September 2017

FXWA9306
Dual Bi-Directional I²C-Bus® and SMBus Voltage-Level Translator

Features

- 2-Bit Bi-Directional Translator for SDA and SCL Lines in Mixed-Mode I²C-Bus Applications
- Standard-Mode, Fast-Mode, and Fast-Mode-Plus I²C-Bus and SMBus Compatible
- Less than 1.5ns Maximum Propagation Delay to Accommodate Standard-Mode and Fast-Mode I²C-Bus Devices and Multiple Masters
- Allows Voltage Level Translation Between:
  - V_{CCA} = 1.0 to 3.6V and V_{CCB} = 1.8- 5.0V
- Supports I²C Clock Stretching and Multi-Master
- Provides Bi-directional Voltage Translation without Direction Pin
- Low 3.5Ω On-State Connection Between Input and Output Ports; Provides Less Signal Distortion
- Open-Drain I²C-Bus I/O Ports (A0, A1, B0, and B1)
- 5V-Tolerant I²C-Bus I/O Ports to Support Mixed-Mode Signal Operation
- Lock-Up-Free Operation
- Flow-Through Pinout for Simpler Printed-Circuit Board Trace Routing
- Packaged in 8-Terminal Leadless MicroPak™ (1.6mm x 1.6mm) and MSOP8 (TSSOP8)

Description

The FXWA9306 is a dual, bi-directional, I²C-bus and SMBus, voltage-level translator with an enable (OE) input that is operational from 1.0V to 3.6V (V_{CCA}) and 1.8V to 5.5V (V_{CCB}) without requiring a direction pin.

Pin Configuration

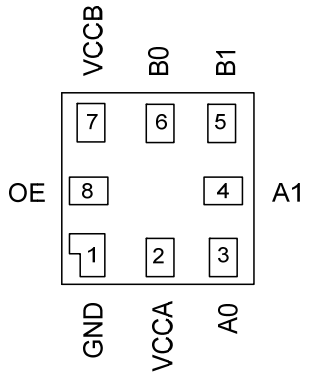

Figure 2. MicroPak™ (Top-Through View)

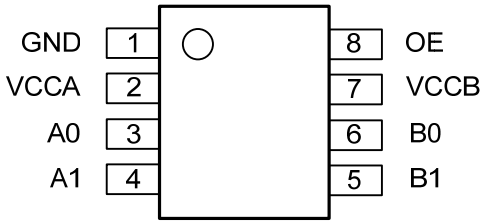

Figure 3. MSOP (Top-Through View)

Pin Definitions

Pin #	Name	Description
1	GND	Ground
2	V_{CCA}	Low Voltage A-Side Power Supply
3	A_0	A-Side Input or 3-State Output. Connect to V_{CCA} through a pull-up resistor.
4	A_1	A-Side Input or 3-State Output. Connect to V_{CCA} through a pull-up resistor.
5	B_1	B-Side Input or 3-State Output. Connect to V_{CCB} through a pull-up resistor.
6	B_0	B-Side Input or 3-State Output. Connect to V_{CCB} through a pull-up resistor.
7	V_{CCB}	High Voltage B-Side Power Supply
8	OE	Output Enable Input; connect to V_{CCB} and pull-up through a high resistor.

Truth Table

Control	Outputs
OE	
LOW Logic Level	3-State
HIGH Logic Level	Normal Operation; A0 = B0, A1 = B1

Note:

1. If the OE pin is driven LOW, the FXWA9306 is disabled and the A_0, A_1, B

DC Electrical Characteristics

Unless otherwise noted, values are at T_A = –40°C to +85°C; all typical values are at T_A = 25°C.

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
V_{IK}	Input Clamping Voltage	I_I = -18mA; $V_{I(OE)}$ = 0V				-1.2	V
I_{IH}	High-Level Input Current	V_I = 5V; $V_{I(OE)}$ = 0V				5	µA
$C_{i(OE)}$	OE Pin Input Capacitance	V_I = 3V or 0V			7.1		pF
$C_{i/O(off)}$	Off-State I/O Pin Capacitance A0, A1, B0, B1	V_O = 3V or 0V; $V_{I(OE)}$ = 0V			4	6	pF
$C_{i/O(on)}$	On-State I/O Pin Capacitance A0, A1, B0, B1	V_O = 3V or 0V; $V_{I(OE)}$ = 3V			9.3	12.5	pF
R_{ON}(7)	On-State Resistance A0/B0, A1/B1	V_I = 0V; I_O = 64mA	$V_{I(OE)}$ = 4.5V		2.4	5.0	Ω
			$V_{I(OE)}$ = 3V		3.0	6.0	
			$V_{I(OE)}$ = 2.3V		3.8	8.0	
			$V_{I(OE)}$ = 1.5V		9.0	20.0	
V_{OL}	Voltage Output Low	V_{CCA} = 1V, V_{PUD} = 5V, I_{OL} = 3mA (B->A Dir)	V_{IN} (B0 or B1) = 0.1V			0.15	V
			V_{IN} (B0 or B1) = 0.2V			0.25	
			V_{IN} (B0 or B1) = 0.3V			0.35	
			V_{IN} (B0 or B1) = 0.4V			0.45	

Notes:

7. Measured by the voltage drop between the A0 and B0 or A1 and B1 terminals at the indicated current through the switch. On-state resistance is determined by the lowest voltage of the two terminals.

AC Electrical Characteristics

T_A = –40°C to +85°C. Direction is from B port to A port (translating down). Values guaranteed by design.

Symbol	Parameter	Conditions	Load Condition:	Min:	Max.	Units
t_{PLH}	Low-to-High Propagation Delay, from (Input) B0 or B1 to (Output) C-7LH					

Application Information

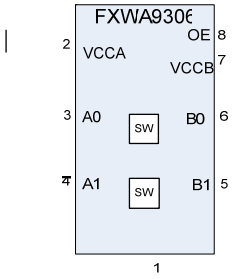

Table 2. Application Operating Conditions

Calculated for V_{OL} = 0.35V; assumes output driver V_{OL} = 0.175V at stated current.

$V_{PU(D)}$	Pull-Up Resistor Value (Ω)					
	15mA		10mA		3mA	
	Nominal	+10%[13]	Nominal	+10%[13]	Nominal	+10%[13]
5.0V	310	341	465	512	1550	1705
3.3V	197	217	295	325	983	1082
2.5V	143	158	215	237	717	788
1.8V	97	106	145	160	483	532
1.5V	77	85	115	127	383	422
1.2V	57	63	85	94	283	312

Note:
13. +10% to compensate for V_{CC} range and resistor tolerance.

Maximum Frequency Calculation

The maximum frequency is totally dependent upon the specifics of the application. The FXWA9306 behaves like a wire with the additional characteristics of transistor device physics and should be capable of performing at higher frequencies if used correctly.

Here are some guidelines to follow that help maximize the performance of the device:

Keep trace lengths to a minimum by placing the FXWA9306 close to the processor.
The trace length should be less than half the time of flight to reduce ringing and reflections.
The faster the edge of the signal, the higher the chance of ringing.
The greater the drive strength (up to 15mA), the higher the frequency the device can use.

In a 3.3V to 1.8V direction level shift, if the 3.3V side is

Physical Dimensions

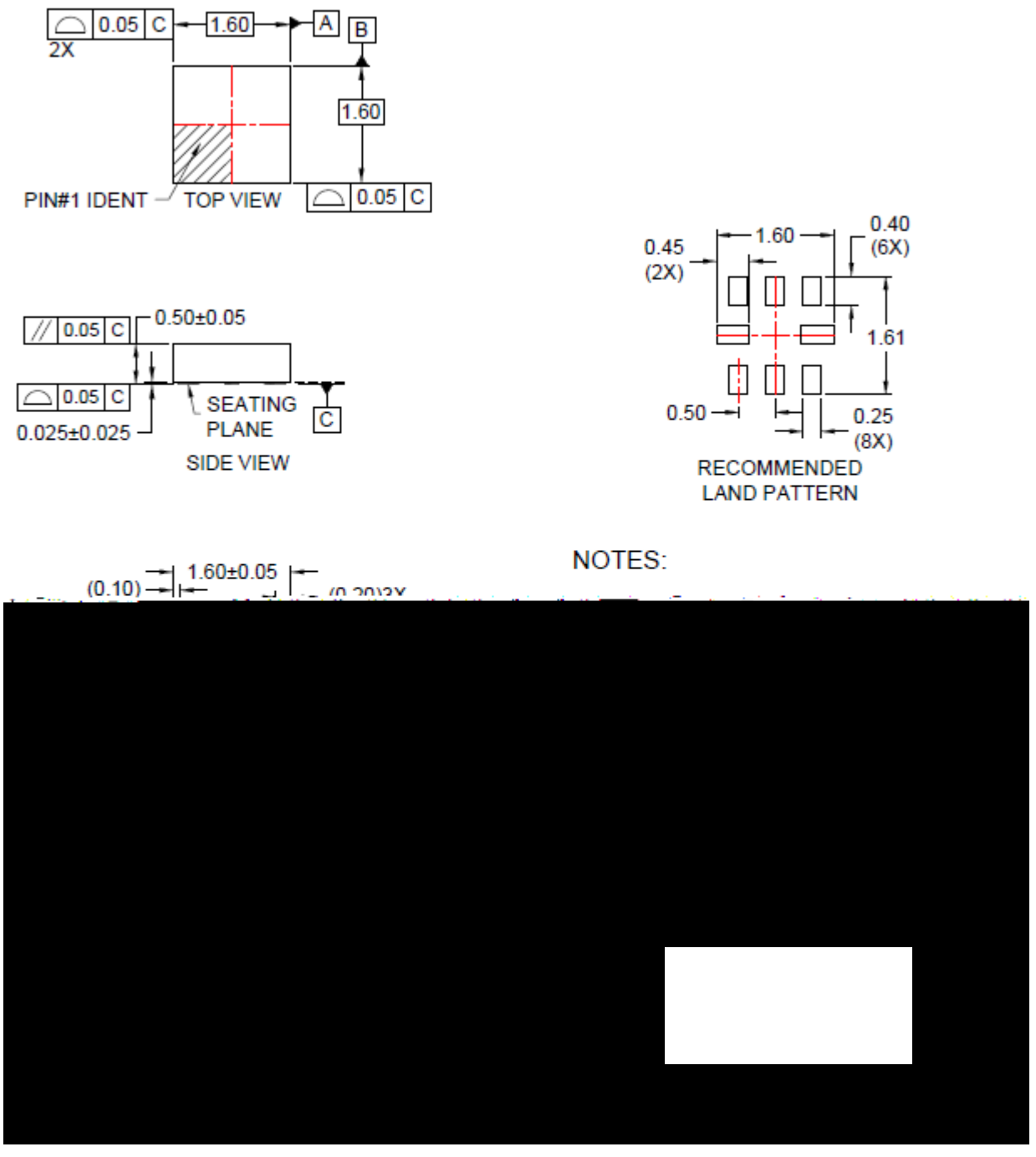

Figure 7. 8-Lead MicroPak™, 1.6mm Wide

Physical Dimensions

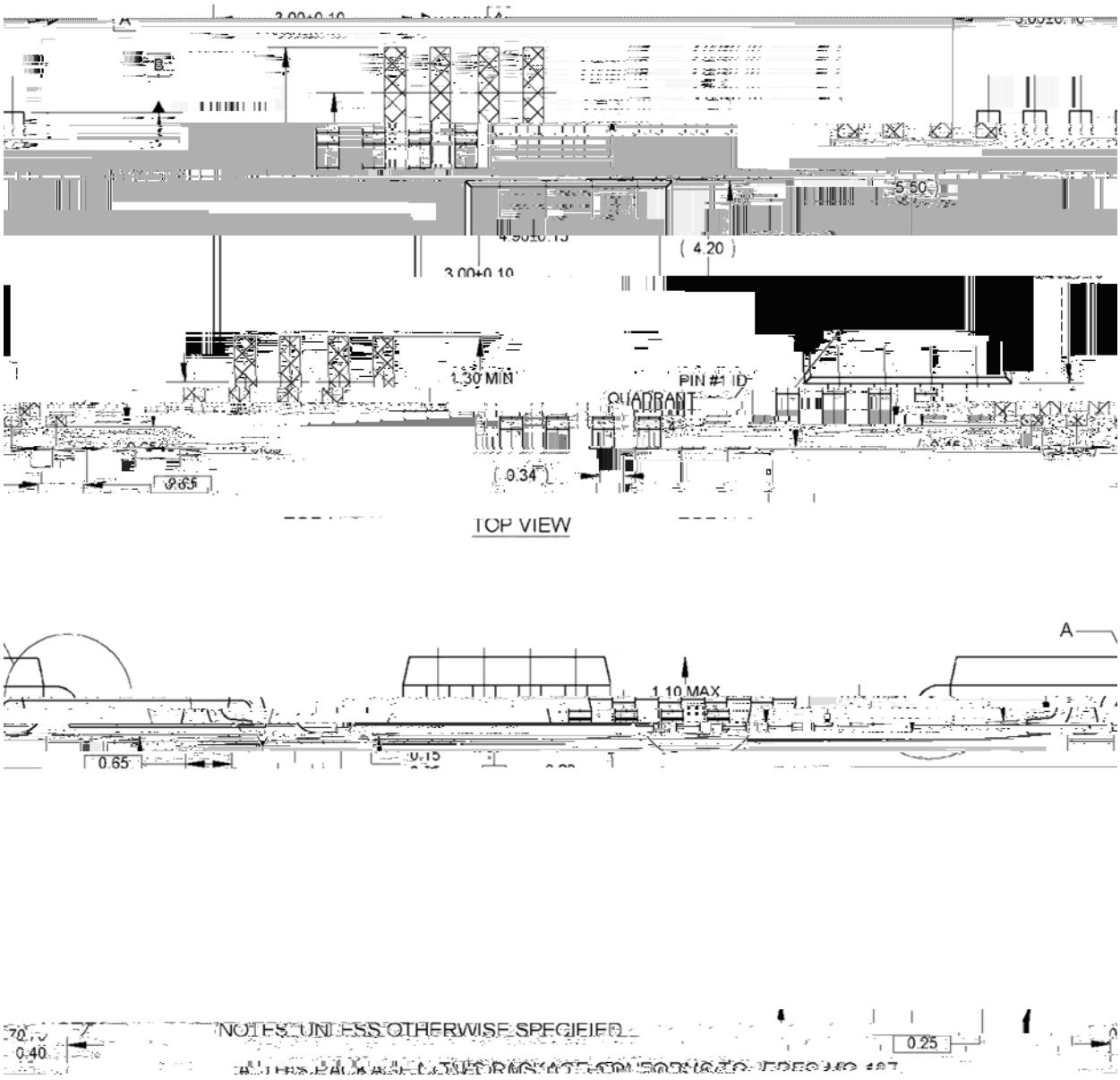

Figure 8. 8-Lead MSOP, 3.0mm Wide