ST4G3235

4-BIT DUAL SUPPLY BUS BUFFER LEVEL TRANSLATOR WITH A SIDE SERIES RESISTOR

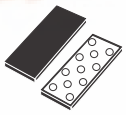
- HIGH SPEED: t_{PD} = 4.3ns (MAX.) at T_A=85°C
  V_{CCB} = 1.65V; V_{CCA} = 3.0V
- LOW POWER DISSIPATION:
  $I_{CCA} = I_{CCB}$ = 5µA(MAX.) at T_A=85°C
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OHA}| = I_{OLA}$ = 10mA MIN at
  V_{CCA} = 2.75V; V_{CCB} = 1.4V to 3.6V
  $|I_{OHB}| = I_{OLB}$ = 4mA MIN at
  V_{CCB} = 1.65V; V_{CCA} = 1.4 to 3.6V)
- BALANCED PROPAGATION DELAYS:
  $t_{PLH} \cong t_{PHL}$
- POWER DOWN PROTECTION ON INPUTS AND OUTPUTS
- 26Ω SERIES RESISTOR ON A SIDE OUTPUTS
- OPERATING VOLTAGE RANGE:
  V_{CCA}(OPR) = 1.4V to 3.6V (1.2V Data Retent)
  V_{CCB}(OPR) = 1.4V to 3.6V (1.2V Data Retent)
- MAX DATA RATES:
  380 Mbps (1.8V to 3.3V translation)
  260 Mbps (<1.8V to 3.3V translation)
  260 Mbps (Translate to 2.5V)
  210 Mbps (Translate to 1.5V)
- LATCH-UP PERFORMANCE EXCEEDS 500mA (JESD 17)
- ESD PERFORMANCE:
  HBM > 2000V (MIL STD 883 method 3015);
  MM > 200V
- R_OHS Compliant for FLIPCHIP Package

DESCRIPTION

The ST4G3235 is a dual supply low voltage CMOS 4-BIT BUS BUFFER level translator fabricated with sub-micron silicon gate and five-layer metal wiring C^2MOS technology. Designed for use as an interface between a 3.3V bus and a 2.5V or 1.8V bus in a mixed 3.3V/1.8V, 3.3V/2.5V, 1.8V/1.4V and 2.5V/1.8V supply systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

This IC is intended for one-way asynchronous communication between data buses. The input and output power down protections disable the device when both power supply are down, so that the buses are effectively isolated.

The input tolerant buffers allow to translate V_{CCB} compatible signals and greater signals than V_{CCB} up/down to V_{CCA} and viceversa.



FLIPCHIP

Table 1: Order Codes

PACKAGE	T & R	Comments
FLIPCHIP11	ST4G3235BJR	5000 parts per reel

All inputs are equipped with protection circuits against static discharge, giving them ESD immunity and transient excess voltage.

Figure 1: Logic Diagram

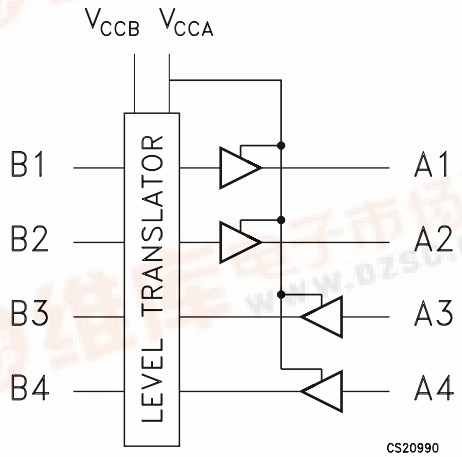


Figure 2: Input And Output Equivalent Circuit

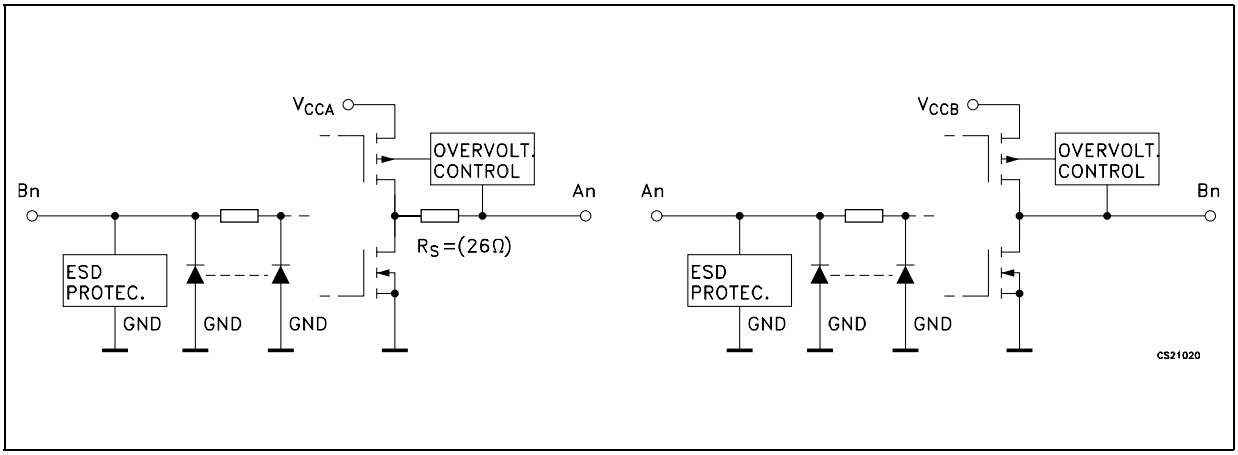


Table 2: Pin Description

PIN°	SYMBOL	NAME AND FUNCTION
A1	A4	Data Output (V_{CCA} referred)
A3	A3	Data Output (V_{CCA} referred)
A5	A2	Data Output (V_{CCA} referred)
A7	A1	Data Output (V_{CCA} referred)
C1	B4	Data Input (V_{CCB} referred)
C3	B3	Data Input (V_{CCB} referred)
C5	B2	Data Input (V_{CCB} referred)
C7	B1	Data Input (V_{CCB} referred)
B2	GND	Ground (0V)
B6	V_{CCA}	Positive Supply Voltage
B4	V_{CCB}	Positive Supply Voltage

Figure 3: Pin Connection (top through view)

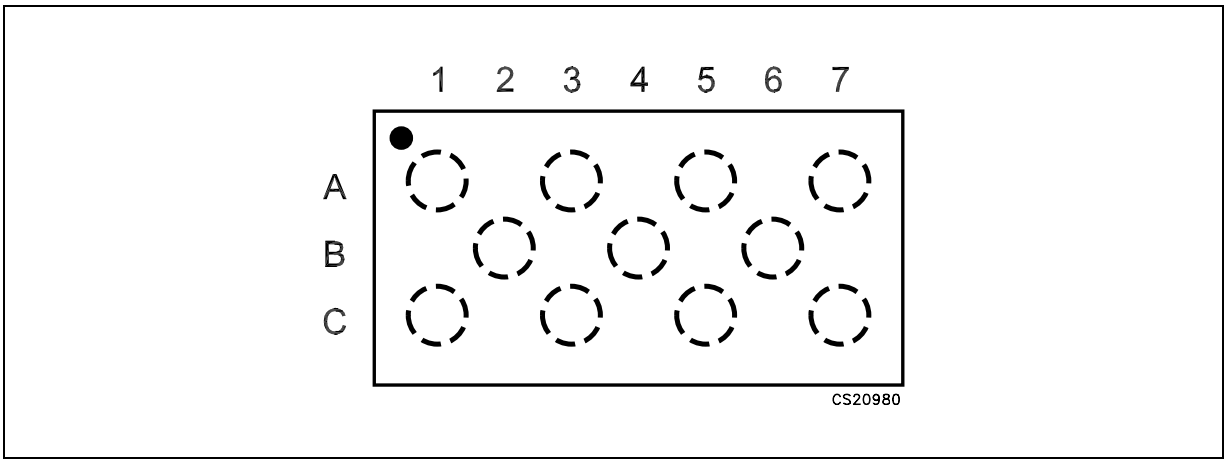


Table 3: Truth Table

INPUTS Bn (V_{CCB} Referred)	OUTPUTS An (V_{CCA} Referred)
L	L
H	H

n = 1..2

INPUTS An (V_{CCB} Referred)	OUTPUTS Bn (V_{CCA} Referred)
L	L
H	H

n = 3..4

Table 4: Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{CCA}	Output Supply Voltage	-0.5 to +4.6	V
V_{CCB}	Input Supply Voltage	-0.5 to V_{CCA} + 0.5	V
V_O	DC Output Voltage (Power Down Mode: V_{CCA}=V_{CCB}=Gnd)	-0.5 to +4.6	V
V_I	DC Input Voltage (Power Down Mode: V_{CCA}=V_{CCB}=Gnd)	-0.5 to +4.6	V
V_{OA}	DC Output Voltage (A1, A2 Outputs)	-0.5 to V_{CCA} + 0.5	V
V_{OB}	DC Output Voltage (B3, B4 Outputs)	-0.5 to V_{CCA} + 0.5	V
V_{IA}	DC Input Voltage (A3, A4 Outputs)	-0.5 to +4.6	V
V_{IB}	DC Input Voltage (B1, B2 Outputs)	-0.5 to +4.6	V
I_{IK}	DC Input Diode Current	– 20	mA
I_{OK}	DC Output Diode Current	– 50	mA
I_{OA}	DC Output Current	± 50	mA
I_{CCA}	DC V_{CCA} or Ground Current	± 100	mA
I_{CCB}	DC V_{CCB} or Ground Current	± 100	mA
P_d	Power Dissipation	400	mW
T_{stg}	Storage Temperature	-65 to +150	°C
T_L	Lead Temperature (10 sec)	260	°C

Absolute Maximum Ratings are those value beyond which damage to the device may occur. Functional operation under these conditions is not implied

Table 5: Recommended Operating Conditions

Symbol	Parameter		Value	Unit
V_{CCA}	Supply Voltage		1.4 to 3.6	V
V_{CCB}	Supply Voltage		1.4 to V_{CCA}	V
V_{IB}	Input Voltage (B1, B2)		0 to V_{CCB}	V
V_{IA}	nput Voltage (A3, A4)		0 to V_{CCA}	V
V_{OB}	Output Voltage (B3, B4)		0 to V_{CCB}	V
V_{OA}	Output Voltage (A1, A2)		0 to V_{CCA}	V
T_{op}	Operating Temperature		-40 to 85	°C
dt/dv	Input Rise and Fall Time (note 1)	V_{CCB} = 3.0 to 3.6V	0 to 10	ns/V
		V_{CCB} = 2.3 to 2.7V	0 to 20	ns/V
		V_{CCB} = 1.4 to 1.95V	0 to 100	ns/V

1) V_I from 0.8V to 2.0V at V_{CC} = 3.0V

Table 6: DC Specification for V_{CCA}

Symbol	Parameter	Test Condition			Value					Unit
		V_{CCB} (V)(*)	V_{CCA} (V)(*)		T_A = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.	Max.	
V_{IHA}	High Level Input Voltage (A3-A4)	1.4 to 3.6V	1.4		0.65V_{CCA}			0.65V_{CCA}		V
			1.8		0.65V_{CCA}			0.65V_{CCA}		
			2.5		1.6			1.6		
			3.3		2.0			2.0		
V_{ILA}	Low Level Input Voltage (A3-A4)	1.4 to 3.6V	1.4				0.35V_{CCA}		0.35V_{CCA}	V
			1.8				0.35V_{CCA}		0.35V_{CCA}	
			2.5				0.7		0.7	
			3.3				0.8		0.8	
V_{OHA}	High Level Output Voltage (A1-A2)	1.4 to 3.6V	1.4	I_O=-100µA	1.2			1.2		V
			2.75	I_O=-0.4mA	2.5			2.5		
			2.75	I_O=-10mA	2.2			2.2		
			2.3	I_O=-6mA	1.8			1.8		
			1.65	I_O=-2mA	1.4			1.4		
			1.4	I_O=-1mA	1.1			1.1		
V_{OLA}	Low Level Output Voltage (A1-A2)	1.4 to 3.6V	1.4	I_O=100µA			0.20		0.20	V
			2.75	I_O=1mA			0.40		0.40	
			2.75	I_O=10mA			0.55		0.55	
			2.3	I_O=6mA			0.40		0.40	
			1.65	I_O=2mA			0.25		0.25	
			1.4	I_O=1mA			0.20		0.20	
I_{IA}	Input Leakage Current (A3-A4)	2.7	3.6	V_{IA}=V_{CCA} or GND			± 0.5		± 5	µA
		1.4	2.7	V_{IA}=3.6V or GND			± 0.5		± 5	µA
I_{OFF}	Power Off Leakage Current	0	0	V_{IB}=GND to 3.6V V_{OA}=GND to 3.6V V_{IA}=GND to 3.6V V_{OB}=GND to 3.6V			± 1.0		± 10	µA
I_{CCtA}	Quiescent Supply Current	1.4 to 3.6V	1.4 to 3.6V	V_{IA} =V_{CCA} or GND V_{IB} =V_{CCB} or GND			0.5		5	µA
ΔI_{CCtA}	Maximum Quiescent Supply Current / Input (An)	2.7	3.6	V_{IA} =V_{CCA} - 0.6V V_{IA} =V_{CCA} or GND V_{IB} =V_{CCB} or GND					0.75	mA
		1.95	3.6							
		1.95	2.7							

(*) V_{CC} range = 3.3±0.3; 2.5±0.2V; 1.8±0.15V

Table 7: DC Specification for V_{CCB}

Symbol	Parameter	Test Condition			Value					Unit
		V_{CCB} (V)(*)	V_{CCA} (V)(*)		T_A = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.	Max.	
V_{IHB}	High Level Input Voltage (B1-B2)	1.4	1.4 to 3.6V		$0.65V_{CCB}$			$0.65V_{CCB}$		V
		1.8			$0.65V_{CCB}$			$0.65V_{CCB}$		
		2.5			1.6			1.6		
		3.3			2.0			2.0		
V_{ILB}	Low Level Input Voltage (B1-B2)	1.4	1.4 to 3.6V				$0.35V_{CCB}$		$0.35V_{CCB}$	V
		1.8					$0.35V_{CCB}$		$0.35V_{CCB}$	
		2.5					0.7		0.7	
		3.3					0.8		0.8	
V_{OHB}	High Level Output Voltage (B3-B4)	1.4	1.4 to 3.6V	I_O=-100µA	1.3			1.3		V
		1.8		I_O=-100µA	1.6			1.6		
		2.75		I_O=-24mA	2.2			2.2		
		2.75		I_O=-18mA	1.7			1.7		
		2.3		I_O=-4mA	1.44			1.44		
		1.65		I_O=-4mA	1.5			1.5		
		1.4		I_O=-2mA	1.25			1.25		
V_{OLB}	Low Level Output Voltage (B3-B4)	1.4	1.4 to 3.6V	I_O=100µA			0.1		0.1	V
		1.8		I_O=100µA			0.2		0.2	
		2.75		I_O=24mA			0.55		0.55	
		2.75		I_O=18mA			0.35		0.35	
		2.3		I_O=4mA			0.39		0.39	
		1.65		I_O=4mA			0.20		0.20	
		1.4		I_O=2mA			0.15		0.15	
I_{IB}	Input Leakage Current (B1-B2)	2.7	3.6	V_{IB}=V_{CCB} or GND			± 0.5		± 5	µA
		1.4	2.7	V_{IB}=3.6V or GND			± 0.5		± 5	µA
I_{OFF}	Power Off Leakage Current	0	0	V_{IB}=GND to 3.6V V_{OA}=GND to 3.6V V_{IA}=GND to 3.6V V_{OB}=GND to 3.6V			± 1.0		± 10	µA
I_{CCtB}	Quiescent Supply Current	1.4 to 3.6V	1.4 to 3.6V	V_{IA} =V_{CCA} or GND V_{IB} =V_{CCB} or GND			0.5		5	µA
ΔI_{CCtB}	Maximum Quiescent Supply Current / Input (Bn)	2.7	3.6	V_{IB} =V_{CCB} - 0.6V V_{IB} =V_{CCB} or GND V_{IB} =V_{CCA} or GND					0.75	mA
		1.95	3.6							
		1.95	2.7							

(*) V_{CC} range = 3.3±0.3; 2.5±0.2V; 1.8±0.15V

Table 8: Dynamic Switching Characteristics

Symbol	Parameter	Test Condition			Value					Unit
		V_{CCB} (V)	V_{CCA} (V)		T_A = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.	Max.	
V_{OLPA}	Dynamic Low Level Quiet An Output	1.4	1.8	C_L = 30pF V_{ILB} = 0V V_{IHB} = V_{CCB}		0.2				V
		1.4-1.8	2.5			0.25				
		1.8-2.5	3.3			0.35				
V_{OLVA}	Dynamic Low Level Quiet An Output	1.4	1.8			-0.2				V
		1.4-1.8	2.5			-0.25				
		1.8-2.5	3.3			-0.35				
V_{OHVA}	Dynamic High Level Quiet An Output	1.4	1.8			1.6				V
		1.4-1.8	2.5			2.1				
		1.8-2.5	3.3			2.7				
V_{OLPB}	Dynamic Low Level Quiet Bn Output	1.4	1.8-2.5	C_L = 30pF V_{ILA} = 0V V_{IHA} = V_{CCA}		0.2				V
		1.8	2.5-3.3			0.25				
		2.5	3.3			0.6				
V_{OLVB}	Dynamic Low Level Quiet Bn Output	1.4	1.8-2.5			-0.2				V
		1.8	2.5-3.3			-0.25				
		2.5	3.3			-0.36				
V_{OHVB}	Dynamic High Level Quiet Bn Output	1.4	1.8-2.5			1.2				V
		1.8	2.5-3.3			1.4				
		2.5	3.3			1.9				

Table 9: AC Electrical Characteristics

Symbol	Parameter	Test Condition			Value		Unit
		V_{CCB} (V)	V_{CCA} (V)		-40 to 85 °C		
					Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay Time Bn to An	2.3 to 3.6	1.4	C_L = 10 pF	2.0	6.5	ns
		1.4 to 1.95	1.4		2.0	6.8	
		2.3 to 3.6	1.65 to 1.95		2.0	5.2	
		1.4 to 1.95	1.65 to 1.95		2.0	5.6	
		1.4 to 1.95	2.3 to 2.7		2.0	4.6	
		1.4 to 1.95	3.0 to 3.6		2.0	4.3	
		2.3 to 2.7	3.0 to 3.6		1.0	3.6	
t_{PLH} t_{PHL}	Propagation Delay Time Bn to An	2.3 to 3.6	1.4	C_L = 30 pF R_L = 500 Ω	2.0	7.5	ns
		1.4 to 1.95	1.4		2.0	7.5	
		2.3 to 3.6	1.65 to 1.95		2.0	6.5	
		1.4 to 1.95	1.65 to 1.95		2.0	6.7	
		1.4 to 1.95	2.3 to 2.7		2.0	5.9	
		1.4 to 1.95	3.0 to 3.6		2.0	5.7	
		2.3 to 2.7	3.0 to 3.6		1.0	4.9	
t_{PLH} t_{PHL}	Propagation Delay Time An to Bn	2.3 to 3.6	1.4	C_L = 10 pF	2.0	5.5	ns
		1.4 to 1.95	1.4		2.0	6.0	
		2.3 to 3.6	1.65 to 1.95		2.0	5.0	
		1.4 to 1.95	1.65 to 1.95		2.0	5.0	
		1.4 to 1.95	2.3 to 2.7		2.0	4.6	
		1.4 to 1.95	3.0 to 3.6		2.0	3.9	
		2.3 to 2.7	3.0 to 3.6		1.0	3.0	
t_{PLH} t_{PHL}	Propagation Delay Time An to Bn	2.3 to 3.6	1.4	C_L = 30 pF R_L = 500 Ω	2.0	7.0	ns
		1.4 to 1.95	1.4		2.0	7.5	
		2.3 to 3.6	1.65 to 1.95		2.0	6.0	
		1.4 to 1.95	1.65 to 1.95		2.0	6.0	
		1.4 to 1.95	2.3 to 2.7		2.0	5.6	
		1.4 to 1.95	3.0 to 3.6		2.0	4.6	
		2.3 to 2.7	3.0 to 3.6		1.0	4.0	
t_{OSLH} t_{OSHL}	Output To Output Skew Time (note1, 2)	1.8 ± 0.15	2.5 ± 0.2	C_L = 30 pF R_L = 500 Ω		0.5	ns
		1.8 ± 0.15	3.3 ± 0.3			0.5	
		2.5 ± 0.2	3.3 ± 0.3			0.75	

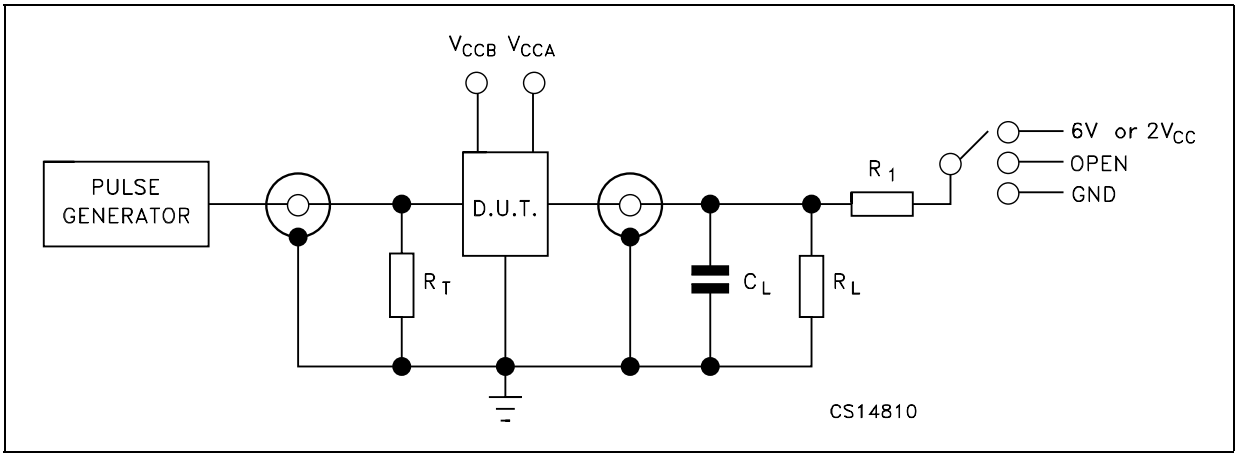
1) Skew is defined as the absolute value of the difference between the actual propagation delay for any two outputs of the same device switching in the same direction, either HIGH or LOW (t_{OSLH} = | t_{PLHm} - t_{PLHn}|, t_{OSHL} = | t_{PHLm} - t_{PHLn}|
2) Parameter guaranteed by design

Table 10: Capacitance Characteristics

Symbol	Parameter	Test Condition			Value					Unit
		V_{CCB} (V)	V_{CCA} (V)		T_A = 25 °C			-40 to 85 °C		
					Min.	Typ.	Max.	Min.	Max.	
C_{IN}	Input Capacitance	open	open			6				pF
C_O	Output Capacitance	1.8-2.5	2.5-3.3			9				pF
C_{PD}	Power Dissipation Capacitance	2.5	3.3	f=10MHz		50				pF
		1.8	3.3			28				
		1.4	2.5			22				
		1.4	1.8			15				
		3.3	1.8			28				

1) C_{PD} is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average current can be obtained by the following equation. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/4$ (per circuit)

Figure 4: Test Circuit



TEST	SWITCH
t_{PLH}, t_{PHL}	Open

C_L = 10/30pF or equivalent (includes jig and probe capacitance)
$R_L = R_1$ = 500Ω or equivalent
$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Table 11: Waveform Symbol Value

Symbol	V_{CC}		
	3.0 to 3.6V	2.3 to 2.7V	1.65 to 1.95V
V_{IH}	V_{CC}	V_{CC}	V_{CC}
V_M	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_X	V_{OL} +0.3V	V_{OL} +0.15V	V_{OL} +0.15V
V_Y	V_{OL} -0.3V	V_{OL} -0.15V	V_{OL} -0.15V

Figure 5: Waveform - Propagation Delay (f=1MHz; 50% duty cycle)

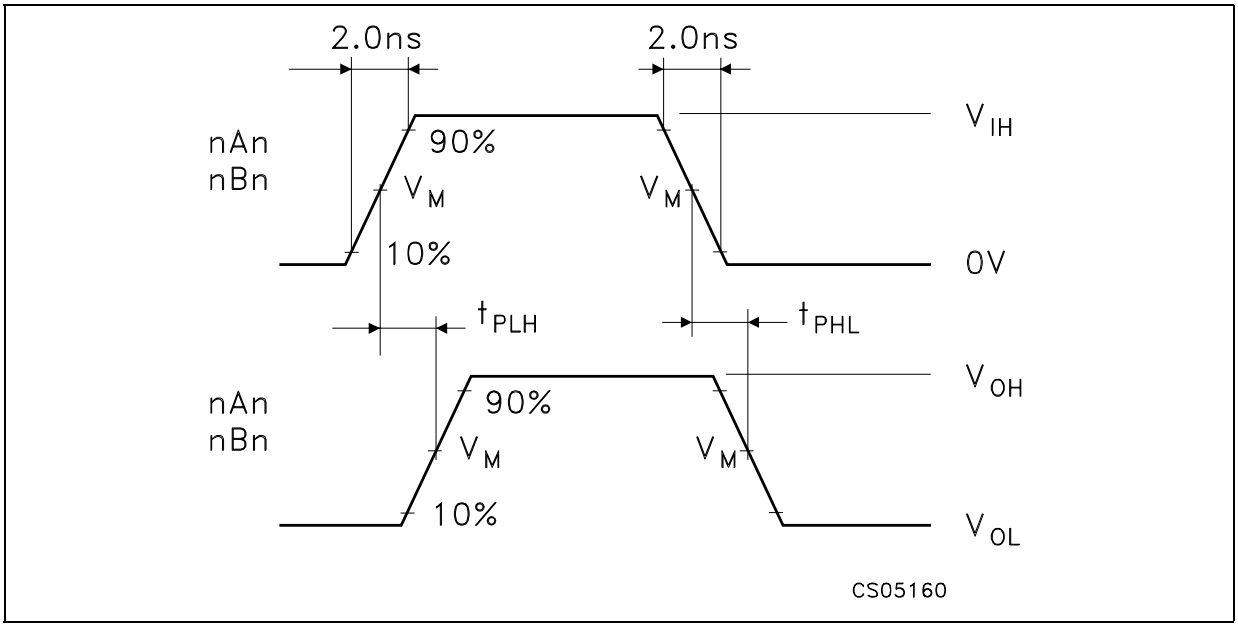
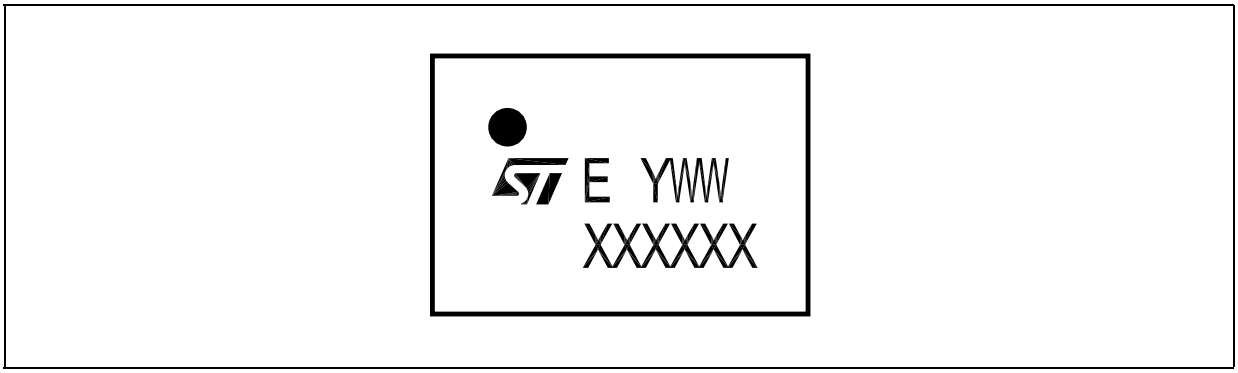


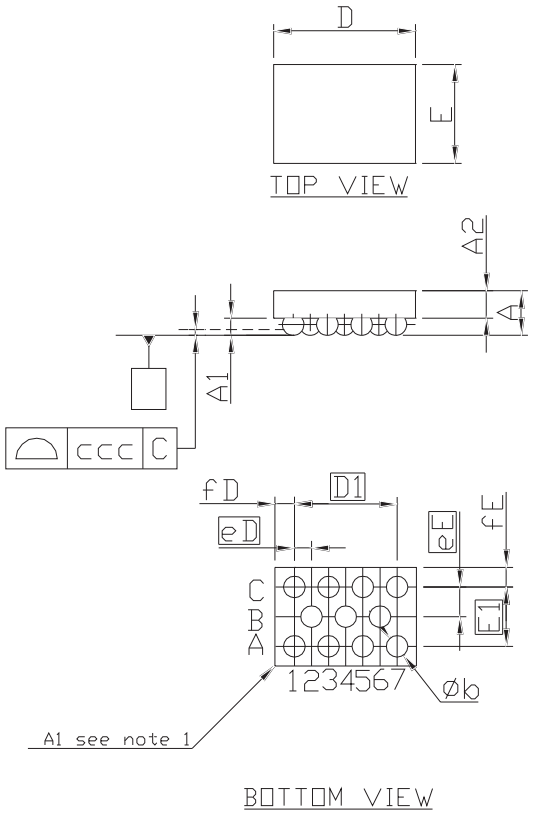
Figure 6: Marking



NOTE: E = Eco Level; Y = Assy Year; WW = Assy Week; X = Marking Area; Marking Code 9521

Flip-Chip11 MECHANICAL DATA

DIM.	mm.			mils		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	0.585	0.65	0.715	23.0	25.6	28.1
A1	0.21	0.25	0.29	8.3	9.8	11.4
A2		0.40			15.7	
b	0.265	0.315	0.365	10.4	12.4	14.4
D	1.99	2.04	2.09	78.3	80.3	82.3
D1		1.5			59.1	
E	1.36	1.41	1.46	53.5	55.5	57.5
E1		0.866			34.1	
eD	0.2	0.25	0.30	7.9	9.8	11.8
eE	0.383	0.433	0.483	15.1	17.0	19.0
fD		0.270			10.6	
fE		0.272			10.7	
ccc		0.080			3.1	



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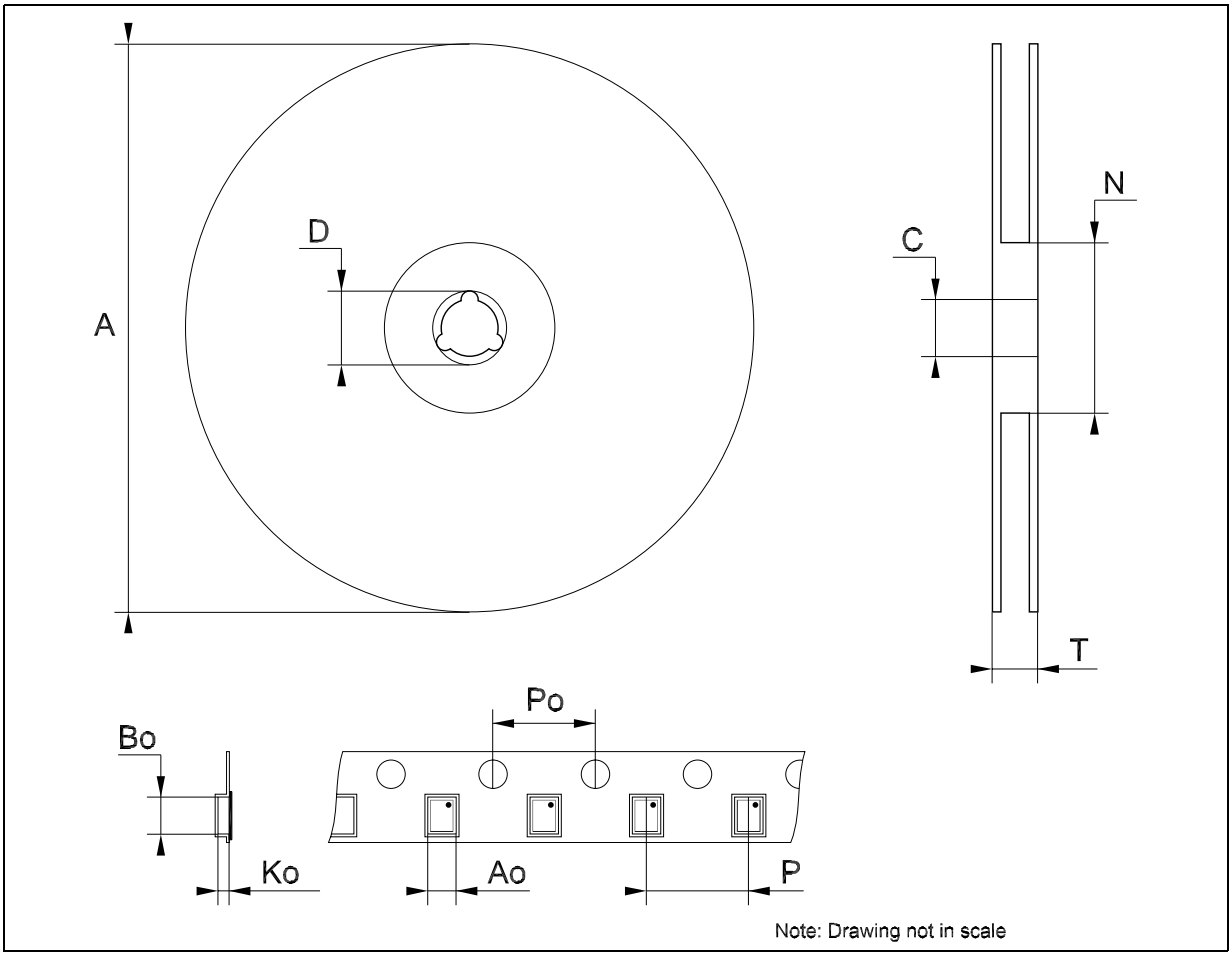
Tape & Reel Flip-Chip 11 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			178			6.926
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	49	50	51	1.929	1.969	2.008
T			12.4			0.488
Ao	2.29	2.34	2.39	0.090	0.092	0.094
Bo	1.65	1.70	1.75	0.065	0.067	0.069
Ko	0.76	0.81	0.86	0.030	0.032	0.034
Po	3.9	4	4.1	0.153	0.157	0.161
P	3.9	4	4.1	0.153	0.157	0.161



Note: Drawing not in scale

Table 12: Revision History

Date	Revision	Description of Changes
14-Oct-2004	1	First Release.
26-Oct-2004	2	Mechanical Data has been updated.
11-Feb-2005	3	Add Tape & Reel and Figure 6.
18-Feb-2005	4	Table 1 has been updated from 4000 to 5000 parts per Reel.
30-Mar-2005	5	Add Features ==> Max Data Rates.
09-May-2005	6	Table 9 and Table 10 have been updated.