EXCELLENCE IN SOLID STATE PULSED POWER

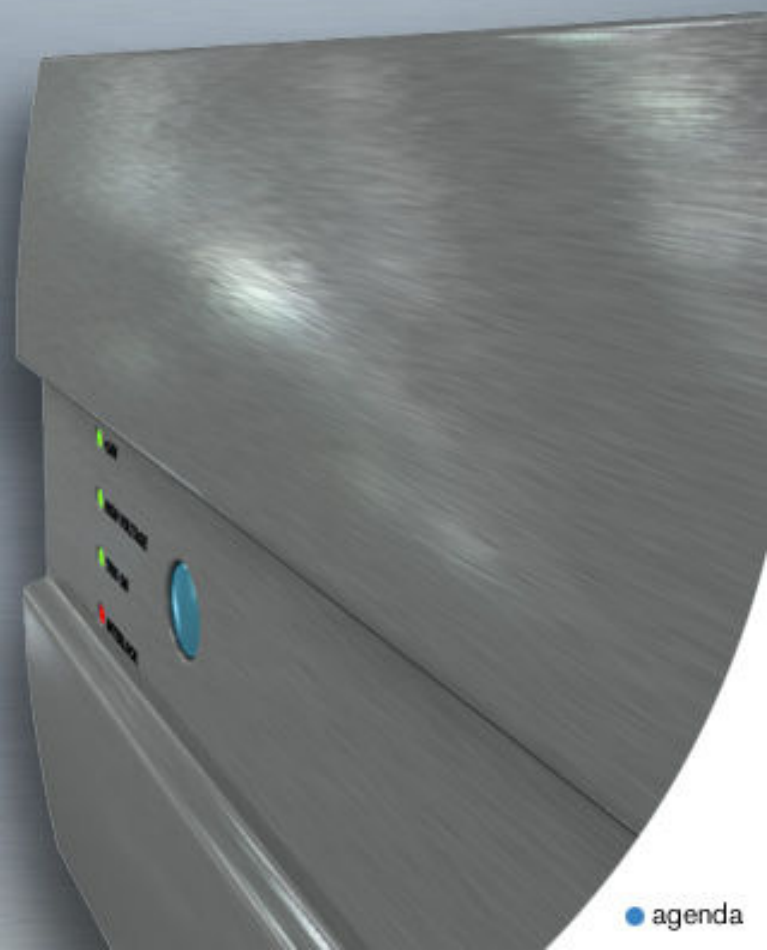
BY SCANDINOVA SYSTEMS AB

Klas Elmquist

SUMMARY

- Established in 2001
- Unique reliable solid state technology
- >60 systems produced
- Installations in 16 countries
- Use in 9 applications
- Accumulated operational hours > 260.000 (>75.000 pulse hours)

THE SOLID STATE TECHNOLOGY
BY
SCANDINOVA SYSTEMS



agenda

SOLID STATE MODULATOR MODELS

ScandiNova

NEXT

K1-SYSTEM

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NEXT

K1-SYSTEM KLYSTRON PULSE 140kV

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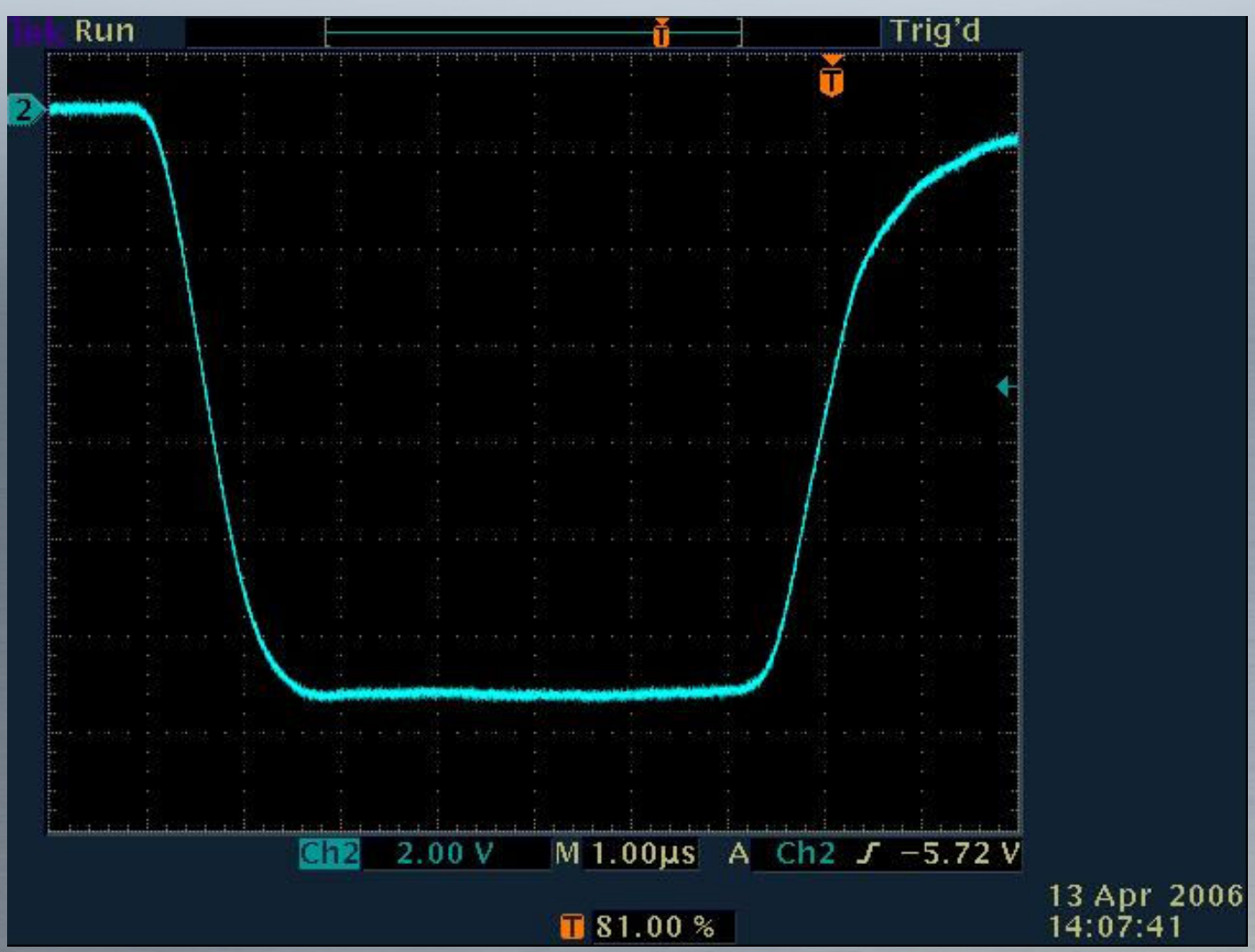

K2-SYSTEM FOR PSI 351kV / 416A

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NEXT

K2-SYSTEM PULSES, 265kV / 262A

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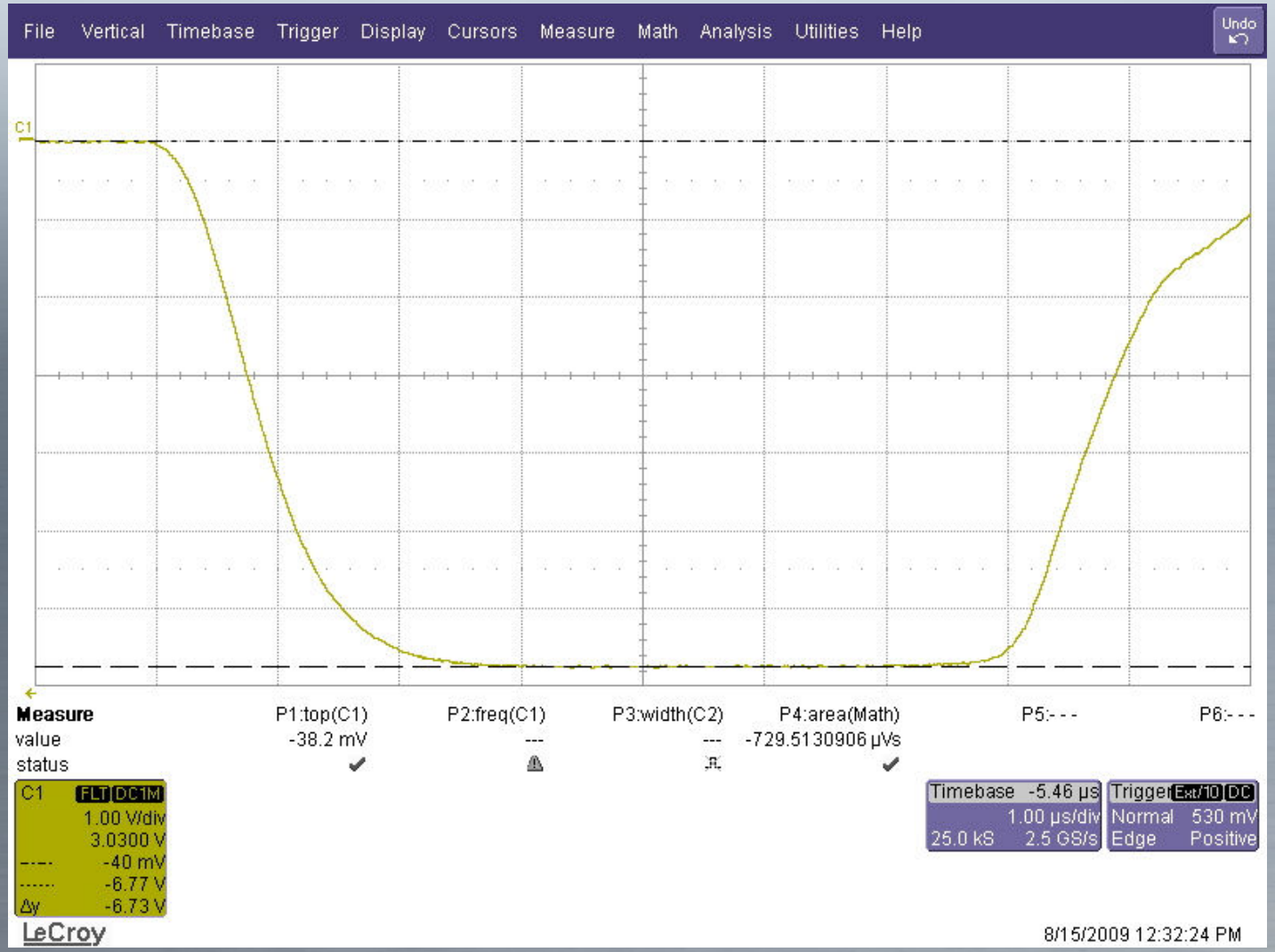

K2-SYSTEM PULSE FLATNESS 0.4%

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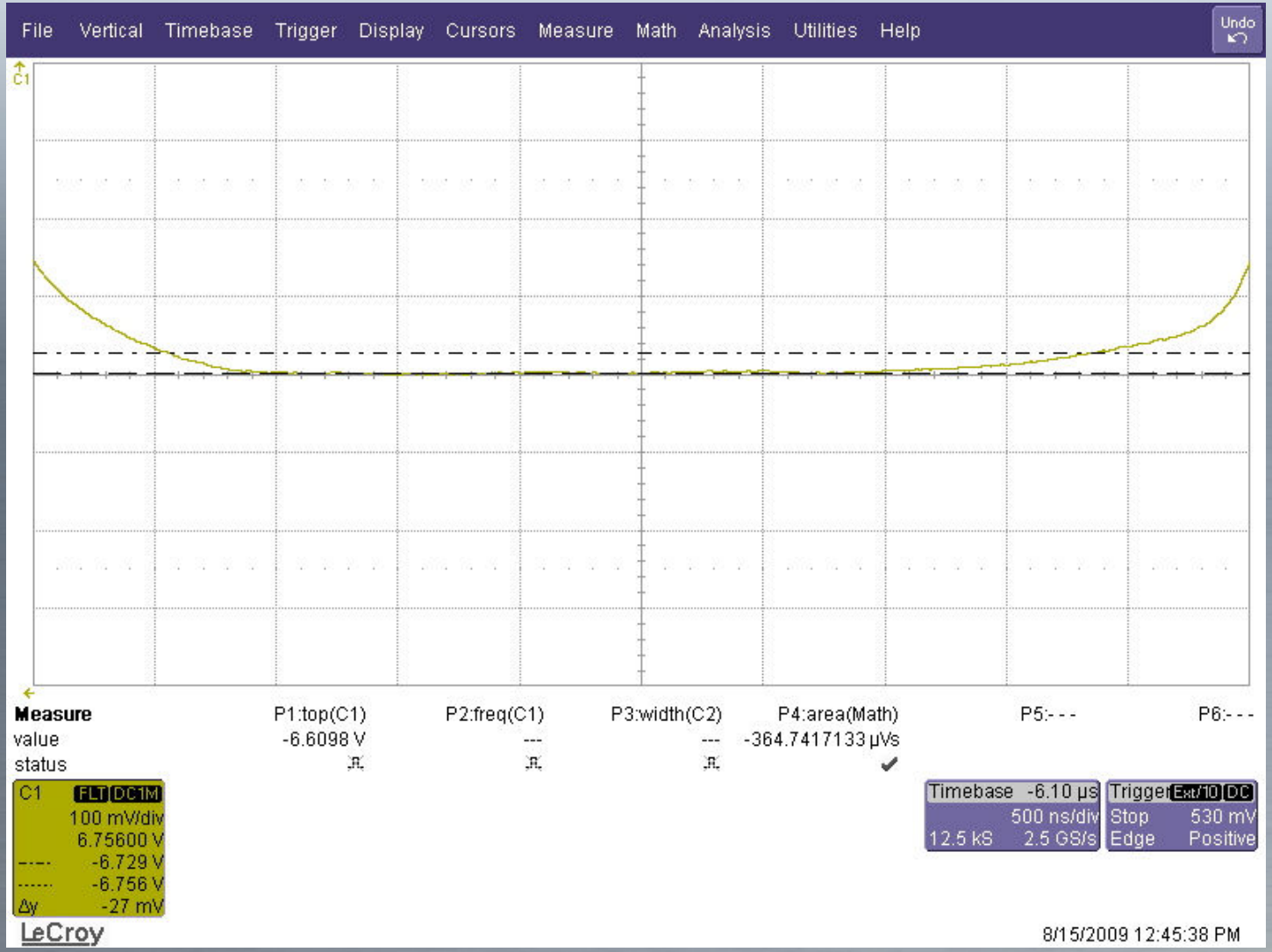

K2-SYSTEM PULSE-PULSE STABILITY

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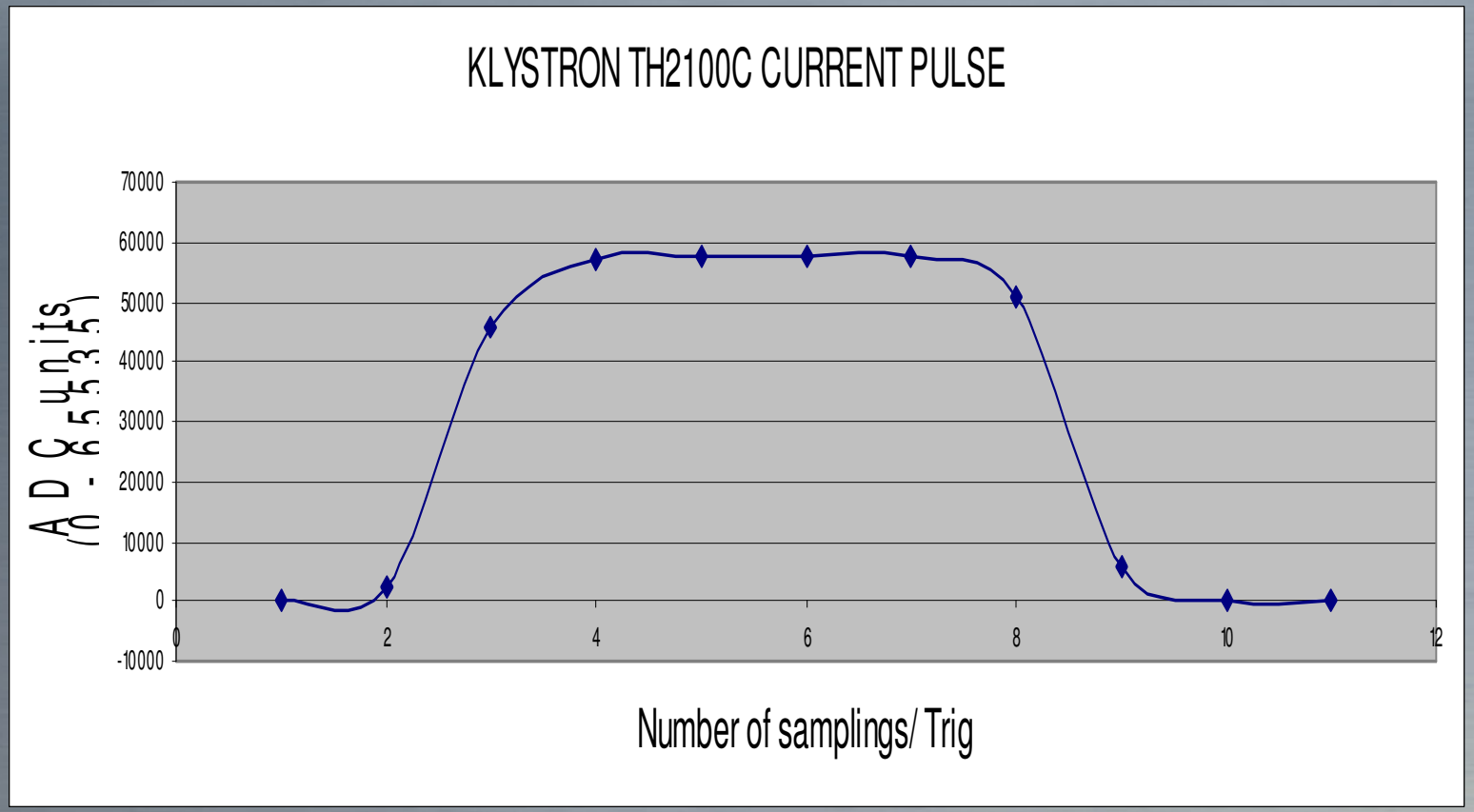
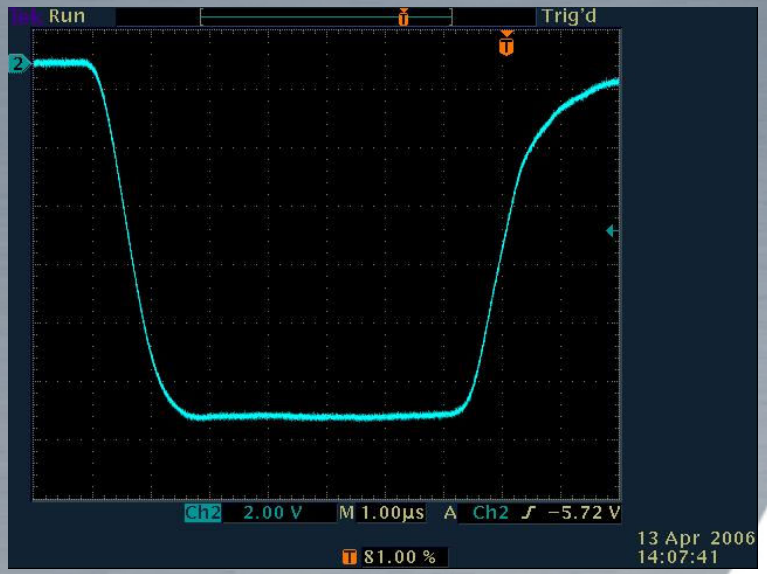
<0.004%

VERIFIED BY 16BIT SAMPLING



ACHIEVED LEVELS

Parameter	Value
Peak Power	147 MW
Average Power	106 kW
Pulse Voltage	507 kV
Pulse Current	4000 A
Pulse length	25 us
Pulse Repetition Rate	1000 Hz
Rise time	286 kV/us
Fall time	280 kV/us
Pulse flatness	± 0.05%
Pulse to Pulse stability	± 0.002%



MARKET & APPLICATIONS

ESTABLISHED APPLICATIONS

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MEDICAL

- RADIOTHERAPY

DEFENSE

- RADAR

INDUSTRIAL

- E-BEAM PROCESSING
- CARGO INSPECTION
- PEF PROCESSING
- CALIBRATION

RESEARCH

- SYNCHROTRON LIGHT SOURCE
- FREE ELECTRON LASER
- CRYSTALOGRAPHY

NEXT

SOME OF OUR CUSTOMERS

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VARIAN medical systems

SECURITY & INSPECTION PRODUCTS

KRAFT

Sterigenics

ADAM
Applications of Detectors and Accelerators to Medicine

NSRRC 國家同步輻射研究中心 National Synchrotron Radiation Research Center

lyncean TECHNOLOGIES, INC.

MAX-lab

AS&E
Leader in X-ray detection technology

SAPTEC

PAUL SCHERRER INSTITUT PSI

NORTHERN NIU ILLINOIS UNIVERSITY

TU Delft
Technische Universiteit Delft

UNIVERSITÀ DEGLI STUDI DI SALERNO

IPJ ZDAJ

SALIGUS

Technische Universität Berlin

CERN

INFN
Istituto Nazionale di Fisica Nucleare

DANFYSIK

BESSY

Australian Synchrotron

METAS
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

EXT

SOME ON-GOING PROJECTS

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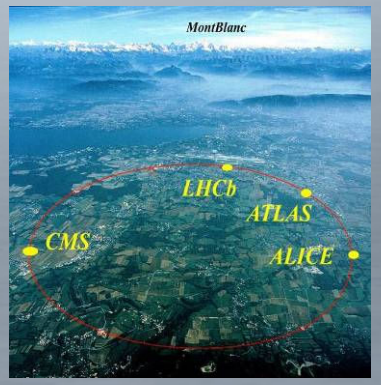
- 6 x K2-system 262-410kV/270-330A to PSI
- K2-system 450kV/330A to CERN / CEA-Saclay
- K2-system 420kV/320A to Lawrence Livermore NL
- 7x K2-system 250kV/250A to Canadian Light Source
- 2x K1-system 160kV / 110A to ETM
- 2x K1-system 130kV / 86A to Lyncean Technologies
- K1-system 160kV / 110A to ADAM / CERN
- K1-system 140kV / 105A to ZDAJ



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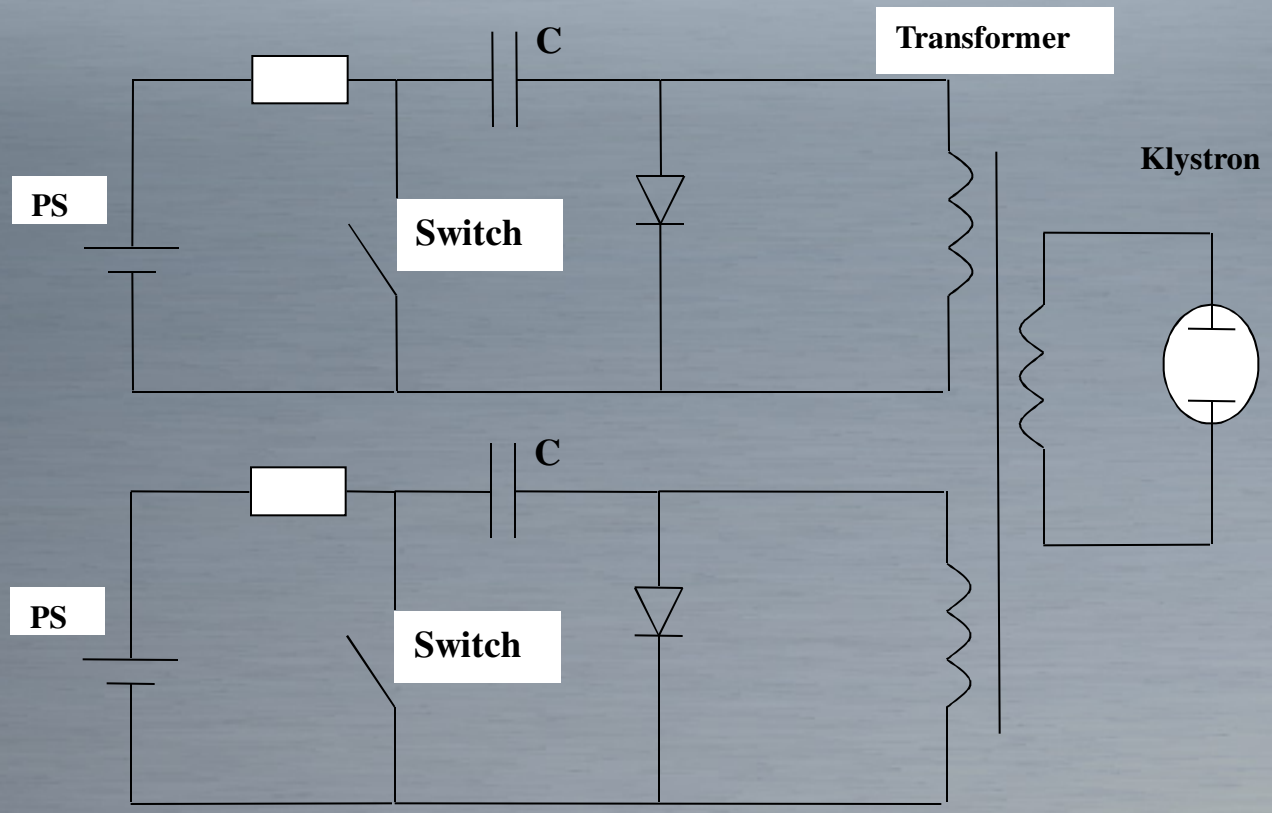
Basic schematic of the Scandinova modulator

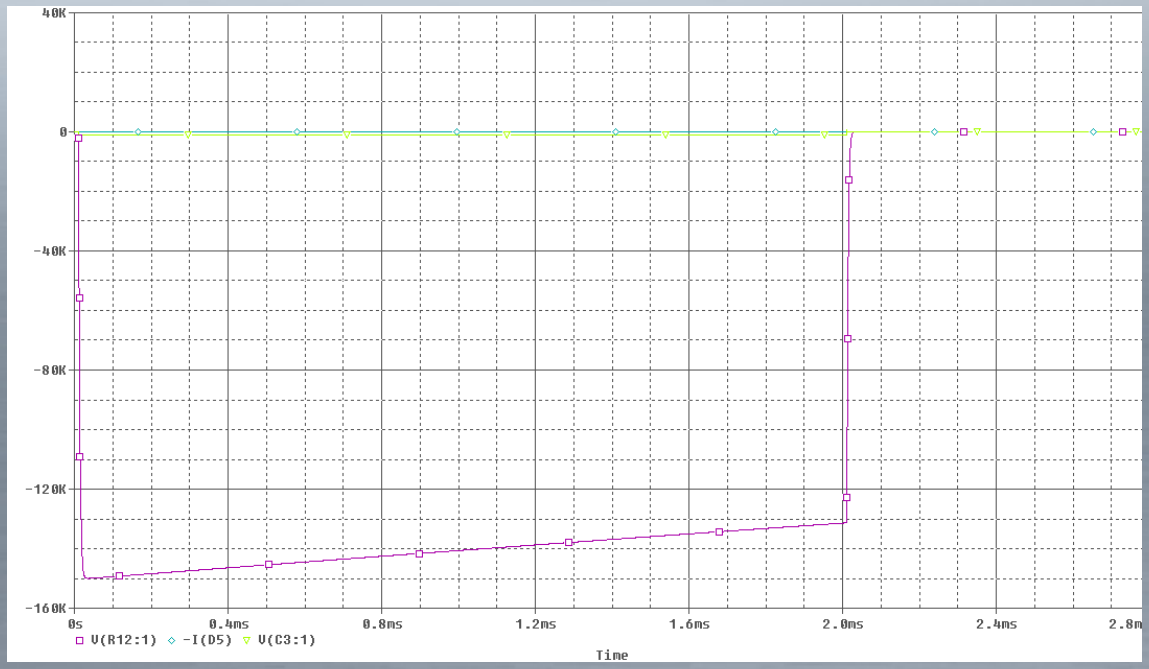
N = number of primary circuits
R = Klystron Resistance
$\mathbf{N_T}$= Transformer ratio (Has to be compensated for with **N**)



Droop

ESS preliminary parameters

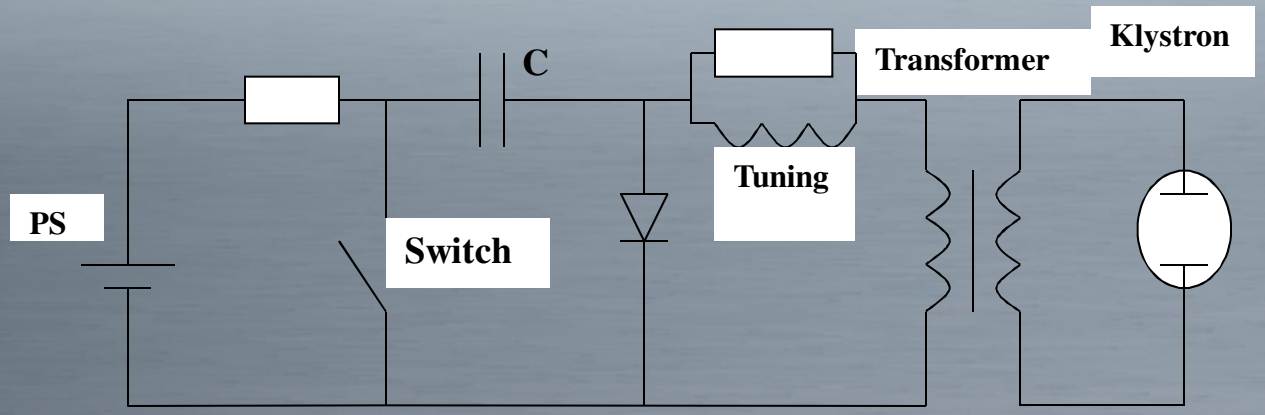
Parameter	Value
P peak	6,2 MW
P mean	248 kW
t pulse	2,0 ms
T period	50 ms
t rise	50 us
t fall	50 us
Klystron voltage	135 kV
Klystron current	46 A
Pulse droop	3%
Overshooot	2%



N=42
C= 2000uF
NT=130

Ecap=1,4 kJ
Etot= 60,5 kJ
Vdc= 1200V

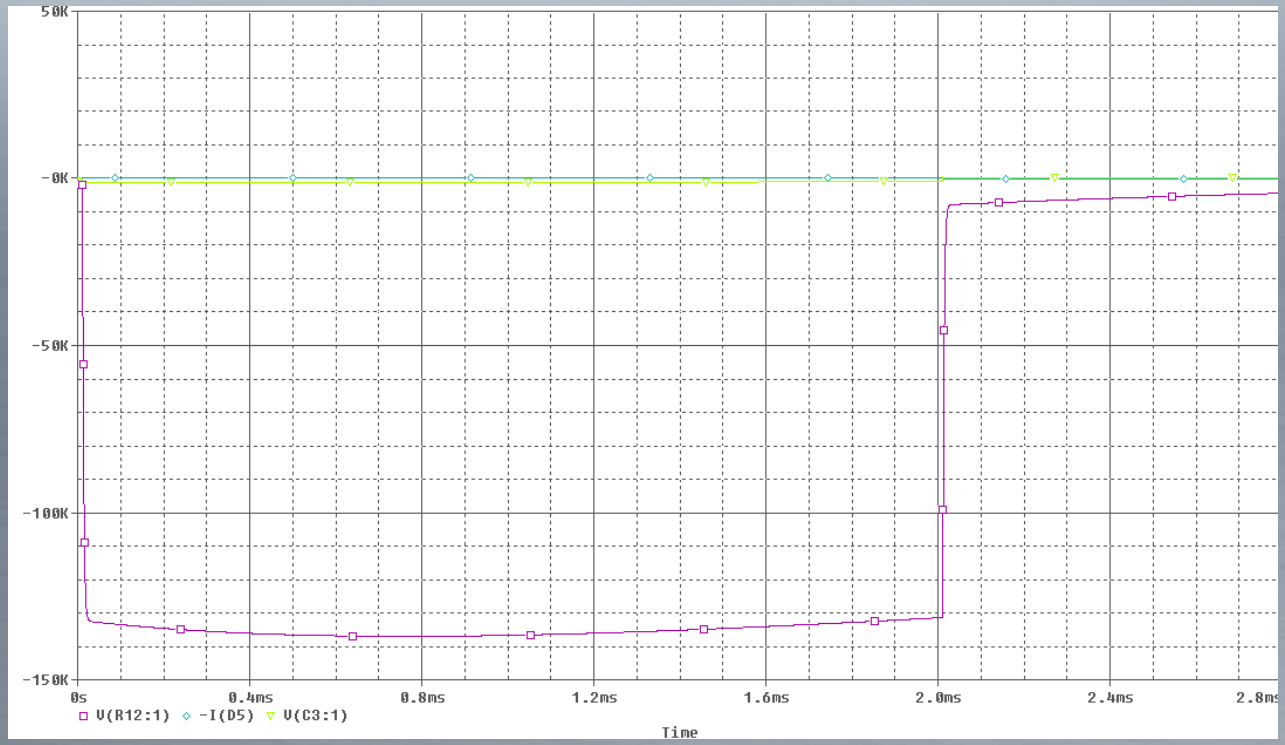
Tuning



Rt = Tuning resistance
Lt= Tuning inductance

Tuning on PSB

When applying
To ESS
Rt = 1 ohm
Lt = 0.7 mH



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Power

- Several power supplies will run in paralell
- Phases will run equally loaded.
- Charging during 48 of the 50ms available.
- Smoothing during the pulse to protect the mains supply.

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Safety aspects

- Paralell operation
  - A switch failure will only dump one 42th of the total stored energy.
  - Of the shelf capacitors will be used
  - A failed module could be deconnected and the loss is 1/42 of the total power capacity
- All High voltage inside the tank
- Primary circuit <1400V
- Pulse over current respond time 2us.
- DC-Voltage discharge time within 10sec

Differences between an ordinary Scandinova modulator and long pulse modulator

- Tuning circuit have larger components to be able to smoothen out the pulse.
- Higher capacitance in the Switch capacitors to reduce the droop.
- Iron core of transformer
  - Larger Iron core in the transformer to prevent saturation of the iron during the long pulse.
  - Relatively low voltage makes the transformer smaller.
  - No need for low inductance makes the transformer smaller.
- Due to the tuning, the heat dissipation in the tank will increase and demand heavier cooling.
- The design of Scandinova modulator is focused on low inductance. This is not neccesary when running pulses >>10 us

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Thank you

NEXT