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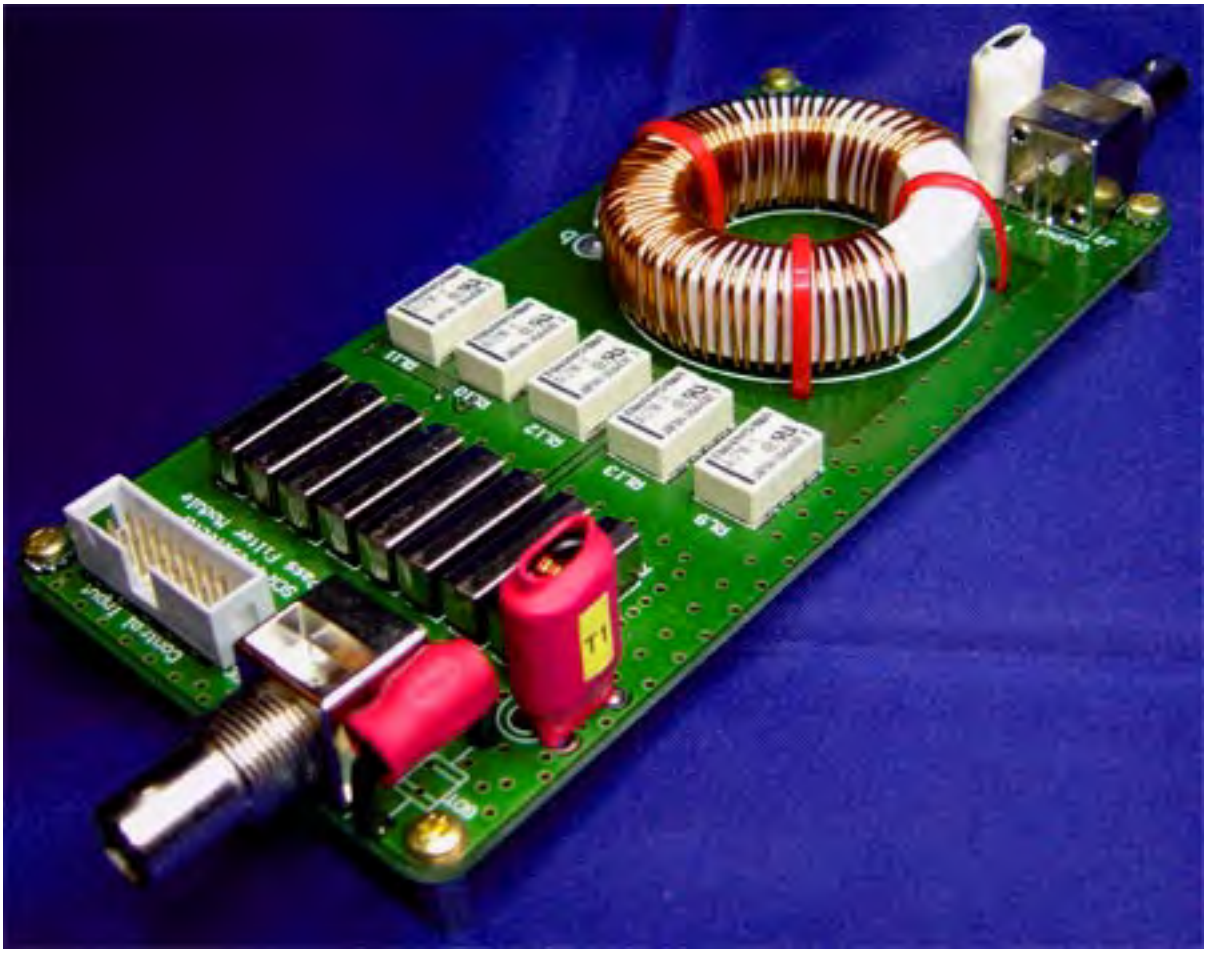

tiny SCR Preselector. User manual.

Modular 1.8MHz to 30MHz Tunable Band Pass Filter bank.

Software Controlled Radio Preselector via USB v2.0 or I2C Bus

Revision B. September 2009

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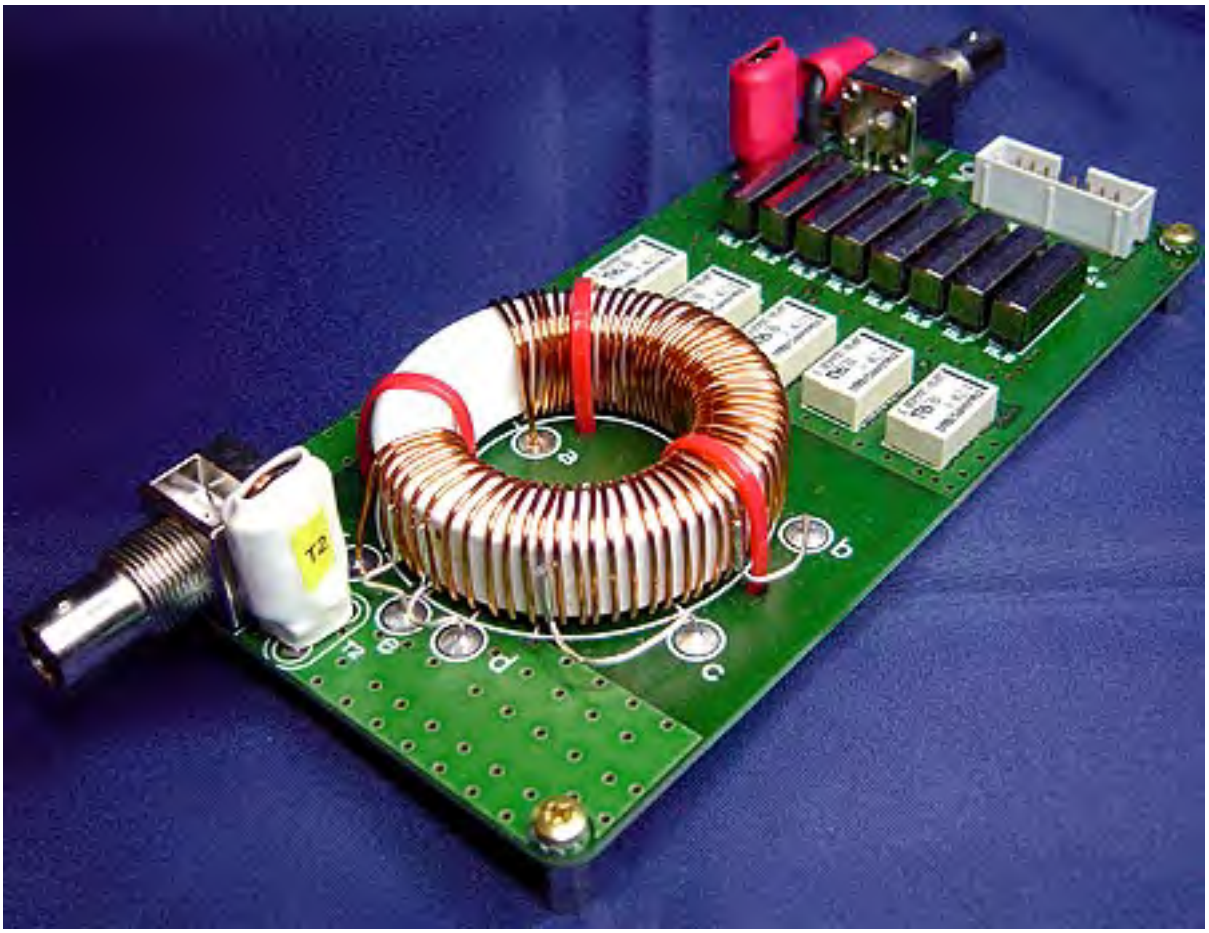
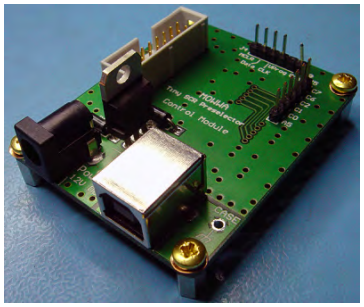
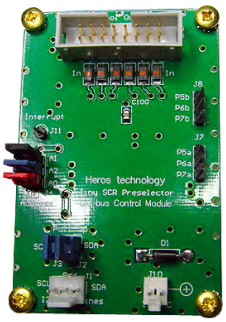
tiny SCR PRESELECTOR

Manual







Features:

- Five bands tuneable Band Pass Filter bank for HF Bands covering 1.8 to 30 MHz.
- Digital tuning.
- Suitable for Software Define Radios thanks to its high linearity.
- Removes the strong signals radiated back to the antenna from quadrature mixers in SDR applications.
- Joined to a VFO can perform tracking tuning function.
- Its modular design lets an easy implementation on your projects.
- I2C Bus or USB control modules optional.
- Tin plated enclosure available.

USB control module option

- PC controlled through graphical user interface (GUI).
- Full speed USB v2.0 compliant.
- Plug and Play feature.
- Runs under Windows XP OS or Windows Vista 32 OS.

I2C Bus control module option

- 16 bits standard I2C Bus serial bus interface.
- Support 100Kbits/s and 400kbits/s FAST I2C Bus protocols.
- Auxiliary Input/Output ports to implement external controls.
- Up to eight control modules can share the same I2C Bus.
- Compatible with most microcontrollers.

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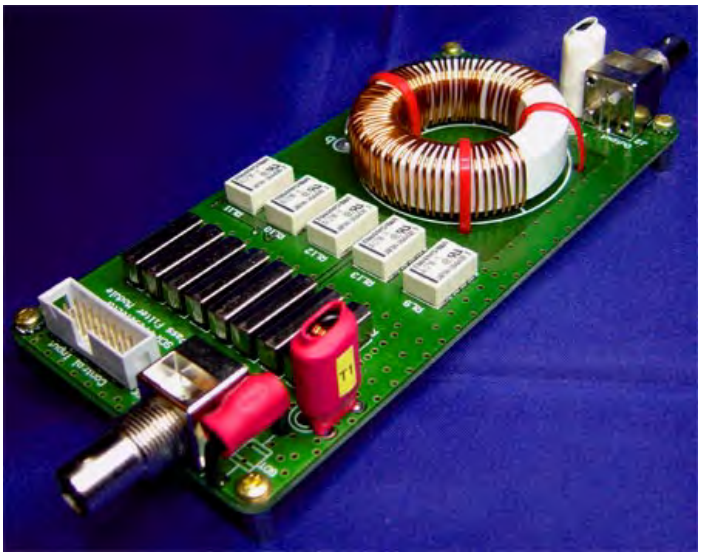


Multi-Band-Pass Filter module.

A five bands tuneable Band-Pass Filter bank make up the core of the tiny SCR Preselector.
On SDR applications, where high linearity is needed its passive design keeps a high IP3 factor thanks to an unique large coil wounded on a T-200 toroidal core, ultra low ESR, C0G (NP0) RF chip capacitors, low RF resistance magnetic shielded relays for tuning and telecom grade relays for band switching, instead of nonlinear semiconductors that cause distortion in front of strong signals and exhibit low tolerance to transients.

The tiny SCR Preselector incorporates on antenna input a gas discharge tube as surge suppressor providing safety against static spikes.

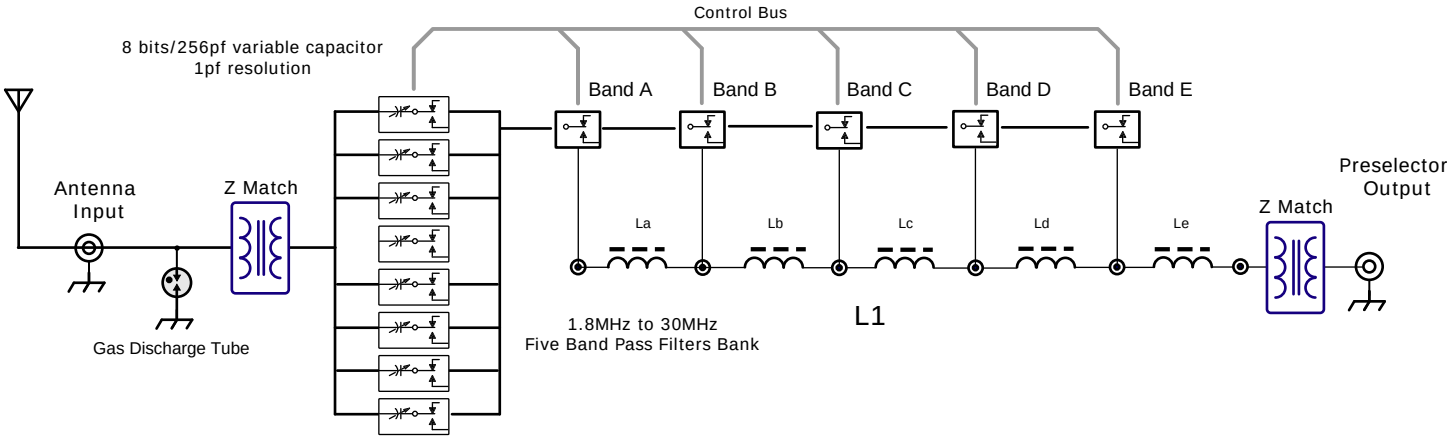
The five telecom grade relays are connected to its corresponding section of the coil through the Band Selector control on the program software.

A network of low ESR RF capacitors of 1 pF, 2 pF, 4 pF, 8 pF, 16 pF, 32 pF, 64 pF and 128 pF are connected to the coil in serial fashion emulating the variable capacitor needed to tune the series resonant circuit formed. Each capacitor is connected to the network by means of its associated tuning relay. The band-pass filter formed in this way is a classic serial tuned LC circuit, offering narrow bandwidth and low attenuation on the band-pass segment of frequencies.
The program performs the task of adding or subtracting capacitor values in binary fashion in direct relationship with the tuning control on the program software. Increments or decrements are done in steps of 1pF.

Available bands are:
• A) 1.8 MHz to 3 MHz • B) 3 MHz to 5.5MHz • C) 5 MHz to 10 MHz • D) 10.5 MHz to 21 MHz E) • 16 MHz to 30 MHz.

A carefully PCB layout design and strong L/C decoupling prevent stages to couple in to each other improving the stop band response and filtering noise from control lines.

Connection to the control module is done with 16 ways ribbon cable and IDC connectors on both sides, carrying control signals and power supply.
BNC connectors are used for Antenna Input and Preselector Output.
Dimensions are: 153x75mm. (6.02x2.95 inch)



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tiny SCR PRESELECTOR

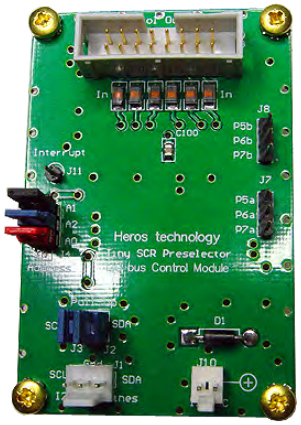
Manual

PIC microcontroller. USB Control module.

They are two optional control modules available: USB and I2C Bus

The tiny SCR Preselector USB is located in a separate module board to avoid introducing noise generated by the microprocessor itself and the noisy USB bus.
A 18F2455 PIC microcontroller is used. It incorporates a full speed (v2.0) USB port peripheral to communicate with the PC.
A four MHz quartz crystal is connected to the oscillator pins generating via internal PLL circuitry, the 48MHz clock for the microcontroller core and the 96 MHz clock to the USB peripheral.
In circuit serial programming (ICSP) connector is provided to let programming the microcontroller firmware without remove it from the PCB.
Two power drivers ULN 2803 ICs interface the PIC microcontroller output ports with the relays on the Band Pass Filter module.
Connection to the Multi-band pass filter module is done with 16 ways ribbon cable and IDC connectors on both sides, carrying control signals and power supply.
To suppress ESD and other transient over voltage events on the USB signals lines, an array of Avalanche Diode Array are connected to them.
A carefully PCB design and strong decoupling avoid introduce noise on the filters board.
Standard 2.5mm diameter power jack and type B USB connector are used.
Power supply: 12V DC/250mA max.

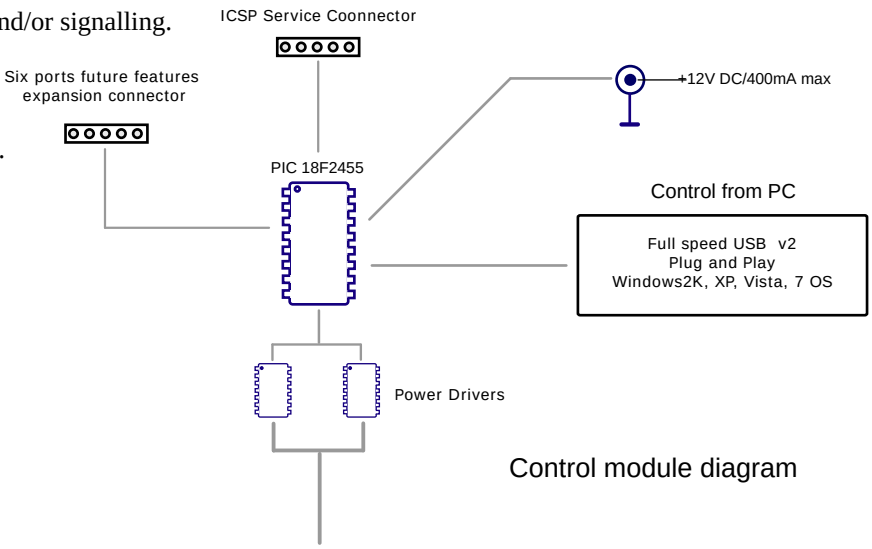
I2C Bus control module



The tiny SCR Preselector I2C Bus control module, located in a separate module board, lets to handle easily the Band pass Filter board from an existing control system on your radio project due the simple implementation of the I2C protocol on any microcontroller.
It is based on the well know PCF8575 remote 16-bit I/O expander for I2C Bus. Two power drivers ULN 2803A interface the PCF8575 output ports with the relays. I2C addresses are configured through J4, J5 and J6 pin headers and J2 and J3 headers connect pull-up resistors to the I2C line if is needed.
Three auxiliary ports are provided for optional controls and/or signalling. J7 are Input/Output ports, 5volts level and J8 are buffered ports at 12volts level.
J11 provides an open-drain interrupt output which can be connected to the interrupt logic of the microcontroller.
Connection to the Multi-band pass filter module is done with 16 ways ribbon cable and IDC connectors on both sides, carrying control signals and power supply.
A carefully PCB design and strong decoupling avoid introduce noise on the filters board.

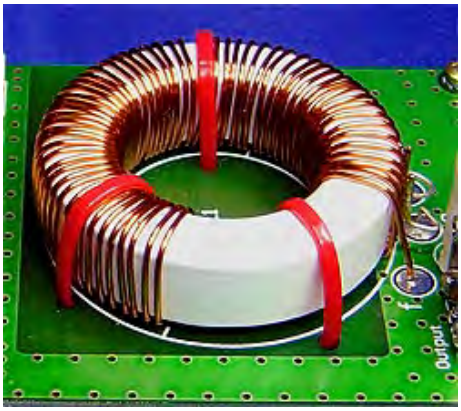
Features of the module are:

- 16 bits standard I2C serial bus interface.
- 100Kbits/s and 400kbits/s FAST I2C Bus.
- Three auxiliary Input/Output ports for optional controls and/or signalling.
- Open-drain interrupt output.
- Sixteen latched outputs with high current drive capability.
- Programmable address by 3 hardware address pins.
- Optional I2C Bus lines pull-up resistors.
- Up to eight modules can share the same I2C Bus.
- Compatible with most microcontrollers.
- Power Supply: 12V DC/250mA max.
- Dimensions: 62x47mm. (2.44x1.85 inch)



Control module diagram

Why a large toroid core T-200 is used in the tiny SCR Preselector?

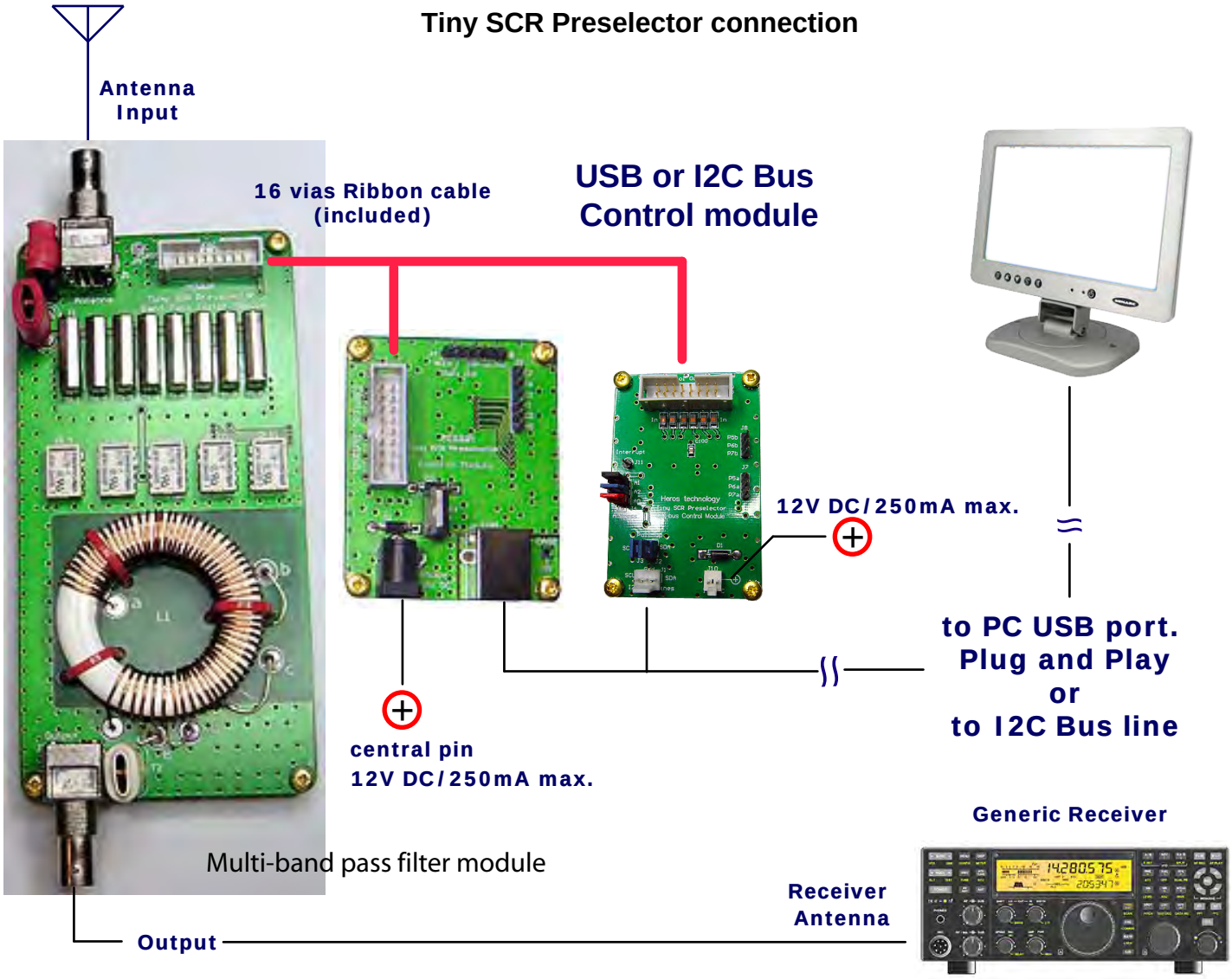


The reason is to keep a high IP3 or in other words achieve tolerance to large signals.

On SDR radios the high linearity of quadrature mixers demands the best linearity possible to the ancillary connected before the mixer stage to avoid to degrading its IP3. Wide cores with large sectional area let wind more turns on it (more inductance); these parameters are essential to keep a low magnetic flux inside the toroidal core to achieve so mush linearity as possible.

On the other hand, the large core offers a non-loaded Q (efficiency) value exceeding 400, providing selectivity and high stop band stop band characteristic, limiting the bandwidth in front of the mixer which improve signal to noise ratio, image rejection and prevents adjacent signals from reaching the circuits on the receiver side where 2nd order IMD and other spurs is most often created because of generalized use of nonlinear semiconductors especially on

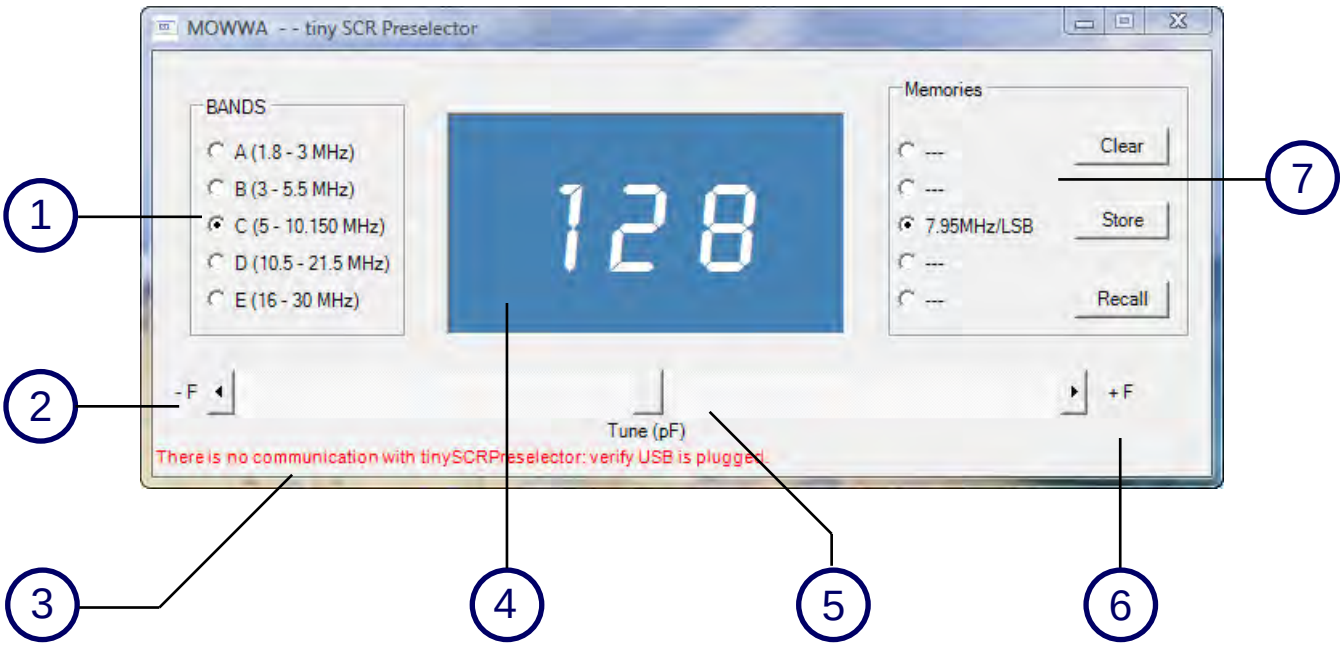
Tiny SCR Preselector connection



The Software

The software program on the PC runs under Windows 2K, XP, Vista32 and Windows 7 OS.
Windows 2K users need to update Framework from Windows Update site.
The user through the Graphic User Interface commands the tiny SCR Preselector.
The program can work at the same time with any SDR software running on the PC, without interference allowing to the user to control both simultaneously.

Standard Graphic User Interface



1- **Band selection.**
By default Band A. Click over any button to change band.

2- **Tuning Decrement**
One step frequency decrement. One step increment of capacity.

3- **Status Bar**

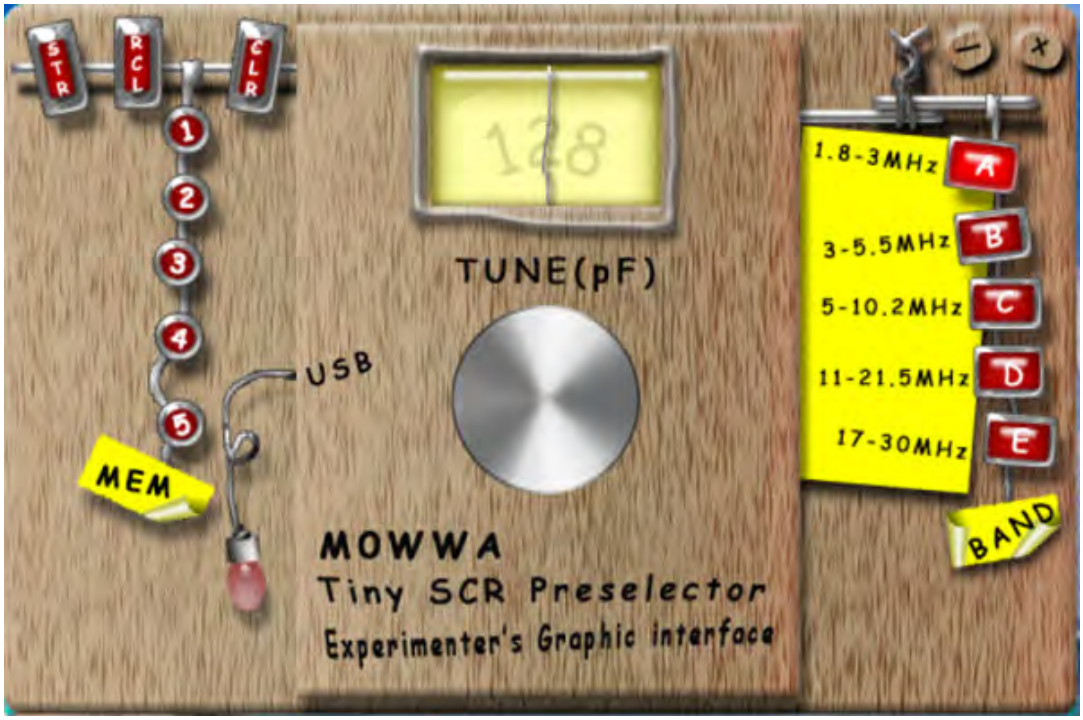
4- **Tune Dial**
Displays the tuning value in picoFarads.
Notice due to the response of series tuned circuits, the attenuation of the pass band filter increases with less capacity. A good practice is to avoid smaller values .

5- **Tuning knob**
Performs tuning moving left or right. Also by pressing left or right arrows on the keyboard or turning mouse wheel. Adjust to maximum signal or background noise.
The tune reference is expressed in picofarads with values between 10pF and 255pF.
Sliding right or left increases or decreases the band-pass frequency.
Notice due to the response of typical series tuned circuits, the attenuation of the pass band filter increases with less capacity. A good practice is to avoid values smaller than 50 picofarads.

6- Tuning Increment
One step frequency increment. One step decrement of capacity.

7- Memories
There are up to five memories per band (25 in total).
Clear-Store and Recall functions for each memory position.
Store function lets write a text label.

Another Graphic User Interface is included.
It incorporates the same functions that the standard GUI.



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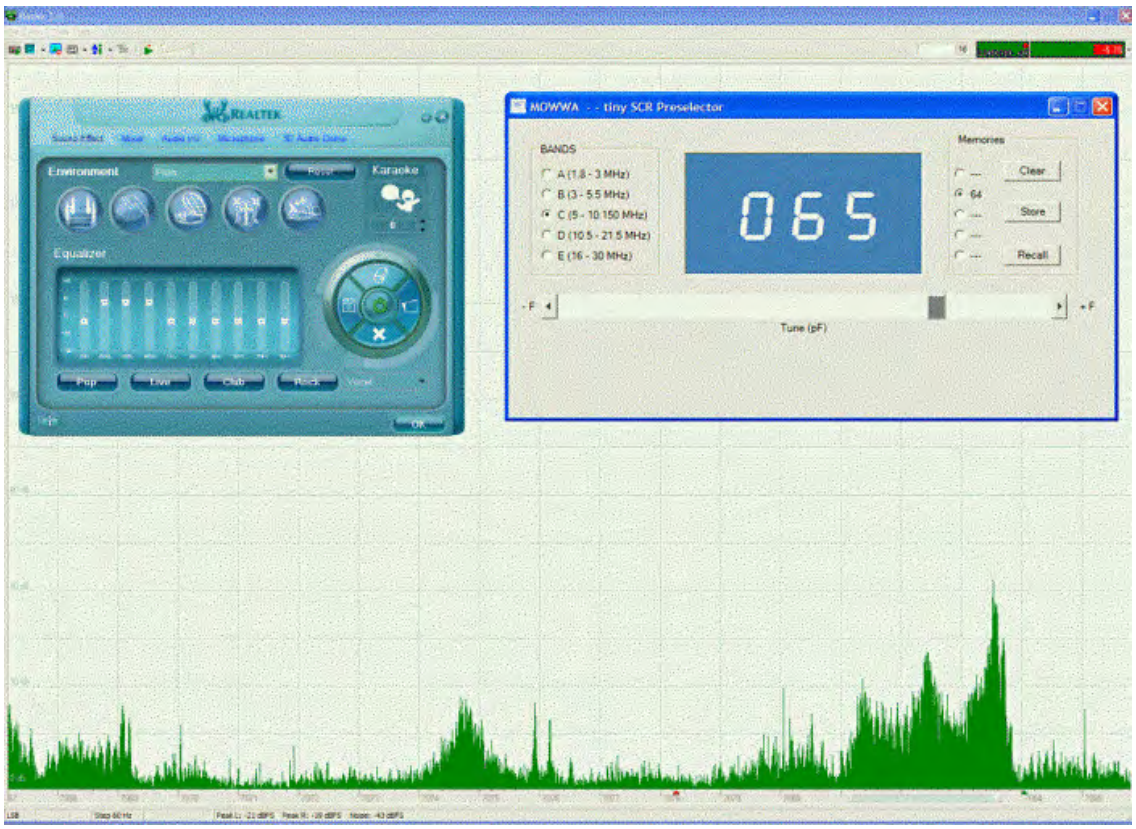
tiny SCR Preselector working with SoftRock Lite + Xtall RX V9_0



When the program starts, it attempts to connect to the tiny SCR-Preselector through the USB port. If it is not connected or the USB Driver is not installed the Status bar indicates this condition.

Driver Installation

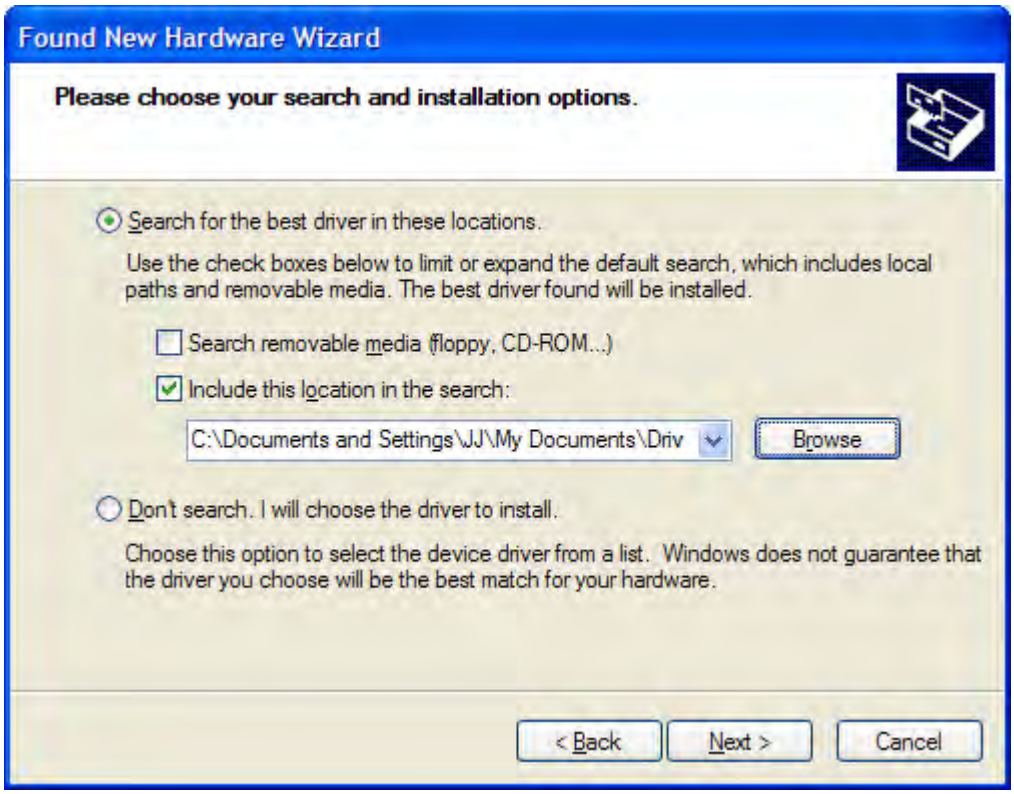
Windows XP OS

Insert the CD ROM labelled “tiny SCR Preselector Software” in your drive. Copy the file included in the CD in your computer, e.g. My Documents.

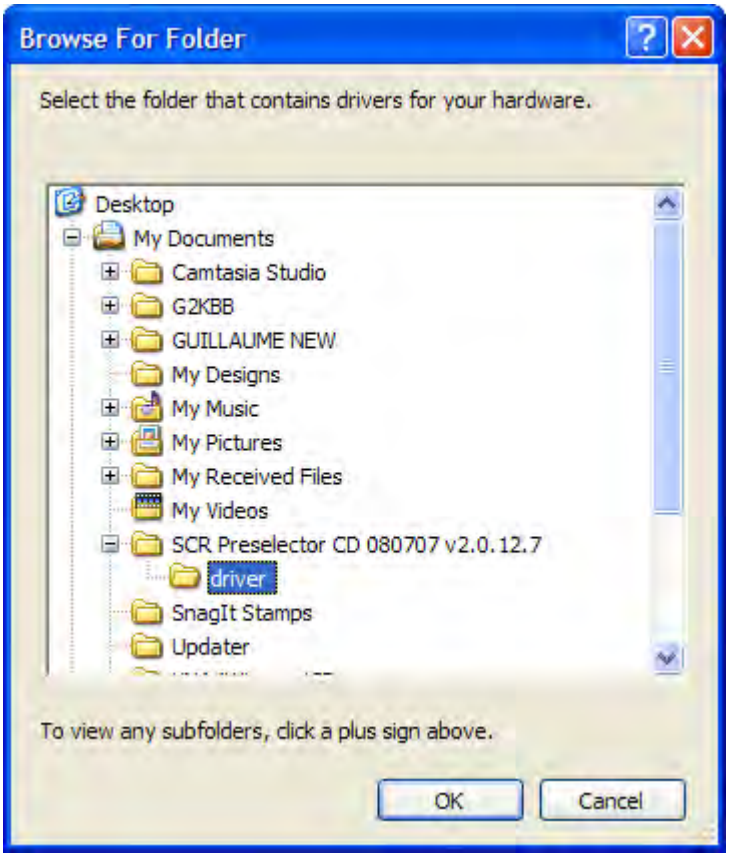
Close the program if previously was open.
Connect the power supply (12VDC/250mA) and USB cable to the tiny SCR Preselector.
A “ Welcome to the Found New Hardware Wizard ” will appear on screen.

Mark on “Install from a list or specific.....” and click next.

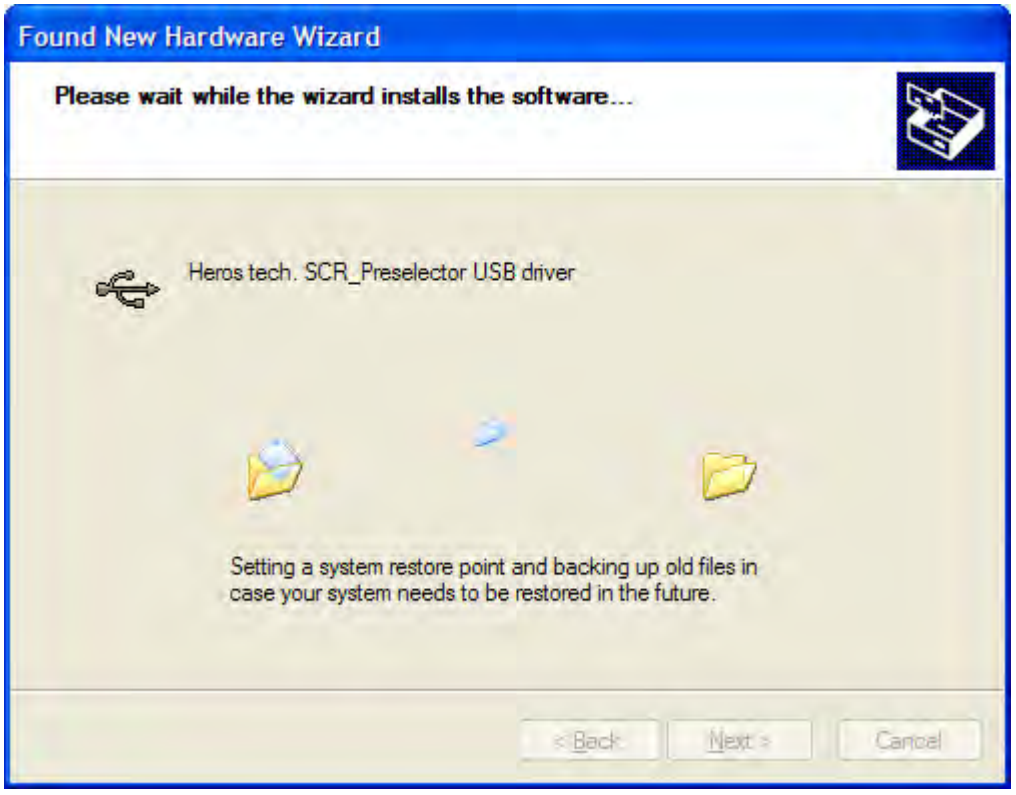
Mark on “ Include this location....” and click on Browse button.



Select the file Driver located inside the file copied in your computer and click OK and Next.

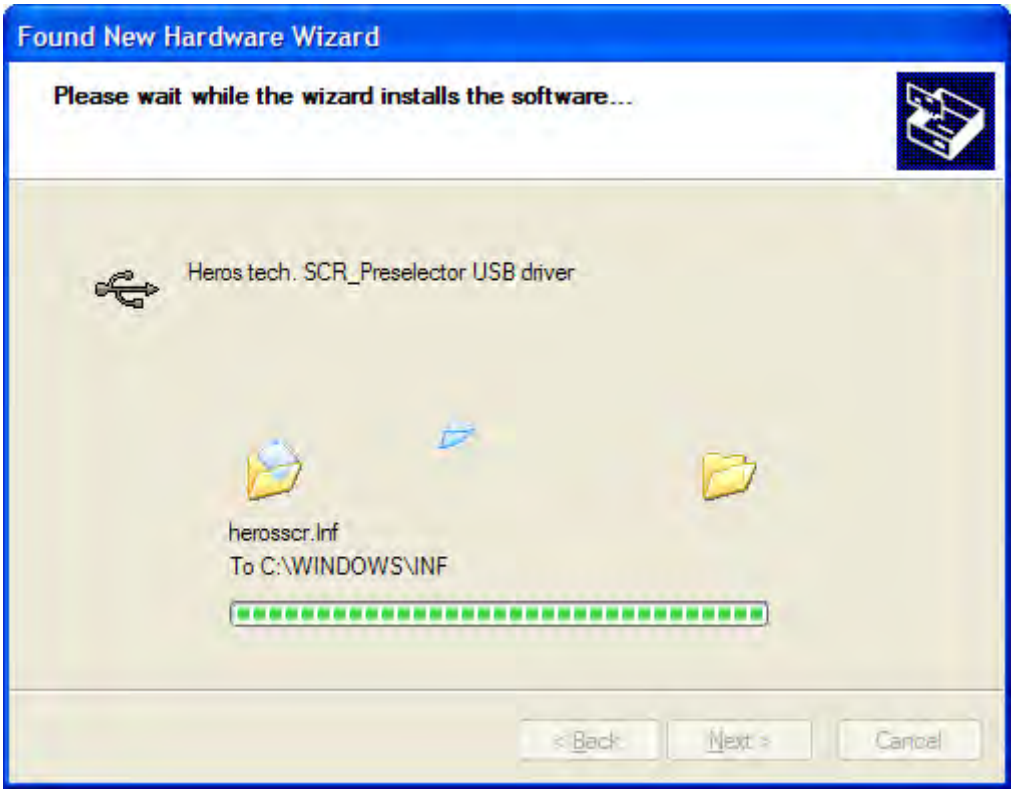


Installing the USB driver



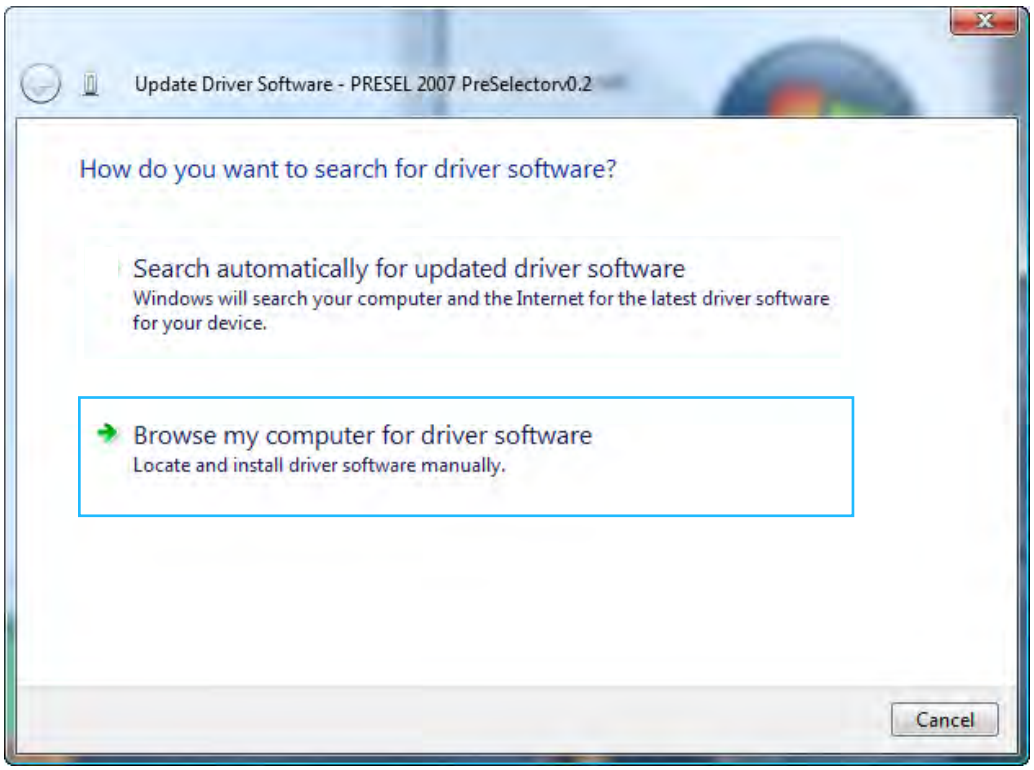
Click on “Continue Anyway” button

The USB driver installation resumes

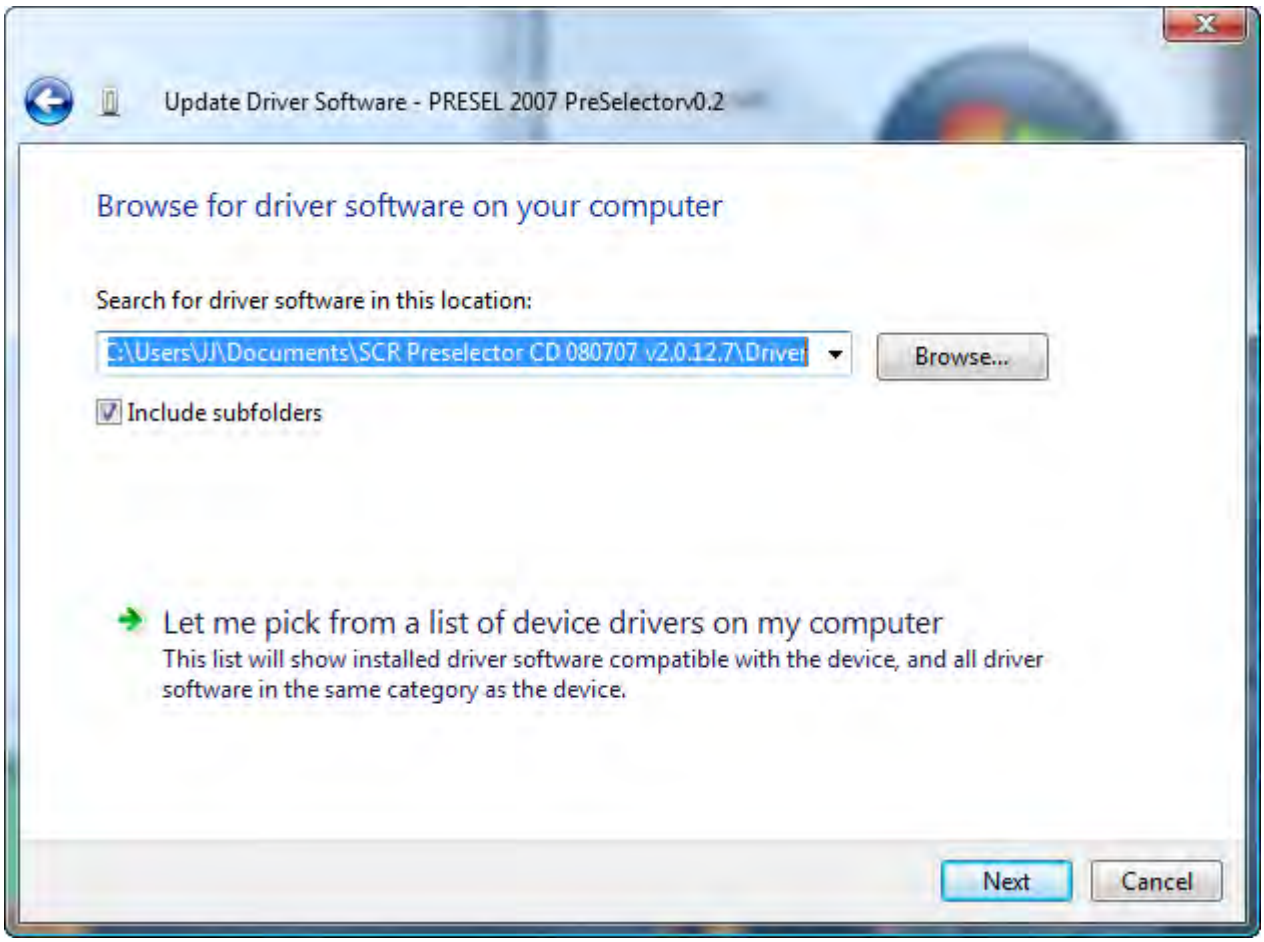


Installation completed.

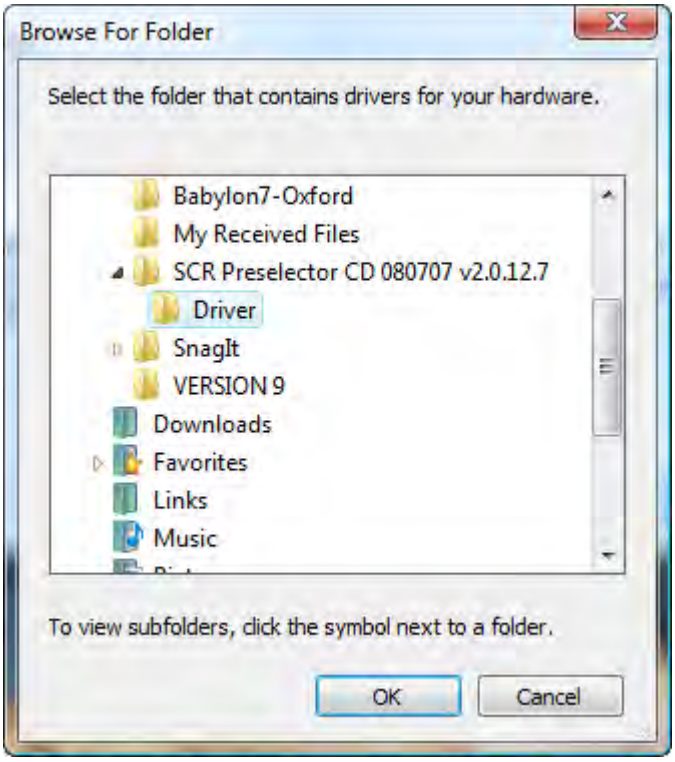
Driver Installation on Windows Vista OS



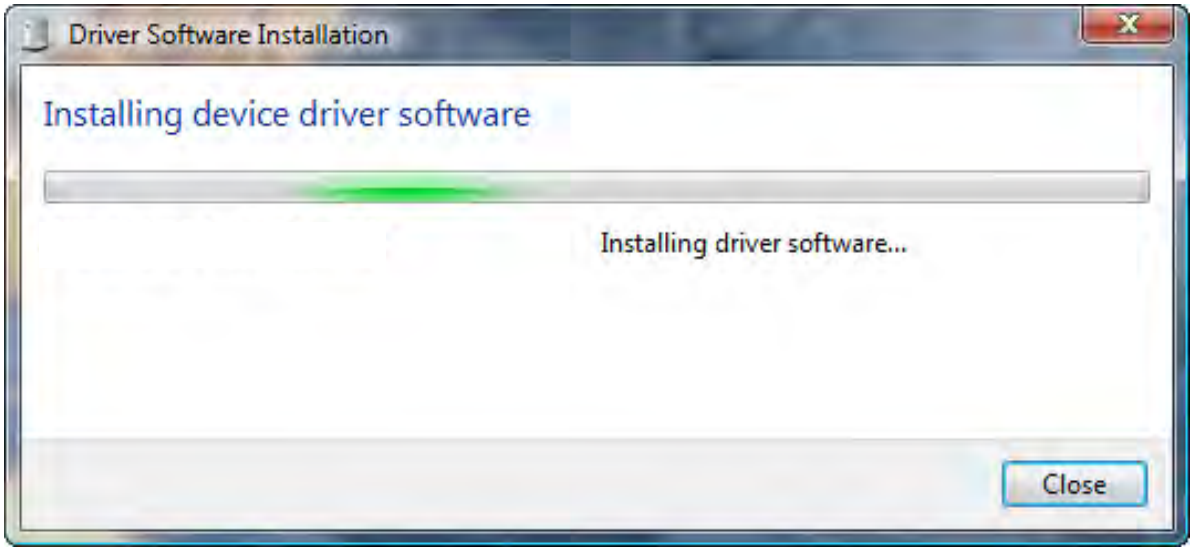
Browse for the file “Driver” located inside the file copied in your computer.



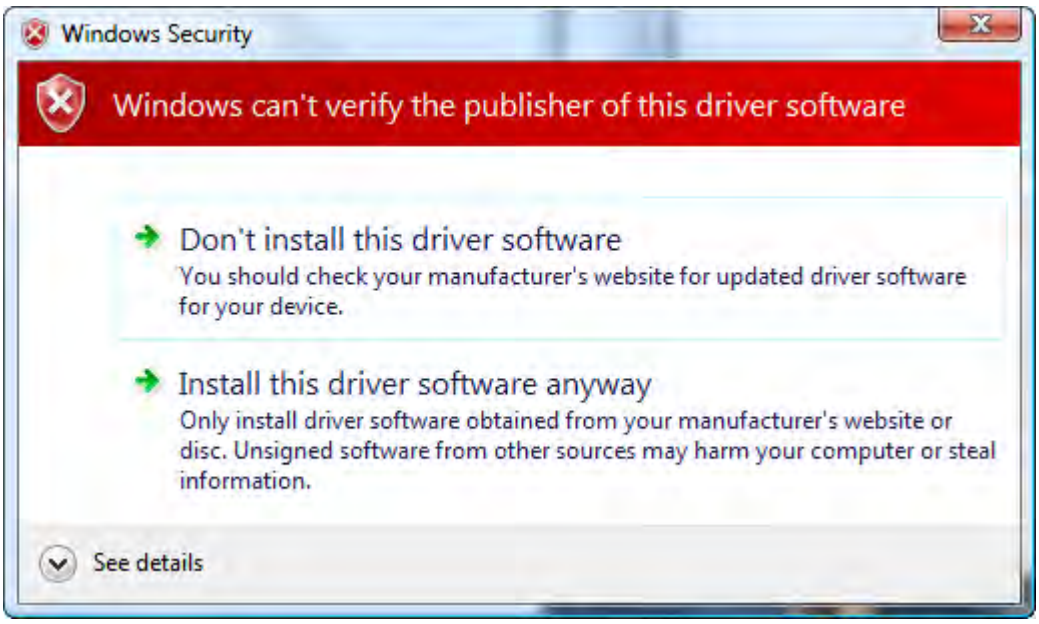
Select the file “Driver”



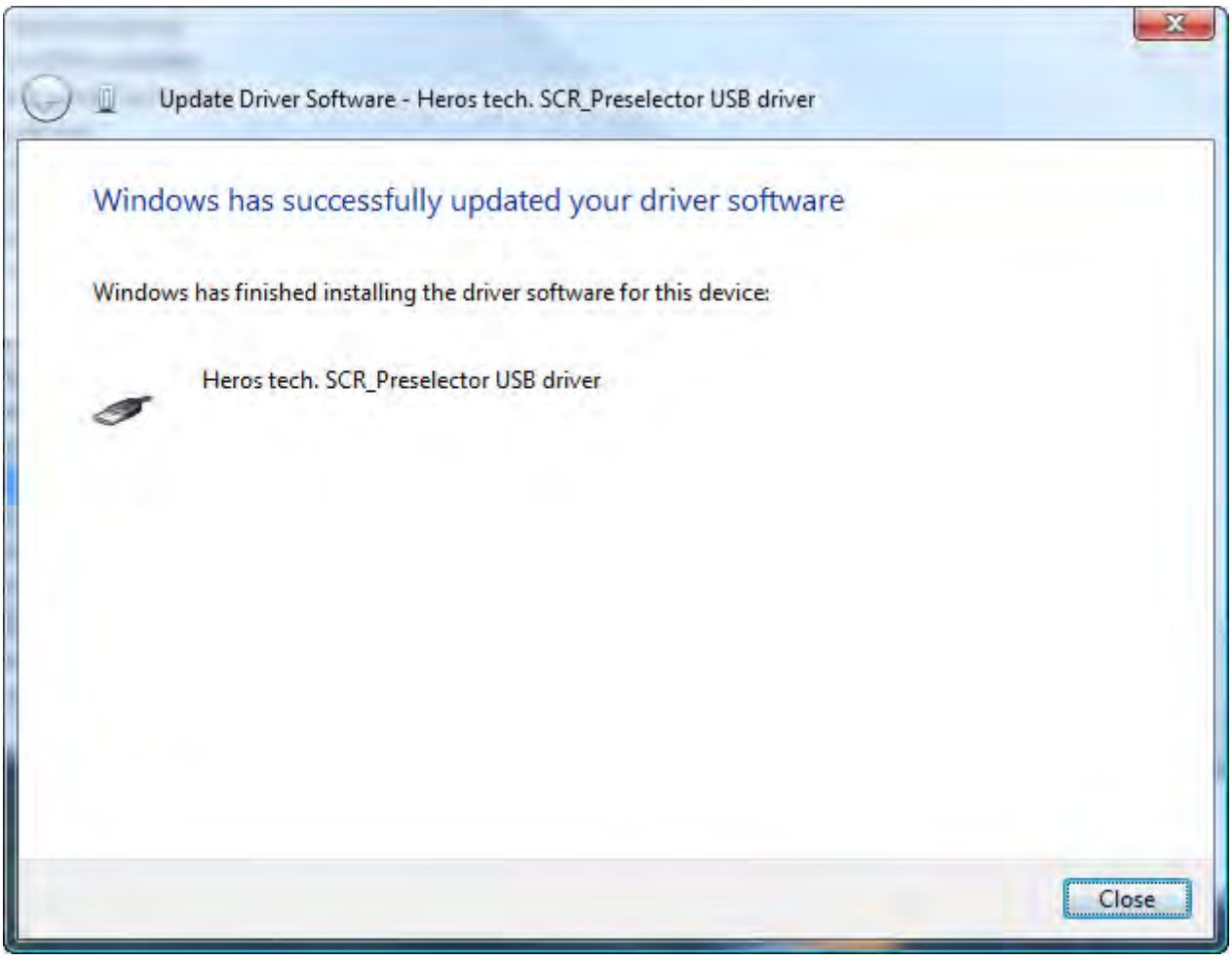
Installing the USB driver

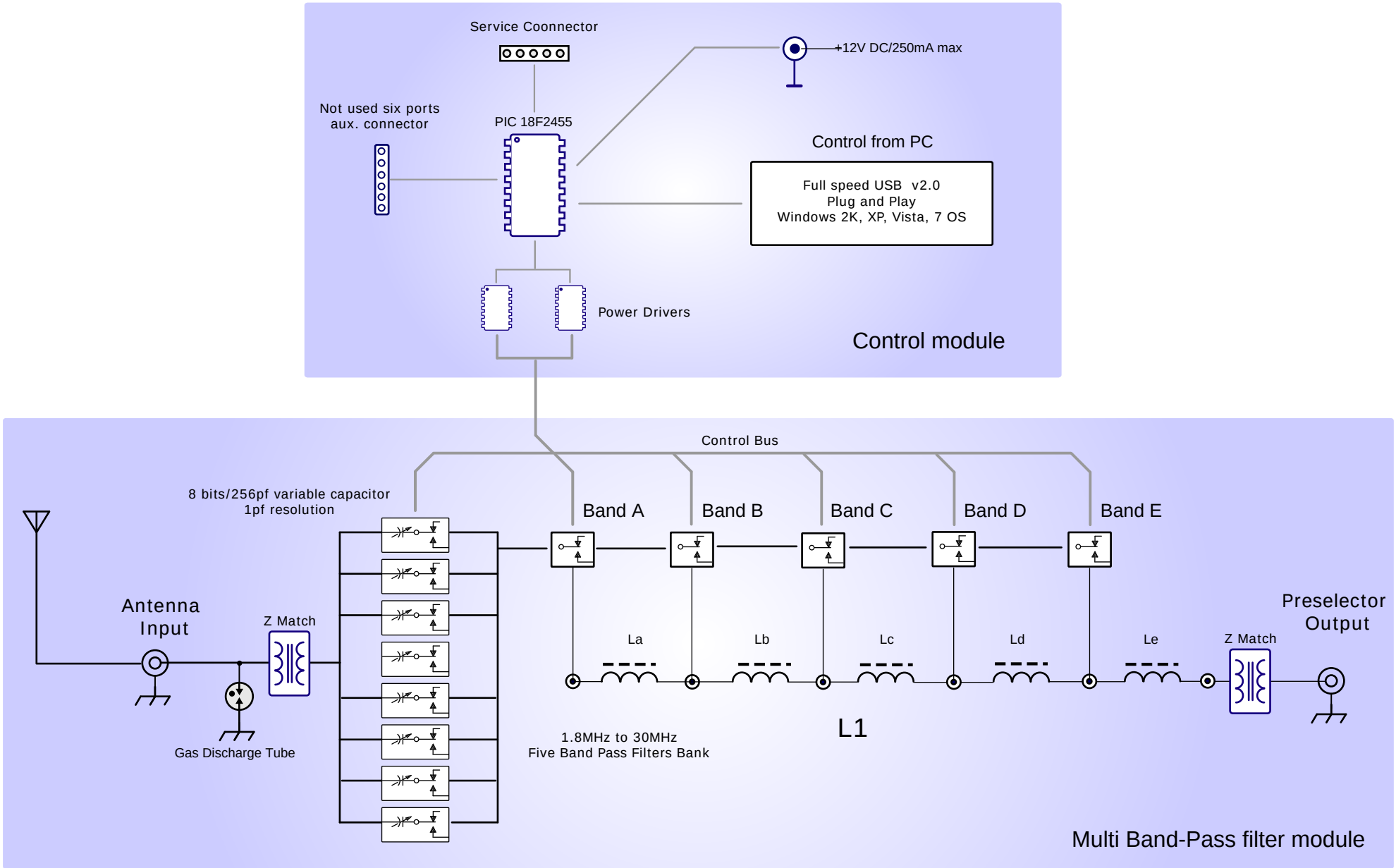


Click on “Install this driver anyway”



Installation completed.





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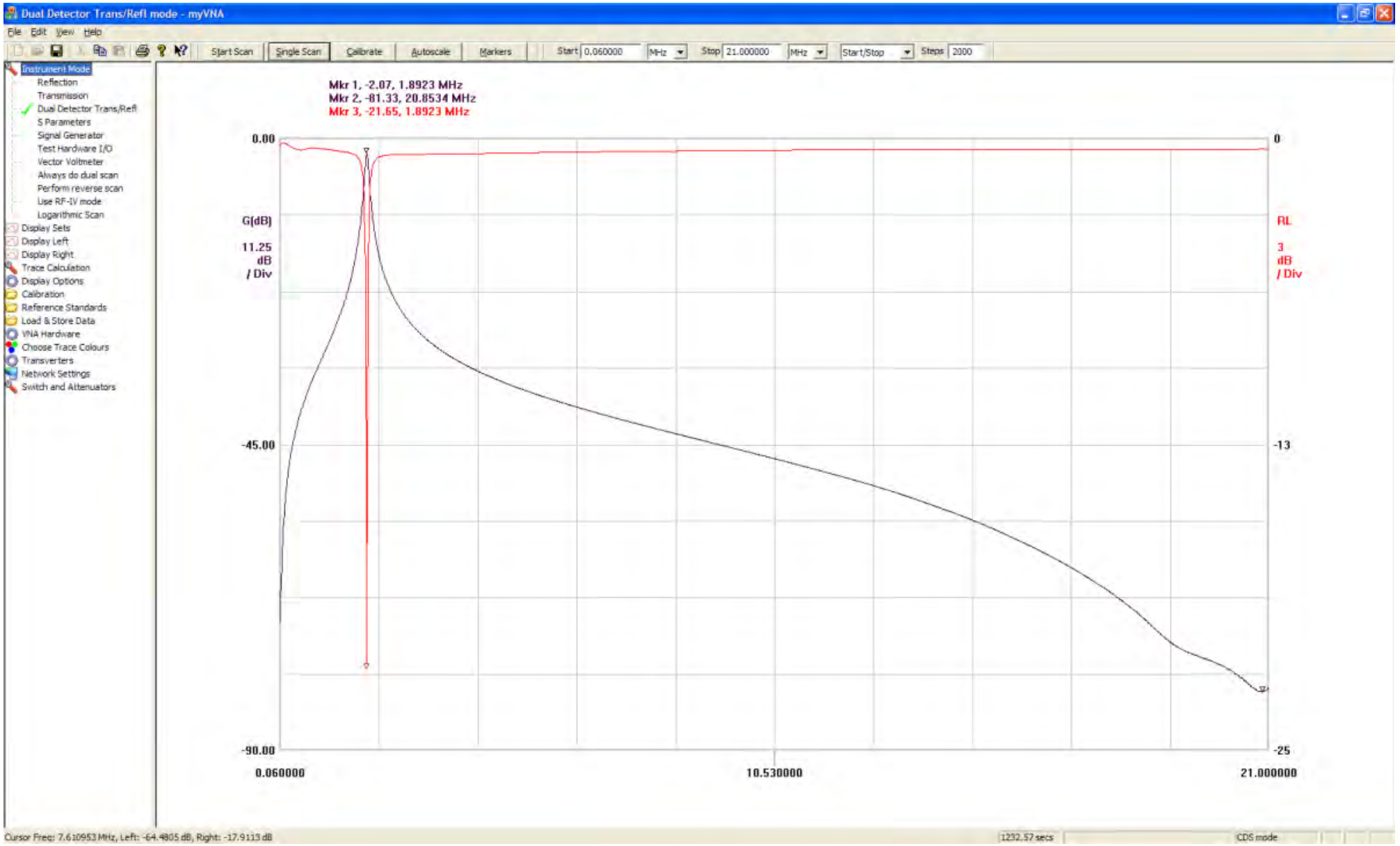
Drawing tiny SCR Preselector_Rev_B Diagram			
Approvals	Size	DWG No	
Issued	A4	REV B	Sheet 1/1
Checked	Scale	FCSM No	
Drawn JJ de Oñate		Date XV VIII MMVIII	

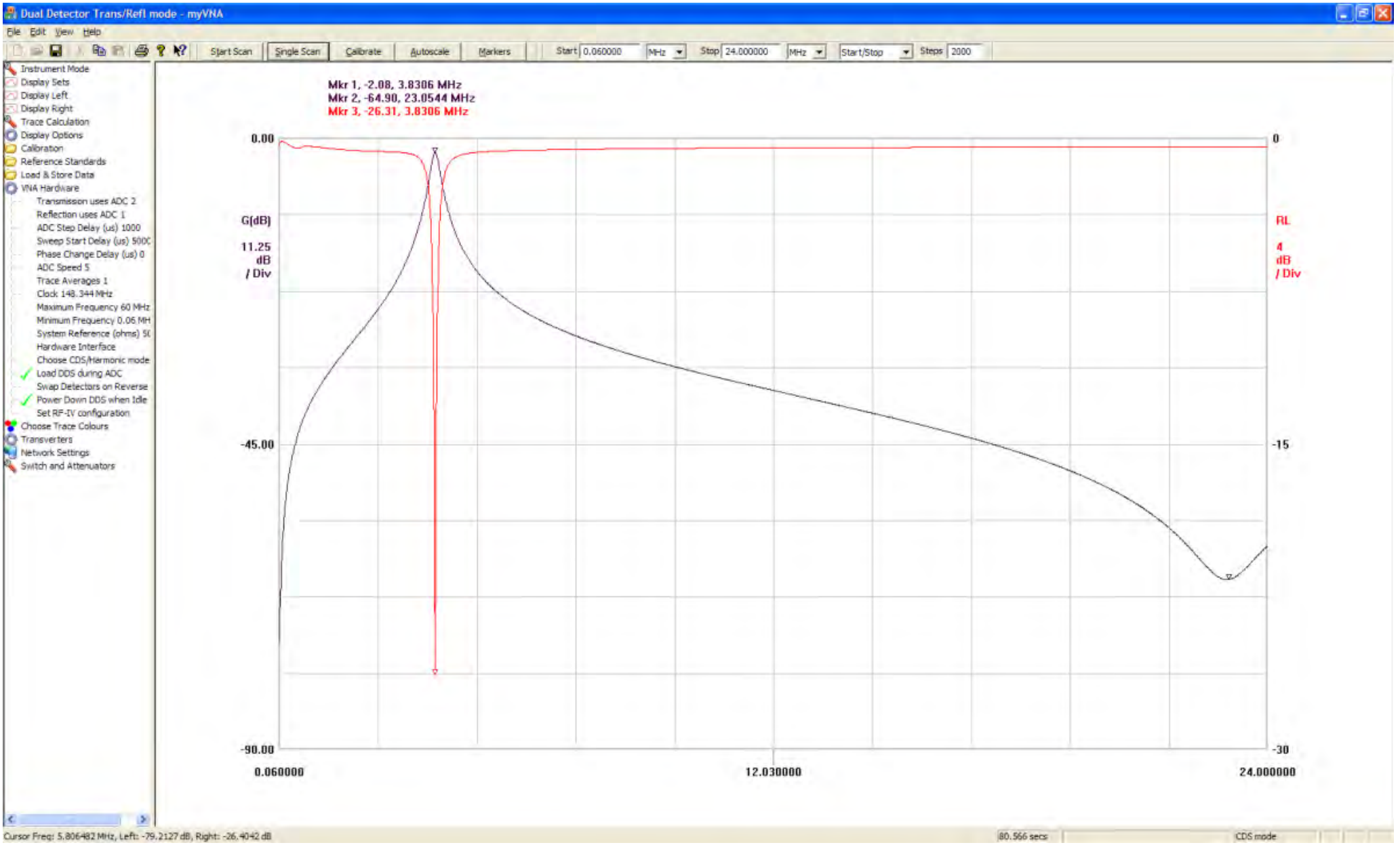
In the following plot a Broadcast Band rejection filter has been connected to the input of the tiny SCR Preselector in order to remove interferences from MW stations.

(N2PK Vector Network Analyzer & My VNA program software)



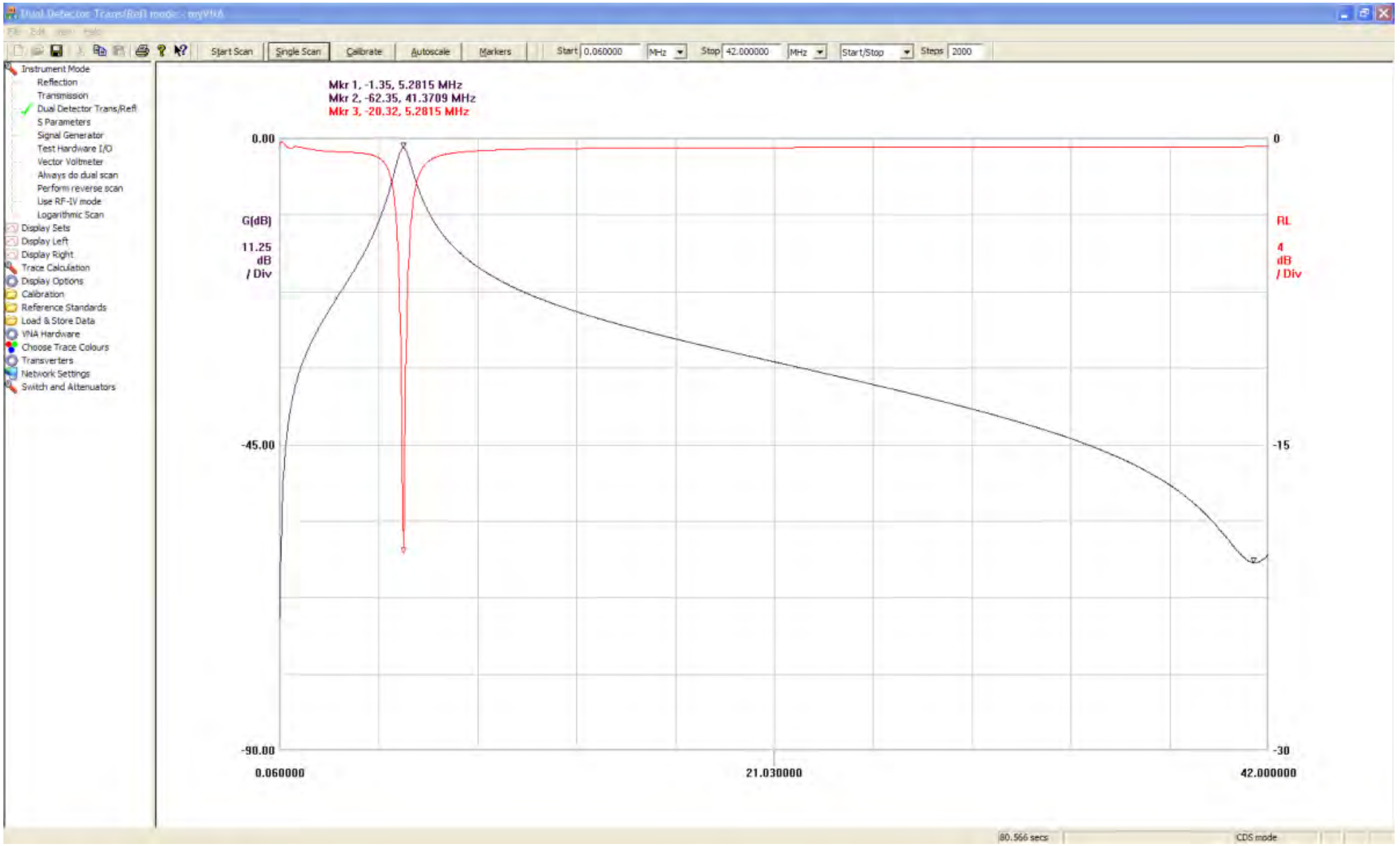
Band A plot

(N2PK Vector Network Analyzer & My VNA program software)



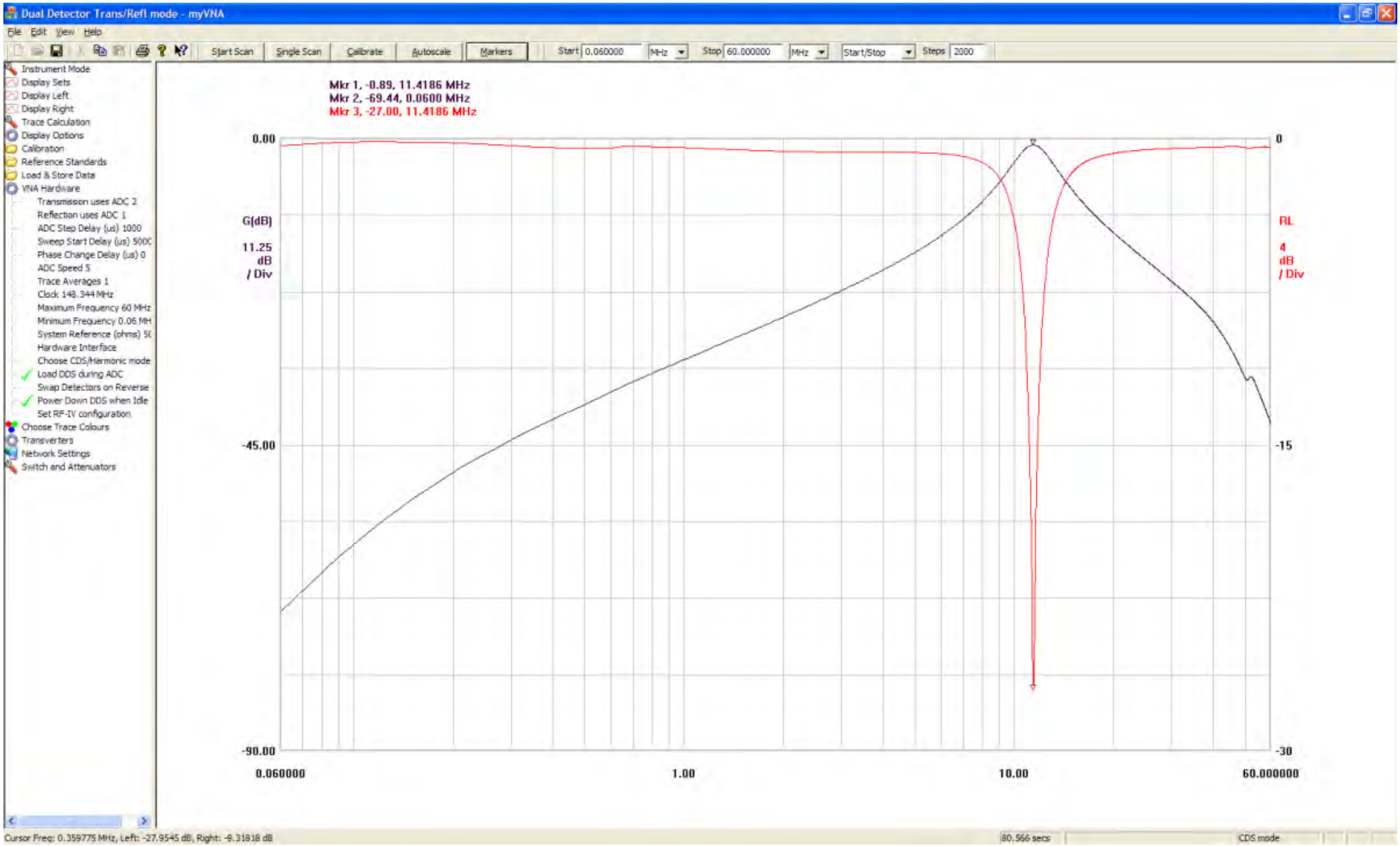
Band B

(N2PK Vector Network Analyzer & My VNA program software)



Band C

(N2PK Vector Network Analyzer & My VNA program software)



Band D

(N2PK Vector Network Analyzer & My VNA program software)

Band E

(N2PK Vector Network Analyzer & My VNA program software)

NOTES: