TEST REPORT # EMCC-180517A, 2018-04-20

EQUIPMENT UNDER TEST:

Device:	DUO-ART 60
Serial Number:	SJ07VZ
Application:	Amplifier
FCC ID:	2AAE5ART60
Manufacturer:	ELAD srl
Address:	Via Col de Rust, 11 Sarone 33070 Caneva PN ITALY
Phone:	+39 0434 77248
Fax:	+39 0434 77231

RELEVANT STANDARD(S): 47 CFR §§ 97.307, 97.317

TEST REPORT PREPARED BY:

Manuel Zenk
EMCCons DR. RAŠEK GmbH & Co. KG
Boelwiese 8
91320 Ebermannstadt
Germany
Phone: +49 9194 7262-0
Fax: +49 9194 7262-199
E-Mail: m.zenk@emcc.de

TEST PERSONNEL:

Manuel Zenk

HEAD OF COMMERCIAL EMC AND RADIO DEPT.:

Wolfgang Döring

CONTENTS

Page

1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance with the 47 CFR §97.307 and §97.317 requirements for the certification of external RF amplifiers operating in the amateur radio service.

1.2 Limits and Reservations

The test results in this report apply only to the particular equipment under test (EUT) as declared in this report. This test report shall not be reproduced except in full without the written permission of EMCCons DR. RAŠEK GmbH & Co. KG.

1.3 Test Location

Test Laboratory:	EMCCons DR. RAŠEK GmbH & Co. KG
Accreditation No.:	D-PL-12067-01-02
Address of Labs I, II, III and Head Office:	EMCCons DR. RAŠEK GmbH & Co. KG Boelwiese 8 91320 Ebermannstadt GERMANY
Address of Labs IV and V:	EMCCons DR. RAŠEK GmbH & Co. KG Stoernhofer Berg 15 91364 Unterleinleiter GERMANY
Phone:	+49 9194 7262-0
Fax:	+49 9194 7262-199
E-Mail:	emc.cons@emcc.de
Web:	www.emcc.de

1.4 Customer

Company Name:	ELAD srl
Street:	Via Col de Rust, 11 Sarone
City:	33070 Caneva PN
Country:	ITALY
Phone:	+39 0434 77248
E-Mail:	+39 0434 77231

1.5 Manufacturer

Company Name:	ELAD srl
Street:	Via Col de Rust, 11 Sarone
City:	33070 Caneva PN
Country:	ITALY

1.6 Dates and Test Location

Date of Receipt of EUT: 2018-04-17
Test Date: 2018-04-17
Test Location: Lab IV

1.7 Ordering Information

Purchase Order: OF1/273/2018, dated 2018-03-29

1.8 Climatic Conditions

Date	Temperature [°C]	Relative Humidity [%]	Air Pressure [hPa]	Lab	Customer attended tests
2018-04-17	24	39	984	IV	Mr Milan

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Trade Name:	DUO-ART 60
Serial Number:	SJ07VZ
FCC ID	2AAE5ART60
Control Board Firmware:	000.058
Software Version:	0.042
Hardware Revision:	1.0, composed by this boards: FALCD Ver 1.5 FACTR Ver. 1.3 FASW Ver. 1.0 FABP Ver. 1.0 FAHEV Ver. 1.0 FAPM Ver 1.3 FAATU Ver 1.3 (optional)
Application:	Amplifier
Power Supply:	100 - 240 VAC
Highest internally generated or used frequency:	Internal Crystals: RPI Compute Module Crystal 19.2 MHz (1.2 GHz ARM internal frequency) LAN controller Crystal 25 MHz FACTR Microcontroller Crystal 12 MHz (100 MHz ARM internal frequency)
Frequency bands as defined by the customer	1.800-2.000 MHz 3.500-4.000 MHz 7.000-7.300 MHz 10.100-10.150 MHz 14.000-14.350 MHz 18.068-18.168 MHz 21.000-21.450 MHz 24.890-24.990 MHz 28.000-29.700 MHz 50.000-54.000 MHz
Output power	60 W
Ports:	ANT1 - ANT2 - ANT3, EXT I/O, LAN, USB HOST, PTT In, PTT Out, USB, RS232, DCIN, DCOUT, AC Mains Inlet Socket, RTX, RX (see Annex 3 for detailed information)
Accessories delivered with EUT:	Exciter, Button, cable harness (see chapter 2.3)
Variants:	None
Remarks:	None

For further information concerning port description see Annex 3.

2.2 Intended Use

Amplifier for amateur radio service.

2.3 EUT Peripherals/Simulators

Button

Exciter (front view), Serial no. SI0JJS

Exciter (back view with cable connection)

Cable harness

An ELAD FDM-DUO Transceiver was used as exciter. The setup was provided by the customer.

FDM-DUO is low power SDR Radio TRANSCEIVER (nominal 5 W, 10 W maximum) for Amateur Radio Operation. It can works stand-alone or with a PC. It can produce Modulation type CW-AM-LSB-USB and FM.

2.4 Mode of Operation during Testing and Test Setup

The EUT was supplied with 115 VAC / 60 Hz and switched on. “ANT1” was connected to a dummy load. The output power was set to full output power (nominal power).

Terminal	Tested with
Power supply	115 VAC / 60 Hz
RF input	“RTX”, for all frequencies
RF output	“ANT1”, for all frequencies
Data	via EXTIO Interface

2.5 Modifications Required for Compliance

None.

3 TEST RESULTS SUMMARY

Summary of test results for the following EUT:

Manufacturer: ELAD srl
Device: DUO-ART 60
Serial No: SJ07VZ

Requirement	47 CFR Section	Report Section	Result
Spurious Emissions & Gain	97.307(d), 97.317(a)	4	Passed

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units and meet the requirements of the specifications referenced herein.
Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.
All requirements were found to be within the limits outlined in this report.
The test results in this report apply only to the particular equipment under test (EUT) as declared in this report.

Test Personnel: Manuel Zenk
Issuance Date: 2018-04-20

4 SPURIOUS EMISSIONS & GAIN

Test Requirement: FCC 47 CFR, § 97.307(d), § 97.307(e), § 97.317(a) & § 97.317(b)

4.1 Regulation

§ 97.307 Emission standards.

(d) For transmitters installed after January 1, 2003, the mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency below 30 MHz must be at least 43 dB below the mean power of the fundamental emission. For transmitters installed on or before January 1, 2003, the mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency below 30 MHz must not exceed 50 mW and must be at least 40 dB below the mean power of the fundamental emission. For a transmitter of mean power less than 5 W installed on or before January 1, 2003, the attenuation must be at least 30 dB. A transmitter built before April 15, 1977, or first marketed before January 1, 1978, is exempt from this requirement.

(e) The mean power of any spurious emission from a station transmitter or external RF power amplifier transmitting on a frequency between 30-225 MHz must be at least 60 dB below the mean power of the fundamental. For a transmitter having a mean power of 25 W or less, the mean power of any spurious emission supplied to the antenna transmission line must not exceed 25 µW and must be at least 40 dB below the mean power of the fundamental emission, but need not be reduced below the power of 10 µW. A transmitter built before April 15, 1977, or first marketed before January 1, 1978, is exempt from this requirement.

§ 97.317 Standards for certification of external RF power amplifiers.

(a) To receive a grant of certification, the amplifier must:

(1) Satisfy the spurious emission standards of §97.307 (d) or (e) of this part, as applicable, when the amplifier is operated at the lesser of 1.5 kW PEP or its full output power and when the amplifier is placed in the “standby” or “off” positions while connected to the transmitter.

(2) Not be capable of amplifying the input RF power (driving signal) by more than 15 dB gain. Gain is defined as the ratio of the input RF power to the output RF power of the amplifier where both power measurements are expressed in peak envelope power or mean power.

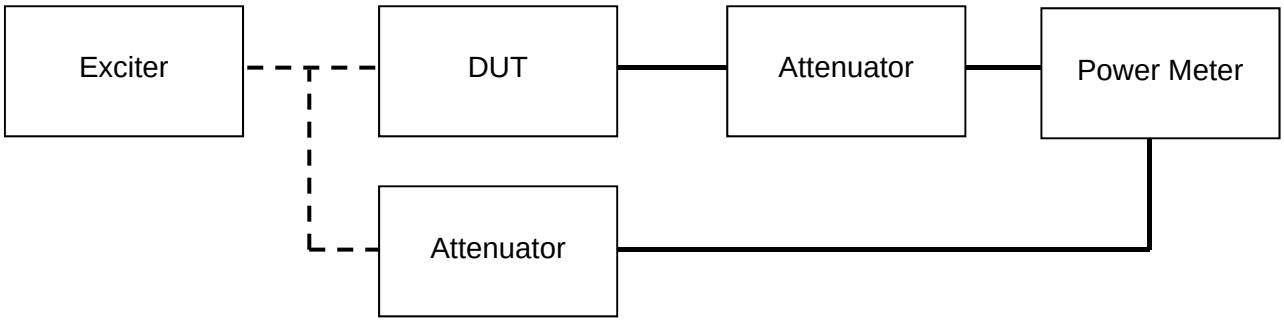
(3) Exhibit no amplification (0 dB gain) between 26 MHz and 28 MHz.

4.2 Test Equipment

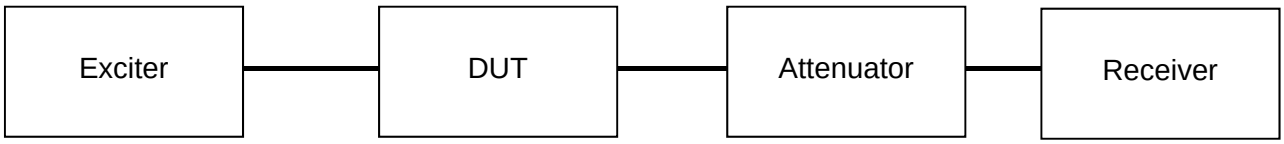
Instrument	Manufacturer	Type	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG	DAMK4/DAGK4	1	n/a	n/a
Power Sensor	Rohde & Schwarz	NRV-Z32 Mod. 05	527	2018-01	2020-07
Power Sensor	Rohde & Schwarz	NRV-Z55	536	2017-12	2018-12
25W/20dB Attenuator	Weinschel	46-20-34	815	n/a	n/a
RF Power Meter	Rohde & Schwarz	NRVD	1265	2016-11	2018-11
500 W/3dB Attenuator/N	Bird	500-WA	1473	n/a	n/a
100 W/6 dB Attenuator/N	Res-Net	RFA 100 NMF-DB 06	1515	n/a	n/a
N-Cable N/50	EMCC DR. RASEK	RG 214	2397	n/a	n/a
20 W Attenuator 20dB	Narda	766-20	2428	n/a	n/a
N-Cable N/50	EMCC DR. RASEK	RG 214	2646	n/a	n/a
N-Cable N/50	EMCC DR. RASEK	RG 214	2649	n/a	n/a
2 W Attenuator 10dB	bird	2-18A-MFN-10	2725	n/a	n/a
EMI Test Receiver	Rohde & Schwarz	ESU8	3846	2018-01	2019-01

4.3 Test Setups

Schematic test setup for gain measurement:



Schematic test setup for spurious emissions measurement:



4.4 Test Result

Amplifier Gain § 37.317				Spurious Emissions § 37.307(d), § 37.307(e)				
Frequency	Input Power	Output Power	Amplifier Gain	2 * f1	3 * f1	4 * f1	5 * f1	6...10 * f1
[MHz]	[dBm]	[dBm]	[dB]	[dBc]	[dBc]	[dBc]	[dBc]	[dBc]
1.900	35.7	47.8	12.1	-69.2	-72.3	-74.4	-64.5	≤ -69.3
3.650	34.6	48.2	13.6	-65.5	-67.6	-78.3	-71.3	≤ -70.0
5.357	35.0	48.2	13.2	-53.3	-64.3	-75.4	-71.0	≤ -68.6
7.100	34.5	47.8	13.3	-67.1	-70.8	-76.0	-64.7	≤ -76.2
10.125	34.3	47.9	13.6	-66.9	-58.4	-68.2	-55.3	≤ -75.2
14.175	36.4	48.0	11.6	-70.8	-55.4	-82.4	-66.7	≤ -65.7
18.110	34.5	47.8	13.3	-72.8	-79.8	-75.9	-55.9	≤ -75.6
21.225	34.8	48.5	13.7	-73.0	-62.6	-67.1	-59.5	≤ -67.4
24.945	34.9	48.0	13.1	-75.2	-68.6	-77.0	-75.3	≤ -53.0
26.000	37.1	36.2	-0.9					
27.000	37.1	36.1	-1.0					
27.999	36.9	36.0	-0.9					
28.000	36.9	48.6	11.7					
28.850	35.0	48.1	13.1	-70.4	-67.0	-75.7	-71.6	≤ -70.7
52.000	37.2	47.2	10.0	-73.2	-72.0	-73.3	-73.5	≤ -70.0

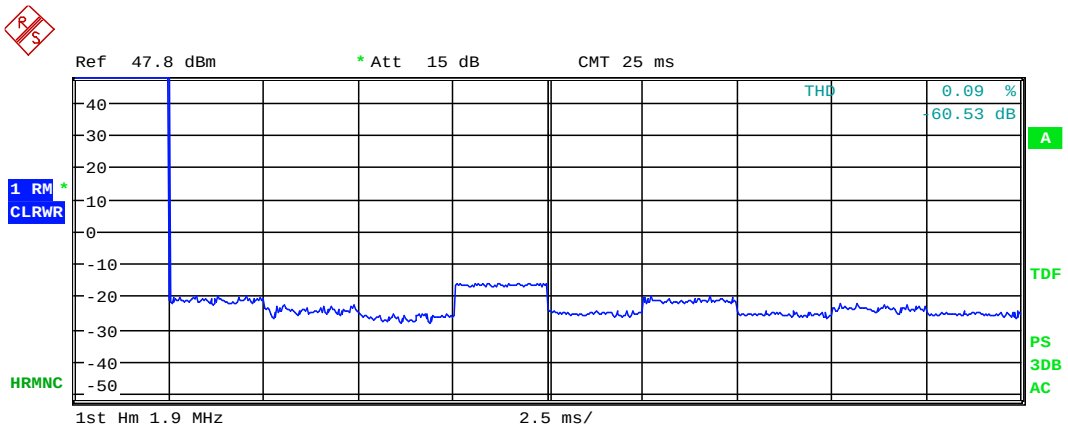
Remark: An amplifier gain of up to 15 dB @ 28 MHz is allowed as stated in § 97.301
(lower band edge of 10 meter band 28 … 29.7 MHz)

Manufacturer: ELAD srl
Device: DUO-ART 60
Serial No: SJ07VZ
Test Date: 2018-04-17

The EUT meets the requirements of this section.

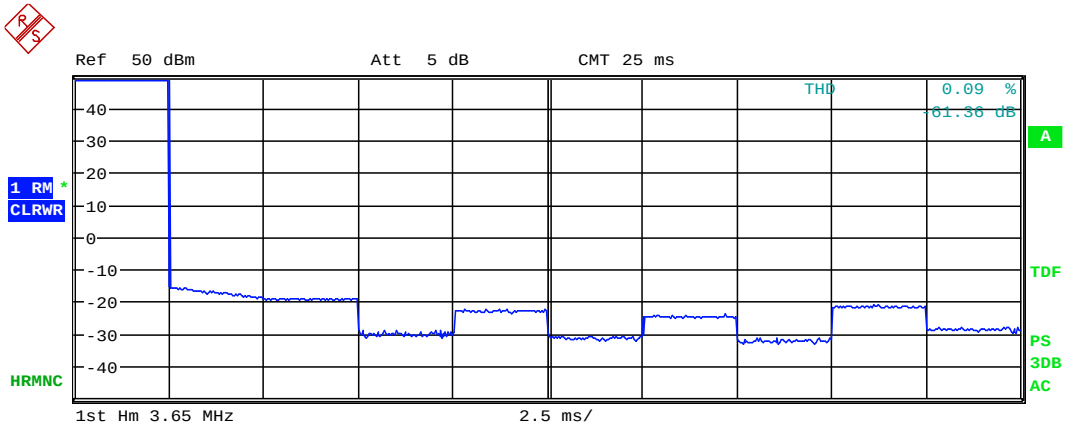
4.5 Measurement Plots

The R&S ESU8 implemented function “harmonic distortion” was used to proof compliance.



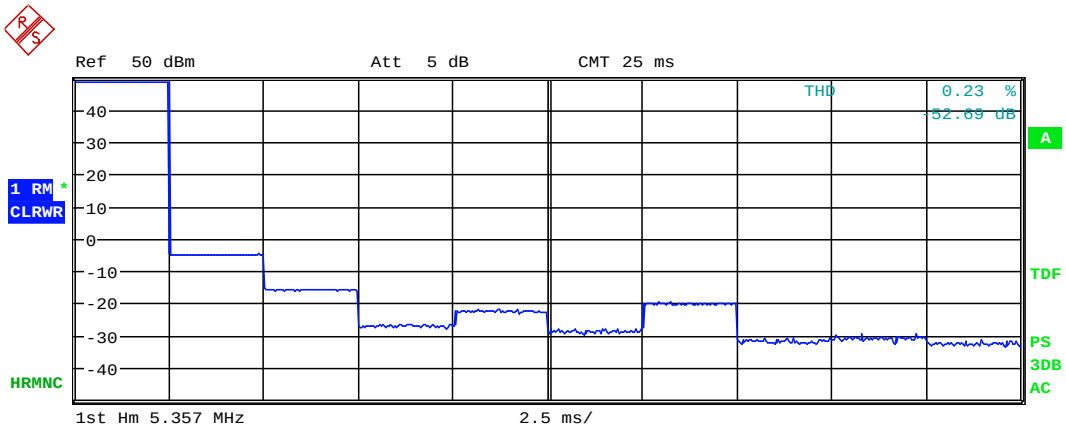
No	Frequency	RBW	Power
1	1.90 MHz	100 kHz	47.86 dBm
2	3.80 MHz	200 kHz	-69.21 dBc
3	5.70 MHz	300 kHz	-72.31 dBc
4	7.60 MHz	500 kHz	-74.43 dBc
5	9.50 MHz	500 kHz	-64.54 dBc
6	11.40 MHz	1 MHz	-73.27 dBc
7	13.30 MHz	1 MHz	-69.33 dBc
8	15.20 MHz	1 MHz	-73.58 dBc
9	17.10 MHz	1 MHz	-71.79 dBc
10	19.00 MHz	1 MHz	-73.52 dBc

$f_{carrier}$ = 1.9 MHz



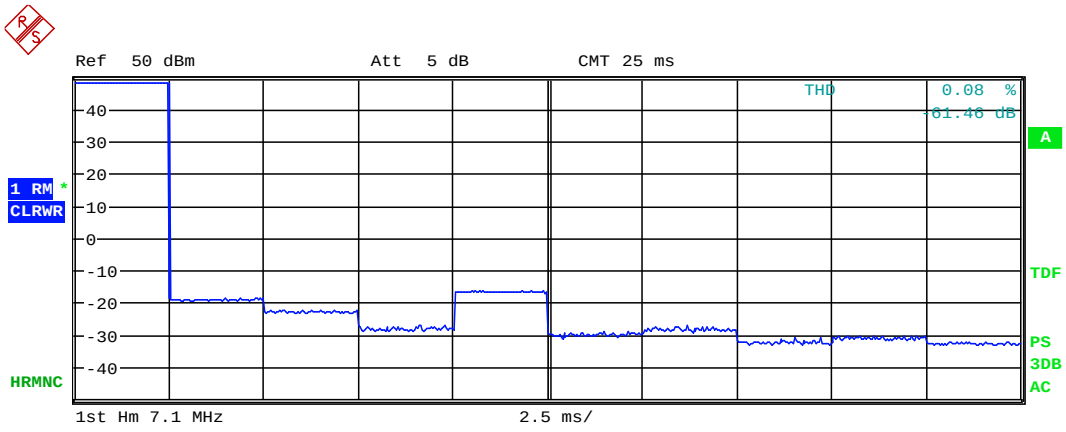
No	Frequency	RBW	Power
1	3.65 MHz	100 kHz	48.21 dBm
2	7.30 MHz	200 kHz	-65.54 dBc
3	10.95 MHz	300 kHz	-67.60 dBc
4	14.60 MHz	500 kHz	-78.32 dBc
5	18.25 MHz	500 kHz	-71.31 dBc
6	21.90 MHz	1 MHz	-79.57 dBc
7	25.55 MHz	1 MHz	-73.09 dBc
8	29.20 MHz	1 MHz	-80.48 dBc
9	32.85 MHz	1 MHz	-70.02 dBc
10	36.50 MHz	1 MHz	-76.93 dBc

$f_{carrier}$ = 3.65 MHz



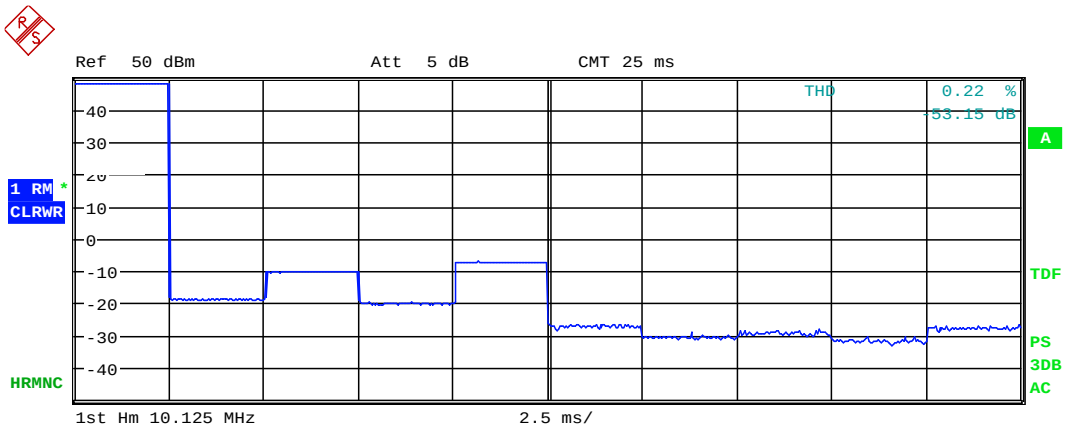
No	Frequency	RBW	Power
1	5.36 MHz	100 kHz	48.27 dBm
2	10.71 MHz	200 kHz	-53.26 dBc
3	16.07 MHz	300 kHz	-64.31 dBc
4	21.43 MHz	500 kHz	-75.41 dBc
5	26.79 MHz	500 kHz	-70.96 dBc
6	32.14 MHz	1 MHz	-77.12 dBc
7	37.50 MHz	1 MHz	-68.60 dBc
8	42.86 MHz	1 MHz	-80.20 dBc
9	48.21 MHz	1 MHz	-79.20 dBc
10	53.57 MHz	1 MHz	-80.86 dBc

$f_{carrier}$ = 5.357 MHz



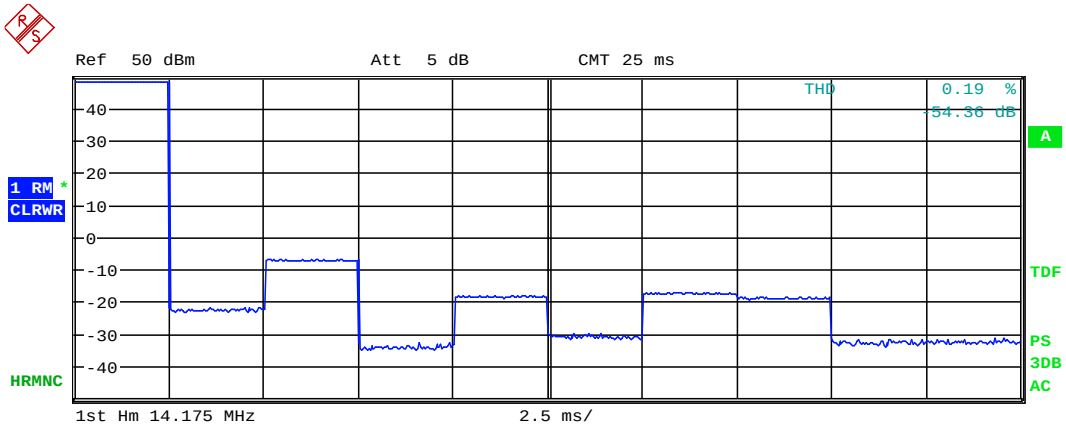
No	Frequency	RBW	Power
1	7.10 MHz	100 kHz	47.82 dBm
2	14.20 MHz	200 kHz	-67.10 dBc
3	21.30 MHz	300 kHz	-70.83 dBc
4	28.40 MHz	500 kHz	-76.04 dBc
5	35.50 MHz	500 kHz	-64.66 dBc
6	42.60 MHz	1 MHz	-77.90 dBc
7	49.70 MHz	1 MHz	-76.24 dBc
8	56.80 MHz	1 MHz	-80.27 dBc
9	63.90 MHz	1 MHz	-78.97 dBc
10	71.00 MHz	1 MHz	-80.64 dBc

$f_{carrier}$ = 7.1 MHz



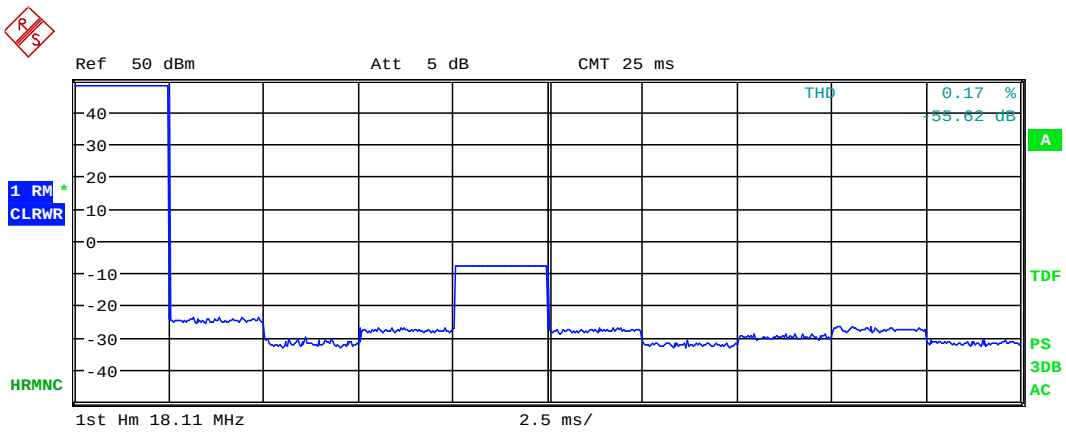
No	Frequency	RBW	Power
1	10.13 MHz	100 kHz	47.96 dBm
2	20.25 MHz	200 kHz	-66.89 dBc
3	30.38 MHz	300 kHz	-58.38 dBc
4	40.50 MHz	500 kHz	-68.21 dBc
5	50.63 MHz	500 kHz	-55.33 dBc
6	60.75 MHz	1 MHz	-75.22 dBc
7	70.88 MHz	1 MHz	-78.53 dBc
8	81.00 MHz	1 MHz	-77.32 dBc
9	91.13 MHz	1 MHz	-79.68 dBc
10	101.25 MHz	1 MHz	-75.83 dBc

$f_{carrier}$ = 10.125 MHz



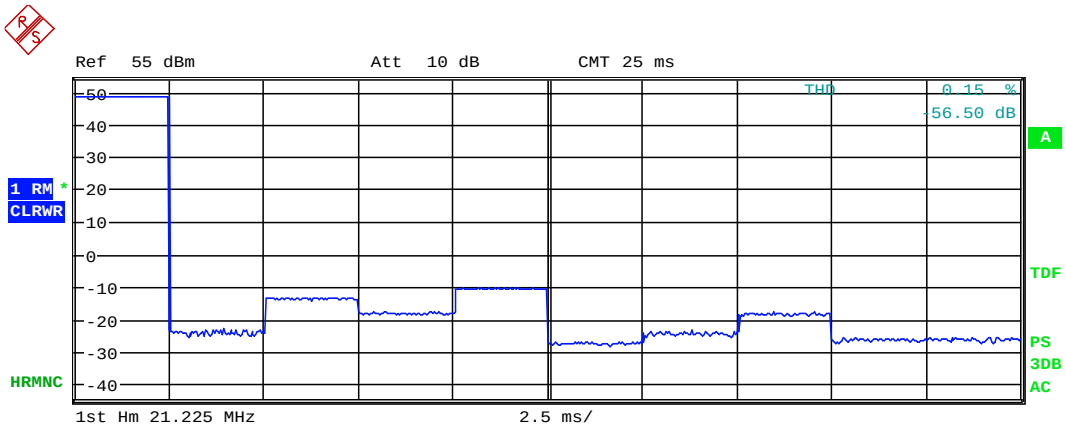
No	Frequency	RBW	Power
1	14.18 MHz	100 kHz	48.10 dBm
2	28.35 MHz	200 kHz	-70.84 dBc
3	42.52 MHz	300 kHz	-55.41 dBc
4	56.70 MHz	500 kHz	-82.35 dBc
5	70.88 MHz	500 kHz	-66.73 dBc
6	85.05 MHz	1 MHz	-79.09 dBc
7	99.22 MHz	1 MHz	-65.74 dBc
8	113.40 MHz	1 MHz	-67.17 dBc
9	127.58 MHz	1 MHz	-80.90 dBc
10	141.75 MHz	1 MHz	-80.71 dBc

$f_{carrier}$ = 14.175 MHz



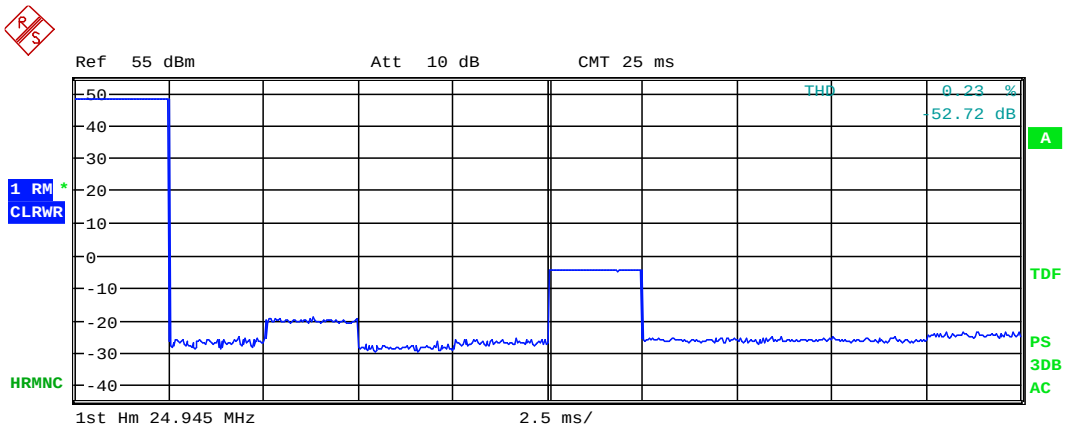
No	Frequency	RBW	Power
1	18.11 MHz	100 kHz	47.95 dBm
2	36.22 MHz	200 kHz	-72.75 dBc
3	54.33 MHz	300 kHz	-79.76 dBc
4	72.44 MHz	500 kHz	-75.87 dBc
5	90.55 MHz	500 kHz	-55.92 dBc
6	108.66 MHz	1 MHz	-75.90 dBc
7	126.77 MHz	1 MHz	-80.25 dBc
8	144.88 MHz	1 MHz	-77.89 dBc
9	162.99 MHz	1 MHz	-75.56 dBc
10	181.10 MHz	1 MHz	-79.74 dBc

$f_{carrier}$ = 18.11 MHz



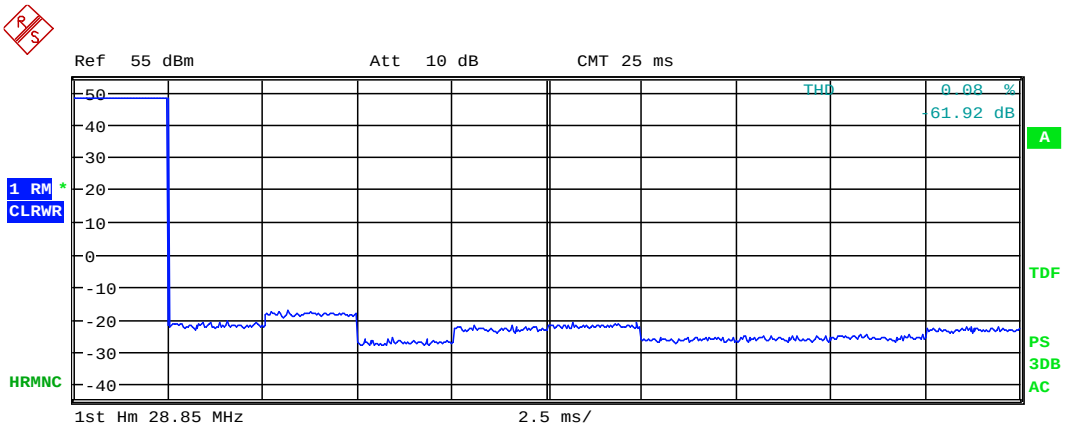
No	Frequency	RBW	Power
1	21.23 MHz	100 kHz	48.62 dBm
2	42.45 MHz	200 kHz	-73.01 dBc
3	63.67 MHz	300 kHz	-62.58 dBc
4	84.90 MHz	500 kHz	-67.10 dBc
5	106.13 MHz	500 kHz	-59.48 dBc
6	127.35 MHz	1 MHz	-76.38 dBc
7	148.57 MHz	1 MHz	-73.36 dBc
8	169.80 MHz	1 MHz	-67.35 dBc
9	191.03 MHz	1 MHz	-75.32 dBc
10	212.25 MHz	1 MHz	-75.20 dBc

$f_{carrier}$ = 21.225 MHz



No	Frequency	RBW	Power
1	24.95 MHz	100 kHz	48.06 dBm
2	49.89 MHz	200 kHz	-75.16 dBc
3	74.83 MHz	300 kHz	-68.62 dBc
4	99.78 MHz	500 kHz	-76.96 dBc
5	124.72 MHz	500 kHz	-75.30 dBc
6	149.67 MHz	1 MHz	-53.03 dBc
7	174.62 MHz	1 MHz	-74.58 dBc
8	199.56 MHz	1 MHz	-74.61 dBc
9	224.51 MHz	1 MHz	-74.65 dBc
10	249.45 MHz	1 MHz	-73.05 dBc

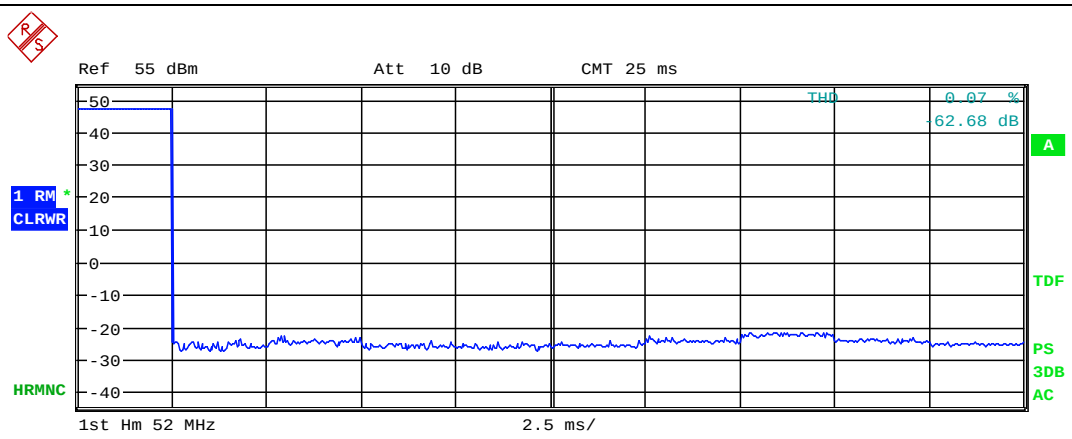
$f_{carrier}$ = 24.945 MHz



No	Frequency	RBW	Power
1	28.85 MHz	100 kHz	48.29 dBm
2	57.70 MHz	200 kHz	-70.43 dBc
3	86.55 MHz	300 kHz	-66.95 dBc
4	115.40 MHz	500 kHz	-75.69 dBc
5	144.25 MHz	500 kHz	-71.58 dBc
6	173.10 MHz	1 MHz	-70.70 dBc
7	201.95 MHz	1 MHz	-74.90 dBc
8	230.80 MHz	1 MHz	-74.61 dBc
9	259.65 MHz	1 MHz	-74.26 dBc
10	288.50 MHz	1 MHz	-71.95 dBc

$f_{carrier}$ = 28.85 MHz

Test of ELAD srl Amplifier DUO-ART 60 to 47 CFR §§ 97.307, 97.317



No	Frequency	RBW	Power
1	52.00 MHz	100 kHz	47.21 dBm
2	104.00 MHz	200 kHz	-73.24 dBc
3	156.00 MHz	300 kHz	-71.95 dBc
4	208.00 MHz	500 kHz	-73.34 dBc
5	260.00 MHz	500 kHz	-73.50 dBc
6	312.00 MHz	1 MHz	-73.19 dBc
7	364.00 MHz	1 MHz	-71.85 dBc
8	416.00 MHz	1 MHz	-69.95 dBc
9	468.00 MHz	1 MHz	-71.77 dBc
10	520.00 MHz	1 MHz	-72.77 dBc

$f_{carrier}$ = 52.0 MHz

5 LIST OF ANNEXES

Following annexes are separated parts from this test report.

Description	Pages
Annex 1: Photographs of test set-up	2
Annex 2: Photographs of equipment under test (EUT)	4
Annex 3: Description of equipment under test (EUT), ports	2

Annex 1 to Test Report # EMCC-180517A, 2018-04-20

PHOTOGRAPHS OF TEST SET-UP

EQUIPMENT UNDER TEST:

Device:	DUO-ART 60
Serial Number:	SJ07VZ
Application:	Amplifier
FCC ID:	2AAE5ART60
Manufacturer:	ELAD srl
Address:	Via Col de Rust, 11 Sarone 33070 Caneva PN ITALY
Phone:	+39 0434 77248
Fax:	+39 0434 77231

RELEVANT STANDARD(S): 47 CFR §§ 97.307, 97.317

Photo A1-1: conducted spurious emissions and amplifier gain measurement

Photo A1-2: conducted spurious emissions and amplifier gain measurement (detail view)

Annex 2 to Test Report # EMCC-180517A, 2018-04-20

PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)

EQUIPMENT UNDER TEST:

Device:	DUO-ART 60
Serial Number:	SJ07VZ
Application:	Amplifier
FCC ID:	2AAE5ART60
Manufacturer:	ELAD srl
Address:	Via Col de Rust, 11 Sarone 33070 Caneva PN ITALY
Phone:	+39 0434 77248
Fax:	+39 0434 77231

RELEVANT STANDARD(S): 47 CFR §§ 97.307, 97.317

Photo A2-1: EUT

Photo A2-2: EUT, front

Photo A2-3: EUT, back

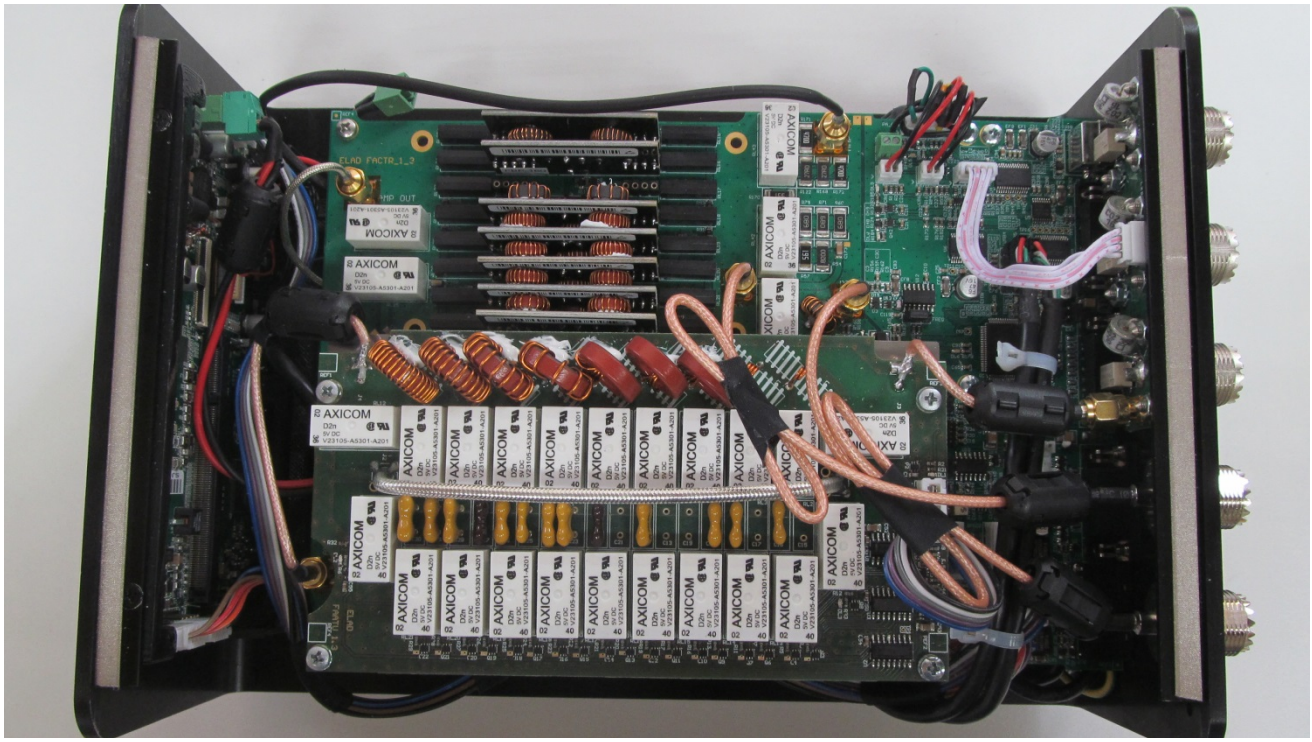


Photo A2-4: EUT, top with open case

Photo A2-5: EUT, label Serial Number

Photo A2-6: EUT, label FCC ID

Annex 3 to Test Report # EMCC-180517A, 2018-04-20

DESCRIPTION OF EQUIPMENT UNDER TEST (EUT), PORTS

EQUIPMENT UNDER TEST:

Device:	DUO-ART 60
Serial Number:	SJ07VZ
Application:	Amplifier
FCC ID:	2AAE5ART60
Manufacturer:	ELAD srl
Address:	Via Col de Rust, 11 Sarone 33070 Caneva PN ITALY
Phone:	+39 0434 77248
Fax:	+39 0434 77231

RELEVANT STANDARD(S): 47 CFR §§ 97.307, 97.317

The following information was delivered by the customer:

ANT1 - ANT2 - ANT3:
Antenna Connection Selectable by software

EXT I/O:
DB9 connectors (2x) Proprietary Communication port with FDM-DUO and accessories

LAN:
Port for remote operation

USB HOST:
ports for connecting to FDM-DUO for Remote Operations
(USB CAT - USB RX - USB TX)

PTT In:
Push to talk input to activate the Power Amplifier

PTT Out:
is the repeat open collector of PTT In for chain operation

USB:
Device AUX for Service

RS232:
for connecting others Transceiver (for example FT817)

DC IN:
Power input 13.8V (for portable operation, it is an alternative to AC POWER)

DC OUT:
Power output for DUO or for auxiliary equipment

AC Mains Inlet Socket

RTX:
Input Connector

RX:
output Connector