Never stop thinking

TDA5150

SmartLEWIS™TX

TDA5150 Evaluation Kit

including TESEUS software

User Guide

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TDA 5150 multichannel transmitter Evaluation Kit

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1 Quick Start Guide

1.1 Overview

This chapter is a quick guide to the TDA5150 evaluation environment installation and usage, showing how to

- install the TESEUS software tool
- connect the Hardware and set up the TDA5150 evaluation environment
- start your first radio transmissions

*Note: In order to work with the **TDA5150 Evaluation Kit**, at least one **Evaluation Board** and one **SIB** board (Version V1.2) are required. For order codes see **Table 5***

Attention: The SIB board V1.2, which is part of the TDA5150 Evaluation Kit contains a dedicated Firmware, suitable for operation with TDA5150 chips.
No other SIB boards (for instance V2, part of TDA5240 Receiver Kit) may be used

The final part of this booklet contains hints and recommendations regarding the implementation of SPI bus communication in a stand-alone system (i.e the TDA5150 transmitter is under the control of a host system, usually a microcontroller).

It is recommended, that users of the TDA5150 transmitter read through those details after getting familiarized with the TESEUS environment, but before switching to implementation of their own, stand-alone applications, to shorten the learning curve.

1.2 Software installation and Hardware setup

In order to install the TESEUS tool, first time users have to go through following steps

- ***Do not*** plug in the SIB board into a USB slot of the PC, before the TESEUS tool and the drivers associated to the SIB board are installed, otherwise a *Missing Driver* error message may occur
- Start the installation of TESEUS and above mentioned drivers, by clicking on the icon of self-extracting ***TESEUS.exe*** package (icon is shown below)

Figure 1 Icon of the self-extracting package

- Choose the directory location and the installation mode - shared or individual (example for individual install is shown below) and follow the instructions. Before proceeding with the installation, please read carefully the software disclaimer and EULA agreement (and click on *Accept* to proceed with install).

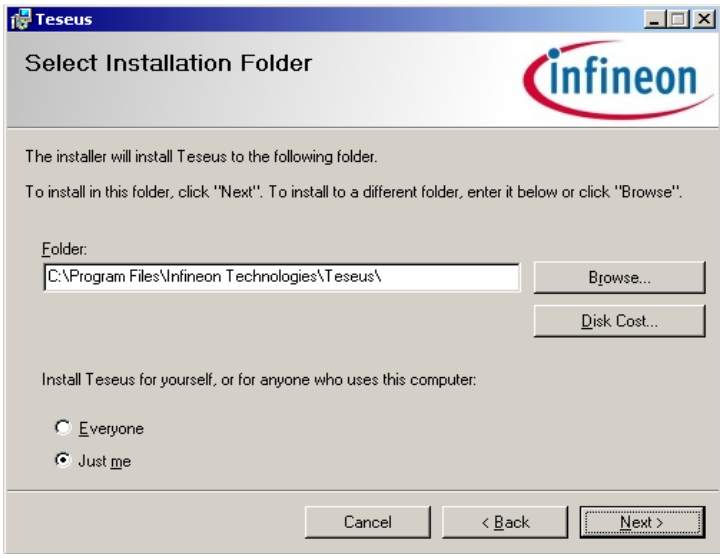

Figure 2 Select the directory location for install

At the end of installation process, a TESEUS shortcut will appear on the desktop, as shown below

Figure 3 TESEUS icon after install

Now, having the TESEUS installation closed, plug the ***TDA5150 Evaluation Board*** and the **SIB** (***S**tandard **I**nterface **B**oard*) together, as shown below. Connect the SIB board to a free USB port of a PC with a USB cable (delivered with TDA5150 Evaluation Kit or a similar one). It is recommended to use a USB cable not longer then 1 meter (3 feet 4 inch).

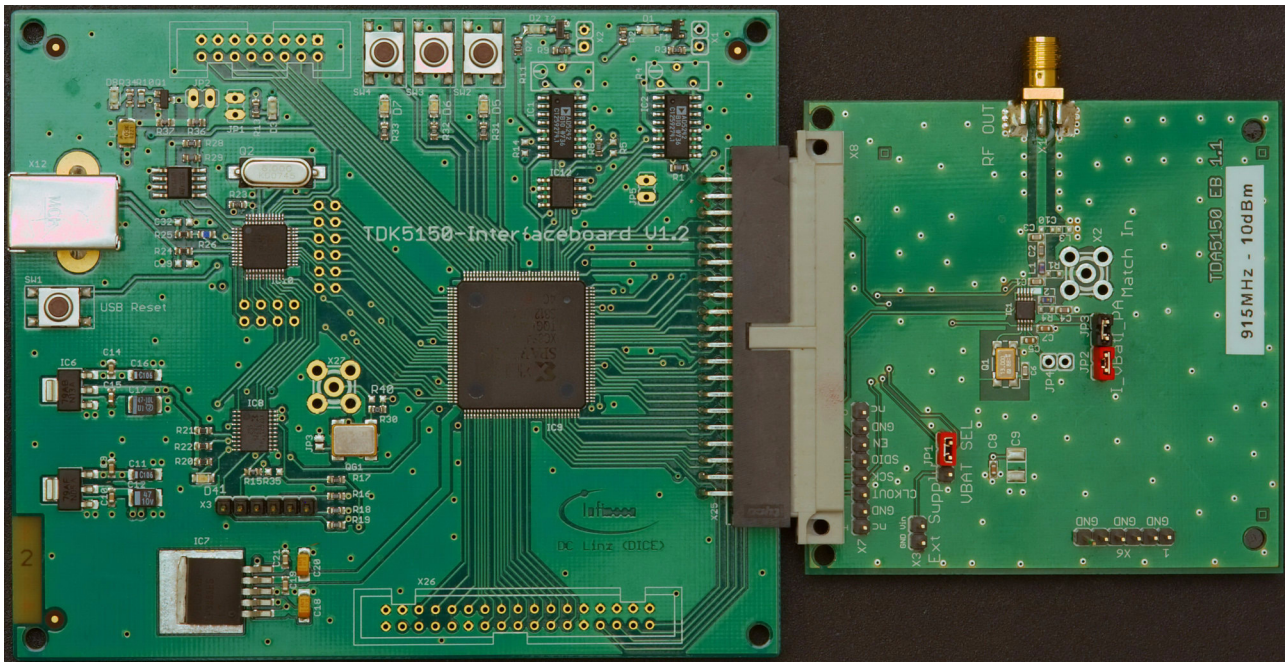

Figure 4 Evaluation Board plugged into SIB board, top side view

If the SIB board is connected for first time to a USB port of a certain PC, a *Found New Hardware* message pops up - as shown below and the drivers for the SIB Board are installed automatically. Please wait until the installation is completed, and the *Found New Hardware* message window deleted from desktop.

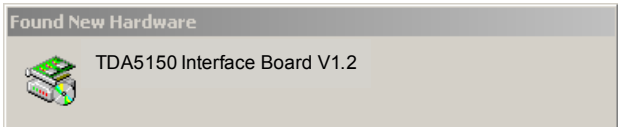

Figure 5 Found New Hardware message

After the installation is properly finished, you can proceed with the next step.
Restart of the PC after TESEUS and driver installations have been finished is not mandatory.

1.3 Hardware setup and functional check

The TDA5150 Evaluation Board can be supplied either from an external power source (voltage range from minimum 1.9 V up to maximum 3.6 V) or use the regulated voltage delivered by SIB board.

The later one is user programmable in the 1,9..3,6V range (see also ***SIB Parameters*** window in ***General*** tab of TESEUS GUI **Figure 24**).

Attention: Supply voltages exceeding 3,6V (the operating range maximum rating for TDA5150) may cause permanent damage to the device.

Jumper ***JP1*** does select the power supply origin for the ***Evaluation Board*** (internal or external). For internal supply jumper ***JP1*** is set as shown below. For supply voltage distribution scheme see also **Figure 31**.
Notice that the ***SIB*** board itself is always supplied via the USB power line, the external supply option applies only for the ***Evaluation Board***.

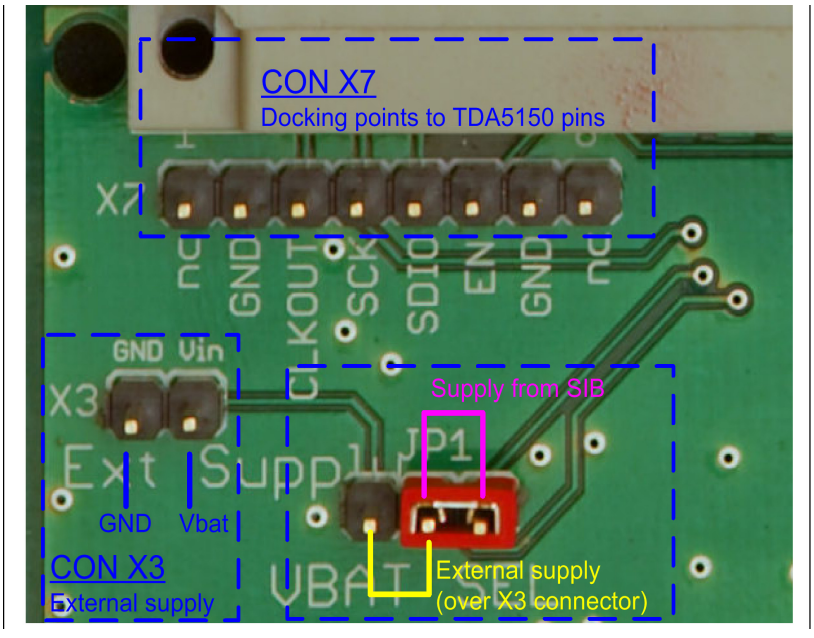

Figure 6 Configuration Supply Voltage source

In order to execute a functional check, start TESEUS (from ***Start Menu*** or left-click the icon) and choose the desired operation mode (***Basic Mode***, ***Advanced Mode*** or ***Firmware Mode***). **Chapter 3.2.1**describes in detail the Operation Modes.

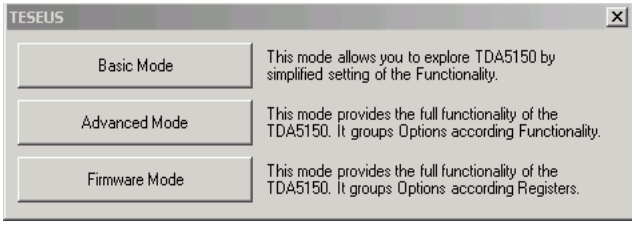

Figure 7 TESEUS Operation Modes

For a brief functional check, click on ***Read Status Registers*** button after TESEUS started and check if ***TDA5150 detected*** and ***SIB Board connected*** LEDs in the lower bar area are lit up in green (each mouseclick on the button does update the connection status).

If the green LEDs are not lit, there is no communication between transmitter board, SIB and/or the PC. For re-establishing the communication, check if the USB cable and the connectors on SIB and transmitter board are properly plugged in, and if the jumper ***JP1*** is set for external supply option, check the state of the power supply (must be ON), then read the status again by clicking on the ***Read Status Registers*** button.

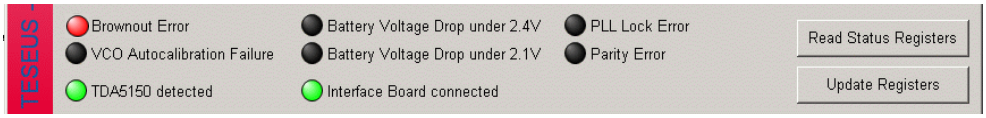

Figure 8 Status and error indicators in TESEUS GUI

1.4 Working with TESEUS

After getting TESEUS started, click on ***Update Registers*** followed by ***Read Status Registers*** button.

If the system is functional,i.e. SIB-to-PC and SIB-to-Evaluation Board connections are established, then the two green LEDs should light. If this does not happen, it is usually an indication either of connection problem (SIB-to-PC and/or SIB-to-Evaluation Board) or of missing supply voltage.

Further if the connection status is ok (indicated by green LEDs) but one or more status indicator LEDs are lighting in red (i.e PLL Lock Error, Parity Error, Brownout Error, VCO Autocalibration Failure) the device's RF power amplifier will be turned off and transmission stopped (as long as the FailSafe is armed and active) thus avoiding erroneous transmissions. Please refer to the TDA5150 Datasheet for detailed explanation and root cause finding (see FailSafe mechanism, Chapter 1.5.6 in ***TDA5150 Datasheet V1.0***, release July 2009).

In next step load the preferred TESEUS settings by selecting the ***Load settings*** command from the ***File*** menu or set the wanted values in accordance with description of the TDA5150 registers (details described in Datasheet). The newly defined or modified settings may be saved by choosing ***Save Settings*** from the ***File*** menu.

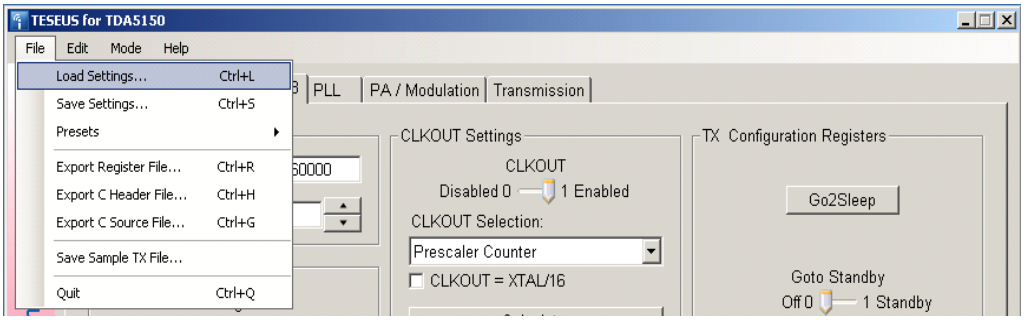

Figure 9 Recall previously stored settings

Attention: *Make sure that the nominal crystal frequency in TESEUS corresponds to the crystal frequency on your TDA5150 board. A difference between the crystal frequency (in HW) and the nominal value, entered*

in TESEUS will lead to a frequency error (deviation from nominal / wanted frequency). Enter the correct crystal frequency value in the corresponding TESEUS Function Tab (General/XOSC/Encoding/SIB)

In the next step choose ***Device Evaluation*** or ***System Emulation*** mode in ***Transmission*** tab. If ***Device Evaluation*** mode is selected, set the parameters associated with *TX Command Byte* (see also screenshot below). For more information on the TX Command Byte structure, refer to ***TDA5150 Datasheet***.

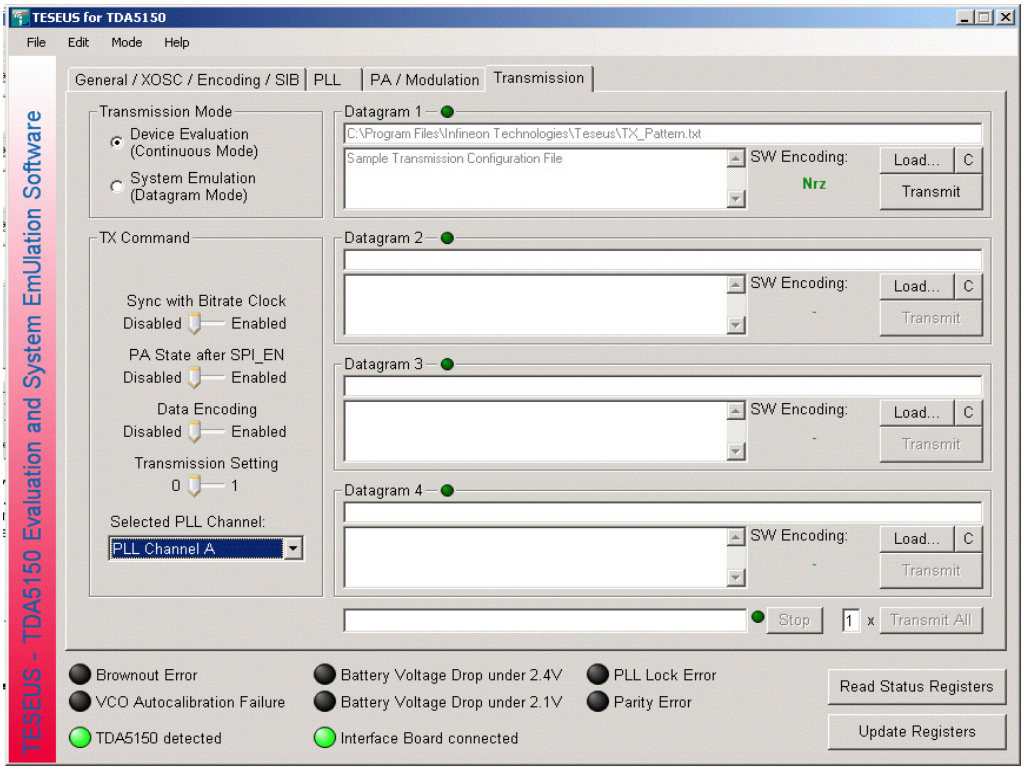

Figure 10 Transmission tab

Attention: *Only if **System Emulation** (i.e. Datagram Mode) is selected the **TX Command Byte** settings are taken over from the TX file. The parameters listed in the file are automatically displayed by TESEUS as long as TX Command dialog box is active.*

If ***Advanced Mode*** or ***Firmware Mode*** is used, select from ***File*** menu *Save Sample Tx File* to save the used file (usually into a project folder). The TX file(s) may be modified and/or renamed - if necessary and later the settings retrieved by loading them again. This might save time during development work and will minimize the potential of error occurrence due to inconsistencies in file content(s). The selected TX_file long path appears in the dialog box. Transmission in Basic Mode uses a default (predefined) datagram. Refer to Chapter 3.3.2 for details.

The screenshot below is an example for *Sample Tx File.*

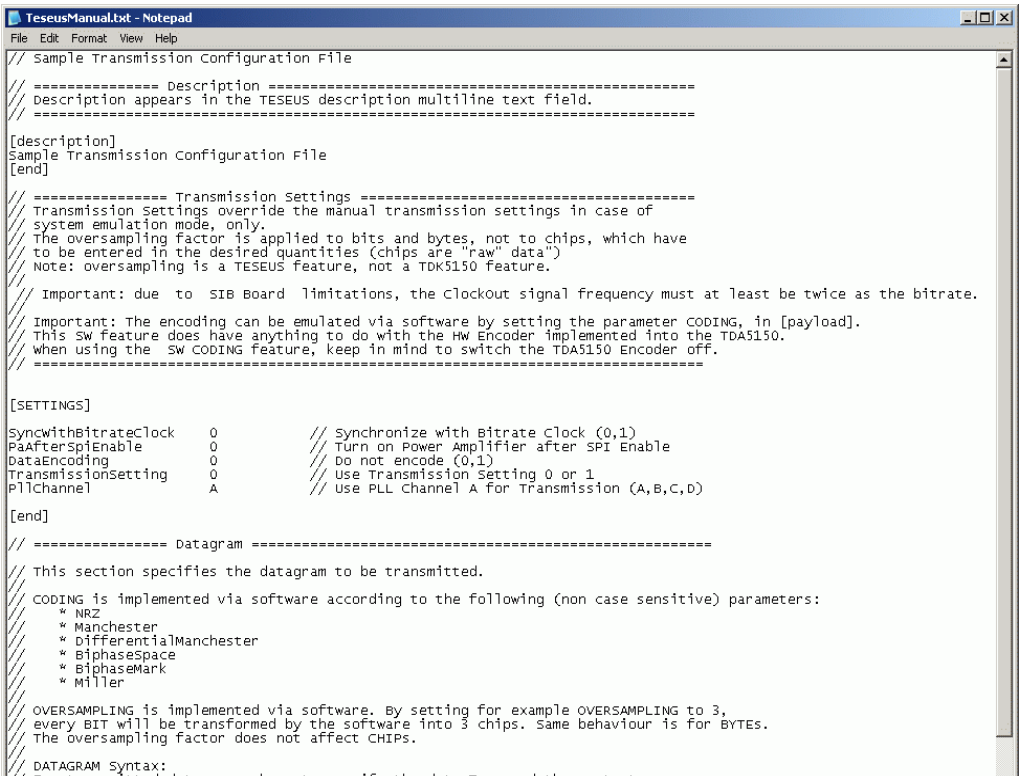

Figure 11 Sample Tx File

Now as all the parameters required by transmission have been updated, it's time to check if the prerequirements for starting an RF-transmission are fulfilled and transmit the Datagram.

To check if there occurred any error conditions since the last transmission (or since last *Reset*) click on the ***Update Registers*** button, and then on ***Read Status Registers***.
This action clears also the latched error flags, details are explained below.

If one or more of the status indicator LEDs are lit red (i.e ***PLL Lock Error***, ***Parity Error***, ***Brownout Error***, ***VCO Autocalibration Failure***) then the device's RF power amplifier will be turned off and transmission stopped (as long as the FailSafe is armed and active) thus avoiding erroneous transmissions. Please refer to the TDA5150 Datasheet for a detailed explanation and root cause finding (see FailSafe mechanism; Chapter 1.5.6 in ***TDA5150 Datasheet V1.0***, release July 2009).

Further keep in mind that reading the ***Status Registers*** delivers the previously latched error(s) and - at the same time clears the ***Error Flags*** in ***Status Register***.

The example below shows a *Brownout Error*. It might happen, that the brownout condition has already vanished (i.e. just a short voltage drop below the brownout threshold detected from *Brownout Detector* block), but the error is still latched until it is cleared by reading the ***Status Register*** or by a *Reset*.

Figure 12 Brownout Error condition

Having checked for errors it's time to start a transmission. To do so, press the ***Transmit*** button associated to a channel (A..D) in the ***Transmit*** tab.
Up to four different Datagrams can be loaded and sent individually, as shown below. The number of repetitions for Datagram transmission and the corresponding PLL Channel can be set as well.

Notice that in the recent TESEUS implementation (V3.2.11) all datagrams are associated to one and the same PLL Channel (A, B, C or D). In the next editions each Datagram should be associated to an individual PLL Channel, independently from the others (i.e for instance Datagram1 to Channel A; Datagram2 to Channel C; Datagram3 to Channel B and so on, without restrictions regarding the sequence of associations).

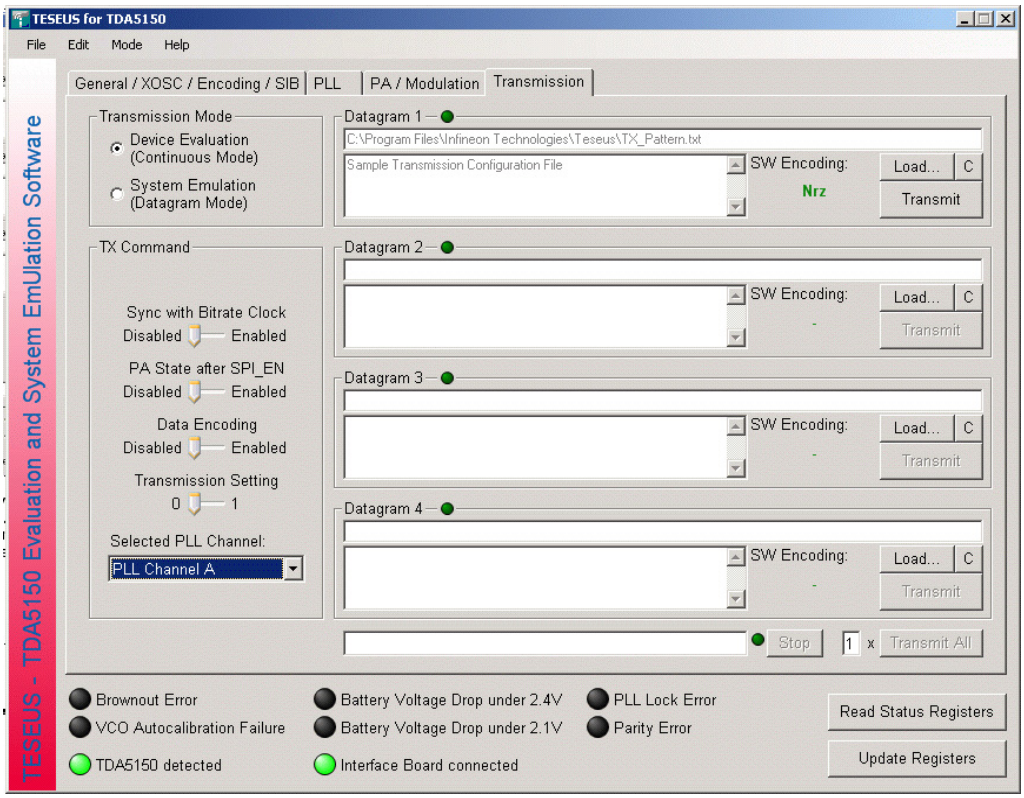

Figure 13 Transmit a Sample Tx File in Device Emulation mode

2 Introduction

2.1 Software Overview

At Infineon Technologies we believe that the supporting process is a key factor for your success. This software tool is intended to help you to shorten the design cycle by embedding of TDA5150 into a host system.

TESEUS is supporting the evaluation of multi-band, multi-channel transmitter of Infineon, the TDA5150 chip.

The term “device evaluation” means that the customer will be able by using the included SW and the Evaluation Kit to fully evaluate the performance of the transmitter device itself (in conjunction with an Infineon Evaluation Board). This ability is referred as **Device Evaluation** mode.

The software is also capable of emulating the behavior of a generic microcontroller which is usually part of a generic application. That is, the SW embeds the ability of transmitting data via the TDA5150 and one or more RF Channels to a not specified receiver, the same way as things would work in a generic application. This ability is referred as **System Emulation** capability.

TESEUS is used to configure the TDA5150 transmitter and to generate the appropriate register settings. The tool does offer a set of dialogs to configure the TDA5150. Each functional unit of the TDA5150 which is visible to user (and is described in the associated Datasheet) is controlled by a separate dialog box. By using the tool a user is able to execute transmissions, save and retrieve project settings including but not limited to SFR register settings and transmission datafiles as well.

2.2 Evaluation Kit Components

TESEUS is part of the TDA5150 evaluation environment. In order to perform your evaluation task, will you need:

- a TDA5150 SIB Board (version V1.2, acting as controller towards the TDA5150 transmitter)
- a USB cable for the interconnection between the SIB Board and the PC
- a TDA5150 Evaluation Board, assembled in accordance with the parameters listed in **Table 5** (frequency band and RF output power classes). This Evaluation Board can be plugged into the connector of a SIB board, but if the customer does wish so, it can be controlled by an external uC, via the SPI bus. In this case the proper supply voltage of 1,9..3,6V must be provided by an external power supply or from the uC-board (as the SIB-board is NOT plugged in, there is no supply voltage available from SIB-board in this case)
- a personal computer with at least one free USB port and one of the following operating systems (OS) installed: Windows 2000; Windows XP (32 bit or 64 bit); Windows Vista (32 or 64 bit); Windows 7 (32 or 64 bit)

2.3 TDA5150 Overview

The TDA5150 is a low power ASK/FSK RF transmitter for the ISM frequency bands 300-320MHz, 425-450 MHz, 863-870 MHz and 902-928 MHz.

Bi-phase modulation schemes like Manchester, bi-phase mark, bi-phase space, etc. are supported. The IC offers a high level of integration and needs only a few external components, like a crystal, a few blocking capacitors and the necessary matching elements on the RF-PA output. A fully integrated sigma-delta fractional-N PLL synthesizer covers all above mentioned frequency bands with a high frequency resolution, using only one VCO running around 1.8 GHz. The on-chip synthesizer comprises a VCO, several dividers, loop filter with programmable bandwidth and a highly accurate 3rd order sigma-delta modulator.

With a programmable data shaping filter, a very accurate GFSK modulation is achieved.

The output stage of the TDA5150 contains a C class power amplifier with a very good efficiency factor, several selectable power stages and user-selectable RF output power level.

A shaped ASK-data input is also provided.

On chip antenna matching capacitor array is available (for tuning).

The main clock source is a single-pin crystal oscillator running at around 13.00 MHz. Datasheet specified frequency range of this reference clock is 12MHz..14MHz.

A programmable divided clock output is available. The device is configured by means of a 3-wire interface (SPI bus), programmable even during power down state.

2.4 TDA5150 Features

The main features of the TDA 5150 transmitter are

- Sigma-delta fractional-N PLL synthesizer with high frequency resolution (<7 Hz)
- Multiband / Multichannel operation (300-320 MHz, 425-450 MHz, 863-870 MHz, 902-928 MHz)
- Supply voltage range 1.9V - 3.6V
- Low battery detector with two threshold levels (2.1 V and 2.4 V)
- Small package size (TSSOP-10)
- Operating temperature range -40°C to +85°C
- Full qualification for automotive standard
- Modulation types ASK (OOK), FSK (CPFSK) and GFSK
- Supports all bi-phase encoding formats
- Low supply current (Power down less then 0.5 mA, RF transmission 9mA @ +5 dBm)
- Programable output power, with nominal levels of +5 dBm, +8 dBm, +10 dBm
- Software selectable on-chip tuning capacitors for antenna matching network
- Programmable divided clock output (for clocking external devices)
- Integrated 3-wire serial interface bus (SPI)

2.5 Applications

- Remote keyless entry systems
- Short range radio data transmission
- Remote control units
- Tire pressure monitoring
- Remote metering and telemetry applications
- Cordless alarm systems

3 Description

3.1 Installation

3.1.1 Hardware and Software Requirements

In order to work with TESEUS, the following hardware and software components are required

- PC with (at least) one of Microsoft's following OS installed:
  Windows 2000; Windows XP (32 bit or 64 bit); Windows Vista (32 or 64 bit) or Windows 7 (32 or 64 bit)
- One free USB port (for PC to SIB board connection)
- Recommended graphical screen resolution – 1024 by 768 pixels, or larger
- FTDI driver package for your installed Windows operating system.
  These drivers, required by SIB board (V1.2) are part of the TESEUS distribution package and are installed automatically during the installation of TESEUS tool

Note: Additionally Microsoft .Net Framework Version 2.0 (or newer version) is required. This is usually part of the Windows installation packages. If there is no .NET Framework version 2.0 installed on the used PC, you'll be prompted to install it. The TESEUS package contains a redistributable version of .NET 2.0.
Either use this package or download the recent .NET Framework Version Redistributable Package from Microsoft's web page http://www.microsoft.com/downloads/en/default.aspx
Please be aware of the minimum requirements and resources for installing the .NET Version 2.0 or never (list on Microsoft web-page)

***Attention:** Please install TESEUS before plugging in the first time the SIB board to your USB port (otherwise, after the Found New Hardware prompt you should be asked to localize the driver source files)*

3.1.2 Installation of TESEUS

To install TESEUS follow the sequence described below

- Copy the distributed TESEUS.exe self-extracting file to a hard disk drive (usually the **C:** drive). You can eventually download it from the www.infineon.com/wirelesscontrol site
- Click on the self-extracting TESEUS.exe file (delivered by Infineon or the recently downloaded one)
- The installation will start and execute automatically
- During installation a default folder will be created under
  - **C:\Program Files\Infineon Technologies\TESEUS**
  - if the user does not modify the path, as explained, based on an example by **Figure 2**

***Attention:** due to security features, TESEUS does not run if launched from a remote (network) drive. Please make sure that TESEUS directory is located on a physical (local) drive on your PC and that you have the required user rights to execute it*

Note: TESEUS requires Microsoft .NET Framework Version 2.0. If .NET Version 2.0 is not available in your MS Operating System, a message box will ask for download /install the .Net Framework Version 2.0. In this case, install the .NET 2. 0 Redistributable package delivered with TESEUS installation package or download a newer version, directly from Microsoft.

- Having TESEUS installed, simply plug in the SIB board into a free USB port of the PC via the USB cable provided with the Evaluation Kit. The SIB board drivers are automatically installed during the installation of TESEUS. The Plug and Play feature of the SIB board will create two channels, designated as Channel A and Channel B within the established USB connection
- You are now ready for launching and running TESEUS by simply double-clicking the TESEUS shortcut icon on your desktop (or in START menu)

*Note: Checking if the USB drivers are correctly installed and the connection is working can be done opening the **Universal Serial Bus** controllers field in the **Device Manager** folder. Different operating systems (Win7, Vista, XP, W2K) offer slightly different path to **Device Manager**, but the principle is the same for all. To open the **Device Manager** folder, for instance under W2K, click **Start**, point to **Settings**, click **Control Panel**, and then double-click **System**. Click the **Hardware** tab, and then click **Device Manager**. Under the **Universal Serial Bus controllers** root, you should find the list of installed drivers. The drivers required by SIB board are named **FT2232C Channel A** and **FT2232C Channel B**. Independently of the installed OS, in doubt or if there is a systematic connection error between the PC and the SIB board (i.e. the error LEDs in TESEUS's Status Bar are lighting) please make shure the USB channel (s) are not marked as in error (this happens usually due to missing driver)*

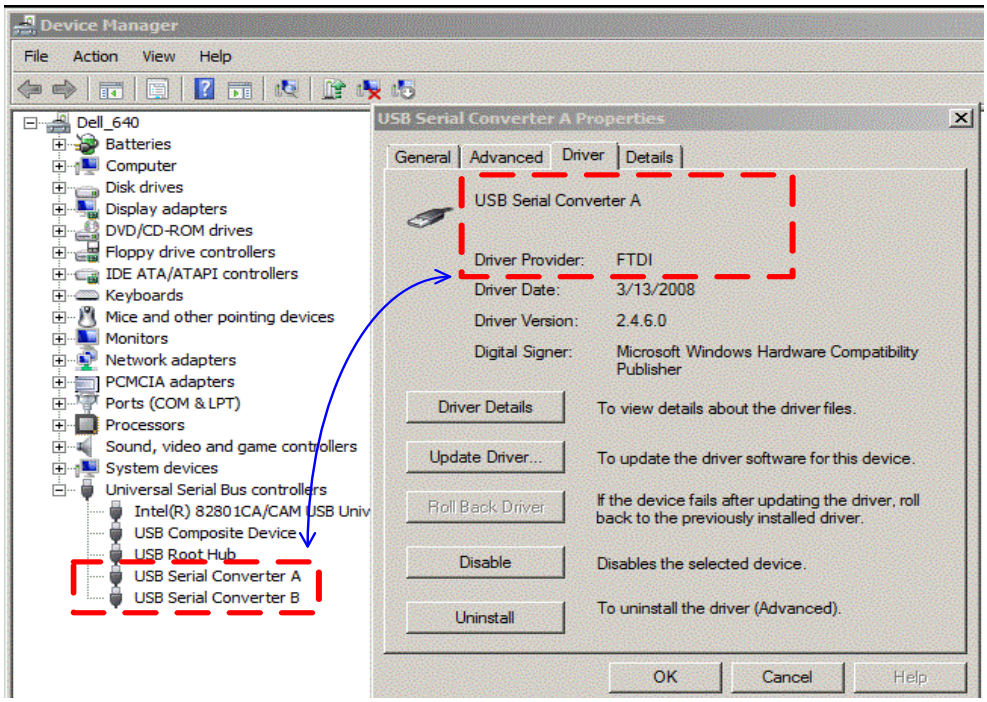

Figure 14 USB ports in Device Manager, as listed in Windows 7

3.2 User Interfaces and Getting started actions

The TDA5150 Evaluation Board can be supplied either from an external power source (voltage range from minimum 1.9 V up to maximum 3.6 V) or use the regulated voltage delivered by SIB board.

3.2.1 GUI Description: Basic, Advanced and Firmware Mode configurations

TESEUS starts in a window which allows the user to choose from three possible Configuration GUIs

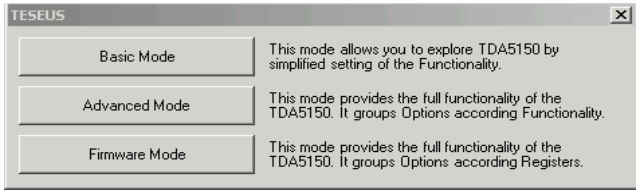

Figure 15 TESEUS startup GUI

These different GUIs visualize a choice of control tabs and settings, tailored to the user's needs. Namely these are:

- **Basic Configuration**: in this mode the user is asked to program just a minimum number of parameters. This configuration is recommended for getting started with the device or for simple functional tests.

- **Advanced Configuration**: the user is offered a wider choice of programable device registers (***SFR***s). Anyway TESEUS takes over the programming of some parameters in order to assist the user by setting the correct values and at the same time to reduce the probability of an erroneous configuration occurrence. This GUI is recommended for in-depth evaluation of the device.
- **Firmware Configuration**: within this GUI, the user is given access to all the parameters and SFRs, without any limitation imposed by the software. By providing a high degree of freedom, this GUI is recommended for users already familiarized with the device.

After one of the three ***Configuration GUI***s is selected, a new window opens, containing additional Tabs, like shown below..

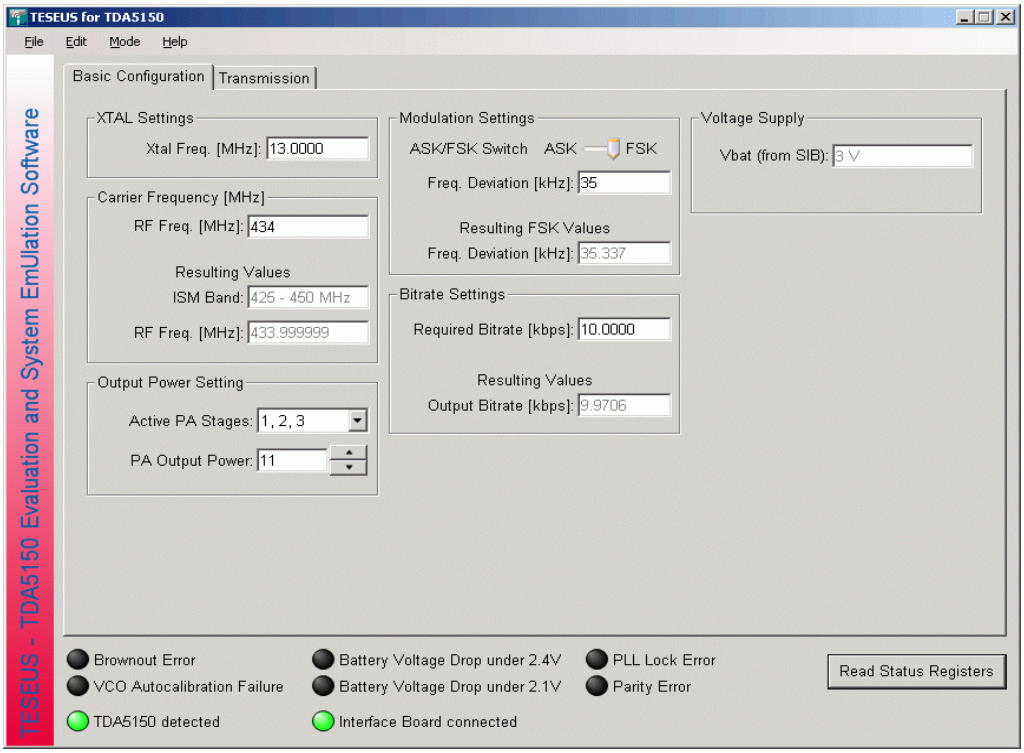

Figure 16 Basic Configuration GUI window

*Note: By un-checking the **Show Startup Selection Dialog** in the **Help** menu, the **Configuration GUI** window is disabled and TESEUS will start the next session with the last used GUI.*

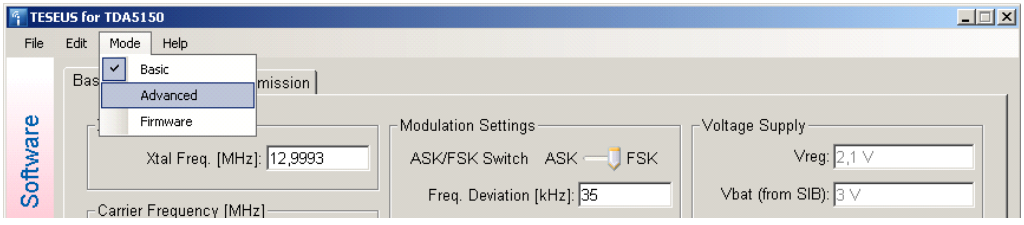

Figure 17 Switching between Configuration Modes

Each Configuration Mode allows the user to

- configure the registers
  (the number and function of user-accessible SFRs depends from the used Configuration Mode)
- configure the transmission mode (ASK; FSK; GFSK), RF-power and to transmit data but the degree of configuration flexibility and access to in-depth parameters is different

3.2.2 Configure the SFR registers

TESEUS assists the user by configuring the registers of the TDA5150 in an easy and comprehensive way. Each register is described by its tooltip descriptor which is visualized by passing the pointer of your mouse on the command. Please refer to the TDA5150 Datasheet for detailed explanation of the register functions and for the TDA5150 behavior. The mentioned registers are referenced as **SFR**s (**S**pecial **F**unction **R**egisters) in the TDA5150 Datasheet and Application Notes.

By pressing <***F1***> when the pointer is hovering over special dialog boxes, an ***Explanation Note*** describing the particular function will pop up.

3.2.3 Transmission Modes

Using TESEUS can significantly shorten the design cycles by supporting the designer both in the evaluation process and the application development. This is achieved by the ability of transmitting both a continuous data stream for ***Device Evaluation*** purposes, or a signal modulated with a customer-specific datagram, as a normal application would do. This ability is referred within this document as ***System Emulation*** capability.

In this way, the Infineon TDA5150 Evaluation Kit comes closer to your final application.

Device Evaluation and ***System Emulation*** are options in the ***Transmission*** tabs of ***Basic Configuration***, ***Advanced Configuration*** and ***Firmware Configuration*** modes.

During programming the registers of the TDA5150 transmitter, via one of the three configuration modes (Basic; Advanced or Firmware), please check out the ***Transmission*** tab corresponding to the desired transmission mode (***Device Evaluation*** or ***System Emulation***)

*Note: in **Basic Mode** the appearance of the **Transmission** tab is slightly different from those in **Advanced Mode** and **Firmware Mode, as these offer a larger number of parameter choices and Data Frame configuration, some of these features are blanked out in Basic Mode***

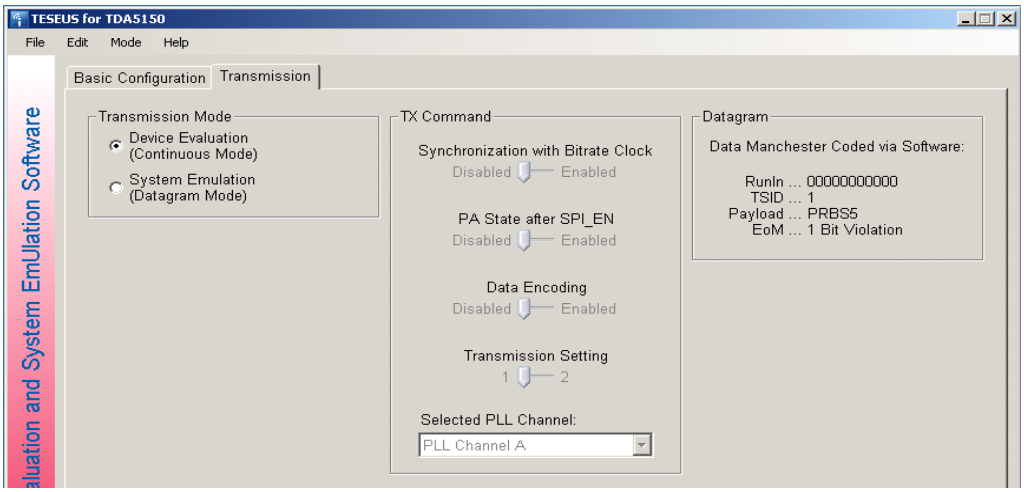

Figure 18 Device Evaluation and System Emulation options, as they appear in Basic Mode

3.2.3.1 Device Evaluation Mode

After selecting the ***Device Evaluation Mode***, a new transmission can be started by clicking the ***TX Start*** button. A continuous RF transmission is then generated according to the parameters downloaded into the ***SFR***s of the TDATDA5150. The modulated information is the datagram contained within *Transmission File* which has been selected in advance, iterated by an infinite loop. The transmission is interrupted (stopped) by clicking the ***TX Stop*** button or if editing any parameter in TESEUS is started. Thus inconsistencies (transmission of partially edited files) is avoided by forcing ***TX Stop*** during editing operations.

The effect of ***Device Emulation*** mode is the same for ***Basic***, ***Advanced*** and ***Firmware*** configuration GUIs. Contrary to ***Firmware*** and ***Advanced*** mode, in ***Basic*** mode a predefined datagram is used, and it is not possible to select a user-defined one.

3.2.3.2 System Emulation Mode

The ***System Evaluation*** mode allows you to program the device to transmit a datagram (i.e. a string of data) once or several times (by a programable number of repetitions). According to the ***Basic Configuration*** vs. ***Advanced*** and ***Firmware*** configuration environments, a default message is sent instead of a fully definable one. The aim is to emulate via software the behavior of the TDA5150, as it would operate under the control of a generic microcontroller or an equivalent host.

The datagram is transmitted after clicking the ***TX Start*** button and ends when the datagram is completely transmitted or when the transmission is intentionally aborted by clicking the ***TX Stop*** button, whichever happens first.

3.2.4 File menu

The ***File*** menu in the TESEUS tool-bar gives access for the user to save, load and export functions, thus the settings used to program the TDA5150 can be saved and retrieved.

After configuring all the required registers and dialog boxes, a register configuration file is generated and saved by clicking ***Save Settings*** in the ***File*** menu of TESEUS tool-bar.

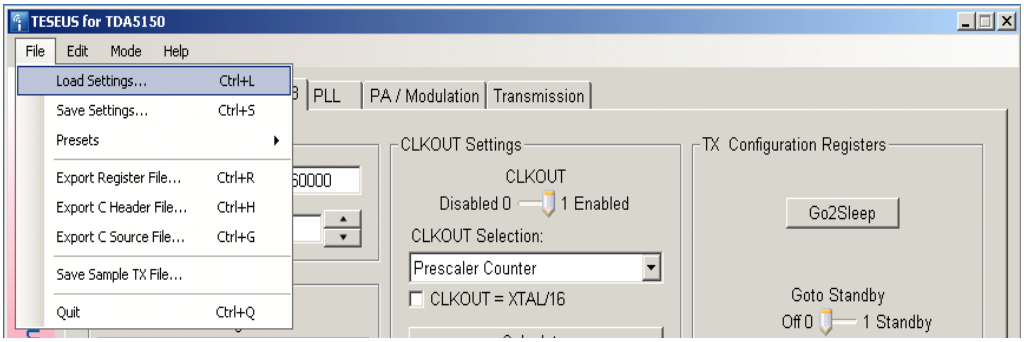

Figure 19 File menu

Teseus uses its own file settings format, with the generic extension *.nxs*. A control window for selecting the path and file name will be prompted to the user. At the same time a default path and file name are suggested by the system. The user can overwrite the existing file or rename it, in case the file already exists. Afterwards the .nxs file can be loaded at your convenience by choosing ***Load Settings*** and browsing to the folder containing the wanted file.

Teseus may be used to export a readable settings file. These list of settings, converted into a Register value file might be used as source during the programming process of a microcontroller (or host), interfaced with the TDA5150 and controlling it.

Table 2 File menu description

Command	Description	Hot Key	Note
Load Settings	Loads .nxs Teseus settings file	Ctrl+L	
Save Settings	Generates and saves .nxs Teseus settings file	Ctrl+S	
Presets	Load default .nxs settings file		
Export Register File	Export Registers values in a .txt text file (ASCII)	Ctrl+R	not available in Basic Mode

Table 2 File menu description

Command	Description	Hot Key	Note
Export C Header File	Export Registers values in a .h *C Language Header* file	Ctrl+H	not available in Basic Mode
Export C Source File	Export Registers values in a .c *C Language Source* file	Ctrl+G	not available in Basic Mode
Save Sample TX File	Save the Template TX File used for Datagram Transmission		
Quit		Ctrl+Q	

3.2.5 Edit menu

The ***Edit*** menu contains the classic functions ***Cut***, ***Copy***, ***Paste*** and ***Delete***.

3.2.6 Mode menu

The ***Mode*** menu allows the swap between ***Basic***, ***Advanced*** and ***Firmware*** configuration GUIs. For further explanation, please refer to **Chapter 3.2.1**

3.2.7 HELP menu

The Help menu gives access to all those implemented options and functionality which make the approach to the software easy and its usage comfortable.

If the ***Show Tooltips*** option is activated (under the ***Help*** menu) then, whenever the pointer of the mouse is hovering over a programmable field, a callout will appear, delivering information about the pointed register like:

- register description
- functionality
- SFR address (in hexadecimal format)
- selectable values
- tips

The ***Help*** menu can be activated by pressing <***F1***> as well as in the specific ***Explication Notes*** related to the popped-up topic. This option, together with a very intuitive layout keeps you on the good track and avoids the “feel lost” impression during navigation between settings and dialog boxes in TESEUS.

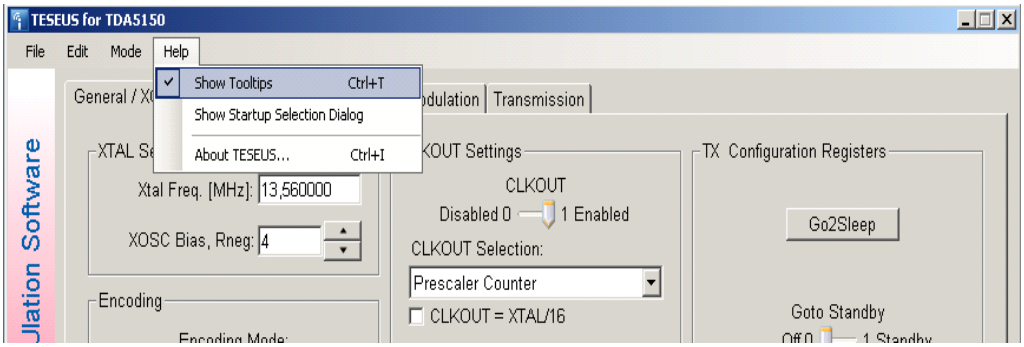

Figure 20 Help menu and tooltip activation

By checking the ***Show Startup Selection Dialog***, the dialog box with choice of GUI modes will appear. By disabling the dialog box, the last configuration mode will be loaded by the next launch of TESEUS. For further explanation, please refer to **“GUI Description: Basic, Advanced and Firmware Mode configurations” on Page 18**

Table 3 Help menu description

Command	Description	Hot Key	Note
Show Tooltips	Enables the tooltip feature. The pointer becomes a question mark (?)	Ctrl+T	
Show Startup Selection Dialog	Enables the Configuration GUI window when starting the program. IF disabled, TESEUS will start the session with the last GUI used.		
About TESEUS	Returns the actual software version number and ownership information	Ctrl+I	

3.3 Basic Mode - getting started

3.3.1 Basic Mode configuration

The ***Basic Mode*** GUI allows the programming of the device with a basic set of parameters. In this way the user can get accustomed with TESEUS and the TDA5150 architecture in a soft way, speeding-up the learning curve on the device. In this mode a significant part of the registers (***SFR***s) are blocked from editing as they are automatically programmed with default values.
Anyway some of the important ***SFR***s content is displayed -despite disabled editing, in order to make more comprehensive the behavior of the device in ***Basic Mode***. To use this mode, just start TESEUS and select ***Basic Mode*** from the ***Startup Selection Dialog*** window.

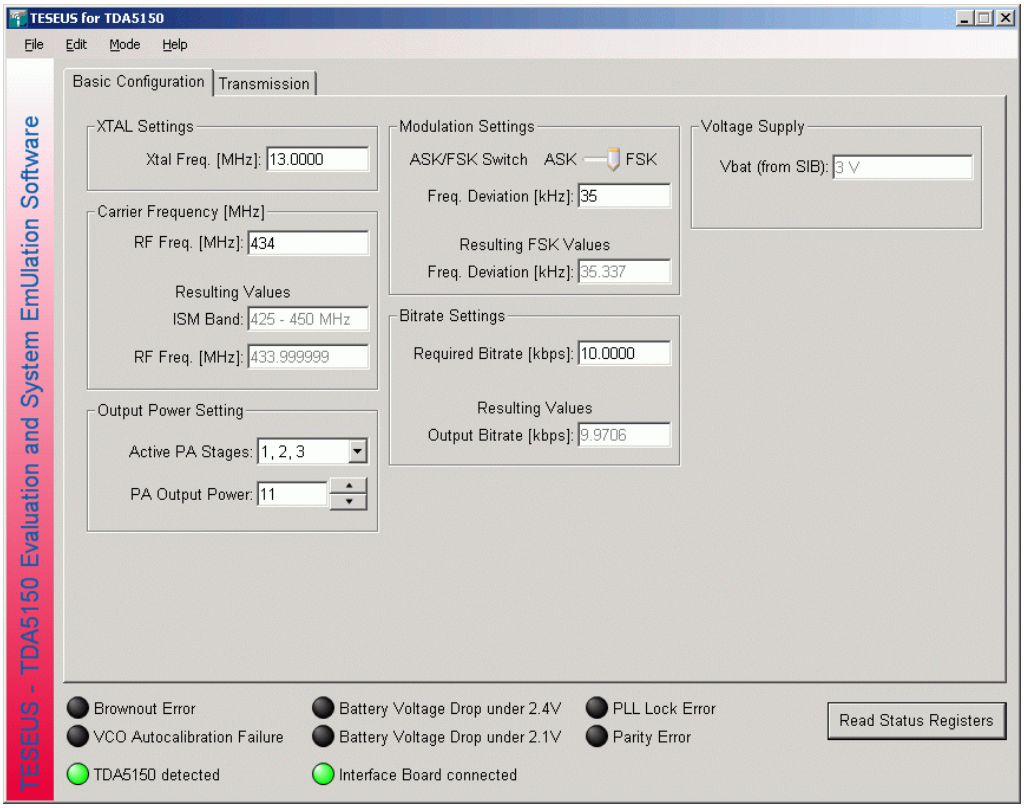

Figure 21 Basic Mode configuration

In the ***Basic Configuration*** tab, the editable parameters are grouped as:

- ***XTAL Settings***: this field contains the crystal frequency value, expressed in MHz. This must be in accordance with the crystal frequency on the used hardware (board). The TDA5150 EvalBoard provided by Infineon contains a crystal with nominal 13.00 MHz value. Anyway it is recommended to check the reference oscillator frequency and make fine adjustments (usually in magnitude below 1 kHz) if the unmodulated carrier (CW) frequency is offset from nominal RF channel value. This alignments can be done at best in ASK mode, as there is an equivocal carrier frequency, but also FSK (or GFSK) modulation may be used, with a symmetrical pattern (for instance 1010...10...) and then center the amplitude dip (i.e. the dip between the two FSK peaks, left and right from carrier on the frequency axis) on the nominal RF channel frequency by means of fine adjustments on the *XTAL Freq* value in the corresponding TESEUS tab. The alignments operation assumes access to a calibrated Frequency Counter or a Spectrum Analyzer, but with a slight trade off a frequency calibrated receiver may be used as well - then tune for best bit- or message error rate, by low RF signal levels. This assumes again an RF attenuator or a receiver placed almost to link range limit (far away from transmitter).
- ***Carrier Frequency***: this field contains the RF frequency field value of the channel used. The ISM band field is automatically updated accordingly. It is recommended to select one or more channels within the ISM band for

which your Evaluation Board is matched, otherwise a significant drop of the RF power might occur (as the RF-PA output would be severely mismatched). The ISM frequency band and nominal RF output power for which the board has been optimized are contained on a small sticker on the top side of the delivered Evaluation Boards.

- ***Output Power Settings***: the RF output power of the device may be controlled by this parameter. Select the desired output power according to your Evaluation Board matching. To achieve the best PA efficiency and consequently low current consumption, make sure to configure the RF PA array for:
  – 9 stages if + 5 dBm output power is required
  – 10 stages if +8 dBm output power is required
  – 11 stages if +10 dBm output power is required

Note: The output power is determined not only by the number of active PA stages of the TDA5150 but it is also influenced by the load impedance of the RF power amplifier. Thus it is recommended to set the PA parameters (number of active stages) in accordance with the impedance (and nominal power) of the evaluation board under test to yield a minima of current consumption and maxima of efficiency.

- ***Modulation Settings***: the possible modulation schemes are ASK and FSK. If FSK is chosen, the Frequency Deviation value have to be programmed as well (otherwise, with a default value of 0 Hz there should be no distinguishable RF carrier modulation)

3.3.2 Transmission in Basic Mode

In the ***Transmission*** Tab of the ***Basic Configuration***, both the ***Device Evaluation*** and ***System Emulation*** can be selected. With this GUI, the ***System Emulation Mode*** datagram is fixed and can not be redefined by user.

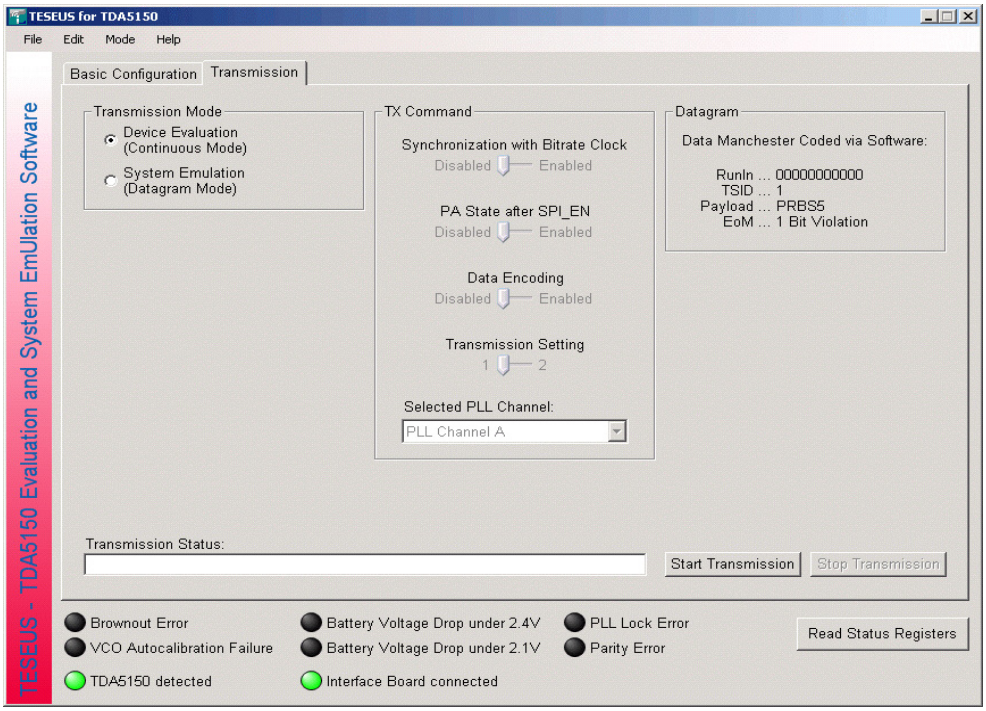

Figure 22 Transmission controls in Basic Mode

The default datagram is defined as following:

- Encoding: Manchester
- RunIn: 11 Bits of '0'
- TSID: 1 Bit of '1'
- PayLoad: PRBS5 (31 Bit)
- EoM: 1 Bit 'M' , Manchester violation

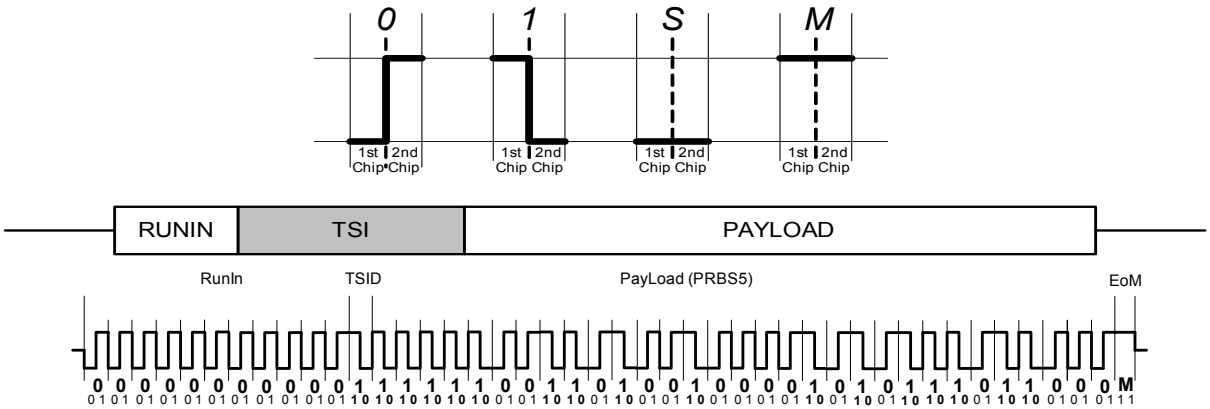

Figure 23 Default datagram structure, Basic Mode

The ***TX Command Byte*** is set by default according to the following description:

- Syncro with Bitrate disabled
- RF-PA off (disabled)
- Data Encoding disabled
- Transmission Setting 1
- Transmission Channel A

3.4 Advanced User Interfaces

This GUI allows you to program all the registers of the TDA5150. The user will be guided through the device´s setting. The registers are grouped in tabs according to functional building blocks and functions. Invalid data will be recognized by automatic controls and proof within the dialog boxes (for instance not allowed transmit frequencies)

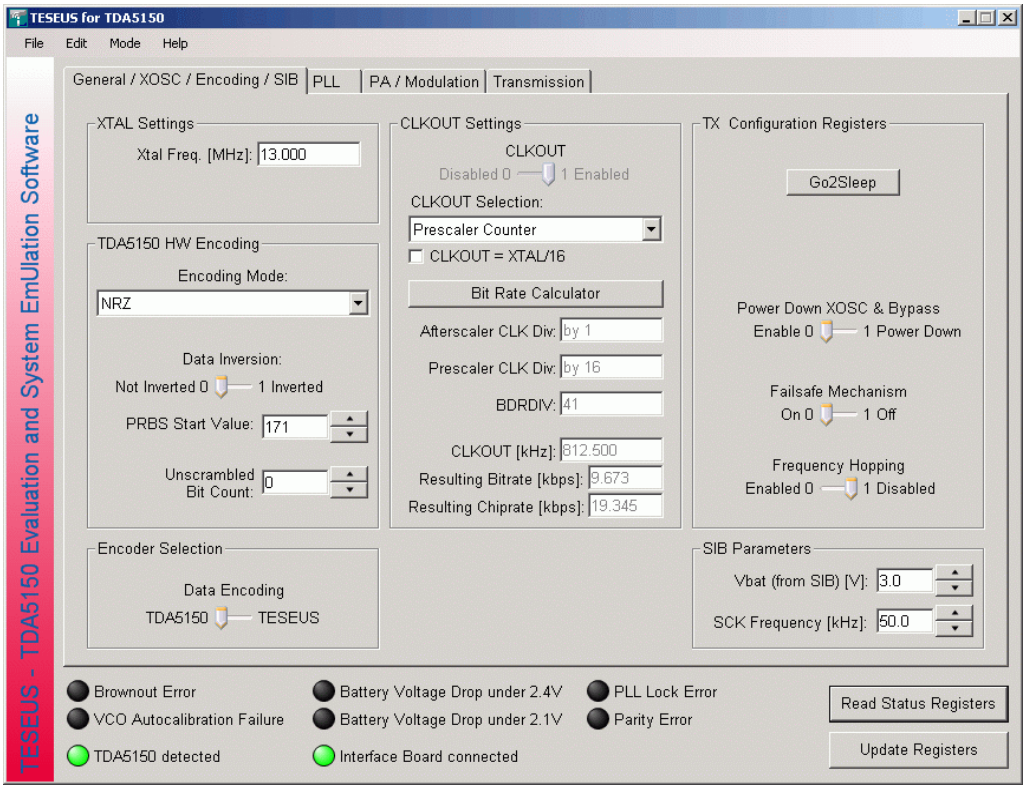

Figure 24 Advanced Mode: configuration tabs

For detailed description of registers and settings, please refer to the TDA5150 Datasheet and particularly to the ***SFR*** descriptions. The TESEUS Tooltips embeds and synthesizes this information within the software (refer to the ***Help menu***).

Note: the majority of the registers have a suggested (default) value. These values are set according to typical implementations and environmental usage, but may be edited and changed.

3.4.1 Advanced Configuration

One of the first inputs required to run the system is the nominal frequency of the crystal oscillator.

Remember that the TDA5150 Evaluation Board provided by Infineon Technologies contains a crystal resonating nominally at 13,00 MHz. It is possible to check the nominal frequency by reading the value on the case of the crystal (values are given usually in kHz by most of manufacturers, i.e. *13.000* is the reading of the crystals mounted on the Evaluation Boards).

Hint: Please follow these instructions, for easy measurement of actual crystal frequency

- Enter the nominal crystal frequency into the ***XTAL Settings*** field
- Program the device with the wanted nominal center frequency (f_c)
- Keep in mind that the nominal carrier frequency (f_c) is

$$fc = r \times fosc$$

where ***r*** is the fractional divider value programmed in the TDA5150 (***Divider*** window, as shown in **Figure 25**)

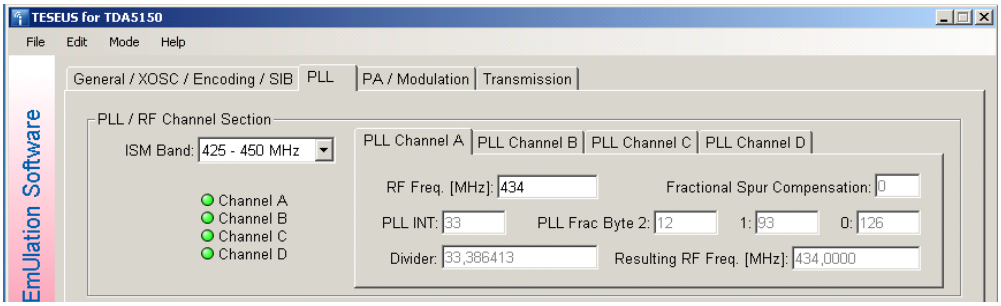

Figure 25 Channel frequency configuration in Advanced Mode

- Start a transmission in continuous mode (CW), choose FSK modulation with 0 Hz frequency deviation, and measure the actual carrier frequency with a spectrum analyzer or frequency counter. Using the value ***r*** it turns out that the actual crystal oscillator frequency is

$$\overline{\text{fosc}} = \text{fc} \div \text{r}$$

- Enter the new XTAL settings value in the corresponding Teseus box and check again if the f_c carrier is centred exactly (or at least within the desired frequency accuracy window) relative to the nominal channel frequency.

In order to easily program the TDA5150, it is recommended to enable the ***Tooltip*** option. Refer to **"HELP menu" on Page 22** for details.

Move the cursor and by pressing <***F1***> when the cursor is hovering over some specific fields, a related document will pop up. This explains in details the way the device or the particular function works, and delivers useful hints.

3.4.2 Minimum set of registers which have to be programmed

In order to start a transmission a minimum set of ***SFR***s of the TDA5150 must be programmed in advance, before a transmission could be started. This is a mandatory action.

Below is a table listing the registers of the TDA5150

- in **green** are listed the registers mandatory to be programmed before a transmission can be started
- registers marked with **black** are the registers which should be used to 'customize' the transmission (but can be left in default- i.e. ***after_Reset*** state as well).
  For default values please consult the ***TDA5150 Datasheet***.

Table 4 Special Function Registers (SFR) table

Register	Addr	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
SPICHKSUM	0x00	SPICHKSUM	SPICHKSUM	SPICHKSUM	SPICHKSUM	SPICHKSUM	SPICHKSUM	SPICHKSUM	SPICHKSUM
TXSTAT	0x01	1	n.u.	LBD_2V1	LBD_2V4	VAC_FAIL	BROUTERR	PARERR	PLLLDERR
VACRES	0x02	n.u.	n.u.	n.u.	n.u.	VAC_RES	VAC_RES	VAC_RES	VAC_RES
VACDIFF	0x03	VAC_DIFF	VAC_DIFF	VAC_DIFF	VAC_DIFF	VAC_DIFF	VAC_DIFF	VAC_DIFF	VAC_DIFF
TXCFG0	0x04	GO2STDBY	reserved	reserved	FSOFF	**ISMB**	**ISMB**	reserved	PD_XOSC
TXCFG1	0x05	GO2SLEEP	ASKFSK2	ASKFSK1	ASKSLOPE	INVERT	ENCMODE	ENCMODE	ENCMODE
CLKOUTCFG	0x06	CLKSRC	CLKSRC	AFTERSCALE	AFTERSCALE	PRESCALE	PRESCALE	PRESCALE	**CLKOUTENA**
BDRDIV	0x07	BDRDIV	BDRDIV	BDRDIV	BDRDIV	BDRDIV	BDRDIV	BDRDIV	BDRDIV
PRBS	0x08	PRBS	PRBS	PRBS	PRBS	PRBS	PRBS	PRBS	PRBS
PLLINTA	0x09	n.u.	**PLLINTA**	**PLLINTA**	**PLLINTA**	**PLLINTA**	**PLLINTA**	**PLLINTA**	**PLLINTA**
PLLFRACA0	0x0A	**PLLFRACA0**	**PLLFRACA0**	**PLLFRACA0**	**PLLFRACA0**	**PLLFRACA0**	**PLLFRACA0**	**PLLFRACA0**	**PLLFRACA0**
PLLFRACA1	0x0B	**PLLFRACA1**	**PLLFRACA1**	**PLLFRACA1**	**PLLFRACA1**	**PLLFRACA1**	**PLLFRACA1**	**PLLFRACA1**	**PLLFRACA1**
PLLFRACA2	0x0C	n.u.	n.u.	**FRACCOMPA**	**PLLFRACA2**	**PLLFRACA2**	**PLLFRACA2**	**PLLFRACA2**	**PLLFRACA2**
PLLINTB	0x0D	n.u.	PLLINTB	PLLINTB	PLLINTB	PLLINTB	PLLINTB	PLLINTB	PLLINTB
PLLFRACB0	0x0E	PLLFRACB0	PLLFRACB0	PLLFRACB0	PLLFRACB0	PLLFRACB0	PLLFRACB0	PLLFRACB0	PLLFRACB0
PLLFRACB1	0x0F	PLLFRACB1	PLLFRACB1	PLLFRACB1	PLLFRACB1	PLLFRACB1	PLLFRACB1	PLLFRACB1	PLLFRACB1
PLLFRACB2	0x10	n.u.	n.u.	FRACCOMPB	PLLFRACB2	PLLFRACB2	PLLFRACB2	PLLFRACB2	PLLFRACB2
PLLINTC	0x11	n.u.	PLLINTC	PLLINTC	PLLINTC	PLLINTC	PLLINTC	PLLINTC	PLLINTC
PLLFRACC0	0x12	PLLFRACC0	PLLFRACC0	PLLFRACC0	PLLFRACC0	PLLFRACC0	PLLFRACC0	PLLFRACC0	PLLFRACC0
PLLFRACC1	0x13	PLLFRACC1	PLLFRACC1	PLLFRACC1	PLLFRACC1	PLLFRACC1	PLLFRACC1	PLLFRACC1	PLLFRACC1
PLLFRACC2	0x14	n.u.	n.u.	FRACCOMPC	PLLFRACC2	PLLFRACC2	PLLFRACC2	PLLFRACC2	PLLFRACC2
PLLINTD	0x15	n.u.	PLLINTD	PLLINTD	PLLINTD	PLLINTD	PLLINTD	PLLINTD	PLLINTD
PLLFRACD0	0x16	PLLFRACD0	PLLFRACD0	PLLFRACD0	PLLFRACD0	PLLFRACD0	PLLFRACD0	PLLFRACD0	PLLFRACD0
PLLFRACD1	0x17	PLLFRACD1	PLLFRACD1	PLLFRACD1	PLLFRACD1	PLLFRACD1	PLLFRACD1	PLLFRACD1	PLLFRACD1
PLLFRACD2	0x18	n.u.	n.u.	FRACCOMPD	PLLFRACD2	PLLFRACD2	PLLFRACD2	PLLFRACD2	PLLFRACD2
SLOPEDIV	0x19	SLOPEDIV	SLOPEDIV	SLOPEDIV	SLOPEDIV	SLOPEDIV	SLOPEDIV	SLOPEDIV	SLOPEDIV
POWCFG0	0x1A	PA_PS2	PA_PS2	PA_PS2	**PA_PS1**	**PA_PS1**	**PA_PS1**	SLOPEDIV	SLOPEDIV
POWCFG1	0x1B	POUT2	POUT2	POUT2	POUT2	**POUT1**	**POUT1**	**POUT1**	**POUT1**
FDEV	0x1C	FDEVSCALE	FDEVSCALE	FDEVSCALE	**FDEV**	**FDEV**	**FDEV**	**FDEV**	**FDEV**
GFDIV	0x1D	GFDIV	GFDIV	GFDIV	GFDIV	GFDIV	GFDIV	GFDIV	GFDIV
GFXOSC	0x1E	FHBLANK	reserved	reserved	reserved	GFBYP	GFDIV	GFDIV	GFDIV
ANTTDCC	0x1F	DCCVBYP	DCCDISABLE	DCCCONF	DCCCONF	TUNETOP	TUNETOP	TUNETOP	TUNETOP
RES1	0x20	n.u.	reserved	reserved	reserved	reserved	reserved	reserved	reserved
VAC0	0x21	**VAC_CTR**	**VAC_CTR**	**VAC_CTR**	**VAC_CTR**	**VAC_CTR**	**VAC_CTR**	**VAC_CTR**	**VAC_CTR**
VAC1	0x22	n.u.	VAC_NXOSC	VAC_NXOSC	VAC_NXOSC	VAC_NXOSC	VAC_NXOSC	VAC_NXOSC	VAC_CTR
VACERRTH	0x23	VAC_ERRTH	VAC_ERRTH	VAC_ERRTH	VAC_ERRTH	VAC_ERRTH	VAC_ERRTH	VAC_ERRTH	VAC_ERRTH
CPCFG	0x24	n.u.	reserved	reserved	reserved	CPTRIM	CPTRIM	CPTRIM	CPTRIM
PLLBW	0x25	reserved	PLLBWTRIM	PLLBWTRIM	PLLBWTRIM	reserved	reserved	reserved	reserved
RES2	0x26	reserved	reserved	reserved	reserved	reserved	reserved	reserved	reserved
ENCCNT	0x27	ENCCNT	ENCCNT	ENCCNT	ENCCNT	ENCCNT	ENCCNT	ENCCNT	ENCCNT

3.4.3 Transmission in Advanced Mode

In the ***Transmission Tab*** of the ***Advanced Configuration*** mode, both ***Device Evaluation*** and ***System Emulation*** options are available.

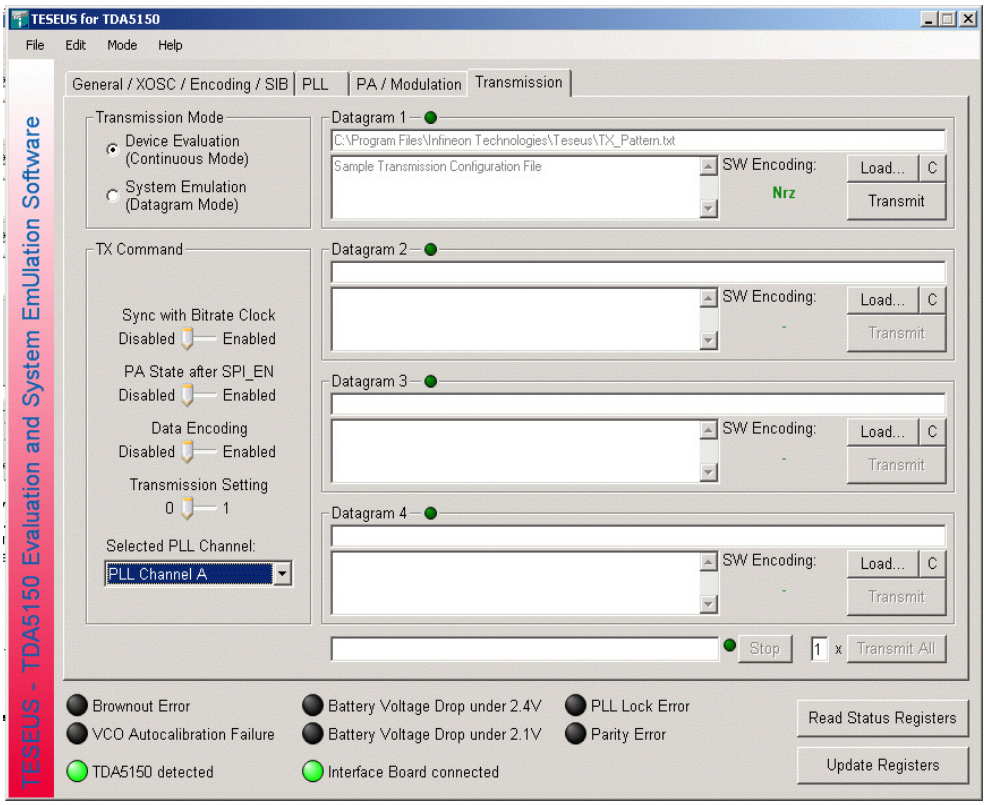

Figure 26 Advanced Mode - Transmission Tab and controls

Opposed to ***Basic Configuration*** Mode, the ***Transmission Command*** byte as well as the datagram must be defined by the user. The *TX File*, whose template can be found under the ***File*** menu, defines the structure and the content of the datagram.

- In ***Device Evaluation*** mode (Continuous Transmit Mode), the ***Transmission Command*** byte must be defined within the GUI. The transmitted data is extracted from the *TX File*
- In ***System Emulation*** mode both ***Transmission Command*** byte and *Datagram* must be defined within the Datagram file. TESEUS allows the usage of up to 4 datagram files at the same time, as shown in above example **Figure 26**

For explanations regarding the ***Transmission Command*** byte, please refer to the TDA5150 Datasheet. To start a transmission, click on the ***Load*** button, which loads a *TX File*. A template can be found in the ***File*** menu. If the user does wish to clear the uploaded file, just press the button ´***C***´, followed by a click on the ***Transmit*** button.

To stop the transmission, click the ***Stop*** button, located at bottom right region.

In the same Tab up to 4 different Tx Files can be processed within individual Tx boxes (Datagram 1..4)

The datagram file can be created ad-hoc in order to meet the format required by your application. Open the file with a text editor (Notepad for instance). The TX File contains a self explicative description regarding its structure and organization.

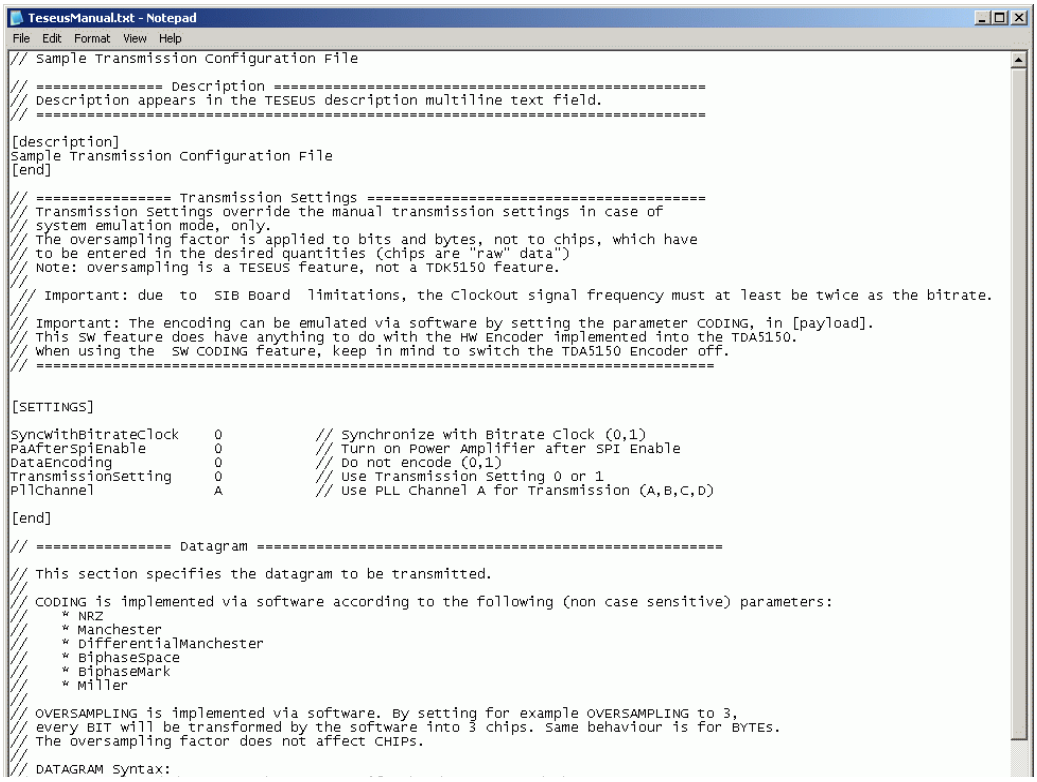

Figure 27 Tx File structure

The transmission file is composed by three main fields

- description
- settings
- datagram

The **description** field contains the description you want to visualize within the datagram window in Teseus. This feature can be used to easily visualize the description of the transmission and to distinguish it from other, alternative files.

The **settings** field defines the Transmission Command byte. Please refer to the TDA5150 Datasheet for detailed explanations.

The **datagram** field is composed of two commands OVERSAMPLING and CODING, followed by the datagram payload content, which should be transmitted.

OVERSAMPLING is used to oversample the data that is passed to the TDA5150.

By setting for example OVERSAMPLING to 5, every BIT will be transformed by the software into 5 chips. Same behavior is true for BYTEs.

For example, if the data rate is set to 1kbps and OVERSAMPLING is 5, the data passed to the TDA5150 will be 5 kchips per second.

That is, for every data-bit the device will receive and transmit 5 chips at a rate 5 times higher than the nominal data rate. This option can be useful for example during a ASK transmission for instance, if the protocol requires a moment of silence of 1.2 bits time length between two consecutive parts of the transmission, oversampling by 5 allows to transmit for the 0.2 chip long duration a space (brake).

CODING is used to encode via SW the data which is then passed to the TDA5150.

The following parameters (non case sensitive) are implemented:

- NRZ
- Manchester

- Differential Manchester
- Biphase Space
- Biphase Mark
- Miller

Coding is accomplished by TESEUS and the datastream transferred to the SIB board afterwards. The data to be transmitted is specified by *Data Type* descriptors, as follows

- "BIT" ..... Bits, will be encoded. Data is contained in "01001" - like sequences. Spaces inserted in the string, for better overview and to structure the data are allowed.
- "CHIP" ..... Chips, usable for example for Manchester Code Violation patterns. Data is contained in "01001" - like sequences. Spaces in the string to structure the data are allowed.
- "BYTE" ..... Byte Data, will be converted to Bits (MSB transmitted first). Data is declared bytewise or string like, according to following styles
  - 0x0F ....Hexadecimal byte (C-style)
  - &H3A ..... Hexadecimal byte (VB.net style)
  - 127 ....Decimal Byte
  - 'B' ....Single ASCII Character
  - 'test' ....ASCII Character String

After defining the datagram, save the *TX File* into a work folder, load it according to previous instructions, then click on the ***Transmit*** button.

3.5 Firmware Mode

This GUI, similar in functionality to the ***Advanced Configuration***, allows to access and program all the registers (***SFR***s) of the TDA5150. The main difference versus the ***Advanced*** GUI is the graphical interface and a reduced set of restrictions by setting of the parameters. It is therefore recommended to use this GUI after all the device´s parameters and behavior are understood.

The sequence of the commands and programming parameters follows the actual order of the registers (hexadecimal addresses in incrementing order) rather than any other logical organization. The tabs are named in accordance with the TDA5150 ***SFR*** address regions and commands are grouped alike.

Some optional controls, like a PLL frequency calculator, a VAC calculator and a frequency deviation calculator are available for advanced users.

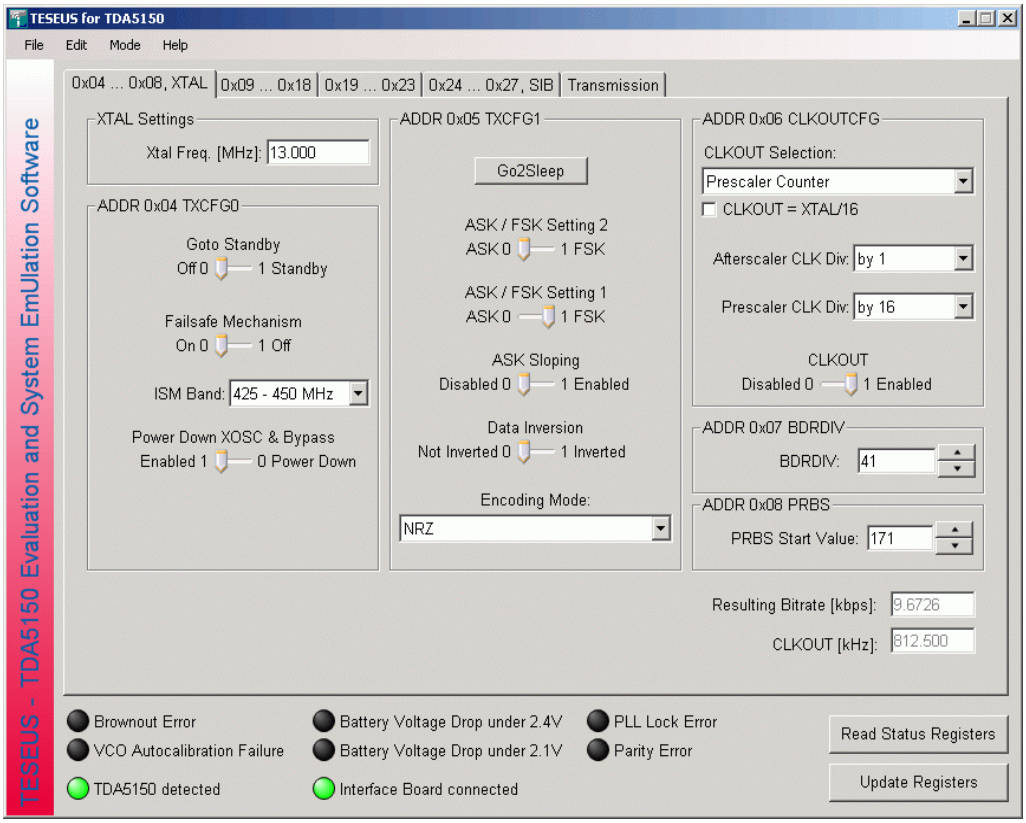

Figure 28 Firmware Mode - SFR tabs

The transmission tab reflects the same structure used in the ***Advanced Configuration***.
Please refer to **“Transmission in Advanced Mode” on Page 30** for further details.

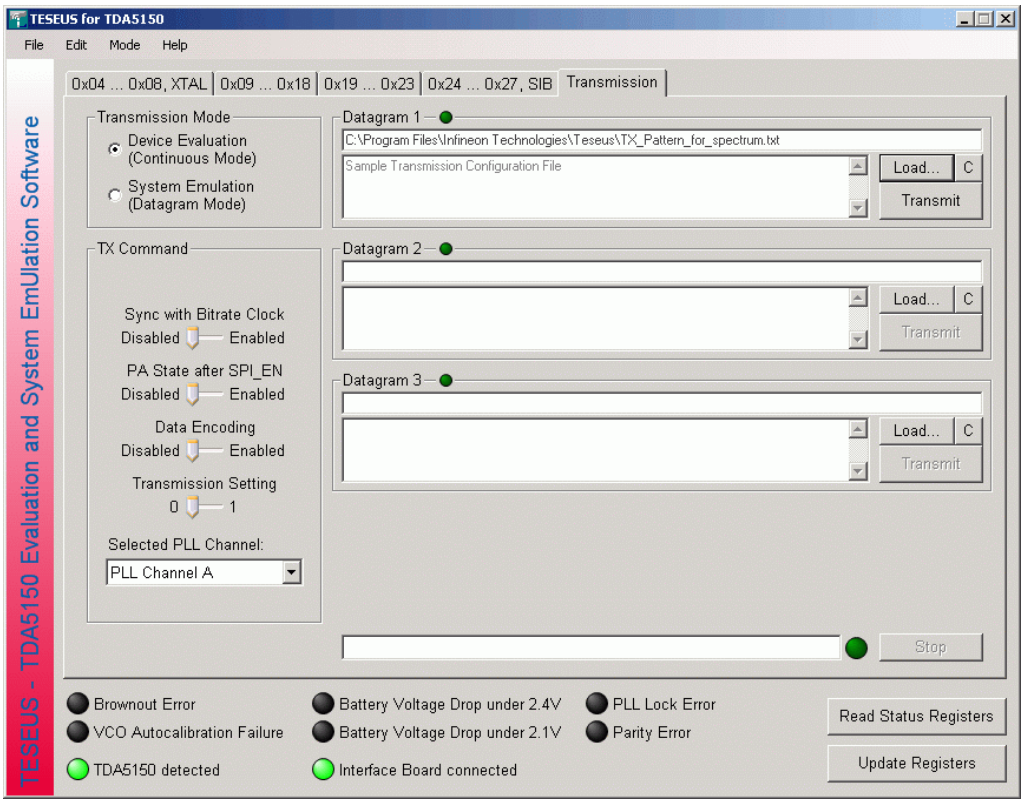

Figure 29 Firmware Mode - Transmission tab

4 TDA5150 Evaluation Board

The TDA5150 Evaluation Boards are deliverable in 5 different matching versions, each optimized in terms of output stage efficiency (RF-PA), for the ISM bands and nominal power classes listed below.

Additionally a ***SIB*** (System Interface Board) can be ordered, this last board is applicable for all ***Evaluation Boards***.

If a user requires Evaluation Boards for more ISM frequency bands - for instance for 315MHz and 915MHz, on cost saving reasons a single ***SIB*** may be ordered in conjunction with several ***Evaluation Boards***. However this solution (more Evaluation Boards and a single SIB) excludes the possibility of simultaneous work, with more Evaluation Boards at the same time.

Table 5 Deliverable Interface and Evaluation Board versions

ISM Band [MHz]	RF-Power [dBm]	ISAR Order Number
315	+5	SP000356305
434	+5	SP000356301
434	+10	SP000356304
868	+10	SP000356303
915	+10	SP000356302
SIB Board V1.2	x	SP000357842

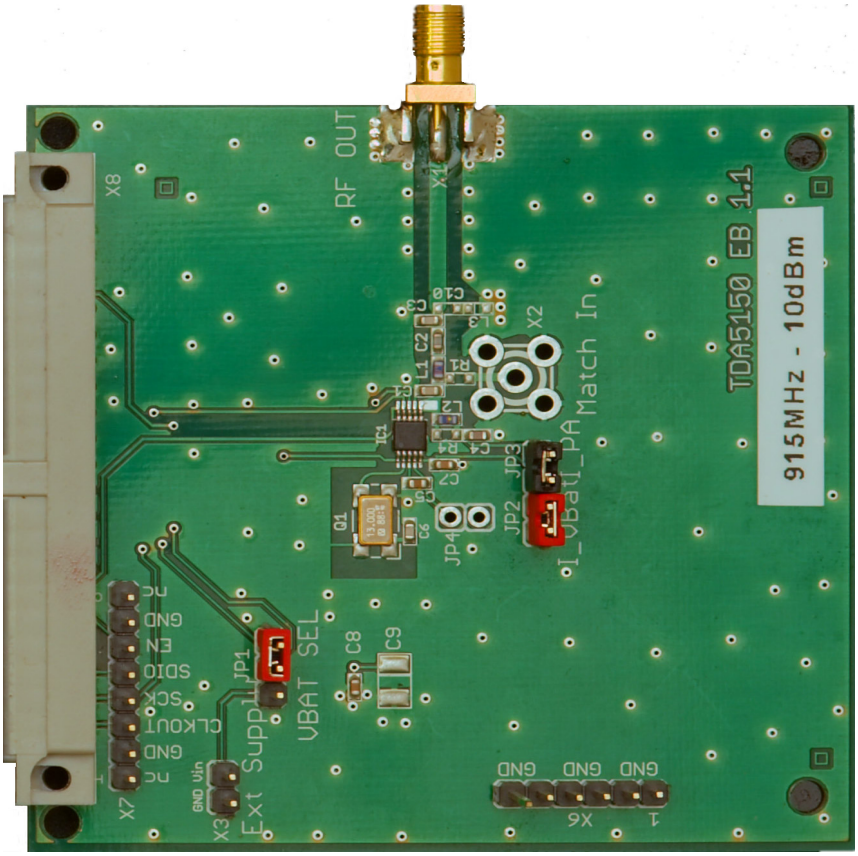

Figure 30 TDA5150 Evaluation Board (version V1.1; component side)

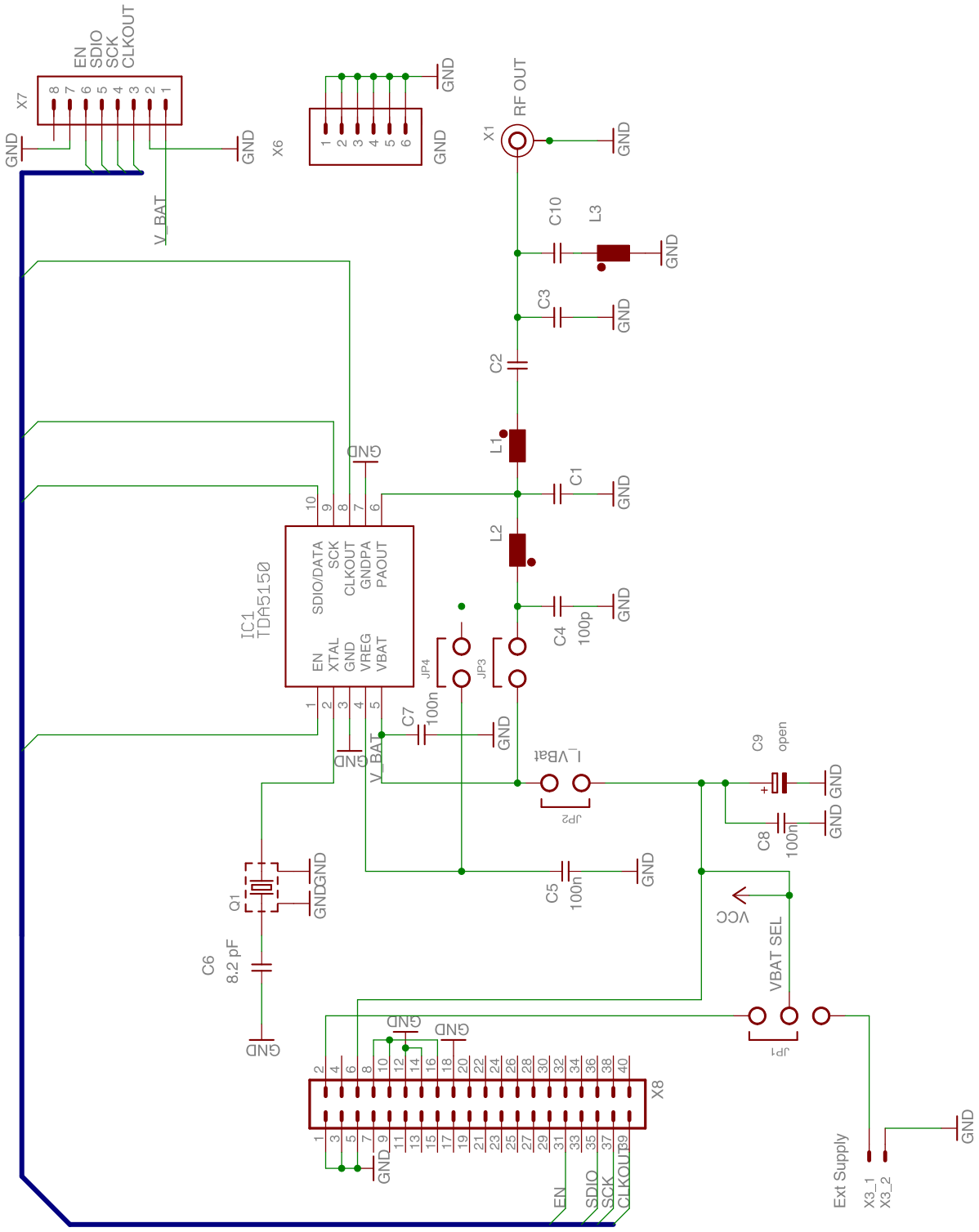

Figure 31 TDA5150 Evaluation Board schematic (version V1.1)

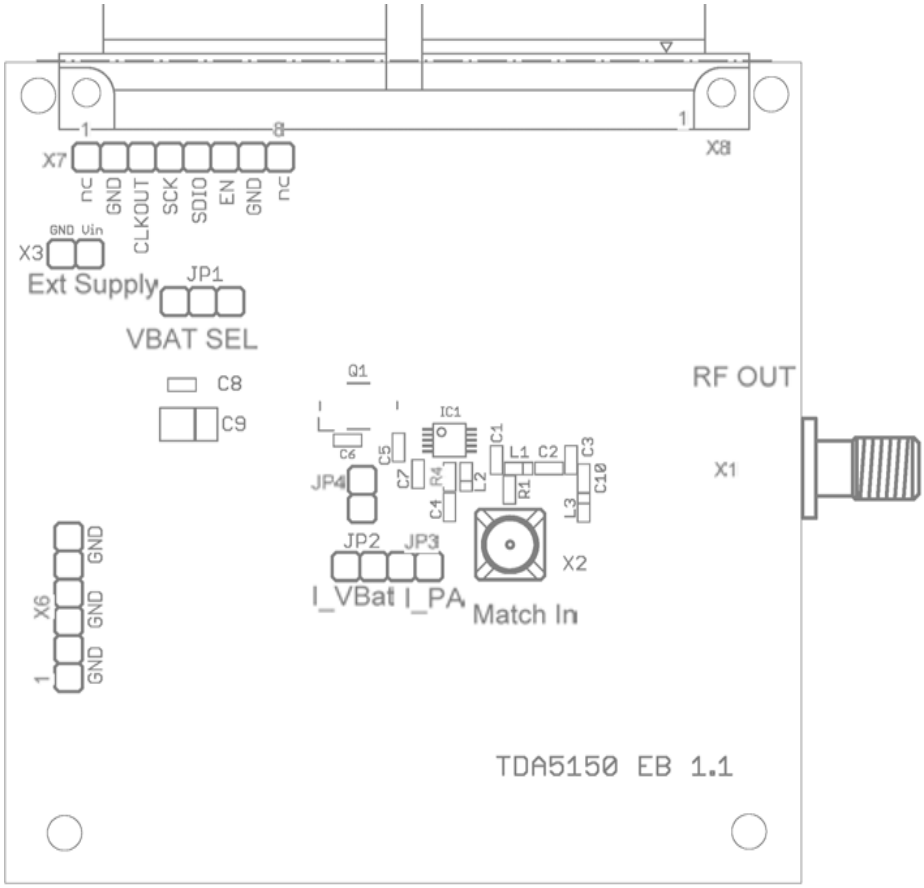

Figure 32 TDA5150 Evaluation Board V1.1, top view with part designators

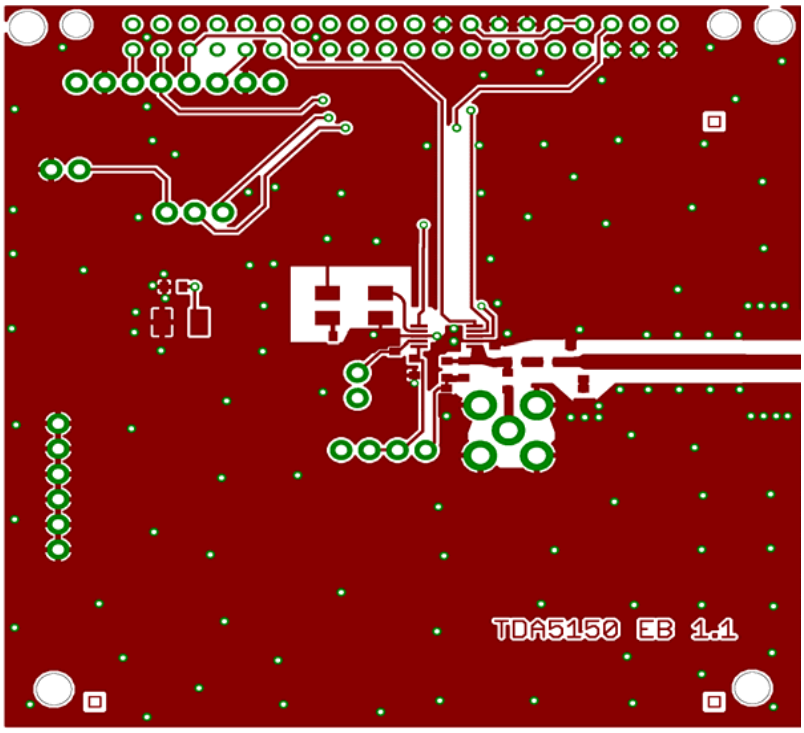

Figure 33 TDA5150 Evaluation Board V1.1, top copper layer

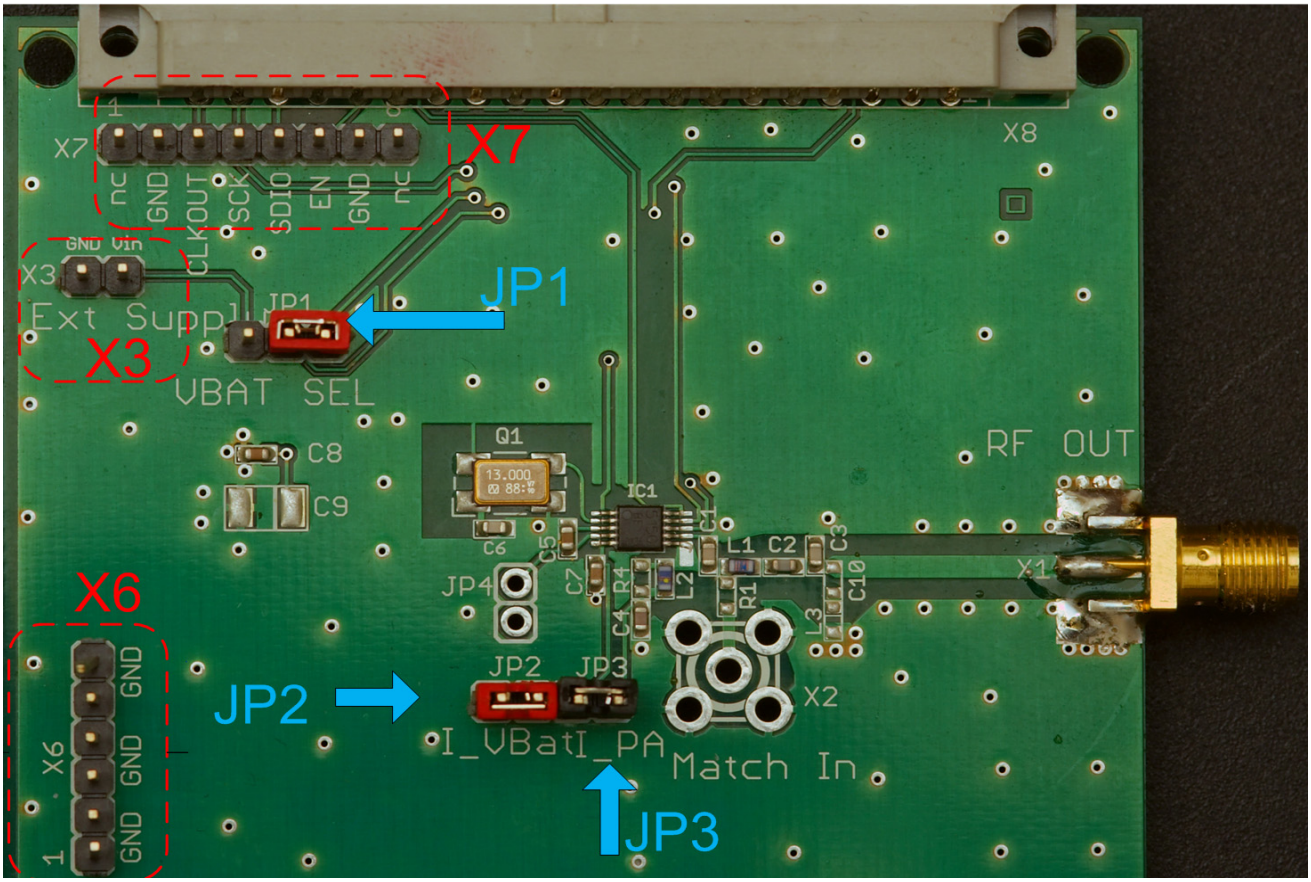

Figure 34 Connectors and docking points on Evaluation Board V1.1

- ***X3*** External voltage supply pins
- ***X7*** Pins for probing the digital signals (CLKOUT, SCK, SDIO, EN)
- ***X6*** ground connections (GND for probes)
- ***JP1*** External or Internal Voltage Supply selector
- ***JP2*** TDA5150 total current measurement pins
- ***JP3*** RF Power Amplifier current measurement pins

5 SIB Board and SPI protocol

SIB stands for **S**tandard **I**nterface **B**oard. Its main function is to interface the PC with the TDA5150 Evaluation Board. The data is downloaded from PC, steered by TESEUS to the SIB, stored in buffers and used to program the TDA5150 via the SPI interface.

Besides the SIB can supply with regulated voltage the TDA5150 Evaluation Board. The delivered supply voltage is Programable in steps of 0.1 V via the TESEUS tool (see also the bottom right side of **General** tab by **Figure 24**

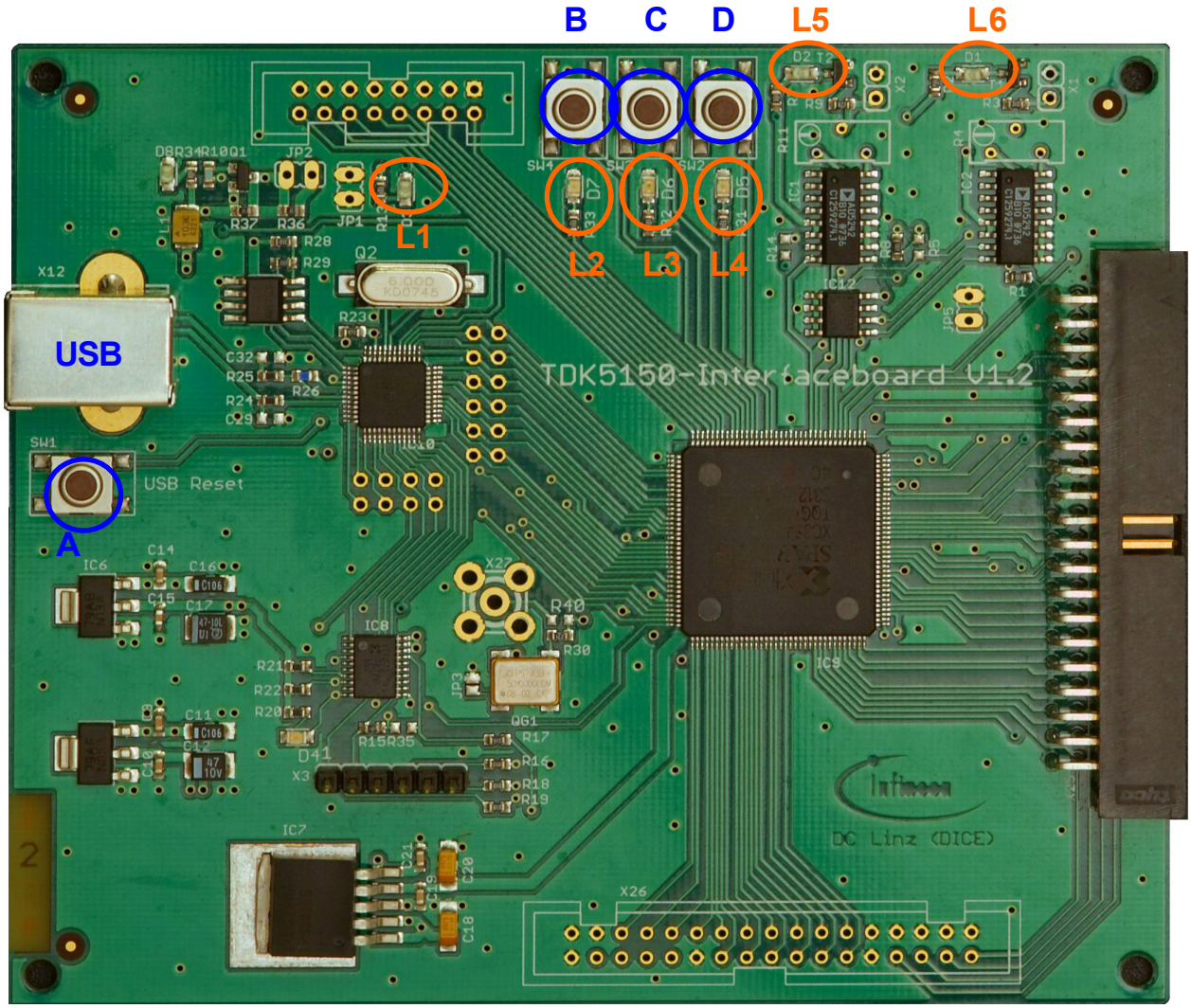

Figure 35 SIB board version V1.2, top view

- Button **A** - Reset the USB interface chip
- Button **B** - used to reset the microcontroller within the FPGA
- Button **C** - not used
- Button **D** - not used
- **LED1** - power supply (from USB) indicator. Probed after FTDI connect
- **LED2** - flashes when a command is transmitted from the PC to the SIB. If the LED is steadily ON (or more than 1 sec.), then an error occurred. Please press button **B** to reset the microcontroller and re-boot the system
- **LED3** - no function assigned
- **LED4** - no function assigned
- **LED5** and **LED6** - indicator for programmable power supply status. **LED6** is also used during internal FW tests, should be OFF during normal operation

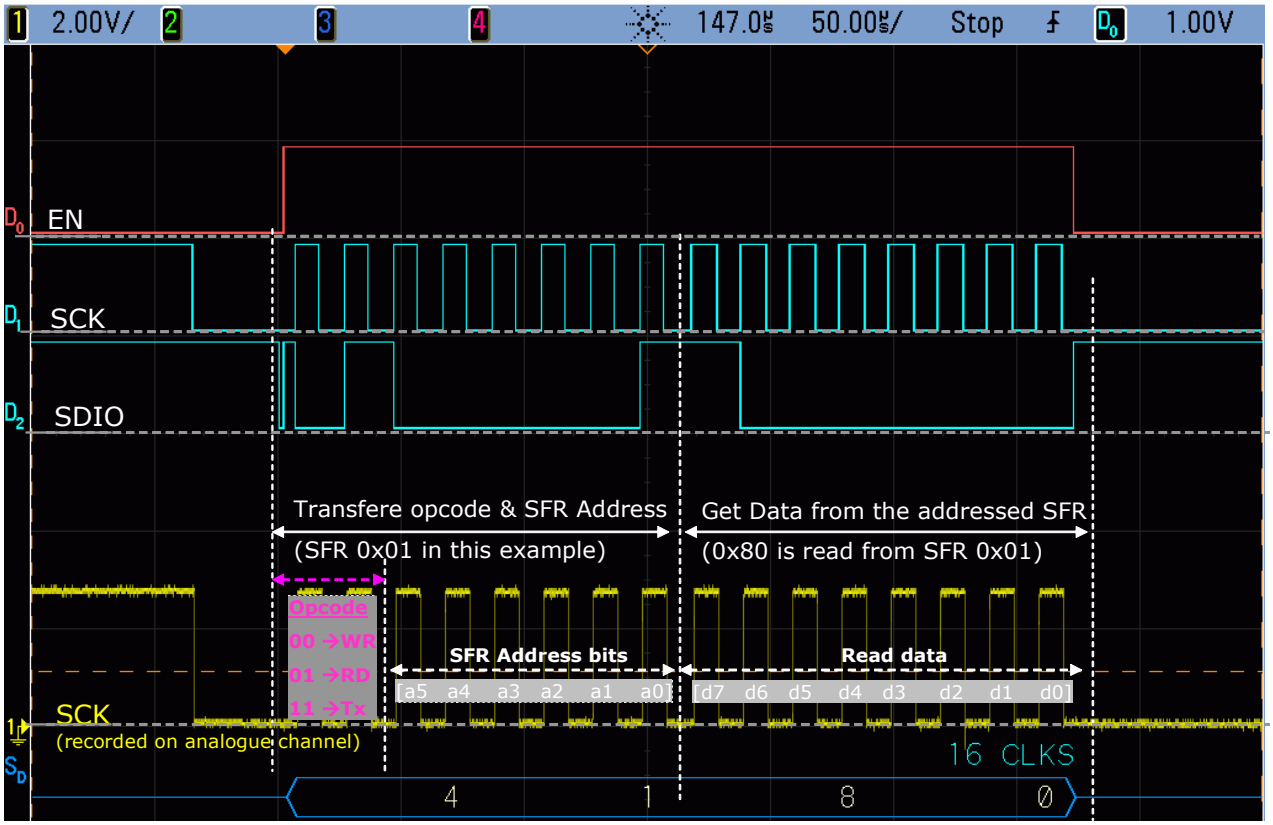

Figure 36 Example for data transfer over the SPI bus

In the above picture the process of data transfer between the SIB and TDA5150 is shown, exemplified on the ***Read*** operation of a register (SFR). During first part the *Operation Code* (Read) is transferred, followed by SFR address (0x01

in this example), then 8 bits of data (0x80) are read from register.

Namely the **EN**able line, the **SDIO** data line, the **SCK** clock line are represented, and at the screenshot's bottom, the SCK channel again, but assigned to an analogue channel and recorded accordingly instead of recording it as a digital line.

In recent implementation of TESEUS whenever a new transmission is started, all the 35 writable ***SFR*** registers of the TDA5150 are programmed, one by one (even if not all of the registers are used in a particular usecase. For instance if only ***Channel A*** of PLL is used, still all the registers assigned to ***Channel B***; ***C*** and ***D*** are programmed (i.e. the PLL integer and fractional ***SFR***s). This is of course not mandatory and the user can shorten up the application programming procedure, limiting the transfer to those SFRs, which must be refreshed.

Note: The write commands generated by the SIB board are individual SFR register write operations (of Write[Address:Data] form). In other words in this implementation the SFRs are not updated in BURST Mode, but in individual Register Write mode, for ease of SPI communication debugging. However the user is free to use BURST Mode for register programming (in the user application) thus shorting at some extent the dead time used for programming the SFRs. A Read operation of the Status Register TXSTAT (0x01) is recommended before Burst Write, to make shure that any fail condition, latched previously is cleared.

The communication between SIB and the TDA5150 transmitter board is implemented in such way (in TESEUS) that immediately after programming of a SFR register, the corresponding checksum is read back and checked for errors (i.e SPICHKSUM register **0x00** is read after a SFR write operation), as shown by **Figure 37**.

Note: Even if the TDA5150 can handle SPI transfer speeds up to 2Mbps, due to limitations of the SIB board, (i.e. the on-board FPGA) the clock frequency output by SIB is limited to the [50..500] kHz range

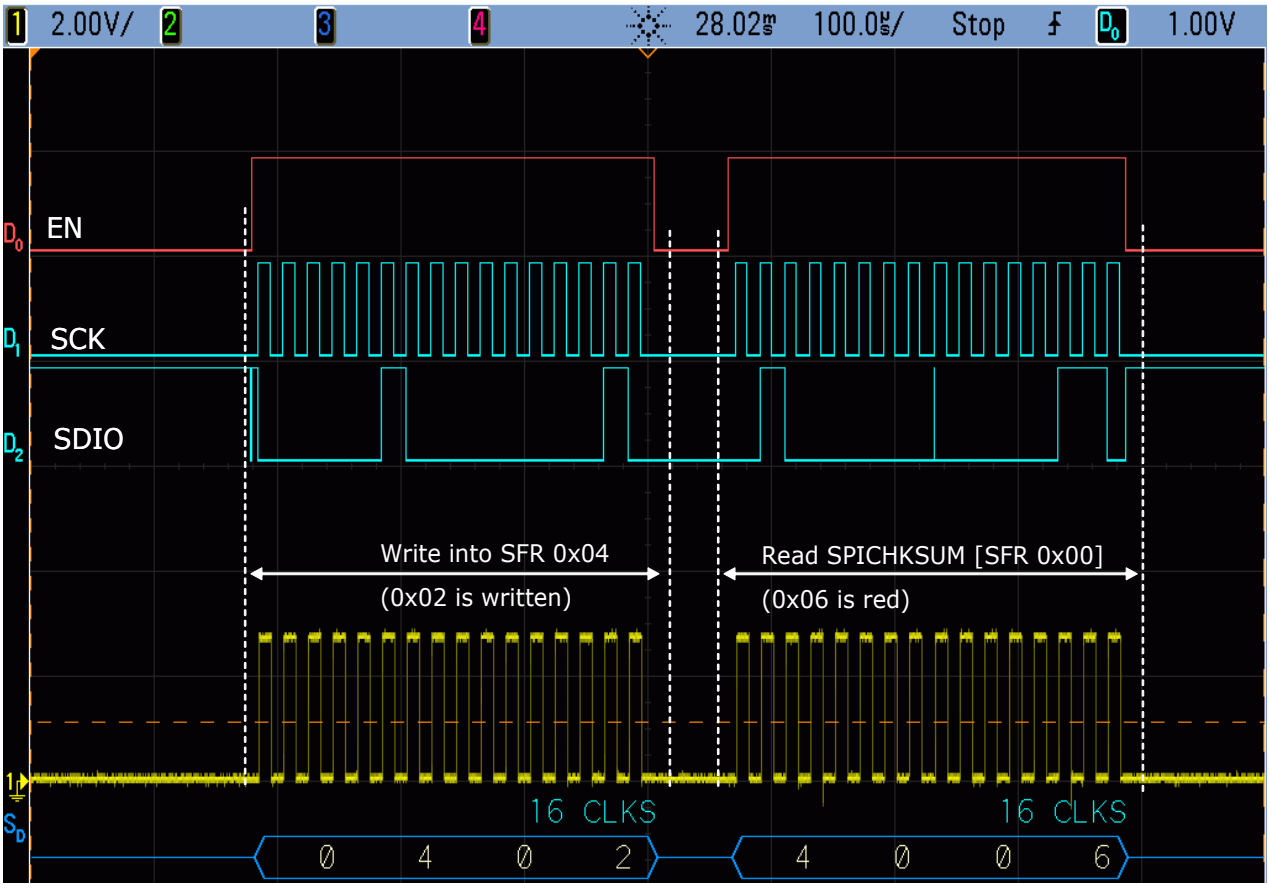

Figure 37 Example of programming a Special Function Register (SFR)

After all the 35 registers are correctly written, the transmission is started by launching the *Transmission Command Byte*, followed by the datagram (which is input into the modulator).

Transmission starts when a SCK active edge is detected after transmission of *TX Command Byte*.

Note: This is just an example how the SPI communication between the SIB board and the TDA5150 can be handled. In particular application approaches significantly different from those shown can be implemented. For example, instead of individually programming each register, the burst mode programming can be used and the dead time, required to transfer the data into SFRs shortened.

w w w . i n f i n e o n . c o m

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