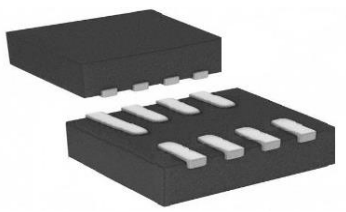
2-bit Bidirectional Voltage-Level Translator for Open-Drain and Push-Pull Application

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 is 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}≤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

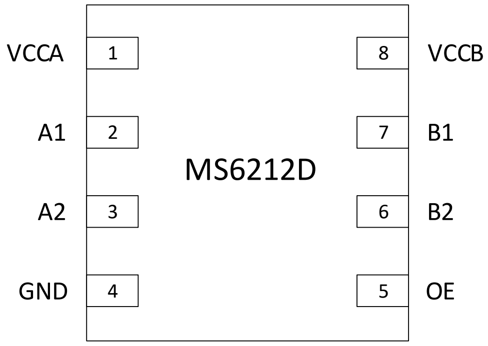
APPLICATIONS

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

PRODUCT SPECIFICATION

Part Number	Package	Marking
MS6212D	DFN8	2D

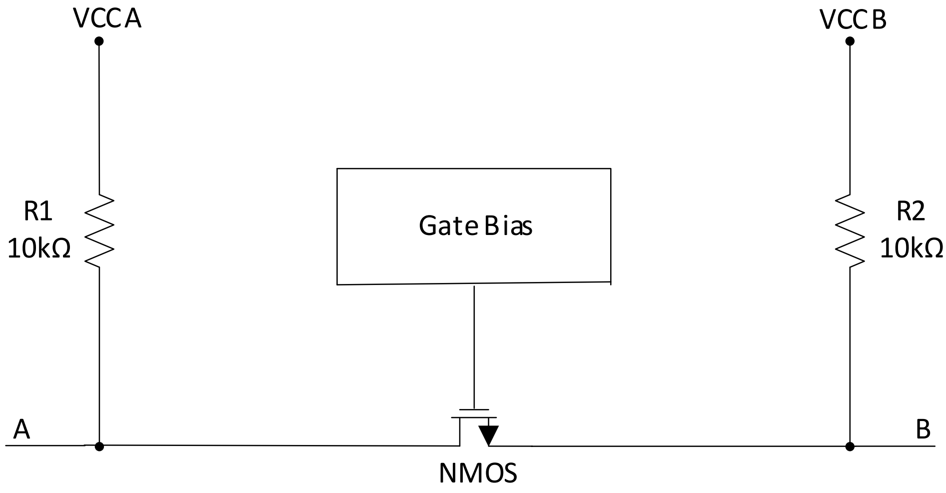
PIN CONFIGURATION



PIN DESCRIPTION

Pin	Name	Type	Description
1	VCCA	-	A Port Supply Voltage, $1.65V \le V_{CCA} \le 5.5V$, And $V_{CCA} \le V_{CCB}$
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. When OE is pulled low, all outputs are 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, $2.3V \le V_{CCB} \le 5.5V$

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_{CCA} Supply Voltage Range		-0.3 ~ +6.0	V
V_{CCB} 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_{CCA}+0.3V	V
	B Port	-0.3 ~ V_{CCB}+0.3V	V
Input Clamp Current	V_I<0V	-50	mA
Output Clamp Current	V_O<0V	-50	mA
Continuous Output Current I_O		±50	mA
Continuous Current through V_{CCA}, V_{CCB}, 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[1, 2]

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

Parameter	Symbol	Condition		Min	Typ	Max	Unit
Supply Voltage [3]	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 ~ 1.95V V_{CCB}=2.3V ~ 5.5V	V_{CCI}-0.2		V_{CCI}	V
			V_{CCA}=2.3V ~ 5.5V V_{CCB}=2.3V ~ 5.5V	V_{CCI}-0.4		V_{CCI}	
		B Port		V_{CCI}-0.4		V_{CCI}	
		OE Port		V_{CCA}×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}×0.2	
Input Signal Variation	Δt/ΔV	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°C, Unless Otherwise Noted.

Electrical Characteristics

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

Parameter	Symbol	Condition		Min	Typ	Max	Unit
Quiescent Current	I_{CCZA}	V_I=V_O=OPEN, I_O=0 OE=GND	V_{CCA}=1.65V~V_{CCB}, V_{CCB}=2.3V~5.5V		0.1		µA
			V_{CCA}=5.5V, V_{CCB}=0V		0.1		
			V_{CCA}=0V, V_{CCB}=5.5V		0.1		
	I_{CCZB}	V_I=V_O=OPEN, I_O=0 OE=GND	V_{CCA}=1.65V~V_{CCB}, V_{CCB}=2.3V~5.5V		0.1		µA
			V_{CCA}=5.5V, V_{CCB}=0V		0.1		
			V_{CCA}=0V, V_{CCB}=5.5V		0.1		
OE Input Capacitance	C_I	V_{CCA}=3.3V,V_{CCB}=3.3V			5		pF
A Port Input Capacitance	C_{IO}	V_{CCA}=3.3V,V_{CCB}=3.3V			6.5		pF
B Port Input Capacitance	C_{IO}				6.5		

Timing Requirements

Parameter		V_{CCB}=2.5V	V_{CCB}=3.3V	V_{CCB}=5V	Unit
		Typ	Typ	Typ	
T_A = +25°C, V_{CCA} = 1.8V, Unless Otherwise Noted.					
Data Rate	Push-Pull Mode	18	18	16	Mbps
	Open-Drain Mode	2	2	2	
T_A = +25°C, V_{CCA} =2.5V, Unless Otherwise Noted.					
Data Rate	Push-Pull Mode	20	18	17	Mbps
	Open-Drain Mode	2	2	2	
T_A = +25°C, V_{CCA} = 3.3V, Unless Otherwise Noted.					
Data Rate	Push-Pull Mode		20	17	Mbps
	Open-Drain Mode		2	2	
T_A = +25°C, V_{CCA} = 5V, Unless Otherwise Noted.					
Data Rate	Push-Pull Mode			17	Mbps
	Open-Drain Mode			2	

Switching Characteristics

T_A = +25°C, V_{CCA} = 1.8V, Unless Otherwise Noted.

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

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

Parameter	Symbol	Condition	V_{CCB} = 2.5V	V_{CCB} = 3.3V	V_{CCB} = 5V	Unit
			TYP	TYP	TYP	
A Port Rising Time	t_{rA}	Push-Pull Mode		12	11	ns
		Open-Drain Mode		87	36	
B Port Rising Time	t_{rB}	Push-Pull Mode		10	9	ns
		Open-Drain Mode		87	56	
A Port Falling Time	t_{fA}	Push-Pull Mode		12	11	ns
		Open-Drain Mode		2.3	2.0	
B Port Falling Time	t_{fB}	Push-Pull Mode		13	16	ns
		Open-Drain Mode		2.0	2.5	
Channel Delay Deviation	$t_{sk(0)}$			0.5	0.5	ns
V_{CCA} = 5.0V						
A to B Delay	t_{PHL}	Push-Pull Mode			5.4	ns
		Open-Drain Mode			26.7	
	t_{PLH}	Push-Pull Mode			1.9	
		Open-Drain Mode			120	
B to A Delay	t_{PHL}	Push-Pull Mode			5.6	ns
		Open-Drain Mode			27.3	
	t_{PLH}	Push-Pull Mode			1.7	
		Open-Drain Mode			126	
OE Enable Time (t_{PZH} and t_{PZL})	t_{EN}				10	ns
OE Disable Time (t_{PHZ} and t_{PLZ})	t_{DIS}				636	
A Port Rising Time	t_{rA}	Push-Pull Mode			8	ns
		Open-Drain Mode			79	
B Port Rising Time	t_{rB}	Push-Pull Mode			7	ns
		Open-Drain Mode			73	
A Port Falling Time	t_{fA}	Push-Pull Mode			8.7	ns
		Open-Drain Mode			2.7	
B Port Falling Time	t_{fB}	Push-Pull Mode			8.6	ns
		Open-Drain Mode			2.4	
Channel Delay Deviation	$t_{sk(0)}$				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. 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 differential power-up sequences for each power couldn't destroy device.

Output Load Caution

The PCB signal trace length should keep enough short to improve signal integrity. One-shot period is close to 30ns in . For larger capacitive load, it is noted whether terminal voltage is pulled to corresponding power rail in one-shot period.

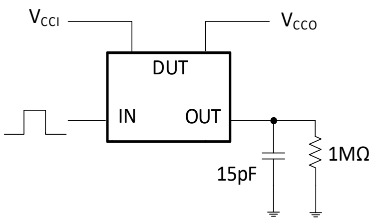
Enable and Disable

OE input terminal is used to disable the device. When OE is in low level, making all I/O ports in high-impedance state. If VCCA is powered up, there will be a 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.

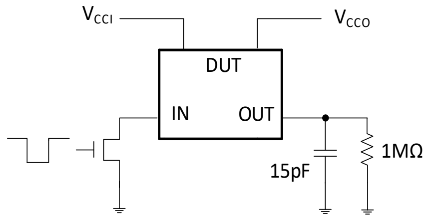
Pull-up and pull-down Resistors on I/O Port

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

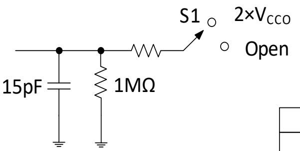
TEST CIRCUIT



Push-pull Mode

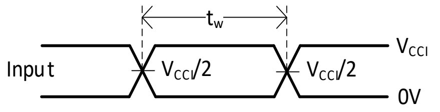


Open-drain Mode

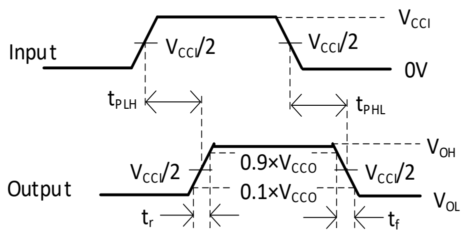


Load Current for Enable/Disable Timing Measurement

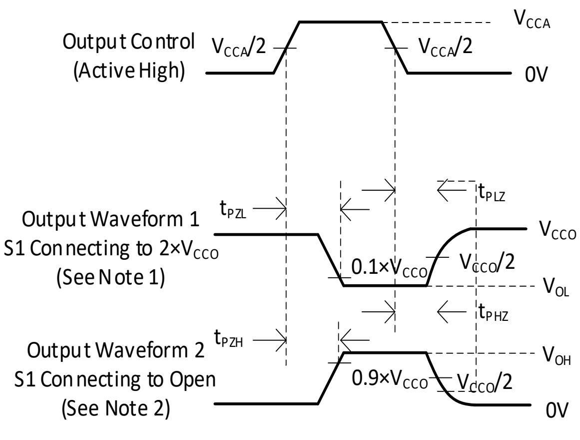
TEST	S1
t_{PZL}/t_{PLZ}	$2 \times V_{CCO}$
t_{PHZ}/t_{PZH}	Open



Voltage Waveforms for Pulse Time



Voltage Waveforms for Propagation Delay



Enabled and Disabled Voltage Waveforms

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≤10MHz, Z_O=50Ω, dv/dt ≥1V/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.

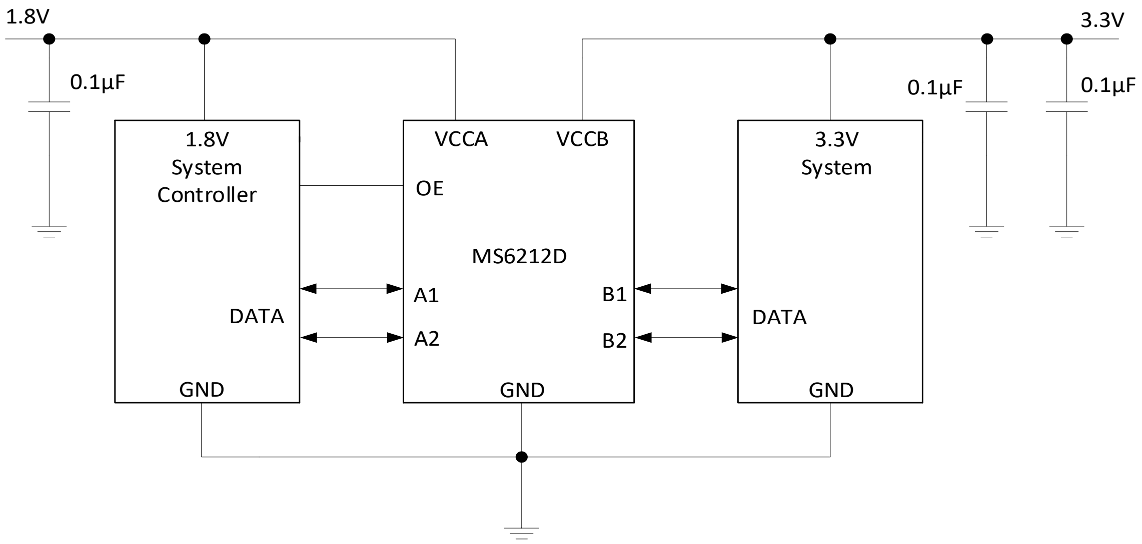
6: t_{PZL}, t_{PZH} and t_{EN} are the same.

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

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

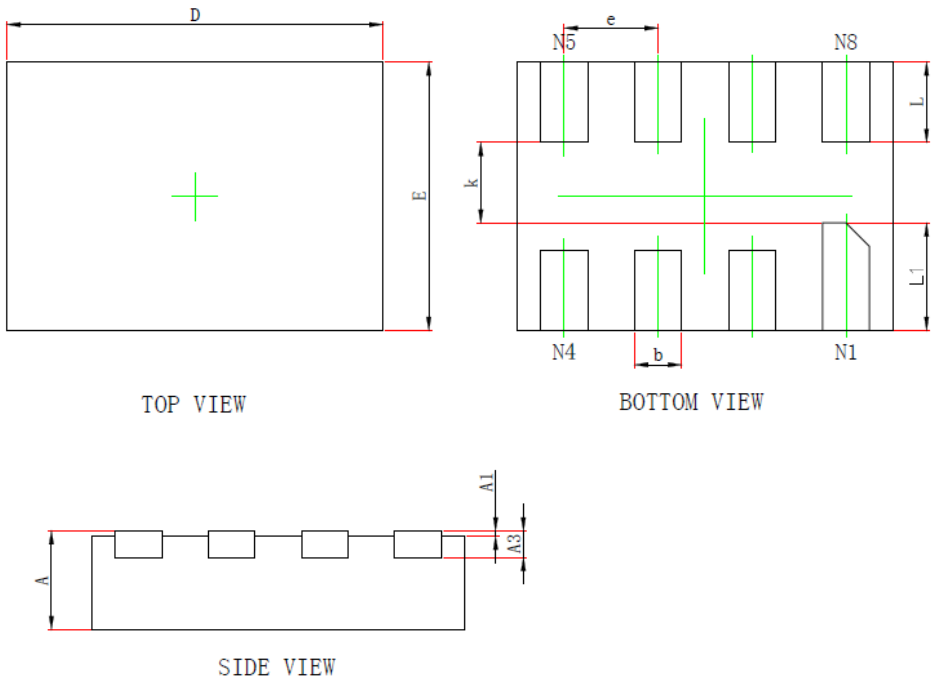
9: V_{CCO} is the V_{CC} associated with the output port.

TYPICAL APPLICATION



PACKAGE OUTLINE DIMENSIONS

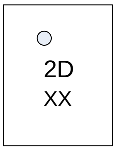
DFN8



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 SPECIFICATION

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

STATEMENT

- All Revision Rights of Datasheets Reserved for Ruimeng. Don't release additional notice.
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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.

+86-571-89966911

Rm701, No.9 Building, No. 1 WeiYe Road, Puyan Street, Binjiang District, Hangzhou, Zhejiang

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