1019 -> 4004 -> 3004 -> 1418 -> 1005

COM-1019 DS spread-spectrum modulator
  -> COM-4004 70 MHz IF modulator
   -> 20 - 40 dB attenuator
    -> COM-3004 20-90 MHz IF receiver
     -> COM-1418 DS spread-spectrum demodulator
      -> COM-1005 BER measurement

Purpose:

Demonstrate the transmission of a 250 Kbit/s data stream modulated with a 3.25 Mchips/s direct-sequence spread-spectrum modulation.

- Spreading code period (spreading gain) : 13 chips
- Spreading code: Barker code
- Modulation: BPSK
- Intermediate frequency: 25 MHz
- Reference clock for IF frequency synthesizer: internal
- Channel: noiseless

The demodulator is configured with the AFC enabled to increase the carrier frequency acquisition window to +/-10% of the symbol rate (+/- 25 KHz), which is less than the COM-4004 and COM-3004 combined frequency drift caused by internal crystals.

Configuration

The settings files imported using the File | Import menu of the ComBlock Control Center.

(a) assemble the ComBlock modules listed above. Insert an RF attenuator (20 to 40 dB will work) between the transmitter assembly and the receiver assembly. Connect a serial link between a host PC and the COM-1019 module. Power up the assemblies.

Using the ComBlock control center, enumerate the ComBlocks (2nd button to the left), then import (Menu File | Import) the transmitter settings file 1019_4004_3004_1418_1005_tx.stn

(b) move the serial link to the COM-3004 module. Using the ComBlock control center, enumerate the ComBlocks (2nd button to the left), then import (Menu File | Import) the receiver settings file 1019_4004_3004_1418_1005_rx.stn

Both assemblies are now configured. Switch the power supply off then on again.

Alternatively, the modules can be configured one by one as illustrated below.

COM3004 IF receiver [20 - 90 MHz] Basic Settings

Frequency Selection: `0`

Frequency 0: `25000000` Hz

Frequency 1: `0` Hz

Frequency 2: `0` Hz

Frequency 3: `0` Hz

Frequency 4: `0` Hz

Frequency 5: `0` Hz

Frequency 6: `0` Hz

Frequency 7: `0` Hz

☐ 10 MHz External Frequency Reference

☐ External Trigger

Number of Frequency Hopping Steps: `3`

[Apply]   [Ok]   [Advan...]   [Cancel]

COM1418 Direct Sequence Spread-Spectrum D...

Chip rate: `3249999.995`

Spreading factor: `13`

Code Type: `Barker code` ▾

Polynomial G1: `000000` Hex

Polynomial G2: `000000` Hex

GPS satellite ID: `0`

Nominal center frequency: `0` Hz

☐ Spectrum inversion

AFC enable: `Automatic AFC selection` ▾

Symbol decoding: `BPSK` ▾

Code sweep period: `8` ▾

☑ Software reset

Output: `J8 connector I/Q serialized` ▾

[Apply]   [Ok]   [Advan...]   [Cancel]

COM1005 Bit Error Rate Measurement Settings

Registers

All register values in HEX

Reg 0 `2C`   Reg 2 `00`   Reg 4 `00`

Reg 1 `00`   Reg 3 `30`

Configuration

Configuration option currently loaded: , rev E

[Apply]   [Ok]   [Cancel]

COM1019 Direct Sequence Spread-Spectrum Modulator 20 Mchip/s Basic Settings

Chip rate: `3249998.093` chips/s

Spreading factor: `13`

Code Type: `Barker code`

Polynomial G1: `000000` Hex

Polynomial G2: `000000` Hex

GPS satellite ID: `0`

Offset carrier frequency: `0` Hz

Signal amplitude: `255` range 0-255

Noise amplitude: `0` range 0-255

☐ Tx spectrum inversion ☑ Output interpolation ☑ Spectrum shaping filter (rrc) ☑ Enable spectrum spreading

Modulation: `BPSK`

Test Modes: `internal PRBS-11 test sequence`

Output: `to COM-4004, format: 2's complement`

[Apply] [Ok] [Advan...] [Cancel]

COM4004 70 MHz IF Modulator Basic Settings

IF Center Frequency: `25000000` Hz

Gain Control: `255`

☐ 10 MHz External Frequency Reference

☐ Unmodulated Test Mode

☑ Output On

[Apply] [Ok] [Advan...] [Cancel]

Proper operation can be observed as follows:

(a) check the receive baseband signals using an oscilloscope at the COM-3004 receiver. The I/Q baseband signals before A/D conversion can be visualized at the COM-3004 receivers at test points TP3 (I-channel) and TP4 (Q-channel).
When the receiver AGC is working properly, the received I and Q baseband signals should be 1Vpp, filtered (no sharp transition) bit streams. Because of carrier phase offset between transmitter and receiver, the received baseband signals are phase rotated versions of the transmitted baseband signals. The envelope (amplitude modulation) reflects the frequency error between the COM-4004 and COM-3004.

(b) Verify demodulator lock at the COM-1005 BER measurement:
  - TP1 is high when the module is synchronized with the PRBS-11
  - TP3 is low (no bit error)
  - TP4 consists of periodic pulses every 2047 bits (26.2 ms).

(c) from the ComBlock control center check the BER (COM-1005 status).
It will show no bit errors (REG 1 through 4) and the synchronization bit (REG5 bit0) is high.

(d) from the ComBlock control center, check that the COM-1418 demodulator show code and carrier lock: status register SREG5= 03
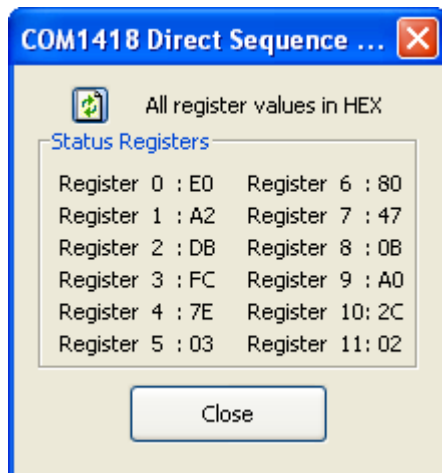
(e) from the ComBlock control center, using ComScope, visualize the key COM-1418 demodulator signals:
- demodulated signal trace 1 signal 3. Ideally, the dots should form a perfect line. The variations are caused by the imperfect filtering of the -25 MHz input image prior to A/D conversion in the COM-3004-B (filter is wideband). Selection of a higher center frequency (say 70 MHz) would result in better image filtering.