

EMC EMISSION - TEST REPORT

Test Report No. **B835501** Issue Date 04 September 1998

Model / Serial No. RS200TX/RS250TX / 01

Product Type Wireless Remote Sensor

Client Compliance and More

Manufacturer Venstar

License holder Venstar

Address 14693 East Wesley Avenue
Aurora, CO 80014-2442

Test Criteria Applied FCC Part 15 15.231C

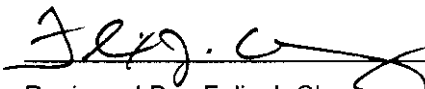
Test Start Date: 14 August 1998

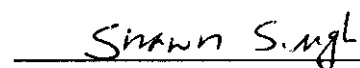
Test End Date: 14 August 1998

Test Result **PASS** **FAIL**

Test Report Project No. **B241835502**

Total Pages including
Appendices 48


Reviewed By : Felix J. Chavez


Reviewed By : Shawn Singh

TÜV Product Service Inc is a subcontractor to TÜV Product Service, GmbH according to the principles outlined in ISO/IEC Guide 25 and EN 45001.

TÜV Product Service Inc reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. TÜV Product Service Inc shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV Product Service Inc issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and ourselves, extracts from the test report shall not be reproduced except in full without our written approval of TÜV Product Service. This report shall not be used by the client to claim product endorsement by NVLAP or any agency of the US government.

TÜV Product Service Inc and its professional staff hold government and professional organization certifications and are members of AAMI, ACIL, AEA, ANSI, IEEE, NVLAP, and VCCI

DIRECTORY - EMISSIONS

| | Page(s) |
|------------------------------------|-----------------|
| Documentation | |
| Test report | <u>1 - 3</u> |
| Directory | <u>2</u> |
| Test Regulations | <u>3</u> |
| General Remarks | <u>3</u> |
| Test-setup Photographs | <u>4-5</u> |
| Test Equipment Used | <u>6-10</u> |
| Appendix A | |
| Transmitter Data Sheets | <u>A1 - A2</u> |
| Appendix B | |
| Detailed Test Data Sheets | <u>B1 - B7</u> |
| Appendix C | |
| Plot of 20 dB bandwidth | <u>C1 - C2</u> |
| Appendix D | |
| Plots of Calculated Duty Cycle | <u>D1 - D5</u> |
| Appendix E | |
| Test Plan/Constructional Data Form | <u>E1 - E19</u> |
| Appendix F | |
| Measurement of Protocol | <u>F1 - F3</u> |

EMISSIONS TEST REGULATIONS :

The tests were performed according to following regulations :

- - Federal Communication Commission part 15 - Class A ■ - Class B
- - Federal Communication Commission part 15, Subpart C ■ - 15.209 ■ - 15.231

All tests performed according to ANSI C63.4

Emission Test Results:

Conducted emissions 150 kHz - 30 MHz

Test Result - PASS - FAIL - Not Applicable

Passing Margin _____ dB at _____ MHz

Remarks: EUT is battery operated.

Radiated emissions (electric field) 30 MHz - 1000 MHz (Unintentional Radiator)

Test Result - PASS - FAIL - Not Applicable

Passing Margin _____ 19 dB at 433.00 MHz

Remarks: _____

Radiated emissions (electric field) 418.17 MHz - 4180.6 MHz (Intentional Radiator)

Test Result - PASS - FAIL - Not Applicable

Passing Margin _____ 2.4 dB at 4180.6 MHz

Remarks: _____

GENERAL REMARKS:

Modifications required to pass:

Added a 15 Ohm resistor pin 4-3 TX out to ground.

Test Specification Deviations: Additions to or Exclusions from: None

Test-setup photo(s):
Conducted Emissions

Test Not Applicable

Test Equipment Used

Colorado Test Equipment

27-Aug-98

Report: B8355 Date: 31 Aug 98 Signature: Shawn Sings

Temp: 21°C Rel. Humd.: 50% Atmo. Pressure: 81 kPa

| Location | Tests | Manufacturer | Model Number | Serial Number | Description | Cal Date | Cal Due |
|----------|-------------------|--------------------|---------------|---------------|--|-----------|-----------|
| | | | | | | | |
| | | | | | | | |
| PW | R | AH Systems | SAS-200/510 | 705 | Log Periodic Antenna (300-1800 MHz) | 06-Jul-98 | 06-Jul-99 |
| PW | R | AH Systems | SAS-200/512 | 104 | Log Periodic Antenna (200-1500 MHz) | 13-Jul-98 | 13-Jul-99 |
| PW | | AH Systems | SAS-200/542 | 256 | Biconical Antenna | 03-Feb-98 | 03-Feb-99 |
| PW | R | AvAntek | AFT97-8434-10 | 1007 | RF Pre-Amplifier (4-8 GHz) | 18-Nov-97 | 18-Nov-98 |
| PW | R | Avantek | AWT-18037 | 1002 | RF Pre-Amplifier (8-18 GHz) | 18-Nov-97 | 18-Nov-98 |
| PW | | bird | 4022 | 1825 | Sensor, 25 to 1000 MHz | | |
| PW | | bird | 4024 | 1863 | Sensor, 1.5 to 32 MHz | | |
| PW | | bird | 4025 | 3702 | Sensor, 100 to 2500kHz | | |
| PW | | Bird | 4421-103 | 1254 | Metering Unit | | |
| PW | R C | California Instr. | 850T-1 | 68458 | Oscillator (45-5000 Hz) | 08-Mar-98 | 08-Mar-99 |
| PW | R C | California Instr. | 9000TCA/3-1 | 50666+ | Power Source 9KVA (45-5000 Hz, 0-280VAC) | | |
| PW | R C | Compaq | 470A | 23605277B504 | Monitor - PW Testbed | | |
| PW | R C | Compaq | DeskPro 575 | g545HSY20483 | Computer for PW Testbed | | |
| PW | R | Compliance Desig | none | RD-1 | Roberts Dipole Ant. Set (30-1000 MHz) | 03-Mar-97 | 02-Mar-00 |
| PW | | EMC Test Systems | 3109 | 3142 | Biconical Antenna | 27-Jan-98 | 27-Jan-99 |
| PW | | EMCO | 1070-4 | 9206-1681 | Antenna tower with manual polarization | | |
| PW | | EMCO | 1080/1081 | 9206-1636 | 2 meter dia. wood turntable | | |
| PW | | EMCO | 1090 | 1134 | Multiple Device Controller | | |
| PW | R | EMCO | 3108 | 2149 | Biconical Dipole Antenna (30-300 MHz) | 19-Jun-98 | 19-Jun-99 |
| PW | R | EMCO | 3108 | 7059203-2457 | Biconical Dipole Antenna (30-300 MHz) | 06-Jul-98 | 06-Jul-99 |
| PW | R | EMCO | 3115 | 3886 | DbI Ridged Horn Antenna (1-18 GHz) | 20-Feb-98 | 20-Feb-99 |
| PW | -3, R | EMCO | 3146 | 9203-3376 | Log Periodic Antenna | 18-Jun-98 | 18-Jun-99 |
| PW | C | EMCO | 3825/2 | 9202-1945 | LISN | 15-Jul-98 | 15-Jul-99 |
| PW | C | EMCO | 3825/2 | 9202-1946 | LISN | 08-Jul-97 | 08-Jul-98 |
| PW | C | EMCO | 3825/2 | 9202-1946 | LISN | 23-Jul-98 | 23-Jul-99 |
| PW | R | EMCO | 4610 | 9205-1199 | Royce field site source | | |
| PW | C | EMCO | 4620 | 9110-1015 | Conducted noise source | | |
| PW | | EMCO | 6502 | 2082 | Magnetic Field Loop | | |
| PW | R | EMCO | 6502 | 9205-2738 | Magnetic loop | 30-Oct-97 | 29-Oct-00 |
| PW | | EMCO | 7123 | 9205-1028 | Field Strength Sensor | | |
| PW | | EMCO | 7123 | 9205-1029 | Field Strength Sensor | 11-Dec-97 | 11-Dec-98 |
| PW | R | EMCO | 7405 | 9203-2175 | Near field probe set | | |
| PW | CISPR14 | Fischer | F-201 | 141 | Absorbing Clamp (30-300 MHz) | 05-Mar-98 | 05-Mar-99 |
| PW | C | Fischer | F-33-1 | 356 | Current Probe (10 kHz - 250 MHz) | 04-May-98 | 04-May-99 |
| PW | 3, C, R, 6 | Fischer Custom Co. | F-61 | 274 | Current Probe | 17-Jun-97 | 17-Jun-98 |
| PW | X | Gishard | 600-1040 mb | 002 | Altimeter | | |
| PW | R | Hewlett Packard | 11940A | 2650A04527 | Close field probe | | |
| PW | R | Hewlett Packard | 11940A | 2650A04563 | Close field probe | | |
| PW | R | Hewlett Packard | 11941A | 2807A02957 | Close field probe | | |
| PW | C | Hewlett Packard | 11947A | 2820A00277 | Transient Limiter | 18-Nov-97 | 18-Nov-98 |
| PW | C | Hewlett Packard | 11947A | 3107A01975 | Transient Limiter | 17-Jun-98 | 17-Jun-99 |
| PW | | Hewlett Packard | 8444A | 2325A07899 | Tracking Generator (1-1200 MHz) | 18-Nov-97 | 18-Nov-98 |
| PW | R C | Hewlett Packard | 8447D | 2727A05399 | Amplifier (30-1000 MHz) | 18-Nov-97 | 18-Nov-98 |
| PW | R, C | Hewlett Packard | 8447F | 3113A04923 | Option H64 Dual Preamp | 21-Nov-97 | 21-Nov-98 |
| PW | R, C, RE101, CISP | Hewlett Packard | 85650A | 2043A00256 | Quasi Peak Adapter (set 1) | 17-Jun-98 | 17-Jun-99 |
| PW | R, C, RE101, CISP | Hewlett Packard | 85650A | 2811A01300 | Quasi Peak Adapter | 18-Nov-97 | 18-Nov-98 |
| PW | C | Hewlett Packard | 85662A | 2112A02220 | Display Section | 11-Mar-98 | 11-Mar-99 |
| PW | R, C, RE101, CISP | Hewlett Packard | 85662A | 2318A04983 | Display Section (set 1) | 17-Jun-98 | 17-Jun-99 |
| PW | C, R | Hewlett Packard | 85662A | 2403A06707 | Display Section (Loaner) | 20-Nov-97 | 20-Nov-98 |
| PW | R, C | Hewlett Packard | 85662A | 2403A08749 | Display Section | 01-Apr-98 | 30-Sep-98 |
| PW | R, C, RE101, CISP | Hewlett Packard | 8566B | 2410A00154 | Spectrum Analyzer (dc-22 GHz) | 01-Apr-98 | 30-Sep-98 |
| PW | R, C | Hewlett Packard | 8566B | 2410A00254 | Spectrum Analyzer (Loaner) | 20-Nov-97 | 20-Nov-98 |

| Location | Tests | Manufacturer | Model Number | Serial Number | Description | Cal Date | Cal Due |
|----------|--------------------|---------------------|----------------|---------------|---|-----------|-----------|
| PW | R, C, RE101, CISP | Hewlett Packard | 8568B | 2304A02508 | Spectrum Analyzer (set 1) (dc-1.8 Ghz) | 17-Jun-98 | 17-Jun-99 |
| PW | | Hewlett Packard | 8590 | 2722A02036 | Spectrum Analyzer | | |
| PW | RE101, -8, -9, -11 | Hewlett Packard | 8594E | 3223A00145 | Spectrum Analyzer | 21-Nov-97 | 21-Nov-98 |
| PW | C | HP | 11947A | 3107A01984 | Transient Limiter | 09-Jun-97 | 09-Jun-98 |
| PW | | JFW | 50FH-003-100N | 9825 | Attenuator | 18-Jun-98 | 18-Jun-99 |
| PW | | JFW | 50FHB-003-5 | 00363 | Attenuator | 18-Nov-97 | 18-Nov-98 |
| PW | R | Mini-Circuits | ZHL-1042J | D020698-14 | RF Pre-Amplifier (10-4200 MHz) | 13-Feb-98 | 13-Feb-99 |
| PW | R | Mini-Circuits | ZHL-1042J | N032698 | RF Pre-Amplifier (30-4000 MHz) | 11-May-98 | 11-May-99 |
| PW | C | Polarad Electronics | ESH3-Z2 | 357.881J.32 | Transient Limiter | | |
| PW | X | Radio Shack | 63-867 | 005 | Temperature / Humidity Indicator | | |
| PW | C R | Rhode & Schwarz | ESHS 30 | 842806/001 | EMI Test Receiver | 07-Oct-97 | 07-Oct-98 |
| PW | C | Rhode & Schwarz | ESH2-Z5 | 830364/002 | LISN 50 ohm/50uH 3 line (1kHz - 30 MHz) | 23-Feb-98 | 23-Feb-99 |
| PW | C | Rhode & Schwarz | ESH3 | 872318/036 | Low Frequency Receiver (9 kHz - 30 MHz) | 06-Aug-97 | 06-Aug-98 |
| PW | R | Rhode & Schwarz | HFH2-Z2 | 880665/042 | Loop Antenna (10 kHz - 30 MHz) | 08-Feb-98 | 08-Feb-99 |
| PW | | Schwarzbeck | NNLK 8129 | 8129126 | LISN | 20-Oct-97 | 20-Oct-98 |
| PW | C | Schwarzbeck | TK 9416 | TUV-600 | Conducted Line Probe (150 kHz - 30 MHz) | 04-Apr-98 | 04-Apr-99 |
| PW | | Shaffner | NSG 431 | 1426 | ESD Tester | | |
| PW | C | Solar | 8028-50-TS-24- | 8305121 | LISN | 23-Feb-98 | 23-Feb-99 |
| PW | C | Solar | 8028-50-TS-24- | 8305122 | LISN (10 kHz - 30 MHz) | 23-Feb-98 | 23-Feb-99 |
| PW | | Tensor | 4105 | 2020 | Ridged Guide Antenna | 11-Jun-98 | 11-Jun-99 |
| PW | | Transjonic | T-100 | 147 | Ion Meter | | |
| PW | | TUV PS | LPS-1 | 1 | P/S for Loop Antenna | | |
| PW | | WaveTek | DM5XL | 60206553 | Hand Held Multimeter | | |
| PW | | Weinschel | 2-3dB | BC5530 | Attenuator | 18-Nov-97 | 18-Nov-98 |
| PW | | Weinschel | 2-3dB | BC5539 | Attenuator | 18-Nov-97 | 18-Nov-98 |
| PW | | Weinschel | 2-6B | BC6492 | Attenuator | 18-Nov-97 | 18-Nov-98 |
| PW | | Weinschel | 2-6dB | BC6487 | Attenuator | 18-Nov-97 | 18-Nov-98 |

Colorado Test Equipment

22-Jul-98

Report: B8355 Date: 14 Aug 98 Signature: [Signature]

Temp: 22°C Rel. Humd.: 40% Atmo. Pressure: 80.0 kPa

| Location | Tests | Manufacturer | Model Number | Serial Number | Description | Cal Date | Cal Due |
|----------|------------------------|-------------------|---------------|---------------|--|-----------|-----------|
| PW | R | AH Systems | SAS-200/510 | 705 | Log Periodic Antenna (300-1800 MHz) | 06-Jul-98 | 06-Jul-99 |
| PW | <u>(R)</u> | AH Systems | SAS-200/512 | 104 | Log Periodic Antenna (200-1500 MHz) | 13-Jul-98 | 13-Jul-99 |
| PW | | AH Systems | SAS-200/542 | 256 | Biconical Antenna | 03-Feb-98 | 03-Feb-99 |
| PW | R | AvAntek | AFT97-8434-10 | 1007 | RF Pre-Amplifier (4-8 GHz) | 18-Nov-97 | 18-Nov-98 |
| PW | R | Avantek | AWT-18037 | 1002 | RF Pre-Amplifier (8-18 GHz) | 18-Nov-97 | 18-Nov-98 |
| PW | | bird | 4022 | 1825 | Sensor, 25 to 1000 MHz | | |
| PW | | bird | 4024 | 1863 | Sensor, 1.5 to 32 MHz | | |
| PW | | bird | 4025 | 3702 | Sensor, 100 to 2500kHz | | |
| PW | | Bird | 4421-103 | 1254 | Metering Unit | | |
| PW | R C | California Instr. | 850T-1 | 68458 | Oscillator (45-5000 Hz) | 08-Mar-98 | 08-Mar-99 |
| PW | R C | California Instr. | 9000TCA/3-1 | 50666+ | Power Source 9KVA (45-5000 Hz, 0-280VAC) | | |
| PW | R C | Compaq | 470A | 23605277B504 | Monitor - PW Testbed | | |
| PW | R C | Compaq | DeskPro 575 | g545HSY20483 | Computer for PW Testbed | | |
| PW | R | Compliance Desig | none | RD-1 | Roberts Dipole Ant. Set (30-1000 MHz) | 03-Mar-97 | 02-Mar-00 |
| PW | | EMC Test Systems | 3109 | 3142 | Biconical Antenna | 27-Jan-98 | 27-Jan-99 |
| PW | | EMCO | 1070-4 | 9206-1681 | Antenna tower with manual polarization | | |
| PW | | EMCO | 1080/1081 | 9206-1636 | 2 meter dia. wood turntable | | |
| PW | | EMCO | 1090 | 1134 | Multiple Device Controller | | |
| PW | <u>(R)</u> | EMCO | 3108 | 2149 | Biconical Dipole Antenna (30-300 MHz) | 19-Jun-98 | 19-Jun-99 |
| PW | R | EMCO | 3108 | 7059203-2457 | Biconical Dipole Antenna (30-300 MHz) | 06-Jul-98 | 06-Jul-99 |
| PW | <u>(R)</u> | EMCO | 3115 | 3886 | Dbi Ridged Horn Antenna (1-18 GHz) | 20-Feb-98 | 20-Feb-99 |
| PW | 3, R | EMCO | 3146 | 9203-3376 | Log Periodic Antenna | 18-Jun-98 | 18-Jun-99 |
| PW | C | EMCO | 3825/2 | 9202-1945 | LISN | 15-Jul-98 | 15-Jul-99 |
| PW | C | EMCO | 3825/2 | 9202-1946 | LISN | 08-Jul-97 | 08-Jul-98 |
| PW | R | EMCO | 4610 | 9205-1199 | Royce field site source | | |
| PW | C | EMCO | 4620 | 9110-1015 | Conducted noise source | | |
| PW | | EMCO | 6502 | 2082 | Magnetic Field Loop | | |
| PW | R | EMCO | 6502 | 9205-2738 | Magnetic loop | 30-Oct-97 | 29-Oct-00 |
| PW | | EMCO | 7123 | 9205-1028 | Field Strength Sensor | | |
| PW | | EMCO | 7123 | 9205-1029 | Field Strength Sensor | 11-Dec-97 | 11-Dec-98 |
| PW | R | EMCO | 7405 | 9203-2175 | Near field probe set | | |
| PW | CISPR14 | Fischer | F-201 | 141 | Absorbing Clamp (30-300 MHz) | 05-Mar-98 | 05-Mar-99 |
| PW | C | Fischer | F-33-1 | 356 | Current Probe (10 kHz - 250 MHz) | 04-May-98 | 04-May-99 |
| PW | 3, C, R, 6 | Fischer Custom Co | F-61 | 274 | Current Probe | 17-Jun-97 | 17-Jun-98 |
| PW | <u>X</u> | Gishard | 600-1040 mb | 002 | Altimeter | | |
| PW | R | Hewlett Packard | 11940A | 2650A04527 | Close field probe | | |
| PW | R | Hewlett Packard | 11940A | 2650A04563 | Close field probe | | |
| PW | R | Hewlett Packard | 11941A | 2807A02957 | Close field probe | | |
| PW | C | Hewlett Packard | 11947A | 2820A00277 | Transient Limiter | 18-Nov-97 | 18-Nov-98 |
| PW | C | Hewlett Packard | 11947A | 3107A01975 | Transient Limiter | 17-Jun-98 | 17-Jun-99 |
| PW | | Hewlett Packard | 8444A | 2325A07899 | Tracking Generator (1-1200 MHz) | 18-Nov-97 | 18-Nov-98 |
| PW | R C | Hewlett Packard | 8447D | 2727A05399 | Amplifier (30-1000 MHz) | 18-Nov-97 | 18-Nov-98 |
| PW | R, C | Hewlett Packard | 8447F | 3113A04923 | Option H64 Dual Preamp | 21-Nov-97 | 21-Nov-98 |
| PW | R, C, RE101, CISP | Hewlett Packard | 85650A | 2043A00256 | Quasi Peak Adapter (set 1) | 17-Jun-98 | 17-Jun-99 |
| PW | <u>(R)</u> RE101, CISP | Hewlett Packard | 85650A | 2811A01300 | Quasi Peak Adapter | 18-Nov-97 | 18-Nov-98 |
| PW | R, C | Hewlett Packard | 85662A | 2112A02220 | Display Section | 11-Mar-98 | 11-Mar-99 |
| PW | R, C, RE101, CISP | Hewlett Packard | 85662A | 2318A04983 | Display Section (set 1) | 17-Jun-98 | 17-Jun-99 |
| PW | C, R | Hewlett Packard | 85662A | 2403A06707 | Display Section (Loaner) | 20-Nov-97 | 20-Nov-98 |
| PW | <u>(R)</u> | Hewlett Packard | 85662A | 2403A08749 | Display Section | 01-Apr-98 | 30-Sep-98 |
| PW | <u>(R)</u> RE101, CISP | Hewlett Packard | 8566B | 2410A00154 | Spectrum Analyzer (dc-22 GHz) | 01-Apr-98 | 30-Sep-98 |
| PW | R, C | Hewlett Packard | 8566B | 2410A00254 | Spectrum Analyzer (Loaner) | 20-Nov-97 | 20-Nov-98 |
| PW | R, C, RE101, CISP | Hewlett Packard | 8568B | 2304A02508 | Spectrum Analyzer (set 1) (dc-1.8 Ghz) | 17-Jun-98 | 17-Jun-99 |

FCC ID:

1

File No. B241835502, Page 9 of 10

TUV PRODUCT SERVICE INC

40 Meadow Road

Pinewood Springs, Lyons, CO 80540 Tel: 303 786 7999 Fax: 303 449 3004 Rev.No 1.0

| Location | Tests | Manufacturer | Model Number | Serial Number | Description | Cal Date | Cal Due |
|----------|--------------------|---------------------|---------------|---------------|---|-----------|-----------|
| PW | | Hewlett Packard | 8590 | 2722A02036 | Spectrum Analyzer | | |
| PW | RE101, -8, -9, -11 | Hewlett Packard | 8594E | 3223A00145 | Spectrum Analyzer | 21-Nov-97 | 21-Nov-98 |
| PW | C | HP | 11947A | 3107A01984 | Transient Limiter | 09-Jun-97 | 09-Jun-98 |
| PW | | JFW | 50FH-003-100N | 9825 | Attenuator | 18-Jun-98 | 18-Jun-99 |
| PW | | JFW | 50FHB-003-5 | 00363 | Attenuator | 18-Nov-97 | 18-Nov-98 |
| PW | (R) | Mini-Circuits | ZHL-1042J | D020698-14 | RF Pre-Amplifier (10-4200 MHz) | 13-Feb-98 | 13-Feb-99 |
| PW | R | Mini-Circuits | ZHL-1042J | N032698 | RF Pre-Amplifier (30-4000 MHz) | 11-May-98 | 11-May-99 |
| PW | C | Polarad Electronics | ESH3-Z2 | 357.881J.32 | Transient Limiter | | |
| PW | | Radio Shack | 63-867 | 005 | Temperature / Humidity Indicator | | |
| PW | C, R | Rhode & Schwarz | ESHS 30 | 842806/001 | EMI Test Receiver | 07-Oct-97 | 07-Oct-98 |
| PW | C | Rhode & Schwarz | ESH2-Z5 | 830364/002 | LISN 50 ohm/50uH 3 line (1kHz - 30 MHz) | 23-Feb-98 | 23-Feb-99 |
| PW | C | Rhode & Schwarz | ESH3 | 872318/036 | Low Frequency Receiver (9 kHz - 30 MHz) | 06-Aug-97 | 06-Aug-98 |
| PW | R | Rhode & Schwarz | HFH2-Z2 | 880665/042 | Loop Antenna (10 kHz - 30 MHz) | 08-Feb-98 | 08-Feb-99 |
| PW | | Schwarzbeck | NNLK 8129 | 8129126 | LISN | 20-Oct-97 | 20-Oct-98 |
| PW | C | Schwarzbeck | TK 9416 | TUV-600 | Conducted Line Probe (150 kHz - 30 MHz) | 04-Apr-98 | 04-Apr-99 |
| PW | | Shaffner | NSG 431 | 1426 | ESD Tester | | |
| PW | C | Solar | 8028-50-TS-24 | 8305121 | LISN | 23-Feb-98 | 23-Feb-99 |
| PW | C | Solar | 8028-50-TS-24 | 8305122 | LISN (10 kHz - 30 MHz) | 23-Feb-98 | 23-Feb-99 |
| PW | | Tensor | 4105 | 2020 | Ridged Guide Antenna | 11-Jun-98 | 11-Jun-99 |
| PW | | Transjonic | T-100 | 147 | Ion Meter | | |
| PW | | TUV PS | LPS-1 | 1 | P/S for Loop Antenna | | |
| PW | | WaveTek | DM5XL | 60206553 | Hand Held Multimeter | | |
| PW | | Weinschel | 2-3dB | BC5530 | Attenuator | 18-Nov-97 | 18-Nov-98 |
| PW | | Weinschel | 2-3dB | BC5539 | Attenuator | 18-Nov-97 | 18-Nov-98 |
| PW | | Weinschel | 2-6B | BC6492 | Attenuator | 18-Nov-97 | 18-Nov-98 |
| PW | | Weinschel | 2-6dB | BC6487 | Attenuator | 18-Nov-97 | 18-Nov-98 |

Appendix A

Transmitter Data Sheets

15.231 PERIODIC OPERATION INTENTIONAL RADIATOR

Date: 14-Aug-98 **Measured @** 418.17 MHz
EUT: Wireless Remote Sensor
Manufacturer: Venstar
Representative: Doug Barnes

Miscellaneous Measurements:
 1) 20 dB Bandwidth 347 kHz
FCC Specification
 1 MHz

Tx Mode: Radiated Measurements

Calculated Averaging Factor: -7 dB (20*Log(duty cycle))
Averaging Factor Applied: -7 dB

Fundamental Field Strength: 80.2 dBuV/m
Peak Measurement
 dBuV/m @ MHz 70.3 418.17

| Harmonics | Specification | Peak Measurement dBuV/m @ MHz | Average Measurement dBuV/m @ MHz | Delta dB |
|----------------------------|---------------|-------------------------------|----------------------------------|----------|
| 2nd harmonic (836.07 MHz) | 60 dBuV/m | 43.8 | 36.8 | -23.2 |
| 3rd harmonic (1254.1 MHz) | 60 dBuV/m | 50.8 | 43.8 | -16.2 |
| 4th harmonic (1672.2 MHz) | 54 dBuV/m | 51.7 | 44.7 | -9.3 |
| 5th harmonic (2090.3 MHz) | 60 dBuV/m | 44.6 | 37.6 | -22.4 |
| 6th harmonic (2508.4 MHz) | 60 dBuV/m | 52.3 | 45.3 | -14.7 |
| 7th harmonic (2926.3 MHz) | 60 dBuV/m | 51.9 | 44.9 | -15.1 |
| 8th harmonic (3344.5 MHz) | 60 dBuV/m | 47.7 | 40.7 | -19.3 |
| 9th harmonic (3762.5 MHz) | 54 dBuV/m | 53.5 | 46.5 | -7.5 |
| 10th harmonic (4180.6 MHz) | 54 dBuV/m | 58.6 | 51.6 | -2.4 |

Minimum Passing Margin: -2.4 dB

Appendix B

Detailed Test Data Sheets

T U V P R O D U C T S E R V I C E
R A D I A T E D E M I S S I O N S

PW1 Test Site
3 Meter Antenna Distance
Equipment Under Test:
Venstar, M/N: RS200TX/RS250TX
Wireless Remote Sensor
Notes: S/N 01, Fresh (2) AA Batteries, FCC ID MUHRSTX.

Report B8355 Run 7
Date 08/15/98 Page 1
Engineer ECJDC
Tech: dmk
Requester [Signature]

| Frequency MHz | Level dBuV | Factor dB | Cable dB | Final dBuV/m | Az deg | Polar\ Height | Delta FCC B | Delta |
|------------------|---------------|--------------|-------------|-----------------|-----------|------------------|----------------|-------|
|------------------|---------------|--------------|-------------|-----------------|-----------|------------------|----------------|-------|

CHECKING FOR UNINTENTIONAL EMISSIONS , 30-1,000 MHz

Bicon Antenna, Vertical

Full turntable rotation, no emissions detected

Bicon Antenna , Horizontal

Full turntable rotation , No emissions detected.

Changing to the Log Periodic Antenna, Vertical.

| | | | | | | | | |
|--------|------|------|-----|------|----|---|----|-------|
| 538.64 | 4.4 | 17.5 | 1.4 | 23.3 | -- | V | -- | -22.7 |
| 618.57 | 5.25 | 19.8 | 1.5 | 26.6 | -- | V | -- | -19.4 |
| 432.43 | 7.45 | 16.1 | 1.2 | 24.8 | -- | V | -- | -21.2 |

All the above readings are maximized.

Changing to Horizontal.

| | | | | | | | | |
|--------|-----|------|-----|----|----|---|----|-----|
| 433.00 | 9.7 | 16.1 | 1.2 | 27 | -- | H | -- | -19 |
|--------|-----|------|-----|----|----|---|----|-----|

The above reading is maximized.

END OF RUN.

T U V P R O D U C T S E R V I C E

RADIATED EMISSIONS

PW1 Test Site
 3 Meter Antenna Distance
 Equipment Under Test:
 Venstar, M/N: RS200TX/RS250TX
 Wireless Remote Sensor
 Notes: S/N 01, Fresh (2) AA Batteries, FCC ID MUHRSTX.

Figure _____

Report B8355 Run 7
 Date 08/15/98 Page 2
 Engineer EX 116
 Tech: dmk
 Requester _____

Measurement Summary

| Frequency MHz | Final dBuV/m | Final uV/m | Azimuth deg | Polar\ Height | Delta FCC B | Delta |
|------------------|-----------------|---------------|----------------|------------------|----------------|-------|
| 432.43 | 24.8 | 17.378 | -- | V -- | -21.2 | |
| 433.00 | 27 | 22.387 | -- | H -- | -19 | |
| 538.64 | 23.3 | 14.621 | -- | V -- | -22.7 | |
| 618.57 | 26.6 | 21.379 | -- | V -- | -19.4 | |

Minimum Passing Margin for FCC B is 19 dB at 433.00 MHz

File B8355 Run 7

T U V P R O D U C T S E R V I C E

RADIATED EMISSIONS

PW1 Test Site
 3 Meter Antenna Distance
 Equipment Under Test:
 Venstar, M/N: RS200TX/RS250TX
 Wireless Remote Sensor
 Notes: S/N 01, Fresh (2) AA Batteries, FCC ID MUHRSTX

Report B8355 Run 6
 Date 08/14/98 Page 1
 Engineer FLA
 Tech: dmK [Signature]
 Requester [Signature]

| Frequency MHz | Level dBuV | Factor dB | Cable dB | Final dBuV/m | Az deg | Polar\ Height | Delta | Delta |
|------------------|---------------|--------------|-------------|-----------------|-----------|------------------|-------|-------|
|------------------|---------------|--------------|-------------|-----------------|-----------|------------------|-------|-------|

NOTE: With Shield over RF Chip area. Installed on a AC cover plate.

418.17 63.8 16.3 1.2 81.3 -- V --
 The above reading is peak, maximized at 2 degrees, 1.2 meters.

4180.9 22.45 34.1 4.5 61 -- V --

NOTE: Moved the antenna Horizontal on the faceplate.

4180.9 22.3 34.1 4.5 60.9 -- V --
 The above reading is max at 129 degrees, 1.4 meters, Vertical.

 NOTE: Added a 15 Ohm resistor , TX out to Gnd. Pin 4-3. (Also removed shield)
 ***** DMK

4180.6 16.6 34.1 4.5 55.2 -- V --
 The above reading is max at 327 degrees, 1.2 meters, Vertical.

Changing to Horizontal.

4180.6 20 34.1 4.5 58.6 -- V --
 The above reading is max at 253 degrees, 1.3 meters, Horizontal.

Going back to check the fundamental.

Log Antenna, Vertical.

418.14 52.85 16.3 1.2 70.3 -- V --
 The above reading is max at 204 degrees, 1.2 meters, Vertical.

418.14 51.45 16.3 1.2 68.9 -- H --
 The above reading is max at 132 degrees, 2 meters, Horiz.

T U V P R O D U C T S E R V I C E

RADIATED EMISSIONS

PW1 Test Site
3 Meter Antenna Distance
Equipment Under Test:
Venstar, M/N: RS200TX/RS250TX
Wireless Remote Sensor
Notes: S/N 01, Fresh (2) AA Batteries, FCC ID MUHRSTX

Report B8355 Run 6
Date 08/14/98 Page 2,
Engineer PSJ
Tech: dmk
Requester [Signature]

| Frequency MHz | Level dBuV | Factor dB | Cable dB | Final dBuV/m | Az deg | Polar\ Height | Delta | Delta |
|------------------|---------------|--------------|-------------|-----------------|-----------|------------------|-------|-------|
|------------------|---------------|--------------|-------------|-----------------|-----------|------------------|-------|-------|

NOTE: When the resistor was added (previous page) the shields were removed .

Continuing to measure the rest of the harmonics.

HORN ANTENNA HORIZONTAL.

(Disregard the above note)

Log Periodic Antenna

836.07 19.75 22.2 1.9 43.8 -- H --

The above reading is max at 98 degrees, 1 meter , Horiz.

Checking Vertical.

836.14 16.75 22.2 1.9 40.8 -- V --

The above reading is max at 234 degrees, 1.2 meters, Vertical.

NOW CHANGING TO THE HORN ANTENNA , HORIZONTAL POLARIZATION

| | | | | | | | |
|--------|-------|------|-----|------|----|---|----|
| 1254.2 | 19 | 25.9 | 2.3 | 47.2 | -- | H | -- |
| 1672.2 | 18.05 | 27.7 | 2.7 | 48.4 | -- | H | -- |
| 2090.3 | 10.4 | 29.3 | 3.1 | 42.8 | -- | H | -- |
| 2508.4 | 15.6 | 30.7 | 3.4 | 49.7 | -- | H | -- |
| 2926.4 | 11.4 | 31.4 | 3.7 | 46.5 | -- | H | -- |
| 3344.5 | 5.15 | 32.4 | 4 | 41.5 | -- | H | -- |
| 3762.5 | 11.45 | 33.6 | 4.2 | 49.2 | -- | H | -- |

4180.8 MHz was previously maximized.

T U V P R O D U C T S E R V I C E

RADIATED EMISSIONS

PW1 Test Site
 3 Meter Antenna Distance
 Equipment Under Test:
 Venstar, M/N: RS200TX/RS250TX
 Wireless Remote Sensor
 Notes: S/N 01, Fresh (2) AA Batteries, FCC ID MUHRSTX

Report B8355 Run 6
 Date 08/14/98 Page 31
 Engineer
 Tech: dmk
 Requester

 Frequency Level Factor Cable Final Az Polar\ Delta Delta
 MHz dBuV dB dB dBuV/m deg Height

Changing to Vertical, Horn Antenna.

| | | | | | | | |
|--------|-------|------|-----|------|----|---|----|
| 1254.1 | 22.6 | 25.9 | 2.3 | 50.8 | -- | V | -- |
| 1672.2 | 21.3 | 27.7 | 2.7 | 51.7 | -- | V | -- |
| 2090.3 | 12.25 | 29.3 | 3.1 | 44.6 | -- | V | -- |
| 2508.4 | 18.2 | 30.7 | 3.4 | 52.3 | -- | V | -- |
| 2926.3 | 16.75 | 31.4 | 3.7 | 51.9 | -- | V | -- |
| 3344.5 | 11.35 | 32.4 | 4 | 47.7 | -- | V | -- |
| 3762.5 | 15.75 | 33.6 | 4.2 | 53.5 | -- | V | -- |

END OF RUN.

T U V P R O D U C T S E R V I C E

RADIATED EMISSIONS

PW1 Test Site
 3 Meter Antenna Distance
 Equipment Under Test:
 Venstar, M/N: RS200TX/RS250TX
 Wireless Remote Sensor
 Notes: S/N 01, Fresh (2) AA Batteries, FCC ID MUHRSTX

Figure_____

Report B8355 Run 6
 Date 08/14/98 Page 4
 Engineer
 Tech: dmk
 Requester

Measurement Summary

| Frequency MHz | Final dBuV/m | uV/m | Azimuth deg | Polar\ Height | Delta | Delta |
|------------------|-----------------|--------|----------------|------------------|-------|-------|
| 418.17 | 81.3 | 11614. | -- | V -- | | |
| 836.07 | 43.8 | 154.88 | -- | H -- | | |
| 1254.1 | 50.8 | 346.73 | -- | V -- | | |
| 1672.2 | 51.7 | 384.59 | -- | V -- | | |
| 2090.3 | 44.6 | 169.82 | -- | V -- | | |
| 2508.4 | 52.3 | 412.09 | -- | V -- | | |
| 2926.3 | 51.9 | 393.55 | -- | V -- | | |
| 3344.5 | 47.7 | 242.66 | -- | V -- | | |
| 3762.5 | 53.5 | 473.15 | -- | V -- | | |
| 4180.6 | 58.6 | 851.13 | -- | V -- | | |
| 4180.9 | 61 | 1122.0 | -- | V -- | | |

File B8355 Run 6

Appendix C

Plots of 20 dB Bandwidth

VENSTAR RS200TX/RS250TX 20dB BANDWIDTH
 REF 57.0 dBμV ATTN 20 dB

MKR Δ 347 KHZ
 -0.10 dB

hp

5 dB/

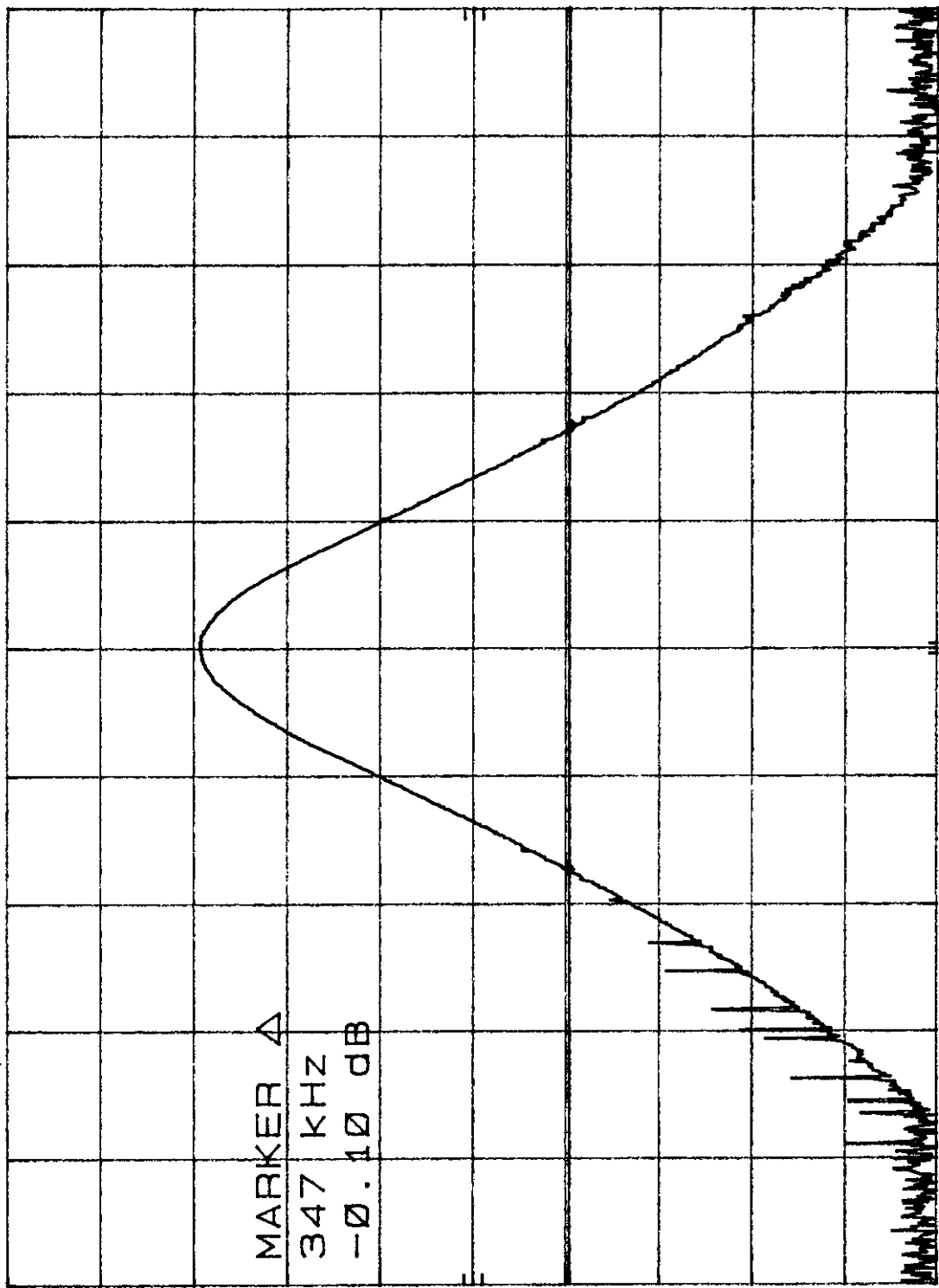
POS PK

OFFSET
 -30.0
 dB

MARKER Δ
 347 KHZ
 -0.10 dB

DL
 26.8
 dBμV

CORR'D



CENTER 418.03 MHz
 RES BW 100 KHZ
 OFS-31 KHZ
 VBW 100 KHZ

SPAN 1.00 MHz
 SWP 20.0 msec

Appendix D

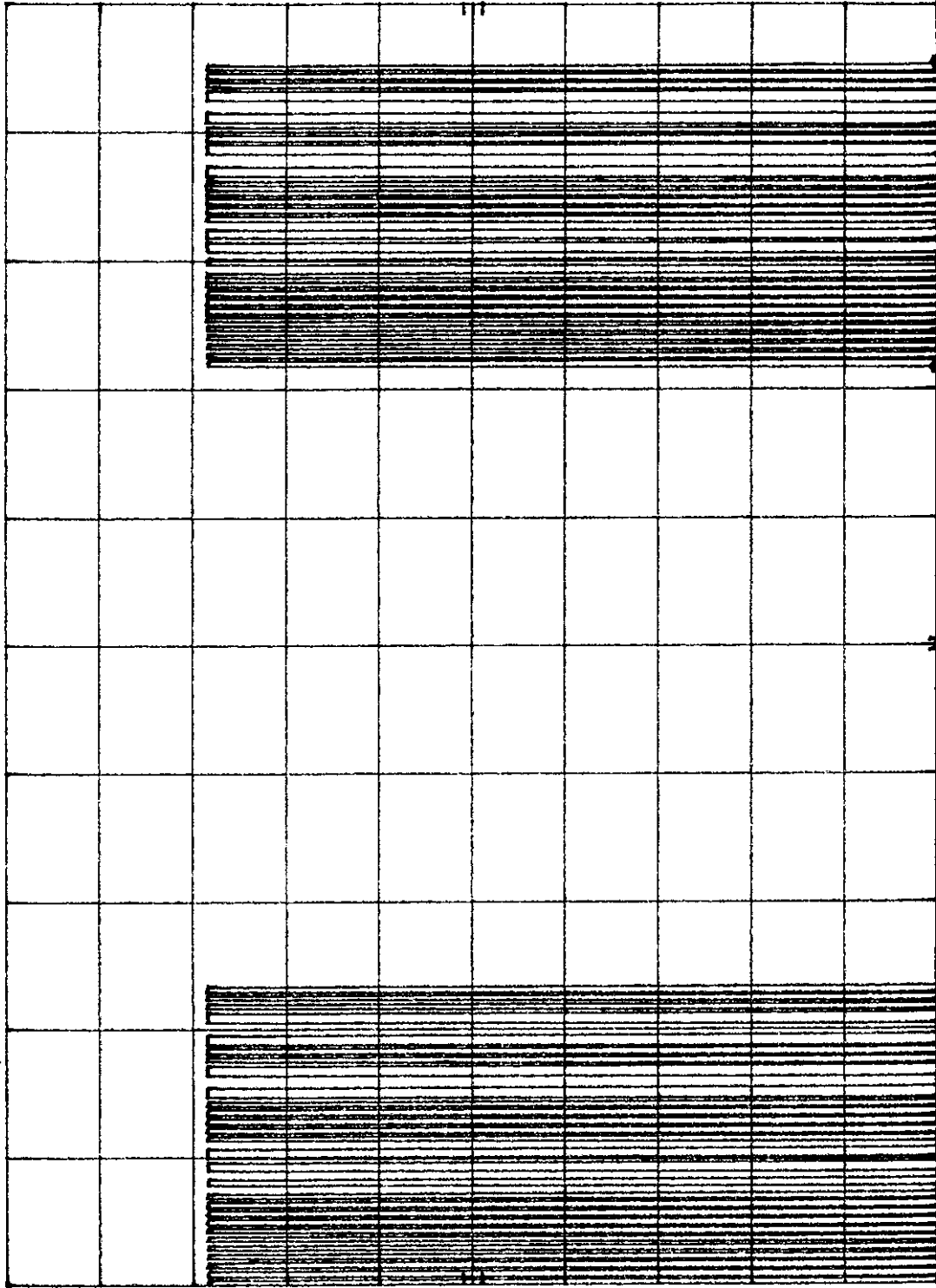
Plots of Calculated Duty Cycle

3.12 ms x 6 = 18.72 ms
 1.16 ms x 22 = 25.52 ms

Duty cycle $\approx \frac{44.2 \text{ ms}}{100 \text{ ms}}$ $10\log = -7 \text{ dB}$
 $= 20 \log 0.44$

FCC ID MUHRSTX
 REF 77.0 dBμV ATTN 0 dB
 MKR Δ 71.10 msec
 0.00 dB

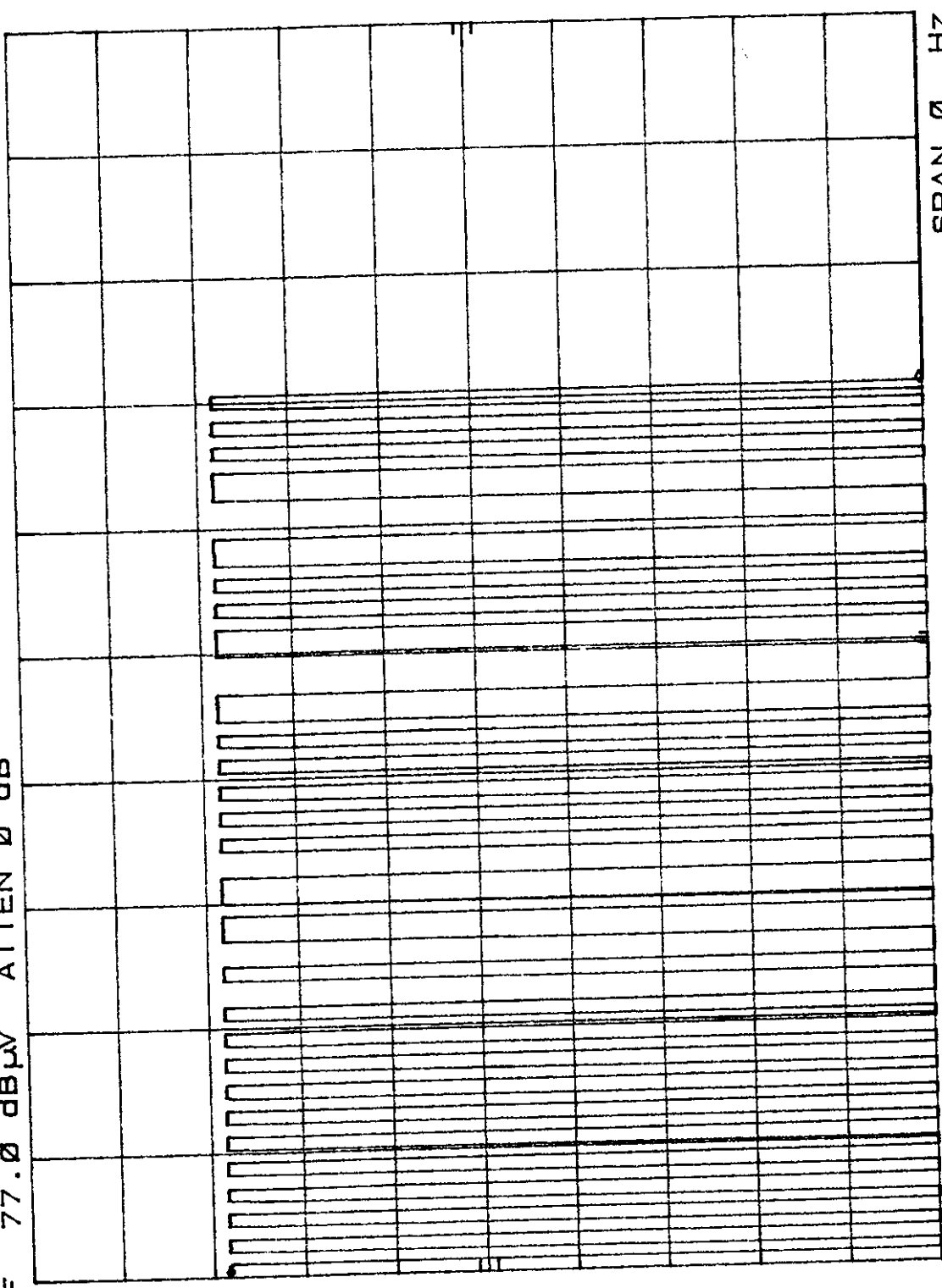
hp
 5 dB/



CENTER 417.994 289 MHz
 RES BW 100 KHZ
 VBW 100 KHZ
 SWP 300 msec
 SPAN 0 HZ

MKR Δ 70.80 msec
-39.15 dB

FCC ID MUHRSTX
REF 77.0 dB μ V
ATTEN 0 dB



SPAN 0 HZ
SWP 100 msec

VBW 30 KHZ

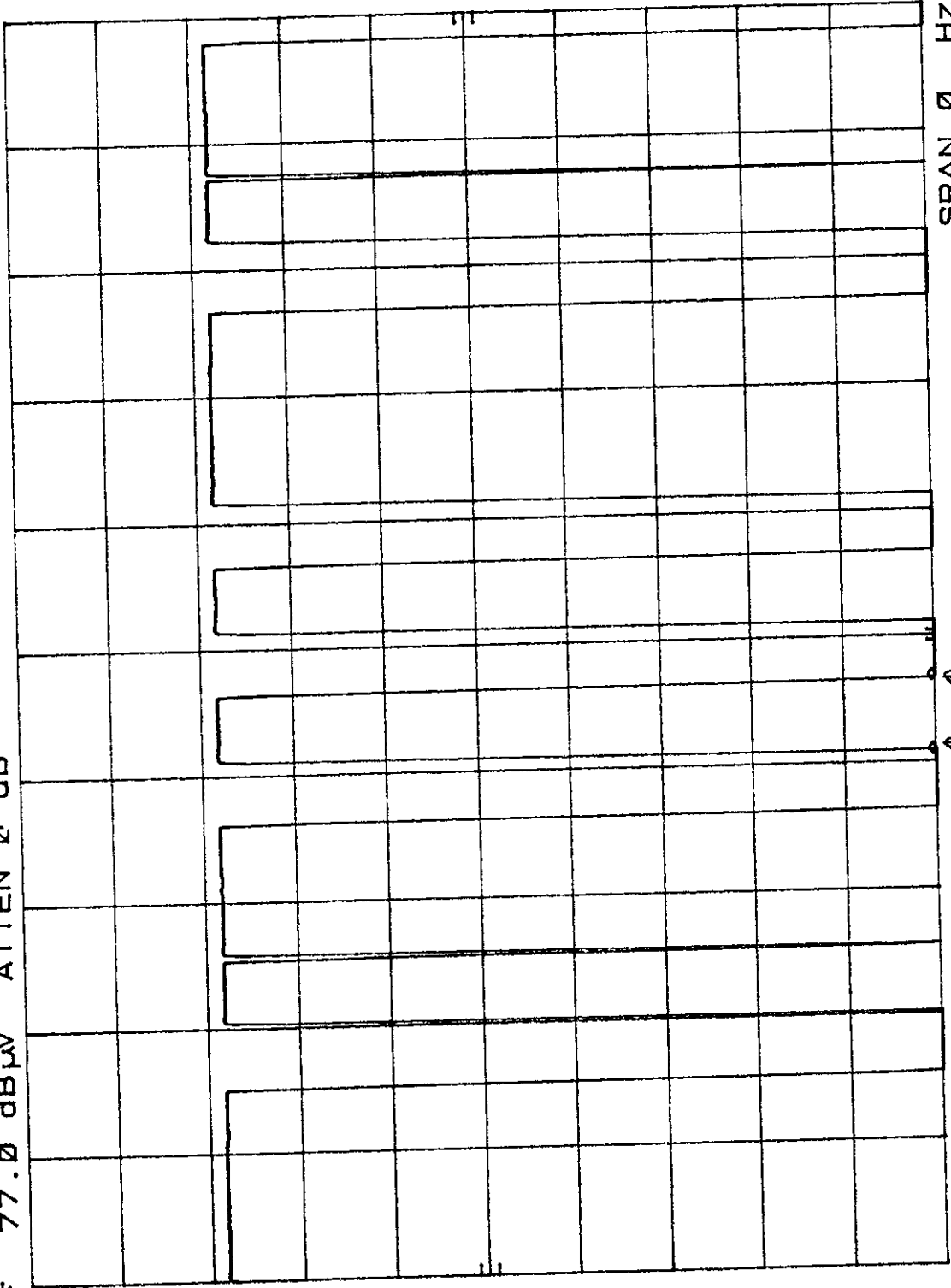
CENTER 417.994 289 MHZ
RES BW 100 KHZ

hp
5 dB/

MKR Δ 1.160 msec
0.00 dB

FCC ID MUHRSTX
REF 77.0 dB μ V
ATTEN 0 dB

hp
5 dB/

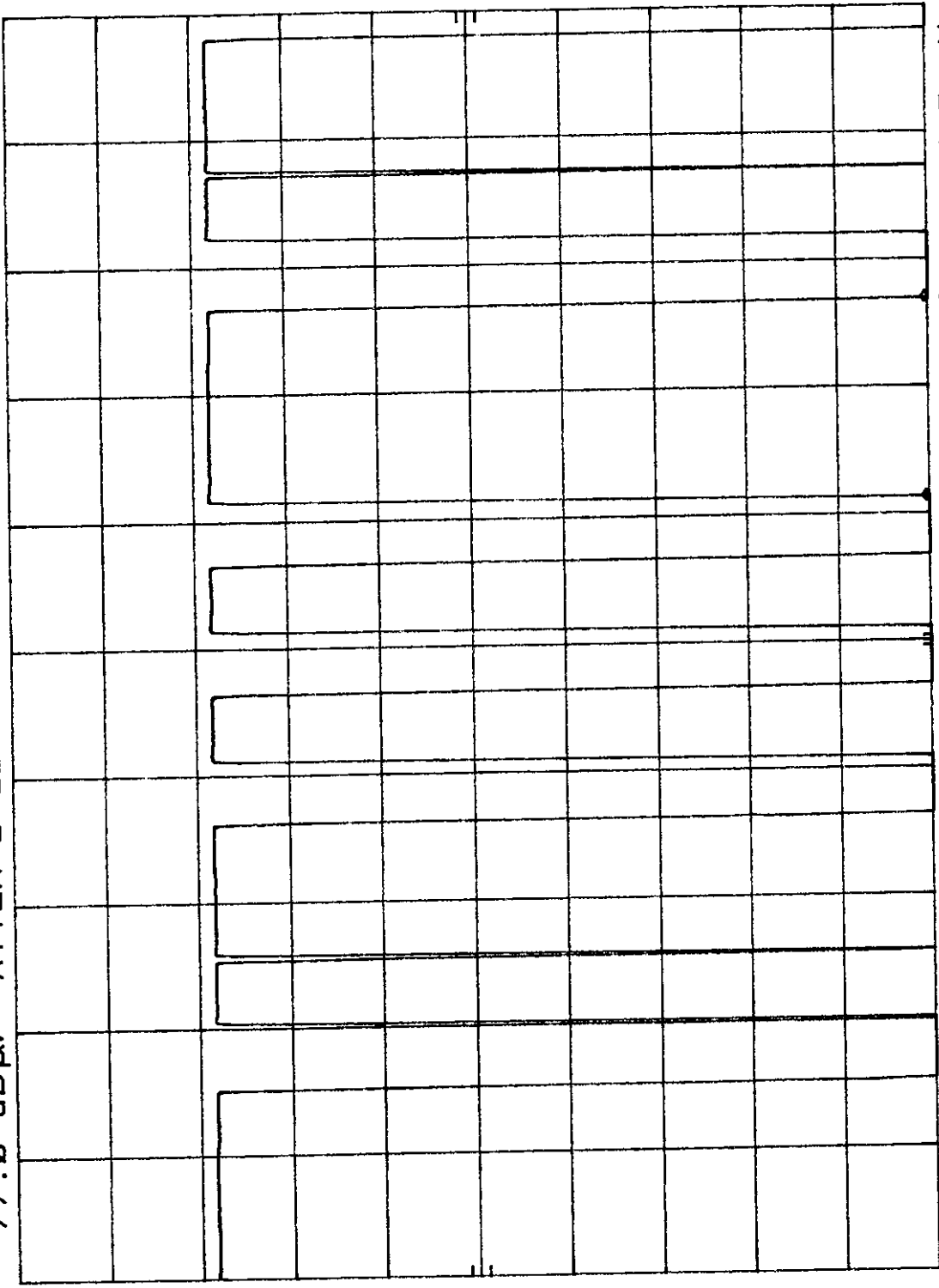


CENTER 417.994 289 MHz
RES BW 100 kHz
VBW 30 kHz
SWP 20.0 msec
SPAN 0 Hz

MKR Δ 3.120 msec
0.00 dB

FCC ID MUHRSTX
REF 77.0 dBμV
ATTEN 0 dB

hp
5 dB/



CENTER 417.994 289 MHZ
RES BW 100 KHZ
VBW 30 KHZ
SPAN 20.0 msec
↑
↑

Appendix E

Test Plan
and
Constructional Data Form

Test Plan for Electromagnetic Compatibility Testing



General Information (if you need assistance completing this form contact your TÜV Product Service representative.)

| | | | |
|-----------------|--------------------------------|-----------------------|--------------|
| Company: | Compliance & More | Quote Number: | |
| Contact: | Doug Barnes | Phone: (business hrs) | 303 751 4453 |
| E-mail Address: | Doug_barnes@comp userve.com | Phone: (after hrs) | 303 751 0370 |

Product Description

| | | | |
|---------------|------------------------|------------------------|------------------------------------|
| Brand Name: | Venstar RF Sensor | | |
| Model Number: | RS 200 RX RS 250 RX | RS 200 TX RS 250 TX | Serial Number: Test1 01 |

Test Objective

| | |
|-------------------------------------|---|
| <input type="checkbox"/> | EMC Directive 89/336/EEC (EMC Requirements) |
| <input type="checkbox"/> | Machinery Directive 89/392/EEC (EMC Requirements) |
| <input type="checkbox"/> | Medical Device Directive 93/42/EEC (EMC Requirements) |
| <input checked="" type="checkbox"/> | FCC Part 15 (list) <i>Declaration of conformity</i> |
| <input checked="" type="checkbox"/> | Other <u>Part 15</u> (list) <i>Certification</i> |

Attendance

| | | |
|---------------|--|---|
| Test will be, | <input checked="" type="checkbox"/> Attended by the customer | <input type="checkbox"/> Unattended by the customer |
|---------------|--|---|

Failure

If a failure occurs, TÜV Product Service should,

| | |
|-------------------------------------|---|
| <input checked="" type="checkbox"/> | Call contract list above, if not available then stop testing. |
| <input type="checkbox"/> | Continue testing to complete test series. |
| <input type="checkbox"/> | Continue testing to define corrective action. |
| <input type="checkbox"/> | Stop testing. |

Test Plan for Electromagnetic Compatibility Testing



| Authorization | |
|---|------------------------|
| <u>Douglas Barner</u> Customer authorization to perform tests according to this test plan. | <u>7-31-98</u> Date |
| <u>Doug Barner</u> Test Plan Prepared By (please print) | <u>7-31-98</u> Date |
| Reviewed by TÜV Product Service Associate | _____ Date |

Test Plan for Electromagnetic Compatibility Testing



Transportation

- Transportation between sites by customer.
 Other. (consult your TÜV Product Service representative)

Dimensions and Weight

Length 2 inches Width 1 inch
 Height 1 inch Weight 1/2 lb

Facilities

Power Requirements

- 230 VAC 50 Hz Single Phase _____ Amps
 400 VAC 50 Hz Three Phase _____ Amps per phase
 120 VAC 60 Hz Single Phase _____ Amps
 208 VAC 60 Hz Three Phase _____ Amps per phase
 _____ VDC _____ Amps
 Battery VDC Expected 10 hrs hours
 life _____
 Other _____

* Note: European power is typically 230 VAC 50 Hz or 400 VAC 50 Hz single and three phase respectively. FCC requires testing to be performed at typical US power ratings at 60 Hz.

Other

- Air _____ cfm _____ psi Water _____ gpm _____ psi
 (describe)
 Other _____

N/A.

Constructional Data Form (CDF)

- Attached

Test Plan Details

- Immunity**
 Applicable (attached) N/A
- Emissions**
 Applicable (attached) N/A

Test Plan for Electromagnetic Compatibility Testing



| | |
|---|--|
| <p>On Site</p> <p><input type="checkbox"/> Applicable (attached)</p> | <p><input checked="" type="checkbox"/> N/A</p> |
|---|--|

TUV Product Service
5541 Central Ave.
Boulder CO 80301
Telephone: (303) 786-7999

UEMC0901.DOC, Rev. Final Draft
Author: B. Dill
Revised: 20 March 1997

**FCC Emissions
Test Plan Details
(ATTACHMENT)**



| Standards to be Applied | | | |
|-------------------------------------|----------------|--------|-----------------------|
| <input type="checkbox"/> | CISPR 22 | | |
| <input type="checkbox"/> | Class A | | |
| <input type="checkbox"/> | Class B | | |
| <input checked="" type="checkbox"/> | FCC Part _____ | (list) | Class <u>B</u> (list) |
| <input type="checkbox"/> | Other _____ | (list) | _____ |

| Required Testing | |
|-------------------------------------|--|
| <input checked="" type="checkbox"/> | Test to minimum requirements |
| <input type="checkbox"/> | Other _____ (describe) |
| <input type="checkbox"/> | Test to margin _____ dB (list) of _____ |

| Description | Basic Document | Requirement |
|--------------------------------|----------------|---|
| Radiated & Conducted Emissions | ANSI 63.4 | Reference Basic Document or Applicable Standard |

| Engineering Justifications / Test Deviations |
|--|
| N/A. |

Constructional Data Form for Electromagnetic Compatibility Testing



Date: 7-31-98

When entering information you may add attachments to this form as necessary for additional documentation space. A completed form will ensure that your product testing goes well. If you need additional help contact you TÜV Product Service representative.

1. Enter company information pertaining to the location where the product is manufactured and for the manufacture's contact soliciting the testing.

| Applicant | |
|-----------|---|
| Company | <u>Compliance + More</u> |
| Address: | <u>14693 E. Wesley Ave</u> <u>Aurora, CO 80014</u> |
| Contact: | <u>Douglas Barnes</u> Position: <u>owner</u> |

1. Enter brand name, model number, serial number and FCC ID number, if applicable.
2. Describe the equipment and all product variants or options of the equipment. Provide enough detail to ensure a good understanding of the product.
3. Indicate which attachments you are providing with this document. It is recommended that you provide all listed.

| General Equipment Description | |
|-------------------------------|--|
| Brand Name: | <u>Venstar</u> <u>RF Sensor</u> |
| Model No.: | <u>RS 200 RX</u> <u>RS 250 TX</u> <u>RS 250 RX</u> <u>RS 200 RX</u> |
| Serial No.: | <u>01</u> 01 |
| FCC ID No.: | <u>MUH RS TX</u> |
| General description: | <u>Wireless RF Transmitter + Receiver</u> <u>418 MHz</u> |
| Product Variant/Options: | <u>Case enclosures supplied by user</u> |

TÜV Product Service
5541 Central Ave.
Boulder CO 80301

UEMC0902 doc, Rev. Final Draft
Author: B. Dill
Revised: 20 March 1997

1

FCC ID:

TÜV PRODUCT SERVICE INC

40 Meadow Road

Pinewood Springs, Lyons, CO 80540 Tel: 303 786 7999 Fax: 303 449 3004 Rev.No 1.0

File No. B241835502, Page E7 of E19


Constructional Data Form for Electromagnetic Compatibility Testing



Attachments: N/A

External Photographs Product Literature High Level Bill of Materials

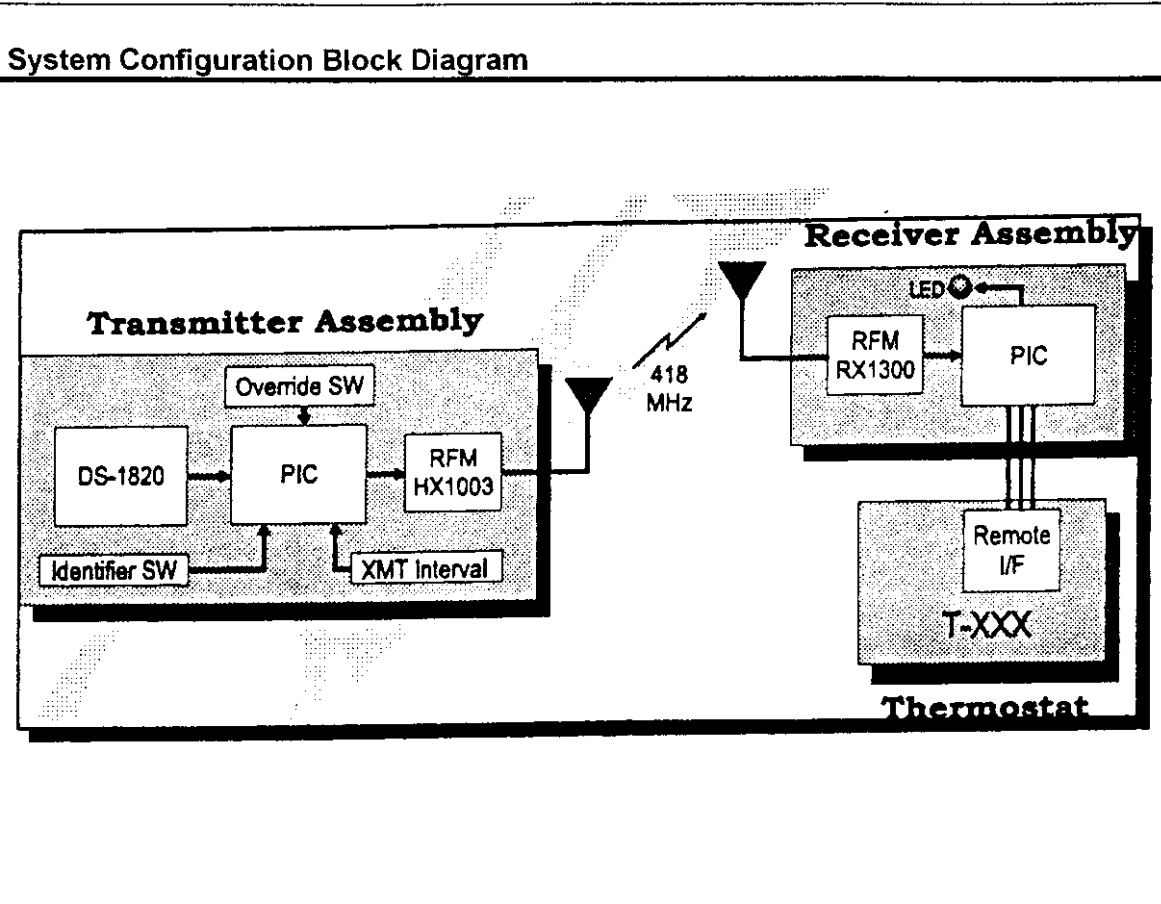
1. Date and Sign each page of the CDF. Original signatures must be present on each page.

Date: 7-3-98 Signature of Applicant: 

Constructional Data Form for Electromagnetic Compatibility Testing



1. Provide a line drawing showing and identifying the equipment under test, simulators, support equipment, I/O cables, power cables and any other pertinent components used during testing.
2. Use a dashed line to show equipment in the testing field versus equipment outside the testing field. Use an additional page if more space is required.



1. Date and Sign each page of the CDF. Original signatures must be present on each page.

Date: 2-31-98 **Signature of Applicant:** *D. B. [Signature]*

Constructional Data Form for Electromagnetic Compatibility Testing



1. Describe the intended installation. Include details such as power connection and system grounding approaches.
2. Describe the intended operating environment, include details such as humidity, cooling, heating and hazardous environments.
3. Indicate if you have attached a copy of an installation manual. It is recommended for proper documentation of your system.

Installation and Environmental Conditions (describe)

To be used as an accessory to a Venstar Digital Thermost T-71, T-250, T-260 as a remote temperature sensor.

Installation manual/instructions (attached)

1. Indicate your system power requirements for the equipment to be tested.

Power Requirements

Rated Voltage 120 VAC Rated Input Power 10 watt

1. Indicate your product's protection class. If you do not know, contact your TÜV Product Service representative.


Protection Class

Type: N/A Class: _____

1. Date and Sign each page of the CDF. Original signatures must be present on each page.

**Constructional Data Form
for Electromagnetic Compatibility Testing**



| | |
|--------------------------------|---|
| Date: <u>7-31-98</u> | Signature of Applicant: <u></u> |
|--------------------------------|---|

Constructional Data Form for Electromagnetic Compatibility Testing



1. Indicate all interface cables which can be attached to the equipment. All cables should be listed even if they are not sold as part of your system.
2. Give a description of the type of port (e.g., Parallel, Serial, SCSI), purpose and indicate if the I/O port is to be exercised during testing. This means active occurrence of data or signals.
3. Indicate the type of transmission and if the cable is a EUT assembly-to-assembly interconnection cable (this could be PC to printer, modem or such).
4. Indicate whether the cable is shielded or not. If so then provide information about the type of shield (e.g., Braid, Foil) and how the shield is terminated (e.g., 360 degree to conductive shell , pigtail) at both ends of the cable.
5. If a cable can have a typical length of ≥ 3.0 meters, then it is required to test with a cable of at least 3.0 meters.

| I/O Ports and Cables | |
|----------------------------------|--|
| Description: | <u>3 wire cable</u> |
| Purpose: | <u>connect Receiver to thermostat</u> |
| Exercised during testing? | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Transmission | <input checked="" type="checkbox"/> Analog <input checked="" type="checkbox"/> Digital |
| Assembly ↔ Assembly Interconnect | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Length of cable: | Maximum : <u>12 inches</u> Tested : _____ |
| Cable shielded: | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Shield Type (describe) | <u>no</u> |
| Termination: (describe) | <u>no</u> |


| I/O Ports and Cables | |
|----------------------------------|--|
| Descriptions: | _____ |
| Purpose: | _____ |
| Exercised during testing? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Transmission | <input type="checkbox"/> Analog <input type="checkbox"/> Digital |
| Assembly ↔ Assembly Interconnect | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Length of cable: | Maximum : _____ Tested : _____ |
| Cable shielded: | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Shield Type (describe) | _____ |
| Termination: (describe) | _____ |

Constructional Data Form for Electromagnetic Compatibility Testing



| I/O Ports and Cables | |
|---|--|
| Description: | _____ |
| Purpose: | _____ |
| Exercised during testing? | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Transmission Assembly ↔ Assembly Interconnect | <input type="checkbox"/> Analog <input type="checkbox"/> Digital <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Length of cable: | Maximum _____ Tested _____ |
| Cable shielded: | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Shield Type (describe) | _____ |
| Termination: (describe) | _____ |

1. Date and Sign each page of the CDF. Original signatures must be present on each page.

| | | | |
|-------|----------------|-------------------------|---|
| Date: | <u>7-31-98</u> | Signature of Applicant: | <u></u> |
|-------|----------------|-------------------------|---|

Constructional Data Form for Electromagnetic Compatibility Testing



1.0 Describe all possible EUT configurations. Provide enough detail to provide a technical understanding of all equipment configurations which may require testing. In some instances it is appropriate to require testing of more than one configuration.

EUT configurations: (list and describe)

1. Identify the operating modes to used during testing of the equipment. It is recommended the equipment be tested while operating in a typical operation mode. In some instances, this may not be practicable to do such. In this case consult your TÜV Product Service representative to determine the proper operating mode(s) to be tested.
2. For FCC testing of personal computers and/or peripherals it is required that a simple program generate a complete line of upper case H's, and that this pattern must be alternately sent to the parallel port device, the serial port device, and must write/read/verify to each disk drive. Monitors must display the H pattern, typically in white letters on a black background.
3. Provide a general description of all software, firmware, and PLD algorithms used in the equipment.
4. List all code modules as described above, with the revision level used during testing.

EUT Software and Operation Modes to be Tested

General Description: *None*
(describe)

Software Revision Level: *N/A*
(list and describe)

Operating modes to be tested: *N/A.*
(list and describe)

Operation manual/instructions (attached)

1. Date and Sign each page of the CDF. Original signatures must be present on each page.

Date:

7-31-98

Signature of Applicant:

[Handwritten Signature]

Constructional Data Form for Electromagnetic Compatibility Testing



1. Describe and list all system, subsystem, major subassemblies and all internal peripherals. This should include such things as an external monitor, parallel interface peripheral, serial interface peripheral and internal disk drives.
2. Indicate if technical drawings are attached. It is recommended that circuit diagrams, assembly and subassembly drawings be attached.

| System, Subsystem, Major Subassemblies or Internal Peripherals | | | |
|--|----------|----------|----------|
| Description | Model # | Serial # | FCC ID # |
| Slimline J-250 | Slimline | Test | N/A. |
| Thermostat. | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| <input type="checkbox"/> Technical Drawings attached | | | |

Describe and list all equipment or peripherals that will be connected to the EUT. For FCC testing a minimum configuration is required. If you have questions about this minimum configuration contact you TÜV Product Service representative.

| Interfacing Equipment and/or Simulators (which is not a part of the EUT) | | | |
|--|---------|----------|----------|
| Description | Model # | Serial # | FCC ID # |
| N/A. | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Constructional Data Form for Electromagnetic Compatibility Testing



1. Date and Sign each page of the CDF. Original signatures must be present on each page.

| | |
|--------------------------------|--|
| Date: <u>7-31-98</u> | Signature of Applicant: <u><i>J. Baran</i></u> |
|--------------------------------|--|

Constructional Data Form for Electromagnetic Compatibility Testing



1. List all frequencies and sub-harmonics which are equal or above 10kHz for such things as oscillators, horizontal line rate of monitors, and clock rates of incorporated OEM assemblies.
2. List all power supplies. Indicate switching frequencies.
3. Indicate the manufacture, model and locations on EUT of any power line filters.
4. Indicate all components used for high frequency noise reduction. (e.g., ceramic capacitor, 0.01 μ F, 1 ea. at C12 - C20).


| EMC System Details | | | | |
|--|---------------|-----------------|--------------------|-----------------------|
| Oscillator Frequencies | | | | |
| Frequency | Sub-harmonics | EUT Location | Description of Use | |
| 4.0 MHz | | | Crystal | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Power Supply | | | | |
| Frequency | Manufacturer | Model # | Serial # | Type (list frequency) |
| Ac Wall Transformer | Stancor | STA-418 | N/A | 60 Hz |
| Batteries | | | | |
| | | | | |
| Power Line Filters | | | | |
| Manufacturer | Model # | Qty | Location on EUT | |
| N/A. | | | | |
| | | | | |
| | | | | |
| Critical EMI Components (Capacitors, ferrites, etc.) | | | | |
| Description | Manufacturer | Part # or Value | Qty | Location on EUT |
| N/A. | | | | |

Constructional Data Form for Electromagnetic Compatibility Testing



| | | | | |
|--|--|--|--|--|
| | | | | |
|--|--|--|--|--|

1. Date and Sign each page of the CDF. Original signatures must be present on each page.

| | |
|--------------------------------|---|
| Date: <u>7-31-98</u> | Signature of Applicant: <u></u> |
|--------------------------------|---|

Constructional Data Form for Electromagnetic Compatibility Testing



1. Indicated any other measure taken to reduce high frequency noise, (e.g., grounding the circuit board on the right rear corner with 0.25" braid, 3 inches long to the chassis).

Other EMI Critical Construction Details

N/A.

1. Describe the principal materials of the enclosure (e.g., plastic, plastic with shielding material, metal, metal with specific shielding contact points, metal with paint on all surfaces).

Description of Enclosure

Plastic Box for Transmitter supplied by
User
heat shrink tubing on Receiver

1. Date and Sign each page of the CDF. Original signatures must be present on each page.

Date:

7-31-98

Signature of
Applicant:

D. Barne

Appendix F

Measurement of Protocol

MEASUREMENT PROTOCOL FOR FCC

GENERAL INFORMATION

Measurement Uncertainty

The test system for conducted emissions is defined as the LISN, tuned receiver or spectrum analyzer, and coaxial cable. The test system for radiated emissions is defined as the antenna, the pre-amplifier, the spectrum analyzer and the coaxial cable. These test systems have a measurement uncertainty of ± 4.5 dB. The equipment comprising the test systems are calibrated on an annual basis.

Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into its characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

CONDUCTED EMISSIONS

The final level, expressed in $\text{dB}\mu\text{V}$, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit.

To convert between $\text{dB}\mu\text{V}$ and μV , the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

RADIATED EMISSIONS

The final level, expressed in $\text{dB}\mu\text{V}/\text{m}$, is arrived at by taking the reading from the spectrum analyzer (Level $\text{dB}\mu\text{V}$) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has the FCC limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets in Attachment B. The amplifier gain is automatically accounted for by using an analyzer offset.

Example:

| Frequency (MHz) | Level ($\text{dB}\mu\text{V}$) | + | Factor & Cable (dB) | = | Final ($\text{dB}\mu\text{V}/\text{m}$) | - | FCC B Limit ($\text{dB}\mu\text{V}/\text{m}$) | = | Delta FCC B (dB) |
|--------------------|-------------------------------------|---|------------------------|---|--|---|---|---|------------------------|
| 32.21 | 13.9 | + | 16.3 | = | 30.2 | - | 40.0 | = | -9.8 |

DETAILS OF TEST PROCEDURES

General Standard Information

The test methods used comply with ANSI C63.4-1992 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

Conducted Emissions

Conducted emissions on the 60 Hz power interface of the EUT are measured in the frequency range of 450 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50 Ω /50 μ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. In some cases, a pre-scan using a spectrum analyzer is initially performed on the units comprising the system under test to locate the highest emissions. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver or spectrum analyzer with quasi-peak and average detection and recorded on the data sheets.

Radiated Emissions

Radiated emissions from the EUT are measured in the frequency range of 30 to 1000 MHz using a spectrum analyzer and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimeters above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna is positioned 3 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees. Intentional radiators are rotated through three orthogonal axes to determine the attitude that maximizes the emissions.