

# Characterization of new HPK SiPMs in Ferrara

R. Calabrese. A. Cotta Ramusino. M. Fiorini. T. Giammaria. M. Guarise. E. Luppi. A. Minotti. L. Tomassetti

Tommaso Giammaria

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# Content

- Results of FBKTT characterization with updated overvoltage values
- Results of HPK prototypes for bursts investigation
- Conclusions

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- **Results of FBKTT characterization with updated overvoltage values**
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# Results of FBKTT characterization with updated overvoltage values

- Six samples: FBKTT15-20 (already tested with different overvoltage values)
- Overvoltage values: 3.5 V, 4.5 V, 7 V
- The measurements presented less noisy signals in general due to different environmental conditions

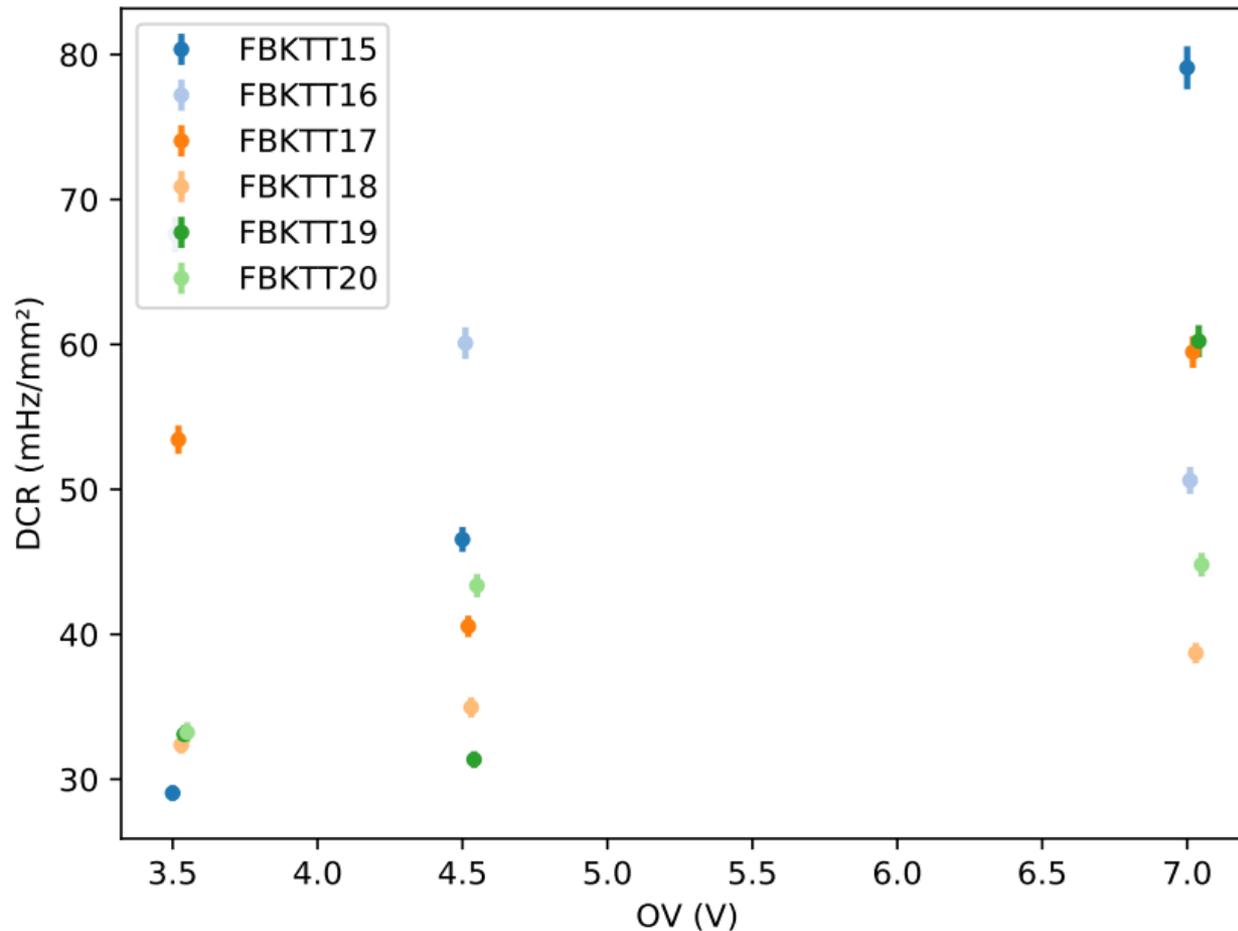
# Results of FBKTT characterization with updated overvoltage values (with bursts)

SiPM	OV(V)	DCR(mHz/mm <sup>2</sup> )	AP(%)	CT(%)	Gain	SNR
FBKTT15	3.5	29.05(0.54)	1.04(0.19)	13.92(0.68)	6.67e+05(7.0e+04)	2.394e+01(3.6e-01)
FBKTT15	4.5	46.55(0.86)	1.50(0.22)	17.11(0.76)	8.57e+05(9.0e+04)	2.903e+01(4.2e-01)
FBKTT15	7.0	79.1(1.5)	3.44(0.34)	32.3(1.0)	1.54e+06(1.6e+05)	4.563e+01(5.0e-01)
FBKTT16	3.5	67.6(1.2)	1.51(0.22)	11.60(0.62)	6.80e+05(7.2e+04)	2.424e+01(3.9e-01)
FBKTT16	4.5	60.1(1.1)	1.28(0.21)	16.99(0.75)	8.67e+05(9.1e+04)	2.953e+01(3.2e-01)
FBKTT16	7.0	50.61(0.93)	3.36(0.33)	28.41(0.96)	1.37e+06(1.4e+05)	4.177e+01(3.4e-01)
FBKTT17	3.5	53.43(0.98)	1.20(0.20)	11.36(0.61)	6.80e+05(7.2e+04)	2.418e+01(3.2e-01)
FBKTT17	4.5	40.55(0.74)	1.26(0.20)	16.20(0.73)	8.54e+05(9.0e+04)	2.931e+01(3.2e-01)
FBKTT17	7.0	59.5(1.1)	3.49(0.34)	31.0(1.0)	1.45e+06(1.5e+05)	4.465e+01(3.7e-01)
FBKTT18	3.5	32.37(0.61)	1.53(0.23)	14.84(0.72)	6.60e+05(7.0e+04)	2.516e+01(2.6e-01)
FBKTT18	4.5	34.96(0.70)	1.55(0.25)	18.40(0.85)	8.44e+05(8.9e+04)	3.009e+01(4.2e-01)
FBKTT18	7.0	38.70(0.71)	3.55(0.34)	34.3(1.0)	1.32e+06(1.4e+05)	4.183e+01(2.9e-01)
FBKTT19	3.5	33.10(0.61)	1.07(0.19)	11.85(0.63)	6.44e+05(6.8e+04)	2.271e+01(2.4e-01)
FBKTT19	4.5	31.36(0.57)	1.29(0.21)	17.07(0.75)	8.38e+05(8.8e+04)	3.117e+01(2.6e-01)
FBKTT19	7.0	60.2(1.1)	3.24(0.32)	27.71(0.94)	1.39e+06(1.5e+05)	4.315e+01(3.5e-01)
FBKTT20	3.5	33.23(0.69)	1.70(0.27)	12.38(0.72)	6.83e+05(7.2e+04)	2.715e+01(2.2e-01)
FBKTT20	4.5	43.36(0.80)	2.09(0.26)	16.62(0.74)	8.71e+05(9.2e+04)	3.376e+01(4.5e-01)
FBKTT20	7.0	44.80(0.82)	5.22(0.40)	29.13(0.95)	1.43e+06(1.5e+05)	4.926e+01(4.7e-01)

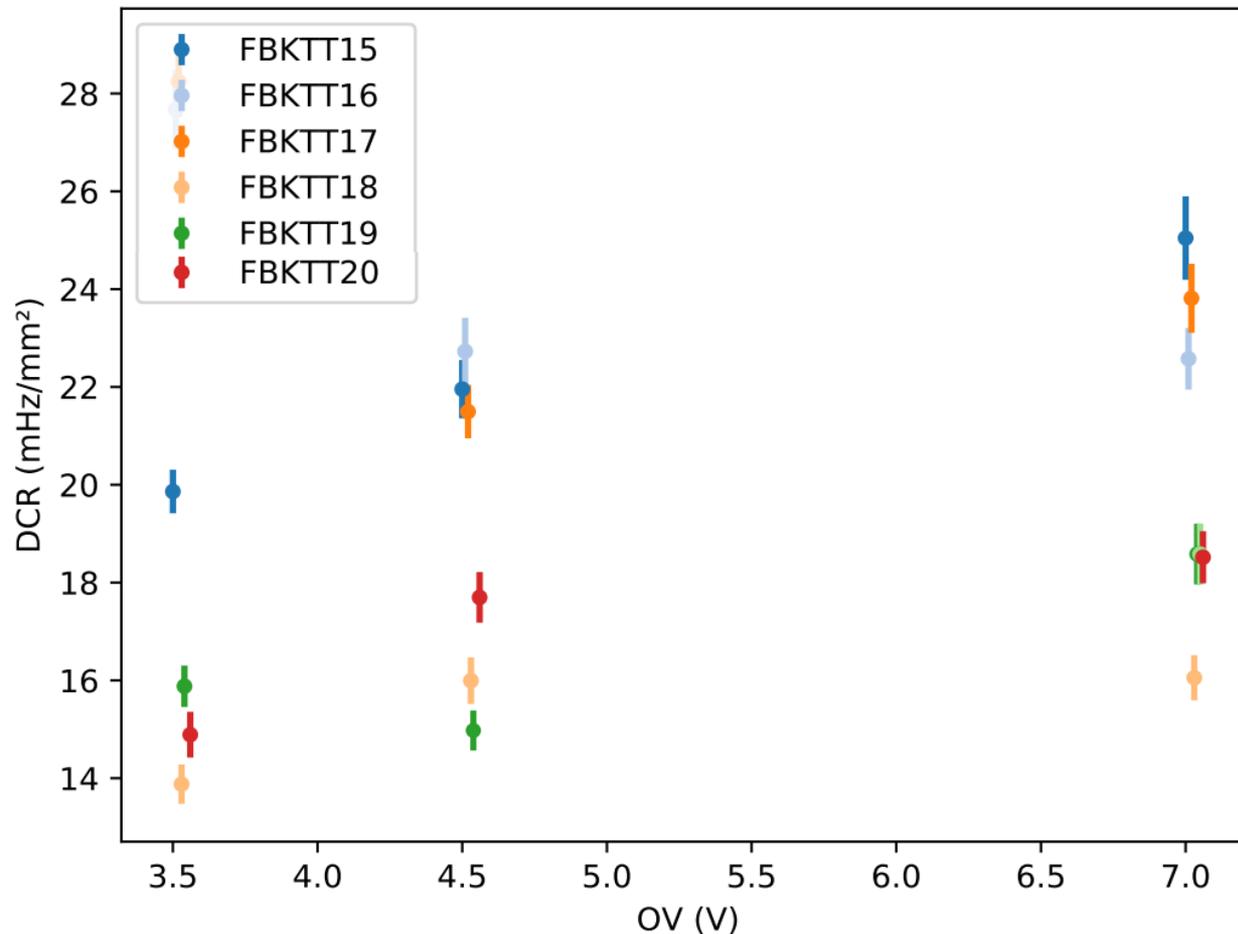
# Results of FBKTT characterization with updated overvoltage values (without bursts)

SiPM	OV(V)	DCR(mHz/mm <sup>2</sup> )	AP(%)	CT(%)	Gain	SNR
FBKTT15	3.5	19.86(0.45)	0.94(0.22)	14.32(0.84)	6.64e+05(7.0e+04)	2.393e+01(4.2e-01)
FBKTT15	4.5	21.96(0.60)	1.67(0.35)	18.1(1.1)	8.57e+05(9.0e+04)	2.956e+01(6.5e-01)
FBKTT15	7.0	25.04(0.85)	3.83(0.65)	34.2(1.9)	1.54e+06(1.6e+05)	4.974e+01(8.3e-01)
FBKTT16	3.5	27.67(0.80)	1.16(0.31)	11.52(0.98)	6.80e+05(7.2e+04)	2.413e+01(6.4e-01)
FBKTT16	4.5	22.73(0.69)	1.44(0.36)	18.9(1.3)	8.67e+05(9.1e+04)	3.139e+01(5.0e-01)
FBKTT16	7.0	22.58(0.63)	2.84(0.46)	29.9(1.5)	1.37e+06(1.4e+05)	4.039e+01(6.5e-01)
FBKTT17	3.5	28.24(0.72)	0.96(0.25)	11.74(0.87)	6.77e+05(7.1e+04)	2.328e+01(4.3e-01)
FBKTT17	4.5	21.50(0.55)	1.21(0.28)	17.4(1.1)	8.57e+05(9.0e+04)	2.979e+01(4.5e-01)
FBKTT17	7.0	23.81(0.71)	3.20(0.52)	31.1(1.6)	1.45e+06(1.5e+05)	4.291e+01(5.7e-01)
FBKTT18	3.5	13.88(0.40)	1.65(0.37)	14.1(1.1)	6.60e+05(7.0e+04)	2.413e+01(6.1e-01)
FBKTT18	4.5	15.99(0.48)	1.30(0.33)	18.8(1.3)	8.44e+05(8.9e+04)	2.957e+01(5.6e-01)
FBKTT18	7.0	16.05(0.46)	3.67(0.54)	32.7(1.6)	1.32e+06(1.4e+05)	4.123e+01(4.6e-01)
FBKTT19	3.5	15.88(0.42)	1.13(0.28)	15.6(1.0)	6.41e+05(6.7e+04)	2.378e+01(5.1e-01)
FBKTT19	4.5	14.98(0.40)	1.74(0.35)	19.7(1.2)	8.38e+05(8.8e+04)	3.014e+01(6.5e-01)
FBKTT19	7.0	18.58(0.62)	3.82(0.64)	29.0(1.8)	1.38e+06(1.5e+05)	4.318e+01(6.0e-01)
FBKTT19	4.5	14.98(0.40)	1.74(0.35)	19.7(1.2)	8.38e+05(8.8e+04)	3.014e+01(6.5e-01)
FBKTT19	7.0	18.58(0.62)	3.82(0.64)	29.0(1.8)	1.38e+06(1.5e+05)	4.318e+01(6.0e-01)
FBKTT20	3.5	14.89(0.47)	2.40(0.48)	14.3(1.2)	6.83e+05(7.2e+04)	2.777e+01(8.8e-01)
FBKTT20	4.5	17.70(0.52)	2.17(0.42)	18.4(1.2)	8.74e+05(9.2e+04)	3.459e+01(5.3e-01)
FBKTT20	7.0	18.52(0.53)	4.44(0.59)	30.9(1.6)	1.43e+06(1.5e+05)	4.667e+01(4.6e-01)

# Results of FBKTT characterization with updated overvoltage values (plots with)



# Results of FBKTT characterization with updated overvoltage values (plots without)



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# Results of HPK prototypes for bursts investigation

- UniFe received 3 samples: (6025cs, 6050ve, 6075cs)

SiPM	Cell pitch	OV	Resin	Package	Bonding	Design
6025CS	25 $\mu\text{m}$	4 V	silicon resin	ceramic	standard lateral wire	non shrunked
6050VE	50 $\mu\text{m}$	3 V	epoxy resin	surface mount type	through-silicon via	shrunked
6075CS	75 $\mu\text{m}$	3 V	silicon resin	ceramic	standard lateral wire	non shrunked

# Results of HPK prototypes for bursts investigation

SiPM	OV(V)	with/without bursts	DCR(mHz/mm <sup>2</sup> )	AP(%)	CT(%)
6025cs	4	with	7.00(0.17)	1.61(0.31)	17.6(1.0)
6025cs	4	without	7.00(0.17)	1.61(0.31)	17.6(1.0)
6050ve	3	with	44.68(0.82)	3.09(0.32)	10.82(0.59)
6050ve	3	without	17.34(0.52)	2.75(0.48)	14.6(1.1)
6075cs	3	with	14.51(0.29)	6.28(0.48)	18.21(0.82)
6075cs	3	without	14.51(0.29)	6.28(0.48)	18.21(0.82)

- The measurements presented (again) less noisy signals in general due to different environmental conditions

# Results of HPK prototypes for bursts investigation

SiPM	OV(V)	with/without bursts	DCR(mHz/mm <sup>2</sup> )	AP(%)	CT(%)
6025cs	4	with	7.00(0.17)	1.61(0.31)	17.6(1.0)
6025cs	4	without	7.00(0.17)	1.61(0.31)	17.6(1.0)
6050ve	3	with	44.68(0.82)	3.09(0.32)	10.82(0.59)
6050ve	3	without	17.34(0.52)	2.75(0.48)	14.6(1.1)
6075cs	3	with	14.51(0.29)	6.28(0.48)	18.21(0.82)
6075cs	3	without	14.51(0.29)	6.28(0.48)	18.21(0.82)

No differences in the DCR (and AP,CT) after bursts removal

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# Conclusions

- **FBKTT characterization with updated overvoltages**
  - Almost the same behaviour in terms of DCR, AP and CT
  - Higher gain for the 7 OV configuration as expected
  - Lower CT with respect to the standard FBK split, as already seen in the previous measurements at 2.5 V, 3 V and 4 V OV
- **HPK prototypes**
  - Two of the three tested devices (6025cs and 6075cs, like the already presented 6050cs) does not present bursts of events
- **The 6-SiPM arrays arrived the last Friday (12/03/2021), measurements are ongoing**