Test Report

of an Intentional Radiator for Certification under Part 15.231(e) of the FCC rules

DUT:	Remote Control Transmitter
FCC ID	SB8-ICEM-FIL-T-3C
Test Date:	07-July-2004

Manufacturer: ICEM Enterprises, Inc.
10 Buttermilk Falls Road
Fort Ann, NY 12827
(518) 761-3063

Prepared by: Control Design & Testing, Inc.
6010 Red Fox Drive
Spotsylvania, VA 22553
(540) 582-2826

A. DEVICE UNDER TEST

The device is a transmitter used to control water filling systems for vehicles, in particular vehicles used for resurfacing ice rinks. The transmitter is manufactured by ICEM Enterprises, Inc and marketed under the trade name Icemakers. The frequency of operation is 418.00 MHz., nominal. The modulation mode is on/off keying using pulse code modulation. This product is designed to operate under the provisions of Part 15.231(e) of the FCC rules and RSS-210 in Canada.

The test sample was supplied in the final production plastic enclosure. The device is powered by an internal 9 volt alkaline battery. The transmitter circuit is comprised of an RF Monolithics, TX-5002 transmitter hybrid IC, a two element inductive match and a 5 inch insulated wire antenna. The antenna is hard soldered to the circuit board. There is no provision to connect an external antenna.

B. FACILITY:

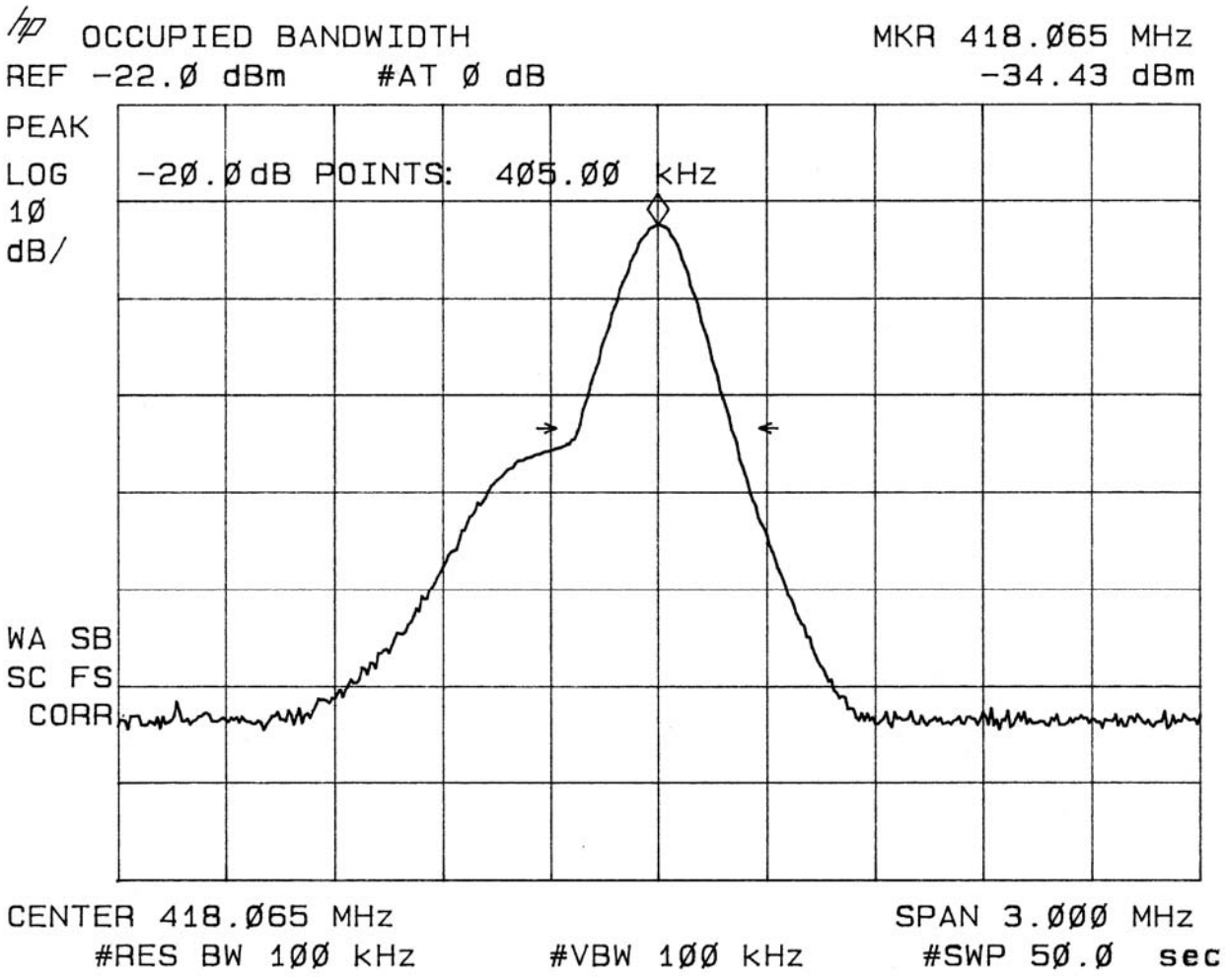
Radiated emissions testing of this device was conducted at the Carl T. Jones test facility located in Springfield, Virginia. FCC Site #90490; IC Site #3101.

C. MEASUREMENT PROCEDURE: RADIATED EMISSIONS

The field strength measurements were conducted according to the procedures set forth in ANSI C63.4 (1992). The device under test was placed on a rotating turntable 0.8 meters high, centered at 3 meters distant from the measurement antenna. The device was placed in the center of the turntable and tested in two positions as shown in the test setup photographs

In normal operation, this device is programmed to transmit whenever an activated sensor is detected; one transmission per second maximum). For the purpose of radiated emissions testing, the test sample was specially programmed with a test routine that began continuously transmitting its code sequence on power-up. The occupied bandwidth (Plot 1) was also captured using this signal.

Plot 1


OCCUPIED BANDWIDTH
MKR 418.Ø65 MHz
REF -22.Ø dBm
#AT Ø dB
-34.43 dBm
PEAK
LOG
1Ø
dB/
-2Ø.Ø dB POINTS: 4Ø5.ØØ kHz
WA SB
SC FS
CORR
CENTER 418.Ø65 MHz
SPAN 3.ØØØ MHz
#RES BW 1ØØ kHz
#VBW 1ØØ kHz
#SWP 5Ø.Ø sec

The field strength measurements were taken using an HP-8596E spectrum analyzer, an EMCO 3121C dipole set, an EMCO 3115 double ridge guide horn and an Avantek UJ210 preamp. The device was scanned from 30 MHz. to 5 GHz. and all emissions were noted. In this case, the only emissions detected were the primary frequency of operation and those frequencies harmonically related to the fundamental transmit frequency.

At each detected emission frequency, the device was measured by rotating the turntable and adjusting the antenna height over a range of 1 to 4 meters to obtain the maximum output level. This procedure was performed with both horizontal and vertical antenna polarizations for both of the positions shown in the test setup photos. The peak reading for each frequency was recorded in the fourth column in Table 1 below.

Measurements taken for weak emissions were performed by reducing the distance from the measurement antenna to 1 meter and factoring –9.54dB into the calculation. This method was used for the 7^{th} and 8^{th} harmonics.

Table 1

RADIATED EMISSIONS DATA

CLIENT: ICEMAKERS FCC ID:
ANTENNA: DIPOLES/DRG HORN DUT: CONTROL TRANSMITTER
PART 15.231(e) DATE: 07-JULY-04

Frequency In MHz.	Ant. Polar. H/V	Ant. Factor dB	Peak reading dBm	Duty Cycle -dB	Peak Power uV/m@3m	Corrected Power uV/m@3m	FCC Limit uV/m@3m
418.070	H	22.7	-46.02	15.9	15276	2449	4133
836.140	H	30.2	-85.38	15.9	390	63	413
1254.210	H	27.6	-92.36	15.9	129	21	413
1672.280	V	29.3	-96.41	15.9	99	16	413
2090.350	V	31.0	-99.89	15.9	80	13	413
2508.420	V	32.2	-102.38	15.9	69	11	413
2926.490	H	33.6	-108.05	15.9	42	7	413
3344.560	V	34.9	-113.29	15.9	27	4	413

D. DUTY CYCLE AND INTERVAL CALCULATIONS

The occupied bandwidth and duty cycle measurements were made using an HP-8594E spectrum analyzer and plotted with an HP-7475A pen plotter. The computation for the duty cycle correction factor for column five in Table 1 is derived from the manufacture's description of the data scheme and is verified by plots 2 through 5 below.

The data format for this device is a modified Manchester phase pulse modulation scheme. The code scheme consists of four packets transmitted as a continuous pulse stream without any spaces between the packets. Each packet is transmitted only one time for any given activation (sensor, low battery, integrity) at intervals of 1 second or longer. There can never be more than one packet in any 100ms. period.

The device does not transmit a control signal every second automatically. The control transmissions are only sent in response to a request from a sensor or, in the event of low battery detection. Transmissions are sent once every 5 minutes for temperature readings once every 10 minutes for battery status (integrity).

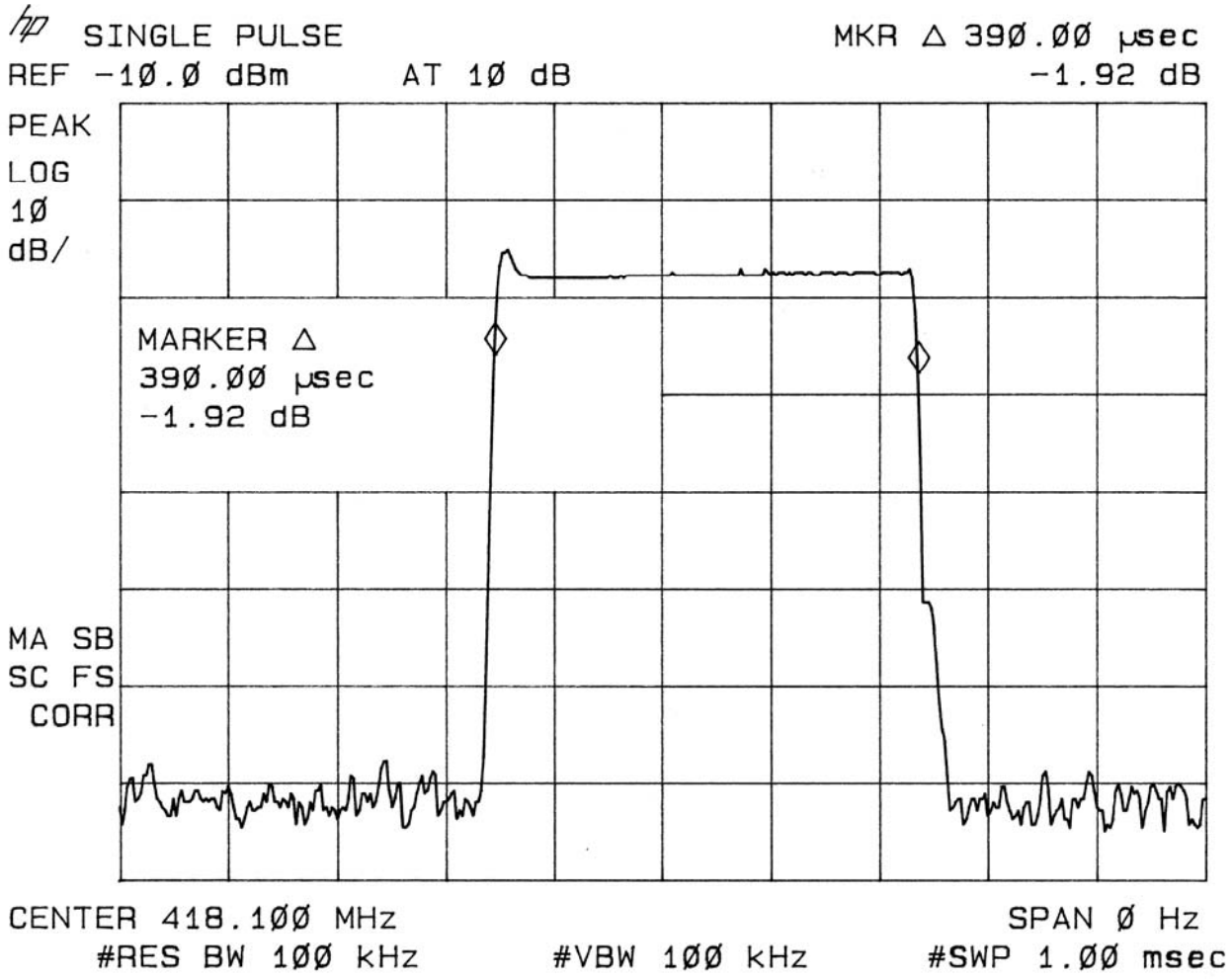
Each transmission is 16ms. long consisting of forty, 400µs. bit frames divided into four 10 bit packets. The start bits, stop bits and 1's are represented by an "on" signal; zero's are represented by an "off" or no transmission period. In actual operation it not possible to have all bits transmitted as 1's. However, the calculation below is based on a transmission of all 1's.

1 Packet	10 bits X 400µs. =	04ms.
Transmission time	4 packets X 4ms =	16ms.
On time per 100ms.		16ms.

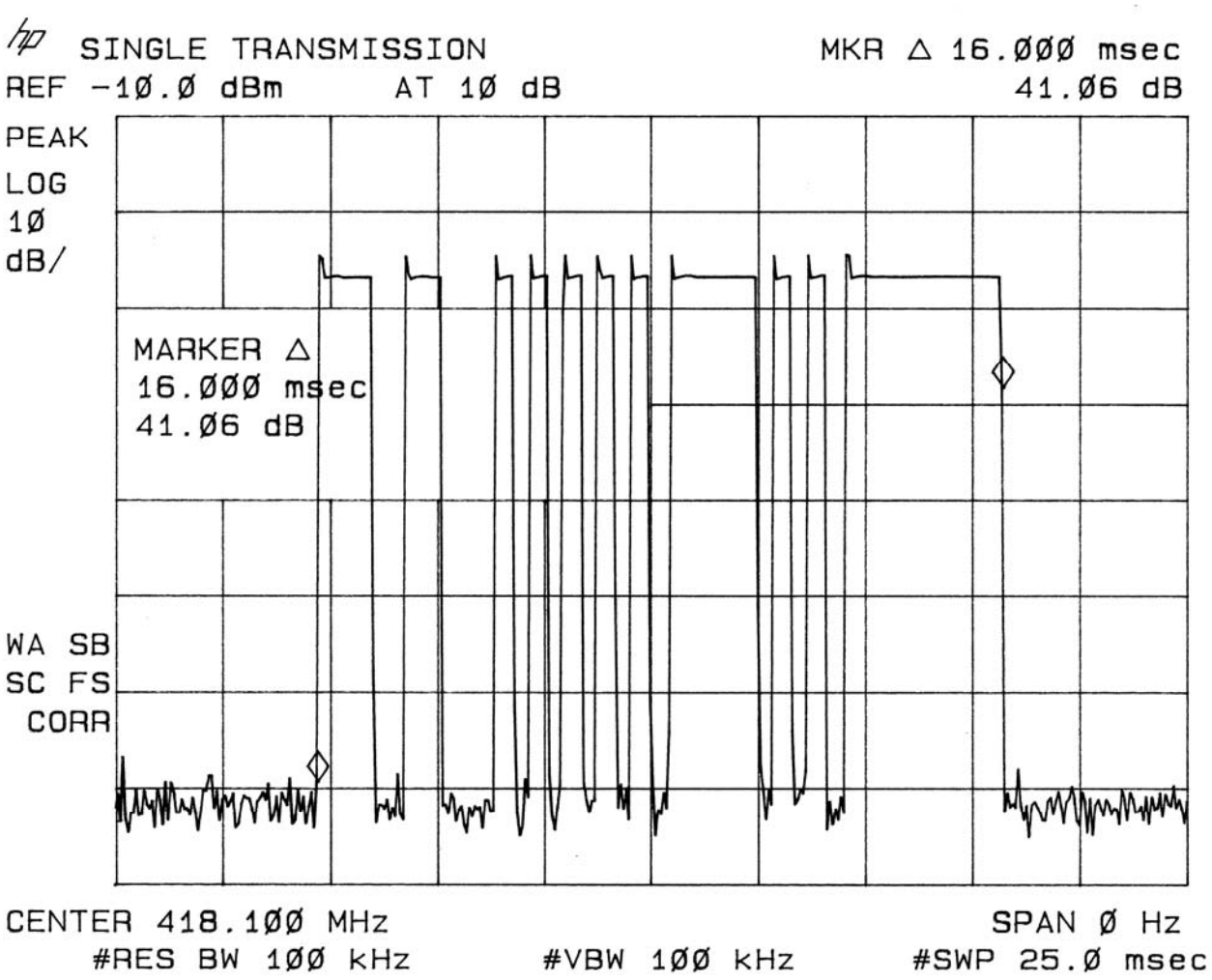
20log(16ms. total on time)/100ms.) = -15.917 dB.

As provided in Part 15.35 of the FCC rules, a correction factor of –15.9 dB is used for the calculations on the data sheet. The duty cycle corrected levels appear in the 7th column in the table above.

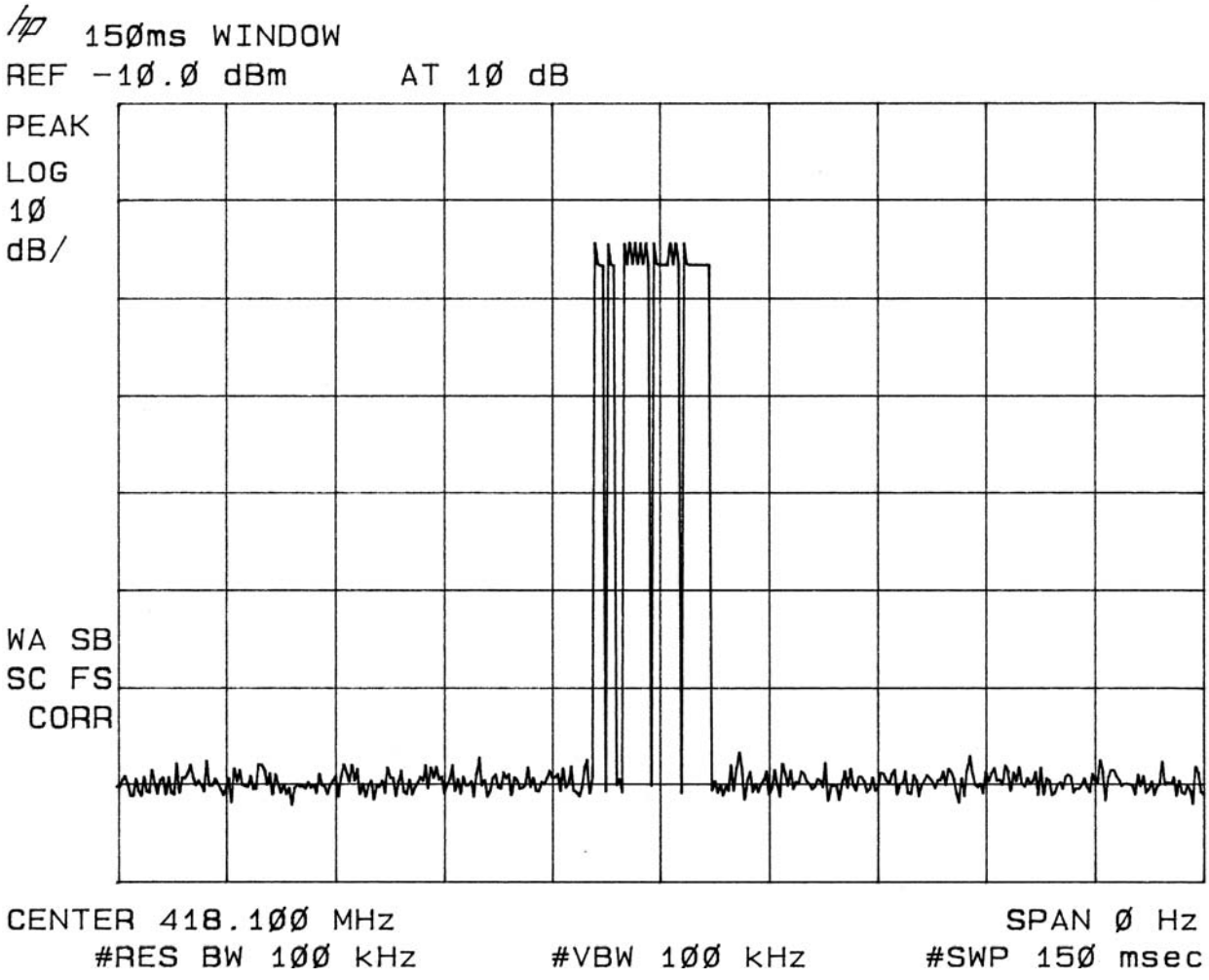
Plot 2


SINGLE PULSE
MKR Δ 39Ø.ØØ µsec
REF −1Ø.Ø dBm
AT 1Ø dB
−1.92 dB
PEAK
LOG
1Ø
dB/
MARKER Δ
39Ø.ØØ µsec
−1.92 dB
MA SB
SC FS
CORR
CENTER 418.1ØØ MHz
SPAN Ø Hz
#RES BW 1ØØ kHz
#VBW 1ØØ kHz
#SWP 1.ØØ msec

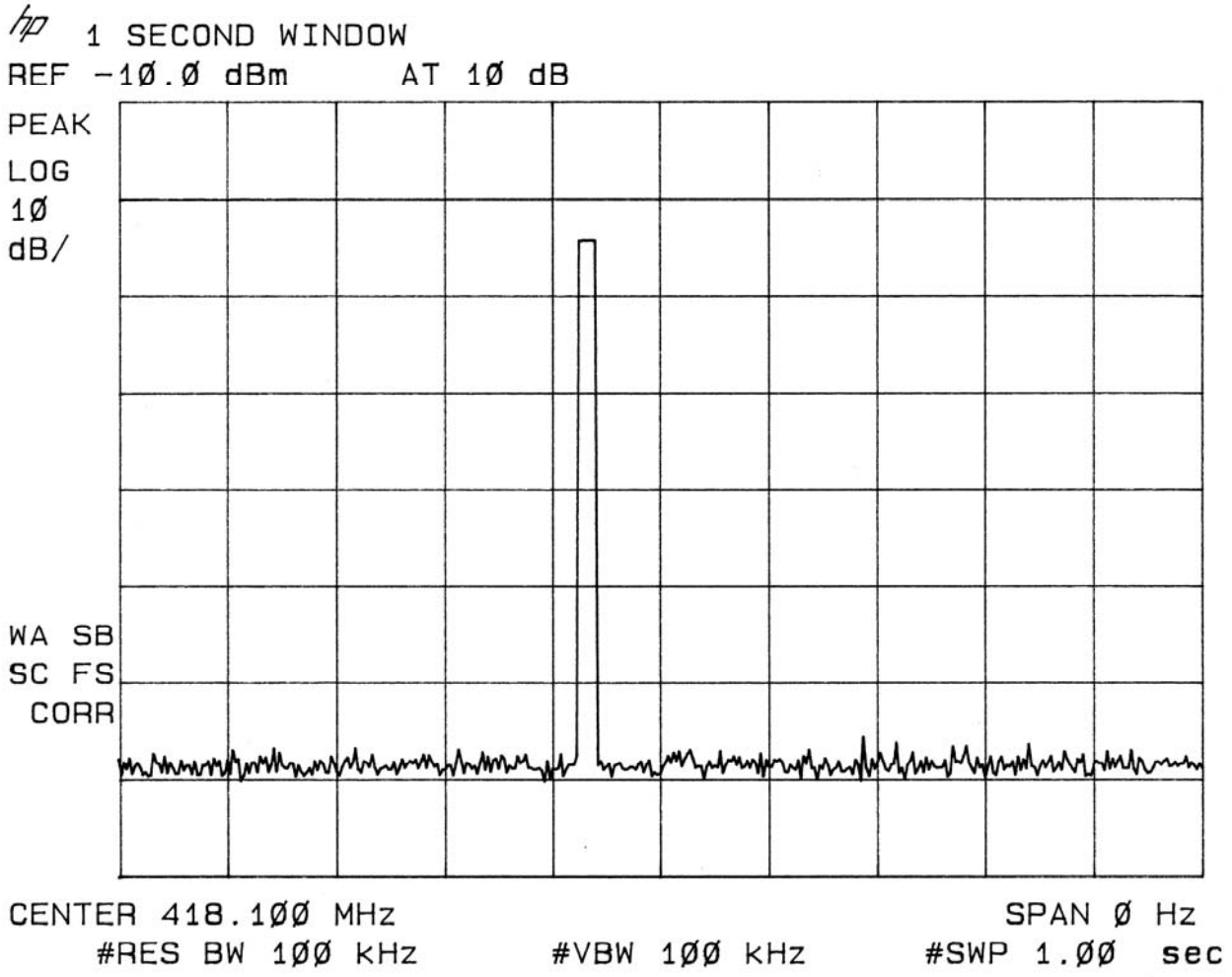
Plot 3


SINGLE TRANSMISSION
MKR Δ 16.ØØØ msec
REF −1Ø.Ø dBm
AT 1Ø dB
41.Ø6 dB
PEAK
LOG
1Ø
dB/
MARKER Δ
16.ØØØ msec
41.Ø6 dB
WA SB
SC FS
CORR
CENTER 418.1ØØ MHz
SPAN Ø Hz
#RES BW 1ØØ kHz
#VBW 1ØØ kHz
#SWP 25.Ø msec

Plot 4


150ms WINDOW
REF -10.0 dBm
AT 10 dB
PEAK
LOG
10
dB/
WA SB
SC FS
CORR
CENTER 418.100 MHz
SPAN 0 Hz
#RES BW 100 kHz
#VBW 100 kHz
#SWP 150 msec

Plot 5


1 SECOND WINDOW
REF −1Ø.Ø dBm
AT 1Ø dB
PEAK
LOG
1Ø
dB/
WA SB
SC FS
CORR
CENTER 418.1ØØ MHz
SPAN Ø Hz
#RES BW 1ØØ kHz
#VBW 1ØØ kHz
#SWP 1.ØØ sec