

RFI mitigation at a 2GHz band by using a wide-band high- temperature superconductor filter

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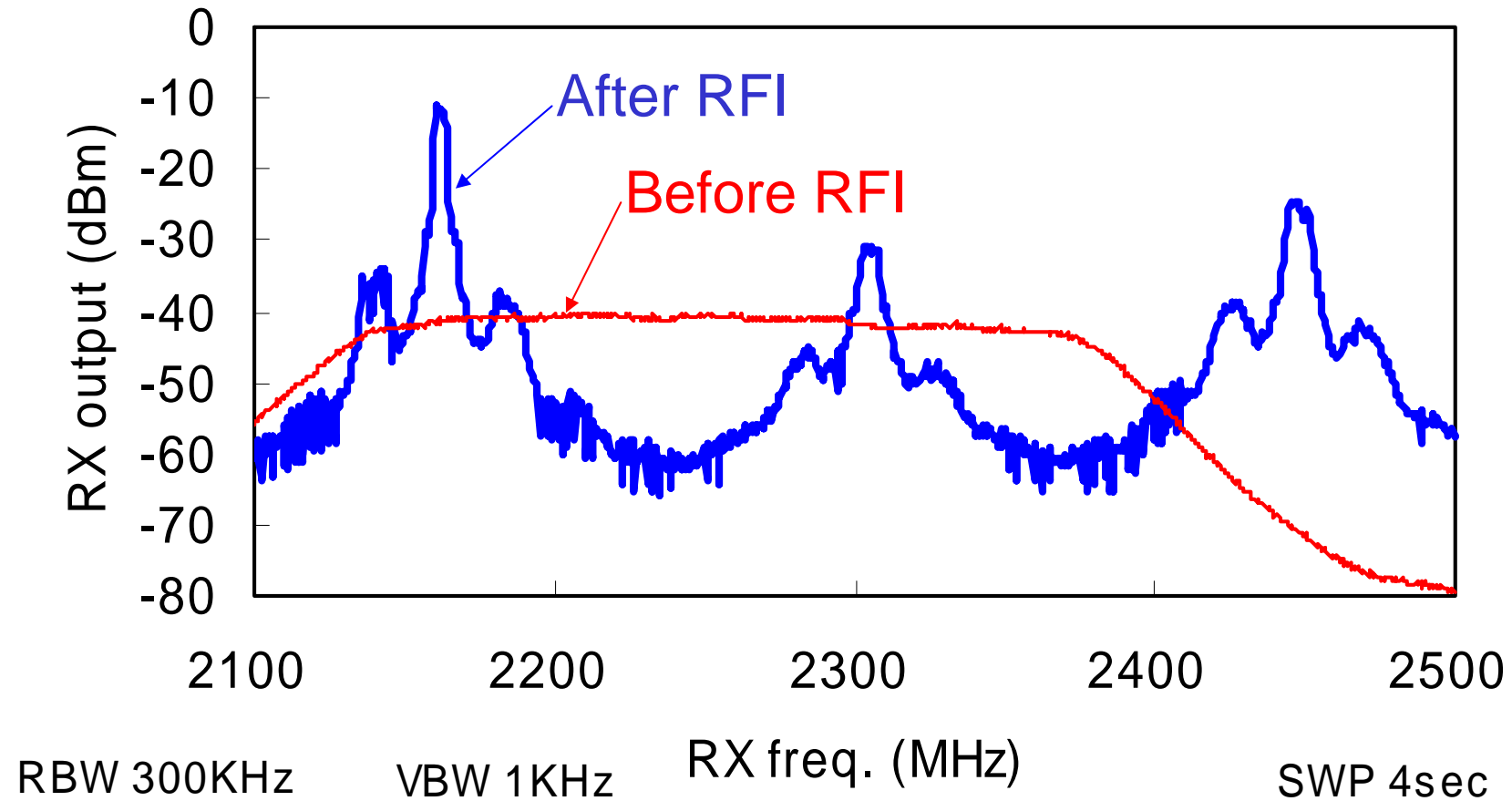
Kashima 34-m antenna



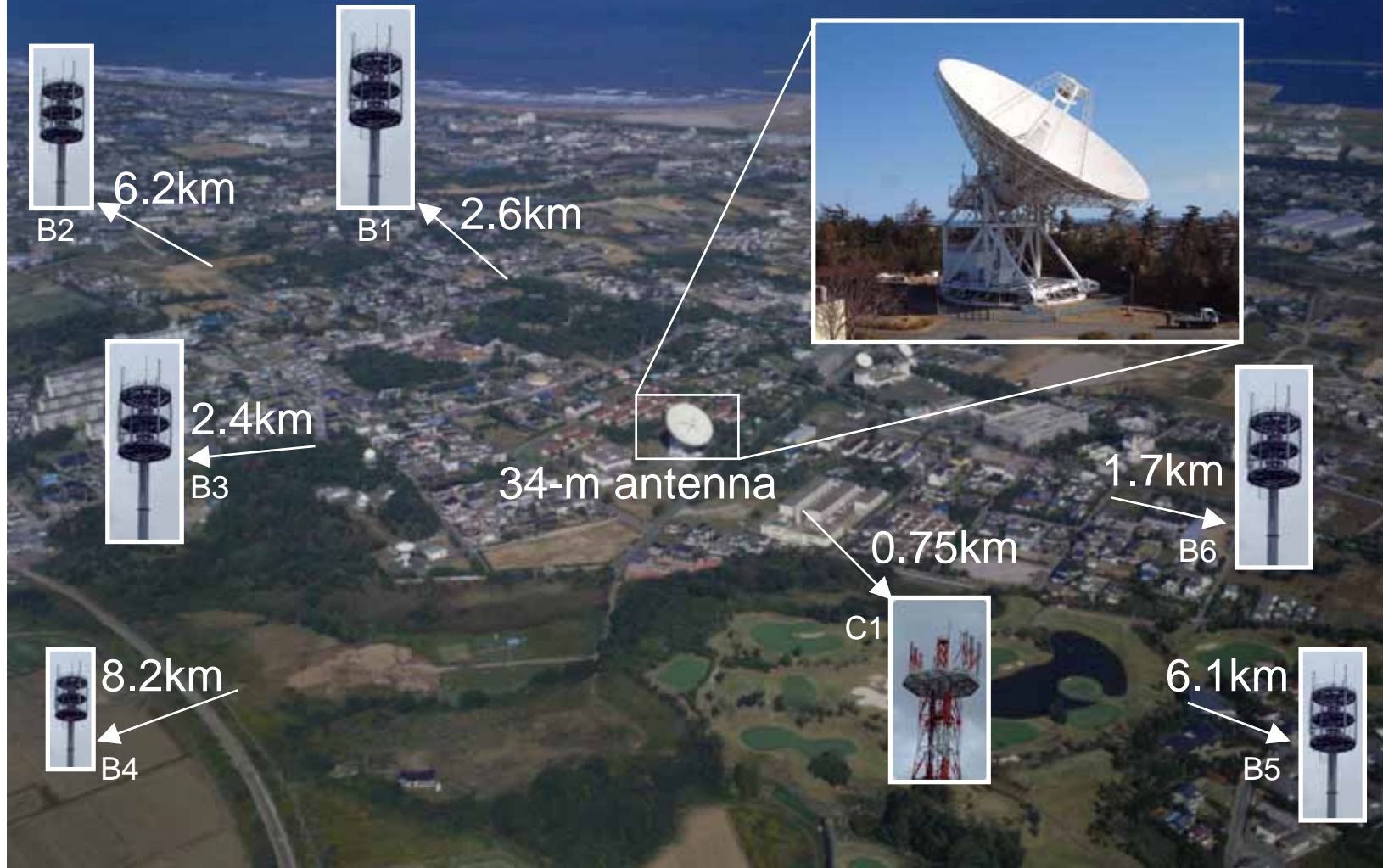
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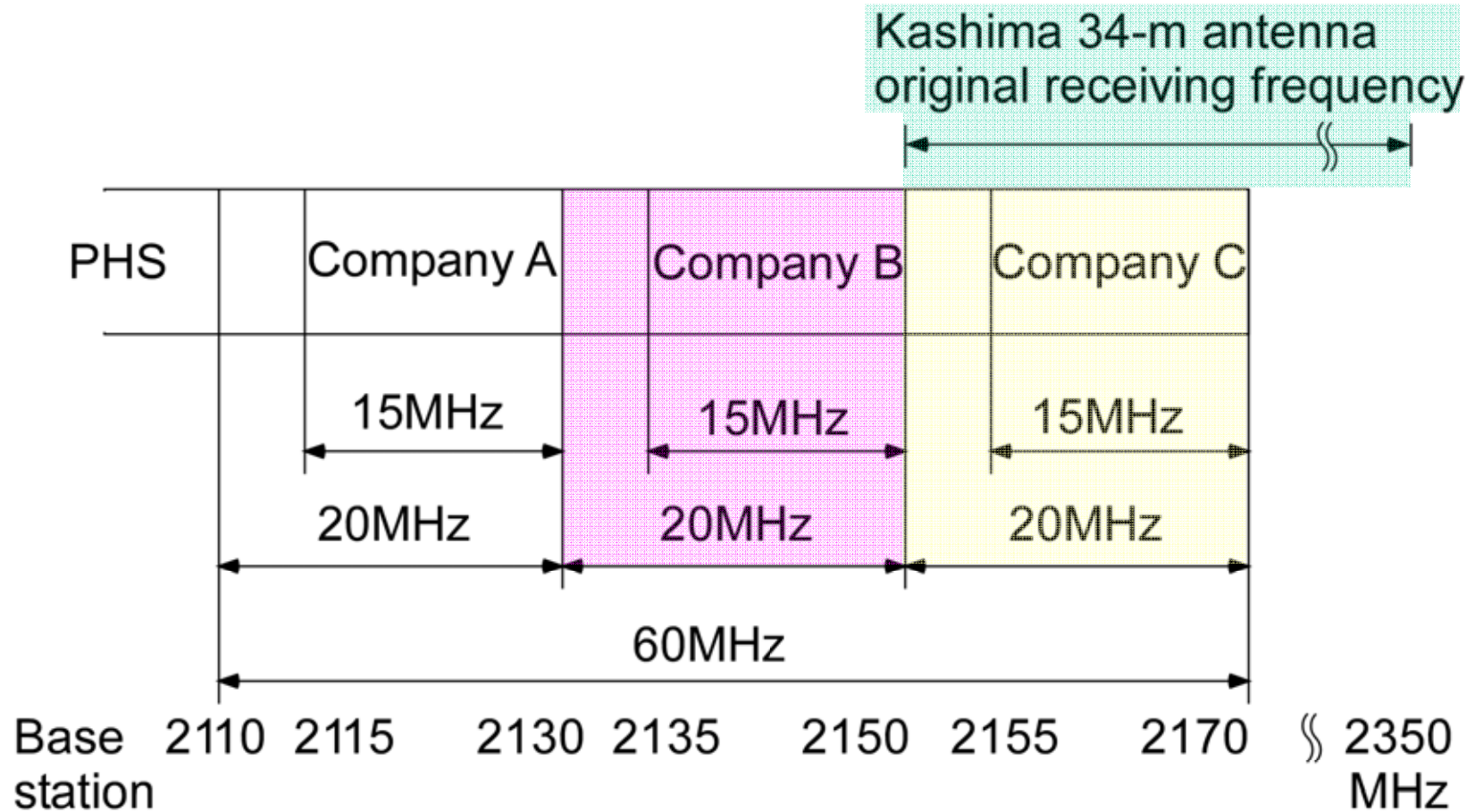
RFI situation at Kashima



Vicinity of Kashima 34-m antenna and the base stations



IMT-2000 frequency assignment and Kashima 34-m antenna receiving frequency

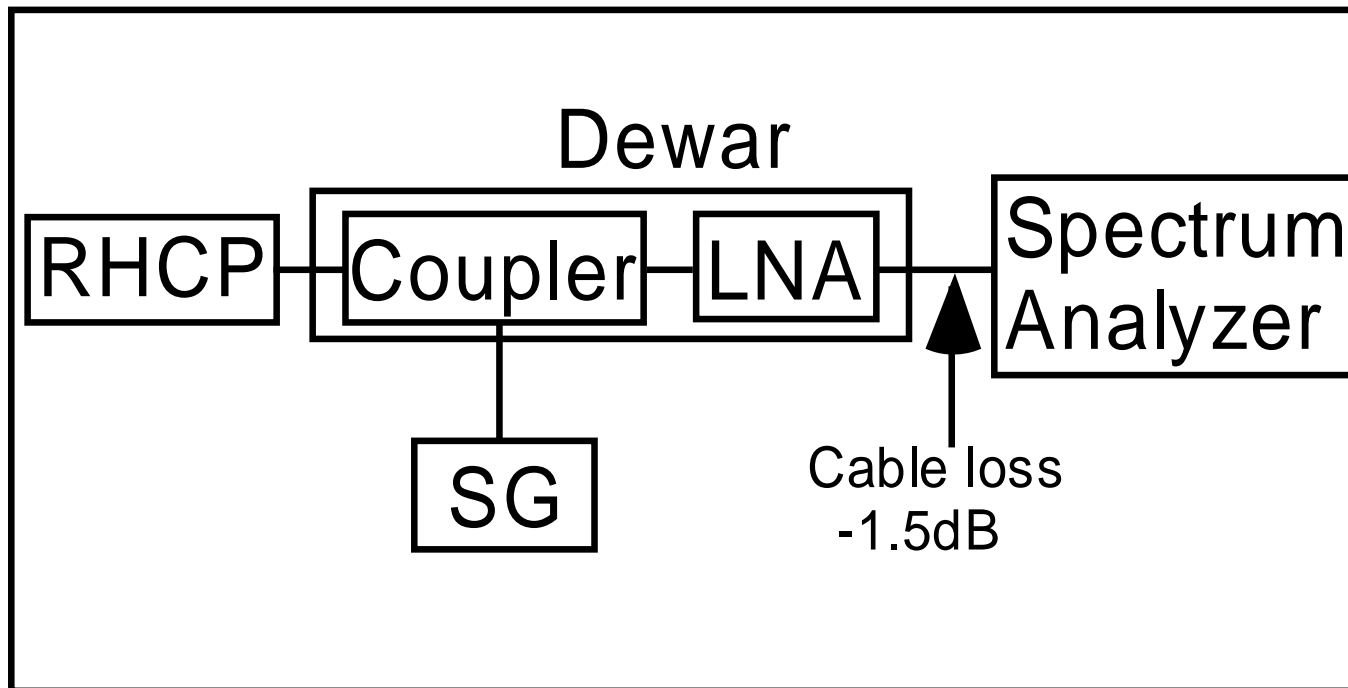


Service start: Company B 2nd March 2002, Company C 1st July 2003

Is LNA saturated?

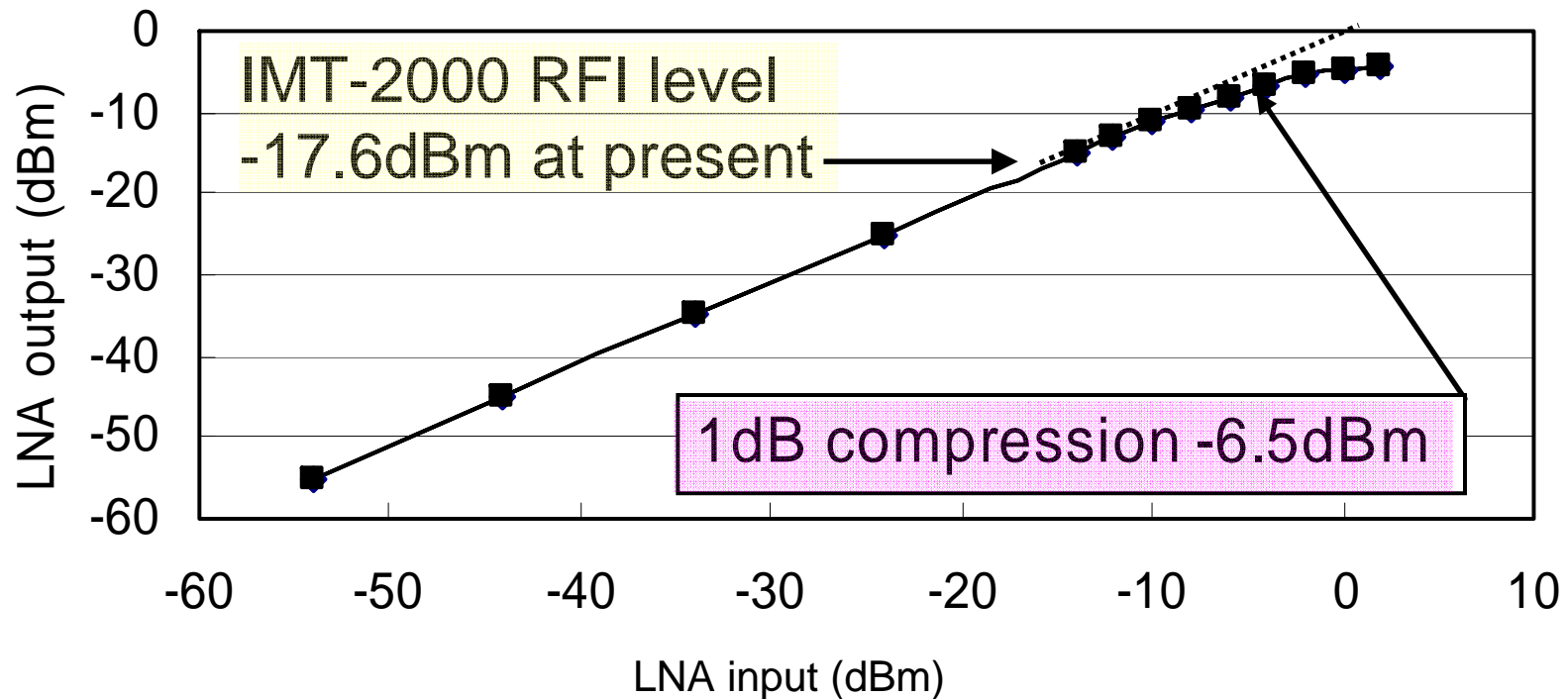
- If LNA is not saturated, we can take countermeasure after LNA.
- Maximum LNA output of interference signal was -17.6dBm .
- We performed to measure LNA linearity.

LNA linearity test



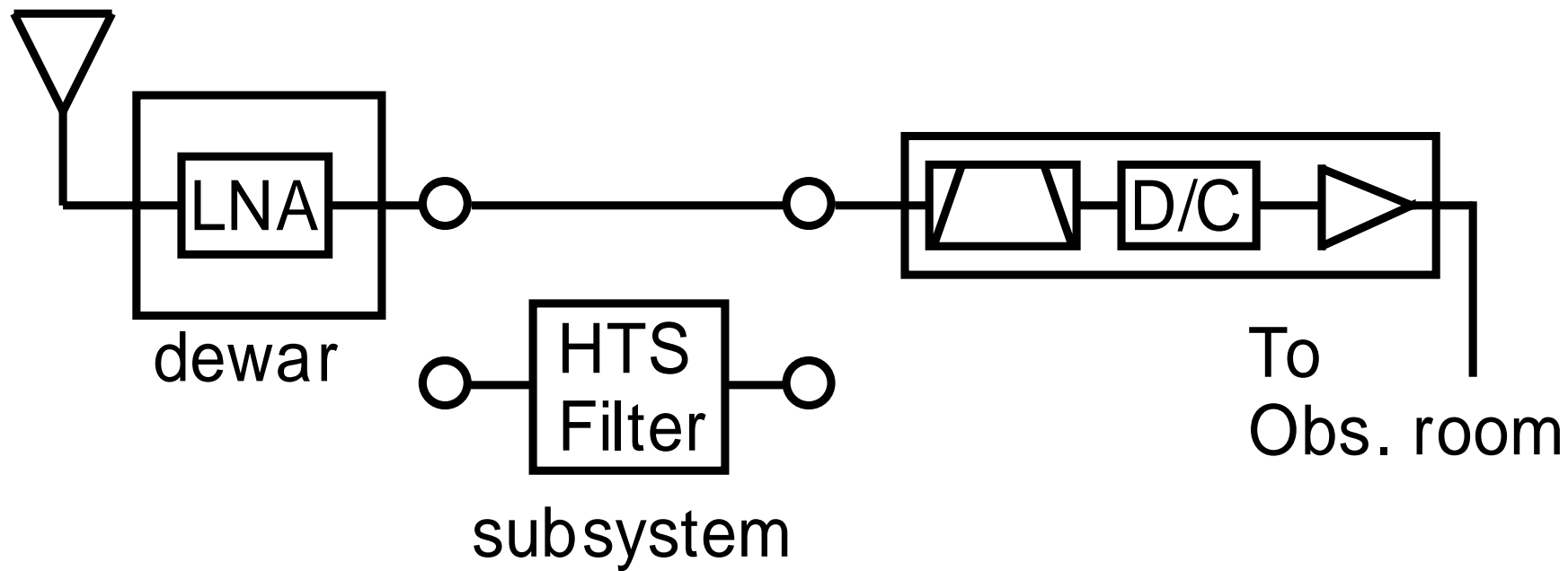
Test block diagram

LNA linearity test result



Current margin is 11.1dB.

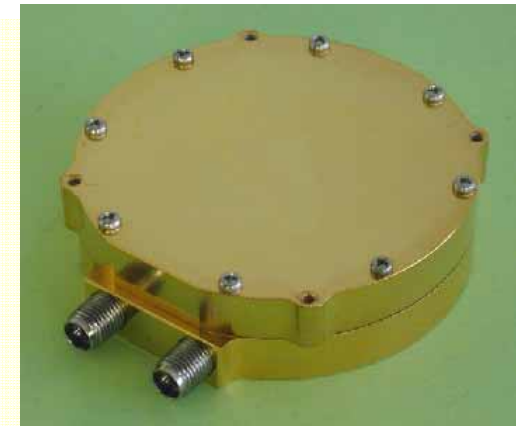
Countermeasure



Receiver block diagram

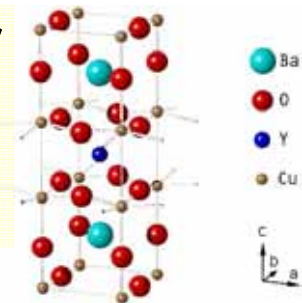
HTS filter

- Low loss: 0.5dB
- Sharp cut-off: 60dB/23MHz
- Wide-band: 280 MHz
- Small size: 60mm in diameter



60 mm

The filters were fabricated on superconductor YBCO films on MgO substrates.
HTS filter operating temperature is 70 K.



From <http://www.kreynet.de/asc/ybco.html>

HTS filter

LNA output

D/C input

To observation room



60 mm

Cryogenic subsystem

filter unit

Low loss

- Due to low resistance of HTS films in microwave frequency, T_{sys} increase can be very small even if the filter is installed before LNA.

HTS filter 0.5dB/32 sections

Conventional filter 1dB/19 sections

Sharp cut-off

- 32 sections was possible due to low resistance of HTS films. 60dB/23MHz
- Resulting extension of observable frequency range than conventional filter.

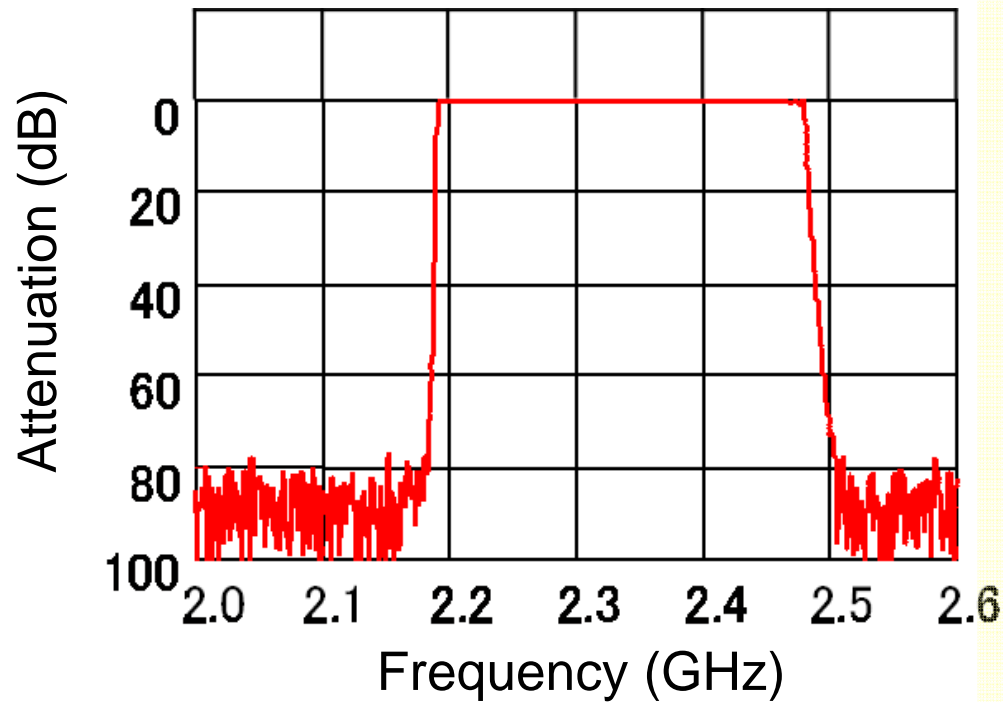
Wide-band

- Wide-band by new filter design.
- Bandwidth ratio 1% ->12%(280MHz)

Small size

- Miniaturization by new filter design.
- Diameter 60mm, thickness 14mm

HTS filter specifications



- Pass band
2193-2473 MHz
- Attenuation
>60 dB at 2170MHz
- Insertion Loss
<0.5dB at 2333MHz
- Dimension
60 x 14 mm
- 32 sections
(model RA-S-32)

Inside of HTS filter subsystem



Weight 11.5kg

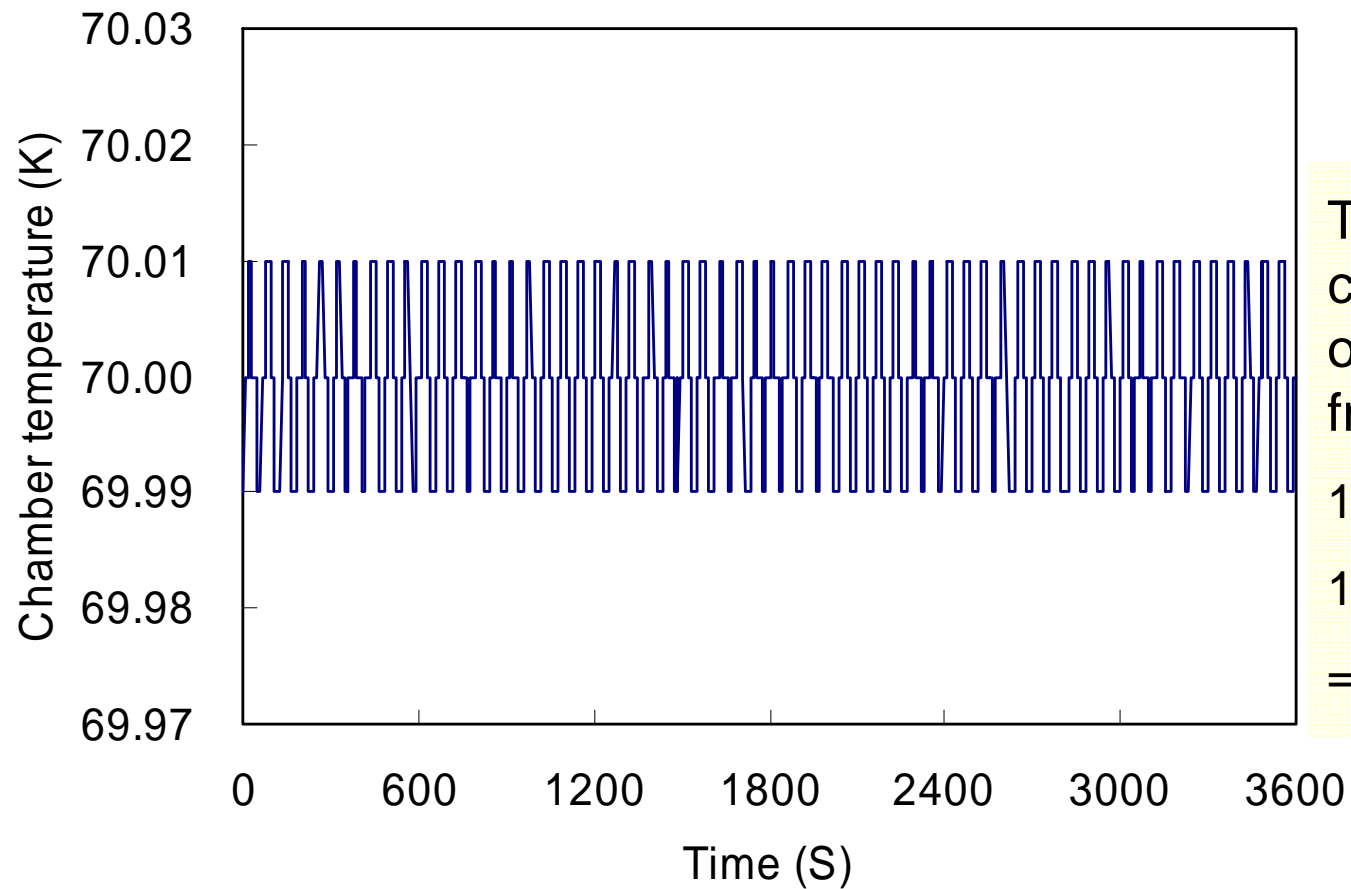
Width 270 mm

Depth 170 mm

Height 270 mm

A case, a controller,
and a power supply
are not included.

Chamber temperature (1 hour)



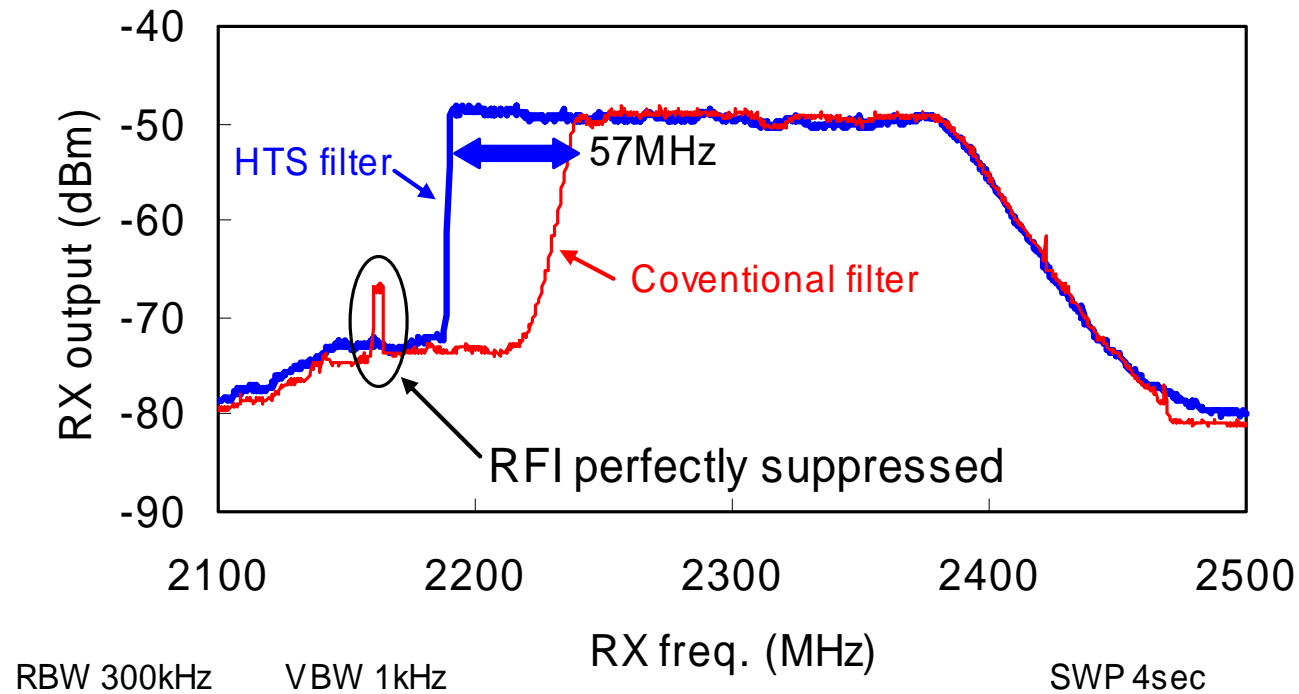
Temperature characteristics of cut-off frequency

100kHz/K(at70K)

100kHz x 0.01K

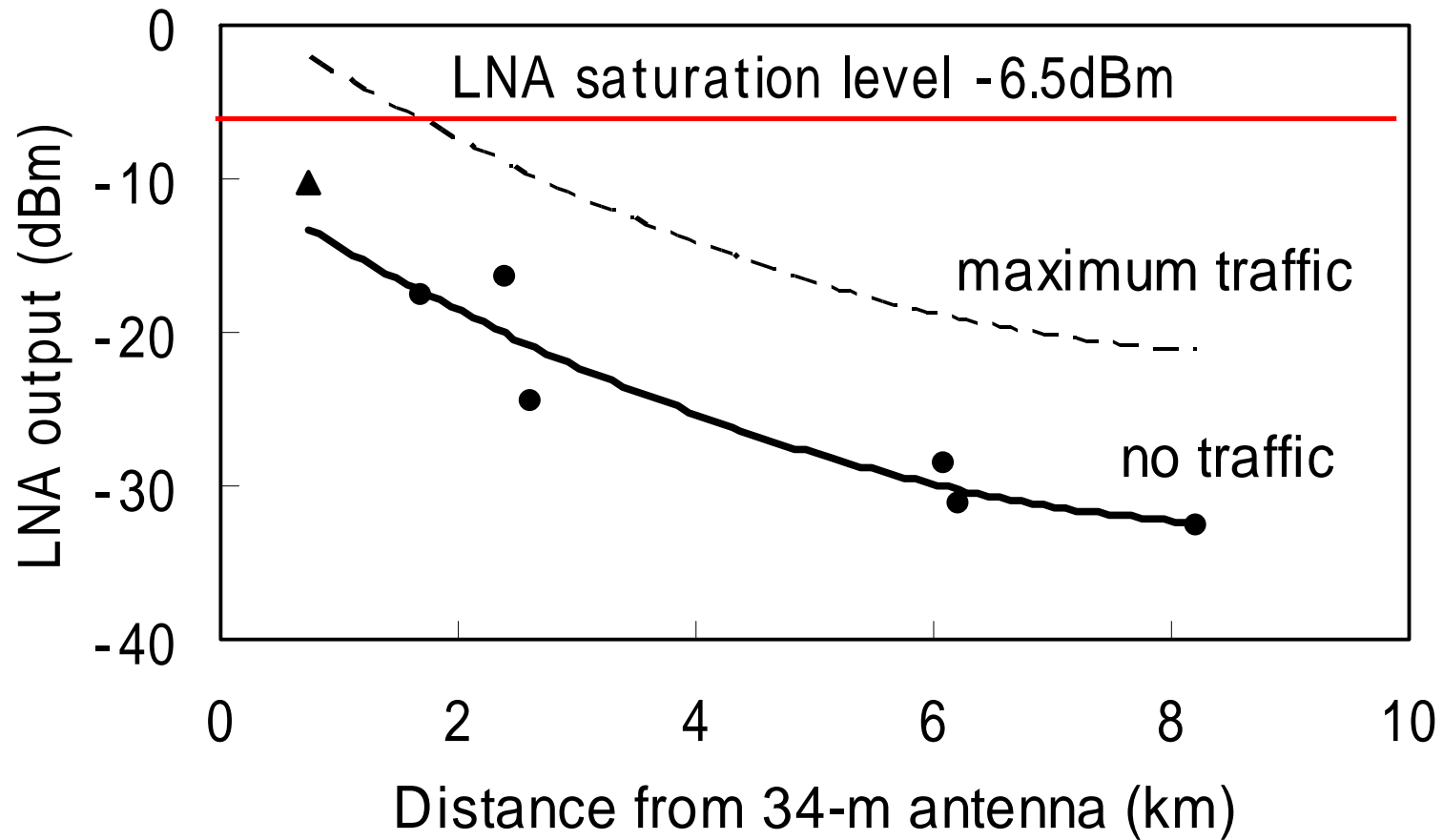
=1kHz

S-band receiver output characteristics



The frequency of 2193 to 2350MHz became observable.

Base station distance and LNA output



Future possibility

The countermeasure for LNA saturation

- As IMT-2000 is becoming popular, the interference level will increase.
- HTS filter can be installed before LNA as a countermeasure.
- The increase of T_{sys} can be minimized by using the HTS filter.

Increase in T_{sys} with a filter

Conventional filter 62K

HTS filter 8K

Conclusions

- S-band observations became difficult after IMT-2000 service started.
- We succeeded to develop HTS filter to mitigate the RFI in S-band.
- Because of its low loss characteristics, the HTS filter can be installed before LNA.