

變頻控制技術及節能應用

Prof. Yen-Shin Lai

Center for Power Electronics Technology

National Taipei University of Technology

E-mail: yslai@ntut.edu.tw

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Summary

- 介紹說明變頻控制相關原理、技術及應用等
- 以線上語音的方式，提供一般民眾收聽與下載教學簡報

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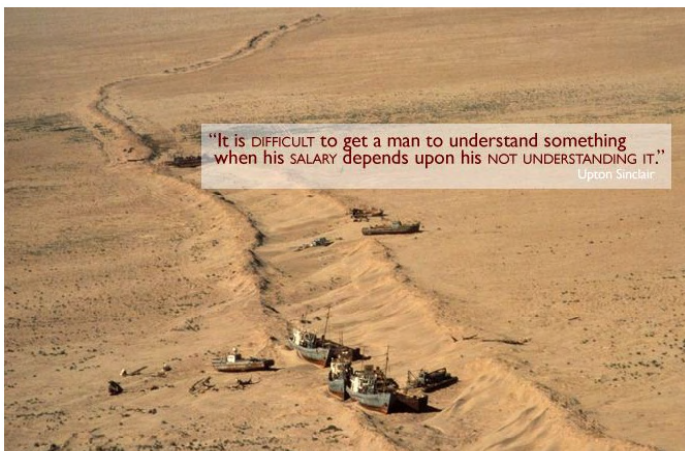
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Outline

- 簡介
- 變頻控制相關原理
- 變頻器技術
- 變頻器的應用例

簡介

An Inconvenient Truth



"It is difficult to get a man to understand something when his SALARY depends upon his NOT understanding it."

簡介



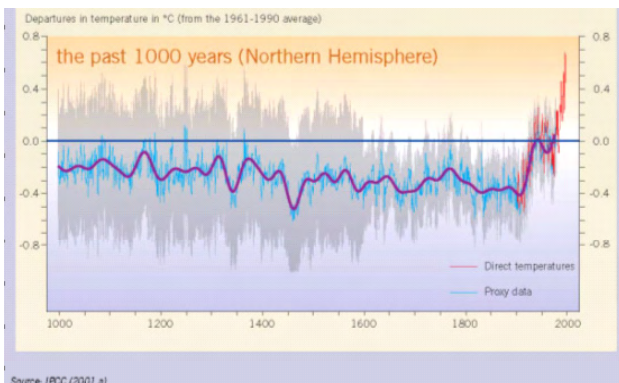
In the past 100 years, (in C)

- Global temperature rise: 0.7 degree
- Taiwan (Average): 0.8 degree
- Taiwan (Urban): 1.4 degree
- Taiwan (Ocean): 0.9-1.1 degree

YSLAI Source: <http://tw.news.yahoo.com/article/url/d/a/091229/1/1xv8s.html>

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簡介



Source: <http://zh.wikipedia.org/>



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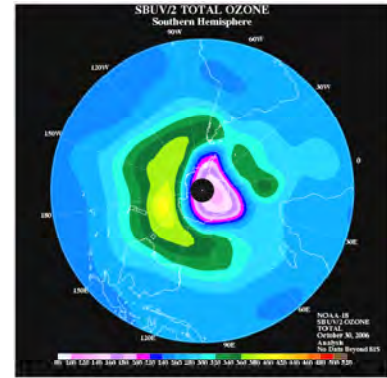
簡介

➤ Kyoto Protocol become effective since Feb. 16, 2005

Participation in the Kyoto Protocol, as of June 2009



Source: <http://zh.wikipedia.org/>



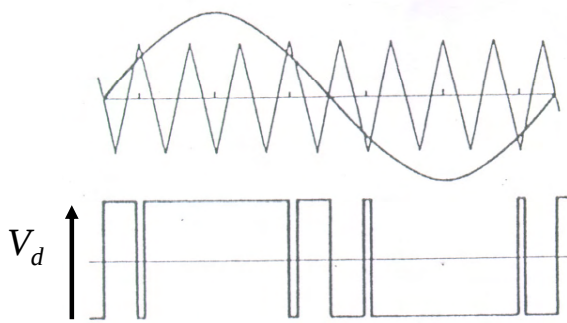
➤ 2008~2012: Reduce greenhouse gas (CO₂, CH₄, N₂O, HFCS, PFCS, SF₆) 5.2% of that in 1990

➤ Motors consume more than 60% of electrical power-WHO

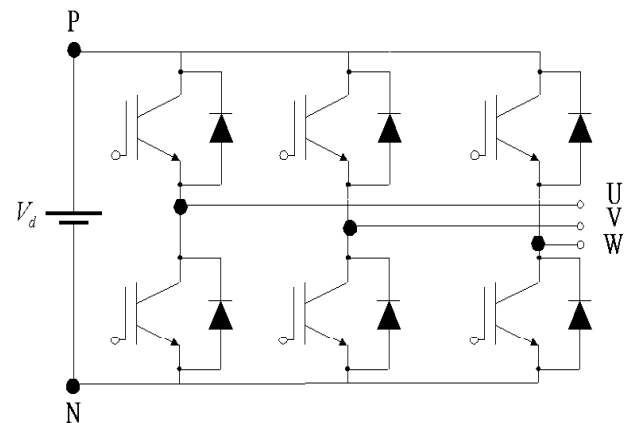
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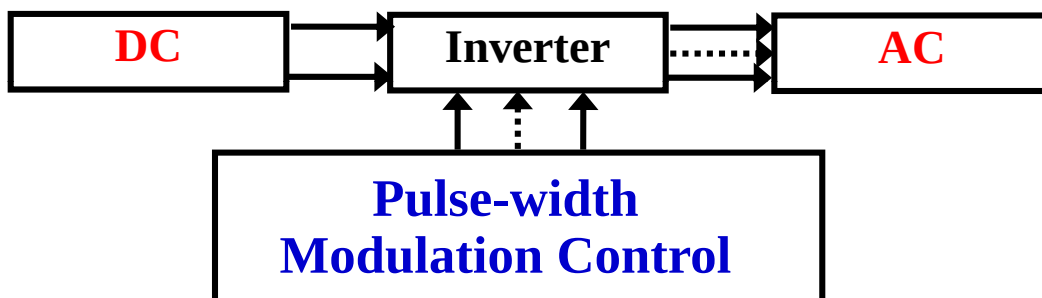
變頻控制相關原理



Voltage Waveform



Inverter

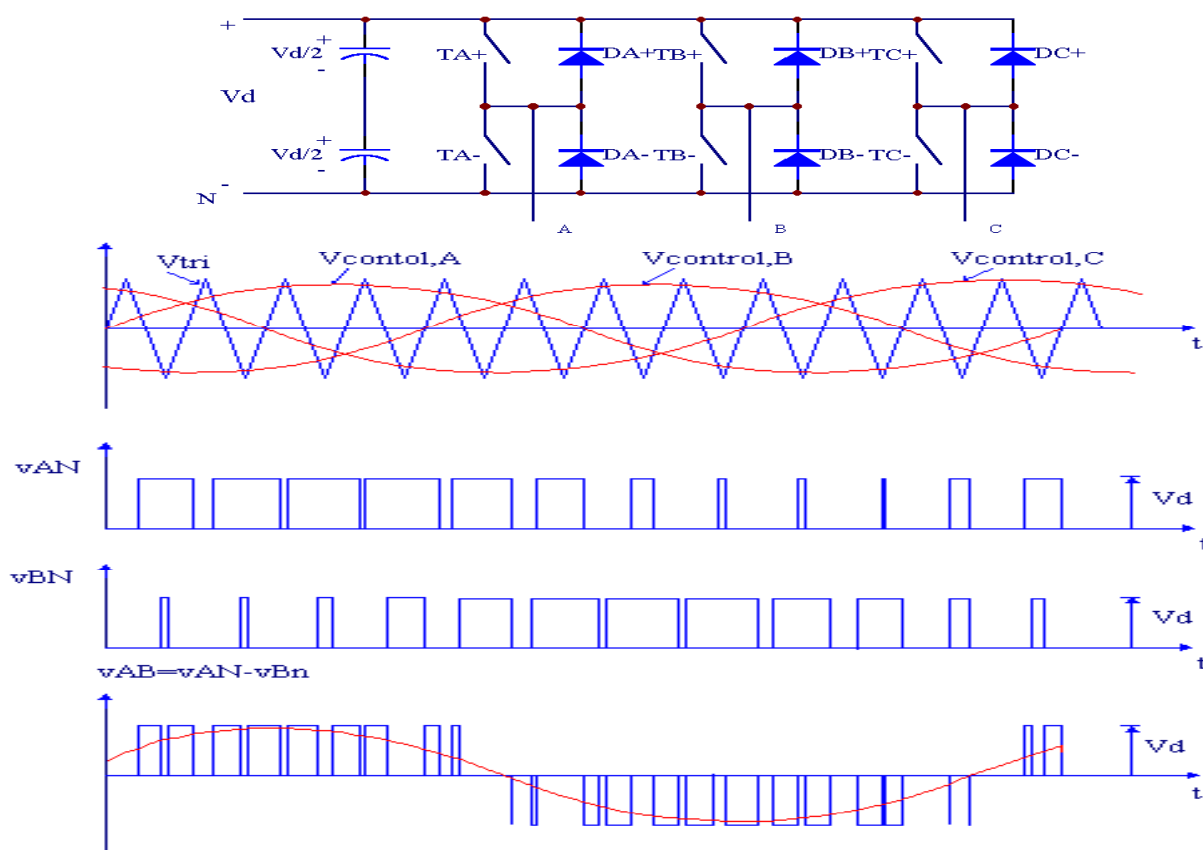


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AC Output: Variable Voltage and Variable Frequency

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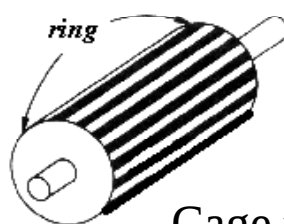
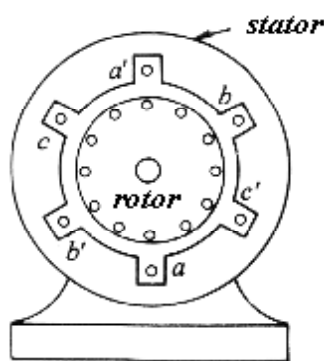
變頻控制相關原理



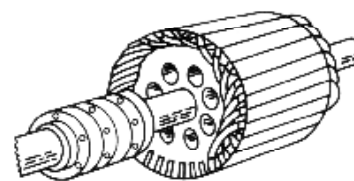
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變頻控制相關原理



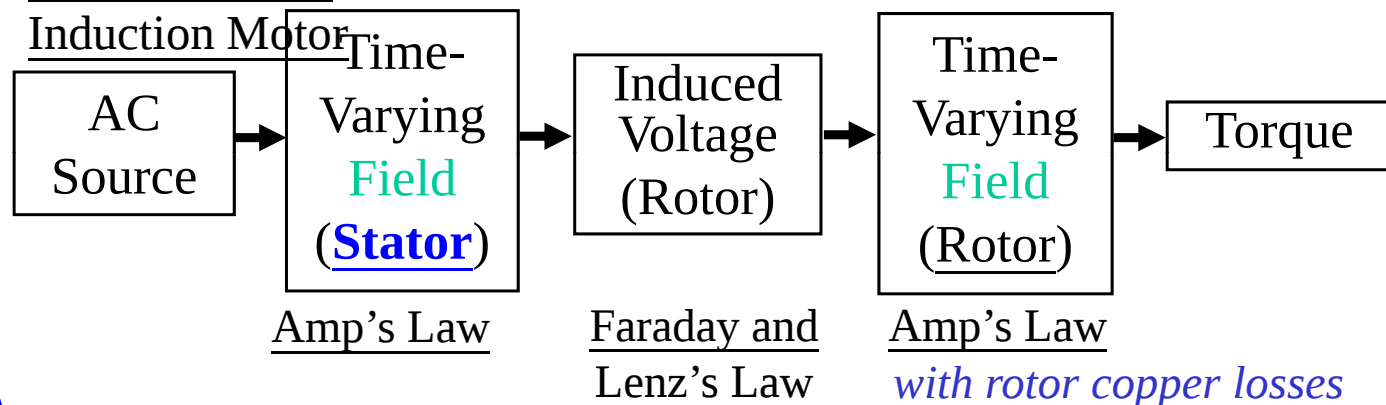
Cage type



Wound type

Construction of
Induction Motor

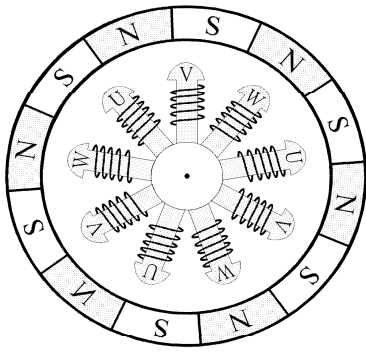
Rotor Construction



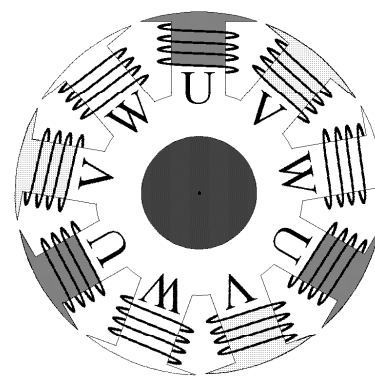
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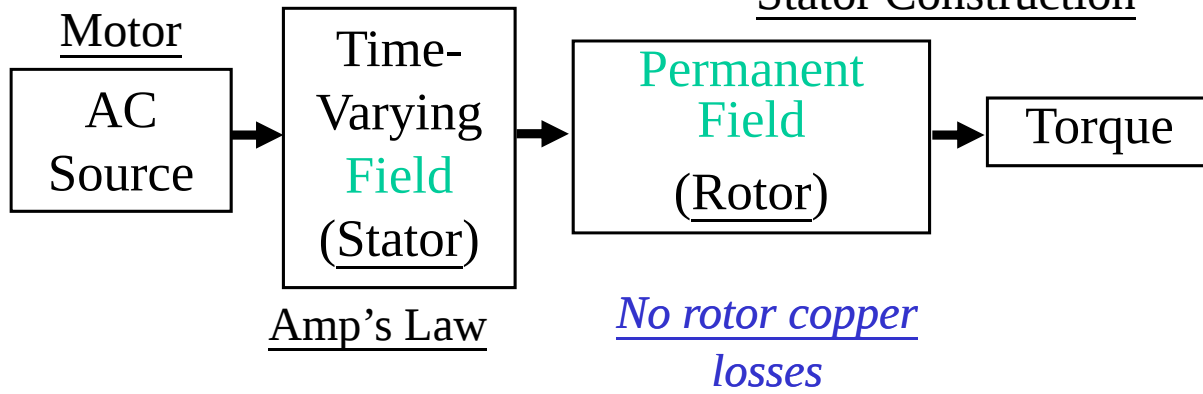
變頻控制相關原理



Construction of Brushless Motor

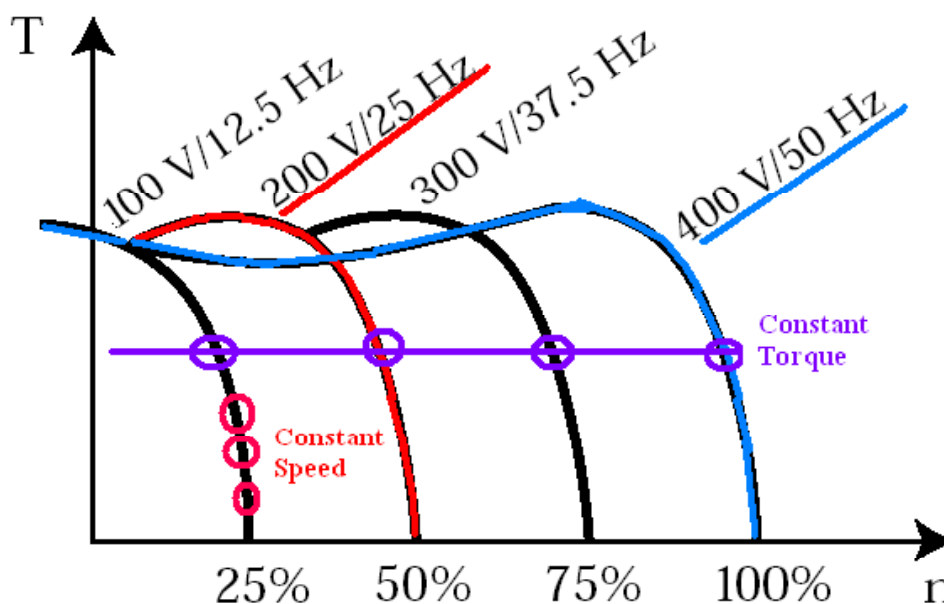


Stator Construction



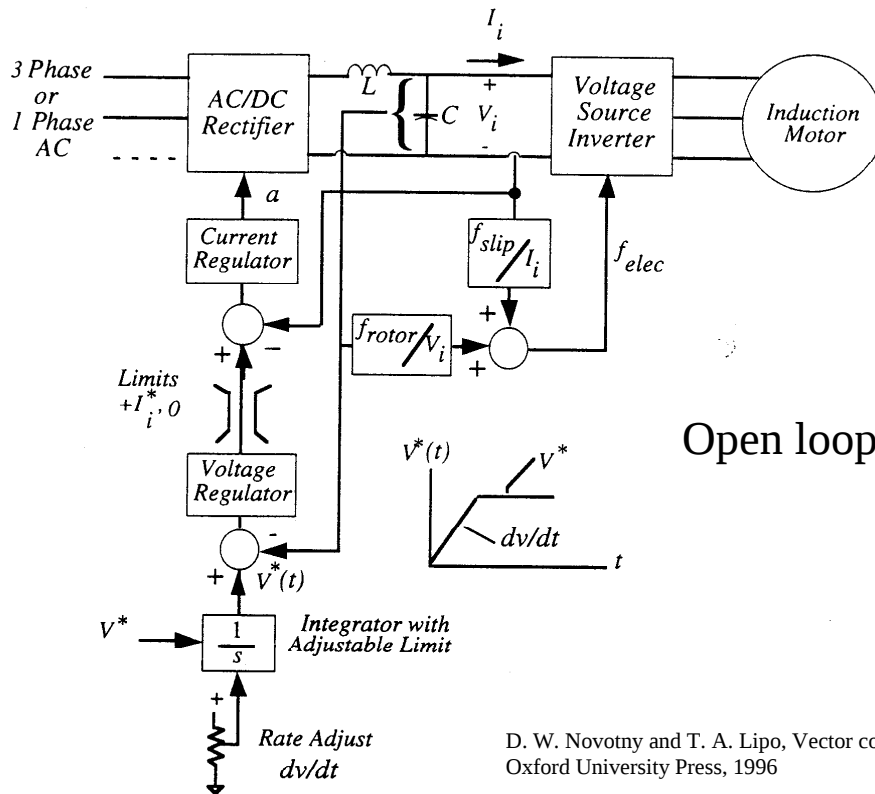
變頻控制相關原理

Frequency Regulation



Torque characteristic using the voltage/frequency control

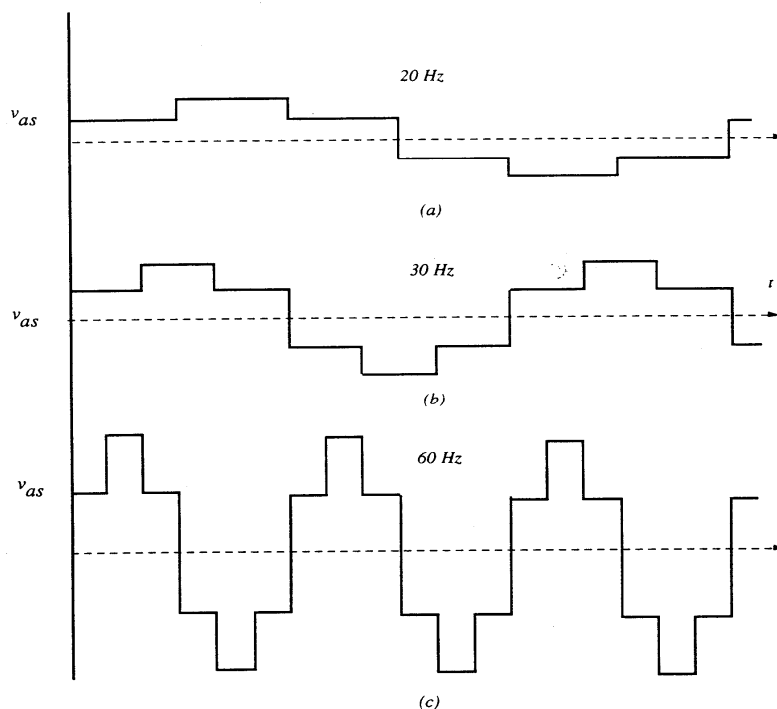
變頻器技術



Open loop control, v/f control

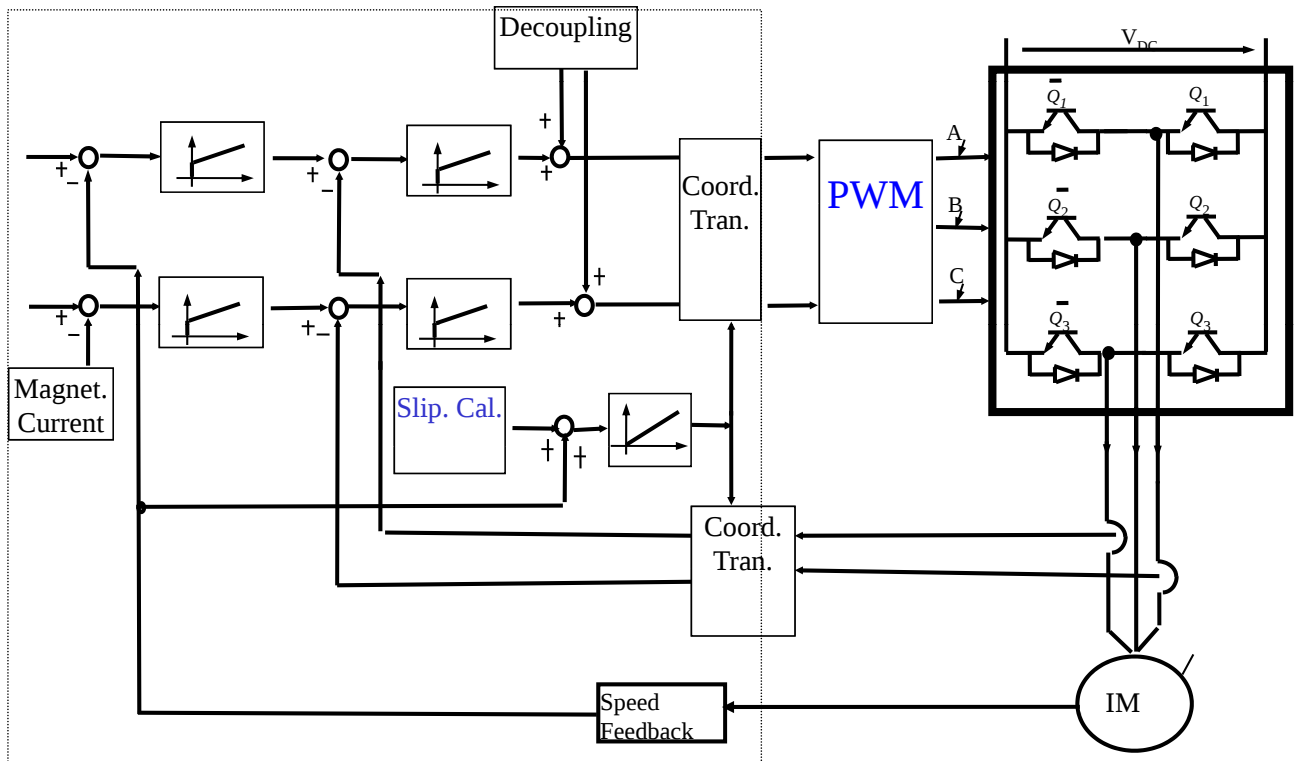
D. W. Novotny and T. A. Lipo, Vector control and dynamics of AC drives, Oxford University Press, 1996

變頻器技術



Control waveforms for v/f control

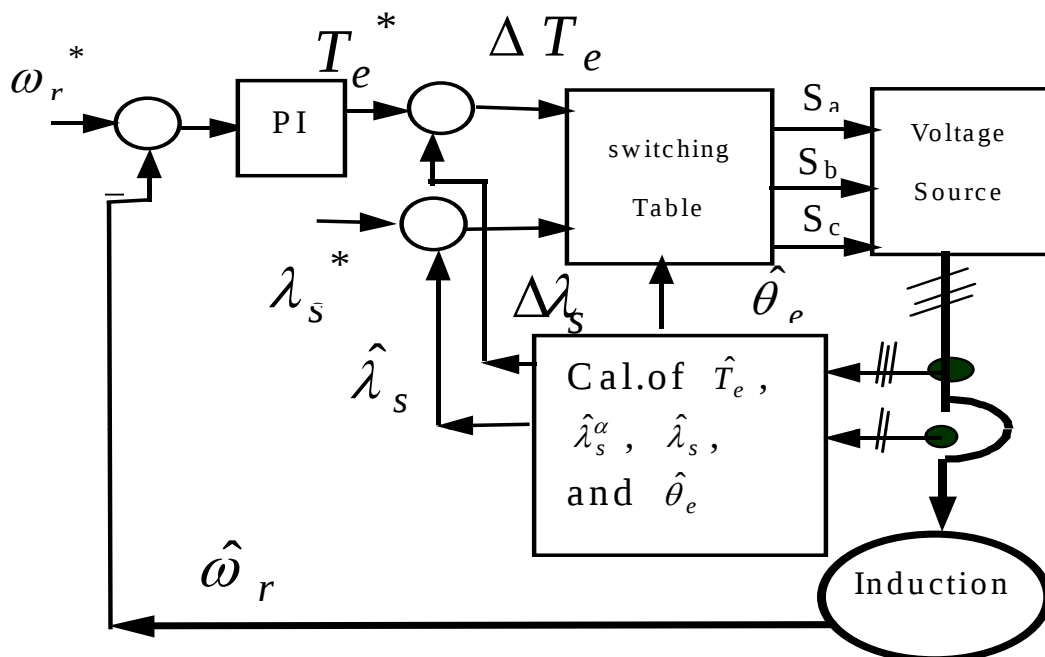
變頻器技術



Vector Control

變頻器技術

Direct Torque Control, DTC



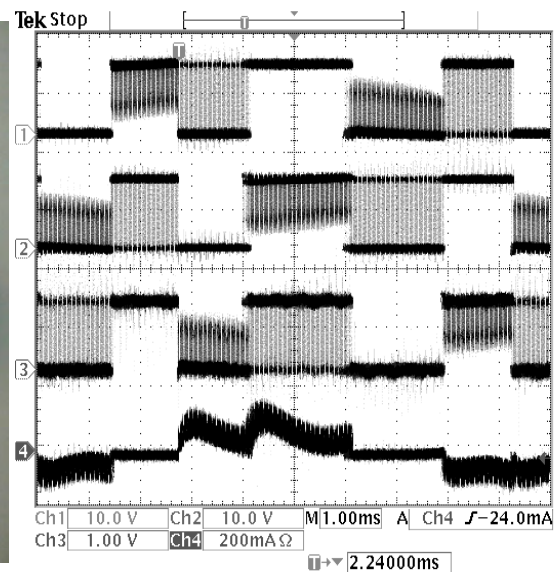
變頻器的應用例

- 交通：飛機（all electric drives）、電動汽車（Hybrid or Fuel Cell Car）、電動機車（Electric Scooter）、電動腳踏車
- 電梯、空調、家用（洗衣機）、風扇、鼓風機
- 資訊（DVD、CDR、CDR/W、HD/FD）
- 自動化產業
- 其他

變頻器的應用例

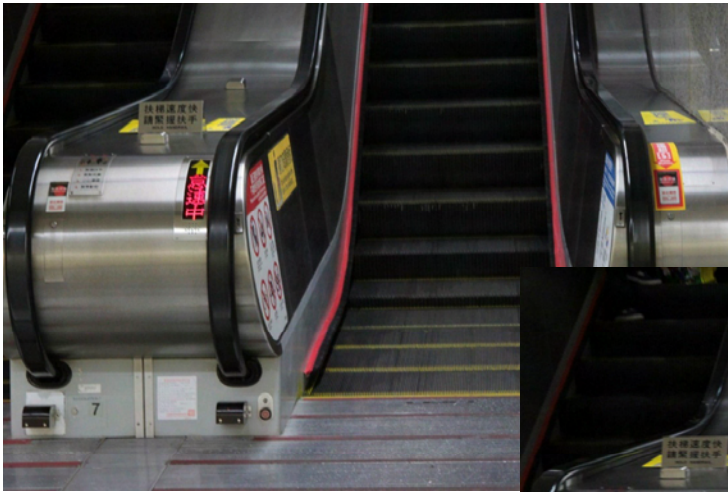


DVD Spindle Motor

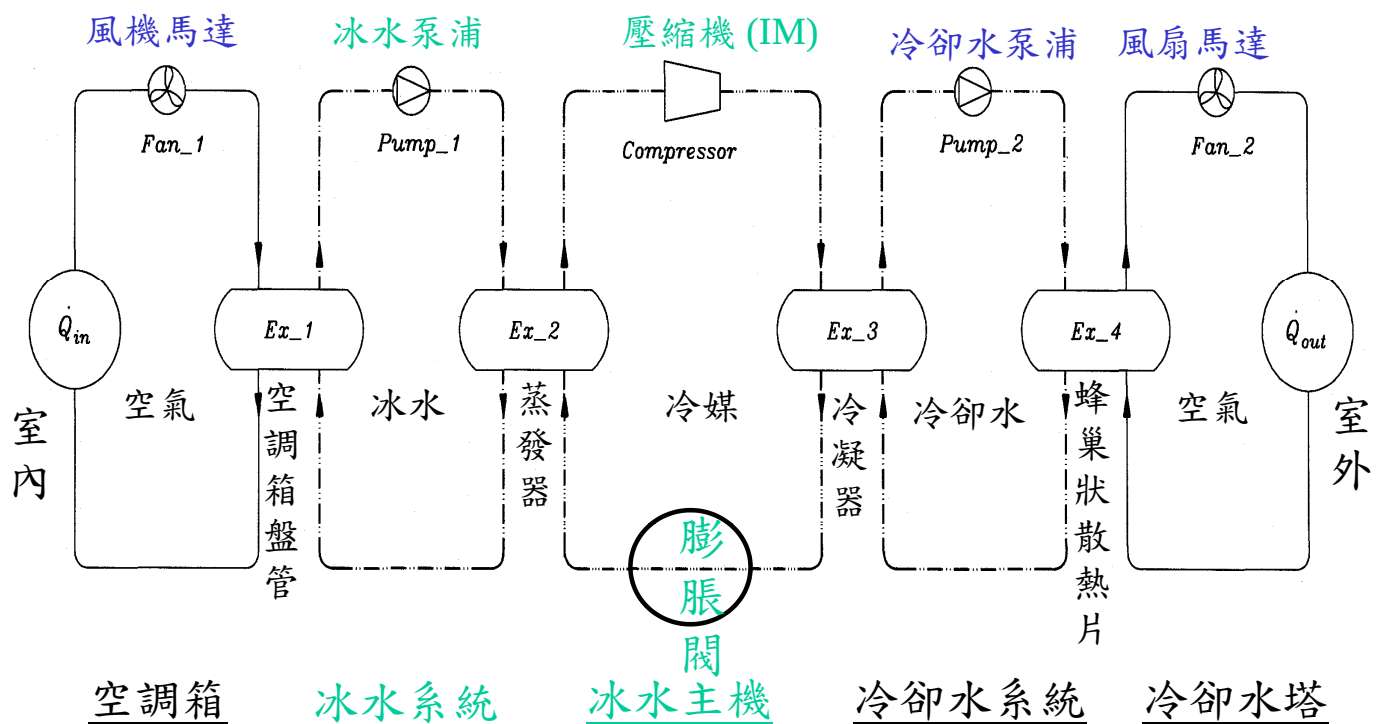


Measured waveform

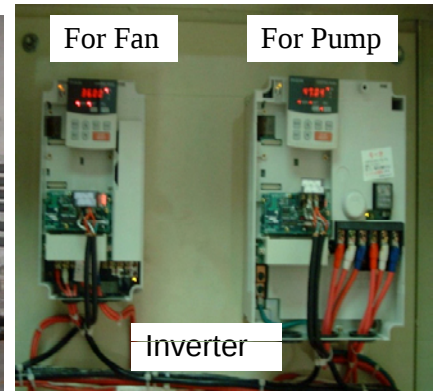
變頻器的應用例



變頻器的應用例



變頻器的應用例



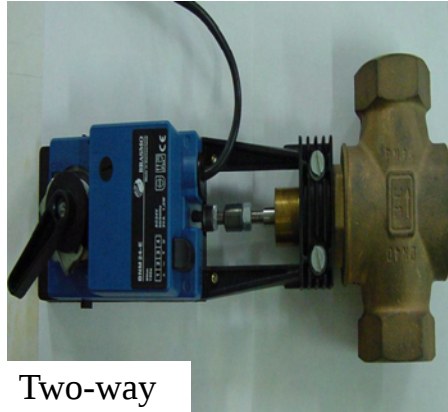
For Fan

For Pump

Inverter



AHU

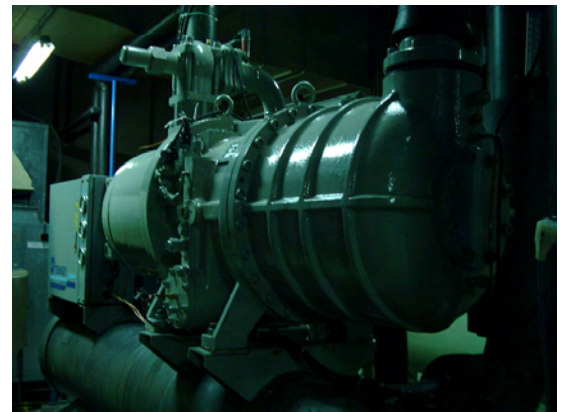
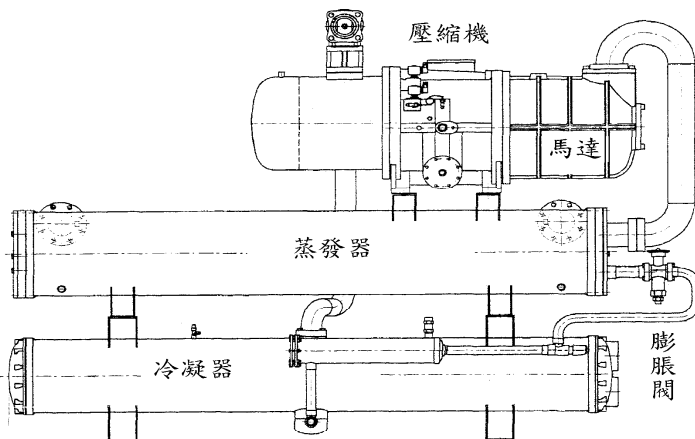


Two-way
Valve



Inverter for AHU

變頻器的應用例



Adjust Speed Drives (Compressor) : 3 Φ 220V 、 60Hz 、 100hp

變頻器的應用例

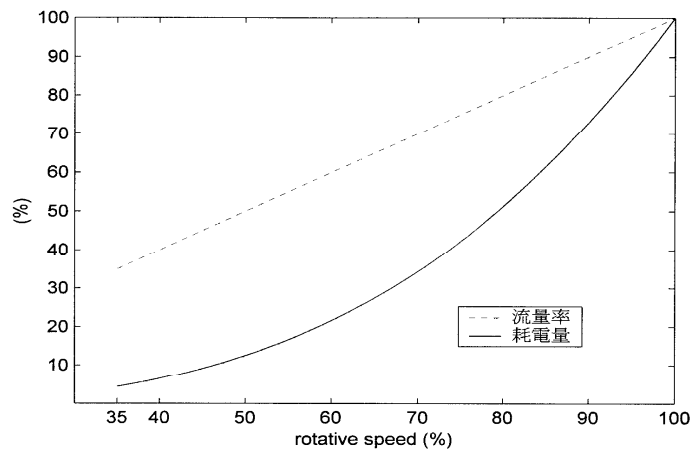
Why Adjust Speed Drives Save Power (Energy)?

➤ Flow Rate vs. Speed

$$\frac{m_1}{m_2} = \frac{\omega_1}{\omega_2}$$

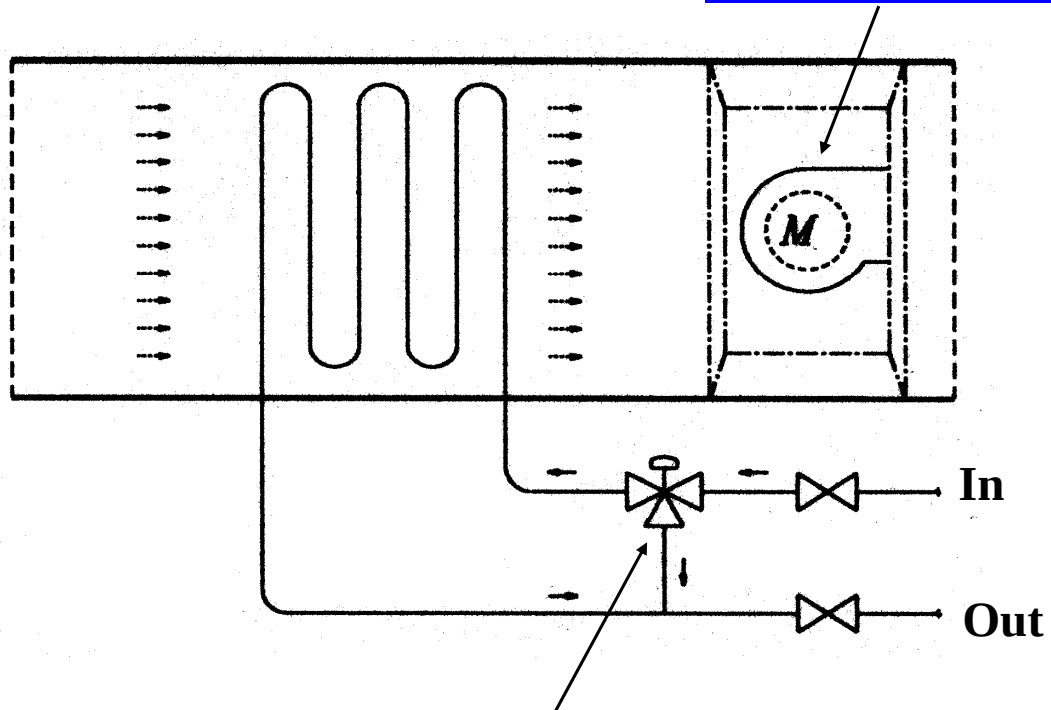
➤ Power vs. Speed

$$\frac{W_1}{W_2} = \left[\frac{\omega_1}{\omega_2} \right]^3$$



變頻器的應用例

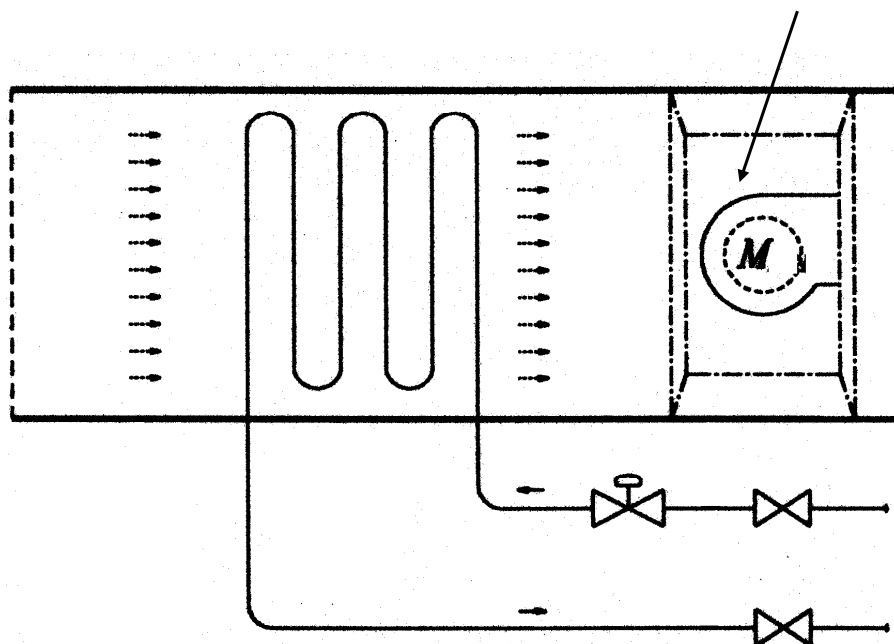
Constant Speed



By-Pass Control

變頻器的應用例

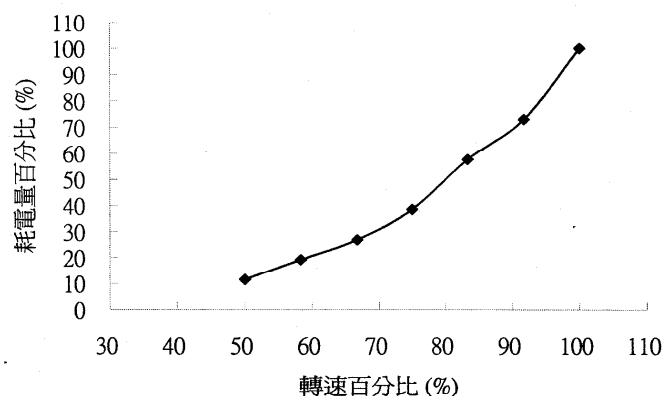
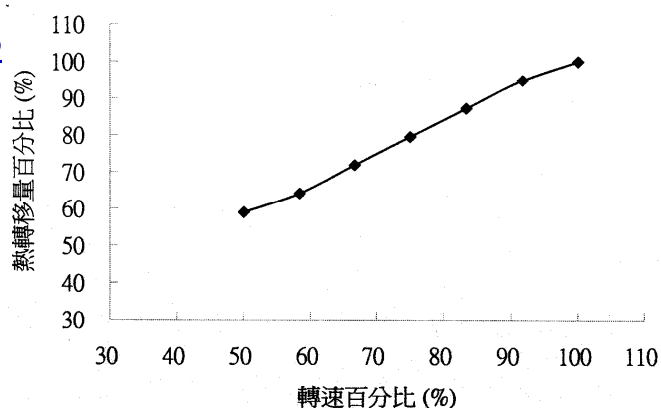
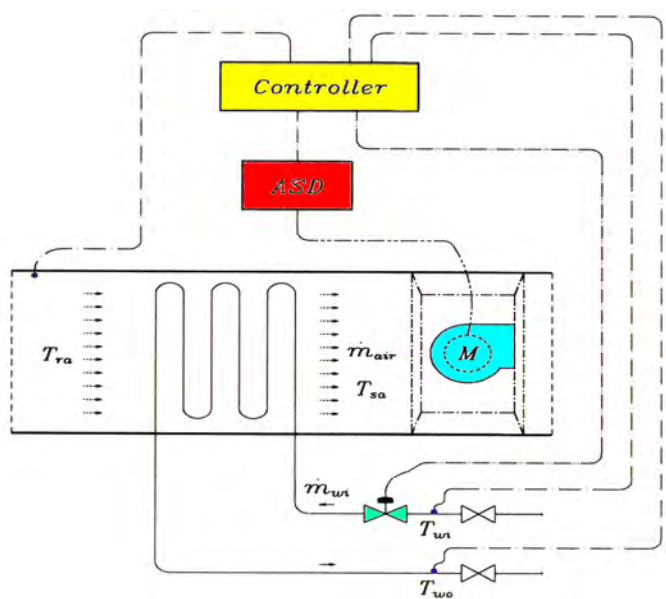
Inverter Control



➤ No more by-pass control with Inverter-controlled Fan

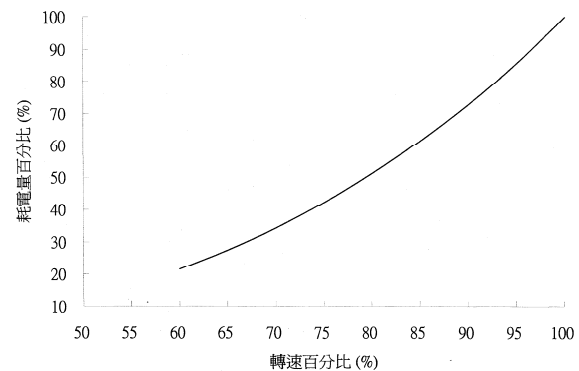
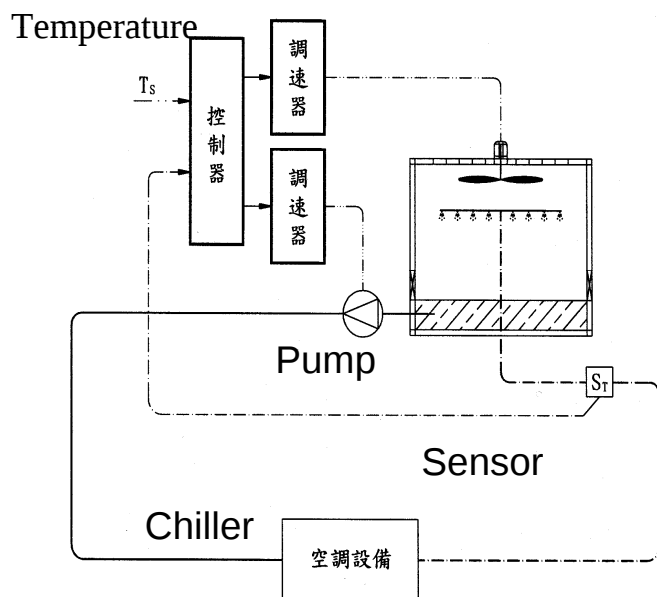
變頻器的應用例

Experimental Set up and Results



heat dissipation vs. speed, up; **power** vs. **speed**

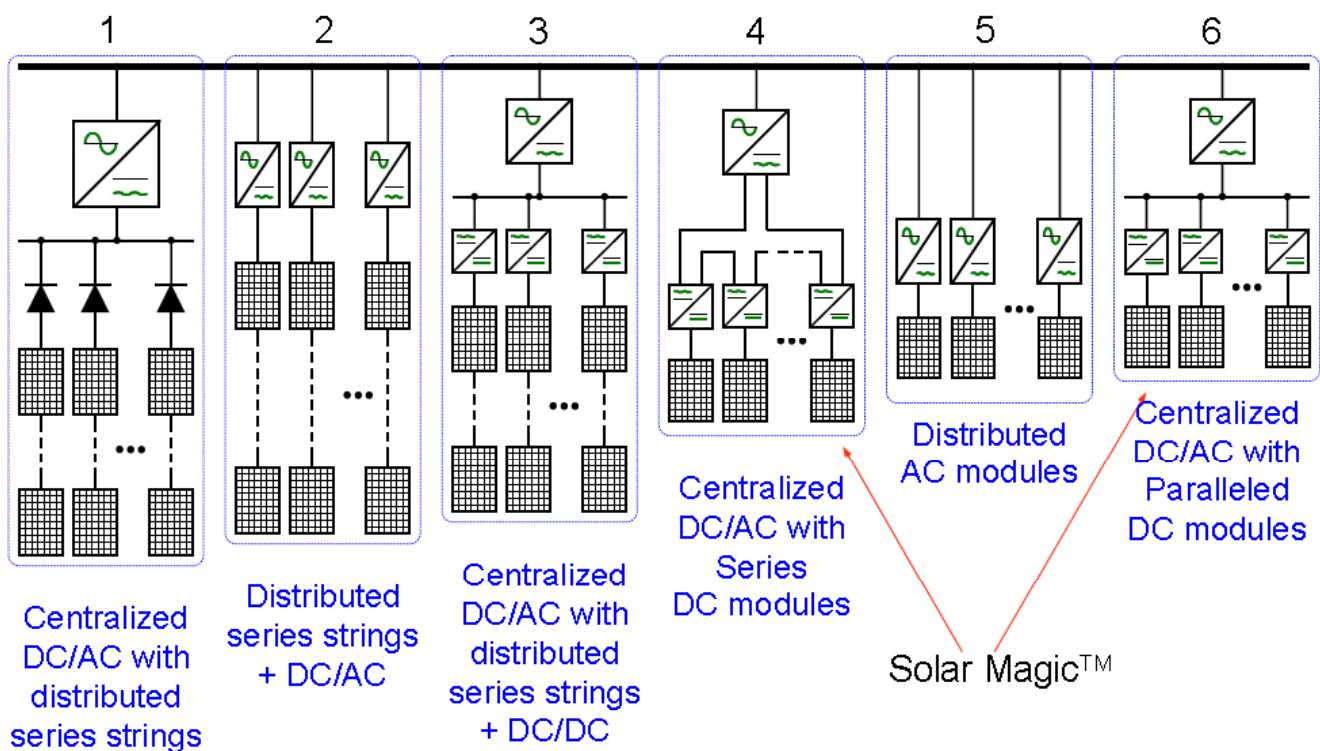
變頻器的應用例



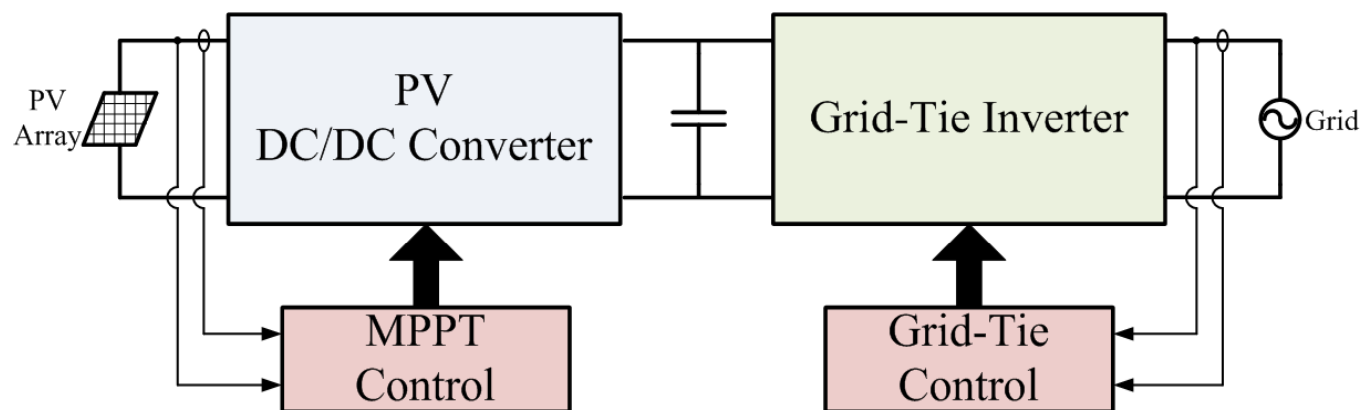
YSLAI ➤ 78% of maximum power saving can be achieved

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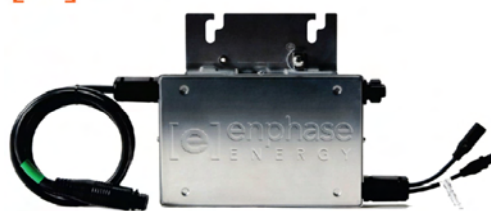
變頻器的應用例



變頻器的應用例



[e] ENPHASE MICROINVERTER M190



Dimension (W x H xD)	335 × 550 × 145(mm)
Weight	14 kg

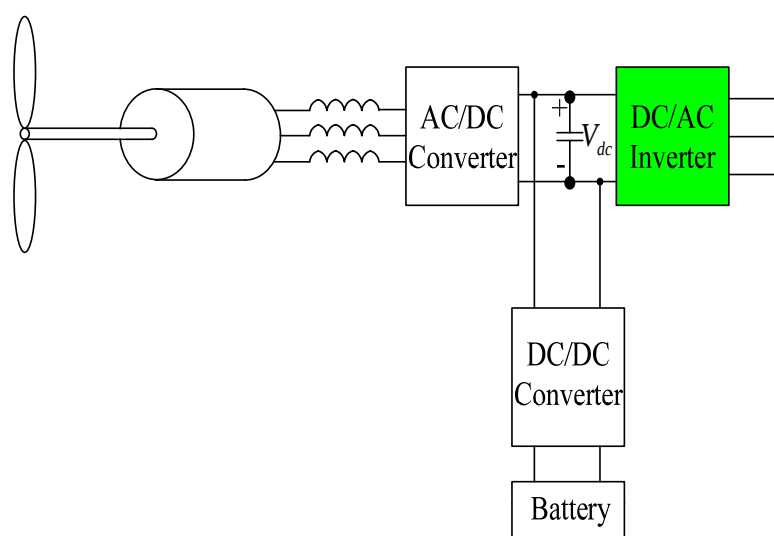
Dimension (W x H xD)	203 × 133 × 31.7(mm)
Weight	1.9958 kg

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Source: Ensolar and Enphase Co. Ltd.

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變頻器的應用例



Source: Dr. M. S. Huang

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Thank you for your Attention!



Sunrise at Ali Mountain (阿里山)

<http://www.newarkinone.thinkhost.com>

YSLAI /brands/promos/PowerQuality.pdf