Modulation – Demodulation Software Radio

Yahoo user group: https://groups.yahoo.com/neo/groups/mdsradio/info

MDSR website: http://users.skynet.be/myspace/mdsr

How to upgrade and connect an analog RF transceiver to a computer for full IF-SDR operation (RX and TX).

Installation procedures for FT-950, IC-756 as addendum.

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Accomplishments since the last publication

Hardware

The MDSR group has released the BiLIF kit and the building instructions. The LIF2012 kit and the partial BiLIF kits are now available through the MDSR group. The complete LIF2012 kit is available on our website and the partial BiLIF kit for full RX-TX operation is available through e-mail request at: alexschwarz@telus.net. Both kits are required to make up the BiLIF assembly that connects any symmetrical 455kHz or 450kHz IF transmitter to a soundcard and works with the MDSR software for IF-SDR operation.

A large portion of time was spent on testing different audio cards and USB audio devices. One of the major findings was that any 24bit audio output device can be used for TX operation. Even on-board sound devices made by Realtek passed the spurious emission tests and the TX filter performance was excellent. Because lower end sound devices use only 16bit ADC resolution for input (RX) high quality sound cards (true 24bit) are recommended. The Xonar PCI-E or a Xonar U7 USB sound device provides excellent performance for a very reasonable cost.
To make it easier to use third party software with the MDSR setup the software setup now uses two audio cards. One audio card performs the IF (high end – true 24bit) and the second one the base audio function. By separating the audio devices to baseband audio and to IF, the software setup becomes very simple. For most computers and laptops the on-board device can be for base band audio processing.

Software

This year the MDSR Team concentrated on making the MDSR easier to use and to set up for RX and TX operation. We had two software releases V2.7 and V2.8. Both releases concentrated on simplifying the setup procedure of the MDSR. Now the setup procedure concentrates in the RX

Parameters and the TX parameters menus. Input and output level indicators have been added into the filter adjustment windows. This eliminates the use of external meters and streamlines the calibration. The Frequency Calibration is still performed in the Calibration menu. The main setup for RX and TX has been reduced to level values and the use of the MDSR-SA (spectrum analyzer) for calibration has been reduced.

The MSDR software now also provides output monitors and automatic level control (ALC) for input and output audio. These control routines make it impossible to overdrive the DAC (digital analog converters) which, if overdriven, can cause close-in spurious emissions. The RX overdrive control can be tuned off by the user. The TX ALC is always required and also limits the power output of the transmitter to prevent overheating.

The MDSR can now be installed on WinXP, WinVista, Win7 and Win8.1.

Note: Computers running Win8.x RD can not be used to run the MDSR or any other third party software that is not downloaded from the Microsoft store directly.

Making the MDSR-BiLIF portable

The BiLIF PCB makes it possible to connect the transmitter IF stream to a soundcard. Since previous setup of MDSR required a PCI or PCI-E internal sound card the setup was limited to base stations only. By using a USB sound device the computer used to run the MDSR software can be a Laptop or a Web the T-100T Transformer Book. To minimize the amount of wiring, the USB audio device and the BiLIF have been built into one box. Now all the capability of the MDSR software can go almost anywhere.

Building Instructions of the 12kHz BiLIF Converter

Introduction

The BiLIF2012 is the continuation of the LIF2012 development, which is now also available as a partial kit. It extents the functionality of the RX-only LIF2012 to TX as well. The partial kit contains all the hard-to-find components, such as crystal filters, IF transformers, relays, regulators and ICs. Capacitors and resistors are not supplied but can easily be obtained from your local electronics store. All components are through-hole and the kit is easily assembled.

The BiLIF is the up- and down-converter hardware that works in conjunction with the MDSR software and turn any symmetrical 455 or 450 kHz 3rd IF transceiver into an IF SDR. The MDSR has been developed as a stand-alone application, and a spectrum analyzer has been added that works in conjunction with the MDSR engine. The transceiver interface software OmniRig has been implemented to control 48 different makes and models of radios. To extend the capability into digital modes, fldigi and Dream for DRM demodulation are included in the download. The MDSR was also tested with WSPR and JT-65-HF with excellent results.

The MDSR software package is available from our Yahoo user group or from our website (http://users.skynet.be/myspace/mdsr) and is free for non-profit amateur radio purposes. This provides a complete transceiver application package for PC desktop computers.

The BiLIF TX functionality has been tested on:
FT-817, FT-857, FT-897, FT-950, IC-7000, IC-756, IC-7200, TS-850.

What is new for BiLIF V2
- The BiLIF2012 converter extends the capabilities of the LIF2012 from RX to RX and TX.
- All test equipment needed, except for a wattmeter, is part of the MDSR software.
- An overdrive monitor prevents DAC overdrive to eliminate close-in band splatter.
- The BiLIF hardware allows for a wider range of LO frequencies: 450 and 455kHz.

• Soundcards that have been tested for FCC compliance are M Audio 2496 and Delta 44, Asus Xonar PCI and Xonar U7 USB.
   Note: other soundcards might work but have not been verified; all soundcards work for RX.

1. Technical Specifications

BiLIF Hardware:

Local Oscillator Frequency: 462 – 474kHz
IF Frequency: 455kHz or 450kHz (± 10kHz)
IF Input Level: (max) 1mV – 20mVpp
IF Output Level: 20mVpp to 400mVpp
RX Conversion Gain (max): 55dB
TX Conversion Gain (max): -3dB
Output Level for S-9: 0.2Vpp
LIF Bandwidth: ± 10kHz
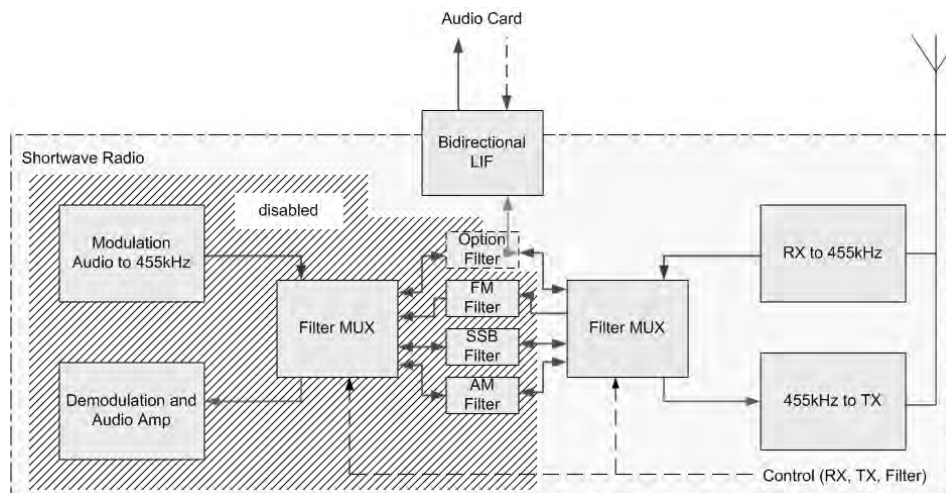LIF Center Frequency: 9 – 18kHz
Supply Voltage Range: 9 – 15V

2. Creation of 12kHz LIF (Low Intermediate Frequency)

How to extract and insert the 455 kHz IF from/to a transceiver

During RX the BiLIF2012 hardware takes the 455 kHz IF, which is generated inside the radio before the signal is filtered and demodulated, and down-converts it to a 12 kHz LIF (Low Intermediate Frequency). During TX the 12 kHz IF is up-converted and then injected via the LIF port. The transceiver further converts and amplifies the computer generated IF and transmits it on the set TX frequency. All HF transceivers use one ceramic filter to separate the USB spectrum from LSB spectrum and use the same filter for RX as well as TX. This creates one point in the transceiver where a 455 kHz unidirectional IF is present. How this IF is routed depends on the state of the transceiver, but all transceiver use same principle for filtering SSB. The models that have already been tested are posted on the website http://users.skynet.be/myspace/mdsr/. There is also a lot of information in the files and photo section on the MDSRadio Yahoo user group.
The LIF port modification does not alter the stand-alone capabilities of the transceiver, but when it is connected to the computer, it creates a powerful IF-SDR transceiver.

The signal flow below shows how the BiLIF is connected and replaces the internal modulation and demodulation hardware.
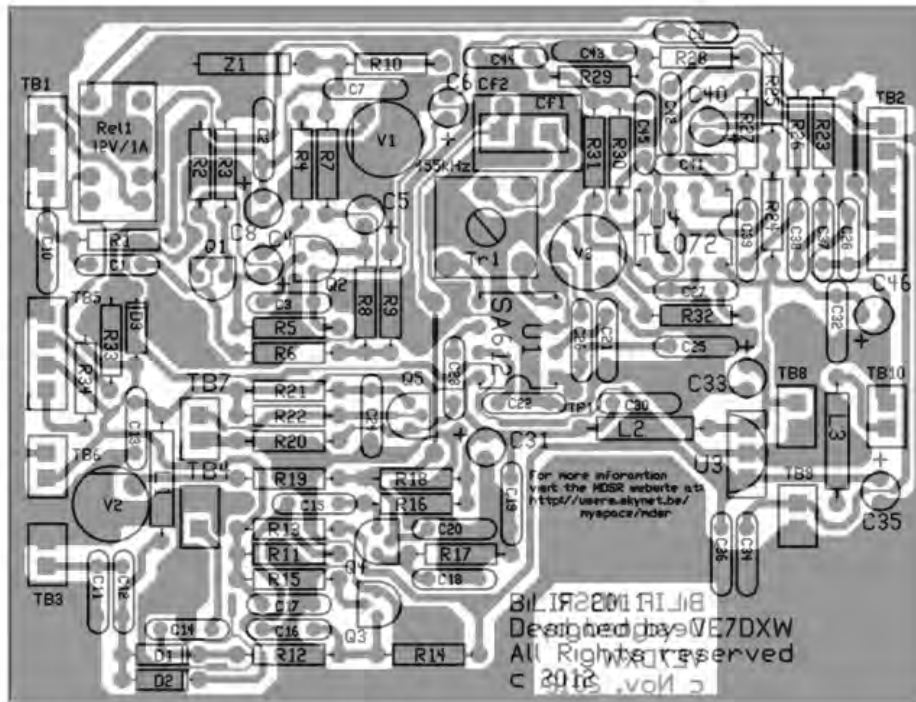
Assembling and Testing the BiLIF PCB

The assembly of the BiLIF unit requires the LIF2012 RX-kit and the BiLIF2012 TX-kit. The LIF 2012 comes with all parts needed to build the kit. The BiLIF2012 kit only contains the hard-to-find parts and the BiLIF PCB. The rest can either be ordered on-line or obtained from your local electronics store. The parts with the orange background are included in the BiLIF kit.

Part List BiLIF2012				
Part Value		**Info**	**Amount**	**Location**
470p	471	monolithic	10	C3 C7 C9 C11 C20 C25 C28 C30 C32 C34
1n	102	monolithic	4	C10 C22 C36 C43 C44 C45
2n2	222	monolithic	3	C2 C41
4n7	472	monolithic	3	C37 C38 C39
10n	103	monolithic	1	C23
47n	473	monolithic	3	C12 C14 C15
100n	104	monolithic	8	C1 C13 C16 C17 C18 C19 C21 C24
220n	224	monolithic	3	C26 C27 C42
1uF	106	25V radial	3	C6 C31* C40
10uF	107	25V radial	2	C4 C46
22uF	227	25V radial	1	C5
47uF	477	25V radial	3	C8 C33* C35
455kHz		crystal filter	2	Cf1 Cf2 note: only one component
1N914		switching	3	D1 D2 D3
470uH		inductive	3	L1 L2 L3
2N3904		NPN	5	Q1 Q2 Q3 Q4 Q5
22		1/4W	1	R17
100		1/4W	2	R4 R16
270		1/4W	1	R10
330		1/4W	1	R8
470		1/4W	1	R21
820		1/4W	1	R9
1k2		1/4W	3	R7 R33 R34
2k2		1/4W	2	R13 R14
2k7		1/4W	1	R23
3k3		1/4W	2	R3 R26
4k7		1/4W	2	R20 R32
5k6		1/4W	1	R19
8k2		1/4W	1	R5
10k		1/4W	4	R1 R11 R12 R15
22k		1/4W	4	R22 R28 R29 R30
33k		1/4W	1	R18
39k		1/4W	1	R27
56k		1/4W	1	R31
82k		1/4W	1	R2
100k		1/4W	3	R6 R24 R25
HK23F		12V/1A	1	Rel1
IF		42IF103	1	Tr1
78L08		8V reg	1	U3
SA612		mixer	1	U1
TL072		dual OPA	1	U2
10k		var	2	V1 V3
5k		var	1	V2
1N4739A		zener 9V1	1	Z1

* radial low profile, highlighted orange: included in the partial kit
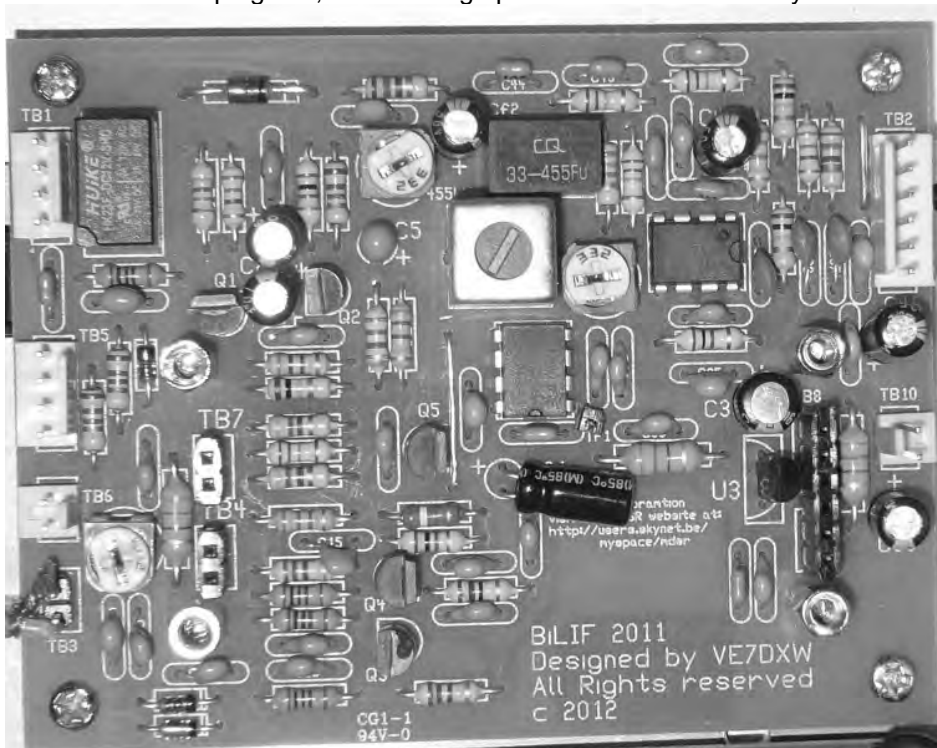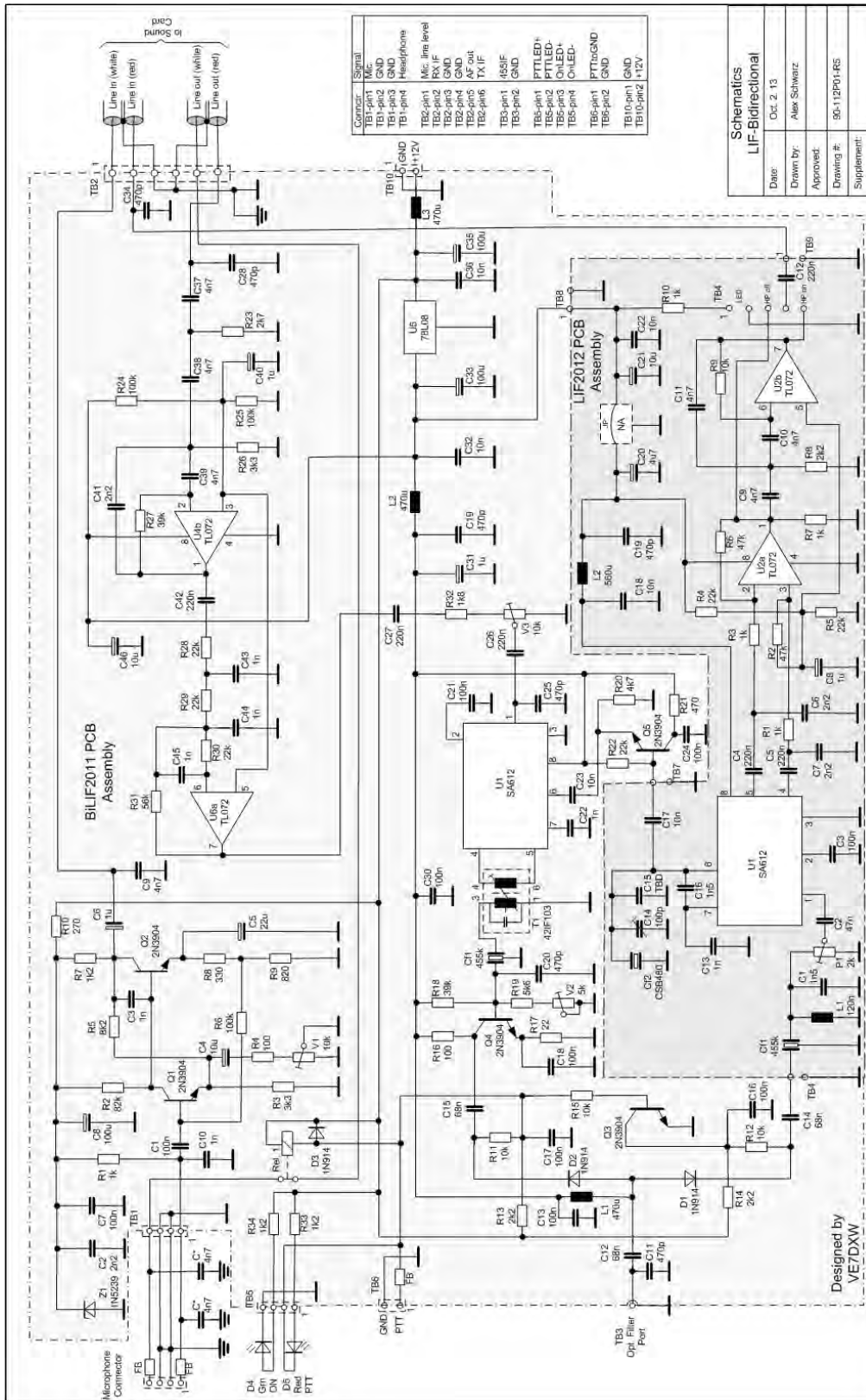
Layout

MDSR_V2.TSS   11/26/12   02:18 pm

BiLIF PCB

The picture below shows the assembled BiLIF2011 PCB. The black female strip connectors provide the location of the LIF2012 to plug into, thus making up the BiLIF2012 assembly.

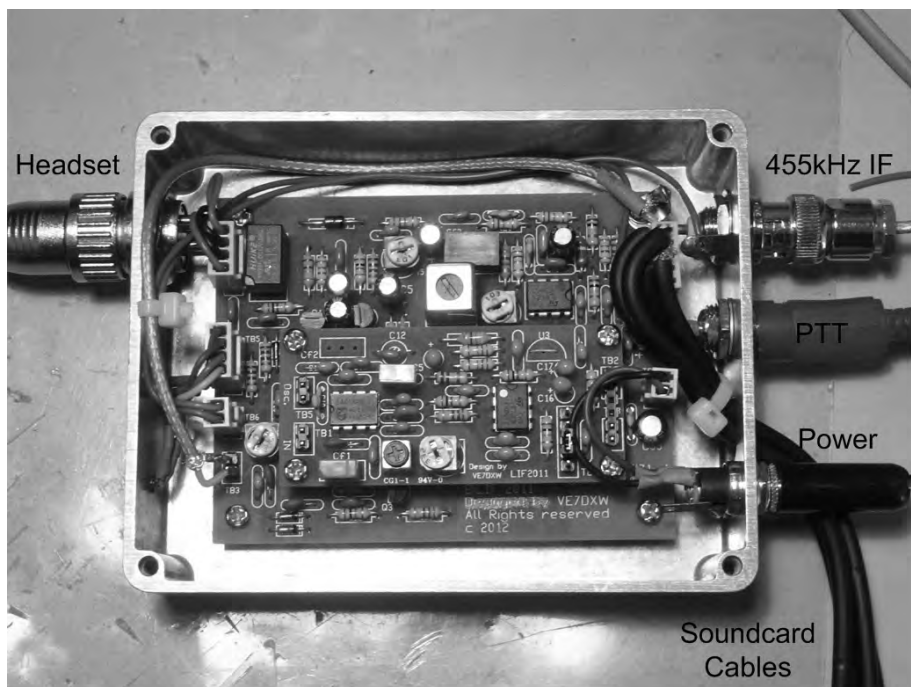# Schematic

Modifying the LIF2012 PCB

If the LIF2012 was assembled as a stand-alone unit with the connectors facing up, follow this procedure to make it ready for the up-converter PCB.

- Remove the connectors TB1, TB2 and TB3.
- Push the pins all the way to one side. Mount and solder the connectors 180 deg so that the pin sticks out from the solder side of the PCB.
- Remove LM78L08 and bridge pin #1 and #3 with a wire. The 8V supply is on the BiLIF2011 PCB.
- Add a 10nF capacitor C17. This extends the LO signal to the LIF2011 PCB.
- Push the pins all the way to one side. Add the TB5 connector facing down towards the BiLIF2011 PCB.
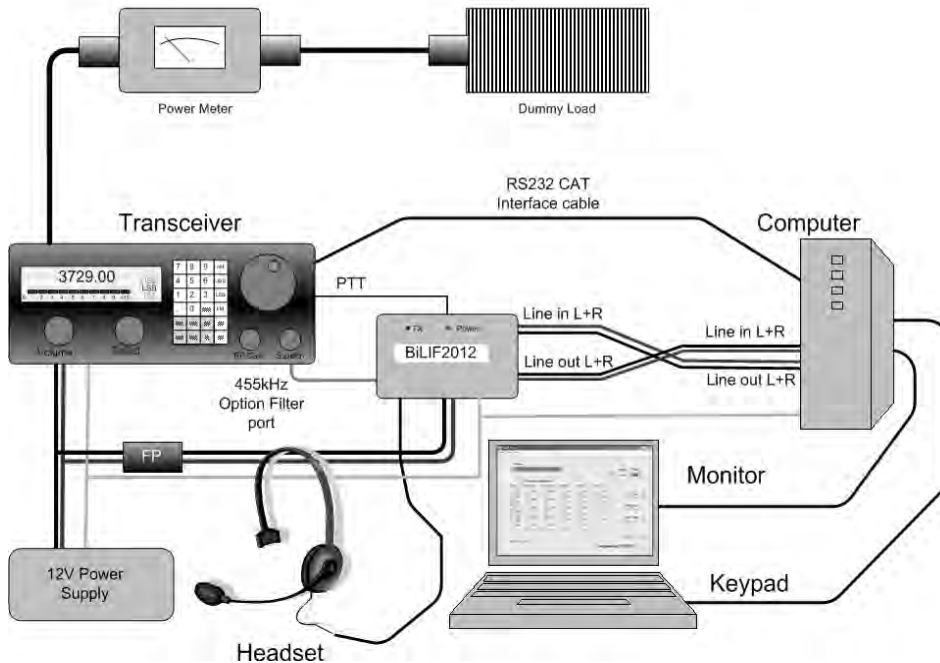

Assembled in an Enclosure

The BiLIF PCB assembly easily fits into a pre-made shielded aluminum enclosure. This is a quick and easy way to get a professional looking unit with a minimum amount of work. All that is required is drilling the holes. The size of the enclosure is 4.7"(l) x 3.7"(w) x 1.3"(d) (120 x 95 x 35mm^3). The up-converter PCB is mounted with 5mm M3 standoffs to the bottom of the enclosure.

Note: Hidden below the power connector is the grounding pin – a 10-24 screw which connects to station ground. The power and PTT LED's are also located on the side where the headset plug is located.

Setting up the BiLiF hardware

Test setup with BiLIF and MDSR

Setting up the maximum power level

Turn the transceiver to 1/5 output power and connect a power meter and dummy load. This will prevent the PA from overheating during setup. This power output setting is now considered "Max power". The MDSR V2.8 is running and RX is configured and working properly.
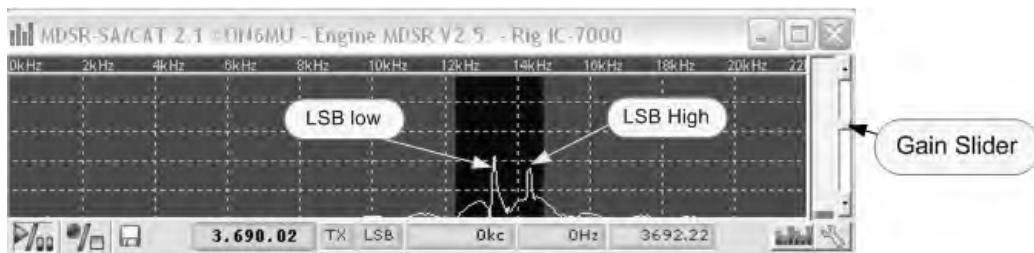
- Open the TX panel window (F3) – select "Voice Parameters".
- Set V2 (near TB3) to (12 o clock) and the V3 near Tr1 to off (5 o clock), set Tr1 into about center position
- In the "Voice Parameters" turn Compression slider to 100%, the RF Gain to 20%, press the "Save" button
- In the "Mod Source" selection select "Carrier" - a carrier becomes visible near the red center line in the SA (if no carrier is visible press the "RST" button and try again)
- Click on the "TX Setup" tab and adjust the RX - TX Frequency Compensation slider until the carrier is exactly behind the red dotted line – 0 BFO setup
- Press the TX button in the TX parameters window – the rig goes into TX mode.
- Adjust the RF Gain slider upwards until the PO meter reads 70% on the main panel – press the save button.
- Adjust V3 slightly upward until the output power reaches max. power (1/5 of total output).
- Use the offset selector and select -700 Hz – now the peak moves into the blue frequency window and a tone will be heard in the speaker.
- Adjust Tr1 to equalize the power output between 0 Hz and -700 Hz
- Use the offset selector and select +700 Hz. Now the peak moves +700 Hz up from the center line. No tone will be heard.
- Adjust Tr1 to equalize the level power output between 0 Hz and +700 Hz.
- Adjust Tr1 for best power equalization of the 3 settings.

Setting up the mic audio level V1

- Same hardware setup as above.
- Open the Audio Setup panel by pressing F5.
- Talk into the mic with a normal voice and adjust V1 for -10dB maximum input (left input channel).

Setting up the TX filter pass

- Same hardware setup as above.
- Select LSB mode on main panel.
- Open the "TX Setup" by pressing the tab.
- Set LSB-Q to 200% and the upper and lower "Filter Form Factors" to 20.
- Set USB – LSB Gain Balance to 400.
- Select Voice Parameters; in "Mod Source" selection select "IMD" and press the "TX" button - two carriers becomes visible in the filter box of the SA (if no carriers are visible press the "RST" button and try again) – now the TX IF level meter is indicating a signal level.
- Go back to "TX Setup". On the bottom of the TX panel adjust the LSB-Q to a TXIF output meter readout of -6dB.
- Adjust the upper and lower filter slope to get both peaks equal in amplitude. Repeat previous step until best results are obtained. **Note:** lower values increase the level.
- Press the "RX" button and then the "Save" button.

- Select USB mode on main panel.
- Set USB-Q to 200% and the upper and lower "Filter Form Factors" to 20.
- Set USB – LSB Gain Balance to 400.
- Select Voice Parameters; in "Mod Source" select "IMD" and press the "TX" button - two carriers becomes visible in the filter box of the SA (if no carriers are visible press the "RST" button and try again) – now the TXIF output meter is indicating a signal level.
- On the bottom of the TX panel adjust the USB-Q to a TX IF output meter readout of -6dB.
- Adjust the upper and lower filter slope to get both peaks equal in amplitude. Repeat previous step until best results are obtained. **Note:** lower values increase the level.
- Close the "Audio Panel" and press "Save" on the "TX Panel", close "TX Panel"

IMD Spectrum for USB mode

Setting up the TX for best audio

Every time the TX panel (F3) is opened the MDSR goes into monitor mode and the mic audio is fed back to the headset. By Pressing and releasing the PTT button this feedback is turned off and the MDSR is in normal mode again.

- Adjust mic gain in TX Panel until the "clipping" flashes when talking in a normal voice – back off on the control slightly.
- Set the "Hi Pass" and the "Low Pass" to your preference.
- Set the Compression (lower is higher compression).
- Press the PTT in TX panel and talk in a normal voice and look at the output power of the radio.
- When you hum or whistle into the mic. and bring the output power to max. power the clipping indicator will start to light up (clipping indicates the activation of the ALC control)
- If there is not enough level – slightly move the V3 pot up or if it is overdriving the PA bring it down.
- Press "Save" to save the adjustments to the hard drive.
- Switch your transceiver back to full power.

Backup your configuration in the profile manager: Go to SA window, select the "Disk" icon (bottom- left) and open the profile manager. In the text field on top enter the name of your radio and press "Save current configuration". In case there is an accidental deletion of your profile you can recall the profile and you do not have to go to the setup again.

Setting up TX modulation and PTT for 3rd party programs

The MDSR setup program comes with fldigi to provide digital modes. For the receive side setup of these programs the MDSR output can be shared. This cannot be done for the TX side. For the TX side a second audio card of lesser quality, like an onboard device, can be used. This requires the setup of the output channel of the third party software to point to this device. A jumper between the audio line output of the second sound device and the MDSR modulation input needs to be set up. The PTT can be simulated by using the VOX control of the MDSR.

Conclusion

This completes the assembly and the test of the BiLIF V2. We hope this unit will provide a new enjoyable experience while operating your radio through the BiLIF – MDSR computer interface.
It is advisable to build the PCB assembly into an aluminum box as shown in this manual. This is an "off the shelf" box made by Hammond/Eddystone. It is necessary to isolate the BiLIF circuit from TX radiation created by the transceiver.
Any issues and/or questions should be directed to the MDSRadio Yahoo group.
To obtain the partial up-converter kit please contact: Alex Schwarz (VE7DXW) via e-mail.
alexschwarz@telus.net

How to setup the audio devices for MDSR

Introduction

Setting up the MDSR software on the computer is easy and automated, and in most cases the MDSR-SA and the MDSR demodulator will work almost immediately after installation. Setting up the baseband audio devices is a bit more complicated because there are so many different sound devices out there and every manufacturer has a different driver.
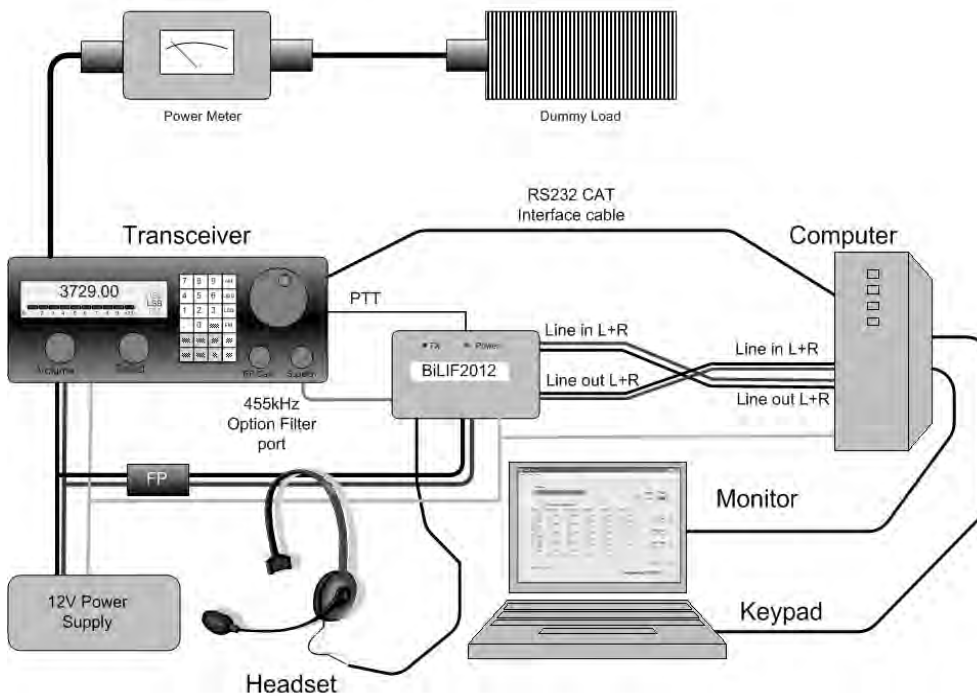Please read the following discussion about the setup of the sound devices to help with the right configuration of computer system to get the most out of the MDSR.

Setting up the Sound Devices for MDSR

For RX the MDSR will work with almost any full duplex sound-card, but in order to meet the FCC requirement of -43dB spurious emissions for TX operation a high grade sound card is needed. The sound cards that were tested and will meet the requirements is the M-Audio Audiophile M2496 and M-Audio Delta44. The RCA input and output connectors on the M2496 card provide excellent ground and RF rejection. This audio card also provides 24bit input - output resolution and low lag times (latency) for RX and TX. A baseband audio mixer output is part of the default setup.
The M Audio Delta card is no longer available, so we have tested the ASUS RealTek onboard audio device as well as the ASUS XONAR PCI-E high performance audio card. Both devices passed the FCC requirement. The RealTek on-board audio device only has a 16bit ADC which adequate, but reduces the overall dynamic range of the MDSR.
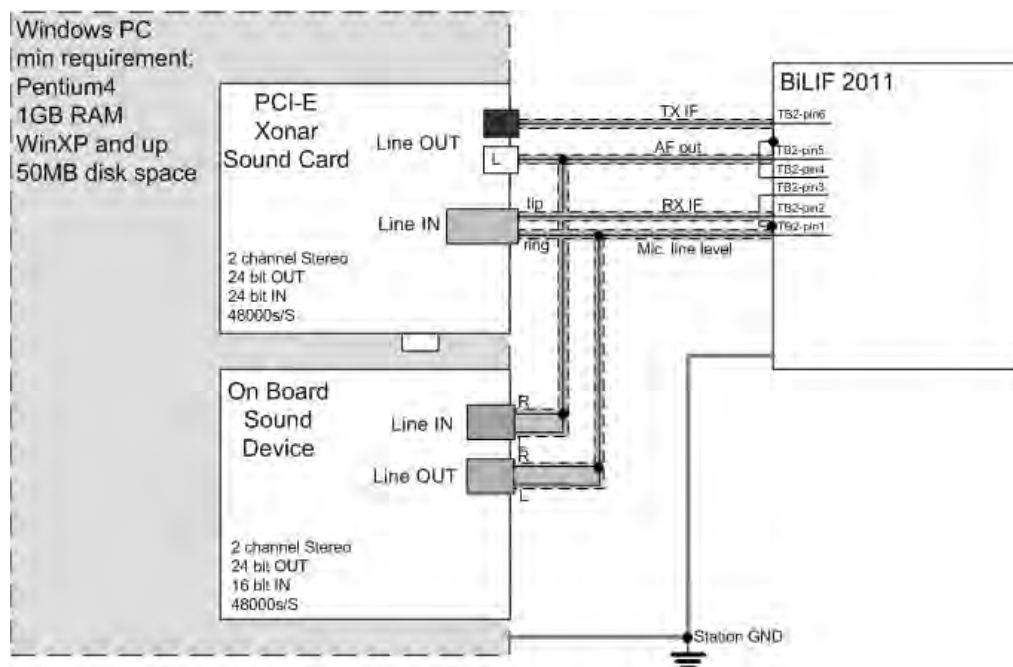

Test setup with BiLIF and MDSR

RealTek Audio cards allow the setup of a "Stereo Mix" input that can be shared among different programs. The input can be set to listen to the demodulation output of the MDSR (speaker out) and then provide the baseband audio for all the additional software (fldigi, WSPR, JT65, VLAN). The audio input (capture) device for all baseband programs is "Stereo Mix". All other devices such as the MDSR-SA and the DRM demodulator which need IF audio, the input will be "Line In".

Separating IF and Baseband Audio System

Not all sound cards have a mixed audio output like the M-Audio card or the ASUS RealTek on-board device, which other applications can share. In this case another separate soundcard can be used for base band applications (e.g. fldigi, WSPR, VLAN, JT65). The MDSR audio output can be fed into the line input of the second audio card and the line output of he baseband card can be fed to the modulation (mic. line level) input of the MDSR input card.

By wiring up two soundcards as shown below the IF and the baseband is handled by individual sound devices. This has the advantage that the setup for the additional allocations like WSPR and JT-65 software becomes very simple, just as the software developers have envisioned they will be set up. The audio input settings are set at the baseband audio device. This strategy has to be used for the ASUS XONAR PCI-E card as well, because the drivers do not work properly when the "Stereo Mix" bus is used.

Below is the wiring configuration that will be used for the BiLIF setup. It is a bit more work to create the audio connection cable between the BiLIF and the two soundcards on the computer, but the software setup is simpler and more robust.

Note: It is highly recommended that the ASUS XONAR PCI-E sound card be used for LIF (and later for BiLIF) operations. This card provides full 24-bit input and output resolution and provides superb RX audio quality. Testing also has been completed on the 24-bit out – 16-bit in, RealTek audio device that can be found on ASUS and other motherboards for RX-TX operation. The RealTek device has passed the FCC spurious emission test, and the 16-bit line in ADC is adequate for RX.

Note: Some soundcards create a "division by 0" error when the IF level is below a certain threshold, and an annoying system ping can be heard. In this case turn off the "System Sound" in the audio control panel and the ping will be muted.
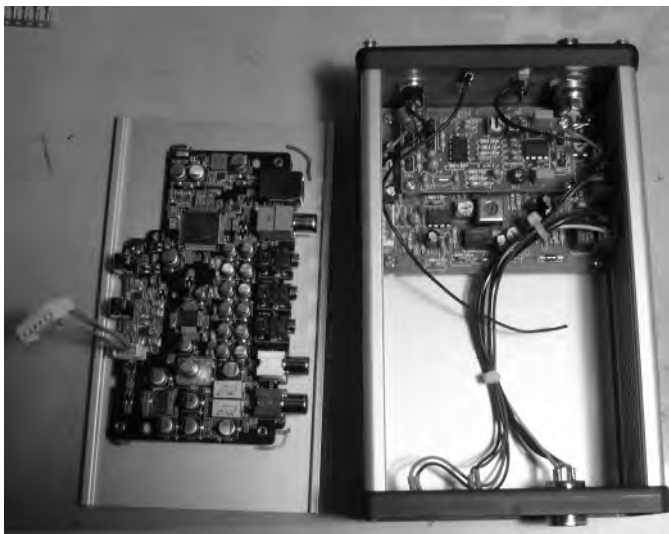
Making the MDSR-BiLIF portable

During the last year several HAM operators have requested to make the MDSR – BiLIF unit portable. To accomplish this, the MDSR Team had to combine the BiLIF assembly and the USB sound card into one enclosure (box on top of IC-7000). We also had to find a portable laptop computer that was fast enough to run the MDSR software. After some research the Asus Transformer notebook (T100-AT) with Win8.1 was chosen for the task. This computer was ideally suited for the task and performs

flawlessly at a very affordable price. It also has enough processing power to run additional digital modulation software like fldigi, JT-65, Dream and WSPR without issues. The battery life for the Asus computer is listed at 10h. Since the USB sound card is powered from the note book too, it reduces battery life to about 7h between charge cycles. **Note:** Note books that have Win 8.x RD installed will not run legacy programs and can not be used for MDSR.
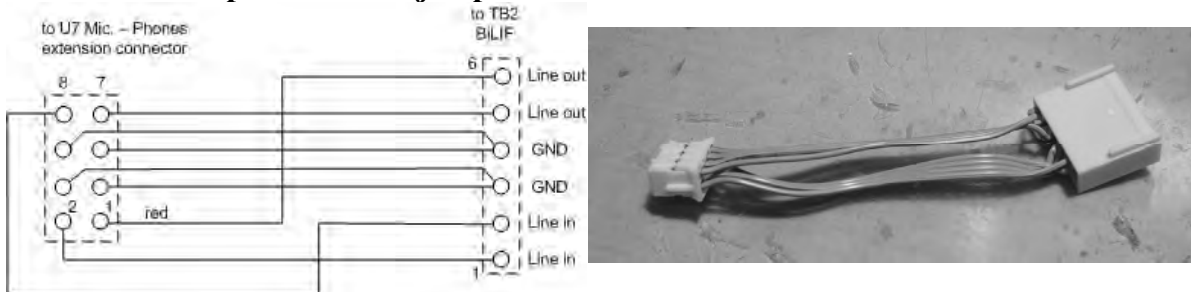

Building the BiLIF and the Asus U7 USB sound card into one box

The picture on the left shows how the BiLIF assembly and the Asus U7 sound card where placed into one box. On the left the USB sound card PCB mounted on the lid of the enclosure. When the PCB was removed from the original box it was found that the line in and line out connector were using an 8 pin header plug. This made it really easy to connect the sound card to the BiLIF PCB with a short 8pin to 6pin adaptor (center left). On the right the analog part of the unit, the BiLIF assembly with all the connectors and indicator LEDs wired to the rear and the front of the box. A square hole was cut into the side of the box to provide access to the USB connector via the USB cable from the computer.
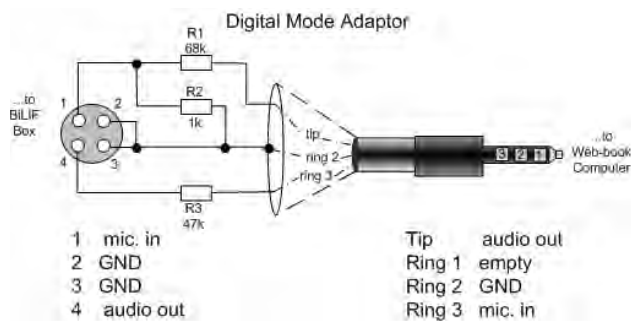
Schematics and picture of the jumper cable:

Note: The Asus sound device dynamically reconfigures the audio connections, so it is important to plug in the connector first before configuring the audio device in the computer.

Connecting the internal sound device to the AF audio stream

In order to be able to connect the base audio to the internal sound card a jumper cable between the BiLIF and the computer's headset connector is needed. As discussed earlier in the paragraph "Separating IF and Baseband Audio System" this setup also uses two soundcards. This will make is easier to set up the additional baseband modulation software. The mic-in and line-out connector on the T100-AT computer is one 3.5mm connector with 3 rings and a tip. The tip provides line level audio out and the 3rd ring is mic audio in. Because we are connecting mic level audio the adaptor needs to attenuate the in and out audio, resistors are used as attenuators. See the schematic "Digital Mode Adaptor" for more details. The resistors are small enough the fit inside the microphone connector housing as seen in the picture below. During digital operations this adaptor is plugged into the headset connector and the audio out/input connector of the T100-AT computer. The headset is not connected during digital mode operation.

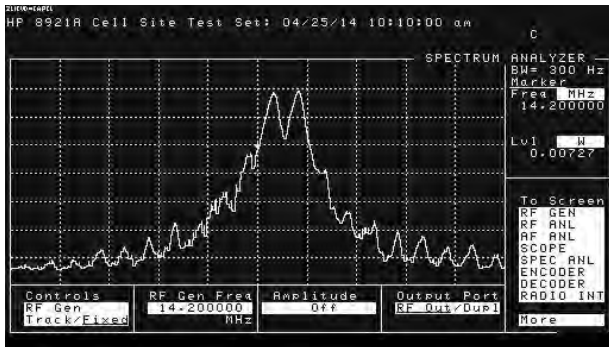## Compliance test of the Asus U7 and BiLIF assembly

For the compliance test a HP-8921 test set was connected to the output of an FT-817. The BiLIF-USB sound card unit sits on top of the transceiver. A Acer laptop running Win7 with the MDSR software V2.8 installed was used.
The tests conducted were IMD and close-in splatter that can be created when the audio device is not set up properly. Both tests passed the requirement of
-31 dB close-in signal attenuation.

Discussion of test results
After the MDSR – BiLIF – FT-817 transceiver combination was calibrated, the internal MDSR IMD test tones where switched on and the unit set into TX mode. The spectrum analyzer in the HP-8921 recorded the following output spectra (USB – left, LSB – right). Maximum power output was 5W and the span of the spectrum was 20kHz.

In both cases the IMD and adjacent-channel interference are measured and are in the lower -40 dBc range. This is a very clean signal and shows the superior performance of the digital modulator.

Conclusion

I want to thank all amateur radio operators that use the MDSR software and also the ones that have purchased the BiLIF and LIF interface kits for their support. I want to especially thank all the operators that have contributed to the project to enhance its capability. Thanks to Guy Roels (ON6MU) for the continued support of the MDSR-SA software and Adam Farson (VA7OJ) for the use of his test lab and his expertise.

Alex (VE7DXW)

Installing a LIF port into the FT-950 transceiver

Introduction

This document describes the procedure for installing a LIF (Low Intermediate Frequency [9 – 18kHz]) port into the FT-950 transceiver. This procedure requires a level of expertise sufficient to dismantle the transceiver and to solder. Nonetheless, the installation is straight forward and should not cause any difficulties for the experienced radio amateur.

It is important to unplug all connectors and power before working on any transceiver. It is also important to be grounded to avoid static discharges.

Please note: no responsibility or liability will be taken by the author of this document for any damage or malfunction caused by user modifications.

FT-950 challenges

The FT-950 has two major differences compared to all the previous transceivers that were fitted with the LIF port.

- The 3rd. IF is 450kHz: the LO crystal and IF filters needed to be changed
- Completely separate RX and TX signal paths, requiring the installation of a LIF-TX and a LIF-RX port
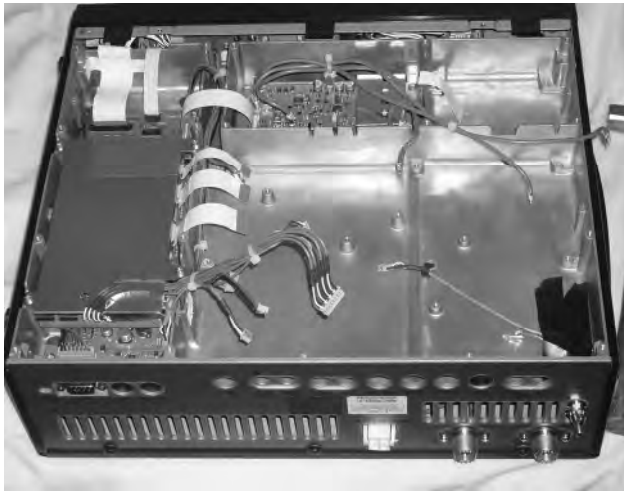
LIF port installation

Dismantling the Transceiver

Access to the IF PCB is through the bottom cover. Put a cloth on the workbench. Turn the FT-950 upside down and remove all the screws on the bottom, except the ones that secure the legs. Take off the bottom cover, and now the Main PCB will be visible.

The best way to mount the two SMA connectors (one for RX and one for TX) is by drilling two holes into the rear wall (if you are not comfortable in removing the PCB and drilling holes, the coax cables can be fed through an unused hole). This means that Main PCB has to be removed so that the holes can be drilled without damaging any of the electronics or having metal shavings cause a short. All the openings to the upper housing and the vents in the back have to be taped shut with masking tape to prevent debris falling down while drilling.

When the holes are marked, make sure the connectors clear the back lip of the cover; otherwise the back cover has to be notched before it can be put back in place. Use a center punch and a small hammer to dent the enclosure, so ass to give an easy start point for the drill. Start with a small drill (1/8" or 3.5 mm) and slowly work your way up, increasing the drill size until the connectors fit through the holes.

FT-950 upside down with Main PCB removed

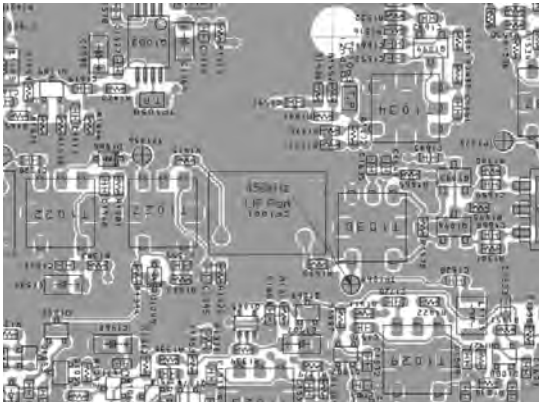## Holes are drilled and one SMA connector installed

After the holes are drilled, use a vacuum cleaner to remove all the metal shavings before removing the masking tape and reinstalling the PCB.
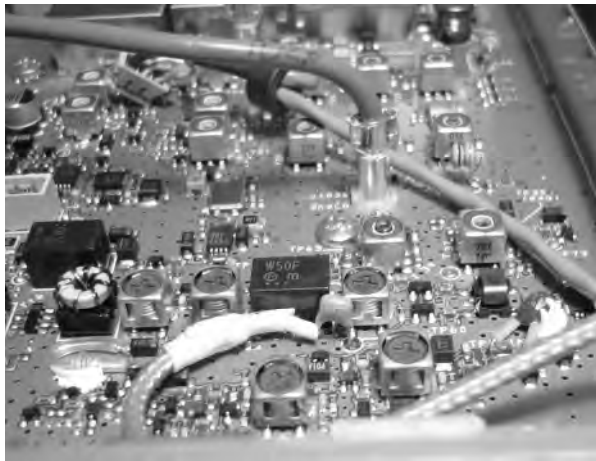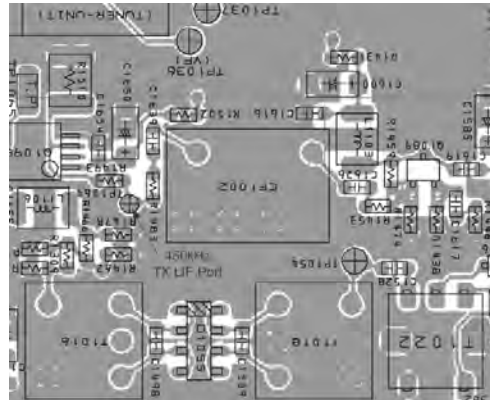
The easiest way to get two 6" male SMA jumpers is to buy a 12" cable with male ends and cut it in half. On the open end of each jumper, solder a 10nF capacitor on the center conductor. Since a good ground is already given by the mounting of the connectors on the chassis, the ground connection on the main PCB is not connected on the PCB end of the jumper. Place two pieces of shrink wrap around the cable end to insolate the ground and the center solder joint separately.

Connecting the RG-174/U cables to the Main PCB

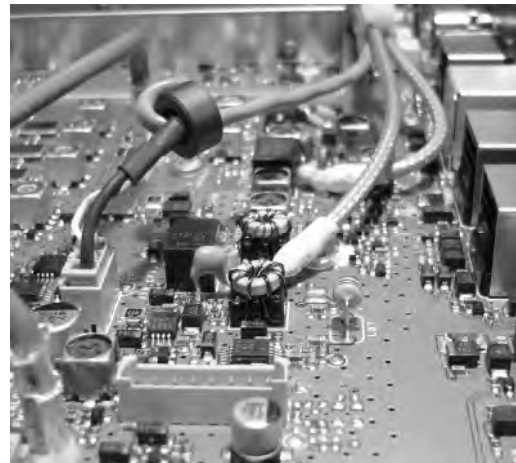450kHz RX Port TP1060

450kHz TX Port TP1064

The loose end of the capacitor for the RX port is soldered on to TP1060. For mechanical stability, it is also recommended to glue the capacitor onto the black filter body.

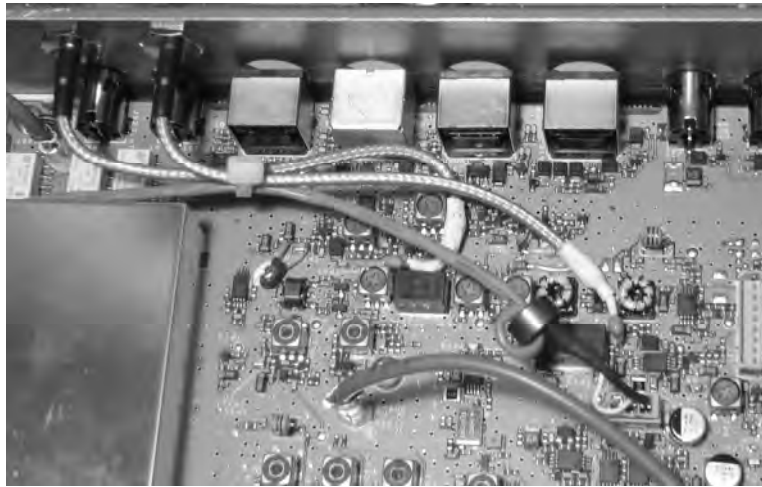Now the 450kHz RX IF can be accessed from the rear panel via a SMA cable.

The loose end of the capacitor for the TX port is soldered on to TP1064. For mechanical stability, it is also recommended to glue the capacitor onto the black filter body.

Now the 450kHz TX IF can be injected into the rear panel via a SMA cable.

⚠Warning: max input level 1Vpp!

Routing the cable and reassembling the transceiver

The best routing for the RG-174/U is shown below for the FT-950. The coaxial cable is secured with a tie-wrap to the audio cable. The LIF or BiLiF box is mounted outside of the transceiver and connected to the transceiver via SMA cables.

Connection of the LIF converter (RX-only)

The LIF RX output of the transceiver connects to the IN port (TB1) of the LIF assembly and the audio Line out (TB3) connects to the tip line-in of the sound card. TB2 provides power (+12V). TB5 is not used for the RX- only version. A jumper has to be placed on TB4 between 3-4 to by pass the 7kHz high pass filter or between 4-5 to enable it.

Note: The transmit audio is still filtered with the existing filter inside the FT-950. If the MDSR is properly configured the standard microphone can be used to transmit, while the RX is processed through the computer.

For more details see "Lock to TXCR" the MDSR help menu.

Setup of the CAT interface

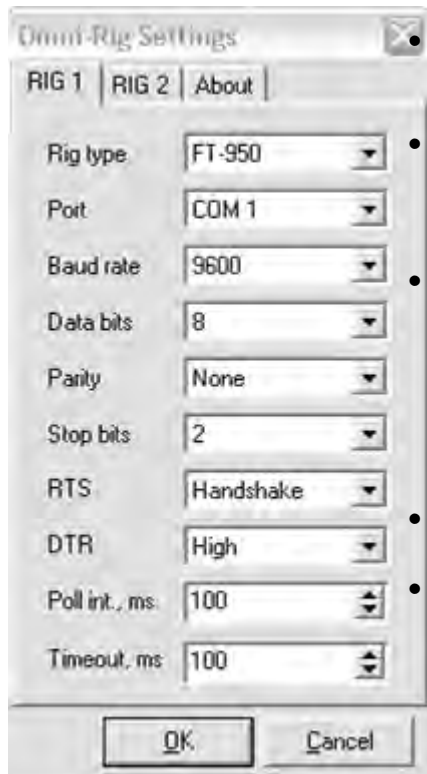The MDSR software controls the transceiver via the CAT port. The connector cable is a straight DB9 cable; all input pins match the output pins (1-1, 2-2,…9-9). This cable can easily be bought or made at home with the right gender connectors. RS-232 port of the computer is then connected to the RS232 connector of the FT-950 and no level converter has to be used. If your computer does not have a RS-232 a virtual RS-232 cable that connects via the USB bus to the computer can be used.

OmniRig Setup for the FT-950 transceiver
To enter setup menu in MDSR-SA select the wrench icon at the bottom center right and select "OmniRig Configuration & Status", select the key icon "Configure OmniRig". Only configure RIG 1.

- Select the transceiver to be controlled from the drop down menu.

- Select the port of the computer. If the Com port is not known go to the "Device Manager" and select the ports icon. The port number should be listed there.

- The Baud Rate has to match the setting in the Transceiver. The default setting for the FT-950 is 4800. It should be changed to at least 9600 (menu item 26 - see transceiver manual p110). Faster speeds may cause reliability problems during transmit.

- By default, the FT-950 uses RTS handshake.

- All the other settings should be as displayed here.

That completes the installation of the LIF port of the FT-950. The MDSR team wishes you all the best. If you like the performance of the MDSR software please tell all your friends about it.

73

The MDSR development team

To order the PCB kit or for more information please go to;
Note: if you are interested in the TX – BiLiF option contact VE7DXW directly.
http://users.skynet.be/myspace/mdsr

Installing a LIF port into the IC-756ProIII transceiver

Introduction

This document describes the procedure for installing a LIF (Low Intermediate Frequency [455kHz]) port into the Icom IC-756ProIII transceiver. The procedures described in this document may also apply to other IC-756 models, but have not yet been attempted. This procedure requires a level of expertise sufficient to dismantle the transceiver and to solder SMT size components. Nonetheless, the installation is straight forward and should not cause any difficulties for the experienced radio amateur. It is important to unplug all connectors and power before working on any transceiver. It is also important to be grounded to avoid static discharges.

Please note: no responsibility or liability will be taken by the author of this document for any damage or malfunction caused by user modifications.

LIF port installation

Dismantling the Transceiver
The bottom cover of the radio must be removed. There are 10 screws that need to be removed and then the cover will come loose. These screws are two on either side and six on the bottom of the radio. The coaxial cable plug P701 @ J211 should be gently unplugged and moved out of the way.

It may be useful to also disconnect J641 (multicolor ATU cable assembly) and move it out of the way as well. You should now have plenty of room to work.

Drilling the Hole
An SMA connector is the preferred connector because of its small size and limited real estate on the IC-756. A hole will need to be drilled next to the DIN 8 (ACC1) jack. Ensure that the hole is centered between the DIN 8 jack and the bulkhead. The SMA connector fits neatly into this space.

Before drilling the hole, cover the PCB with masking tape to prevent metal shavings from falling into the lower part of the transceiver. Vacuum out the metal dust and clean all surfaces before reassembling.

Connecting the RF cable to the PCB

The 455kHz bidirectional port of the IC-756ProIII is on the bottom side of
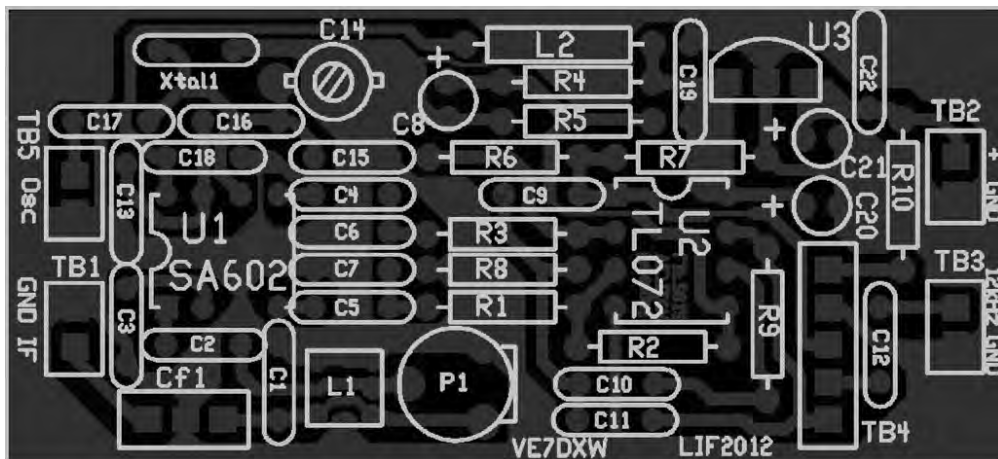the main circuit board. The RF cable center is soldered onto a 1nF (1000pF) ceramic decoupling
capacitor.

The Layout design drawing (left) and the picture of the actual PCB (right and below).

The other lead of the capacitor is bent by 90 degrees and soldered onto Pin 1 of IC151. For mechanical
stability, it is advisable to solder a small ground wire to the RF cable shield first, and then to the nearby
J211. I also added a drop of hot melt glue to the assembly in order to help reduce the likelihood of
movement by increasing mechanical stability. If required, cover the exposed shield with heat shrink
tubing. During this process, care must be taken to not overheat the SMD components.

Routing the cable and reassembling of the transceiver

There is enough clearance to route the 6" RF cable over and around components on the PCB without
getting in the way. For mechanical stability, it is recommended to tack down the RF cable with a dab
of hot melt glue to the top of the Noise Blanker Circuit cover as shown in the photo below.

Replace the bottom cover and all screws.

Connection of the LIF converter (RX-only)

The LIF RX output of the transceiver connects to the IN port (TB1) of the LIF assembly and the audio Line out (TB3) connects to the tip line-in of the sound card. TB2 provides power (+12V). TB5 is not used for the RXonly version. A jumper has to be placed on TB4 between 3-4 to bypass the 7kHz high pass filter or between 4-5 to enable it.

Note: The transmit audio is still filtered with the existing filter inside the IC-756. If the MDSR is properly configured the standard microphone can be used to transmit, while the RX is processed through the computer.

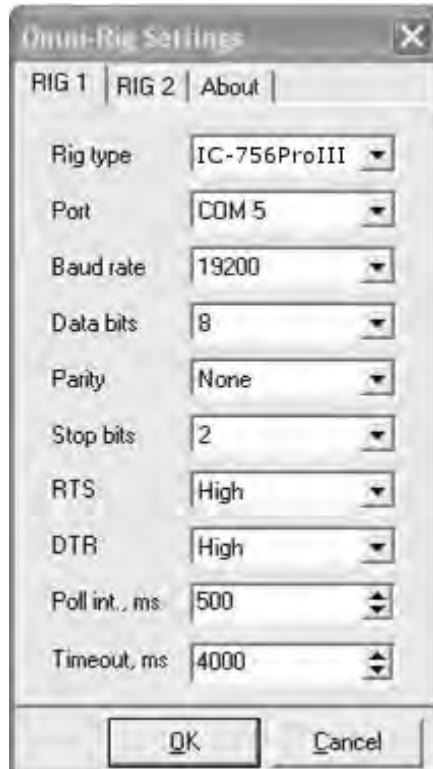For more details see "Lock to TXCR" the MDSR help menu.

Setup of the CAT interface

The MDSR software controls the transceiver via the CAT port. The connector cable CI-V is the Icom version of the interface cable that plugs into the back of the radio and the RS-232 port of the computer. There are also virtual RS-232 cables available that connect via the USB bus to the computer.

OmniRig Setup for the IC-756ProIII series transceivers
To enter setup menu in MDSR-SA, select the tool icon at the bottom right and select "OmniRig Configuration & Status", select the key icon "Configure OmniRig". **Note:** Only configure RIG 1.

Select the transceiver to be controlled from the drop down menu (IC-56ProIII).

Select the port of the computer. If the Com port is not known, go to the "Device Manager" and select the ports icon. The port number should be listed there.

The Baud Rate has to match the setting in the Transceiver. The default setting for the IC-756ProIII is 19200.

All the other settings should be as displayed here.

That completes the installation of the LIF port of the FT-950. The MDSR team wishes you all the best. If you like the performance of the MDSR software please tell all your friends about it.

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The MDSR Development Team

To order the PCB kit or for more information please go to:
http://users.skynet.be/myspace/mdsr
Specify: 455k IF
Note: if you are interested in the TX – BiLiF option contact VE7DXW directly.