TVP9900EVM

User's Guide

Literature Number: SLEU081A
March 2007–Revised July 2007

Texas Instruments

Contents

List of Figures

List of Tables

TVP9900EVM User's Guide

1 Functional Description

The TVP9900EVM evaluation module is a printed circuit board (PCB) designed for evaluation of the TVP9900 VSB/QAM receiver. The board is designed with a 36-pin connector that allows connection to multiple radio-frequency (RF) tuner boards; the EVM is shipped with a standard tuner module. The board is designed to provide ease of use, while allowing full evaluation of the TVP9900 VSB/QAM receiver.

1.1 Description Overview

The TVP9900EVM provides the user one RF input through a standard RF connector. The EVM provides, as an output, a digital parallel or serial MPEG-2 transport stream that is compliant to DVB-SPI. This output stream can be easily connected to a BER tester or to an MPEG-2 decoder, such as the TVP9000.

The differential intermediate frequency (IF) output signals from the tuner board are input to the TVP9900, which supports processing of ATSC 8-VSB or ITU-T Annex B QAM IF inputs with forward error correction (FEC). It provides peripheral support including automatic gain control (AGC) control, direct tuner control, and antenna control. In general, the receiver demodulates the input IF signal into a digital MPEG-2 transport stream, with advanced integrated features for AGC control, filtering, tracking, and error correction. An AGC control interface can be used to control the IF AGC amplifier gain in the tuner. The outputs supported by the EVM include parallel/serial MPEG-2 outputs with error packet indicator.

A 25-MHz clock is required to drive the PLL of the TVP9900. Some tuner devices have a 4-MHz clock output that can be used as the demodulator clock source. The TVP9900EVM has the option of using a 4-MHz clock input from the tuner as the clock source, or the default setting of using the onboard 25-MHz crystal. This selection is controlled by Jumper 1 together with R24, R25, and R26. See Section 2.1 for more details.

The TVP9900 includes the option of attaching a 12-V power supply and using the modular jack interface to provide CEA-909 compliant smart antenna control. The TVP9900 receives the antenna parameters from the host processor via I^2C and sends the modulated PWM signal to the antenna. The antenna parameters include antenna direction, antenna polarization, preamplifier gain, and channel number.

The TVP9900EVM uses the PC parallel port to emulate the I^2C bus, which provides communication with the TVP9900 receiver and the RF tuner. WinVCC (Windows® Video Control Center), a Windows compatible application, communicates with the devices via the I^2C and is provided on the EVM CD-ROM. This application software provides the user interface to experiment with the programmable features and to perform register-level and high-level control of the TVP9900 receiver and the RF tuner. The TVP9900EVM provides the option of whether the TVP9900 or the PC is the tuner I^2C master. This is controlled with jumpers 4 and 5, and the configuration is automatically detected by the WinVCC software. See Section 2.1 for more details.

2 Board-Level Description

The TVP9900EVM consists of the TVP9900EVM module and the tuner EVM module. A two-row 36-pin connector connects the boards. The block diagram of the EVM set is shown in Figure 1.

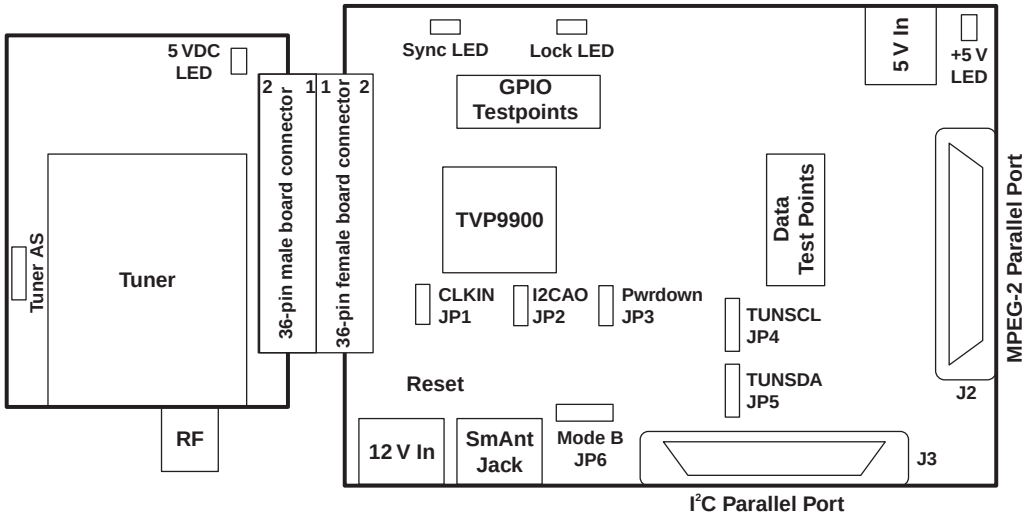


Figure 1. TVP9900EVM Block Diagram

2.1 Test Points and Jumpers

The TVP9900EVM was designed with test points and jumpers to help in evaluation and troubleshooting. Each jumper is set by default to its preferred state for the TVP9900EVM. There are test points for I^{2}C SCL and SDA, GND, 5 V, 3.3 V, and 1.5 V. The digital MPEG-2 transport stream data and GPIO signals are brought out to two dual-row headers that allow easy connect to test equipment.

The I^{2}C address selection is made with one shunt jumper, which is only read after a reset or at power up. The default address is 0xB8.

Note: If the I^{2}C address is changed on either the TVP9900 board or the tuner board while the TVP9900EVM is powered up, that device does not recognize the new I^{2}C address. The reset button on the TVP9900EVM must be pressed, and WinVCC must be exited, restarted, and configured for the new I^{2}C address.

Table 1. I^{2}C Address Selection Jumper (I2CA0, JP2)

JP2	I^{2}C Address
ON	0xB8
OFF	0xBA

Table 2. Power-Down Mode Selection Jumper (PWRDOWN, JP3)

JP3	Mode
ON	Normal operation
OFF	Power-down mode

JP1, together with R24, R25, and R26, control whether a 4-MHz clock from the tuner or a 25-MHz clock from the onboard crystal are used to drive the TVP9900. The jumper settings and resistor populate (POP) or do-not-populate (DNP) options are listed in Table 3. The default setting is for the 25-MHz clock.

Table 3. Clock Input Selection Jumper (CLKIN_SEL, JP1)

JP1	R24	R25	R26	Clock
ON	POP	POP	DNP	25 MHz
OFF	DNP	DNP	POP	4 MHz

The TVP9900EVM provides the option of whether the TVP9900 or the PC is the tuner I^2C master, and this is selected with JP4 (SCL) and JP5 (SDA). The default setting is for the TVP9900 to be the I^2C master.

Table 4. Tuner I^2C Master Selection Jumper (TUNSCL, JP4 and TUNSDA, JP5)

JP4	JP5	I^2C Master
1-2	1-2	PC
2-3	2-3	TVP9900

The TVP9900 has a CEA-909 compliant smart antenna control interface and the TVP9900EVM has the option of supporting either a Mode A (basic one-direction control) or Mode B (advanced bidirectional control) antenna using the 1-pin mode of the smart antenna control interface pin on the TVP9900 (pin 29). JP6 is used to enable or disable Mode B for smart antenna support. The default setting is for Mode A.

Table 5. Mode B Selection Jumper (Mode B, JP6)

JP6	Mode
1-2	Mode A
2-3	Mode B

2.2 Common Board Interface

The TVP9900EVM uses a two-row 36-pin connector (H1) to share common signals and the 5-V power supply between the boards. This connection allows multiple tuner boards to be connected to the TVP9900EVM. The EVM package is shipped with a standard tuner module. This connector shares the differential IF signals, AGC, 5 V, ground, I^2C bus (SCL and SDA), and, if desired, a 4-MHz clock, two general-purpose input/output (GPIO) signals, and reset.

2.3 Input Description

The differential IF output signals from the tuner board are input to the TVP9900, which supports processing of ATSC 8-VSB or ITU-T Annex B QAM IF inputs with forward error correction (FEC).

The TVP9900EVM receiver has an analog input channel that accepts one differential or single-ended 44-MHz center frequency IF input that is ac coupled. The receiver supports a maximum differential input voltage range of 1 V peak-to-peak. The programmable gain amplifier (PGA) and the AGC circuit work together and make sure that the input signal is amplified sufficiently to ensure the proper input range for the ADC. An external downconverter is not required to use the IF direct sampling method. The analog front end and adjacent digital filter relax the requirement for external analog filters, and only one external SAW filter is required.

2.4 Output Description

The EVM provides, as an output, a digital parallel or serial MPEG-2 transport stream that is compliant to DVB-SPI. The 8-bit MPEG-2 transport stream data output of the TVP9900, together with the clock and packet signals (see following list), are routed to a 20-pin header (H3) and then to an LVDS line driver, which is connected to a standard DB25F edge connector. This output stream can be easily connected to a bit error rate (BER) tester or to a MPEG-2 decoder. In serial mode, the DATAOUT7_SO pin is used as the serial data output (available on pin 17 of header 3), with the most-significant bit (MSB) output first. The maximum output rate is 42.1 Mbit/s in serial mode.

MPEG-2 clock and packet signals:

- DCLK – Data clock output
- PACK_SYNC – Byte start signal (indicates the first byte of a transport stream data packet)
- BYTE_VALID – Interface packet framing signal (indicates length of the valid data packet)
- D_ERROR – Interface data error (indicates an error in the data output packet)

3 System-Level Description

A system-level block diagram incorporating the TVP9900 is shown in Figure 2. The primary features of this configuration are:

- Power is provided by a single 5-V power supply provided with the EVM and is shared between both modules via the 36-pin connector.
- Supports one RF input through a standard RF connector
- Provides 8-bit MPEG-2 parallel or serial transport stream data output
- I^2C bus initializes the video devices via a PC parallel port.
- TVP9900 VSB/QAM receiver performance parameters may be measured with a BER tester.

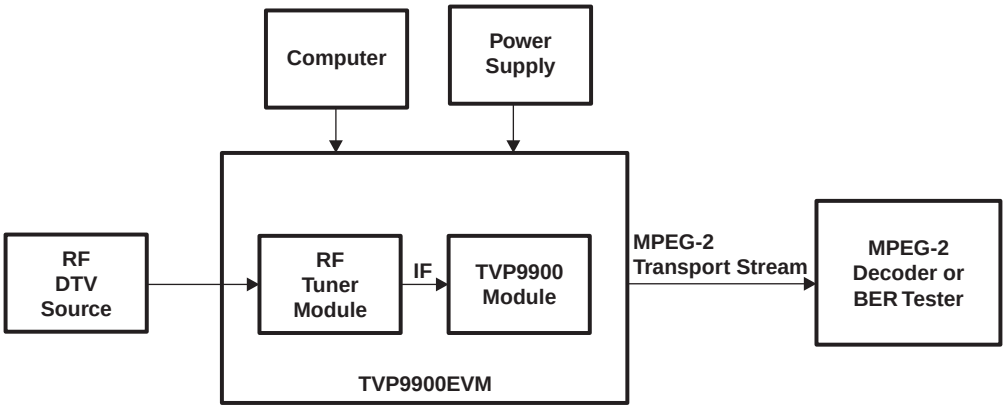


Figure 2. TVP9900EVM System-Level Block Diagram

4 Required Hardware and Equipment

The required hardware and equipment necessary to use the TVP9900EVM are:

- TVP9900EVM (provided)
- Universal 5-V power supply (provided)
- Parallel cable (provided)
- Windows-based PC with CD-ROM drive and Win95™ or later
- RF cable for input
- Parallel cable for output
- RF video source (terrestrial antenna, DTV cable, 8VSB/QAM test transmitter, etc.)
- MPEG-2 decoder or BER tester

5 Hardware Setup

Figure 1 shows the TVP9900EVM layout and indicates the location of the power supply and the appropriate connectors. All connectors are labeled according to their function. To prepare the EVM for evaluation, connect the following:

1. There are two parallel interfaces on the EVM. The one labeled J3 is for the I^2C interface to the PC. Connect a parallel port cable from this connector on the EVM to the PC.
2. The other connector, labeled J2, provides a digital MPEG-2 transport stream that is compliant to DVB-SPI. Connect this to a BER tester or to an MPEG-2 decoder.
3. Connect an RF video source to the TVP9900EVM tuner board RF input.
4. Connect the 5-V power supply to the dc jack on the TVP9900 board. A green LED on the board should now be lit.

The I^2C slave address can be selected with jumper JP2. There are two possible addresses: 0xB8 and 0xBA. The default setting for this jumper is for the shunt to be in place, which selects 0xB8. This is connected to TVP9900 pin 38, which is read at power up. If the shunt is removed and the EVM reset, the TVP9900 now responds to I^2C slave address 0xBA. The tuner I^2C address is set by default on the tuner EVM board to 0xC2 (tuner board jumper JP1 is open). This jumper setting is required to match the I^2C slave address in the Tuner Type window in the WinVCC software.

Note: If the I^2C address is changed on the TVP9900 or tuner board while the TVP9900EVM is powered up, the device does not recognize the new I^2C address. The reset button on the TVP9900EVM must be pressed, and WinVCC must be exited, restarted, and configured for the new I^2C address.

6 Software Installation

WinVCC is a Windows application that uses the PC parallel port to emulate I^2C, providing access to each device on the I^2C bus. WinVCC makes use of CMD files, which are text editable files that allows preset receiver setups to be programmed easily.

This feature allows the user to easily set multiple I^2C registers with the press of a button. WinVCC also has property sheets for the TVP9900, which allow the user to control the I^2C registers with a GUI. A tuner control page is provided to setup and control the included RF tuner.

All necessary software for the TVP9900EVM is provided on the enclosed CD. Perform the following steps to install WinVCC:

1. Explore the provided TVP9900EVM software CD.
2. Install Port95NT.exe. This is the parallel port driver used by WinVCC. This driver must be installed and the PC must be rebooted before WinVCC can operate correctly. This does not affect normal parallel port operation.
3. Install Setup.exe. Click Next at all prompts and click Finish to complete the installation process. This installs WinVCC onto the PC. No reboot is required.
4. Run WinVCC.exe.

Note: A shortcut to WinVCC and additional TVP9900 related documentation can be found at Start→All Programs→TVP9900EVM Software.

7 WinVCC Quick Start

Perform the following steps to get an MPEG-2 transport stream out of the TVP9900EVM.

1. Once WinVCC is executed, the WinVCC Configuration screen appears, as shown in Figure 3. This dialog box configures the I²C bus. Next to TVP9900, select the TVP9900 and ensure the I²C address is set to 0xB8 (default setting on EVM.) This must match the I²C ADDR jumper on the TVP9900 board.
2. The tuner I²C address is set by default in WinVCC to 0xC2. This is also the default setting on the tuner EVM board; verify the correct TUNER_AS jumper setting on the tuner board.

Note: If WinVCC is running and the TVP9900 or tuner board I²C address is changed, power must be cycled on the EVM.

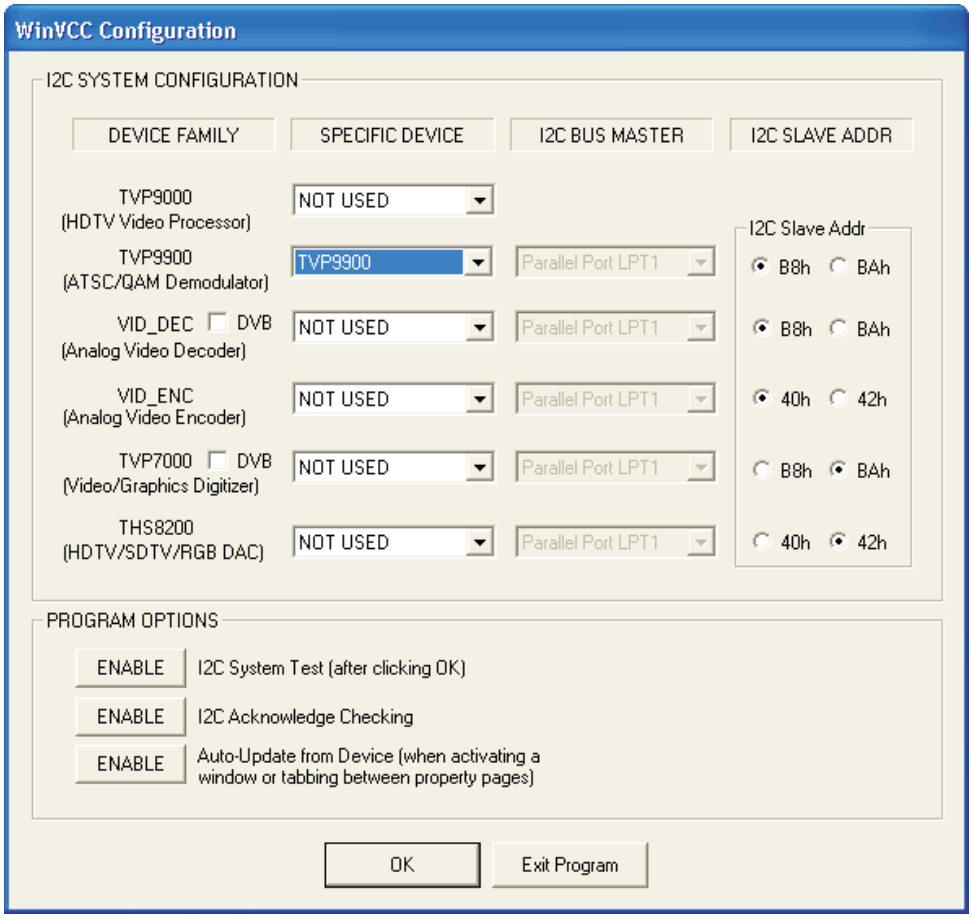


Figure 3. WinVCC – I²C Configuration Screen

3. Ensure that all other boxes are set to NOT USED and that all program options buttons are set to ENABLE. Click *OK*.
4. If there are no I²C communication issues, the WinVCC Main Screen dialog window displays next, as shown in Figure 4. If there are I²C issues, an I²C Test Report box displays. Completely exit out of WinVCC, double check the parallel port cable connections, cycle power on the TVP9900EVM, and run WinVCC again.

Figure 4. WinVCC – Main Screen

5. Load the provided initialization command (CMD) file into WinVCC by clicking on Tools→System Initialization and clicking *Browse*. The default directory is C:\Program Files\Texas Instruments\WinVCC\TVP9900\Initialization.
6. In the System Initialization Window, shown in Figure 5, click the "Program TVP9900 - 8-VSB mode - outputs enabled" dataset in the window and then click *PROGRAM Device(s) Using Selected Dataset* to initialize the TVP9900EVM for 8-VSB mode. The 64QAM mode and 256QAM mode can be set up by using the other datasets in this command file.

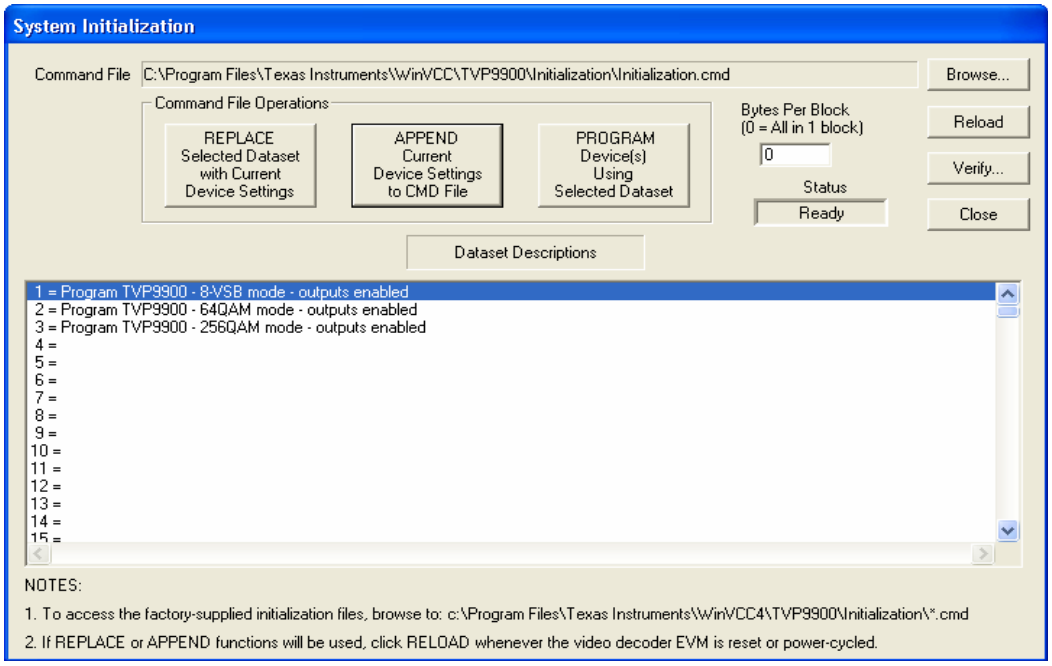


Figure 5. WinVCC – System Initialization

7. Click *Close*.
8. Program the tuner by clicking Tools→TV Tuner Control→ ATSC. The Tuner Type window, as shown in Figure 6, allows the user to select tuner and source settings. Select the Standard Digital ATSC Tuner button and click on OK to use the default tuner shipped with the TVP9900EVM.

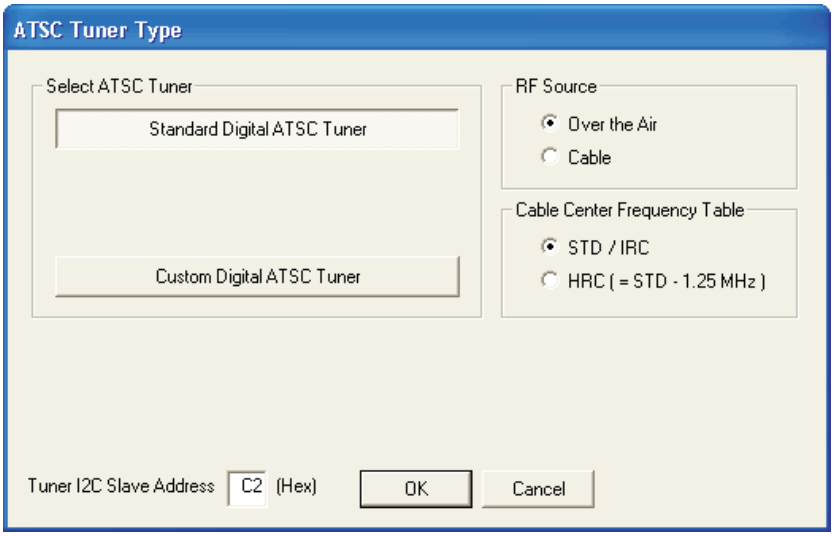


Figure 6. ATSC Tuner Type

9. In the TV Tuner Control window, as shown in Figure 7, select a channel from the "Add to Channel List"

drop down box.

10. Click *Add*. After approximately one second, the tuner is programmed to the selected channel.
11. For direct entry of the RF center frequency, type in the center frequency (for example, 189) into the "RF Center Freq (MHz)" box. Click *Program* to program the tuner.

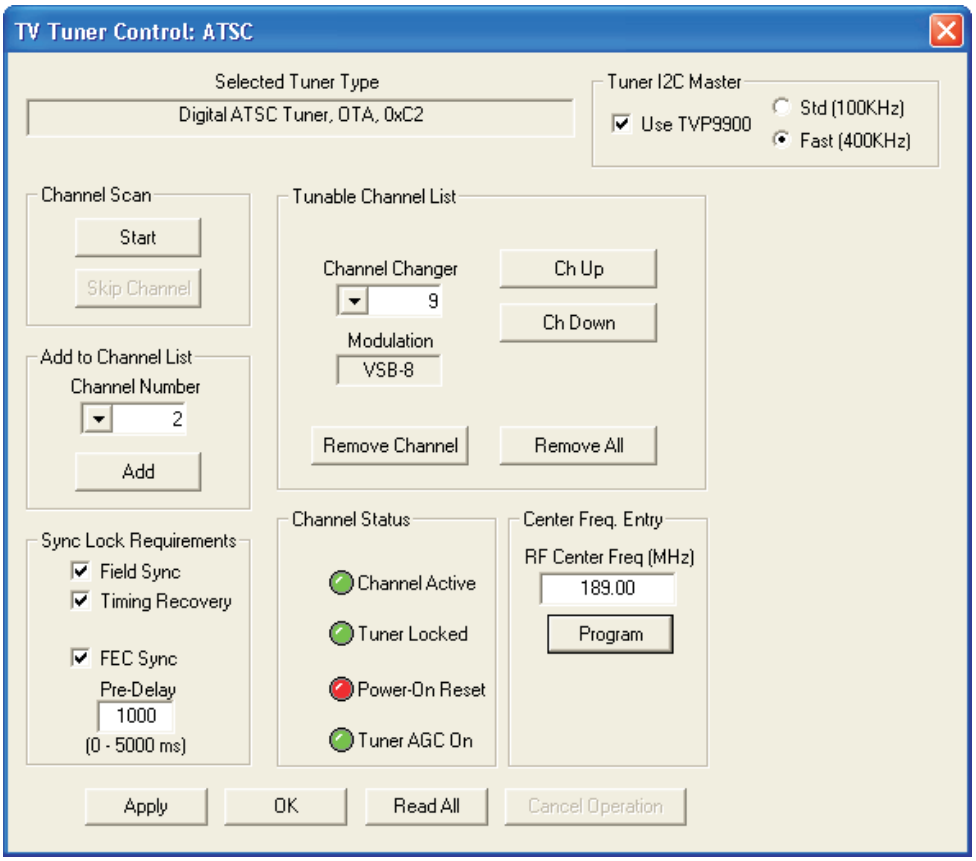


Figure 7. TV Tuner Control for ATSC

12. To perform a channel scan when the input is from an antenna (or cable), click *Start* on the TV Tuner Control page. This selects all channels for which the TVP9900 indicates locked status. The locking criteria are selectable on this page: Field Sync Lock (Default: ON), Timing Recovery (Default: ON), and FEC Sync Lock (Default: ON). The Pre-Delay is not needed.
13. After scanning, switching between channels can be easily done using the channel up/down buttons (*Ch Up* and *Ch Down*) or the "Channel Changer" drop-down list.
14. Click *OK* to close the TV Tuner Control tool.

15. Open the TVP9900 Property Sheets by clicking Edit→Property Sheets→TVP9900. Click on the Status tab, as shown in Figure 8. Click *Auto-Update* to enable it, and then click *Soft Reset*. The demodulator and FEC status are shown on this page.

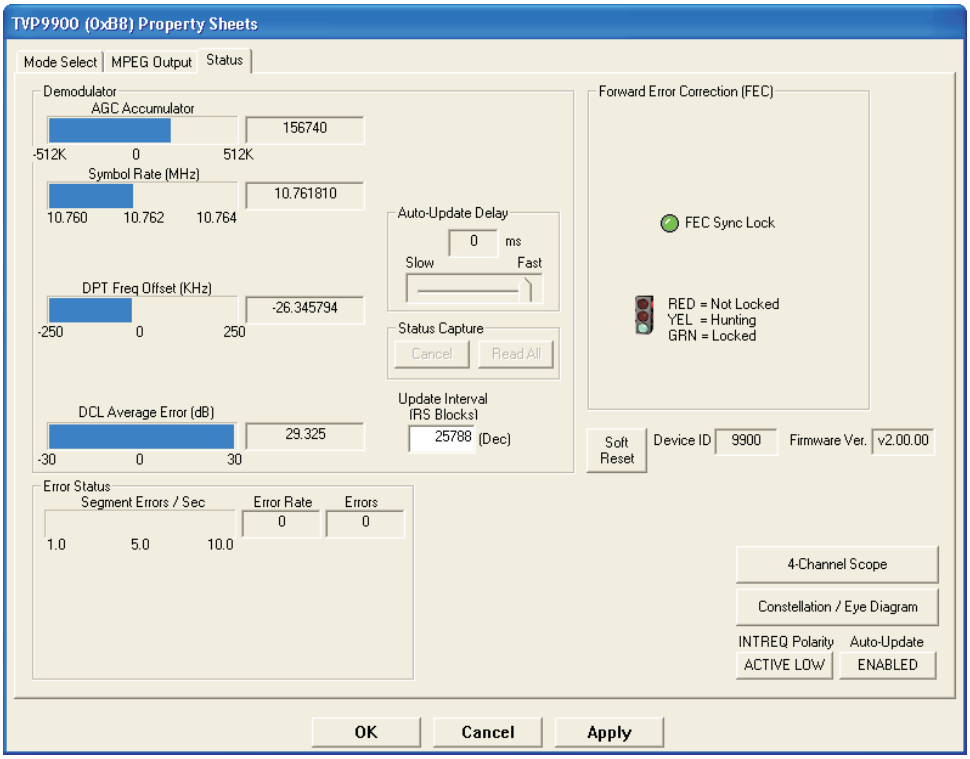


Figure 8. TVP9900 Property Sheets

16. With an RF source provided to the tuner RF connector, and the EVM output connected to a BER tester or MPEG-2 decoder, the MPEG-2 transport stream should be available. If the transport stream is not output from the TVP9900EVM, ensure the following is correct:
    - The input/output cables are connected correctly to the sources, EVM, and tester/decoder.
    - The input source is working properly and providing the expected RF input. Lock can be confirmed with the above property sheet.
    - The correct dataset is selected and programmed for the correct RF input format.

8 WinVCC in Depth

The following sections describe how to use WinVCC in depth. It discusses various features and screens that the user may encounter while evaluating the TVP9900EVM.

8.1 Starting WinVCC

The Port95NT parallel port driver must be installed before using WinVCC. WinVCC may be started by clicking on Start→All Programs→TVP9900EVM Software→WinVCC.

If the dialog box shown in Figure 9 is displayed, then it means one of two things:

- WinVCC terminated abnormally the last time it ran. In this case, click *OK* to exit the program and restart WinVCC.
- There is more than one instance of WinVCC running at the same time. In this case, click *OK* to exit the program. Then, press Ctrl+Alt+Delete to open the Task Manager. Select and click *End Task* on all occurrences of WinVCC or WinVCC CONFIGURATION. Restart WinVCC.

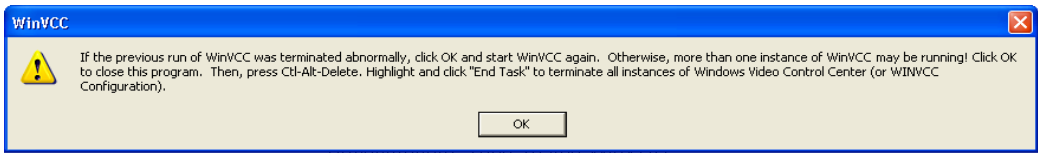


Figure 9. WinVCC Multiple Occurrences Error Message

8.2 WinVCC Configuration Dialog Box

The WinVCC Configuration dialog box, as seen in Figure 10, should now be visible. This dialog box configures the I^2C bus on the TVP9900EVM. All settings from this dialog box are stored in the Windows registry and are restored the next time the program is started. After initial installation, the TVP9900 (QAM/VSB Receiver) device family is set to TVP9900, and all other devices are set to NOT USED.

The I^2C slave address for each device must match the I^2C slave address selected by jumpers on the TVP9900EVM. These jumpers are set by the factory to use 0xB8 for the TVP9900 and 0xC2 for the tuner.

All Program Options must be enabled. Disabling these options is only required if you are debugging a problem with the I^2C bus.

Click *OK* to begin I^2C communication with the selected devices.

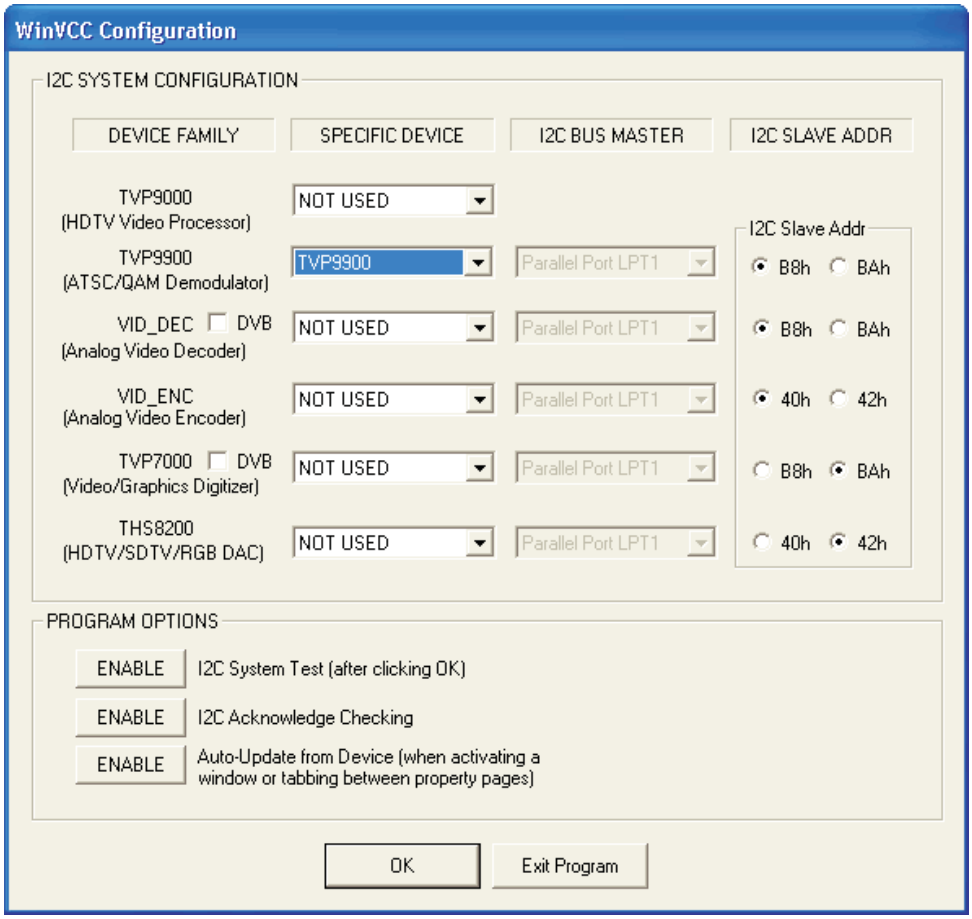


Figure 10. WinVCC I²C Address Configuration

8.3 I²C System Test

The I²C system test of the selected devices runs immediately after closing the WinVCC Configuration dialog box by clicking *OK* (unless the I²C system test program options button was disabled).

If the test fails, a dialog box similar to Figure 11 appears. See Section 10, *Troubleshooting*, for details on how to resolve this issue.

The I²C system test can be run at anytime by clicking Run System I²C Test in the Tools menu.

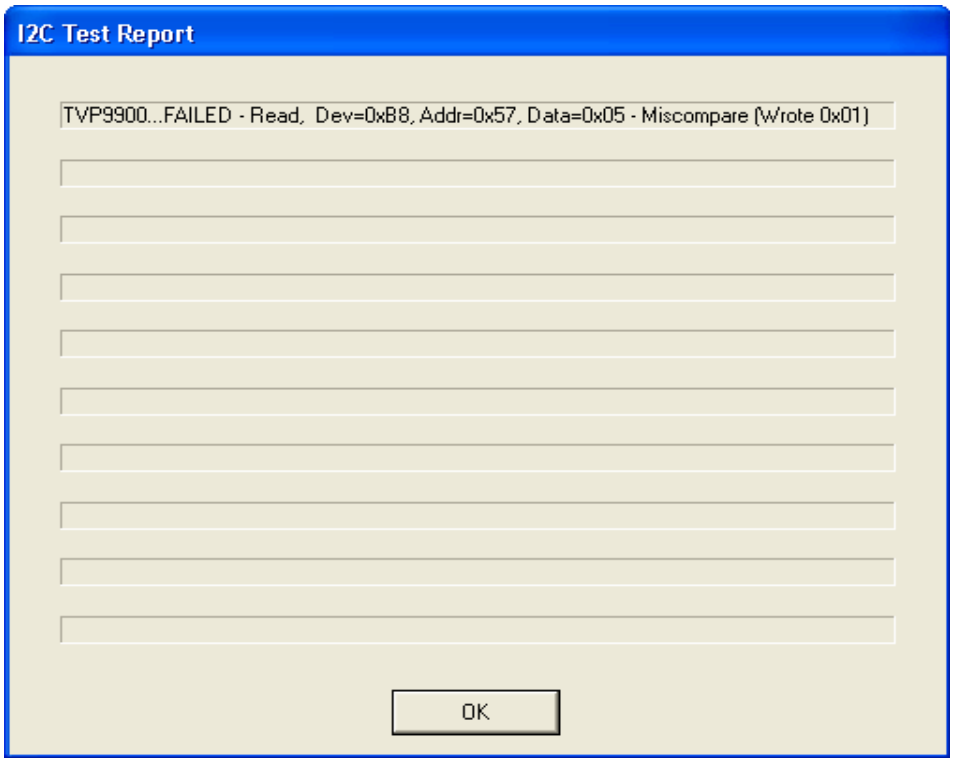


Figure 11. I²C System Failure

8.4 Main Menu

After closing the WinVCC configuration dialog, the main menu is displayed (see Figure 12). The menus that are used to operate WinVCC are File, Edit, Tools, Window, and Help. The File menu's only function is Exit, which terminates the program. Table 6 summarizes the main menu contents.

Figure 12. WinVCC – Main Screen

Table 6. Main Menu Summary

Menu	Contents
File	Exit
Edit	Register Map TVP9900 Generic I^2C Property Sheets TVP9900
Tools	System Initialization Real-time Polling TV Tuner Control NTSC CATV PAL CATV ATSC Multi-byte I^2C Transfers Set I^2C Bit Rate Run System I^2C Test Run Continuous I^2C Test
Window	Allows selection of the active window. Multiple windows can be open at the same time.
Help	Displays program version

8.4.1 System Initialization

Clicking System Initialization in the Tools menu displays the dialog box shown in Figure 13. This dialog box provides the means for initializing the TVP9900 receiver for a particular IF input mode. The details of the initialization are contained in the command file (with a CMD file extension).

The command file is loaded by clicking *Browse*. Once the command file is opened, a text list displays descriptions of the individual datasets contained within the command file.

Click once on the desired dataset description to select it. Click *Program Device(s) Using Selected Dataset* to run the selected dataset, which loads the devices via the I^2C bus. When the device initialization has completed, the status indicator displays Ready.

Note: If Ready does not display, the devices are not initialized, and the I^2C bus is not communicating. See Section 10, *Troubleshooting*, for possible solutions.

Click *Close* to close the dialog box. Each time the System Initialization dialog box is closed, the initialization file pathname and the dataset selection number are saved in the Windows registry to allow these settings to be retained for the next time WinVCC runs.

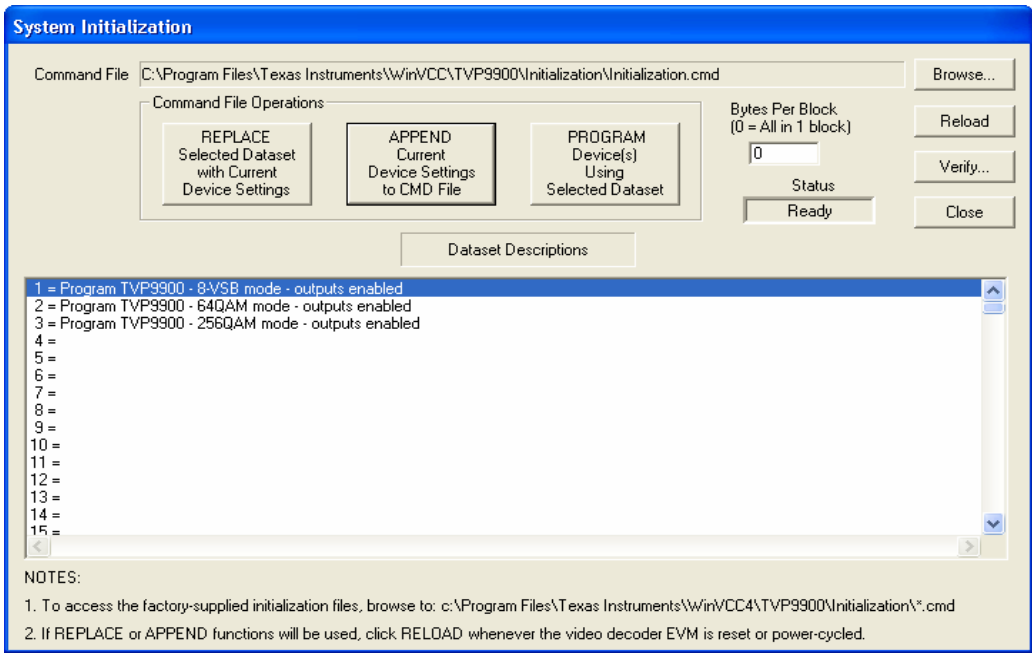


Figure 13. System Initialization

8.4.1.1 Adding a Custom Dataset

After programming the EVM via the System Initialization tool using the factory-supplied command file, customize the device register settings to fit the application needs. Perform the following steps to save the custom settings:

1. Reopen the System Initialization dialog box via the Tools menu.
2. Click *Append Current Device Settings to Command File*. A dialog box requesting a description of the new dataset appears.
3. Optionally, click the drop-down box and select one of the existing descriptions.
4. Modify the description text or type your own description.
5. Click *OK*. All non-default register values from the TVP9900 and tuner are appended to the current command file as an additional dataset.

Select the custom dataset and load it by clicking *Program Device(s) Using Selected Dataset*.

Using the same procedure but clicking *Replace Selected Dataset with Current Device Settings* overwrites an existing dataset with the current settings.

Note: If editing the command file (.CMD) using a standard editor, the file must be saved as plain text.

8.4.1.2 Command Files

The command file is a text file that can be generated using any common editor; however, it must be saved as plain text. In Windows Explorer, use right-click→Edit to open a command file. (Double clicking on a command file or using right-click→Open causes the command file to run as a script in a DOS window.)

Command files are especially useful for quickly switching between various system configurations. A default command file has been provided on the CD. This command file contains examples of common setups. This command file is located at:

C:\Program Files\Texas Instruments\WinVCC\TVP9900\Initialization\

A command file can contain up to 250 datasets. A dataset is a set of register settings to initialize the TVP9900 receiver and/or tuner for a particular IF input mode. Each dataset includes a description that is displayed in one row of the dataset descriptions list. The register settings may be located in the command file itself and/or may be stored in separate include file(s) (with an .INC file extension) and be included into the command file using the INCLUDE statement.

8.4.1.3 Example Command File

An example of one dataset within a command file is shown below.

```
BEGIN_DATASET

DATASET_NAME,"Program TVP9900 - 8-VSB mode - outputs enabled"

WR_REG,TVP9900,1,0X53, 0XFF // Enable outputs and clock
WR_REG,TVP9900,1,0X54, 0X03
WR_REG,TVP9900,1,0X00, 0X20 // soft reset

END_DATASET
```

Each command file may contain individual write-to-register (WR_REG) commands.

- The comment indicator is the double-slash, //.
- The command file is not case sensitive and ignores all white-space characters.
- All numbers can be entered as hexadecimal (beginning with 0x) or as decimal.
- Every dataset in a command file begins with BEGIN_DATASET and ends with END_DATASET. The maximum number of datasets is 250.
- The dataset text description is entered between double quotes using the DATASET_NAME command. The enclosed text can be up to 128 characters in length. This text appears in the System Initialization dialog box when the command file is opened.
- The INCLUDE command inserts the contents of an include file (with an .INC file extension) in-line in place of the INCLUDE command. Therefore, the include file must not contain the BEGIN_DATASET, END_DATASET, and DATASET_NAME commands.

Note: All included files must be located in the same directory as the command (CMD) file.

- The write-to-register command is written as follows:

  WR_REG, <DeviceFamily>, <Number of data bytes (N)>, <subaddress>, <Data1>,…, <DataN>

  or

  WR_REG, <Literal slave address>, <Number of data bytes (N)>, <subaddress>, <Data1>,…, <DataN>

  The valid device family mnemonics are:

  VID_DEC for the video decoders
  VID_ENC for the video encoders
  TVP9000 for the TVP900x HDTV video processors
  TVP9900 for the TVP9900 VSB/QAM demodulator
  TVP7000 for the TVP700x video/graphic ADC devices
  THS8200 for the THS8200 HDTV/SDTV/RGB DAC device

  WinVCC translates the device family mnemonic to the slave address that was selected in the WinVCC Configuration dialog box upon program startup. This eliminates the need to edit command files if the alternate slave address must be used.

  If the literal slave address method is used, then the slave address entered is used directly. This method can be used for programming the tuner.
- A delay may be inserted between commands using the WAIT command, which is written as follows:

  WAIT,<# milliseconds>
- If an I^2C write without a subaddress is required, use two consecutive commas instead of "subaddress,".

8.4.2 Register Editing

The following sections describe the three available modes of register editing: register map editor, generic I^2C register editor, and TVP9900 property sheets. Each of these functions can be selected from the Edit menu.

8.4.2.1 Register Map Editor

The register map editor (see Figure 14) allows the display and editing of the entire used register space of the device within a simple scrolling text box. To open this, click on Register Map in the Edit menu and click on the device type to edit. Table 7 describes how to use each of the controls in the register map editor.

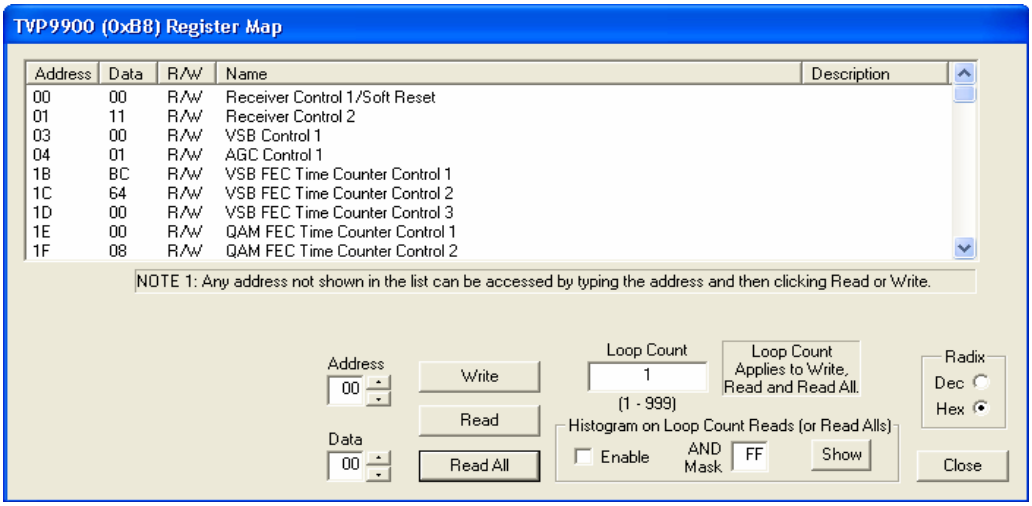


Figure 14. Register Map Editor

Table 7. Register Map Editor Controls

Control	Definition
Register Window	Scrolling text box that displays the address and data for the I^2C registers that are defined for the device
Address Edit Box	This contains the I^2C subaddress that is accessed using the Write and Read buttons. Clicking on a row selects an address, which then appears in the address edit box. NOTE: After clicking on a row, the Data Edit box contains the data that was in the register window. The device has not yet been read. The address up/down arrows are used to jump to the next/previous subaddress that is defined for the device. If an address is not defined for the device, it can still be accessed by typing the subaddress in the Address Edit box.
Data Edit Box	This contains the data which will be written to or was read from the I^2C subaddress. The data up/down arrows increment/decrement the data value by 1.
Write Button	Writes the byte in the Data edit box to the address in the Address edit box. The I^2C register is written to whether or not the data is different from the last time the register was read.
Read Button	Reads the data from the address in the Address edit box into the Data edit box and the register window
Read All Button	Reads all defined readable registers from the device and updates the register window
Hex Button	Converts all values in the register window and address and data edit boxes to hexadecimal
Dec Button	Converts all values in the register window and address and data edit boxes to decimal
Close Button	Closes the dialog NOTE: Multiple edit register map windows can be open at the same time (one for each device). Use the Window menu to navigate.
Loop Count	Causes subsequent write, read, or read all operations to be performed N times. N is entered as a decimal number from 1 to 999.

8.4.2.2 Generic I²C Register Editor

The generic I²C register editor (see Figure 15) allows the display and editing of any device on the I²C bus. This editor works like the TVP9900 register map editor, except that the I²C slave address must be entered and the *Read All* button is disabled.

To open this window, click Register Map in the Edit menu and then click Generic I²C.

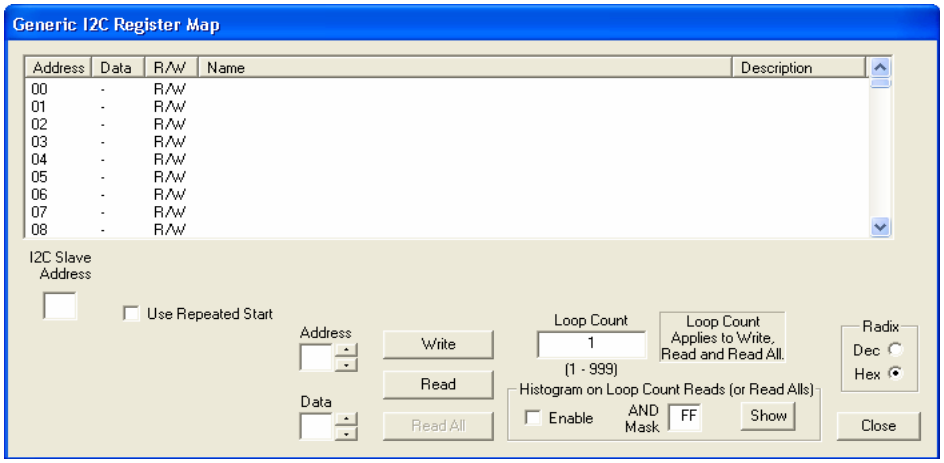


Figure 15. Generic I²C Register Editor

8.4.2.3 TVP9900 Property Sheets

The property sheets represent the register data in a user-friendly format. The data is organized by function, with each function having its own page and being selectable via tabs at the top (see Figure 16).

To open this, click on Property Sheets in the Edit menu and select the device type to edit.

When the property sheet function is started or when tabbing to a different page, all readable registers in the device are read from hardware to initialize the dialog pages. Values on the page are changed by manipulating the various dialog controls as described in the Table 8.

There are *OK*, *Cancel*, and *Apply* buttons at the bottom of each property page. These are explained in Table 9.

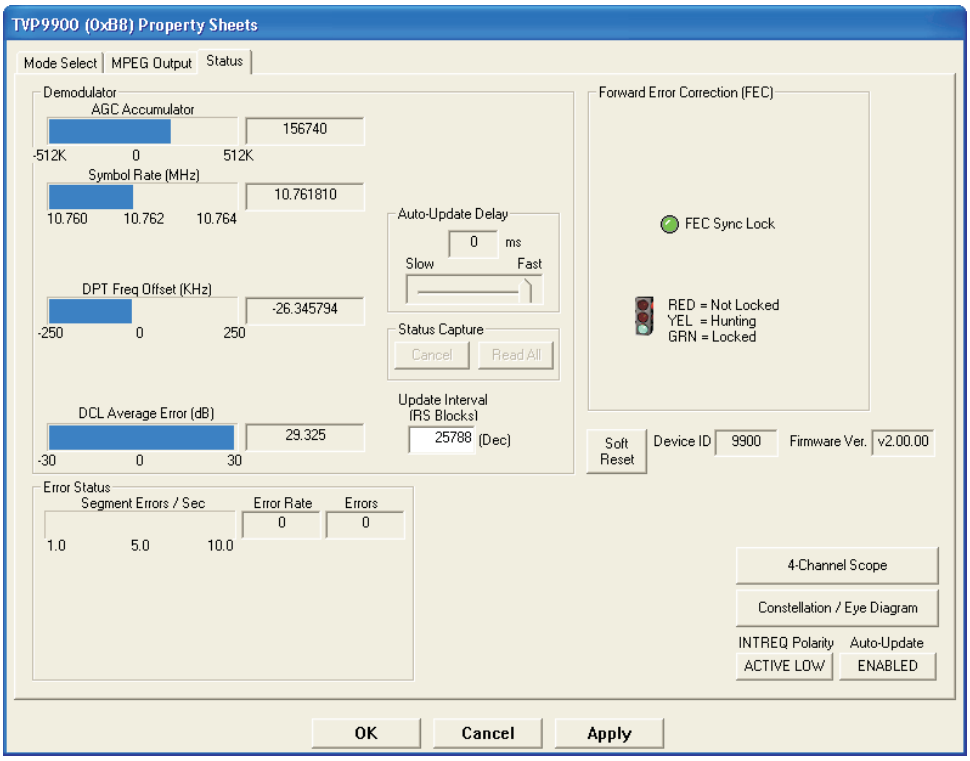


Figure 16. Property Sheets

Available on the TVP9900 Property Sheets Status page is a Constellation / Eye Diagram plot tool and a four-channel virtual oscilloscope tool. Both analysis tools are accessed by clicking on the respective button on the Status page.

The Eye Diagram / Constellation window (see Figure 17) displays signal variation at the carrier recovery slicer input with persistent plots and allows the user to save data to a log file. The eye diagram displays I-data at three consecutive points, and the constellation plot shows the distinct I-data levels along the horizontal axis.

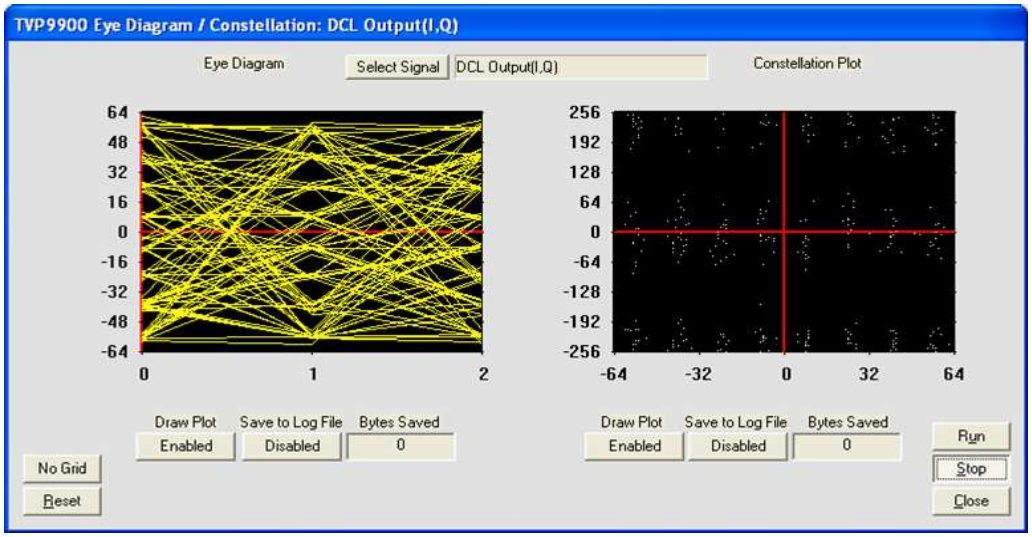


Figure 17. Eye Diagram / Constellation Plots

The four-channel oscilloscope tool (see Figure 18) stores all acquired data from time zero and provides the option of saving data for off-line analysis. This tool provides many useful features to aid in signal analysis, including the following:

- Real-time plots of up to four status registers
- Real, magnitude, phase, or Doppler plot types
- Variable time and division
- Variable Y offset and Y scale, with automatic Y scale
- Horizontal pan and zoom

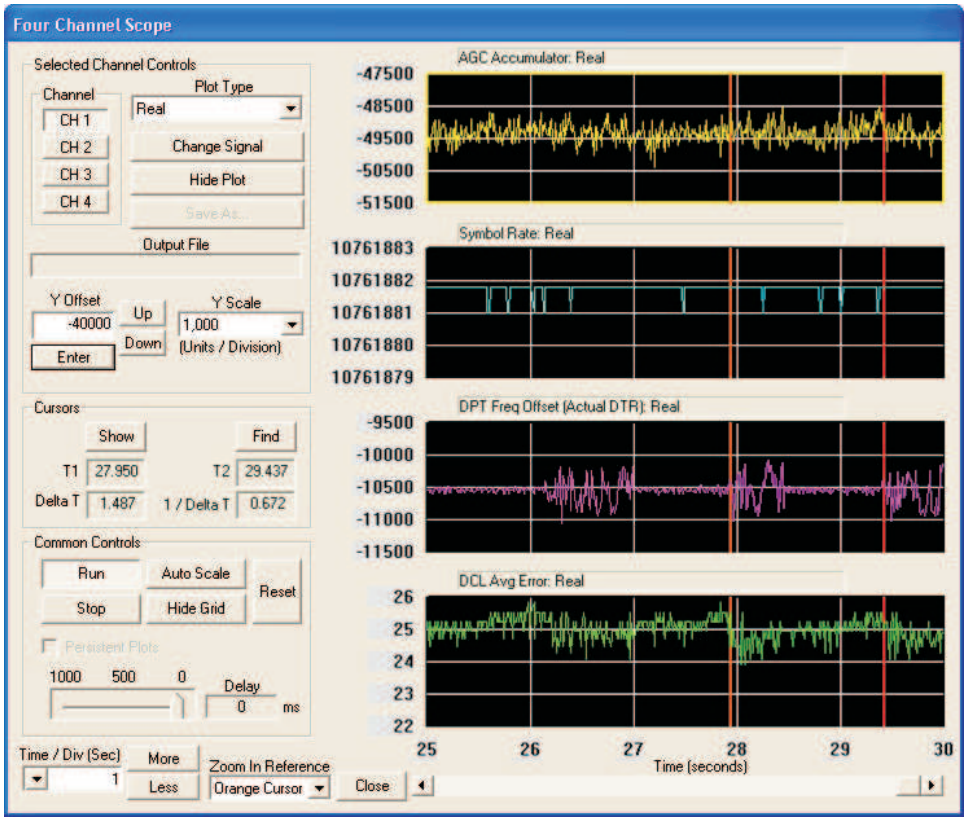


Figure 18. Four Channel Scope

8.4.2.3.1 Property Sheet Refresh

The property sheets were designed so that the data displayed is always current. Certain actions cause the entire register map to be read from the device and to update the property sheets:

- When property sheets are initially opened
- When tabbing from one page to another
- When *Read All* is clicked
- When making the property sheets window the active window (by clicking on it)
- When making a register map editor window the active window (by clicking on it)

8.4.2.3.2 Auto-Update From Device

Items 4 and 5 above are referred to as the auto-update feature. Auto-update can be disabled by setting its program option button to DISABLED. This button is located on the initial dialog box (WinVCC Configuration).

The user can open both the property sheets and the register map editor at the same time, and changes made to the property sheets (and applied) are updated in the register map window as soon as the register map window is clicked on. Additionally, changes made in the register map editor are updated in the property sheets as soon as the property sheets window is clicked on.

Table 8. Use of Property Sheet Controls

Dialog Control	What Do I Do With It?	When Is Hardware Updated?
Read-only edit box	Read status information	N/A
Check box	Toggle a single bit	After *Apply*
Drop-down list	Select from a text list	After *Apply*
Edit box	Type a number	After *Apply*
Edit box with up/down arrows	Use up/down arrows or type a number	Up/Down Arrows: Immediately Type a number: After *Apply*
Slider	Slide a lever	Immediately
Push button	Initiate an action	Immediately

Table 9. Property Sheet Button Controls

Button Control	Definition
OK	Writes to all writeable registers whose data has changed. A register is flagged as changed if the value to be written is different from the value last read from that address. Closes the dialog.
Cancel	Causes all changes made to the property page since the last Apply to be discarded. Changes made to dialog controls with 'immediate hardware update' are not discarded, since they have already been changed in hardware. Does not write to hardware. Closes the dialog.
Apply	Writes to all writeable registers whose data has changed. A register is flagged as changed if the value to be written is different from the value last read from that address.

9 TV Tuner Control

This chapter discusses how to program the tuner on this EVM. Program the tuner by clicking Tools→TV Tuner Control→ ATSC. The Tuner Type window (see Figure 19) allows the user to change the tuner I2C slave address (C2h by default) and RF source settings. Click the Standard Digital ATSC Tuner button and click OK to use the default tuner shipped with the TVP9900EVM.

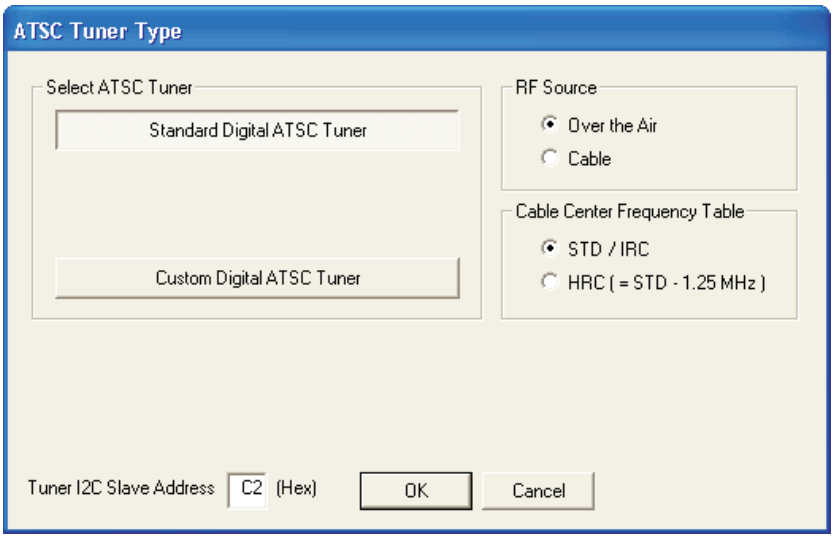


Figure 19. ATSC Tuner Type

To use other tuner boards that have the same TVP9900 EVM board interface, click the Custom Digital ATSC Tuner button. This allows the user to select a tuner configuration file that is used to program the TV Tuner Control settings to work with the desired tuner. Additional details and an example Tuner Configuration File can be provided by Texas Instruments if this option is desired.

In the TV Tuner Control window (see Figure 20), select a channel from the "Add to Channel List" drop-down box. Click *Add*. After approximately 1 second, the tuner is programmed to the selected channel. For direct entry of the RF center frequency, type in the center frequency (for example, 189) into the "RF Center Freq (MHz)" box. Click the Program button to program the tuner.

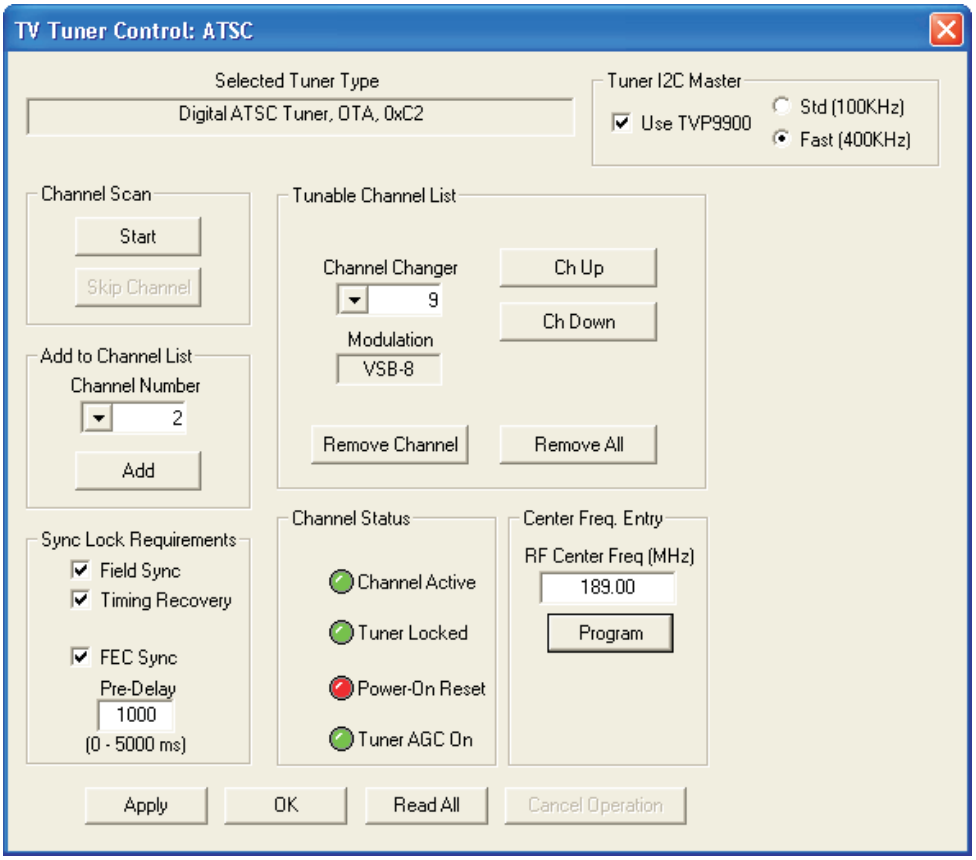


Figure 20. TV Tuner Control for ATSC

To perform a channel scan when the input is from an antenna (or cable), click *Start* on the TV Tuner Control page. This selects all channels for which the TVP9900 indicates locked status. The locking criteria are selectable on this page: Field Sync Lock (Default: ON), Timing Recovery (Default: ON), and FEC Sync Lock (Default: ON). The Pre-Delay is not needed. After scanning, switching between channels can be easily done using the channel up/down buttons (*Ch Up* and *Ch Down*) or the "Channel Changer" drop-down list.

Open the TVP9900 Property Sheets by clicking Edit→Property Sheets→TVP9900. Click the Status tab, as shown in Figure 16. Click *Auto-Update* to enable it, and then click *Soft Reset*.

10 Troubleshooting

This chapter discusses ways to troubleshoot the TVP9900EVM.

10.1 Troubleshooting Guide

If you are experiencing problems with the TVP9900EVM hardware or the WinVCC software, see Table 10 for available solutions.

Table 10. TVP9900EVM Troubleshooting

Symptom	Cause	Solution
At startup, the error message *Cannot find DLL file DLPORTIO.DLL* appears.	The parallel port driver supplied with the EVM has not been installed.	Run Port95NT.EXE on the CD to install the driver.
Blank screen	Tuner is not programmed correctly.	Program the tuner by clicking Tools→TV Tuner Control→ATSC. The tuner type and settings are programmed for the default tuner shipped with the EVM. Different tuners must be programmed separately.
	MPEG-2 data outputs, clock, or packet signals are disabled.	Go to Edit→Property Sheets→TVP9900, MPEG Output Control page, click the *DATAOUT Enable* and *Signal Enable* buttons and click *Apply*.
WinVCC I^2C test fails unexpectedly	Initial test fails to operate correctly.	Exit out of WinVCC, and restart.
No I^2C communication	Receiver I^2C slave address is wrong.	Make sure I^2C slave address jumper on the TVP9900 receiver module is set for the correct address.
	Tuner I^2C slave address is wrong.	Make sure I^2C slave address jumper on the tuner module is set for the correct address.
	Parallel cable is not connected from PC parallel port to the TVP9900 receiver module DB25 connector.	Connect cable
	EVM is not powered on.	Power supply must be plugged into a 100-V to 240-V/47-Hz to 63-Hz power source, and the cord must be plugged into the power connector on the EVM.
	Wrong type of parallel cable	Some parallel cables are not wired straight through pin-for-pin. Use the cable supplied with the EVM.
	Device was placed in power-down mode.	Verify jumper JP3 is set to its default (shunt is on) position. Press the Reset button on the TVP9900 Receiver Module.
	PC parallel port mode is not set correctly.	DO THIS AS A LAST RESORT. Reboot PC, enter BIOS setup program, and set parallel port LPT1 mode (Addr 378h) to ECP mode or bidirectional mode (sometimes called PS/2 mode or byte mode). If already set to one of these two modes, switch to the other setting (see Section 10.2.)
	Still no I^2C communication	PC may not be capable of operating in the required parallel port mode. This is true of some laptop computers. Use a different computer, preferably a desktop PC.

When WinVCC is started and the WinVCC Configuration dialog box is closed with *OK*, the I^2C system test is performed (unless the I^2C System Test program option is disabled).

If the I^2C system test fails, a dialog box like Figure 21 appears. This example reports that a read from TVP9900 failed, using slave address 0xB8, subaddress 0x57. The data read was 0x05. The expected data was 0x01.

After noting which device had a problem, click *OK* to continue. Next, the Corrective Action Dialog box appears to help fix the problem.

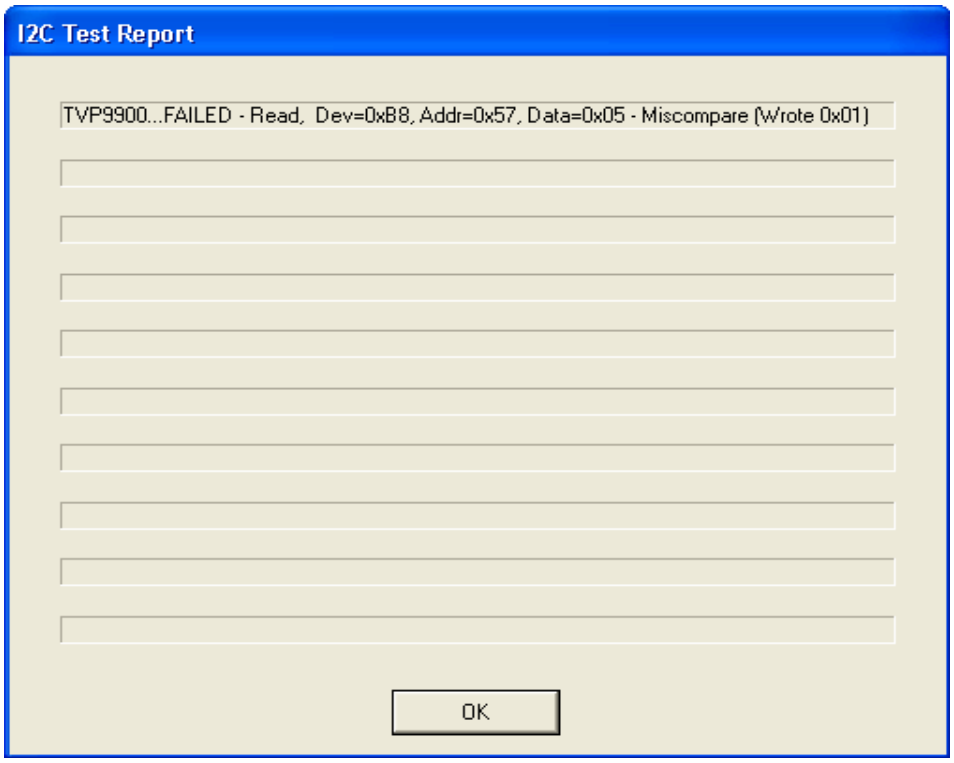


Figure 21. I²C System Failure Dialog Box

10.2 Corrective Action Dialogs

After closing the I²C system test report dialog box, a corrective action dialog box appears (see Figure 22).

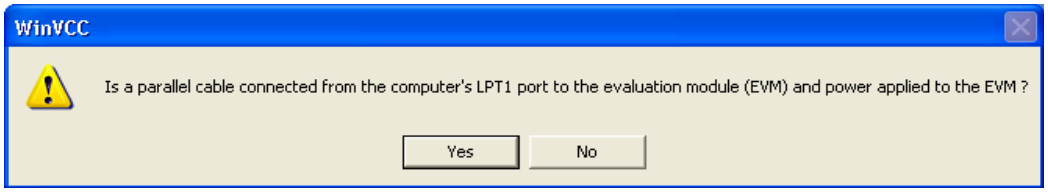


Figure 22. Corrective Action Dialog Box

1. If the parallel port cable is NOT connected between to PC and the TVP9900EVM or if the EVM power is not on:
   a. Click *No*.
   b. The dialog box shown in Figure 23 appears instructing you to correct the problem.
   c. Correct the problem.
   d. Click *OK* to continue. The main menu dialog should appear.

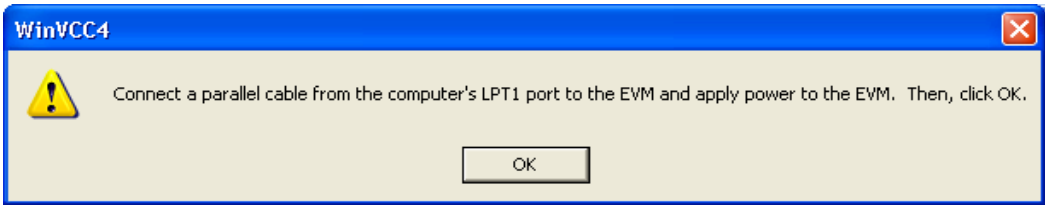


Figure 23. Corrective Action Required

2. If the cable is connected from the PC parallel port to the TVP9900EVM and the EVM power is on:
   a. Click *Yes*.
   b. The dialog box shown in Figure 24 appears. This dialog box appears if the PC parallel port mode setting may need to be changed.

Note: Only run the PC BIOS setup program if the I^2C communication problem cannot be resolved in another way (correct slave address settings, reset, or power cycle the EVM and/or check that the device type selected was TVP9900).

   c. Click *OK* to continue.
   d. The main menu dialog appears.
   e. Click Exit in the File menu to exit the program.
   f. See troubleshooting guide in Section 10.1.

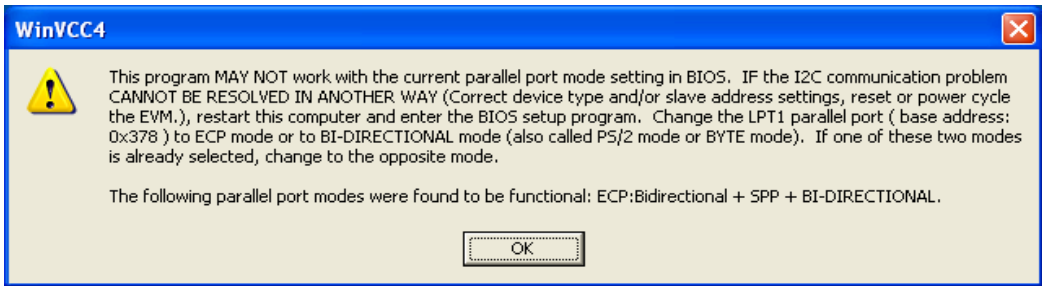


Figure 24. Corrective Action Required

10.2.1 Setting the PC Parallel Port Mode

Note: Only run the PC BIOS setup program if the I^2C communication problem cannot be resolved in another way (correct slave address settings, reset, or power cycle the EVM and/or check that the device type selected was TVP9900).

1. Restart the PC.
2. During the boot process, enter the BIOS setup program by pressing the required key (usually the initial text screen tells you which key to press).
3. Find the place where the parallel port settings are made.
4. Set the parallel port LPT1 at address 378h to ECP mode or bidirectional mode (sometimes called PS/2 mode or byte mode). If one of these two modes is already selected, then change to the opposite mode.
5. Exit and save changes.

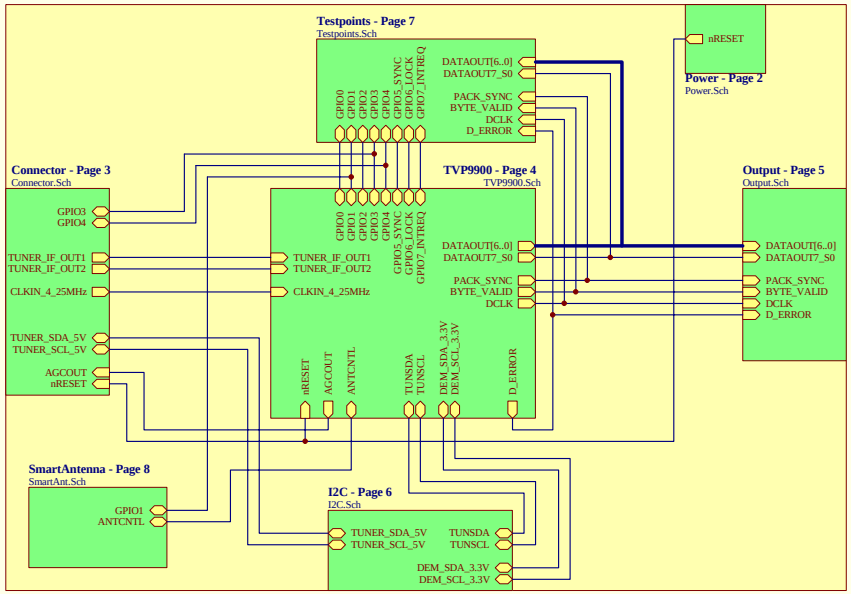
10.2.2 General I^2C Error Report

The error report shown in Figure 25 appears when an I^2C error occurs at any time other than after the I^2C system test. In this example, there was an acknowledge error at slave address 0xB8 (the receiver module). The error occurred on Read Cycle Phase 1 on the device (slave) address byte.

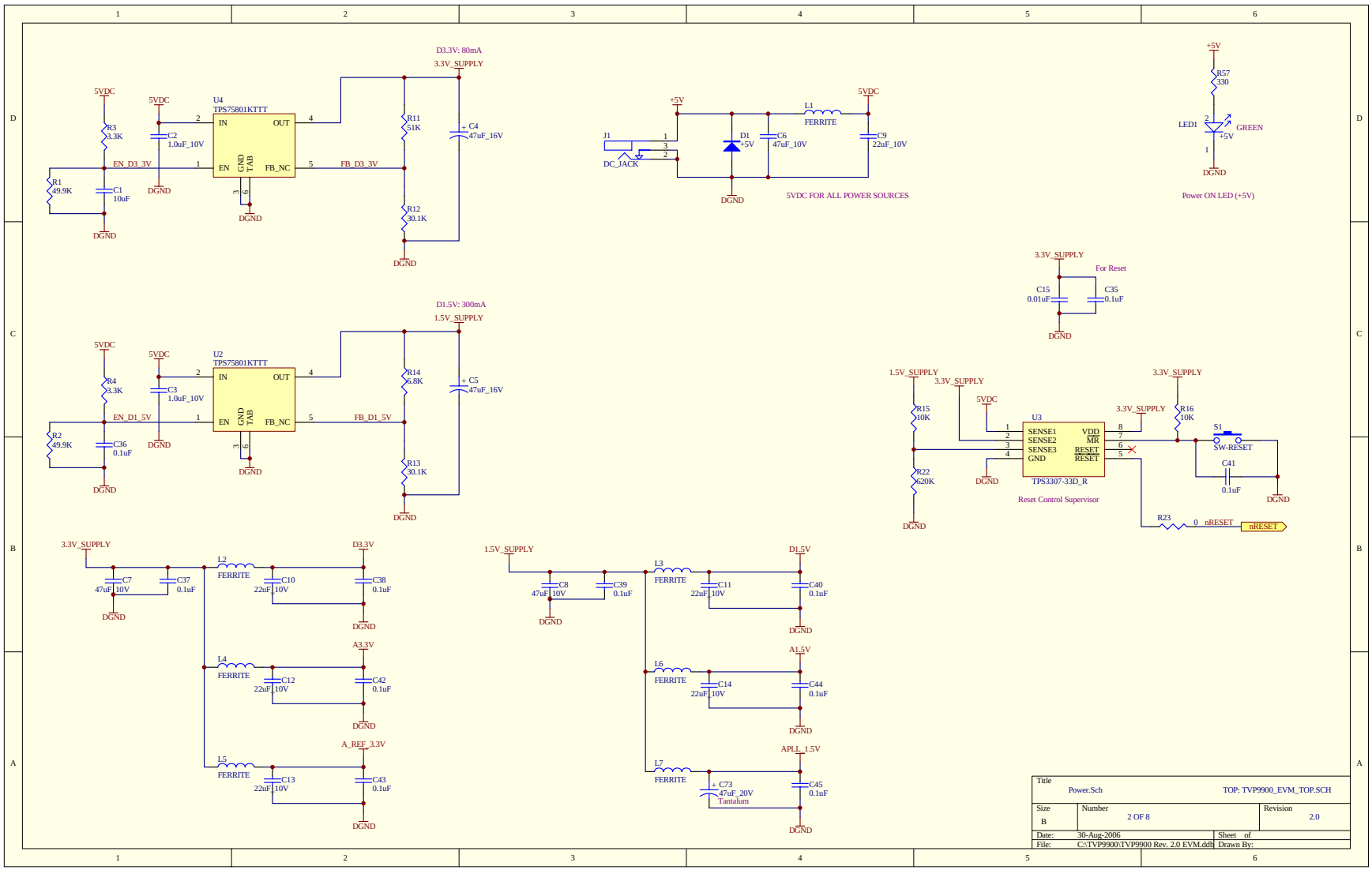
Figure 25. I^2C Error

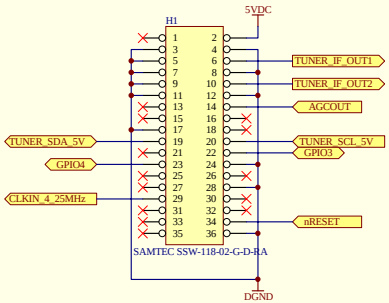
11 TVP9900EVM Schematics

This chapter contains the TVP9900EVM schematics.



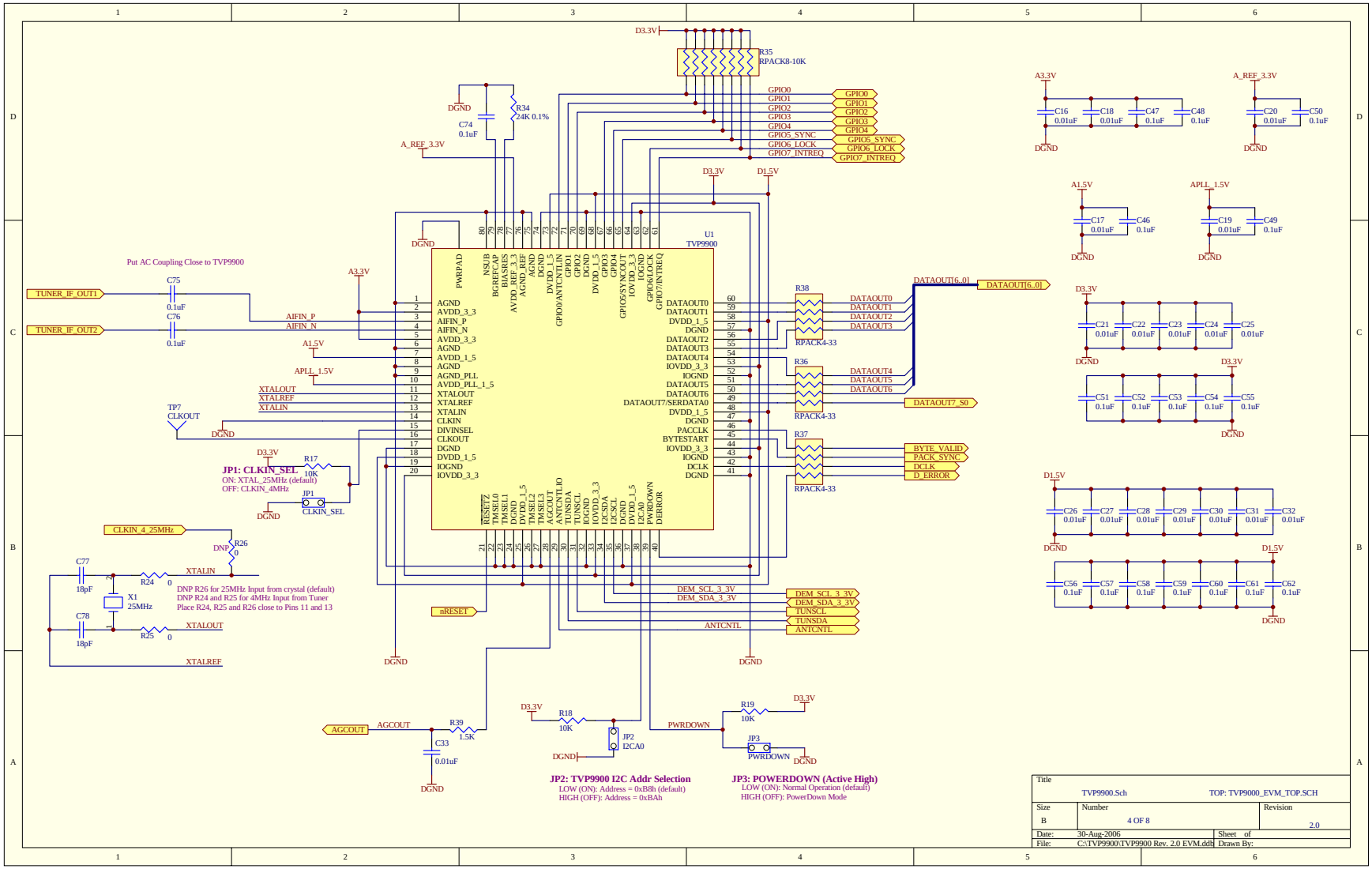
Title	TVP9900_EVM_TOP.SCH	TOP: TVP9900_EVM_TOP.SCH
Size: B	Number: 1 OF 8	Revision: 2.0
Date: 30-Aug-2006	Sheet of	
File: C:\TVP9900\TVP9900 Rev. 2.0 EVM.ddb	Drawn By:	

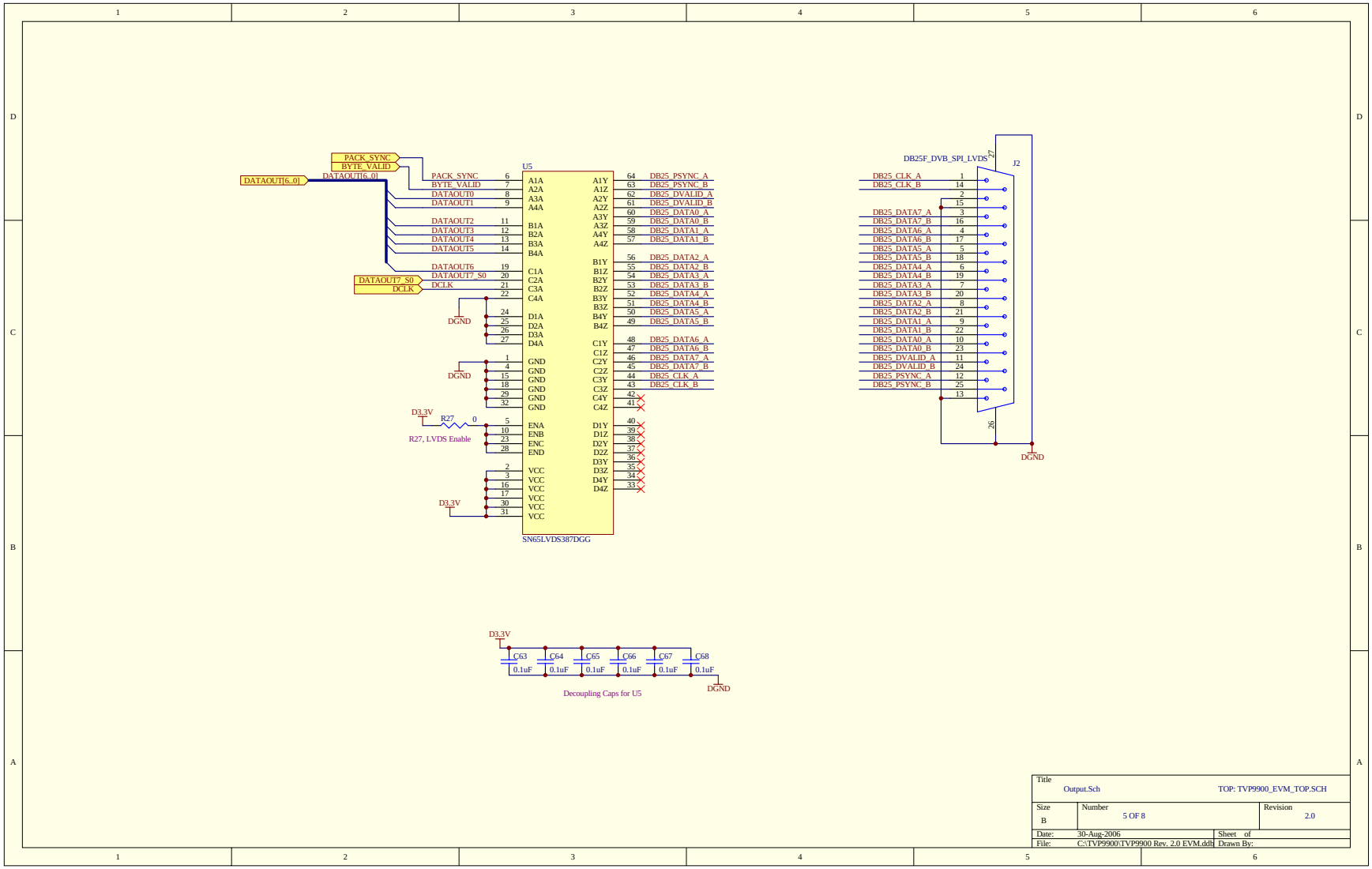

D3.3V: 80mA
3.3V_SUPPLY
5VDC
5VDC
U4
TPS75801KTTT
IN
OUT
EN
GND
TAB
FB_NC
R3
3.3K
C2
1.0uF_10V
R1
49.9K
C1
10uF
EN_D3_3V
FB_D3_3V
R11
51K
R12
30.1K
+ C4
47uF_16V
DGND
J1
DC_JACK
+5V
D1
+5V
L1
FERRITE
C6
47uF_10V
C9
22uF_10V
5VDC FOR ALL POWER SOURCES
R57
330
LED1
GREEN
Power ON LED (+5V)
D1.5V: 300mA
1.5V_SUPPLY
U2
TPS75801KTTT
R4
3.3K
C3
1.0uF_10V
R2
49.9K
C36
0.1uF
EN_D1_5V
FB_D1_5V
R14
6.8K
R13
30.1K
+ C5
47uF_16V
3.3V_SUPPLY
For Reset
C15
0.01uF
C35
0.1uF
1.5V_SUPPLY
3.3V_SUPPLY
5VDC
U3
SENSE1
SENSE2
SENSE3
GND
VDD
MR
RESET
RESET
TPS3307-33D_R
R15
10K
R22
620K
R16
10K
S1
SW-RESET
C41
0.1uF
R23
0
nRESET
Reset Control Supervisor
3.3V_SUPPLY
L2
FERRITE
C7
47uF_10V
C37
0.1uF
C10
22uF_10V
C38
0.1uF
D3.3V
L4
FERRITE
C12
22uF_10V
C42
0.1uF
A3.3V
L5
FERRITE
C13
22uF_10V
C43
0.1uF
A_REF_3.3V
1.5V_SUPPLY
C8
47uF_10V
C39
0.1uF
L3
FERRITE
C11
22uF_10V
C40
0.1uF
D1.5V
L6
FERRITE
C14
22uF_10V
C44
0.1uF
A1.5V
L7
FERRITE
+ C73
47uF_20V
Tantalum
C45
0.1uF
APLL_1.5V
Title
Power.Sch
TOP: TVP9900_EVM_TOP.SCH
Size
B
Number
2 OF 8
Revision
2.0
Date:
30-Aug-2006
Sheet of
File:
C:\TVP9900\TVP9900 Rev. 2.0 EVM.ddb
Drawn By:



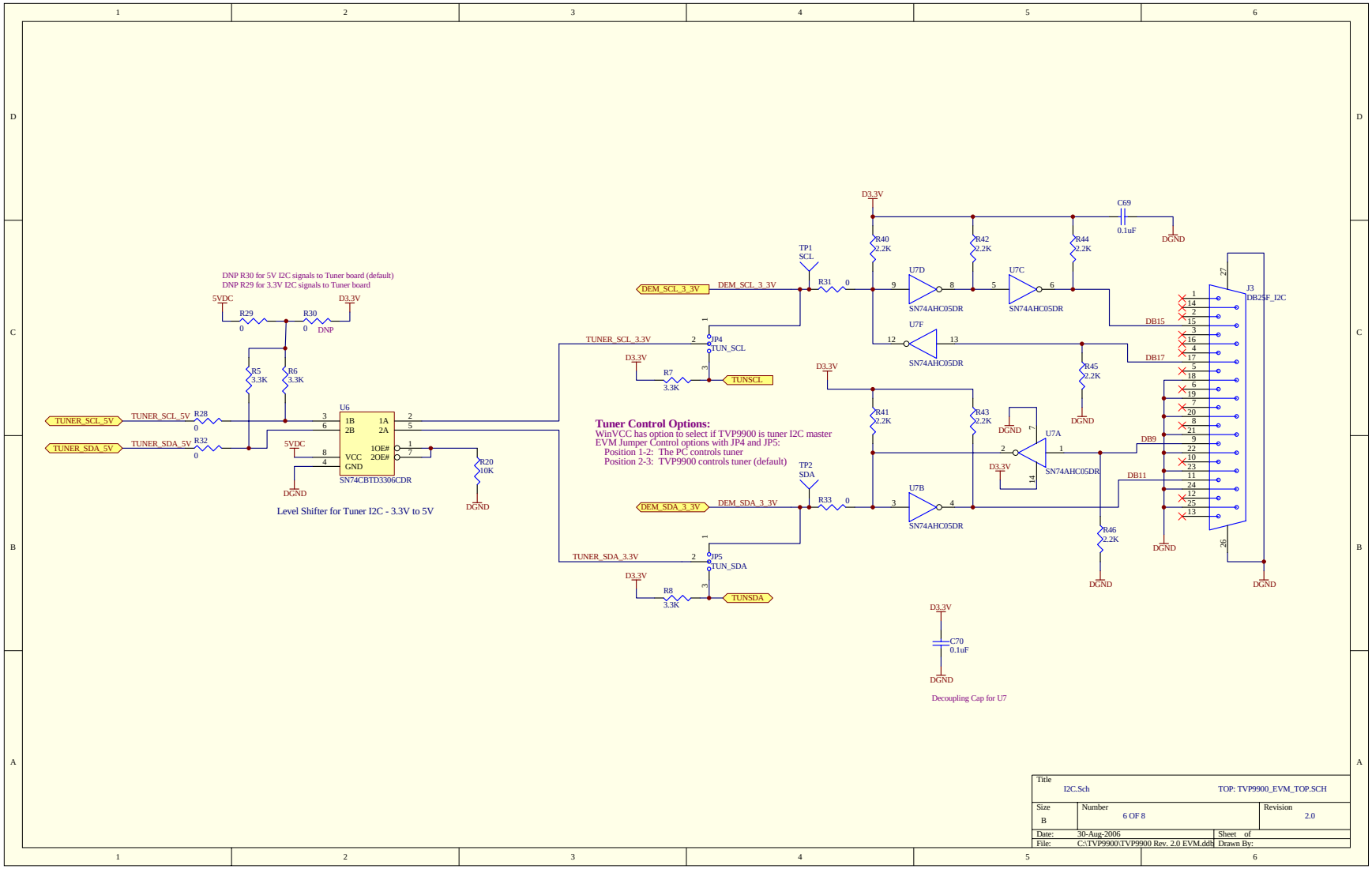
NOTE: Layout must support vertical or horizontal mount for tuner board
Use SAMTEC SSW-118-02-G-D-RA for horizontal mount (default)
Use SAMTEC SSW-118-02-G-D for vertical mount

Title: Connector.Sch		TOP: TVP9000_EVM_TOP.SCH
Size: B	Number: 3 OF 8	Revision: 2.0
Date: 30-Aug-2006	Sheet of	
File: C:\TVP9900\TVP9900 Rev. 2.0 EVM.ddb	Drawn By:	

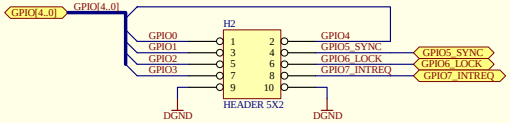

U1
TVP9900
R35
RPACK8-10K
R34
24K 0.1%
C74
0.1uF
Put AC Coupling Close to TVP9900
TUNER_IF_OUT1
TUNER_IF_OUT2
C75
C76
0.1uF
AIFIN_P
AIFIN_N
XTALOUT
XTALREF
XTALIN
CLKOUT
TP7
JP1: CLKIN_SEL
ON: XTAL_25MHz (default)
OFF: CLKIN_4MHz
JP1
CLKIN_SEL
R17
10K
CLKIN_4_25MHz
DNP
R26
0
X1
25MHz
C77
C78
18pF
R24
R25
DNP R26 for 25MHz Input from crystal (default)
DNP R24 and R25 for 4MHz Input from Tuner
Place R24, R25 and R26 close to Pins 11 and 13
nRESET
DEM_SCL_3_3V
DEM_SDA_3_3V
ANTCNTL
TUNSCL
TUNSDA
BYTE_VALID
PACK_SYNC
DCLK
D_ERROR
DATAOUT[6..0]
DATAOUT7_S0
R38
R36
R37
RPACK4-33
GPIO0
GPIO1
GPIO2
GPIO3
GPIO4
GPIO5_SYNC
GPIO6_LOCK
GPIO7_INTREQ
AGCOUT
R39
1.5K
C33
0.01uF
R18
10K
JP2
I2CA0
PWRDOWN
R19
JP3
JP2: TVP9900 I2C Addr Selection
LOW (ON): Address = 0xB8h (default)
HIGH (OFF): Address = 0xBAh
JP3: POWERDOWN (Active High)
LOW (ON): Normal Operation (default)
HIGH (OFF): PowerDown Mode
D3.3V
D1.5V
A3.3V
A1.5V
APLL_1.5V
A_REF_3.3V
DGND
C16
C18
C47
C48
C20
C50
C17
C46
C19
C49
C21
C22
C23
C24
C25
C51
C52
C53
C54
C55
C26
C27
C28
C29
C30
C31
C32
C56
C57
C58
C59
C60
C61
C62
0.01uF
0.1uF
Title
TVP9900.Sch
TOP: TVP9000_EVM_TOP.SCH
Size
B
Number
4 OF 8
Revision
2.0
Date:
30-Aug-2006
Sheet of
File:
C:\TVP9900\TVP9900 Rev. 2.0 EVM.ddb
Drawn By:

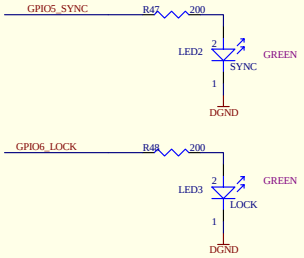


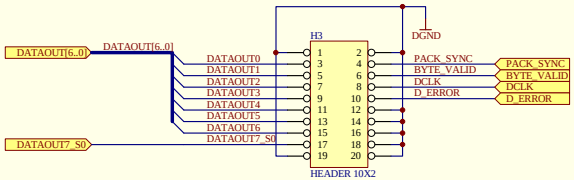
Title	Output.Sch	TOP: TVP9900_EVM_TOP.SCH
Size: B	Number: 5 OF 8	Revision: 2.0
Date: 30-Aug-2006	Sheet of	
File: C:\TVP9900\TVP9900 Rev. 2.0 EVM.ddb	Drawn By:	



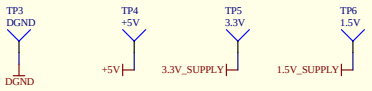
Title	I2C.Sch	TOP: TVP9900_EVM_TOP.SCH
Size: B	Number: 6 OF 8	Revision: 2.0
Date: 30-Aug-2006	Sheet of	
File: C:\TVP9900\TVP9900 Rev. 2.0 EVM.ddb	Drawn By:	







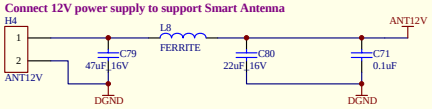
TPs also on I2C and TVP9900 pages

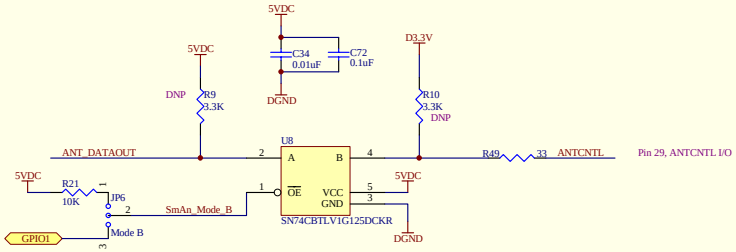


Use through-hole for TP's

Title: Testpoints.SCH		TOP: TVP9900_EVM_TOP.SCH
Size: B	Number: 7 OF 8	Revision: 2.0
Date: 30-Aug-2006	Sheet of	
File: C:\TVP9900\TVP9900 Rev. 2.0 EVM.ddb	Drawn By:	

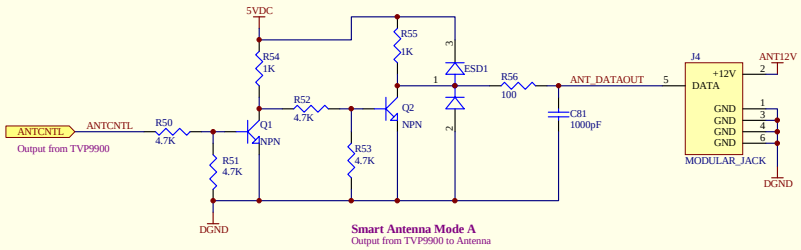
Connect 12V power supply to support Smart Antenna





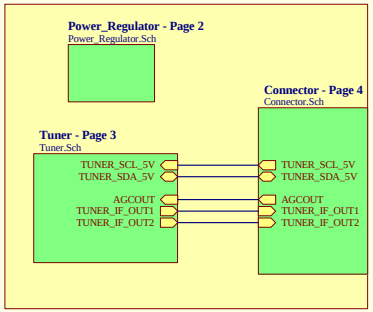
JP 6: Mode B Selection (EVM supports 1 pin mode only)
Position 1-2: Disable Mode B (default)
Position 2-3: Enable Mode B

GPIO1 Output = Direction of Pin 29 (ANTCNTL)
0 = Input from Antenna to TVP9900 — Output from Antenna to TVP9900 uses Mode B circuit above
1 = Output from TVP9900 to Antenna — Output from TVP9900 to Antenna uses Mode A circuit below

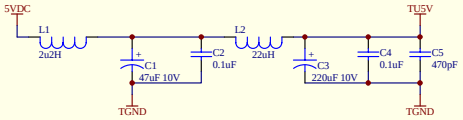


Smart Antenna Mode A
Output from TVP9900 to Antenna

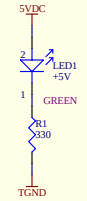
Title: SmartAnt.Sch		TOP: TVP9900_EVM_TOP.SCH
Size: B	Number: 8 OF 8	Revision: 2.0
Date: 30-Aug-2006	Sheet of	
File: C:\TVP9900\TVP9900 Rev. 2.0 EVM.ddb	Drawn By:	



Title: TVP9900_EVM_TUNER_TOP.Sch		TOP: TVP9900_EVM_TUNER_TOP.Sch
Size: B	Number: 1 OF 4	Revision: 4.0
Date: 5-Jun-2007	Sheet of	
File: C:\TVP9900\TVP9900 EVM - Thomson Tuner\TVP6801 Board Rev. 4.0.ddb		

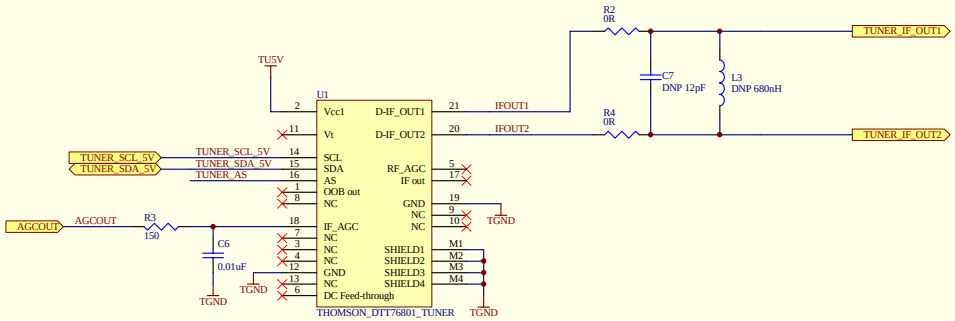


L1 and C1 - C2 should be placed close to connector
L2 and C3 - C5 should be placed close to tuner



Power ON LED (+5V)

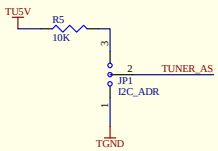
Title: Power_Regulator.Sch		TOP: TVP9900_EVM_TUNER_TOP.Sch
Size: B	Number: 2 OF 4	Revision: 4.0
Date: 5-Jun-2007	Sheet of	
File: C:\TVP9900\TVP9900 EVM - Thomson Tuner\TVP6801 Board Rev. 4.0.ddb		



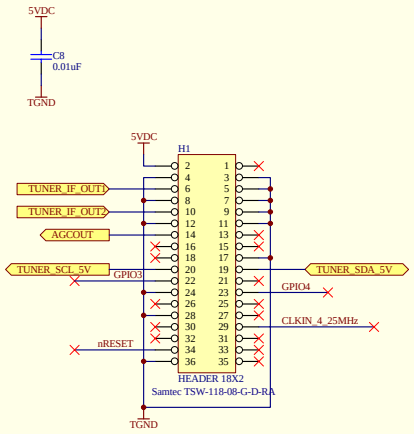
Uses Thomson DTT76801 with integrated DC to DC converter

Tuner I2C Address Selection

Open: Address = 0xC2 (default)
Position 1-2: Address = 0xC0
Position 2-3: Address = 0xC6



Title	Tuner.Sch	TOP: TVP9900_EVM_TUNER_TOP.Sch
Size: B	Number: 3 OF 4	Revision: 4.0
Date: 5-Jun-2007	Sheet of	
File: C:\TVP9900\TVP9900 EVM - Thomson Tuner DTT76801 Board Rev. 4.0.ddb	Drawn By:	



Vertical or Horizontal Connection to 9900 board

Title	Connector.Sch	TOP: TVP9900_EVM_TUNER_TOP.Sch
Size: B	Number: 4 OF 4	Revision: 4.0
Date: 5-Jun-2007	Sheet of	
File: C:\TVP9900\TVP9900 EVM - Thomson Tuner\TVP6801 Board Rev. 4.0.ddb	Drawn By:	

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
Low Power Wireless	www.ti.com/lpw	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265