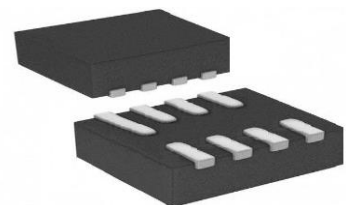


## 2-bit Bidirectional Voltage-Level Translator for Open-Drain and Push-Pull Application

### PRODUCT DESCRIPTION

The MS6212D is a bidirectional voltage-level translator that can be used in a mixed-voltage digital signal system. It is powered by two separate architectures. The power supply voltage range of terminal A is 1.65V to 5.5V, and that of terminal B is 2.3V to 5.5V. It can be used in logic signal conversion systems with power supply voltage of 1.8V, 2.5V, 3.3V and 5V. when the OE pin is low, all IO ports are in high resistance state, which significantly reduces the static power consumption. When VCCA is powered up, the OE pin is integrated with pull-down current sources. To ensure that the port maintains high impedance during power up or power down, the OE pin should be grounded by a pull-down resistance. The resistance value is determined by the ability of driving the current source.

The MS6212D is available in DFN8 package, and operating temperature ranges from -40°C to +100°C.



DFN8

### FEATURES

- No Need for Direction Control
- Data Rate: 20Mbps(Push-pull Mode) and 2Mbps(Open-drain Mode)
- A Port Power Supply Range: 1.65V to 5.5V  
B Port Power Supply Range: 2.3V to 5.5V( $V_{CCA} \leq V_{CCB}$ )
- VCC Isolation: If any power supply is connected to the ground, the ports are in high-impedance state.
- No Power Supply Sequencing Required
- Support Power-down Mode

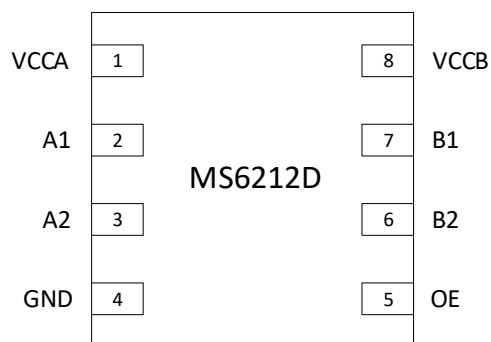
### APPLICATIONS

- I<sup>2</sup>C/SMBus (System Management Bus)
- UART (Universal Asynchronous Receiver/Transmitter)
- GPIO (General Purpose Input/Output)

### PRODUCT SPECIFICATION

Part Number	Package	Marking
MS6212D	DFN8	2D

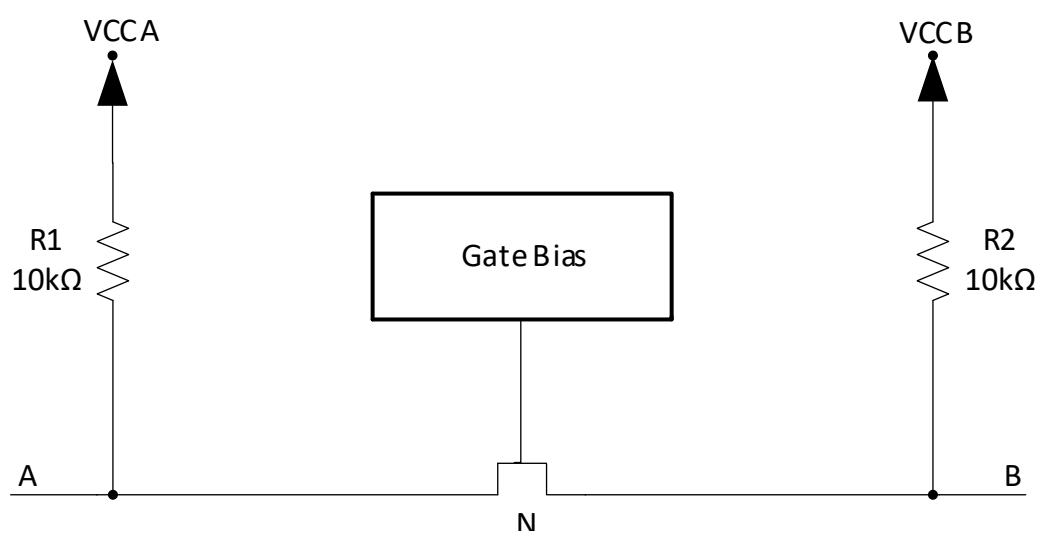
## PIN CONFIGURATION



## PIN DESCRIPTION

Pin	Name	Type	Description
1	VCCA	-	A Port Supply Voltage, $1.65V \leq V_{CCA} \leq 5.5V$ , And $V_{CCA} \leq V_{CCB}$
2	A1	I/O	Input/Output A, Referenced to VCCA
3	A2	I/O	Input/Output A, Referenced to VCCA
4	GND	-	Ground
5	OE	I	Output Enable, Pull OE Low to Make All Outputs in High-impedance State
6	B2	I/O	Input/Output B, Referenced to VCCB
7	B1	I/O	Input/Output B, Referenced to VCCB
8	VCCB	-	B Port Supply Voltage, $2.3V \leq V_{CCB} \leq 5.5V$

# BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

Any exceeding absolute maximum rating application causes permanent damage to device. Because long-time absolute operation state affects device reliability. Absolute ratings just conclude from a series of extreme tests. It doesn't represent chip can operate normally in these extreme conditions.

Parameter	Condition	Range	Unit
V <sub>CCA</sub> Supply Voltage Range		-0.3 ~ +6.0	V
V <sub>CCB</sub> Supply Voltage Range		-0.3 ~ +6.0	V
Input Voltage Range		-0.3 ~ +6.0	V
Voltage Applied to Output in High-impedance State or Power-down State		-0.3 ~ +6.0	V
Voltage Applied to Output in Normal State	A Port	-0.3 ~ V <sub>CCA</sub> +0.3V	V
	B Port	-0.3 ~ V <sub>CCB</sub> +0.3V	V
Input Clamp Current	V <sub>I</sub> <0V	-50	mA
Output Clamp Current	V <sub>O</sub> <0V	-50	mA
Continuous Output Current I <sub>O</sub>		±50	mA
Continuous Current through V <sub>CCA</sub> , V <sub>CCB</sub> , GND		±100	mA
Operating Temperature Range		-40 ~ +100	°C
Junction Temperature		150	°C
Storage Temperature		-65 ~ +150	°C
Lead Temperature (10s)		260	°C

# RECOMMENDED OPERATING CONDITIONS<sup>1, 2</sup>

$V_{CCA}=1.65V-5.5V$ ,  $V_{CCB}=2.3V-5.5V$ , Typical Values at  $T_A=25^{\circ}C$ , Unless Otherwise Noted.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage <sup>3</sup>	$V_{CCA}$		1.65		5.5	V
	$V_{CCB}$		2.3		5.5	
High-level Input Voltage	$V_{IH}$	A Port	$V_{CCA}=1.65V \sim 1.95V$ $V_{CCB}=2.3V \sim 5.5V$	$V_{CCI}-0.4$	$V_{CCI}$	V
			$V_{CCA}=2.3V \sim 5.5V$ $V_{CCB}=2.3V \sim 5.5V$	$V_{CCI}-0.4$	$V_{CCI}$	
		B Port		$V_{CCI}-0.4$	$V_{CCI}$	
		OE Port		$V_{CCA} \times 0.8$	5.5	
Low-level Input Voltage	$V_{IL}$	A Port	0		0.4	V
		B Port	0		0.4	
		OE Port	0		$V_{CCA} \times 0.2$	
Input Signal Variation	$\Delta t/\Delta V$	A Port Push-pull Driving			10	ns/V
		B Port Push-pull Driving			10	
		Control Input			10	

Note 1:  $V_{CCI}$  is the  $V_{CC}$  associated with the input port.

2:  $V_{CCO}$  is the  $V_{CC}$  associated with the output port.

3:  $V_{CCA}$  must be less than or equal to  $V_{CCB}$ , and  $V_{CCA}$  should not exceed 5.5V.

## ELECTRICAL CHARACTERISTICS

$V_{CCA}=1.65V-5.5V$ ,  $V_{CCB}=2.3V-5.5V$ , Typical Values at  $T_A=25^{\circ}C$ , Unless Otherwise Noted.

### Electrical Characteristics

Parameter	Symbol	Condition		Min	Typ	Max	Unit
A Port High-level Output Voltage	$V_{OHA}$	$I_{OH}=-20\mu A$ , $V_{IB}\geq V_{CCB}-0.4V$			$V_{CCA}\times 0.8$		V
A Port Low-level Output Voltage	$V_{OLA}$	$I_{OL}=1mA$ , $V_{IB}\leq 0.15V$			0.2		
B Port High-level Output Voltage	$V_{OHB}$	$I_{OH}=-20\mu A$ , $V_{IA}\geq V_{CCA}-0.4V$			$V_{CCB}\times 0.8$		
B Port Low-level Output Voltage	$V_{OLB}$	$I_{OL}=1mA$ , $V_{IA}\leq 0.15V$			0.2		
OE Input Leakage Current	$I_I$	OE			0.1		$\mu A$
Power-down Leakage Current	$I_{OFF}$	A Port	$V_{CCA}=0V$ , $V_{CCB}=0V\sim 5.5V$		0.1		
		B Port	$V_{CCA}=0V\sim 5.5V$ , $V_{CCB}=0V$		0.1		
Tri-state Output Leakage Current	$I_{OZ}$	A or B Port	OE=0V		0.1		$\mu A$
Quiescent Current	$I_{CCA}$	$V_I=V_O=OPEN$ , $I_O=0$	$V_{CCA}=1.65V\sim V_{CCB}$ , $V_{CCB}=2.3V\sim 5.5V$		0.1		$\mu A$
			$V_{CCA}=5.5V$ , $V_{CCB}=0V$		0.1		
			$V_{CCA}=0V$ , $V_{CCB}=5.5V$		0.1		
	$I_{CCA+}$ $I_{CCB}$	$V_I=V_O=OPEN$ , $I_O=0$	$V_{CCA}=1.65V\sim V_{CCB}$ , $V_{CCB}=2.3V\sim 5.5V$		5.5		$\mu A$
	$I_{CCB}$	$V_I=V_O=OPEN$ , $I_O=0$	$V_{CCA}=1.65V\sim V_{CCB}$ , $V_{CCB}=2.3V\sim 5.5V$		5.5		$\mu A$
			$V_{CCA}=5.5V$ , $V_{CCB}=0V$		0.1		
			$V_{CCA}=0V$ , $V_{CCB}=5.5V$		0.1		

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Quiescent Current	I <sub>CCZA</sub>	V <sub>I</sub> =V <sub>O</sub> =OPEN, I <sub>O</sub> =0 OE=GND	V <sub>CCA</sub> =1.65V~V <sub>CCB</sub> , V <sub>CCB</sub> =2.3V~5.5V	0.1		μA
			V <sub>CCA</sub> =5.5V, V <sub>CCB</sub> =0V	0.1		
			V <sub>CCA</sub> =0V, V <sub>CCB</sub> =5.5V	0.1		
	I <sub>CCZB</sub>	V <sub>I</sub> =V <sub>O</sub> =OPEN, I <sub>O</sub> =0 OE=GND	V <sub>CCA</sub> =1.65V~V <sub>CCB</sub> , V <sub>CCB</sub> =2.3V~5.5V	0.1		μA
			V <sub>CCA</sub> =5.5V, V <sub>CCB</sub> =0V	0.1		
			V <sub>CCA</sub> =0V, V <sub>CCB</sub> =5.5V	0.1		
OE Input Capacitance	C <sub>I</sub>	V <sub>CCA</sub> =3.3V, V <sub>CCB</sub> =3.3V		5		pF
A Port Input Capacitance	C <sub>IO</sub>	V <sub>CCA</sub> =3.3V, V <sub>CCB</sub> =3.3V		6.5		pF
B Port Input Capacitance	C <sub>IO</sub>			6.5		

### Timing Requirements

Parameter		V <sub>CCB</sub> =2.5V	V <sub>CCB</sub> =3.3V	V <sub>CCB</sub> =5V	Unit
		Typ	Typ	Typ	
T <sub>A</sub> = +25°C, V <sub>CCA</sub> = 1.8V, Unless Otherwise Noted.					
Data Rate	Push-Pull Mode	18	18	16	Mbps
	Open-Drain Mode	2	2	2	
T <sub>A</sub> = +25°C, V <sub>CCA</sub> = 2.5V, Unless Otherwise Noted.					
Data Rate	Push-Pull Mode	20	18	17	Mbps
	Open-Drain Mode	2	2	2	
T <sub>A</sub> = +25°C, V <sub>CCA</sub> = 3.3V, Unless Otherwise Noted.					
Data Rate	Push-Pull Mode		20	17	Mbps
	Open-Drain Mode		2	2	
T <sub>A</sub> = +25°C, V <sub>CCA</sub> = 5V, Unless Otherwise Noted.					
Data Rate	Push-Pull Mode			17	Mbps
	Open-Drain Mode			2	

# Switching Characteristics

T<sub>A</sub> = +25°C, V<sub>CCA</sub> = 1.8V, Unless Otherwise Noted.

Parameter	Symbol	Condition	V <sub>CCB</sub> = 2.5V	V <sub>CCB</sub> = 3.3V	V <sub>CCB</sub> = 5V	Unit
			TYP	TYP	TYP	
V <sub>CCA</sub> = 1.8V						
A to B Delay	t <sub>PHL</sub>	Push-Pull Mode	2.4	3.0	5.4	ns
		Open-Drain Mode	26.0	26.3	26.7	
	t <sub>PLH</sub>	Push-Pull Mode	4.0	3.6	3.5	
		Open-Drain Mode	175	145	110	
B to A Delay	t <sub>PHL</sub>	Push-Pull Mode	2.0	2.6	3.6	ns
		Open-Drain Mode	26.0	26.1	26.2	
	t <sub>PLH</sub>	Push-Pull Mode	1.7	1.5	1.4	
		Open-Drain Mode	133	69	51	
OE Enable Time (t <sub>PZH</sub> and t <sub>PZL</sub> )	t <sub>EN</sub>		5.2	4.4	3.8	ns
OE Disable Time (t <sub>PHZ</sub> and t <sub>PLZ</sub> )	t <sub>DIS</sub>		614	616	626	
A Port Rising Time	t <sub>rA</sub>	Push-Pull Mode	16	15	14	ns
		Open-Drain Mode	89	31	10	
B Port Rising Time	t <sub>rB</sub>	Push-Pull Mode	12	11	9	ns
		Open-Drain Mode	128	98	58	
A Port Falling Time	t <sub>fA</sub>	Push-Pull Mode	10	9	8	ns
		Open-Drain Mode	1.9	1.7	1.6	
B Port Falling Time	t <sub>fB</sub>	Push-Pull Mode	9	14	18	ns
		Open-Drain Mode	2.2	2.3	2.9	
Channel Delay Deviation	t <sub>sk(0)</sub>		0.5	0.5	0.5	ns
Data Rate		Push-Pull Mode	18	18	17	Mbps
		Open-Drain Mode	2	2	2	
V <sub>CCA</sub> = 2.5V						
A to B Delay	t <sub>PHL</sub>	Push-Pull Mode	2.7	3.3	4.8	ns
		Open-Drain Mode	26.2	26.4	26.7	
	t <sub>PLH</sub>	Push-Pull Mode	2.6	2.4	2.3	
		Open-Drain Mode	169	144	110	



Parameter	Symbol	Condition	V <sub>CCB</sub> = 2.5V	V <sub>CCB</sub> = 3.3V	V <sub>CCB</sub> = 5V	Unit
			TYP	TYP	TYP	
B to A Delay	t <sub>PHL</sub>	Push-Pull Mode	2.4	2.3	2.4	ns
		Open-Drain Mode	26.3	26.4	26.5	
	t <sub>PLH</sub>	Push-Pull Mode	2.0	1.9	1.8	
		Open-Drain Mode	165	118	55	
OE Enable Time (t <sub>PZH</sub> and t <sub>PZL</sub> )	t <sub>EN</sub>		14	13	12	ns
OE Disable Time (t <sub>PHZ</sub> and t <sub>PLZ</sub> )	t <sub>DIS</sub>		630	635	640	
A Port Rising Time	t <sub>rA</sub>	Push-Pull Mode	13	13	12	ns
		Open-Drain Mode	120	70	10	
B Port Rising Time	t <sub>rB</sub>	Push-Pull Mode	4.5	3.4	2.6	ns
		Open-Drain Mode	122	96	62	
A Port Falling Time	t <sub>fA</sub>	Push-Pull Mode	8	7	6	ns
		Open-Drain Mode	2.0	1.9	1.7	
B Port Falling Time	t <sub>fB</sub>	Push-Pull Mode	8	12	15	ns
		Open-Drain Mode	1.9	2.1	2.7	
Channel Delay Deviation	t <sub>sk(0)</sub>		0.5	0.5	0.5	ns
<b>V<sub>CCA</sub> = 3.3V</b>						
A to B Delay	t <sub>PHL</sub>	Push-Pull Mode		3.5	4.9	ns
		Open-Drain Mode		26.3	26.7	
	t <sub>PLH</sub>	Push-Pull Mode		2.2	2.0	
		Open-Drain Mode		133	104	
B to A Delay	t <sub>PHL</sub>	Push-Pull Mode		3.0	3.2	ns
		Open-Drain Mode		26.6	26.8	
	t <sub>PLH</sub>	Push-Pull Mode		1.8	1.7	
		Open-Drain Mode		132	83	
OE Enable Time (t <sub>PZH</sub> and t <sub>PZL</sub> )	t <sub>EN</sub>			12	11	ns
OE Disable Time (t <sub>PHZ</sub> and t <sub>PLZ</sub> )	t <sub>DIS</sub>			630	635	

Parameter	Symbol	Condition	V <sub>CCB</sub> = 2.5V	V <sub>CCB</sub> = 3.3V	V <sub>CCB</sub> = 5V	Unit
			TYP	TYP	TYP	
A Port Rising Time	t <sub>rA</sub>	Push-Pull Mode		12	11	ns
		Open-Drain Mode		87	36	
B Port Rising Time	t <sub>rB</sub>	Push-Pull Mode		10	9	ns
		Open-Drain Mode		87	56	
A Port Falling Time	t <sub>fA</sub>	Push-Pull Mode		12	11	ns
		Open-Drain Mode		2.3	2.0	
B Port Falling Time	t <sub>fB</sub>	Push-Pull Mode		13	16	ns
		Open-Drain Mode		2.0	2.5	
Channel Delay Deviation	t <sub>sk(0)</sub>			0.5	0.5	ns
<b>V<sub>CCA</sub> = 5.0V</b>						
A to B Delay	t <sub>PHL</sub>	Push-Pull Mode			5.4	ns
		Open-Drain Mode			26.7	
	t <sub>PLH</sub>	Push-Pull Mode			1.9	
		Open-Drain Mode			120	
B to A Delay	t <sub>PHL</sub>	Push-Pull Mode			5.6	ns
		Open-Drain Mode			27.3	
	t <sub>PLH</sub>	Push-Pull Mode			1.7	
		Open-Drain Mode			126	
OE Enable Time (t <sub>PZH</sub> and t <sub>PZL</sub> )	t <sub>EN</sub>				10	ns
OE Disable Time (t <sub>PHZ</sub> and t <sub>PLZ</sub> )	t <sub>DIS</sub>				636	
A Port Rising Time	t <sub>rA</sub>	Push-Pull Mode			8	ns
		Open-Drain Mode			79	
B Port Rising Time	t <sub>rB</sub>	Push-Pull Mode			7	ns
		Open-Drain Mode			73	
A Port Falling Time	t <sub>fA</sub>	Push-Pull Mode			8.7	ns
		Open-Drain Mode			2.7	
B Port Falling Time	t <sub>fB</sub>	Push-Pull Mode			8.6	ns
		Open-Drain Mode			2.4	
Channel Delay Deviation	t <sub>sk(0)</sub>				0.5	ns

## APPLICATION DESCRIPTION

The MS6212D could be applied to interface two different voltage nodes, in order to connect logic level in electronic system. It can be used in point-to-point topology to connect the device or system operated in different interface voltages. The main purpose is to connect data with I/O port in open-drain mode, such as I<sup>2</sup>C and 1-Wire. And the data is bidirectional transmission without control signal, it also can be connected with I/O port in push-pull mode.

### Input Driver Requirement

The falling time ( $t_{fA}$ ,  $t_{fB}$ ) depends on the output impedance of external driver, which could drive the data I/O of the MS6212D. Similarly,  $t_{PHL}$  and data rate depend on the output impedance of external driver.  $t_{fA}$ ,  $t_{fB}$ ,  $t_{PHL}$  in data table and conversion rate are defined as the value where the output impedance of external driver is less than 50Ω.

### Power up

During operation, ensure that  $V_{CCA} \leq V_{CCB}$ . And each power sequencing couldn't destroy device. Therefore, elevating any power supply is allowed.

### Output Load Caution

We recommend to use PCB layout with short traces, in order to avoid overlarge capacitance load and ensure correct trigger. PCB signal traces should be short enough to make that each reflex go-back delay is less than one trigger duration. Signal integrity can be improved by ensuring that there is low impedance at driver in any reflex. The designed period of one trigger approaches to 30ns. In addition, the maximum capacitance driving total lumped loads is also directly up to one trigger duration. For very large capacitive load, one trigger could time out before the signal is driven completely. By balancing dynamic characteristic  $I_{CC}$ , load driving capacity and the maximum bit rate, setting one trigger duration in the best condition. The PCB trace length and connector would increase the capacitance value seeing from of the MS6212D output. Therefore, it is recommended to use lumped load capacitor to avoid system-stage influences, such as one trigger, bus competition, output signal shock and so on.

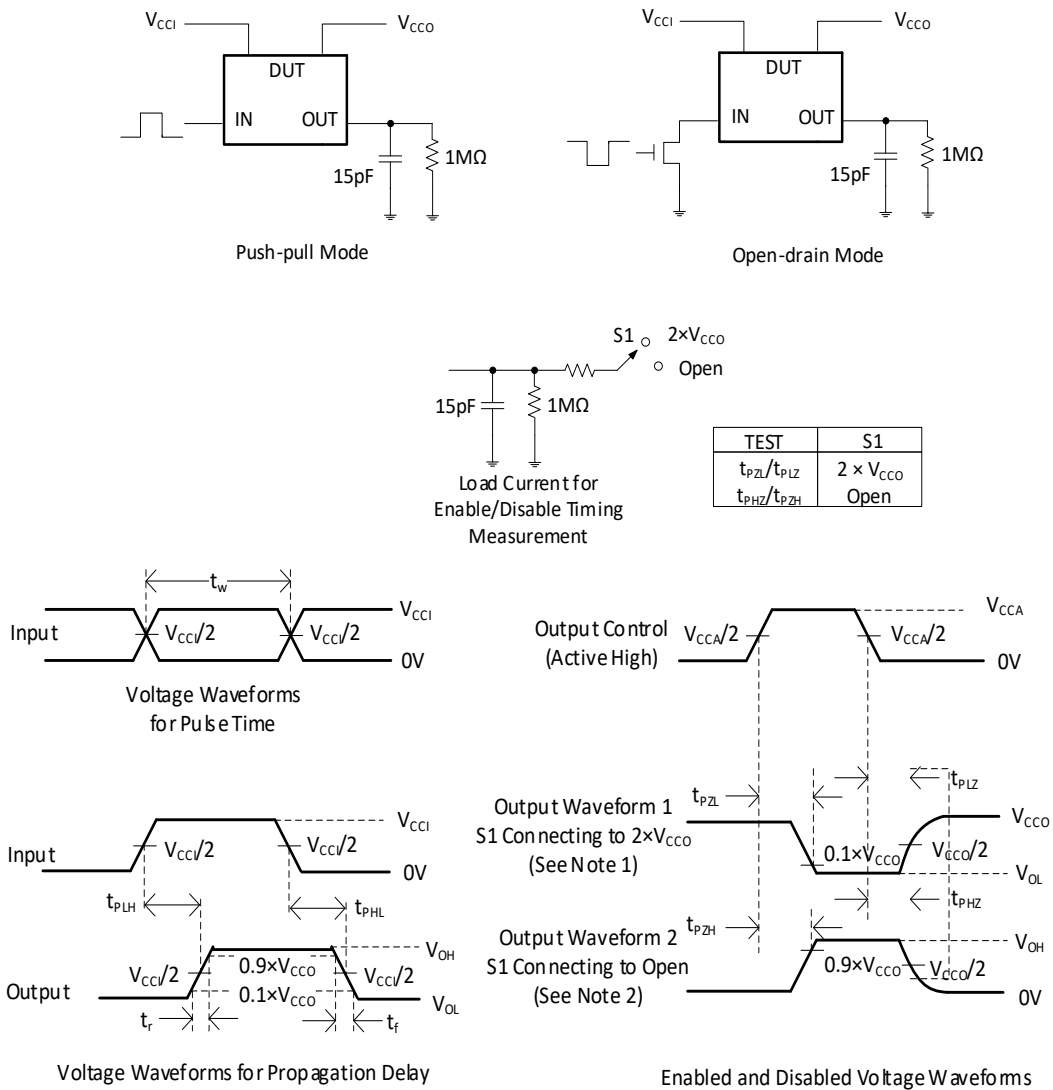
### Enable and Disable

The MS6212D has an OE input terminal to disable the device when OE is in low level, making all I/O ports in high-impedance state. If  $V_{CCA}$  is powered up, there will be an internal pull-down current source on the OE pin. Disable time( $t_{DIS}$ ) is the delay between OE becoming low and output in high-impedance state. Enable time ( $t_{EN}$ ) is the time during which the user must allow a single trigger circuit to run after OE goes high.

### Pull-up and pull-down Resistors on I/O Port

Each A terminal has an internal 10kΩ pull-up resistor for  $V_{CCA}$ ; Each B terminal has an internal 10kΩ pull-up resistor for  $V_{CCB}$ . If a smaller pull-up resistor is required, it is necessary to add an external resistor between I/O and  $V_{CCA}/V_{CCB}$ . While adding a smaller pull-up resistor would affect  $V_{OL}$ . When OE is in low level, pull-up resistor in the MS6212D would be disabled.

## TEST CIRCUIT



Note 1:  $C_L$  includes probe and jig capacitance.

2: Waveform 1 is used for outputs with internal conditions to make the output low unless the output control terminal is disabled. Waveform 2 is used for outputs with internal conditions to make the output high unless the output control terminal is disabled.

3: All input pulses are supplied by a generator with the following characteristics:  $PRR \leq 10\text{MHz}$ ,  $Z_0 = 50\Omega$ ,  $dv/dt \geq 1\text{V/ns}$ .

4: Take one measurement after each output, each measurement needs to be converted once.

5:  $t_{PLZ}$ ,  $t_{PHZ}$  and  $t_{DIS}$  are the same.

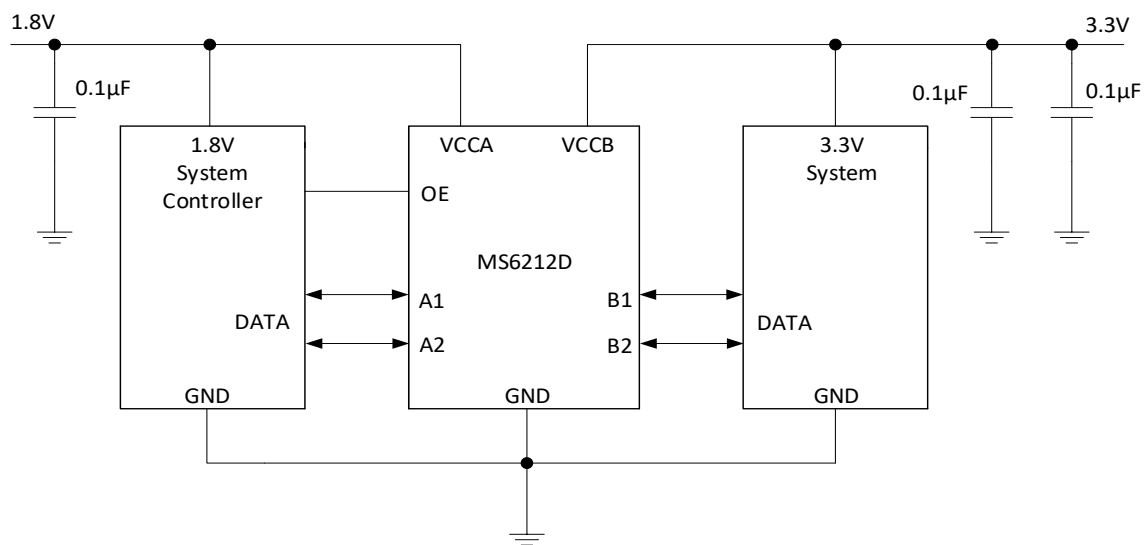
6:  $t_{PZL}$ ,  $t_{PZH}$  and  $t_{EN}$  are the same.

7:  $t_{PLH}$ ,  $t_{PHL}$  and  $t_{PD}$  are the same.

8:  $V_{CCI}$  is the  $V_{CC}$  associated with the input port.

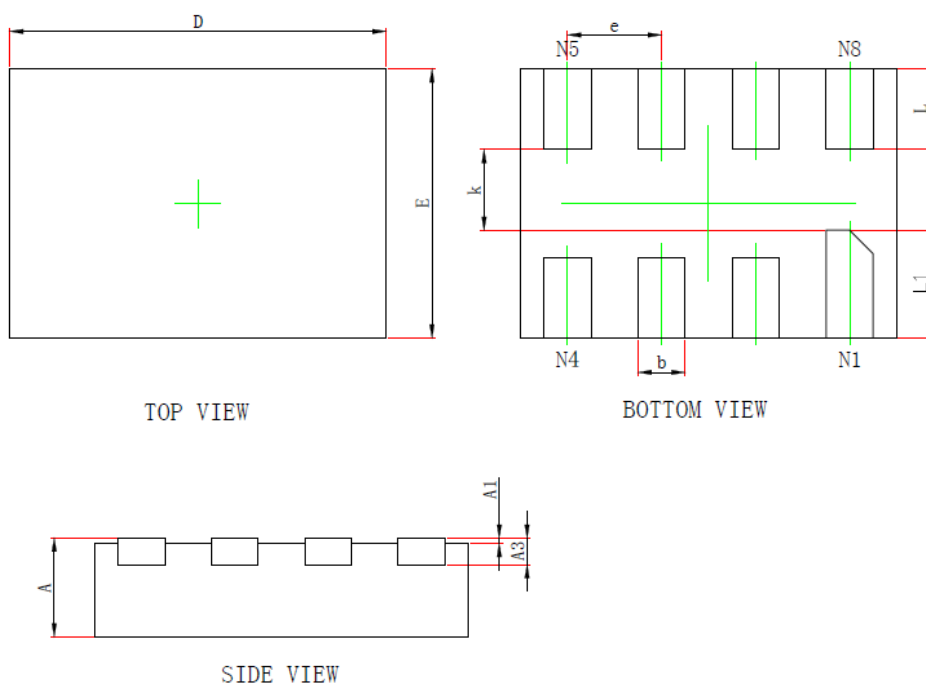
9:  $V_{CCO}$  is the  $V_{CC}$  associated with the output port.

## TYPICAL APPLICATION



# PACKAGE OUTLINE DIMENSIONS

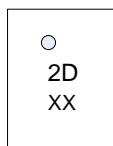
## DFN8



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	0.340	0.400	0.013	0.016
A1	0.000	0.050	0.000	0.002
A3	0.100REF		0.004REF	
D	1.350	1.450	0.053	0.057
E	0.950	1.050	0.037	0.041
D1	-	-	-	-
E1	-	-	-	-
k	0.200MIN		0.008MIN	
b	0.150	0.200	0.006	0.008
e	0.350TYP		0.014TYP	
L	0.250	0.350	0.010	0.014
L1	0.350	0.450	0.014	0.018

## MARKING and PACKAGING SPECIFICATIONS

### 1. Marking Drawing Description



Product Name: 2D

Product Code: XX

### 2. Marking Drawing Demand

Laser printing, contents in the middle, font type Arial.

### 3. Packaging Specification

Device	Package	Piece/Reel	Reel/Box	Piece/Box	Box/Carton	Piece/Carton
MS6212D	DFN8	3000	10	30000	4	120000

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- The process of improving product is endless. And our company would sincerely provide more excellent product for customer.



**MOS CIRCUIT OPERATION PRECAUTIONS**

Static electricity can be generated in many places. The following precautions can be taken to effectively prevent the damage of MOS circuit caused by electrostatic discharge:

1. The operator shall ground through the anti-static wristband.
2. The equipment shell must be grounded.
3. The tools used in the assembly process must be grounded.
4. Must use conductor packaging or anti-static materials packaging or transportation.



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