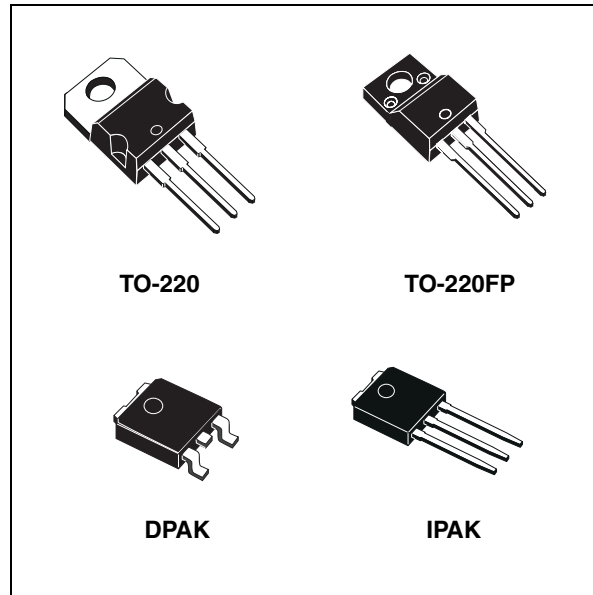


### Features

- Output current to 0.5 A
- Output voltages of 5; 6; 8; 9; 12; 15; 24 V
- Thermal overload protection
- Short circuit protection
- Output transition SOA protection

### Description

The L78MxxC series of three-terminal positive regulators is available in TO-220, TO-220FP, DPAK and IPAK packages and with several fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. Each type employs internal current limiting, thermal shutdown and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 0.5 A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltage and currents.



**Table 1. Device summary**

| Part numbers | Order codes |             |              |              |                 | Output voltages |
|--------------|-------------|-------------|--------------|--------------|-----------------|-----------------|
|              | TO-220      | TO-220 (1)  | TO-220FP     | DPAK         | IPAK            |                 |
| L78M05C      | L78M05CV    | L78M05CV-DG | L78M05CP     | L78M05CDT-TR | L78M05CDT-1     | 5 V             |
| L78M06C      |             |             |              | L78M06CDT-TR | L78M06CDT-1 (2) | 6 V             |
| L78M08C      | L78M08CV    | L78M08CV-DG |              | L78M08CDT-TR | L78M08CDT-1 (2) | 8 V             |
| L78M09C      | L78M09CV    | L78M09CV-DG |              | L78M09CDT-TR | L78M09CDT-1 (2) | 9 V             |
| L78M12C      | L78M12CV    | L78M12CV-DG |              | L78M12CDT-TR |                 | 12 V            |
| L78M15C      | L78M15CV    | L78M15CV-DG |              | L78M15CDT-TR |                 | 15 V            |
| L78M24C      | L78M24CV    | L78M24CV-DG | L78M24CP (2) | L78M24CDT-TR | L78M24CDT-1 (2) | 24 V            |

1. TO-220 Dual Gauge frame

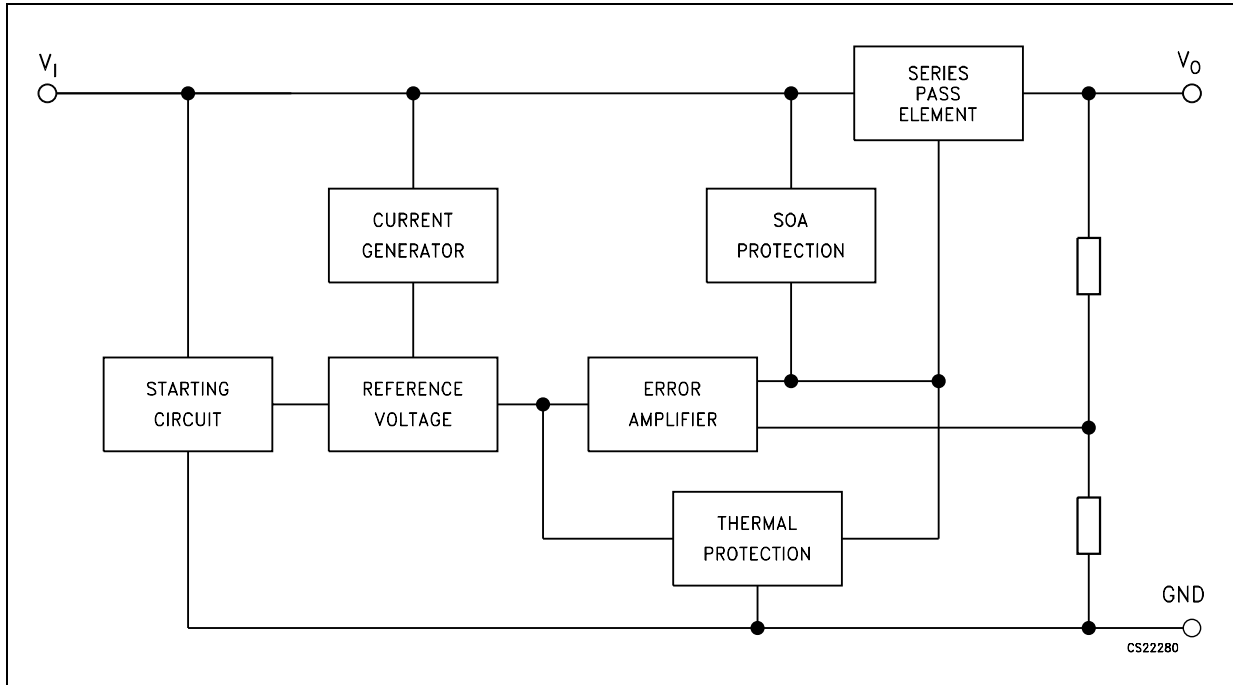
2. Available on request

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# 1 Diagram

Figure 1. Block diagram



## 2 Pin configuration

Figure 2. Pin connections (top view)

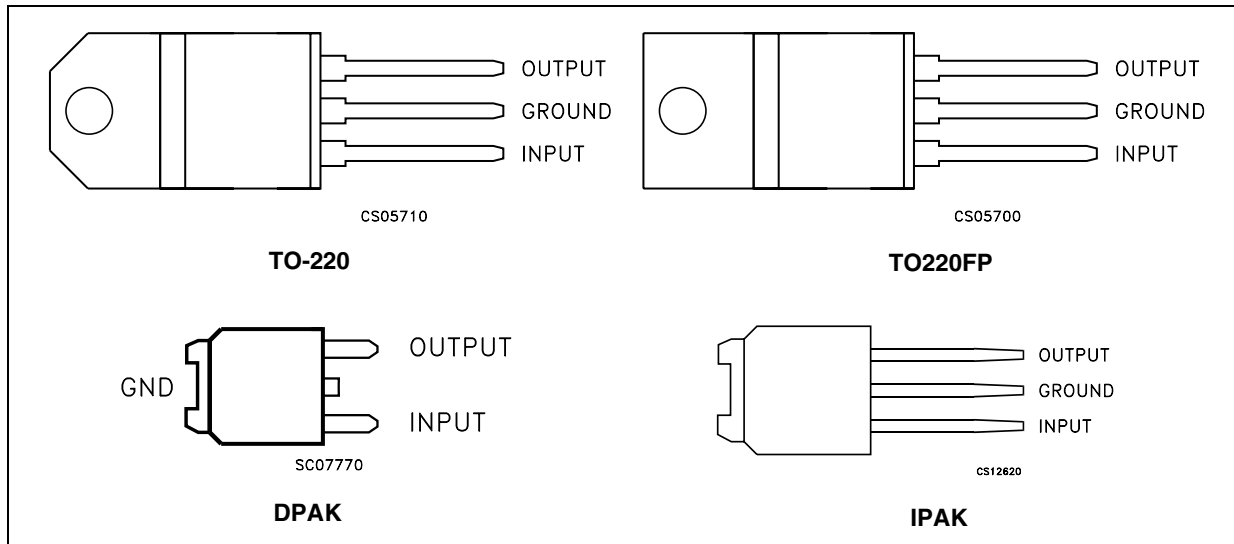
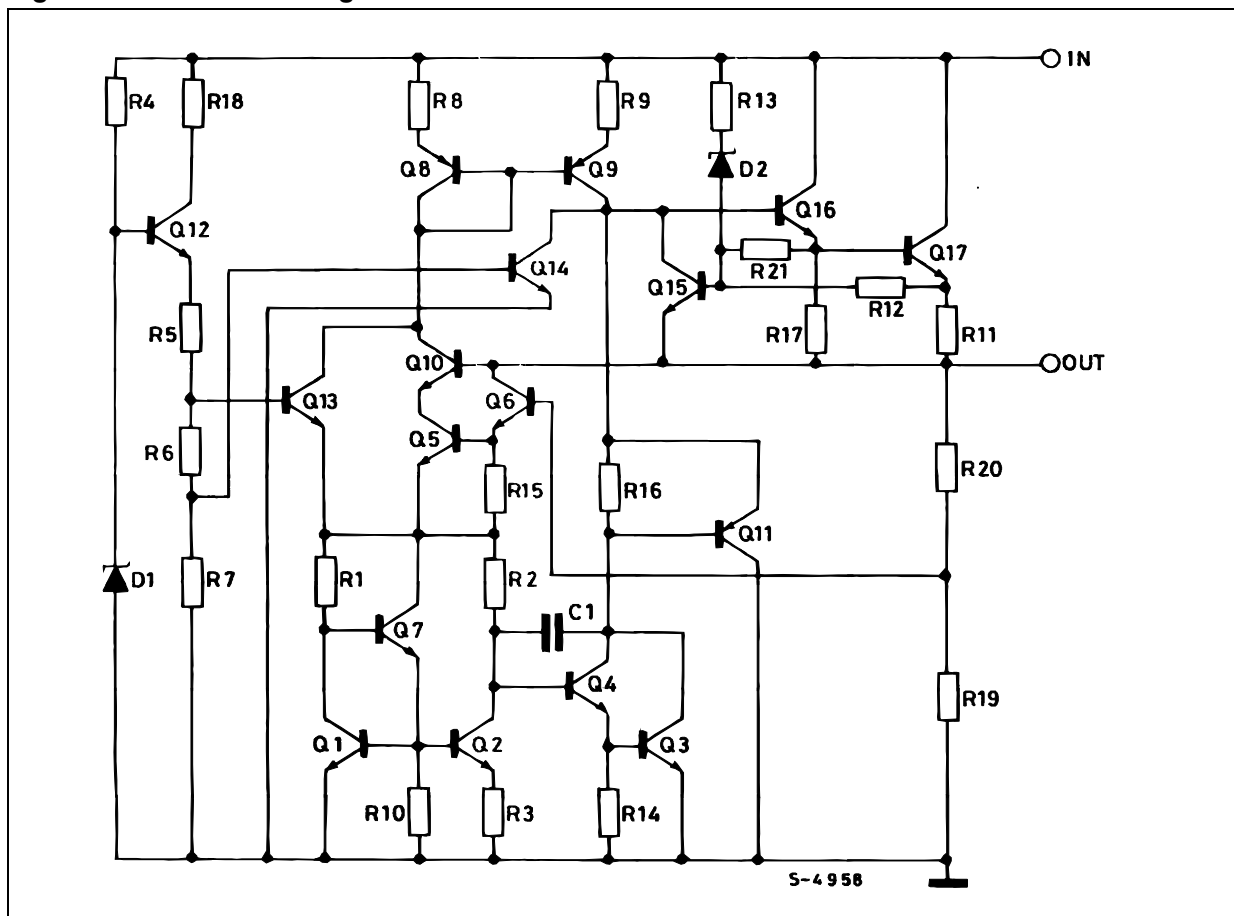


Figure 3. Schematic diagram



### 3 Maximum ratings

**Table 2. Absolute maximum ratings**

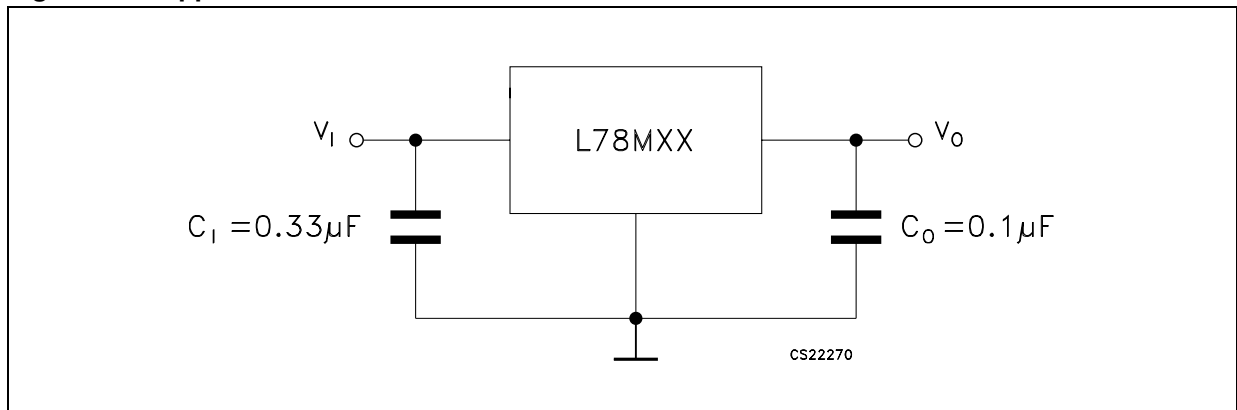
| Symbol    | Parameter                            | Value                 | Unit |
|-----------|--------------------------------------|-----------------------|------|
| $V_I$     | DC input voltage                     | for $V_O = 5$ to 18 V | 35   |
|           |                                      | for $V_O = 20, 24$ V  | 40   |
| $I_O$     | Output current                       | Internally limited    | mA   |
| $P_D$     | Power dissipation                    | Internally limited    | mW   |
| $T_{STG}$ | Storage temperature range            | - 65 to 150           | °C   |
| $T_{OP}$  | Operating junction temperature range | 0 to 150              | °C   |

*Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.*

**Table 3. Thermal data**

| Symbol     | Parameter                           | TO-220 | TO-220FP | DPAK | IPAK | Unit |
|------------|-------------------------------------|--------|----------|------|------|------|
| $R_{thJC}$ | Thermal resistance junction-case    | 5      | 5        | 8    |      | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient | 50     | 60       | 100  |      | °C/W |

**Figure 4. Application circuit**



# 4 Test circuits

Figure 5. DC parameter

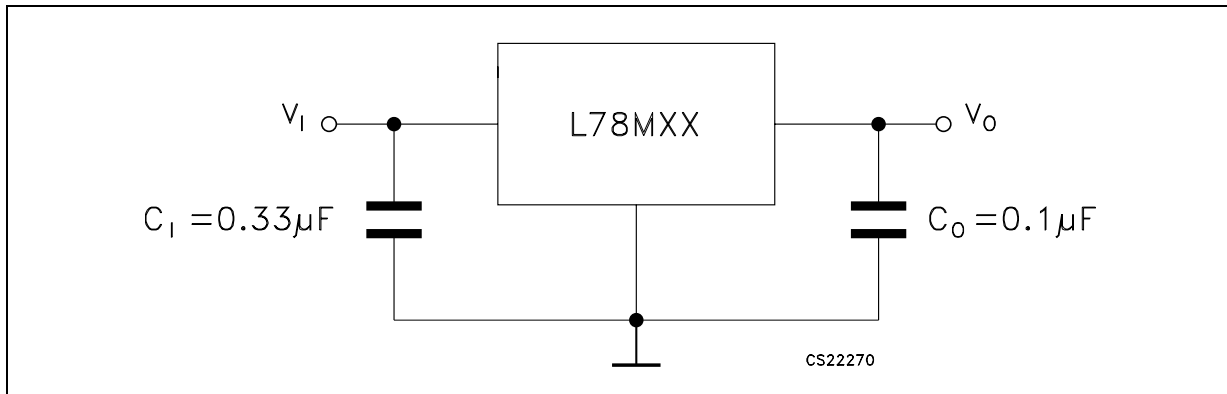


Figure 6. Load regulation

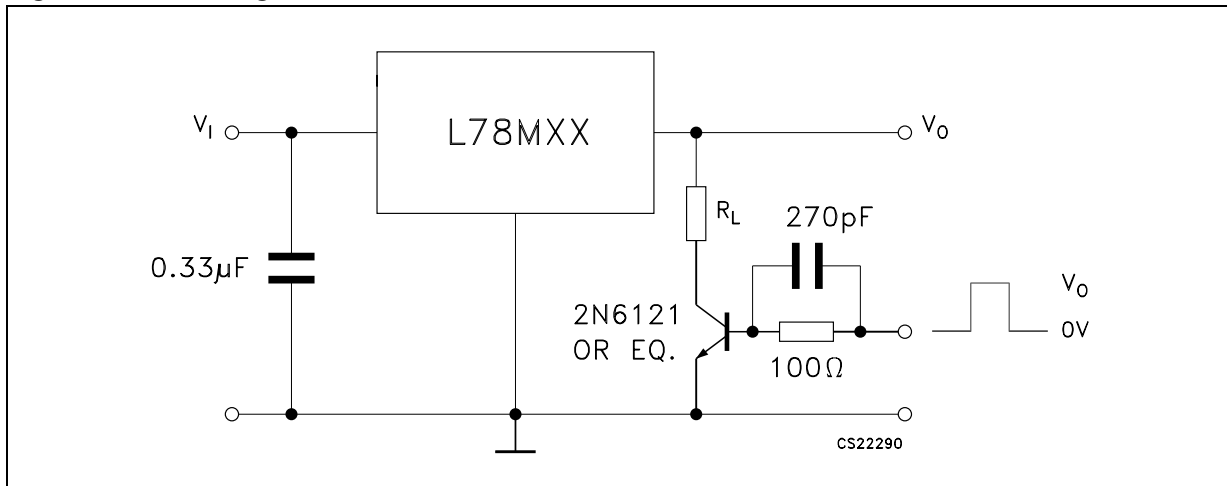
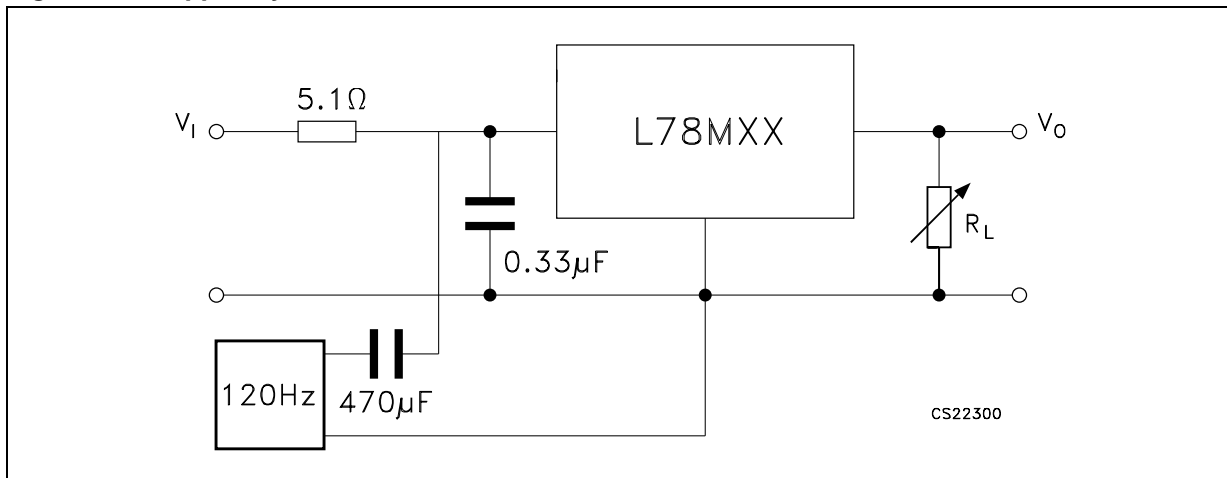


Figure 7. Ripple rejection



## 5 Electrical characteristics

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 10\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified.

**Table 4. Electrical characteristics of L78M05C**

| Symbol                | Parameter                | Test conditions   | Min. | Typ. | Max. | Unit          |
|-----------------------|--------------------------|---|------|------|------|---------------|
| $V_O$                 | Output voltage           |   | 4.8  | 5    | 5.2  | V             |
| $V_O$                 | Output voltage           | $I_O = 5\text{ to }350\text{ mA}$ , $V_I = 7\text{ to }20\text{ V}$           | 4.75 | 5    | 5.25 | V             |
| $\Delta V_O$          | Line regulation          | $V_I = 7\text{ to }25\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 100  | mV            |
|                       |                          | $V_I = 8\text{ to }25\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 50   |               |
| $\Delta V_O$          | Load regulation          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25\text{ °C}$                      |      |      | 100  | mV            |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25\text{ °C}$                      |      |      | 50   |               |
| $I_d$                 | Quiescent current        |   |      |      | 6    | mA            |
| $\Delta I_d$          | Quiescent current change | $I_O = 5\text{ to }350\text{ mA}$   |      |      | 0.5  | mA            |
|                       |                          | $I_O = 200\text{ mA}$ , $V_I = 8\text{ to }25\text{ V}$                       |      |      | 0.8  |               |
| $\Delta V_O/\Delta T$ | Output voltage drift     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125\text{ °C}$                       |      | -0.5 |      | mV/°C         |
| SVR                   | Supply voltage rejection | $V_I = 8\text{ to }18\text{ V}$ , $f = 120\text{ Hz}$ , $I_O = 300\text{ mA}$ | 62   |      |      | dB            |
| eN                    | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}$  |      | 40   |      | $\mu\text{V}$ |
| $V_d$                 | Dropout voltage          |   |      | 2    |      | V             |
| $I_{sc}$              | Short circuit current    | $V_I = 35\text{ V}$   |      | 300  |      | mA            |

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 11\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified.

**Table 5. Electrical characteristics of L78M06C**

| Symbol                | Parameter                | Test conditions   | Min. | Typ. | Max. | Unit          |
|-----------------------|--------------------------|---|------|------|------|---------------|
| $V_O$                 | Output voltage           |   | 5.75 | 6    | 6.25 | V             |
| $V_O$                 | Output voltage           | $I_O = 5\text{ to }350\text{ mA}$ , $V_I = 8\text{ to }21\text{ V}$           | 5.7  | 6    | 6.3  | V             |
| $\Delta V_O$          | Line regulation          | $V_I = 8\text{ to }25\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 100  | mV            |
|                       |                          | $V_I = 9\text{ to }25\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 50   |               |
| $\Delta V_O$          | Load regulation          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25\text{ °C}$                      |      |      | 120  | mV            |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25\text{ °C}$                      |      |      | 60   |               |
| $I_d$                 | Quiescent current        |   |      |      | 6    | mA            |
| $\Delta I_d$          | Quiescent current change | $I_O = 5\text{ to }350\text{ mA}$   |      |      | 0.5  | mA            |
|                       |                          | $I_O = 200\text{ mA}$ , $V_I = 9\text{ to }25\text{ V}$                       |      |      | 0.8  |               |
| $\Delta V_O/\Delta T$ | Output voltage drift     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125\text{ °C}$                       |      | -0.5 |      | mV/°C         |
| SVR                   | Supply voltage rejection | $V_I = 9\text{ to }19\text{ V}$ , $f = 120\text{ Hz}$ , $I_O = 300\text{ mA}$ | 59   |      |      | dB            |
| eN                    | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}$  |      | 45   |      | $\mu\text{V}$ |
| $V_d$                 | Dropout voltage          |   |      | 2    |      | V             |
| $I_{sc}$              | Short circuit current    | $V_I = 35\text{ V}$   |      | 270  |      | mA            |

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 14\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified.

**Table 6. Electrical characteristics of L78M08C**

| Symbol                | Parameter                | Test conditions   | Min. | Typ. | Max. | Unit          |
|-----------------------|--------------------------|---|------|------|------|---------------|
| $V_O$                 | Output voltage           |   | 7.7  | 8    | 8.3  | V             |
| $V_O$                 | Output voltage           | $I_O = 5\text{ to }350\text{ mA}$ , $V_I = 10.5\text{ to }23\text{ V}$                | 7.6  | 8    | 8.4  | V             |
| $\Delta V_O$          | Line regulation          | $V_I = 10.5\text{ to }25\text{ V}$ , $I_O = 200\text{ mA}$                            |      |      | 100  | mV            |
|                       |                          | $V_I = 11\text{ to }25\text{ V}$ , $I_O = 200\text{ mA}$                              |      |      | 50   |               |
| $\Delta V_O$          | Load regulation          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25\text{ °C}$                              |      |      | 160  | mV            |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25\text{ °C}$                              |      |      | 80   |               |
| $I_d$                 | Quiescent current        |   |      |      | 6    | mA            |
| $\Delta I_d$          | Quiescent current change | $I_O = 5\text{ to }350\text{ mA}$   |      |      | 0.5  | mA            |
|                       |                          | $I_O = 200\text{ mA}$ , $V_I = 10.5\text{ to }25\text{ V}$                            |      |      | 0.8  |               |
| $\Delta V_O/\Delta T$ | Output voltage drift     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125\text{ °C}$                               |      | -0.5 |      | mV/°C         |
| SVR                   | Supply voltage rejection | $V_I = 11.5\text{ to }21.5\text{ V}$ , $f = 120\text{ Hz}$ ,<br>$I_O = 300\text{ mA}$ | 56   |      |      | dB            |
| eN                    | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}$  |      | 52   |      | $\mu\text{V}$ |
| $V_d$                 | Dropout voltage          |   |      | 2    |      | V             |
| $I_{sc}$              | Short circuit current    | $V_I = 35\text{ V}$   |      | 250  |      | mA            |



Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 15\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified.

**Table 7. Electrical characteristics of L78M09C**

| Symbol                | Parameter                | Test conditions   | Min. | Typ. | Max. | Unit          |
|-----------------------|--------------------------|---|------|------|------|---------------|
| $V_O$                 | Output voltage           |   | 8.65 | 9    | 9.35 | V             |
| $V_O$                 | Output voltage           | $I_O = 5\text{ to }350\text{ mA}$ , $V_I = 11.5\text{ to }24\text{ V}$              | 8.55 | 9    | 9.45 | V             |
| $\Delta V_O$          | Line regulation          | $V_I = 11.5\text{ to }25\text{ V}$ , $I_O = 200\text{ mA}$                          |      |      | 100  | mV            |
|                       |                          | $V_I = 12\text{ to }25\text{ V}$ , $I_O = 200\text{ mA}$                            |      |      | 50   |               |
| $\Delta V_O$          | Load regulation          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25\text{ °C}$                            |      |      | 180  | mV            |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25\text{ °C}$                            |      |      | 90   |               |
| $I_d$                 | Quiescent current        |   |      |      | 6    | mA            |
| $\Delta I_d$          | Quiescent current change | $I_O = 5\text{ to }350\text{ mA}$   |      |      | 0.5  | mA            |
|                       |                          | $I_O = 200\text{ mA}$ , $V_I = 11.5\text{ to }25\text{ V}$                          |      |      | 0.8  |               |
| $\Delta V_O/\Delta T$ | Output voltage drift     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125\text{ °C}$                             |      | -0.5 |      | mV/°C         |
| SVR                   | Supply voltage rejection | $V_I = 12.5\text{ to }23\text{ V}$ , $f = 120\text{ Hz}$ ,<br>$I_O = 300\text{ mA}$ | 56   |      |      | dB            |
| eN                    | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}$  |      | 58   |      | $\mu\text{V}$ |
| $V_d$                 | Dropout voltage          |   |      | 2    |      | V             |
| $I_{sc}$              | Short circuit current    | $V_I = 35\text{ V}$   |      | 250  |      | mA            |

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 19\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified.

**Table 8. Electrical characteristics of L78M12C**

| Symbol                | Parameter                | Test conditions  | Min. | Typ. | Max. | Unit          |
|-----------------------|--------------------------|--|------|------|------|---------------|
| $V_O$                 | Output voltage           |  | 11.5 | 12   | 12.5 | V             |
| $V_O$                 | Output voltage           | $I_O = 5\text{ to }350\text{ mA}$ , $V_I = 14.5\text{ to }27\text{ V}$         | 11.4 | 12   | 12.6 | V             |
| $\Delta V_O$          | Line regulation          | $V_I = 14.5\text{ to }30\text{ V}$ , $I_O = 200\text{ mA}$                     |      |      | 100  | mV            |
|                       |                          | $V_I = 16\text{ to }30\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 50   |               |
| $\Delta V_O$          | Load regulation          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25\text{ °C}$                       |      |      | 240  | mV            |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25\text{ °C}$                       |      |      | 120  |               |
| $I_d$                 | Quiescent current        |  |      |      | 6    | mA            |
| $\Delta I_d$          | Quiescent current change | $I_O = 5\text{ to }350\text{ mA}$  |      |      | 0.5  | mA            |
|                       |                          | $I_O = 200\text{ mA}$ , $V_I = 14.5\text{ to }30\text{ V}$                     |      |      | 0.8  |               |
| $\Delta V_O/\Delta T$ | Output voltage drift     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125\text{ °C}$                        |      | -1   |      | mV/°C         |
| SVR                   | Supply voltage rejection | $V_I = 15\text{ to }25\text{ V}$ , $f = 120\text{ Hz}$ , $I_O = 300\text{ mA}$ | 55   |      |      | dB            |
| eN                    | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}$   |      | 75   |      | $\mu\text{V}$ |
| $V_d$                 | Dropout voltage          |  |      | 2    |      | V             |
| $I_{sc}$              | Short circuit current    | $V_I = 35\text{ V}$  |      | 240  |      | mA            |

Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 23\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified.

**Table 9. Electrical characteristics of L78M15C**

| Symbol                | Parameter                | Test conditions  | Min.  | Typ. | Max.  | Unit          |
|-----------------------|--------------------------|--|-------|------|-------|---------------|
| $V_O$                 | Output voltage           |  | 14.4  | 15   | 15.6  | V             |
| $V_O$                 | Output voltage           | $I_O = 5\text{ to }350\text{ mA}$ , $V_I = 17.5\text{ to }30\text{ V}$             | 14.25 | 15   | 15.75 | V             |
| $\Delta V_O$          | Line regulation          | $V_I = 17.5\text{ to }30\text{ V}$ , $I_O = 200\text{ mA}$                         |       |      | 100   | mV            |
|                       |                          | $V_I = 20\text{ to }30\text{ V}$ , $I_O = 200\text{ mA}$                           |       |      | 50    |               |
| $\Delta V_O$          | Load regulation          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25\text{ °C}$                           |       |      | 300   | mV            |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25\text{ °C}$                           |       |      | 150   |               |
| $I_d$                 | Quiescent current        |  |       |      | 6     | mA            |
| $\Delta I_d$          | Quiescent current change | $I_O = 5\text{ to }350\text{ mA}$  |       |      | 0.5   | mA            |
|                       |                          | $I_O = 200\text{ mA}$ , $V_I = 17.5\text{ to }30\text{ V}$                         |       |      | 0.8   |               |
| $\Delta V_O/\Delta T$ | Output voltage drift     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125\text{ °C}$                            |       | -1   |       | mV/°C         |
| SVR                   | Supply voltage rejection | $V_I = 18.5\text{ to }28.5\text{ V}$ , $f = 120\text{ Hz}$ , $I_O = 300\text{ mA}$ | 54    |      |       | dB            |
| eN                    | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}$   |       | 90   |       | $\mu\text{V}$ |
| $V_d$                 | Dropout voltage          |  |       | 2    |       | V             |
| $I_{sc}$              | Short circuit current    | $V_I = 35\text{ V}$  |       | 240  |       | mA            |

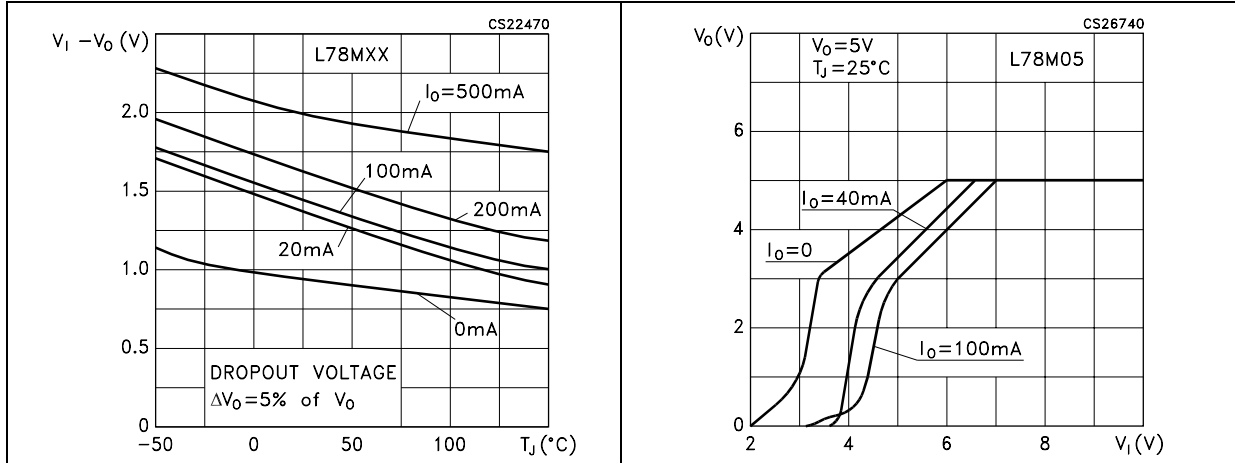
Refer to the test circuits,  $T_J = 25\text{ °C}$ ,  $V_I = 23\text{ V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified.

**Table 10. Electrical characteristics of L78M24C**

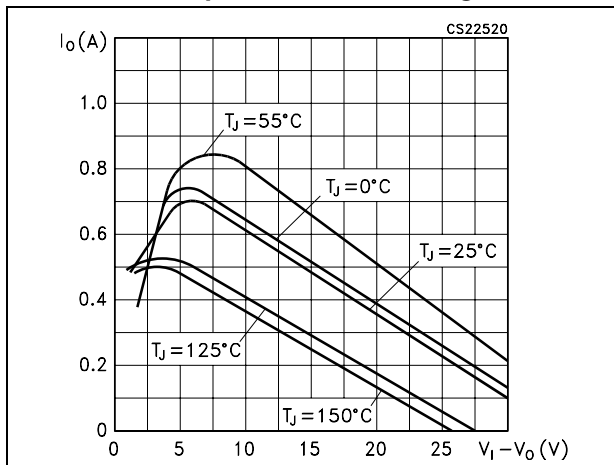
| Symbol                | Parameter                | Test conditions  | Min. | Typ. | Max. | Unit          |
|-----------------------|--------------------------|--|------|------|------|---------------|
| $V_O$                 | Output voltage           |  | 23   | 24   | 25   | V             |
| $V_O$                 | Output voltage           | $I_O = 5\text{ to }350\text{ mA}$ , $V_I = 27\text{ to }38\text{ V}$           | 22.8 | 24   | 25.2 | V             |
| $\Delta V_O$          | Line regulation          | $V_I = 27\text{ to }38\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 100  | mV            |
|                       |                          | $V_I = 28\text{ to }38\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 50   |               |
| $\Delta V_O$          | Load regulation          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25\text{ °C}$                       |      |      | 480  | mV            |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25\text{ °C}$                       |      |      | 240  |               |
| $I_d$                 | Quiescent current        |  |      |      | 6    | mA            |
| $\Delta I_d$          | Quiescent current change | $I_O = 5\text{ to }350\text{ mA}$  |      |      | 0.5  | mA            |
|                       |                          | $I_O = 200\text{ mA}$ , $V_I = 27\text{ to }38\text{ V}$                       |      |      | 0.8  |               |
| $\Delta V_O/\Delta T$ | Output voltage drift     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125\text{ °C}$                        |      | -1.2 |      | mV/°C         |
| SVR                   | Supply voltage rejection | $V_I = 28\text{ to }38\text{ V}$ , $f = 120\text{ Hz}$ , $I_O = 300\text{ mA}$ | 50   |      |      | dB            |
| eN                    | Output noise voltage     | $B = 10\text{ Hz to }100\text{ kHz}$   |      | 170  |      | $\mu\text{V}$ |
| $V_d$                 | Dropout voltage          |  |      | 2    |      | V             |
| $I_{sc}$              | Short circuit current    | $V_I = 35\text{ V}$  |      | 240  |      | mA            |

## 6 Typical performance

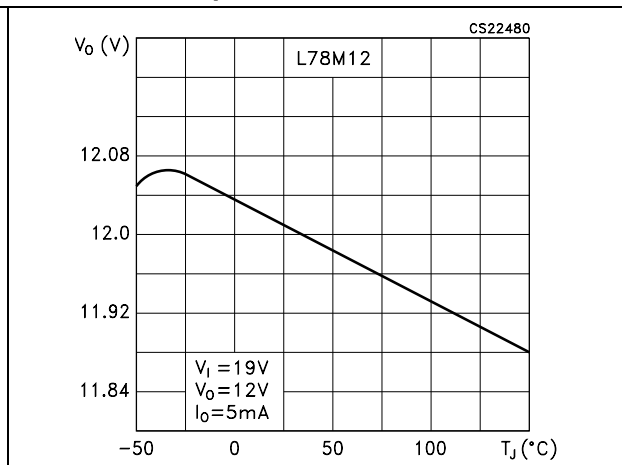
**Figure 8. Dropout voltage vs. junction temp.** **Figure 9. Dropout characteristics**



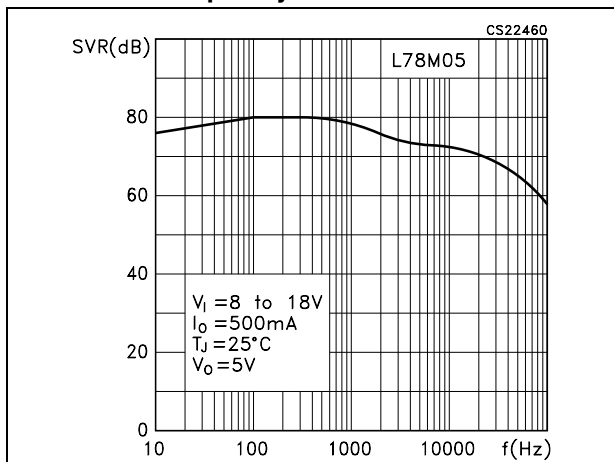
**Figure 10. Peak output current vs. input-output differential voltage**



**Figure 11. Output voltage vs. junction temperature**



**Figure 12. Supply voltage rejection vs. frequency**



**Figure 13. Quiescent current vs. junction temperature**

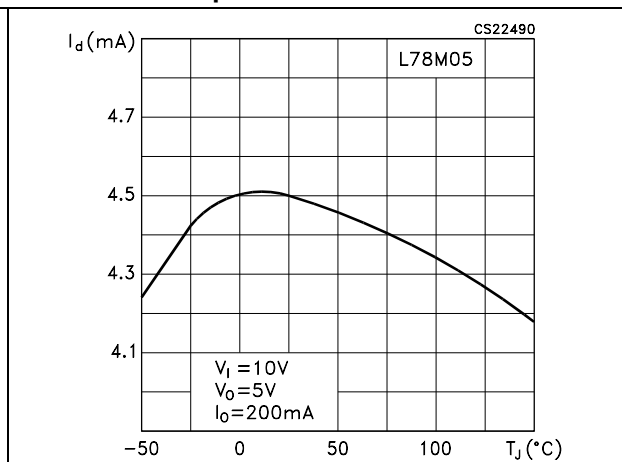


Figure 14. Load transient response

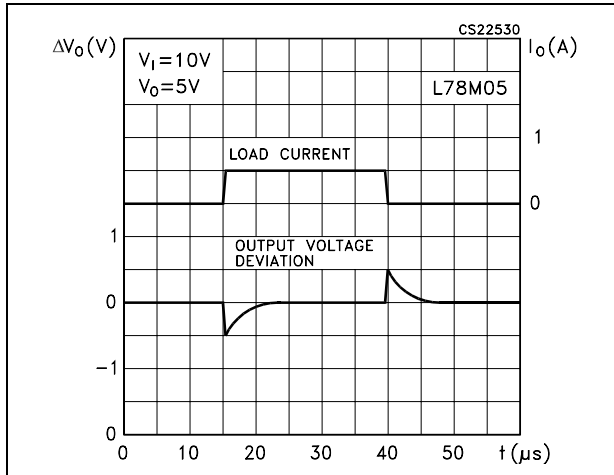


Figure 15. Line transient response

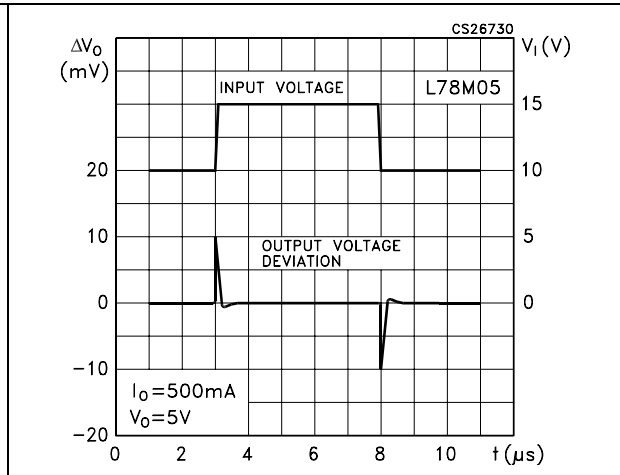


Figure 16. Quiescent current vs. input voltage

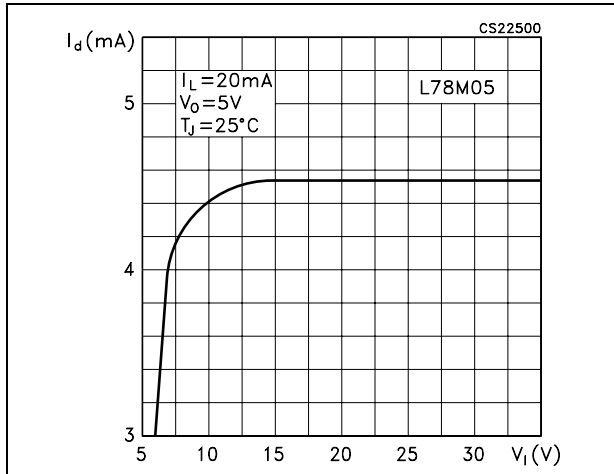
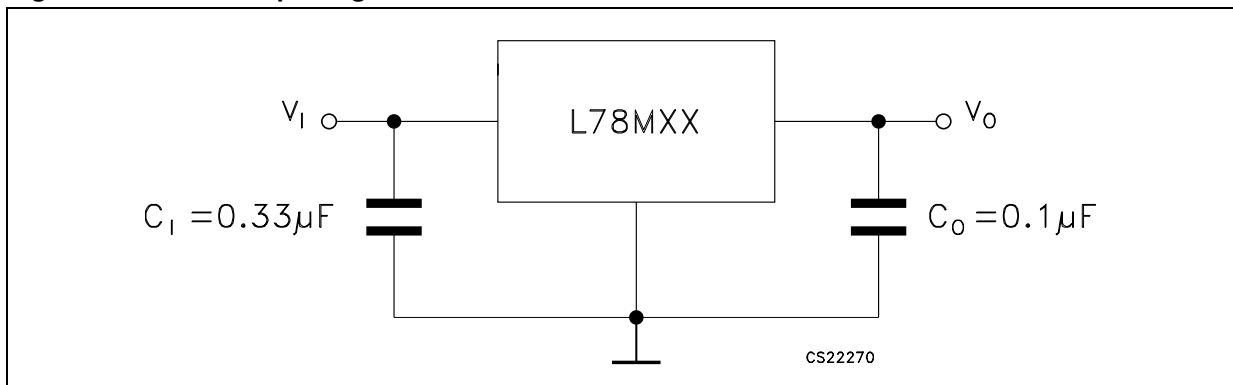


Figure 17. Fixed output regulator



1. To specify an output voltage, substitute voltage value for "XX".
2. Although no output capacitor is need for stability, it does improve transient response.
3. Required if regulator is locate an appreciable distance from power supply filter.

Figure 18. Constant current regulator

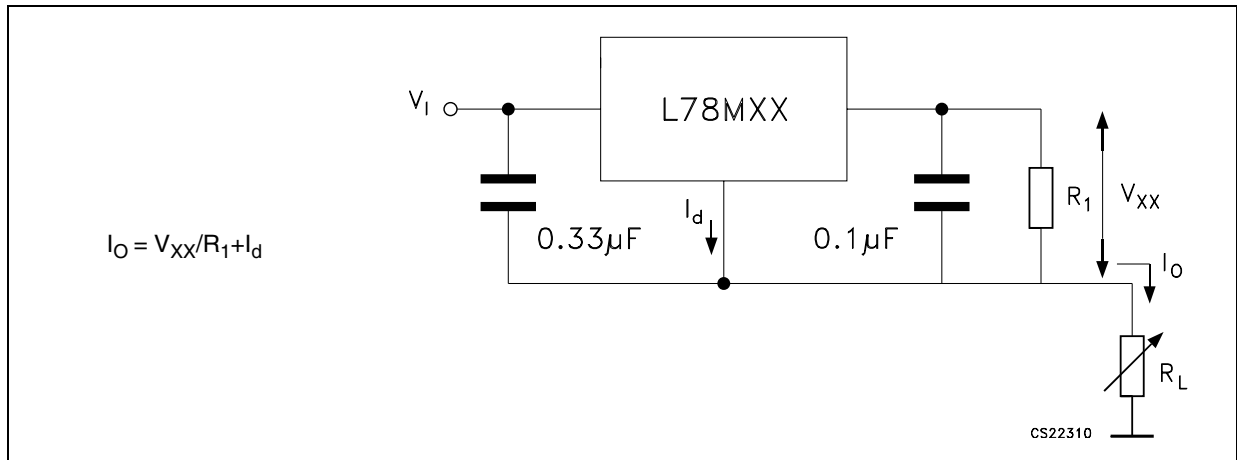


Figure 19. Circuit for increasing output voltage

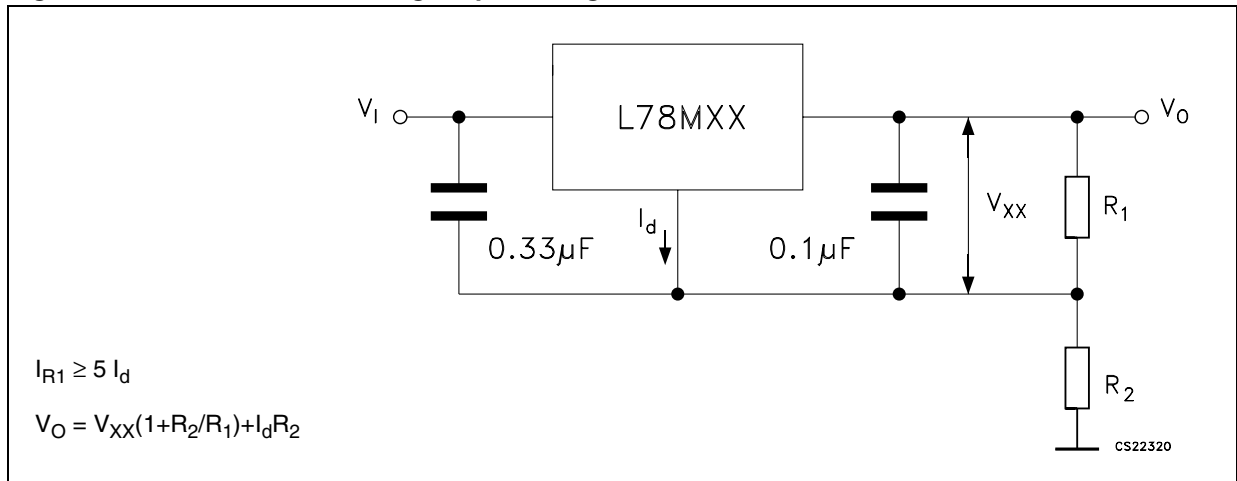


Figure 20. Adjustable output regulator (7 to 30 V)

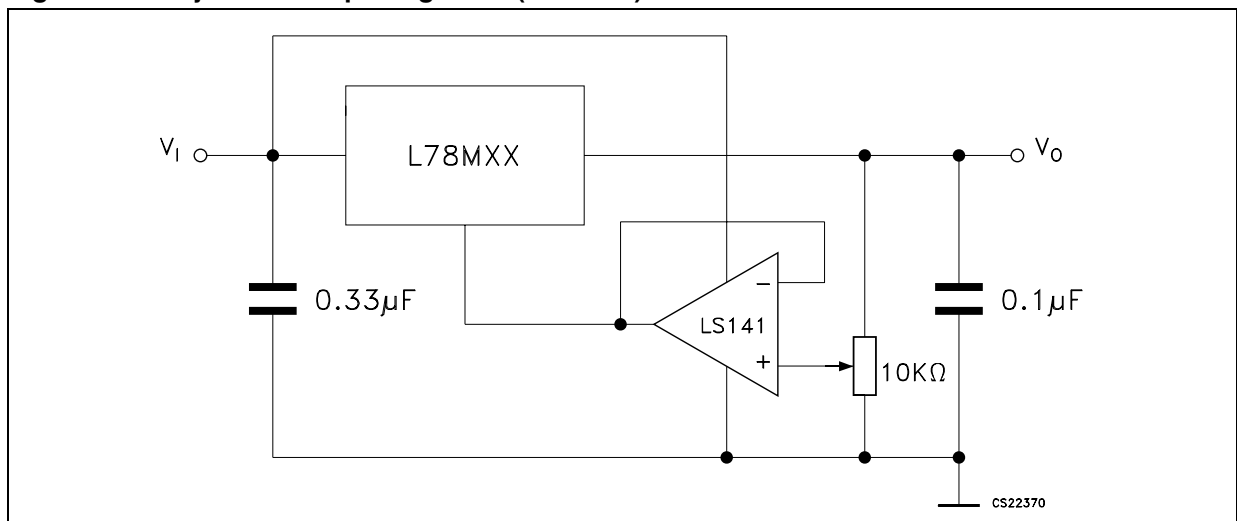


Figure 21. 0.5 to 10 V regulator

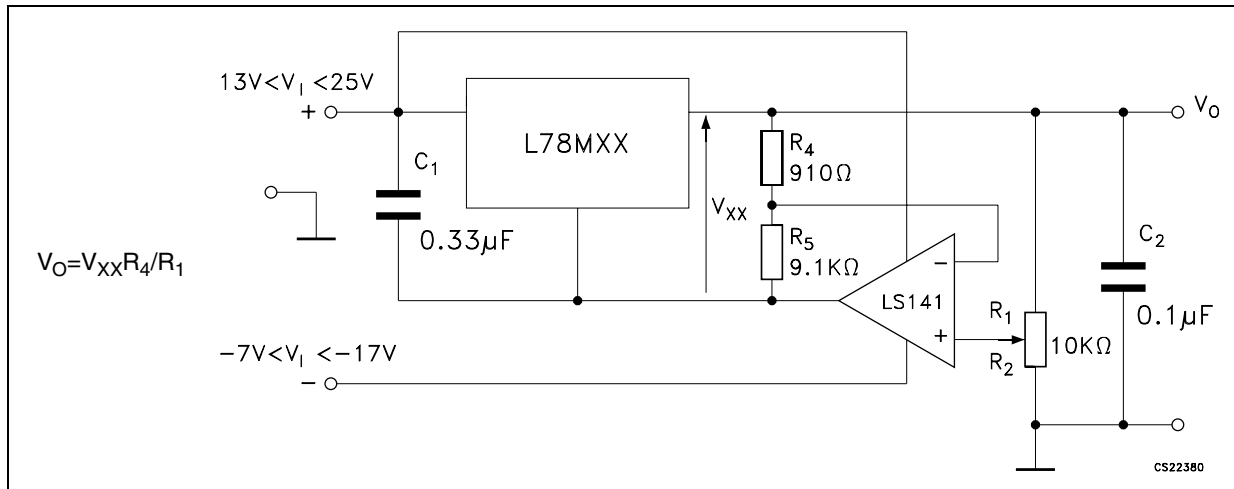


Figure 22. High current voltage regulator

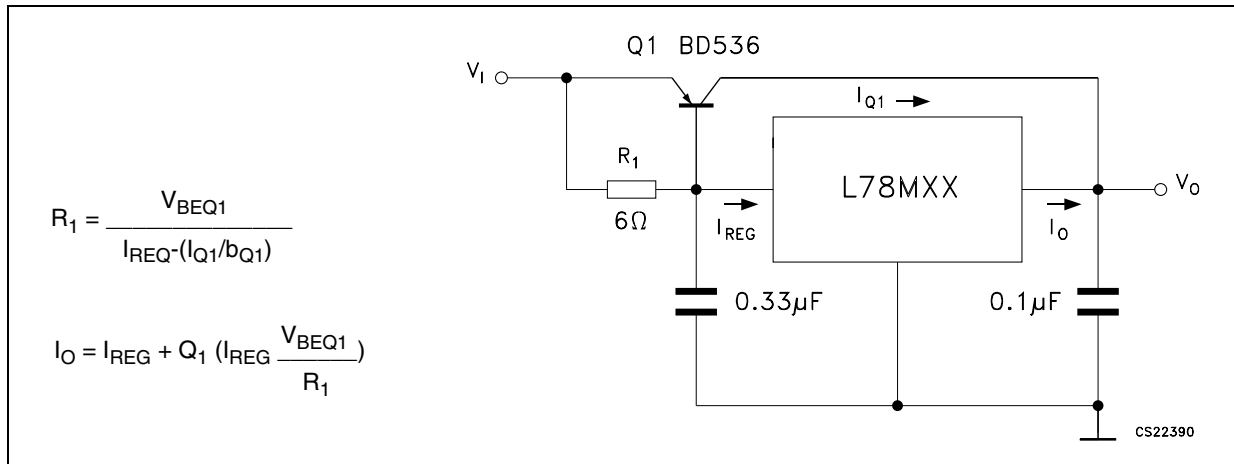


Figure 23. High output current with short circuit protection

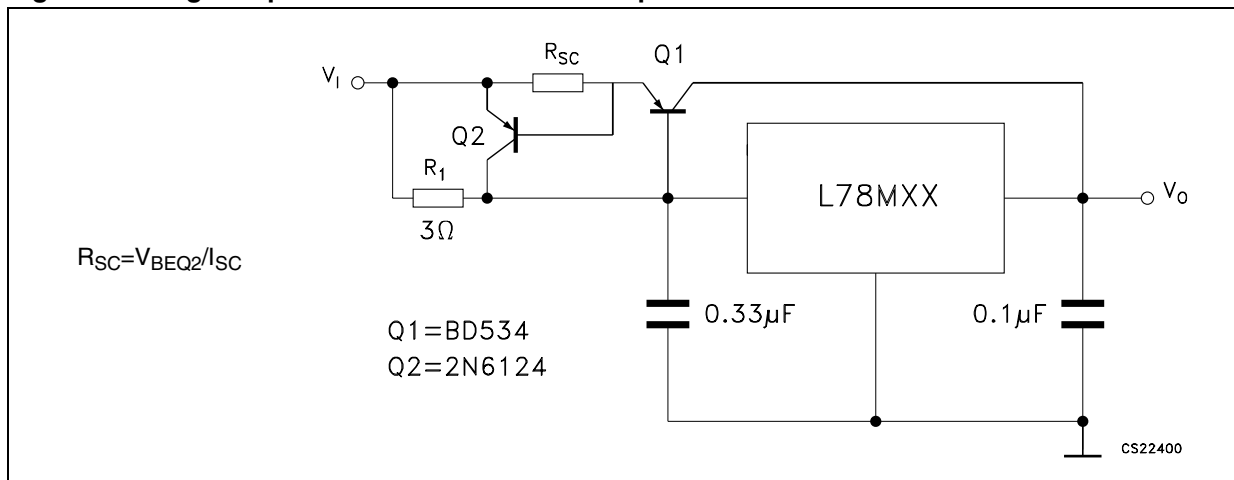


Figure 24. Tracking voltage regulator

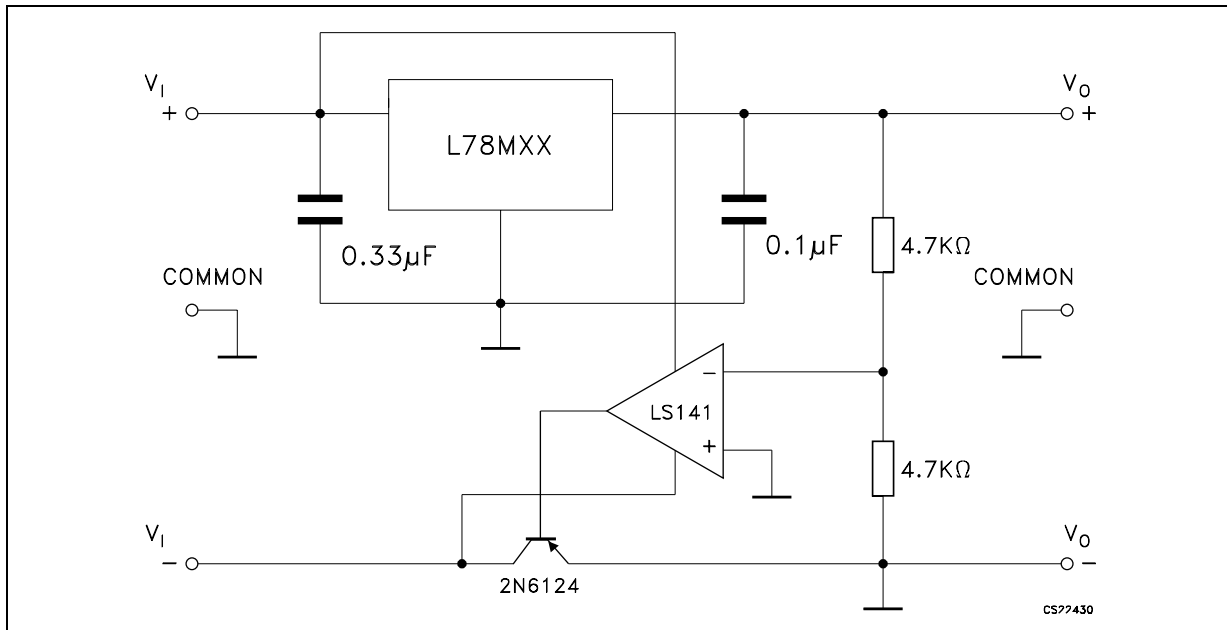


Figure 25. High input voltage circuit

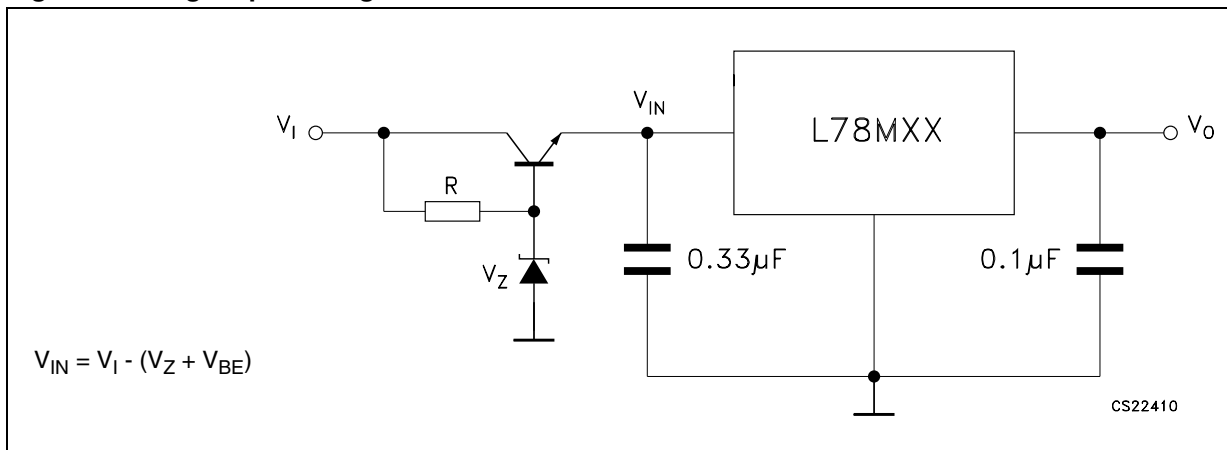


Figure 26. Reducing power dissipation with dropping resistor

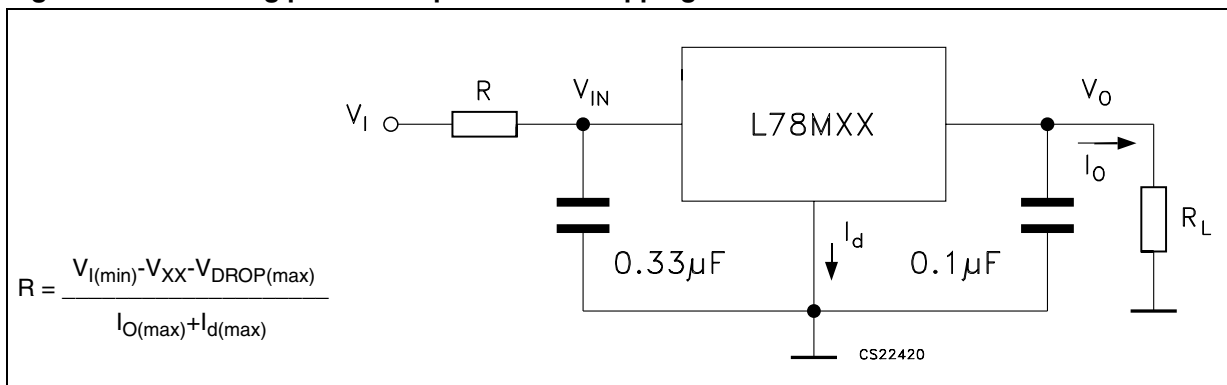
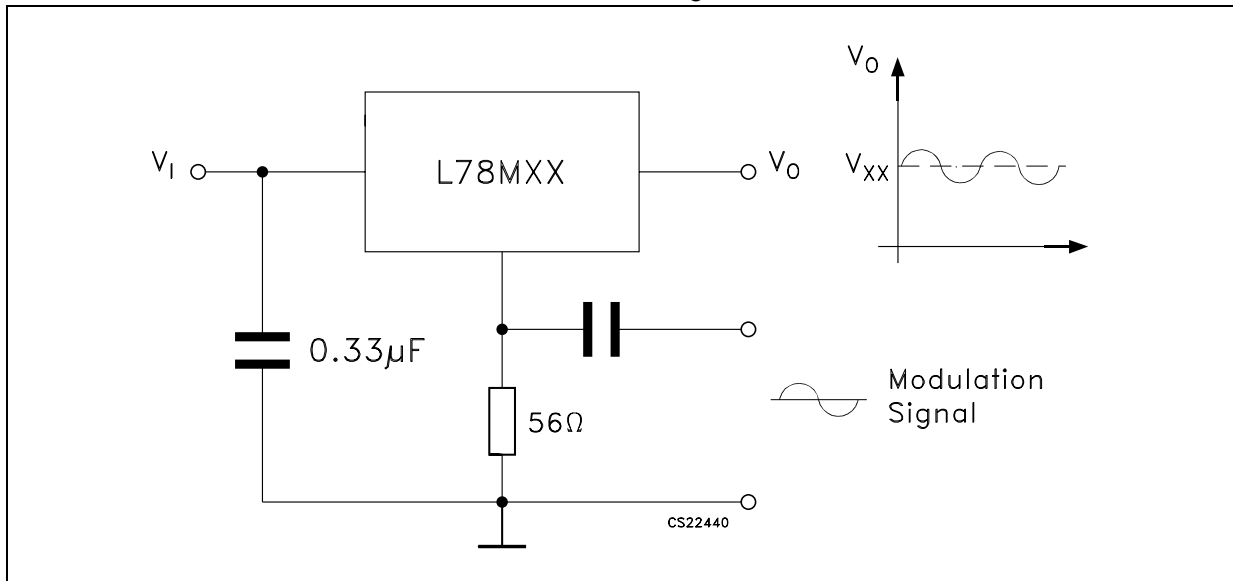
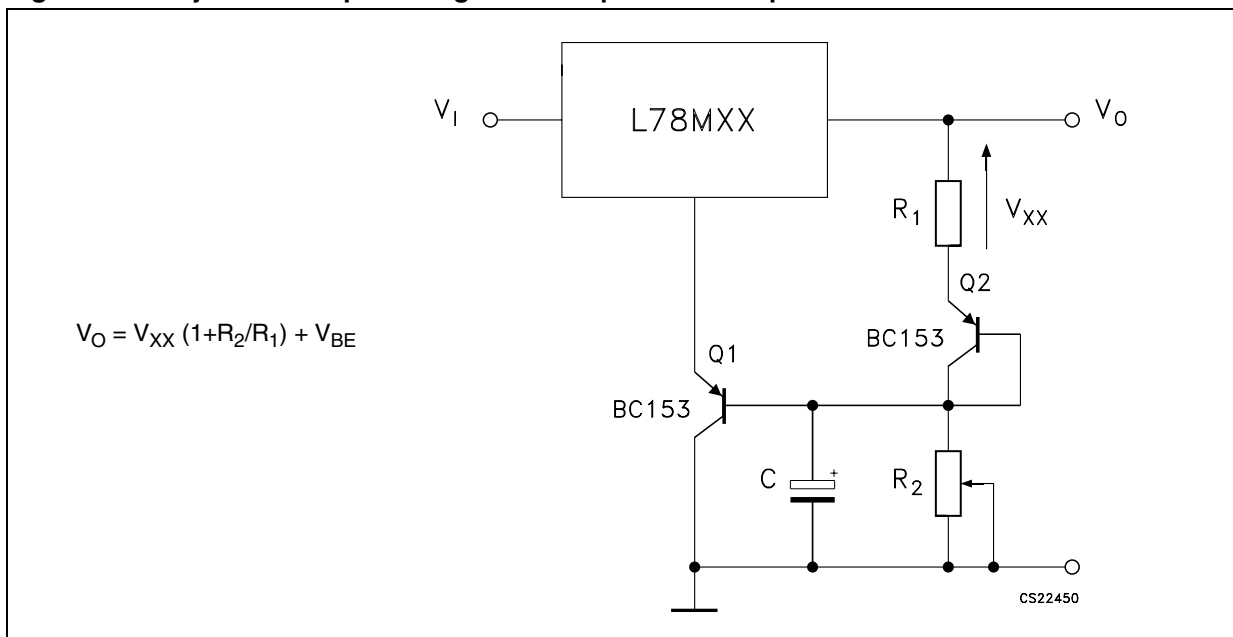


Figure 27. Power AM modulator (unity voltage gain,  $I_O \leq 0.5$ )



Note: The circuit performs well up to 100 kHz.

Figure 28. Adjustable output voltage with temperature compensation



Note:  $Q_2$  is connected as a diode in order to compensate the variation of the  $Q_1 V_{BE}$  with the temperature.  $C$  allows a slow rise time of the  $V_O$ .



## 7 Package mechanical data

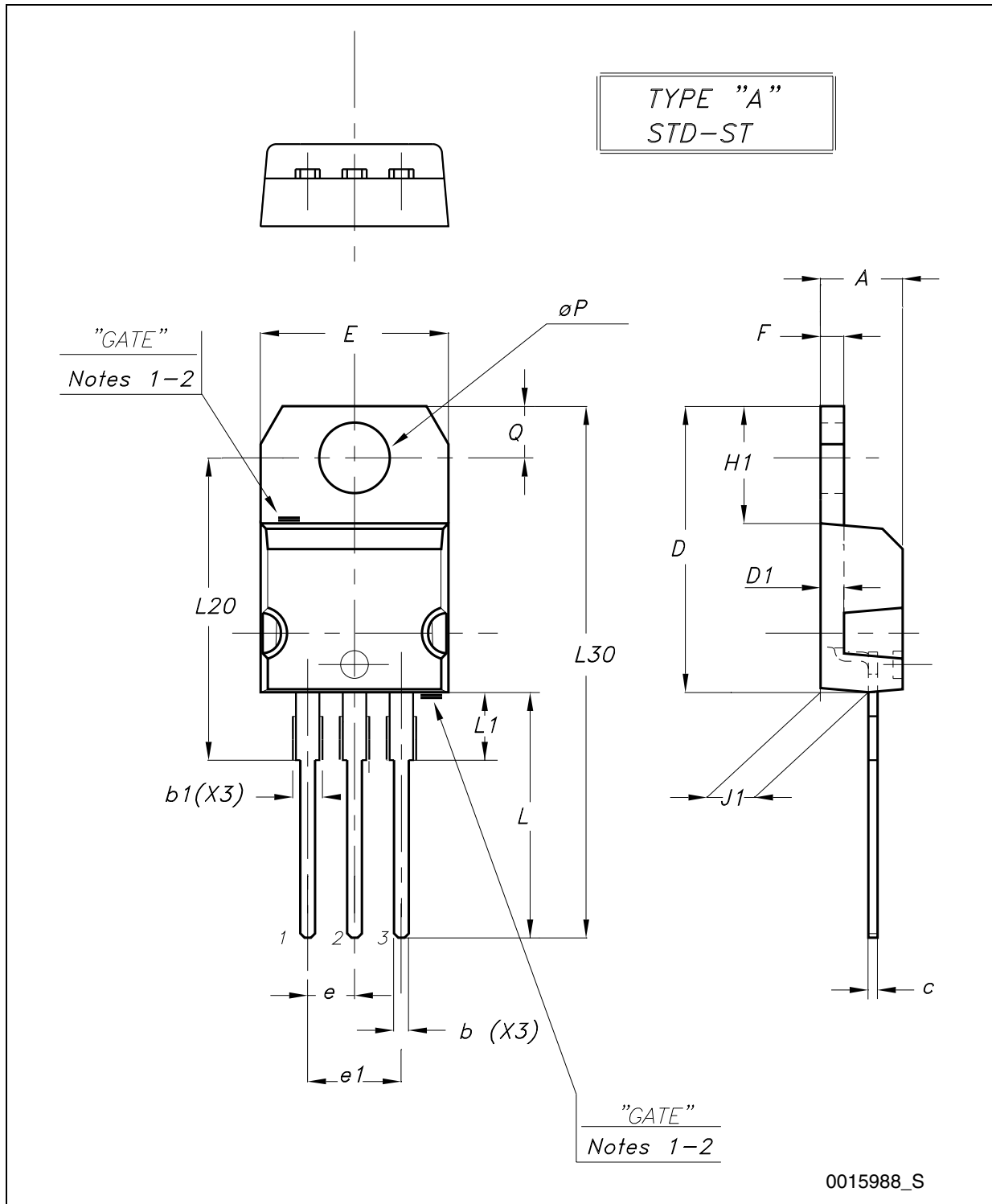
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK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

**Table 11. TO-220 mechanical data**

| Dim. | Type STD - ST Dual Gauge |       |       | Type STD - ST Single Gauge |       |       |
|------|--------------------------|-------|-------|----------------------------|-------|-------|
|      | mm.                      |       |       | mm.                        |       |       |
|      | Min.                     | Typ.  | Max.  | Min.                       | Typ.  | Max.  |
| A    | 4.40                     |       | 4.60  | 4.40                       |       | 4.60  |
| b    | 0.61                     |       | 0.88  | 0.61                       |       | 0.88  |
| b1   | 1.14                     |       | 1.70  | 1.14                       |       | 1.70  |
| c    | 0.48                     |       | 0.70  | 0.48                       |       | 0.70  |
| D    | 15.25                    |       | 15.75 | 15.25                      |       | 15.75 |
| D1   |                          | 1.27  |       |                            |       |       |
| E    | 10.00                    |       | 10.40 | 10.00                      |       | 10.40 |
| e    | 2.40                     |       | 2.70  | 2.40                       |       | 2.70  |
| e1   | 4.95                     |       | 5.15  | 4.95                       |       | 5.15  |
| F    | 1.23                     |       | 1.32  | 0.51                       |       | 0.60  |
| H1   | 6.20                     |       | 6.60  | 6.20                       |       | 6.60  |
| J1   | 2.40                     |       | 2.72  | 2.40                       |       | 2.72  |
| L    | 13.00                    |       | 14.00 | 13.00                      |       | 14.00 |
| L1   | 3.50                     |       | 3.93  | 3.50                       |       | 3.93  |
| L20  |                          | 16.40 |       |                            | 16.40 |       |
| L30  |                          | 28.90 |       |                            | 28.90 |       |
| ∅P   | 3.75                     |       | 3.85  | 3.75                       |       | 3.85  |
| Q    | 2.65                     |       | 2.95  | 2.65                       |       | 2.95  |

*In spite of some difference in tolerances, the packages are compatible.*

Figure 29. Drawing dimension TO-220 (type STD-ST Dual Gauge)



- Note: 1 Maximum resin gate protrusion: 0.5 mm.  
 2 Resin gate position is accepted in each of the two positions shown on the drawing, or their symmetrical.

Figure 30. Drawing dimension TO-220 (type STD-ST Single Gauge)

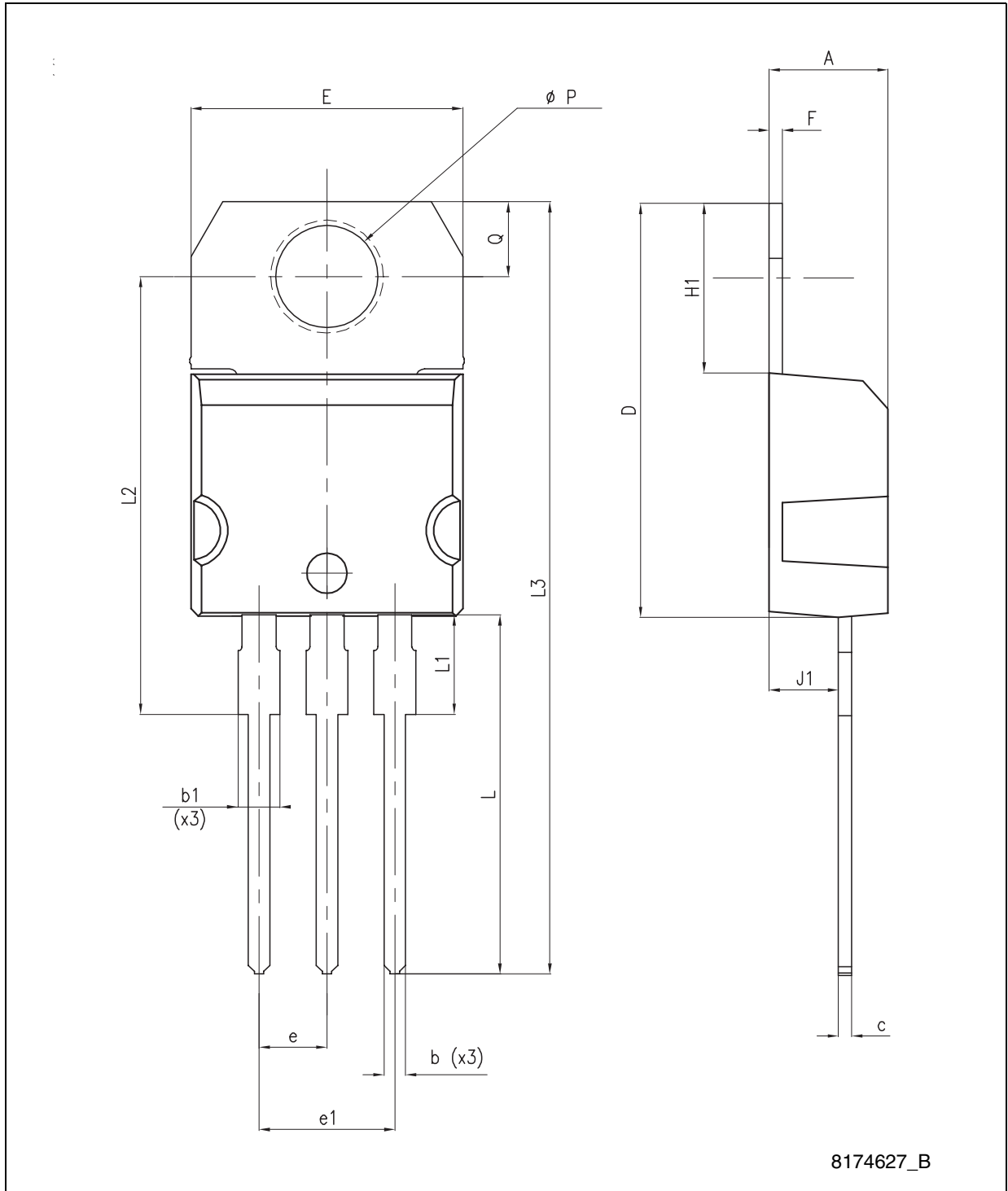


Figure 31. Drawing dimension tube for TO-220 Dual Gauge (mm.)

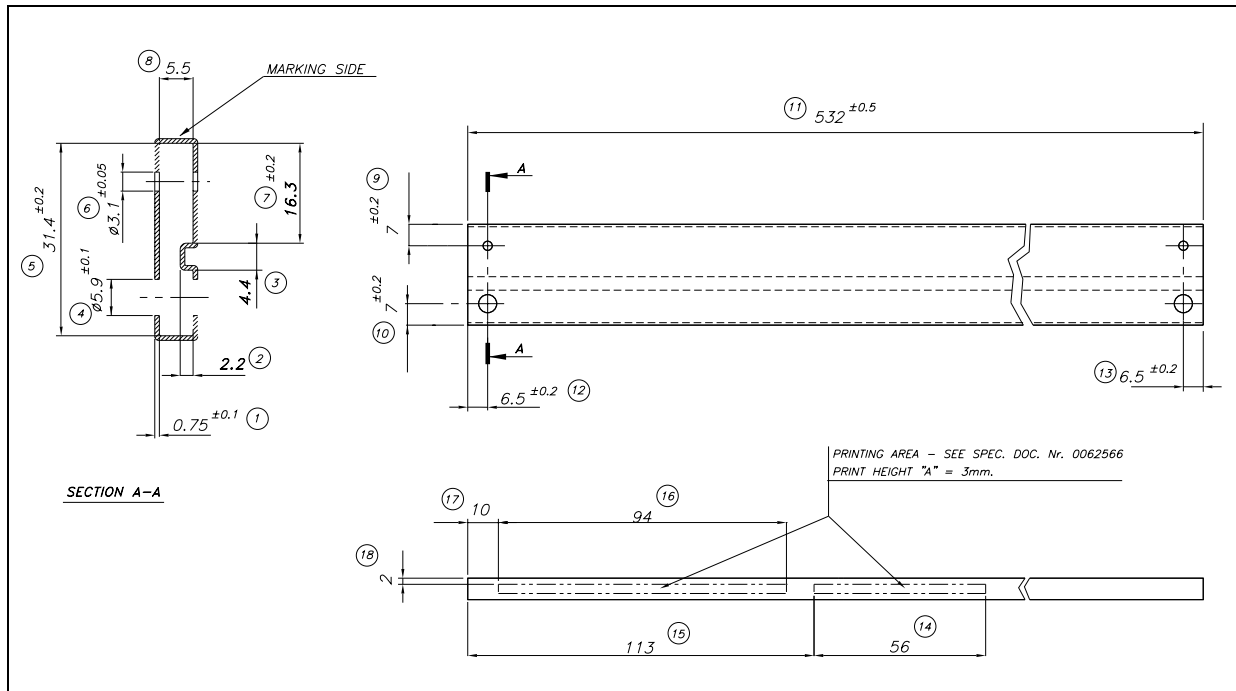
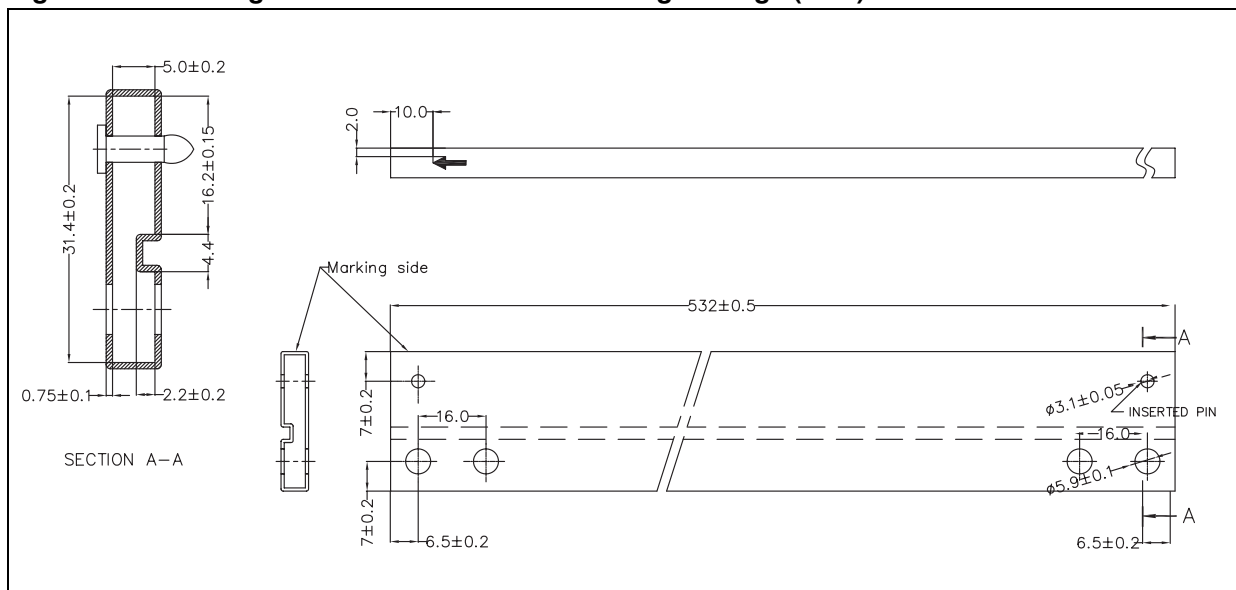


Figure 32. Drawing dimension tube for TO-220 Single Gauge (mm.)



**TO-220FP mechanical data**

| Dim. | mm.  |     |       | inch. |       |       |
|------|------|-----|-------|-------|-------|-------|
|      | Min. | Typ | Max.  | Min.  | Typ.  | Max.  |
| A    | 4.40 |     | 4.60  | 0.173 |       | 0.181 |
| B    | 2.5  |     | 2.7   | 0.098 |       | 0.106 |
| D    | 2.5  |     | 2.75  | 0.098 |       | 0.108 |
| E    | 0.45 |     | 0.70  | 0.017 |       | 0.027 |
| F    | 0.75 |     | 1     | 0.030 |       | 0.039 |
| F1   | 1.15 |     | 1.50  | 0.045 |       | 0.059 |
| F2   | 1.15 |     | 1.50  | 0.045 |       | 0.059 |
| G    | 4.95 |     | 5.2   | 0.194 |       | 0.204 |
| G1   | 2.4  |     | 2.7   | 0.094 |       | 0.106 |
| H    | 10.0 |     | 10.40 | 0.393 |       | 0.409 |
| L2   |      | 16  |       |       | 0.630 |       |
| L3   | 28.6 |     | 30.6  | 1.126 |       | 1.204 |
| L4   | 9.8  |     | 10.6  | 0.385 |       | 0.417 |
| L5   | 2.9  |     | 3.6   | 0.114 |       | 0.142 |
| L6   | 15.9 |     | 16.4  | 0.626 |       | 0.645 |
| L7   | 9    |     | 9.3   | 0.354 |       | 0.366 |
| DIA. | 3    |     | 3.2   | 0.118 |       | 0.126 |

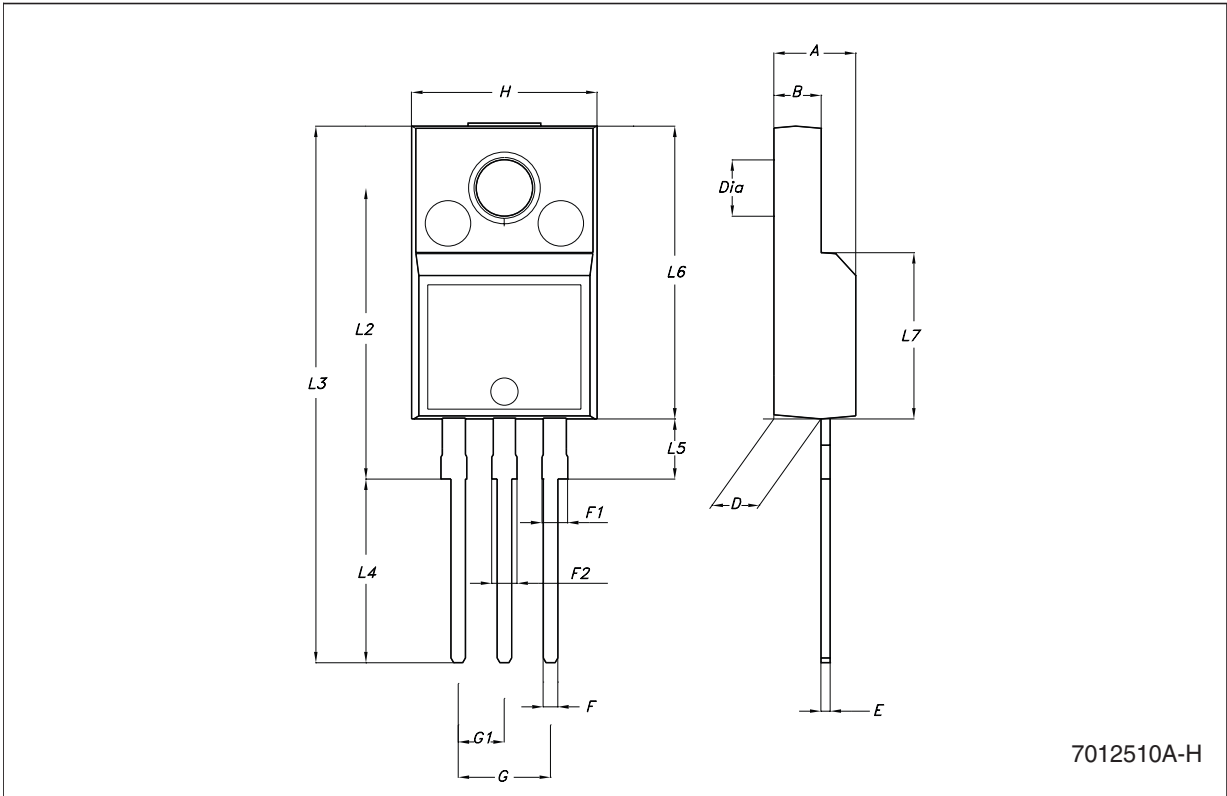
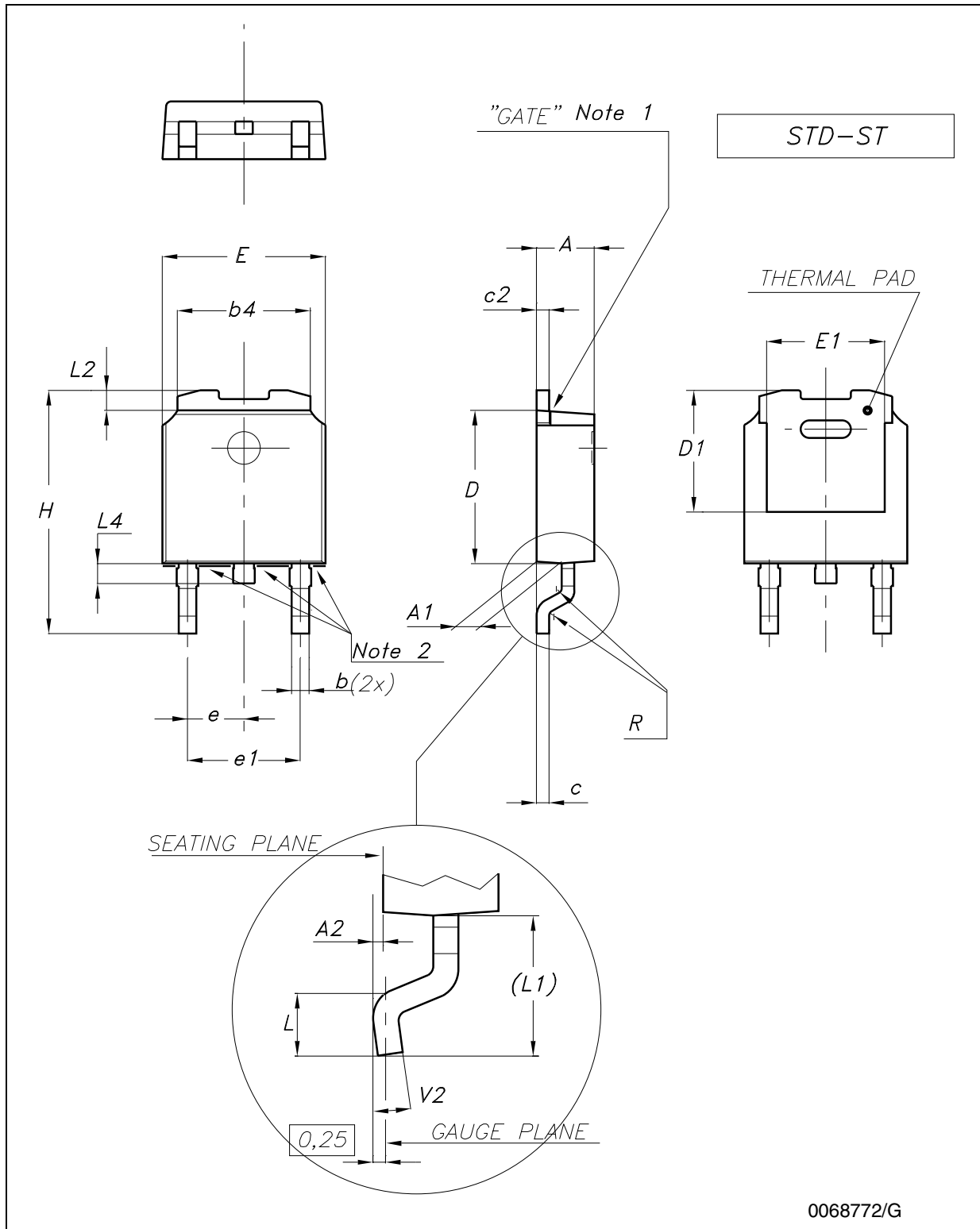


Figure 33. Drawing dimension DPAK (type STD-ST)



Note: 1 Max resin gate protrusion: 0.5 mm.

2 Max resin protrusion: 0.25 mm.

Figure 34. Drawing dimension DPAK (type FUJITSU-subcon.)

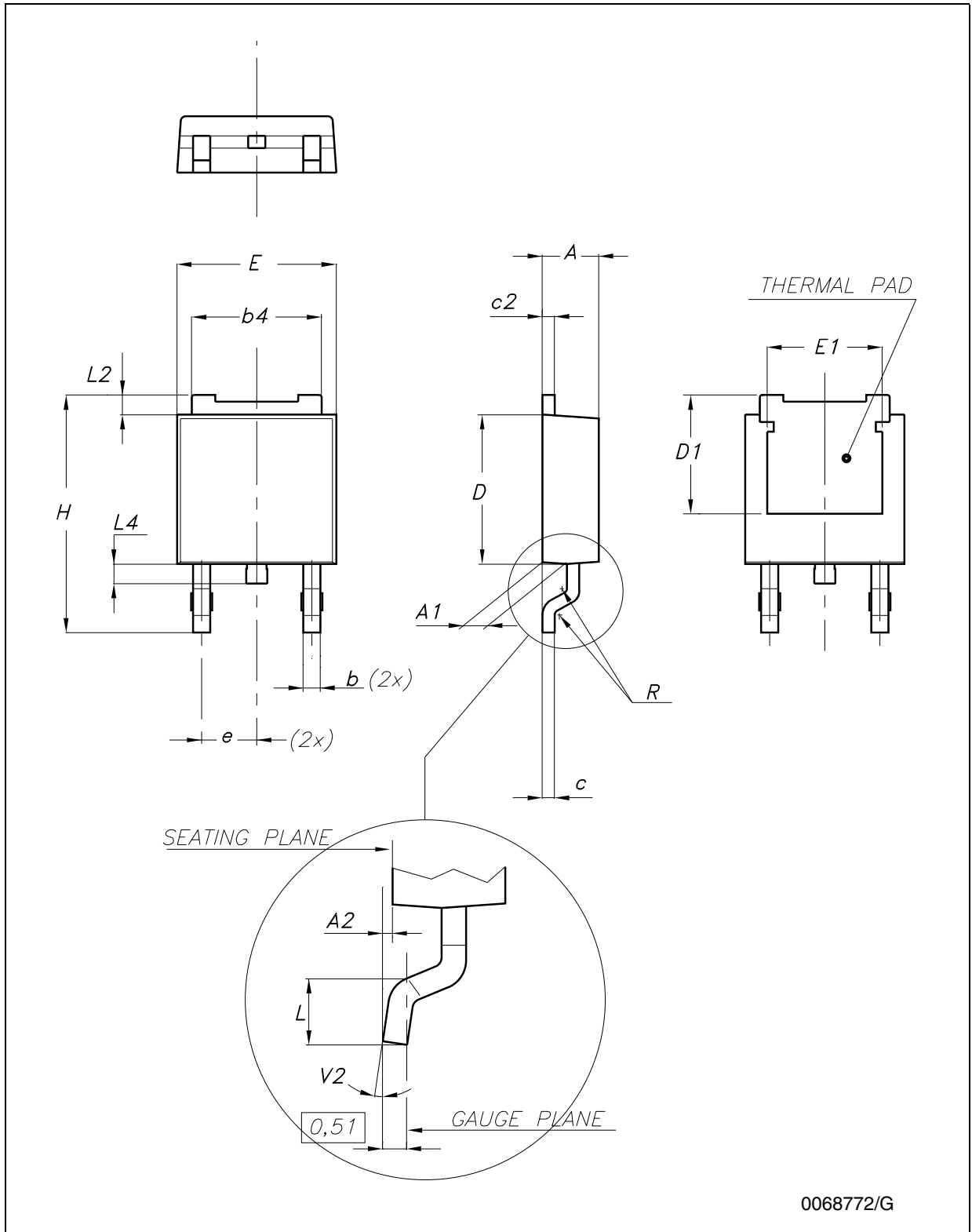
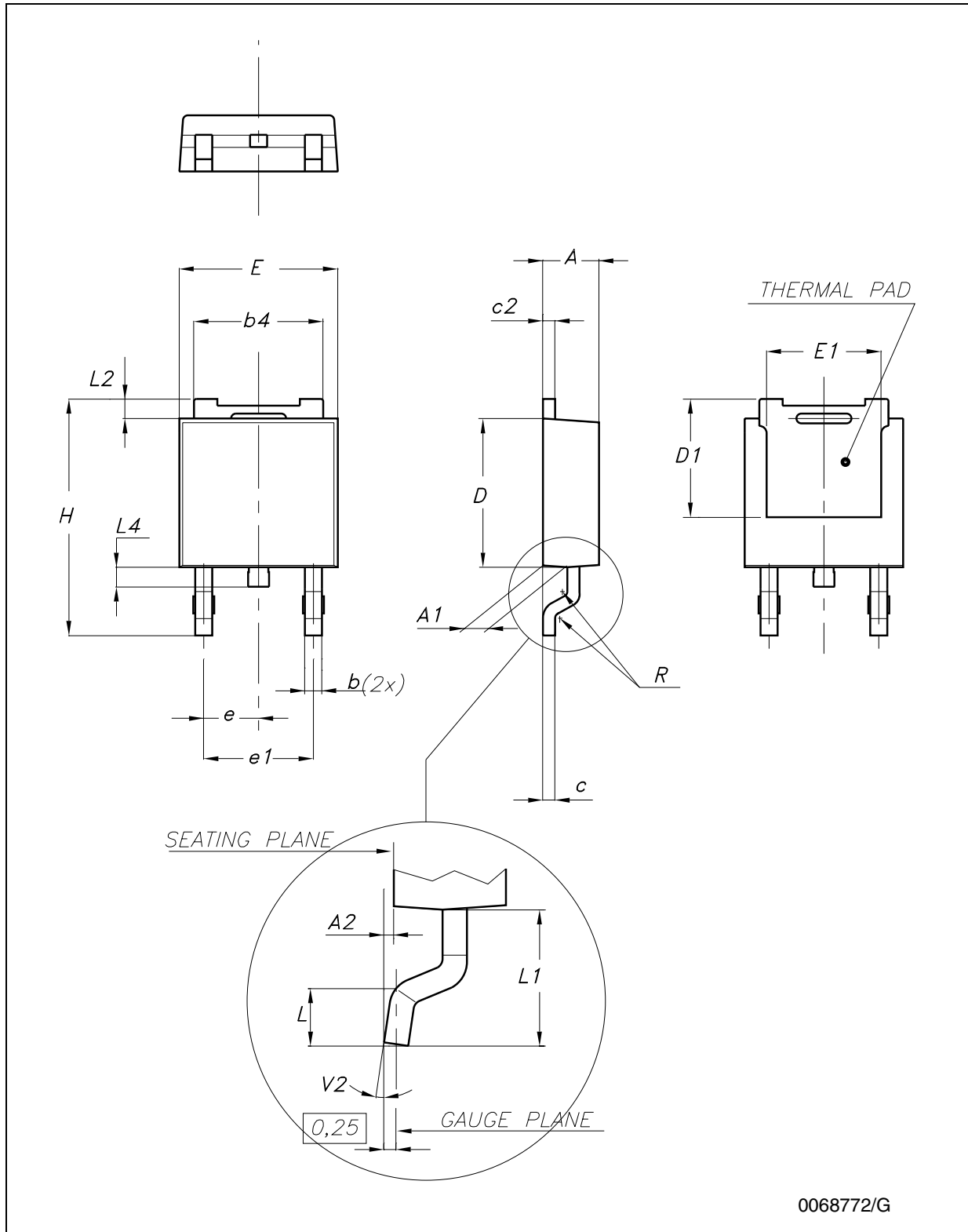


Figure 35. Drawing dimension DPAK (type IDS-subcon.)



0068772/G



Table 12. 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 36. DPAK footprint recommended data

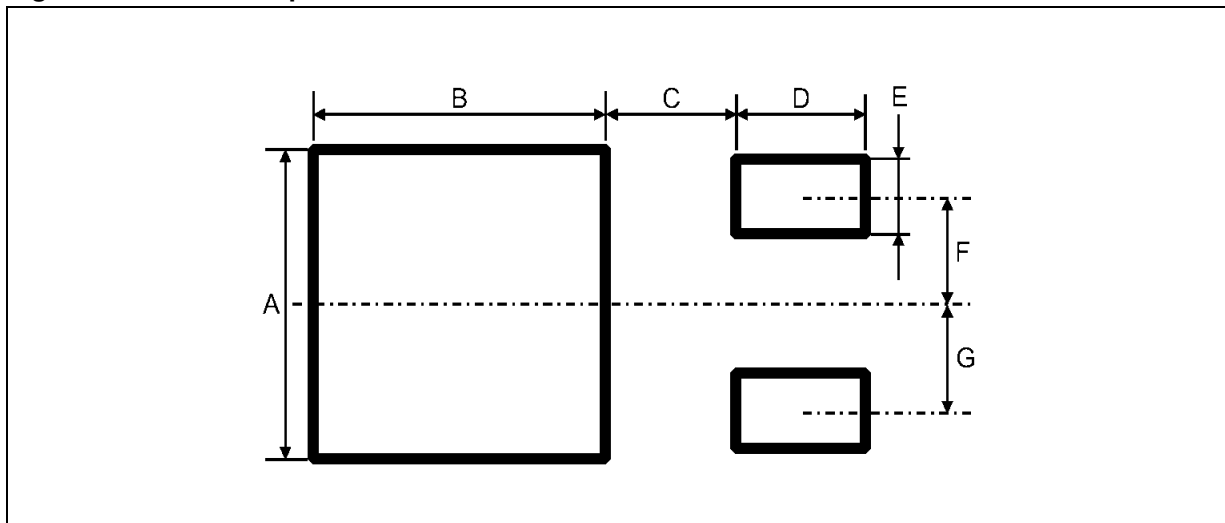
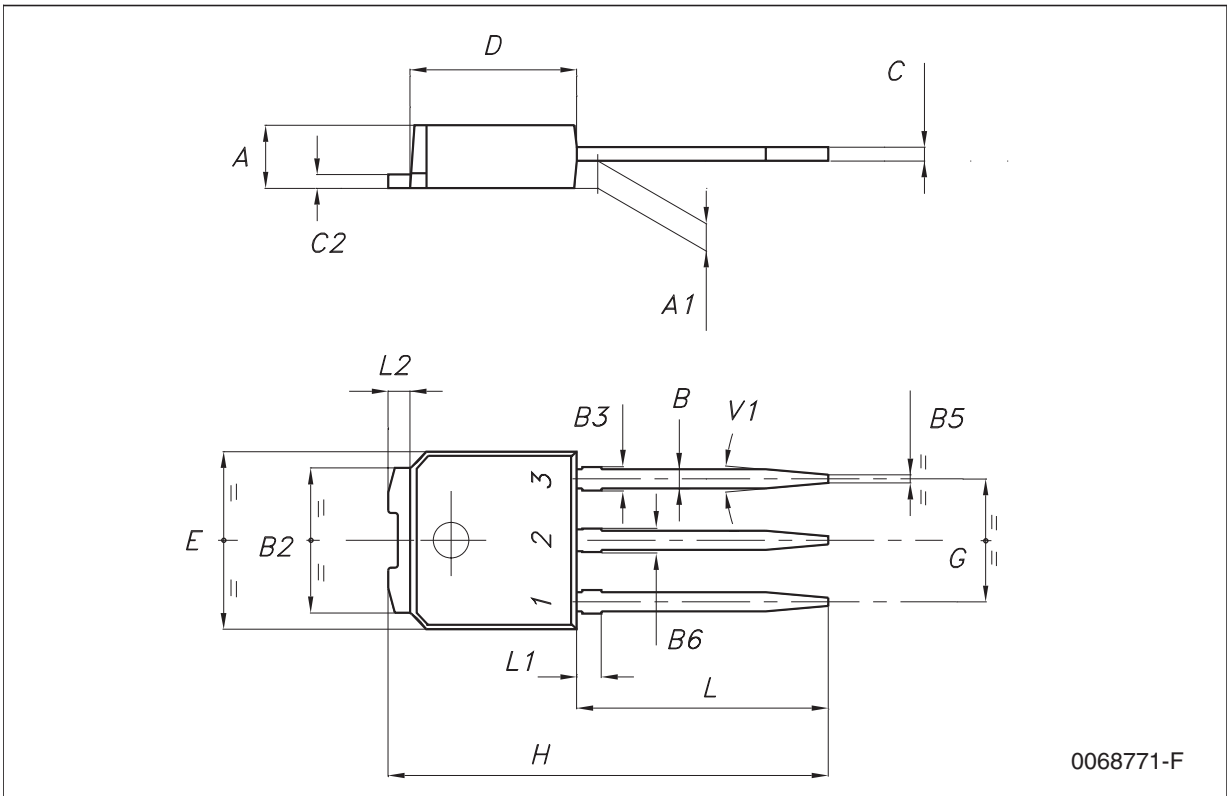


Table 13. Footprint data

| Dim. | 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 |

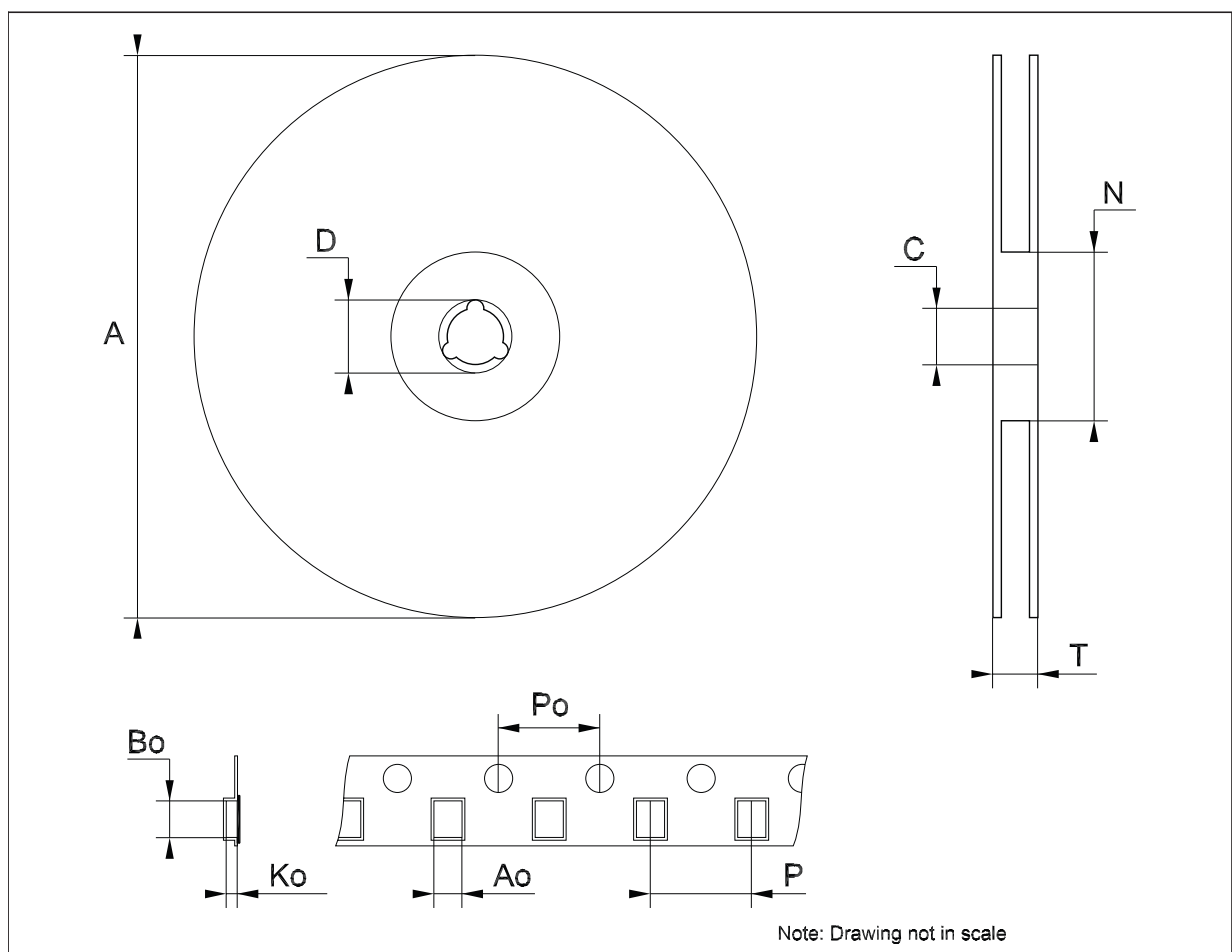
**IPAK mechanical data**

| 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 |
| B    | 0.64 |      | 0.9  | 0.025 |       | 0.035 |
| B2   | 5.2  |      | 5.4  | 0.204 |       | 0.212 |
| B3   |      |      | 0.95 |       |       | 0.037 |
| B5   |      | 0.3  |      |       | 0.012 |       |
| B6   |      |      | 0.95 |       |       | 0.037 |
| 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    | 4.4  |      | 4.6  | 0.173 |       | 0.181 |
| H    | 15.9 |      | 16.3 | 0.626 |       | 0.641 |
| L    | 9    |      | 9.4  | 0.354 |       | 0.370 |
| L1   | 0.8  |      | 1.2  | 0.031 |       | 0.047 |
| L2   |      | 0.8  | 1    |       | 0.031 | 0.039 |



**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 | 0.276  |
| 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  |



## 8 Revision history

**Table 14. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 21-Jun-2004 | 6        | Document updating.  |
| 30-Aug-2006 | 7        | Order codes updated.  |
| 29-Nov-2006 | 8        | DPAK mechanical data updated and add footprint data.  |
| 06-Jun-2007 | 9        | Order codes updated.  |
| 10-Dec-2007 | 10       | Added <a href="#">Table 1</a> .   |
| 19-Feb-2008 | 11       | Modified: <a href="#">Table 1 on page 1</a> .   |
| 15-Jul-2008 | 12       | Modified: <a href="#">Table 1 on page 1</a> and <a href="#">Table 14 on page 29</a> .   |
| 07-Apr-2009 | 13       | Modified: <a href="#">Figure 9 on page 11</a> and <a href="#">Figure 15 on page 12</a> .  |
| 14-Jun-2010 | 14       | Added: <a href="#">Table 11 on page 17</a> , <a href="#">Figure 29 on page 18</a> , <a href="#">Figure 30 on page 19</a> , <a href="#">Figure 31</a> and <a href="#">Figure 32 on page 20</a> . |
| 11-Nov-2010 | 15       | Modified: $R_{thJC}$ value for TO-220 <a href="#">Table 3 on page 5</a> .   |
| 08-Feb-2012 | 16       | Added: order codes L78M05CV-DG, L78M12CV-DG and L78M15CV-DG <a href="#">Table 1 on page 1</a> .   |
| 09-Mar-2012 | 17       | Added: order codes L78M08CV-DG and L78M09CV-DG <a href="#">Table 1 on page 1</a> .  |
| 15-May-2012 | 18       | Added: order codes L78M24CV-DG <a href="#">Table 1 on page 1</a> .  |

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