

STPIC6C595

Power logic 8-bit shift register

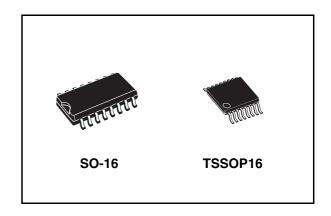
Features

- 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



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 (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 $\overline{\text{CLR}}$ is low, the input shift register is cleared. When output enable $(\overline{\text{G}})$ 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 $T_C = 25\,^{\circ}\text{C}$. 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 STPIC6C595

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1 Logic symbol and pin configuration

Figure 1. Logic symbol and pin configuration EN3 RCK C2 SRG8 SRCK 16 GND > C1 V_{CC} [] 1 SER IN ⊳ 2 DRAINO SER IN 2 15 SRCK 1 D DRAIN0 14 DRAIN7 DRAIN1 DRAIN1 🛮 4 13 DRAIN6 DRAIN2 DRAIN2 [5 12 DRAIN5 DRAIN3 DRAIN3 6 11 DRAIN4 DRAIN4 10 RCK CLR 7 DRAIN5 $\overline{\mathsf{G}}$ 9 SER OUT

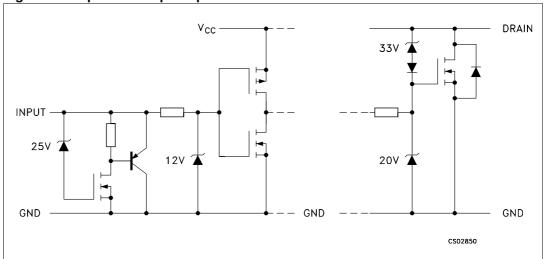
DRAIN6

DRAIN7
SER OUT

Figure 2. Input and output equivalent circuits

⊳ 2

CS02960



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Maximum rating STPIC6C595

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
VI	Logic input voltage range	-0.3 to 7	V
V _{DS}	Power DMOS drain to source voltage (See Note 2)	33	٧
I _{DS}	Continuous source to drain diode anode current	250	mA
I _{DS}	Pulsed source to drain diode anode current (See <i>Note 3</i>)	500	mA
I _D	Pulsed drain current, each output, all output ON $(T_C = 25 ^{\circ}C)$	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 <i>Note 3</i>)	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 ≤ 25 °C)	1087	mW
P _d	Continuous total dissipation (T _C = 125 °C)	217	mW
TJ	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
TL	Lead temperature 1.6 mm (1/16 inch) from case for 10 seconds	260	°C

STPIC6C595 Maximum rating

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	Тур	Max	Unit
V _{CC}	Logic supply voltage	4.5		5.5	٧
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 <i>Note 3</i> , <i>Note 5</i> and <i>Figure 15</i>)			250	mA
t _{su}	Set-up time, SER IN high before SRCK ↑ (see <i>Figure 4</i> and <i>Figure 8</i>)	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

Electrical characteristics STPIC6C595

3 Electrical characteristics

3.1 DC characteristics

Table 5. DC characteristics ($V_{CC} = 5 \text{ V}, T_{C} = 25 ^{\circ}\text{C}$, unless otherwise specified.)

Symbol	Parameter	Test conditions	Min	Тур	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	$I_{OH} = -20 \mu A, V_{CC} = 4.5 V$	4.4	4.49		V
VOH	voltage SER OUT	$I_{OH} = -4 \text{ mA}, V_{CC} = 4.5 \text{ V}$	4	4.2		V
V _{OL}	Low level output	$I_{OH} = 20 \mu A, V_{CC} = 4.5 V$		0.005	0.1	V
VOL.	voltage SER OUT	I _{OH} = 4 mA, V _{CC} = 4.5 V		0.3	0.5	V
I _{IH}	High level input current	$V_{CC} = 5.5 \text{ V}, V_I = V_{CC}$			1	μА
I _{IL}	Low level input current	$V_{CC} = 5.5 \text{ V}, V_{I} = 0$			-1	μА
I _{CC}	Logic supply current	V_{CC} = 5.5 V, all outputs OFF or ON		20	200	μА
I _{CC(FRQ)}	Logic supply current at frequency	f _{SRCK} = 5 MHz, C _L = 30 pF All outputs OFF (See <i>Figure 6</i> , <i>Figure 18</i> and <i>Figure 19</i>)			2	mA
I _N	Nominal current	$V_{DS(on)} = 0.5 \text{ VI}_{N} = I_{D}$ $T_{C} = 85 \text{ °C}$ (See <i>Note 5</i> , <i>Note 6</i> , <i>Note 7</i>)		90		mA
		$V_{DS} = 30 \text{ V}, V_{CC} = 5.5 \text{ V}$		0.3	5	μА
I _{DSX}	Off-state drain current	V _{DS} = 30 V, V _{CC} =5.5 V or 0 V T _C = 125 °C		0.6	8	μА
	Static drain source on	$I_D = 50 \text{ mA}, V_{CC} = 4.5 \text{ V}$		4.5	6	Ω
R _{DS(on)}	state resistance (See <i>Note 5</i> , <i>Note 6</i> and <i>Figure 14</i> ,	$I_D = 50 \text{ mA}, V_{CC} = 4.5 \text{ V}$ $T_C = 125 ^{\circ}\text{C}$		6.5	9	Ω
	Figure 16)	I _D = 100 mA, V _{CC} = 4.5 V		4.5	6	Ω

Switching characteristics 3.2

Table 6. Switching characteristics ($V_{CC} = 5 \text{ V}$, $T_{C} = 25 ^{\circ}\text{C}$, unless otherwise specified.)

Symbol	Parameter	Test conditions	Min	Тур	Max	Unit
t _{PHL}	Propagation delay time, high to low level output from G			80		ns
t _{PLH}	Propagation delay time, low to high level output from G	C _L = 30 pF, I _D = 75 mA (See <i>Figure 4</i> , <i>Figure 5</i> , <i>Figure 6</i> , <i>Figure 7</i> , <i>Figure 20</i>)		130		ns
t _r	Rise time, drain output	rigule 6, Figule 7, Figule 20)		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 <i>Figure 5</i> , <i>Figure 6</i> , and		39		ns
t _{rr}	Reverse recovery time	Figure 9, Figure 10)		115		ns

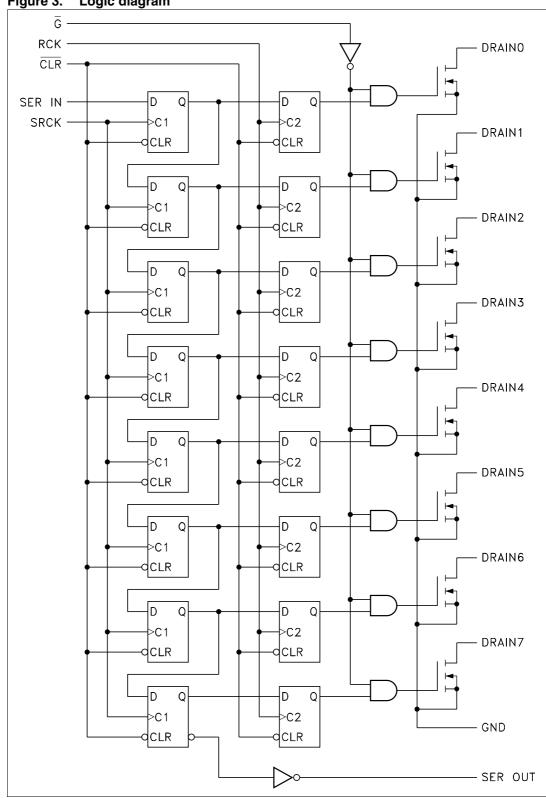
Note:

- 1 All voltage value are with respect to GND
- 2 Each power DMOS source is internally connected to GND
- 3 Pulse duration \leq 100 μ s and duty cycle \leq 2 %
- Drain supply voltage = 15 V, starting junction temperature (T_{JS}) = 25 °C. L = 1.5 H and $I_{AS} = 200 \text{ mA (see Fig. 11 and 12)}$
- Technique should limit T_J T_C to 10 °C maximum 5
- These parameters are measured with voltage sensing contacts separate from the currentcarrying contacts.
- 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.

Logic diagram STPIC6C595

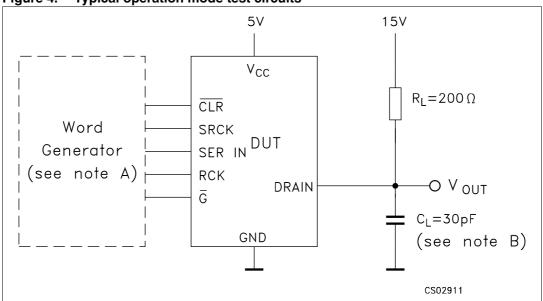
Logic diagram 4



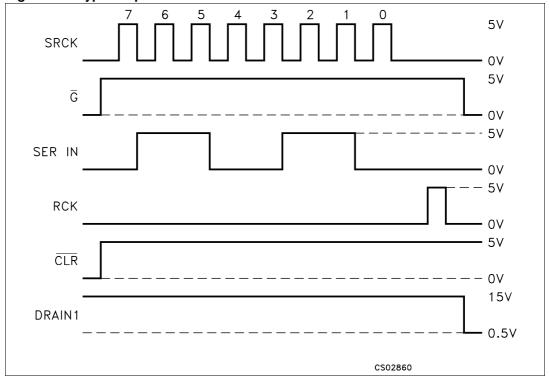


5 Typical operating circuit

Figure 4. Typical operation mode test circuits







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

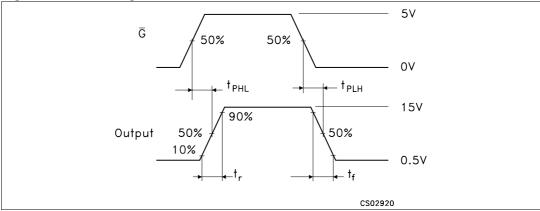
2 B) C_1 includes probe and jig capacitance.

5//

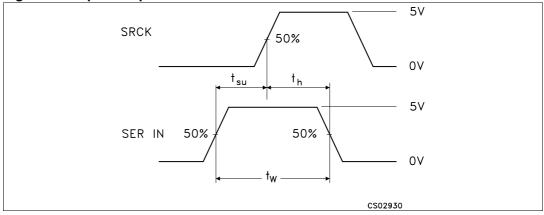
15V 5٧ V_{CC} $R_L=200\,\Omega$ $\overline{\mathsf{CLR}}$ Word SRCK SER IN DUT Generator (see note A) **RCK** O V OUT DRAIN $\bar{\mathsf{G}}$ $C_L = 30pF$ GND (see note B) CS02911

Figure 6. Typical operation mode test circuits









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

2 B) C₁ includes probe and jig capacitance.

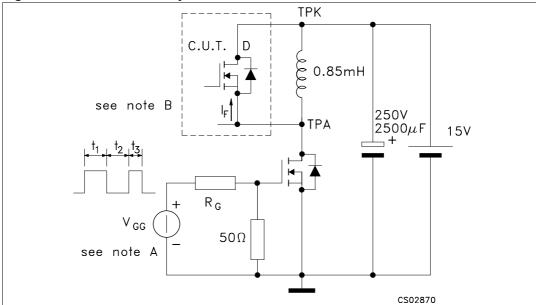
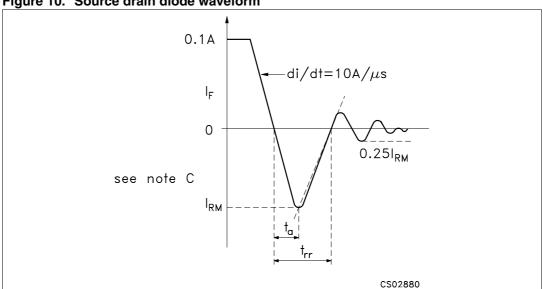


Figure 9. Reverse recovery current test circuits

Figure 10. Source drain diode waveform



- Note:
- A) The V_{GG} amplitude and R_{G} are adjusted for di/dt = 10 A/ μ s. A V_{GG} double-pulse train is used to set $I_F = 0.1$ A. where $t_1 = 10 \ \mu s$, $t_2 = 7 \ \mu s$ and $t_3 = 3 \ \mu s$
- 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.

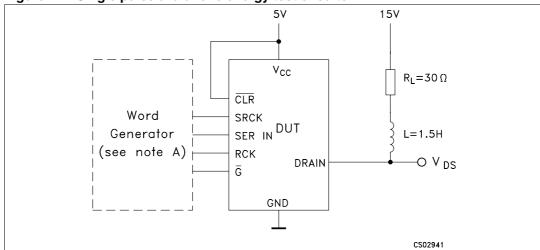
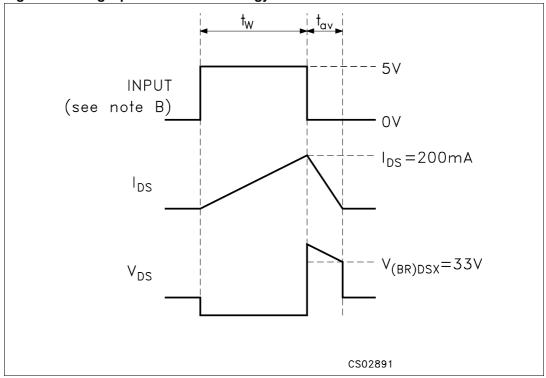


Figure 11. Single pulse avalanche energy test circuits

Figure 12. Single pulse avalanche energy waveform



Note: 1 A) The word generator has the following characteristics: $t_r \le 10$ ns, $t_f \le 10$ ns,

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 $T_J = 25 \, ^{\circ}C$)

Figure 13. Max continuous drain current Figure 14. Static drain-source on-state vs number of outputs resistance vs drain current conducting simultaneously

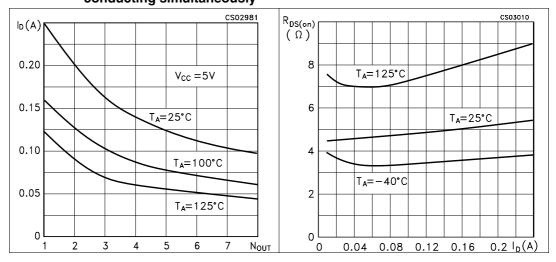


Figure 15. Maximum peak drain current vs number of outputs conducting simultaneously

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

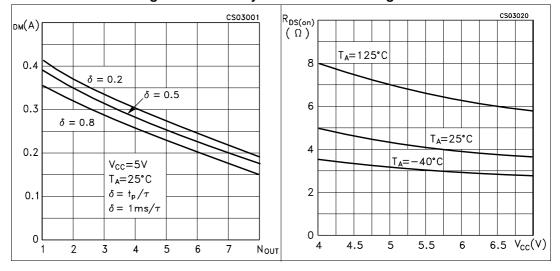
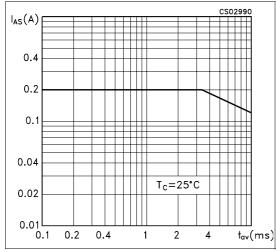


Figure 17. Peak avalanche current vs time duration of avalanche

Figure 18. Supply current vs frequency



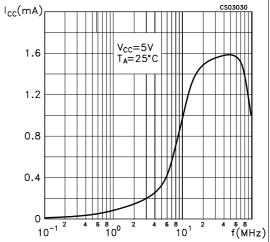
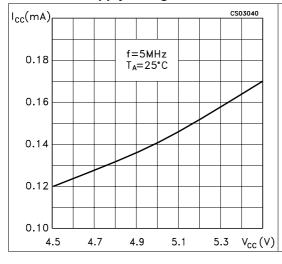
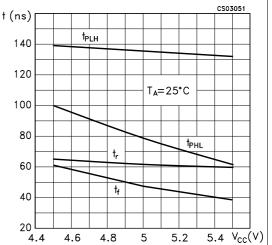


Figure 19. Supply current vs supply voltage

Figure 20. Switching time vs case temperature





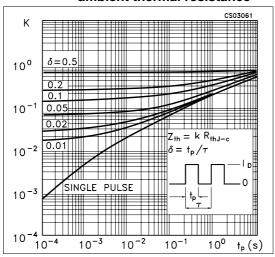


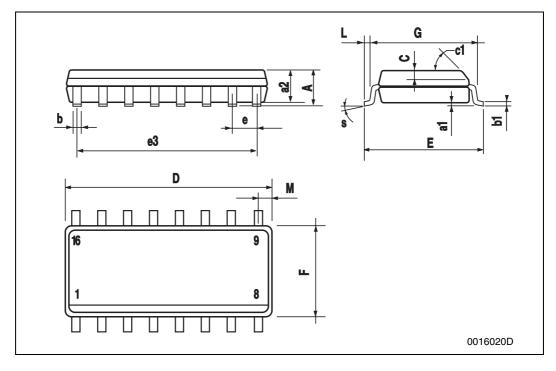
Figure 21. Normalized junction to ambient thermal resistance

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

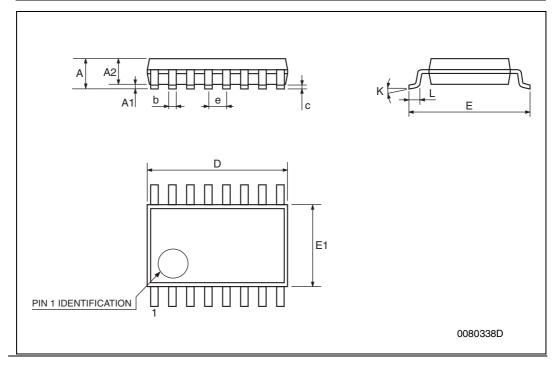
DIM		mm.			inch		
DIM.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.	
А			1.75			0.068	
a1	0.1		0.25	0.004		0.010	
a2			1.64			0.063	
b	0.35		0.46	0.013		0.018	
b1	0.19		0.25	0.007		0.010	
С		0.5			0.019		
c1			45°	(typ.)			
D	9.8		10	0.385		0.393	
E	5.8		6.2	0.228		0.244	
е		1.27			0.050		
e3		8.89			0.350		
F	3.8	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



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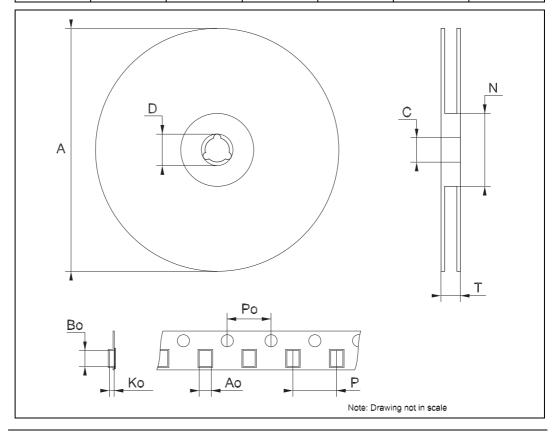
TSSOP16 MECHANICAL DATA

DIM.	mm.			inch		
DIWI.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
А			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
С	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
е		0.65 BSC			0.0256 BSC	
К	0°		8°	0°	_	8°
L	0.45	0.60	0.75	0.018	0.024	0.030

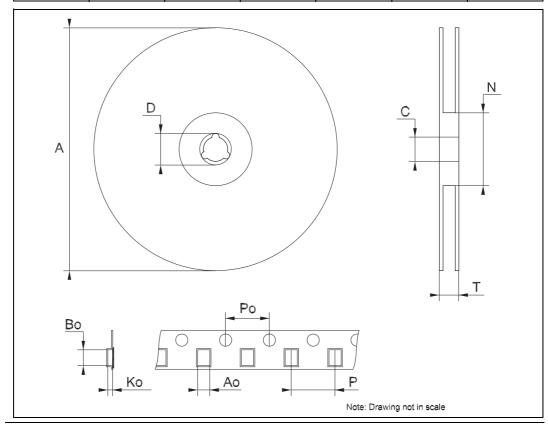


Tape & Reel SO-16 MECHANICAL DATA

DIM		mm.		inch		
DIM.	MIN.	ТҮР	MAX.	MIN.	TYP.	MAX.
Α			330			12.992
С	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
Т			22.4			0.882
Ao	6.45		6.65	0.254		0.262
Во	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
Р	7.9		8.1	0.311		0.319



DIM	mm.			inch		
DIM.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
Α			330			12.992
С	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
Т			22.4			0.882
Ao	6.7		6.9	0.264		0.272
Во	5.3		5.5	0.209		0.217
Ko	1.6		1.8	0.063		0.071
Ро	3.9		4.1	0.153		0.161
Р	7.9		8.1	0.311		0.319



STPIC6C595 Revision history

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 <i>Table 4</i> , ESD value on cover page
16-Mar-2009	5	Updated Table 5 on page 6

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