Radio Shield – RS-UV3
Rev: C
FM Radio Manual

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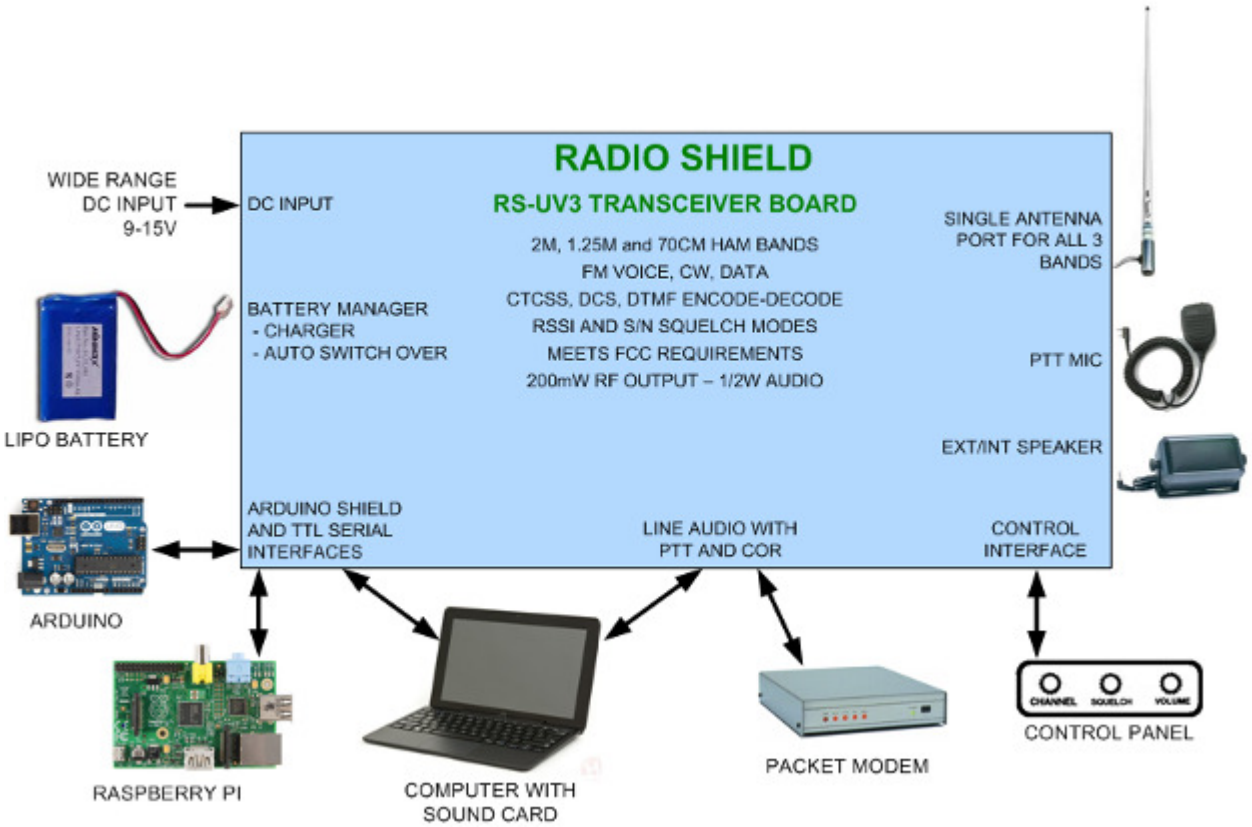
1. INTRODUCTION

Congratulations on your purchase of a RS-UV3 FM transceiver board. The RS-UV3 is designed to support a wide range of FM communication applications in the 144, 220 and 450 MHz amateur radio bands. The primary applications are:

- Voice Communications
  - Single/multi channel RX, TX and Transceiver functions
  - Repeater/remote base operation
  - Base station/Mobile/Portable Transceiver
- Data Communications
  - Packet 1200/9600 Baud
  - DTMF Encode and Decode
  - CW
- Microprocessor Support
  - Arduino Interface
  - Connections for Raspberry PI and other SBCs
  - ON board PIC processor

The Rev C board adds additional connection points for the upcoming sub-receiver, the ability to put power on the DB-9 to support a range of accessories and three LED indicators for power, TX and a user definable status.



2. SPECIFICATIONS

ITEM	SPECIFICATION
Frequency Range	2M Band: 136 – 174 MHz 1.25M Band: 200 – 260 MHz 70 CM Band: 400 – 520 MHz The RSUV3 is only designed to transmit on Amateur Radio frequencies. Due to the configuration of the output filtering, TX operation outside the amateur radio bands may exhibit reduced power.
Rx Sensitivity	<-120 dBm for 12 dB SINAD
Output Power	>200 mW (23 dBm +/- 1 dB)
TX Spurious	<-50 dBc for ham band transmissions
DC Power	9-16 Volts, 180mA max RX, 400mA max TX
Modulation	FM with switchable pre/de-emphases and LP filters
Input/Output Jacks	RF – SMA jack DC Power – 5.5X2.1 MM circular connector Spkr/Mic – 4C TRRS 3.5MM audio jack Line Audio, TTL Serial, IO – DB9 plug Batter, Pwr Switch, Arduino, FDTI cable, internal Spkr/Mic/PTT – 0.1” (2.54mm) headers
Board Size	120 X 75mm, (4 11/16” X 3 15/16”) (not including connectors) Overall Height – 16mm (5/8”)
Weight	40 grams (1.5 oz)

3. Getting Started

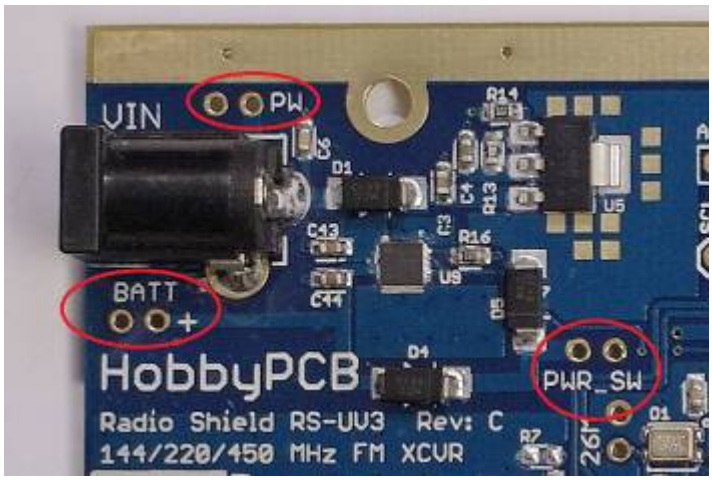
Getting your new RS-UV3 up and running depends on what you intend to do with it. This section covers a few of the possible use cases and how to quickly get your RS-UV3 operating.

1. Basics

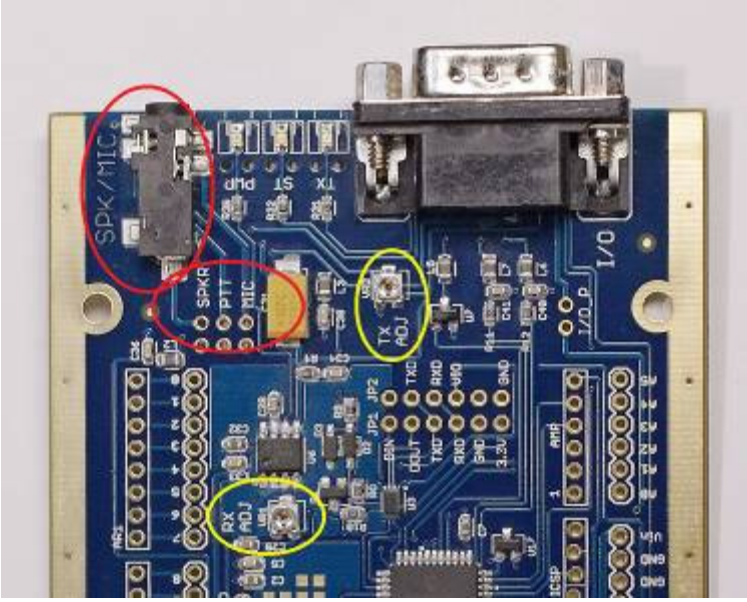
ANTENNA: For every application of the RS-UV3 you'll need an antenna or at least a 50 ohm load connected to the antenna jack. Antennas are available that operate on one, two or all three of the bands covered by the RS-UV3 and can be directly attached to the RS_UV3 for handheld operation or connected via a cable for mobile or base station operations.

The RS-UV3 is tolerant of antenna mismatches ranging from open to short circuits. However we recommend a well matched antenna system for optimum performance and equipment life.

DC POWER: The RS-UV3 runs on any regulated DC power source from 9 – 16V. The board itself draws a maximum of 0.2A which may increase to 0.7A if a battery is connected and charging. In the most basic setup a 9V battery could be connected to the BATT header or a 12V wall-wart connected to the VIN connector. The DC input is diode protected against reverse polarity but we recommend adding a 1A fuse in series with the positive lead. The PW header is connected directly to the VIN jack and provides a place to power other devices on supply power to the RS-UV3. Once you have selected a power source, you'll need to either connect a power switch or jumper the PWR_SW connections on the PCB:



SPEAKER, MICROPHONE and PTT: The final connections needed for basic operation are a speaker for listening to the received signal, a microphone for transmitting a voice signal and a Push-To-Talk switch to activate the transmitter. All of these signals can be directly wired to the RS-UV3 board using the SPKR, PTT and MIC connection points:

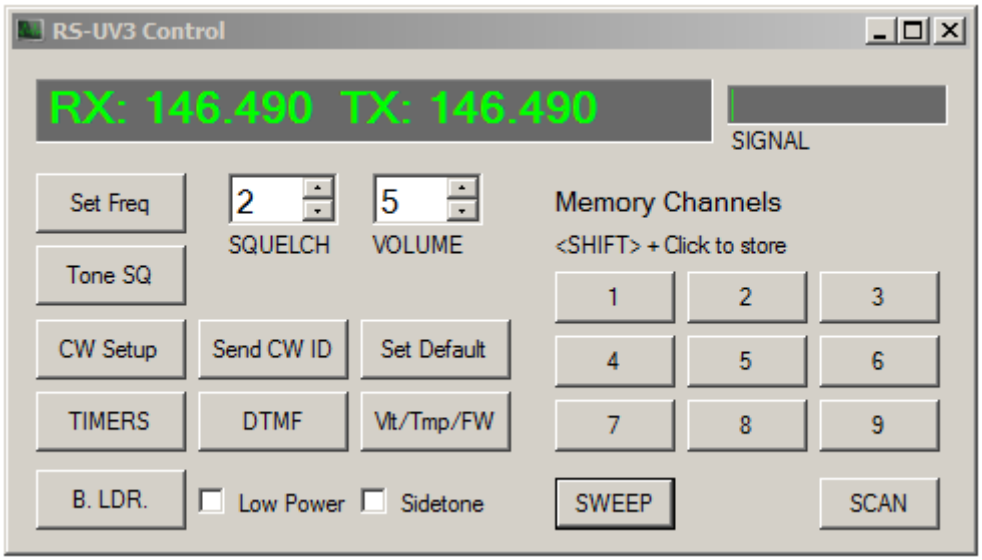


The connection points immediately below SPKR, PTT and MIC are ground connection to facilitate wiring. Alternately, you can connect a handheld speaker/mic to the SPK/MIC connector. Details for connecting to the SPK/MIC jack are in the CONNECTIONS section of this manual. The audio level from the speaker can be adjusted using RX ADJ (VR1), FREQ ADJ (VR2) was set at the factory so that the RS-UV3 is within 100 Hz of the selected frequency and TX ADJ (VR3) adjusts the level of the TX audio on the I/O connector. Microphone audio is automatically adjusted by the radio.

At this point, your RS-UV3 is ready to operate on 146.52 MHz, simplex which is the factory default setting of the radio. To operate on different frequencies you will need a TTL serial data connection to the RS-UV3.

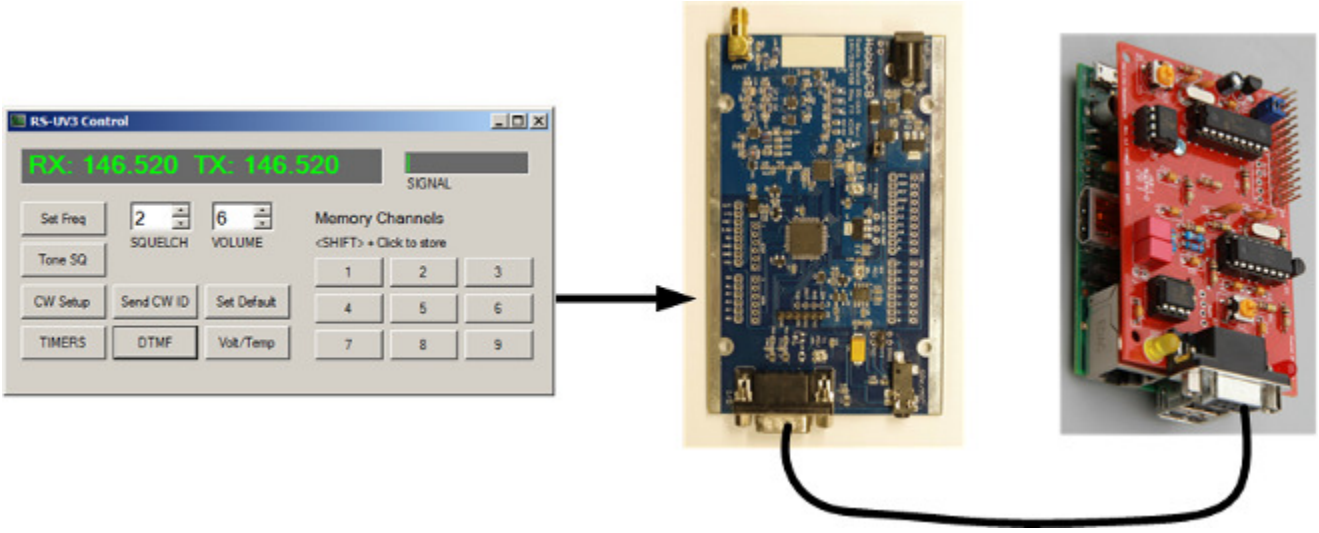
TTL SERIAL CONNECTION: There are many possible ways to connect the RS-UV3 to a computer to provide access to all of the operating parameters of the radio. The easiest way to do this is a FTDI based USB to serial adapter which can be soldered/plugged/wired directly into JP2 on the RS-UV3. For a serial access via the DB9 I/O connector see the CONNECTIONS section of this manual.

If you use an FTDI based USB to serial converter the drivers will load automatically. With converters that use other chipsets, driver installation may be required. Once the USB to serial converter is connected to and installed in the computer you can use a terminal program to issue the serial commands listed in the COMMANDS section of this manual or download the RS-UV3 control program for Windows computers from the HobbyPCB website.



2. Packet/Data/APRS Operation

The RS-UV3 is designed to support various forms of data communications. For single channel data operations, use the RS-UV3 control program (or a terminal emulator) to configure the RS-UV3 operating parameters and store them as the default power-on settings. Then use the I/O connector to connect the RX audio, TX audio and PTT to the modem or TNC.



3. Beacon Operation

The RS-UV3 has built-in functions to support basic beacon operation. Using the BT (beacon time) and BM (beacon message), described in the COMMANDS section of this manual, the RS-UV3 can be set-up send a FM modulated audio CW or a true on/off carrier CW message on any frequency in the 2m, 1.25m or 70cm band at a specified time interval up to 10 minutes. Only a case, power source and antenna are required.

First let's define some terms:

1 – MCW is modulated CW which means that the RS-UV3 acts as a FM transmitter with CW modulated as an audio signal . It can be received with a standard FM receiver, like a handie-talkie but it's restricted to the voice portions of the band.

2 – CW is 'true' CW where the carrier is switched on/off to send Morse code. This takes a CW receiver but requires less bandwidth and can be operated in data/CW only band segments of the bands.

The BT command sets the time interval between MCW beacons and the MC command tells the RS-UV3 to change channels between subsequent beacons to allow multi-channel and/or multi power level beacons.

For more advanced beacon applications APRS and interactive beacon modes, a small microprocessor, like the Arduino can be connected to the RS-UV3 to interface with a GPS receiver, data modem or make interactive beacon modes.

4. Repeater/Satellite Operation

An individual RS-UV3 does not support simultaneous transmit and receive operations. However the small size and low cost of the RS-UV3 makes it possible to support full duplex (simultaneous transmit and receive) operation using a pair of RS-UV3's.

The firmware in the RS-UV3 allows users to configure TX hang times (HT command), TX time-out time (TO command), CW identification time (IT command), call sign and the speed and frequency of the CW ID. This allows a pair of RS-UV3 to be configured as a repeater station with no additional control circuitry.

For satellite communications, one RS-UV3 could be tuned to the uplink frequency and a second to the downlink.

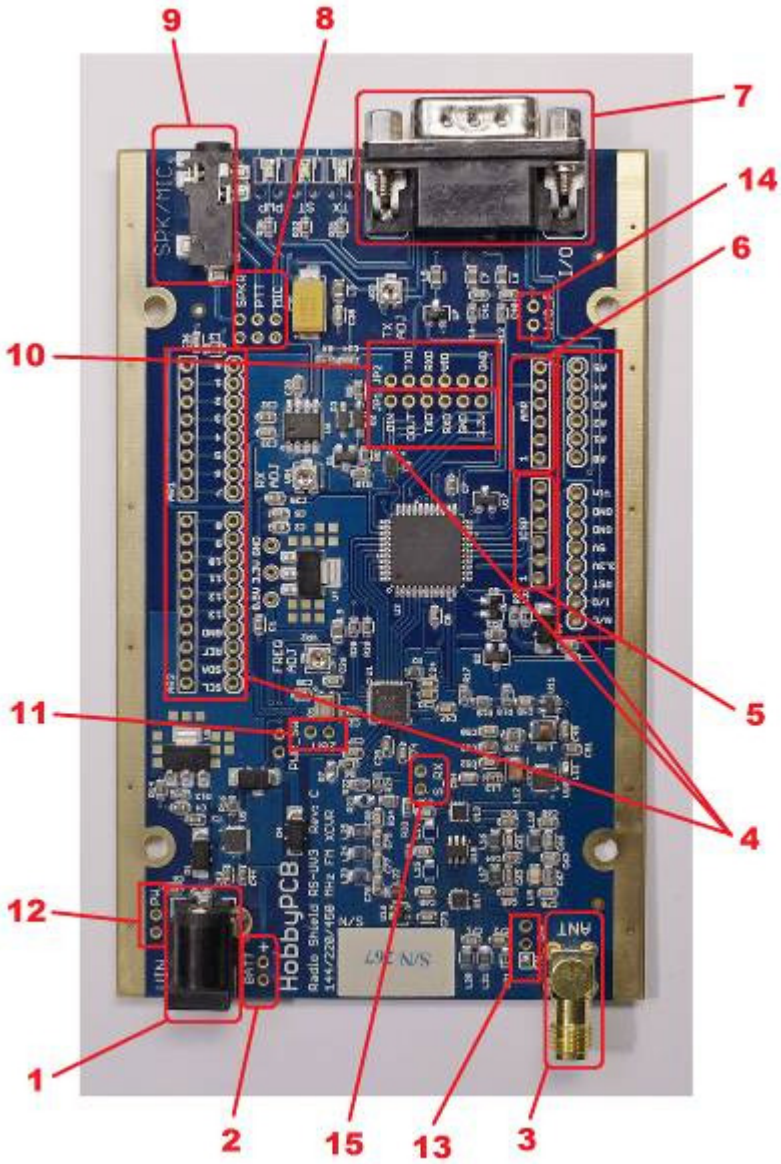
5. Test, Measurement and Direction Finding

The small size, low cost and versatility of the RS-UV3 make it ideal for test equipment applications. By adding a step attenuator the RS-UV3 could be used as a high quality signal generator covering 136-174 MHz, 200-260MHz and 400-520 MHz with excellent frequency accuracy and low harmonic content.

The FM command provides the ability to measure the signal level of any frequency in the RS-UV3's range. This capability could form the basis for a channel activity monitor or basic spectral display.

As an FM receiver, the RS-UV3 supports pseudo-doppler DF techniques and could add direction finding capabilities to a monitor receiver.

4. CONNECTIONS



1. DC Power Connector
2. 8.4V Dual-Cell Battery Connector
3. Antenna
4. Arduino Connections
5. ICSP Programming Header
6. Connection for Power Amp
7. External Audio/Control Interface Connector
8. Connections for Internal Speaker, Microphone and PTT switch
9. Connections for External Speaker, Microphone and PTT Switch
10. Header for FTDI serial cable
11. 26 MHz clock signal
12. VIN power input/output
13. Main RF input/output
14. I/O power jumper
15. Sub-RX RF output

1. DC Power

The DC power for the RS-UV3 is supplied via a 2.1mm circular power connector. The center of the connector is positive, the outside is negative. The input is diode protected against inadvertent reverse polarity. A 1 amp fuse is recommended.

2. Battery

The RS-UV3 has a battery charge management controller (Microchip MCP73213) that supports a dual-cell 8.4V LiPo battery pack. The contact closest to the edge of the PCB is negative. The charge current is set for 0.15A maximum and the RS-UV3 will automatically switch between the battery and

DC input. When the DC input is present, the RS-UV3 can charge the battery and operate simultaneously.

3. Antenna

A SMA jack is used for RF in and out of the RS-UV3. A 100 MHz high-pass filter is connected to the antenna jack in both TX and RX modes to reject large out-of-band signals and provide resistance to static discharge. The TX signal has individual low-pass filters for the 2M, 1.25M and 0.7M bands and the RX has a LNA followed by an equalizing band-pass filter to normalize the gain across the 3 bands. The maximum RF input should be limited to -10 dBm RF and 25V DC.

4. Arduino (JP1)

To connect the RS-UV3 to an Arduino board a set of 4 headers must be added to the RS-UV3. If the system only consists of the Arduino board and the RS-UV3, male-male headers added to be back side of the RS-UV3 are required. For systems that will use additional Arduino Shields, install male-female headers at the places indicated on the silk screen.

The AR1 and AR2 headers on the RS-UV3 are connected directly to the Arduino 0 – 13, GND, REF, SDA and SCL pins. This allows the user to connect the RS-UV3 control signals on JP1 to desired locations on the Arduino. The following table describes the various control signals on the RS-UV3:

SIGNAL	DESCRIPTION
DIN	Digital input to the UR-UV3. Can be configured as PTT input, Squelch Open input or no-function using the 'AI' command. If used, it should be connected to a digital output pin on the Arduino.
RXD	Serial data in to the RS-UV3. Should be connected to TXD of either a soft-serial or UART pin on the Arduino. The default baud rate is 19200 which can be changed using the 'B1" command.
DOUT	Digital output from the UR-UV3. Can be configured as always low, Squelch Open, DTMF Detected, TX ON, CTCSS Detected or always high using the 'A0' command. . If used, it should be connected to a digital input pin on the Arduino.
TXD	Serial data out of the RS-UV3. Should be connected to RXD of either a soft-serial or UART pin on the Arduino. The default baud rate is 19200 which can be changed using the 'B1" command.

All digital signals from the Arduino to the RS-UV3 can be either 3.3V or 5V logic and the logic levels sent from the RS-UV3 to the Arduino can be any level from 2 – 5V and is derived from the voltage on the Arduino VI/O pin.

JP1 also includes 3.3V and ground to allow connections to Bluetooth or other serial communications modules that require power. For connection to devices (like the Raspberry PI) that do not provide an external I/O voltage, place a jumper between JP1 3.3V and JP2 VIO to provide 3.3V signaling.

The 8.5V rail on the RS-UV3 is applied, via a diode, to the Arduino Vin pin. This allows the RS-UV3 to power the Arduino from the battery or external DC supply. The RS-UV3 cannot be powered by the Arduino.

5. ICSP Header

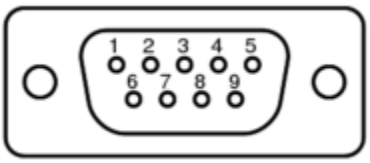
The In Circuit Serial Programming (ICSP) header is used to program the PIC processor. The pins are staggered to allow good electrical connection without adding a header to the board. Here is the ISCP header pinout:

6. Amp Header

The AMP header is primarily used to connect the RS-UV3 to a RF power amplifier board. RC1 and RC2 provide a digital control signals for the power amp; AN1 and AN2 are for analog parameters from the amplifier. Here si the AMP header pinout:

7. I/O Connector

The I/O connecter provides external connections for line-level audio input and output, PTT and configurable control signals. The connector is a BD-9 male and mates with a DB9 female. Here is the pin configuration looking in to the connector on the RS-UV3:



The following table lists the pins and their functions:

PIN	DESCRIPTION
1	Transmit audio input. Level is adjustable using VR3
2	Push-to-Talk (PTT). Grounding this pin switched the RS-UV3 to TX mode
3	Ground
4	Receive audio output. Level is adjustable using the “VU” command.
5	COR output – Low when squelch is open, open circuit when squelch is closed.
6	N/C or 8.5V power is I/O_P jumper is installed
7	External TX signal (E_TX). External serial port TXD (connect to RX data on external device) or high in TX mode; low in RX.
8	External RX signal (E_RX). External serial port RXD (connect to TX data on attached device) or low when the SQ is open; high when closed
9	Ground

The “EX”’ command sets the function of pins 7 and 8. Digital input signals are compatible with 3.3 and 5V logic. The E_TX signal uses 3.3V logic. The PTT signal can accept -24 to +24V with input below 0.5V interpreted as a TX signal. The default baud rate is 19200 which can be changed using the “B2” command.

8. Internal Speaker, Microphone and PTT

These connections provide a convenient place to connect components that are mounted inside the enclosure with the RS-UV3. In the drawing below, the connection points marked with a + are ground and the other connections are the corresponding signal.

The SPKR signal supports a low impedance speaker. The level is adjustable using VR1 and also by using the “VU” command.

The MIC signal has a 3.3V bias to operate electret microphone elements. This bias can be removed by removing R6 and placing it in the open R7 position or by placing a capacitor in series with the MIC line.

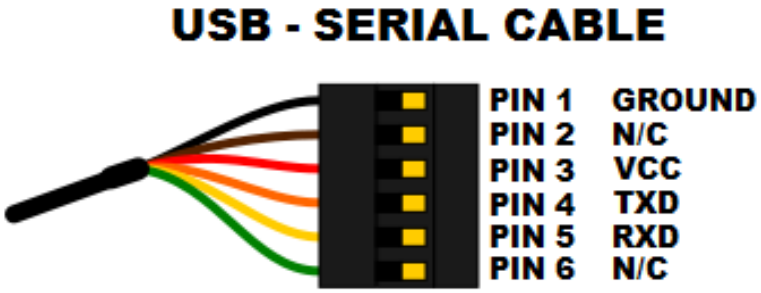
Grounding the PTT signal keys the transmitter.

9. External Speaker, Microphone and PTT

The SPK/MIC jack is a four conductor 3.5mm TIP-RING-RING-SLEEVE connector. The speaker, microphone, PTT and ground signals can be connected using the following diagram:

10. USB - Serial Cable Connection (JP2)

JP2 provides a connection point for a USB-Serial cable for connection to a computer with a USB port or for direct connection to a device (Raspberry PI) that has TTL serial ports. TXD on the cable connects to RXD on the RS-UV3 and RXD on the cable connects to TXD on the RS-UV3. This is the same physical port as JP1 so only one should be used in any given installation. The input on the RS-UV3 is 3.3V compatible and 5V tolerant and the output level is from 2 – 5V and is derived from the voltage on the VCC pin. The default baud rate is 19200 which can be changed using the "B1" command.



11. 26 MHz Oscillator Output

The header location "26M" is connected to the 26MHz TXCO that provides the time base for the RDA1846S chip. It is designed as a connection point for the sub-receiver and should only be used in advanced applications. Refer to the TXC 7Q-26.000MBS-T data sheet for signal levelas and loading information. The pin closest to the '2' has the 26MHz signal, the pin closest to the 'M' is ground. Do not connect these pins together.

12. PW Header

The PW header provides a direct connection to the power on the VIN jack. It can be used as an alternate method to power the RS-UV3 or supply power to a peripheral device. The pin closest to the ‘PW’ is th positive voltage, the other pin is ground. Do not connect these pins together.

13. PA Header and SJ1 Solder Jumper

The PA header and SJ1 solder jumper provide in internal connection point for the RS-UVPA 5W power amplifier. As supplied from the factory, SJ1 will have solder on it, making a jumper that connects the RF input and output to the ANT jack. In this case, no connection should be made to the PA header. Clearing the solder from SJ1 eliminates the RF connection to the ANT jack and allows the power amp to be connected to the PA header. The pin near ‘P’ contains the RF signals; the pin near ‘A’ is ground.

14. I/O_P Header

The I/O_P header can be used to put 8.5V DC power on pin 6 of the I/O DB9 connector. This would allow connection to a device that requires power like a GPS or Bluetooth modules. On earlier versions of the RS-UV3 this pin was connected to ground and it is possible to jumper the pin closest to ‘P’ to ground to maintain legacy compatibility.

15. S_RX Header

The S_RX header provides access to the received RF signal. It is designed to provide an RF output to a second or sub-receiver. The RF signal is tapped after the T/R switch, LNA and filtering and is about 10 dB higher than the RF supplied to the antenna with a noise figure of less than 1 dB and is an exact copy of the signal provided to the RF input of the RDA1846S chip.

It is possible to use a small coax jumper and use this signal to drive a second, RX only, RS-UV3. A 10 dB attenuator should be placed in line to maintain proper gain distribution. The pin closest to the ‘S’ has the signal, the pin closest to ‘RX’ is ground. Do not send a transmit signal into this header.

5. COMMANDS

This section describes the serial commands that are used to control the RS-UV3. The default baud rate is 19200 bits per second and commands may be sent to the RS-UV3 via the Arduino connector (JP1), the USB serial connector (JP2) or the I/O connector. The pinouts for these connections are explained in the 'Connections' section of this manual.

> *NOTE: The DB-9 connector on the RS-UV3 is **NOT** a standard RS-232 serial connector. The serial connector on the RS-UV3 uses 3.3V or 5V signals not the standard RS-232 signaling voltages.*

Commands are not case sensitive; all lower case letters are converted to upper case prior to processing in the RS-UV3. All commands are terminated by an ASCII carriage return <CR>. Commands that require numeric parameters have a specific number of digits associated with the parameter and all digits are required. For example, when setting the volume to volume level 8, the command is VU08<CR>. Sending VU8<CR> is not correct and may have undesired effects.

These are the commands for the RS-UV3 listed in alphabetical order:

AF – Audio LPF On/Off

Command: AF
Syntax: AFn or AF?
Description: Turns on (n = 1) or off (n = 0) Audio Lowpass Filter
Default State: On
Notes: 300-2500 Hz - Filter ON; 300-5500 Hz Filter Off
Response: AF? Reports current Audio Lowpass Filter state

AI – Arduino Input Pin Function

Command: AI
Syntax: AIn or AI?
Description: Sets Function of the Arduino DIN pin
Default State: 0 - OFF
Notes: 0 - OFF, 1 - SQ OPEN, 2 - PTT
Response: AI? Reports current Arduino DIN pin function

AO – Arduino Output Pin Function

Command: AO
Syntax: AOn or AO?
Description: Sets Function of the Arduino DOUT pin
Default State: 0 - LOW

Notes: 0 - LOW, 1 - SQ OPEN, 2 - DTMF DETECT, 3 - TX ON, 4 - CTCSS DET, 5 - HIGH
Response: AO? Reports current Arduino DOUT pin function

B1 – Arduino/USB Serial Port Baud Rate

Command: B1
Syntax: B1n or B1?
Description: Sets serial port 1 baud rate (Arduino/FTDI/internal)
Default State: 19200
Notes: 0 - 1200, 1 - 4800, 2 - 9600, 3 - 19200, 4 - 38400, 5 – 57600, requires a power cycle to change
Response: B1? Reports current serial port 1 baud rate

B2 – I/O Connector Serial Port Baud Rate

Command: B2
Syntax: B2n or B2?
Description: Sets serial port 2 baud rate (Arduino/FTDI/internal)
Default State: 19200
Notes: 0 - 1200, 1 - 4800, 2 - 9600, 3 - 19200, 4 - 38400, 5 - 57600, requires a power cycle to change

BC - Set CW Beacon Timer

Command: BC
Syntax: BCnnn or BC?
Description: Sets the true CW Beacon Timer to nnn sec, setting this command will set the MCW beacon timer (BT) to 0.
Default State: 0 sec (off)
Notes: Send true CW Beacon Message after nnn seconds; 60 - 600 seconds, 0 = off. All digits required.
Response: BC? Reports true CW Beacon Time

BL – Send Control to the Bootloader

Command: BL
Syntax: BL
Description: Sends program control to the bootloader
Default State: N/A
Notes: See Firmware Update section of the manual
Response: None

BM – Set Beacon Message

Command: BM
Syntax: BM<text> or BM?
Description: Sets beacon mode CW message to <text>. Both MCW and true CW beacons send the BM message. In true CW the BM message supports sending unmodulated carrier of 1-30 seconds by

inserting a #nn where nn is the length of the desired carrier. The & character causes the entire message to repeat from the beginning. Any characters after the & are sent once. For example BT#05& W6ZZZ<CR> will send two 5-second carriers followed by W6ZZZ. These advances feature are only supported in the true CW beacons, MCW beacons use standard message processing.
Default State: 'RS-UV3'
Notes: <text> will be sent in audio CW every time the beacon timer times out.
Response: BM? Reports current beacon message

BT – Set MCW Beacon Timer

Command: BT
Syntax: BTnnn or BT?
Description: Sets the modulated FM CW Beacon Timer to nnn sec, setting this command will set the real CW beacon timer (BC) to 0.
Default State: 0 sec (off)
Notes: Send MCW Beacon Message after nnn seconds; 60 - 600 seconds, 0 = off. All digits required.
Response: BT? Reports MCW Beacon Time

CC – Check Squelch State on a Channel

Command: CC
Syntax: CCn
Description: Checks to see if the squelch is open on memory channel n
Notes: Takes about 50 mS for carrier squelch and 100 mS for channels with tone squelch, returns to current operating channel when finished.
Response: 0 - squelch closed; 1 – squelch open

CF – Set CW Audio Frequency

Command: CF
Syntax: CFnnnn or CF?
Description: Sets CW audio tone frequency to nnnn Hz
Default State: 650 Hz
Notes: 400 – 1300Hz, all digits required
Response: CF? Reports current CW audio frequency

CL – Set CW Call Sign

Command: CL
Syntax: CL<text> or CL?
Description: Sets call sign to <text>, 15 characters max
Default State: 'RS-UV3'
Notes: The call sign will be sent then the ID timer times out or if an ID command is sent
Response: CL? Reports current call sign

CP – Report Channel Parameters

Command: CP
Syntax: CPn
Description: Returns all parameter for memory channel n without switching to that channel
Notes: TX Fr, RX Fr, Tone Fr, SQ Mode, PWR; Channel 0 is current operating set
Response: TX Fr<CR> RX Fr<CR> Tone Fr<CR> SQ Mode<CR> PWR<CR>

CS – Set CW Speed

Command: CS
Syntax: CSnn or CS?
Description: Sets CW speed to nn WPM
Default State: 22 WPM
Notes: Sets CW ID, Beacon and Text-to-CW speed, both digits required
Response: CS? Reports current CW speed

CT – Send MCW Text

Command: CT
Syntax: CT<text>
Description: Sends <text> in audio CW
Default State: N/A
Notes: Non CW characters generate a space, 28 characters max
Response: N/A

CW – Send CW Text

Command: CW
Syntax: CW<text>
Description: Sends <text> in true OOK CW
Default State: N/A
Notes: Non CW characters generate a space, 28 characters max
Response: N/A

DD – DTMF Tone Duration

Command: DD
Syntax: DDnnnn or DD?
Description: Sets DTMF tone duration to nnnn milliseconds
Default State: 500 ms.
Notes: Range: 50 – 2000 ms., all digits required
Response: DD? Reports current DTMF tone duration

DP – Pre-emphasis/De-emphasis ON/OFF

Command: DP
Syntax: DPn or DP?
Description: Turns on (n = 1) or off (n = 0) De-emphasis/Pre-emphasis
Default State: ON
Notes:
Response: DP? Reports current De-emphasis/Pre-emphasis state

DR – DTMF Tone Detector ON/OFF

Command: DR
Syntax: DRn or DR?
Description: Turns on (n = 1) or off (n = 0) DTMF Tone Detector
Default State: OFF
Notes: Will send the hex value of the DTMF character via serial port
Response: DR? Reports current DTMF detection state

DS – Send a String of DTMF Characters

Command: DS
Syntax: DS<text>
Description: Sends DTMF characters 0,1,2,3,4,5,6,7,8,9,A,B,C,D,* and #
Default State: N/A
Notes: Non DTMF characters generate a pause, 28 characters max, automatically keys the TX if needed
Response: N/A

EX – Set the Function of the E_TX and E_RX Pins

Command: EX
Syntax: EXn or EX?
Description: Sets the function of E_TX and E_RX pins on the DB9 I/O connector
Default State: 1 – TTL Serial Port
Notes: 0 - E_TX radio transmitting, E_RX sq open; 1 - TTL serial port
(E_RX) Squelch Open = Logic 0; Squelch Closed = Logic 1
(E_TX) Xmit Keyed = Logic 1; Xmit Unkeyed = Logic 0
Response: EX? Reports current function of the E pins,
"COMM" = TTL Serial Port; "I/O" = E_TX/R_TX states

FD1 – Set the RS-UV3 to Factory Default State

Command: FD1
Syntax: FD1
Description: Sets all memory channels and operating parameters to factory default settings
Default State: 1 N/A

Notes: Some settings require a power cycle to change
Response: N/A

F – Set the RS-UV3 Operating Frequency

Command: F
Syntax: Fz nnnnnn or F?
Description: Sets TX and/or RX frequency (depending on z) to nnnnnn kHz
Default State: TX – 146.52 MHz; RX 146.52 MHz
Notes: all digits are required,
R – Set RX frequency only
T – Set TX frequency only
S – Set both TX and RX to same frequency, simplex
D – Set RX to nnnnnn kHz and TX to nnnnnn – the repeater offset
U – Set RX to nnnnnn kHz and TX to nnnnnn + the repeater offset

Repeater offsets: 2M - 600 kHz; 1.25M – 1600 kHz; 70cm – 5000 kHz
Response: F? Reports RX and TX frequencies

FM – Measure the Signal Level on a Specific Frequency

Command: FM
Syntax: FMnnnnnn
Description: Tunes the RX to nnnnnn kHz measures and reports the signal strength then returns to the original frequency
Default State: N/A
Notes: all digits required
Response: Reports the signal strength on the given frequency in dBm

FW – Report the Current Firmware Version

Command: FW
Syntax: FW
Description: Reports the current firmware version
Default State: N/A
Notes: N/A
Response: Reports the current firmware version

GM – Set Microphone Gain

Command: GM
Syntax: GMnn or GM?
Description: Sets Microphone Gain level from 0 - 15 in 2 dB steps
Default State: 10
Notes: all digits required

Response: Reports the current Microphone gain setting

GT – Set CW/DTMF Tone Gain

Command: GT
Syntax: GTnn or GT?
Description: Sets DTMF/CW Tx Gain level from 0 - 15 in 2 dB steps
Default State: 8
Notes: all digits required
Response: Reports the current DTMF/CW gain setting

HP – Turns on/off the audio HP filter

Command: HP
Syntax: HPn or HP?
Description: Turns on (n = 1) or off (n = 0) Audio High-pass Filter
Default State: 1
Notes: Sets the low frequency corner
Response: Reports the current audio HP filter setting

HT – Set the TX Hangtime

Command: HT
Syntax: HTnnnn or HT?
Description: Sets the length of time the TX stays keyed after the PTT signal goes away, useful for repeater applications.
Default State: 0 msec.
Notes: all digits required, 0 – 5000 msec.
Response: Reports the Hang-time

ID – Sends CW ID

Command: ID
Syntax: ID
Description: Sends the call sign in audio CW, automatically keys the TX if needed
Default State: N/A
Notes: N/A
Response: N/A

IT – Sets CW ID Timer

Command: IT
Syntax: ITnnn or IT?
Description: Sets the CW ID Timer to nnn seconds
Default State: 0

Notes: Will send CW ID after the current transmission ends, 0 - 500 sec, 0 = off, all digits required
Response: IT? Reports CW ID Time

LD – ST LED Function

Command: LD
Syntax: LDn or LD?
Description: Sets the funstion of the ST LED
Default State: 2 – Squelch Open
Notes: 0 - off, 1 - on, 2 - sq open, 3 - Batt Chg Stat
Response: LD? Reports the ST LED Function

MC – Beacon Memory Channels

Command: MC
Syntax: MCn or MC?
Description: Sets the maximum channel for multichannel beacons
Default State: 0
Notes: n = 0 is a single channel beacon. n = 2 - 9 will cause the RS-UV3 to recal a new channel before sending a beacon starting at channel 1 going to channel n and repeating
Response: MC? Reports the current maximum beacon channel

PD – Power Down

Command: PD
Syntax: PDn or PD?
Description: Turns on (n = 1) or off (n = 0) the transceiver chip
Default State: 1 - ON
Notes: Reduces the current by 70mA.
Response: PD? Reports the current PD state

PW – Set TX Power Level

Command: PW
Syntax: PWn or PW?
Description: Sets TX power to high (n = 1) or low (n = 0)
Default State: 1 - High
Notes: High is 23-24 dBm, low is 9 – 10 dBm
Response: PW? Reports current power setting

RC – Recall Memory Channel

Command: RC
Syntax: RCn
Description: Recalls operating parameters from channel n

Default State: N/A
Notes: 1 – 9, Recalls RX/TX frequency, squelch, CTCSS Frequency/mode and TX power
Response: N/A

RR – Transceiver Chip Register Read (Advanced)

Command: RR
Syntax: RRxx
Description: Reads RDA1846S register xx
Default State: N/A
Notes: xx is in Hex, find info about the RDA1846S registers on the Internet.
Response: Reports the 16 bit HEX value of register xx

RS – Transceiver Chip Register Set (Advanced)

Command: RS
Syntax: RSxxyyyy
Description: Sets RDA1846S register xx to yyyy
Default State: N/A
Notes: xx, yyyy in Hex, find info about the RDA1846S registers on the Internet.
Response: if successful, reports: OK, otherwise nothing

SD – CW/DTMF Side Tone On/Off

Command: SD
Syntax: SDn of SD?
Description: Turns the CW/DTMF side tone (1) On or (0) Off
Default State: 0
Notes: Allows the CW and DTMF tones to be heard through the speaker
Response: SD? Reports current state of the side tone

SN – Read Noise Level of RX Signal

Command: SN
Syntax: SN
Description: Returns receiver noise strength
Default State: N/A
Notes: Lower is a better quality signal
Response: SN: xxxx

SO – Report the Current State of the Squelch

Command: SO
Syntax: SO
Description: Returns 1 if the squelch is open; 0 if the squelch is closed

Default State: N/A
Notes: Works with RSSI and CTCSS squelches
Response: SO: x

SQ – Set the Squelch Level

Command: SQ
Syntax: SQn or SQ?
Description: Sets the level of the RSSI squelch to n
Default State: 3
Notes: 0 – 9; 0 = always open, 9 = never open
Response: SQ? Reports current SQ level

SS – Read Signal Level of RX Signal

Command: SS
Syntax: SS
Description: Returns receiver signal strength
Default State: N/A
Notes: In dBm
Response: SS: xxxx

ST – Store Memory Channel

Command: ST
Syntax: STn
Description: Store operating parameters from channel n
Default State: N/A
Notes: 1 – 9, Stores RX/TX frequency, squelch, CTCSS Frequency/mode and TX power; ST0 stores the current operating parameters as power-on defaults
Response: N/A

TF – Set CTCSS Tone Frequency

Command: TF
Syntax: TFnnnn or TF?
Description: Sets CTCSS tone frequency to nnnn/100 hz
Default State: 131.8 Hz
Notes: all digits are required, example: TF13180 sets tone to 131.8 hz
Response: TF? Reports current CTCSS tone frequency

TG – Set TX Time Out CW Message

Command: TG
Syntax: TG<text> or TG?

Description: Sets TO message to text 7 char max
Default State: 'TO'
Notes: Message is sent after the TX times out and before the TX unkeys
Response: TG? Reports current TO messege

TM – Set CTCSS Mode

Command: TM
Syntax: TMn or TM?
Description: Sets CTCSS mode to Off (0), TX (1) and RX/TX (2)
Default State: 0 - Off
Notes: N/A
Response: TM? Reports the current CTCSS Mode

TO – Set TX Time Out Timer

Command: TO
Syntax: TOnnn or TO?
Description: Sets the Timeout Time in mec, 0 - 600 seconds, 0 = off.
Default State: 0 - Off
Notes: Max transmit time, after specified time sends TO_msg and unkeys
Response: TO? Reports current Timeout Time

TP – Read RS-UV3 PCB Temperature

Command: TP
Syntax: TP
Description: Reads the temperature of the RS-UV3 PCB
Default State: N/A
Notes: N/A
Response: Reports the current PCB temperature in C

TX – Turn the Transmitter On/Off

Command: TX
Syntax: TXn
Description: Turns the transmitter on/off
Default State: 0 - Off
Notes: n = 0 off (RX); n = 1 - 5 on (TX) with a time-out of n minutes. Overrides the set time-out for the current transmission only. TX0 will end a transmission even if the PTT line is low. If the TX is off, RX is on.
Response: none

VL – Sets the VOX Sensitivity Level

Command: VL

Syntax: VLn
Description: Set VOX sensitivity level
Default State: Meduim
Notes: n = 0 high, n = 1 medium, n = 2 low
Response: VL? Reports the current VOX Sensitivity setting

VT – Read RS-UV3 Operating Voltage

Command: VT
Syntax: VT
Description: Reads the operating voltage of the RS-UV3 PCB
Default State: N/A
Notes: Reads the 8.5V rail if the unit is on DC power or the battery voltage if running on a battery
Response: Reports the current operating voltage

VU – Sets the Receiver Audio Volume

Command: VU
Syntax: VUnn or VU?
Description: Sets volume level from 0 - 39 in 1 dB steps
Default State: 12
Notes: All digits required; DTMF decode works best around 15
Response: VU? Reports current volume level

VX – Turns VOX on or off

Command: VX
Syntax: VXnn or VX?
Description: Turns VOX on or off
Default State: Off
Notes: 0 - off, 1 = on.
Do not use VOX with the speaker/mic. RX audio will key the TX
Activation the PTT line turns VOX off
Response: VX? Reports current VOX setting

6. Firmware Upgrade

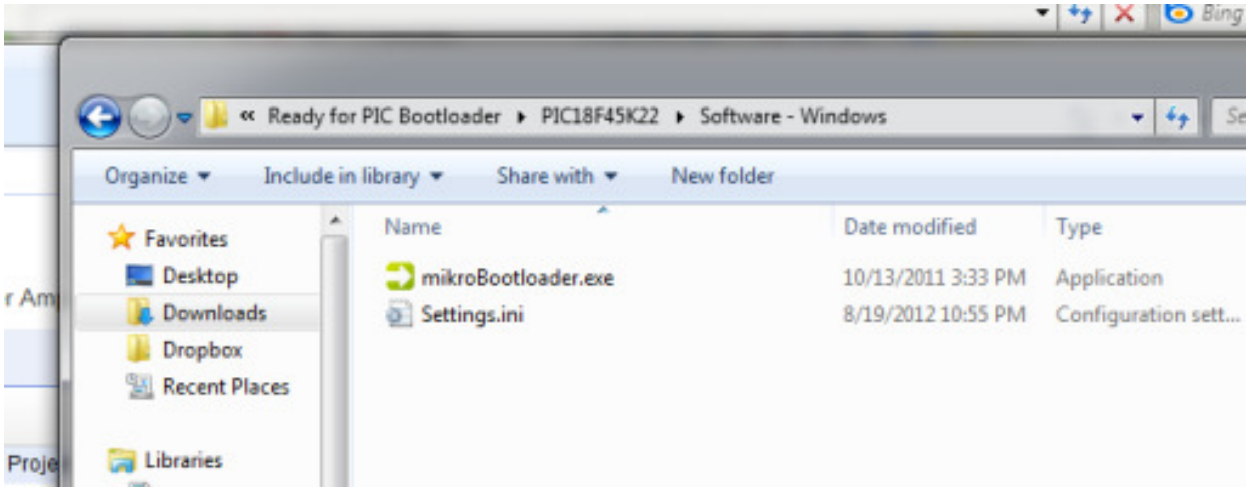
1. Establishing a Serial Connection and Installing the Bootloader

In order to facilitate easy updating without an expensive programmer, we have included a bootloader that is provided by our compiler of choice, MikroC PRO for PIC. This is a serial bootloader and is interfaced by one of the two TTL serial ports on the RS-UV3 board.

If you have been using a USB-Serial cable to communicate with the RS-UV3, the same connection can be used for the bootloader. If not you'll need to establish a USB-serial connection between the computer and the RS-UV3.. The easiest way to do this is a FTDI based USB to serial adapter which can be soldered/plugged/wired directly into JP2 on the RS-UV3. For a removable see the CONNECTIONS section for information on how to connect to the serial data on the I/O connector.

If you use an FTDI based USB to serial converter the drivers will load automatically. With converters that use other chipsets, driver installation may be required.

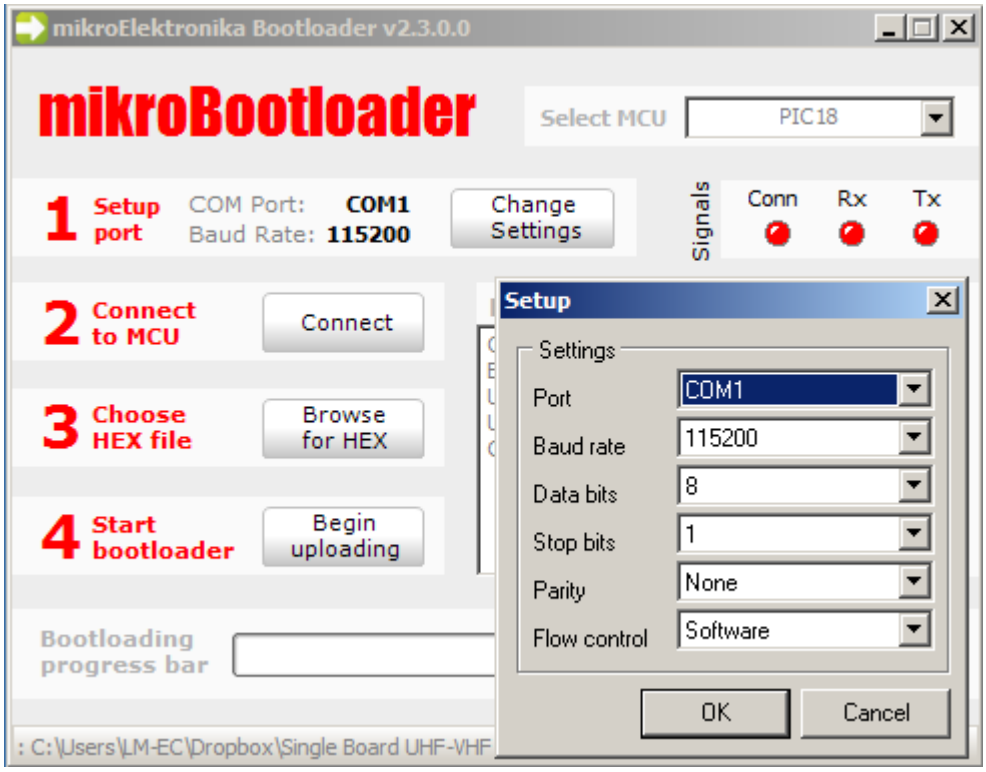
The next thing you'll need is the file called "mikroBootloader2.3.zip" just Google the file name and you can download it from multiple places. After you download and extract the zip, you will see a directory structure that looks like the following. You want to run the bootloader for the PIC18F45K22. This is a standalone program and doesn't need to be installed. You can run it from where it was extracted or save it somewhere else, your choice.



2. Getting the RS-UV3 Listening for the Bootloader

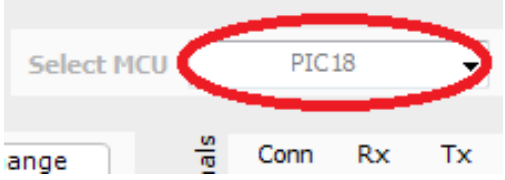
Download the latest RS-UV3 firmware 'RS_UV3 FIRMWARE VX-X.HEX' from the HobbyPCB files download page.

Launch the bootloader program and you will be presented with the mikroBootloader and 4 steps to follow. When you click on "Change Settings" to change the serial port settings, you will see the following display:



Change the Port to whatever COM port your RS-UV3 is connected to. Change the Baud rate to 115200, leave the rest of the settings alone and click OK.

Make certain that **PIC18** is selected in the 'Select MCU' box in the upper left portion of the bootloader.

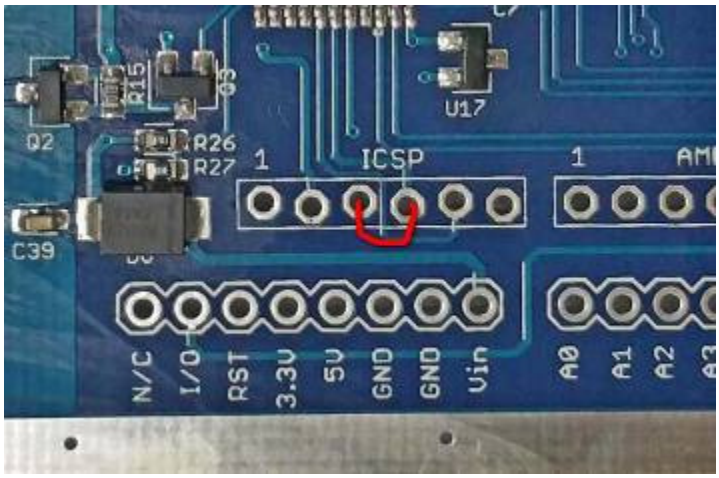


The next step is to make the RS-UV3 listen for the bootloader connection. Regardless of which port you are connected to if you open a terminal emulator program and send a BL<cr> command to the RS-UV3 it

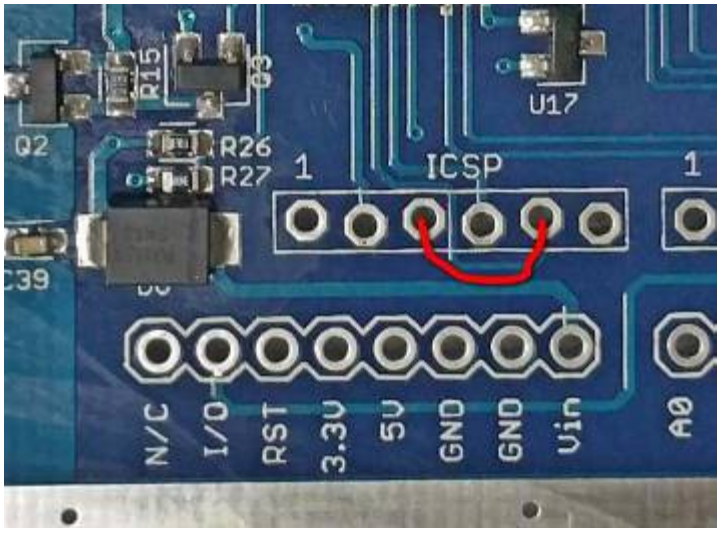
will start listening for the bootloader on the same port on which the BL command was received. It will do this indefinitely so if you decide not to upload firmware of issue the command inadvertently, the RS-UV3 must be power cycled to return to normal operation. You must exit the terminal emulator before pressing 'Connect' in the bootloader program.

If for some reason you cannot issue the BL command (maybe incorrect firmware was sent to the RS-UV3 and it is unresponsive), you can force the RS-UV3 to listen for the bootloader on start-up by placing one of two jumpers on the ICSP header, depending on which serial port you will use to upload the firmware.

If your USB to TTL serial converter is connected to JP1 or JP2 on the RS-UV3, place a jumper here:



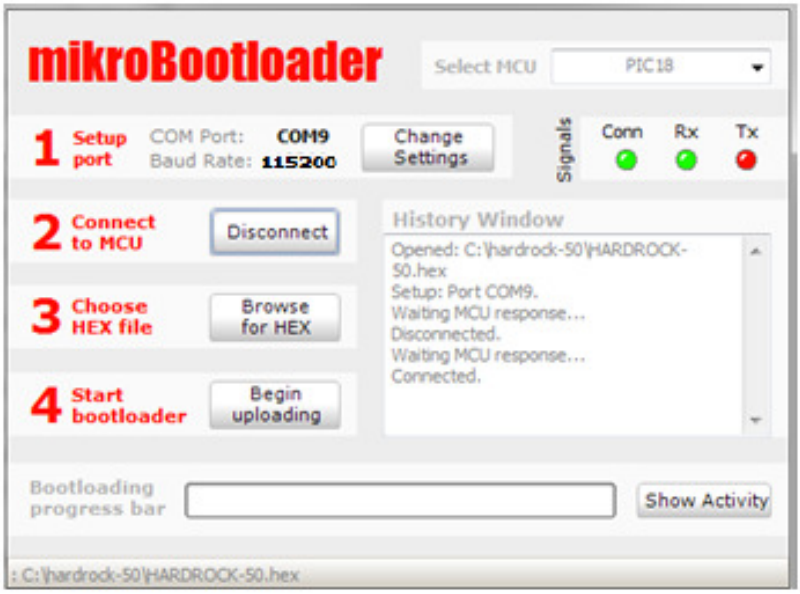
If your USB to TTL serial converter is connected to the I/O DB9 connector, place a jumper here:



In either case, after you put the jumper in place, turn the power to the RS-UV3 off and then on again. *Do not cycle the power if you issued the 'BL' command.*

3. Connecting and Uploading

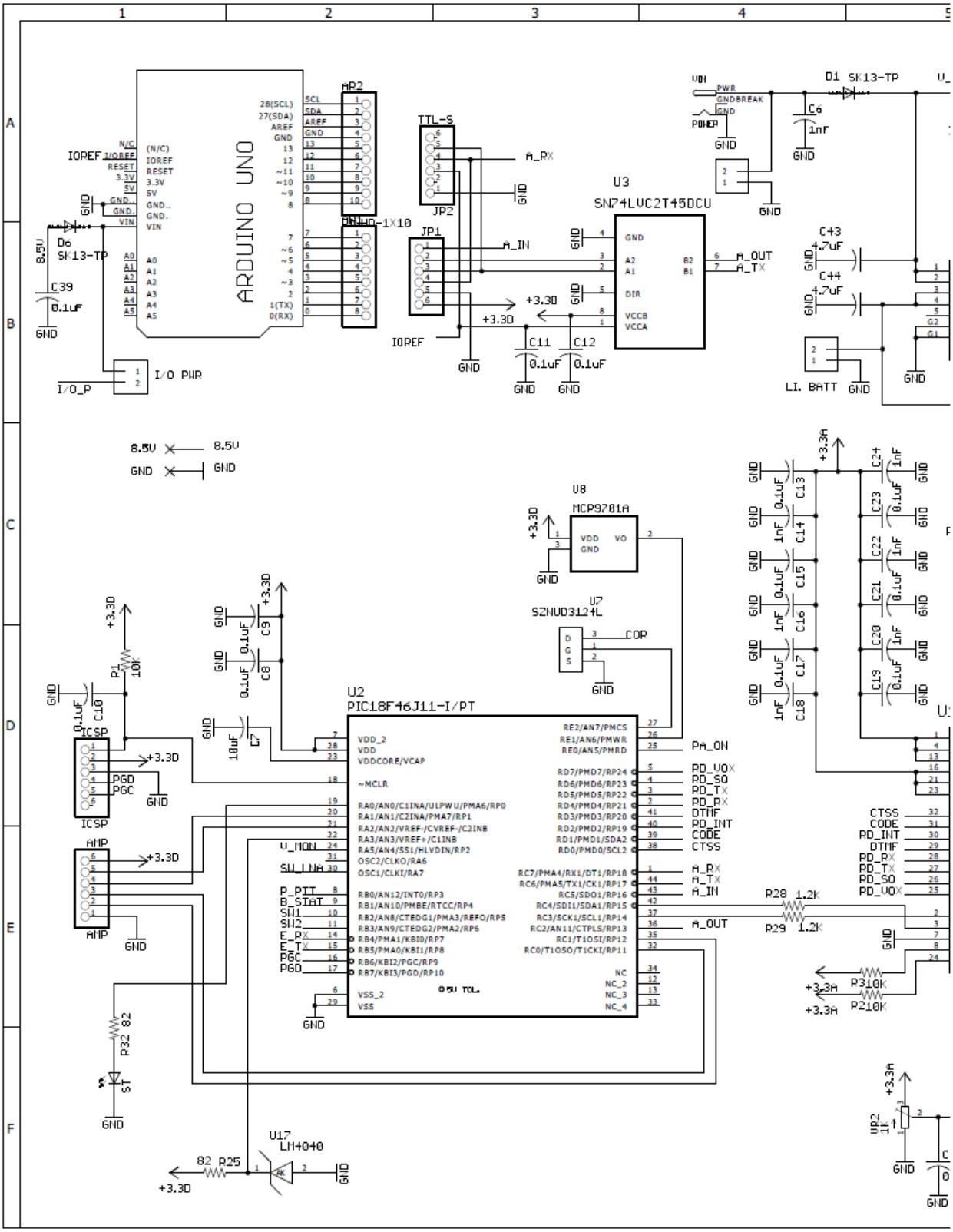
Now press the ‘Connect’ button on the bootloader. If everything goes right, you will see the following screen:

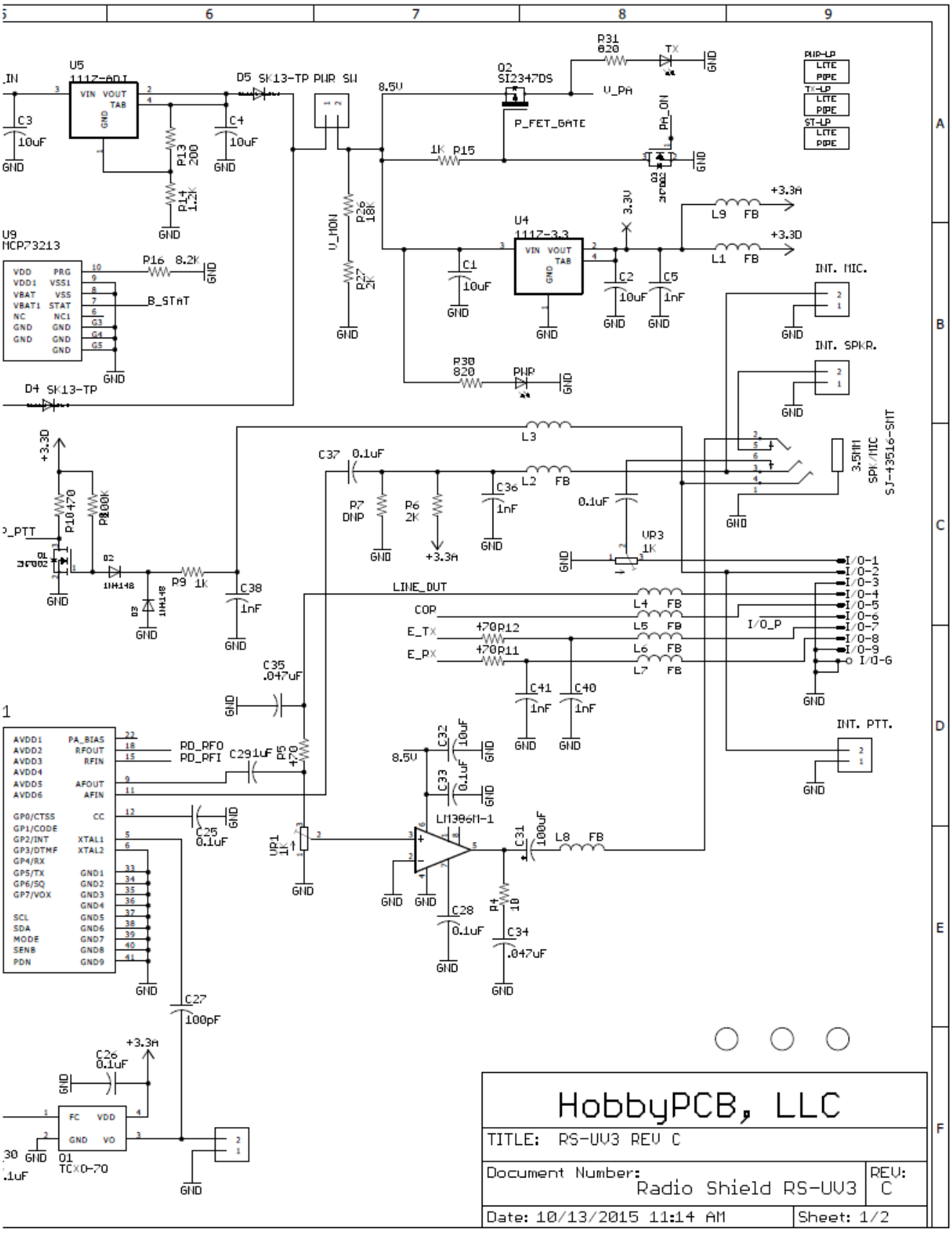


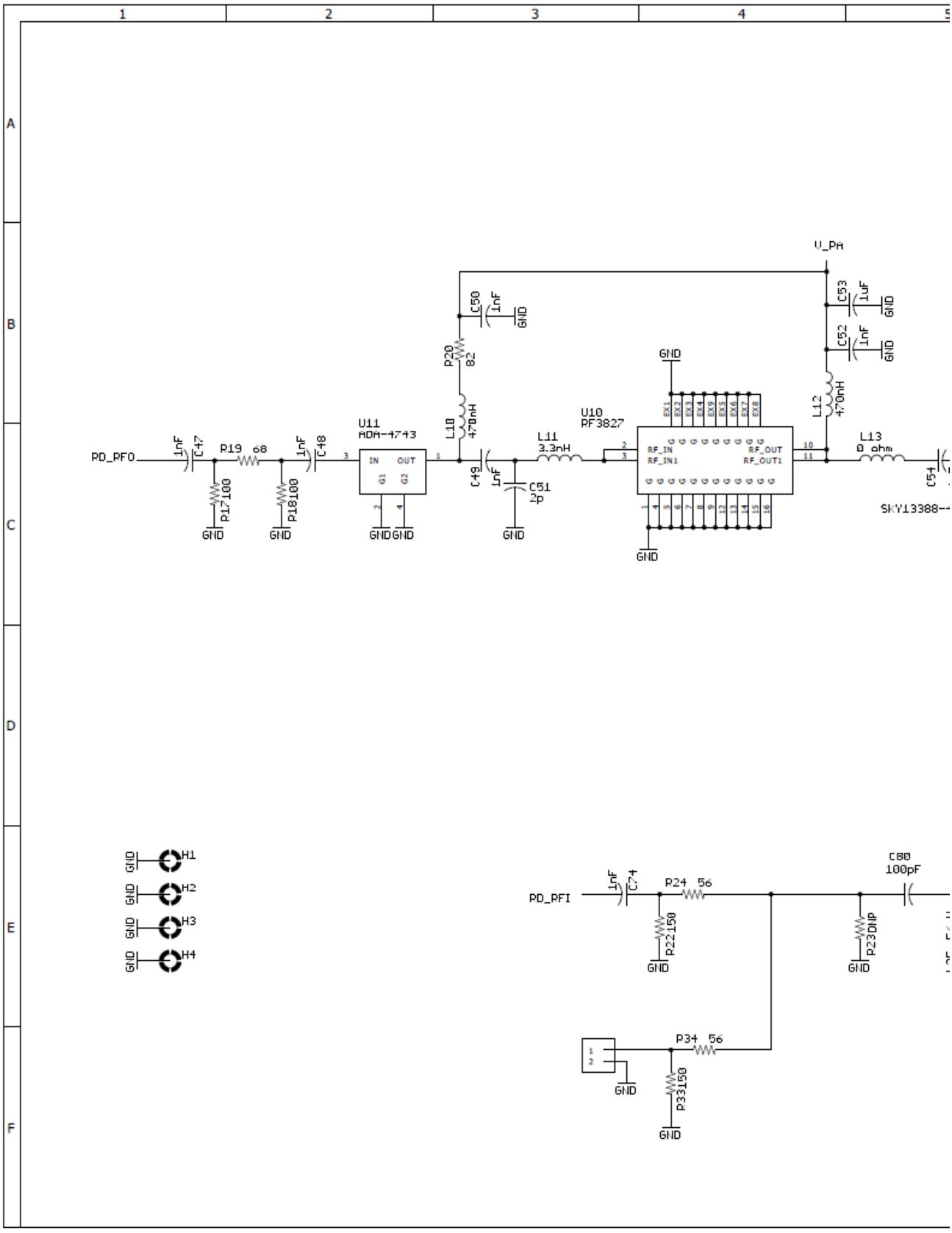
Note the Green lights and the word "Connected" in the History Window. Now you can move to Step 3 and browse for the RS-UV3 FIRMWARE VX-X.HEX file you downloaded from ATU files page.

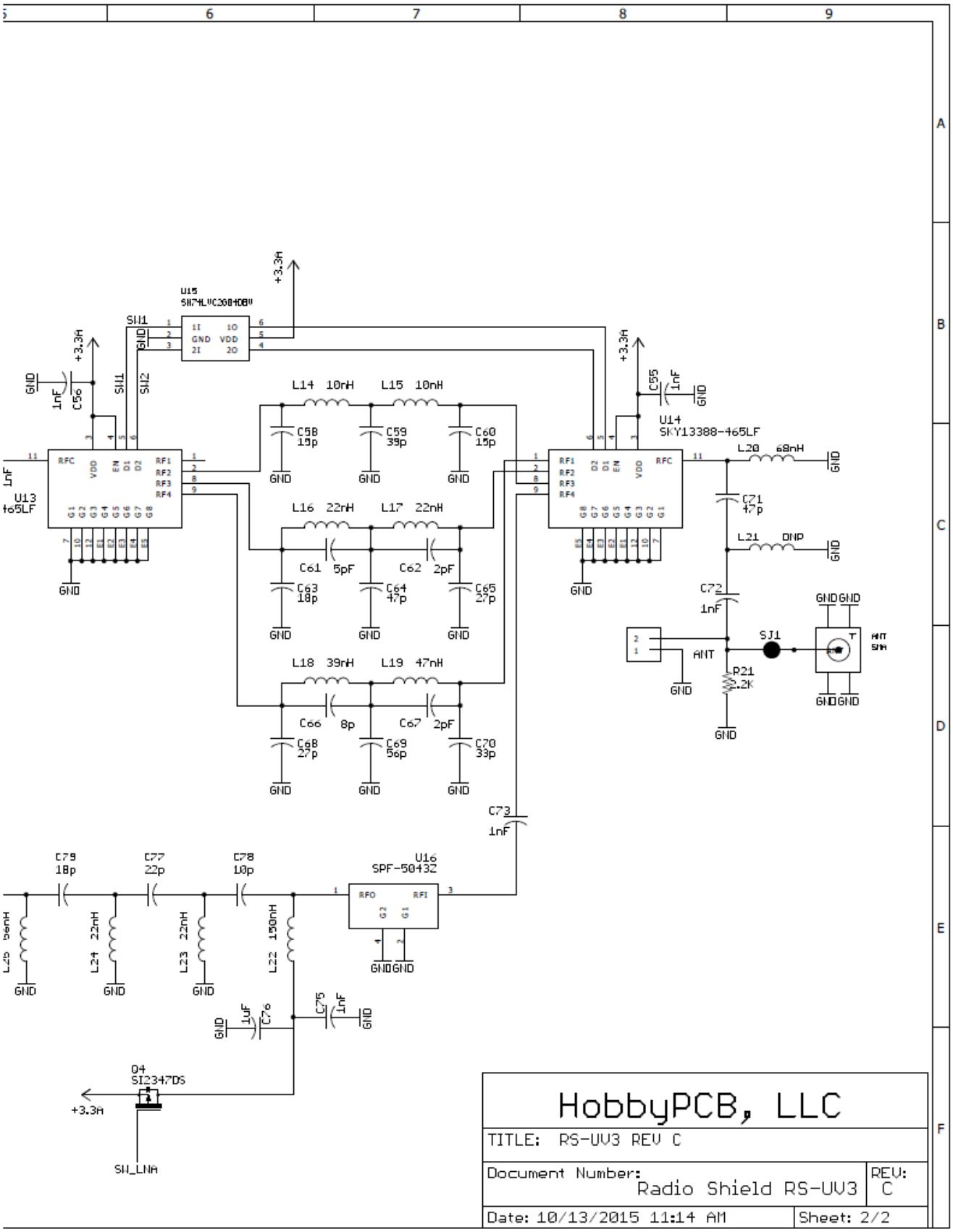
Last, click "Begin uploading" to upload the new version of the firmware to your RS-UV3. After successful upload, you will need to cycle power on the RS-UV3.

7. Schematic Diagrams




HobbyPCB, LLC
TITLE: RS-UV3 REV C
Document Number: Radio Shield RS-UV3
REV: C
Date: 10/13/2015 11:14 AM
Sheet: 1/2


1
2
3
4
5
A
B
C
D
E
F
V_PA
C50
1nF
GND
P20
82
C53
1uF
C52
1nF
L12
470nH
U10
PF3827
RF_IN
RF_IN1
RF_OUT
RF_OUT1
L13
0 ohm
C54
SKY13388--
PD_PF0
C47
1nF
P19
68
C48
1nF
U11
ADA-4743
IN
OUT
G1
G2
L10
470nH
C49
1nF
C51
2p
L11
3.3nH
P17100
P18100
H1
H2
H3
H4
PD_PFI
C74
1nF
P24
56
P22150
C80
100pF
P23DNP
P34
56
P33150


HobbyPCB, LLC
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Document Number: Radio Shield RS-UV3
REV: C
Date: 10/13/2015 11:14 AM
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U14
SKY13388-465LF
U13
to5LF
U16
SPF-5043Z
Q4
SI2347DS
SW_LNA
+3.3A
GND
L14 10nH
L15 10nH
L16 22nH
L17 22nH
L18 39nH
L19 47nH
L20 68nH
L21 DNP
L22 150nH
L23 22nH
L24 22nH
C58 15p
C59 39p
C60 15p
C61 5pF
C62 2pF
C63 18p
C64 47p
C65 27p
C66 8p
C67 2pF
C68 27p
C69 56p
C70 33p
C71 47p
C72 1nF
C73 1nF
C75 1nF
C76 1uF
C77 22p
C78 10p
C79 18p
C55 1nF
C56 1nF
SJ1
ANT
P21 2.2K