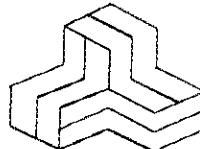


ENGINEERING TEST REPORT



ESL Module
MODEL NO.: 5410, 5420, 9410, 9420

In Accordance With

FCC PART 15, SUBPART C, PARA. 15.209
LOW POWER COMMUNICATION DEVICE TRANSMITTER
OPERATING AT 131.072 kHz

UltraTech FILE NO.: TPL5-FTX

Tested for:

TELEPANEL SYSTEMS INC.
245 Riviera Drive
Markham, Ontario
Canada, L3R 5J9

Tested by:

ULTRATECH GROUP OF LABS
3000 Bristol Circle
Oakville, Ontario
Canada L6H 6G4

REPORT PREPARED BY: Dan Huynh

DATE: July 6, 1999

UltraTech

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4

Telephone (905) 829-1570 Facsimile (905) 829-8050

Website: www.ultratech-labs.com Email: vhk.ultratech@sympatico.ca

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ULTRATECH GROUP OF LABS

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1. EXHIBIT 1 - SUMMARY OF TEST RESULTS & GENERAL STATEMENT OF CERTIFICATION

FCC PARAGRAPH.	TEST REQUIREMENTS	COMPLIANCE (YES/NO)
**	Spectrum Bandwidth of a Low Power Communication Device Transmitter	Yes
15.209	Transmitter Radiated Emissions	Yes
15.107, 15.109	AC Power Conducted Emissions & Radiated Emissions for Receiver and Digital Circuit Portions	Not applicable for battery operated devices

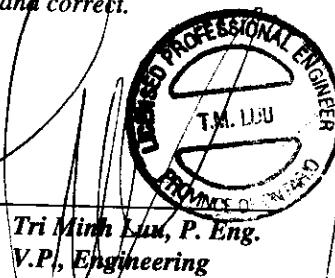
Note 1: The digital portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class A Digital Devices. The engineering test report can be provided upon FCC requests.

TESTIMONIAL AND STATEMENT OF CERTIFICATION

THIS IS TO CERTIFY:

- 1) *THAT the application was prepared either by, or under the direct supervision of the undersigned.*
- 2) *THAT the measurement data supplied with the application was taken under my direction and supervision.*
- 3) *THAT the data was obtained on representative production units.*
- 4) *THAT, to the best of my knowledge and belief, the facts set forth in the application and accompanying technical data are true and correct.*

Certified by:



Tri Minh Luu, P. Eng.
V.P., Engineering

DATE: July 6, 1999

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2. EXHIBIT 2 - GENERAL INFORMATION

2.1. APPLICANT

TELEPANEL SYSTEMS INC.
245 Riviera Drive
Markham, Ontario
Canada, L3R 5J9

Applicant's Representative: Mr. Dan Iacobescu

2.2. MANUFACTURER

TELEPANEL SYSTEMS INC.
245 Riviera Drive
Markham, Ontario
Canada, L3R 5J9

2.3. DESCRIPTION OF EQUIPMENT UNDER TEST

PRODUCT NAME: ESL Module
SERIAL NUMBER: Pre-production
TYPE OF EQUIPMENT: LOW POWER COMMUNICATION DEVICE TRANSMITTER
OPERATING FREQ.: 131.072 kHz
26 dB BANDWIDTH: 26.86 kHz
EMISSION DESIGNATION: 26K8L1D
DUTY CYCLE: 85% maximum
OSC. FREQUENCY(IES): 32.767 kHz
INPUT SUPPLY: 3 V, Lithium battery
ASSOCIATED DEVICES: Programmer, Model TX3021 and Transceiver, Model TX3030
FCC ID: F7X4IEMMC-2
INTERFACE PORTS: N/A

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2.4. RELATED SUBMITTAL(S)/GRANT

Not applicable.

2.5. TEST METHODOLOGY

These tests were conducted on a sample of the equipment for the purpose of certification compliance with Code of Federal Regulations (CFR47-1991), Part 15, Subpart C, Para. 15.209, Low Power Communication Device Transmitters operating at 131.072 kHz.

Radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4-1992 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz.

2.6. TEST FACILITY

Radiated Emissions were performed at the UltraTech's 3-10 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

The above site have been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: September 20, 1998.

The above test site is also filed with Interference Technology International Ltd (ITI - An EC Directive on EMC).

2.7. UNITS OF MEASUREMENTS

Measurements of radiated emissions are reported in units of dB referenced to one microvolt per meter [dB(μ V)/m] at the distance specified in the report, wherever it is applicable.

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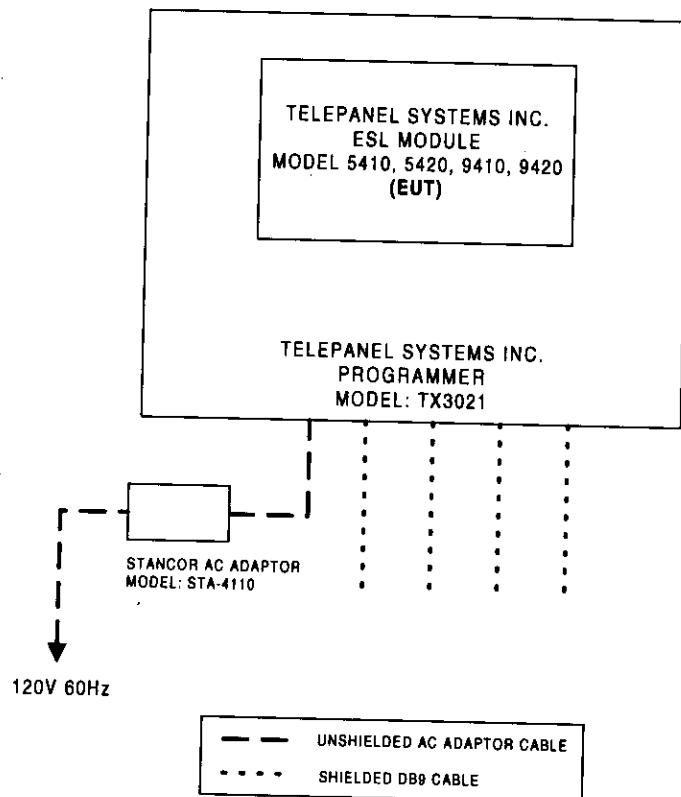
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3. EXHIBIT 3 - SYSTEM TEST CONFIGURATION

3.1. BLOCK DIAGRAMS FOR CONDUCTED & RADIATED EMISSION MEASUREMENTS



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3.3. JUSTIFICATION

No deviation, in both configuration and operation manners, different from normal operation were required.

3.4. EUT OPERATING CONDITION

Software provided by TELEPANEL SYSTEMS INC. to set the EUT to transmit or receive at desired channel frequency (131.072 kHz).

3.5. SPECIAL ACCESSORIES

No special accessories were required.

3.6. EQUIPMENT MODIFICATIONS

To achieve compliance, the following change(s) were made by UltraTech's test house during compliance testing:

Not required.

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4. EXHIBIT 4 - TEST DATA

4.1. 26 DB BANDWIDTH

PRODUCT NAME: ESL Module, Model No.: 5410, 5420, 9410 and 9420

FCC REQUIREMENTS:

The spectrum of the RF signal shall be entirely in FCC permitted band and shall not spread out in the restricted band.

CLIMATE CONDITION:

Standard Temperature and Humidity:

- Ambient temperature: 23 °C
- Relative humidity: 43 %

POWER INPUT: 3 V, Lithium battery.

TEST EQUIPMENT:

- EMI Receiver System/Spectrum Analyzer, Hewlett Packard, Model 8546A, Input +25dBm max., 9KHz-5.6GHz, 50 Ohms, built-in Peak, Quasi-Peak & Average Detectors, Pre-Amplifier and Tracking Signal Generator. This System includes: (1) HP 85460A RF Filter Section, S/N: 3448A00236 and (2) HP 85462A Receiver RF Section/Display, S/N: 3520A00248.
- **Spectrum Analyzer**, Advantest, Model R3271, S/N: 15050203, 100 Hz to 32 GHz)
- **Active Loop Antenna**, Emco, Model 6507, SN 8906-1167, Frequency Range 1 KHz - 30 MHz, @ 50 Ohms
- **Log Periodic/Bow-Tie Antenna**, Emco, Model 3143, SN 1029, 20 - 1000 MHz, @ 50 ohms.

TEST RESULTS: Conforms.

TEST PERSONNEL: Mr. Vinh K. Ngo, RFI/EMI Technician

DATE: March 22, 1999

MEASUREMENT DATA:

26 dB BW = 26.86 kHz

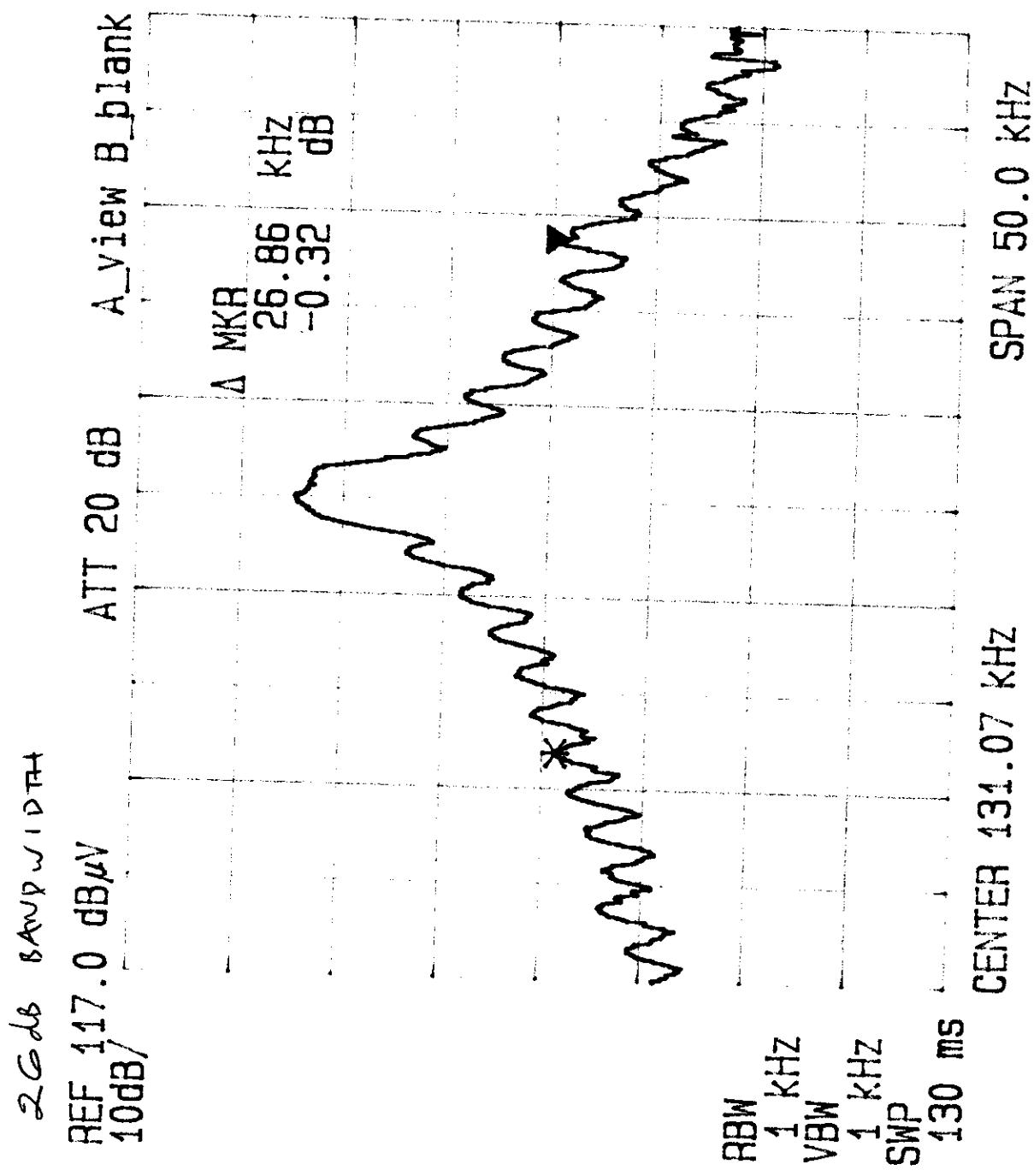
See attached plot for detailed OBW measurements. No RF signal was found to be spread out in the adjacent restricted bands.

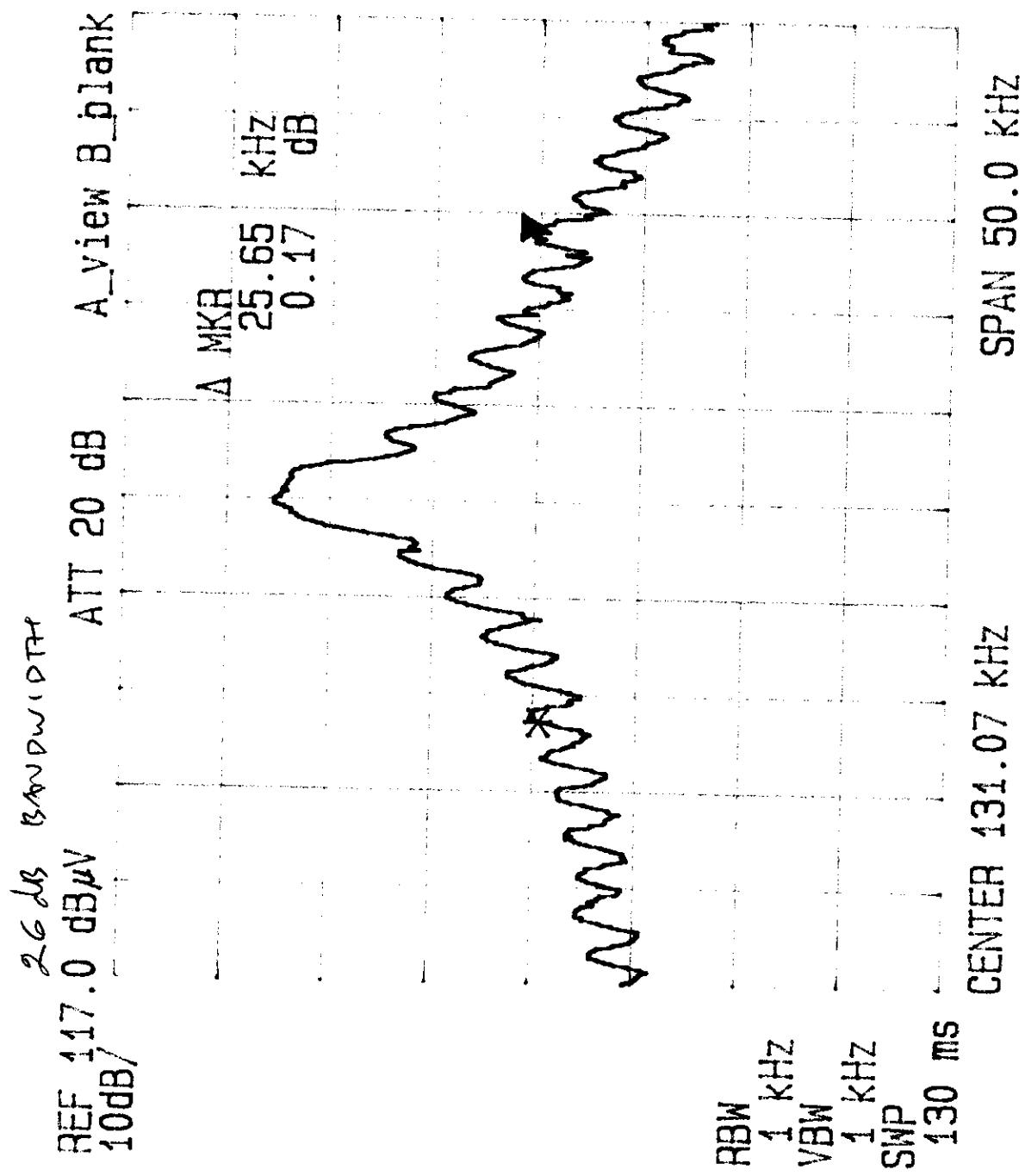
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4.2. TRANSMITTER RADIATED EMISSIONS @ 3 METERS, FCC CFR 47, PARA. 15.209

PRODUCT NAME: ESL Module, Model No.: 5410, 5420, 9410, 9420

FCC REQUIREMENTS:

- The rf spectrum carrier shall not fall inside the restricted bands specified in the following table.

FCC CFR 47, Part 15, Subpart C, Para. 15.205(a) - Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	162.0125 - 167.17	2310 - 2390	9.3 - 9.5
0.49 - 0.51	167.72 - 173.2	2483.5 - 2500	10.6 - 12.7
2.1735 - 2.1905	240 - 285	2655 - 2900	13.25 - 13.4
8.362 - 8.366	322 - 335.4	3260 - 3267	14.47 - 14.5
13.36 - 13.41	399.9 - 410	3332 - 3339	14.35 - 16.2
25.5 - 25.67	608 - 614	3345.8 - 3358	17.7 - 21.4
37.5 - 38.25	960 - 1240	3600 - 4400	22.01 - 23.12
73 - 75.4	1300 - 1427	4500 - 5250	23.6 - 24.0
108 - 121.94	1435 - 1626.5	5350 - 5460	31.2 - 31.8
123 - 138	1660 - 1710	7250 - 7750	36.43 - 36.5
149.9 - 150.05	1718.8 - 1722.2	8025 - 8500	Above 38.6
156.7 - 156.9	2200 - 2300	9000 - 9200	

- Fundamental and Spurious/harmonic emissions shall not exceed the limits specified in the following table:

**FCC CFR 47, Part 15, Subpart C, Para. 15.209(a)
 -- Field Strength Limits within Restricted Frequency Bands --**

FREQUENCY (MHz)	FIELD STRENGTH LIMITS (microvolts/m)	DISTANCE (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

CLIMATE CONDITION:

Standard Temperature and Humidity:

- Ambient temperature: 23 °C
- Relative humidity: 43 %

POWER INPUT:

3 V, Lithium battery.

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TEST EQUIPMENT:

- EMI Receiver System/Spectrum Analyzer, Hewlett Packard, Model 8546A, Input +25dBm max., 9KHz-5.6GHz, 50 Ohms, built-in Peak, Quasi-Peak & Average Detectors, Pre-Amplifier and Tracking Signal Generator. This System includes: (1) HP 85460A RF Filter Section, S/N: 3448A00236 and (2) HP 85462A Receiver RF Section/Display, S/N: 3520A00248.
- **Spectrum Analyzer**, Advantest, Model R3271, S/N: 15050203, 100 Hz to 32 GHz)
- **Active Loop Antenna**, Emco, Model 6507, SN 8906-1167, Frequency Range 1 KHz - 30 MHz, @ 50 Ohms
- **Log Periodic/Bow-Tie Antenna**, Emco, Model 3143, SN 1029, 20 - 1000 MHz, @ 50 ohms.

METHOD OF MEASUREMENTS:

Refer to **ANSI 63.4-1992, Para. 8** for detailed radiated emissions measurement procedures.

Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. the maximum permitted average field strength is listed in Section 15.209. A Pre-Amp and highpass filter are used for this measurement.

For measurement below 1 GHz, set RBW = 100 KHz, VBW \geq 100 KHz, SWEEP=AUTO.

For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz (Peak)

If the emission is pulsed, modified the unit for continuous operation, then use the settings above for measurements, then correct the reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

FCC CFR 47, Para. 2.997 - Frequency spectrum to be investigated

The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10th harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and subharmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

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FCC CFR 47, Para. 2.993 - Field Strength Spurious Emissions

(a) Measurements was made to detect spurious emissions radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data were supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph 2.989(c) as appropriate. For equipment operating on frequencies below 1 GHz, an Open Field Test is normally required, with the measuring instrument antenna located in the far field at all test frequencies. In event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurement will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with the reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

(b) Measurements specified in paragraph (a) of this section shall be made for the following equipment:

- (1) Those in which the spurious emission are required to be 60 dB or more below the mean power of the transmitter.
- (2) All equipment operating on frequencies higher than 25 MHz
- (3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
- (4) Other types of equipment as required, when deemed necessary by the Commission.

TEST RESULTS: Conforms.

TEST PERSONNEL: Mr. Vinh K. Ngo, RFI/EMI Technician

DATE: March 22, 1999

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MEASUREMENT DATA

RADIATED EMISSIONS MEASUREMENTS @ 3 METERS

TEST CONFIGURATION

- For measuring radiated emissions at frequencies below 1 GHz, the Spectrum Analyzer was set as 100 KHz RBW, $VBW \geq RBW$, SWEEP TIME: AUTO, PEAK DETECTOR.
- For measuring radiated emissions at frequencies above 1 GHz, the Spectrum Analyzer was set as 1 MHz RBW, $VBW \geq RBW$, SWEEP TIME: AUTO, PEAK DETECTOR.
- The following measurements were the worst cases when the radiating antenna was placed in both horizontal and vertical polarization.
- **RF Average Level:** the average rf levels were calculated by subtracting the Peak readings added by the duty cycle correction factor. **DUTY CYCLE FACTOR** = $20\log_{10}(0.85) = -1.4 \text{ dB}$

Remark: The ESL Modules (model: 5410, 5420, 9410 9420) circuitry are the same, only the display sizes are different. Therefore two samples (model 5420 and 9420) were selected for testing and the results will represent the other modules (model 5410 and 9410).

TX3021 Programmer with 5420 ESL Module

CHANNEL FREQUENCY TESTED: 131.702 kHz						
FREQUENCY (MHz)	RF PEAK LEVEL (dBuV/m)	RF AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	*LIMIT 15.209 (dBuV/m)	LIMIT MARGIN (dB)	PASS/ FAIL
0.131	74.13	72.72	V	105.3	-32.5	PASS
0.131	71.79	68.18	H	105.3	-37.1	PASS
0.262	45.11	43.70	H	99.2	-55.5	PASS

No other significant emissions were found in the frequency range from 130 kHz to 1 GHz. Refer to attached plots for details

* The limit at 300 M was converted to 3 M limit using $20\log(300/3)^2$ factor.

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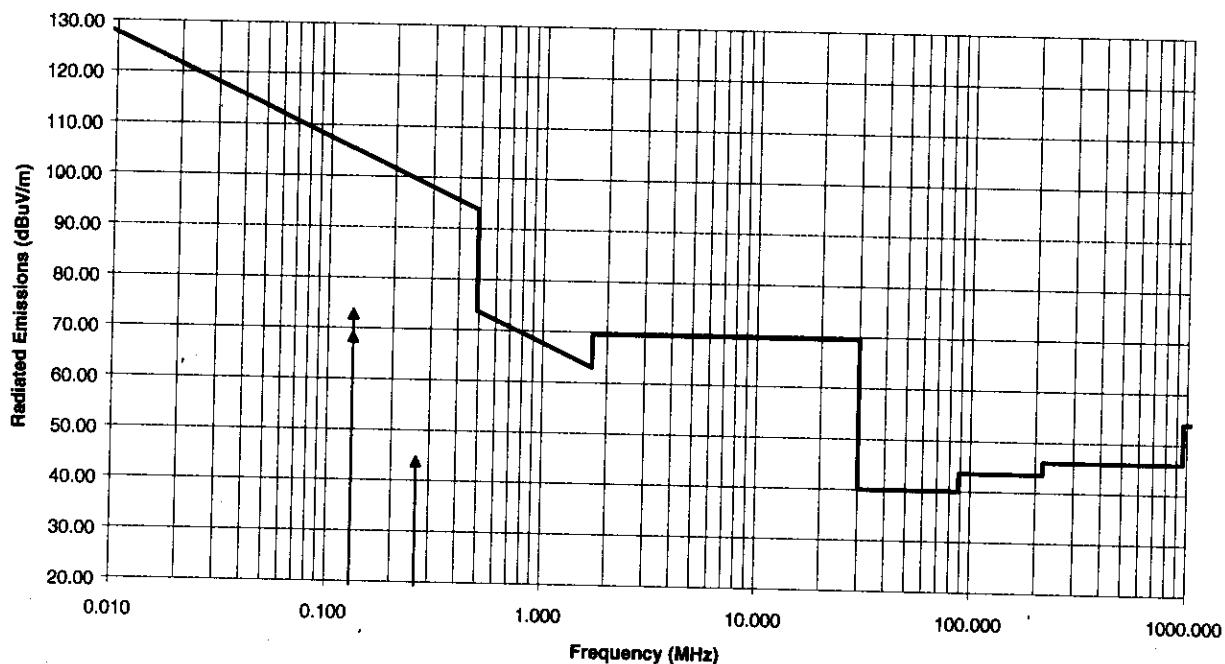
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TX3021 Programmer with 5420 ESL Module

Transmitter Radiated Emissions Measurements at OFTS @ 3 Meters
Telepanel Systems Inc.
ESL Module, Model 5420
TRANSMIT Freq.: 131.072 kHz



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TX3021 Programmer with 9420 ESL Module

CHANNEL FREQUENCY TESTED: 131.702 kHz

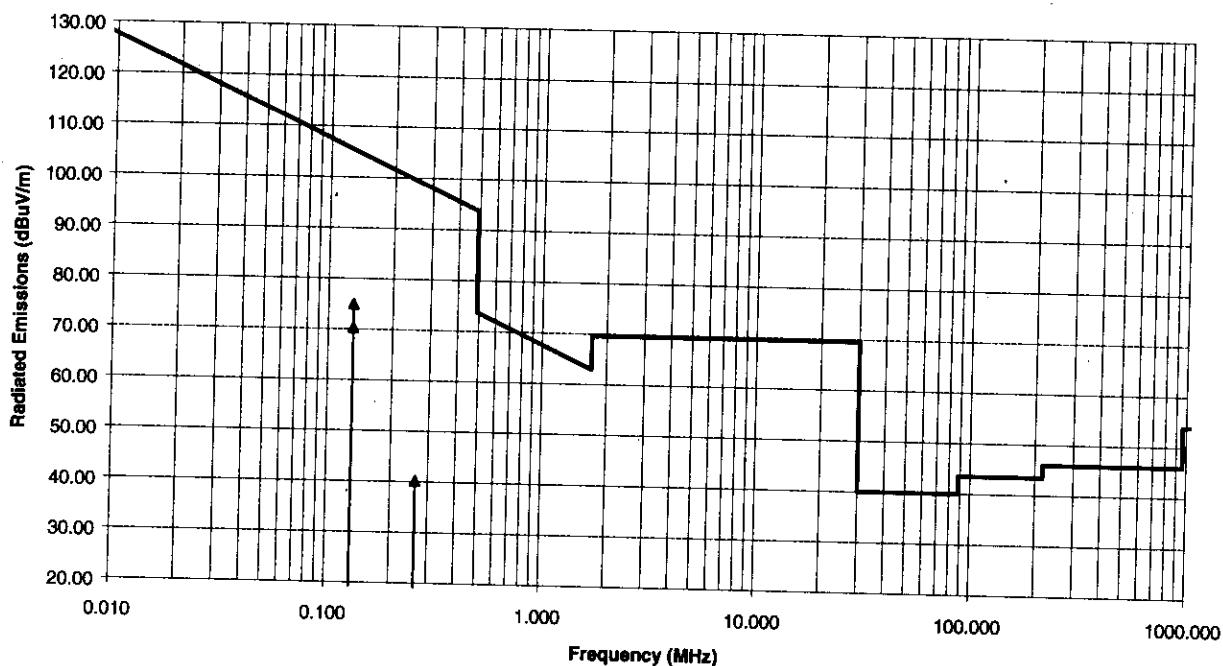
FREQUENCY (MHz)	RF PEAK LEVEL (dBuV/m)	RF AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	*LIMIT 15.209 (dBuV/m)	LIMIT MARGIN (dB)	PASS/FAIL
0.131	76.33	74.92	V	105.3	-30.3	PASS
0.131	73.87	70.26	H	105.3	-35.0	PASS
0.262	41.61	40.20	H	99.2	-59.0	PASS

No other significant emissions were found in the frequency range from 130 kHz to 1 GHz. Refer to attached plots for details

* The limit at 300 M was converted to 3 M limit using $20\log(300/3)^2$ factor.

Transmitter Radiated Emissions Measurements at OFTS @ 3 Meters

Telepanel Systems Inc.
 ESL Module, Model 9420
 TRANSMIT Freq.: 131.072 kHz



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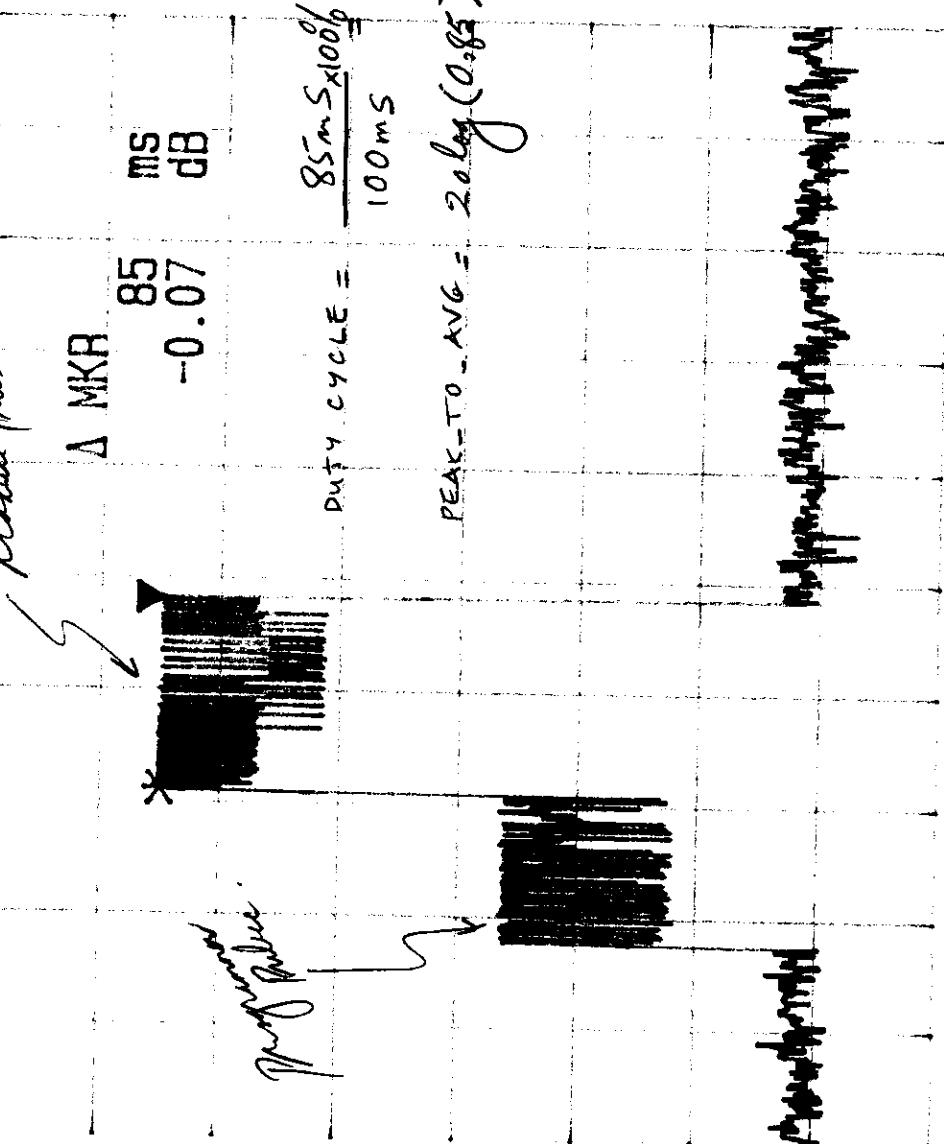
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TELEPANEL - TX3021 WITH ESS2 MODULE, MID: 5420

REF 117.0 dB μ V
10dB/

ATT 20 dB A_view B_blank



RBW 1 kHz
VBW 1 kHz
SWP 500 ms

TELEPANEL - TX3021 WITH ESSL MODULE, M/D: 9420

REF 147.0 dB μ V
10dB/

ATT 20 dB

A_view B_plank

Multi. pulse

A MKR

84 ms
-0.32 dB

$$\text{DUTY CYCLE} = \frac{84\text{ms}}{100\text{ms}} \times 100 = 84\%$$

RBW 1 kHz
VBW 1 kHz
SWP 500 ms

CENTER 131.072 kHz

SPAN 0.000 kHz

5. EXHIBIT 5 - GENERAL TEST PROCEDURES

5.1. ELECTRICAL FIELD RADIATED EMISSIONS MEASUREMENTS - GENERAL TEST METHOD

- The radiated emission measurements were performed at the UltraTech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario. The Attenuation Characteristics of OFTS have been filed to FCC.
- Radiated emissions measurements were made using the following test instruments:
 - 1) Calibrated EMCO active loop antenna in the frequency range from 10 KHz to 1 MHz
 - 2) Calibrated EMCO biconilog antenna in the frequency range from 30 MHz to 2000 MHz.
 - 3) Horn Antennas:
 - a) Horn Antenna, Emco, Model 3115, 1 – 18 GHz
 - b) Horn Antenna, Emco, Model 3160-09, 18-26.5GHz
 - c) Horn Antenna, Emco, Model 3160-10, 26.5-40GHz
 - d) Mixer, Tektronix, P/N 118-0098-00, 18-26.5GHz
 - e) Mixer, Tektronix, P/N 119-0098-00, 26.5-40GHz
 - 4) Calibrated Advantest spectrum analyzer and pre-selector/pre-amplifier. In general, the spectrum analyzer would be used as follows:
 - The rf electric field levels were measured with the spectrum analyzer set to PEAK detector (1 KHz RBW and 1 KHz VBW for frequency below 30 MHz, 100 KHz RBW and VBW \geq RBW for Frequency below 1 GHz and 1 MHz RBW and 1 MHz VBW for frequency greater than 1 GHz).
 - If any rf emission was observed to be a broadband noise, the spectrum analyzer's CISPR QUASI-PEAK detector (120 KHz RBW and 1MHz VBW) was then set to measure the signal level.
 - If the signal being measured was narrowband and the ambient field was broadband, the bandwidth of the spectrum analyzer was reduced.
- The EUT was set-up in its typical configuration and operated in its various modes as described in 3.2 of the test report.
- The frequencies of emissions was first detected. Then the amplitude of the emissions was measured at the specified measurement distance using required antenna height, polarization, and detector characteristics.
- During this process, cables and peripheral devices were manipulated within the range of likely configuration.
- For each mode of operation required to be tested, the frequency spectrum was monitored. Variations in antenna heights (from 1 meter to 4 meters above the ground plane), antenna polarization (horizontal plane and vertical plane), cable placement and peripheral placement (each variable within bounds specified elsewhere) were explored to produce the highest amplitude signal relative to the limit.

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July 6, 1999

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The maximum radiated emission for a given mode of operation was found by using the following step-by-step procedure:

- Step1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.
- Step2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.
- Step3: Rotate the EUT 360 degrees to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat Step 2. Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.
- Step4: Move the antenna over its full allowed range of travel (1 to 4 meters) to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to Step 2 with the highest amplitude observation and proceed.
- Step5: Change the polarization of the antenna and repeat Step 2 through 4. Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.
- Step6: The effects of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.
- Step7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.

Calculation of Field Strength:

The field strength is calculated by adding the calibrated antenna factor and cable factor, and subtracting the Amplifier gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$\boxed{FS = RA + AF + CF - AG}$$

Where	FS	=	Field Strength
	RA	=	Receiver/Analyzer Reading
	AF	=	Antenna Factor
	CF	=	Cable Attenuation Factor
	AG	=	Amplifier Gain

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Example: If a receiver reading of 60.0 dB μ V is obtained, the antenna factor of 7.0 dB/m and cable factor of 1.0 dB are added, and the amplifier gain of 30 dB is subtracted. The actual field strength will be:

Field Level in dB μ V/m = $60 + 7.0 + 1.0 - 30 = 38.0$ dB μ V/m.

Field Level in μ V/m = $10^{(38/20)} = 79.43$ μ V/m.

Notes: The frequency and amplitude of at least six highest conducted emissions relative to the limit are recorded unless such emissions are more than 20 dB below the limit. If less than six emissions are within 20dB of the limit, the background or receiver noise level shall be reported at representative frequencies.

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