

File Number: NC4557
Project Number: 02ME04169
Model Number: M850
FCC ID: EP9TMXM850

Issued: 2/4/2002

Underwriters Laboratories Inc.
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**Report of Measurements
of Electromagnetic Compatibility Testing**

Test Report File No.	:	NC4557	Date of issue: 2/4/2002
Applicant	:	Timex Corporation	
Model#’s.	:	M850	
Product Type	:	GPS Speed and Distance System	
Power Supply	:	4.5 VDC (Battery)	
Manufacturer	:	Same As Applicant	
License holder	:	Same As Applicant	
Address	:	P.O Box 310	
	:	Middlebury, CT 06762	
Test Type	:	☒ Compliance Investigation ☐ Manufacturer’s Specification	
Test Project Number	:	02ME04169	
References(s)	:	FCC ID: EP9TMXM850	

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1.0 G E N E R A L - Product Description

The GPS speed and distance system is composed of two units a transceiver (M850) and a receiver (M849) watch.

The EUT (Equipment under Test) was configured in a typical user configuration. The Timex M850 is a 139.5 kHz radio transmitter, which utilizes a Mark frequency of 137.5KHz and a Space frequency of 141.03KHz in conjunction with the receiver located inside a wristwatch (M849). The receiver receives the transmitted radio signals, decodes it and displays the information on the LCD screen of the watch. The system uses an FSK (frequency shift keying) based simplex data communication scheme. The data rate does not exceed 1024 baud. The system is designed to function up to a maximum distance of 1 meter between transmitter and receiver.

The Transmit antenna is permanently attached to the M850 Transceiver.

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1.1 Device Configuration During Test

Device	Manufacturer	Model Number	Serial Number	FCC ID
Transceiver	Timex	M850	006	EP9TMXM850
Receiver	Timex	M849	CR 2025	----- -

Note: The EUT orientation was tested in a vertical axis, which was deemed worst case emissions.

"The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report"

1.2 Deviations from ANSI C63.4

☒ Not Applicable

☐ As described below:

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1.3 Device Modifications Necessary for Compliance

☒ N/A

☐ As described below:

1.4 Test Summary

Test	Basic Standard	Considered	Tested	In Compliance
Conducted Voltage Emissions	FCC Subpart C Class B	Yes	Not applicable EUT operates on batteries	Yes
Radiated Emissions	FCC Subpart C Class B	Yes	Yes	Yes

Environmental conditions in the lab:

Temperature:	<u>Range</u> 20-25°C
Relative Humidity	30 - 60 %
Atmospheric pressure	680 - 1060 mbar

2.0 EMISSIONS TEST REGULATIONS

FCC Part 15, Subpart B (15.109).
FCC Part 15, Subpart C; (15.209).
The Mark Frequency 137.5KHz
The Space Frequency 141.03KHz

2.1 EUT OPERATION MODE - EMISSIONS TESTS

- ☐ Standby
- ☐ Test program (H-Pattern)
- ☐ Test program (color bar)
- ☐ Test program (customer specific)
- ☐ Practice operation
- ☒ Normal operation Mode:
☒ As per manufacturer's instructions: The receiver receives the transmitted radio signals, decodes it and displays the information on the LCD screen of the watch. The system uses an FSK (frequency shift keying) based simplex data communication scheme. The data rate does not exceed 1024 baud. The system is designed to function up to a maximum distance of 1 meter between transmitter and receiver.

2.1.1 Conducted Emissions Tests

☐ Test Applicable ☒ Test Not Applicable

The GPS Transceiver operates on three 1.5 volt dc batteries.

2.1.2 Radiated Emissions Test (10 Meter Semi-Anechoic Chamber)

☒ Test Applicable ☐ Test Not Applicable

Measurement distance: ☒ 3 ☐ 10 meters

Frequency Range: ☐ 50Hz – 10kHz ☐ Magnetic
Measurement Distance for 50Hz – 10kHz
☐ 10cm (Rack mount Equipment)
☐ 1m (Equipment not intended to be rackmounted.)
☒ 90kHz - 30MHz ☐ Magnetic ☒ Electric
☒ 30MHz - 1000MHz ☒ Electric
☐ 1GHz - 2GHzv ☐ Electric
☐ 1GHz - 5GHz ☐ Electric
☒ 1GHz - 7.5GHz ☒ Electric
☐ 1GHz - 10GHz ☐ Electric

90kHz – 30MHz a Magnetic Loop Antenna was utilized. The measurement antennas distance 3 meters from the EUT. The limit was adjusted using the 40dB/decade-limit extrapolation method.

30MHz – 1000MHz the measurement antennas distance 3 meters from the EUT.

Tests were performed on the transmitter in accordance with the limitation set forth by CFR47 FCC Part 15 Subpart C Paragraph 15.209 and tested in accordance with the test procedures and methodologies in ANSI C63.4: 2001.

The EUT was checked throughout the frequency band 90kHz to 1000MHz. The transmitter operated at 139.5 kHz. The allowable field strength limits in accordance with 15.209 were applied to the fundamental frequency. All other emissions were tested in accordance with the general limitations 15.209.

All frequencies were evaluated and the plots enclosed show worst case emissions. In addition, the limits shown are incorrect. However, the emissions levels from the EUT (equipment under test) are well under the actual limit levels per section 15.209.

Test equipment used for final radiated emissions tests:

☒ HP 8574A	Hewlett-Packard	EMI Receiver,	Equipment No.: ME5A-461
Range: 90KHz – 1000MHz	Last Calibration Date: 25 Jan 02	Calibration Due Date: 25Jan 03	
Consisting of:	HP - 8566B	Hewlett-Packard	Spectrum Analyzer,
		Resolution BW: 9KHz:	150KHz—30MHz
		120KHz	30MHz—1000MHz
		Video BW: 3KHz	9KHz to 150KHz
			150KHz to 30MHz
		300KHz	30 – 1000MHz
		QPBW: 200 Hz	9 to 150KHz
		9KHz	150KHz to 30MHz

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		120KHz	30 to-1000MHz
	HP - 85662A	Hewlett-Packard	Analyzer Display
	HP - 85650A	Hewlett-Packard	Quasi-Peak Adapter,
		BW: 120kHz	
	HP - 85685A	Hewlett-Packard	Preselector
☐	R3261C	Advantest	Equipment No.: ME5A-229
		Spectrum Analyzer	
		Resolution BW: 1MHz	
		Video BW: 1MHz	
		QP BW: 120KHz	

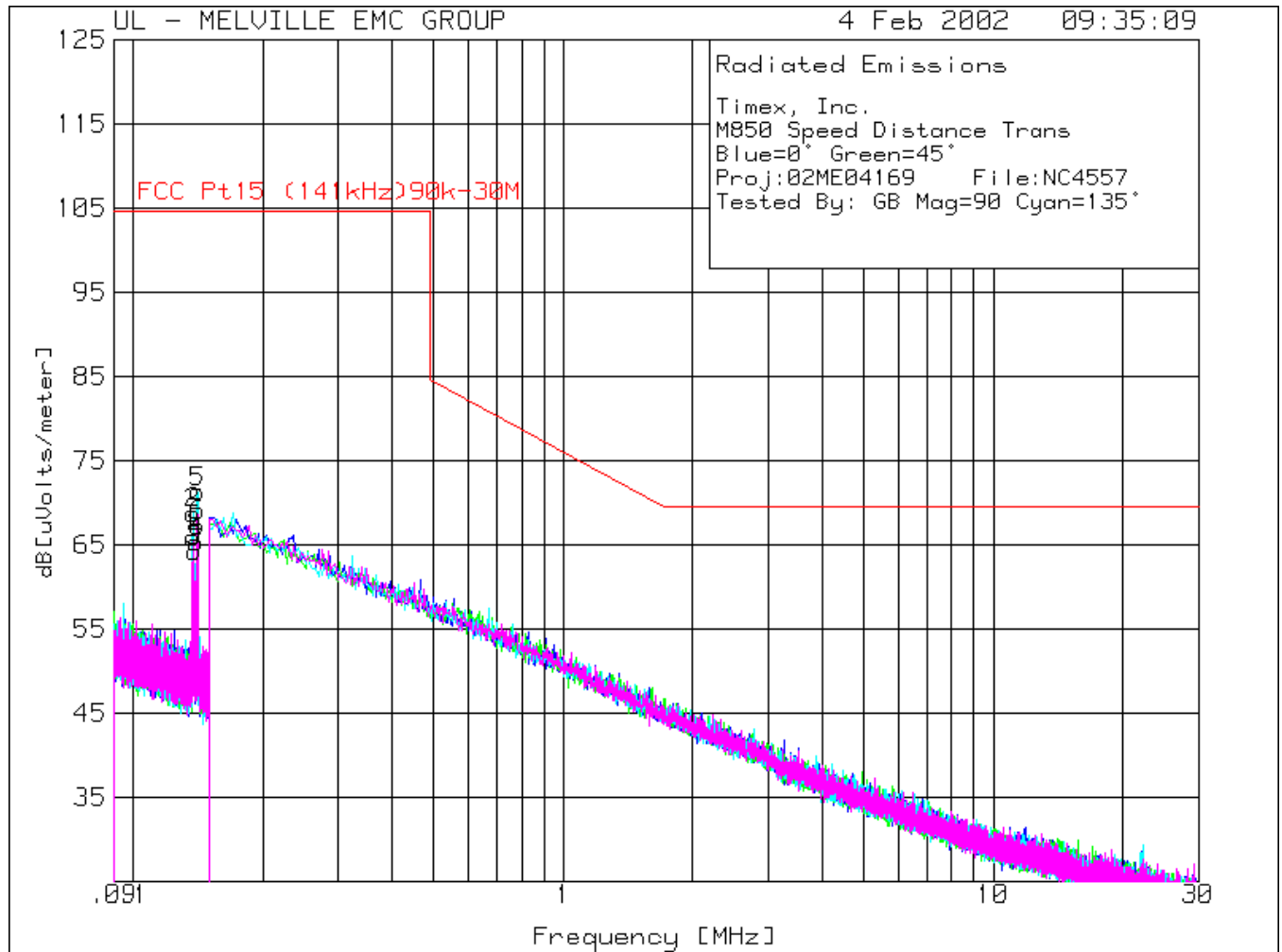
Range: _____ Last Calibration Date: _____ Calibration Due Date: _____
☐ R3551 Advantest Pre-Selector Equipment No.: ME5A-228
Range: _____ Last Calibration Date: _____ Calibration Due Date: _____

For Measurements above 1GHz:

☒	HP - 8566B	Hewlett-Packard	Spectrum Analyzer,	Equipment No.: ME5A-461
		Resolution BW: 1MHz		
		Video BW: 1MHz		
		Range: 1-7.5GHz	Last Calibration Date: 25 Jan 02	Calibration Due Date: 25 Jan 03
☒	HP - 85662A	Hewlett-Packard	Analyzer Display	Equipment No. ME5A-461
		Last Calibration Date: 25 Jan 02	Calibration Due Date: 25 Jan 03	

Test Accessories for Radiated Emissions:

☒	3104C	EMCO	Biconnical Antenna	Equipment No.: ME5-810
		Last Calibration Date: 16 March 01	Calibration Due Date: 16 March 02	
☐	94455-1	Ailtech	Biconnical Antenna	Equipment No.: ME5-439
		Last Calibration Date: _____	Calibration Due Date: _____	
☐	3146	EMCO	Log Periodic Antenna	Equipment No.: ME5-451
		Last Calibration Date: _____	Calibration Due Date: _____	
☒	3146	EMCO	Log Periodic Antenna	Equipment No.: ME5-811
		Last Calibration Date: 07 March 01	Calibration Due Date: 07 March 02	
☐	3142	EMCO	BiconiLog Antenna	Equipment No.: ME5A-131
		Last Calibration Date: _____	Calibration Due Date: _____	
☐	3142	EMCO	BiconiLog Antenna	Equipment No.: ME5A-261
		Last Calibration Date: _____	Calibration Due Date: _____	
☒	RGA-180	EMCO	Horn Antenna	Equipment No.: ME5-565
		Last Calibration Date: 14 May 01	Calibration Due Date: 14 May 02	
☐	3115	EMCO	Horn Antenna	Equipment No.: ME5A-766
		Last Calibration Date: _____	Calibration Due Date: _____	
☒	8449B	Hewlett Packard	1-26GHz Pre-Amp	Equipment No.: ME5-914
☒	8447D	Hewlett Packard	10k-1.3GHz Pre-Amp	Equipment No.: ME5A-652
☐	7604	EMCO	Loop Antenna	Equipment No.: ME5A-151
		Last Calibration Date: _____	Calibration Due Date: _____	
☒	6507	EMCO	Active Loop Antenna	Equipment No.: ME5A-288
		Last Calibration Date: 1 Feb 01	Calibration Due Date: 28 Feb 02	
☐	EM-6871	EMCO	Loop Antenna	Equipment No.: ME5A-612
		Last Calibration Date: _____	Calibration Due Date: _____	
☐	3301B	EMCO	Active Monopole Antenna	Equipment No.: ME5A-055
		Last Calibration Date: _____	Calibration Due Date: _____	



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Timex, Inc.
 M850 GPS Speed Distance Trans
 Blue=0° Green=45°
 Proj:02ME04169 File:NC4557
 Tested By: GB Mag=90 Cyan=135°

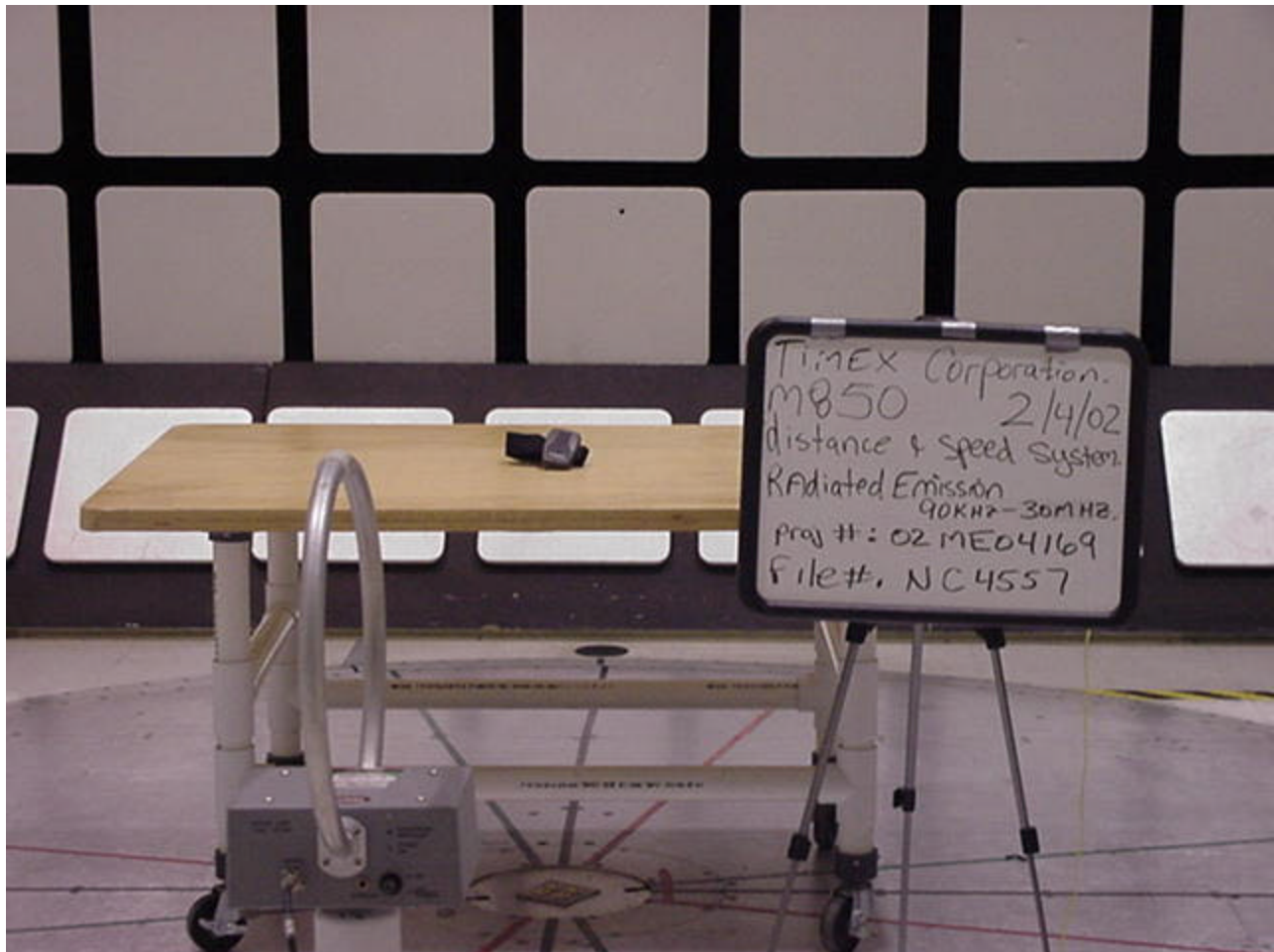
Test No.	Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level Limit:1 dB[uVolts/meter]	2	3	4
1	.13725	49.7 pk	.1	16.1	65.9	104.6	N/A	N/A
Azimuth: 0		Height:148	Horz	Margin	[dB]	-38.7	N/A	N/A
2	.13775	52.6 pk	.1	16.1	68.8	104.6	N/A	N/A
Azimuth: 0		Height:148	Horz	Margin	[dB]	-35.8	N/A	N/A
3	.13826	48.1 pk	.1	16.1	64.3	104.6	N/A	N/A
Azimuth: 0		Height:148	Horz	Margin	[dB]	-40.3	N/A	N/A
4	.1403	49.1 pk	.1	16.1	65.3	104.6	N/A	N/A
Azimuth: 0		Height:148	Horz	Margin	[dB]	-39.3	N/A	N/A
5	.14082	55.1 pk	.1	16.1	71.3	104.6	N/A	N/A
Azimuth: 0		Height:148	Horz	Margin	[dB]	-33.3	N/A	N/A
6	.14136	51.1 pk	.1	16.1	67.3	104.6	N/A	N/A
Azimuth: 0		Height:148	Horz	Margin	[dB]	-37.3	N/A	N/A

LIMIT 1: FCC Pt15 (141kHz)90k-30M
 LIMIT 2: NONE
 LIMIT 3: NONE
 LIMIT 4: NONE

pk - Peak detector
 qp - Quasi-Peak detector
 av - Average detector
 tm - Trace Math Result

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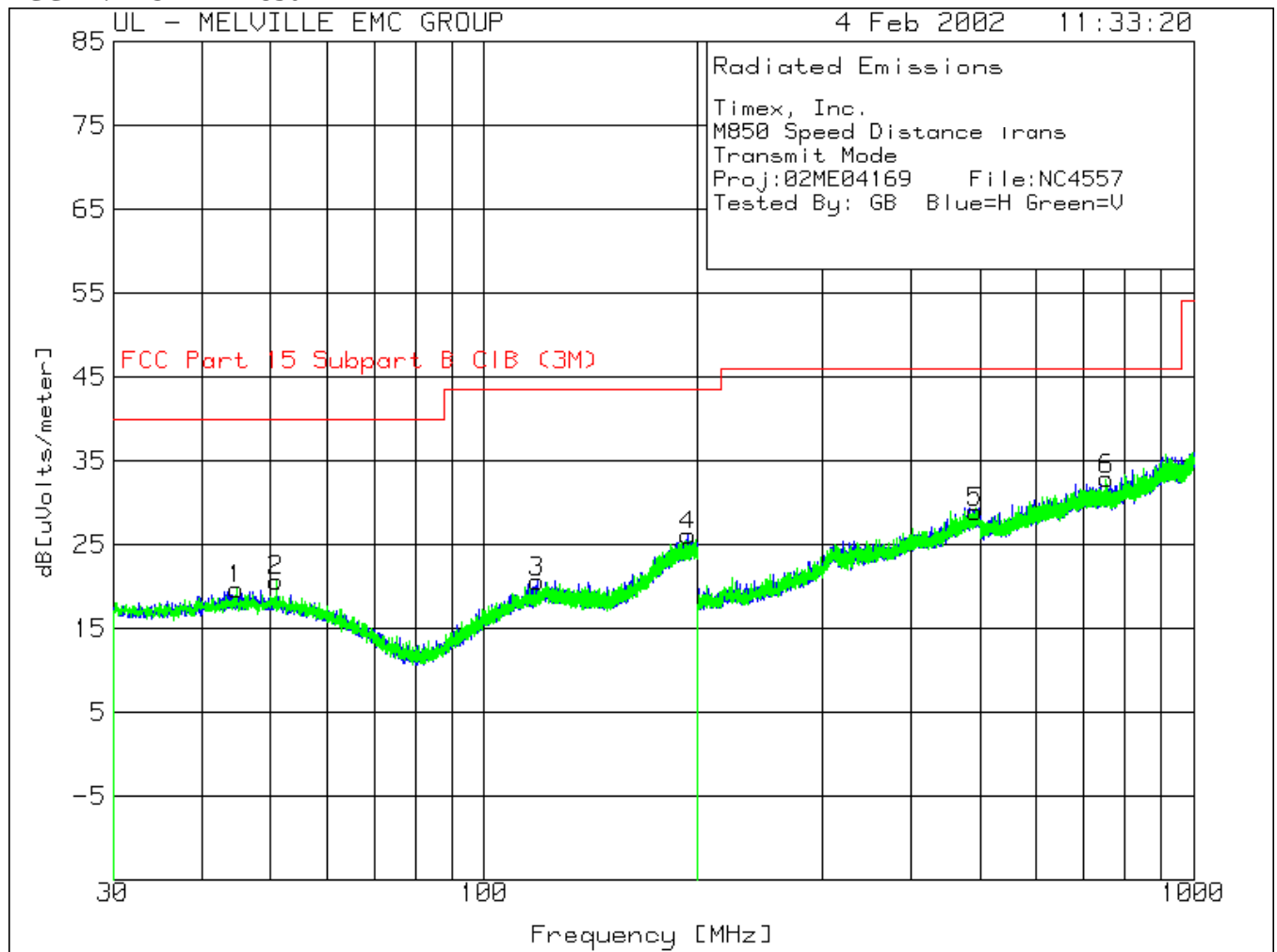
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Radiated Emissions 90 kHz to 30 MHz

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File Number: NC4557
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 Model Number: M850
 FCC ID: EP9TMXM850

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Timex, Inc.
 M850 Speed Distance Trans
 Transmit Mode
 Proj:02ME04169 File:NC4557
 Tested By: GB Blue=H Green=V

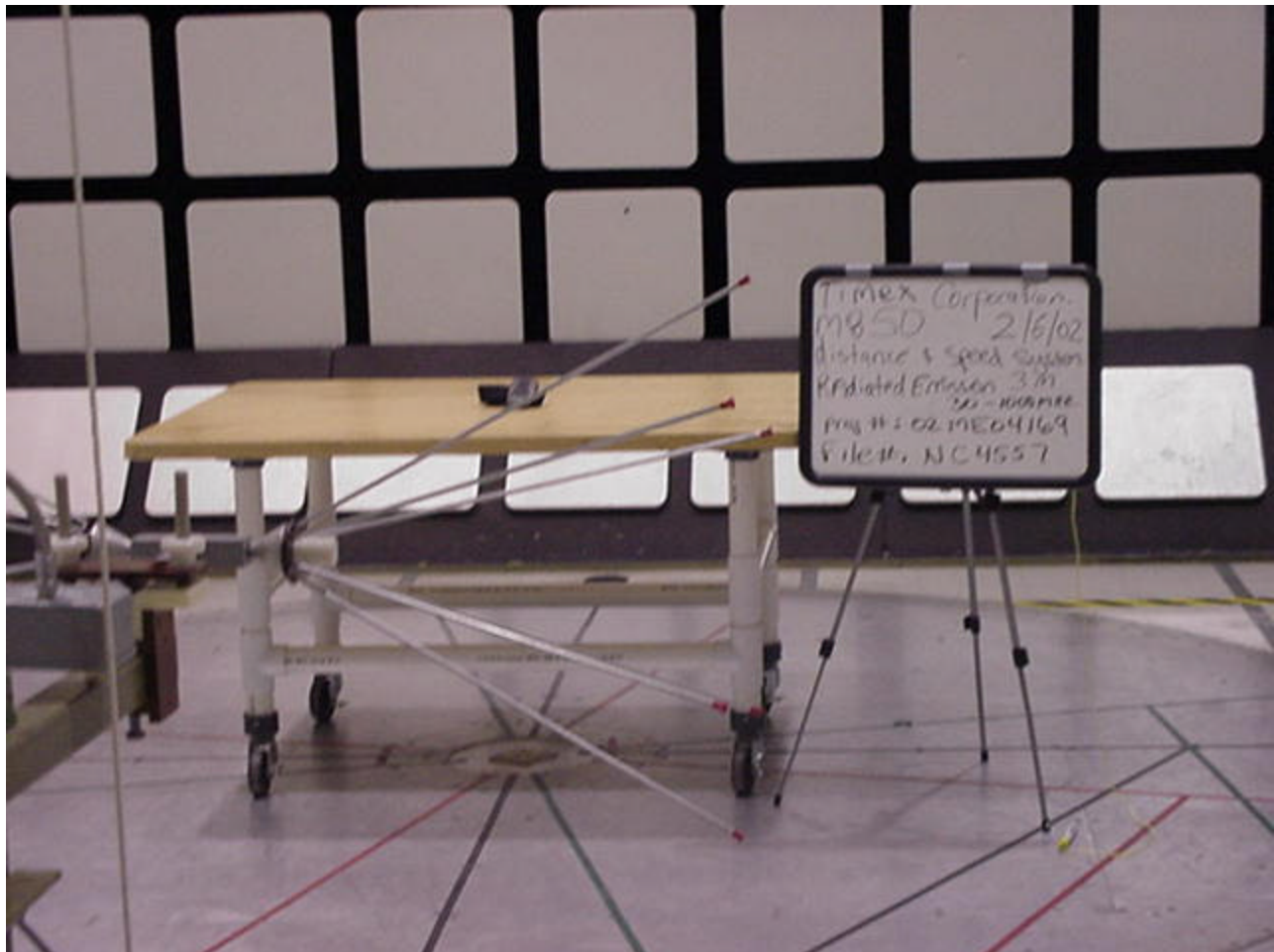
Test No.	Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4
1	44.694	5.8 pk	1	12.9	19.7	40	N/A	N/A	N/A
Azimuth: 107		Height:200	Vert	Margin	[dB]	-20.3	N/A	N/A	N/A
2	50.8943	7 pk	1	12.7	20.7	40	N/A	N/A	N/A
Azimuth: 0		Height:400	Vert	Margin	[dB]	-19.3	N/A	N/A	N/A
3	118.716	6.1 pk	1.5	13	20.6	43.5	N/A	N/A	N/A
Azimuth: 345		Height:100	Horz	Margin	[dB]	-22.9	N/A	N/A	N/A
4	193.7572	6.2 pk	2	17.9	26.1	43.5	N/A	N/A	N/A
Azimuth: 337		Height:201	Horz	Margin	[dB]	-17.4	N/A	N/A	N/A
5	492.423	7.2 pk	3.5	18.2	28.9	46	N/A	N/A	N/A
Azimuth: 0		Height:400	Horz	Margin	[dB]	-17.1	N/A	N/A	N/A
6	752.7394	7.3 pk	4	21.5	32.8	46	N/A	N/A	N/A
Azimuth: 238		Height:200	Vert	Margin	[dB]	-13.2	N/A	N/A	N/A

LIMIT 1: FCC Part 15 Subpart B ClB (3M)
 LIMIT 2: NONE
 LIMIT 3: NONE
 LIMIT 4: NONE

pk - Peak detector
 qp - Quasi-Peak detector
 av - Average detector
 tm - Trace Math Result

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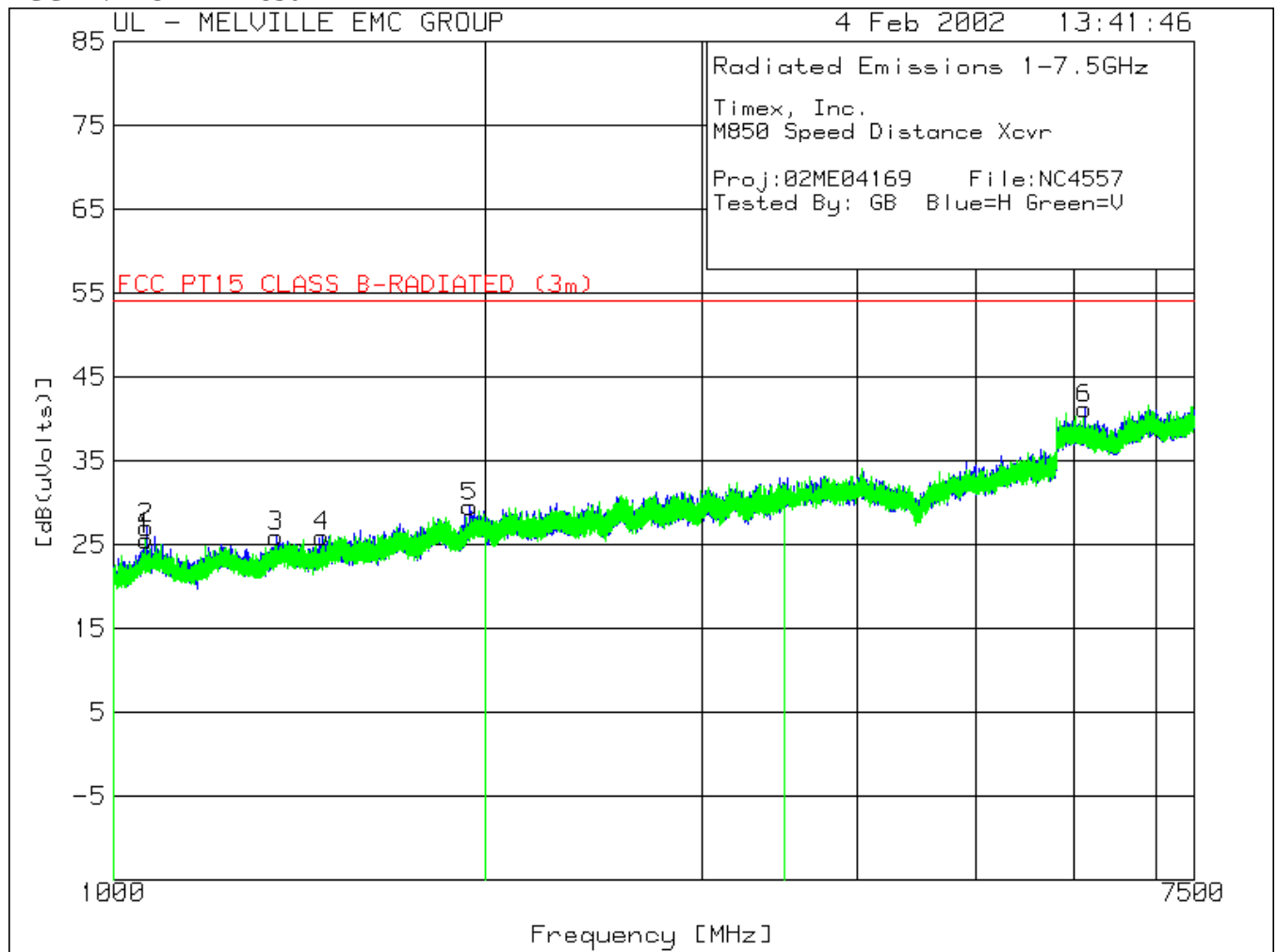
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Radiated Emission 30MHz to 1000MHz

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File Number: NC4557
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 Model Number: M850
 FCC ID: EP9TMXM850

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Timex, Inc.
 M850 Speed Distance Xcvr
 Rcv Mode
 Proj:02ME04169 File:NC4557
 Tested By: GB Blue=H Green=V

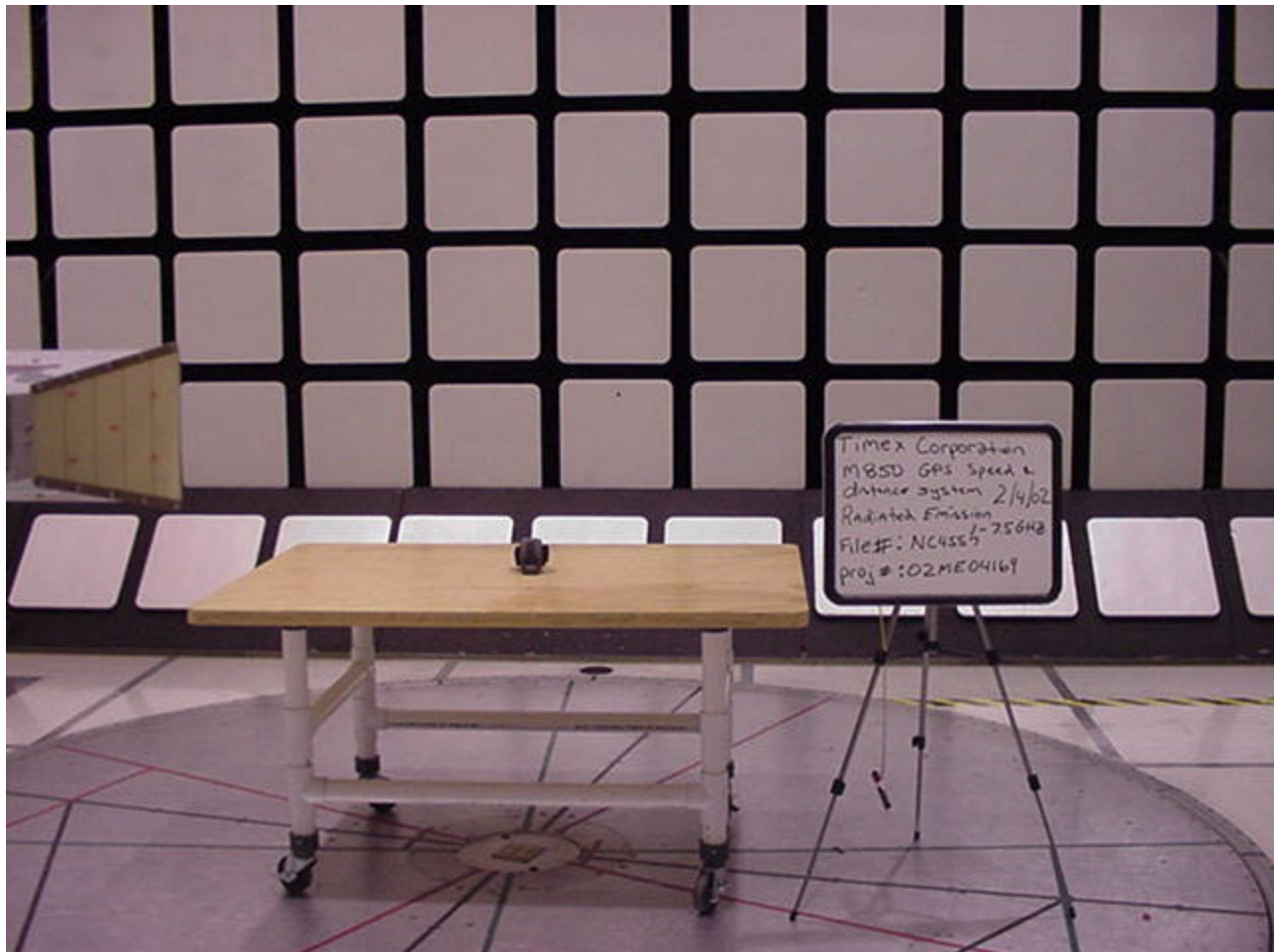
Test No.	Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	2	3	4
1	1062.281	33.7 pk	-33.5	25.4	25.6	54	N/A	N/A	N/A
Azimuth: 319		Height:98	Vert	Margin	[dB]	-28.4	N/A	N/A	N/A
2	1063.614	35.1 pk	-33.5	25.4	27	54	N/A	N/A	N/A
Azimuth: 300		Height:98	Horz	Margin	[dB]	-27	N/A	N/A	N/A
3	1354.871	32.3 pk	-32.7	26.4	26	54	N/A	N/A	N/A
Azimuth: 0		Height:199	Horz	Margin	[dB]	-28	N/A	N/A	N/A
4	1474.771	31.6 pk	-32.4	26.8	26	54	N/A	N/A	N/A
Azimuth: 27		Height:98	Horz	Margin	[dB]	-28	N/A	N/A	N/A
5	1943.88	31.5 pk	-30.9	28.9	29.5	54	N/A	N/A	N/A
Azimuth: 310		Height:98	Horz	Margin	[dB]	-24.5	N/A	N/A	N/A
6	6119.208	29 pk	-24.6	36.8	41.2	54	N/A	N/A	N/A
Azimuth: 0		Height:199	Horz	Margin	[dB]	-12.8	N/A	N/A	N/A

LIMIT 1: FCC PT15 CLASS B-RADIATED (3m)
 LIMIT 2: NONE
 LIMIT 3: NONE
 LIMIT 4: NONE

pk - Peak detector
 qp - Quasi-Peak detector
 av - Average detector
 tm - Trace Math Result

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Radiated Emission 1 to 7.5GHz

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Issued: 2/4/2002

Sample Calculation:

Radiated Emission Limit Conversion from dBuV/m
(Limits in accordance with paragraph 15.109)

Radiated Emissions Limit (dBuV/m) = $20 \times \log(\mu\text{V/m})$

Radiated Emissions Limit (dBuV/m) = $20 \times \log(90)$

Radiated Emissions Limit (dBuV/m) = 39.0

Radiated Emissions test data obtained during measurements.

Field strength (dBuV / m) = Measured field strength (dBuV) + Antenna factor (dB) + cable factor (dB).

Field strength (dBuV / m) = 51.1 dBuV/m + 15.8 dB + 0.3 dB.

Field strength (dBuV / m) = 71.3

Radiated Emissions Limit conversion from uV/m to dBuV/m add 40 dB / Decade.
(Limits in accordance with paragraph 15.209).

Radiated Emissions Limits General Requirements.

Frequency between 0.009-0.490 MHz,

$2400/F$ (kHz) at 300 meters = Field strength in uV/meter.

Fundamental Frequency = 139.5KHz.

$2400/(139.5)$ at 300 meters

Radiated Emission at 139.5 kHz at 300 meters = 17.2uV/meter.

dBuV/m $20 \times \log(17.2\mu\text{V/m})$.

dBuV/M = 24.7 at 300 meters.

Add 40 dB /decade

300meters to 3 meters = 80 dB.

Radiated Emission Limit = dBuV/M + dB.

$24.7 + 80$

104.7dBuV/M

Magnetic field conversion of the active loop antenna:

The magnetic field reading was converted to an electrical field reading by adding the electric field factors (dB) to the field strength reading. The electric antenna factors are established at the time of the antenna calibration.

Antenna factor (dB) + constant = Field strength dBuV/m

At 100 kHz $16.4 + 51.5 = 67.9$.

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3.0 SUMMARY:

The equipment under test has

☒ met the technical requirements as defined under section(s) ☒ 2.0 and ☐ 3.0

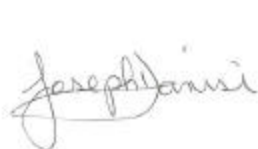
☐ not met the technical requirements as defined under section(s) ☐ 2.0 and ☐ 3.0

Test Start Date: 2/4/02

Test Completion Date: 2/7/02

- UNDERWRITERS LABORATORIES, INC. -

Project Engineer



Joseph Danisi (Ext.23055)
Senior Engineering Associate
International EMC Services
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Reviewer



Bob DeLisi (Ext.22452)
Engineering Group Leader
International EMC Services
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