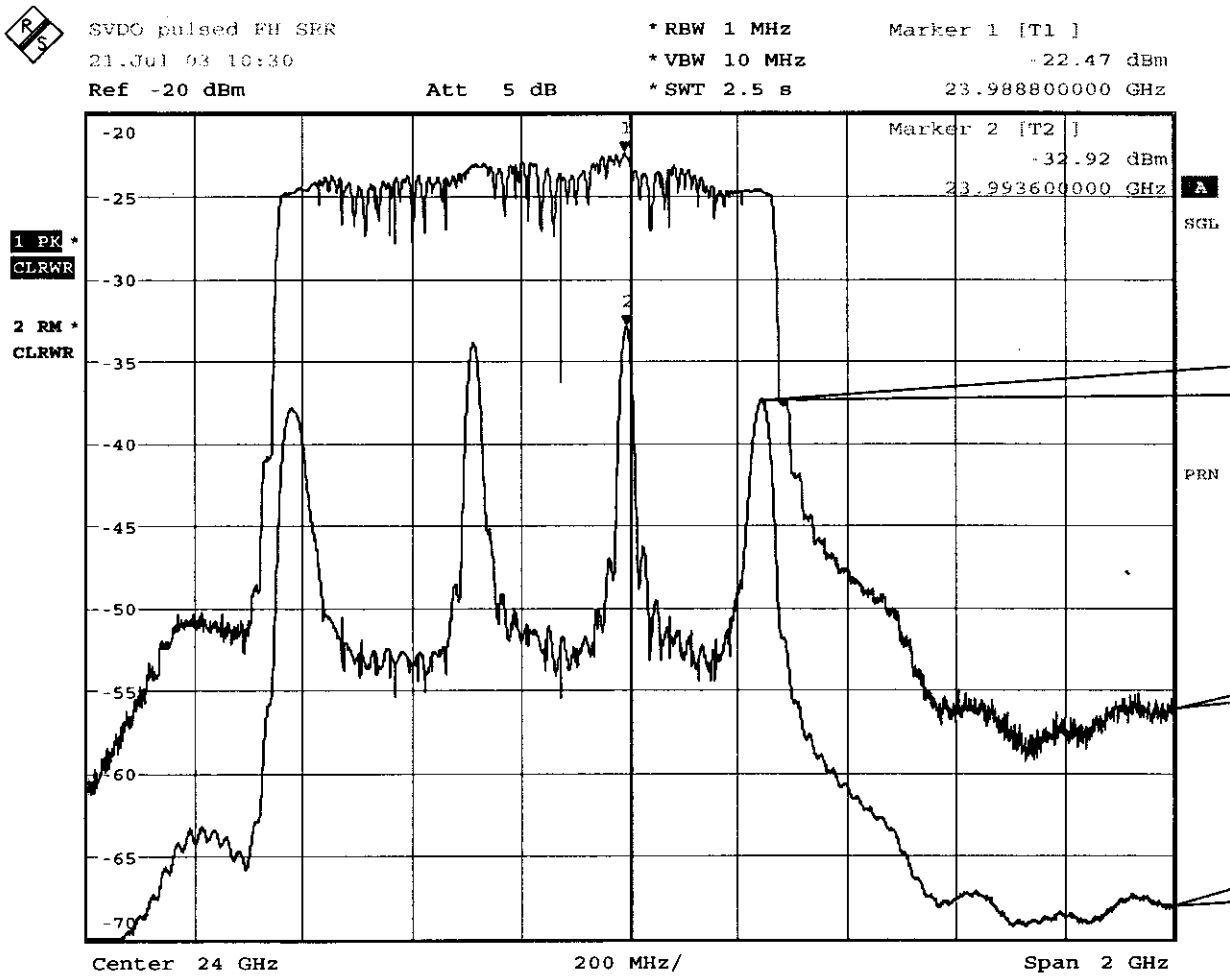
Pulse-modulated carrier (50 ns PW, 1 MHz PRF): 4 discrete FH frequencies



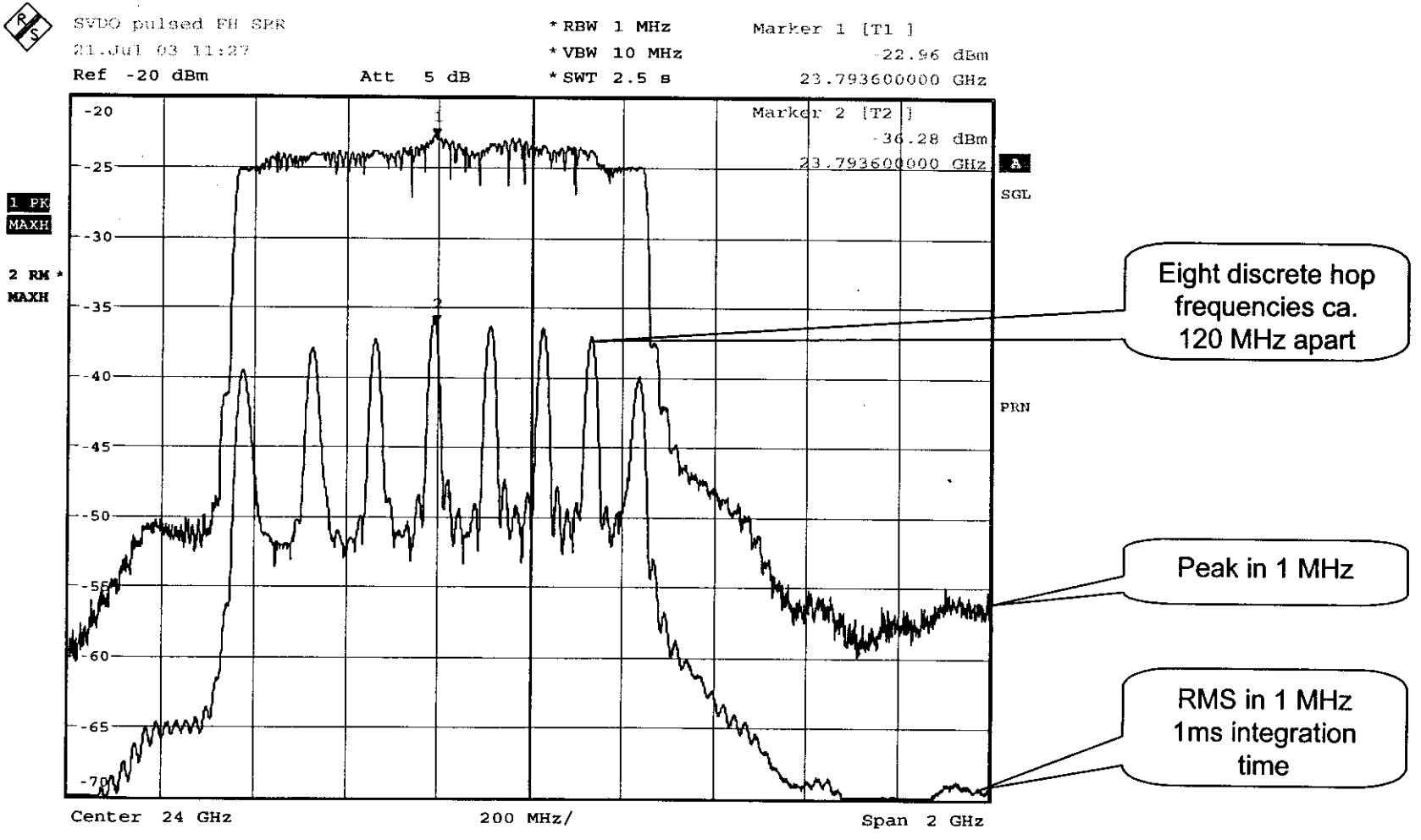
Four discrete hop frequencies ca. 300 MHz apart

Peak in 1 MHz

RMS in 1 MHz 1ms integration time

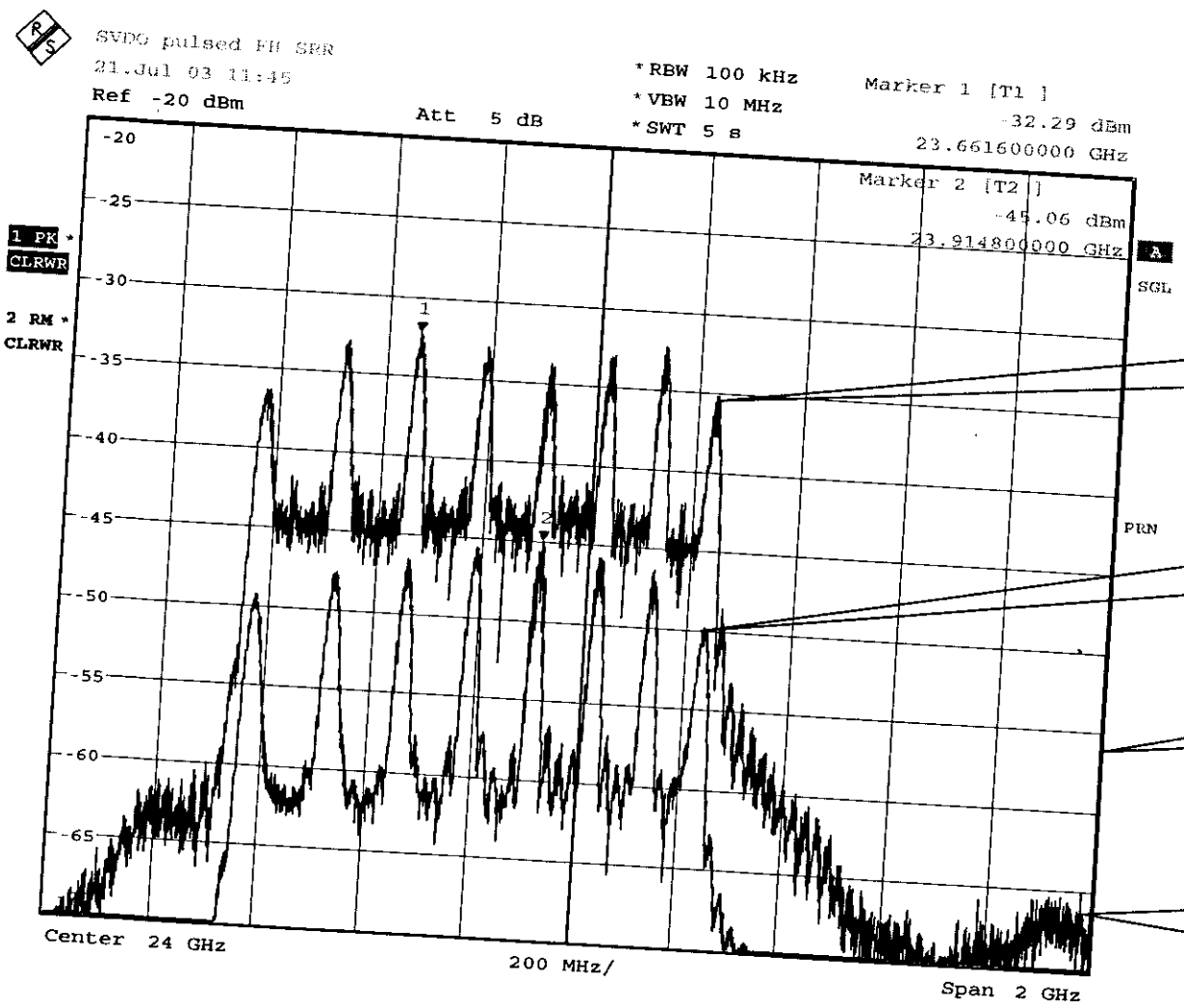
Comment A: 4-tone pulsed FH 50ns PW, 1MHz PRF,40 µs tone PRF, 25%each
VBW 10MHz RBW 1MHz 2501points 2.5s ST, singleS
Date: 21.JUL.2003 10:31:04

Pulse-modulated carrier (50 ns PW, 1 MHz PRF): 8 discrete FH frequencies



Comment A: 8-tone pulsed FH 50ns PW, 1MHz PRF,40 µs tone PRF,12.5%each
VBW 10MHz RBW 1MHz 2501points 2.5s Stime singleS
Date: 21.JUL.2003 11:27:11

Pulse-modulated carrier (50 ns PW, 1 MHz PRF): 8 discrete FH frequencies



RBW < PRF => SLP gets visible

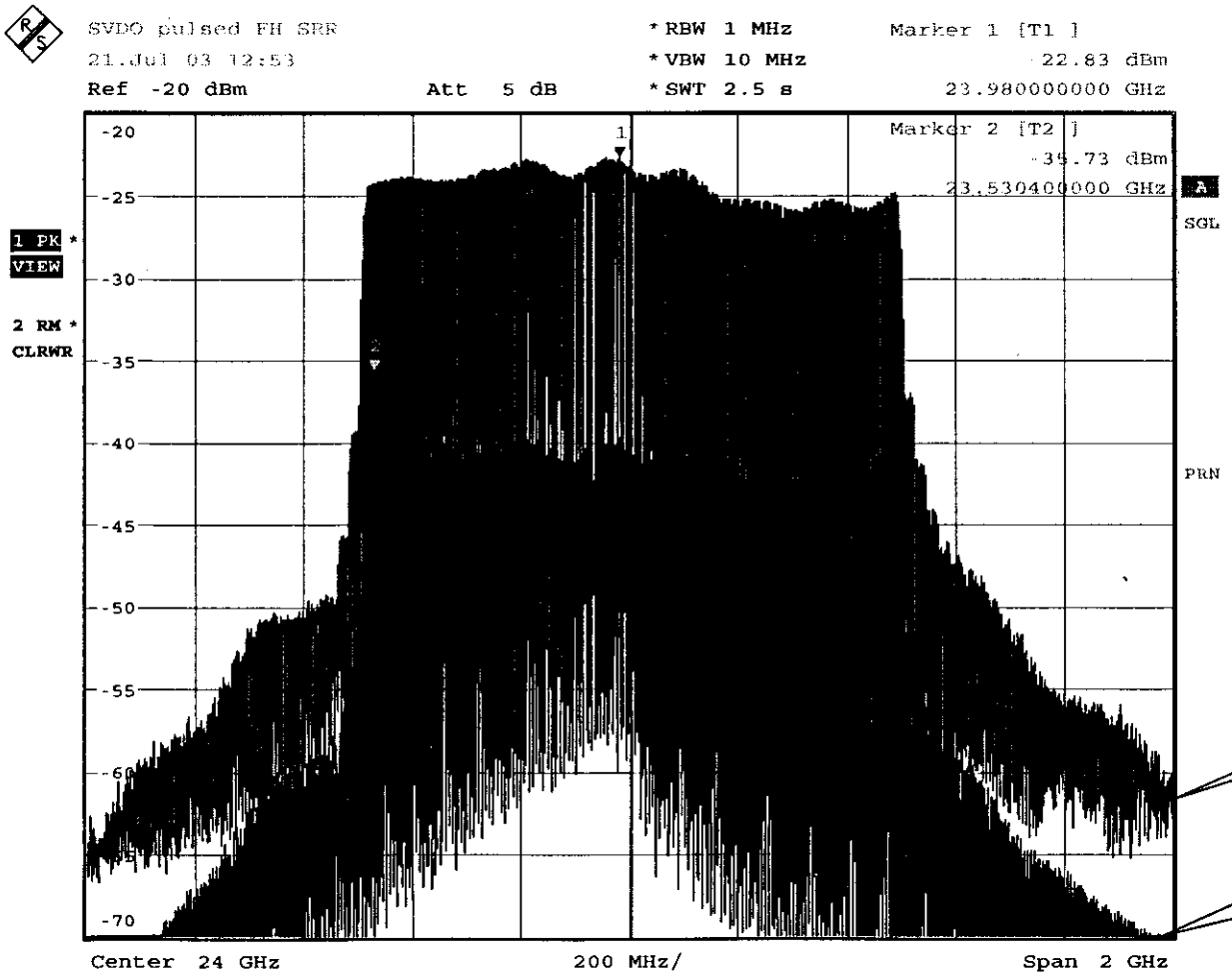
Eight discrete hop frequencies ca. 120 MHz apart

Peak in 1 MHz

RMS in 1 MHz 1ms integration time

Comment A: 8-tone pulsed FH 50ns PW, 1MHz PRF,40 µs tone PRF,12.5%each
VBW 10MHz RBW 100kHz 5001points 5s Stime singleS
Date: 21.JUL.2003 11:45:52

Pulse-modulated carrier (50 ns PW, 1 MHz PRF): 64 discrete FH frequencies

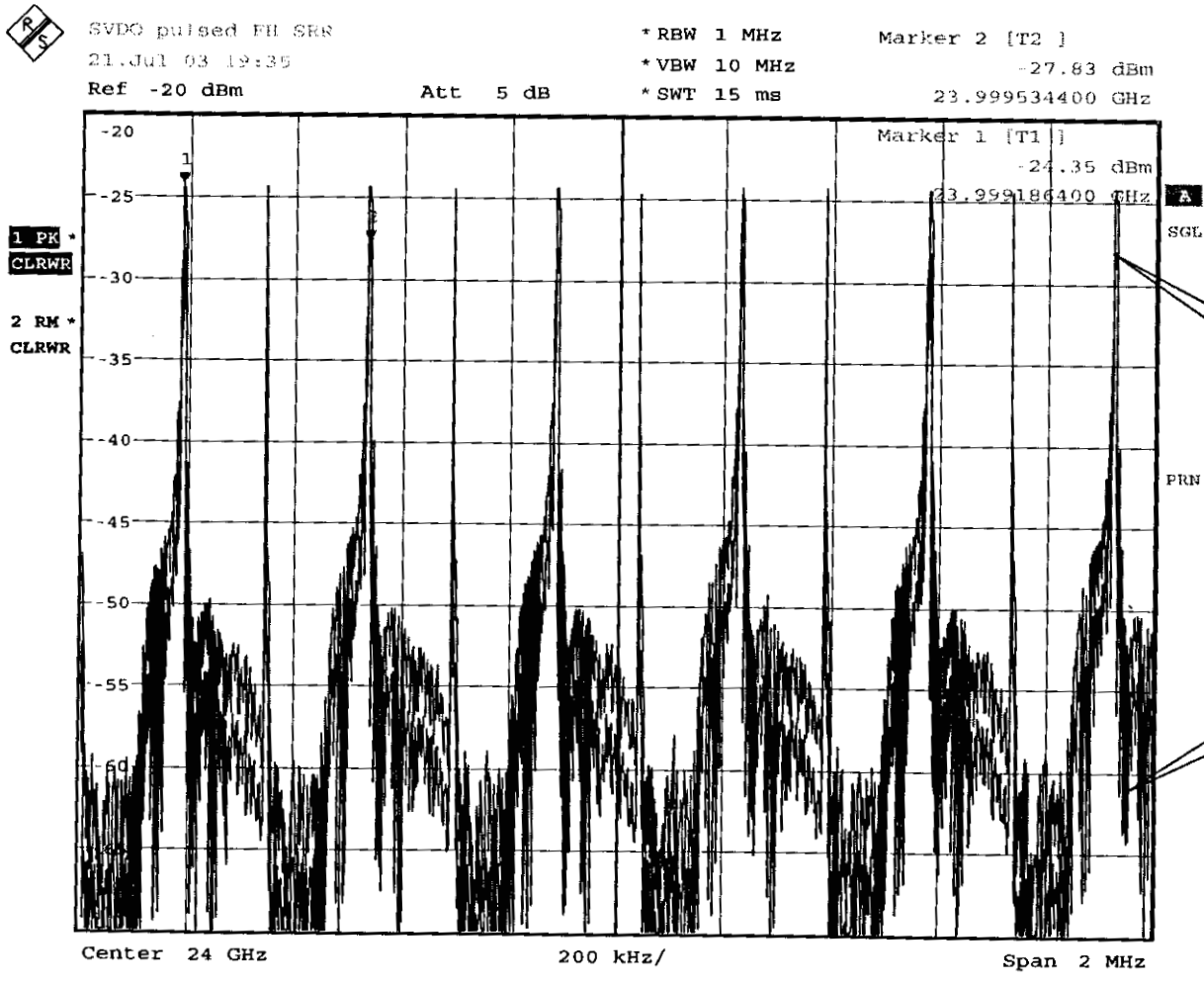


Peak in 1 MHz

RMS in 1 MHz
1ms integration
time

Comment A: 64-tone pulsed FH 50ns PW, 1MHz PRF,2.621 ms total frametime
VBW 10MHz RBW 1MHz 2500points 2.5s Stime singleS
Date: 21.JUL.2003 12:53:37

Pulse-modulated carrier (50 ns PW, 1 MHz PRF): 64 discrete FH frequencies

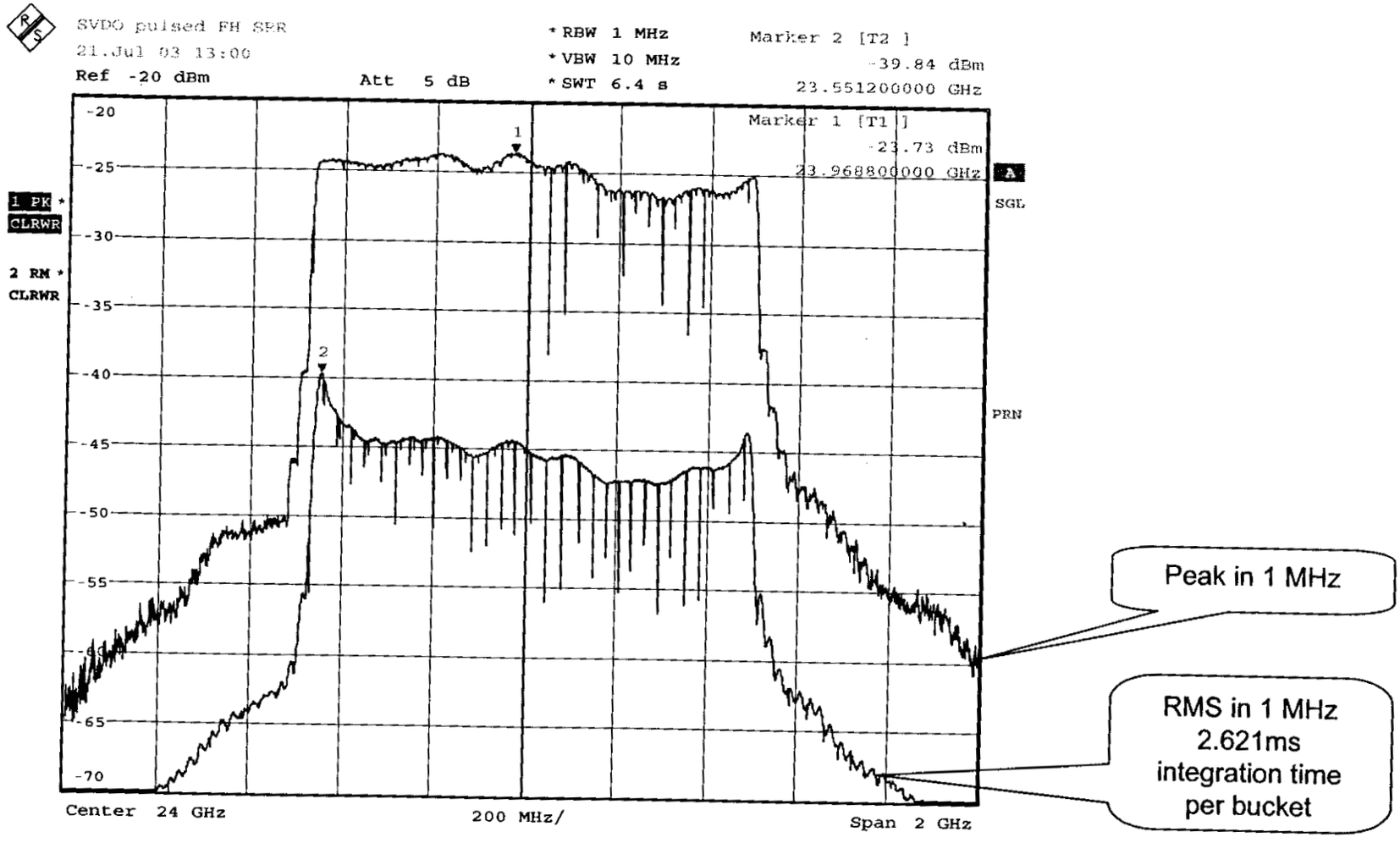


Peak in 1 MHz

RMS in 1 MHz
0.006 ms
integration time

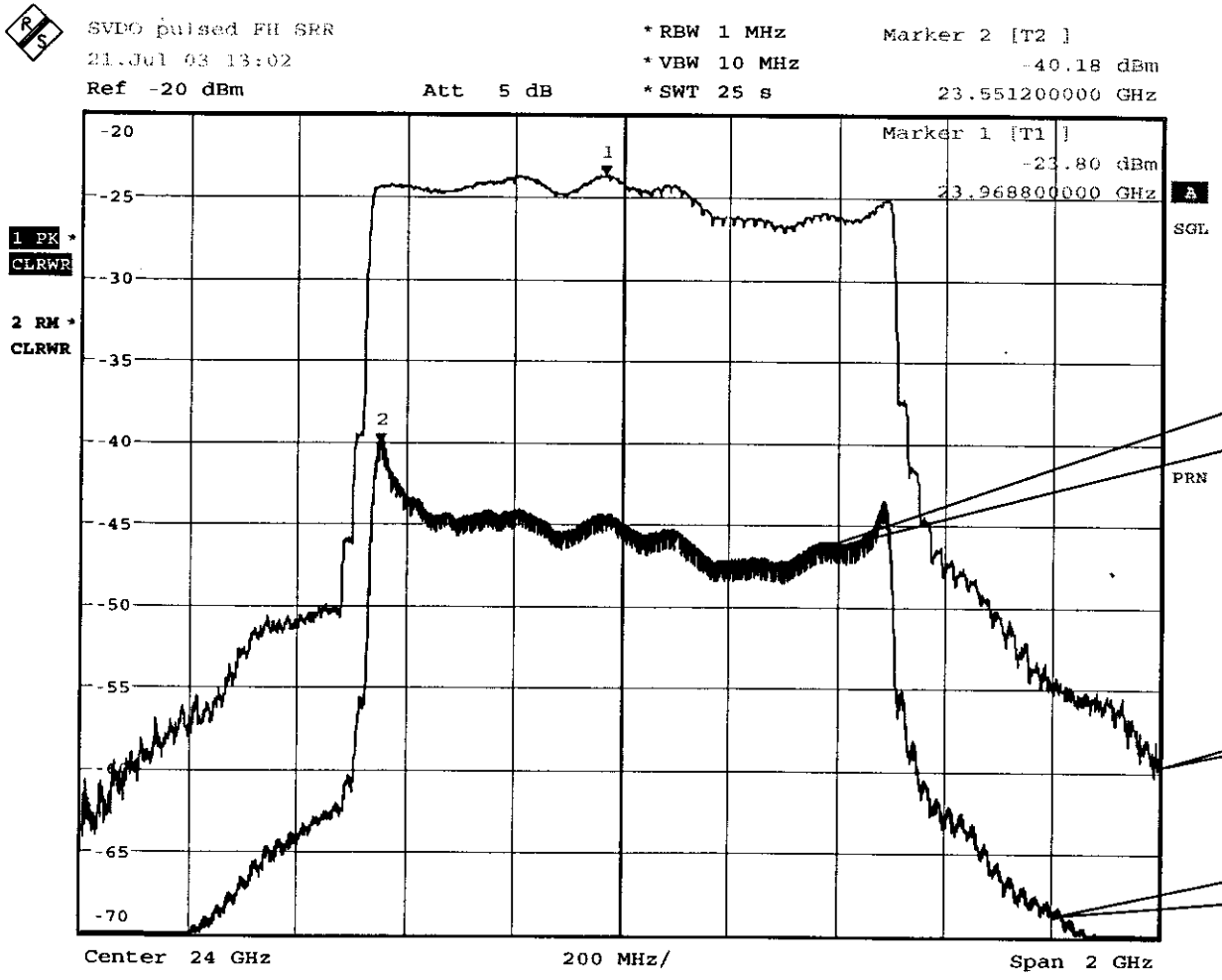
Comment A: 64-tone pulsed FH 50ns PW, 1MHz PRF,2.621 ms total frametime
VBW 10MHz RBW 1MHz 2500points 15ms Sweeptime
Date: 21.JUL.2003 19:35:28

Pulse-modulated carrier (50 ns PW, 1 MHz PRF): 64 discrete FH frequencies



Comment A: 64-tone pulsed FH 50ns PW, 1MHz PRF,2.621 ms total frametime
VBW 10MHz RBW 1MHz 2500points 6.4s Stime singleS
Date: 21.JUL.2003 13:00:41

Pulse-modulated carrier (50 ns PW, 1 MHz PRF): 64 discrete FH frequencies



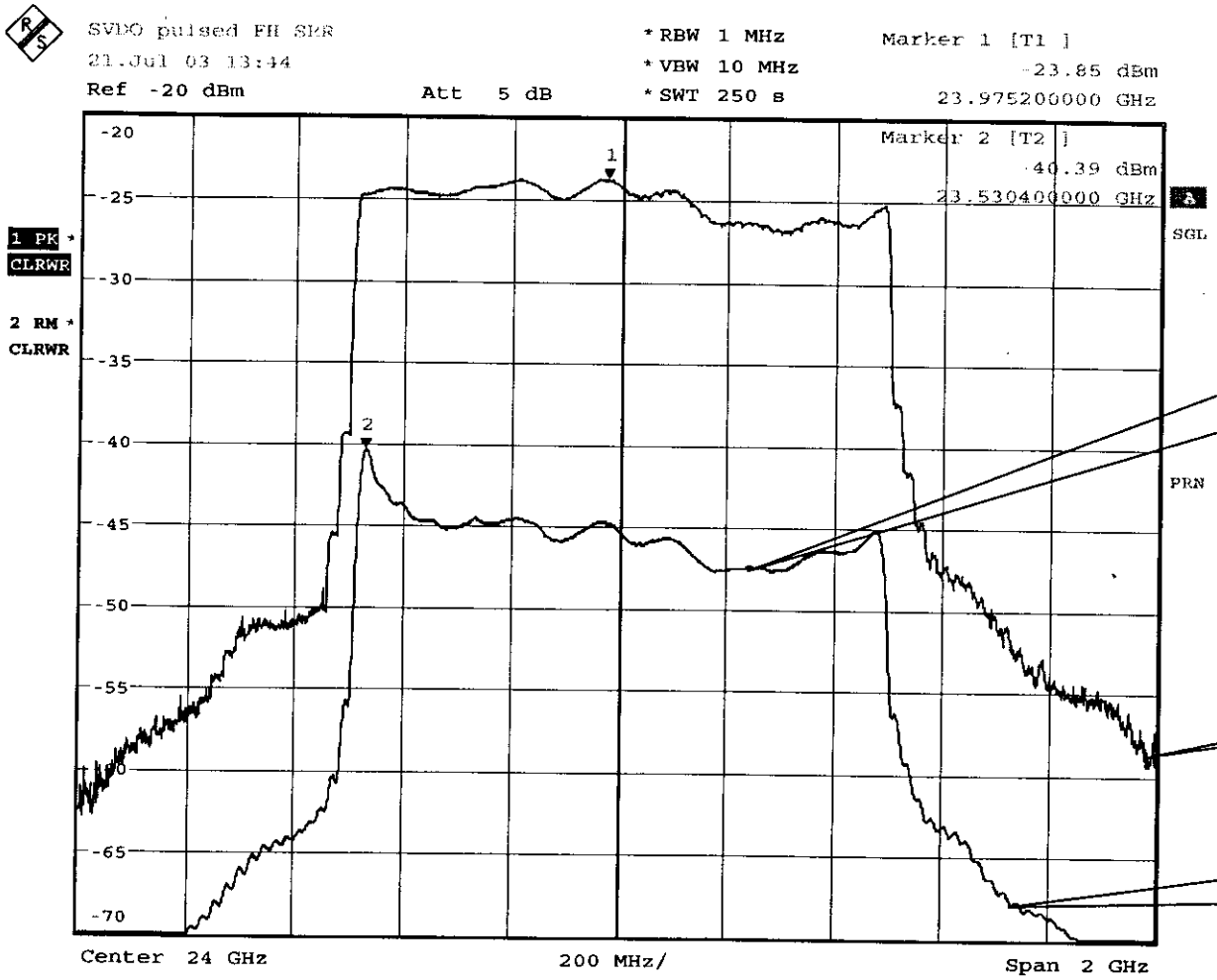
RMS integration time is ca. 4 times the frame time
=> max. ripple < 1 dB

Peak in 1 MHz

RMS in 1 MHz 10ms integration time

Comment A: 64-tone pulsed FH 50ns PW, 1MHz PRF,2.621 ms total frametime
VBW 10MHz RBW 1MHz 2500points 25s Stime singleS
Date: 21.JUL.2003 13:02:39

Pulse-modulated carrier (50 ns PW, 1 MHz PRF): 64 discrete FH frequencies



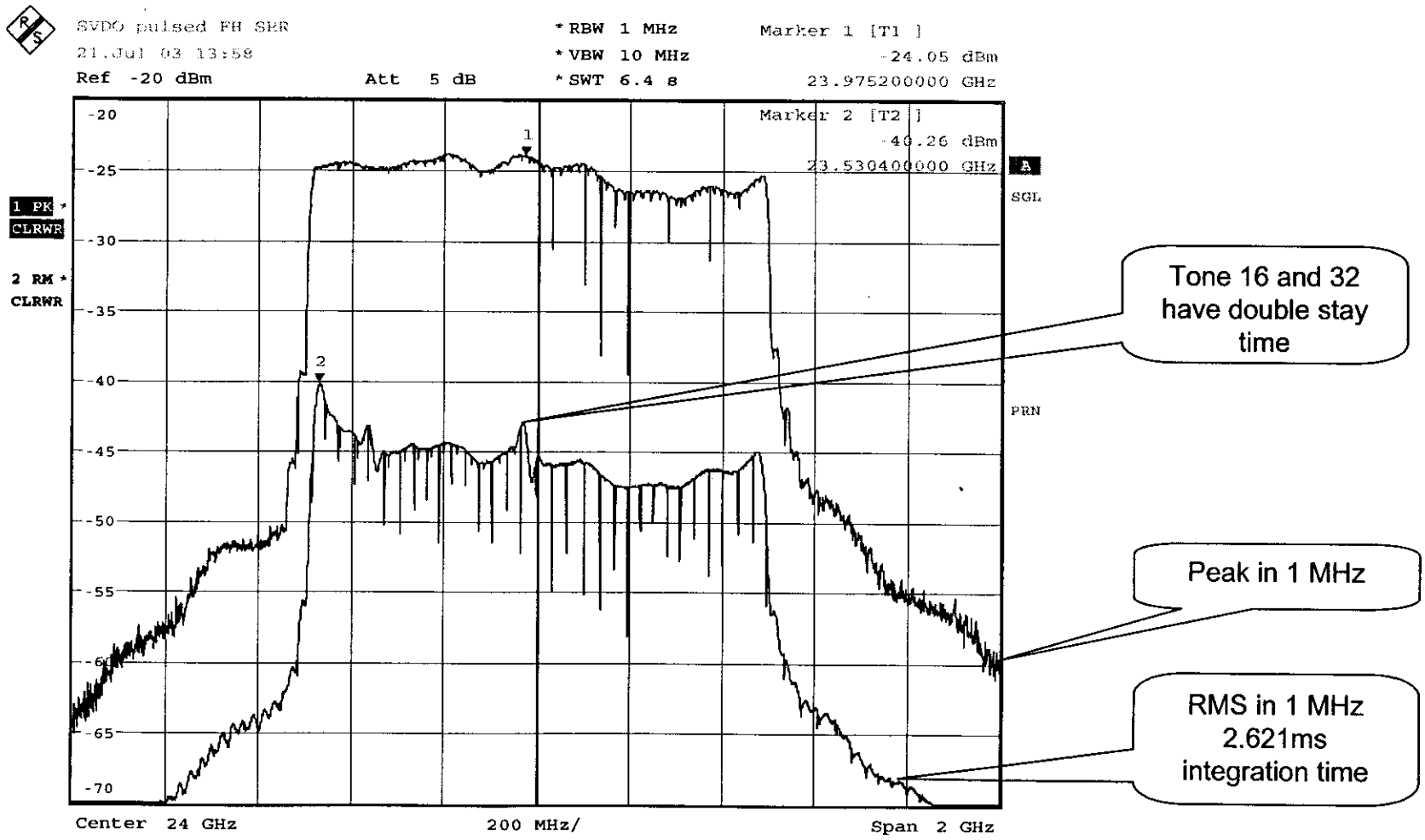
RMS integration time is ca. 40 times the frame time => no more ripple visible

Peak in 1 MHz

RMS in 1 MHz 100ms integration time

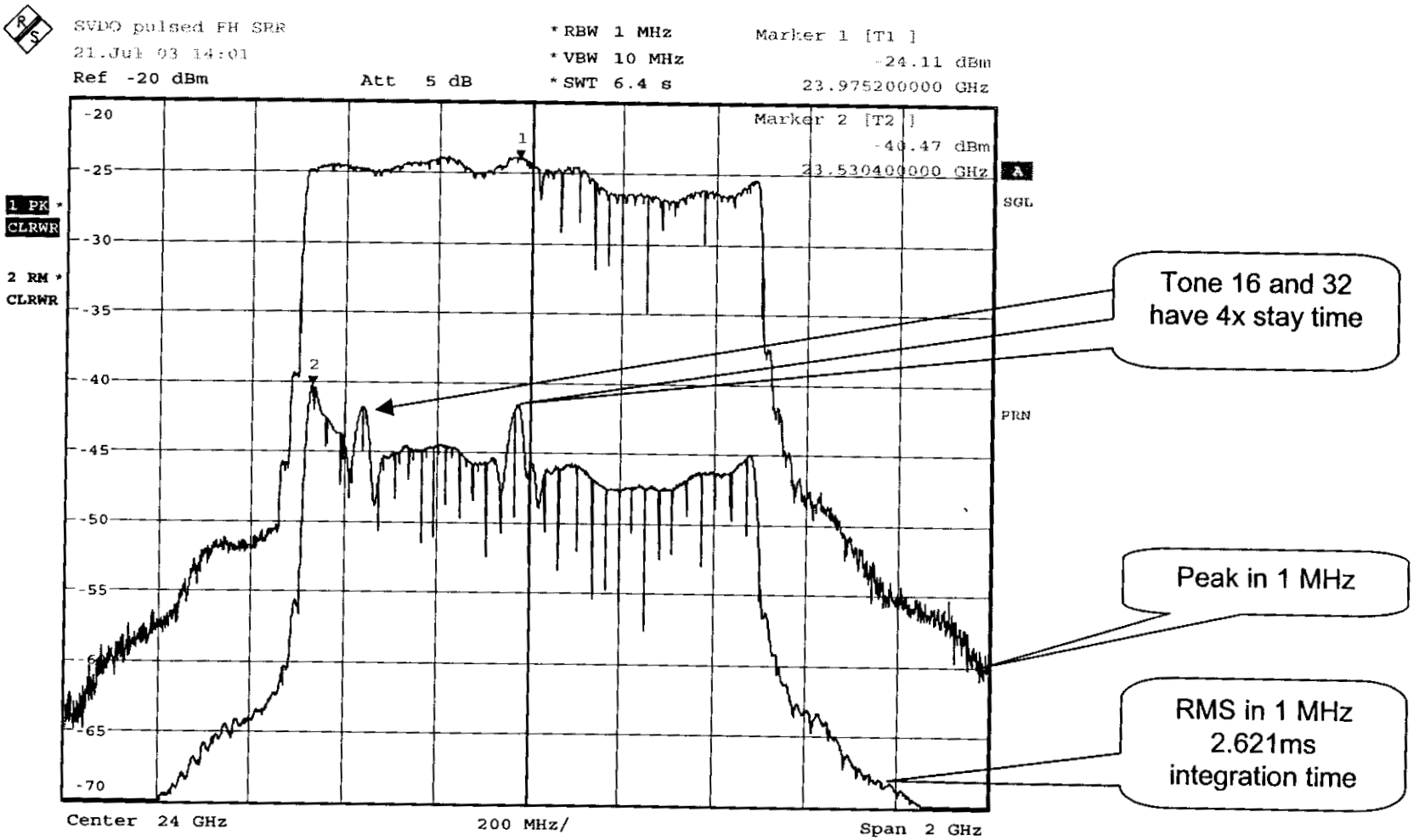
Comment A: 64-tone pulsed FH 50ns PW, 1MHz PRF,2.621 ms total frametime
VBW 10MHz RBW 1MHz 2500points 250s Stime singleS
Date: 21.JUL.2003 13:45:03

Pulse-modulated carrier (50 ns PW, 1 MHz PRF): 64 discrete FH frequencies



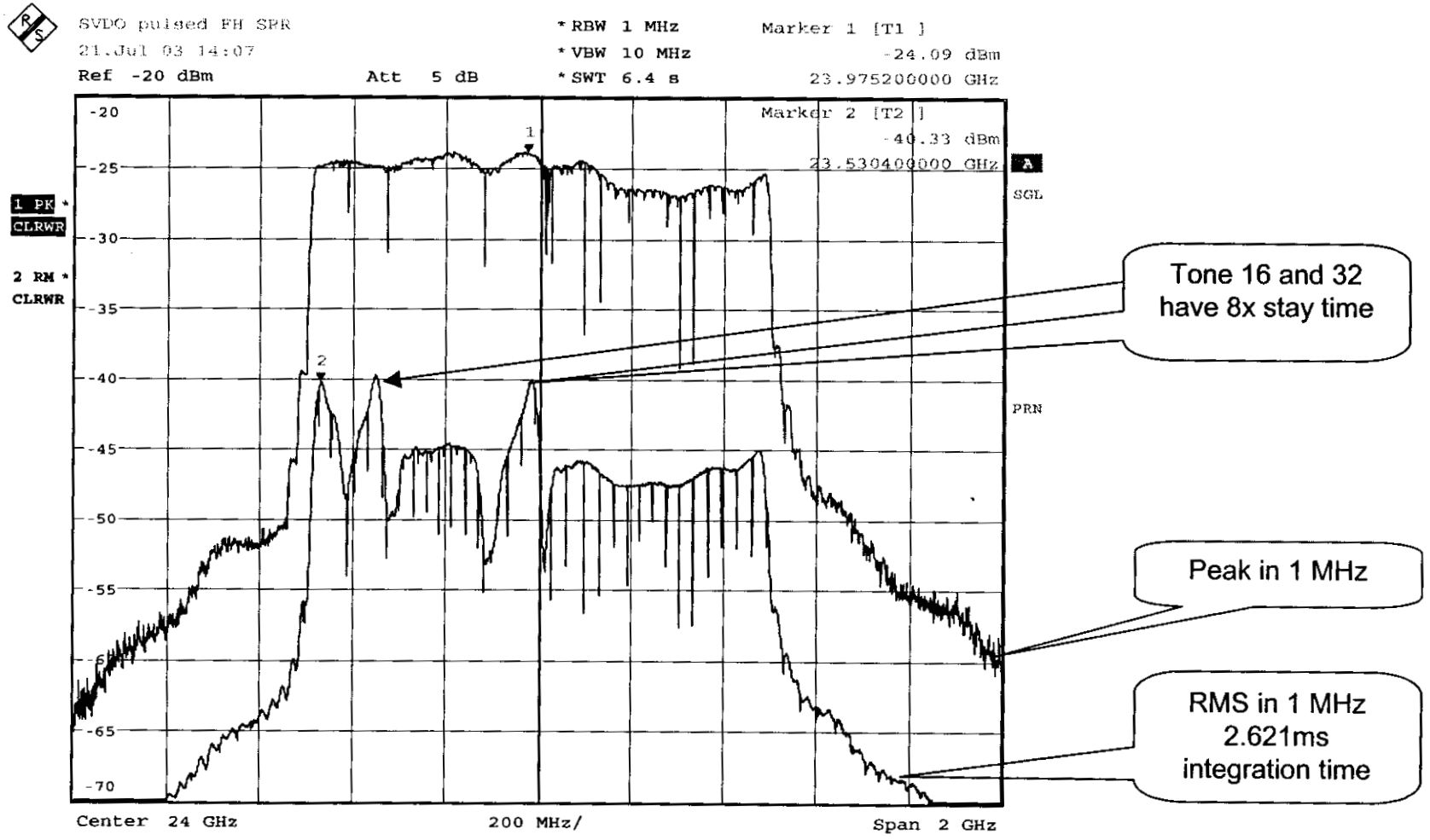
Comment A: 64-tone pulsed FH 50ns PW, 1MHz PRF,2.621 ms total frametime
VBW 10MHz RBW 1MHz 2500points tone 16 and 32 2times
Date: 21.JUL.2003 13:58:23

Pulse-modulated carrier (50 ns PW, 1 MHz PRF): 64 discrete FH frequencies



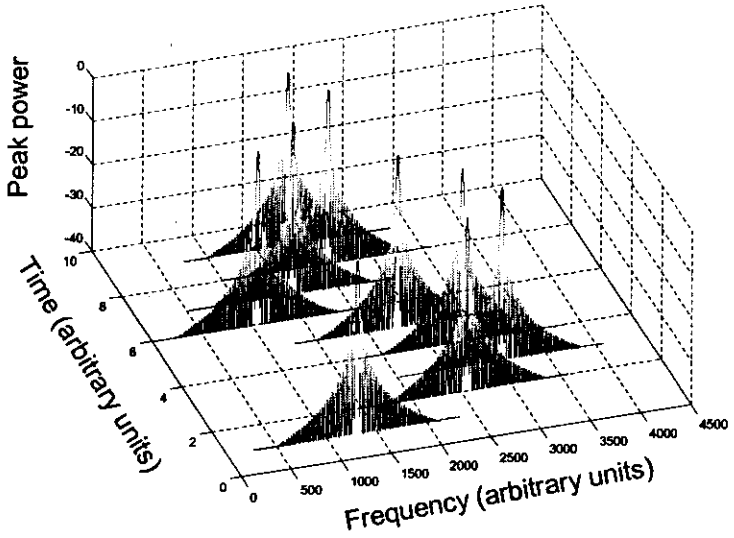
Comment A: 64-tone pulsed FH 50ns PW, 1MHz PRF,2.621 ms total frametime
VBW 10MHz RBW 1MHz 2500points tone 16 and 32 4times
Date: 21.JUL.2003 14:01:31

Pulse-modulated carrier (50 ns PW, 1 MHz PRF): 64 discrete FH frequencies

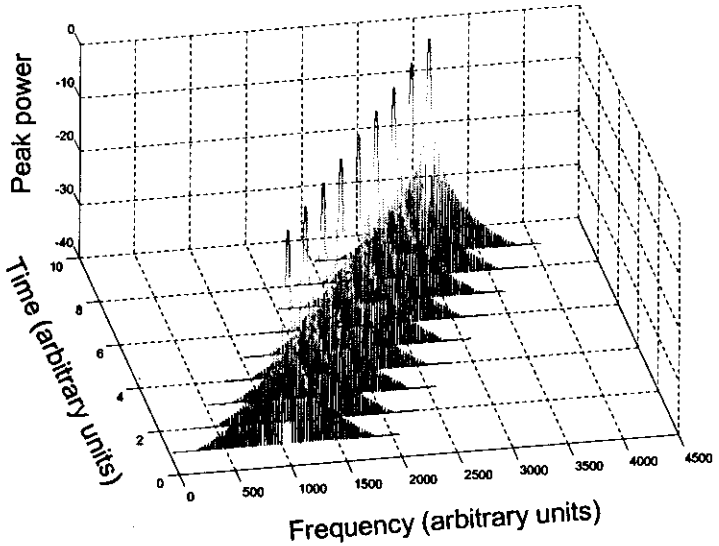


Comment A: 64-tone pulsed FH 50ns PW, 1MHz PRF,2.621 ms total frametime
VBW 10MHz RBW 1MHz 2500points tone 16 and 32 8times
Date: 21.JUL.2003 14:07:11

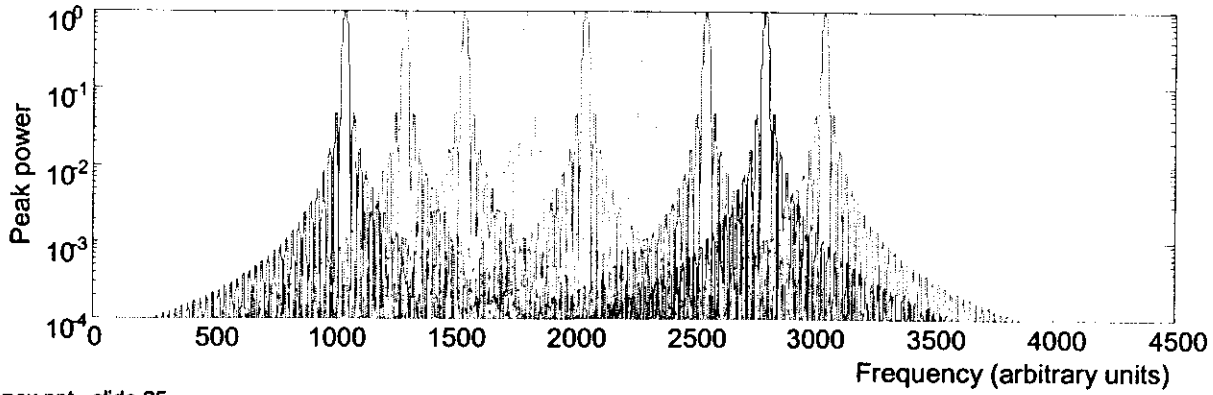
one frame with random FH over time



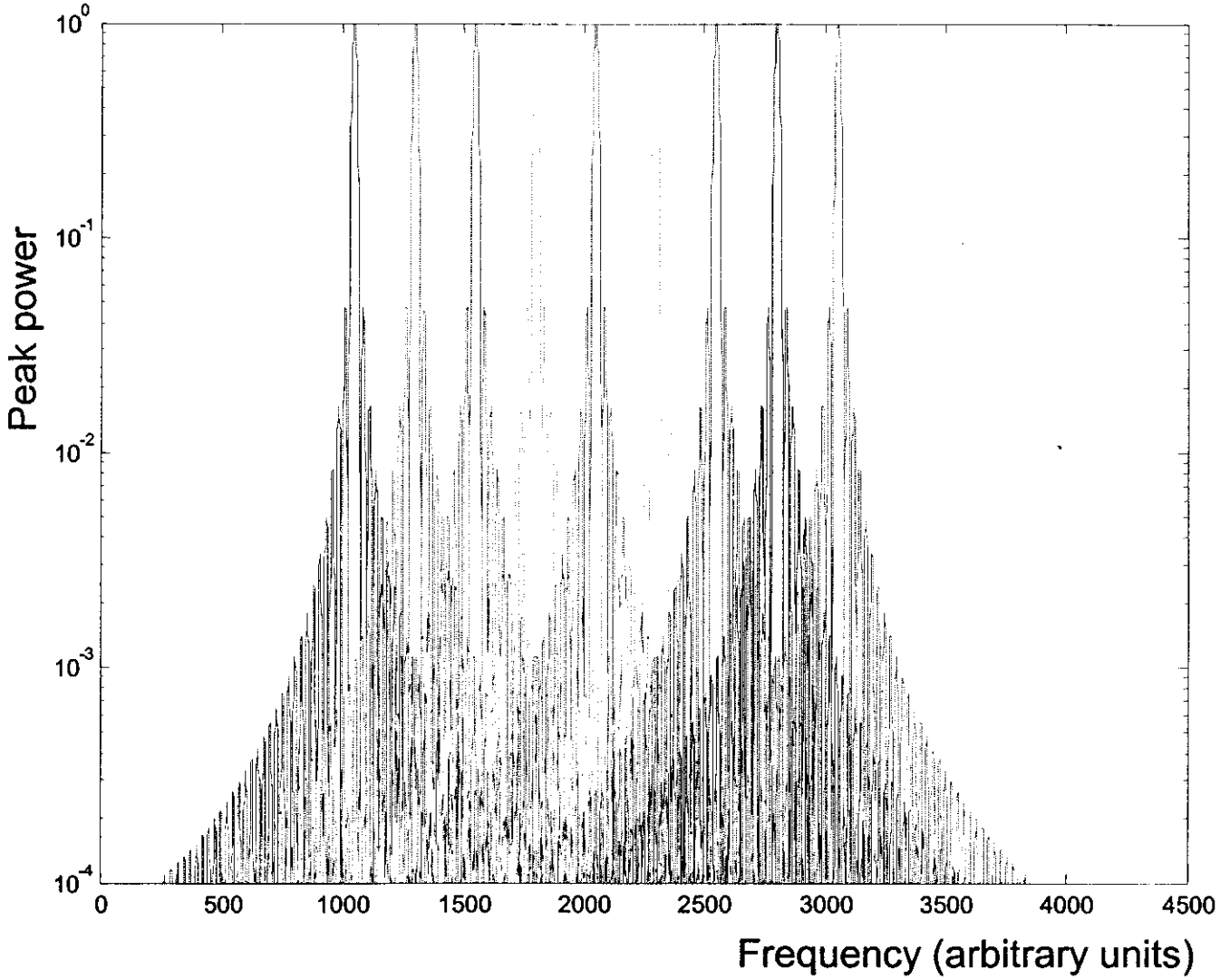
one frame with linear FH over time



spectrum of complete frame

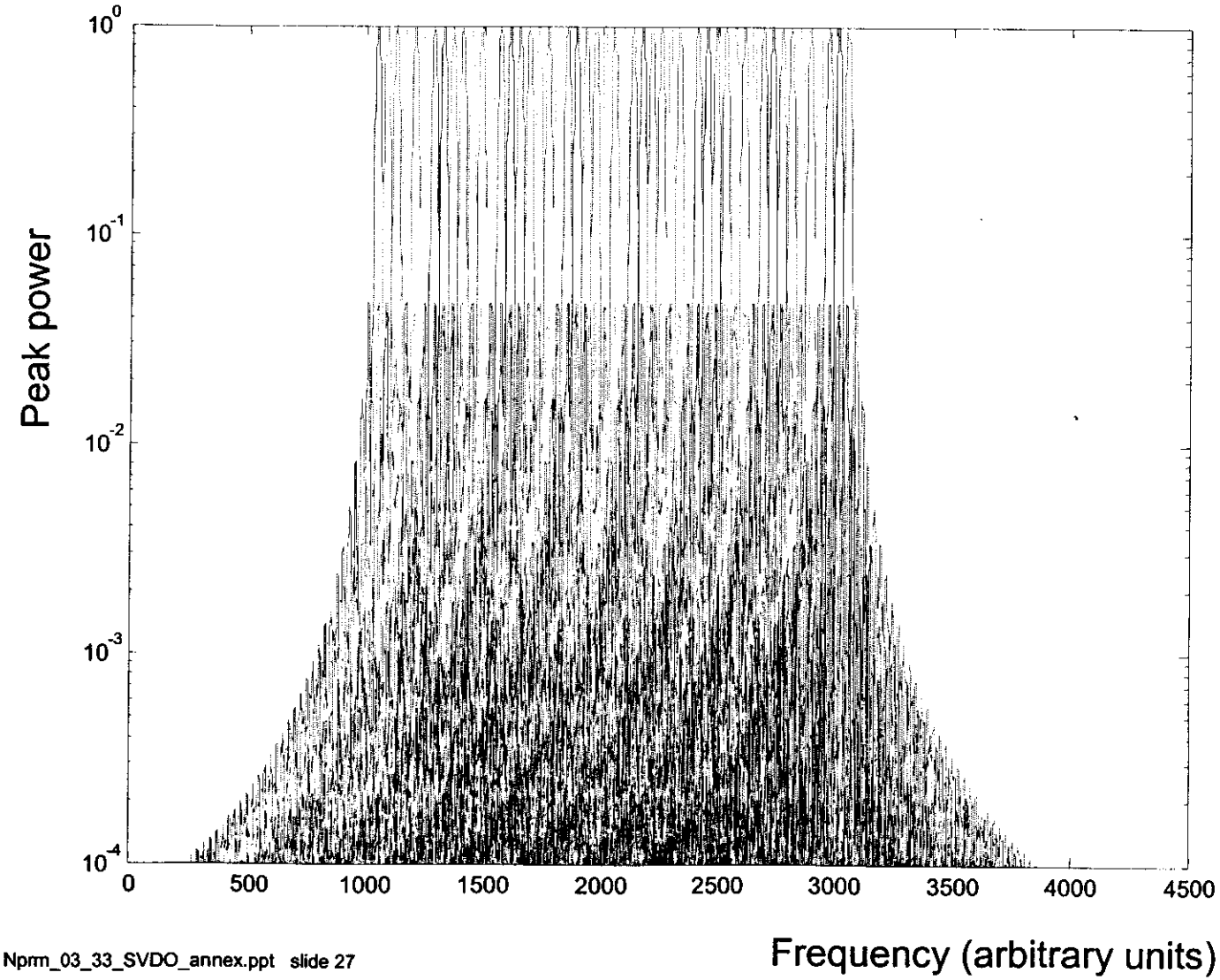


Spectrum of a complete frame with 9 discrete hop frequencies



Remark:
The overlapping of the 9 individuel hop frequencies is not enough to generate a smooth peak or RMS spectrum over the whole frame time period

Spectrum of a complete frame with 51 discrete hop frequencies



Remark:
The overlapping of the 51 individuel hop frequencies is enough to generate a smooth peak or RMS spectrum over the whole frame time period

ATTACHMENT B

CETECOM™

Member of RWTÜV Group RWTÜV

ICT Services GmbH

Summary - Interference Study (SRR – RSM)

Customer: SARA (Short Range Automotive Radar frequency Allocation)
co DaimlerChrysler AG
EP/ER, HPC X912
Calwer Straße
71059 Sindelfingen
Germany

Test laboratory: CETECOM ICT Services GmbH
RSC - Radio/Satellite Communications
Untertuerkheimer Str. 6-10
D-66117 Saarbruecken

Object: Investigation of the interference potential caused by Ultra-Wideband Short Range Radar detectors (UWB-SRR) intended for automotive applications to already used Radar Speed Meters (RSM) operating in the 24 GHz frequency range.

Reference: Test Report No 2-3129-01-01/03

Statement: This summary consists of 3 pages including this cover page and provides an aggregation of Report No 2-3129-01-01/03 from which the details of the investigation performed can be seen.

Saarbrücken, 2003-05-22
Place, date

CETECOM
Cetecom ICT Services
Accredited Test Laboratory
Untertürkheimer Str. 6-10
D-66117 Saarbrücken

i.V. Manager of Laboratory)

accredited by DAR *under Accreditation Certificate* TTI-P-G 166/98-00:

General

The SARA group (Short range Automotive Radar frequency Allocation) commissioned CETECOM ICT Services GmbH as an independent and accredited test house and notified certification body to execute an interference investigation.

In particular, the impact of Ultra-Wideband Short Range Radar detectors (UWB-SRR) to Radar Speed Meters (RSM) used by the police and both operating in the 24 GHz frequency range, was to examine.

Components

The following two RSM were involved in the interference investigation, further RSM versions were requested but not made available.

- RSM 1:
  Cordless Falcon Hand-Held Radar, Serial No. FF 17577, Kustom Signals, Inc.
- RSM 2:
  Muni Quip K-GP 2000 Hand-Held Radar, Serial No. 1514, Unipar Services Ltd

The used UWB-SRR represent all developed modulation types and give a realistic mix of a potential interference situation.

- UWB-SRR module 1: Tyco Electronics M/A-Com, Inc.
- UWB-SRR module 2: Siemens VDO Automotive AG
- UWB-SRR module 3: Valeo Schalter & Sensoren GmbH
- UWB-SRR module 4: Delphi Automotive Systems

Test procedure

The test procedure is described in test report no 2-3129-01-01/03. Wherever assumptions or simplifications were necessary, the corresponding conditions were set to "worse case" for SRR and in favour of the RSM.

Conclusion of results considering UWB emissions

Based on the investigations performed, it seems quite unlikely that UWB-SRR equipped cars will interfere the RSMs, operating in a similar way as the RSMs tested, under real road conditions.

The worst-case measurement result achieved under reproducible laboratory conditions had to be adopted by modelling to real road situations and the common use of RSM.

This transformation was made on the basis of:

- total power budget, considering uncorrelated interference sources
- attenuation of E/M field ($1/r^2$)
- screening effects of cars driving in line
- high directivity of RSM antenna
- practical road scenarios
- 100% of cars UWB-SRR equipped

The modelling of different road scenarios resulted in a worst case margin of 11 dB, even though the following details were considered:

- 6 lane situation
- low traffic speed (for short car-to-car distances)
- maximum car density in the RSM detection beam
- 192 UWB-SRR modules involved
- RSM positioning in the middle of the dual carriageway.

For better clarification of this margin, the 11 dB could be understood as 2255 additional cars in 100 m distance within the beam of the RSM. It is self evident that this case with such enormous number of cars could never occur, even if the cars would be distributed on other distances. The consideration of longer distances (300-1000m) would also not gain worse results, because of a kind of saturation effect, caused by increase of screening effects and field attenuation. This example shows that there is no realistic way to exhaust the remaining margin.

Conclusion of results considering Doppler CW radar functionality

Beside the above-mentioned tests, some immunity testing using a synthetically generated CW signal was done to reflect the Doppler CW radar functionality. [1]
These results show also high immunity of the RSMs, and interference threshold can be reached only when the operation frequencies of Doppler radar and RSM are very close to each other (less than 1 MHz) and the Doppler radar unit positioned very close to the RSM and within the RSM´s main beam. However, such constellation seems to be rather unlikely in real terms, and the interference potential by that option can be assessed as quite marginal.

[1] This was done because the supplied SRR modules were not equipped with Doppler functionality.

DOCKET NO. 98-153 Attachment A

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