

**THE TRANSMITTER PERFORMANCE
AND ELECTROMAGNETIC EMISSIONS ACCORDING TO**

**FCC PART 90, 1998
AND
FCC PART 15, SUBPART B, CLASS B, 1997**

OF THE

**BURGHARDT INC.
BU-1000/155 DATA TRANSCEIVER**

PREPARED FOR

**BURGHARDT INC.
710 10th STREET SW
P.O. BOX 73
WATERTOWN, SD 57201-0073**

PREPARED BY

**GLOBAL CERTIFICATION LABORATORIES, LTD.
4 MATTHEWS DRIVE
EAST HADDAM CT 06423**

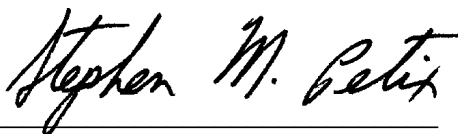
DATE RELEASED

3/31/00

FILE REF: BUR0001

SIGNATURE PAGE

THIS REPORT WAS PREPARED BY:



STEPHEN M. PETIX

TESTING WAS PERFORMED BY:



STEPHEN M. PETIX

THIS REPORT WAS REVIEWED BY:



JAMES COSTELLO

TABLE OF CONTENTS

Title Page.....	i
Signature Page.....	ii
Table of Contents	iii
Introduction	1
Product Identification.....	2
Technical Description.....	3
Compliance Statement.....	9
Test Instrumentation.....	10
Test Procedures, Terminal Disturbance Voltage Test.....	11
Block Diagram, Terminal Disturbance Voltage Test.....	12
Test Data Explanation (Conducted).....	13
Terminal Disturbance Voltage Test Data Printout.....	14
Test Procedures, Unintentional Radiated E-Field Emissions Test.....	18
Test Procedures, Effective Radiated Power & Intentional Emissions Test.....	19
Block Diagram, Radiated Electric Field Emissions Test Set-up.....	21
Test Data Explanation (Radiated)	22
Radiated Emissions Data (including FCC Part B, ERP, & Radiated Spurious).....	23
Modulation Characteristics.....	38
Occupied Bandwidth Measurements.....	39
Spurious Emissions & RF Power at Antenna Terminals.....	40
Frequency Stability Measurements	41
Transient Frequency Behavior	45
Test Summary.....	46

Due to their size, the Plot & Photographic sections are in separate exhibits.

INTRODUCTION

This report describes the results of electromagnetic emissions testing on the

BURGHARDT INC.
BU-1000/155 DATA TRANSCEIVER,

The Equipment Under Test. The EUT was subjected to the following tests:

FCC PART 90, using emission mask "C" and
FCC PART 15, SUBPART B, CLASS B.

The tests and measurements included in the standards above are:

TERMINAL DISTURBANCE VOLTAGES
(CONDUCTED EMISSIONS) ANALYSIS

RADIATED ELECTRIC FIELD EMISSIONS ANALYSIS
(ABSOLUTE FIELD STRENGTH & EFFECTIVE RADIATED POWER
MEASUREMENTS)

MODULATION CHARACTERISTICS

OCCUPIED BANDWIDTH

FREQUENCY STABILITY DUE TO TEMPERATURE & POWER VOLTAGE
VARIATIONS

SPURIOUS EMISSIONS (MEASURED AS FIELD STRENGTHS AND
RELATIVE LEVELS AT ANTENNA TERMINALS)

TRANSIENT FREQUENCY RESPONSE

The FCC ID Code number of the BU-1000/155 is:

The results reported in this document relate only to the unit(s) tested.

All testing was performed at the facilities of

Global Certification Laboratories, Ltd.
East Haddam CT.

All test equipment calibration is N.I.S.T. traceable. This report contains detailed descriptions of the test procedures, test data, and a written summary of the results. The report may not be reproduced, except in its entirety, without the permission of Global Certification Laboratories. This report contains 1 numbered pages, plus Title, Signature, and Table of Contents Pages.

PRODUCT IDENTIFICATION

EQUIPMENT UNDER TEST (EUT): BURGHARDT INC.

MODEL:

BU-1000/155 DATA TRANSCEIVER, three boards:

Three transceiver boards configured at the following frequencies were examined:

- 1) 150 MHz
- 2) 154.6 MHz
- 3) 160 MHz

SERIAL: NONE

DEVIATIONS FROM SPECIFICATIONS: NONE

EUT SUPPORT EQUIPMENT:

BURGHARDT Fabricated ENCLOSURE:
Consisting of a GENERAL ELECTRIC “Rr13%” power meter with a Meter Reading Unit (MRU) and pulse initiator included inside the meter housing.

EMCO™ DIPOLE ANTENNA, s/n B-1

BURGHARDT Supplied METER READING UNIT (MRU) using the OMNI-PRO SOFTWARE (Madison SD). This software is used to control the MRU. It defines the test modulation. The test modulation is representative of an actual condition with the exception that it is on continuously.

140 to 400 MHz Reference Dipole Antenna
(Used during measurement of spurious emissions from the enclosure)

TECHNICAL DESCRIPTION
BURGHARDT INC.
BU-1000/155 DATA TRANSCEIVER

The BU-1000/155 DATA TRANSCEIVER is a low-power data transceiver board. It is used to communicate the electrical power consumption of a home or other facility to the local electric power provider via a radio link. It uses the F2D emission type.

The BU-1000/155 is connected with two cables to a Meter Reading Unit or “MRU” board. One cable supplies +12 VDC power, while the second cable carries interface signals between the BU-1000/155 and MRU boards. The MRU is located in the power meter housing. An encoder that reads the rotation of the power meter dial is used to encode the meter movement to the MRU. The OMNI-PRO nonvolatile PROM code controls the MRU.

The BU-1000/155 is normally in a passive, receive mode. It is continually powered by the building mains power. When the local Power Company requires a meter reading, it transmits a wakeup signal to all BU-1000/155's in a 2-kilometer radius.

When a BU-1000/155 receives this signal with an antenna supplied by the power company antenna, the MRU board encodes the meter reading with the pulse initiator/encoder and passes this information to the BU-1000. The BU-1000/155 then transmits the meter reading to the power company. If a customer is further than 2 kilometers from the company, repeater stations are used to relay the signal.

The BU-1000/155 does not have an audio low pass filter. There is no provision for the user to alter the output power or the modulation characteristics. The BU-1000/155 is powered by 12 VDC from the MRU board. The entire test vehicle is powered by 120 VAC, 60 Hz power.

**TECHNICAL DESCRIPTION
BURGHARDT INC.
BU-1000/155 DATA TRANSCEIVER**

David Smith of BURGHARDT has supplied the following theory of operation and specifications for the BU-1000/155:

THEORY OF OPERATION

The BU-1000/155 is a low power data transceiver.

RECEIVER SECTION

The receiver is a double conversion superhetrodyne design. When in the receive mode, signal is allowed to pass to the Q1 RF AMP, where it is amplified and sent to U1 for the first mix. X2 is a 3rd overtone crystal which is tripled by Q2 to produce the first mix frequency. The first mixer is located in U1 and produces a 10.7MHZ first IF. X1 produces the 2nd mix frequency of 10.245MHZ. It is mixed in U1 to produce a 455KHZ 2nd IF frequency. Receiver audio is then detected in U1 to produce RXA out.

TRANSMIT SECTION

Modulation is applied to D3 varactor and is used to shift the frequency of X201 to produce FM modulation. X201 is a 3rd overtone crystal. Its frequency is tripled by Q241 to give the appropriate output frequency. It is then amplified by Q242 pre-driver and Q243 final. It is passed through D440/441 switching when in transmit mode and from there applied to the antenna.

BU-1000/155 SPECIFICATIONS:

GENERAL:

FREQUENCY COVERAGE:1 CHANNEL(150 to 160 MHz)

TX CURRENT DRAW: 250MA

RX CURRENT DRAW: 120MA

RECEIVER:

SENSITIVITY: 10DB SINAD AT .8UV

AUDIO OUTPUT LEVEL: 2VPP AT 3KHZ DEVIATION

1ST IF FREQUENCY: 10.7 MHz

2ND IF FREQUENCY: 455 kHz

TRANSMITTER

POWER: 250MW

TECHNICAL DESCRIPTION
BURGHARDT INC.
BU-1000/155 DATA TRANSCEIVER

BU-1000/155 DATA TRANSCEIVER BOARD PARTS LIST
(155 MHz)

RECEIVER SECTION

C2,8,10,11,13,16,17,18,19,20,23,24	.1UF NEWARK 07WX6808
C6	33PF DIGIKEY PCC330CCT-ND
C7	18PF DIGIKEY PCC180CCT-ND
C14	120PF DIGIKEY PCC121CCT-ND
C4	4.7PF DIGIKEY PCC4R7CCT-ND
C15,1	47PF DIGIKEY PCC470CCT-ND
C5	22PF DIGIKEY PCC220CCT-ND
C12	1UF TANTILUM NEWARK 93F2694
C9	3.9PF DIGIKEY PCC3R9CCT-ND
C3	100PF DIGIKEY PCC101CCT-ND
C25	1000PF DIGIKEY PCC102BCT-ND
C21	2200PF DIGIKEY PCC222BCT-ND
R6,2	470 NEWARK 07WX0214
R10,12	39K NEWARK 08WX8266
R3,7,8	1K NEWARK 07WX0211
R4	5.6K NEWARK 08WX8274
R5	15K NEWARK 08WX7826
R1	100K NEWARK 96F6995R100.0K
R9	10K NEWARK 08WX8237
R11,13	22K NEWARK 08WX8252
R14	330 OHM 1/2 WATT DIGIKEY 330H-ND
FL1	MURATA SFE10.7MJA10-A
FL2	MURATA CFU455B2
L1	43NH DIGIKEY DN4010-ND
L2	1.5UH DIGIKEY TK1412-ND
L3	.108UH DIGIKEY TK2713-ND
L4	.64MH DIGIKEY TK1302-ND
U1	MC13135DW NEWARK 07F2896
U2	78L05ACP NEWARK 07F7397
X1	10.245 MHz BOMAR
X2	SELECTED BOMAR
Q1	MRF901 NEWARK 08F1298
Q2	2N3904 NEWARK 09F5663
ZD1	6.8 V 1/2 WATT ZENER NEWARK 09F4090

TECHNICAL DESCRIPTION
BURGHARDT INC.
BU-1000/155 DATA TRANSCEIVER

TRANSMITTER SECTION

C265,252,259,260,261,263,272	.1UF NEWARK 07WX6808
C253,254,269	47PF DIGIKEY PCC470CCT-ND
C255	18PF DIGIKEY PCC180CCT-ND
C224	3.9PF DIGIKEY PCC3R9CCT-ND
C262,250	220PF DIGIKEY PCC221BCT-ND
C258	6.8PF DIGIKEY PCC6R8CCT-ND
C251,221,222	8.2PF DIGIKEY PCC8R2CCT-ND
C257	27PF DIGIKEY PCC270CT-ND
C264	15PF DIGIKEY PCC150CCT-ND
C267	2.2PF DIGIKEY PCC2R2CCT-ND
C271,273	1000PF DIGIKEY PCC102BCT-ND
C256	33PF DIGIKEY PCC330CCT-ND
C268	.01UF DIGIKEY PCC103BCT-ND
R210	470 OHM NEWARK 07WX0214
R212	15K NEWARK 08WX7826
R221,216,211,217	1K NEWARK 07WX0211
R214	5.6K NEWARK 08WX8274
R215,220	18K DIGIKEY P18KECT-ND
R219,223	100K NEWARK 96F6995R100.0K
R222,218	10 OHM DIGIKEY P10ECT-ND
R224	4.7K DIGIKEY P4.7KECT-ND
R225	330 OHM 1/2 WATT DIGIKEY 330H-ND
R226	150 OHM DIGIKEY P150ECT-ND
L290	1.5UH DIGIKEY TK1412-ND
L291	.137UH DIGIKEY TK2714-ND
L292,296,297,299	43 NH DIGIKEY DN4010-ND
L294,300	1UH DIGIKEY PCD1131CT-ND
L295	.241UH DIGIKEY TK2707-ND
L293	.375UH DIGIKEY TK2729-ND
L298	.211UH DIGIKEY TK2706-ND
Q242,241	MRF901 NEWARK 08F1298
Q243	2N4427 NEWARK 10WX2083
X201	SELECTED
ZD2	6.8V ZENER NEWARK 09F4090
D3	MV2105 VARACTOR NEWARK 08F2197

TECHNICAL DESCRIPTION
BURGHARDT INC.
BU-1000/155 DATA TRANSCEIVER

COMMON SECTION

<u>R401,402,403,400</u>	<u>1K NEWARK 07WX0211</u>
<u>C460,461</u>	<u>.1UF NEWARK 07WX6808</u>
<u>L475</u>	<u>56UH DIGIKEY PCD1106CT-ND</u>
<u>D440,441</u>	<u>MPN3404 NEWARK 07F9506</u>
<u>Q450</u>	<u>2N3906 DIGIKEY 2N3906DICT-ND</u>
<u>LED1</u>	<u>GREEN LED DIGIKEY 67-1059-ND</u>
<u>LED2</u>	<u>RED LED DIGIKEY 67-1065-ND</u>
<u>CN1</u>	<u>5 PIN JACK DIGIKEY H2097-ND</u>
<u>CN2</u>	<u>BNC JACK DIGIKEY ARF1178-ND</u>
<u>2 PIN JACK(OPTIONAL)</u>	<u>DIGIKEY H2094-ND</u>
<u>5 PIN PLUG(ACCESSORY)</u>	<u>DIGIKEY H2086-ND</u>
<u>2 PIN PLUG(OPTIONAL)</u>	<u>DIGIKEY H2083-ND</u>
<u>PINS(ACCESSORY)</u>	<u>DIGIKEY H2138-ND</u>

BU-1000 INSTALLATION

The BU-1000/155 has a 5 pin connector for hookup to the MRU (meter reading unit) modem and a BNC connector for connection to a half wave dipole. The pinout of the 5 pin connector is as follows.

- 1) PTT (push to talk)
- 2) 12V (regulated 12 volt input)
- 3) Mod in (modulation input)
- 4) RXA (receiver audio output)
- 5) GND (ground)

The BU-1000/155 is to be installed and maintained by authorized personnel only.

TECHNICAL DESCRIPTION
BURGHARDT INC.
BU-1000 DATA TRANSCEIVER

A single BU-1000/155 can only be configured for a single frequency. For this application, testing was performed on the lowest, middle and highest frequencies of the entire frequency band. The performance of the BU-1000/155 at the following test frequencies is representative of what to expect over the entire frequency coverage range:

- 1: 150.0 MHz
- 2: 156.4 MHz
- 3: 160.0 MHz

The BU-1000/155 has a two-pin connector to receive the +/-12 VDC power signal from the MRU. For all tests and measurements in this report, the ½ wave dipole was adjusted for use at the fundamental frequency of all three boards. A short length of coax was used to connect the antenna (or spectrum analyzer) to the BNC antenna connector mounted on the BU-1000/155 board for generic antennas..

The impedance looking into the antenna port is 50 ohms. Therefore, no impedance matching network was needed for measurements directly connected to 50-ohm instrumentation.

The 150 MHz, 156.4 MHz and 160 MHz boards all underwent the same tests and measurements. The measurements included effective radiated power of the carrier, absolute field strength of spurious and unintentional emissions from the enclosure, occupied bandwidth and frequency stability under temperature & voltage variations and transient frequency response. A reference dipole was used as the transmit antenna during spurious/unintentional emissions.

The EUT is used in the Private Land and Mobile Service bands specified by FCC Part 90. The authorized bandwidth of the BU-1000/155 DATA TRANSCEIVER is 20kHz.

All spurious and intentional radiated emissions are to meet emission mask “C” limits of FCC Part 90. All unintentional radiated emissions produced during the most common, receive states are to meet FCC Part 15, Class B.

The EUT may use generic antennas. A BNC connector is used to connect the antenna to the BU-1000/155 transmitter board. All spurious emissions were measured with a dipole antenna tuned to the particular BU-1000/155 board being tested.

The test modulation used for most measurements is an “AFSK”. This modulation scheme consists of two FM modulated audio frequency tones that behave like a binary (1’s & 0’s) system to form representative digital information.

COMPLIANCE STATEMENT
BURGHARDT INC.
BU-1000/155 DATA TRANSCEIVER

The BU-1000/155 DATA TRANSCEIVER complies with the requirements of FCC PART 90, Emission Mask “C” as well as FCC PART 15 Subpart B, Class B for conducted and radiated emissions, when configured as received by Global Certification Laboratories.

The measurements in this report represent the maximum levels of emissions from the BU-1000/155 DATA TRANSCEIVER. The measurements and limits are discussed later in the report. Calibration of all instrumentation used in this test program is N.I.S.T. traceable.

This report will show that the EUT meets the Part 90 radiated power requirements, has a frequency stability of 5 ppm under temperature and power variations, has an acceptable transient frequency response, controls spurious emissions, and has an occupied bandwidth within 20 kHz when transmitting.

ANSI C63.4 and FCC Parts 2, 90 and 15 of the Code of Federal Regulations, Title 47 were consulted to insure the measurements are accurate and the test site correctly configured.

TEST INSTRUMENTATION

The following instrumentation is used in emissions measurements. All test equipment calibration is N.I.S.T. traceable.

	Model	Serial	Last	Cal.
			Cal.	Due
ADVANTEST Spectrum Analyzer	R3361A	91730394	1/20/00	1/20/01
ADVANTEST Preamplifier	R14601	93120019	1/20/00	1/20/01
AILTECH Log Periodic Antenna	90005/3146	1095	11/11/99	11/11/00
ELECTROMETRICS Horn Antenna	RGA-60	6139	N/A	N/A
FLUKE Digital Multimeter	76	6540398	4/11/99	4/11/00
FLUKE Thermocouple Module	80TK	6698122	7/21/99	7/21/00
GLOBAL Laboratories	N/A	N/A	3/1/00	3/1/01
3 meter O.A.T.S.				
HEWLETT PACKARD	8569B	2607A03112	8/25/99	8/25/00
Spectrum Analyzer				
MARCONI Signal Generator	2022C	52022-930X	4/26/99	4/26/00
OAKTON Thermal-hygrometer	35612-00	none	4/13/99	4/13/00
RAYPROOF Shielded Room		4536	N/A	N/A
SCHWARZBECK	NNLK 8121	8121245	1/4/00	1/4/01
50 Ω Artificial Mains Network				
SCHWARZBECK	VHA-9103	"A"	11/6/99	11/6/00
Biconical Antenna				
SCHWARZBECK RF Receiver	VUME 1518	1518167	1/20/00	1/20/01
9KH to 30 MHz.				
SCHWARZBECK RF Receiver	VUME 1520	1520427	1/20/00	1/20/00
30 to 1000 MHz				
STACO ENERGY PRODUCTS	None	H-214	N/A	N/A
Variable Autotransformer				

FCC PART 15, SUBPART B

TERMINAL DISTURBANCE VOLTAGES (CONDUCTED EMISSIONS)

FCC PART 15 Terminal Disturbance Voltage Tests are normally performed in an 8'x10'x15' shielded enclosure with filtered power supply lines. The EUT is configured per FCC Part 15, Subpart B to maximize emissions. A Radio Frequency test receiver, in accordance with CISPR 16 is used to measure disturbance voltages. An Artificial Mains Network (AMN), also in accordance with CISPR 16, is used to isolate the EUT from any interference on the power lines and to maintain a constant $50\Omega/50\mu\text{H}$ impedance across the test bandwidth. Specific devices are noted on data pages.

The EUT is placed on a wooden table 0.8m high, located $>0.4\text{m}$ from any wall of the shielded room and at least 0.8m from the AMN. Floor-standing EUTs are placed on a horizontal ground plane, which is not in contact with the reference ground. The EUT is connected to the AMN, which is supplied with the rated power of the EUT. If the EUT supply cord is $>1\text{m}$ in length, it is shortened by bundling in a coil no longer than 0.4m. Ground wires are connected. Equipment with multiple power cords are connected per CISPR 16 or tested separately.

The frequency spectrum for the test is from 0.45MHz to 30.00MHz. The neutral and all phase lines are separately scanned for disturbance voltages.

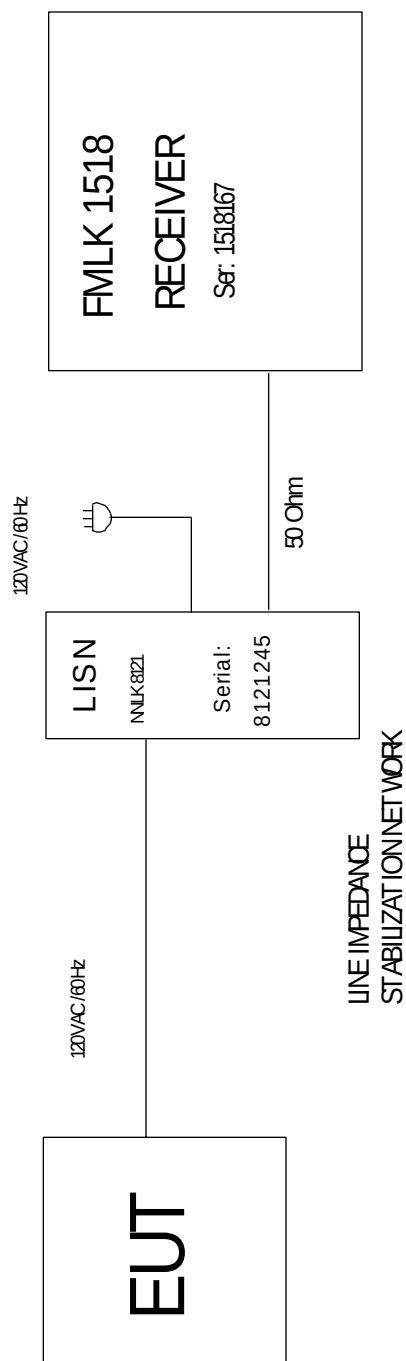
The test spectrum is slowly scanned with the receiver in Quasi-Peak mode. When a disturbance signal is detected, it is observed for a minimum of 5 seconds. Frequency and amplitude are entered into an Excel spreadsheet, where the measurement is compared to limits.

Limits for Terminal Disturbance Voltages are:

	Freq. (MHz)	dB (μV) Quasi-Peak
CLASS A	0.45-1.705	60
	1.705-30.0	69.5
CLASS B	0.45-30.0	48

GLOBAL CERTIFICATION LABORATORIES, LTD

TERMINAL DISTURBANCE VOLTAGE TEST SET-UP



(EXCEPT WHERE EUT SIZE PROHIBITS, TESTING IS DONE IN A SHIELDED ROOM)

DATA TABLE EXPLANATION
TERMINAL DISTURBANCE VOLTAGE TEST

The DATA TABLE PAGES contain the following information:

TITLE: indicating the test performed
EUT
PERSON WHO PERFORMED THE TEST
TEST STANDARD(S)
DATE OF TEST
TEST SITE
TEST INSTRUMENTATION
NOTES
THE LINE UNDER TEST

The DATA TABLE headings are as follows:

FREQ. MHz	the FREQUENCY, in megahertz, at which a signal is detected.
QUASI-P dB(μV)	The QUASI-PEAK AMPLITUDE, in decibels per microvolt, of the signal.
LIMIT QUASI-P dB(μV)	The LIMIT, in decibels per microvolt, or picowatt, for the above signal.
PASS?	Is the signal acceptable under the standards? ("YES" or "NO")
MARGIN dB	The MARGIN, in decibels per microvolt, by which the EUT passes or fails.
AMPL AVER dB(μV)	The AVERAGE AMPLITUDE, in decibels per microvolt, of the signal.
LIMIT AVER dB(μV)	The LIMIT, in decibels per microvolt, for the above signal.
PASS?	Is the signal acceptable under the standards? ("YES" or "NO")
MARGIN dB	The MARGIN, in decibels, by which the EUT passes or fails.

TERMINAL DISTURBANCE VOLTAGE DATA

TERMINAL DISTURBANCE VOLTAGES DETECTED FROM 0.45MHz - 30MHz FOR FCC PART 15, SUBPART B, CLASS B.

FILE: BUR0001

EUT NAME: BU-1000/155 DATA TRANSCEIVER

THE EUT IS A 155 MHz TRANSCEIVER TO BE MOUNTED ON ELECTRIC POWER METERS.
THE BU-1000 WILL REPORT THE ELECTRICAL USAGE TO THE LOCAL ELECTRIC POWER
COMPANY VIA A 155 MHz RF LINK WHEN QUERIED.

THE EUT IS POWERED BY 120 VAC, 60 Hz.

THE EUT ARE NOT SERIALIZED.

CUSTOMER REPRESENTATIVE: DAVE J. SMITH (not present)

MEASURED BY JACK ROGERS ON 2/22/00 TO FCC PART 15, SUBPART B, CLASS
B IN AN 8'x10'x15' SHIELDED ROOM UTILIZING A SCHWARZBECK ARTIFICIAL MAINS
NETWORK MODEL>NNLK8121 AND A SCHWARZBECK INTERFERENCE RECEIVER MODEL
FMLK 1518.

In all the measurements below, the EUT is transmitting a modulated test signal programmed in the
MRU. Prior measurements showed that this produces the highest conducted emissions available
from the EUT.

Three BU-1000 boards have been made, they are each operating at one of the three frequencies.
Measurements are taken on all three boards.

Continued on next page.

TERMINAL DISTURBANCE VOLTAGE DATA

The 160 MHz BU-1000/115 board is measured first.

TESTING NEUTRAL LINE :

FREQ. (MHz)	AMPL QUASI-P dB(μV)	AMPL + LISN LOSSES dB(μV)	LIMIT QUASI-P dB(μV)	PASS?	MARGIN dB
0.45	25	25.11	48	YES	22.9
0.62	28	28.11	48	YES	19.9
ALL SIGNALS ARE BELOW 30 dBuV.					
7.00	5	5.06	48	YES	42.9
7.37	39	39.06	48	YES	8.9
8.00	25	25.06	48	YES	22.9
12.28	33	33.61	48	YES	14.4
14.31	27	27.61	48	YES	20.4
ALL SIGNALS ARE BELOW 25 dBuV.					
24.00	25	27.30	48	YES	20.7
28.80	22	23.40	48	YES	24.6
30.00	8	11.05	48	YES	37.0
ALL OTHER FREQUENCIES BELOW LIMITS					

TESTING LINE1:

FREQ. (MHz)	AMPL QUASI-P dB(μV)	AMPL + LISN LOSSES dB(μV)	LIMIT QUASI-P dB(μV)	PASS?	MARGIN dB
0.45	25	25.11	48	YES	22.9
0.68	29	29.11	48	YES	18.9
ALL SIGNALS ARE BELOW 30 dBuV.					
7.37	39	39.06	48	YES	8.9
8.00	21	21.06	48	YES	26.9
12.28	34	34.61	48	YES	13.4
14.31	23	23.61	48	YES	24.4
ALL SIGNALS ARE BELOW 25 dBuV.					
24.00	24	26.30	48	YES	21.7
28.80	6	7.40	48	YES	40.6
30.00	8	11.05	48	YES	37.0
ALL OTHER FREQUENCIES BELOW LIMITS					

Continued on next page.

TERMINAL DISTURBANCE VOLTAGE DATA

The 154.6 MHz BU-1000/115 board is

TESTING NEUTRAL LINE

FREQ. (MHz)	AMPL QUASI-P dB(μV)	AMPL + LISN LOSSES dB(μV)	LIMIT QUASI-P dB(μV)	PASS?	MARGIN dB
0.45	25	25.11	48	YES	22.9
ALL SIGNALS ARE BELOW 30 dBuV.					
7.30	26	26.06	48	YES	21.9
14.31	26	26.61	48	YES	21.4
20.00	18	19.67	48	YES	28.3
ALL SIGNALS ARE BELOW 25 dBuV.					
28.00	25	26.40	48	YES	21.6
29.90	8	10.40	48	YES	37.6
ALL OTHER FREQUENCIES BELOW					

TESTING LINE1:

FREQ. (MHz)	AMPL QUASI-P dB(μV)	AMPL + LISN LOSSES dB(μV)	LIMIT QUASI-P dB(μV)	PASS?	MARGIN dB
0.45	24	24.11	48	YES	23.9
8.00	22	22.06	48	YES	25.9
ALL SIGNALS ARE BELOW 30 dBuV.					
12.00	26	26.61	48	YES	21.4
12.29	33	33.61	48	YES	14.4
14.32	23	23.61	48	YES	24.4
16.00	20	21.16	48	YES	26.8
ALL SIGNALS ARE BELOW 25 dBuV.					
19.00	12	13.67	48	YES	34.3
20.00	20	21.67	48	YES	26.3
30.00	10	13.05	48	YES	35.0
ALL OTHER FREQUENCIES BELOW					

Continued on next page.

TERMINAL DISTURBANCE VOLTAGE DATA

The 150 MHz BU-1000 board is measured.

TESTING NEUTRAL LINE :

FREQ. (MHz)	AMPL QUASI-P dB(μV)	AMPL + LISN LOSSES dB(μV)	LIMIT QUASI-P dB(μV)	PASS?	MARGIN dB
0.45	26	26.11	48	YES	21.9
7.37	39	39.06	48	YES	8.9
ALL SIGNALS ARE BELOW 30 dBuV.					
12.29	26	26.61	48	YES	21.4
14.31	22	22.61	48	YES	25.4
20.00	32	33.67	48	YES	14.3
ALL SIGNALS ARE BELOW 25 dBuV.					
28.00	24	25.40	48	YES	22.6
28.80	6	7.40	48	YES	40.6
29.90	17	19.40	48	YES	28.6
ALL OTHER FREQUENCIES BELOW LIMITS					

TESTING LINE1:

FREQ. (MHz)	AMPL QUASI-P dB(μV)	AMPL + LISN LOSSES dB(μV)	LIMIT QUASI-P dB(μV)	PASS?	MARGIN dB
0.45	26	26.11	48	YES	21.9
7.37	39	39.06	48	YES	8.9
ALL SIGNALS ARE BELOW 30 dBuV.					
12.00	24	24.61	48	YES	23.4
12.28	34	34.61	48	YES	13.4
14.32	21	21.61	48	YES	26.4
16.00	16	17.16	48	YES	30.8
ALL SIGNALS ARE BELOW 25 dBuV.					
19.00	12	13.67	48	YES	34.3
20.00	32	33.67	48	YES	14.3
30.00	12	15.05	48	YES	33.0
ALL OTHER FREQUENCIES BELOW LIMITS					

THE BURGHARDT BU-1000/115 MEETS THE CONDUCTED EMISSION REQUIREMENT OF FCC PART 15 FOR CLASS B, WITHOUT MODIFICATIONS.

IT ACHIEVES THIS WHILE IT IS IN THE TRANSMITTING OR RECEIVING MODES.

EMI TEST PROCEDURES
FCC PART 15, SUBPART B
UNINTENTIONAL RADIATED E-FIELD EMISSIONS

Unintentional emissions may be produced whenever the EUT is in the receive state. FCC Part 15 is used to evaluate them. Part 15 radiated measurements are performed on an open field test site with a metal ground plane, which conforms to specifications in CISPR 16. At Global Laboratories, our 3 & 10m test site is sheltered with a pegged post-and-beam wooden building. The EUT is positioned on a remotely controlled turntable to permit emission measurements from all sides of the EUT. The EUT is configured per FCC Part 15 to maximize emissions.

A Radio Frequency test receiver, in accordance with CISPR 16 is used to measure radiated emissions. Antenna height is variable between 1 and 4 meters for maximum signal reception. An antenna-to-EUT separation of 3 (Class B), or 10 (Class A) meters is established. Broadband antennas are used in both horizontal and vertical attitudes for maximum signal reception.

Emissions are first examined with a spectrum analyzer in Peak mode to isolate EUT-generated signals from the ambient. Signals are then measured with a Quasi-Peak receiver conforming to CISPR 16 and compared to limits. Antenna factors and cable loss are calculated in a computer spreadsheet.

Limits for radiated emissions are:

	Freq. (MHz)	dB(μV/m) Quasi-Peak
Class A (@ 10m)	30-88	39
	88-216	43.5
	216-960	46.4
	960-1000	49.5
Class B (@3m)	30-88	40
	88-216	43.5
	216-960	46
	960-1000	54

**EMI TEST PROCEDURES
FCC PART 90
EFFECTIVE RADIATED POWER EMISSION &
INTENTIONAL/SPURIOUS RADIATED EMISSION MEASUREMENTS**

The effective radiated power (ERP) emission measurements use a substitution method. The ERP measurements are used to determine the radiated power of the fundamental carrier as well as the limit of any spurious emissions produced by the EUT whenever it is transmitting. Spurious emissions are those emissions, other than the carrier, that appear when the transmitter is operating.

Measurements are performed in the open area test site (OATS) normally used to measure unintentional emission. The OATS uses a metal ground plane that conforms to specifications in CISPR 16 and ANS C63. In most projects, the 1 and 3 meter test sites are used. A frequency range of 9 kHz to the 10th harmonic of the fundamental carrier frequency is evaluated.

The EUT is positioned with the radiating element oriented normally and 1.5 meters above a metal ground plane. The radiating element can be an integral or external antenna, used to project the transmission signal. The test antenna is oriented to receive the maximum level of the fundamental carrier signal. Horizontal and vertical antenna polarities are used. The maximum carrier signal level is stored in a spectrum analyzer channel.

After this is done, the EUT is removed from the measurement site and replaced with a reference dipole antenna. The reference antenna element lengths are adjusted for ½ wave resonance at the carrier frequency. Then it is located in the former EUT position.

A signal generator and amplifier/preamplifier (if necessary) are used to inject a signal into the dipole. Using the second channel of the spectrum analyzer, the signal generator output is adjusted until the same emission level is produced from the dipole as what was produced from the EUT.

The effective radiated power (ERP) produced by the EUT is calculated from the power generated by the signal generator/amplifier/pre-amplifier and factoring in the cable losses and antenna gain factors.

**EMI TEST PROCEDURES
FCC PART 90
EFFECTIVE RADIATED POWER EMISSION &
INTENTIONAL/SPURIOUS RADIATED EMISSION MEASUREMENTS**

The limits all spurious emissions must meet are calculated from formulas stated in the standard. The formulas depend on the type of emission (i.e. F3E), the carrier frequency and the authorized bandwidth for the carrier. The limits are in terms of decibels below the ERP of the carrier frequency. The limit formulae are called “emission masks.”

For example, emission mask “C” of Part 90 uses a limit formula of $43 + 10 \log P$, where P is the effective radiated power of the EUT in watts. Any frequency more than 250% removed from the authorized bandwidth is to be reduced in dB calculated with this formula.

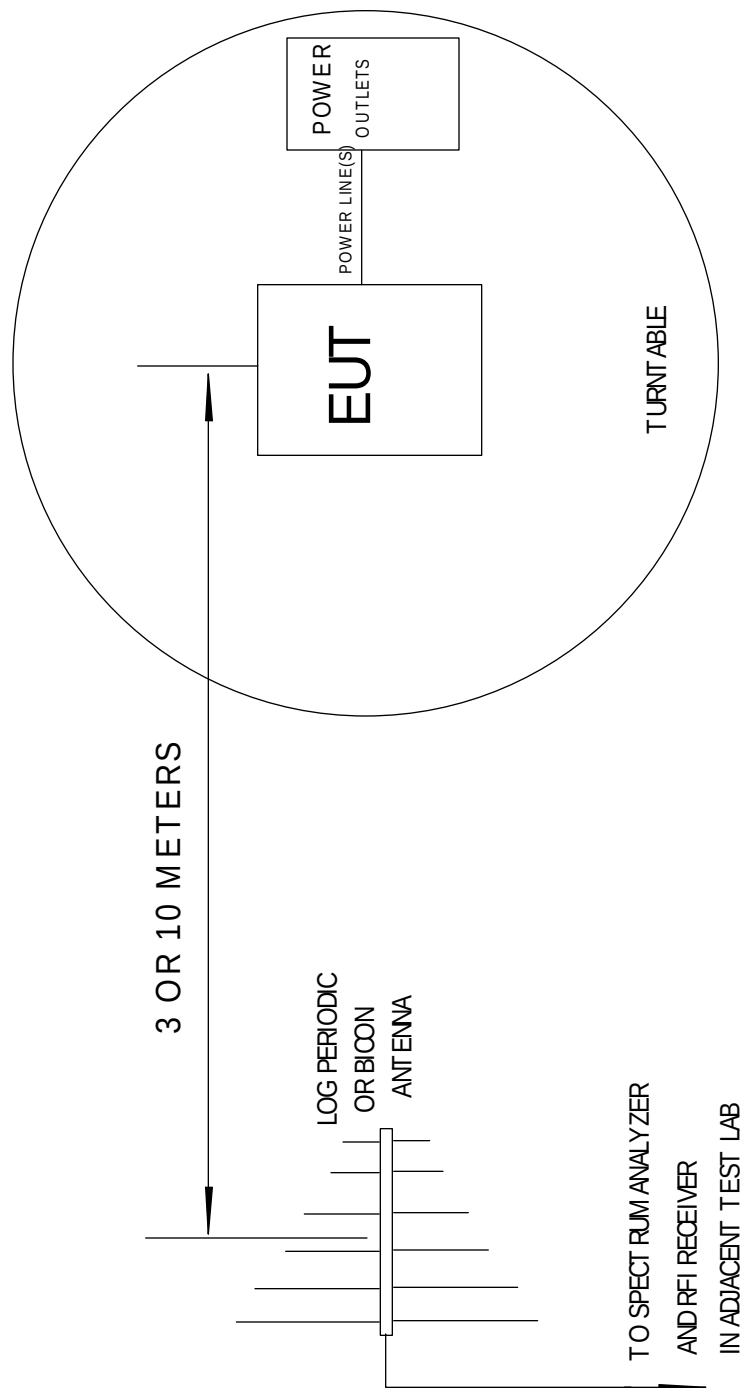
For convenience, the maximum allowable level of the spurious emissions calculated by the emission mask formula is replicated with the same signal source/reference dipole antenna combination that was used to measure the ERP.

The receiver reading obtained is converted to an absolute field strength value as in conventional EMC measurements.

All spurious emissions measurements are performed with the carrier signal modulated. The modulation is representative of actual EUT operation unless specifically defined in the standard. The ERP calculation is based on measurements performed with an unmodulated carrier signal.

GLOBAL CERTIFICATION LABORATORIES, LTD. RADIATED EMISSIONS TEST SET-UP

TURNTABLE AND ANTENNA ARE LOCATED
 IN A POST-AND-BEAM WOODEN "BARN"



DATA TABLE EXPLANATION
RADIATED ELECTRIC EMISSIONS TESTS

The DATA TABLE PAGES contain the following information:

TITLE: indicating the test performed
EUT
PERSON WHO PERFORMED THE TEST
TEST STANDARD(S)
DATE OF TEST
TEST SITE
TEST INSTRUMENTATION
NOTES

The DATA TABLE headings are as follows:

FREQ. MHz	The FREQUENCY, in megahertz, at which a signal is detected.
AMPL QUASI-P dB(μV)	The QUASI-PEAK AMPLITUDE, in decibels microvolt, of the signal.
AMPL PEAK dBm	The PEAK AMPLITUDE, in decibels milliwatt, of the signal.
AZIMUTH DEGREES	Approximate turntable position with respect to the antenna (mostly for diagnostics).
CABLE LOSS	Insertion loss due to the transmission line between the antenna and the measuring set. Measured in dB.
ANTENNA FACTORS dB /m	Convert measured antenna voltage to units of field strength, also account for antenna's loss receiving the radiated signal.
TOTAL FIELD dB(μV/m)	the sum of the received signal at the measuring set, plus cable and antenna losses.
EFFECTIVE RADIATED POWER	the power supplied to an antenna multiplied by the gain of the antenna in linear units. The gain is added if dB units are used. The units may be in dBm or mW.
LIMIT QUASI-P dB(μV/m)	the LIMIT, in decibel microvolt per meter, for the above signal
PASS?	Is the signal acceptable under the standards? ("YES" or "NO")
MARGIN	the MARGIN, in decibels, by which the EUT passes or fails.

RADIATED EMISSIONS TEST DATA

RADIATED EMISSIONS DATA USING THE FCC PART 90 METHODS FOR EMISSIONS THAT APPEAR WHEN THE EUT IS TRANSMITTING AND FCC PART 15, CLASS B WHEN THE EUT IS IN THE RECEIVE OR IDLE STATE.

FILE NAME: BUR0001

BU1000/155: BU-1000/155 DATA TRANSCEIVER

THE EUT IS POWERED BY 120 VAC, 60 Hz.

THE EUT(s) ARE NOT SERIALIZED:

CUSTOMER REPRESENTATIVES: DAVID SMITH (not present)

MEASURED BY STEVE PETIX FROM 2/22/00 TO 3/16/00 TO FCC PARTS 15(B) & 90 USING THE 3 METER OPEN AREA TEST SITE, (OATS).

THE EUT MEASURING ANTENNAS ARE:

A SCHWARZBECK MODEL VHA9103 BICONICAL ANTENNA, (s/n: A) IS USED FOR 30 TO 300 MHz. AN AILTECH MODEL 96005, (s/n 1095), LOG PERIODIC ANTENNA IS USED FOR 300 TO 1000 MHz. AN EMCO MODEL 3115 s/n 2498 GUIDED RIDGE HORN ANTENNA IS USED FOR 1 TO 2.8 GHz.

SUBSTITUTION ANTENNA:

THE EMCO 140 to 400 MHz DIPOLE IS USED FOR THE SUBSTITUTION MEASUREMENTS.

THE ANTENNAS ARE FACING THE METER SIDE OF THE EUT IN ORDER TO OBTAIN FREQUENCIES OF INTEREST. ONCE THE FREQUENCIES OF INTEREST ARE FOUND, THEY WILL BE MAXIMIZED BY ANTENNA HEIGHT SCANS.

THE EUT ANTENNA IS 1.5 METERS ABOVE THE GROUND PLANE. BECAUSE OF THE FIELD PATTERN FROM THE ANTENNA USED, ONLY ANTENNA HEIGHT SCANS ARE NEEDED TO FIND THE MAXIMUM VALUE OF A SIGNAL.

WHEN THE SUBSTITUTION ANTENNA IS USED, IT IS ORIENTED THE SAME AS THE EUT AND AT THE SAME HEIGHT.

A SCHWARZBECK RFI RECEIVER IS USED FOR QUASI-PEAK DETECTION.

ADVANTEST R3361A & HP8569B SPECTRUM ANALYZERS ARE USED IN PEAK DETECTION.

Three boards have been made. They are configured for the following frequencies: 150 MHz, 154.6 MHz and 160 MHz.

Radiated emission measurements will be made on all three boards using a tuned dipole set for each board's frequency. The purchaser of the BU-1000/155 transmitter board may use any generic antenna. The dipole is required in section 2.1053 of the rules for measuring spurious emissions from the enclosure.

Because the spurious emissions detected at the antenna port were negligible compared to the fundamental, the BU-1000/155 is measured in an unshielded enclosure. For convenience, the enclosure is opened during testing.

continued on next page

RADIATED EMISSIONS TEST DATA

The EUT is now operated continuously in the transmit mode. The carrier is unmodulated.

(Fundamental = 160 MHz)							
THE 140 TO 400 MHz SUBSTITUTION DIPOLE IS VERTICAL.							
FREQ. (MHz)	LENGTH OF EACH DIPOLE AERIAL (mm)	MATCH SIG GEN OUTPUT (dBuV)	MATCH SIG GEN OUTPUT (dBm)	LAB to OATS REF ANT CABLE LOSS (dB)	DIPOLE ANTENNA GAIN (dBi)	EFFECTIVE RADIATED POWER (dBm)	EFFECTIVE RADIATED POWER (mw)
160.00	439	134	27.00	3.4	1.90	26	398.11

The formula $43 + 10\log P$ gives us 39 dB, which is the level the spurious emissions need to be reduced to with respect to the fundamental carrier level. The effective radiated power, P, is .39811 watts in this case. The Matching signal generator output level entered into the table above includes a 37 dB gain contributed by a power amplifier that was needed to reproduce the signal level made by the BU-1000/155.

The maximum radiated power of spurious emissions that are removed from the authorized bandwidth by 250% (50kHz) need to be 39 dBm below the unmodulated carrier. A signal generator output of 58+37 or 95 dBm produces an equivalent maximum spurious emission level.

This power is now measured by a quasi-peak receiver to state the maximum spurious emission level in terms of a field strength. The table below calculates this.

THE 30 TO 300 MHz ANTENNA IS VERTICAL @3m.				
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)
160.00	64	2.98	16.70	83.68

The limit for all spurious emissions greater than +/- 50 kHz from the carrier shall be no higher than 83.68 dBuV/m. The amplifier will not be used with measurements. The EUT signal will be modulated by the modulation signal supplied by Burghardt for the spurious emissions. The same tuned dipole used for the substitution measurements will be used for the measurement of spurious emissions.

Each dipole antenna element is 439 mm long.

continued on next page

RADIATED EMISSIONS TEST DATA

The following measurements are performed with the BU-1000/155 in the receive mode and not transmitting. The FCC Part 15 Class B limits are used. All measurements are using QUASI-PEAK detection. When used, the Advantest R33614 spectrum analyzer is set up to use a 10 MHz Span,

Resolution Bandwidth of 120 kHz, Video Bandwidth of 1 MHz and 5 dB per division.

(Fundamental = 160 MHz)							
THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
149.33	18	1.92	13.98	33.90	44	YES	9.60
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 160 MHz)							
THE 30 TO 300 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
149.33	23	1.92	13.98	38.90	44	YES	4.60
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 160 MHz)							
THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 160 MHz)							
THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

The BU-1000/155 is now transmitting at the carrier frequency and that signal is modulated.
The limit calculated during the substitution measurements is used.
All measurements are PEAK detections.

(Fundamental = 160 MHz)							
THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
53.36	39	0.63	10.10	49.73	83.68	YES	33.95
80.00	47	1.05	5.64	53.69	83.68	YES	30.00
106.73	45	1.22	10.93	57.15	83.68	YES	26.53
142.17	22	1.92	12.67	36.59	83.68	YES	47.09
149.33	29	1.92	13.98	44.90	83.68	YES	38.78
152.87	37	1.92	14.77	53.69	83.68	YES	29.99
154.50	29	1.92	15.21	46.13	83.68	YES	37.56
156.50	36	1.92	15.64	53.56	83.68	YES	30.12
160.00	102	1.92	16.51	120.43	N/A	N/A	N/A
163.57	33	1.92	16.75	51.67	83.68	YES	32.01
167.19	35	2.17	16.82	53.99	83.68	YES	29.70
170.71	29	2.17	16.88	48.05	83.68	YES	35.63
184.81	24	2.17	17.90	44.07	83.68	YES	39.61
213.34	61	2.45	18.60	82.05	83.68	YES	1.63
240.00	42	2.59	18.60	63.19	83.68	YES	20.49
266.73	44	2.84	18.96	65.80	83.68	YES	17.88
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 160 MHz)							
THE 30 TO 300 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
53.39	31	0.63	10.10	41.73	83.68	YES	41.95
106.65	31	1.22	10.93	43.15	83.68	YES	40.53
106.66	33	1.22	10.93	45.15	83.68	YES	38.53
149.32	30	1.92	13.98	45.90	83.68	YES	37.78
156.50	26	1.92	15.64	43.56	83.68	YES	40.12
160.00	88	1.92	16.51	106.43	N/A	N/A	N/A
163.60	24	1.92	16.75	42.67	83.68	YES	41.01
167.17	22	2.17	16.82	40.99	83.68	YES	42.70
213.36	36	2.45	18.60	57.05	83.68	YES	26.63
266.74	45	2.84	18.96	66.80	83.68	YES	16.88
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

(Fundamental = 160 MHz)							
THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
320	56	3.38	17.84	77.22	83.68	YES	6.47
373.34	34.5	3.70	15.76	53.97	83.68	YES	29.72
426.736	37	3.70	15.48	56.18	83.68	YES	27.50
480.03	36	4.44	17.44	57.88	83.68	YES	25.80
533.34	43	5.05	18.43	66.48	83.68	YES	17.21
586.7	54	4.81	19.00	77.82	83.68	YES	5.87
640	57	4.81	19.70	81.52	83.68	YES	2.17
746.74	45	5.47	20.37	70.84	83.68	YES	12.85
800	46	5.81	20.16	71.97	83.68	YES	11.71
853.34	45	5.81	22.24	73.05	83.68	YES	10.63
906.73	42	7.13	24.06	73.19	83.68	YES	10.50
960.4	36	7.77	22.32	66.09	83.68	YES	17.59
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 160 MHz)							
THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
320	49	3.38	17.84	70.22	83.68	YES	13.47
373.34	35	3.70	15.76	54.47	83.68	YES	29.22
426.736	44.5	3.70	15.48	63.68	83.68	YES	20.00
480.03	44	4.44	17.44	65.88	83.68	YES	17.80
533.34	47	5.05	18.43	70.48	83.68	YES	13.21
586.7	51	4.81	19.00	74.82	83.68	YES	8.87
640	51	4.81	19.70	75.52	83.68	YES	8.17
746.74	41	5.47	20.37	66.84	83.68	YES	16.85
800	44	5.81	20.16	69.97	83.68	YES	13.71
853.34	46	5.81	22.24	74.05	83.68	YES	9.63
906.73	40	7.13	24.06	71.19	83.68	YES	12.50
960.4	29	7.77	22.32	59.09	83.68	YES	24.59
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

The following measurements were done with the HP 8569B spectrum analyzer set to 5dB/Division, 100 kHz resolution bandwidth, no video filtering and 0 dB attenuation.

(Fundamental = 160 MHz)								
THE 1 TO 18 GHz HORN IS VERTICAL AND AT 3 METERS.								
FREQ. (MHz)	AMPL PEAK dBm	AMPL PEAK dBuV	CABLE LOSS dB	HORN ANTENNA FACTOR	TOTAL FIELD (dBuV/m)	FCC LIMIT dB(μV/m)	PASS?	MARGIN (dBμV)
1014	-79	28	10.85	24.8	53	83.68	YES	30.88
1067	-68	39	10.85	24.8	64	83.68	YES	19.88
1095	-85	22	10.85	24.8	47	83.68	YES	36.88
1121	-76	31	10.85	25.04	56	83.68	YES	27.64
1174	-81	26	10.85	25.04	51	83.68	YES	32.64
1281	-82	25	13.39	25.28	50	83.68	YES	33.40
1308	-82	25	13.39	25.52	51	83.68	YES	33.16
1334	-82	25	13.39	25.52	51	83.68	YES	33.16
1362	-82	25	16.60	25.52	51	83.68	YES	33.16
1388	-82	25	16.60	25.52	51	83.68	YES	33.16
1442	-79	28	16.60	25.76	54	83.68	YES	29.92
1603	-88	19	15.08	26.5	46	83.68	YES	38.18
1763	-87	20	15.22	27	47	83.68	YES	36.68
NO OTHER SIGNIFICANT EUT SIGNALS FOUND FOR THE 1 TO 2.8 GHz RANGE.								

(Fundamental = 160 MHz)								
THE 1 TO 18 GHz HORN IS HORIZONTAL AND AT 3 METERS.								
FREQ. (MHz)	AMPL PEAK dBm	AMPL PEAK dBuV	CABLE LOSS dB	HORN ANTENNA FACTOR	TOTAL FIELD (dBuV/m)	FCC LIMIT dB(μV/m)	PASS?	MARGIN (dBμV)
1014	-84	23	10.85	24.8	48	83.68	YES	35.88
1067	-65	42	10.85	24.8	67	83.68	YES	16.88
1121	-78	29	10.85	25.04	54	83.68	YES	29.64
1174	-82	25	10.85	25.04	50	83.68	YES	33.64
1281	-80	27	13.39	25.28	52	83.68	YES	31.40
1388	-88	19	16.60	25.52	45	83.68	YES	39.16
1442	-87	20	16.60	25.76	46	83.68	YES	37.92
1603	-86	21	15.08	26.5	48	83.68	YES	36.18
1763	-90	17	15.22	27	44	83.68	YES	39.68
NO OTHER SIGNIFICANT EUT SIGNALS FOUND FOR THE 1 TO 2.8 GHz RANGE.								

continued on next page

RADIATED EMISSIONS TEST DATA

THE BU-1000/155 TRANSCEIVER BOARD IS REPLACED WITH ONE OPERATING AT 154.6 MHz.

The following measurements are performed with the BU1000/155 in the receive mode and not transmitting. The FCC Part 15 Class B limits are used. All measurements are QUASI-PEAK detection.

Each antenna element has been lengthened to 453 mm.

(Fundamental = 154.6 MHz)							
THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
143.89	15	1.92	12.96	29.88	44	YES	13.62
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 154.6 MHz)							
THE 30 TO 300 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
143.89	20	1.92	12.96	34.88	44	YES	8.62
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 154.6 MHz)							
THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 154.6 MHz)							
THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

The BU-1000/155 is now transmitting at the carrier frequency and that signal is modulated.
The limit calculated during the substitution measurements is used.
All measurements are PEAK detection.

(Fundamental = 154.6 MHz)							
THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
51.6	27	0.63	10.42	38.05	83.68	YES	45.63
103.06	39	1.22	10.70	50.91	83.68	YES	32.77
143.92	32	1.92	13.10	47.03	83.68	YES	36.66
147.54	35	1.92	13.69	50.61	83.68	YES	33.08
151.00	51	1.92	14.34	67.26	83.68	YES	16.42
154.62	101	1.92	15.21	118.13	N/A	N/A	N/A
158.19	46	1.92	16.07	63.99	83.68	YES	19.69
206.13	50	2.45	18.62	71.07	83.68	YES	12.61
257.00	50	2.84	18.56	71.40	83.68	YES	12.28
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 154.6 MHz)							
THE 30 TO 300 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
103.06	33	1.22	10.70	44.91	83.68	YES	38.77
143.92	30	1.92	13.10	45.03	83.68	YES	38.66
147.54	23	1.92	13.69	38.61	83.68	YES	45.08
151.00	26	1.92	14.34	42.26	83.68	YES	41.42
154.62	80	1.92	15.21	97.13	N/A	N/A	N/A
158.19	27	1.92	16.07	44.99	83.68	YES	38.69
165.36	27	2.17	16.78	45.95	83.68	YES	37.73
206.13	44	2.45	18.62	65.07	83.68	YES	18.61
210.00	46	2.45	18.60	67.05	83.68	YES	16.63
257.00	45	2.84	18.56	66.40	83.68	YES	17.28
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

(Fundamental = 154.6 MHz)							
THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
309.24	54	3.38	18.32	75.70	83.68	YES	7.99
360.77	42	3.38	16.24	61.62	83.68	YES	22.07
412.31	41	3.70	15.06	59.76	83.68	YES	23.92
463.81	46	4.44	16.74	67.18	83.68	YES	16.50
515.39	50	5.05	18.21	73.26	83.68	YES	10.43
567	52	5.05	18.78	75.83	83.68	YES	7.85
618.43	55	4.81	19.38	79.19	83.68	YES	4.49
669.96	37	5.23	20.03	62.26	83.68	YES	21.42
721.47	48	5.47	20.44	73.91	83.68	YES	9.77
773.01	43	5.47	20.29	68.75	83.68	YES	14.93
824.56	32	5.81	21.12	58.93	83.68	YES	24.75
876.11	36	7.13	23.20	66.33	83.68	YES	17.36
927.64	35	7.13	23.44	65.57	83.68	YES	18.12
968.47	23	7.77	22.08	52.84	83.68	YES	30.84
979.16	35	7.77	21.83	64.59	83.68	YES	19.09
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 154.6 MHz)							
THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
309.24	50	3.38	18.32	71.70	83.68	YES	11.99
360.77	45	3.38	16.24	64.62	83.68	YES	19.07
412.31	42	3.70	15.06	60.76	83.68	YES	22.92
463.81	38	4.44	16.74	59.18	83.68	YES	24.50
515.39	52	5.05	18.21	75.26	83.68	YES	8.43
567	50	5.05	18.78	73.83	83.68	YES	9.85
618.43	48	4.81	19.38	72.19	83.68	YES	11.49
669.96	41	5.23	20.03	66.26	83.68	YES	17.42
721.47	40	5.47	20.44	65.91	83.68	YES	17.77
762.31	23	5.47	20.32	48.79	83.68	YES	34.89
769.47	27	5.47	20.30	52.77	83.68	YES	30.92
773.01	46	5.47	20.29	71.75	83.68	YES	11.93
824.56	48	5.81	21.12	74.93	83.68	YES	8.75
876.11	40	7.13	23.20	70.33	83.68	YES	13.36
927.64	40	7.13	23.44	70.57	83.68	YES	13.12
968.47	22	7.77	22.08	51.84	83.68	YES	31.84
979.16	30	7.77	21.83	59.59	83.68	YES	24.09
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

RADIATED EMISSIONS TEST DATA

The following measurements were done with the HP 8569B spectrum analyzer set to 5dB/Division, 100 kHz resolution bandwidth, no video filtering and 0 dB attenuation.

(Fundamental = 154.6 MHz)								
THE 1 TO 18 GHz HORN IS VERTICAL AND AT 3 METERS.								
FREQ. (MHz)	AMPL PEAK dBm	AMPL PEAK dBuV	CABLE LOSS dB	HORN ANTENNA FACTOR	TOTAL FIELD (dBuV/m)	FCC LIMIT dB(μV/m)	PASS?	MARGIN (dBμV)
1032	-81	26	10.85	24.8	51	83.68	YES	32.88
1084	-79	28	10.85	24.8	53	83.68	YES	30.88
1135	-80	27	10.85	25.04	52	83.68	YES	31.64
1187	-80	27	13.39	25.04	52	83.68	YES	31.64
1238	-79	28	13.39	25.28	53	83.68	YES	30.40
1290	-69	38	13.39	25.28	63	83.68	YES	20.40
1342	-77	30	13.39	25.52	56	83.68	YES	28.16
1393	-77	30	16.60	25.52	56	83.68	YES	28.16
1445	-82	25	16.60	25.76	51	83.68	YES	32.92
1497	-82	25	16.60	25.76	51	83.68	YES	32.92
1549	-88	19	15.08	26	45	83.68	YES	38.68
1652	-90	17	15.08	26.5	44	83.68	YES	40.18
1704	-89	18	15.08	27	45	83.68	YES	38.68
NO OTHER SIGNIFICANT EUT SIGNALS FOUND FOR THE 1 TO 2.8 GHz RANGE.								

(Fundamental = 154.6 MHz)								
THE 1 TO 18 GHz HORN IS HORIZONTAL AND AT 3 METERS.								
FREQ. (MHz)	AMPL PEAK dBm	AMPL PEAK dBuV	CABLE LOSS dB	HORN ANTENNA FACTOR	TOTAL FIELD (dBuV/m)	FCC LIMIT dB(μV/m)	PASS?	MARGIN (dBμV)
1032	-76	31	10.85	24.8	56	83.68	YES	27.88
1084	-69	38	10.85	24.8	63	83.68	YES	20.88
1135	-73	34	10.85	25.04	59	83.68	YES	24.64
1393	-80	27	16.60	25.52	53	83.68	YES	31.16
1445	-80	27	16.60	25.76	53	83.68	YES	30.92
NO OTHER SIGNIFICANT EUT SIGNALS FOUND FOR THE 1 TO 2.8 GHz RANGE.								

continued on next page

RADIATED EMISSIONS TEST DATA

THE BU-1000/155 TRANSCEIVER BOARD IS REPLACED WITH ONE OPERATING AT 150 MHz.

The following measurements are performed with the BU-1000/155 in the receive mode and not transmitting. The FCC Part 15 Class B limits are used. All measurements are QUASI-PEAK detection.

Each antenna element has been lengthened to 468 mm.

(Fundamental = 150 MHz)							
THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
76.3	11	1.05	5.38	17.43	40	YES	22.57
80	13	1.05	5.64	19.69	40	YES	20.31
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 150 MHz)							
THE 30 TO 300 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
76	6	1.05	5.38	12.43	40	YES	27.57
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 150 MHz)							
THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 150 MHz)							
THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL QUASI-P dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
NO SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

The BU-1000/155 is now transmitting at the carrier frequency and that signal is modulated.
The limit calculated during the substitution measurements is used.
All measurements are PEAK detection.

(Fundamental = 150 MHz)							
THE 30 TO 300 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
50	38	0.63	11.08	49.71	83.68	YES	33.98
100.00	50	1.22	10.47	61.69	83.68	YES	22.00
139.33	28	1.92	12.54	42.46	83.68	YES	41.22
146.52	36	1.92	13.54	51.46	83.68	N/A	N/A
146.82	33	1.92	13.54	48.46	83.68	YES	35.22
150.00	96	1.92	14.12	112.04	N/A	N/A	N/A
153.29	33	1.92	14.99	49.91	83.68	YES	33.77
153.58	40	1.92	14.99	56.91	83.68	YES	26.77
160.72	28	1.92	16.68	46.60	83.68	YES	37.08
164.29	25	1.92	16.75	43.67	83.68	YES	40.01
167.90	23	2.17	16.83	42.00	83.68	YES	41.68
171.43	27	2.17	16.90	46.07	83.68	YES	37.61
175.20	33	2.17	16.97	52.14	83.68	YES	31.55
200.00	61	2.45	18.62	82.07	83.68	YES	1.61
250.00	51	2.84	18.56	72.40	83.68	YES	11.28
300.00	51	3.38	20.64	75.02	83.68	YES	8.67
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

(Fundamental = 150 MHz)							
THE 30 TO 300 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
100.00	36	1.22	10.47	47.69	83.68	YES	36.00
139.33	22	1.92	12.54	36.46	83.68	YES	47.22
146.52	21	1.92	13.54	36.46	83.68	YES	47.22
150.00	81	1.92	14.12	97.04	N/A	N/A	N/A
153.29	22	1.92	14.99	38.91	83.68	N/A	N/A
153.58	24	1.92	14.99	40.91	83.68	YES	42.77
200.00	53	2.45	18.62	74.07	83.68	YES	9.61
250.00	38	2.84	18.56	59.40	83.68	YES	24.28
300.00	49	3.38	20.64	73.02	83.68	YES	10.67
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

(Fundamental = 150 MHz)							
THE 300 TO 1000 MHz ANTENNA IS VERTICAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
297.93	42	3.34	18.10	63.44	83.68	YES	20.24
300	58	3.38	18.64	80.02	83.68	YES	3.67
302	44	3.38	18.64	66.02	83.68	YES	17.67
297 & 302 MHz are broadband peaks.							
325	42	3.38	17.68	63.06	83.68	YES	20.63
350	38	3.38	16.72	58.10	83.68	YES	25.59
375	49	3.70	15.76	68.47	83.68	YES	15.22
400	39	3.70	14.64	57.34	83.68	YES	26.34
425	38	3.70	15.48	57.18	83.68	YES	26.50
450	53	4.44	16.32	73.76	83.68	YES	9.92
475	38	4.44	17.16	59.60	83.68	YES	24.08
500	45	4.44	18.08	67.52	83.68	YES	16.17
508.36	25	4.44	18.17	47.61	83.68	YES	36.08
525	46	5.05	18.34	69.39	83.68	YES	14.29
550	45	5.05	18.61	68.65	83.68	YES	15.03
575	36	5.05	18.87	59.92	83.68	YES	23.77
600	49	4.81	19.16	72.98	83.68	YES	10.71
625	38	4.81	19.49	62.30	83.68	YES	21.38
650	37	5.23	19.81	62.05	83.68	YES	21.64
675	43	5.23	20.08	68.32	83.68	YES	15.37
700	44	5.23	20.50	69.74	83.68	YES	13.95
725	38	5.47	20.43	63.90	83.68	YES	19.79
750	49	5.47	20.36	74.83	83.68	YES	8.86
775	40	5.47	20.29	65.75	83.68	YES	17.93
800	48	5.81	20.16	73.97	83.68	YES	9.71
825	41	5.81	21.12	67.93	83.68	YES	15.75
850	51	5.81	22.08	78.89	83.68	YES	4.79
875	31	7.13	23.04	61.17	83.68	YES	22.52
900	33	7.13	24.18	64.31	83.68	YES	19.37
925	26	7.13	23.44	56.57	83.68	YES	27.12
950	39	9.84	22.70	71.54	83.68	YES	12.14
975	31	7.77	21.95	60.72	83.68	YES	22.97
1000	32	8.19	21.10	61.29	83.68	YES	22.40
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

(Fundamental = 150 MHz)							
THE 300 TO 1000 MHz ANTENNA IS HORIZONTAL AND AT 3 METERS.							
FREQ. (MHz)	AMPL PEAK dB(μV)	CABLE LOSS, dB	ANTENNA FACTORS dB/m	TOTAL FIELD dB(μV/m)	LIMIT QUASI-P dB(μV/m)	PASS?	MARGIN dB
297.93	40	3.34	18.10	61.44	83.68	YES	22.24
300	60	3.38	18.64	82.02	83.68	YES	1.67
302	54	3.38	18.64	76.02	83.68	YES	7.67
297 & 302 MHz are broadband peaks.							
325	38.5	3.38	17.68	59.56	83.68	YES	24.13
348	31	3.38	16.72	51.10	83.68	YES	32.59
350	47	3.38	16.72	67.10	83.68	YES	16.59
352.19	35.5	3.38	16.56	55.44	83.68	YES	28.25
375	46	3.70	15.76	65.47	83.68	YES	18.22
400	47	3.70	14.64	65.34	83.68	YES	18.34
425	37	3.70	15.48	56.18	83.68	YES	27.50
450	53	4.44	16.32	73.76	83.68	YES	9.92
475	36	4.44	17.16	57.60	83.68	YES	26.08
500	40	4.44	18.08	62.52	83.68	YES	21.17
508.36	32	4.44	18.17	54.61	83.68	YES	29.08
525	51	5.05	18.34	74.39	83.68	YES	9.29
550	49	5.05	18.61	72.65	83.68	YES	11.03
575	44	5.05	18.87	67.92	83.68	YES	15.77
600	55	4.81	19.16	78.98	83.68	YES	4.71
625	36	4.81	19.49	60.30	83.68	YES	23.38
650	38	5.23	19.81	63.05	83.68	YES	20.64
675	47	5.23	20.08	72.32	83.68	YES	11.37
700	44	5.23	20.50	69.74	83.68	YES	13.95
725	36	5.47	20.43	61.90	83.68	YES	21.79
750	50	5.47	20.36	75.83	83.68	YES	7.86
775	41	5.47	20.29	66.75	83.68	YES	16.93
800	48	5.81	20.16	73.97	83.68	YES	9.71
825	42	5.81	21.12	68.93	83.68	YES	14.75
850	45	5.81	22.08	72.89	83.68	YES	10.79
875	45	7.13	23.04	75.17	83.68	YES	8.52
900	45	7.13	24.18	76.31	83.68	YES	7.37
925	29	7.13	23.44	59.57	83.68	YES	24.12
950	26	9.84	22.70	58.54	83.68	YES	25.14
975	36	7.77	21.95	65.72	83.68	YES	17.97
1000	34	8.19	21.10	63.29	83.68	YES	20.40
NO OTHER SIGNIFICANT EUT GENERATED SIGNALS FOUND FOR THIS RANGE.							

continued on next page

RADIATED EMISSIONS TEST DATA

The following measurements were done with the HP 8569B spectrum analyzer set to 5dB/Division, 100 kHz resolution bandwidth, 1 MHz/division, no video filtering and 0 dB attenuation.

(Fundamental = 150 MHz)								
THE 1 TO 18 GHz HORN IS VERTICAL AND AT 3 METERS.								
FREQ. (MHz)	AMPL PEAK dBm	AMPL PEAK dBuV	CABLE LOSS dB	HORN ANTENNA FACTOR	TOTAL FIELD (dBuV/m)	FCC LIMIT dB(μV/m)	PASS?	MARGIN (dBμV)
1000	-72	35	10.85	24.8	60	83.68	YES	23.88
1051	-70	37	10.85	24.8	62	83.68	YES	21.88
1101	-73	34	10.85	25.04	59	83.68	YES	24.64
1152	-75	32	10.85	25.04	57	83.68	YES	26.64
1202	-73	34	13.39	25.28	59	83.68	YES	24.40
1252	-74	33	13.39	25.28	58	83.68	YES	25.40
1352	-75	32	13.39	25.52	58	83.68	YES	26.16
1403	-77	30	16.60	25.76	56	83.68	YES	27.92
1453	-74	33	16.60	25.76	59	83.68	YES	24.92
1653	-76	31	15.08	26.5	58	83.68	YES	26.18
NO OTHER SIGNIFICANT EUT SIGNALS FOUND FOR THE 1 TO 2.8 GHz RANGE.								

(Fundamental = 150 MHz)								
THE 1 TO 18 GHz HORN IS HORIZONTAL AND AT 3 METERS.								
FREQ. (MHz)	AMPL PEAK dBm	AMPL PEAK dBuV	CABLE LOSS dB	HORN ANTENNA FACTOR	TOTAL FIELD (dBuV/m)	FCC LIMIT dB(μV/m)	PASS?	MARGIN (dBμV)
1000	-84	23	10.85	24.8	48	83.68	YES	35.88
1051	-74	33	10.85	24.8	58	83.68	YES	25.88
1101	-79	28	10.85	25.04	53	83.68	YES	30.64
1152	-79	28	10.85	25.04	53	83.68	YES	30.64
1202	-77	30	13.39	25.28	55	83.68	YES	28.40
1252	-79	28	13.39	25.28	53	83.68	YES	30.40
1352	-89	18	13.39	25.52	44	83.68	YES	40.16
1457	-80	27	16.60	25.76	53	83.68	YES	30.92
1502	-89	18	16.60	26	44	83.68	YES	39.68
1552	-87	20	15.08	26	46	83.68	YES	37.68
1602	-89	18	15.08	26.5	45	83.68	YES	39.18
1653	-85	22	15.08	26.5	49	83.68	YES	35.18
NO OTHER SIGNIFICANT EUT SIGNALS FOUND FOR THE 1 TO 2.8 GHz RANGE.								

THE BURGHARDT BU-1000/155 MEETS THE RADIATED EMISSIONS REQUIREMENT OF FCC PART 15, CLASS B AND PART 90.

**EMI TEST PROCEDURES
FCC PART 90
MODULATION CHARACTERISTICS**

Part 2, section 2.1047 of the FCC title 47 rules requires a description of the modulation characteristics of the EUT. For equipment that is voice modulated, it is necessary to plot the frequency response of the audio modulating circuit while using a modulation signal of 100 to 5000 Hz in discrete steps. For equipment that employs audio modulation limiting circuitry, it is necessary to plot the frequency response of the audio modulating circuit as a function of modulating signal voltage.

For equipment that uses internal modulation sources and limiting circuits, plots are not absolutely necessary. But the report should describe the modulating signal and display an oscilloscope trace of it.

For this project, a measurement of the RF output deviation as a function of modulation signal voltage was performed by David Smith. The modulation signal is a digital encoding of the meter reading that is formatted by the MRU board.

These measurements are typical of all versions the BU-1000/155, as well as future versions of Burghardt's BU-1000 transmitter board that operate in other frequency bands.

Modulation (Volts Peak To Peak)	Deviation (+/-kHz)
0.5	0.6
1	1
1.5	1.4
2	1.7
2.5	2
3	2.2
3.5	2.5
4	2.6
4.5	2.8
5	3

The deviation of the BU-1000/155 is limited to (+-) 3khz by deviation control circuitry located in the MRU board.

EMI TEST PROCEDURES
FCC PART 90
OCCUPIED BANDWIDTH MEASUREMENTS,

It is necessary to measure and submit the occupied bandwidth of the fundamental or carrier transmitter signals according to Part 2, section 2.1049 and Part 90, section 90.209 of title 47 of the FCC rules. The occupied bandwidth is the frequency span, centered on the fundamental frequency, where 99% of the radiated power exists. The FCC specifies the occupied bandwidth i.e. “authorized bandwidth” for all relevant product families.

The spectrum analyzer plots included in this report document the occupied bandwidth for the transmitter frequencies of this EUT. All measurements are with a modulated carrier unless noted otherwise. The modulation is representative of actual EUT function unless directly specified by the standard.

It is necessary to measure and submit the occupied bandwidth of the fundamental or carrier transmitter signals according to Part 2, section 2.1049 of title 47 of the FCC rules. The occupied bandwidth is the frequency span, centered on the fundamental frequency, where 99% of the radiated power exists. The FCC specifies the occupied bandwidth i.e. “authorized bandwidth” for all relevant product families.

The occupied bandwidth measurements were obtained at the EUT antenna terminals. The antenna impedance was 50 ohms, so a good impedance match for the spectrum analyzer was achieved without an impedance matching network. The spectrum analyzer’s “max Hold” and marker features were used to determine the frequency bandwidth occupied by the transmitter signal. The resulting trace is plotted.

The EUT was modulated by a signal that originated from the MRU board.

The modulated carrier bandwidth of all three test frequencies was within the 20 kHz limit authorized in Part 90, section 90.209. The spectrum analyzer plots included in the separate plot and photo section document the occupied bandwidth for all test frequencies.

EMI TEST PROCEDURES
FCC PART 90
SPURIOUS EMISSIONS AND RF POWER OUTPUT
AT THE ANTENNA TERMINALS

Part 2; section 2.1051 of the FCC title 47 rules requires a relative measurement of spurious emissions at the antenna terminals of the EUT. Section 2.1046 requires the RF power be measured in the same way.

In this case, the measurements were performed by using the same connection to the EUT as was used in the occupied bandwidth measurements. The spectrum analyzer was connected the EUT board with a coaxial cable using the BNC connector at the antenna output that was present on the board.

The spectrum analyzer reference level was adjusted so the peak of the fundamental was at the reference level. The spectrum is plotted up to the tenth harmonic of the fundamental carrier frequency, as well as down to 0 MHz.

All spurious emissions are at least 30 dB below the carrier power level when measured this way. Because the spectrum analyzer vertical scale was operating in dBm, and a 50 ohm system was used, the RF power was measured at the same time.

The RF power for each frequency component has been plotted. If the RF output is sent to a RF Watt meter (or Bolometer), an RF power of 350 to 400 milliwatts would be measured.

Spectrum analyzer plots of the relative level of spurious emissions for all test frequencies are included in the plot and photo section of this report.

**EMI TEST PROCEDURES
FCC PART 90
FREQUENCY STABILITY MEASUREMENTS**

Part 2; section 2.1055 of the FCC title 47 rules requires a measurement of the carrier frequency stability under temperature and power voltage variations. The same methods of interfacing the EUT to the spectrum analyzer that were used for the occupied bandwidth measurements are used for the frequency stability measurements.

A refrigerator partially loaded with dry ice is used to produce the coldest temperature. To produce warmer temperatures, the refrigerator is vented of the dry ice, while monitoring the EUT temperature as it slowly warms. By monitoring the EUT temperature of the EUT and its ambient atmosphere during the temperature change, acceptable control of the EUT temperature is achieved. The EUT is not powered while it is reaching thermal equilibrium. Once the desired temperature is reached, the EUT is powered up. Any temperature compensating circuits are allowed to stabilize and then the carrier frequency is measured. This is repeated for every 10°C of temperature rise.

The vents are closed and the refrigerator is allowed to again cool to the lowest temperature for the remainder of the samples that are tested. It may be necessary to add dry ice to complete tests on all samples. Typically, the transmitters are configured for the upper, middle and lowest temperatures of the tuning range.

To get above room temperature (20°C), a portable heater is used. A thermocouple and its multimeter-based measuring device as well as a thermohygrometer are used to observe the temperatures of the EUT during all phases of the test.

Measurements are taken every 10°C until the highest temperature of the test is reached. The measurements are put into tabular form. The total frequency change tolerance allowed by the standard is expressed in terms of parts-per-million. The unmodulated carrier frequency is measured with the spectrum analyzer marker function operating over a narrow enough frequency span that allowed precision to 0.0000001 MHz.

The thermohygrometer is used to supply a calibration check of the thermocouple measurements. Typically one thermocouple will be mounted on the EUT transmitter board while it is inside an ESD-safe bag while a second one will be suspended in the refrigerated cavity to monitor the ambient temperature surrounding the EUT.

Frequency stability is also measured in much the same way while varying the power input voltage from 85% to 115% of nominal. An AC power source or autotransformer is used to produce varying AC power voltage. A DC power supply is used to produce varying DC power voltage for battery or DC powered equipment. Measurements were made every at 5% change in power voltage.

EMI TEST PROCEDURES
FCC PART 90
FREQUENCY STABILITY MEASUREMENT RESULTS

The BU-1000/155 frequency stability due to the 30°C to 50°C temperature and 80% to 115% power supply voltage variation for all tested boards is described by the tables below.

Carrier Design Frequency: 150 MHz

Power Supply Voltage Variation:

Power Supply % Voltage	Measured Carrier Frequency
80%: 96	150.000021
85%: 102	150.000014
90%: 108	150.000043
95%: 114	150.000064
100%: 120	150.000071
105%: 126	150.000093
110%: 132	150.000107
115%: 138	150.000171

Temperature Variation:

Temperature °C	Measured Carrier Frequency, MHz
-30	150.000656
-20	150.000514
-10	150.000449
0	150.000292
10	150.000284
20	150.000178
30	150.000207
40	150.000114
50	150.000171

For all measurements, FCC Rule 90.213 specifies a frequency stability of 5 p.p.m.
(5 X 10⁻⁶), which when multiplied by the carrier is +/- 0.000750 MHz, corresponding to:

High Limit 150.000750 MHz

Low Limit 149.999925 MHz

EMI TEST PROCEDURES
FCC PART 90
FREQUENCY STABILITY MEASUREMENT RESULTS, Continued

Carrier Design Frequency: 154.6 MHz

Power Supply Voltage Variation:

Power Supply % Voltage	Measured Carrier Frequency
80%: 96	154.600542
85%: 102	154.600328
90%: 108	154.600093
100%: 120	154.599971
105%: 126	154.599878
110%: 132	154.599850
115%: 138	154.599721

Temperature Variation:

Temperature °C	Measured Carrier Frequency, MHz
-30	154.600771
-20	154.600342
-10	154.600278
0	154.600071
10	154.600092
20	154.600142
30	154.599750
40	154.600721
50	154.600300

For all measurements, FCC Rule 95.627 specifies a frequency stability of 5 p.p.m.
(5 X 10⁻⁶), which when multiplied by the carrier is +/- 0.000773 MHz, corresponding to:

High Limit 154.600773 MHz
Low Limit 154.599227 MHz

EMI TEST PROCEDURES
FCC PART 90
FREQUENCY STABILITY MEASUREMENT RESULTS, Continued

Carrier Design Frequency: 160 MHz

Power Supply Voltage Variation:

Power Supply % Voltage	Measured Carrier Frequency
80%: 96	160.000128
85%: 102	160.000099
90%: 108	160.000113
95%: 108	160.000120
100%: 120	160.000142
105%: 126	160.000175
110%: 132	160.000192
115%: 138	160.000206

Temperature Variation:

Temperature °C	Measured Carrier Frequency, MHz
-30	160.000177
-20	160.000041
-10	160.000055
0	160.000727
10	160.000284
20	160.000106
30	160.000371
40	160.000428
50	160.000565

For all measurements, FCC Rule 95.627 specifies a frequency stability of 5 p.p.m.
(5 X 10⁻⁶), which when multiplied by the carrier is +/- 0.000800 MHz, corresponding to:

High Limit 160.000800 MHz
Low Limit 159.999200 MHz

EMI TEST PROCEDURES
FCC PART 90
TRANSIENT FREQUENCY BEHAVIOUR

Section 90.214 requires transmitters designed to operate in the 150-174 MHz and 421-512 MHz bands to control transient frequency effects within defined time intervals and frequency differences. The purpose is to measure the frequency difference between the actual and assigned carrier transmitter frequency that is caused by keying the transmitter on and off while using a 1kHz modulation test signal.

For this project, the modulation signal supplied by Burghardt was removed and replaced with a 1 kHz test signal that was injected into pin three of the five-pin connector on the BU-1000/155 board. A 0.1uFd capacitor was used between the coax center conductor and pin 3 to block low frequency signals. The outer shield coax conductor was soldered to the circuit ground plane. The test signal generator produced a one-volt signal level.

Measurements are taken by first recording in one spectrum analyzer channel the carrier under the 1KHz modulation. The “key” wire is then disconnected from its post on the MRU board. When the “key” signal is re-connected, the carrier frequency appears briefly displaced from where it had been centered in the first spectrum analyzer channel. Because power was never removed from the BU-1000/155 and the temperature never had a chance to change, the frequency displacement is due to the capture of the 1 kHz modulating test signal by the BU-1000/155.

Plots are included for all three boards that show the carrier frequency differences with the transmit function controlled by keying of the MRU board. The total frequency change is within 1 kHz for all boards.

SUMMARY
BURGHARDT INC.
BU-1000/155 DATA TRANSCEIVER

The BU-1000/155 DATA TRANSCEIVER, the EUT, was tested for RF emissions in accordance with the applicable agency rules and guidelines. In all tests, the cables were manipulated to achieve maximum emissions

The EUT was subjected to a TERMINAL DISTURBANCE VOLTAGE (CONDUCTED) EMISSIONS ANALYSIS.

The frequency closest to the applicable limits with the **150 MHz** board is: 7.37 MHz, with a 8.9 dB margin on the LINE and NEUTRAL conductors.

The frequency closest to the applicable limits with the **154.6 MHz** board is: 12.29 MHz, with a 14.4 dB margin on the LINE conductor.

The frequency closest to the applicable limits with the **160 MHz** board is: 7.37 MHz, with an 8.9 dB margin on the LINE and NEUTRAL conductors.

The EUT was subjected to Part 15 RADIATED ELECTRIC FIELD ANALYSIS.

The frequency closest to the limits with the **150 MHz** board was 80 MHz, with a 20.31 dB margin.

The frequency closest to the limits with the **154.6 MHz** board was 143.89 MHz, with a 8.62 dB margin.

The frequency closest to the limits with the **160 MHz** board was 149.33 MHz, with a 4.6 dB margin.

The EUT was subjected to PART 90 RADIATED SPURIOUS ELECTRIC FIELD ANALYSIS, using emission Mask "C" .

The frequency closest to the limits with the **150 MHz** board was 300 MHz, with a 1.67 dB margin.

The frequency closest to the limits with the **154.6 MHz** board was 618.43 MHz, with a 4.49 dB margin.

The frequency closest to the limits with the **160 MHz** board was 213.34 MHz, with a 1.63 dB margin.

The EUT's occupied bandwidth was measured and found to be within 20 kHz when it was modulated with the internally generated modulation signal.

The EUT has adequate frequency stability during temperature and power voltage variations. Transient frequency effects due to transmitter modulation turn-on time is within 1kHz.

The BURGHARDT INC. BU-1000/155 DATA TRANSCEIVER complies with all the requirements above without modifications.