

Procedure/checklists for the CACTUS Operator

DUNE Photosensor WG Meeting (DUNE-SP-PDS)

April 23th, 2024

The Production Readiness Review team visited us on March 13 and 14 at the CACTUS facilities in Bologna and Milan.

Production Readiness Review Team

Name	Title
Terri Shaw	Senior Principal Engineer
Linda Bagby	Senior Engineering Physicist
Jim Mateyack	DUNE Senior Quality Assurance Engineer

The purpose was to perform a visual inspection and observation of the SiPM board testing and handling process.

Recommendation:

Develop a document with the procedure and checklist for the CACTUS operator.

Goal: the CACTUS operator can quickly verify the step by step and be sure that no steps are skipped.

PROTOTYPE No.S16517-06AS(ES1)		Doc.No.K30-B70191				
3.3. Electrical and Optical Characteristics (Ta=25 °C, Vop= VBR+3.0V, unless otherwise noted)						
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Spectral response range	λ	V _R = V _{op}	280 to 900			nm
Peak sensitivity wavelength	λ_p	V _R = V _{op}	--	450	--	nm
Photon detection efficiency *1	PDE	V _R = V _{op} , $\lambda=450\text{nm}$	46	50	--	%
Breakdown voltage	V _{BR}	--	50	52	54	V
Recommended operating voltage	V _{op}	V _{BR} + 3.0 V	53	55	57	V
V _{op} variation (max. – min. in a group)	ΔV_{op}	50 pcs (= 300ch./group)	--	0.1	0.2	V
Dark count rate *2	DCR	V _R = V _{op}	--	2000	6000	keps/ch
Dark current	I _d	V _R = V _{op}	--	1500	4500	nA/ch.
Crosstalk probability	CTP	V _R = V _{op}	--	12.5	--	%
Gain	M	V _R = V _{op}	--	4.0	--	$\times 10^6$
Temperature coefficient of V _{op} (around room temperature)	ΔV_{op}	--	--	54	--	mV / °C
Terminal capacitance	C _t	V _R = V _{op} , 100kHz	--	1300	--	pF/ch.
Quenching resistance at 25°C	R _q	--	360	450	540	k Ω
Quenching resistance at -196°C	R _q (-196)	--	1440	1800	2160	k Ω

*1 : Photon detection efficiency does not include crosstalk and after pulse.
*2 : at 0.5p.e. threshold



Number of pixels 6364 pixels

Room T: Min 56- Max 85 Ω
LN2 T: Min 226- Max 340 Ω

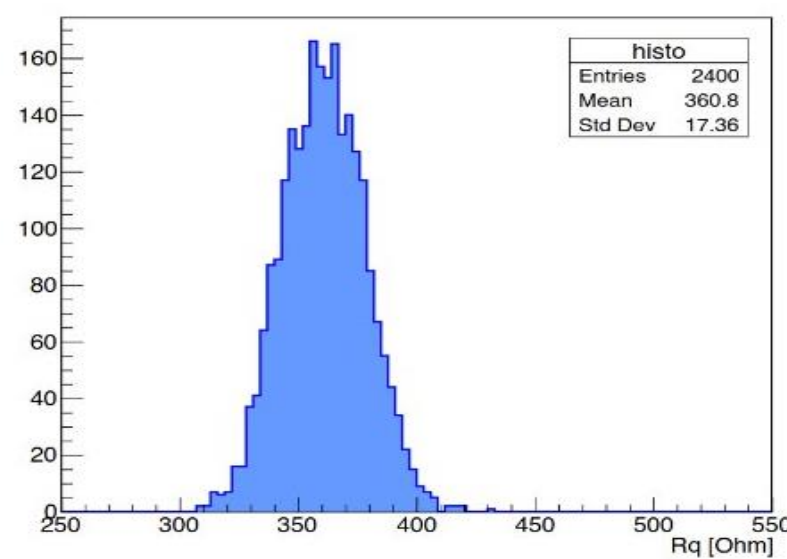
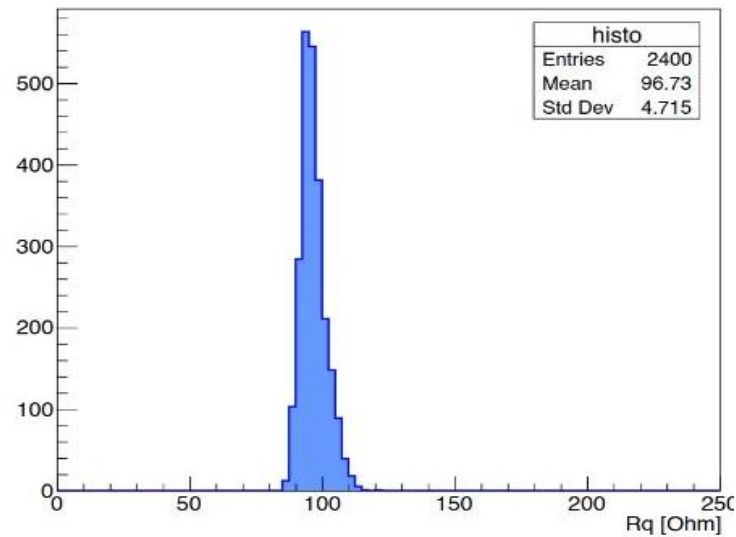
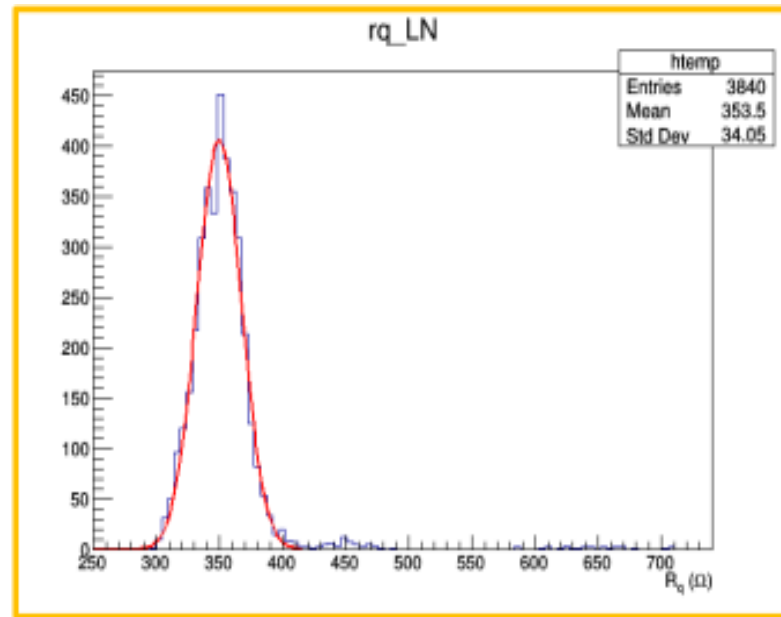
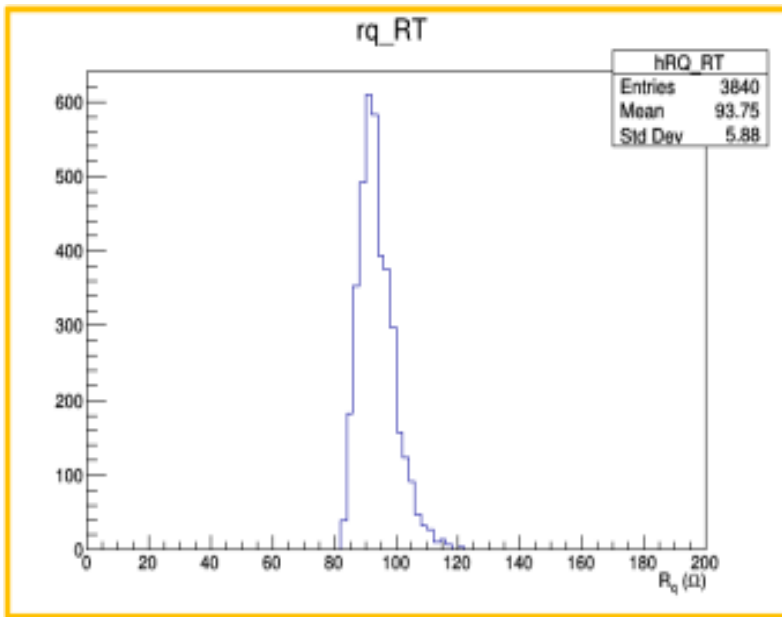
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- CACTUS/Labview have a defined thresholds:
Room T: Min 90- Max 150 Ω
LN2 T: Min 300- Max 450 Ω
- When we observe high resistance we have identified: humidity problems in the connector, bias connector or cables, daughter boards, etc.

} Number of pixels 6364 pixels → Room T: Min 56- Max 85 Ω
LN2 T: Min 226- Max 340 Ω



- Rq observed with CACTUS is not in agreement with Hamamatsu specifications.
- When is a high Rq?
- What do we do with SiPMs with high Rq?
- Is it important in the DUNE requirements?