Commercial APIC versions in prep. for sales for 2017*

3 versions:

APIC-MPGD  fast MPGD’s (25ns/400ns) for high rate up 1 MHz
APIC-MPGD-H  fast MPGD’s (25ns/400ns) for high rate up 3MHz
APIC-MPCC  high capacitance/charge MPPCs 1us/10us up 50 kHz (prelim)

“NIM in a box”, 0.8kg, 24h autonomy, solar panel charger

APIC internal Modules
- CSA + Shaper slow/fast
- NIM Trigger
- Bias Voltage for Si detectors
- Lithium Power management

* SRStechnology.ch

APIC for RD51, WG5 Philadelphia Mai 2017
APIC basic version*: CSA preamplifier, Shaper fast/slow

Test signal 1 kHz

- DC input to CSA (BNC)
- AC input to CSA (SHV)
- 390 pF / 4.7 nF coupling selector
- HV to AC input filtered (SHV)

- CSA preamplifier 50 OHM output
  - 0.5mV/fC 2ns risetime, 0.5 us falltime

- Shaper selections 25 ns – 400 ns
- Baseline selections: variable – fixed – zero

NIM cable power
Battery status display
Solar LiPo charger plug
Gain pot. 1..1000
complementary shaper outputs
Baseline pot +/- 2V

APIC for RD51, WG5 Philadelphia Mai 2017
26/05/2017
APIC internal modules:

- APIC (preamplifier-shaper) includes Battery and charger plugs

- NIM Trigger and AUX power Unit

- HV Bias Unit (10-110V Option so far)
**APIC PREAMPLIFIER-SHAPER MAINBOARD**

**SHV**
- HV bias Input
- max + -4K V

**HV shield**

**+/− SHV**
- (AC input)

**+/− BNC**
- (DC input)

**2.7M Ω**
- 4.7nF, 5kV

**4.7nF 5kV**
- Spark protection

**Q(Δt)**

**390pF 1kV**

**Input selector switch**

**NIM Test out**

**SHV (AC input)**

**2.7M Ω**
- 4.7nF, 5kV

**+/− SHV (AC input)**

**4.7nF 5kV**
- Spark protection

**1.5M Ω**
- 4.7nF, 5kV

**CSA PZ VGA**
- CSA (50 W)

**Shaper**
- $\tau_p = 2 \tau_s$
- Highpass
- Lowpass
- 2nd Order

**Driver OUT**
- $V(t)_{\text{peak}} \sim Q(\Delta t)$

**Test pulse on/off/(on)**

**Gain = 1**

**Gain = 4**

**Gain = 15**

**50 Ω**

**SHV (AC input)**

**SHV HV bias Input**

**CSAmon**

**PL9 test charge inject**

**PL15**
- permanent
- TEST pulse on/off/(on)

**Gain = 1**

**Gain = 4**

**Gain = 15**

**U_{\text{ref}}**

**PL10 test charge inject**

**PL10 test charge inject**

**Gain = 1**

**Gain = 4**

**Gain = 15**

**U_{\text{ref}}**

**Shaper selector Switch**

**V(t) \sim Q/C_f \left[t/\tau_p\right]^2 \exp\{2 [t/\tau_p]\}$

**U_{\text{peak}} \sim Q**

**APIC for RDS1, WGS Philadelphia Mai 2017**

**26/05/2017**
shaper output 50 OHM +/- 1.5 V linear invert and non-invert
Power on, red LED
Battery charging mode, green LED
Low Battery, blinking LED
Battery charger +/- Volt from PS or solar panel up to 65V
Direct NIM standard preamp power (RS232 cable)
Direct round Jack DC power +12V 5.5mm Dia

20 turn potentiometer for gain 0 ...1000
20 turn potentiometer for variable baseline mode
Gain voltage for gain determination
APIC GND plug 4mm Banana jack

APIC for RDS1, WGS Philadelphia Mai 2017
Detector signal / HV input schemes

DC = direct input to CSA preamplifier, must be very small signal
AC = input to CSA via capacitor selection 360pF(DC enabled)/4.7nF(DC disabled)
AC = detector input (mesh etc.) with AC coupling as selected 4.7nF/360pF
HV bias = input via 2.7MOHM and LC filter to AC input for HV supply of detector mesh
CSA preamp output and Shaper selector side

CSA preamplifier output, 50 OHM
Gain V/V=4, both polarities, tr = 2ns

Shaper selection, peaking time
MPGD fast = 25 ns, slow = 400 ns
MPPC fast = 1 us, slow = 10 us

Temp. compensated var. baseline +/- 1.5 V
zero/fixed baseline 0 V
HV bias and Test pulse

HV bias option 10V...110V filtered for solid-state detectors (APD, Si PM, photodiodes, CVdiamond, etc)
UMON= direct HV unfiltered for DVM

Test pulse NIM output square wave, rate fixed via trimmer pos. signals on rising edge, neg. signals on falling edge single or permanent trigger via actuator switch
Use of clip cable -> short edge pulse to trigger UV LED
NIM Trigger Option side

- **P-Z** positive signal threshold
- **P-T** positive input triggered
- **N-T** negative input triggered
- **N-Z** negative input threshold
- Discriminator trimmer for positive and negative APIC input
- LED indicator for discriminator settings
- Complementary NIM output 50 OHM, 30-50ns pulse width depending on threshold
APIC RESPONSE TO TEST SIGNAL

Measurements with unconnected APIC

**Time domain 10 ns**
Test signal -> CSA internal response (probe)
  -> CSA external response 50 OHM

**Time domain 500 ns**
Test signal -> CSA step+ longterm decay shape
  -> Fast shaper signal
  -> Slow shaper
PULSE TIME AS FUNCTION OF DETECTOR CAPACITY

$C_D = 0 \text{ pF}$

Fast shaper

Slow shaper
PULSE TIME AS FUNCTION OF DETECTOR CAPACITY

$C_D = 200 \text{ pF}$

Fast shaper  Increased noise and risetime  Slow shaper  low noise and normal risetime
Noise short/long shaper for $C_D = 390\,\text{pF}$

Short shaper, $C_D = 390\,\text{pF}$
important noise and increased peaking time

Long shaper, $C_D = 390\,\text{pF}$
tolerable noise normal peaking time

for $C_D > 400\,\text{pF}$, long shaping time preferable
**APIC NIM TRIGGER**

Shown trigger selection:
- Trigger on positive CSA = negative input

Not shown, other trigger selections:
- Trigger on negative CSA = positive input
- Trigger on both negative and positive

**Trigger details:**
- Trigger delay ca. 25 ns after rising edge of CSA preamplifier
- Trigger pulse width 10-50ns tunable via internal trimmer

Complementary NIM out
Miniaturized power supply for MPGD’s (ongoing)

Active voltage generator/divider for MPGs up to 9 fields

1. HV module up 5kV
2. Active MPGD field generation with user-defined resistor configurator
3. Max. 9 fields (4 GEMS + Drift)
4. Rate-independent active fields
5. Glitch-free, proportionally coupled MPGD fields
6. Short circuits on single GEM does not alter the other fields
7. Prompt e-Fuses for detector currents O(10uA) adjustable
8. Spark energy quenchers on all fields
9. Realtime Voltage and Pico-ampere measurement on up 4 GEM stages
10. Control, and monitoring with parameter display
11. Manual control panel

**AVD NIM box** with 3 functional units

- Prototype NIM box with HV and monitoring board exists
- Preparing for distributable prototypes
AVD STATUS

- 1st AVD prototype tested for ALICE TPC upgrade in 2014/15
- GDD upgrade with Arduino control, e-Fuses, HV and picoamp readout in 2015
- Upgrade from external HV supply to internal HV module -> complete & compact
- summer student 2016: 1st Arduino controlled AVD – NIM

Planned 2017 Summer activity
- merge all AVD modules in a NIM box dual width 4 modular PCB’s
- test a new, alternative HV module
- new MPGD field configurator: plugin instead of individual resistors
WHERE TO BUY SRS

( this is the most difficult about SRS )

SRS procurement until 2016

INHOUSE production RD51 (basically all early systems)

CERN Store (from producers like Rentron, Prisma, NEOHM etc)
https://edh.cern.ch/Document/SupplyChain/MAG

AVP hybrids, FEC + ADC cards, Minicrates, HDMI cables, SRS accessories

However!!! Only via team account, delivery only to CERN, APV purchase restrictions

EicSys http://www.eicsys.eu/

Blades, RTM cards; ADC mezzanines waiting for news and testbeam qualification

SRS procurement from 2017+

INHOUSE production RD51: stopped!

CERN Store: continued for team account owners only

NEW SRS production and purchase licences* 2017

No team account? ask CERN/KT for SRS purchase licence

Direct SRS sales starting in 2017:

SAMWAY Electronics: http://www.samwayelectronic.com

SAMWAY FEC and ADC cards, Eurocrates, SRS-ATCA mezzanines etc

SRS Technology: http://www.srstechnology.ch

SRS APIC, hybrids, Powerbox, DVMcards, SRU, AVD etc

APIC for RD51, WGS Philadelphia Mai 2017

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**APV (Analogue)**

**APV (250 nm CMOS)**
- Pipeline depth: max. 192 clocks
- Trigger latency: max. 3 us
- Noise: < 500 e- intrinsic > 750..1400 e- on detector
- Dynamic range: 25 fC
- Detector capacity: 18... < 60 pf
- ADC ext. 4096/1000 [counts/baseline]
- Gain: fixed CSA gain 100uA/mip, 5 output signal gains (in step of 20%)
- Timing jitter: $\frac{1}{2}(1/fc)$ [+– 12 ns]
- Shaping times: 50 ns adjustable to 80 ns
- Max readout rate (few samples): 5 kHz

**VMM (Digital)**

**VMM (130nm CMOS)**
- Pipeline depth: 64 digital frames (peak)
- Trigger latency: (self triggered) or L0 (12.8 us)
- Noise: < 400 e- on 10x10 detector reported
- Dynamic range: expect >> 25 fC
- Detector capacity: 30pF ... < 1nF
- ADC: embedded, 10 bit
- Gains: 8 CSA gains [0.5..16mV/fC]
- Timing jitter: 20 bit t-stamp, 1ns resolution
- Shaping times: 4 [25...200 ns]
- Max readout rates: estimated 1 MHz/ch
ADAPTERS  PANASONIC-HRS

Panasonic 130pin_male

Hirose male 140 pin

Hirose 140pin female

Panasonic 130 pin female

Adapter Hirose to Panasonic