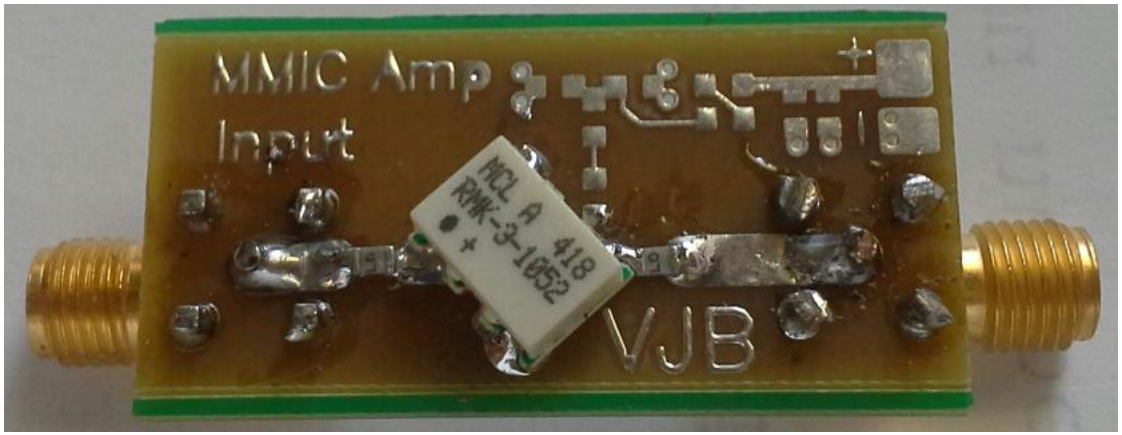
# Multipliers for 5616 MHz and 10224 MHz

- MCL RMK-3-1052 Fits on WA5VJB MMIC Board




- KSX2-722 (X2) will take a new board
- Can buy ZX90-2-36S  in package with connectors for $37
- Mini-Circuits sell eval boards (board and two connectors) for each of the multipliers for about $35 each
- Warning – do not orient package as shown (Pin 4 in input, not Pin 1)

# 432.380 MHz NTMS Beacon

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- Merged and modified K6HX keyer code and F1CJN ADF4351 code
  - Using only the SPI bus interface from F1CJN code
    - Delays in human interface interfered with keyer timing
  - Hand calculated ADF4351 register values to use with 10 MHz and 25 MHz references (comment out unused set)
- Keyer output available on Pin A5.
  - Arduino SPI function uses the Arduino pin 13 which is also the on-board LED
  - Positive logic keyer output
- Programmed ADF4351 to accomplish RF on/off keying
  - On-the-air tests sound good
  - Pout = 1.5 dBm
- Added code for real-time temperature telemetry w/LM35

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# ADF4351

## APPLICATIONS

Wireless infrastructure (W-CDMA, TD-SCDMA, WiMAX, GSM, PCS, DCS, DECT)
Test equipment
Wireless LANs, CATV equipment
Clock generation

## FUNCTIONAL BLOCK DIAGRAM

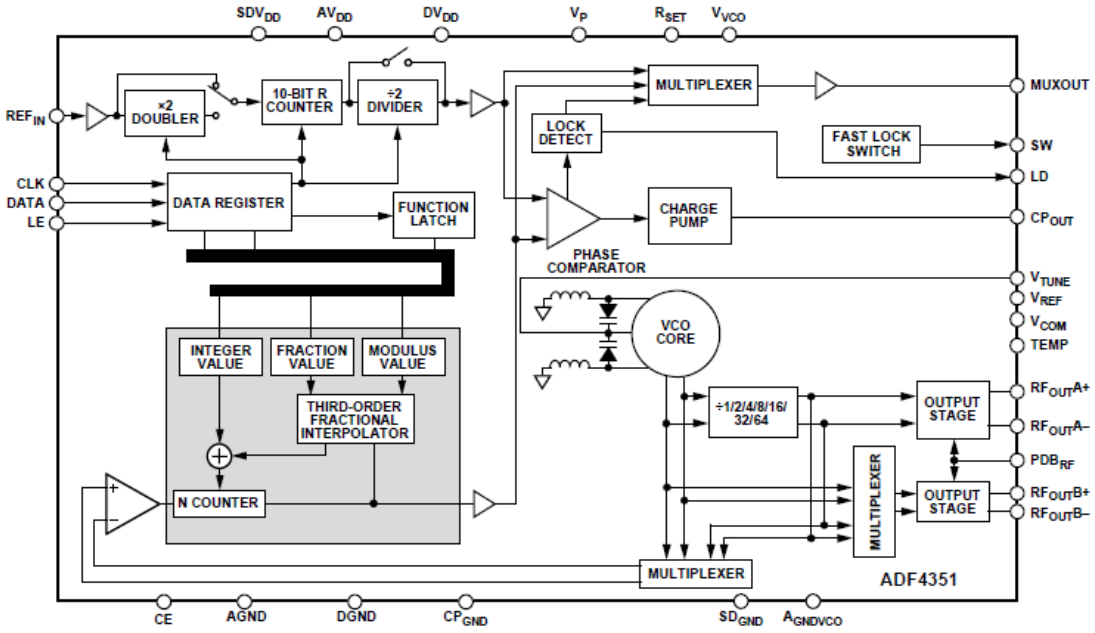



*Figure 1.*

# Calculating Frequency Settings



- The RF VCO frequency (RFOUT) equation is

  $RFOUT = fPFD \times (INT + (FRAC/MOD))$ where:

  – *RFOUT* is the output frequency of the voltage controlled oscillator (VCO).

  – *INT* is the preset divide ratio of the binary 16-bit counter (23 to65,535 for the 4/5 prescaler; 75 to 65,535 for the 8/9 prescaler).

  – *FRAC* is the numerator of the fractional division (0 to MOD − 1).

  – *MOD* is the preset fractional modulus (2 to 4095).

# Calculating Frequency Settings (2)

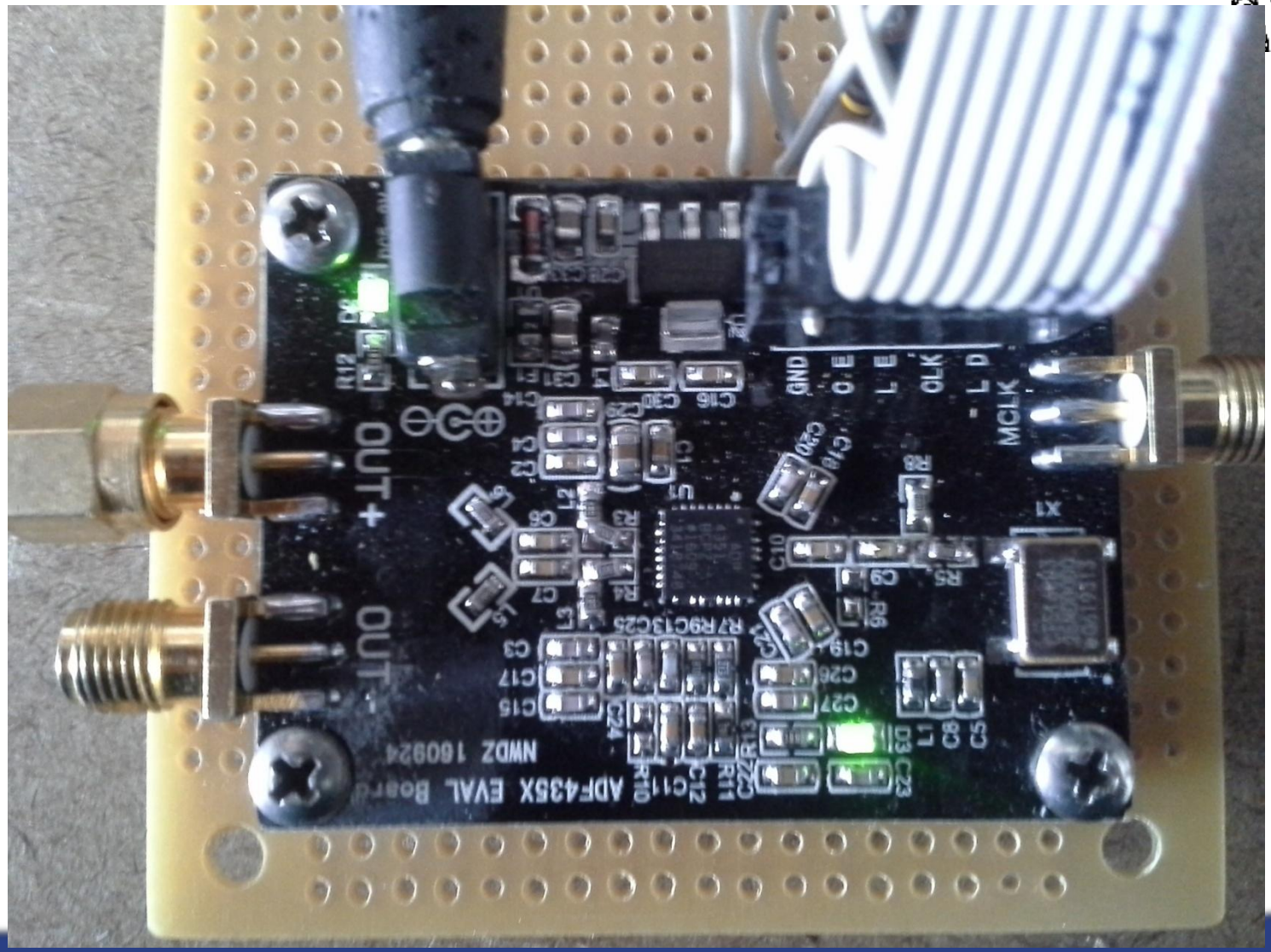


- *fPFD is the reference frequency*
  - *fPFD* = *REFIN* × [(1 + *D*)/(*R* × (1 + *T*))] (2) where:
  - *REFIN* is the reference input frequency.
  - *D* is the REFIN doubler bit (0 or 1).
  - *R* is the preset divide ratio of the binary 10-bit programmable
  - reference counter (1 to 1023).
  - *T* is the REFIN divide-by-2 bit (0 or 1).

# 432.380 MHz Example

- Desired output = 432.380 MHz
- Reference = 10 MHz
- Frequency range required the VCO output to be divided by 8
- 432,380,000 = [INT + FRAC/MOD]*(10MHz/8)
  - INT + FRAC/MOD = 345.904
  - INT = 345 or 0x159
  - FRAC/MOD = 0.904
    - Use FRAC = 904 or 0x388
    - Used MOD = 1000 or 0x3E8
- Map bits for INT and FRAC into Register 0
- Map bits for MOD into Register 1

# Chinese ADF4351 Eval Board



# Interface Between the Arduino Uno and the ADF3451 Eval Board

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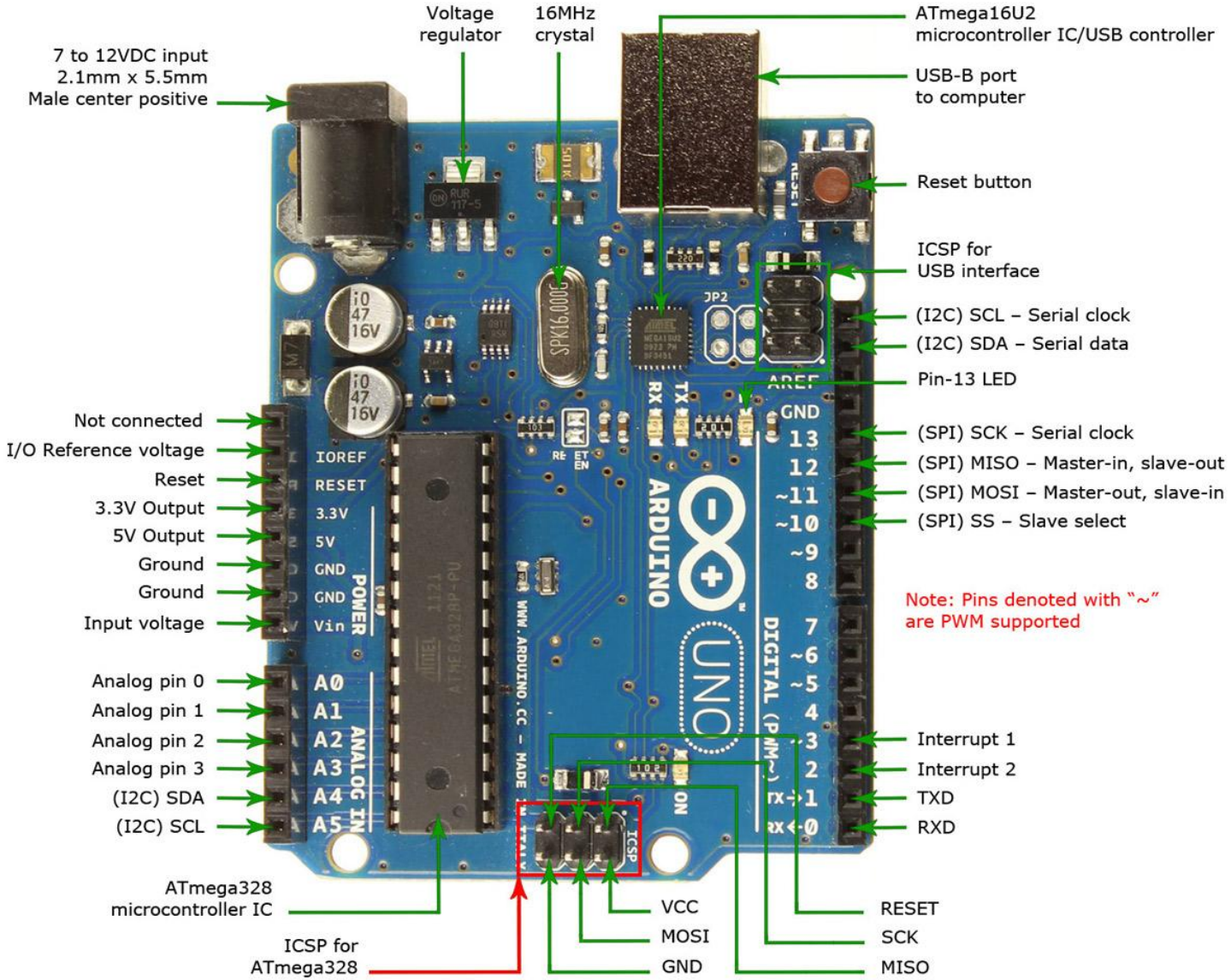
| ADF4351 Signal | Arduino Function | Arduino Pin* | Direction | Level Shift Required |
|---|---|---|---|---|
| ADF Data | MOSI | 11 | To ADF4351 | Yes |
| ADF Clock | SCK | 13 | To ADF4351 | Yes |
| ADF LE | Select | 3 | To ADF4351 | Yes |
| Muxout | Lock Detect | 2 | From ADF4351 | No |
| +5VDC | | | | |
| GND | | | | |

Interface via the LCD Button Shield and Interface Board
*Per F1CJN software

# Arduino Uno Board

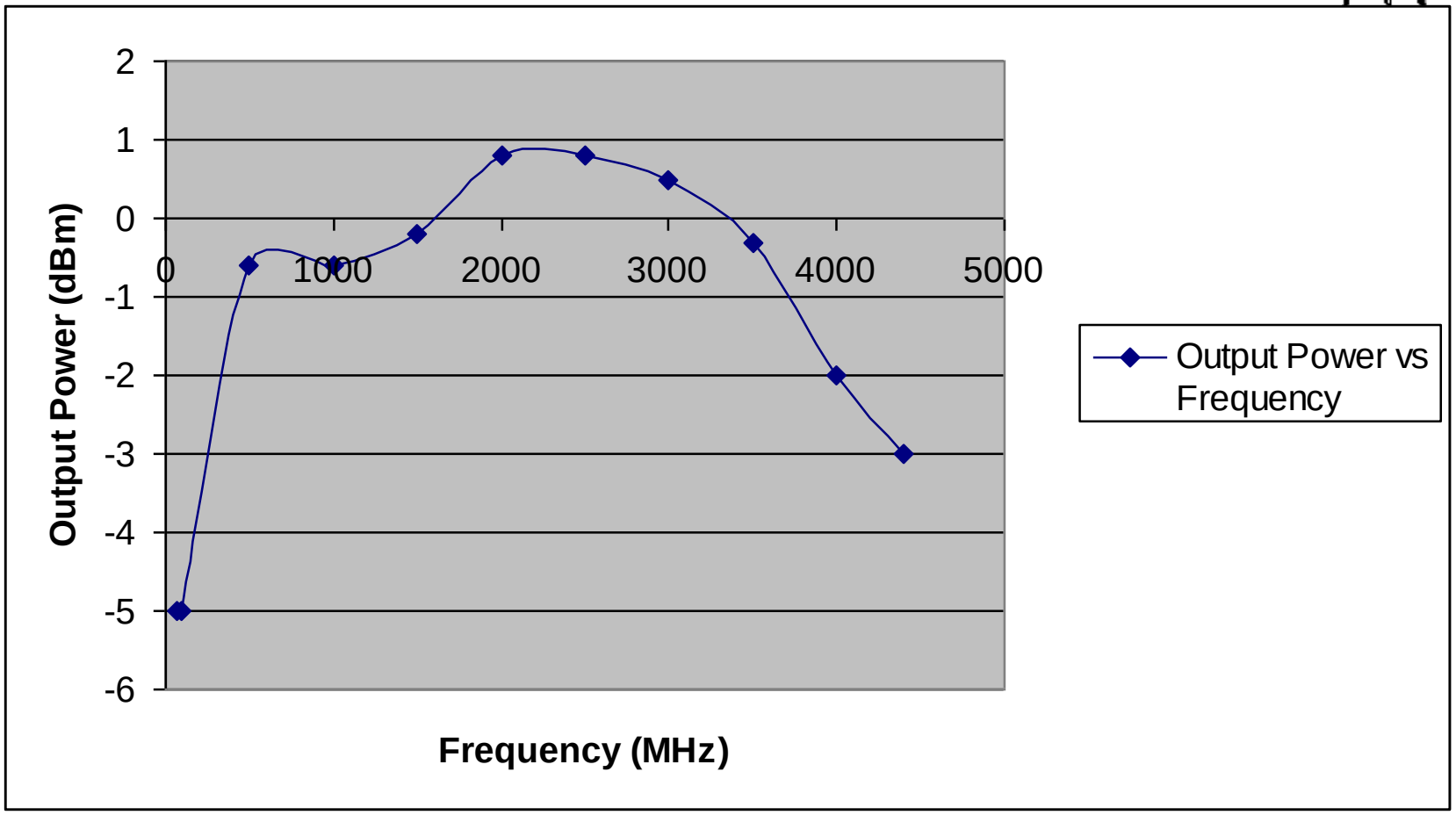




# F1CJN Software

- Alain Fort, F1CJN wrote software for controlling the ADF4351
- Code compiles and loads on the Arduino Uno and available at
  - http://f6kbf.free.fr/html/ADF4351%20and%20Arduino_Fr_Gb.htm (thanks to WW2R and W5LUA)

# Measured Output Power*




*Single ended with other polarity terminated

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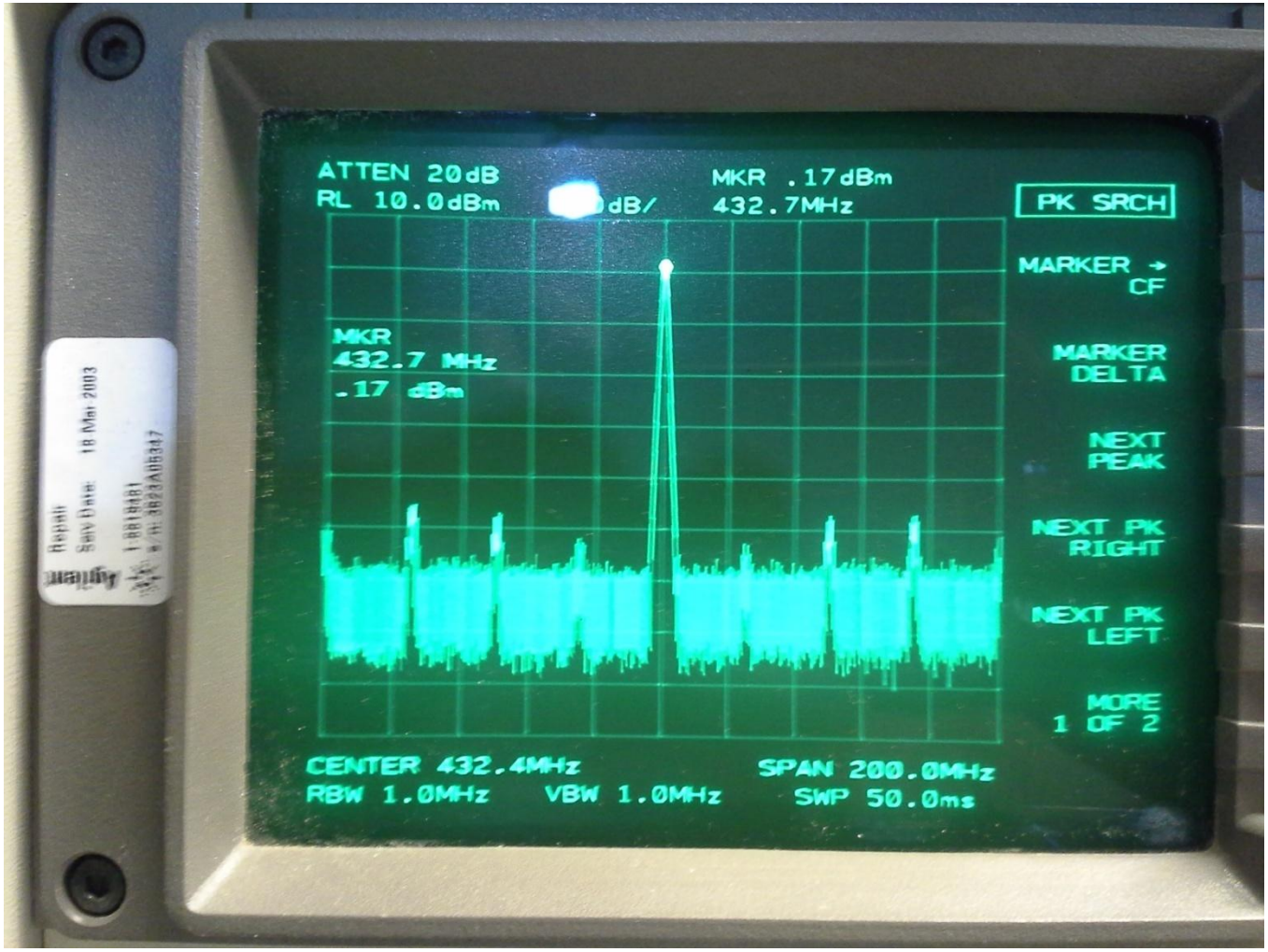
# Spectrum: 432.280 MHz

With on-board 25 MHz XTAL



# Phase Noise: 432.380 MHz

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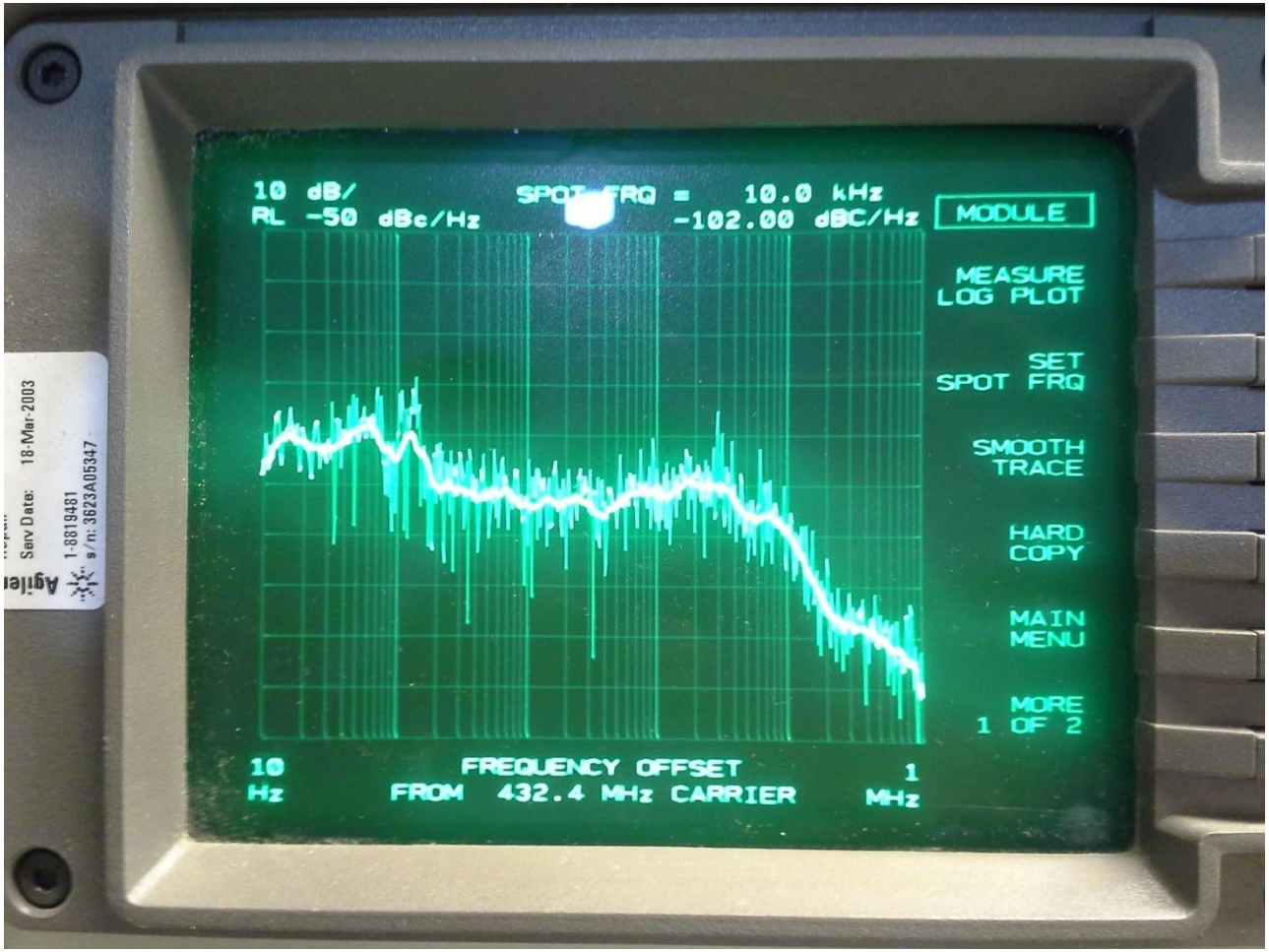
With on-board 25 MHz XTAL



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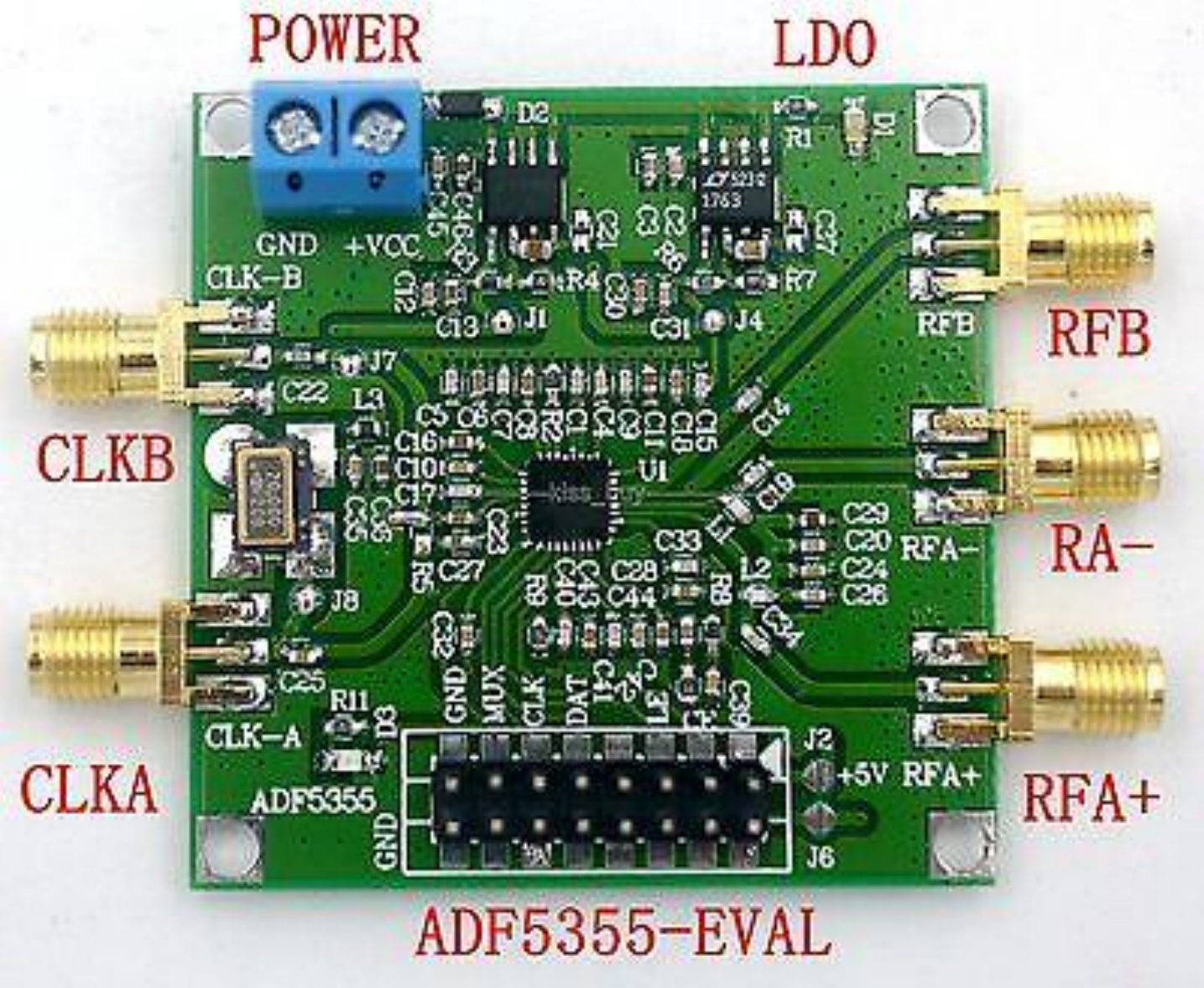

# ADF5355 Eval Board

- On-board XTAL reference is 20 MHz
- Separate supplies for logic (3.3V) and RF (5V)
- Differential external reference input – can use single-ended
- Two separate RF Outputs
  - RF Output A
    - Differential
    - 54 MHz to 6.8 GHz
  - RF Output B
    - Single-ended
    - 6.8 GHz to 13.6 GHz
- Hand calculated register values for 5616 MHz and 10224 MHz with 10 MHz and 20 MHz references
- Wrote control program for the ADF5355 using F1CJN's interface to the LCD Button Shield

# PLANS

- Build up interface for ADF5355 eval board and test with:
  - Fixed, calculated register values
  - Code for user entered frequency values
- Check ADF5355 performance
- Continue work with ADF4351
  - Frequency multipliers
- No further work on retaining register values on power off
  - Can be accomplished with a backup battery
  - Easier to spend the few extra $ for an Arduino