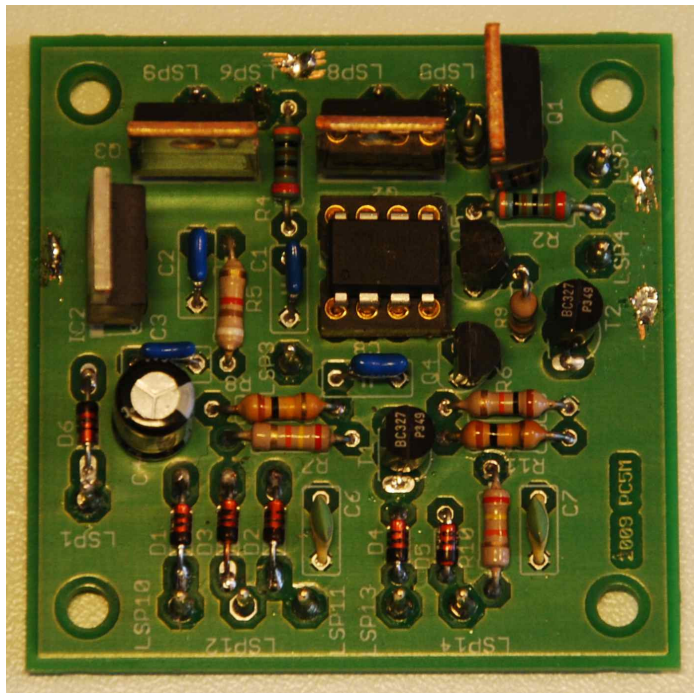


TX/RX SEQUENCER

Generating precise timed sequence signal upon transition from receive to transmit and vice versa

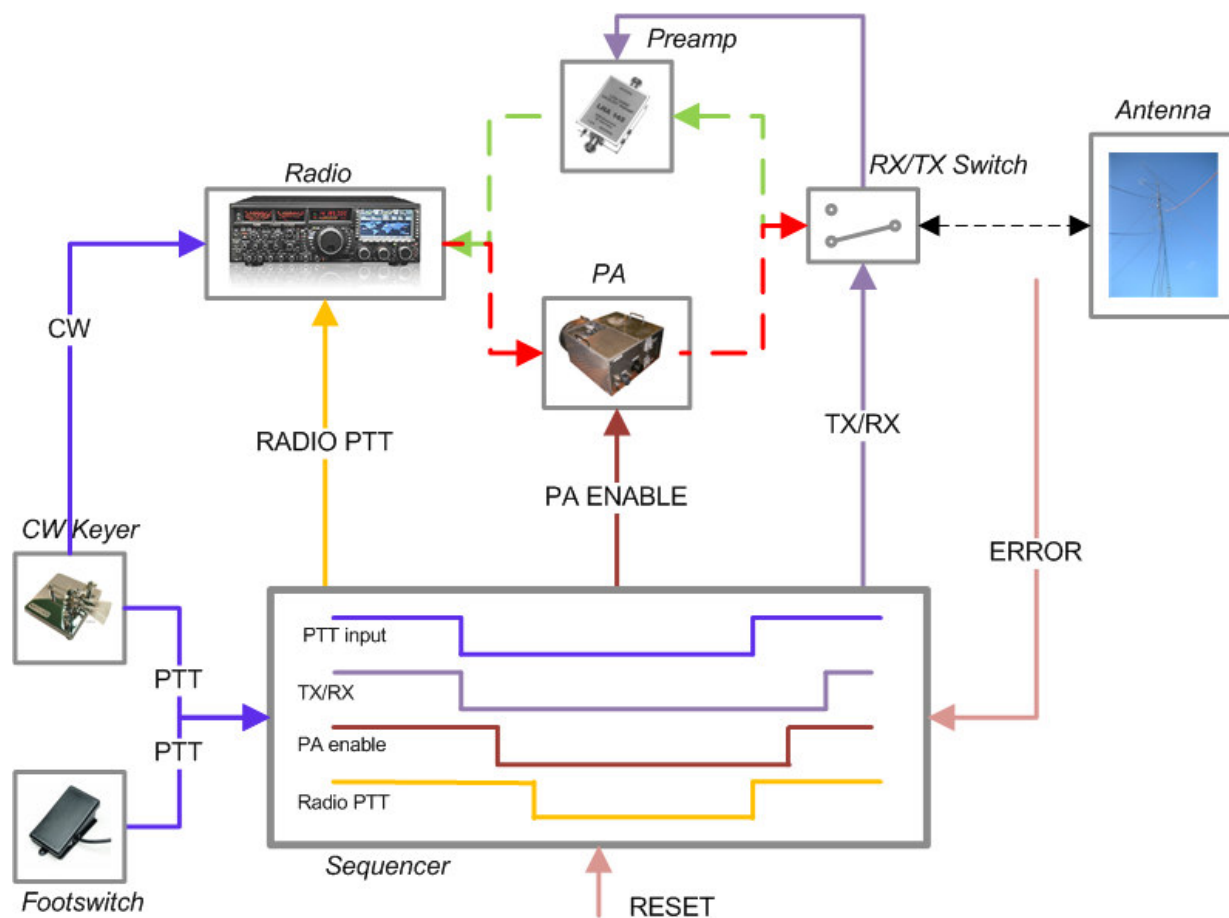


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1 Description



The sequencer has 3 input sources: PTT, ERROR and RESET. PTT is the input which need to be asserted when transmission should start. When PTT is pulled low the sequencer starts the predefined timed sequence of activating the 3 outputs: RADIO PTT, PA ENABLE and TX/RX. Subsequently if PTT is released the sequence will be halted and reversed. An ERROR input is provided to signal an ERROR situation to the sequencer, for instance this can be a high SWR situation or a separate signal from the TX/RX coaxswitch that this switch is for sure in the TX position. To resume normal operation when this ERROR has occurred the sequencer should be reset via pulling the RESET input low or via a full power cycle.

The 3 output signals are used to signal the transceiver between receive and transmit state (RADIO PTT), toggling the external power amplifier (PA ENABLE) and commanding the transmit/receive RF switch (TX/RX).

Inputs are high impedance and active state (TX, RESET or ERROR active) is low/ground. Outputs are open drain active low signals, pulling the output low/ to ground when in TX position. In additions 3 LED's can be connected (anode to output, cathode to ground) for state indication.



1.1 Use and connecting

SSB operation

PTT input will be connected to a footswitch or microphone switch. Microphone element connected to the radio in the normal manor. VOX should be switched off. When PTT is asserted the sequence is started (see chapter 1.2 for detailed information on the sequences).

CW operation

To be able to use this sequencer for CW operation the radio should be able to work in no "break-in" or vox mode, i.e. upon activating the CW KEY input of the radio it should NOT go into transmit (preferable only sidetone should be activated). A separate radio PTT input must be available for commanding the radio to go into transmit and only then RF power should be output following the CW KEY input. In addition the CW keyer should provide an outgoing PTT signal (low active) signaling start of CW message with sufficient "tail/hang" time such it wouldn't go inactive between CW characters. For instance the Winkey device from k1el is perfectly suited.

CW output of the keyer needs to be connected to the KEY input of the radio and PTT keyer output to the PTT input of the sequencer. When PTT is asserted (start of CW) the sequence is started.

For both mode of operation a DC power supply should be connected and if applicable 3 LED's can be connected to provide an indication if the corresponding output is active. These LED's should be connected with the anode to the pin and cathode to ground.



1.2 "Go to RX" and "Go to TX" Sequences:

During receive when PTT is brought LOW the "go to TX" sequence will start and will continue as long as PTT is LOW. In case PTT goes inactive during the sequence the "go to TX" sequence will be stopped immediately and reverted onwards.

Go to TX sequence:

Sequence description	Action description
1. TX/RX signal is brought active (Low) immediately	The TX/RX coax relays will be switched to the TX position
2. Fixed delay of 100ms	Wait till the TX/RX coax relays has been switched
3. Power amplifier is enabled for transmission (PA ENABLE = Low)	Enable the power amplifier, no power is output yet
4. Fixed delay of 100ms	Wait till the power amplifier has switched internally to TX
5. Radio is set to TX mode (RADIO PTT = low) if no Error is seen (ERROR is not Low)	The radio is put into TX, power is output

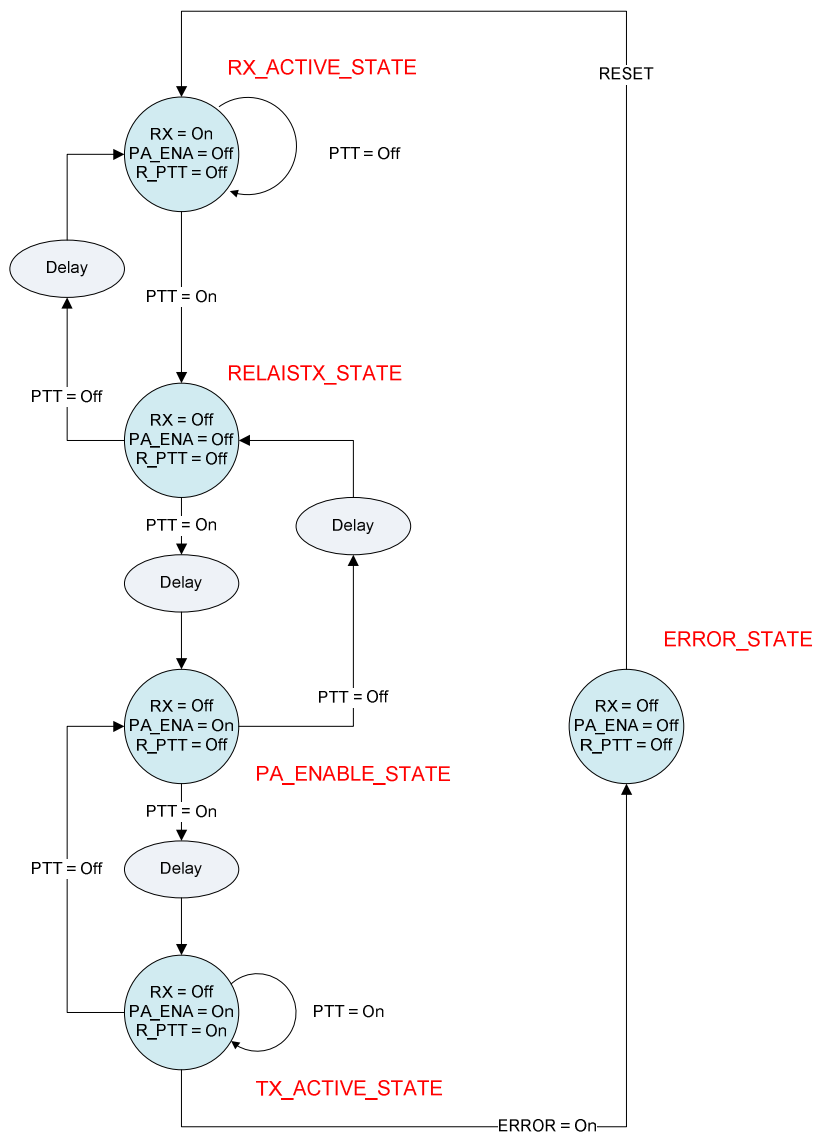
When transmitting and PTT is released the "go to RX" sequence will start and will continue as long as PTT is released. In case PTT goes active during the sequence the "go to RX" sequence will be stopped and the "go to TX" sequence is started onwards.

Go to RX sequence:

Sequence description	Action description
1. Radio is set immediately to RX mode (RADIO PTT = NOT low)	The radio releases TX goes into RX mode
2. Fixed delay of 100ms	Wait till the radio has released TX mode
3. Power amplifier is disabled for transmission (PA ENABLE = NOT Low)	Disable the power amplifier
4. Fixed delay of 100ms	Wait till the power amplifier is disabled
5. TX/RX signal is brought inactive (TX/RX = NOT Low)	Switch the RF switch to RX position

2 State diagram

The sequencer is build around a state machine build in software. The four sequenced states can be seen together with the state of the output signals. Upon RESET (of a power cycle) the state machine will enter the RX_ACTIVE_STATE and remain in that state as long PTT is not asserted. When PTT is asserted the RELAISTX_STATE is entered. If PTT stays active PA_ENABLE_STATE will be entered after a fixed amount of delay time, however if PTT is released the state machine reverts to the RX_ACTIVE_STATE. The other states and transitions are fairly self explanatory, special notice to the ERROR_STATE (this will be entered when the ERROR signal becomes active during the TX_ACTIVE_STATE). ERROR_STATE will disable the power amplifier and sets the radio to receive, however the RF switch remains in the (safe) TX/Transmit position. Only way to get out of the ERROR_STATE is to reset the sequencer via the reset signal of power cycle the unit.



3 Specifications

3.1 ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Conditions	Limits
Output voltage	V_{OUT}	TX/RX, PA ENABLE and RADIO PTT pins	100V
Continues output current	I_{OUT}	PTT = GND TX/RX, PA ENABLE and RADIO PTT pins	7A
Input voltage	V_{IN}	DC power, PTT and Error pins	30V
	V_{IN}	Reset and LED output pins	6V

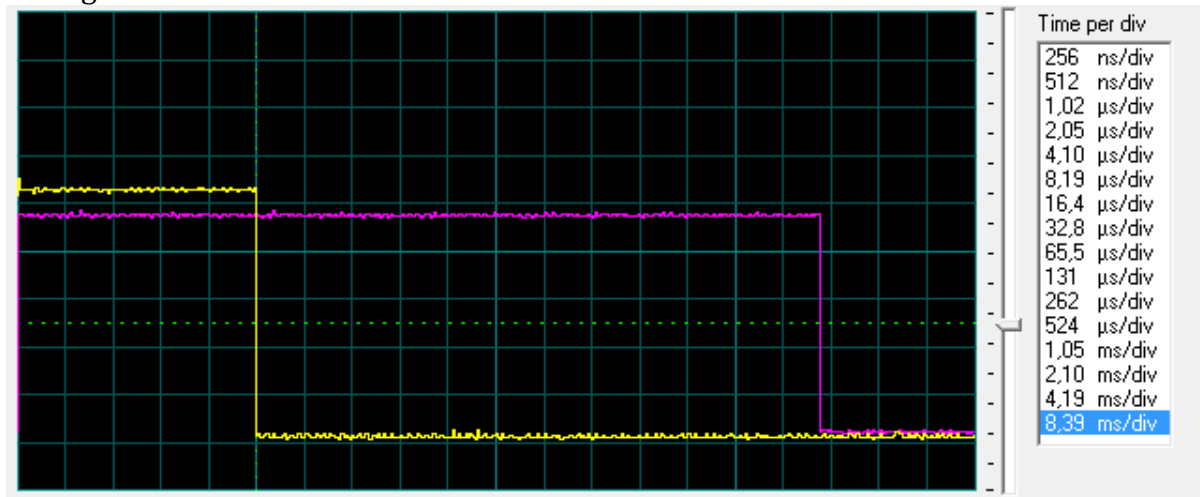
3.2 DC CHARACTERISTICS

Characteristic	Symbol	Condition	Limits			
			Min	Typ	Max	Units
Input voltage	$V_{IN(ON)}$	PTT input and ERROR pin	tbd		1	V
	V_{in}	DC input	8	12	30	V
	$V_{IN(ON)}$	RESET pin	-0.5		1	V
Power supply current	I_{CC}	PTT= 0V			70	mA
		PTT = Open			6	mA
Input current	I_{IN}	PTT and ERROR pins $V_{in}=0.2V$		- 50		μA
		$V_{in}=12V$			100	nA
Output Low Voltage	V_{OL}	$I_{OL}= 200mA$, RX/TX, PA ENABLE, RADIO PTT pins		0.1		V
Output current	I_{LED}	LED current each pin		10	30	mA

3.3 AC CHARACTERISTICS

Characteristic	Symbol	Condition	Limits			
			Min	Typ	Max	Units
Timing delay	Td	Ta = 25 degree C		100		ms

In the picture below the timing is given as measured, note the awkward time axis scaling.



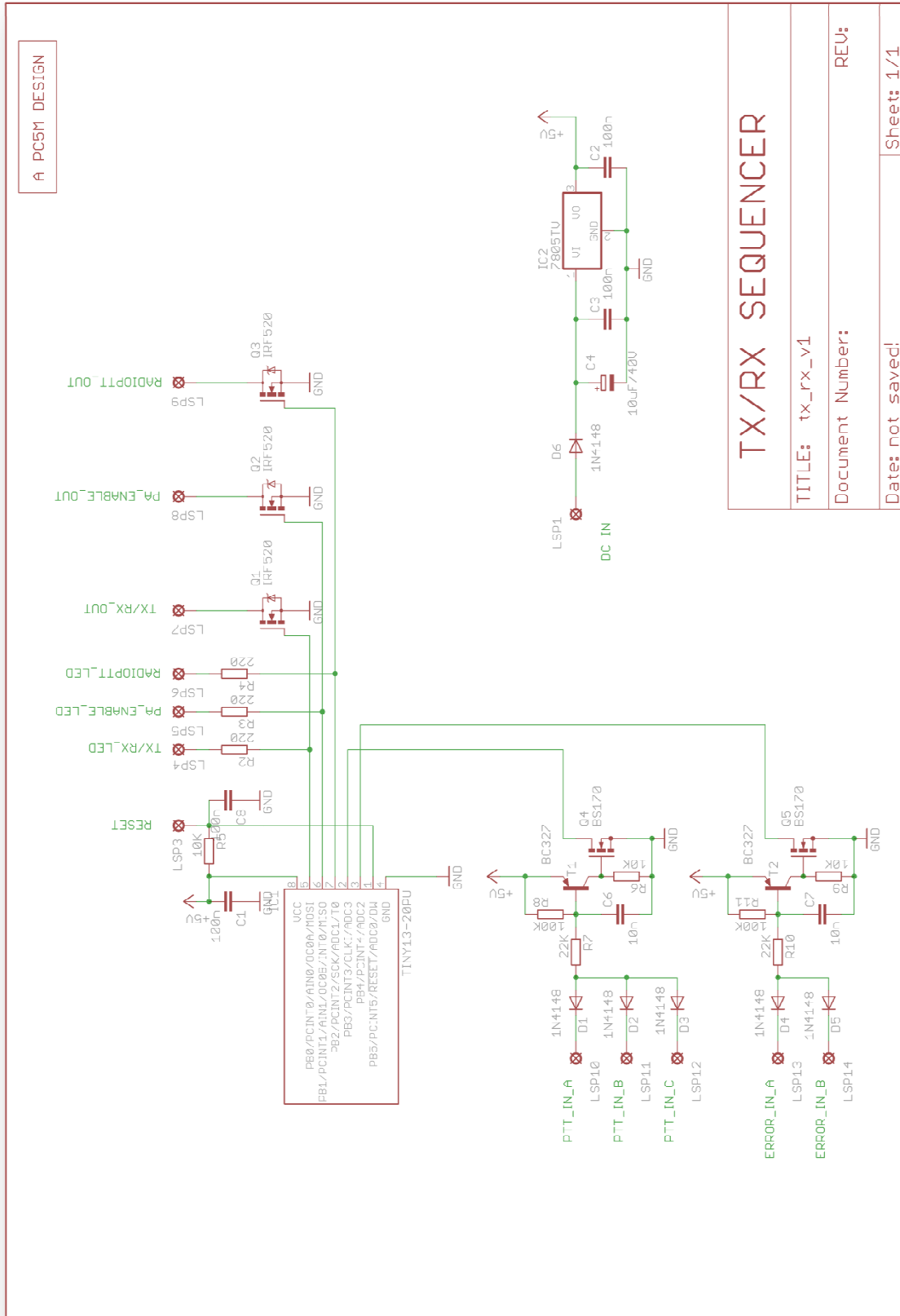
3.4 MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Condition	Limits			
			Min	Typ	Max	Units
Length and width (square)	-			2.1		inch
				53.3		mm
Height		Including components and PCB		0.9		inch
				22		mm

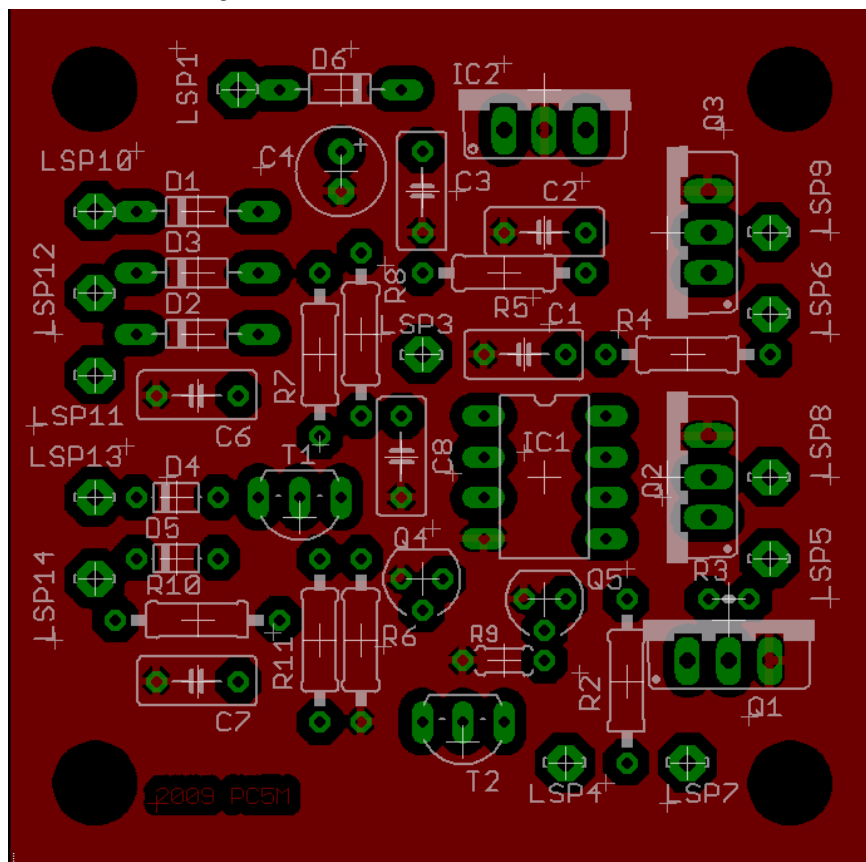
4 Design implementation

CAD developed using Eagle 5.6. Board is double clad FR4 with component silkscreen. For a good RF immunity the top plane is almost fully copper/ground. Inputs are well decoupled, but for optimal RF immunity it is advised to mount the PCB in a shielded box and use small valued (100pF) feedthrough capacitors.

4.1 Schematic



4.2 Board layout



4.3 Connections

Connection	Input/Output	Use
LSP1	Input	DC power supply input, typical +12VDC
LSP3	Input	RESET input
LSP4	Output	LED TX/RX (Anode of LED)
LSP5	Output	LED PA ENABLE (Anode of LED)
LSP6	Output	LED PTT RADIO (Anode of LED)
LSP7	Output	TX/RX
LSP8	Output	PA ENABLE
LSP9	Output	PTT RADIO
LSP10,11,12	Input	PTT
LSP 13,14	Input	ERROR

4.4 Software

Software is developed in C using AVR Studio 4 and WinAVR GCC C compiler for AVR ATtiny13. Internal 4.8 MHz oscillator is used.

Fuse settings:

Fuse	Setting	Description
CSEL1.0	01	Internal 4.8 MHz oscillator
SUT1.0	10	Slow rising power startup