Resistance measurements on OTE 2 for EndCap A

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Overview

Once the assembly is finished, we did measure the electrical resistances on different OTE areas. Due to its size and geometry it hasn't been possible to use a single conductive material sheet to cover the whole area, so several pieces have been assembled.

Moreover any electrically conductive material must be connected in order to avoid floating masses.

The connection of the external layer (made of Cu-kapton) is obtained by means of a soldered 3.2 mm copper conductive strip [1]. In order to connect the outer Cu-k layer to the inner Al-kapton one some conductive tabs made from Cu-kapton and glued to the surfaces are used. The location and the type of conductive tabs used (as two different designs were used) are shown at the "*grounding Scheme*" [2] document.

The electrical resistance measurement has been done by applying an electrical current between the points of interest, measuring the voltage drop between them and finally the resistance is obtained by dividing both values.

Measurements have been done by applying a voltage of 5 volts and a electrical current of 1A.

Following, a sketch of the setup is shown:

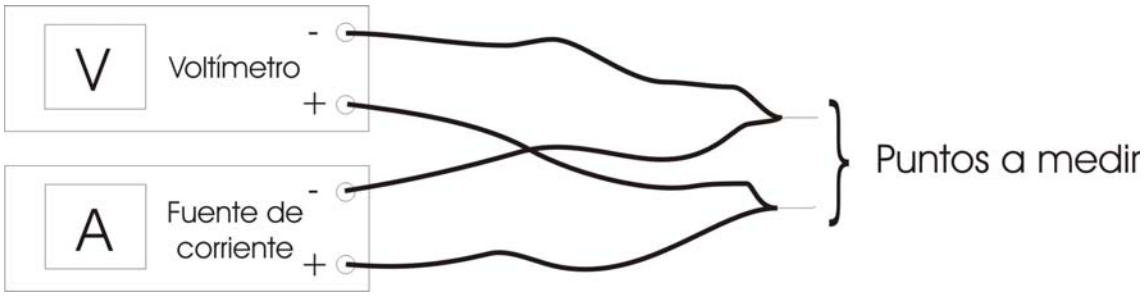

Fig. 1 Sketch of the measurement setup.

Ref. [1] Soldering.pdf
Ref. [2] grounding Scheme.pdf

Test details

First measurements have been done on the external Cu-kapton layer, not only on the cylinder to cylinder side but also on the cylinder to Rear Flange (RF) one. The figure below identifies the measuring points and the values are listed in the attached table.

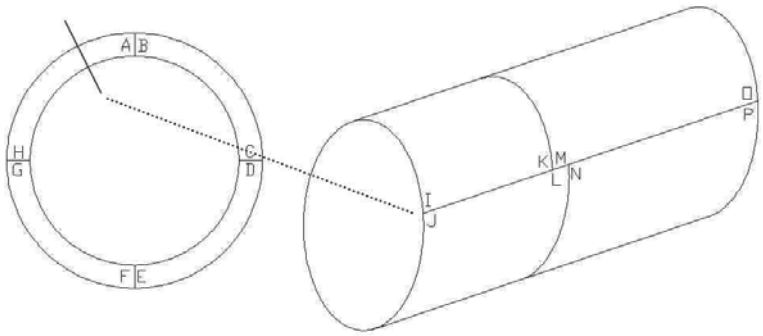

Fig. 2 Location of points of interest

Location	Points of interest	mV	Ohms
	Cables	1.0	0.001
RF	A-B	2.0	0.001
	C-D	2.8	0.0018
	E-F	2.7	0.0017
	G-H	1.7	0.0007
RF-CIL.	A-A’	2.3	0.0013
	B-B’	2.4	0.0014
	C-C’	1.9	0.0009
	D-D’	2.5	0.0015
	E-E’	3.0	0.002
	F-F’	2.2	0.0012
	G-G’	2.1	0.0011
	H-H’	2.5	0.0015
CIL.	I-J	2.2	0.0012
	K-L	1.5	0.0005
	K-M	1.5	0.0005
	M-L	2.4	0.0014
	M-N	2.5	0.0015
	O-P	2.2	0.0012

Tabla 1 Electrical resistance values on the Cu-k layer [3].

Note: points with a prima sign refers to the closest point on the cylinder to the one with the same letter labelled on the RF.

Ref. [3] The electrical resistance values of the table shown the mean measured value at each point once subtracted the cable resistance value.

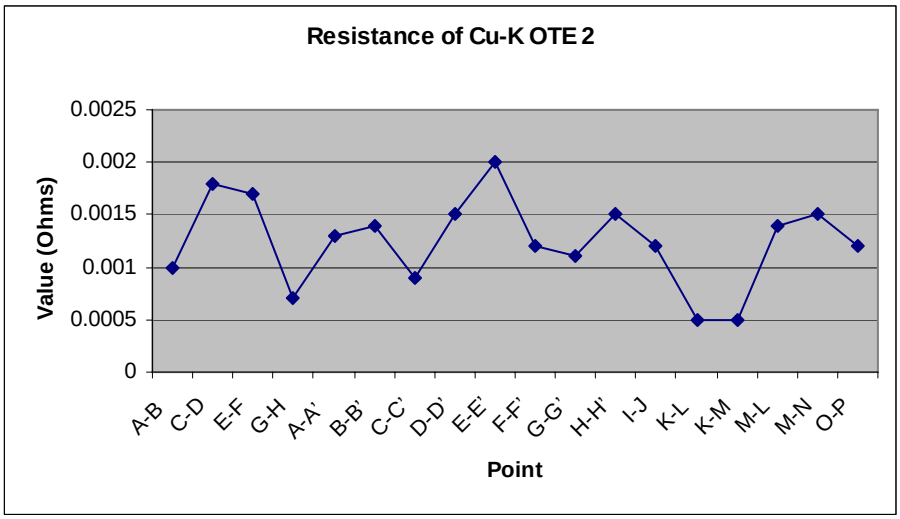

Fig. 3 Graph display of the results from the table above.

A second set of measurements are done on the connection between the external Cu-kapton layer to the internal Al-kapton layer and also the ones to connect the external Al-k layer of the Rear Flange to the internal layer of the same material.

They are connected by using Cu-kapton tabs type 2, as described at *"Test ground pdf"* [4] document.

The following table shows the results from measurements of the different OTE electrical surfaces.

Point	1	2	3	4	5	6	7	8
FF (Cu-Al) (mV)	4.3	5.5	5.6	3.3	3.4	6	6	5.8
FF (Cu-Al) (Ohms)	0.475	0.608	0.619	0.364	0.375	0.663	0.663	0.641
RF(Ext) (Al-Al) (mV)	36	9	8.5	9.2	13.5	14	14.5	12.5
RF(Ext) (Al-Al)	3.984	0.995	0.940	1.017	1.493	1.549	1.604	1.383
RF(Int) (Al-Cu) (mV)	4.8	6.5	4.9	5.5	4.9	7.7	6.5	10.7
RF(Int) (Al-Cu)	0.530	0.718	0.541	0.608	0.541	0.851	0.718	1.183

Tabla 2 Resistance value.

Ref. [4] test ground.pdf

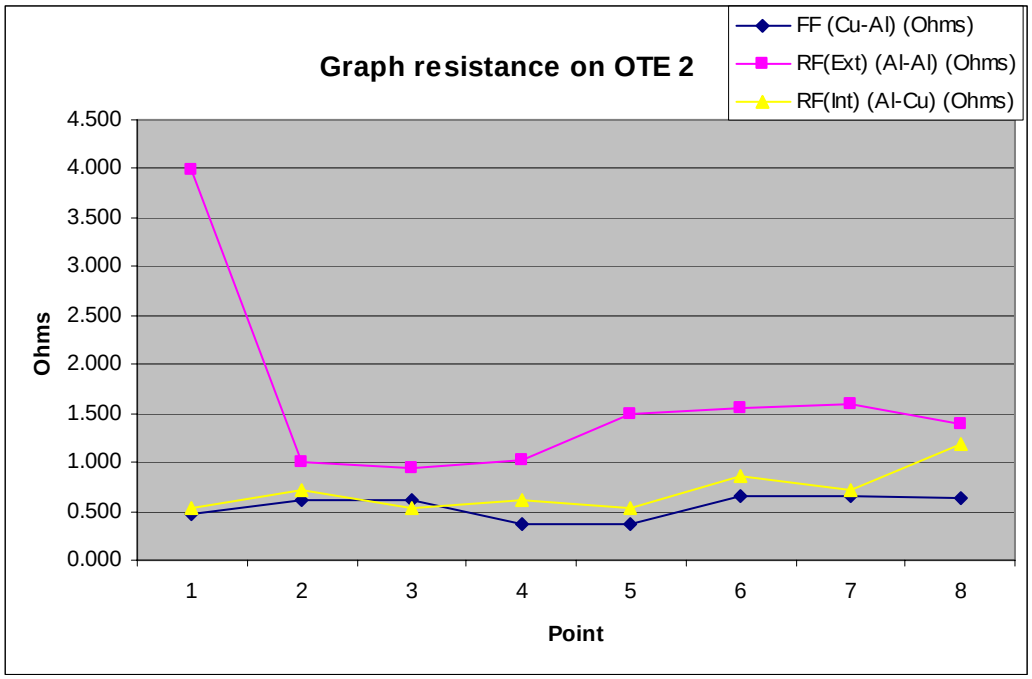

Fig. 4 Electrical resistance at different OTE layers.

Conclusions

The graph above shows a good uniformity between measurements at different locations, having bigger values, (as expected because the Al-k has bigger electrical resistance than the Cu-k one), when connecting two aluminised surfaces.

Only the first measurement shows a deviation from the others due to a poorer electrical contact.

Added to this the inner sheets of Al-kapton have also been connected at 4 points using the conductive strips and their resistance measured values is about 3 ohms.