RADIO TEST REPORT
ETSI EN 300 220-1 V2.4.1(2012-05)
ETSI EN 300 220-2 V2.4.1(2012-05)

Product： Ajax SpaceControl

Trade Name： AJAX

Model Name： Ajax SpaceControl

Serial Model： N/A

Report No.： NTEK- 2016NT05246039R

Prepared for

Ajax Systems Inc

910 Foulk Rd., Wilmington, DE 19803, United States

Prepared by

Shenzhen NTEK Testing Technology Co., Ltd.

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TEST RESULT CERTIFICATION

Applicant's name	:	Ajax Systems Inc
Address	:	910 Foulk Rd., Wilmington, DE 19803, United States
Manufacture's Name	:	"Research and Production Enterprise "Ajax"LLC
Address	:	5, Sklyarenko, Kyiv04073, Ukraine.

Product description

Product name	:	Ajax SpaceControl
Trademark	:	AJAX
Model and/or type reference	:	Ajax SpaceControl
Serial Model	:	N/A
Rating(s)	:	DC 3.0V
Standards	:	EN 300 220-1 V2.4.1: 2012-05 EN 300 220-2 V2.4.1: 2012-05

This device described above has been tested by Shenzhen NTEK, and the test results show that the equipment under test (EUT) is in compliance with the of article 3.2 of the Directive 1999/5/EC requirements. And it is applicable only to the tested sample identified in the report.

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Date of Test	:	
Date (s) of performance of tests	:	26 May. 2016 ~14 June 2016
Date of Issue	:	14 June 2016
Test Result	:	**Pass**

Testing Engineer : Jack Li

(Jack Li)

Technical Manager : Jason Chen

(Jason Chen)

APPROVED

Authorized Signatory : Sam. Chen

(Sam Chen)

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1. Summary Of Test Results

Test procedures according to the technical standards:
ETSI EN 300 220-1 V2.4.1 (2012-05)
ETSI EN 300 220-2 V2.4.1 (2012-05)

Clause	Description of Test Item	Results(Pass/Fail)	N.T(Not Test)
Transmitter Parameters			
7.1	Frequency error and frequency drift		N.T
7.2	Average power	Pass	
7.3	Effective radiated power		N.T
7.4	Spread spectrum modulation		N.T
7.5	Transient power	Pass	
7.6	Adjacent channel power		N.T
7.7	Modulation bandwidth	Pass	
7.8	spurious emissions	Pass	
7.9	Frequency stability under low-voltage conditions	Pass	
7.10	Duty cycle		N.T
7.11	Time-out-timer		N.T
Receiver Parameters			
8.1	Receiver sensitivity		N.T
8.2	Receiver LBT threshold		N.T
8.3	Adjacent channel selectivity		N.T
8.4	Blocking	Pass	
8.5	Spurious response rejection		N.T
8.6	Receiver spurious radiation	Pass	

1.1 Test Facility

NTEK Testing Technology Co., Ltd.
Add. : 1/F, Building E, Fenda Science Park, Sanwei Community, Xixiang Street, Bao'an District, Shenzhen P.R. China
FCC Registered No.: 791972 IC Registered No.:9270A-1
CNAS Registration No.:L5516

1.2 Measurement Uncertainty

The reported uncertainty of measurement **y ± U**，where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**，providing a level of confidence of approximately **95** %。

No.	Item	Uncertainty
1	Conducted Emission Test	±1.38dB
2	RF power,conducted	±0.16dB
3	Spurious emissions,conducted	±0.21dB
4	All emissions,radiated(<1G)	±4.68dB
5	All emissions,radiated(>1G)	±4.89dB
6	Temperature	±0.5°C
7	Humidity	±2%

2. General Information

2.1 General Description Of EUT

Equipment	Ajax SpaceControl
Brand Name	AJAX
Model Name.	Ajax SpaceControl
Serial Model	N/A
Model Difference	N/A
Product Description	The EUT is Ajax SpaceControl Operation Frequency: 868 MHz – 868.5MHz; Channel number 3 Channels Modulation Type: FM Antenna Gain(Peak) -12dBi Antenna Designation: Built-in Planar Inverted L-antenna Power Rating DC 3.0V Based on the application, features, or specification exhibited in User's Manual, the EUT is considered as an ITE/Computing Device. More details of EUT technical specification, please refer to the User's Manual.
Channel List	Refer to below
Adapter	N/A
Battery	DC 3.0V
Hardware Version （wireless module）	N/A
Hardware Version	N/A
Software Version	N/A

Note:

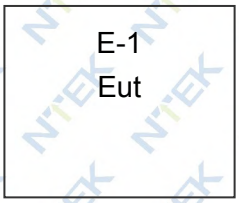
1. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

2.

Channel	Frequency (MHz)
00	868.1
01	868.3
02	868.5

2.2 Description Of Test Conditions

1.Block diagram of transmitter



2.2.1 Test Conditions and Channel

	Normal Test Conditions	Extreme Test Conditions
Temperature	15°C - 35°C	-10°C ~ 40°C Note: (1)
Relative Humidity	20% - 75%	N/A
Supply Voltage	AC 230V	AC 207-253V
Supply Voltage	DC 3.0V	DC 2.9-3.5V

Note:

(1) For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in clause 5.4.1.2, at the upper and lower temperatures of the range as follow: temperature: -10°C to +40°C;

(2) For the Leclanché or lithium type battery: 0.85 times the nominal voltage of the battery; for the mercury or nickel-cadmium type of battery: 0.9 times the nominal voltage of the battery.
In both cases, the upper extreme test voltage shall be 1.15 times the nominal voltage of the battery.

(3) The measurements are performed at the highest, middle, lowest available channels.

2.3 Description Of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
E-1	Ajax SpaceControl	AJAX	Ajax SpaceControl	N/A	

Item	Shielded Type	Ferrite Core	Length	Note

Note:

(1) The support equipment was authorized by Declaration of Confirmation.
(2) For detachable type I/O cable should be specified the length in cm in『Length』column.

2.4 Equipments List For All Test Items

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until	Calibration period
1	Spectrum Analyzer	Agilent	E4407B	160400005	2015.07.06	2016.07.05	1 year
2	Test Receiver	R&S	ESPI	101318	2015.07.06	2016.07.05	1 year
3	Bilog Antenna	TESEQ	CBL6111D	31216	2015.07.06	2016.07.05	1 year
4	50Ω Coaxial Switch	Anritsu	MP59B	6200264416	2015.07.06	2016.07.05	1 year
5	Spectrum Analyzer	ADVANTEST	R3132	150900201	2015.07.06	2016.07.05	1 year
6	Horn Antenna	EM	EM-AH-20180	2011071402	2015.07.06	2016.07.05	1 year
7	Horn Ant	Schwarzbeck	BBHA 9170	9170-181	2015.07.06	2016.07.05	1 year
8	Amplifier	EM	EM-30180	060538	2015.07.06	2016.07.05	1 year
9	Loop Antenna	ARA	PLA-2030/B	1029	2015.07.06	2016.07.05	1 year
10	Power Meter	R&S	NRVS	100696	2015.07.06	2016.07.05	1 year
11	Signal Generator	R&S	SMT 06	832080/007	2015.07.06	2016.07.05	1 year
12	Temperature & Humitidy Chamber	GIANT FORCE	GTH-056P	GF-94454-1	2015.07.06	2016.07.05	1 year
13	Power Sensor	R&S	URV5-Z4	0395.1619.05	2015.07.06	2016.07.05	1 year

3. Frequency error and frequency drift

3.1 Applied procedures / limit

The frequency error and drift shall not exceed the values given in table 1 or 2 under normal and extreme conditions.

Table 1: Frequency error for systems with channel spacings of less than or equal to 25 kHz

Channelization	Frequency error limit (kHz)				
	47 MHz	47 MHz to 137 MHz	137 MHz to 300 MHz	300 MHz to 500 MHz	500 MHz to 1000 MHz
Channelized systems	±10	±10	±10	±12	±12.5
Note：For equipment having a channel spacing of 12,5 kHz or less, the frequency error limit shall not exceed 50 % of the channel spacing.50 % of the channel spacing.					

Table 2: Frequency error for all other systems

Operating frequency	Frequency error limit (ppm),seenote
≤ 1 000 MHz	±100
NOTE: The frequency error measured shall not exceed the designated frequency band.	

3.2 Measuring Instruments and Setting

The following table is the setting of Spectrum Analyzer.

Spectrum Analyzer	Setting
Attenuation	10~20dB
Span Frequency	500kHz
RB	10 kHz
VB	30 kHz
Detector	Peak
Trace	Peak 50 sweeps

3.3 Test Procedures

a)Connected the antenna port to the Spectrum Analyzer via a Attenuator,

b)Set center frequency of spectrum analyzer = operating carrier frequency.

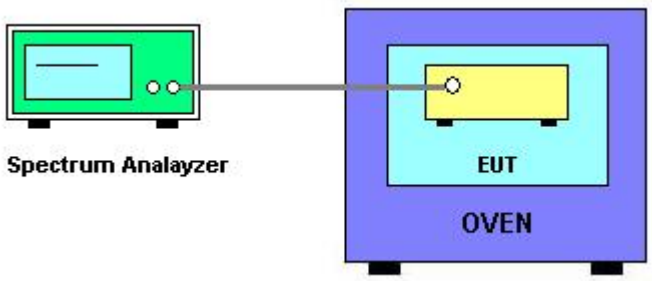
set the Spectrum Analyzer as below:

Resolution BW: 10 kHz
Video BW: 30 kHz
Span: 500 kHz

c)When the trace completed, find the peak value of the power envelope and record the frequency.

The above procedure shall be performed at normal and extreme test conditions.d. The measurement shall be repeated at the lowest, the middle, and the highest channel of the stated frequency range. These measurements shall also be performed at normal and extreme test conditions.

3.4 Test Setup Layout



3.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

3.6 TEST RESULTS

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	26°C	Relative Humidity：	60 %
Pressure：	1012 hPa	Test Voltage ：	N/A
Test Mode ：	N/A		

Note: the equipment is not capable of producing an unmodulated carrier.

4. Average power (conducted)

4.1 Limits

Under normal and extreme test conditions, the average output power (conducted) shall be less than or equal to the value given in table 3 for the respective frequency band, application, and channel spacing.

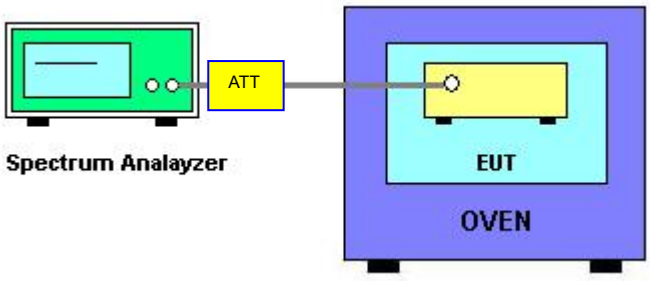
Table 3

Frequency Bands	Maximum radiated power, e.r.p. / power spectral density	Channel spacing	Spectrum access and mitigation requirement (e.g. Duty cycle or LBT + AFA)
863,000 MHz ~ 870,000 MHz	25 mW Power density is limited to -4,5 dBm/100 kHz	No requirement	0,1 % or LBT + AFA
868,000 MHz ~868,600 MHz	25 mW	No requirement	1 % or LBT + AFA
869,400 MHz ~869,650 MHz	500 mW	≤25 kHz The whole stated frequency band may be used as 1 wideband channel for high speed data transmission	10 % or LBT + AFA

4.2 Measuring Instruments and Setting

Spectrum Analyzer	Setting
Attenuation	Auto
Center Frequency	The frequency which is transmitting
Detector	Average
Sweep Time	Auto
RBW	100 kHz
VBW	≧RBW

4.3 Test setup



4.4 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.5 TEST RESULTS

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	26°C	Relative Humidity：	60 %
Pressure：	1012 hPa	Test Voltage ：	DC 3.0V(NORMAL)
Test Mode ：	TX CH00		

868MHz~868.6MHz

TEST CONDITIONS				Total e.i.r.p (dBm)		
				CH00		
T nom (°C)	20.00	V nom (V)	3.0	9.37		
T min (°C)	-10.00	V max (V)	3.5	9.33		
		V min (V)	2.9	9.36		
T max (°C)	40.00	V max (V)	3.5	9.32		
		V min (V)	2.9	9.26		
Max RF Power				**9.37**		
Limits				20dBm (-10dBW)		
Result				**Complies**		

5. Effective radiated power

5.1 Applied procedures / limit

The effective radiated power shall not exceed the values 25mW

5.2 Measuring Instruments and Setting

The following table is the setting of the power meter.

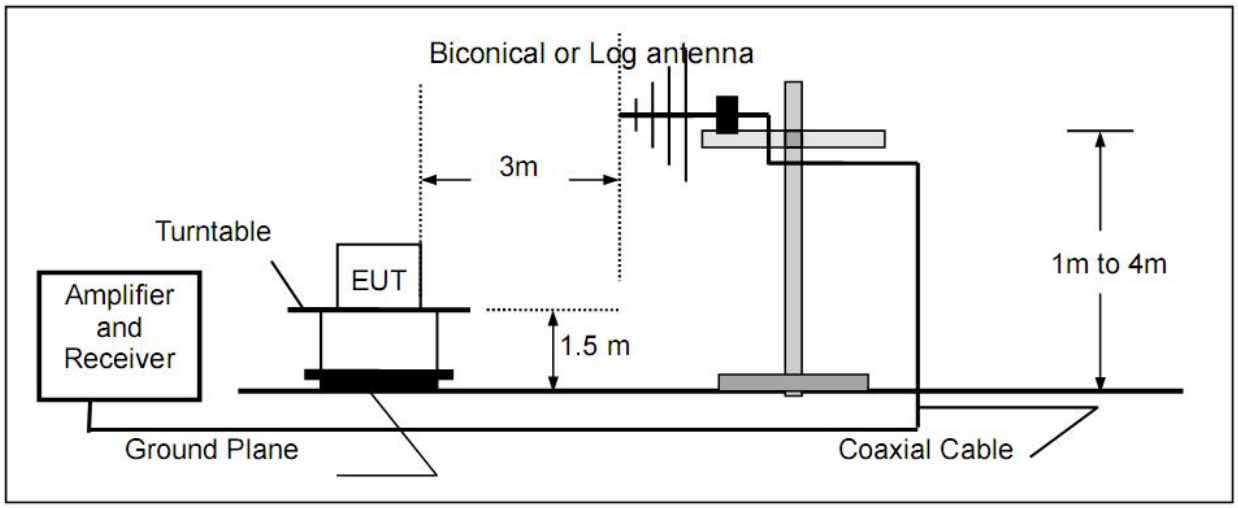
Spectrum Analyzer	Setting
Attenuation	Auto
Start Frequency	25 MHz
Stop Frequency	1000 MHz
Detector	Positive Peak
Sweep Time	Auto
RB / VB	100 kHz/100 kHz

5.3 Test Procedures

EUT was placed on a 1.5m outdoor wooden table. The search antenna is placed at 3m distances from the EUT and search antenna height is from 1-4m. With the transmitter operating at continuously mode, the turntable was slowly rotated to locate the direction of maximum emission. Once maximum direction is determined, the search antenna was raised and lowered in both vertical and horizontal polarizations.

The EUT was removed from the turntable and replaced with a linearly polarized antenna connected to a calibrated RF signal generator. The RF generator was set to a measured emission frequency and the search antenna was raised and lowered to produced a maximum received reading. The generator output was increased to match the radiated emission reading measured previously, and the result expressed in dB E.I.R.P. or ERP.

5.4 Test Setup Layout



5.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.6 TEST RESULTS

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	26°C	Relative Humidity：	60 %
Pressure：	1012 hPa	Test Voltage ：	N/A
Test Mode ：	N/A		

6. Frequency stability under low voltage conditions

6.1 Applied procedures / limit

This test is for battery operated equipment only.
The equipment shall either:

a) remain on channel, for channelized equipment within the limits stated in clause 5.1.1 , or within the assigned operating frequency band, for non-channelized equipment, whilst the radiated or conducted power is greater than the spurious emission limits; or

b) the equipment cease to function below the providers declared operating voltage.

6.2 Measuring Instruments and Setting

The following table is the setting of Spectrum Analyzer.

Spectrum Analyzer	Setting
Attenuation	10~20dB
Span Frequency	500kHz
RB	10 kHz
VB	30 kHz
Detector	Peak
Trace	Peak 50 sweeps

6.3 Test Procedures

a)Connected the antenna port to the Spectrum Analyzer via a Attenuator,

b)Set center frequency of spectrum analyzer = operating carrier frequency.

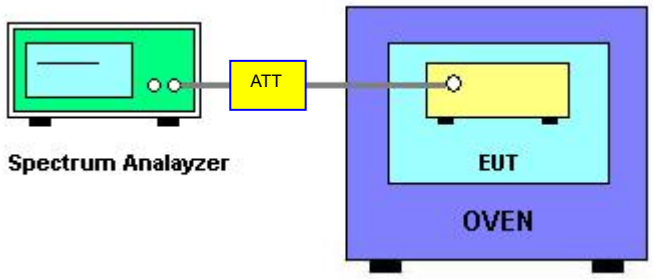
set the Spectrum Analyzer as below:

Resolution BW: 10 kHz
Video BW: 30 kHz
Span: 500 kHz

c)When the trace completed, find the peak value of the power envelope and record the frequency.

The above procedure shall be performed at normal and extreme test conditions.d. The measurement shall be repeated at the lowest, the middle, and the highest channel of the stated frequency range. These measurements shall also be performed at normal and extreme test conditions.

6.4Test Setup Layout



6.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

6.6 TEST RESULTS

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	26 °C	Relative Humidity：	60 %
Pressure：	1012 hPa	Test Voltage ：	DC 3.0V
Test Mode ：	TX CH1		

AC power Supplied (V) AC	Conducted Power	Limits
3.0V	5.04dBm	a) Remain on channel, for channelized equipment within the limits stated in clause 7.1.3, or within the assigned operating frequency band, for non-channelized equipment, whilst the radiated or conducted power is greater than the spurious emission limits; or b) The equipment cease to function below the providers declared operating voltage.
3.5V	2.18dBm	
2.9V	0.54dBm	
⩽1.6	No function	

7. Spurious emissions – Transmitter (25- 1000MHz)

7.1 Applied procedures / limit

State	47 MHz to 74 MHz 87.5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies ≤ 1 000 MHz	Frequencies > 1 000 MHz
Operating	4 nW /-54dBm	250 nW/-36dBm	1 μW /-30dBm
Standby	2 nW /-57dBm	2 nW /-57dBm	20 nW /-47dBm

7.2 Measuring Instruments and Setting

The following table is the setting of the Spectrum Analyzer.

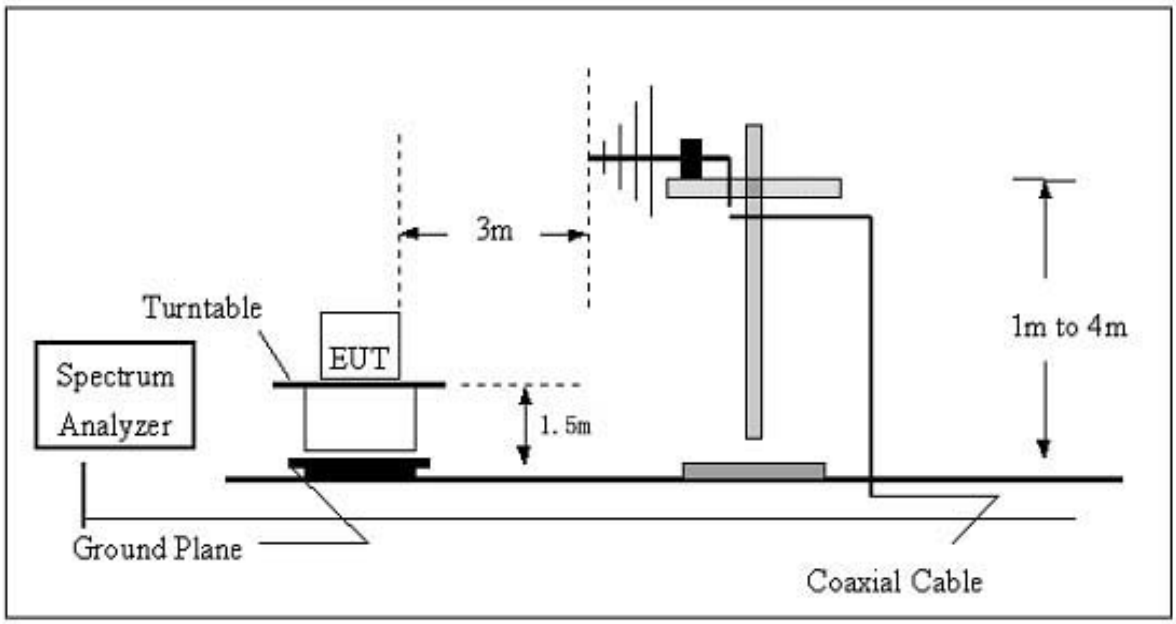
Spectrum Analyzer	Setting
Attenuation	Auto
Start Frequency	25 MHz
Stop Frequency	1000 MHz
Detector	Positive Peak
Sweep Time	Auto
RB / VB	100 kHz/100 kHz

7.3 Test Procedures

a. The EUT was placed on the top of the turntable in open test site area.
b. The test shall be made in the transmitting mode. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
c. This measurement shall be repeated with the transmitter in standby mode where applicable.
d. For 30~1000MHz spurious emissions measurement, the broad band bi-log receiving antenna was placed 3 meters far away from the turntable.
e. The broadband receiving antenna was fixed on the same height with the EUT to find each suspected emissions of both horizontal and vertical polarization. Each recorded suspected value is indicated as Read Level (Raw).
f. Replace the EUT by standard antenna and feed the RF port by signal generator.
g. Adjust the frequency of the signal generator to the suspected emission and slightly rotate the turntable to locate the position with maximum reading.
h. Adjust the power level of the signal generator to reach the same reading with Read Level (Raw).
i. The level of the spurious emission is the power level of (8) plus the gain of the standard antenna in dBi and minus the loss of the cable used between the signal generator and the standard antenna.
j. If the level calculated in (9) is higher than limit by more than 6dB, then lower the RBW of the spectrum analyzer to 30KHz. If the level of this emission does not change by more than 2dB, then it is taken as narrowband emission, otherwise, wideband emission.
k. The measurement shall be repeated at the lowest and the highest channel of the stated frequency range.

7.4 Test Setup Layout

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz



7.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

7.6 Results of Standby Mode Spurious Emissions

For the initial investigation on standby mode and receiving mode, no significant differences in spurious emissions were observed between these 2 modes. So test data for standby mode was omitted in this section.

7.7 TEST RESULTS (25MHz ~ 1000MHz)

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	24 ℃	Relative Humidity：	54%
Pressure：	1010 hPa	Test Power ：	DC 3.0V
Test Mode ：	TX		

Polar (H/V)	Frequency (MHz)	Meter Reading (dBm)	Factor (dB)	Emission Level (dBm)	Limits (dBm)	Margin (dB)	Detector Type
V	34.14	60.44	18.95	-79.73	-36.00	-43.73	peak
V	173.20	40.31	12.51	-86.38	-36.00	-50.38	peak
V	672.90	58.54	20.87	-76.10	-54.00	-22.10	peak
V	902.56	39.39	24.09	-69.47	-36.00	-33.47	peak
H	32.83	58.51	19.42	-79.31	-36.00	-43.31	peak
H	149.30	35.61	-5.17	-86.77	-36.00	-50.77	peak
H	409.92	62.26	-10.82	-83.29	-36.00	-47.29	peak
H	34.14	60.44	18.95	-79.73	-36.00	-43.73	peak

Remark:
Absolute Level= ReadingLevel+ Factor, Margin= Absolute Level - Limit

8. Spurious emissions – Transmitter (Above 1000MHZ)

8.1 Applied procedures / limit

State	47 MHz to 74 MHz 87.5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies ≤ 1 000 MHz	Frequencies > 1 000 MHz
Operating	4 nW /-54dBm	250 nW/-36dBm	1 μW /-30dBm
Standby	2 nW /-57dBm	2 nW /-57dBm	20 nW /-47dBm

8.2 Measuring Instruments and Setting

The following table is the setting of the Spectrum Analyzer.

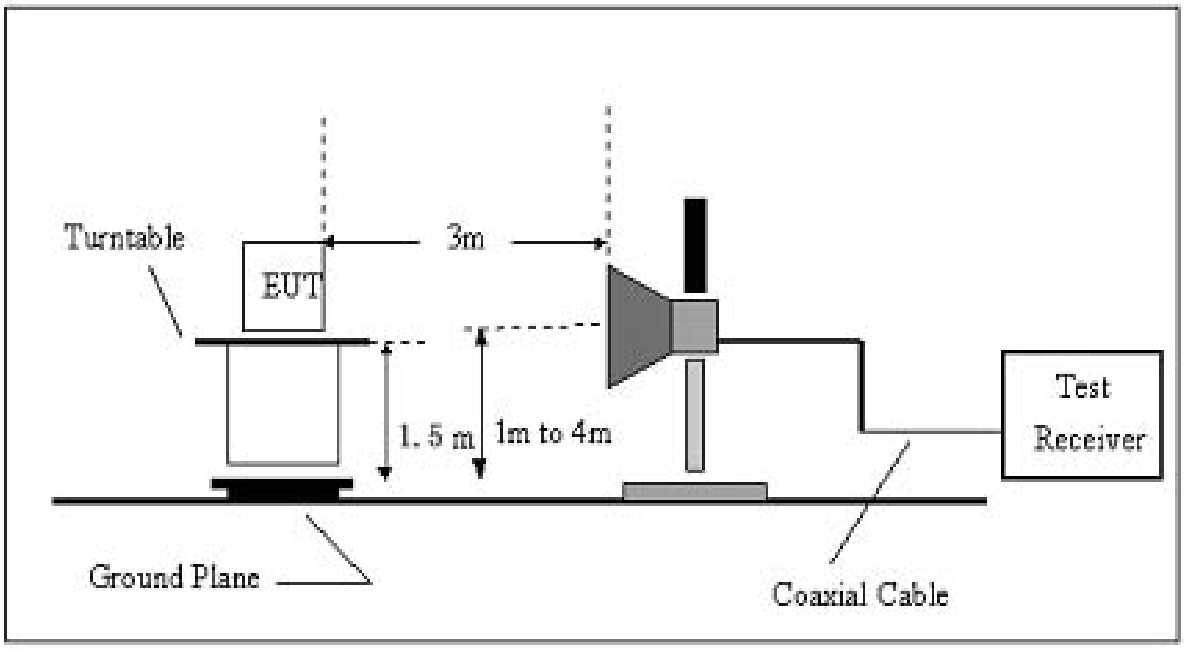
Spectrum Analyzer	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier frequency
Detector	Positive Peak
Sweep Time	Auto
RB / VB	1 MHz / 1 MHz

8.3 Test Procedures

a. The EUT was placed on the top of the turntable in open test site area.
b. The test shall be made in the transmitting mode. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
c. This measurement shall be repeated with the transmitter in standby mode where applicable.
d. For 30~1000MHz spurious emissions measurement, the broad band bi-log receiving antenna was placed 3 meters far away from the turntable.
e. The broadband receiving antenna was fixed on the same height with the EUT to find each suspected emissions of both horizontal and vertical polarization. Each recorded suspected value is indicated as Read Level (Raw).
f. Replace the EUT by standard antenna and feed the RF port by signal generator.
g. Adjust the frequency of the signal generator to the suspected emission and slightly rotate the turntable to locate the position with maximum reading.
h. Adjust the power level of the signal generator to reach the same reading with Read Level (Raw).
i. The level of the spurious emission is the power level of (8) plus the gain of the standard antenna in dBi and minus the loss of the cable used between the signal generator and the standard antenna.
j. If the level calculated in (9) is higher than limit by more than 6dB, then lower the RBW of the spectrum analyzer to 30KHz. If the level of this emission does not change by more than 2dB, then it is taken as narrowband emission, otherwise, wideband emission.
k. The measurement shall be repeated at the lowest and the highest channel of the stated frequency range.

8.4 Test Setup Layout

(B) Radiated Emission Test Set-Up Frequency Above 1 GHz



8.5 EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

8.6 Results of Standby Mode Spurious Emissions

For the initial investigation on standby mode and receiving mode, no significant differences in spurious emissions were observed between these mode. So test data for standby mode was omitted in this section.

8.7 TEST RESULTS

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	26°C	Relative Humidity：	53 %
Pressure：	1012 hPa	Test Voltage ：	DC 3.0V
Test Mode ：	TX		

Polar (H/V)	Frequency (MHz)	Meter Reading (dBm)	Factor (dB)	Emission Level (dBm)	Limits (dBm)	Margin (dB)	Detector Type
V	1736.78	60.44	3.14	-40.23	-30.00	-10.23	peak
V	2618.03	40.31	9.27	-40.91	-30.00	-10.91	peak
V	3469.91	58.54	8.61	-49.55	-30.00	-19.55	peak
V	9491.78	39.39	14.83	-47.70	-30.00	-17.70	peak
H	1736.78	58.51	3.45	-44.16	-30.00	-14.16	peak
H	2676.78	35.61	-5.17	-49.56	-30.00	-19.56	peak
H	4145.53	62.26	-10.82	-51.32	-30.00	-21.32	peak
H	10784.28	44.51	-10.82	-43.11	-30.00	-13.11	peak

Remark:
Absolute Level= ReadingLevel+ Factor, Margin= Absolute Level - Limit

9. Duty cycle

9.1 Applied procedures / limit

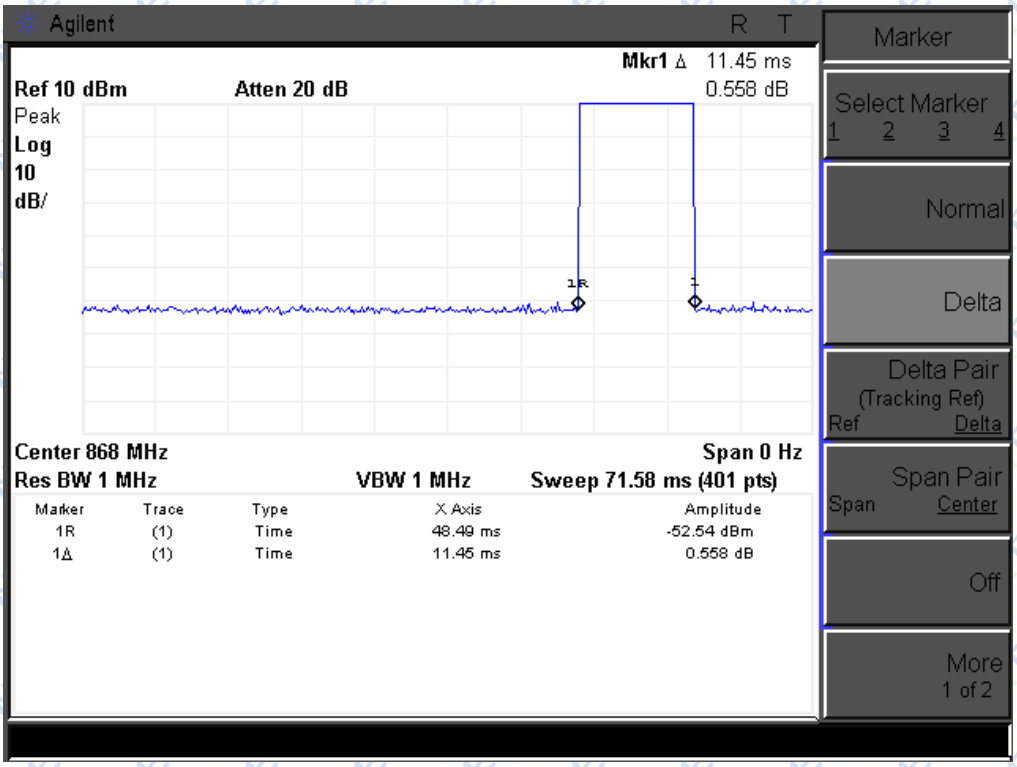
In a period of 1 hour the duty cycle shall not exceed 1%

9.2 TEST RESULTS

Test Result

Duty Cycle	Limit	Result
≦1%Note	1%	Complies

Note: The result is that the customer claims that its prototype emission per hour less than 3144 times the number obtained.



10. Transient power

10.1 Applied procedures / limit

At all frequencies where the emission levels measured in step 1 exceed the spurious domain limits (clause 7.8.3), the power level measured in step 1 shall not exceed the power level measured in Step 2 by more than 3 dB.

10.2 Test Procedures

Step 1

The transmitter shall be operated with powering on and off (e.g. by switching between active and standby state) at least 5 times within a maximum period of 60 seconds. The recommended powering on- and off-time is at least 1 s respectively. If other on- and off-times are used, this shall be stated in th test report.

The measured power level shall be recorded for the measurement period covering at least 5 powering on and off events for the measurement receiver setting above and below the wanted channel.

If the resulting maximum power level in step 1 is above the spurious domain limit (clause 7.8.3), the second measurement step shall be performed.

Step 2

In the second measurement, the procedure shall be repeated with the same settings of the measuring receiver, whereas

the transmitter shall be set on continuous transmission. If this is not possible, the measurements shall be carried out in a period shorter than the duration of the modulated transmitted burst.

The measured power level shall be recorded for the measurement period identical to the one in step 1 for the measurement receiver setting above and below the wanted channel.

Measurement step 1 shall be repeated within the spectrum mask every 120 kHz from the primarily adjusted point to both sides of the wanted frequencies, until either it is clearly ascertained that no powe increases or limit exceeding appear, or until the frequency offset to the wanted frequency exceeds 2 MHz.

10.3 Test Result

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	26°C	Relative Humidity：	53 %
Pressure：	1012 hPa	Test Voltage ：	DC 3.0V
Test Mode ：	TX CH0		

FA

Channel Spacing	Step 1	Step 2	△(Step 1-Step2)	Limit	Results
(times)	(dBm)	(dBm)	dB	dB	(P/F)
1(+100kHz)	4.183	4.368	-0.185	3	PASS
2(+120kHz)	/	/	/	3	PASS

FB

Channel Spacing	Step 1	Step 2	△(Step 1-Step2)	Limit	Results
(times)	(dBm)	(dBm)	dB	dB	(P/F)
1(+100kHz)	-27.53	-28.55	1.02	3	PASS
2(+120kHz)	-37.37	-39.24	1.87	3	PASS
3(+240kHz)	/	/	/		PASS
4(+360kHz)	/	/	/		PASS

11. Adjacent channel power

11.1 Applied procedures / limit

These measurements are applicable to narrowband systems.

Adjacent channel power limits applicable to narrowband systems

	Channel separation < 20 kHz	Channel separation ≥ 20 kHz
Normal test conditions	10 μW	200 nW
Extreme test conditions	32 μW	640 nW
NOTE: These limits also apply to spread spectrum equipment.		

11.2 Test Procedures

a) The transmitter shall be operated at the carrier power determined under normal test conditions.
The output of the transmitter shall be linked to the input of the "receiver" by a connecting device such that the impedancepresented to the transmitter is 50 Ω and the level at the "receiver input" is appropriate

b) With the transmitter unmodulated, the tuning of the "receiver" shall be adjusted so that a maximum response is obtained. This is the 0 dB response point. The "receiver" attenuator setting and the reading of the meter shall be recorded. If an unmodulated carrier cannot be obtained, then the measurement shall be made with the transmitter modulated with the normal test signal as appropriate, in which case this fact shall be recorded in test reports.

c) The transmitter shall be modulated by a normal test signal as appropriate.

d) The "receiver" variable attenuator shall be adjusted to obtain the same meter reading as in step b), or a known relation to it.

e) The ratio of the adjacent channel power to the carrier power is the difference between the attenuator settings in steps b) and d), corrected for any differences in the reading of the meter.

11.3 Test Result

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	26°C	Relative Humidity：	53 %
Pressure：	1012 hPa	Test Voltage ：	N/A
Test Mode ：	N/A		

12. Modulation bandwidth

12.1 Applied procedures / limit

Emission Limits of the modulated signal

Reference Bandwidth (RBW)	Limit	Lower envelope point minimum frequency	Upper envelope point maximum frequency
1 kHz	1 uW	fe, lower	fe, upper
1 kHz	250 nW	(fe, lower - 200 kHz)	(fe, upper + 200 kHz)
10 kHz	250 nW	(fe, lower - 400 kHz)	(fe, upper + 400 kHz)
100 kHz	250 nW	(fe, lower - 1 000 kHz)	(fe, upper + 1000kHz)

In table , fe,lower and fe,upper are the lower and upper edges of the band in which the equipment operates.

12.2 Measuring Instruments and Setting

Spectrum Analyzer	Setting
Attenuation	Auto
Detector	Positive Peak
Sweep Time	Auto
RB	1KHZ, 10KHz, 100KHz
VB	3RB

12.3 Test Procedures
In clauses 7.2 or 7.3

12.4 Test Result

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	26°C	Relative Humidity：	53 %
Pressure：	1012 hPa	Test Voltage ：	DC 3.0V
Test Mode ：	TX CH0		

Test Conditions :

TNVN

Upper envelope point maximum frequency	Max Vaule (dBm)	Limit	**Reference Bandwidth (RBW)**	Result
(fe, upper + 200 kHz)	-32.27	-30dBm	1KHz	PASS
(fe, upper + 400 kHz)	-50.10	-36dBm	10KHz	PASS
(fe, upper + 1 000 kHz)	-49.85	-36dBm	100KHz	PASS
> (fe, upper + 1 000 kHz)	-46.75	-36dBm	100KHz	PASS

Lower envelope point minimum frequency	Max Vaule (dBm)	Limit	**Reference Bandwidth (RBW)**	Result
(fe, lower - 200 kHz)	-32.73	-30dBm	1KHz	PASS
(fe, lower - 400 kHz)	-51.9	-36dBm	10KHz	PASS
(fe, lower - 1 000 kHz)	-50.44	-36dBm	100KHz	PASS
< (fe, lower - 1 000 kHz)	-47.31	-36dBm	100KHz	PASS

THVH

Upper envelope point maximum frequency	Max Vaule (dBm)	Limit	**Reference Bandwidth (RBW)**	Result
(fe, upper + 200 kHz)	-32.95	-30dBm	1KHz	PASS
(fe, upper + 400 kHz)	-52.57	-36dBm	10KHz	PASS
(fe, upper + 1 000 kHz)	-49.67	-36dBm	100KHz	PASS
> (fe, upper + 1 000 kHz)	-46.12	-36dBm	100KHz	PASS

Lower envelope point minimum frequency	Max Vaule (dBm)	Limit	Reference Bandwidth (RBW)	Result
(fe, lower - 200 kHz)	-32.69	-30dBm	1KHz	PASS
(fe, lower - 400 kHz)	-51.64	-36dBm	10KHz	PASS
(fe, lower - 1 000 kHz)	-50.84	-36dBm	100KHz	PASS
< (fe, lower - 1 000 kHz)	-46.58	-36dBm	100KHz	PASS

TLVL

Upper envelope point maximum frequency	Max Vaule (dBm)	Limit	Reference Bandwidth (RBW)	Result
(fe, upper + 200 kHz)	-32.06	-30dBm	1KHz	PASS
(fe, upper + 400 kHz)	-52.89	-36dBm	10KHz	PASS
(fe, upper + 1 000 kHz)	-49.91	-36dBm	100KHz	PASS
> (fe, upper + 1 000 kHz)	-46.94	-36dBm	100KHz	PASS

Lower envelope point minimum frequency	Max Vaule (dBm)	Limit	Reference Bandwidth (RBW)	Result
(fe, lower - 200 kHz)	-32.92	-30dBm	1KHz	PASS
(fe, lower - 400 kHz)	-51.01	-36dBm	10KHz	PASS
(fe, lower - 1 000 kHz)	-50.68	-36dBm	100KHz	PASS
< (fe, lower - 1 000 kHz)	-46.66	-36dBm	100KHz	PASS

THVL

Upper envelope point maximum frequency	Max Vaule (dBm)	Limit	Reference Bandwidth (RBW)	Result
(fe, upper + 200 kHz)	-32.79	-30dBm	1KHz	PASS
(fe, upper + 400 kHz)	-52.51	-36dBm	10KHz	PASS
(fe, upper + 1 000 kHz)	-49.68	-36dBm	100KHz	PASS
> (fe, upper + 1 000 kHz)	-47.04	-36dBm	100KHz	PASS

Lower envelope point minimum frequency	Max Vaule (dBm)	Limit	Reference Bandwidth (RBW)	Result
(fe, lower - 200 kHz)	-33.09	-30dBm	1KHz	PASS
(fe, lower - 400 kHz)	-51.64	-36dBm	10KHz	PASS
(fe, lower - 1 000 kHz)	-50.58	-36dBm	100KHz	PASS
< (fe, lower - 1 000 kHz)	-47.14	-36dBm	100KHz	PASS

TLVH

Upper envelope point maximum frequency	Max Vaule (dBm)	Limit	Reference Bandwidth (RBW)	Result
(fe, upper + 200 kHz)	-32.26	-30dBm	1KHz	PASS
(fe, upper + 400 kHz)	-52.52	-36dBm	10KHz	PASS
(fe, upper + 1 000 kHz)	-49.91	-36dBm	100KHz	PASS
> (fe, upper + 1 000 kHz)	-47.29	-36dBm	100KHz	PASS

Lower envelope point minimum frequency	Max Vaule (dBm)	Limit	Reference Bandwidth (RBW)	Result
(fe, lower - 200 kHz)	-33.02	-30dBm	1KHz	PASS
(fe, lower - 400 kHz)	-51.64	-36dBm	10KHz	PASS
(fe, lower - 1 000 kHz)	-51.96	-36dBm	100KHz	PASS
< (fe, lower - 1 000 kHz)	-48.87	-36dBm	100KHz	PASS

13 Receiver sensitivity

13.1 Limit

Under normal test conditions, the value of the maximum usable sensitivity for a 25 kHz channel spacing equipment with a 16 kHz bandwidth shall not exceed +6 dBµV emf for a 50 Ω receiver input impedance. This corresponds to a receiver sensitivity of -107 dBm which shall not be exceeded. The limit for usable sensitivity for other receiver bandwidths than 16 kHz is given by:

$$S = +6 + 10\log\frac{BW}{16}\ \text{dB}\mu\text{V emf}\ ;$$

$$S_P = 10\log\frac{BW}{16} - 107\ \text{dBm}$$

where:

• S is the sensitivity in dBµV emf;

• S_P is the sensitivity in dBm;

• BW is the receiver bandwidth in kHz. The receiver bandwidth is a declaration by the manufacturer. The declaration shall be stated in the test report.

13.2 Method of measurement with continuous bit streams

The method please refer to the standard ETSI EN 300 220-1 V2.4.1: 2012-05 clause 8.1.2.

13.3 Method of measurement with messages

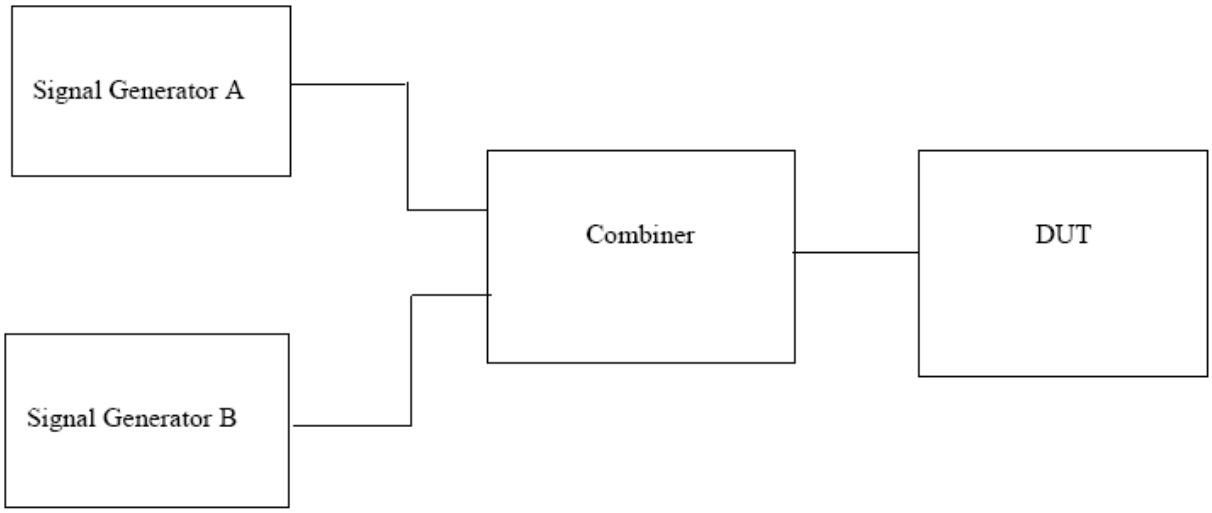
The method please refer to the standard ETSI EN 300 220-1 V2.4.1: 2012-05 clause 8.1.3.

14. Blocking

14.1 Applied procedures / limit

Receiver category	Frequency offset	Limit
1	±2 MHz	⩾84 dB -A (note 2)
2	±2 MHz	⩾35 dB -A (note 2)
3	±2 MHz	⩾24 dB -A (note 2)
1	±10 MHz	⩾84 dB -A (note 2)
2	±10 MHz	⩾60 dB -A (note 2)
3	±10 MHz	≥44 dB -A (note 2)
NOTE 1: The limits apply also for the repeated tests in case of equipment using LBT or category 1 receivers, reduced by 13 dB or 40 dB, respectively, to account for the increased wanted signal level. NOTE 2: A = 10 log (BWkHz / 16 kHz) BW is the receiver bandwidth.		

14.2 Method of measurement



14.3 Test Procedures

In clauses EN 300 220-1 8.4.2

14.4 Test Result:

Receiver bandwidth=788.59KHz

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	26°C	Relative Humidity：	53 %
Pressure：	1012 hPa	Test Voltage ：	DC 3.0V
Test Mode ：	RX		

Receiver category	Frequency offset	Reciever BW(kHz)	Measurement Vause(dB)	Limit(dB)
3	-2 MHz	788.59	21.54	7.07
	+2 MHz	788.59	23.08	7.07
	-10 MHz	788.59	34.57	27.07
	-10 MHz	788.59	36.91	27.07

15. Spurious emissions – Receiver (30-1000MHz)

15.1 Applied procedures / limit

Clause	Test Item	Frequency(MHz)	Limit
4.3.5	Spurious emissions (radiated)	25-1000	-57dBm
		Above 1000	-47dBm

15.2 Measuring Instruments and Setting

The following table is the setting of the Spectrum Analyzer.

Spectrum Analyzer	Setting
Attenuation	Auto
Start Frequency	25 MHz
Stop Frequency	1000 MHz
Detector	Positive Peak
Sweep Time	Auto
RB / VB	100 kHz/100 kHz

15.3 Test Procedures

a. The EUT was placed on the top of the turntable in open test site area.
b. The test shall be made in the receiving mode. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
c. For 30~1000MHz spurious emissions measurement, the broad band bi-log receiving antenna was placed 3 meters far away from the turntable. .
d. The broadband receiving antenna was fixed on the same height with the EUT to find each suspected emissions of both horizontal and vertical polarization. Each recorded suspected value is indicated as Read Level (Raw).
e. Replace the EUT by standard antenna and feed the RF port by signal generator.
f. Adjust the frequency of the signal generator to the suspected emission and slightly rotate the turntable to locate the position with maximum reading.
g. Adjust the power level of the signal generator to reach the same reading with Read Level (Raw).
h. The level of the spurious emission is the power level of (7) plus the gain of the standard antenna in dBi and minus the loss of the cable used between the signal generator and the standard antenna.
i. The measurement shall be repeated at the lowest and the highest channel of the stated frequency range.

15.4 Test Setup Layout

This test setup layout is the same as that shown in section 5.1.3

15.5 EUT Operation during Test

The EUT was programmed to be in continuously receiving mode.

15.6 TEST RESULTS (25MHz-1000MHz)

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	26°C	Relative Humidity：	53 %
Pressure：	1012 hPa	Test Voltage ：	DC 3.0V
Test Mode ：	RX		

Polar (H/V)	Frequency (MHz)	Meter Reading (dBm)	Factor (dB)	Emission Level (dBm)	Limits (dBm)	Margin (dB)	Detector Type
V	37.17	60.44	17.31	-81.14	-57.00	-24.14	peak
V	175.01	40.31	12.42	-85.18	-57.00	-28.18	peak
V	331.45	58.54	13.60	-75.36	-57.00	-18.36	peak
H	39.69	39.39	16.17	-79.40	-57.00	-22.40	peak
H	336.09	58.51	13.75	-75.90	-57.00	-18.90	peak
H	390.40	35.61	-5.17	-76.70	-57.00	-19.70	peak

Remark:
Absolute Level= ReadingLevel+ Factor, Margin= Absolute Level - Limit

16. Spurious emissions – Receiver (above 1000MHz)

16.1 Applied procedures / limit

Clause	Test Item	Frequency(MHz)	Limit
4.3.5	Spurious emissions (narrowband)	25-1000	-57dBm
		Above 1000	-47dBm

16.2 Measuring Instruments and Setting

Please refer to section 9.1.1 in this report. The following table is the setting of the Spectrum Analyzer.

Spectrum Analyzer	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	12750 MHz
Detector	Positive Peak
Sweep Time	Auto
RB / VB	1MHz / 1MHz

16.3 Test Procedures

a. The EUT was placed on the top of the turntable in open test site area.
b. The test shall be made in the receiving mode. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
c. For 30~1000MHz spurious emissions measurement, the broad band bi-log receiving antenna was placed 3 meters far away from the turntable. .
d. The broadband receiving antenna was fixed on the same height with the EUT to find each suspected emissions of both horizontal and vertical polarization. Each recorded suspected value is indicated as Read Level (Raw).
e. Replace the EUT by standard antenna and feed the RF port by signal generator.
f. Adjust the frequency of the signal generator to the suspected emission and slightly rotate the turntable to locate the position with maximum reading.
g. Adjust the power level of the signal generator to reach the same reading with Read Level (Raw).
h. The level of the spurious emission is the power level of (7) plus the gain of the standard antenna in dBi and minus the loss of the cable used between the signal generator and the standard antenna.
i. The measurement shall be repeated at the lowest and the highest channel of the stated frequency range.

16.4 Test Setup Layout

This test setup layout is the same as that shown in section 6.1.3

16.5 EUT Operation during Test

The EUT was programmed to be in continuously receiving mode.

16.6 TEST RESULTS (Above 1000MHz)

EUT：	Ajax SpaceControl	Model Name ：	Ajax SpaceControl
Temperature：	26°C	Relative Humidity：	53 %
Pressure：	1012 hPa	Test Voltage ：	DC 3.0V
Test Mode ：	RX		

Polar (H/V)	Frequency (MHz)	Meter Reading (dBm)	Factor (dB)	Emission Level (dBm)	Limits (dBm)	Margin (dB)	Detector Type
V	2970.53	60.44	8.96	-58.36	-47.00	-11.36	peak
V	6436.78	40.31	12.99	-57.48	-47.00	-10.48	peak
V	8463.66	58.54	15.69	-55.94	-47.00	-8.94	peak
V	10343.66	39.39	16.44	-55.89	-47.00	-8.89	peak
H	2823.66	58.51	8.71	-59.73	-47.00	-12.73	peak
H	6613.03	35.61	-5.17	-58.19	-47.00	-11.19	peak
H	7964.28	62.26	-10.82	-57.05	-47.00	-10.05	peak
H	10784.28	44.51	-10.82	-51.46	-47.00	-4.46	peak

Remark: Absolute Level= ReadingLevel+ Factor, Margin= Absolute Level - Limit

Radiated Measurement Photos