EE-463 STATIC POWER CONVERSION-I

(aka Power Electronics-I)

Ozan Keysan

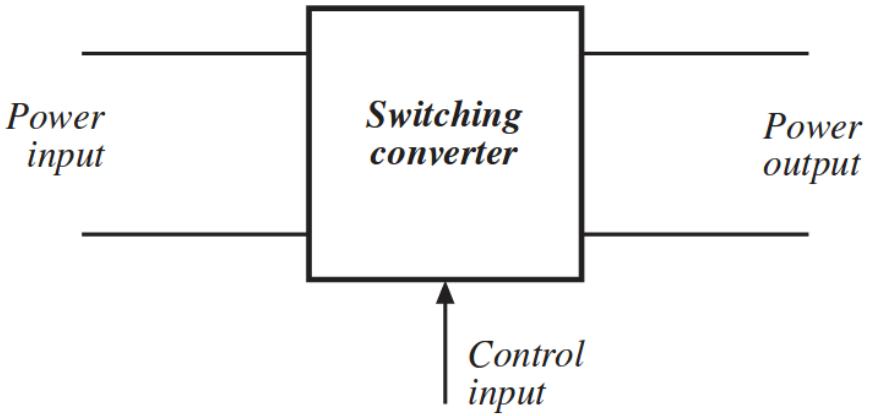
keysan.me

Office: C-113 • Tel: 210 7586

Introduction to Power Processing

Introduction to Power Processing

Fundamental Block Diagram



Different Source Voltage Characteristics

Different Source Voltage Characteristics

- DC (At various voltages)

Different Source Voltage Characteristics

- DC (At various voltages)

- Single Phase AC (Commonly 110-240V 50/60 Hz)

Different Source Voltage Characteristics

- DC (At various voltages)

- Single Phase AC (Commonly 110-240V 50/60 Hz)

- Three Phase AC

...

Different Requirements at the Output

Different Requirements at the Output

- DC (Regulated, constant magnitude)

Different Requirements at the Output

- DC (Regulated, constant magnitude)

- Adjustable DC

Different Requirements at the Output

- DC (Regulated, constant magnitude)
- Adjustable DC
- AC (Constant frequency, variable magnitude)

Different Requirements at the Output

- DC (Regulated, constant magnitude)
- Adjustable DC
- AC (Constant frequency, variable magnitude)
- AC (Variable frequency and magnitude)

Control is almost always needed

Control is almost always needed

- Output Voltage Regulation

Control is almost always needed

- Output Voltage Regulation

- Overload Protection

Control is almost always needed

- Output Voltage Regulation
- Overload Protection
- Power Quality

Control is almost always needed

- Output Voltage Regulation

- Overload Protection

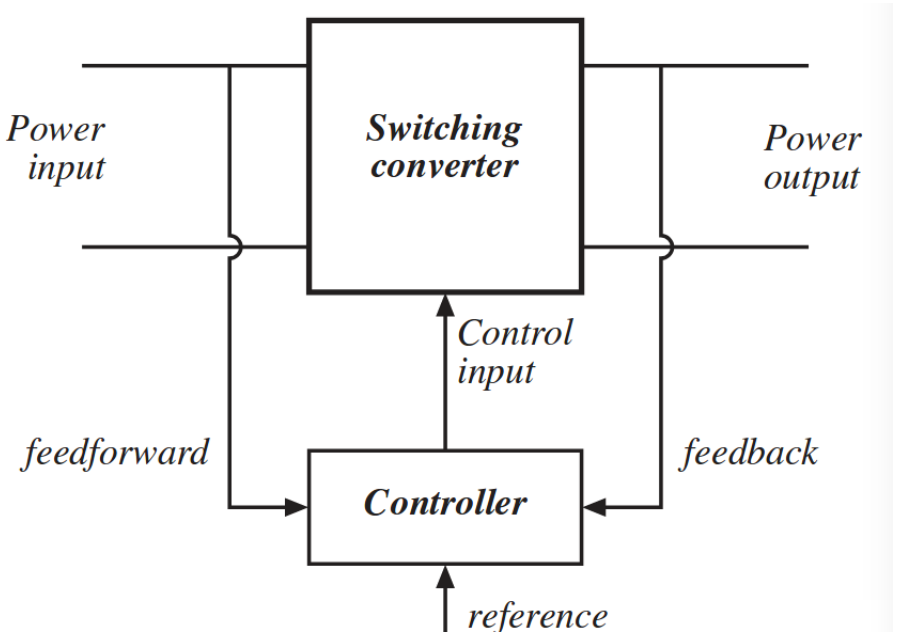
- Power Quality

- Frequency Fixing (i.e. grid connected inverters)

...

Control is almost always needed

Control is almost always needed



Classification wrt Switching Characteristics

Classification wrt Switching Characteristics

- Line frequency (naturally commutated) converters

Classification wrt Switching Characteristics

- Line frequency (naturally commutated) converters

(e.g. diode rectifiers)

Classification wrt Switching Characteristics

- Line frequency (naturally commutated) converters

(e.g. diode rectifiers)

- Switching (forced-commutated) converters

Classification wrt Switching Characteristics

- Line frequency (naturally commutated) converters

(e.g. diode rectifiers)

- Switching (forced-commutated) converters

(e.g. switched mode power supplies)

Classification wrt Switching Characteristics

- Line frequency (naturally commutated) converters

(e.g. diode rectifiers)

- Switching (forced-commutated) converters

(e.g. switched mode power supplies)

-Resonant converters (zero voltage or zero current switching)

Basic Building Blocks

Basic Building Blocks

- AC/DC Converters (aka Rectifiers)

Basic Building Blocks

- AC/DC Converters (aka Rectifiers)

- DC/AC Converters (aka Inverters)

Basic Building Blocks

- AC/DC Converters (aka Rectifiers)

- DC/AC Converters (aka Inverters)

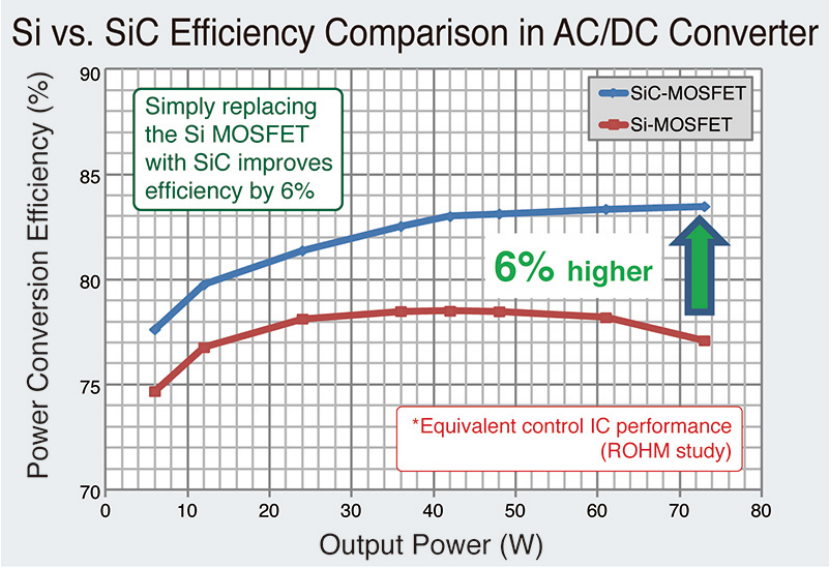
- DC/DC Converters (e.g. SMPS)

Basic Building Blocks

- AC/DC Converters (aka Rectifiers)
- DC/AC Converters (aka Inverters)
- DC/DC Converters (e.g. SMPS)
- AC/AC Converter (e.g. Cycloconverter)

What are the desired factors?

- High Efficiency



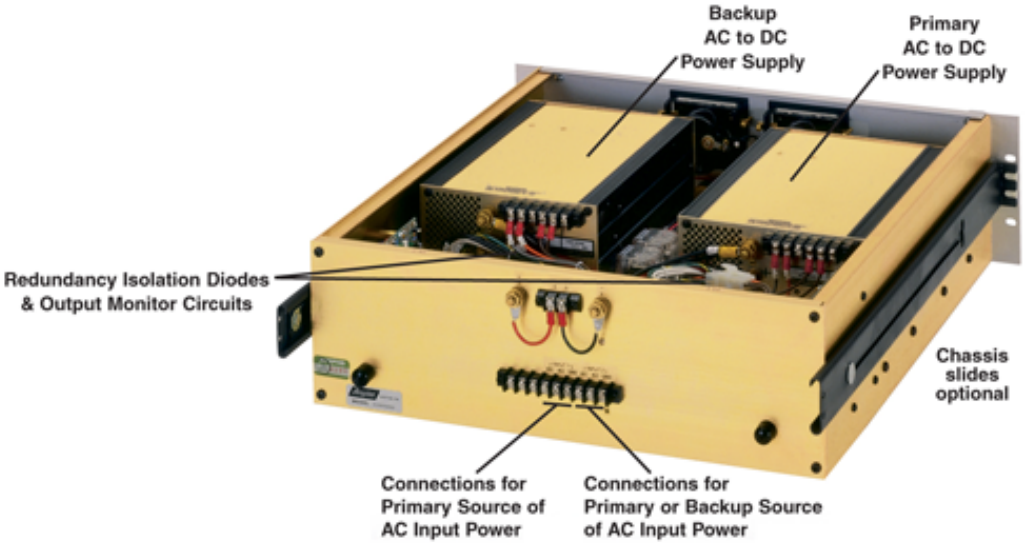
What are the desired factors?

- High Power Density (i.e. small size)

[Toyota Hybrid Car Inverters]

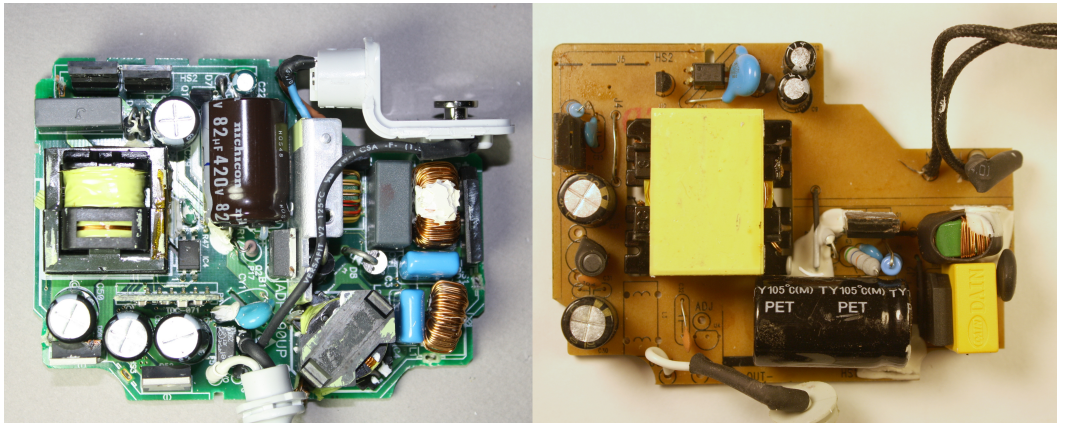
What are the desired factors?

- Reliability, high quality output (and input) power



What are the desired factors?

Of Course Low Cost

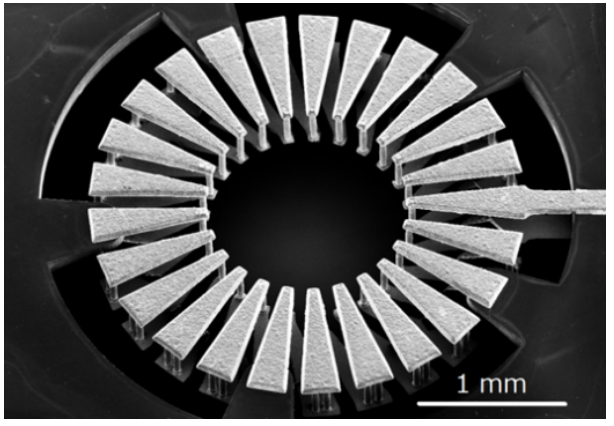


[Original vs. Cheap Macbook Charger]

Applications of Power Electronics

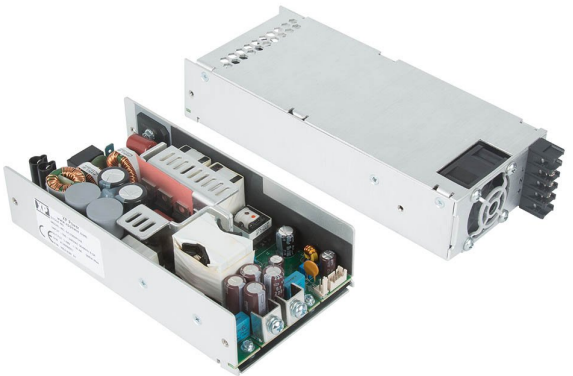
Applications of Power Electronics

- <1W in portable equipments (Tiny Power)



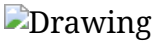
Applications of Power Electronics

- ~100Ws for power supplies, house hold applications (Power Supply)



Applications of Power Electronics

- Several kWs for industrial motor drives (ABB Drives)

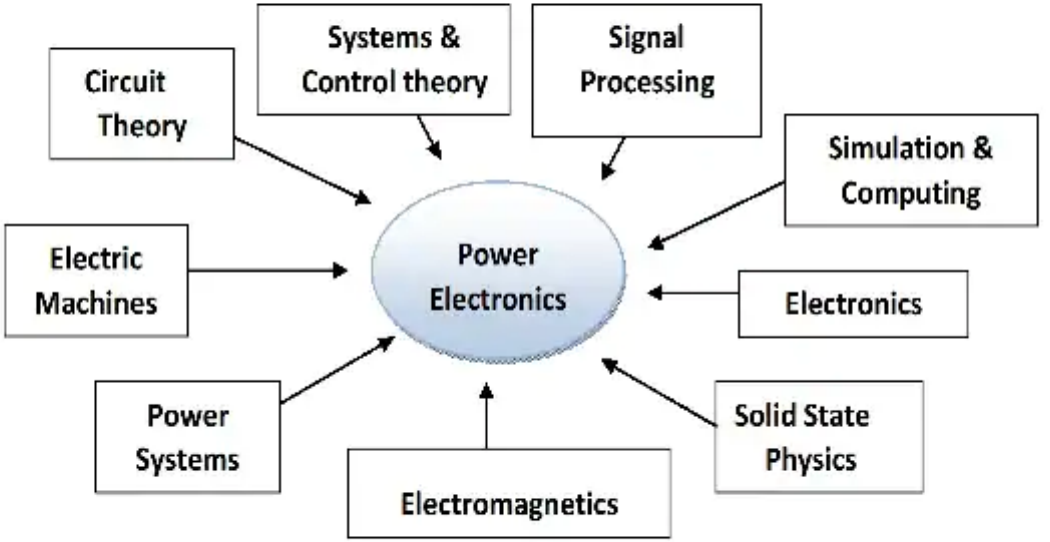


Applications of Power Electronics

- >1 MW for grid applications (HVDC transmission, renewable energy) (ABB 3000 MW, 1100kV HVDC)

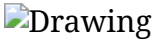
You need to consider many aspects

Interdisciplinary Nature of Power Electronics



Examples

Phone Charger

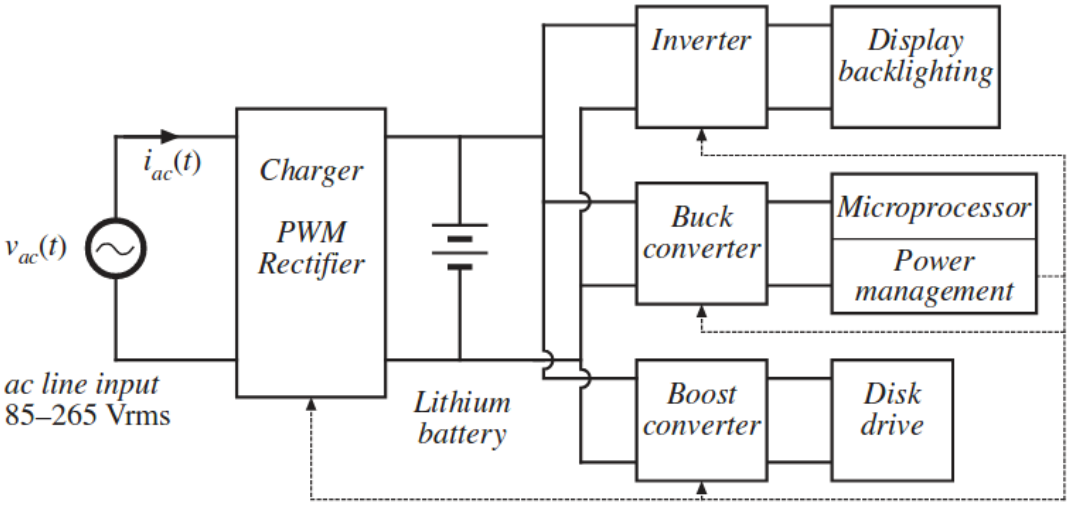


Can you plot the main block diagrams?

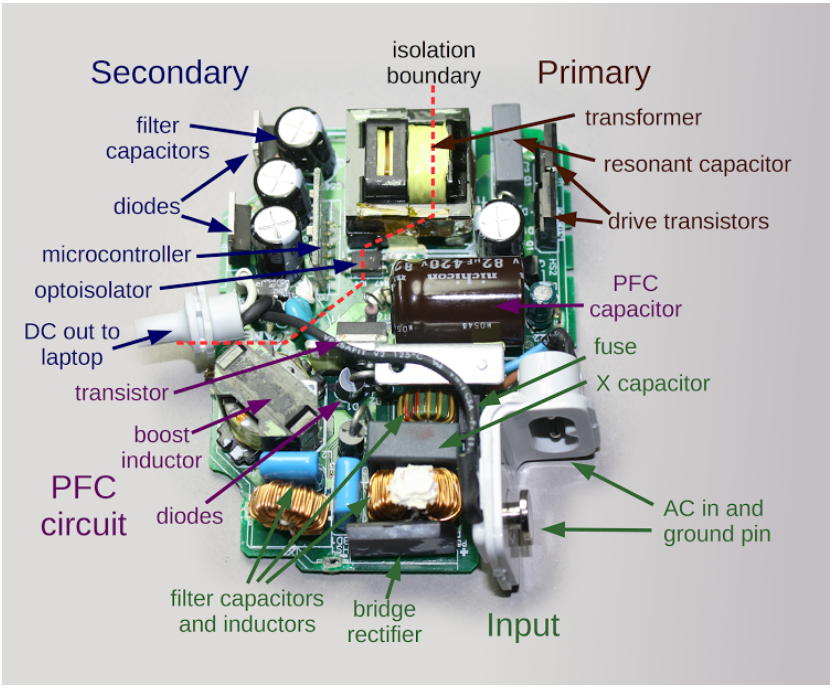
Power Electronics in a Laptop

Can you plot the main block diagrams?

Main Blocks (and other PE components)

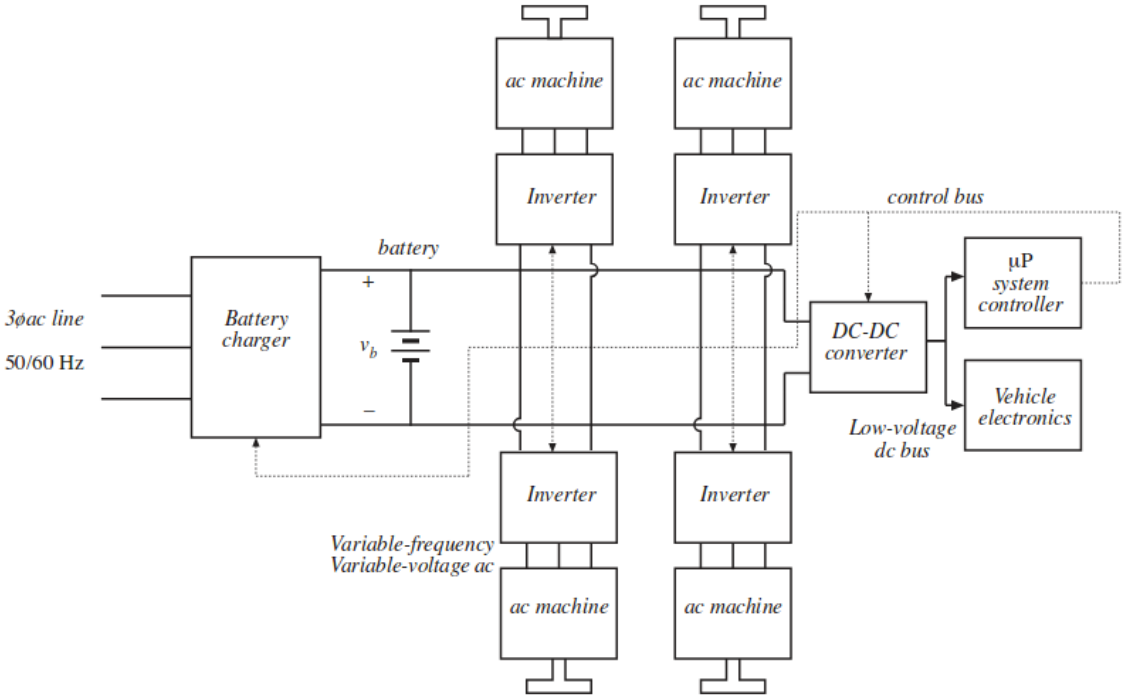


Inside a Laptop Charger



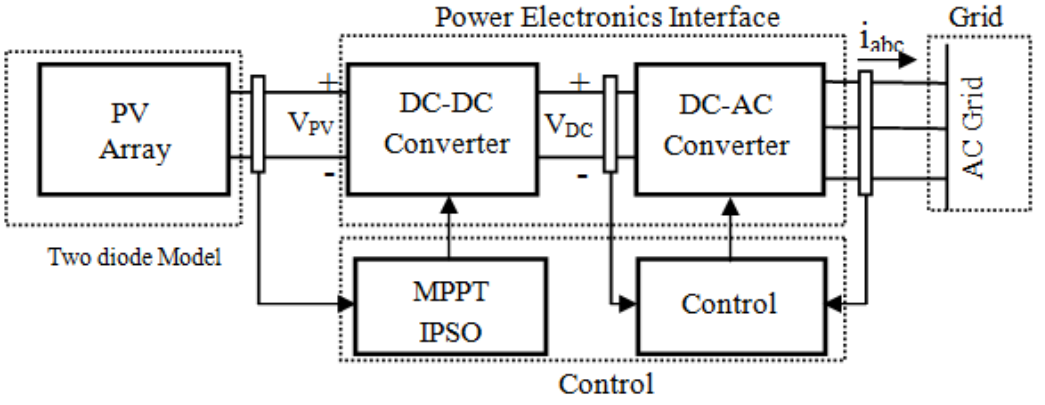
Power Electronics in an Electric Car

Power Electronics in an Electric Car



Grid Connected PV System

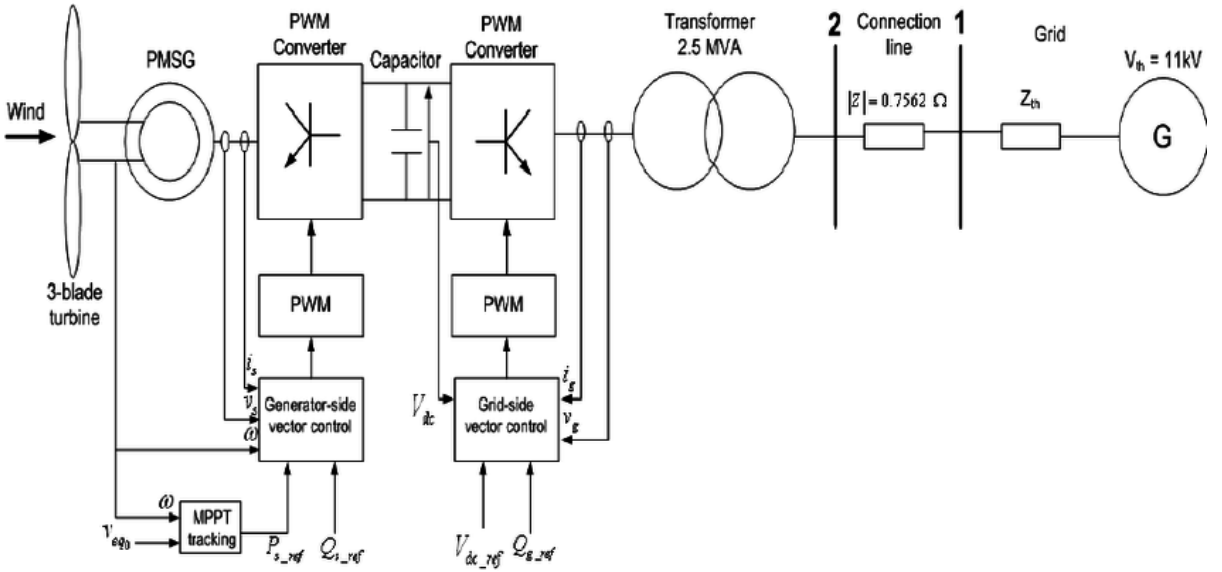
Grid Connected PV System



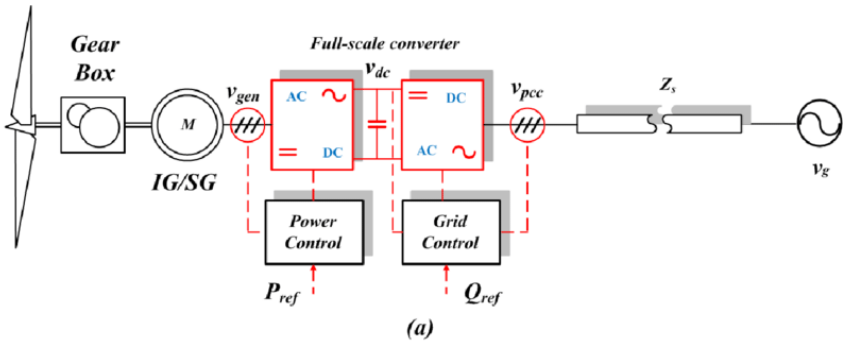
Wind Turbine

Wind Turbine

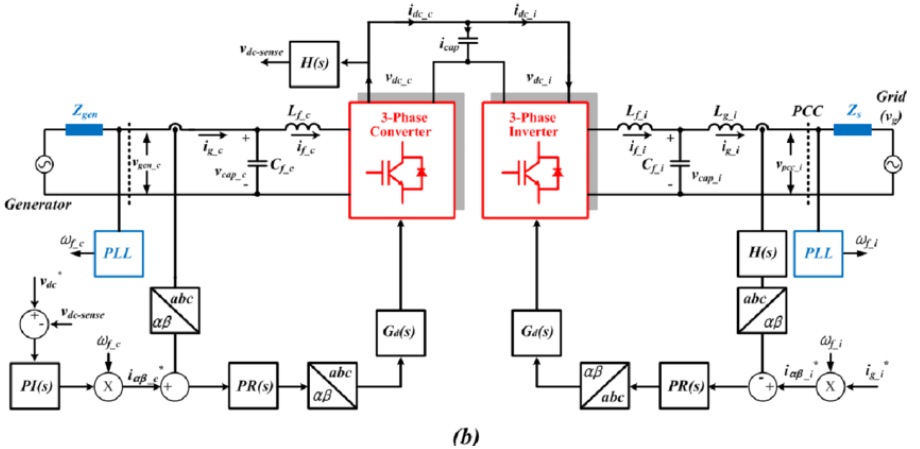
Back-to-back Converter



Back-to-back Converter



(a)



(b)

You can download this presentation from:
keysan.me/ee463