Test Report

of an Intentional Radiator for Certification under Part 15 of the FCC rules

Device Under Test	Thermostat with RF Transceiver
Model	T8665E
Test Date:	14-Jan-2003

Manufacturer:	Honeywell, Inc. Home and Building Controls 1985 Douglas Drive (763) 954-4972
Prepared by:	Control Design & Testing, Inc. 6010 Red Fox Drive Spotsylvania, VA 22553 (540) 582-2826

A. DEVICE UNDER TEST

The product submitted for test is a thermostat used to control heating and air conditioning systems. The product incorporates a radio transceiver circuit to exchange data and control commands with other devices as part of an energy management system. The product is designed to operate under the provisions of Part 15.249 of the FCC rules. This product is similar to the T8665D (previously submitted) the difference being that the two LED status indicators and associated bias components have been omitted.

The transmit and receive frequencies are 916.500 MHz. nominal. The modulation mode is on/off keying using a proprietary protocol at 19.2 K bits/second. The device is designed to operate from the 24 VAC NEMA Class II source, typical of low voltage transformers found on residential air conditioning systems. The tranceiver circuitry is powered from an internal regulated source at 3 volts DC.

The rf section is contained on a separate circuit board that is soldered to the sub-base. The transceiver section consists of an RF Monolithics TR1000L transceiver hybrid circuit, a two element antenna matching network and a 3.1 inch, #18AWG, insulated solid wire antenna. The antenna is soldered directly to the printed circuit board. There is no provision to connect an external antenna.

B. MEASUREMENT PROCEDURE: RADIATED EMISSIONS

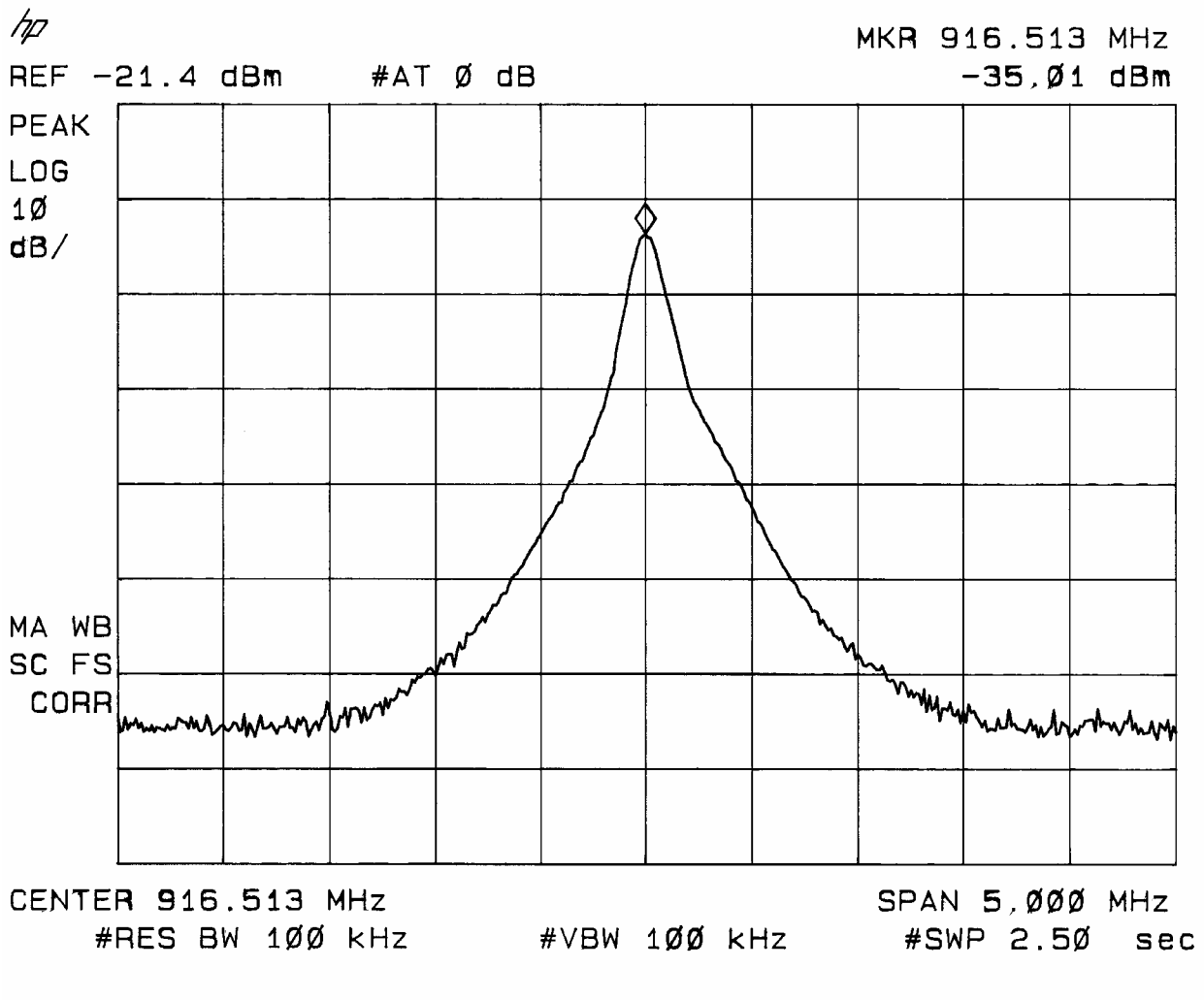
Testing of this device was conducted at the Carl T. Jones Laboratory test facility located in Springfield, Virginia. Site #90490.

Transmitter field strength measurements were conducted according to the procedures set forth in ANSI C63.4 (1992). Testing was conducted with the samples powered from the mains through a 24 VAC NEMA Class II transformer.

The device under test was placed on a rotating turntable 0.8 meters high, centered 3 meters distant from the measurement antenna. The sample was placed in the center of the turntable with the supply wires from the transformer routed up through an access hole. The samples were tested in the two positions shown in the setup photographs.

For transmitted radiated emission measurements, the sample was programmed to continuously transmit a typical data pattern. This mode was also used to capture the occupied bandwidth plot shown below.

Plot 1



The field strength measurements were taken using an HP8596E spectrum analyzer, an EMCO 3121C dipole set, an EMCO 3115 double ridge guide horn and an Avantek UJ210 preamp. The device was scanned in both transmit and receive modes from 30MHz. to 10GHz. and all emissions within 30 dB. of the limits were noted.

The receiver in this device is a pulse sequenced TRF, clocked at approximately 1.54 MHz. and has no local oscillator. An effort was made to detect emissions that would be harmonically related to the sequencer clock but none were found.

The rf controller circuit has a clock oscillator at 8 MHz. This frequency and its related harmonics were also investigated. A harmonic frequency related to the 8 MHz. clock (32.00 MHz.) was detected but was greater than 30dB below the limit and is not recorded in the table. The thermostat circuitry has clocks at 32.768 KHz. and 500 KHz. No emissions related these clocks were found.

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 setup positions shown in the test setup photos. The peak reading for each frequency was recorded in the fourth column in Table 1 below.

Table 1

RADIATED EMISSIONS DATA

CLIENT: HONEYWELL FCC ID: HS9-T8665E

ANTENNA: DIPOLES/DRG HORN EUT: DATA TRANSMITTER

PART 15.249 TEST DATE: 14-JAN-03

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
916.510	V	30.8	-45.23		42511		50000
1833.020	V	30.2	-90.07		227		500
2749.530	V	33.4	-94.11		206		500
3666.040	H	35.7	-97.14		190		500
4582.550	H	36.6	-100.29		146		500
5499.060	V	38.6	-103.01		135		500
6415.570	H	39.1	-112.87		46		500
7332.080	V	40.7	-116.62		36		500

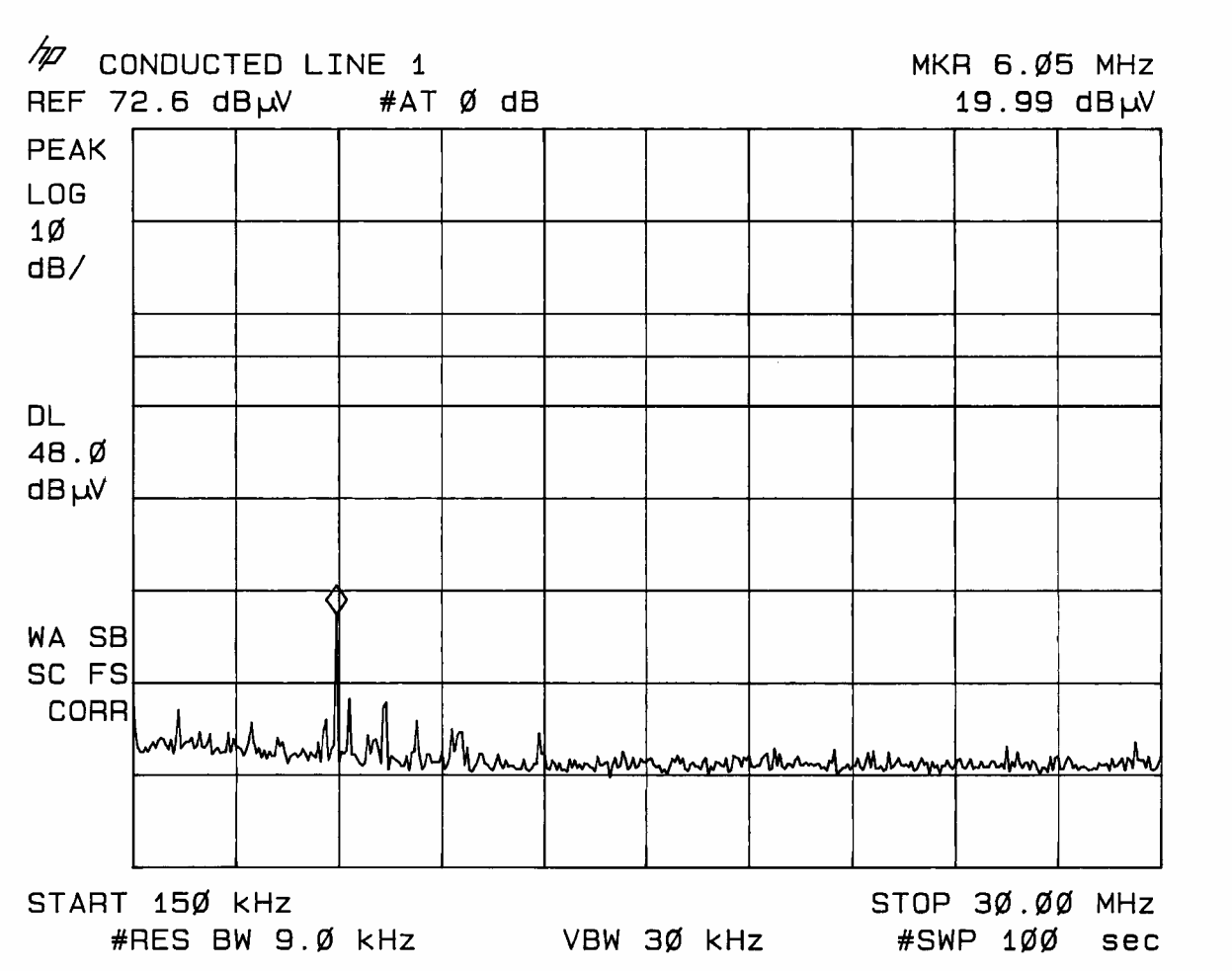
Measurements taken for weak emissions were performed by reducing the distance from the measurement antenna to 1 meter and factoring –9.54dB into the calculation. This method was used for the 7^{th} and 8^{th} harmonics.

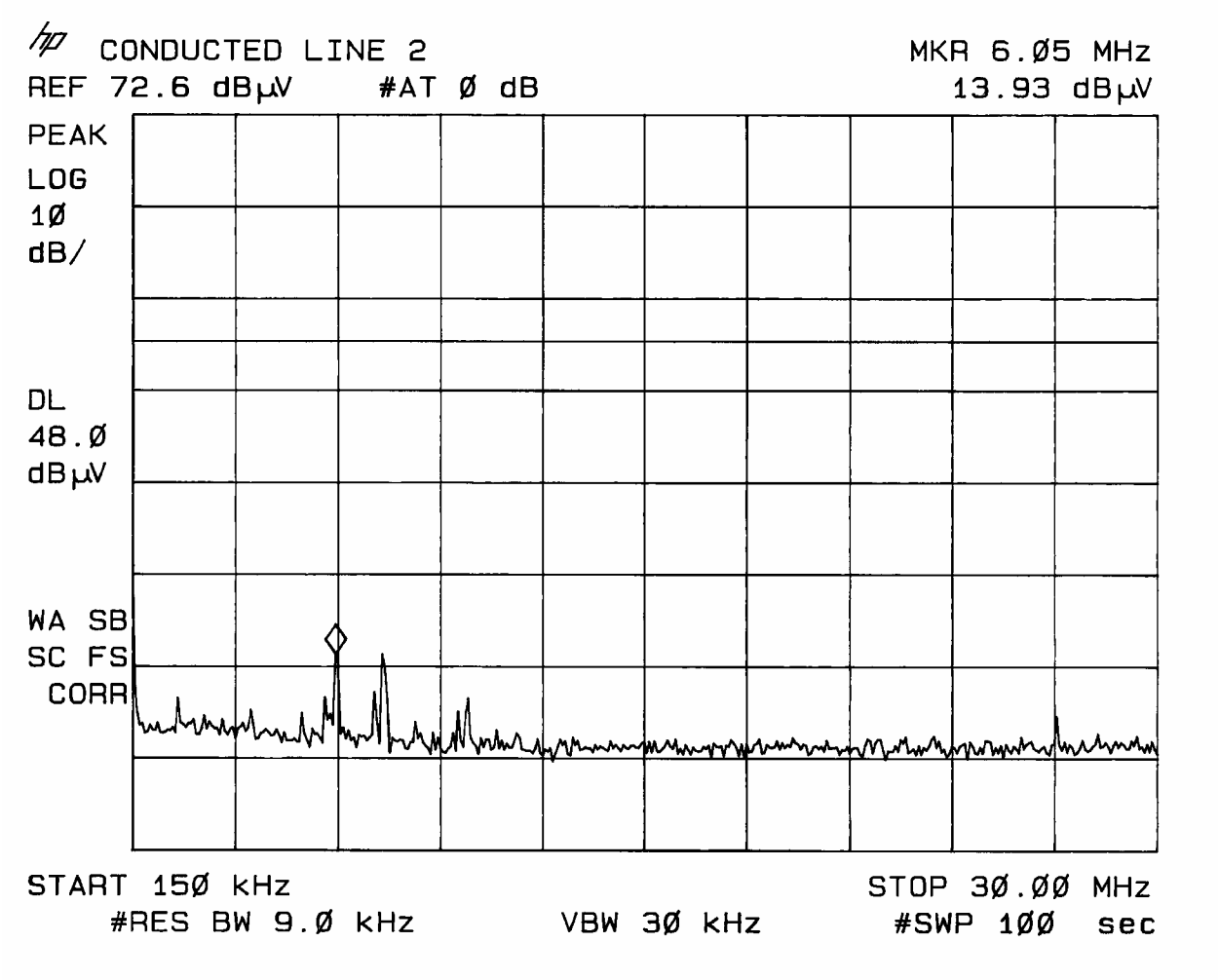
C. OCCUPIED BANDWIDTH AND DUTY CYCLE

The occupied bandwidth measurement was made using an HP8596E spectrum analyzer and plotted with an HP7475A pen plotter. The duty cycle average for this device results in a correction factor (per 15.35) of approximately –16 dB, but since the peak readings for all detected harmonics were below the limits, the duty cycle correction factor was not applied to the calculations.

D. LINE CONDUCTED EMISSIONS

Measurements of line conducted emissions covering the range of 150 kHz. to 30 MHz. were made at the mains leads. The device was connected to a Compliance Design, 50µH, line impedance stabilization network (LISN). The 50Ω (LISN) port was monitored with a HP8594E spectrum analyzer set to the EMI 9 kHz. bandwidth mode. Separate readings for each side of the line were taken and plotted with an HP7475A pen plotter. The plots appear below.




CONDUCTED LINE 2
MKR 6.Ø5 MHz
REF 72.6 dBµV
#AT Ø dB
13.93 dBµV
PEAK
LOG
1Ø
dB/
DL
48.Ø
dBµV
WA SB
SC FS
CORR
START 15Ø kHz
STOP 3Ø.ØØ MHz
#RES BW 9.Ø kHz
VBW 3Ø kHz
#SWP 1ØØ sec