MeshConnect™ EM35x USB Sticks
ZM357S-USB(-LR) and ZM3588S-USB(-LR)
Ember™ EM35x Transceiver - Based USB Sticks

ZigBee®/ Thread / MeshWorks™/ IEEE 802.15.4
Wireless Mesh Networking

DESCRIPTION

California Eastern Laboratories (CEL) MeshConnect™ EM35x USB Sticks enable hardware vendors to quickly integrate ZigBee® and Thead into existing devices with a USB port. No RF design expertise is required. They can be used as a hardware development platform for rapid prototyping and as a companion to the MeshConnect EM35x family of wireless modules.

DEVELOPMENT USES

· **Platform for custom firmware development**
  - Runs EmberZNet PRO™ stack, including Smart Energy, Home Automation, Commercial Building Automation and Light Link ZigBee profiles
  - ZM3588-USB(-LR) supports Silicon Labs Thread stack for IP-based wireless mesh networking applications
  - Virtual COM port is easily accessible by application software using a UART interface
  - Compatible with CEL's award-winning MeshWorks™ platform
  - Ember InSight Port allows full debugging and trace capabilities

· **Sniffer for Over-the-Air (OTA) Network Logging**
  - Full support for Silicon Laboratories Desktop Network Analyzer, including Protocol Decoding, Event Aggregation, Filtering and Visualization Tools
  - Quickly determines the root cause of any networking issue to get your product to market faster

· **GUIs using Windows, Mac and Linux**
  - Allows users to interact with ZigBee network
  - Develops simulators to allow development testing to be completed if a certain network element is unavailable

PRODUCTION USES

· **Network commissioning tool**
  - USB form factor provides a convenient interface for technicians to setup and verify new network installations and troubleshoot existing ones

· **Adds ZigBee or Thread functionality to any device with a USB port**
  - Easy to retrofit existing products to add ZigBee or Thread functionality
  - Reduces time to market and avoids the cost of a hardware redesign required for module- or IC-level integration

MeshConnect™ EM35x USB Sticks

· **Network Provisioning and Monitoring**
  - Ideal for use as a commissioning tool when setting up networks
· **Firmware Upgrades via Ember InSight Port or OTA**

ORDERING INFORMATION

Order Number	ZM357S-USB	ZM357S-USB-LR	ZM3588S-USB	ZM3588S-USB-LR
Tx	+8 dBm	+20 dBm	+8 dBm	+20 dBm
Rx	-100 dBm	-103 dBm	-100 dBm	-103 dBm
Link Budget	+108 dB	+123 dB	+108 dB	+123 dB
Flash Memory	192 kB + 1 MB		512 kB	512 kB
ZigBee	√	√	√	√
Thread			√	√
MeshWorks			√	√
Min/Multiple	1/1pcs	1/1pcs	1/1pcs	1/1pcs

FEATURES

- Enable ZigBee and Thread on any device with a USB serial port
- Based on Silicon Labs EM35x family equipped with a 32-bit ARM® Cortex™-M3 processor
- Best-in-class RF performance for superior range
- Direct connection to Ember InSight Adapter (ISA3) for programming and debugging EM35x applications
- Contains the industry's premier ZigBee PRO stack: Ember ZNet PRO™
- Supports Mesh, Point-to-Point and Point-to-Multipoint Networks

APPLICATIONS

- Smart Energy/Smart Grid
- Commercial and Residential Lighting
- Home Automation and Control
- Building Automation and Control
- Security and Monitoring
- M2M Industrial Controls
- General ZigBee and Thread Wireless Sensor Networking

SPECIFICATIONS

- Frequency: 2405-2480 MHz
- Output Power: +8 dBm and +20 dBm
- Rx Sensitivity: -100 dBm and -103 dBm
- RF Link Budget: +108 dB and +123 dB
- Operating Temperature: -30°C to +70°C
- Data Rate: 250 kbps
- Dimensions: 2.075" x 0.984" x 0.393" (52.70 mm x 24.99 mm x 9.98 mm) —Excluding USB connector
- RoHS Compliant

USB

- USB 2.0 complaint (full speed)
- Enumerates as Virtual COM Port
- Driver support for Windows, Mac and Linux

EMBER INSIGHT PORT

- Direct connection to the Ember InSight Adapter (ISA3)
- Provides programming, debugging and data emulation capability for EM35x applications
- Fully supports Ember's Desktop Network Analyzer for OTA network sniffing
- Self-powered; no USB connection required

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BLOCK DIAGRAM
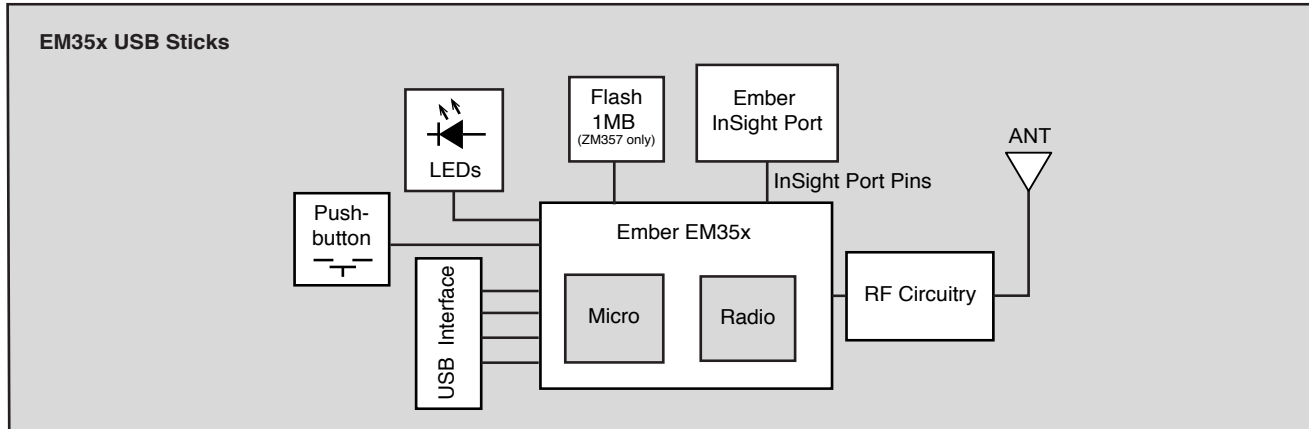
TRANSCEIVER IC

CEL's MeshConnect EM35x USB Sticks use the Ember EM357 or the EM3588 Transceiver IC. These ICs incorporate an RF transceiver with baseband modem, a hardwired MAC and an embedded ARM® Cortex™-M3 microcontroller, offering an excellent low cost, high performance solution for all IEEE 802.15.4 / ZigBee / Thread applications.

For more information about the EM357 or EM3588 IC, visit www.silabs.com/products/wireless/zigbee.

ADDITIONAL FLASH MEMORY

The MeshConnect EM357 USB Sticks (ZM357S-USB and ZM357S-USB-LR) incorporate an additional 1MB Flash memory for OTA updates. The flash memory is wired to the following EM357 pins:

EM357 Pin	EM357 Function	Flash Memory Pin	Flash Memory Function
PA0	SC2MOSI	MOSI	Serial Data Input
PA1	SC2MISO	MISO	Serial Data Output
PA2	SC2SCLK	SCLK	Serial Clock
PA3	SC2nSSEL	SS	Chip Select

The instruction set for the Flash memory is similar to the Micron M25PE80. Visit www.micron.com for more information on the instruction set.

The ZM3588S-USB and ZM3588-USB-LR do not contain the additional off chip memory since the EM3588's 512KB of internal flash is sufficient for supporting all ZigBee and Thread OTA requirements.

USB

The USB interface is a USB 2.0 compliant (full speed) virtual COM port. ZM3588S-USB(-LR) uses the same virtual COM port as ZM357-USB(-LR), rather than the EM3588 internal USB device peripheral. Drivers are available for the following operating systems:

- Windows:
  CEL provides a driver that has been certified for Windows 2000, Server 2003, XP, Vista, 7 and 8.

- Linux
- Mac OS X

The virtual COM port USB driver is available at:
http://meshconnect.cel.com/products/usb-sticks/em357-usb-lr#product-tabs4.

TABLE OF CONTENTS

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SOFTWARE / FIRMWARE

CEL's MeshConnect EM35x USB Sticks are ideal platforms for EmberZNet PRO, the industry's most deployed and field-proven ZigBee-compliant stack supporting the ZigBee PRO feature set. EmberZNet PRO is a complete ZigBee PRO protocol software package containing all the elements required for mesh networking applications. The ZM3588-USB(-LR) variants are also ideal platforms for Thread, an IP-based mesh networking stack that allows direct IPv6 connectivity to all devices within the network. For more information regarding the software development for the EM35x IC family, visit www.silabs.com/products/wireless/zigbee.

For more information on developing with the EM35x USB Sticks, please see the *EM35x Mini Module Datasheet*.

EMBER INSIGHT PORT

Figure 1 below details the pins and their connections to the Ember InSight Port on the USB Stick. The Ember InSight Port is used for debugging and programming in conjunction with the Ember InSight Adapter (ISA3).
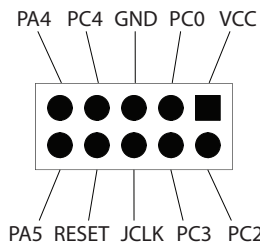

PA4 PC4 GND PC0 VCC

PA5 RESET JCLK PC3 PC2

Figure 1: Ember InSight Port

Connection between the USB Stick and the Ember InSight Adapter (ISA3) can be seen in Figure 2.

The ISA3 provides an interface to the USB Stick for software downloading and debugging. It also provides an interface to InSight Desktop for monitoring and recording network data.

The ISA3 has the following components:

• InSight Port interface to the USB Stick radio, providing programming and debugging services
• TCP / IP 10 / 100 Ethernet interface with Power over Ethernet functionality
• USB Interface

Figure 2: USB Stick and ISA3 Connection

For more information about the ISA3, see Silicon Laboratories *EM35x Development Kit User Guide*, document link can be found in Reference Section of this document.
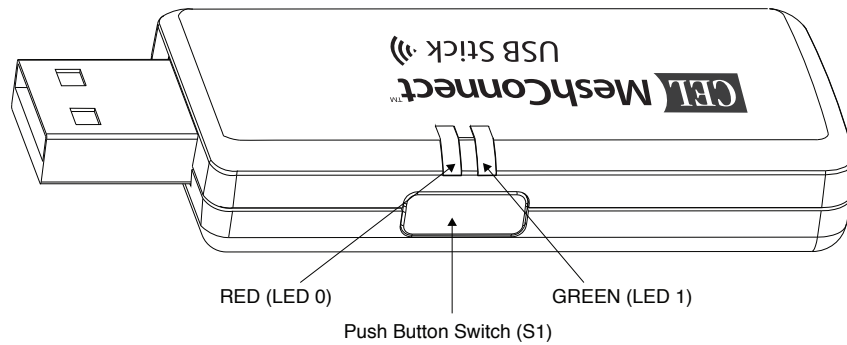
USB STICK PORT ADAPTER AND SWITCHES

RED (LED 0)   GREEN (LED 1)

Push Button Switch (S1)

Figure 3: Profile of USB Stick showing push button switch and red and green LED

Hardware Interface	EM35x I/O
LED 0 (RED)	PA6
LED1 (GREEN)	PA7
Switch S1	PB6

Table 1: Hardware mapping to physical I/O on EM35x

Programming Port (J1)   Pin 1 (Upper Right)
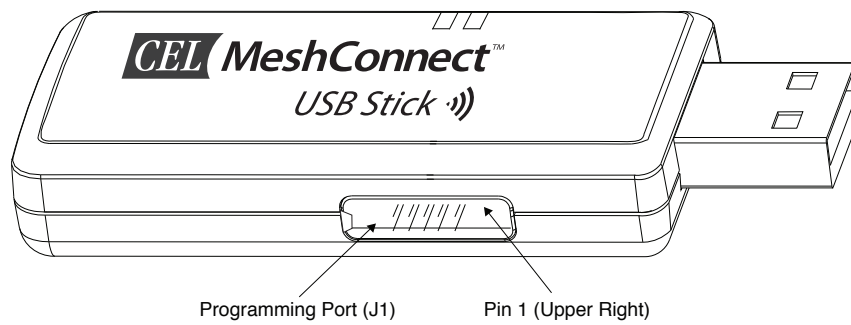
Figure 4: Profile of USB Stick showing programming port adapter and Pin 1

J1

VCC_3V3	1	2	PC2
PC0	3	4	PC3
	5	6	JTCK
PC4	7	8	RESET
PA4	9	10	PA5

FTSH-105-04-F-DH-A_SAMTEC
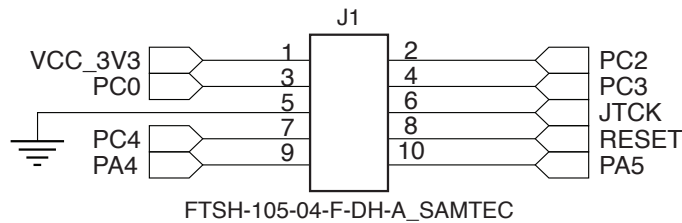
Figure 5: Shows programming pins for EM35x and internal connector with connections

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ABSOLUTE MAXIMUM RATINGS

Description	MeshConnect USB Sticks		Unit
	Min	Max	
Power Supply Voltage (V$_{DD}$)	-0.3	5.8	VDC
Storage Temperature Range	-30	80	°C

Note: *Exceeding the maximum ratings may cause permanent damage to the USB Stick or other devices.*

RECOMMENDED OPERATING CONDITIONS

Description	MeshConnect USB Sticks			Unit
	Min	Typ	Max	
Power Supply Voltage (V$_{DD}$)	4.0	5.0	5.25	VDC
Ambient Temperature Range	-30	25	70	°C

## DC CHARACTERISTICS *(@ 25°C, V$_{DD}$ = 5.0 V, ZM35xS-USB TX Power Mode 1, ZM35x-USB-LR TX Power Mode 2)*

Description		MeshConnect USB Sticks			Unit
		Min	Typ	Max	
Transmit Mode Current @ 8 dBm	ZM357S-USB ZM3588S-USB	–	65.0	–	mA
Transmit Mode Current @ 0 dBm		–	52.0	–	mA
Receive Mode Current		–	51.0	–	mA
Transmit Mode Current @ 20 dBm	ZM357S-USB-LR ZM3588S-USB-LR	–	165.0	–	mA
Transmit Mode Current @ 0 dBm		–	79.0	–	mA
Receive Mode Current		–	55.0	–	mA

RF CHARACTERISTICS *(@ 25°C, V$_{DD}$ = 5.0 V, ZM35xS-USB TX Power Mode 1, ZM35xS-USB-LR TX Power Mode 2)*

Description		MeshConnect USB Sticks			Unit
		Min	Typ	Max	
General Characteristics					
RF Frequency Range		2405	–	2480	MHz
RF Channels		11	–	26	–
Frequency Error Tolerance		-96.2	–	96.2	kHz
Transmitter					
Maximum Output Power	ZM357S-USB ZM3588S-USB	–	8	–	dBm
Minimum Output Power		–	-40	–	dBm
Offset Error Vector Magnitude		–	5	35	%
Maximum Output Power	ZM357S-USB-LR ZM3588S-USB-LR	–	20	21	dBm
Minimum Output Power		–	-40	–	dBm
Offset Error Vector Magnitude		–	5	35	%
Receiver					
Sensitivity (1% PER, boost mode)	ZM357S-USB ZM3588S-USB	–	-100	-94	dBm
Saturation (maximum input level)		0	–	–	dBm
Sensitivity (1% PER, normal mode)	ZM357S-USB-LR ZM3588S-USB-LR	–	-103	-97	dBm
Saturation (maximum input level)		-10	–	–	dBm

USB STICK DIMENSIONS

MeshConnect™ USB Stick

2.075 in
52.70 mm

0.984 in
24.99 mm

0.393 in
9.98 mm
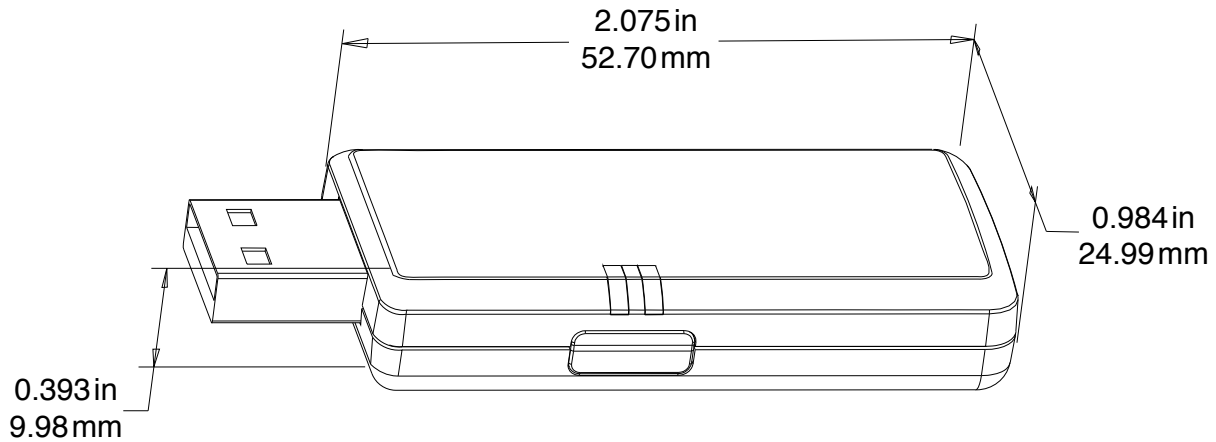
AGENCY CERTIFICATIONS

The MeshConnect USB Sticks have been certified to FCC and IC requirements.

FCC COMPLIANCE STATEMENT (PART 15.19) SECTION 7.15 OF RSS-GEN

This device complies with Part 15 of the FCC Rules and with Industry Canada Licence-Exempt RSS Standards. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

1. l'appareil ne doit pas produire de brouillage, et
2. l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Warning (Part 15.21)

Changes or modifications not expressly approved by CEL could void the user's authority to operate the equipment.

20 cm Separation Distance

To comply with FCC/IC RF exposure limits for general population/uncontrolled exposure, the USB Sticks must maintain a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

IC CERTIFICATION — INDUSTRY CANADA STATEMENT

The term "IC" before the certification/registration number only signifies that the Industry Canada technical specifications were met.

CERTIFICATION IC — DÉCLARATION D'INDUSTRIE CANADA

Le terme "IC" devant le numéro de certification/d'enregistrement signifie seulement que les spécifications techniques Industrie Canada ont été respectées.

Section 14 of RSS-210

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population. Consult *Safety Code 6*, obtainable from Health Canada's website: http://hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php

L'article 14 du CNR-210

Le programme d'installation de cet équipement radio doit s'assurer que l'antenne est située ou orientée de telle sorte qu'il ne pas émettre de champ RF au-delà des limites de Santé Canada pour la population générale. Consulter le Code de sécurité 6, disponible sur le site Web de Santé Canada, http://hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php

CE CERTIFICATION — EUROPE

The MeshConnect ZM357S-USB and ZM3588S-USB are in the process of being tested and certified for use in the European Union.

SOFTWARE COMPLIANCE

The USB Sticks require software restrictions to meet agency certification requirements. These restrictions have been implemented in the sample application included with the Software Development Kit.

Customers must implement the following output power restrictions to use the FCC or IC Certification:

	Certification	RF Channel	Valid TX Power Steps	Typical Max Output Power
ZM357S-USB & ZM3588S-USB	FCC/IC	11 - 25	-43 to 8	8 dBm
		26	-43 to 0	1 dBm
ZM357S-USB-LR & ZM3588S-USB-LR	FCC/IC	11 - 24	-43 to -2	20 dBm
		25	-43 to -6	17 dBm
		26	-43 to -26	-3 dBm

Note: For ZM357S-USB-LR & ZM3588S-USB-LR, Power Mode 2 with power setting -2 is the maximum setting allowed for FCC Compliance. Operating in Power Mode 3 at higher power settings may damage the Power Amplifier.

QUALITY

CEL's USB Sticks offer the highest quality at competitive prices. Our USB Sticks are built with ZICM35xSPx Modules, which are manufactured in compliance with IPC-A-610 specification, Class II and go through JESD22 qualification processes which includes high temperature operating life tests, mechanical shock, temperature cycling, humidity and reflow testing. CEL conducts RF and DC factory testing on 100% of all ZICM357SPx modules.

CEL builds the quality into our products, giving our customers confidence when integrating our products into their systems.

REFERENCES

Reference Documents	Download
Silicon Laboratories EM35x Development Kit User Guide	Link
0011-00-07-01-000 CEL ZICM35xSPx Datasheet - EM35x Mini Modules	Link
0011-01-16-03-001 CEL USB Stick Driver Installation Instructions - Application Note	Link
ZM35xS-USB(-LR) Driver Installation Files	Link

REVISION HISTORY

Previous Versions	Changes to Current Version	Page(s)
0011-01-07-03-000 (Issue A) July 26, 2012	Initial preliminary datasheet	N/A
0011-01-07-03-000 (Issue B) February 5, 2013	Changes to Absolute Maximum Ratings, Recommended Operating Conditions, DC Characteristics, RF Characteristics, USB Stick Dimensions; Updated Certification Compliance Statements	4, 6, 7
0011-01-07-03-000 (Issue C) July 31, 2013	Updated Photography, Agency Certifications	1, 7
0011-01-07-03-000 (Issue D) November 8, 2013	Added New Section "USB Stick Port Adapter and Switches". Updated Operating and Storage Temperature ranges	1, 5, 6
0011-01-07-03-000 (Issue E) September 10, 2014	Updated USB Drivers support	2
0011-09-07-00-000 (Issue F) June 16, 2015	Included ZM3588S-USB, ZM388S-USB-LR; Updated document number	All
0011-09-07-00-000 (Issue G) October 29, 2015	Removed Preliminary datasheet from the header	1

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For More Information

For more information about CEL MeshConnect products and solutions, visit our website at:
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