SEMTECH

Software Modem Shield Evaluation Kit:

User Guide

2019-07-03

1 Contents

Table of Figures

2 Introduction

The Software Modem (referred to modem) is a software set running on a LoRa based module to provide an API for end node operation.

To facilitates the evaluation of the Modem, an application layer firmware was developed to run on a separate application processor.

The purpose of this document is to provide a quick start guide for users to get started with the evaluation of the Software Modem.

3 Evaluation Kit Information

3.1 Components

The evaluation kit of the Modem consists of 2 hardware pieces: the CMWX1ZZABZ mbed shield board and the Application Processor board.

- Modem board
- Currently the Software Modem firmware (MAC stack and Modem service) developed by Semtech is flashed into the MuRata LoRa module. This module is mounted on a CMWX1ZZABZ mbed shield.
- Application board
  A separate STM32L073RZ[1] microcontroller is used as the application processor. This processor resides on a NUCLEO L073RZ[5] evaluation board.

3.2 Connections

The communication of Request/Response between the Software Modem and the Application Processor is made through a UART link; the communication from the evaluation kit to the host PC is made through a Mini USB. This is necessary for command sending and response reading.

[1] More information at: https://www.st.com/en/microcontrollers-microprocessors/stm32l073rz.html

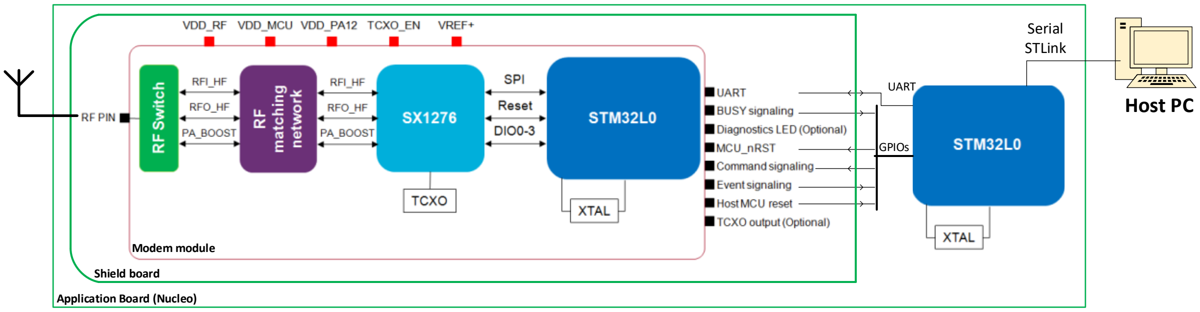


Figure 1 Block diagram illustrating the connections between the Software Modem evaluation kit, the Application Processor, and the Host PC

4 Quick Start Guide

4.1 Connecting Hardware

1 Plug the CMWX1ZZABZ mbed Shield board on top of the Nucleo-L073RZ as showed below:

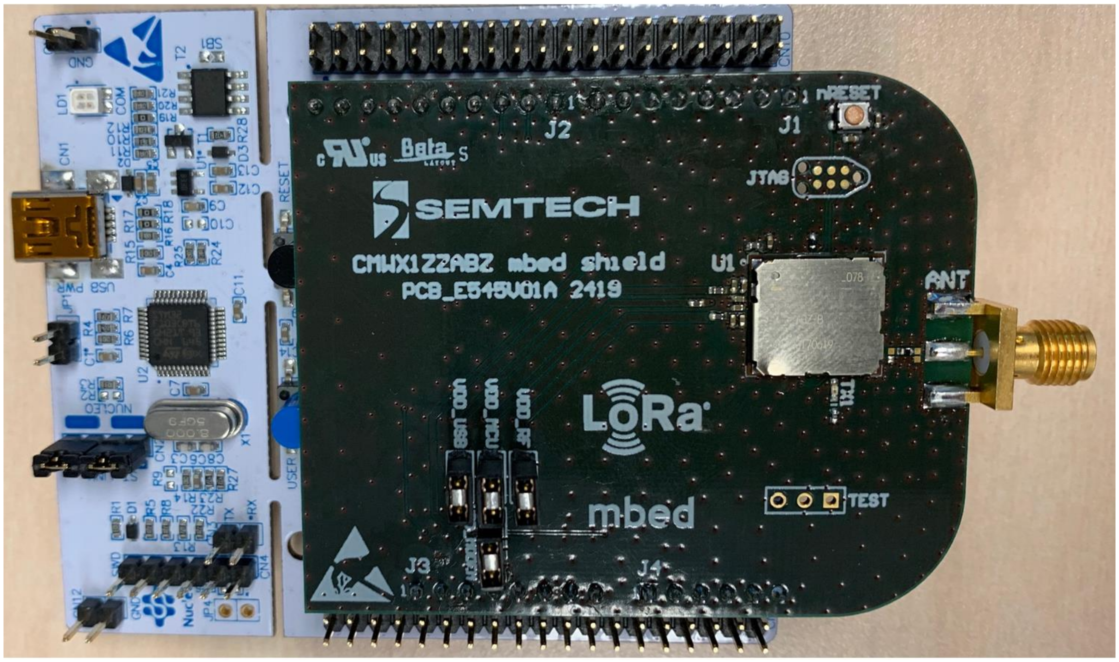


Figure 2 Connections between Software Modem board and Application board

2 Connect Mini USB cables from the host PC to the Nucleo-L073RZ board.

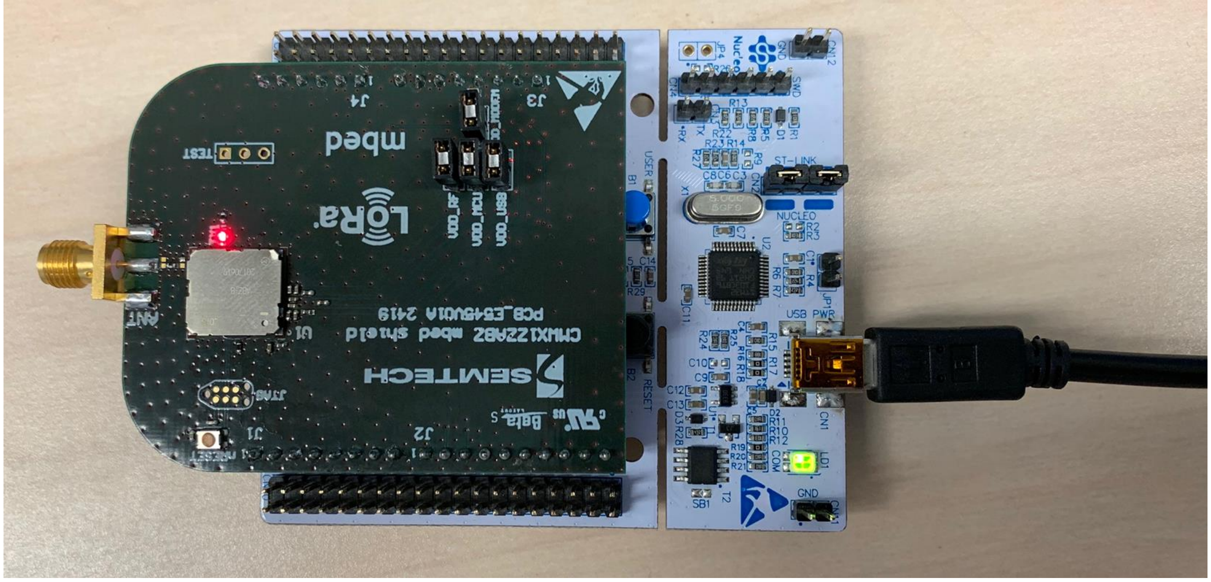
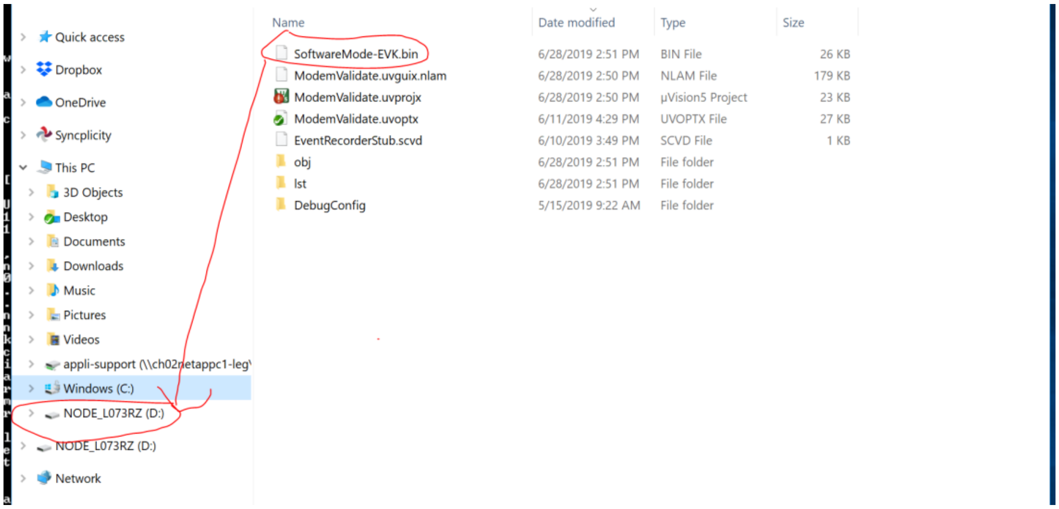


Figure 3 Fully operational Software Modem and Application evaluation kit

4.2 Flashing Firmware

There are 2 firmwares: Software Modem firmware in the CMWX1ZZABZ module and application firmware in the Nucloe-L073RZ

1. Software Modem firmware: Software Modem firmware pre-loaded into the CMWX1ZZABZ module.
2. Application firmware: an application firmware can be loaded into the Nucelo_L073RZ by drag and drop a bin file to the Nucelo_L073RZ



Name	Date modified	Type	Size
SoftwareMode-EVK.bin	6/28/2019 2:51 PM	BIN File	26 KB
ModemValidate.uvguix.nlam	6/28/2019 2:50 PM	NLAM File	179 KB
ModemValidate.uvprojx	6/28/2019 2:50 PM	µVision5 Project	23 KB
ModemValidate.uvoptx	6/11/2019 4:29 PM	UVOPTX File	27 KB
EventRecorderStub.scvd	6/10/2019 3:49 PM	SCVD File	1 KB
obj	6/28/2019 2:51 PM	File folder	
lst	6/28/2019 2:51 PM	File folder	
DebugConfig	5/15/2019 9:22 AM	File folder	

4.3 Getting the Host PC Ready

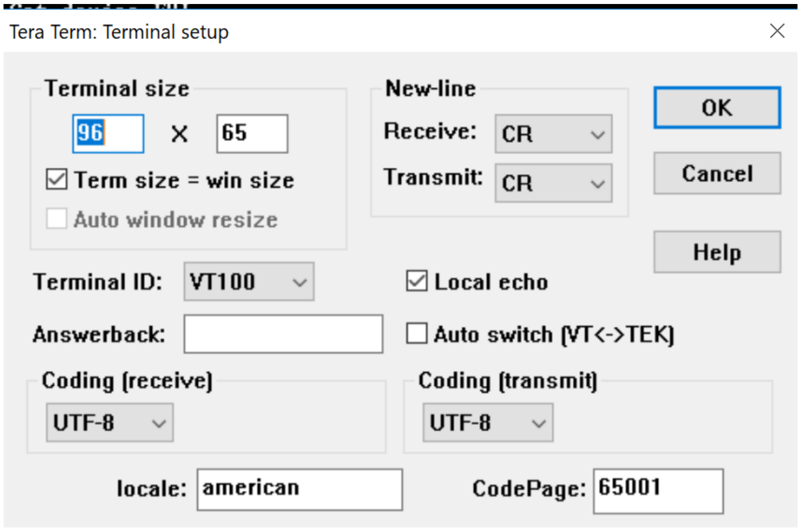
A COM terminal software can be used to send a command to the evaluation kit, and read the output from either application MCU or Modem MCU. Tera Term[2], Putty[3] or MobaXterm[4] can be used as the terminal.

Configuration for the COM port connection:

- Baud rate: 115200
- Data bits: 8
- Stop bits: 1
- Parity: None
- Flow control: None

Configuration for the terminal:

- Implicit CR in every LF
- Local echo force on



Tera Term: Terminal setup

Terminal size

96 × 65

☑ Term size = win size

☐ Auto window resize

New-line

Receive: CR

Transmit: CR

Terminal ID: VT100

Answerback:

☑ Local echo

☐ Auto switch (VT<->TEK)

Coding (receive) UTF-8

Coding (transmit) UTF-8

locale: american

CodePage: 65001

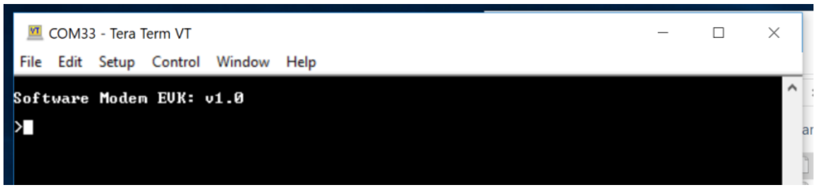
Figure 4 Terminal configuration example for TeraTerm

Connect a mini USB cable from host to application MCU board and open a serial terminal.   After pressing RESET button on the Nucleo-L073RZ, the serial terminal should show the start-up information printed by the application MCU as below:

[2] Open source, more information available at: https://ttssh2.osdn.jp/index.html.en

[3] Open source, more information available at: https://www.putty.org/

[4] Free for personal use, more information available at: https://mobaxterm.mobatek.net/

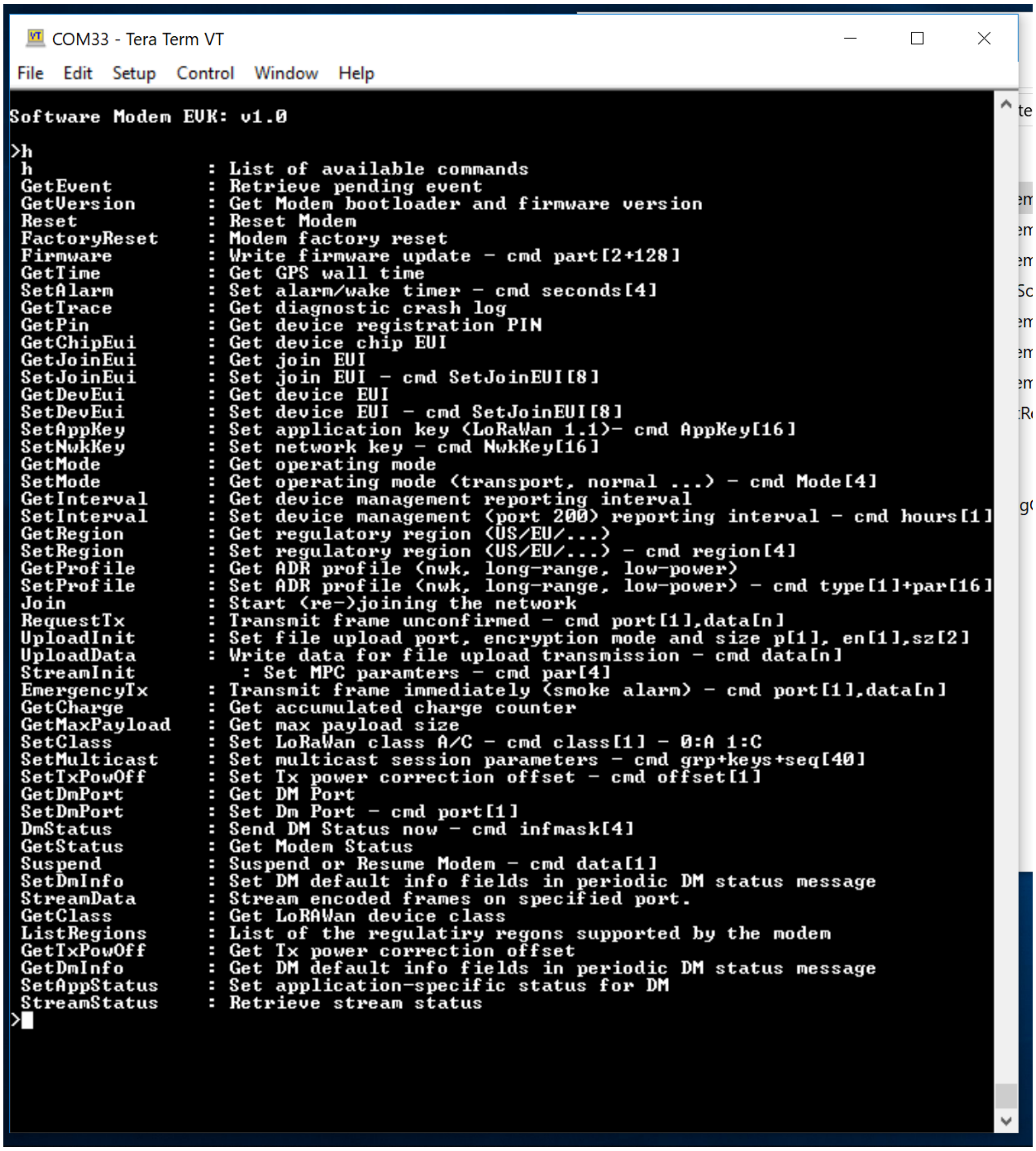


```
Software Modem EVK: v1.0
>
```

Figure 5 Application board start-up information

4.4 Using Commands to Operate Modem

On the application board terminal, using command “h” can list the supported commands.



```
Software Modem EVK: v1.0

>h
 h                : List of available commands
 GetEvent         : Retrieve pending event
 GetVersion       : Get Modem bootloader and firmware version
 Reset            : Reset Modem
 FactoryReset     : Modem factory reset
 Firmware         : Write firmware update - cmd part[2+128]
 GetTime          : Get GPS wall time
 SetAlarm         : Set alarm/wake timer - cmd seconds[4]
 GetTrace         : Get diagnostic crash log
 GetPin           : Get device registration PIN
 GetChipEui       : Get device chip EUI
 GetJoinEui       : Get join EUI
 SetJoinEui       : Set join EUI - cmd SetJoinEUI[8]
 GetDevEui        : Get device EUI
 SetDevEui        : Set device EUI - cmd SetJoinEUI[8]
 SetAppKey        : Set application key (LoRaWan 1.1)- cmd AppKey[16]
 SetNwkKey        : Set network key - cmd NwkKey[16]
 GetMode          : Get operating mode
 SetMode          : Get operating mode (transport, normal ...) - cmd Mode[4]
 GetInterval      : Get device management reporting interval
 SetInterval      : Set device management (port 200) reporting interval - cmd hours[1]
 GetRegion        : Get regulatory region (US/EU/...)
 SetRegion        : Set regulatory region (US/EU/...) - cmd region[4]
 GetProfile       : Get ADR profile (nwk, long-range, low-power)
 SetProfile       : Set ADR profile (nwk, long-range, low-power) - cmd type[1]+par[16]
 Join             : Start (re-)joining the network
 RequestTx        : Transmit frame unconfirmed - cmd port[1],data[n]
 UploadInit       : Set file upload port, encryption mode and size p[1], en[1],sz[2]
 UploadData       : Write data for file upload transmission - cmd data[n]
 StreamInit         : Set MPC paramters - cmd par[4]
 EmergencyTx      : Transmit frame immediately (smoke alarm) - cmd port[1],data[n]
 GetCharge        : Get accumulated charge counter
 GetMaxPayload    : Get max payload size
 SetClass         : Set LoRaWan class A/C - cmd class[1] - 0:A 1:C
 SetMulticast     : Set multicast session parameters - cmd grp+keys+seq[40]
 SetTxPowOff      : Set Tx power correction offset - cmd offset[1]
 GetDmPort        : Get DM Port
 SetDmPort        : Set Dm Port - cmd port[1]
 DmStatus         : Send DM Status now - cmd infmask[4]
 GetStatus        : Get Modem Status
 Suspend          : Suspend or Resume Modem - cmd data[1]
 SetDmInfo        : Set DM default info fields in periodic DM status message
 StreamData       : Stream encoded frames on specified port.
 GetClass         : Get LoRAWan device class
 ListRegions      : List of the regulatiry regons supported by the modem
 GetTxPowOff      : Get Tx power correction offset
 GetDmInfo        : Get DM default info fields in periodic DM status message
 SetAppStatus     : Set application-specific status for DM
 StreamStatus     : Retrieve stream status
>
```

Figure 6 Supported commands

4.4.1 Sending Commands

We can type commands to generate corresponding opcode and parameters to the Modem board through UART.

The general command format is:

“command” “parameters”

- The “command” is the name of operations, for example, “join” or “requesttx”
- The “parameters” is a list of the parameters sent to the Modem. If it is a hex string, it is converted to an integer, with space in between.
  For example, we can use the command “tx 100 0 1 2 3 4” to send an uplink frame of 5 bytes using FPort 100.

Two types of commands are supported

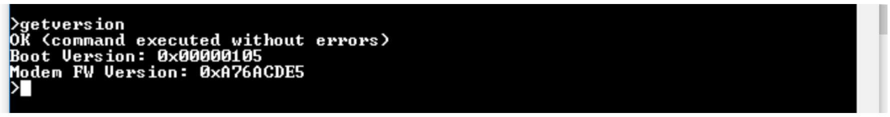
- Synchronous command: commands sent to the Modem with an instant response expected, the response time should be within 50 us.
- Asynchronous command: commands sent to the Modem with an additional non-instant response expected.

Proper network coverage is required so that the Modem can join the network, send uplink frames and receive downlink frames.

4.4.2 Reading Responses

On the console, if a response message is available, the application MCU will pull the data, validates the checksum, and display the response data and status.

A screenshot of a successful synchronous command sending and response pull is shown below.



```
>getversion
OK (command executed without errors)
Boot Version: 0x00000105
Modem FW Version: 0xA76ACDE5
>
```

Figure 7 Screenshot of the message exchange for info command

Sometimes the terminal displays “NO RESPONSE FROM MODEM”, which indicates the response is not ready by the predefined timeout (50 ms) after finished sending the commands.

5 Command Reference

List of commands supported is listed below.

More information:

- A multi-byte parameter should be converted to a list of bytes, which is input by decimal number 0-255.
- The input parameter is LSB first. For example: “alarm 10 0 0 0” is the command to set the alarm to 10 seconds.

Table 1 List of synchronous commands and responses

Name	Code	Description	Input	Output
GetEvent	0x00	Retrieve pending events		type[1], count[1], eventdata[n]
GetVersion	0x01	Get bootloader + firmware version		bootversion[4], firmwareversion
Reset	0x02	Reset modem		
FactoryReset	0x03	Perform modem factory reset		
Firmware	0x04	Write firmware update	part[4+128]	
GetTime	0x05	Get GPS wall time		timestamp[4]
SetAlarm	0x06	Set alarm / wakeup timer	seconds[4]	
GetTrace	0x07	Get diagnostic crash log		backtrace log[n]
GetPin	0x08	Get device registration PIN		PIN[4]
GetChipEui	0x09	Get device chip EUI		ChipEUI[8]
GetJoinEui	0x0A	Get join EUI		JoinEUI[8]
SetJoinEui	0x0B	Set join EUI and derive keys	JoinEUI[8]	
GetDevEui	0x0C	Get device EUI		DeviceEUI[8]
SetDevEui	0x0D	Set device EUI and derive keys	DeviceEUI[8]	
SetAppKey	0x0E	Set application key	Appkey[16]	
SetNwkKey	0x0F	Set network key	NwkKey[16]	
GetInterval	0x12	Get DM reporting interval		interval[1]
SetInterval	0x13	Set DM reporting interval	interval[1]	
GetRegion	0x14	Get regulatory region		region[1]
SetRegion	0x15	Set regulatory region	region[1]	
GetProfile	0x16	Get ADR profile		type[1]

SetProfile	0x17	Set ADR profile and optional parameters	type[1]+list[16]*	
Join	0x18	Start (re-)joining the network		
RequestTx	0x19	Transmit frame unconfirmed	port[1], data[n]	
UploadInit	0x1A	Set file upload port, encryption mode, size	p[1],en[1],sz[2]	
UploadData	0x1B	Write data for file upload transmission	data[n]	
StreamInit	0x1C	Set data stream parameters	param[2-5]	
EmergencyTx	0x1D	Transmit frame immediately (smoke alarm)	port[1], data[n]	
GetCharge	0x1E	Get accumulated charge counter		charge[4]
GetMaxPayload	0x1F	Get max payload size		size[1]
SetClass	0x20	Set LoRaWAN class A/C	class[1]	
SetMulticast	0x21	Set multicast session parameters	param[40]	
SetTxPowOff	0x22	Set TX power correction offset	offset[1]	
GetDmPort	0x23	Get DM port		port[1]
SetDmPort	0x24	Set DM port	port[1]	
DmStatus	0x25	Send DM status now	inflist[n]	
GetStatus	0x26	Get modem status		status[1]
Suspend	0x27	Suspend/Resume radio operations	suspend[1]	
SetDmInfo	0x28	Set default info for DM status	inflist[n]	
StreamData	0x29	Send data stream record	port[1]+record[n]	
GetClass	0x2A	Get the LoRaWAN device class		class[1]
ListRegions	0x2B	List the supported regulatory regions		regions[1:5]
GetTxPowOff	0x2C	Get power correction offset		offset[1]
GetDmInfo	0x2D	Get default info fields for DM status		inflist[n]
SetAppStatus	0x2E	Set application-specific status for DM	appstatus[8]	
StreamStatus	0x2F	Retrieve stream status	port[1]	pending[2]+free[2]
Test	0x32	Radio test functions (Not Implement Yet)		

The Modem could send an asynchronous event to the application MCU, which is also displayed on the terminal.

Table 2 List of the events

Event	Code	Description	Output
Reset	0x00	Modem has been reset	reset count[2]
Alarm	0x01	Alarm timer expired	
Joined	0x02	Network successfully joined	
TxDone	0x03	Frame transmitted	Status[1]
DownData	0x04	Downlink data received	port[1], downdata[n]
UploadDone	0x05	File upload completed	Status[1]
SetConf	0x06	Config has been changed by DM	Info tag[1]
Mute	0x07	Modem has been muted or unmuted by DM	Mute[1]
StreamDone	0x08	Data Stream Fragments Sent	

Important Notice

Information relating to this product and the application or design described herein is believed to be reliable, however such information is provided as a guide only and Semtech assumes no liability for any errors in this document, or for the application or design described herein. Semtech reserves the right to make changes to the product or this document at any time without notice. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. Semtech warrants performance of its products to the specifications applicable at the time of sale, and all sales are made in accordance with Semtech's standard terms and conditions of sale.

SEMTECH PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS, OR IN NUCLEAR APPLICATIONS IN WHICH THE FAILURE COULD BE REASONABLY EXPECTED TO RESULT IN PERSONAL INJURY, LOSS OF LIFE OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. INCLUSION OF SEMTECH PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE UNDERTAKEN SOLELY AT THE CUSTOMER'S OWN RISK. Should a customer purchase or use Semtech products for any such unauthorized application, the customer shall indemnify and hold Semtech and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs damages and attorney fees which could arise.

The Semtech name and logo are registered trademarks of the Semtech Corporation. All other trademarks and trade names mentioned may be marks and names of Semtech or their respective companies. Semtech reserves the right to make changes to, or discontinue any products described in this document without further notice. Semtech makes no warranty, representation or guarantee, express or implied, regarding the suitability of its products for any particular purpose. All rights reserved.

Contact Information

Semtech Corporation

Wireless & Sensing Products

200 Flynn Road, Camarillo, CA 93012

E-mail: sales@semtech.com

Phone: (805) 498-2111, Fax: (805) 498-3804
www.semtech.com