

Negative voltage regulators

Datasheet – production data

Features

- Output current up to 1.5 A
- Output voltages of - 5; - 8; - 12; - 15 V
- Thermal overload protection
- Short circuit protection
- Output transition SOA protection

Description

The L79xxC series of three-terminal negative regulators is available in TO-220, TO-220FP and D²PAK packages and 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; furthermore, having the same voltage option as the L78xx positive standard series, they are particularly suited for split power supplies. If adequate heat sinking is provided, they can deliver over 1.5 A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

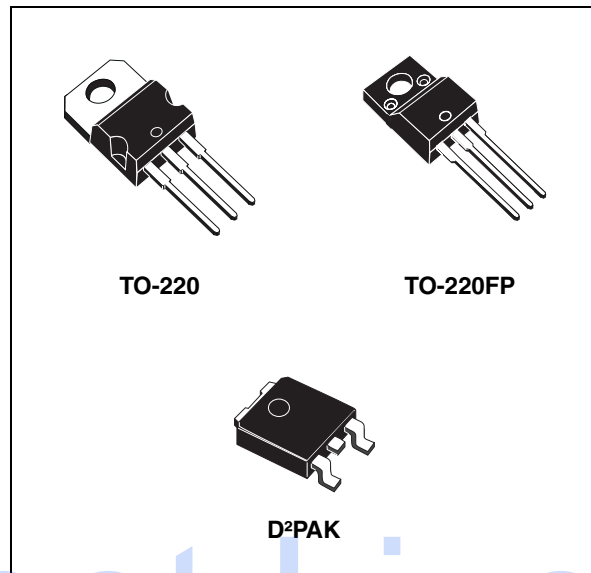


Table 1. Device summary

| Part numbers | Order codes | | | Output voltages | |
|--------------|-------------|---------------------------|--------------------|-----------------|----------|
| | TO-220 | | D ² PAK | | TO-220FP |
| L7905C | L7905CV | L7905CV-DG ⁽¹⁾ | L7905CD2T-TR | L7905CP | - 5 V |
| L7908C | L7908CV | L7908CV-DG ⁽¹⁾ | | | - 8 V |
| L7912C | L7912CV | L7912CV-DG ⁽¹⁾ | L7912CD2T-TR | L7912CP | - 12 V |
| L7915C | L7915CV | L7915CV-DG ⁽¹⁾ | L7915CD2T-TR | L7915CP | - 15 V |

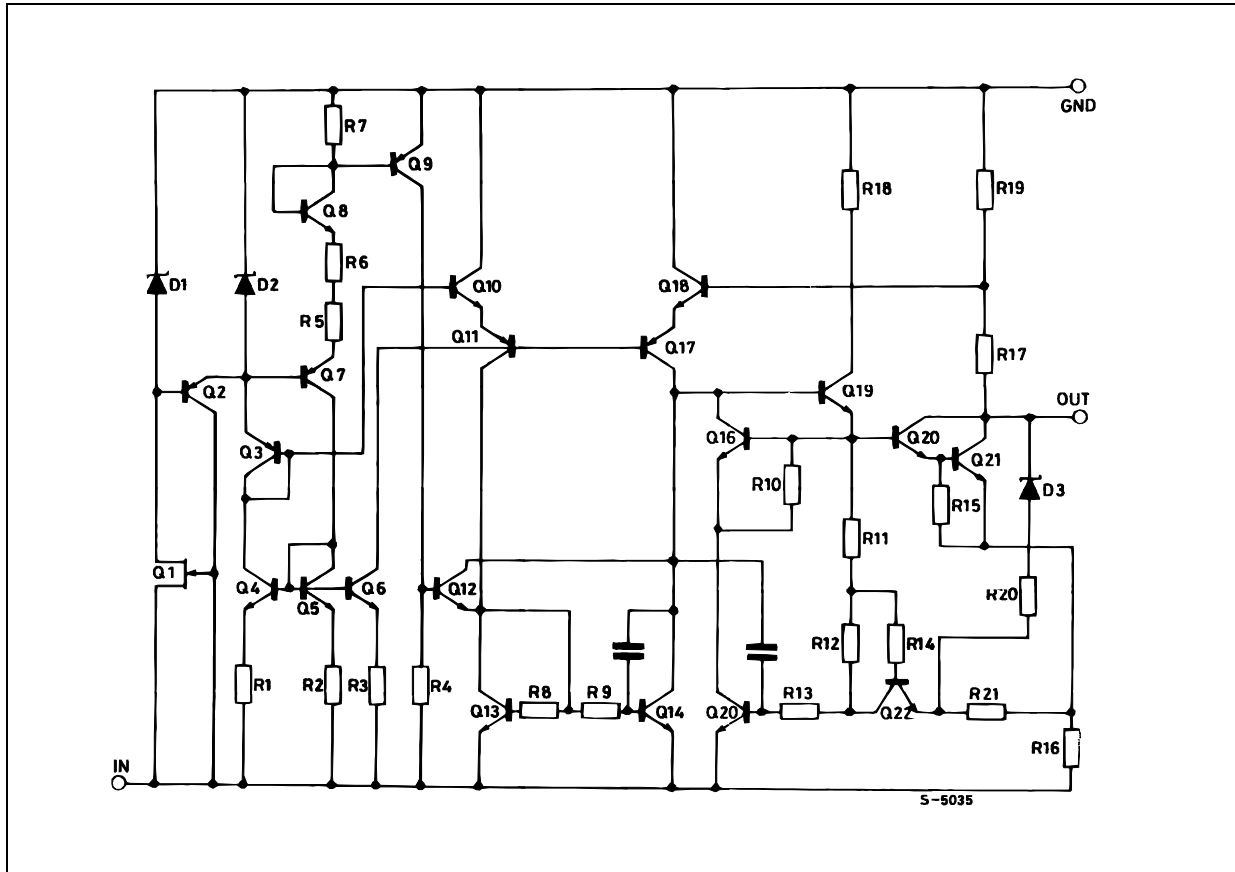
1. TO-220 Dual Gauge frame.

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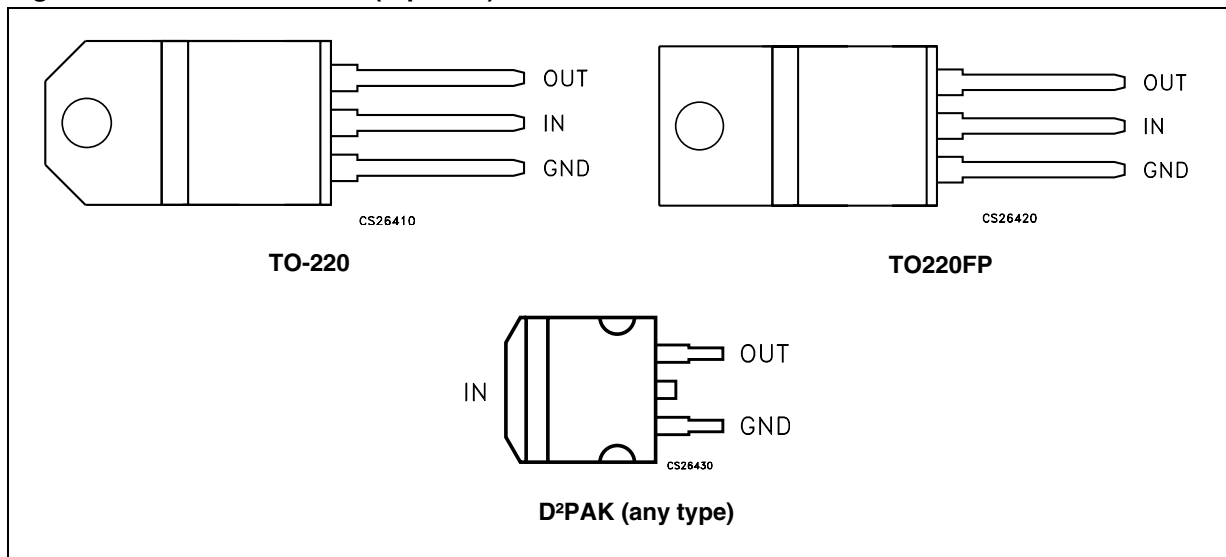
1 Diagram

Figure 1. Schematic diagram



2 Pin configuration

Figure 2. Pin connections (top view)



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 | V |
| | | for $V_O = -20$ to -24 V | -40 | |
| I_O | Output current | | Internally limited | |
| P_D | Power dissipation | | Internally limited | |
| T_{STG} | Storage temperature range | | -65 to 150 | °C |
| T_{OP} | Operating junction temperature range | | 0 to 150 | °C |

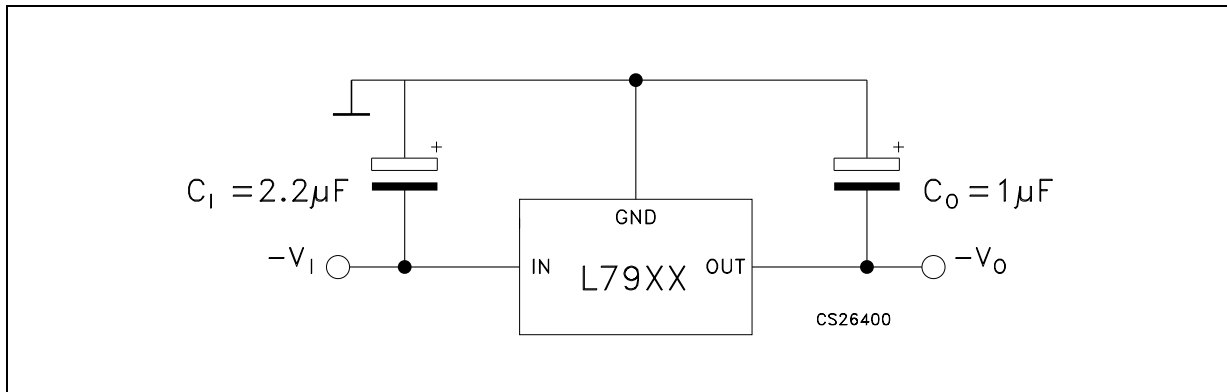
Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

Table 3. Thermal data

| Symbol | Parameter | D ² PAK | TO-220 | TO-220FP | Unit |
|------------|-------------------------------------|--------------------|--------|----------|------|
| R_{thJC} | Thermal resistance junction-case | 3 | 5 | 5 | °C/W |
| R_{thJA} | Thermal resistance junction-ambient | 62.5 | 50 | 60 | °C/W |

4 Test circuit

Figure 3. Test circuit



5 Electrical characteristics

Refer to the test circuits, $T_J = 0$ to 125 °C, $V_I = -10$ V, $I_O = 500$ mA, $C_I = 2.2$ μ F, $C_O = 1$ μ F unless otherwise specified.

Table 4. Electrical characteristics of L7905C

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------|--------------------------|---|-------|------|-------|---------|
| V_O | Output voltage | $T_J = 25^\circ\text{C}$ | -4.8 | -5 | -5.2 | V |
| V_O | Output voltage | $I_O = -5$ mA to -1 A, $P_O \leq 15$ W $V_I = -8$ to -20 V | -4.75 | -5 | -5.25 | V |
| $\Delta V_O^{(1)}$ | Line regulation | $V_I = -7$ to -25 V, $T_J = 25^\circ\text{C}$ | | | 100 | mV |
| | | $V_I = -8$ to -12 V, $T_J = 25^\circ\text{C}$ | | | 50 | |
| $\Delta V_O^{(1)}$ | Load regulation | $I_O = 5$ mA to 1.5 A, $T_J = 25^\circ\text{C}$ | | | 100 | mV |
| | | $I_O = 250$ to 750 mA, $T_J = 25^\circ\text{C}$ | | | 50 | |
| I_d | Quiescent current | $T_J = 25^\circ\text{C}$ | | | 3 | mA |
| ΔI_d | Quiescent current change | $I_O = 5$ mA to 1 A | | | 0.5 | mA |
| | | $V_I = -8$ to -25 V | | | 1.3 | |
| $\Delta V_O/\Delta T$ | Output voltage drift | $I_O = 5$ mA | | -0.4 | | mV/°C |
| eN | Output noise voltage | $B = 10$ Hz to 100 kHz, $T_J = 25^\circ\text{C}$ | | 100 | | μ V |
| SVR | Supply voltage rejection | $\Delta V_I = 10$ V, $f = 120$ Hz | 54 | 60 | | dB |
| V_d | Dropout voltage | $I_O = 1$ A, $T_J = 25^\circ\text{C}$, $\Delta V_O = 100$ mV | | 1.4 | | V |
| I_{sc} | Short circuit current | | | 2.1 | | A |

1. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

Refer to the test circuits, $T_J = 0$ to 125 °C, $V_I = -14$ V, $I_O = 500$ mA, $C_I = 2.2$ μ F, $C_O = 1$ μ F unless otherwise specified.

Table 5. Electrical characteristics of L7908C

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------|--------------------------|--|------|------|------|---------|
| V_O | Output voltage | $T_J = 25^\circ\text{C}$ | -7.7 | -8 | -8.3 | V |
| V_O | Output voltage | $I_O = -5$ mA to -1 A, $P_O \leq 15$ W $V_I = -11.5$ to -23 V | -7.6 | -8 | -8.4 | V |
| $\Delta V_O^{(1)}$ | Line regulation | $V_I = -10.5$ to -25 V, $T_J = 25^\circ\text{C}$ | | | 160 | mV |
| | | $V_I = -11$ to -17 V, $T_J = 25^\circ\text{C}$ | | | 80 | |
| $\Delta V_O^{(1)}$ | Load regulation | $I_O = 5$ mA to 1.5 A, $T_J = 25^\circ\text{C}$ | | | 160 | mV |
| | | $I_O = 250$ to 750 mA, $T_J = 25^\circ\text{C}$ | | | 80 | |
| I_d | Quiescent current | $T_J = 25^\circ\text{C}$ | | | 3 | mA |
| ΔI_d | Quiescent current change | $I_O = 5$ mA to 1 A | | | 0.5 | mA |
| | | $V_I = -11.5$ to -25 V | | | 1 | |
| $\Delta V_O/\Delta T$ | Output voltage drift | $I_O = 5$ mA | | -0.6 | | mV/°C |
| eN | Output noise voltage | $B = 10\text{Hz}$ to 100kHz , $T_J = 25^\circ\text{C}$ | | 175 | | μ V |
| SVR | Supply voltage rejection | $\Delta V_I = 10$ V, $f = 120\text{Hz}$ | 54 | 60 | | dB |
| V_d | Dropout voltage | $I_O = 1$ A, $T_J = 25^\circ\text{C}$, $\Delta V_O = 100$ mV | | 1.1 | | V |
| I_{sc} | Short circuit current | | | 1.5 | | A |

1. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

Refer to the test circuits, $T_J = 0$ to 125 °C, $V_I = -19$ V, $I_O = 500$ mA, $C_I = 2.2$ μ F, $C_O = 1$ μ F unless otherwise specified.

Table 6. Electrical characteristics of L7912C

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------|--------------------------|--|-------|------|-------|---------|
| V_O | Output voltage | $T_J = 25^\circ\text{C}$ | -11.5 | -12 | -12.5 | V |
| V_O | Output voltage | $I_O = -5$ mA to -1 A, $P_O \leq 15$ W $V_I = -15.5$ to -27 V | -11.4 | -12 | -12.6 | V |
| $\Delta V_O^{(1)}$ | Line regulation | $V_I = -14.5$ to -30 V, $T_J = 25^\circ\text{C}$ | | | 240 | mV |
| | | $V_I = -16$ to -22 V, $T_J = 25^\circ\text{C}$ | | | 120 | |
| $\Delta V_O^{(1)}$ | Load regulation | $I_O = 5$ mA to 1.5 A, $T_J = 25^\circ\text{C}$ | | | 240 | mV |
| | | $I_O = 250$ to 750 mA, $T_J = 25^\circ\text{C}$ | | | 120 | |
| I_d | Quiescent current | $T_J = 25^\circ\text{C}$ | | | 3 | mA |
| ΔI_d | Quiescent current change | $I_O = 5$ mA to 1 A | | | 0.5 | mA |
| | | $V_I = -15$ to -30 V | | | 1 | |
| $\Delta V_O/\Delta T$ | Output voltage drift | $I_O = 5$ mA | | -0.8 | | mV/°C |
| eN | Output noise voltage | $B = 10\text{Hz}$ to 100kHz , $T_J = 25^\circ\text{C}$ | | 200 | | μ V |
| SVR | Supply voltage rejection | $\Delta V_I = 10$ V, $f = 120\text{Hz}$ | 54 | 60 | | dB |
| V_d | Dropout voltage | $I_O = 1$ A, $T_J = 25^\circ\text{C}$, $\Delta V_O = 100$ mV | | 1.1 | | V |
| I_{sc} | Short circuit current | | | 1.5 | | A |

1. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

Refer to the test circuits, $T_J = 0$ to 125 °C, $V_I = -23$ V, $I_O = 500$ mA, $C_I = 2.2$ μ F, $C_O = 1$ μ F unless otherwise specified.

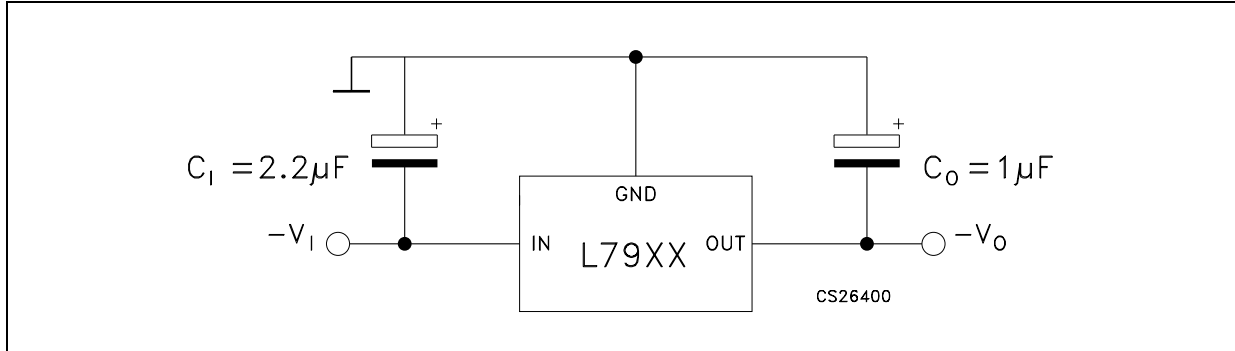
Table 7. Electrical characteristics of L7915C

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------|--------------------------|--|-------|------|-------|---------|
| V_O | Output voltage | $T_J = 25^\circ\text{C}$ | -14.4 | -15 | -15.6 | V |
| V_O | Output voltage | $I_O = -5$ mA to -1 A, $P_O \leq 15$ W $V_I = -18.5$ to -30 V | -14.3 | -15 | -15.7 | V |
| $\Delta V_O^{(1)}$ | Line regulation | $V_I = -17.5$ to -30 V, $T_J = 25^\circ\text{C}$ | | | 300 | mV |
| | | $V_I = -20$ to -26 V, $T_J = 25^\circ\text{C}$ | | | 150 | |
| $\Delta V_O^{(1)}$ | Load regulation | $I_O = 5$ mA to 1.5 A, $T_J = 25^\circ\text{C}$ | | | 300 | mV |
| | | $I_O = 250$ to 750 mA, $T_J = 25^\circ\text{C}$ | | | 150 | |
| I_d | Quiescent current | $T_J = 25^\circ\text{C}$ | | | 3 | mA |
| ΔI_d | Quiescent current change | $I_O = 5$ mA to 1 A | | | 0.5 | mA |
| | | $V_I = -18.5$ to -30 V | | | 1 | |
| $\Delta V_O/\Delta T$ | Output voltage drift | $I_O = 5$ mA | | -0.9 | | mV/°C |
| eN | Output noise voltage | $B = 10$ Hz to 100 kHz, $T_J = 25^\circ\text{C}$ | | 250 | | μ V |
| SVR | Supply voltage rejection | $\Delta V_I = 10$ V, $f = 120$ Hz | 54 | 60 | | dB |
| V_d | Dropout voltage | $I_O = 1$ A, $T_J = 25^\circ\text{C}$, $\Delta V_O = 100$ mV | | 1.1 | | V |
| I_{sc} | Short circuit current | | | 1.3 | | A |

1. Load and line regulation are specified at constant junction temperature. Changes in V_O due to heating effects must be taken into account separately. Pulse testing with low duty cycle is used.

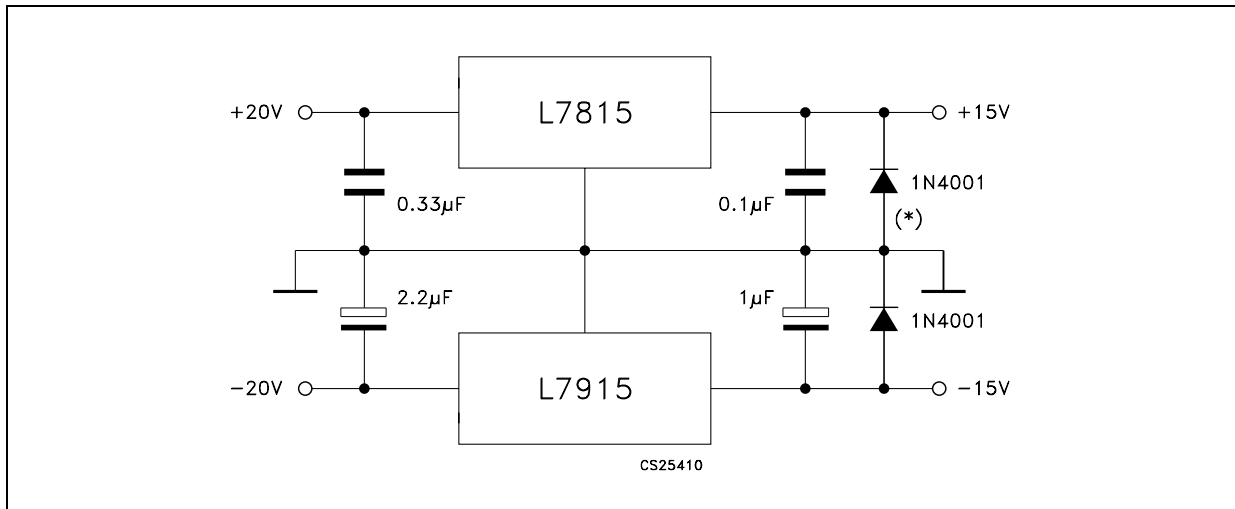
6 Application information

Figure 4. Fixed output regulator



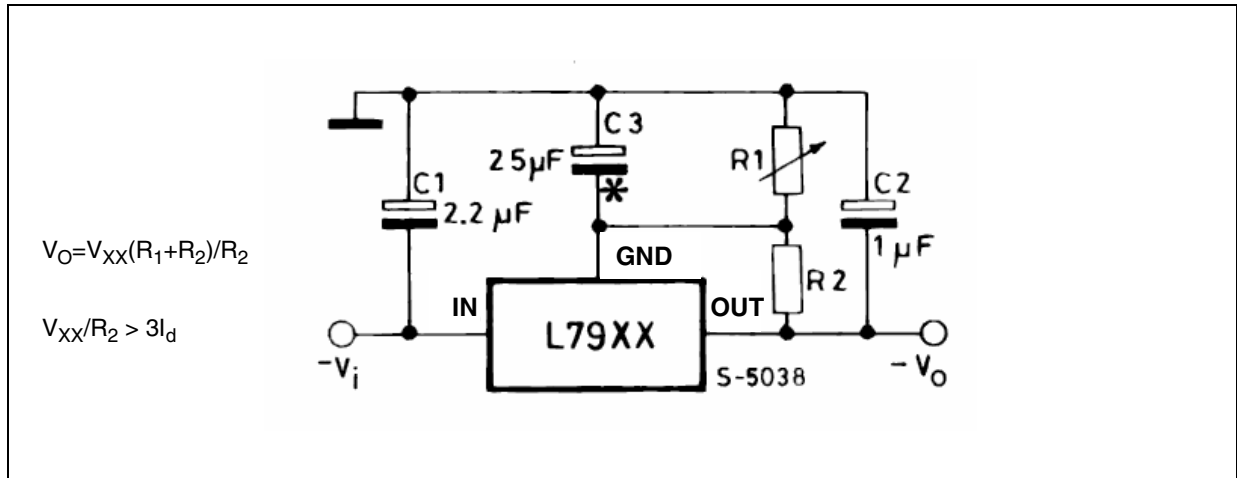
1. To specify an output voltage, substitute voltage value for "XX".
2. Required for stability. For value given, capacitor must be solid tantalum. If aluminium electrolytic are used, at least ten times value should be selected. C1 is required if regulator is located an appreciable distance from power supply filter.
3. To improve transient response. If large capacitors are used, a high current diode from input to output (1N4001 or similar) should be introduced to protect the device from momentary input short circuit.

Figure 5. Split power supply ($\pm 15\text{ V} - 1\text{ A}$)



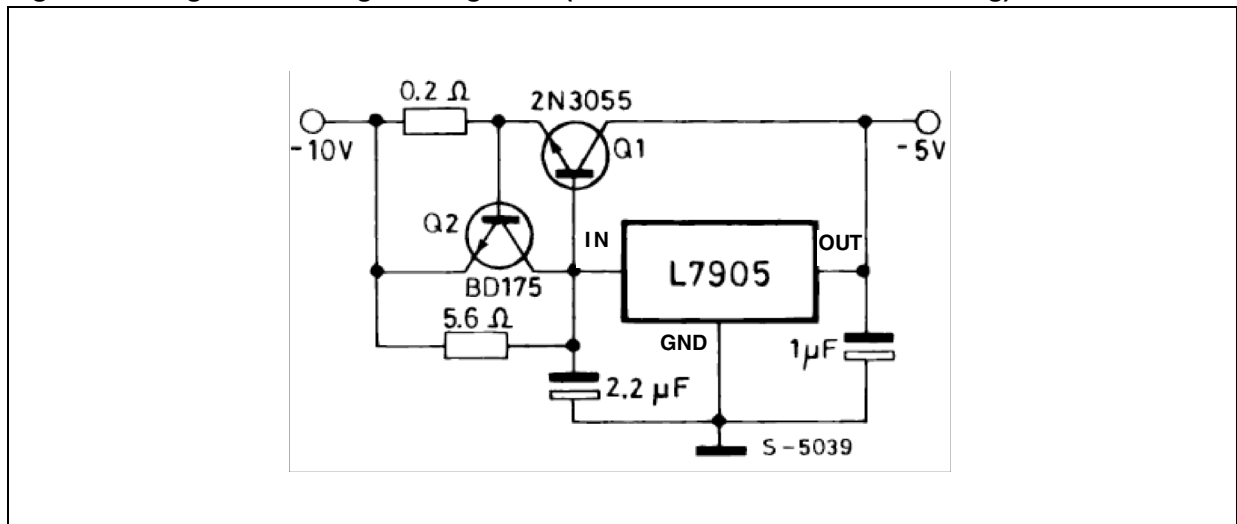
(*) Against potential latch-up problems.

Figure 6. Circuit for increasing output voltage



C3 Optional for improved transient response and ripple rejection.

Figure 7. High current negative regulator (- 5 V / 4 A with 5 A current limiting)



7 Package mechanical data

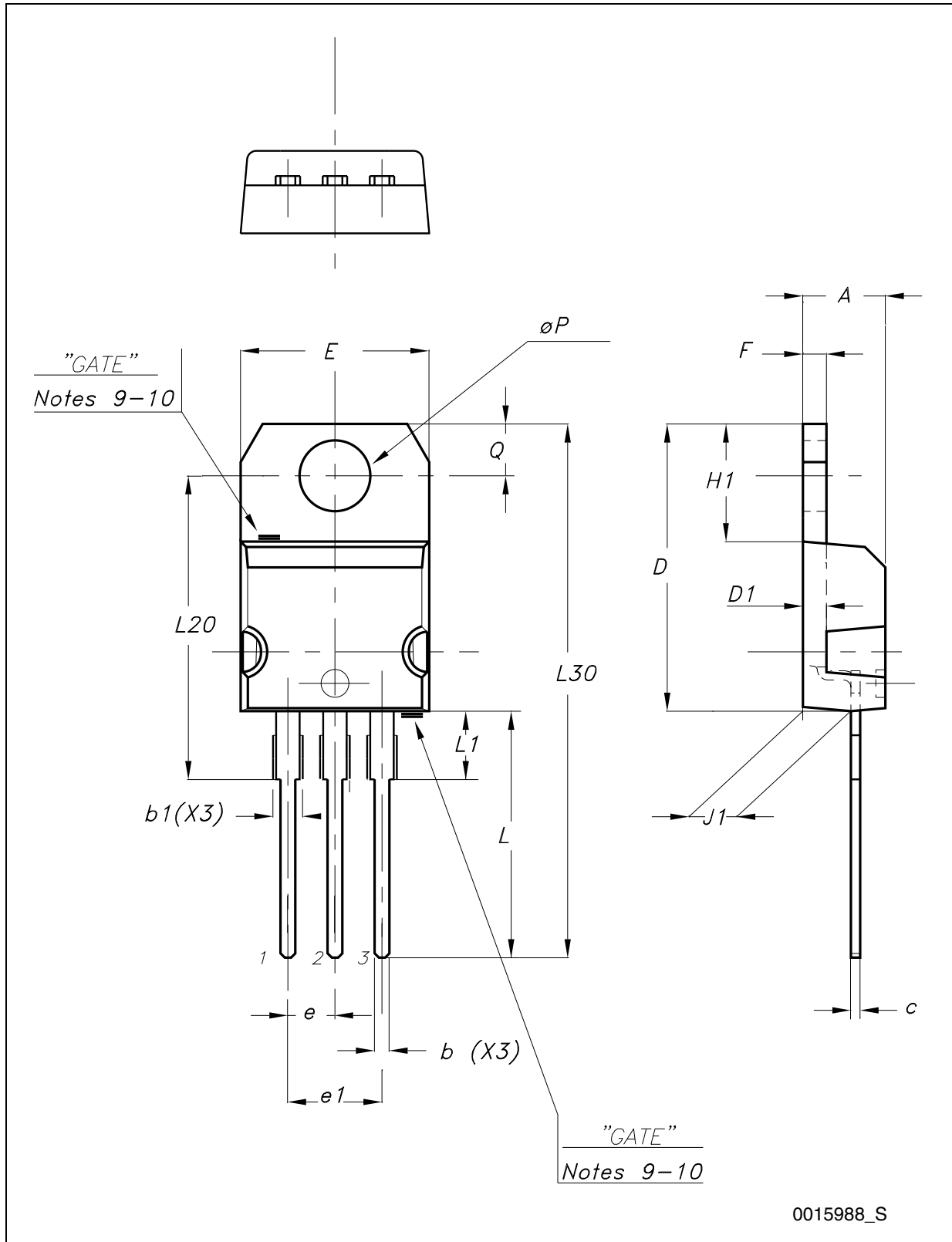
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK[®] packages, depending on their level of environmental compliance. ECOPACK[®] specifications, grade definitions and product status are available at: www.st.com. ECOPACK[®] is an ST trademark.

Table 8. 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 |

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

Figure 8. Drawing dimension TO-220 (type STD-ST Dual Gauge)



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Figure 9. Drawing dimension TO-220 (type STD-ST Single Gauge)

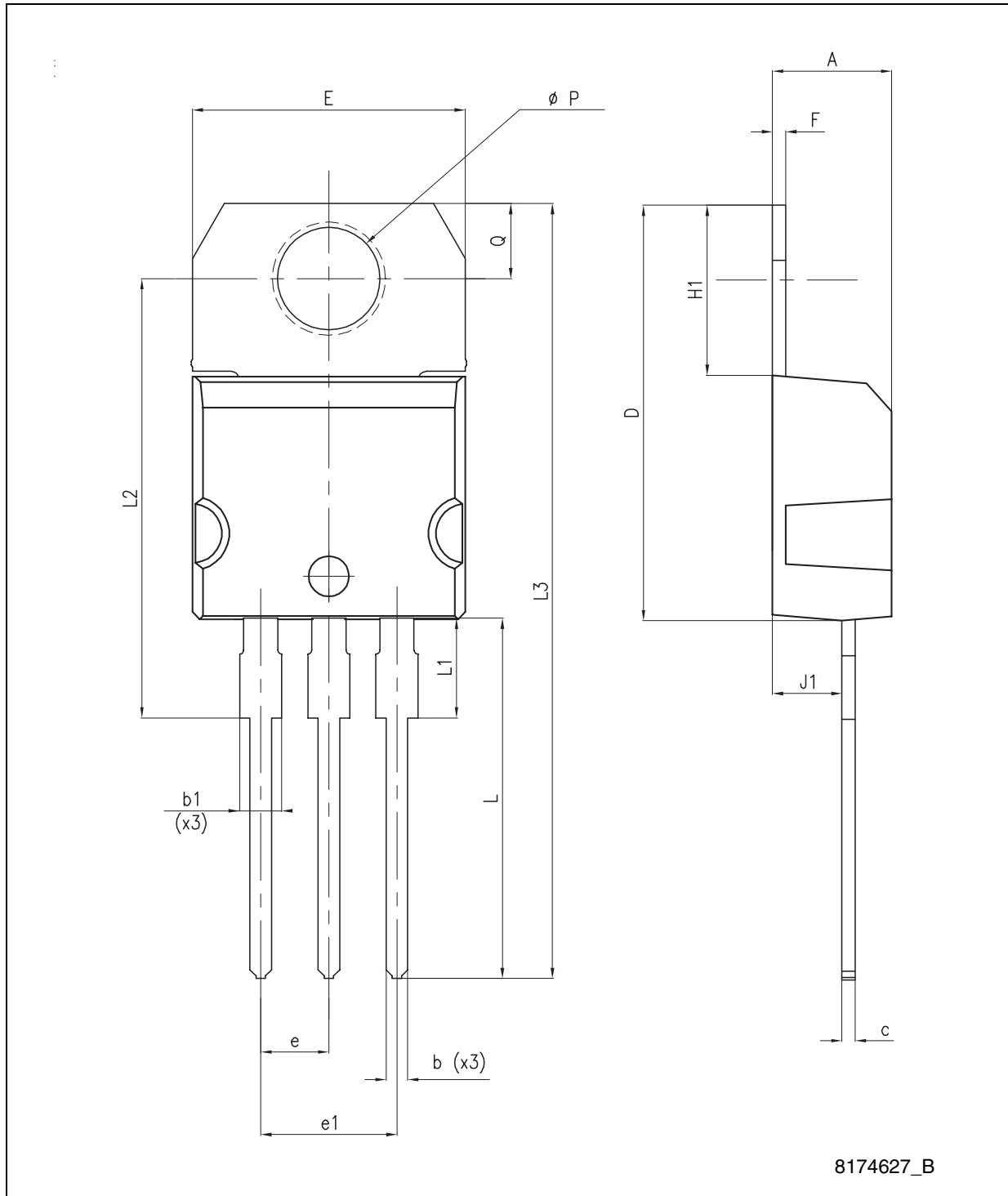


Figure 10. Drawing dimension tube for TO-220 Dual Gauge (mm)

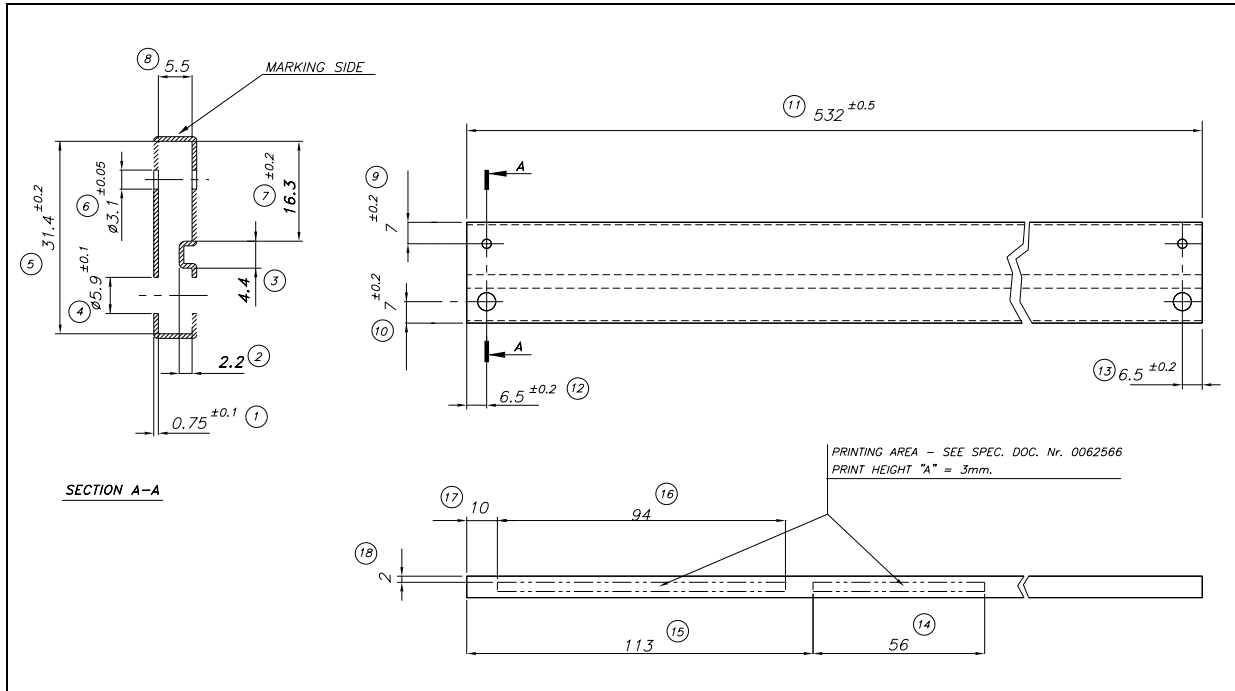
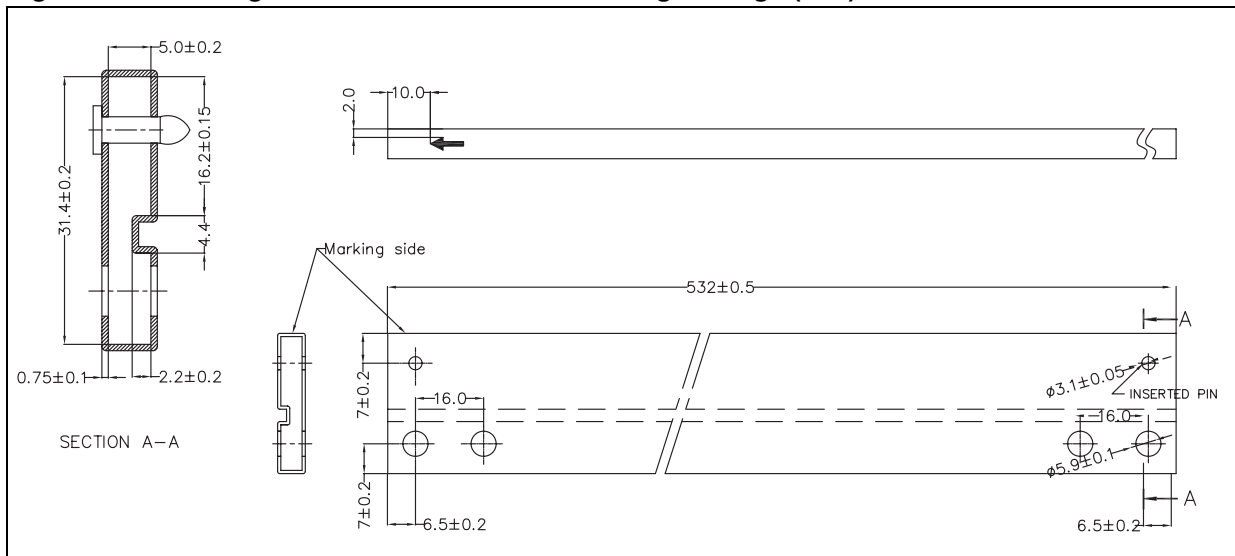


Figure 11. Drawing dimension tube for TO-220 Single Gauge (mm)



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 |

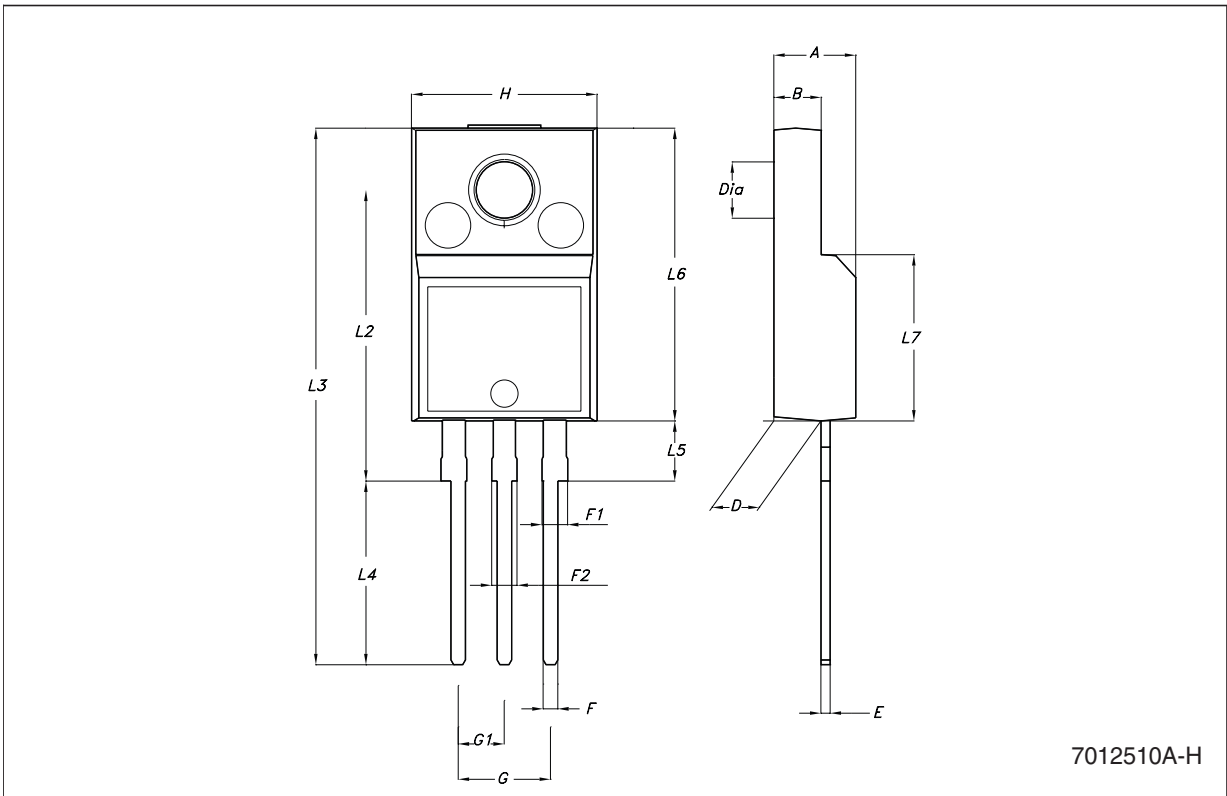


Figure 12. Drawing dimension D²PAK (type STD-ST)

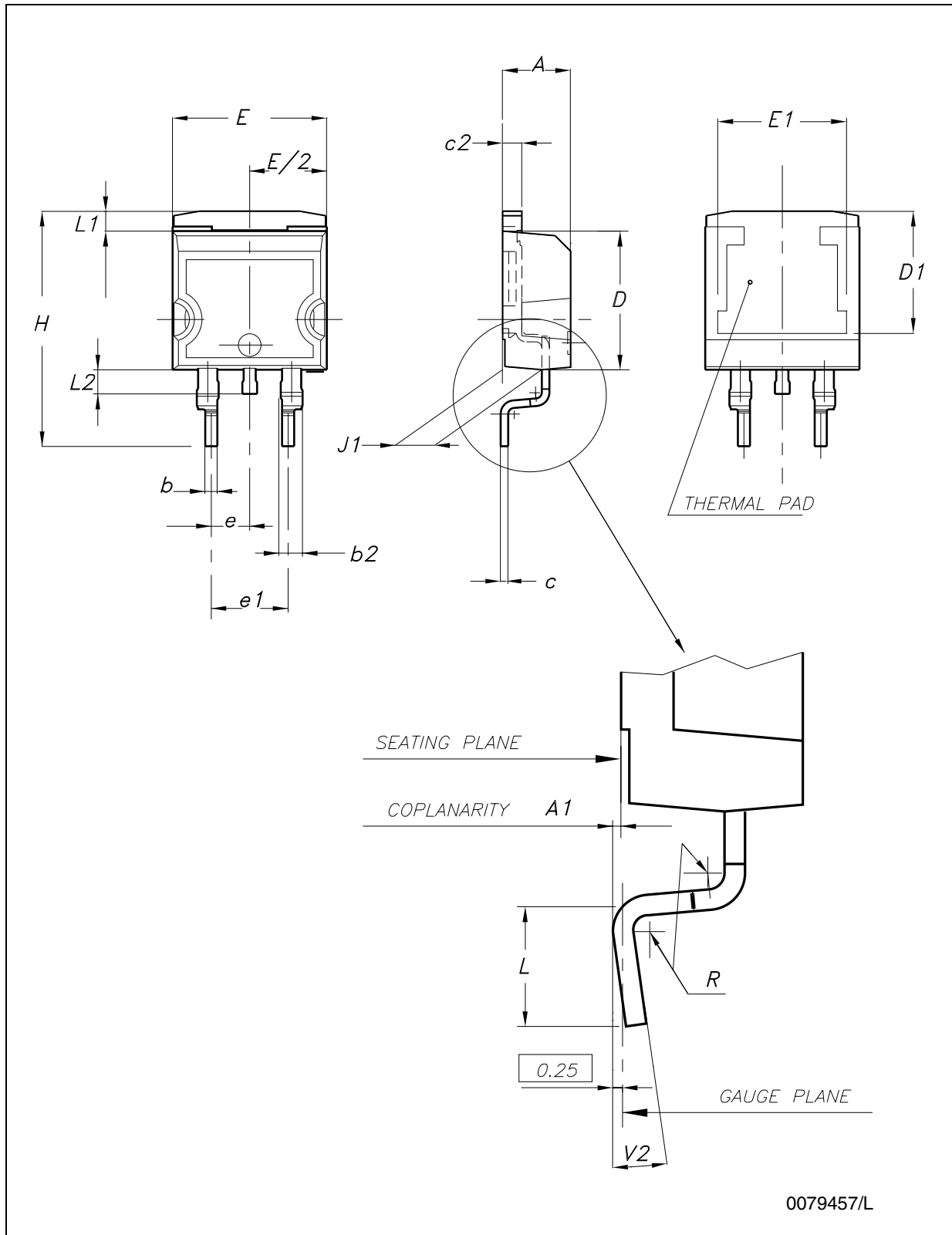


Figure 13. Drawing dimension D²PAK (type WOOSEOK-subcon.)

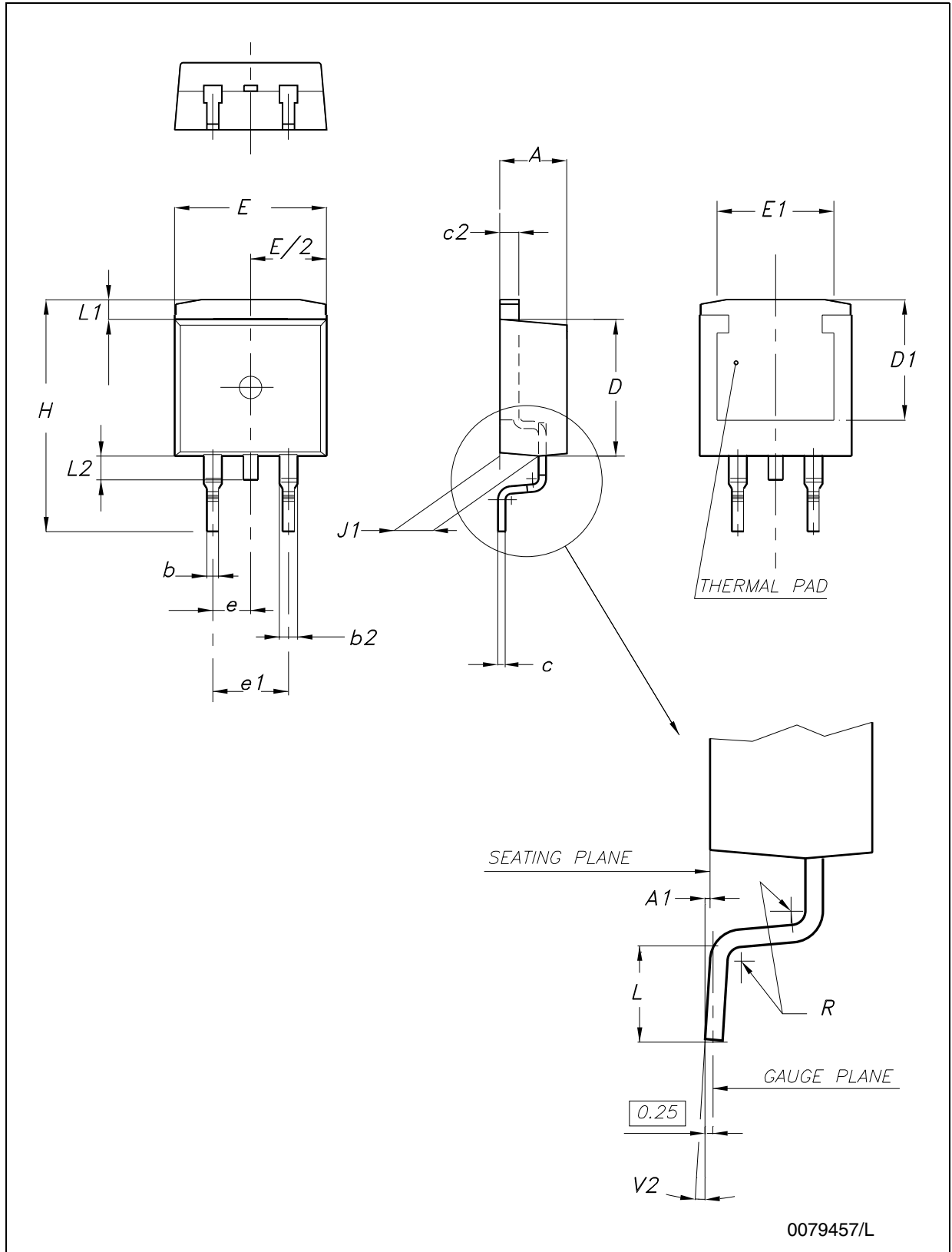


Table 9. D²PAK mechanical data

| Dim. | Type STD-ST | | | Type WOOSEOK-subcon. | | |
|------|-------------|------|-------|----------------------|-------|-------|
| | mm. | | | mm. | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 4.40 | | 4.60 | 4.30 | | 4.70 |
| A1 | 0.03 | | 0.23 | 0 | | 0.20 |
| b | 0.70 | | 0.93 | 0.70 | | 0.90 |
| b2 | 1.14 | | 1.70 | 1.17 | | 1.37 |
| c | 0.45 | | 0.60 | 0.45 | 0.50 | 0.60 |
| c2 | 1.23 | | 1.36 | 1.25 | 1.30 | 1.40 |
| D | 8.95 | | 9.35 | 9 | 9.20 | 9.40 |
| D1 | 7.50 | | | 7.50 | | |
| E | 10 | | 10.40 | 9.80 | | 10.20 |
| E1 | 8.50 | | | 7.50 | | |
| e | | 2.54 | | | 2.54 | |
| e1 | 4.88 | | 5.28 | | 5.08 | |
| H | 15 | | 15.85 | 15 | 15.30 | 15.60 |
| J1 | 2.49 | | 2.69 | 2.20 | | 2.60 |
| L | 2.29 | | 2.79 | 1.79 | | 2.79 |
| L1 | 1.27 | | 1.40 | 1 | | 1.40 |
| L2 | 1.30 | | 1.75 | 1.20 | | 1.60 |
| R | | 0.4 | | | 0.30 | |
| V2 | 0° | | 8° | 0° | | 3° |

Note: The D²PAK package coming from the subcontractor WOOSEOK is fully compatible with the ST's package suggested footprint.

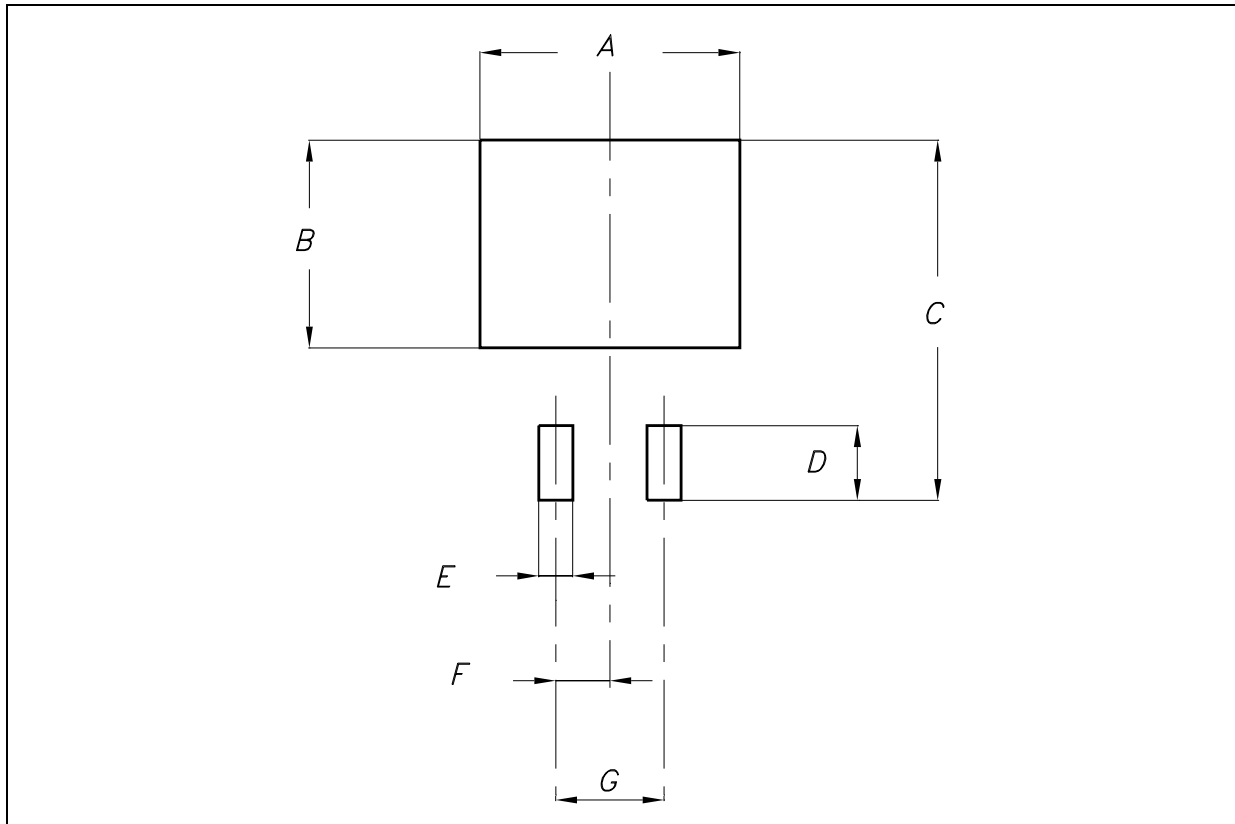
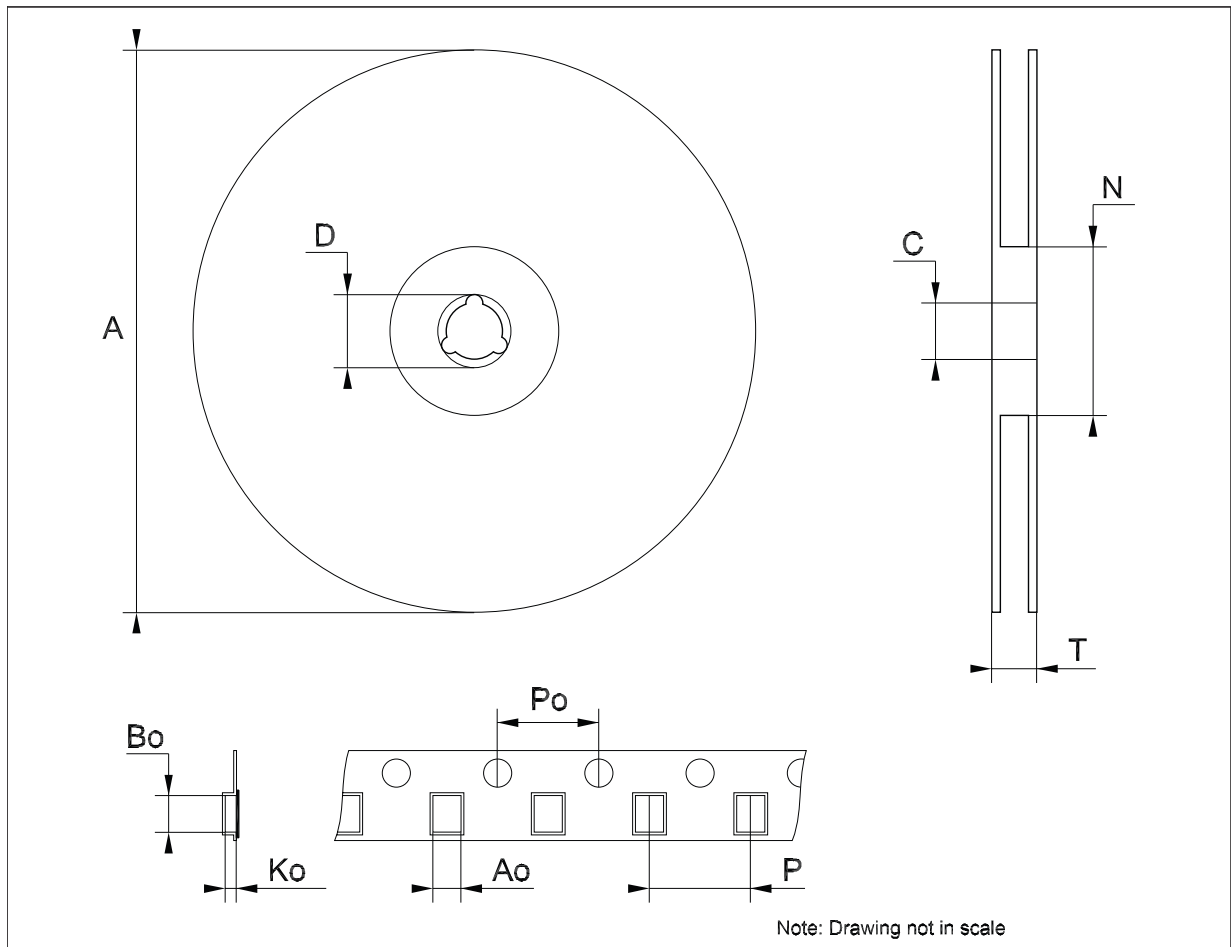
Figure 14. D²PAK footprint recommended data

Table 10. Footprint data

| Dim. | Values | |
|------|--------|-------|
| | mm. | inch. |
| A | 12.20 | 0.480 |
| B | 9.75 | 0.384 |
| C | 16.90 | 0.665 |
| D | 3.50 | 0.138 |
| E | 1.60 | 0.063 |
| F | 2.54 | 0.100 |
| G | 5.08 | 0.200 |

Tape & reel D²PAK-P²PAK-D²PAK/A-P²PAK/A mechanical data

| Dim. | mm. | | | inch. | | |
|------|-------|-------|-------|-------|-------|-------|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 180 | | | 7.086 |
| C | 12.8 | 13.0 | 13.2 | 0.504 | 0.512 | 0.519 |
| D | 20.2 | | | 0.795 | | |
| N | 60 | | | 2.362 | | |
| T | | | 14.4 | | | 0.567 |
| Ao | 10.50 | 10.6 | 10.70 | 0.413 | 0.417 | 0.421 |
| Bo | 15.70 | 15.80 | 15.90 | 0.618 | 0.622 | 0.626 |
| Ko | 4.80 | 4.90 | 5.00 | 0.189 | 0.193 | 0.197 |
| Po | 3.9 | 4.0 | 4.1 | 0.153 | 0.157 | 0.161 |
| P | 11.9 | 12.0 | 12.1 | 0.468 | 0.472 | 0.476 |



8 Revision history

Table 11. Document revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 22-Jun-2004 | 9 | Order codes updated Table 3. |
| 31-Aug-2005 | 10 | Add new order codes (TO-220 E Type) on Table 3. |
| 19-Jan-2007 | 11 | D ² PAK mechanical data updated and add footprint data. |
| 06-Jun-2007 | 12 | Order codes updated. |
| 25-Oct-2007 | 13 | Modified: Figure 3 , Figure 4 , Figure 6 and Figure 7 . |
| 05-Dec-2007 | 14 | Modified: Table 1 . |
| 18-Feb-2008 | 15 | Modified: Table 1 on page 1 . |
| 15-Jul-2008 | 16 | Modified: Table 1 on page 1 . |
| 19-Jan-2010 | 17 | Modified: Table 8 on page 13 , added: Figure 8 on page 14 , Figure 9 on page 15 , Figure 10 and Figure 11 on page 16 . |
| 26-May-2010 | 18 | Modified: V_I parameter Table 2 on page 5 . |
| 12-Nov-2010 | 19 | Modified: R_{thJC} value for TO-220 Table 3 on page 5 . |
| 18-Nov-2011 | 20 | Added: order codes L7905CV-DG, L7912CV-DG and L7915CV-DG Table 1 on page 1 . |
| 15-May-2012 | 21 | Added: order codes L7908CV-DG Table 1 on page 1 . |

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