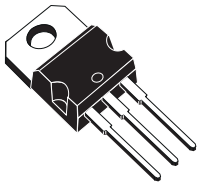
L78MxxAB
L78MxxAC

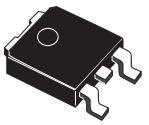
Precision 500 mA regulators

Features

- Output current to 0.5 A
- Output voltages of 5; 6; 8; 9; 10; 12; 15; 24 V
- Thermal overload protection
- Short circuit protection
- Output transition SOA protection
- ± 2 % Output voltage tolerance
- Guaranteed in extended temperature range



TO-220



DPAK

Description

The L78MxxA series of three-terminal positive regulators is available in TO-220 and DPAK 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.

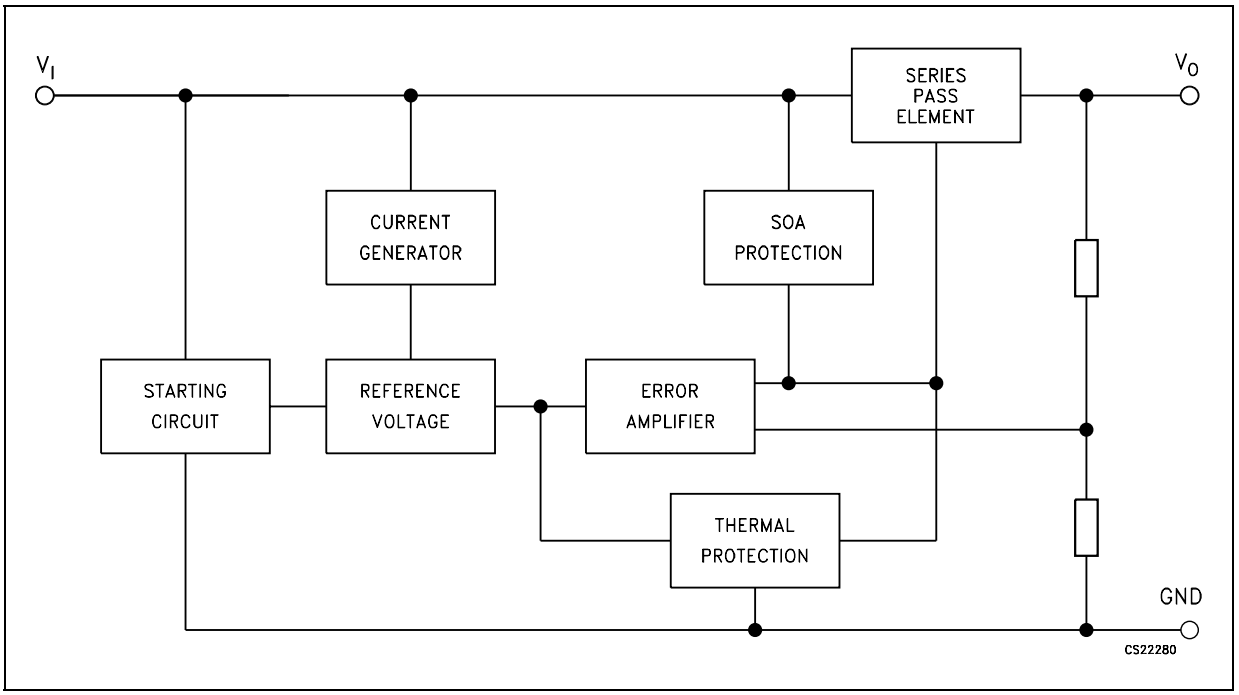
Table 1. Device summary

Part numbers	
L78M05AB	L78M12AB
L78M05AC	L78M12AC
L78M06AB	L78M15AB
L78M08AB	L78M24AB
L78M09AB	L78M24AC
L78M10AB	

Contents

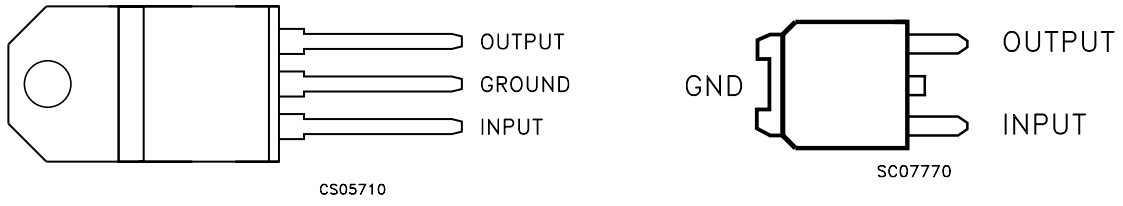
1 Diagram

Figure 1. Block diagram



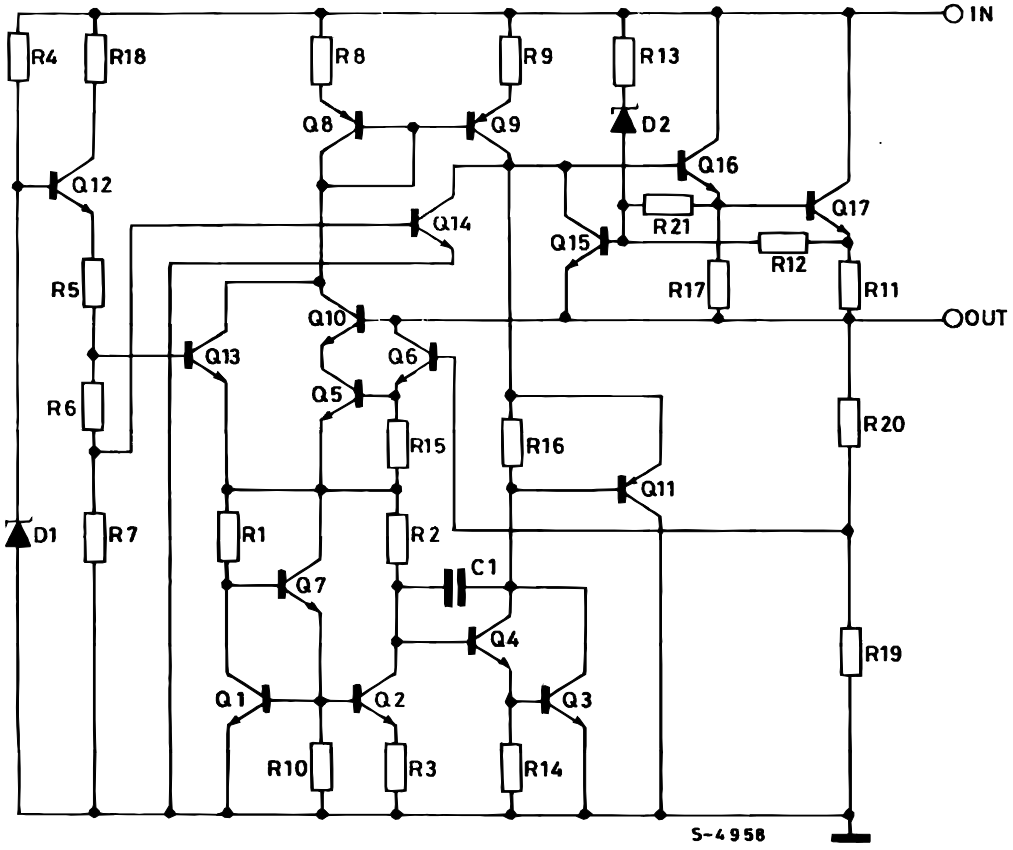
2 Pin configuration

Figure 2. Pin connections (top view)



TO-220 DPAK

Figure 3. Schematic diagram



3 Maximum ratings

Table 2. Absolute maximum ratings

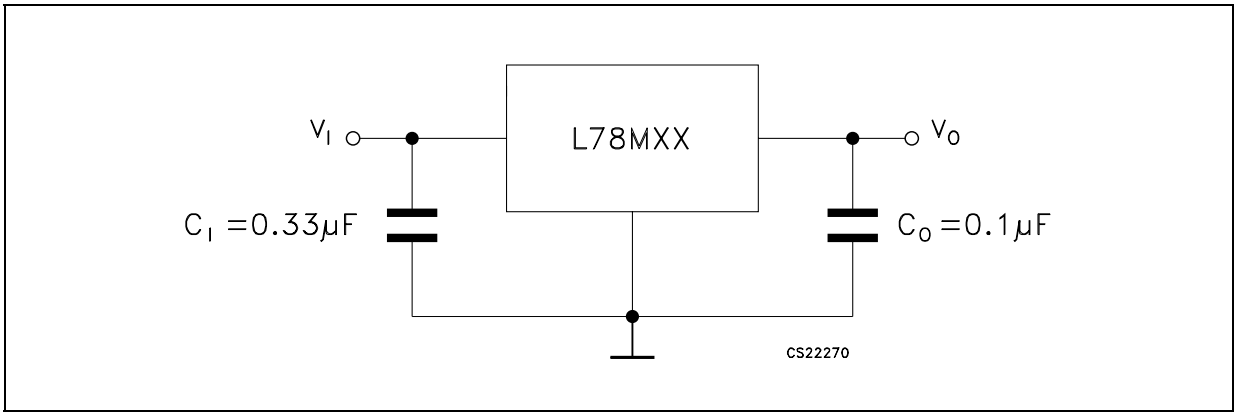
Symbol	Parameter		Value	Unit
V_I	DC input voltage	for V_O = 5 to 18 V	35	V
		for V_O = 20, 24 V	40	
I_O	Output current		Internally limited	mA
P_D	Power dissipation		Internally limited	mW
T_{STG}	Storage temperature range		-65 to 150	°C
T_{OP}	Operating junction temperature range	for L78M00AC	0 to 125	°C
		for L78M00AB	-40 to 125	

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

Figure 4. Application circuit



4 Test circuits

Figure 5. DC parameter

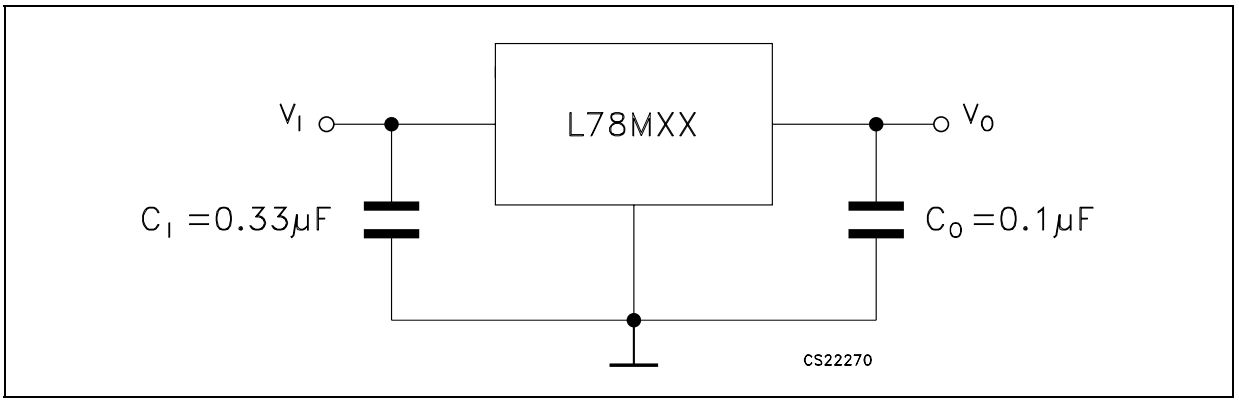


Figure 6. Load regulation

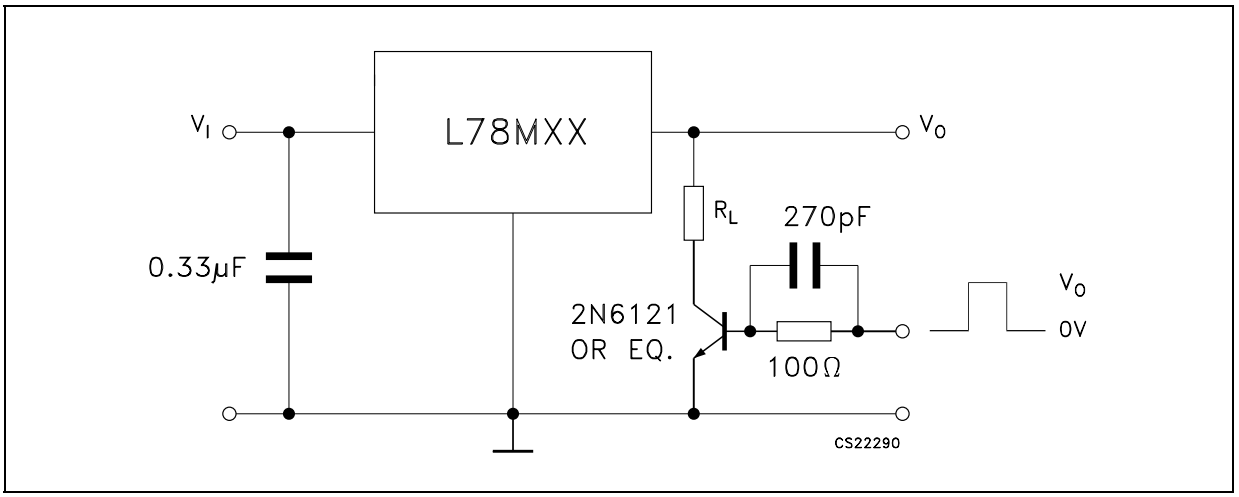
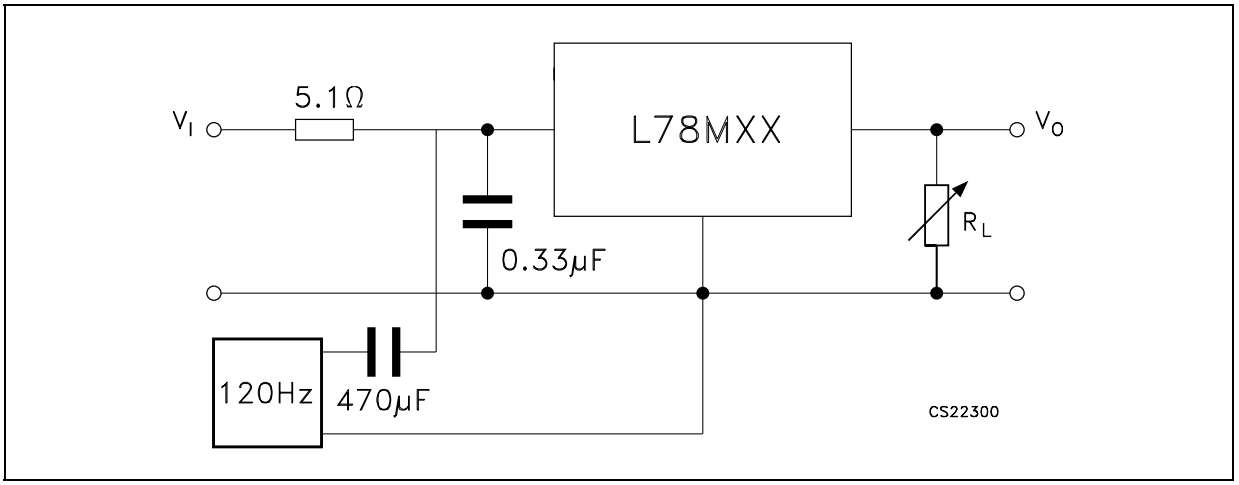


Figure 7. Ripple rejection



5 Electrical characteristics

Refer to the test circuits, V_I = 10 V, I_O = 350 mA, C_I = 0.33 µF, C_O = 0.1 µF, T_J = -40 to 125 °C (AB), T_J = 0 to 125 °C (AC) unless otherwise specified.

Table 4. Electrical characteristics of L78M05XX

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	4.9	5	5.1	V
V_O	Output voltage	I_O = 5 to 350 mA, V_I = 7 to 20 V	4.8	5	5.2	V
ΔV_O	Line regulation	V_I = 7 to 25 V, I_O = 200 mA, T_J = 25°C			100	mV
		V_I = 8 to 25 V, I_O = 200 mA, T_J = 25°C			50	
ΔV_O	Load regulation	I_O = 5 to 500 mA, T_J = 25°C			100	mV
		I_O = 5 to 200 mA, T_J = 25°C			50	
I_d	Quiescent current	T_J = 25°C			6	mA
ΔI_d	Quiescent current change	I_O = 5 to 350 mA			0.5	mA
		I_O = 200 mA, V_I = 8 to 25 V			0.8	
$\Delta V_O/\Delta T$	Output voltage drift	I_O = 5 mA		-0.5		mV/°C
SVR	Supply voltage rejection	V_I = 8 to 18 V, f = 120Hz, I_O = 300mA, T_J = 25°C	62			dB
eN	Output noise voltage	B =10Hz to 100kHz, T_J = 25°C		40		µV
V_d	Dropout voltage	T_J = 25°C		2		V
I_{sc}	Short circuit current	T_J = 25°C, V_I = 35 V		300		mA
I_{scp}	Short circuit peak current	T_J = 25°C		700		mA

Refer to the test circuits, V_I = 11 V, I_O = 350 mA, C_I = 0.33 µF, C_O = 0.1 µF, T_J = -40 to 125 °C (AB), T_J = 0 to 125 °C (AC) unless otherwise specified.

Table 5. Electrical characteristics of L78M06XX

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	5.88	6	6.12	V
V_O	Output voltage	I_O = 5 to 350 mA, V_I = 8 to 21 V	5.75	6	6.3	V
ΔV_O	Line regulation	V_I = 8 to 25 V, I_O = 200 mA, T_J = 25°C			100	mV
		V_I = 9 to 25 V, I_O = 200 mA, T_J = 25°C			30	
ΔV_O	Load regulation	I_O = 5 to 500 mA, T_J = 25°C			120	mV
		I_O = 5 to 200 mA, T_J = 25°C			60	
I_d	Quiescent current	T_J = 25°C			6	mA
ΔI_d	Quiescent current change	I_O = 5 to 350 mA			0.5	mA
		I_O = 200 mA, V_I = 9 to 25 V			0.8	
$\Delta V_O/\Delta T$	Output voltage drift	I_O = 5 mA		-0.5		mV/°C
SVR	Supply voltage rejection	V_I = 9 to 19 V, f = 120Hz, I_O = 300mA, T_J = 25°C	59			dB
eN	Output noise voltage	B =10Hz to 100kHz		45		µV
V_d	Dropout voltage	T_J = 25°C		2		V
I_{sc}	Short circuit current	T_J = 25°C, V_I = 35 V		270		mA
I_{scp}	Short circuit peak current	T_J = 25°C		700		mA

Refer to the test circuits, V_I = 14 V, I_O = 350 mA, C_I = 0.33 µF, C_O = 0.1 µF, T_J = -40 to 125 °C (AB), T_J = 0 to 125 °C (AC) unless otherwise specified).

Table 6. Electrical characteristics of L78M08XX

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	7.84	8	8.16	V
V_O	Output voltage	I_O = 5 to 350 mA, V_I = 10.5 to 23 V	7.7	8	8.3	V
ΔV_O	Line regulation	V_I = 10.5 to 25 V, I_O = 200 mA, T_J = 25°C			100	mV
		V_I = 11 to 25 V, I_O = 200 mA, T_J = 25°C			30	
ΔV_O	Load regulation	I_O = 5 to 500 mA, T_J = 25°C			160	mV
		I_O = 5 to 200 mA, T_J = 25°C			80	
I_d	Quiescent current	T_J = 25°C			6	mA
ΔI_d	Quiescent current change	I_O = 5 to 350 mA			0.5	mA
		I_O = 200 mA, V_I = 10.5 to 25 V			0.8	
$\Delta V_O/\Delta T$	Output voltage drift	I_O = 5 mA		-0.5		mV/°C
SVR	Supply voltage rejection	V_I = 11.5 to 21.5 V, f = 120Hz I_O = 300mA, T_J = 25°C	56			dB
eN	Output noise voltage	B =10Hz to 100kHz, T_J = 25°C		52		µV
V_d	Dropout voltage	T_J = 25°C		2		V
I_{sc}	Short circuit current	T_J = 25°C, V_I = 35 V		250		mA
I_{scp}	Short circuit peak current	T_J = 25°C		700		mA

Refer to the test circuits, V_I = 15 V, I_O = 350 mA, C_I = 0.33 µF, C_O = 0.1 µF, T_J = -40 to 125 °C (AB), T_J = 0 to 125 °C (AC) unless otherwise specified).

Table 7. Electrical characteristics of L78M09XX

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	8.82	9	9.18	V
V_O	Output voltage	I_O = 5 to 350 mA, V_I = 11.5 to 24 V	8.64	9	9.36	V
ΔV_O	Line regulation	V_I = 11.5 to 25 V, I_O = 200 mA, T_J = 25°C			100	mV
		V_I = 12 to 25 V, I_O = 200 mA, T_J = 25°C			30	
ΔV_O	Load regulation	I_O = 5 to 500 mA, T_J = 25°C			180	mV
		I_O = 5 to 200 mA, T_J = 25°C			90	
I_d	Quiescent current	T_J = 25°C			6	mA
ΔI_d	Quiescent current change	I_O = 5 to 350 mA			0.5	mA
		I_O = 200 mA, V_I = 11.5 to 25 V			0.8	
$\Delta V_O/\Delta T$	Output voltage drift	I_O = 5 mA		-0.5		mV/°C
SVR	Supply voltage rejection	V_I = 12.5 to 23 V, f = 120Hz, I_O = 300mA, T_J = 25°C	56			dB
eN	Output noise voltage	B =10Hz to 100kHz, T_J = 25°C		52		µV
V_d	Dropout voltage	T_J = 25°C		2		V
I_{sc}	Short circuit current	V_I = 35 V, T_J = 25°C		250		mA
I_{scp}	Short circuit peak current	T_J = 25°C		700		mA

Refer to the test circuits, V_I = 16 V, I_O = 350 mA, C_I = 0.33 µF, C_O = 0.1 µF, T_J = -40 to 125 °C (AB), T_J = 0 to 125 °C (AC) unless otherwise specified.

Table 8. Electrical characteristics of L78M10XX

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	9.8	10	10.2	V
V_O	Output voltage	I_O = 5 to 350 mA, V_I = 12.5 to 25 V	9.6	10	10.4	V
ΔV_O	Line regulation	V_I = 12.5 to 30 V, I_O = 200 mA, T_J = 25°C			100	mV
		V_I = 13 to 30 V, I_O = 200 mA, T_J = 25°C			30	
ΔV_O	Load regulation	I_O = 5 to 500 mA, T_J = 25°C			200	mV
		I_O = 5 to 200 mA, T_J = 25°C			100	
I_d	Quiescent current	T_J = 25°C			6	mA
ΔI_d	Quiescent current change	I_O = 5 to 350 mA			0.5	mA
		I_O = 200 mA, V_I = 12.5 to 30 V			0.8	
$\Delta V_O/\Delta T$	Output voltage drift	I_O = 5 mA		-0.5		mV/°C
SVR	Supply voltage rejection	V_I = 13.5 to 24 V, f = 120Hz, I_O = 300mA, T_J = 25°C	56			dB
eN	Output noise voltage	B =10Hz to 100kHz, T_J = 25°C		64		µV
V_d	Dropout voltage	T_J = 25°C		2		V
I_{sc}	Short circuit current	V_I = 35 V, T_J = 25°C		245		mA
I_{scp}	Short circuit peak current	T_J = 25°C		700		mA

Refer to the test circuits, V_I = 19 V, I_O = 350 mA, C_I = 0.33 µF, C_O = 0.1 µF, T_J = -40 to 125 °C (AB), T_J = 0 to 125 °C (AC) unless otherwise specified.

Table 9. Electrical characteristics of L78M12XX

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	11.75	12	12.25	V
V_O	Output voltage	I_O = 5 to 350 mA, V_I = 14.5 to 27 V	11.5	12	12.5	V
ΔV_O	Line regulation	V_I = 14.5 to 30 V, I_O = 200 mA, T_J = 25°C			100	mV
		V_I = 16 to 30 V, I_O = 200 mA, T_J = 25°C			30	
ΔV_O	Load regulation	I_O = 5 to 500 mA, T_J = 25°C			240	mV
		I_O = 5 to 200 mA, T_J = 25°C			120	
I_d	Quiescent current	T_J = 25°C			6	mA
ΔI_d	Quiescent current change	I_O = 5 to 350 mA			0.5	mA
		I_O = 200 mA, V_I = 14.5 to 30 V			0.8	
$\Delta V_O/\Delta T$	Output voltage drift	I_O = 5 mA		-1		mV/°C
SVR	Supply voltage rejection	V_I = 15 to 25 V, f = 120Hz, I_O = 300mA, T_J = 25°C	55			dB
eN	Output noise voltage	B =10Hz to 100kHz, T_J = 25°C		75		µV
V_d	Dropout voltage	T_J = 25°C		2		V
I_{sc}	Short circuit current	V_I = 35 V, T_J = 25°C		240		mA
I_{scp}	Short circuit peak current	T_J = 25°C		700		mA

Refer to the test circuits, V_I = 23 V, I_O = 350 mA, C_I = 0.33 µF, C_O = 0.1 µF, T_J = -40 to 125 °C (AB), T_J = 0 to 125 °C (AC) unless otherwise specified.

Table 10. Electrical characteristics of L78M15XX

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	14.7	15	15.3	V
V_O	Output voltage	I_O = 5 to 350 mA, V_I = 17.5 to 30 V	14.4	15	15.6	V
ΔV_O	Line regulation	V_I = 17.5 to 30 V, I_O = 200 mA, T_J = 25°C			100	mV
		V_I = 20 to 30 V, I_O = 200 mA, T_J = 25°C			30	
ΔV_O	Load regulation	I_O = 5 to 500 mA, T_J = 25°C			300	mV
		I_O = 5 to 200 mA, T_J = 25°C			150	
I_d	Quiescent current	T_J = 25°C			6	mA
ΔI_d	Quiescent current change	I_O = 5 to 350 mA			0.5	mA
		I_O = 200 mA, V_I = 17.5 to 30 V			0.8	
$\Delta V_O/\Delta T$	Output voltage drift	I_O = 5 mA		-1		mV/°C
SVR	Supply voltage rejection	V_I = 18.5 to 28.5 V, f = 120Hz, I_O = 300mA, T_J = 25°C	54			dB
eN	Output noise voltage	B =10Hz to 100kHz, T_J = 25°C		90		µV
V_d	Dropout voltage	T_J = 25°C		2		V
I_{sc}	Short circuit current	V_I = 35 V, T_J = 25°C		240		mA
I_{scp}	Short circuit peak current	T_J = 25°C		700		mA

Refer to the test circuits, V_I = 33 V, I_O = 350 mA, C_I = 0.33 µF, C_O = 0.1 µF, T_J = -40 to 125 °C (AB), T_J = 0 to 125 °C (AC) unless otherwise specified.

Table 11. Electrical characteristics of L78M24XX

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage	T_J = 25°C	23.5	24	24.5	V
V_O	Output voltage	I_O = 5 to 350 mA, V_I = 27 to 38 V	23	24	25	V
ΔV_O	Line regulation	V_I = 27 to 38 V, I_O = 200 mA, T_J = 25°C			100	mV
		V_I = 28 to 38 V, I_O = 200 mA, T_J = 25°C			30	
ΔV_O	Load regulation	I_O = 5 to 500 mA, T_J = 25°C			480	mV
		I_O = 5 to 200 mA, T_J = 25°C			240	
I_d	Quiescent current	T_J = 25°C			6	mA
ΔI_d	Quiescent current change	I_O = 5 to 350 mA			0.5	mA
		I_O = 200 mA, V_I = 27 to 38 V			0.8	
$\Delta V_O/\Delta T$	Output voltage drift	I_O = 5 mA		-1.2		mV/°C
SVR	Supply voltage rejection	V_I = 28 to 38 V, f = 120Hz, I_O = 300mA, T_J = 25°C	50			dB
eN	Output noise voltage	B =10Hz to 100kHz, T_J = 25°C		170		µV
V_d	Dropout voltage	T_J = 25°C		2		V
I_{sc}	Short circuit current	V_I = 35 V, T_J = 25°C		240		mA
I_{scp}	Short circuit peak current	T_J = 25°C		700		mA

6 Typical performance

Figure 8. Dropout voltage vs. junction temp.

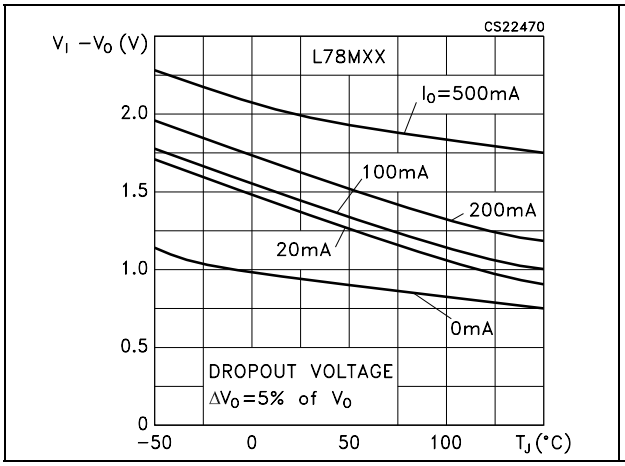


Figure 9. Dropout characteristics

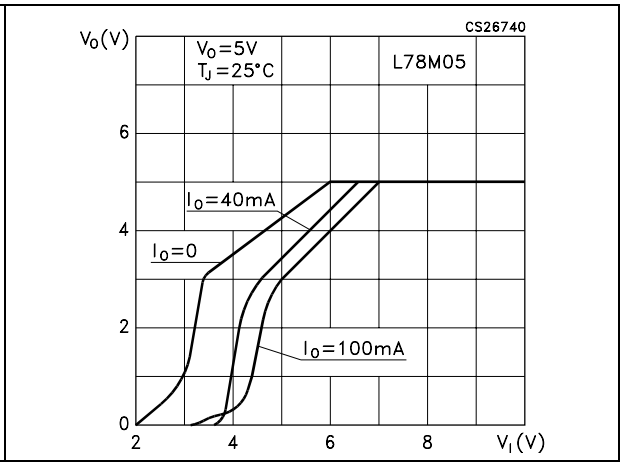


Figure 10. Peak output current vs. input-output differential voltage

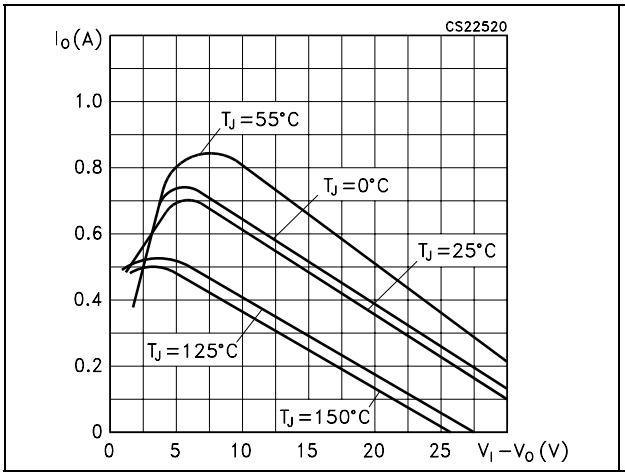


Figure 11. Output voltage vs. junction temperature

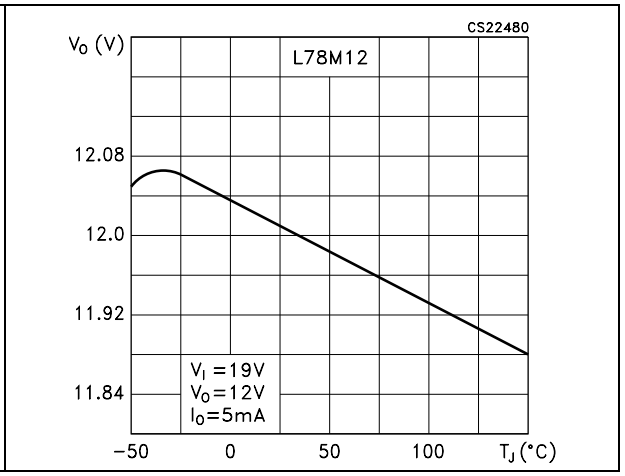


Figure 12. Supply voltage rejection vs. freq.

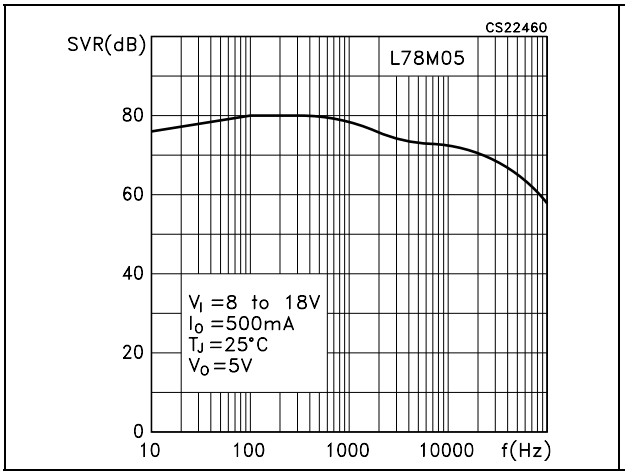


Figure 13. Quiescent current vs. junction temp.

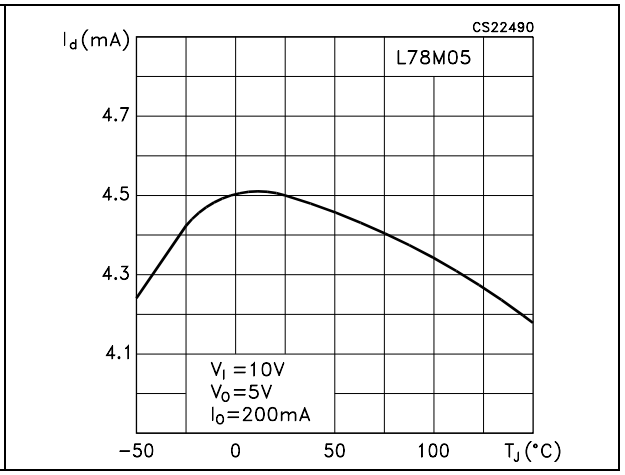


Figure 14. Load transient response

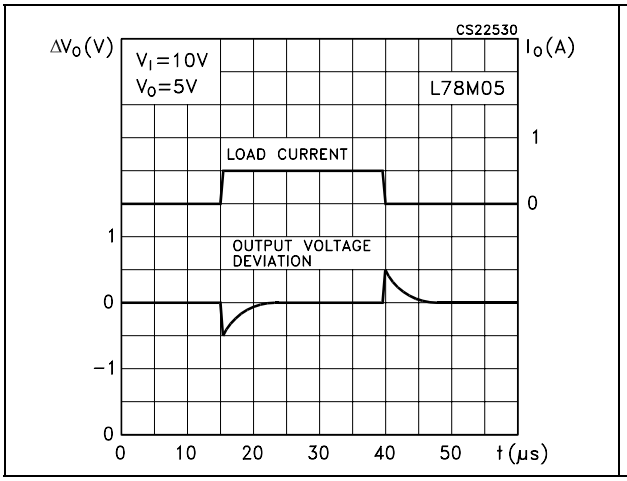


Figure 15. Line transient response

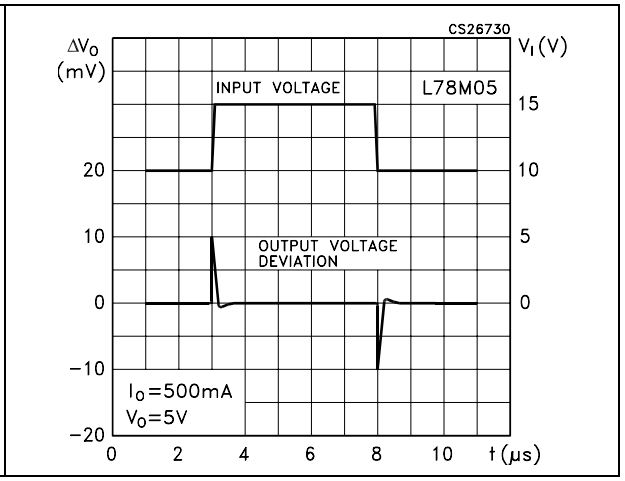
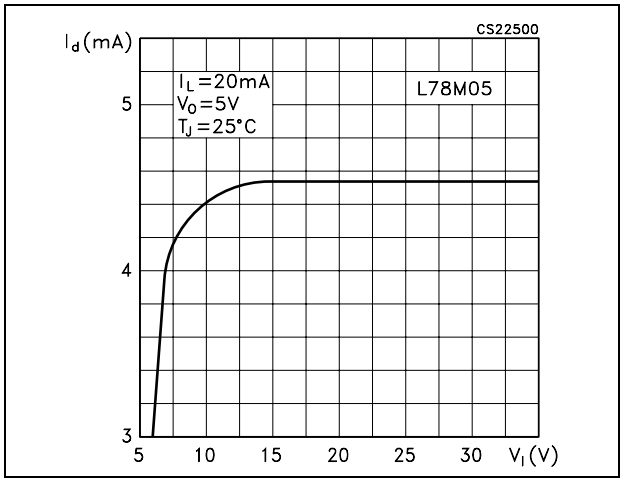


Figure 16. Quiescent current vs. input voltage



7 Applications information

7.1 Design considerations

The L78MxxA series of fixed voltage regulators are designed with thermal overload protection that shuts down the circuit when subjected to an excessive power overload condition, internal short-circuit protection that limits the maximum current the circuit will pass, and output transistor safe-area compensation that reduces the output short-circuit as the voltage across the pass transistor is increased. In many low current applications, compensation capacitors are not required. However, it is recommended that the regulator input be bypassed with a capacitor if the regulator is connected to the power supply filter with long wire lengths, or if the output load capacitance is large. An input bypass capacitor should be selected to provide good high-frequency characteristics to insure stable operation under all load conditions. A 0.33 µF or larger tantalum, mylar, or other capacitor having low internal impedance at high frequencies should be chosen. The bypass capacitor should be mounted with the shortest possible leads directly across the regulators input terminals. Normally good construction techniques should be used to minimize ground loops and lead resistance drops since the regulator has no external sense lead.

Figure 17. Current regulator

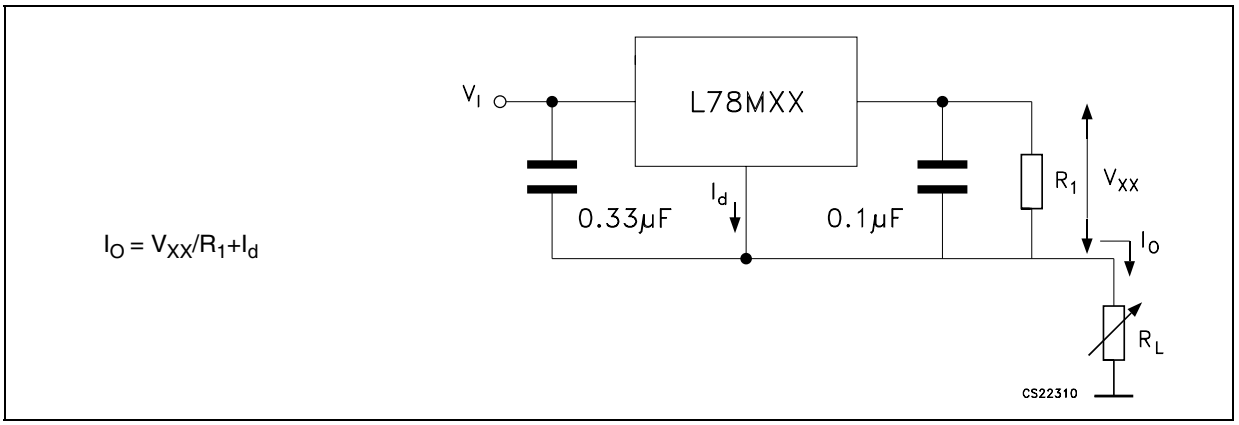


Figure 18. Adjustable output regulator

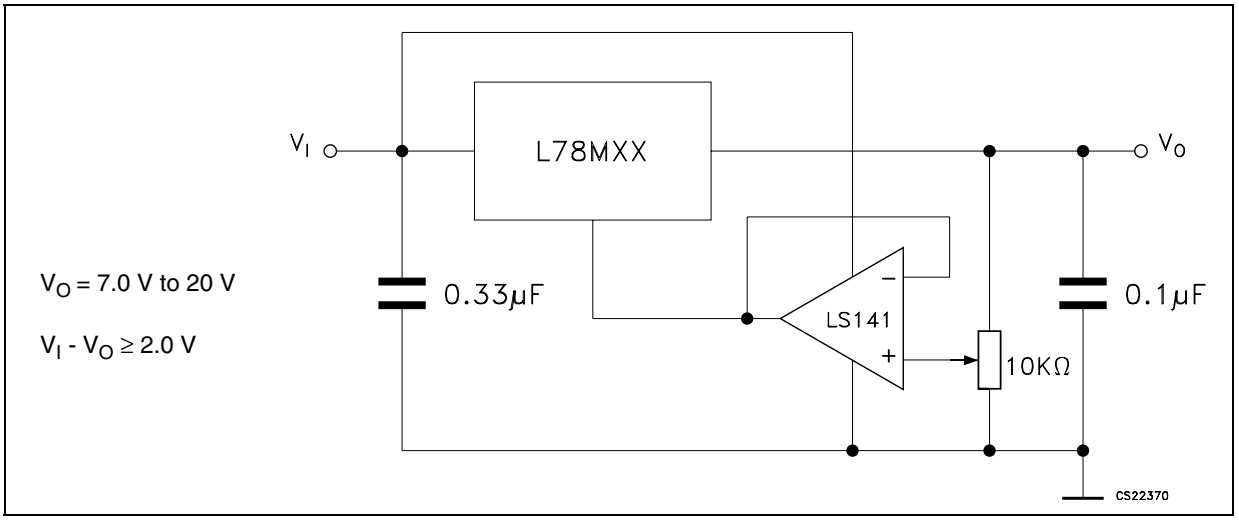


Figure 19. Current boost regulator

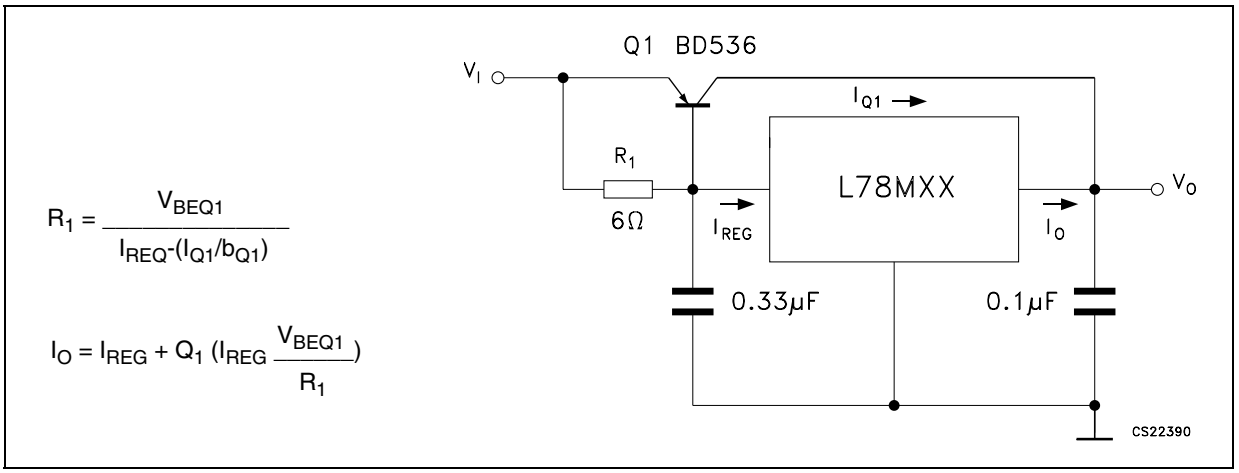
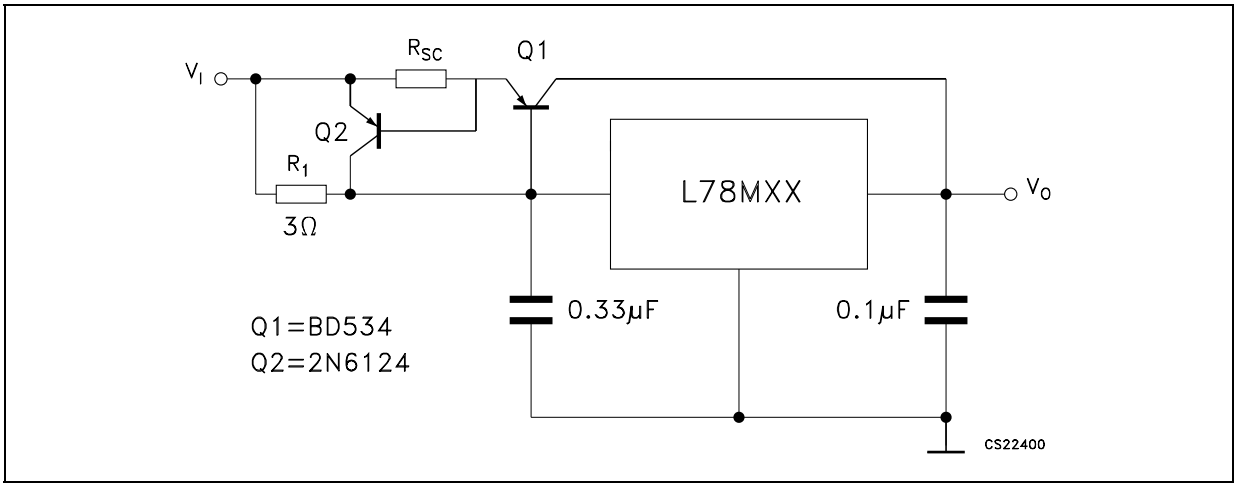


Figure 20. Short-circuit protection



Note: The circuit of Figure 19 can be modified to provide supply protection against short-circuits by adding a short-circuit sense resistor, R_{SC}, and an additional PNP transistor. The current sensing PNP must be able to handle the short-circuit current of the three-terminal regulator. Therefore, a four ampere plastic power transistor is specified.

8 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.

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

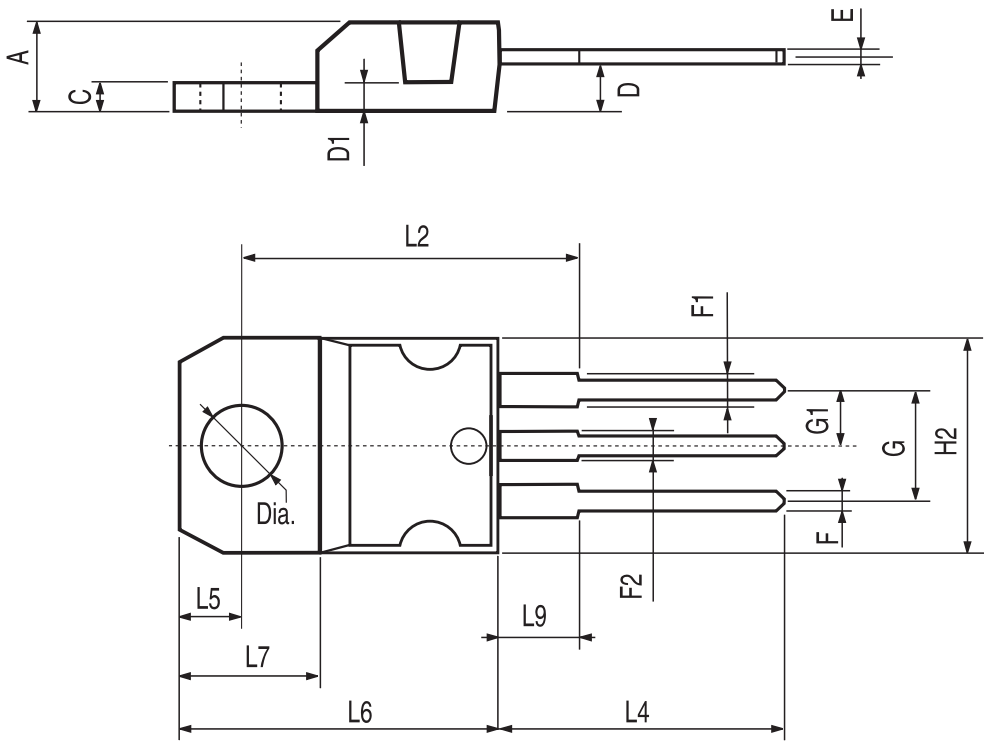


Figure 21. Drawing dimension DPAK type STD-ST

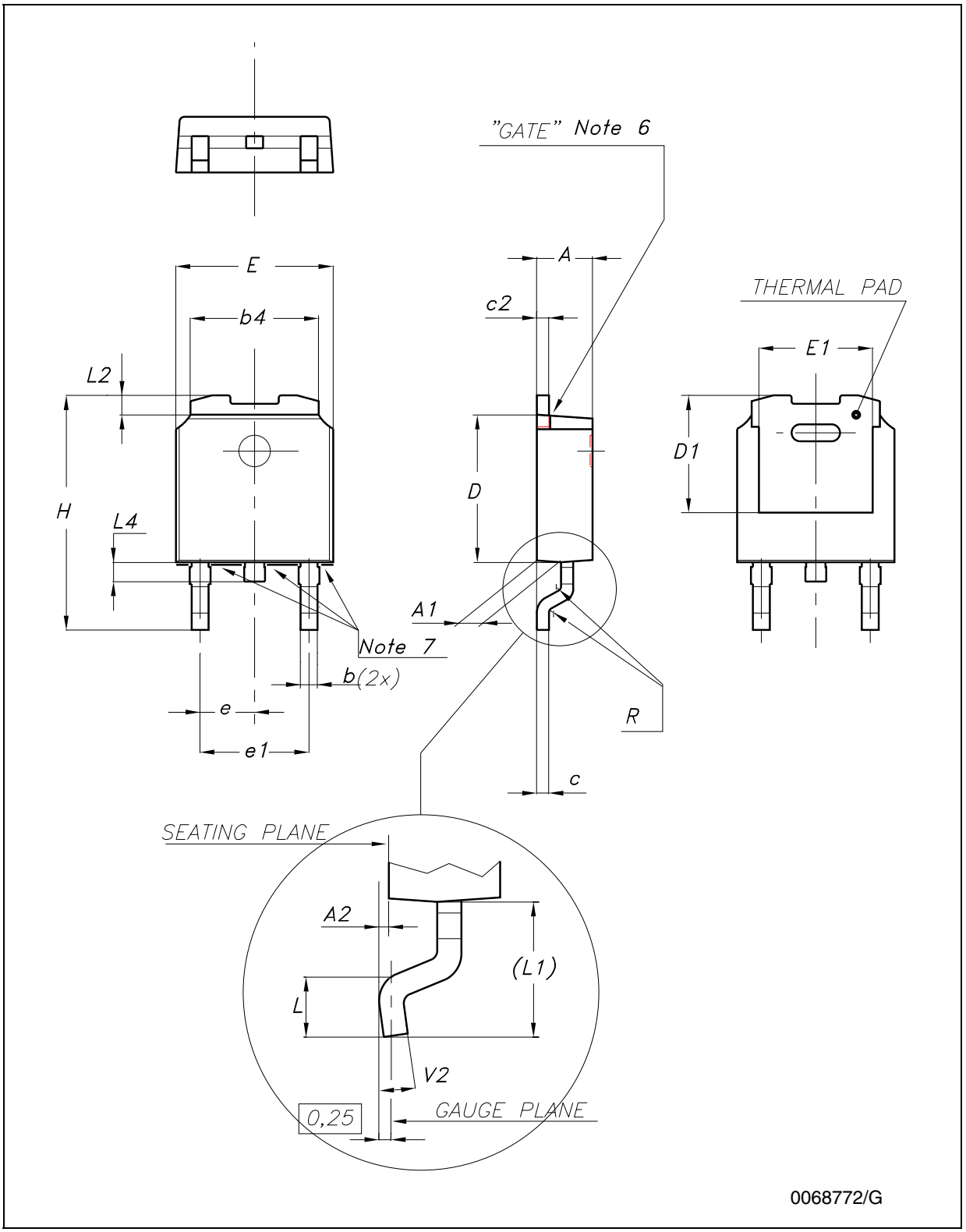


Figure 22. Drawing dimension DPAK type FUJITSU-subcon.

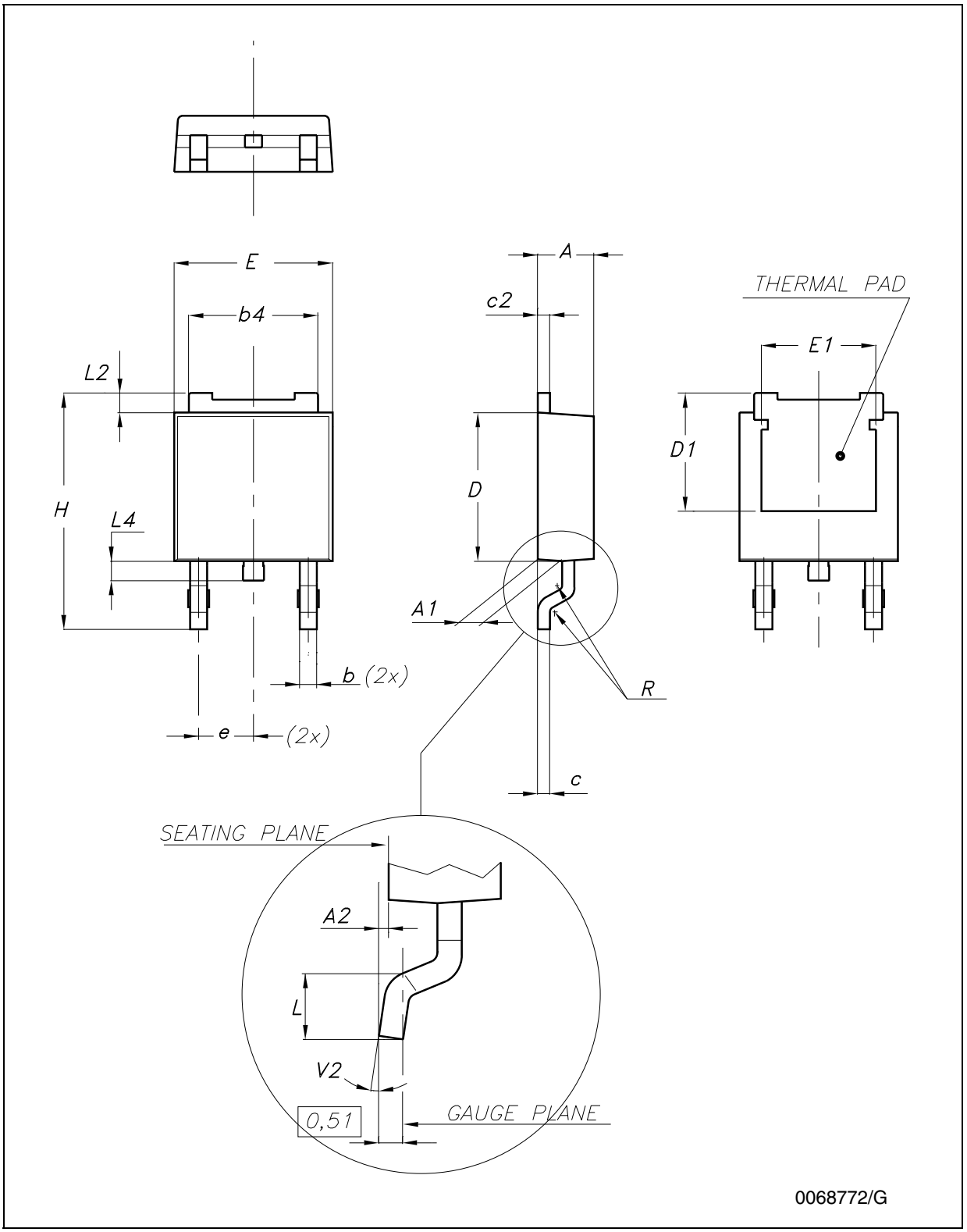


Figure 23. Drawing dimension DPAK type IDS-subcon.

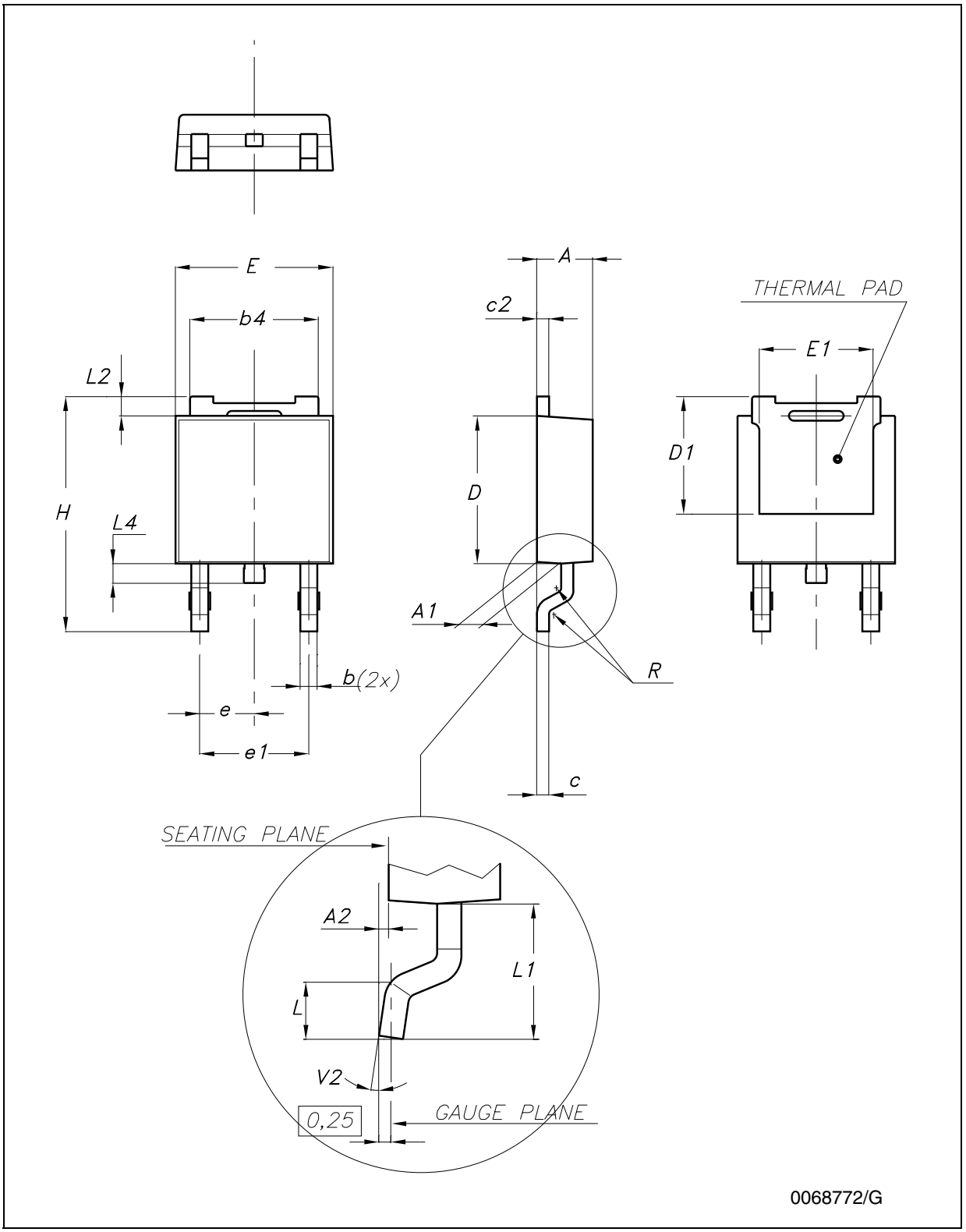


Table 12. DPAK mechanical data

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 24. DPAK footprint recommended data

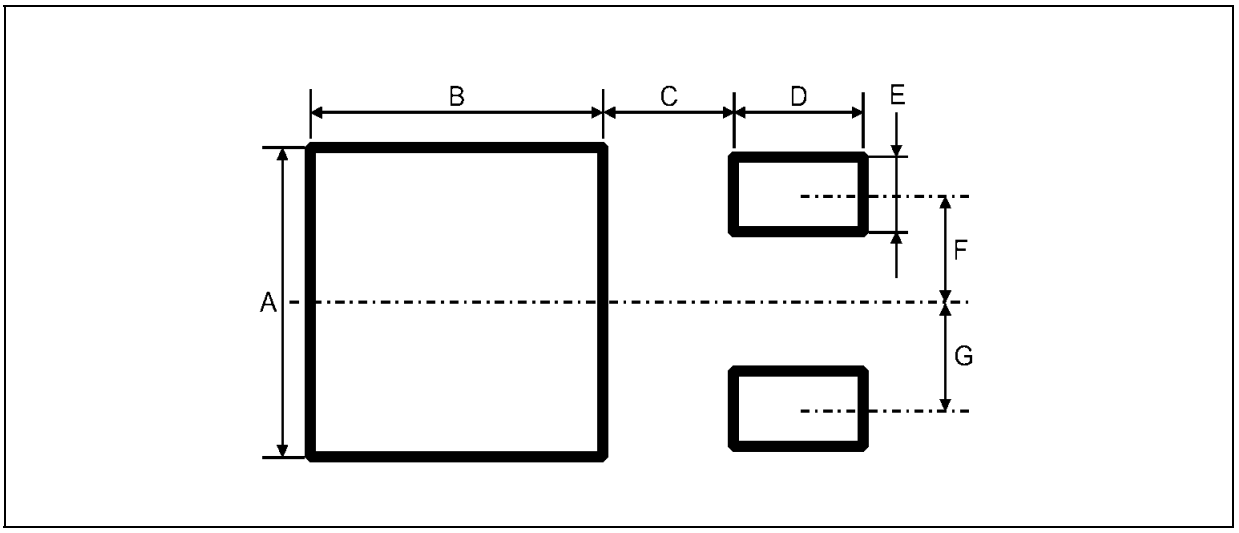
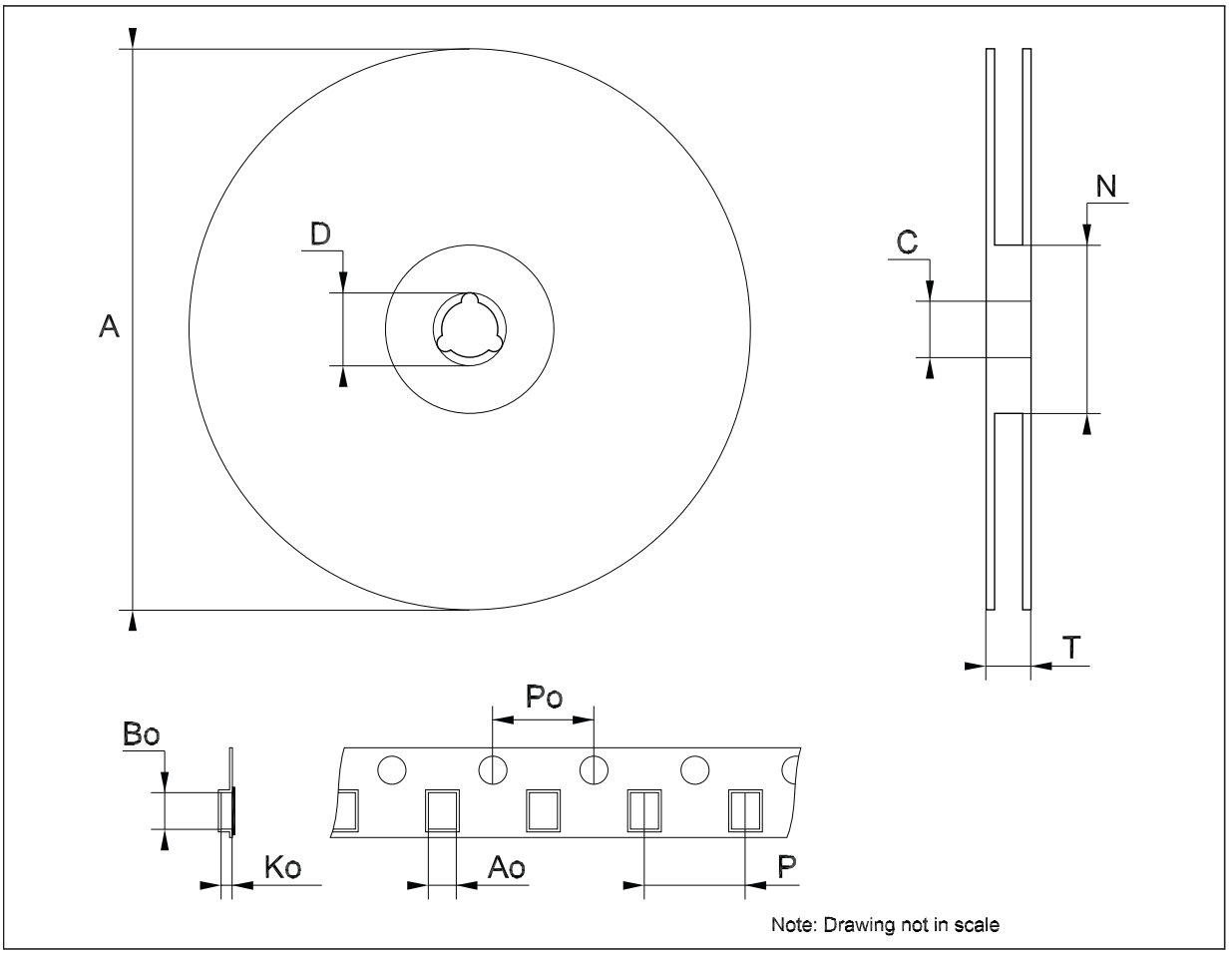


Table 13. Footprint data

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

Tape & reel DPAK-PPAK mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			330			12.992
C	12.8	13.0	13.2	0.504	0.512	0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.80	6.90	7.00	0.268	0.272	0.2.76
Bo	10.40	10.50	10.60	0.409	0.413	0.417
Ko	2.55	2.65	2.75	0.100	0.104	0.105
Po	3.9	4.0	4.1	0.153	0.157	0.161
P	7.9	8.0	8.1	0.311	0.315	0.319



Note: Drawing not in scale

9 Order codes

Table 14. Order codes

Part numbers	Packaging		
	TO-220	DPAK	Output voltages
L78M05AB	L78M05ABV	L78M05ABDT-TR	5 V
L78M05AC		L78M05ACDT-TR	5 V
L78M06AB		L78M06ABDT-TR	6 V
L78M08AB		L78M08ABDT-TR	8 V
L78M09AB		L78M09ABDT-TR	9 V
L78M10AB		L78M10ABDT-TR	10 V
L78M12AB	L78M12ABV	L78M12ABDT-TR	12 V
L78M12AC		L78M12ACDT-TR	12 V
L78M15AB	L78M15ABV	L78M15ABDT-TR	15 V
L78M24AB		L78M24ABDT-TR	24 V
L78M24AC		L78M24ACDT-TR	24 V

10 Revision history

Table 15. Document revision history

Date	Revision	Changes
30-Aug-2006	3	Order codes updated.
05-Oct-2006	4	DPAK mechanical data updated and add footprint data.
10-Dec-2007	5	Modified: *Table 14*.
20-Feb-2008	6	Modified: *Table 14 on page 27*.
15-Jul-2008	7	Modified: *Table 14 on page 27*.
15-Apr-2009	8	Modified: *Figure 9 on page 15* and *Figure 15 on page 16*.
28-Jul-2009	9	Modified: *Table 14 on page 27*.