VMM3 Hybrid quality test system

Results of 24 hybrids

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GEFÖRDERT VOM

Introduction

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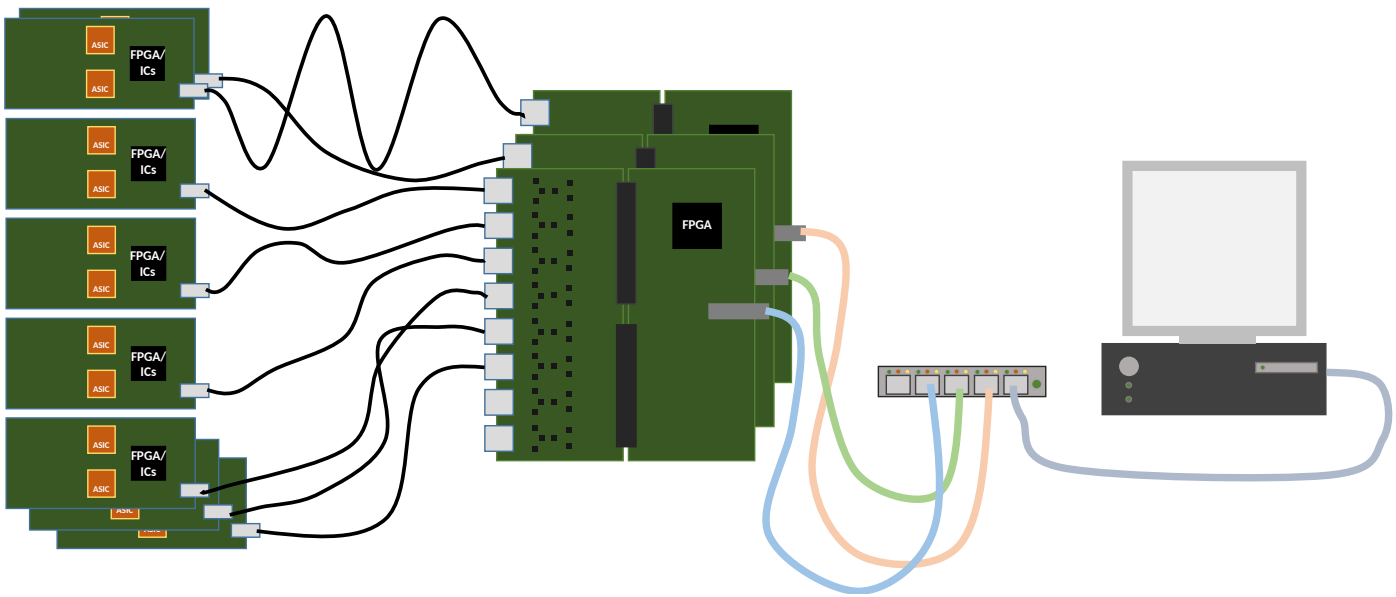
- VMM3a: new readout chip for SRS
- Transition prototypes to mass production
- Large quantities to be produced
- Automated tests needed for quality assurance. Manual tests are slow
- VTC system from CERN limited to basic tests
- Classification of hybrids not possible with VTC



Hybrid ⇔ HDMI Cable ⇔ Adapter card+FEC ⇔ Ethernet ⇔ Switch ⇔ Ethernet ⇔ PC

[Implementation of the VMM ASIC in the Scalable Readout System,M.Lupberger]

Testing Setup

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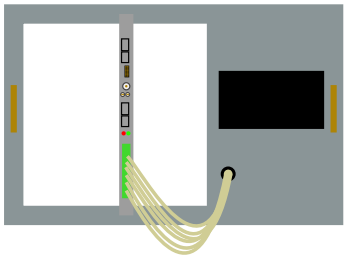
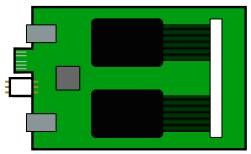
Minimal System



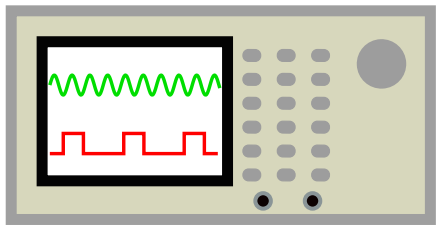
SRS Crate



VMM Hybrid

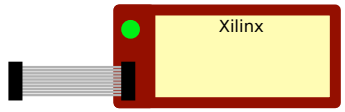
Computer
+
VMM Slow Control

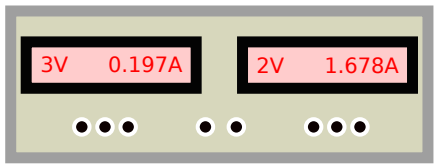
Optional "extensions"



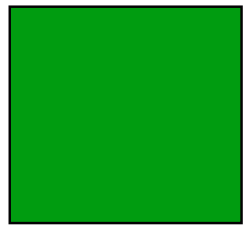
Signal Generator

JTAG Programmer





Power Supply

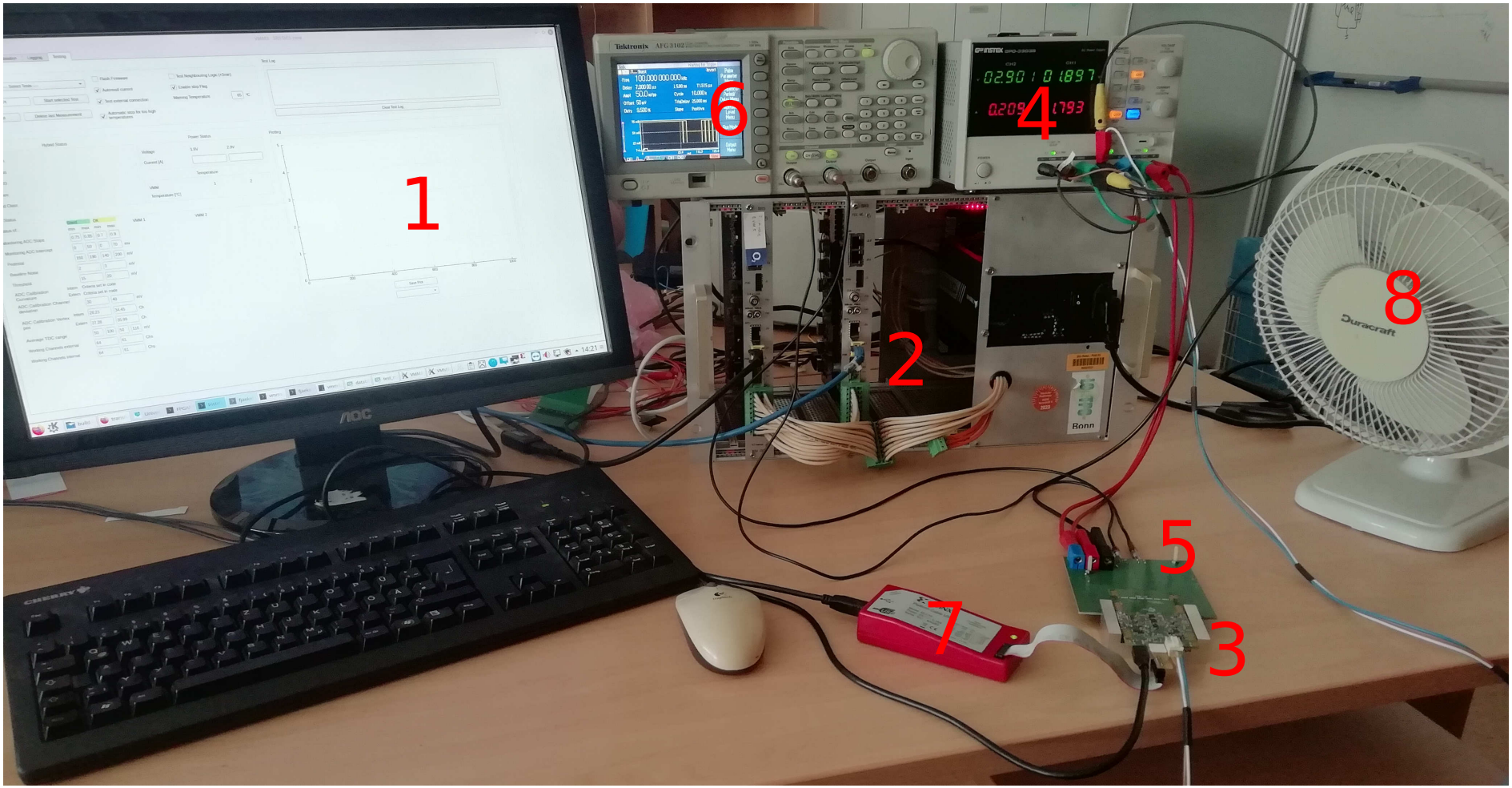


Multiplexer PCB

- Read VMM monitoring Output
- Read VMM data
- Many more possible

- Load Firmware
- Measure power consumption of hybrid
- Test connection detector plug $\leftrightarrow$ VMMs incl. protection circuit

Testing Setup



1: VMM-Slow Control, 2: SRS, 3: Hybrid with provisional cooling, 4: Power supply, 5: Test pulse board, 6: Signal generator, 7: JTAG Programmer, 8: Cooling Fan

Testing Procedure

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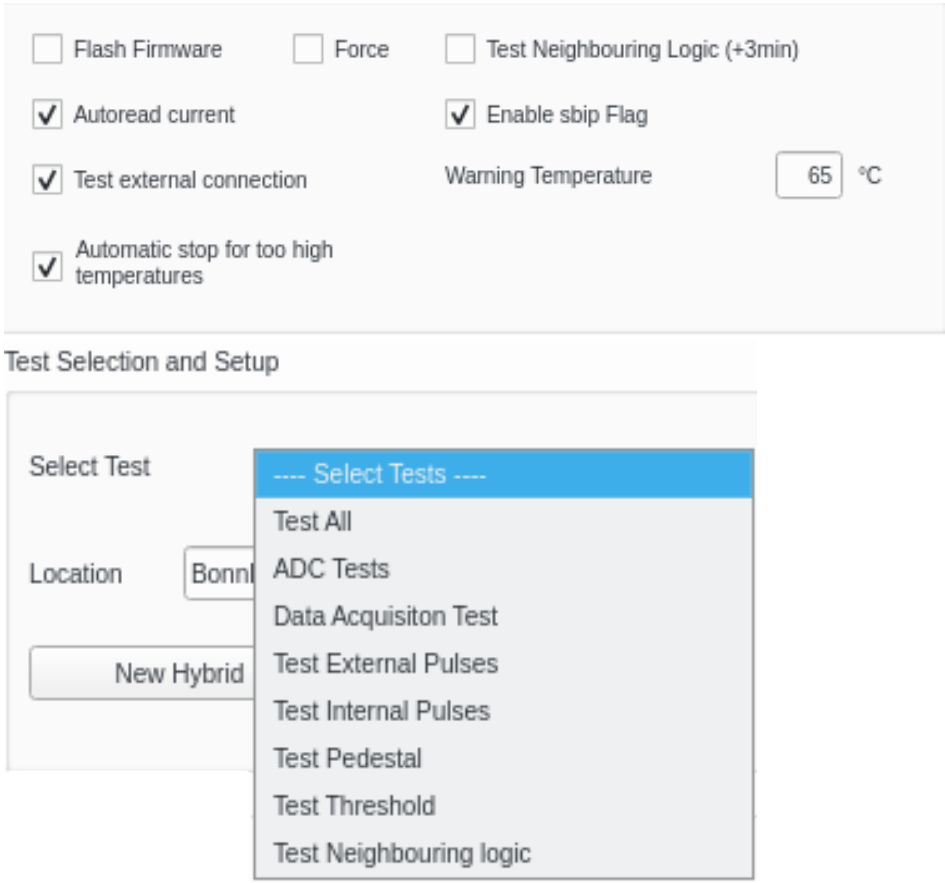
- Connect hybrid to the system
- Select optional settings
- Select test to perform
- Start test and relax for 2 min
- All measurements are performed automatically
- Tests use monitoring outputs of VMM and data acquisition of SRS



External Test Pulses

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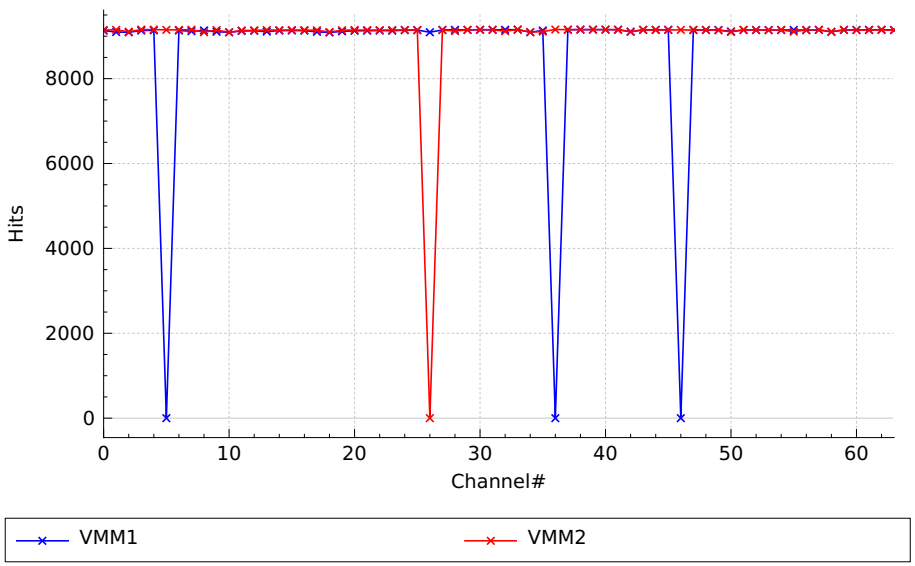
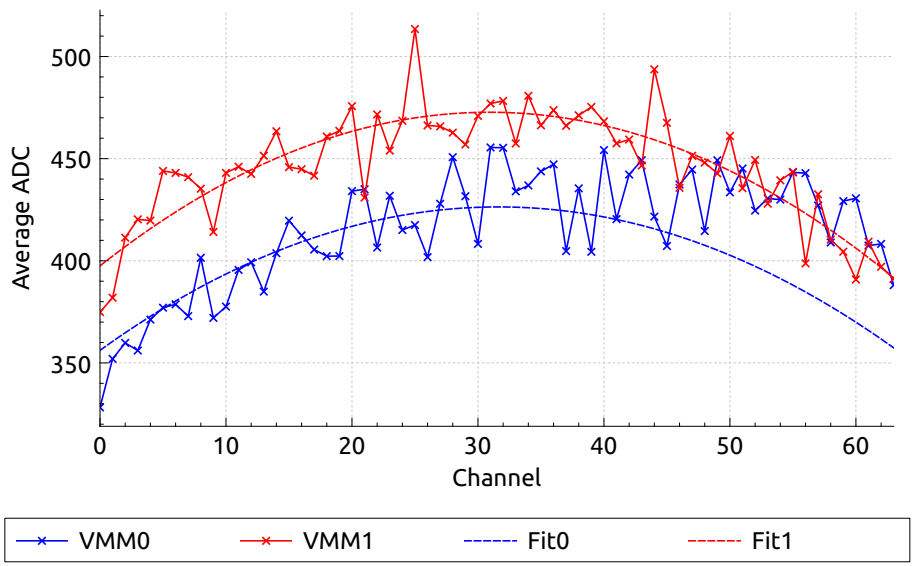
- Give 10 000 TestPulses on every channel of the hybrid
- Data acquisition records for each hit VMM number, channel number, ADC value, BCID +TDC values (timing)
- Analysis number of hits per channel and average ADC value for each channel





Pedestal Measurement

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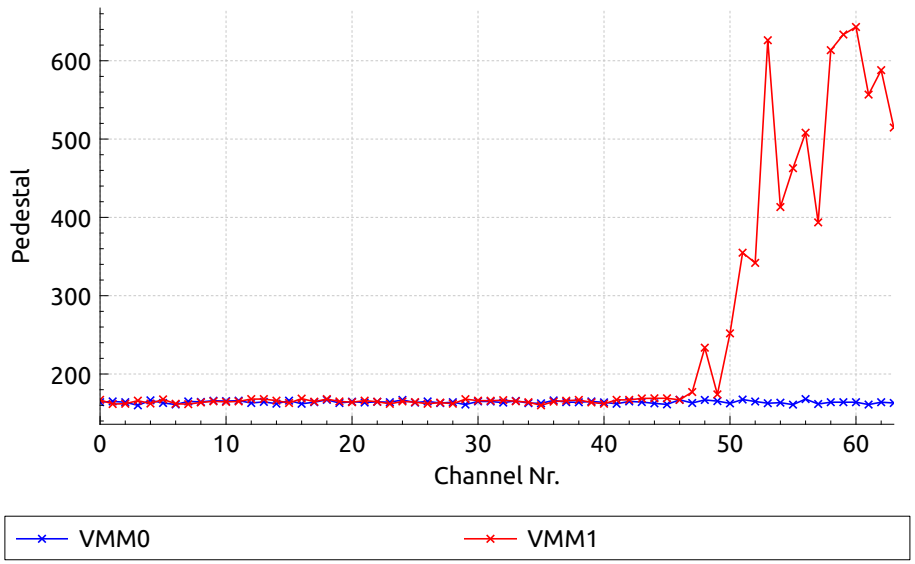
- Using VMM monitoring output measure pedestal (channel voltage w/o signal)
- After sending instructions to VMM, baseline needs to settle
- Measuring quickly can lead to bad baselines
- `sbip` flag should remove this completely
- For high gains and some hybrids still bad baselines happen
- only this system detects these basline faults



Single VMM-ASIC Classification

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Use classification from CERN manual testing (done by Dorothea Pfeiffer):

Class	Description
A	All channels working
B	One channel broken
C	2-3 channels broken
D	Many channels broken
E	VMM broken (e.g. when Hybrid has a short, or MonitoringADC is broken)

Table: Single VMM-ASIC classification

Hybrid Classification

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VMM class 1	VMM class 2	Hybrid class	Description
A	A	a	Two good VMMs
A	B	b	1-3 channels broken
A	C	b	on hybrid
B	B	b	
B	C	b	$\leq$ 3 broken channels total
B	C	c	$>$ 3 broken channels total
A/B/C/D	D	c	One ok hybrid
A/B/C/D	E	c	
E	E	d	Hybrid broken

Table: Hybrid classification

Measurements

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- Bonn:
  - Developement of system using 4 old production hybrids
  - Small scale test using 10 new production hybrids
- Mainz:
  - Test of 4 old and 6 new hybrids
- LSBB Rustrel,France:
  - Testing cancelled due to Corona-restrictions
  - Plan to remotely test 160 hybrids (hopefully in october, VTC-System from CERN needs to be delivered before using test system)
- All data put into database

Results of measurements

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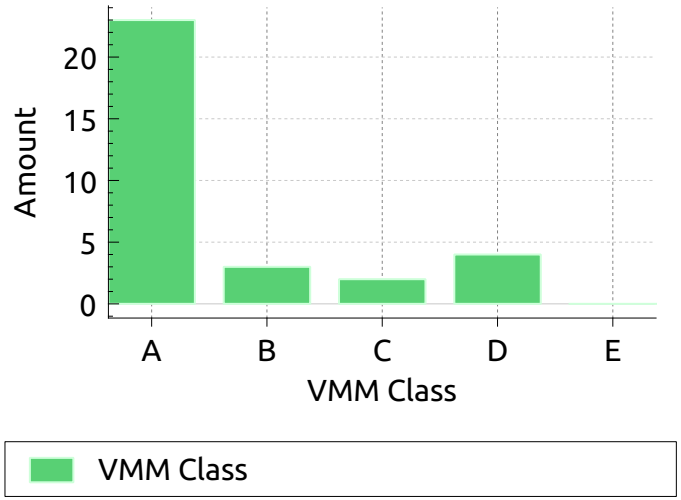
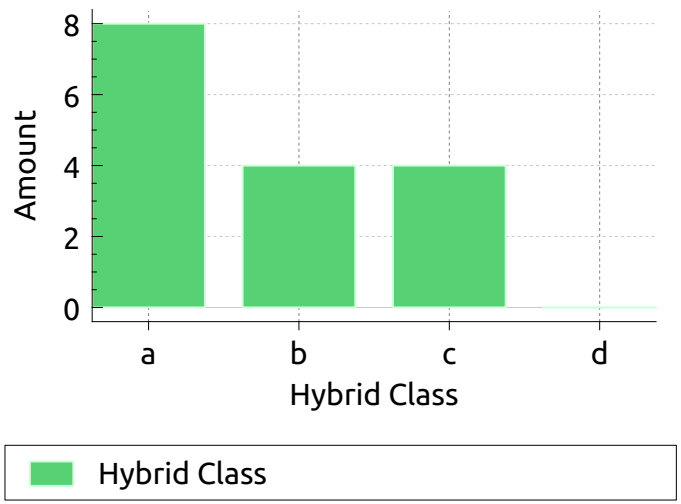
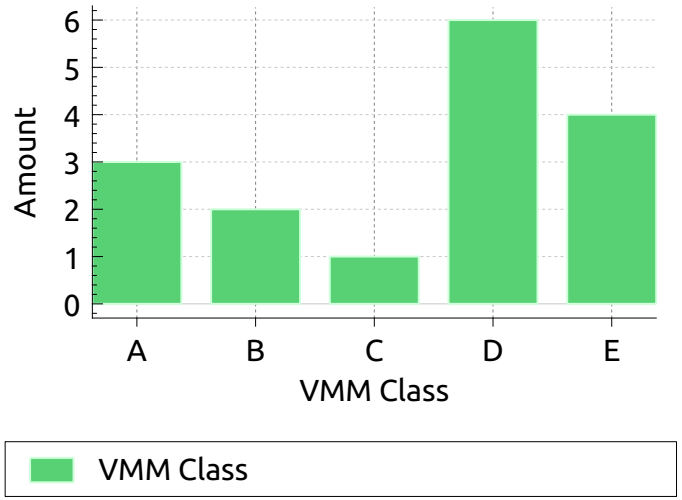
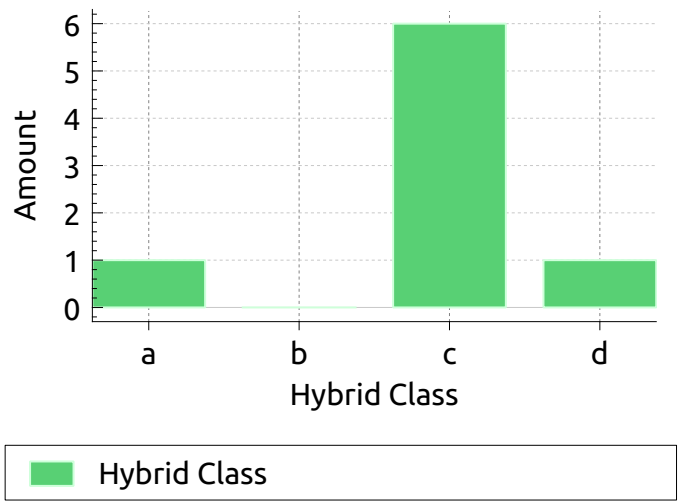
New Production Hybrids





Old hybrids





Yields

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VMM Class	old Hybrids	new Hybrids	CERN
A	19 %	71 %	85 %
B	13 %	9 %	6 %
C	6 %	6 %	2 %
D	38 %	13 %*	2 %
E	25 %	0 %	5 %

Table: Single VMM-chip yield

Hybrid class	old Hybrids	new Hybrids	CERN
a	12.5 %	50 %	74 %
b	0 %	25 %	14 %
c	75 %	25 %*	11 %
d	12.5 %	0 %	2 %

Table: Hybrid yields

*: Don't panic

Do not panic!

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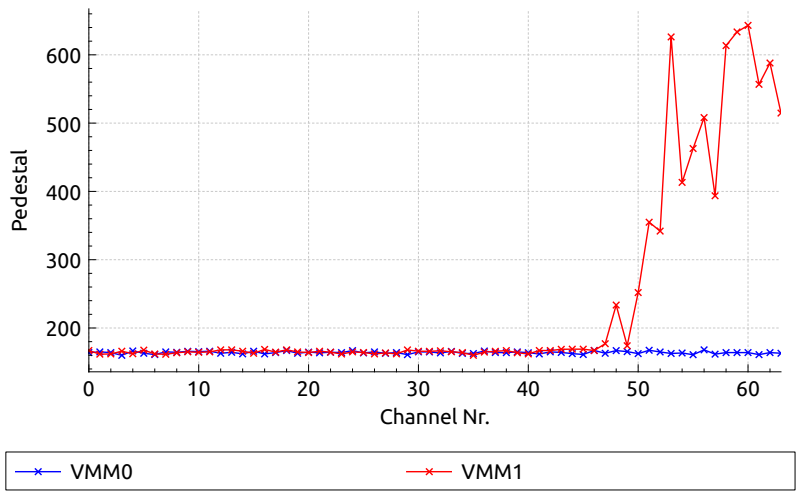
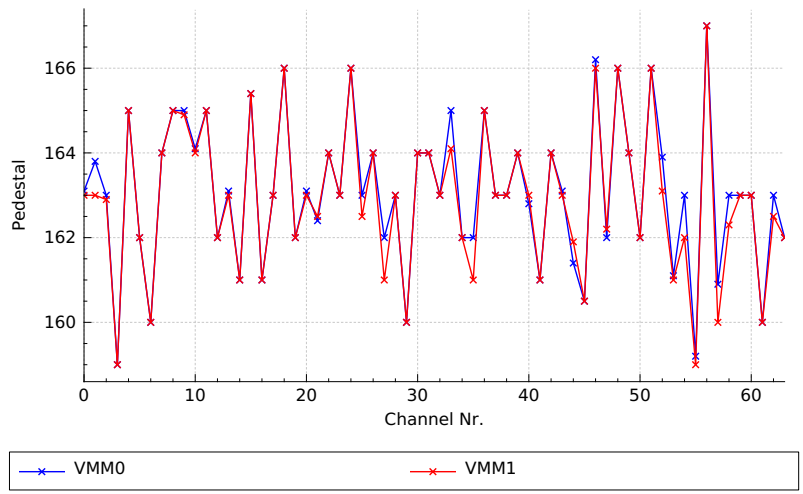
- Old hybrids are bad due to them being old prototypes and being heavily tested
- new hybrids:
  - 3 of 4 VMM classified as D have bad pedestal:



Gain 16 $\frac{\text{mV}}{\text{fC}}$



Gain 3 $\frac{\text{mV}}{\text{fC}}$

  - work perfectly fine at lower gains, all of the 3 would be classified to A
  - more realistic: 69 % of hybrids classified as a, 6 % as c
  - Pedestal measurement situation not applicable to normal application
- Lower sample size compared to CERN measurement
- CERN results confirmed (more or less)

Conclusion

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- System working now, ready to be used
- Other hardware (Signal generators, Power supplies) easy to implement
- 24 Hybrids (16 new, 8 old) were tested successfully
- Yield of sample lower than CERN results, but explained by more sensitive Pedestal measurement

Thanks for listening

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Questions...?

Bonn Hybrids

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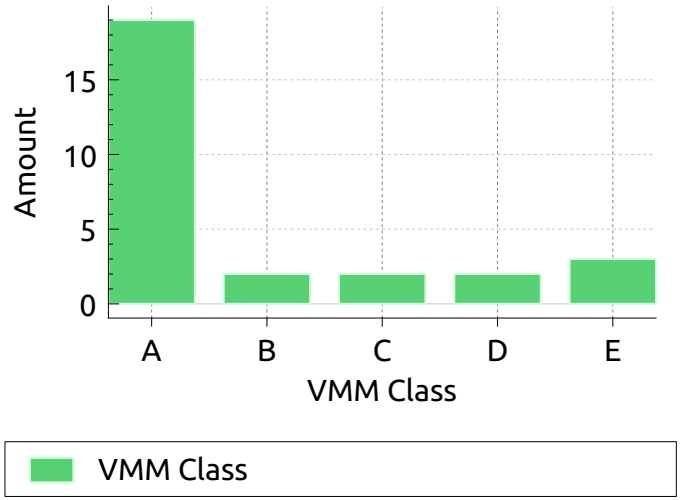
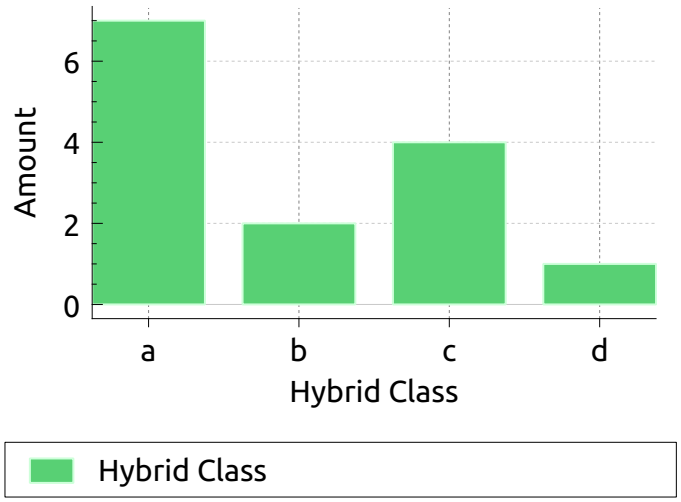
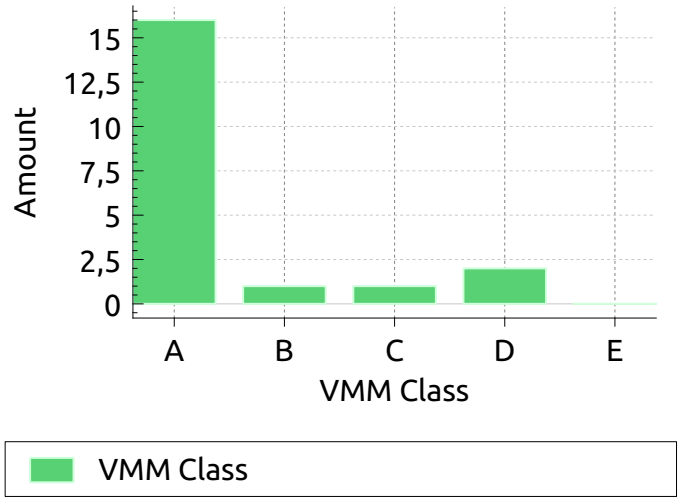
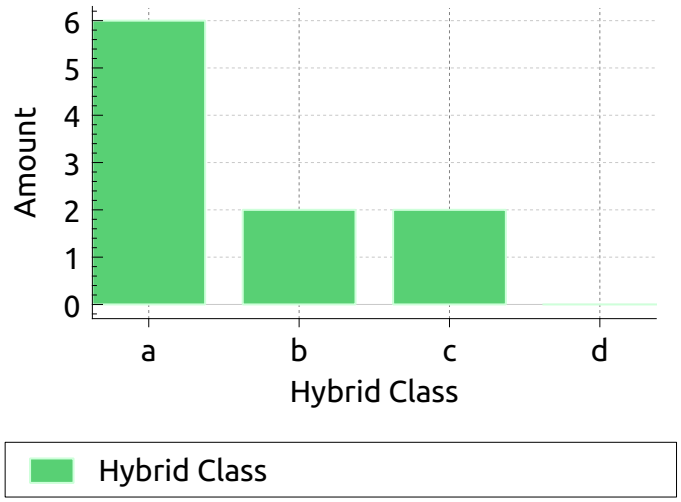
All hybrids





Only new hybrids





Mainz Hybrids

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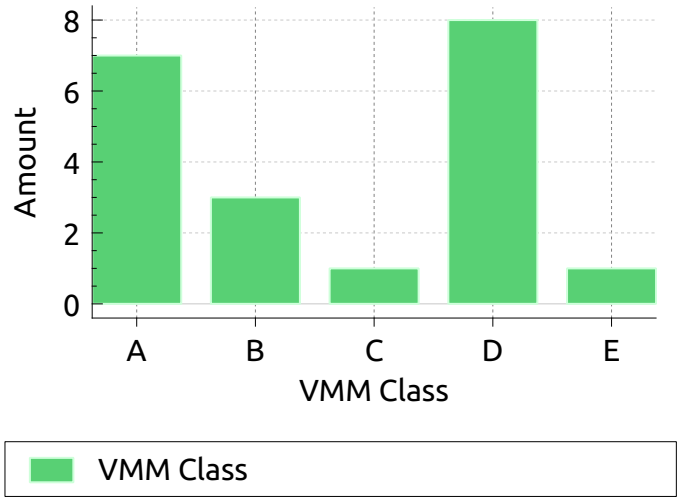
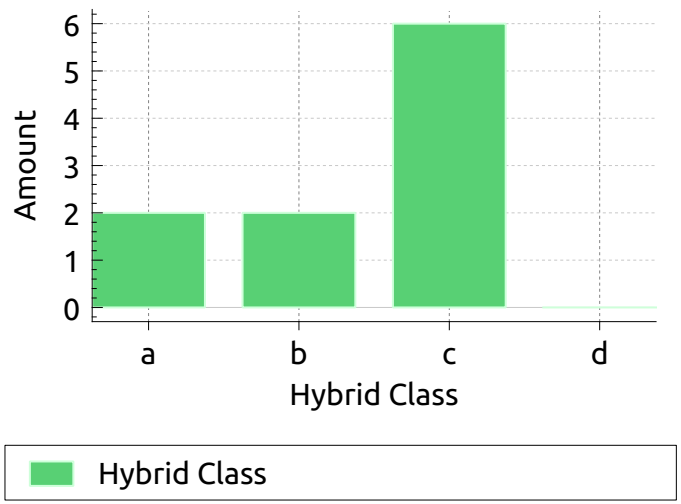
All hybrids





Only new hybrids