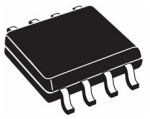
ST755C

Adjustable inverting negative output current mode PWM regulators

Features

- 2.7V to 11V input to adjustable negative output conversion
- 1W guaranteed output power (V_I > 4.5V, T_A ≤70°C)
- 68% typ. efficiency at 6V
- Very low quiescent current: 1.2mA in on mode, 10µA in shut down mode
- Soft start
- Very low noise output
- 160KHz fixed frequency oscillator
- Mixed bipolar-CMOS technology



SO-8

Description

The ST755 is an adjustable inverting switch-mode DC-DC regulator with internal Power MOSFET that generators an adjustable negative output from a voltage input of 2.7V to 11V, output current guaranteed at 200mA (for V_I > 4.5V, V_O = -5V and T_A = 0°C to 70°C) and 275mA (typical value at T_A = 25°C, V_O = -5V).

A logic controlled shut down pin that interfaces directly with microprocessor reduces supply current to only 10mA. Input to Output differential voltage is limited to V_I+|V_O|<12.7V. No load supply current is 1.2mA

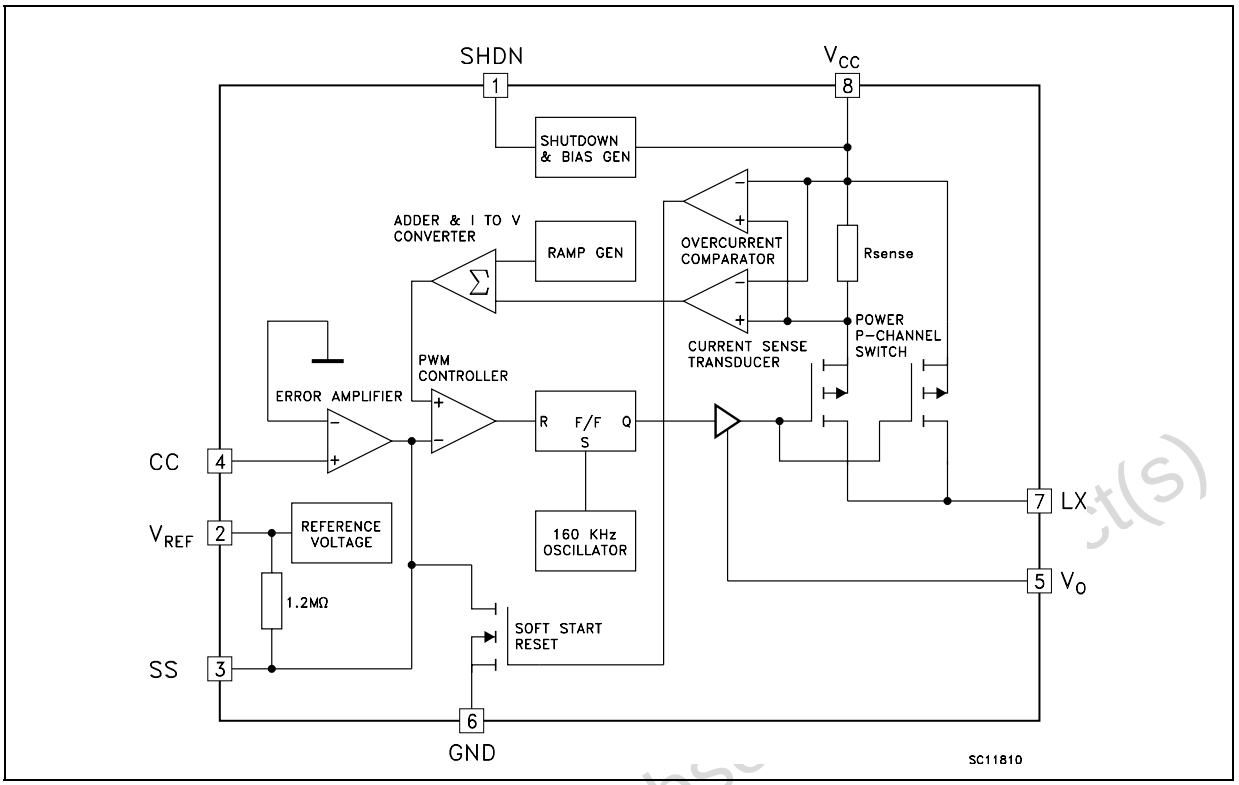
Table 1. Device summary

Part number	Package	Packaging
ST755C	ST755CD-TR	SO-8 (tape & reel)

Contents

1 Diagram

Figure 1. Schematic diagram



2 Pin configuration

Figure 2. Pin connections (top view)

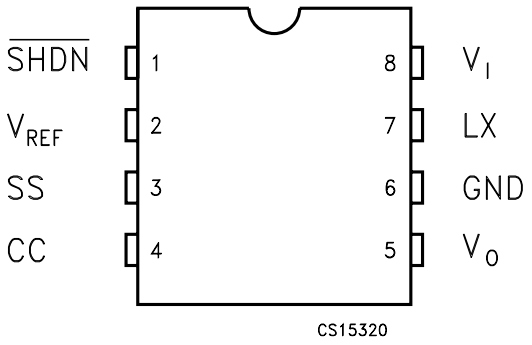


Table 2. Pin description

Pin N°	Symbol	Name and function
1	$\overline{SHDN}$	SHUT-DOWN control (V_{CC} = ON, GND = Shutdown)
2	V_{REF}	Reference output voltage: (1.25V)
3	SS	Soft start
4	CC	Compensation input
5	V_O	Negative output voltage
6	GND	Ground
7	LX	Switch output
8	V_{CC}	Supply voltage input

3 Maximum ratings

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	DC input voltage to GND (1)	-0.3 to 12	V
V_{SHDN}	Shutdown voltage, SS Voltage, CC Voltage	-0.3 to (V_{CC} + 0.3)	V
V_{LX}	Switch voltage (LX to V_{CC})	-12.5 to + 0.3	V
V_{FB}	Feedback voltage (V_O to GND)	-11 to + 0.9	V
I_{LX}	Peak switch current	2	A
P_{TOT}	Continuous power dissipation at T_A = 70°C (SO-8)	470	mW
T_{op}	Operating junction temperature range (C series)	-40 to 185	°C
T_{stg}	Storage temperature range	-55 to +150	°C

1. The input to output differential voltage is limited to $V_{CC}+|V_O|<12.7V$

Note: Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied

Table 4. Thermal data

Symbol	Parameter	SO-8	Unit
R_{thJA}	Thermal resistance junction-ambient (1)	160	°C/W

1. This value depends from thermal design of PCB on which the device is mounted.

4 Electrical characteristics

Table 5. Electrical characteristics (Refer to the test circuits, V_{CC} = 5V, V_O = -5.25 to -4.75V, I_{LOAD} = 0mA, $T_A = T_{MIN}$ to T_{MAX}, unless otherwise specified. Typical value are referred at T_A = 25°C)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_I	Input voltage		4		11	V
V_O	Output voltage	V_{CC} = 4.5 to 6.2V, I_O =0 to 200mA	4.75	5	5.25	V
I_O	Output current	V_{CC} = 4.5 to 6.2V, T_A = 0 to 70°C	200	275		mA
		V_{CC} = 4.5 to 6.2V, T_A = -40 to 85°C	175			
		V_{CC} = 4V, V_O = -5V		175		
		V_{CC} = 2.7V, V_O = -5V		125		
I_{SUPPLY}	Supply current (including switching current)	No Load, $V_{SHDN} = V_{CC}$		1.2	3.5	mA
I_{OFF}	Standby current)	No Load, V_{SHDN} = 0V		10	100	µA
I_{SC}	Short circuit current)			1.2		A
ΔV_O	Line regulation	V_{CC} = 4 to 6.2V		0.1		%/V
ΔV_O	Load regulation	I_O = 0 to 200mA		0.003		%/mA
V_{REF}	Reference voltage	T_A = 25°C	1.18	1.25	1.32	V
ΔV_{REF}	Reference drift	$T_A = T_{MIN}$ to T_{MAX}		50		ppm/°C
R_{DSON}	LX on resistance			0.7		Ω
I_{LEAK}	LX leakage current)	V_{DS} = 10V		1		µA
I_{SH}	Shutdown pin current)				1	µA
V_{IH}	SHDN input high threshold		2			V
V_{IL}	SHDN input low threshold				0.25	V
f_{OSC}	Oscillator frequency			160		KHz
h	Power efficiency	I_O =100mA		68		%
CC	Compensation pin impedance			7.5		KΩ

Note: Do not overload or short the Output to Ground. If the above conditions are observed, the device may be damaged.

5 Application information

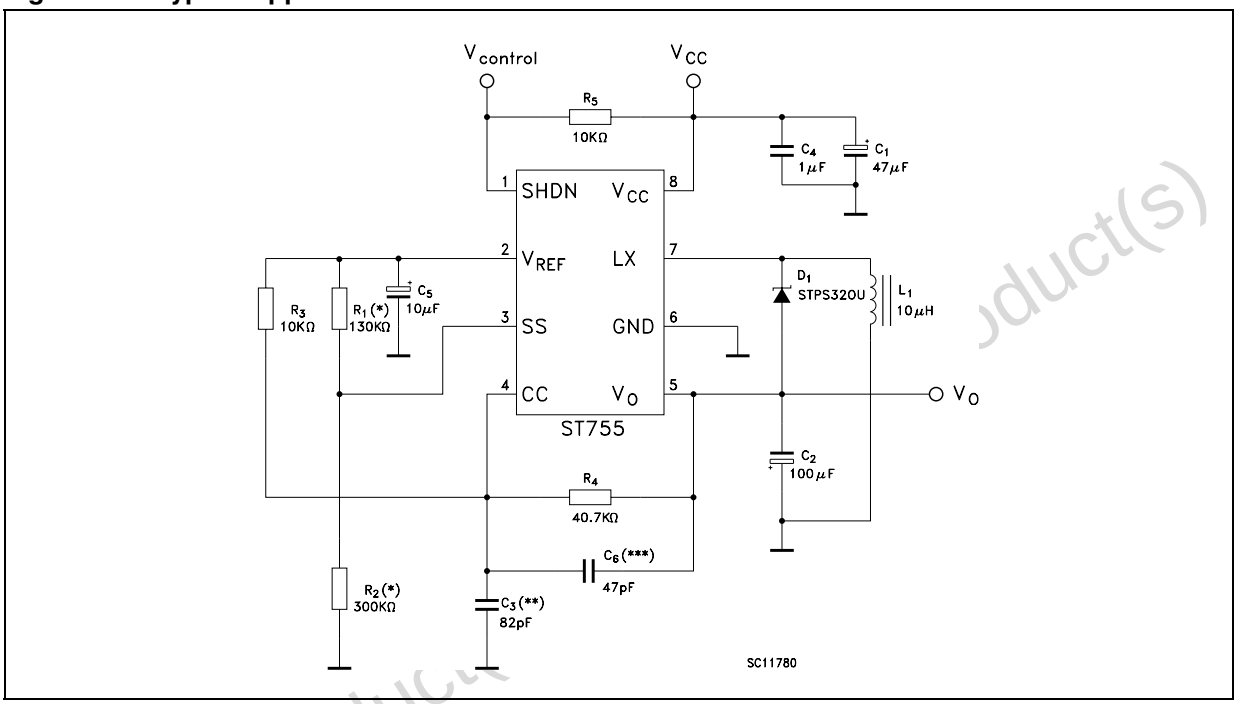
The ST755 is an IC developed for voltage conversion from an input voltage ranging from +2.4V to 11V to a regulated adjustable negative output limited by $|V_O| \leq 12.7V - V_I$. The circuit adopts a current-mode PWM control scheme to achieve good efficiency, high stability and low noise performance. The figure in the first page shown the detailed block diagram of the device.

ST755 is realized in a BCD technology in order to achieve high temperature stability, the best REFERENCE precision, a very low quiescent current and jitter free operations. The final stage is built around a 0.7Ω - 2A P-Channel Power MOS. A fraction of the output current is splitted out for current detection.Internal clock frequency is fixed to 160KHz. Error amplifier drives the PWM comparator in order to keep 0V on the CC input. So R_3 and R_4 resistors are calculated by the following formulae $R_4 = (|V_O|/V_{REF})*R_3$ (see *Figure 3.*). For R_3 can be choose any value between 2KΩ and 20KΩ Soft-Start (SS) input is a voltage dependent-output current limit (see *Figure 11.*, Switch Current Limit vs. SS Input Voltage). SS pin is internally pulled to V_{REF} through a 1.2 MΩ resistor. Applying an appropriate capacitor at SS input is possible to obtain a soft-start current imitation during power up. Forcing Soft-Start (SS) input to a lower voltage through a resistive voltage driver (R_1 and R_2), the maximum LX current limit can be lowered according the diagram showed in *Figure 11.* When SHDN input is low, the total current consumption is reduced to 10µA.

6 Application circuit

To achieve the best performances from switching power supply topology, particular care to layout drawing is needed, in order to minimize EMI and obtain low noise, jitter free operation moreover, it ensures the full device functionality. Layout design proposed on demoboard (see *Figure 4.*) helps to lower the developing time. Wire lengths must be minimized, filter and by-pass capacitors C_1, C_2 and C_3 must be low ESR type, placed as close possible to the integrated circuit. The 10µH inductor must be chosen built on a core, taking care that saturation current should be higher than the peak LX switch current. See the Peak inductor current vs. load current graph (*Figure 6.*).

Figure 3. Typical application circuit

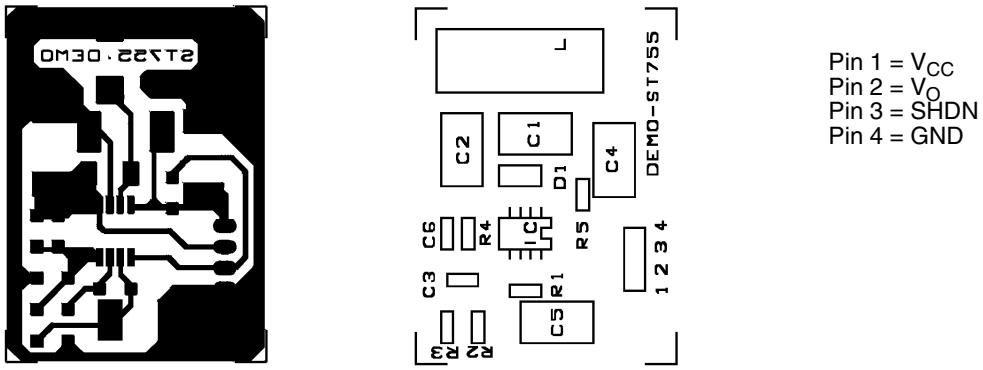


(*) R1 and R2 can be omitted for I_O<200mA.

(**) C6: Very low noise but poor transient and load response speed.

(***) C3 (alternative to C6): faster transient and load response.

Figure 4. Printed demoboard



Note: Drawings not in scale

Table 6. Component values

Capacitor	Value	Unit	Resistor	Value	Unit
C1	47	µF	R1	130	KΩ
C2	100	µF	R2	300	KΩ
C3	82	pF	R3	10	KΩ
C4	1	µF	R4	40.7	KΩ
C5	10	µF	R5	10	KΩ
C6	47	pF			

7 Typical performance characteristics

(Unless otherwise specified T_J = 25°C)

Figure 5. Load current vs supply voltage

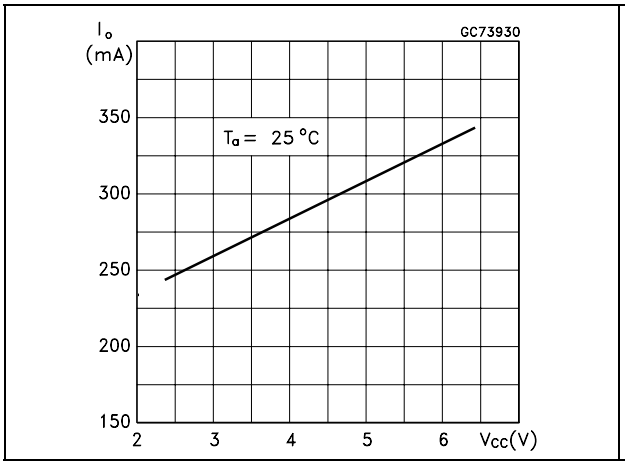


Figure 6. Peak inductor current vs load curr.

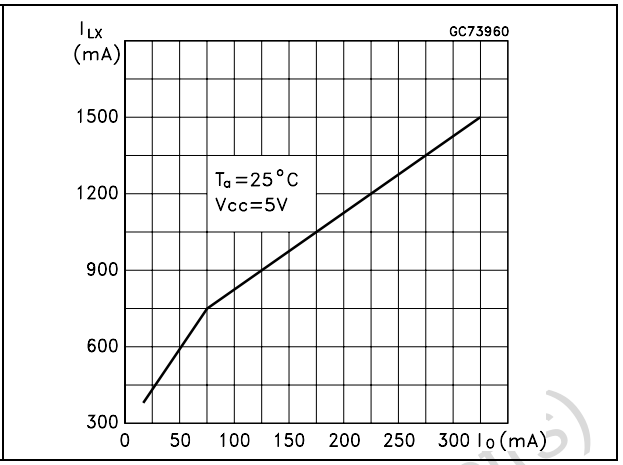


Figure 7. Load current vs supply voltage

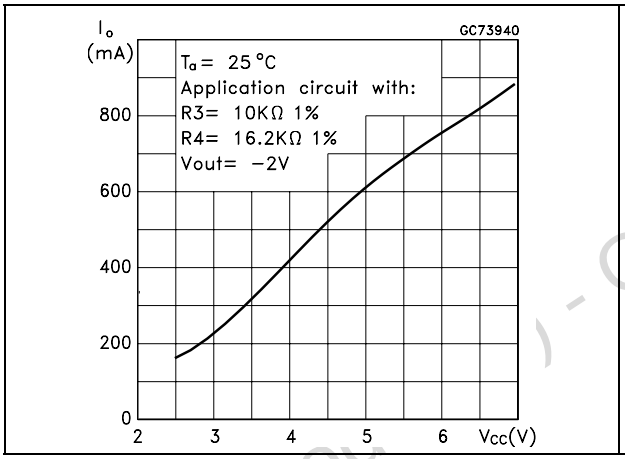


Figure 8. Switch ON resist. vs supply voltage

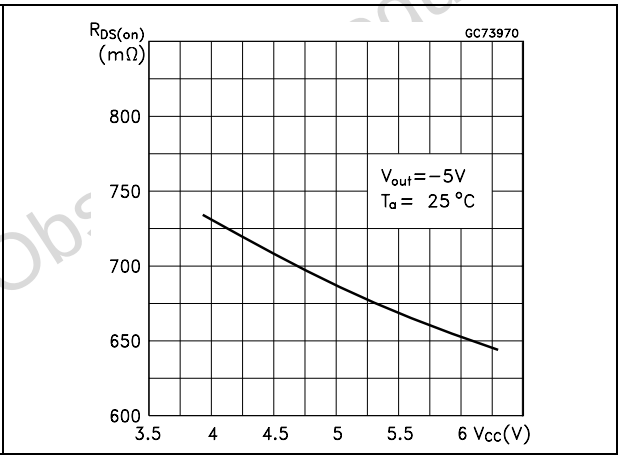


Figure 9. Efficiency vs load current

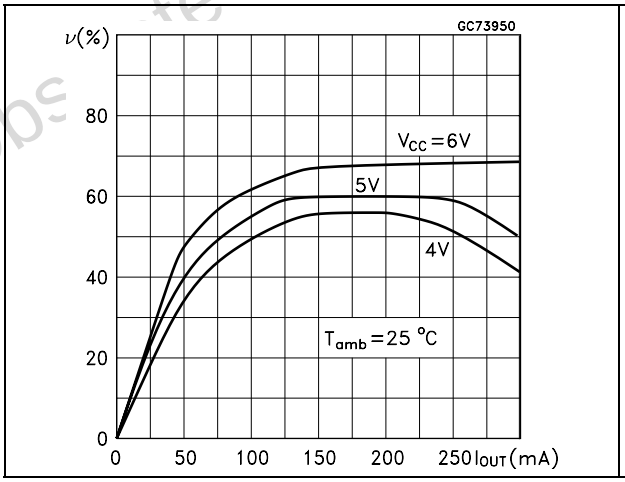


Figure 10. Oscillator frequency vs temperature & supply voltage

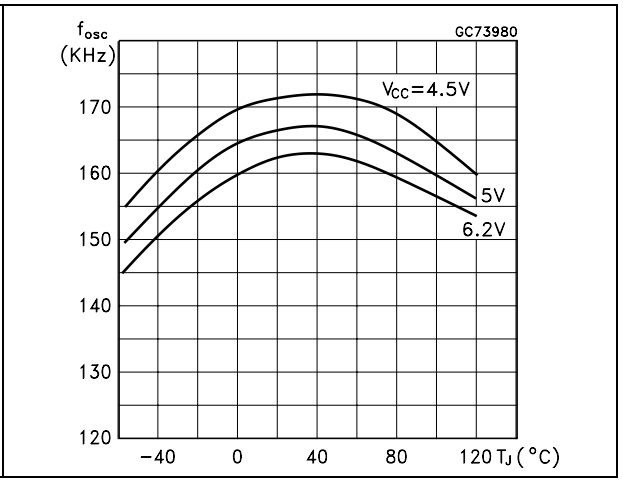


Figure 11. Switch current limit vs soft start voltage

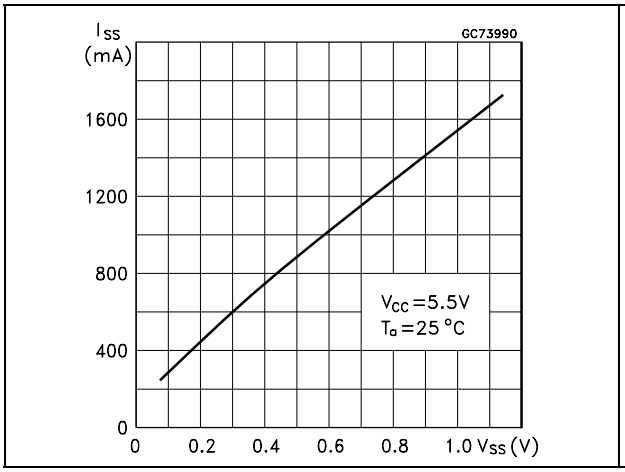


Figure 12. Reference voltage vs temperature

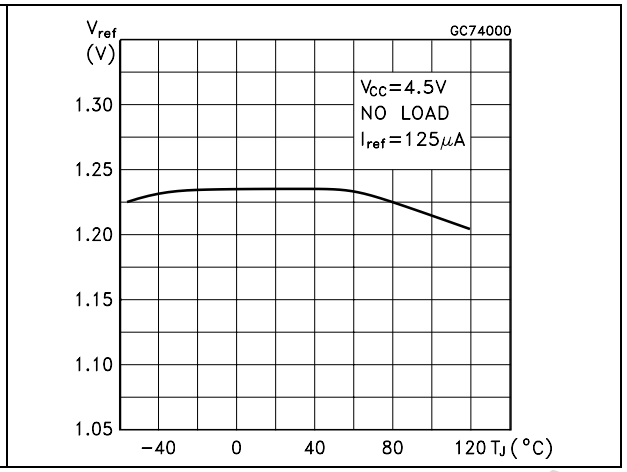
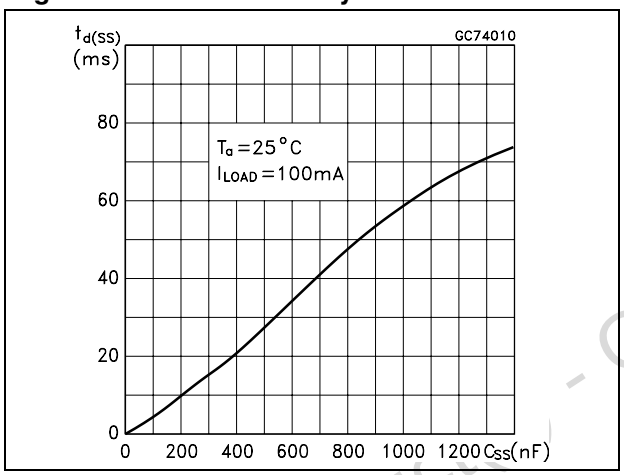


Figure 13. Soft start delay time

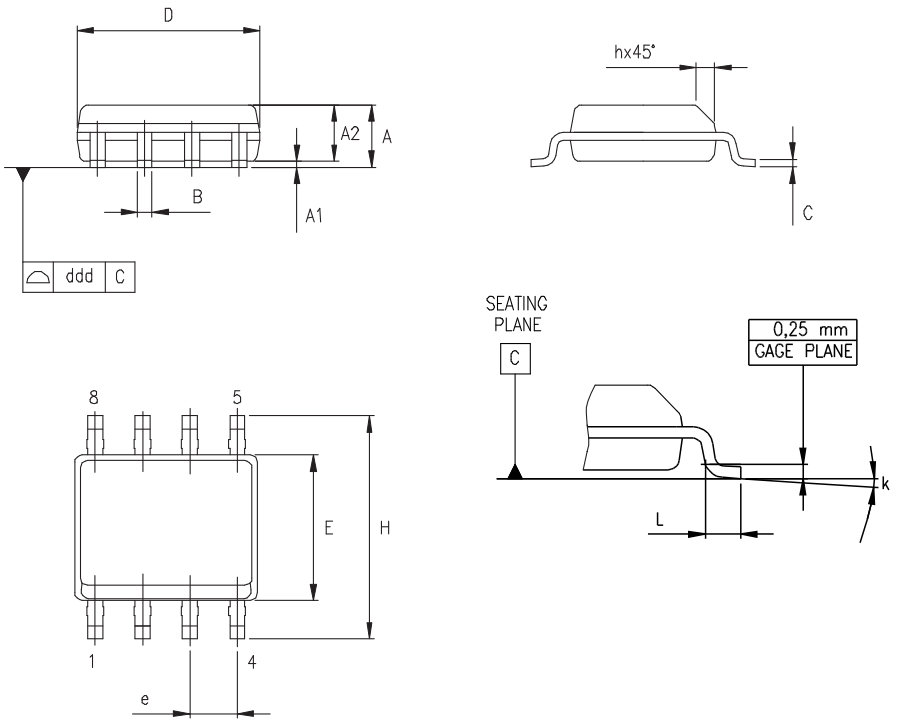


8 Package mechanical data

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.

SO-8 MECHANICAL DATA

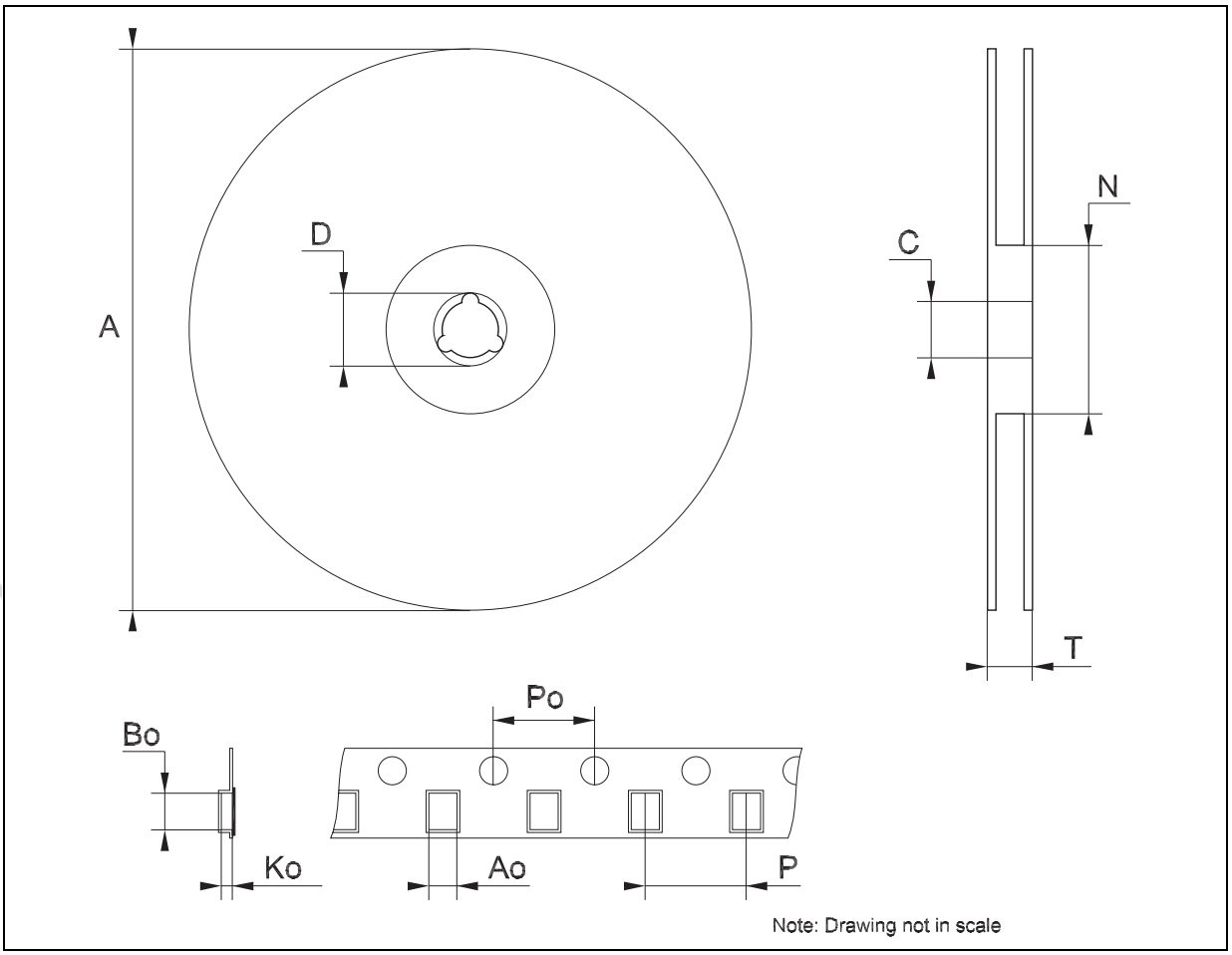
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	8° (max.)					
ddd			0.1			0.04



0016023/C

Tape & Reel SO-8 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	8.1		8.5	0.319		0.335
Bo	5.5		5.9	0.216		0.232
Ko	2.1		2.3	0.082		0.090
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



Note: Drawing not in scale

9 Revision history

Table 7. Revision history

Date	Revision	Changes
06-Jul-2007	5	Device summary updated and the document has been reformatted.

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