TTM Technologies Time-To-Market Interconnect Solutions	Quality Procedure	CORP-SA-003
Corporate Level 2 Document	Testing requirements for PTFE Laminates made with Ohmega Foil	

DATE	REVISION	DESCRIPTION OF CHANGES
07/06/2022	Initial	Initial Release
09/27/2022	A	Added Roger's Corporation agreed upon exceptions.

TITLE	APPROVAL SIGNATURE	DATE
Director of Quality - NA		9/2/2022
Senior Quality Systems Manager - NA		9/2/2022

1.0 PURPOSE: To establish resistive targets and outline testing procedures for qualifying Ohmega Technologies, Inc. resistive foils laminated to PTFE substrate. The test procedure is intended to be performed by the foil supplier (Ohmega Technologies, Inc.) with the results reported to TTM on the Certificate of Conformance. Each roll of Ohmega Technologies, Inc. foil shall be qualified and meet the resistive targets noted below.

2.0 SCOPE: This document is specific for Ohmega Technologies, Inc. resistive foils laminated to PTFE substrate.

3.0 DEFINITIONS

4.0 RESPONSIBILITY: The foil supplier (Ohmega Technologies, Inc.) shall perform the qualification procedure to validate the resistive targets are with-in the specified tolerance. This qualification testing shall be performed on all rolls of resistive foil laminated to PTFE and sold to TTM. The laminate supplier shall verify the reported values are with-in tolerance and communicate the results of the qualification testing on the laminate C of C.

5.0 Procedure / Process: The approved test procedure for laminating Ohmega Technologies, Inc. foil to PTFE is Ohmega Technologies, Inc. Document number OP007, rev 02, dated April 29, 2022 and is included as a reference in Appendix A.

Appendix A: Ohmega Technologies, Inc. Document number OP007, rev 02, dated April 29, 2022

- Target values for 25 Ohm per Square = 28 ohm +/- 2.2 ohms for the mean measurements
- Target values for 50 Ohm per Square = 60 ohms +/- 5 ohms for the mean measurement

1. Fill out OhmegaPly sample order request form. A single 51-inch sheet will be cut to 4 – 20 inch by 25.5 inch pieces.
2. Cut one of the pieces to 2 – 9 in. by 12 in. pieces for pressing in Wabash press
    a. ** Ship 2 of the pieces to Rogers CT team for lamination.*
3. Store the last 20 in. by 25.5 in. for future use. Discard after 24 months
4. Use Rogers supplied dielectric material and lay-up two 9 in. by 12 in. samples and press in Wabash press. Use the following press conditions:

TARGET TEMP (°F)	RAMP TIME (MIN)	SOAK TIME (MIN)		
			RT to 725F	70 Min
725	70	70	725F Dwell	70 Minutes
700	60	0	Cool to 700F	60 Min
680	15	0	Cool to 680	15 min
615	60	0	Cool to 615	60 Minutes
75	60	100 *	Cool to RT	
			Open Below 250F	
* This is because my press won't cool to room temp that quickly.				
460 PSI throughout cycle				

Table 1: Wabash representative PTFE lamination press parameters

5. Prepare both Rogers CT and Wabash pressed samples for DES process
    a. Pumice scrub
    b. Apply photoresist
    c. Image OhmegaPly CERT pattern
    d. Develop
    e. Etch copper
    f. Strip unwanted OhmegaPly NiP material
    g. Strip photoresist

h. Repeat steps 5(a)-5(e), 5(g) for second copper etch to finish resistors then move on to step 6

6. Measure resistors
7. Put samples in temperature chamber and run 121C, RH 50%, 2 hour bake test cycle
8. Remove samples from temperature chamber when complete and carefully scratch off oxidation on copper pads
9. Remeasure resistance
10. Report PTFE representative resistance on OhmegaPly Material Certification Form PD006
11. Open run log for corresponding sample(s) tested
12. Calculate average production plating power and input to OhmegaPly Material Certification Form along with plating power upper and lower limits
13. Supply OhmegaPly Material Certification Form to sales team to complete OhmegaPly RCM Certificate of Conformance form.

** Note: Rogers CT lab press will be used in the interim until resistance correlation is verified between Roger CT lab press and Ohmega Wabash press*

Appendix B: Accepted exceptions from Roger's Corporations to Ohmega Technologies, Inc. Document number OP007, rev 02, dated April 29, 2022

ROGERS CORPORATION

100 South Roosevelt Avenue / Chandler, AZ 85226-3415 / 480.961.1382 / Fax: 480.961.4533

August 24, 2022

Subject: CORP-Ohmega Test Procedures, Rev B

To Whom It May Concern,
A customer specification review committee went through your requirements to ensure we can satisfy your requirements or bring attention to areas where exceptions or provisions may be required. Please see the following exceptions and clarifications in the table below.

Note: Rogers Corporation only complies with the current version of IPC-4103, ISO 9001:2015 and/or IATF 16949:2016, other standards referenced within this specification are not guaranteed. Rogers reserves the right to reevaluate specifications on file after an extended period of time.

Reference to Customer Specification	Requirement	Rogers Exception or Clarification
5.10	Report PTFE representative resistance on OhmegaPly Material Certification Form PD006	Exception Taken: Rogers will report PTFE post bake values on Rogers supplied CofA or CofC.
5.12	Calculate average production plating power and input to OhmegaPly Material Certification Form along with plating power upper and lower limits	Exception Taken: Rogers will not provide plating power, only PTFE post bake values will be reported on Rogers supplied CofA or CofC.
5.13	Supply OhmegaPly Material Certification Form to sales team to complete OhmegaPly RCM Certificate of Conformance form.	Exception Taken: Rogers does not provide customers with supplier information. However, a CofA or CofC is supplied with each shipment which includes quality tested product property, test conditions/parameters, specifications, test results, lots and quantity and the date of manufacture.
*Note	Rogers CT lab press will be used in the interim until resistance correlation is verified between Roger CT lab press and Ohmega Wabash press	Sending samples to Rogers CT is only needed until Ohmega qualifies their Wabash press at which point Ohmega will be doing the lamination. Rogers CT press work will be an interim solution until Ohmega finishes their own press validation.

We appreciate the opportunity to review your specification and hope our response is met with your approval. It is our intention to provide our customers with the highest quality products and services available. Should you have any questions regarding the exceptions noted, please don't hesitate to contact your Customer Service Representative.

Rogers Corporation will assume that the customer agrees to the details written in this letter if a response is not received within 10 working days from the date issued. Additionally, the continued placement of purchase orders with Rogers Corporation will be considered as implied consent and agreement to this letter.

Best Regards,
Alex Arebalo
Alex Arebalo
Quality Supervisor

Customer Agreement Signature:

Title: Director of Quality, NA

Date: 9/27/2022