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ON Semiconductor®

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# FUSB301A

## Autonomous USB Type-C Controller with Configurable I<sup>2</sup>C Address

### Features

- Fully Autonomous Type-C Controller Supports Type-C Versions 1.1 and 1.0
- V<sub>DD</sub> Operating Range, 3.0 V- 5.5 V
- Low Disable Power: I<sub>CC</sub> = 2.0  $\mu$ A (Max.)
- Low Standby Power: I<sub>CC</sub> = 7.0  $\mu$ A (Max.)
- DRP Mode with Optional Accessory Support
- Configurable I<sup>2</sup>C Address
- Capable of Supporting Try.SNK and Try.SRC
- Dead Battery Support (SINK Support when No Power Applied)
- 2 kV HBM ESD Protection
- Small Packaging, 12 Lead TMLP (1.6 mm x 1.6 mm x 0.375 mm)

### Description

The FUSB301A is a fully autonomous Type-C controller optimized for <15 W applications. The FUSB301A offers CC logic detection for Source Mode, Sink Mode, DRP, accessory detection support, and dead battery support. The FUSB301A features configurable I<sup>2</sup>C address to support multiple ports per system. The FUSB301A features an extremely low power disable mode as well as low power during normal operation. It is available in an ultra thin, 12-Lead TMLP package.

### Applications

- Smartphones
- Tablets
- Notebooks
- Ultra Portable Applications

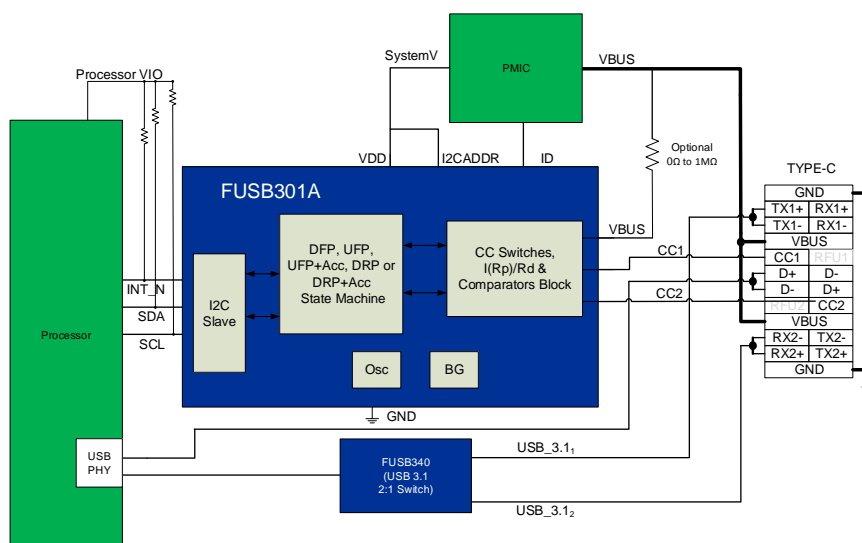


Figure 1. Typical Application

### Ordering Information

Part Number	Top Mark	Operating Temperature Range	Package	Packing Method
FUSB301A	NX	-40 to 85°C	12-Lead Ultra-thin Molded Leadless Package (TMLP) 1.6 mm x 1.6 mm x 0.375 mm	Tape and Reel

## Block Diagram

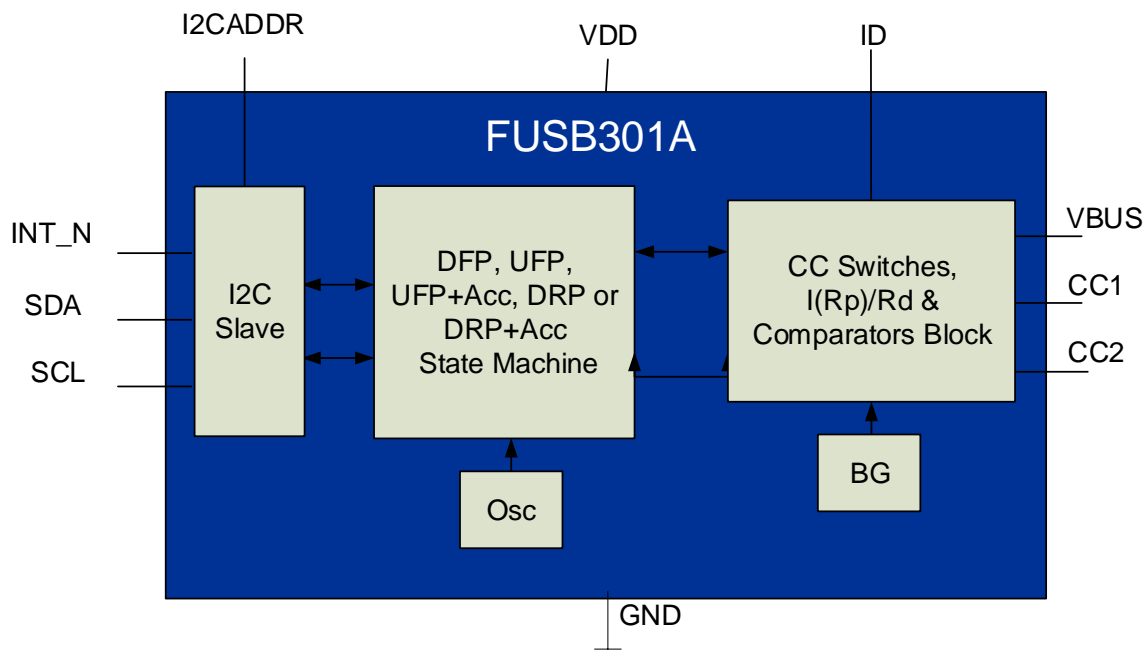


Figure 2. Block Diagram

## Pin Configuration

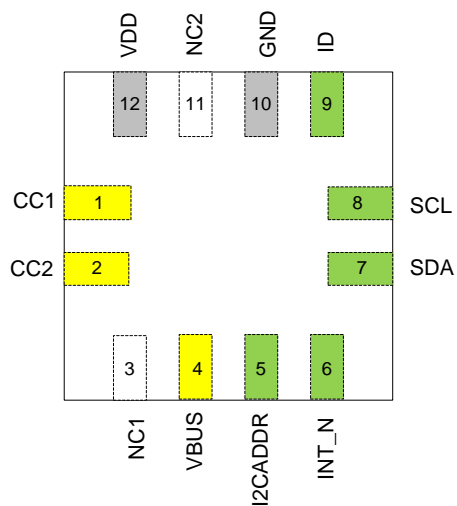


Figure 3. Pin Assignment (Top Through View)

## Pin Descriptions

Pin #	Name	Type	Description
<b>USB Type-C Connector Interface</b>			
1, 2	CC1, CC2	I/O	Type-C Configuration Channel
4	VBUS	Input	VBUS input pin for attach and detach detection
10	GND	Ground	Ground
<b>Power Interface</b>			
12	VDD	Power	Input Supply Voltage
<b>Signal Interface</b>			
8	SCL	Input	I <sup>2</sup> C serial clock signal to be connected to the I <sup>2</sup> C master.
7	SDA	Open-Drain I/O	I <sup>2</sup> C serial data signal to be connected to the I <sup>2</sup> C master
6	INT_N	Open-Drain Output	Active LOW open drain interrupt output used to prompt the processor to read the I <sup>2</sup> C register bits
9	ID	Open-Drain Output	Used to Identify if connected device is Source or Sink. The ID Pin can be used to interface with USB2.0 Input on the processor.
5	I2CADDR	Input	Used to change bit 3 of the I2C address so that multiple addresses can be used in a system where two device addresses conflict
3	NC1	NC	No Connect – Tie to Ground or Float
11	NC2	NC	No Connect – Tie to Ground or Float

### Dead Battery

If power is not applied to FUSB301A and it is attached to a Source device, then the Source would pull up the CC line connected through the cable. The FUSB301A in response would turn on the pull-down that will bring the CC voltage to a range that the Source can detect an attach and turn on VBUS.

### Power Up, Initialization and Reset, Interrupt Operation

When power is first applied, the FUSB301A will power up in Sink mode with all interrupts masked. The local processor must configure the FUSB301A to the desired mode and clear the global interrupt mask bit, INT\_MASK. The INT\_N pin is an active low, open drain output. This pin indicates to the host processor that an interrupt has occurred in the FUSB301A which needs

attention. The INT\_N pin is in a high impedance state by default after power-up or device reset, and the global interrupt mask (INT\_MASK in Control register) is set. After INT\_MASK bit is cleared by the local processor, the INT\_N pin stays high impedance in preparation of future interrupts. When an interruptible event occurs, INT\_N is driven LOW and is in a high impedance state again when the processor clears the interrupt by reading the interrupt registers. Subsequent to the initial power up or reset; if the processor writes a “1” to global interrupt mask bit when the system is already powered up, the INT\_N pin stays in a high impedance state and ignores all interrupts until the global interrupt mask bit is cleared. If an event happens that would ordinarily cause an interrupt when the global interrupt mask bit is set, the INT\_N pin goes LOW when the global interrupt mask is cleared.

**Table 1. ID Pin Truth Table**

TYPE Register (h12, bit 4)	Description	ID
SINK = b0	SINK Not Detected	Hi-Z (default)
SINK = b1	SINK Detected	Low

## 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			Min.	Max.	Unit
V <sub>DD</sub>	Supply Voltage from V <sub>DD</sub>			-0.5	6.0	V
V <sub>BUS</sub>	VBUS supply voltage			-0.5	28	V
V <sub>CC_HDDRP</sub>	CC pins when configured as Host, Device or Dual Role Port			-0.5	6.0	V
T <sub>STORAGE</sub>	Storage Temperature Range			-65	+150	C
T <sub>J</sub>	Maximum Junction Temperature				+150	C
T <sub>L</sub>	Lead Temperature (Soldering, 10 seconds)				+260	C
ESD	IEC 61000-4-2 System ESD	Connector Pins (VBUS, CC1 & CC2)	Air Gap	15		kV
			Contact	8		
	Human Body Model, JEDEC JESD22-A114	Connector Pins (VBUS, CC1 and CC2)		4		kV
		Others		2		
	Charged Device Model, JEDEC LESD22-C101	All Pins		1		

## 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	Min.	Typ.	Max.	Unit
V <sub>BUS</sub>	VBUS Supply Voltage	3.7	5.0	21	V
V <sub>DD</sub>	Supply Voltage	2.8 <sup>(1)</sup>	3.3	5.5	V
T <sub>A</sub>	Operating Temperature	-40		+85	C

### Note:

1. This is for functional operation only and isn't the lowest limit for all subsequent electrical specifications below. All electrical parameters have a minimum of 3 V operation.

## DC and Transient Characteristics

Unless otherwise specified: Recommended T<sub>A</sub> and T<sub>J</sub> temperature ranges. All typical values are at T<sub>A</sub>=25°C and V<sub>DD</sub>=3.3 V unless otherwise specified.

Symbol	Parameter	T <sub>A</sub> = -40 to +85°C T <sub>J</sub> = -40 to +125°C			Unit
		Min.	Typ.	Max	
Type C Specific Parameters					
I <sub>80_CCX</sub>	Source 80 µA CC Current (Default) HOST_CUR1=0, HOST_CUR0=1	64	80	96	µA
I <sub>180_CCX</sub>	SOURCE 180 µA CC Current (1.5 A) HOST_CUR1=1, HOST_CUR0=0	166	180	194	µA
I <sub>330_CCX</sub>	SOURCE 330 µA CC Current (3 A) HOST_CUR1=1, HOST_CUR0=1	304	330	356	µA
V <sub>SNKDB</sub>	SINK Pull-Down Voltage in Dead Battery Under all Pull-up SOURCE Loads			2.18	V
R <sub>DEVICE</sub>	Device Pull-Down Resistance when VDD is within Operating Range	4.6	5.1	5.6	kΩ
zOPEN	CC Resistance for Disabled State	126			kΩ
vRa-SRCdef	Ra Detection Threshold for CC Pin for Source for Default Current on VBUS	0.15	0.20	0.25	V
vRa-SRC1.5A	Ra Detection Threshold for CC Pin for Source for 1.5 A Current on VBUS	0.35	0.40	0.45	V
vRa-SRC3A	Ra Detection Threshold for CC Pin for Source for 3 A Current on VBUS	0.75	0.80	0.85	V
vRd-SRCdef	Rd Detection Threshold for Source for Default Current (HOST_CUR1/0=01)	1.50	1.60	1.65	V
vRd-SRC1.5A	Rd Detection Threshold for Source for 1.5 A Current (HOST_CUR1/0=10)	1.50	1.60	1.65	V
vRd-SRC3A	Rd Detection Threshold for Source for 3 A Current (HOST_CUR1/0=11)	2.45	2.60	2.75	V
vRa-SNK	Ra Detection Threshold for CC Pin for Sink	0.15	0.20	0.25	V
vRd-def	Rd Default Current Detection Threshold for Sink	0.61	0.66	0.70	V
vRd-1.5A	Rd 1.5 A Current Detection Threshold for Sink	1.16	1.23	1.31	V
vRd-3.0A	Rd 3 A Current Detection Threshold for Sink	2.04	2.11	2.18	V
vVBUSthr	VBUS Threshold at which I_VBUSOK Interrupt is Triggered			3.7	V

## Current Consumption

Symbol	Parameter	V <sub>DD</sub> (V)	Conditions	T <sub>A</sub> = -40 to +85°C T <sub>J</sub> = -40 to +125°C			Unit
				Min.	Typ.	Max.	
I <sub>disable</sub>	Disabled Current	3.0 to 5.5	Disabled State		0.35	2.0	μA
I <sub>stby</sub>	Unattached.Sink	3.0 to 5.5	Nothing attached		3.5	7.0	μA
	Unattached Sink + Acc, Source + Acc, or DRP		Nothing attached, Internally Toggling		5	20	μA
I <sub>attach</sub>	Attach Current (Less Host Current)	3.0 to 5.5	Attached as a Sink		5	15	μA
			Attached as a Source		10	15	

## Timing Parameters

Symbol	Parameter		T <sub>A</sub> = -40 to +85°C T <sub>J</sub> = -40 to +125°C			Unit
			Min.	Typ.	Max.	
t <sub>CCDebounce</sub>	Debounce Time for CC (Source or Accessory)		100	150	200	ms
	Debounce Time for CC (Sink)		63	75	87	ms
t <sub>PDDebounce</sub>	Debounce Time for CC Detach Detection		10	15	20	ms
t <sub>AccDetect</sub>	Debounce Time to Detect AudioAccessory, or DebugAccessory is Attached		50	100	200	ms
t <sub>ErrorRecovery</sub>	Time staying in the ErrorRecovery State if sent there via the ERROR_REC bit or by a change of Modes		25	50	100	ms
t <sub>VBUSondeb</sub>	Debounce Time of VBUS Detection when acting as a Sink to Signal VBUS is present		0.167	0.200	0.375	ms
t <sub>VBUSoffdeb</sub>	Debounce Time of VBUS Detection when acting as a Sink to Signal VBUS has been removed		10	15	20	ms
t <sub>DRPToggle1</sub>	For DRP Operation, Time Spent in Unattached.Sink before going to Unattached.Source State	DRPTOGGLE=00	35		70	ms
		DRPTOGGLE=01	30		60	ms
		DRPTOGGLE=10	25		50	ms
		DRPTOGGLE=11	20		40	ms
t <sub>DRPToggle2</sub>	For DRP Operation, Time Spent in Unattached.Source before going to Unattached.Sink State	DRPTOGGLE=00	15		30	ms
		DRPTOGGLE=01	20		40	ms
		DRPTOGGLE=10	25		50	ms
		DRPTOGGLE=11	30		60	ms

## IO Specifications

Symbol	Parameter	V <sub>DD</sub> (V)	Conditions	T <sub>A</sub> = -40 to +85°C T <sub>J</sub> = -40 to +125°C			Unit
				Min.	Typ.	Max.	
Host Interface Pins (ID)							
V <sub>OLID</sub>	Output Low Voltage	3.0 to 5.5	I <sub>OL</sub> =4 mA			0.4	V
Host Interface Pins (I2CADDR)							
V <sub>ILADDR</sub>	Low-Level Input Voltage	3.0 to 5.5				0.3V <sub>DD</sub>	V
V <sub>IHADDR</sub>	High-Level Input Voltage	3.0 to 5.5		0.7V <sub>DD</sub>			V
Host Interface Pins (INT_N)							
V <sub>OLINTN</sub>	Output Low Voltage	3.0 to 5.5	I <sub>OL</sub> =4 mA			0.4	V
I <sup>2</sup> C Interface Pins – Fast Mode SDA, SCL							
V <sub>ILI2C</sub>	Low-Level Input Voltage	3.0 to 5.5				0.4	V
V <sub>IHI2C</sub>	High-Level Input Voltage	3.0 to 5.5		1.2			V
V <sub>HYS</sub>	Hysteresis of Schmitt Trigger Inputs	3.0 to 5.5		0.2			V
I <sub>I2C</sub>	Input Current of SDA and SCL Pins,	3.0 to 5.5	Input Voltage 0.26 V to 2 V	-10		10	μA
I <sub>CCTI2C</sub>	VDD Current when SDA or SCL is HIGH	3.0 to 5.5	Input Voltage 1.8 V			10	μA
V <sub>OLSDA</sub>	Low-Level Output Voltage at 3 mA Sink Current (Open-Drain)	3.0 to 5.5		0		0.3	V
C <sub>I</sub>	Capacitance for Each I/O Pin <sup>(2)</sup>	3.0 to 5.5				10	pF

**Note:**

2. Guaranteed by characterization. Not production tested.

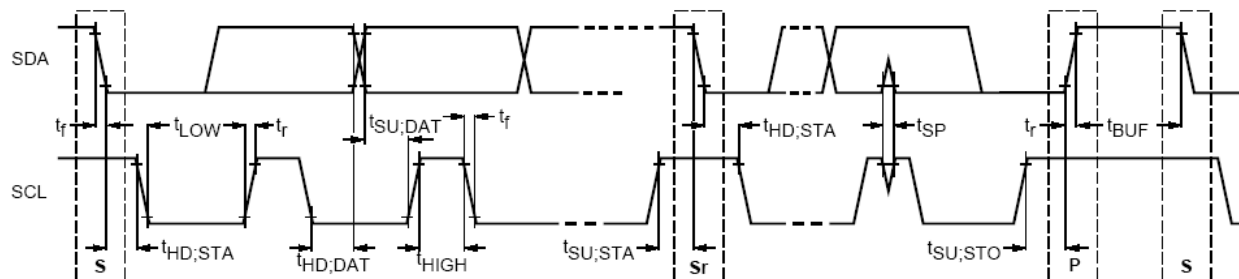


**Fast Mode I<sup>2</sup>C Specifications<sup>(3)</sup> (see Figure 4)**

Symbol	Parameter	Fast Mode		
		Min.	Max.	Unit
f <sub>SCL</sub>	I2C_SCL Clock Frequency	0	400	kHz
t <sub>HD;STA</sub>	Hold Time (Repeated) START Condition	0.6		μs
t <sub>LOW</sub>	LOW Period of I2C_SCL Clock	1.3		μs
t <sub>HIGH</sub>	HIGH Period of I2C_SCL Clock	0.6		μs
t <sub>SU;STA</sub>	Set-up Time for Repeated START Condition	0.6		μs
t <sub>HD;DAT</sub>	Data Hold Time	0	0.9	μs
t <sub>SU;DAT</sub>	Data Set-up Time <sup>(4)</sup>	100		ns
t <sub>r</sub>	Rise Time of I2C_SDA and I2C_SCL Signals <sup>(5)</sup>	20*(V <sub>DD</sub> /5.5 V)	250	ns
t <sub>f</sub>	Fall Time of I2C_SDA and I2C_SCL Signals <sup>(5)</sup>	20*(V <sub>DD</sub> /5.5 V)	250	ns
t <sub>SU;STO</sub>	Set-up Time for STOP Condition	0.6		μs
t <sub>BUF</sub>	BUS-Free Time between STOP and START Conditions	1.3		μs
t <sub>SP</sub>	Pulse Width of Spikes that Must Be Suppressed by the Input Filter	0	50	ns

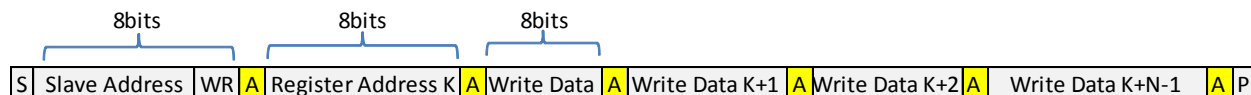
**Notes:**

- Guaranteed by characterization. Not production tested
- A fast-mode I<sup>2</sup>C-bus device can be used in a standard-mode I<sup>2</sup>C-bus system, but the requirement t<sub>SU;DAT</sub> ≥ 250 ns must be met. This is automatically the case if the device does not stretch the LOW period of the I2C\_SCL signal. If such a device does stretch the LOW period of the I2C\_SCL signal, it must output the next data bit to the I2C\_SDA line t<sub>r\_max</sub> + t<sub>SU;DAT</sub> = 1000 + 250 = 1250 ns (according to the standard-mode I<sup>2</sup>C bus specification) before the I2C\_SCL line is released.
- C<sub>b</sub> equals the total capacitance of one bus line in pF. If mixed with high-speed devices, faster fall times are allowed according to the I<sup>2</sup>C specification.

**Figure 4. Definition of Timing for Full-Speed Mode Devices on the I<sup>2</sup>C Bus**

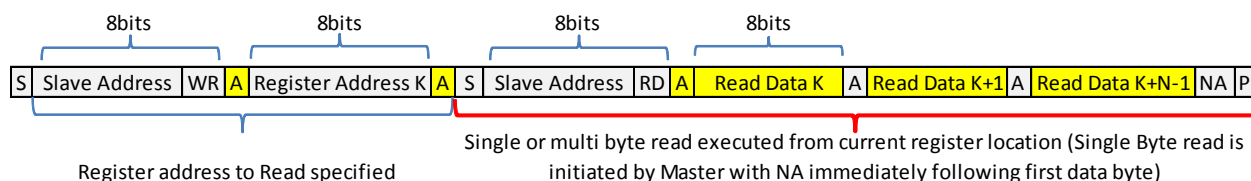
## I<sup>2</sup>C Interface

The FUSB301A includes a full I<sup>2</sup>C slave controller. The I<sup>2</sup>C slave fully complies with the I<sup>2</sup>C specification version 6 requirements. This block is designed for fast mode. Examples of an I<sup>2</sup>C write and read sequence are shown Figure 5 and Figure 6 respectively.





**Note:** Single Byte read is initiated by Master with P immediately following first data byte

**Figure 5. I<sup>2</sup>C Write Example**



**Note:** If Register is not specified Master will begin read from current register. In this case only sequence showing in Red bracket is needed

	From Master to Slave	<b>S</b>	Start Condition	<b>NA</b>	NOT Acknowledge (SDA High)	<b>RD</b>	Read =1
	From Slave to Master	<b>A</b>	Acknowledge (SDA Low)	<b>WR</b>	Write=0	<b>P</b>	Stop Condition

**Figure 6. I<sup>2</sup>C Read Example**

## I<sup>2</sup>C Address

The I2CADDR bit high or low is indicated in bit3 of the slave address shown in Table 2.

**Table 2. FUSB301A I<sup>2</sup>C Slave Address**

Name	Size (Bits)	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Slave Address	8	0	1	0	0	I2CADDR	0	1	R/W

## Register Definitions

**Table 3. Register Map**

Address	Register Name	Type	Rst Val	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x01	Device ID	RO	12	Version ID[3:0]				Revision ID[3:0]			
0x02	Modes	R/W	04			DRP+ACC	DRP	Sink+ACC	Sink	Source+ACC	Source
0x03	Control	R/W	03	DRPTOGGLE					HOST_CUR1	HOST_CUR0	INT_MASK
0x04	Manual	W/C	00					UNATT_SNK	UNATT_SRC	DISABLED	ERROR_REC
0x05	Reset	W/C	00								SW_RES
0x06-0x0F	Reserved	X	xx	Do Not Use							
0x10	Mask	R/W	00					M_ACC_CH	M_BC_LVL	M_DETACH	M_ATTACH
0x11	Status	RO	00			ORIENT1	ORIENT0	VBUSOK	BC_LVL1	BC_LVL0	ATTACH
0x12	Type	RO	00				Sink	Source		DEBUGACC	AUDIOACC
0x13	Interrupt	R/C	00					I_ACC_CH	I_BC_LVL	I_DETACH	I_ATTACH
0x14-0x1F	Reserved	X	xx	Do Not Use							

### Notes:

6. Do not use registers that are blank
7. Values read from undefined register bits are invalid. Do not write to undefined registers.

**Table 4. Device ID**

Address: 01h

Reset Value: 0x0001\_0010

Type: Read Only

Bit #	Name	Size (Bits)	Description
7:4	Version ID	4	Device version ID by Trim or etc. A_[Version ID]: 0010 ( <b>FUSB301ATMX</b> )
3:0	Revision ID	4	Revision History of each version [Revision ID]_revC: <b>0010</b>

**Table 5. Modes**

Address: 02h

Reset Value: 0x0000\_0100

Type: Read/Write

Bit #	Name	Size (Bits)	Description
7:6	Reserved	2	Do Not Use
5	DRP+ACC	1	1: Configure device as a Dual Role Port (DRP) with accessory support
4	DRP	1	1: Configure device as a Dual Role Port (DRP) without accessory support
3	Sink+ACC	1	1: Configure device as a Sink with accessory support
2	Sink	1	<b>1: Configure device as a Sink without accessory support</b>
1	Source+ACC	1	1: Configure device as a Source with accessory support
0	Source	1	1: Configure device as a Source without accessory support

**Table 6. Control**

Address: 03h

Reset Value: 0xXX00\_X011

Type: Read/Write

Bit #	Name	Size (Bits)	Description
7:6	Reserved	2	Do Not Use
5:4	DRPTOGGLE	1	Selects different timing for Dual Role Port Toggle between Unattached.Sink State and Unattached.SOURCE State. <b>00: 35 ms min. in Unattached.Sink and 15 ms min. in Unattached.SOURCE</b> 01: 30 ms min. in Unattached.Sink and 20 ms min. in Unattached.SOURCE 10: 25 ms min. in Unattached.Sink and 25 ms min. in Unattached.SOURCE 11: 20 ms min. in Unattached.sink and 30 ms min. in Unattached.SOURCE
3	Reserved	1	Do Not Use
2:1	HOST_CUR[1:0]	2	1: Controls the pull-up current when device enabled as a Source 00: No Current <b>01: 80 <math>\mu</math>A – Default USB Power</b> 10: 180 $\mu$ A – Medium Current Mode: 1.5 A 11: 330 $\mu$ A – High Current Mode: 3 A
0	INT_MASK	1	<b>1: Global interrupt mask to mask all interrupts</b>

**Table 7. Manual<sup>(8)</sup>**

Address: 04h

Reset Value: 0xFFFF\_0000

Type: Write/Clear

Bit #	Name	Size (Bits)	Description
7:4	Reserved	4	Do Not Use
3	UNATT_SINK	1	1: Put device in Unattached.Sink State as defined in the Type C spec
2	UNATT_SOURCE	1	1: Put device in Unattached.Source state as defined in the Type C spec
1	DISABLED <sup>(9)</sup>	1	1: Put device in Disabled state as defined in the Type C spec
0	ERROR_REC	1	1: Put device in ErrorRecovery state as defined in the Type C spec

**Notes:**

8. If more than one bit is set to “b1” simultaneously then an order of priority will be used. 1st priority is DISABLED, 2nd is ERROR\_REC, 3rd is UNATT\_SOURCE, last is UNATT\_SINK. The highest priority bit will take precedence and all other bits will be cleared automatically.
9. The DISABLED bit must be manually cleared.

**Table 8. Reset**

Address: 05h

Reset Value: 0xFFFF\_XXX0

Type: Write/Clear

Bit #	Name	Size (Bits)	Description
7:6	Reserved	7	Do Not Use
0	SW_RES	1	1: Reset the system and I2C Register.

**Table 9. Mask**

Address: 10h

Reset Value: 0xFFFF\_0000

Type: Read/Write

Bit #	Name	Size (Bits)	Description
7:4	Reserved	4	Do Not Use
3	M_ACC_CH	1	1: Mask a change from Accessory Present to Attached Accessory
2	M_BC_LVL	1	1: Mask a change in I_BC_LVL interrupt bit
1	M_DETACH	1	1: Mask the I_DETACH interrupt bit
0	M_ATTACH	1	1: Mask a change in the I_ATTACH interrupt bit

**Table 10. Status**

Address: 11h

Reset Value: 0xXX00\_0000

Type: Read

Bit #	Name	Size (Bits)	Description
7:6	Reserved	2	Do Not Use
5:4	ORIENT[1:0]	2	Status to indicate which CCx pins has the CC cable connection 11: A fault has occurred during the detection 10: Cable CC is connected through the CC2 pin 01: Cable CC is connected through the CC1 pin <b>00: No or unresolved connection detected</b>
3	VBUSOK	1	1: Status to indicate VBUS is in the valid range
2:1	BC_LVL[1:0]	2	Thresholds that allow detection of current advertisement on CC line <b>00: Ra or unattached Sink</b> 01: Rd threshold for Sink default current advertisement 10: Rd threshold for Sink 1.5 A current advertisement 11: Rd threshold for Sink 3 A current advertisement
0	ATTACH	1	1: Attached to a device or accessory of a type shown in the Type register

**Table 11. Type**

Address: 12h

Reset Value: 0xXXX0\_0X00

Type: Read

Bit #	Name	Size (Bits)	Description
7:5	Reserved	3	Do Not Use
4	Sink	1	1: Indicates a Sink has been detected
3	Source	1	1: Indicates a Source has been detected
2	Reserved	1	Do Not Use
1	DEBUGACC	1	1: Indicates a Debug Accessory has been detected
0	AUDIOACC	1	1: Indicates a Audio Accessory has been detected

**Table 12. Interrupt0**

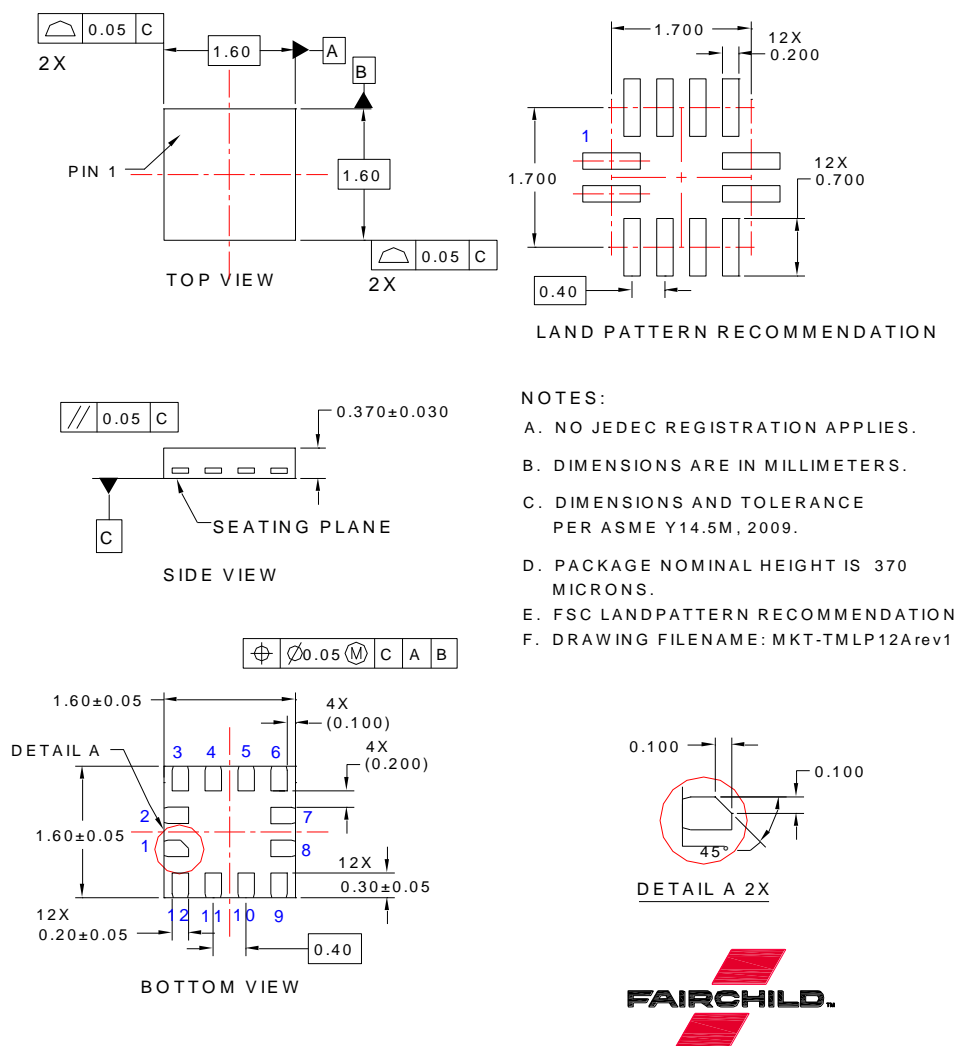
Address: 13h

Reset Value: 0xFFFF\_X000

Type: Write/Clear

Bit #	Name	Size (Bits)	Description
7:4	Reserved	5	Do Not Use
3	I_ACC_CH	1	1: Interrupt flagged when a change from Accessory Present to Audio Accessory or Debug Accessory occurs
2	I_BC_LVL	1	1: Interrupt flagged when a change in BC_LVL advertised current level has occurred
1	I_DETACH	1	1: Interrupt flagged when a device or accessory has been detached
0	I_ATTACH	1	1: Interrupt flagged when a device or accessory of type indicated in the Type register has been attached

## Physical Dimensions



**Figure 7. 12 Lead, TMLP, Quad, Ultra-Thin MLP, 1.6 mm x 1.6 mm x 0.375 mm**

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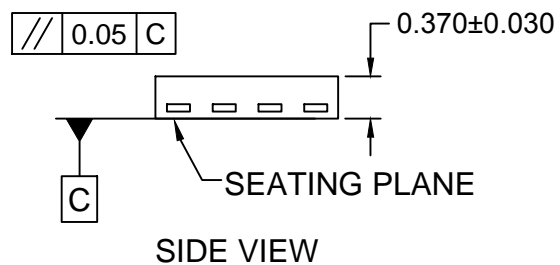
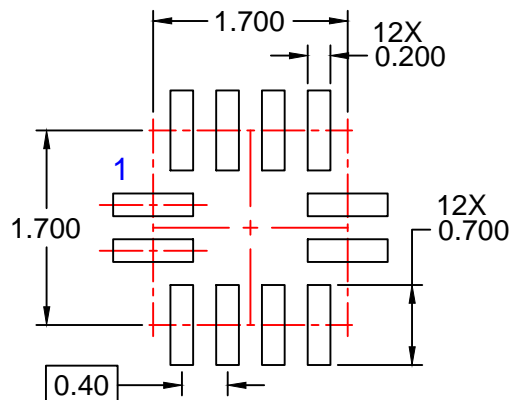
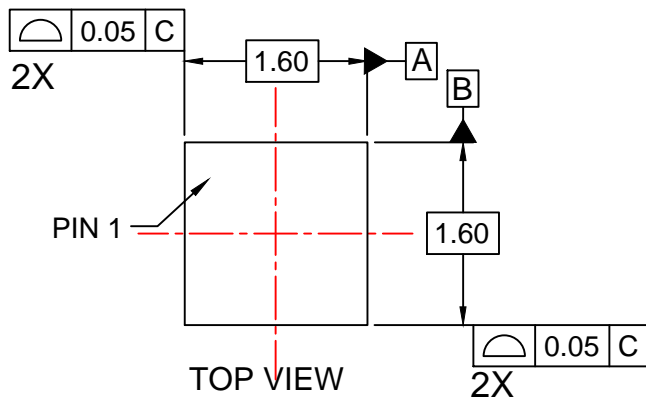
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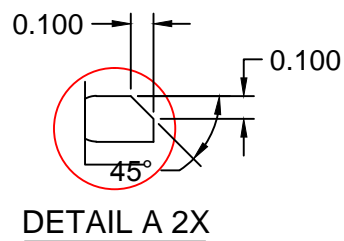
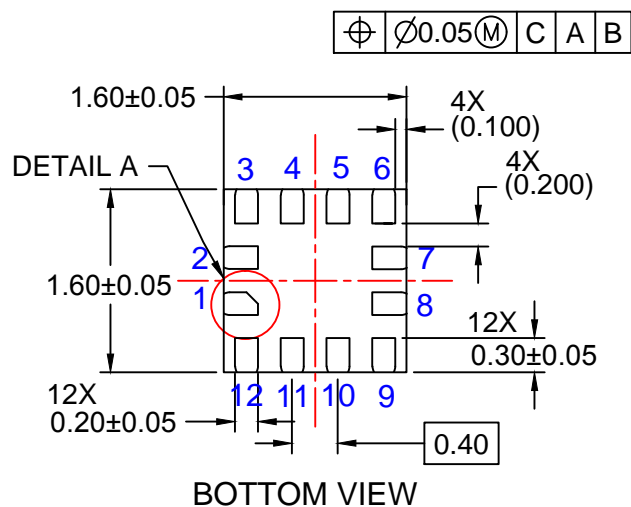
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- C. DIMENSIONS AND TOLERANCE PER ASME Y14.5M, 2009.
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