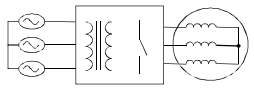
UNIVERSITY OF MINNESOTA
Driven to Discover℠

# Research on Three-Phase AC/AC Power Electronic Transformer-based PWM converters

## Statement of the Problem



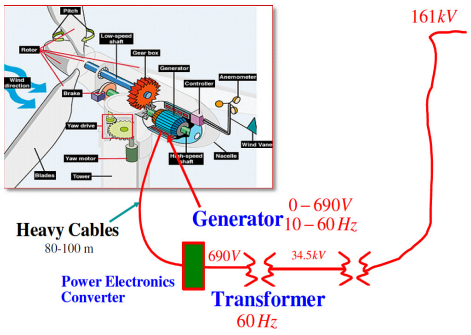

- High frequency AC link adjustable three-phase balanced Pulse Width Modulated AC waveforms
- Source is a balanced three phase AC Voltage
- Load is Inductive in nature
- No storage element

## Desirable Features

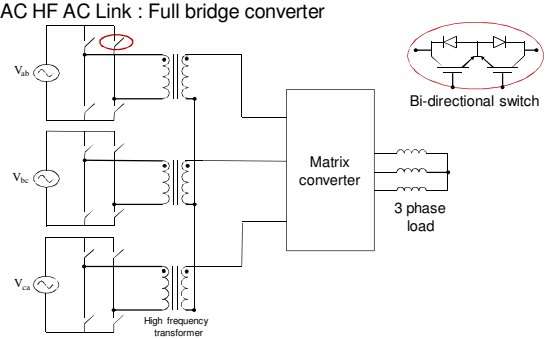
- High Power density
- Flexible voltage transfer ratio
- Galvanic isolation
- Bidirectional power flow
- Single stage power conversion ( no unreliable electrolytic DC capacitance)
- Common mode voltage suppression
- Input Power factor correction
- High quality output voltage synthesis

## Applications

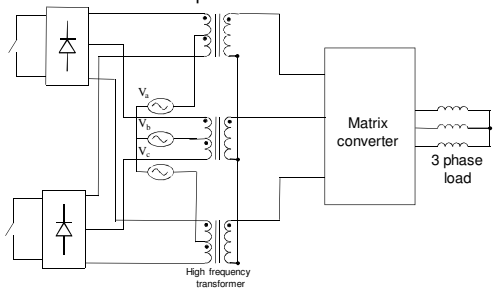
- Wind Power: 300 GW by 2030
- Photovoltaic, Fuel cell
- Replacement of Power Transformers in Power Systems
- Electric Ship



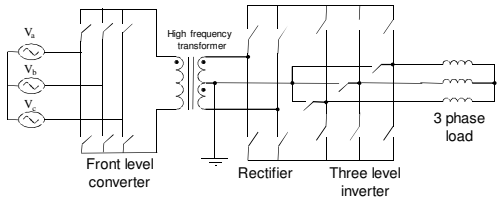

## I AC/AC HF AC Link : Full bridge converter



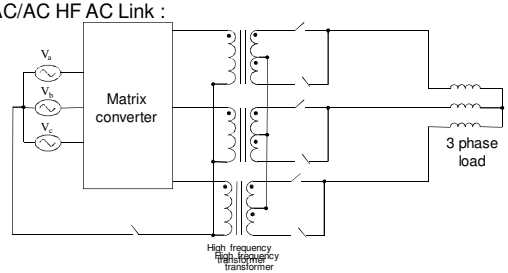

## II AC/AC HF AC Link : Push pull converter



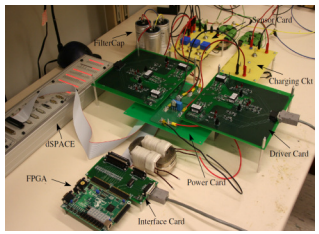

## III AC/AC HF AC Link : Back to back converters



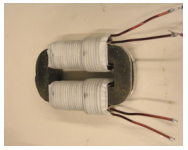

## IV AC/AC HF AC Link :

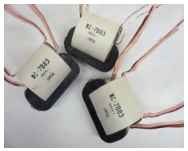



## Experimental Setup



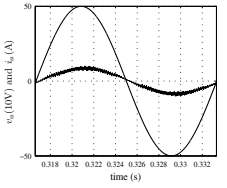

3 kW direct link three phase to single phase Matrix Converter



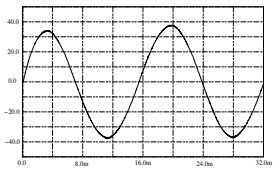


High Frequency Transformer (5 kVA, 120V/240V, 5 kHz)

## Simulation Results

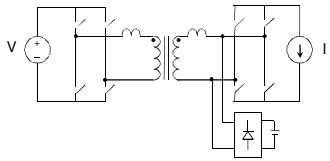



Input voltage and current (filtered)



Output current

## Challenge : Leakage Inductance




Clamp circuit

Due to the presence of leakage inductance the switching of the load with transformer winding requires commutation of the leakage energy.

Solutions

- Clamp Circuit and energy recovery circuit
- Source based commutation
- PWM Technique