

DORIS BEACON RF CHARACTERISTICS

Written by:

C. JAYLES

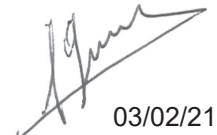
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Accepted by :

A. GUERRY

Date and Signature


03/02/21

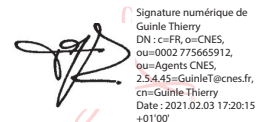
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For	DS4	DS5	DH2A	DH2B	DPP	DJ1	DJ2	DCY2	DOA	D3S	DHY2	DST3
Application												
to	DJ3										DOR	SMM
											X	X
Models												

DORIS project internal management :

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Conf. Appliquée :	Y		

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DOCUMENT CHANGE RECORD

The modifications are listed in the Change Record section of the document and identified by change bars in affected sections.

Issue	Date	Modifications
0.0	22/10/01	This document cancels and takes over the following document : - CM-NT-1223-4698 : Orbit determination beacons RF characteristics
1.0	26/07/04	DM-CO-B-378-CN p. 14
1.1	10/11/2011	Mise à jour modèle document et nouvelle version word
1.2	12/01/2021	DM CO-FT-3317-CN : 4th generation beacons information added

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APPLICABLE AND REFERENCE DOCUMENTS

The contents of applicable documents, in their common edition, have to be applied as a supplement to the text of the present document. If an applicable document, listed in the table below, is not called in the text of the present document with detailed application condition, he can be considered to be a reference document for supplementary benefit of information and, because of that, not mandatorily applicable.

Reference	Document title
	AD 1
	AD 2
	DR1.
	DR2.

TBC AND TBD LIST

(in case of no TBC or TBD mention "none" is mandatory in the table here after)

TBC/TBD	Section	Brief description
TBC	none	
TBD	none	

ABBREVIATIONS

RF	Radio Frequency
USO	Ultra-stable Oscillator

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1 PURPOSE OF DOCUMENT

This document defines the RF characteristics of a DORIS beacon.

2 APPLICABILITY

This document is applicable to the DORIS 3rd and 4th generation beacons in exploitation phase.

3 BEACON CHARACTERISTICS

3.1 BEACON BLOCK DIAGRAM (3RD GENERATION)

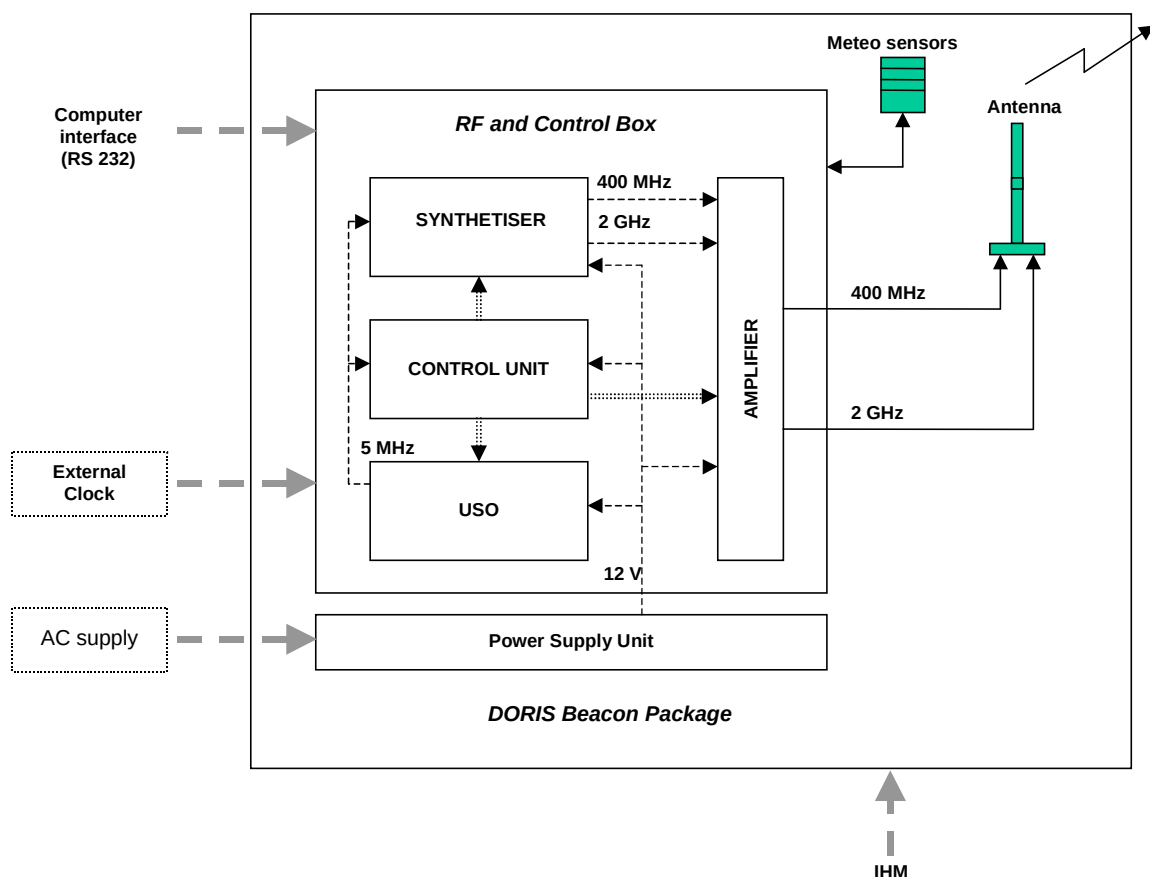


Figure 1

Note that all signals are synthesised from the 5 MHz USO signal.

3.2 TRANSMITTERS SIGNALS (3RD GENERATION)

- Frequencies

The DORIS beacon emits 2 carriers:

- one in the 401.25 MHz $\pm$ 10 kHz frequency range on the 400 MHz channel,
- one in the 2036.25 MHz $\pm$ 45 kHz frequency range on the 2 GHz channel.

- Stability

The stability of each carrier is $< 7.5 \cdot 10^{-13}$ on 10 to 100 seconds
is $< \pm 2 \cdot 10^{-7}$ on the long term (10 years)

- Modulation

400 MHz and 2 GHz channels are modulated intermittently

Type of modulation: biphase PCM/SPL/PM $\pm \pi/3$

Rate: 200 bits/s

- Spectra

Typical spectra are given in Annex 1.

- Maximum transmitted power (at antenna interface, cables losses included)

On the 400 MHz channel: 6.35 W (5.5 W typical)

On the 2 GHz channel: 10 W (9.5 W typical)

- RF flux at 10 meters:

The flux are calculated with typical cable losses and at 10 meters, with the maximum transmitted power:

- 400 MHz channel: the maximum flux for an elevation below 10 degrees (maximum for this interval is at 10 degrees) is 2.94 dBm/m² = 0.00197 W/m².

This value is far below the maximum public limit which is 2 W/m², the professional limit is 10 W/m². Limits are given by the International Radiation Protection Association (IRPA), they are for permanent exposure.

- 2 GHz channel: the maximum flux for an elevation below 10 degrees (maximum for this interval is at 10 degrees) is 9.27 dBm/m² = 0.00845 W/m².

This value is far below the maximum public limit which is 10 W/m², the professional limit is 50

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W/m². Limits are given by the International Radiation Protection Association (IRPA), they are for permanent exposure.

3.3 BEACON BLOCK DIAGRAM (4TH GENERATION)

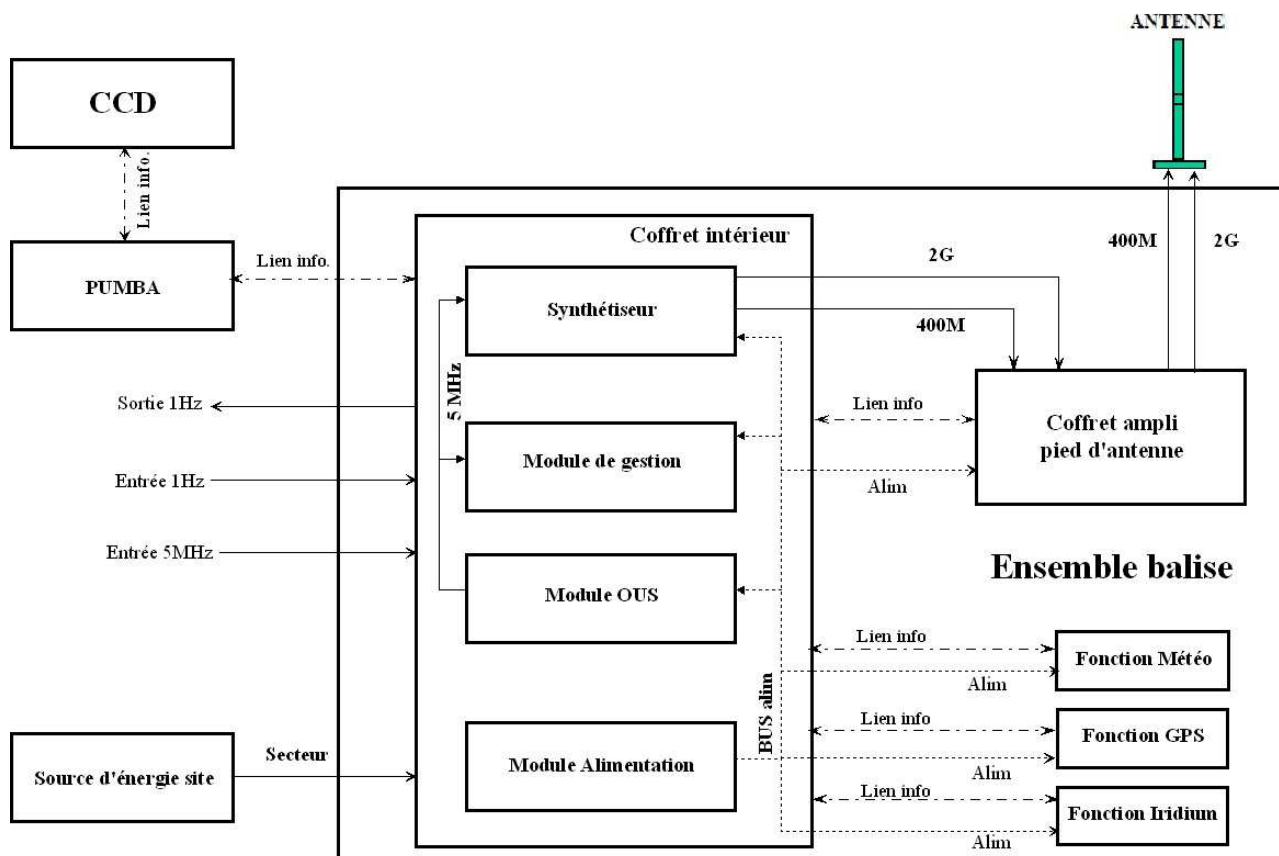


Figure 2 : Synopsis of the 4th generation beacon in its environment

3.4 TRANSMITTERS SIGNALS (4TH GENERATION)

4th generation beacons have similar characteristics, except for the following points :

- Stability

The stability of each carrier is $< 1.0 \cdot 10^{-12}$ on 10 to 100 seconds
is $< \pm 1 \cdot 10^{-7}$ on the long term (10 years)

- Maximum transmitted power (at antenna interface, cables losses included) :

On the 400 MHz channel: 5 W
On the 2 GHz channel: 10 W

- Spectra

Typical spectra are given in Annex 2.

Then antenna filters this signal (band-pass filter). That is why it is not necessary to plot the modulated signal on a larger bandwidth (10 MHz). The modulated spectrum has a $\sin(x)/x$ shape, so it can be calculated.

Adaptation measures may help to evaluate the impact on the emission spectrum. They are given in Annex 5.

- Meteo Sensor ("Meteo GPS Modem")

Iridium SBD modem.

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3.5 ANTENNA CHARACTERISTICS

- Radiation pattern: hemispheric, see Annex 3.
- Polarisation: right hand circular.

3.6 DORIS BEACON DECLARATION

A copy of DORIS beacon declaration AP3 is given in Annex 4

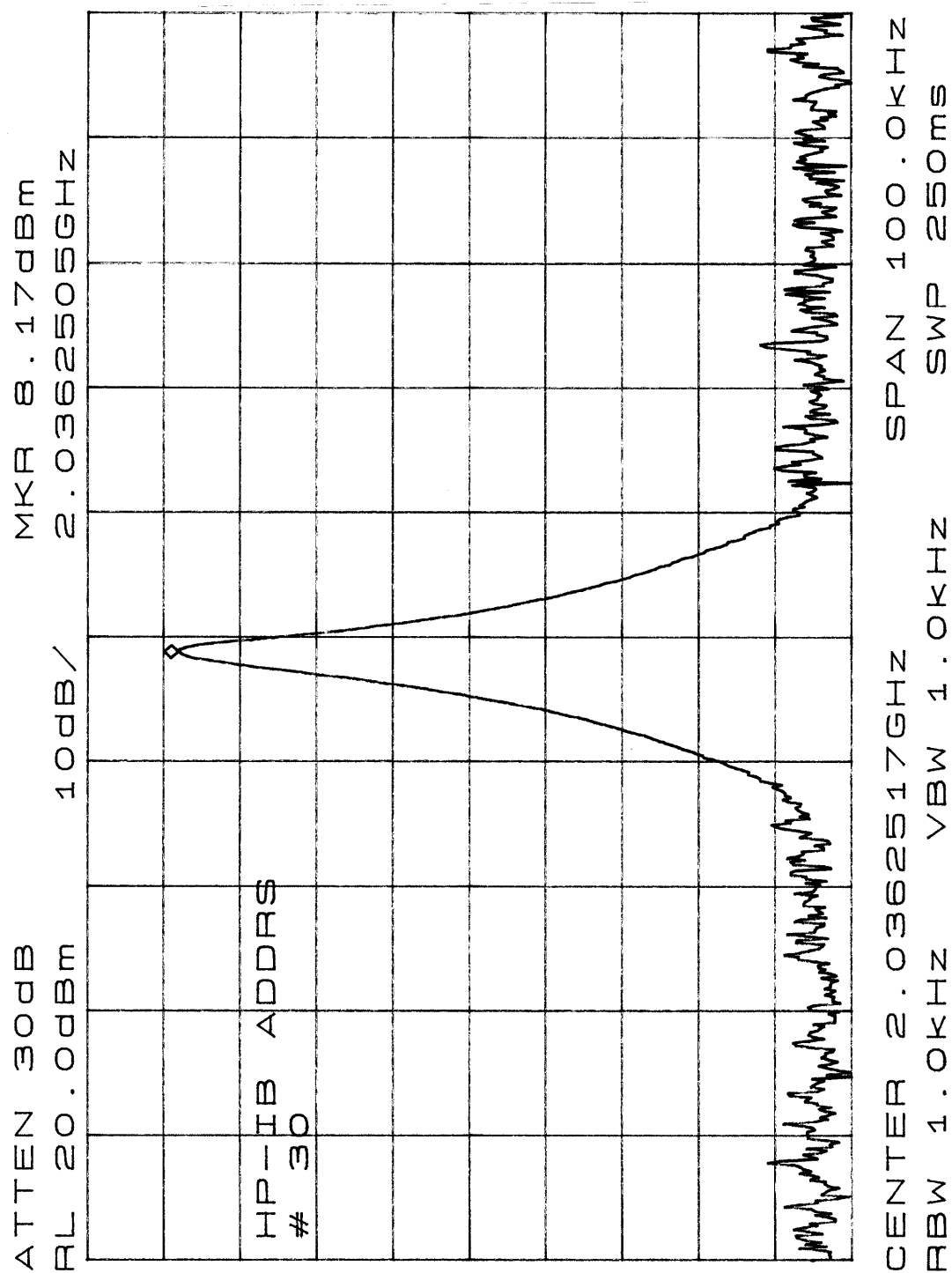
		Reference : CO-DF-B-OP-12961-CN Version : 1.2 Date : 12/01/2021 Page : 10/29
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ANNEX 1

DORIS 3RD GENERATION BEACON TYPICAL SPECTRA

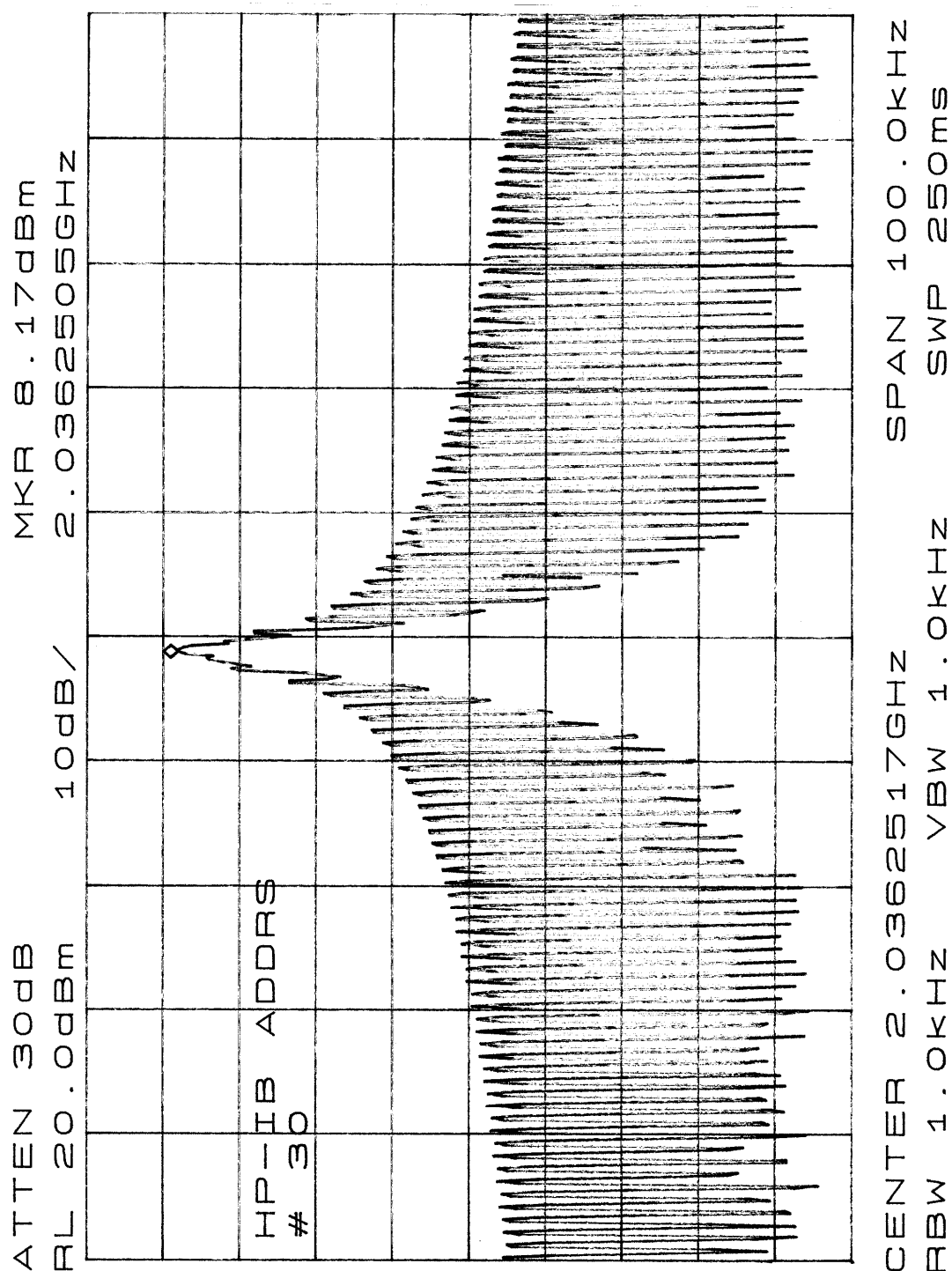
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2GHz BEACON SPECTRA (not modulated)



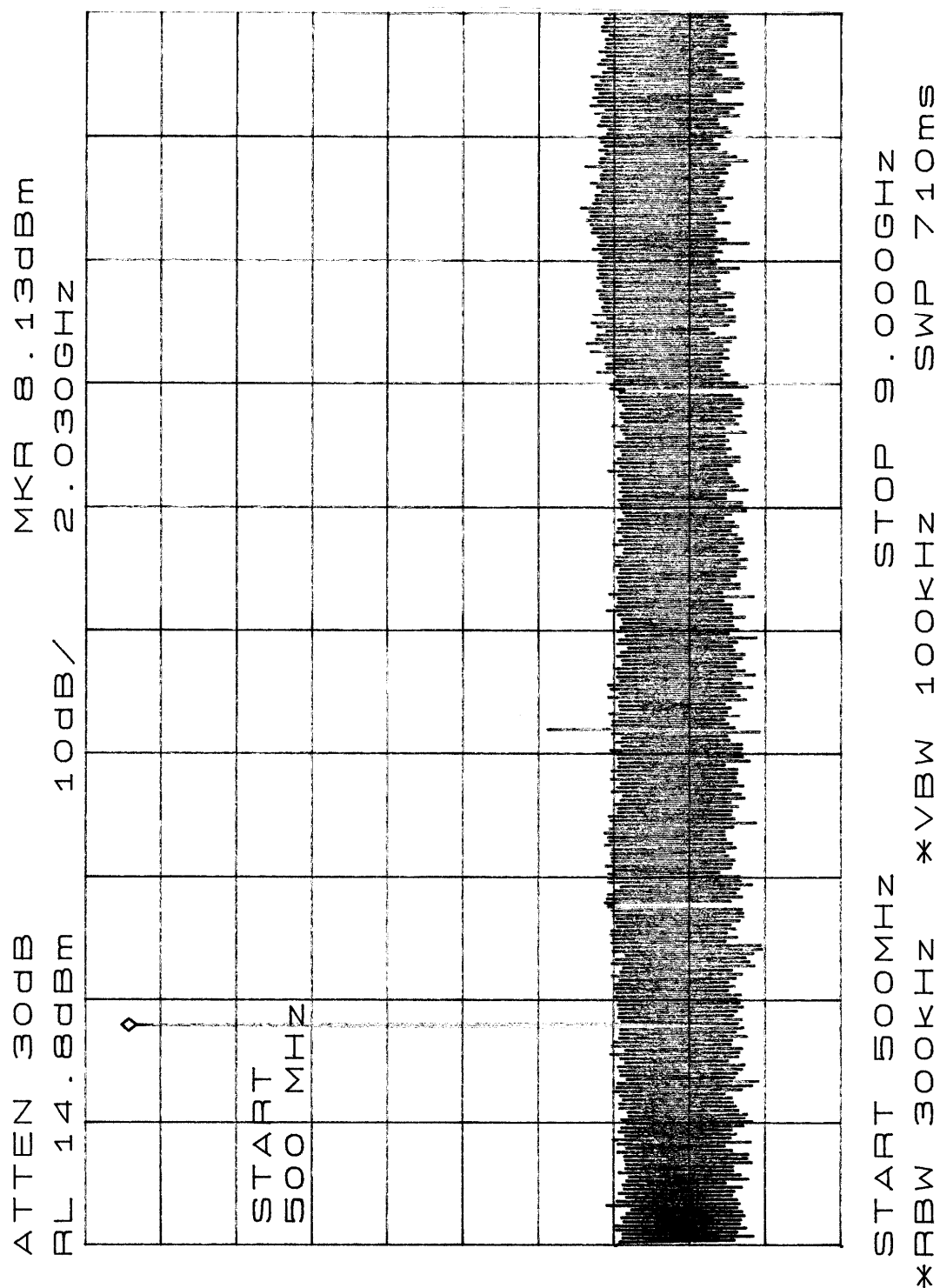
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2GHz BEACON SPECTRA (modulated)



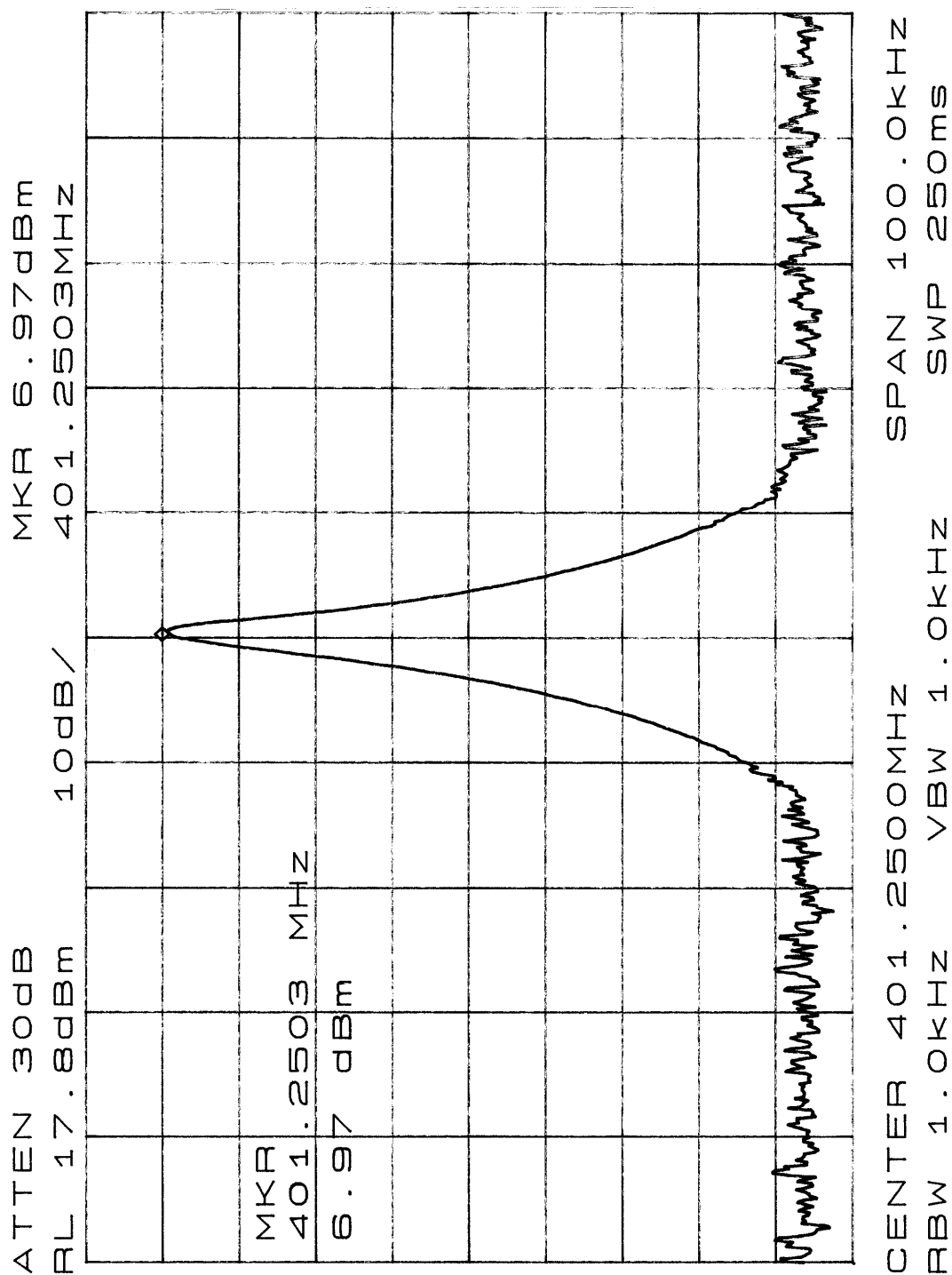
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2GHz BEACON SPECTRA (harmonics)



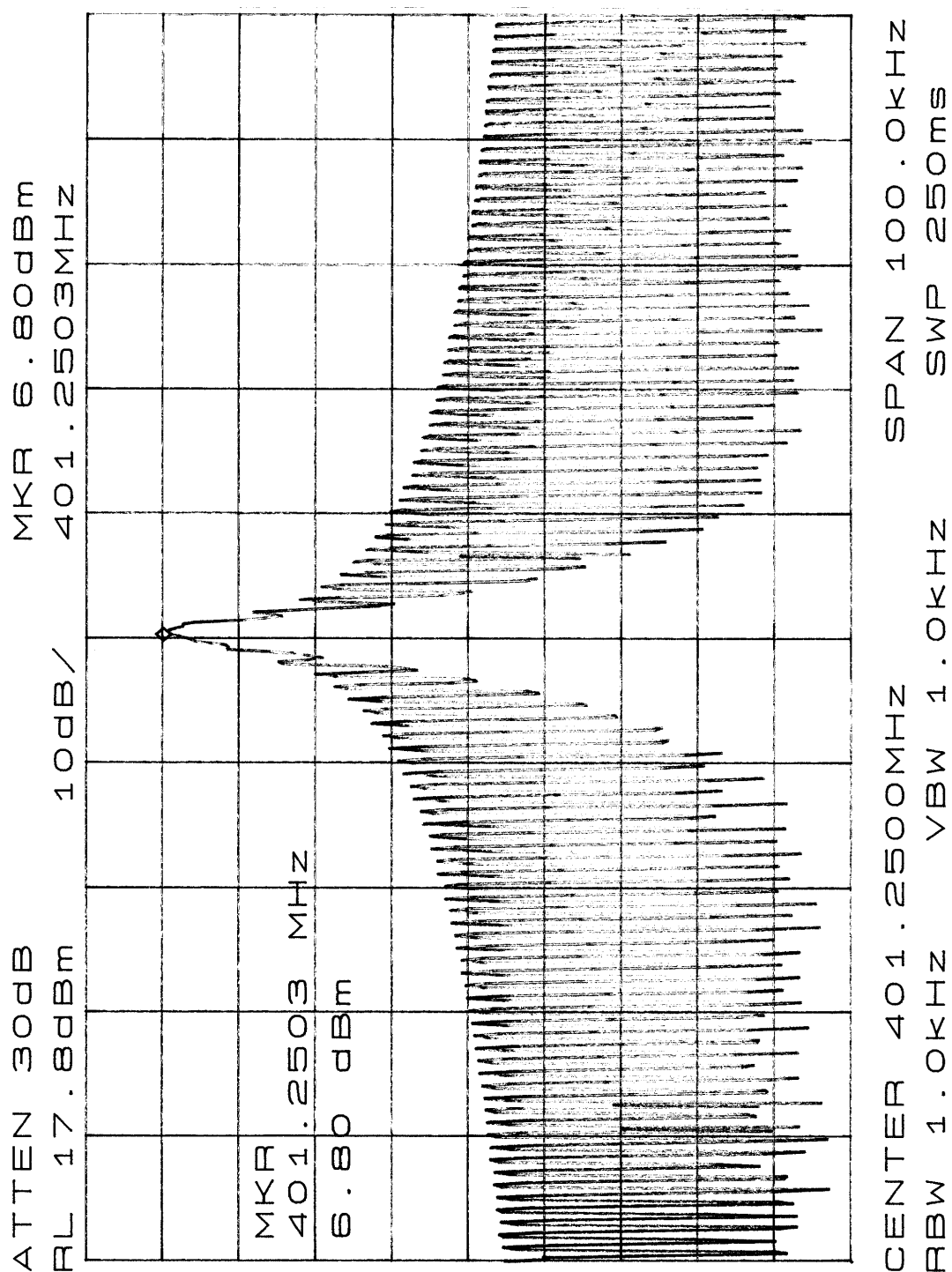
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400MHz BEACON SPECTRA (not modulated)



Title : DORIS BEACON RF CHARACTERISTICS

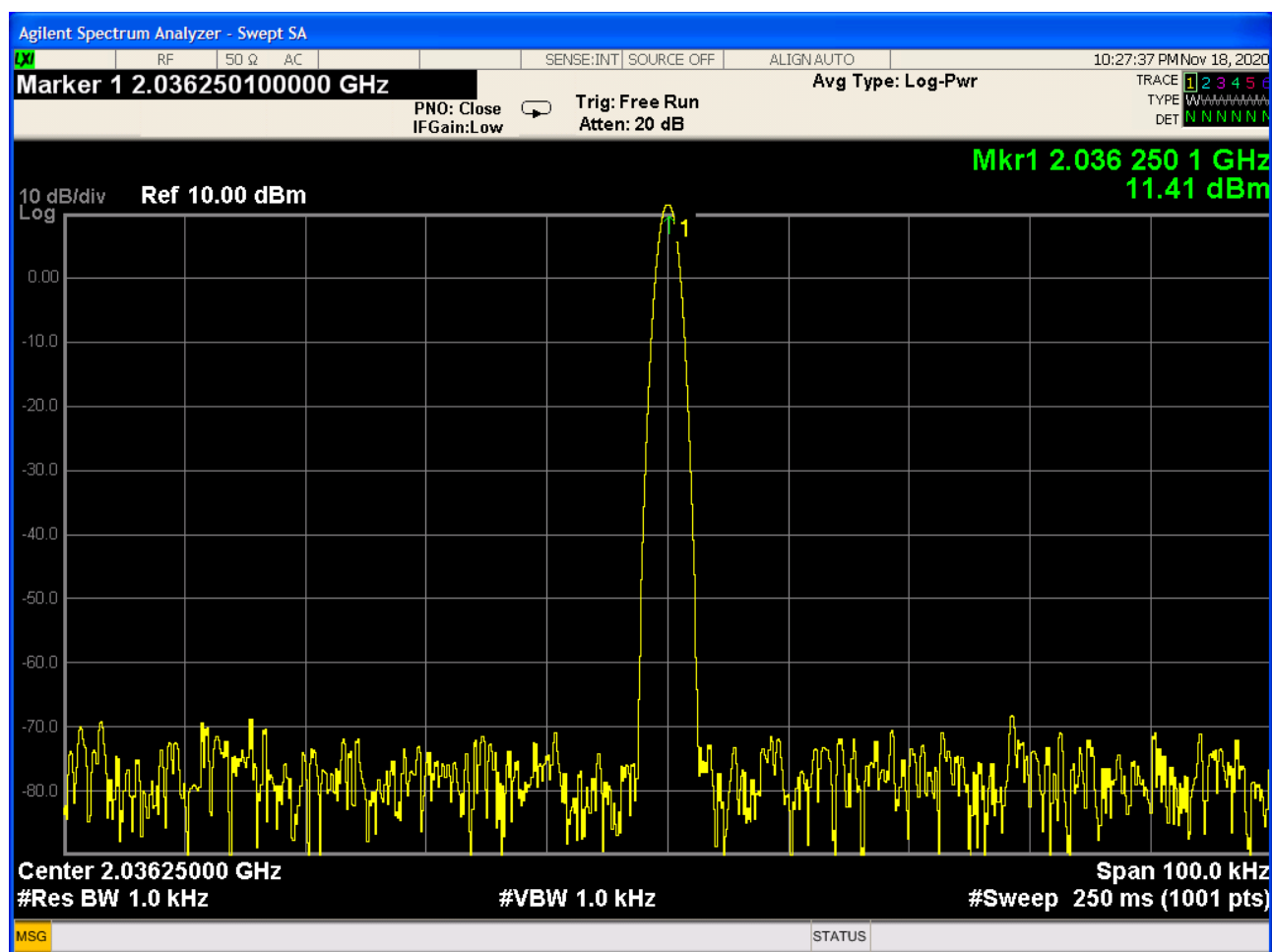
400MHz BEACON SPECTRA (modulated)



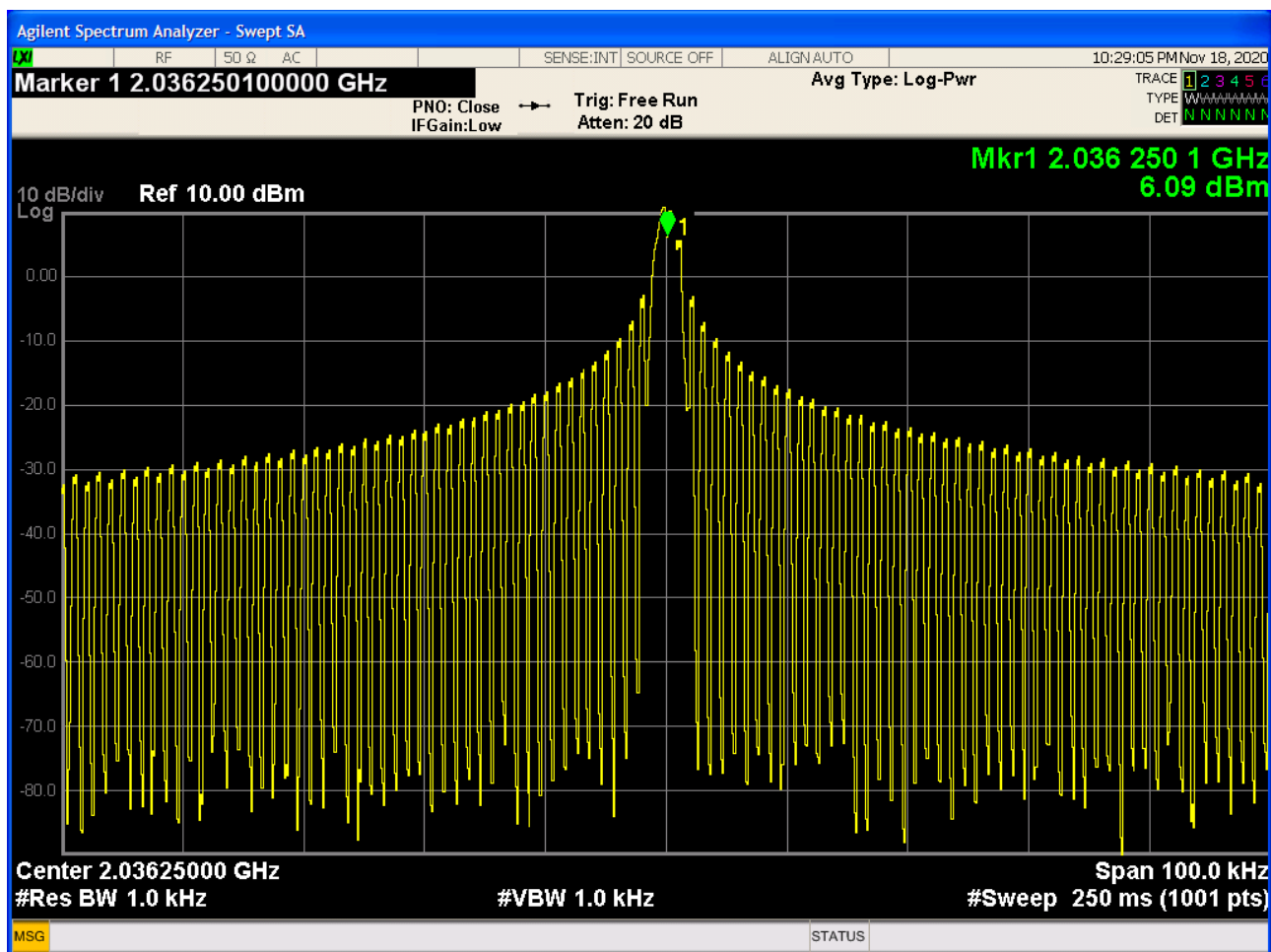
Title : DORIS BEACON RF CHARACTERISTICS

ANNEX 2

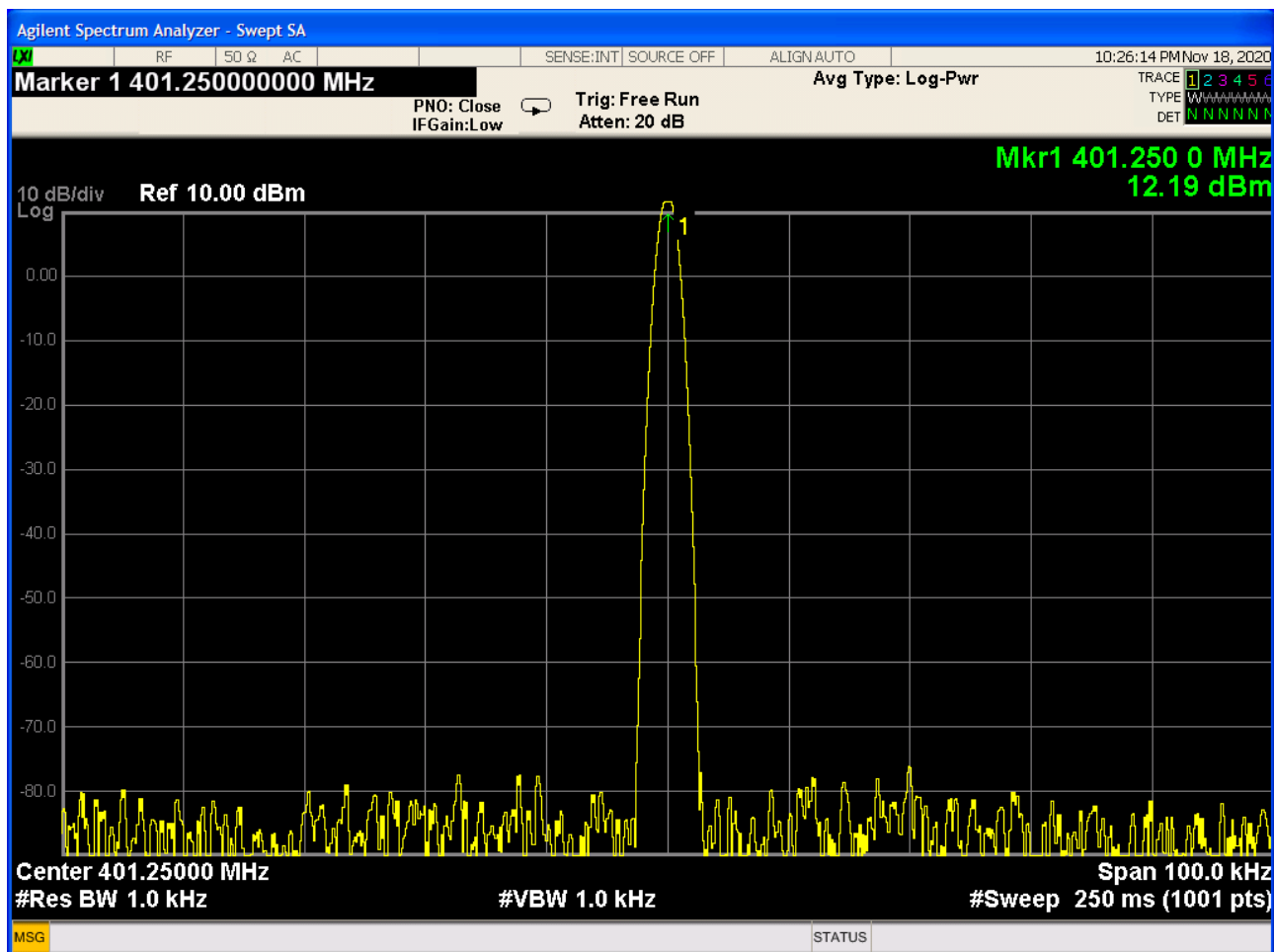
DORIS 4TH GENERATION BEACON TYPICAL SPECTRA



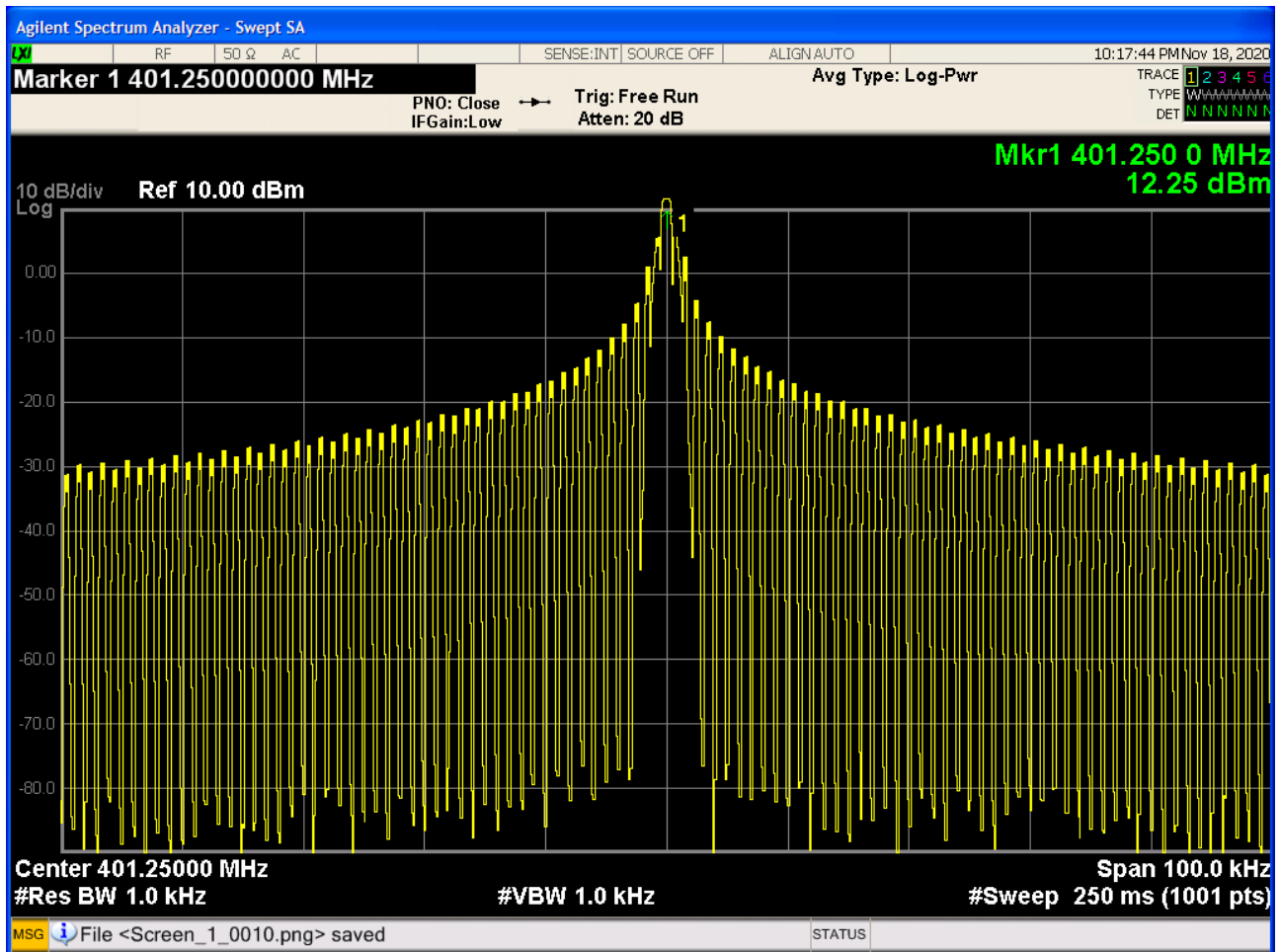
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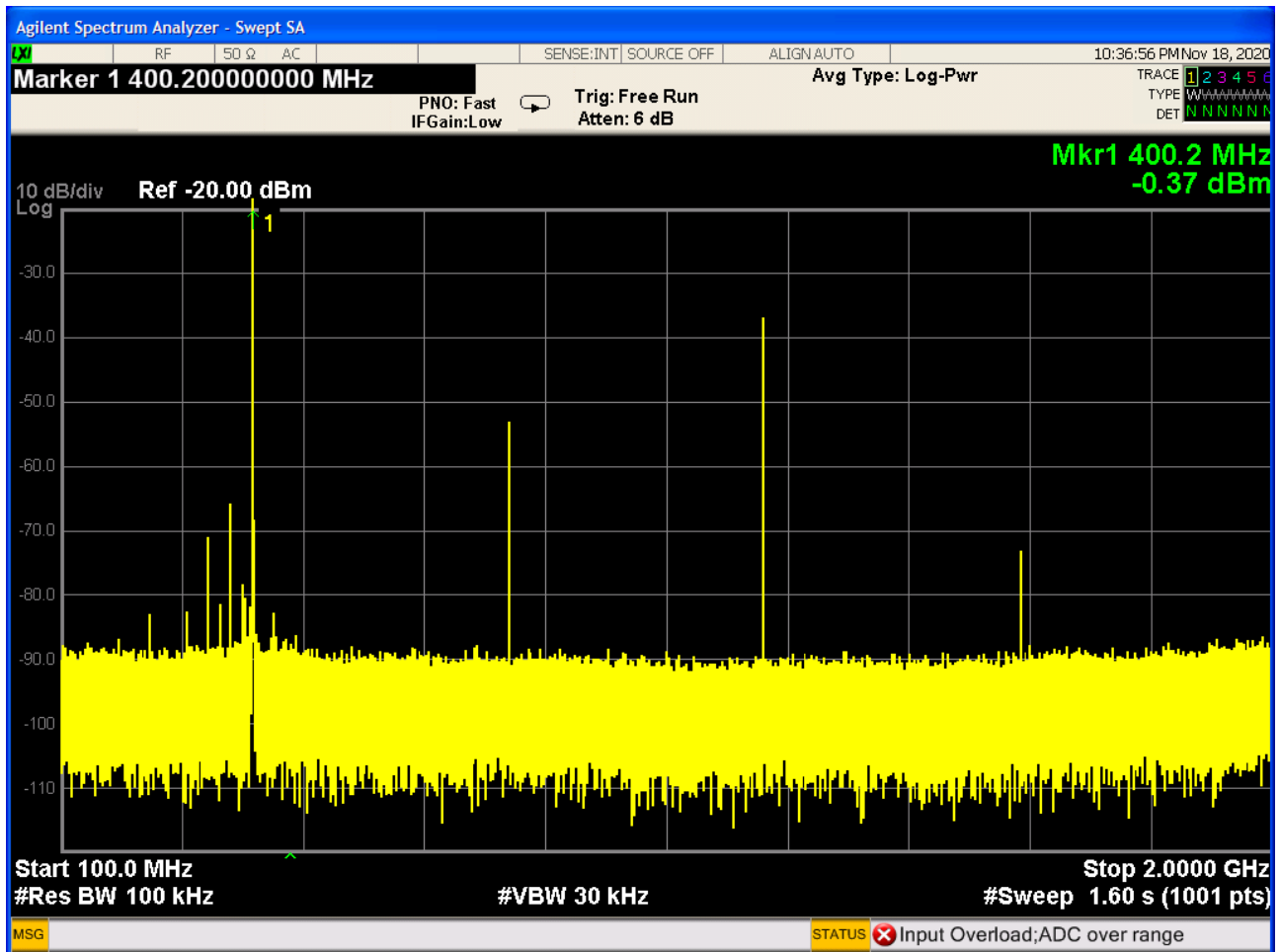
Title : DORIS BEACON RF CHARACTERISTICS



Title : DORIS BEACON RF CHARACTERISTICS



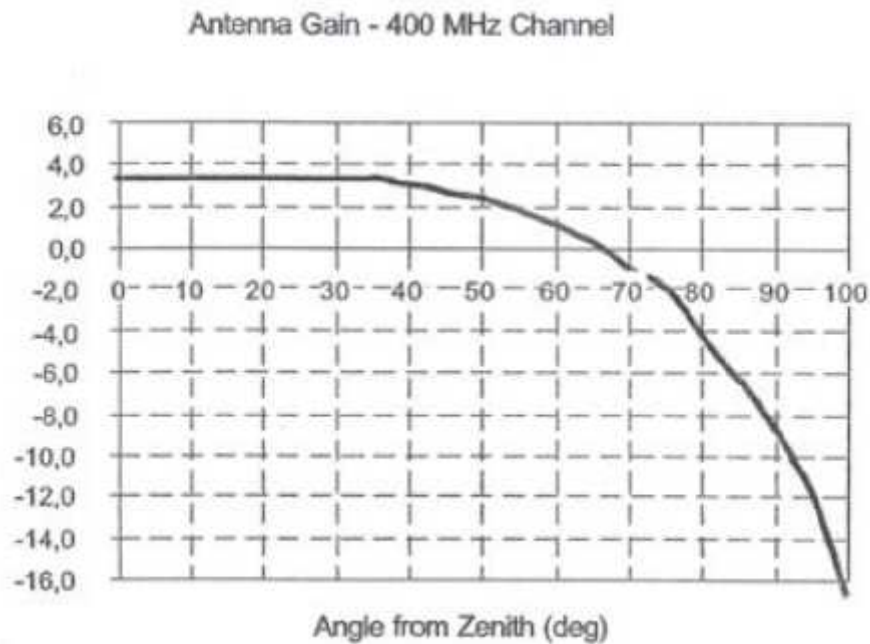
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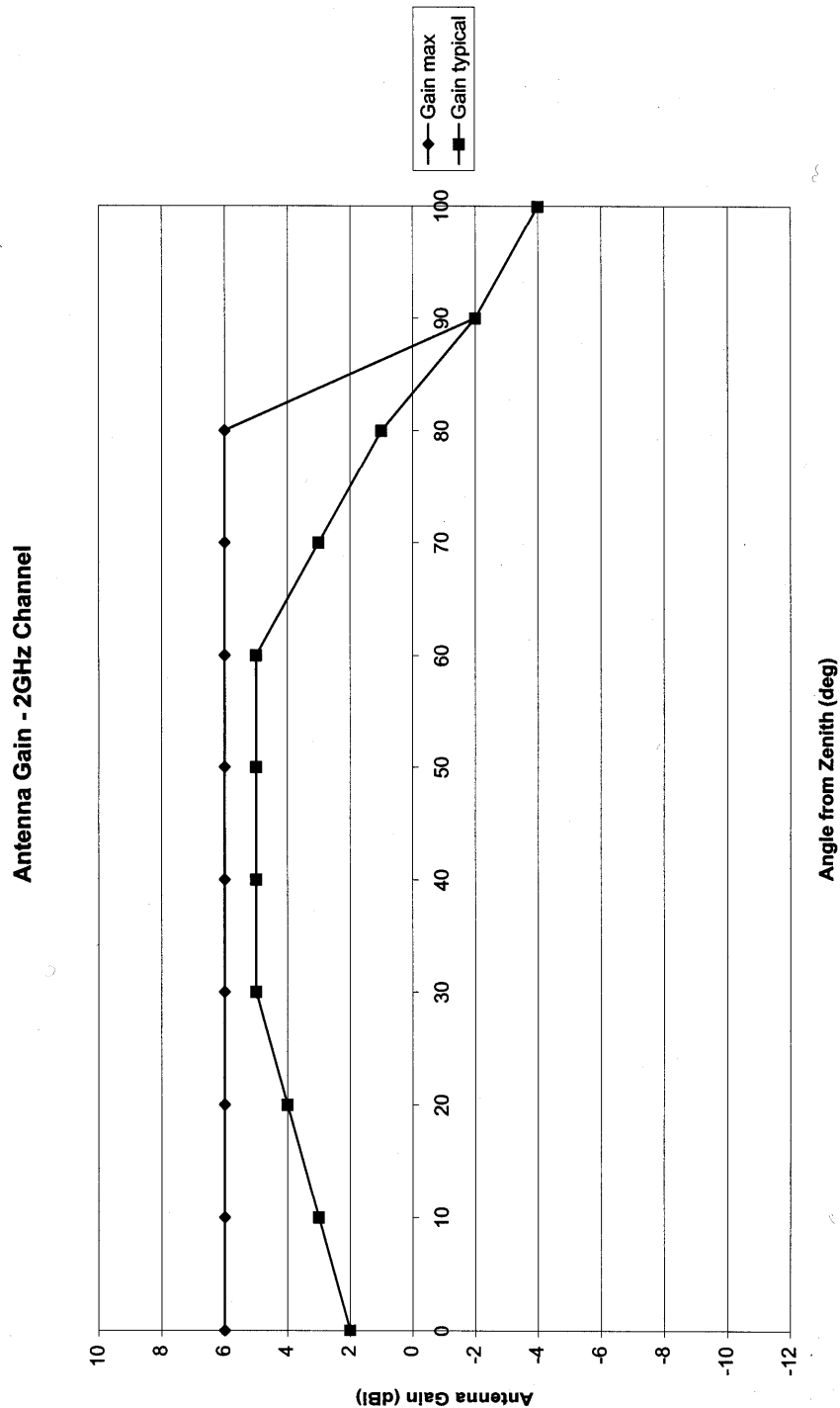
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ANNEX 3

DORIS ANTENNA PATTERNS



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ANNEX 4

DORIS BEACON AP3 DECLARATION

Date		Date		MODELE DE FICHE STATION TERRIENNE D'EMISSION (APPENDICE 3 - SECTION 6)		(Réserve à l'IFRB)		AP3/	
A ADMINISTRATION NOTIFICATION		B N° de série de l'administration		C1 RR 1488		C2 RR 1494		C3 RR 1060	
E1		E2		E3		E4		E5	
Notification présentée à l'Agence		Notification d'une station terrestre mobile type		Demande de coordination		Accord aux termes de l'article 14 RR 1611		Demande de l'assistance du Comité RR 1060 et/ou RR 1107	
Notification		Notification		Notification		Notification		Notification	
1- Fréquence assignée		2- Bande de fréquences assignée		3a- Date Coi. 2c		3b- Date Coi. 2c		3c- Date Coi. 2c	
2036.025000 MHz		95 kHz		TW		CP		30/06/85	
4a- Nom de la station terrestre d'émission		4b- Pays		4c- Coordonnées géographiques		4d- Coordonnées géographiques		4e- Coordonnées géographiques	
BALISES		AAB		Longitude		Latitude		AR/11/A/147	
5a- Nom de la station spatiale de réception ou identifiant de satellite		5b- Long. orb. nom		5c- Désignation du faisceau de satellite de réception		5d- Désignation du faisceau de satellite de réception		5e- Désignation du faisceau de satellite de réception	
DORIS 1		5b- Long. orb. nom		5c- Désignation du faisceau de satellite de réception		5d- Désignation du faisceau de satellite de réception		5e- Désignation du faisceau de satellite de réception	
6a- Gain maximal		6b- Ouverture du faisceau		6c- Angle de site		6d- Limites de variation de l'azimut pendant l'exploitation		6e- Diagramme de rayonnement	
6		170.00		10.0		000.0/360.0		ND	
7a- Désignation de l'émission		7b- Puissance totale en crête		7c- Puissance maximale de puissance		7d- Puissance maximale de puissance		7e- Puissance maximale de puissance	
95K00G4D		+10.0		-26.0		-26.0		-26.0	
12- Coordination		13- Accords conformes à d'autres dispositions du RR		14- Administration ou Compagnie exploitante		15- Administration dont le site est station		16- Administration dont le site est station	
12- Coordination		13- Accords conformes à d'autres dispositions du RR		14- Administration ou Compagnie exploitante		15- Administration dont le site est station		16- Administration dont le site est station	
12- Coordination		13- Accords conformes à d'autres dispositions du RR		14- Administration ou Compagnie exploitante		15- Administration dont le site est station		16- Administration dont le site est station	

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Page de		Date		MODELE DE FICHE STATION TERRIENNE D'ÉMISSION (APPENDICE 3 – SECTION B)				Réserve à l'IFRB		AP3/	
A - ADMINISTRATION NOTIFICATRICE		B - N° de série de l'administration		C - Principale notification		D - Notification présentée à nouveau		E1 - RR 1488 Notification d'une station terrienne mobile type		E2 - RR 1494 Notification d'une station terrienne mobile type	
				E3 - RR 1060 Demande de coordination		E4 - Accord aux termes de l'article 16 RR 1611		E5 - Demande de l'assistance du Comité RR 1060 et/ou RR 1107		F - Notification pour	
										1) ADD 2) MOD 3) SUP	
CARACTÉRISTIQUES DE L'ASSIGNATION											
1 - Fréquence assignée		2 - Bande de fréquences assignée		3a - Date Col. 2c		3b - Date Col. 2c		3c - Date Col. 2c		3d - Date Col. 2c	
401.25000 MHz		23 kHz		TW		CP		3006185		00002400	
CARACTÉRISTIQUES DE LA STATION											
4a - Nom de la station terrienne d'émission				4b - Pays				4c - Coordonnées géographiques			
BALISES				AAB				AR/11/A/147			
STATION SPATIALE ASSOCIÉE											
5a - Nom de la station spatiale de réception ou identité du réseau à satellite				5b - Long. orbit. nom.				5c - Désignation du faisceau du satellite de réception			
DORIS 1				C				Remplir une fiche pour chaque faisceau de satellite utilisé par la station terrienne			
CARACTÉRISTIQUES DES "ENTRÉES" FAISANT PARTIE DE L'ASSIGNATION											
6a - Gain isotope maximal		6b - Ouverture du faisceau		6c - Angle de site		6d - Limites de variation de l'azimut pendant l'exploitation		6e - Diagramme de rayonnement		6f - Altitude	
+ 6		170.00		10.0		000.0360.0		ND		ND	
CARACTÉRISTIQUES PARTICULIÈRES POUR CHAQUE "ENTRÉE"											
1) Entrée		2) ADD		3) MOD		4) SUP		7a - Désignation de l'émission		7b - Puissance totale en crête	
								23 K00G1D		+ 7.0	
										- 29.0	
RENSEIGNEMENTS CONNEXES											
12 - Coordination											
13 - Accords conformes à d'autres dispositions du RR											
RENSEIGNEMENTS OU OBSERVATIONS SUPPLÉMENTAIRES											
S. Tournis sur une/des feuilles séparées. Indiquer le nombre.											

ANNEX 5

ANTENNA ADAPTATION MEASUREMENT

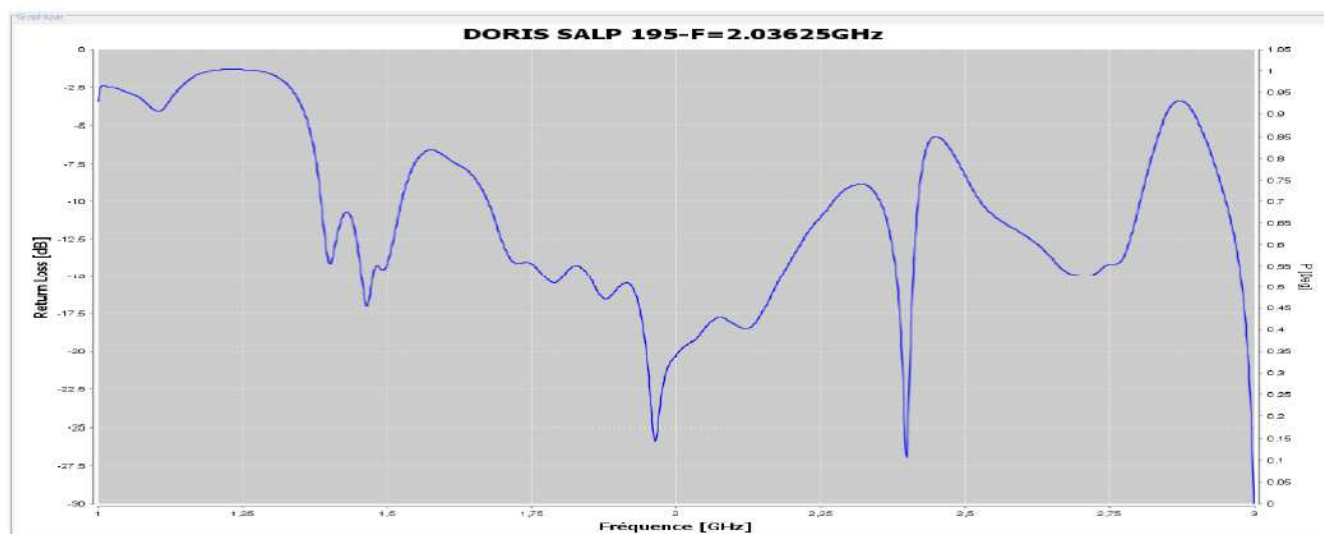


Figure 6 : Mesure d'adaptation de l'antenne DORIS SALP 195 à $F=2.03625\text{GHz}$

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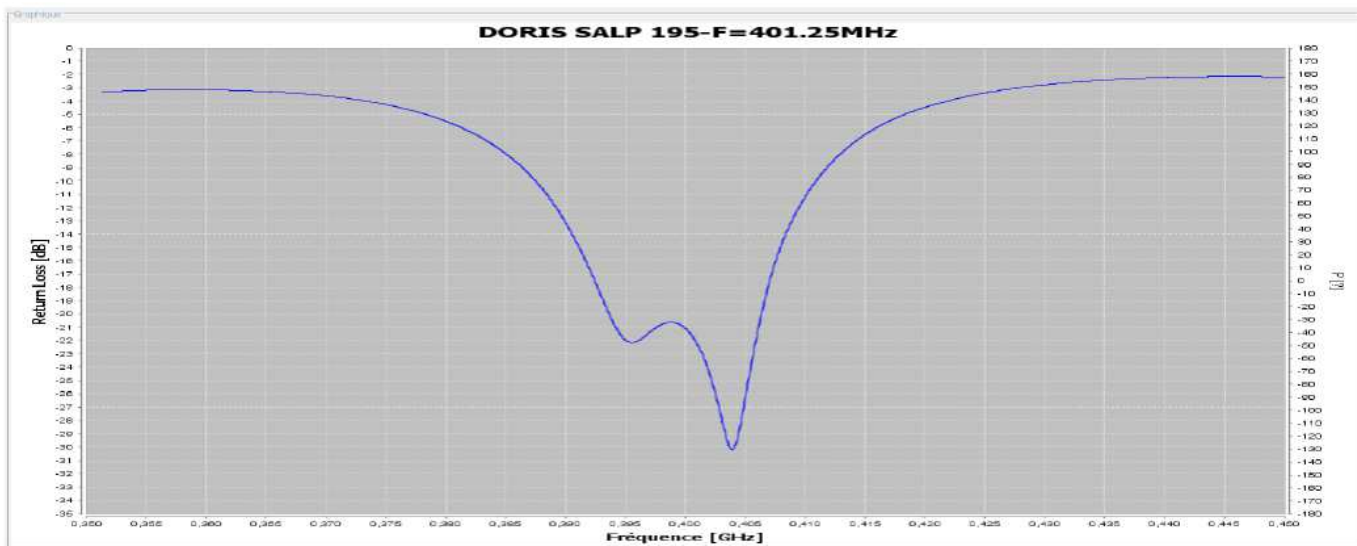


Figure 9 : Mesure d'adaptation de l'antenne DORIS SALP 195 à F=401.25MHz

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