

适用于开漏或推挽应用的 4 位双向多电压电平转换器

UMLSF0204 TSSOP14/CSP12 1.9×1.4/QFN12 1.7×2.0/QFN14 3.5×3.5
UMLSF0204D TSSOP14/CSP12 1.9×1.4/QFN12 1.7×2.0/QFN14 3.5×3.5

1 描述

UMLSF020 系列器件可在 0.8V 至 4.5V(V_{REF_A})和 1.8V 至 5.5V(V_{REF_B})电压范围内运行。该范围支持在 0.8V 和 5.0V 之间进行双向电压转换，无需在漏极开路或推挽应用中使用方向端子。对于采用 15pF 电容负载和 165Ω 上拉电阻器的漏极开路系统，该器件支持传输速度大于 100MHz (200Mbps) 的电平转换应用。

当 An 或 Bn 端口为低电平时，此时开关处于接通状态，而且 An 和 Bn 端口之间存在低电阻连接。低 R_{ON} 的开关可实现具有超低传播延迟和超小信号失真的连接。A 端或 B 端的电压将限制为 V_{REF_A} ，且可上拉至 V_{REF_A} 到 5V 之间的任何电压水平。能够在每个通道上设置不同的转换电压，使用户能够在较高和较低电压之间实现无缝转换，而无需方向控制引脚，从而最大限度地减少系统的工作量。

UMLSF0204 的 EN 引脚为高电平时，转换器开关打开，I/O An 分别连接至 I/O Bn。相反，UMLSF0204D 的 EN 引脚为低电平有效。

UMLSF0204 系列提供 CSP12 1.9×1.4、QFN12 1.7×2.0、QFN14 3.5×3.5 和 TSSOP14 共 4 种封装。

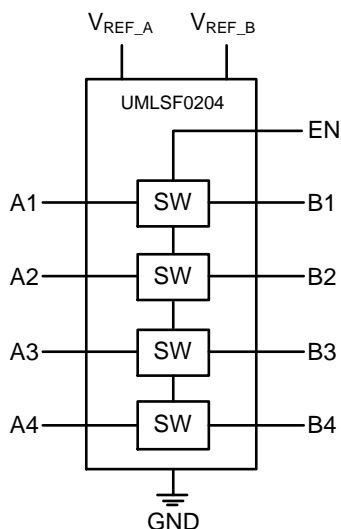
2 特性

- 可在无方向引脚的情况下提供自动双向电压转换
- I_{OFF} 支持局部断电模式运行
- 可实现以下电压之间的双向电压电平转换：
 - 0.8 V ↔ 1.8, 2.5, 3.3, 5 V
 - 1.2 V ↔ 1.8, 2.5, 3.3, 5 V
 - 1.8 V ↔ 2.5, 3.3, 5 V
 - 2.5 V ↔ 3.3, 5 V
 - 3.3 V ↔ 5 V
- ESD 保护性能超过 JESD 22 规范要求
 - ±5000V 人体放电模型
 - ±2000V 充电器件模型
- 上行转换
 - ≤ 100MHz (200Mbps); $C_L \leq 30$ pF
 - ≤ 40MHz (80Mbps); $C_L = 50$ pF
- 下行转换
 - ≥ 100MHz (200Mbps); $C_L \leq 30$ pF
 - ≥ 40MHz (80Mbps); $C_L = 50$ pF
- 低待机电流
- 支持 TTL 的 5V 耐压 I/O 端口
- 低 R_{ON} 带来较少的信号失真
- EN 未激活时，I/O 端口处于高阻态
- 闩锁性能 (Latch-up) 超过 200mA，超过 JESD 78, Class II 规范要求

3 应用

- GPIO、MDIO、PMBus、SMBus、SDIO、UART、I²C 和电信基础设施中的其他接口
- 工业
- 汽车
- 个人计算

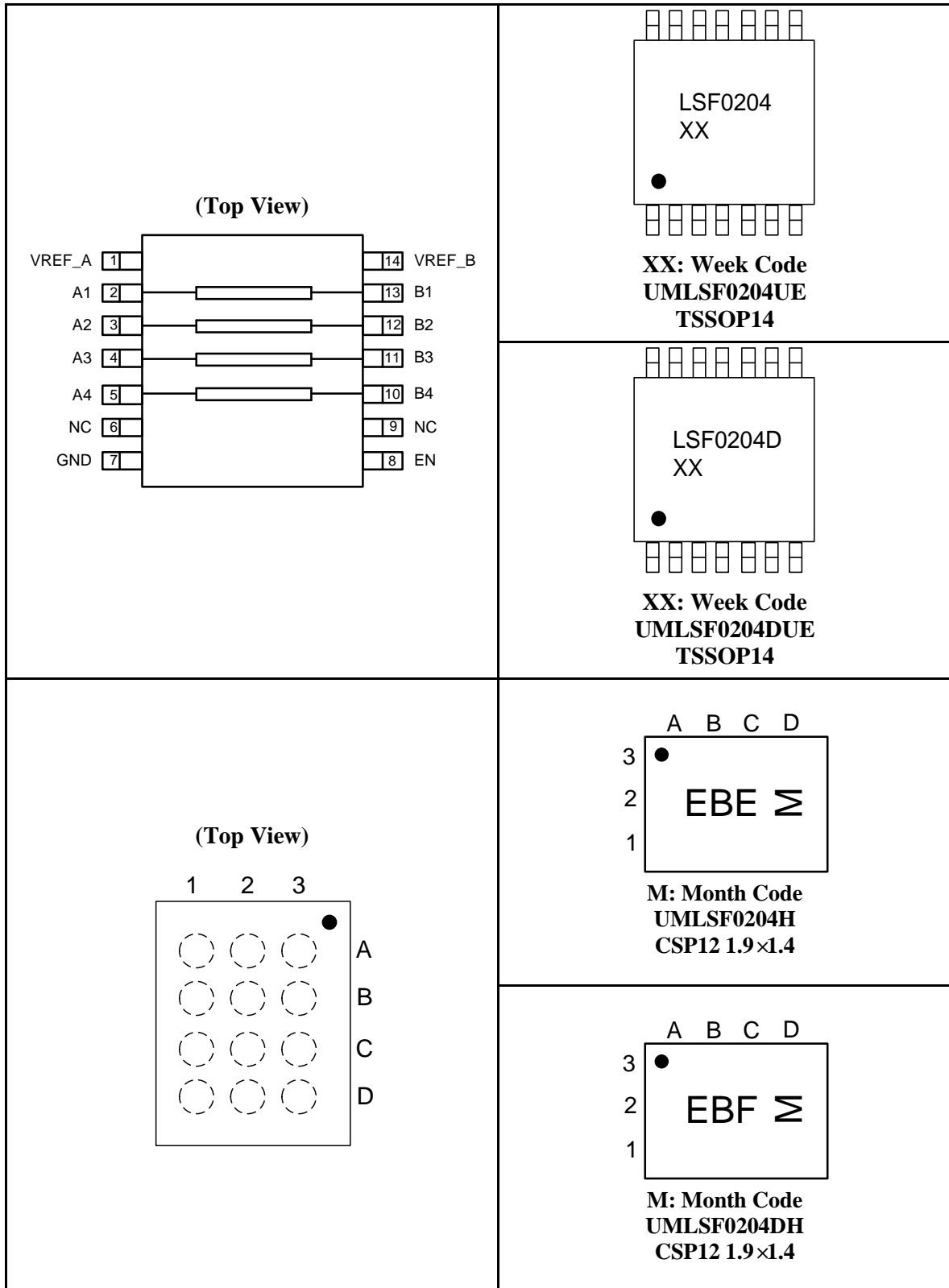
4 Simplified Schematic



5 Ordering Information

Part Number	Mark Code	Package Type	Shipping Qty
UMLSF0204UE	LSF0204	TSSOP14	3000pcs/13Inch Tape & Reel
UMLSF0204H	EBE	CSP12 1.9×1.4	3000pcs/7Inch Tape & Reel
UMLSF0204QA	APD	QFN12 1.7×2.0	3000pcs/7Inch Tape & Reel
UMLSF0204QS	UMLSF0204	QFN14 3.5×3.5	3000pcs/7Inch Tape & Reel
UMLSF0204DUE	LSF0204D	TSSOP14	3000pcs/13Inch Tape & Reel
UMLSF0204DH	EBF	CSP12 1.9×1.4	3000pcs/7Inch Tape & Reel
UMLSF0204DQA	APE	QFN12 1.7×2.0	3000pcs/7Inch Tape & Reel
UMLSF0204DQS	UMLSF0204D	QFN14 3.5×3.5	3000pcs/7Inch Tape & Reel

6 Pin Configuration and Function



6 Pin Configuration and Function (continued)

<p style="text-align: center;">(Top View)</p> <p style="text-align: center;">EN</p> <p>VREF_A 1 12 11 VREF_B</p> <p>A1 2 10 B1</p> <p>A2 3 9 B2</p> <p>A3 4 8 B3</p> <p>A4 5 6 7 B4</p> <p style="text-align: center;">GND</p>	<div style="border: 1px solid black; padding: 10px; text-align: center;"> <p>APD Σ</p> <p>●</p> </div> <p>M: Month Code UMLSF0204QA QFN12 1.7×2.0</p>
<p style="text-align: center;">(Top View)</p> <p style="text-align: center;">EN GND</p> <p style="text-align: center;">8 7</p> <p>NC 9 6 NC</p> <p>B4 10 5 A4</p> <p>B3 11 4 A3</p> <p>B2 12 3 A2</p> <p>B1 13 2 A1</p> <p style="text-align: center;">14 1</p> <p style="text-align: center;">VREF_B VREF_A</p>	<div style="border: 1px solid black; padding: 10px; text-align: center;"> <p>UMLSF 0204 XX</p> <p>●</p> </div> <p>XX: Week Code UMLSF0204QS QFN14 3.5×3.5</p>
	<div style="border: 1px solid black; padding: 10px; text-align: center;"> <p>UMLSF 0204D XX</p> <p>●</p> </div> <p>XX: Week Code UMLSF0204DQS QFN14 3.5×3.5</p>

6 Pin Configuration and Function (continued)

6.1 Mapping for UMLSF0204H and UMLSF0204DH

Transparent Top View

	A	B	C	D
3	A1	A2	A3	A4
2	VREF_B	VREF_A	EN	GND
1	B1	B2	B3	B4

Table 6-1. Pin Functions

Pin Name	Function
VREF_A	Reference supply voltage.
A1	Input/output 1.
A2	Input/output 2.
A3	Input/output 3.
A4	Input/output 4.
GND	Ground.
EN	Switch enable input. Referenced to V_{REF_A} . EN is high-active for UMLSF0204; EN is low-active for UMLSF0204D.
NC	No connection. Not internally connected.
B4	Input/output 4.
B3	Input/output 3.
B2	Input/output 2.
B1	Input/output 1.
VREF_B	Reference supply voltage.

7 Specifications

7.1 Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Value	Unit
V _I	Input Voltage (Note 2)	-0.5 to +7	V
V _{IO}	Input/output voltage (Note 2)	-0.5 to +7	V
V _{ESD}	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001	±5000	V
	Charged device model (CDM), per JEDEC specification JESD22-C101	±2000	V
	Continuous channel current	128	mA
I _{IK}	Input clamp current	V _I < 0	-50 mA
T _J	Operating Junction Temperature	-40 to +150	°C
T _{STG}	Storage Temperature	-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 input and input/output negative-voltage ratings may be exceeded if the input and input/output clamp-current ratings are observed.

7.2 Recommended Operating Conditions

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

Symbol	Parameter	Min	Max	Unit
V _{IO}	Input/output voltage	0	5.5	V
V _{REF_A/B/EN}	Reference voltage	0	5.5	V
I _{PASS}	Pass transistor current		64	mA
T _A	Operating free-air temperature	-40	125	°C

7.3 Thermal Information

Symbol	Parameter	Value	Unit	
R _{θJA}	Junction-to-ambient thermal resistance	TSSOP14	156.9	°C/W
		CSP12 1.9×1.4	82.7	
		QFN12 1.7×2.0	194.8	
		QFN14 3.5×3.5	82.2	
R _{θJC(TOP)}	Junction-to-case (top) thermal resistance	TSSOP14	81.3	°C/W
		CSP12 1.9×1.4	0.6	
		QFN12 1.7×2.0	97.7	
		QFN14 3.5×3.5	97.2	
R _{θJB}	Junction-to-board thermal resistance	TSSOP14	99	°C/W
		CSP12 1.9×1.4	22.7	
		QFN12 1.7×2.0	121.6	
		QFN14 3.5×3.5	59.2	

7.4 Electrical Characteristics (Note 1)

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

Parameter		Test Conditions	Min	Typ	Max	Unit
V _{IK}		I _I = -18 mA, V _{EN} = 0 V			-1.2	V
I _{IH}		V _I = 5 V, V _{EN} = 0 V			5	μA
I _{CCBA} (Note 2)	Leakage from V _{REF_B} to V _{REF_A}	V _{REF_B} = 3.3 V, V _{REF_A} = 1.8 V, V _{EN} = V _{REF_A} , I _O = 0, V _I = 3.3 V or GND		2.8	10	μA
I _{CCA} +I _{CCB}		V _{REF_B} = 3.3 V, V _{REF_A} = 1.8 V, V _{EN} = V _{REF_A} , I _O = 0, V _I = 3.3 V or GND		0.2		μA
I _{IN}		V _{REF_B} = 5.5 V, V _{REF_A} = 4.5 V, V _{EN} = 0 V to V _{REF_A} , I _O = 0 V			±1	μA
I _{OFF}		V _{REF_B} = V _{REF_A} = 0 V, V _{EN} = GND, I _O = 0, V _I = 5 V or GND		0.3	±3.5	μA
C _{I(REF_A/B/EN)}		V _I = 3 V or 0 V		9		pF
C _{IO(OFF)}		V _O = 3 V or 0 V, V _{EN} = 0 V		4.5	6	pF
C _{IO(ON)}		V _O = 3 V or 0 V, V _{EN} = V _{REF_A}		9.5	13	pF
V _{IH}	High-level input voltage for EN pin	V _{REF_A} = 1.5 V to 4.5 V	0.7× V _{REF_A}			V
V _{IL}	Low-level input voltage for EN pin	V _{REF_A} = 1.5 V to 4.5 V			0.3× V _{REF_A}	V
V _{IH}	High-level input voltage for EN pin	V _{REF_A} = 1.0 V to 1.5 V	0.8× V _{REF_A}			V
V _{IL}	Low-level input voltage for EN pin	V _{REF_A} = 1.0 V to 1.5 V			0.3× V _{REF_A}	V
Δ t/Δ v				10		ns/V
R _{ON} (Note 3)		V _I = 0 V, I _O = 64 mA, V _{REF_A} = V _{EN} = 3.3 V; V _{REF_B} = 5 V		3		Ω
		V _I = 0 V, I _O = 64 mA, V _{REF_A} = V _{EN} = 1.8 V; V _{REF_B} = 5 V		4		
		V _I = 0 V, I _O = 32 mA, V _{REF_A} = V _{EN} = 1.0 V; V _{REF_B} = 5 V		8		

7.4 Electrical Characteristics (Note 1) (continued)

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

Parameter	Test Conditions	Min	Typ	Max	Unit
R _{ON} (Note 3)	V _I = 0 V, I _O = 32 mA, V _{REF_A} = V _{EN} = 1.8 V; V _{REF_B} = 5 V		4		Ω
	V _I = 0 V, I _O = 32 mA, V _{REF_A} = V _{EN} = 2.5 V; V _{REF_B} = 5 V		4		
	V _I = 1.8 V, I _O = 15 mA, V _{REF_A} = V _{EN} = 3.3 V; V _{REF_B} = 5 V		5		
	V _I = 1.0 V, I _O = 10 mA, V _{REF_A} = V _{EN} = 1.8 V; V _{REF_B} = 3.3 V		10		
	V _I = 0 V, I _O = 10 mA, V _{REF_A} = V _{EN} = 1.0 V; V _{REF_B} = 3.3 V		6		
	V _I = 0 V, I _O = 10 mA, V _{REF_A} = V _{EN} = 1.0 V; V _{REF_B} = 1.8 V		6.5		

Note 1: All typical values are at T_A = 25°C.

Note 2: The actual supply current for UMLSF0204 is I_{CCA} + I_{CCB}; the leakage from V_{REF_B} to V_{REF_A} can be measured on V_{REF_A} and V_{REF_B} pin.

Note 3: Measured by the voltage drop between the A and B terminals at the indicated current through the switch. On-state resistance is determined by the lowest voltage of the two (A or B) terminals.

7.5 Switching Characteristics: Translating Down, 3.3 V to 1.8 V

V_{REF_A} = 1.8 V, V_{REF_B} = 3.3 V, V_{EN} = 1.8 V, V_{PU_1} = 3.3 V, V_{PU_2} = 1.8 V, R_L = NA, V_{IH} = 3.3 V, V_{IL} = 0 V, V_M = 1.15 V. Over recommended operating free-air temperature range (unless otherwise noted).

Parameter	From (Input)	To (Output)	C _L = 50 pF		C _L = 30 pF		C _L = 15 pF		Unit
			Typ	Max	Typ	Max	Typ	Max	
t _{PLH}	A or B	B or A	0.8	5.49	0.5	5.29	0.3	5.19	ns
t _{PHL}			0.9	4.9	0.7	4.7	0.5	4.5	ns
t _{PLZ}			8.4	18	8.4	16.5	8.3	15	ns
t _{PZL}			6.5	45	6.4	40	6.3	37	ns
f _{MAX}			50		100		100		MHz

7.5 Switching Characteristics (continued): Translating Down, 3.3 V to 1.2 V

$V_{REF_A} = 1.2\text{ V}$, $V_{REF_B} = 3.3\text{ V}$, $V_{EN} = 1.2\text{ V}$, $V_{PU_1} = 3.3\text{ V}$, $V_{PU_2} = 1.2\text{ V}$, $R_L = \text{NA}$, $V_{IH} = 3.3\text{ V}$, $V_{IL} = 0\text{ V}$, $V_M = 0.85\text{ V}$. Over recommended operating free-air temperature range (unless otherwise noted).

Parameter	From (Input)	To (Output)	$C_L = 50\text{ pF}$		$C_L = 30\text{ pF}$		$C_L = 15\text{ pF}$		Unit
			Typ	Max	Typ	Max	Typ	Max	
t_{PLH}	A or B	B or A	1.1	4.1	0.7	3.9	0.4	3.8	ns
t_{PHL}			0.8	4.7	0.7	4.5	0.5	4.3	ns
f_{MAX}			50		100		100		MHz

7.5 Switching Characteristics (continued): Translating Up, 1.8 V to 3.3 V

$V_{REF_A} = 1.8\text{ V}$, $V_{REF_B} = 3.3\text{ V}$, $V_{EN} = 1.8\text{ V}$, $V_{PU_1} = 3.3\text{ V}$, $V_{PU_2} = 1.8\text{ V}$, $R_L = 500\ \Omega$, $V_{IH} = 1.8\text{ V}$, $V_{IL} = 0\text{ V}$, $V_M = 0.9\text{ V}$. Over recommended operating free-air temperature range (unless otherwise noted).

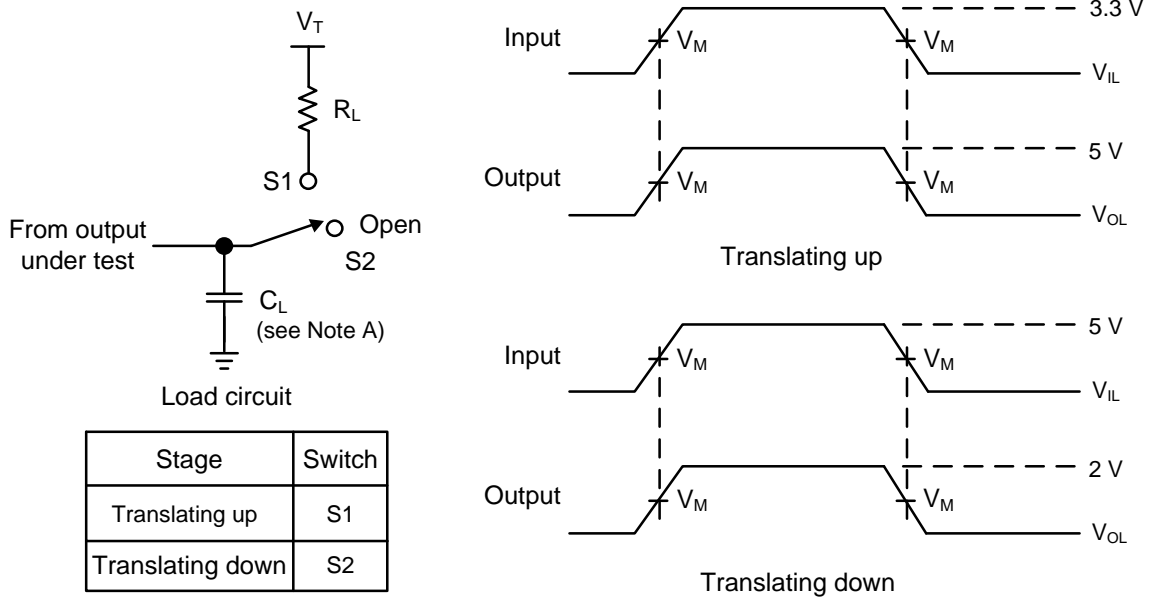
Parameter	From (Input)	To (Output)	$C_L = 50\text{ pF}$		$C_L = 30\text{ pF}$		$C_L = 15\text{ pF}$		Unit
			Typ	Max	Typ	Max	Typ	Max	
t_{PLH}	A or B	B or A	0.6	5.7	0.4	5.3	0.1	5.13	ns
t_{PHL}			1.6	6.7	1.2	6.4	0.8	5.3	ns
t_{PLZ}			10.3	18	9.4	16.5	9	15	ns
t_{PZL}			13.4	45	11.5	40	9.8	37	ns
f_{MAX}			50		100		100		MHz

7.5 Switching Characteristics (continued): Translating Up, 1.2 V to 1.8 V

$V_{REF_A} = 1.2\text{ V}$, $V_{REF_B} = 1.8\text{ V}$, $V_{EN} = 1.2\text{ V}$, $V_{PU_1} = 1.8\text{ V}$, $V_{PU_2} = 1.2\text{ V}$, $R_L = 500\ \Omega$, $V_{IH} = 1.2\text{ V}$, $V_{IL} = 0\text{ V}$, $V_M = 0.6\text{ V}$. Over recommended operating free-air temperature range (unless otherwise noted).

Parameter	From (Input)	To (Output)	$C_L = 50\text{ pF}$		$C_L = 30\text{ pF}$		$C_L = 15\text{ pF}$		Unit
			Typ	Max	Typ	Max	Typ	Max	
t_{PLH}	A or B	B or A	0.8	7.25	0.5	7.05	0.2	6.85	ns
t_{PHL}			1.8	7.03	1.4	6.5	1	5.4	ns
f_{MAX}			50		100		100		MHz

8 Parameter Measurement Information



Note 1: C_L includes probe and jig capacitance.

Note 2: All input pulses are supplied by generators having the following characteristics: $PRR \leq 10$ MHz, $Z_O = 50\Omega$, $t_R \leq 2$ ns, $t_F \leq 2$ ns.

Note 3: The outputs are measured one at a time, with one transition per measurement.

Figure 8-1. Load Circuit for Outputs

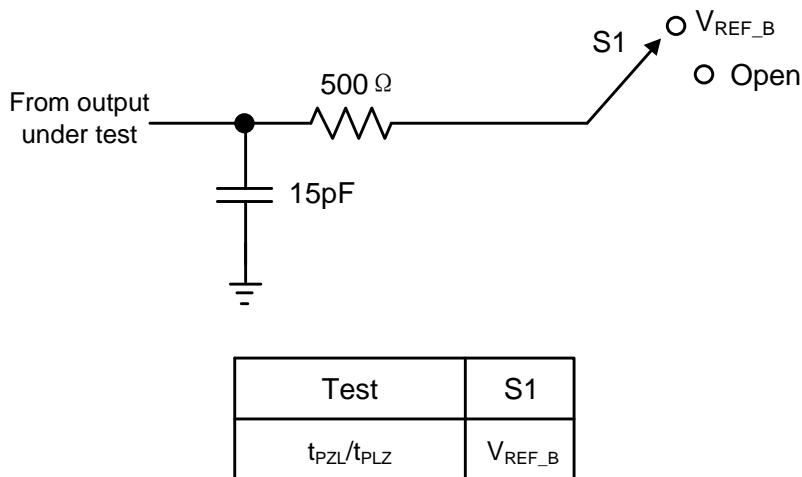


Figure 8-2. Load Circuit for Enable/Disable Time Measurement

8 Parameter Measurement Information (continued)

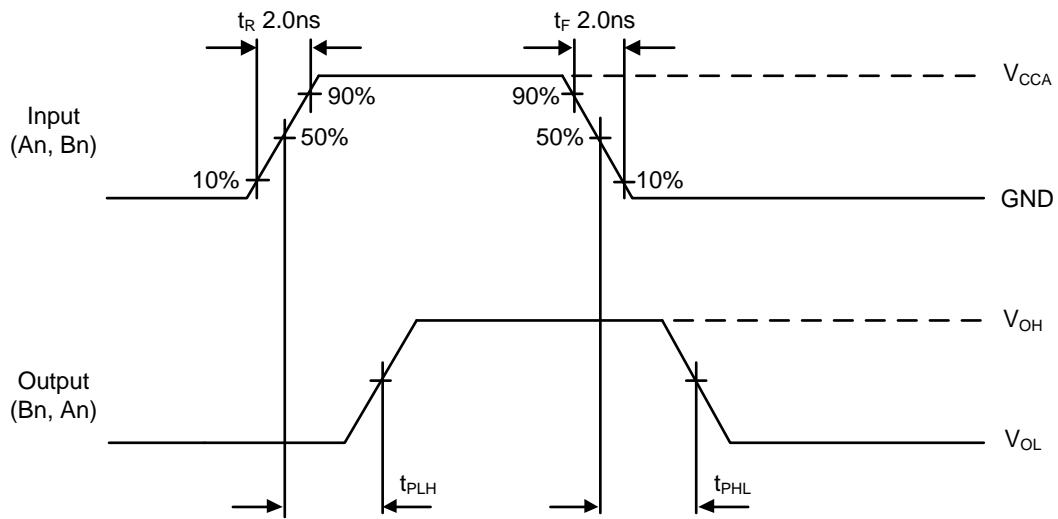


Figure 8-3. Voltage Waveforms t_{PLH} , t_{PHL}

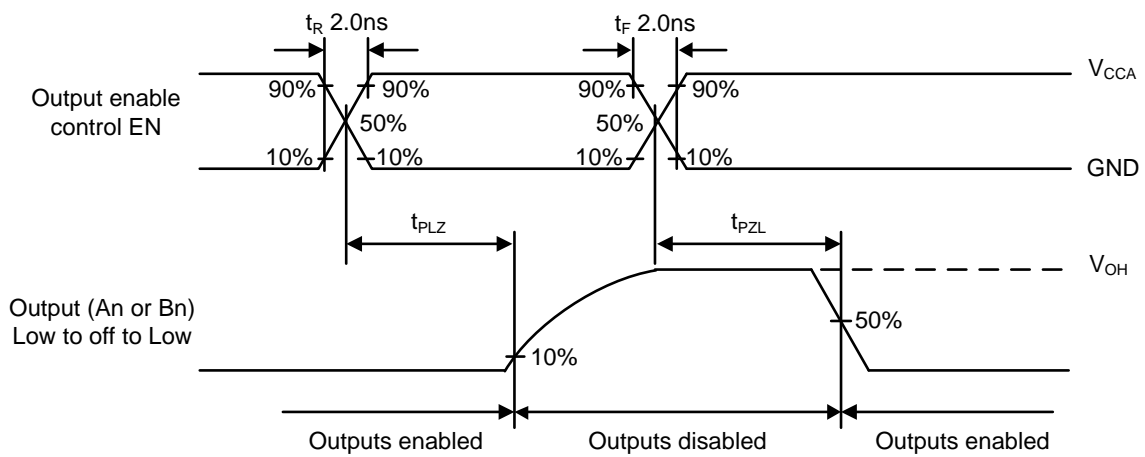


Figure 8-4. Voltage Waveforms t_{PLZ} , t_{PZL}

9 Detailed Description

9.1 Overview

The UMLSF0204 series may be used in level translation applications for interfacing devices or systems operating at different interface voltages with one another. The devices are ideal for use in applications where an open-drain driver is connected to the data I/Os. The devices can achieve 100 MHz with the appropriate pull-up resistors and layout. What's more, the UMLSF0204 may also be used in applications where a push-pull driver is connected to the data I/Os.

9.2 Functional Block Diagram

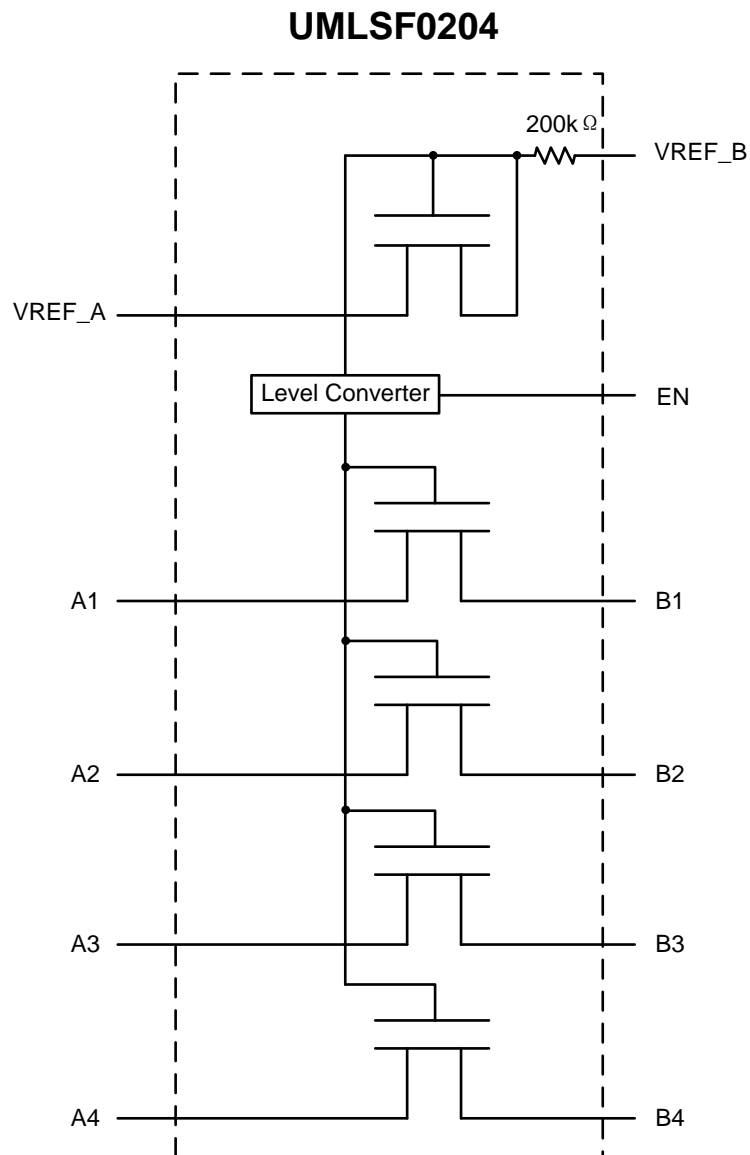


Figure 9-1. UMLSF0204 Block Diagram

10 Feature Description

10.1 Support High Speed Translation, Greater than 100MHz

The UMLSF0204 series support more consumer or telecom interfaces (MDIO or SDIO).

10.2 Bidirectional Voltage Translation Without DIR Terminal

The UMLSF0204 series support automatic direction voltage translation that minimizes system effort to develop voltage translation for bidirectional interface (PMBus, I²C, or SMBus).

10.3 5V Tolerance on IO Port and 125°C Support

The UMLSF0204 series feature 5V tolerance and -40°C to 125°C operating temperature range that compliant with TTL levels in industrial and telecom applications.

10.3 I_{OFF} Supports Partial Power Down Mode Operation

When V_{REF_A} , $V_{REF_B} = 0$, all of data pins and EN pin are Hi-Z, inhibiting current backflow into the device.

EN logic circuit is supplied by V_{REF_A} , once V_{REF_A} power up first and all of data pins are unknown state until V_{REF_B} and EN ready. No power sequence is required to enable UMLSF0204 and operate function normally.

10.4 Functional Modes

Table 10-1 lists the device functional modes of the UMLSF0204x.

Table 10-1. Function Table

Input EN terminal	Function	
	UMLSF0204	UMLSF0204D
H	An, Bn channel Enabled	Hi-Z
L	Hi-Z	An, Bn channel Enabled

11 Application Information

11.1 Application Information

The UMLSF0204 series are suitable for open-drain or push-pull interface like GPIO, SPI, MDIO, SMBus, PMBus, I²C, UART, SVID.

11.2 Typical Applications

The UMLSF0204 series are suitable for open-drain or push-pull interface like GPIO, SPI, MDIO, SMBus, PMBus, I²C, UART, SVID.

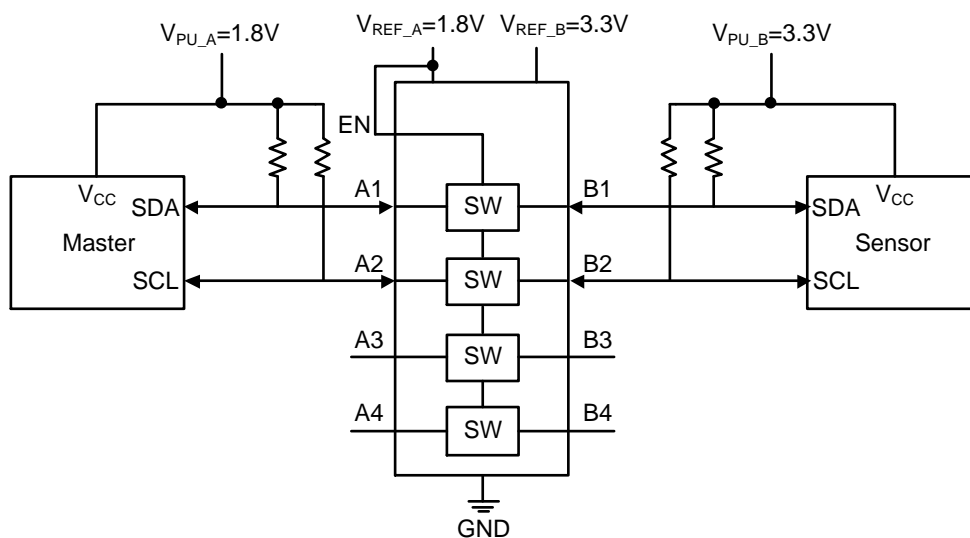
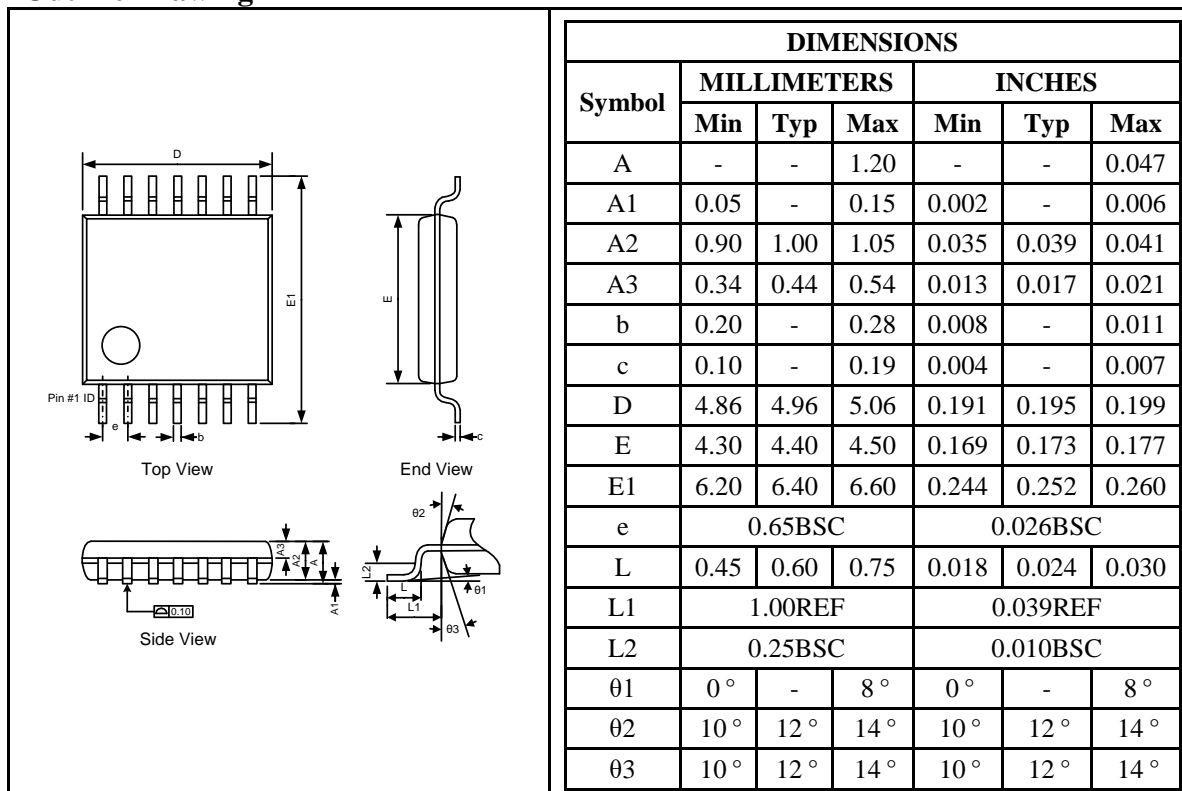


Figure 11-1. UMLSF0204 I²C Bidirectional Translation

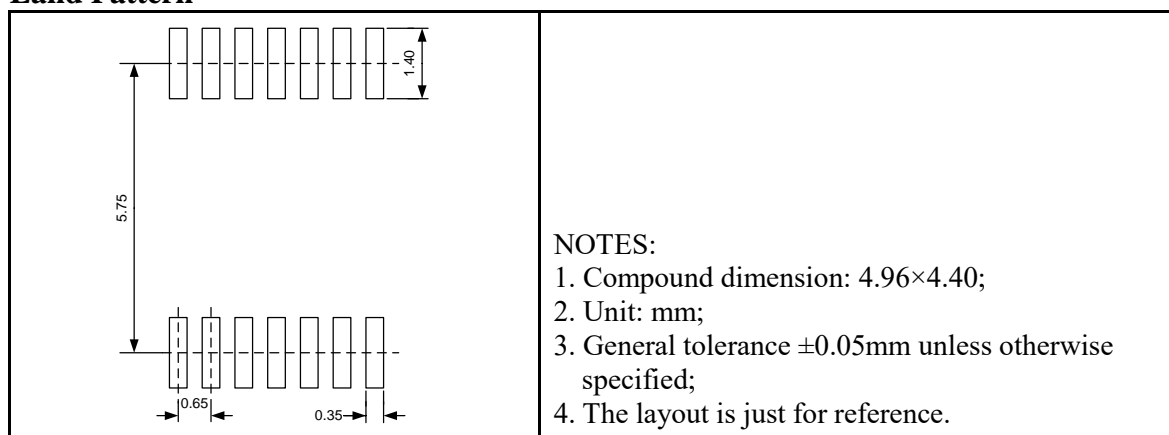
Package Information

TSSOP14

Outline Drawing

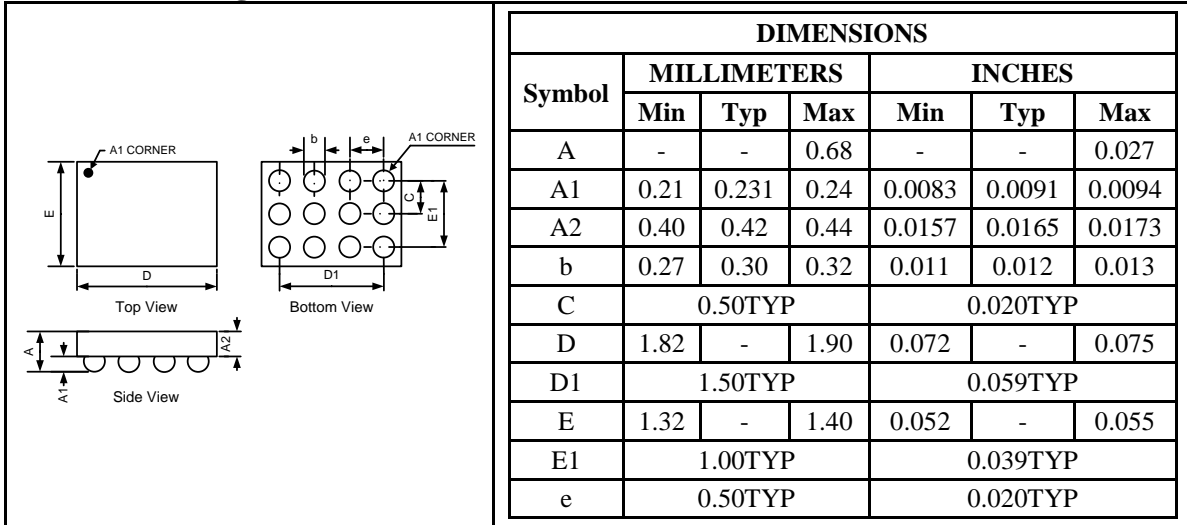


Land Pattern

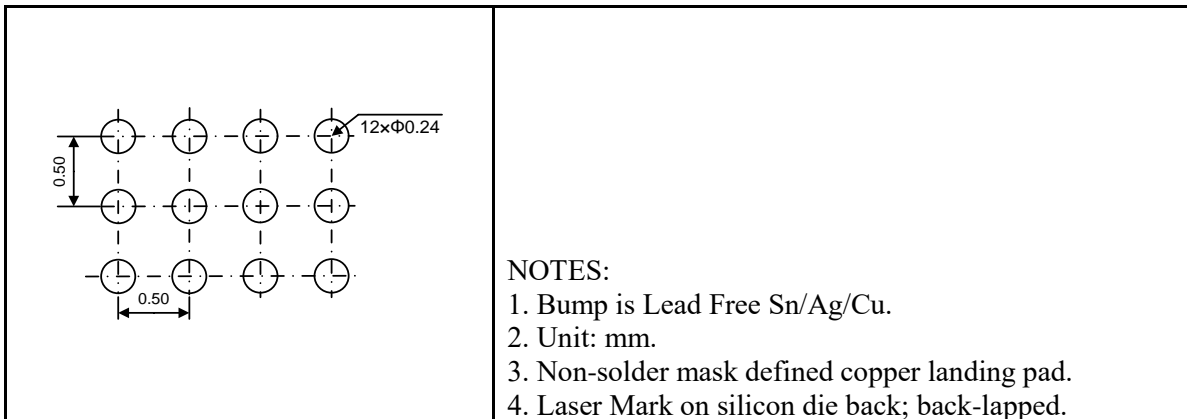


CSP12 1.9×1.4

Outline Drawing

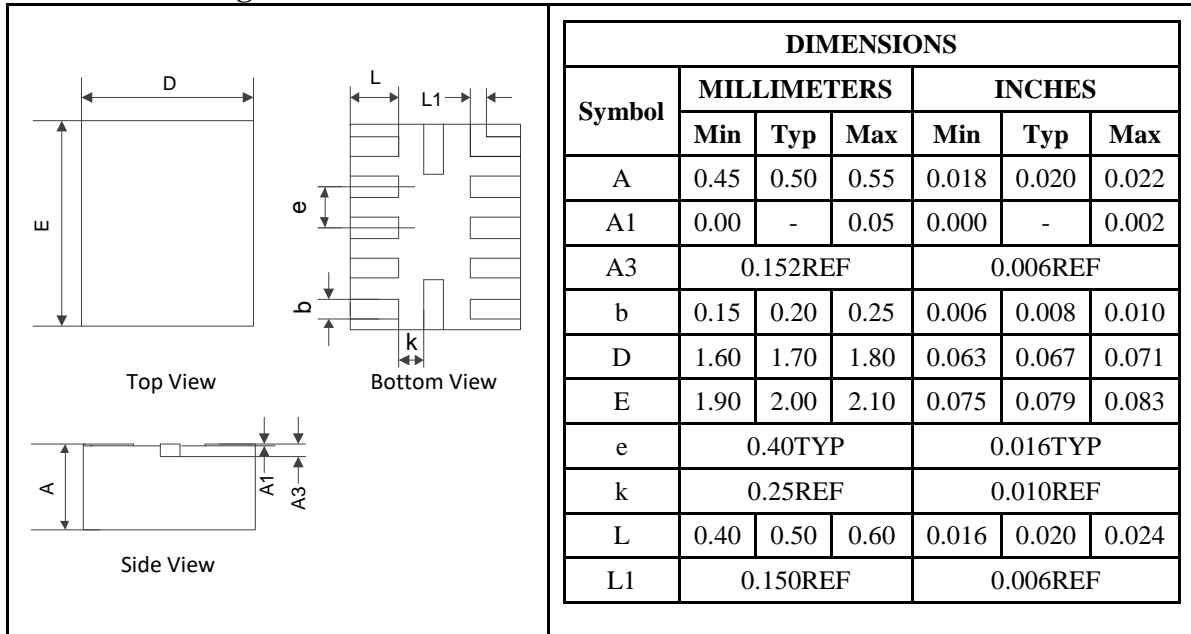


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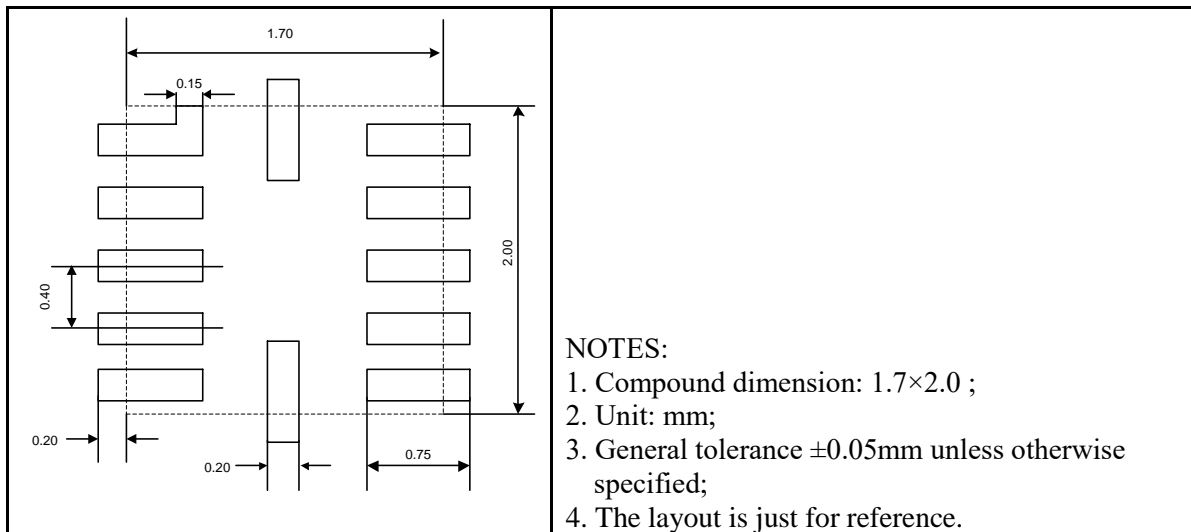


QFN12 1.7×2.0

Outline Drawing

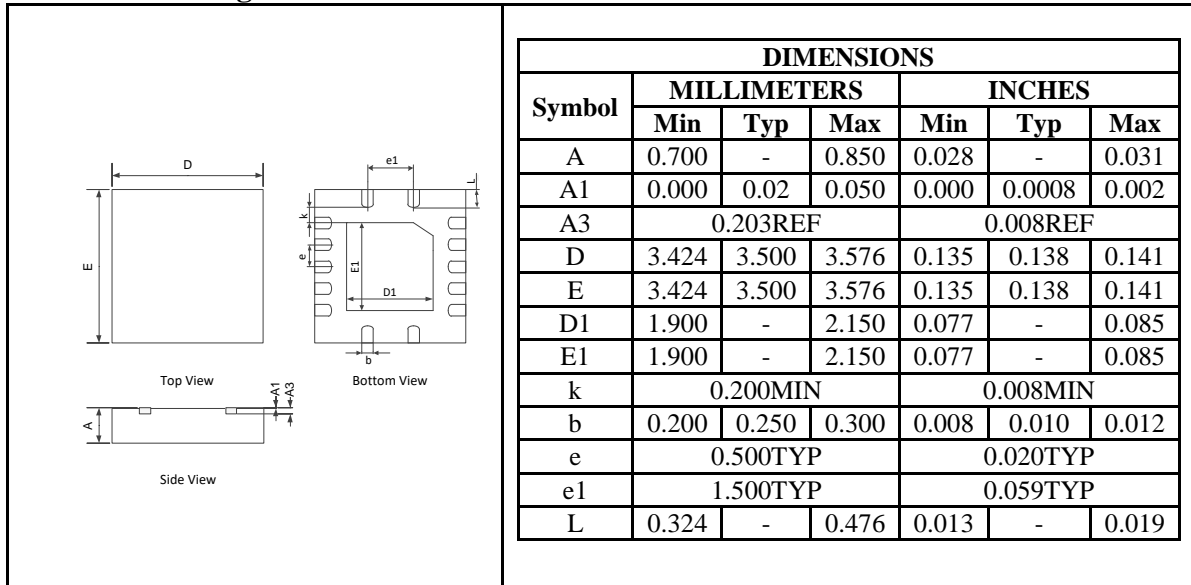


Land Pattern

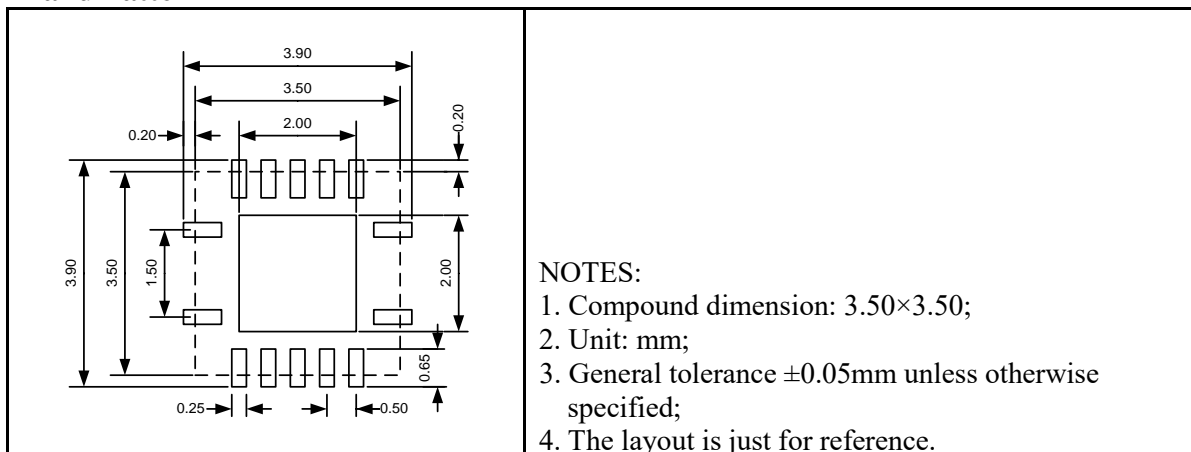


QFN14 3.5×3.5

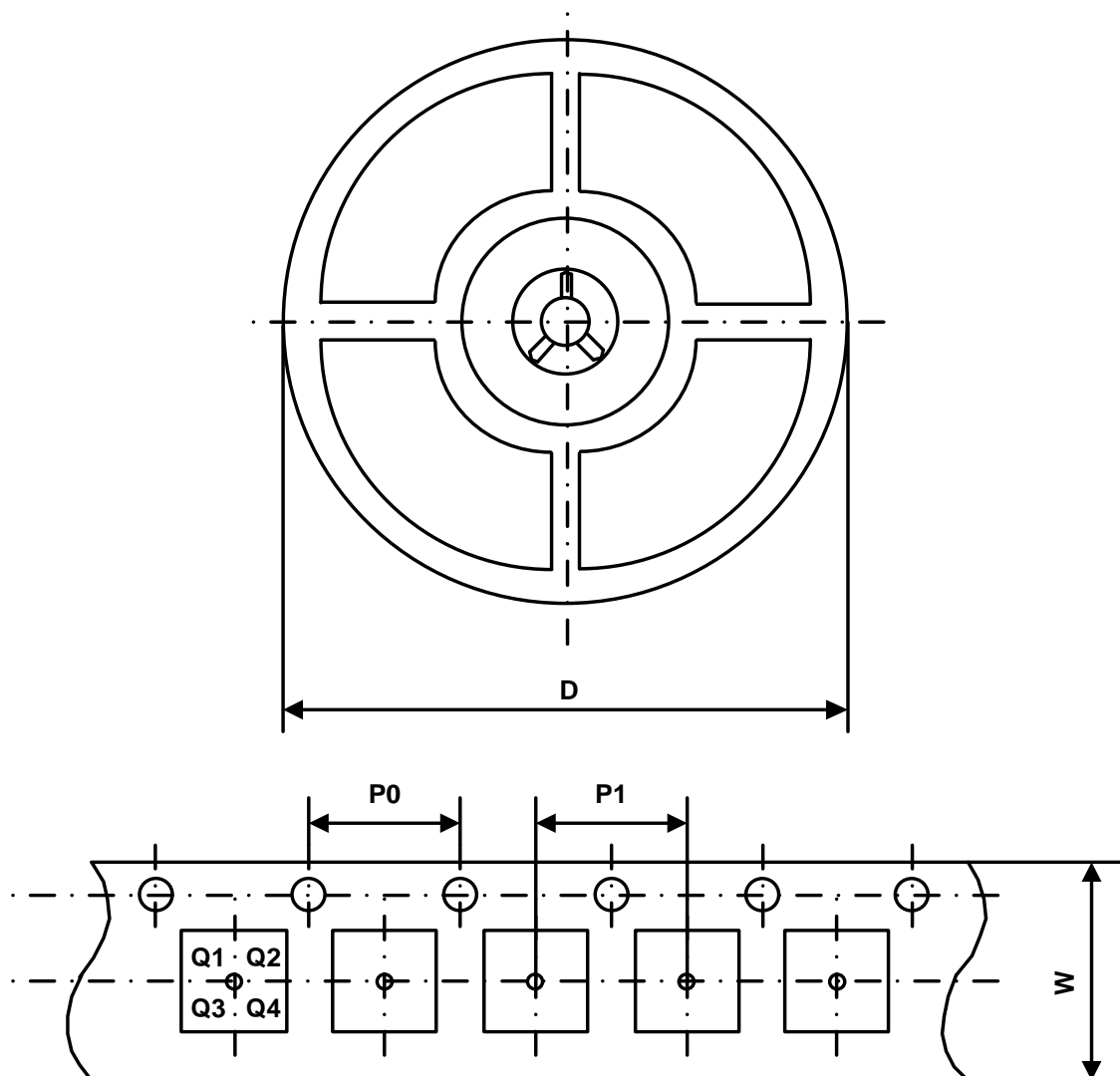
Outline Drawing



Land Pattern



Packing Information



Part Number	Package Type	Carrier Width (W)	Pitch (P0)	Pitch (P1)	Reel Size (D)	PIN 1 Quadrant
UMLSF0204UE	TSSOP14	16 mm	4 mm	8 mm	330 mm	Q1
UMLSF0204H	CSP12 1.9×1.4	8 mm	4 mm	4 mm	180 mm	Q2
UMLSF0204QA	QFN12 1.7×2.0	8 mm	4 mm	4 mm	180 mm	Q1
UMLSF0204QS	QFN14 3.5×3.5	12 mm	4 mm	8 mm	330 mm	Q1
UMLSF0204DUE	TSSOP14	16 mm	4 mm	8 mm	330 mm	Q1
UMLSF0204DH	CSP12 1.9×1.4	8 mm	4 mm	4 mm	180 mm	Q2
UMLSF0204DQA	QFN12 1.7×2.0	8 mm	4 mm	4 mm	180 mm	Q1
UMLSF0204DQS	QFN14 3.5×3.5	12 mm	4 mm	8 mm	330 mm	Q1

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.

All Union components are compliant with the RoHS directive, which helps to support customers in their compliance with environmental directives. For more green compliance information, please visit:

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

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