



Detected Interferences at S-band from
the 40-m Radiotelescope Servo System

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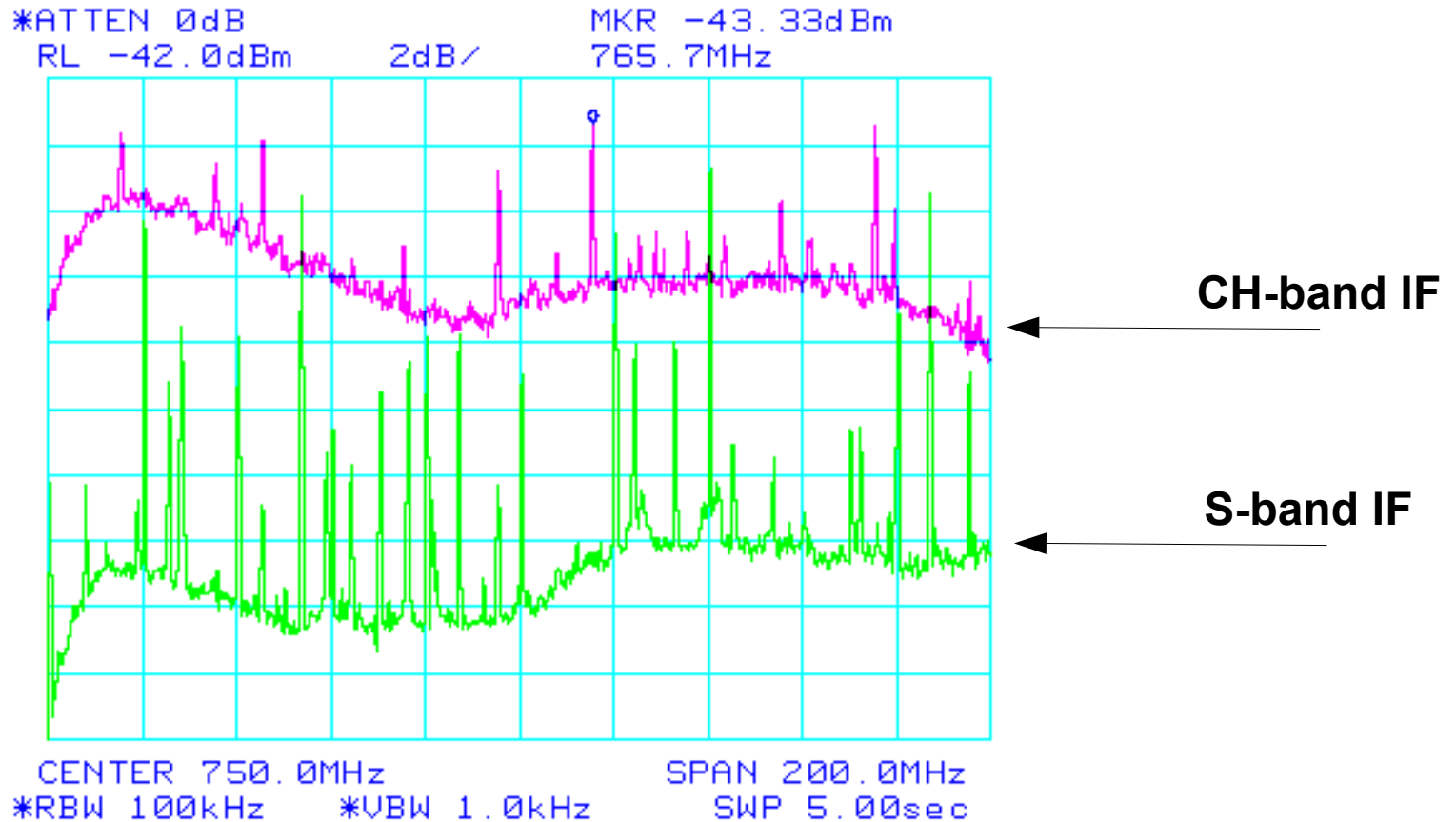
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40m Receivers in operation

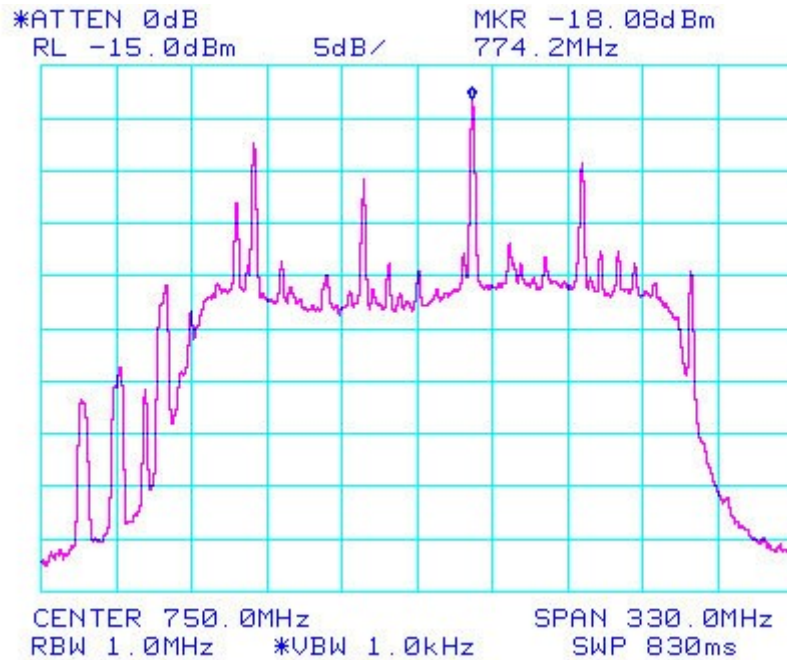
Receiver	Band (GHz)	Trx (K)	Polarization	Comments
S-band	2.2 – 2.37	50	Dual circ.	RFI !!
CH-band	3.215 - 3.385	55	Dual circ.	RFI !!
C-band	4.56 – 5.06 5.9 – 6.9	70	Dual circ.	First EVN observ. Last week
X-band	8.18 – 8.98	10	Dual circ.	-
K-band	21.75 – 22.85 23.35 – 24.45	20	Dual circ.	-
Holography	10.9 - 12.75	80	Lin.	Prime focus
3mm	84 - 116	50	Single lin or circ.	Coming soon ...

Interferences from Servo Electronics

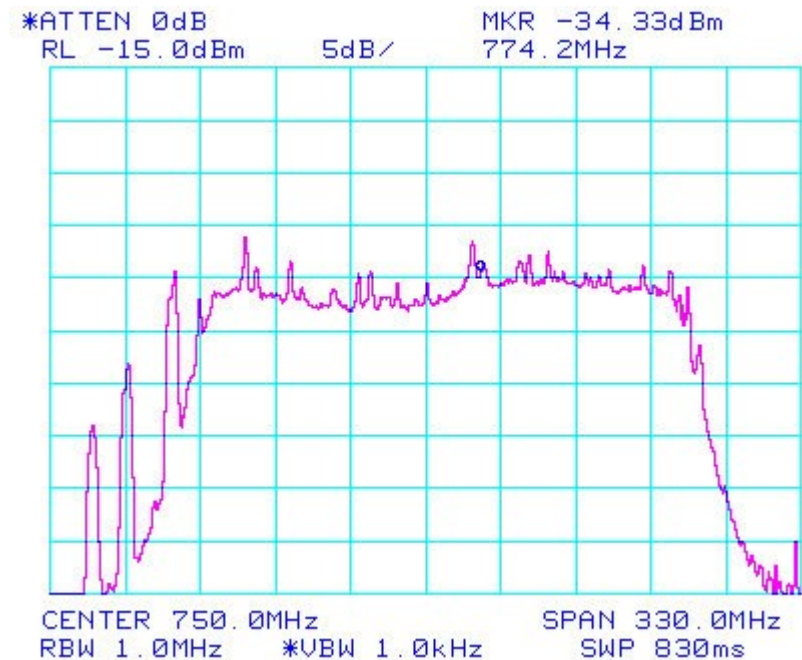


RFI spectrum in S band (green line) and CH-band (magenta line) under normal antenna and Rx's operation

Interferences from Servo Electronics



Profibus modules ON

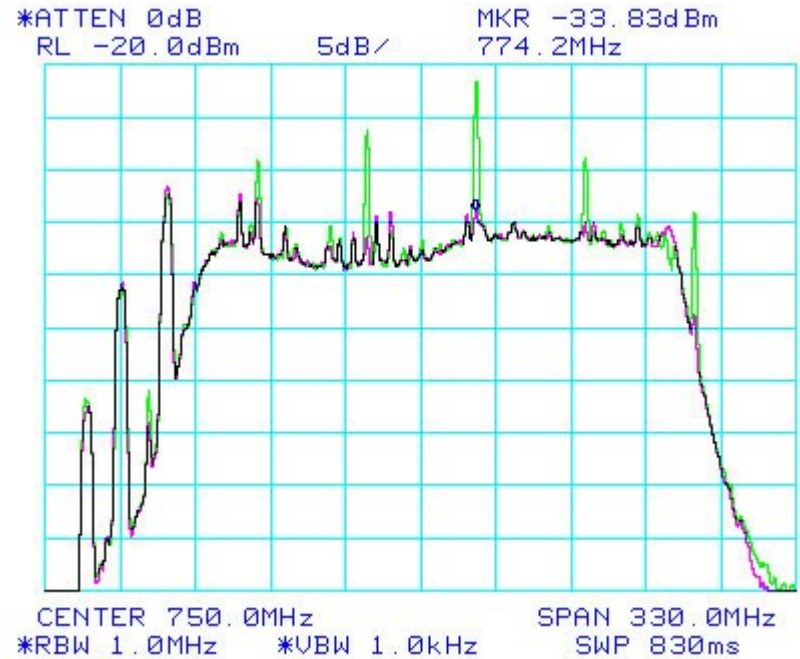


Profibus modules OFF

Interferences from Servo Electronics



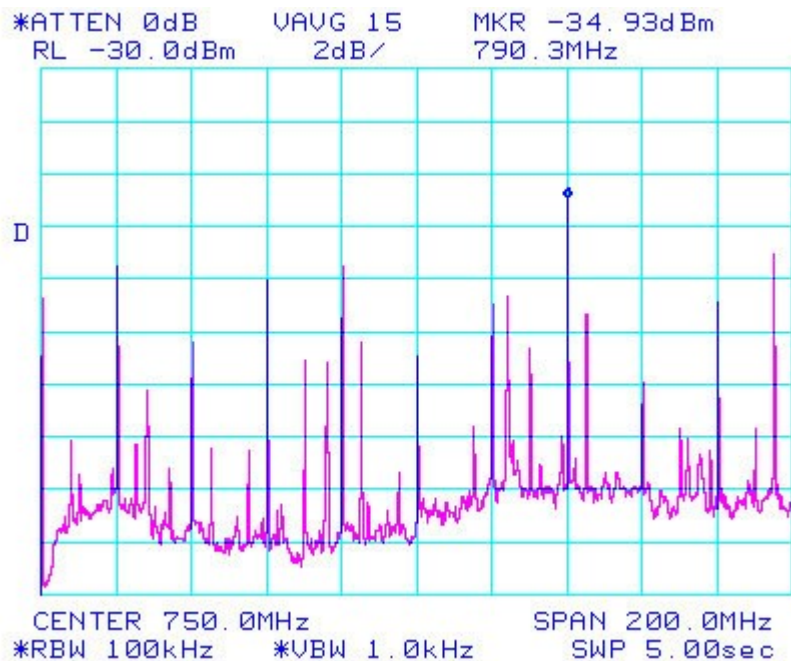
**M3 Mirror Profibus Module
inside shielded box**



Some improvement ...

but not enough !

Interferences from Servo Electronics

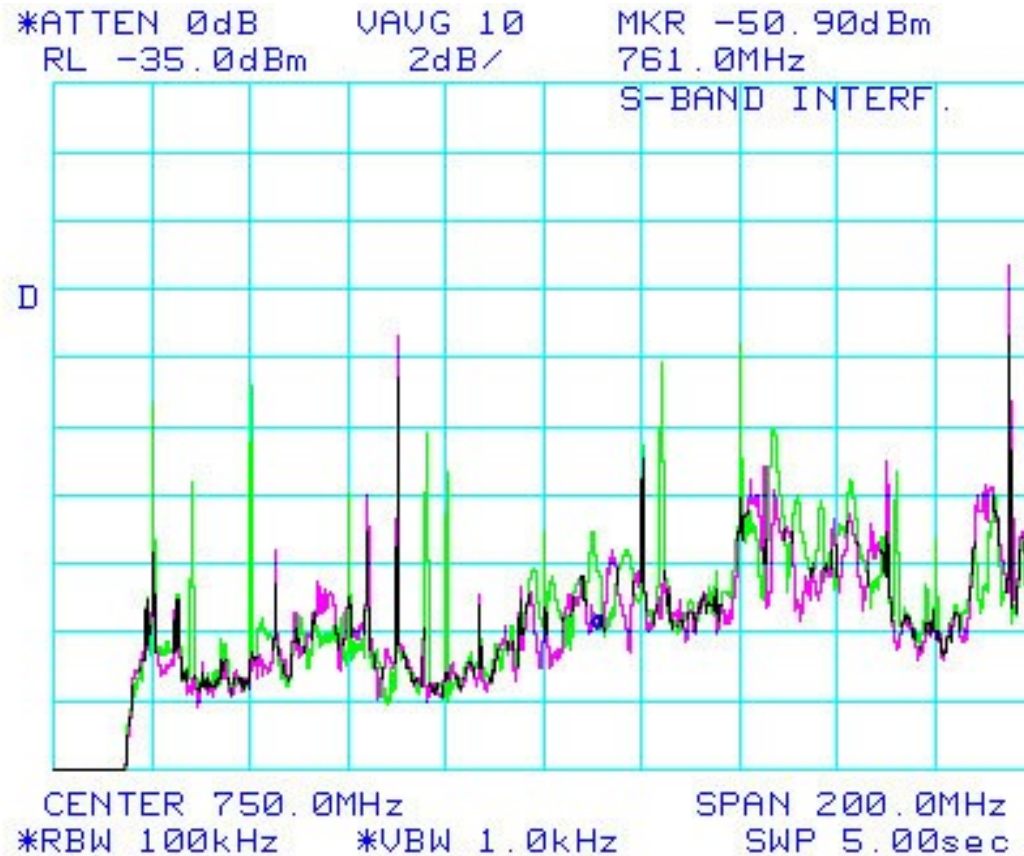


RFI spectrum in S band under normal antenna and Rx's operation

Main sources of interference from servos are:

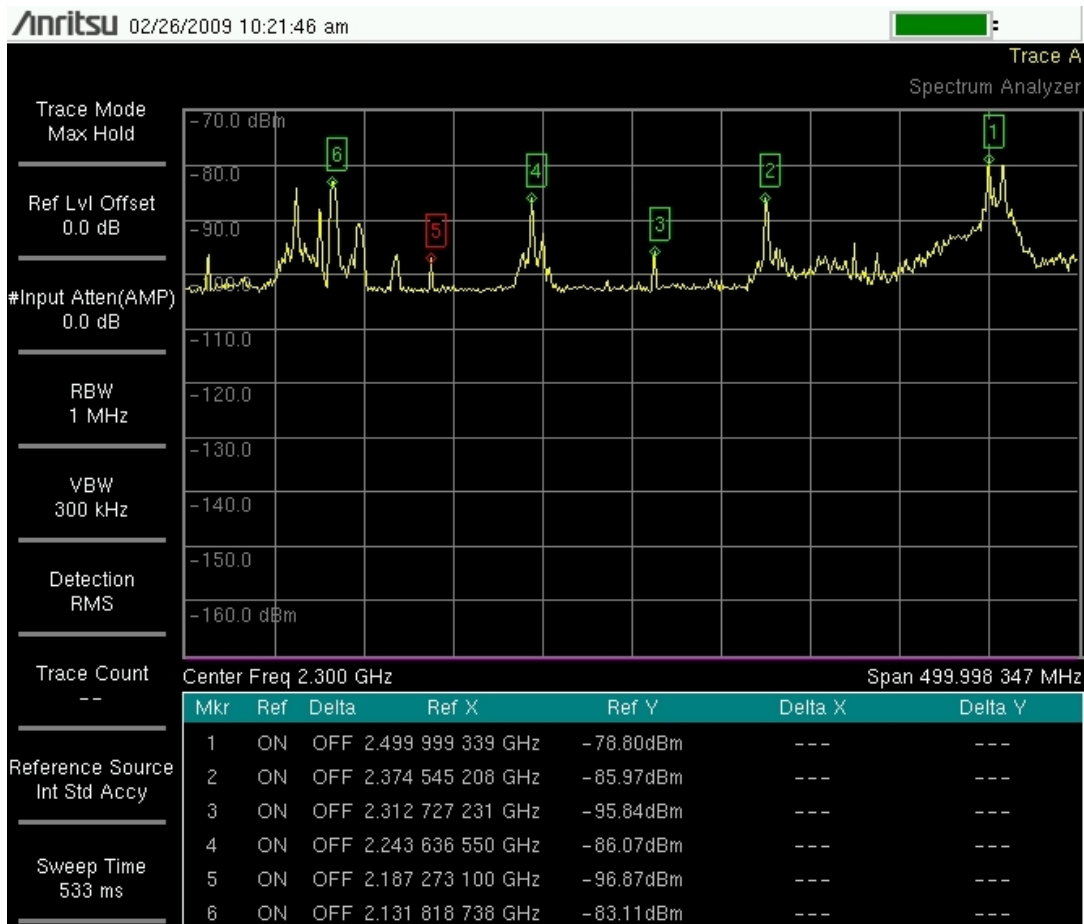
- **Beckhoff Local Control Panels (train of 20MHz spaced lines).**
- **Hand-Held panel for service operations.**
- **Profibus modules for sensor control (train of 16MHz & 48MHz spaced lines).**
- **Power supply from servo racks to servo equipment in Rx room.**

Interference from Servo Electronics



Even with all servos OFF (magenta line) , some RFI is remaining !

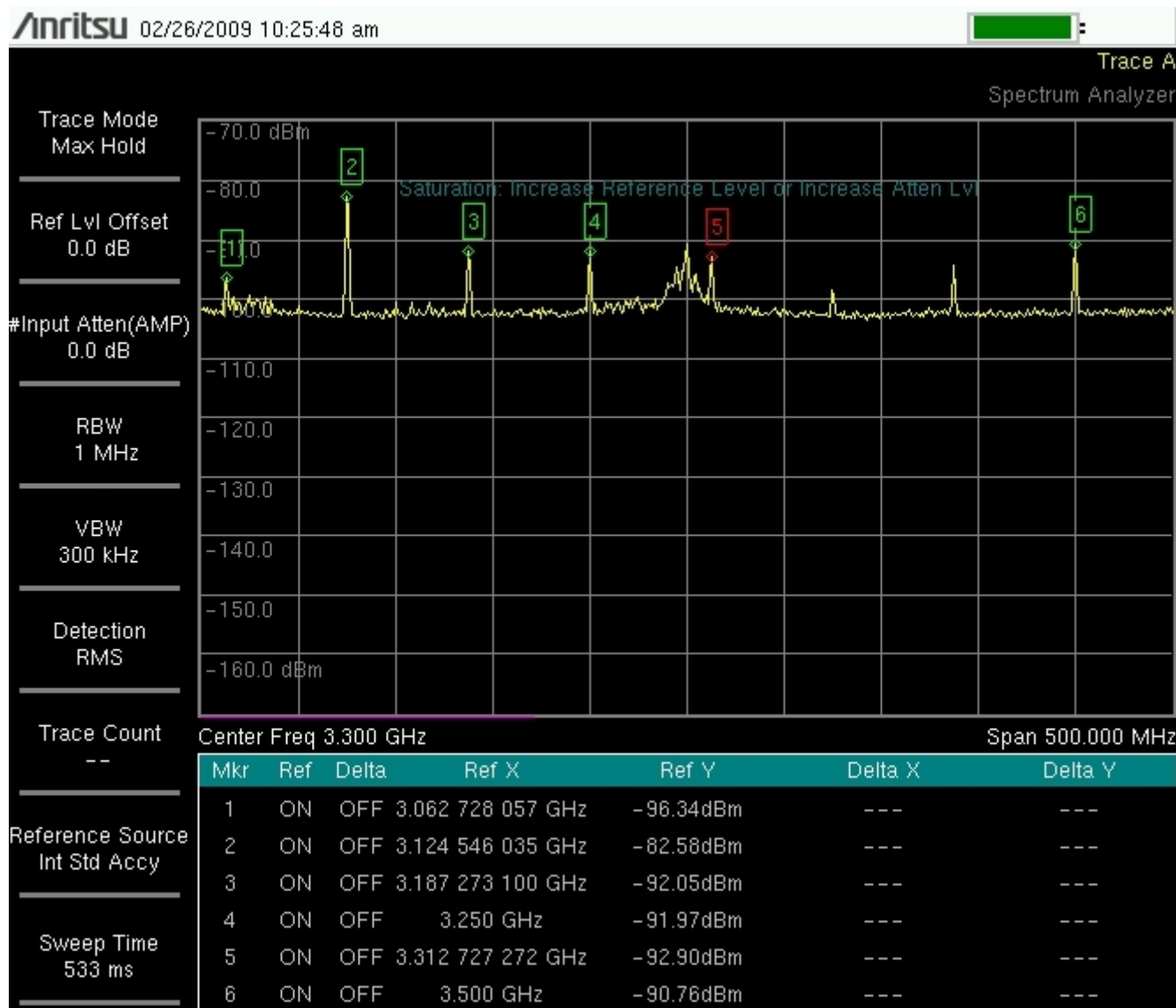
Interferences from Domestic Equipment @ S-Band



**Signals radiated by LAN
Ethernet Switch in S-band**

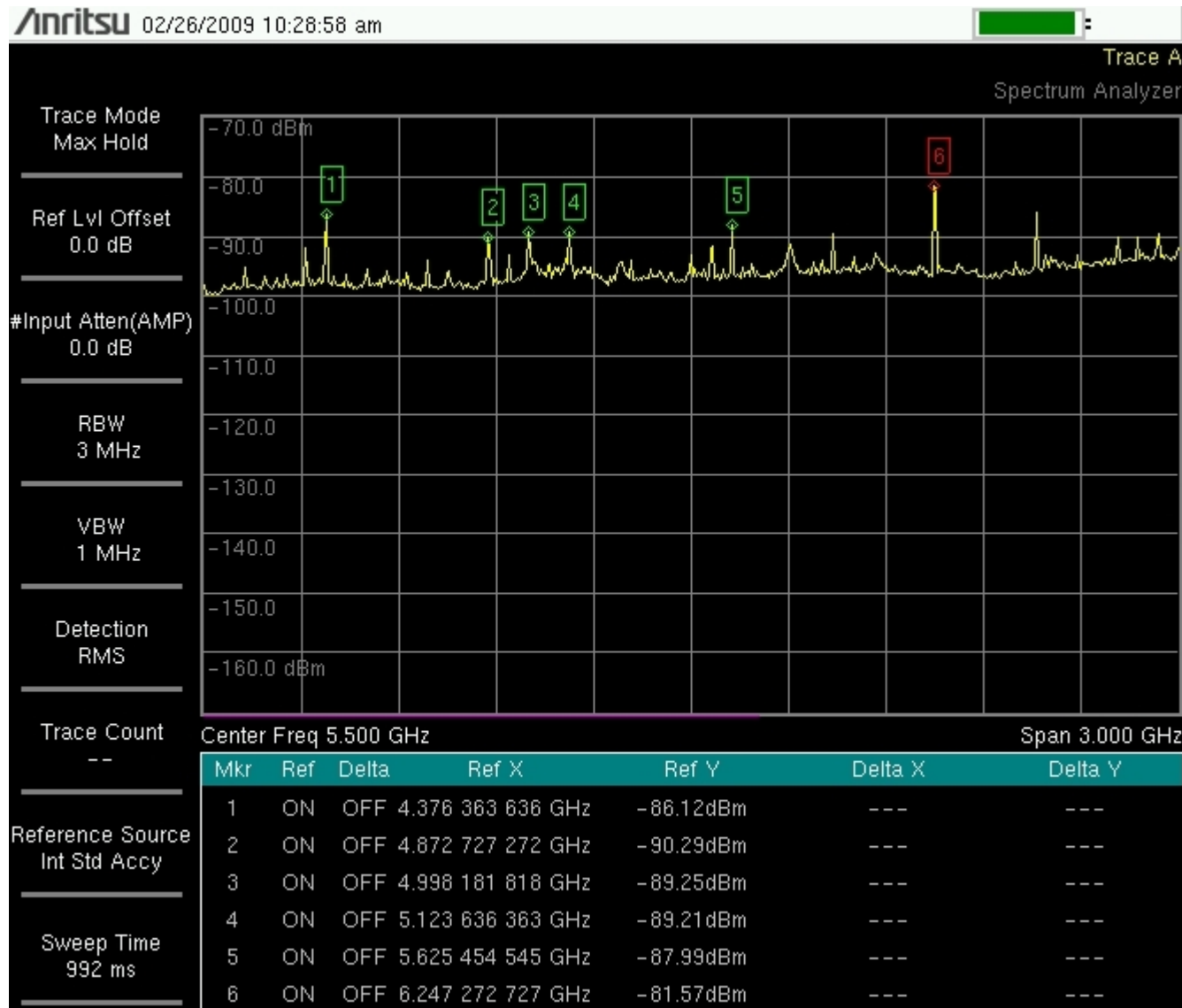
**Reduction of LAN speed to
100MHz or 10MHz doesn't
show significant
improvement.**

Interferences from Domestic Equipment @ CH-Band



Signals radiated by
LAN Ethernet Switch
in CH-band

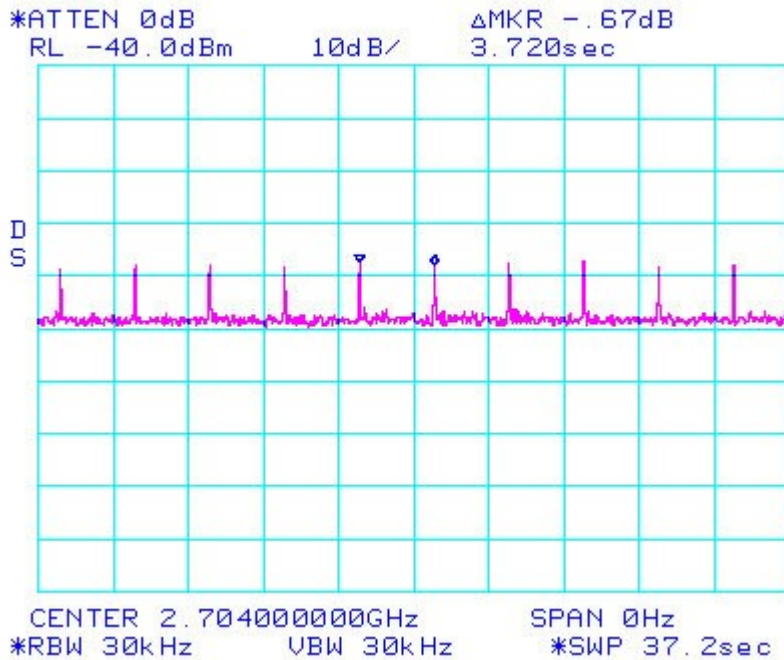
Interferences from Domestic Equipment @ C-Band



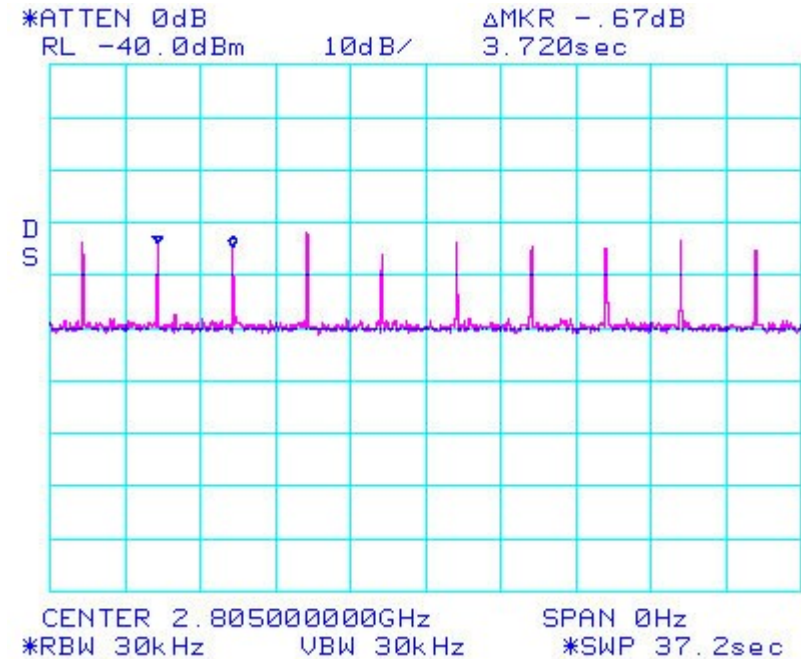
Signals radiated by
LAN Ethernet Switch
in C-band

External Interferences (Radars)

Torrejón Air Base Radars @ 30Km distance

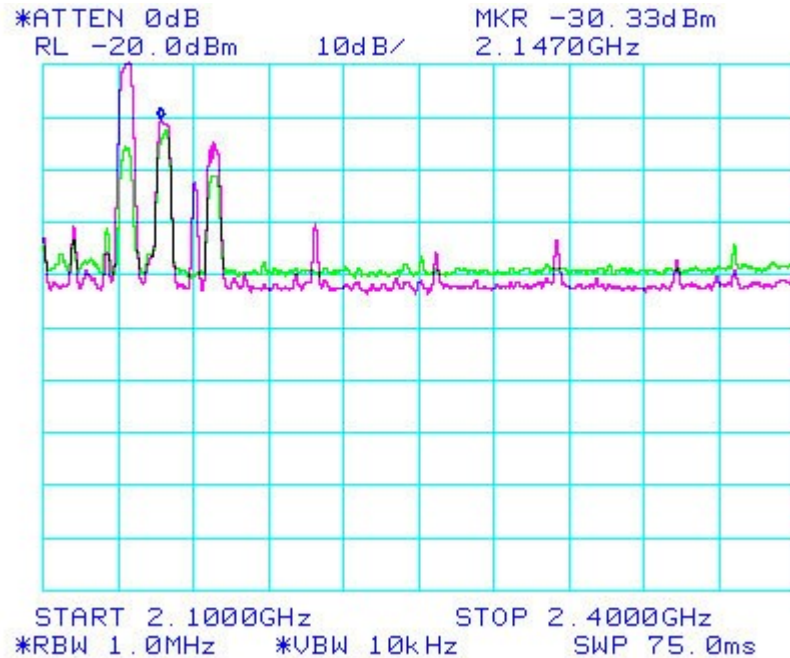


**Radar @ 2704 MHz
16 rpm**



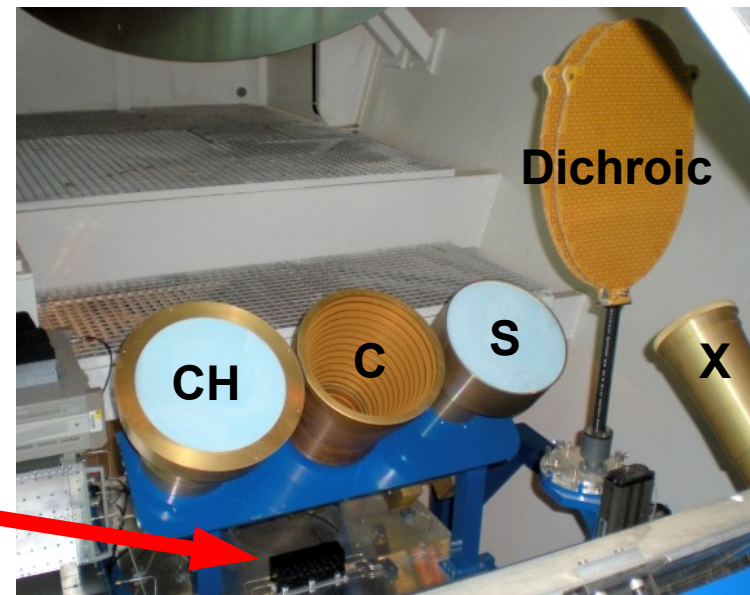
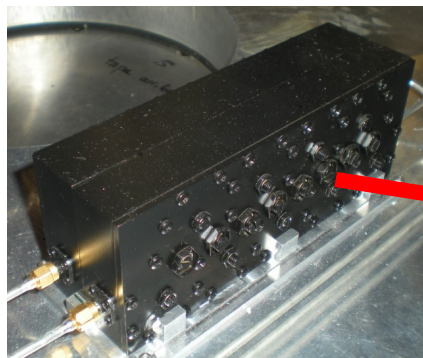
**Radar @ 2805 MHz
16 rpm**

External Interferences (Radio-Links)

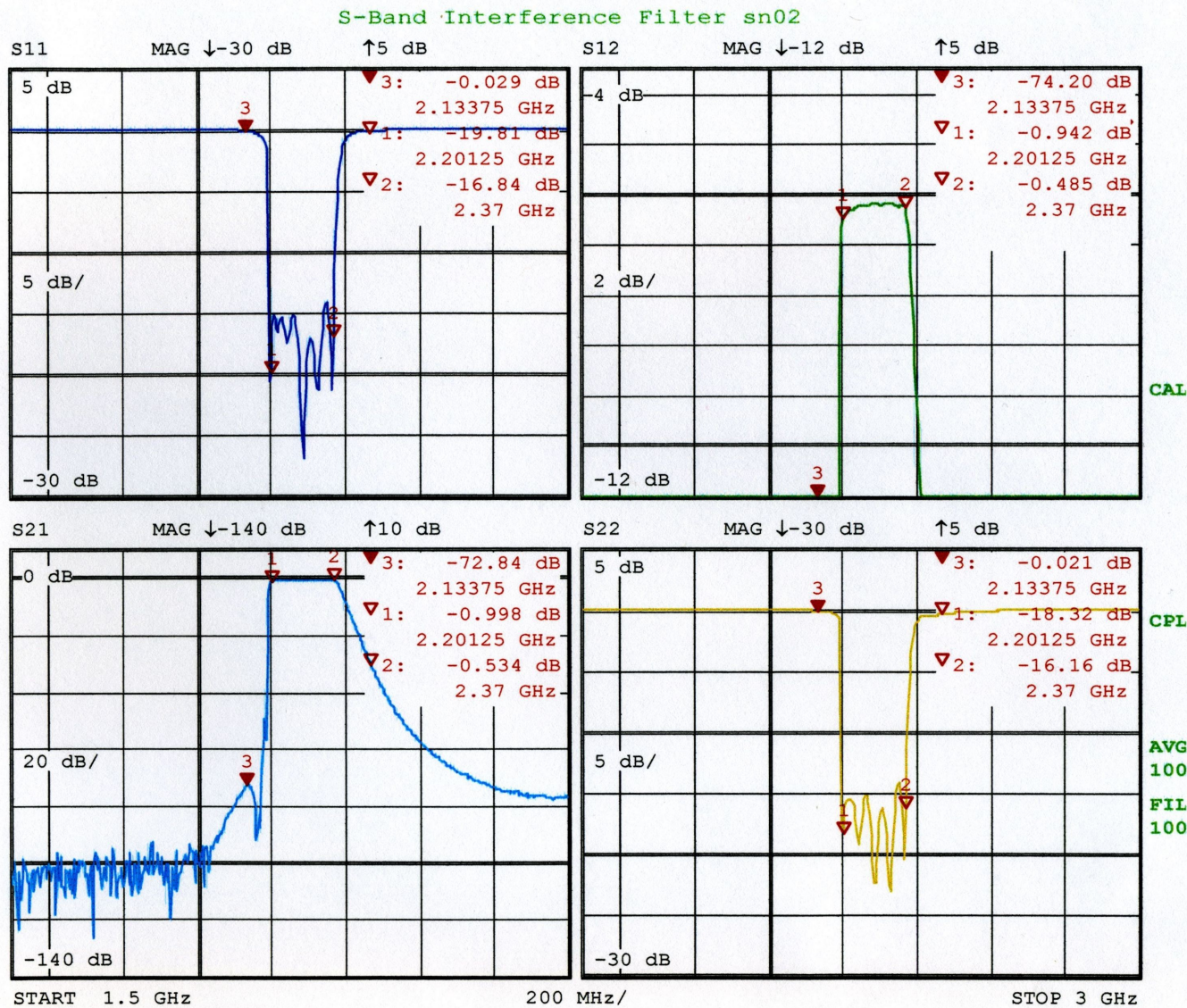


Three 4MHz BW lines coming from outside Yebes.

They were filtered out using custom designed 8-sections band-pass filters (see pictures below)



External Interferences (Radio-Links)



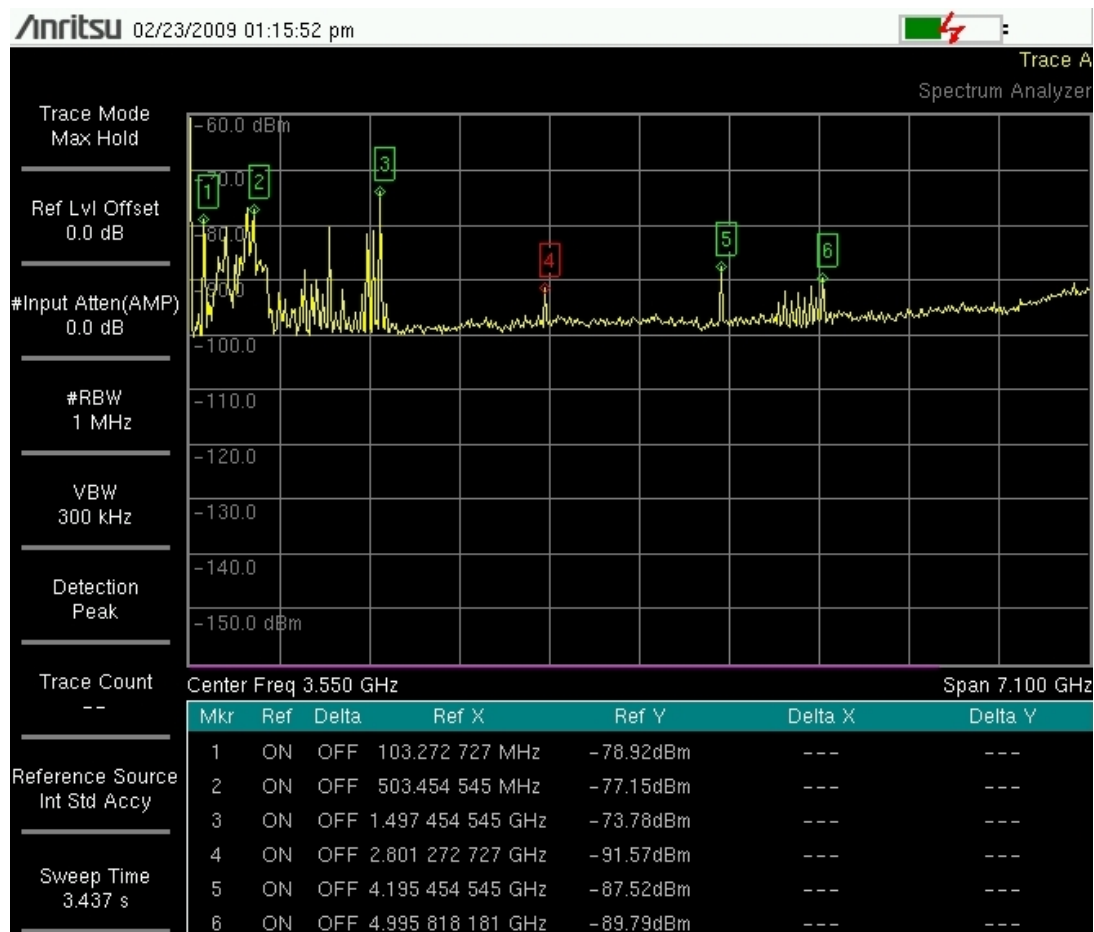
**S Band RFI
High Selectivity
Filter Response**

Date: 22.OCT.08 10:47:41

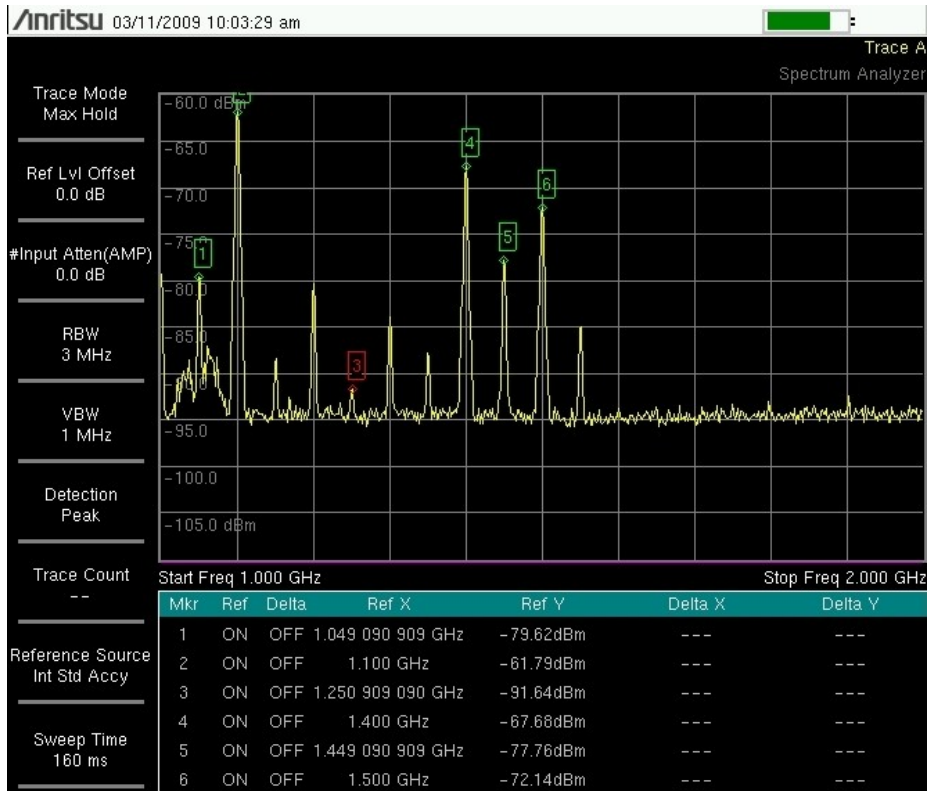
19.03.2009

IVS VLBI2010 /FRFF2009

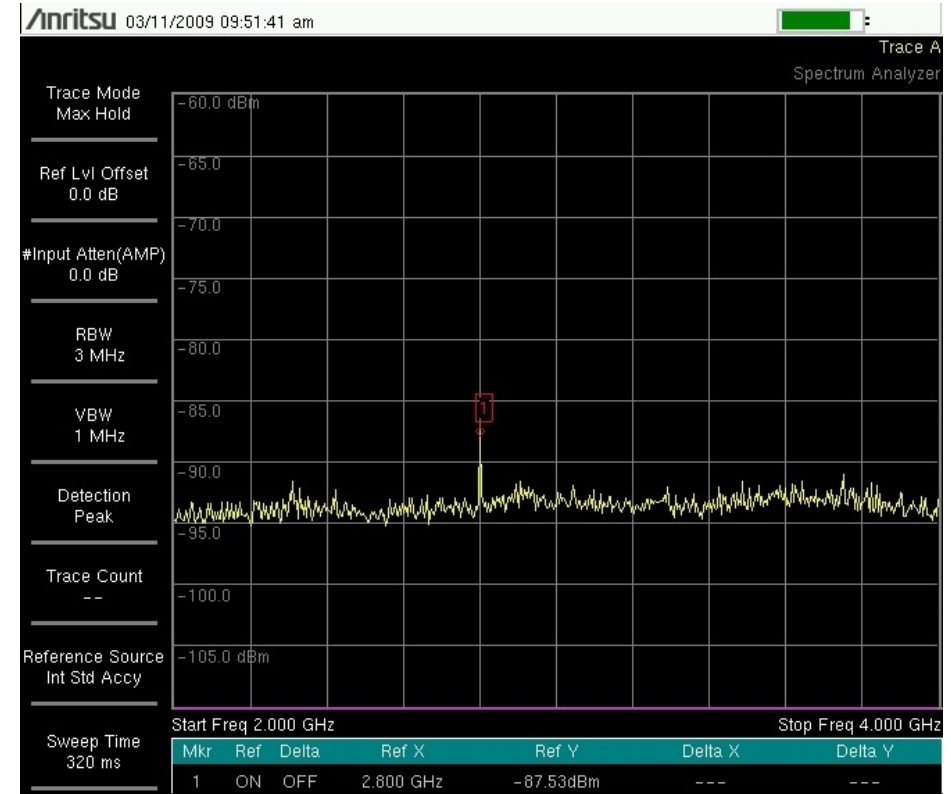
Radiation from Hydrogen Maser



Radiation from Hydrogen Maser

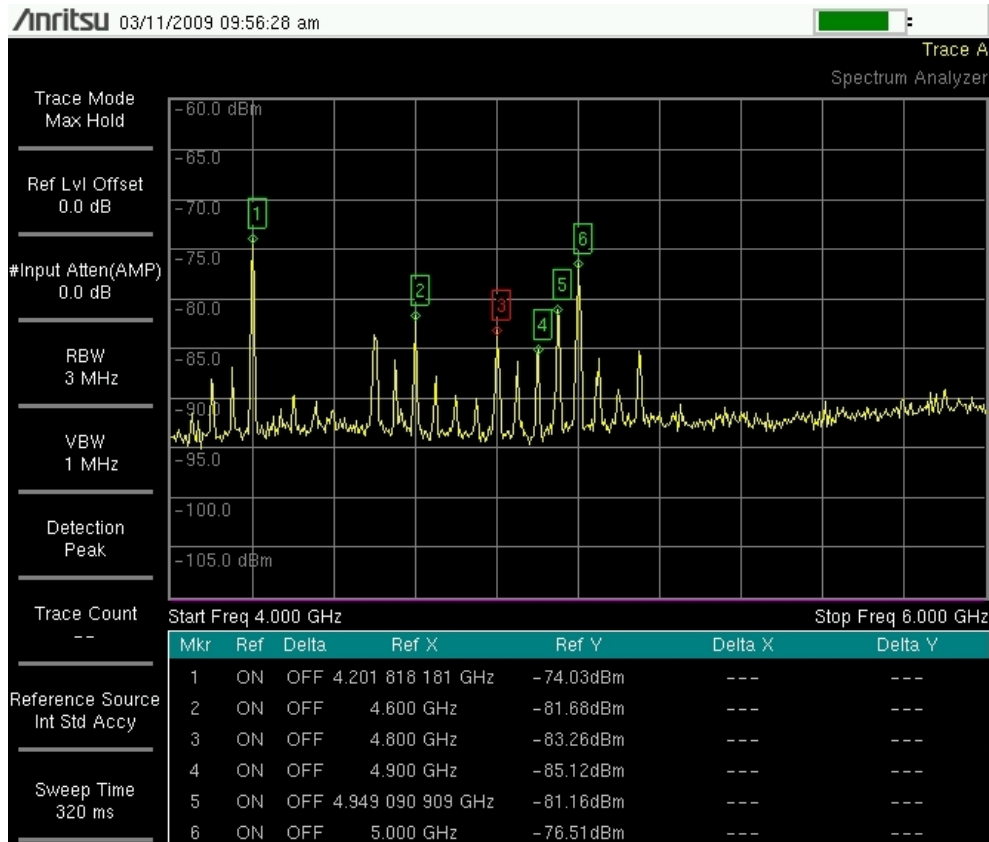


**Radiation from
1GHz to 2GHz**

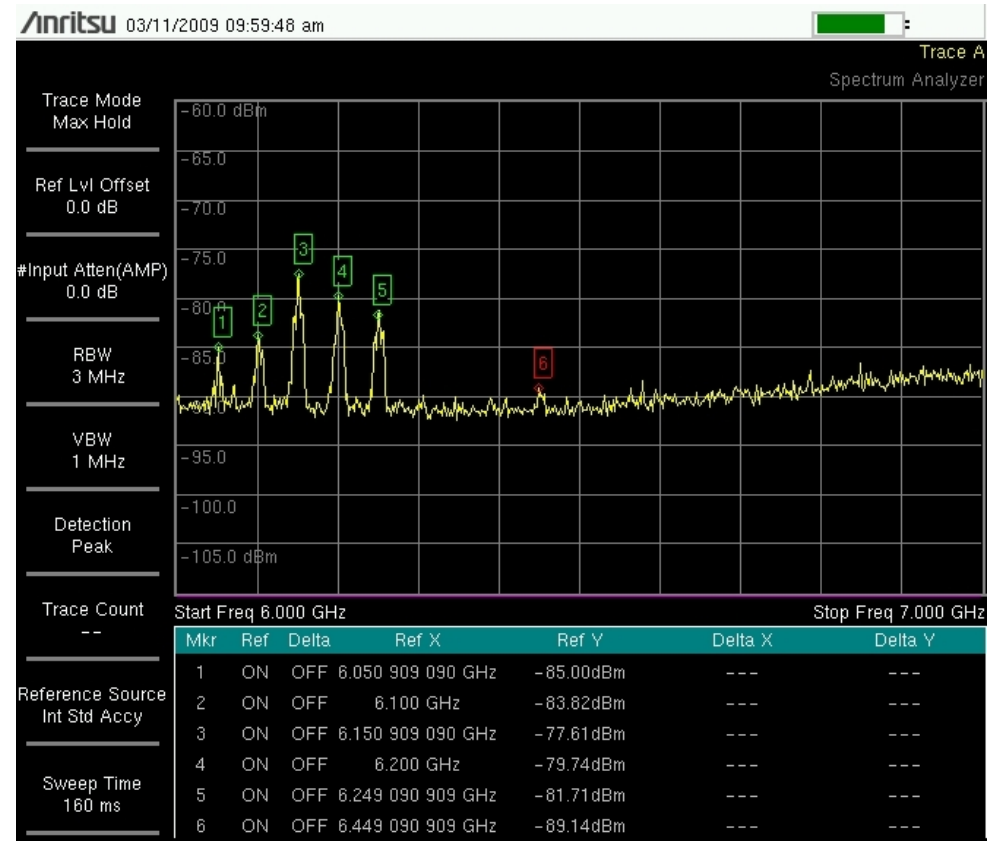


**Radiation from
2GHz to 4GHz**

Radiation from Hydrogen Maser



**Radiation from
4GHz to 6GHz**



**Radiation from
6GHz to 7GHz**

Conclusions

- **Most interferences are self-generated by servo electronics and domestic equipment**
- **Radio-links in the edge of S-band filtered out with custom high selectivity BPF.**
- **Detected S-band radars do not saturate LNA's and are filtered out by IF filters**
- **Radiation from maser seems to be innocuous as yet.**
- **No interferences detected as yet from X to K band.**
- **Actions in progress:**
 - ✓ **Domestic equipment racks shielding**
 - ✓ **Servo cabling to be improved**
 - ✓ **Lab testing of any equipment prior to installation in the antenna**