

# HV Unit Status

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# Approach to the HV System

- HV unit provides the single regulated voltage to be used with PMT-specific divider (base)
- Individual HV units are monitored locally by micro-controller interfaced to the PMT electronic channel
- General control and parameters setup is done through the Global Control Unit (GCU)

# JUNO HV Unit development

## MARATHON Ltd affiliated with MSU

 **Family of HV Digital voltage sources (mainly for PMT)**

Marathon Ltd. in 2013 started internal R&D program focused on the development of the digital programmable industrial HV power supply family for PMT

HV2000-2 – unipolar, 2 ch, 0- 2kV , 0,5mA, "Euro- mechanic 2U – 19"	HV2000-1/18 – unipolar, 2 ch, 0- 2kV , 0,5mA, "Euro- mechanic 3U – 4H"	Voltage step of Umax- $10^{-4}$
		Temperature stability- 50 ppm/K
		Ripple - $< 2 \cdot 10^{-5}$
		Programmable ramp up and down
		Open, CiA DS-401 remote control

DC-HV-Juno- "±" or "±", 1 ch,  
In- 24V Out- 0-3kV, 0,3mA,  
50x40x20 mm or Ø 50x25 mm  
RS-232

- schematic – ready
- prototype - under tests
- control algorithms - ready
- PCB under routing
- first samples – in 5-6 weeks

Design based on conventional transformers

## HVSYS- affiliated with JINR

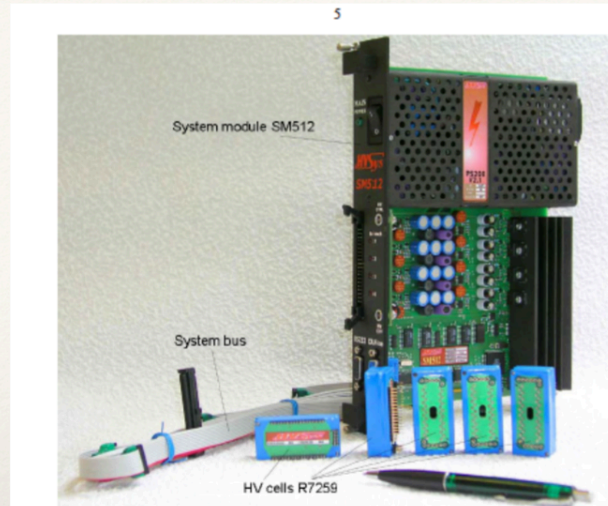


Fig.3 SM512 module and multichannel PMT cell for Hamamatsu R7259, University of Mainz (Germany).

### 2.3 High-voltage cell for PMT powering

Design based on Cockroft-Walton chains

Two Russian companies are working on the JUNO HV units design supervised by JINR

# Parameters request for HV unit

Specification HVU have been finally fixed at the PMT Dubna meeting in May 2015

1	The scheme of PMT connection, grounded	Cathode	HV divider with decoupling capacitor needed
2	Regulation range of the anode voltage, V	1500 to 3000	?
3	Step of regulation of the anode voltage, V	0.5	
4	Ripple. $V_{ptp}$	0.01	At 3000 V
5	Systematic error of the output voltage, %	3	
6	Stability of a PMT voltage, %	0.05	
7	Output voltage temperature coefficient, ppm/°C	100	
8	Maximum anode current, $\mu\text{A}$	100	up to 300
9	Input voltage ( $V_{bais}$ ), V	24	
9	Remote control channel	RS-485(?)	
10	Dimension about, mm	50x40x20	Non waterproof



# JUNO HV unit 1<sup>st</sup> prototype

According to the specifications both companies (HVSYS and MARATHON) started work on the pilot set of the HVU

- ❖ JINR placed an order of 50 HVU and 3 controllers at HVSYS (CW) – expected by December, 2015
- ❖ MARATHON is working on 5 units (expected in 2-3 weeks) to test them, and (if OK) is aiming to provide 50 units with controllers by December.
- ❖ Both sets will be available for the interested labs and for use with the JUNO prototype

Both companies have produced prototypes which are undergoing tests at IHEP

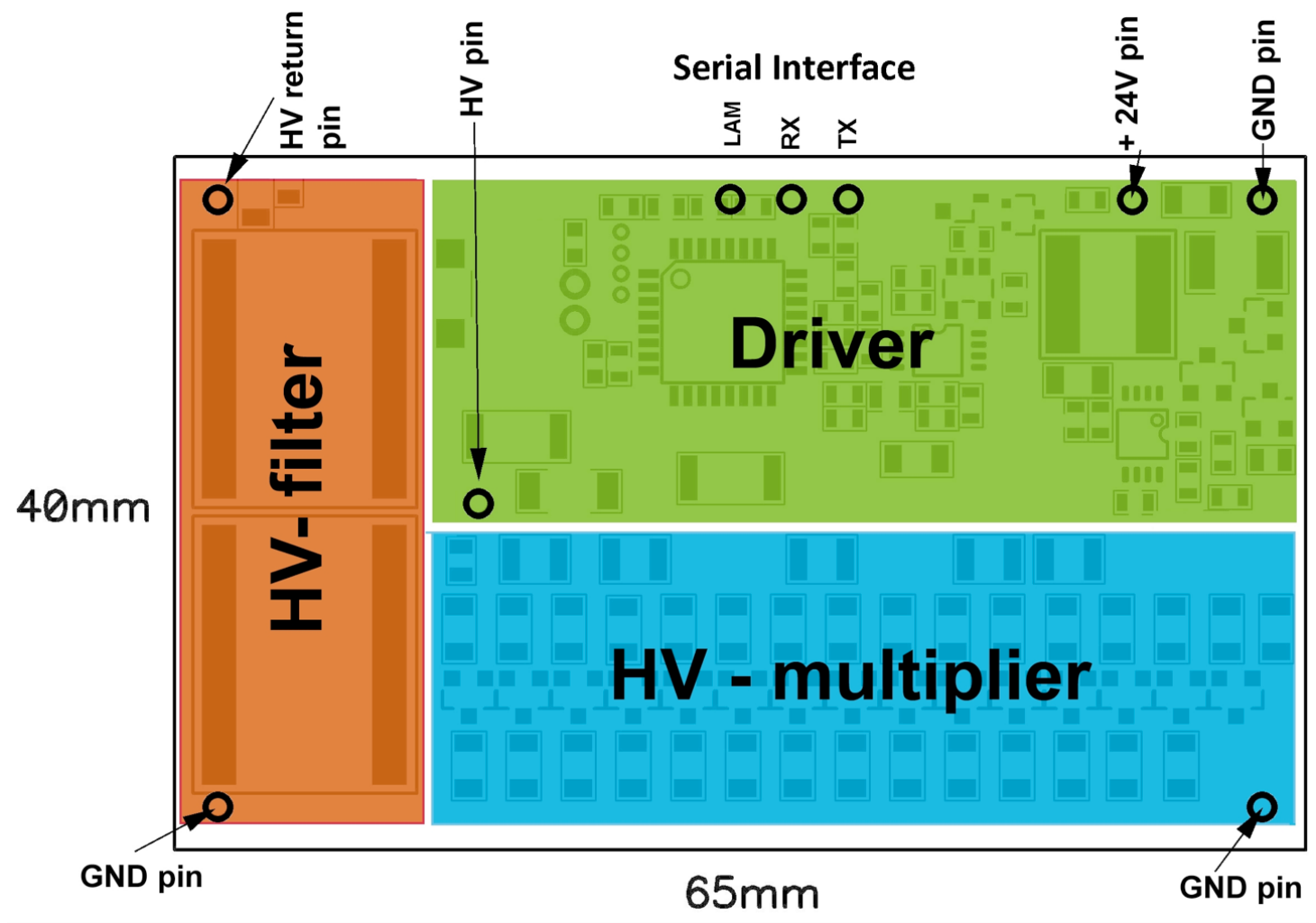
Trying to use the advantages existing at either of the companies we have agreed on the approach of a combined contract for the second prototype, namely:

- ✓ Design at HVSYS and Production and factory tests at MARATHON

# Steps of the contract

- HVSYS produce a design for cross check with JUNO electronic group and introduce modifications, if necessary.
  - Now
- The design is transferred to MARATHON for implementation, evaluation, estimate of components ordering, etc.
  - ASAP
- Few samples are produced for design validation tests at HVSYS.
  - End of 2016
- Contract with MARATHON is concluded for a few hundred of second prototype samples.
  - Jan/Feb 2017

# Contract First Step design by HVSYS



# HVSYS comments

- HV module is based on double sided printed circuit board. Components are mounted only on one side (top) of the PCB. The size of the PCB is 65\*40 mm, see figure 1.
- Copper screen is used to minimize background produced by the high frequency driver of the module. The copper screen has a thickness of 0.3 mm and has to be soldered over whole perimeter to the PCB. Inner space of the module is filled by two component silicon sealant.
- For electrical connection following pins are used:
  - 4 ground pins (including one HV return pin) located at corners of the module
  - 1 pin +24 Volt power supply
  - 2 pins serial (RS232) interface
  - 1 pin LAM – look at me signal
  - 1 pin HV output located far enough from low potential parts.
- All pins are of diameter 0.5 – 0.8 mm and they are soldered to HV module. We propose also to solder them to the carrying PCB although use of pin and socket is also possible.



# Additional remarks

- For the second prototype special attention was paid to the critical components indicated by several reliability calculations.
- It is planned to check the radioactivity of different components (thanks to the work of the Milano group).
- However from practical point of view, we can probably influence (optimize) only the sealant. Therefore, the priority should be given to that.

# Summary

- JUNO HV Unit second prototype design was issued for cross check.
- It was found that the GCU/HVU interface in this design will probably need final adjustment. We expect a decision on that at this meeting.
- The HVSYS design of second prototype is transferred to MARATHON for production of validation samples.
- After that the production of a few hundred units will be launched.