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Neptune Technology Group, Inc.
FCC Part 15,
Class II Permissive Change Application
Model Advantage (M/N 12011-XXX)

January 21, 2003

MEASUREMENT/TECHNICAL REPORT

COMPANY NAME: **Neptune Technology Group, Inc.**

MODEL: **Advantage (M/N 12011-XXX)**

FCC ID: **P2SNTGADV1201**

DATE: **January 21, 2003**

This report concerns (check one): Original grant___
Class II change__X__

Equipment type: **Low Power Transmitter Under 15.249**

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No_X_

If yes, defer until:_____
date

__N.A.__ agrees to notify the Commission by__N.A.____
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

United States Technologies, Inc.
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

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SECTION 1

GENERAL INFORMATION

GENERAL INFORMATION

1.1 Product Description

The Equipment Under Test (EUT) is a Neptune Technology Group, Inc., Advantage (M/N: 12011-XXX). Hand held probe to interrogate and read water meter encoders. One end of the probe has an inductive coupling and the other end has a pin lock to interface with the water meter encoders. It has 6 keypads, 2x16 LCD display and a rechargeable NiCd battery. It reads an encoder by interrogating it with 1200 or 19.2 kHz clock. Returned signal are filtered and read stored in an EEPROM. Data can be reviewed and retransmitted using the keypad. It transmits data at 1200 Bi-Phase. It's an unlicensed 914 MHz Saw device from RFM. The transmitter used in the design is a model TX6004.

The unit contains two PCB sandwiched together. The MPU board is a digital micro board and it has the slot antenna printed on the PCB. The I/O board is an analog board, which produces clock to read the encoder and filters data before going to the MPU board. A trigger in the unit starts the encoder reading process. If not used within 5 minutes unit will go into a deep sleep mode until the trigger was activated again. The operating voltage is 3.65 volts.

1.2 Related Submittal(s)/Grant(s)

The EUT will be used with an approved receiver. The purpose of this application is to submit a Class II Permissive Change for Neptune Technology Group, Inc.'s, Advantage (M/N: 12011-XXX) previously granted under FCC ID: P2SNTGADV1201.

1.3 Description of Changes in Certified Equipment

Changes to the Advantage MPU board P/N 12011-XXX

Introduction

We have experienced some yield problem with Advantage MPU board. Most of the RFM chips bit rise time varied from 1 micro second to 40 microseconds. Receiver had difficult time to compensate for the bit rise time delay. After reviewing the TX6004 RFM transmit chip we discovered that the same chip could be used in ASK mode with only 1 micro second bit rise time delay. We have consulted with RFM and they recommended to go with ASK modulation instead of OOK to keep the bit rise time variation tightly controlled. While improving the RF interface circuit we discovered that the antenna length was not optimized for 914 MHz. In the improved design we have made sure that the antenna is optimized and other peripheral circuits are implemented per the RFM specification. Overall it looks like a more rugged, consistent and quiet design. Based on our preliminary lab test results the RF spurious noise has been reduced significantly.

These are the following changes made to the new design over the existing design:

1. Changed RF modulation from OOK to ASK
2. Optimized antenna length for the intended center frequency 914 MHz. But no change to the transmit frequency.
3. Used a voltage switch circuit to keep the unit 100% on when transmitting and turn it 100% off when not transmitting. This helps to eliminate the leakage current in the circuit and increases battery life.
4. We used proper pull ups to make sure that the signal levels are correct for the RFM chip.
5. Updated the RF output matching circuits to have more consistent RF power and reduced RF spurious noise
6. Kept the RF power under 1 mWatt as specified in the RFM TX6004 transmit chip.
7. Minor layout changes to incorporate items listed above.
8. Updated firmware to change the RF modulation from OOK to ASK.
9. Kept everything else same as the current production units.
10. RF transmit circuitry same as before

By: Mohammed Ali
Neptune technology Group
Principal Engineer
Date: 01-22-03

1.4 Copy of Previous Grant

TCB

GRANT OF EQUIPMENT AUTHORIZATION
Certification
Issued Under the Authority of the Federal Communications Commission
By:

TCB

American TCB, Inc.
6731 Whittier Avenue
Suite C110
McLean, VA 22101

Date of Grant: 01/09/2002

Application Dated: 01/09/2002

Neptune Technology Group Inc.
1600 Alabama Highway 229
Tallassee,AL36078
Attention: James Brennan

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: P2SNTGADV1201
Name of Grantee: Neptune Technology Group Inc.

Equipment Class: Part 15 Low Power Communication Device Transmitter

Notes: Water Meter Reader Tool

Grant Notes	FCC Rule Parts	Frequency Range (MHZ)	Output Watts	Frequency Tolerance	Emission Designator
	15C	914 - 914			

SECTION 2

TESTS AND MEASUREMENTS

TESTS AND MEASUREMENTS

2.1 Configuration of Tested System

The sample was tested per ANSI C63.4, Methods of Measurement from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (1992). Conducted and radiated emissions data were taken with the test receiver or spectrum analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are shown in Figure 2.

Since the EUT is a hand held device, it was placed into a continuous mode of transmit and rotated about all 3 axis to obtain worse case results.

2.2 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and submitted to the FCC, and accepted in their letter marked 31040/SIT. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number IC2982.

2.3 Modifications

No modifications were made to bring the EUT into compliance with FCC Part 15, Class B Requirements.

2.4 Test Equipment

Table 2 describes test equipment used to evaluate this product.

FIGURE 1

TEST CONFIGURATION

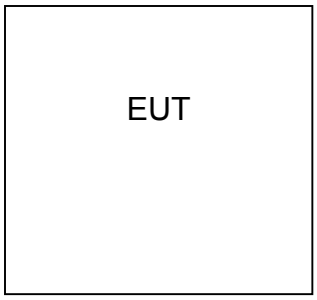

FIGURE 2a

Photograph(s) for Spurious and Fundamental Emissions

FIGURE 2b

Photograph(s) for Spurious and Fundamental Emissions

FIGURE 2c

Photograph(s) for Spurious and Fundamental Emissions

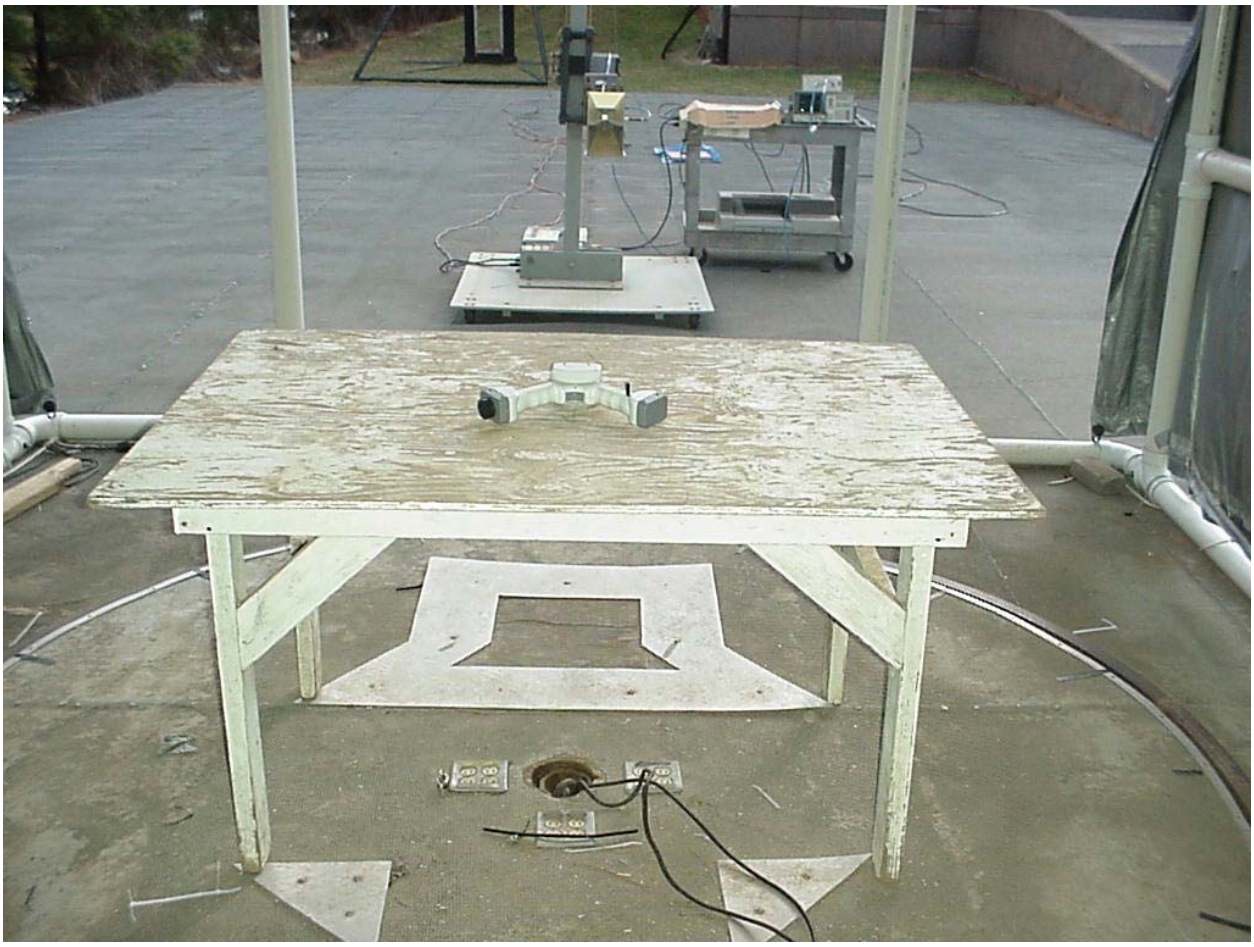

FIGURE 2d

Photograph(s) for Spurious and Fundamental Emissions

FIGURE 2e

Photograph(s) for Spurious and Fundamental Emissions

FIGURE 2f

Photograph(s) for Spurious and Fundamental Emissions

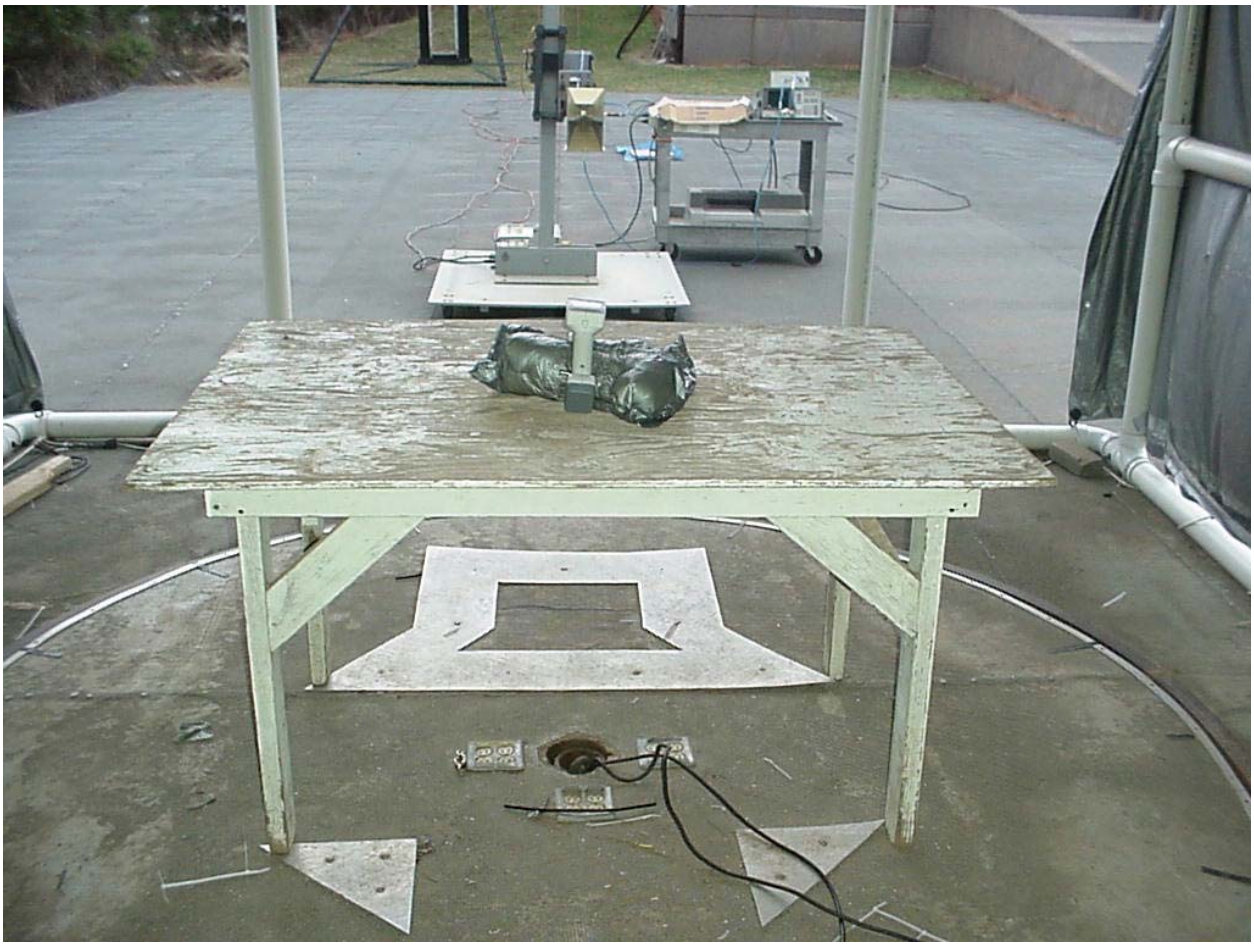

FIGURE 2g

Photograph(s) for Spurious and Fundamental Emissions

FIGURE 2h

Photograph(s) for Spurious and Fundamental Emissions

TABLE 1

EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
Transmitter Neptune Technology Group, Inc. (EUT)	Advantage (M/N 12011-XXX)	ENG000504	P2SNTGADV1201	None

TABLE 2

TEST INSTRUMENTS

TYPE	MANUFACTURER	MODEL	SN.
SPECTRUM ANALYZER	HEWLETT-PACKARD	8593E	3205A00124
SPECTRUM ANALYZER	HEWLETT-PACKARD	8558B	2332A09900
S A DISPLAY	HEWLETT-PACKARD	853A	2404A02387
COMB GENERATOR	HEWLETT-PACKARD	8406A	1632A01519
RF PREAMP	HEWLETT-PACKARD	8447D	1937A03355
RF PREAMP	HEWLETT-PACKARD	8449B	3008A00480
HORN ANTENNA	EMCO	3115	3723
BICONICAL ANTENNA	EMCO	3110	9307-1431
LOG PERIODIC ANTENNA	EMCO	3146	9110-3600
LISN	SOLAR ELE.	8028	910495 & 910494
THERMOMETER	FLUKE	52	5215250
MULTIMETER	FLUKE	85	53710469
PLOTTER	HEWLETT-PACKARD	7475A	2325A65394
BILOG	CHASE	CBL6112A	2238

2.6 Antenna Description (Paragraph 15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The Model Neptune Technology Group, Inc. Advantage (M/N 12011-XXX) incorporates an internal antenna only.

2.7 Field Strength of Fundamental within the Band 902-928 MHz per FCC Section 15.249(a)

Peak power within the band 902-928 MHz has been measured with a spectrum analyzer (RBW = 120 kHz, VBW = 300 kHz). Peak measurements were made using a peak or quasi-peak detector. Average emissions are not considered applicable since the measurement was below 1000 MHz.

The results of the measurements for peak fundamental emissions are given in Table 3 and Figure 3.

Table 3
FIELD STRENGTH OF FUNDAMENTAL EMISSION

Test Date: January 20, 003
UST Project: 03-0011
Customer: Neptune Technology Group, Inc.
Model: Advantage (M/N 12011-XXX)

FREQ. (MHz)	TEST DATA (dBm) @ 3m	ANTENNA FACTOR + CABLE ATTENUATION	RESULTS (uV/m) @ 3m	PEAK FCC LIMITS (uV/m) @ 3m
913.87	-48.91	29.3	23,384.0	50,000

SAMPLE CALCULATIONS:

RESULTS uV/m @ 3m = Antilog ((-48.91 + 29.3 + 107)/20) =23,384.0
CONVERSION FROM dBm TO dBuV = 107 dB

Tested by
Signature:  **Name:** David Blethen

Figure 3
Field Strength of Fundamental Emissions 15.249(a)

Plot Not Available

2.8 Peak Radiated Spurious Emissions in the Frequency Range 30 - 10000 MHz (FCC Section 15.249(c))

A preliminary scan was performed on the EUT to determine frequencies that were caused by the transmitter portion of the product. Radiated measurements below 1 GHz were tested with a RBW = 120 kHz. Radiated measurements above 1 GHz were measured using a RBW = VBW = 1 MHz. The results of peak radiated spurious emissions are given in Table 4 and Figure 4.

Table 4 Peak Radiated Spurious Emissions

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
No emissions were detected within 10 dB of the FCC Limit						

NOTE: No Harmonic emissions were detected within 10 dB of the Limit.

Tester Signature:  **Name: David Blethen**

Figure 4
Peak Radiated Spurious Emission 15.247(c)

No Emissions were detected within 10 dB of the FCC Limit

2.9 Average Spurious Emission in the Frequency Range 30 - 10000 MHz (FCC Section 15.249(c))

The Average measurement was derived from applying any possible duty cycle correction to the peak reading. The results of average radiated spurious emissions are given in Table 5 and Figure 5.

Duty Cycle Correction During 100 msec:

Not Necessary

Table 5 Average Radiated Spurious Emissions

Freq. (GHz)	Test Data* (dBm) @3m	Amp. Gain (dB)	Antenna Factor (dB)	Cable Loss (dB)	Results (uV/m) @3m	FCC Limits (uV/m) @3m
No emissions were detected within 10 dB of the FCC Limit						

Tester Signature:  **Name: David Blethen**

Figure 5
Average Radiated Spurious Emission 15.247(c)

No Emissions were detected within 10 dB of the FCC Limit

2.10 Power Line Conducted Emissions for Transmitter FCC Section 15.207

The conducted voltage measurements have been carried out in accordance with FCC Section 15.207, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmit. The results are given in Table 6.

Table 6 Conducted Emissions Data
Class B

Test Date: January 20, 2003
UST Project: 03-0011
Customer: Neptune Technology Group, Inc.
Product: Advantage (M/N 12011-XXX)

Frequency (MHz)	Test Data (dBm) Phase Neutral	RESULTS (uV) Phase Neutral	FCC Limits (uV)
Conducted Emissions were considered not applicable since the EUT is portable and only battery powered.			

Tester Signature: David P. Blethen **Name:** David Blethen

2.11 Radiated Emissions (47 CFR 15.109a)

Radiated emissions were evaluated from 30 to 5000 MHz. Measurements were made with the analyzer's bandwidth set to 120 kHz for measurements made less than 1 GHz and 1 MHz for measurements made 1 GHz and higher. Results for less than 1 GHz are shown in Table 7a. Measurements made over 1 GHz results are shown in Table 7b.

Table 7a Radiated Emissions Data

Class B

Test Date: January 20, 2003
UST Project: 03-0011
Customer: Neptune Technology Group, Inc.
Product: Advantage (M/N 12011-XXX)

Freq. (MHz)	Test Data (dBm) @3m	Antenna Factor + Antenna Atten.	Results (uV/m) @3m	FCC Limits (uV/m) @3m	Margin Below FCC Limits (uV/m)
275.0	-81.0	17.3	146.2	200.0	2.7
295.0	-81.0	17.5	150.3	200.0	2.5

SAMPLE CALCULATION:
RESULTS (uV/m @ 3m) = Antilog ((-81.0 + 17.3 + 107)/20) = 146.2
CONVERSION FROM dBm TO dBuV = 107 dB

Tester Signature: _____ **Name:** David Blethen

Table 7b Radiated Emissions Data

Class B

Test Date: January 20, 2003
UST Project: 03-0011
Customer: Neptune Technology Group, Inc.
Model: Advantage (M/N 12011-XXX)

Measurements >1GHz

Frequency (MHz)	Receiver Reading (dBm) @3m	Correction Factor (dB)	Corrected Reading (uV/m)	FCC Limit (uV/m) @3m
No emissions were detected within 10 dB of the FCC Limit				

Tested By
Signature: _____ **Name:** David Blethen

2.12 Power Line Conducted Emissions for Digital Device FCC Section 15.107

The conducted voltage measurements have been carried out in accordance with FCC Section 15.107, with a spectrum analyzer connected to a LISN and the EUT placed into a continuous mode of transmit. The results are given in Table 8.

Table 8 Conducted Emissions Data – Digital Device
Class B

Test Date: January 20, 2003
UST Project: 03-0011
Customer: Neptune Technology Group, Inc.
Product: Advantage (M/N 12011-XXX)

Frequency (MHz)	Test Data (dBm) Phase Neutral	RESULTS (uV) Phase Neutral	FCC Limits (uV)
Conducted Emissions were considered not applicable since the EUT is portable and only battery powered.			

Tester Signature: David B. Blethen **Name:** David Blethen