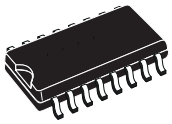
STPIC6C595

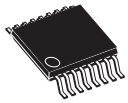
Power logic 8-bit shift register

Features

- Low $R_{DS(on)}$: 4 Ω typ
- 30 mJ avalanche energy
- Eight 100 mA DMOS outputs
- 250 mA current limit capability
- 33 V output clamp voltage
- Device are cascadable
- Low power consumption



SO-16



TSSOP16

Description

This STPIC6C595 is a monolithic, medium-voltage, low current power 8-bit shift register designed for use in systems that require relatively moderate load power such as LEDs. The device contains a built-in voltage clamp on the outputs for inductive transient protection. Power driver applications include relays, solenoids, and other low-current or medium-voltage loads.

The device contains an 8-bit serial-in, parallel-out shift register that feeds an 8-bit D-type storage register. Data transfers through both the shift and storage register clock (SRCK) and the register clock ($\overline{RCK}$), respectively. The device transfers data out the serial output (SER OUT) port on the rising edge of SRCK. The storage register transfers data to the output buffer when shift register clear (CLR) is high. When $\overline{CLR}$ is low, the input shift register is cleared. When output enable ($\overline{G}$) is held high, all data in the output buffer is held low and all drain output are off. When G is held low, data from the storage register is transparent to the output buffer.

When data in the output buffers is low, the DMOS transistor outputs are off. When data is high, the DMOS transistor outputs have sink-current capability. The SER OUT allows for cascading of the data from the shift register to additional devices.

Output are low-side, open-drain DMOS transistors with output ratings of 33 V and 100 mA continuous sink-current capability. Each output provides a 250 mA maximum current limit at T_C = 25 °C. The current limit decreases as the junction temperature increases for additional device protection. The device also provides up to 1.5 kV of ESD protection when tested using the human-body model and 150 V machine model.

The STPIC6C595 is characterized for operation over the operating case temperature range of -40 °C to 125 °C.

Table 1. Device summary

Order codes	Package	Packaging
STPIC6C595MTR	SO-16 (Tape and reel)	2500 parts per reel
STPIC6C595TTR	TSSOP16 (Tape and reel)	2500 parts per reel

Contents

1 Logic symbol and pin configuration

Figure 1. Logic symbol and pin configuration

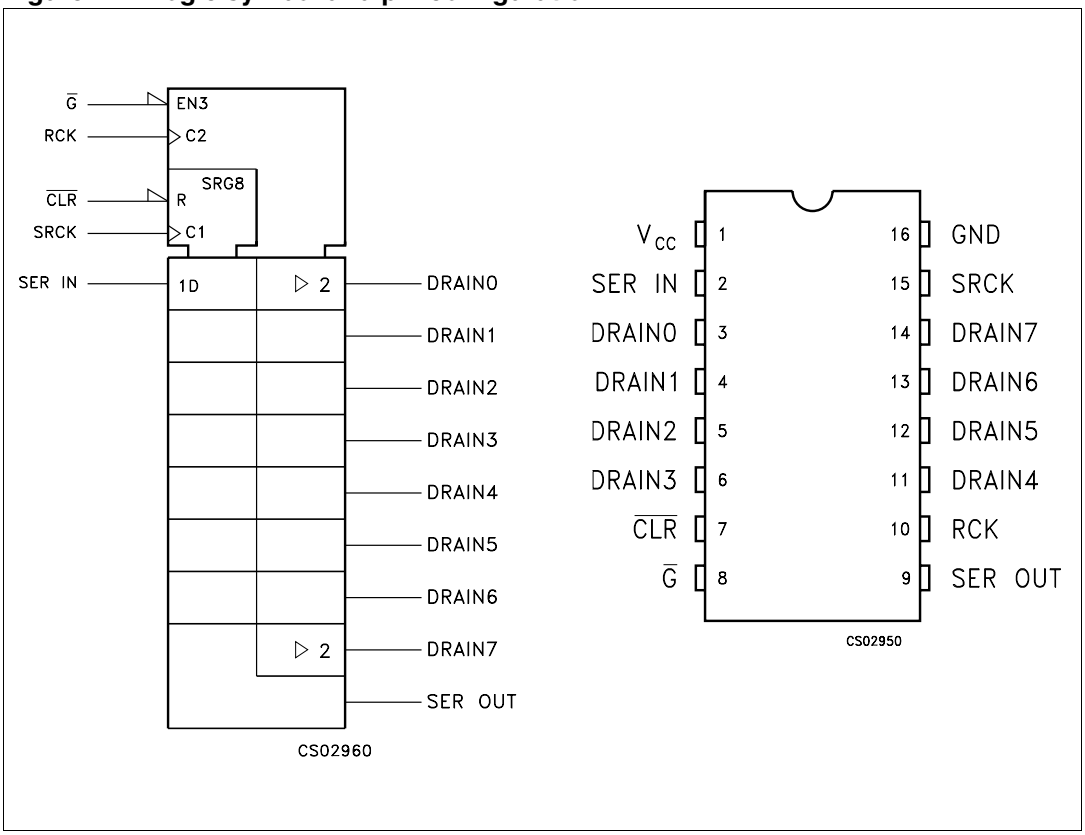
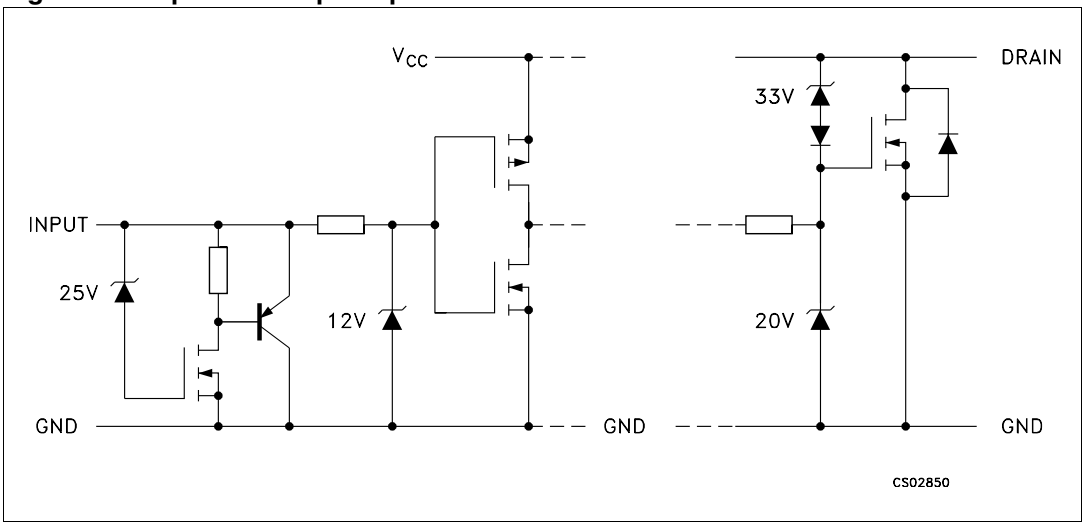


Figure 2. Input and output equivalent circuits



2 Maximum rating

Stressing the device above the rating listed in the “absolute maximum ratings” table may cause permanent damage to the device. These are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

2.1 Absolute maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Logic supply voltage (See *Note 1*)	7	V
V_I	Logic input voltage range	-0.3 to 7	V
V_{DS}	Power DMOS drain to source voltage (See *Note 2*)	33	V
I_{DS}	Continuous source to drain diode anode current	250	mA
I_{DS}	Pulsed source to drain diode anode current (See *Note 3*)	500	mA
I_D	Pulsed drain current, each output, all output ON (T_C = 25 °C)	250	mA
I_D	Continuous current, each output, all output ON (T_C = 25 °C)	100	mA
I_D	Peak drain current single output (T_C = 25 °C) (See *Note 3*)	250	mA
E_{AS}	Single pulse avalanche energy (See *Figure 11* and *Figure 12*)	30	mJ
I_{AS}	Avalanche current (See *Note 4* and *Figure 17*)	200	mA
P_d	Continuous total dissipation ($T_C \leq$ 25 °C)	1087	mW
P_d	Continuous total dissipation (T_C = 125 °C)	217	mW
T_J	Operating virtual junction temperature range	-40 to +150	°C
T_C	Operating case temperature range	-40 to +125	°C
T_{stg}	Storage temperature range	-65 to +150	°C
T_L	Lead temperature 1.6 mm (1/16 inch) from case for 10 seconds	260	°C

2.2 Thermal data

Table 3. Thermal data

Symbol	Parameter	Value	Unit
$R_{th(JA)}$	Thermal resistance junction-ambient	115	°C/W

2.3 Recommended operating conditions

Table 4. Recommended operating conditions

Symbol	Parameter	Min	Typ	Max	Unit
V_{CC}	Logic supply voltage	4.5		5.5	V
V_{IH}	High level input voltage	$0.85V_{CC}$		V_{CC}	V
V_{IL}	Low level input voltage	0		$0.15V_{CC}$	V
I_{DP}	Pulse drain output current (T_C = 25 °C, V_{CC} = 5 V, all outputs ON) (see *Note 3*, *Note 5* and *Figure 15*)			250	mA
t_{su}	Set-up time, SER IN high before SRCK ↑ (see *Figure 4* and *Figure 8*)	1.6	3.0	5.7	ns
t_{hL}	Hold time, SER IN high before $\overline{G}$ ↑ (see *Figure 4*, *Figure 7*, *Figure 8*)	2.8	4.0	9.6	ns
t_W	Pulse duration (see *Figure 8*)	40			ns
T_C	Operating case temperature	-40		125	°C

3 Electrical characteristics

3.1 DC characteristics

Table 5. DC characteristics (V_{CC} = 5 V, T_C = 25 °C, unless otherwise specified.)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$V_{(BR)DSX}$	Drain-to-source breakdown voltage	I_D = 1 mA	33	37		V
V_{SD}	Source-to-drain diode forward voltage	I_F = 100 mA		0.85	1.2	V
V_{OH}	High level output voltage SER OUT	I_{OH} = -20 µA, V_{CC} = 4.5 V	4.4	4.49		V
		I_{OH} = -4 mA, V_{CC} = 4.5 V	4	4.2		V
V_{OL}	Low level output voltage SER OUT	I_{OH} = 20 µA, V_{CC} = 4.5 V		0.005	0.1	V
		I_{OH} = 4 mA, V_{CC} = 4.5 V		0.3	0.5	V
I_{IH}	High level input current	V_{CC} = 5.5 V, V_I = V_{CC}			1	µA
I_{IL}	Low level input current	V_{CC} = 5.5 V, V_I = 0			-1	µA
I_{CC}	Logic supply current	V_{CC} = 5.5 V, all outputs OFF or ON		20	200	µA
$I_{CC(FRQ)}$	Logic supply current at frequency	f_{SRCK} = 5 MHz, C_L = 30 pF All outputs OFF (See *Figure 6*, *Figure 18* and *Figure 19*)		0.2	2	mA
I_N	Nominal current	$V_{DS(on)}$ = 0.5 VI_N = I_D T_C = 85 °C (See *Note 5*, *Note 6*, *Note 7*)		90		mA
I_{DSX}	Off-state drain current	V_{DS} = 30 V, V_{CC} = 5.5 V		0.3	5	µA
		V_{DS} = 30 V, V_{CC} =5.5 V or 0 V T_C = 125 °C		0.6	8	µA
$R_{DS(on)}$	Static drain source on state resistance (See *Note 5*, *Note 6* and *Figure 14*, *Figure 16*)	I_D = 50 mA, V_{CC} = 4.5 V		4.5	6	Ω
		I_D = 50 mA, V_{CC} = 4.5 V T_C = 125 °C		6.5	9	Ω
		I_D = 100 mA, V_{CC} = 4.5 V		4.5	6	Ω

3.2 Switching characteristics

Table 6. Switching characteristics (V_{CC} = 5 V, T_C = 25 °C, unless otherwise specified.)

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
t_{PHL}	Propagation delay time, high to low level output from $\overline{G}$	C_L = 30 pF, I_D = 75 mA (See *Figure 4*, *Figure 5*, *Figure 6*, *Figure 7*, *Figure 20*)		80		ns
t_{PLH}	Propagation delay time, low to high level output from $\overline{G}$			130		ns
t_r	Rise time, drain output			60		ns
t_f	Fall time, drain output			50		ns
t_{pd}	propagation delay time			20		ns
t_a	Reverse recovery current rise time	I_F = 100 mA, di/dt = 10 A/µs (See *Figure 5*, *Figure 6*, and *Figure 9*, *Figure 10*)		39		ns
t_{rr}	Reverse recovery time			115		ns

Note: 1 All voltage value are with respect to GND

2 Each power DMOS source is internally connected to GND

3 Pulse duration ≤ 100 µs and duty cycle ≤ 2 %

4 Drain supply voltage = 15 V, starting junction temperature (T_{JS}) = 25 °C. L = 1.5 H and I_{AS} = 200 mA (see Fig. 11 and 12)

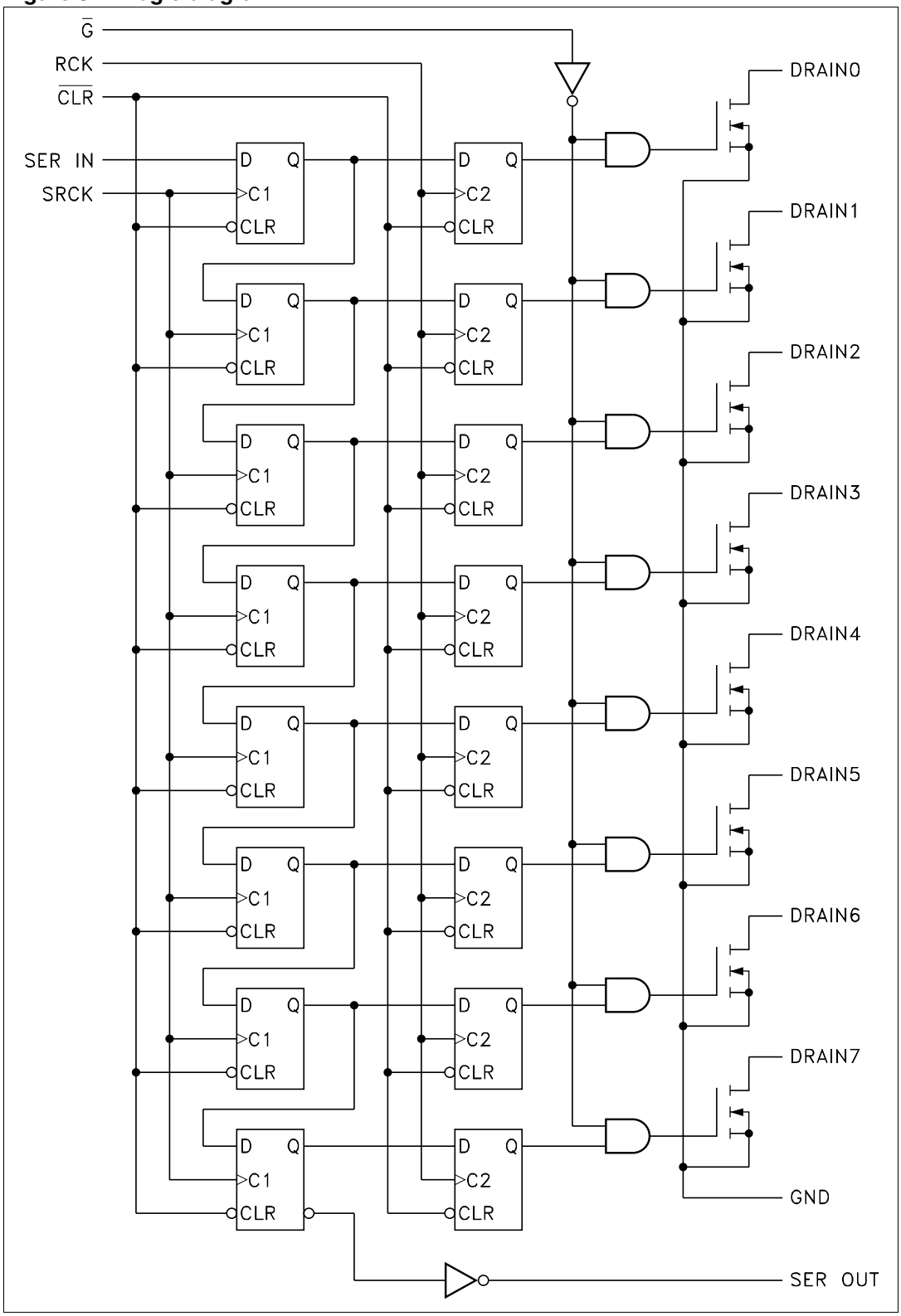
5 Technique should limit T_J - T_C to 10 °C maximum

6 These parameters are measured with voltage sensing contacts separate from the current-carrying contacts.

7 Nominal current is defined for a consistent comparison between devices from different sources. It is the current that produces a voltage drop of 0.5 V at T_C = 85 °C.

4 Logic diagram

Figure 3. Logic diagram



5 Typical operating circuit

Figure 4. Typical operation mode test circuits

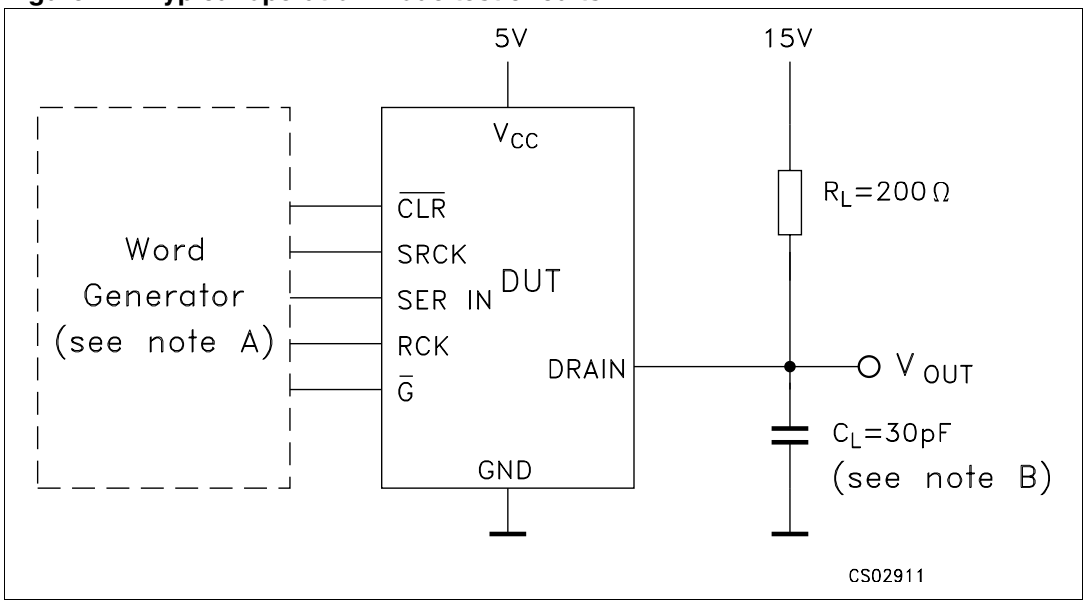
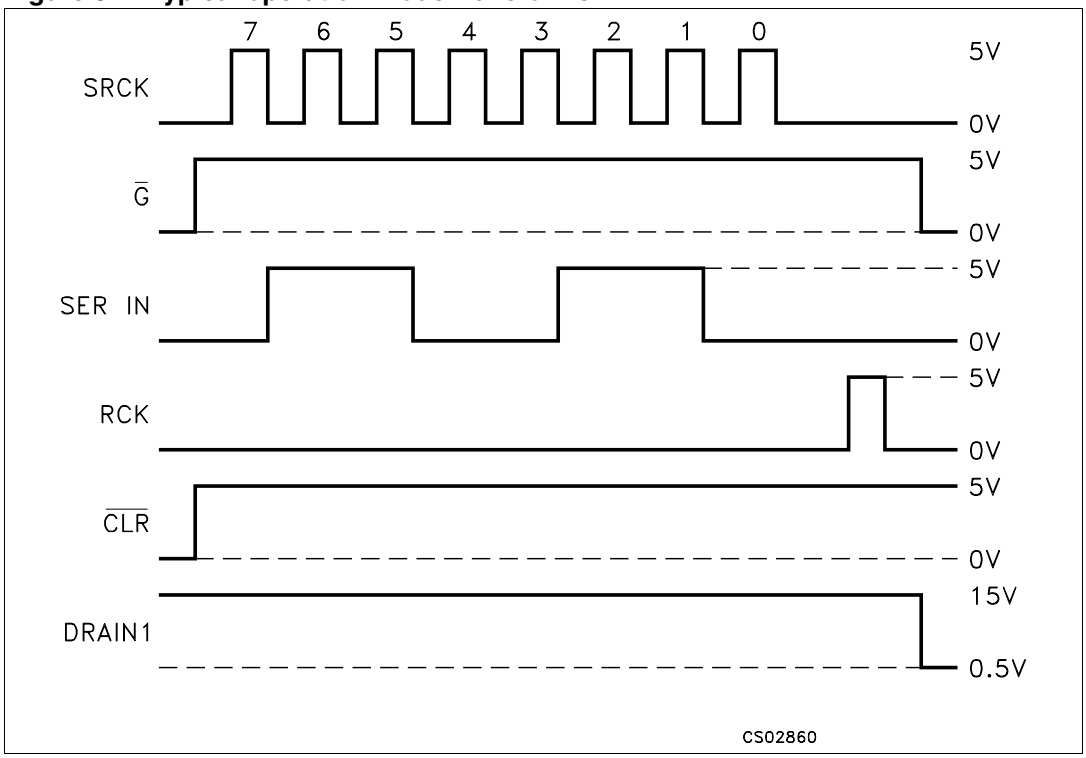


Figure 5. Typical operation mode waveforms



Note: 1 A) The word generator has the following characteristics: $t_r \leq 10$ ns, $t_f \leq 10$ ns, $t_W = 300$ ns, pulse repetition rate (PRR) = 5 kHz, $Z_O = 50\ \Omega$

2 B) C_L includes probe and jig capacitance.

Figure 6. Typical operation mode test circuits

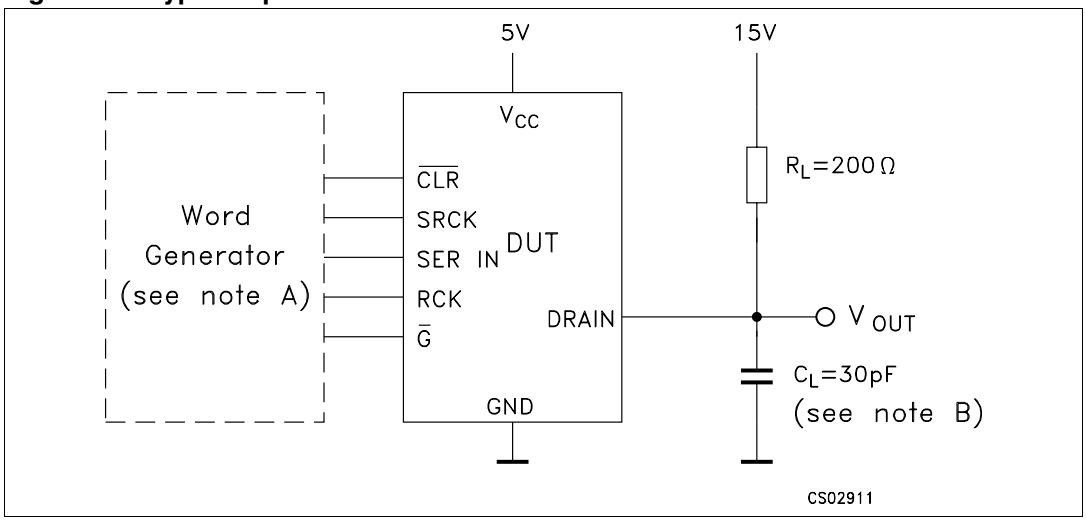


Figure 7. Switching time waveform

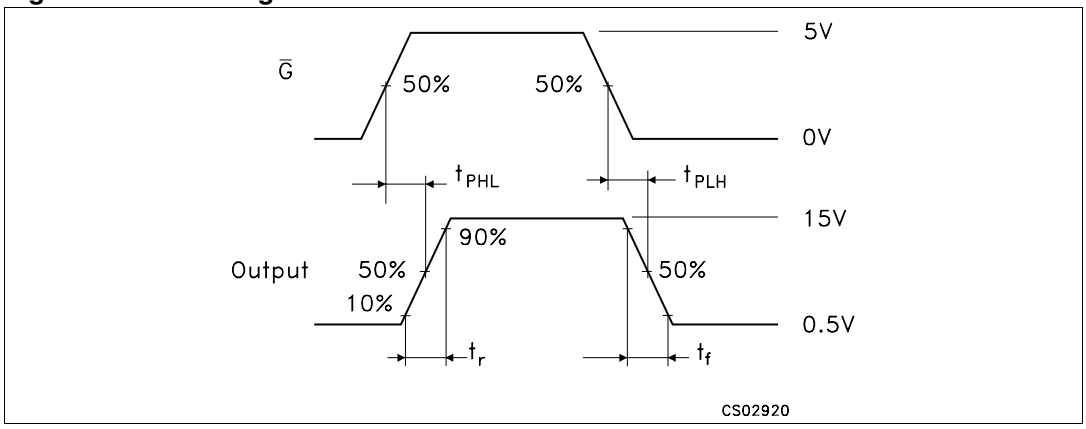
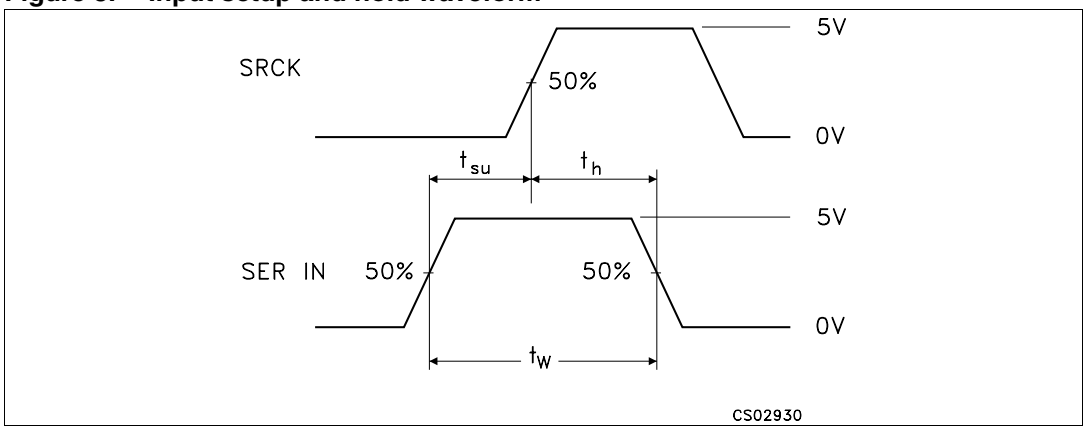


Figure 8. Input setup and hold waveform



Note: 1 A) The word generator has the following characteristics: $t_r \leq 10$ ns, $t_f \leq 10$ ns, $t_W = 300$ ns, pulse repetition rate (PRR) = 5 kHz, $Z_O = 50\ \Omega$

2 B) C_L includes probe and jig capacitance.

Figure 9. Reverse recovery current test circuits

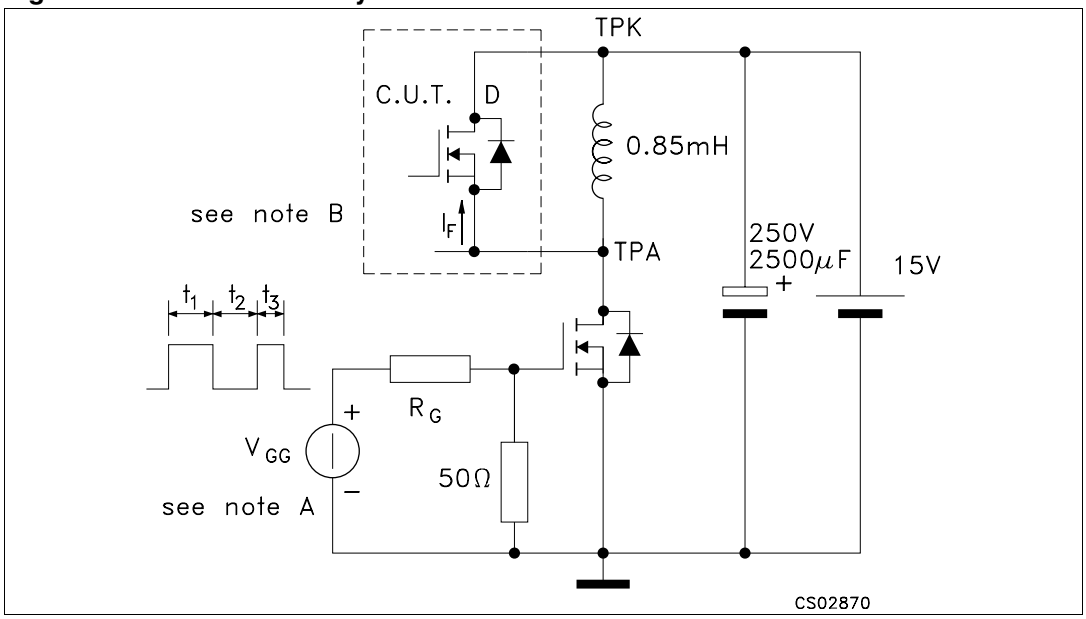
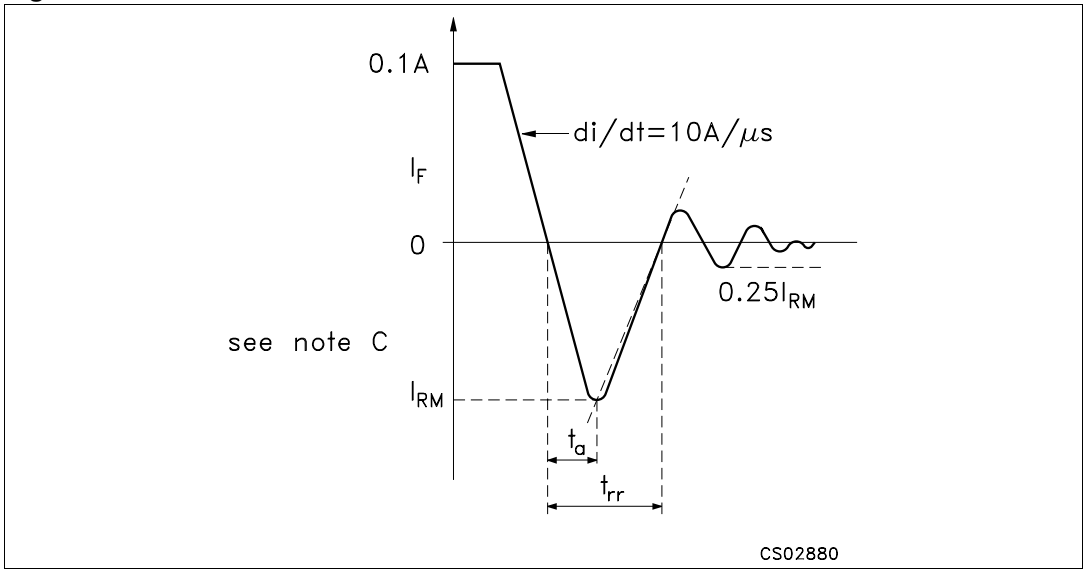


Figure 10. Source drain diode waveform



Note: 1 A) The V_{GG} amplitude and R_G are adjusted for di/dt = 10 A/µs. A V_{GG} double-pulse train is used to set I_F = 0.1 A. where t_1 = 10 µs, t_2 = 7 µs and t_3 = 3 µs

2 B) The drain terminal under test is connected to the TPK test point. All other terminals are connected together and connected to the TPA test point.

3 C) I_{RM} = maximum recovery current.

Figure 11. Single pulse avalanche energy test circuits

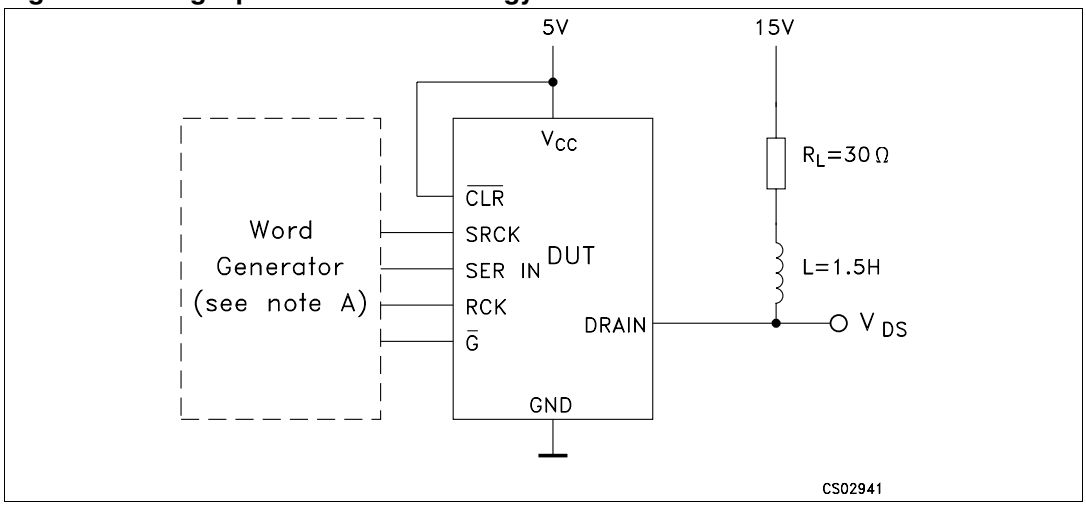
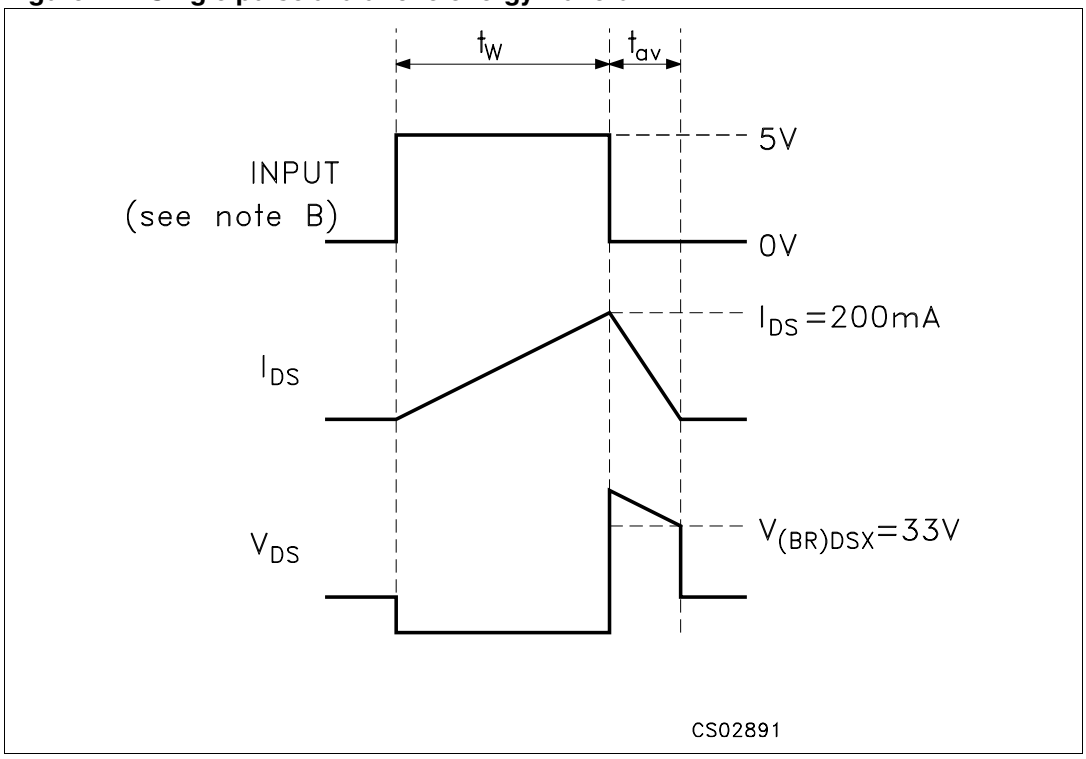


Figure 12. Single pulse avalanche energy waveform



Note: 1 A) The word generator has the following characteristics: $t_r \leq 10$ ns, $t_f \leq 10$ ns, $Z_O = 50\ \Omega$

2 B) Input pulse duration, t_W is increased until peak current I_{AS} = 200 mA. Energy test level is defined as $E_{AS} = (I_{AS} \times V_{(BR)DSX} \times t_{AV})/2$ = 30 mJ.

6 Typical performance and characteristics

(unless otherwise specified T_J = 25 °C)

Figure 13. Max continuous drain current vs number of outputs conducting simultaneously

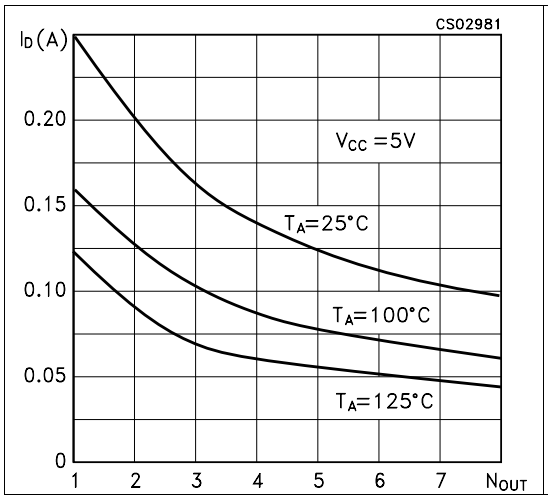


Figure 14. Static drain-source on-state resistance vs drain current

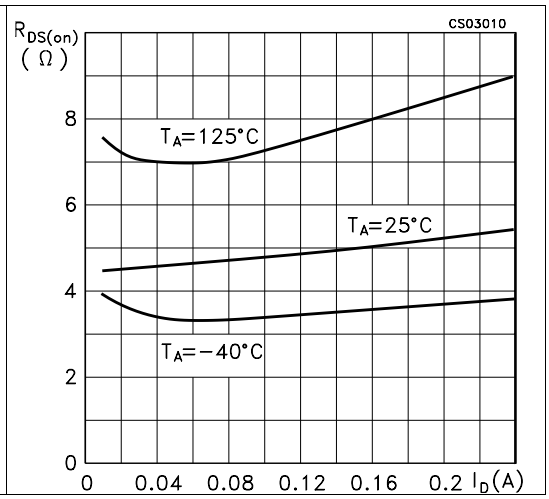


Figure 15. Maximum peak drain current vs number of outputs conducting simultaneously

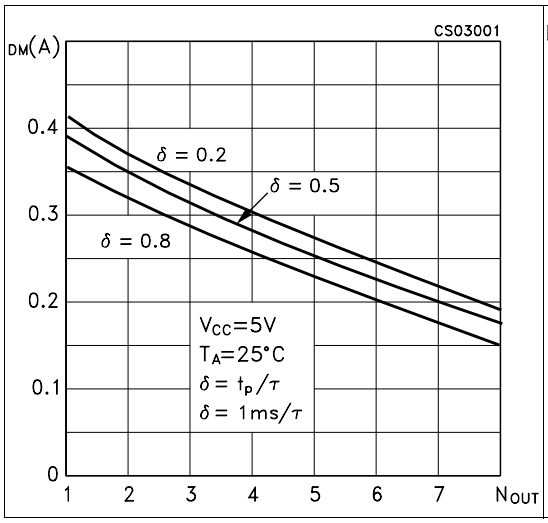


Figure 16. Static drain-source on-state resistance vs logic supply voltage

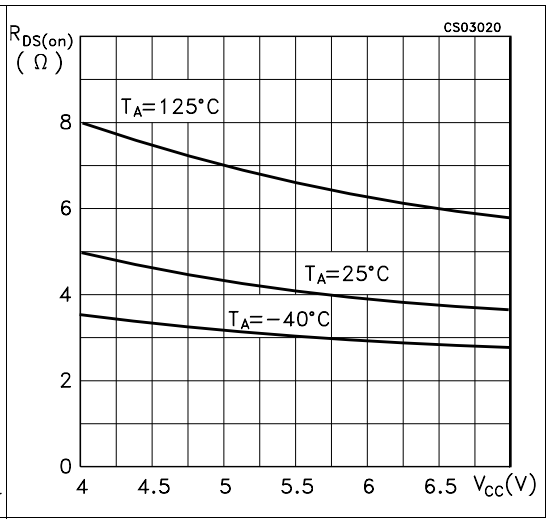


Figure 17. Peak avalanche current vs time duration of avalanche

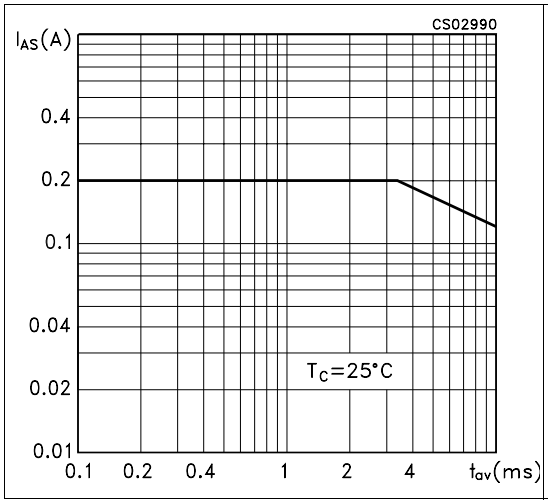


Figure 18. Supply current vs frequency

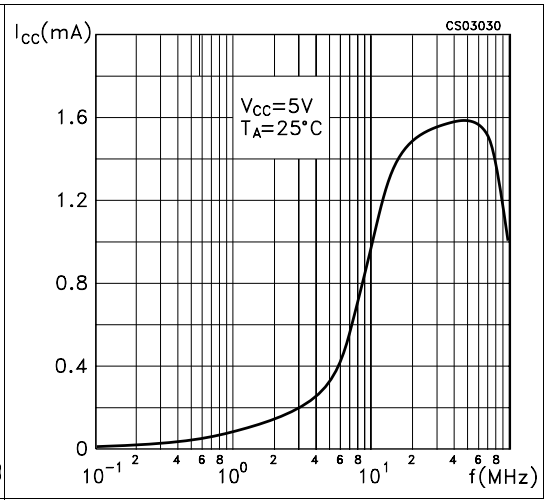


Figure 19. Supply current vs supply voltage

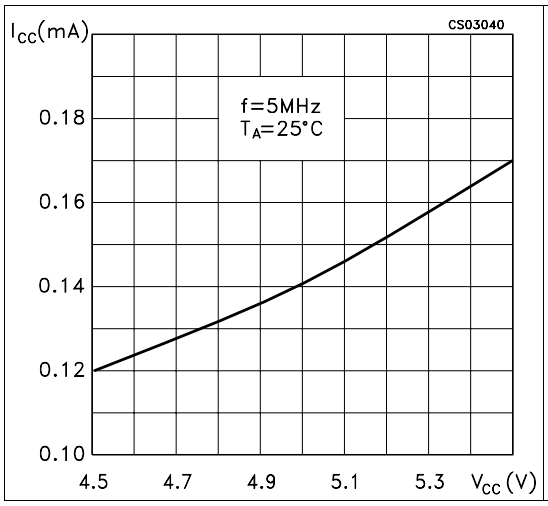


Figure 20. Switching time vs case temperature

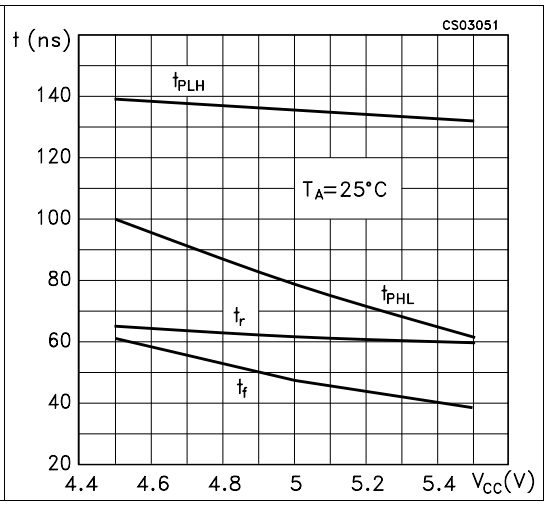
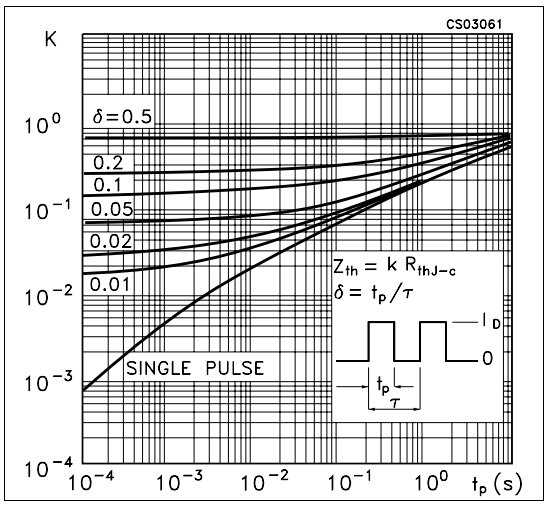


Figure 21. Normalized junction to ambient thermal resistance

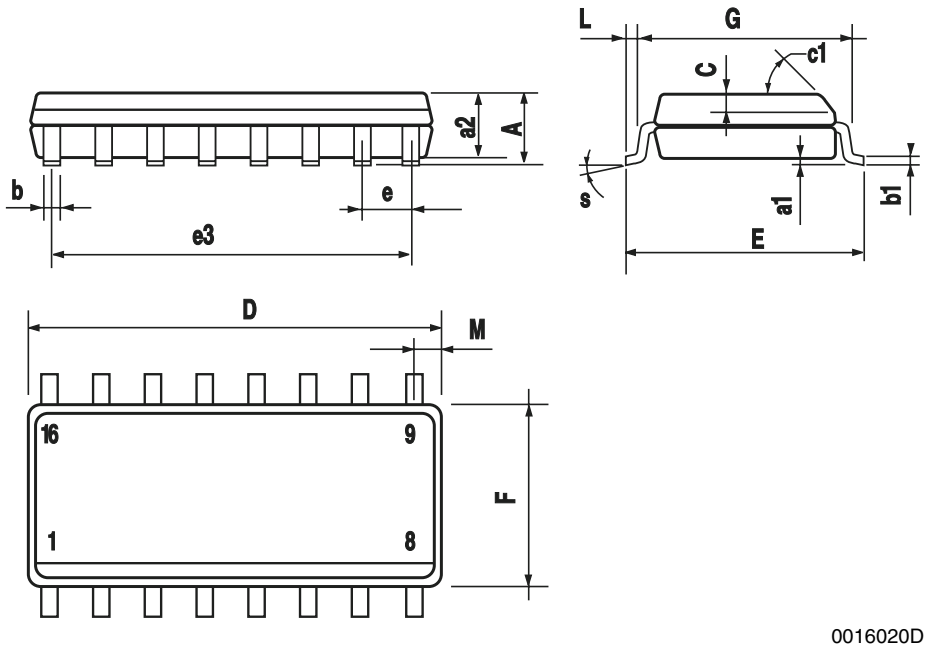


7 Package mechanical data

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.

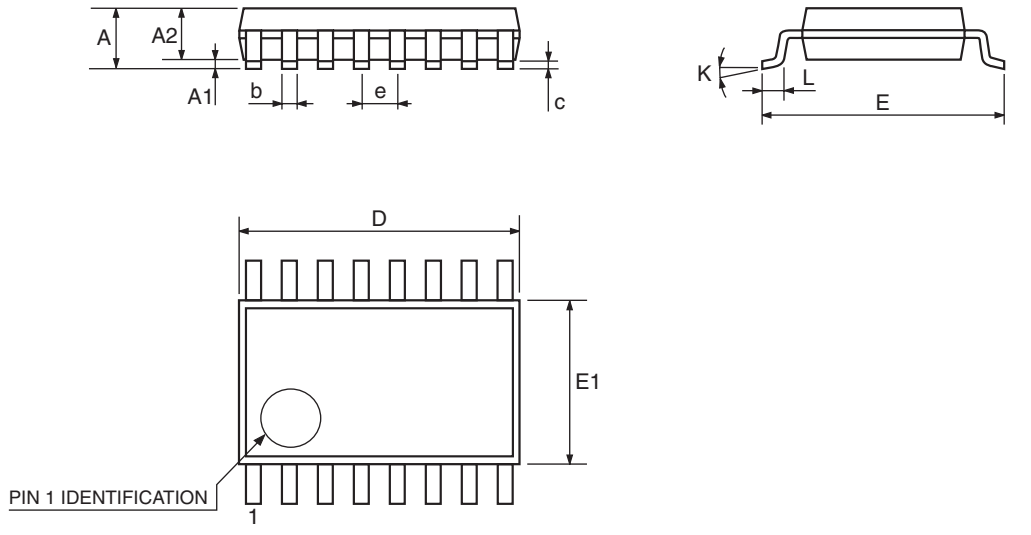
SO-16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.25	0.004		0.010
a2			1.64			0.063
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



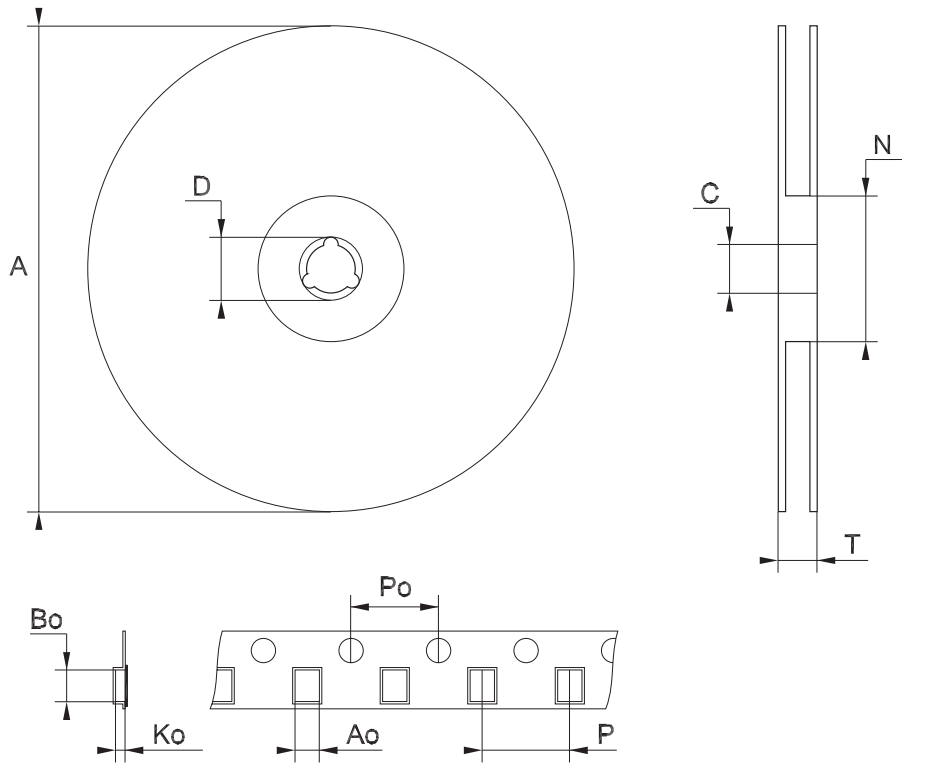
TSSOP16 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
c	0.09		0.20	0.004		0.0079
D	4.9	5	5.1	0.193	0.197	0.201
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
e		0.65 BSC			0.0256 BSC	
K	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



Tape & Reel SO-16 MECHANICAL DATA

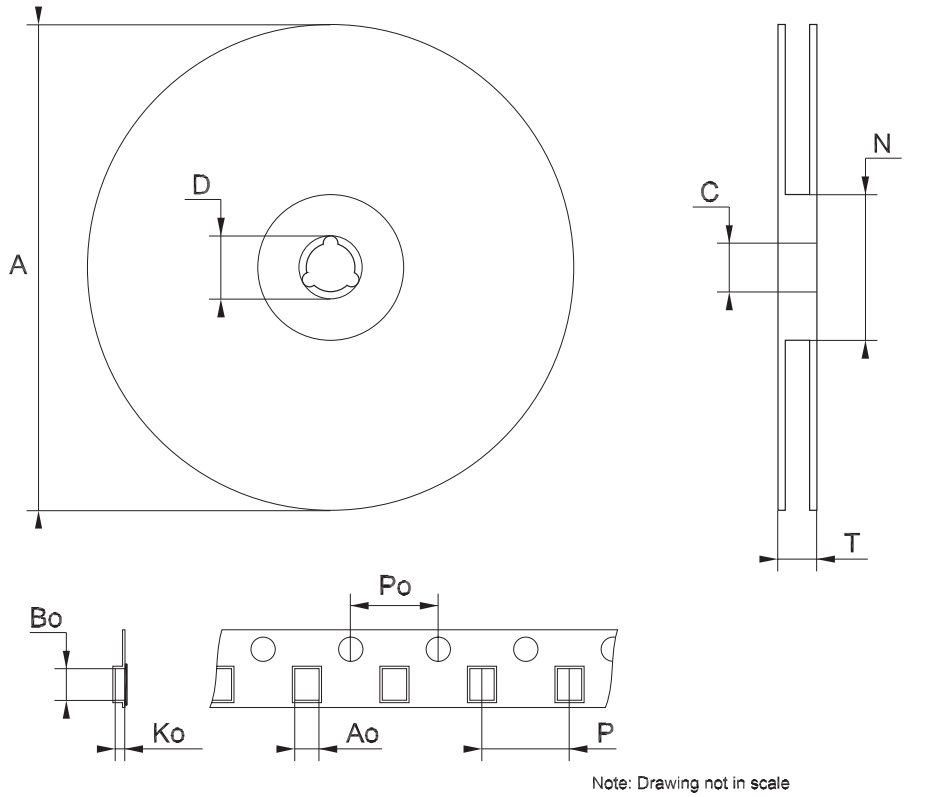
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.45		6.65	0.254		0.262
Bo	10.3		10.5	0.406		0.414
Ko	2.1		2.3	0.082		0.090
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



Note: Drawing not in scale

Tape & Reel TSSOP16 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	6.7		6.9	0.264		0.272
Bo	5.3		5.5	0.209		0.217
Ko	1.6		1.8	0.063		0.071
Po	3.9		4.1	0.153		0.161
P	7.9		8.1	0.311		0.319



Note: Drawing not in scale

8 Revision history

Table 7. Document revision history

Date	Revision	Changes
07-Jul-2004	2	Update *Figure 3*
07-May-2007	3	Document reformatted, tube package deleted
21-May-2008	4	Update: tsu and ThL values in *Table 4*, ESD value on cover page
16-Mar-2009	5	Updated *Table 5 on page 6*