



Module Production and Testing in the U.S.

Since module production resumed late last year

FNAL has assembled 342 TOB modules

UCSB has assembled 354 TOB modules and 105 TEC modules

as of last Tuesday. Both groups continue to build modules, FNAL at a rate of 12 per day and UCSB at 18 per day.

Both groups have the capacity to build and test a larger number of modules per day but have been holding back until rod assembly and testing begins. We have just received the first shipments of re-qualified rod frames from CERN.

Most of these modules have been constructed with HPK sensors.



Testing Principals

FNAL

UCSB

Hybrid testing

Selcuk Cihangir

Milan Nikolic

Fast (ARC) testing

Lisa Chabalina

Tony Affolder

LT (Vienna box) testing

Timour Ten

Chris McGuinness

Rod testing

Yuri Gotra

Puneeth Kalavase

Ryan Hooper

Jim Lamb



FNAL Hybrid Testing

Hybrid ID		Rec'ed	Weekly		Cumulative		%Pass	PLL (%)
			Pass	Fail	Pass	Fail		
2.2.1.220	R2S							
2.2.2.210	R2D							
2.2.1.520	R5S							
2.2.2.510	R5D							
2.1.1.600	R6U							
3.2.1.500	L56p	233			230	3	98.71	78 (33.48)
3.1.1.110	L34p&L12pu	267	91	4	256	11	95.88	89 (33.33)
3.1.2.110	L12pd							
3.1.2.120	L12su							
3.1.2.120	L12sd							
Total		500			486	14	97.20	167 (33.40)



UCSB Hybrid Testing

	Pass	Fail	% Pass
L12pd	0	0	0.00%
L34p	319	4	98.76%
L56p	347	5	98.58%
R5N	65	2	97.01%
R5S	47	0	100.00%
R6	87	1	98.86%
R7	0	0	0.00%
Total	865	12	<u>98.63%</u>



Hybrid Failures*

FNAL

- 5 with Shorts in PA
- 7 Noisy channels-usually entire chip or chips
- 1 a few open and noisy channels

UCSB

- 6 with Shorts in PA
 - Repairable
- 1 Major Scratch in PA
- 1 Smashed APV-PA Bonds
 - Repairable
- 2 Failed Inspection
 - Never should have sent
- 1 Broken Ceramic
- 1 Bad Bond Feet
- 1 Weak Wirebonds
- 1 with unknown failure

*It is expected that some of the failures will eventually be repaired.



Hybrid Testing

The hybrid testing throughput is very high at both sites. However,

Initially about 10% retesting was required at FNAL

- **Noisy edge channels – raise global ADC cut**
- **Shorts – pull one PA-APV wire and retest**

Not all of the failures are completely understood

- **E.g., single channel shorts, entire noisy APV's**

At 45 to 55 minutes per 4 hybrids the test takes too long for the anticipated peak rates at each site.

- **Not too long ago CERN released a new version of the hybrid ARCS code that significantly speeds up the process. At present this code fails too many hybrids and we are waiting on a new release.**



FNAL Fast Testing

	Weekly			Cumulative			% A or B
	A	B	F	A	B	F	
L12pu	0	0	0	12	0	0	100.00%
L12pd	0	0	0	0	0	0	0.00%
L12su	0	0	0	0	0	0	0.00%
L12sd	0	0	0	0	0	0	0.00%
L34p	6	0	0	103	0	2	98.00%
L56p	54	0	0	228	1	2	99.02%
R5N	0	0	0	0	0	0	0.00%
R5S	0	0	0	0	0	0	0.00%
R6	0	0	0	0	0	0	0.00%
R7	0	0	0	0	0	0	0.00%
Total	60	0	0	343	1	4	99.00%



FNAL Fast Testing

This Week (7949-7996)

- **one unexpected pinhole - pulled (mod 7955 # 768)**
- **7972 – no readout (does not find APVs)**
- **7970 - breakdown current behavior @430V (see plots)**

Cumulative (7835-7996)

- **1 grade “B” (handling)**
- **2 handling failures**
- **1 – DCU problem (high noise)**
- **1 – failure to initialize (handling?)**
- **Total of 7 pinholes**



UCSB Fast Testing

Failed Modules

1 with >2% Bad Channels

- Debris on sensor

1 bad DCU

1 HV Shorted to CF Frame

2 with >20 μ A Bias Current

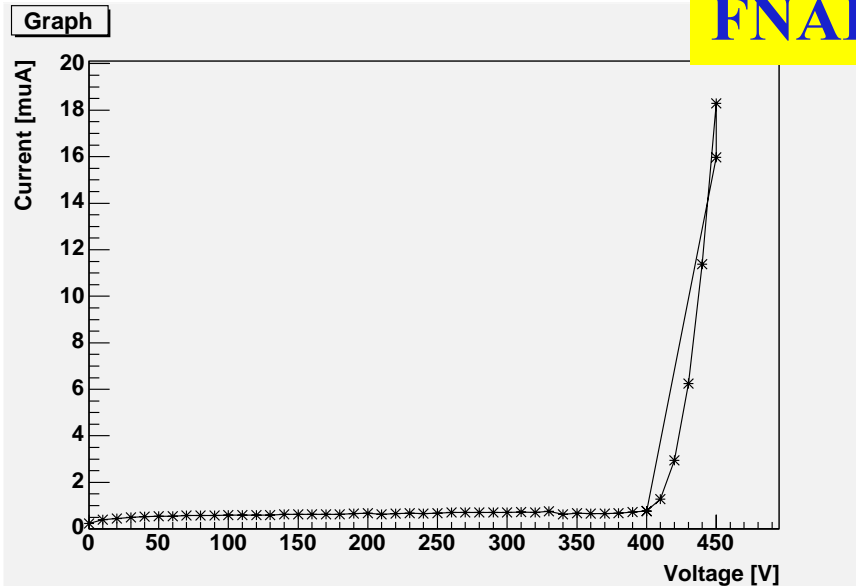
- 1 leaky pinhole
- 1 scratched sensor

	A	B	F	% A or B
L12pu	0	0	0	0.00%
L12pd	0	0	0	0.00%
L12su	0	0	0	0.00%
L12sd	0	0	0	0.00%
L34p	85	1	2	97.73%
L56p	237	1	2	99.17%
R5N	32	1	1	97.06%
R5S	0	0	0	0.00%
R6	24	0	0	100.00%
R7	0	0	0	0.00%
Total	378	3	5	98.70%

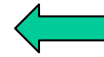


Fast Testing- Grey Area

FNAL 7970



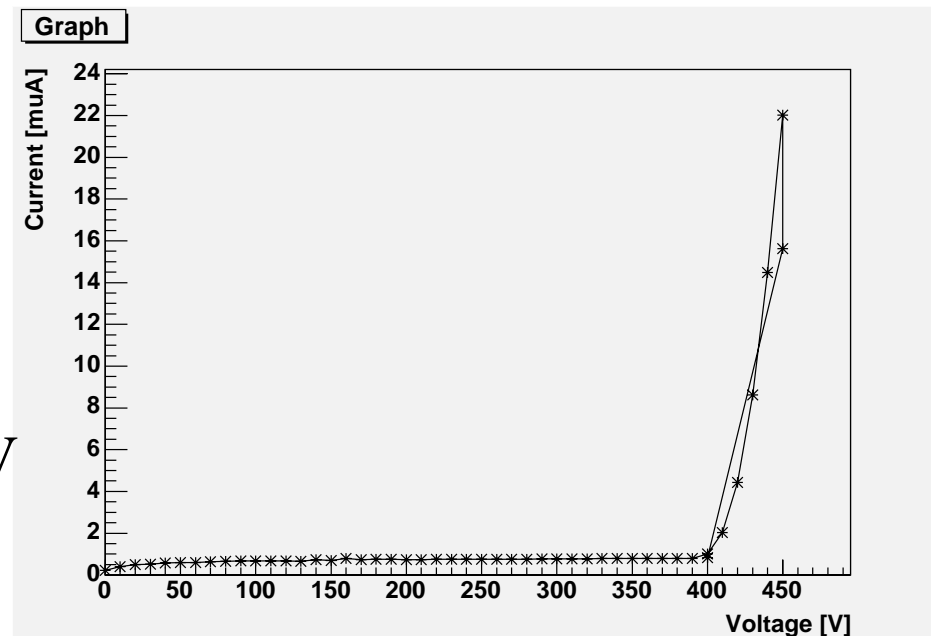
Test 1:
Graded as "A"



Test 2:
Graded as "F"

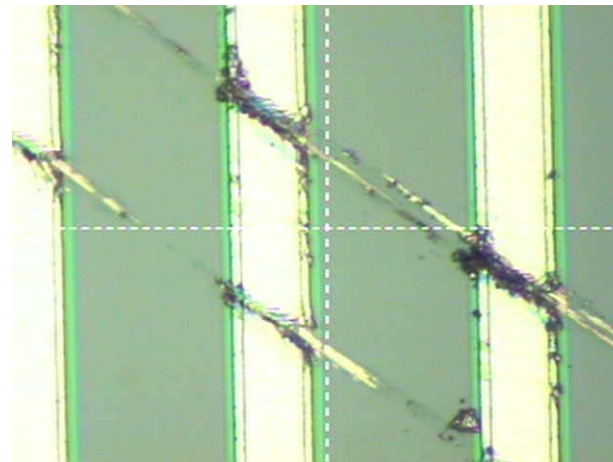
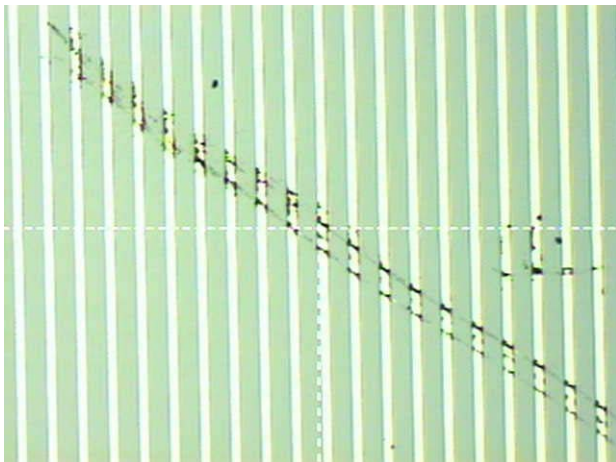
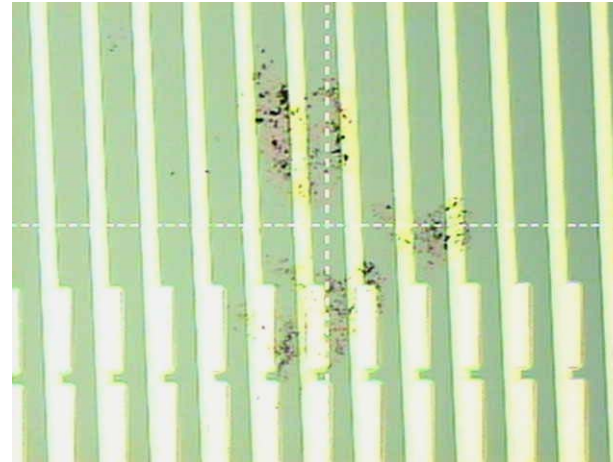
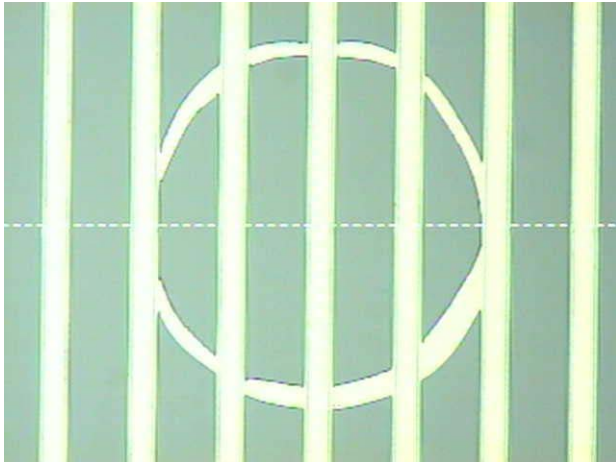


Unstable current beyond 400 V
No high noisy channel found.
Graded "A/F"





Sensor Issues





Fast Testing Issues

Both groups still using ARCS 7.2bf

Still need to validate ARCS 8.0

The percentage of bad channels is very low: $< .1\%$

18 new pinholes at UCSB and 7 new pinholes at FNAL represents a higher rate than what we observed in STM modules last summer.

The majority of the UCSB pinholes are attributed to a problem with the wire bonder, now solved.

Following the removal of wire bonds (e.g., for pinholes) some of modules have marginal currents – may pass one time and fail another

Might try removing additional bonds in cases.

In general it may be a good idea to label modules with breakdown behavior toward the end of the IV curve.



UCSB LT Testing

See a low level problem with low noise/mis-initialization of modules

Found that there is usually a resistive connection between extender and backplane

Reseating extender always fixes problem

- Will need to watch to see if problem is worsening with time

	Pass	Fail	% Pass
L12pu	0	0	0.00%
L12pd	0	0	0.00%
L12su	0	0	0.00%
L12sd	0	0	0.00%
L34p	84	0	100.00%
L56p	223	0	100.00%
R5N	34	0	0.00%
R5S	0	0	0.00%
R6	15	0	100.00%
R7	0	0	0.00%
Total	356	0	100.00%



FNAL LT Testing

Modules 30200020007883 – 7990 were tested during April 5 – April 18 period.

Modules 30200020007883-7889

30200020007979-7990 passed LT testing successfully with grade A.

Rest of all runs have problems with cold and last records.

Data cannot be processed: afs backup, xml uploading.

80+ modules need to be retested.

Prior to this period the LT test results were fine (all grade A).

Problem appears with sub-type 20 hybrids.

Problem is being investigated with help from P. Gartung



Rod Testing Status

UCSB received a first shipment of re-qualified rod frames from CERN last week and FNAL should receive its first shipment in a day or two.

The single and multi-rod systems at both sites are basically ready for production rods.

Rod qualification and grading criteria will be developed as we get experience in testing production rods.

The largest concern at this point is the appearance of intermittent APV header errors after many hours of running in either the single or multi-rod systems.

- Some evidence that this is restricted to particular rods, particular modules, and particular APV's.**
- It is important to understand the source of the errors.**



Testing Summary

Hybrid and module fast testing is solid at both sites.

However, the hybrid test needs to be shortened if we are to have a cushion when we go to higher testing rates.

FNAL has had some I2C errors starting in the LT cold cycle for 6-APV, sub-type 20 TOB hybrids.

This has led to a backlog of ~80 hybrids that need to be retested.

This condition has not been seen at UCSB.

Successful LT test almost never reveals a new problem at either site.

Assembly and testing of (re-)qualified rods is only now beginning

Initial results from 8 non-qualified rods with qualified modules in the FNAL multi-rod system are very encouraging.

It is still important to understand the source of header errors seen earlier.