APPLICATION FOR EQUIPMENT FREQUENCY ALLOCATION	CLASSIFICATION UNCLASSIFIED	DATE 1/26/00	Page 1 of 9 Pages

DOD GENERAL INFORMATION

USAF Frequency Management Agency 4040 North Fairfax Drive Suite 203 Arlington VA 22203	FROM AFMC AFMC CSO/SCMF 4226 Logistics Ave Suite 20 Wright Patterson AFB OH 45433

APPLICATION TITLE (U) Digital Airport Surveillance Radar (DASR)

SYSTEM NOMENCLATURE (U) ASR-11, AN/GPN-30

STAGE OF ALLOCATION (U) [ ] a. STAGE 1 CONCEPTUAL [ ] b. STAGE 2 EXPERIMENTAL [ ] c. STAGE 3 DEVELOPMENTAL [X] d. STAGE 4 OPERATIONAL

FREQUENCY REQUIREMENTS

a. FREQUENCY(IES)	(U)	2700 MHz - 2900 MHz	2700 MHz - 2900 MHz	1030 MHz	1090 MHz
b. EMISSION DESIGNATORS	(U)	3M00Q3N	5M60P0N	9M00M1D	12M00M1D

TARGET STARTING DATE FOR SUBSEQUENT STAGES

a. STAGE 2 (U) N/A	b. STAGE 3 (U) N/A	c. STAGE 4 (U) 02-28-00

EXTENT OF USE (U) Continuous

GEOGRAPHICAL AREA FOR

a. STAGE 2 (U)

b. STAGE 3 (U) Eglin AFB FL, Stockton CA, Oklahoma OK

c. STAGE 4 (U) US&P

NUMBER OF UNITS

a. STAGE 2 (U)	b. STAGE 3 (U)	c. STAGE 4 (U) 213

NUMBER OF UNITS OPERATING SIMULTANEOUSLY IN THE SAME ENVIRONMENT (U) 1

OTHER J/F 12 APPLICATION NUMBER(S) TO BE (U)
[ ] a. SUPERSEDED J/F 12/ 7099/2
[ ] b. RELATED J/F 12/

11. IS THERE ANY OPERATIONAL REQUIREMENT AS DESCRIBED IN THE INSTRUCTIONS FOR PARAGRAPH 11? (U) [X] a. YES [ ] b. NO [ ] c. NAVAIL

NAMES AND TELEPHONE NUMBERS (U)

a. PROGRAM MANAGER Michael Freie	(1) COMMERCIAL 781-377-8890	(2) DSN 478-8890
b. PROJECT ENGINEER Holly Arbaczawski	(1) COMMERCIAL 781-377-9253	(2) DSN 478-9253

REMARKS (U)

Block 4

Frequency	Emission Designator
2700-2900 MHz	3M00Q3N 5M60P0N
1030 MHz	9M00M1D
1090 MHz	12M00M1D

Note: No more than 2 frequencies in band for the radar will be used, conforming to NTIA manual, Para 5.3.3. Each frequency will cary two emission designators, one for a long pulse (89 microseconds) and one for the short pulse (1 microsecond). The DASR system will also include a beacon system with the same transmit and receive characteristics as the UPX-27, (J/F 12/3181). The beacon system will be a Monopulse Secondary Surveillance Radar (MSSR) type.

DOWNGRADING INSTRUCTIONS

J/F 12/

CLASSIFICATION UNCLASSIFIED

TRANSMITTER EQUIPMENT CHARACTERISTICS

NOMENCLATURE, MANUFACTURER'S MODEL NO.
(U) ASR-11, AN/GPN-30

2. MANUFACTURER'S NAME
(U) Raytheon Company

TRANSMITTER INSTALLATION
(U) Fixed Sheltered

4. TRANSMITTER TYPE
(U) Non-Linear Frequency Modulated Pulse

TUNING RANGE
(U) 2700 MHz - 2900 MHz

6. METHOD OF TUNING
(U) Crystal Controlled

8. EMISSION DESIGNATORS
(U) 3M00Q3N (U) 5M60P0N (U)

RF CHANNELING CAPABILITY
(U) NA Fixed

12. EMISSION BANDWIDTH
[ ] CALCULATED [X] MEASURED

FREQUENCY TOLERANCE
(U) 30 ppm

a. -3 dB	(U) 0.9 Hz	(U) 0.7 Hz	(U)
b. -20 dB	(U) 1.8 Hz	(U) 3.2 Hz	(U)
c. -40 dB	(U) 3.3 Hz	(U) 8.8 Hz	(U)
d. -60 dB	(U) 6.4 Hz	(U) 19.5 Hz	(U)
e. OC-BW	(U) 2.6 Hz	(U) 5.6 Hz	(U)

FILTER EMPLOYED
(U) [X] a. YES [ ] b. NO

15. MAXIMUM MODULATION FREQUENCY
(U) 2 MHz

SPREAD SPECTRUM
(U) [ ] a. YES [X] b. NO

MAXIMUM BIT RATE
(U) NA

17. DEVIATION RATIO
(U)

MODULATION TECHNIQUES AND CODING
(U) Non-Linear Frequency Modulated (NLFM): 4 MHz across 89 microsec pulse

18. PULSE CHARACTERISTICS

a. RATE	(U) 700 pps - 1000 pps	(U) 700 pps - 1000 pps	(U)
b. WIDTH	(U) 89 s	(U) 1.45 s	(U)
c. RISE TIME	(U) 0.7 s	(U) 0.6 s	(U)
d. FALL TIME	(U) 1.0 s	(U) 0.32 s	(U)
e. COMP RATIO	(U) 89	(U) 1	(U)

PRE-EMPHASIS
(U) [ ] a. YES [X] b. NO

POWER

MEAN	(U) 2.1 KW	(U) 0.021 KW	(U)
PEP	(U) 25.0 KW	(U) 25. KW	(U)

21. HARMONIC LEVEL

a. 2nd	(U)	-74 dB
b. 3rd	(U)	-80 dB
c. OTHER	(U)	NAvail

OUTPUT DEVICE
(U) Solid State Transistors, Class C

SPURIOUS LEVEL
(U) -80 dB

FCC TYPE ACCEPTANCE NO.
(U) NA

REMARKS (U)

Block 4: Solid State Transmitter

Block 7: 4 Preset crystals

Block 10: Harmonic filter has a 0.12 dB loss in band and an attenuation of 29 dB at the second harmonic

Block 12: The generation of the NLFM pulse has the -20 dB point at 1.6 MHz but the full chirp is over +/- 2 MHz relative to the carrier. The carrier is taken +/- 0.5 MHz alternately from the specified system operating frequency. this results in a total emission bandwidth of 3.0 MHz for the long pulse (the Mason Zimmerman formula does not apply for this waveform). The emission bandwidth for the short pulse is 5.6 MHz.

Block 17: +/- 2 MHz

TRANSMITTER REMARK OVERFLOW PAGE

Block 18: The RF emission consist of a series of pulse pairs at each frequency alternating between a short and long pulse with a common PRF. The five pulse pairs constitute a coherent processing interval (CPI). PRFs of 1008, 898, 757, and 694 Hz are used alternately in a fixed sequence for each CPI. Figure 2 of the NTIA General Information shows the DASR pulse train waveform.

Block 19: Mean power assumes that the pulses are continuouly operated at a fixed frequency. In operation, the mean power of the pulses is approximately one half of the mean power at the first frequency and one half of the mean power at the second frequency.

Block 22: In compliance with applicable NTIA spectral requirements, emission levels are in compliance with the NTIA additional EMC provisions as specified in 5.3.3 Criteria D, Section 9a, dated 5/94. The more stringent radar emission bandwidth criteria for the 89 microsecond pulse is applied to the 1 microsecond pulse, and referenced to the maximum spectral power density of the 89 microsecond pulse, because both pulses use the same frequency, but are time sequenced.

DASR TRANSMISSION EQUIPMENT COMPLIANCE WITH NTIA REQUIREMENTS

The DASR system requirements for the operating frequency state that the radar shall transmit in the frequency range of 2700 to 2900 MHz using no more than two frequency assignments within the National Telecommunications and Information Administration (NTIA) guidelines for radar emission bandwidth. The operating frequencies will be assigned by the government and are site dependent. The Spectrum Engineering Criteria state that the radar shall meet the requirements stated in 5.3.3, Radar Spectrum Engineering Criteria, NTIA "Manual of Regulations and Procedures for Federal Radio Frequency Management", (Title 47, Part 300 of CFR). Raytheon's radar requires two frequency assignments as determined by the NTIA guidelines for radar emission bandwidth. A +/- 0.5 MHz offset is introduced with each frequency assignment to decorrelate rain which causes the statistics of rain returns be be noise-like and not raise the false alarm rate in those areas. The NTIA guidelines and additional EMC emission level provisions with the +/- MHz offset are both met because of the purity of the transmissions.

The NTIA radar emission bandwidth criteria for the waveform for F1 and F2 are determined from the pulsewidth, pulse rise or falltime and the pulse CHIRP bandwidth, ie

The Radar Emission Bandwidth at -40 dBc = $(6.2 / (t_r t)^{0.5}) + 2 (B_c + (0.105 / t_r)) =$ 9.2 MHz,
where typically $t = 89\ \mu s$, $t_r = 0.6\ \mu s$, $t_f = 0.84\ \mu s$, $B_c = 4.0$ MHz.

The Radar Emission Bandwidth at –80 dBc = 10 * Radar Emission Bandwidth at -40 dBc = 92 MHz when considering the minimum requirement of –40 dBc/decade rolloff between –40 dBc and –80 dBc.

The Radar Emission Bandwidth at –80 dBc = $(10)^{0.5}$ * Radar Emission Bandwidth at –40 dBc = 29.1 MHz when considering the additional provision requirement of –80 dB/decade rolloff between –40 dBc and –80 dBc.

NTIA compliance was demonstrated at the Operational Capabilities Demonstration (OCD) on 23 February 1996, and the spectral data attached, which was recorded during the OCD, clearly shows that only two frequency assignments are required. Figure 1 shows the system running full waveform with and without the NTIA spectrum control system active, and demonstrates compliance to below –70 dBc, and is only constrained by the Spectrum Analyzer noise level. Figure 2 demonstrates compliance to below the –80 dBc level.

The NTIA spectral emission requirements are met using the spectral control system employing the Raytheon patented Spurious Frequency Suppressor (patent numbers 5381110 and 5568105 granted 10 January 1995).

Figure 2: These typical DASR transmitted spectrum plots of the individual F1 and F2 frequencies were taken during OCD demo on 23 February, 1996 at Raytheon Canada Ltd. These are compliant with both the NTIA requirements (-40 dB/decade) and the additional provisions (-80 dB/decade). The NTIA requirements lines were adjusted for the use of a notch filter to enable measurement to the -80 dBc level as described above.

Figures 3-5: These figures show the combined short and long pulse transmitted spectrum at three frequencies (2700, 2796, 2900 MHz) across the operating band. The notch filter compensated NTIA requirements have been overlaid to show that the transmitted spectrum is well within the requirements at each frequency.

Figures 6-8: These figures show the typical long pulse transmitted spectra associated with block 12 of the Transmitter Equipment Characteristics section. A span of 20 MHz was used to measure the emission bandwidth of the system at the -3 dB, -20 dB, -40 dB, and -60 dB points. The emission bandwidths have been measured and included on the plots. Associated transmitted output powers, pulsewidths, risetimes, and falltimes are given in the table below.

Frequency (MHz)	Width (us)	Risetime (us)	Falltime (us)	Peak Power (watts)	B(-40dB) (MHz)	B(-80 dB) S=40 (MHz)	B(-80 dB) S=80 (MHz)
2700	88.8	0.634	1.26	20324	9.15	91.54	28.95
2800	89.0	0.687	0.99	22600	9.10	90.99	28.77
2900	88.64	0.695	1.41	18030	9.09	90.92	28.75

Figures 9-11: These figures show the typical short pulse transmitted spectra associated with block 12 of the Transmitter Equipment Characteristics section. A span of 20 MHz was used to measure the emission bandwidth of the system at the -3 dB, -20 dB, -40 dB, and -60 dB points. The emission bandwidths have been measured and included on the plots. Associated transmitted output powers, pulsewidths, risetimes, and falltimes are given in the table below.

Frequency (MHz)	Width (us)	Risetime (us)	Falltime (us)	Peak Power (watts)
2700	1.37	0.58	0.24	20091
2800	1.48	0.64	0.31	22548
2900	1.27	0.64	0.24	17701

With notch filter

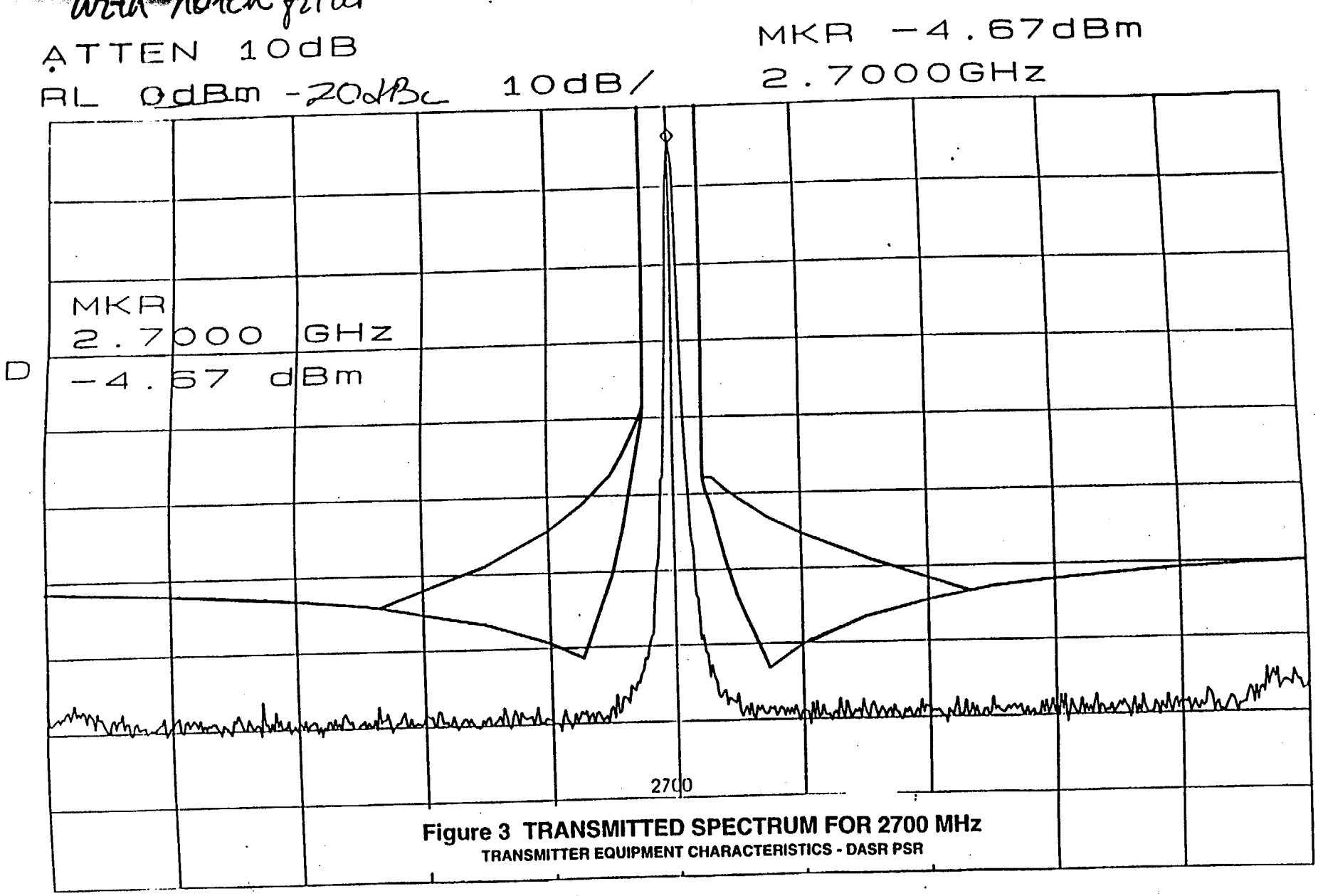

Figure 3 TRANSMITTED SPECTRUM FOR 2700 MHz

TRANSMITTER EQUIPMENT CHARACTERISTICS - DASR PSR

REX_A F_2 (2796MHz)
with notch filter

5/8/97

2796
2805CDN Chart 19

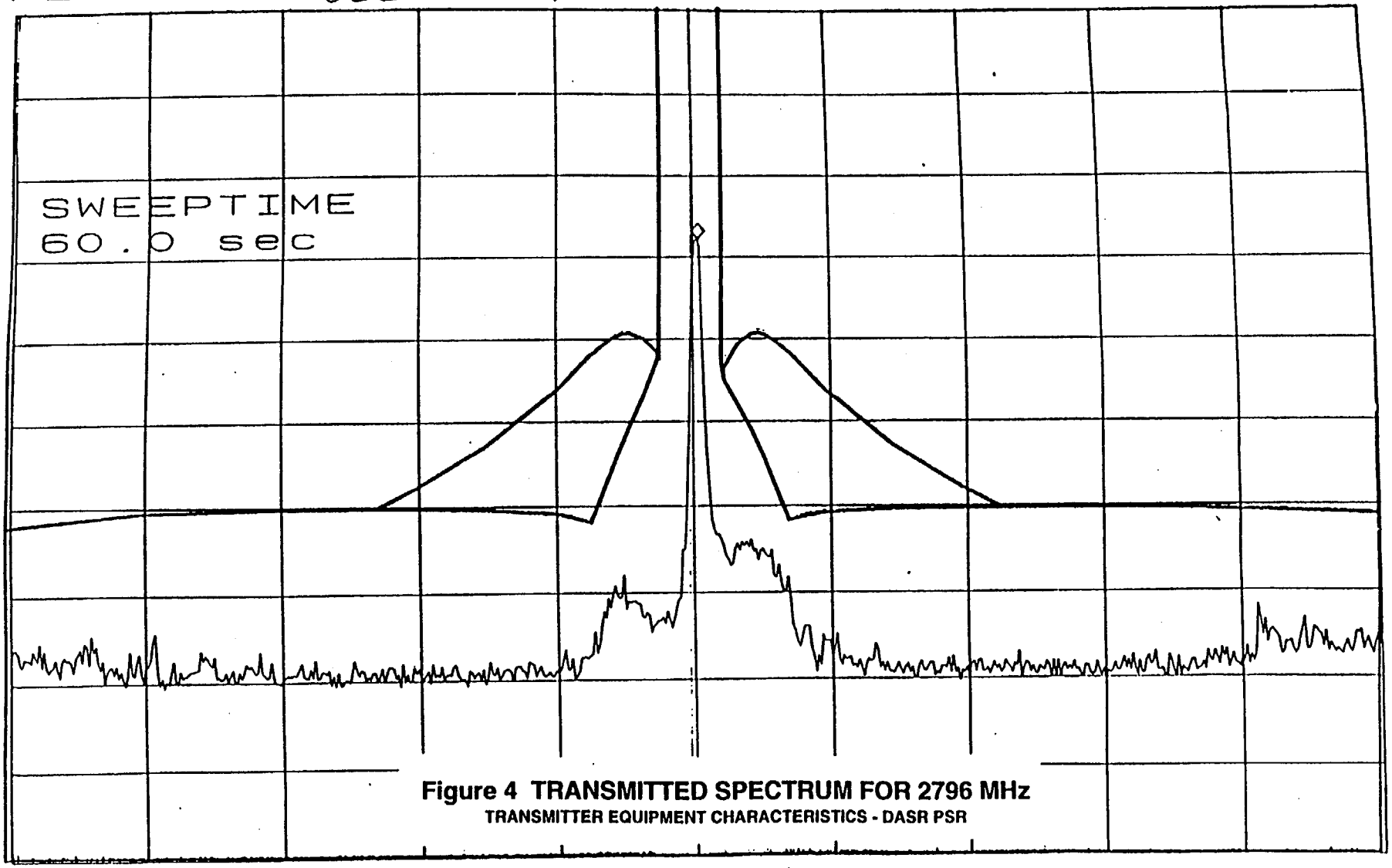

Figure 4 TRANSMITTED SPECTRUM FOR 2796 MHz

TRANSMITTER EQUIPMENT CHARACTERISTICS - DASR PSR

with notch filter

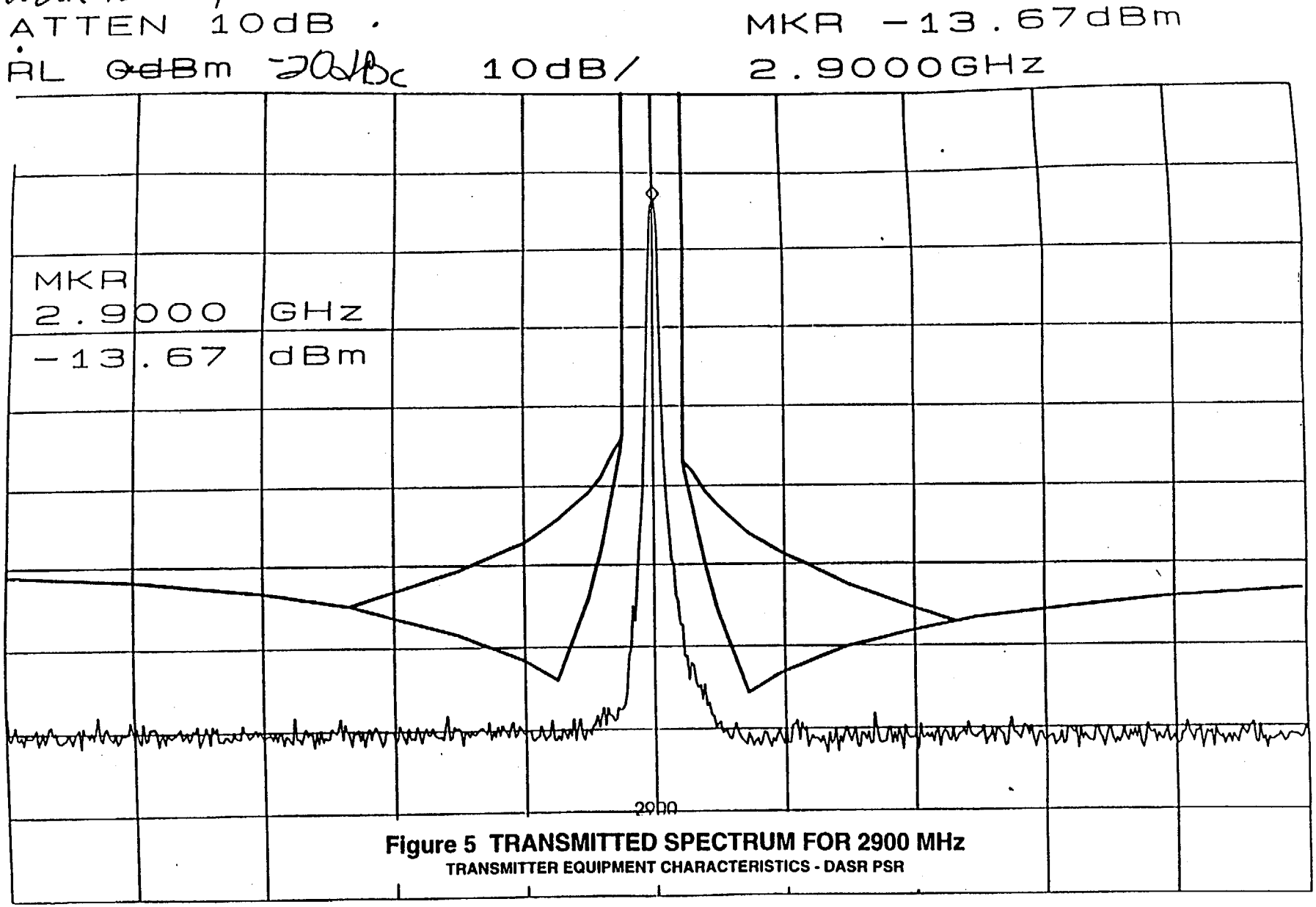

Figure 5 TRANSMITTED SPECTRUM FOR 2900 MHz

TRANSMITTER EQUIPMENT CHARACTERISTICS - DASR PSR

Long Pulse

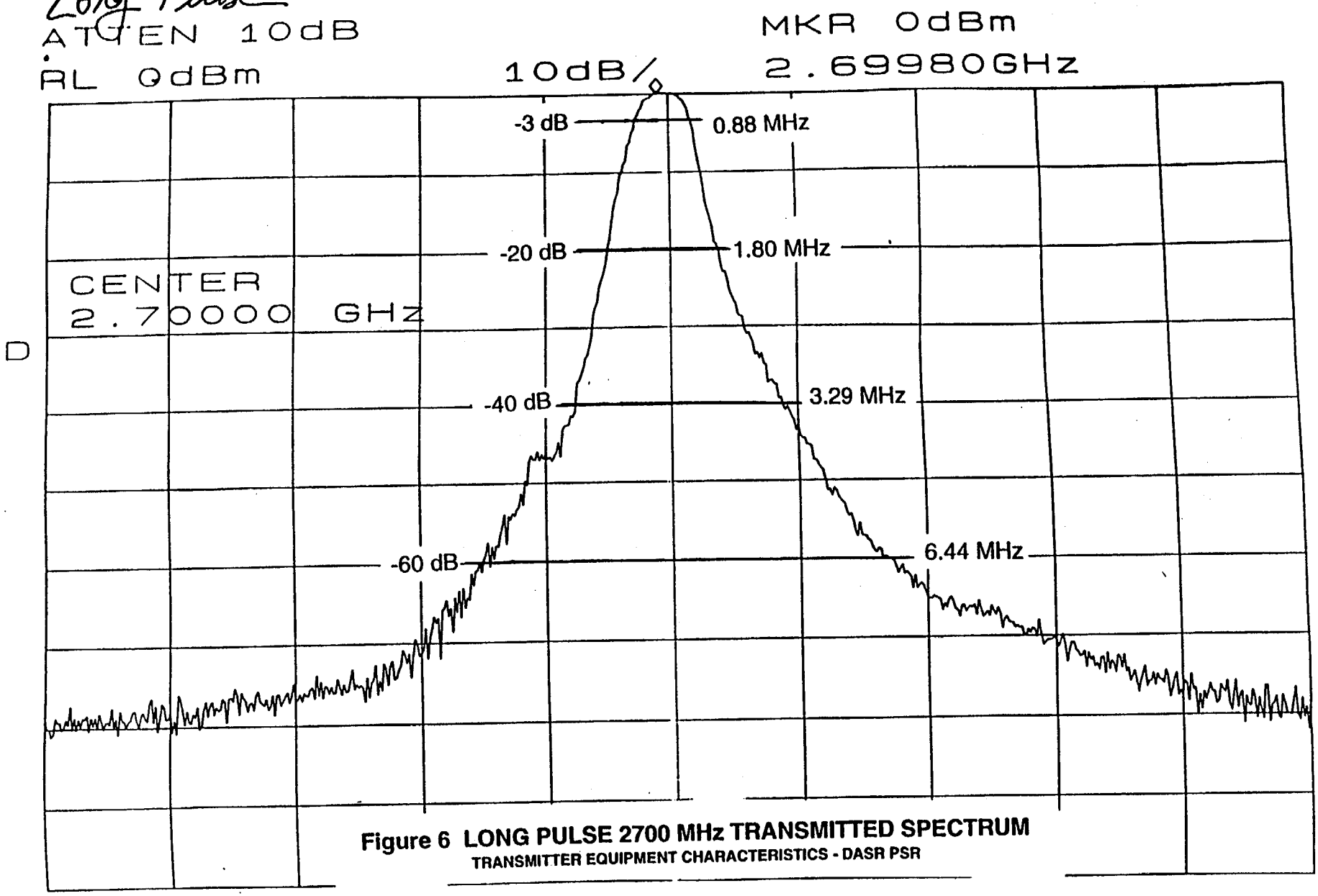

Figure 6 LONG PULSE 2700 MHz TRANSMITTED SPECTRUM

TRANSMITTER EQUIPMENT CHARACTERISTICS - DASR PSR

5/8/97

Long Pulse

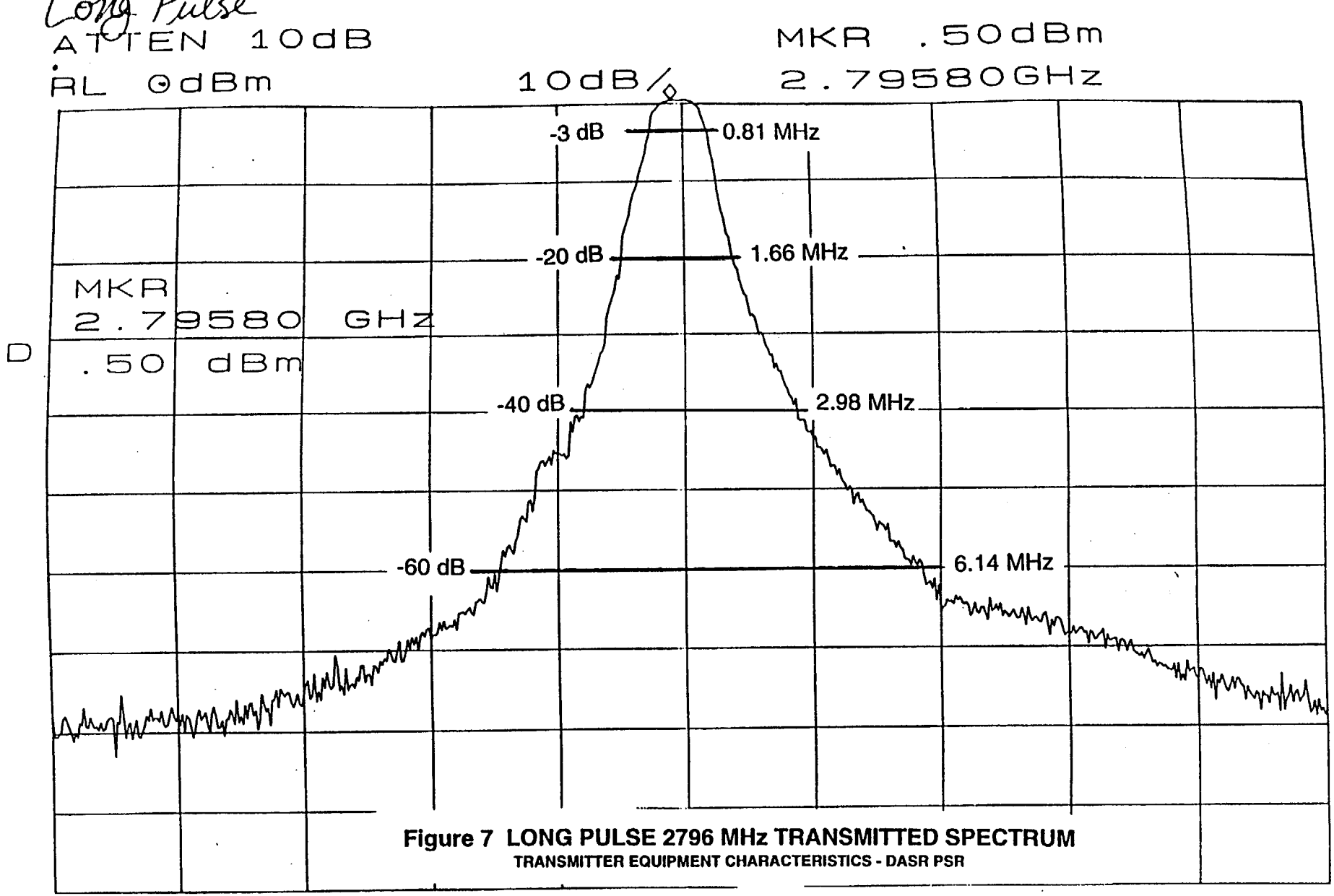

Figure 7 LONG PULSE 2796 MHz TRANSMITTED SPECTRUM

Long Pulse

5/8/97

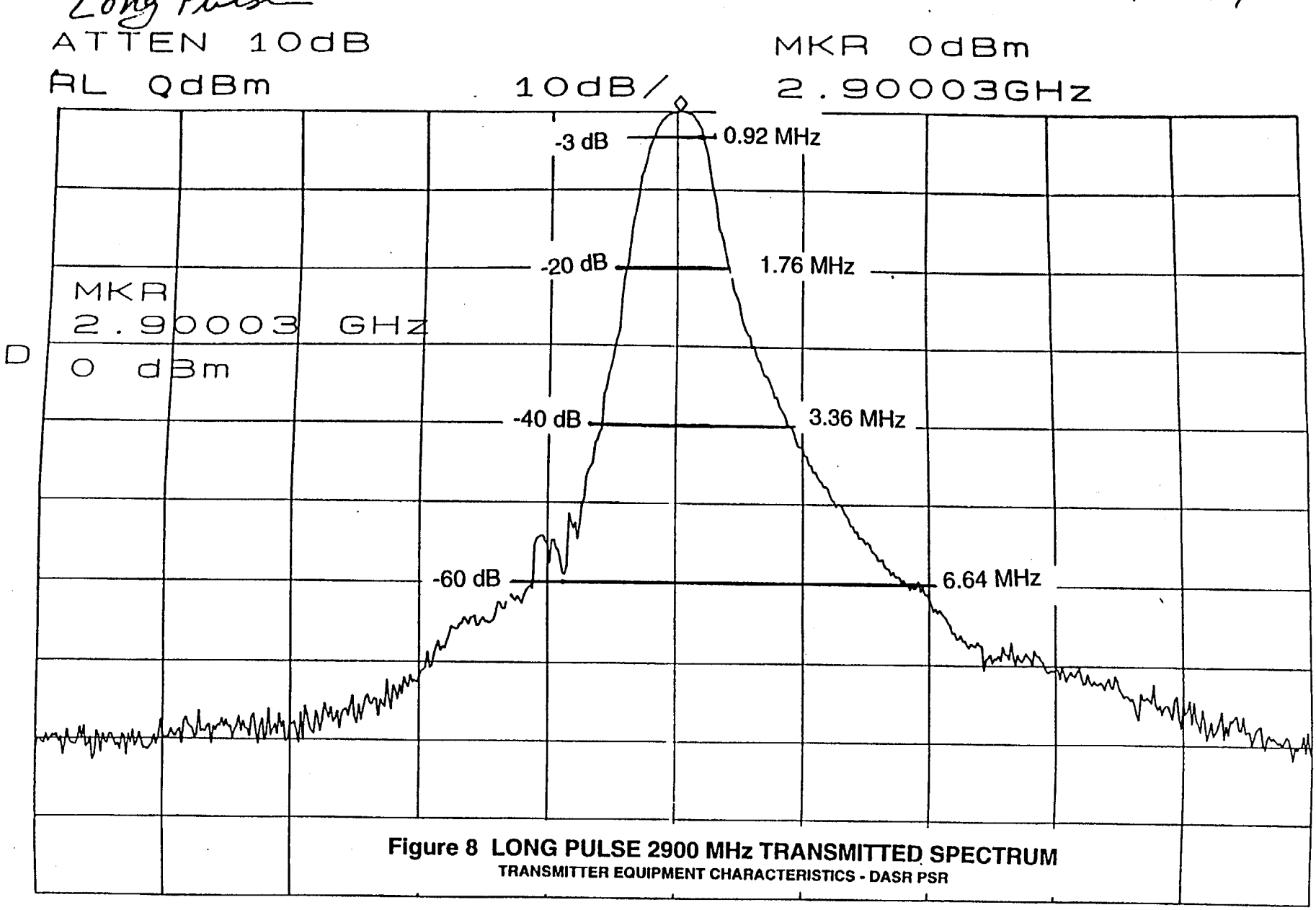

Figure 8 LONG PULSE 2900 MHz TRANSMITTED SPECTRUM

TRANSMITTER EQUIPMENT CHARACTERISTICS - DASR PSR

KEX-H f, (2700MHz)

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Short Pulse

* removed 20dB from path, no notch filter

ATTEN 10dB

MKR −11.67dBm

RL 0dBm

10dB/

2.70000GHz

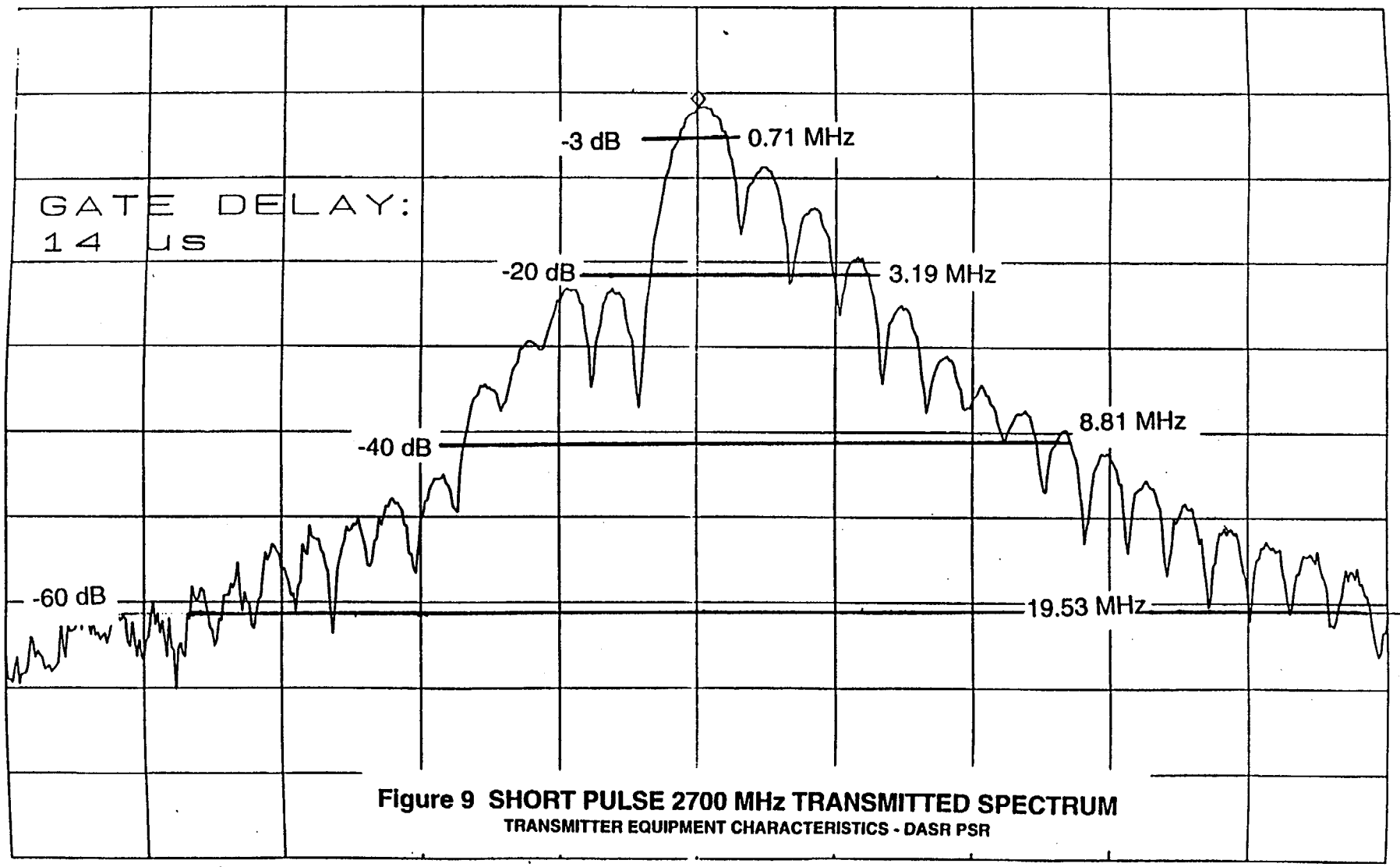

Figure 9 SHORT PULSE 2700 MHz TRANSMITTED SPECTRUM

TRANSMITTER EQUIPMENT CHARACTERISTICS - DASR PSR

CENTER 2.70000GHz

SPAN 20.00MHz

*RBW 100kHz

*VBW 30kHz

*SWP 15.0sec

K6HCG

Short pulse *removed 20 dB from path, no notch filter

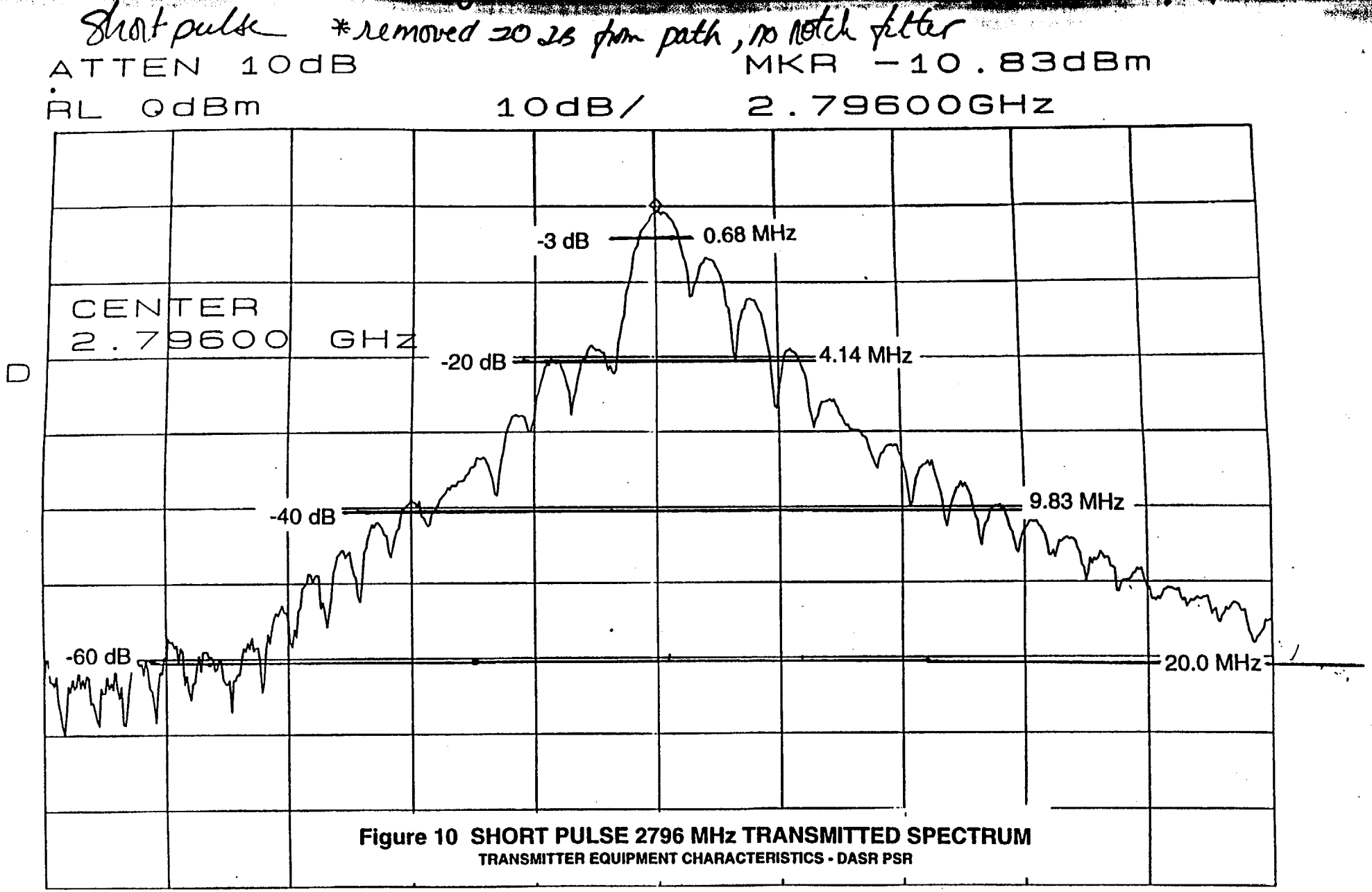

Figure 10 SHORT PULSE 2796 MHz TRANSMITTED SPECTRUM

TRANSMITTER EQUIPMENT CHARACTERISTICS - DASR PSR

Short Pulse * removed 20 dB fm path, no notch filter

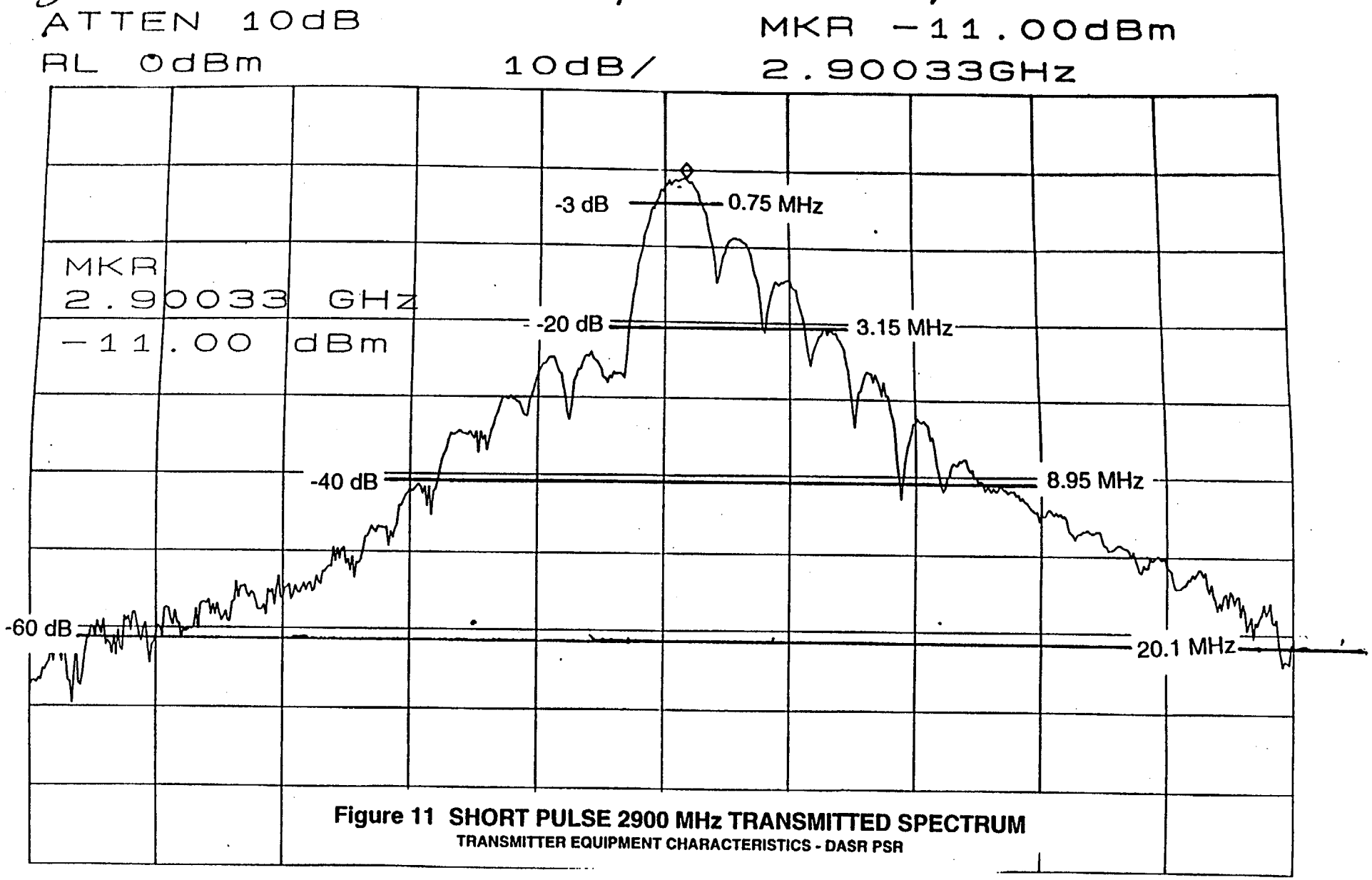

Figure 11 SHORT PULSE 2900 MHz TRANSMITTED SPECTRUM

ANTENNA EQUIPMENT CHARACTERISTICS

(U) [ ] a. TRANSMITTING [ ] b. RECEIVING [X] c. TRANSMITTING AND RECEIVING

2. NOMENCLATURE, MANUFACTURER'S MODEL NO. (U) ASR-11, AN/GPN-30	3. MANUFACTURER'S NAME (U) Raytheon Co. (Andrew Antenna)
4. FREQUENCY RANGE (U) 2700 MHz - 2900 MHz	5. TYPE (U) Parabolic Reflector
6. POLARIZATION (U) Circular or Linear	7. SCAN CHARACTERISTICS a. TYPE (U) MECHANICAL
8. GAIN	b. VERTICAL SCAN (U) Adjustable Mount
a. MAIN BEAM (U) 34 dBi	(1) Max Elev (U) +5.0 deg
b. 1st MAJOR SIDE LOBE (U) 9.5 dBi @ 3.5 deg	(2) Min Elev (U) -3.0 deg
BEAMWIDTH	(3) Scan Rate (U) NA
a. HORIZONTAL (U) 1.45 deg	c. HORIZONTAL SCAN (U) Mechanical
b. VERTICAL (U) 4.8 deg	(1) Sector Scanned (U) 360
	(2) Scan Rate (U) 12.5 RPM
	d. SECTOR BLANKING (U) [X] (1) YES [ ] (2) NO

10. REMARKS (U)

Block 5: Doubly-Curved reflector, 5 meters wide by 2.75 meters tall

Block 7: Transmitter control inhibits RF output

Block 8: Antenna meets NTIA RSEC Criteria D specifications: Median antenna gain is less than -10 dBi

ANTENNA EQUIPMENT CHARACTERISTICS – DASR PSR

FIGURE 1 : This antenna pattern has greater than 61.7% below the –10 dBi line. The antenna has a peak gain of +34 dBi . The antenna pattern is a 360 degree azimuth cut taken at the peak of the beam.

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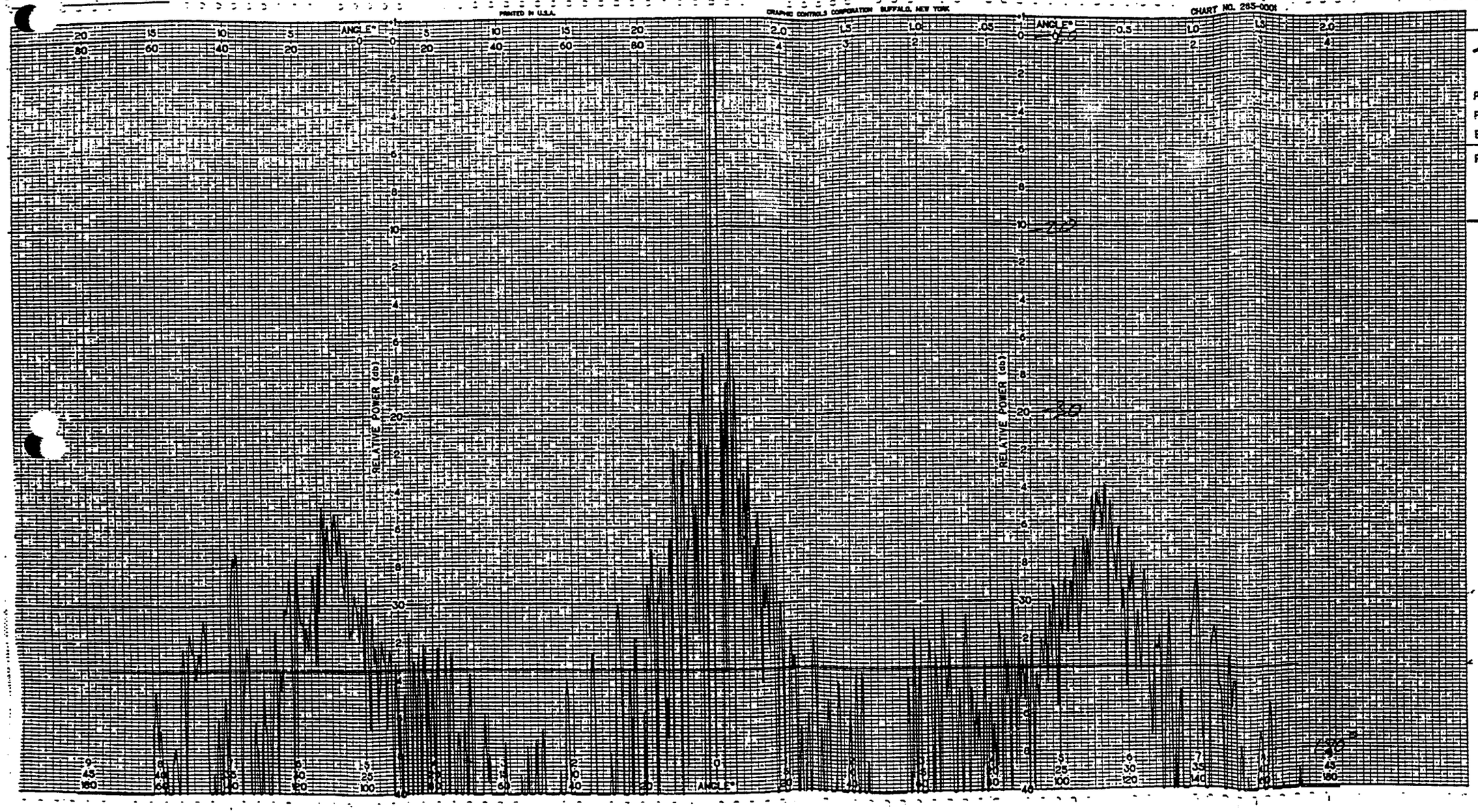
Pg 3 of 39.



ANDREW

PATTERN NO. JAN 24 1988 DATE

PROJECT

ENGRS.

REMARKS

3-RLB-2800