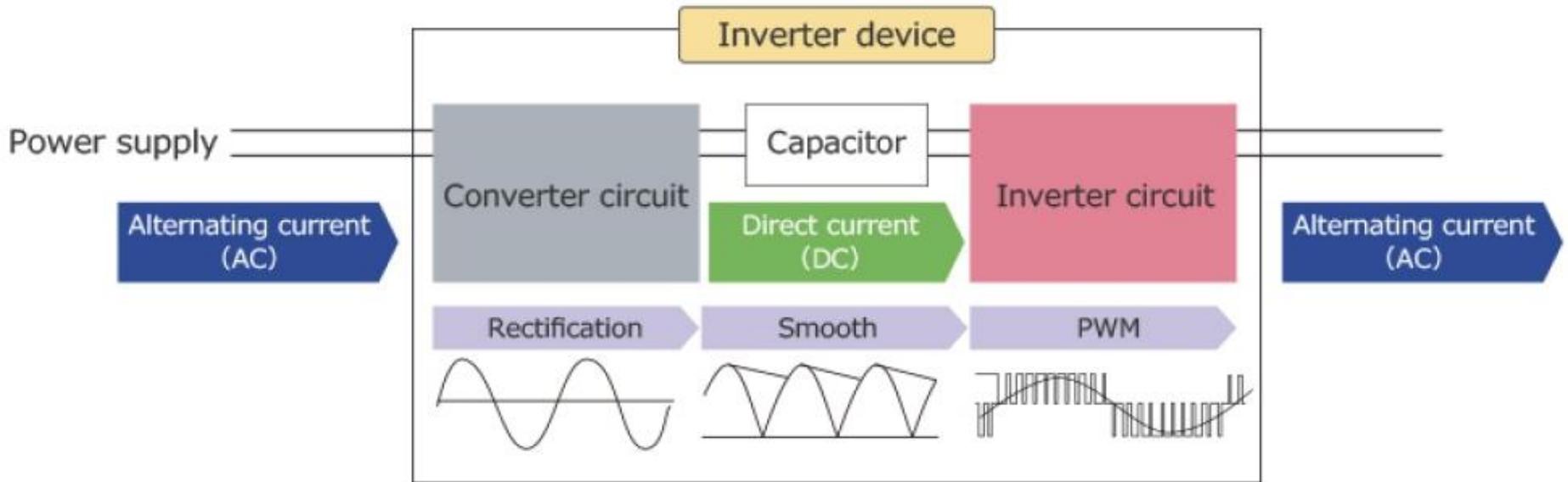# An introduction to inverters

[Fuji_inverters,TI_tiduay6e,TI_tidub21d]

Introduction

- General block diagram

- An important point is the harmonic content of the obtained sinusoidal voltage

Main different types

- What is varied
    - □ VVVF: variable voltage and frequency
        - e.g. motors (to adjust the motor's rotation speed)
    - □ CVVF: variable frequency only
        - e.g. fluorescent lights (to suppress flickering)
    - □ CVCF: constant voltage and frequency
        - e.g. UPS (uninterruptible power supply)

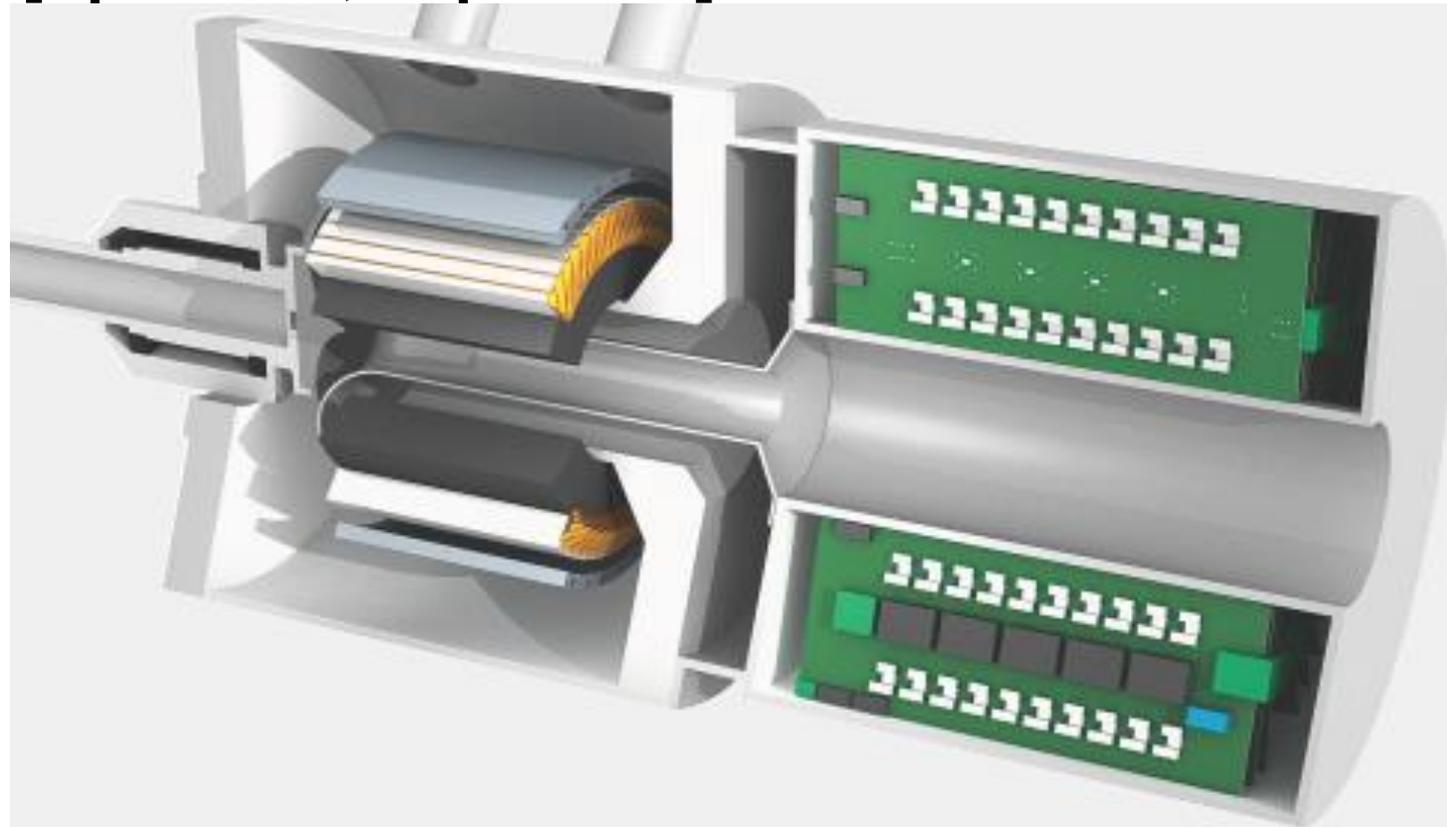- PWM
    - □ bipolar
    - □ unipolar

An example: brushless motor control

■ The sum of two magnetic fields (red and blue) generated by the coils (excited by 120 deg delayed sines) is a rotating magnetic field (green)
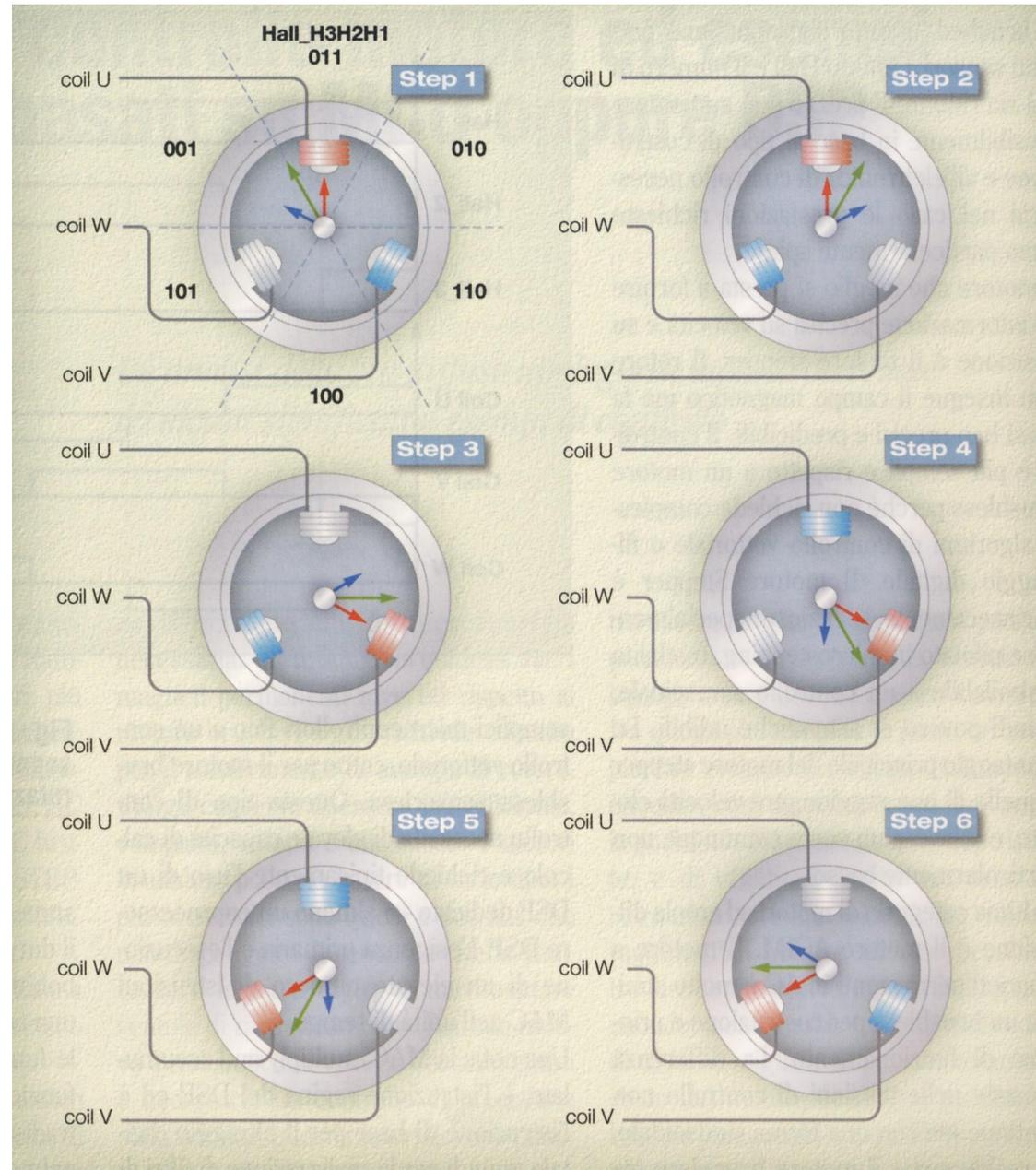
# An example [Spectrum, Sept. 2023]: 1 MW motor control

■ This motor has a very special application: commercial airliners

Researchers at MIT have developed a 1-megawatt electrical motor that could help electrify commercial airliners and lead to new types of hybrid or fully electric aircraft. At top is the demonstrator prototype, including (1) a low-loss, tooth-and-slot stator surrounded by a thermal management system, and (2) 30 custom-built, high-speed power-electronics boards that enable high-frequency alternating current in the stators, thus increasing the motor's rotating speeds.

Without PWM

TS-500 Inverter
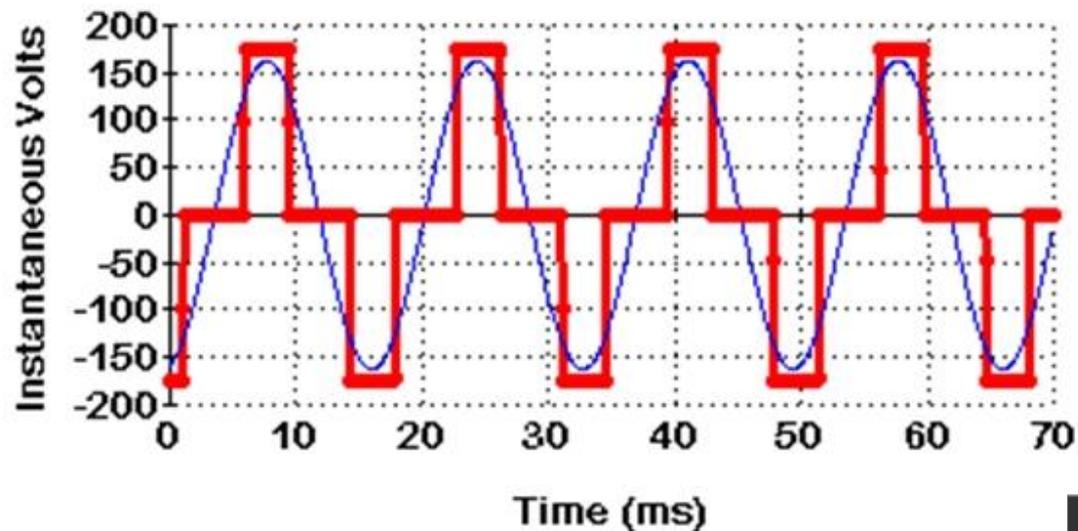
Very poor harmonic performance
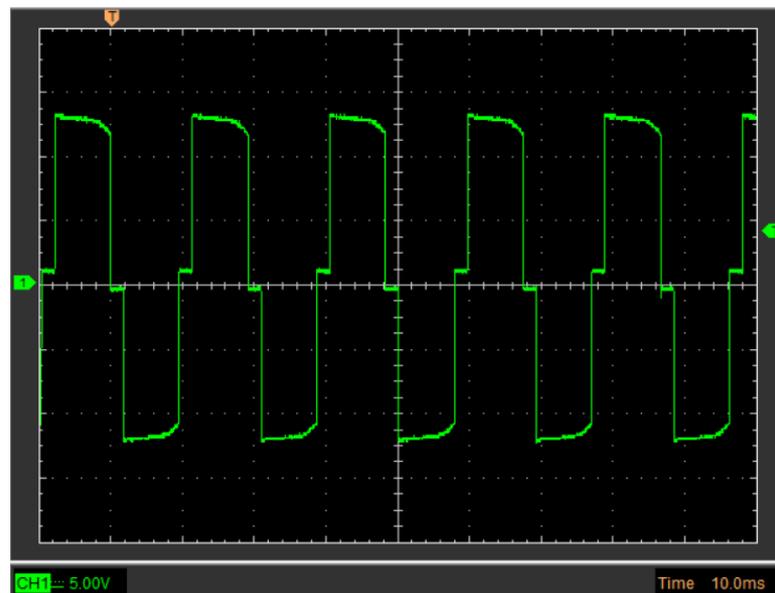
Bipolar PWM

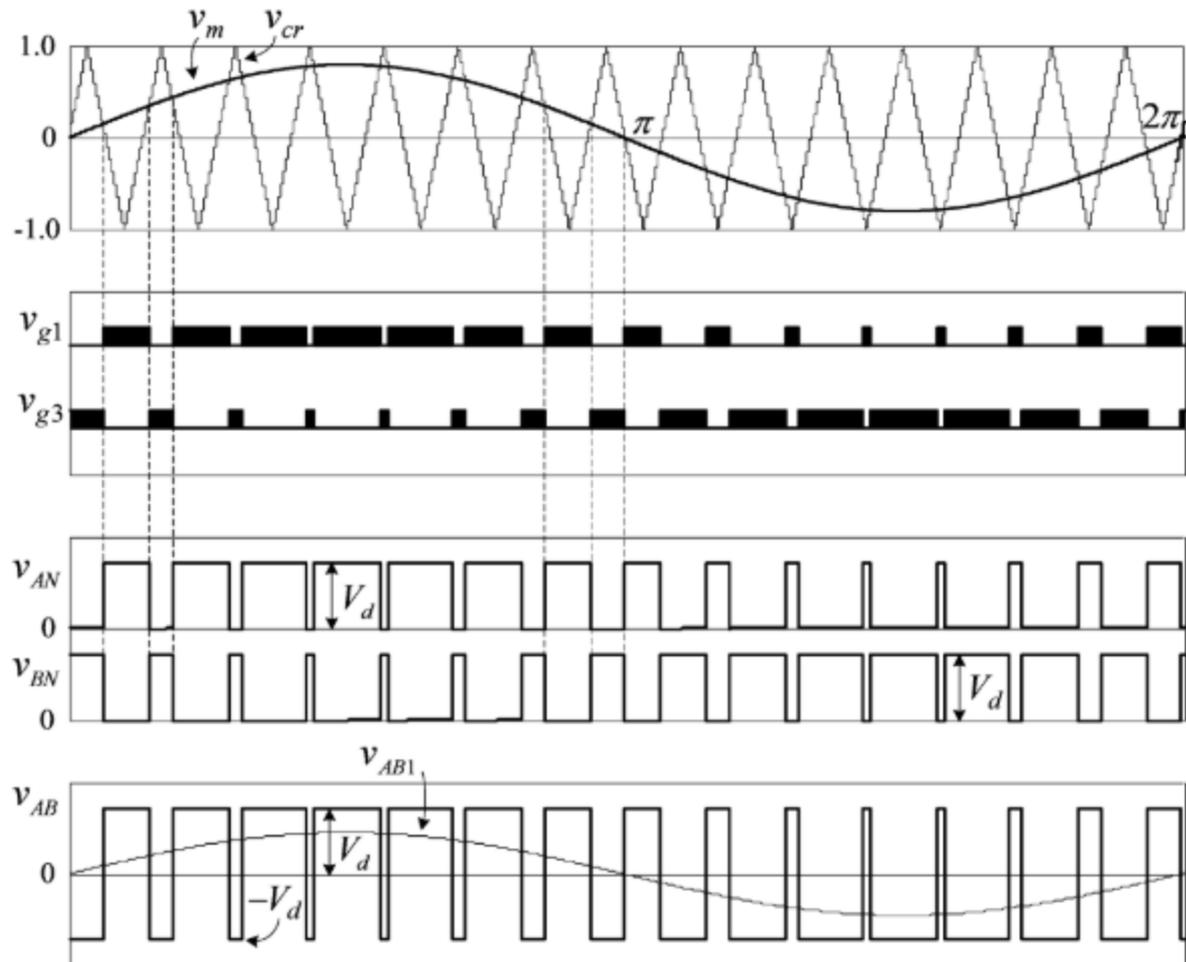Name bipolar is given as voltage switches in both directions throughout the cycle

Fig. 3: Waveforms of Bipolar Modulation Scheme

Unipolar PWM

Name unipolar is given as voltage applied to the load remain positive during positive cycle and negative during negative cycle.
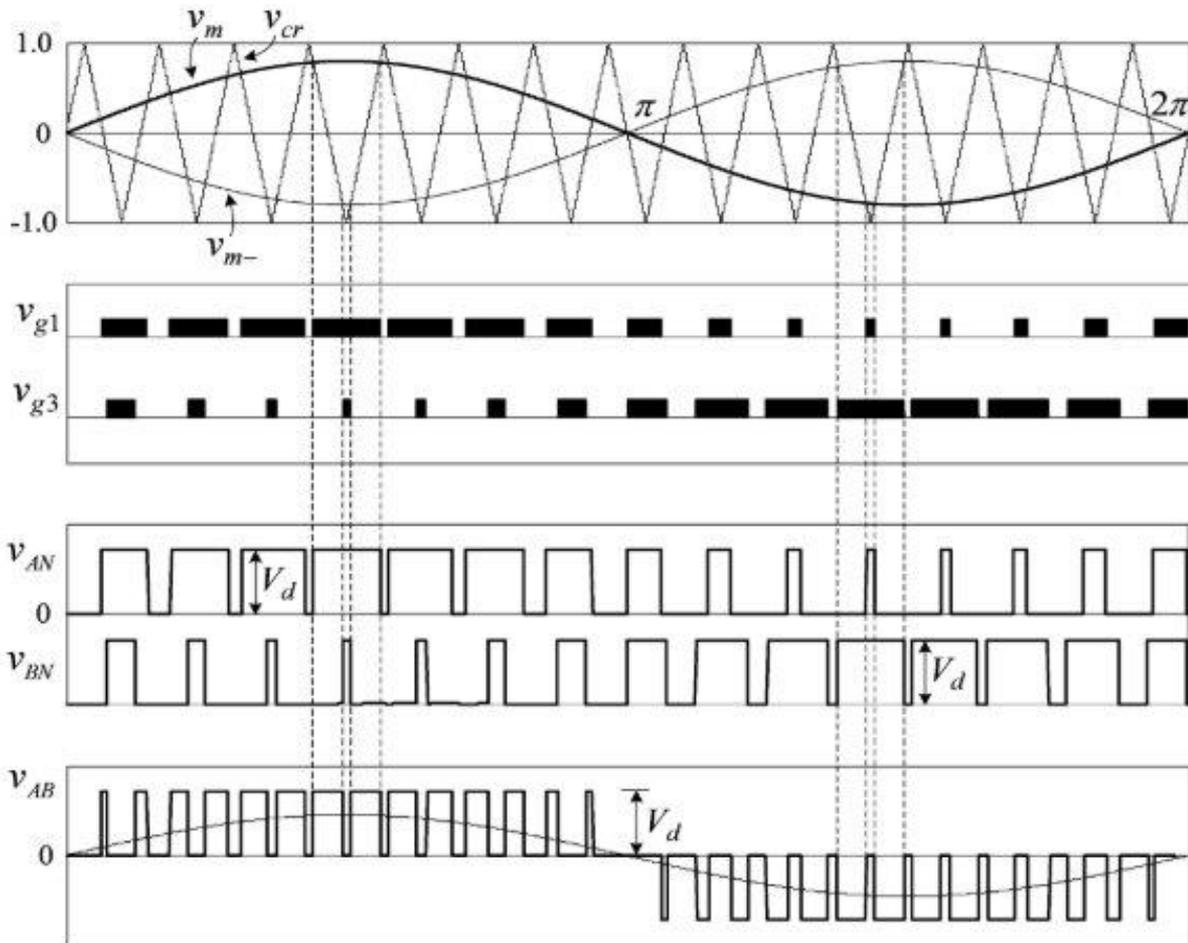
Better harmonic performance and lower switching losses wrt bipolar

Fig. 4: Waveforms of Unipolar Modulation Scheme