Proceedings of International Conference on Astronomy and Space Science
Celebrating 20th Anniversary of Korea Space Science Society, Jeju, 2004

KOMPSAT-2 RF COMPATIBILITY TEST FOR S-BAND

Seung-Won Cho†, Young-Su Youn, Jong-Yeon Choi, Seok-Weon Choi
KARI, Yusong-gu, Daejeon 305-348, Korea
email: orpheous@kari.re.kr

(Received September 25, 2004; Accepted October 1, 2004)

ABSTRACT

KOMPSAT-2 (Korea Multi Purpose Satellite 2) which is scheduled to launch in 2005 year will communicate with KARI TTC (Tracking, Telemetry, and Command) station flying along sun synchronous orbits (685 km). The command from KARI TTC passes S-band omni-antenna, RF assembly, and transponder and finally reachs OBC (On Board Computer). The telemetry from KOMPSAT-2 arrives at KARI TTC through inverse procedure. In this paper, RF compatibility test between KOMPSAT-2 and KARI TTC station is demonstrated. RF interface for this test was established through real space and uplink signal test and downlink signal test and uplink & downlink signal test were performed.

Keywords: S-band omni antenna, RF assembly, transponder, up-link, down-link

1. INTRODUCTION

RF compatibility test is required on ground in order to verify RF compatibility between satellite and ground station as a real system before satellite is launched. The purpose of this paper is to verify RF compatibility between KOMPSAT-2 and KARI TTC station. RF compatibility test for KOMPSAT-2 was performed in S-band. We are not concerned here with X-band for payload. This test was fully performed by antenna to antenna interface between KOMPSAT-2 and TTC station. All tests were performed in accordance with test procedure made by KARI (Chung et al. 2004). Test criteria was observed by KOMPSAT-2 S/G S-band ICD (Interface Control Document) and KOMPSAT-2 TC&R (Telemetry Command and Ranging) Subsystem specification.

2. TEST CONFIGURATION

Test configuration for RF compatibility is showed in Figure 1. KOMPSAT-2 was located in KARI AI&T high bay and EGSE (Electrical Ground Support Equipment) and SATS (Spacecraft Automated Test System) were in control room. All activities controlling KOMPSAT-2 during this test were performed by SATS except some items. S-band antenna hat was connected to roof-top antenna which is the type of omni-directional antenna with -4 dB loss. The distance between KARI AI&T building and KARI TTC station was about 700 m, and space loss due to the distance was about 96 dB. MCE (Mission Control Element) antenna gain and LNA (Low Noise Amplifier) gain was 43

†corresponding author

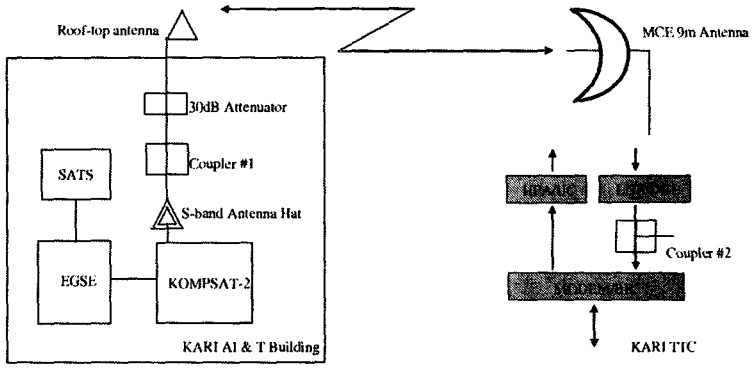

Figure 1. RF compatibility test configuration for S-Band.

Table 1. Status of telemetry after commands.

	Initial	CMD CNOOP	CMD ANOOP	CMD ENOOP	10 CMD CNOOP
CSWHACCT	4	6	8	10	12
CSWHRJCT	0	0	0	0	0
ACMDCNTR	0	0	1	1	1
CCMDCNTR	0	1	1	1	11
ECMDCNTR	0	0	0	1	1
ACMDREJ	0	0	0	0	0
ECMDREJ	0	0	0	0	0
CCMDREJ	0	0	0	0	0

dB and 45 dB each. Coupler #1 and Coupler #2 were established for observing and measuring uplink & downlink signal spectrum.

3. TEST RESULT

3.1 Downlink

It was verified that transmission signal from KOMPSAT-2 was compatible with S-band interface requirements in both low rate (2048 bps) and high rate (1.5 Mbps). The measured items were downlink center frequency, carrier power, and telemetry frame acceptance. When KOMPSAT-2 transmitted the downlink signal with power of 36 dBm (3.98 W), the measured value at coupler#2 was –66 dBm. Therefore total loss from output of transmitter to front of MCE 9 m antenna was 175 dB.

3.2 Uplink

First, the unmodulated and the modulated uplink carrier power were measured in coupler #1 after HPA (High Power Amplifier) power of TTC station was set to 1 Watt. When transponder was carrier-locked, the measured power was –74 dBm. the measured power was decreased to –76 dBm after modulation index was set to 1.0. Secondly, command frame acceptance, rejection ratio was measured. Selected command for frame acceptance test was NOOP (No Operation) command. Table 1 displays the results of the frame acceptance and rejection ratio test. CSWHACCT, CSWHRJCT, ACMDCNTR, CCMDCNTR, ECMDCNTR, ACMDREJ, ECMDREJ, and CCMDREJ were teleme-

Table 2. Receiver lock status when up link frequency was offset.

	F - 30 kHz	F	F + 30 kHz
Lock Status (A)	Lock	Lock	Lock
Lock Status (B)	Lock	Lock	Lock

try mnemonics related with command frame. Whenever command was transmitted to KOMPSAT-2 from TTC station, there was an increase in the number of two in OBC software header acceptance counter, and simultaneously command counter of processor handling each command was increased as large as one. After 10 OBC command is continuously sent, 10 was exactly added to OBC command counter. During this test, All tried commands were accepted successfully and any rejection was not occurred. Thirdly, the capability of the KOMPSAT-2's receiver to acquire RF carrier phase lock was measured when the uplink carrier is offset (approximately 30 kHz) from the receiver's best lock frequency. Table 2 shows the result. After the receiver was locked to best lock frequency, uplink frequency was offset to +/–30 kHz, but all of the receivers were locked. Fourthly, 10 length of command was transmitted to KOMPSAT-2 at the minimum and the maximum modulation index to check command phase modulation sensitivity. Nominal modulation index was 1.0 and added to this, we set the maximum and the minimum modulation index to 1.1 and 0.9 each. Without regard to the variation of modulation index, transponders were successfully locked.

3.3 Uplink & Downlink

When command was sent to KOMPSAT-2 from KARI TTC station, it was measured that the coherent turn-around ratio was 221/240, and it met the requirement of specification. All these things make it clear that there are no problem with RF compatibility between KOMPSAT-2 and TTC station.

4. CONCLUSION

In this paper, downlink signal test, uplink signal test, command frame rejection ratio test, RF acquisition frequency range test, command phase sensitivity test, and turn-around ratio test were performed, and the results of it were demonstrated. We may, therefore, reasonably conclude that RF compatibility in S-band between KOMPSAT-2 and KARI TTC station was verified.

ACKNOWLEDGEMENTS: The present work was supported by Korea Ministry of Science and Technology

REFERENCES

Chung, D.-W. 2004, Kompsat-2 S/G RF Compatibility Test Procedure, K2-D0-760-024 (Daejeon: KARI)