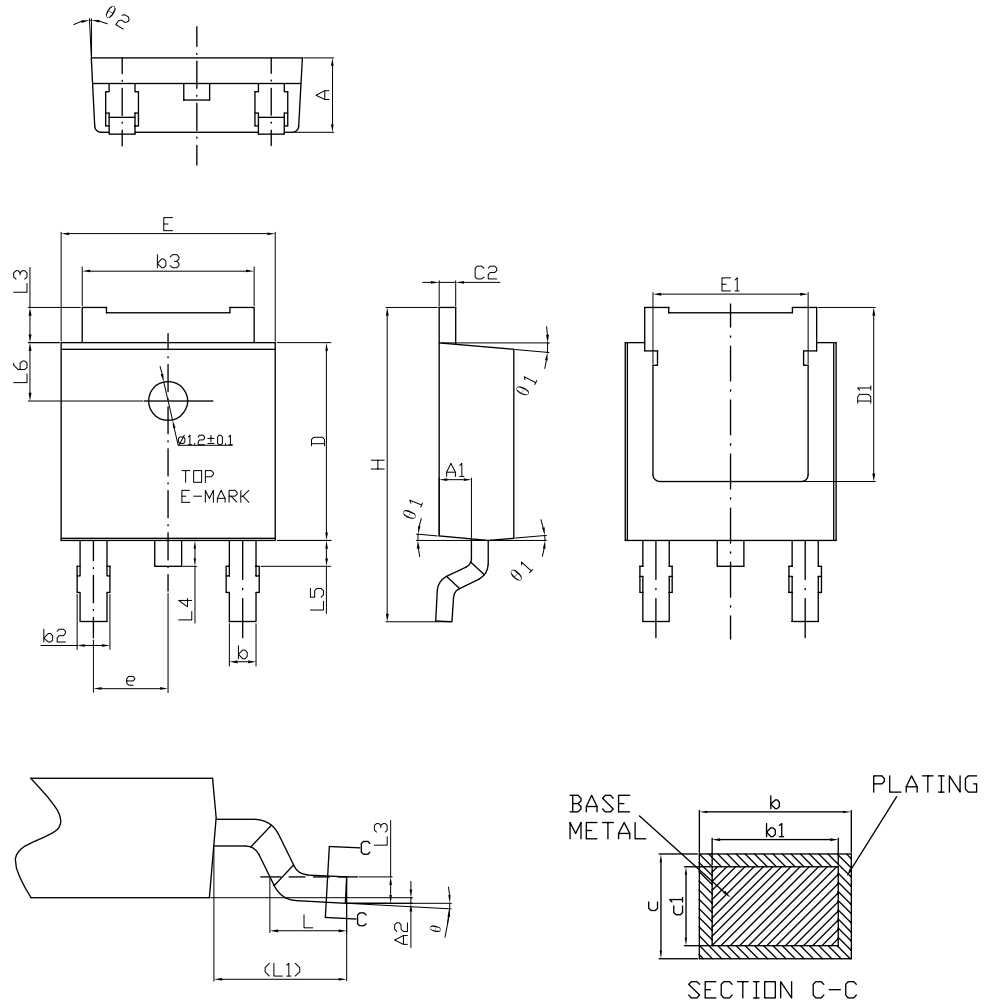
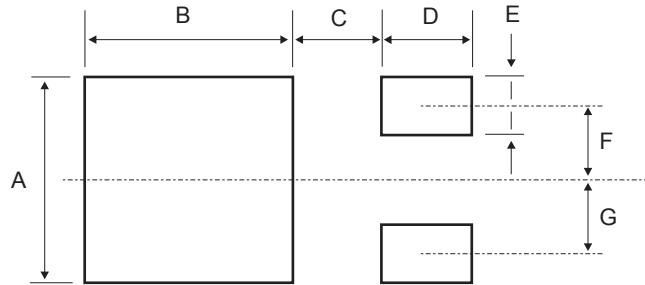


Table 9. DPAK footprint data

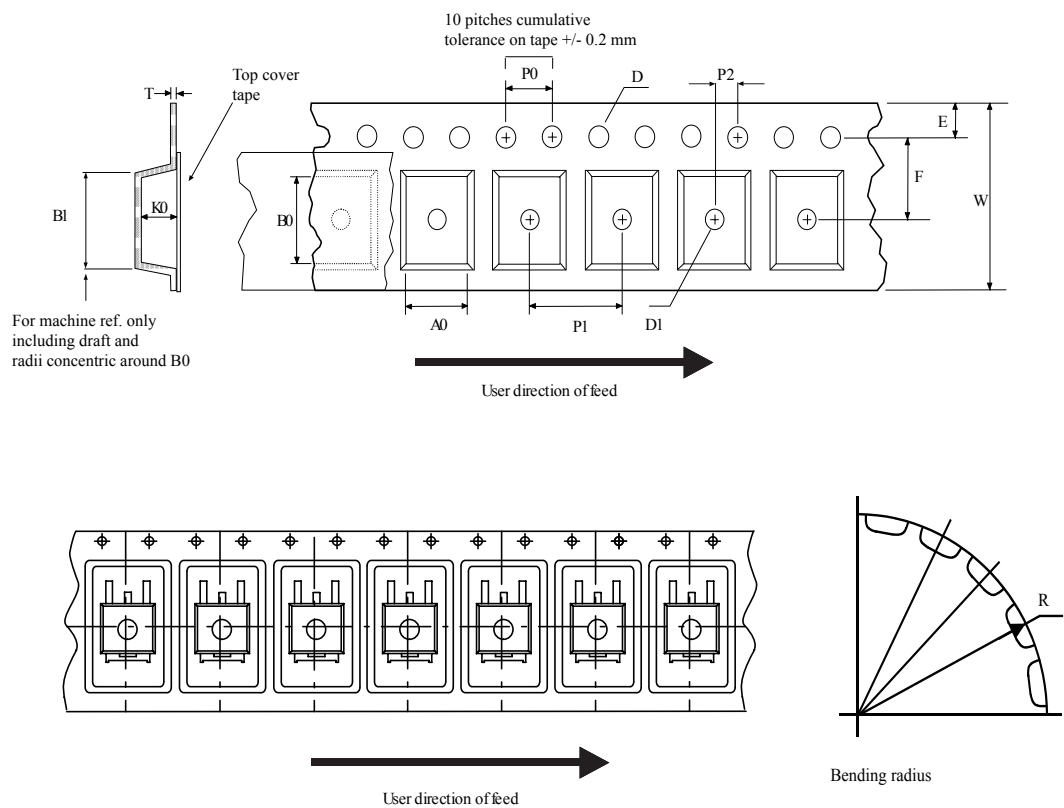
|   | Values |       |
|---|--------|-------|
|   | mm.    | inch. |
| A | 6.70   | 0.264 |
| B | 6.70   | 0.64  |
| C | 1.80   | 0.070 |
| D | 3.00   | 0.118 |
| E | 1.60   | 0.063 |
| F | 2.30   | 0.091 |
| G | 2.30   | 0.091 |

Figure 16. DPAK footprint recommended data



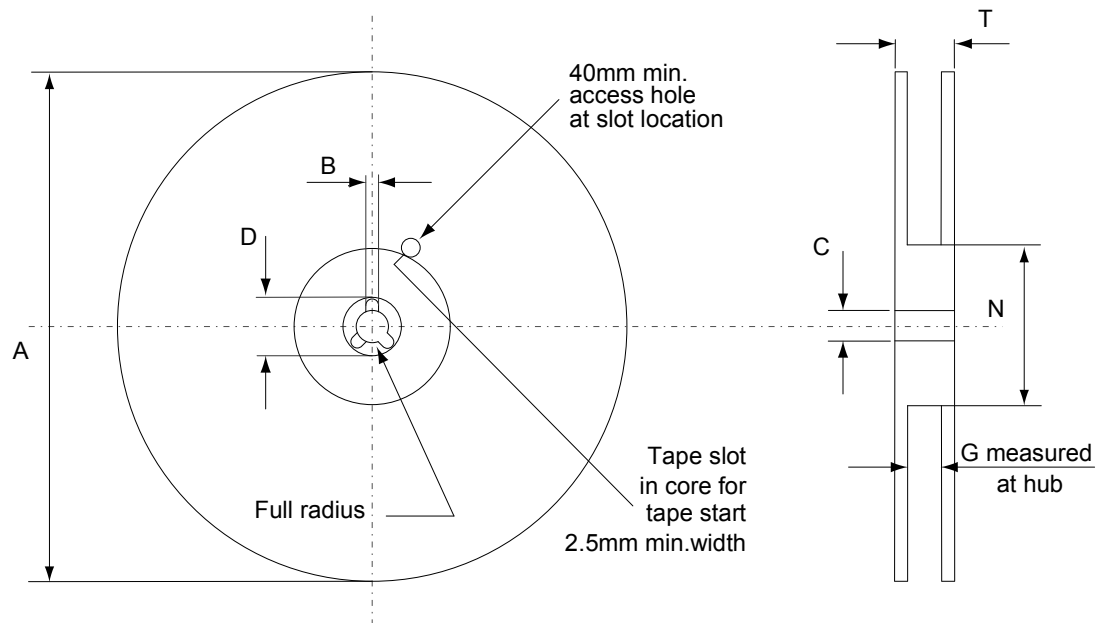
## 9.2 DPAK (TO-252) packing information

Figure 17. DPAK (TO-252) tape outline



AM08852v1

Figure 18. DPAK (TO-252) reel outline



AM06038v1

Table 10. DPAK (TO-252) tape and reel mechanical data

| Tape |      |      | Reel |           |      |
|------|------|------|------|-----------|------|
| Dim. | mm   |      | Dim. | mm        |      |
|      | Min. | Max. |      | Min.      | Max. |
| A0   | 6.8  | 7    | A    |           | 330  |
| B0   | 10.4 | 10.6 | B    | 1.5       |      |
| B1   |      | 12.1 | C    | 12.8      | 13.2 |
| D    | 1.5  | 1.6  | D    | 20.2      |      |
| D1   | 1.5  |      | G    | 16.4      | 18.4 |
| E    | 1.65 | 1.85 | N    | 50        |      |
| F    | 7.4  | 7.6  | T    |           | 22.4 |
| K0   | 2.55 | 2.75 |      |           |      |
| P0   | 3.9  | 4.1  |      | Base qty. | 2500 |
| P1   | 7.9  | 8.1  |      | Bulk qty. | 2500 |
| P2   | 1.9  | 2.1  |      |           |      |
| R    | 40   |      |      |           |      |
| T    | 0.25 | 0.35 |      |           |      |
| W    | 15.7 | 16.3 |      |           |      |

## Revision history

**Table 11. Document revision history**

| Date         | Revision | Changes   |
|--------------|----------|---|
| 21-Jun-2004  | 5        | The document has been reformatted.  |
| 06-Dec-2006  | 6        | DPAK mechanical data updated, added footprint data.   |
| 11-Feb-2008  | 7        | Added: Table 1 on page 1.   |
| 07-Jul-2014  | 8        | Updated Table 1: Device summary.<br>Updated Section 8.1: TO-220 and Section 8.2: DPAK.<br>Updated Figure 3, Figure 6, Figure 8, Figure 9, Figure 10, Figure 11, Figure 12.<br>Minor text changes.                           |
| 16- Oct-2015 | 9        | Removed TO-220 package.<br>Updated description in cover page, Table 1: "Device summary",<br>Figure 2: "Pin connections (top view)", Table 3: "Thermal data" and<br>Section 8: "Package information".<br>Minor text changes. |
| 19-Jun-2019  | 10       | Updated Section 9.1 DPAK (TO-252) package information.  |
| 26-Nov-2019  | 11       | Updated <a href="#">Section 9.1 DPAK (TO-252) package information</a> .   |

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