SHENZHEN ART-TECH R/C HOBBY CO., LTD. DONGGUAN BRANCH

Application
For
Certification

(FCC ID: 2AAIZ11151)

Radio Control Flight System
Additional Name(s): See Page 2

Model: 11151AC
Additional Model(s): See Page 2

2.4GHz Transceiver

Report No.: 130618015SZN-001

We hereby certify that the sample of the above item is considered to comply with the requirements of FCC Part 15, Subpart C for Intentional Radiator, mention 47 CFR [10-1-12]

Prepared and Checked by:	Approved by:
Sign on file	 Digitally signed by Tommy Leung Location: Intertek Testing Services
Harry Wu Testing Engineer	Billy Li Supervisor Date: July 22, 2013

- The test results reported in this test report shall refer only to the sample actually tested and shall not refer or be deemed to refer to bulk from which such a sample may be said to have been obtained.
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TRF No.: FCC 15C_TX_b

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LIST OF EXHIBITS

MEASUREMENT/TECHNICAL REPORT

SHENZHEN ART-TECH R/C HOBBY CO., LTD. DONGGUAN BRANCH
Model: 11151AC

FCC ID: 2AAIZ11151

This report concerns (check one:) Original Grant X Class II Change _____

Equipment Type: DXX - Part 15 Low Power Communication Device Transmitter

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

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 [10-1-12 Edition] provision.

Report prepared by:

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Exhibit type	File Description	Filename
Test Report	Test Report	report.pdf
Test Setup Photo	Radiated Emission	radiated photos.pdf
Test Report	Bandedge Plot	bandedge.pdf
Test Report	20dB BW Plot	bw.pdf
Test Report	Timing Plot	af.pdf
External Photo	External Photo	external photos.pdf
Internal Photo	Internal Photo	internal photos.pdf
Block Diagram	Block Diagram	block.pdf
Schematics	Circuit Diagram	circuit.pdf
Operation Description	Technical Description	descri.pdf
ID Label/Location	Label Artwork and Location	label.pdf
User Manual	User Manual	manual.pdf
Cover Letter	Letter of Agency	agency.pdf
Cover Letter	Certification Agreement	agreement.pdf

EXHIBIT 1

GENERAL DESCRIPTION

1.0 General Description

1.1 Product Description

The Equipment under Test (EUT) is a Control unit for Radio Control Flight System model: 11151AC operating at 2.4GHz band. It is powered by 4 x 1.5V AA size batteries. For more detail information pls. refer to the user manual.

The Models: 11011CS, 11071EP, 11085EP, 11012CS, 11075EP, 11094EP, 11095EP, 11091EP, 11092EP, 11111EP, 11301EP, 72751EP, 72752EP are the same as the Model: 11151AC in hardware aspect. The models are different in the appearance and model no. for trading purpose.

The models no. corresponding to product name listing.

Production name	Model No.
Radio Control Flight System	11151AC
WARBIRDS Indoor (Starter) Flight System Golden Eagle (P-51D)	11011CS
WARBIRDS Expansion Plane Raging Roc (P51D)	11071EP
WARBIRDS Expansion Plane Retaliator (P51D)	11085EP
WARBIRDS Indoor (Starter) Flight System Crimson Fury (Spitfire MKXVI)	11012CS
WARBIRDS Expansion Plane Huntmaster (Spitfire MKIV)	11075EP
JET COMMAND Expansion Plane Scorpion (Mirage)	11094EP
JET COMMAND Expansion Plane Pteranodon (Mirage)	11095EP
JET COMMAND Expansion Plane Hornet (F18)	11091EP
JET COMMAND Expansion Plane Sonic Blast	11092EP
VTOL Expansion Plane Backlash (Pogo)	11111EP
VTOL Expansion Plane Alpha Strike (Pogo)	11301EP
STUNT MAVERICKS Expansion plane Vortex (Yak 54)	72751EP
STUNT MAVERICKS Expansion Plane Fire Storm (Yak 54)	72752EP

Antenna Type: Integral antenna

Modulation Type: GFSK

For electronic filing, the brief circuit description is saved with filename: descri.pdf.

1.2 Related Submittal(s) Grants

The receiver for this transmitter is exempted from the Part 15 technical rules per 15.101(b).

1.3 Test Methodology

Radiated emission measurement was performed according to the procedures in ANSI C63.4 (2009). Radiated emission measurement was performed in Semi-anechoic chamber. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the 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. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

1.4 Test Facility

The Semi-anechoic chambe used to collect the radiated data is **Intertek Testing Services Shenzhen Ltd. Kejiyuan Branch** and located at 6F, D Block, Huahan Building, Langshan Road, Nanshan District, Shenzhen, P. R. China. This test facility and site measurement data have been fully placed on file with the FCC(Registration Number: 242492).

EXHIBIT 2

SYSTEM TEST CONFIGURATION

2.0 System Test Configuration

2.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.4 (2009).

The EUT was powered by four new 1.5V AA size batteries during the test.

For maximizing emissions, the EUT was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data reported in Exhibit 3.

The unit was operated stand alone and placed in the centre of the turntable.

The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). The EUT was placed on a turn table, which enabled the Testing Engineer to maximize emissions through its placement in the three orthogonal axes.

2.2 EUT Exercising Software

There was no special software to exercise the device.

2.3 Special Accessories

No special accessories used.

2.4 Equipment Modification

Any modifications installed previous to testing by SHENZHEN ART-TECH R/C HOBBY CO., LTD. DONGGUAN BRANCH will be incorporated in each production model sold / leased in the United States.

No modifications were installed by Intertek Testing Services Shenzhen Ltd Kejiyuan Branch.

2.5 Measurement Uncertainty

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

2.6 Support Equipment List and Description

Description	Manufacturer	Model No.
Receiver Unit	ART-TECH	11151AC-1

EXHIBIT 3

EMISSION RESULTS

3.0 **Emission Results**

Data is included 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 Radiated Test Results

A sample calculation, configuration photographs and data tables of the emissions are included.

3.1.1 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD + AV

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
PD = Pulse Desensitization in dB
AV = Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

FS = RA + AF + CF - AG + PD + AV

Assume a receiver reading of 62.0 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. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dBµV/m. This value in dBµV/m was converted to its corresponding level in µV/m.

RA = 62.0 dBµV
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
PD = 0 dB
AV = -10 dB
FS = 62 + 7.4 + 1.6 - 29 + 0 + (-10) = 32 dBµV/m

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

3.1.2 Radiated Emission Configuration Photograph

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos. pdf.

3.1.3 Radiated Emissions

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Worst Case Radiated Emission
at
844.800 MHz

Judgement: Passed by 11.4 dB

TEST PERSONNEL:

Sign on file

Harry Wu, Testing Engineer
Typed/Printed Name

July 22, 2013
Date

Applicant: SHENZHEN ART-TECH R/C HOBBY CO., LTD. DONGGUAN BRANCH
Date of Test: July 22, 2013
Model: 11151AC
Sample: 1/1
Worst Case Operating Mode: Transmit

Table 1

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)
Horizontal	537.795	26.1	20.0	18.9	25.0	46.0	-21.0
Horizontal	810.365	27.3	20.0	23.9	31.2	46.0	-14.8
Horizontal	844.800	30.4	20.0	24.2	34.6	46.0	-11.4
Vertical	31.940	24.2	20.0	17.5	21.7	40.0	-18.3
Vertical	147.370	24.6	20.0	8.6	13.2	43.5	-30.3
Vertical	963.140	24.8	20.0	26.3	31.1	54.0	-22.9

NOTES:
1. Quasi-Peak detector is used except for others stated.
2. All measurements were made at 3 meters. Harmonic emissions not detected at the 3-meter distances 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 harmonic 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. All emissions are below the QP limit.

3.1.4 Transmitter Spurious Emissions (Radiated)

Worst Case Radiated Emission
at
7422.000 MHz

For electronic filing, the worst case radiated emission configuration photograph is saved with filename: radiated photos. pdf.

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Judgement: Passed by 7.6 dB

TEST PERSONNEL:

Sign on file

Harry Wu, Testing Engineer
Typed/Printed Name

July 22, 2013
Date

Applicant: SHENZHEN ART-TECH R/C HOBBY CO., LTD. DONGGUAN BRANCH
Date of Test: July 22, 2013
Model: 11151AC
Sample: 1/1
Worst Case Operating Mode: Transmit

Table 2

Radiated Emissions

(2430MHz)

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2430.000	101.8	36.7	28.5	93.6	114.0	-20.4
Horizontal	4860.000	58.2	36.7	35.0	56.5	74.0	-17.5
Horizontal	7290.000	53.5	36.1	37.0	54.4	74.0	-19.6
Horizontal	9720.000	54.4	36.2	37.5	55.7	74.0	-18.3

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2430.000	101.8	36.7	28.5	10.6	83.0	94.0	-11.0
Horizontal	4860.000	58.2	36.7	35.0	10.6	45.9	54.0	-8.1
Horizontal	7290.000	53.5	36.1	37.0	10.6	43.8	54.0	-10.2
Horizontal	9720.000	54.4	36.2	37.5	10.6	45.1	54.0	-8.9

Notes: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meter. Harmonic 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 harmonic 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.

Test Testing Engineer: Harry Wu

Applicant: SHENZHEN ART-TECH R/C HOBBY CO., LTD. DONGGUAN BRANCH
Date of Test: July 22, 2013
Model: 11151AC
Sample: 1/1
Worst Case Operating Mode: Transmit

Table 3

Radiated Emissions

(2452MHz)

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2452.000	104.1	36.7	28.5	95.9	114.0	-18.1
Horizontal	4904.000	57.6	36.7	35.0	55.9	74.0	-18.1
Horizontal	7356.000	55.9	36.1	37.0	56.8	74.0	-17.2
Horizontal	9808.000	54.9	36.2	38.0	56.7	74.0	-17.3

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2452.000	104.1	36.7	28.5	10.6	85.3	94.0	-8.7
Horizontal	4904.000	57.6	36.7	35.0	10.6	45.3	54.0	-8.7
Horizontal	7356.000	55.9	36.1	37.0	10.6	46.2	54.0	-7.8
Horizontal	9808.000	54.9	36.2	38.0	10.6	46.1	54.0	-7.9

Notes: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meter. Harmonic 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 harmonic 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.

Test Testing Engineer: Harry Wu

Applicant: SHENZHEN ART-TECH R/C HOBBY CO., LTD. DONGGUAN BRANCH
Date of Test: July 22, 2013
Model: 11151AC
Sample: 1/1
Worst Case Operating Mode: Transmit

Table 4

Radiated Emissions

(2474MHz)

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2474.000	104.3	36.7	28.3	95.9	114.0	-18.1
Horizontal	4948.000	56.6	36.7	35.3	55.2	74.0	-18.8
Horizontal	7422.000	56.1	36.1	37.0	57.0	74.0	-17.0
Horizontal	9896.000	52.9	36.3	38.7	55.3	74.0	-18.7

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Average Factor (-dB)	Net at 3m (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
Horizontal	2474.000	104.3	36.7	28.3	10.6	85.3	94.0	-8.7
Horizontal	4948.000	56.6	36.7	35.3	10.6	44.6	54.0	-9.4
Horizontal	7422.000	56.1	36.1	37.0	10.6	46.4	54.0	-7.6
Horizontal	9896.000	52.9	36.3	38.7	10.6	44.7	54.0	-9.3

Notes: 1. Peak Detector Data unless otherwise stated.

2. All measurements were made at 3 meter. Harmonic 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 harmonic 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.

Test Testing Engineer: Harry Wu

EXHIBIT 4

EQUIPMENT PHOTOGRAPHS

4.0 Equipment Photographs

For electronic filing, the photographs of the tested EUT are saved with filename: external photos.pdf & internal photos.pdf.

EXHIBIT 5

PRODUCT LABELLING

5.0 **Product Labelling**

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

EXHIBIT 6

TECHNICAL SPECIFICATIONS

6.0 Technical Specifications

For electronic filing, the block diagram and schematics of the tested EUT 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.

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

EXHIBIT 8

MISCELLANEOUS INFORMATION

8.0 **Miscellaneous Information**

This miscellaneous information includes details of the measured bandedge, the test procedure and calculation of factor such as pulse desensitization.

8.1 Bandedge Plot

For electronic filing, the plot shows the fundamental emission when modulated is saved with filename: bandedge.pdf. From the plot, the field strength of any emissions outside of the specified frequency band are attenuated to the general radiated emission limits in section 15.209. It fulfils the requirement of 15.249(d).

Peak Measurement

Bandedge compliance is determined by applying marker-delta method, i.e (Bandedge Plot).

(i) Lower channel 2430MHz:

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot
= 93.60 dBµv/m-49.08 dB
= 44.52 dBµv/m

Average Resultant field strength = Fundamental emissions (Average value) – delta from the bandedge plot
= 83.00 dBµv/m –49.08dB
= 33.92 dBµv/m

(ii) Upper channel 2474MHz:

Peak Resultant field strength = Fundamental emissions (peak value) – delta from the bandedge plot
= 95.90 dBµv/m-42.99 dB
= 52.91 dBµv/m

Average Resultant field strength = Fundamental emissions (Average value) – delta from the bandedge plot
= 85.30 dBµv/m –42.99 dB
= 42.31 dBµv/m

The resultant field strength meets the general radiated emission limit in section 15.209, which does not exceed 74dBµv/m (Peak Limit) and 54dBµv/m (Average Limit).

8.1 Bandedge Plot (cont'd)

Pursuant to FCC part 15 Section 15.215(c), the 20dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered.

Figure 8.1 Bandwidth

8.2 Discussion of Pulse Desensitization

Pulse desensitivity is not applicable for this device.The effective period (T_{eff}) is approximately 0.24 ms for a digital "1" bit, as shown in the plots of Exhibit 8.3. With a resolution bandwidth (3 dB) of 100 kHz, the pulse desensitivity factor was 0 dB.

8.3 Calculation of Average Factor

Averaging factor in dB = 20 log (duty cycle)

The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The time period over which the duty cycle is measured is 100 milliseconds, or the repetition cycle, whichever is a shorter time frame. The worst case (highest percentage on) duty cycle is used for the calculation. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities.

A plot of the worst-case duty cycle as detected in this manner are saved with filename: af.pdf

The duty cycle is simply the on-time divided by the period:

The duration of one cycle = 12.16ms

Effective period of the cycle = 0.24ms x 15 = 3.60ms

DC = 3.60ms / 12.16ms = 0.296 or 29.60%

Therefore, the averaging factor is found by 20 $\log_{10}$ 0.296 = -10.6 dB

8.4 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C rules.

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 - 2009.

The transmitting equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately one meter in height above the ground plane. During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The EUT is adjust through all three orthogonal axes to obtain maximum emission levels. The antenna height and polarization are varied during the testing to search for maximum signal levels.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings.

The frequency range scanned is from 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 40 GHz, whichever is lower.

8.4 Emissions Test Procedures (cont'd)

The EUT is warmed up for 15 minutes prior to the test.

AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new, fully charged battery is used.

The IF bandwidth used for measurement of radiated signal strength was 10 kHz for emission below 30 MHz and 120 kHz for emission from 30 MHz to 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application Note 150-2. Above 1000 MHz, a resolution bandwidth of 1 MHz is used.

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the restricted bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.

EXHIBIT 9

TEST EQUIPMENT LIST

9.0 Test Equipment List

Equipment No.	Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Due Date
SZ061-04	BiConiLog Antenna	ETS	3142C	00066460	29-Jun-13	29-Jun-14
SZ185-01	EMI Receiver	R&S	ESCI	100547	12-Mar-13	12-Mar-14
SZ061-08	Horn Antenna	ETS	3115	00092346	03-Nov-12	03-Nov-13
SZ061-07	Horn Antenna	ETS	3160-09	00083067	16-Feb-12	16-Aug-13
SZ061-06	Active Loop Antenna	Electro-Metrics	EM-6876	217	12-Mar-13	12-Mar-14
SZ056-03	Spectrum Analyzer	R&S	FSP 30	101148	12-Mar-13	12-Mar-14
SZ181-04	Preamplifier	Agilent	8449B	3008A02474	12-Mar-13	12-Mar-14
SZ188-01	Anechoic Chamber	ETS	RFD-F/A-100	4102	02-Mar-13	02-Mar-14
SZ062-02	RF Cable	RADIALL	RG 213U	--	26-Feb-13	26-Aug-14
SZ062-06	RF Cable	RADIALL	0.04-26.5GHz	--	12-Mar-13	12-Mar-14
SZ062-12	RF Cable	RADIALL	0.04-26.5GHz	--	12-Mar-13	12-Mar-14
SZ067-04	Notch Filter	Micro-Tronics	BRM50702-02	--	12-Mar-13	12-Mar-14