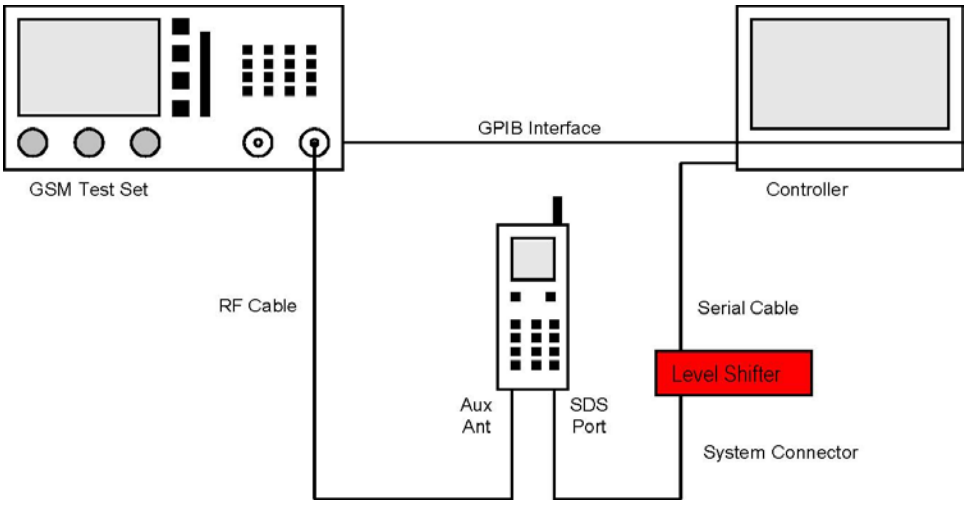
4. Calibration Procedure

4.1. Calibration Setup



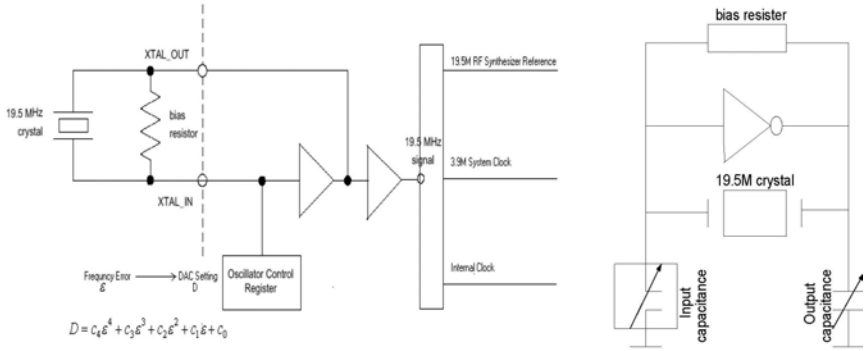
❖ **Procedure**

- Install calibration software on PC
- Install GPIB card in PC and connect it to GPIB port on GSM Test Set such as HP8922, HP8960, CMD55, CMU200, W4400, and etc.
- Connect serial cable to computer's com port and system connector (including the serial port line) to the unit under test
- Connect RF cable from the test port (RF switch) on the unit under test to GSM Test Set
- To get into calibration mode, loop-back the signal DEBUG_TX and DEBUG_RX before turning on the unit under test

4.2. Calibration Items

❖ CCXO Characterization

➢ Function Diagram

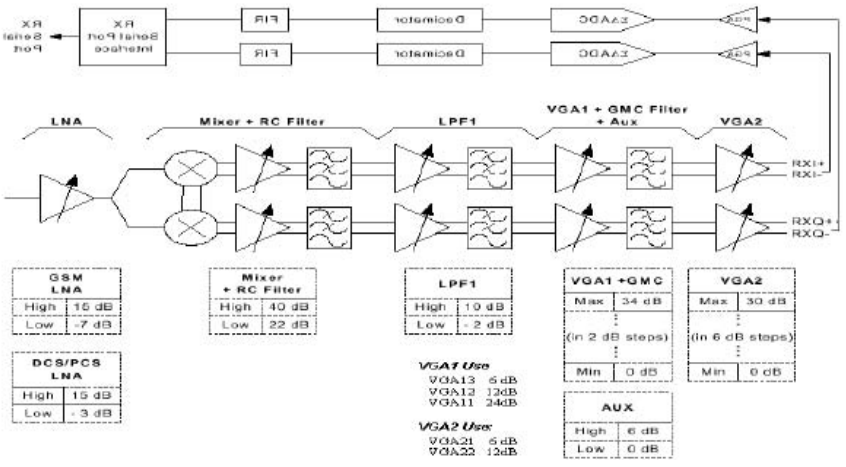


➢ Procedure

- ✓ Handset receives signal of known frequency
  Channel 62 with -40dBm
- ✓ Get the coarse adjustment register by changing the register seeting until the frequency error reach 0
- ✓ Ccontrol DAC stepped, frequency error scan taken by DSP each step, and then DAC setting/frequency error table derived. Finally generate polynomial from table
- ✓ Load coefficient of polynomial and output capacitance register value to DSP

❖ Receiver Gain Stage Calibration

➢ Function Diagram



- Procedure

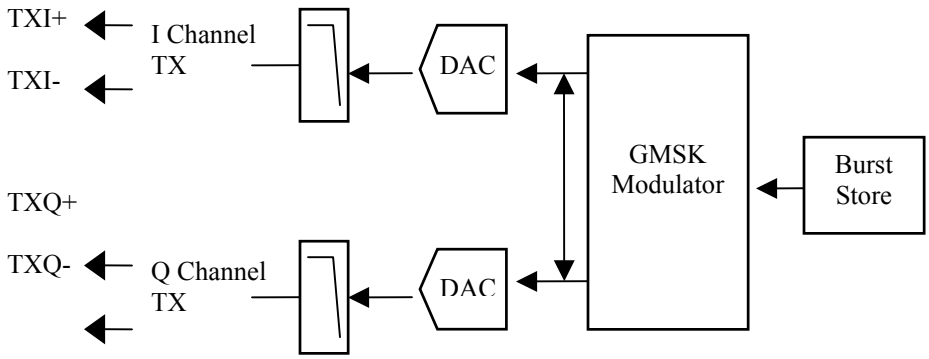
  - ✓ Handset receives signal of known frequency
    Channel 62/698 with -40dBm
  - ✓ Each gain stage individually enabled
    IAIC Section in U200
    All IAIC is set to 0
    RF Section in U100
    LNA Gain
    Mixer Gain
    LPF Gain
    VGA1 Gain
    VGA2 Gain
  - ✓ Resultant gain calculated

Gain Code	Gain
0x0000	*G0 = Pref(-33)*
0xA000	*G1 = Gm in*
0x8000	*G2 = Gm in +G V 2 1*
0x6000	*G3 = Gm in +G V 2 2*
0x4000	*G4 = Gm in +G V V 2 1 +G V 2 2*
0x4008	*G5 = Gm in + G V 2 1 +GV 2 2 + GV 13*
0x5000	*G6 = Gm in + G V 2 1 +GV 2 2 + GL P F*
0x4400	*G7 = Gm in + G V 2 1 +GV 2 2 + GL N A*
0x4408	*G8 = Gm in + G V 2 1 +GV 2 2 + GL N A + G V 1 3*
0x5400	*G9 = Gm in + G V 2 1 +GV 2 2 + GL P F + GL N A*
0x4C00	*G1 0 = Gm in + G V 2 1 +GV 2 2 + G M IX + GL N A*
0x4C08	*G1 1 = Gm in + G V 2 1 +GV 2 2 + G M IX + GL N A +G V 1 3*
0x5C00	*G1 2 = Gm in + G V 2 1 +GV 2 2 ++GL P F + GM IX + GL N A*
0x5C08	*G1 3 = Gm in +G V 2 1+ GV2 2 ++GL PF+ GM IX + GL N A +G V 1 3*
0x5C04	*G1 4 = Gm in + G V 2 1 +GV 2 2 ++GL P F + GM IX + GL N A +GV1 2*
0x5C0C	*G1 5 = Gm in + G V 2 1 +GV 2 2 ++GL P F + GM IX + GL N A +GV1 2 + GV 1 3*
0x5C02	*G1 6 = Gm in + G V 2 1 +GV 2 2 ++GL P F + GM IX + GL N A +GV1 1*

  - ✓ Data transferred into NV storage as AGC data table
  - ✓ Carried out 900MHz EGSM, DCS1800MHz and then PCS 1900MHz

❖ Transmit IQ Gain & Phase Balance Calibration

➢ Function Diagram



➢ Procedure

- ✓ Handset transmits to spectrum analyzer of GSM Test Set
- ✓ Determine optimal values for IAIC register (Gain and Phase Imbalance should be calibrated respectively)
  - ▪ Measure amplitude of side bands at 3 different register settings (+3, 0, -3)
  - ▪ Perform line fit on data
  - ▪ TXI, TXQ, Gain Imbalance
- ✓ Optimal values minimize the side bands
- ✓ Sideband attenuation relative to negative sideband is measured after optimization. The attenuation of unwanted signals must be min. of 40dB

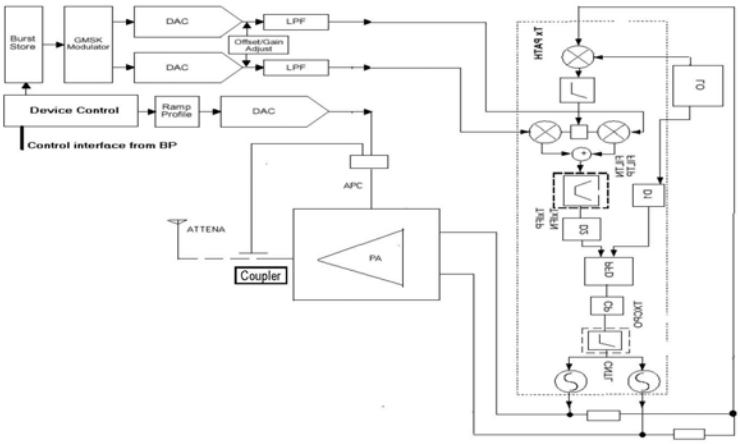
❖ Transmit IQ DC Offset Calibration

➢ Procedure

- ✓ Handset transmits to spectrum analyzer of GSM Test Set
- ✓ Determine optimal values for IAIC register (I and Q should be calibrated respectively)
  - ▪ Measure amplitude of side bands at 3 different register settings (+16, 0, -16)
  - ▪ Perform line fit on data
  - ▪ TXI, TXQ, DC Offset
- ✓ Optimal values minimize the side bands
- ✓ Carrier attenuation relative to negative sideband is measured after optimization. The attenuation of unwanted signals must be min. of 40dB

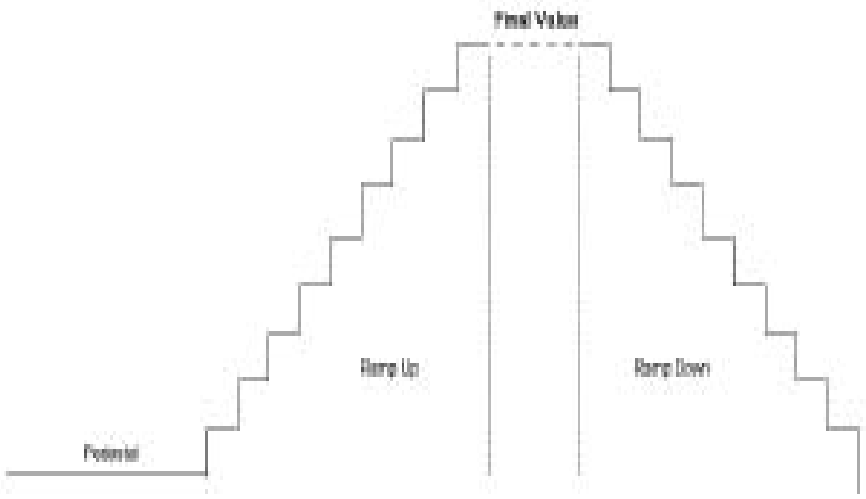
❖ Transmit Power Calibration

➢ Function Diagram



➢ Ramp Profile

- ✓ Ramp profile consist 18 Scaling Factors and Duration, 9 for ramp up and 9 for Ramp Down.
- ✓ Ramp Step Value: Ramp(nth)=a(nth)*(Final-Pedestal)+Pedestal Duration =(n+1)nits (1nit=Frame/10000=0.4615us)
- ✓ The scaling factor and duration are same for all the band and power levels
- ✓ Final Value is different and should be calibrated for each power level
- ✓ Pedestal is same for each band and only need calibrated once in each band



❖ **Battery Voltage Calibration**

➢ Procedure

✓ Set the PS to 3.1V and get the 1st ADC reading
✓ Set the PS to 4.2V and get the 2nd ADC reading
✓ Calculate K and b and save them to NVM

❖ **Battery Pack Size Calibration**

➢ Procedure

✓ Set V_{POWER} to 5.0V and connect an known value resistance R_{PACK}=10K in the terminal BAT_PK_IN and then measure V_{MUX} and calculate B = (V_{POWER}/V_{MUX} -1)
✓ Save B to the NVM

❖ **Charging Current Calibration**

➢ Procedure

✓ Connect 5V PS to charger terminal and set the DAC value to 225
✓ Connect the 7Ohms resistance between $V_{BATTERY}$ terminal produce 0.1C current, then get the ADC reading
✓ Connect the 70Ohms resistance between $V_{BATTERY}$ terminal produce 1C current, then get the ADC reading
✓ Calculate M and e and save them to NVM