

2-Bit Bidirectional Voltage-Level Translator for Open-Drain and Push-Pull Application UM3202Q DFN8 1.70×1.35 UM3202H CSP8 1.9×0.9 UM3202V VSSOP8

General Description

The UM3202Q/3202H/3202V is $\pm 15 \text{kV}$ dual channel ESD-protected level translator provide the level shifting necessary to allow data transfer in a multi-voltage system. Externally applied voltages, V_{CCB} and V_{CCA} , set the logic levels on either side of the device. A low-voltage logic signal present on the V_{CCA} side of the device appears as a high-voltage logic signal on the V_{CCB} side of the device, and vice-versa. The UM3202Q/3202H/3202V bidirectional level translator utilizes a transmission-gate based design to allow data translation in either direction ($V_{CCA} \leftrightarrow V_{CCB}$) on any single data line. The UM3202Q/3202H/3202V accepts V_{CCA} from +1.65V to +3.6V and V_{CCB} from +2.3V to +5.5V, making it ideal for data transfer between low-voltage ASICs / PLDs and higher voltage systems.

The UM3202Q/3202H/3202V enters a three-state output mode to reduce supply current when output enable (OE) is low. The UM3202Q/3202H/3202V is designed so that the OE input circuit is supplied by $V_{\rm CCA}$. $\pm 15 {\rm kV}$ ESD protection on the $V_{\rm CCB}$ side for greater protection in applications that route signals externally.

The UM3202Q/3202H/3202V is a dual level translator available in DFN8 1.70×1.35 , CSP8 1.9×0.9 and VSSOP8 packages.

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
- Cell-Phones
- GPS
- Telecommunications Equipment

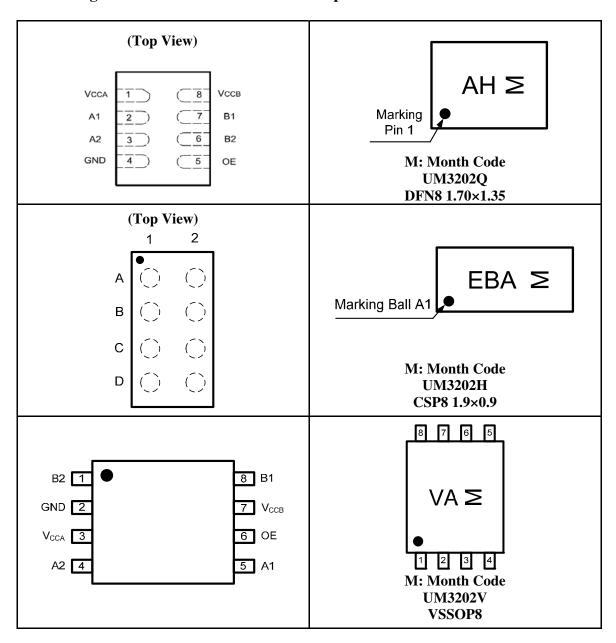
Features

- Max Data Rates:
 24Mbps (Push Pull),
 2Mbps (Open Drain)
- Bidirectional Level Translation
- 1.65V to 3.6V on A Port and 2.3V to 5.5V on B Port ($V_{CCA} \le V_{CCB}$)
- ±15kV ESD Protection on B Port
- No Power-Supply Sequencing Required V_{CCA} or V_{CCB} can be Ramped First
- DFN8, CSP8 and VSSOP8 Packages



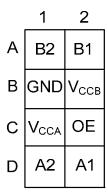
Pin Configurations

Top View





Ball Mapping for UM3202H



Transparent Top View

Pin Description

Pin Name	Function
V_{CCA}	A-Port Supply Voltage. $1.65V \le V_{CCA} \le 3.6V$ and $V_{CCA} \le V_{CCB}$
A1	Input/Output 1. Referenced to V _{CCA}
A2	Input/Output 2. Referenced to V _{CCA}
GND	Ground
OE	3-State Output Enable. Pull OE low to place all outputs in 3-state mode. Referenced to $V_{\rm CCA}$
B2	Input/Output 2. Referenced to V _{CCB}
B1	Input/Output 1. Referenced to V _{CCB}
V_{CCB}	B-Port Supply Voltage. 2.3V\(\secondsymbol{V}\)CCB\(\leq 5.5V\)

Ordering Information

Part Number	Packaging Type	Marking Code	Shipping Qty
UM3202Q	DFN8 1.70×1.35	АН	2000 /7.1 1
UM3202H	CSP8 1.9×0.9	EBA	3000pcs/7 Inch Tape & Reel
UM3202V	VSSOP8	VA	rape & Reer



Absolute Maximum Ratings (Note 1)

Over operating free-air temperature range (unless otherwise noted)

Symbol	Parameter		Value	Unit
V_{CCA}	Supply Voltage Range		-0.5 to +4.5	V
V_{CCB}	Supply Voltage Range		-0.5 to +6.5	V
V	Input Voltage Dange	A Ports	-0.5 to +4.5	V
$V_{\rm I}$	Input Voltage Range	B Ports	-0.5 to +6.5	V
V_{O}	Voltage Range Applied to Any Output in the High-Impedance or	-0.5 to +4.5	V	
v ₀	Power-Off State	-0.5 to +6.5	V	
V_{O}	Voltage Range Applied to Any Output in the High or Low State	A Ports	-0.5 to $(V_{CCA}+0.5)$	V
v ₀	(Note 2)	B Ports	-0.5 to (V _{CCB} +0.5)	V
I_{IK}	Input Clamp Current	$V_I < 0$	-50	mA
I_{OK}	Output Clamp Current	$V_0 < 0$	-50	mA
I_{O}	Continuous Output Current		±50	mA
	Continuous Current through V _{CCA} , V _{CC}	_{CB} , or GND	±100	mA
T_{OP}	Operating Temperature Range		-40 to +85	°C
T_{STG}	Storage Temperature Range		-65 to +150	°C

Note 1. Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Note 2. The value of V_{CCA} and V_{CCB} are provided in the recommended operating conditions table.

Recommended Operating Conditions (Note 1, 2)

Symbol	Paran	eter	V_{CCA}	V _{CCB}	Min	Max	Unit
V_{CCA}	Supply V	oltage			1.65 2.3	3.6 5.5	V
	High Level	A-Port	1.65V to 1.95V 2.3V to 3.6V	2.3V to 5.5V	V _{CCI} -0.2 V _{CCI} -0.4	V _{CCI}	V
$ m V_{IH}$	Input Voltage	B-Port OE	1.65V to 3.6V	2.3V to 5.5V	V_{CCI} -0.4 $V_{\text{CCA}} \times 0.65$	V _{CCI} 5.5	V
$V_{\rm IL}$	Low Level Input Voltage	A-Port B-Port OE	1.65V to 3.6V	2.3V to 5.5V	0	0.15 0.15 0.35	V
Δt/ΔV	Input Transition Rise or Fall Time	A-Port Push-Pull Driving B-Port Push-Pull Driving Control Input	1.65V to 3.6V	2.3V to 5.5V		10	ns/V

Note 1. V_{CCI} is the supply voltage associated with the input port.

Note 2. V_{CCA} must be less than or equal to V_{CCB} and must not exceed 3.6 V.



Electrical Characteristics (Note 1, 2, 3)

Over recommended operating free-air temperature range (unless otherwise noted)

	Daa	Took Conditions	X 7	X 7	$T_A =$	25°C	-40°C to 8	35°C	T I *4
	Parameter	Test Conditions	V_{CCA}	V_{CCB}	Тур	Max	Min	Max	Unit
	V_{OHA}	I _{OH} =-20μA	1.65V to 3.6V	2.3V to 5.5V			$V_{CCA} \times 0.8$		V
	V_{OLA}	I _{OL} =1mA	1.65V to 3.6V	2.3V to 5.5V				0.4	V
	V_{OHB}	IOH=-20μA	1.65V to 3.6V	2.3V to 5.5V			$V_{CCB} \times 0.8$		V
	V_{OLB}	I _{OL} =1mA	1.65V to 3.6V	2.3V to 5.5V				0.4	V
I_{I}	OE	$V_I = V_{CCI}$ or GND	1.65V to 3.6V	2.3V to 5.5V		±1		±2	μΑ
I_{OZ}	A or B Port	$OE=V_{IL}$	1.65V to 3.6V	2.3V to 5.5V		±1		±2	μΑ
		V-V	$1.65V$ to V_{CCB}	2.3V to 5.5V				2.4	
	I_{CCA}	$V_I = V_O = open,$ $I_O = 0$	3.6V	0V				2.2	μΑ
		1 _O -0	0V	5.5V				-1	
		37. 37.	$1.65V$ to V_{CCB}	2.3V to 5.5V				12	
	I_{CCB}	$V_I = V_O = open,$ $I_O = 0$	3.6V	0V				-1	μΑ
		10-0	0V	5.5V				1	
	I _{CCA} +I _{CCB}	$V_I = V_O = open,$ $I_O = 0$	1.65V to 3.6V	2.3V to 5.5V				14.4	μΑ
C_{i}	OE		3.3V	3.3V	2.5			3.5	pF
C	A Port		3.3V	3.3V	5			6.5	рE
C_{iO}	B Port		3.3 V	3.3 V	12			16.5	pF

Note 1. V_{CCI} is the supply voltage associated with the input port.

Timing Requirements

Over recommended operating free-air temperature range, $V_{\text{CCA}}=1.8V\pm0.15V$ (unless otherwise noted)

			$V_{CCB} = \pm 0.$		$V_{CCB} = \pm 0.$		V _{CCB} ±0.		Unit
			Min	Max	Min	Max	Min	Max	
Data Bata	Push-Pull Drivin	Push-Pull Driving		24		24		24	Mhaa
Data Rate	Open-Drain Drivi	ng		2		2		2	Mbps
t _w Pulse	Push-Pull Driving	Data	41		41		41		na
Duration	Open-Drain Driving	Inputs	500		500		500		ns

Timing Requirements (Continued)

Over recommended operating free-air temperature range, V_{CCA} =2.5 $V\pm0.2V$ (unless otherwise noted)

		V _{CCB} =		V _{CCB} =			3=5V 0.5V	Unit	
			Min	Max	Min	Max	Min	Max	
Data Bata	Push-Pull Drivin	ıg		24		24		24	Mhac
Data Rate	Open-Drain Drivi	ng		2		2		2	Mbps
t _w Pulse	Push-Pull Driving	Data	41		41		41		***
Duration	Open-Drain Driving	Inputs	500		500	·	500		ns

Note 2. V_{CCO} is the supply voltage associated with the output port.

Note 3. V_{CCA} must be less than or equal to V_{CCB} and must not exceed 3.6V.



Timing Requirements (Continued)

Over recommended operating free-air temperature range, V_{CCA} =3.3V±0.3V (unless otherwise noted)

			V _{CCB} =		V _{CCF} ±0		Unit
			Min	Max	Min	Max	
Data Bata	Push-Pull Dr	riving		24		24	Mbps
Data Rate	Open-Drain D	Priving		2		2	Mops
t _w Pulse	Push-Pull Driving	Doto Inputa	41		41		ng
Duration	Open-Drain Driving	Data Inputs	500		500		ns

Switching Characteristics

Over recommended operating free-air temperature range, V_{CCA} =1.8V \pm 0.15V (unless otherwise noted)

Parameter	From (Input)	To (Output)	Test Conditions		=2.5V 0.2V		=3.3V 0.3V		3=5V 0.5V	Unit
	(IIIput)	(Output)	Conditions	Min	Max	Min	Max	Min	Max	
4			Push-Pull		4.6		4.7		5.8	
$t_{ m PHL}$	A	В	Open-Drain	2.9	8.8	2.9	9.6	3	10	10.0
4	A	D	Push-Pull		6.8		6.8		7	ns
$t_{\rm PLH}$			Open-Drain	45	260	36	208	27	198	
+			Push-Pull		4.4		4.5		4.7	
$t_{ m PHL}$	В	A	Open-Drain	1.9	5.3	1.1	4.4	1.2	4	na
+	В	A	Push-Pull		5.3		4.5		0.5	ns
$t_{\rm PLH}$			Open-Drain	45	175	36	140	27	102	
4	OE	A			200		200		200	nc
t_{en}	OE	В			200		200		200	ns
4	OE	A			50		40		35	nc
$t_{\rm dis}$	OE	В			50		40		35	ns
4	A Dort D	ise Time	Push-Pull	3.2	9.5	2.3	9.3	2	7.6	ns
t_{rA}	ATORK	lise Time	Open-Drain	38	165	30	132	22	95	115
4	D Dort D	ise Time	Push-Pull	4	10.8	2.7	9.1	2.7	7.6	ns
$t_{ m rB}$	D FOILK	ise Tille	Open-Drain	34	145	23	106	10	58	115
4	A Dort E	all Time	Push-Pull	2	5.9	1.9	6	1.7	13.3	na
t_{fA}	Arontr	an Time	Open-Drain	4.4	6.9	4.3	6.4	4.2	6.1	ns
<u> </u>	D Dort E	all Time	Push-Pull	2.9	7.6	2.8	7.5	2.8	8.8	ns
$ m t_{fB}$	D FOIL F	all Tille	Open-Drain	6.9	13.8	7.5	16.2	7	16.2	118
$t_{SK(O)}$	Channel-t	o-Channel			1		1		1	ns
Max Data			Push-Pull		24		24		24	Mhnc
Rate			Open-Drain		2		2		2	Mbps



Switching Characteristics (Continued) Over recommended operating free-air temperature range, V_{CCA} =2.5 $V\pm0.2V$ (unless otherwise noted)

Parameter	From (Input)	To (Output)	Test Conditions	V _{CCB} =		V _{CCB} = ±0.			3=5V .5V	Unit	
	(Input)	(Output)	Conditions	Min	Max	Min	Max	Min	Max		
4			Push-Pull		3.2		3.3		3.4		
t_{PHL}	٨	В	Open-Drain	1.7	6.3	2	6	2.1	5.8		
4	A	В	Push-Pull		3.5		4.1		4.4	ns	
$t_{ m PLH}$			Open-Drain	43	250	36	206	27	190		
4			Push-Pull		3		3.6		4.3		
$t_{ m PHL}$	В		Open-Drain	1.8	4.7	2.6	4.2	1.2	4		
4	В	A	Push-Pull		2.5		1.6		0.7	ns	
t_{PLH}			Open-Drain	44	170	37	140	27	103		
4	OE	Α			200		200		200		
t_{en}	OE	В			200		200		200	ns	
4	OE	Α			50		40		35	***	
$t_{ m dis}$	OE	В			50		40		35	ns	
4	A Dort D	ise Time	Push-Pull	2.8	7.4	2.6	6.6	1.8	5.6	nc	
t_{rA}	Aron	ise Time	Open-Drain	34	149	28	121	24	89	ns	
4	D Dort D	ise Time	Push-Pull	3.2	8.3	2.9	7.2	2.4	6.1	na	
$t_{ m rB}$	D FUILK	ise Tille	Open-Drain	35	151	24	112	12	64	ns	
t .	A Dort E	all Time	Push-Pull	1.9	5.7	1.9	5.5	1.8	5.3	ns	
t_{fA}	ATOILI	all Tille	Open-Drain	4.4	6.9	4.3	6.2	4.2	5.8	115	
4	D Dort E	B Port Fall Time		2.2	7.8	2.4	6.7	2.6	6.6	na	
${ m t_{fB}}$	ъ Роп г	an inne	Open-Drain	5.1	8.8	5.4	9.4	5.4	10.4	ns	
$t_{SK(O)}$	Channel-t	o-Channel			1		1		1	ns	
Max Data			Push-Pull	24		24		24		Mhnc	
Rate			Open-Drain	2		2		2		Mbps	



Switching Characteristics (Continued) Over recommended operating free-air temperature range, V_{CCA} =3.3V \pm 0.3V (unless otherwise noted)

Parameter	From	To (Output)	Test Conditions		=3.3V .3V		3=5V 0.5V	Unit
	(Input)	(Output)		Min	Max	Min	Max	
4			Push-Pull		2.4		3.1	
t_{PHL}		D	Open-Drain	1.2	4.2	1.4	4.6	
4	A	В	Push-Pull		4.2		4.4	ns
$t_{ m PLH}$			Open-Drain	36	204	28	165	
4			Push-Pull		2.5		3.3	
$t_{ ext{PHL}}$	D		Open-Drain	1	124	1	97	
4	В	A	Push-Pull		2.5		2.6	ns
$t_{ m PLH}$			Open-Drain	3	139	3	105	
4	OF	A			200		200	
t _{en}	OE	В			200		200	ns
4	OE	A			40		35	
$t_{ m dis}$	OE	В			40		35	ns
4	A Dort D	lise Time	Push-Pull	2.3	5.6	1.9	4.8	***
t_{rA}	A Poit K	ase Time	Open-Drain	25	116	19	85	ns
_	D Dowt D	ise Time	Push-Pull	2.5	6.4	2.1	7.4	
t_{rB}	В Роп к	lise Time	Open-Drain	26	116	14	72	ns
4	A Dant E	Fall Time	Push-Pull	2	5.4	1.9	5	
t_{fA}	A Poit i	an Time	Open-Drain	4.3	6.1	4.2	5.7	ns
_	D Dowt E	Call Times	Push-Pull	2.3	7.4	2.4	7.6	
${ m t_{fB}}$	ВРОПЕ	Fall Time	Open-Drain	5	7.6	4.8	8.3	ns
t _{SK(O)}	Channel-t	o-Channel			1		1	ns
Max Data		_	Push-Pull	24		24		Mhac
Rate			Open-Drain	2		2		Mbps



Applications Information

The UM3202Q/3202H/3202V can be used in level-translation applications for interfacing devices or systems operating at different interface voltages with one another. The UM3202Q/3202H/3202V is ideal for use in application where an open-drain driver is connected to the data I/Os. The UM3202Q/3202H/3202V can also be used in applications where a push-pull driver is connected to the data I/Os, but the UM3302 might be a better option for such push-pull applications.

Block Diagram

The UM3202Q/3202H/3202V (block diagram see Figure 1) does not require a direction-control signal to control the direction of data flow from A to B or from B to A. Each A-port I/O has an internal $10k\Omega$ pull-up resistor to V_{CCA} , and each B-port I/O has an internal $10k\Omega$ pull-up resistor to V_{CCB} . During a rising edge, the one-shot turns on the PMOS transistors (PU1, PU2) for a short duration, that speeds up the low-to-high transition.

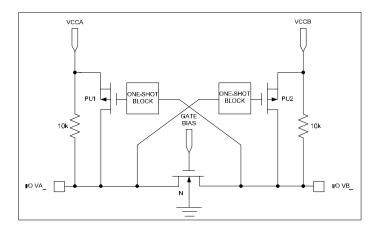


Figure 1 Block Diagram of UM3202Q/3202H/3202V I/O Cell

Input Driver Requirements

The fall time (t_{fA} , t_{fB}) of a signal depends on the output impedance of the external device driving the data I/Os of the UM3202Q/3202H/3202V. Similarly, the t_{PHL} and the maximum date rates also depend on the output impedance of the external driver. The values for t_{fA} , t_{fB} , t_{PHL} , and the maximum date rates in the data sheet assume that the output impedance of the external driver is less than 50Ω .

Power Up

During operation, ensure that $V_{CCA} \le V_{CCB}$ at all times. During power-up sequencing, $V_{CCA} \ge V_{CCB}$ does not damage the device, so any power supply can be ramped up first.

Enable and Disable

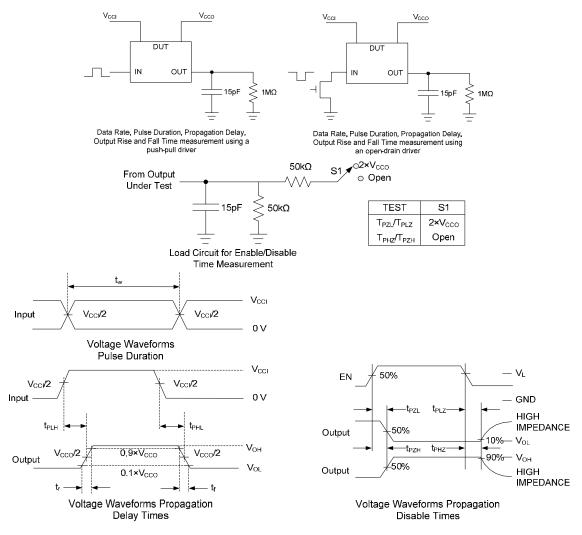
The UM3202Q/3202H/3202V has an OE input that is used to disable the device by setting OE=low, which places all I/Os in the high-impedance (Hi-Z) state. The disable time (t_{dis}) indicates the delay between the time when OE goes low and when the outputs actually get disabled (Hi-Z). The enable time (t_{en}) indicates the amount of time the user must allow for the one-shot circuitry to become operational after OE is taken high.



Pull-up or Pull-down Resistors on I/O Lines

Each A-port I/O has an internal $10k\Omega$ pull-up resistor to V_{CCA} , and each B-port I/O has an internal $10k\Omega$ pull-up resistor to V_{CCB} . If a smaller value of pull-up resistor is required, an external resistor must be added from the I/O to V_{CCA} or V_{CCB} (in parallel with the internal $10k\Omega$ resistor).

Test Circuits



- A. C_L includes probe and jig capacitances.
- B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control.

Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.

- C. All input pulses are supplied by generators having the following characteristics: $PRR \le 100MHz$, $Z_0 = 50\Omega$, $dV/dt \ge 1V/ns$.
- D. The outputs are measured one at a time, with one transition per measurement.
- E. T_{PLZ} and T_{PHZ} are the same as t_{dis} .
- $F.\ T_{PZL}$ and T_{PZH} are the same as $t_{en}.$
- G. T_{PLH} and T_{PHL} are the same as t_{pd} .
- H. V_{CCI} is the V_{CC} associated with the input port.
- I. V_{CCO} is the V_{CC} associated with the output port.
- J. All parameters and waveforms are not applicable to all devices.

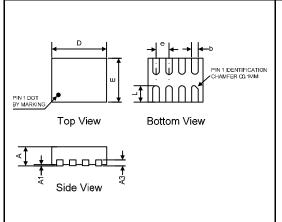
Figure 2 Load Circuits and Voltage Waveforms



Package Information

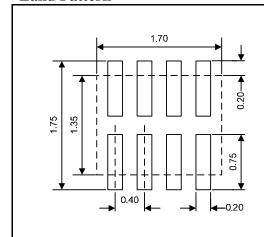
UM3202Q: DFN8 1.70×1.35

Outline Drawing



	DIMENSIONS											
Carrack of	MIL	LIME	ΓERS	INCHES								
Symbol	Min	Тур	Max	Min	Max							
A	0.50	0.55	0.60	0.020	0.022	0.024						
A1	0.00	-	0.05	0.000	-	0.002						
A3	0.15REF			0	0.006RE	F						
b	0.15	0.20	0.25	0.006	0.008	0.010						
D	1.65	1.70	1.75	0.065	0.067	0.069						
Е	1.30	1.35	1.40	0.051	0.053	0.055						
e	(0.40BSC		0.016BSC								
L	0.45	0.50	0.55	0.018	0.020	0.022						

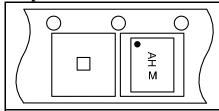
Land Pattern



NOTES:

- 1. Compound dimension: 1.70×1.35;
- 2. Unit: mm;
- 3. General tolerance ± 0.05 mm unless otherwise specified;
- 4. The layout is just for reference.

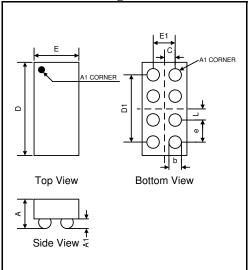
Tape and Reel Orientation





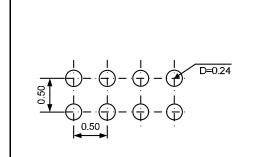
UM3202H: CSP8 1.9×0.9

Outline Drawing



DIMENSIONS									
Symbol	MILLIMETERS			INCHES					
	Min	Тур	Max	Min	Тур	Max			
A	1	-	0.68	-	-	0.027			
A1	0.21	0.231	0.24	0.0083	0.0091	0.0094			
b	0.27	0.30	0.32	0.011	0.012	0.013			
С	0.25BSC			0.010BSC					
D	1.85	1.90	1.95	0.073	0.075	0.077			
D1	1.50BSC			0.059BSC					
Е	0.85	0.90	0.95	0.033	0.035	0.037			
E1	0.50BSC			0.020BSC					
e	0.50BSC			0.020BSC					
L	0.25BSC			0.010BSC					

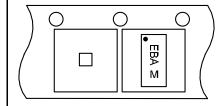
Land Pattern



NOTES:

- 1. Bump is Lead Free Sn/Ag/Cu.
- 2. Unit: mm;
- 3. Non-solder mask defined copper landing pad.
- 4. Laser Mark on silicon die back; back-lapped.

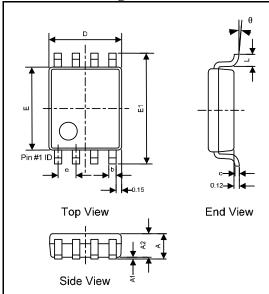
Tape and Reel Orientation





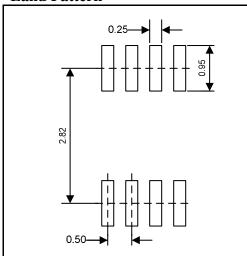
UM3202V: VSSOP8

Outline Drawing



DIMENSIONS									
Symbol	MILLIMETERS			INCHES					
	Min	Тур	Max	Min	Тур	Max			
A	0.60	0.75	0.90	0.023	0.029	0.035			
A1	0.00	0.05	0.10	0.000	0.002	0.004			
A2	0.60	0.70	0.80	0.023	0.027	0.031			
b	0.17	-	0.27	0.007	-	0.011			
c	0.08	-	0.23	0.003	-	0.009			
D	1.90	2.00	2.10	0.075	0.079	0.083			
Е	2.20	2.30	2.40	0.086	0.090	0.094			
E1	3.00	3.10	3.20	0.118	0.122	0.126			
e	0.50BSC			0.020BSC					
L	0.20	0.28	0.35	0.008	0.011	0.014			
θ	0°	3°	6°	0°	3°	6°			

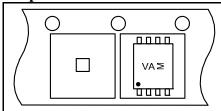
Land Pattern



NOTES:

- 1. Compound dimension: 2.00×2.30;
- 2. Unit: mm;
- 3. General tolerance ±0.05mm unless otherwise specified;
- 4. The layout is just for reference.

Tape and Reel Orientation





GREEN COMPLIANCE

Union Semiconductor is committed to environmental excellence in all aspects of its operations including meeting or exceeding regulatory requirements with respect to the use of hazardous substances. Numerous successful programs have been implemented to reduce the use of hazardous substances and/or emissions.

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http://www.union-ic.com/index.aspx?cat_code=RoHSDeclaration

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