

Agenda Item 3.3

INSAT-3A SAR PAYLOAD COMMISSIONING TEST RESULTS

1. ACTION REQUIRED

The Joint Committee is invited to note:

The results of the INSAT-3A SAR Payload commissioning testing provided at Attachment-1.

2. BACKGROUND

INSAT-3A was successfully launched from Kourou (French Guyana) by Ariane-5 launch vehicle on 10 April 2003. The satellite is placed at 93.5 deg E. After necessary orbit corrections, testing of the SAR payload was carried out; the results were assessed and the INSAT-3A SAR Payload was declared at IOC in May 2003.

In order to qualify the payload for formal inclusion in the Cospas-Sarsat system, INSAT-3A SAR payload commissioning testing was carried out on 5 and 6 May 2004 as per the guidelines provided in Cospas-Sarsat document “Cospas-Sarsat GEOSAR Space Segment Commissioning Standard” (C/S T.013). The test results are provided in the Attachment-1.

During the testing Australian test beacon, which is in the footprint of INSAT-3A, was radiated and detected successfully. In addition to detection of test beacons, several other operational beacons of opportunity were also detected. The beacon test results are included in the Table-1 under Attachment-1. Most of the test results exceed the specifications, and the overall performance of the payload was found to be satisfactory.

3. SUMMARY OF TEST RESULTS

- ◆ Payload Status (FOC) : Full Operational Capability
- ◆ Initial Operational configuration (Channel Bandwidth) : Wide Band mode
- ◆ Operational Limitations : No Limitations (D/L Receive in Indian region only – Spot beam)

4. RECOMMENDATIONS

India recommends that the Joint Committee formally accepts commissioning of INSAT-3A SAR payload at FOC for operational use of the alert data into the Cospas-Sarsat system.

GEOSAR IOC STATUS MESSAGE

Test	Result	Pass / Fail	Comments
B.1 EIRP in SAR Channel	40.99 dBm	Pass	Nil
B.2 Spectral Occupancy of the Downlink	500KHz	Pass	Nil
B.3 Spurious Output Levels	-122.8	Pass	Nil
B.4 G/T of 406 MHz Repeater (Calculated)	-16.84 dB/K	Pass	Nil
B.5 Channel Bandwidth (1 dB) and Amplitude Ripple	80 KHz	Pass	Spurious present
B.6 Downlink Carrier Frequency	4505.696040 MHz	Pass	In MHz
B.7 ALC Dynamic Range	-	-	N A
B.8 Modulation Index	1 Radian	Pass	Nil
B.9 Translation Frequencies	100.0 KHz	Pass	Nil
B.10 Intermodulation and Harmonic Levels	No intermods	Pass	For Nominal Beacon levels
B.11 Beacon Signal Processing	Receiving OK	Pass	1 test beacon radiated from Australia during the test period was successfully detected, additionally 13 beacons of opportunity were detected (Table-1 Attached)

SPACECRAFT: INSAT-3A

DATE: 05-06 MAY 2004

I O C MODE

- ◆ Channel bandwidth : WB (Wide Band)
- ◆ ALC : Not applicable
- ◆ Operational limitations : No limitations
(D/L receive coverage in Indian region)

COMMISSIONING AUTHORITY:

Director Satellite Communication Programme Office, ISRO Head Quarters, Bangalore, India

GEOSAR COMMISSIONING REPORT

SPACECRAFT: INSAT-3A

DATE: 05-06 MAY 2004

Configuration	Pass/ Fail	Operational, Limited Operation, Not Operational	Comments
NB/Fixed gain	Pass	Available	In Standby mode
NB/ALC on	-	Not Applicable	No ALC
WB/Fixed gain	Pass	Operational	--
WB/ALC on		Not Applicable	No ALC

- ◆ Payload Status : **Full Operational Capability**
- ◆ Initial Operational configuration : **Wide Band mode**
- ◆ Initially S/C will be operated in the following mode
 - Ø Channel Bandwidth : **Wideband mode**
 - Ø ALC : **Not Applicable**
- ◆ Operational Limitations : **No Limitations
(D/L Receive in Indian region only)**
- ◆ Other Remarks : **Nil**

COMMISSIONING AUTHORITY:

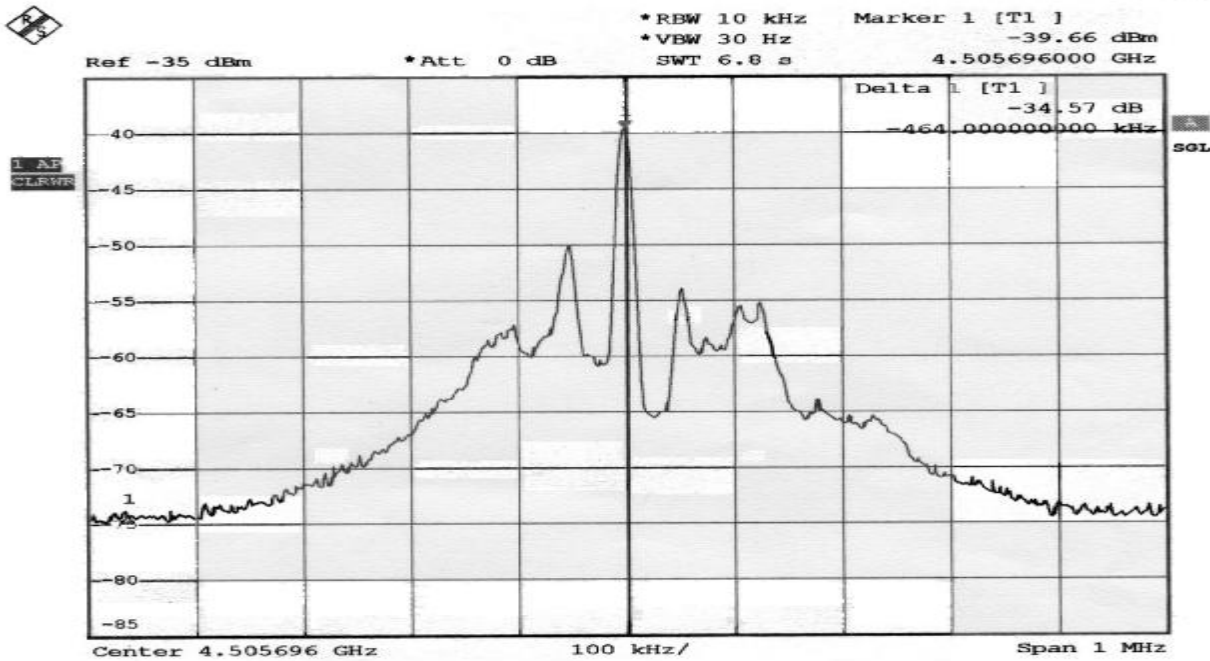
Director Satellite Communication Programme Office, ISRO Head Quarters, Bangalore, India

APPENDIX-1**INSAT-3A SAR P/L SPECIFICATIONS**

PERFORMANCE PARAMETER	UNIT	SPECIFICATION
CHANNEL FREQUENCY RECEIVE TRANSMIT	MHz	406.05 & 406.025 4505.7
RECEIVE G / T	dB/°k	-19.0
CHANNEL EIRP	dBm	+34.0
POLARISATION SENSE UHF RECEIVE EXT-C-TRANSMIT		RHCP LINEAR –V
CROSS POL. ISOLATION UHF RECEIVE EXT. C- TRANSMIT	dB	18.02 26.0
RECEIVE COVERAGE		GLOBAL
TRANSMIT		INDIA COVERAGE
PHASE DEVIATION	Rad	1.0 ± 0.2
USABLE BANDWIDTH	kHz	80 AND 20
FREQUENCY CONVERSION	ppm	± 1 ppm
SPURIOUS OUTPUT OUTSIDE TX. BAND, IN 4 kHz DUE TO RECEIVER L O DUE TO SSPA POWER SUPPLY	dBW dBc dBc	-60.0 -75.0 -60.0
GAIN STABILITY a. OVER A DAY b. OVER LIFE	dB p-p	2.0 4.0

APPENDIX-2**EIRP MEASUREMENT**

D/L C/KT	=	74.57 dBHz
SCES-4 G/T	=	31.7 dB/°k
D/L PATH LOSS	=	196.72 dB
K	=	-198.6 dBm/°K-Hz
EIRP	=	74.57+196.72-31.7-198.6
EIRP	=	40.99 dBm (10.99 dBw)
Spec.	=	34 dBm (4.0 dBw)
IOT Result	=	40.96 dBm

EIRP Measurement

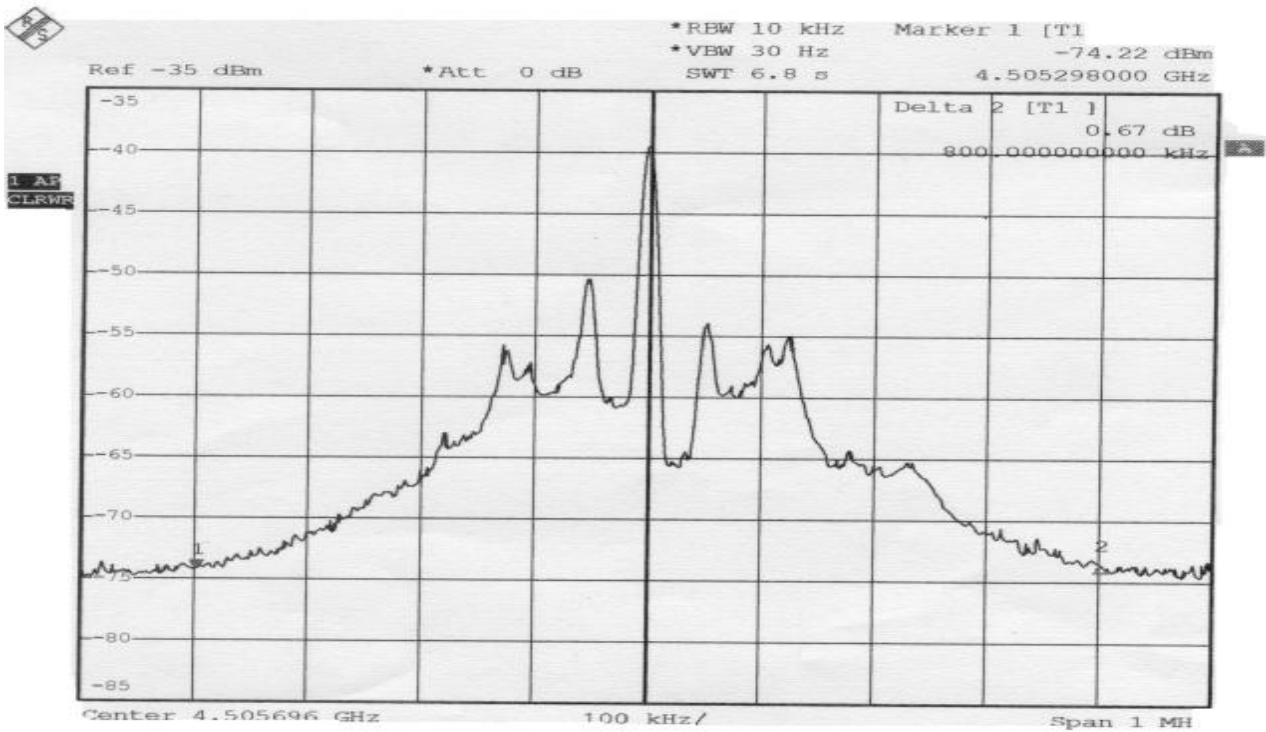
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APPENDIX-3**D/L SPECTRAL OCCUPANCY**

PLOTS TAKEN WITH 1 MHz & 2 MHz SPECTRUM SPAN BANDWIDTH

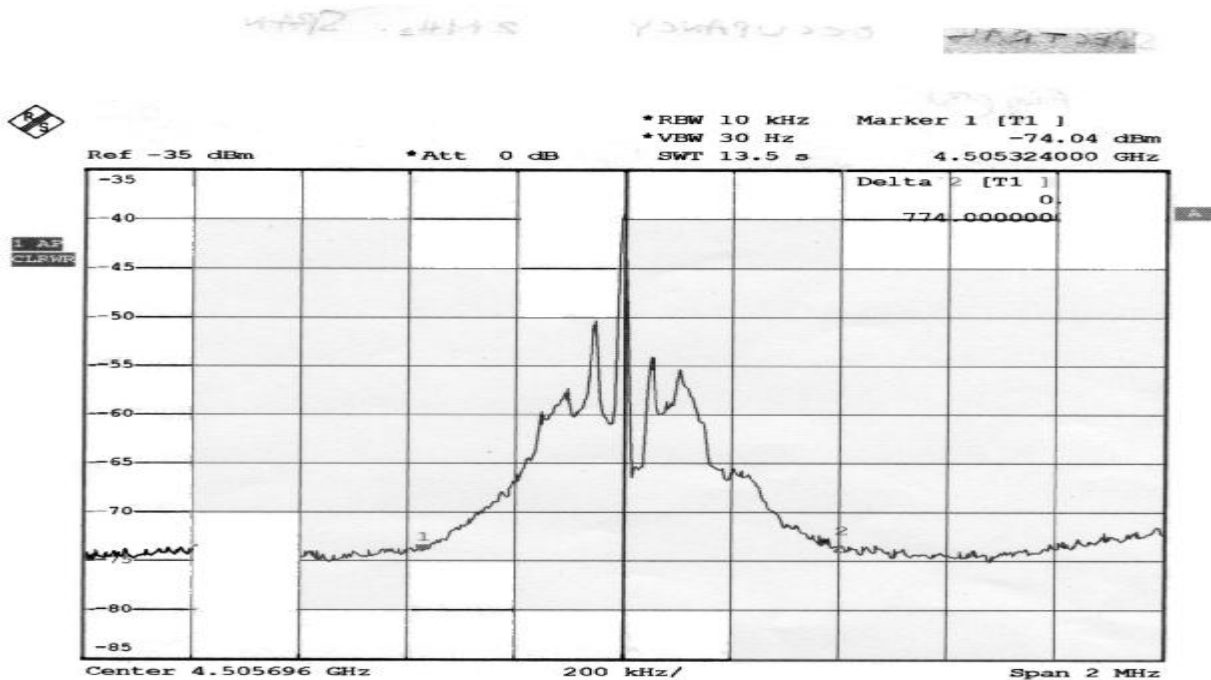
-30 dBc BANDWIDTH = 500 KHz
 IOT RESULT = 500 KHz

**(A) Spectral Occupancy of the Downlink
 Span : 1 MHz**



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**(B) Spectral Occupancy of the Downlink
Span : 2 MHz**



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APPENDIX-4

SPURIOUS O/P LEVELS

- ◆ One spurious carrier at 406.0 MHz is continuously received by INSAT-3A SAR Transponder.
- ◆ SARSAT & COSPAS satellite received signal analysis located the interference @ 43.283 deg N, 76.927 deg E.
- ◆ Spurious signal sideband is about 5 dB higher than the nominal Beacon Sideband. U/L EIRP is about $7+5=12$ dBw = 42 dBm
- ◆ Spurious signal at the i/p of SAR Rx. is $C_{spu} = U/L \text{ EIRP} - PL + \text{Ant Gain} - I/P \text{ Losses}$

$$C_{spu} = 42 - 175.8 + 12 - 1$$

$$= -122.8 \text{ dBm}$$

APPENDIX-5**CHANNEL BW & Amp. RIPPLE**

Measured on Spectrum Analyzer on the D/L Received signal

- ◆ 1 dB BW min. = 80 KHz
- ◆ 3 dB BW min. = 98 KHz
- ◆ Amplitude Ripple : Not possible to measure due to the presence of Spurious signal

APPENDIX-6**D/L CARRIER FREQUENCY**

Measured on Spectrum Analyzer in Frequency counter mode on the D/L Received signal:

- ◆ Averaged over 20 measurements over 20 minutes period.
- ◆ D/L Frequency is 4505.696040 MHz
- ◆ IOT Measurement is 4505.695390 MHz (On 27 April 2003)
- ◆ Frequency variation after about one year of payload operation is +650 Hz

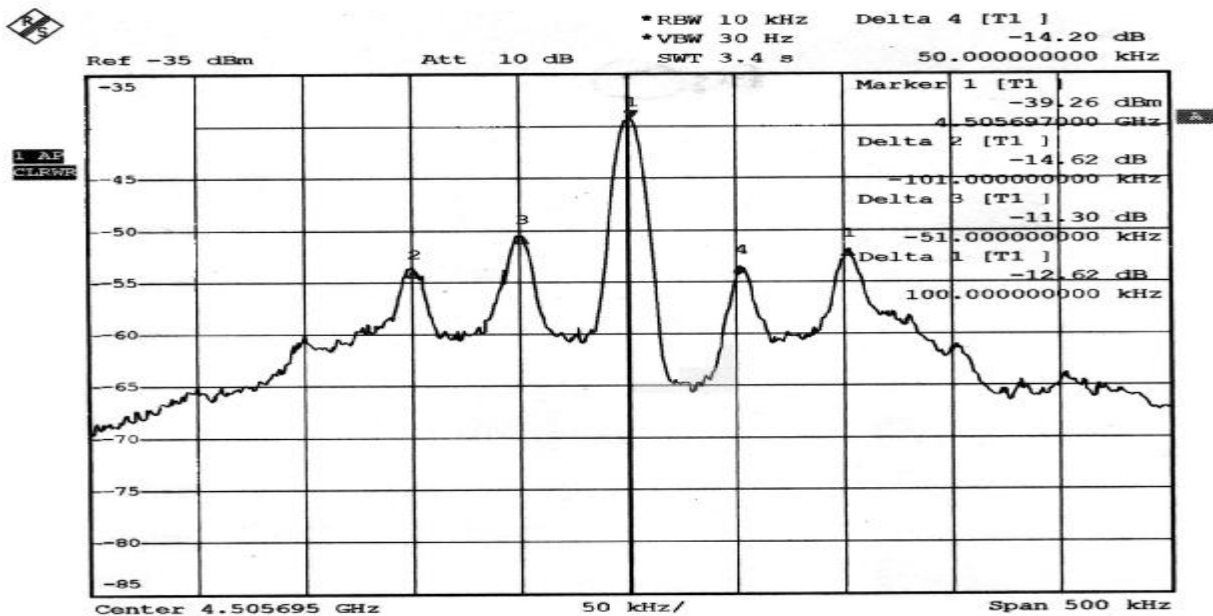
APPENDIX-7

MODULATION INDEX

Spec. = 1 ± 0.2 Radian

- ◆ In the INSAT-3A SAR payload a nominal Beacon transmitted EIRP (+ 7 dBw) appears as a side band of -16.75 dBc to -18.75 dBc at the down link carrier signal .Which corresponds to modulation index of 0.8 to 1.2 Rad. After about one year of operation, the up-link signal is providing side bands of -17dBc . This is within the specification of modulation index of 1 ± 0.2 Rad.

Modulation Index



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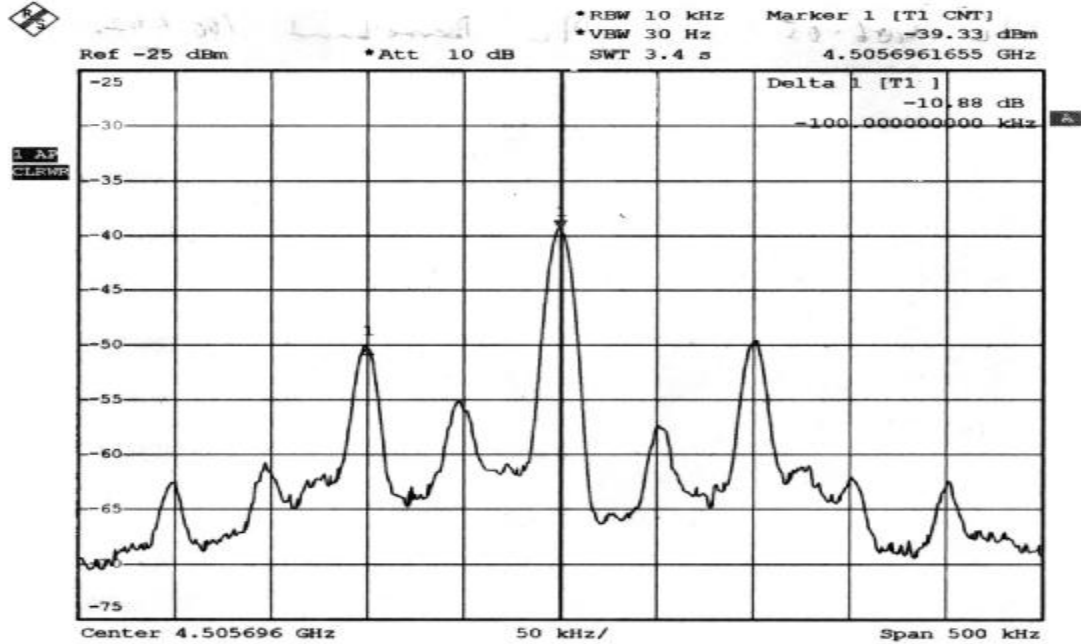
APPENDIX-8

TRANSLATION FREQUENCY

According to P/L configuration the U/L signal is Down converted to baseband.

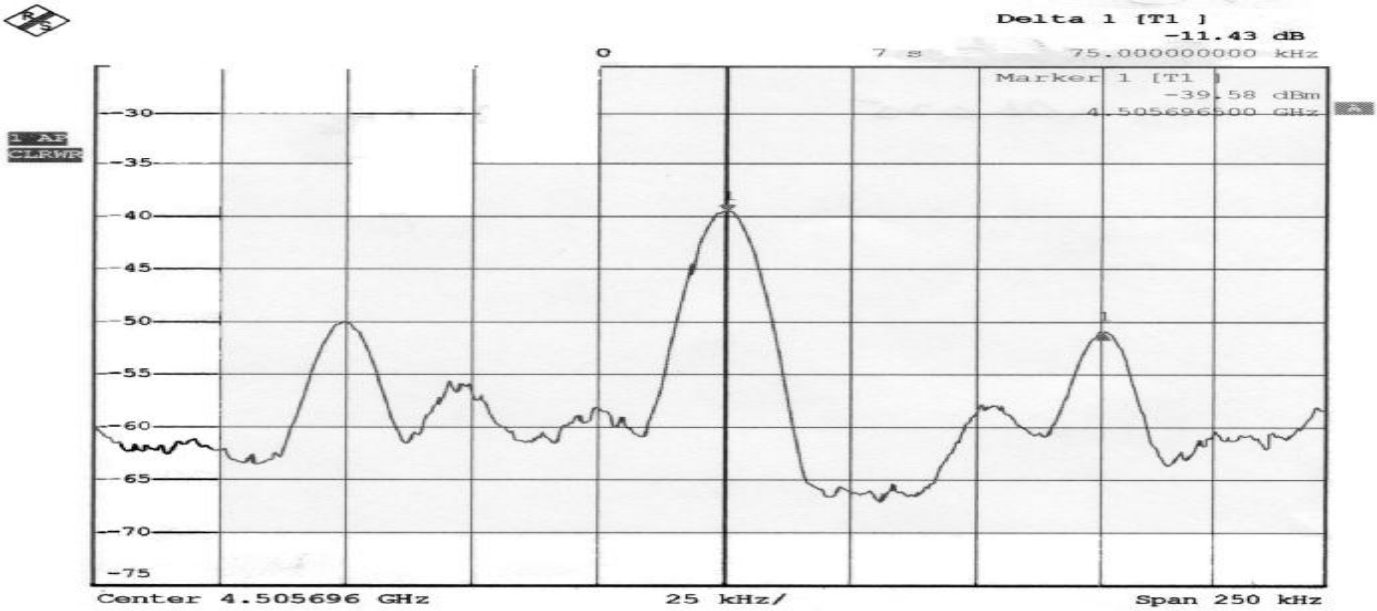
U/L Signal	Side band	Measured
406.025 MHz	75 KHz	75.0 KHz
406.050 MHz	100 KHz	100.0 KHz

**(A) Translation Frequency
406.050 to 100 KHz**



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**(B) Translation Frequency
406.025 to 75 KHz**



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APPENDIX-9

SAR RECEIVE G/T (CALCULATED)

INPUT:

- Gain of Rx Antenna-(Ga)=12 dBi
- Loss between Ant. And LNA (L) = 1.44 dB (1.39)
- Gain of LNA (G) = 22dB (158)
- Noise figure of LNA = 1.99 dB (1.58)=168.2 °K
- Earth noise temp.=300 °K

$$T_{sys} = \frac{T_a}{L} + \frac{(L-1)T_o}{L} + \frac{T_{e1}}{G} + \frac{T_{e2}}{G}$$

$$T_{sys} = 215.83 + 81.37 + 168.2 + 1.07 = 466.47 \text{ °K}$$

$$\text{Total Noise Temp.} = 466.47 + 300 = 766.47 \text{ °K} = 28.84 \text{ dB °K}$$

$$G/T = \text{Ant. gain} - \text{Total Noise Temp.} = 12 - 28.84 = -16.84 \text{ dB/ °K}$$

fig:

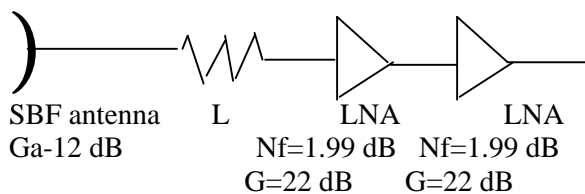


TABLE-1

**LIST OF BEACONS DETECTED DURING INSAT-3A PAYLOAD COMMISSIONING TEST
(ON 5TH AND 6TH MAY 2004) BY GEOLUT SYSTEM AT BANGALORE**

SL NO	DATE	INSAT-3A (GEOLUT) Detection time(ut)	Beacon ID (15Hex)	Country	Beacon type	COSPAS-SARAT satellites (LEOLUT) detection details			Remarks
						Latitude (deg)	Long. (deg)	Detection time (ut)	
1	05/05/04	11:06:00	B389934D54A34D1	CHINA	Emergncy	+11.28	+74.13	10:53:00	This Beacon detected on 6 th May also
2.	05/05/04	12:43:00	C6EA4974BBE64D1	THAILAND	Emergncy	+15.77	+109.74	12:40:00	
3.	05/05/04	14:10:00	B389938A143AD90	CHINA	Emergncy	-	-	-	Exclusive by GEO
4.	05/05/04	16:18:00	A1E8D7413500CD1	TURKEY	Emergncy	unlocated		16:17:00	
5.	05/05/04	19:33:00	341BDB72CB81AE5	TAIPEI	SPARE	-	-	-	Exclusive by GEO
6.	05/05/04	19:42:00	AC48355034D34D1	PANAMA	Emergncy	+8.68	+106.60	4/05/04& 11:25:42	
7.	05/05/04	22:45:00	B38A4933E29D8D1	CHINA	Emergncy	unlocated		22:44:00	
8.	06/05/04	06:16:00	C689070A34D34D1	SINGAPORE	Emergncy	a)+25.60 b)+29.72	+127.45 +147.12	06:13:00	
9.	06/05/04	10:14:00	3EFE1387BF81FE0	AUSTRALIA	TEST	-28.23	+153.41	10:14:00	
10.	06/05/04	02:53:00	B709034D71D34D1	KOREA_SOU	Emergncy	unlocated		02:53:00	
11.	06/05/04	05:48:00	A22D41DCB4000ED	RUSSIA	Emergncy	a)+44.93 b)+48.37	+146.11 +167.25	05:48:40	
12.	06/05/04	10:32:00	AO68141034D34D1	NORWAY	Emergncy	unlocated		10:31:00	
13.	06/05/04	13:59:00	9F09965C34D34D1	MALTA	Emergncy	+24.79	+67.02	13:59:00	
14.	06/05/04	20:35:00	B388D31D54134D1	CHINA	Emergncy	a)+32.80 b)+25.67	+124.19 +158.22	20:32:00	

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