



FCC RF Co-location Test Report

APPLICANT : Microstrip LLC
EQUIPMENT : Digital Media Receiver
MODEL NAME : DW84JL
FCC ID : 2ANZL-2474
STANDARD : FCC Part 15 Subpart C §15.247
CLASSIFICATION : (DTS) Digital Transmission System

The testing was completed on Dec. 12, 2017. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by: Joseph Lin / Supervisor

Approved by: Jones Tsai / Manager



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FCC ID : 2ANZL-2474

Page Number : 1 of 15

Report Issued Date : May 17, 2018

Report Version : Rev. 01

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR7D0544-01G	Rev. 01	Initial issue of report	May 17, 2018



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result
3.1	15.247(d)	Unwanted Emissions	15.209(a) & 15.247(d)	Pass
3.2	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass



1 General Description

1.1 Applicant

Microstrip LLC

15 Constitution Drive. 1st Floor Bedford, New Hampshire 03110

1.2 Product Feature of Equipment Under Test

Product Feature	
Equipment	Digital Media Receiver
Model Name	DW84JL
FCC ID	2ANZL-2474
EUT supports Radios application	Zigbee WLAN 11b/g/n HT20 WLAN 11a/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE

1.3 Modification of EUT

No modifications are made to the EUT during all test items.



1.4 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW0007 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd Rd. Guishan Dist, Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	Sporton Site No.
	03CH11-HY

Note: The test site complies with ANSI C63.4 2014 requirement.

1.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04
- ♦ ANSI C63.10-2013

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.



2 Test Configuration of Equipment Under Test

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

2.1 Carrier Frequency and Channel

2400-2483.5 MHz Bluetooth		2400-2483.5 MHz WLAN	
Channel	Freq. (MHz)	Channel	Freq. (MHz)
Hopping Mode		01	2412

5150-5250 MHz WLAN	
Channel	Freq. (MHz)
157	5785

2.2 Test Mode

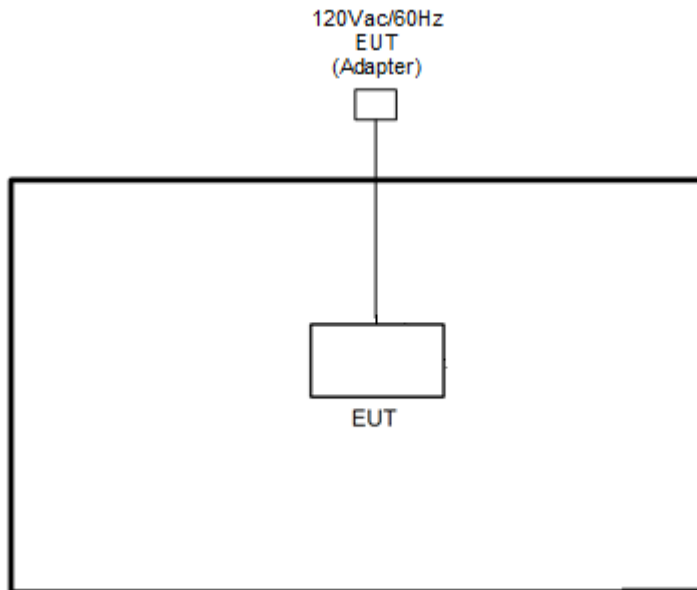
Final test mode of conducted test items and radiated spurious emissions are considering the modulation and worse data rates as below table.

<Co-Location>

Modulation	Data Rate
Bluetooth + WLAN 2.4GHz	Hopping + Normal Mode
Bluetooth + WLAN 5GHz	Hopping + Normal Mode

2.3 Connection Diagram of Test System

<Co-Location Mode>



2.4 EUT Operation Test Setup

The EUT was attached to the Bluetooth earphone or WLAN AP.



3 Test Result

3.1 Unwanted Emissions Measurement

3.1.1 Limit of Unwanted Emissions

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

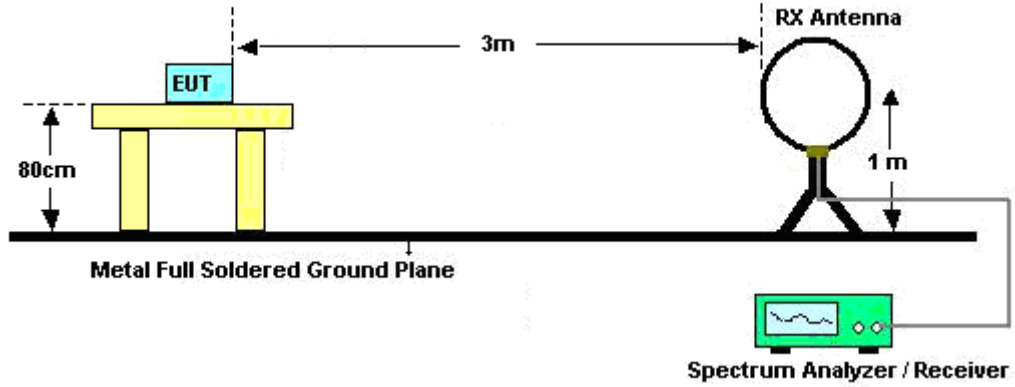


3.1.3 Test Procedures

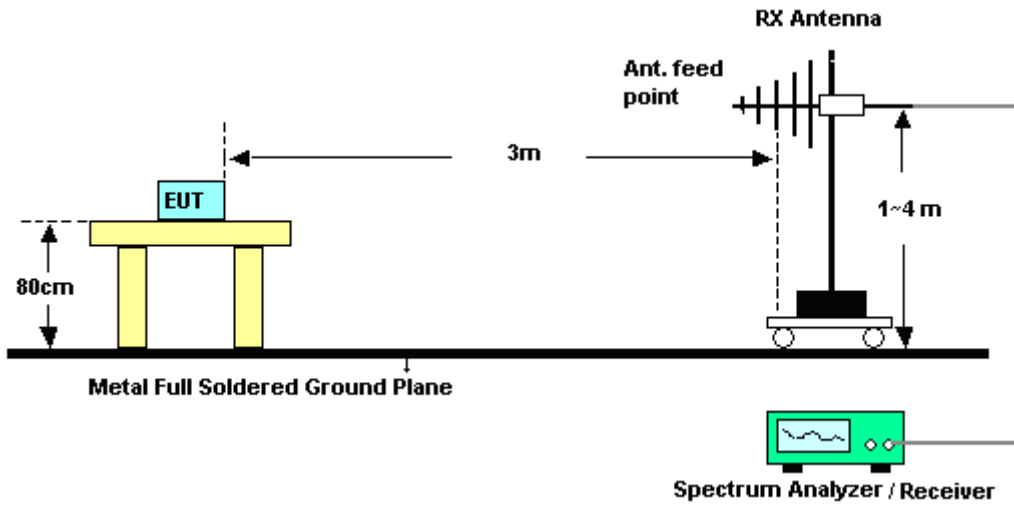
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for $f < 1$ GHz; VBW \geq RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1$ GHz for peak measurement.
For average measurement:
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.1.4 Test Setup

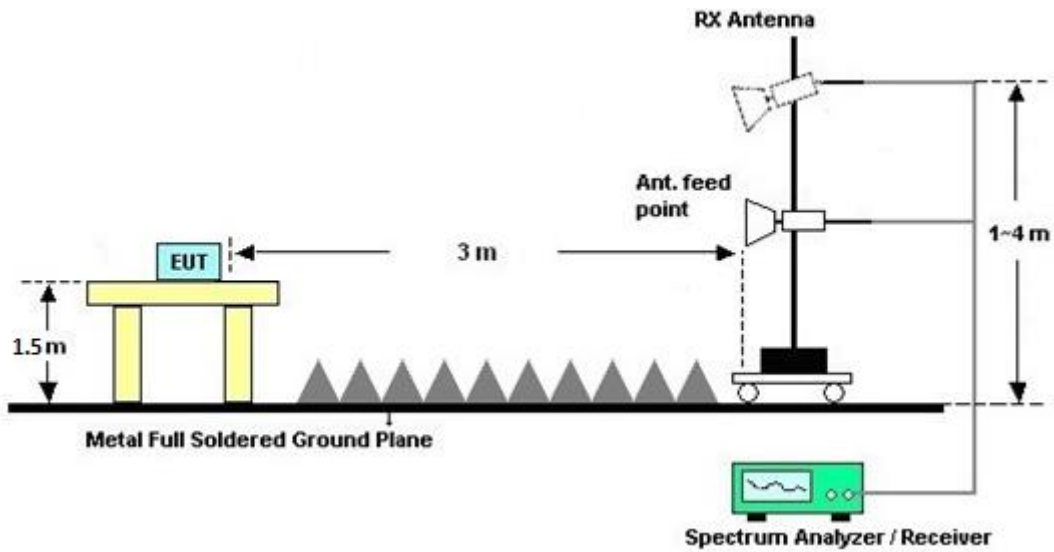
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.1.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.1.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A.

3.1.7 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic)

Please refer to Appendix A.



3.2 Antenna Requirements

3.2.1 Standard Applicable

If transmitting antenna directional gain is greater than 6 dBi, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.2.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.2.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz, VSWR : 2.5:1 max	Jul. 18, 2017	May 11, 2018	Jul. 17, 2018	Radiation (03CH11-HY)
Amplifier	SONOMA	310N	187312	9kHz~1GHz	Jan. 16, 2018	May 11, 2018	Jan. 15, 2019	Radiation (03CH11-HY)
Bilog Antenna	TESEQ	CBL 6111D&N-6-0 6	35414&AT-N06 02	30MHz~1GHz	Oct. 14, 2017	May 11, 2018	Oct. 13, 2018	Radiation (03CH11-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-1326	1GHz ~ 18GHz	Oct. 16, 2017	May 11, 2018	Oct. 15, 2018	Radiation (03CH11-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Nov. 23, 2017	May 11, 2018	Nov. 22, 2018	Radiation (03CH11-HY)
Preamplifier	Keysight	83017A	MY53270080	1GHz~26.5GHz	Jan. 16, 2018	May 11, 2018	Jan. 15, 2020	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200486	10Hz ~ 44GHz	Oct. 19, 2017	May 11, 2018	Oct. 18, 2018	Radiation (03CH11-HY)
Antenna Mast	EMEC	AM-BS-4500- B	N/A	1~4m	N/A	May 11, 2018	N/A	Radiation (03CH11-HY)
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	May 11, 2018	N/A	Radiation (03CH11-HY)
Preamplifier	MITEQ	AMF-7D-0010 1800-30-10P	1590074	1GHz~18GHz	May. 22, 2017	May 11, 2018	May. 21, 2018	Radiation (03CH11-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA9170584	18GHz- 40GHz	Nov. 27, 2017	May 11, 2018	Nov. 26, 2018	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4	9K-30M	Mar. 20, 2018	May 11, 2018	Mar. 19, 2019	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4	30M-18G	Mar. 15, 2018	May 11, 2018	Mar. 14, 2019	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2589/2	30M-18G	Mar. 15, 2018	May 11, 2018	Mar. 14, 2019	Radiation (03CH11-HY)
Filter	Wainwright	WHKX8-5872 .5-6750-1800 0-40ST	SN3	6.75GHz High Pass	Sep. 18, 2017	May 11, 2018	Sep. 17, 2018	Radiation (03CH11-HY)
Filter	Wainwright	WLK4-1000-1 530-8000-40S S	SN11	1G Low Pass	Sep. 18, 2017	May 11, 2018	Sep. 17, 2018	Radiation (03CH11-HY)
Software	Audix	E3 6.2009-8-24	RK-001042	N/A	N/A	May 11, 2018	N/A	Radiation (03CH11-HY)



5 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.20
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.50
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.20
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Appendix A. Radiated Spurious Emission Plots

Test Engineer :	Hao Hsu, Chuan Zhu, and Ken Wu	Temperature :	22~25°C
		Relative Humidity :	52~57%

WLAN 2.4GHz Link + Bluetooth Link

WLAN 2.4GHz Link + Bluetooth Link																																																																																																		
	Horizontal	Vertical																																																																																																
Peak	<p>Date: 2018-05-11</p>	<p>Date: 2018-05-11</p>																																																																																																
Avg.	<p>Site : 03CH11-HY Condition : PEAK_74 3m HORN 9120D-HF HORIZONTAL Detector : Peak Project : 7D0544-01 : WLAN 2.4G Link + Bluetooth Link</p> <table border="1"> <thead> <tr> <th>Over</th> <th>Limit</th> <th>ReadAntenna</th> <th>Cable</th> <th>Preamp</th> <th>A/Pos</th> <th>T/Pos</th> <th>Remark</th> </tr> <tr> <th>Freq</th> <th>Level</th> <th>Limit</th> <th>Line</th> <th>Level</th> <th>Factor</th> <th>Loss</th> <th>Factor</th> </tr> <tr> <th>MHz</th> <th>dBuV/m</th> <th>dB</th> <th>dBuV/m</th> <th>dBuV</th> <th>dB/m</th> <th>dB</th> <th>dB</th> <th>cn</th> <th>deg</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>4924.00</td> <td>40.01</td> <td>-33.99</td> <td>74.00</td> <td>55.64</td> <td>31.48</td> <td>9.55</td> <td>57.10</td> <td>100</td> <td>0 Peak</td> </tr> <tr> <td>2</td> <td>7386.00</td> <td>42.89</td> <td>-31.11</td> <td>74.00</td> <td>52.12</td> <td>36.47</td> <td>11.30</td> <td>57.38</td> <td>100</td> <td>0 Peak</td> </tr> </tbody> </table>	Over	Limit	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark	Freq	Level	Limit	Line	Level	Factor	Loss	Factor	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cn	deg	1	4924.00	40.01	-33.99	74.00	55.64	31.48	9.55	57.10	100	0 Peak	2	7386.00	42.89	-31.11	74.00	52.12	36.47	11.30	57.38	100	0 Peak	<p>Site : 03CH11-HY Condition : PEAK_74 3m HORN 9120D-HF VERTICAL Detector : Peak Project : 7D0544-01 : WLAN 2.4G Link + Bluetooth Link</p> <table border="1"> <thead> <tr> <th>Over</th> <th>Limit</th> <th>ReadAntenna</th> <th>Cable</th> <th>Preamp</th> <th>A/Pos</th> <th>T/Pos</th> <th>Remark</th> </tr> <tr> <th>Freq</th> <th>Level</th> <th>Limit</th> <th>Line</th> <th>Level</th> <th>Factor</th> <th>Loss</th> <th>Factor</th> </tr> <tr> <th>MHz</th> <th>dBuV/m</th> <th>dB</th> <th>dBuV/m</th> <th>dBuV</th> <th>dB/m</th> <th>dB</th> <th>dB</th> <th>cn</th> <th>deg</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>4924.00</td> <td>40.39</td> <td>-33.61</td> <td>74.00</td> <td>56.02</td> <td>31.48</td> <td>9.55</td> <td>57.10</td> <td>100</td> <td>0 Peak</td> </tr> <tr> <td>2</td> <td>7386.00</td> <td>42.57</td> <td>-31.43</td> <td>74.00</td> <td>51.00</td> <td>36.47</td> <td>11.30</td> <td>57.38</td> <td>100</td> <td>0 Peak</td> </tr> </tbody> </table>	Over	Limit	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark	Freq	Level	Limit	Line	Level	Factor	Loss	Factor	MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	cn	deg	1	4924.00	40.39	-33.61	74.00	56.02	31.48	9.55	57.10	100	0 Peak	2	7386.00	42.57	-31.43	74.00	51.00	36.47	11.30	57.38	100	0 Peak
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WLAN 2.4GHz Link + Bluetooth Link_LF

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7D0544-01														Freq	Level	Limit	Over	Line	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark			MHz	dBuV/m	dB	dBuV/m	dBuV	dB/m	dB	dB	dB	cm	deg		1	46.47	36.16	-3.84	40.00	51.91	15.72	1.02	32.49	100	263	---	Peak	2	62.67	38.40	-9.60	40.00	50.22	11.64	1.02	32.49	---	---	---	Peak	3	81.84	25.41	-14.59	40.00	43.34	13.32	1.22	32.48	---	---	---	Peak	4	685.00	32.00	-14.00	46.00	39.99	23.72	2.56	32.33	---	---	---	Peak	5	721.40	32.99	-13.01	46.00	34.93	26.94	3.40	32.41	---	---	---	Peak	6	912.50	34.12	-11.88	46.00	32.52	29.20	3.79	31.55	---	---	---
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1	46.74	26.15	-13.85	40.00	41.90	15.72	1.02	32.49	---	---	---	Peak																																																																																																																																																																																																																																																																																																																					
2	149.07	23.11	-20.39	43.50	36.99	16.87	1.61	32.44	---	---	---	Peak																																																																																																																																																																																																																																																																																																																					
3	214.95	27.06	-16.44	43.50	42.63	15.04	1.72	32.39	---	---	---	Peak																																																																																																																																																																																																																																																																																																																					
4	685.00	26.10	-19.90	46.00	33.89	21.92	2.56	32.33	---	---	---	Peak																																																																																																																																																																																																																																																																																																																					
5	734.00	29.79	-16.21	46.00	31.16	27.47	3.40	32.37	---	---	---	Peak																																																																																																																																																																																																																																																																																																																					
6	902.70	34.66	-11.34	46.00	33.32	29.02	3.79	31.63	100	151	---	Peak																																																																																																																																																																																																																																																																																																																					
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1	46.47	36.16	-3.84	40.00	51.91	15.72	1.02	32.49	100	263	---	Peak																																																																																																																																																																																																																																																																																																																					
2	62.67	38.40	-9.60	40.00	50.22	11.64	1.02	32.49	---	---	---	Peak																																																																																																																																																																																																																																																																																																																					
3	81.84	25.41	-14.59	40.00	43.34	13.32	1.22	32.48	---	---	---	Peak																																																																																																																																																																																																																																																																																																																					
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5	721.40	32.99	-13.01	46.00	34.93	26.94	3.40	32.41	---	---	---	Peak																																																																																																																																																																																																																																																																																																																					
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