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April 2014

FXL2T245 — Low Voltage Dual Supply 2-Bit Signal Translator with Configurable Voltage Supplies

FXL2T245
Low-Voltage, Dual-Supply, 2-Bit, Signal Translator with Configurable Voltage Supplies and Signal Levels and 3-State Outputs

Features

- Bi-Directional Interface between any 2 Levels from 1.1 V to 3.6 V
- Fully Configurable, Inputs Track V_{CC} Level
- Non-Preferential Power-up Sequencing; either V_{CC} maybe Powered-up First
- Outputs Remain in 3-State until Active V_{CC} Level is Reached
- Outputs Switch to 3-State if either V_{CC} is at GND
- Power-Off Protection
- Control Inputs (T/R, OE) Levels are Referenced to V_{CCA} Voltage
- Packaged in 10-Lead MicroPak (1.6 mm x 2.1 mm) Package
- ESD Protection Exceeds:
  - 4 kV HBM ESD JESD22-A114 & Mil Std 883e 3015.7)
  - 8kV HBM I/O to GND ESD (per JESD22-A114 & Mil Std 883e 3015.7)
  - 1 kV CDM ESD (per ESD STM 5.3)
  - 200 V MM ESD (per JESD22-A115 & ESD STM5.2)

Description

The FXL2T245 is a configurable, dual-voltage-supply translator designed for uni-directional and bi-directional voltage translation between two logic levels. The device allows translation between voltages as high as 3.6 V to as low as 1.1 V. The A port tracks the V_{CCA} level and the B port tracks the V_{CCB} level. This allows for bi-directional voltage translation over a variety of voltage levels: 1.2 V, 1.5 V, 1.8 V, 2.5 V, and 3.3 V.

The device remains in 3-state until both V_{CC}s reach active levels, allowing either V_{CC} to be powered-up first. Internal power-down control circuits place the device in 3-state if either V_{CC} is removed.

The Transmit / Receive (T/$\overline{R}$) input determines the direction of data flow through the device. The $\overline{OE}$ input, when HIGH, disables both the A and B ports by placing them in a 3-state condition. The FXL2T245 is designed so control pins T/$\overline{R}$ and $\overline{OE}$ are supplied by V_{CCA}.

Ordering Information

Part Number	Operating Temperature Range	Package	Packing Method
FXL2T245L10X	-40°C to +85°C	10-Lead, MicroPak™, JEDEC MO255,1.6 x 2.1 mm	Tape and Reel

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Pin Configuration

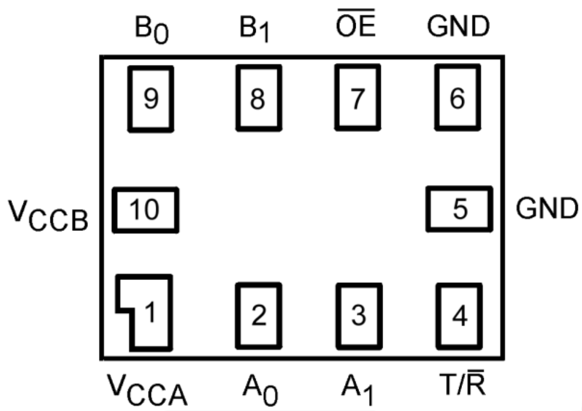

Figure 1. Pin Assignments

Pin Descriptions

Pin#	Pin Name	Description
1	V_{CCA}	Side A Power Supply
2	A_0	Side A Inputs or 3-State Outputs
3	A_1	Side A Inputs or 3-State Outputs
4	$T/\overline{R}$	Transmit/Receive Input
5, 6	GND	Ground
7	$\overline{O/E}$	Output Enable Input
8	B_1	Side B Inputs or 3- State Outputs
9	B_0	Side B Inputs or 3-State Outputs
10	V_{CCB}	Side B Power Supply

Truth Table

Inputs		Outputs
$\overline{OE}$	$T/\overline{R}$	
LOW	LOW	Bus B Data to Bus A
LOW	HIGH	Bus A Data to Bus B

Notes:

1. LOW = low voltage level.
2. HIGH = high voltage level.

Functional Description

Power-Up / Power-Down Sequencing

Due to the chip design, the FXL2T245 translator offers the advantage of either V_{CC} being powered up first. When either V_{CC} is at 0 V, outputs are in a high-impedance state. The control inputs ($T/\overline{R}$ and $\overline{OE}$) are designed to track the V_{CCA} supply. A pull-up resistor tying $\overline{OE}$ to V_{CCA} should be used to ensure that bus contention, excessive currents, or oscillations do not occur during power-up/power-down. The size of the pull-up resistor is based upon the current-sinking capability of the $\overline{OE}$ driver.

The recommended power-up sequence is:

1. Apply power to either V_{CC}.
2. Apply power to the $T/\overline{R}$ input (logic HIGH for A-to-B operation; logic LOW for B-to-A operation) and to the respective data inputs (A port or B port). This may occur at the same time as step 1.
3. Apply power to the other V_{CC}.
4. Drive the $\overline{OE}$ input LOW to enable the device.

The recommended power-down sequence is:

1. Drive $\overline{OE}$ input HIGH to disable the device.
2. Remove power from either V_{CC}.
3. Remove power from the other V_{CC}.

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Conditions		Min.	Max.	Unit
V_{CCA}	Supply Voltage			-0.5	4.6	V
V_{CCB}				-0.5	4.6	
V_I	DC Input Voltage	I/O Port A		-0.5	4.6	V
		I/O Port B		-0.5	4.6	
		Control Inputs ($T/\overline{R}$, $\overline{OE}$)		-0.5	4.6	
V_O	Output Voltage(3)	Output 3-State		-0.5	4.6	V
		Output Active (A_n)		-0.5 to V_{CCA}	0.5	
		Output Active (B_n)		-0.5 to V_{CCB}	0.5	
I_{IK}	DC Input Diode Current	$V_I < 0$ V			-50	mA
I_{OK}	DC Output Diode Current	$V_O < 0$ V			-50	mA
		$V_O > V_{CC}$			+50	
I_{OH}/I_{OL}	DC Output Source/Sink Current				±50	mA
I_{CC}	DC V_{CC} or Ground Current per Supply Pin				±100	mA
T_{STG}	Storage Temperature Range			-65	+150	°C
ESD	Electrostatic Discharge Capability	Human Body Model, JESD22-A114, Mil Std 883e 3015.7	All Pins		4	kV
			I/O to GND		8	
		Charged Device Model, JESD22-C101,STM 5.3			1	
		Machine Model, JESD22-A115,STM 5.2			200	V

Note:
3. I/O absolute maximum ratings must be observed.

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance. Fairchild does not recommend exceeding them or designing to Absolute Maximum Ratings.

Symbol	Parameter	Conditions		Min.	Max.	Unit
V_{CC}	Power Supply	Operating V_{CCA} or V_{CCB}		1.1	3.6	V
V_I	Input Voltage	Port A		0	3.6	V
		Port B		0	3.6	
		Control Inputs ($T/\overline{R}$, $\overline{OE}$)		0	V_{CCA}	
I_{OH}/I_{OL}	Output Current	V_{CC}	3.0 V to 3.6 V		±24	mA
			2.3 V to 2.7 V		±18	
			1.65 V to 1.95 V		±6	
			1.40 V to 1.65 V		±2	
			1.1 V to 1.4 V		±0.5	
T_A	Operating Temperature, Free Air			-40	+85	°C
$\Delta V/\Delta t$	Minimum Input Edge Rate	$V_{CCA/B}$ =1.1 V to 3.6 V			10	ns/V

Note:
4. All unused inputs must be held at V_{CCI} or GND.

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Electrical Characteristics

Symbol	Parameter	Conditions	V_{CCO} (V)	V_{CCI} (V)	Min.	Max.	Unit
V_{IH}	HIGH Level Input(5)	Data Inputs A_n, B_n	1.10 to 3.60	2.70 to 3.60	2.00		V
				2.30 to 2.70	1.60		
				1.65 to 2.30	0.65 x V_{CCI}		
				1.40 to 1.65	0.65 x V_{CCI}		
				1.10 to 1.40	0.90 x V_{CCI}		
		Control Pins /$\overline{OE}$, T/$\overline{R}$ (Referenced to V_{CCA})		2.70 to 3.60	2.00		
				2.30 to 2.70	1.60		
				1.65 to 2.30	0.65 x V_{CCA}		
				1.40 to 1.65	0.65 x V_{CCA}		
				1.10 to 1.40	0.90 x V_{CCA}		
V_{IL}	LOW Level Input(5)	Data Inputs A_n, B_n	1.10 to 3.60	2.70 to 3.60		0.80	V
				2.30 to 2.70		0.70	
				1.65 to 2.30		0.35 x V_{CCI}	
				1.40 to 1.65		0.35 x V_{CCI}	
				1.10 to 1.40		0.10 x V_{CCI}	
		Control Pins /$\overline{OE}$, T/$\overline{R}$ (Referenced to V_{CCA})		2.70 to 3.60		0.80	
				2.30 to 2.70		0.70	
				1.65 to 2.30		0.35 x V_{CCI}	
				1.40 to 1.65		0.35 x V_{CCI}	
				1.10 to 1.40		0.10 x V_{CCI}	
V_{OH}	HIGH Level Output(6)	I_{OH} = -100 µA	1.10 to 3.60	1.10 to 3.60	V_{CC0} - 0.20		V
		I_{OH} = -12 mA	2.70	2.70	2.20		
		I_{OH} = -18 mA	3.00	3.00	2.40		
		I_{OH} = -24 mA	3.00	3.00	2.20		
		I_{OH} = -6 mA	2.30	2.30	2.00		
		I_{OH} = -12 mA	2.30	2.30	1.80		
		I_{OH} = -18 mA	2.30	2.30	1.70		
		I_{OH} = -6 mA	1.65	1.65	1.25		
		I_{OH} = -2 mA	1.40	1.40	1.05		
		I_{OH} = -0.5 mA	1.10	1.10	0.75 x V_{CC0}		
V_{OL}	LOW Level Output(6)	I_{OL} = 100 µA	1.10 to 3.60	1.10 to 3.60		0.20	V
		I_{OL} = 12 mA	2.70	2.70		0.40	
		I_{OL} = 18 mA	3.00	3.00		0.40	
		I_{OL} = 24 mA	3.00	3.00		0.55	
		I_{OL} = 12 mA	2.30	2.30		0.40	
		I_{OL} = 18 mA	2.30	2.30		0.60	
		I_{OL} = 6 mA	1.65	1.65		0.30	
		I_{OL} = 2 mA	1.40	1.40		0.35	
		I_{OL} = 0.5 mA	1.10	1.10		0.30 x V_{CC0}	

Continued on the following page…

Electrical Characteristics

Symbol	Parameter	Conditions	V_{CCO} (V)	V_{CCI} (V)	Min.	Max.	Unit
I_L	Input Leakage Current, Control Pins	V_I=V_{CCA} or GND	3.60	1.10 to 3.60		±1.0	µA
I_{OFF}	Power Off Leakage Current	A_n, V_I or V_O=0 V to 3.6 V	3.60	0		±10	µA
		B_n, V_I or V_O=0 V to 3.6 V	0	3.60		±10	
I_{OZ}	3-State Output Leakage ($0 \le V_O \le 3.6$ V, V_I=V_{IH} or V_{IL})	A_n, B_n, /OE=V_{IH}	3.60	3.60		±10	µA
		B_n, /OE= Don't Care(7)	3.60	0		±10	
		A_n, /OE= Don't Care(7)	0	3.60		±10	
$I_{CCA/B}$	Quiescent Supply Current(8)	V_I=V_{CCI} or GND; I_O=0	1.10 to 3.60	1.10 to 3.60		20	µA
I_{CCZ}			1.10 to 3.60	1.10 to 3.60		20	
I_{CCA}		V_I=V_{CCA} or GND; I_O=0	1.10 to 3.60	0		-10	
			0	1.10 to 3.60		10	
I_{CCB}		V_I=V_{CCB} or GND; I_O=0	0	1.10 to 3.60		-10	
			1.10 to 3.60	0		10	
$\Delta I_{CCA/B}$	Increase in I_{CC} per Input; Other Inputs at V_{CC} or GND	V_{IH}=3.0 V	3.60	3.60		500	µA

Notes:

5. V_{CCI} = the V_{CC} associated with the data input under test.
6. V_{CCO} = the V_{CC} associated with the output under test.
7. Don't care = any valid logic level.
8. Reflects current per supply, V_{CCA} or V_{CCB}.

AC Electrical Characteristics

Symbol	Parameter	T_A= -40 to +85°C										Unit
		V_{CCB}=3.0 V to 3.6 V		V_{CCB}=2.3 V to 2.7 V		V_{CCB}=1.65 V to 1.95 V		V_{CCB}=1.4 V to 1.6 V		V_{CCB}=1.1 V to 1.3V		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
V_{CCA}=3.0 V to 3.6 V												
t_{PLH}, t_{PHL}	Propagation Delay A to B	0.2	3.5	0.3	3.9	0.5	5.4	0.6	6.8	1.4	22.0	ns
	Propagation Delay B to A	0.2	3.5	0.2	3.8	0.3	4.0	0.5	4.3	0.8	13.0	
t_{PZH}, t_{PZL}	Output Enable /OE to B	0.5	4.0	0.7	4.4	1.0	5.9	1.0	6.4	1.5	17.0	ns
	Output Enable /OE to A	0.5	4.0	0.5	4.0	0.5	4.0	0.5	4.0	0.5	4.0	
t_{PHZ}, t_{PLZ}	Output Disable /OE to B	0.2	3.8	0.2	4.0	0.7	4.8	1.5	6.2	2.0	17.0	ns
	Output Disable /OE to A	0.2	3.7	0.2	3.7	0.2	3.7	0.2	3.7	0.2	3.7	
V_{CCA}=2.3 V to 2.7 V												
t_{PLH}, t_{PHL}	Propagation Delay A to B	0.2	3.8	0.4	4.2	0.5	5.6	0.8	6.9	1.4	22.0	ns
	Propagation Delay B to A	0.3	3.9	0.4	4.2	0.5	4.5	0.5	4.8	1.0	7.0	
t_{PZH}, t_{PZL}	Output Enable /OE to B	0.6	4.2	0.8	4.6	1.0	6.0	1.0	6.8	1.5	17.0	ns
	Output Enable /OE to A	0.6	4.5	0.6	4.5	0.6	4.5	0.6	4.5	0.6	4.5	
t_{PHZ}, t_{PLZ}	Output Disable /OE to B	0.2	4.1	0.2	4.3	0.7	4.8	1.5	6.7	2.0	17.0	ns
	Output Disable /OE to A	0.2	4.0	0.2	4.0	0.2	4.0	0.2	4.0	0.2	4.0	
V_{CCA}=1.65 V to 1.95 V												
t_{PLH}, t_{PHL}	Propagation Delay A to B	0.3	4.0	0.5	4.5	0.8	5.7	0.9	7.1	1.5	22.0	ns
	Propagation Delay B to A	0.5	5.4	0.5	5.6	0.8	5.7	1.0	6.0	1.2	8.0	
t_{PZH}, t_{PZL}	Output Enable /OE to B	0.6	5.2	0.8	5.4	1.2	6.9	1.2	7.2	1.5	18.0	ns
	Output Enable /OE to A	1.0	6.7	1.0	6.7	1.0	6.7	1.0	6.7	1.0	6.7	
t_{PHZ}, t_{PLZ}	Output Disable /OE to B	0.2	5.1	0.2	5.2	0.8	5.2	1.5	7.0	2.0	17.0	ns
	Output Disable /OE to A	0.5	5.0	0.5	5.0	0.5	5.0	0.5	5.0	0.5	5.0	

Continued on the following page…

AC Electrical Characteristics

Symbol	Parameter	T_A= -40 to +85°C										Unit
		V_{CCB}=3.0 V to 3.6 V		V_{CCB}=2.3 V to 2.7 V		V_{CCB}=1.65 V to 1.95 V		V_{CCB}=1.4 V to 1.6 V		V_{CCB}=1.1 V to 1.3V		
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
V_{CCA}=1.4 V to 1.6 V												
t_{PLH}, t_{PHL}	Propagation Delay A to B	0.5	4.3	0.5	4.8	1.0	6.0	1.0	7.3	1.5	22.0	ns
	Propagation Delay B to A	0.6	6.8	0.8	6.9	0.9	7.1	1.0	7.3	1.3	9.5	
t_{PZH}, t_{PZL}	Output Enable /OE to B	1.1	7.5	1.1	7.6	1.3	7.7	1.4	7.9	2.0	20.0	ns
	Output Enable /OE to A	1.0	7.5	1.0	7.5	1.0	7.5	1.0	7.5	1.0	7.5	
t_{PHZ}, t_{PLZ}	Output Disable /OE to B	0.4	6.1	0.4	6.2	0.9	6.2	1.5	7.5	2.0	18.0	ns
	Output Disable /OE to A	1.0	6.0	1.0	6.0	1.0	6.0	1.0	6.0	1.0	6.0	
V_{CCA}=1.1 V to 1.3 V												
t_{PLH}, t_{PHL}	Propagation Delay A to B	0.8	13.0	1.0	7.0	1.2	8.0	1.3	9.5	2.0	24.0	ns
	Propagation Delay B to A	1.4	22.0	1.4	22.0	1.5	22.0	1.5	22.0	2.0	24.0	
t_{PZH}, t_{PZL}	Output Enable /OE to B	1.0	12.0	1.0	9.0	2.0	10.0	2.0	11.0	2.0	24.0	ns
	Output Enable /OE to A	2.0	22.0	2.0	22.0	2.0	22.0	2.0	22.0	2.0	22.0	
t_{PHZ}, t_{PLZ}	Output Disable /OE to B	1.0	15.0	0.7	7.0	1.0	8.0	2.0	10.0	2.0	20.0	ns
	Output Disable /OE to A	2.0	15.0	2.0	12.0	2.0	12.0	2.0	12.0	2.0	12.0	

Capacitance

Symbol	Parameter	Conditions	T_A=+25°C	Unit
			Typical	
C_{IN}	Input Capacitance (Pins O/E, TR)	V_{CCA}=V_{CCB}=3.3 V, V_I=0V or $V_{CCA/B}$	4	pF
$C_{I/O}$	Input / Output Capacitance A_n, B_n Ports	V_{CCA}=V_{CCB}=3.3 V, V_I=0V or $V_{CCA/B}$	5	pF
C_{PD}	Power Dissipation Capacitance	V_{CCA}=V_{CCB}=3.3 V, V_I=0V or V_{CC}, f=10 MHz	20	pF

AC Loadings and Waveforms

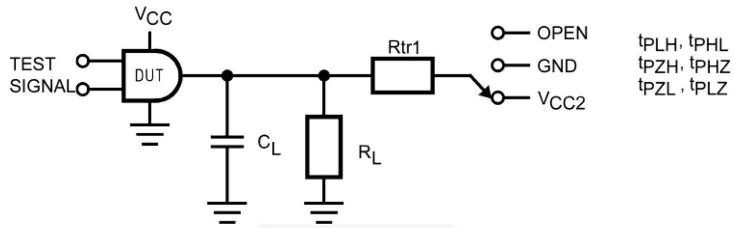
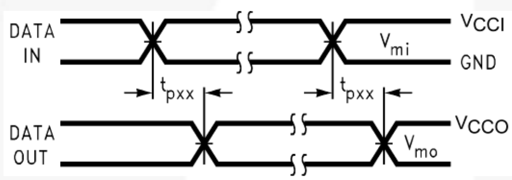


Figure 2. AC Test Circuit

Test	Switch
t_{PLH},t_{PHL}	Open
t_{PLZ},t_{PZL}	V_{CC0} • 2 at V_{CCO}=3.3 ±0.3 V, 2.5 V ±0.2 V, 1.8 V ±0.15 V, 1.5 V ±0.1 V, 1.2 V ±0.1 V
t_{PHZ},t_{PZH}	GND

Table 1. AC Load Table

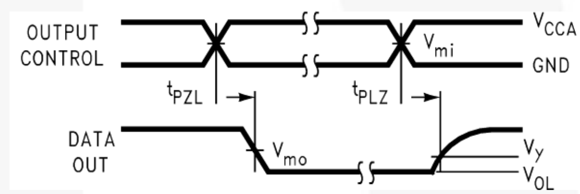
V_{CC0}	C_L	R_L	Rtr1
1.2 V ±0.1 V	15 pF	2 kΩ	2 kΩ
1.5 V ±0.1 V	15 pF	2 kΩ	2 kΩ
1.8 V ±0.15 V	15 pF	2 kΩ	2 kΩ
2.5 V ±0.2 V	15 pF	2 kΩ	2 kΩ
3.3 V ±0.3 V	15 pF	2 kΩ	2 kΩ



Note:

9. Input t_R=t_F=2.0 ns, 10% to 90%.
10. Input t_R-t_F=2.5 ns, 10% to 90%, at V_I=3.0 V to 3.6 V only.

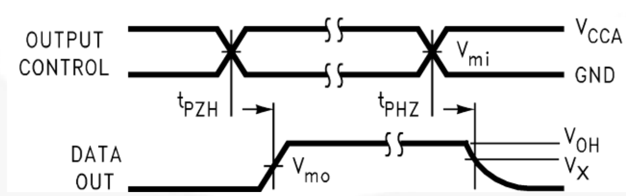
Figure 3. Waveform for Inverting and Non-Inverting Functions



Note:

11. Input t_R=t_F=2.0 ns, 10% to 90%.
12. Input t_R-t_F=2.5 ns, 10% to 90%, at V_I=3.0 V to 3.6 V only.

Figure 4. 3-State Output Low Enable and Disable for Low Voltage Logic



Notes:

13. Input t_R=t_F=2.0 ns, 10% to 90%.
14. Input t_R-t_F=2.5 ns, 10% to 90%, at V_I=3.0 V to 3.6 V only.

Figure 5. 3-State Output High Enable and Disable for Low Voltage Logic

Symbol	V_{CC}				
	3.3 V ± 0.3 V	**2.5 V ± 0.2 V**	**1.8 V ± 0.15 V**	**1.5 V ± 0.1 V**	**1.2 V ± 0.1 V**
V_{MI}	V_{CCI}/2	V_{CCI}/2	V_{CCI}/2	V_{CCI}/2	V_{CCI}/2
V_{MO}	V_{CCO}/2	V_{CCO}/2	V_{CCO}/2	V_{CCO}/2	V_{CCO}/2
V_X	V_{OH} - 0.3 V	V_{OH} – 0.15 V	V_{OH} – 0.15 V	V_{OH} – 0.1 V	V_{OH} – 0.1 V
V_Y	V_{OL} + 0.3 V	V_{OL} + 0.15 V	V_{OL} + 0.15 V	V_{OL} + 0.1 V	V_{OL} + 0.1 V

Note:

15. For V_{MI} V_{CCO}=V_{CCA} for control pins $T/\overline{R}$ and $\overline{OE}$ or V_{CCA}/2.

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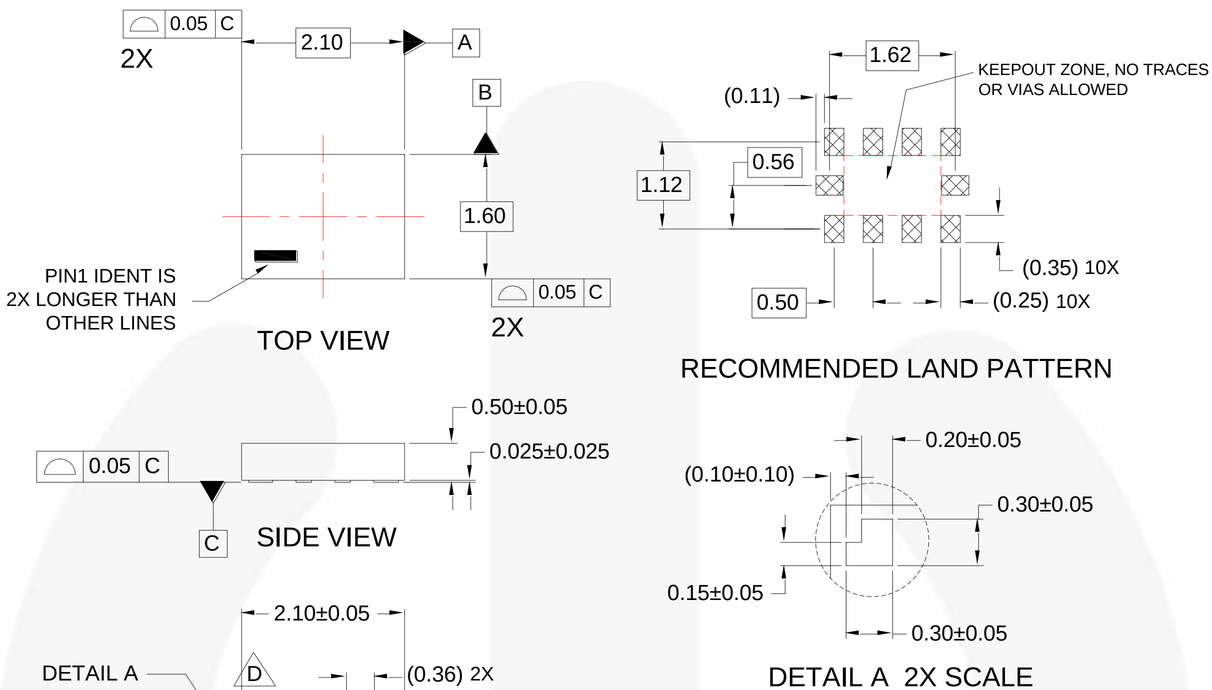
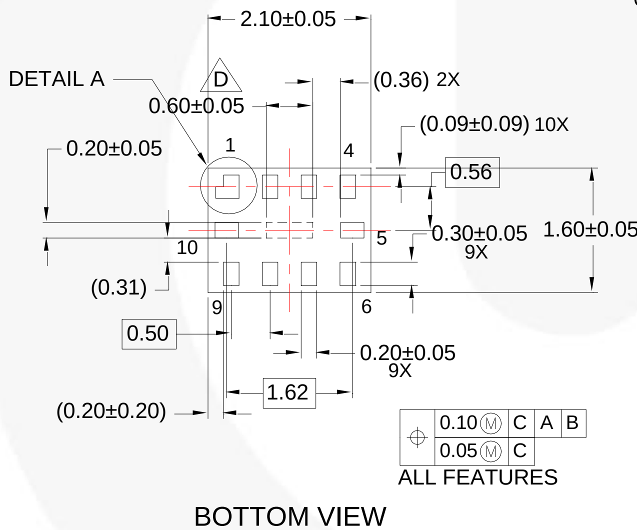
Physical Dimensions





NOTES:

A. PACKAGE CONFORMS TO JEDEC REGISTRATION MO-255, VARIATION UABD .
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009.
D. PRESENCE OF CENTER PAD IS PACKAGE SUPPLIER DEPENDENT. IF PRESENT IT IS NOT INTENDED TO BE SOLDERED AND HAS A BLACK OXIDE FINISH.
E. DRAWING FILENAME: MKT-MAC10Arev6.
F. DIMENSIONS WITHIN ( ) ARE UNCONTROLLED

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Figure 6. 10-Lead, MicroPak™, JEDEC MO255,1.6 x 2.1 mm

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