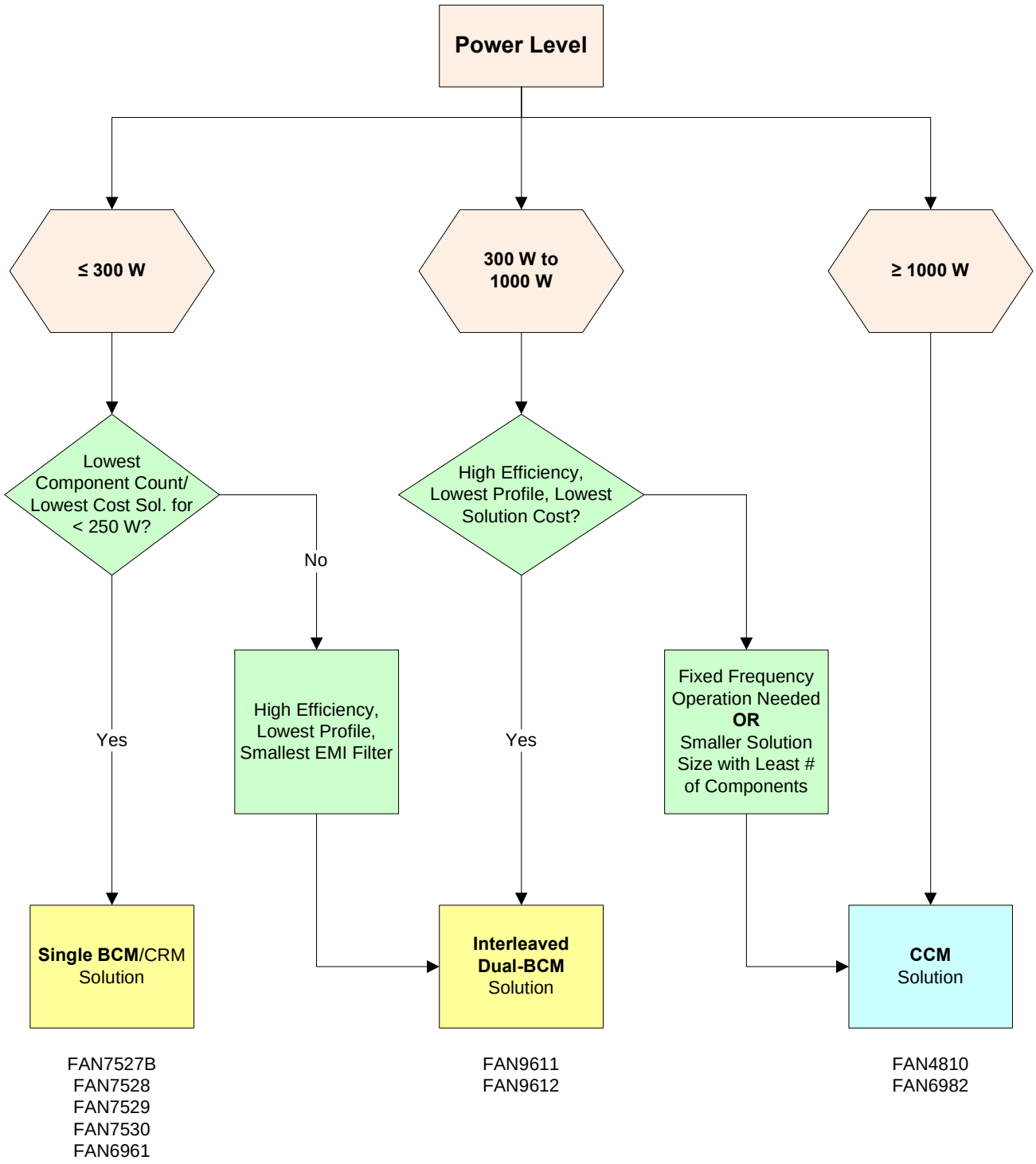
# Stand-Alone PFC Solutions Selection Guide




BCM = Boundary-Conduction Mode
(Also known as Critical Conduction Mode (CRM, CrCM, DCMB) or Transition Mode (TM))
CCM = Continuous-Conduction Mode

Note: To see Fairchild's complete PFC product offering including PFC+PWM combo controllers, please visit www.fairchildsemi.com/pfc

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# Comparison of PFC Technologies

| | Single BCM / CRM | Interleaved BCM / CRM | CCM |
|---|---|---|---|
| Advantages | • Simple to design, well understood control technique<br>• Good PF and THD<br>• Good efficiency at low power<br>• MOSFET turns on at zero current and minimum voltage<br>• No reverse recovery in boost diode<br>o Low cost, low $V_F$ diodes<br>o Less switching loss, less EMI<br>• Less switching loss than CCM PFC (valley switching)<br>• Lower current sensing loss compared to CCM PFC | • Extension of single BCM simple control<br>• Good PF and THD<br>• Best efficiency<br>• Modular lower power designs<br>• Lower component stresses<br>• Easier thermal management<br>• No reverse recovery in boost diode<br>o Low cost, low $V_F$ diodes<br>o Less switching loss, less EMI<br>• Lower current sensing loss compared to CCM PFC<br>• Smaller inductor than single CCM PFC (Overall inductor size is reduced)<br>• Less switching loss than CCM PFC (valley switching)<br>• Phase management can improve light-load efficiency<br>• Reduced ripple current in the output capacitor (longer life time) | • Fixed frequency<br>• Best PF and THD<br>• Can be used at any power level<br>• Good efficiency at high power<br>• Peak to RMS ratio lower: Lower $I^2R$ losses<br>• Low Ripple current: Lower core losses<br>• Lower EMI : Smaller Input Filter |
| Disadvantages | • Larger MOSFET conduction loss<br>• High peak current limits practical use to ~300W (Impact on EMI filter)<br>• Large inductor for the same power level<br>• Variable Frequency | • Higher number of components<br>• Needs good current balancing between the paralleled power stages. (If currents are not equal, losses can be higher than single stage design!)<br>• Variable Frequency | • Complex control<br>• Requires very fast boost diode with low $I_{RR}$<br>o SiC diodes are often used<br>• Larger Inductor than Int. BCM<br>• MOSFET Switching Loss (hard switching) |
| EFFICIENCY | | | |
| Efficiency | Good (lower power levels) | Best | Good (higher power levels) |
| Diode Reverse Recovery Loss | ZCS operation → No reverse recovery loss | ZCS operation → No reverse recovery loss | Reverse recovery current → higher switching loss |
| ZVS of MOSFET | ZVS ($V_{AC}(t) < V_O/2$ ) or Valley switching ($V_{AC}(t) > V_O/2$ ) | ZVS ($V_{AC}(t) < V_O/2$ ) or Valley switching ($V_{AC}(t) > V_O/2$ ) | Not applicable. Costly ZVS implementation. |
| Current sensing loss | Small (lower threshold just for protection) | Small (lower threshold just for protection) | Large (higher threshold for control) |
| OPERATION | | | |
| Optimum Power Range | ≤ 300 W | Between 300 W and 1000 W | Can be used at any power level |
| Switching Freq. | Variable frequency` | Variable frequency | Fixed frequency |
| Ripple Current | Higher ripple current → larger conduction loss | Smaller ripple currents | Smallest ripple current |
| SIZE and COST | | | |
| Number of Components | Minimal | Needs 2 MOSFETs, 2 diodes, 2 L's & 2 CS R's | Moderate |
| Inductor Size | Small | Smallest | Small to medium |
| Cost | Lowest Cost (but also limited to <300W) | Low Cost solution (300W-800W) | High cost components to maintain high efficiency |
| Line (EMI) Filter | High peak currents → large line filter | Small line filter | Smallest line filer |
| Diode cost | Inexpensive Diodes | Inexpensive Diodes | Need SiC / Hyper FR Diodes at higher power levels |
| Bulk Capacitor Size | Determined by hold-up time | Determined by hold-up time | Determined by hold-up time |