74GTL1655A

16 BIT LVTTL TO GTL/GTL + UNIVERSAL BUS TRANSCEIVERS WITH LIVE INSERTION

- HIGH SPEED GTL/GTL+ UNIVERSAL TRANSCEIVER:
  t_{PD} = 4.6 ns (MAX.) A to B at V_{CC} = 3V
- COMBINES D-TYPE LATCHES AND D-TYPE FLIP-FLOPS FOR OPERATION IN TRANSPARENT, LATCHED, OR CLOCKED MODE
- OPERATING VOLTAGE RANGE:
  V_{CC}(OPR) = 3.0V to 3.6V
- SYMMETRICAL OUTPUT IMPEDANCE:
  $|I_{OH}| = I_{OL}$=24mA (MIN) at V_{CC} = 3V (A PORT)
- OUTPUT IMPEDANCE:
  I_{OL} = 100mA (MIN) at V_{CC} = 3V (B PORT)
- HIGH-IMPEDANCE STATE DURING POWER UP AND POWER DOWN up to V_{CC}=BIASV_{CC}=1.5V PERMITT LIVE INSERTION
- B-PORT PRECHARGED BY BIASV_{CC} REDUCE NOISE ON THE LINE DURING LIVE INSERTION
- EDGE RATE-CONTROL INPUT CONFIGURES THE B-PORT OUTPUT RISE AND FALL TIMES
- BUS HOLD ON DATA INPUTS ELIMINATES THE NEED FOR EXTERNAL PULL-UP/ PULL-DOWN RESISTORS (A PORT)
- DISTRIBUTED V_{CC} AND GND PIN CONFIGURATION MINIMIZES HIGH-SPEED SWITCHING NOISE IN PARALLEL COMUNICATIONS
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 1655

DESCRIPTION

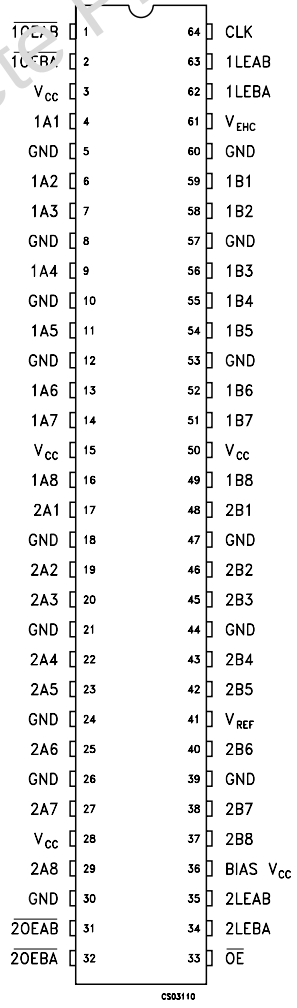
The 74GTL1655A devices are 16-bit high-drive (100mA), low-output-impedance universal bus transceivers designed for backplane applications. The 74GTL1655A devices provide live-insertion capability for backplane applications by tolerating active signals on the data ports when the devices are powered off. In addition, a biasing pin preconditions the GTL/GTL+ port to minimize disruption to an active backplane.
The edge rate-control (V_{ERC}) input is provided so the rise and fall time of the B outputs can be configured to optimize for various backplane loading conditions. Data flow in each direction is

TSSOP

Table 1: Order Codes

PACKAGE	T & R
TSSOP	74GTL1655ATTR

Figure 1: Pin Connection



Rev. 1

controlled by output-enable ($\overline{OEAB}$ and $\overline{OEBA}$), latch-enable (LEAB and LEBA), and clock (CLK) inputs. For A-to-B data flow, the devices operate in the transparent mode when LEAB is high. When LEAB is low, the A data is latched if CLK is held at a high or low logic level. If LEAB is low, the A data is stored in the latch/flip-flop on the low-to-high transition of CLK. When $\overline{OEAB}$ is low, the outputs are active. When $\overline{OEAB}$ is high, the outputs are in the high-impedance state. Data flow for B to A is similar to that of A to B, but uses $\overline{OEBA}$, LEBA, and CLK. The output enable ($\overline{OE}$) is used to disable both ports simultaneously.

Active bus-hold circuitry is provided on the A port to hold unused or floating data inputs at a valid logic level. When V_{CC} is between 0 and 1.5 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.5V, $\overline{OE}$ should be tied to V_{CC} through a pull-up resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

All input and output are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

Figure 2: Input And Output Equivalent Circuit

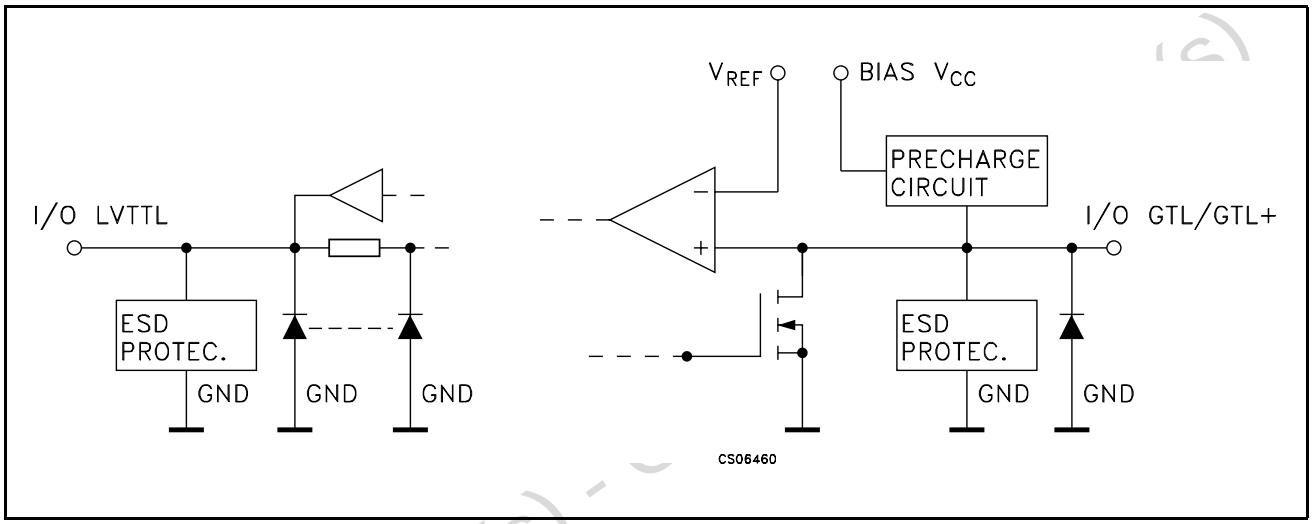


Table 2: Pin Description

PIN N°	SYMBOL	NAME AND FUNCTION
1, 2	$\overline{1OEAB}$, $\overline{1OEBA}$	Output Enable Input
4, 6, 7, 9, 11, 13, 14, 16	1A1 to 1A8	Data Inputs/Outputs LVTTL
17, 19, 20, 22, 23, 25, 27, 29	2A1 to 2A8	Data Inputs/Outputs LVTTL
31, 32	$\overline{2OEAB}$, $\overline{2OEBA}$	Output Enable Input
33	$\overline{OE}$	Output Enable Input
34, 35	2LEBA, 2LEAB	Latch Enable
36	BIAS V_{CC}	Pre-Charge Supply Voltage
37, 38, 40, 42, 43, 45, 46, 48	2B8 to 2B1	Data Inputs/Outputs GTL/GTL+
41	V_{REF}	GTL Voltage Reference Input
49, 51, 52, 54, 55, 56, 58, 59	2A1 to 2A8	Data Inputs/Outputs GTL/GTL+
61	V_{ERC}	Edge Rate Control
62, 63	1LEBA, 1LEAB	Latch Enable
64	CLK	Clock Input (LOW to HIGH edge triggered)
5, 8, 10, 12, 18, 21, 24, 26, 30, 39, 44, 47, 53, 57, 60	GND	Ground (0V)
3, 15, 28, 50	V_{CC}	Positive Supply Voltage

Table 3: Function Table (1)

INPUTS				OUTPUT	MODE
$\overline{OEAB}$	LEAB	CLK	A	B	
H	X	X	X	Z	Isolation
L	H	X	L	L	Transparent
L	H	X	H	H	Transparent
L	L	⎍	L	L	Registered
L	L	⎍	H	H	Registered
L	L	H	X	B0(2)	Previous State
L	L	L	X	B0(3)	Previous State

1) A to B data flow is shown. B to A flow is similar, but uses $\overline{OEBA}$, LEBA and CLK
2) Output level before the indicated steady-state input conditions were established, provided that CLK was high before LEAB went low
3) Output level before the indicated steady-state input conditions were established

Table 4: Output Enable Truth Table

INPUTS			OUTPUTS	
$\overline{OE}$	$\overline{OEAB}$	$\overline{OEBA}$	A PORT	B PORT
L	L	L	Active	Active
L	L	H	Z	Active
L	H	L	Active	Z
L	H	H	Z	Z
H	X	X	Z	Z

Table 5: B-Port Edge Rate Control (V_{ERC}) Truth Table

INPUT V_{ERC}		OUTPUT B PORT EDGE RATE
LOGIC LEVEL	NOMINAL VOLTAGE	
H	V_{CC}	Slow
L	GND	Fast

Figure 3: Logic Diagram

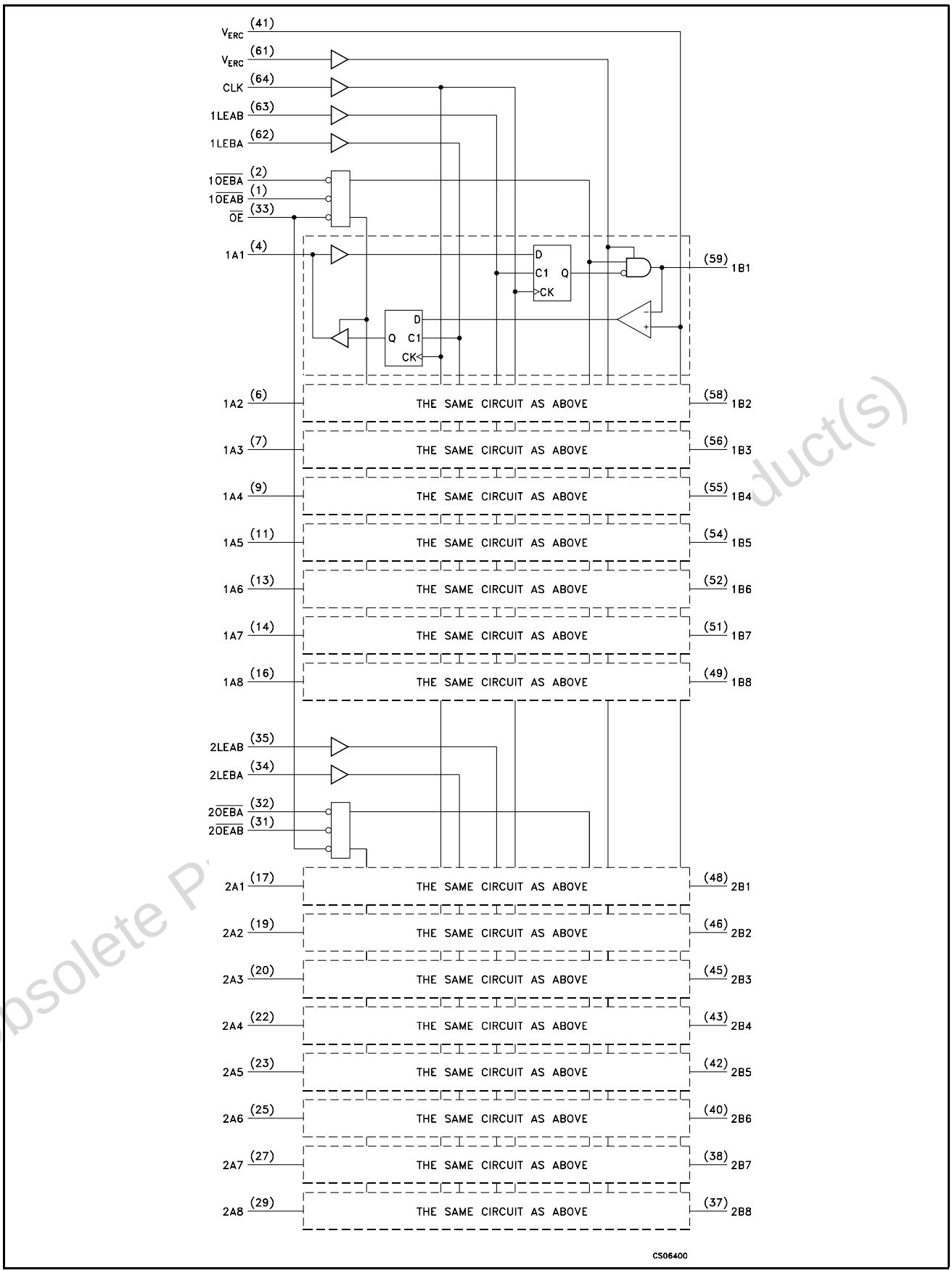


Table 6: Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage, Bias V_{CC}	-0.5 to +4.6	V
V_{IA}	DC Input Voltage A Side, Control Input	-0.5 to +4.6	V
V_{IB}	DC Input Voltage B Side, V_{ERC}, V_{REF}	-0.5 to +4.6	V
V_{OA}	DC Output Voltage A Side	-0.5 to +4.6	V
V_{OB}	DC Output Voltage B Side	-0.5 to +4.6	V
I_{IK}	DC Input Diode Current	- 50	mA
I_{OK}	DC Output Diode Current	- 50	mA
I_{OA}	DC Output Current A Side	± 48	mA
I_{OB}	DC Output Current B Side in the Low State	200	mA
T_{stg}	Storage Temperature	-65 to +150	°C
T_L	Lead Temperature (10 sec)	300	°C

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

Table 7: Recommended Operating Conditions

Symbol	Parameter		Value			Unit
			Min.	Typ.	Max.	
V_{CC}	Supply Voltage		3.0	3.3	3.6	V
V_{TT}	Termination Voltage	GTL	1.14	1.2	1.26	V
		GTL+	1.35	1.5	1.65	
V_{REF}	Supply Voltage	GTL	0.74	0.8	0.87	V
		GTL+	0.87	1	1.1	
V_I	Input Voltage	B port	0		V_{TT}	V
		other	0		V_{CC}	
V_{IH}	High Level Input Voltage	B port	V_{REF}+0.05			V
		other	2			
V_{IL}	Low Level Input Voltage	B port			V_{REF}-0.05	V
		other			0.8	
I_{IK}	Input Clamp Current				-18	mA
I_{OH}	High Level Output Current	A port			-24	mA
I_{OL}	Low Level Output Current	A port			24	mA
		B port			100	
dt/dV_{CC}	Power -up ramp rate		200			µs/V
T_{op}	Operating Temperature		-40		85	°C

1) V_{TT} and R_{TT} can be adjusted to adapt backplane impedance if DC recommended I_{OL} ratings are not exceeded
2) V_{REF} can be adjusted to optimize noise margin (typ two-thirds V_{TT})

Table 8: DC Specifications

Symbol	Parameter		Test Condition		Value			Unit
			V_{CC} (V)		-40 to 85 °C			
					Min.	Typ.	Max.	
V_{IK}	High Level Input Voltage		3				-1.2	V
V_{OHA}	High Level Output Voltage A Port		3 to 3.6	I_O=-100µA	V_{CC}-0.2			V
			3	I_O=-12mA	2.4			
			3	I_O=-24mA	2.2			
V_{OLA}	Low Level Output Voltage A Port		3 to 3.6	I_O=100µA			0.2	V
			3	I_O=12mA			0.4	
			3	I_O=24mA			0.55	
V_{OLB}	Low Level Output Voltage B Port		3	I_O=40mA			0.2	V
			3	I_O=80mA			0.4	
			3	I_O=100mA			0.5	
I_I	Input Current	Control	3.6	V_I = V_{CC} or GND			±10	µA
		B Port	3.6	V_I = V_{TT} or GND			±10	µA
I_{off}	Power Off Leakage Current		0	V_I or V_O = 0 to 3.6V			±100	µA
$I_{I(HOLD)}$	Bus Hold A Port Input Current		3	V_I = 0.8V	75		20	µA
			3	V_I = 2V	-75			
			3.6	V_I = 0 to V_{CC}			± 500	
I_{OZHB}	3-State Output Current B Port		3.6	V_O = 1.5V			10	µA
I_{OZLB}	3-State Output Current B Port		3.6	V_O = 0.4V			-10	µA
I_{OZ} (*)	3-State Output Current A Port		3.6	V_O = V_{CC} or GND			±10	µA
I_{OZPU}**	3-State Output Current A Port		0 to 1.5	V_O = 0.5 to 3V $\overline{OE}$ = LOW			±50	µA
I_{OZPD}**	3-State Output Current A Port		1.5 to 0	V_O = 0.5 to 3V $\overline{OE}$ = LOW			±50	µA
I_{CC}	Quiescent Supply Current		3.6	V_I = V_{CC} or GND I_O=0		10	40	mA
ΔI_{CC}	Δ Supply Current except B port		3.6	V_{IN} = V_{CC} or GND One input V_{CC} =0.6V			1	mA
C_I	Control Input Capacitance			V_{IN} = V_{CC} or GND		3	5	pF
C_O	Input Capacitance A Port			V_O = V_{CC} or GND		5	6	pF
	Input Capacitance B Port					6	8	

(*) For I/O ports, the parameter I_{OZ} includes the input leakage current
(**) Is also guaranteed when connecting BiasV_{CC} with V_{CC}.

Table 9: Live Insertion Specifications

Symbol	Parameter	Test Condition		Value			Unit
		V_{CC} (V)		-40 to 85 °C			
				Min.	Typ.	Max.	
I_{CC} (Bias V_{CC})	Quiescent Bias Current	0 to 3.0	$V_{O(Bport)}$ = 0 to 1.2V			5	mA
		3 to 3.6	$V_{I(Bias\ Vcc)}$ = 3 to 3.6V			10	µA
V_O	Output Voltage B Port	0	$V_{I(Bias\ Vcc)}$ = 3.3V	1		1.2	V
I_O	Output Current B Port	0	$V_{O(Bport)}$ = 0.4V $V_{I(Bias\ Vcc)}$ = 3 to 3.6V	-1			µA
		0 to 3.6	$\overline{OE}$ = 3.3V			100	µA
		0 to 1.5	$\overline{OE}$ = 0 to 3.3V			100	µA

Table 10: AC Electrical Characteristics for GTL
(V_{CC}=3.3 ± 0.3V, V_{TT}=1.2V, V_{REF}=0.8V, V_{ERC}=V_{CC} or GND)

Symbol	Parameter	Test Condition	Value			Unit
			-40 to 85 °C			
			Min.	Typ.	Max.	
f_{MAX}	Maximum Frequency A to B or B to A		160			MHz
t_{PLH}	Propagation Delay Time A to B	V_{ERC}=V_{CC} R_1=12.5Ω C_L=30pF	1.5		5.2	ns
t_{PHL}			1.5		6.2	
t_{PLH}	Propagation Delay Time CK to B	V_{ERC}=V_{CC} R_L=12.5Ω C_L=30pF	1.5		5.5	ns
t_{PHL}			1.5		5.8	
t_{PLH}	Propagation Delay Time LEAB to B	V_{ERC}=V_{CC} R_L=12.5Ω C_L=30pF	1.5		5.8	ns
t_{PHL}			1.5		6.4	
t_{EN}	Enable Delay Time OEAB or OE to B	V_{ERC}=V_{CC} R_L=12.5Ω C_L=30pF	1.5		5.4	ns
t_{DIS}	Disable Delay Time OEAB or OE to B		1.5		6.2	
t_{PLH}	Propagation Delay Time A to B	V_{ERC}=GND R_L=12.5Ω C_L=30pF	1.5		4.3	ns
t_{PHL}			1.5		4.6	
t_{PLH}	Propagation Delay Time CK to B	V_{ERC}=GND R_L=12.5Ω C_L=30pF	1.5		4.3	ns
t_{PHL}			1.5		4.9	
t_{PLH}	Propagation Delay Time LEAB to B	V_{ERC}=GND R_L=12.5Ω C_L=30pF	1.5		4.9	ns
t_{PHL}			1.5		4.8	
t_{EN}	Enable Delay Time OEAB or OE to B	V_{ERC}=GND R_L=12.5Ω C_L=30pF	1.5		4.8	ns
t_{DIS}	Disable Delay Time OEAB or OE to B		1.5		4.2	
t_{PLH}	Propagation Delay Time B to A	R_L=500Ω C_L=50pF	1.5		4.7	ns
t_{PHL}			1.5		4.8	
t_{PLH}	Propagation Delay Time CK to A	R_L=500Ω C_L=50pF	1.5		4	ns
t_{PHL}			1.5		4	
t_{PLH}	Propagation Delay Time LEBA to A	R_L=500Ω C_L=50pF	1.5		4	ns
t_{PHL}			1.5		3.7	

Symbol	Parameter	Test Condition		Value			Unit
				-40 to 85 °C			
				Min.	Typ.	Max.	
t_{EN}	Enable Delay Time OEBA or OE to A	R_L=500Ω R_1=500ΩC_L=50pF		1		4.6	ns
t_{DIS}	Disable Delay Time OEBA or OE to A			1		6.1	
t_{SU}	Set-up Time	Data before clock		2.7			ns
		Data before LE	Ck High	2.8			
			Ck Low	2.6			
t_H	Hold Time	Data after clock		0.4			ns
		Data after LE Ck High or LOW		0.9			
t_W	Pulse duration	LE High		3			ns
		CK High or Low		3			
Slew rate	Slew rate B output both transition (0.6 to 1.3V)	V_{ERC}=V_{CC}				1	ns/V
		V_{ERC}=GND				1	
t_{sk}	Skew between drivers (in the same package)	Switching in the same direction				1	ns
		Switching in any direction				1	

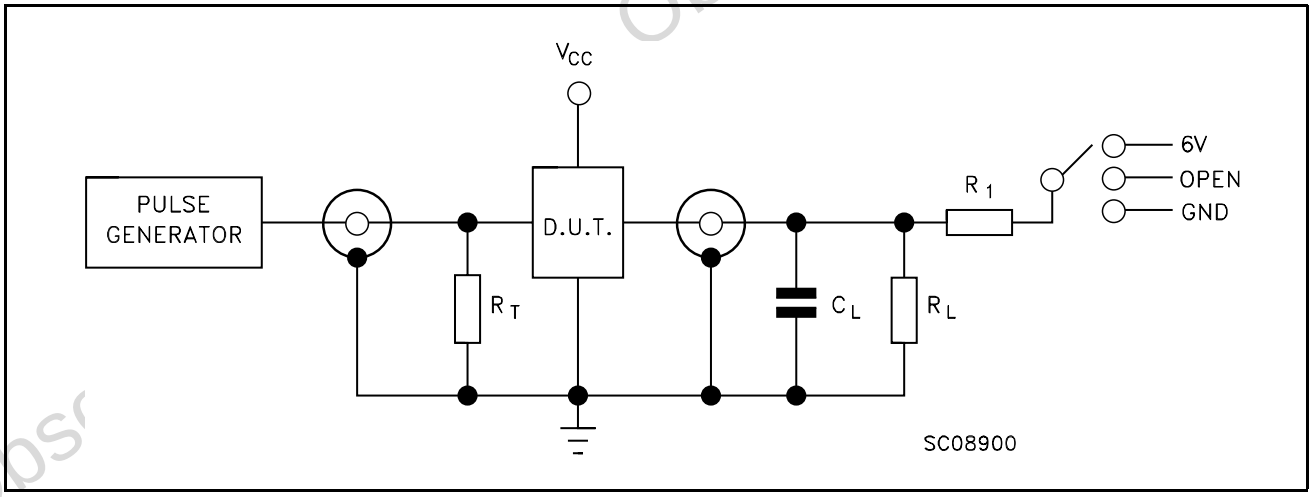
Table 11: AC Electrical Characteristics for GTL+

(V_{CC}=3.3 ± 0.3V, V_{TT}=1.5V, V_{REF}=1.0V, V_{ERC}=V_{CC} or GND)

Symbol	Parameter	Test Condition	Value			Unit
			-40 to 85 °C			
			Min.	Typ.	Max.	
f_{MAX}	Maximum Frequency B to A or A to B		160			MHz
t_{PLH}	Propagation Delay Time A to B	V_{ERC}=V_{CC} R_L=12.5Ω C_L=30pF	1.5		5.1	ns
t_{PHL}			1.5		6.5	
t_{PLH}	Propagation Delay Time CK to B	V_{ERC}=V_{CC} R_L=12.5Ω C_L=30pF	1.5		5.4	ns
t_{PHL}			1.5		6.2	
t_{PLH}	Propagation Delay Time LEAB to B	V_{ERC}=V_{CC} R_L=12.5Ω C_L=30pF	1.5		5.7	ns
t_{PHL}			1.5		6.7	
t_{EN}	Enable Delay Time OEAB or OE to B	V_{ERC}=V_{CC} R_L=12.5Ω C_L=30pF	1.5		5.5	ns
t_{DIS}	Disable Delay Time OEAB or OE to B		1.5		5.8	
t_{PLH}	Propagation Delay Time A to B	V_{ERC}=GND R_L=12.5Ω C_L=30pF	1.0		4.3	ns
t_{PHL}			1.0		4.9	
t_{PLH}	Propagation Delay Time CK to B	V_{ERC}=GND R_L=12.5Ω C_L=30pF	1.0		4.0	ns
t_{PHL}			1.0		5.5	
t_{PLH}	Propagation Delay Time LEAB to B	V_{ERC}=GND R_L=12.5Ω C_L=30pF	1.0		4.0	ns
t_{PHL}			1.0		5.4	
t_{EN}	Enable Delay Time OEAB or OE to B	V_{ERC}=GND R_L=12.5Ω C_L=30pF	1.0		5.1	ns
t_{DIS}	Disable Delay Time OEAB or OE to B		1.0		4.9	

Symbol	Parameter	Test Condition		Value			Unit
				-40 to 85 °C			
				Min.	Typ.	Max.	
t_{PLH}	Propagation Delay Time B to A	R_L=500Ω C_L=50pF		1.5		4.8	ns
t_{PHL}				1.5		4.7	
t_{PLH}	Propagation Delay Time CK to A	R_L=500Ω C_L=50pF		1.5		4.4	ns
t_{PHL}				1.5		4.1	
t_{PLH}	Propagation Delay Time LEBA to A	R_L=500Ω C_L=50pF		1.5		4	ns
t_{PHL}				1.5		3.7	
t_{EN}	Enable Delay Time OEBA or OE to A	R_L=500Ω R_1=500ΩC_L=50pF		1		4.2	ns
t_{DIS}	Disable Delay Time OEBA or OE to A			1		6.1	
Slew rate	Slew rate B output both transition (0.6 to 1.3V)	V_{ERC}=V_{CC} R_L=12.5Ω C_L=30pF				1	ns/V
		V_{ERC}=GND R_L=12.5Ω C_L=30pF				1	
t_W	Pulse duration	LE High		3			ns
		CK High or Low		3			
t_{SU}	Set-up Time	Data before clock		2.7			ns
		Data before LE	Ck High	2.8			
			Ck Low	2.6			
t_H	Hold Time	Data after clock		0.4			ns
		Data after LE Ck High or LOW		0.9			
t_{sk}	Skew between drivers (in the same package)	Switching in the same direction				1	ns
		Switching in any direction				1	

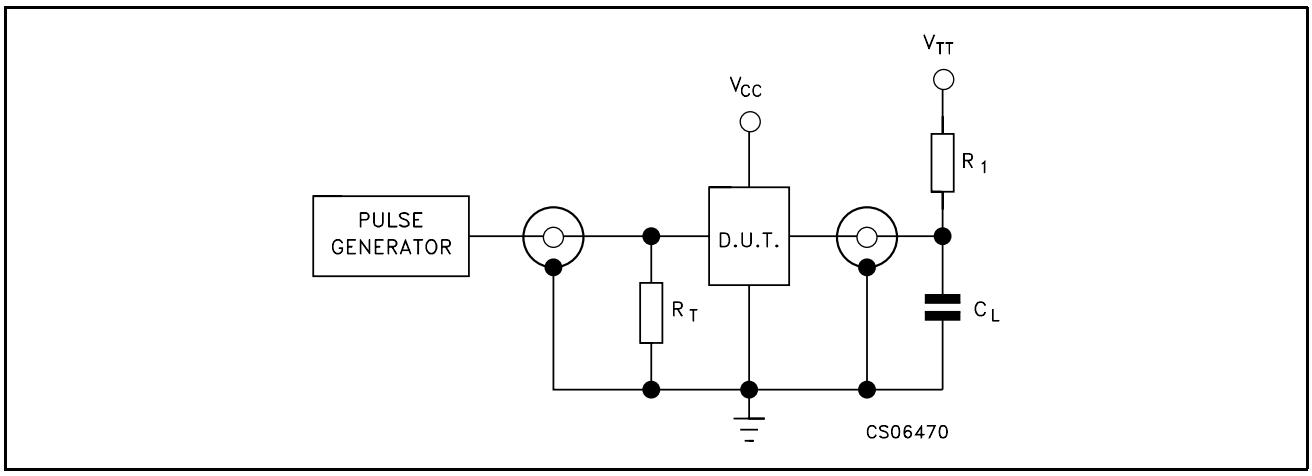
Figure 4: Test Circuit For "A" Outputs



Test	Switch
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V
t_{PZH}, t_{PHZ}	GND

C_L = 50pF or equivalent (includes jig and probe capacitance)
R_L = R_1 = 500Ω or equivalent
R_T = Z_{OUT} of pulse generator (typically 50Ω)
t_r=t_f <=2.5ns

Table 12: Test Circuit For "B" Outputs



C_L = 30pF or equivalent (includes jig and probe capacitance)

R_L = R1 = 12.5Ω or equivalent

R_T = Z_{OUT} of pulse generator (typically 50Ω)

t_r=t_f <=2.5ns

Figure 5: Waveform - Pulse Duration (A Port, Control Pin)

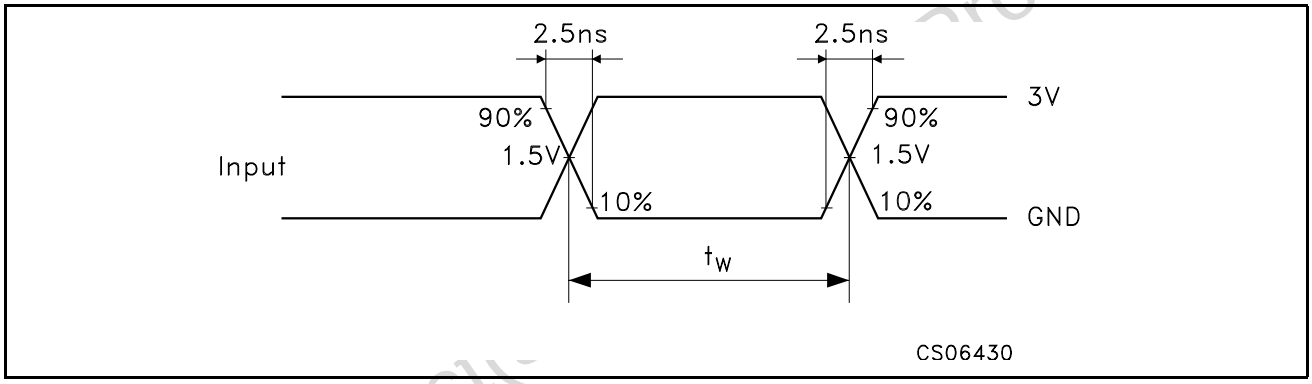


Figure 6: Waveform - Clock To B Port Propagation Delay Time

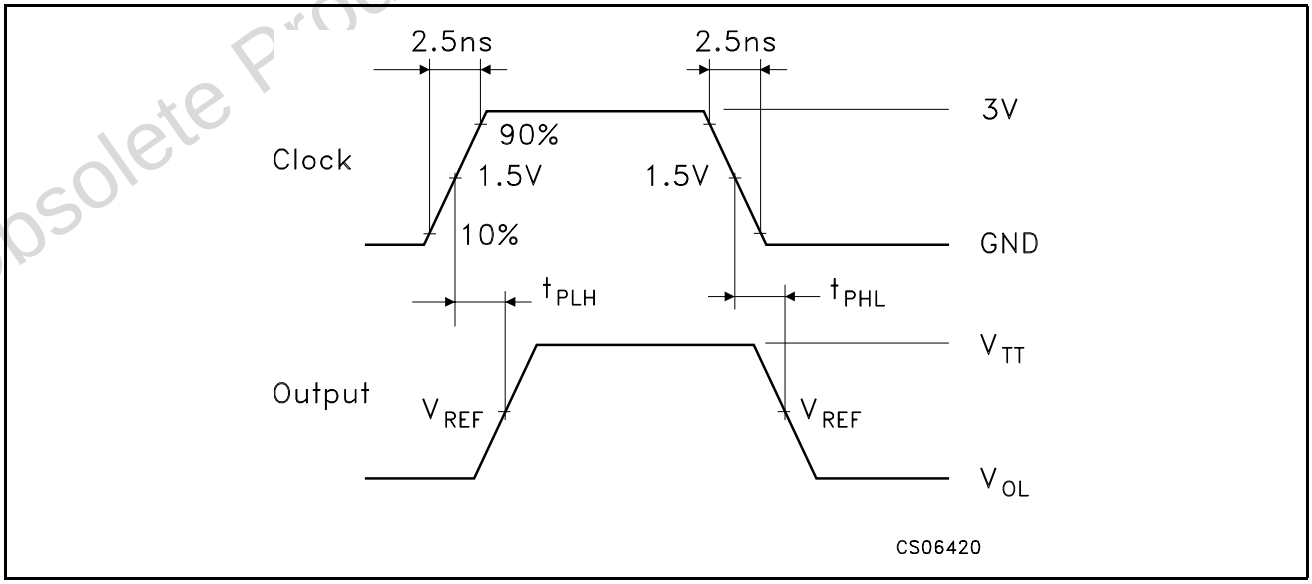


Figure 7: Waveform - Clock To A Port Propagation Delay Time

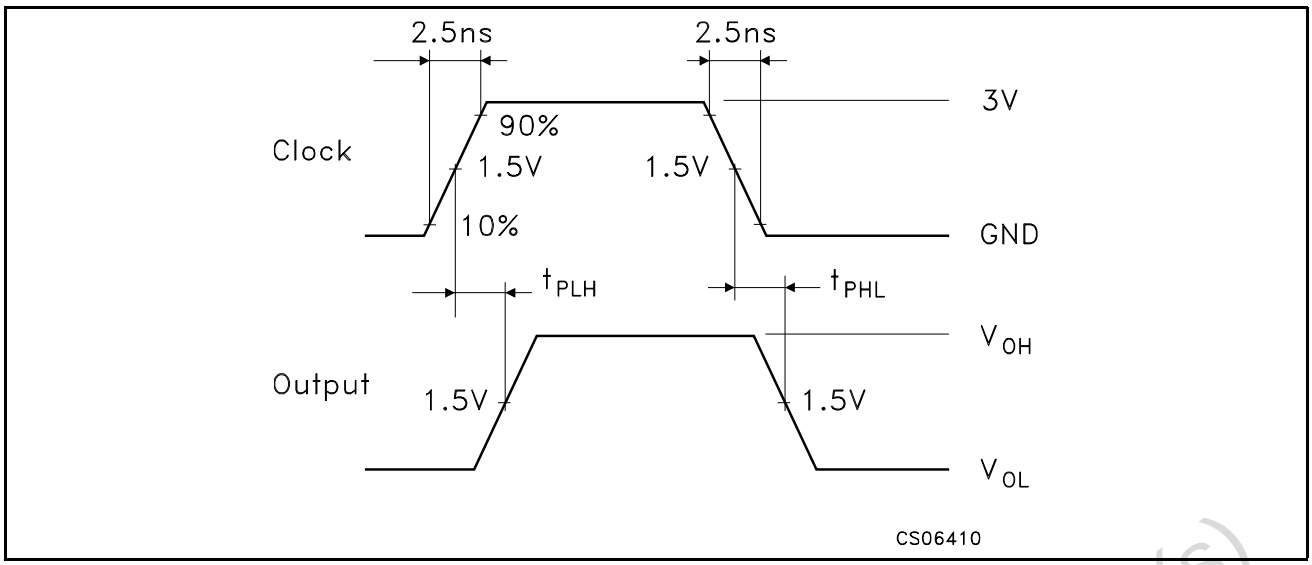


Figure 8: Waveform - Setup And Hold Time

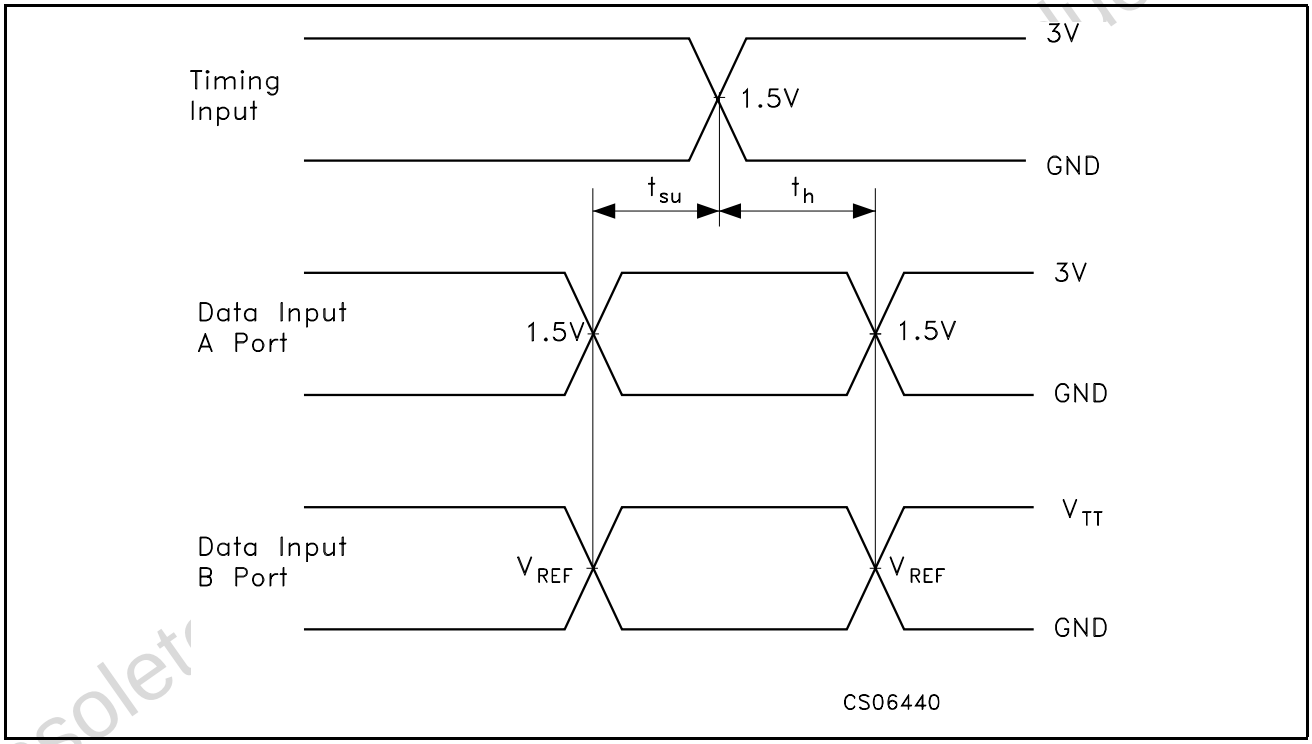
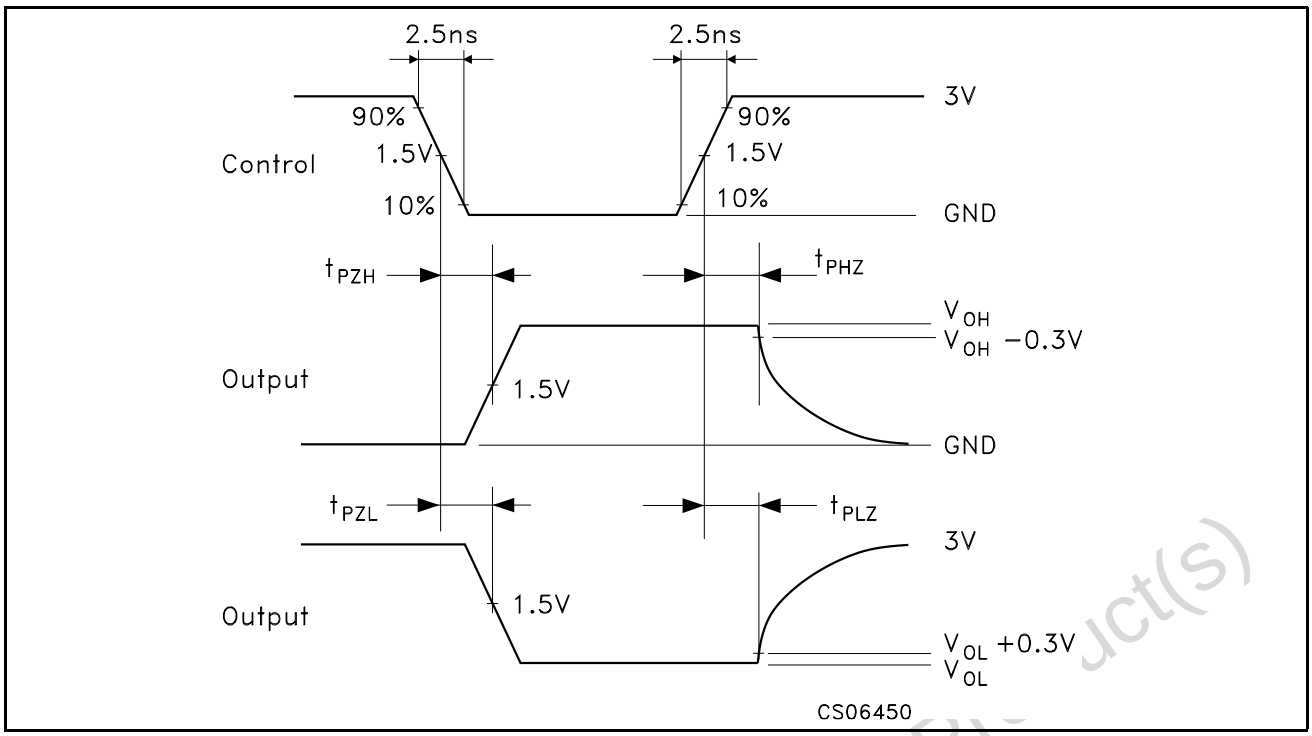
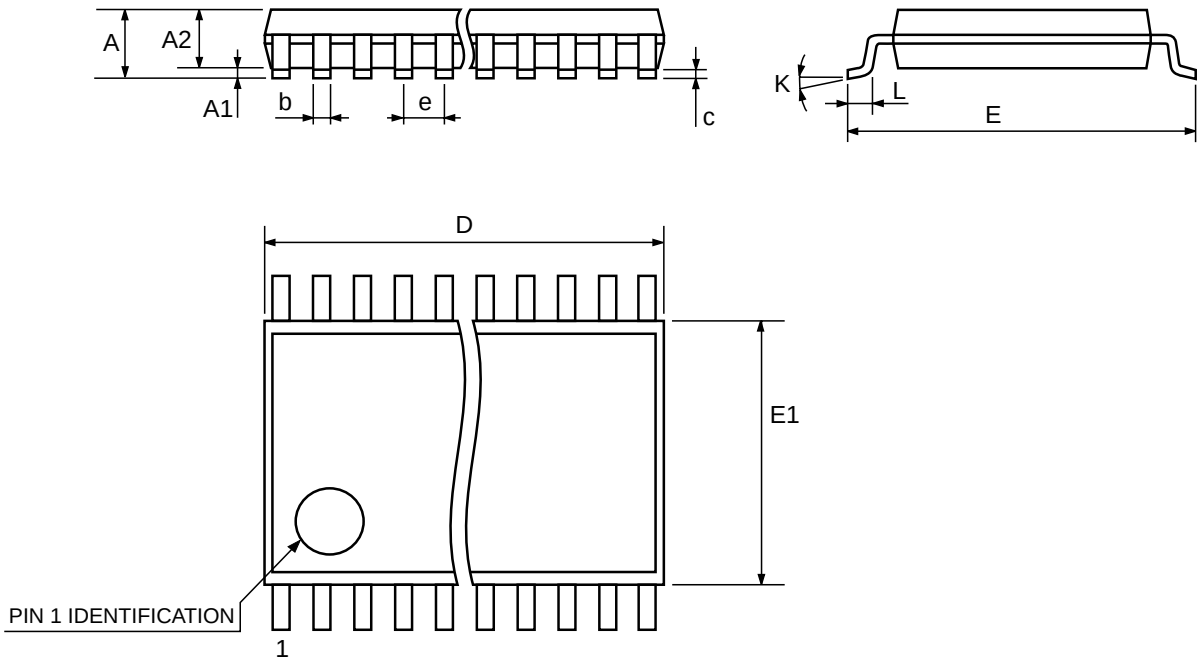


Figure 9: Waveform - Enable And Disable Time (A Port)



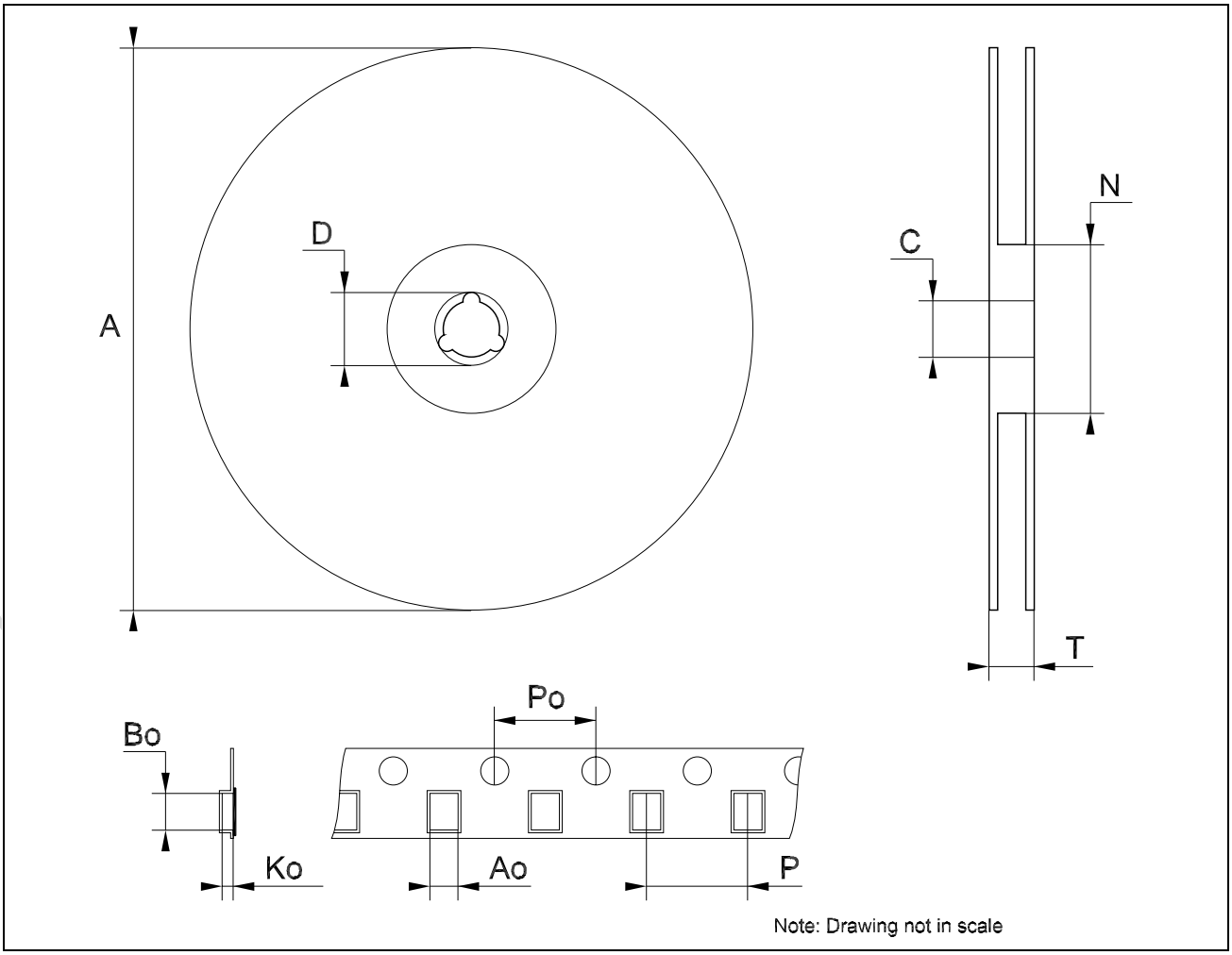
TSSOP64 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.1			0.043
A1	0.05		0.15	0.002		0.006
A2		0.9			0.035	
b	0.17		0.27	0.0067		0.011
c	0.09		0.20	0.0035		0.0079
D	16.9		17.1	0.665		0.673
E		8.1			0.318	
E1	6.0		6.2	0.236		0.244
e		0.5 BSC			0.0197 BSC	
K	0°		8°	0°		8°
L	0.50		0.75	0.020		0.030



Tape & Reel TSSOP64 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			30.4			1.197
Ao	8.7		8.9	0.342		0.350
Bo	17.2		17.4	0.677		0.685
Ko	1.4		1.6	0.055		0.063
Po	3.9		4.1	0.153		0.161
P	11.9		12.1	0.468		0.476



Note: Drawing not in scale

Table 13: Revision History

Date	Revision	Description of Changes
18-Oct-2004	1	First Release.