

## COM-4006 PCS FREQUENCY BAND [1850 – 2050 MHz] QUADRATURE RF MODULATOR

### Key Features

- Quadrature modulator 1850 – 2050 MHz center frequency.
- Low-noise frequency synthesizer can be tuned over entire range by steps of 100, 31.25 or 25 KHz.
- Optional output power measurement has 0.1 dB resolution.
- 8 preset frequencies for fast (<2ms) local oscillator frequency tuning.
- Selectable internal / external 10 MHz frequency reference for the frequency synthesizer.
- Single 5V supply
- Connectorized 3"x 3" module for ease of prototyping. SMA connectors.



(shown without shield)

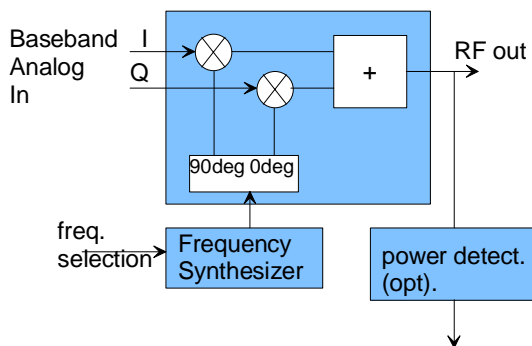
### Electrical Interface

#### Inputs / Outputs

For the latest data sheet, please refer to the **ComBlock** web site: [www.comblock.com/download/com4006.pdf](http://www.comblock.com/download/com4006.pdf). These specifications are subject to change without notice.

For an up-to-date list of **ComBlock** modules, please refer to [www.comblock.com/product\\_list.htm](http://www.comblock.com/product_list.htm).

### Block Diagram



Input Module Interface	Definition
ANALOG_I_IN	Modulated input signal, analog, baseband, real (I) axis. 1Vpp max. Positive DC bias is required so that signal is within the [0.3 – 3.0V] rails. The DC bias is removed internally by a low-pass filter with cutoff bandwidth < 2 Hz. SMA male connector.
ANALOG_Q_IN	Modulated input signal, analog, baseband, imaginary (Q) axis. 1Vpp max. Same electrical characteristics as above.
EXT_REF_CLK	External 10 MHz frequency reference for frequency synthesis. Sinewave, clipped sinewave or squarewave. Minimum level 0.5Vpp. Maximum level: 3.3Vpp. Use square wave for best phase noise performances.

Analog Output Signals	Definition
RF_OUT	Modulated RF output. 1850 – 2050 MHz Maximum output level: -6 dBm. Impedance: 50 Ohms. SMA female connector
Control Lines	Definition
ENABLE	Low-voltage TTL input control. Used to turn the modulator on/off. Level signal: 3.3V = ON, 0V = OFF Response time is typically in the range 5 10 µsec On/Off rejection = 14 dB typ. Connector J1 Pin B3. This control signal is enabled only when REG6 bit 1 = '1'.
PLL_STROBE	Low-voltage (3.3V / 0V) TTL input control. Used to increment the modulo- $N_{\text{freq}}$ frequency pointer (where $N_{\text{freq}}$ is defined in Register 35) RF frequency 0 -> RF frequency 1 -> RF frequency 2 -> RF frequency 0 > etc... Rising edge triggered. Minimum pulse width: 10 µsec. Connector J1 Pin A3.
Serial Monitoring & Control	DB9 connector. 115 Kbaud/s. 8-bit, no parity, one stop bit. No flow control.
Power Interface	4.75 – 5.25VDC. Terminal block. Power consumption is 300mA max.

**Important: digital I/O signals are 0-3.3V LVTTTL. Inputs are NOT 5V tolerant!**

### Configuration (via Serial Link / LAN)

Complete assemblies can be monitored and controlled centrally over a single serial, LAN, PCMCIA or USB connection.

The module configuration parameters are stored in non-volatile memory.

The COM-4006 ignores any M&C message received within 1 ms of a transition on the PLL\_STROBE and ENABLE signals.

Programmers developing custom applications (using the [ComBlock API](#) instead of the supplied ComBlock control center graphical user interface) should know that frequency changes are enacted upon (re-)writing to the last register (REG35).

Parameters	Configuration
RF frequency 0	Preselected frequency 0. Range 1850 MHz to 2050 MHz, by steps 100, 31.25 or 25 KHz, expressed in Hz. REG0: bit 7:0 (LSB) REG1: bit 15:8 REG2: bit 23:16 REG3: bit 31:24 (MSB)
Gain control	10-bit control. Non-linear scale. Zero is lowest power. AGC range : TBD dB @ 1850 MHz (typ.) TBD dB @ 2050 GHz (typ.) REG4: bit 7-0 (LSB) REG5: bit 1-0 (MSB)
External/Internal frequency reference	0 = internal 1 = external. REG6: bit 0
External controls enabled/disabled	Enable or disable the PLL_STROBE and output ENABLE external controls on the J1 connector. 0 = external controls disabled 1 = external controls enabled REG6: bit 1
Modulator on/off	0 = modulator off 1 = modulator on Note: external control ENABLE may override this register. REG6: bit 2
Step size selection	Chose between 100, 31.25 or 25 KHz step size. 00 = 100 KHz step 01 = 31.25 KHz step 10 = 25 KHz step REG6 bits 4-3.
Frequency selection	Use to switch local oscillator frequency among preselected values. Note: the external PLL_STROBE control may override this selection. Range 0 through 7 REG6 bits 7-5.
RF frequency 1	Preselected frequency 1. Same format as RF frequency 0. REG7: bit 7:0 (LSB) REG8: bit 15:8 REG9: bit 23:16 REG10: bit 31:24 (MSB)

RF frequency 2	Preselected frequency 2. Same format as RF frequency 0. REG11: bit 7:0 (LSB) REG12: bit 15:8 REG13: bit 23:16 REG14: bit 31:24 (MSB)
RF frequency 3	Preselected frequency 3. Same format as RF frequency 0. REG15: bit 7:0 (LSB) REG16: bit 15:8 REG17: bit 23:16 REG18: bit 31:24 (MSB)
RF frequency 4	Preselected frequency 4. Same format as RF frequency 0. REG19: bit 7:0 (LSB) REG20: bit 15:8 REG21: bit 23:16 REG22: bit 31:24 (MSB)
RF frequency 5	Preselected frequency 5. Same format as RF frequency 0. REG23: bit 7:0 (LSB) REG24: bit 15:8 REG25: bit 23:16 REG26: bit 31:24 (MSB)
RF frequency 6	Preselected frequency 6. Same format as RF frequency 0. REG27: bit 7:0 (LSB) REG28: bit 15:8 REG29: bit 23:16 REG30: bit 31:24 (MSB)
RF frequency 7	Preselected frequency 7. Same format as RF frequency 0. REG31: bit 7:0 (LSB) REG32: bit 15:8 REG33: bit 23:16 REG34: bit 31:24 (MSB)
Number of RF frequencies Nfreq in the scanning list	Each time a PLL_STROBE pulse is received, the frequency pointer increments modulo Nfreq. Nfreq is in the range 1 – 8. REG35: bit 7:0.

PLL lock status	A persistent '1' indicates that the frequency synthesizer is locked to the frequency reference. REG38 bit 0.
Option / Version	Returns '4006Cv or Dv' when prompted for option (-C or -D) and software version number v.

## Operations

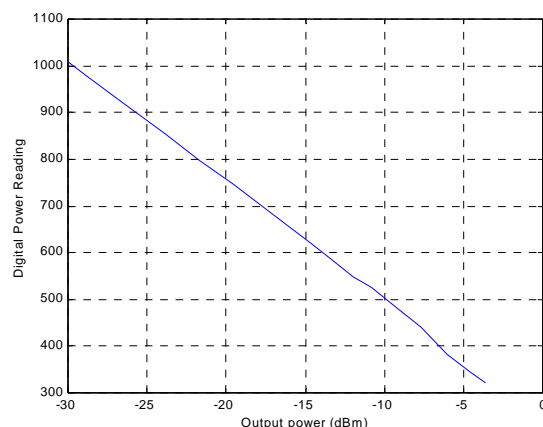
### Internal vs External Frequency Reference

In order to use the external frequency reference, select external frequency reference by software command from the ComBlock control center. Then connect a 10 MHz sinewave, clipped sinewave or square wave to the SMA connector J2. Switching from internal to external frequency reference generally requires a power cycle (turn power off then on again).

In order to use the internal frequency reference, either physically disconnect the external 10 MHz signal at SMA connector J2, or place the external input signal in high impedance mode. Then select internal frequency reference by software command from the ComBlock control center.

### Power Measurement (Option -D)

Output power measurement is provided as an option (-D). Output power measured with +/- 0.2 dB accuracy over a range from -30 dBm to the maximum output power. The 10-bit measurement linearity is shown below:



Baseline configurations can be found at [www.comblock.com/tsbasic\\_settings.htm](http://www.comblock.com/tsbasic_settings.htm) and imported into the ComBlock assembly using the ComBlock Control Center File | Import menu.

## Monitoring (via Serial Link / LAN)

Parameters	Monitoring
Power measurement (option -D)	10-bit number. The higher the number, the lower the power. The power measurement linearity is shown below. REG36 bits 7-0: bit 7-0 (LSB) REG37 bits 1-0: bits 9-8 (MSB)

## Test Points

Test points are provided for easy access by an oscilloscope probe.

Test Point	Definition
TP1	Internal / External reference clock
TP2	Frequency synthesizer PLL lock status. Active low: '0' when locked. <i>Note: do not connect any long test cable to this test point as it may inject noise into the RF PLL.</i>

## Schematics

The schematics are available on the ComBlock CD shipped with every module.

## Performance

### Internal Clock Reference

The internal crystal performance is as follows:

- tolerance:  $\pm 75$  ppm max @25C
- temperature stability (-10C to +60C):  $\pm 50$  ppm max
- aging:  $\pm 5$ ppm/year max @25C

### Modulation

Quadrature phase error: 1. deg rms. typ

I/Q amplitude balance error: 0.2 dB.typ

ON/OFF rejection (using modulator on/off command only):  $> 80$  dB.

LO leakage (at output, maximum AGC gain):

-33 dBm @ 1850 MHz, typ.

-33 dBm @ 2050 GHz, typ.

Sideband suppression:

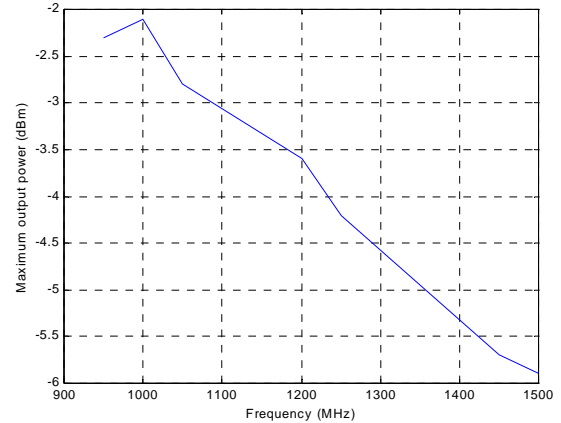
-41 dBc @ 1850 MHz, typ.

-36 dBc @ 2050 GHz, typ.

Out-of-band spurious spectral lines:  $< -60$  dBc

(Exception: a  $-40$ dBc spectral line may be present at 120 MHz from the center frequency).

Maximum output power level (typical):



Minimum output power: -27dBm (1850-2050 MHz).

## Frequency Synthesizer

LO frequency switching time:  $< 2$  ms

Phase noise (100 KHz step size):

$< -50$  dBc @ 100 Hz

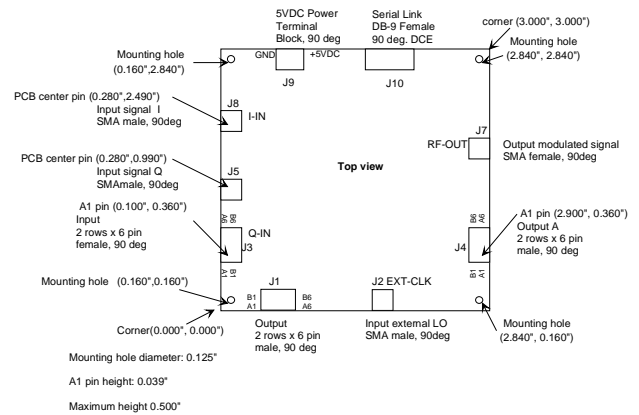
$< -65$  dBc @ 1 KHz

$< -82$  dBc @ 10 KHz

$< -110$  dBc @ 100 KHz

The phase noise measurements are similar when internal or external frequency references are used.

## Mechanical Interface

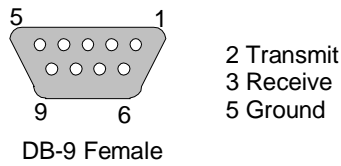


## Pinout

### Serial Link J10

The DB-9 connector is wired as data circuit terminating equipment (DCE). Connection to a PC

is over a straight-through cable. No null modem or gender changer is required.



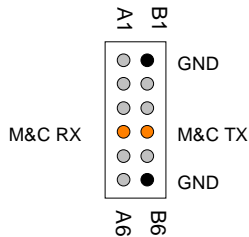
## I/O Compatibility List

(not an exhaustive list)

Input	Output
COM-2001 digital-to-analog converter, 40 Msamples/s	COM-3006 PCS frequency band [1850 – 2050 MHz] receiver (back to back with RF attenuation in-between)

## Input Connector J3

12-pin (2 rows x 6) 2mm female connector.



This module is designed for direct connection to the COM-2001 baseband digital-to-analog conversion module.

## ComBlock Ordering Information

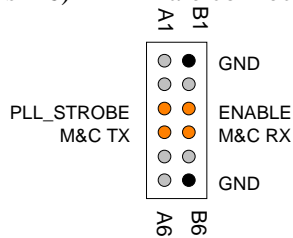
COM-4006-C PCS FREQUENCY BAND [1850 – 2050 MHz] QUADRATURE MODULATOR

COM-4006-D PCS FREQUENCY BAND [1850 – 2050 MHz] QUADRATURE MODULATOR W/ OUTPUT POWER MEASUREMENT.

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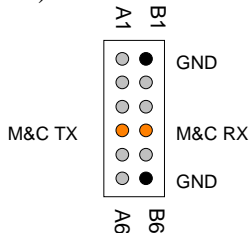
## Connector J1

12-pin (2 rows x 6) 2mm male connector.



## Output Connector J4

12-pin (2 rows x 6) 2mm male connector.



This connector is to forward monitoring and control signals to subsequent analog modules.