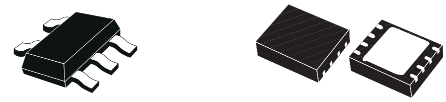
ST715XX
ST715XX25 - ST715XX33

High input voltage - 85 mA LDO linear regulator

Features

- 2.5 V to 24 V input voltage
- Low dropout voltage (500 mV typ. at 85 mA)
- Very low quiescent current (3.8 µA typ. at full load)
- 85 mA guaranteed output current
- Output voltage: fixed or adjustable
- Compatible with ceramic output capacitors from 0.47 µF to 10 µF
- Internal current limit
- Package DFN8 (3x3 mm), SOT23-5L
- Temperature range: -40 °C to 125 °C



Description

The ST715xx is a high voltage, ultra low quiescent low drop linear regulator capable of providing an output current in excess of 85 mA. The device operates over an input voltage range spanning from 2.5 V to 24 V, and is also stable with output ceramic capacitors. Fault condition protection includes short-circuit current limitation. The ultra low quiescent current of 3.8 µA at full load makes it highly suitable for low power applications and battery powered systems. Typical applications are mobile phones, personal digital assistant (PDAs), cordless phones and similar battery powered systems. The wide input voltage range makes the ST715xx an ideal solution for low power industrial applications also.The ST715xx is available in the DFN8 (3x3 mm) 8 leads or the SOT23-5.

Table 1. Device summary

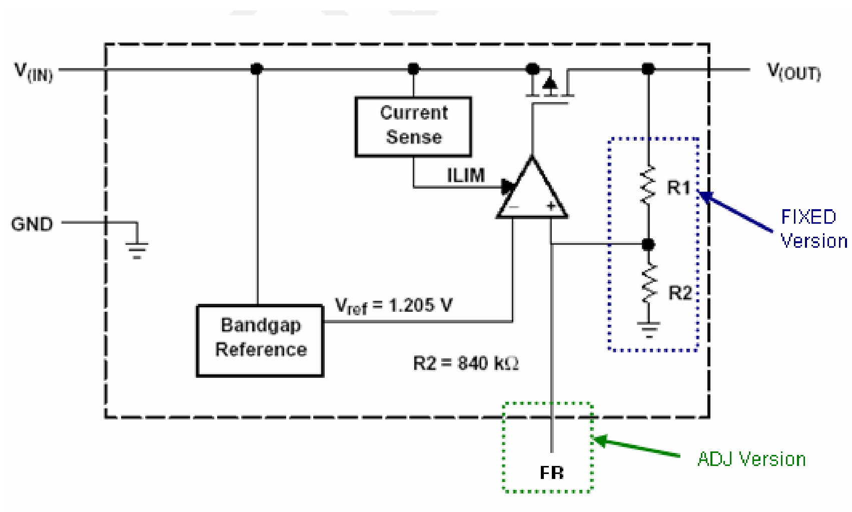
Order codes				Output Voltage
SOT23-5L	Marking	DFN8 (3x3 mm)	Marking	
ST715MR	71AD	ST715PUR	715AD	ADJ
ST715M15R (1)	7115	ST715PU15R (1)	71515	1.5 V
ST715M18R (1)	7118	ST715PU18R (1)	71518	1.8 V
ST715M25R	7125	ST715PU25R (1)	71525	2.5 V
ST715M28R (1)	7128	ST715PU28R (1)	71528	2.8 V
ST715M33R (1)	7133	ST715PU33R	71533	3.3 V

1. Available on request.

Contents

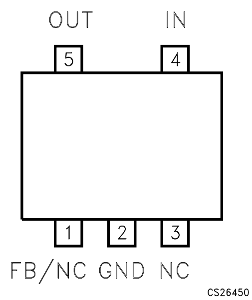
1 Diagram

Figure 1. Block diagram

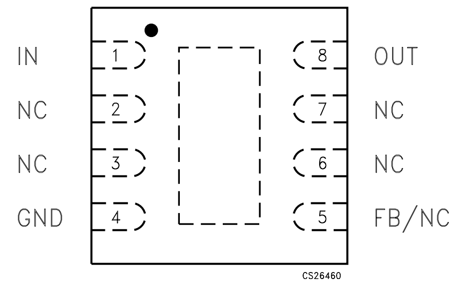


2 Pin configuration

Figure 2. Pin connections (top view)



SOT23-5L



DFN8 (3x3)

Table 2. Pin description (DFN8 3x3 mm)

Symbol	Pin for fixed	Pin for adjustable	Name and function
IN	1	1	Input voltage of the LDO
NC	2, 3, 5, 7, Exp. pad	2, 3, 6, 7, Exp. pad	Not internally connected
GND	4	4	Common ground
FB	-	5	Feedback pin
OUT	8	8	Output voltage

Table 3. Pin description (SOT23-5L)

Symbol	Pin for fixed	Pin for adjustable	Name and function
IN	4	4	Input voltage of the LDO
NC	3	1, 3	Not internally connected
GND	2	2	Common ground
FB	1		Feedback pin
OUT	5	5	Output voltage

3 Maximum ratings

Table 4. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{IN}	DC input voltage	from -0.3 to 26	V
V_{OUT}	DC output voltage	From -0.3 to V_{IN}+0.3	V
I_{OUT}	Continuous output current DFN package	According to package power dissipation	A
	Continuous output current SOT23-5 package	According to package power dissipation	
V_{ESD}	ESD ratings	± 2	kV
P_D	Power dissipation DFN package	= 5	W
	Power dissipation SOT23-5 package	= 1	
T_{STG}	Storage temperature range	-65 to 150	°C
T_{OP}	Operating junction temperature range	-40 to 125	°C

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

Table 5. Thermal data

Symbol	Parameter	SOT23-5L	DFN8	Unit
R_{thJA}	Thermal resistance junction-ambient	255	52	°C/W

4 Electrical characteristics

Table 6. Electrical characteristics - adjustable version
(T_J = 25 °C, V_{IN} = $V_{OUT(NOM)}$ + 1 V, C_{IN} = 0.1 µF, C_{OUT} = 1 µF, I_{OUT} = 1 mA, unless otherwise specified) (Note 1)

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage	I_{OUT} = 85mA		2.5		24	V
V_{OUT}	Output voltage range			1.2			V
I_{OUT}	Output current	V_{IN}=2.5 to 6V, T_J=-40°C to 125°C				85	mA
V_{FB}	Feedback voltage				1.2		V
	V_{FB} accuracy (Note 1)	V_{IN}=V_{OUT}+1 to 24V, I_{OUT} =1mA to 85mA, T_J=-40°C to 125°C		-4.0		4.0	%
ΔV_{OUT}	Line regulation	V_{IN}=V_{OUT}+1 to 24V, I_{OUT}=1mA, T_J=-40°C to 125°C			0.001	0.004	%/V
ΔV_{OUT}	Load regulation	I_{OUT} =1mA to 85mA, T_J=-40°C to 125°C			0.002	0.004	%/mA
e_N	Output noise voltage (Note 4)	200Hz to 100kHz, I_{OUT} = 50mA, C_{OUT}= 10µF, T_J=-40°C to 125°C, V_{OUT}=1.2V				95	μV_{RMS}
SVR	Supply voltage rejection	V_{IN}=V_{OUTNOM}+1V+/-$V_{RIPPLE,}$ V_{RIPPLE}=0.2V, I_{OUT} = 1mA, C_{OUT}= 10µF	f=1kHz		45		dB
		T_J=-40°C to 125°C	f=100kHz		62		
I_Q	Quiescent current	I_{OUT}=0mA to 85mA, T_J=-40°C to 125°C				4.5	µA
		I_{OUT}=0mA to 85mA, V_{IN}=24V T_J=-40°C to 125°C				5.5	
I_{SC}	Short circuit current	V_{OUT}=0, T_J=-40°C to 125°C V_{IN}=3.8V		120			mA
T_{ON}	Turn on time (Note 3)	V_{IN} =4.2V, C_{OUT}= 10µF, I_{OUT}=60mA, T_J=-40°C to 125°C			0.7		ms
C_{OUT}	Output capacitor	Capacitance f = 100kHz		0.47			µF

Note: 1 *For $V_{OUT(NOM)}$ < 2 V, V_{IN} = 2.5 V.*

2 *Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value. This specification does not apply for output voltages below 2 V.*

3 *Turn-on time is time measured between the input just exceeding 90% of its final value and the output voltage just reaching 95 % of its nominal value.*

4 *Guaranteed by design.*

Table 7. Electrical characteristics - fixed version
(T_J = 25 °C, V_{IN} = $V_{OUT(NOM)}$ + 1 V, C_{IN} = 0.1 µF, C_{OUT} = 1 µF, I_{OUT} = 1 mA, V_{OUT} = 3.3 V unless otherwise specified) (*Note 1*)

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage	I_{OUT} = 85mA, T_J=-40°C to 125°C		V_{OUT} +$V_{DROPTYP}$		24	V
I_{OUT}	Output current	V_{IN}=4.3 to 24V, T_J=-40°C to 125°C		0		85	mA
V_{OUT}	V_{OUT} total accuracy (*Note 1*)	V_{IN}=V_{OUT}+1 to 24V, I_{OUT}=0 to 85mA, T_J=-40°C to 125°C		-5		+5	%
ΔV_{OUT}	Line regulation	V_{IN}=4.3 to 24V, I_{OUT}=1mA, T_J=-40°C to 125°C			0.001	0.004	%/V
ΔV_{OUT}	Load regulation	I_{OUT} =100µA to 85mA, T_J=-40°C to 125°C			0.002	0.003	%/mA
V_{DROP}	Drop output voltage (*Note 2*)	I_{OUT}=85mA, T_J=-40°C to 125°C			500	1000	mV
e_N	Output noise voltage (*Note 4*)	200Hz to 100kHz, I_{OUT} = 50mA, C_{OUT}= 10µF, T_J=-40°C to 125°C				210	$µV_{RMS}$
SVR	Supply voltage rejection	V_{IN}=V_{OUTNOM}+1V+/-$V_{RIPPLE,}$ V_{RIPPLE}=0.2V, I_{OUT}=1mA, C_{OUT}= 10µF	f=1kHz		38		dB
		T_J=-40°C to 125°C	f=100kHz		57		
I_Q	Quiescent current	I_{OUT}=0mA to 85mA, T_J=-40°C to 125°C			3.75	4.5	µA
			V_{IN}=24V		4.15	5.5	
I_{SC}	Short circuit current	V_{OUT}=0, T_J=-40°C to 125°C V_{IN}=3.8V		120			mA
T_{ON}	Turn on time (*Note 3*)	V_{IN} =4.2V, C_{OUT}= 10µF, I_{OUT}=60mA, T_J=-40°C to 125°C			0.7		ms
C_{OUT}	Output capacitor	Capacitance f = 100kHz		0.47			µF

Note: 1 *For $V_{OUT(NOM)}$ < 2 V, V_{IN} = 2.5 V.*

2 *Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value. This specification does not apply for output voltages below 2 V.*

3 *Turn-on time is time measured between the input just exceeding 90 % of its final value and the output voltage just reaching 95% of its nominal value.*

4 *Guaranteed by design.*

5 Output voltage selection for adjustable version

The ST715xx features an adjustable output voltage using two external resistors connected as a voltage divider to the FB pin as shown in the typical application circuit *Figure 4*. The output voltage is set using the following equation:

$V_{OUT} = V_{FB} (1 + R_1/R_2)$

where typically V_{FB} = 1.2 V. Choose $R_2 \geq$ 5 kΩ in order to optimize quiescent current, accuracy, and high-frequency power-supply rejection. To simplify resistor selection use the following equation:

$R_1 = R_2 \times (V_{OUT}/V_{FB} - 1)$

5.1 External capacitor requirements

A 0.1 µF or larger input bypass capacitor, connected between IN and GND and located close to the device, is recommended to improve transient response and noise rejection of the power supply as a whole. A higher-value input capacitor may be necessary if large, fast-rise-time load transients will be present in the application and if the device is located several inches away from the power source.

The ST715xx requires an output capacitor connected between OUT and GND to stabilize the internal control loop. Any capacitor (including ceramic and tantalum) with a value higher than 0.47 µF will properly stabilize this loop.

5.2 Power dissipation and junction temperature

To ensure reliable operation, worst-case junction temperature should not exceed 125 °C. This restriction limits the power dissipation the regulator can handle in any given application. To ensure that the junction temperature is within acceptable limits, calculate the maximum allowable dissipation, $P_{D(max)}$, and the actual dissipation, P_D, which must be less than or equal to $P_{D(max)}$.

The maximum power dissipation limit is determined using the following equation:

$P_{D(max)} = (T_{JMAX} - T_A) / R_{thJA}$

where:

T_{JMAX} is the maximum allowable junction temperature.

R_{thJA} is the thermal resistance junction-to-ambient for the package.

T_A is the ambient temperature.

The regulator dissipation is calculated using the following equation:

$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$

Power dissipation resulting from quiescent current is negligible.

The ST715xx features internal current limiting. During normal operation, it limits output current to approximately 350 mA. When current limiting engages, the output voltage scales back linearly until the overcurrent condition ends. Take care not to exceed the power dissipation ratings of the package.

6 Typical application

Figure 3. Application circuit for fixed version

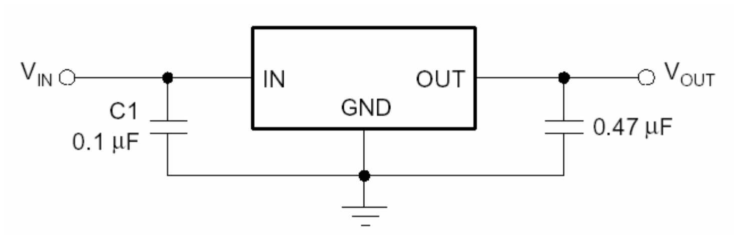
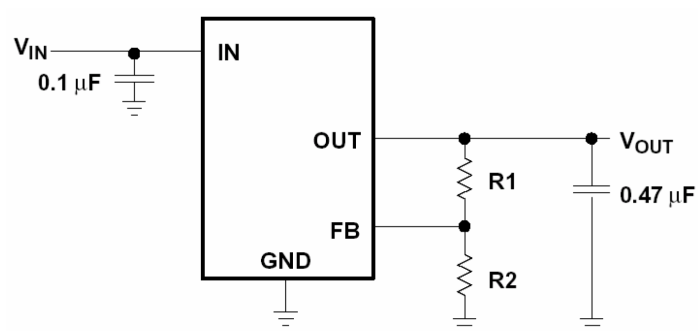


Figure 4. Application circuit for adjustable version



7 Typical performance characteristics

Figure 5. Output voltage vs temperature

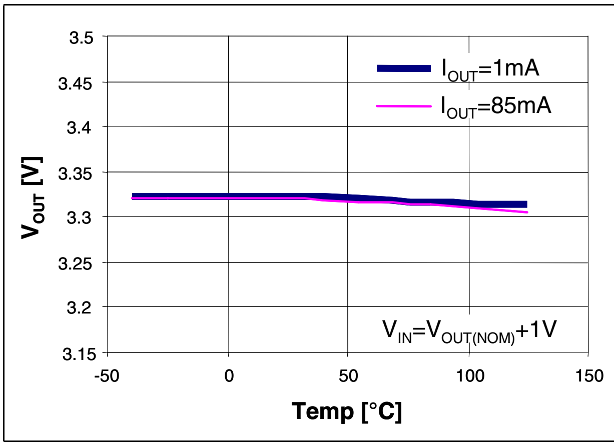


Figure 6. Output voltage vs input voltage

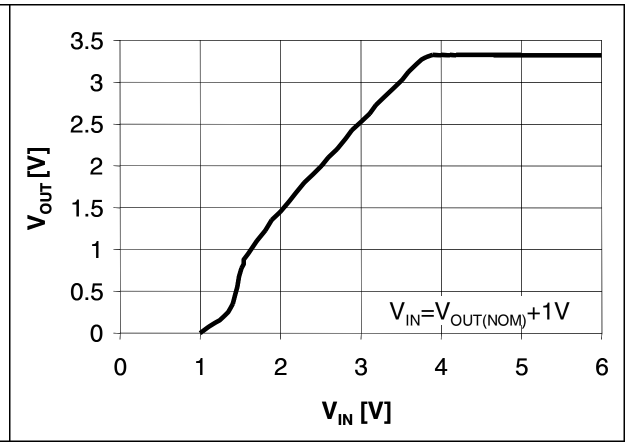


Figure 7. Dropout voltage vs output current

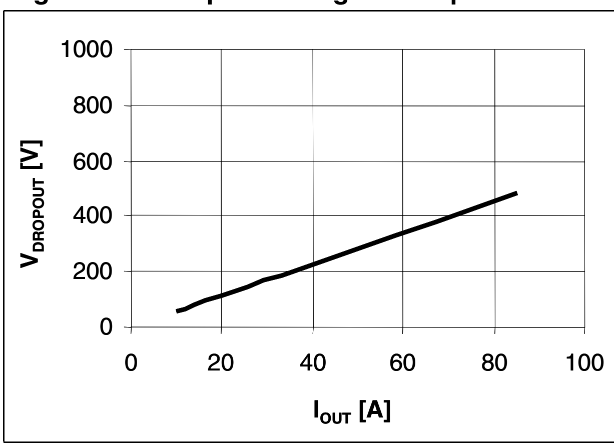


Figure 8. C_{OUT} stability region

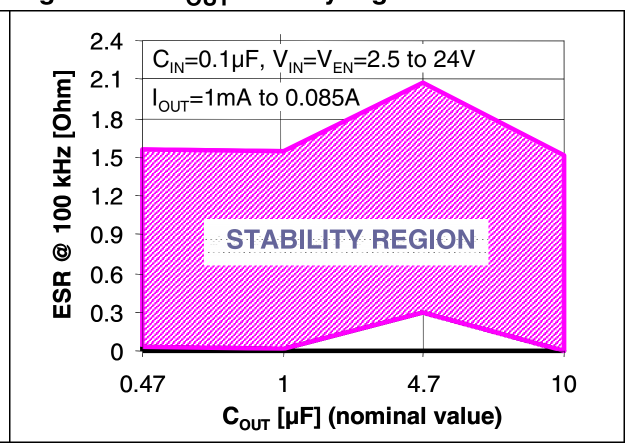


Figure 9. Supply voltage rejection vs frequency

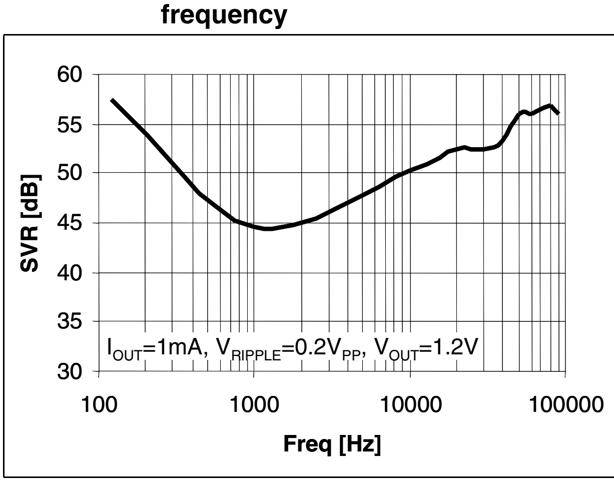


Figure 10. Output noise voltage vs frequency

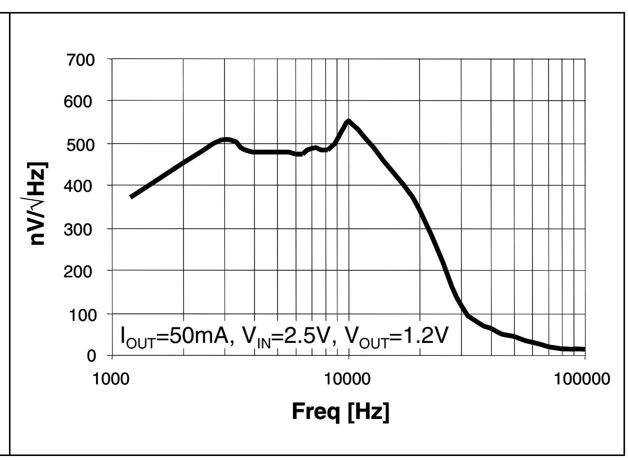


Figure 11. Quiescent current vs input voltage

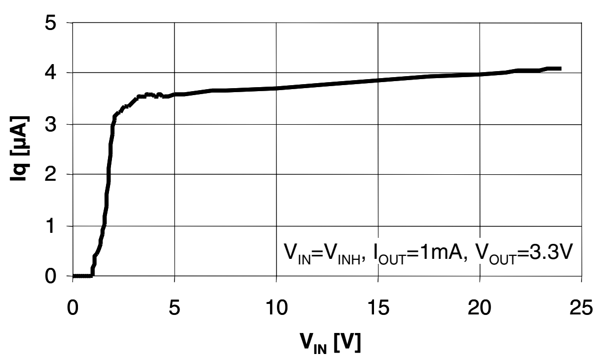
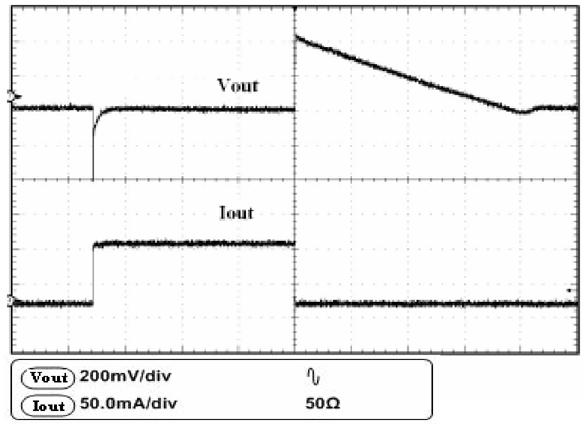
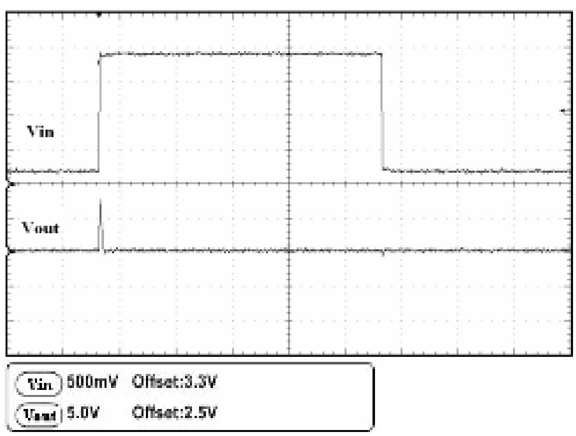


Figure 12. Load transient



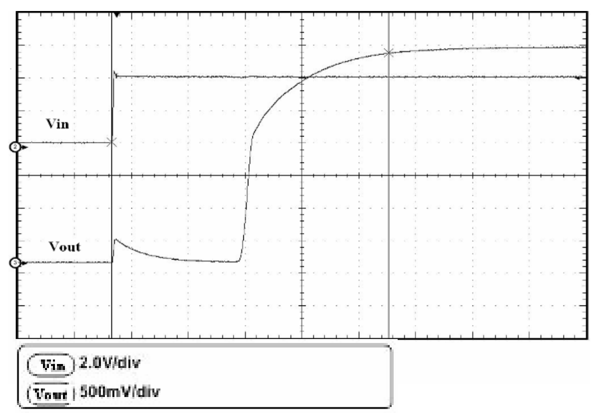
C_{IN}=C_{OUT}=1µF, V_{EN} =V_{IN}=24V I_{OUT}=from 1mA to 85mA t_R=t_F=5µS

Figure 13. Line transient



C_{OUT}=1µF; V_{IN}=V_{EN}=from 4.3 to 22V; I_{OUT}=1mA; t_R=t_F=5µs

Figure 14. Enable transient



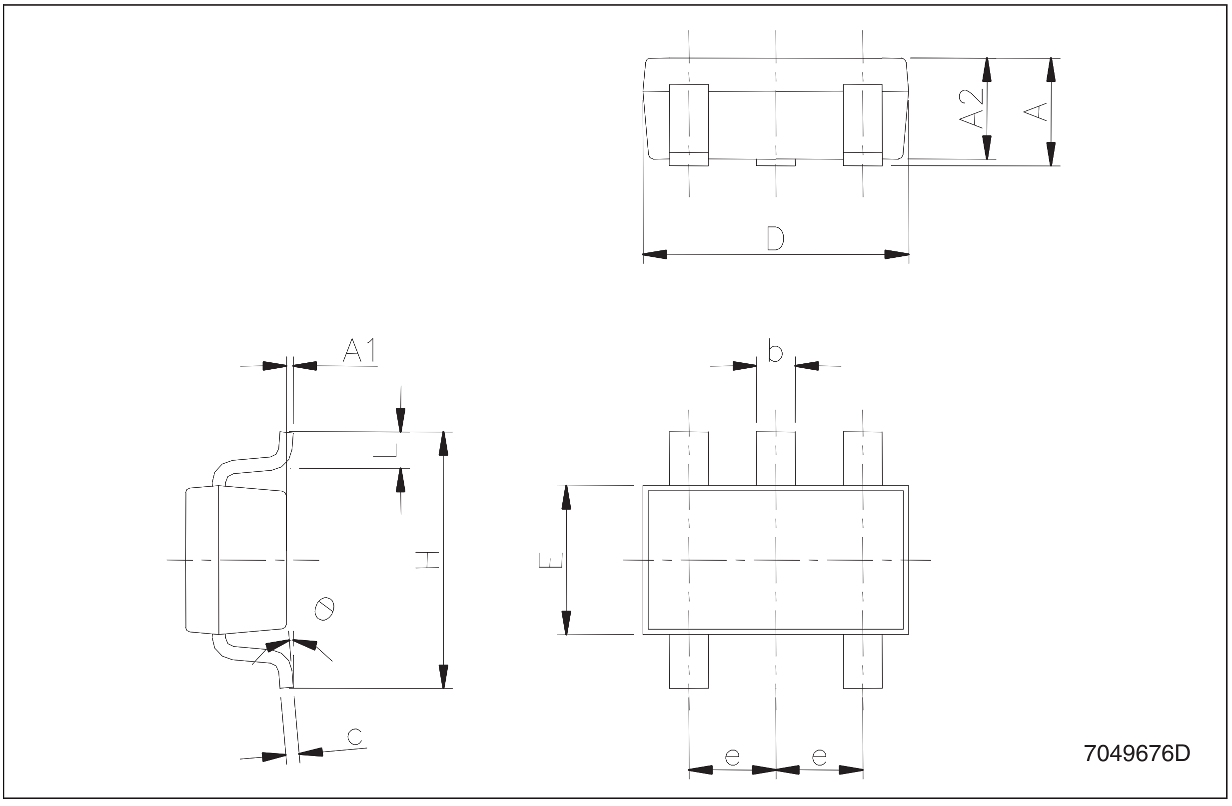
C_{IN}= C_{OUT}=1µF, V_{EN}=V_{IN}=0 to 4.3V, I_{OUT}=1mA

8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® 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.

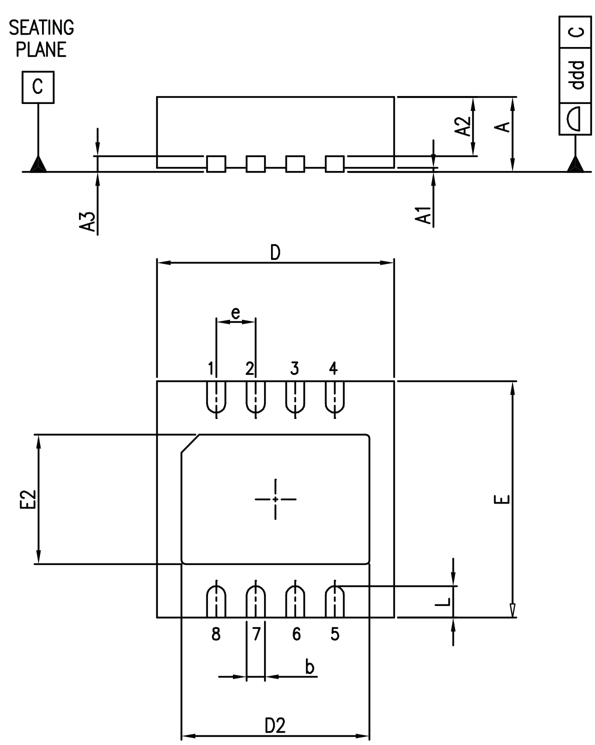
SOT23-5L mechanical data

Dim.	mm.			mils.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90		1.45	35.4		57.1
A1	0.00		0.10	0.0		3.9
A2	0.90		1.30	35.4		51.2
b	0.35		0.50	13.7		19.7
C	0.09		0.20	3.5		7.8
D	2.80		3.00	110.2		118.1
E	1.50		1.75	59.0		68.8
e		0.95			37.4	
H	2.60		3.00	102.3		118.1
L	0.10		0.60	3.9		23.6



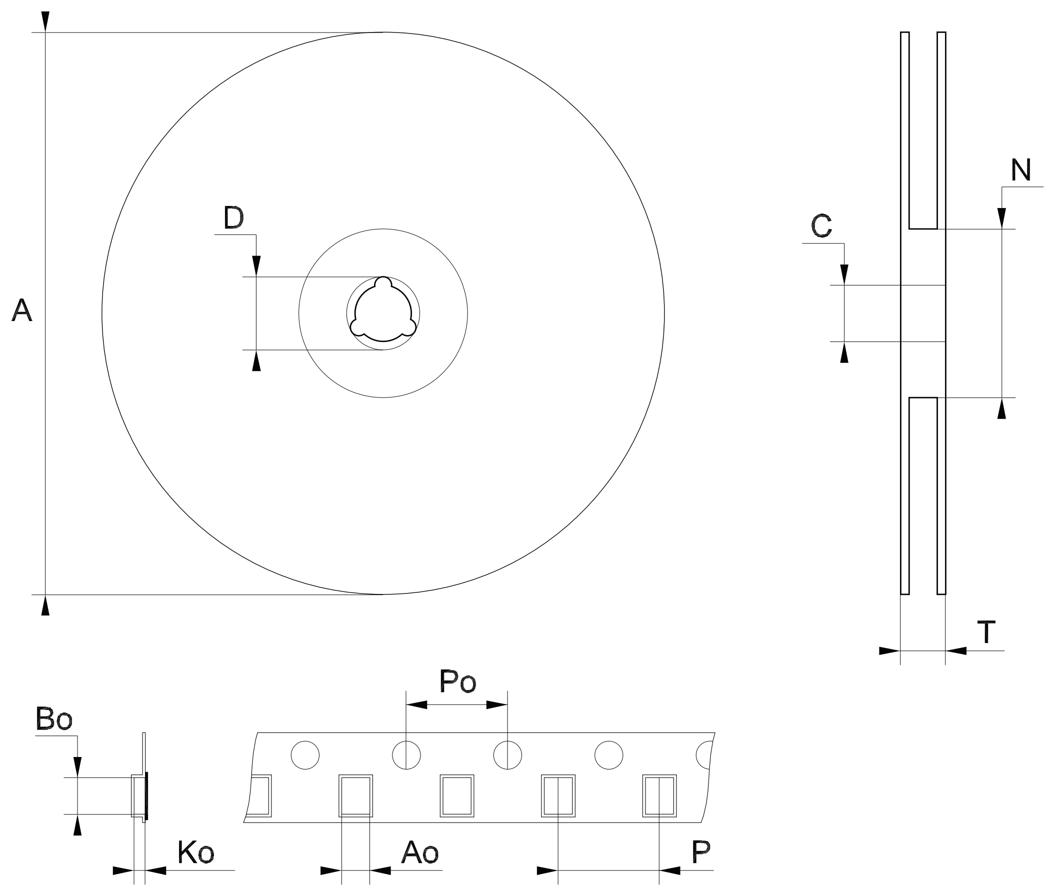
DFN8 (3x3 mm) mechanical data

Dim.	mm.			mils.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.80	0.90	1.00	31.5	35.4	39.4
A1		0.02	0.05		0.8	2.0
A3		0.20			7.9	
b	0.25	0.30	0.35	9.8	11.8	13.8
D	2.85	3.00	3.15	112.2	118.1	124
D2	1.603	1.753	1.853	63.1	69	73
E	2.85	3.00	3.15	112.2	118.1	124
E2	1.345	1.495	1.595	53	58.9	62.8
e		0.65			25.6	
L	0.30	0.40	0.50	11.8	15.7	19.7



Tape & reel SOT23-xL mechanical data

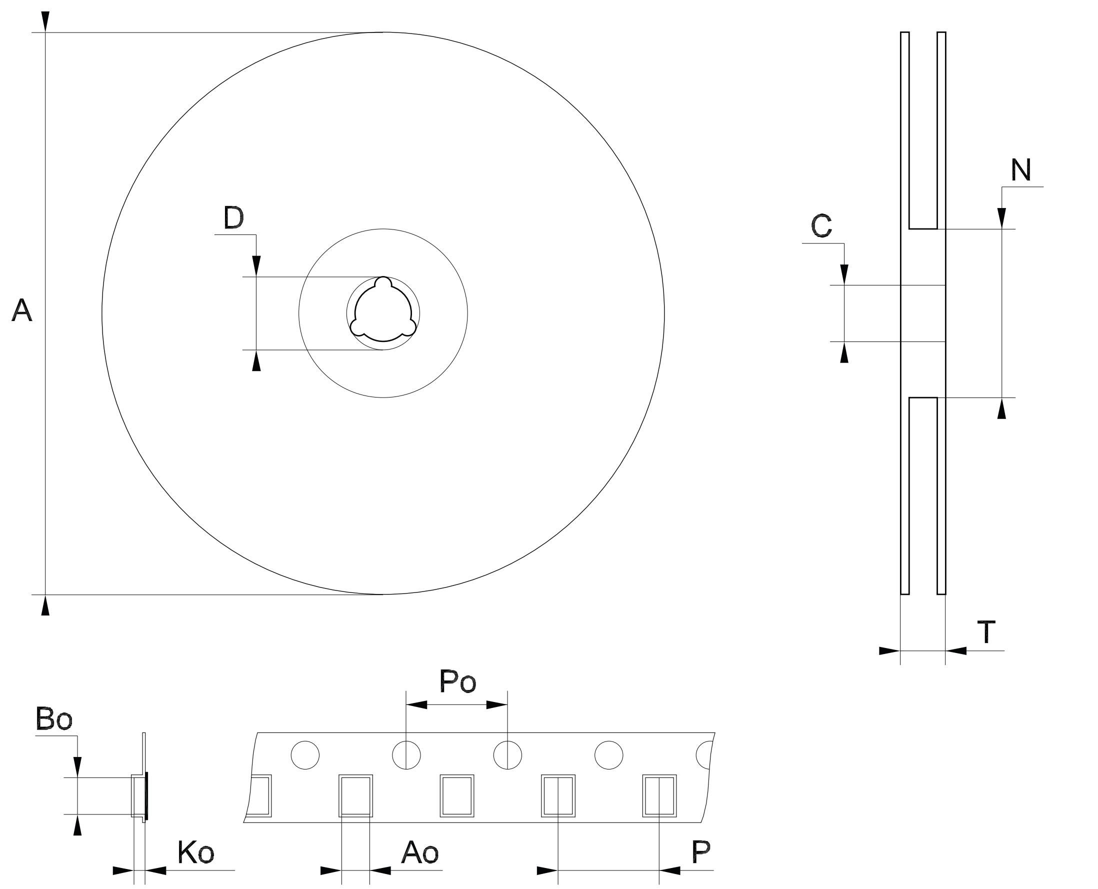
Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			180			7.086
C	12.8	13.0	13.2	0.504	0.512	0.519
D	20.2			0.795		
N	60			2.362		
T			14.4			0.567
Ao	3.13	3.23	3.33	0.123	0.127	0.131
Bo	3.07	3.17	3.27	0.120	0.124	0.128
Ko	1.27	1.37	1.47	0.050	0.054	0.0.58
Po	3.9	4.0	4.1	0.153	0.157	0.161
P	3.9	4.0	4.1	0.153	0.157	0.161



Note: Drawing not in scale

Tape & reel QFNxx/DFNxx (3x3) mechanical data

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			180			7.087
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			14.4			0.567
Ao		3.3			0.130	
Bo		3.3			0.130	
Ko		1.1			0.043	
Po		4			0.157	
P		8			0.315	



Note: Drawing not in scale

9 Revision history

Table 8. Document revision history

Date	Revision	Changes
08-Feb-2008	1	Initial release.
19-Feb-2008	2	Modified: *Features on page 1*.
22-Sep-2008	3	Modified: DFN8 (3x3 mm) mechanical data *on page 14*.
26-Nov-2008	4	Modified: *Section 5 on page 8*.