Evaluation Kit

GPS/GLONASS/GALILEO

NV08C-CSM Receiver

NV08C-EVK-CSM

User Guide

Version 1.3

Revision History

Revision ID	Date	Description
1.0	Feb, 2011	First release
1.1	Mar, 2011	Electrical schematic (X14 jumper position), chapter 3.2 and Table 2 modified
1.2	Mar, 2011	Table 2 and Figure 4 (X22 jumper) modified
1.3	November, 2013	Table 3. User settings (GPIO7 description) updated. Section 1.6 updated concerning active antenna power supply.

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1. Device Overview

Evaluation Kit NV08C-EVK-CSM (referred in this document as EVK-CSM later on) is a set of instruments for a developer of systems based on NV08C-CSM module. Use of EVK-CSM is a convenient way to learn functionality of NV08C-CSM and start the system design quickly.

The EVK-CSM may be used in navigation systems to obtain the current position (latitude, longitude and elevation), velocity vector and time from the signals of global navigation systems (GNSS) GPS, GLONASS, GALILEO and SBAS in any location on Earth and at any time.

The EVK-CSM is a flexible tool that allows users to evaluate various modes of operation of the NV08C-CSM and to override a default configuration and connection diagram with jumpers. Connectors and jumpers on EVK-CSM PCB provide simple monitoring of intermediate signals and parameters (digital IOs state, power supply voltages and currents on individual supply inputs).

1.1. Navigation Related Features

Table 1 describes navigation features and parameters of EVK-CSM.

Table 1. Navigation features and parameters of EVK-CSM

Parameter	Description
Supported signals	▪ L1 GLONASS ST code ▪ L1 GPS/SBAS C/A code ▪ L1 GALILEO OS Data+Pilot
Number of channels	32 universal channels
Time to first fix	Cold start – 30 s (average) Warm start – 30 s (average) Hot start – 3 s (average)
Sensitivity	Cold start -143 dBm A-GNSS mode -160 dBm Tracking mode -160 dBm
Accuracy (CEP)	Autonomous mode – 2.5 m SBAS mode – 2.0 m DGNSS mode – 1.0 m Velocity – 0.05 m/s
Assisted GNSS	Supported
1PPS accuracy	15 ns (RMS), 38.5ns granularity
Navigation output rate	up to 10 Hz
Usage Restrictions	Speed – up to 500 m/s (1000 knots) Acceleration – up to 5 g Elevation – up to 18 000 m

Notes:

1. *Navigation parameters are shown for application with an external active antenna GLONASS+GPS in «Open sky» mode with input signal level -135 dBm.*
2. *Detailed parameters are provided in the NV08C-CSM Datasheet.*

1.2. Package Contents

EVK-CSM package contains:

- NV08C-CSM PCB assembly in aluminum housing
- Active GPS&GLONASS Antenna
- Mini-USB cable
- USB memory stick with user software, the NV08C-CSM datasheet and the EVK-CSM User Guide (this document)
- Packaging

1.3. External connectors and indicators

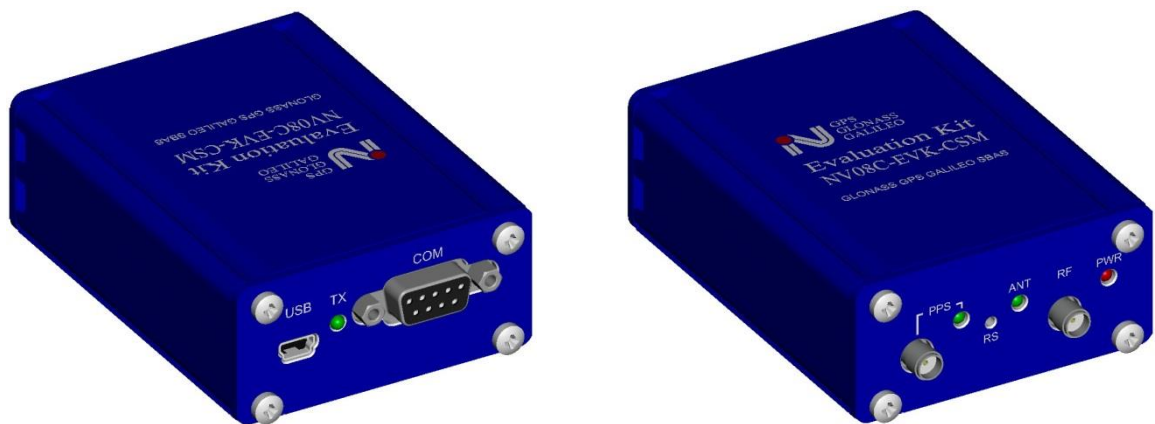**Figure 1** shows the EVK-CSM housing front and rear views.

Figure 1. EVK-CSM Front and Back panels

EVK-CSM's External connectors and indicators:

- **RF** SMA connector – active antenna connector
- **PPS** SMA connector – PPS output
- **USB** port:
    - EVK-CSM power supply
    - Data I/O from UART A of NV08C-CSM module
- **COM** port (DRB-9F type):
    - Data I/O from UART B of NV08C-CSM module
- **PWR** LED – receiver's power indicator (red LED)
- **PPS** LED – PPS output (flashing indicator)
- **ANT** LED – indicates connection of active antenna with current consumption above 1.1 mA
- **TX** LED – USB data transfer in progress (blinking indicator)
- **RS** button – asserts a Reset signal to the CSM receiver. After reset the EVK-CSM comes up with default configuration or settings that are previously set and stored by the user. Data in non-volatile memory remains intact.

1.4. Functional Specification

General functional diagram of EVK-CSM is illustrated on **Figure 2**.

EVK-CSM board contains:

- NV08C-CSM module
- LDO based DC/DC power supply unit
- EDLC capacitor for VBAT power
- RF connectors for an active antennas and for 1PPS output signal
- RS-232 interface with D-SUB 9 connector
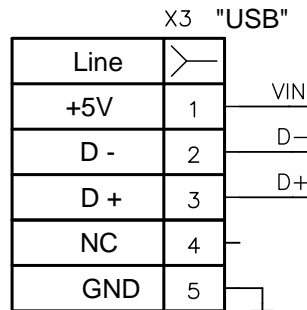- USB port with Mini-USB connector
- Reset button
- Jumpers
- LEDs
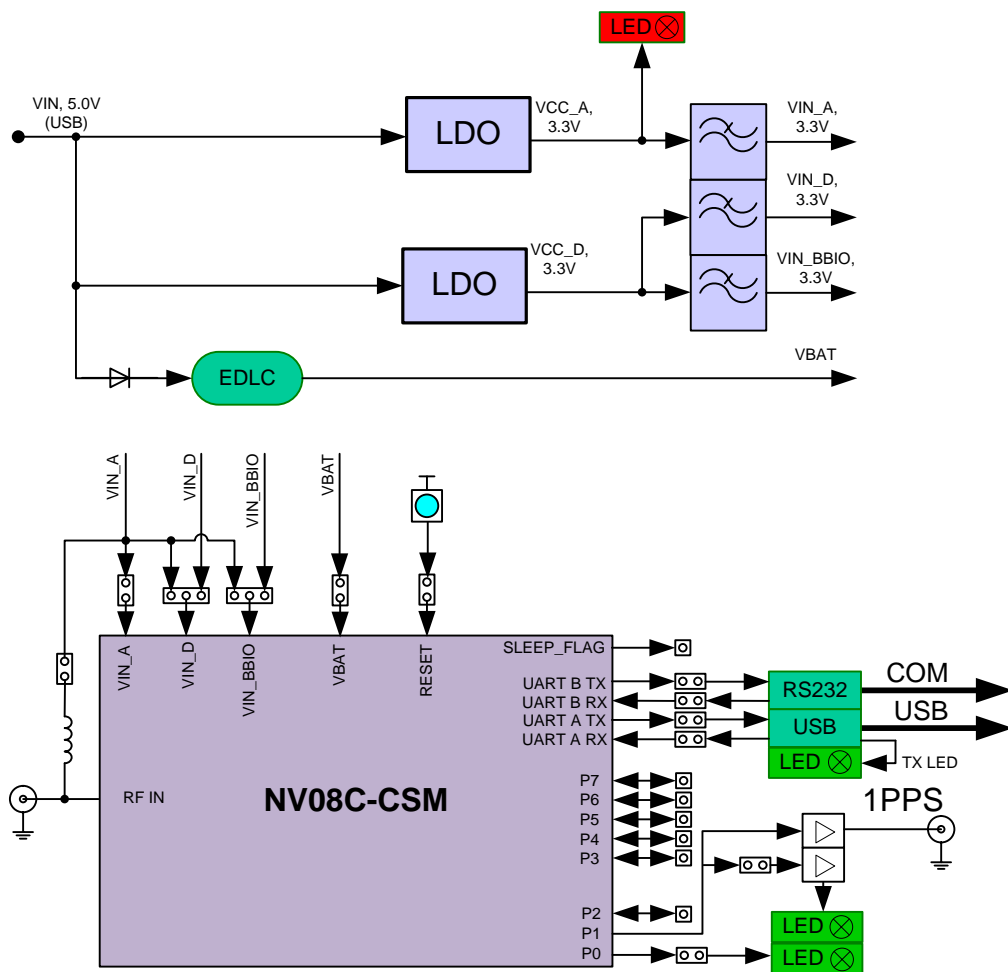
Figure 2. Functional Diagram of EVK-CSM

1.5. Power Supply

EVK-CSM Power Supply is provided via Mini-USB connector. EVK-CSM can be powered by:

- Standard USB-port of a user's device

- External power supply via pin#1 (VCC) and pin#5 (GND) of Mini-USB connector (see. Figure 3).

X3 "USB"

Line		
+5V	1	VIN
D -	2	D−
D +	3	D+
NC	4	
GND	5	

Figure 3. USB Pinout

Input voltage should be from 3.5V to 5.5V in this case. Voltage ripple should not exceed 100 mV. While selecting an external power supply unit the current consumption of the following components have to be accounted: the NV08C-CSM's current is 80 mA max; the EVK-CSM ICs current is 100mA max; the current of active antenna provided through EVK-CSM. The active antenna included in the EVK-CSM package draws 20mA max.

EVK-CSM contains a automatically chargeable capacitor (EDLC) which is used as back-up power source for real time clock (RTC) and Back-up RAM in case of main power is switched off. Back-up power is necessary to provide Warm start and store user configuration of EVK-CSM.

1.6. Recommended Antennas

Evaluation Kit EVK-CSM has an input for external active antenna connection («RF» SMA connector located on the EVK-CSM front panel).

Active antenna supply voltage is provided from LDO DA1. The voltage is 3.3V (nom). **ANT LED is not active in this configuration (not lighting).**

User may also modify EVK-CSM such that the power for active antenna is provided by NV08C-CSM module. The power supply voltage in this case is 2.7V (nom). To achieve this function, a C2 20pF capacitor shall be replaced with a 0402 zero Ohm resistor and jumper X6 shall be removed. The maximum antenna current in this configuration is limited by automatic short protection to 57 mA. A built-in current sensor detects if an active antenna is connected. If the current $I_{ANTBIAS}$ exceeds 1.1 mA, then the active antenna is deemed connected and the output P0/ANTFLAG is driven high (**ANT LED is lighting**).

In order to choose an appropriate antenna the following aspects shall be taken into account. An antenna with a high gain and a wide passband may reduce the quality of signal reception due to in-band and out of band interference. However, an antenna with a low gain (or high attenuation in the cable) may decrease module's sensitivity.

Recommended parameters for an active antenna:
- GLONASS & GPS L1, fc = 1590Mhz @ 35 MHz passband;
- Gain including cable attenuation 20±2dB;
- Noise figure of the antenna < 2 dB;
- Out of band signals suppression: no less than 35dB @ fc ± 70 Mhz.

2. Evaluation Kit Interfaces and Settings

2.1. Interfaces

USB Interface

USB port of EVK-CSM supports USB 2.0 and is intended for connecting to user's devices (PC, laptop, PDA etc.) running the following Operating Systems:

 • Windows 98/ME/2000/XP/Vista/7

 • Windows CE 4.2-5.2/CE 6.0/Mobile 5/Mobile 6.

RS-232 Interface

COM port is intended for connecting to the user's RS-232 interface (for example to a PC through a standard COM port connector and cable).

PPS signal

The PPS is a time synchronization output signal with frequency of 1 Hz. It's provided on the «PPS» connector on the front panel of EVK-CSM.

PPS signal features:
- voltage logic levels – same as on GPIO
- frequency – 1, 2, 5, 10 Hz (corresponds to the frequency of navigation solution, 1 Hz on default)
- the true value of time corresponds to the leading or trailing edge pulse (set by BINR protocol, leading edge on default)
- pulse duration – 40 ns to 2,5 ms, 1 ms on default
- synchronization with GPS, GLONASS, UTC or UTC SU time scales, UTC on default
- accuracy of synchronization – 15 ns (RMS, not including delay in a cable)

2.2. Jumper Assignment and Default Position

The EVK-CSM board contains jumpers for easy access to various signals of NV08C-CSM. Jumpers are used for the following purposes:

- Signals state check

- Configuration change

- External power supplies connection

- Connection of NV08C-CSM directly to the user's system bypassing drivers and components on EVK-CSM board.

Table 2 and **Figure 4** describe jumper assignment and default position on EVK-CSM board.
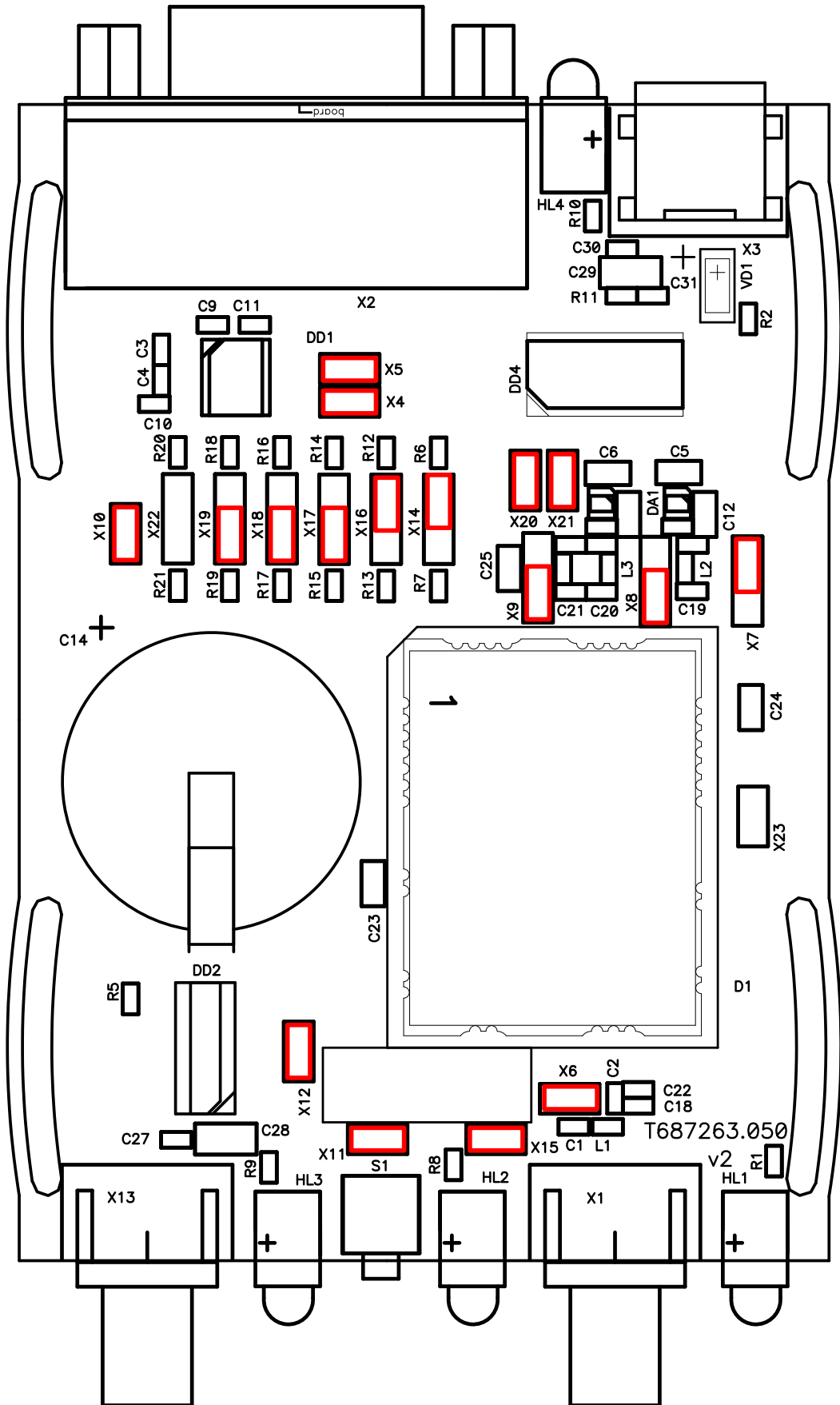
Figure 4. EVK-CSM board and jumper default position

Table 2. Jumper placement and functions on EVK-CSM

Designation on board	Pin	Default Setting	Description and comments
X4	X4:(1-2)	closed	UART B (RX) signal connection from RS-232 driver to the NV08C-CSM
X5	X5:(1-2)	closed	UART B (TX) signal connection from RS-232 driver to the NV08C-CSM
X6	X6:(1-2)	closed	3.3V Power Supply for antenna (Refer chapter 1.6)
X7	X7:(1-2)	–	Reserved
	X7:(2-3)	closed	Connection of VIN_D line to DA1 LDO
X8	X8:(1-2)	closed	Connection of VIN_D line to DA2 LDO
	X8:(2-3)	–	Connection of VIN_D line to DA1 LDO
X9	X9:(1-2)	closed	Connection of VIN_BBIO line to DA2 LDO
	X9:(2-3)	–	Connection of VIN_BBIO line to DA1 LDO
X10	X10:(1-2)	closed	Connection of VBAT line to EDLC
X11	X11:(1-2)	closed	RESET button (S1) connection
X12	X12:(1-2)	closed	Connection of PPS signal to the LED "PPS"
X15	X15:(1-2)	closed	Connection of ANTFLAG (GPIO0) to "ANT" LED
X14	X14:(1-2)	–	GPIO7 pulled down to «0»
	X14:(2-3)	closed	GPIO7 pulled-up to «1»
X16	X16:(1-2)	–	GPIO6 pulled down to «0»
	X16:(2-3)	closed	GPIO6 pulled-up to «1»
X17	X17:(1-2)	closed	GPIO5 pulled down to «0»
	X17:(2-3)	–	GPIO5 pulled-up to «1»
X18	X18:(1-2)	closed	GPIO4 pulled down to «0»
	X18:(2-3)	–	GPIO4 pulled-up to «1»
X19	X19:(1-2)	closed	GPIO3 pulled down to «0»
	X19:(2-3)	–	GPIO3 pulled-up to «1»
X22	X22:(1-2)	–	GPIO2 pulled down to «0»
	X22:(2-3)	–	GPIO2 pulled-up to «1»
X20	X20:(1-2)	closed	UART A (RX) signal connection from USB driver to the NV08C-CSM
X21	X21:(1-2)	closed	UATR A (TX) signal connection from USB driver to the NV08C-CSM
X23	X23:(2-3)	–	SLEEP_FLAG signal output

2.3. Exchange Protocols and Configuration

NV08C-CSM supports communication with external user devices through the following protocols:

- NMEA 0183
- RTCM 104
- BINR (proprietary binary protocol).

Note – Any port may be configured for receiving differential corrections data in RTCM format. In this case it is still possible to control the module by adding NMEA-commands to RTCM stream since the module's SW is able to sort out these data types.

Basic configuration of the module is as follows:

- navigation mode: GLONASS / GPS;
- SBAS data: used automatically when available;
- RAIM: automatic;
- Assisted data: used automatically when available;
- issuing navigation data rate: 1 Hz;
- NMEA message types: GSA, RMC, GGA, GSV, GBS.

Change of the module configuration relative to the base can be made by:

- Choosing one of the preset configurations by an appropriate code on the GPIO inputs (Table 3)
- Commands via IO ports

Table 3. User settings

GPIO (Jumper / CSM pin#)	Parameter	PIO value	Description
GPIO3 (X19/#3), GPIO4 (X18/#7), GPIO5 (X17/#4)	UART port configuration	GPIO5 = 0 (default) GPIO4 = 0 (default) GPIO3 = 0 (default)	UART A – 115200 NMEA UART B – 115200 BINR
		GPIO5 = 0 GPIO4 = 0 GPIO3 = 1	UART A – 4800 NMEA UART B – 19200 BINR
		GPIO5 = 0 GPIO4 = 1 GPIO3 = 0	UART A – 9600 NMEA UART B – 19200 BINR
		GPIO5 = 0 GPIO4 = 1 GPIO3 = 1	UART A – 19200 NMEA UART B – 57600 BINR
		GPIO5 = 1 GPIO4 = 0 GPIO3 = 0	UART A – 38400 NMEA UART B – 38400 BINR
		GPIO5 = 1 GPIO4 = 0 GPIO3 = 1	UART A – 38400 NMEA UART B – 4800 RTCM NMEA_time_sym = 2
		GPIO5 = 1 GPIO4 = 1 GPIO3 = 0	UART A – 4800 NMEA UART B – 4800 RTCM NMEA_time_sym = 2
		GPIO5 = 1 GPIO4 = 1 GPIO3 = 1	UART A – 57600 NMEA UART B – 57600 BINR
GPIO7 (X14/#5)	User settings saving mode	GPIO7 = 1 (default)	Settings are saved
		GPIO7 = 0	Settings are not saved

2.4. EVK-CSM Firmware update

Firmware (FW) updates of NV08C-CSM may be accomplished with the PatchWriter software utility. PatchWriter is provided on the USB memory stick (included as a part of EVK-CSM package) or can be downloaded from the NVS web site http://nvs-gnss.com/support/soft/item/20-patchwriter.html.

Another way is to use any RS-232 terminal program (for example standard Windows HyperTerminal). In this case following command should be sent to the EVK-CSM:

   - when using of NMEA format: $POPRL,B*3F\r\n

   - when using of BINR format: 0x10 0x01 0x52 0x45 0x4C 0x4F 0x41 0x44 0x5F 0x42 0x10 0x03

   Once the EVK-CSM receives this command, it enters a FW reprogram mode and starts transmitting 0x43 symbols (ASCII "C" symbol) to the port as an indication that EVK-CSM is ready to receive the FW patch code now. The code shall be send then to EVK-CSM by X-modem protocol. The updated FW code is stored and activated for future starts. After successful FW update EVK-CSM will restart automatically.

3. Initial setup and usage of EVK-CSM

3.1. Connection of EVK-CSM to user equipment

Figure 5 shows the components and connections diagram for working with the EVK-CSM.
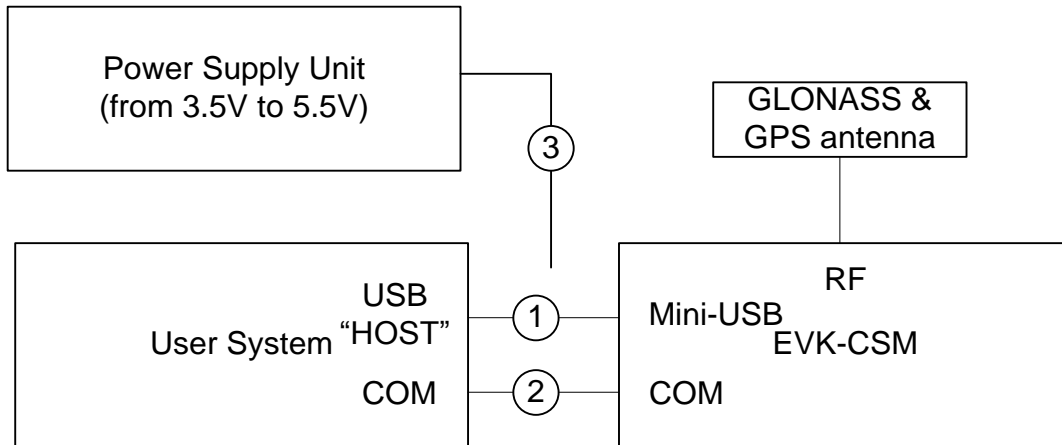

Figure 5. Workplace setup of EVK-CSM

The setup consists of:

- GLONASS/GPS antenna
- EVK-CSM
- User device (PC, laptop etc.)
- Mini-USB cable (1)

Optional setup components:

- Power supply
- COM-port cable (2)
- Power cable (3)

Note – Please refer to chapter 1.5 for Power supply details.

«COM» port (D-SUB 9 plug connector) is used for connecting the EVK-CSM to a RS-232 port of external device. See **Figure 6** for pin assignment of the «COM» port. «COM» receives and transmits data from UART B of NV08C-CSM.
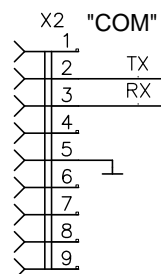

Figure 6. «COM» port pinout

3.2. Getting Started with EVK-CSM

For working with the EVK-CSM via USB port the following steps shall be executed:

1. Install EVK-CSM USB drivers from USB memory stick or download FT232R drivers from http://www.ftdichip.com/Drivers/VCP.htm (for appropriate operating system).

   Note – Windows 7 doesn't require drivers to be downloaded and installed manually and normally install the drivers automatically once EVK-CSM is connected to USB port. It's recommended to disconnect the EVK-CSM and connect it again after the first connection and driver installation.

2. Connect EVK-CSM via a USB cable. Red LED "PWR" will light on.

3. Operating system should detect a new device. Specify driver location ("…:\Drivers\<OS>"). Operating system will continue installing two drivers.

4. For PDA and Smart phone driver installation, see device's user manual.

5. EVK-CSM is now set up.

Note – Skip steps 1, 3 and 4 if USB drivers are already set up.

For working with the EVK-CSM via COM port:

1. Connect the COM port cable 2.

2. Apply power to EVK-CSM either from external power supply or by connecting USB cable (only USB power supply option will be activated). Red LED "PWR" will light on.

3. EVK-CSM is now set up.

3.3. Antenna Connection

In order to receive GNSS signals, a GLONASS/GPS antenna has to be connected to EVK-CSM to «RF» input (for more antenna info see 1.6). If an active antenna is connected the «ANT» LED will light up.

In order to ensure EVK-CSM's proper functionality, antenna should not be placed in proximity to metal or other objects that would be blocking GNSS signal from sky. It is not recommended to use an antenna inside buildings or place it in casings made from material that shield radio signals.

3.4. EVK-CSM operation

Use the software from the USB memory stick provided in the EVK-CSM package or download the latest version from the website.

Set up the appropriate ports as per instructions in 2.3.

Communication with EVK-CSM is performed via USB and RS-232 connectors located on the front panel. User can also get data from NV08C-CSM directly from EVK-CSM's IO jumpers (for jumper placement see **Figure 4** and **Table 2**).

Note – EVK-CSM will save user's port configurations by default. If after an IO settings change the connection speed or protocol cannot be determined, then the following procedure should be attempted. Turn off EVK-CSM from the power supply, open the case and place jumper X14 into X14:(2-3) position (see **Figure 4**). Then turn EVK-CSM on, and ensure that the data output is functioning properly as described in **Table 3**. Turn off EVK-CSM and return the jumper X14 to its prior setting. Close EVK-CSM's case.

Appendix 1

EVK-CSM v2.2 electrical schematic (volume production devices)