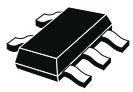
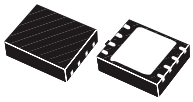
LDK715

High input voltage 85 mA LDO linear regulator

Datasheet - production data



SOT23-5L



DFN8 3x3

Features

- 4.3 V to 24 V input voltage
- Low-dropout voltage (500 mV typ. at 85 mA)
- Very low quiescent current (5 µA typ. at full load)
- 85 mA guaranteed output current
- Output voltages 3.3 V, 4.2 V and 5.0 V (other versions available on request)
- Compatible with ceramic output capacitors from 0.47 µF to 10 µF
- Internal current limit
- Packages: SOT23-5L and DFN8 3x3
- Temperature range: from -40 °C to 125 °C

Applications

- Mobile phones
- Industrial
- battery-powered systems

Description

The LDK715 is a high voltage, ultra low quiescent current and low drop linear regulator capable of providing an output current in excess of 85 mA. The device operates over an input voltage range from 4.3 V to 24 V, and it is stable with output ceramic capacitors. Fault condition protection includes short-circuit current limitation. The ultra low quiescent current of 5 µA at full load makes it highly suitable for low power applications and battery-powered systems. The wide input voltage range makes the LDK715 an ideal solution for low power industrial applications. The LDK715 is available in SOT23-5, or DFN8 3x3 - 8 leads.

Table 1. Device summary

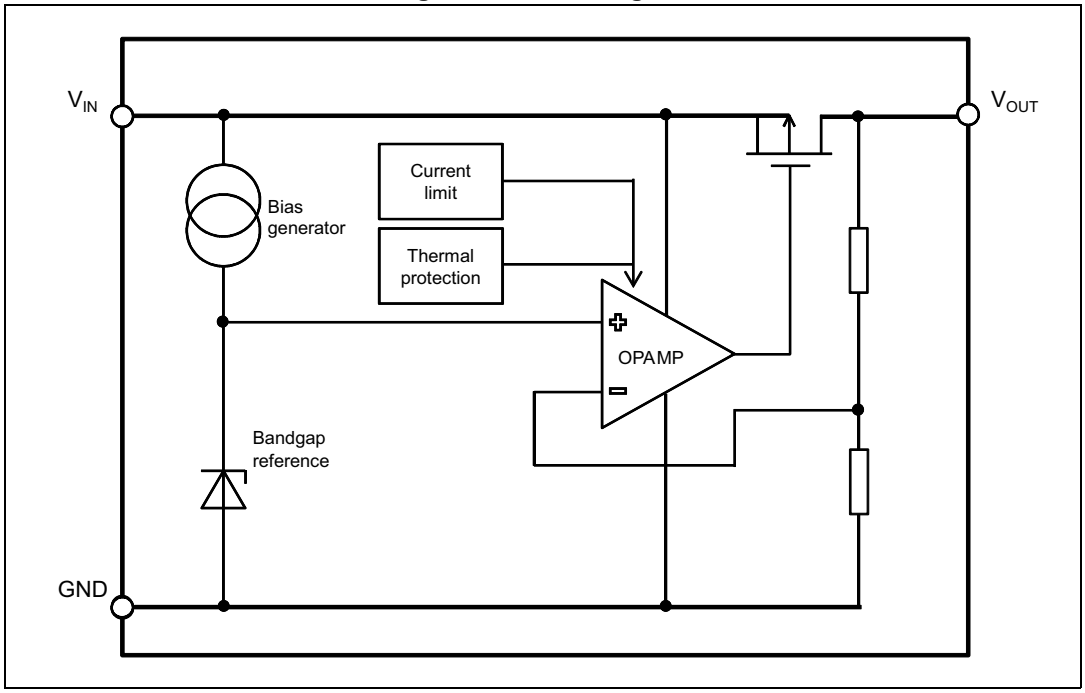
Order codes		Output voltage
SOT23-5L	DFN8 3x3	
LDK715M33R	LDK715PU33R	3.3 V
LDK715M42R	LDK715PU42R	4.2 V
LDK715M50R	LDK715PU50R(1)	5.0 V

1. Available on request.

Contents

1 Diagram

Figure 1. Block diagram



2 Pin configuration

Figure 2. Pin connection (top view)

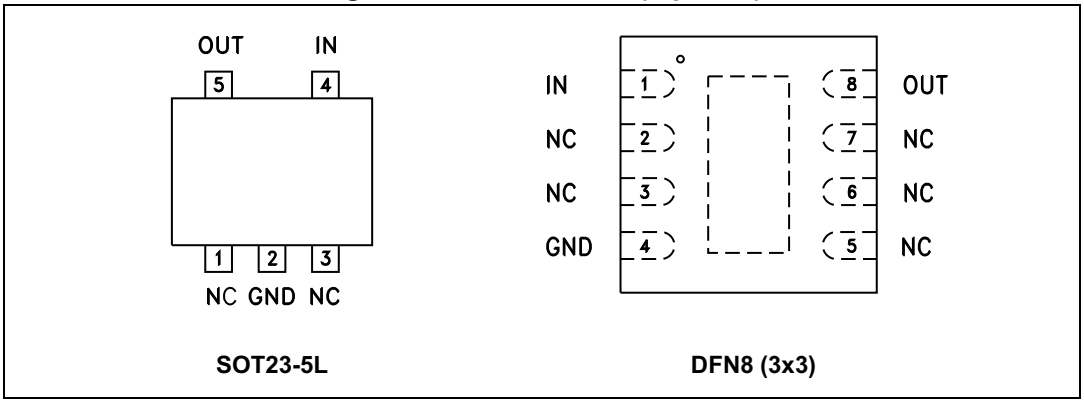


Table 2. Pin description for DFN8 3x3

Symbol	Pin number	Name and function
IN	1	Input voltage
NC	2, 3, 5, 6, 7, and exp. pad	Not internally connected
GND	4	Common ground
OUT	8	Output voltage

Table 3. Pin description for SOT23-5L

Symbol	Pin number	Name and function
IN	4	Input voltage
NC	1.3	Not internally connected
GND	2	Common ground
OUT	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	According to package power dissipation	A
P_D(1), (2)	Maximum power dissipation, DFN package	2	W
	Maximum power dissipation, SOT23-5L package	0.45	
T_{STG}	Storage temperature range	-65 to 150	°C
T_{OP}	Operating junction temperature range	-40 to 125	°C

1. P_D is based on an operating temperature of 25 °C or less. It must be derated according to the operating temperature.
2. The LDK715 has an internal constant current limit feature. Take care not to exceed the power dissipation ratings of the package also during current limit and short-circuit events.

Note: Absolute maximum ratings are those 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	195	52	°C/W

4 Electrical characteristics

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[a].

Table 6. Electrical characteristics

Symbol	Parameter	Test conditions		Min.	Typ.	Max.	Unit
V_{IN}	Operating input voltage	I_{OUT} = 85 mA, T_J = -40 °C to 125 °C		4.3	-	24	V
I_{OUT}	Output current	V_{IN} = $V_{OUT(NOM)}$+1 to 24 V, T_J = -40 °C to 125 °C		0	-	85	mA
V_{OUT}	V_{OUT} accuracy(1)	T_J = 25 °C		-1	-	+1	%
		V_{IN} = $V_{OUT(NOM)}$+1 to 24 V, T_J = - 40 °C to 125 °C		-2	-	+2	
Δ_{VOUT}	Line regulation	V_{IN} = $V_{OUT(NOM)}$ +1 to 24 V to 24 V, I_{OUT} = 1 mA, T_J = -40 °C to 125 °C		-	0.001	0.004	%/V
Δ_{VOUT}	Load regulation	I_{OUT} = 100 µA to 85 mA, T_J = -40 °C to 125 °C		-	0.002	0.003	%/mA
V_{DROP}	Drop output voltage(2)	I_{OUT} = 85 mA, T_J = -40 °C to 125 °C		-	500	1000	mV
e_N	Output noise voltage(3)	200 Hz to 100 kHz, I_{OUT} = 50 mA, C_{OUT} = 10 µF, T_J =-40 °C to 125 °C		-	-	210	μV_{RMS}
SVR	Supply voltage rejection	V_{IN} = $V_{OUT(NOM)}$ +1 V +/- V_{RIPPLE}, V_{RIPPLE} = 0.2 V, I_{OUT} = 1 mA, C_{OUT} = 10 µF	f = 1 kHz	-	38	-	dB
		T_J = -40 °C to 125 °C	f = 100 kHz	-	57		
I_Q	Quiescent current	I_{OUT} = 0 mA to 85 mA, T_J = -40 °C to 125 °C		-	5	7	µA
			V_{IN} = 24 V	-	-	8.5	
I_{SC}	Short-circuit current	V_{OUT} = 0, T_J = -40 °C to 125 °C V_{IN} = $V_{OUT(NOM)}$ +1 to 24 V		120	-	-	mA
T_{ON}	Turn on time (4)	V_{IN} = $V_{OUT(NOM)}$ +1 to 24 V, C_{OUT} = 10 µF, I_{OUT} = 60 mA, T_J = -40 °C to 125 °C		-	0.7	-	ms
C_{OUT}	Output capacitor	Capacitance f = 100 kHz		0.47	-	-	µF

1. For $V_{OUT(NOM)}$ < 3.3 V, V_{IN} = 4.3 V.
2. Dropout voltage is the input-to-output voltage difference at which the output voltage is 100 mV below its nominal value.
3. Guaranteed by design.
4. 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.

a. For $V_{OUT(NOM)}$ < 3.3 V, V_{IN} = 4.3 V.

4.1 External capacitor requirements

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

The LDK715 requires an output capacitor connected between OUT and GND to stabilize the internal control loop. Please refer to *Figure 7*. for the allowable output capacitance and ESR combinations.

4.2 Power dissipation and junction temperature

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

The maximum power dissipation limit is given by the following equation:

Equation 1

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

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 by the following equation:

Equation 2

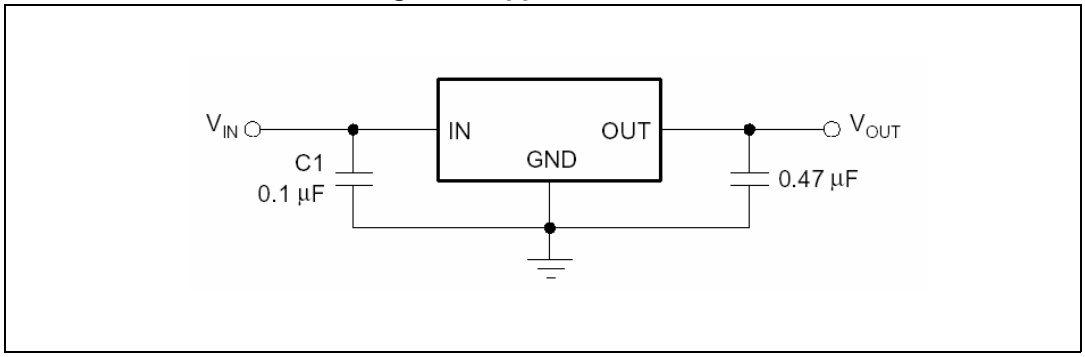
$$P_D = (V_{IN} - V_{out}) \times I_{out}$$

Power dissipation coming from quiescent current is negligible.

The ST715 features the internal current limit. During normal operation, it limits the output current to approximately 350 mA. When the current limit engages, the output voltage scales back linearly until the overcurrent condition ends. Do not exceed the power dissipation ratings of the package.

5 Typical application

Figure 3. Application circuit



6 Typical performance characteristics

Figure 4. Output voltage vs. temperature

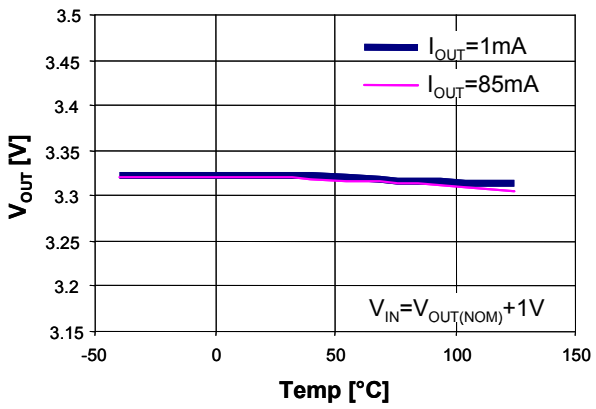


Figure 5. Output voltage vs. input voltage

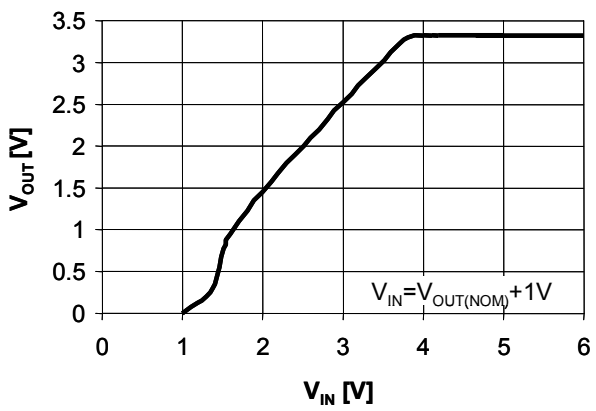


Figure 6. Dropout voltage vs. output current

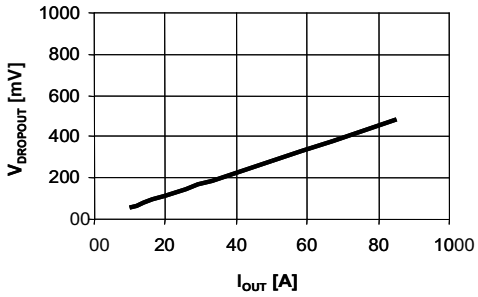
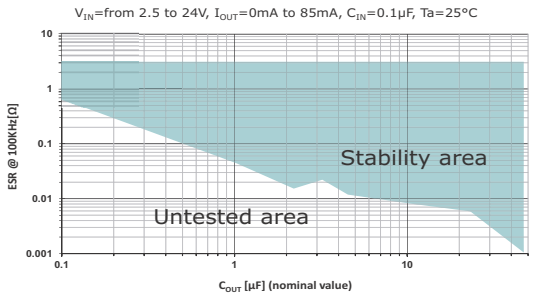


Figure 7. C_{OUT} stability region



GIPG220520131251RV

Figure 8. Supply voltage rejection vs. frequency

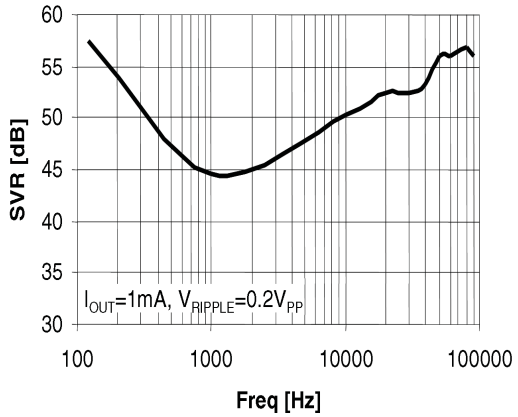


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Figure 9. Output noise voltage vs. frequency

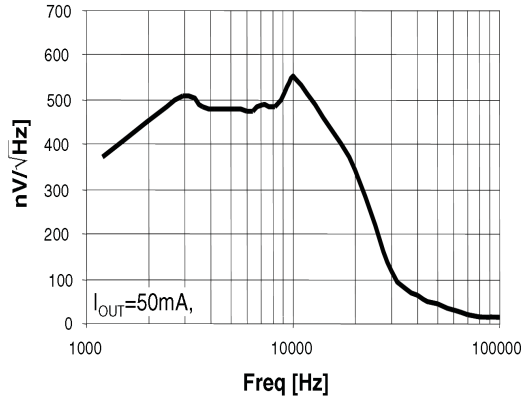

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Figure 10. Quiescent current vs. input voltage

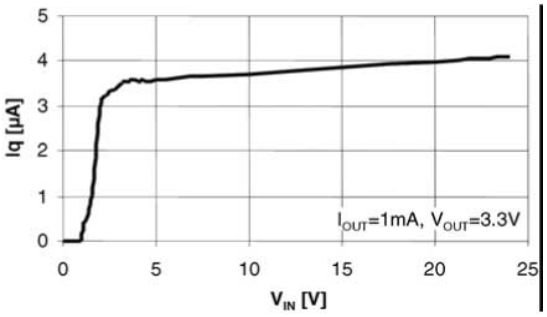

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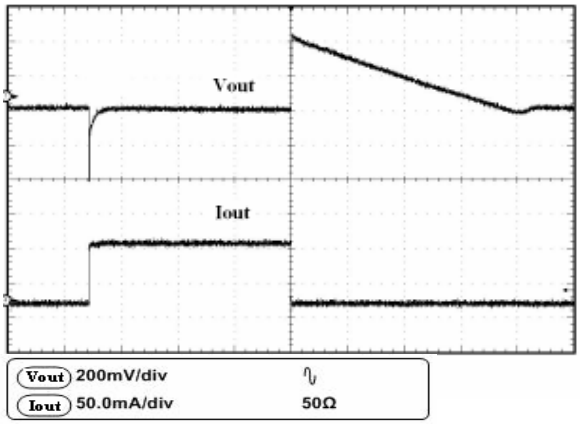
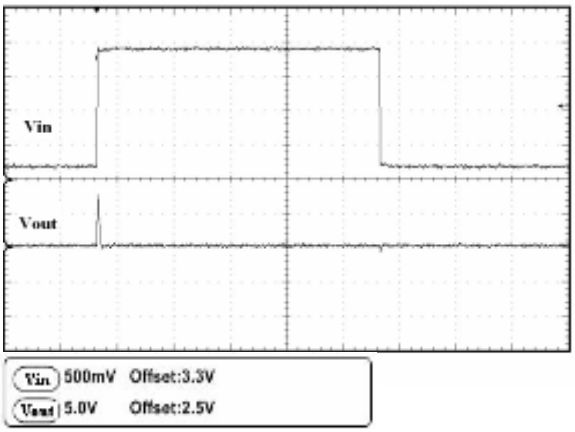
Figure 11. Load transient



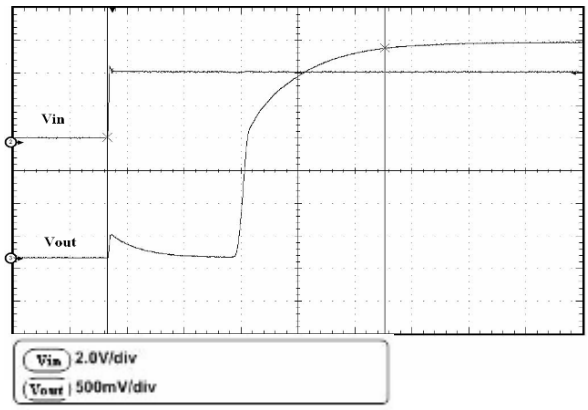
C_{IN} = C_{OUT} = 1 µF, V_{EN} = V_{IN} = 24 V, I_{OUT} = from 1 mA to 85 mA, t_R = t_F = 5 µS

Figure 12. Line transient



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

Figure 13. Enable transient



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

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 SOT23-5L package information

Figure 14. SOT23-5L package outline

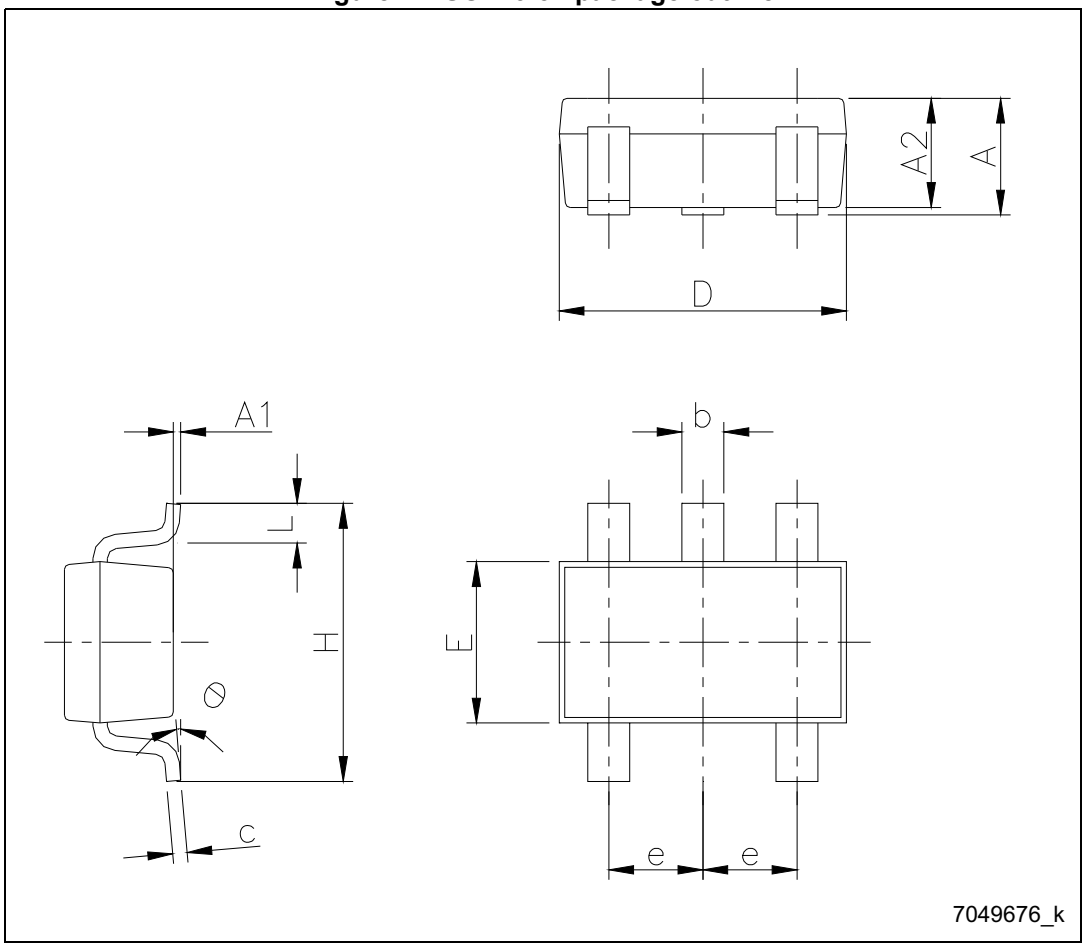
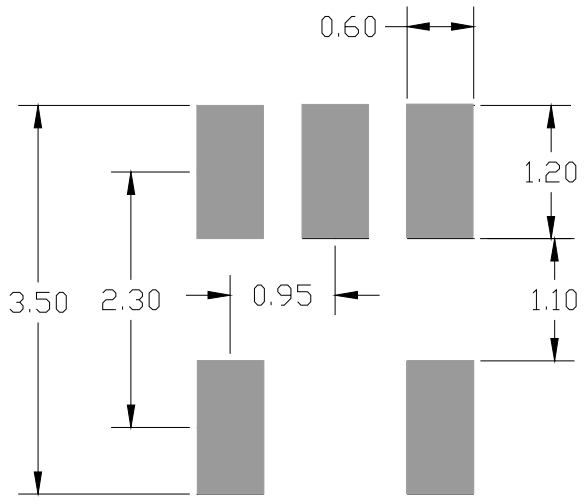


Table 7. SOT23-5L package mechanical data

Symbol	Dimensions (mm)		
	Min.	Typ.	Max.
A	0.90	-	1.45
A1	0.00	-	0.15
A2	0.90	-	1.30
b	0.30	-	0.50
c	0.009	-	0.20
D	2.80	2.95	3.05
E	1.50	1.60	1.75
e	-	0.95	-
H	2.60	2.80	3.00
L	0.30	-	0.60
q	0.00	-	8.00

Figure 15. SOT23-5L recommended footprint (dimensions in mm)



7.2 DFN8 3x3 package information

Figure 16. DFN8 3x3 package outline

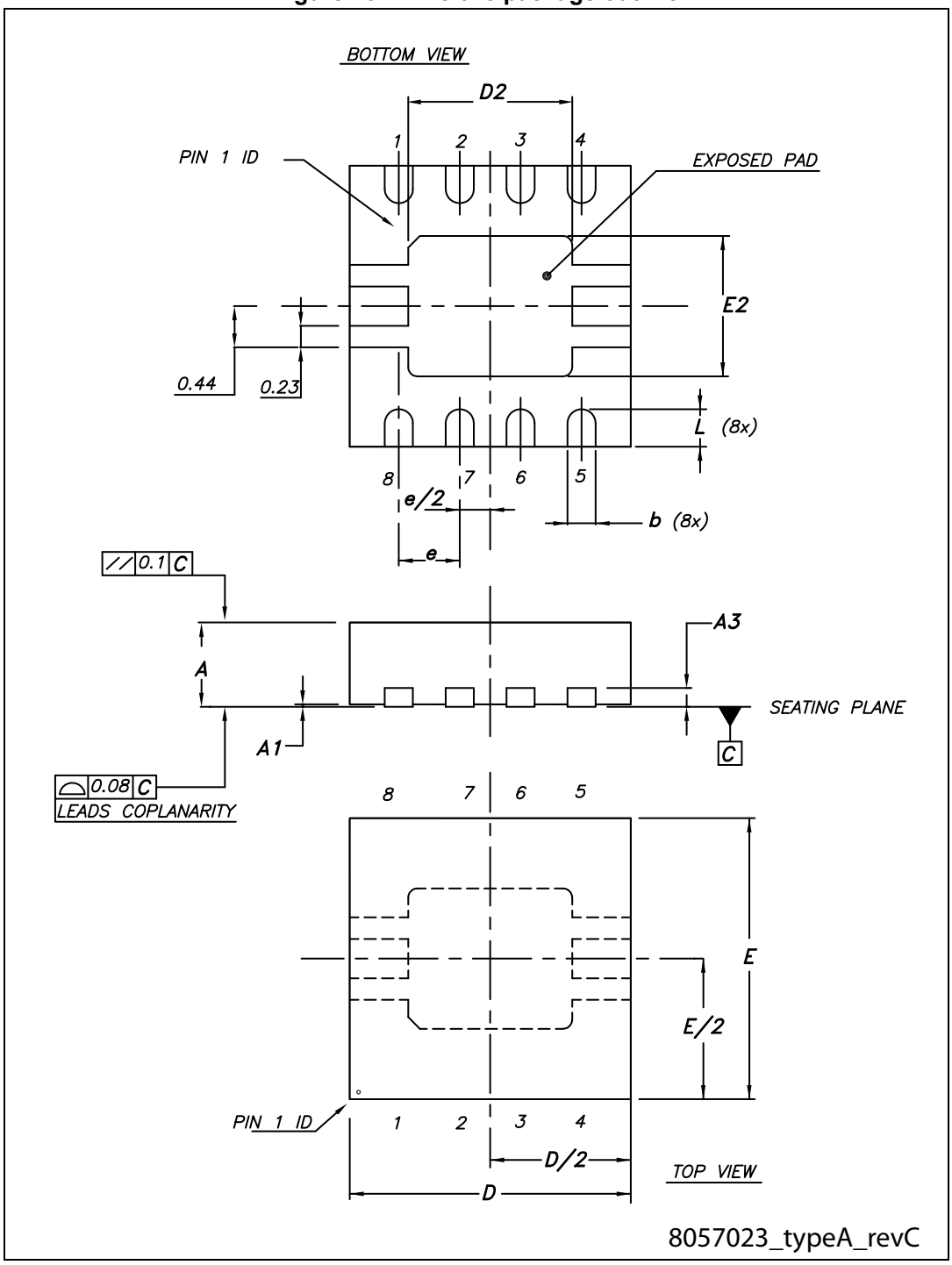
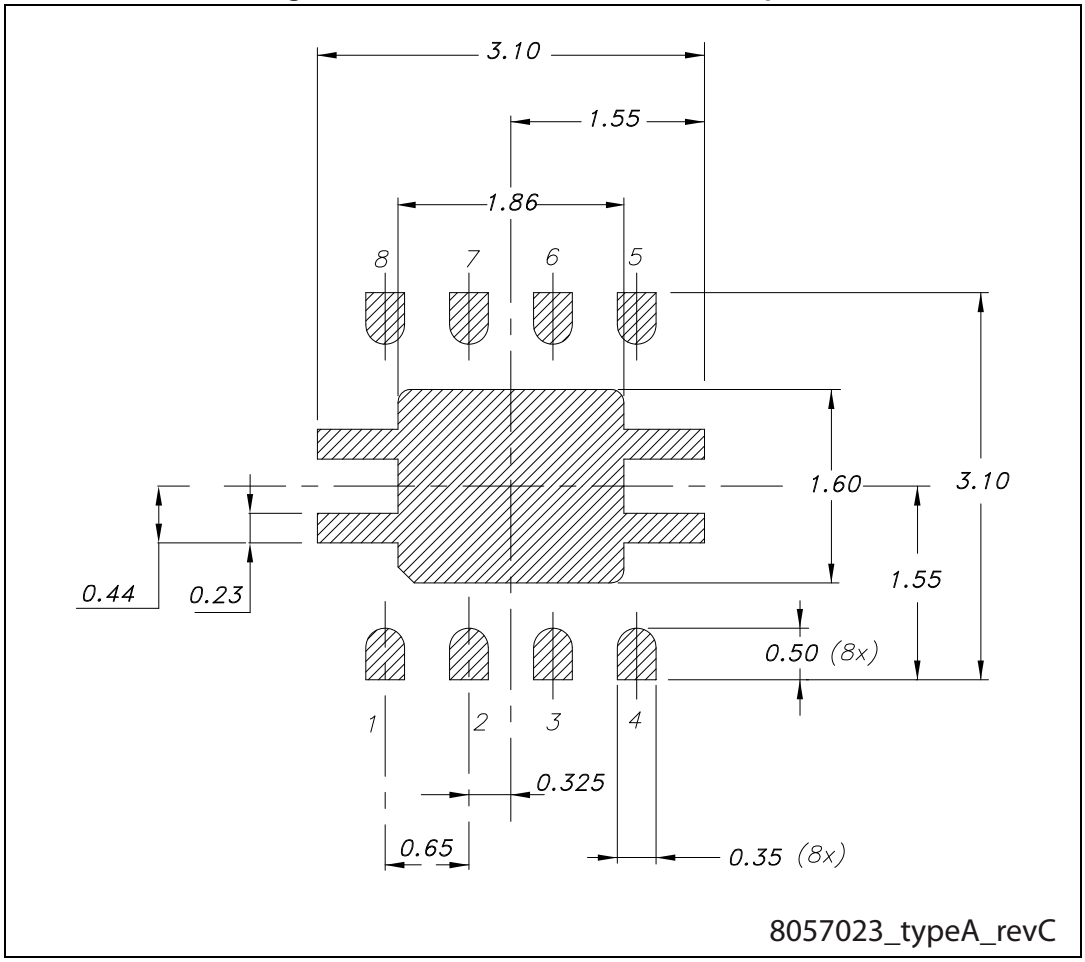


Table 8. DFN8 3x3 package mechanical data

Symbol	Dimensions (mm)		
	Min	Typ	Max.
A	0.80	0.90	1.00
A1	0.00	0.02	0.05
A3	-	0.20	-
b	0.25	0.30	0.35
D	2.85	3.00	3.15
D2	1.603	1.753	1.853
E	2.85	3.00	3.15
E2	1.345	1.495	1.595
e	0.00	0.65	-
L	0.30	0.40	0.50

Figure 17. DFN8 3x3 recommended footprint



8 Packaging information

8.1 Tape and reel SOT23-5L

Figure 18. SOT23-5L tape and reel drawing

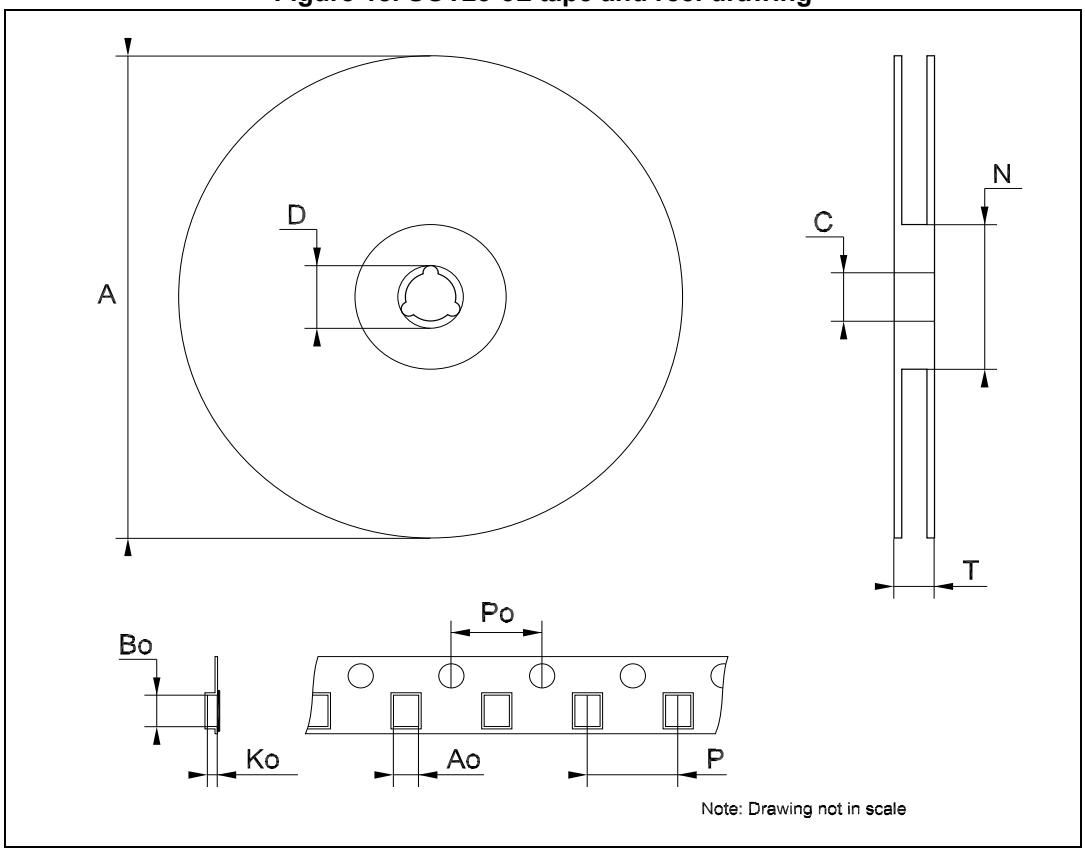
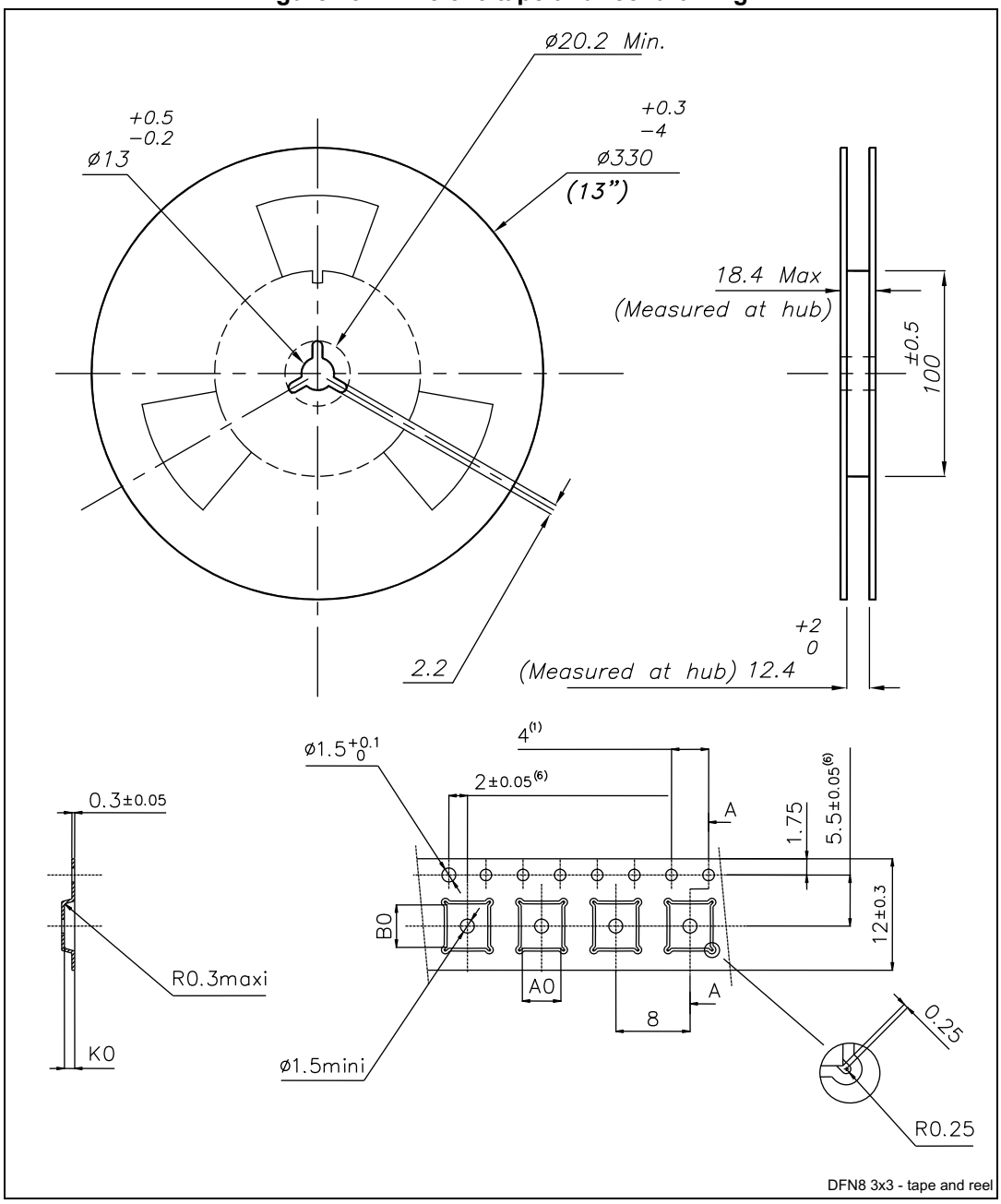


Table 9. SOT23-5L tape and reel mechanical data

Symbol	Dimensions (mm)		
	Min.	Typ.	Max.
A		-	180.00
C	12.80	13.00	13.20
D	20.20	-	-
N	60.00	-	-
T	-	-	14.40
Ao	3.13	3.23	3.33
Bo	3.07	3.17	3.27
Ko	1.27	1.37	1.47
Po	3.90	4.00	4.10
P	3.90	4.00	4.10

8.2 Tape and reel DFN8 3x3

Figure 19. DFN8 3x3 tape and reel drawing



1. 10 sprocket hole pitch cumulative tolerance ±0.2.
2. Camber not to exceed 1 mm in 100 mm.
3. Material: PS + C.
4. A0 and B0 measured as indicated.
5. K0 measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
6. Pocked position relative to sprocket hole measured as true position of pocket, not pocket hole.

Table 10. DFN8 3x3 tape and reel mechanical data

Symbol	Dimensions (mm)		
	Min.	Typ.	Max.
A	-	-	180.00
C	12.80	-	13.20
D	20.20	-	-
N	60.00	-	-
T	-	-	14.40
Ao	-	3.30	-
Bo	-	3.30	-
Ko	-	1.10	-
Po	-	4.00	-
P	-	8.00	-

9 Revision history

Table 11. Document revision history

Date	Revision	Changes
09-Jul-2014	1	Initial release.
28-Nov-2017	2	Updated *Table 1 on page 1* (removed references to note *1.* from LDK715M33R, LDK715PU33R, and LDK715PU42R). Added *Figure 19 on page 16*. Minor modifications throughout document.