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<u>Weekly Report #2 – RF Switching</u>

Goals
- Understand the format of I2C-Repeater Commands from the RTL SDR
- Extend the Keenerd RTL SDR driver library so that the Raspberry Pi can send commands to the Supervisory RTL-SDR to activate and manage the I2C-Repeater
- Send terminal commands to synchronously switch between antenna inputs and the noise source at all receivers, and test this with GQRX

RTL SDR I2C Transfer Specification

The RTL2832U has a core capable of sending I2C commands to peripheral devices. The I2C repeater within the core was originally intended for internal demodulator and tuner communication but can be adapted for use with communicating with the Noise Card and RF Switch peripheral devices on the coherent receiver [1].
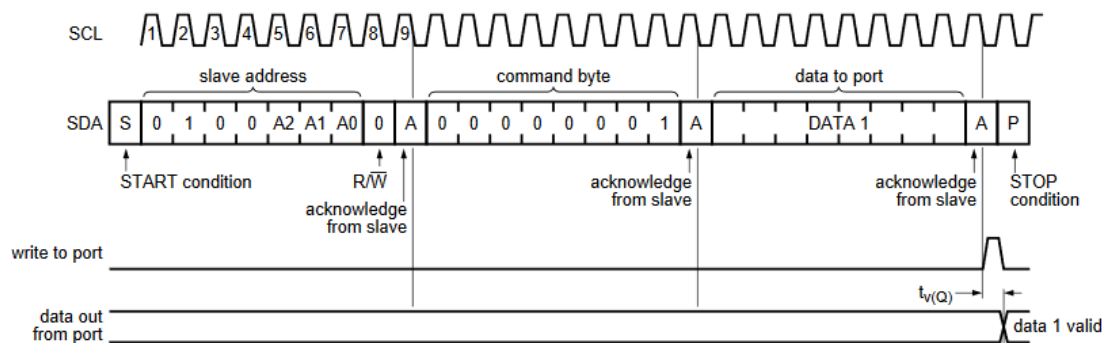

Figure 1: Format for Writing to an Output Port Register [2]

Each I2C transfer starts with an 8-bit slave address, then a command byte, and finally a byte dedicated to the data/values being sent. All I2C commands will be sent to an 8-bit register on the clock card which has an address of 0x40. The first I2C command consists of configuring the clock card 8-bit register as an output port register. The format for this first command would be 0x40 – 0x03 – 00 corresponding to the address, command, and data respectively [1, 2]. The next I2C command would consist of writing to this output port register so that commands can be sent to peripheral devices (i.e. switching all receivers to the noise input). An example format for this second command would be 0x40 – 0x01 – 0x1f corresponding to the address, command, and data respectively [1,2]. The I2C repeater must be activated before sending the I2C transfers and deactivated after the I2C transfers are sent.

To help clarify the above procedure, the respective pseudocode of the I2C transfers as described above to perform a specific action (i.e. switching all receivers to the noise inputs) is included below [1]:

```
//set the bias tee by setting the gpio bit 0 to bias_on
rtlsdr_set_bias_tee(dev, bias_on);

//set rtlsdr repeater for the i2communication via RTL2832U
rtlsdr_set_i2c_repeater(dev, 1);
//set register to the output
rtlsdr_i2c_write_reg(dev, i2c_addr, 0x03, 00);
//set value to the register as described in the table
rtlsdr_i2c_write_reg(dev, i2c_addr, 0x01, i2c_value);
//close the i2c_repeater
rtlsdr_set_i2c_repeater(dev, 0);

exit:
//set the bias tee by setting the gpio bit 0 to bias_off
rtlsdr_close_bt(dev);
```

Keenerd Library Extension for RF Switching Capability

Coding the entire functionality of the I2C repeater for every program that requires RF Switching would be redundant and extremely inefficient. Therefore, I decided to include an executable file called "rtl_biast.c" [1] within the Keenerd Library's source code which reduces an RF Switch to a one-line command (from the Linux Terminal or a Bash Script). The updated library called "RTL-Library" can be found here. Also, the installation of the additional rtl_biast library is no longer required when the RTL-Library is installed to the Raspberry Pi.

To implement the new library, the files "librtlsdr.c," "CMakeLists.txt", and "rtl-sdr.h," had to be altered in addition to including the "rtl_biast.c" file. The alterations were made after closely perusing the available RTL SDR driver libraries currently available on GitHub to see how executable files were linked to the Cmake compilation of the entire library and determining what functions within "rtl_biast.c" are inherited from "librtlsdr.c" and "rtl-sdr.h."

Once the "RTL-Library" driver software is installed, two simple commands can be used to switch between RF/antennas and Noise at the receiver inputs (no bias tee activation/deactivation required). These commands are:

Switch to RF Input: `LD_LIBRARY_PATH=/usr/local/lib rtl_biast -d 0 -a 0x40 -v 0x00`

Switch to Noise Input: `LD_LIBRARY_PATH=/usr/local/lib rtl_biast -d 0 -a 0x40 -v 0x1f`

Due to file overlapping, these commands must be sent with the installation path specified [3]:
`LD_LIBRARY_PATH=/usr/local/lib`

GQRX Testing

RF Switching Commands were sent to the supervisory RTL SDR via the Linux Terminal and the received signal was monitored using GQRX. A video of the RF switching between the antenna inputs and the noise source can be viewed [here](#).

Cross Correlation Preview
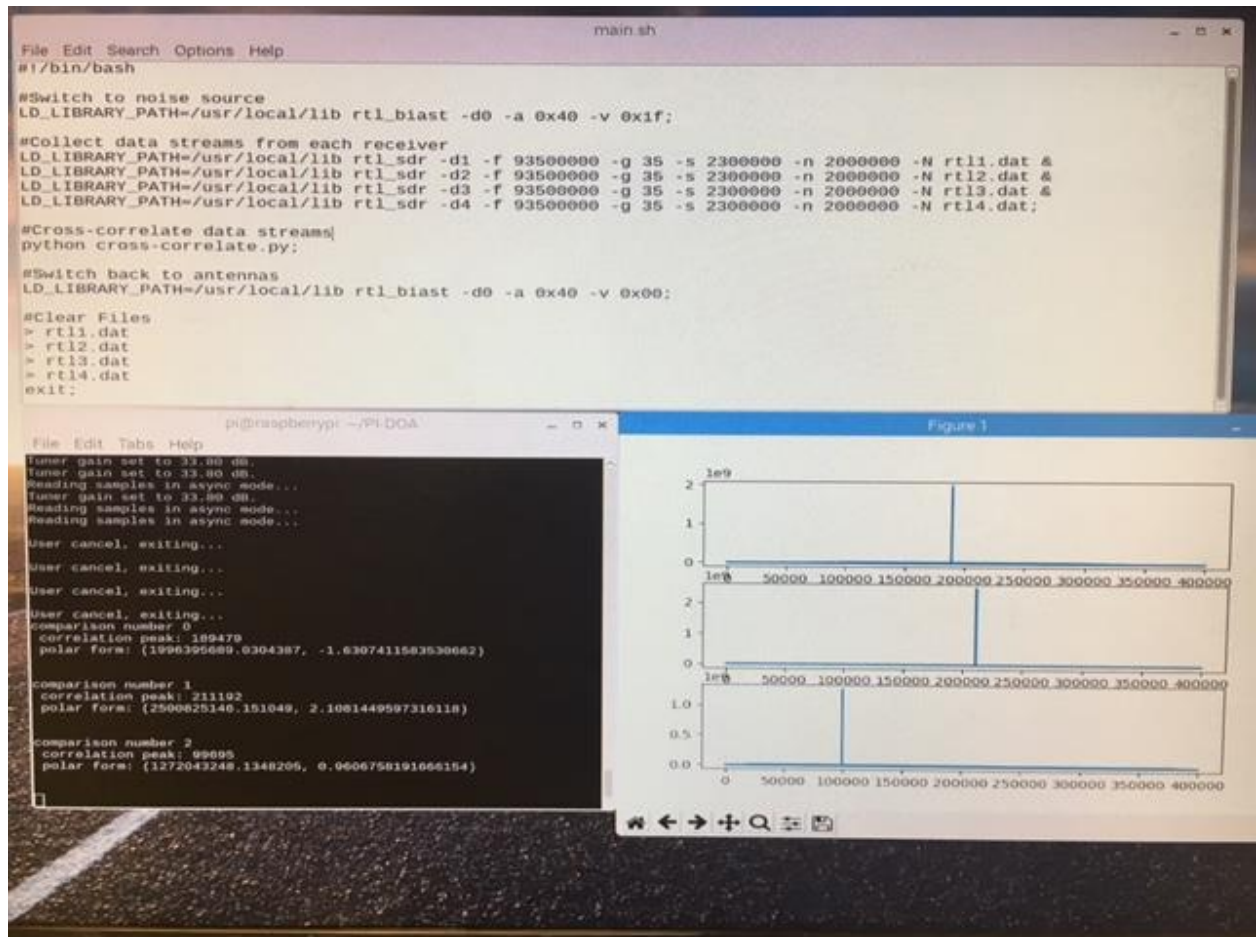
(Not ready for full weekly report description)

Resources and relevant Forum Posts
[1] https://coherent-receiver.com/support
[2] I2C Repeater Datasheet: https://www.nxp.com/docs/en/data-sheet/PCA9534.pdf
[3] https://github.com/rtlsdrblog/rtl_biast/issues/2