JUMA-TRX2 DDS / Control Board description
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General

Key functions of the JUMA-TRX2 DDS / Control board are:

- provide user interface functions with LCD display, buttons, potentiometers
- generate user interface tones and CW side tone
- provide I/Q LO frequency to the JUMA-TRX2 main board
- provide clock frequency to main board SCAF filters
- measure and process analog input signals from main and PA board
- and VFO encoder
- provide digital control signals for main and PA board control
- provide RS232 serial interface to external equipment
- provide CW keyer functions

Key components of the DDS / control board are dsPIC30F6014A microcontroller, 2*16 character LCD display, high resolution optical encoder, pushbutton switches, potentiometers, AD9851 DDS chip, 30MHz reference oscillator and RS232 driver chip. JUMA-TRX2 control unit is formed with these components and over 3000 lines of software code stored in the dsPIC30F6014A Flash memory.

Voltage regulator / power switch

Main operating voltage of the DDS / control board is +5VDC. 5V voltage is generated from the power feed (about +14VDC) with linear regulator. Linear regulator's benefit is low noise emission. Less wanted characteristics are poor efficiency and high heat dissipation. In JUMA-TRX2 the DDS board +5VDC regulator is mounted to enclosure's aluminum frame to ensure maximum heat dispersion. Power switch is implemented with push button, FET switch and software. This combination enables to use power switch button in multiple ways (see operating instructions). Software can detect power switch push button state (PWR-SW signal). Push button also activates FET switch directly. This function is needed to get board power on and software running. When the software is running, power FET switch is kept on with power on digital output signal (PWR-ON). Power on signal is also connected to the main board to operate power switches there. When user has decided to turn JUMA-TRX2 off software executes power down tasks and then removes power on signal (PWR-ON).

LCD display

2*16 character LCD module is used to implement JUMA-TRX2 user interface display. Few special fonts are loaded into the LCD display's RAM character generator to allow graphic S-meter display. LCD module power feed is filtered with a simple RC filter to reduce RF noise.

Contrast and back light intensity adjustment

LCD module contrast voltage and LED back light current are generated with PWM type DAC. PWM DAC's are formed with software, dsPIC30F6014A PWM outputs and few other components. RC filter and a buffer amplifier (IC3A) are for the contrast voltage. RC filter and current generator (IC11A and Q3) are for LCD back light. Typical control voltage value is about 0,5V. Back light current can be adjusted from 0 to about 100mA. Normal value is between 20 to 50mA.

Push button switches

User interface push button switches SW1 to SW6 are connected to dsPIC30F6014A digital inputs. All of these inputs are kept high (1) with pull up resistors. When a switch is pressed input state goes low (0). The push button functions are defined in the software logic.

VFO encoder

High-resolution optical encoder is mounted to the DDS board. Main usage of this encoder is VFO tuning. Encoder is also used in various user interface configuration functions. Encoder generates two logic level signals, which are quadrature phased. Phasing allows software to detect the direction of rotation. Both encoder signals are connected to dsPIC30F6014A interrupt pins. Encoder processing is done in software with interrupts to get smooth and reliable operation even when encoder is rotated in high speed.

Analog inputs

Seven analog signals are measured with dsPIC30F6014A A/D converter. A/D converters reference voltage is derived directly from AVDD +5V supply. DDS board voltage regulator is "generic" 7805 part. Good quality parts should be used here to maintain the analog measurement accuracy. DDS board's +5V supply voltage should be 5V+/- 0,05V or better accuracy.

Signal descriptions

Potentiometers

Two front panel potentiometers (CW SPEED and RIT) are directly connected to dsPIC30F6014A analog inputs. With this arrangement software can read potentiometer positions in numeric format.

FWD-PWR and REW_PWR

PA board contains SWR bridge, power peak detectors and buffer amplifier. Amplifier outputs are scaled so that 10W are about 2,05V at analog input.

ID (drain current)

PA board contains measurement shunt resistors, power peak detectors and buffer amplifier. Amplifier output is scaled to produce 1,21V/A at analog input.

S-METER

Audio agc circuit in the main board generates S-meter voltage. S9 corresponds about 1V at analog input.

BATT (JUMA-TRX2 power feed voltage)
This measurement is taken from DDS board power supply input with voltage divider. 14V input generate 3,25V at analog input

Tone generator
User interface tones and CW side tone are generated with dsPIC30F6014A timer system. Tone signal is delivered as a 5V-logic signal to main board where it is conditioned, filtered and summed to the audio chain.

SCAF filter clock generator
Switched capacitor (SCAF) filters are used in the JUMA-TRX2 RX and TX chains. SCAF filter is a low pass filter which response is defined with filter clock frequency. Filter clocks are generated with dsPIC30F6014A timer system. See JUMA-TRX2 operating instructions for filter adjustments.

Digital control signals
Several digital control signals are read and generated by JUMA-TRX2 control software. Some of these signals are directly connected to dsPIC30F6014A general-purpose digital I/O pins. Additional digital outputs are implemented with local I/O registers in the main and PA (multiband) boards.

Directly connected I/O signals

PTT in / out
From PPT_IN signal JUMA-TRX2 control software finds out when TX is on and performs needed operations. PTT_OUT signal enables software controlled TX. This is needed for CW keyer operation.

DASH / DOT
DASH and DOT are the key state inputs for keyer software. Inputs are sampled with 1ms interval.

KEY
Key output controls the CW modulator in the main board. CW keyer software and tune mode logic drives this signal.

SPI bus to main and PA boards
Four signals form the SPI bus. SPI_SDI, SPI_SDO, SPI_CLK and SPI_LATHC. SPI_SDI is not used. SPI signals are controlled by dsPIC30F6014A SPI I/O block and TRX2 control software. To minimize RF noise SPI bus is active only when a change is needed in the main or PA board outputs state.

Main board SPI bus controlled digital outputs

SSB/CW	Select main board SSB or CW operating mode
SB-SELECT	Select sideband LSB or USB
NAR	Select SSB or CW band pass filter
FAST-AGC	Select AGC speed
PROC-ON	Select TX speech processor ON / OFF
NB	Select noise blanker option ON / OFF
MIC/LINE	Select Mic input signal level
7M	Select 3,5 or 7 MHz RF filters in two-band PA board

All band Filter and PA board digital outputs

Output I/O register is located in the RF FILTER BOARD but two of the control signals are connected to the PA board.

B0, B1, B2 Three bit binary coded filter select. See filter board schematics for details

ATT-0, ATT-1 Two-bit binary coded RF attenuator control for the PA board, See schematics for details.

DDS LO

Analog Devices AD9851 DDS chip is used for LO frequency generation. JUMA-TRX2 comutating mixer needs four different states (quadrants) per one LO cycle. AD9851 DDS digital output is 2 * LO frequency. AD9851 output and output complement signals are used to clock IC7A and IC7B flip-flops. Flip-flops are connected so that output is quadrature signal (I/Q) for the RX and TX mixers. In the main board analog switch IC8 is used to select the order of LO-A and LO-B signals going to the mixers. Order of the LO signals selects the desired sideband. AD9851 DDS chip is clocked with 30MHz reference oscillator. The 30MHz reference clock frequency is multiplied by six to get required 180MHz internal clock rate for the DDS chip. DDS chip is controlled by JUMA-TRX2 control software via serial bus. For details see software source code and Analog Devices AD9851 data sheet. Analog Devices have published also very good application notes and DDS tutorials in their www pages.

30MHz Reference oscillator

Good quality crystal oscillator is needed for 30MHz-reference frequency generation. Most important parameter is phase noise of the oscillator. This is important because the DDS chip multiplies the clock frequency by six. Also errors are multiplied by factor of six. Frequency accuracy is not so important because it can be corrected with JUMA-TRX2 calibration setup. Good thermal stability is however required. There are two decals (places) in the DDS printed circuit board for 30MHz oscillators. One place is for surface mount version and another through hole version. This makes easier to find good oscillator components. Of course only one is populated.

DsPIC30F6014A is also clocked with this reference oscillator. Current software version operates with 30MHz clock. 30MHz frequency is connected to the micro controller via 0R jumper R54. For future use there is possibility to

install flip flop IC6 and get 7,5MHz external clock rate for the dsPIC30F6014A micro controller. This “low frequency” clock is needed if dsPIC30F6014A internal PLL is used for clock frequency generation. With internal PLL 120MHz clock rate can be produced. This is needed if software performs heavy DSP operations.

Mic/line input
Microphone input is designed so that electrete microphone can be directly connected into it. Microphone input can also accept other kind of signal source. Input sensitivity level can be controlled with software. Microphone input is a 3,5mm stereo jack. Tip is the microphone and Ring is the PTT signal.

RS232 interface
DsPIC30F6014A UARTs are buffered with RS232 transceiver IC10. UART #1 is connected via main board and connector board to JUMA-TRX2 back plane. This RS232 I/O can be used for PC/Terminal connection or for JUMA External keyboard connection. See operation instructions and software source code for details. UART #2 is connected to pin header J1 and reserved for future use.

Option board connectors
Behind DDS board there are connectors (pin headers) J5, J8 and J7. These connectors are for various option boards. Connector J5 provides access to microphone / line input circuit. Connector J8 provides access to audio out path. If no option board is installed there should be jumper between J8-1 and J8-2 connecting RX audio to AF gain potentiometer. J7 provides digital I/O control and power supply to the option board. For future use dsPIC30F6014A DCI interface (codec interface) is also wired to J7.

ICD2 connector
Connector J19 is for Microchip ICD2 debugger / programmer. ICD2 is needed if there is no on board flasher available or it is corrupted. See Microchip www pages for details.

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