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FCC CERTIFICATION REPORT

for

C&K Systems, Inc.
625 Coolidge Drive
Folsom, CA 95630

FCC ID: C2DLWSN-90-KR

April 1, 1999

WLL PROJECT #: 4587X

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FCC CERTIFICATION REPORT

for

FCC ID: C2DLWSN-90-KR

1.0 Introduction

This report has been prepared on behalf of C&K Systems, Inc. to support the attached Application for Equipment Authorization. The test and application are submitted for an Intentional Radiator under Section 15.247 of the FCC Rules and Regulations. The Equipment Under Test was the C&K Systems, Inc. Direct Sequence Spread Spectrum Transmitter.

All measurements herein were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and field Strength Instrumentation. Calibration checks are made periodically to verify proper performance of the measuring instrumentation.

All measurements are performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

All results reported herein relate only to the equipment tested. The measurement uncertainty of the data contained herein is ±2.3 dB. Refer to Appendix A for Statement of Measurement Uncertainty. This report shall not be used to claim product endorsement by NVLAP or any agency of the US Government.

1.1 Summary

The C&K Systems, Inc. Direct Sequence Spread Spectrum Transmitter complies with the limits for an Intentional Radiator under Section 15.247.

2.0 Description of Equipment Under Test (EUT)

The C&K Systems, Inc. Model SN990-Keypad and SN990-Remote Direct Sequence Spread Spectrum Transmitters are 923.58 MHz low power spread spectrum transmitters that are used as a remote control for the Sierra 5000 Control Panel System. The battery powered unit contains a permanently attached (soldered) internal antenna. The device transmits 7.6 ms "on" pulse followed by a 250 ms blank, or "off" pulse.

Both models are identical with the exception of the front plastic cover. The SN990 contains a cover which has keypad whereas the SN991 cover omits the keypad.

2.1 On-board Oscillators

The C&K Systems, Inc. Direct Sequence Spread Spectrum Transmitter contains a 14.66 MHz oscillator.

3.0 Test Configuration

To complete the test configuration required by the FCC, the EUT was tested in all three orthogonal planes.

3.1 Testing Algorithm

The EUT was powered on and constantly transmitting. Worst case emissions are recorded in the data tables.

3.2 Conducted Emissions Testing

Conducted emissions testing is not required as the EUT is DC powered.

3.3 Radiated Emissions Testing

The EUT was placed on an 80 cm high 1 x 1.5 meters non-conductive motorized turntable for radiated testing on a 3 meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Biconical and log periodic broadband antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-1992. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak for frequencies below 1000 MHz and peak for frequencies above 1000 MHz. For frequencies below 1000 MHz, the measurement bandwidth on the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth. For frequencies above 1000 MHz, the resolution bandwidth on the spectrum analyzer system was set to 1 MHz and the video bandwidth on the spectrum analyzer system was set to 1 MHz for peak measurements.

3.3.1 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are grouped into a composite antenna factor (AFc) and are supplied in the AFc column of Table 1. The AFc in dB/m is algebraically added to the Spectrum Analyzer Voltage in dbμV to obtain the Radiated Electric Field in dBμV/m. This level is then compared with the FCC limit.

Since the limits for the transmitter are average levels above 1 GHz, the peak spectrum analyzer reading is corrected using the duty cycle of the pulse modulated signal (over the worst case 0.1 second interval). The duty cycle factor (AFd) is added to the spectrum analyzer level to convert the peak level to an average level. This level is then compared with the limit.

Example:

Duty Cycle:	AFd = 7.6 ms on-time/100 ms = 7.6% = -22.38 dB
Spectrum Analyzer Voltage:	VdBμV
Composite Antenna Factor:	AFcdB/m
Electric Field:	EdBμV/m = VdBμV + AFcdB/m
To convert to linear units:	EμV/m = antilog (EdBμV/m/20)

Data is recorded in Table 1.

3.4 RF Antenna Conducted Emissions Testing

The EUT antenna was replaced with a short piece of microwave "hard line" coaxial cable and the cable was connected directly into the spectrum analyzer input. The analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 1 MHz. The emissions were scanned up to the tenth harmonic of the carrier. At each frequency, an external attenuator or filter was used to confirm that the transmitter input was not overloading the spectrum analyzer input.

Data is recorded in Table 2. Plots for the RF Antenna Conducted Emissions are located in Exhibit 2.

3.5 Transmitted Power Density Testing

The EUT antenna was replaced with a short piece of microwave "hard line" coaxial cable and the cable was connected directly into the spectrum analyzer input. The highest peak of the carrier was centered on the analyzer display. The analyzer resolution bandwidth was set to 3 kHz, the video bandwidth was set to 10 kHz, the sweep time was set to 100 seconds, and the span was set to 300 kHz. An external attenuator or filter was used to confirm that the transmitter input was not overloading the spectrum analyzer input. The highest level was measured in dBm and compared to the FCC limit.

The measured transmitter power density was 0.99 dBm.

3.6 Carrier Bandwidth Testing

The EUT antenna was replaced with a short piece of microwave "hard line" coaxial cable and the cable was connected directly into the spectrum analyzer input. The analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 1 MHz. The highest peak of the carrier was centered on the analyzer display. An external attenuator or filter was used to confirm that the transmitter input was not overloading the spectrum analyzer input. The 6dB bandwidth of the modulated carrier was measured and compared to the FCC limit.

A spectrum analyzer plot of the bandwidth is located in Exhibit 1. The measured 6dB bandwidth was 1.313 MHz.

3.7 Power Output Testing

The EUT antenna was replaced with a short piece of microwave "hard line" coaxial cable and the cable was connected directly into the spectrum analyzer input. The analyzer resolution and video bandwidths were set to 3 MHz (greater than the 6dB bandwidth). The highest peak of the carrier was centered on the analyzer display. An external attenuator or filter was used to confirm that the transmitter input was not overloading the spectrum analyzer input. The peak power in dBm was measured and compared to the FCC limit.

The measured peak power was 21.82 dBm, or 152.05 mW.

Table 1

FCC 15.247(c) Radiated Emissions Data - Site 2

CLIENT: C&K Systems, Inc.
FCC ID: C2DLWSN-90-KR
DATE: 3/11/99
BY: Steve Koster
JOB #: 4587X

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	[illegible] dBuV	[illegible]	[illegible] dBuV/m	[illegible] uV/m	Limit uV/m	Margin dB
960.00	H	0.00	1.0	2.3	29.0	31.3	36.9	200.0	-14.7
1231.45	H	270.00	1.0	54.0	-9.0	45.0	177.0	5000.0	-29.0
1231.45	V	180.00	1.0	46.4	-9.0	37.4	73.9	5000.0	-36.6
2668.10	H	315.00	1.0	36.1	-2.3	33.8	49.0	5000.0	-40.2
2668.00	V	180.00	1.0	38.9	-2.3	36.6	67.2	5000.0	-37.4
2770.00	H	180.00	1.0	39.3	-2.1	37.2	72.4	5000.0	-36.8
2770.00	V	180.00	1.0	39.2	-2.1	37.1	71.6	5000.0	-36.9
3695.00	H	180.00	1.0	35.4	-1.6	33.8	49.0	5000.0	-40.2
3695.00	V	180.00	1.0	35.1	-1.6	33.5	47.4	5000.0	-40.5
4002.00	H	180.00	1.0	41.4	-1.6	39.8	97.7	5000.0	-34.2
4002.00	V	180.00	1.0	41.6	-1.6	40.0	100.0	5000.0	-34.0
4310.00	H	180.00	1.0	36.6	-0.9	35.7	61.0	5000.0	-38.3
4310.00	V	180.00	1.0	42.7	-0.9	41.8	123.0	5000.0	-32.2
4925.00	H	180.00	1.0	36.8	0.4	37.2	72.4	5000.0	-36.8
4925.00	V	180.00	1.0	42.5	0.4	42.9	138.8	5000.0	-31.1
5131.00	H	180.00	1.0	34.8	0.8	35.6	60.3	5000.0	-38.4
5131.00	V	180.00	1.0	36.4	0.8	37.2	72.4	5000.0	-36.8
5438.00	H	180.00	1.0	31.6	1.3	32.9	44.2	5000.0	-41.1
5438.00	V	180.00	1.0	34.4	1.3	35.7	61.0	5000.0	-38.3

All measurements above 1GHz are peak.

Table 1 (cont'd.)

FCC 15.247(c) Radiated Emissions Data - Site 2

CLIENT: C&K Systems, Inc.
FCC ID: C2DLWSN-90-KR
DATE: 3/11/99
BY: Steve Koster
JOB #: 4587X

Average Measurements Above 1 GHz

Frequency MHz	Polarity H/V	Azimuth Degree	Antenna Height m	SA Level Average dBuV	[illegible] (Duty Cycle) [illegible]	[illegible] dB/m	E-Field dBuV/m	E-Field uV/m	Limit uV/m	Margin dB
1231.45	H	270.00	1.0	54.0	-22.4	-9.0	22.6	13.5	500.0	-31.4
1231.45	V	180.00	1.0	46.4	-22.4	-9.0	15.0	5.6	500.0	-39.0
2668.10	H	315.00	1.0	36.1	-22.4	-2.3	11.4	3.7	500.0	-42.6
2668.00	V	180.00	1.0	38.9	-22.4	-2.3	14.2	5.1	500.0	-39.8
2770.00	H	180.00	1.0	39.3	-22.4	-2.1	14.8	5.5	500.0	-39.2
2770.00	V	180.00	1.0	39.2	-22.4	-2.1	14.7	5.4	500.0	-39.3
3695.00	H	180.00	1.0	35.4	-22.4	-1.6	11.4	3.7	500.0	-42.6
3695.00	V	180.00	1.0	35.1	-22.4	-1.6	11.1	3.6	500.0	-42.8
4002.00	H	180.00	1.0	41.4	-22.4	-1.6	17.4	7.4	500.0	-36.6
4002.00	V	180.00	1.0	41.6	-22.4	-1.6	17.6	7.6	500.0	-36.4
4310.00	H	180.00	1.0	36.6	-22.4	-0.9	13.3	4.6	500.0	-40.7
4310.00	V	180.00	1.0	42.7	-22.4	-0.9	19.4	9.4	500.0	-34.6
4925.00	H	180.00	1.0	36.8	-22.4	0.4	14.8	5.5	500.0	-39.2
4925.00	V	180.00	1.0	42.5	-22.4	0.4	20.5	10.6	500.0	-33.5
5131.00	H	180.00	1.0	34.8	-22.4	0.8	13.2	4.6	500.0	-40.8
5131.00	V	180.00	1.0	36.4	-22.4	0.8	14.8	5.5	500.0	-39.2
5438.00	H	180.00	1.0	31.6	-22.4	1.3	10.5	3.4	500.0	-43.5
5438.00	V	180.00	1.0	34.4	-22.4	1.3	13.3	4.6	500.0	-40.7

Table 2

15.247 RF Antenna Conducted Emissions Results

CLIENT:	C&K Systems, Inc.
FCC ID:	C2DLWSN-90-KR
DATE:	3/11/99
BY:	Steve Koster
JOB #:	4587X

FREQ MHz	LEVEL [illegible] dBm	LIMIT dBm	MARGIN dB
923.71	15.47	N/A	N/A
618.6	-7.9	-4.5	-3.4
928.01	-8.95	-4.5	-4.5
1231.45	-15.2	-4.5	-10.7
1829	-9.86	-4.5	-5.4
3700	-20.5	-4.5	-16.0

Table 3

System Under Test

FCC ID: C2DLWSN-90-KR

EUT:	C&K Systems, Inc. Direct Sequence Spread Spectrum Transmitter; M/N: SN990 KEYPAD & SN991 REMOTE; S/N: N/A; FCC ID: C2DLWSN-90-KR

Table 4

Measurement Equipment Used

The following equipment is used to perform measurements:

Hewlett-Packard Spectrum Analyzer: HP 8568B

Hewlett-Packard Quasi-Peak Adapter: HP 85650A

Hewlett-Packard Preselector: HP 85685A

Hewlett-Packard Spectrum Analyzer: HP 8593A

Hewlett-Packard Preamplifier: HP 8449B

Antenna Research Associates, Inc. Biconical Log Periodic Antenna: LPB-2520A (Site 2)

Antenna Research Associates, Inc. Standard Gain Horn Antenna: DRG-118/A

Solar 50 Ω/50 μH Line Impedance Stabilization Network: 8012-50-R-24-BNC

Solar 50 Ω/50 μH Line Impedance Stabilization Network: 8028-50-TS-24-BNC

AH Systems, Inc. Portable Antenna Mast: AMS-4 (Site 2)

AH Systems, Inc. Motorized Turntable (Site 2)

RG-214 semi-rigid coaxial cable

RG-223 double-shielded coaxial cable

EXHIBIT 8

PROCESSING GAIN

PROCESS GAIN TESTING

RULE SECTION: 15.247(e)

The processing gain of a direct sequence system shall be at least 10 dB. The processing gain shall be determined from the ratio in dB of the signal to noise ratio with the system spreading code turned off to the signal to noise ratio with the system spreading code turned on, as measured at the demodulated output of the receiver.

TEST RESULTS:

Complies. The processing gain of the system is 12 dB inclusive of system implementation losses.

TEST EQUIPMENT:

IFR A-8000 spectrum analyzer, Boonton 4220 power meter, HP8640B signal generator, LeCroy 9400 oscilloscope, parameter extraction test fixture (see below), Mini Circuits SBL-1X mixer, Mini Circuits ZFSC-2-4 splitter, Mini Circuits ZFSWA-2-46 RF switch, HP 8495B 0-70 dB attenuator, HP 8494B 0-11 dB attenuator.

METHOD OF MEASUREMENT:

General Notes

The spread spectrum system is designed to run open loop. In open loop operation the receiver acquires the pseudo-random sequence by a correlation search on the preamble sent by the transmitter. This search aligns the incoming PRC from the transmitter to within 1/8 chip of synchronization. The receiver notes a local timing offset that achieves this correlation and sets the receiver to that offset for the remainder of the message time. The crystal controlled references at the receiver and the transmitter are specified to drift an amount that insures the receiver maintains local code timing within 1/8 chip without re-searching for the duration of the message time.

To measure the processing gain with the method requested in 15.247(e) with the pulsed nature of the system design requires us to keep the code timing of the receiver and transmitter locked for more than the prescribed transmitter on-time of 7.63 mSec. To accomplish this, the receiver spreading code will not be generated by the slave processor for the testing. The imported PRC to the receiver will be generated by a PRC generator that produces an exact replica of the PRC sequence the system uses. The PRC waveshape and timing are exactly the same as the system utilizes.

EXPLANATION OF TEST FIXTURE:

Exhibit IX, Illustration IX-A is the block diagram of the test fixture built to extract the information to prove compliance with 15.247(e). A HP 8640B signal generator set to the 900 MHz receive frequency feeds a Mini Circuits splitter. The splitter outputs are fed to a HP attenuator and a Mini Circuits mixer. The mixer and attenuator are then fed to a Mini Circuits RF switch. A spread spectrum biphase modulated RF signal is produced by the Mini Circuits mixer that duplicates the RF signal produced by the system transmitter. The spread spectrum signal is generated by applying a 63 chip pseudo-random code to the mixer which is generated by a shift register pseudo-random code generator. The code output by the generator is identical to the sequence used by the system transmitter. The chipping code is fed through a shift register delay line to provide the "transmitted" signal with time shifts to facilitate testing. The time shifts may be either 1/4 chip increments or infinitely variable increments less than 1/4 chip. A second output from the PRC generator feeds the receiver code filter (as opposed to the code being generated by the slave microprocessor) for several tests. The chip rate oscillator utilizes a 14.66 MHz crystal identical to the system transmitter to clock the PRC generator and delay line. The Mini Circuits RF switch allows either a spread spectrum or CW output to be selected through the switch control circuit.

The attenuator allows the CW signal to match the spread spectrum signal in power level offsetting the mixer loss.

The output of the RF switch may be routed to either the Boonton 4220 power meter for calibration or to another Mini Circuits splitter via a two-foot length of RG58 coaxial cable. The two outputs of the Mini Circuits splitter feed the two antenna inputs of the receiver through two four-inch pieces of RG188 coaxial cable connected to the Mini circuits splitter on one end and soldered to the receiver antenna inputs on the other.

The MC1496 despreader output from the receiver is routed via three different paths for testing:

a. The despreader output is fed to a Murata Erie SFE10.7MHY 110 kHz ceramic filter and then to the IFR analyzer. This will be noted as Configuration #1.

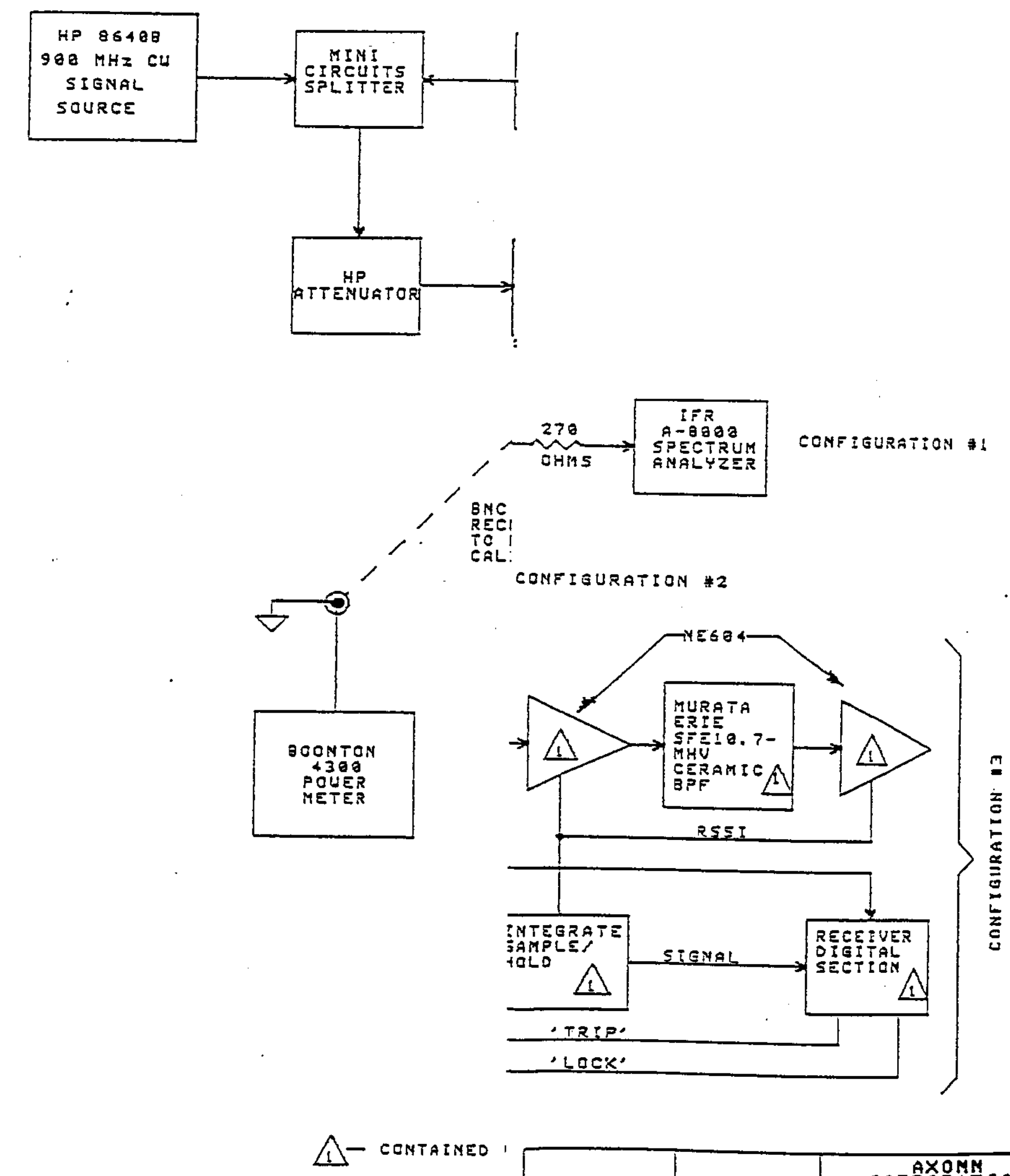
b. The despreader output is fed directly to the IFR analyzer. This will be noted as Configuration #2.

c. The despreader output is connected as usual to the remainder of the receiver. In this test, the integrated RSSI output is monitored by the LeCroy 9400 oscilloscope. This will be noted as Configuration #3.

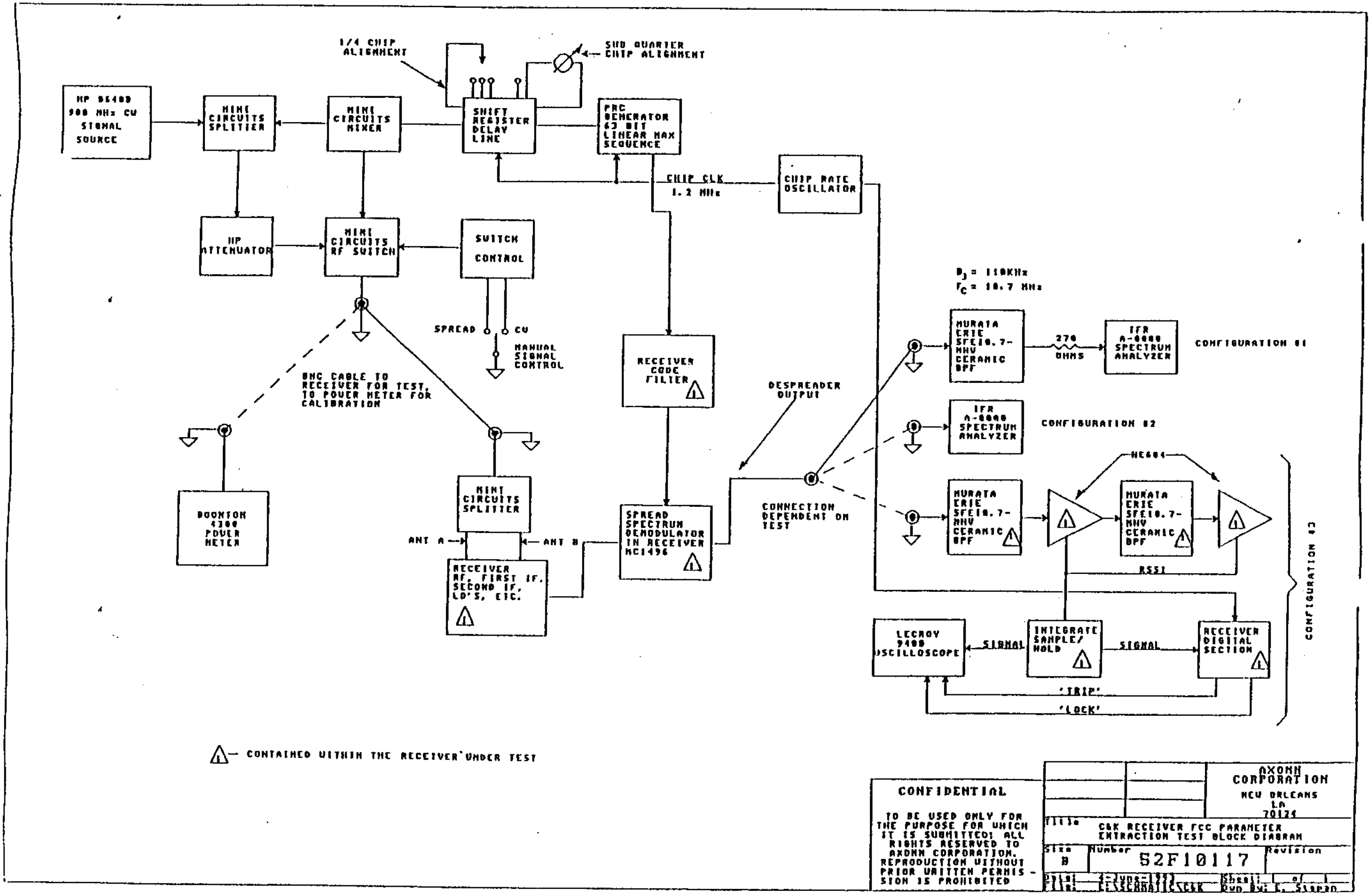
TESTING:

Methodology

The receiver utilizes a Signetics NE604A Received Signal Strength Indication (RSSI) integrated circuit for demodulation. The NE604 RSSI output, when connected to the integrator circuit on the digital board, produces a 500 mV per 10 dB change in signal strength output. Since this signal is the one actually used for demodulation by the receiver, the last test will show that a voltage differential of at least 12 dB is experienced when the system spreading code is turned on and off. The spreading code will be manipulated at the transmission end of the system to facilitate the testing as the 1496 demodulator does not support CW operation as configured in the circuit. The NE604 detector transfer function is not linear over the dynamic range of the device, however. Because of this, we thought that a more representative view of the processing gain of the system should be measured at the correlator's output first wide band, and then with the 110 kHz filter applied (ie. as the detector "sees" it). Another test is included at this point to show the jamming margin of the system for completeness.



	AXONN CORPORATION NEW ORLEANS LA 70124
Title	C&K RECEIVER FCC PARAMETER EXTRACTION TEST BLOCK DIAGRAM
Size B	Number 52E10117 Revision


HP 8640B 900 MHz CW SIGNAL SOURCE
MINI CIRCUITS SPLITTER
MINI CIRCUITS MIXER
1/4 CHIP ALIGNMENT
SHIFT REGISTER DELAY LINE
SUB QUARTER CHIP ALIGNMENT
PRC GENERATOR 63 BIT LINEAR MAX SEQUENCE
CHIP CLK 1.2 MHz
CHIP RATE OSCILLATOR
HP ATTENUATOR
MINI CIRCUITS RF SWITCH
SWITCH CONTROL
SPREAD
CW
MANUAL SIGNAL CONTROL
BNC CABLE TO RECEIVER FOR TEST, TO POWER METER FOR CALIBRATION
BOONTON 4300 POWER METER
MINI CIRCUITS SPLITTER
ANT A
ANT B
RECEIVER RF, FIRST IF, SECOND IF, LO'S, ETC.
RECEIVER CODE FILTER
SPREAD SPECTRUM DEMODULATOR IN RECEIVER MC1496
DESPREADER OUTPUT
CONNECTION DEPENDENT ON TEST
B_3 = 110KHz
f_C = 10.7 MHz
MURATA ERIE SFE10.7-MHV CERAMIC BPF
270 OHMS
IFR A-8000 SPECTRUM ANALYZER
CONFIGURATION #1
IFR A-8000 SPECTRUM ANALYZER
CONFIGURATION #2
NE604
MURATA ERIE SFE10.7-MHV CERAMIC BPF
RSSI
LECROY 9400 OSCILLOSCOPE
SIGNAL
INTEGRATE SAMPLE/ HOLD
SIGNAL
RECEIVER DIGITAL SECTION
'TRIP'
'LOCK'
CONFIGURATION #3
— CONTAINED WITHIN THE RECEIVER UNDER TEST
CONFIDENTIAL
TO BE USED ONLY FOR THE PURPOSE FOR WHICH IT IS SUBMITTED; ALL RIGHTS RESERVED TO AXONN CORPORATION. REPRODUCTION WITHOUT PRIOR WRITTEN PERMISSION IS PROHIBITED
AXONN CORPORATION
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Title C&K RECEIVER FCC PARAMETER EXTRACTION TEST BLOCK DIAGRAM
Size B
Number 52F10117
Revision
Sheet of
Drn By: E. Sispan

TEST #1

This test shows the output of the 1496 decorrelator with a RF spread spectrum input signal that is decorrleated versus a CW input signal of the same power.

NOTE: These signals are not band limited by the 110 kHz bandwidth filter. These photographs show just the difference in demodulator output with the two types of signals. Test Configuration #2.

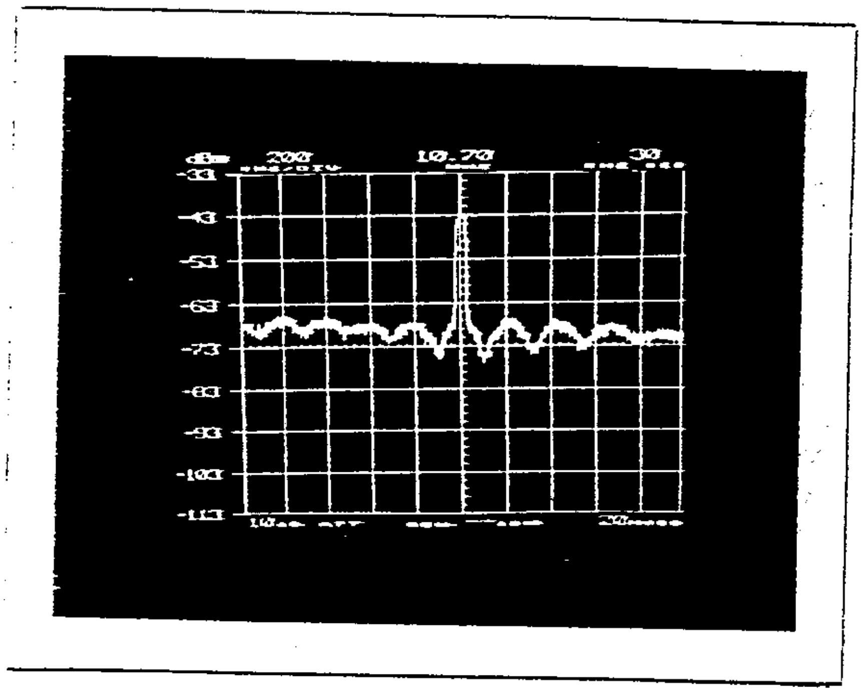


Exhibit IX, Illustration IX-B

Spread spectrum signal input at 900 MHz. 10.7 MHz IF output after decorrelation.

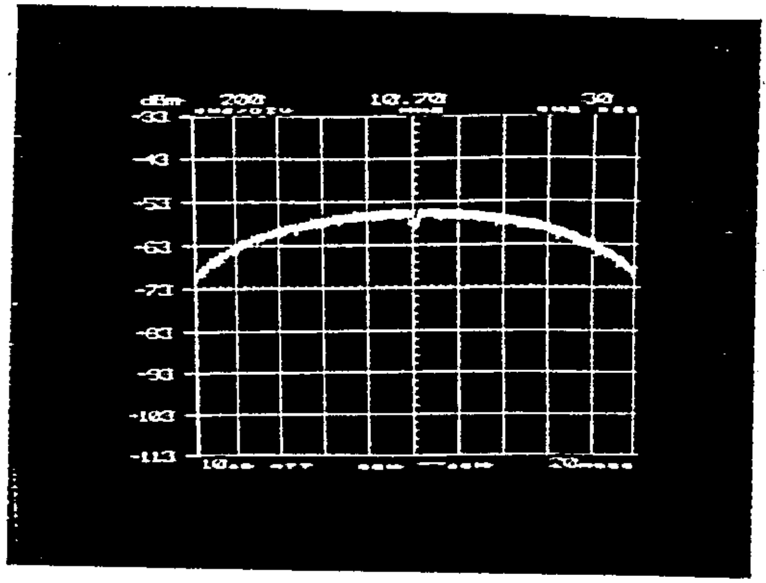


Exhibit IX, Illustration IX-C
CW signal input at 900 MHz, 10.7 MHz IF output after decorrelator.

Testing Performed By:

Robert J. Davis, Senior RF Engineer
Life Point Systems

6-23-93
Date
C & K Systems SN912-RCV

TEST #2

Same as Test #1, with the exception that a 110 kHz bandpass filter is following the decorrelator. Test Configuration #1.

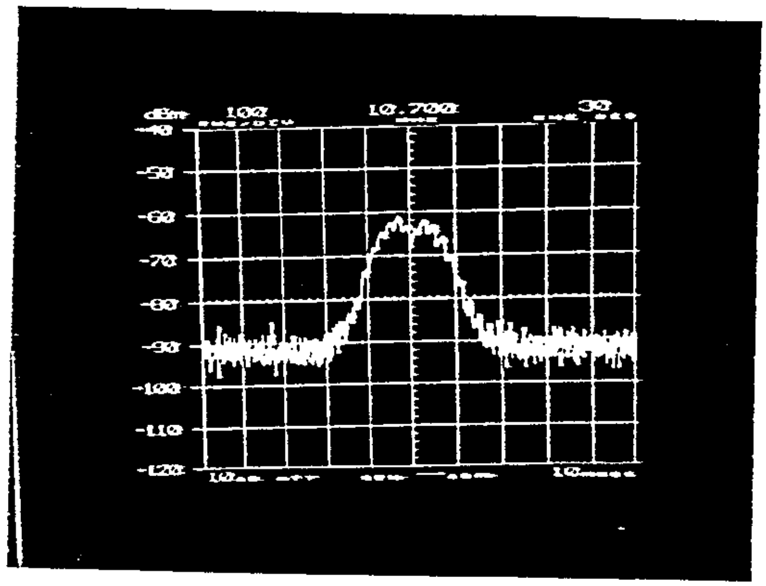


Exhibit IX, Illustration IX-D
Spread spectrum signal input at 900 MHz, 10.7 MHz output after decorrelator band limited to 110 kHz.

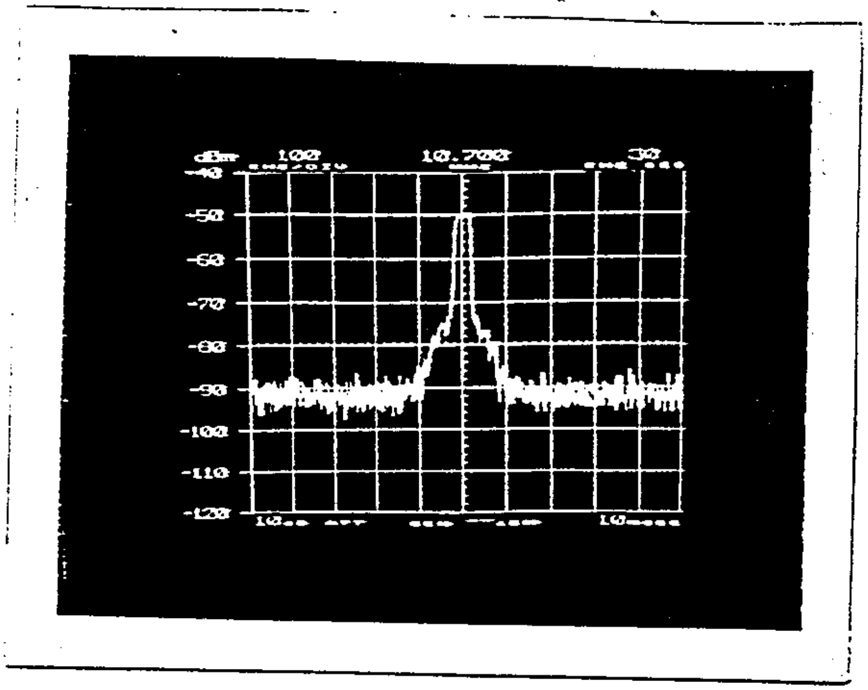


Exhibit IX, Illustration E

CW signal input at 900 MHz, 10.7 MHz output after decorrelator band limited to 110 kHz.

NOTE: Process gain of at least 12 dB.

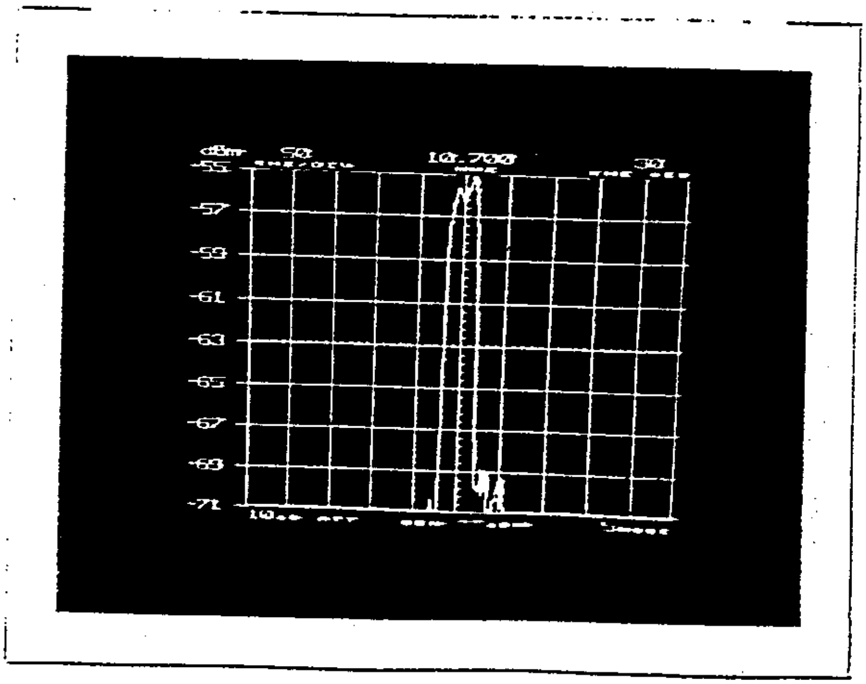


Exhibit IX, Illustration IX-F

Same as Illustration IX-D, with the exception of spectrum analyzer dB scale set to 2 dB per division to show finer amplitude resolution. SNR = 13 dB.

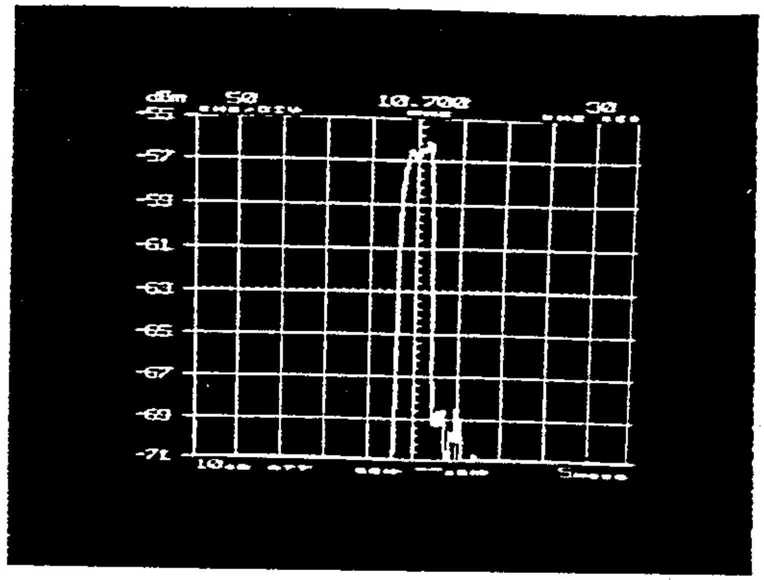


Exhibit IX, Illustration IX-G

Same as Illustration IX-F, with the exception that the receiver pseudo-random codes are purposely offset by 1/8 chip delayed from the transmitter (ie. worse case offset due to system implementation), showing roughly 1 dB delta in SNR.

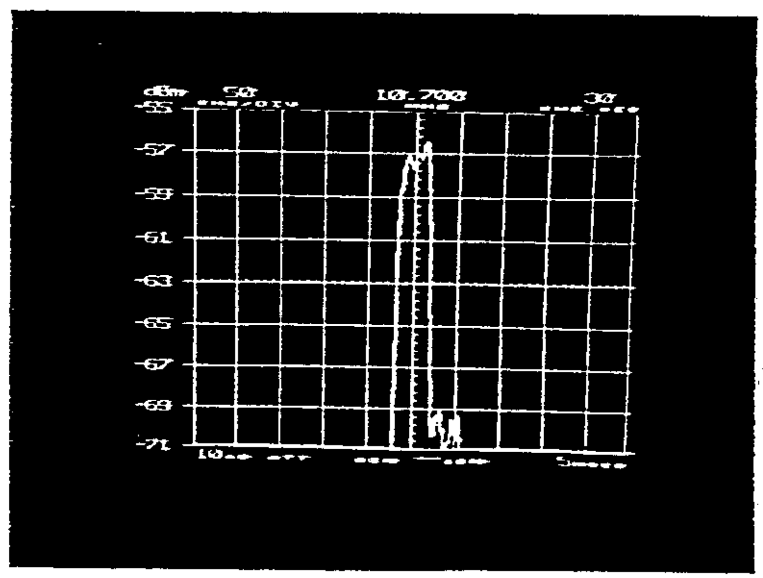


Exhibit IX, Illustration IX-H

Same as Illustration IX-G, with the exception that receiver pseudo-random codes are advanced 1/8 chip, showing roughly 1 dB delta in SNR.

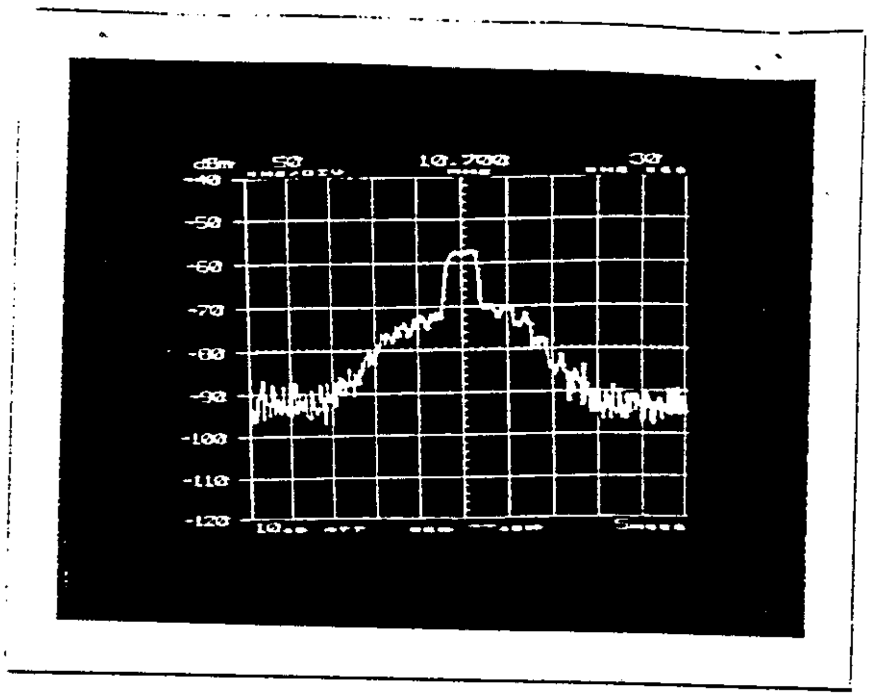


Exhibit IX, Illustration IX-I

Same setup as Illustration IX-H with the exception that the Mini Circuits RF switch at 900 MHz has been replaced with a 3 dB splitter/combiner to apply both spread spectrum and CW signals to the receiver input at the same power. Jamming SNR = 12 dB.

Testing Performed By:

Robert J. Davis, Senior RF Engineer
Life Point Systems

6-23-93
Date

C & K Systems SN912-RCV

TEST #3

Test Configuration #3. The 1496 output is connected to the NE604A through the Murata 110 kHz bandpass filter (normal operating condition). The integrated RSSI signal is probed with the LeCroy scope at the A to D input of the master processor. This signal will change 500 mV for each 10 dB change in signal strength input to the NE604A (100 mV for 2 dB, 50 mV for 1 dB, etc.). The Mini Circuits RF switch is switched between CW and correlated spread spectrum output (ie. the selected spread spectrum output signal from the Mini Circuits mixer generated by the chipping code from the PRC generator is in synchronization with the chipping signal presented to the receiver's 1496 decorrelator). This produces a voltage change at the A to D input of the master processor (via the integrator circuit) whose peak to peak voltage will show the processing gain of the receiver, as the master processor encounters it. This RSSI signal is used for all system acquisition and data demodulation functions and is the correct "demodulator output" to measure in our system to show compliance with 15.247(e) when the peak to peak voltage excursion is scaled with the 500 mV per 10 dB factor mentioned above (ie. 13 dB of process gain would produce a 650 mV peak to peak signal.).

The following Illustration IX-J shows the oscilloscope readings of RSSI (signal) detector change at input to master processor A to D converter for three receiver signal strength inputs at 900 MHz showing minimal indication of process gain at 12 dB.

Integrated RSSI Voltage Readings vs. Signal Strength Input for the C & K SN912-RCV Receiver with A Spread Spectrum Input Signal vs. A CW Input Signal of the Same Magnitude

SIGNAL LEVEL at 900 MHz (dBm)	RSSI LEVEL (mV)		DELTA (mV)
	CW	SPREAD SPECTRUM	
-90.0	895	1535	640
-80.0	1365	2100	735
-70.0	1960	2755	795
-60.0	2590	3225	635
-50.0	3050	3600	550

Exhibit IX, Illustration IX-J

NOTE: Although the RSSI delta value indicates that the process gain exceeds 12 dB in some cases, this is caused by the non-monotonic nature of the NE604 detector in its mid-band region. The readings that show the smallest deltas are the most accurate.

Testing Performed By:

Robert J. Davis/Senior RF Engineer
Life Point Systems

6-23-92
Date

C & K Systems SN912-RCV

EXHIBIT 9

THEORY OF OPERATION

ENGINEERING SPECIFICATION

SPREADNET

SN990- KEYPAD/ SN991- REMOTE

CONTENTS

Theory of Operation

The SN990/991 Keypad and Remote SpreadNet transmitters are used with the Sierra 5000 Control Panel system. The basic circuit blocks are :

1) Supervisory
2) Keypad with Reset
3) Microprocessor
4) Piezo sounder
5) RF circuits.

The following is a brief description of each circuit:

1. Supervisory (Watchdog) Circuit

The microprocessor is normally in the sleep mode which helps reduce power consumption to less than 7 uA. The watchdog circiuts will generate a pulse every 10 seconds. This pulse is sent to the 'reset' of the microprocessor via Q1, and wakes it up. Capacitor, C10, charges very slowly through resistor, R14. When the voltage of cap C10 crosses the voltage at + input of OP_AMP, the ouput of U8 turns low to triger reset.

2. Keypad and Reset.

Any keypress generates a reset by pulling the collector of one of 4 transistors Q4, Q6, Q7, Q8 low. When the processor awakes from a reset, it will poll the input ports to determine which of the keys were pressed or, if none, then a supervisory signal is assumed. A piezo sounder is energized from one of the processor ports whenever a key is pressed. This will produce an audible keypress feedback.

3. Microprocessor

The microprocessor is normally in the sleep mode to minimize current consumption. When it wakes up it will poll the programming connector to see if anything is connected. It will then scan the keypad inputs. If no programming connector exists, it will transmit the data.when a key is pressed The transmitter is enabled with with RFEN- and RFKEY+. A spread spectrum code is generated through Mod+ and Mod-. This code selects the phase of RF signal at 307.86 MHz. This mixing of the modulation code and 308 MHz RF causes the spectrum to spread in a BPSK manner. RFKEY enables and disables the transmission as ones and zeros in order to send the data.

An EEPROM, U5, is used to store the programmed data. This allows the batteries to be changed without having to reprogram the device. U6 provides the power to EEPROM only when needed thus saving battery power when not used.

The low battery detection is performed 50 milliseconds after a transmission while the battery charges up large capacitor. A voltage comparator sets the low battery threshold point. Low battery reporting is accomplished by monitoring the first burst of each transmission message 50msec after the burst. This will ensure the measurement is read from battery charging up the storage capacitor. A long delay in charge time corresponds to large battery impedance or low battery. Low baterry or low battery restoral reporting will be held off up to 4 consecutive transmission messages to be considered valid.

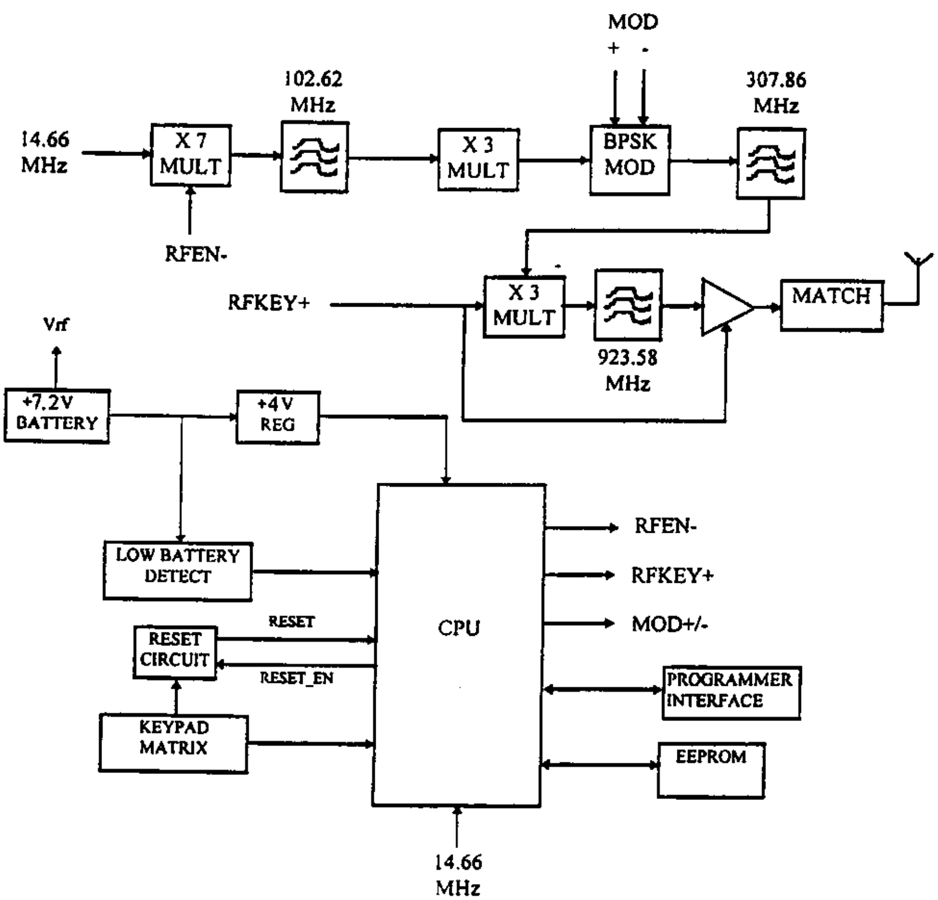
4. Piezo Section

The piezo sounder is driven by an oscillator shown as U7. Oscillation is enabled by the processor through p3.6. The oscillation frequency is determined by the piezo's feedback.

5. RF Section

The transmitter's center frequency is held constant by the microprocessor crystal, Y1. This 14.660 MHz is coupled to U7 via C35. U7 is being used as a harmonic generator. The filter consisting of L5 and L4 and associated capacitors and selects the harmonic at 102.62 MHz. C38 and U3 to generate the harmonic of 307.86 Mhz. MOD+ and MOD- select the phase with a pseudo random code, generating the spread spectrum modulation. T1 and filters L2 and L3, along with associated capactors, select the harmonic of 307.86 Mhz, and further filter unwanted harmonic while matching impedance to Q3.Q3 is a tripler that generates the 923.58 MHz signal. PL1 and L6 and associated capacitos filter unwanted harmonics, and impedance match to the next stage, Q5. Q5 is a power amplifier delivering up to 100 mW output to the antenna. PL3 and L1 and associated capacitors filter and match impedance to the antenna. RF key turns Q3 and Q5 on and off to modulate the serial data on the output with ASK modulation.

BLOCK DIAGRAM



TRANSMITTER DATA FORMAT

The transmitter data byte is formatted to support existing SpreadNet Receivers Pendant operation along with the SN915-Bus Receiver for Sierra. The format is as follows:

8	7	6	5	4	3	2	1
Key_3	Key_2	Key_1	Key_0	New Key	EXT #1	Tamper	Low Batt

Key_3	Key_2	Key_1	Key_0	Key Function
0	0	0	0	No Key
0	0	0	1	Key ARM
0	0	1	0	Key DISARM
0	0	1	1	Key AUX1
0	1	0	0	Key AUX2
0	1	0	1	Key DOOR
0	1	1	0	Key 1
0	1	1	1	Key 2
1	0	0	0	Key 3
1	0	0	1	Key 4
1	0	1	0	Key 5
1	0	1	1	Key 6
1	1	0	0	Key 7
1	1	0	1	Key 8
1	1	1	0	Key 9
1	1	1	1	PANIC

New Key = Toggle bit specifying new key stroke.

EXT #1 = Active High Alarm bit.

Tamper = Active High Tamper bit.

Low Batt = Active High Low Battery bit.

EXT #1, Tamper, and Low Batt bits are compatible for the SN912, SN911, and SN914 Receivers. Bits 4 through 8 are not used with these receivers. New Key bit is toggled whenever a new key stroke is ready to send.

Keypad Operation

A key queue is used to buffer keys prior to transmitting which enables the user to press multiple key entries without having to wait for each transmission to complete its cycle. The key buffer will be limited and keystrokes will be lost if the user continually presses keys faster than 650msec. All keystrokes are hardware debounced and are considered valid upon the make period.

The SN990 (Keypad) and SN991 (Remote) one-way keypads will structure the keys as above. Panic key entries will also set the EXT #1 Alarm bit for compatibility with the Pendant function. Two keys are pressed and held simultaneously for 2 seconds to activate the Panic function. All key entries provide 8 burst transmission . Minimum transmission time between different key entries will take approximately 650msec .

The piezo will beep once for 50msec for every valid keystroke except Panic. Multiple beeps will sound at 50msec ON at a 50 % duty cycle. Long Single beeps will turn on the piezo for 150msec. The CPU will be in idle mode during the piezo beeps to save battery life. The following table lists piezo requirements for each function:

Key Function	**Piezo Beep**
0 - 9, Door	Short Single
Arm	Dual
Disarm	Long Single
Panic	Silent

SN900 PROGRAMMER INTERFACE

Hardware:
Connector: 4 pin Molex;
Pin 1 is Serial In, pin 2 is not used, Pin 3 is Ground, pin 4 is Serial Out.
Level is TTL; TTL 1 is a mark; TTL 0 is a space.
Protocol is half duplex, asynchronous.
1 start bit, 8 data bits, no parity, 1 stop bit at 9600 baud.

Binary Protocol:
The programmer protocol uses a subset of commands from the Life Point Binary Message Protocol. The protocol takes advantage of the receiver address byte to use as transmitter messages. All messages take the form: *Header, Command, Data Length, Data, CRC.* A brief description of the commands are listed as follows:

Status Message:
The transmitter sends this message to the programmer and waits up to one second for a response. If no response, the transmitter goes back to sleep. The transmitter may be woken up by pressing any key on the Keyfob.

Setup Message:
The programmer sends this message to program a transmitter with the data shown below. The transmitter will respond with a status message for confirmation.

Transmitter Messages:

	Status Message Tx → Prog	Setup Message Prog → Tx	Keypad Data Range
Header	0x1B	0x1B	-
Command	0x51	0x44	-
Length	0x0A	0x0A	-
Data 1	Channel	Channel	1 or 2
Data 2	Property Code (MSB)	Property Code (MSB)	0x010-0xFDF (1-4048)
Data 3	Property Code (LSB) & TX Type	Property Code (LSB) & TX Type	Type 1 = Brinks Type 5 = C&K Type E, F = Testing
Data 4	Transmitter ID	TX ID (LSB)	201-208: Keypads
Data 5	Supervisory Rate	Supervisory Rate	0 - No Supervisory
Data 6	Alarm Burst Rate	Alarm Burst Rate	Fixed at 5
Data 7	Number of Bursts	Number of Bursts	Fixed at 8 bursts max.
Data 8	Alarm Lockout Time	Alarm Lockout Time	Fixed at 0x0C (2 min) but H/W Disabled
Data 9	Battery Status	CCITT-16 CRC-LO	0 = Low bat 0x48 = h/w ID
Data 10	Status	CCITT-16 CRC-HI	0x3F = Good 0x25 = Bad
Checksum			Multiple 0xFF

ELECTRICAL SPECIFICATIONS

Transmitter Voltage:	4V Regulated
Power Consumption:	75mA for 7.6msec
Standby Current:	5 - 7uA typical
Center Frequency:	923.58MHz
Radiated Output Power:	100 mW max.
RF Data Rate:	19.36k baud
RF Bandwidth:	2.44MHz (90% power)
Chip Rate:	1.22M chips/sec
Modulation:	BPSK spread spectrum
Oscillator Stability:	± 20ppm over temp.
Antenna:	1dBi external wire antenna
Battery:	2x3.6V Lithium Battery Capacity 1.20Ah
Battery Life:	4 years max.
Environmental: Temperature:	0°C to 50°C, 32°F to 122°F
Humidity:	10% - 90% at 90°F Splash Proof
Regulatory:	FCC 15.247 Canada Australia

Appendix A

Statement of Measurement Uncertainty

For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

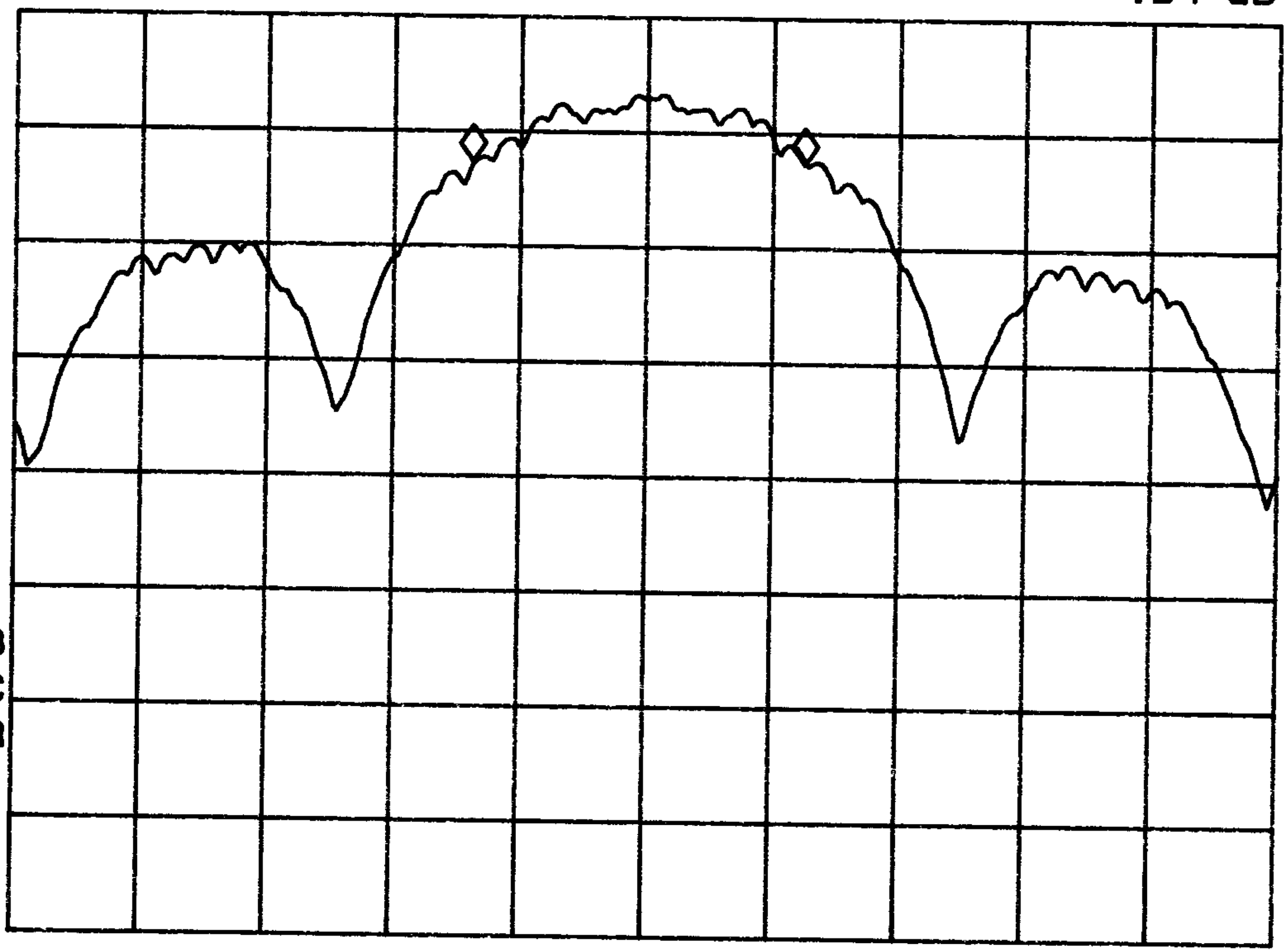
$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:
A = Antenna calibration uncertainty, in dB = 2 dB
B = Spectrum Analyzer uncertainty, in dB = 1 dB
C = Site uncertainty, in dB = 4 dB
n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\,(2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB

EXHIBIT 1

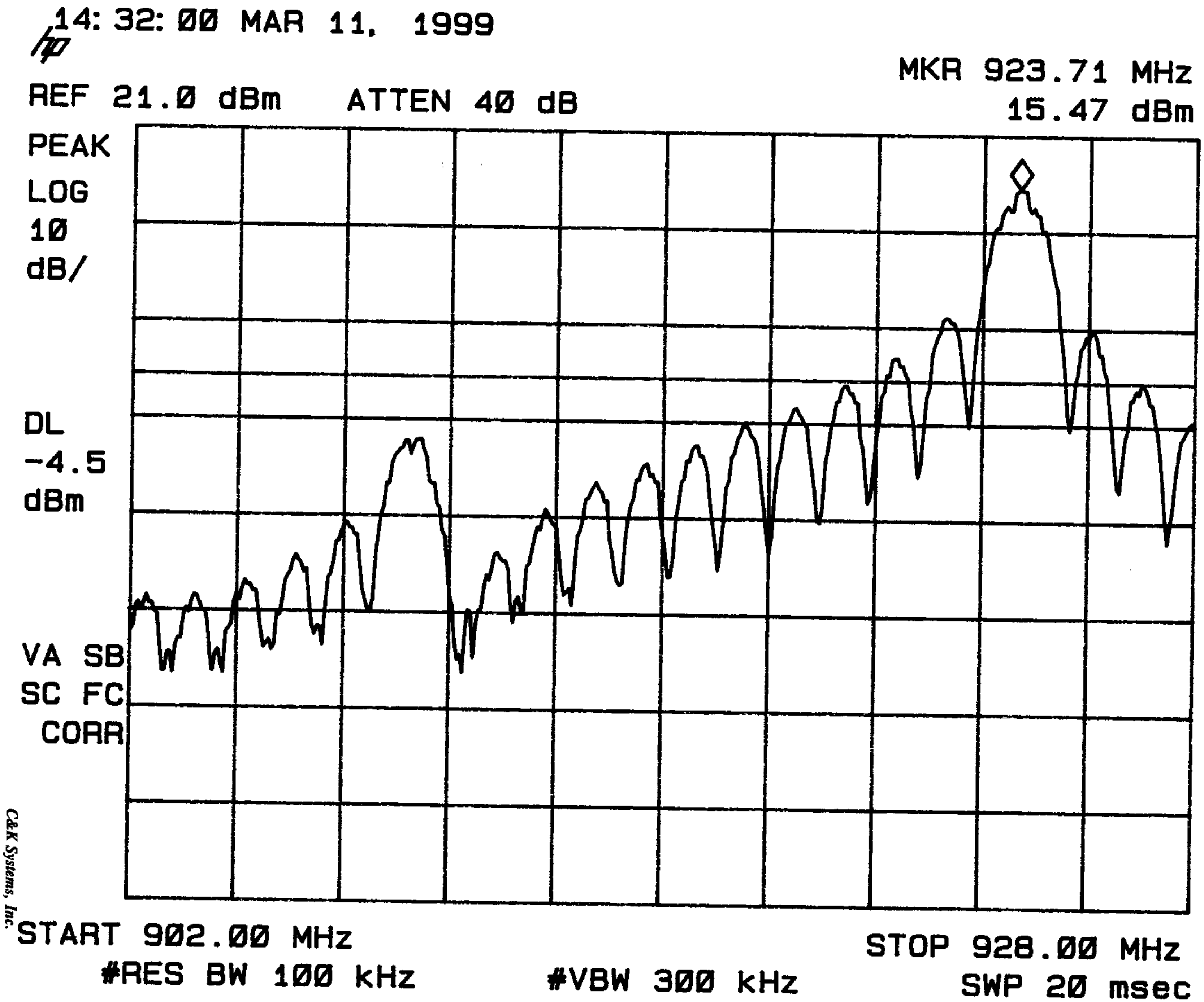
CARRIER BANDWIDTH PLOT



C&K Systems, Inc.
FCC ID: C2DLWSN-90-KR
WLL Project #: 4587X

EXHIBIT 2

RF ANTENNA CONDUCTED EMISSIONS PLOTS



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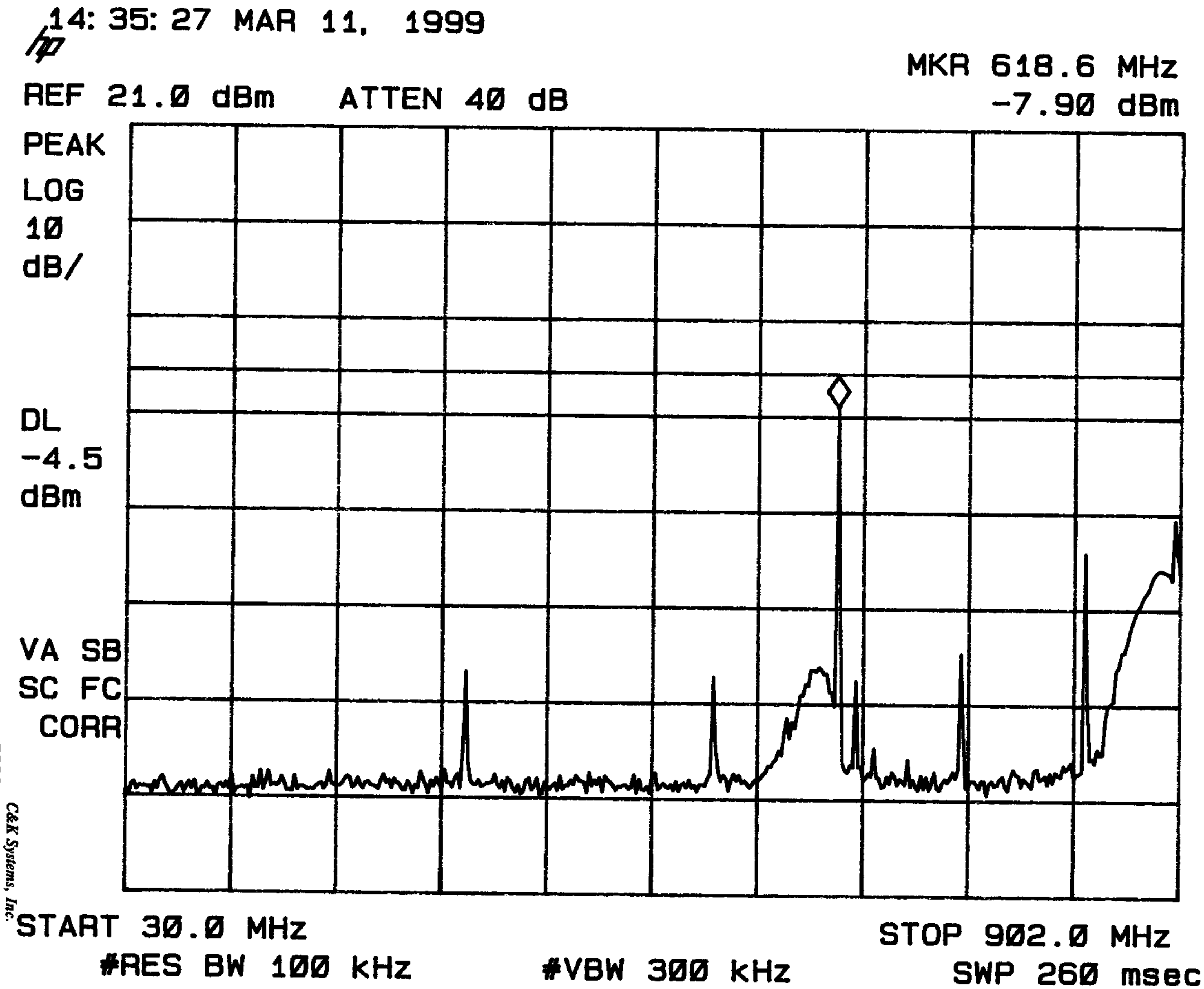

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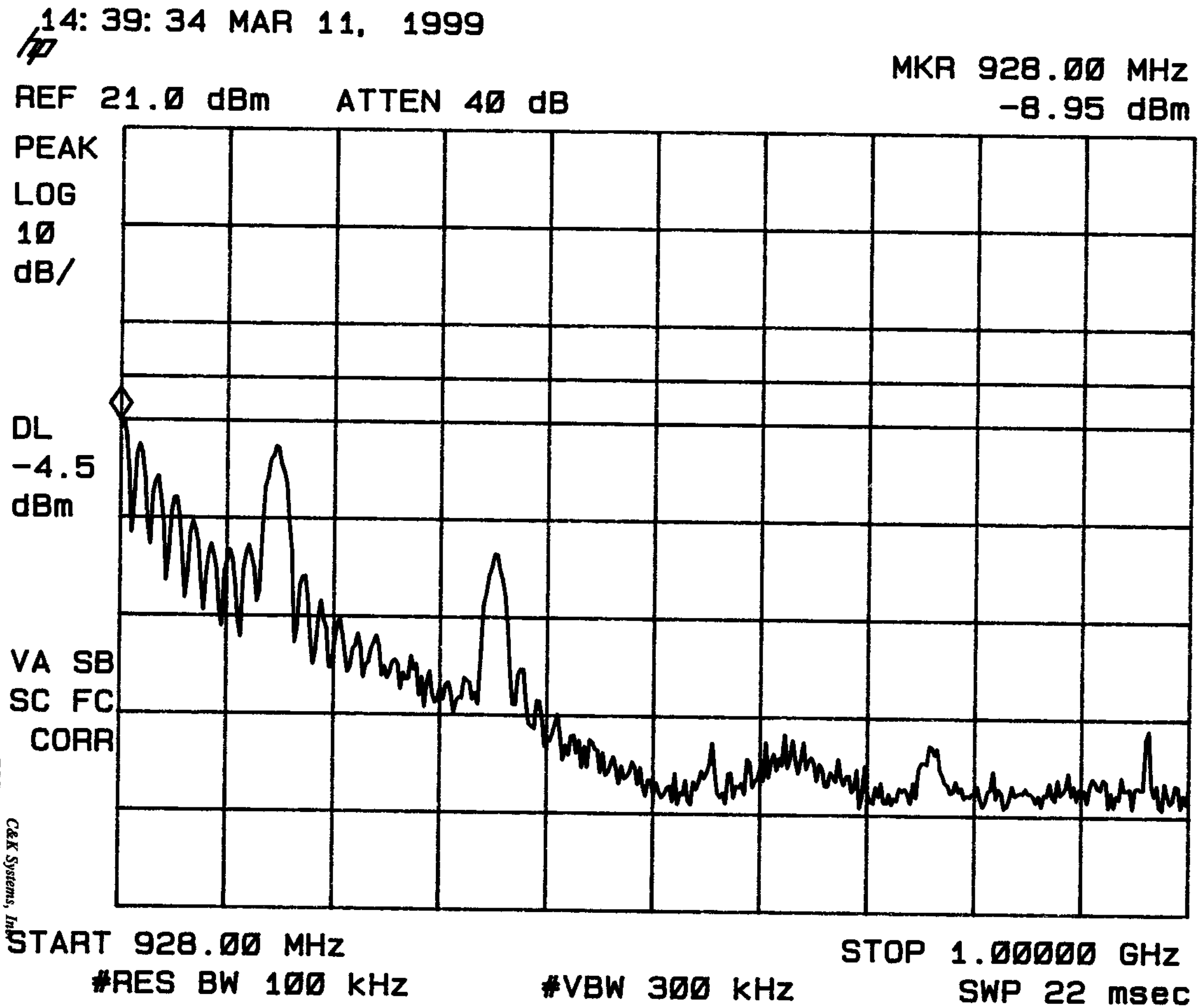

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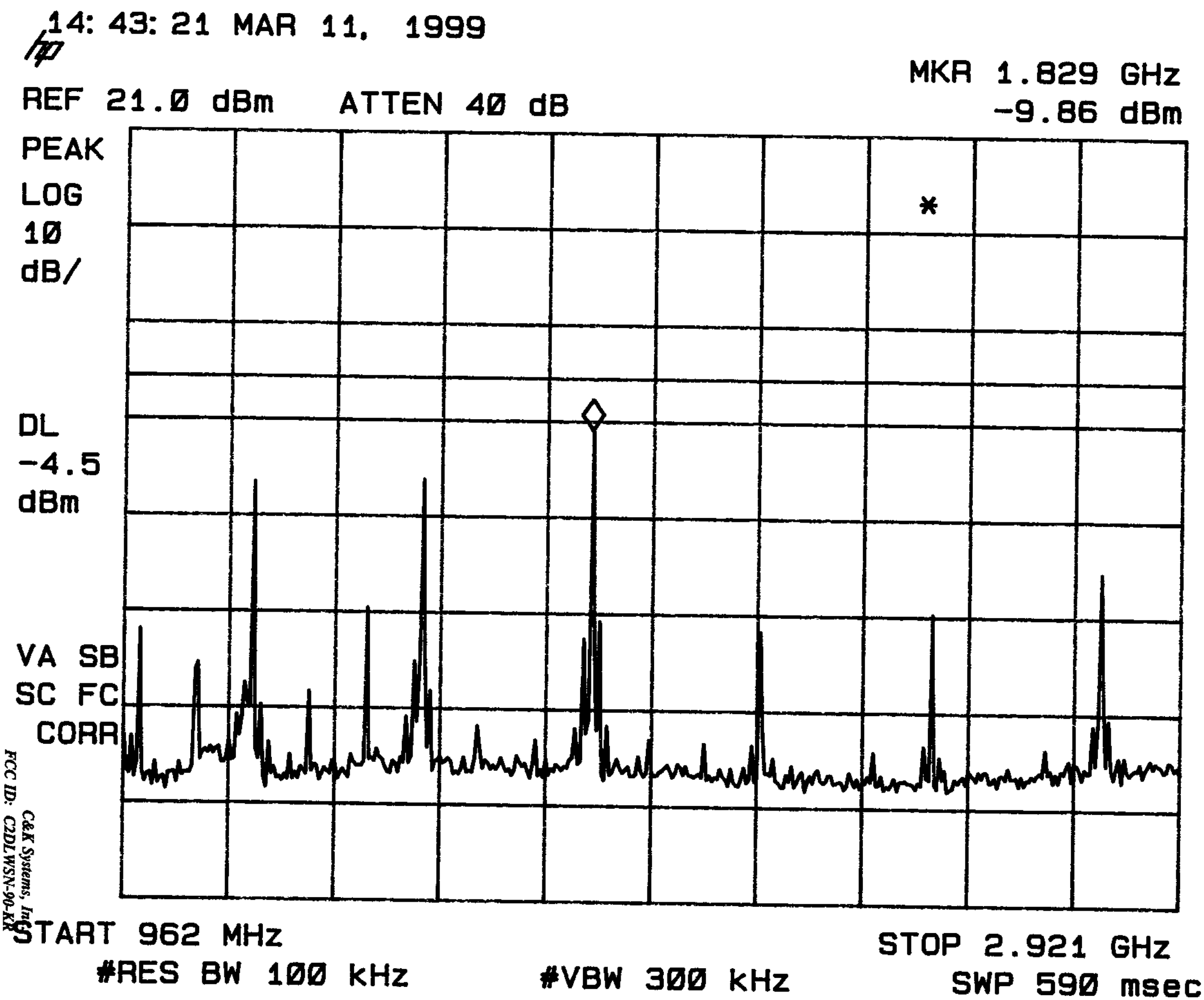

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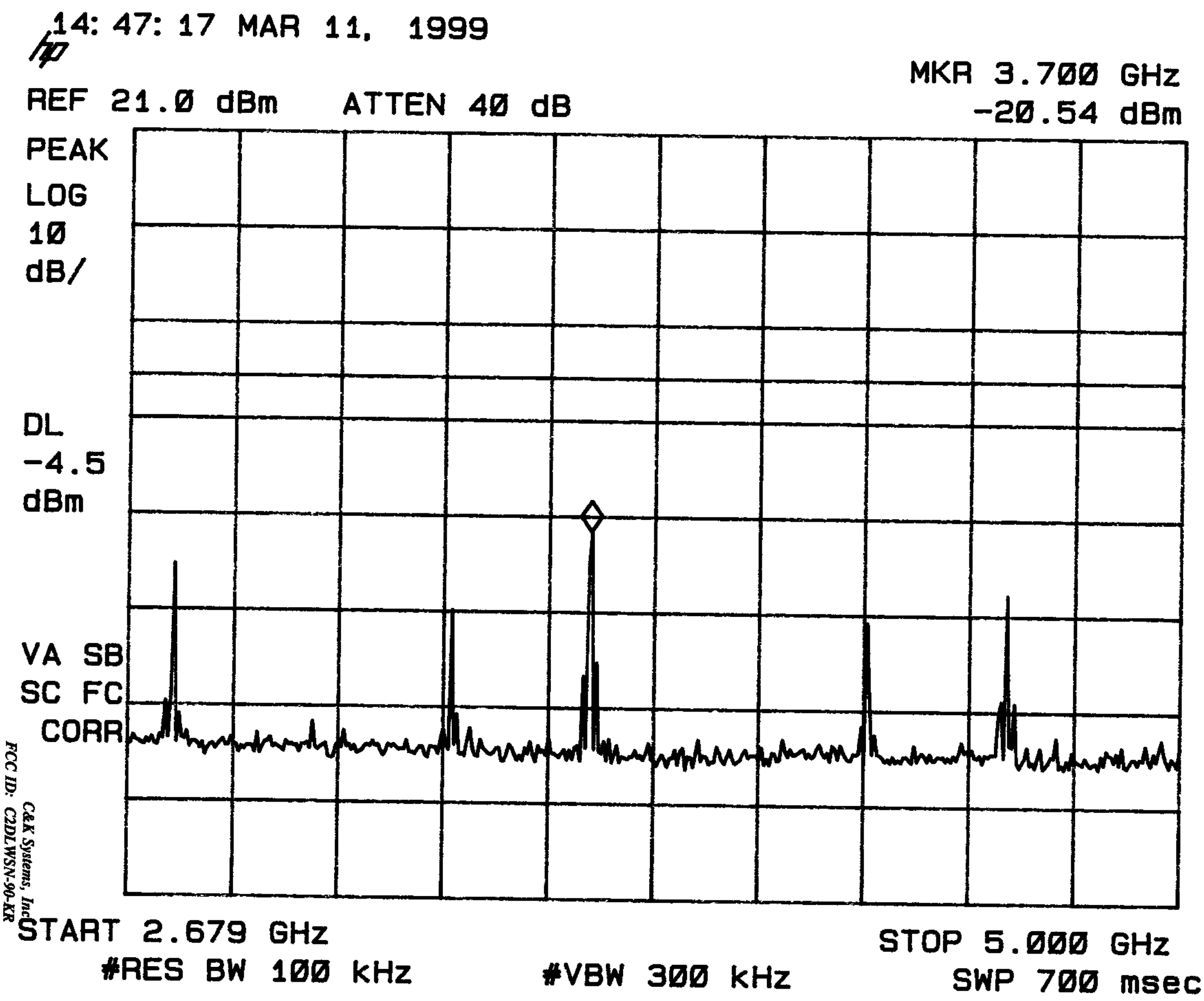

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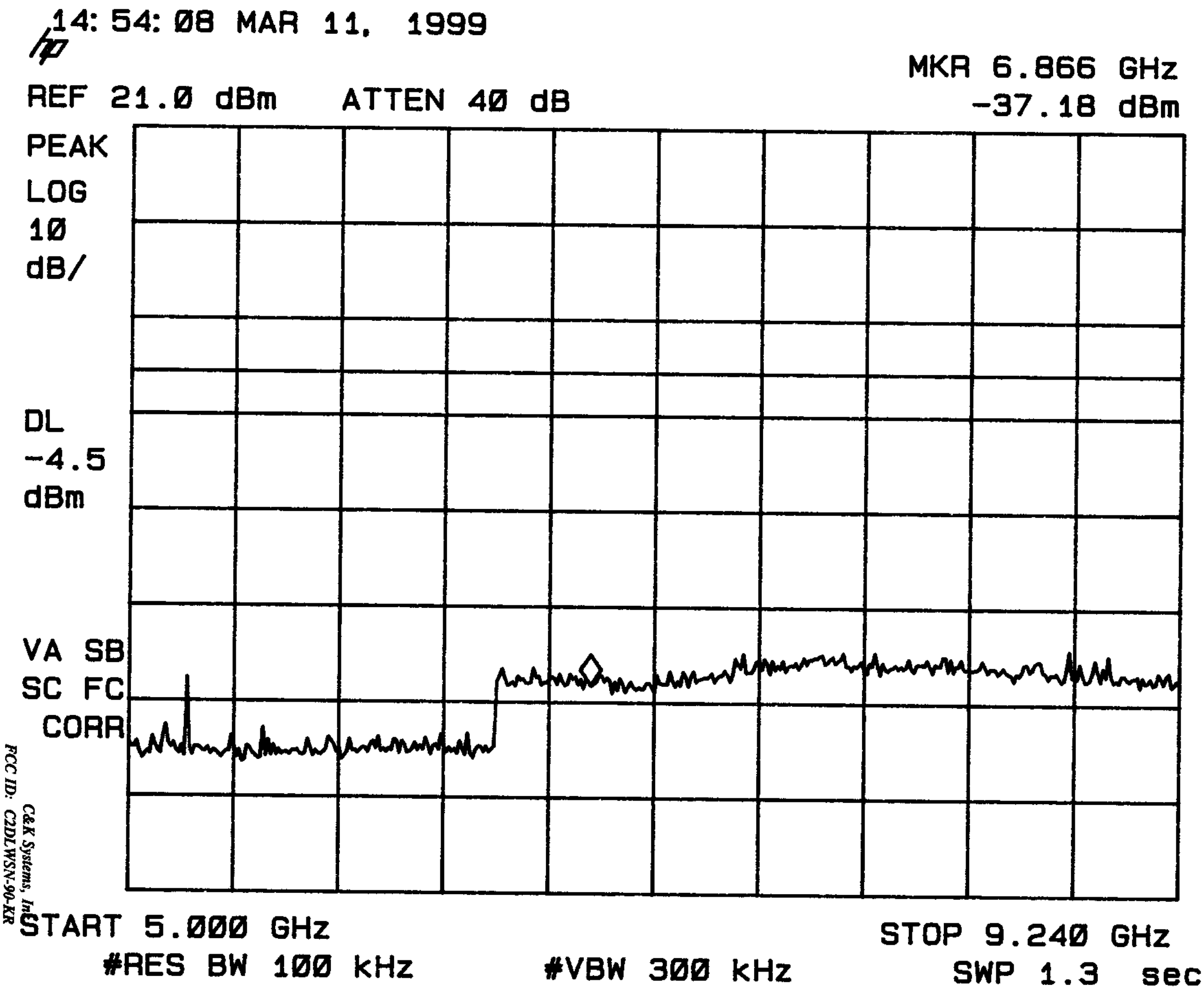

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