
Experience with a Static Series Compensation Device (DVR) at a Semiconductor Facility

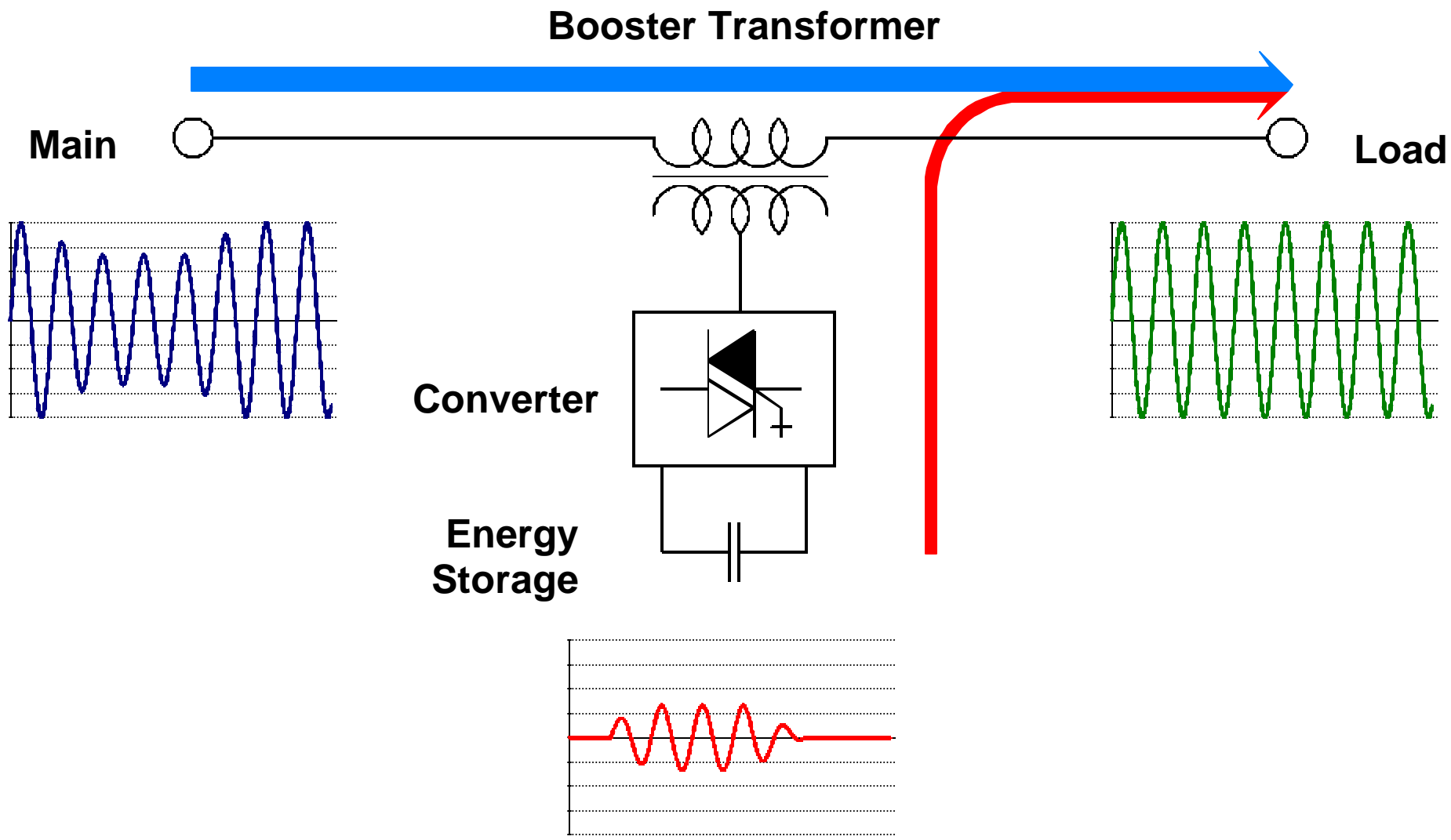
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14 April, 1999



DVR Concept

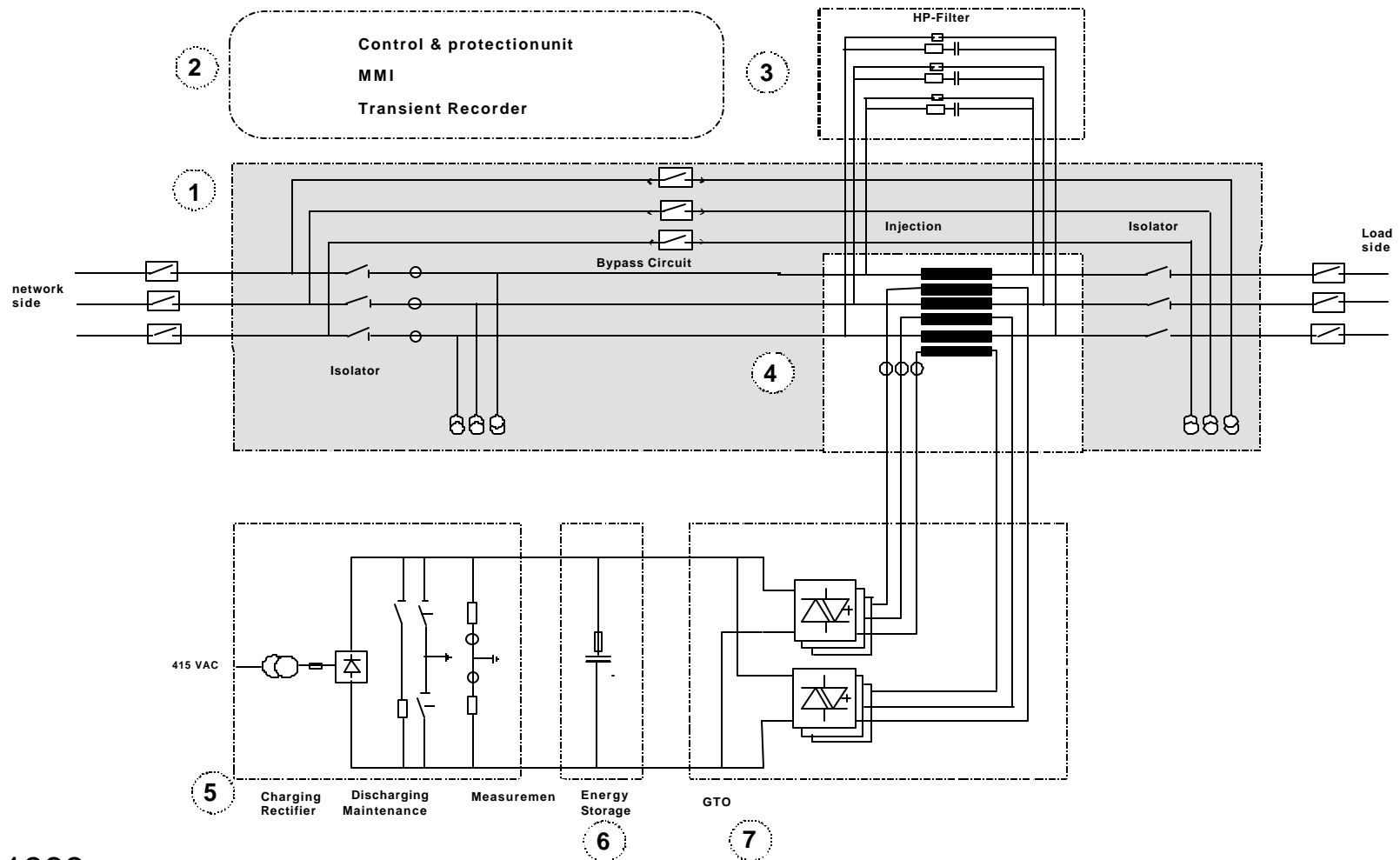


DVR Requirement Specification

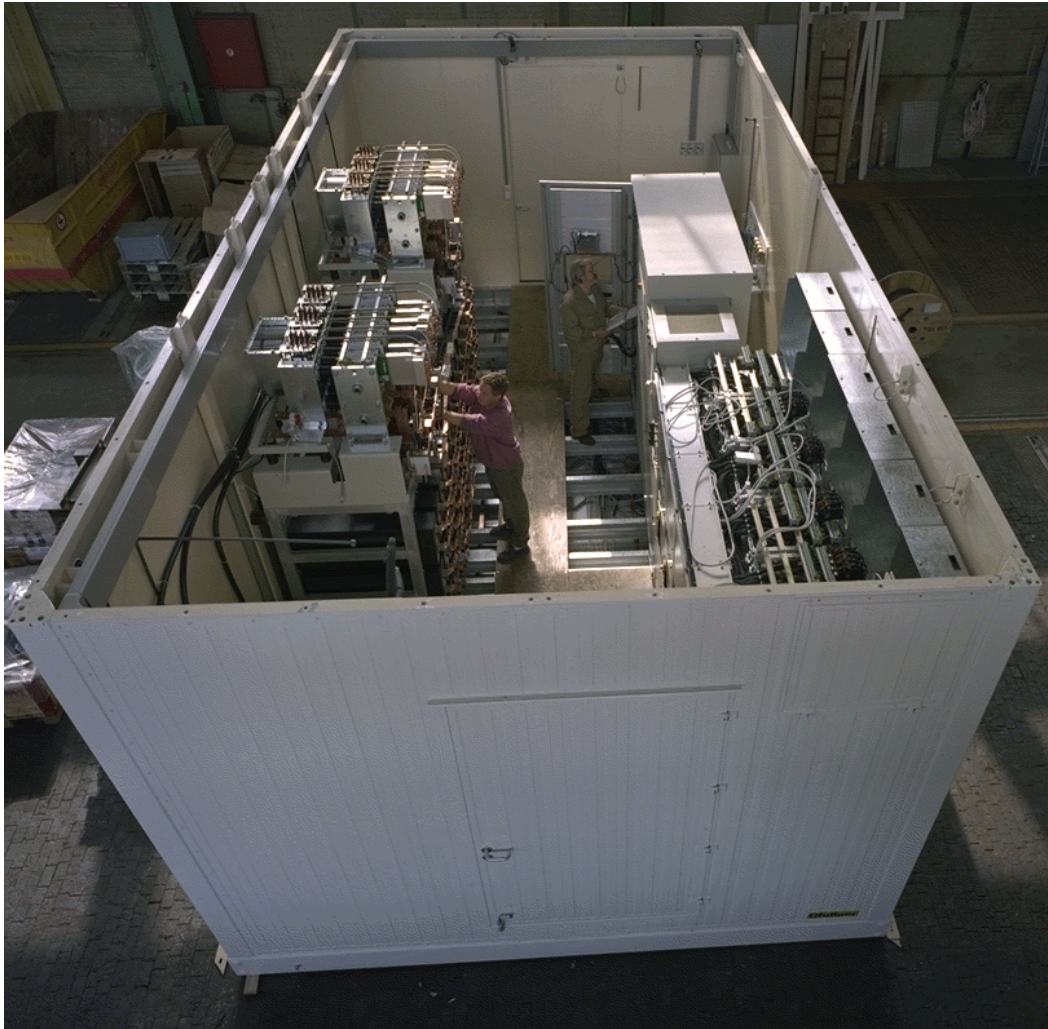
- 4 MVA Load (22kV)
- 50% Boost (single phase voltage sags)
- 38% Boost (three phase voltage sags)
- 150 msec. ride through
- 10 msec. response
- 5% accuracy of restored voltage

Single Line Diagram

Power Quality Dynamic Voltage Restorer



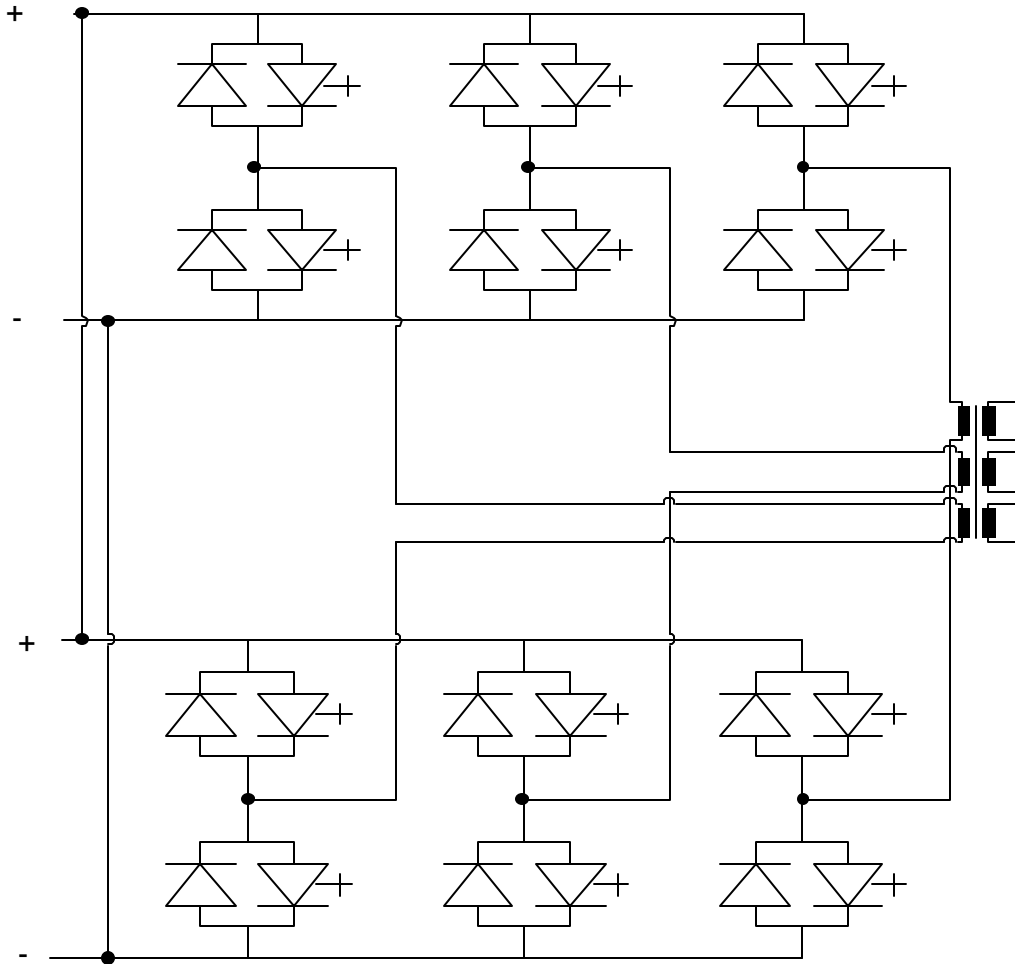
Container Solution



- 25.6' x 13.5'
- Converters
- Energy Storage
- Switchgear
- Controls
- Aux. Power
- DC Precharge
- Discharge
- Air Cooled

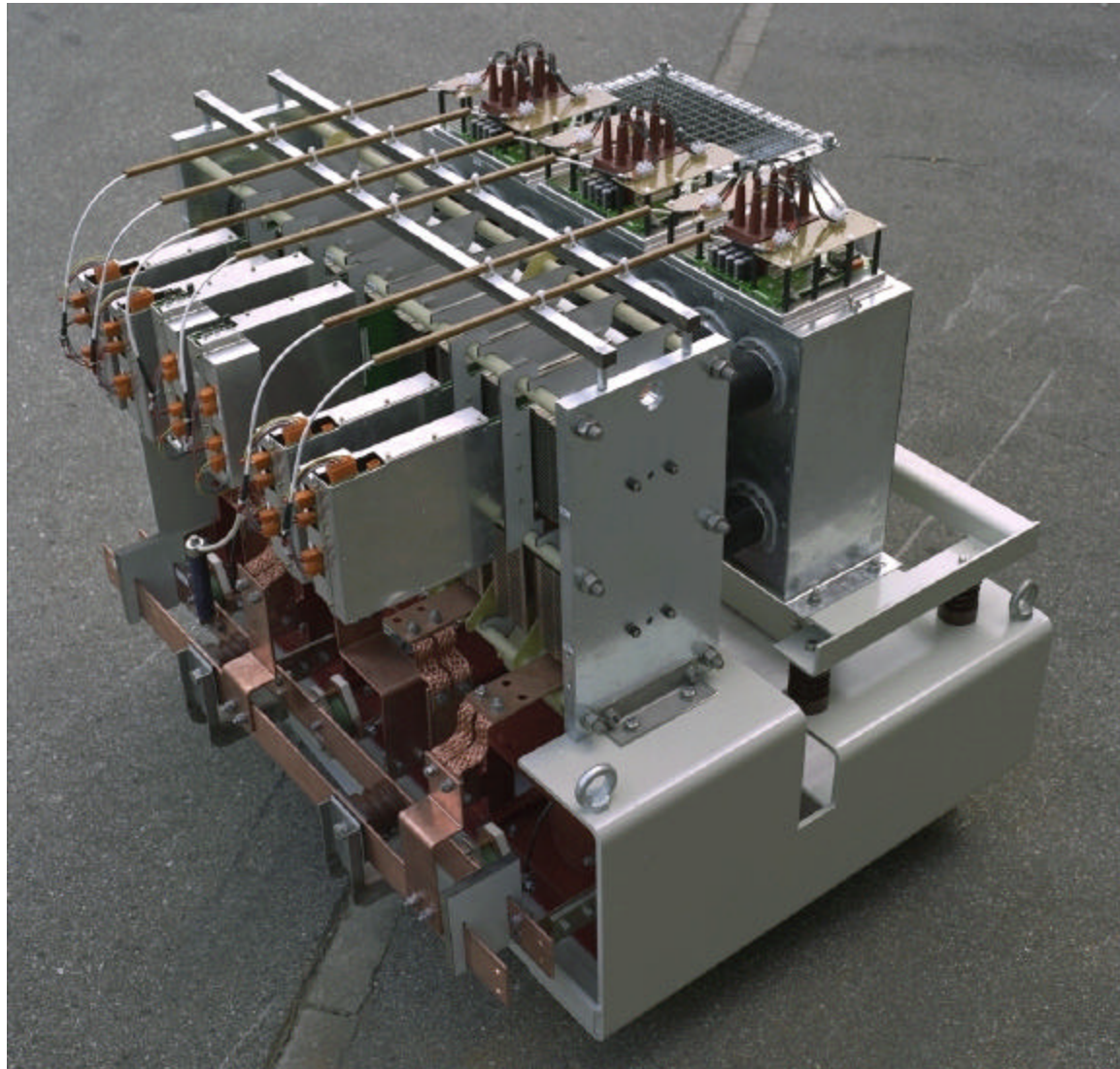
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Basic Converter Topology



- 12 IGCT Devices
- 2.2 kV DC bus
- 2 Level topology
- Scalable to 100 MVA
(3 Level & Series IGCTs)

DVR Converter

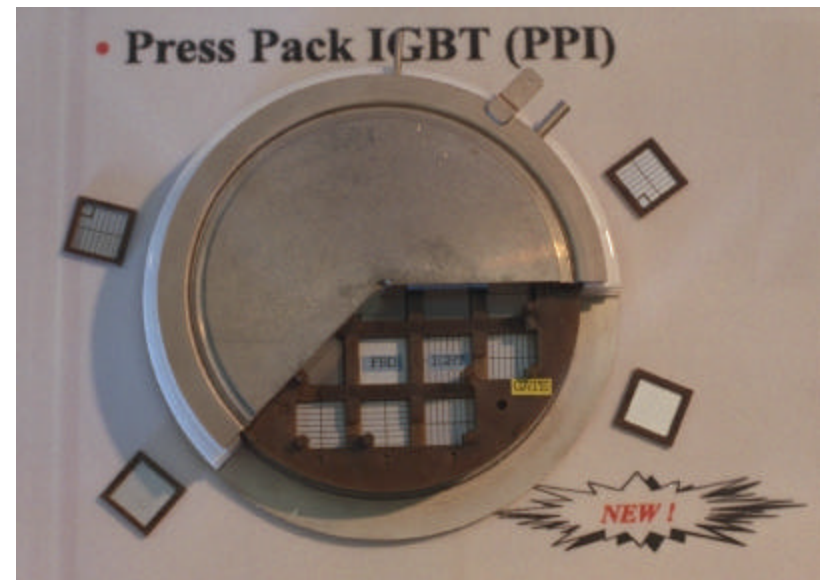


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IGCT and IGBT



**4.5kV 4kA
IGCT**



**2.5kV 1kA
Press Pack IGBT**

Converter & Energy Storage



- Air cooled
- Air conditioned
- 150 msec. ride-through
- DC Capacitors

Performance

- **Standby mode:**

Converter shorted

System losses: 65 kW, 98% efficiency

1% Voltage drop

- **Dynamic performance:**

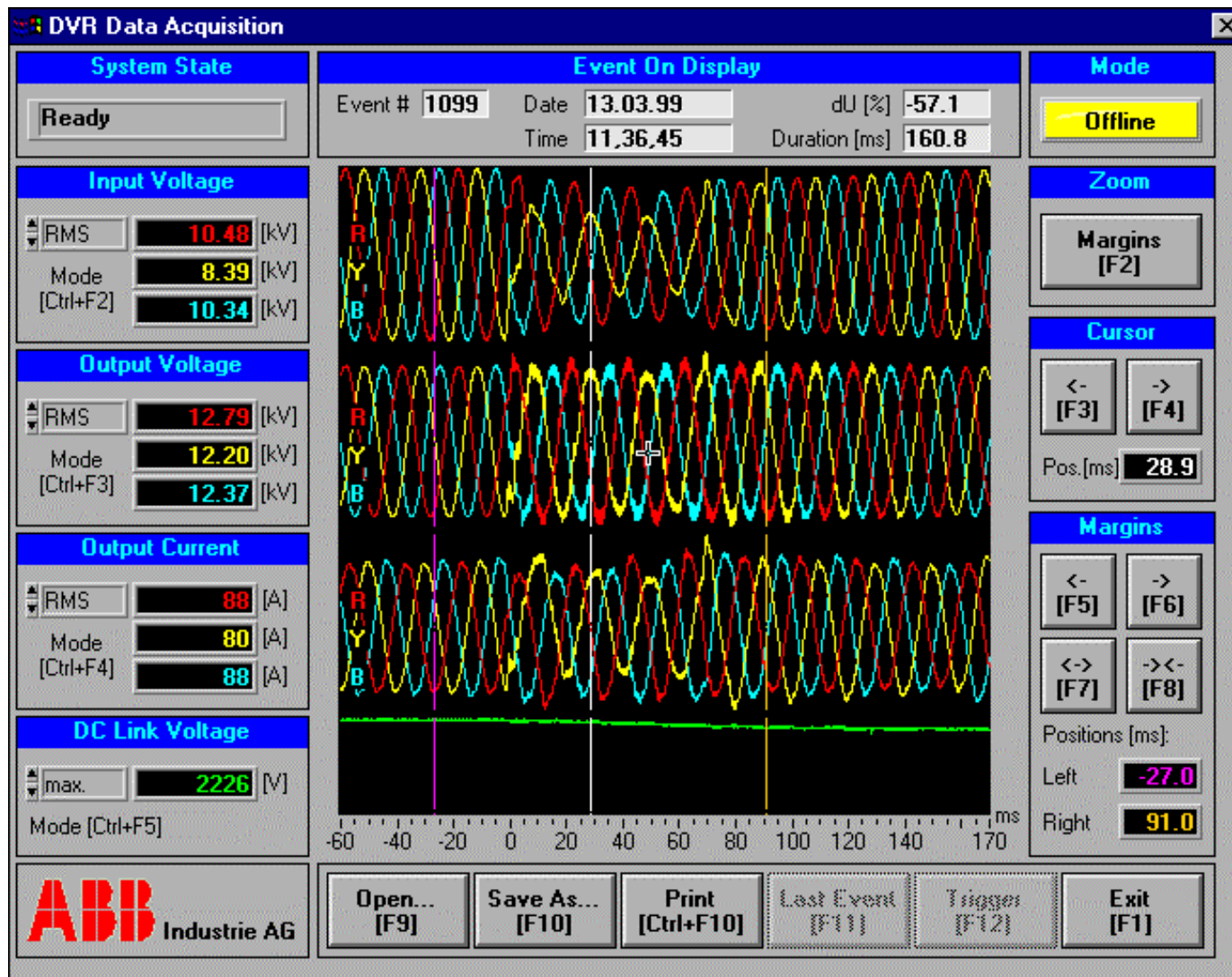
Output voltage controlled in magnitude and phase

Response time: Less than 1 ms

Boost time: Less than 1/4 cycle

Charging time: 2 Minutes

Performance



14 April, 1999

Operational Summary

26 May, 1998: Protecting newspaper plant

8 July, 1998: 30 minute bypass for software upgrade

30 August, 1998: Connected to semiconductor plant

8/30 thru 3/12: Multiple “mini” sags corrected

13 March, 1999: First “deep” sag corrected

18 March, 1999: First unit trip, due to utility event

20 March, 1999: Unit available for operation

99.37% Availability since commissioning

Operating Highlights

- 196 Consecutive days of 100% availability
- Two trips since end of commissioning
- Trip 1: Controls upgrade
- Trip 2: Self protection
- One plant save