RADIO COMMUNICATIONS AND EMC TESTING

HOBBY ENGINE MODEL LTD

Excavator

Model: 0703
Additional Models: 0701 to 0799 INCLUSIVE, 0703C, 0704, 0704W, 0705, 0705C, 0706, 0706C, 0707, 0708, 0708C, 0711, 0711W, 0712, 0712C, 0715, 0715C, 0717, 0718, 0718C, 0720, 0720C, 0721, 0731

Test Report : SZHH01168200-001

Test Engineer :	Abel Zhou Senior Engineer	Sign On File
Report Approved By :	Jimmy Wen Assistant Supervisor	Digitally signed by jimmy.wen Location: Intertek Testing Services
Date :	28 July 2017	

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TRF No.: EN300440_2a

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RADIO PERFORMANCE MEASUREMENTS
RESULT SUMMARY

Requirements	ETSI EN 300 440		Compliance
	Technical requirements	Test Specification	
	Clause Number		
Equivalent Isotropically Radiated Power (EIRP)	4.2.2	4.2.2.3	Complied
Permitted Range of Operating Frequencies	4.2.3	4.2.3.3	Complied
Unwanted emissions in the spurious domain	4.2.4	4.2.4.3	Complied
Blocking or desensitization	4.3.4	4.3.4.3	Complied
Spurious radiation	4.3.5	4.3.5.3	Complied
When determining the test conclusion, the Measurement Uncertainty of test has been considered.			

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EMC COMPLIANCE MEASUREMENTS
RESULT SUMMARY

	ETSI EN 301 489-3	ETSI EN 301 489-1	Compliance
	Clause Number		
EMC Emission	7.1	8.2	Complied
Electrostatic Discharge	7.2	9.3	Complied
Radio Frequency Electromagnetic Field (80MHz-6GHz)	7.2	9.2	Complied
When determining the test conclusion, the Measurement Uncertainty of test has been considered.			

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EQUIPMENT UNDER TEST (EUT)

INFORMATION

Applicant :	HOBBY ENGINE MODEL LTD ROOM 619, 6/F. PENINSULA CENTER, 67 MODY ROAD, TSIM SHA TSUI, HONG KONG.
Description of EUT :	Excavator
Brand Name(s)/ Type	N/A / 0703
Serial Number(s) :	Not Labelled
Equipment Received :	24 June 2017
Test Date(s) :	24 June 2017 to 28 July 2017
Classification of EUT :	Categories 2
Extreme Temp.:	-10 °C to 55 °C
Modulation Type:	GFSK
Antenna Type:	Integral Antenna of Control Unit and Receiver Unit
Test Specification(s) :	ETSI EN 300 440 V2.1.1 (2017-03)
	DRAFT ETSI EN 301 489-1: V2.2.0 (2017-03):
	FINAL DRAFT ETSI EN 301 489-3: V2.1.1 (2017-03)

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EXHIBIT 1

GENERAL DESCRIPTION

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1 INTRODUCTION

Intertek Testing Services Shenzhen Limited Longhua Branch has tested the HOBBY ENGINE MODEL LTD 0703, Excavator. The sample was tested to the relevant performance specification published by the European Telecommunications Standards Institute. This report contains the results of these tests and is submitted to HOBBY ENGINE MODEL LTD as the final test results.

The additional models: 0701 to 0799 INCLUSIVE, 0703C, 0704,0704W, 0705, 0705C, 0706, 0706C, 0707, 0708, 0708C, 0711, 0711W, 0712, 0712C, 0715, 0715C, 0717, 0718, 0718C, 0720, 0720C, 0721, 0731 are the same as the Model: 0703 in hardware aspect. The difference in model number and appearance serves as marketing strategy.

2 TEST SPECIFICATION

2.1 RELEVANT PERFORMANCE SPECIFICATION

The relevant performance specification for HOBBY ENGINE MODEL LTD 0703, Excavator are ETSI EN300 440 V2.1.1 (2017-03) and Draft ETSI EN301 489-1 V2.2.0 (2017-03). The harmonised standards are ETSI EN300 440 V2.1.1 (2017-03) and the technical standard are Final Draft ETSI EN301 489-3 V2.1.1 (2017-03) and Draft ETSI EN301 489-1 V2.2.0 (2017-03).

The tests performed are those required to demonstrate compliance with the technical specifications and the essential requirements of Article 3.2 of the Radio Equipment Directive (2014/53/EU) for regulatory purposes.

2.2 TEST ENVIRONMENT

The tests were performed in the Radio communications Test Facility at Intertek Testing Services Shenzhen Limited (CNAS No.: L0220). The tests were performed in the Radio communications and Electromagnetic Compatibility Test Facility at Intertek Testing Services Shenzhen Limited. The sample was subjected to the ambient conditions in the laboratory and indoor test site except during tests at extremes of temperatures and the Radiated Emissions Tests. The temperature and relative humidity recorded during the period of each test are given in the results.

2.3 CONFIGURATION OF TEST SAMPLE

The test samples consisted of one transmitter (Control Unit) and one receiver (Receive Unit).

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2.4 TEST POWER SOURCES

The Control Unit is intended to operate from 9.0VDC (6 x 1.5V AA batteries). The Receive Unit is powered by 7.2VDC (1 x 7.2V Internal Rechargeable battery). The test power source voltages declared by the manufacturer were:

Control Unit:

Nominal test voltage	9.0VDC
Lower extreme test voltage	7.65VDC
Upper extreme test voltage	9.0VDC

The Receive Unit is powered by 7.2V DC (1 x 7.2V Internal Rechargeable battery).

2.5 TEST FREQUENCIES

The sample supplied operated nominally at 2.411 - 2.463GHz for transceiver. The tests were carried out on channel Low, Medium and High of the alignment range.

2.6 MEASUREMENT UNCERTAINTY

All measurement uncertainties stated in this report are estimated to a 95% confidence level.

2.7 SUPPORT EQUIPMENT - RADIO PERFORMANCE MEASUREMENTS

N/A

2.8 SUPPORT EQUIPMENT - EMC COMPLIANCE MEASUREMENTS

N/A

2.9 PERFORMANCE CRITERIA

2.9.1 PERFORMANCE CRITERIA FOR CONTINUOUS PHENOMENA (CT & CR)

During test, there may be loss of function but there should be no unintentional responses.
After test, EUT should operate as intended. Lost functions should be self-recoverable.

2.9.2 PERFORMANCE CRITERIA FOR TRANSIENT PHENOMENA (TT & TR)

At the conclusion of each exposure the EUT shall operated with no user noticeable loss of communication link.

Where the EUT is transmitter, tests shall be repeated with the EUT in standby mode to ensure that any unintentional transmission does not occur.

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EXHIBIT 2

TEST RESULT

OF

RADIO PERFORMANCE MEASUREMENTS

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3 EQUIVALENT ISOTROPICALLY RADIATED POWER (E.I.R.P.)

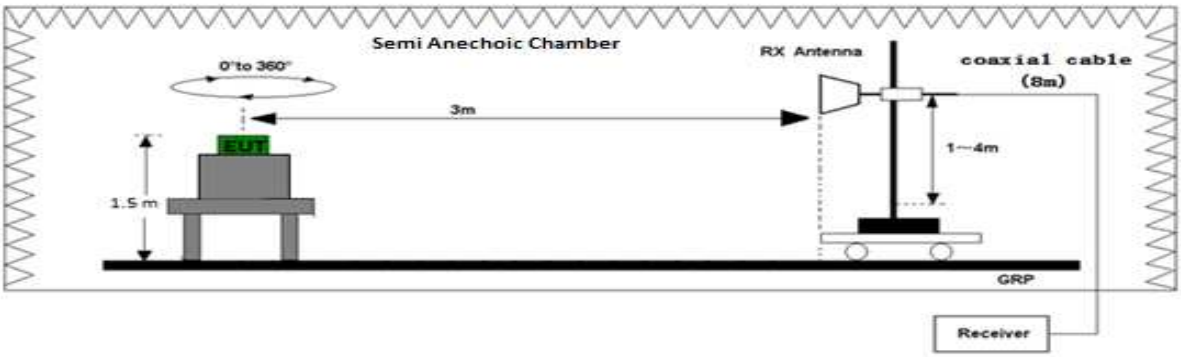
3.1 TEST METHOD AND SUMMARY

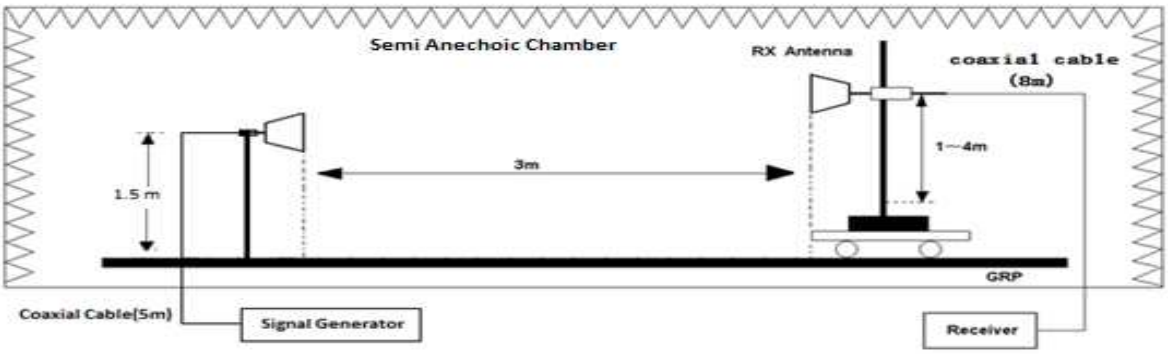
Basic Standard :	ETSI EN 300 440 V2.1.1 (2017-03)
Clause :	4.4.2
Test method	Radiated measurement

3.2 EQUIPMENT LIST

Equip No.	Description	Manufacturer	Model No.	Cal. Date	Due Date
SZ061-12	Biconilog Antenna	ETS	3142E	15-Sep-16	15-Sep-17
SZ016-12	Temperature & Humidity Chamber	Terchy	MHK-120NK	31-Jul-16	31-Jul-17
SZ185-01	EMI Receiver	R&S	ESCI	31-Jul-16	31-Jul-17
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	16-Aug-16	16-Aug-18
SZ056-06	Signal Analyzer	R&S	FSV40	31-Jul-16	31-Jul-17
SZ056-03	Spectrum Analyzer	R&S	FSP30	31-Jul-16	31-Jul-17
SZ006-12	AC Power Source	APC	AFC-11005GS	30-Dec-16	30-Jul-17

3.3 Test Setup





Test set-up of radiated disturbance (above 1GHz)

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3.4 TEST RESULT

Ambient Test Conditions: Temperature 25°C; Humidity 50%

(Control Unit)

Test Conditions			Power (dBm)	Limit (dBm)	Margin (dB)
Temperature(°C) Humidity(%)	Voltage	CH			
Tmin 25 ℃ Hmin 50%	❒ VDC nom 9.0VDC	L 2411(MHz)	-13.4	10.0	-23.4
Tmin -10 ℃ Hmin 0%	❒ VDC max 9.0VDC		-13.0	10.0	-23.0
	❒ VDC min 7.65VDC		-13.5	10.0	-23.5
Tmax 55 ℃ Hmax 50%	❒ VDC max 9.0VDC		-13.5	10.0	-23.5
	❒ VDC min 7.65 VDC		-13.7	10.0	-23.7
Ambient	❒ VDC nom 9.0VDC	M 2442(MHz)	-13.8	10.0	-23.8
Tmin -10 ℃ Hmin 0%	❒ VDC max 9.0VDC		-13.3	10.0	-23.3
	❒ VDC min 7.65VDC		-13.9	10.0	-23.9
Tmax 55 ℃ Hmax 50%	❒ VDC max 9.0VDC		-13.8	10.0	-23.8
	❒ VDC min 7.65VDC		-13.9	10.0	-23.9
Ambient	❒ VDC nom 9.0VDC	H 2463(MHz)	-15.9	10.0	-25.9
Tmin -10 ℃ Hmin 0%	❒ VDC max 9.0VDC		-15.6	10.0	-25.6
	❒ VDC min 7.65VDC		-15.8	10.0	-25.8
Tmax 55 ℃ Hmax 50%	❒ VDC max 9.0VDC		-15.7	10.0	-25.7
	❒ VDC min 7.65VDC		-15.9	10.0	-25.9

Notes:

1. Negative sign (-) in the margin column signify levels below the limit.
2. 10 dBm corresponds to 10 mW.
3. Measurement Uncertainty : ±4.8dB.
4. Cable loss and antenna gain was combined in the calculated result.

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4 PERMITTED RANGE OF OPERATING FREQUENCIES

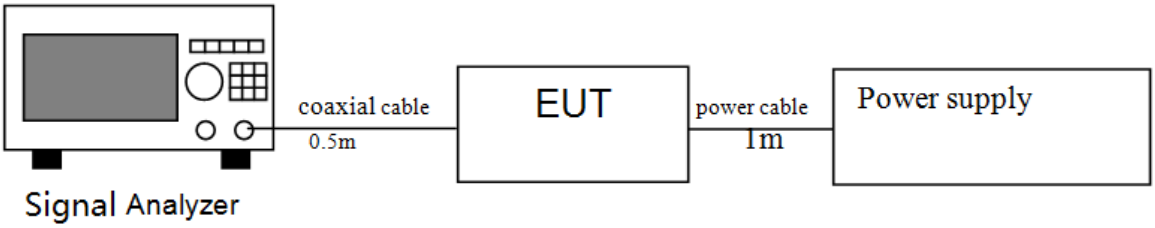
4.1 TEST METHOD AND SUMMARY

Basic Standard :	ETSI EN 300 440 V2.1.1 (2017-03)
Clause :	4.2.3
Test method	Conducted measurements

4.2 EQUIPMENT LIST

Equip No.	Description	Manufacturer	Model No.	Cal. Date	Due Date
SZ056-06	Signal Analyzer	R&S	FSV40	31-Jul-16	31-Jul-17
SZ016-12	Temperature & Humidity Chamber	Terchy	MHK-120NK	31-Jul-16	31-Jul-17
SZ006-12	AC Power Source	APC	AFC-11005GS	31-Dec-16	31-Jul-17

4.3 Test Setup



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4.4 TEST RESULT

PERMITTED RANGE OF OPERATING FREQUENCIES

Test Conditions			Frequency Range (GHz)	
Temperature (°C) **Humidity (%)**	**Voltage**	**CH**	**F_L**	**F_H**
T_{nom} 25°C H_{nom} 50%	VDC $_{nom}$ 9.0VDC	Low 2411(MHz)	2.410627	2.463281
T_{min} -10°C H_{min} 0%	VDC $_{max}$ 9.0VDC		2.410635	2.463280
	VDC $_{min}$ 7.65VDC		2.410638	2.463292
T_{max} 55°C H_{max} 50%	VDC $_{max}$ 9.0VDC	High 2463(MHz)	2.410641	2.463272
	VDC $_{min}$ 7.65VDC		2.410650	2.463263
Measurement Uncertainty			± 240Hz	

BAND EDGE WORSE RESULT

		Frequency (GHz)	Within Assigned Frequency Band
Lowest F_L	F_{LB}	2.410627	Complied
Highest F_H	F_{HB}	2.463292	Complied

where

F_{LB} Lowest frequency at appropriate spurious emission level

F_{HB} Highest frequency at appropriate spurious emission level

EUT was tested during absence of modulation.

The permitted range of modulation bandwidth must be within the limits of the assigned frequency band 2.4-2.4835 GHz.

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5 UNWANTED EMISSION IN THE SPURIOUS DOMAIN FOR TRANSMITTERS

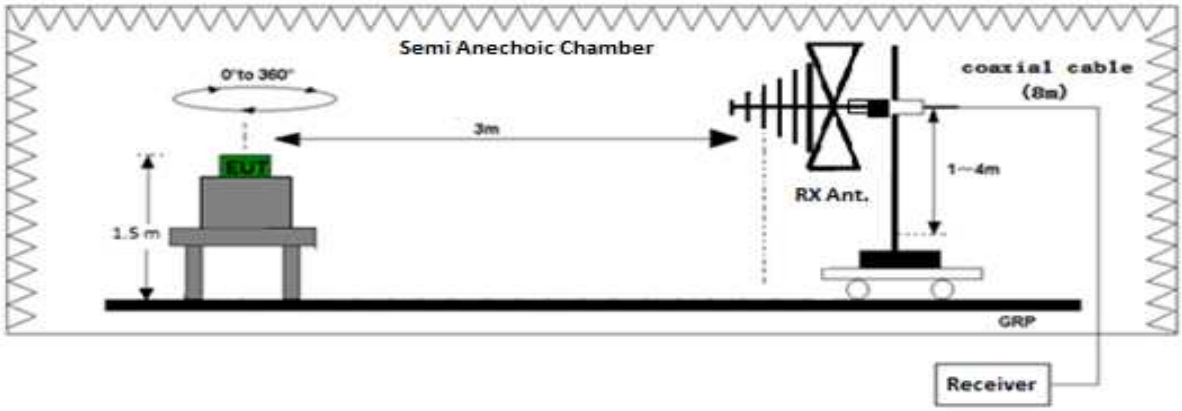
5.1 TEST METHOD AND SUMMARY

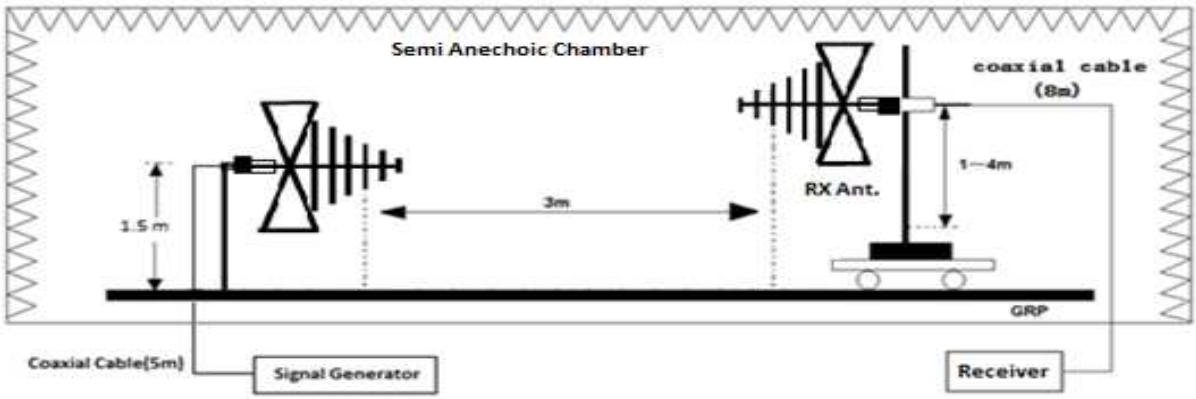
Basic Standard :	ETSI EN 300 440 V2.1.1 (2017-03)
Clause :	4.2.4
Test method	Conducted measurements

5.2 EQUIPMENT LIST

Equip No.	Description	Manufacturer	Model No.	Cal. Date	Due Date
SZ056-06	Signal Analyzer	R&S	FSV40	31-Jul-16	31-Jul-17
SZ061-12	BiConiLog Antenna	ETS	3142E	9-Sep-16	9-Sep-17
SZ061-09	Double - Ridged Waveguide Horn Antenna	ETS	3115	27-Oct-16	27-Oct-17
SZ181-04	Preamplifier	Agilent	8449B	9-Feb-17	9-Feb-18
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	16-Jan-17	16-Jan-19

5.3 Test Setup





Test set-up of radiated disturbance (30MHz-1GHz)

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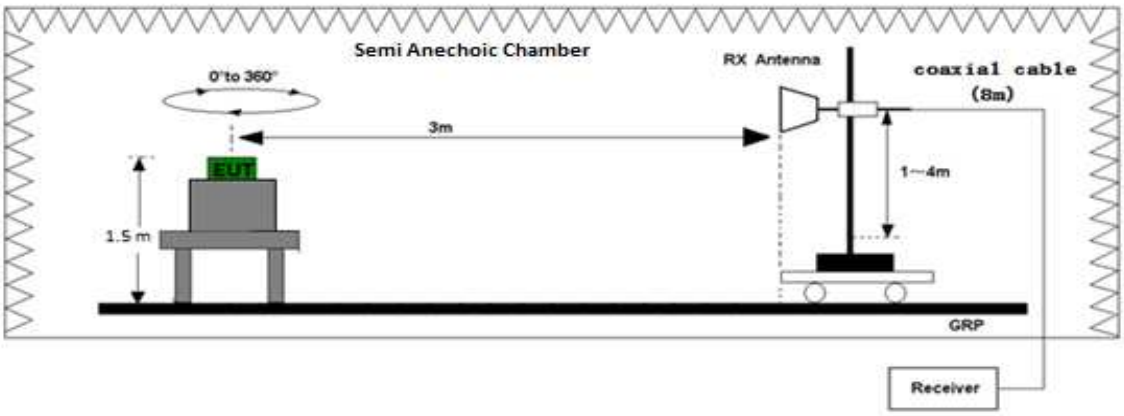

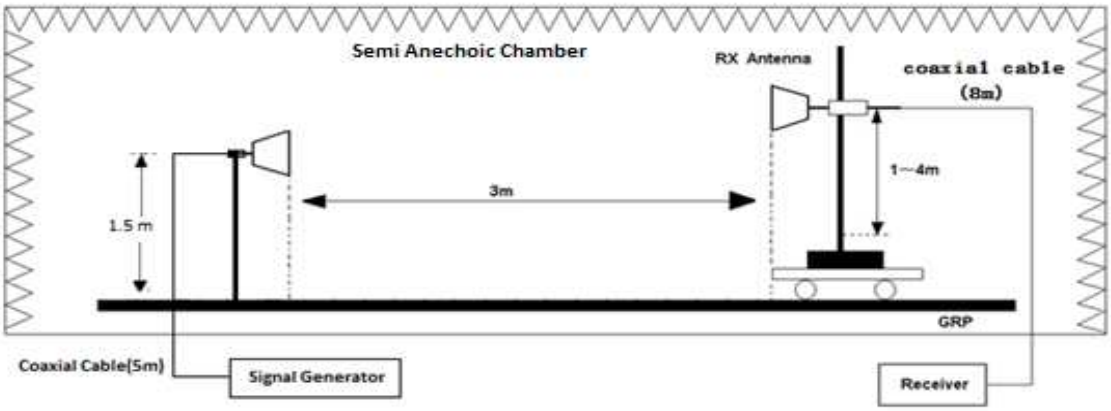

Test set-up of radiated disturbance (above 1GHz)

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5.4 Test Result

Test Conditions: Temperature 25.0°C; Humidity 50.0%

SPURIOUS EMISSIONS – OPERATING

The Channel: Low, Middle, High had been tested, and showed the worse data in the report.

Channel: Low			
Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dB)
4822.000	-44.0	-30.0	-14.0
7233.000	-39.6	-30.0	-9.6

Channel: Medium			
Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dB)
4884.000	-43.7	-30.0	-13.7
7326.000	-39.6	-30.0	-9.6

Channel: High			
Frequency (MHz)	Measured Power (dBm)	Limit (dBm)	Margin (dB)
4926.000	-44.0	-30.0	-14.0
7389.000	-39.5	-30.0	-9.5

5.5 SPURIOUS EMISSIONS - STANDBY

There were no emissions found above system measuring level (at least 10 dB below the limit).

Notes:

1. Negative sign (-) in the margin column signify levels below the limit.
2. Other emissions found were at least 10 dB below the limit.
3. -30 dBm corresponds to 1 μW.
4. Measurement Uncertainty: ±4.8dB.
5. Correction value was combined in the calculated result.

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6 SPURIOUS RADIATIONS FOR RECEIVERS

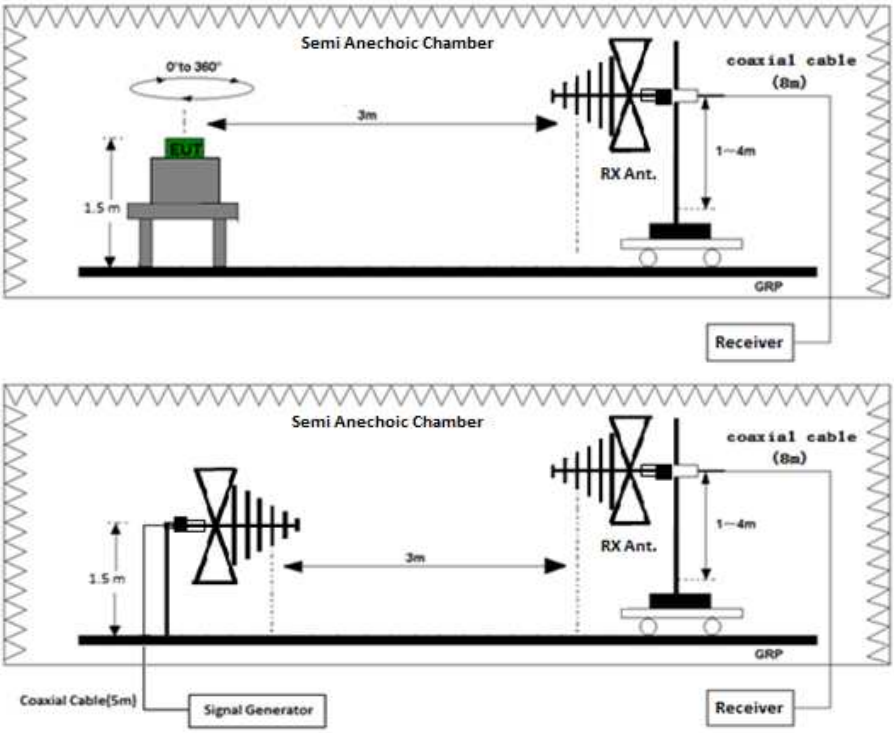
6.1 TEST METHOD AND SUMMARY

Basic Standard :	ETSI EN 300 440 V2.1.1 (2017-03)
Clause :	4.3.5
Test method	Radiated measurements

6.2 EQUIPMENT LIST

Equip No.	Description	Manufacturer	Model No.	Cal. Date	Due Date
SZ056-06	Signal Analyzer	R&S	FSV40	31-Jul-16	31-Jul-17
SZ061-12	BiConiLog Antenna	ETS	3142E	9-Sep-16	9-Sep-17
SZ061-09	Double - Ridged Waveguide Horn Antenna	ETS	3115	27-Oct-16	27-Oct-17
SZ181-04	Preamplifier	Agilent	8449B	9-Feb-17	9-Feb-18
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	16-Jan-17	16-Jan-19

6.3 Test Setup



Test set-up of radiated disturbance (30MHz-1GHz)

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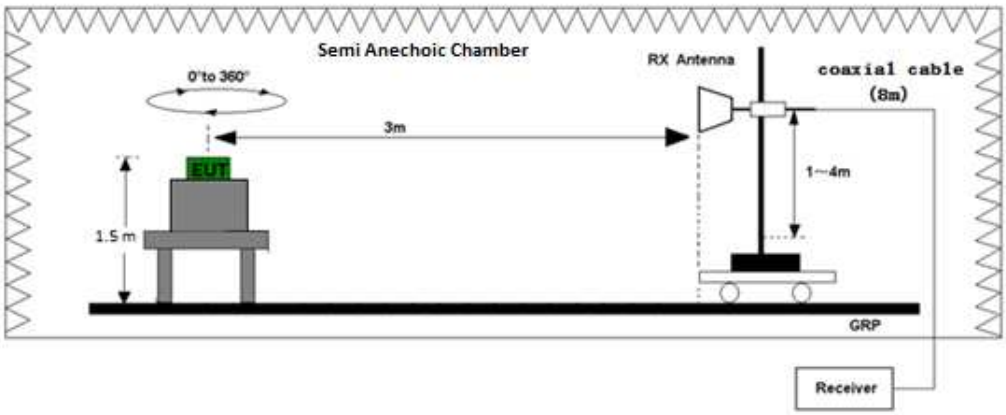

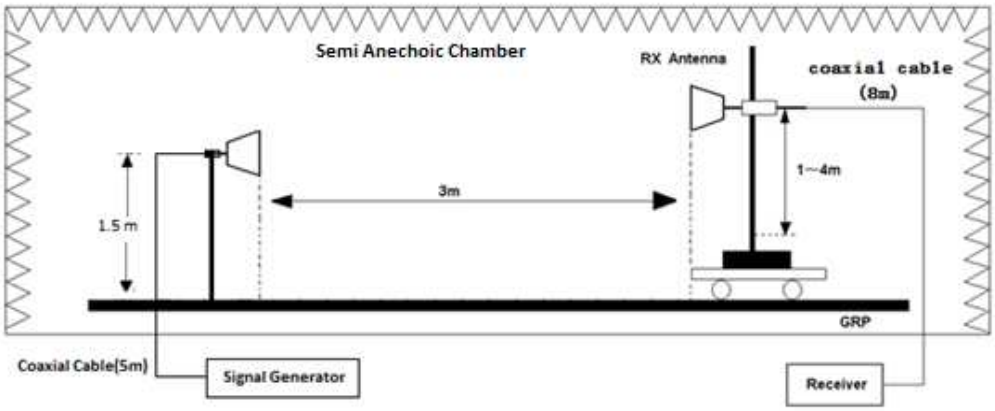

Test set-up of radiated disturbance (above 1GHz)

6.4 Test Result

Test Conditions: Temperature 27.1°C; Humidity 68%

SPURIOUS EMISSIONS - OPERATING

There were no emissions found above system measuring level (at least 10 dB below the limit).

SPURIOUS EMISSIONS - STANDBY

There were no emissions found above system measuring level (at least 10 dB below the limit).

Notes:

1. Negative sign (-) in the margin column signify levels below the limit.
2. Other emissions found were at least 10 dB below the limit.
3. -57 dBm corresponds to 2nW, -47 dBm corresponds to 20nW.
4. Measurement Uncertainty : ±5.0dB.

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7 BLOCING OR DESENSITIZATION

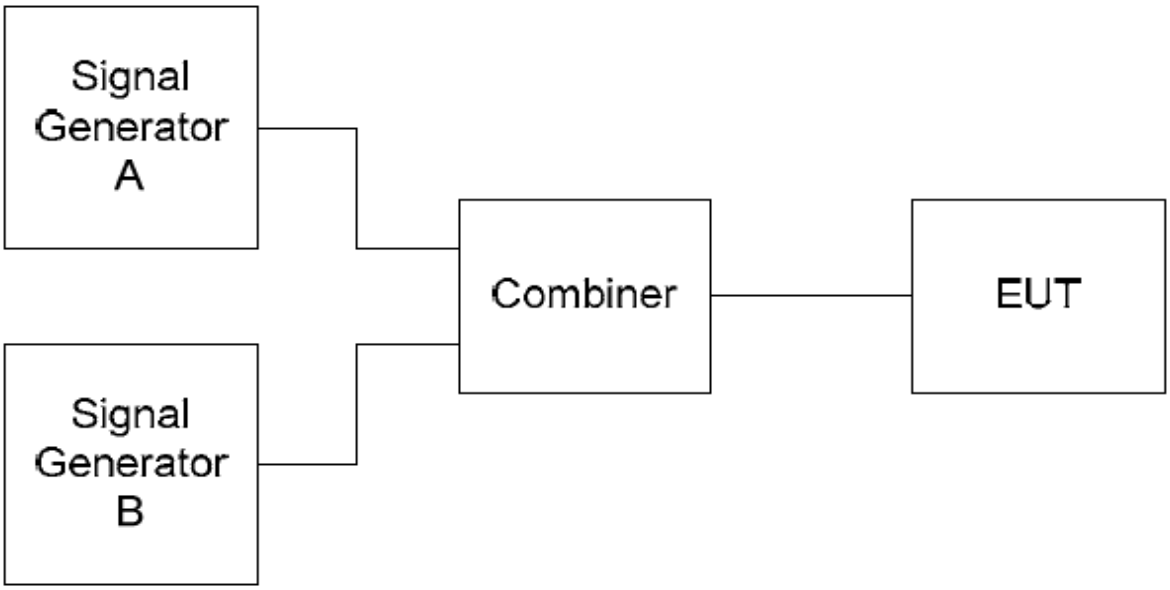
7.1 TEST METHOD AND SUMMARY

Basic Standard :	ETSI EN 300 440 V2.1.1 (2017-03)
Clause :	4.3.4
Test method	Conducted measurements

7.2 EQUIPMENT LIST

Equip No.	Description	Manufacturer	Model No.	Cal. Date	Due Date
SZ056-07	Signal Analyzer	R&S	FSV40	13-Nov-16	13-Nov-17
SZ180-13	MXG Vector Signal Generator	Keysight	N5182B	27-Oct-16	27-Oct-17
SZ180-15	Signal Generator	R&S	SMB100A	27-Oct-16	27-Oct-17
SZ070-21	Combiner	Mini-Circuits	ZN2PD-63-S+	01-Sep-16	01-Sep-17
SZ070-05	Directional Coupler	Agilent	87300C	09-Feb-17	09-Feb-18
SZ070-18	Attenuator	Agilent	8494B	09-Feb-17	09-Feb-18
SZ070-19	Attenuator	Agilent	8495B	09-Feb-17	09-Feb-18
SZ068-03	RF Shielding Cover	Changruixing	50×50×60cm	17-Mar-17	17-Sep-17

7.3 Test Setup



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7.4 TEST RESULT - DC TEST VOLTAGE

The minimum level of Wanted signal from companion device (dBm) (P_{min}+3dB)	Blocking signal frequency (MHz)		Blocking signal power (dBm)	Limit (-45 dBm + k)	Result
-38+3	±10*BW	Lower: 2425.3	-28	-51.3	Pass
-38+3		Upper: 2454.7	-28	-51.3	Pass
-38+3	±20*BW	Lower: 2411.3	-28	-51.3	Pass
-38+3		Upper: 2468.7	-28	-51.3	Pass
-38+3	±50*BW	Lower: 2369.3	-28	-51.3	Pass
-38+3		Upper: 2510.7	-28	-51.3	Pass

Notes:
1. When adjusts the level for the wanted signal at the input of the UUT to -38dBm, the UUT still gives sufficient response. And when below the level -38dBm, the UUT couldn't give sufficient response.
2. The receive channel bandwidth (BW) is 1.4 MHz, which is declared by manufacturer.
3. The nominal frequency of the receiver f during test is 2440MHz.
4. The correction factor k = −20log f −10log BW. Where f is the frequency in GHz and BW is the channel bandwidth in MHz. As the f is 2440MHz and BW is 1.4MHz, the correction factor k is -9.2dB.

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EXHIBIT 3

TEST RESULT

OF

EMC COMPLIANCE MEASUREMENTS

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8 EMC EMISSION TEST

8.1 RADIATED EMISSION TEST

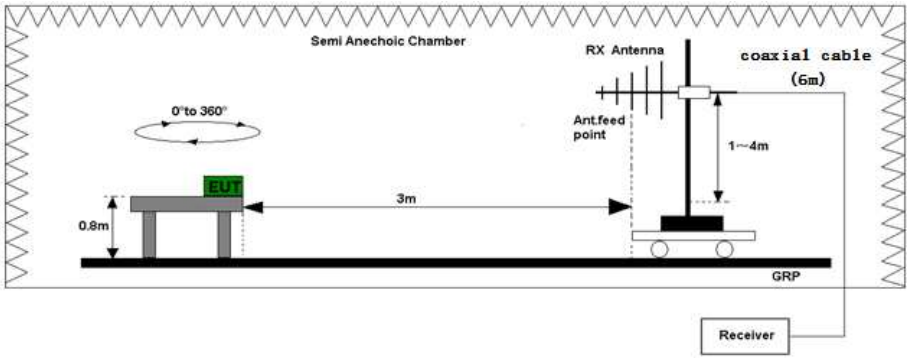
8.2 TEST METHOD AND SUMMARY

Basic Standard :	EN 55032: 15
Test :	Radiated Emission
Classification :	Class B
Port :	Enclosure Port of Ancillary Equipment

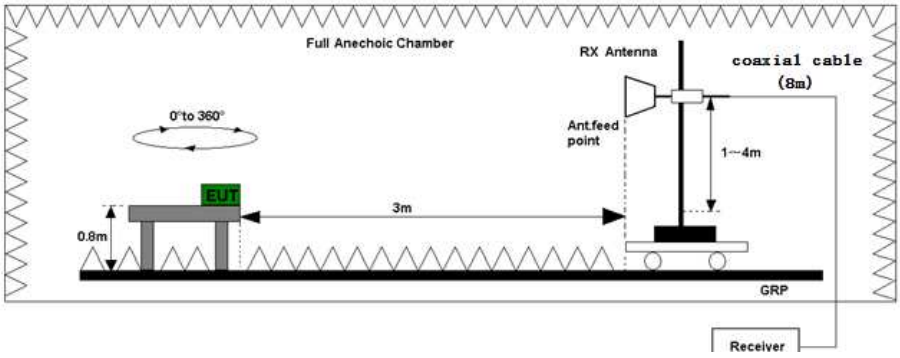
8.3 TEST EQUIPMENT

Equip No.	Description	Manufacturer	Model No.	Cal. Date	Due Date
SZ185-01	EMI Receiver	R & S	ESCI	31-Jul-16	31-Jul-17
SZ061-12	Biconilog Antenna	ETS	3142E	15-Sep-16	15-Sep-17
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	16-Aug-16	16-Aug-18

8.4 TEST SETUP



Test set-up of radiated disturbance (30MHz-1GHz)



Test set-up of radiated disturbance (above 1GHz)

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8.5 TEST RESULT

Worst-case Operating Mode: Forward Running (Motoring)

30MHz - 1GHz radiated disturbance Data Table

Polarization	Frequency (MHz)	Net at 3m (dBμV/m)	Calculated Net at 10m (dBμV/m)	Limit at 10m (dBμV/m)	Margin (dB)
H	143.490	27.2	17.2	30.0	-12.8
H	371.925	34.8	24.8	37.0	-12.2
H	919.520	37.7	27.7	37.0	-9.3
V	39.215	20.3	10.3	30.0	-19.7
V	109.540	24.1	14.1	30.0	-15.9
V	967.505	37.2	27.2	37.0	-9.8

Notes: 1. Quasi-Peak Detector Data
2. Negative sign (-) in the margin column signify levels below the limit
3. Frequency range scanned: 30 MHz to 1000 MHz
4. Only emissions significantly above equipment noise floor are reported.

8.6 MEASUREMENT UNCERTAINTY

Measurement Uncertainties: ± 4.8dB. The measured result is above the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliance based on the 95% level of confidence. However, the result indicates that compliance is more probable than non-compliance with the specification limit.

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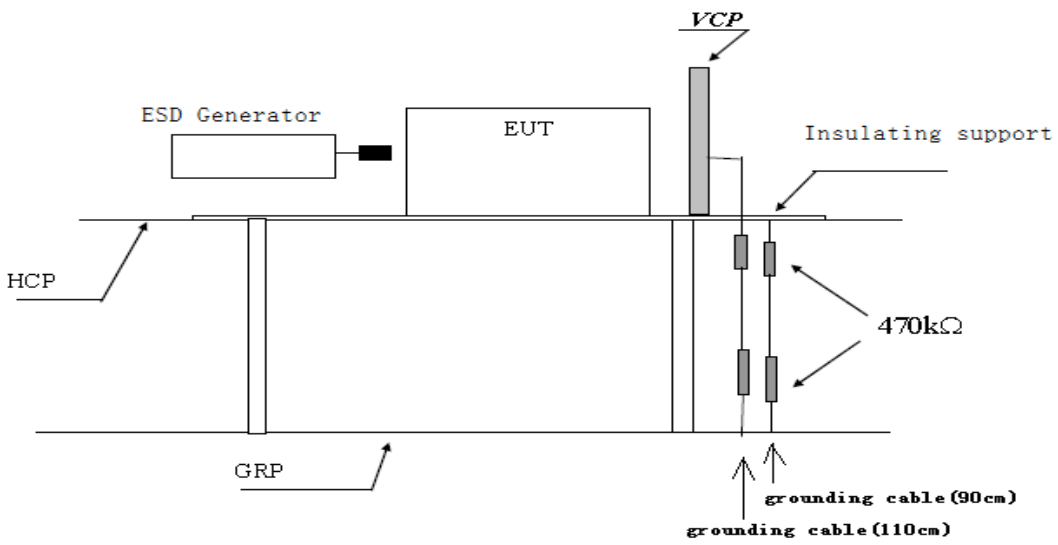
9 ELECTROSTATIC DISCHARGE

9.1 TEST METHOD AND SUMMARY

Basic Standard :	EN 61000-4-2: 2009
Port :	Enclosure
Required Performance Criterion :	TT & TR
Level :	± 2.0, ± 4.0, ±8.0 kV (Air Discharge) ± 2.0, ±4.0 kV (Contact Discharge) ± 2.0, ±4.0 kV (Indirect Contact Discharge)
No. of Discharge(s) :	Minimum of 10 Discharges per Each Polarity
Time Between Each Discharge :	1 second
Test Mode :	TX : Stand-by and Transmission, Power-off RX : Stand-by and Operating (Motor), Power-off
Test Setup :	Table-top
Temperature :	25.1^{0}C
Relative Humidity :	48.6%
Test of Post-installation :	N/A

9.2 TEST SETUP



Test set-up of electrostatic discharge

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9.3 TEST EQUIPMENT

Equipment No.	Equipment	Manufacturer	Model No.	Cal. Date	Due Date
SZ189-03	ESD Simulator	Teseq	NSG 435	14-Nov-16	14-Nov-17

9.4 TEST RESULT

9.5 TEST RESULT

Discharge Type	Applied Voltage	Result (Pursuant to ETSI EN 301 489-3 Criterion TT & TR)
Contact Discharge	± 2.0, ± 4kV	Complied
Air Discharge	± 2, ± 4, ± 8kV	Complied
Indirect HCP Discharge	± 2.0, ± 4kV	Complied
Indirect VCP Discharge	± 2.0, ± 4kV	Complied

9.6 ADDITIONAL RESULT INFORMATION

The EUT worked normally as intended during and after the test. No any observable change occurred.

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10 RADIO FREQUENCY ELECTROMAGNETIC FIELD

10.1 TEST METHOD AND SUMMARY

Basic Standard :	EN 61000-4-3: 2006 + A1: 2008 + A2: 2010
Port :	Enclosure
Required Performance Criterion :	CT & CR
Level :	3.0 V/m (rms)
Test Modulation :	1kHz, 80% AM
Frequency :	80 MHz to 6000 MHz
Dwell Time :	1s
Frequency Step :	10%
Temperature :	27.1^{0}C
Relative Humidity :	59.7%
Test Facility :	Full Anechoic Chamber
Antenna Polarization :	Horizontal and Vertical
Type of Antenna :	Broadband Antenna
Test Distance :	3m
Test Mode :	TX : Stand-by and Transmission, Power-Off RX : Stand-by and Operating (Motor), Power-Off
Test Setup :	Table-top

* The Equipment would be verified together with the test system before testing.

10.2 TEST EQUIPMENT

Equipment No.	Equipment	Manufacturer	Model No.	Cal. Date	Due Date
SZ061-04	BiConiLog Antenna	ETS	3142C	27-Jun-16	27-Dec-17
SZ180-01	Signal Generator	R&S	SML03	31-Jul-16	31-Jul-17
SZ181-01	Amplifier	PRANA	AP32 MT215	31-Jul-16	31-Jul-17
SZ181-02	Power Amplifier	MILMEGA	AS0825-35	31-Jul-16	31-Jul-17
SZ182-01	RF Power Meter	BOONTON	4232A	25-Jul-16	25-Jul-17
SZ188-02	Anechoic Chamber	ETS	RFD-F/A-100	30-Dec-16	30-Jul-17
SZ062-02	RF Cable	RADIALL	RG 213U(6M)	30-Jul-16	30-Jul-17
SZ186-01	Field Probe	ETS	HI-6105	30-Jul-16	30-Jul-17
SZ070-05	Directional Coupler	Agilent	87300C	30-Jan-17	30-Jul-17

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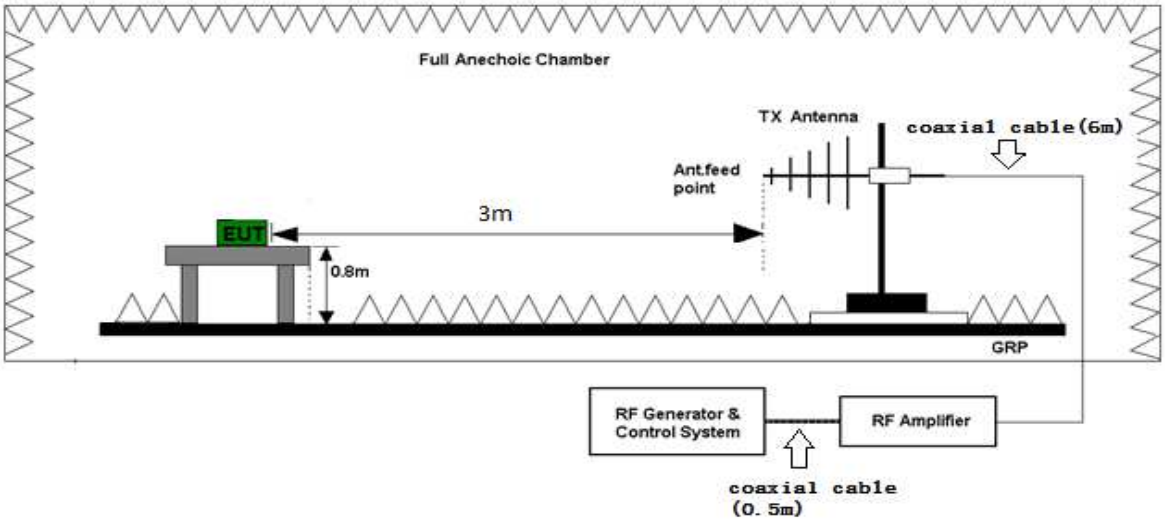
10.3 TEST SETUP



Test set-up of Immunity to Radiated Electric Fields

10.4 TEST RESULT

Frequency (MHz)	Exposed Side	Result (Pursuant to ETSI EN 301 489-3 Criterion CT & CR)
80 to 6000	Front	Complied
80 to 6000	Left	Complied
80 to 6000	Rear	Complied
80 to 6000	Right	Complied

10.5 ADDITIONAL RESULT INFORMATION

The EUT worked normally as intended during and after the test. No any observable change occurred.

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EXHIBIT 4

PHOTOS OF EUT

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10 EUT PHOTOS

10.1 EXTERNAL PHOTOS

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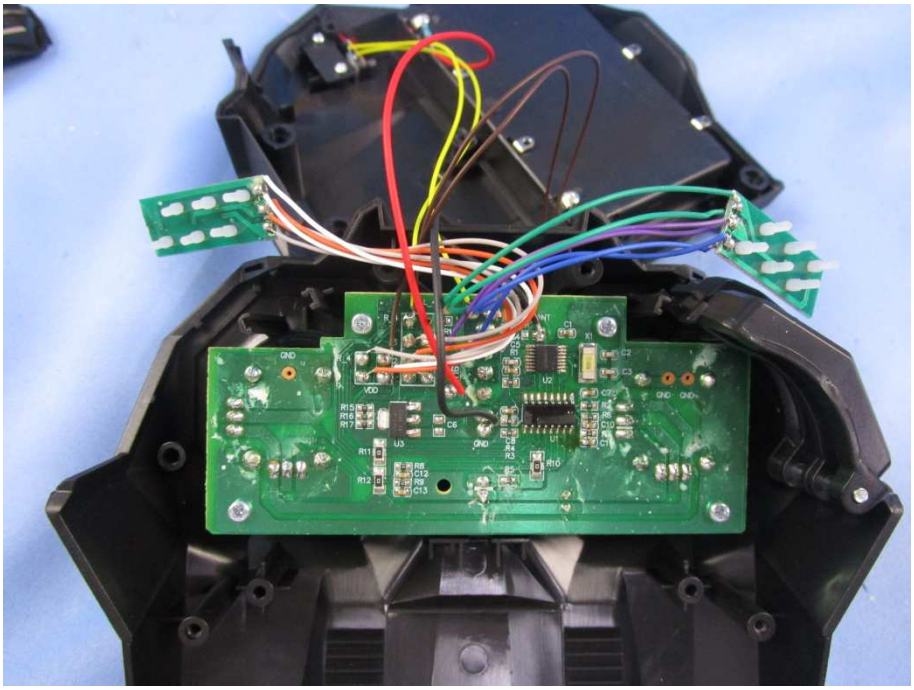
10.2 INTERNAL PHOTOS (Control Unit)



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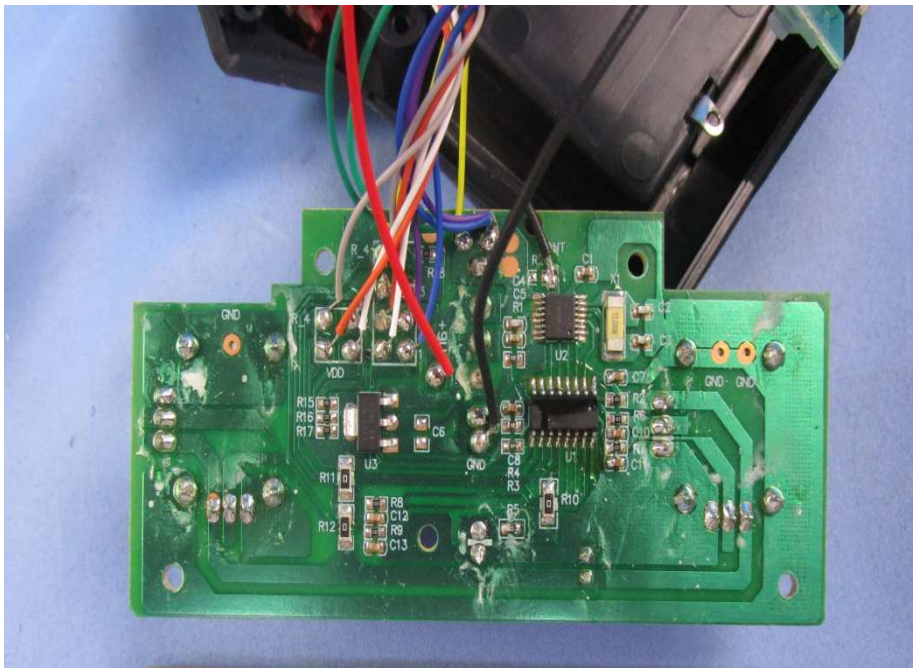

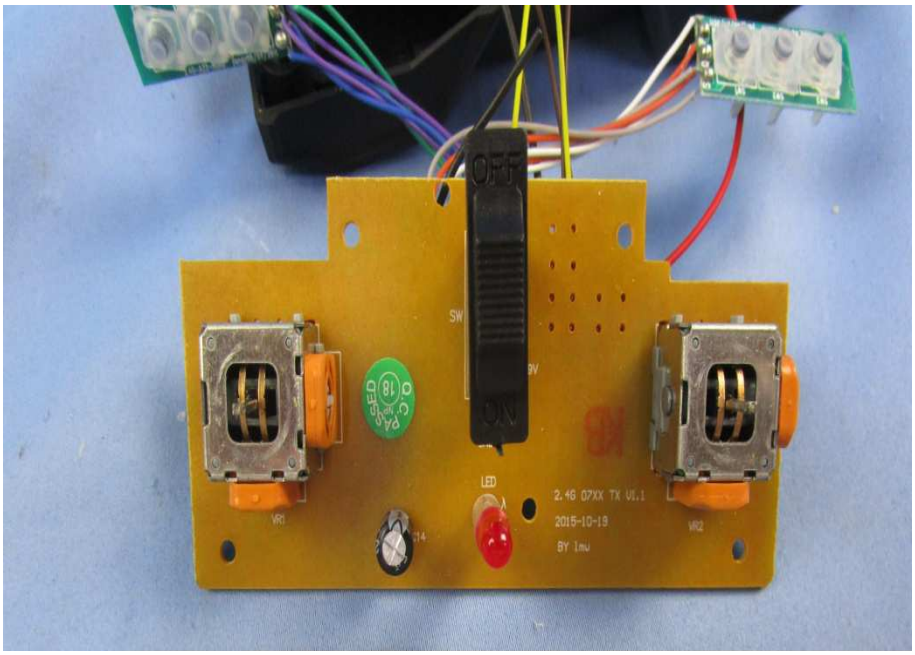

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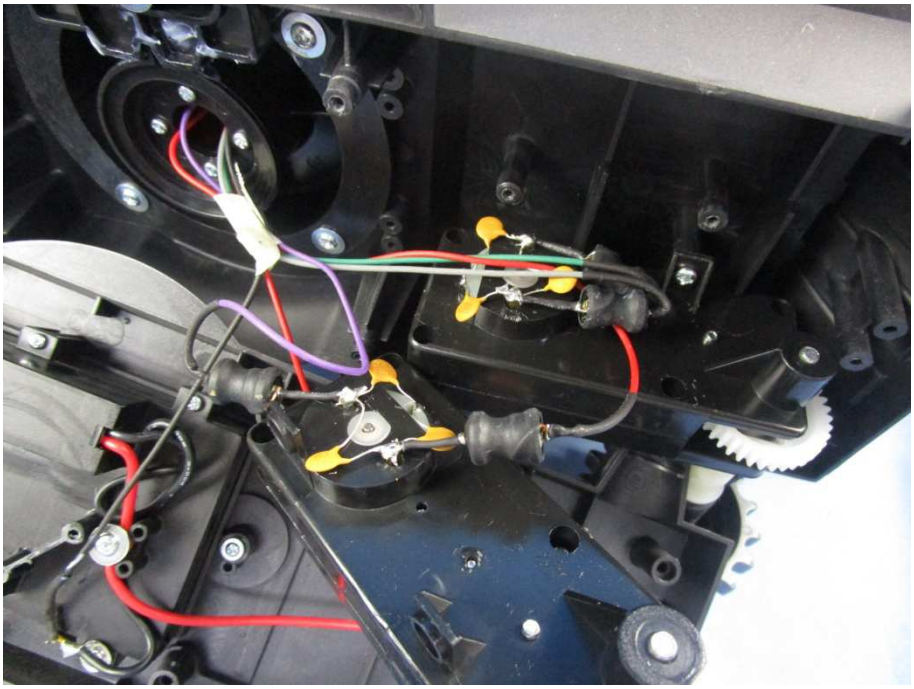
10.3 INTERNAL PHOTOS (RECEIVE UNIT)



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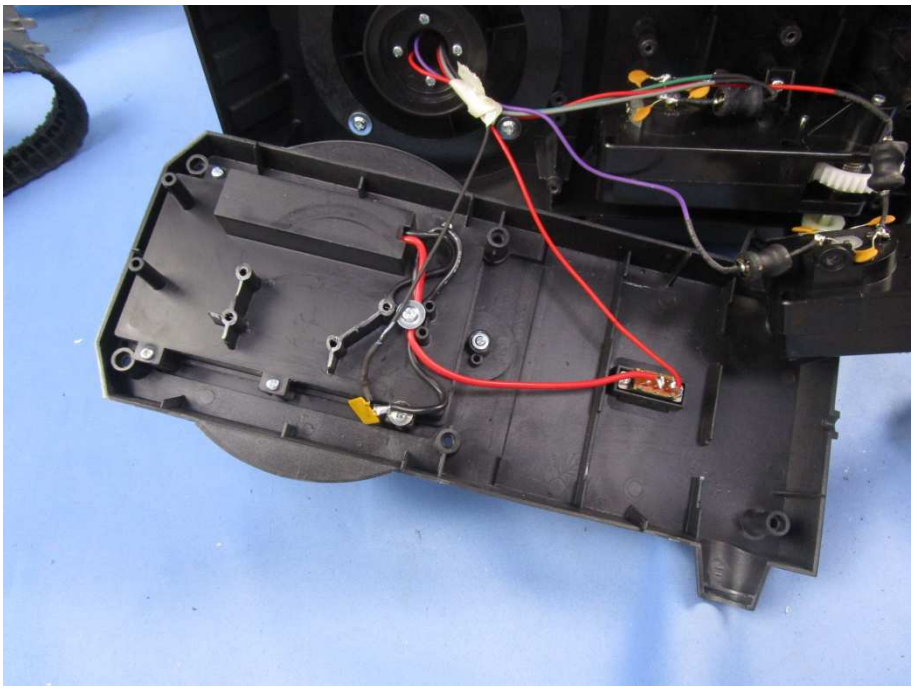

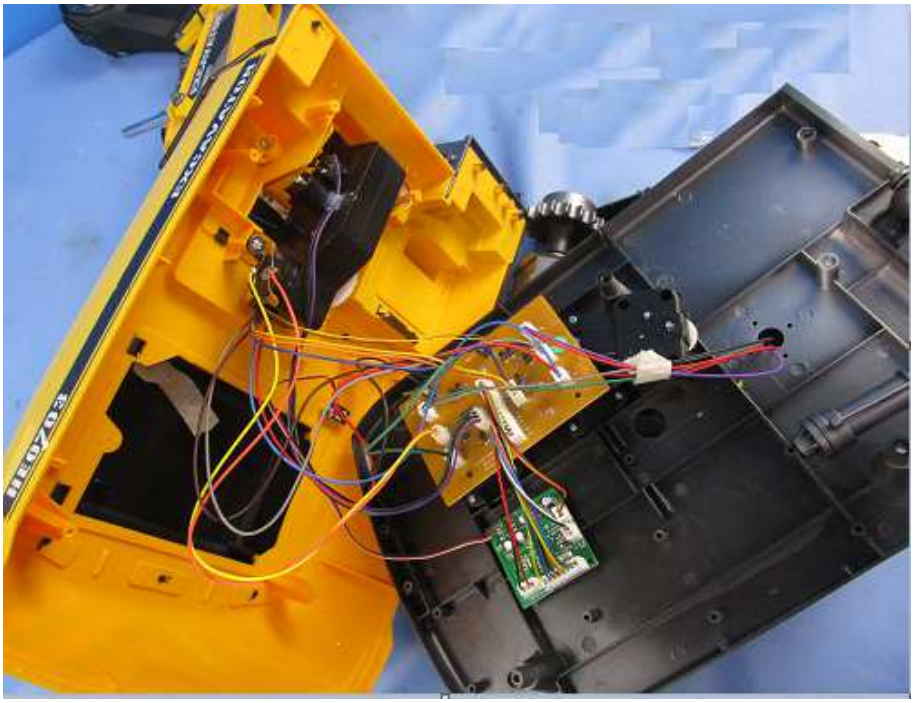

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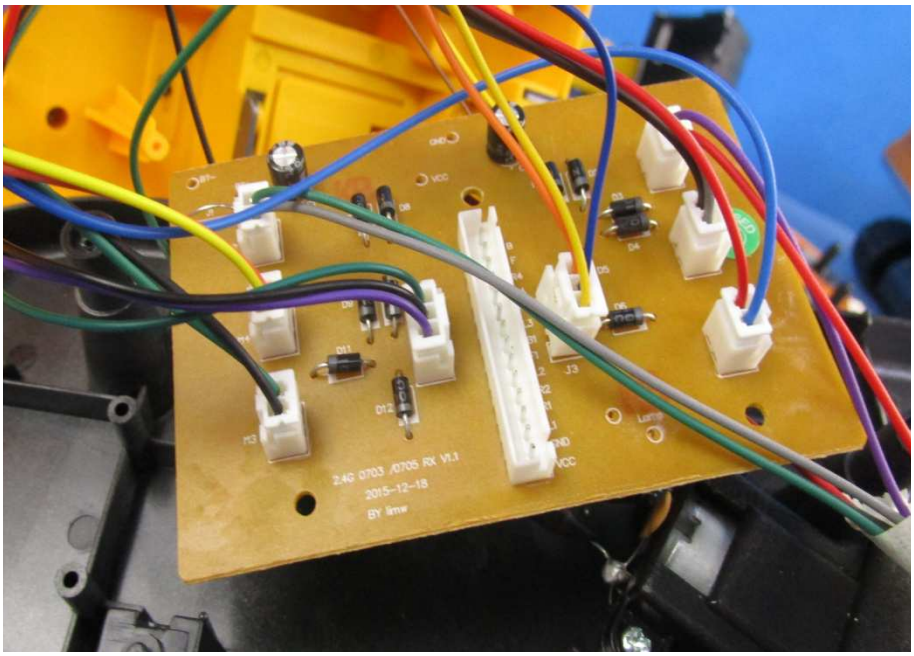

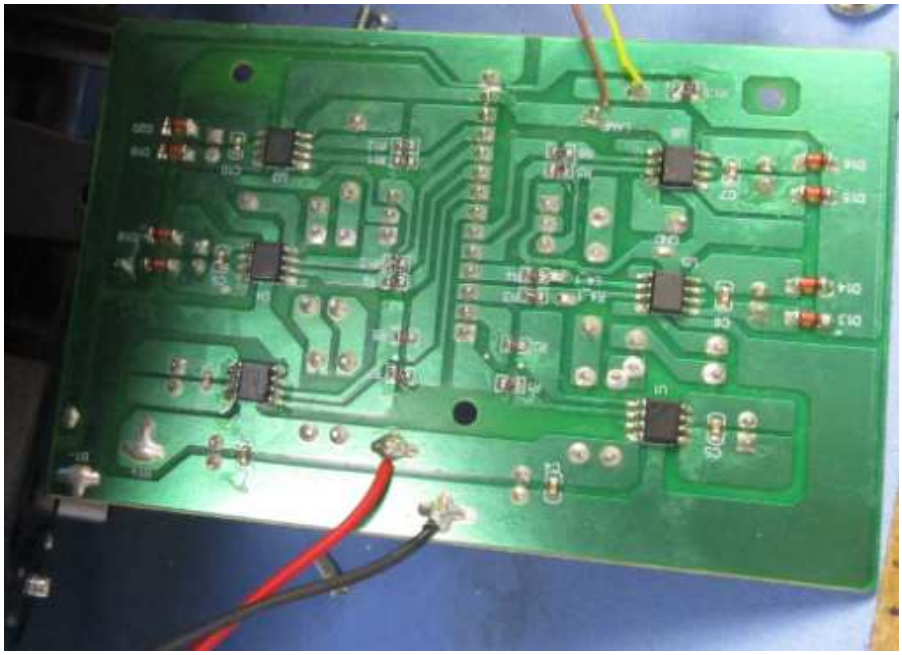

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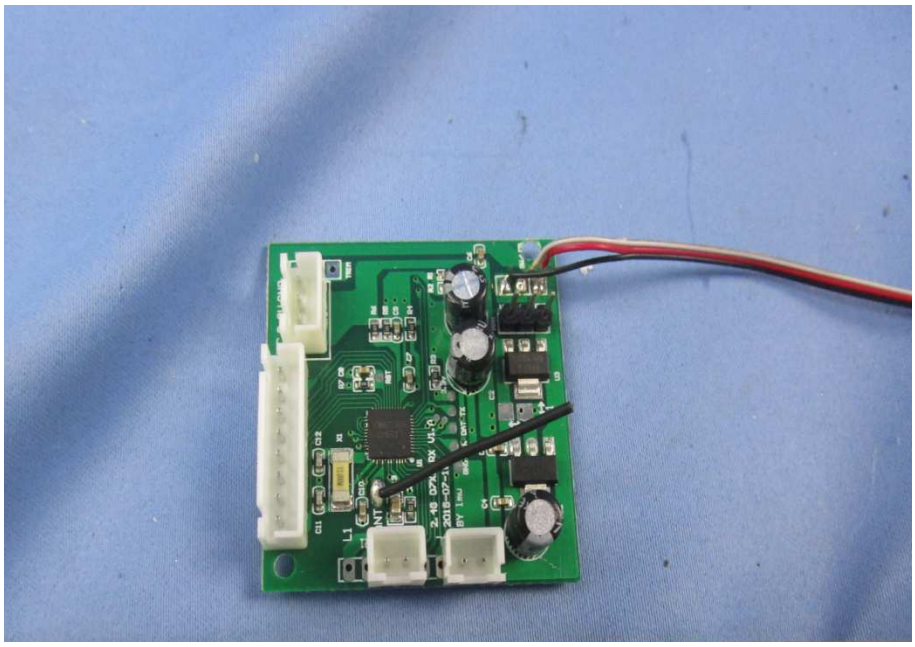

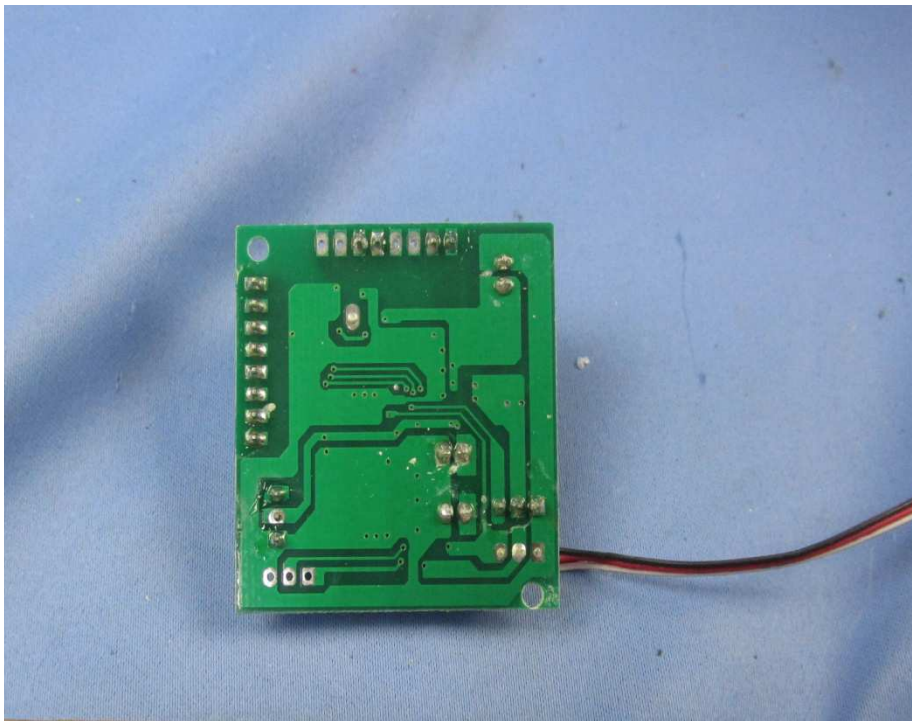

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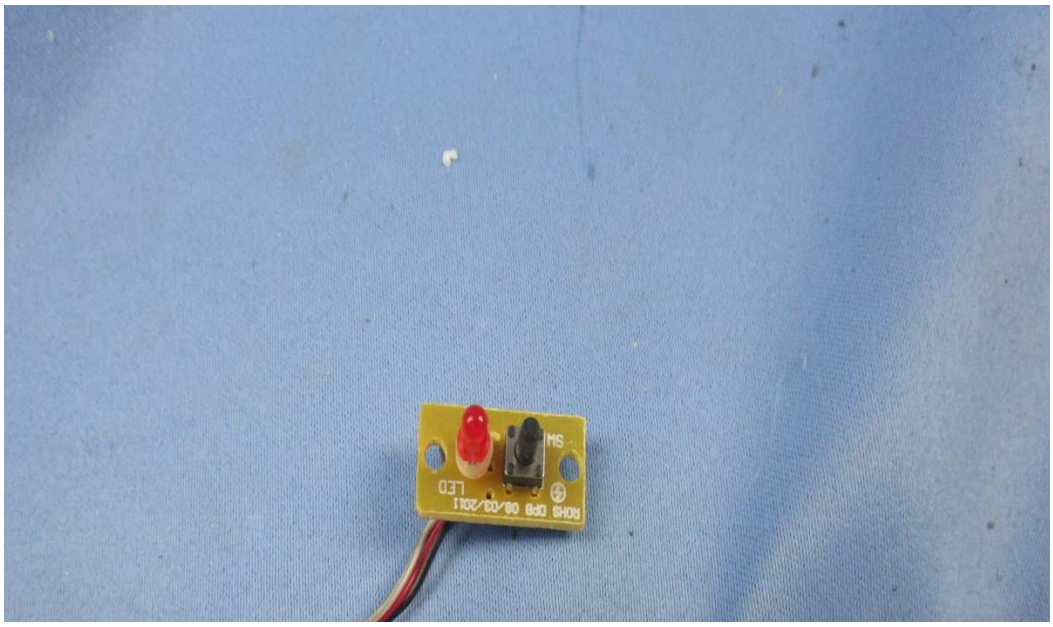

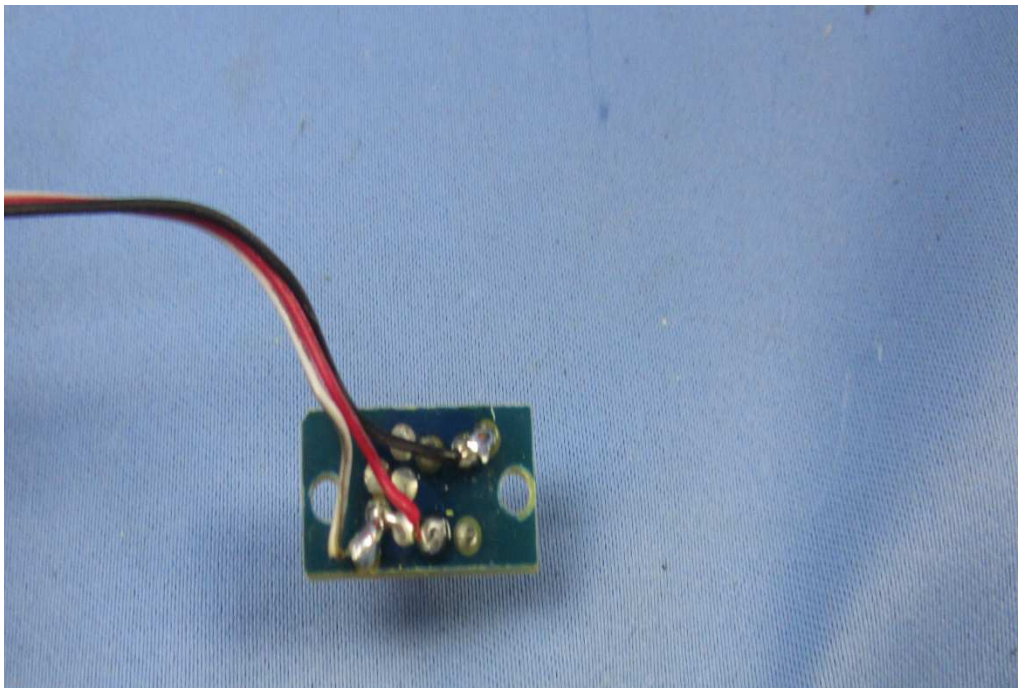

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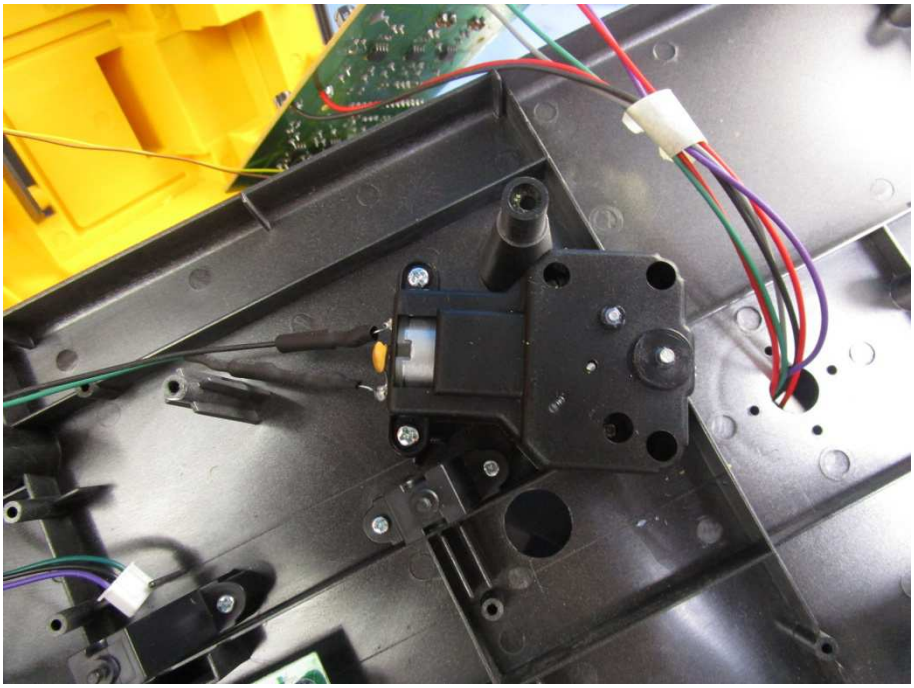

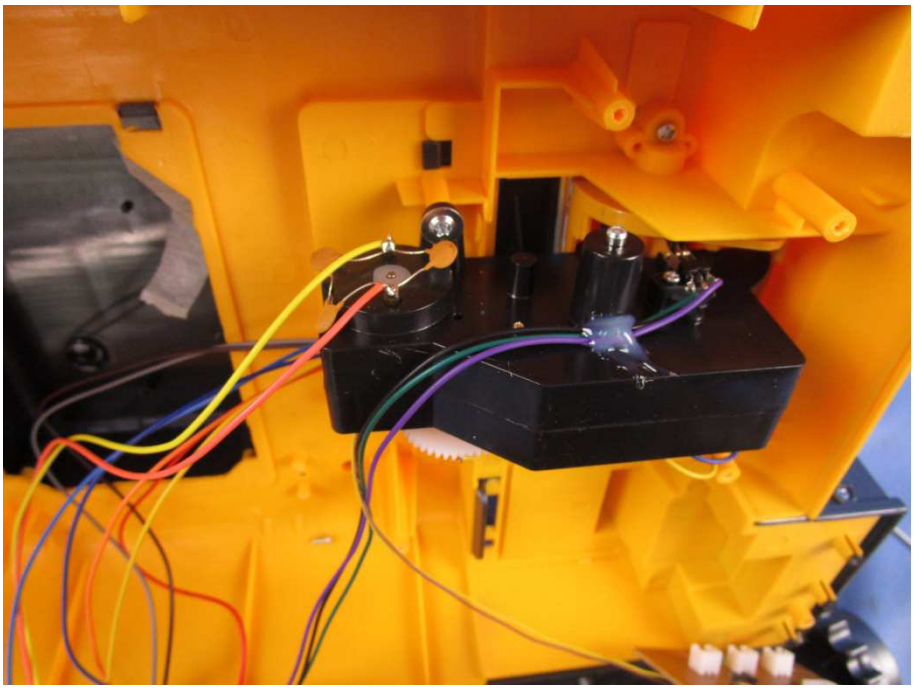

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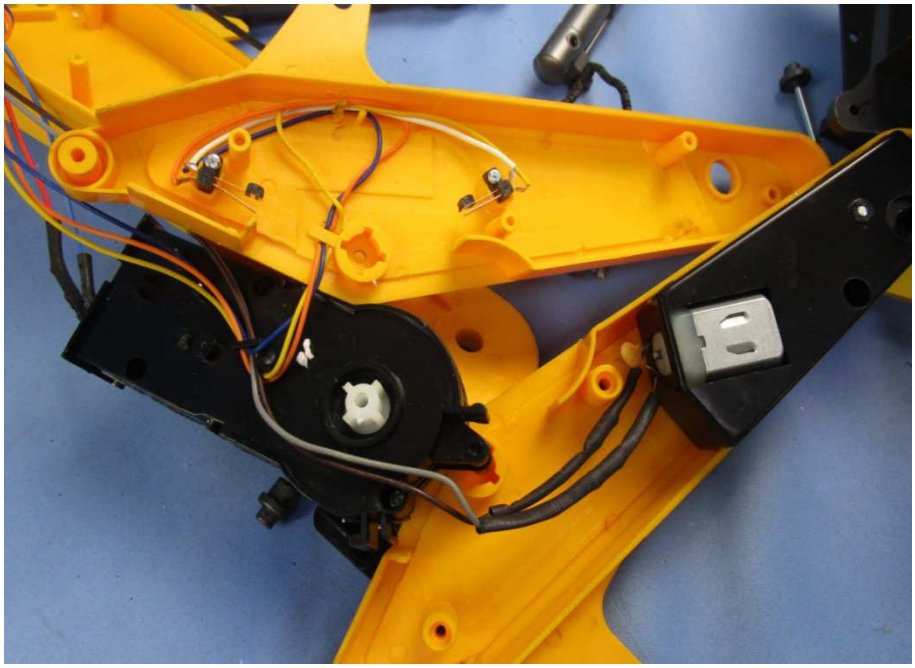

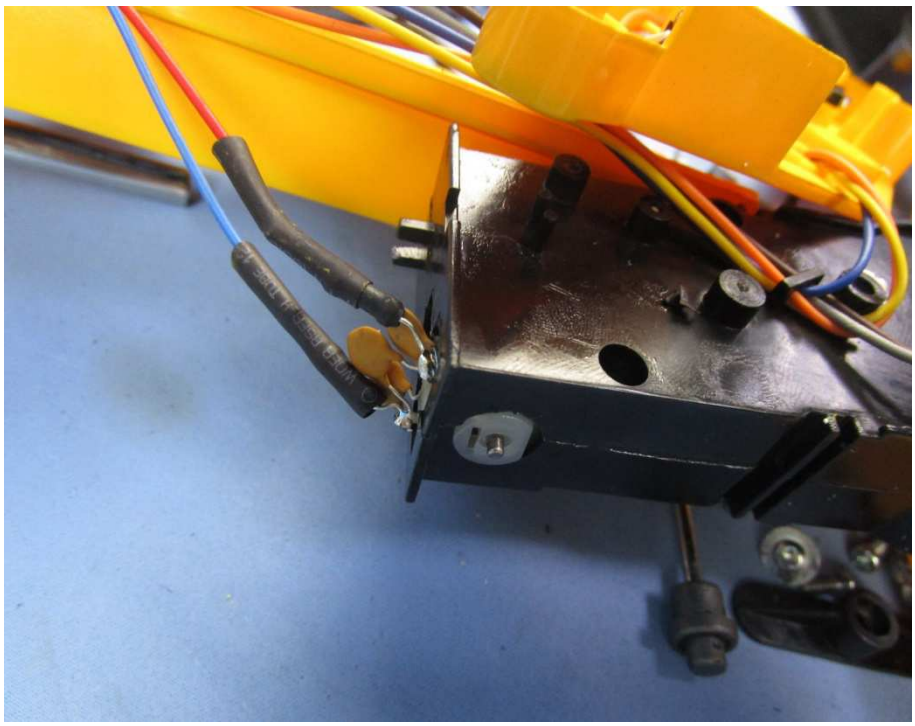

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