

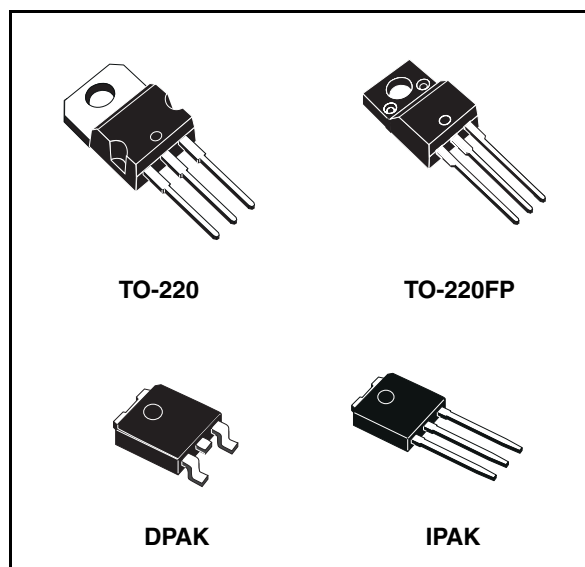
## Positive voltage regulators

### Features

- Output current to 0.5A
- Output voltages of 5; 6; 8; 9; 10; 12; 15; 18; 20; 24V
- Thermal overload protection
- Short circuit protection
- Output transition SOA protection

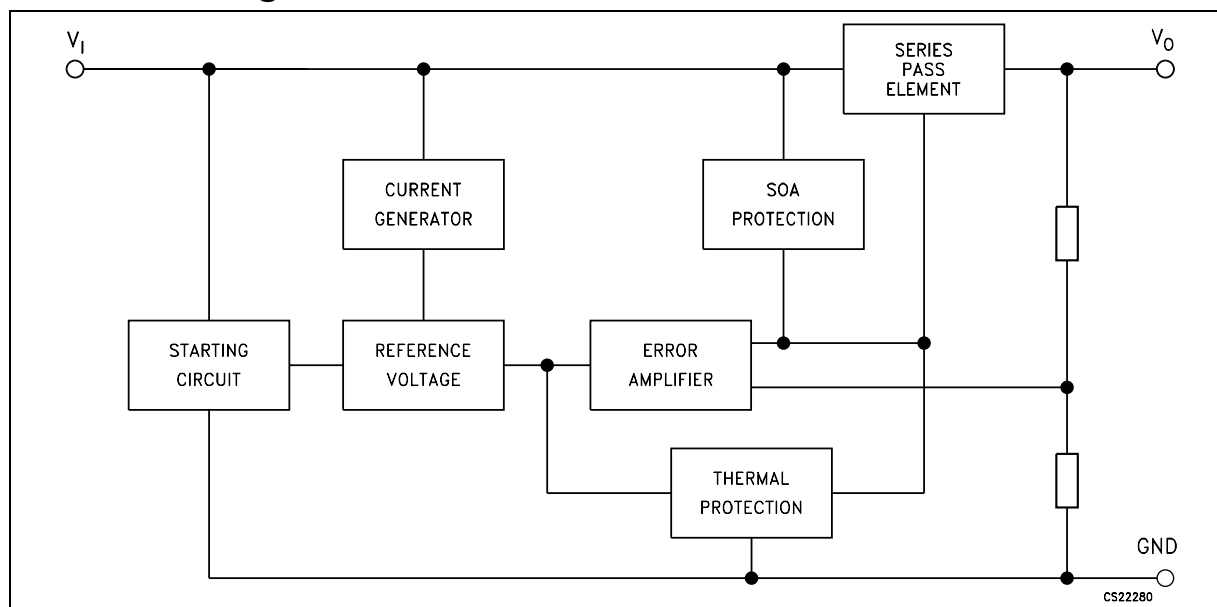
### Description

The L78M00 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 shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can



deliver over 0.5A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltage and currents.

### Schematic diagram



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# 1 Pin configuration

Figure 1. Pin connections (top view)

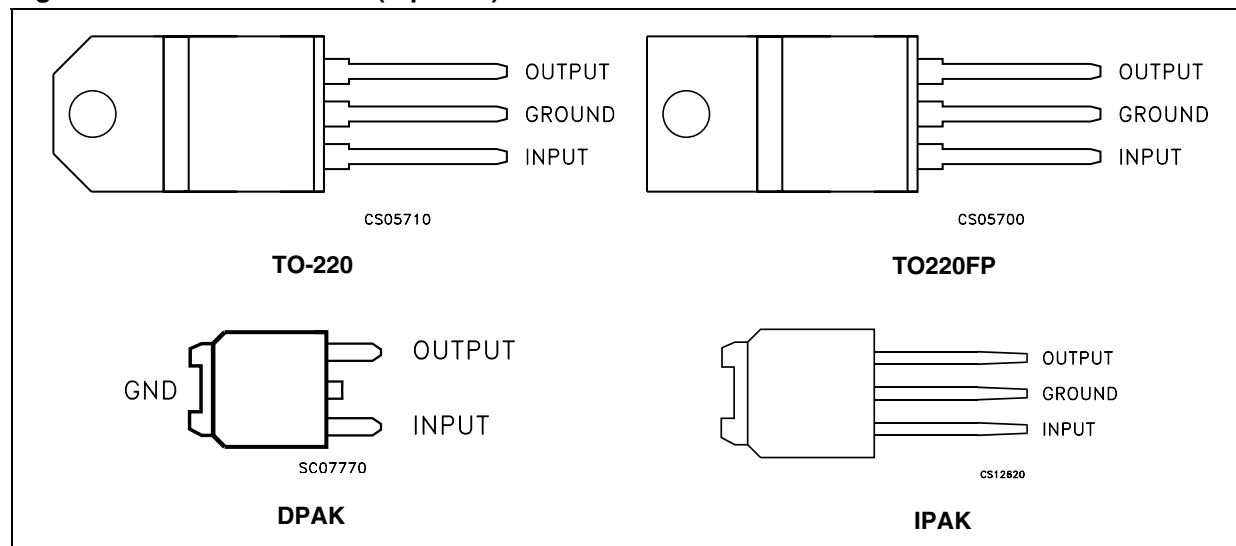
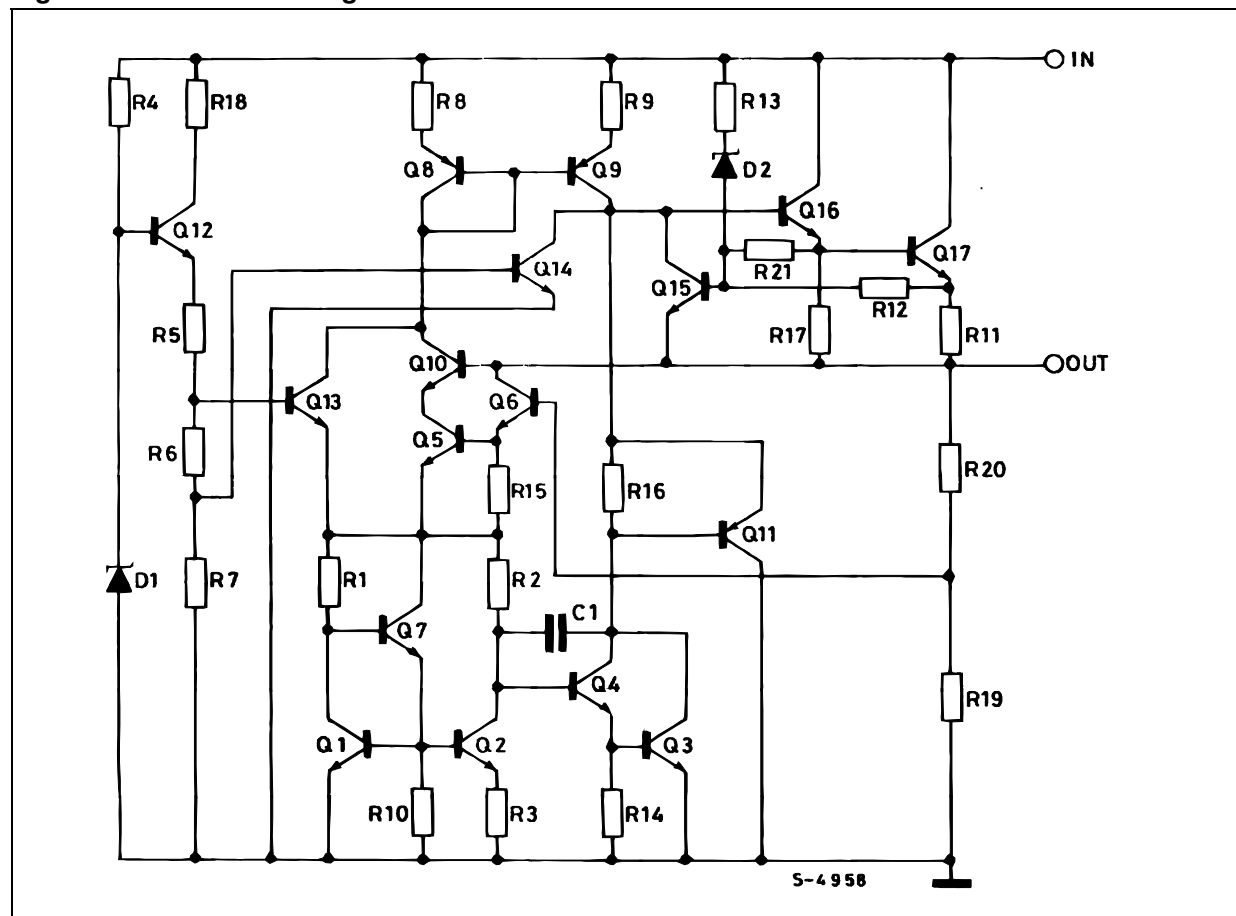


Figure 2. Schematic diagram



## 2 Maximum ratings

Table 1. Absolute maximum ratings

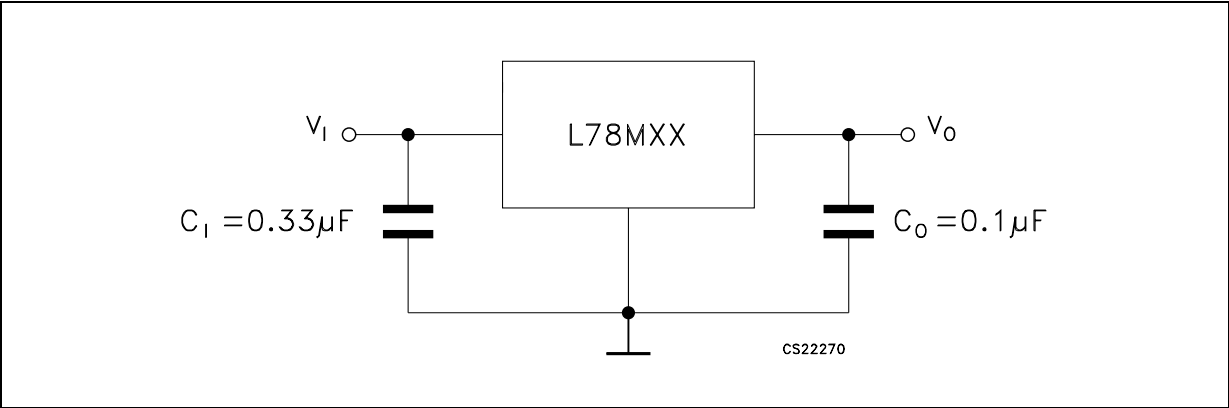
| Symbol    | Parameter                            |                        | Value              | Unit |
|-----------|--------------------------------------|------------------------|--------------------|------|
| $V_I$     | DC Input voltage                     | for $V_O = 5$ to $18V$ | 35                 | V    |
|           |                                      | for $V_O = 20, 24V$    | 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 2. Thermal data

| Symbol     | Parameter                           | TO-220 | TO-220FP | DPAK | IPAK | Unit |
|------------|-------------------------------------|--------|----------|------|------|------|
| $R_{thJC}$ | Thermal resistance junction-case    | 3      | 5        | 8    |      | °C/W |
| $R_{thJA}$ | Thermal resistance junction-ambient | 50     | 60       | 100  |      | °C/W |

Figure 3. Application circuits



### 3 Test circuits

Figure 4. DC Parameter

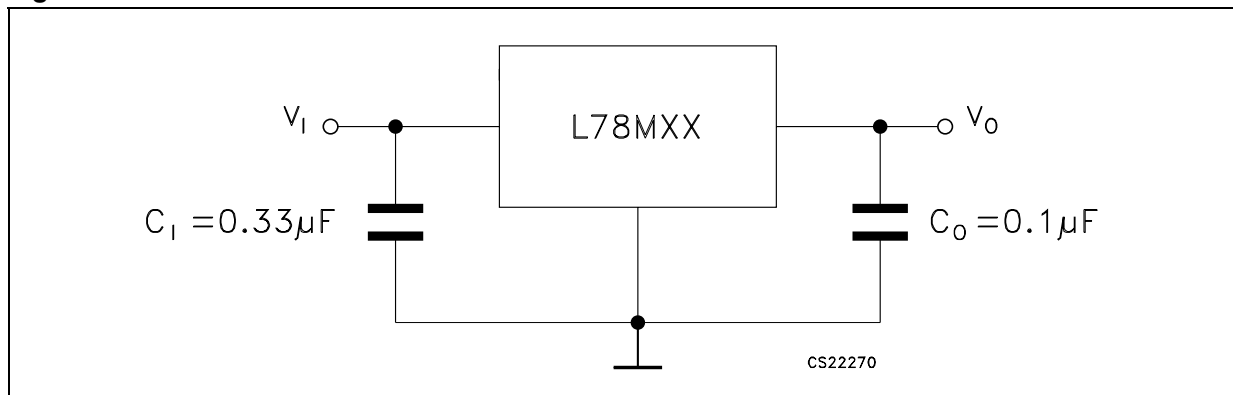


Figure 5. Load regulation

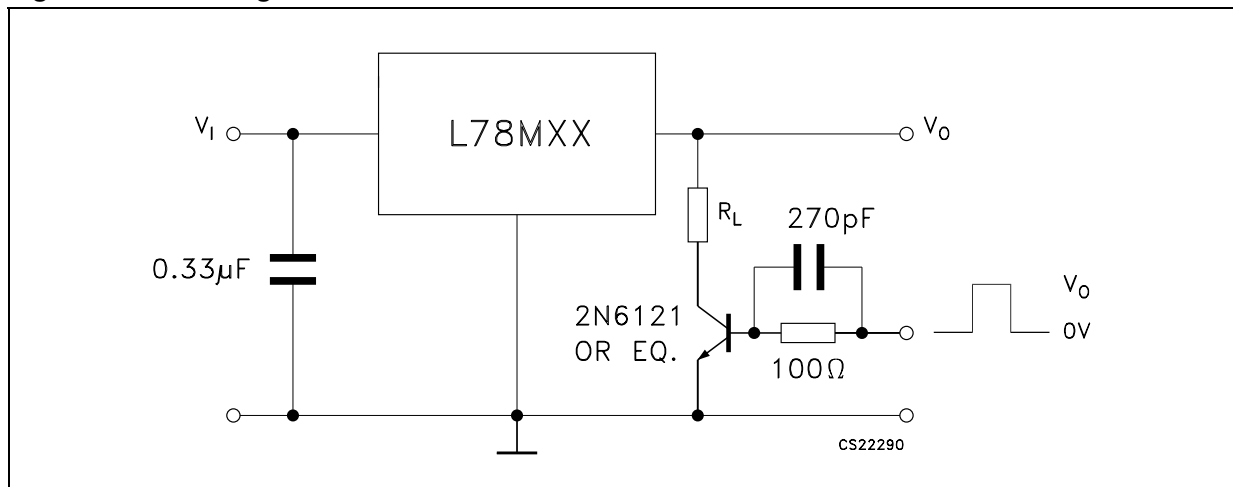
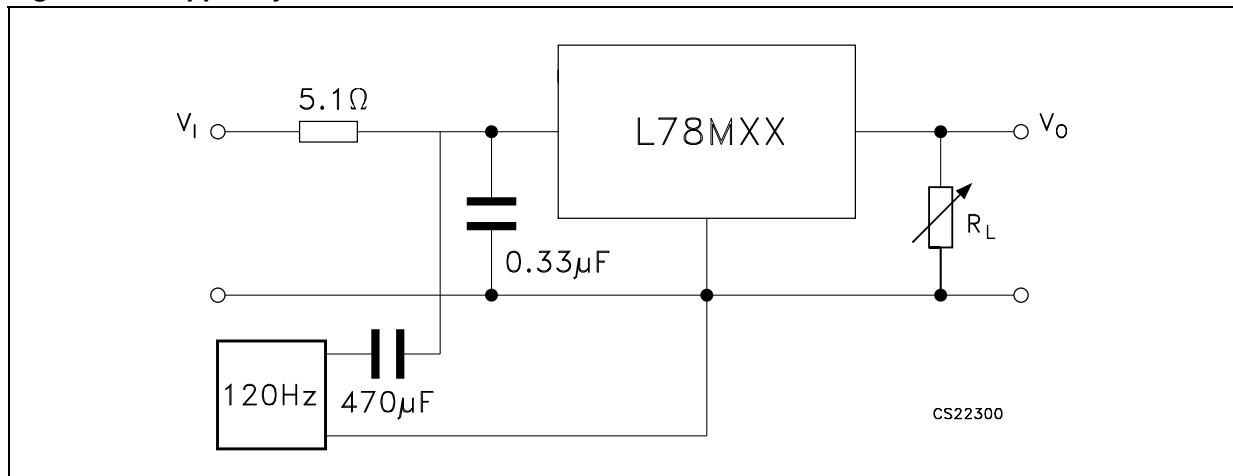


Figure 6. Ripple rejection



## 4 Electrical characteristics

**Table 3. Electrical characteristics of L78M05C** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 10\text{V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified)

| 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          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25^\circ\text{C}$                  |      |      | 100  | mV            |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25^\circ\text{C}$                  |      |      | 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     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125^\circ\text{C}$                   |      | -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            |

**Table 4. Electrical characteristics of L78M06C** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 11\text{V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified)

| 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          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25^\circ\text{C}$                  |      |      | 120  | mV            |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25^\circ\text{C}$                  |      |      | 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     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125^\circ\text{C}$                   |      | -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            |

**Table 5. Electrical characteristics of L78M08C** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 14\text{V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified)

| 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          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25^\circ\text{C}$                       |      |      | 160  | mV                   |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25^\circ\text{C}$                       |      |      | 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     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125^\circ\text{C}$                        |      | -0.5 |      | mV/ $^\circ\text{C}$ |
| SVR                   | Supply voltage rejection | $V_I = 11.5\text{ to }21.5\text{ V}$ , $f = 120\text{ Hz}$ , $I_O = 300\text{ mA}$ | 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                   |

**Table 6. Electrical characteristics of L78M09C** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 15\text{V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified)

| 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          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25^\circ\text{C}$                     |      |      | 180  | mV                   |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25^\circ\text{C}$                     |      |      | 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     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125^\circ\text{C}$                      |      | -0.5 |      | mV/ $^\circ\text{C}$ |
| SVR                   | Supply voltage rejection | $V_I = 12.5\text{ to }23\text{ V}$ , $f = 120\text{ Hz}$ , $I_O = 300\text{ mA}$ | 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                   |

**Table 7. Electrical characteristics of L78M10C** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 16\text{V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified)

| Symbol                | Parameter                | Test conditions                                                                  | Min. | Typ. | Max. | Unit                 |
|-----------------------|--------------------------|----------------------------------------------------------------------------------|------|------|------|----------------------|
| $V_O$                 | Output voltage           |                                                                                  | 9.6  | 10   | 10.4 | V                    |
| $V_O$                 | Output voltage           | $I_O = 5\text{ to }350\text{ mA}$ , $V_I = 12.5\text{ to }25\text{ V}$           | 9.5  | 10   | 10.5 | V                    |
| $\Delta V_O$          | Line regulation          | $V_I = 12.5\text{ to }30\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 100  | mV                   |
|                       |                          | $V_I = 13\text{ to }30\text{ V}$ , $I_O = 200\text{ mA}$                         |      |      | 50   |                      |
| $\Delta V_O$          | Load regulation          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25^\circ\text{C}$                     |      |      | 200  | mV                   |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25^\circ\text{C}$                     |      |      | 100  |                      |
| $I_d$                 | Quiescent current        |                                                                                  |      |      | 6    | mA                   |
| $\Delta I_d$          | Quiescent current change | $I_O = 5\text{ to }350\text{ mA}$                                                |      |      | 0.5  | mA                   |
|                       |                          | $I_O = 200\text{ mA}$ , $V_I = 12.5\text{ to }30\text{ V}$                       |      |      | 0.8  |                      |
| $\Delta V_O/\Delta T$ | Output voltage drift     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125^\circ\text{C}$                      |      | -0.5 |      | mV/ $^\circ\text{C}$ |
| SVR                   | Supply voltage rejection | $V_I = 13.5\text{ to }24\text{ V}$ , $f = 120\text{ Hz}$ , $I_O = 300\text{ mA}$ | 56   |      |      | dB                   |
| eN                    | Output noise voltage     | $B = 10\text{ Hz to }100\text{ KHz}$                                             |      | 64   |      | $\mu\text{V}$        |
| $V_d$                 | Dropout voltage          |                                                                                  |      | 2    |      | V                    |
| $I_{sc}$              | Short circuit current    | $V_I = 35\text{ V}$                                                              |      | 245  |      | mA                   |

**Table 8. Electrical characteristics of L78M12C** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 19\text{V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified)

| 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          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25^\circ\text{C}$                   |      |      | 240  | mV                   |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25^\circ\text{C}$                   |      |      | 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     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125^\circ\text{C}$                    |      | -1   |      | mV/ $^\circ\text{C}$ |
| 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                   |

**Table 9. Electrical characteristics of L78M15C** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 23\text{V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified)

| 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          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25^\circ\text{C}$                       |       |      | 300   | mV                   |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25^\circ\text{C}$                       |       |      | 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     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125^\circ\text{C}$                        |       | -1   |       | mV/ $^\circ\text{C}$ |
| 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                   |

**Table 10. Electrical characteristics of L78M18C** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 26\text{V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified)

| Symbol                | Parameter                | Test conditions                                                                | Min. | Typ. | Max. | Unit                 |
|-----------------------|--------------------------|--------------------------------------------------------------------------------|------|------|------|----------------------|
| $V_O$                 | Output voltage           |                                                                                | 17.3 | 18   | 18.7 | V                    |
| $V_O$                 | Output voltage           | $I_O = 5\text{ to }350\text{ mA}$ , $V_I = 20.5\text{ to }33\text{ V}$         | 17.1 | 18   | 18.9 | V                    |
| $\Delta V_O$          | Line regulation          | $V_I = 21\text{ to }33\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 100  | mV                   |
|                       |                          | $V_I = 24\text{ to }33\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 50   |                      |
| $\Delta V_O$          | Load regulation          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25^\circ\text{C}$                   |      |      | 360  | mV                   |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25^\circ\text{C}$                   |      |      | 180  |                      |
| $I_d$                 | Quiescent current        |                                                                                |      |      | 6    | mA                   |
| $\Delta I_d$          | Quiescent current change | $I_O = 5\text{ to }350\text{ mA}$                                              |      |      | 0.5  | mA                   |
|                       |                          | $I_O = 200\text{ mA}$ , $V_I = 21\text{ to }33\text{ V}$                       |      |      | 0.8  |                      |
| $\Delta V_O/\Delta T$ | Output voltage drift     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125^\circ\text{C}$                    |      | -1.1 |      | mV/ $^\circ\text{C}$ |
| SVR                   | Supply voltage rejection | $V_I = 22\text{ to }32\text{ V}$ , $f = 120\text{ Hz}$ , $I_O = 300\text{ mA}$ | 53   |      |      | dB                   |
| eN                    | Output noise voltage     | $B = 10\text{ Hz to }100\text{ KHz}$                                           |      | 100  |      | $\mu\text{V}$        |
| $V_d$                 | Dropout voltage          |                                                                                |      | 2    |      | V                    |
| $I_{sc}$              | Short circuit current    | $V_I = 35\text{ V}$                                                            |      | 240  |      | mA                   |

**Table 11. Electrical characteristics of L78M20C** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 29\text{V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified)

| Symbol                | Parameter                | Test conditions                                                                | Min. | Typ. | Max. | Unit                 |
|-----------------------|--------------------------|--------------------------------------------------------------------------------|------|------|------|----------------------|
| $V_O$                 | Output voltage           |                                                                                | 19.2 | 20   | 20.8 | V                    |
| $V_O$                 | Output voltage           | $I_O = 5\text{ to }350\text{ mA}$ , $V_I = 23\text{ to }35\text{ V}$           | 19   | 20   | 21   | V                    |
| $\Delta V_O$          | Line regulation          | $V_I = 23\text{ to }35\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 100  | mV                   |
|                       |                          | $V_I = 24\text{ to }35\text{ V}$ , $I_O = 200\text{ mA}$                       |      |      | 50   |                      |
| $\Delta V_O$          | Load regulation          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25^\circ\text{C}$                   |      |      | 400  | mV                   |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25^\circ\text{C}$                   |      |      | 200  |                      |
| $I_d$                 | Quiescent current        |                                                                                |      |      | 6    | mA                   |
| $\Delta I_d$          | Quiescent current change | $I_O = 5\text{ to }350\text{ mA}$                                              |      |      | 0.5  | mA                   |
|                       |                          | $I_O = 200\text{ mA}$ , $V_I = 23\text{ to }35\text{ V}$                       |      |      | 0.8  |                      |
| $\Delta V_O/\Delta T$ | Output voltage drift     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125^\circ\text{C}$                    |      | -1.1 |      | mV/ $^\circ\text{C}$ |
| SVR                   | Supply voltage rejection | $V_I = 24\text{ to }34\text{ V}$ , $f = 120\text{ Hz}$ , $I_O = 300\text{ mA}$ | 53   |      |      | dB                   |
| eN                    | Output noise voltage     | $B = 10\text{ Hz to }100\text{ KHz}$                                           |      | 110  |      | $\mu\text{V}$        |
| $V_d$                 | Dropout voltage          |                                                                                |      | 2    |      | V                    |
| $I_{sc}$              | Short circuit current    | $V_I = 35\text{ V}$                                                            |      | 240  |      | mA                   |

**Table 12. Electrical characteristics of L78M24C** (refer to the test circuits,  $T_J = 25^\circ\text{C}$ ,  $V_I = 23\text{V}$ ,  $I_O = 350\text{ mA}$ ,  $C_I = 0.33\text{ }\mu\text{F}$ ,  $C_O = 0.1\text{ }\mu\text{F}$  unless otherwise specified)

| 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          | $I_O = 5\text{ to }500\text{ mA}$ , $T_J = 25^\circ\text{C}$                   |      |      | 480  | mV                   |
|                       |                          | $I_O = 5\text{ to }200\text{ mA}$ , $T_J = 25^\circ\text{C}$                   |      |      | 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     | $I_O = 5\text{ mA}$ , $T_J = 0\text{ to }125^\circ\text{C}$                    |      | -1.2 |      | mV/ $^\circ\text{C}$ |
| 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                   |

## 5 Typical performance

Figure 7. Dropout voltage vs junction temp.

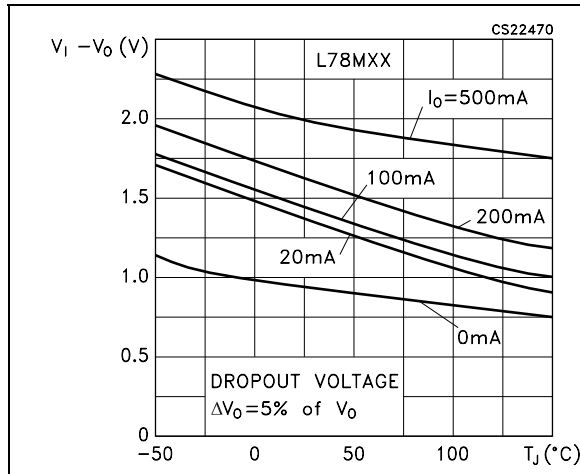


Figure 8. Dropout characteristics

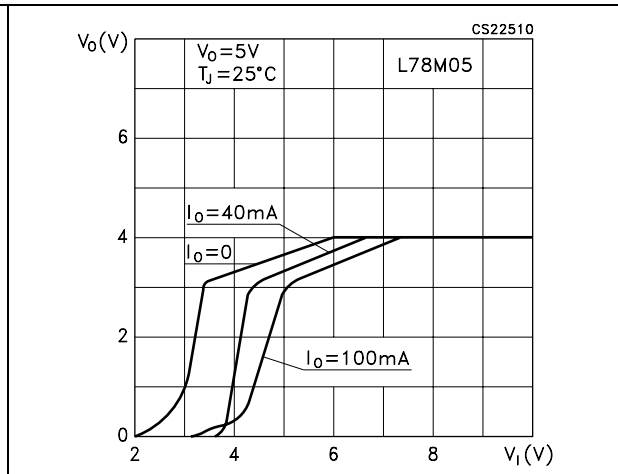


Figure 9. Peak output current vs input-output differential voltage

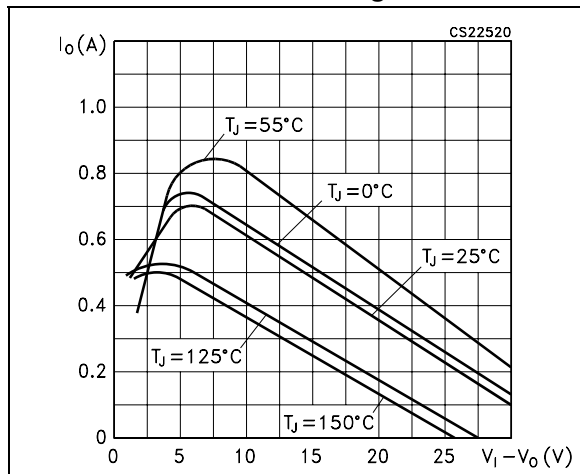


Figure 10. Output voltage vs junction temperature

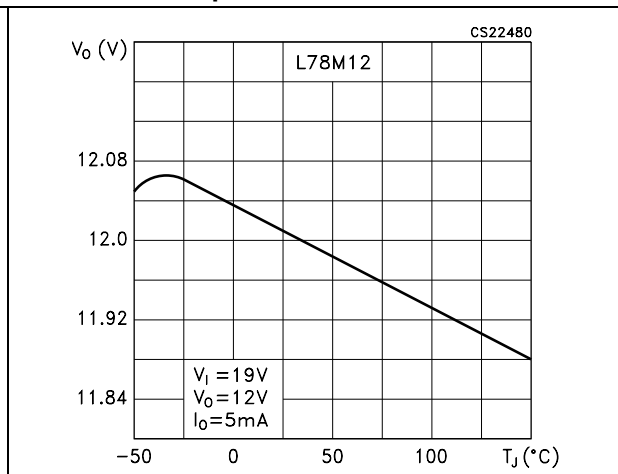


Figure 11. Supply voltage rejection vs freq.

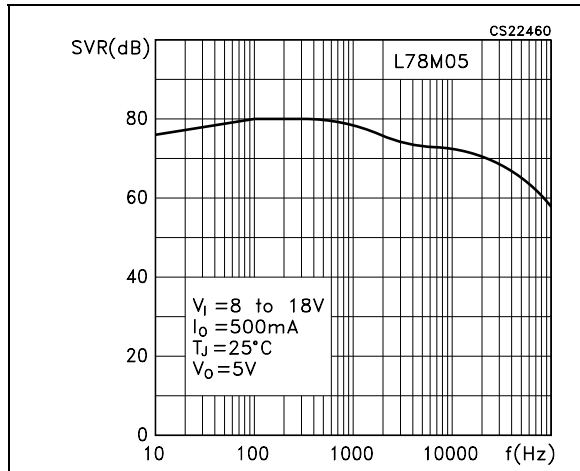


Figure 12. Quiescent current vs junction temp.

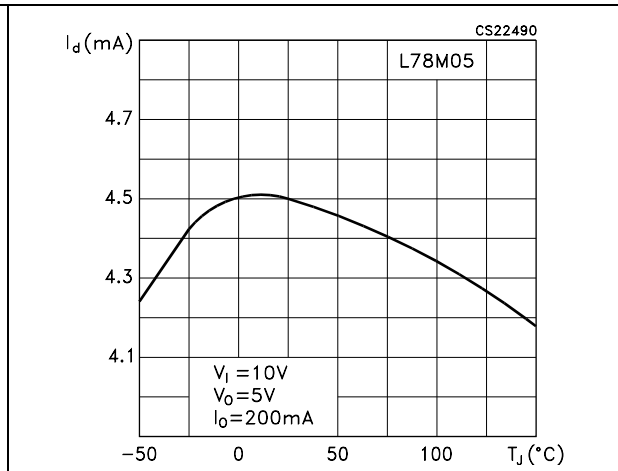


Figure 13. Load transient response

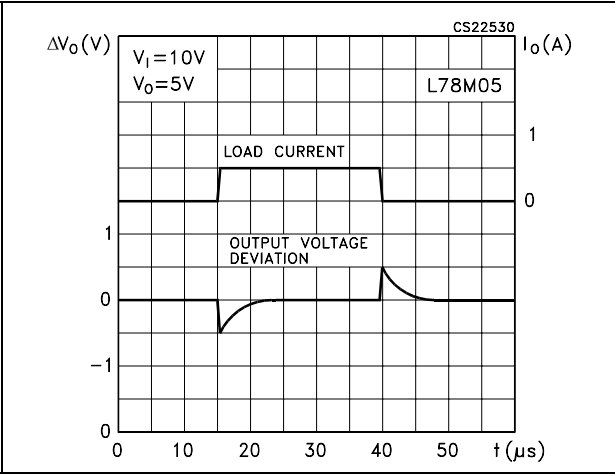


Figure 14. Line transient response

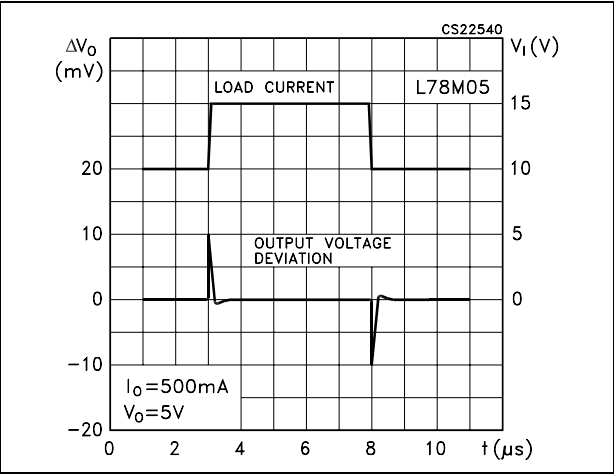
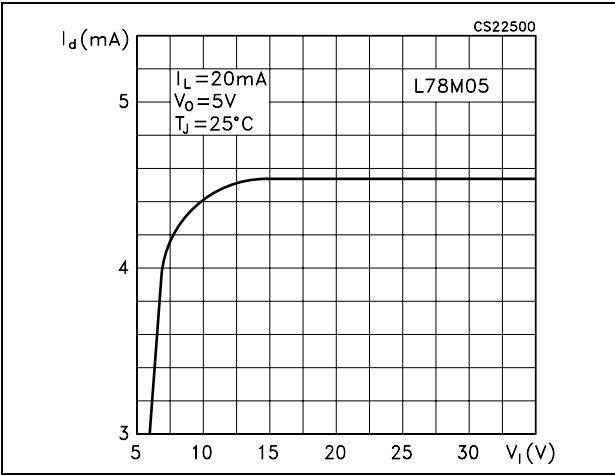
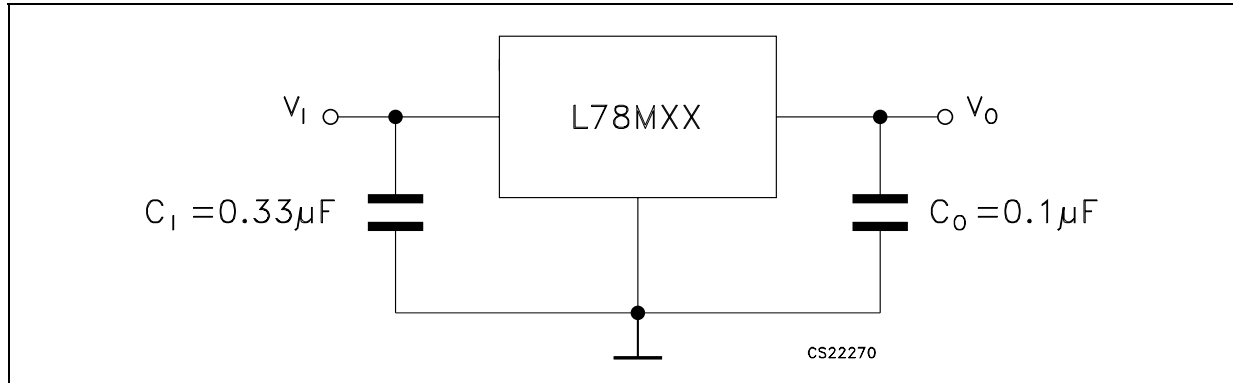


Figure 15. Quiescent current vs input voltage



**Figure 16. 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.

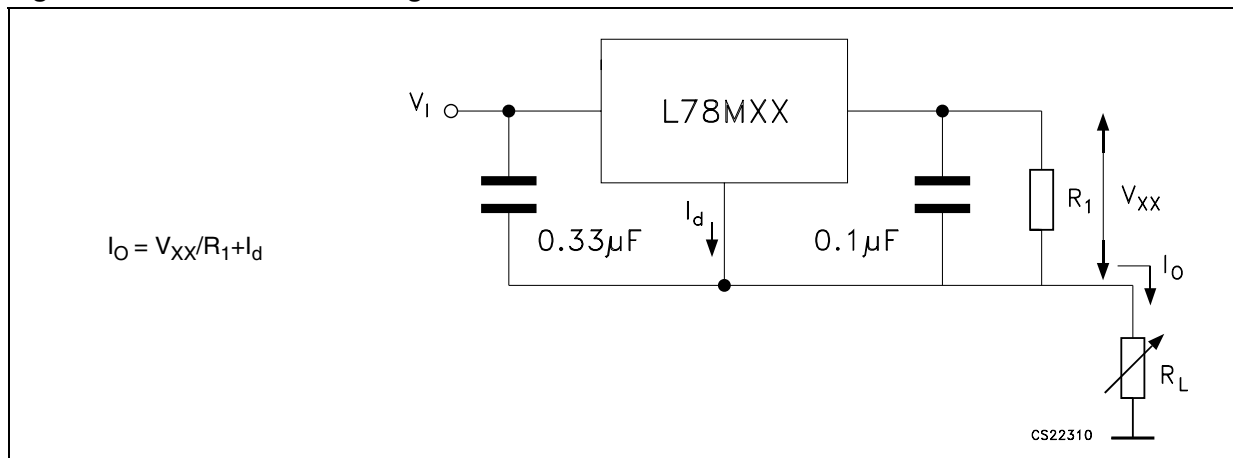
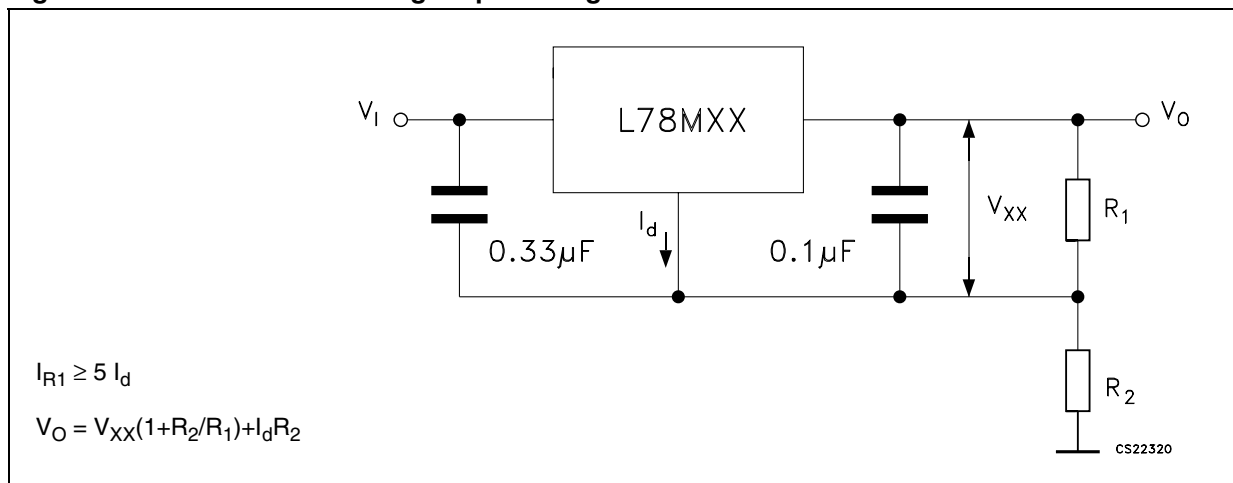
**Figure 17. Constant current regulator****Figure 18. Circuit for increasing output voltage**

Figure 19. Adjustable output regulator (7 to 30V)

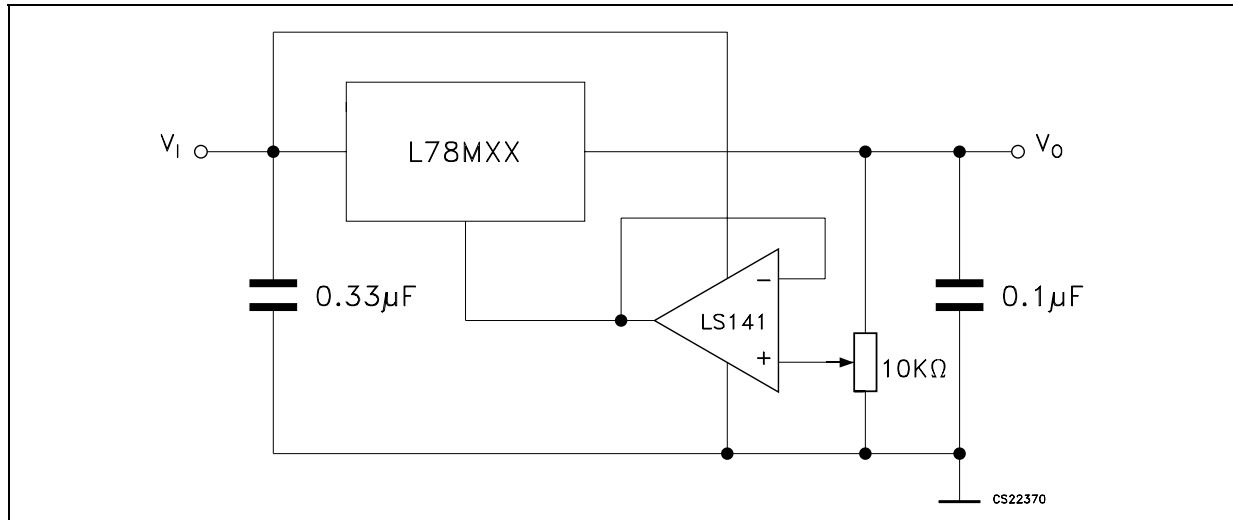


Figure 20. 0.5 to 10V Regulator

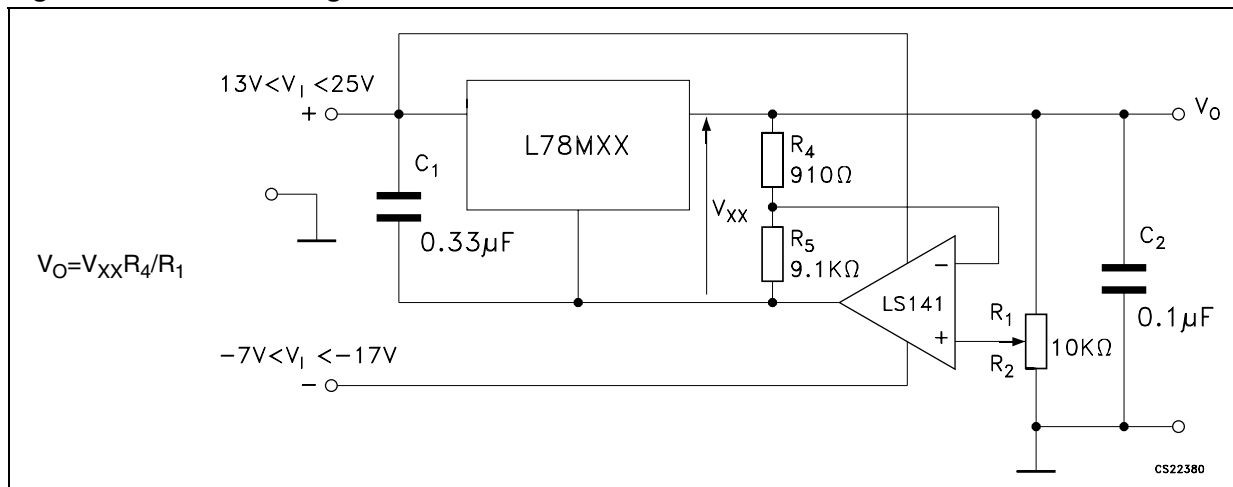


Figure 21. High current voltage regulator

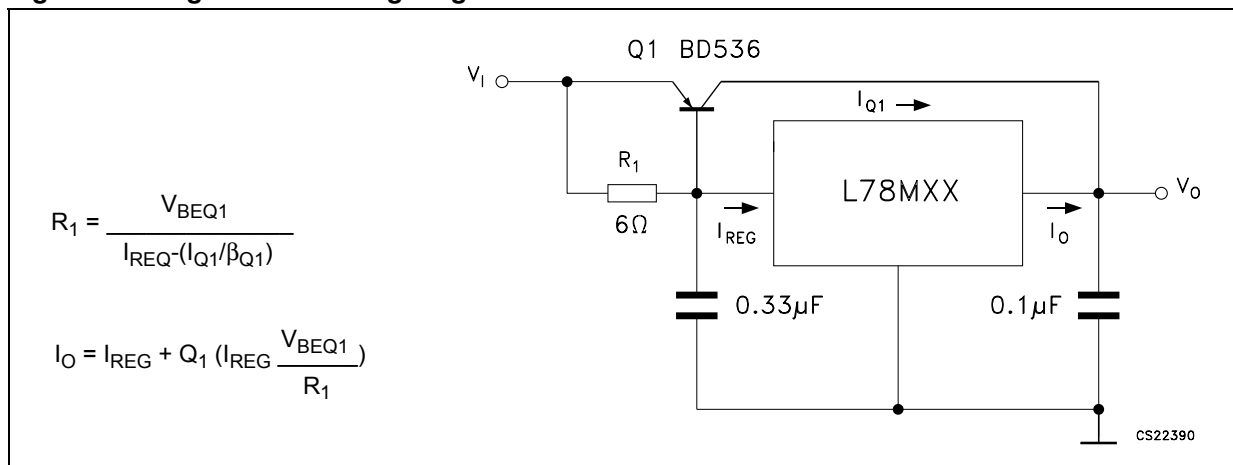


Figure 22. High output current with short circuit protection

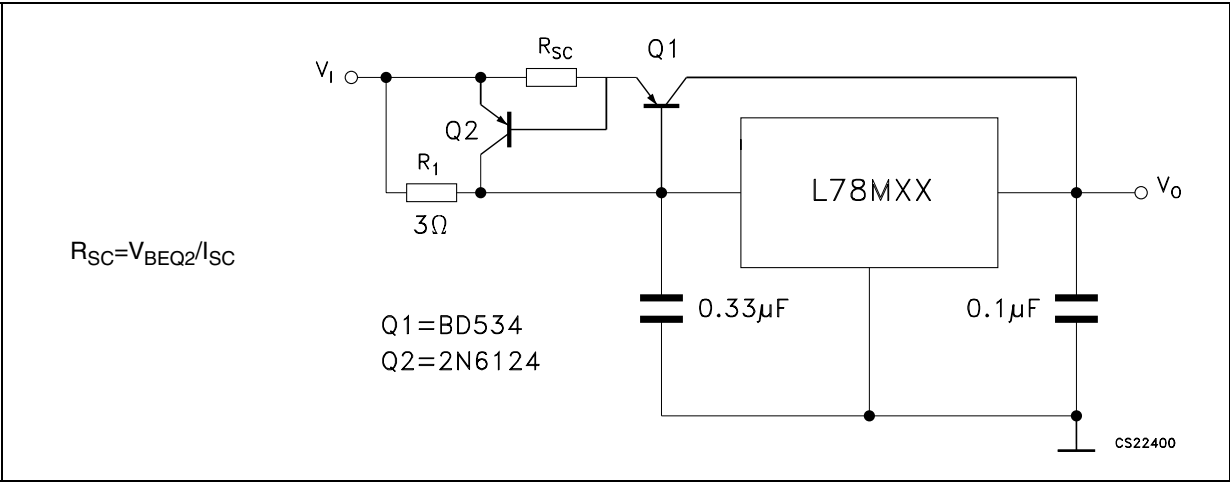


Figure 23. Tracking voltage regulator

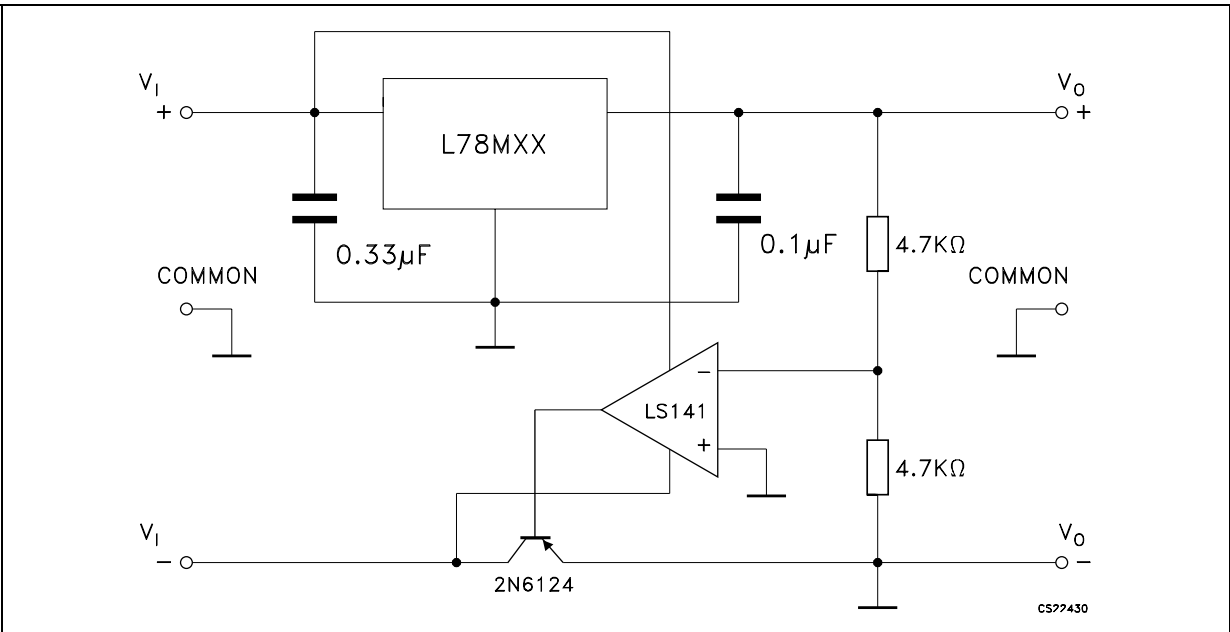


Figure 24. High input voltage circuit

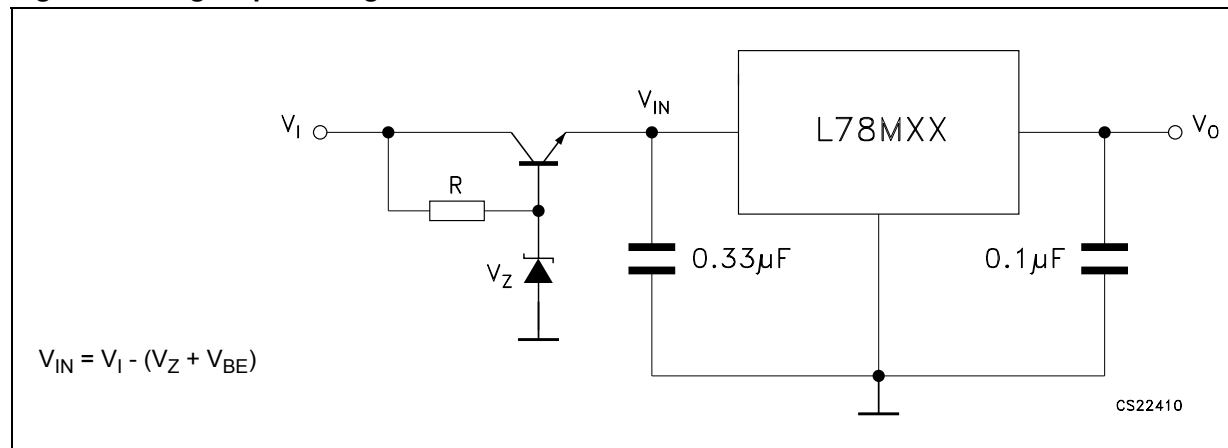
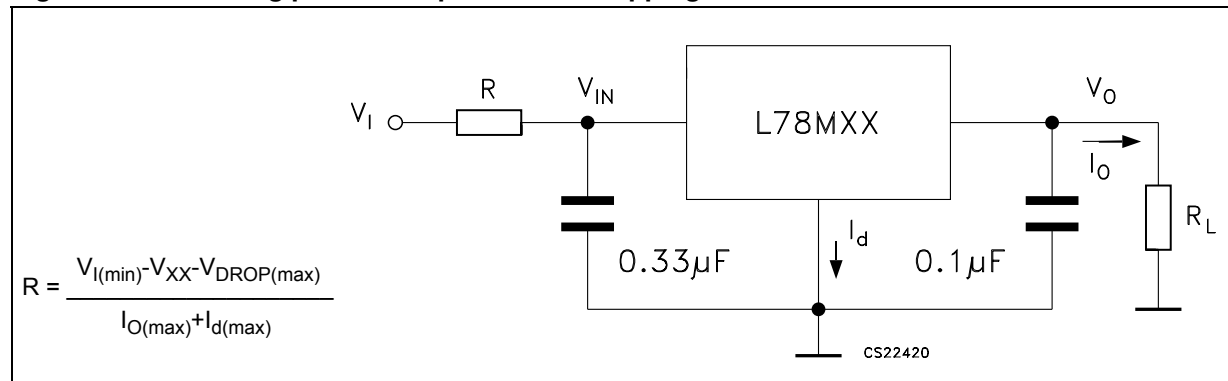
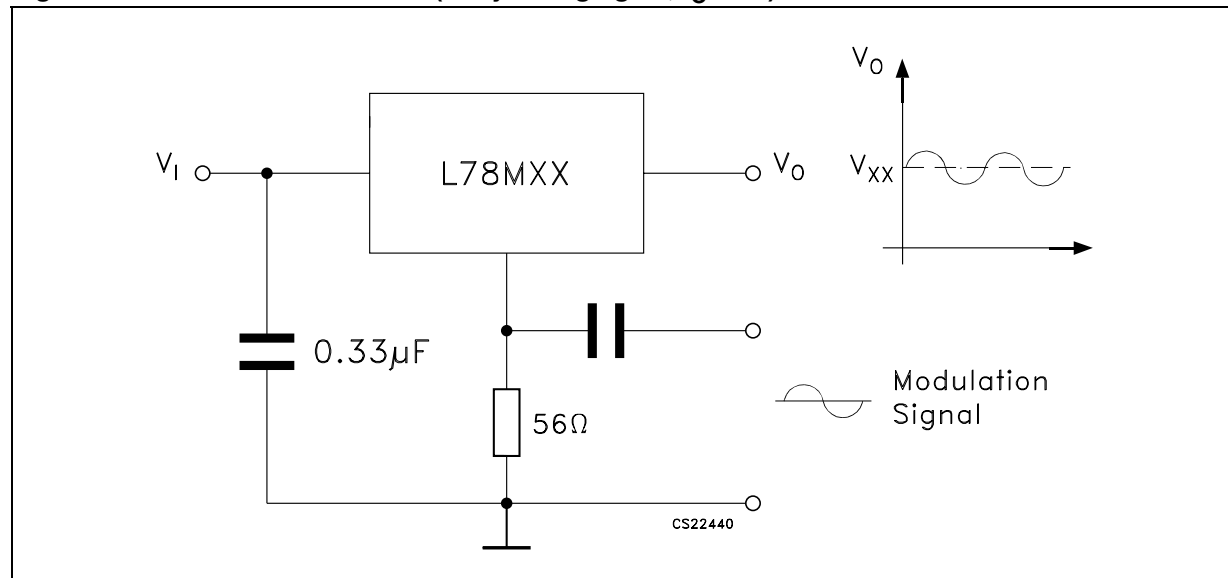
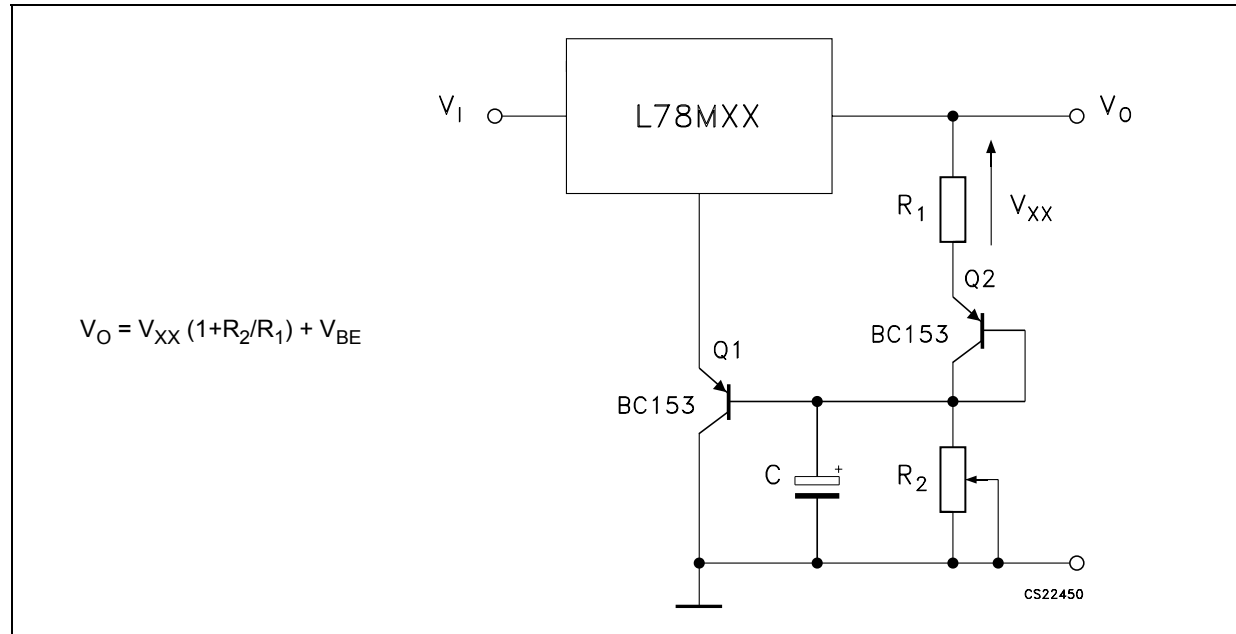


Figure 25. Reducing power dissipation with dropping resistor

Figure 26. Power AM Modulator (unity voltage gain,  $I_O \leq 0.5$ )

Note: The circuit performs well up to 100 KHz.

**Figure 27. Adjustable output voltage with temperature compensation**

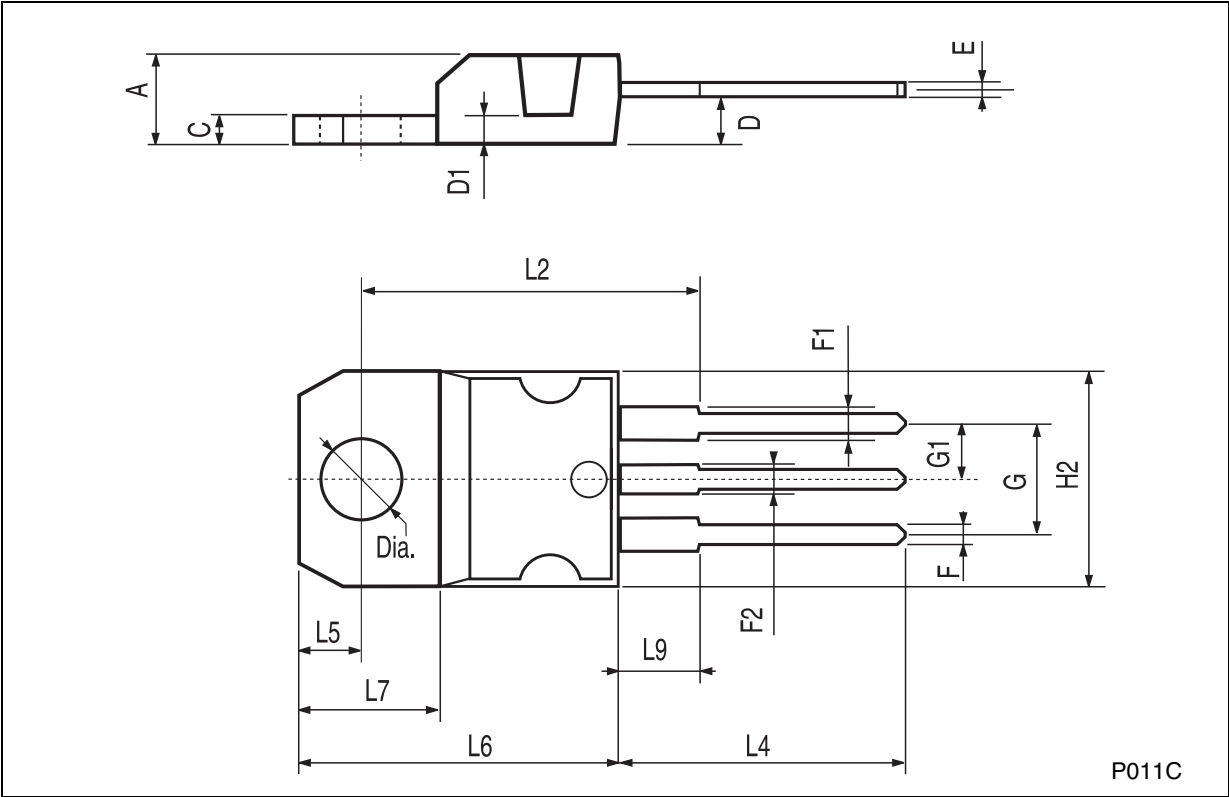
**Note:**  $Q_2$  is connected as a diode in order to compensate the variation of the  $Q_1$   $V_{BE}$  with the temperature.  $C$  allows a slow rise time of the  $V_O$ .

## 6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> 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](http://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 |



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 |

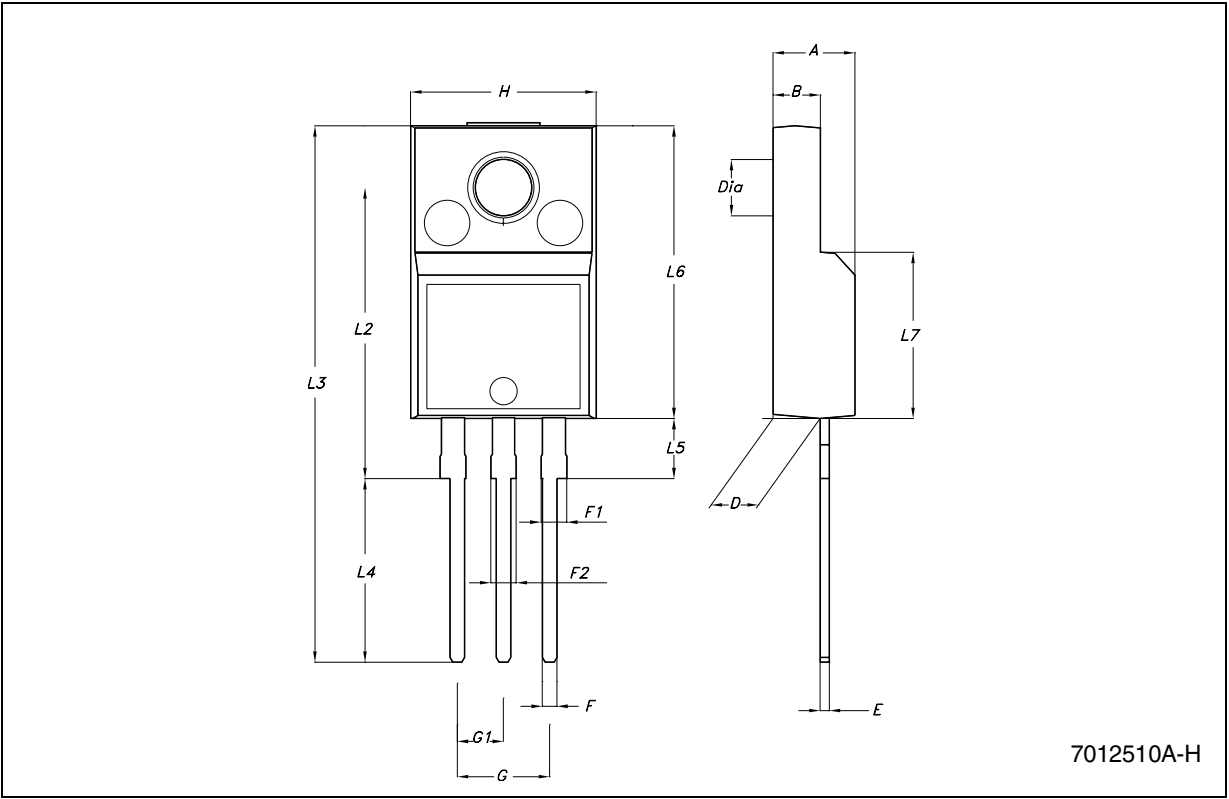


Figure 28. DRAWING DIMENSION DPAK (TYPE STD-ST)

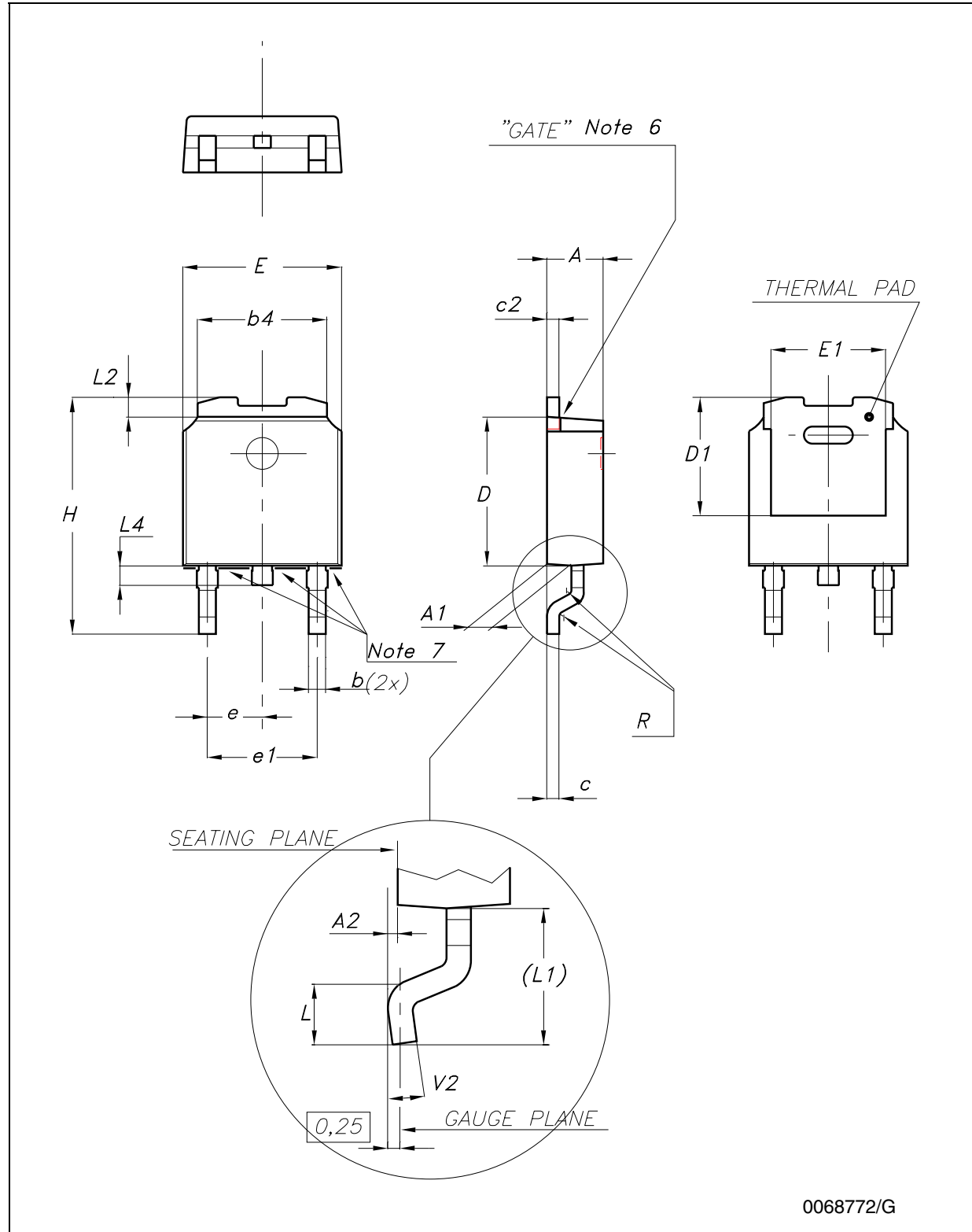


Figure 29. DRAWING DIMENSION DPAK (TYPE FUJITSU-SUBCON.)

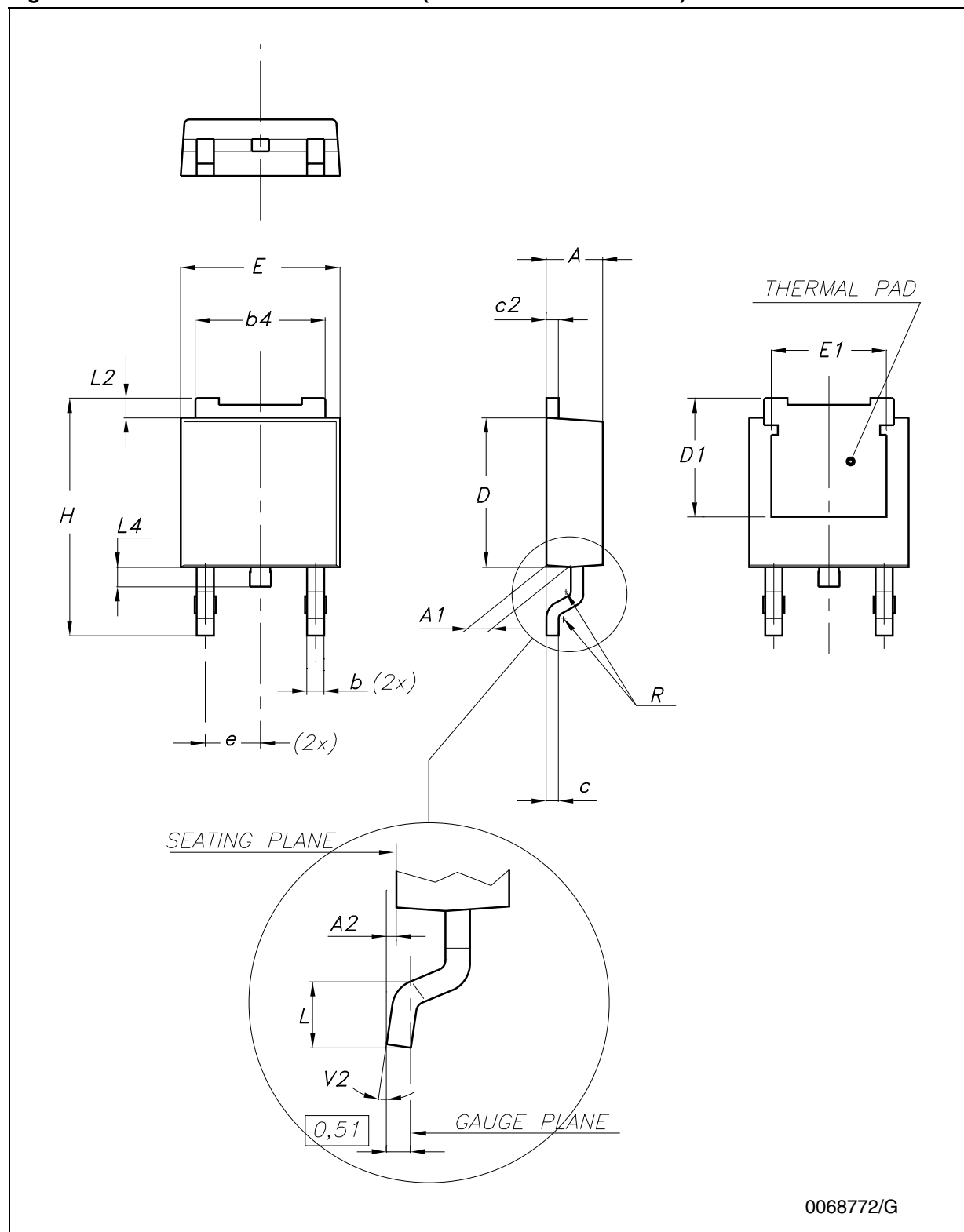


Figure 30. DRAWING DIMENSION DPAK (TYPE IDS-SUBCON.)

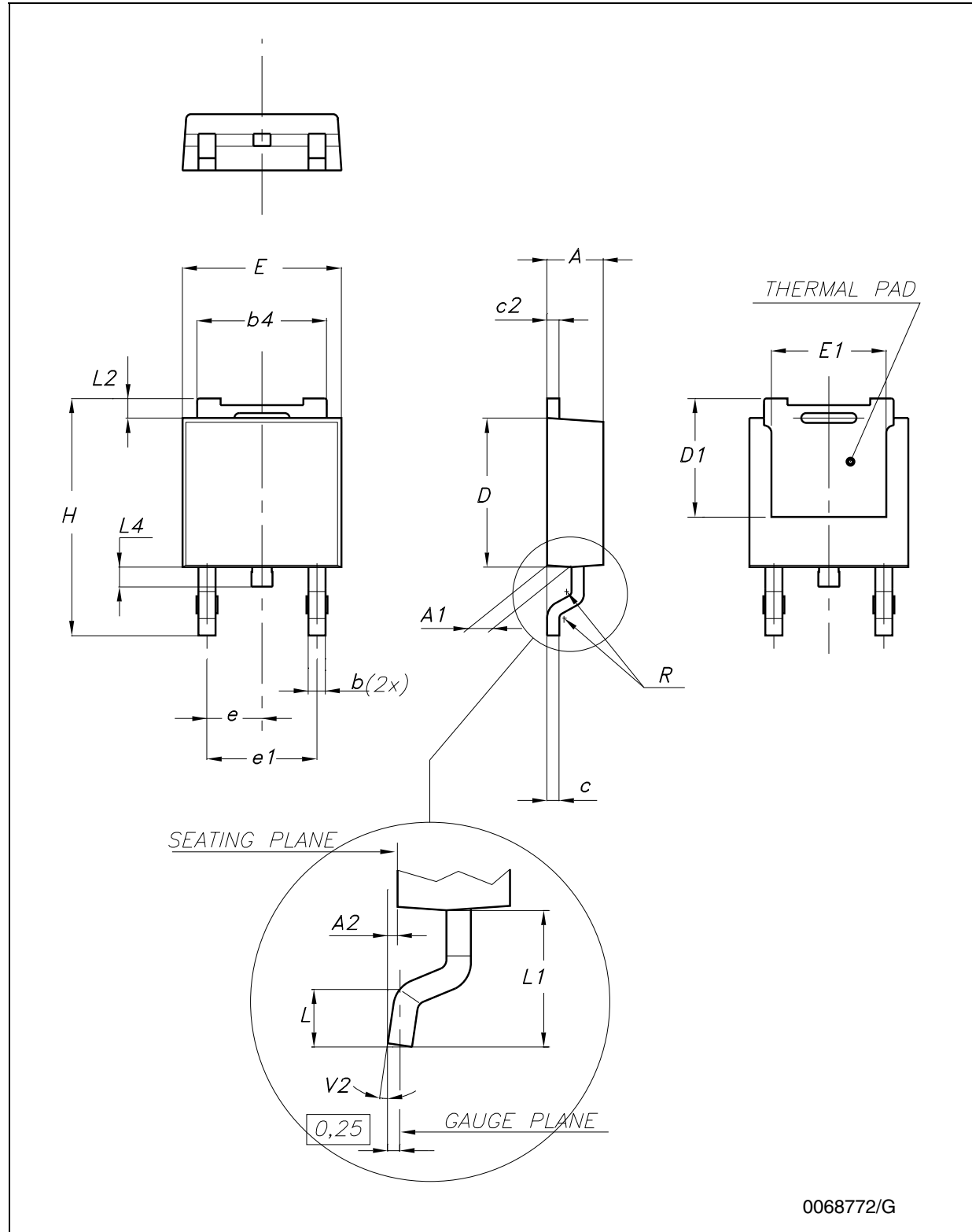


Table 13. DPAK MECHANICAL DATA

| 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 31. DPAK FOOTPRINT RECOMMENDED DATA

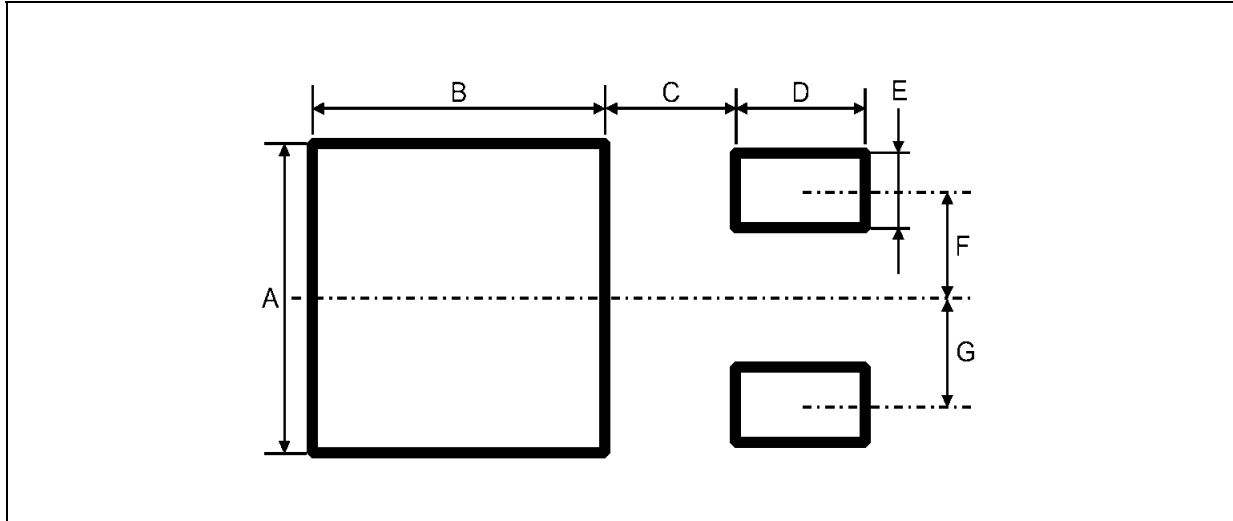
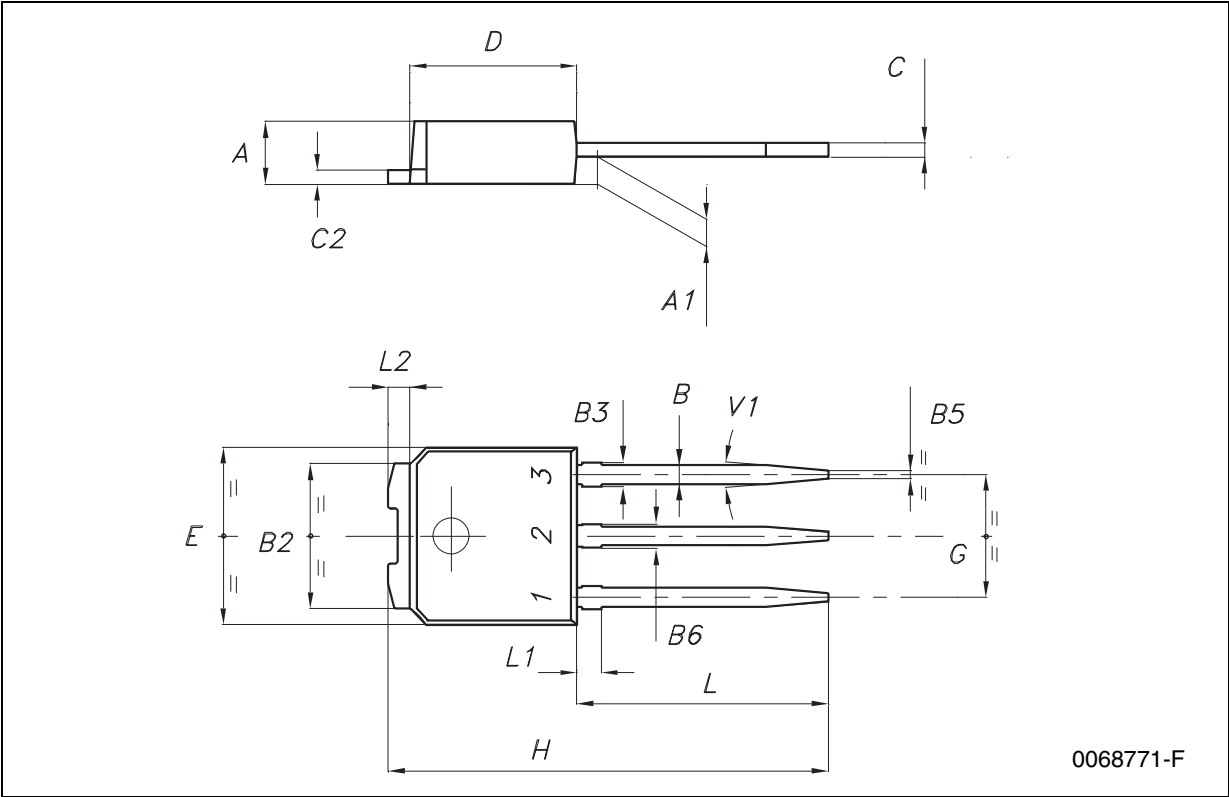


Table 14. FOOTPRINT DATA

| 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 |

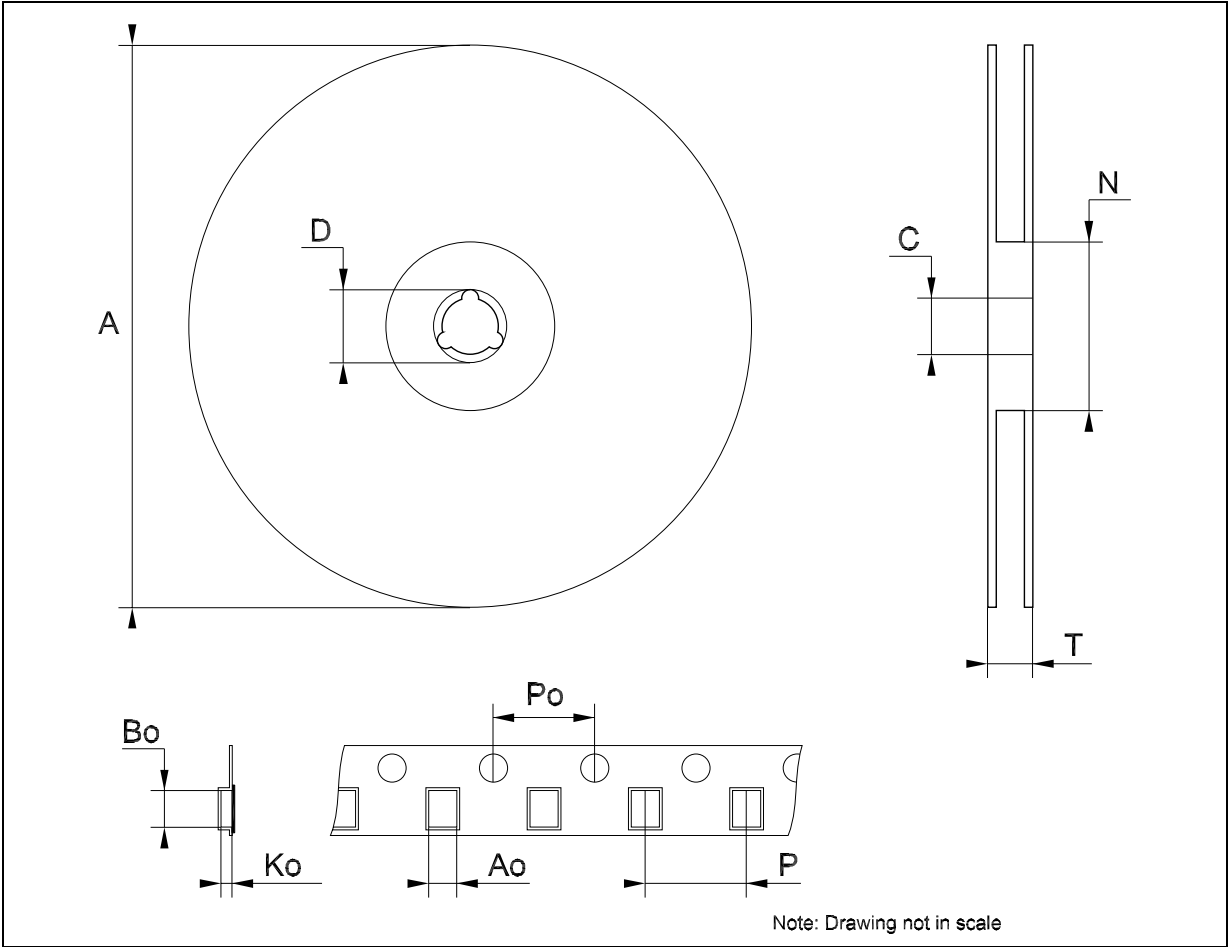
IPAK MECHANICAL DATA

| 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  |



## 7 Order code

Table 15. Order code

| Part numbers | Packaging |                         |                             |                            |                |
|--------------|-----------|-------------------------|-----------------------------|----------------------------|----------------|
|              | TO-220    | TO-220FP                | DPAK                        | IPAK                       | Output voltage |
| L78M05       | L78M05CV  | L78M05CP                | L78M05CDT-TR                | L78M05CDT-1                | 5 V            |
| L78M06       | L78M06CV  | L78M06CP                | L78M06CDT-TR                | L78M06CDT-1 <sup>(1)</sup> | 6 V            |
| L78M08       | L78M08CV  | L78M08CP                | L78M08CDT-TR                | L78M08CDT-1 <sup>(1)</sup> | 8 V            |
| L78M09       | L78M09CV  | L78M09CP                | L78M09CDT-TR                | L78M09CDT-1 <sup>(1)</sup> | 9 V            |
| L78M10       | L78M10CV  | L78M10CP                | L78M10CDT-TR                | L78M10CDT-1 <sup>(1)</sup> | 10 V           |
| L78M12       | L78M12CV  | L78M12CP                | L78M12CDT-TR                | L78M12CDT-1                | 12 V           |
| L78M15       | L78M15CV  | L78M15CP                | L78M15CDT-TR                |                            | 15 V           |
| L78M18       | L78M18CV  | L78M18CP <sup>(1)</sup> | L78M18CDT-TR                | L78M18CDT-1 <sup>(1)</sup> | 18 V           |
| L78M20       | L78M20CV  | L78M20CP <sup>(1)</sup> | L78M20CDT-TR <sup>(1)</sup> | L78M20CDT-1 <sup>(1)</sup> | 20 V           |
| L78M24       | L78M24CV  | L78M24CP <sup>(1)</sup> | L78M24CDT-TR                | L78M24CDT-1 <sup>(1)</sup> | 24 V           |

1. Available on request

## 8 Revision history

**Table 16. Revision history**

| Date        | Revision | Changes                                                       |
|-------------|----------|---------------------------------------------------------------|
| 21-Jun-2004 | 6        | Document updating.                                            |
| 30-Aug-2006 | 7        | Order codes has been updated and new template.                |
| 29-Nov-2006 | 8        | DPAK mechanical data has been updated and add footprint data. |
| 06-Jun-2007 | 9        | Order codes has been updated.                                 |

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