1. Electrical Performance

Factor	Phase-Shifted Full-Bridge (PSFB)	Boost + Two-Switch Forward Converter	References
Input Voltage Range	Wide (e.g., 350–450 V typical, can extend to 200–800 V for EV chargers)	Boost stage handles wide range (e.g., 85–265 VAC rectified to 120–400 V DC), Forward stage sees regulated bus	TI PSFB Guide [ti.com], IEEE EV Charging PSFB [ieeexplore.ieee.org] https://www.infineon.com/assets/row/public/documents/10/59/infineon-hv-dcdc-v2-whitepaper-en.pdf
Output Voltage Range	Regulated, typically 12–54 V for telecom/server; can scale to 250–1000 V for EV chargers	Forward stage provides regulated low voltage (e.g., 12–48 V) after boost. Transformer design becomes challenging.	Infineon PSFB Reference Design [infineon.com]
Output Current Capability	High current capability due to full-bridge and synchronous rectification	Moderate; forward stage limited by transformer reset and duty cycle	TI Seminar PSFB Fundamentals [ti.com]
Efficiency	92–96% (ZVS reduces switching losses, more current paths, with less Rds ON, losses can be reduced)	85–91% (boost stage hard-switching dominates losses)(Hard switching loss can be scaled as Psw = K.V*I*fsw) (cumulative losses increase)	Infineon PSFB Control [infineon.com], Infineon Boost Guide [infineon.com], https://www.princeton.edu/~minjie/files/chen-multidcdc-2017.pdf
Power Density	High (with SiC MOSFETs, can achieve higher power density) (up to 67 W/in^3 with GaN and 350 kHz switching)	Lower (two stages increase size; boost inductor adds bulk)	Infineon PSFB Reference Design [infineon.com]
Voltage Ripple	Low output ripple with proper LC filter; input ripple depends on bus capacitance	Boost stage introduces higher input ripple; forward stage output ripple moderate	ResearchGate PSFB Ripple Analysis [researchgate.net]
Current Ripple	Low on secondary due to output inductor; primary ripple depends on phase-shift	Boost stage has high input current ripple; forward stage smoother	Infineon Boost Guide [infineon.com]
Transient Response	Fast (digital control + feed-forward improves line/load response)	Slower due to two-stage architecture	Infineon PSFB Reference Design [infineon.com]

Regulation	Excellent (line and load regulation with digital control and synchronous rectifiers)	Good but depends on coordination between boost and forward stages	TI PSFB Guide [ti.com]
Switching Frequency	Typically 50–200 kHz (up to 350 kHz with GaN)	Boost: 50–100 kHz; Forward: 50–100 kHz	Infineon PSFB Reference Design [infineon.com]
Control Method	Voltage mode or peak current mode; digital control common	Boost: voltage or current mode; Forward: voltage mode	TI PSFB Guide [ti.com], Infineon Boost Guide [infineon.com]

2. Component Stress

Factor	Phase-Shifted Full-Bridge (PSFB)	Boost + Two-Switch Forward Converter	References
Switch Voltage Stress	Each MOSFET sees **≈ input bus voltage** (e.g., 400–750 V typical)	Boost switch sees **full input voltage**; Forward switches see **output voltage**	TI PSFB Design Guide [ti.com], Infineon PSFB Reference Design [infineon.com], Infineon Boost Guide [infineon.com]
Switch Current Stress	Moderate, distributed across 4 MOSFETs; circulating current adds stress at light load	Boost switch carries **full input current**; Forward switches carry **load current**	Infineon PSFB Control [infineon.com]
Diode Voltage/Current Stress	Secondary diodes see **output voltage**; body diodes on MOSFETs see bus voltage	Boost diode sees **output voltage**; Forward rectifiers see **output voltage and load current**	TI PSFB Fundamentals [ti.com]
Inductor Current Ripple	Output inductor ripple depends on duty cycle and switching frequency; typically low due to synchronous rectification	Boost inductor ripple is significant (depends on CCM/DCM mode); Forward stage ripple moderate	TI PSFB Guide [ti.com], Infineon Boost Guide [infineon.com]
Capacitor RMS Current	Input capacitor handles high RMS current due to full-bridge switching; output capacitor ripple low	Boost stage input capacitor sees high RMS current; forward stage output capacitor handles moderate ripple	TI PSFB Guide [ti.com]
Thermal Stress (Junction Temp, Heat Dissipation)	Lower switching losses due to ZVS; conduction losses dominate; GaN/SiC improves thermal profile	Boost stage hard-switching increases thermal stress; forward stage moderate	ResearchGate PSFB Thermal Analysis [researchgate.net], Infineon PSFB Simulation Tool [plex.infineon.com]

3. Topology Characteristics

Factor	Phase-Shifted Full-Bridge (PSFB)	Boost + Two-Switch Forward Converter	References
Isolation	**Isolated** (uses transformer for galvanic isolation)	Boost stage: **Non-isolated**, Forward stage: **Isolated**	TI PSFB Guide [ti.com], Infineon PSFB Reference Design [infineon.com]
Number of Active Switches	4 MOSFETs in full bridge	Boost: 1 MOSFET, Forward: 2 MOSFETs → Total = 3	TI PSFB Fundamentals [ti.com], Infineon Boost Guide [infineon.com]
Number of Passive Components	Transformer + output inductor + filter capacitors	Boost inductor + transformer + output filter capacitors	TI PSFB Guide [ti.com]
Complexity of Design	High (phase-shift modulation, ZVS timing, synchronous rectification)	Moderate (two separate control loops: boost + forward)	Infineon PSFB Control [ti.com]
Size and Weight	Compact for high power (high power density up to 67 W/in^3 with GaN)	Larger (two stages increase size; boost inductor adds weight)	Infineon PSFB Reference Design [infineon.com]
Scalability (Higher Power)	Excellent (used in 10 kW–50 kW EV chargers and industrial supplies)	Limited (boost stage becomes inefficient at very high power)	ResearchGate PSFB High-Power Design [researchgate.net]

4. Loss Analysis

Loss Component	Phase-Shifted Full-Bridge (PSFB)	Boost + Two-Switch Forward Converter	References
Conduction Losses (Switches, Diodes, Inductors)	Moderate; distributed across 4 MOSFETs and synchronous rectifiers; circulating current adds extra loss at light load	Higher in boost stage due to single switch carrying full input current; forward stage moderate	TI PSFB Fundamentals [ti.com], Infineon PSFB Control [infineon.com], Infineon Boost Guide [infineon.com]
Switching Losses	Very low due to ZVS on primary switches; lagging leg may lose ZVS at light load	High in boost stage (hard-switching at high voltage); forward stage moderate	TI PSFB Design Guide [ti.com], Infineon Switching Loss Guideline [infineon.com]
Core Losses (Magnetic Components)	Lower due to high-frequency operation and optimized transformer design; but leakage inductance adds circulating current	Boost inductor core losses significant at high ripple; forward transformer moderate	ResearchGate HF Conductor Losses [researchgate.net]
Gate Drive Losses	Higher (4 MOSFETs + synchronous rectifiers); mitigated by efficient drivers	Lower overall (3 main switches), but two stages require separate drivers	TI PSFB Application Note [ti.com]

Auxiliary Losses (Control Circuitry)	Higher due to complex phase-shift control and ZVS timing	Moderate; two controllers (boost + forward) but simpler algorithms	Infineon PSFB Control Strategies [infineon.com]

5. Control & Dynamics

Factor	Phase-Shifted Full-Bridge (PSFB)	Boost + Two-Switch Forward Converter	References
Control Complexity (Analog vs Digital)	High: Often implemented with **digital controllers** for phase-shift timing, ZVS optimization, and synchronous rectification; analog possible but complex	Moderate: Two separate loops (boost + forward), usually analog or hybrid digital	TI PSFB Guide [ti.com], Infineon PSFB Control Strategies [infoscience.epfl.ch]
Stability (Small-Signal Model, Loop Compensation)	Requires detailed small-signal modeling for phase-shift modulation; digital control simplifies compensation	Boost and forward stages each need separate compensation; simpler than PSFB but more tuning effort overall	TI Seminar PSFB Fundamentals [studylib.net]
Dynamic Response (Speed of Regulation)	Fast: Digital control with feed-forward improves transient response significantly	Slower: Two-stage architecture introduces delay; coordination between stages needed	Infineon PSFB Reference Design
Soft Start Capability	Built-in in most digital controllers; prevents inrush and overshoot	Common in analog controllers; implemented separately for boost and forward stages	TI PSFB Guide [ti.com]
Protection Features (OVP, UVP, OCP, OTP)	Comprehensive: Digital control enables programmable OVP, UVP, OCP, OTP, and fault logging	Available but simpler; usually analog comparators for OVP/OCP, thermal shutdown in drivers	Infineon PSFB Control Strategies [infoscience.epfl.ch]

6. EMI & Noise

Aspect	PSFB (Phase-Shifted Full-Bridge)	Boost + Two-Switch Forward	References

EMI tendency (general)	Typically **lower conducted/radiated EMI** than hard-switched bridges because PSFB achieves **ZVS** on the primary; reduced **dv/dt** and **di/dt** lowers high-frequency energy. At **light load**, ZVS may be lost on the lagging leg, increasing spikes.	**Higher EMI**, mainly from the **boost stage** (hard-switching at high bus voltage) and from diode reverse recovery/inductor ripple. Bridgeless/advanced PFC variants can further **increase CM emissions** if not carefully designed.	TI PSDS PSFB fundamentals (ZVS, EMI) PDF; TI power-tip on ZVS bridges PDF; TI E2E note on PSFB losing ZVS at light load Forum; TI bridgeless PFC EMI note AAJ article
Dominant DM noise sources	**Primary switch nodes** and **rectifier commutation**; residual ringing from transformer leakage + MOSFET **Coss**; output inductor ripple coupling to line via input bus.	**Boost inductor current ripple** (pulsating), **switch node** of the boost FET, and **diode** (or SR) recovery dominate DM noise; forward stage adds switching edges but at lower bus voltage.	TI “EMI tips & tricks” (DM mechanisms, π filter) Slides; Infineon CCM boost design guide (loss/EMI design) PDF
Dominant CM noise sources	**Parasitic capacitance** from primary switch node/transformer to chassis; even with ZVS, high-frequency voltage swings couple CM currents to earth; transformer stray capacitance and layout are key.	**Parasitic capacitance** of boost switch node (large dv/dt relative to earth) and input wiring to chassis; bridgeless topologies often show **higher CM** due to floating return paths.	TI “EMI tips & tricks” (CM fundamentals and test setups) Slides; TI bridgeless PFC design discussion AAJ article
Filtering requirements (typical)	**Input DM**: π filter (L–C–L/C), damping (R–C) to control peaking; **CM**: common-mode choke, Y-capacitors sized to limits.	**Stronger DM filtering** at input (larger **boost inductor ripple**), often **two-stage π filter**; **CM choke** frequently larger (especially bridgeless PFC) and careful **Y-cap placement**; forward stage adds secondary-side snubbing/RC damping.	TI “EMI tips & tricks” (π filter design, parasitics, 2-stage filters) Slides; Infineon CCM boost guide & PFC controller docs (filter examples, protections) PDF
	Benefits from ZVS: **smaller** DM filter than hard-switched bridges; still need CM choke/Y-caps because transformer/wiring capacitance dominates CM.		

Layout sensitivity	High-side/low-side gate-drive loops must be compact; minimize **leakage** and **Coss-induced ringing**; symmetry in transformer and short return paths reduce CM.	Minimize boost **switch-diode loop** area; tight **input loop** to cut DM; careful **earth/chassis coupling** to manage CM; bridgeless needs special sensing and **EMI mitigation**.	TI SMPS layout guide (dv/dt/di/dt, EMI) Slides; TI bridgeless PFC EMI note AAJ article
Measured examples (indicative)	PSFB reference designs show **high efficiency** and good EMI with proper filters and layout (e.g., 1–1.4 kW boards; GaN/Si devices, digital control).	High-efficiency PFC demo boards need **explicit EMI filters** (CM choke, DM π filters); EMI section documented in dual-boost 3 kW demo notes.	Infineon PSFB reference designs (performance, control) PDFs; Infineon 3 kW dual-boost PFC demo (EMI filter section) PDF

7. Reliability & Robustness

Fault Tolerance	Moderate: Complex topology means more failure points; digital control can implement advanced fault handling (UVP, OVP, OCP, OTP, short-circuit protection)	Moderate: Two-stage design adds coordination complexity; simpler analog protection circuits common	TI PSFB Guide [research.tudelft.nl], Infineon PSFB Control Strategies [vicorpower.com]
Component Count (affects MTBF)	Higher: 4 MOSFETs + synchronous rectifiers + complex driver circuits; more components can reduce MTBF	Lower: Boost stage (1 MOSFET) + Forward stage (2 MOSFETs) + simpler drivers; fewer components generally improve MTBF	TI PSFB Fundamentals [researchgate.net]
Thermal Management	Easier: ZVS reduces switching losses; conduction losses dominate; heat spread across multiple MOSFETs; GaN/SiC improves thermal profile	Harder: Boost stage hard-switching at high voltage → higher heat concentration; forward stage moderate	Infineon PSFB Reference Design
Surge and Transient Handling	Good: Transformer isolation provides inherent surge protection; digital control adds programmable transient response	Moderate: Boost stage exposed to line surges; forward stage isolated but coordination needed for surge handling	TI PSFB Guide [research.tudelft.nl], Infineon Boost Guide

8. Practical Considerations

Factor	Phase-Shifted Full-Bridge (PSFB)	Boost + Two-Switch Forward Converter	References

Cost (Component & Manufacturing)	Higher: Requires 4 MOSFETs, synchronous rectifiers, complex magnetics, and digital controller; GaN/SiC devices increase cost but improve efficiency	Lower: Fewer active switches (3 total), simpler magnetics, and analog control possible; cost-effective for medium power	TI PSFB Fundamentals [ti.com], Infineon PSFB Reference Design [infineon.com]
Availability of Components	High: Widely supported by TI, Infineon, and others; GaN/SiC MOSFETs and digital controllers available for high-performance designs	High: Boost and forward converters use standard MOSFETs, diodes, and controllers; widely available for industrial and consumer designs	Infineon PSFB Control Strategies [infineon.com], Infineon Boost Guide [infineon.com]
Ease of Implementation	Complex: Requires precise phase-shift timing, ZVS optimization, and synchronous rectifier control; usually digital	Easier: Two separate control loops (boost + forward), analog or hybrid digital; simpler gate drive	TI PSFB Design Guide [ti.com]
PCB Area	Larger: Full-bridge layout, transformer, and heat sinks; high-density designs possible with GaN and advanced cooling	Smaller: Boost inductor and forward transformer dominate; simpler layout overall	Infineon PSFB Evaluation Board [infineon.com]
Cooling Requirements	Moderate: ZVS reduces switching losses; heat spread across multiple MOSFETs; advanced cooling concepts available	Higher: Boost stage hard-switching at high voltage → concentrated heat; forward stage moderate	Infineon PSFB Reference Design [infineon.com]
Maintenance	More complex: Higher component count and digital control require skilled maintenance; firmware updates possible	Easier: Fewer components, simpler analog control; less specialized maintenance	ResearchGate PSFB Reliability Study [researchgate.net]

9. Application-Specific Factors

Factor	Phase-Shifted Full-Bridge (PSFB)	Boost → Two-Switch Forward	References

Bidirectional Capability	**Feasible and proven** with appropriate modulation (e.g., bidirectional PSFB/B-PSFB). Achieves **near-full ZVS** in both directions and mitigates secondary overshoot when properly controlled; demonstrated **2 kW–3.3 kW** prototypes with **97.5–98% peak efficiency** in both buck and boost modes.	Typically **unidirectional** in common implementations. Making the **boost + forward** chain bidirectional is uncommon and **complex**, because the boost front end is **current-sourced** and the forward stage rectification must be replaced by an active bridge (raising device count and control complexity).	Bidirectional PSFB modulation & prototypes (IEEE/ResearchGate) link [infineon.com]; Infineon/UGR bidirectional PSFB paper PDF [infineon.com]
Modularity	Commonly used as a **modular isolated DC-DC stage** in multi-kilowatt supplies (server PSUs, EV chargers), with standardized controllers and gate drivers; **fixed-frequency PSFB** integrates well with upstream PFC or DC bus and downstream PoL converters.	Also modular in two-stage supplies (PFC **boost** front end + isolated **forward** second stage). Easy to partition by power level, but **filtering/EMI** for the boost stage often dominates module interfaces.	TI PSFB fundamentals & design seminar PDF [infineon.com]; Infineon 1 kW PSFB GaN reference design (modular digital controller & telemetry) PDF [infineon.com]; PFC/boost stage modular resources PDF [ti.com]
Safety Standards Compliance	PSFB reference designs and controllers commonly target **IEC/UL** and **IT/server PSU** standards; isolation transformer facilitates meeting **SELV** and creepage/clearance. Digital PSFB platforms include **OVP/UVP/OCP/OTP** and **fault logging** to assist compliance and validation.	Boost PFC guidelines explicitly reference **IEC 1000-3-2 / EN 61000-3-2** harmonic/current limits; **EMI filters** sized to CISPR requirements. Isolation and SELV compliance achieved in the **forward stage**; protections typically analog (OVP/OCP, UVLO, thermal).	Infineon PSFB eval & ref designs with protection & PMBus (compliance-oriented features) PDF [studylib.net]; TI PSFB guide (controllers & protections) PDF [infineon.com]; Infineon CCM boost PFC design guide (IEC/CISPR context) PDF [ieeexplore.ieee.org]; TI AAJ on bridgeless PFC EMI & compliance PDF [research.tudelft.nl]

Environmental Conditions (Temperature, Humidity)	PSFB designs routinely validated for **wide ambient ranges** (e.g., −10 °C to 80 °C) and include **thermal modeling**; ZVS **reduces thermal stress**, easing operation at higher ambient and facilitating **higher power density** with appropriate heatsinks. Isolation helps when operating in **high-humidity** or noisy environments by breaking ground loops.	Boost stage's **hard-switching** increases switching losses and **hot-spots**; environmental robustness depends heavily on **thermal design** and **EMI filter durability**. Forward stage isolation helps with environmental noise; overall two-stage solutions see **larger passive components** that may be sensitive to humidity/contamination unless conformally coated.	Infineon PSFB WebSIM/PLECS tool (thermal overview; ambient & heatsink parameters) Web [ieeexplore.ieee.org]; Infineon PSFB eval board with innovative cooling (97% peak efficiency) PDF [studylib.net]; Infineon dual-boost 3 kW PFC demo (EMI filter section & thermal considerations) PDF [ti.com]