FCC PART 15 SUB-PART B
EMI TEST REPORT

on

T1 to Fiber Optic Multiplexor

model name & number

DigiTie Fiber Optic Multiplexor (000-60001-001)

provided for evaluation by

Micropak Systems, Incorporated
498 Linderbergh Avenue
Livermore, California 94550

tests and evaluation performed by

Rockford Engineering Services Inc.
9959 Calaveras Road
Sunol, CA 94586
Tel: (510) 862-2944
Fax: (510) 862-9013
Email: service@rockfordengr.com

NVLAP® VCCI, EN45001 Accredited Laboratory

FCC PART 15 SUB-PART B
EMI TEST REPORT

on

T1 to Fiber Optic Multiplexor
DigiTie Fiber Optic Multiplexor (000-60001-001)

provided for evaluation by

Micropak Systems, Incorporated
498 Linderbergh Avenue
Livermore, California 94550

This report contains 27 pages without attachments

Accepted by the Federal Communications Commission (FCC)
for Declaration of Conformity Testing (Ref: NVLAP Lab Code 200172-0)

Approved by the Industry Canada for Telecom Testing

Certified by CETECOM GmbH for EMC Testing according to the European EMC Directive 89/336/EEC per EN45001

Certified by the Voluntary Control Council for Interference by Information Technology Equipment (VCCI) for EMC testing, in accordance with the Regulations for Voluntary Control Measures, Article 8, Registration Numbers- Site 1: C-714 & R-696 and Site 2: C-715 & R-697

Tested and Evaluated by Rockford Engineering Services, Incorporated

NVLAP®

NVLAP Accredited (Code 200172-0)

TABLE OF CONTENTS

TABLES

TABLE OF CONTENTS CONTD.

APPENDICES

PART 1 - GENERAL

1.1. TEST METHODOLOGY

The electromagnetic interference tests which this report describes were performed by an independent electromagnetic compatibility consultant, Rockford Engineering Services Inc., in accordance with the FCC test procedure ANSI C63.4-1992.

1.1.1 Test Facility

The open area test site, the conducted measurement facility, and the test equipment used to collect the emissions data is located in Sunol, California, and is fully described in site attenuation report dated April 7, 1994. The site attenuation description is currently on file at the Federal Communications Commission and was reviewed and approved by the Commission in its letter dated June 23, 1994.

1.1.2 Accuracy of Test Data

The test results contained in this report accurately represent the radiated and powerline conducted electromagnetic emissions generated by the sample equipment under test.

Equipment Tested: T1 to Fiber Optic Multiplexor,
Model Name & Number: DigiTie Fiber Optic Multiplexor (000-60001-001)

Date of Test: March 2, 1998

Test Performed:

1. Powerline conducted emissions in a shielded room utilizing two LISN's in accordance with the FCC test procedure ANSI C63.4-1992. See Part 2 of this report for full details.

2. Radiated emissions in a 3 meter open area site. See Part 3 of this report for full details.

The result show that the sample equipment tested as described in this report is in compliance with the Class B conducted and radiated emission limits of FCC Rules Part 15, SubPart B.

Frank Ibrahim
Project Engineer

GENERAL CONTD.

1.2. SUMMARY

1.2.1 Description of Equipment Under Test (EUT)

Description:	See Appendix E
Model Name(s):	DigiTie Fiber Optic Multiplexor (000-60001-001
Applicant: **Address:**	Micropak Systems, Incorporated 498 Linderbergh Avenue Livermore, California 94550 Tel: (925) 373-8655 Fax: (925) 373-9488
Client Contact:	Tony Warren
Test Technician:	Bruce Gordon
Test Number:	2971219-1

1.2.2 Support Equipment Included in Tests

The T1 to Fiber Optic Multiplexor was supported with the following peripherals

1. Micropak 8-Channel T1 Generator
2. LZR Electronics Power Supply, model LZUSD02007

See appendix D for details

1.2.3 Test Procedure

All capable speeds of the EUT were checked and there was no significant difference between data, therefore the data recorded in the following tables is representative of the worst case.

PART 2 - POWERLINE CONDUCTED EMISSIONS per FCC PART 15 SUB-PART B

2.1. CONFIGURATION AND PROCEDURE

2.1.1 EUT Configuration

The T1 to Fiber Optic Multiplexor was set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was a receiver with bandwidth parameters as stipulated in ANSI C63.4-1992.

The T1 to Fiber Optic Multiplexor was set up on a wooden non conductive table top, 80 cm above the ground reference plane, in a shielded room. It was supported with peripherals as listed in 1.2.2. Excess cord of the equipment and peripherals were folded back and forth, on top of LISN to form a 30 cm by 40 cm bundle.

2.1.2 Test Procedure

The system was set up as described above, with EMI diagnostic software running. The system was operated with the test software scrolling "Hs" to the monitor, serial and parallel devices. The system was operated again with the test software running the EUT in service mode. Data with the EUT operating in service mode is worst case and is recorded in the report as representative of the system. The powerline conducted EMI tests were run on all the current carrying conductors of the power cords of the EUT and the peripheral devices. The highest emissions were also analyzed in detail by operating the spectrum analyzer in fixed tuned mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables were moved around to maximize the emissions, and the position of the peripheral devices were interchanged to check for any changes in emissions.

2.1.3 Data Table Legend And Field Strength Calculation

'Margin' indicates the degree of compliance with the applicable limit. For example,
a margin of -8 dB means that the emissions is 8 dB below the limit (in compliance);
a margin of +4 dB means that the emission is 4 dB over the limit (out of compliance).
The margin is calculated as follows:
Margin = Corrected Amplitude - Limit
where Corrected Amplitude = Amplitude + Cable Loss - Distance Factor, the amplitude measured in a quasi peak mode.

2.2. POWERLINE CONDUCTED EMISSIONS per FCC PART 15 SUB-PART B

2.2.1 Administrative Details

Date(s) of Test: March 2, 1998
Emission Limits: Class B
Test Technician(s): Bruce Gordon

Technician's Signature: 

2.2.2 EUT Configuration Summary

See 2.1.1.

2.2.3 Test Results

The table below shows a summary of the highest conducted emissions on both the hot and neutral current carrying conductors of the EUT power cord compared to the FCC Class B limit.

INDICATED FREQ MHz	AMPL dBuV	CABLE LOSS dB	CORR AMPL dBuV	COND - -	GND - -	FCC CLASS B LIMIT dBuV	MARGIN dB
1.04	41.5	1.0	42.5	Hot	con	48.0	-5.5
5.37	46.9	1.0	47.9	Neut	con	48.0	-0.1
5.40	38.6	1.0	39.6	Hot	con	48.0	-8.4
14.04	32.8	1.0	33.8	Neut	con	48.0	-14.2
17.06	30.5	1.0	31.5	Neut	con	48.0	-16.5
17.41	35.6	1.0	36.6	Hot	con	48.0	-11.4

Table 2.2.3 Powerline Conducted Emissions

No emissions of significant levels were observed between 450 KHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest frequencies shown in the above data and 30 MHz.

PART 3 - OPEN FIELD RADIATED EMISSIONS per FCC PART 15 SUB-PART B

3.1. CONFIGURATION AND PROCEDURE

3.1.1 EUT Configuration

The T1 to Fiber Optic Multiplexor was set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992. The measurement instrumentation used was a Hewlett Packard 8567A Spectrum Analyzer with detector and bandwidth parameters as stipulated in C63.4-1992.

The T1 to Fiber Optic Multiplexor was set up on a wooden non conductive table top, 80 cm above the ground reference plane, in an open field. It was supported with peripherals as listed in 1.2.2. Excess cord was folded back to form a 30 cm by 40 cm bundle which were hanging in the middle distance above the ground plane.

3.1.2 Test Procedure

The system was set up as described above, with the EMI diagnostic software running. The system was operated with the test software scrolling "Hs" to the monitor, serial and parallel devices. The system was operated again with the test software running the EUT in service mode. Data with the EUT operating in service mode is worst case and is recorded in the report as representative of the system. Maximum emissions were obtained by varying the height of the antennas and then orienting the turntable in 360 degree turns with the analyzer in the manual mode.

The highest emissions were also analyzed in detail by operating the spectrum analyzer in fixed tuned quasi-peak mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables were moved around and the antenna height was varied between one and four meters, and polarization was changed between vertical and horizontal. The turntable was rotated to maximize emissions and the position of the peripheral devices were interchanged to check for any changes in emissions.

3.1. CONFIGURATION AND PROCEDURE CONTD.

3.1.3 Data Table Legend And Field Strength Calculation

'Margin' indicates the degree of compliance with the applicable limit. For example, a margin of -8 dB means that the emissions is 8 dB below the limit (in compliance); a margin of +4 dB means that the emission is 4 dB over the limit (out of compliance). The margin calculated as follows:
Margin = Corrected Amplitude - Limit
where Corrected Amplitude = Amplitude + Antenna Correction Factor + Cable Loss - Distance Factor, measured in quasi peak mode.

3.2. OPEN FIELD RADIATED EMISSIONS per FCC PART 15 SUB-PART B

3.2.1 Administrative Details

Date(s) of Test: March 2, 1998
Emission Limits: FCC Part 15 SubPart B
Test Technician(s): Bruce Gordon
Antenna Used: Biconical Antenna, model # 3104, S/N 3459 and Log Periodic Antenna, model # 3146, S/N 2075 (both calibrated July 3, 1997)

Technician's Signature: 

3.2.2 EUT Configuration Summary

See 3.1.1.

3.2.3 Test Results

The table below shows a summary of the highest amplitudes of the radiated emissions from the equipment under test at various antenna heights, antenna polarizations, and EUT orientations.

INDICATED FREQ MHz	AMPL dBuV/m	CORRECTION ANT dB	CAB dB	FACT DIST dB	CORR AMPL dBuV/m	TURNTAB ANG DEG	HGT (M)	ANT POL -	FCC CLASS B LIMIT dBuV/m	MARGIN dB
34.72	28.7	6.8	2.5	0.0	37.9	45	1.0	VB	40.0	-2.1
47.87	25.0	9.0	2.7	0.0	36.7	180	2.0	HB	40.0	-3.3
78.86	25.0	5.3	3.2	0.0	33.5	45	2.0	HB	40.0	-6.5
78.86	0.0	5.3	3.2	0.0	8.5	0	1.0	HB	40.0	-31.5
129.70	23.9	11.3	4.2	0.0	39.4	45	1.0	HB	43.0	-3.6
149.80	0.0	15.0	4.4	0.0	19.4	45	1.0	HL	43.0	-23.6
208.26	21.0	9.3	5.4	0.0	35.7	45	1.0	HL	43.0	-7.3
208.26	7.5	9.3	5.4	0.0	22.2	180	1.0	VL	43.0	-20.8
258.75	15.5	12.2	6.0	0.0	33.7	180	4.0	VL	46.0	-12.3
258.78	19.2	12.2	6.0	0.0	37.4	45	1.0	HL	46.0	-8.6

Table 3.2.3 Open Field Radiated Emissions

No emissions of significant levels were observed between 30 MHz and the lowest frequencies shown in the above data. No emissions of significant levels were observed between the highest frequency shown in the above data and 1000MHz.

APPENDIX A
MEASUREMENT PROCEDURES

MEASUREMENT PROCEDURES

POWERLINE CONDUCTED EMISSIONS

The measurements are performed in a 21' x 14' x 9' shielded room. A wooden bench 80 cm in height is located at the center of the shielded room; desktop EUT are placed on top of this bench. The rear of the EUT and bench are placed 40 cm from the shielded room wall. All items on the table (or test-table) are placed at least 10 cm apart. Excess EUT power cord is folded back and forth to form a 30 cm by 40 cm long bundle, hanging approximately in the middle between the ground plane and table. The EUT power cord is plugged into a LISN 80 cm away, while all other devices are plugged into a second LISN, also 80 cm away from the closest part of the EUT.

The highest emissions are also analyzed in detail by operating the spectrum analyzer in fixed tuned mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables are moved around to maximize the emissions, and the position of the peripheral devices are interchanged to check for any changes in emissions.

RADIATED EMISSIONS

The EUT is set up in accordance with the suggested configuration given in FCC Measurement Procedure ANSI C63.4-1992.

The EUT and support equipment are set up on the turntable of an open field site. Desktop EUT are set up on a wooden stand (test table), 80 cm above the ground plane. All items on the table are placed at least 10 cm apart. Interconnecting cables which hang closer than 40 cm to the ground plane are folded back and forth to form a 30 cm by 40 cm long bundle, hanging approximately between the ground plane and table.

The highest emissions are also analyzed, in detail, by operating the spectrum analyzer in fixed tuned quasi-peak mode to determine the precise amplitude of the emissions. While doing so, the interconnecting cables are moved around and at the highest amplitudes observed, the EUT is rotated in the horizontal plane while changing the antenna polarization in the vertical plane to maximize the reading. Once the maximum reading is obtained, the antenna elevation and polarization will be varied between specified limits to maximize the readings. The position of the peripheral devices are interchanged to check for any changes in emissions.

APPENDIX B
DESCRIPTION OF OPEN FIELD TEST SITE

DESCRIPTION OF OPEN FIELD TEST SITE

The open field test site is located on a 5.5 acre parcel, in the agriculturally zoned section of the city of Sunol, California. It is situated adjacent to Highway 680 on the West side, and adjacent to Calaveras Road in the South East. Distance of the site to each of these roads is a minimum of 200 feet. The north end of the site is surrounded by hills measuring up to 150 ft. high. The distance of the site to the hills is approximately 200 ft.

Supporting structures used to support device being measured and test instrumentation include the following:

a. Test Platform measuring 50 ft by 100 ft. The platform is located on top of a very large ground screen, to enhance a homogeneous reflective surface.

b. Test Site building measures approx. 5000 Sq. ft. This building houses the test laboratory, the shielded room, for performing Line Conducted test, test personnel and other support staff. The test building is an all wooden building, constructed using 2 by 4 inch studs. It also contains all necessary electrical wiring and utilities.

The Rockford Engineering Services RFI test site described above has been approved for conducting contract RFI measurement work for client companies following the procedures stated in FCC/OET ANSI C63.4-1992, EN55011, EN55022 Vfg. 243/1991 and VDE-0877. The site attenuation characteristics are routinely measured and recorded every three months.

Test site approved by VDE, File # F-R HF-MK.
Test site approved by FCC, Registration # 31010/SIT/ Rockford.
Test site approved by VCCI, Membership # 242.
Test site approved by the Industry Canada, Registration # DEB 5072-7, DEB 90-3008.

APPENDIX C
TEST EQUIPMENT

TEST EQUIPMENT

Some or all of the following test equipment is currently used to measure the conducted and/or radiated emissions from the equipment under test:

TEST EQUIPMENT	MODEL	S/N
Spectrum Analyzer	Hewlett Packard 8590A	2752 A02715
Spectrum Monitor	Rhode & Schwarz EZM	881 334/025
Test Receiver (9KHz-30MHz)	Rhode & Schwarz ESH3	RES 0753
Test Receiver (20-1300MHz)	Rhode & Schwarz ESVP	RES 0749
Spectrum Analyzer	Hewlett-Packard 8566B	2618A02909
Spectrum Analyzer	Hewlett-Packard 8567A	2602A00239
Spectrum Analyzer Display (Site 1)	Hewlett-Packard 8590A	2542A11954
Spectrum Analyzer Display (Site 2)	Hewlett-Packard 85662A	2542A12593
Quasi Peak Adapter (Site 1)	Hewlett-Packard 85650	2521A00871
Quasi Peak Adapter (Site 2)	Hewlett-Packard 85650A	2521A00737
Preselector (Site 1)	Hewlett-Packard 85685A	2620A00265
Preselector (Site 2)	Hewlett-Packard 85685A	2648A00462
Preamp	Hewlett-Packard 8447D	2648A04855
Preamp	Hewlett-Packard 8449B	3008A00101
Computer	Hewlett-Packard 9000/300	RES 449
Absorbing Clamp	MDS21	891 092/025
Antenna Cable (OPTK45)	RG8/u	
Antenna System	EMCO 3230	
Biconical Antenna (Site 1)	EMCO 3104	3549
Biconical Antenna (Site 2)	EMCO 3104C	9111-4463
Log Periodic Antenna (Site 1) (200-1000MHz)	EMCO 3146	2075
Log Periodic Antenna (Site 2) (200-1000MHz)	EMCO 3146	9510-4202
Adj. Element Dipole Antenna (28 MHz-1GHz)	EMCO 3120	
Horn Antenna	Eaton 96001	2632
LISN (25 Amp)	EMCO 38825/2	9210-2008
LISN (100 Amp)	Solar 8610-50-TS-100N	
LISN	EMCO 3825/2R	1188/1001

TEST EQUIPMENT CONTD.

TEST EQUIPMENT	MODEL	S/N
Remote Controlled 8 ft Rotating Table	RES RT1	
Remote Controlled 25 ft Rotating Table	RES RT2	
Remote Controlled 4 ft Rotating Table	RES RT3, RT4, RT5	
Remote Controlled 4 m Antenna Mast	RES AM1	
Remote Controlled 6 m Antenna Mast	RES AM2, RES AM3	
Generator	3 Phase 220Vac/50Hz	DB7130B40
Oscilloscope (300MHz)	Tektronix 2465	
Digital Scope	Hitachi VC-6075	8110016
Power Analyzer	Valhalla Scientific/2101 RES 574	
Digital Thermometer	Omega 440	
DC Power Supply	Kepco JQE 150-1.5m	H177085

The spectrum analyzers are self-calibrated before every shift and are calibrated to NIST standards annually. All of the other EMI equipment is calibrated on a monthly basis using the spectrum analyzers as standards.

APPENDIX D
DESCRIPTION OF SUPPORT EQUIPMENT

DESCRIPTION OF SUPPORT EQUIPMENT

Support Equipment #1

Description	8-Channel T1 Generator
Manufacturer	Micropak
Model Name	Not Provided
Serial Number	Not Provided
Power Supply Type	From LZR Power Supply
Power Cord	Not Shielded
Data Cable	Shielded with Wire Braid, 3m long
FCC ID	FCC Class A Type

Support Equipment #2

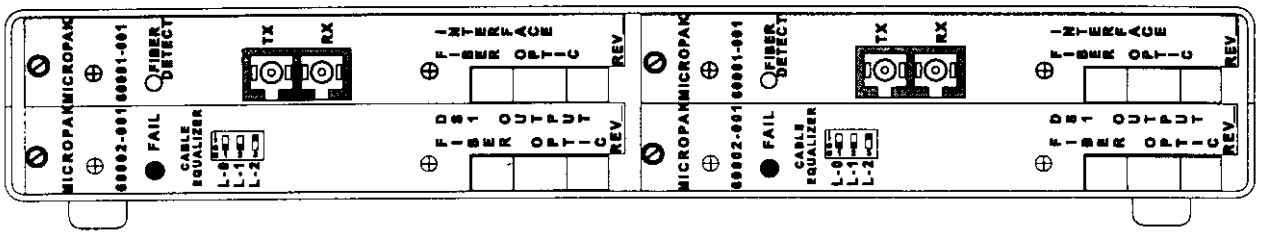
Description	Switching Power Supply
Manufacturer	LZR Electronics
Model	LZUSD02007
Part Number	Not Provided
Serial Number	Not Provided
Power Cord	Shielded
Data Cable	Not Shielded, 1.5m long
FCC ID	Not Provided

APPENDIX E
EUT TECHNICAL DESCRIPTION

MICROPAK SYSTEMS

MCRK 60000-001
3 December 1997

Technical and Installation Practice
DigiTie Fiber Optic Multiplexor
60000-001



CONTENTS

FEATURES

- LOW COST INTER- OR INTRA-BUILDING MULTIPLEXOR
- DS1 OUTPUT EQUALIZATION TO 655 FEET
- WALL MOUNT, DESK TOP OR RACK MOUNT HOUSING
- RS-232 ALARM AND DIAGNOSTIC PORT
- REMOTE TROUBLESHOOTING TO UNIT LEVEL
- -48 V OPERATION OR AC POWER

GENERAL:

The DigiTie 6000 Fiber Optic Multiplexor is self contained unit which multiplexes and demultiplexes four synchronous or asynchronous DS1 signals at 1.544 MHz to a DS2 transmit/receive fiber pair.

The DS1 signals terminate on a 50 pair Amphenol or Amp Champ connector which is part of the backplane.

The mounting houses two complete system and may be used in a CPE environment in a wall mount installation or as a desk top device or on a rack mount equipment tray.

External Diagnostics and control are available through RS-232 interface.

TECHNICAL DESCRIPTION:

The block diagram illustrates the system partition between the DS1 Interface board and the Fiber Optic interface unit.

Each DS1 is terminated with a transformer and line interface IC. The receive signal has a DSX-1 high level to a low level of 655 feet of cable loss.

Each DS1 may be remotely looped back at the line interface for test purposes.

The output of the line interface IC's drive a M12 multiplexor which adds and deletes stuff bits to synchronize each of the DS1 inputs.

The 6.312 Mbit output drives a Manchester coder/decoder on the Fiber Interface which creates the drive signal for the output LED and recovers clock and reconstructs the data from the optical receiver.

498 Lindbergh Ave.
Livermore, CA 94550

Phone (510) 373-8655
FAX (510) 373-9488

INSTALLATION:

TBD

APPLICATIONS:

TBD

5.0 SPECIFICATIONS:

System

Power	-48 VDC +/- 8 VDC
Connector	Screw Terminal
Frame Ground	Screw terminal, 18 GA
AC	External 50 Watt converter
Mounting	MPN 60000-001 Wall Mount Desk Top Rack Mount
Management	RS-232 per System
Connector	DB-9, DTE, Female

Environmental

Temperature	0 to 50 °C
Storage	-40 to +70 °C
Humidity	95% non-condensing
Altitude	-200 to 18,000 ' rel. to sea level

DS-1 Input

Impedance	110 Ohms, twisted pair
Level	DSX-1 - 650 ft ABAM attenuation
Frequency	1.544 MHz +/- 32 ppm

DS-1 Output

Impedance	110 Ohms, twisted pair
Level	DSX-1, Equalized for: 0' to 133', 133' to 266', 266' to 399', 399' to 533', 533' to 655'
Frequency	Equal to the input
Connector	4 DS1 circuits per 25 Amphenol or AMP Champ connector

Optical

Driver	1300 nm LED
Output Power	-18 dBm
Rx Sensitivity	-30 dBm
Max. Cable Loss	12 dB
Connector	Duplex SC

APPENDIX A

PROTECTING CIRCUIT BOARDS FROM ELECTROSTATIC DISCHARGE

Shipping, Storage and Unpacking:

Circuit boards are packed and shipped in antistatic packing material to protect against ESD during normal shipping and storage. Boards should be kept in the factory packing material until the time of installation. Once plugged into the appropriate equipment shelf, they are protected against ESD by the normal equipment grounding. If a board is removed from the shelf for any reason, it should be replaced immediately in the original packing material and kept there until reinstalled in the equipment shelf.

Handling:

All likely sources of static potential should be grounded to the same potential. Ungrounded personnel should not handle or touch the equipment.

STATIC CAUTION

Many circuit boards include semiconductor devices which can be damaged by static electricity. Since large electrostatic voltages (as high as 15,000 volts) can be generated by personnel performing ordinary installation and maintenance, sensitive equipment must be protected from electrostatic discharge (ESD).