

The southern hemisphere's first X-band radio-frequency test facility at the University of Melbourne.

CLIC Project Meeting Dec-2022



X-BAND LABORATORY FOR ACCELERATORS AND BEAMS

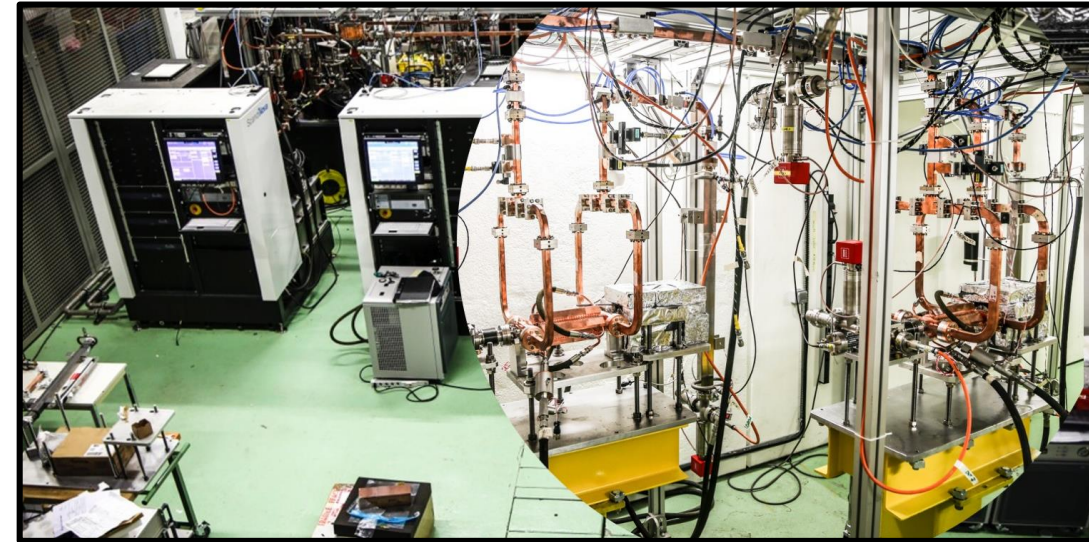
Matteo Volpi on behalf of the group:

Suzie L. Sheehy , Roger Rassool, Geoffrey Taylor, Scott David Williams, P. Giansiracusa, P. Pushkarna
(The University of Melbourne), Rohan Dowd, (AS - ANSTO)

X-band Laboratory for Accelerators and Beams (X-LAB)

- A new laboratory is under commission at the University of Melbourne (UoM)
- First high-power, high-frequency accelerator laboratory in the South Hemisphere.
- Testing high gradient structure prototype and RF components for CLIC
- Ultra-precision manufacturing
- Design and develop more widely available high quality x-ray sources
- This project will provide local researchers and students with an opportunity to make significant advances in accelerator design
- Excellent potential for applications in medical radiation therapy and beyond

$\frac{1}{2}$ XBOX3 \Rightarrow Mel-BOX



Long Journey



On 16 September 2020, a container filled with half of a CERN high-gradient test facility left CERN's Meyrin site to embark on a two-month sea journey to the other side of the world.



ABOUT

NEWS

Xcitement down under: Australia gets first X-band facility

Half of a CERN high-gradient test facility embarks on a new life at the University of Melbourne

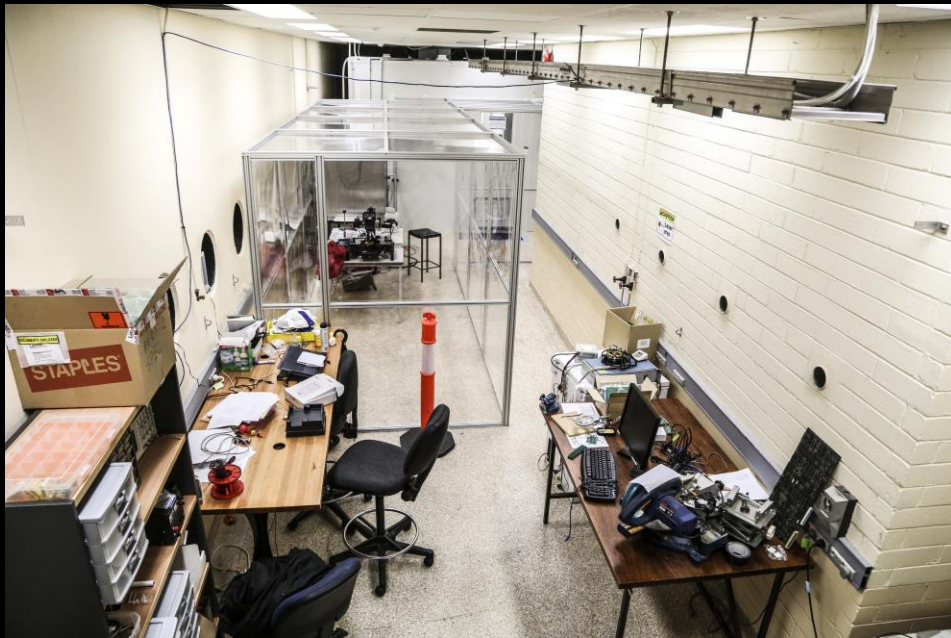
15 JANUARY, 2021 | By Achintya Rao

CERN news!

Melbourne



Melbourne bunker evolution



Melbourne bunker evolution



X-LAB

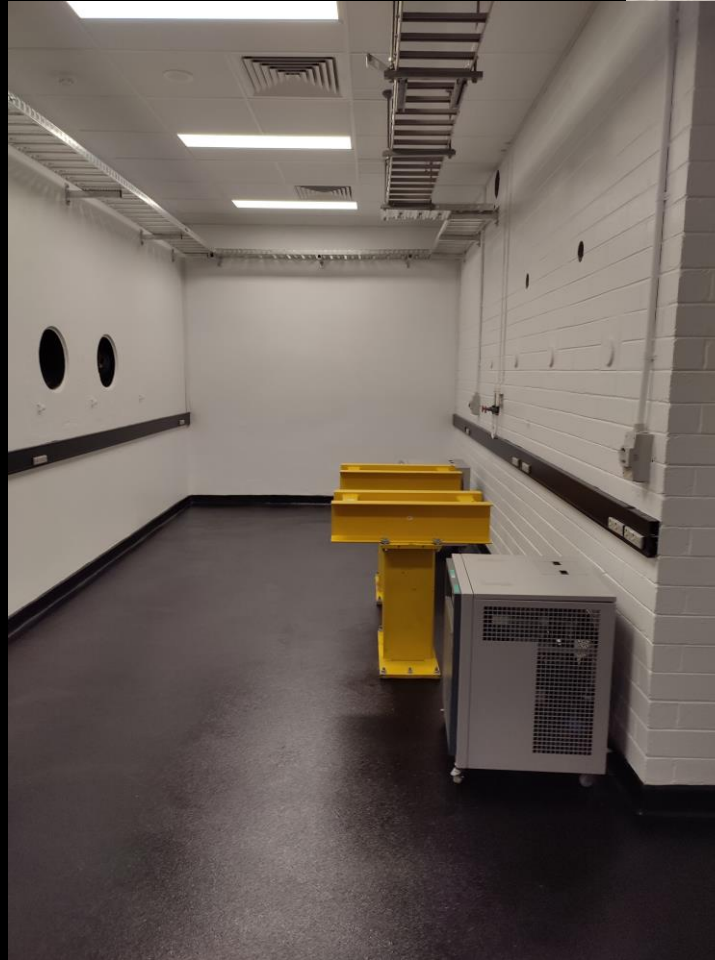
- Previously (1970) used for 35 MeV betatron
- ~80m²: Space for x-band linac and medical applications



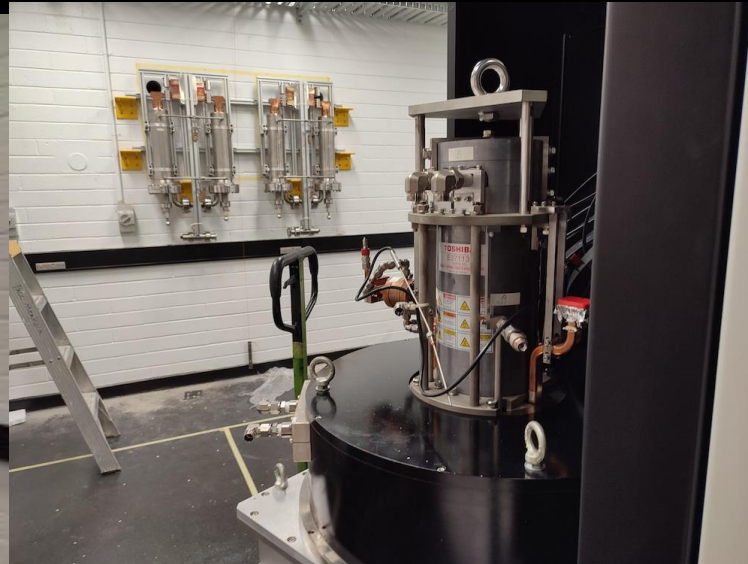
Melbourne bunker today



Melbourne bunker today



Mel-Box installation



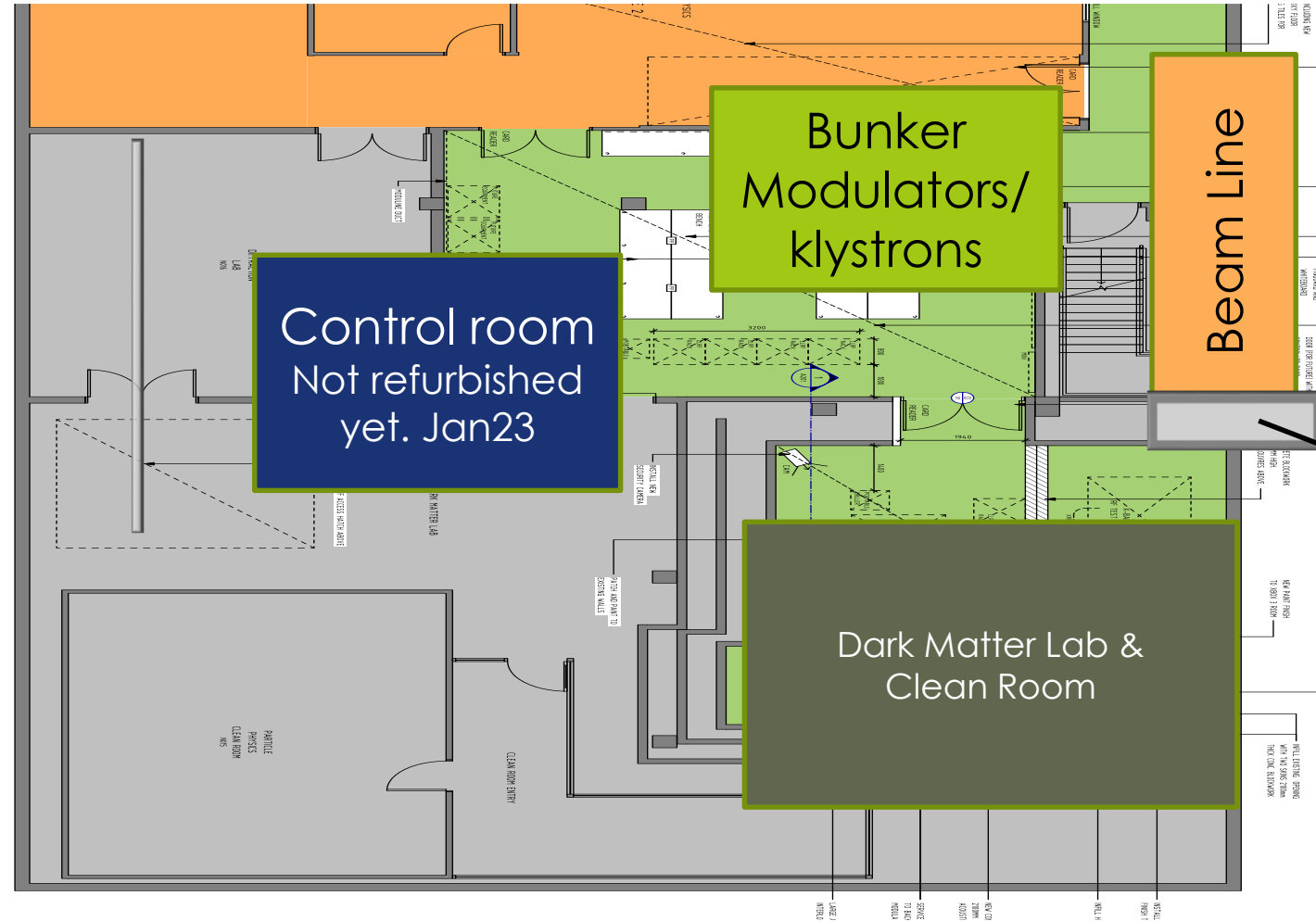
Basement Lab: The “X-Lab”

Control room~ 60m²

Bunker ~ 50m²

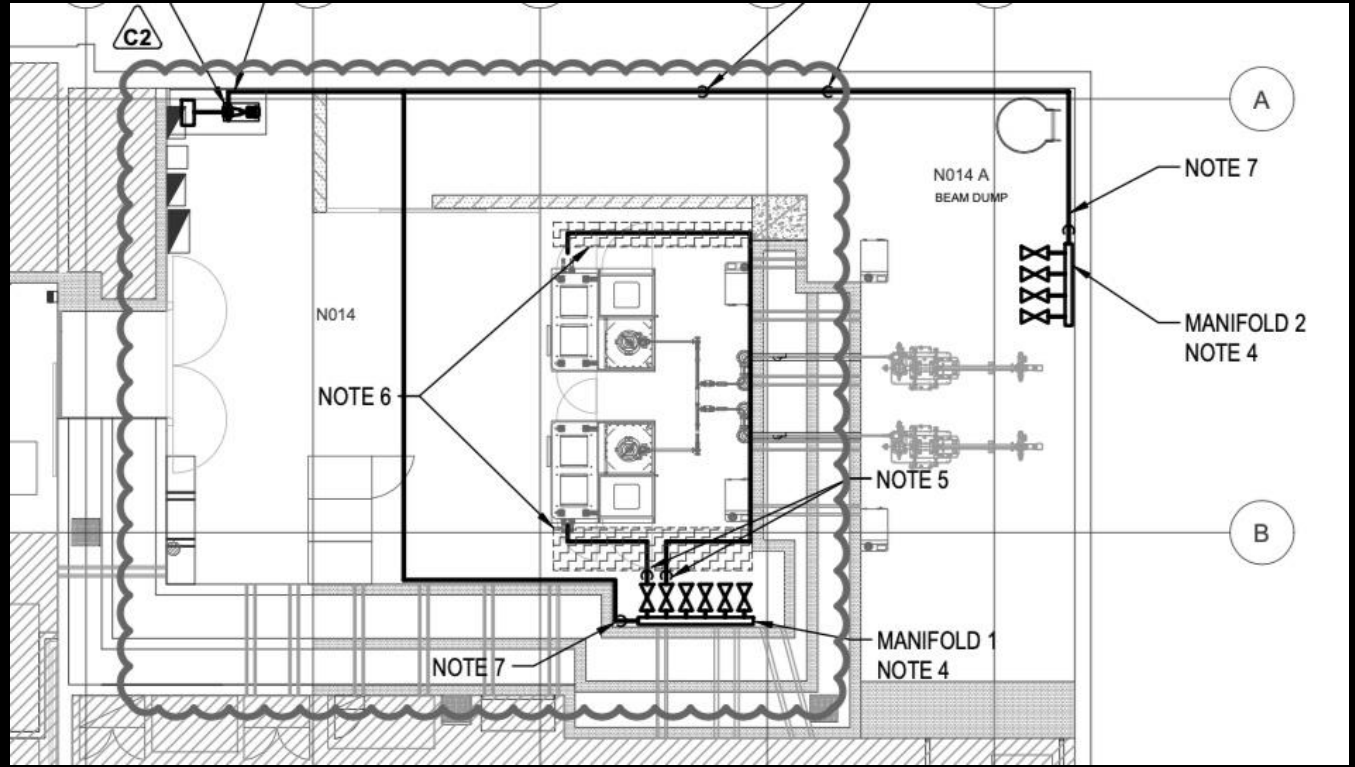
Beam Line ~25m²

Pelletron
&
1-4 MeV proton
(beamline test
area)



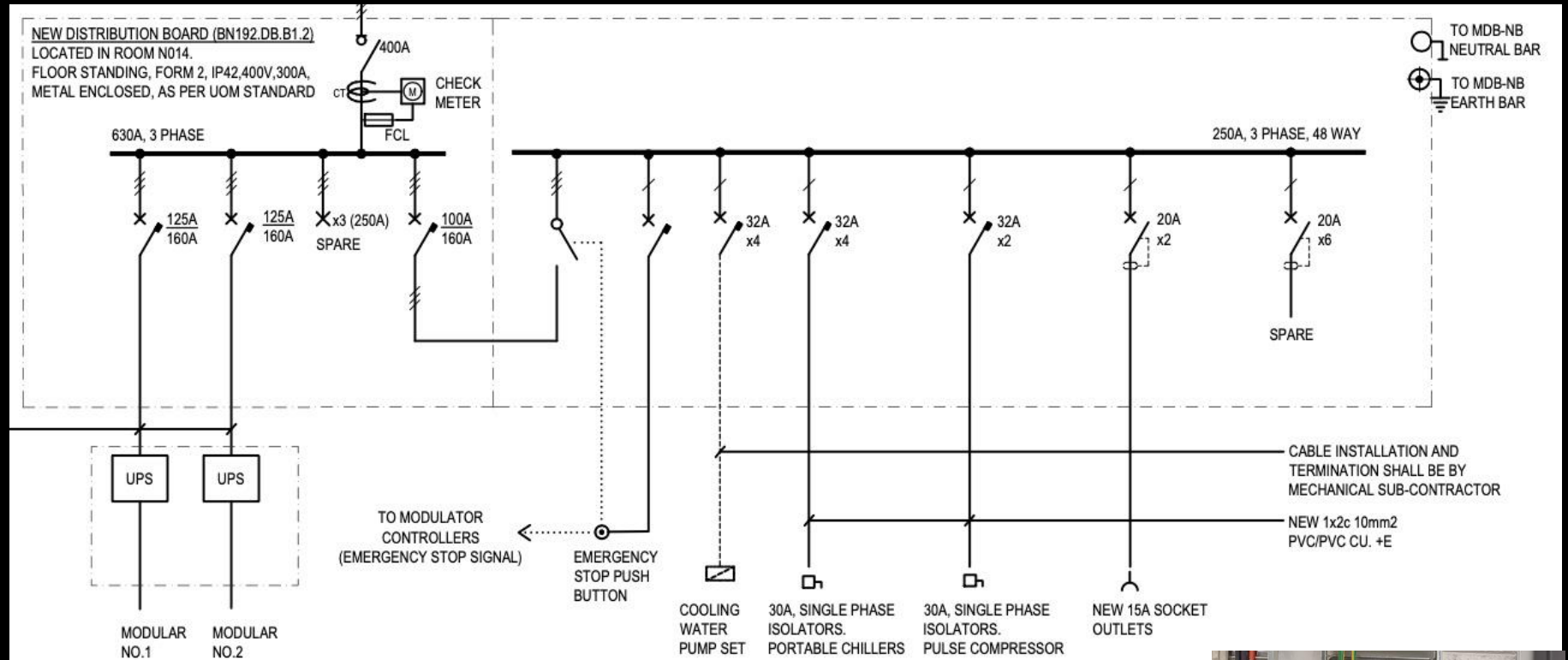
80cm thick
new wall

Low Conductivity Water

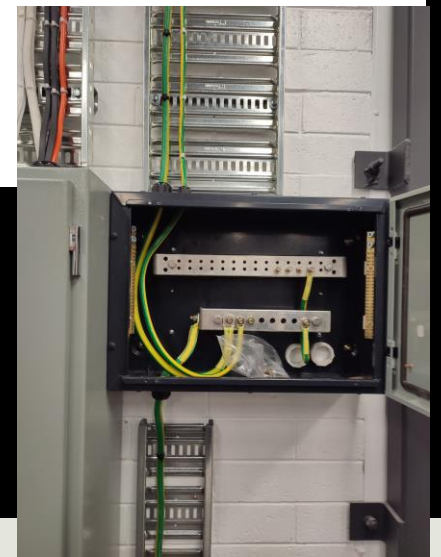


- Each Modulator unit needs
 - Flow: 80-135 l/min. Limited by water pressure max 10 bar.
 - Pressure drop: ~4 bar at 80 l/min
 - Water temperature : 10-40C° (non-condensing)
- Temperature interlocks
- Humidity control to prevent dew point
- Insulated water pipes

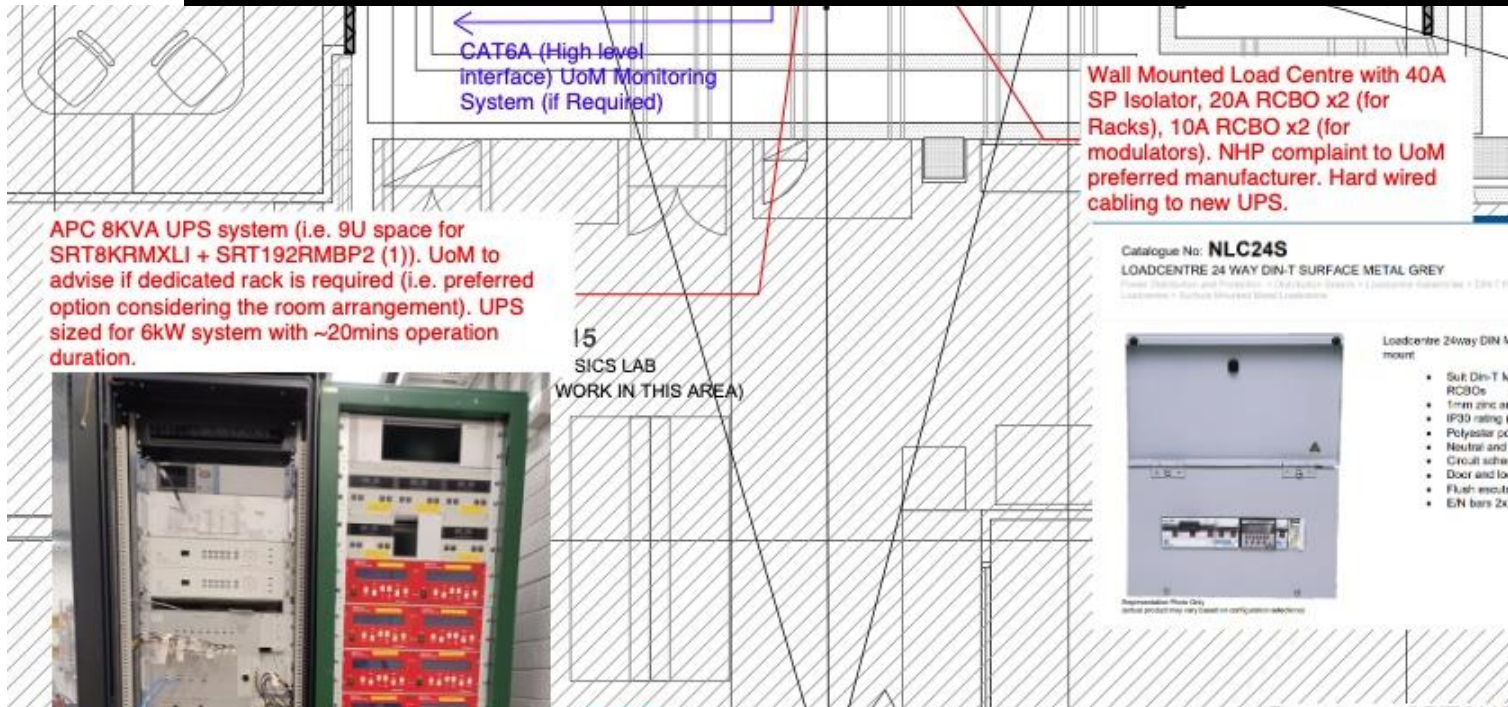
Power Distribution Units



DISTRIBUTION BOARD SCHEMATIC



UPS system



UPS system will support the rack equipment and modulators' single-phase supply (i.e. for the controls) only.

With the estimation of 6kW (i.e. 4A for each Modulator and 10A for each Rack), we propose an **8kVA UPS** (APC, SMART UPS) which can sustain more than 15min. operation



APC Search apc.com

Products & Services - Solutions - Support - How to buy - Partners & Alliances

Home > All products > Uninterruptible Power Supply (UPS) > Network and Server > Smart-UPS On-Line > SRT192RMBP2

View all Smart-UPS On-Line

APC Smart-UPS On-Line, 8kVA/8kW, Rackmount 6U, 230V/400V, 6x C13+4x C19 IEC outlets, Network Card+SmartSlot, W rail kit

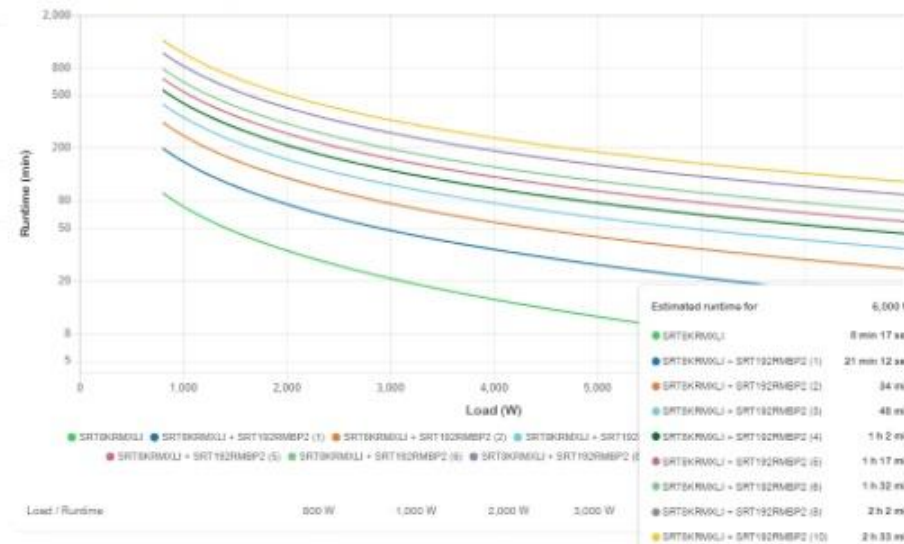
APC 8K 8000W Compare

APC Smart-UPS SRT 192V 8 and 10kVA RM Battery Pack

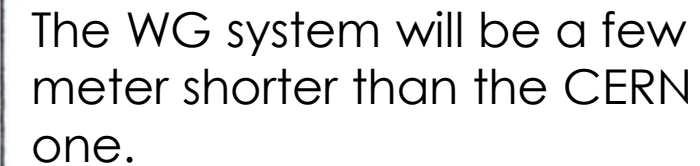
SRT192RMBP2 Compare

Buy Online

Runtime: SRT8KRMXLI



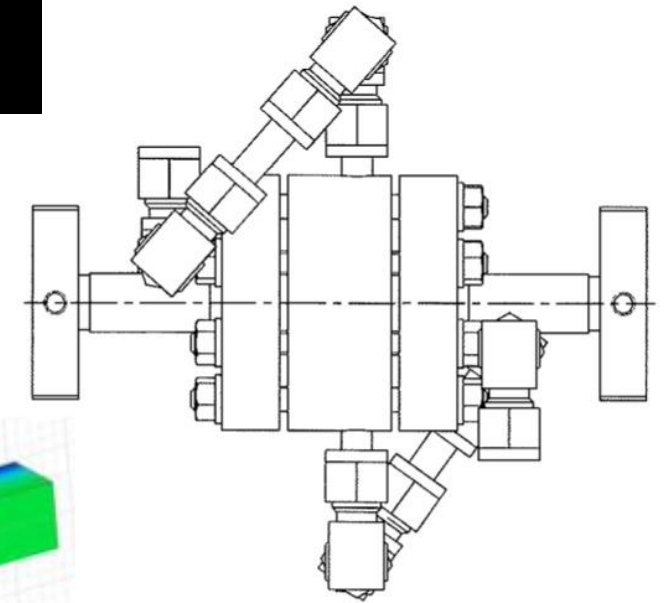
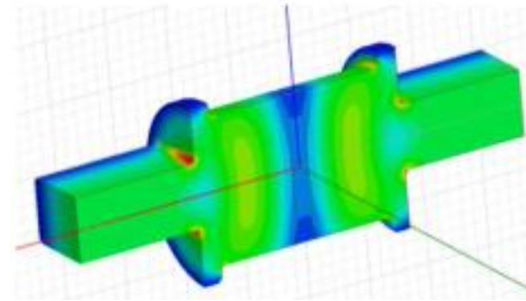
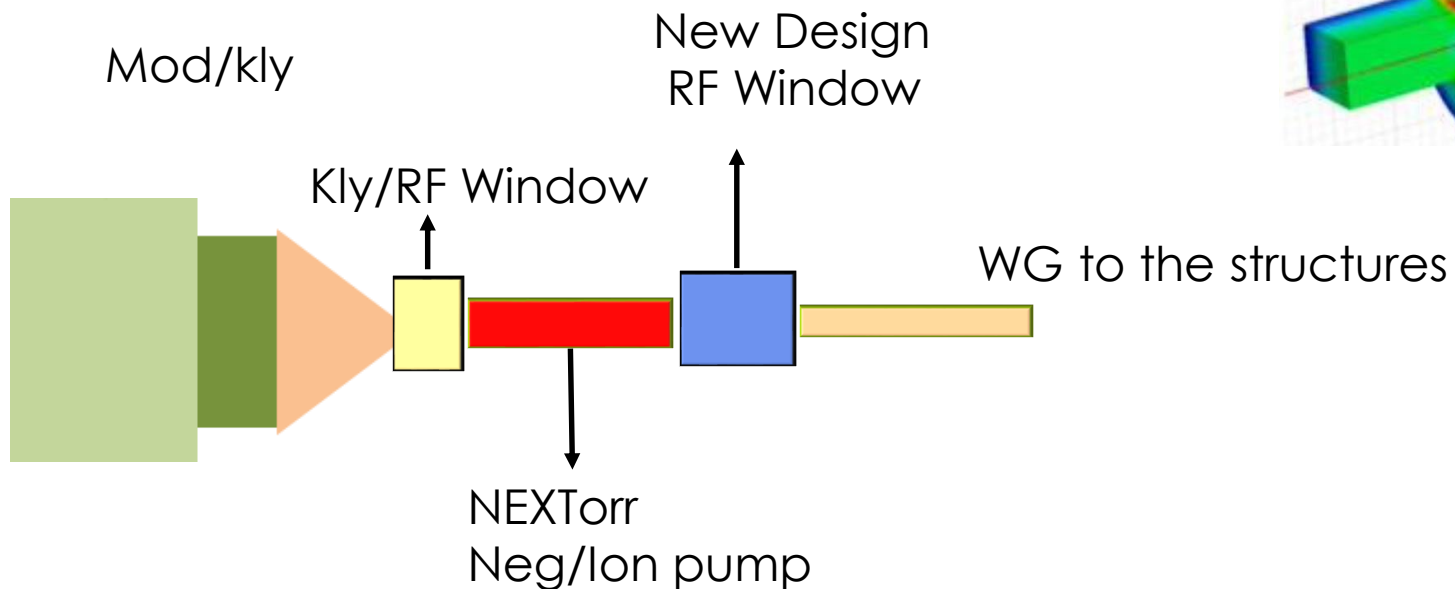
13



1m of WG => 0.1dB (2.3%)

What it is different ?

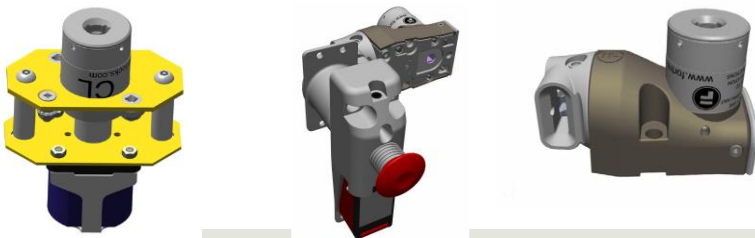
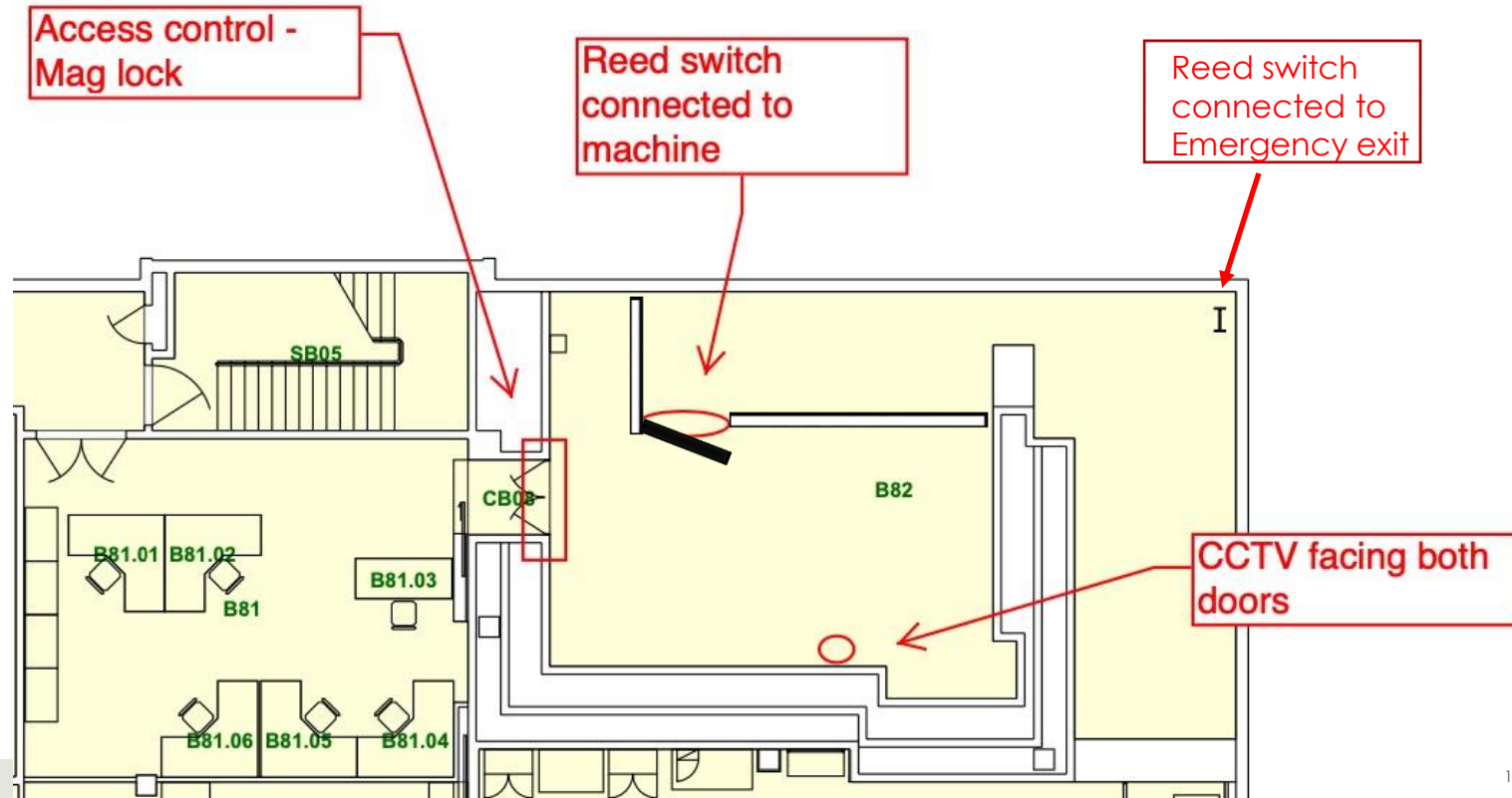
- We add an **extra RF window** to each Modulator unit
- Compact window with travelling wave in ceramic with higher RF power capacity than in existing device.



| | Value | Units |
|---------------------------|-----------|-------|
| f_0 | 11.9942 | GHz |
| P_{IN} | 10 | MW |
| Material | Al_2O_3 | |
| Relative Permittivity | 9.8 | |
| Dielectric Loss Tangent | 0.002 | |
| S_{11} | -55 | dB |
| S_{21} | -0.03 | dB |
| $E_{Max \text{ Ceramic}}$ | 3.9 | MV/m |

Safety, Interlocks and control Algorithms

- Main personal safety issue is X-ray radiation during operation.
 - Interlocks on the bunker door and klystron/modulator access doors
 - Stop modulator pulsing if opened.
 - Modulator interlocked is radiation levels are too high inside or outside of the bunker.
 - **Installation of fortress e-stop (limiting switch) – for emergency egress (in case lock is engaged with someone inside)**
- Reed switches installed to emergency exit door exiting into loading
- CCTV camera
- Machine protection issue is from high vacuum and reflected power to the klystron (Same of CERN)



Radiation monitors



RADIATION DETECTION

DPU-3 Area Monitor

Part of the WebiSmarts System



DESCRIPTION

WebiSmarts is a web-based software package which receives online radiation data from DPU-3 Area Monitors which are strategically installed throughout the cyclotron lab. Users can access maps showing radiation levels on color-coded points therefore presenting a detailed yet concise radiological map.

The DPU3 is the latest addition to the renowned MediSmarts Area and Stack Monitoring System. Combining the same respected reliability which has made MediSmarts a world leader, with the latest state-of-the-art technology, the DPU3 brings the 21st century into your laboratory. The plastic (IP65) cased data processing unit is capable of supporting one internal and three external detectors.

FEATURES

- Automatic recognition of detectors
- Supports our full range of detectors and others
- Provides Wi-Fi, Ethernet, PoE, Xbee, RS-485 and USB connectivity
- The wide screen TFT color Display is configurable to show any of the parameters
- The Display can be setup to show up to four displays simultaneously
- Optional battery backup for nine hours after power failure
- Free software for diagnostics
- Calibration performed via the touch panel or remotely
- Data records are internally saved for a period of one month in cyclic fashion



DPU-3 Monitoring Channel with Wide Range Internal Detector

- Measuring Range: 0.1 uSv/h to 10 Sv/h (0.01 mR/h to 1,000 R/h)
- Sensitivity: 17 cps/mR/h, 0.3 cps/mR/h
- Energy Range: 50 keV to 1.3 MeV
- Accuracy: $\pm 10\%$ over the full measuring range

Looking for monitor software ☺

Type of Radiation: Gamma and X-Ray.

3x

GM-42 Detector



| | |
|-----------------------------|--|
| Geiger Type | ZP-1201 or equivalent |
| Measuring Range | 0.1 μ Sv/h to 10 mSv/h (0.01 mR/h to 1 R/h) |
| Sensitivity | 17 cps/mR/h |
| Accuracy | $\pm 10\%$ reading within the measuring range |
| Energy Range | 50 keV - 1.3 MeV |
| Energy Dependence | $\pm 20\%$ |
| Angular Dependence | Less than $\pm 20\%$ for $\pm 45^\circ$ of preferred direction |
| Temperature Range | Operation: -10°C to $+50^\circ\text{C}$ Storage: -20°C to $+60^\circ\text{C}$ |
| Humidity Range | 40% to 95% RH (non condensing) |
| Dimensions: | 197 mm (7.75") Length x 38 mm (1.5") Diameter |
| Weight | 250 gr (0.55 lb) |
| Casing | Aluminium, splash proof |
| Hook-up cable length | up to 100 m |
| Output signals | TTL pulses (5V, 5ms) Detector status logic: Identification, malfunction, overflow |

NOTE: Radiation Management Licence (RML) submitted, covering all ionising radiation activities within the University

Local Manufacturing

- **Australian National Fabrication Facility (ANFF):** already manufactured a W90 to waveguide adaptor
- Making progress:
 - tried diamond milling on the new precision 7 axis machine
 - capability upgrades of ultra-high precision turning and milling machines.
 - looking for CMM
- Thy to make the disk just after Christmas.
- NOTE: for beam line commissioning we would like to use a 100keV DC photogun.
 - We are investigating the use and “manufacture” a low beta acceptance X-band accelerating structure. (S. Williams, IPAC2022, Bangkok, Thailand, ACoW Publishing ISBN: 978-3-95450-227-1 ISSN: 2673-5490 doi:10.18429/JACoW-IPAC2022-THPOST006)

Specification

ANFF-SA were tasked to fabricate 1 W90 adaptor flange from 316LN to drawing specification 2021 052 F P001.

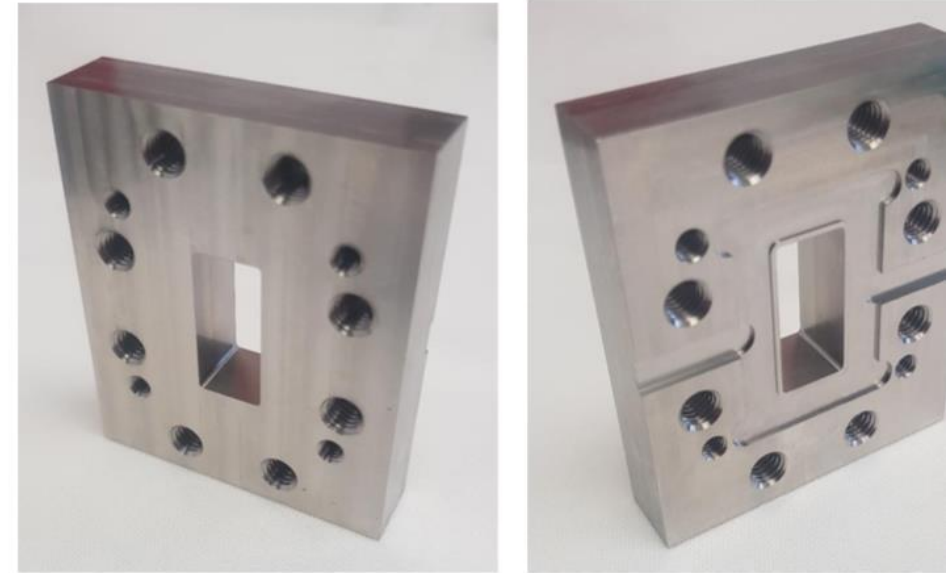
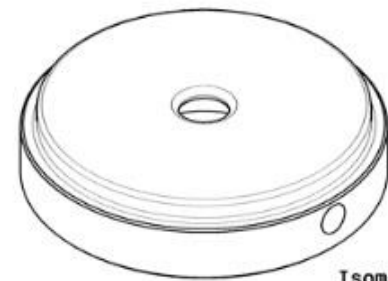


Fig 1. Images of finished part (front and back).

CERN: T24 disk



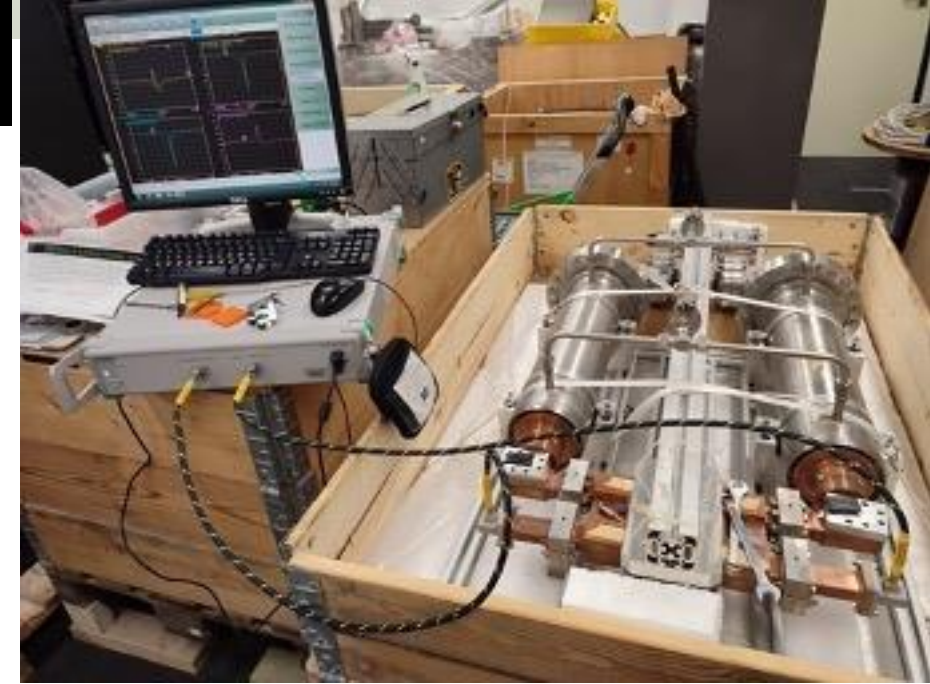
Isometric view
Scale: 2:1

Standard disk

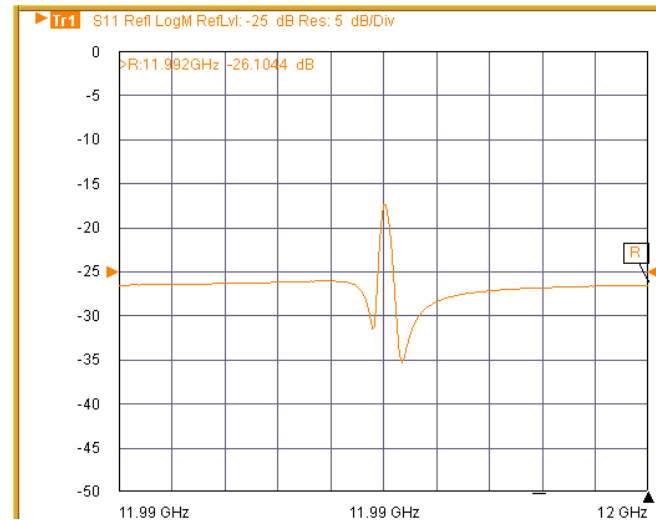


Short term plan

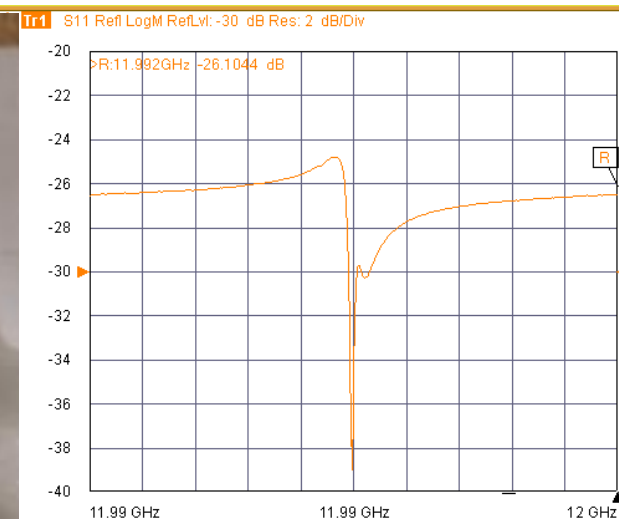
- Instrumentation available.
 - 2 Port VNA
 - 2 x power Meters
 - RF pulse generator
 - Baking RF structure/components: vacuum oven available at the Aus. Synchrotron (AS) $1e-3$ @ 200 degC
- ToDo list
 - Modulators commissioning/conditioning (Feb 2022)
 - Extra RF Windows + load, only
 - Baking RF structure/components
 - Bead-pull (structures)
 - Pulse compressors calibration
 - ...
 - Rebuild the WG system



Before tuning



After tuning



Conclusion

- The project is moving forward, many thanks to the CLIC collaboration
 - Refurbishment of the bunker is ready, it will be commission before the end of the year
 - Modulator commissioning - Feb 2023
- Welcome to visit the facility!
 - Help and support are more than welcome !
- Warmest Wishes from all Mel-team !



LCW

LCW-HE

SONDEX®

Danfoss HEXSelector 1.0.20-beta.940

#36-211112144802

| | | | |
|-----------------|--------------|----------------|--------------|
| Customer | | Date | 12/11/2021 |
| Project | UoM- XBOX | Engineer | Sandeep Jain |
| HEX Type | S7A-ST16 | Contact Person | |
| | | E-mail | |
| Units Connected | 1 (Parallel) | | |

| Calculated Parameters | Unit | Side 1 | Side 2 |
|-----------------------|-------|----------------|--------|
| Flow Type | | CounterCurrent | |
| Heat Load | kW | 42.00 | |
| Inlet Temperature | °C | 18.6 | 9.0 |
| Outlet Temperature | °C | 16.0 | 14.0 |
| Mass Flow Rate | kg/s | 3.86 | 2.01 |
| Volumetric Flow Rate | L/min | 232.07 | 120.41 |
| Total Pressure Drop | kPa | 24.88 | 6.30 |

| Properties of Fluid | Unit | Side 1 | Side 2 |
|-----------------------------|---------|----------|-----------|
| Fluid | | Water | Water |
| Liquid Viscosity | mPa.s | 1.0705 | 1.2637 |
| Liquid Density | kg/m³ | 999.2405 | 1000.1273 |
| Liquid Heat Capacity | kJ/kg.K | 4.1795 | 4.1855 |
| Liquid Thermal Conductivity | W/m.K | 0.5911 | 0.5786 |

| Specifications | Unit | Side 1 | Side 2 |
|-------------------------------|--------------------------|--|--|
| HEX Type | | S7A-ST16 | |
| Plate Thickness | mm | 0.4 | |
| Plate Material | | AISI316L | |
| Gasket Material | | NBRH (HangOn) | |
| Frame | Type | ST | |
| | Length | mm | 437 |
| | Maximum Number of Plates | | 40 |
| Volume | l | 2.4 | 2.4 |
| Weight, empty | kg | 86 | |
| Paint Category | | Category C2L | |
| Paint Color | | BLUE RAL 5010 | |
| Connection | Inlet | F1: 2 INCH Threaded pipe BSP, AISI 316 | F3: 2 INCH Threaded pipe BSP, AISI 316 |
| | Outlet | F4: 2 INCH Threaded pipe BSP, AISI 316 | F2: 2 INCH Threaded pipe BSP, AISI 316 |
| Certification/Approval Type | | None | |
| Minimum Design Temperature | °C | 0.0 | |
| Maximum Design Temperature | °C | 90.0 | |
| Maximum Differential Pressure | bar | 10.0 | |
| Maximum Test Pressure | bar | 13.0 | |
| Maximum Design Pressure | bar | 10.0 | 10.0 |

H61.2-1.0.20-beta.940



Company name: Automatic Heating
Created by: Gilberto Aguja
Phone: 1800 337 959
Email: gilberto.aguja@automaticheating.com.au
Date: 05/11/2021

Qty. Description

1 CRI 15-7 A-FGJ-A-E-HQQE



Note! Product picture may differ from actual product

Product No.: On request

Vertical, multistage centrifugal pump with inlet and outlet ports on same the level (inline). Pump materials in contact with the liquid are in stainless steel. A cartridge shaft seal ensures high reliability, safe handling, and easy access and service. Power transmission is via a rigid split coupling. Pipe connection is via combined DIN-ANSI-JIS flanges.

The pump is fitted with a 3-phase, fan-cooled asynchronous motor.

Liquid:
Pumped liquid: Water
Liquid temperature range: -20 .. 120 °C
Selected liquid temperature: 16 °C
Density: 998.9 kg/m³

Technical: