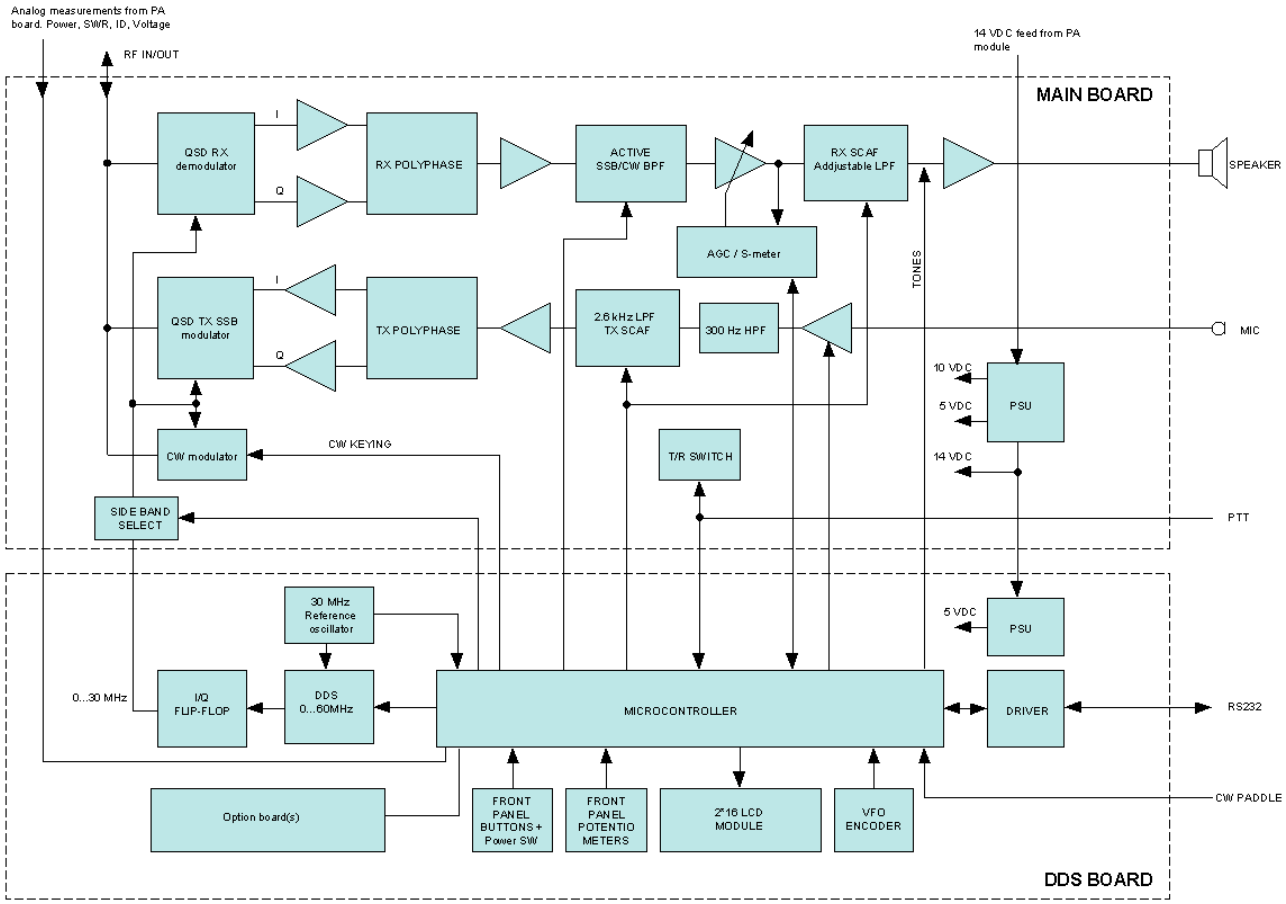
General

JUMA TRX2 is using the quadrature sampling technique for demodulation and modulation with the low noise phasing method. The main board handles all the RF and AF exciter funtions for reception and transmission.



Block diagram of the JUMA TRX2 exciter, the main board and the DDS board

RX section *(Refer to the main board schematics page 1)*

The antenna RF signal, without any RF amplification, goes directly to the wide band transformer T1 to achieve good dynamic range. The transformer T1 transforms the unbalanced 50 ohm antenna signal into the 200 ohm balanced signal. This signal is fed to the doubly balanced demodulator (RX mixer) IC1 which is a high speed, low ohmic analog multiplexer controlled by dual local oscillator signals which are shifted by 90 degrees. These local oscillator signals I and Q are coming from the DDS board. The demodulator IC1 is sampling the antenna signal into the four sampling capacitors C4, C5, C6, C7. The signals in these capacitors are in baseband frequency range i.e. < 15 kHz and all the capacitors have equal signal content, but the phase of these four signals are different, which are 0, 90, 180 and 270 degrees, called I and Q signals and their complement signals.

The I and Q signals are amplified in the differential preamplifiers A1 and A2. The gains of these preamplifiers are set precisely to equal each other by using 0.1% feedback resistors R3 - R8. The preamplifiers are feeding the RX polyphase module which proportionally delays the Q signal by 90 degrees compared to the I signal. (Read more of the polyphase module in its own description section). The signals after the polyphase are buffered and further amplified by the instrumentation type amplifier A3 and A4-A.

The output of the amplifier A4-A is demodulated SSB audio signal at the band width of 15 kHz. The signal is then filtered in the SSB/CW 1st filter module. This 1st filter has two band pass ranges, 300 Hz…2.5 kHz for SSB and 300 Hz…1kHz for CW. The width is selected by the pin 5 in the filter module. (Read more of the 1st filter module in its own description section).

After the 1st filter the signal is fed to the AGC circuit which consists of the variable gain amplifier A4-B, the full wave signal rectifier amplifier A6 and the AGC rise and fall timing components R44, R45, R46, R47, R67, C34 and C35. In the fast AGC mode the MOSFET TR6 is used to connect the resistor R67 in parallel with the timing circuit. The AGC control voltage which is coming from the timing components defines the resistance of the feedback FET TR4 and thus defines the gain of the AGC variable gain amplifier. Signal for the S meter is processed from the AGC control voltage by the DC amplifier A7. Nominal S meter output voltage is 1 V with a S9 (50µV) signal and 2 V with a S9+40 dB signal. The threshold of the AGC is defined by the trimmer resistor. The adjustment can be done by means of a 50µV (S9) antenna signal and by turning

the trimmer R53 until the S meter reading is 1V. S9 reading is in the middle in graphical LCD bar and is marked with two dots.

The output audio level of the variable gain amplifier A4-B is regulated to the range of 5 mV…10 mV which is amplified by the post amplifier A5-A to a suitable 200 mV…500 mV level for the Switched Capacitor Filter (SCAF) IC10. The SCAF is a variable 8th-Order, Elliptic lowpass filter. The corner frequency is defined by the clock frequency coming from the CPU in the DDS board. Thus the final RX selectivity can be set by the user. The output from the SCAF is fed to the AF GAIN potentiometer located in the DDS board and fed back the speaker amplifier A12 in the main board.

The CW sidetone and the acknowledge tones coming from the DDS board are summed to the AF signal in the post amplifier by the resistor R52.

Additionally there are I/Q buffer amplifiers A13-A and A13-B for the I and Q signals at a bandwidth of ±15 kHz. This signal is available in the rear panel AUX connector by selecting corresponding AUX select jumper positions. The I/Q output can be used for a software demodulation by feeding the I/Q signals to a PC via a sound card input.

TX section *(Refer to the main board schematics page 2)*
The AF signal from the microphone is fed to the amplifier A8-A which acts also as user switch selectable speech processor. The mic input is designed for an electret type microphone with a direct two wire connection. The electret bias is fed by the resistors R62 and R61. If a dynamic microphone is preferred the bias should eliminated by adding a 470 nF capacitor in series with the dynamic microphone "hot" wire. The speech processor is using a soft clipping to form a logarithmic type of compressor. When the processor is engaged the high frequency pre-emphasis is magnified which will emphasize high tones to get a more penetrating SSB transmission. The mic input can be switched to the line signal level mode for e.g. digi-mode reception. The line signal level can be matched to the audio source e.g. sound card by changing the value of the resistor R82.

The audio signal from the mic amplifier is filtered by the highpass filter A8-B at 300 Hz and by the SCAF lowpass filter IC9 at 2.6 kHz. Then the signal is split into the differential signals by the amplifiers A9-A and A9-B. The gain of the SSB drive is adjusted by the trimmer resistor R26. Then the audio signal is the fed to the TX polyphase module which splits the signal into the two phases I and Q and their complements. The I and Q signals are buffered by the TX driver amplifies A10 and A11. The gain of these TX drivers are set precisely to equal each other by using 0.1% feedback resistors R16, R17, R18, R21, R22, R23. The I and Q signals are fed to the SSB modulator IC2 (TX mixer) which is a high speed, low ohmic analog multiplexer controlled by dual local oscillator signals which are shifted by 90 degrees. The output of the modulator is SSB RF signal on the local oscillator frequency at the nominal level of 6 dBm (~4 mW)

The other half of the TX mixer IC2 is used for the CW modulator. It generates carrier on the local oscillator frequency. The carrier level is defined by the constant DC current generator TR1. The constant DC current level and thus the CW drive is defined by the trimmer resistor R28. The keying envelope is defined by the capacitor C19 with the reflected RF impedance of 100 ohms. Nominal rise/fall time is 5 ms. The CW rise and fall times can be customized by changing the value of the capacitor C19 if desired.

Control section *(Refer to the main board schematics page 3)*
The control section includes the power ON/OFF switch and the voltage regulators for 10 V and 5 V. The Power ON/OFF MOSFET switch TR7 is controlled by the DDS board via the MOSFET TR8. The rare 13.8 V (+V) is used directly for the speaker amplifier. The 10 volt from the low dropout regulator REG2 is used for all the OPAMPS and the reference (midpoint 5 V) is made by the resistor divider R83 and R58 and filtered with the capacitor C76. The 5 volt from the regulator REG1 is used for all the logic circuits including the RX and TX demodulator muxers.

The **functions** of the main board are controlled by the shift register IC6. The functions are:
- Sideband selection
- 1st filter width
- AGC speed
- Speech processor ON/OFF
- Noise blanker ON/OFF (option board)
- AF input level (mic/line)
- 80 m / 40 m band selection in two band model (change point frequency 4 MHz)

The shift register is driven by the DDS board with the serial SPI bus including data, clock and latch signals. The clock signal is filtered with R95 and C91 and squared with the Schmitt trigger inverter IC7. The SPI

signals with the cascade output are fed to the second shift register in the RF filter board for RF bandpass and PA lowpass filter selection. See more of the SPI principle in its own document

The analog muxer IC8 is used to swap the I and Q signals coming from the DDS board. The order of the I and Q signals defines the sideband (LSB or USB). The swapping is controlled by the shift register IC6 pin 1.

The quad NAND IC4 controls the transmit, receive and the mode of operation by using the PTT and sideband input signals.

The AUX selector jumper block defines the rear panel AUX connector signals. The alternatives are I/Q output or PTT in/KEY out, see schematics for the jumper positions. The PTT input can be used e.g. for a foot switch PTT. When the key input is grounded the rig switches to the TX state. The PTT signal is wired on the main board to the 5 volt via the 4k7 R71 and it requires 1 mA sink current to operate. The Key out can be used e.g. for a linear amplifier control. The key output is implement by the open drain MOSFET TR10 capable of sink max 0.1 A current at a max voltage of +50 V. Note, the key output can not be used in a negative voltage control.

The resistor and capacitor block marked "TONE LPF" is a passive lowpass filter for the sidetone and acknowledge tones coming from the DDS board. The resistors R87 and R88 keep the DC level in the middle during tone breaks to achieve a smooth audio tone output.

Adjustments
There are three trimmer resistors on the main board, the AGC threshold (R53), the SSB transmit gain (R26) and the CW carrier level (R28). See the instructions in the main board adjustment document.