Active Power Filtering Capability of a 10 kV SiC MOSFET-Based Asynchronous Microgrid Power Conditioning System

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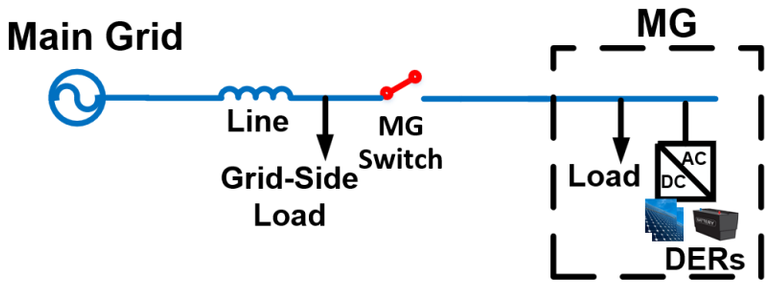
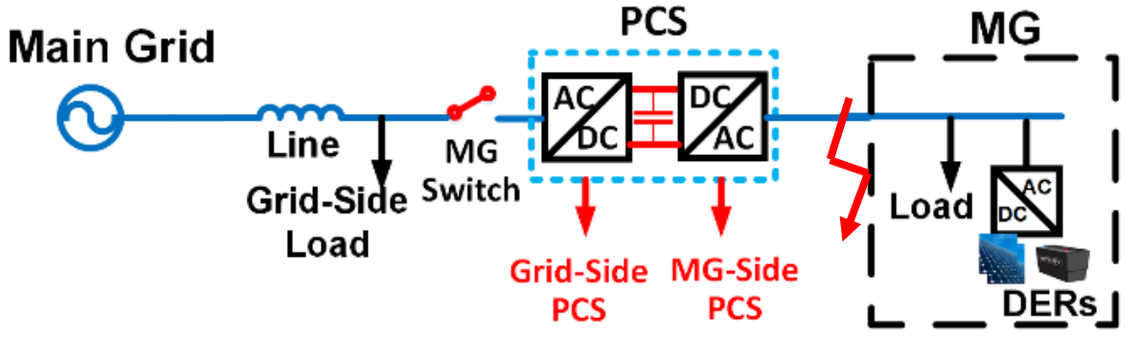
Asynchronous Microgrids (ASMGs) with PCS

- An ASMG is connected to the main grid through a power conditioning system (PCS)
- PCS can bring numerous benefits (dynamic decoupling, etc.)
- 10 kV SiC-based PCS is more advantageous compared with Si-based PCS
- More system-level benefits from 10 kV SiC-based PCS need further investigating
- ***Active power filtering*** capability of PCS can be enhanced by 10 kV SiC-based PCS



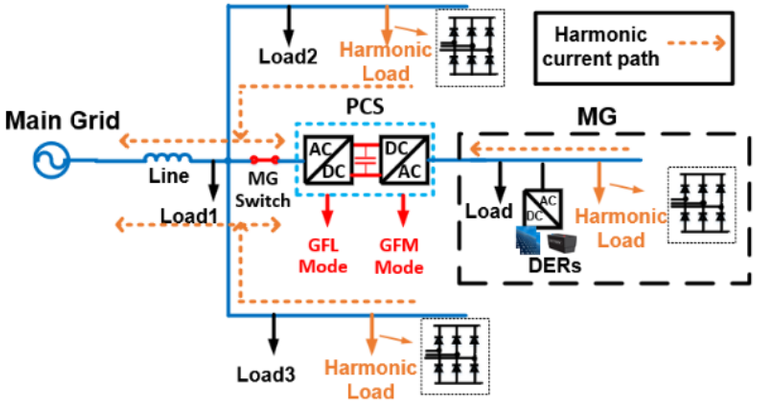
Synchronous microgrid



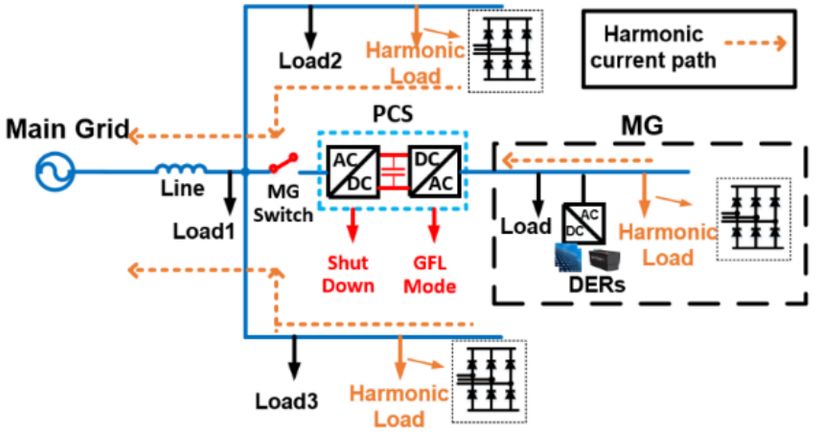
ASMG

SiC-Based PCS APF Capability

- Diode rectifiers are the main contributors to grid harmonics
- Odd-order harmonics are dominated
- Grid-side PCS APF based on grid needs in the grid-connected mode
- The microgrid-side PCS can potentially provide APF for the microgrid in both grid-connected and islanded modes



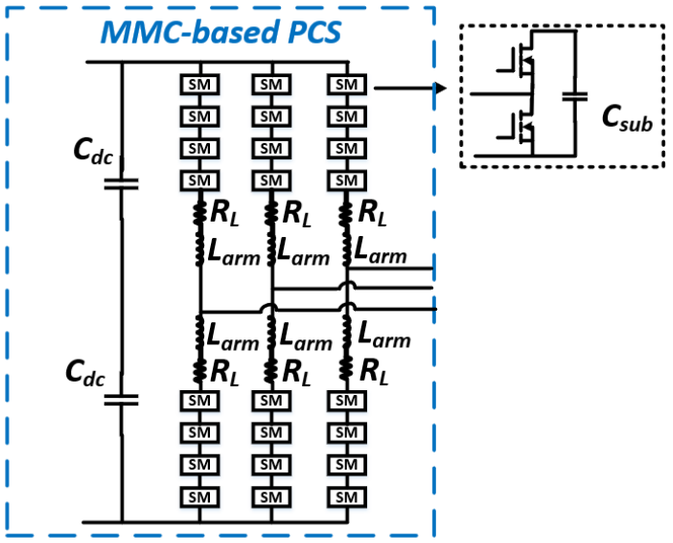
Grid-connected mode



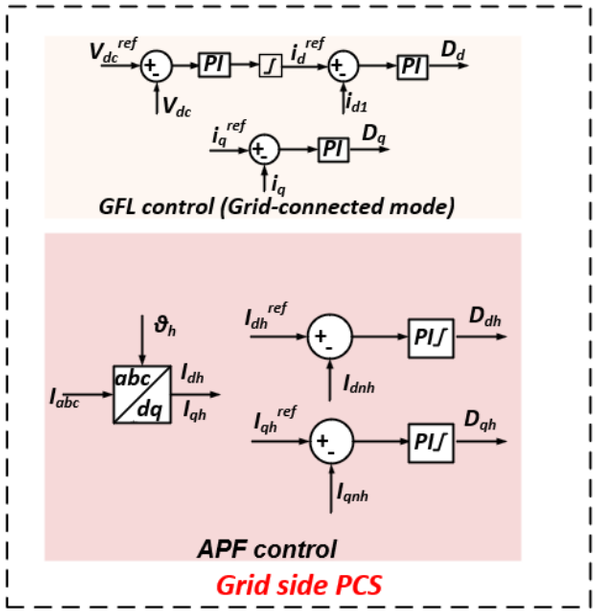
Islanded mode

PCS APF Algorithms

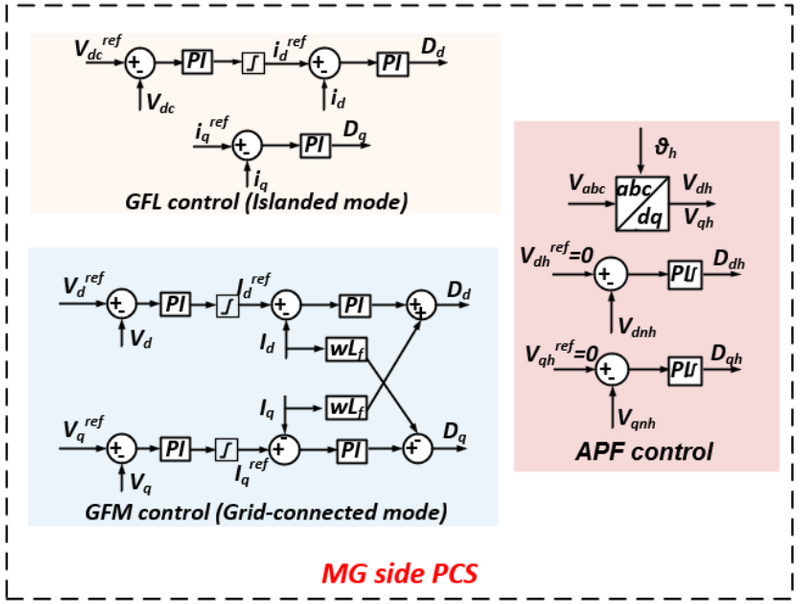
- Two five-level, 10kV SiC MOSFET-based modular multi-level converters (MMCs) are used as the PCS
- The harmonic current references of grid-side PCS comes from grid requirements
- Microgrid-side PCS absorbs harmonic currents by achieving zero harmonic impedance



PCS topology



Grid-side PCS control algorithms



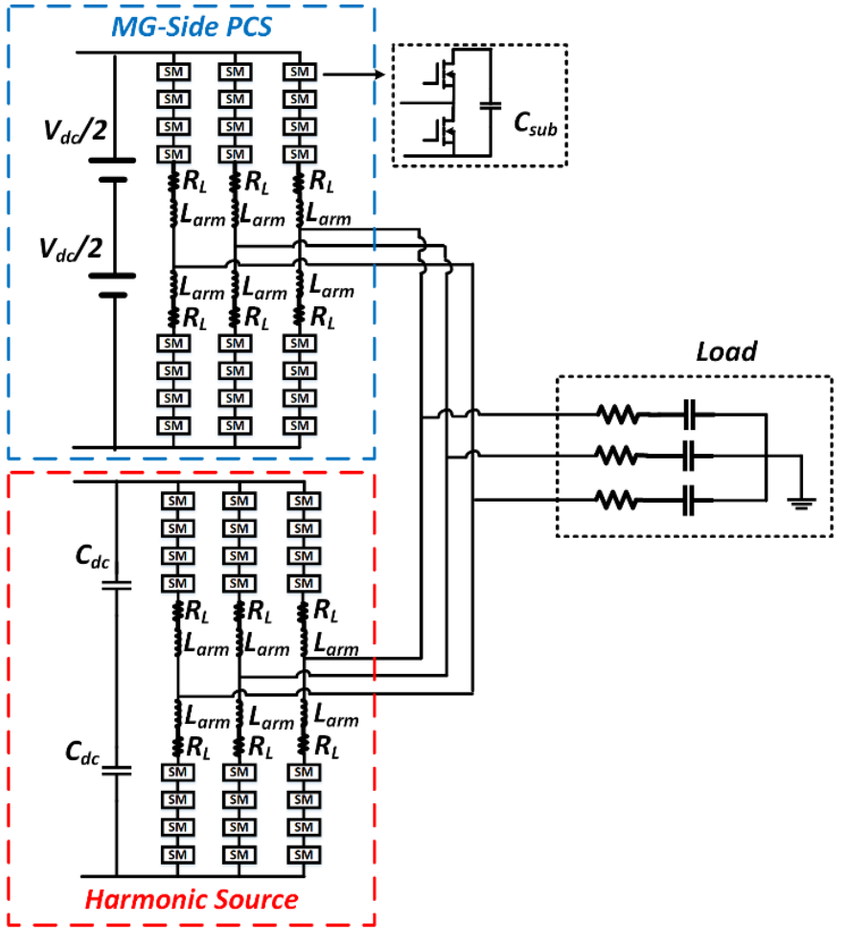
Microgrid-side PCS control algorithms

Experiment Setup

- One MMC is applied as the harmonic source
- PCS filters the load harmonic currents

Parameters	Values
DC-link voltage (V_{dc})	12 kV
AC line voltage (V_{ac})	6.8 kV
Load (R_{load} and C_{load})	R_{load}=246 Ω, C_{load}=1.25 uF
Line frequency (f_l)	60 Hz
Arm inductor (L and R_L)	L=90 mH, R_L= 5 mΩ
Control frequency (f_c)	10 kHz

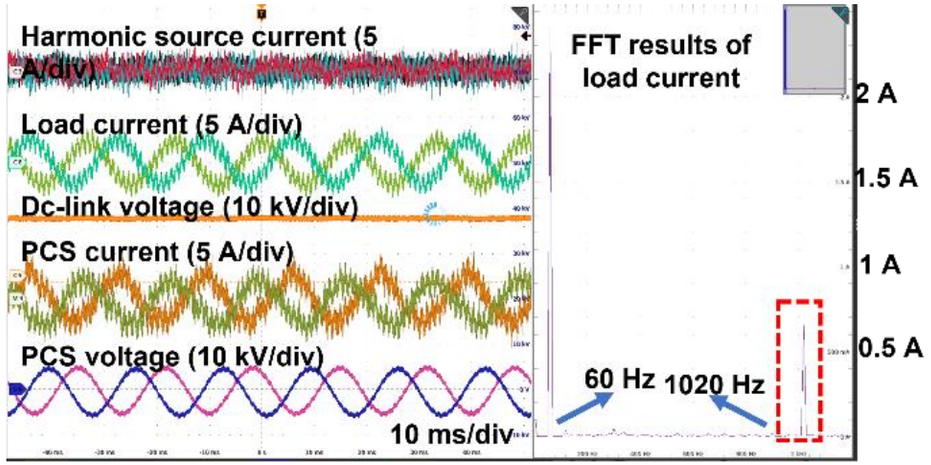
Hardware setup

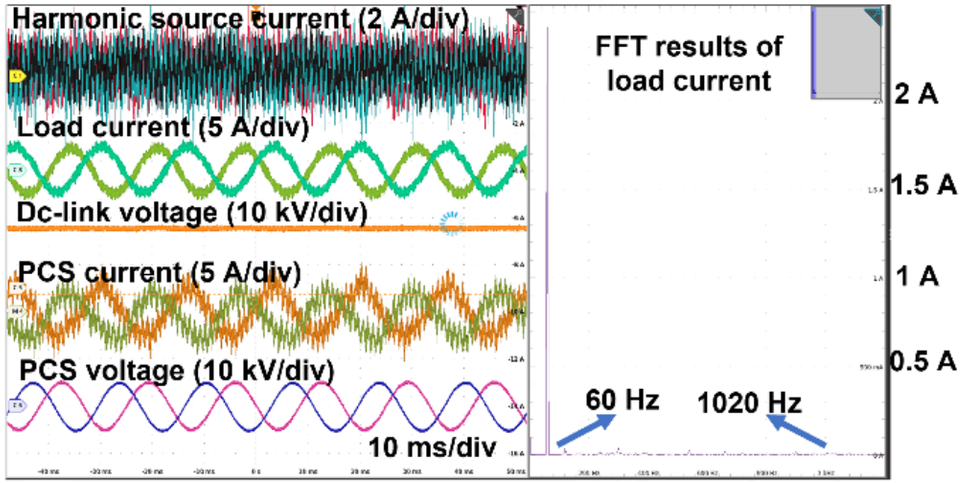


PCS APF testing setup

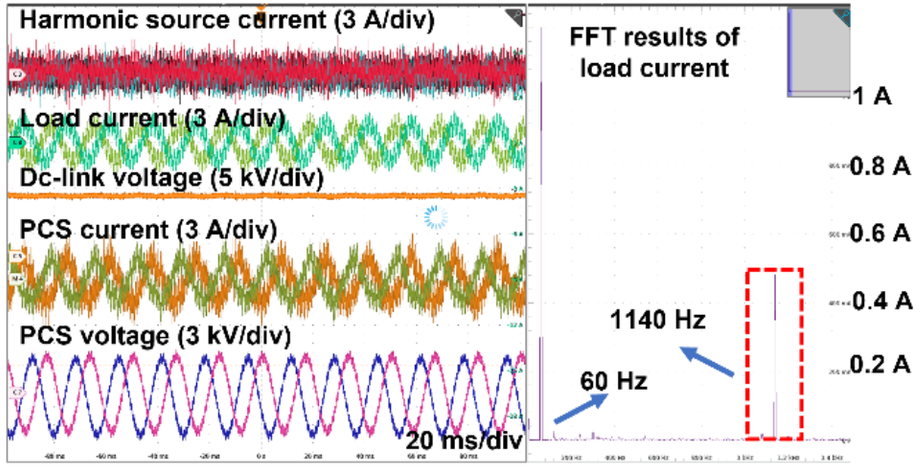
Testing Results

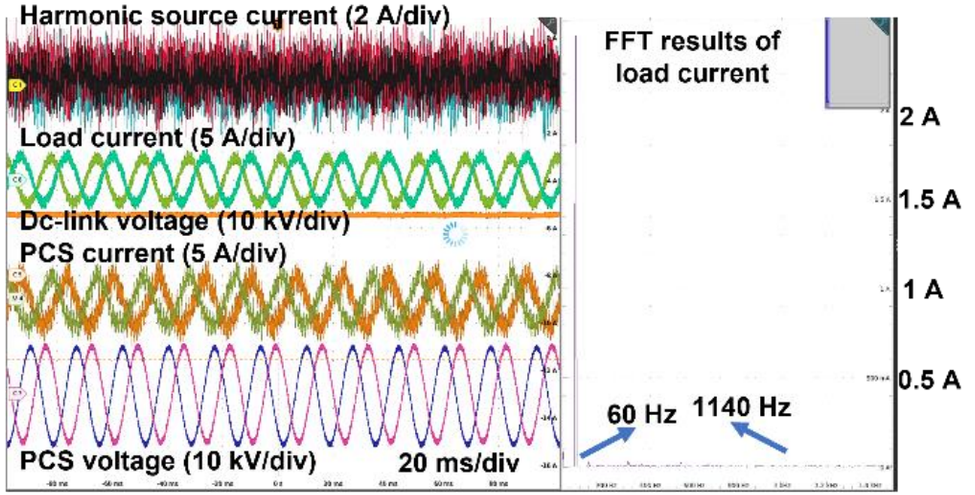
17th-order harmonics





19th-order harmonics





Before filtering

After filtering

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