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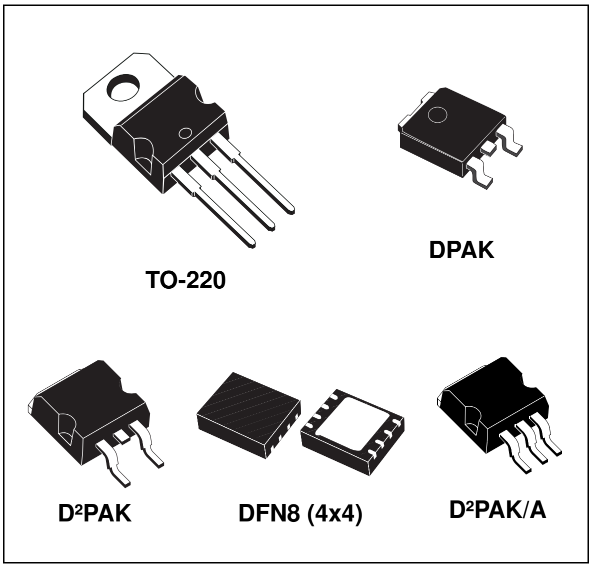
1.5 A adjustable and fixed low drop positive voltage regulator

Datasheet - production data



Features

- Typical dropout: 1.3 V at 1.5 A
- Three-terminal adjustable or fixed output voltage: 1.8 V, 2.5 V, 3.3 V, 5 V, 12 V
- Automotive grade (adjustable V_{OUT} in TO-220 and DPAK packages only)
- Output current guaranteed up to 1.5 A
- Output tolerance: ± 1% at 25 °C and ± 2% in full temperature range
- Internal power and thermal limit
- Wide operating temperature range - 40 °C to 125 °C
- Package available: TO-220, D²PAK, D²PAK/A, DPAK and DFN8 (4x4)
- Pinout compatibility with standard adjustable voltage regulators

Description

The LD1086 is a low drop voltage regulator capable of providing up to 1.5 A of output current. Dropout is guaranteed at a maximum of 1.2 V at the maximum output current, decreasing at lower loads. The LD1086 is pin-to-pin compatible with older 3-terminal adjustable regulators, but has better performance in terms of drop and output tolerance. Unlike PNP regulators, where a part of the output current is wasted as quiescent current, the LD1086 quiescent current flows into the load, increasing efficiency. Only a 10 µF (minimum) capacitor is needed for stability. The device is available in a TO-220, D²PAK, D²PAK/A, DPAK or DFN8 (4x4) package. On-chip trimming allows the regulator to reach a very tight output voltage tolerance; within ± 1% at 25 °C. The LD1086 is available as automotive grade for adjustable output voltages in the TO-220 and DPAK packages. The PAT, SYL, SBL statistical tests have been performed, and the devices are qualified according to the AEC-Q100 specification for the automotive market in the temperature range of - 40 °C to 125 °C.

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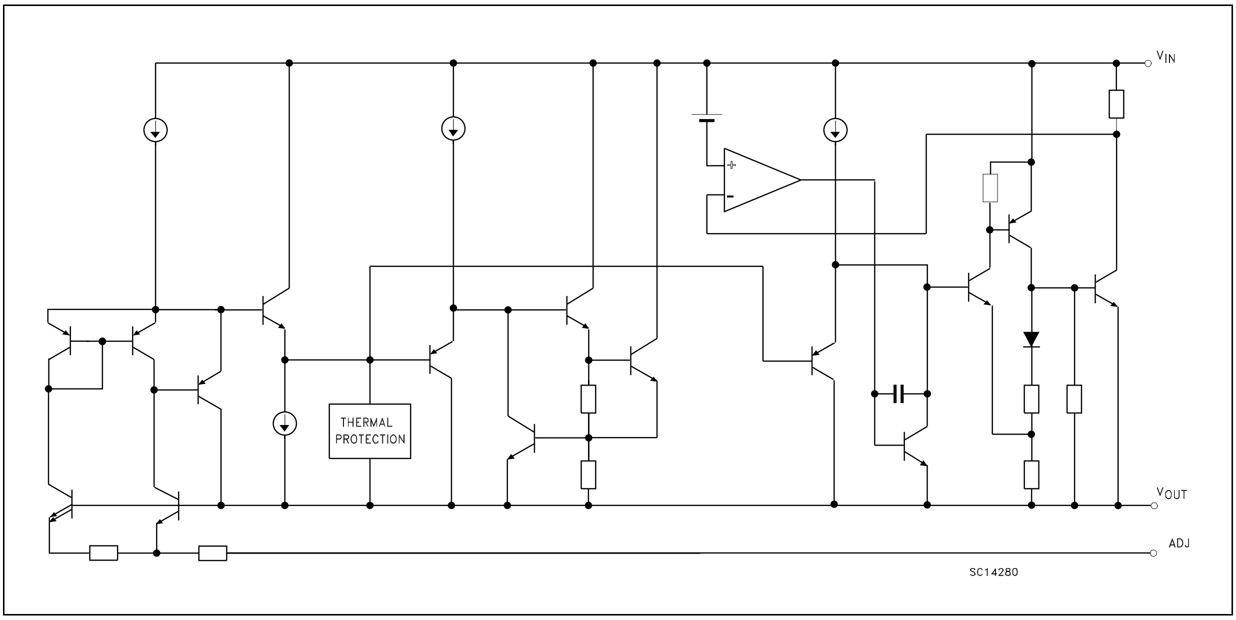
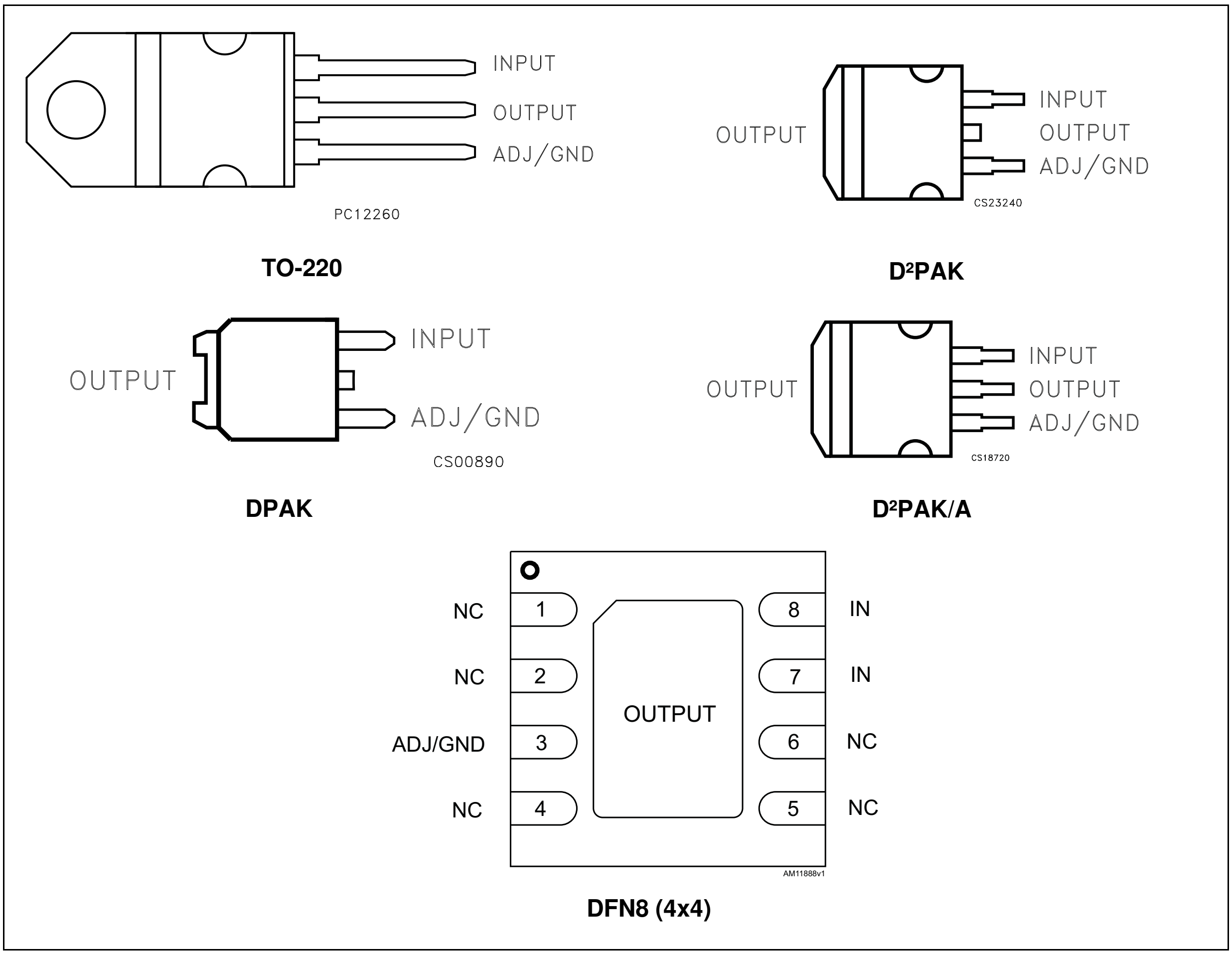
1 Diagram

Figure 1. Schematic diagram



2 Pin configuration

Figure 2. Pin connections (top view)



Note: The TAB is physically connected to the output (this is valid for the TO-220 package too).

3 Maximum ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_I	DC input voltage	30	V
I_O	Output current	Internally Limited	mA
P_D	Power dissipation	Internally Limited	mW
T_{STG}	Storage temperature range	-55 to +150	°C
T_{OP}	Operating junction temperature range	-40 to +125	°C

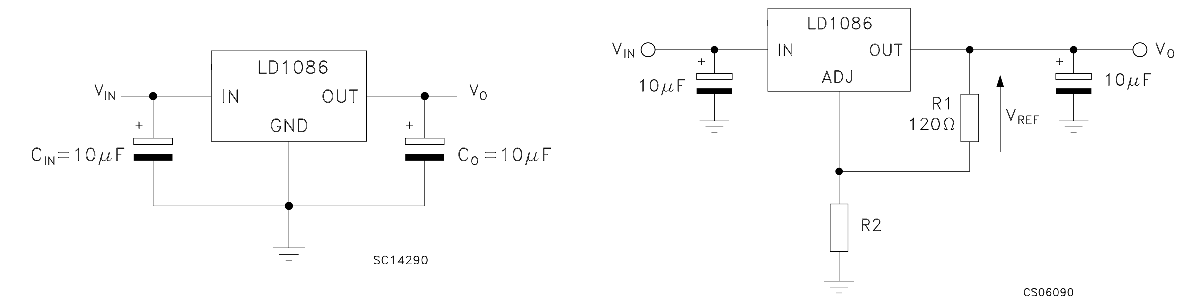
Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

Table 2. Thermal data

Symbol	Parameter	TO-220	D²PAK D²PAK/A	DPAK	DFN8 (4x4)	Unit
R_{thJC}	Thermal resistance junction-case	5	3	8	1.5	°C/W
R_{thJA}	Thermal resistance junction-ambient	50	62.5	100	33	°C/W

4 Schematic application

Figure 3. Application circuit



$$V_O = V_{REF} \cdot \left(1 + \frac{R_2}{R_1}\right)$$

5 Electrical characteristics

V_I = 4.8 V, C_I = C_O =10 µF, T_A = -40 to 125 °C, unless otherwise specified.

Table 3. Electrical characteristics of LD1086#18

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage [(1)]	I_O = 0 mA, T_J = 25 °C	1.782	1.8	1.818	V
		I_O = 0 to 1.5 A, V_I = 3.4 to 30 V	1.764	1.8	1.836	V
ΔV_O	Line regulation	I_O = 0 mA, V_I = 3.4 to 18 V, T_J = 25 °C		0.2	4	mV
		I_O = 0 mA, V_I = 3.4 to 15 V		0.4	4	mV
ΔV_O	Load regulation	I_O = 0 to 1.5 A, T_J = 25 °C		0.5	8	mV
		I_O = 0 to 1.5 A		1	16	mV
V_d	Dropout voltage	I_O = 1.5 A		1.3	1.5	V
I_q	Quiescent current	$V_I \leq 30$ V		5	10	mA
I_{sc}	Short-circuit current	V_I - V_O = 5 V	1.5	2		A
		V_I - V_O = 25 V	0.05	0.02		A
	Thermal regulation	T_A = 25 °C, 30 ms pulse		0.01	0.04	%/W
SVR	Supply voltage rejection	f = 120 Hz, C_O = 25 µF, I_O = 1.5 A V_I = 6.8 ± 3 V	60	82		dB
eN	RMS output noise voltage (% of V_O)	T_A = 25 °C, f =10 Hz to 10 kHz		0.003		%
S	Temperature stability			0.5		%
S	Long term stability	T_A = 125 °C, 1000 Hrs		0.5		%

1. See short-circuit current curve for available output current at fixed dropout.

V_I = 5.5 V, C_I = C_O =10 µF, T_A = -40 to 125 °C, unless otherwise specified.

Table 4. Electrical characteristics of LD1086#25

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage [(1)]	I_O = 0 mA, T_J = 25 °C	2.475	2.5	2.525	V
		I_O = 0 to 1.5 A, V_I = 4.1 to 30 V	2.45	2.5	2.55	V
ΔV_O	Line regulation	I_O = 0 mA, V_I = 4.1 to 18 V, T_J = 25 °C		0.2	4	mV
		I_O = 0 mA, V_I = 4.1 to 18 V		0.4	4	mV
ΔV_O	Load regulation	I_O = 0 to 1.5 A, T_J = 25 °C		0.5	8	mV
		I_O = 0 to 1.5 A		1	16	mV
V_d	Dropout voltage	I_O = 1.5 A		1.3	1.5	V
I_q	Quiescent current	$V_I \leq 30$ V		5	10	mA
I_{sc}	Short-circuit current	V_I - V_O = 5 V	1.5	2		A
		V_I - V_O = 25 V	0.05	0.2		A
	Thermal regulation	T_A = 25 °C, 30 ms pulse		0.008	0.04	%/W
SVR	Supply voltage rejection	f = 120 Hz, C_O = 25 µF, I_O = 1.5 A V_I = 7.5 ± 3 V	60	81		dB
eN	RMS output noise voltage (% of V_O)	T_A = 25 °C, f =10 Hz to 10 kHz		0.003		%
S	Temperature stability			0.5		%
S	Long term stability	T_A = 125 °C, 1000 Hrs		0.5		%

1. See short-circuit current curve for available output current at fixed dropout.

V_I = 6.3 V, C_I = C_O =10 µF, T_A = -40 to 125 °C, unless otherwise specified.

Table 5. Electrical characteristics of LD1086#33

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage [1]	I_O = 0 mA, T_J = 25 °C	3.267	3.3	3.333	V
		I_O = 0 to 1.5 A, V_I = 4.9 to 30 V	3.234	3.3	3.366	V
ΔV_O	Line regulation	I_O = 0 mA, V_I = 4.9 to 18 V, T_J = 25 °C		0.5	6	mV
		I_O = 0 mA, V_I = 4.9 to 18 V		1	6	mV
ΔV_O	Load regulation	I_O = 0 to 1.5 A, T_J = 25 °C		1	10	mV
		I_O = 0 to 1.5 A		7	25	mV
V_d	Dropout voltage	I_O = 1.5 A		1.3	1.5	V
I_q	Quiescent current	$V_I \leq$ 30 V		5	10	mA
I_{sc}	Short-circuit current	V_I - V_O = 5 V	1.5	2		A
		V_I - V_O = 25 V	0.05	0.2		A
	Thermal regulation	T_A = 25 °C, 30 ms pulse		0.008	0.04	%/W
SVR	Supply voltage rejection	f = 120 Hz, C_O = 25 µF, I_O = 1.5 A V_I = 8.3 ± 3 V	60	79		dB
eN	RMS output noise voltage (% of V_O)	T_A = 25 °C, f =10 Hz to 10 kHz		0.003		%
S	Temperature stability			0.5		%
S	Long term stability	T_A = 125 °C, 1000 Hrs		0.5		%

1. See short-circuit current curve for available output current at fixed dropout.

V_I = 8 V, C_I = C_O =10 µF, T_A = -40 to 125 °C, unless otherwise specified.

Table 6. Electrical characteristics of LD1086#50

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage [1]	I_O = 0 mA, T_J = 25 °C	4.95	5	5.05	V
		I_O = 0 to 1.5 A, V_I = 6.6 to 30 V	4.9	5	5.1	V
ΔV_O	Line regulation	I_O = 0 mA, V_I = 6.6 to 20V, T_J = 25 °C		0.5	10	mV
		I_O = 0 mA, V_I = 6.6 to 20 V		1	10	mV
ΔV_O	Load regulation	I_O = 0 to 1.5 A, T_J = 25 °C		5	20	mV
		I_O = 0 to 1.5 A		10	35	mV
V_d	Dropout voltage	I_O = 1.5 A		1.3	1.5	V
I_q	Quiescent current	$V_I \leq 30$ V		5	10	mA
I_{sc}	Short-circuit current	V_I - V_O = 5 V	1.5	2		A
		V_I - V_O = 25 V	0.05	0.2		A
	Thermal regulation	T_A = 25 °C, 30 ms pulse		0.01	0.04	%/W
SVR	Supply voltage rejection	f = 120 Hz, C_O = 25 µF, I_O = 1.5 A $V_I = 10 \pm 3$ V	60	75		dB
eN	RMS output noise voltage (% of V_O)	T_A = 25 °C, f =10 Hz to 10 kHz		0.003		%
S	Temperature stability			0.5		%
S	Long term stability	T_A = 125 °C, 1000 Hrs		0.5		%

1. See short-circuit current curve for available output current at fixed dropout.

V_I = 15 V, C_I = C_O =10 µF, T_A = -40 to 125 °C, unless otherwise specified.

Table 7. Electrical characteristics of LD1086#12

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_O	Output voltage [(1)]	I_O = 0 mA, T_J = 25 °C	11.88	12	12.12	V
		I_O = 0 to 1.5 A, V_I = 13.8 to 30 V	11.76	12	12.24	V
ΔV_O	Line regulation	I_O = 0 mA, V_I = 13.8 to 25 V, T_J = 25 °C		1	25	mV
		I_O = 0 mA, V_I = 13.8 to 25 V		2	25	mV
ΔV_O	Load regulation	I_O = 0 to 1.5 A, T_J = 25 °C		12	36	mV
		I_O = 0 to 1.5 A		24	72	mV
V_d	Dropout voltage	I_O = 1.5 A		1.3	1.5	V
I_q	Quiescent current	$V_I \leq$ 30 V		5	10	mA
I_{sc}	Short-circuit current	V_I - V_O = 5 V	1.5	2		A
		V_I - V_O = 25 V	0.05	0.2		A
	Thermal regulation	T_A = 25 °C, 30 ms pulse		0.01	0.04	%/W
SVR	Supply voltage rejection	f = 120 Hz, C_O = 25 µF, I_O = 1.5 A V_I = 17 ± 3 V	54	66		dB
eN	RMS output noise voltage (% of V_O)	T_A = 25 °C, f =10 Hz to 10 kHz		0.003		%
S	Temperature stability			0.5		%
S	Long term stability	T_A = 125 °C, 1000 Hrs		0.5		%

1. See short-circuit current curve for available output current at fixed dropout.

V_I = 4.25 V, C_I = C_O =10 µF, T_A = -40 to 125 °C, unless otherwise specified.

Table 8. Electrical characteristics of LD1086B#

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{ref}	Reference voltage (1)	I_O = 10 mA T_J = 25 °C	1.231	1.25	1.269	V
		I_O = 10 mA to 1.5 A, V_I = 2.85 to 30 V	1.219	1.25	1.281	V
ΔV_O	Line regulation	I_O = 10 mA, V_I = 2.8 to 16.5 V, T_J = 25 °C		0.015	0.2	%
		I_O = 10 mA, V_I = 2.8 to 16.5 V		0.035	0.2	%
ΔV_O	Load regulation	I_O = 10 mA to 1.5 A, T_J = 25 °C		0.1	0.3	%
		I_O = 0 to 1.5 A		0.2	0.4	%
V_d	Dropout voltage	I_O = 1.5 A		1.3	1.5	V
$I_{O(min)}$	Minimum load current	V_I = 30 V		3	10	mA
I_{sc}	Short-circuit current	V_I - V_O = 5 V	1.5	2.3		A
		V_I - V_O = 25 V	0.05	0.2		A
	Thermal regulation	T_A = 25 °C, 30 ms pulse		0.01	0.04	%/W
SVR	Supply voltage rejection	f = 120 Hz, C_O = 25 µF,C_{ADJ} = 25 µF, I_O = 1.5 A, V_I = 6.25 ± 3 V	60	88		dB
I_{ADJ}	Adjust pin current	V_I = 4.25 V, I_O = 10 mA		40	120	µA
ΔI_{ADJ}	Adjust pin current change (1)	I_O = 10 mA to 1.5 A, V_I = 2.8 to 16.5 V		0.2	5	µA
eN	RMS output noise voltage (% of V_O)	T_A = 25 °C, f =10 Hz to 10 kHz		0.003		%
S	Temperature stability			0.5		%
S	Long term stability	T_A = 125 °C, 1000 Hrs		0.5		%

1. See short-circuit current curve for available output current at fixed dropout.

V_I = 4.25 V, C_I = C_O =10 µF, T_A = -40 to 125 °C, unless otherwise specified.

Table 9. Electrical characteristics of LD1086#

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{ref}	Reference voltage (1)	I_O = 10 mA T_J = 25 °C	1.237	1.25	1.263	V
		I_O = 10 mA to 1.5 A, V_I = 2.85 to 30 V	1.225	1.25	1.275	V
ΔV_O	Line regulation	I_O = 10 mA, V_I = 2.8 to 16.5 V, T_J = 25 °C		0.015	0.2	%
		I_O = 10 mA, V_I = 2.8 to 16.5 V		0.035	0.2	%
ΔV_O	Load regulation	I_O = 10 mA to 1.5 A, T_J = 25 °C		0.1	0.3	%
		I_O = 0 to 1.5 A		0.2	0.4	%
V_d	Dropout voltage	I_O = 1.5 A		1.3	1.5	V
$I_{O(min)}$	Minimum load current	V_I = 30 V		3	10	mA
I_{sc}	Short-circuit current	V_I - V_O = 5 V	1.5	2.3		A
		V_I - V_O = 25 V	0.05	0.2		A
	Thermal regulation	T_A = 25 °C, 30 ms pulse		0.01	0.04	%/W
SVR	Supply voltage rejection	f = 120 Hz, C_O = 25 µF, C_{ADJ} = 25 µF, I_O = 1.5 A, V_I = 6.25 ± 3 V	60	88		dB
I_{ADJ}	Adjust pin current	V_I = 4.25 V, I_O = 10 mA		40	120	µA
ΔI_{ADJ}	Adjust pin current change (1)	I_O = 10 mA to 1.5 A, V_I = 2.8 to 16.5 V		0.2	5	µA
eN	RMS output noise voltage (% of V_O)	T_A = 25 °C, f =10 Hz to 10 kHz		0.003		%
S	Temperature stability			0.5		%
S	Long term stability	T_A = 125 °C, 1000 Hrs		0.5		%

1. See short-circuit current curve for available output current at fixed dropout.

V_I = 4.25 V, C_I = C_O =10 µF, T_A = -40 to 125 °C, unless otherwise specified.

Table 10. Electrical characteristics of LD1086DTTRY and LD1086VY (Automotive grade)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{ref}	Reference voltage (1)	I_O = 10 mA T_A = 25 °C	1.237	1.25	1.263	V
		I_O = 10 mA to 1.5 A, V_I = 2.85 to 30 V	1.225	1.25	1.275	V
ΔV_O	Line regulation	I_O = 10 mA, V_I = 2.8 to 16.5 V		0.035	0.2	%
ΔV_O	Load regulation	I_O = 0 to 1.5 A		0.2	0.4	%
V_d	Dropout voltage	I_O = 1.5 A		1.3	1.5	V
$I_{O(min)}$	Minimum load current	V_I = 30 V		3	10	mA
I_{sc}	Short-circuit current	V_I - V_O = 5 V, T_A = 25 °C	1.5	2.3		A
		V_I - V_O = 25 V, T_A = 25 °C	0.05	0.2		A
	Thermal regulation	T_A = 25 °C, 30 ms pulse		0.01	0.04	%/W
SVR	Supply voltage rejection	f = 120 Hz, C_O = 25 µF,C_{ADJ} = 25 µF, I_O = 1.5 A, V_I = 6.25 ± 3 V, T_A = 25 °C	60	88		dB
I_{ADJ}	Adjust pin current	V_I = 4.25 V, I_O = 10 mA		40	120	µA
ΔI_{ADJ}	Adjust pin current change (1)	I_O = 10 mA to 1.5 A, V_I = 2.8 to 16.5 V		0.2	5	µA
eN	RMS output noise voltage (% of V_O)	T_A = 25 °C, f =10 Hz to 10 kHz		0.003		%
S	Temperature stability			0.5		%
S	Long term stability	T_A = 125 °C, 1000 Hrs		0.5		%

1. See short-circuit current curve for available output current at fixed dropout.

6 Typical application

Unless otherwise specified T_J = 25 °C, C_I = C_O = 10 µF.

Figure 4. Output voltage vs. temp. (V_I = 5 V)

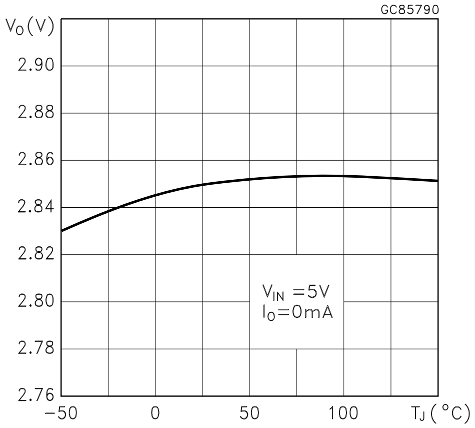


Figure 5. Output voltage vs. temp. (V_I = 15 V)

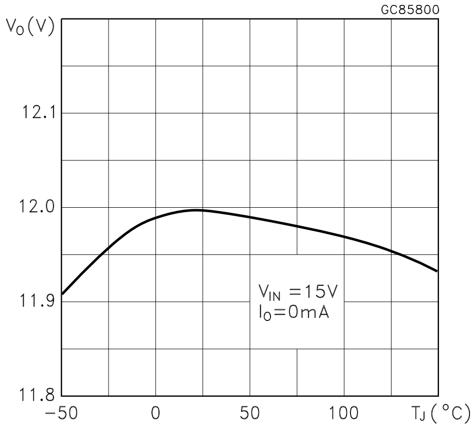


Figure 6. Output voltage vs. temperature (V_I = 4.25 V)

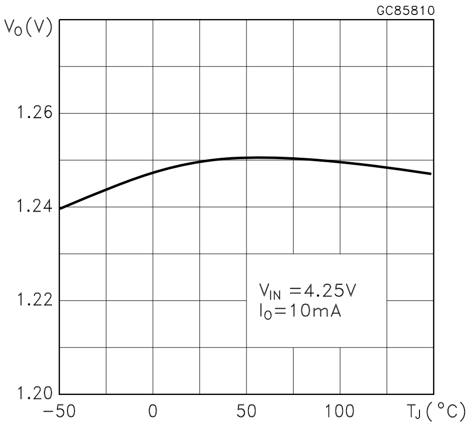


Figure 7. Short-circuit current vs. dropout voltage

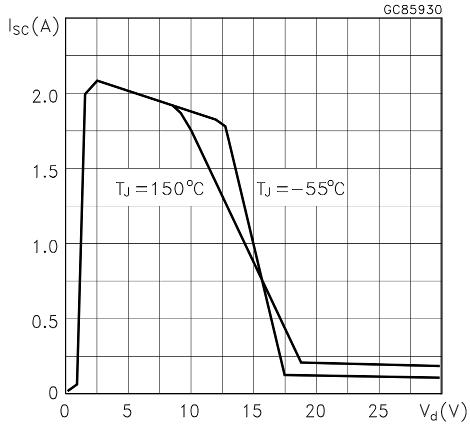


Figure 8. Line regulation vs. temperature

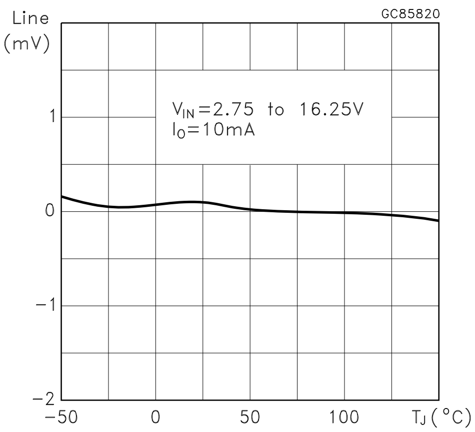


Figure 9. Load regulation vs. temperature

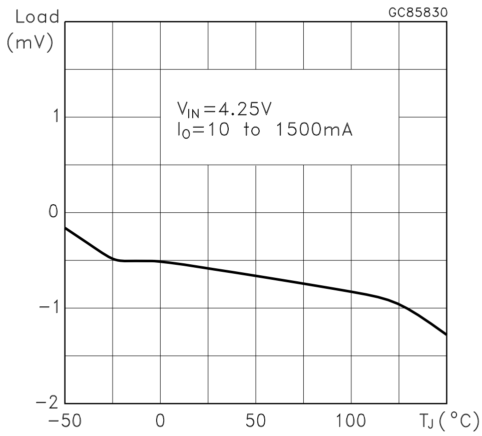


Figure 10. Dropout voltage vs. temperature

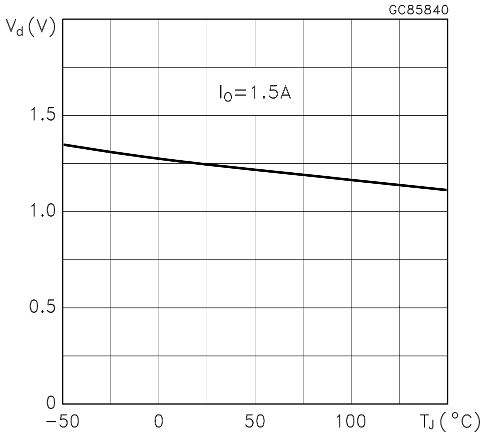


Figure 11. Dropout voltage vs. output current

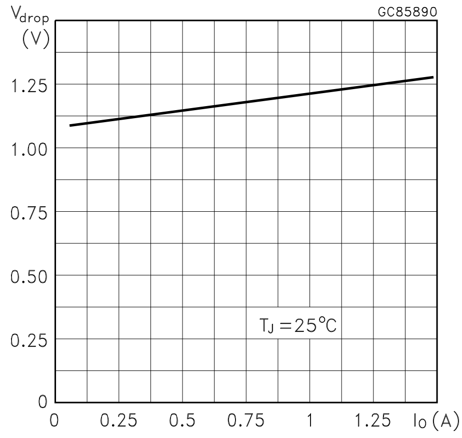


Figure 12. Adjust pin current vs. input voltage

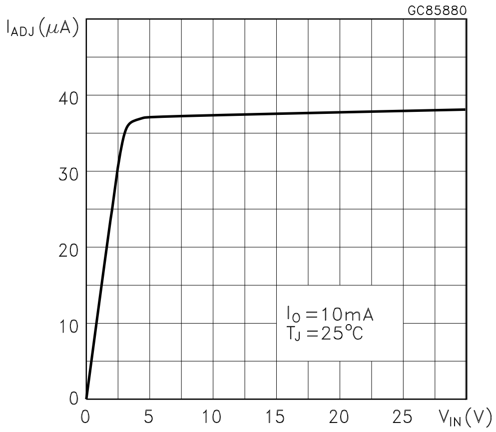


Figure 13. Adjust pin current vs. temperature

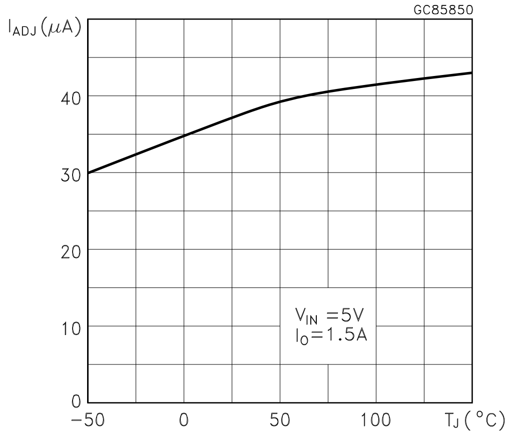


Figure 14. Adjust pin current vs. output current

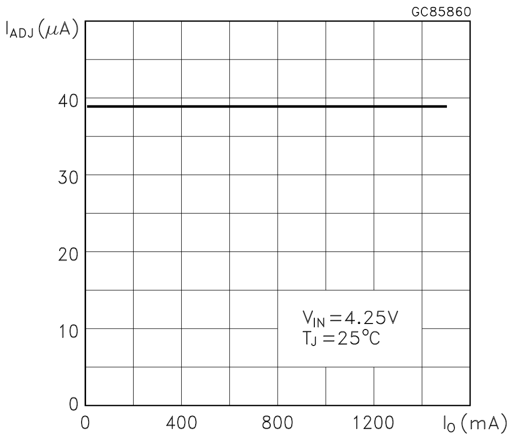


Figure 15. Quiescent current vs. output current

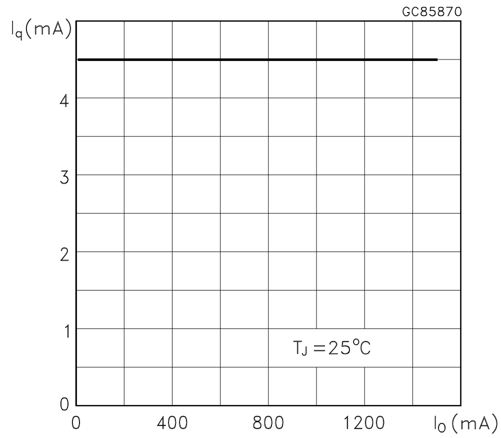


Figure 16. Quiescent current vs. input voltage

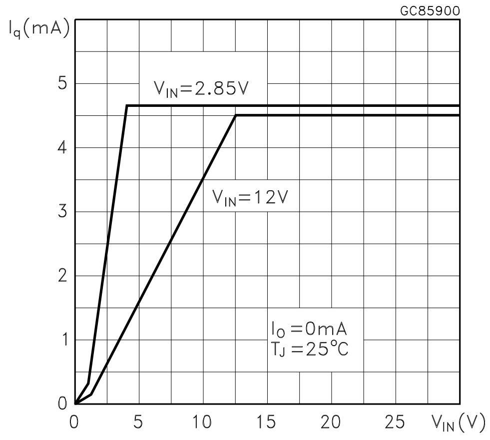


Figure 17. Supply voltage rejection vs. output current

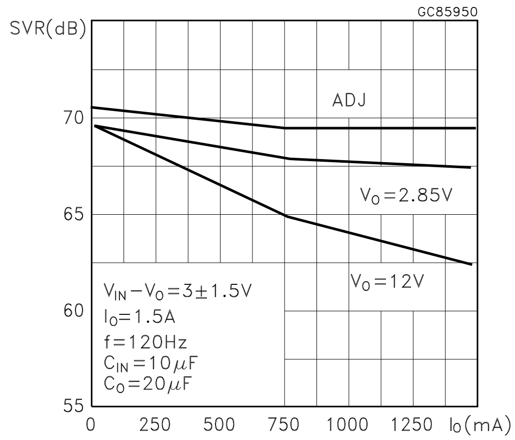


Figure 18. Supply voltage rejection vs. frequency

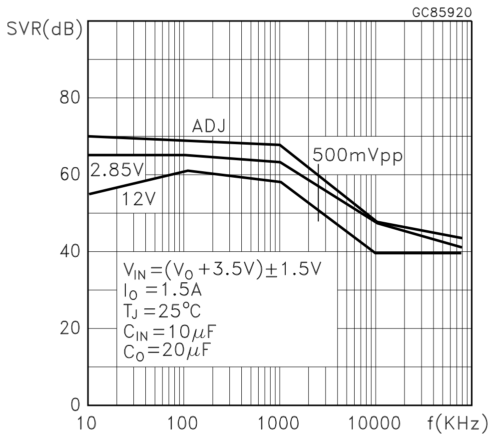


Figure 19. Supply voltage rejection vs. temperature

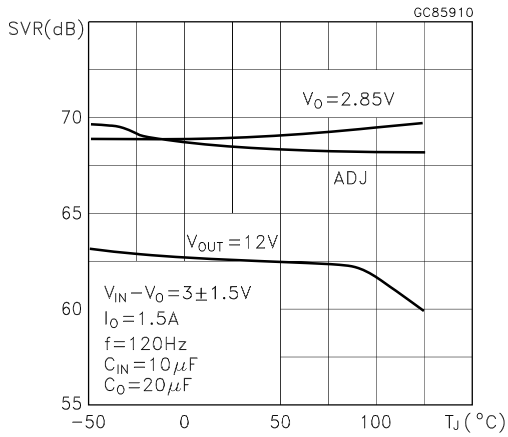


Figure 20. Minimum load current vs. temperature

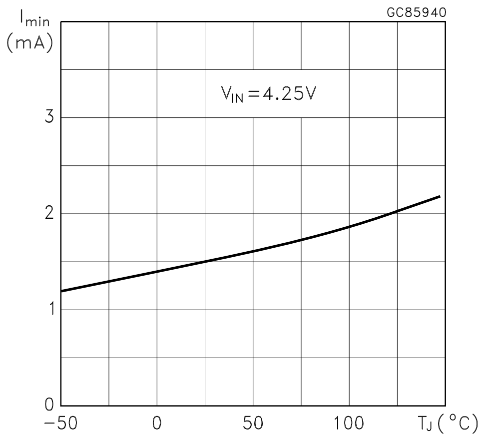


Figure 21. Stability for adjustable

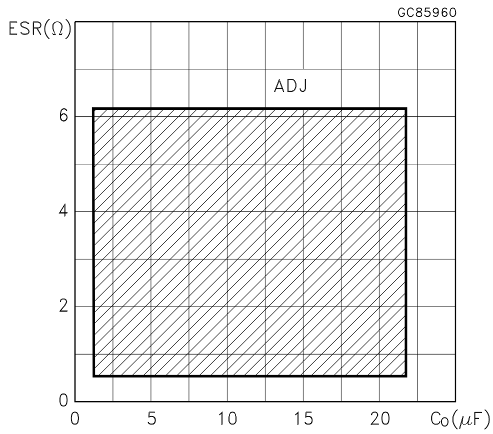


Figure 22. Stability for 2.85 V

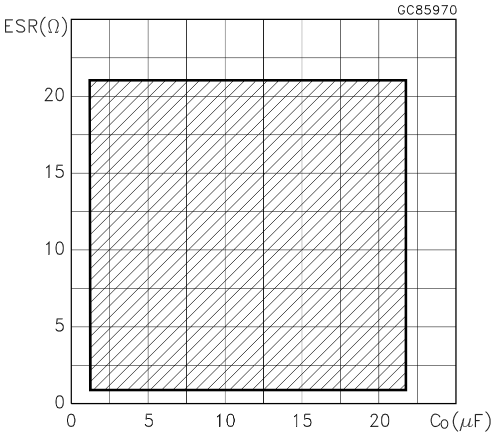


Figure 23. Stability for 12 V

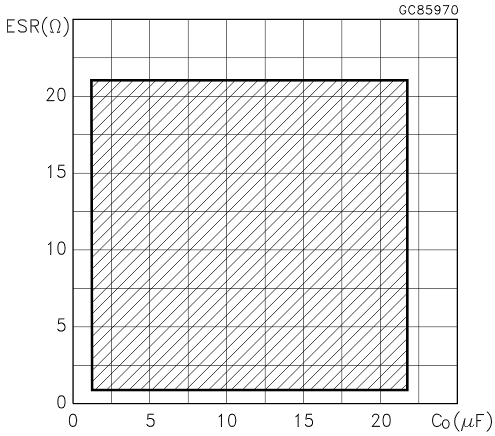
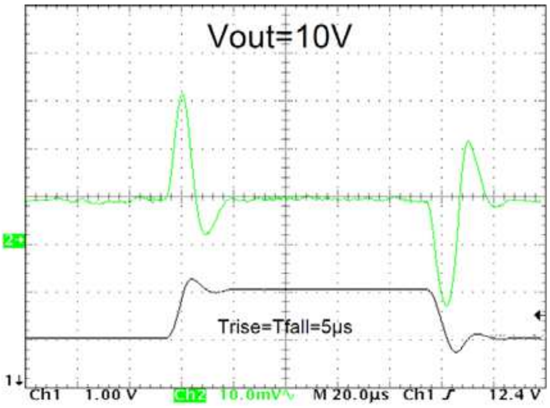
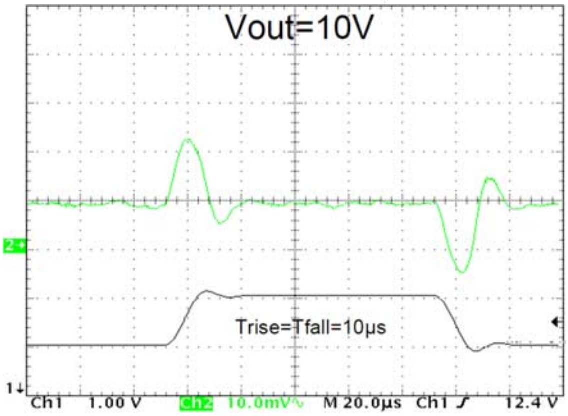


Figure 24. Line transient (V_I = 12 to 13 V)



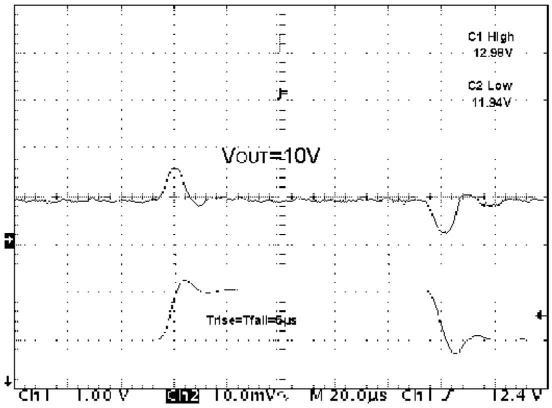
V_I = 12 to 13 V, I_O = 200 mA, C_I = 1 µF (tant), C_O = 10 µF (tant), No C_{ADJ}

Figure 25. Line transient (I_O = 200 mA)



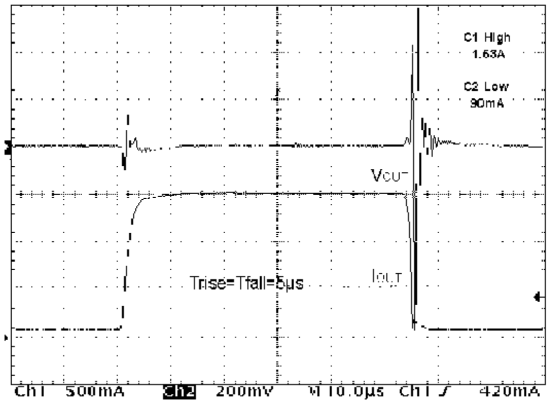
V_I = 12 to 13 V, I_O = 200 mA, C_I = 1 µF (tant), C_O = 10 µF (tant), No C_{ADJ}

Figure 26. Line transient (C_{ADJ} = 1 µF)



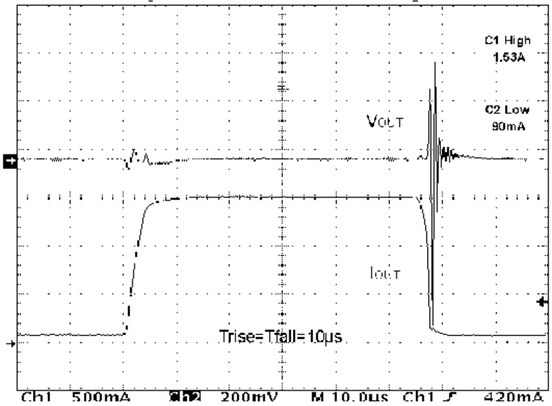
V_I = 12 to 13 V, I_O = 200 mA, C_I = 1 µF (tant), C_O = 10 µF (tant), C_{ADJ} = 1 µF

Figure 27. Load transient



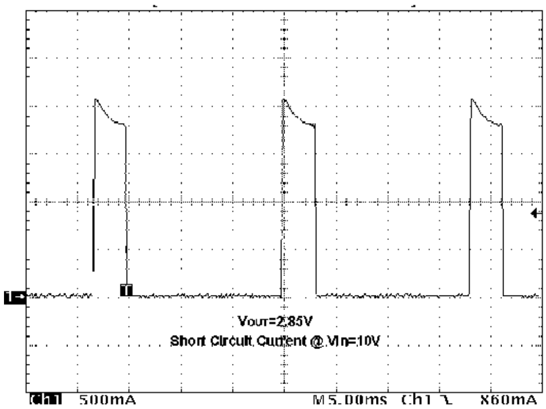
V_I = 13 V, I_O = 0.1 to 1.5 A, C_I = 1 µF (tant), C_O = 10 µF (tant) C_{ADJ} = 1 µF

Figure 28. Load transient ($T_{rise} = T_{fall} = 10\ \mu s$)



V_I = 13 V, I_O = 0.1 to 1.5 A, C_I = 1 µF (tant), C_O = 10 µF (tant), C_{ADJ} = 1 µF

Figure 29. Thermal protection



V_O = 2.85 V

7 Package information

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

7.1 TO-220 (STD-ST dual gauge) type A package information

Figure 30. TO-220 (STD-ST dual gauge) type A package outline

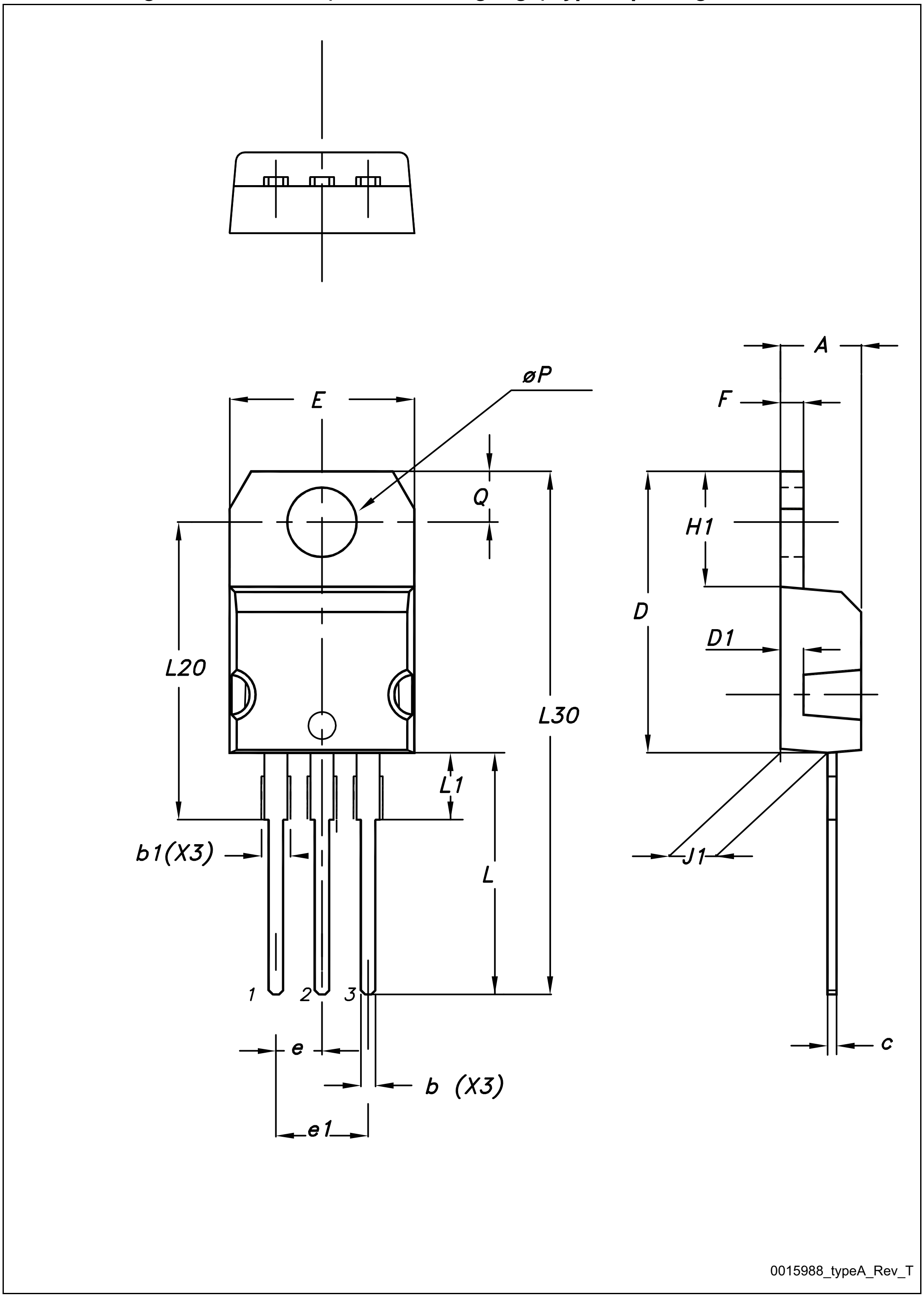


Table 11. TO-220 (STD-ST dual gauge) type A mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95

7.2 DPAK package information

Figure 31. DPAK package outline