SGM4T245S
4-Bit Dual-Supply Bus Transceiver with Configurable Voltage Translation and 3-State Outputs

GENERAL DESCRIPTION

The SGM4T245S is a 4-bit bus transceiver with configurable voltage translation and 3-state outputs. The nAn and nBn are 4-bit data input and output ports, nDIR is the direction control input and n$\overline{OE}$ is an output enable input. V_{CCA} and V_{CCB} are dual-supply pins. The supply voltage of V_{CCA} and V_{CCB} can range from 1.2V to 5.5V, making the device suitable for bidirectional translating among any of the 1.2V, 1.5V, 1.8V, 2.5V, 3.3V and 5.5V voltage nodes. The nAn, nDIR and n$\overline{OE}$ pins are referenced to V_{CCA}, and nBn pins are referenced to V_{CCB}.

The direction control (nDIR) input determines the direction of the data flow. The nDIR (active high) enables data from nAn ports to nBn ports. The nDIR (active low) enables data from nBn ports to nAn ports. When the output enable (n$\overline{OE}$) input is high, both nAn and nBn ports are disabled, so the buses are effectively isolated.

This device is highly suitable for partial power-down applications using power-off leakage current (I_{OFF}) circuit. When the device is powered down, the current backflow will be prevented from passing through the device.

FEATURES

- **V_{CCA} Supply Voltage Range: 1.2V to 5.5V**
- **V_{CCB} Supply Voltage Range: 1.2V to 5.5V**
- **Inputs Accept Voltages Higher than the Supply Voltage**
- **+20mA/-20mA Output Current**
- **Outputs in High-Impedance State when V_{CCA} or V_{CCB} = 0V**
- **-40℃ to +125℃ Operating Temperature Range**
- **Available in Green TSSOP-16 and TQFN-2.6×1.8-16L Packages**

APPLICATIONS

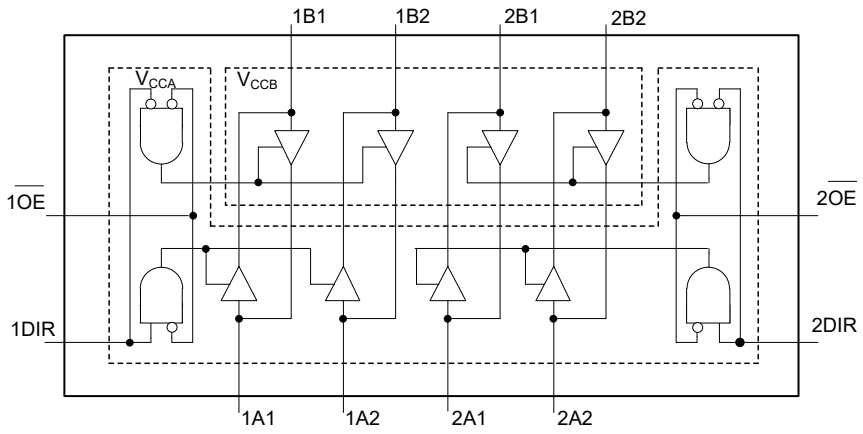
Personal Electronic
Industrial Equipment
Enterprise Infrastructures
Telecom Equipment

FUNCTION TABLE

CONTROL INPUTS		INPUT/OUTPUT	
n$\overline{OE}$	nDIR	nAn	nBn
L	L	nAn = nBn	Inputs
L	H	Inputs	nBn = nAn
H	*X*	Z	Z

H = High Voltage Level; L = Low Voltage Level
Z = High-Impedance State; *X* = Don't Care

LOGIC DIAGRAM

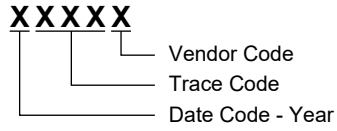


PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM4T245S	TSSOP-16	-40℃ to +125℃	SGM4T245SXTS16G/TR	SGM06L XTS16 XXXXX	Tape and Reel, 4000
	TQFN-2.6×1.8-16L	-40℃ to +125℃	SGM4T245SXTQA16G/TR	06K XXXXX	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code.



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

ABSOLUTE MAXIMUM RATINGS (1)

Supply Voltage Range, V_{CCA} ..... -0.3V to 6.0V
Supply Voltage Range, V_{CCB} ..... -0.3V to 6.0V
Input Voltage Range, V_I (2) ..... -0.3V to 6.0V
Output Voltage Range, V_O (2)
3-State Mode ..... -0.3V to 6.0V
High-State or Low-State
A Ports ..... -0.3V to MIN(6.0V, V_{CCA} + 0.3V)
B Ports ..... -0.3V to MIN(6.0V, V_{CCB} + 0.3V)
Input Clamp Current, I_{IK} (V_I < 0V) ..... -70mA
Output Clamp Current, I_{OK} (V_O < 0V) ..... -70mA
Continuous Output Current, I_O ..... ±70mA
Continuous Output Current (V_{CCA}, V_{CCB} or GND) ..... ±100mA
Junction Temperature (3) ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility
HBM 2000V
CDM 1000V

RECOMMENDED OPERATING CONDITIONS

Supply Voltage Range, V_{CCA} ..... 1.2V to 5.5V
Supply Voltage Range, V_{CCB} ..... 1.2V to 5.5V
Input Voltage Range, V_I ..... 0V to 5.5V
Output Voltage Range, V_O
3-State Mode ..... 0V to 5.5V
High-State or Low-State
A Ports ..... 0V to V_{CCA}
B Ports ..... 0V to V_{CCB}
Operating Temperature Range ..... -40℃ to +125℃

OVERSTRESS CAUTION

1. Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

2. The input and output voltage ratings may be exceeded if the input and output clamp current ratings are observed.

3. The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability.

ESD SENSITIVITY CAUTION

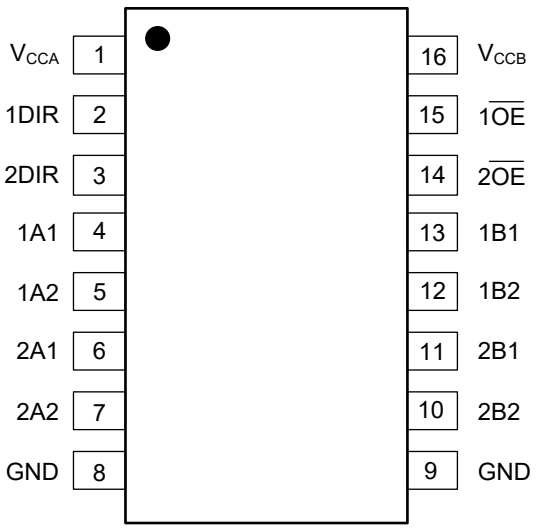
This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

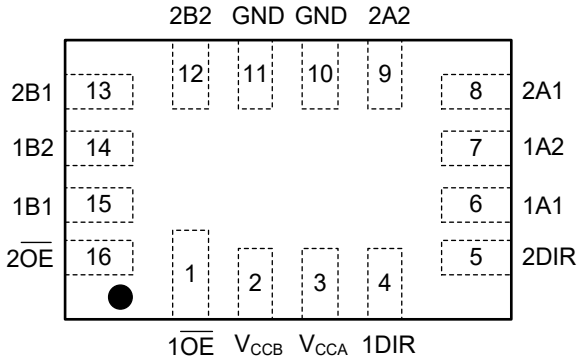
PIN CONFIGURATIONS

(TOP VIEW)



TSSOP-16

(TOP VIEW)



TQFN-2.6×1.8-16L

PIN DESCRIPTION

PIN		NAME	FUNCTION
TSSOP-16	TQFN-2.6×1.8-16L		
1	3	V_{CCA}	Supply Voltage V_{CCA}. The nAn, nDIR and n$\overline{OE}$ signals are referenced to V_{CCA}.
2, 3	4, 5	1DIR, 2DIR	Direction Control Inputs.
4, 5	6, 7	1A1, 1A2	Data Inputs/Outputs.
6, 7	8, 9	2A1, 2A2	Data Inputs/Outputs.
8, 9	10, 11	GND	Ground.
11, 10	13,12	2B1, 2B2	Data Inputs/Outputs.
13, 12	15, 14	1B1, 1B2	Data Inputs/Outputs.
15, 14	16, 1	1$\overline{OE}$, 2$\overline{OE}$	Output Enable Inputs (Active Low).
16	2	V_{CCB}	Supply Voltage V_{CCB}. The nBn signals are referenced to V_{CCB}

ELECTRICAL CHARACTERISTICS

(Full = -40℃ to +125℃, all typical values are measured at T_A = +25℃. V_{CCI} is the supply voltage associated with the data input ports. V_{CCO} is the supply voltage associated with the data output ports, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		TEMP	MIN	TYP	MAX	UNITS
High-Level Input Voltage	V_{IH}	Data inputs	V_{CCI} = 1.2V to 1.4V	Full	0.85 × V_{CCI}			V
			V_{CCI} = 1.4V to 2.3V	Full	0.75 × V_{CCI}			
			V_{CCI} = 2.3V to 3.3V	Full	1.75			
			V_{CCI} = 3.3V to 5.0V	Full	2.20			
		nDIR, n$\overline{OE}$ inputs	V_{CCI} = 1.2V to 1.4V	Full	0.85 × V_{CCA}			
			V_{CCI} = 1.4V to 2.3V	Full	0.75 × V_{CCA}			
			V_{CCI} = 2.3V to 3.3V	Full	1.75			
			V_{CCI} = 3.3V to 5.0V	Full	2.20			
Low-Level Input Voltage	V_{IL}	Data inputs	V_{CCI} = 1.2V to 1.4V	Full			0.10 × V_{CCI}	V
			V_{CCI} = 1.4V to 2.3V	Full			0.15 × V_{CCI}	
			V_{CCI} = 2.3V to 3.3V	Full			0.50	
			V_{CCI} = 3.3V to 5.0V	Full			0.65	
		nDIR, n$\overline{OE}$ inputs	V_{CCI} = 1.2V to 1.4V	Full			0.10 × V_{CCA}	
			V_{CCI} = 1.4V to 2.3V	Full			0.15 × V_{CCA}	
			V_{CCI} = 2.3V to 3.3V	Full			0.50	
			V_{CCI} = 3.3V to 5.0V	Full			0.65	
High-Level Output Voltage	V_{OH}	V_I = V_{IH}	I_{OH} = -100μA, V_{CCA} = V_{CCB} = 1.2V to 5.0V	Full	V_{CC} - 0.05	V_{CC} - 0.005		V
			I_{OH} = -1mA, V_{CCA} = V_{CCB} = 1.2V	Full	1.1	1.18		
			I_{OH} = -5mA, V_{CCA} = V_{CCB} = 1.4V	Full	1.2	1.32		
			I_{OH} = -16mA, V_{CCA} = V_{CCB} = 1.65V	Full	1.1	1.44		
			I_{OH} = -20mA, V_{CCA} = V_{CCB} = 2.3V	Full	1.9	2.13		
			I_{OH} = -20mA, V_{CCA} = V_{CCB} = 5.0V	Full	4.7	4.89		
Low-Level Output Voltage	V_{OL}	V_I = V_{IL}	I_{OL} = 100μA, V_{CCA} = V_{CCB} = 1.2V to 5.0V	Full		0.005	0.05	V
			I_{OL} = 1mA, V_{CCA} = V_{CCB} = 1.2V	Full		0.02	0.1	
			I_{OL} = 5mA, V_{CCA} = V_{CCB} = 1.4V	Full		0.07	0.2	
			I_{OL} = 16mA, V_{CCA} = V_{CCB} = 1.65V	Full		0.19	0.4	
			I_{OL} = 20mA, V_{CCA} = V_{CCB} = 2.3V	Full		0.18	0.4	
			I_{OL} = 20mA, V_{CCA} = V_{CCB} = 5.0V	Full		0.14	0.3	
Input Leakage Current	I_I	Control inputs, V_{CCA} = 1.2V to 5.5V, V_{CCB} = 1.2V to 5.5V, V_I = V_{CCA} or GND		Full		±0.01	±2	μA
Power-Off Leakage Current	I_{OFF}	A port, V_{CCA} = 0V, V_{CCB} = 1.2V to 5.5V, V_I or V_O = 0V to 5.5V		Full		±0.01	±10	μA
		B port, V_{CCB} = 0V, V_{CCA} = 1.2V to 5.5V, V_I or V_O = 0V to 5.5V		Full		±0.01	±10	
Off-State Output Current (1)	I_{OZ}	A or B port, V_{CCA} = V_{CCB} = 5.5V, V_O = 0V or V_{CCO}		Full		±0.01	±10	μA
		A port, V_{CCA} = 5.5V, V_{CCB} = 0V, V_O = 0V or V_{CCO}		Full		±0.01	±10	
		B port, V_{CCA} = 0V, V_{CCB} = 5.5V, V_O = 0V or V_{CCO}		Full		±0.01	±10	
Supply Current	I_{CCA}	V_{CCA} = 1.2V to 5.5V, V_{CCB} = 1.2V to 5.5V, V_I = V_{CCI} or GND, I_O = 0A		Full		10	15	μA
	I_{CCB}			Full		20	28	
	I_{CCA} + I_{CCB}			Full		30	43	
Input Capacitance	C_I	Control inputs, V_{CCA} = V_{CCB} = 3.3V, V_I = 3.3V or GND		+25℃		4.5		pF
Input/Output Capacitance	C_{IO}	A or B ports, V_{CCA} = V_{CCB} = 3.3V, V_O = 3.3V or GND		+25℃		7		pF

NOTE: 1. For I/O ports, the parameter I_{OZ} includes the input leakage current.

DYNAMIC CHARACTERISTICS

(See Figure 1 for test circuit. See Figure 2 and Figure 3 for waveforms. Full = -40℃ to +125℃, all typical values are measured at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	V_{CCB}									UNITS
			1.2V			1.5V			1.8V			
			MIN (1)	TYP	MAX (1)	MIN (1)	TYP	MAX (1)	MIN (1)	TYP	MAX (1)	
V_{CCA} = 1.2V												
Propagation Delay	t_{PLH}	nAn to nBn		68			43			36		ns
	t_{PHL}			92			43			28		
	t_{PLH}	nBn to nAn		70			59			55		ns
	t_{PHL}			97			92			90		
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn		102			102			102		ns
	t_{PZL}			128			128			128		
	t_{PZH}	$n\overline{OE}$ to nBn		97			64			54		ns
	t_{PZL}			125			70			56		
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn		44			44			44		ns
	t_{PLZ}			38			38			38		
	t_{PHZ}	$n\overline{OE}$ to nBn		80			50			51		ns
	t_{PLZ}			79			56			54		
V_{CCA} = 1.5V												
Propagation Delay	t_{PLH}	nAn to nBn		53		2	29	74	2	22	49	ns
	t_{PHL}			86		2	37	80	2	24	52	
	t_{PLH}	nBn to nAn		43		2	30	74	1	26	63	ns
	t_{PHL}			43		2	38	80	1	36	71	
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn		43		2	43	96	2	43	96	ns
	t_{PZL}			48		2	48	110	2	48	110	
	t_{PZH}	$n\overline{OE}$ to nBn		75		2	45	98	2	33	71	ns
	t_{PZL}			99		2	39	110	2	35	76	
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn		20		2	20	43	5	20	43	ns
	t_{PLZ}			17		2	17	32	2	17	32	
	t_{PHZ}	$n\overline{OE}$ to nBn		62		10	36	75	10	29	62	ns
	t_{PLZ}			60		10	34	61	5	27	49	
V_{CCA} = 1.8V												
Propagation Delay	t_{PLH}	nAn to nBn		50		2	24	63	2	17	39	ns
	t_{PHL}			84		1	35	71	2	22	43	
	t_{PLH}	nBn to nAn		35		0.1	28	60	2	18	39	ns
	t_{PHL}			31		5	24	52	2	23	43	
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn		27		2	27	58	2	27	58	ns
	t_{PZL}			29		2	29	62	2	29	62	
	t_{PZH}	$n\overline{OE}$ to nBn		70		2	36	85	2	27	58	ns
	t_{PZL}			98		2	42	97	2	29	64	
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn		14		2	14	30	2	14	30	ns
	t_{PLZ}			11		2	11	22	2	11	22	
	t_{PHZ}	$n\overline{OE}$ to nBn		56		10	29	64	5	23	52	ns
	t_{PLZ}			53		5	28	52	5	21	42	

DYNAMIC CHARACTERISTICS (continued)

(See Figure 1 for test circuit. See Figure 2 and Figure 3 for waveforms. Full = -40℃ to +125℃, all typical values are measured at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	V_{CCB}									UNITS
			1.2V			1.5V			1.8V			
			MIN (1)	TYP	MAX (1)	MIN (1)	TYP	MAX (1)	MIN (1)	TYP	MAX (1)	
V_{CCA} = 2.5V												
Propagation Delay	t_{PLH}	nAn to nBn		42		1	22	60	1	14	35	ns
	t_{PHL}			81		1	33	68	2	19	41	
	t_{PLH}	nBn to nAn		31		1	16	36	0.1	13	25	ns
	t_{PHL}			21		1	15	34	0.1	17	31	
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn		15		1	15	28	2	15	28	ns
	t_{PZL}			15		1	15	28	2	15	28	
	t_{PZH}	$n\overline{OE}$ to nBn		65		2	31	76	2	22	49	ns
	t_{PZL}			87		1	37	90	2	24	54	
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn		8		1	8	24	1	8	24	ns
	t_{PLZ}			6		1	6	14	1	6	14	
	t_{PHZ}	$n\overline{OE}$ to nBn		52		10	25	58	2	18	40	ns
	t_{PLZ}			49		5	23	44	2	16	32	
V_{CCA} = 3.3V												
Propagation Delay	t_{PLH}	nAn to nBn		46		0.1	21	58	1	13	34	ns
	t_{PHL}			80		0.1	32	68	2	19	40	
	t_{PLH}	nBn to nAn		27		1	15	32	1	11	22	ns
	t_{PHL}			19		0.1	13	23	1	11	20	
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn		10		1	10	20	1	10	20	ns
	t_{PZL}			10		1	10	18	1	10	18	
	t_{PZH}	$n\overline{OE}$ to nBn		64		2	30	74	2	20	44	ns
	t_{PZL}			86		2	36	85	2	22	50	
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn		8		1	8	19	1	8	19	ns
	t_{PLZ}			6		1	6	12	1	6	12	
	t_{PHZ}	$n\overline{OE}$ to nBn		50		10	24	52	2	17	40	ns
	t_{PLZ}			47		5	22	40	2	15	30	
V_{CCA} = 5.0V												
Propagation Delay	t_{PLH}	nAn to nBn		46		0.1	20	58	1	13	33	ns
	t_{PHL}			80		1	34	68	2	21	40	
	t_{PLH}	nBn to nAn		27		1	14	31	1	9	20	ns
	t_{PHL}			19		1	11	20	1	9	16	
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn		9		1	9	14	1	9	14	ns
	t_{PZL}			8		1	8	13	1	8	13	
	t_{PZH}	$n\overline{OE}$ to nBn		62		2	30	75	2	20	43	ns
	t_{PZL}			91		1	35	81	2	22	48	
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn		7		1	7	17	1	7	17	ns
	t_{PLZ}			5		0.1	5	10	0.1	5	10	
	t_{PHZ}	$n\overline{OE}$ to nBn		50		10	23	50	2	16	40	ns
	t_{PLZ}			47		5	21	40	2	14	28	

DYNAMIC CHARACTERISTICS (continued)

(See Figure 1 for test circuit. See Figure 2 and Figure 3 for waveforms. Full = -40℃ to +125℃, all typical values are measured at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	V_{CCB}									UNITS
			2.5V			3.3V			5.0V			
			MIN (1)	TYP	MAX (1)	MIN (1)	TYP	MAX (1)	MIN (1)	TYP	MAX (1)	
V_{CCA} = 1.2V												
Propagation Delay	t_{PLH}	nAn to nBn		31			30			30		ns
	t_{PHL}			22			20			19		
	t_{PLH}	nBn to nAn		52			51			51		ns
	t_{PHL}			89			88			90		
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn		102			102			102		ns
	t_{PZL}			128			128			128		
	t_{PZH}	$n\overline{OE}$ to nBn		49			48			49		ns
	t_{PZL}			49			47			48		
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn		44			44			44		ns
	t_{PLZ}			38			38			38		
	t_{PHZ}	$n\overline{OE}$ to nBn		47			46			47		ns
	t_{PLZ}			46			46			46		
V_{CCA} = 1.5V												
Propagation Delay	t_{PLH}	nAn to nBn	1	17	36	1	15	32	1	14	31	ns
	t_{PHL}		1	15	34	0.1	13	23	0.1	11	20	
	t_{PLH}	nBn to nAn	1	23	60	0.1	22	58	0.1	21	58	ns
	t_{PHL}		1	34	68	1	33	68	0.1	35	68	
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn	2	43	96	2	43	96	2	43	96	ns
	t_{PZL}		2	48	110	2	48	110	2	48	110	
	t_{PZH}	$n\overline{OE}$ to nBn	2	26	53	2	24	46	2	23	43	ns
	t_{PZL}		2	27	54	2	24	46	2	23	43	
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn	5	20	43	5	20	43	2	20	43	ns
	t_{PLZ}		2	17	32	2	17	32	2	17	32	
	t_{PHZ}	$n\overline{OE}$ to nBn	5	24	52	5	23	50	5	23	48	ns
	t_{PLZ}		5	22	40	2	22	39	2	23	38	
V_{CCA} = 1.8V												
Propagation Delay	t_{PLH}	nAn to nBn	1	12	24	0.1	10	22	0.1	9	20	ns
	t_{PHL}		1	14	24	0.1	11	20	0.1	9	18	
	t_{PLH}	nBn to nAn	1	15	35	1	14	34	1	13	33	ns
	t_{PHL}		2	20	41	2	19	40	2	21	40	
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn	2	27	58	2	27	58	2	27	58	ns
	t_{PZL}		2	29	62	2	29	62	2	29	62	
	t_{PZH}	$n\overline{OE}$ to nBn	2	20	38	2	18	32	2	17	28	ns
	t_{PZL}		2	20	39	2	17	32	2	16	27	
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn	2	14	30	2	14	30	2	14	30	ns
	t_{PLZ}		2	11	22	2	11	22	2	11	22	
	t_{PHZ}	$n\overline{OE}$ to nBn	2	17	42	2	16	40	5	16	38	ns
	t_{PLZ}		2	16	33	2	15	32	2	14	26	

DYNAMIC CHARACTERISTICS (continued)

(See Figure 1 for test circuit. See Figure 2 and Figure 3 for waveforms. Full = -40℃ to +125℃, all typical values are measured at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	V_{CCB}									UNITS
			2.5V			3.3V			5.0V			
			MIN (1)	TYP	MAX (1)	MIN (1)	TYP	MAX (1)	MIN (1)	TYP	MAX (1)	
V_{CCA} = 2.5V												
Propagation Delay	t_{PLH}	nAn to nBn	1	9	21	0.1	7	16	1	6	13	ns
	t_{PHL}		1	11	22	0.1	8	16	1	6	13	
	t_{PLH}	nBn to nAn	1	9	21	1	8	20	1	8	19	ns
	t_{PHL}		1	11	22	1	10	22	1	12	21	
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn	1	15	28	1	15	28	1	15	28	ns
	t_{PZL}		1	15	28	1	15	28	1	15	28	
	t_{PZH}	$n\overline{OE}$ to nBn	2	15	30	1	13	22	1	11	20	ns
	t_{PZL}		2	15	30	1	12	22	2	11	18	
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn	1	8	24	1	8	24	1	8	24	ns
	t_{PLZ}		1	6	14	1	6	14	1	6	14	
	t_{PHZ}	$n\overline{OE}$ to nBn	2	13	32	2	35	44	1	12	25	ns
	t_{PLZ}		2	11	24	1	10	22	2	10	20	
V_{CCA} = 3.3V												
Propagation Delay	t_{PLH}	nAn to nBn	1	8	20	0.1	9	18	0.1	5	12	ns
	t_{PHL}		1	10	22	0.1	9	19	0.1	5	10	
	t_{PLH}	nBn to nAn	1	7	16	1	7	14	0.1	6	14	ns
	t_{PHL}		1	8	15	1	7	16	1	9	15	
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn	1	10	20	1	10	20	1	10	20	ns
	t_{PZL}		1	10	18	1	10	18	1	10	18	
	t_{PZH}	$n\overline{OE}$ to nBn	2	13	26	1	11	21	1	9	15	ns
	t_{PZL}		2	13	26	1	10	19	1	8	16	
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn	1	8	19	1	8	19	1	8	19	ns
	t_{PLZ}		1	6	12	1	6	12	1	6	12	
	t_{PHZ}	$n\overline{OE}$ to nBn	1	11	27	1	10	25	1	9	22	ns
	t_{PLZ}		1	10	20	1	10	18	2	8	16	

DYNAMIC CHARACTERISTICS (continued)

(See Figure 1 for test circuit. See Figure 2 and Figure 3 for waveforms. Full = -40℃ to +125℃, all typical values are measured at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	V_{CCB}									UNITS
			2.5V			3.3V			5.0V			
			MIN (1)	TYP	MAX (1)	MIN (1)	TYP	MAX (1)	MIN (1)	TYP	MAX (1)	
V_{CCA} = 5.0V												
Propagation Delay	t_{PLH}	nAn to nBn	1	8	19	0.1	6	18	0.1	5	10	ns
	t_{PHL}		1	12	22	1	9	16	0.1	8	12	
	t_{PLH}	nBn to nAn	1	6	13	0.1	5	12	0.1	5	11	ns
	t_{PHL}		1	6	11	0.1	5	10	0.1	8	12	
Enable Time	t_{PZH}	$n\overline{OE}$ to nAn	1	9	14	1	9	14	1	9	14	ns
	t_{PZL}		1	8	13	1	8	13	1	8	13	
	t_{PZH}	$n\overline{OE}$ to nBn	1	14	24	1	11	18	1	10	14	ns
	t_{PZL}		1	14	24	1	11	17	1	9	13	
Disable Time	t_{PHZ}	$n\overline{OE}$ to nAn	1	7	17	1	7	17	1	7	17	ns
	t_{PLZ}		0.1	5	10	0.1	5	10	0.1	5	10	
	t_{PHZ}	$n\overline{OE}$ to nBn	2	10	30	1	9	25	1	8	22	ns
	t_{PLZ}		2	9	18	1	7	15	1	10	14	

NOTE:

1. Specified by design and characterization, not production tested.

TYPICAL POWER DISSIPATION CAPACITANCE

(T_A = +25℃, V_{CCA} = V_{CCB}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	V_{CCA} = V_{CCB}					UNITS
			1.5V	1.8V	2.5V	3.3V	5.0V	
Power Dissipation Capacitance (1) (2)	C_{PD}	A ports: (direction nAn to nBn)	1.3	1.3	1.3	1.3	1.3	pF
		A ports: (direction nBn to nAn)	18.0	18.0	18.0	18.0	18.0	
		B ports: (direction nAn to nBn)	18.0	18.0	18.0	18.0	18.0	
		B ports: (direction nBn to nAn)	1.3	1.3	1.3	1.3	1.3	

NOTES:

1. C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

   $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$

   where:

   f_i = Input frequency in MHz.

   f_o = Output frequency in MHz.

   C_L = Output load capacitance in pF.

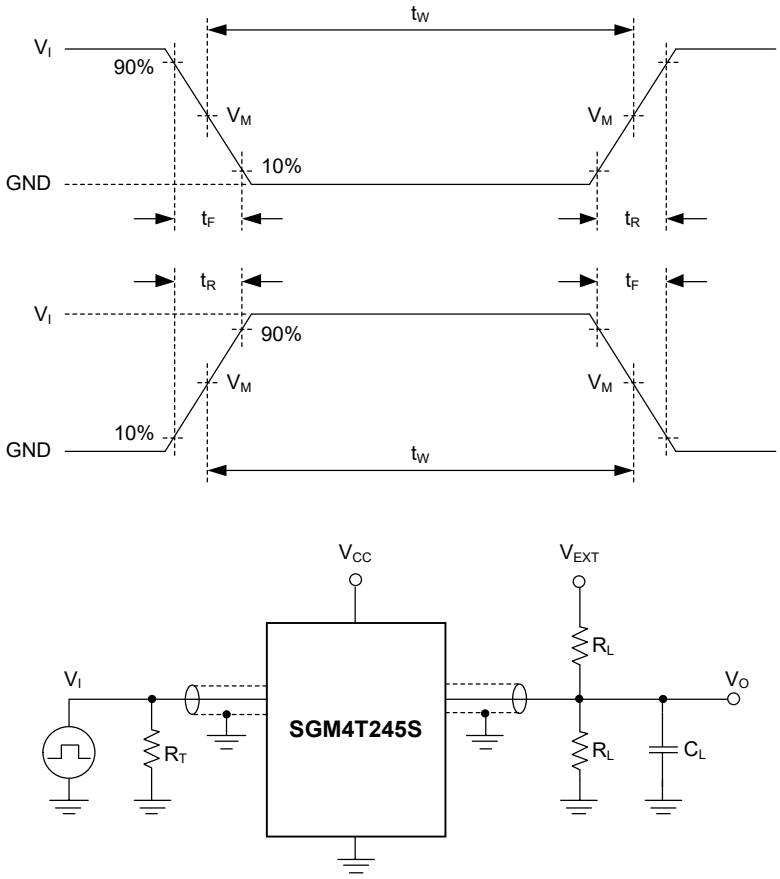
   V_{CC} = Supply voltage in Volts.

   N = Number of inputs switching.

   $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = Sum of the outputs.

2. Per transceiver, f_i = 10MHz, t_R = t_F = 1ns, C_L = 0pF.

TEST CIRCUIT



Test conditions are given in Table 1.

Definitions for test circuit:

R_L: Load resistance.

C_L: Load capacitance (includes jig and probe).

R_T: Termination resistance (equals to output impedance Z_O of the pulse generator).

V_{EXT}: External voltage is used to measure switching time.

Figure 1. Test Circuit for Measuring Switching Times

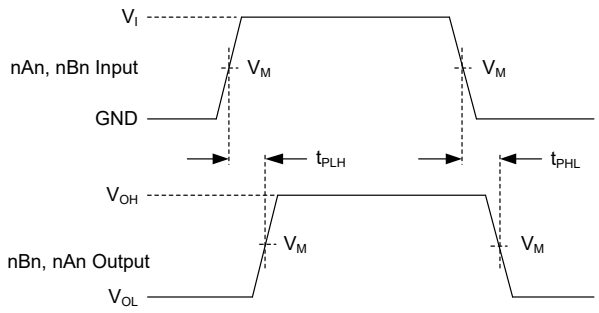
Table 1. Test Conditions

SUPPLY VOLTAGE	INPUT		LOAD		V_{EXT}		
V_{CCA}, V_{CCB}	V_I (1)	Δt/ΔV	C_L	R_L	t_{PLH}, t_{PHL}	t_{PZH}, t_{PHZ}	t_{PZL}, t_{PLZ} (2)
1.2V to 5.5V	V_{CCI}	≤ 1.0ns/V	15pF	2kΩ	Open	GND	2 × V_{CCO}

NOTES:

1. V_{CCI} is the supply voltage associated with the data input ports.
2. V_{CCO} is the supply voltage associated with the data output ports.

WAVEFORMS

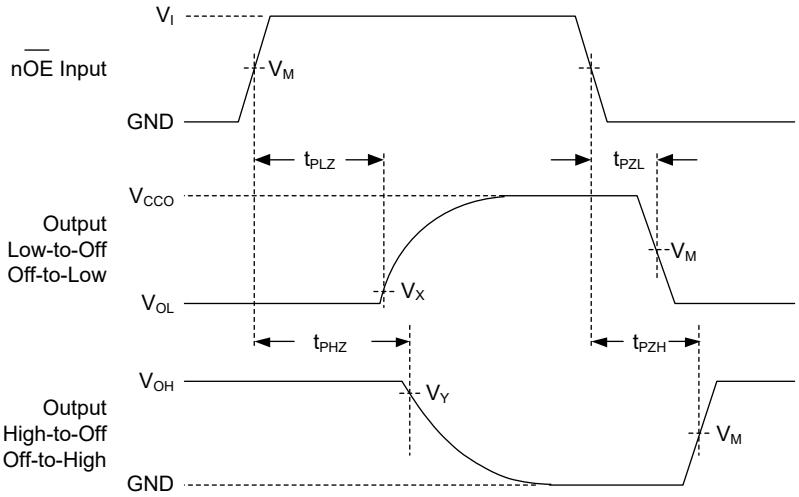


Test conditions are given in Table 1.

Measurement points are given in Table 2.

Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Figure 2. Input (nAn, nBn) to Output (nBn, nAn) Propagation Delay Times



Test conditions are given in Table 1.

Measurement points are given in Table 2.

Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Figure 3. Enable and Disable Times

Table 2. Measurement Points

SUPPLY VOLTAGE	INPUT (1)		OUTPUT		
V_{CCA}, V_{CCB}	V_I	V_M (2)	V_M (3)	V_X	V_Y
1.2V	V_{CCI}	0.5 × V_{CCI}	0.5 × V_{CCO}	V_{OL} + 0.1V	V_{OH} - 0.1V
1.5V ± 0.1V	V_{CCI}	0.5 × V_{CCI}	0.5 × V_{CCO}	V_{OL} + 0.1V	V_{OH} - 0.1V
1.8V ± 0.15V	V_{CCI}	0.5 × V_{CCI}	0.5 × V_{CCO}	V_{OL} + 0.15V	V_{OH} - 0.15V
2.5V ± 0.2V	V_{CCI}	0.5 × V_{CCI}	0.5 × V_{CCO}	V_{OL} + 0.15V	V_{OH} - 0.15V
3.3V ± 0.3V	V_{CCI}	0.5 × V_{CCI}	0.5 × V_{CCO}	V_{OL} + 0.3V	V_{OH} - 0.3V
5.0V ± 0.5V	V_{CCI}	0.5 × V_{CCI}	0.5 × V_{CCO}	V_{OL} + 0.5V	V_{OH} - 0.5V

NOTES:

1. V_{CCI} is the supply voltage associated with the data input ports.
2. The measurement points should be V_{IH} or V_{IL} when Δt/ΔV > 1.0ns/V.
3. V_{CCO} is the supply voltage associated with the data output ports.

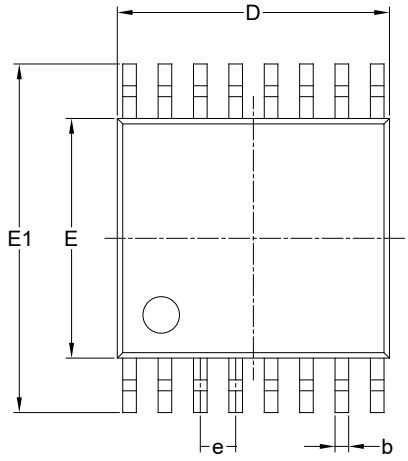
REVISION HISTORY

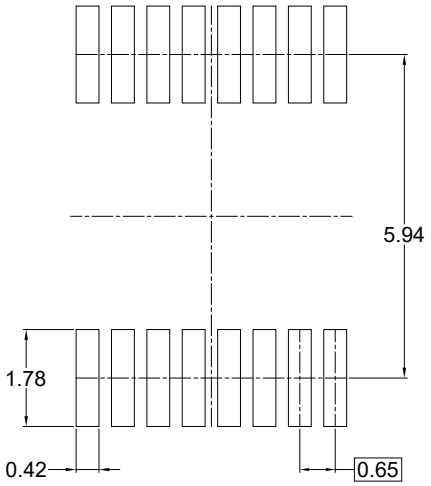
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (DECEMBER 2023) to REV.A	Page
Changed from product preview to production data	All

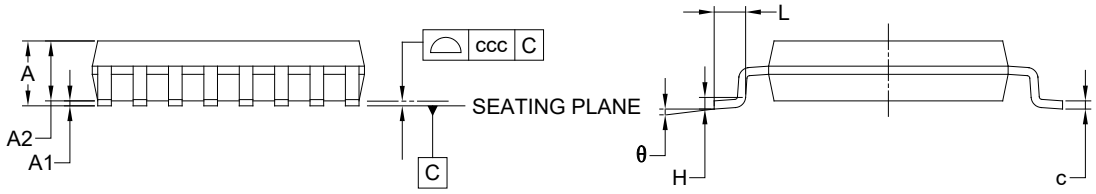
PACKAGE OUTLINE DIMENSIONS

TSSOP-16





RECOMMENDED LAND PATTERN (Unit: mm)

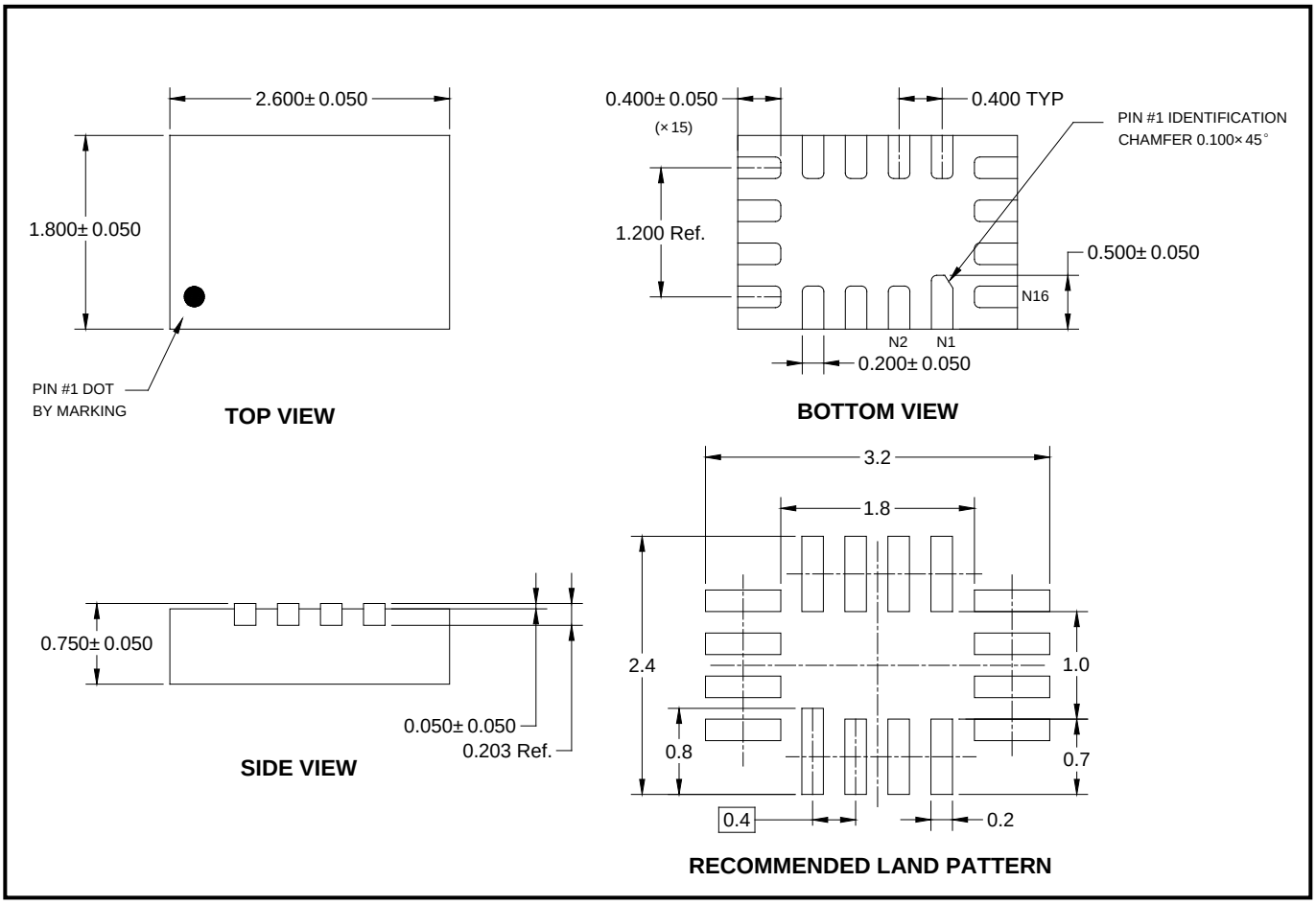


Symbol	Dimensions In Millimeters		
	MIN	MOD	MAX
A	-	-	1.200
A1	0.050	-	0.150
A2	0.800	-	1.050
b	0.190	-	0.300
c	0.090	-	0.200
D	4.860	-	5.100
E	4.300	-	4.500
E1	6.200	-	6.600
e	0.650 BSC		
L	0.450	-	0.750
H	0.250 TYP		
θ	0°	-	8°
ccc	0.100		

NOTES:
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-153.

PACKAGE OUTLINE DIMENSIONS

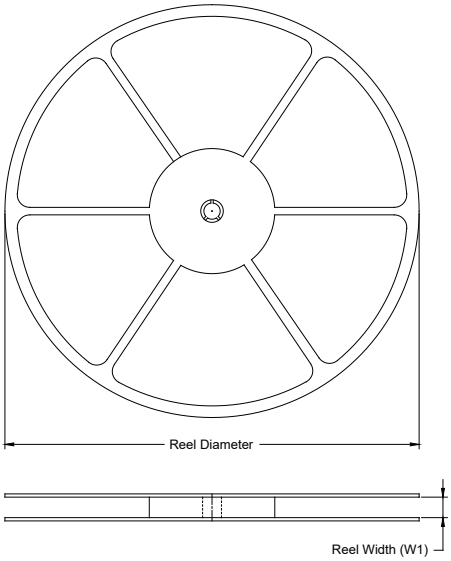
TQFN-2.6×1.8-16L



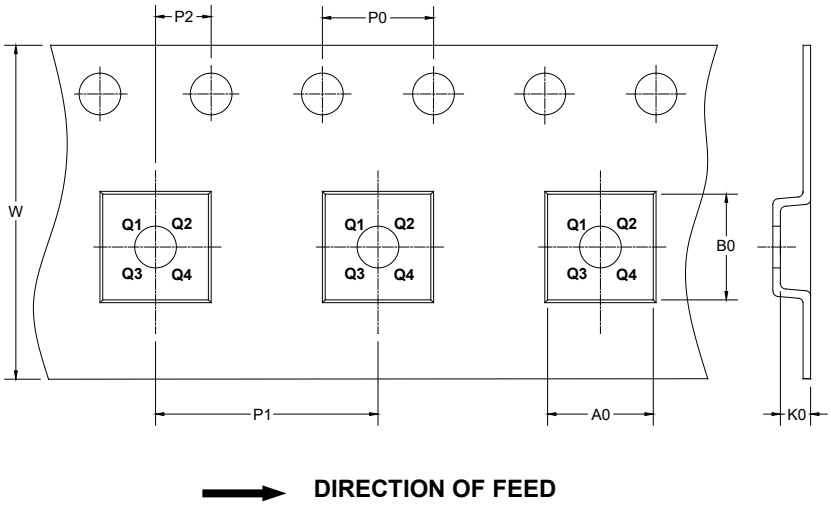
NOTES:
1. All linear dimensions are in millimeters.
2. This drawing is subject to change without notice.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



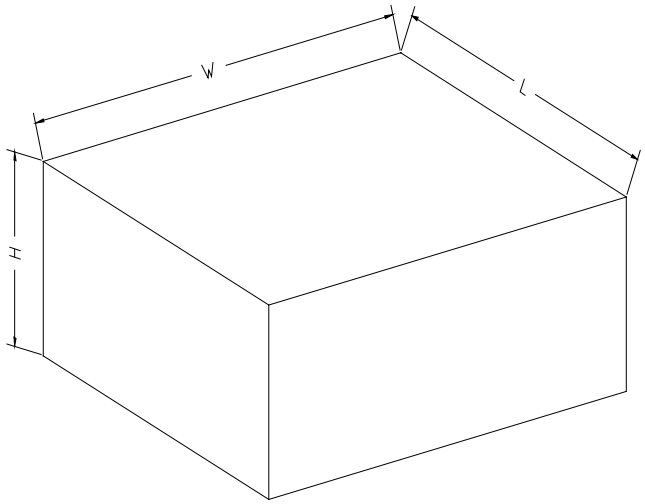
NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TSSOP-16	13"	12.4	6.80	5.40	1.50	4.0	8.0	2.0	12.0	Q1
TQFN-2.6×1.8-16L	7"	9"	2.01	2.81	0.93	4.0	4.0	2.0	8.0	Q1

DD0001

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7″ (Option)	368	227	224	8
7″	442	410	224	18
13″	386	280	370	5

DD0002