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

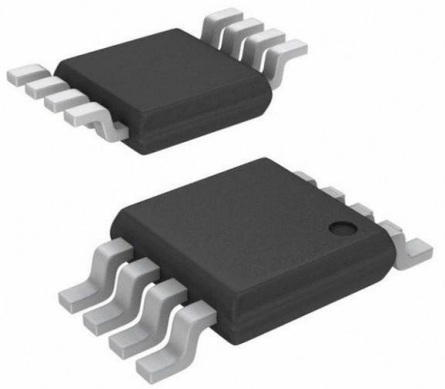
PRODUCT DESCRIPTION

MS4553M is a two-channel level converter that can be used as 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 at low level, all IO ports are in high resistance state, which significantly reduces the static power consumption.To ensure that the port maintains high Impedance during power up or power down, the OE end should be grounded by a pull-down resistance whose resistance value is determined by the ability to drive the current source.

The MS4553M is packaged in MSOP8 with operating temperature ranging from -40℃ to +100℃.

FEATURES

- No need for direction control
- Data rate:20MSPS(Push-Pull mode) and 2MSPS(Open-Drain mode)
- A port voltage range:1.65V to 5.5V
- B port voltage range:2.30V to 5.5V
- If VCCA or VCCB is at low to GND,Both IO Ports are in the High-Impedance State
- No power supply sequencing required
- Support power down mode



MSOP8

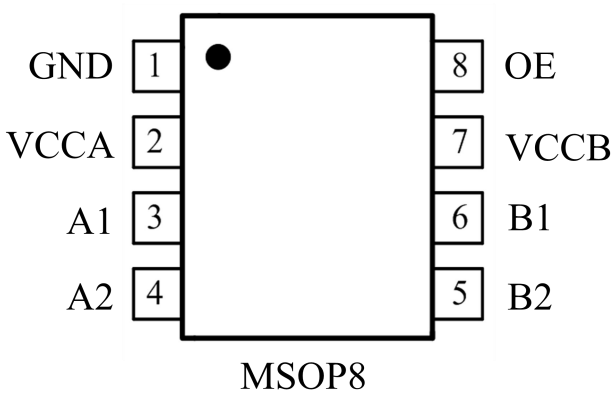
APPLICATIONS

- SPI, MICROWIRE, and I2C Level Translation
- Low-Voltage ASIC Level Translation
- Smart Card Readers
- Cell-Phone Cradles
- Portable POS Systems
- Portable Communication Devices
- Low-Cost Serial Interfaces

PRODUCT SPECIFICATION

Part Number	Package	Marking
MS4553M	MSOP8	MS4553M

PIN CONFIGURATION

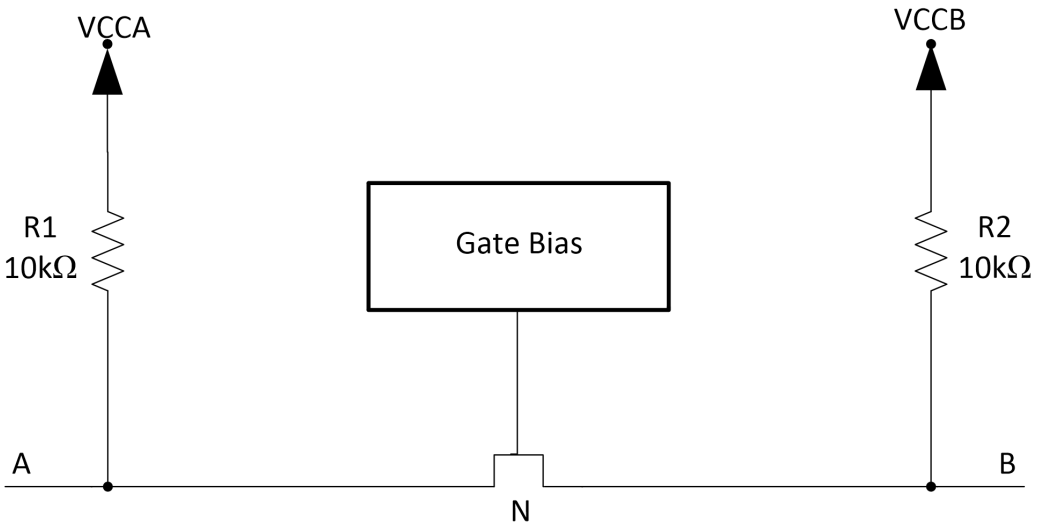


MSOP8

PIN DESCRIPTION

Pin	Name	Type	Description
1	GND	--	ground
2	VCCA	--	A Port supply voltage,1.65V≤VCCA≤5.5V,VCCA≤VCCB
3	A1	I/O	INPUT/OUTPUT A,referenced VCCA
4	A2	I/O	INPUT/OUTPUT A,referenced VCCA
5	B2	I/O	INPUT/OUTPUT B,referenced VCCB
6	B1	I/O	INPUT/OUTPUT B,referenced VCCB
7	VCCB	--	B Port supply voltage,2.3V≤VCCB≤5.5V
8	OE	I	Enable input， Pull OE low, all outputs are set to high Impedance state, Referenced to VCCA.

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
VCCA supply range		-0.3～+6.0	V
VCCB supply range		-0.3～+6.0	V
Input voltage range		-0.3～+6.0	V
Voltage Range Applied to Output in the High-Impedance or Power-Off State		-0.3～+6.0	V
Voltage Range Applied to Output in the High or Low State	A port	-0.3～VCCA+0.3V	V
	B port	-0.3～VCCB+0.3V	V
Input lamp current	VI<0V	-50	mA
output lamp current	VO<0V	-50	mA
Output continuous current		±50	mA
VCCA,VCCB and GND continuous current		±100	mA
Operating Temperature Range		-40 ~ +100	℃
Junction Temperature		150	℃
Storage Temperature Range		-60~+150	℃
Lead Temperature（10s）		260	℃

ELECTRICAL CHARACTERISTICS

(VCCA=1.6V-5.5V，VCCB=2.3V-5.5V，typical values at T_A=25℃,unless otherwise noted.)

PARAMETER		TEST CONDITIONS	min	typ	max	unit
Recommended operating conditions						
Supply voltage	VCCA		1.2		5.5	V
	VCCB		1.8		5.5	
High level input voltage(V_{IH})	A PORT	VCCA=1.65V～1.95V VCCB=2.3V～5.5V	V_{CCA}-0.4		V_{CCA}	V
		VCCA=2.3V～5.5V, VCCB=2.3V～5.5V	V_{CCA}-0.4		V_{CCA}	
	B PORT		V_{CCBI}-0.4		V_{CCB}	
	OE PORT		VCCA×0.8		5.5	
low level input voltage(V_{IL})	A PORT		0		0.4	V
	B PORT		0		0.4	
	OE PORT		0		VCCA×0.2	
Rise and fall rate (Δt/ΔV)		A PORT Push-Pull driving			10	ns/V
		B PORT Push-Pull driving			10	
		Control input			10	
ELECTRICAL CHARACTERISTICS						
A PORT High level output voltage(V_{OHA})		I_{OH}=-20μA, V_{IB}≥VCCB-0.4V		VCCA×0.8		V
A PORT low level output voltage(V_{OLA})		I_{OL}=1mA, V_{IB}≤0.15V		0.2		
B PORT High level output voltage(V_{OHB})		I_{OH}=-20μA, V_{IA}≥VCCA-0.4V		VCCB×0.8		
B PORTlow level output voltage(V_{OLB})		I_{OL}=1mA, V_{IA}≤0.15V		0.2		
OE input leakage current（I_I）	OE			0.1		μA
Power off leakage current （I_{OFF}）	A PORT	VCCA=0V, VCCB=0V～5.5V		0.1		
	B PORT	VCCA=0V～5.5V, VCCB=0V		0.1		

3-state output leakage（I_{OZ}）	A or B PORT	OE=0V		0.1		
Quiescent Supply current（I_{CCA}）	V_I=V_O=OPEN I_O=0	VCCA=1.65V～VCCB, VCCB=2.3V～5.5V		0.1		μA
		VCCA=5.5V, VCCB=0V		0.1		
		VCCA=0V, VCCB=5.5V		0.1		
Quiescent Supply current(I_{CCA}+I_{CCB})	V_I=V_O=OPEN I_O=0	VCCA = 1.65V～VCCB, VCCB = 2.3V～5.5V		5.5		μA
Quiescent Supply current（I_{CCB}）	V_I=V_O=OPEN I_O=0	VCCA=1.65V～VCCB, VCCB=2.3V～5.5V		5.5		μA
		VCCA=5.5V, VCCB=0V		0.1		
		VCCA=0V, VCCB=5.5V		0.1		
Quiescent Supply current（I_{CCZA}）	V_I=V_O=OPEN I_O=0， OE=GND	VCCA=1.65V～VCCB, VCCB=2.3V～5.5V		0.1		μA
		VCCA=5.5V, VCCB=0V		0.1		
		VCCA=0V, VCCB=5.5V		0.1		
Quiescent Supply current（I_{CCZB}）	V_I=V_O=OPEN I_O=0 OE=GND	VCCA=1.65V～VCCB, VCCB=2.3V～5.5V		0.1		μA
		VCCA=5.5V, VCCB=0V		0.1		
		VCCA=0V, VCCB=5.5V		0.1		
OE input capacitance（C_I）	VCCA=3.3V,VCCB=3.3V			5		pF
A PORT input capacitance（C_{IO}）	VCCA=3.3V,VCCB=3.3V			6.5		pF
B PORT input capacitance（C_{IO}）				6.5		

Timing requirements:

		VCCB=2.5V	VCCB=3.3V	VCCB=5V	unit
		typ	typ	typ	
(T_A = +25℃, VCCA = 1.8V,unless otherwise noted)					
Data rate	Push-Pull driving	18	18	16	Mbps
	Open-Drain driving	2	2	2	
(T_A = +25℃, VCCA =2.5V,unless otherwise noted)					
Data rate	Push-Pull driving	25	18	17	Mbps
	Open-Drain driving	2	2	2	
(T_A = +25℃, VCCA = 3.3V,unless otherwise noted)					
Data rate	Push-Pull driving		20	17	Mbps
	Open-Drain driving		2	2	
(T_A = +25℃, VCCA = 5V,unless otherwise noted)					
Data rate	Push-Pull driving			17	Mbps
	Open-Drain driving			2	

Switching characteristics:

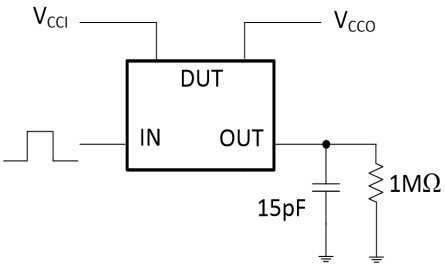
PARAMETER	symbol	TEST CONDITIONS	VCCB = 2.5V	VCCB = 3.3V	VCCB = 5V	unit
			TYP	TYP	TYP	
VCCA = 1.8V						
A to B delay	tPHL	Push-Pull driving	2.4	3.0	5.4	ns
		Open-Drain driving	26.0	26.3	26.7	
	tPLH	Push-Pull driving	4.0	3.6	3.5	
		Open-Drain driving	175	145	110	
B to A delay	tPHL	Push-Pull driving	2.0	2.6	3.6	ns
		Open-Drain driving	26.0	26.1	26.2	
	tPLH	Push-Pull driving	1.7	1.5	1.4	
		Open-Drain driving	133	69	51	
OE enable time (tPZH and tPZL)	tEN		5.2	4.4	3.8	ns
OE disable time (tPHZ and tPLZ)	tDIS		614	616	626	
A PORT rise time	trA	Push-Pull driving	16	15	14	ns
		Open-Drain driving	89	31	10	
B PORT rise time	trB	Push-Pull driving	12	11	9	ns

		Open-Drain driving	128	98	58	
A PORT fall time	tfA	Push-Pull driving	10	9	8	ns
		Open-Drain driving	1.9	1.7	1.6	
B PORT fall time	tfB	Push-Pull driving	9	14	18	ns
		Open-Drain driving	2.2	2.3	2.9	
Channel to channel skew	tsk(0)		0.5	0.5	0.5	ns
Data rate		Push-Pull driving	18	18	17	Mbps
		Open-Drain driving	2	2	2	
VCCA = 2.5V						
A to B delay	tPHL	Push-Pull driving	2.7	3.3	4.8	ns
		Open-Drain driving	26.2	26.4	26.7	
	tPLH	Push-Pull driving	2.6	2.4	2.3	
		Open-Drain driving	169	144	110	
B to A delay	tPHL	Push-Pull driving	2.4	2.3	2.4	ns
		Open-Drain driving	26.3	26.4	26.5	
	tPLH	Push-Pull driving	2.0	1.9	1.8	
		Open-Drain driving	165	118	55	
OE enable time (tPZH and tPZL)	tEN		14	13	12	ns
OE disable time (tPHZ and tPLZ)	tDIS		630	635	640	
A PORT rise time	trA	Push-Pull driving	13	13	12	ns
		Open-Drain driving	120	70	10	
B PORT rise time	trB	Push-Pull driving	4.5	3.4	2.6	ns
		Open-Drain driving	122	96	62	
A PORT fall time	tfA	Push-Pull driving	8	7	6	ns
		Open-Drain driving	2.0	1.9	1.7	

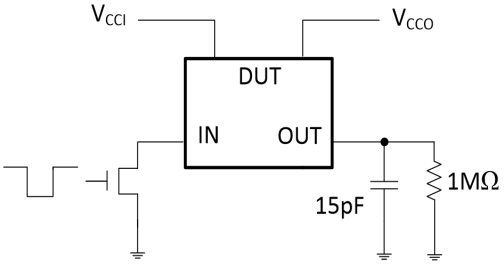
B PORT fall time	tfB	Push-Pull driving	8	12	15	ns
		Open-Drain driving	1.9	2.1	2.7	
Channel to channel skew	tsk(0)		0.5	0.5	0.5	ns
VCCA = 3.3V						
A to B delay	tPHL	Push-Pull driving		3.5	4.9	ns
		Open-Drain driving		26.3	26.7	
	tPLH	Push-Pull driving		2.2	2.0	
		Open-Drain driving		133	104	
B to A delay	tPHL	Push-Pull driving		3.0	3.2	ns
		Open-Drain driving		26.6	26.8	
	tPLH	Push-Pull driving		1.8	1.7	
		Open-Drain driving		132	83	
OE enable time (tPZH and tPZL)	tEN			12	11	ns
OE disable time (tPHZ and tPLZ)	tDIS			630	635	
A PORT rise time	trA	Push-Pull driving		12	11	ns
		Open-Drain driving		87	36	
B PORT rise time	trB	Push-Pull driving		10	9	ns
		Open-Drain driving		87	56	
A PORT fall time	tfA	Push-Pull driving		12	11	ns
		Open-Drain driving		2.3	2.0	
B PORT fall time	tfB	Push-Pull driving		13	16	ns
		Open-Drain driving		2.0	2.5	
Channel to channel skew	tsk(0)			0.5	0.5	ns

VCCA = 5.0V						
A to B delay	tPHL	Push-Pull driving			5.4	ns
		Open-Drain driving			26.7	
	tPLH	Push-Pull driving			1.9	
		Open-Drain driving			120	
B to A delay	tPHL	Push-Pull driving			5.6	ns
		Open-Drain driving			27.3	
	tPLH	Push-Pull driving			1.7	
		Open-Drain driving			126	
OE enable time (tPZH and tPZL)	tEN				10	ns
OE disable time (tPHZ and tPLZ)	tDIS				636	
A PORT rise time	trA	Push-Pull driving			8	ns
		Open-Drain driving			79	
B PORT rise time	trB	Push-Pull driving			7	ns
		Open-Drain driving			73	
A PORT fall time	tfA	Push-Pull driving			8.7	ns
		Open-Drain driving			2.7	
B PORT fall time	tfB	Push-Pull driving			8.6	ns
		Open-Drain driving			2.4	
Channel to channel skew	tsk(0)				0.5	ns

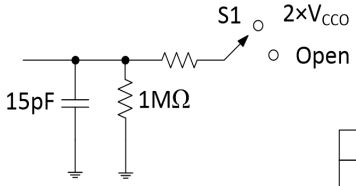
TEST CIRCUIT



Push-Pullmode

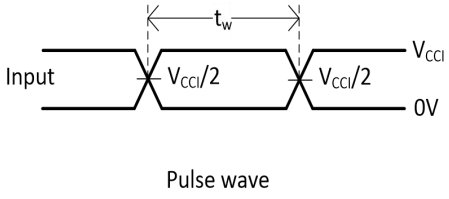


Open-Drain mode

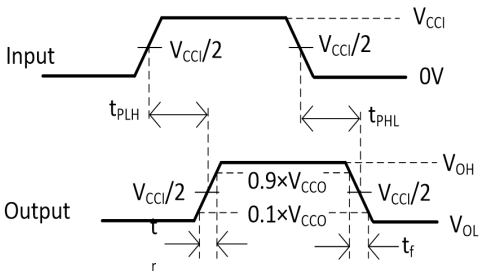


TEST	S1
t_{PZL}/t_{PLZ}	2 × V_{CCO}
t_{PHZ}/t_{PZH}	Open

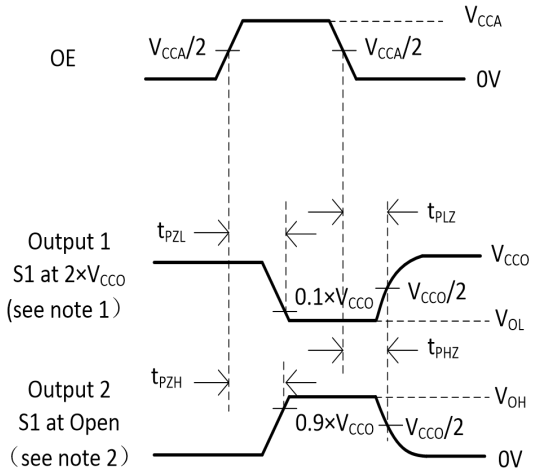
OE input enable and disable timing measurement



Pulse wave



Propagation delay times



Enable and disable times

Note :

1: CL includes probe and jig capacitance.

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

3: All input pulses are supplied by a generator with the following characteristics: PRR < 10MHz, ZO = 50, dv/dt < 1V/ns.

4: Output measurements once, each measurement needs to be converted once.

5:tPLZ, tPHZ and tDIS are the same

6:tPZL, tPZH are the same as tEN

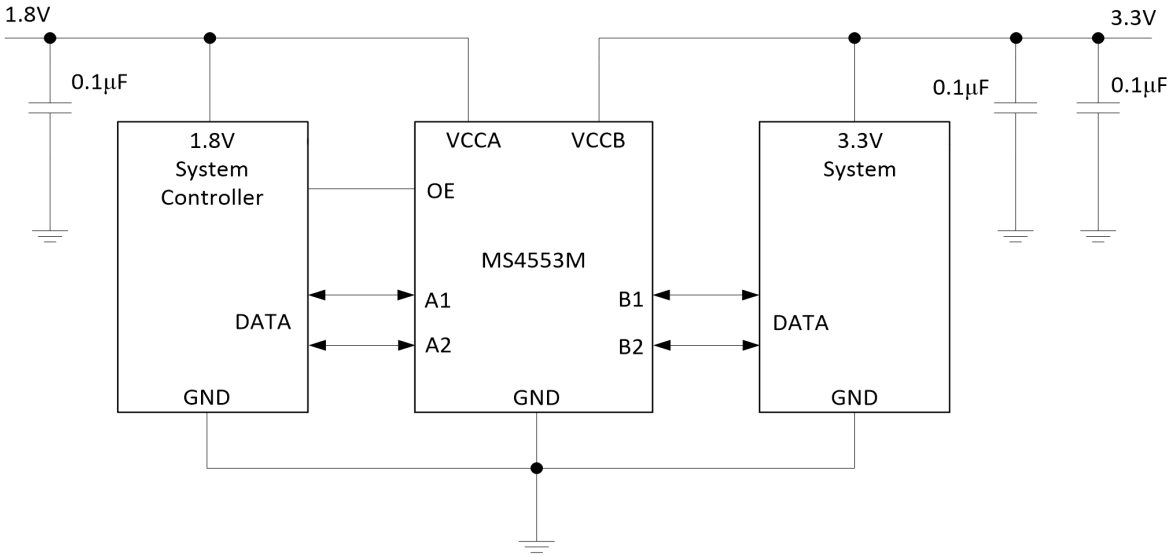
7:tPLH, tPHL and tPD are the same

8:VCCI is the VCC associated with the input port.

9:VCCO is the VCC associated with the output port.

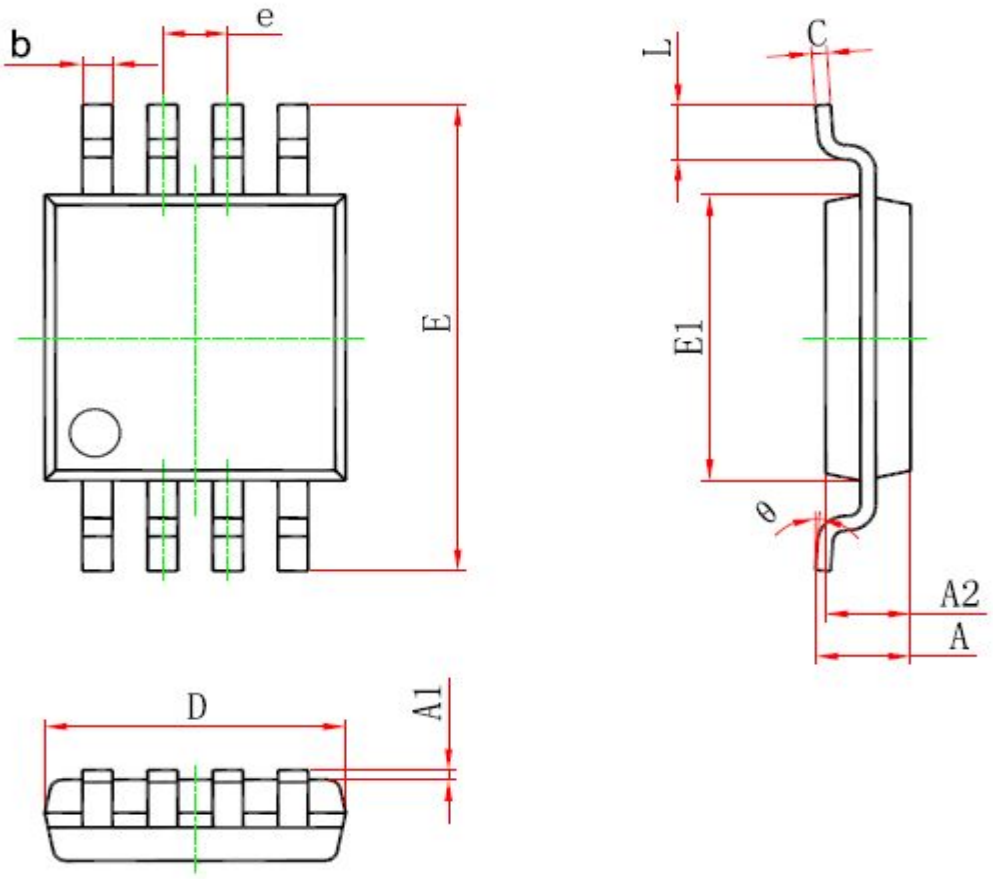
10: All parameters and waveforms are not applicable to all devices.

TYPICAL APPLICATION



PACKAGE OUTLINE DIMENSIONS

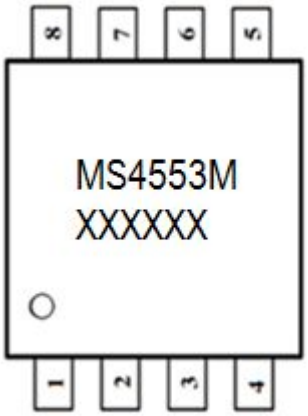
MSOP8：



symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	---	1.100	---	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
e	0.650BSC		0.026BSC	
E	4.750	5.050	0.187	0.199
E1	2.900	3.100	0.114	0.122
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

MARKING and PACKAGING SPECIFICATIONS

1. Marking Drawing Description



MS4553：Product Name
XXXXXX：Product Code

2. Marking Drawing Demand

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

3. Packaging Specifications

Device	Package	Piece/Reel	Reel/Box	Piece/Box	Box/Carton	Piece/Carton
MS4553M	MSOP8	3000	1	3000	8	24000

REVISION HISTORY

Revision	Revision Date	Description	Page
V1.0	2021/02/02	V1.0	

STATEMENT

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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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