

NIGCOMSAT – 1R TECHNICAL MANUAL

2012 Edition

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2012 Edition.

This document contains a summarized technical description of NigComSat–1R payload, highlighting some key performance featuress

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INTRODUCTION

NigComSat-1R is a hybrid geostationary satellite with 28 transponders for providing cutting-edge telecommunications solutions that are both reliable and cost-effective. The quad band satellite is located at 42.5 degrees East with a lifespan of at least 15years and footprints in West, East and Southern Africa, Europe and Asia. NigComSat-1R inherits many flight proven technologies used by NigComSat-1, VENESAT-1 and DHF-3 series spacecrafts.

The NigComSat-1R communications subsystem consists of C-band, Ku-band, Ka-band and L-band. The Ku-band payload consists of fourteen (14) active channels, with a bandwidth of 31.5MHz each and three fixed beams over East Africa, West Africa and Kashi. The C-band payload consists of four (4) active channels, with a bandwidth of 36MHz each and coverage over West, Central and Eastern Africa.

The L-band Navigational payload receives two uplink signals on C-band, using a separate C-band antenna covering Europe and Nigeria, and transmits two downlink signals on L-band (L1 and L5) using a global coverage.

The Ka-band payload consists of eight (8) active channels, with a bandwidth of 120MHz each for communications and broadcast services. It has three fixed spot beams over Nigeria, South Africa and Europe.

In order to ensure independent gain adjustment of the HPA in FGM, each payload has commandable gain controls for each RF-channel.Furthermore, the spacecraft is designed to guarantee that each RF channel maintains its specified requirements throughout its service life, including eclipse conditions, with allowance for degradation, wear-out and radiation damages. The NigComSat-1R structure is based on DFH-4 platform.

The structure supports seven (7) on-board antennas which includes two deployable shaped dual reflector antennas for Ku-band ECOWAS-1 and ECOWAS-2; three (3) fixed reflector antennas in which two are for Ka-band transmit and receive beams while the third is for C-band ECOWAS-1 beam.

Other antennas include a helical antenna for L-band coverage and a horn antenna for C-band navigational uplink.

SATELLITE CONTROL

NigComSat-1R has two ground control stations. The main station is in Abuja, Nigeria and the back-up station is in Kashi, China. Both stations are equipped with state of the art satellite control equipment and software.

BEACON FREQUENCIES

The satellite has two beacon frequencies on C-band.

- Beacon Frequency 1 3696.84MHz (LHCP)
- Beacon Frequency 2 3694.14MHz (RHCP)

TECHNICAL SUMMARY

LAUNCH INFORMATION:

Orbital Location	Launch Vehicle	Life Expectancy	LaunchDate
42.5° E	LM-3BE	>15 years	19 th December 2011

TRANSPONDER INFORMATION:

PAYLOAD	COVERAGE	BANDWIDTH/TRANSPONDER	POWER
Ku-BAND	WEST, SOUTH	31.5MHz	150 Watt TWTA
	AFRICA ,& KASHI		
C-BAND	WEST , EAST AND	36 MHz	60 Watt TWTA
	CENTRAL AFRICA		
Ka-BAND	EUROPE,NIGERIA	120 MHz	70 Watt TWTA
	& SOUTH AFRICA		
L-BAND	GLOBAL	L1 = 4 MHz	L1 = 62 W SSPA
		L5 =20 MHz	L5 = 45 W SSPA

STATION KEEPING WINDOW: ±0.05° E/W & N/S

POINTING ACCURACY: ±0.13° for norminal operations

SATELLITE ANTENNAS:

PAYLOAD	ANTENNA TYPE
Ku-BAND	2-DEPLOYABLE SHAPED DUAL REFLECTOR
C-BAND	1-FIXED-REFLECTOR
	1-HORN
Ka-BAND	2-FIXED REFLECTOR
L-BAND	1-HELICAL

SATELLITE PHYSICAL DESIGN:

M ANUFACT'URER:	China Great Wall Industries Corporation (CGWIC)
SPACECRAFT PLATFORM :	DFH-4
TOTAL MASS AT LAUNCH:	5088.2 Kg
STRUCTURE DIMENSIONS(STOWED):	2360mm X 2100mm X 3700mm
BOL Power:	9KW
EOL power:	7.75KW



FIGURE 1: STOWED NIGCOMSAT-1R IN LAUNCH CONFIGURATION



FIGURE 2: FULLY DEPLOYED NIGCOMSAT-1R IN ORBIT CONFIGURATION



TECHNICAL DESCRIPTION

Ku-BAND PAYLOAD SUMMARY

The Ku-Band payload has fourteen (14) channels with a bandwidth of 31.5MHz each. It consists of channel filters to provide input multiplexers for transmission path separation and output multiplexers for establishing a means of combining RF signals at the appropriate transmit antenna. The input section has three (3) fixed receive beams covering Ecowas1, Ecowas2 and Kashi.

The HPA configuration has fourteen (14) active amplifiers where each amplifier is equipped with a linearized CAMP, a dedicated EPC and a TWTA. It has a single redundancy ring of 16:14 with RF switches provided at the output of the TWTA and the input to the CAMPS such that any two amplifiers in the ring can fail without loss of operation at any channel.

The Ku-Band Payload has a TWTA RF output power of 150 Watts with a commendable channel gain control for each RF channel to allow independent gain adjustment of each HPA in the FGM. It also operates in ALC mode.



KU-BAND PAYLOAD FREQUENCY AND POLARIZATION PLAN

FIGURE 4: Ku- BAND PAYLOAD FREQUENCY AND POLARIZATION PLAN

KU-BAND PAYLOAD EIRP AND G/T



FIGURE 6: Ku BAND ECOWAS 1 BEAM G/T (dB/K)







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Ku-BAND PAYLOAD CROSS-POLARIZATION ISOLATION

The west antenna receive cross-polarization isolation (XPI) for any RF channel from any location within the specified coverage area is greater than or equal to 30dB for 100% of the coverage. Under any EIRP condition, the cross-polarization isolation (XPI) is greater than or equal to 30dB for any location within the specified coverage area

C-BAND PAYLOAD SUMMARY

The C-Band payload has four channels with a bandwidth of 36 MHZ each. It consists of channel filters to provide input multiplexers for transmission path separation and output multiplexers for establishing a means of combining RF signals at the appropriate transmit antenna. The input section has a receive beam on one polarization.

The HPA configuration has four active amplifiers, each amplifier is equipped with a linearized CAMP, a dedicated EPC and a TWTA. It has a single redundancy ring of 6:4 with RF switches provided at the output of the TWTA and the input to the CAMPS such that any two amplifiers in the ring can fail without loss of operation in any channel.

The C-Band Payload has a TWTA RF output power of 60 Watts with a commendable channel gain control for each RF channel to allow independent gain adjustment of each HPA in the fixed gain mode.



C-BAND PAYLOAD FREQUENCY AND POLARIZATION PLAN

FIGURE 11: C- BAND PAYLOAD FREQUENCY AND POLARIZATION PLAN

C-BAND PAYLOAD EIRP AND G/T



FIGURE 12: C-BAND PAYLOAD EIRP (dBW)



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C-BAND CROSS-POLARIZATION ISOLATION

The receive cross-polarization isolation for any RF channel from any location within 80% of the specified coverage area is greater than or equal to 30dB and 27dB for 100% of the coverage. Under any EIRP condition, the cross-polarized EIRP isolation is greater than or equal to 30dB for any location within 80% of the specified coverage area and 27dB for 100% of the coverage area.

Ka-BAND PAYLOAD SUMMARY

The Ka-Band payload has eight channels with a bandwidth of 120 MHz each and three spot beams over Nigeria, South Africa and Europe. Channels 1, 2, 5 and 7 are for trunking between Europe and Nigeria while channels 3 and 4 are for trunking between South Africa and Nigeria. Finally, channels 6 and 8 will provide broadcast capability over Nigeria.

It is equipped with channel filters to provide input multiplexers for transmission path separation and output multiplexers for establishing a means of combining RF signals at the appropriate transmit antenna.

The HPA configuration has eight active amplifiers were each amplifier is equipped with a linearized CAMP, a dedicated EPC and a TWTA. It has a single redundancy ring of 10:8 with RF switches provided at the output of the TWTA and the input to the CAMPS such that any two amplifiers in the ring can fail without loss of operation at any channel.

The Ka-Band Payload has a TWTA RF output power of 70 Watts with a commendable channel gain control for each RF channel to allow independent gain adjustment of each HPA in the Fixed gain mode.

Ka-BAND PAYLOAD FREQUENCY AND POLARIZATION PLAN





Ka Band Payload Broadcasting

FIGURE 15: Ka-BAND PAYLOAD CHANNEL CONFIGURATION

Ka-BAND PAYLOAD EIRP AND G/T





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Ka-BAND PAYLOAD CROSS-POLARIZATION ISOLATION

The receive cross-polarization isolation for any RF channel from any location within the specified coverage area is greater than or equal to 28 dB for 100% of the coverage. Under any EIRP condition, the cross-polarized EIRP isolation is greater than or equal to 28 dB for any location within the specified coverage area.

L-BAND PAYLOAD SUMMARY

The navigation payload provides a C-band receive beam covering minimally northern Africa and Europe with a 2:1 receiver redundancy. This payload is equipped with an input multiplexer to provide two separate transmission paths for two navigational signals, as well as two separate L-band downlink carriers and an output multiplexer to provide a means of combining both navigational signals for transmission.

L-BAND PAYLOAD FREQUENCY AND POLARIZATION PLAN



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L-BAND PAYLOAD EIRP AND G/T







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L-BAND PAYLOAD CROSS-POLARIZATION ISOLATION

For the C-band navigation antenna, the receive cross-polarization isolation within the C-band coverage for any RF channel from any location within the coverage of that beam area is greater than or equal to 27 dB for 100% of the coverage area. For the L-band navigation antenna the axial ratio will not be greater than 2 dB within the global coverage area and over the full operational bandwidth of L1 and L5.

APPENDIX

COMMUNICATIONS PAYLOAD EIRP SUMMARY

PAYLOAD	BEAM	PEAK EIRP	EOC EIRP
		(dBW)	(dBW)
	ECOWAS-1	55	53.09
	ECOWAS-2	52	50.29
Ku-BAND	KASHI	58.5	48.46
	ECOWAS-1	46	44.01
C-BAND			
	EUROPEAN	58	53.63
	SOUTH AFRICA	58	53.63
Ka-BAND	NIGERIA	58	53.63
	L1	33.82	33.5
NAVIGATION	L5	33.4	31.9

COMMUNICATIONS PAYLOAD G/T SUMMARY

PAYLOAD	BEAM	G/T
		dB/K
	ECOWAS-1	5.11
	ECOWAS-2	1.10
	KASHI	6.70
Ku-BAND		
	ECOWAS-1	1.21
		_
C-BAND		
	EUROPEAN	9.78
	SOUTH AFRICA	9.85
Ka-BAND	NIGERIA	9.78
	C1	-10.98
NAVIGATION	С5	-11.28