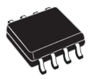
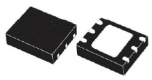
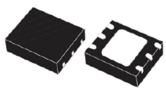
High PSRR, low drop linear regulator IC



SO-8



DFN6 (2x2)



DFN6 (3x3)

Maturity status link
LDL212

Features

- Input voltage from 2.5 V to 18 V
- 20 V AMR
- Any fixed output voltages, from 1.2 V to 12 V in 100 mV steps (from 1.2 V to 6.6 V in 50 mV steps) available on request
- Adjustable version from 1.18 V to V_{IN} - $V_{DROP(MAX)}$
- Guaranteed output current 1.2 A
- Typical dropout 350 mV @ 1.2 A
- Undervoltage lockout
- Enable function
- Internal thermal, current and power limitation
- High PSRR: 87 dB @ 120 Hz, 75 dB @ 1 kHz
- Operating temperature range: -40 °C to 125 °C
- Packages SO-8 batwing plastic micropackage, DFN6 (3x3) and DFN6 (2x2)

Applications

- Consumer
- Industrial
- SMPS
- Point-of-load
- DC-DC post-regulation

Description

The LDL212 provides 1.2 A of maximum current from an input voltage range from 2.5 V to 18 V, with a typical dropout voltage of 350 mV @ 1.2 A.

The high power supply rejection ratio of 87 dB at 120 Hz, and more than 40 dB at 100 kHz, makes the LDL212 suitable for direct regulation in SMPS and secondary linear regulation in DC-DC converters. The LDL212 goes to shutdown mode due to the enable logic control function, reducing the total current consumption.

The device also includes the current limit, SOA and thermal protections.

1 Block diagram

Figure 1. **Block diagram (fixed)**

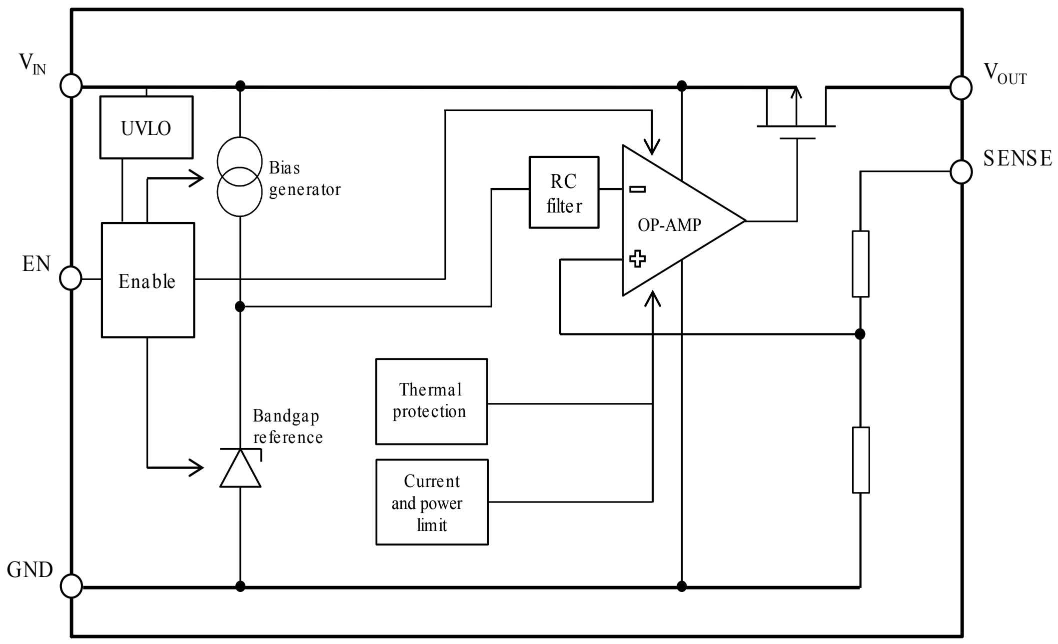


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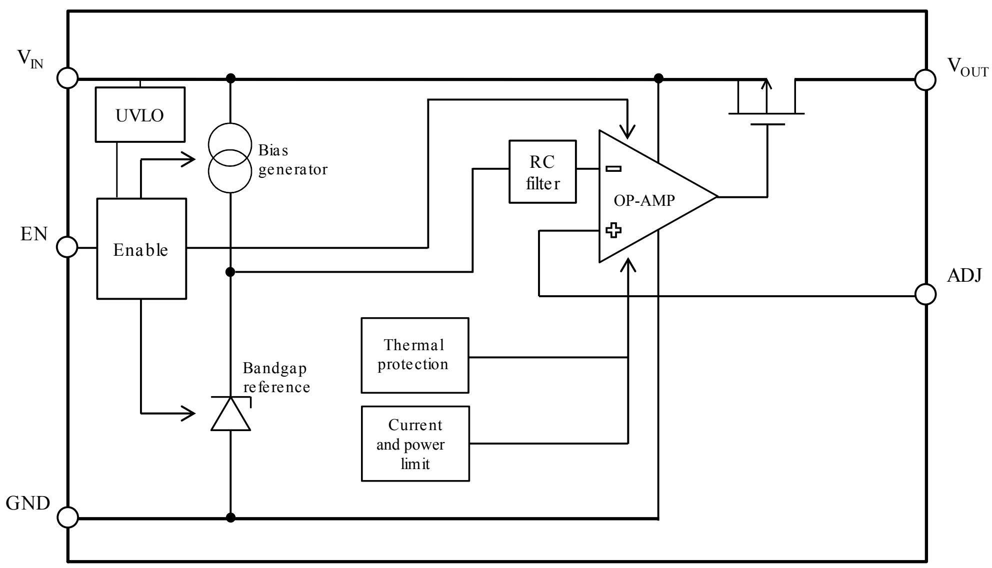
Figure 2. **Block diagram (adjustable)**



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2 Pin configuration

Figure 3. Pin configuration (top view)

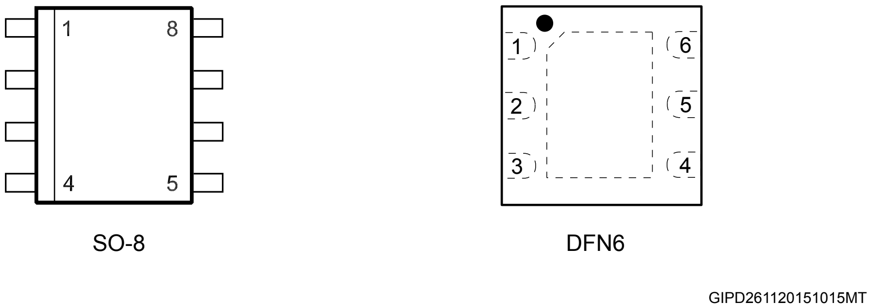


Table 1. Pin description

Pin name	Pin number (SO-8)	Pin number (DFN6)	Description
V_{IN}	4	4	Input voltage
V_{OUT}	1	3	Output voltage
GND	2, 3, 6, 7	1	Ground
ADJ/sense	8	2	Feedback pin for adjustable version / V_{OUT} sense on fixed version
EN	5	6	Enable pin. The device is in off-state when this pin is pulled low
NC	-	5	Not connected
GND	-	exposed pad	Exposed pad must be connected to GND

1. *The sense pin on the fixed version must be connected to V_{OUT} for proper operation.*

3 Typical application

Figure 4. **Typical application circuit (adjustable version)**

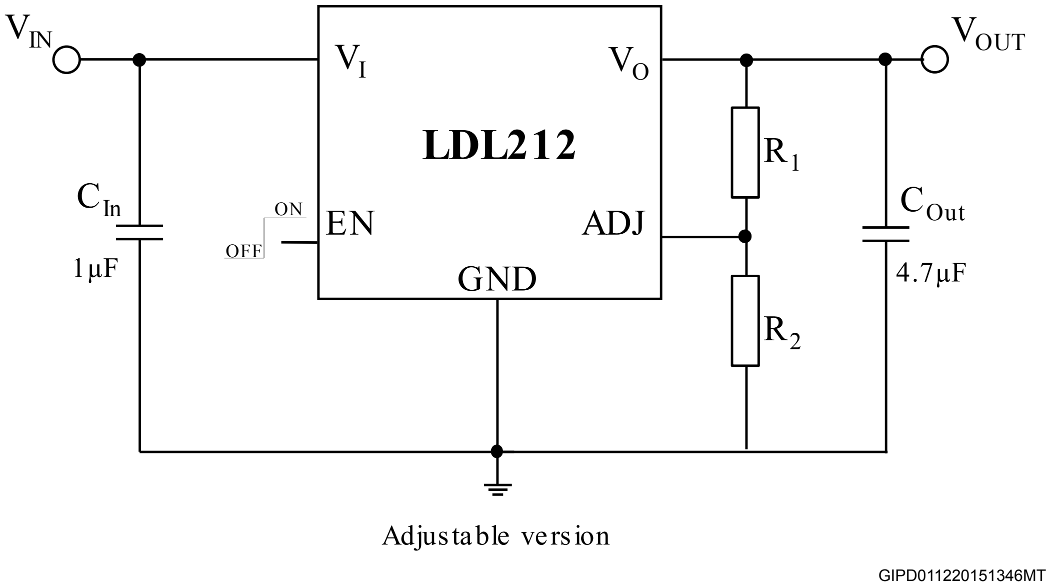
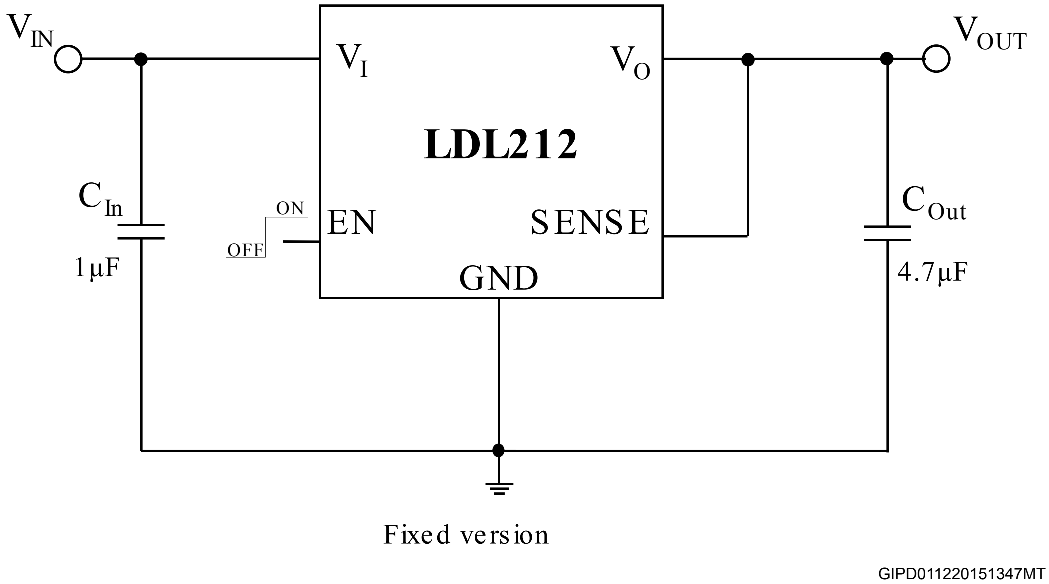


Figure 5. **Typical application circuit (fixed version)**



Note: *R1 and R2 are calculated according to the following formula: $R_1 = R_2 \times (V_{OUT}/V_{ADJ} - 1)$. The output voltage of the adjustable version can be set from 1.18 V to V_{IN}-$V_{DROP(MAX)}$, where $V_{DROP(MAX)}$ is the maximum dropout voltage, as defined in Table 4. Electrical characteristics.*

4 Maximum ratings

Table 2. **Absolute maximum ratings**

Symbol	Parameter	Value	Unit
V_{IN}	DC input voltage	- 0.3 to 20	V
V_{OUT}	DC output voltage	- 0.3 to V_{IN} + 0.3	V
V_{EN}	Enable input voltage	- 0.3 to V_{IN} + 0.3	V
V_{SENSE}	Output sense pin voltage	- 0.3 to V_{IN} + 0.3	V
V_{ADJ}	ADJ pin voltage	- 0.3 to 2	V
I_{OUT}	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 3. **Thermal data**

Symbol	Parameter	Value	Unit
SO-8 batwing plastic micropackage	Thermal resistance junction-to-case	20	°C/W
	Thermal resistance junction-to-ambient	55	
DFN6 (2x2)	Thermal resistance junction-to-case	15	
	Thermal resistance junction-to-ambient	65	
DFN6 (3x3)	Thermal resistance junction-to-case	10	
	Thermal resistance junction-to-ambient	55	

5 Electrical characteristics

T_J = 25 °C, V_{IN} = $V_{OUT(NOM)}$ + 1 V, C_{IN} = 1 µF, C_{OUT} = 4.7 µF, I_{OUT} = 10 mA, V_{EN} = V_{IN}, unless otherwise specified. (For $V_{OUT(NOM)}$ ≤ 1.5 V, V_{IN} = 2.7 V.)

Table 4. Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage		2.5		18	V
V_{UVLO}	Turn-on threshold			2.3	2.4	V
	Hysteresis			200		mV
V_{OUT}	V_{OUT} accuracy	I_{OUT} = 10 mA T_J = 25 °C	-2		2	%
		I_{OUT} = 10 mA -40 °C < T_J < 125 °C	-3		3	%
V_{ADJ}	Adjustable pin voltage	V_{IN} = 2.5 V, I_{OUT} = 10 mA		1.18		V
		T_J = 25 °C	-2		+2	%
		V_{IN} = 2.5 V, I_{OUT} = 10 mA -40 °C < T_J < 125 °C	-3		+3	%
I_{ADJ}	Adjustable pin current	V_{IN} = 2.5 V, I_{OUT} = 10 mA		20		nA
ΔV_{OUT}	Line regulation	V_{OUT} + 1 V ≤ V_{IN} ≤ 18 V, I_{OUT} = 10 mA		0.002	0.01	%/V
ΔV_{OUT}	Load regulation	I_{OUT} = 10 mA to 1.2 A		0.0001	0.0005	%/mA
V_{DROP}	Dropout voltage (1)	I_{OUT} = 1.2 A V_{OUT} > 3 V		350	600	mV
	Dropout voltage for SO-8 (1)	-40 °C < T_J < 125 °C			700	mV
eN	Output noise voltage	10 Hz to 100 kHz, I_{OUT} = 100 mA		60		$\mu V_{RMS}/V_{OUT}$
SVR	Supply voltage rejection	V_{IN} = $V_{OUT(NOM)}$ + 1 V ± V_{RIPPLE} V_{RIPPLE} = 0.5 V, f = 120 Hz		87		dB
		V_{IN} = $V_{OUT(NOM)}$ + 1 V ± V_{RIPPLE} V_{RIPPLE} = 0.5 V, f = 1 kHz		75		dB
		V_{IN} = $V_{OUT(NOM)}$ + 1 V ± V_{RIPPLE} V_{RIPPLE} = 0.5 V, f = 100 kHz		50		dB
I_Q	Quiescent current	I_{OUT} = 0 mA to 1.2 A -40 °C < T_J < 125 °C		250	380	µA
		V_{IN} input current in OFF mode V_{EN} = GND V_{IN} = 18 V		0.3	1.5	µA
I_{SC}	Short-circuit current	R_L = 0	1.5	2		A
V_{EN}	Enable input logic low	V_{IN} = 2.5 V to 18 V -40 °C < T_J < 85 °C			0.4	V
	Enable input logic high	V_{IN} = 2.5 V to 18 V	1.2			V

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{EN}		-40 °C < T_J < 85 °C				V
I_{EN}	Enable input current			1.5		µA
		$V_{EN} = V_{IN}$, V_{IN} = 18 V		16	20	
T_{ON}	Turn-on time (2)			120		µs
T_{SHDN}	Thermal shutdown			175		°C
	Hysteresis			25		

1. *Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value. This specification is not valid for output voltages below 2.2 V.*
2. *Turn-on time is the time measured between the enable input just exceeding V_{EN} high value and the output voltage just reaching 95% of its nominal value.*

6 Typical performance characteristics

Figure 6. Output voltage vs. temperature (V_{IN} = 2.5 V, V_{OUT} = V_{ADJ}, I_{OUT} = 0 mA)

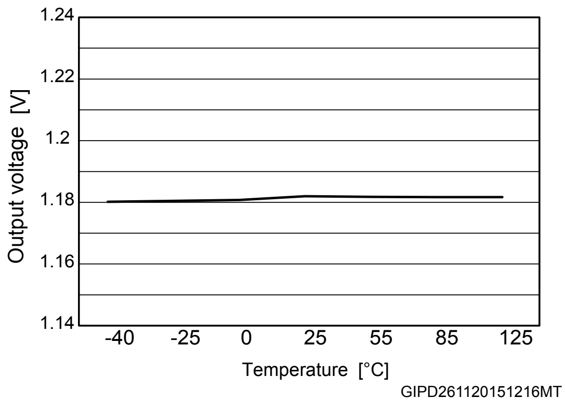


Figure 7. Output voltage vs. temperature (V_{IN} = 2.5 V, V_{OUT} = V_{ADJ}, I_{OUT} = 1200 mA)

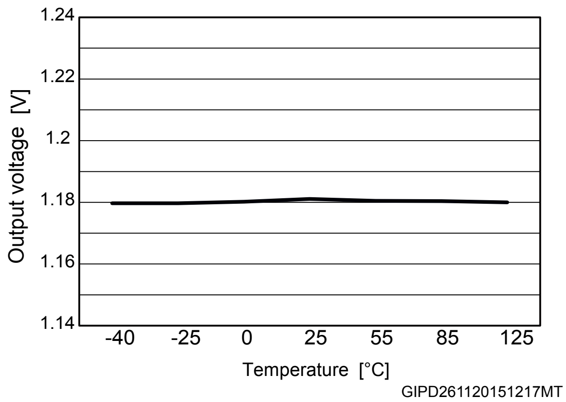


Figure 8. Output voltage vs. temperature (V_{IN} = 6 V, V_{OUT} = 5 V, I_{OUT} = 10 mA)

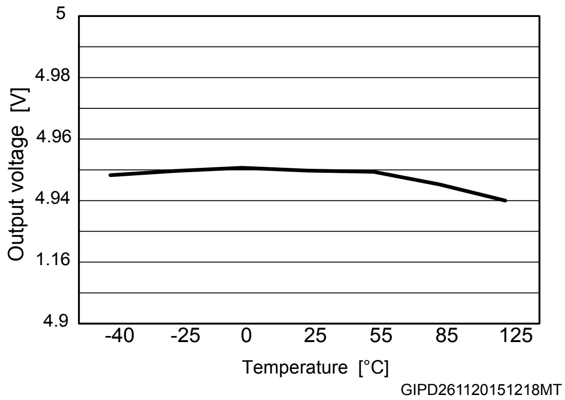


Figure 9. Output voltage vs. temperature (V_{IN} = 6 V, V_{OUT} = 5 V, I_{OUT} = 1200 mA)

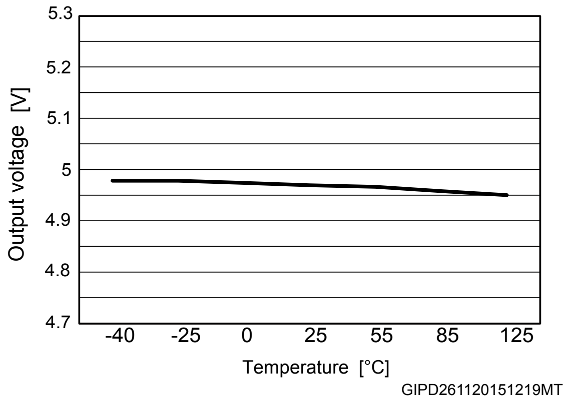


Figure 10. Line regulation vs. temperature (V_{IN} = 6 to 18 V, V_{OUT} = 5 V, I_{OUT} = 10 mA)

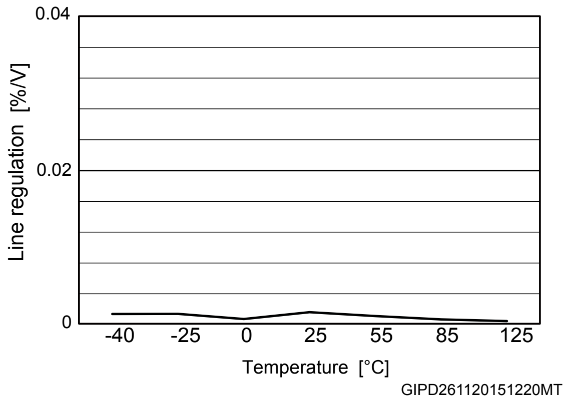


Figure 11. Line regulation vs. temperature (V_{IN} = 2.5 to 18 V, V_{OUT} = V_{ADJ}, I_{OUT} = 10 mA)

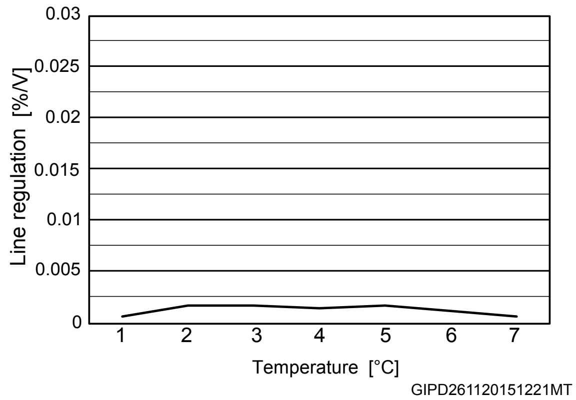


Figure 12. Load regulation vs. temperature (V_{IN} = 6 V, V_{OUT} = 5 V, I_{OUT} = 10 to 1200 mA)

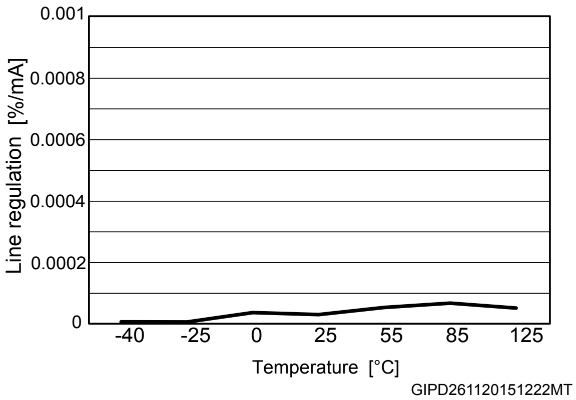


Figure 13. Load regulation vs. temperature (V_{IN} = 2.5 V, V_{OUT} = V_{ADJ}, I_{OUT} = 0 to 1200 mA)

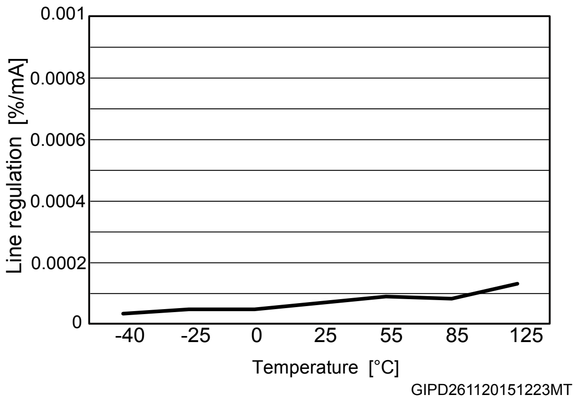


Figure 14. Enable thresholds vs. temperature (V_{OUT} = V_{ADJ})

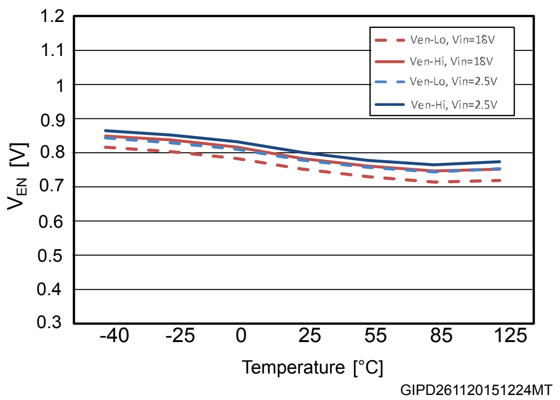


Figure 15. Enable thresholds vs. temperature(V_{OUT} = 5 V)

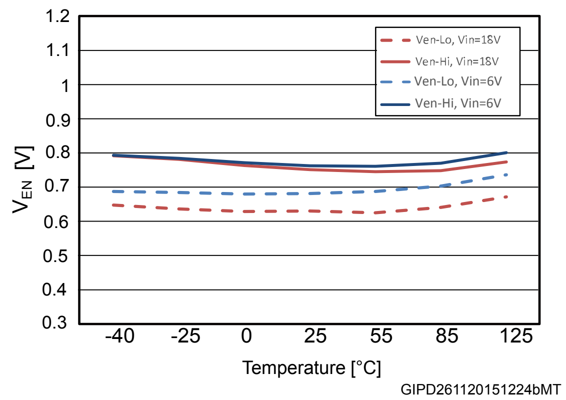


Figure 16. **Dropout voltage vs. temperature**

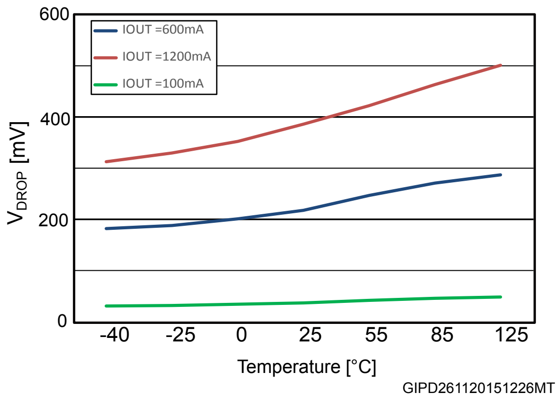


Figure 17. **Quiescent current vs. temperature (V_{OUT} = 5 V, I_{OUT} = 0 mA)**

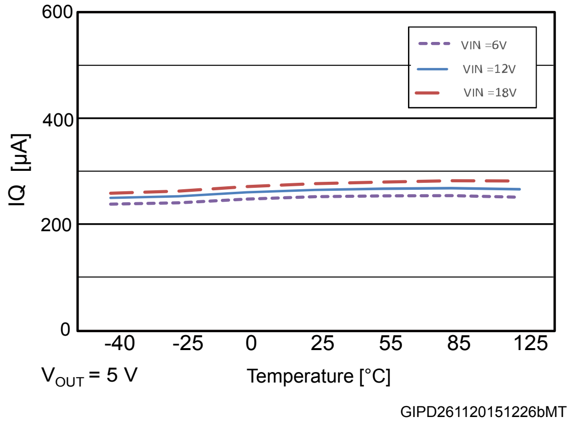


Figure 18. **Quiescent current vs. temperature (V_{OUT} = 5 V, I_{OUT} = 600 mA, 1.2 A)**

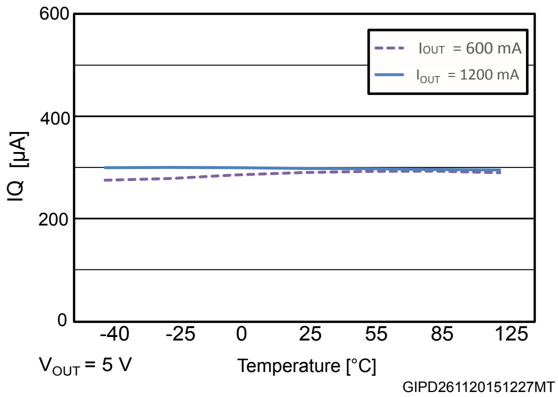


Figure 19. **Quiescent current vs. temperature (V_{OUT} = V_{ADJ}, I_{OUT} = 0 mA)**

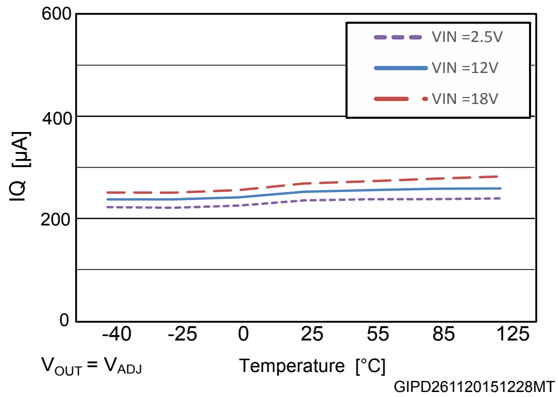


Figure 20. **Quiescent current vs. temperature (V_{OUT} = V_{ADJ}, I_{OUT} = 600 mA)**

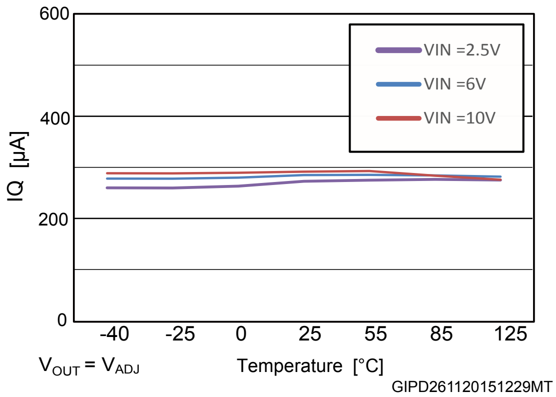


Figure 21. **Quiescent current vs. temperature (V_{OUT} = V_{ADJ}, I_{OUT} = 1.2 A)**

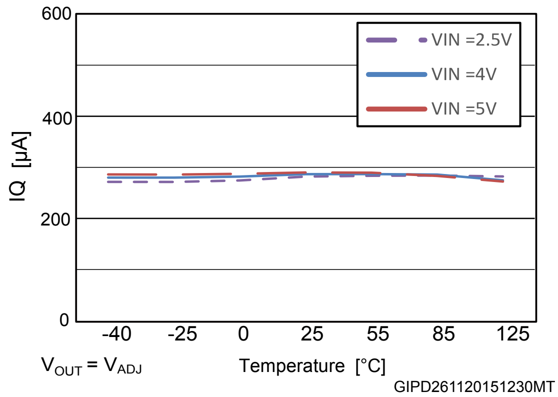


Figure 22. Off-state current vs. temperature (V_{OUT} = 5 V)

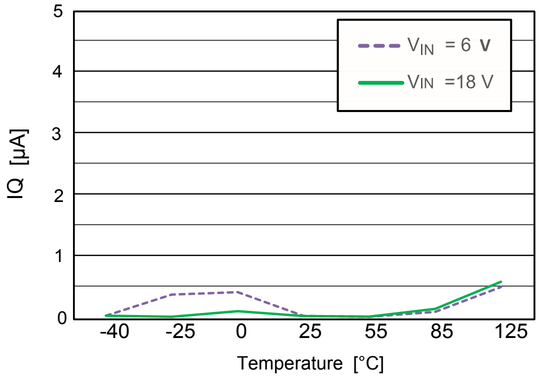


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Figure 23. Off-state current vs. temperature (V_{OUT} = V_{ADJ})

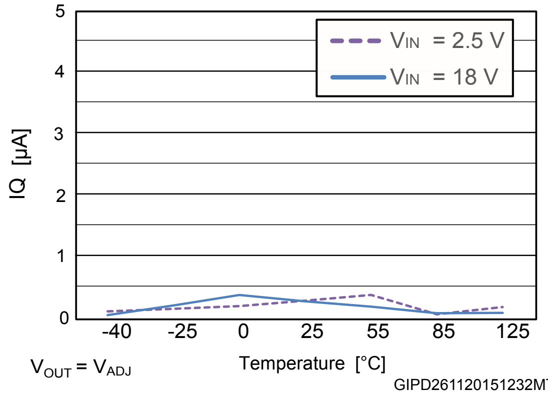

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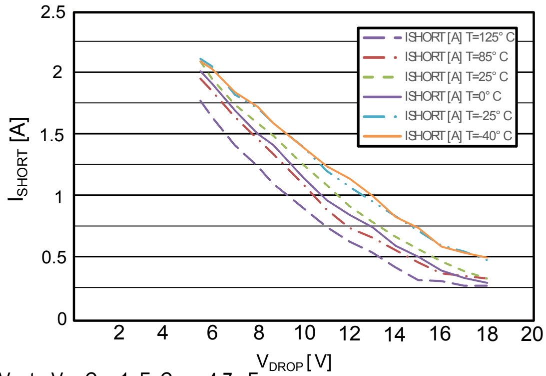
Figure 24. Short-circuit current vs. dropout voltage (V_{OUT} = 5 V)



V_{EN} to V_{IN}, C_{IN}=1µF, C_{OUT}=4.7 µF

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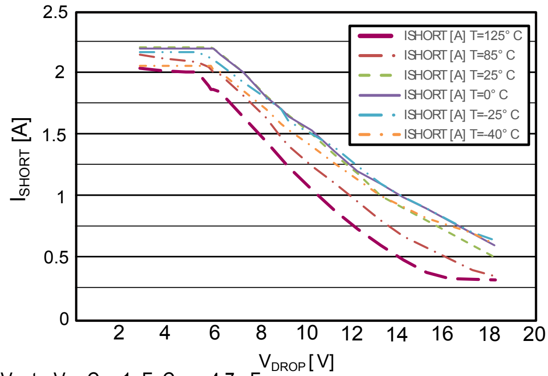
Figure 25. Short-circuit current vs. dropout voltage (V_{OUT} = V_{ADJ})



V_{EN} to V_{IN}, C_{IN}=1µF, C_{OUT}=4.7 µF

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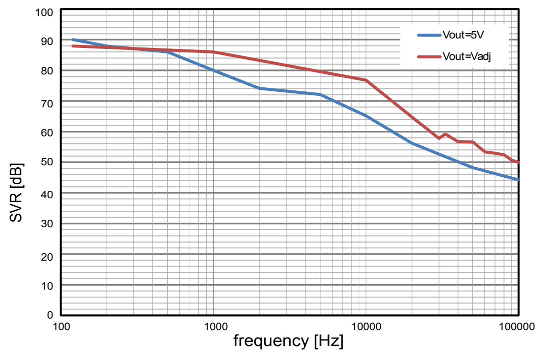
Figure 26. SVR vs. frequency



For V_{OUT} = 5V, V_{IN} = V_{EN}= from 5.5 to 6.5V, I_{OUT} = 10mA, C_{IN} = 1µF, C_{OUT} = 4.7µF
For V_{OUT} = V_{ADJ} , V_{IN} = V_{EN}= from 2.5 to 3.5V, I_{OUT} = 10mA, No C_{IN}, C_{OUT} = 4.7µF

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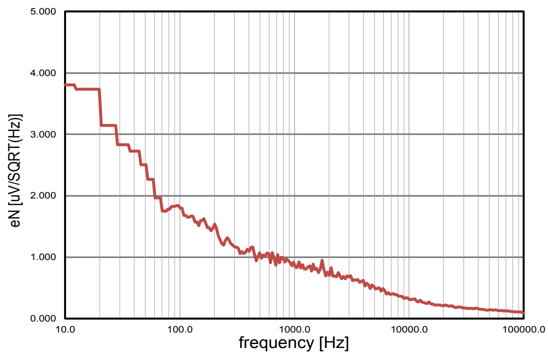
Figure 27. Output noise spectral density (V_O = V_{ADJ})



V_{IN}= V_{EN} = 2.5V, V_{OUT} = V_{ADJ}, I_{OUT} = 100mA, C_{IN} = 1µF, C_{OUT} = 4.7µF

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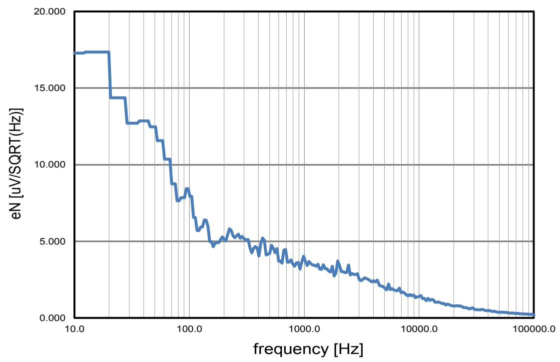
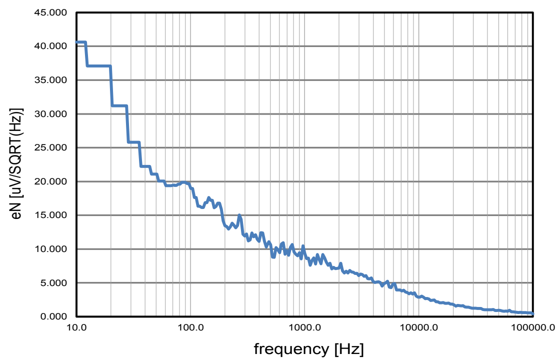
Figure 28. **Output noise spectral density (V_O = 5 V)**



$V_{IN} = V_{EN}$ = 6V, V_{OUT} = 5V, I_{OUT} = 100mA, C_{IN} = 1µF, C_{OUT} = 4.7 µF

GIPD261120151238MT

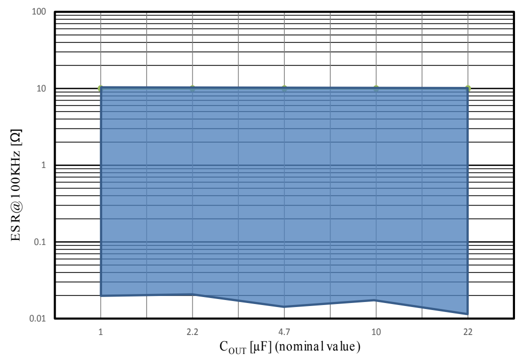
Figure 29. **Output noise spectral density (V_O = 12 V)**



$V_{IN} = V_{EN}$ = 6V, V_{OUT} = 5V, I_{OUT} = 100mA, C_{IN} = 1µF, C_{OUT} = 4.7 µF

GIPD261120151239MT

Figure 30. **Stability plan (V_{OUT} = 5 V)**



$V_{EN} = V_{IN}$ = from 6 V to 18 V, I_{OUT} = from 10 mA to 1.2 A (according to Max I_{OUT} vs V_{drop} characteristics), C_{IN} = 1 µF

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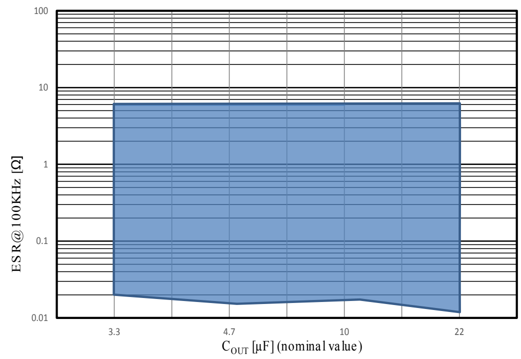
Figure 31. **Stability plan ($V_{OUT} = V_{ADJ}$)**



$V_{EN} = V_{IN}$ = from 2.5 V to 18 V, I_{OUT} = from 10 mA to 1.2 A (according to Max I_{OUT} vs Vdrop characteristics), C_{IN} = 1 µF

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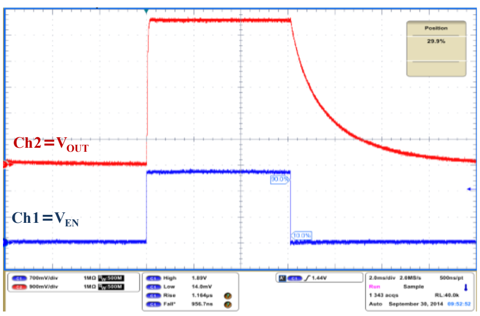
Figure 32. **Startup with enable (V_{OUT} = 5 V)**



V_{IN} = 15 V, V_{EN} from 0 to 2 V, I_{OUT} = 10 mA $C_{IN} = C_{OUT}$ = 1 µF T_{rise} = 1 µs

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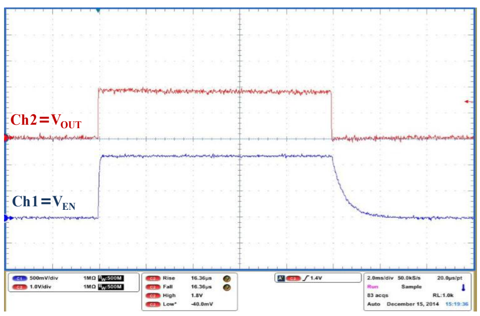
Figure 33. **Startup with enable ($V_{OUT} = V_{ADJ}$)**



V_{IN} = 15 V, V_{EN} from 0 to 2 V, I_{OUT} = 10 mA $C_{IN} = C_{OUT}$ = 1 µF T_{rise} = 1 µs

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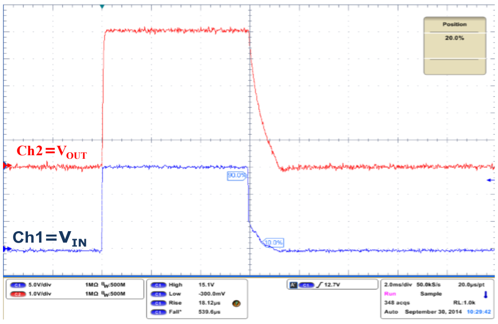
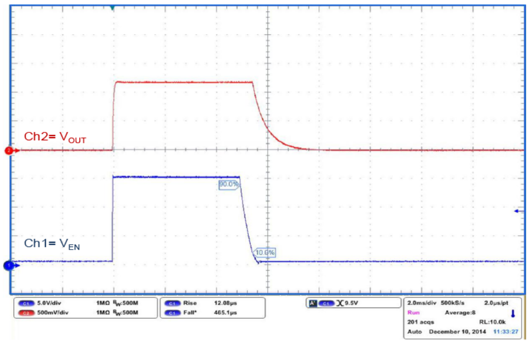
Figure 34. Turn-on time (V_{OUT} = 5 V)



V_{EN} = V_{IN} = from 0 to 15 V, I_{OUT} = 10 mA, C_{OUT} = 1 µF T_{rise} = 10 µs

GIPD301120151407MT

Figure 35. Turn-on time (V_{OUT} = V_{ADJ})



V_{EN} = V_{IN} = from 0 to 15 V, I_{OUT} = 10 mA, C_{IN} = 1 µF, C_{OUT} = 4.7 µF, trise = 10 µs

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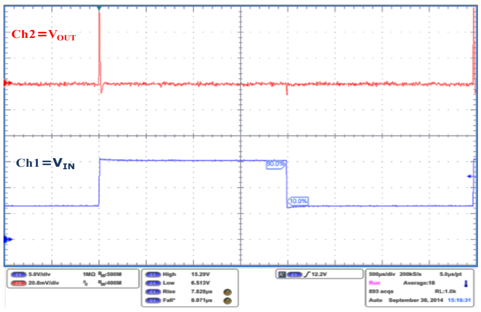
Figure 36. Line transient (V_{OUT} = 5 V)



V_{IN} = from 6 to 15 V, I_{OUT} = 10 mA , C_{OUT} = 4.7 µF, tr = 5 µs

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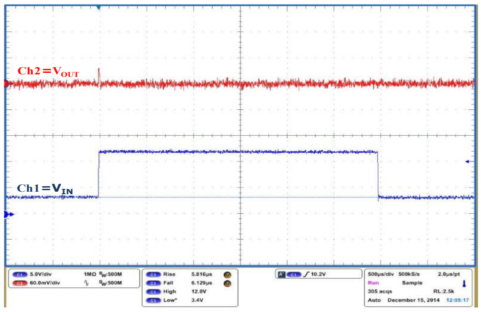
Figure 37. Line transient (V_{OUT} = V_{ADJ})



V_{IN} = from 3.5 to 15 V, I_{OUT} = 10 mA, NO C_{IN}, C_{OUT} = 4.7 µF, tr = 5 µs

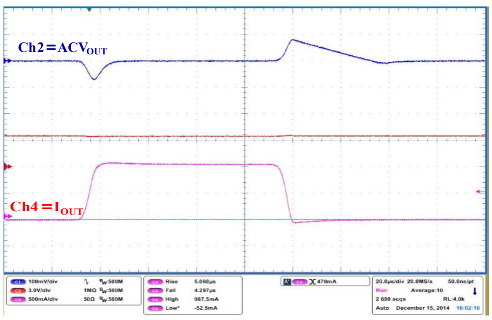
GIPD301120151410MT

Figure 38. Load transient (V_{OUT} = 5 V)

V_{EN} to V_{CC} V_{IN} = 6 V, I_{OUT}= from 10 mA to 1.2 A , C_{IN} = 1 µF C_{OUT} = 4.7 µF T_{rise} = 5 µs

GIPD301120151411MT

Figure 39. Load transient (V_{OUT} = V_{ADJ})



V_{EN} to V_{CC} V_{IN} = 3.5 V, I_{OUT} = from 10 mA to 1.2 A , C_{IN} = 1 µf C_{OUT} = 4.7 µF T_{rise} = 5 µs

GIPD301120151412MT

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 DFN6 (3x3) package information

Figure 40. DFN6 (3x3) package outline

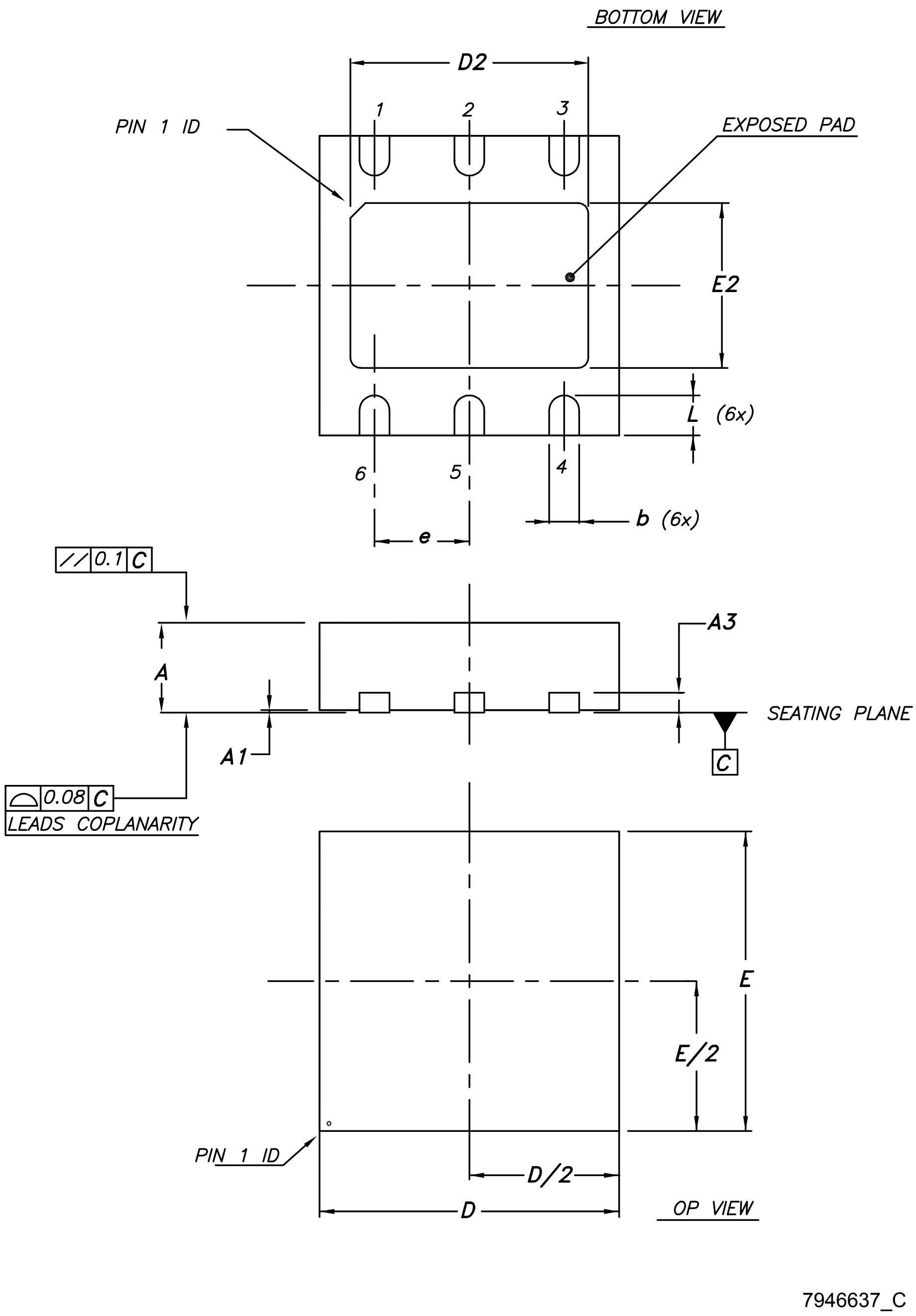
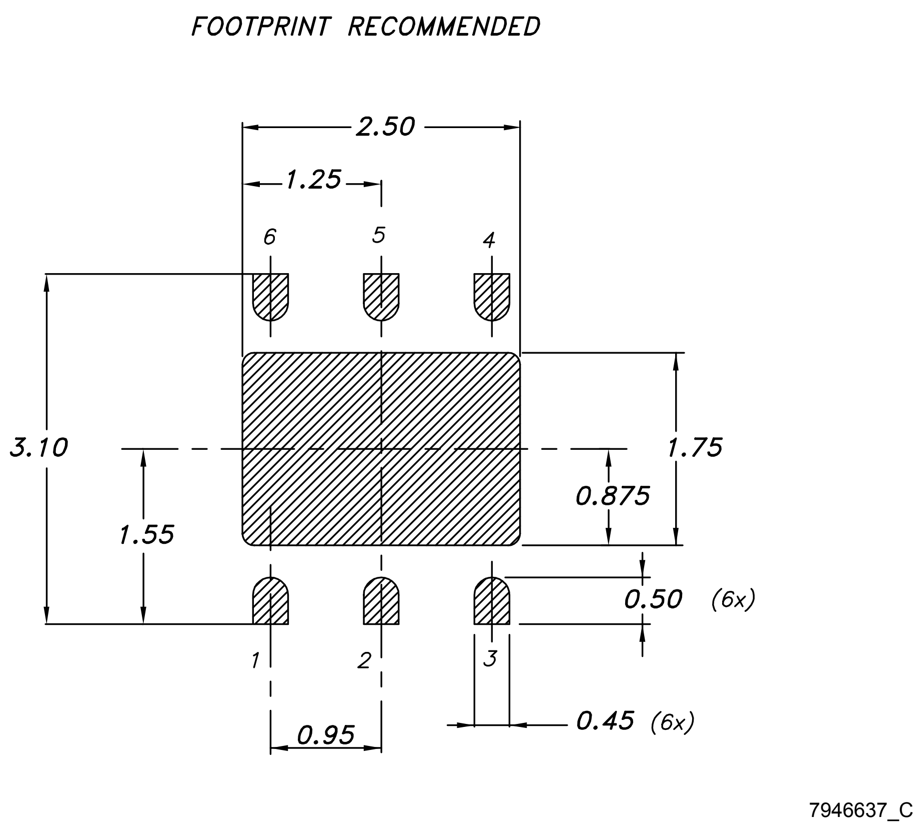


Table 5. **DFN6 (3x3) mechanical data**

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1
A1	0	0.02	0.05
A3		0.20	
b	0.23		0.45
D	2.90	3	3.10
D2	2.23		2.50
E	2.90	3	3.10
E2	1.50		1.75
e		0.95	
L	0.30	0.40	0.50

Figure 41. **DFN6 (3x3) recommended footprint**



7.2 DFN6 (3x3) packing information

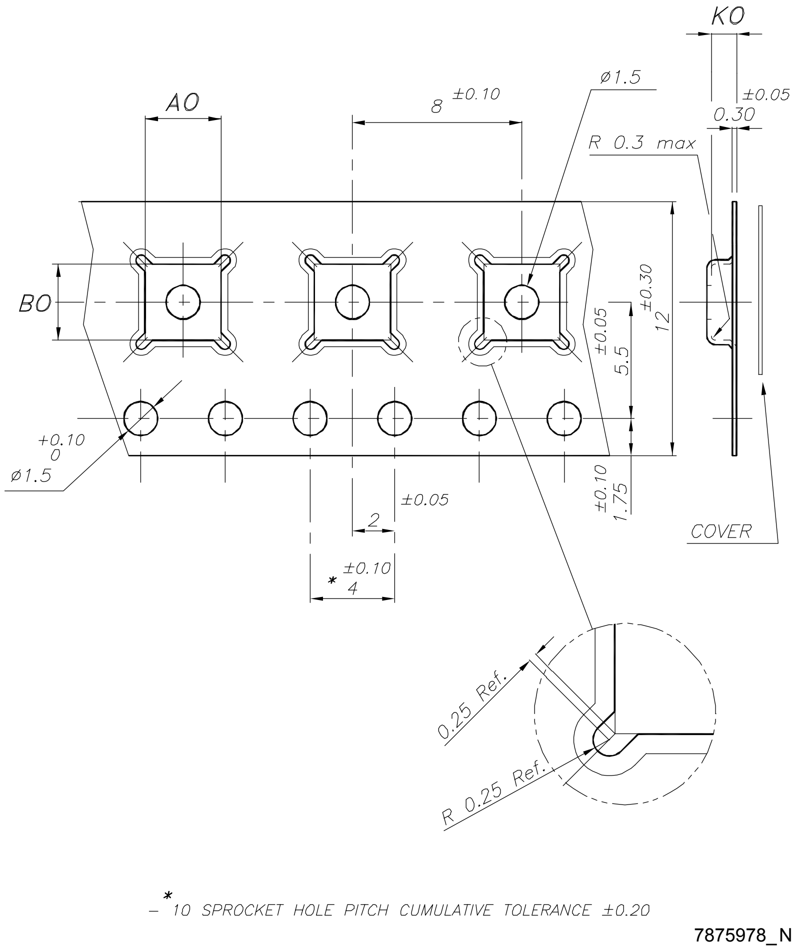


Figure 42. DFN6 (3x3) tape outline

Figure 43. DFN6 (3x3) reel outline

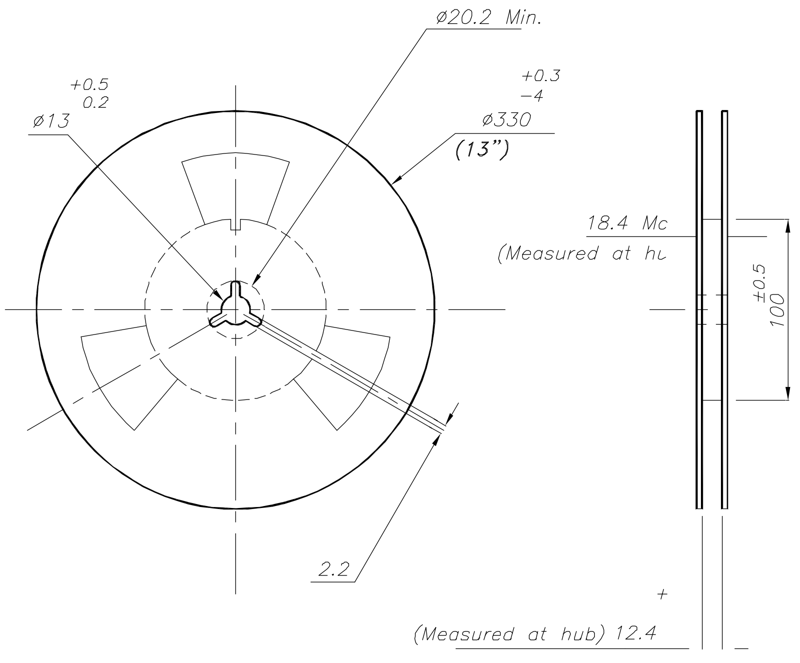
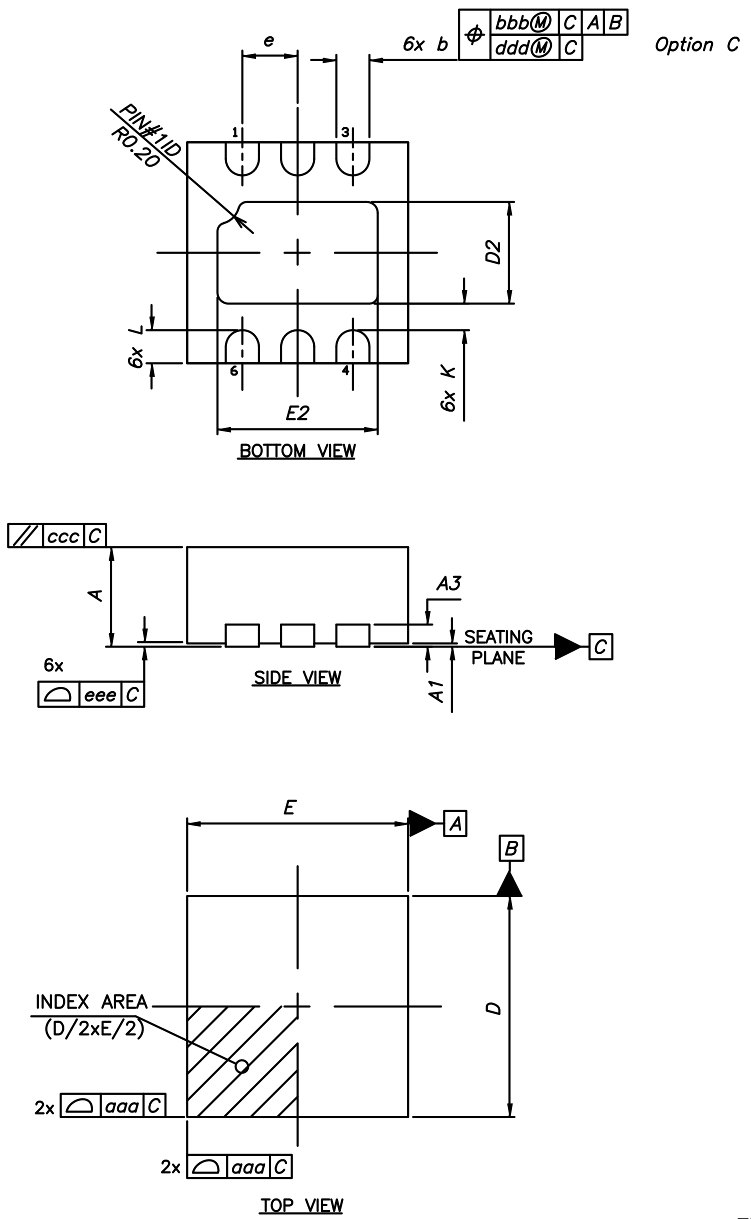


Table 6. DFN6 (3x3) tape and reel mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A0	3.20	3.30	3.40
B0	3.20	3.30	3.40
K0	1	1.10	1.20

7.3 DFN6 (2x2) package information

Figure 44. **DFN6 (2x2) package outline**

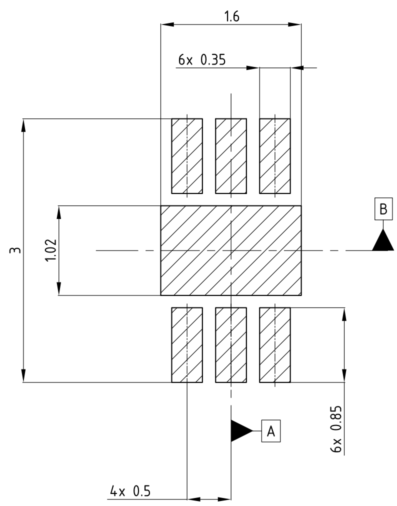


7733060

Table 7. DFN6 (2x2) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	-	0.203 ref	-
b	0.25	0.30	0.35
D	-	2.00	-
E	-	2.00	-
e	-	0.50	-
D2	0.77	0.92	1.02
E2	1.30	1.45	1.55
K	0.15	-	-
L	0.20	0.30	0.40
aaa	-	0.05	-
bbb	-	0.10	-
ccc	-	0.10	-
ddd	-	0.05	-
eee	-	0.08	-

Figure 45. DFN6 (2x2) recommended footprint



Notes:
1) This footprint is able to ensure insulation up to 32 Vrms (according to CEI IEC 664-1)
2) The device must be positioned within ⌖ 0.02 | A | B

7733060 revE

7.4 DFN6 (2x2) packing information

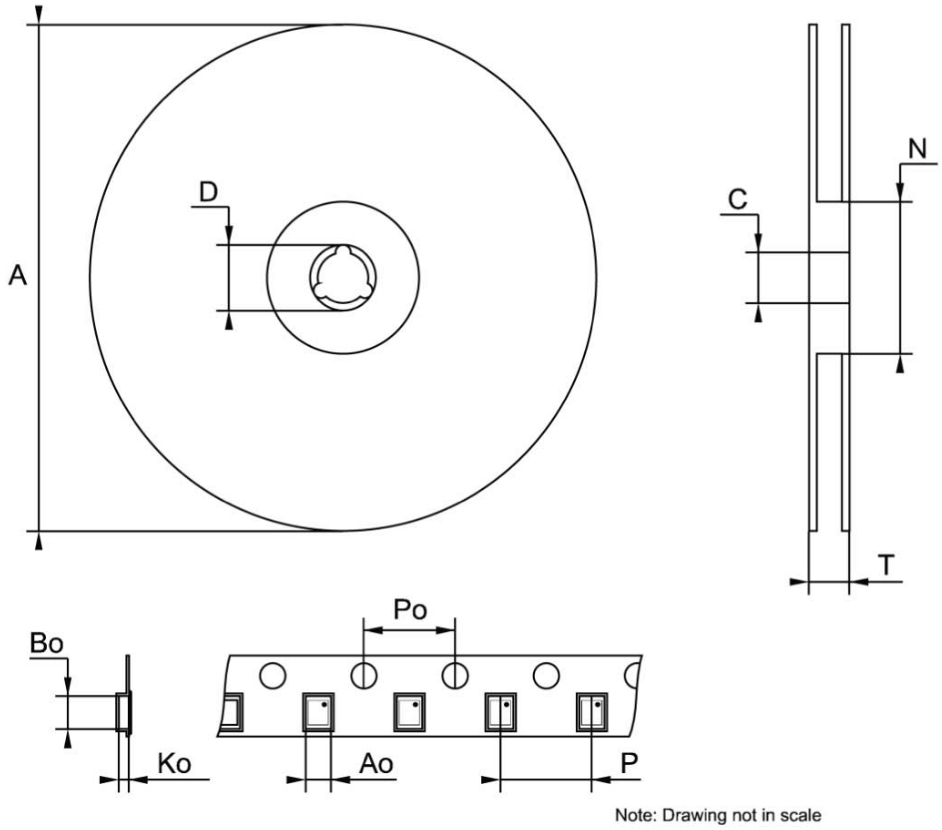


Figure 46. DFN6 (2 x 2 mm) reel outline

Table 8. DFN6 (2 x 2 mm) tape and reel mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			180
C	12.8		13.2
D	20.2		
N	60		
T			14.4
A0		2.4	
B0		2.4	
K0		1.3	
P0		4	
P		4	

7.5 SO8 package information

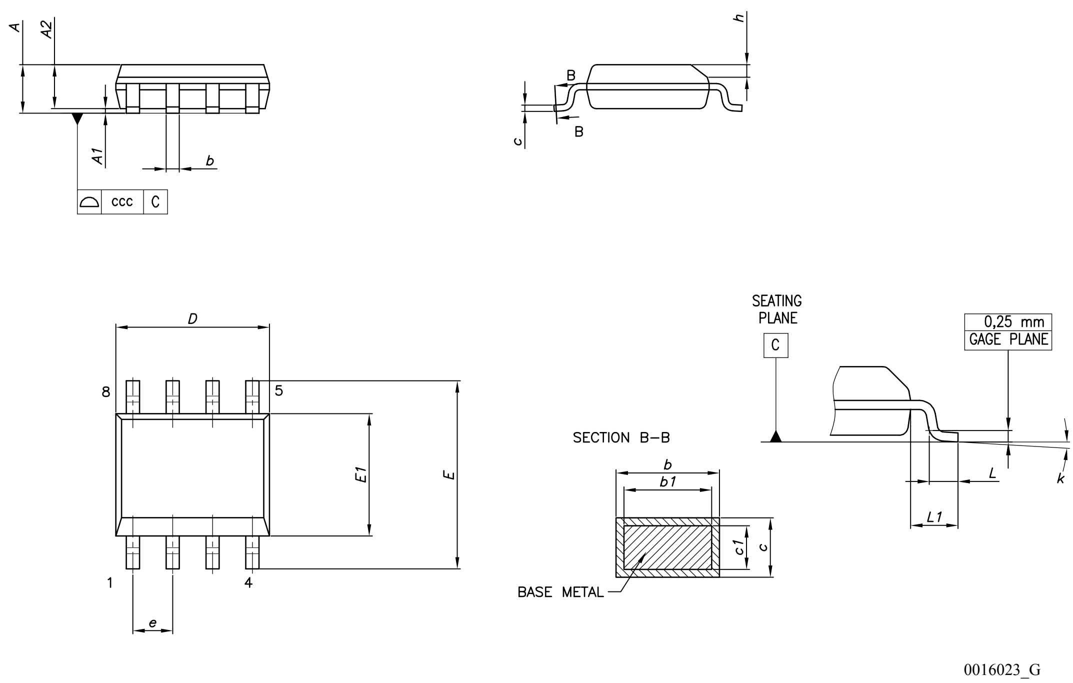
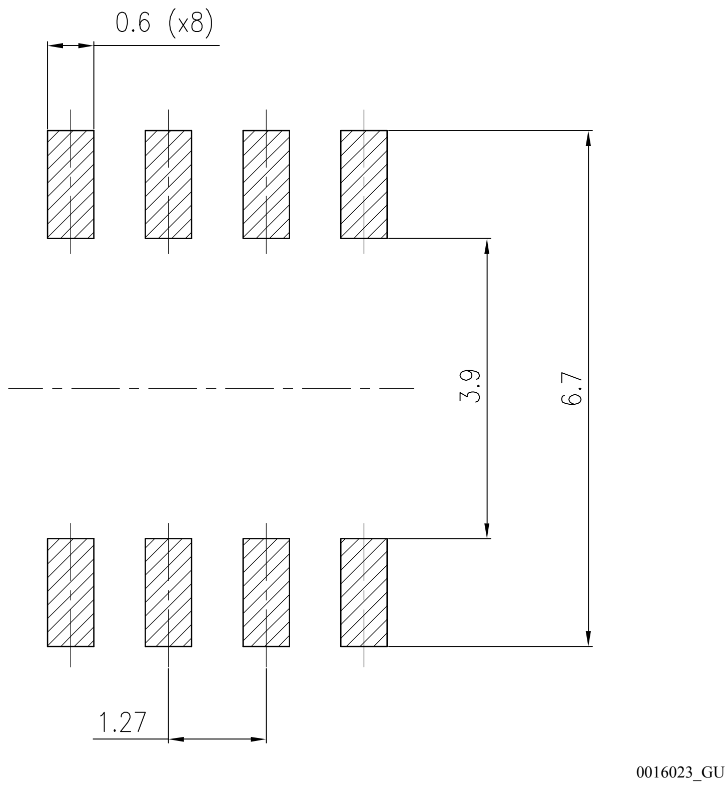


Figure 47. SO-8 batwing package outline

Table 9. SO-8 batwing mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			1.75
A1	0.10		0.25
A2	1.25		
b	0.31		0.51
b1	0.28		0.48
c	0.10		0.25
c1	0.10		0.23
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e		1.27	
h	0.25		0.50
L	0.40		1.27
L1		1.04	
L2		0.25	
k	0°		8°
ccc			0.10

Figure 48. **SO-8 batwing recommended footprint**



8 Ordering information

Table 10. Order code

DFN6 (3x3)	DFN6 (2x2)	SO-8 batwing plastic micropackage	Output voltage (V)
LDL212PU12R (1)			1.2
LDL212PU15R			1.5
LDL212PU18R (1)			1.8
LDL212PU25R (1)			2.5
LDL212PU30R (1)			3
	LDL212PV33R	LDL212D33R	3.3
LDL212PU50R			5
LDL212PUR	LDL212PVR	LDL212DR	Adjustable

1. *Available on request.*

Revision history

Table 11. Document revision history

Date	Revision	Changes
02-Mar-2016	1	Initial release.
19-Sep-2016	2	Updated Table 3: "Thermal data" and Section 5: "Electrical characteristics". Minor text changes.
17-Sep-2018	3	Added: GND pin name in Table 1. Pin description and new order code LDL212D33R in Table 10. Order code.
16-Apr-2019	4	In Table 10. Order code, in LDL2012D33R the note has been removed. Updated GND description in Table 1. Pin description.
21-Feb-2020	5	Added dropout voltage for SO-8 in Table 4. Electrical characteristics.

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Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

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- Поставка сложных, дефицитных, либо снятых с производства позиций;
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- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.

Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.