

Ekinler Industry

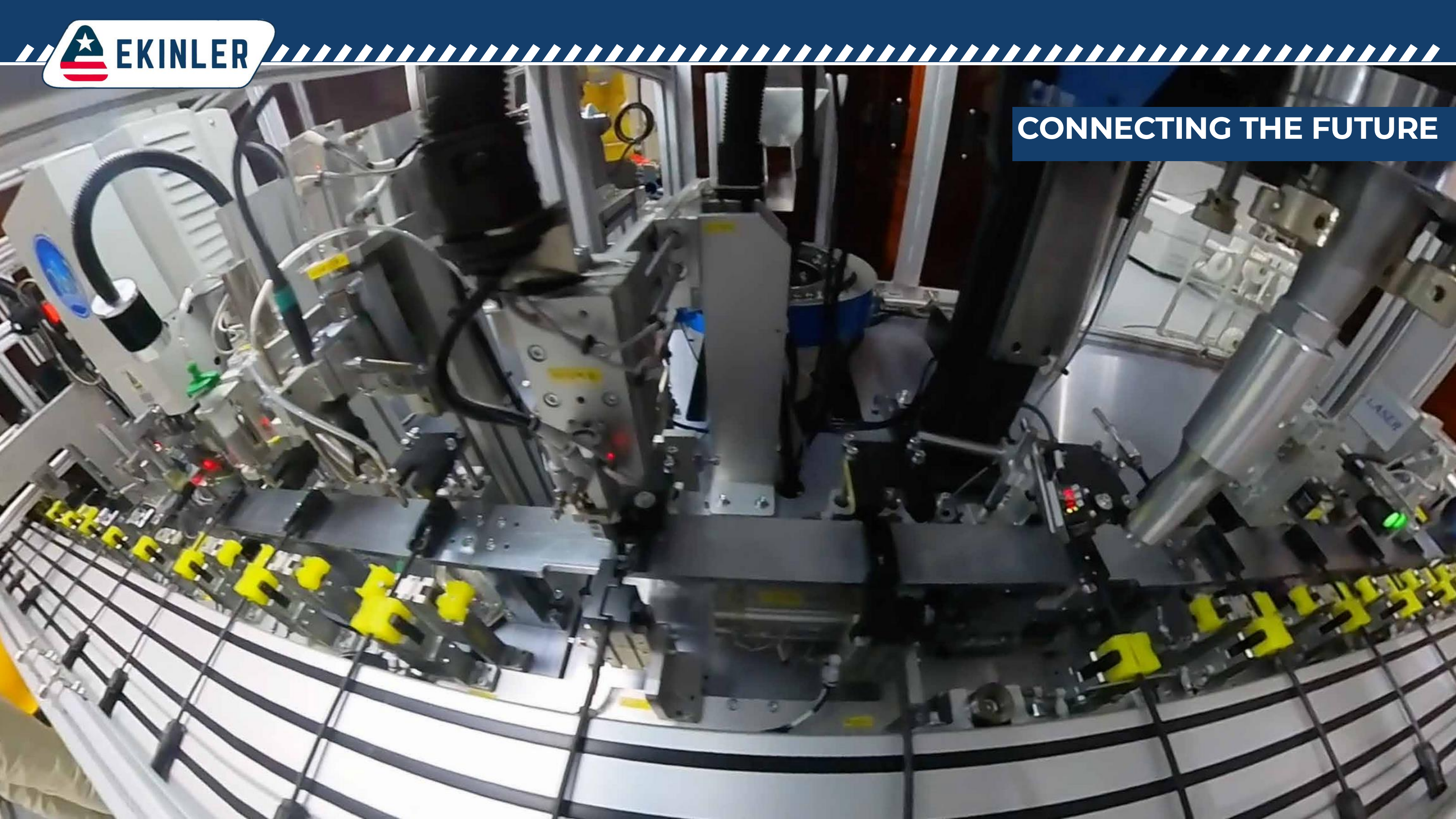
JUNCTION BOX
TECHNICAL
PRESENTATION

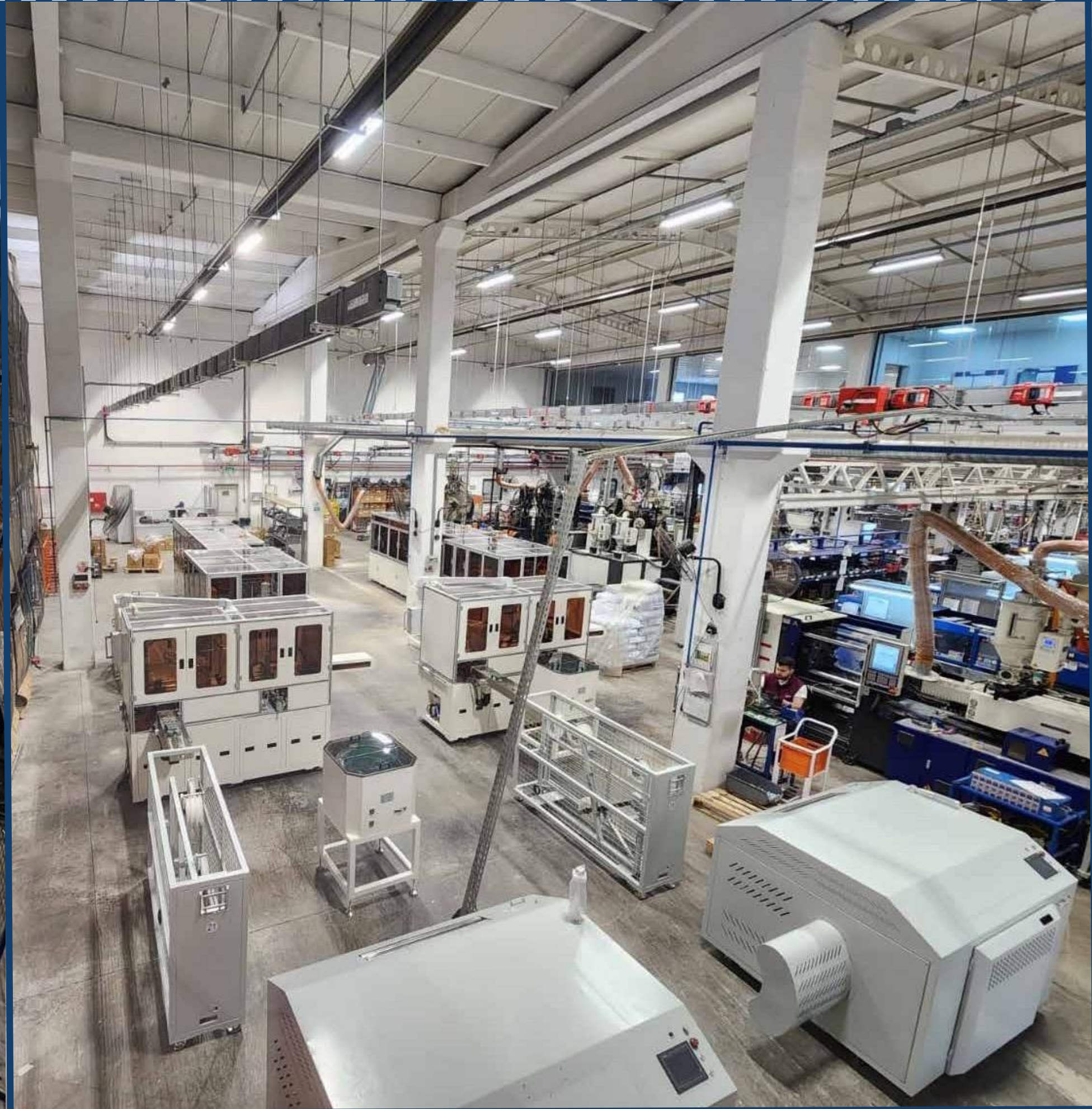


As Ekinler Industry, we are Turkey's first Junction Box manufacturer. We have 15 years of experience in the solar industry and 40 years of experience in production.



Our JBB product, which we put on the market by trying to keep up with the developing technology; It is our 6th generation Junction Box after our JB1, JB2, JB3, JB3x and JBS models and is Domestic Production.





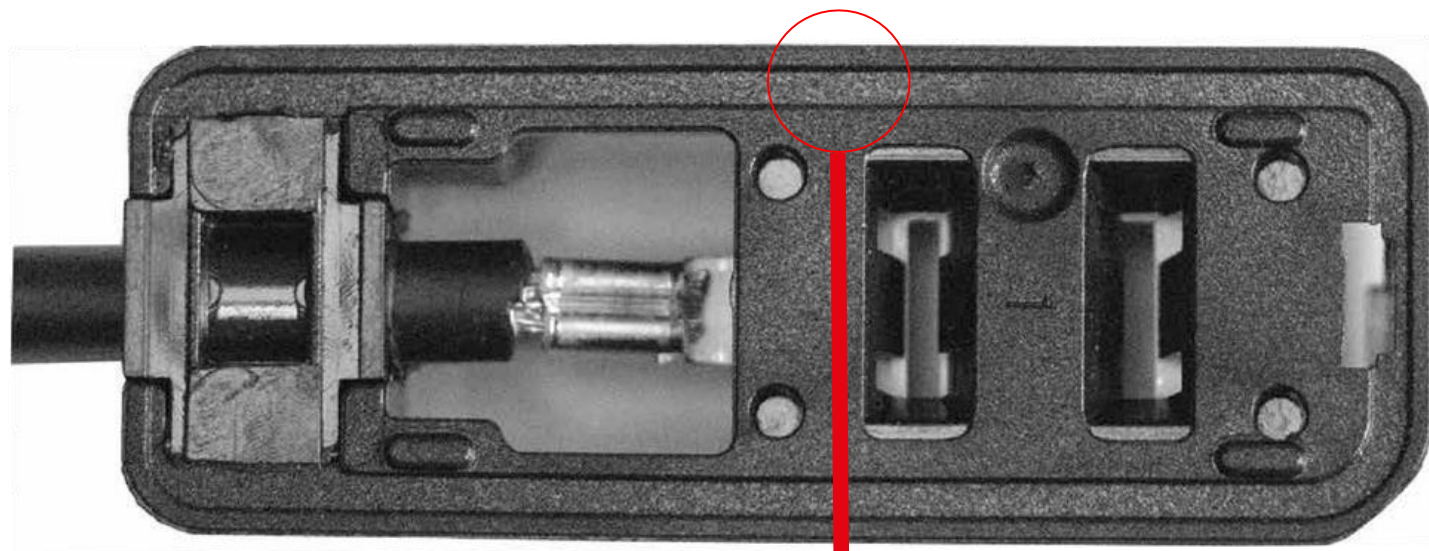


Staubli MC4 Evo2 Connector

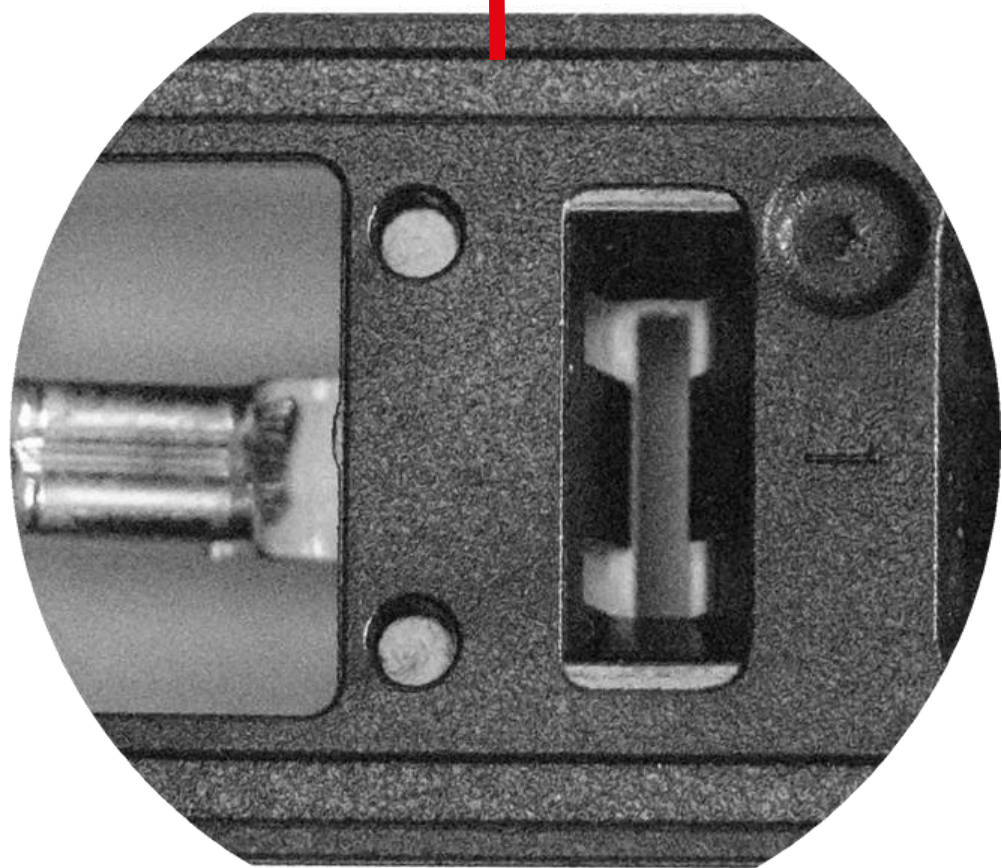


Zerun Connector

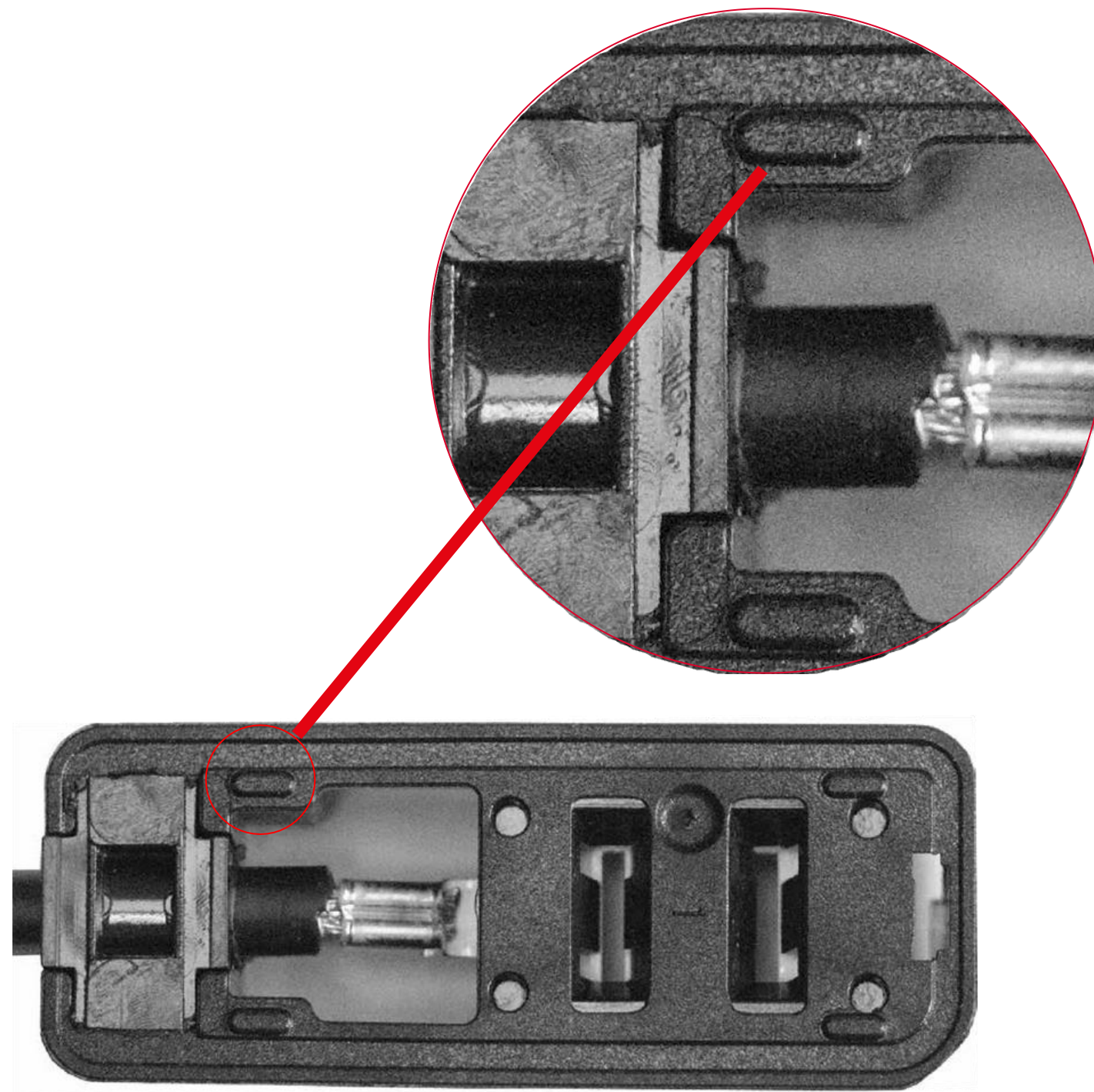
**Staubli MC4 Evo2 Connector
Zerun Connector competence to
use**



Silicone Channels



Adhesive Silicone Riser Feet



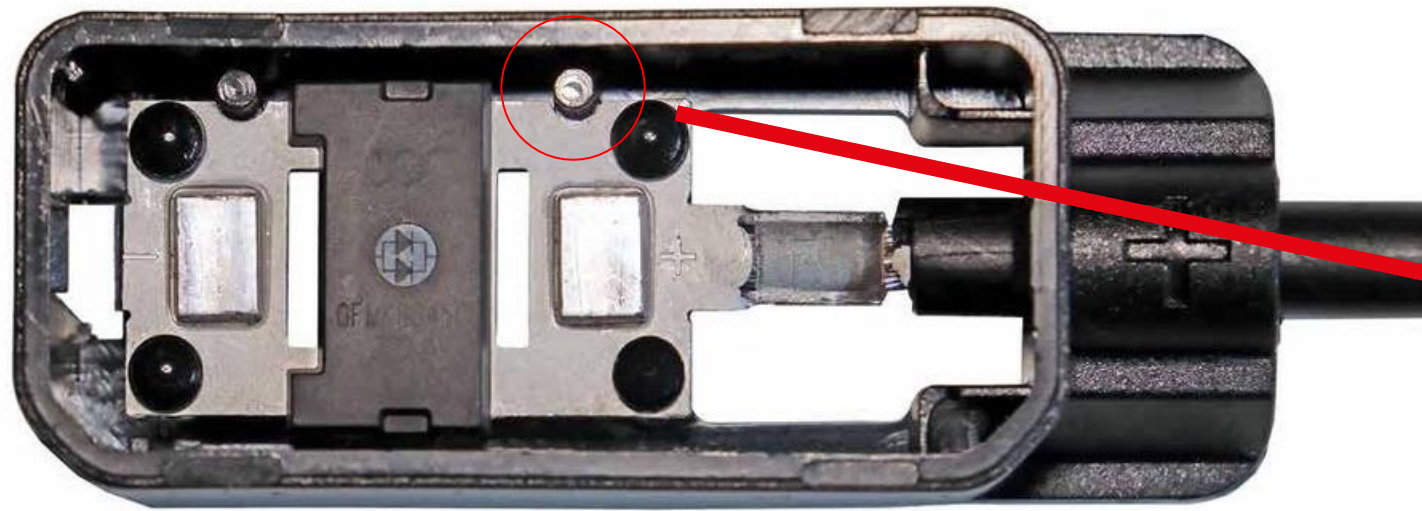
Product traceability with QR marking.

**In internal assembly processes
100% Electrical Control**

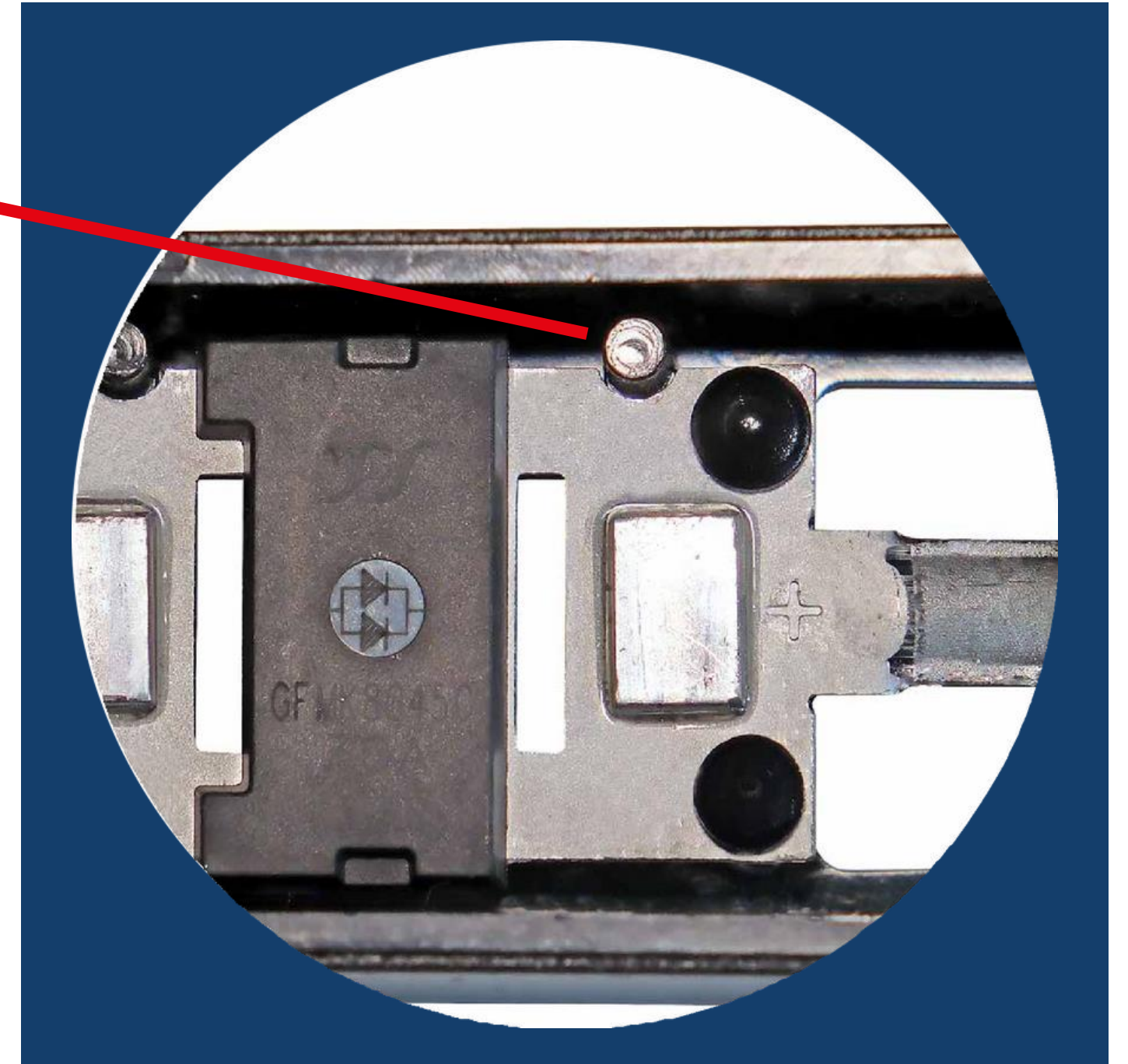
100% QR Verification

NOK product in diode tester
Unable to write QR Code.

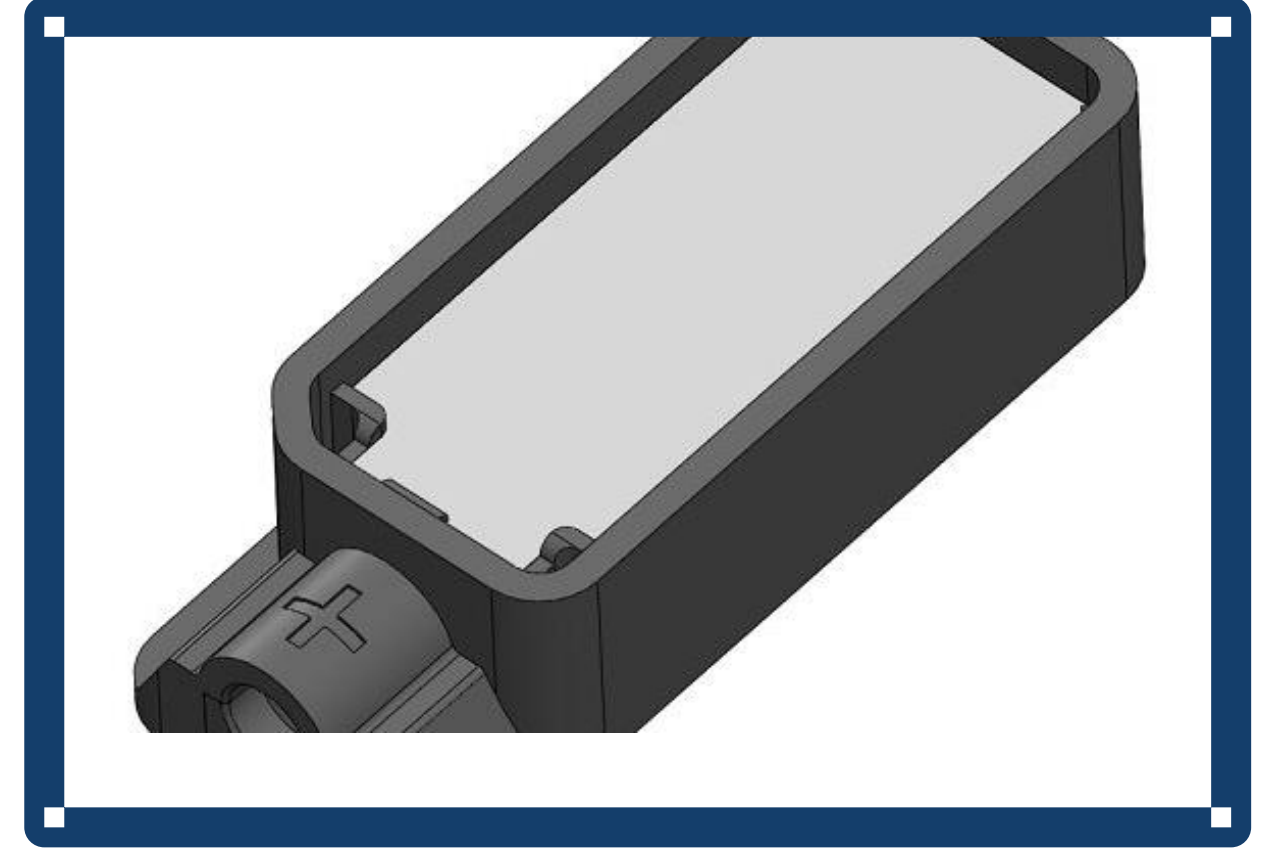
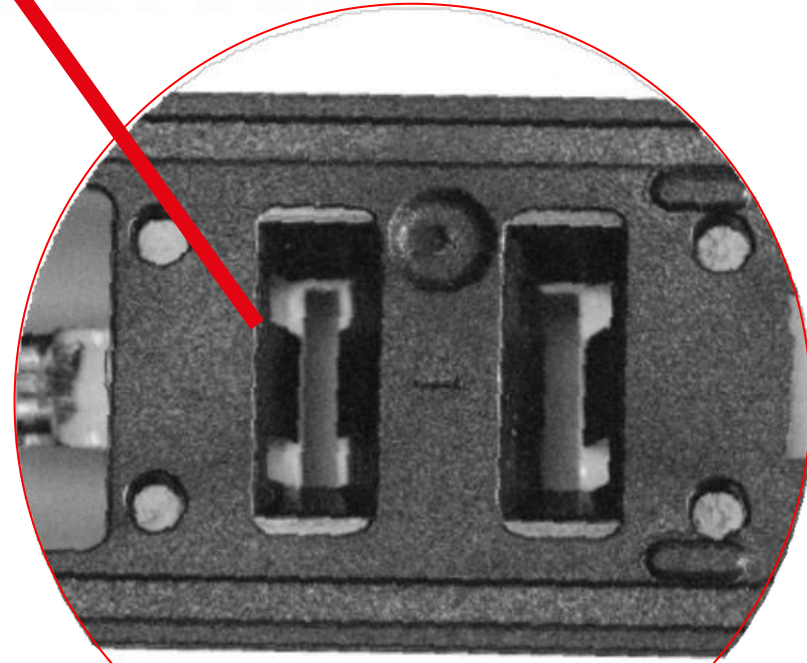
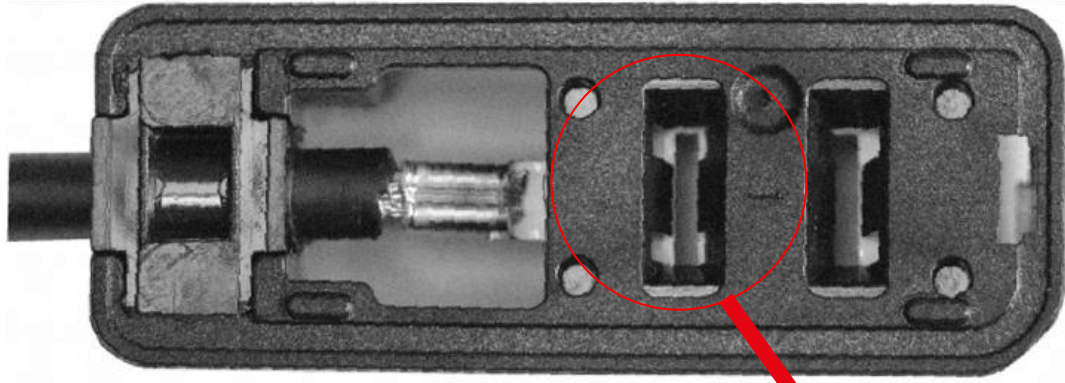




Both in the diode and in
the body
Poka Yoke



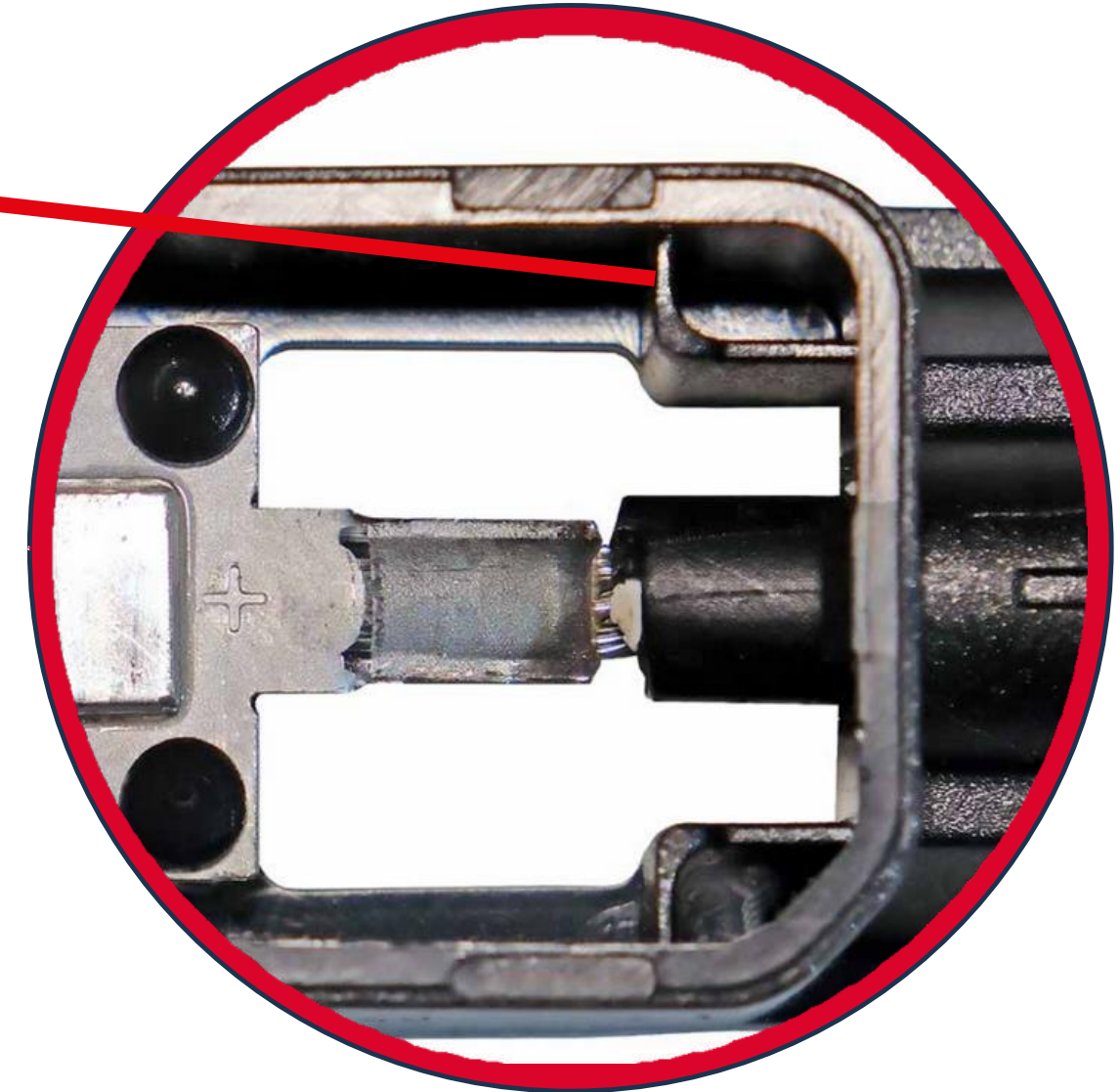
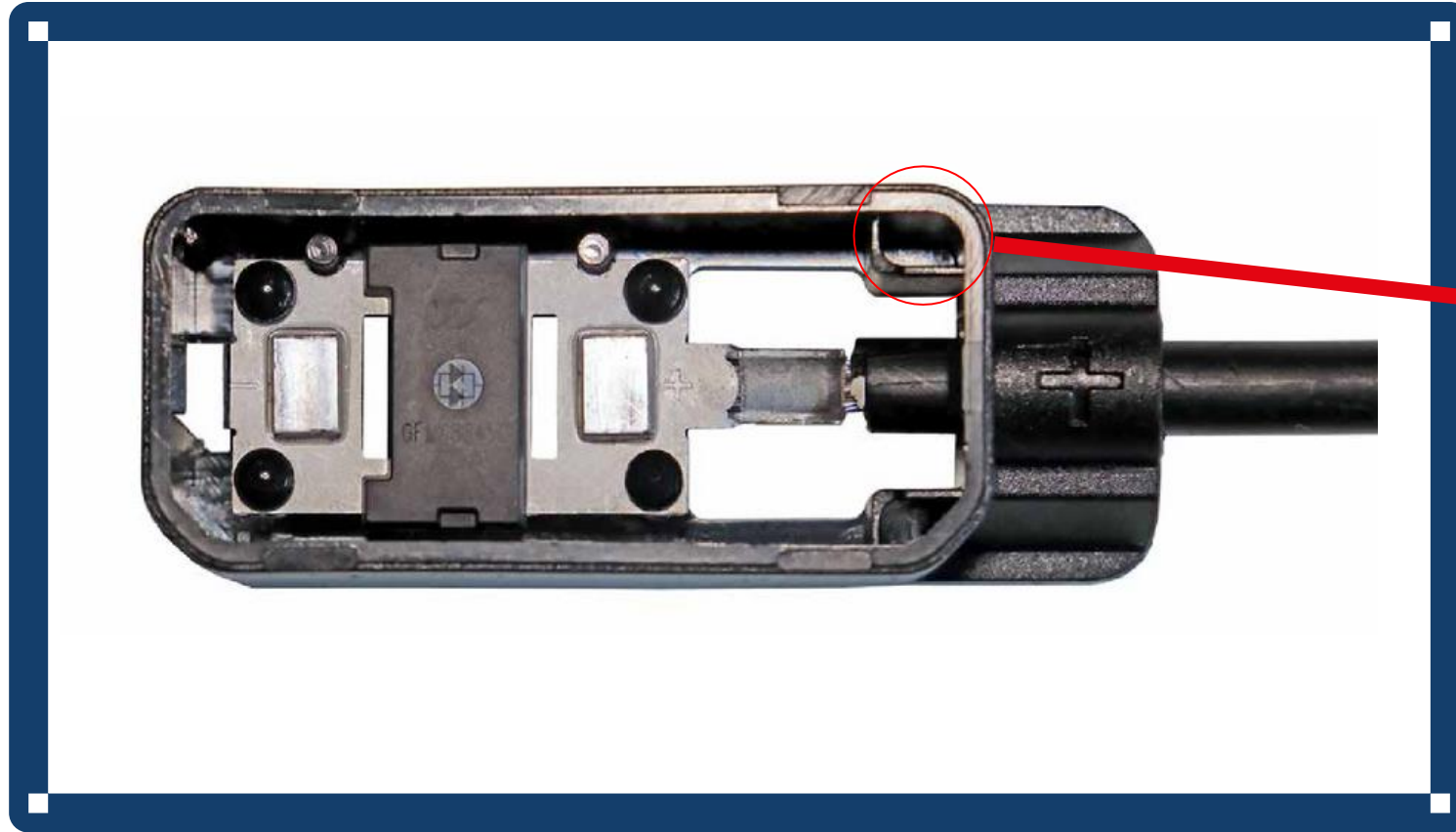
Routing channels in our JBB body molds
easy assembly.



Together with our JBB product, it saves more than 50% potting compared to previous generations.

JBB has an internal volume of 15 cm³ in set.

In the case of the JBS model, this value was 40 cm³.

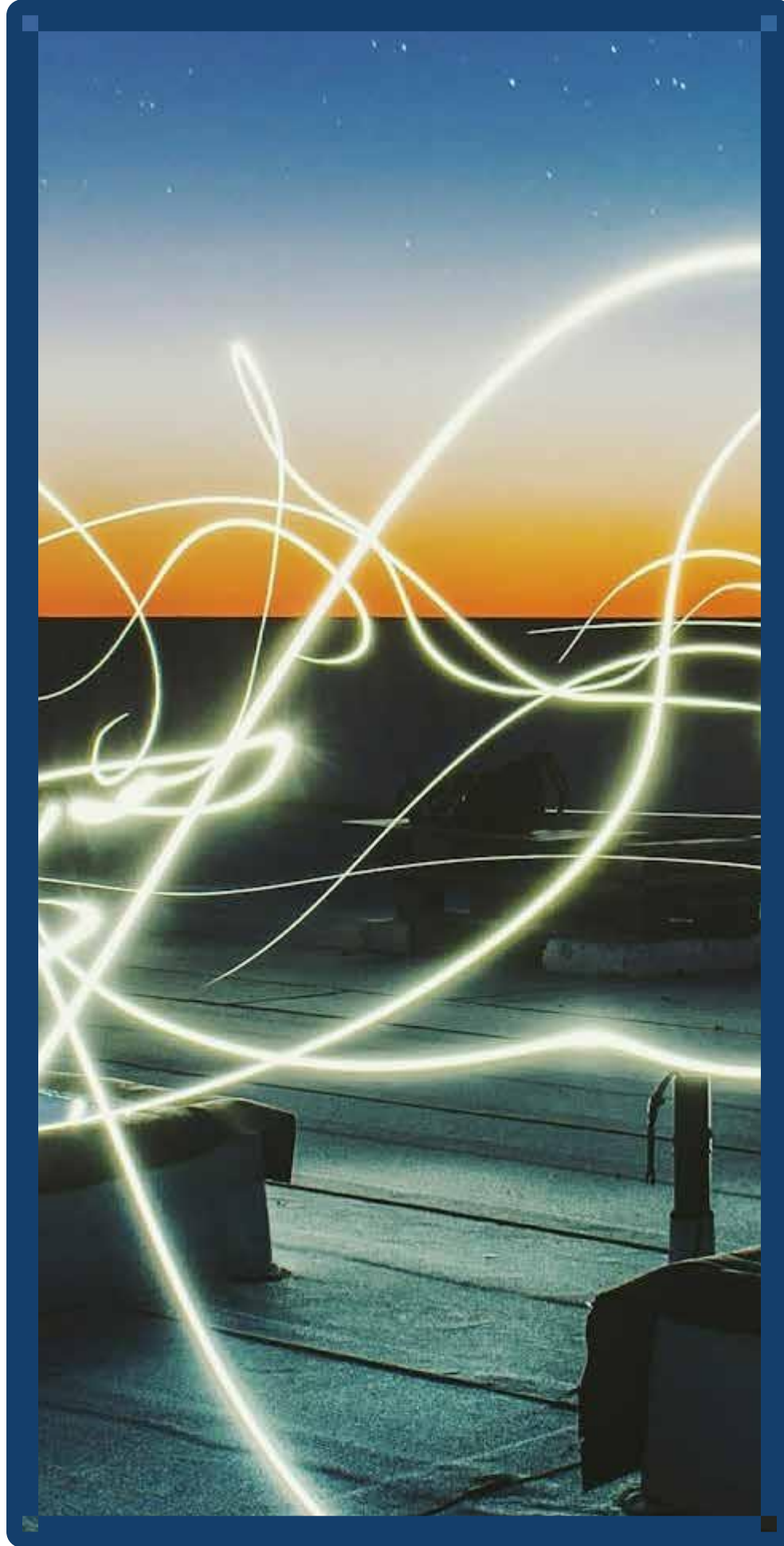


Overflow basins in the hulls against the risk of exceeding the standard potting filling level.



Quality

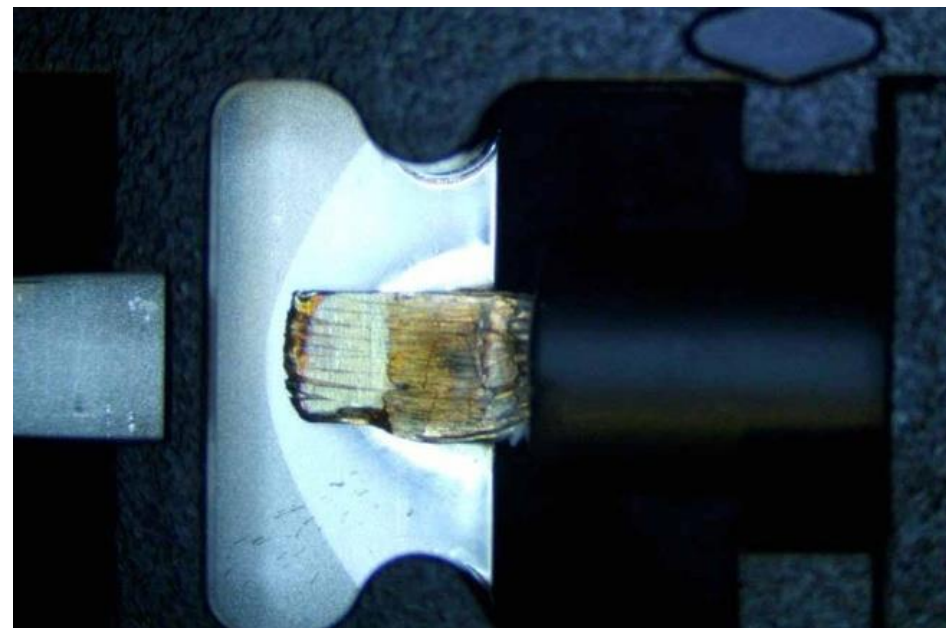
All raw materials used in our production are 100% controlled in our high-tech laboratory.





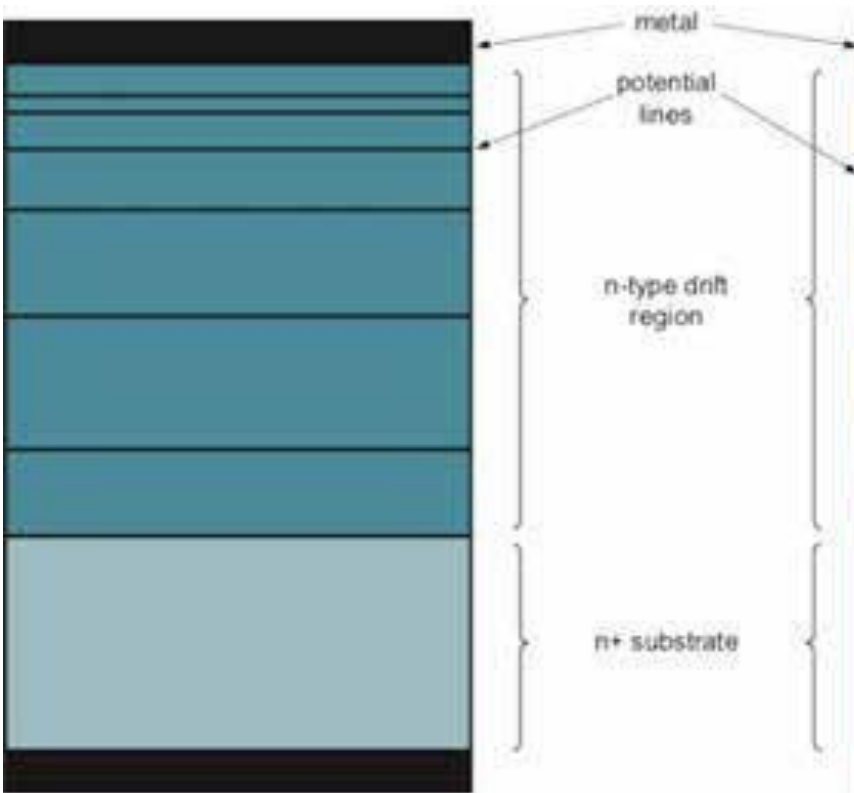
The fastening quality of the nailed terminal is checked both dimensionally and visually.

Crimping method is more reliable than tailstock and solder

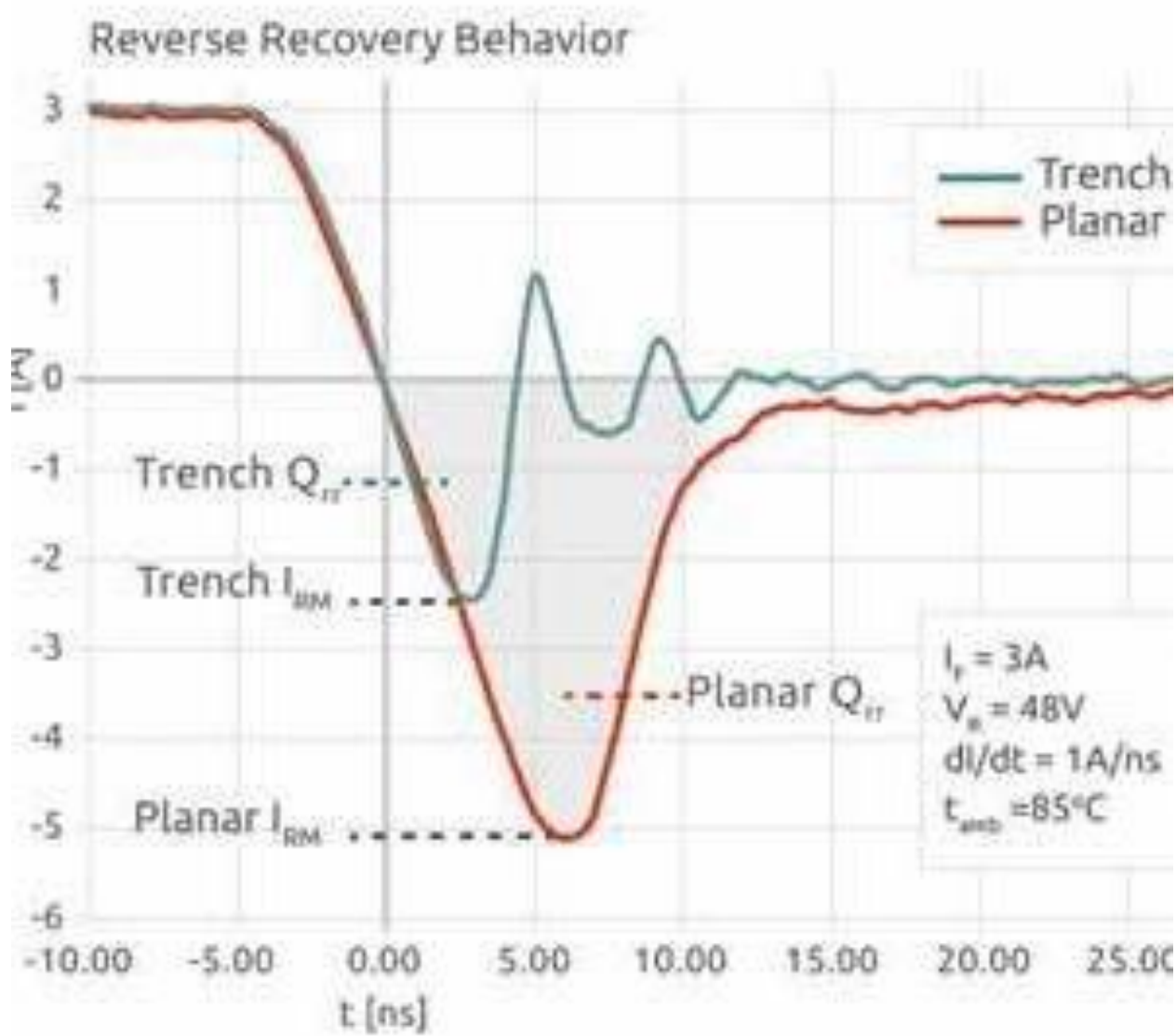
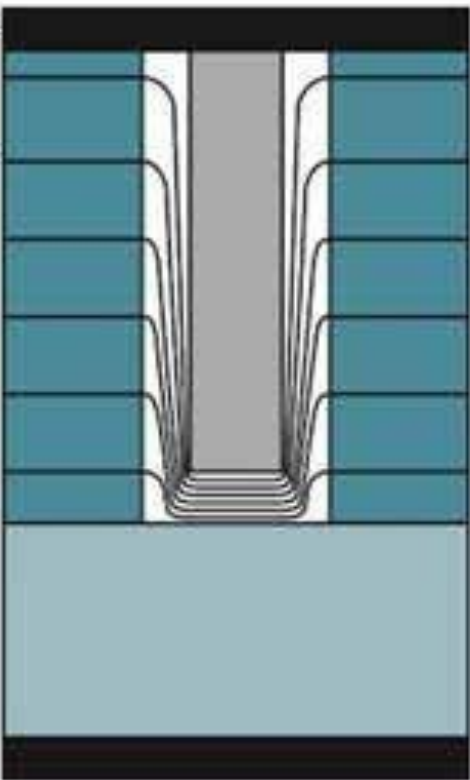


With the special developments made, long-lasting and 10% more efficient diodes by using double chip and trench technology in our diodes.

Planar Chip



Trench Chip



Same Rated Current Chip Technology Lost Power Calculation in Different Diode to Datasheet Data

25A PLANER DIODE

$V_f \text{ avg} = 500 \text{ mV}$
 $I_F = 25\text{A}$

$I_R \text{ avg} = 57,228 \mu\text{A}$
 $V_B \text{ avg} = 54,683 \text{ V}$

$P_{\text{transmission}} = V_F \cdot I_F$
 $P_{\text{transmission}} = 0,5 \cdot 25$
 $P_{\text{transmission}} = 12,5 \text{ Watt}$

$P_{\text{leak}} = V_B \cdot I_R$
 $P_{\text{leak}} = 54,683 \cdot (57,228 \cdot 10^{-6})$
 $P_{\text{leak}} = 0,018 \text{ Watt}$

$P_{\text{sum}} = P_{\text{leak}} + P_{\text{transmission}}$
 $P_{\text{sum}} = 12,5 + 0,018$
 $P_{\text{sum}} = 12,518 \text{ Watt}$

25A TRENCH DIODE

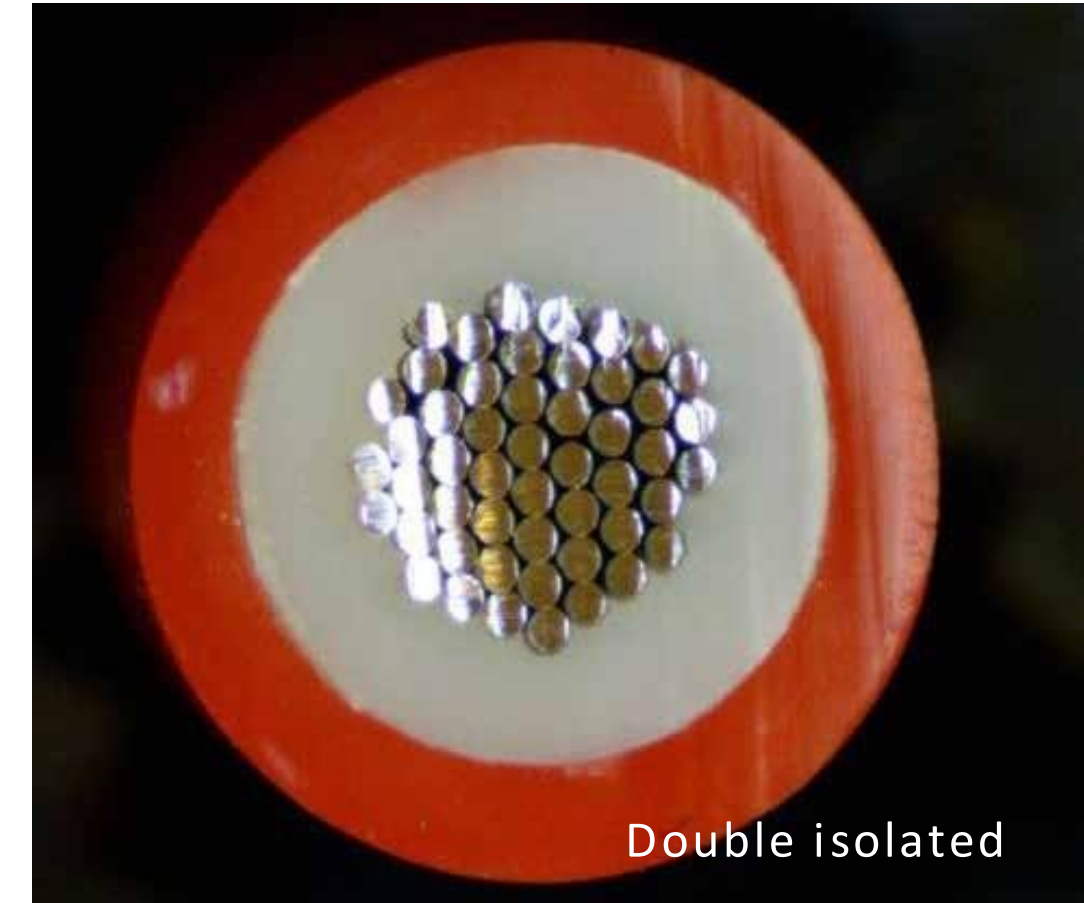
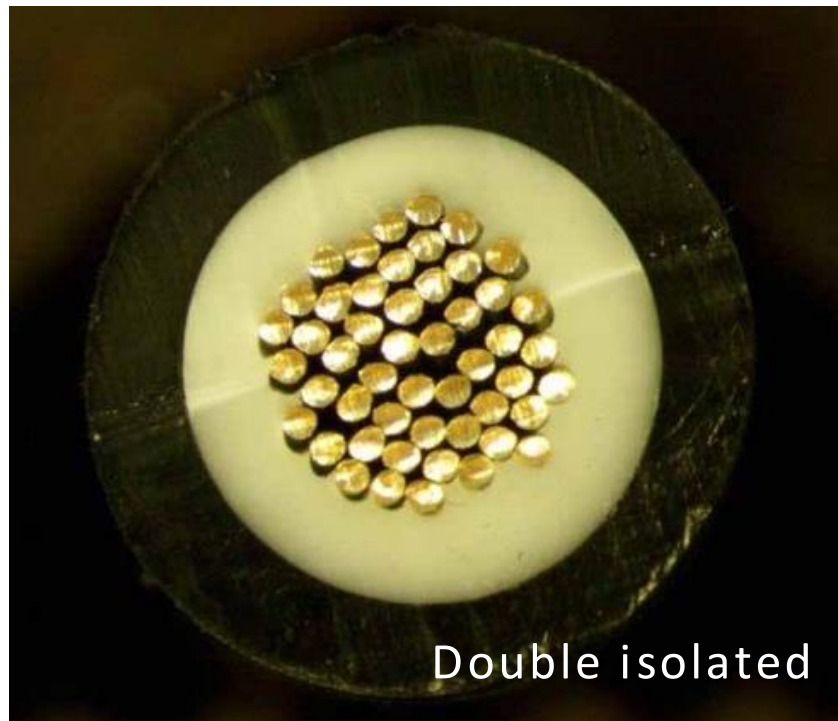
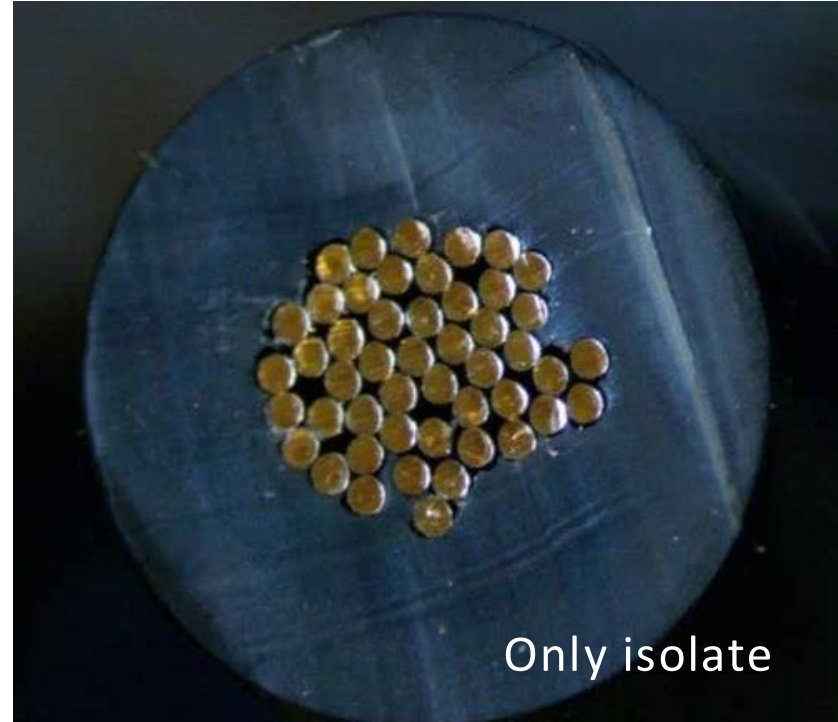
$V_f \text{ avg} = 459,9 \text{ mV}$
 $I_F = 25\text{A}$

$I_R \text{ avg} = 23,130 \mu\text{A}$
 $V_B \text{ avg} = 53,05 \text{ V}$

$P_{\text{transmission}} = V_F \cdot I_F$
 $P_{\text{transmission}} = 0,459 \cdot 25$
 $P_{\text{transmission}} = 11,475 \text{ Watt}$

$P_{\text{leak}} = V_B \cdot I_R$
 $P_{\text{leak}} = 53,05 \cdot (23,130 \cdot 10^{-6})$
 $P_{\text{leak}} = 0,00736 \text{ Watt}$

$P_{\text{sum}} = P_{\text{leak}} + P_{\text{transmission}}$
 $P_{\text{sum}} = 11,475 + 0,00736$
 $P_{\text{sum}} = 11,482 \text{ Watt}$



In solar cables
TS EN 50618 & IEC 62930
High strength with double insulation in accordance with standards

On Our JBB Line

In our **Cable Cutting, Terminal Fastening** process, which is the first station of our current process, we prevent possible errors by performing camera control and **Crimp Force Control**.



A u t o m a t i c S o r t i n g

Automatic sorting with error-proofing system.

In diode assembly; Direction control with image processing technology, height with laser, ultrasonic welding and body position control.

Image Processing Technology



4 GW

installed in the field on
Junction Box

Certification

TÜV – IEC 62790 – AS
9100 IATF 16949-UL

Our products have product
liability insurance coverage.



UL-US-26115569-0



IEC
62790

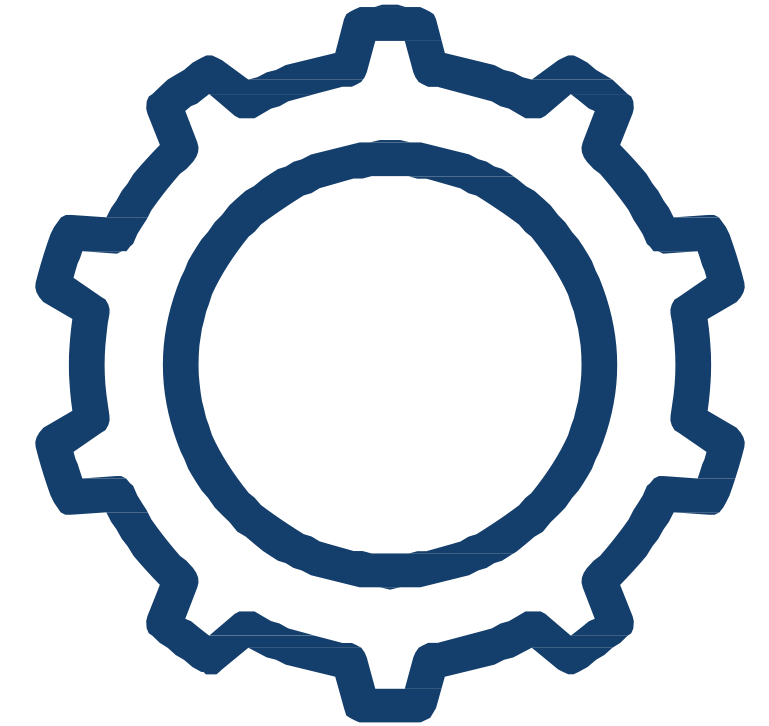
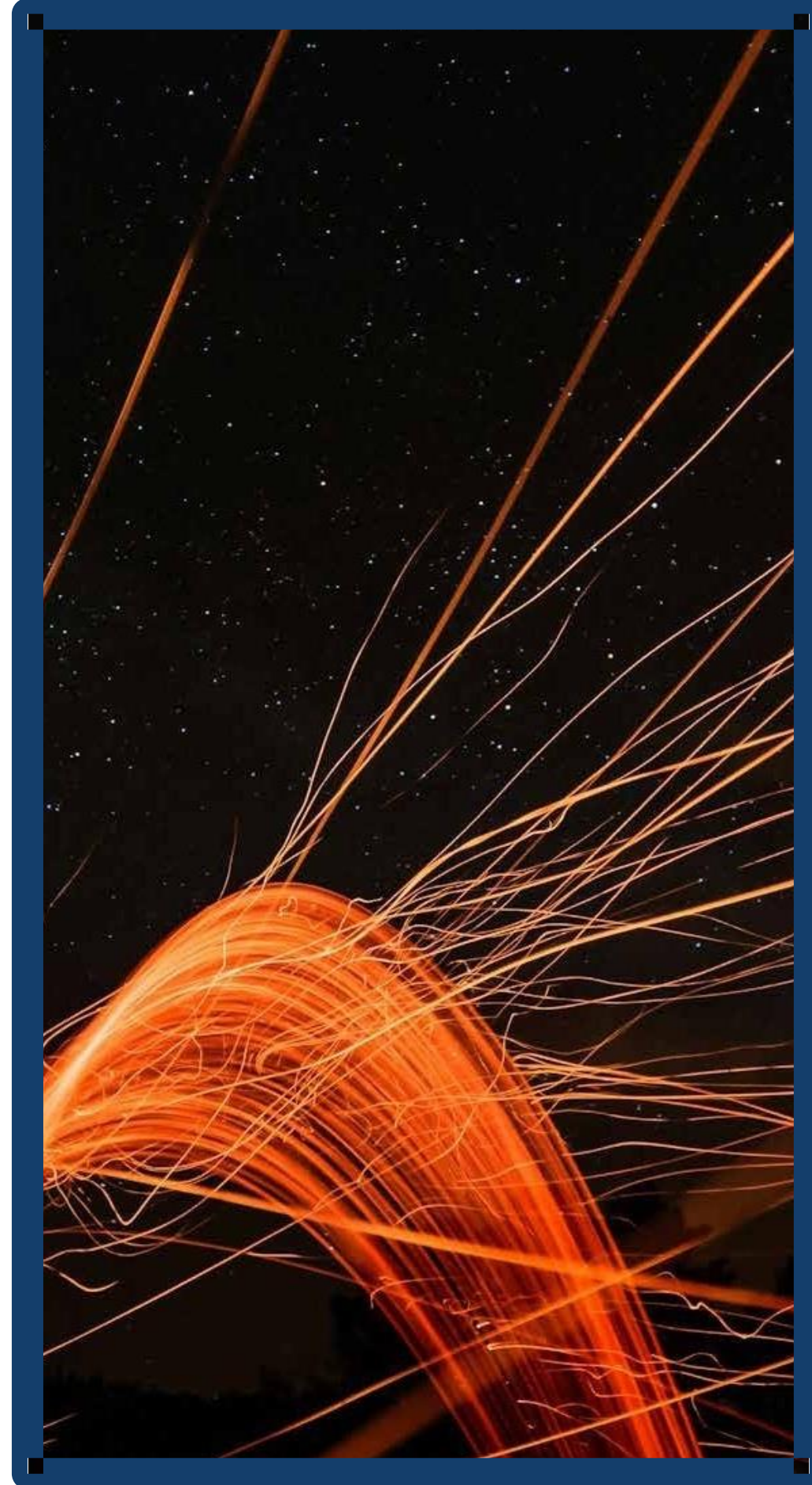


AS 9100



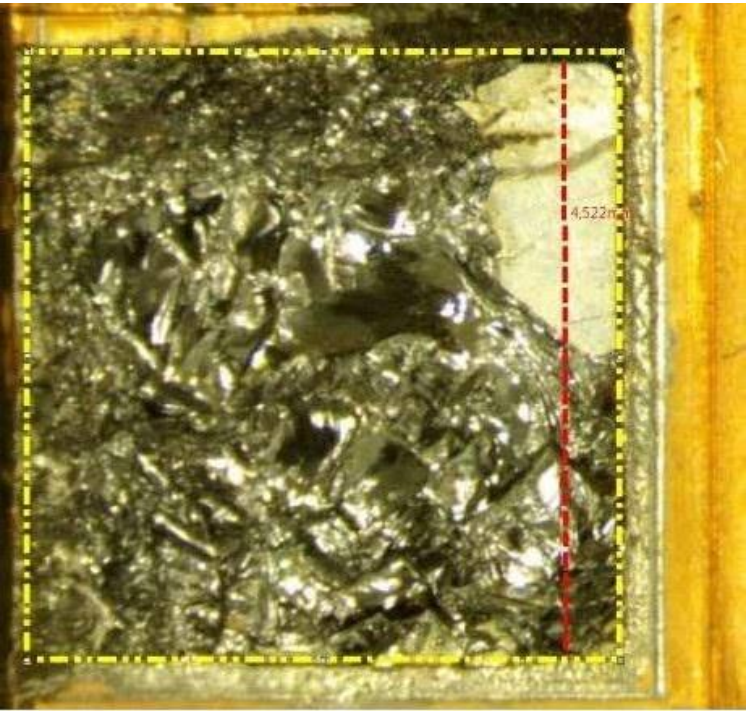
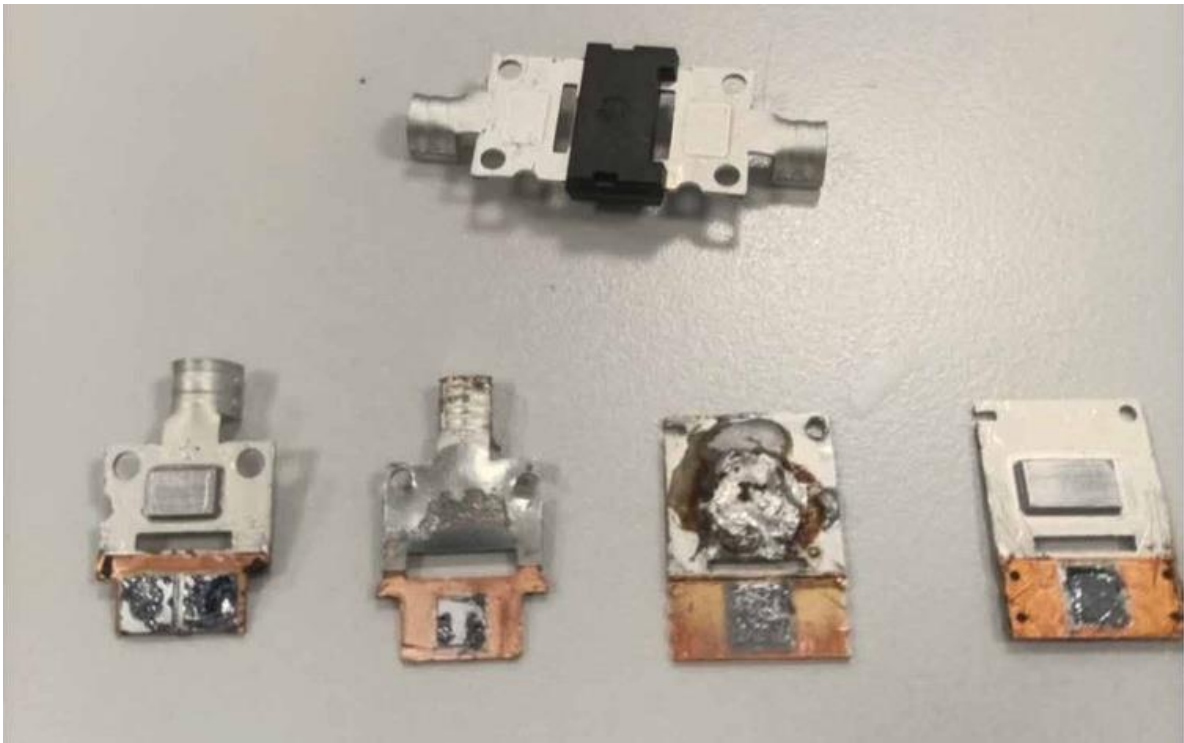
IATF 16949

Product Verification & Performance Tests



Verification

Diode Chip Size



If we calculate;

Under the microscope, the edge length of a chip was 4,522 mm. If we convert in miles; $=4,522/0,0254 =178.8=$ miles. When the chip sizes of competing products are measured with this method, the following table is formed.

Application Procedure

By removing the plastic injection on the diode, the images of the chip dimensions are measured under a microscope.
Diode Chip sizes are usually expressed in miles in the literature.
1 mil=0.0254 mm

Product	
JBB	180
Competitor 1	151
Competitor 2	141
Competitor 3	185

Comment Conclusion:

PV diodes are the basic building blocks of photovoltaic (PV) cells and are used to convert sunlight into electrical energy. The increase in chip size in the diode can often have a number of effects on efficiency and performance.

After all

Increasing chip size in PV diode can often provide benefits such as greater power generation and cost reduction, but this growth can also bring with it structural, mechanical, and thermal challenges. Therefore, a continuous process of balancing and improving PV technology is required.

Heat Current Transport Test

In the table below, the two highest temperatures are marked in red and the two lowest temperatures are marked in green to give an idea.



Thermal Camera Images

20A 10 min			25A 10 min			30A 10 min			Min	Max
+	ORTA	-	+	ORTA	-	+	ORTA	-	Değer	Değer
(C°)	(C°)	(C°)	(C°)	(C°)	(C°)	(C°)	(C°)	(C°)		
168.3	193.9	172	191.3	218.5	195.1	212.4	240.8	216	168.3	240.8
219	246	212	190	215	187	214	235.3	206.5	190	246
240.5	273.6	257.9	219.1	249.6	221.5	247.8	283	247.2	219.1	283
174.7	202.5	180	252	294	257	234.8	266	237.3	174.7	294

With Power Supply 20A - 25 A - 30 A

Post-Test Deformation Amounts



JBB



JBB



Competitor 1



Competitor 1



Competitor 2



Competitor 2

Interpretation and conclusion

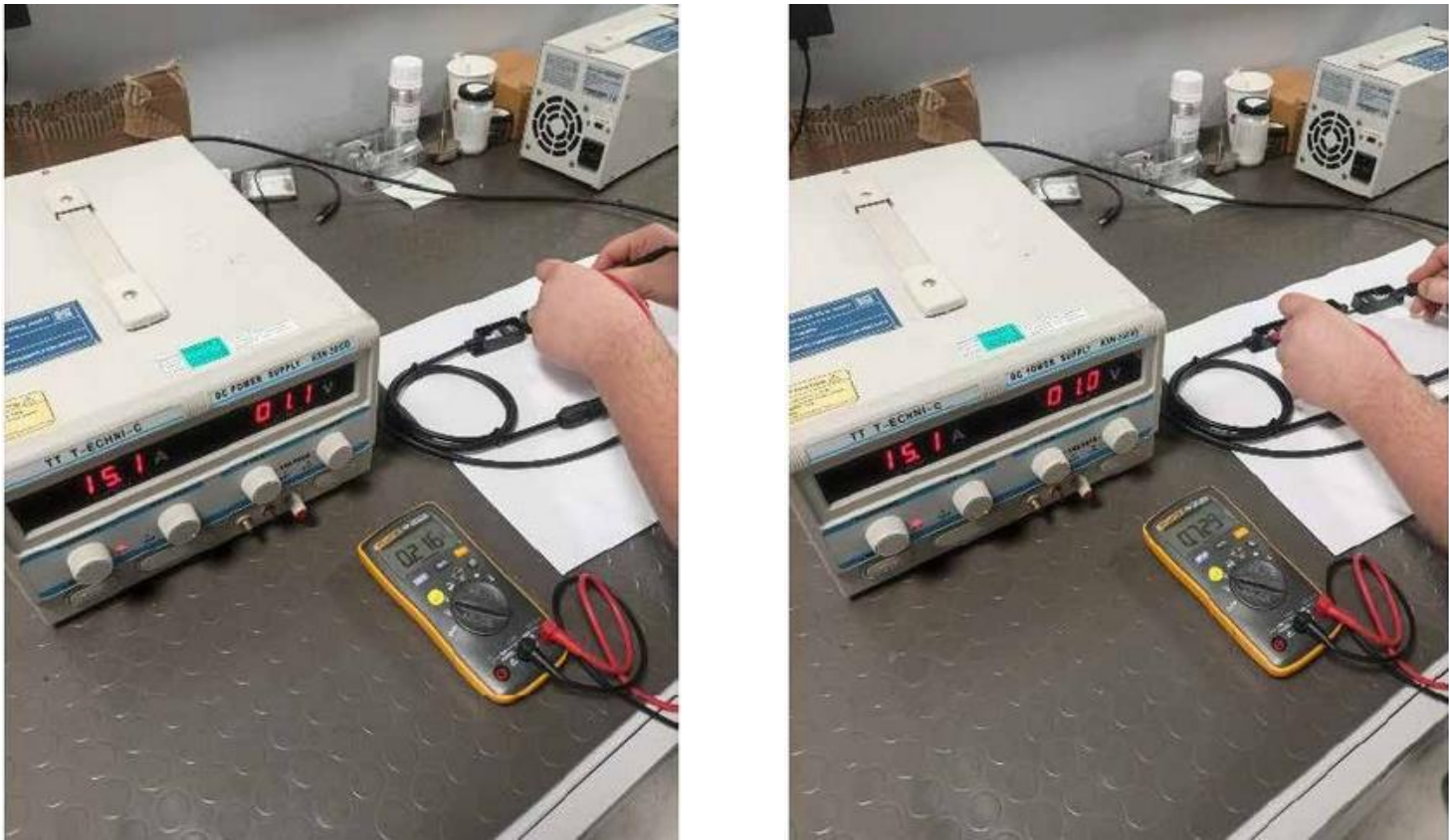
Heating in JBs has a negative effect on their current carrying capacity and efficiency. In addition, sudden temperature increases cause deterioration in diodes and directly affect panel and line efficiency.

It has been observed that melting in solders can reach dangerous levels. Although the ribbon connection is supported by potting here, there will always be **a risk of short circuit** in overheated JBs. This can pose serious security risks.

Summarize

In this test, the thermal equilibrium of the crops with the diode used in the JBB product It has been observed as the most suitable product.

Voltage Drop Test



It affects the power passing through the diode. If the VF increases, the power loss on the diode may also increase. This can cause the diode to heat up and reduce its efficiency.

The Vf value should be considered when evaluating the performance of a PV diode.

A lower Vf value is often associated with better performance and higher efficiency.

If the diode VF increases, this can lead to various consequences. The most important of these is;

Product	Diot	Voltage Measurement
JBB JBB	MEDIUM DIODE SET PRODUCT	0,214 0,721
COMPETITOR 1 COMPETITOR 1	MEDIUM DIODE SET PRODUCT	0,275 0,888
COMPETITOR 2 COMPETITOR 2	MEDIUM DIODE SET PRODUCT	0,245 0,811
COMPETITOR 3 COMPETITOR 3	MEDIUM DIODE SET PRODUCT	0,187 0,625

Measurements were made after 15A - 10 minutes of application with Power Supply.

CONTACT RESISTANCE AND HEAT OBSERVATION MEASUREMENTS / BENCHMARK TESTS OF SOLAR CONNECTORS

TEST DESCRIPTION;

To observe the resistance values of the connectors used, under load and under no load, to interpret the performance by measuring the heating under the same conditions with the help of a Thermal Camera.

Conditions;

Sample preparation with 100centimeter identical cables

Performing tests at room temperature of 25°C

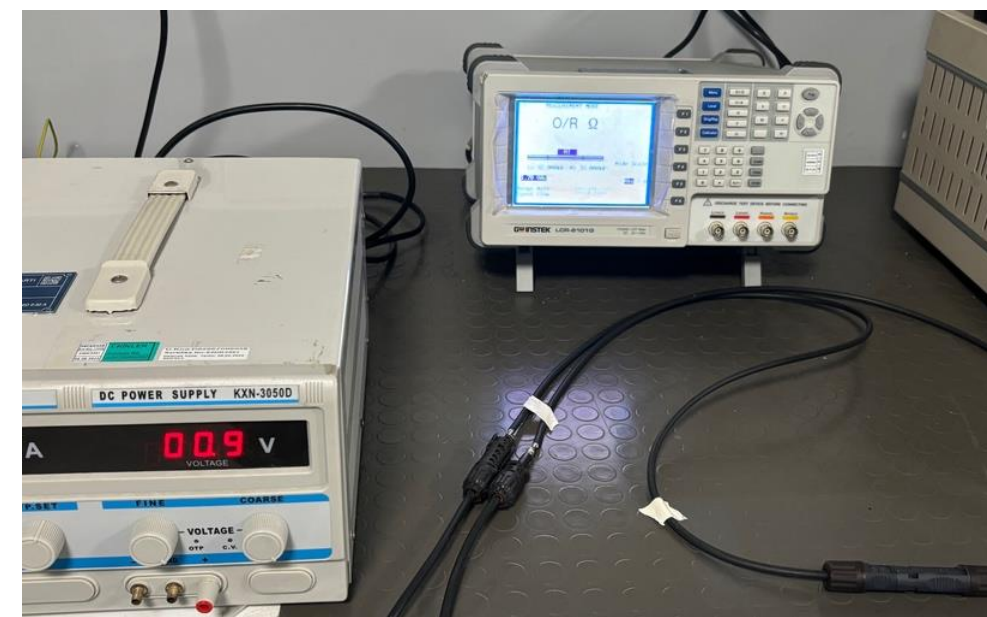
25A 30 minutes loading of products

1A 1 minute conductor resistance test under load

Performing no-load conductor resistance test

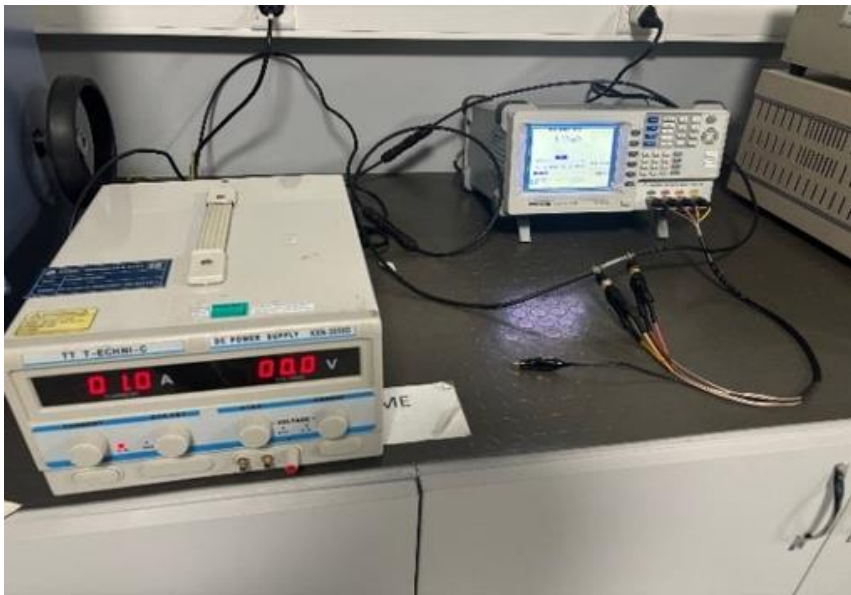
Competitor connectors and ZERUN connectors were used in the tests.

TEST APPLICATION SAMPLE VISUALS



TEST 1 (CONTACT RESISTANCE TEST)

The measurement results of the connectors tested under 1A load and without load are the values in the table below. Tests were performed simultaneously under load and without load. The test under load was applied as 1 A 60 sec.

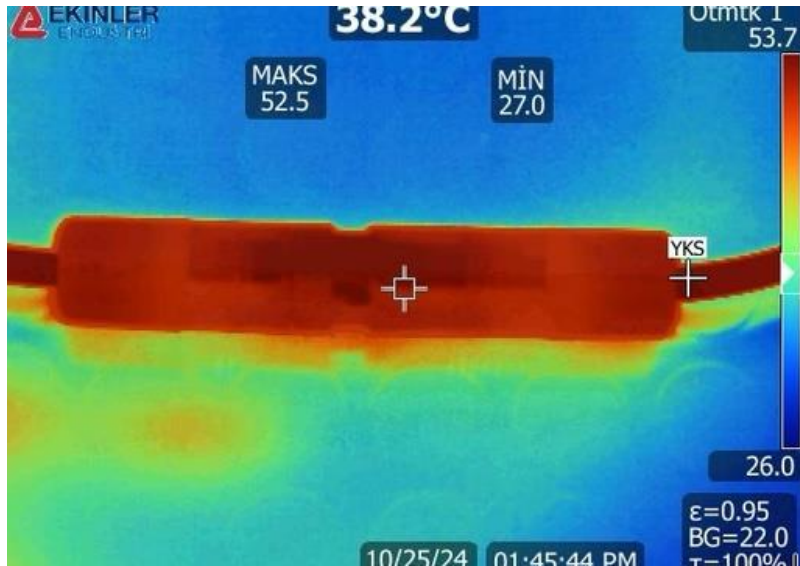


	1A INSTALLED	UNLOADED
COMPETITOR	5.77 mΩ	5.48 mΩ
ZERUN	4.85 mΩ	4.66 mΩ

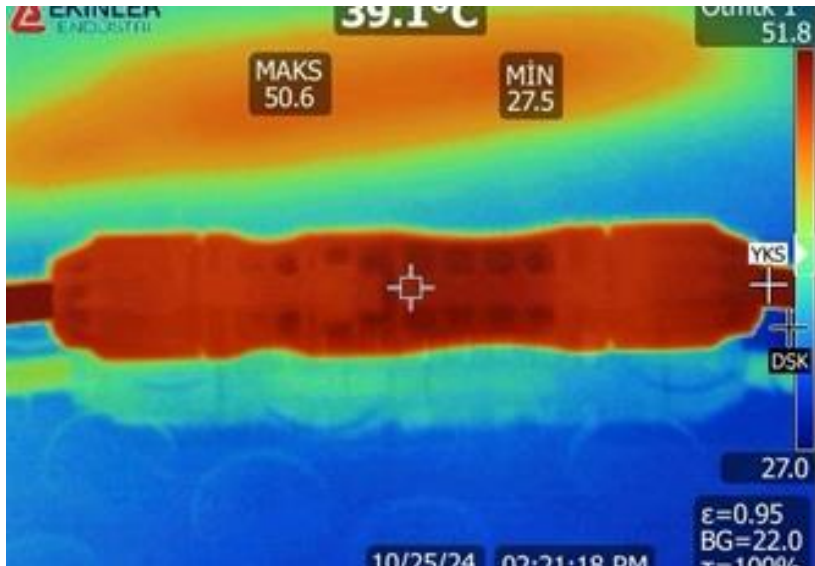
TEST 2 (HEAT OBSERVATION TEST)

25 Ampere current was passed through the test products for 30 minutes, and the heat dissipation of the connectors was observed during the applied time in this test. Their heating was recorded with a thermal camera.

ZERUN



COMPETITOR



CONNECTOR	25A/30 min Temperature Measurement Under Load
COMPETITOR	39.1 °C
ZERUN CONNECTOR	38.2 °C

INTERPRET AND CONCLUSION

In these tests, the ZERUN Model connector from Ekinler products showed slightly better performance (less heating) than the COMPETITOR connector in the HEAT OBSERVATION TEST (TEST 2). In addition, in the contact resistance test (TEST 1), it was observed that it had lower resistance values under load and when it was not under load.

As a result, contact resistance testing and heat observation testing are critical tools in evaluating the reliability and performance of PV systems. High resistance values indicate maintenance or repair requirements, while low resistance values indicate healthy connections.

IEC 62790:2020 Diode Performance Test (TJ)

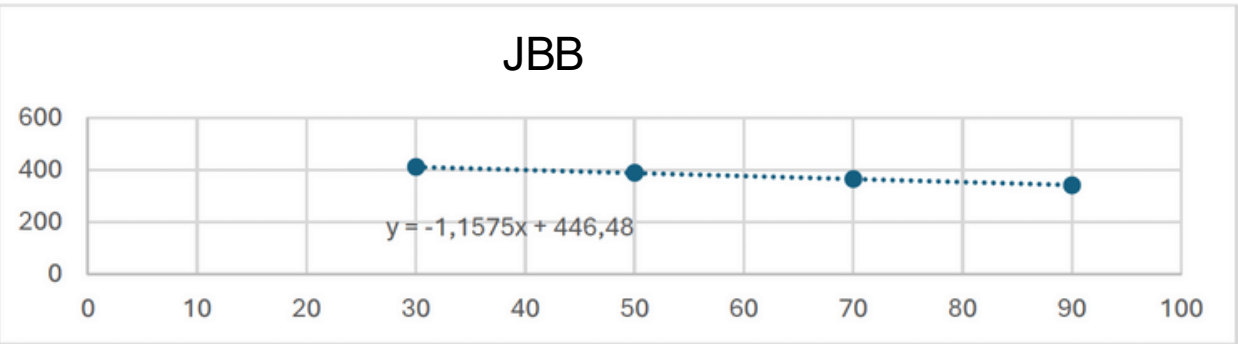
JB products are loaded with a furnace rated current of 25A current with a pulse of 1 ms and the instantaneous voltage (mV) is measured from the diode tester.

Then, the rated current is loaded at 25A for 1 hour at a temperature of 75°C and the voltage is measured with the help of a multimeter.

Then, with the help of excel and using the least squares method, these values are formulated into a trend line with mV values at 30-50-70-90° degrees.

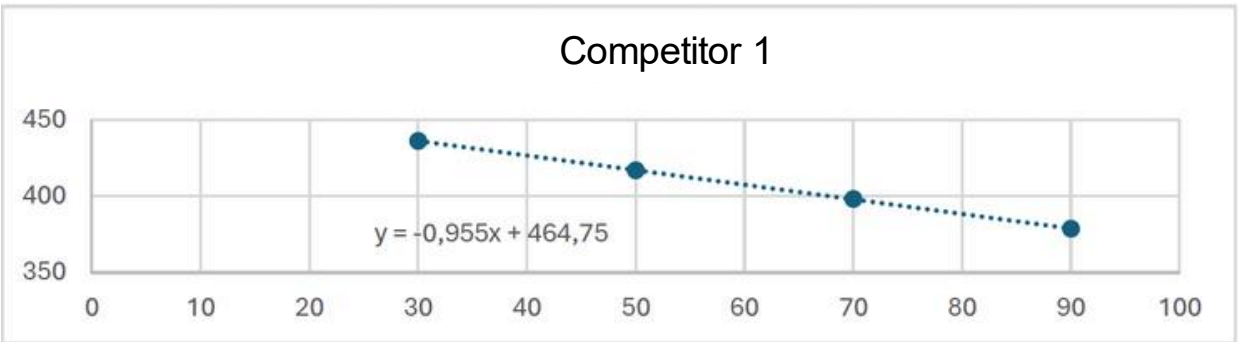
The Junction Temperature TJ value of the diodes is recorded by using the mV value at 75°C on the trend line after formulaization.

JBB						1 Saat
Tempareture	30	50	70	90		75° C
VF(mV) IF=25A	411,5	388,9	365,6	342,1		220



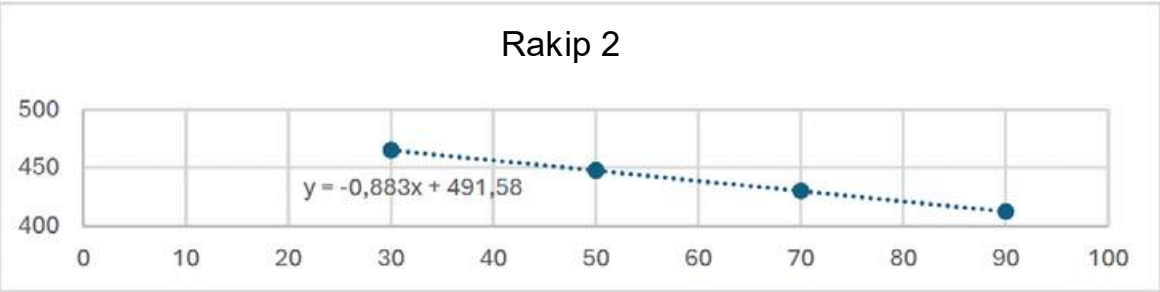
"y" is VF "x" is Tj	220	-1,1575	TJ	446,48
y = -1,1575x + 446,48	TJ	195,663067		

Competitor 1						1 Saat
Tempareture	30	50	70	90		75° C
VF(mV) IF=25A	436,1	416,9	398,1	378,7		245



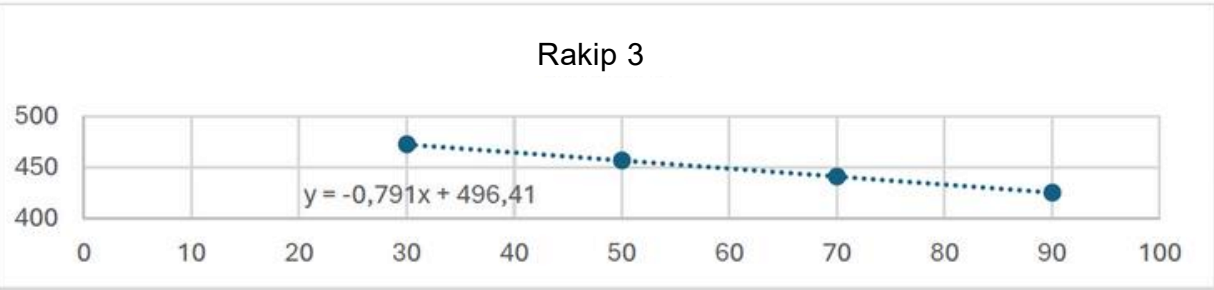
"y" is VF "x" is Tj	245	-0,955	TJ	464,75
y = -0,955x + 464,75	TJ	230,104712		

Rakip 2					1 Saat
Tempareture	30	50	70	90	75° C
VF(mV) IF=25A	465,1	447,4	429,8	412,1	241



"y" is VF	241	-0,883	TJ	491,58
"x" is Tj				
y = -0,883x + 491,58	TJ	283,7825595		

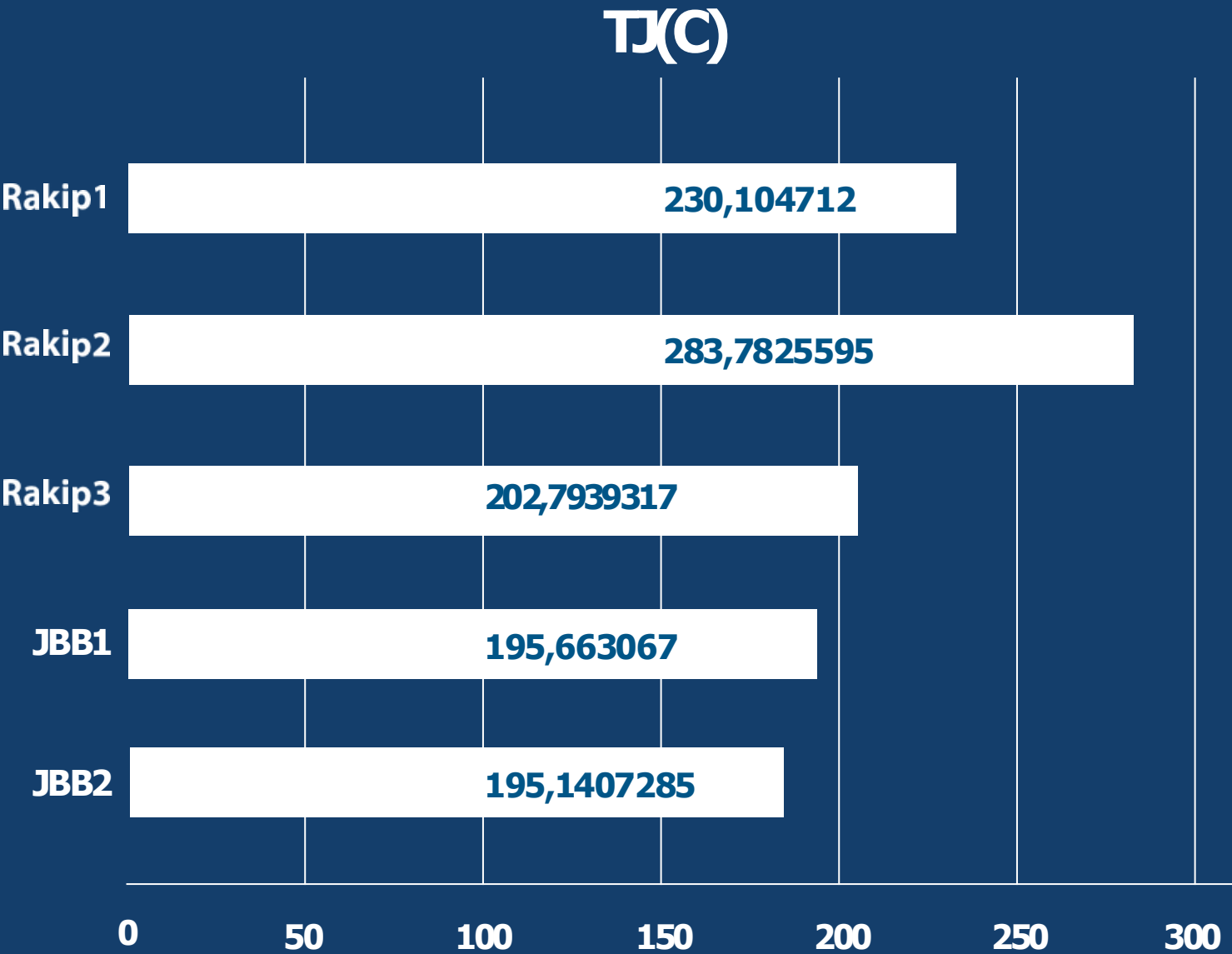
Rakip 3					1 Saat
Tempareture	30	50	70	90	75° C
VF(mV) IF=25A	472,7	456,8	441,1	425,2	336



"y" is VF	336	-0,791	TJ	496,41
"x" is Tj				
y = -0,791x + 496,41	TJ	202,7939317		

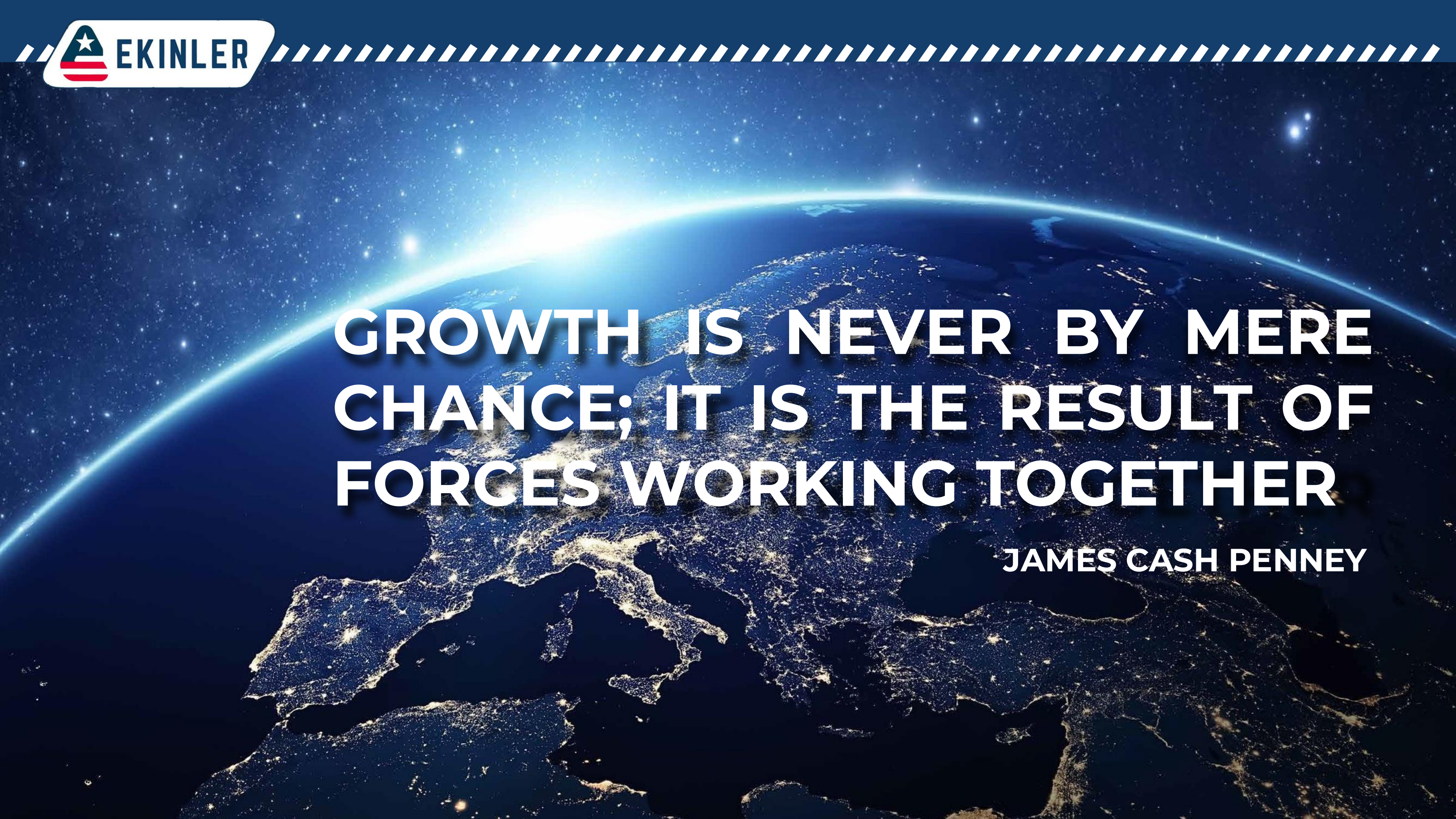
COMMENT AND CONCLUSION

According to the IEC 61215 2016 diode performance test, which is one of the most important acceptance criteria for Junction Boxes; After the calculation, the Diode Junction temperature (Tj) should not exceed the value shared in the manufacturer's technical specification.



In general, this value is published as +200 ° C, but it can also be specified as + 175 ° C in various manufacturers. The Tj values of all the products we tested are based on +200°C.

According to this important acceptance criterion, there are 2 products suitable for certification. (JBB 1 & JBB 2)



**GROWTH IS NEVER BY MERE
CHANCE; IT IS THE RESULT OF
FORCES WORKING TOGETHER**

JAMES CASH PENNEY