

TECH NOTE: Strain and Strain Rate Measurement on Printed Circuit Boards (PCBs)

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Intro

In the course of our daily lives, we have to place trust on electronic components integrated in cars, smartphones, airplanes, and countless other devices, according to their reliability. In many of these products printed circuit boards (PCBs) are integrated. The reliability of complex electronics and overall electrical systems is a result of experienced development and intensive testing.

The aim of this Tech Note is to give you an overview about mechanical PCB testing. The document describes how strain gauges are installed on PCBs and how to analyse test data in order to evaluate whether the PCB is reliably working within the specified mechanical constraints or whether it might get damaged during manufacturing process, transport or operation.

Keywords: strain gauge, printed circuit board, PCB testing, data acquisition, QuantumX, catman

Main Focus of this TUTORIAL

This Tech Note is focussing on the following topics:

- Theoretical background of PCB testing
- Strain gauge application on printed circuit boards
- Strain and strain rate measurement on PCBs in the context of durability testing
 - Set up of the measurement chain as well as operating some tests
 - Parameterizing inputs
 - Starting, stopping and storing data the DAQ job
 - Visualization and analysis



Theoretical Background

PCBs are exposed to mechanical and thermal impacts not only during their manufacturing process, but also during their transport and in action (for example: deformation, misuse, vibration, shock, thermal exposure).

During the manufacturing process of PCBs, the following failures and stresses may occur:

- Bending strain during the installation of connectors, power rails, cooling plates, contact pins, solder terminations, or battery holders
- Breakage during mounting of surface-mounted device (SMD), surface-mounted technology (SMT), and through-hole device (THD), through the hole (THT) and pin in hole (PIH) fitting
- Stress cracks and dislodging of solder points with ball grid arrays (BGA)
- Transient strain peaks during separation (determination of critical strains/shear strains during separation)
- Elevated mechanical stress (strain) that occurs due to press fitting, screw tightening, or encapsulation processes in housings
- Broken SMD capacitors due to high bending stress in other steps of the process
- Hard touchdown of the test probes during the ICT test

During transport and operation, the following impacts could lead to failure:

- Mechanical load (static)
- Vibration and shock (dynamic)
- Thermal effects resulting in cracks caused by thermal expansion (differing α values of housing, heat sink, printed circuit board, and electronic components)



Figure 1: Strain gauge rosettes installed on PCB

All these effects can lead to a complete failure of components. If a systematic failure of a PCB is detected too late, the fulminating costs would be massive. The costs would continue to increase, as long as the detection of the malfunction is delayed. The rule of 10 shows that the later a systematic failure of a new product is detected, the costs per defect unit multiply by a factor of 10.



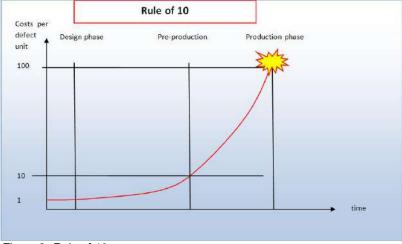


Figure 2: Rule of 10

Extended Requirement and international standards for PCB testing

Based on the fact that detecting systematic failures at an early stage of development is absolutely essential, OEM manufacturers have increasingly begun to request their suppliers to check the mechanical quality of PCBs.

The utilization of PCBs has increased in recent years due to the following reasons:

- Use of lead-free solder (RoHS conformity, EU guideline) that is more sensitive in relation to mechanical load and tends to crack earlier (flexure-induced damage)
- More compact construction elements such as ball grid arrays (BGA) instead of surface-mounted devices (SMD)
- Stiffer contacts that lead to higher mechanical tension

International associations such as IPC (Association Connecting Electronics Industries) and JEDEC (Joint Electron Device Engineering Council) – 9704 have been established, and these provide guidelines describing where and how and wherewith strain measurements on PCBs have to be performed.

Many companies have created their own test procedures to ensure that all manual handling steps are executed correctly during the assembly as well as developed test scenarios for PCB testing to cover all relevant cases.

How to measure strain on PCBs

Numerical simulation methods such as FEA are limited in their scope since they are based on mathematical model approaches. Therefore, physical tests on real PCBs are at least additionally required to test the real strain behavior of the board.

Other test methods such as CTs and X-rays are not sufficiently adequate to check the influence of the mechanical impact and are, on top of that, expensive methods to employ. Strain values are the only reliable calculations for measuring the mechanical deformation of PCBs.

Therefore, strain gauges are designated to measure the deformation of the PCBs to an extremely accurate degree. PCBs are usually small in dimension, and the challenge is to install strain gauges in the limited space available.

HBM offers over 2000 different strain gauges for special applications, alongside some specialized strain gauges for PCB strain measurement.

The RF91 three-grid miniature rosette, for example, is an excellent product to measure strain on miniature components. It is available in different variants. Three-grid rosettes are used for PCB strain measurement applications since the direction of principal strain is unknown.



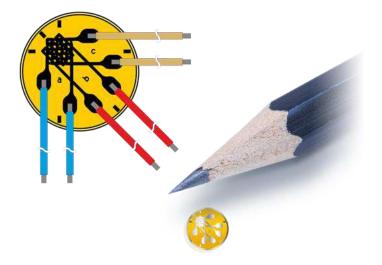
RF91 is available in two different versions:

- Prewired
- With integrated solder pads

It is only 5mm in diameter and can, therefore, be mounted easily on PCBs. Other strain gauges, such as the RY31-3/120 (6.9mm diameter), can also be used for PCB testing. More information about this product is available on the website. It can also be ordered via the HBM web shop.

Key facts about the HBM RF91 miniature rosette

- Only 5mm diameter for miniature applications
- 120 Ω resistance
- Deliverable ex stock
- Measurement of two-axis tension state when the principal stress direction is unknown
- Three-stacked measurement grids
- Temperature compensation for austenitic and ferritic steel as well as aluminum
- Prewired (0.5m) or with solder pads
- No soldering on strain gauge
- For two-, three-, and patented HBM four-wire configuration usable
- Different colors of paint-insulated cooper wire



Where to measure strain on PCBs

The tension status on PCBs is mostly unknown and quite mechanically complex. Strain situations result in the deformation of a plate. Plate deformation does not follow the classic models of beam deformation or torsion of a shaft, which are quite accurately described by linear electrostatics.

Furthermore, it needs to be considered that an assembled PCB contains a lot single components that are soldered or connected in different ways to the PCB. This means that a PCB is quite heterogeneous in its material properties.

It is neither useful nor possible with respect to cost and time to check every single section of a PCB according to the strain properties and behaviour.

Therefore, measurements on PCBs are set at areas where the risk of failure is estimated to be especially high, such as:

- Corners: Corners can be mechanically critical if they are fixed.
- Stiff regions of the board (e.g. the ones close to capacitors): Big elements lead to increased stiffness of PCB.
- Regions close to interconnect (solder-joint failures): Solder points are weak points in terms of yield strength.



How to install RF91 miniature rosette on PCBs (quick-step guide)

- In the first step, the PCB needs to be prepared for the installation of a foil strain gauge. Therefore, an even surface is required. Depending upon the location at which the foil strain gauge needs to be positioned, a disassembly of the PCB is required. By desoldering electronical elements and using a milling cutter, the surface can be prepared. The milling of the surface is required to remove the paint layer on the PCB. (Attention: Removing of components influences the stiffness of the PCB.)
- In the next step, the PCB surface needs to be cleaned. Cleaning before bonding strain gauges is an unavoidable requirement!
- Do not use aggressive solvents. Such solvents can cause tension in the PCB material.
- Use one drop of HBMs Z70 cold curing bond to wet the designated area for the strain gauge.
- Attach the RF91 rosette at the designated area.
- Use a Teflon paper to ensure that only strain gauge and PCB are bonded.
- Apply slight and homogeneous pressure on the rosette to bond it to the PCB for around one minute.
- Remove the Teflon paper afterwards as shown.

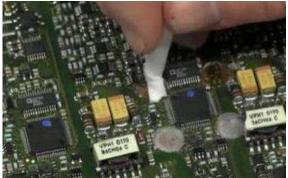


Figure 3: Cleaning of PCB before bonding



Figure 4: Application of bond on PCB surface



Figure 5: Separation of the Teflon foil after the bonding process



- Install strain relief on the measurement wire. It is absolutely essential to ensure that the strain gauge is uncoupled from the cable itself. Different options can be used to set a strain relief.
 - 1. Strain relief directly on the measurement cable
 - 2. Strain relief through solder pads
 - Finally, check the quality of the strain gauge installation (resistance and isolation).



Figure 6: Strain relief directly on measurement cable

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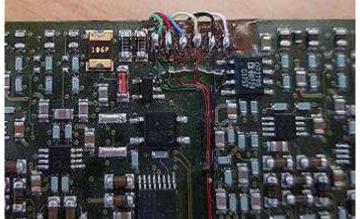


Figure 7: Strain relief on PCB through solder



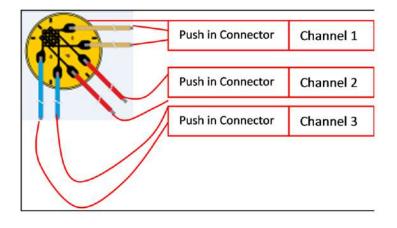
How to connect RF91 miniature rosette to QuantumX MX1615B

- In this setup, a QuantumX MX1615B is an off-the shelf DAQ system of HBM, specialized for strain gauges applications
- The push-in connector can be easily used to quickly connect wires to the module.



Figure 8: Push-in connector

• The RF91 is a three-stacked grid rosette. For each grid, one quarter bridge channel is required. In total, three channels are required to perform the measurement calculations with RF91.





How to set up a strain (rate) measurement in catman®AP

As a reminder,

• Strain describes the relative change in shape or size of material due to externally-applied forces.

$$\varepsilon = \frac{\Delta I}{I}$$

• *Strain rate* describes the change in strain of a material with respect to time.

With the HBM DAQ software catman AP, it is easy to set up a PCB board strain measurement. A quick and easy visualization of data is one of the strengths of catman. Data recording can be performed differently using trigger or special time points. The latest versions of catman[®] support strain rate measurement (the strain is derived from the time). The following steps show how to set up a strain rate measurement in catman[®]:

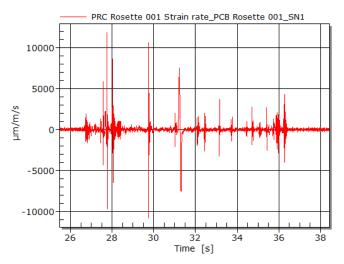


Figure 9: Strain rate measurement

The three measurement grids of the RF91 rosette allow the calculation of maximum and minimum principal strain (rates) as well as the corresponding angles.

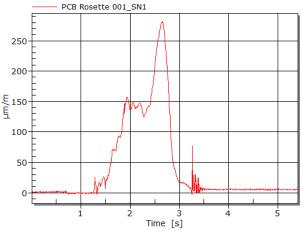


Figure 10: Maximum principal stress

• Open the catman[®] software and check the relevant channel of the strain gauge. Green lights indicate that the channel is detected and is ready for measurement. In this example, the three grids of the rosette are connected with channels 1, 2 and 3.

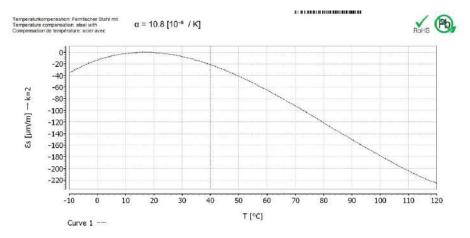
• Use the sensor database to assign the channels to the sensor application. In this case, drag and drop the 3-wire- 120Ω strain gauge n to each of the three active strain channels.

Star		Rename Sample *	Active Displa	P Default	Configur ates/filter	TEDS	Sensor	Adap Edit		Execute Zero balance	6	
onfigu	ne DA	Q channels Device	s: 1 Hardwa	re channels: 16	Computa	tion chann	els: 10	[Display	filter act	ive] [Live u	spda	
			Channel nam	e		Readin	g		Sampl	e rate/Filter		
1 4	0	MX1615B										
5	_	PCB Test Rosette gr	id_A			6989,9 µm	m	► 300	Hz/BE	50 Hz (Auto)		
6	1	PCB Test Rosette gr	id_B			6583,7 µm	/m	► 300	Hz/BE	50 Hz (Auto)		
7		PCB Test Rosette gr	id_C			7778,7 µm	/m	PF 300	Hz/BE	50 Hz (Auto)		
8	1	MX1615 CS_9029_0	XH 4			20,6 °C		►► 300	Hz/BE	50 Hz (Auto)		

- Cha	niel name	Reading	Sample rate/Pitter	SIO	type	Type expected	Senser/Function	Sensorda	abase.sdb			
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1 NX1615CS_9	29_CH 5 😐 N	lo signal	>> 300 PL (BE 5) Hz (Auto)	5	MX16158	MX1615B	Resistance thermometer F	F				
MK1615C8_9	29_CH 6 🔛 N	lo signal	++ 300 HE / BC 60 HE (Auto)	6	M0(1615B	M0(16150	CC Voltage					
1 🗮 NX1615 CS_90	29_CH7 💮 N	lo signal	>> 300 HE / BE 50 PK (Auto)	7	MX1615B	MU.1615B	DC Voltage					
2 🕂 MX1615 C8_9	29_CH 6 🕒 N	lo signal	++ 300 Hz / BE 59 Hz (Ada)	8	MX1015B	MX1615B	DC Voltage					
3 TH NX1615CS_9	29_CH 9 💮 N	lo signal	>> 300 Hz / BE 59 Hz (Auto)	9	MX1615B	M0(1615B	DC Voltage					
4 T NX1615 CS_9	29_CH 10 N	lo signal	+ 300 HE/ BE 59 HE (Auto)	10	MX1616D	N0.1015D	CC Voltage					
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7 🗮 NX1615CS_9	29_CH 13	lo signal	>> 300 Hz / BE 50 Hz (Auto)	13	MX1615B	MX1615B	DC Voltage					
8 🗮 NX1015C3_9	29_CH 14 📄 N	io signal	>> 300 Hc / BE 59 Hz (Auto)	14	MILLO1SE	Mitinise	ial no Voltage					
9 🗮 NX1615CS_9	29_CH 15 💮 N	lo signal	>> 300 Hz / BE 50 Hz (Auto)	15	-	10	voltage					
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B PCB Rosette 0	01_SN1						45*90* rosette Principal strai	1 No. 6000	_gauge_r			
9 PCB Rosette 0	01_AG						45"/00" rosette Angle a: PCB		_gauge_n			
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Now, the sensor specifications need to be set. Set correct parameters by using the k-factor displayed on the datasheet of each HBM strain gauge package. Enter the excitation voltage, bridge factor and measurement range. Ensure that you look at the temperature compensation polynomial in order to correctly consider the temperature fluctuation properties of different materials.

Set the sample rate (classic or decimal) and filters correctly before beginning your measurement.



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Figure 11: Extract from HBM data sheet



 Click on 'Create new sensor' and activate 'Update in sensor data base' to save your parameters in the database.

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• Select all channels and zero the strain channels of the rosette.

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- DAQ channels Video DAQjobs Channel check Visualization Dataviewer Sensor database Rename Ħ > Slow - (\mathbf{E}) 101 ×E 3 Sample * ▶ Default TEDS Sensor 👪 mV/V 🝞 Edit Strive update * Active Display Start Configure Execute >>> Fast Sensor Measurement Channel Sample rates/filter Zero balance Configure DAQ channels Devices: 1 Hardware channels: 16 Computation channels: 10 [Display filter active] [Live upda Reading -Channel name Sample rate/Filter 1 a mx1615B 👯 PCB Test Rosette grid_A 😑 0,3 µm/m > 300 Hz / BE 50 Hz (Auto) 5 PCB Test Rosette grid_B \varTheta 0,3 µm/m >> 300 Hz / BE 50 Hz (Auto) 6 Rosette grid_C -0,6 µm/m 300 Hz / BE 50 Hz (Auto) 7 ++ MX1615 CS_9029_CH 4 ▶ 300 Hz / BE 50 Hz (Auto) ≥ 20,6 °C 8 9 MX1615 CS_9029_CH 5 📄 No signal >> 300 Hz / BE 50 Hz (Auto) 1 MX1615 CS_9029_CH 6 >> 300 Hz / BE 50 Hz (Auto) 10 😑 No signal
- Zeroed strain channels appear.



Now we have to set up the rosette calculation channel. A new channel needs to be created, and catman[®]
makes it easy for the user to create different setups for rosette calculations.

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- Add all three channels in a, b, c and define the material properties and the transverse sensitivity of the gauges. Choose the right rosette type (0/45 or 60/120 for the three grid rosettes).
- Select the relevant strains (principal strain, shear strain).

Create com	putation Close	Help on computation channels	i
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ame PCB Rosette	001]	From strain channels
Strain channels			Create computation channels
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PCB Test Ro	sette grid_B		Principal nominal stress 1 Principal nominal stress 2
PCB Test Ro	sette grid_C		Shear stress Reference stress (v. Mises)
Automatic	ally complete (get b and c continuing	from a)	Stress X
Type of rosette	Material properties	Transversal sensitivity in %	✓ Principal strain 1 ✓ Principal strain 2
9 45°/90°	200000 Young's modulus	-0,1 Grid a	Strain X
0 60°/120*	N/mm²	-0,1 Grid b	🗆 Strain Y
🖯 90° 2-axis	0.3 Poisson's ratio	-0,1 Grid c	Shear strain

• Click on 'Create calculation'. Now, the calculated channels appear in the channel list.

21	Computation channels	
22	🖪 Peak counter principal stress_MAX 🛛 😔 0,00000 µm/m	Peak-Valley (PCB TestRoset 0.00000 µr
23	🔁 Peak counter principal stress_MIN 🛛 😔 0,00000 µm/m	Peak-Valley (PCB TestRoset 0,00000 µm
24	A Peak counter principal stress_COUI 👄 0,00000	Peak-Valley (PCB Test Roset 0.00000
25	🜈 PCB Stress SS1 🔥 NA.	Rainflow From-Te (PCB Test N.A.
26	PCB Rosette 001_SNA	45°/90° rosette Angle of shear 0,00000 µm
27	PCB Rosette 001_SN2	45*/90* rosette Principal strai 0,00000 µm
28	PCB Rosette 001_SN1	45*/90* rosette Principal strai 0.00000 µn
29	PCB Rosette 001_AG	45"/90" rosette Angle a: PCB 0.00000 *



• Set a name and click on 'Apply changes'

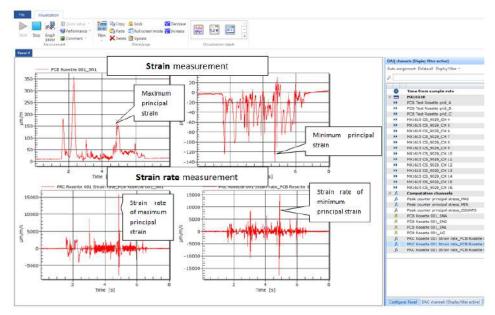
Edit computation: PCB Rosette 001_SN1

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			a 💀 🐖
Rosettes	Temperat	ure compensation	Strain rate
ne	Principal st	train (rate) PCB Rose	te 001
train channels		CB Rosette 001_SN1	

• The strain rate channels will appear in the 'computation channel' list at the end.

	- Channel name	Reading	Sample rate/Filter	Siot	Type	Type expected	Sessor/Function	Zero value	Limit val
1	dMX1015B								
5	PCB Test Rosette grid A	👄 -0.01356 µm/m	> 300 Hz / BE 50 Hz (Auto)	1	MX1615B	MX16158	SG guarter bridge 120 Ohm, 3-wire circuit	7156.7 um/m	
6.	PCB Test Rosate grid_B	a .0,5245 µm/m	1 300 Hz / BE 50 Hz (Auto)	2	MX1615B	MX1615B	SC guarter bridge 120 Ohm. 3 wire dirtuit	6594.7 µm/m	
7	PCB Test Rosette grid C	👄 -0.2215 µm/m	> 300 Hz / BE 50 Hz (Auto)	3	MX1615B	MX1615B	SG quarter bridge 120 Ohm, 3-wire circuit	7778.0 µm/m	
	mx1615 CS_9029_CH4	6 20,80 °C	1 300 Hz / BE 50 Hz (Auto)	4	MX1615B	MX16158	Resistance thermometer Pt100	20.00 °C	
9	MX1615 CS 9029 CH5	No signal	19 300 Hz / BE 50 Hz (Auto)	5	MX1615B	MX1615B	Resistance thermometer P1100	17,00 °C	
10	T MX1615 CS 9029 CH6	No signal	1 300 Hz / BE 50 Hz (Auto)	6	MX1615B	MX16158	x DC voltage	0.00000 V	
11	T MX1615 CS 9029 CH7	No signal	300 Hz / BE 50 Hz (Auto)	7	MX1615B	MX1615B	DC voltage	0.00000 V	
12	T MX1615 CS 9029_CH8	A No signal	1 300 Hz / BE 50 Hz (Auto)	8	MX1615B	MX1615B	DC Voltage	-0,09167 V	
13	T MX1615 CS_9029_CH9	No signal	➡ 300 Hz / BE 50 Hz (Auto)	9	MX1615B	MX16158	A DC Voltage	0.00000 V	
14	T MX1615 CS 9029 CH 10	R No signal	>> 300 Hz / BE 50 Hz (Auto)	10	MX1615B	MX1615B	DC voltage	0.00000 V	
15	T MX1615 CS_9029_CH 11	No signal	1 300 Hz / BE 50 Hz (Auto)	11	MX1615B	MX1615B	DC voltage	0.00000 V	
16	1 MX1615 CS_9029_CH 12	No signal	1 300 Hz / BE 50 Hz (Auto)	12	MX1615B	MX16158	AL DC Voltage	293,89 V	
17	1 MX1615 CS_9029_CH 13	No signal	300 Hz / BE 50 Hz (Auto)	13	MX1615B	MX1615B	DC Voltage	566.33 V	
18	14 MX1615 CS_9029_CH 14	No signal	1 300 Hz / BE 50 Hz (Auto)	14	MX1615B	MX1615B	IDC Voltage	0,00000 V	
19	T MX1615 CS_9029_CH 15	No signal	# 300 Hz / BE 50 Hz (Auto)	15	MX1615B	MX16158	DC voltage	0.00000 V	
20	10 MX1615 CS_9029_CH 16	😔 No signal	1 300 Hz / BE 50 Hz (Auto)	16	MX1615B	MX1615B	S DC voltage	0,00000 V	
21	Computation channels								
22	A Peak counter principal stress_MAX	OK OK					Peak-Valley (PCB Test Rosette crid_A) Peak	mmu 00000,0	
23	Peak counter principal stress_WIN	OK OK					Peak-Valley (PCB Test Rosette grid_A) Valle	0,00000 µmim	
24	Peak counter principal stress_COUNTS	e ok					Peak-Valley (PCB Test Rosette grid_A) Crok-	0,00000	
25	PCB Rosette 001_SNA	e ok					45"/90" rosette Angle of shear a: PCB Test R	0.00000 µm/m	
26	PCB Rosette 001_SN2	OK OK					45*/90* rosette Principal strain 2 a. PCB Tes	mmu 00000,0	
27	PCB Rosette 001_SN1	e ok					45*/90* rosette Principal strain 1 a. PCB Tes	0,00000 µm/m	
20	PCB Roselle 001_AG	e ox		_			40'190' rosette Angle a. PCD Test Rosette gr	0.00000	
29	M PRC Rosette (01 Strain rate_PCB Rosette 001_SNA	e ok					Rate of change of PCB Rosette 001_SNA	m/mg 00000,0	
30	A PRC Rosette 101 Strain rate_PCB Rosette 001_SN2	G OK					Rate of change of PCB Rosette 001_SN2	0,00000 µmm	
31	N PRC Rosette 601 Strain rate_PC8 Rosette 001_SN1	OK OK					Rate of change of PCB Rosette 001_SN1	9,00000 gimm	

• Go to 'Visualization' and configure your own GUI





Data analysis in catman®

The aim of the analysis is to check if the measured data meets the acceptable criteria for the PCB strain. The following diagram illustrates the boundary lines as a function of the strain rate and the board thickness according to IPC / JEDEC-9704A (2012).

The idea is that the maximum principal strain (Y-axis) should not exceed a certain value. With increased PCB thickness higher principal strains are acceptable. Additionally, another criterion needs to be considered – the strain rate. This means that the lifespan of a PCB is impacted not only by the pure value of the maximum principal strain but also by the speed of changing the strain (impulse). Fast changes in material usually result in earlier micro cracks and material damage.

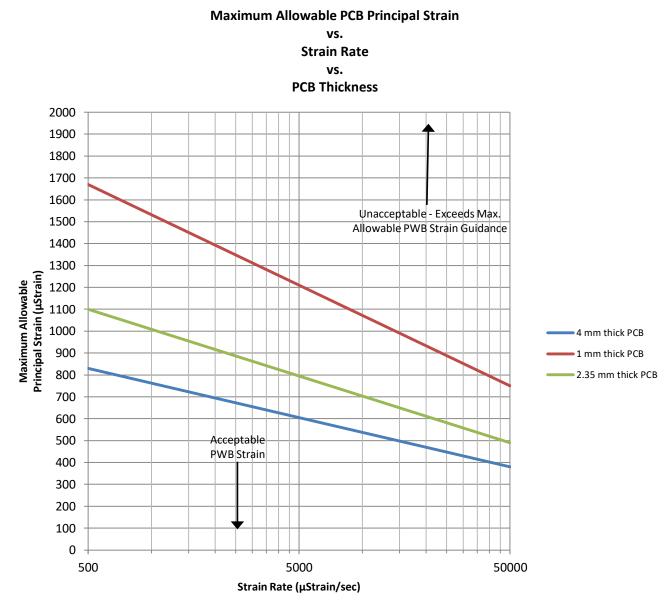


Figure 12: Maximum Allowable PCB Principal Strain based on IPC/JEDEC-9704



• To analyze the test data, open a new 'Analyze' Project in catman[®].

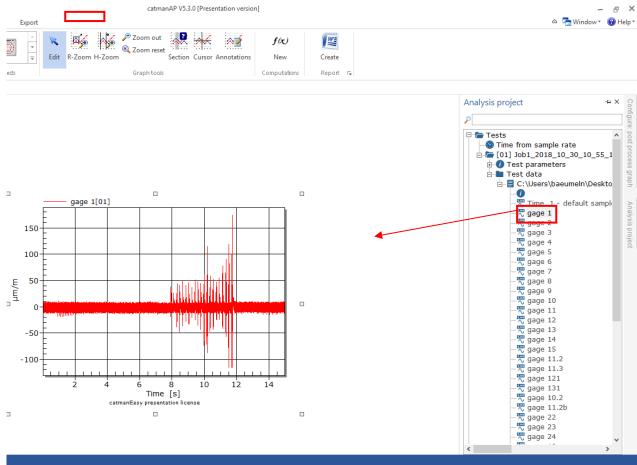
n 5.3		×
U)	🔎 catman [®] AP	
	Resume my last session Continue working with data, computations and visualizations last in use	
Continue		
	Start a new analysis project Onen existing test files and create computations, diagrams, reports and	
New	video playback	
	Load an existing analysis project	
Open		
	Continue New	Image: Weight of the system Catman [®] AP Image: Weight of the system Resume my last session Image: Weight of the system Continue working with data, computations and visualizations last in use Image: Weight of the system Start a new analysis project Image: Weight of the system Open existing test files and create computations, diagrams, reports and video playback Image: Weight of the system Start a new analysis project Image: Weight of the system Aproject contains all computations and diagrams

• Search for the test data and drag & drop it to the column on the right hand side.

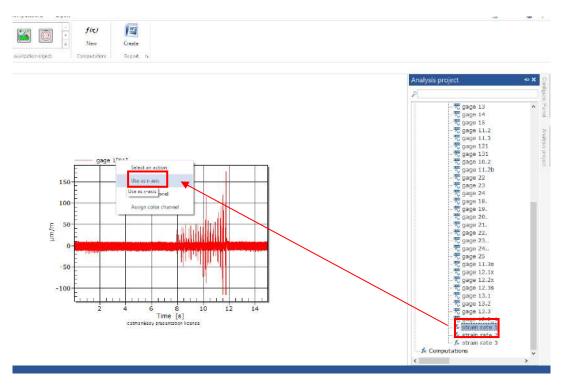
Collapse all C	Convert Merge Dewnload Tools	infiguration E configuration	
arch directories	ChUsers\baeumeIn\Desktop\Bosch_Catman_Proje	affiles (1 files)	Analysis project
My favorites	the state of the s	Specify search filter (e.g. F/e*,TST or Test parameter-Value) 🔹 🐴 🥝 💽	2
Desktop & Baumel, Nadine	Display file comments	Search sub folders	🗄 🚰 Tests
Dieser PC Bibliotheken	Name Job1 2018 10 30 10 55 10.75T	Size (kB) Modified Typ	Time from sample rate Image: State 10.1 State
Papirkon Popirkon Popirkon Popirkon Popirkon Catman Projektiles catmanEasy_5_3			■ Test data ■ C:\UsersYbacumeh\Desktog\Des h_Catu ▼ Time 1 - default sample rate ♥ Gage 1 ♥ Gage 1 ♥ Gage 5 ♥ Gage 6 ♥ Gage 7 ♥ Gage 8 ♥ Gage 11 ♥ Gage 12 ♥ Gage 13 ♥ Gage 14 ♥ Gage 14 ♥ Gage 15 ♥ Gage 13 ♥ Gage 24



• Now, change to the 'Visualization' panel. Create a graph by dragging & dropping the test data of gage 1 to the empty surface.

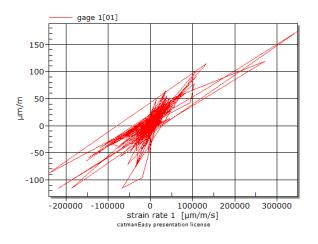


• Then choose the corresponding *strain rate 1* and drag it onto the text *gage 1[01]* in the graph explanations. Use strain rate 1 *as* the *x*-*axis*.





• The following graph will appear.

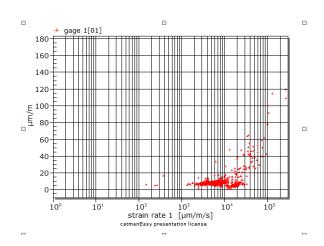


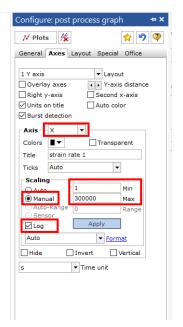
• As this is not the desired shape of the graph, configure the plot as follows (dotted-style).

Configure: post process graph 🛛 🖷 🗙 💡	catman&PVS.J.@ (Presentation Version) eos Esport	→ 🖻 > 🕞 Window - 🔞 He
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• Adjust the x-axis by choosing a manual logarithmic scaling.





As a reminder: This is the target graph:

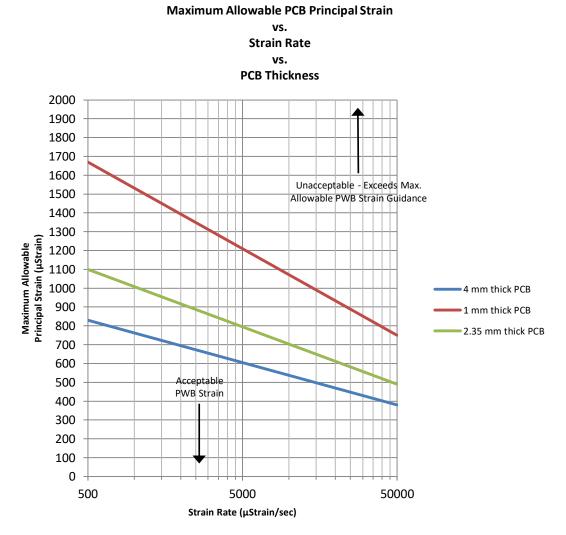
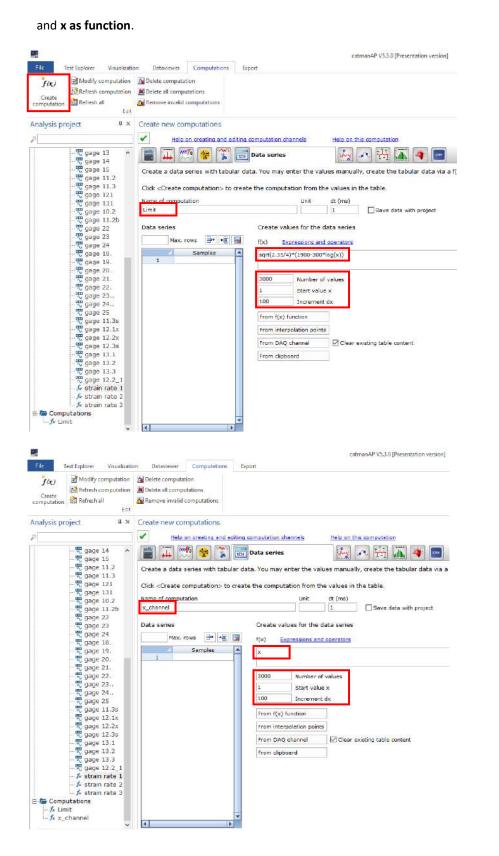


Figure 13: Maximum Allowable PCB Principal Strain based on IPC/JEDEC-9704



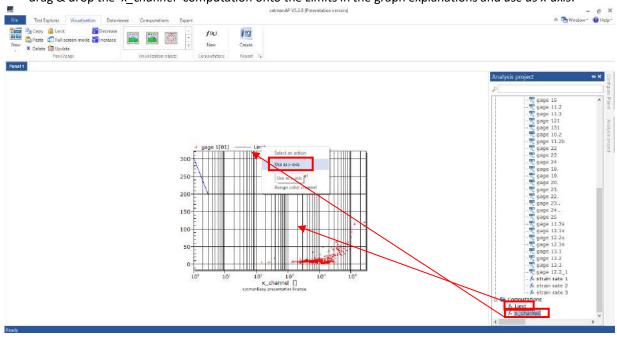
• To picture the limit line, define the following *data series* function (*according to IPC/JEDEC-9704*)

Max. allowable strain = sqrt[2.35/(PWB thickness)]*[1900-300*log(strain rate)]

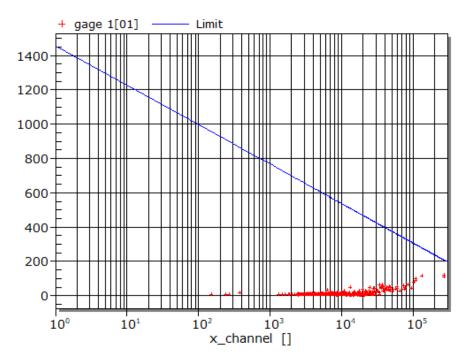




• Finally visualize the computed functions. Drag & drop the '*Limits*' computation to the displayed graph. Then drag & drop the '*x_channel*' computation onto the Limits in the graph explanations and *use as x-axis*.



The resulting graph looks as follows:



According to *IPC/JEDEC-9704 Printed Wiring Board Strain Gage Test Guideline*, the measured strain is within the acceptable strain range. The tested PCB is, then, not damaged during the manufacturing process.



QuantumX Measurement Amplifiers

Quantum^X is a modular, freely scalable and distributable data acquisition system from HBM for measurement and testing purposes allowing quicker innovation. All modules offer an Ethernet interface and can be freely combined with each other. All channels work completely time synchronized - module to module with < 1 µs.

MX1615B – Strain gauge bridge amplifier



Every channel can be individually parameterized via software, supporting the following:

- Strain gauges in full-, half- or quarter-bridge (120 or 350 Ω)
- Standard voltage, PT100, resistor, potentiometer
- Individual data rates up to 20kS/s per channel, active low pass filter

catman®AP Software

catman[®]AP from HBM is a powerful software package for PC based data acquisition and data analysis with the following classified operation fields:

Live Data View and Storage

- Visualize live data: physical quantities, digital bus signals, video, position (GPS), wheel force transducer, status in powerful objects over time, angle, other physical inputs or frequency of process and test data
 - o y-t, x-y graph with history
 - Online analysis frequency graph
 - Numeric display
 - o Instrument
 - Bar graph
 - Interactive operation: switch, checkbox
 - Measurement and data acquisition jobs
 - High data throughput: 12 MS/s
 - Start/stop condition: manual or automatic (trigger events), condition (zeroing)
 - Data packaging: keep all data, peaks, cycle
 - o Storage format: binary, ASCII, Excel, MDF 3/4, Diadem, nSoft, Matlab, UFF, RPC III
 - Meta information: tester, condition, part description

Live Data Analysis

- General online scientific math
 - o Basic algebra
 - Statistics: class counting, min / max, mean, RMS
 - o Integral, differential
 - Filter box / phase correction
 - Trigonometric function, logic, ,
- Structural durability testing math
 - Rosette calculation: resulting strain, angle



- Cycle counter
- Vibration analysis in frequency domain
- Powertrain / drivetrain math
 - \circ ~ angle based statistics: min, max, peak-to-peak

Post process Data Analysis and handling

- Post-process data analysis
 - o Graphical data visualization in time, frequency domain, position
 - o Data cleansing and preparation: curve operation (cut, eliminate outliers), statistics
 - o General online scientific math
 - Export in different data format
 - Video based data analysis
 - o Structural durability testing math
 - Powertrain / drivetrain math
- Export data and report test result
 - Export to different storage format
 - Export visualization objects to Microsoft Word report template
 - Printer page

Automating recurrent activity

- Auto sequencer
- Scripting

Additional system functionality

- Device configuration: communication, scan, parameterization, source naming, synchronization
 - IO parameterization
 - Online / offline
 - Inputs (analog, digital, video, bus signals, GPS, ...), outputs
- Diagnostics

Thanks to an intuitive user interface, you are only a few clicks away from starting your measurement. Simply configure the amplifier using TEDS, the transducer electronic data sheet, or the extendible sensor database – and the test can start. Many options for graphical data analysis and versatile export options make catman[®]AP a reliable and indispensable tool for every measurement technician.

-- END

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