

# Fuel Cell Inverter

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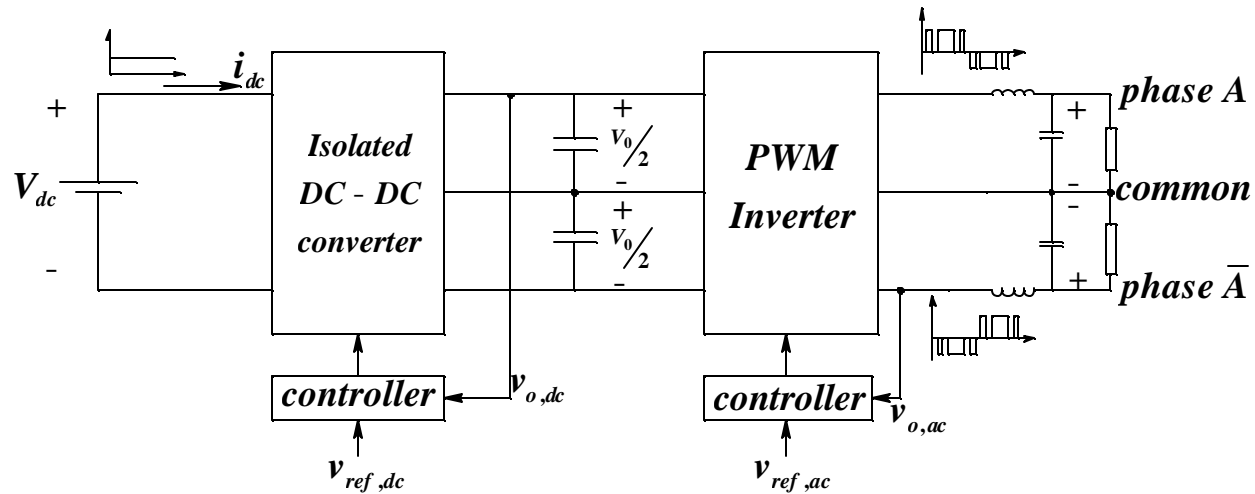
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# Introduction

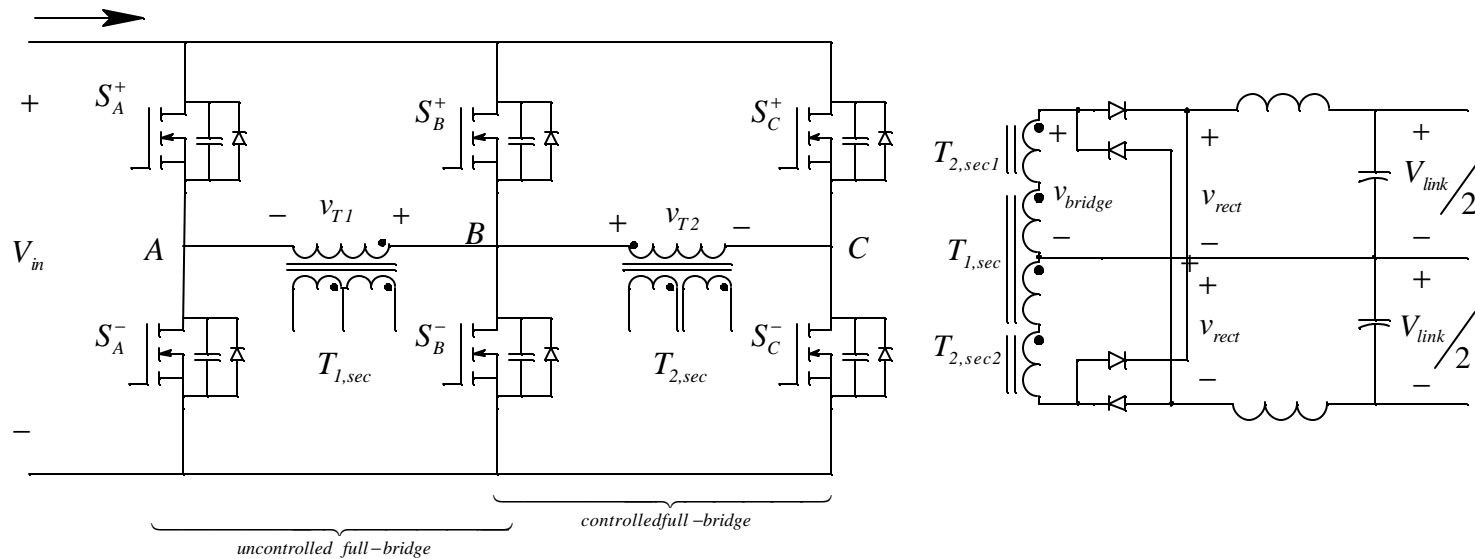
- ↖ Proposed Topology
- ↖ Novel DC-DC Converter
- ↖ Utility Interactive System
- ↖ Seamless Transfer

# Power Circuit Topology



- ❑ DC - DC converter produces a split output voltage
- ❑ PWM inverter consists of two half-bridge inverters operated independently
- ❑ Independent control of DC-DC converter and PWM inverter

# DC-DC Converter Configuration



- Primary side of the DC - DC converter consists of an uncontrolled full bridge and a controlled full bridge

Secondary side of the converter consists of a center-tapped transformer with a high frequency diode bridge rectifier

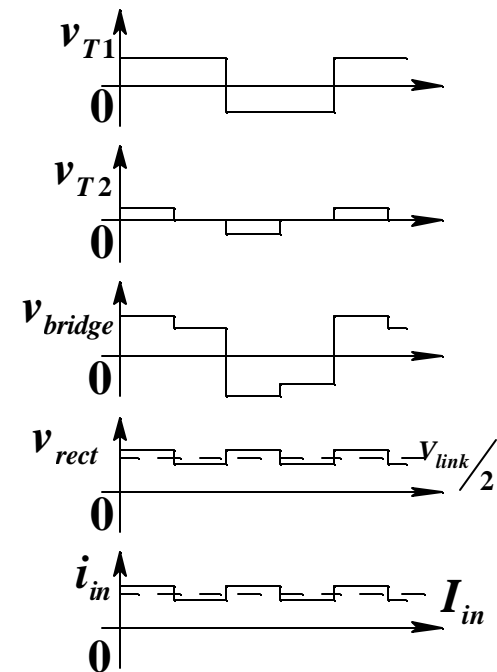
Patent Number: 6310785

Issue Date: October 30, 2001

Title: Zero voltage switching DC-DC converter

# Operation of the DC-DC Converter

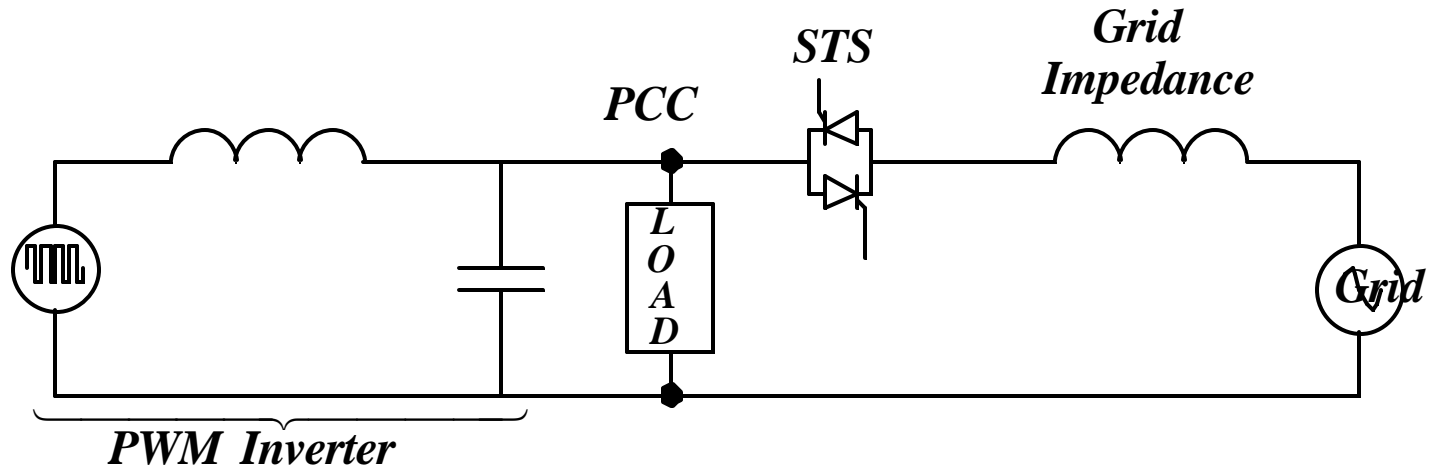
- ❑ Legs A & B are uncontrolled; they generate a square wave across transformer T1
- ❑ Phase shift between legs B and C is adjusted to control the output voltage
- ❑ The voltage across transformer T2 is added to the voltage across transformer T1



# Advantages of the Chosen Topology

- ❑ Primary side switches are phase shift controlled
- ❑ All six controllable switches achieve Zero Voltage Switching from full-load to no load
- ❑ No significant conduction loss penalty to achieve ZVS (as in the case of the conventional phase modulated converter (PMC) )
- ❑ The filter requirements are reduced by one-third as compared to the conventional PMC (for a 1:2 input voltage variation)

# Interconnection of the Inverter to the Grid



- ⌞ Back-to-back thyristors are ideally suited as Static Transfer Switches (STS) for medium power applications
- ⌞ Thyristor pair interrupts the grid current at the first zero after it has been turned off

# Control of the Inverter

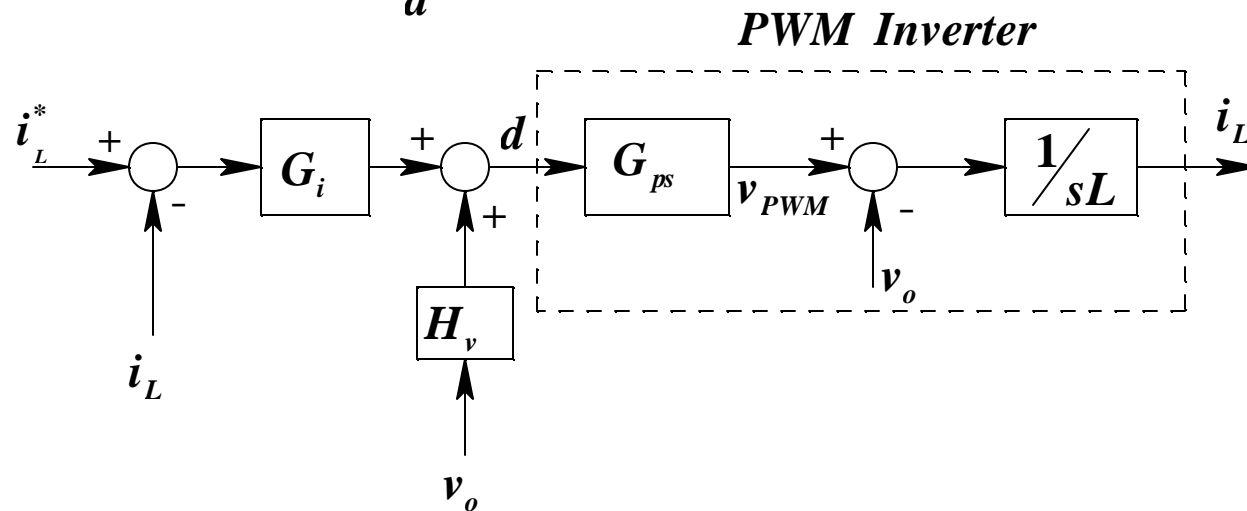
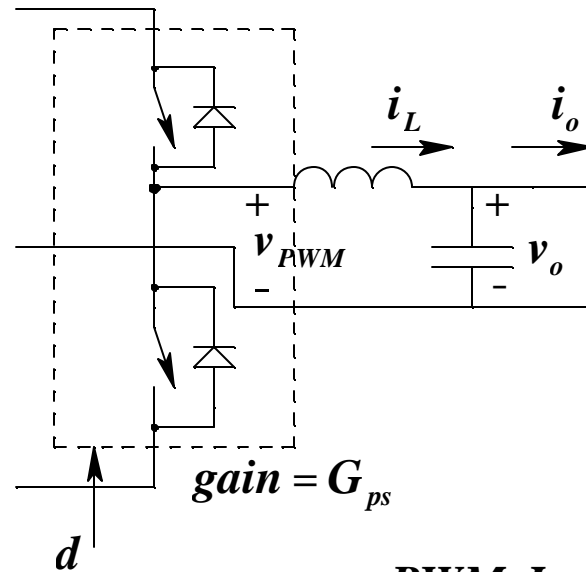
## Stand-Alone Mode

- ↖ Inverter supplies power to a load
- ↖ Inverter is operated in *Voltage Controlled Mode*

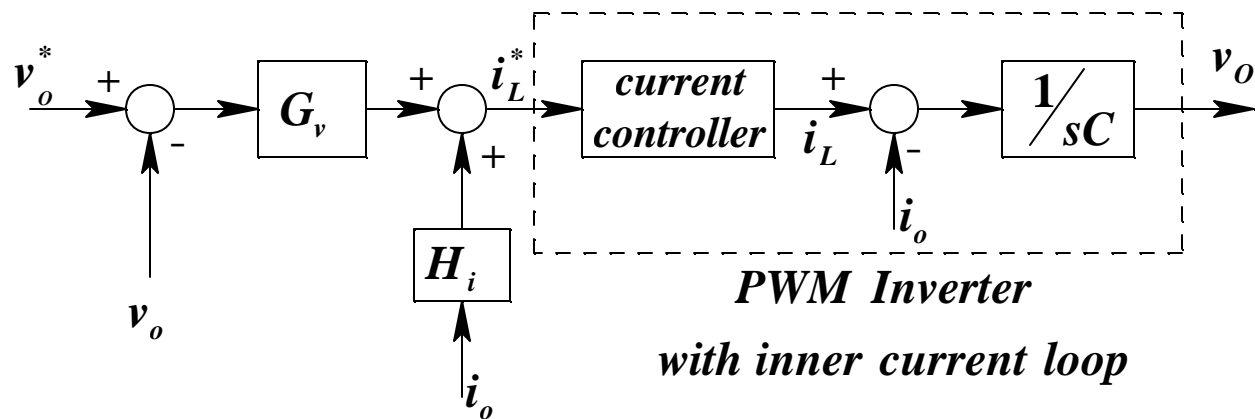
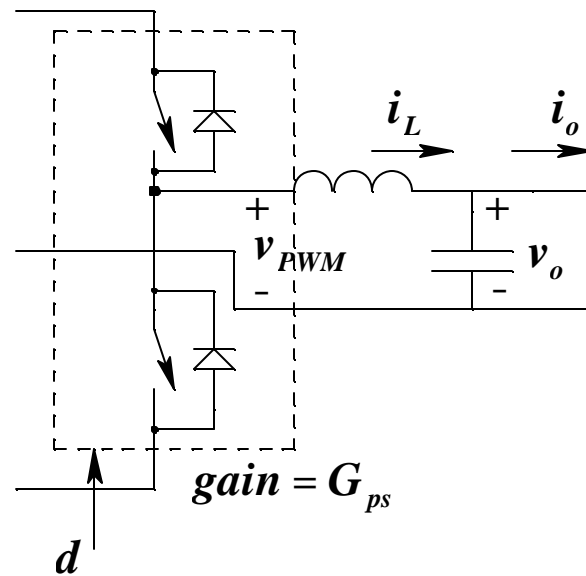
## Utility-Interactive Mode

- ↖ Inverter supplies power to the grid
- ↖ The grid sets the voltage at the terminals of the inverter
- ↖ Inverter is operated in *Current Controlled Mode*

# Current Controller for the PWM Inverter



# Voltage Controller for the PWM Inverter



# Seamless Transfer

Transfer between the current-controlled mode and the voltage-controlled mode with minimum disruption to the load

## Grid Tied to Off-Grid Mode

ensure that the voltage applied across the load matches the load voltage just before disconnect

## Off-Grid to Grid Tied Mode

inverter voltage should match the grid voltage both in magnitude and phase before triac is turned on

# Summary

- ⌞ Novel DC-DC Converter topology is ideally suited for fuel cell applications as it achieves ZVS for the switches over a wide load range
- ⌞ Utility Interactive converters make fuel cell systems very useful as they can be used in both grid-tied and off-grid applications
- ⌞ Seamless transfer helps to maintain power across loads during grid failures