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Internal Technical Report

BASEBAND LOCAL OSCILLATOR (4TH LO)

Modification Report

(Version 1.0)

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Objective

This is a technical report to know the modification done in the baseband Local oscillator system which is referring as IVth LO. The report is a design guide to a baseband Local Oscillator and describes the detail information of the system and modification work done for control a synthesizer through new rabbit card MCM.

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Team Member

1. Introduction

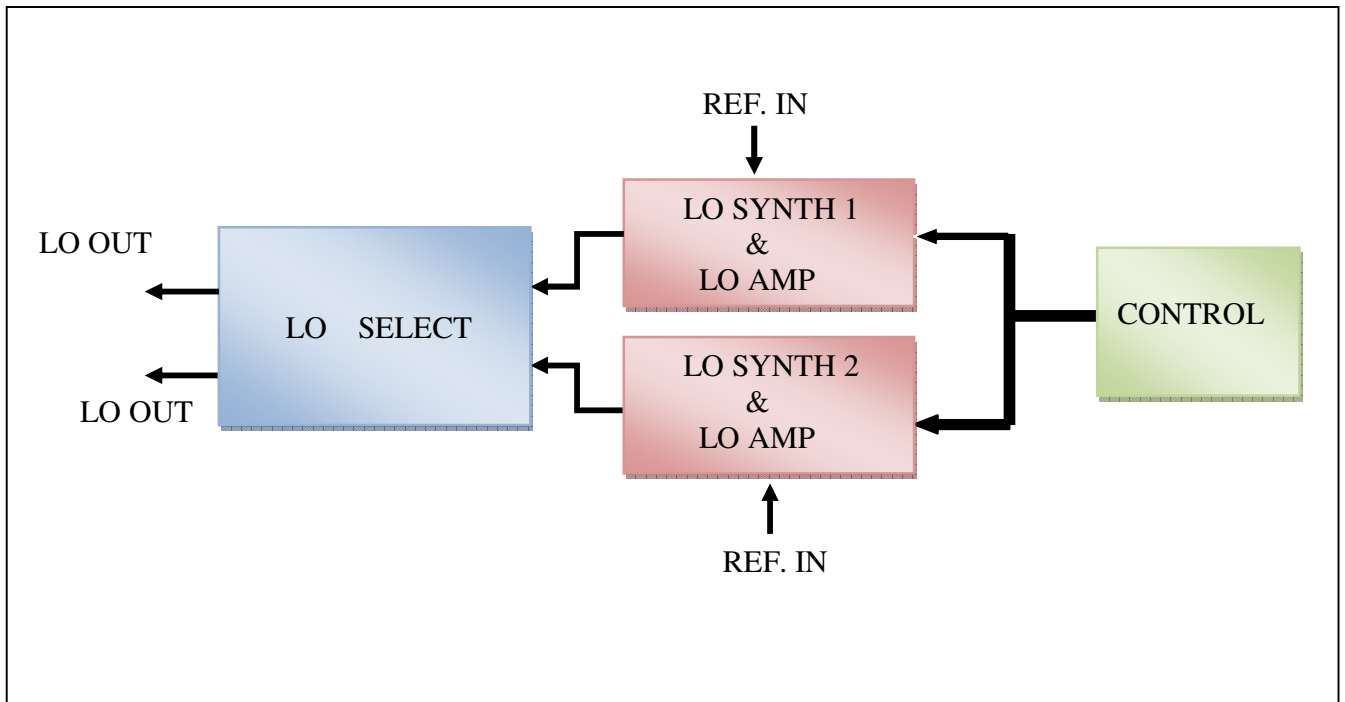
1.1 Baseband Local Oscillator

The local oscillator circuits generate the necessary LO signals for frequency conversions in the baseband system. A 5 Mhz reference signal from the time and frequency reference standard is used to generate the local oscillator for the IF to baseband conversion. A 50 Mhz to 90 Mhz Direct Digital Synthesizer (DDS) based circuit is used as the oscillator. The Synthesizers are controlled with thumbwheel and MCM card using interface card. The system has two synthesizers which generates the LO signals for all the antennas. The LO power is amplified through linear power amplifiers and divided and distributed to New IF conversion circuits. An LO switching circuit facilitates driving all antennas from same LO source or to have one synthesizer drive each polarization channel systems. In the second scheme the two polarization channels can have different frequencies of observation.

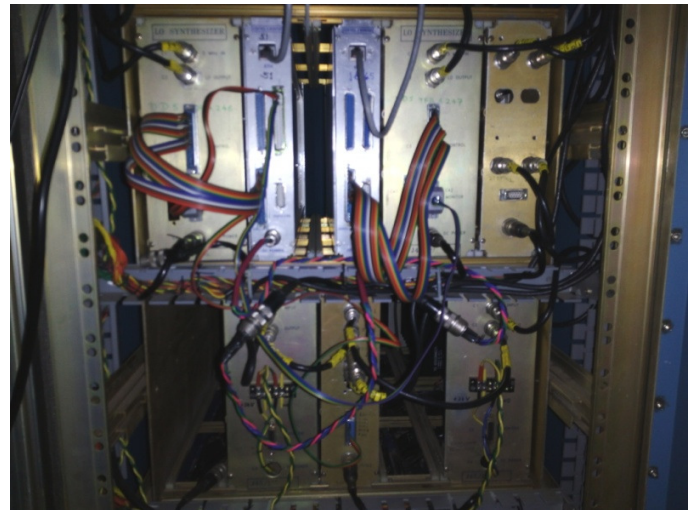
1.2 LO Characteristics

Tunable Frequency Range	50-90 Mhz
Step Size	100Hz
Frequency Tuning Control	TTL, BCD Format
Spurious Signal Levels	< -60 dBc Non-Harmonics < -30 dBc Harmonic
Phase Noise	< -80 dBc/Hz at 100Hz
Switching Time	< 100 mS

1.3 New Basic Block Diagram



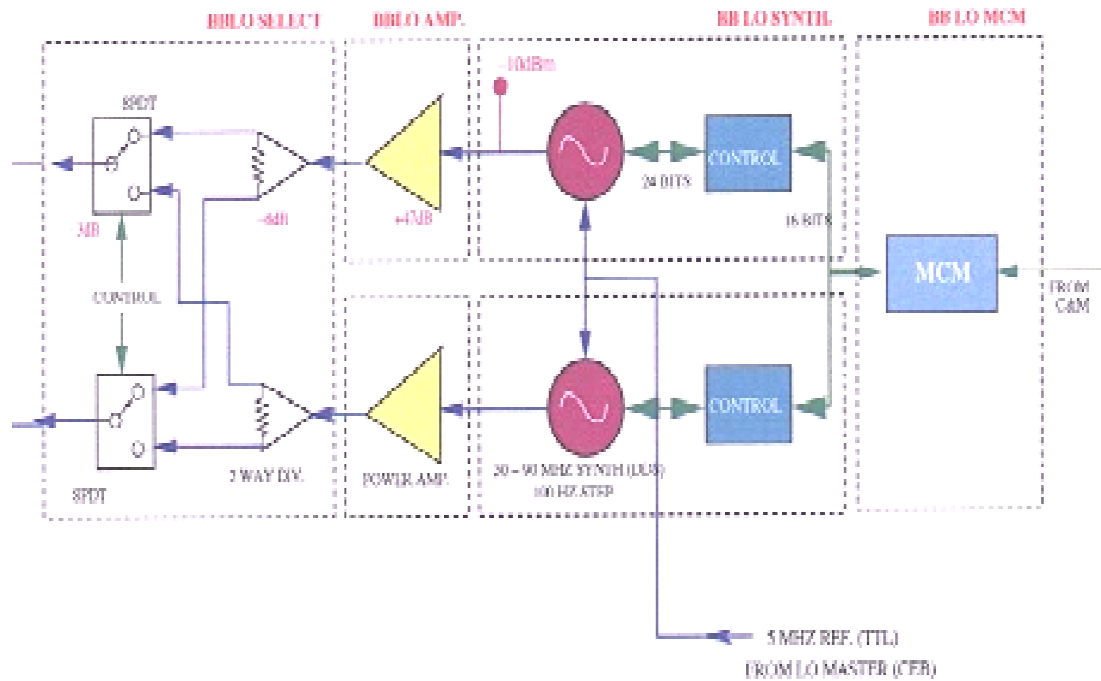
Front Side



Rear Side

Fig; Baseband Local Oscillator System

1.4 Baseband LO System Unit wise Block Diagram



Above figure shows the detail block diagram of the baseband LO system. Full system is integrated in six plug-in-units. First and second PIU is for the generating LO signal through a DDS synthesizers called LO Synth PIU, third and fourth PIU is for a power amplifier called as LO AMP PIU, fifth one is for LO selection called as LO Select PIU and sixth PIU for control & monitor called as MCM PIU.

2. Modification Work

Old MCM card provides 16 bit control signals. MCM card communicates through RS485 communication. LO synthesizer needs a 24 bit control signal. An interface card is used for making 24 control bits from 16 control bits using D latch & line selector ICs.

Now the new MCM card will replace present MCM card which uses 80C535 micro controller and the new card will be using Rabbit micro-controller (RCM 4300). The new MCM provides 32 control signals. The new MCM card can be controlled through :

- TCP/IP Server program running on any PC using ASCII based commands.
- Any WEB browser running on Windows or Linux PC.
- Any Telnet client running on Windows or Linux PC.

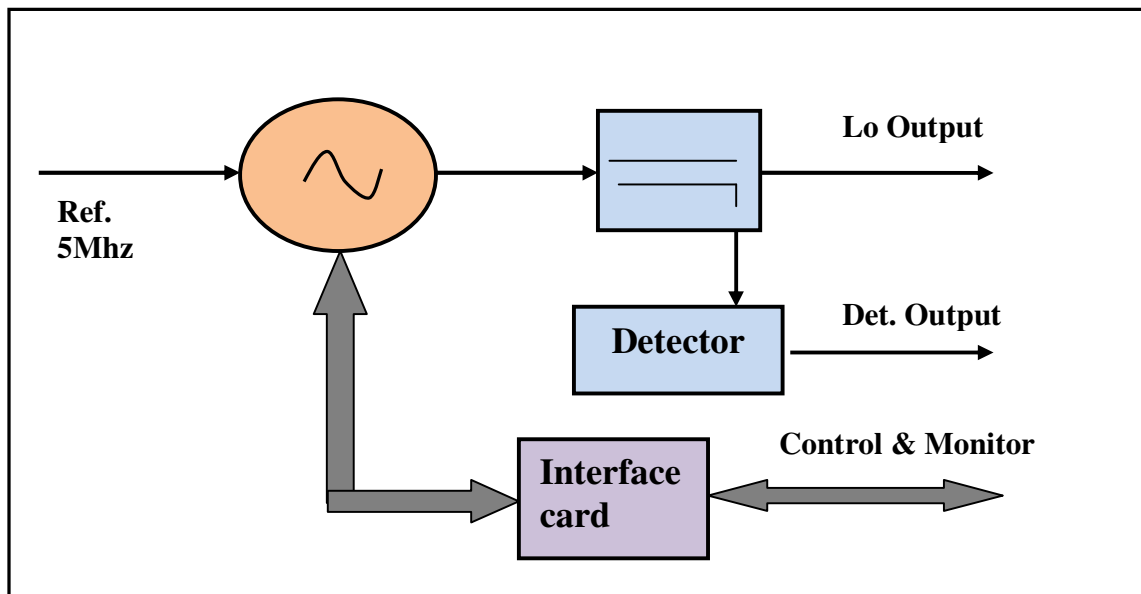
For changing old MCM to new MCM for controlling the baseband LO, needs some changes in hardware and software. The details of this are given below.

- 1) Remove the Interface Card and new interface card for new control connection.
- 2) Add monitor facility.
- 3) Change the control & Monitor Cabling
- 3) New software written for control & Monitor.

Changes are done in LO Synth PIU. Changed the old MCM PIU and used new MCM PIU in place of old MCM. No changes are done in LO AMP & LO Select PIU. Only control & monitor cabling done from MCM PIU to LO Synth & LO Select PIU. Separate MCM is used to control & Monitor for each synthesizer. New software is written for controlling the Local Oscillator.

3. LO Synthesizer PIU (LO Synth)

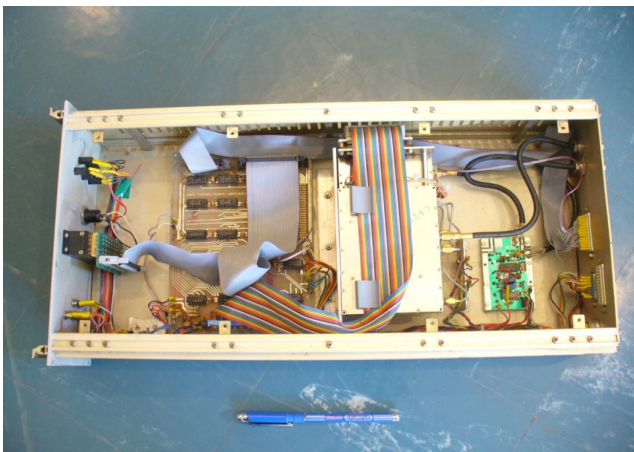
3.1 Block Diagram of LO Synth PIU



DDS Synthesizer is type of frequency synthesizer used for creating arbitrary waveform from a single, fixed frequency reference clock. A 5 MHz reference signal is feed to Synthesizer unit, which generate Local oscillator frequency from 50 MHz to 90 MHz with 100 Hz step size using Thumbwheel. The unit need +5V & +24V Dc power supply. An Interface card is used for providing 24 Control Bits. Detector unit gives facility to monitor the LO output.

3.2 Modification done in LO Synth PIU:

Removed Old interface card, detector card and installed new interface card, Detector unit in same PIU. In old PIU, The power supply was supplied through the old interface card. The old interface card removed from the unit so the arrangement of the DC power supply to the synthesizer and other unit is made using new power supply card. All the DC wiring & RF cabling is changed as per new design. Also add a detector unit, which shows the output in DC voltages and have a facility to monitor the Local Oscillator on Front panel. LO Synth piu is having LO lock/unlock monitor facility on front panel. No thumbwheel setting facility.



Before Modification



After Modification

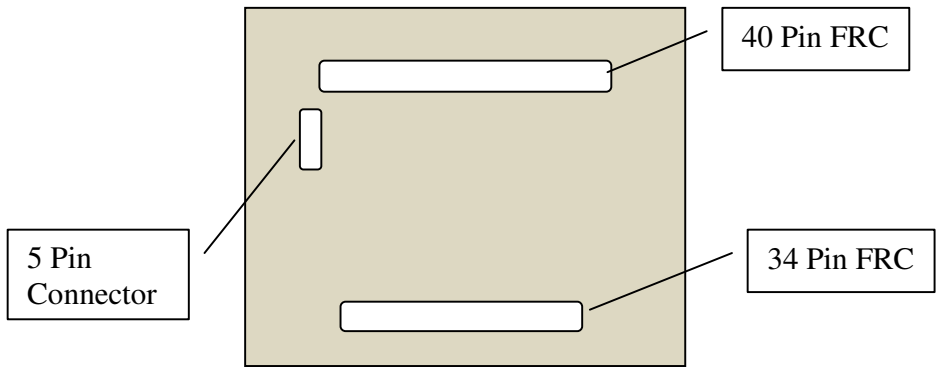
Fig: LO Synthesizer PIU (LO Synth)

3.3 Synthesizer Unit Connector Details

(40 Pin FRC)

GND	1	2.....	GND
+5V	3	4.....	+5V
+24V	5	6.....	+24V
Lock	7	8.....	NC
NC	9	10.....	d41 ⁻
d42 ⁻	11	12.....	d64 ⁻
d44 ⁻	13	14.....	d48 ⁻
d51 ⁻	15	16.....	d68 ⁻
d52 ⁻	17	18.....	d62 ⁻
d54 ⁻	19	20.....	d61 ⁻
d58 ⁻	21	22.....	NC
NC	23	24.....	NC
d28 ⁻	25	26.....	d31 ⁻
d24 ⁻	27	28.....	d32 ⁻
d22 ⁻	29	30.....	d38 ⁻
d21 ⁻	31	32.....	d18 ⁻
d14 ⁻	33	34.....	d34 ⁻
d12 ⁻	35	36.....	d11 ⁻
GND	37	38.....	NC
NC	39	40.....	NC

3.4 Interface Card



34 Pin FRC	40 Pin FRC	5 Pin Connector
1	36	
2	35	
3	33	
4	32	
5	31	
6	29	
7	27	
8	25	
9	26	
10	28	
11	34	
12	30	
13	10	
14	11	
15	13	
16	14	
17	15	
18	17	
19	19	
20	21	
21	20	
22	18	
23	12	
24	16	
	1,39,40= GND	
	1 & 2	GND
	3 & 4	+5V
	5 & 6	+24V
	7	Lock

3.5 Control & Monitor Details

Control Connection

Interface Card (34 pin FRC) to Rear panel of LO synth PIU (37 pin D Type female)

34 Pin FRC	37 Pin D Type
1	1
2	20
3	2
4	21
5	3
6	22
7	4
8	23
9	5
10	24
11	6
12	25
13	7
14	26
15	8
16	27
17	9
18	28
19	10
20	29
21	11
22	30
23	12
24	31
25	13
26	32
27	14
28	33
29	15
30	34
31	16
32	35
33	17 -GND
34	36- GND

Control Cable

From MCM PIU to LO synth & Lo select PIU

LO Synth PIU 37 D type (M)	MCM PIU 37 D Type (M)	LO Select PIU 15 Pin D Type (M)
1	1	
20	20	
2	2	
21	21	
3	3	
22	22	
4	4	
23	23	
5	5	
24	24	
6	6	
25	25	
7	7	
26	26	
8	8	
27	27	
9	9	
28	28	
10	10	
29	29	
11	11	
30	30	
12	12	
31	31	
	13	1
	32	2
	14	3
	33	4

Monitor Cable

From MCM PIU to LO synth & Lo select PIU

Lo Synth-1 PIU	MCM PIU (Monitor)	LO Synth-2 PIU
15 Pin D Type (M)	37 Pin D type (M)	15 Pin D Type (M)
1	1	
2	20	
3	2	
4	21	
	3	1
	22	2
	4	3
	23	4

LO Synth-1 & LO Synth-2 PIU Monitor Connector details

- 1 - Lock Indicator
- 2 - Detector Voltage
- 3 - Power Monitor
- 4- Temperature Monitor

Monitor Status

- Lock Indicator
 - 0V means LED OFF (Unlock)
 - +2V means LED ON (Lock)
- Detector Voltage
 - 0V means LED OFF (LO Power OK)
 - +2V means LED ON (LO Power not OK)
- Power Monitor
 - 0 V means No Power
 - +4.96V means Power OK

4. Control & Monitor PIU (MCM PIU)

This PIU is used for controlling the LO synthesizer and Lo selection. MCM is a general purpose Micro-controller based card which provides 16 TTL Control O/Ps and monitors 64 analog signals. Antcom communicates with MCMs thro' RS485 communication link @ 9.6 Kbaud rate.

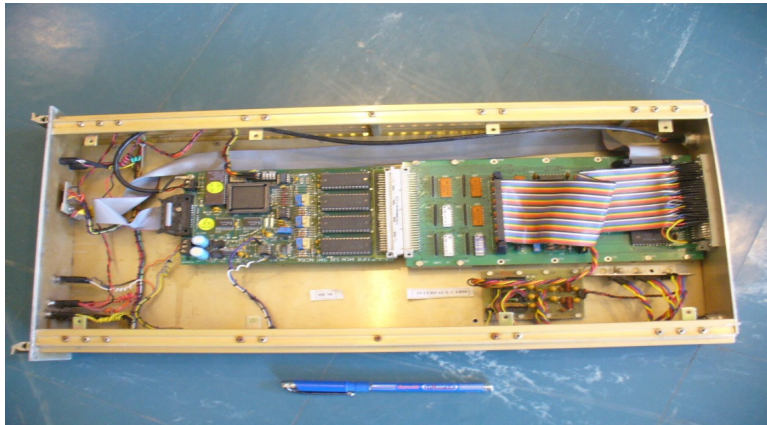


Fig : Old MCM PIU

New MCM card will replace present MCM card which uses 80C535 micro controller and the new card will be using Rabbit micro-controller (RCM 4300). The new MCM provides 32 control signals. The new MCM card can be controlled through Ethernet.



Fig: New MCM PIU

5. Lo Amplifier PIU (LO AMP)

LO signal generated from LO synth piu is amplified through the high power amplifier. A 5 Watt amplifier is used for amplification. This unit need +24 V DC power supply.

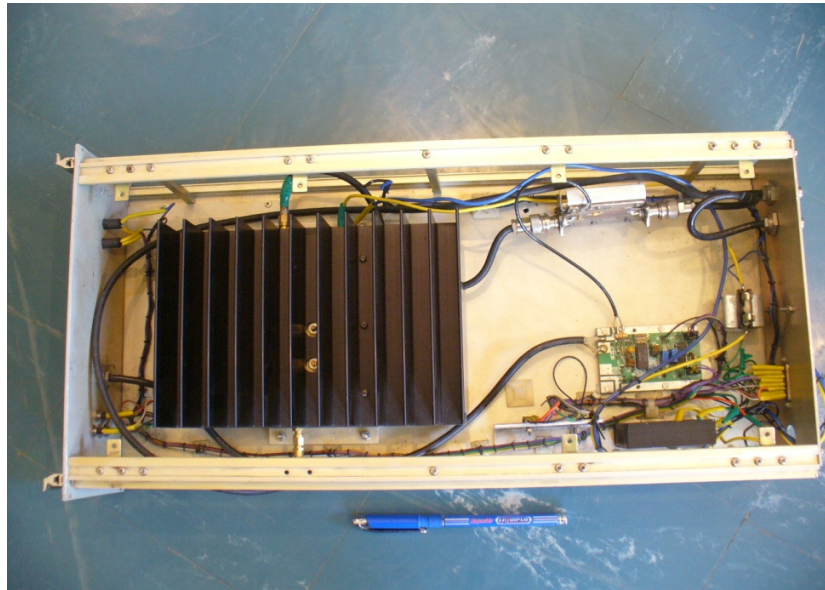


Fig : LO Amplifier PIU (LO AMP)

6. LO Selector PIU (LO SELECT)

Output of LO synth-1 & LO synth-2 is connected to a LO Select PIU as an Input. This PIU will select the output as per the selection as shown below.

Selection 1 - Lo synth-1 output for Both Channel (130 & 175)

Selection 2 - Lo synth-2 output for Both Channel (130 & 175)

Selection 3 - Lo synth-1 output for ch1 (130) & Lo synth-2 for ch2 (175)

Selection 4 - Lo synth-1 output for ch2 (175) & Lo synth-2 for ch1 (130)

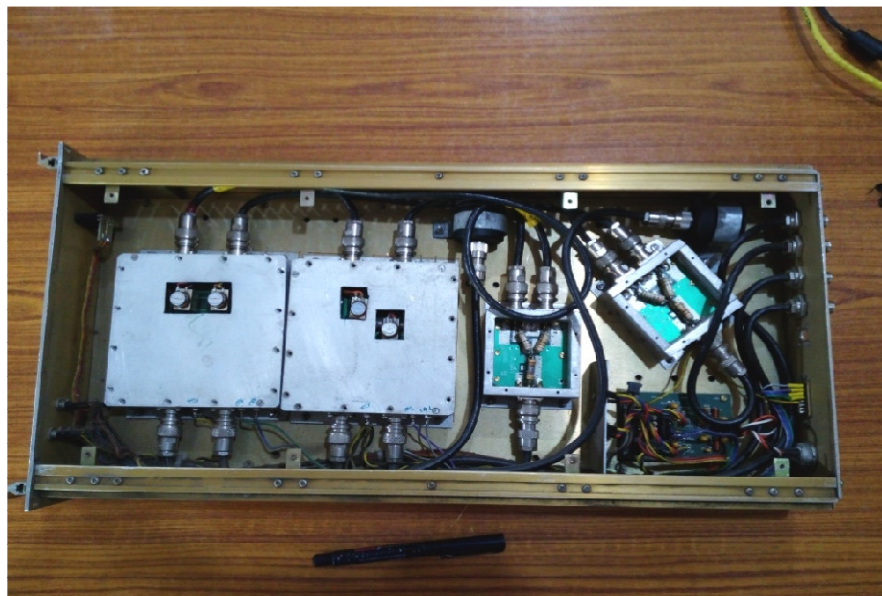
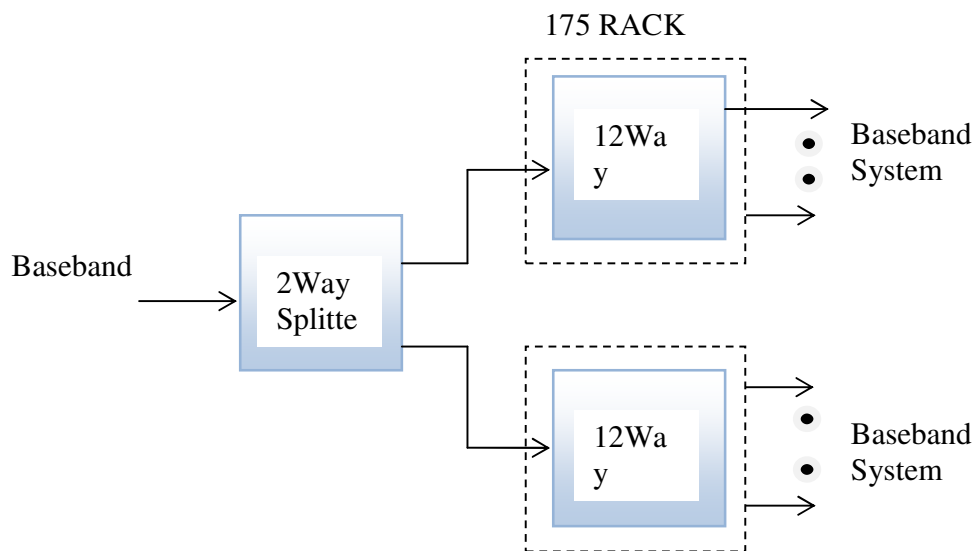
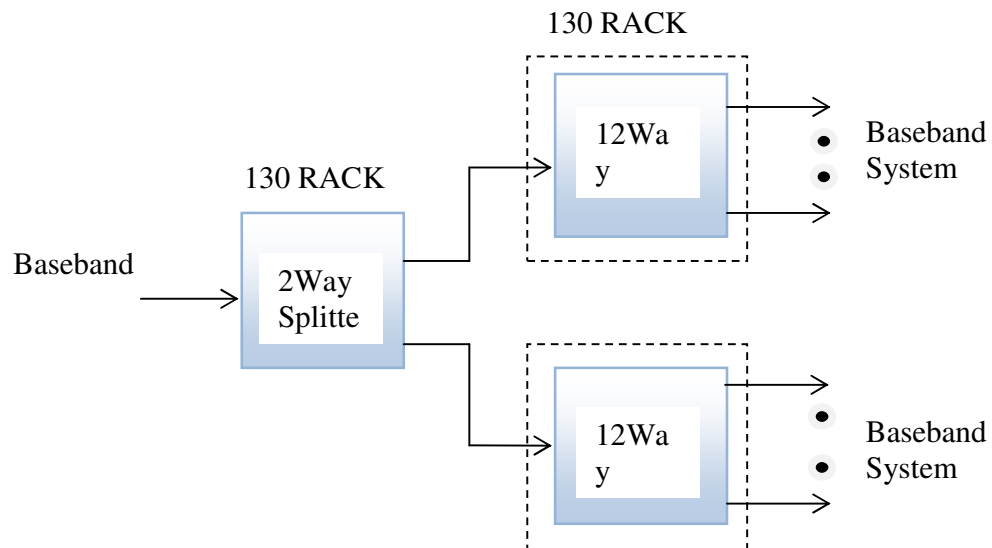
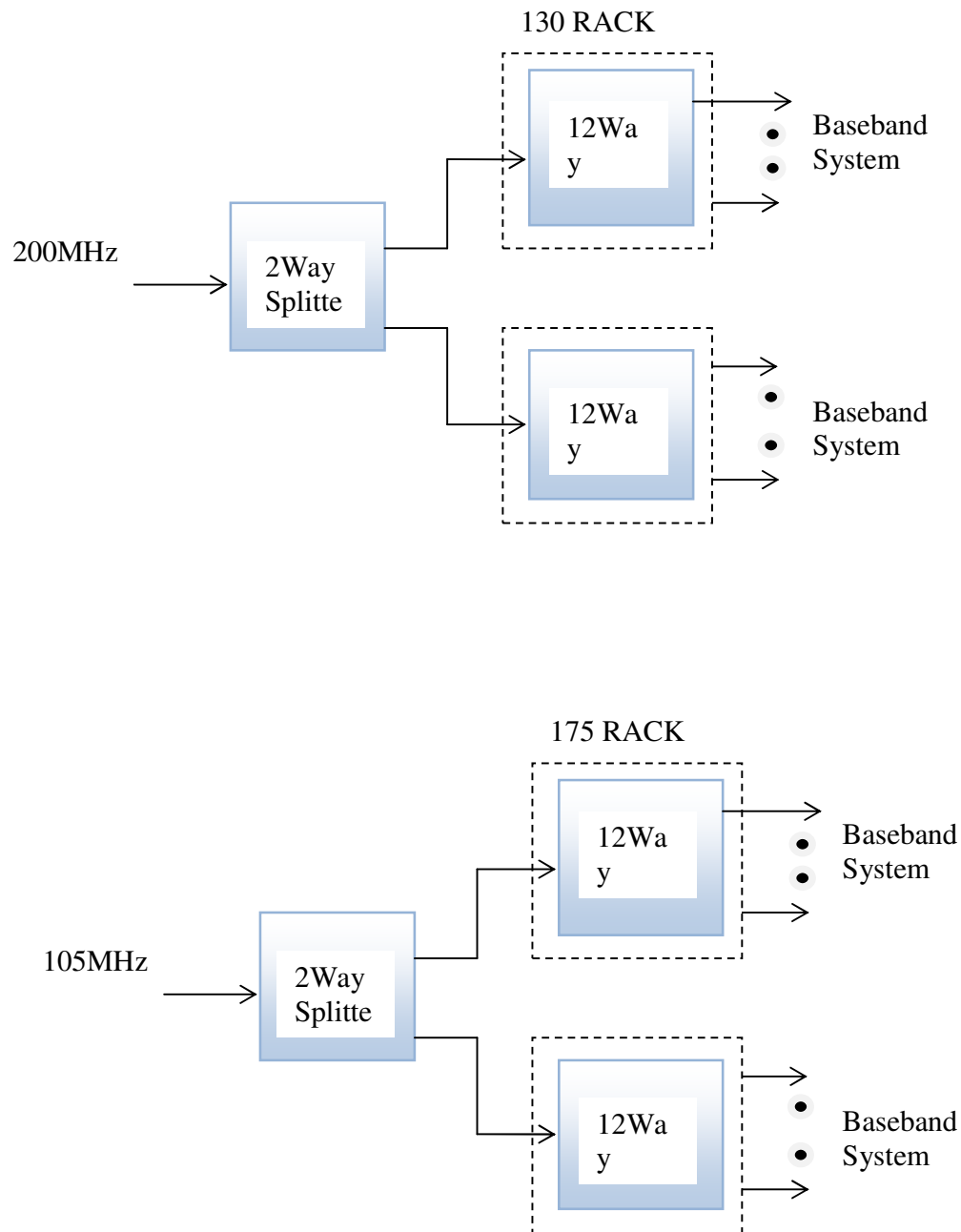


Fig : LO Selector PIU (LO Select)

7. Baseband LO Distribution to Baseband System



8. 105MHz & 200MHz LO Distribution to Baseband System



Annexure- A

Baseband LO set procedure

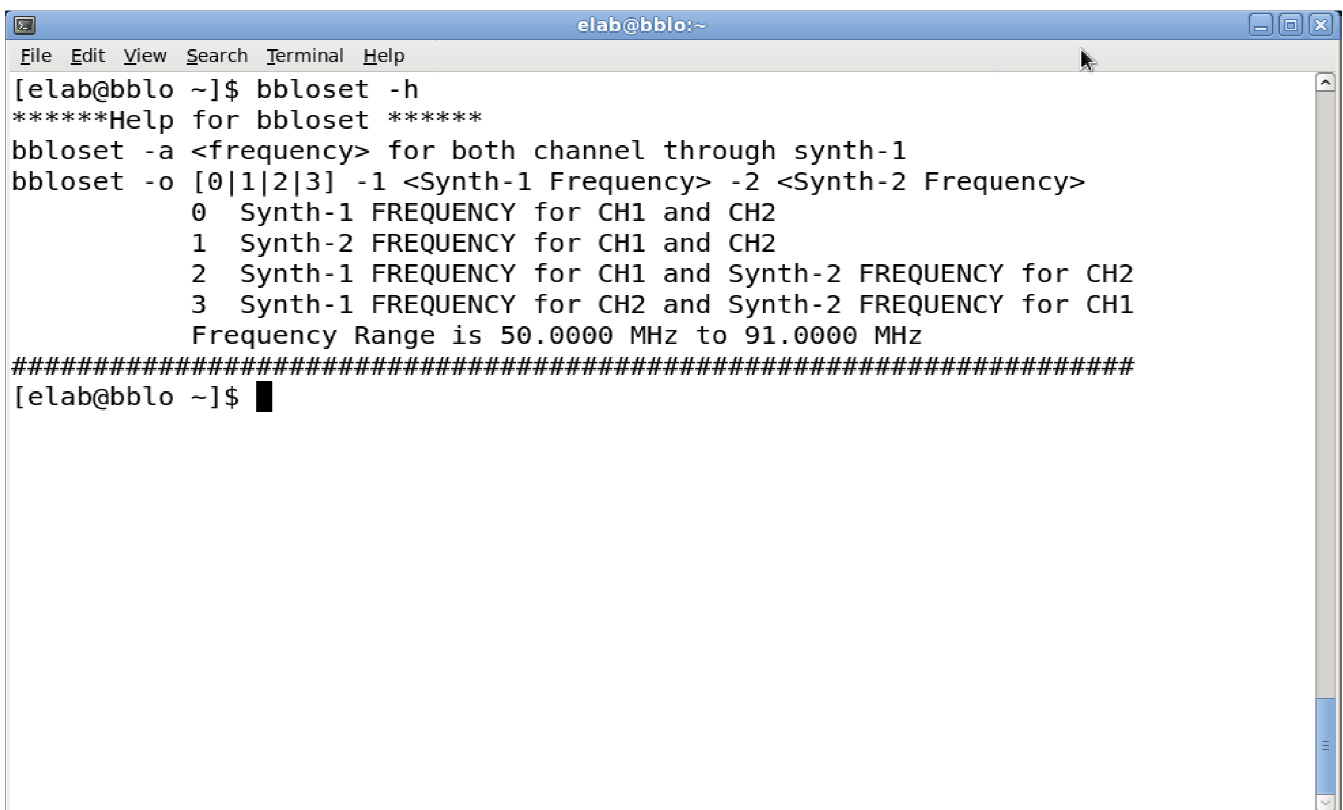
1. LOGIN TO BBLO MACHINE (FROM ANY m/c. IN GMRT NETWORK).

```
ssh -X elab@bblo  
password: .elab123
```

2. SETTING THROUGH COMMAND LINE:

Issue a command `bbloset`.
e.g, `bbloset -a 51.0000`

`bbloset` is multi option command line program.
Its detail shown below.



```
elab@bblo:~  
File Edit View Search Terminal Help  
[elab@bblo ~]$ bbloset -h  
*****Help for bbloset *****  
bbloset -a <frequency> for both channel through synth-1  
bbloset -o [0|1|2|3] -1 <Synth-1 Frequency> -2 <Synth-2 Frequency>  
0 Synth-1 FREQUENCY for CH1 and CH2  
1 Synth-2 FREQUENCY for CH1 and CH2  
2 Synth-1 FREQUENCY for CH1 and Synth-2 FREQUENCY for CH2  
3 Synth-1 FREQUENCY for CH2 and Synth-2 FREQUENCY for CH1  
Frequency Range is 50.0000 MHz to 91.0000 MHz  
#####  
[elab@bblo ~]$
```

Annexure- B

Baseband LO Monitor procedure

1. Open a web browser
2. Enter following address

http:// 192.168.30.38

(The page will look like this)

64 MONITORING CHANNELS															
01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
501	1374	113	840	618	1194	407	832	828	824	828	828	826	828	828	826
2.529	-2.08	4.578	0.739	1.912	-1.13	3.026	0.782	0.803	0.824	0.803	0.803	0.813	0.803	0.803	0.813
17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
829	827	830	829	829	827	832	827	828	830	825	827	827	828	827	827
0.797	0.808	0.792	0.797	0.797	0.808	0.782	0.808	0.803	0.792	0.818	0.808	0.808	0.803	0.808	0.808
33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
830	827	826	830	830	829	828	824	828	829	826	828	828	827	829	827
0.792	0.808	0.813	0.792	0.792	0.797	0.803	0.824	0.803	0.797	0.813	0.803	0.803	0.808	0.797	0.808
49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
829	825	829	826	825	827	827	824	828	827	828	828	827	827	828	831
0.797	0.818	0.797	0.813	0.818	0.808	0.808	0.824	0.803	0.808	0.803	0.803	0.808	0.808	0.803	0.787

MCM STATUS			
MCM Time	11:49:46	29-01-2016	Clock Frequency 60 MHz
Spectrum Spreader	Normal (0-50MHz)	Normal (>50MHz)	Clock Doubler On
Digital Mask	0F01	0000	Clock Divided By 1

BASE-BAND LO STATUS		
Parameters	Channel 1	Channel 2
LO Frequency	51.0000 (Synth1)	51.0000 (Synth1)
Lock Indication	Lock	Lock
RF Power	Ok	Ok
DC Power	Ok	Ok
Temp. (Inside PIU)	14.79 °C	15.63 °C

Baseband LO status will show the various monitoring parameters.

Lo frequency will show - **“set frequency & synth no.”**

Lock Indicator will show - Lo **“lock”** or **“unlock”**

RF Power will show – RF power from the synth. **“OK”** or **“No Power”**

DC Power will show – DC power in the synth. PIU **“OK”** or **“No Power”**

Temp. Inside PIU will show – Inside Temp. of each synth. PIU in **“°C”**

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