

# RF Emissions Test Report To Determine Compliance With: FCC, Part 15 Rules and Regulations

**Model numbers:** 809-3544

November 20, 2000

**Manufacturer:** Computer Process Control  
1640 Airport Rd  
Suite 104  
Kennesaw, GA 30144

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## Section 1

### General Information

<b>Manufacturer:</b>	Computer Process Control 1640 Airport Rd Suite 104 Kennesaw, GA 30144
<b>Manufacturer representative:</b>	<b>Mr. Scott Gelber</b>
<b>Equipment covered by this report:</b>	Model no. 809-3544
<b>Options covered by this report:</b>	None
<b>Equipment serial no.</b>	Prototype
<b>Test specifications:</b>	To determine compliance with: FCC, Part 15, Subpart C Rules and Regulations, Class B
<b>Test report number:</b>	00-203A
<b>Test commenced:</b>	November 14, 2000
<b>Test completed:</b>	November 14, 2000
<b>Test engineer:</b>	<b>Kent Stewart</b>
<b>Test Facility:</b>	The test facility used to perform these tests is on file with the FCC under file 31040/SIT, 1300F2 and located at:

**EMC Testing Laboratories, Inc.**  
2420 Oak Street West  
Cumming, GA. 30041-6456

## Section 2

### Test report summary sheet 1 of 3

**Summary:**

Tests	Results
FCC, Part 15, Class B, Radiated emissions:	<b>Pass</b>
FCC, Part 15, Class B, Conducted emissions:	<b>N/A</b>

- 1- The product(s) covered by this report was found to comply with the limits indicated in paragraphs 15.109 Subpart B and 15.231, Part 15, Subpart C of the FCC Rules and Regulations. Additionally, since the equipment covered by this report is designed to periodically transmit data the alternative limits indicated in (e) of paragraph 15.231 were used.

Note: The conducted emissions test was not performed since the EUT is battery operated with no means for connection to public mains.

**Product description:**

The product(s) covered by this report consisted of a model 809-3544, battery operated temperature transmitter, intended for use with refrigeration equipment.

Model 809-3542 is an intentional radiator operating at 418MHz and is programmed to transmit once every 3 minutes. The transmit duration is 18.8 mS maximum (on time).

The equipment utilizes a maximum 10.42% duty cycle.

The enclosure is constructed of plastic with overall dimensions measuring 7.8cm deep by 7.8cm wide by 3.8cm high and encloses the following components judged as critical:

1. A printed wiring board, manufactured by Computer Process Controls, part no. 537-3544, Rev. 1.50.
2. An RF module, manufactured by Linx, part no. TX-418-LC-R.
3. Two unshielded integral cables. One cable is terminated with a thermistor (thermistor cable) and the other cable is for connection to a switch (clean switch cable).

## Test report summary sheet 2 of 3

**Test configuration:**

The equipment under test was set-up and configured as specified by the manufacturer.

1- The EUT was connected to the following support peripherals.

A) None

2- The EUT was connected to the following cables.

A) An unshielded, integral thermistor cable terminated with a thermistor.

B) An unshielded, integral clean switch cable was left unterminated.

**Test operation:**

For all measurements, the equipment under test was and caused to function in a continuous mode of operation for maximum electrical activity as specified by the manufacturer. Specifically, during the intentional radiator measurement the EUT's transmitter was put in a CW mode.

**Modifications:**

The following modifications were required to comply with the indicated limits:

- 1- The manufacture added a T-pad to attenuate the transmitter output by 4dB. To accommodate adding the T-pad, ground plane space was added to the trace layout. Additionally, the trace widths of the transmitter output were increased and a capacitor in the transmitter vicinity was moved for assembly purposes.
- 2- The "clean switch" and "thermocouple" cables were looped through a ferrite manufactured Steward, part number 28A2029-OAO. The ferrite was placed as close as possible to the enclosures cable exit.

## Test report summary sheet 3 of 3

**Conclusion:**

With the above indicated modifications, the product(s) covered by this report has been tested and found to comply with the limits indicated in paragraph 15.231 table (e) of the FCC, Part 15, Subpart C Rules and Regulations and all subsequent limits indicated therein for a class B device.

Tested by:

Reviewed by:

**Kent Stewart**  
**Laboratory Manager**  
**EMC Testing Laboratories, Inc.**  
November 20, 2000

**Gene J. Bailey**  
**Engineering Manager**  
**EMC Testing Laboratories, Inc.**  
November 20, 2000

Section 2 cont...

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## Section 3

### **STANDARD REFERENCE**

The following primary standards were used for this test:

- 1) **ANSI C63.4-1992:** Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 Khz to 40 Ghz.
- 2) **US Code of Federal Regulations (CFR) 1998:** Title 47, Part 15, Radio Frequency Devices, Subpart C, Intentional Radiators.



## Section 4

# TEST METHOD

### INTRODUCTION:

The product(s) covered by this report were subjected to electromagnetic interference emissions measurements to determine compliance with the FCC, Part 15 requirements.

Radiated emissions were measured in accordance with Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 Khz to 40 Ghz, C63.4.

### MEASUREMENT CALCULATIONS:

#### Radiated Emissions:

For radiated emissions measurements, the signal attenuation due to impedance losses in the antenna and signal cable was significant and was added to the spectrum analyzer reading to give corrected signal strength reading. If a preamplifier was used, the signal gain was subtracted from the signal strength reading. Radiated emissions data was specified as microvolt per meter ( $\mu\text{V}/\text{m}$ ) of radiated field strength.

$$\text{Radiated emissions } (\mu\text{V}/\text{m}) = \text{Analyzer reading } (\mu\text{V}) \text{ plus} \\ \text{antenna factor (dB) plus cable factor (dB) minus Amplifier gain (dB)}$$

### RADIATED EMISSIONS MEASUREMENT:

Radiated emissions measurements were performed at an open field test site. The receiving antenna was positioned 10 meters from the equipment under test as indicated below, along the center axis of the test site. Measurements were made with broadband antennas and if necessary, detected emissions were verified with dipole antennas. The dipole antenna was manually tuned to the signal frequency by adjusting the length of the antenna elements. The radiated emissions were measured for both the horizontal and vertical signal planes by rotating the antennas. Additionally, the EUT was rotated by the turntable and the antenna height was raised and lowered 1 to 4 meters to locate the maximum emission strength at each frequency.

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Emission measurements made from 30MHz to 1000MHz were made at an antenna to EUT distance of 10 meters.

Emission measurements made from 1000 MHz to 10 GHz were made at an antenna to EUT distance of 3 meters.

The following antennas were used to measure the radiated emissions within the specified frequency spans.

<u>Antenna</u>	<u>Frequency Span</u>
Biconical	20 - 200 Mhz
Log Periodic	200 - 1000 Mhz
Dipoles	20 - 1000 Mhz
Horn	1-18 Ghz

#### **INSTRUMENTATION:**

Radiated strength measurements were taken with a spectrum analyzer. Radiated emissions are measured with broadband and tuned dipole antennas. The test equipment consists of the following:

<u>Test Equipment</u>	<u>Model No.</u>	<u>Serial No.</u>	<u>Cal. Due</u>
Spectrum Analyzer	HP 8591A	2919A00171	06-20-01
Spectrum Analyzer	8592L	3649A00744	02-10-01
LISN	94641-1	0145/0146	06-05-01
Biconical Antenna	3110B	1708	10-09-01
Biconical Antenna	BIA-25	2451	10-20-01
Log Periodic	LPA25	1112	10-20-01
Dipole Antenna	DM-105A-T1	31402-110	05-25-01
Dipole Antenna	DM-105A-T2	31402-105	05-25-01
Dipole Antenna	DM-105A-T3	31402-109	05-25-01
Horn Antenna	3115	9405-4264	10-09-01
R.F. Amplifier	QB-820	11602	10-10-01
Preamplifier	8449B	3008A00914	10-10-01

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**DETECTOR FUNCTION FOR OUT OF BAND EMISSIONS:**

The out of band emissions measurements were taken using a peak hold signal detector function. In this mode, the spectrum analyzer makes continuous scans across the frequency band and stores the highest emission value detected at each frequency for all scans. The peak hold integration will detect transient or low duty cycle emissions peak which might be missed on single scan measurement. The emission value at each frequency was a true value.

**SPECTRUM ANALYZER SETTING FOR OUT OF BAND EMISSIONS:**

For all out of band emissions measurements, the spectrum analyzer was set for a 10 dB input attenuation, 10 dB/Division vertical scale and 90 or 100 dB $\mu$ V reference level. The resolution bandwidth is set at 9 KHz for the 0.45 - 30 Mhz span and at 120 KHz for 30 - 1000 Mhz span. The video bandwidth and sweep rates were automatically coupled by the analyzer.

## Section 5

# **RADIATED OUT OF BAND EMISSIONS MEASUREMENTS**

**Radiated Out of Band Emissions - Section 15.209 Limits****Model number:** 809-3544**Test date:** 11/14/00

<b>Frequency Mhz</b>	<b>Measurement Reading dBμV</b>	<b>Corrected Reading dBμV</b>	<b>FCC Limit dBμV</b>	<b>Minimum Margin dBμV</b>
<b>Horizontal</b>				
218.8	35.3	26.5	33.5	-7.0
236.8	34.4	26.0	33.5	-7.5
245.2	33.4	25.4	33.5	-8.1
617.3	38.1	38.8	44.0	<b>-5.2</b>
911.4	32.9	39.1	44.0	<b>-4.9</b>
*985.3	29.4	37.8	44.0	-6.2
<b>Vertical</b>				
*236.8	35.4	27.4	33.5	-6.1
617.3	29.9	30.8	44.0	-13.2

\* - Indicates Quasi-Peak Measurement.

## Section 6

### Fundamental Frequency Radiated Emissions Measurements

## **EMISSION MEASUREMENTS FOR EQUIPMENT WITH PERIODIC OPERATION IN THE BAND 40.66 – 40.70 MHz AND ABOVE 70 MHz:**

As per Section 15.231 of the 47 CFR and in accordance with the measurement provisions in Section 15.35, the peak and average emissions field strength of the fundamental frequency were measured and recorded. For the harmonics emissions above 1000 MHz, peak and average measurements were recorded. After measurement data was recorded the data was then corrected, as indicated in the Measurement Calculations section above.

The average measurements, were derived at by the following method:

$$\text{Corrected peak radiated emissions measurement } (\mu\text{V}) * \text{duty cycle} \\ 10.42\% = \text{Average Reading}$$

During the emission measurements of the fundamental frequency and harmonics up to 1000 MHz, the antenna was positioned 10 meters from the EUT and with the spectrum analyzer in the Linear mode and the resolution bandwidth set to 10Khz minimum resolution bandwidth the fundamental frequency was measured. The measurements were performed with the antenna in the horizontal and vertical polarization. The fundamental frequency's peak measurements were taken as indicated in the plot.

During the emission measurements above 1000MHz of the harmonic emissions of the fundamental frequency, the antenna was positioned 3 meters from the EUT and with the spectrum analyzer in the Linear mode and the resolution bandwidth set to 1 MHz minimum the harmonic emissions were measured. The measurements were performed with the antenna in the horizontal and vertical polarization.

Additionally the following graphs show that the maximum field strength for the fundamental frequency was in compliance with the peak limits as indicated in Section 15.231.

The limits indicated in the tables below have been calculated for the measurement distances as indicated above.

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**Model:** 809-3544

**Test date:** 11-14-00

Frequency Mhz	Detection method	Total Level dBμV/m	FCC Limit dBμV/m	Margin dBμV
<b>Horizontal</b>				
418.0	Peak	80.7	82.3	-1.6
836.0	Peak	36.4	62.3	-25.9
1254.0	Peak	43.8	72.3	-28.5
1672.0	Peak	39.7	72.3	-32.6
2090.0	Peak	42.8	72.3	-29.5
2508.0	Peak	40.4	72.3	-31.9
<b>Vertical</b>				
418.0	Peak	79.8	82.3	-2.5
836.0	Peak	38.2	62.3	-24.1
1254.0	Peak	40.2	72.3	-32.1
1672.0	Peak	37.7	72.3	-34.6
2090.0	Peak	44.0	72.3	-28.3
2508.0	Peak	38.1	72.3	-34.2
3762.0	Peak	42.4	72.3	-29.9

Frequency Mhz	Detection method	Total Level dBμV/m	FCC Limit dBμV/m	Margin dBμV
<b>Horizontal</b>				
418.0	Average	61.1	62.3	-1.2
836.0	Average	16.8	42.3	-25.5
1254.0	Average	24.2	52.3	-28.1
1672.0	Average	20.1	52.3	-32.2
2090.0	Average	23.2	52.3	-29.1
2508.0	Average	20.8	52.3	-31.5
<b>Vertical</b>				
418.0	Average	60.2	62.3	-2.1
836.0	Average	18.6	42.3	-23.7
1254.0	Average	20.6	52.3	-31.7
1672.0	Average	18.1	52.3	-34.2
2090.0	Average	24.3	52.3	-28.0
2508.0	Average	18.4	52.3	-33.9
3762.0	Average	22.7	52.3	-29.6



## Section 7

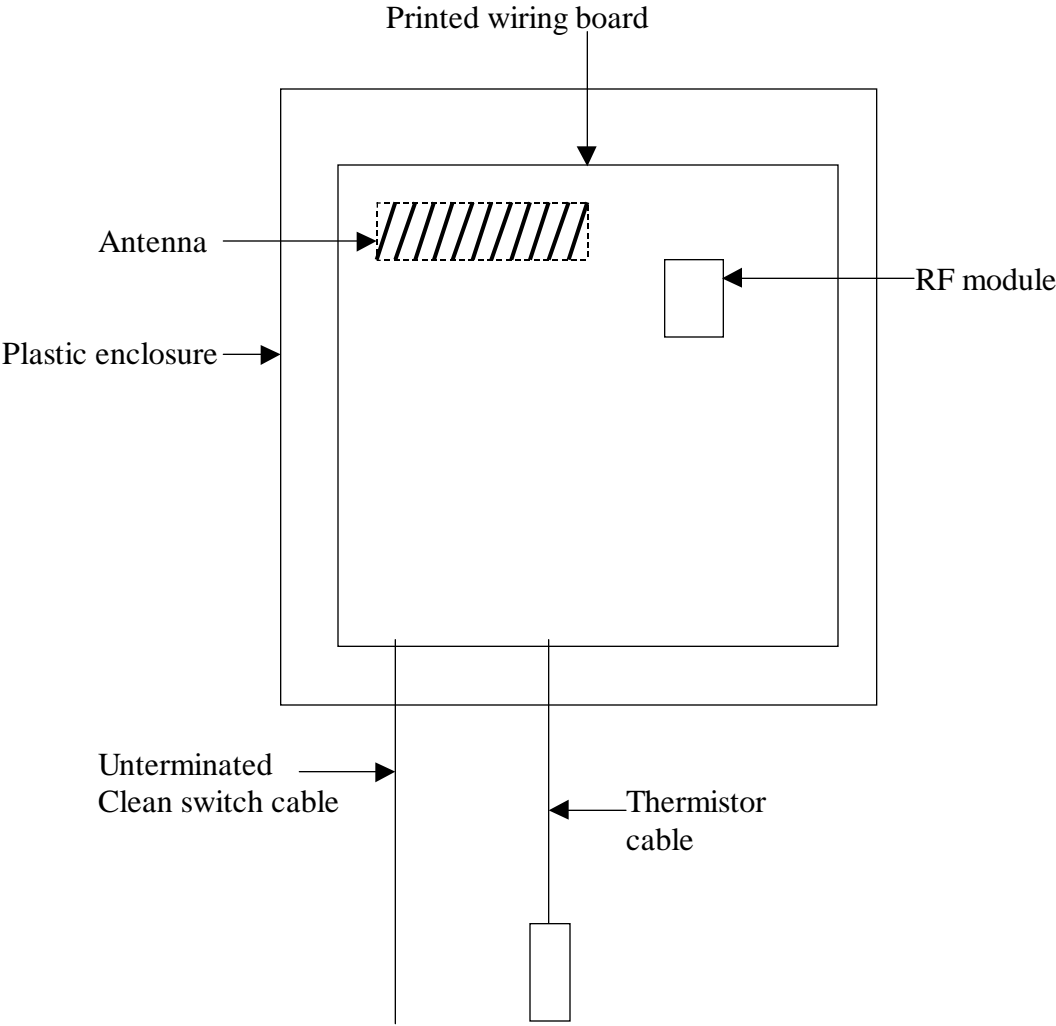
### Occupied Bandwidth Measurements

**OCCUPIED BANDWIDTH MEASUREMENTS:**

As per Section 15.231 (c), the following graphs show that the minimum 20dB bandwidth is less than 0.25% of the center frequency. The bandwidth was measured with the spectrum analyzer's resolution bandwidth set to 10 kHz and the span set to 500 kHz. The measurement was taken 20dB down on each side of the center frequency and the total occupied bandwidth was recorded.

Center Frequency Mhz	Allowed Occupied Bandwidth	Total Occupied Bandwidth
418	1 Mhz	37.6kHz

# Section 8 Configuration



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