

z051 USB GNSS Dongle with PPS*

Navigation & Timing



Starter Kit

Installation Guide

** The **Pulse Per Second (PPS)** is an electrical signal that very precisely indicates the start of a second. The z051 GNSS chipset delivers the PPS signal with an accuracy ± 20 nanoseconds.*

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Revision 3

Product Overview

The z051 USB dongle provides a GNSS receiver from an USB port and a **PPS timing output**. The z051 unit is based on a GNSS receiver from u-blox with 72-channel whose 32-channel continuous tracking and high sensitivity (tracking -167dBm GPS & Glonass).

This dongle receives and tracks multiple GNSS systems: GPS, Galileo, Glonass and BeiDou. Owing to the dual-frequency RF front-end architecture, either Glonass or BeiDou can be processed concurrently with GPS and Galileo signals providing reception of three GNSS systems according to the permissible combinations shown below (* = enabled):

GPS	Galileo	Glonass	BeiDou
*	*	-	-
*	*	*	-
*	*	-	*
*	-	*	-
*	-	-	*
-	*	*	-
-	*	-	*
-	-	*	*

- ⇒ The augmentation systems SBAS and QZSS can be enabled only if GPS operation is configured.
- ⇒ **The z051 product is configured by default with GPS, Glonass and Galileo.**

With its higher sensitivity, performance and faster startup times, the z051 module is a complete GNSS receiver that generates position fixes with high accuracy in extremely challenging environments and under poor signal conditions (down to -167 dBm), velocity and time data with leading edge acquisition times. In addition, the GNSS receiver provides a configurable 1 PPS synchronized to GPS/UTC, typically within 20 nanoseconds (one sigma) at chipset level and an update rate up to 4 Hz.

The z051 dongle optionally supports Satellite-Based Augmentation System (SBAS), including the U.S. Wide Area Augmentation System (WAAS), the European Geostationary Overlay Service (EGNOS), MSAS in Japan and GAGAN in India. Assisted GNSS (A-GNSS) is also supported.

Key Features

- u-blox M8 concurrent GNSS timing chipset
- Concurrent reception of GPS/QZSS, GLONASS, BeiDou and Galileo
- Market leading acquisition and tracking sensitivity
- Optimized accuracy and availability with survey-in and single-satellite timing
- Maximized reliability with integrity monitoring and alarms
- Assisted GNSS (AssistNow Online and Offline from u-blox, AssistNow Autonomous)
- Satellite-Based Augmentation System (SBAS): WAAS (US), EGNOS (Europe), MSAS (Japan) and GAGAN (India) and QZSS for the Pacific region covering Japan and Australia

- Max navigation update rate: 4 Hz (GPS & Glonass, GPS & Beidou), 10 Hz (GPS, Glonass, BeiDou, Galileo)
- Protocols: NMEA, UBX binary, RTCM
- **PPS timing output**
- **Built in GNSS Ceramic Patch Antenna** or use of an external active GNSS antenna
- Compact Design with a size of a USB key (USB 2.0 Interface)
- Suitable for Laptop, Desktop, Mobile Device, UMPC, Eee PC, Notebooks and Netbooks
- RoHS Compliance

Use with built-in GNSS Antenna	Use with external GNSS Antenna
	

Note: ZTI Communications is not responsible for the operation or failure of operation of GNSS satellites or the availability of GNSS satellite signals.

GNSS Performance Specifications

GNSS performance statistics are clear view, stationary. Sensitivity based on signals measured at the antenna.

Parameter	Value	
Receiver type	72-channel u-blox M8 engine GPS L1 C/A, QZSS L1C/A, QZSS L1SAIF, GLONASS L1OF, BeiDou B1, Galileo E1-B/C SBAS: WAAS (US), EGNOS (Europe), MSAS (Japan), GAGAN (India)	
Navigation Update Rate	Concurrent GNSS: up to 4 Hz, 1 Hz (default) GPS, Glonass, BeiDou, Galileo: up to 10 Hz	
Position Accuracy	2.5 m CEP (Autonomous) 2.0 m (SBAS)	
Acquisition time	GPS & Glonass	GPS & BeiDou
Cold starts:	25 s	28 s
Aided cold starts:	2 s	2 s
Sensitivity	GPS & Glonass	GPS & BeiDou
Tracking & Navigation:	-167 dBm	-166 dBm
Cold start (aided):	-157 dBm	-157 dBm
Cold start (autonomous):	-148 dBm	-148 dBm
Reacquisition:	-160 dBm	-160 dBm
Anti jamming	Active CW detection and removal; on-board SAW band pass filter	
Memory	Internal SQI flash for firmware update	
Timing Accuracy	≤ 20 ns Clear Sky ≤ 500 ns Indoor	
Time Pulse Frequency	0.25 Hz – 10 MHz, 1 Hz (default)	
Time-pulse jitter	±11 ns	
Integrity reports	RAIM active, phase uncertainty Time-pulse rate/duty-cycle	
Protocols	NMEA, UBX binary, RTCM	
Operational limits	Dynamics	≤4g
	Altitude	50,000 m
	Velocity	500 m/s

GNSS Communication Parameters

GNSS output is available from the USB Interface. The output adheres to NMEA 0183 protocol V4.1 with the following characteristics.

Parameter	Value(s)
Protocol	NMEA 0183, version 2.3 or 4.0 or 4.1 configurable V4.1 selected for the z051 dongle
Baud Rate	
Default	57600
Other	4800, 9600, 19200, 38400, 115200, 230400, 460800

Message Output Rate	1 Hz (Up to 4 Hz)
Number of message types restricted by Baud Rate	

NMEA 0183 Messages

Message	Description
DTM	Datum Reference
GBQ	Poll a standard message (if BeiDou)
GBS	Satellite Fault Detection
GGA	Global positioning system fix data
GLL	Latitude and longitude, with time of position fix and status
GLQ	Poll a standard message (if Glonass)
GNQ	Poll a standard message (if any combination of GNSS)
GNS	GNSS fix data
GPQ	Poll a standard message (if GPS, SBAS, QZSS)
GRS	GNSS Range Residuals
GSA	GNSS DOP and Active Satellites
GST	GNSS Pseudo Range Error Statistics
GSV	GNSS satellites in view
RMC	Recommended minimum data
TXT	Text Transmission
VLW	Dual ground/water distance
VTG	Course over ground and Ground speed
ZDA	Time and date

⇒ NMEA messages V4.1 configured for the z051 dongle: GGA, GSV, GSA, VTG, RMC and ZDA

Mechanical and Environmental

Dimensions (including USB connector)	78.3mm L x 22.3mm W x 14.1mm H
High Speed USB 2.0 (480 Mbit/s)	USB A-type Male Plug for connection to a USB host or Hub port. The maximum cable length is 5 meters according to the USB 2.0 specification.
External Aerial Connector	MCX
Operating Temperature	-40°C to +85°C
Storage Temperature	-40°C to +85°C
Humidity	5% to 95% non-condensing @ 60°C
Weight	20g
Warranty	1-Year
Environmental	RoHS compliant (lead-free)
Power	Voltage DC 5V via USB port, Current < 55mA (tracking)

Use and care

The z051 USB GNSS dongle is a high-precision electronic instrument and should be treated with reasonable care.

Technical assistance

If you have a problem and cannot find the information you need in the documentation, please contact ZTI Communications Technical Assistance Center:

- Phone: +33 2 9613 4003
- Email support@zti-communications.com

System Requirements

Hardware

- z051 USB GNSS Dongle with USB extension cable (recommended)
- Optional: GNSS patch antenna 26dB with MCX connector

Computer

- Computer running Windows operating system (10, Seven, Vista) or MAC OS X or Windows CE or Linux.

Software

- u-center from u-blox: this software is used to monitor the GNSS performance of the z051 USB GNSS dongle and to change its settings. The software is compatible with Microsoft Windows Vista up to and including Windows 10. Please refer to the u-center documentation provided on the CD-ROM with the starter kit.
- Time Service Software (TSS-P for z051) from ZTI Communications: compatible with Windows Seven, 8 and Win10. The software is used to update the clock of the computer with a guaranteed accuracy of 1 millisecond. Please consult the CD-ROM documentation provided with the starter kit.

z051 Starter Kit

The starter kit is composed of several items:

z051 Timing & Navigation / USB GNSS Dongle with PPS



USB Extension Cable



GNSS Patch antenna with 5m cable and MCX connector

CD-ROM (Software & Documentation)
with Windows **TSS-P for z051** software – single license
(TSS-P for z051 = Time Service Software updates the PC
clock with **1 millisecond guaranteed accuracy**)



Setting up the z051 Starter Kit

1. We recommend to not directly plug the z051 USB GNSS dongle into the USB port of the target machine, but to plug first the USB extension cable and then the USB GNSS dongle. Directly plug-in the USB GNSS Dongle into the USB port may degrade GNSS performance due to RF interference from your equipment.

Four configurations are possible depending on the conditions of GNSS signal reception (indoor or outdoor use). For indoor use, we recommend placing the GNSS dongle or the external GNSS patch antenna near a window with a clear view of the sky.

Configuration #1	Configuration #2
<p>USB Dongle connected directly to the equipment (use of the Built in GNSS Ceramic Patch Antenna)</p>  <p><i>Note: GNSS performance degradation due to RF interference from the laptop</i></p>	<p>USB Dongle + USB extension cable connected to the equipment (use of the Built in GNSS Ceramic Patch Antenna)</p>  <p><i>Note: configuration recommended for use without the external GNSS patch antenna</i></p>
Configuration #3	Configuration #4
<p>External GNSS patch antenna + USB Dongle connected directly to the equipment</p> 	<p>External GNSS patch antenna + USB Dongle + USB extension cable connected to the equipment</p>  <p><i>Note: optimal configuration for receiving GNSS signals</i></p>

2. Use one of the configurations described above with the GNSS USB dongle, and then install the USB driver by using the CD-ROM software of the starter kit if the operating system doesn't install automatically the FTDI driver.

When the USB dongle is connected to your equipment (desktop, laptop, netbook, UMPC ...), a virtual serial port is available after installation of the driver by the operating system - for example: USB Serial Port (Com x).

For most of the operating systems two types of driver are available: Virtual COM Port (VCP) drivers and direct (D2XX) drivers.

- The VCP driver emulates a standard PC serial port such that the USB device may be communicated with as a standard RS232 device. Virtual COM port (VCP) drivers cause the USB device to appear as an additional COM port available to the PC. Application software can access the USB device in the same way as it would access a standard COM port.
- The D2XX driver allows direct access to the USB device via a DLL interface. Application software can access the USB device through a series of DLL function calls.

VCP drivers currently supported:

- Windows 7, Windows Server 2008 R2 and Windows 8, 8.1, Windows server 2012 R2, Windows Server 2016 and Windows 10.
- Linux (VCP driver is integrated in the kernel)
- Mac OS X 10.3 to 10.8
- Mac OS X 10.9 and above
- Windows CE 4.2-5.2: includes the following versions of Windows CE 4.2-5.2 based operating systems: Windows Mobile 2003, Windows Mobile 2003 SE, Windows Mobile 5, Windows Mobile 6, Windows Mobile 6.1, Windows Mobile 6.5
- Windows CE 6.0/7.0
- Windows CE 2013

D2XX direct drivers currently supported:

- Windows 7, Windows Server 2008 R2 and Windows 8, 8.1, Windows server 2012 R2, Windows Server 2016 and Windows 10.
- Windows RT (x86-32 & ARM)
- Linux
- Mac OS X 10.4 Tiger or later
- Windows CE 4.2-5.2: includes the following versions of Windows CE 4.2-5.2 based operating systems: Windows Mobile 2003, Windows Mobile 2003 SE, Windows Mobile 5, Windows Mobile 6, Windows Mobile 6.1, Windows Mobile 6.5
- Windows CE 6.0/7.0
- Windows CE 2013
- Android (Java D2XX)

The USB dongle contains a USB to serial UART interface and the PPS signal provided by the GNSS chipset is connected internally to pin 8 (CTS). So, the PPS signal delivered by the USB dongle is available by using the CTS signal on the virtual com port used.

Please refer to the documentation in the CD-ROM to install if needed the FTDI driver related to your operating system (XP, 2000, Vista or Seven) or visit <http://www.ftdichip.com/Drivers/VCP.htm> (FTDI Drivers) and <http://www.ftdichip.com/Support/Documents/InstallGuides.htm> (installation guides) for more information (FTDI chipset: FT232R).

3. Once the FTDI driver is installed, you can check that the GNSS dongle is operational by using the u-center application from u-blox.

Using the u-center application to monitor the z051 USB GNSS Dongle

Configuration by default for the z051 USB GNSS Dongle:

- Baud Rate: 57600, N, 8, 1
- PPS Pulse Width: 100 ms
- Update rate: 1Hz
- NMEA messages:
 - GGA (Global positioning system fix data)
 - GSV (GNSS satellites in view)
 - GSA (GNSS DOP and Active Satellites)
 - VTG (Course over ground and Ground speed)
 - RMC (Recommended minimum data)
 - ZDA (Time and Date)

The CD-ROM provided with the z051 Starter kit contains the directory "u-center" with the following files:

- u-center_vX.XX.exe (GNSS evaluation software for Windows)
- u-center_UserGuide.pdf (User Guide for the u-center software)

Install first the u-center software. Be sure to have the USB GNSS dongle plugged in before launching the software.

To start the u-center application, double-click the icon in the folder where the application is stored. The main u-center window opens.

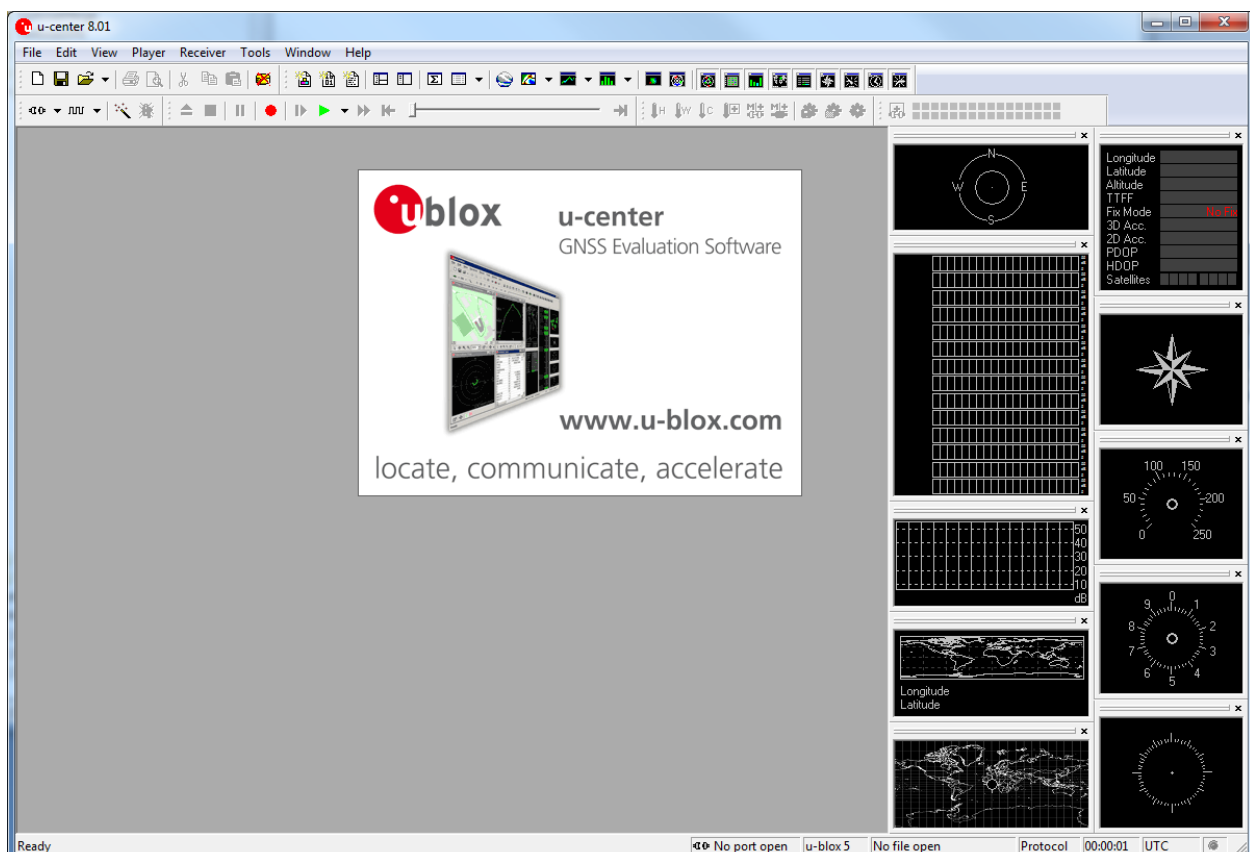
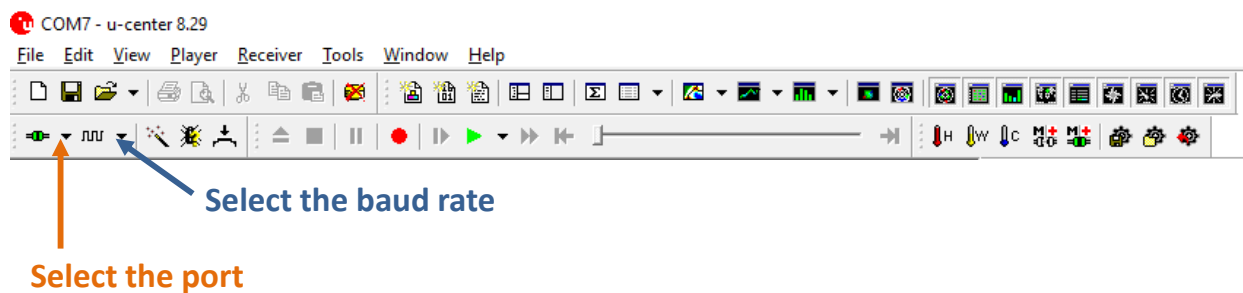


Figure 1: Start display

Connecting u-center to the z051 GNSS dongle



Select the port

Locate the communication toolbar (Figure 2) and click on the arrow beside the icon. This will show a list with all available COM ports (Figure 3).

Select the corresponding COM port where the receiver is connected. If a link could be established, the icon will turn green and the text in the status bar changes from "No port open" to "Com X 9600".

This does not mean that the communication already works but only that the port could be opened.

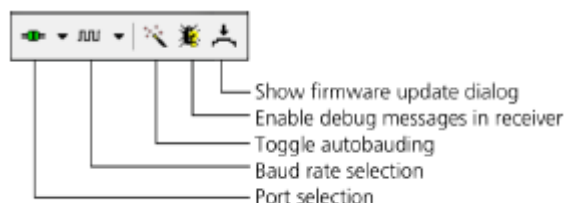


Figure 2: Communication Toolbar

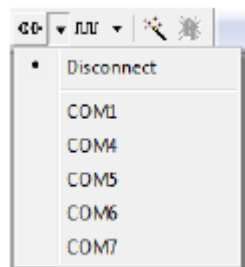



Figure 3: List of available COM ports

Select the baud rate (only for COM ports)

Again in the communication toolbar, click on the arrow beside the  icon.

This will show a list with all available baud rates (Figure 4). Select the correct baud rate on which the z051 USB dongle is communicating (57'600 baud).

If u-center is able to decode data from the GNSS receiver of the z051 dongle, the status bar begins to blink in green. This means that the connection is established successfully and the communication between the z051 dongle and u-center is working.

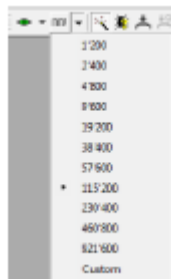
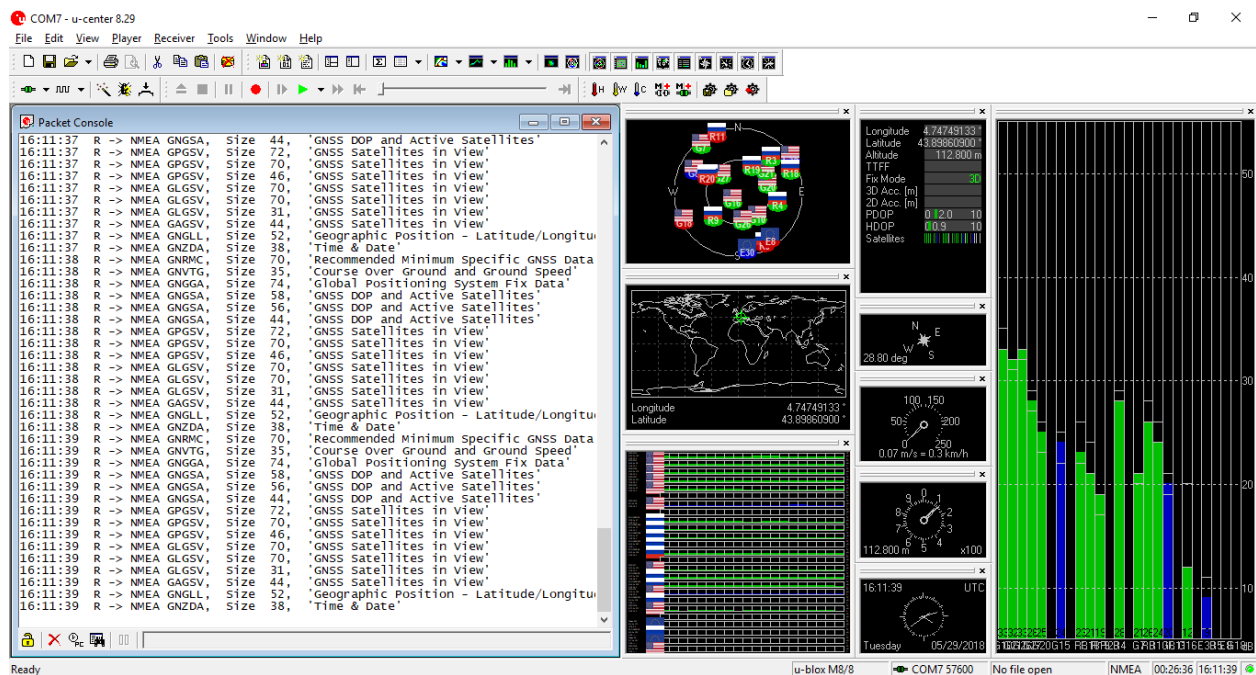


Figure 4: List of available baud rates

Now you are ready to use the z051 GNSS receiver.



*Example with GNSS satellites in view
(z051 indoor with external GNSS antenna near a window facing South-East)*

Please refer to the u-center User Guide for more information.

TSS-P Software

High Precision **Time Service Software (TSS-P for z051)** software provides accurate time synchronization and updates automatically the PC clock.

Synchronized to GPS/UTC (typically 25 ns) with the PPS signal delivered by the z051 USB GNSS dongle, **TSS-P for z051** delivers a guaranteed accuracy of 1 millisecond thanks to sophisticated calculations and corrections algorithms developed by ZTI Communications.

PC clock is updated by TSS-P for z051 if the PC is not set to automatically synchronize with an Internet time server.

TSS-P for z051 is compatible with Windows Seven, 8 and 10 (32 or 64-bit platforms).

To install the software included on the CD-ROM, launch the TSS-P setup procedure and refer to TSS-P for z051 User Guide for more information.

TSS-P for z051

Configuration
This application updates local PC date and time by using UTC date and time provided by your GNSS unit. To use it, you should specify first the communication port where the GNSS unit is plugged in.

Port for the GNSS Unit:


Current Time Zone:


Internet Time Server:


Last Windows Clock Update:


Status Legend

Current Status

 The GNSS unit synchronizes the local PC date and time with a guaranteed accuracy of 1 millisecond

 Waiting for GNSS synchronization or the accuracy of 1 millisecond can't be guaranteed.

 No GNSS unit available

 The PC is automatically synchronized with an Internet time server. TSS-P for z051 can't update the date and time of the local PC.

Information provided by the GNSS Unit

Satellite Information

Satellite	Level C/No (dB:1Hz)
(E27)	31.00
(G12)	39.00
(G14)	20.00
(G19)	25.00
(G2)	28.00
(G24)	27.00
(G25)	31.00
(G29)	35.00
(G31)	25.00
(G32)	21.00
(G6)	21.00

GNSS Information

Latitude	Longitude	Altitude	Speed
43° 53.91376' N	4° 44.84987' E	62.60	0
(Sexagesimal unit)		(meters)	(Km/h)

Date and Time

UTC (Universal Time Coordinated):

PC Clock with the Time Zone:

GNSS Unit Feature

☒ Baud Rate: 57600 - Receiving NMEA messages

Using the z051 USB GNSS Dongle with Linux

Linux driver installation and checking

Installation of the Linux driver

The z051 USB dongle embeds a FTDI chipset to output NMEA messages and PPS information to the USB interface. The FTDI driver is included in the recent Linux kernels. Answer to your questions about the Linux kernel and the FTDI chipset driver might be located at <http://ftdi-usb-sio.sourceforge.net/>


When you plug the z051 USB dongle, a `/dev/ttyUSBxx` should be automatically setup.

The Linux command `dmesg | grep -i ftdi` gives you the `tttyUSBxx` device description allocated to the GNSS receiver.

Checking the z051

As far as you know the `tttyUSBxx` description, you might get the NMEA messages through a terminal emulator like `minicom`.

Assuming the z051 got the `/dev/ttyUSB0`, the `minicom` configuration looks like the following:



```
+-----+
| A -   Serial Device       : /dev/ttyUSB0 |
| B -   Lockfile Location   : /var/lock    |
| C -   Callin Program      :              |
| D -   Callout Program     :              |
| E -   Bps/Par/Bits        : 9600 8N1     |
| F -   Hardware Flow Control : No         |
| G -   Software Flow Control : No         |
|                                     |
|   Change which setting?           |
+-----+
| Screen and keyboard |
| Save setup as dfl   |
| Save setup as ..    |
| Exit                |
| Exit from Minicom   |
+-----+
```

Next figure shows z051 NMEA frames, captured from the `minicom` user interface:


```

zticom@zticom-Precision-T5600 ~
$GPGSV,2,2,06,86,18,280,31,,,,,36*59
$GNGLL,4631.08942,N,00146.50534,W,165720.00,A,A*61
$GNZDA,165720.00,30,05,2018,00,00*72
$GNRMC,165721.00,A,4631.08950,N,00146.50535,W,0.061,,300518,,,A*73
$GNVTG,,T,,M,0.061,N,0.114,K,A*3E
$GNGGA,165721.00,4631.08950,N,00146.50535,W,1,11,2.04,12.6,M,48.5,M,,*6D
$GNGSA,A,3,20,27,08,07,30,21,,,,,,2.50,2.04,1.45*15
$GNGSA,A,3,76,85,69,84,86,,,,,,2.50,2.04,1.45*1C
$GPGSV,2,1,06,07,16,295,44,08,48,300,42,20,34,057,37,21,22,062,33*77
$GPGSV,2,2,06,27,81,029,38,30,09,321,33*79
$GPGSV,2,1,06,69,39,075,30,76,32,313,36,84,37,063,31,85,62,331,38*6C
$GPGSV,2,2,06,86,18,280,31,,,,,36*59
$GNGLL,4631.08950,N,00146.50535,W,165721.00,A,A*62
$GNZDA,165721.00,30,05,2018,00,00*73
$GNRMC,165722.00,A,4631.08960,N,00146.50535,W,0.065,,300518,,,A*77
$GNVTG,,T,,M,0.065,N,0.120,K,A*3D
$GNGGA,165722.00,4631.08960,N,00146.50535,W,1,11,2.04,12.7,M,48.5,M,,*6C
$GNGSA,A,3,20,27,08,07,30,21,,,,,,2.50,2.04,1.45*15
$GNGSA,A,3,76,85,69,84,86,,,,,,2.50,2.04,1.45*1C
$GPGSV,2,1,06,07,16,295,44,08,48,300,42,20,34,057,37,21,22,062,33*77
$GPGSV,2,2,06,27,81,029,38,30,09,321,33*79
$GPGSV,2,1,06,69,39,075,30,76,32,313,36,84,37,063,32,85,62,331,38*6F
$GPGSV,2,2,06,86,18,280,31,,,,,36*59
$GNGLL,4631.08960,N,00146.50535,W,165722.00,A,A*62
$GNZDA,165722.00,30,05,2018,00,00*70
$GNRMC,165723.00,A,4631.08966,N,00146.50535,W,0.066,,300518,,,A*73
$GNVTG,,T,,M,0.066,N,0.122,K,A*3C
$GNGGA,165723.00,4631.08966,N,00146.50535,W,1,11,2.04,12.8,M,48.5,M,,*64
$GNGSA,A,3,20,27,08,07,30,21,,,,,,2.50,2.04,1.45*15
$GNGSA,A,3,76,85,69,84,86,,,,,,2.50,2.04,1.45*1C
$GPGSV,2,1,06,07,16,295,43,08,48,300,42,20,34,057,37,21,22,062,33*70
$GPGSV,2,2,06,27,81,029,38,30,09,321,33*79
$GPGSV,2,1,06,69,39,075,31,76,32,313,36,84,37,063,32,85,62,331,38*6E
$GPGSV,2,2,06,86,18,280,31,,,,,36*59
$GNGLL,4631.08966,N,00146.50535,W,165723.00,A,A*65
$GNZDA,165723.00,30,05,2018,00,00*71
$GNRMC,165724.00,A,4631.08972,N,00146.50536,W,0.067,,300518,,,A*73
$GNVTG,,T,,M,0.067,N,0.124,K,A*3B
$GNGGA,165724.00,4631.08972,N,00146.50536,W,1,11,2.04,12.8,M,48.5,M,,*65
$GNGSA,A,3,20,27,08,07,30,21,,,,,,2.50,2.04,1.45*15
$GNGSA,A,3,76,85,69,84,86,,,,,,2.50,2.04,1.45*1C
$GPGSV,2,1,06,07,16,295,43,08,48,300,42,20,34,057,37,21,22,062,33*70
$GPGSV,2,2,06,27,81,029,38,30,09,321,33*79
$GPGSV,2,1,06,69,39,075,31,76,32,313,35,84,37,063,32,85,62,331,38*6D
$GPGSV,2,2,06,86,18,280,31,,,,,36*59
$GNGLL,4631.08972,N,00146.50536,W,165724.00,A,A*64
$GNZDA,165724.00,30,05,2018,00,00*76

```

CTRL-A Z for help | 9600 8N1 | NOR | Minicom 2.7 | VT102 | Offline | ttyUSB0

Software

Updating the local clock using a z051 GNSS receiver is often based on the `gpsd` and `nptd` Linux daemons. Next paragraphs give hints about the download and installation for these daemons.

GPSD daemon

`gpsd` software can be downloaded through you Linux update system e.g. `apt-get` or the source code from <http://download-mirror.savannah.gnu.org/releases/gpsd/>

Installation of gpsd is detailed at <http://www.catb.org/gpsd/installation.html>

Note that the --enable-pps-cts configure option should be activated. If this is not the case in your installation, you have to download the source code and recompile it accordingly.

The options for gpsd can be found at <http://gpsd.berlios.de/gpsd.html> where you may read a paragraph "Use with NTP" describing the interface between gpsd and ntpd that includes details about the ntp.conf instruction for the dialog with gpsd.

NTPD daemon

ntpd software is available with most of Linux distributions. It can be downloaded from the update repository of your distribution or the source code from <http://www.eecis.udel.edu/~mills/ntp/html/index.html>

PPS signal (Pulse Per Second)

The z051 GNSS receiver is outputting a PPS signal as RS232 CTS signal emulation.

By default configuration, the PPS is delivered when the GNSS receiver of the z051 dongle has 3Dfix state i.e. enough satellites to insure the best accuracy.