Modeling 3-phase motor drive using GaNPower devices

By
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GaN power transistors for 3-phase motor drive

- Generation of PWM waveforms using space vector modulation
- Motor load model
- OVP-GaN
- Circuit model for 3-phase motor drive
Basic 3-phase motor configuration
Space vector modulation method

Voltage space vectors available using a three phase inverter

Six-step motor plotted on hex is the space vector configuration we work on.

\[ t_0 = 2U(3^{\alpha/2})\sin(\alpha) \]
\[ t_a = U[\cos(\alpha) - (3^{\alpha/2})\sin(\alpha)] \]

where \( U = |u_s| \) (Modulation Index)

\( \alpha = \angle u_s \)

a=> 1   b=>2
Use of symmetric pulse for better performance
With $u_{111}$ inserted in pulse center

PWM switching sequence using both $u_{000}$ and $u_{111}$ as zero vectors
Induction motor equivalent circuit (single phase)
GaNPower New Product: GaN EHEMT with Integrated Over-Voltage Protection Circuit

Characteristics of GaN with OVP–IC

Current (A)

0 0.2 0.4 0.6 0.8 1 1.2 1.4

Vgo (V)

0 5 10 15 20 25 30

Ig(ref)

Monolithic Integration

OVP-IC

Id(OVP–IC) Ig(OVP–IC) Ig(Ref)
DFN8x8-OVP. Suggested driving range G: 5-6V; GO: 5-15V, protection > 30V

8LEAD DFN (8x8x0.75mm, Pitch 1.95mm)

IMPORTANT: Please connect the bottom thermal pad to the source electrode on PCB
A demo example of 3 phase motor driven by PWM generated by space vector modulation model. Waveforms stored in files alo.txt, ahi.txt, etc.
Normalized waveform for all six transistors
Single phase output voltage for one AC-line period
Line-to-line output voltage for a single AC-line period
Conclusions

• A 3-phase motor circuit model has been set up to demonstrate the use of over-voltage protection GaN (OVP-GaN) from GaNPower.
• Space vector modulation method has been used to generate the proper PWM 15V waveform to drive the OVP-GaN.
• Good sine wave line-to-line output has been achieved on the simulated motor load equivalent circuit.
• Feasible to use OVP-GaN for motor drive and other inverter applications.
Let’s work together

Our Believes
Integrity
Technology Innovation
Fast Growing

GaNPower
THANKS FOR YOUR PATIENCE AND SUPPORT
衷心感謝您的耐心與支持