LEGO Systems Inc

Application
For
Certification

Mindstorm-NxT

(FCC ID: NPI53788)

06059431
KL/ Ann Choy
July 10, 2006

LIST OF EXHIBITS

INTERTEK TESTING SERVICES

MEASUREMENT/TECHNICAL REPORT

LEGO Systems Inc - Model: 53788
FCC ID: NPI53788

This report concerns (check one:)   Original Grant _X_   Class II Change ___

Equipment Type : <u>DXT - Part 15 Low Power Transceiver, Rx Verified</u>
<u>JBP - Part 15 Class B Computer Peripheral</u>

Deferred grant requested per 47 CFR   Yes _____   No _X_
0.457(d)(1)(ii)?

If yes, defer until : _____
                                                                            date

Company Name agrees to notify the Commission
by: _____
                                                                 date

of the intended date of announcement of the product so that the grant can be issued
on that date.

Transition Rules Request per 15.37 ?   Yes _____   No _X_

If no, assumed Part 15, Subpart C for intentional radiator - the new 47 CFR [04-05-05
Edition] Provision.

Report prepared by: Lam Chun Cheong, Kenneth
                                                     Intertek Testing Services Hong Kong Ltd.
                                                     2/F., Garment Centre,
                                                     576 Castle Peak Road,
                                                     Kowloon, Hong Kong.
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                                                     Fax: 852-2741-1693

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INTERTEK TESTING SERVICES

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Test Report	Emission Plot	emission.pdf
Test Setup Photo	Conducted Emission	config photos.doc
Test Report	Conducted Emission Test Result	conduct.pdf
Test Report	Duty Cycle Calculation and Measurement	dcc.pdf
External Photo	External Photo	external photos.doc
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Block Diagram	Block Diagram	block.pdf
Schematics	Circuit Diagram	circuit.pdf
ID Label/Location	Label Artwork and Location	label.pdf
User Manual	User Manual	manual.pdf
User Manual	FCC Information	fcc information.pdf

EXHIBIT 1
GENERAL DESCRIPTION

1.0 **General Description**

1.1 Product Description

The 53788 is a Mindstorm-NxT. It operates at frequency range of 2402.000MHz to 2480.000MHz with 79 physical hopping frequencies and 79/32 logical hopping frequencies.

The Mindstorm-NxT is a electronic robot which bricks with a 32-bit microprocessor, memory, different kinds of sensors (ultrasonic, sound, light and touch) and servo motors that makes Mindstorm-NxT can see, walk, move and react to sound, light and even object.

Three output ports A, B, C are connected to the servo motors and the four input ports 1, 2, 3, 4 are connected to ultrasonic, sound, light and touch sensor respectively. All the input and output ports use a 6 pins to 6 pins cable for connection.

The built-in USB 2.0 and buletooth allows Mindstorm-NxT to communicate with external devices such as personal computer and mobile phone.

The Mindstorm-NxT can be simply controlled by 4 buttons. The orange button is a "Power On/Enter" button, 2 light grey arrow buttons are used for selection in the NXT menu and the dark grey button is used for "Clear/Go Back" operation.

The antenna used in EUT is integral, and the tested sample is a prototype.

The circuit description and frequency hopping algorithm is saved with filename: descri.pdf

1.2   Related Submittal(s) Grants

This is an application for Certification of a DXT-Part 15 Low Power Transcevier, Rx Verified and JBP-Part 15 Class B Computing Device Peripheral. One transmitter is included in this application.

1.3   Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.4 (2003). All measurements were performed in Open Area Test Sites. Preliminary scans were performed in the Open Area Test Sites only to determine worst case modes. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

1.4   Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at Garment Centre, 576 Castle Peak Road, Kowloon, Hong Kong. This test facility and site measurement data have been fully placed on file with the FCC.

EXHIBIT 2
SYSTEM TEST CONFIGURATION

2.0 **System Test Configuration**

2.1 Justification

For emissions testing, the equipment under test (EUT) was setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, all cables were manipulated to produce worst case emissions. The EUT was powered by a fully charged battery with AC adaptor.

For the measurements, the EUT was attached to a plastic stand if necessary, and accessories were placed on the wooden turntable in typical use. The EUT was attached to a personal computer through an USB cable. The three motor ports and four sensors ports of EUT were attached to three servomotors and four typical sensors respectively. The motors and sensors were placed closer than 10 cm spacing as typical as normal use, and followed the procedures as defined in ANSI C63.4 (2003), section 6.2.1.2.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. Care is taken to ensure that the resolution is larger than 20dBc bandwidth of EUT. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

2.2 EUT Exercising Software

The EUT exercise program LEGO MINDSTORMS NxT, version 1.0 was used for radiated and conducted emissions testing. It was designed to exercise the various system components in a manner similar to a typical use.

2.3   Support Equipment List and Description

The FCC ID's for all equipment, plus descriptions of all cables used in the tested system are:

HARDWARE:

The unit was operated standalone. An AC adaptor and a battery (provided with the unit) were used to power the device. Their description are listed below.

(1)   An AC adaptor (120VAC to 10.8VAC 700mA 8W, Model: A31185C)
(2)   A "Li-ion Polymer" type rechargeable battery (7.4V 1400mAh)

EQUIPMENT ACCESSORIES:

(Supplied by Client)
(1)   3 x servo motor
(2)   1 x light sensor
(3)   1 x ultrasonic sensor
(4)   1 x microphone
(5)   1 x touch sensor

CABLES:

(Supplied by Client)
(1)   1 x USB cable with 2 meter long
(2)   7 x 0.5m signal cable (6 pins to 6 pins)

OTHERS:

(1)   1 x USB Dongle, Model: ET-BTHADTU
(2)   6 x "AA" size 1.5VDC Battery

For Radiated Emission Test:
(1)   HP Computer, Model: D530S, S/N: CNG4110FN, DoC Product
(2)   HP Keyboard, Model: SK-2502, S/N: M981135799, FCC ID: GYUR41SK
(3)   Philips Monitor, Model: 150B4CG, S/N: CX000409301774, DoC Product
(4)   HP Mouse, Model: M-S34, S/N: LZC84609205, FCC ID: DZL211029
(5)   HP Printer, Model: C2642A, S/N: SG6121702C, FCC ID: B94C2642X
(6)   Hayes Modem, Model: 6800CN, S/N: A00900153317, FCC ID: BFJ9D907-00038

For Conducted Emission Test:
(1)   HP Computer, Model: Vectra VL420, S/N: SG21901049
(2)   HP Keyboard, Model: SK-2502C, S/N: M990644806, DoC Product
(3)   Samsung Monitor, Model: NB15ASHB/XSH, S/N: NB15HVEX103069X
(4)   HP Mouse, Model: C3751B, S/N: LZB72359748, FCC ID: DZL211029
(5)   HP Printer, Model: C6431D, S/N: CN23B 680ZP, DoC Product
(6)   Genius Modem, Model: GM56EX, S/N: ZT5505000355, DoC Product

2.4   Measurement Uncertainty

When determining of the test conclusion, the Measurement Uncertainty test has been considered.

2.5   Equipment Modification

Any modifications installed previous to testing by LEGO Systems Inc will be incorporated in each production model sold/leased in the United States.

No modifications were installed by ETL Division, Intertek Testing Services Hong Kong Ltd.

All the items listed under section 2.0 of this report are confirmed by:

Confirmed by:

> *Lam Chun Cheong, Kenneth*
> *Senior Lead Engineer*
> *Intertek Testing Services*
> *Agent for LEGO Systems Inc*

_____Signature

_____July 10, 2006_____Date

**EXHIBIT 3
EMISSION RESULTS**

3.0 **Emission Results**

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

3.1   Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$FS = RA + AF + CF - AG$

where FS = Field Strength in dBμV/m
                RA = Receiver Amplitude (including preamplifier) in dBμV
                CF = Cable Attenuation Factor in dB
                AF = Antenna Factor in dB
                AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows:-

$FS = RR + LF$

where FS = Field Strength in dBμV/m
                RR = RA - AG in dBμV
                LF = CF + AF in dB

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB   RR = 23.0 dBμV
CF = 1.6 dB   LF = 9.0 dB
AG = 29.0 dB
FS = RR + LF
FS = 23 + 9 = 32 dBμV/m

Level in μV/m = Common Antilogarithm [(32 dBμV/m)/20] = 39.8 μV/m

3.2   Radiated Emission Configuration Photograph

Worst Case Radiated Emission

at 826.667 MHz

For electronic filing, the worst case radiated emission configuration photographs
are saved with filename: config photos.doc
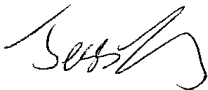
3.3   Radiated Emission Data

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

Judgement : Passed by 15.2 dB margin

****

TEST PERSONNEL:

_____
Tester Signature

Jess Tang, Lead Engineer___
Typed/Printed Name

 July 10, 2006_____
Date

INTERTEK TESTING SERVICES

Company:LEGO Systems Inc   Date of Test: April 4-May 22, 2006
Model: 53788
Mode : TX-Channel 1

Table 1

Radiated Emissions

Polari-zation	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (-dB)	Calculated at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
V	2402.000	100.2	33	29.4	96.6	42.2	54.4	94.0	-39.6
V	800.667	23.4	16	31.0	38.4	0.0	38.4	54.0	-15.6
V	*1601.333	53.2	33	27.2	47.4	42.2	5.2	54.0	-48.8
V	*4003.333	38.3	33	34.8	40.1	42.2	-2.1	54.0	-56.1
V	*4804.000	40.4	33	34.9	42.3	42.2	0.1	54.0	-53.9
V	7206.000	37.2	33	37.9	42.1	42.2	-0.1	54.0	-54.1

NOTES: 1. Peak detector is used for the emission measurement.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Horn antenna is used for the emission over 1000MHz.

5. Emissions radiated outside of the specified frequency bands, except harmonics, are attenuated by 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation, which meet the requirement of part 15.249(d).

* Emission within the restricted band meets the requirement of part 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

Test Engineer: Jess Tang

Company: LEGO Systems Inc   Date of Test: April 4-May 22, 2006
Model: 53788
Mode : TX-Channel 40

Table 2

Radiated Emissions

Polari-zation	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (-dB)	Calculated at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
V	2441.000	100.9	33	29.4	97.3	42.2	55.1	94.0	-38.9
V	813.667	23.6	16	31.0	38.6	0.0	38.6	54.0	-15.4
V	1627.333	53.6	33	27.2	47.8	42.2	5.6	54.0	-48.4
V	*4068.333	38.5	33	34.8	40.3	42.2	-1.9	54.0	-55.9
V	*4882.000	40.7	33	34.9	42.6	42.2	0.4	54.0	-53.6
V	*7323.000	37.6	33	37.9	42.5	42.2	0.3	54.0	-53.7
V	*8136.667	36.9	33	39.0	42.9	42.2	0.7	54.0	-53.3

NOTES: 1. Peak detector is used for the emission measurement.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Horn antenna is used for the emission over 1000MHz.

5. Emissions radiated outside of the specified frequency bands, except harmonics, are attenuated by 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation, which meet the requirement of part 15.249(d).

* Emission within the restricted band meets the requirement of part 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

Test Engineer: Jess Tang

Company: LEGO Systems Inc   Date of Test: April 4-May 22, 2006
Model: 53788
Mode : TX-Channel 79

Table 3

Radiated Emissions

Polari-zation	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBμV/m)	Average Factor (-dB)	Calculated at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
V	2480.000	100.0	33	29.4	96.4	42.2	54.2	94.0	-39.8
V	826.667	23.8	16	31.0	38.8	0.0	38.8	54.0	-15.2
V	1653.333	53.6	33	27.2	47.8	42.2	5.6	54.0	-48.4
V	*4133.333	38.8	33	34.8	40.6	42.2	-1.6	54.0	-55.6
V	*4960.000	41.2	33	34.9	43.1	42.2	0.9	54.0	-53.1
V	*7440.000	38.1	33	37.9	43.0	42.2	0.8	54.0	-53.2
V	*8266.667	36.2	33	39.0	42.2	42.2	0.0	54.0	-54.0

NOTES: 1. Peak detector is used for the emission measurement.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

4. Horn antenna is used for the emission over 1000MHz.

5. Emissions radiated outside of the specified frequency bands, except harmonics, are attenuated by 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation, which meet the requirement of part 15.249(d).

* Emission within the restricted band meets the requirement of part 15.205. The corresponding limit as per 15.209 is based on Quasi peak limit for frequencies below 1000 MHz and average limit for frequencies over 1000 MHz. The radio frequency emissions above 1GHz also meet corresponding 20dB permitted peak limit with a peak detector function.

Test Engineer: Jess Tang

FCC ID: NPI53788

3.4   Radiated Emission on the Bandedge

From the following plots, they show that the fundamental emissions are confined in the specified band (2400MHz and 2483.5MHz). In case of the fundamental emissions are within two standard bandwidths from the bandedge, the delta measurement technique is used for determining bandedge compliance.   Standard bandwidth is the bandwidth specified by ANSI C63.4 (2003) for frequency being measured.

Emissions radiated outside of the specified frequency bands, except harmonics, are attenuated by 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation, which meet the requirement of part 15.249(d).

Please refer to the following plots for radiated emission on the bandedge:

Plot B1A*: Low Channel Emissions
Plot B1B: High Channel Emissions

For electronic filing, the above plots are saved with filename: emission.pdf

* Bandedge compliance is determined by applying market-delta method, i.e.

   Resultant field strength in peak value

        = Fundamental emission - delta from the plot

        = 96.6dBμV/m - 42.05dB

        = 54.55dBμV/m

   Resultant field strength in average value

        = Resultant field strength in peak value - average factor

        = 54.55dBμV/m - 42.2dB

        = 12.35dBμV/m

   The resultant field strength meets the general radiated emission limit in section 15.209, which does not exceed 54dBμV/m in average or 74dBμV/m in peak.

3.5   Line Conducted Configuration Photograph

Worst Case Line-Conducted Configuration

at 4.180 MHz & 21.940 MHz

For electronic filing, the worst case line conducted configuration photographs are
saved with filename: config photos.doc

3.6   Line Conducted Emission Data

The data on the following pages list the significant emission frequencies, the limit, and the margin of compliance.

Judgement : Passed by 20 dB margin compare with the average limit

TEST PERSONNEL:

_____
Tester Signature

Jess Tang, Lead Engineer
Typed/Printed Name

 July 10, 2006
Date

Company: LEGO Systems Inc   Date of Test: April 4-May 22, 2006
Model: 53788

Conducted Emissions

For electronic filing, the conducted emission test result is saved with filename: conduct.pdf

Company: LEGO Systems Inc   Date of Test: April 4-May 22, 2006
Model: 53788

3.7   Radiated Emissions from Digital Portion of EUT and Class B Personal Computer
      Peripheral, FCC Ref: 15.109

[ ]   Not required - No digital part

[×]   Test results are attached

[ ]   Included in the separated DOC report.

Company: LEGO Systems Inc   Date of Test: April 4-May 22, 2006
Model: 53788
Mode: Download Program Using USB

Table 4

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
V	34.681	30.9	16	10.0	24.9	40.0	-15.1
V	38.147	31.9	16	10.0	25.9	40.0	-14.1
V	43.862	33.0	16	10.0	27.0	40.0	-13.0
V	47.424	33.2	16	11.0	28.2	40.0	-11.8
V	53.767	33.9	16	11.0	28.9	40.0	-11.1
V	59.776	34.7	16	10.0	28.7	40.0	-11.3

NOTES: 1. Quasi-peak detector is used for the emission below or equal to 1000 MHz.

2. All measurements were made at 3 meters. Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit. No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3. Negative value in the margin column shows emission below limit.

Test Engineer: Jess Tang

Company: LEGO Systems Inc   Date of Test: April 4-May 22, 2006
Model: 53788
Mode: Download Program Using Bluetooth

Table 5

Radiated Emissions

Polarization	Frequency (MHz)	Reading (dBμV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBμV/m)	Limit at 3m (dBμV/m)	Margin (dB)
V	34.681	30.8	16	10.0	24.8	40.0	-15.2
V	38.148	31.1	16	10.0	25.1	40.0	-14.9
V	43.867	33.4	16	10.0	27.4	40.0	-12.6
V	47.426	33.3	16	11.0	28.3	40.0	-11.7
V	53.767	33.9	16	11.0	28.9	40.0	-11.1
V	59.776	34.7	16	10.0	28.7	40.0	-11.3

NOTES: 1.   Quasi-peak detector is used for the emission below or equal to 1000 MHz.

2.   All measurements were made at 3 meters.   Radiated emissions not detected at the 3-meter distance were measured at 0.3-meter and an inverse proportional extrapolation was performed to compare the signal level to the 3-meter limit.   No other radiated emissions than those reported were detected at a test distance of 0.3-meter.

3.   Negative value in the margin column shows emission below limit.

Test Engineer: Jess Tang

Company: LEGO Systems Inc   Date of Test: April 4-May 22, 2006
Model: 53788

3.8   Transmitter Duty Cycle Calculation and Measurements, FCC Rule 15.35(b), (c)

The EUT antenna output port was connected to the input of the spectrum analyzer. The analyzer center frequency was set to EUT RF channel carrier. The SWEP function on the analyzer was set to ZERO SPAN. The transmitter ON time was determined from the resultant time-amplitude display:

Talk Operation:

Duty cycle (DC) = Maximum ON time in 98.75ms/98.75ms
$\qquad$ = (0.3875 x 1)ms/98.75ms

Duty cycle correction, dB = 20* log (DC)
$\qquad$ = 20* log (0.00392)
$\qquad$ = -48.1 dB

Paging Operation:

Duty cycle (DC) = Maximum ON time in 20ms/20ms
$\qquad$ = 0.155ms/20ms

Duty cycle correction, dB = 20* log (DC)
$\qquad$ = 20* log (0.00775)
$\qquad$ = -42.2 dB

X	See attached spectrum analyzer chart (s) for transmitter timing Base Unit: Plots B2A-B
	See transmitter timing diagram provided by manufacturer
	Not applicable, duty cycle was not used.

For electronic filing, the above plots are saved with filenames: dcc.pdf

EXHIBIT 4
EQUIPMENT PHOTOGRAPHS

4.0 **Equipment Photographs**

For electronic filing, the photographs are saved with filename: external photos.doc & internal photos_1.doc and internal photos_2.doc.

EXHIBIT 5
PRODUCT LABELLING

5.0 **Product Labelling**

For electronic filing, the FCC ID label artwork and location is saved with filename: label.pdf

EXHIBIT 6
TECHNICAL SPECIFICATIONS

6.0   <u>**Technical Specifications**</u>

For electronic filing, the block diagram and circuit diagram are saved with filename: block.pdf and circuit.pdf respectively.

EXHIBIT 7
INSTRUCTION MANUAL

7.0 **Instruction Manual**

For electronic filing, a preliminary copy of the Instruction Manual is saved with filename: manual.pdf

Please note that the required FCC Information to the User is saved with filename: fcc information.pdf.

This manual will be provided to the end-user with each unit sold/leased in the United States.

EXHIBIT 8
CONFIDENTIALITY REQUEST

8.0   <u>**Confidentiality Request**</u>

For electronic filing, a preliminary copy of the Confidentiality Request is saved with filename: request.pdf