

Wide Bandgap Power Electronics based Electric Machine Drives

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The demand on high performance high power density electric machine drive systems continues to grow as multiple industry sectors look to cut costs and improve power density and efficiency. For this reason, researchers and engineers have been working on wide bandgap (WBG) based power electronics circuits to meet the immediate needs of industry and satisfy future requirements.

The following tutorial provides an in-depth look of challenges and status of WBG motor drives, covering topics on both circuit level and system level, which includes gate drive design, circuit layout, reflective wave, thermal design, EMI, leakage current, and insulation stress to motor windings with high dv/dt PWM. Two case studies, one on a 1.8 kVA integrated GaN based motor drive and the other on 7 kV 1 MVA SiC based motor drive, will be used as examples during the discussion.

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Bio

Jin Wang (IEEE Fellow) received his Ph.D. degree from Michigan State University, East Lansing, in 2005. From Sept., 2005 to Aug. 2007, he worked at the Ford Motor Company as a Core Power Electronics Engineer. He joined the Ohio State University in 2007 and currently serves as a full professor. His research interests include wide bandgap power devices and their applications, high-voltage and high-power converter/inverters, integration of renewable energy sources, and electrification of transportation.

Dr. Wang received multiple teaching and research awards including the Nagamori Award for his work on Wide Bandgap Power Electronics based motor drives in 2020, IEEE Power Electronics Society Richard M. Bass Young Engineer Award in 2011 and the National Science Foundation's CAREER Award in 2011. Dr. Wang has over 200 peer-reviewed journal and conference publications and 9 patents.



Yousef Abdullah (IEEE Member) received the B.S degree in electrical engineering from Kuwait University in 2013. He received the M.S. and PhD degrees in 2016 and 2020 respectively from the Ohio State University. In 2020, he joined Kuwait University as an assistant Professor. His main research interests include power electronics applications of WBG devices, electro-magnetic interference, motor drives, and dc arcs.

