STATCOM (SVC)

from Zener Electric

Sinesaver

The New Technology in Power Factor Correction

An Innovative Product,
Designed and Manufactured by
Zener Electric Pty Ltd

What is Power Factor

- A measure of inefficient use of power
- PF of 1 or unity power factor is the ideal
- The lower the Power Factor the more current required to supply the same True Power.
  - True power = consumed power

Poor Power Factor

- Larger conductors required
- Larger transformers
- Higher rated switchgear
- Fuses of a higher rating
- Higher voltage drops
- Extra copper losses
- Higher generating and capital costs
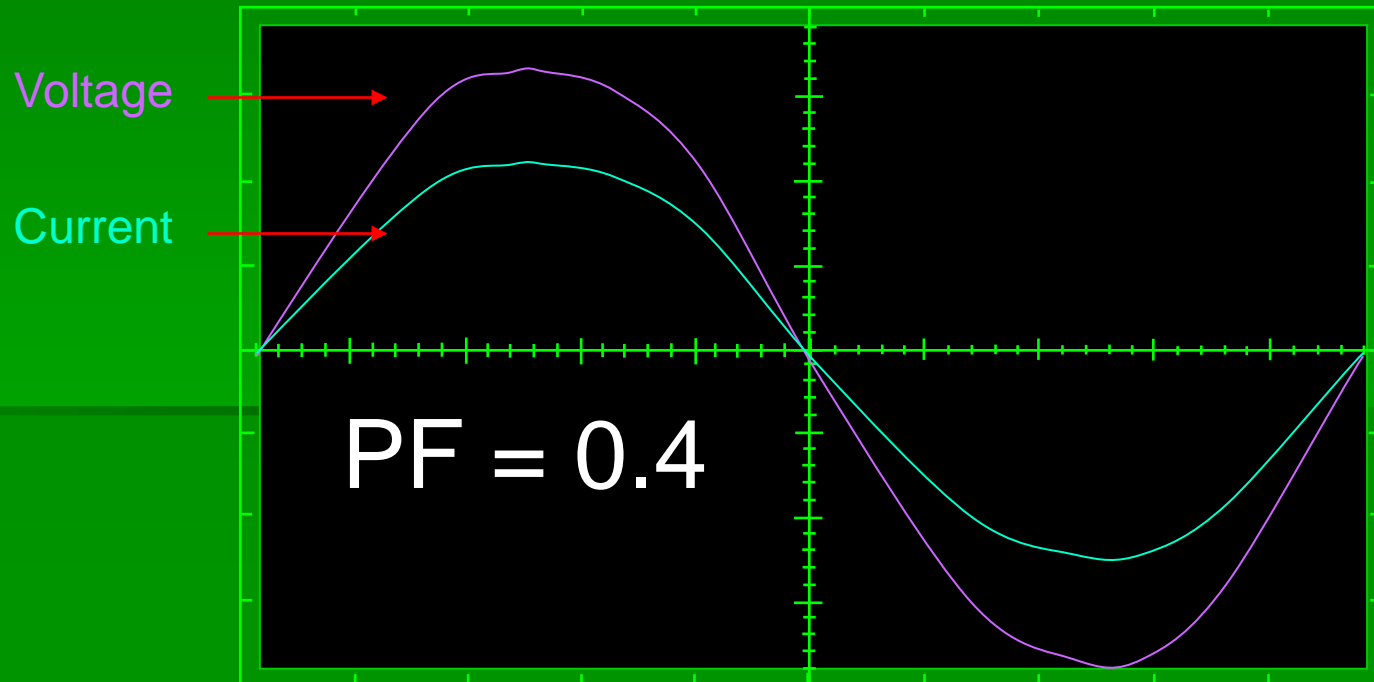 - Infrastructure / upgrade costs

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Why improve power factor

- Environmental Responsibility
  - 'Cleaner / Greener' production initaives
- Supply Infrastructure at limits
  - Penalties imposed to improve efficiency of current power generating plants.
- Reduce Plant operating costs
- Reduce energy costs

Explanation

- AC wave form is sinusoidal

Voltage

Current

PF = 0.4

Waveforms are in Phase with each other

What is the cause

- Resistive loads
  - Unity Power Factor
    - Resistor Heater elements / lamps
- Inductive Loads
  - Current lags the voltage (90°)
    - Motors and fluoro's (ballasts)
- Capacitive Loads
  - Current Leads the voltage (90°)

How to overcome

- Static Correction
  - Attached to specific load

- Bulk / Group Correction
  - Conventional or Old Method
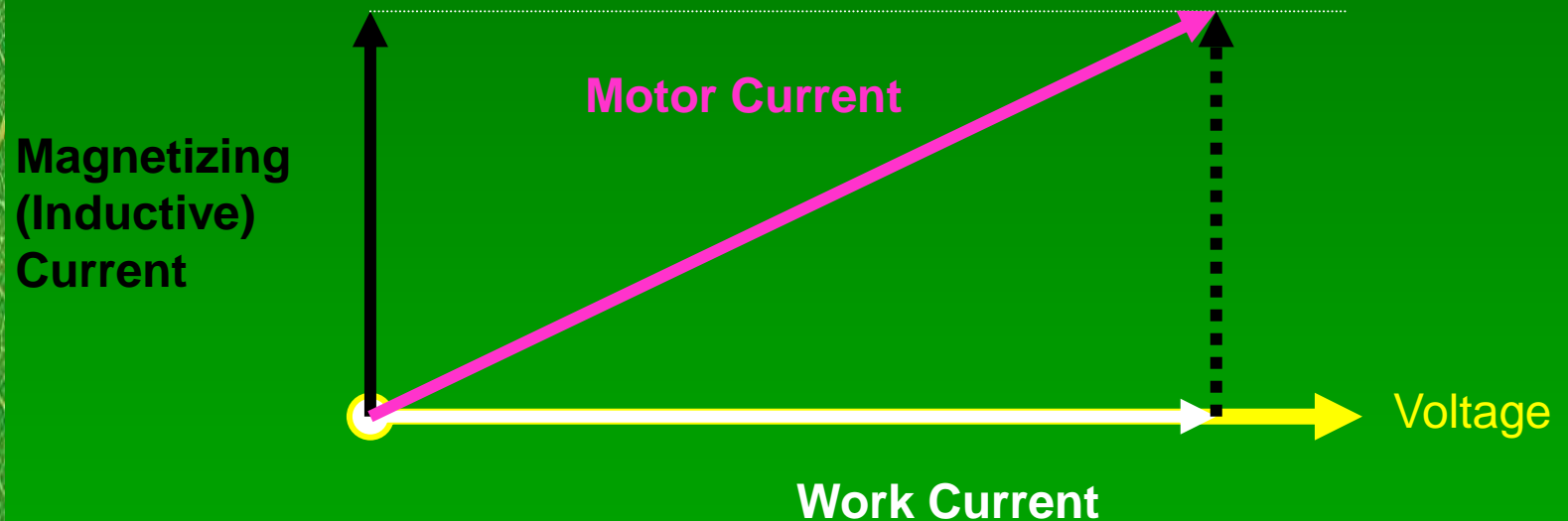 - Active Type; The New Method !!

Static Correction

- Advantages
  - Inexpensive
  - Simple to install
  - Ideal for specific load

- Disadvantages
  - Control considerations
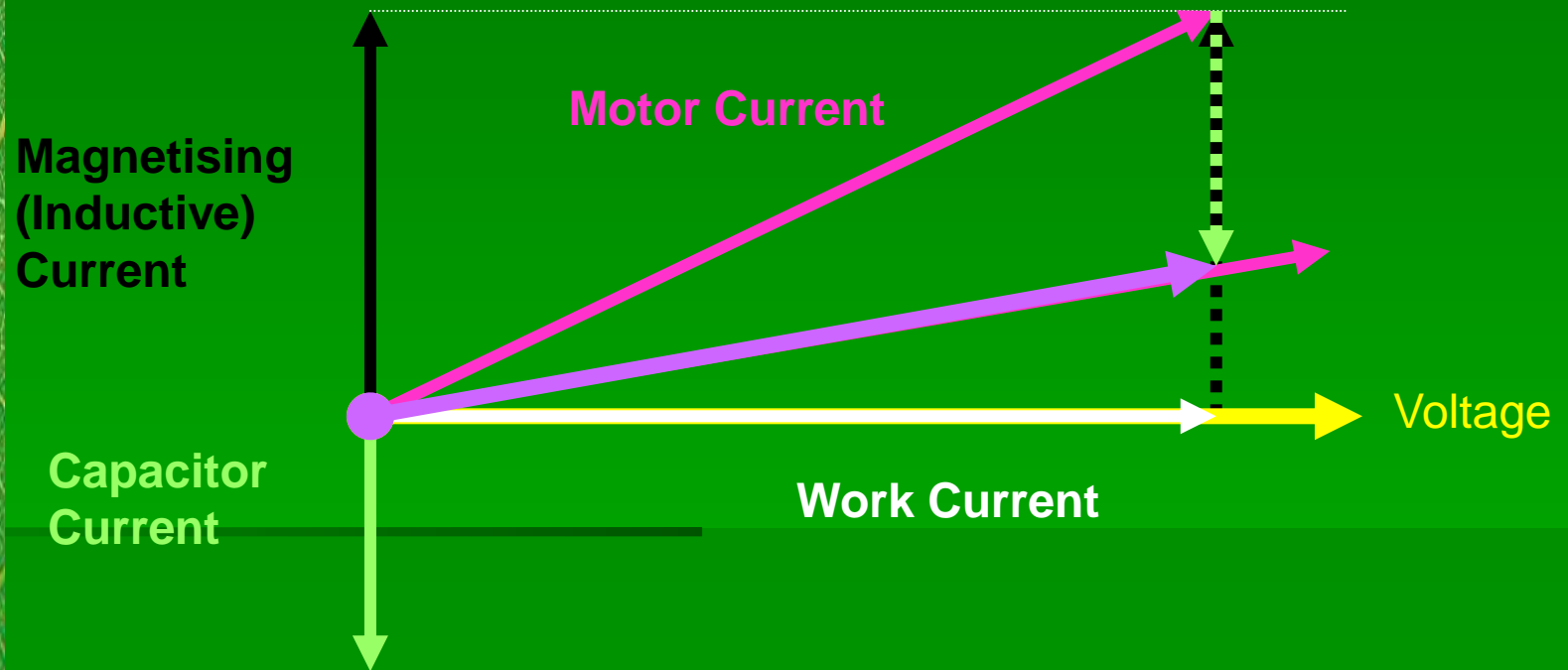 - Fixed amount of correction

The Vector Diagram
of a Motor

- The Motor Current is the vector sum of the Work Current and the Magnetizing current

The Vector Diagram
of a Motor with PF capacitor

Magnetising (Inductive) Current

Motor Current

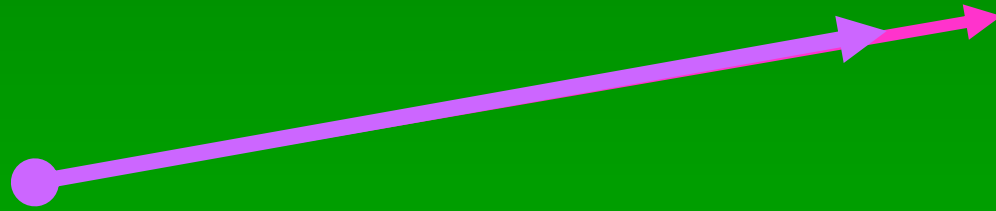**Capacitor Current**

Work Current

Voltage

- The capacitor current cancels the inductive current (180°)

The Vector Diagram
of a Motor with PF capacitor

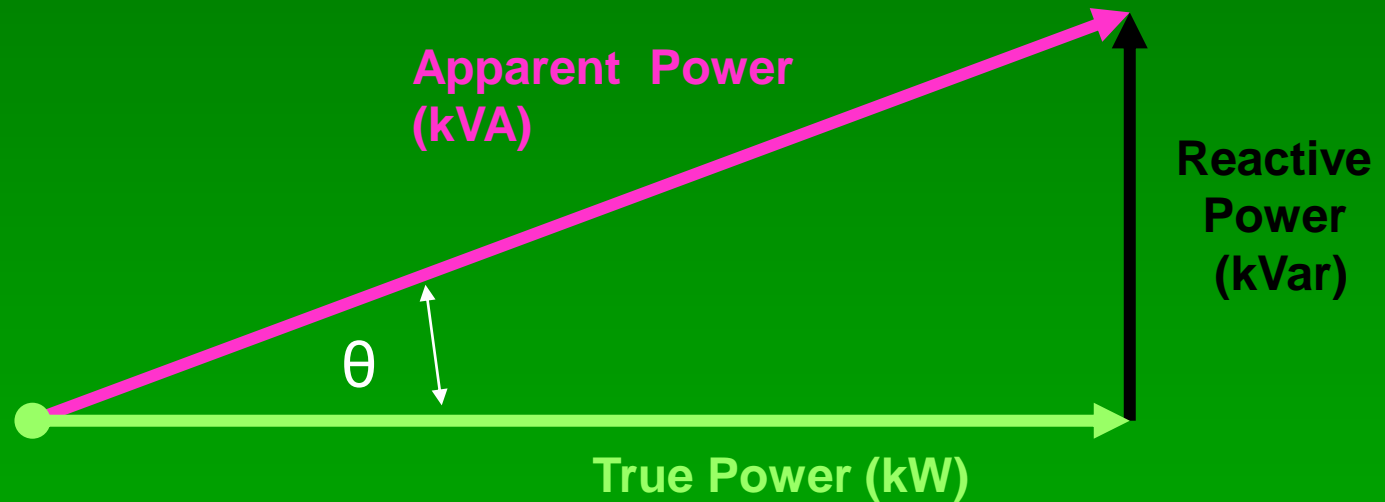- The end result
  - Less Motor Current

Bulk - Conventional

- Advantages
  - System/site approach
  - Degree of automation
  - Ideal for sites with qty of inductive loads
- Disadvantages
  - More Investment required
  - High maintenance costs
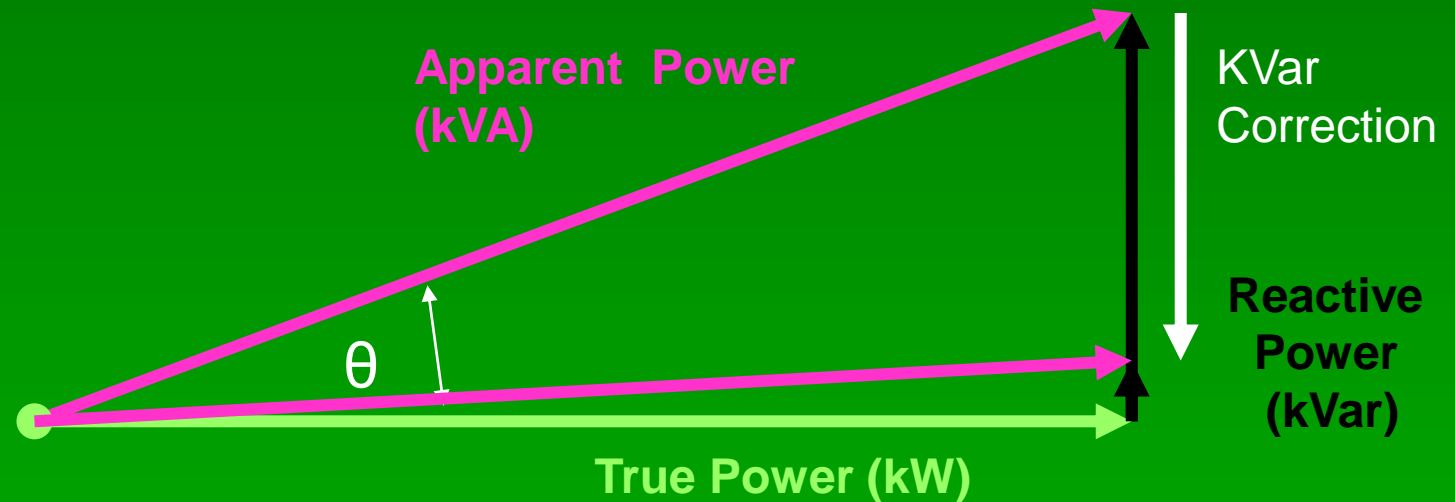 - Possible Harmonic Issues

The Vector Diagram
for Power

Apparent Power (kVA)

Reactive Power (kVar)

θ

True Power (kW)

$$\text{Power Factor} = \text{Cos } \theta = \frac{\text{True Power}}{\text{Apparent Power}}$$

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The Vector Diagram
with Correction

The vector diagram showing Apparent Power (kVA), Reactive Power (kVar), True Power (kW), KVar Correction, and angle θ.

- The end result is more efficient use of power & supply infrastructure
- Power consumed remains constant
- Savings on tariff penalties (if applicable)

Conventional PFC
The Old Technology

- Consists of a control panel to switch in banks of capacitors
  - Uses Contactors
  - Pre-programmed stages
    - Capacitors are switched at pre-determined levels of power Factor
    - Delayed response to prevent continuous relay operation

STATCOM (SVC)

New Technology

- Advantages
  - Latest Technology
  - Linear correction
  - Can achieve unity Power Factor
  - Faster payback period
  - Capacity can be easily increased
  - Greater monitoring and control
- Disadvantages
  - investment required

A STATCOM (SVG) from Zener Sinesaver

- Replaces older technology
- New Technology in Power Correction
- Improved performance
  - Linear control
  - Unity Power Factor
  - Instantaneous correction
- Greater reliability with the use of power semiconductors

Advantages
over conventional type

- Control
  - Instantaneous response to load changes
    - Vs. delayed reaction to PF changes & ignores fast changes such as motor starting
  - Linear Control of Power Factor & Precise Control of Power Factor
    - Vs. Stepped control of contactors to connect banks of capacitors.
  - Not effected by Harmonics
    - Vs. Harmonics result in expensive damage to capacitors

Advantages
V's. conventional type

- Control Continued'
  - Uses latest technology in Power Electronics resulting in improved reliability and reduced maintenance costs.
    - V's. Use of high maintenance contactors to control continual switching of capacitor banks

  - Reduced Surge currents on the Supply
    - V's. Direct switching of capacitors on the supply results in current surges on the supply.

  - Not effected by voltage/frequency fluctuations
    - V's. The PF correction will vary with changes in voltage & Frequency.

Advantages

V's. conventional type

- Installation
  - One size only ; 100Kvar unit only, add multiple units in parallel for >100kvar
    - V's. Multiple units with various amounts of capacitor banks as required.
- Setup
  - Set the desired Power Factor with a push of a button eg. 1.00
    - V's. Required to be factory Preset fro step control of capacitor Banks

Advantages

V's. conventional type

- Adaption to site changes
  - KVar correction is easily increased by adding an additional SineSaver unit.
    - V's. Substantial modifications and factory setup required, may require complete changeover unit.

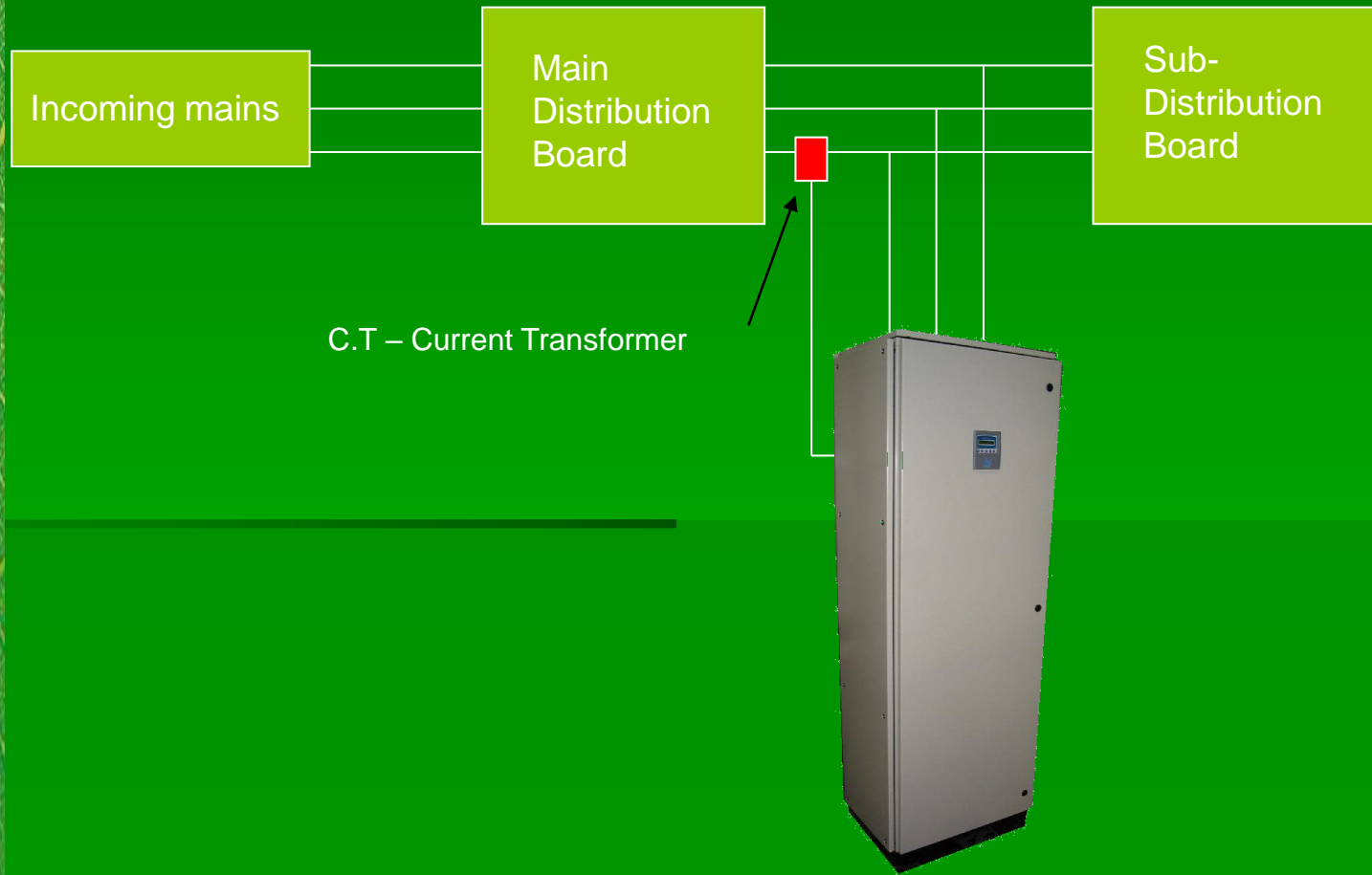100Kvar **+** 100Kvar **+** 100Kvar **=** **300Kvar Correction**

The SineSaver
Technical Specs

- Available in 100Kvar Units
- IP00 for retrofit
  OR
- Enclosed to IP43
  - Complete with :
    - Isolation Switches
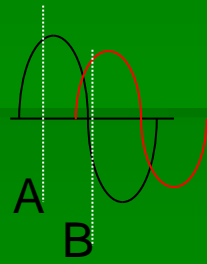   - Semiconductor Fuses
- Dimensions
  - IP00 :
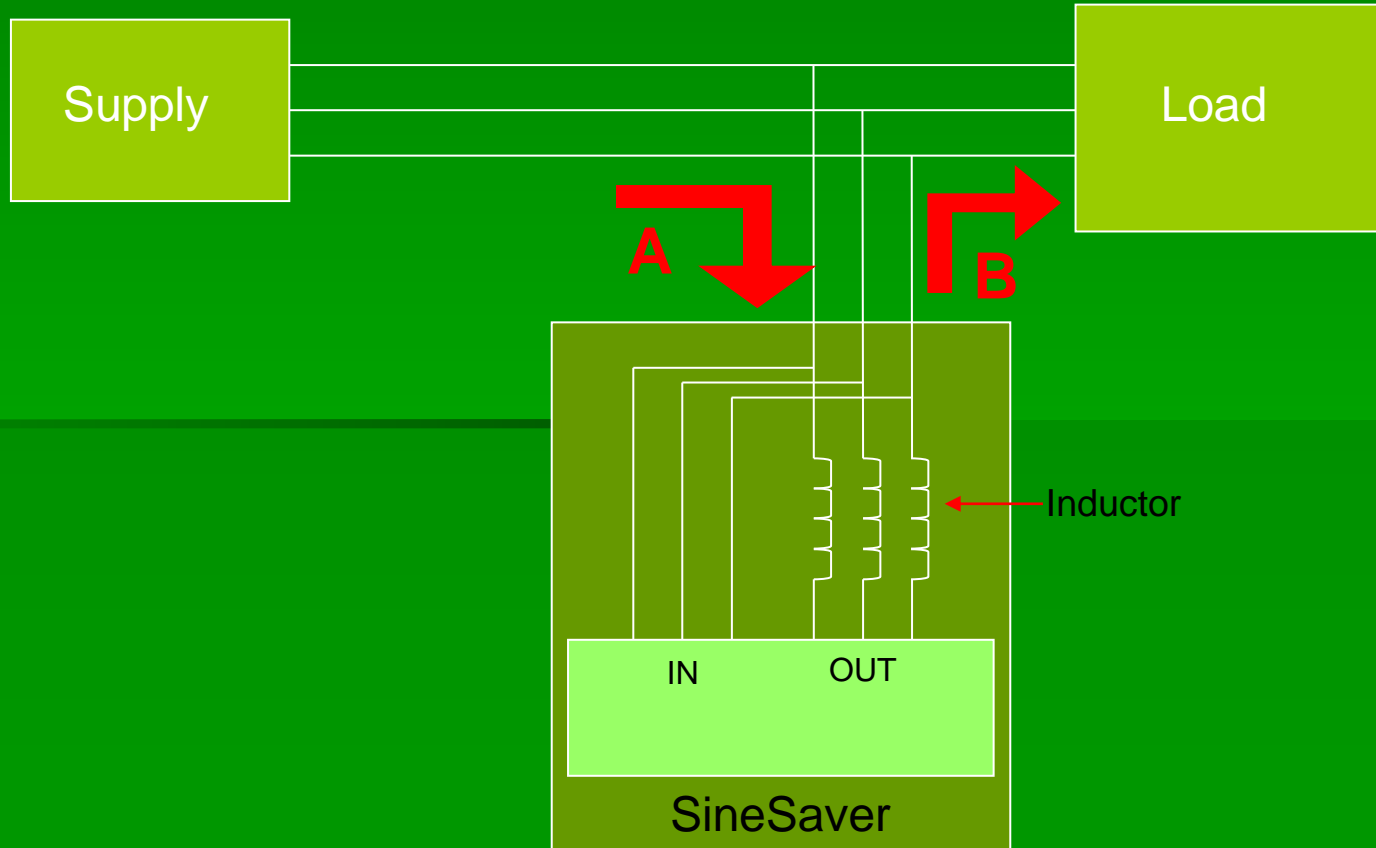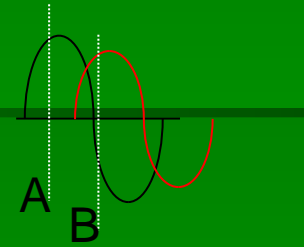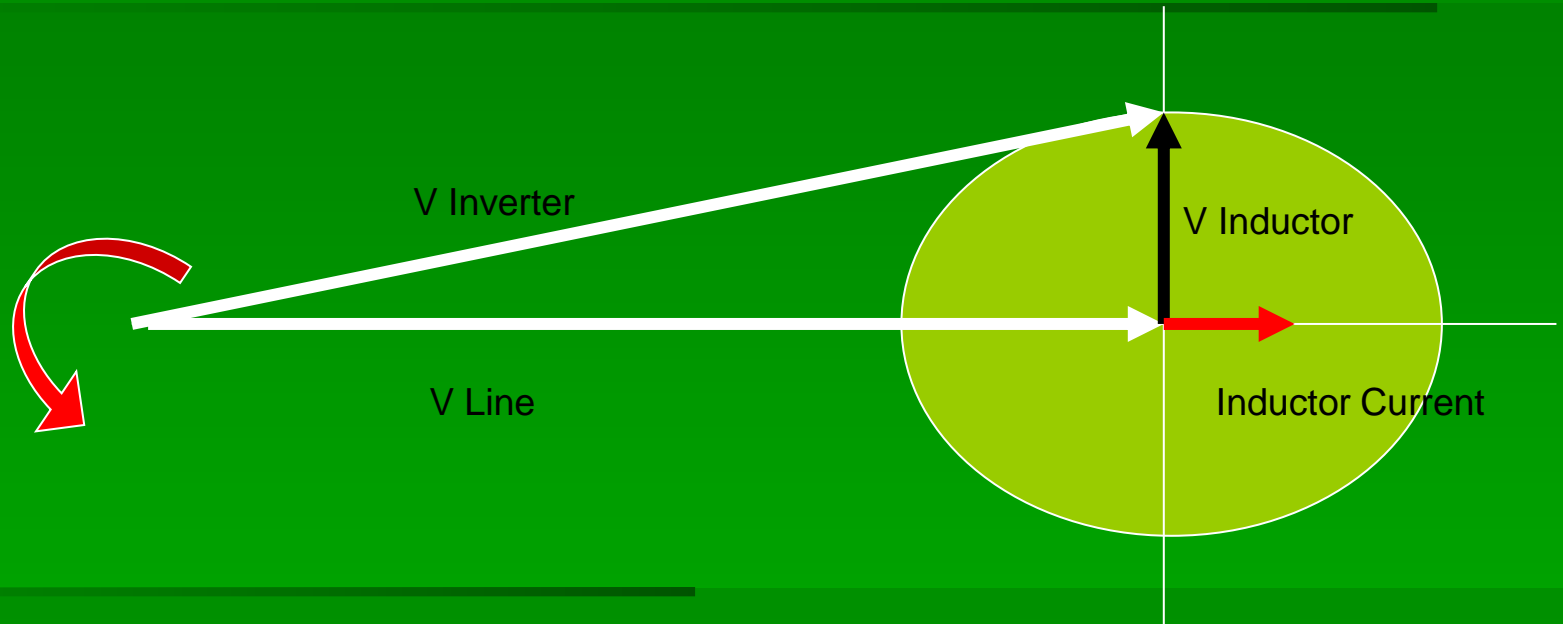 - IP43 :

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How is it installed ?

| Incoming mains | | Main Distribution Board | | Sub-Distribution Board |

C.T – Current Transformer

How does it work ?

Voltage

Current

A
B

A
B

Supply

Load

A

B

Inductor

IN   OUT

SineSaver

Technical Explanation

V Inverter

V Line

V Inductor

Inductor Current

- V Inverter is slightly higher voltage than V Line
- Inductor Current is 90º to Inductor Voltage, happens to be in phase with V line
- The Result is a Power Factor of 1, ie. Unity

What are the savings ?

- **KWH Charge**
  - This is the true power used/consumed this will generally remain constant
- **Infrastructure / Capital expense**
  - More efficient use of your infrastructure means greater capacity in what you have, reduce costs of upgrade work.
- **PF Penalties**
  - Reduce energy costs where penalties maybe incurred for poor power factor.
- **Maximum Demand kVA**
  - Reduce energy costs resulting from peak demands. This is measured in KVA, which is the apparent power

Payback Periods

- Determined by reduced energy costs
  - Can be estimated based on past electricity bills.
  - Accuracy depends on type of penalty
    - Maximum Demand or PF Penalty
- Reduction in capital expenditure
  - Infrastructure costs