Test Report

Electromagnetic Compatibility (EMC)

FINAS Finnish Accreditation Service T004 (EN ISO/IEC 17025)

TESTS ACCORDING TO FCC PART 15 B AND INDUSTRY CANADA REQUIREMENTS

Equipment Under Test:	Welding Camera
Model:	C300
Type:	-
Manufacturer:	Cavitar Ltd. Kuokkamaantie 4 A FI-33800 Tampere Finland
Customer:	Cavitar Ltd. Kuokkamaantie 4 A FI-33800 Tampere Finland
FCC Rule Part: IC Rule Part:	FCC CFR 47 Part 15 Subpart B (2019), Class A ICES-003 Issue 6 (update 2019), Class A

Date:	18 November 2020	Date:	18 November 2020
Issued by:	Henri Mäki Testing Engineer	Checked by:	Rauno Repo Senior EMC/RF Specialist

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GENERAL REMARKS

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.

RELEASE HISTORY

Version	Changes	Issued
1.0	Initial release	18 November 2020

PRODUCT DESCRIPTION

Equipment Under Test (EUT)

EUT information	
General Product Description	Welding Camera
Trademark	Cavitar Welding Camera
Model	C300
Type	-
Serial number	5640345
Power input port type	Sensor unit: DC, Power supply: AC
Rated voltage	Sensor unit: 24 V_{DC}, Power supply: 100 – 240 V_{AC}
Rated current	Sensor unit: 0.5 A, Power supply: 0.22 – 0.55 A
Rated frequency	Sensor unit: DC, Power supply: 47 – 63 Hz
Rated power	Sensor unit: 12 W, Power supply: 25 W
EUT Highest operation freq.	600 MHz
Hardware Version (if any)	Sensor Unit v1.3
Software Version (if any)	PC software: Cavitar Capture v4.0
Mechanical size of the EUT	Height: 45 mm Width: 30 mm Length: 99 mm
Parallel models	The working distance can be either fixed (default) or adjustable (150…300 mm), and the housing material can be either anodized aluminium (default) or stainless steel.

The EUT was tested as a tabletop unit.

General description

The equipment under test is a welding camera for monitoring various welding processes, including MIG, MAG, and TIG processes.

Samples and modifications

No.	Name	Description
1	Sample 1	Normal sample

Ports and cables

Port name and purpose	Connected from-to	Length (max)	Type	Shielded
Mains	to AC/DC power supply	2 m	L/N/PE	☐ Yes ☒ No
DC power	AC/DC power supply – sensor unit	10 m	M8	☒ Yes ☐ No
Gigabit Ethernet	sensor unit – PC	10 m	CAT6A	☒ Yes ☐ No

Peripherals

Peripheral	Description / Usage
AC/DC adapter	Sinpro SPU25A-108 / Powering the EUT (supplied by the customer)
PC	Intel BKNUC8v5PNK / PC with Cavitar Software for controlling and monitoring the camera (supplied by the customer)
AC/DC adapter	FSP090-DBBN3 / Powering the peripheral PC (supplied by the customer)
Monitor	Samsung T24E310EX / Connected to the peripheral PC (supplied by the laboratory)
Remote control	Samsung AA59-00741A / Controlling the peripheral monitor (supplied by the laboratory)
AC/DC adapter	Samsung A3514_FPN / Powering the peripheral monitor (supplied by the laboratory)
Mouse	Logitech RX250 M-BAD58B / Controlling to the peripheral PC (supplied by the laboratory)

TEST CONDITIONS

EUT Test Conditions During EMC-Testing

Configuration of the EUT was made to correspond to the actual assembling conditions as far as possible. During testing heat sinks were attached to two sides of the EUT.

The EUT was monitored with peripheral PC using software provided by the manufacturer.

During testing the power supply voltage and frequency was 120 V / 60 Hz.

The test conditions were proposed by the customer.

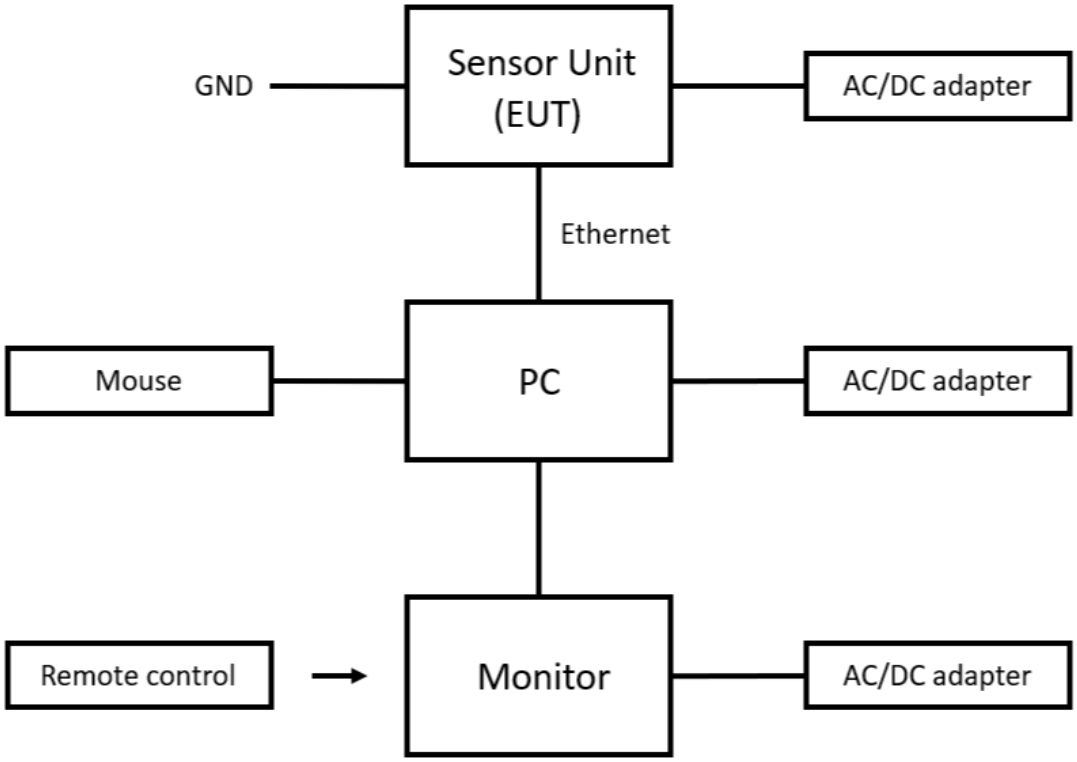

Figure 1: Test setup blocking diagram

Operation modes

During the tests the EUT was in the following operation modes:

Mode	Description
1	The camera and the laser inside the sensor unit were ON. The camera was capturing and the laser was illuminating images with maximum camera capture rate (100 frames/s).

Emission Measurement Uncertainty

The uncertainties comply with CISPR 16-4-2 ed.2 requirements ($U_{lab} < U_{cispr}$).

SUMMARY OF TESTING

Test Specification	Description of Test	Result
FCC CFR 47 15/B §15.107, ICES-003 §6.1	Conducted emissions, Class A	**PASS**
FCC CFR 47 15/B §15.109, ICES 003 §6.2	Radiated emissions, Class A	**PASS**

Decision rule used for the emission tests are defined in standard CISPR 16-4-2 / EN 55016-4-2 clause 4.2

Test Facility

Testing Laboratory / address: FCC designation number: **FI0002** ISED CAB identifier: **T004**	SGS Fimko Ltd Takomotie 8 FI-00380, HELSINKI FINLAND
Test Site:	☐ K10LAB, ISED Canada registration number: **8708A-1** ☒ K5LAB, ISED Canada registration number: **8708A-2** ☐ T10LAB

EMISSION TEST RESULTS

Conducted Emissions In The Frequency Range 150 kHz – 30 MHz

Standard:	ANSI C63.4	(2014)
Tested by:	RRE	
Date:	6 November 2020	
Humidity:	27 %RH	
Temperature:	23 °C	
Barometric pressure:	1009 mbar	
Measurement uncertainty:	± 2.9 dB	Level of confidence 95 % (k = 2)

FCC Rule: 15.107(a)
ICES-003: 6.1

Test Plan

Conducted disturbance voltage was measured with an artificial mains network from 150 kHz to 30 MHz with a resolution bandwidth of 9 kHz. Measurements were carried out with peak and average detectors from the phase(s) and neutral lines of the power supply cable.

The EUT was working as described in the section “EUT Test Conditions”.

Class A limits:

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15 – 0.5	79	66
0.5 – 30	73	60

Test results

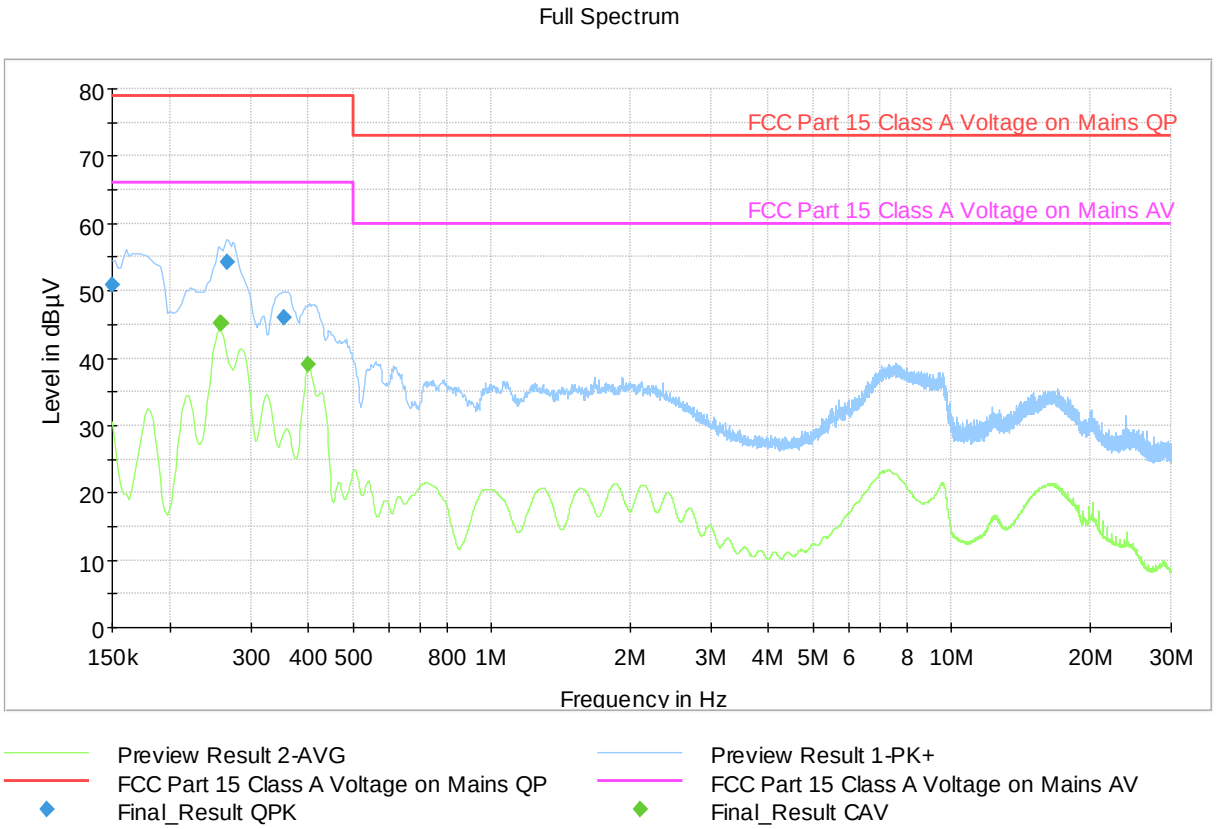

Figure 2: The measured curves with peak-detector and average detector

Final measurements from the worst frequencies

Table 1: Final measurement from the worst frequencies

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Line	Corr. (dB)
0.150000	50.88	---	79.00	28.12	15x1s	9.000	N	9.6
0.258250	---	45.10	66.00	20.90	15x1s	9.000	N	9.6
0.258750	---	45.23	66.00	20.77	15x1s	9.000	N	9.6
0.266000	54.17	---	79.00	24.83	15x1s	9.000	N	9.6
0.354250	46.08	---	79.00	32.92	15x1s	9.000	N	9.6
0.400500	---	38.95	66.00	27.05	15x1s	9.000	N	9.7

Correction factor (dB) in the final result tables contains the sum of the transducers (cables + LISN). QuasiPeak and Average values are the measured values corrected with the correction factor.

Radiated Emissions In The Frequency Range 30 – 5000 MHz

Standard:	ANSI C63.4 (2014)	
Tested by:	RRE	
Date:	6 November 2020	
Humidity:	27 %RH	
Temperature:	23 °C	
Barometric pressure:	1009 mbar	
Measurement uncertainty:	± 4.9 dB (30 – 200 MHz) ± 4.1 dB (200 – 1 000 MHz) ± 4.3 dB (1 – 5 GHz)	Level of confidence 95 % (k = 2).

FCC Rule: 15.109(a)
ICES-003: 6.2

Test plan

The radiated emission measurements were done within a semi anechoic screened chamber. Additional floor absorbers were used on the floor between the EUT and receiving antenna in radiated emission test above 1 GHz. The EUT was placed on a table 0.8 m above the reflecting ground plane.The measurement distance was 3 meters. The worst interferences were determined during measurements by rotating the turntable and adjusting the antenna height. The measurements were done in horizontal and vertical antenna polarizations. The supply voltage to the turntable was fed through the filter.

The EUT was working as described in the section “EUT Test Conditions”.

Radiated measurement settings

Preliminary testing (30 – 1000 MHz):		**Final testing (30 – 1000 MHz):**	
Turntable movement:	20 ° step	Turntable movement:	Continuous
Turntable position:	10 ° to 350 °	Turntable position:	± 30 °
Antenna movement:	1.5 m step	Antenna movement:	Continuous
Antenna height:	1.0 m to 4.0 m	Antenna height:	± 0.75 m
Antenna polarization:	Vertical and horizontal	Antenna polarization:	Vertical and horizontal

Preliminary testing (1 – 5 GHz):		**Final testing (1 – 5 GHz):**	
Turntable movement:	15 ° step	Turntable movement:	Continuous
Turntable position:	0 ° to 345 °	Turntable position:	± 7.5 °
Antenna movement:	1.0 m step	Antenna movement:	Continuous
Antenna height:	1.0 m to 4.0 m	Antenna height:	± 0.50 m
Antenna polarization:	Vertical and horizontal	Antenna polarization:	Vertical and horizontal

Measured Quasi-Peak Values In The Frequency Range 30 – 1000 MHz

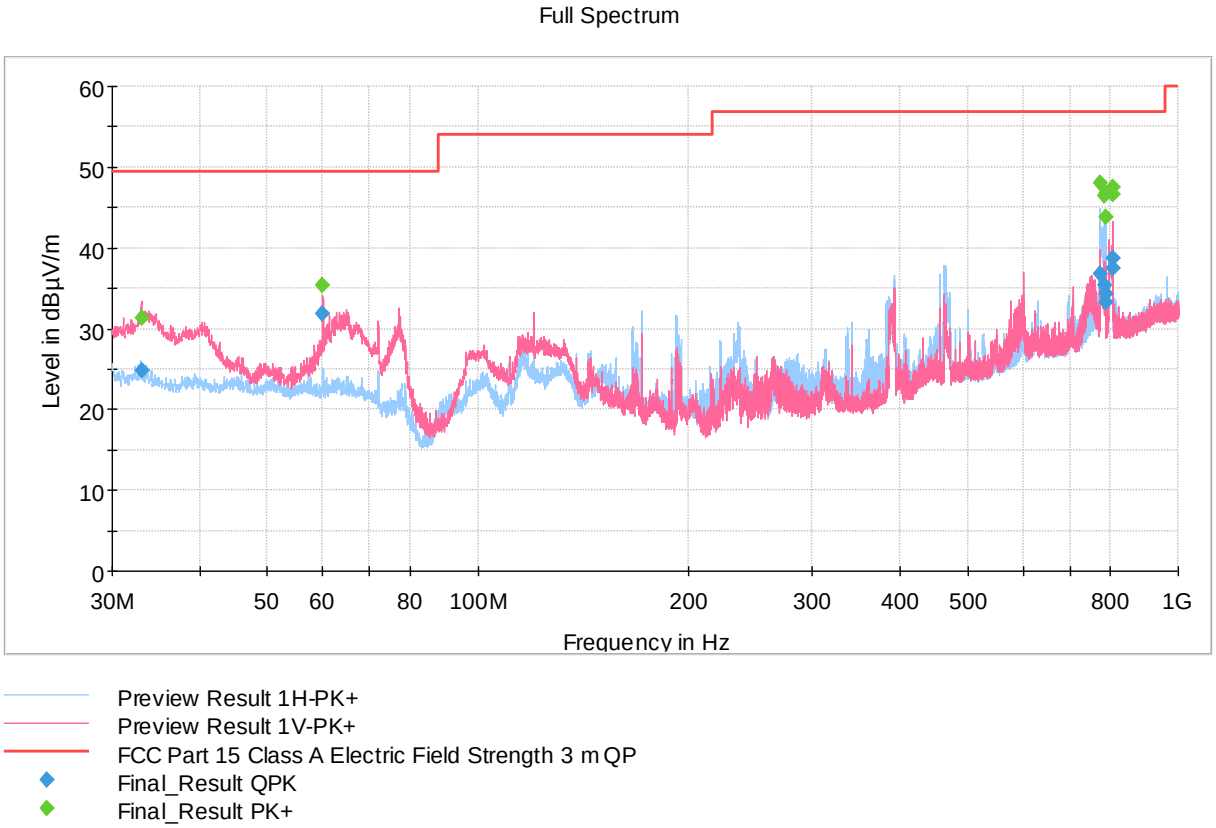

Figure 3: Measured curve with peak-detector. Final peak results (green tags) are only informative.

Final measurements from the worst frequencies

Table 2: Final quasi-peak measurement from the worst frequencies

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
33.030000	24.84	49.49	24.65	15x1s	120.000	128.0	V	51.0	16.6
60.000000	31.90	49.47	17.57	15x1s	120.000	108.0	V	160.0	17.9
774.220000	36.73	56.86	20.13	15x1s	120.000	100.0	H	332.0	29.7
785.660000	35.40	56.86	21.46	15x1s	120.000	108.0	H	327.0	29.7
786.470000	34.28	56.86	22.58	15x1s	120.000	115.0	H	324.0	29.7
787.340000	33.20	56.86	23.66	15x1s	120.000	253.0	H	216.0	29.8
805.160000	38.77	56.86	18.09	15x1s	120.000	100.0	V	301.0	29.9
805.600000	37.52	56.86	19.34	15x1s	120.000	100.0	V	287.0	29.9

Correction factor (dB) in the final result tables contains the sum of the transducers (antenna + amplifier + cables). QuasiPeak values are measured values corrected with the correction factor.

Measured Peak and Average Values In The Frequency Range 1 – 5 GHz

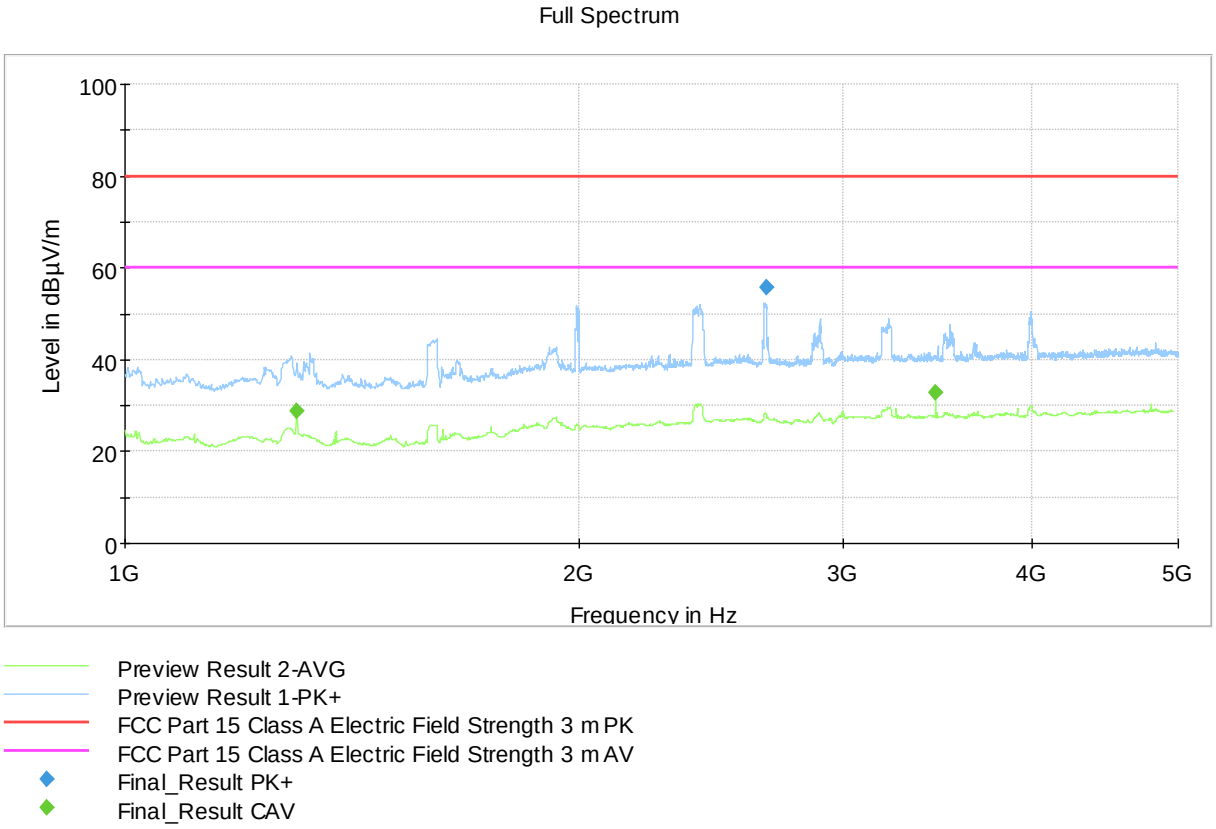

Figure 4: Measured curve with peak and average detector.

Final measurements from the worst frequencies

Table 3: Final peak and average measurement from the worst frequencies

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1300.025000	---	28.71	60.00	31.29	15x1s	1000.000	118.0	H	347.0	0.3
2663.125000	55.88	---	80.00	24.12	15x1s	1000.000	350.0	V	8.0	4.1
3449.825000	---	32.67	60.00	27.33	15x1s	1000.000	109.0	V	296.0	4.7

Correction factor (dB) in the final result tables contains the sum of the transducers (antenna + amplifier + cables).

TEST EQUIPMENT

Conducted Emissions

DESCRIPTION	MANUFACTURER	MODEL	IDENTIFIER	CAL. DATE	CAL. DUE
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv. 10679	2020-07-20	2021-07-20
LISN	ROHDE & SCHWARZ	ENV216	inv. 9611	2020-03-03	2021-03-03
LISN	ROHDE & SCHWARZ	ESH3-Z5	inv. 8019	2020-05-19	2021-05-19
POWER SUPPLY	CALIFORNIA INSTR.	5001 iX Series II	inv. 7826	NCR	-
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-

Radiated Emissions

DESCRIPTION	MANUFACTURER	MODEL	IDENTIFIER	CAL. DATE	CAL. DUE
ANTENNA	SCHWARZBECK	VULB 9168	inv. 9963	2019-10-07	2021-10-07
ANTENNA	EMCO	3117	inv. 7293	2020-03-11	2022-03-11
ANTENNA MAST	MATURO	TAM 4.0E	inv. 10181	NCR	-
ATTENUATOR	PASTERNACK	PE 7004-4 (4dB)	inv. 10126	2019-04-01	2021-04-01
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW26	inv. 10679	2020-07-20	2021-07-20
MAST & TURNTABLE CONTROLLER	MATURO	NCD	inv. 10183	NCR	-
POWER SUPPLY	CALIFORNIA INSTR.	5001 iX Series II	inv. 7826	NCR	-
RF PREAMPLIFIER	CIAO	CA118-3123	inv. 10278	2020-10-09	2021-10-09
TEST SOFTWARE	ROHDE & SCHWARZ	EMC-32	-	-	-
TURNTABLE	MATURO	DS430 UPGRADED	inv. 10182	NCR	-

NCR = No calibration required

END OF REPORT