MOTOR CONTROL

Tech Tips

CROSS REFERENCE 1-14

from HITACHI AMERICA, LTD.

Key Phrase Cross Reference for Tech Tips 1 through 14

Key Phrase Locator

In a continuing effort to bring to its customers easy to use Hitachi BLDC Motor Control Systems application information, we offer this handy, Key Phrase Cross Reference covering the first 14 issues of Tech Tips that have been published.

Here's How It Works

There are over 700 key phrases throughout the first 14 issues of Hitachi Motor Control Tech Tips. These phrases have been compiled and listed in numeric/alpha sequence. Simply locate the phrase of the subject and it will guide you to the appropriate Tech Tips Title, Issue Number, and Issue Date. This is especially handy where Tech Tips subjects have multiple parts that span several Issues. An example is Introduction to BLDC Motor Torque Control Part 1 (Issue 3), Part 2 (Issue 4), Part 3 (Issue 5). This will quickly assist you in locating the information you need from the proper Tech Tip so that time consuming searching is eliminated.

Example: Your Key Phrase is "2-Quadrant TOP Arm Switches at Commutation Rate"

You'll find it covered in: Introduction to BLDC Motor Torque Control - Part 2 Issue 4 May '02

Missing a Tech Tips? Need More Assistance?

On the back page of this Cross Reference Guide and on the back page of each Hitachi Tech Tips is the contact number for additional information and support. We'll assist you with any BLDC Motor Control request you may have. If you would like Hitachi to investigate publishing a Tech Tips for a specific topic that has not yet been covered to date, just contact us and let us know the specifics.

Key Phrases	Tech Tip Title	Issue #	Issue Date
2-Quad : Current Rises to Sum of Applied & BEMF Volts at Reversal	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
2-Quad : Modified Controlled Deceleration : COASTS to a Low Speed	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
2-Quad : Rsa : Sink Temp = Ta + Rsa x (Total Inverter Watts)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
2-Quad : Speed Control : Pole BOTTOM Arms ONLY at PWM	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
2-Quad : Speed Control : Pole TOP Arms at Comm Frequency ONLY	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
2-Quad : Speed Control : Pole TOP Arms at Comm Frequency ONLY	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
2-Quad : Speed Control : PWM Duty Cycle makes Average Voltage	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
2-Quad : TOP could be IGBTs : BOTTOM could be MOSFETs	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
2-Quad : TOP Transistors Dissipate LESS Watts than BOTTOM Transistors	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
2-Quad : TOP Watts = Watts(TOP) : BOTTOM Watts = Watts(BOT)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
2-Quad Torque Direction Limited by TOP Arm Freewheel	BLDC Motor - Safe Direction Reversal	6	July '02
2-Quad(BOT) : Rcsb : CaseTempBOT = Sink Temp + Rcsb x Watts(BOT)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
2-Quad(BOT) : Rjcb : JuncTempBOT = CaseTempBOT + Rjcb x Watts(BOT)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
2-Quad(TOP) : Rcst : CaseTempTOP = Sink Temp + Rcst x Watts(TOP)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
2-Quad(TOP) : Rjct : JuncTempTOP = CaseTempTOP + Rjct x Watts(TOP)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
2-Quadrant : PWM Squarewave BLDC : BLDC PWM Squarewave	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
2-Quadrant : Thermal Model of 3-Phase, 6-Transistor Power Inverter	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
2-Quadrant 3rd Order PWM Current Loop Stability	Reference Information on Modulator Stability	4A	May '02
2-Quadrant Average Current Control Approximation	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant BOTTOM Arm PWM Chopping	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant COASTS to a Low Speed at Low PWM	BLDC Motor - Safe Direction Reversal	6	July '02
2-Quadrant Current Control	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant Current Control Stability	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant Freewheeling Max Current = VBEMF/Rm	BLDC Motor - Safe Direction Reversal	6	July '02
2-Quadrant Freewheeling TOP Arm Current Limit	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant Friction Deceleration	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant Kinetic Energy Reduced by Increased Freewheeling	BLDC Motor - Safe Direction Reversal	6	July '02
2-Quadrant Peak Winding Current Torque Control	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant PWM 100% Controls Torque Unidirectionally	BLDC Motor - Safe Direction Reversal	6	July '02
2-Quadrant PWM Controls only the BOTTOM Arms	BLDC Motor - Safe Direction Reversal	6	July '02
2-Quadrant PWM Modulator Stability	Reference Information on Modulator Stability	4A	May '02
2-Quadrant Reversal waits for Low (or Zero) Freewheel Current	BLDC Motor - Safe Direction Reversal	6	July '02
2-Quadrant Reversal waits for Low (or Zero) Freewheel Current	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
2-Quadrant Single Chip Hitachi BLDC Speed Reversal	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
2-Quadrant Speed (Voltage) Control	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
2-Quadrant Speed Control with (TOP Arm) Higher Efficiency	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
2-Quadrant TOP Arm Switches at Commutation Rate	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant Torque Control	Introduction to BLDC Motor Torque Control - Part 2	4	May '02

Key Phrases	Tech Tip Title	Issue #	Issue Date
2-Quadrant Torque Control by Peak Winding Current	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant Torque Control Simplicity	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant Torque Control Stability	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant Torque Control with (TOP Arm) Higher Efficiency	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant Torque Loop Freq-Comp in the Velocity Loop	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
2-Quadrant Torque Only in the Rotating Direction	BLDC Motor - Safe Direction Reversal	6	July '02
2-Quadrant Voltage (Speed) Control	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
3 Hall Sensors : 6 Valid Conduction Cycles : 3-Phase Drive	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
3-Phase Drive : 3 Hall Sensors : 6 Valid Conduction Cycles	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
3-Phase Hall Emulator : BLDC Test Fixture : Motorless Test Fixture	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
3rd Order PWM Current Loop Stability : 2-Quadrant	Reference Information on Modulator Stability	4A	May '02
4-Quad : Current Reversal Charges the DC Bus Capacitor	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
4-Quad : Current Reverses between PWM-ON vs PWM-OFF Cycles	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
4-Quad : Higher Losses dues to TOP and BOTTOM PWM	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
4-Quad : Inner Current (Torque) Loop : Outer Speed (Position) Loop	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
4-Quad : PWM-OFF (50%) Cycle Decelerates (or, Brakes) BLDC	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
4-Quad : PWM-OFF Brake R Dissipates RMS Brake Current Squared	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
4-Quad : PWM-OFF Dyn-Brake R Dissipation also gated by OVLO	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
4-Quad : PWM-OFF Kinetic Energy Absorbed in Dynamic Braking R	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
4-Quad : PWM-ON (50%) Cycle Accelerates (Motors) BLDC	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
4-Quad : Rcs : Case Temp = Sink Temp + Rcs x (Transistor Watts)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
4-Quad : Rjc : Junction Temp = Case Temp + Rjc x (Transistor Watts)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
4-Quad : Rsa : Sink Temp = Ta + Rsa x (Total Inverter Watts)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
4-Quad : Servo Peak Torque(Full Duty Cycle) : PWM (30%) Full Continuous	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
4-Quad : Switching Losses Higher due to TOP and BOTTOM PWM	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
4-Quad : Transistor Watts = (Total Inverter Watts) / 6	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
4-Quadrant : Accelerate vs Decelerate via PWM Duty Cycle	BLDC Motor - Safe Direction Reversal	6	July '02
4-Quadrant : PWM Squarewave BLDC : BLDC PWM Squarewave	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
4-Quadrant : Thermal Model of 3-Phase, 6-Transistor Power Inverter	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
4-Quadrant Accelerate/Decelerate in Both Directions	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
4-Quadrant Average Current Mode Control	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
4-Quadrant Current Control	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
4-Quadrant Current Control Loop	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
4-Quadrant Current Error Differential Amplifier	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
4-Quadrant DC Side Dynamic Braking	BLDC Motor - Safe Direction Reversal	6	July '02
4-Quadrant Inner Current Loop	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
4-Quadrant Inner Loop Stability	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
4-Quadrant Inner Torque Loop	Introduction to BLDC Motor Torque Control - Part 1	3	April '02

Key Phrases	Tech Tip Title	Issue #	Issue Date
4-Quadrant Loop Compensation	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
4-Quadrant Magnitude Drives the Inner Torque Loop	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
4-Quadrant Position Control Loop	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
4-Quadrant Sign Drives the Commutator	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
4-Quadrant Sign via a Voltage Comparator	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
4-Quadrant Speed Reversal	BLDC Motor - Safe Direction Reversal	6	July '02
4-Quadrant Torque Control	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
4-Quadrant Torque Control Loop	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
4-Quadrant Velocity Control Loop	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
50 to 500 msec	Motor Soft-Start	1	February '02
6 Valid Conduction Cycles : 3-Phase Drive : 3 Hall Sensors	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
AC Side Dynamic Braking	BLDC Permanent Magnet Motor Braking Circuits	2	March '02
Accelerate & Rotate in the Same Direction	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Accelerate vs Decelerate via PWM Duty Cycle : 4-Quadrant	BLDC Motor - Safe Direction Reversal	6	July '02
Accelerate/Decelerate in Both Directions : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Air Gaps : Thermal Grease : Thermal Resistance : Case-to-Sink : Rcs	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Alum-Copper : Larger Area : Smaller Path Length : Rsa : Thermal Conductivity	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Analog Isolation	BLDC Command Signal Isolation	8	September '02
Analog Isolation : Instrumentation Amplifiers	BLDC Command Signal Isolation	8	September '02
Analog Isolation : Low Cost Isolation : Bipolar Signal Isolation	BLDC Command Signal Isolation	8	September '02
Analog Speed Reversal	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Appliance Isolation Example	BLDC Command Signal Isolation	8	September '02
Appliances : Isolated Digital Interfaces	BLDC Command Signal Isolation	8	September '02
Average Current Control Approximation : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Average Current Mode Control : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Average Current/Switch : RMS Current/Switch : Switching Currents	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Back EMF Voltage : BEMF : Motor BEMF (Voltage) Constant (Ke)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Bandwidth of Isolation	BLDC Command Signal Isolation	8	September '02
BEMF	BLDC Permanent Magnet Motor Braking Circuits	2	March '02
BEMF : Motor BEMF (Voltage) Constant (Ke) : Back EMF Voltage	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
BEMF Voltage OPPOSES Power Inverter Voltage	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Bipolar Signal Isolation : Analog Isolation : Low Cost Isolation	BLDC Command Signal Isolation	8	September '02
Bipolar Transistor : Higher Drive Power than MOSFET/IGBT : Slow ON/OFF	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Bipolar Transistor : Lower(< IGBT) Die Cost : Recent Gain/Switch Advances	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Bipolar Transistor : Secondary Breakdown : Snubber	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Bipolar Transistors : MOSFETs : IGBTs : Power Inverter Components	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
BLDC Bridge Thermal Steady State : Thermal Steady State BLDC Bridge	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
BLDC Design Equations (Set of 19 Equations)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03

Key Phrases	Tech Tip Title	Issue #	Issue Date
BLDC Dissipation : Motor Winding (Rm) : Friction & Damping Losses	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
BLDC Drive : Multi-Phase : Variable Voltage : Variable Frequency	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
BLDC Drive Efficiency : Power Inverter Efficiency : BLDC Motor Efficiency	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
BLDC Input : Voltage and Current : Input Electrical Power	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
BLDC Motor : BLDC Motor Efficiency : Pout(Inverter) : Pout(Motor)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
BLDC Motor : Estimating Efficiency : Efficiency	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
BLDC Motor Efficiency : BLDC Drive Efficiency : Power Inverter Efficiency	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
BLDC Motor Efficiency : Pout(Inverter) : Pout(Motor) : BLDC Motor	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
BLDC Motors : Linear Torque/Speed : PM Brushed Motors	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
BLDC Motors Capable of Higher Speeds than PM Brushed	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
BLDC Motors have Lower Inertia than PM Brushed	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
BLDC Motors have no Brush Arcing or Brushes to Wear Out	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
BLDC Motors Smaller than PM Brushed	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
BLDC Operating Power Level : Specifying	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
BLDC Power Stage : DC to AC Power Inverter	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
BLDC PWM Squarewave : 2-Quadrant : PWM Squarewave BLDC	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
BLDC PWM Squarewave : 4-Quadrant : PWM Squarewave BLDC	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
BLDC Test Fixture : Motorless Test Fixture : 3-Phase Hall Emulator	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
BLDC WYE & DELTA : Power Inverter : PolyPhase Currents & Voltages	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Block All Volts @ Zero Current : Power Inverter IDEAL : Switch-OFF	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Blocks a Specific Range of Voltage : Power Inverter Specs : Switch-OFF	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Blocks Voltage Range @ Low Current : Power Inverter REAL : Switch-OFF	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Bodies Reside at Ambient Temp until they Dissipate Heat	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Bodies Rise above Ambient Temp when they Dissipate Heat	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Body at 150 Deg C Lowers Temp ONLY by contact with a Colder Temp	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
BOTTOM Arm PWM Chopping : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
BOTTOM could be MOSFETs : 2-Quad : TOP could be IGBTs	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
BOTTOM Watts = Watts(BOT) : 2-Quad : TOP Watts = Watts(TOP)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Braking Resistor	BLDC Permanent Magnet Motor Braking Circuits	2	March '02
Built-In Design Margin : Voltage(0.6 to 0.75) : Current(0.33 to 0.5) : Derating	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
BUS Over Voltage Lock Out	BLDC Power BUS Under/Over Voltage Protection	7	August '02
BUS Under Voltage Lock Out	BLDC Power BUS Under/Over Voltage Protection	7	August '02
BUS Voltage is Outside Operating Specs : Inhibit BLDC Drive	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Calibrate Tachometer : Tachometer Calibration	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Cascaded Control Loops	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Cascaded Speed/Torque Control	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Case Temp = Sink Temp + Rcs x (Transistor Watts) : 4-Quad : Rcs	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
CaseTempBOT = Sink Temp + Rcsb x Watts(BOT) : 2-Quad(BOT) : Rcsb	BLDC Motor Drive Power Stage Design - Part 4	14	May '03

Key Phrases	Tech Tip Title	Issue #	Issue Date
CaseTempTOP = Sink Temp + Rcst x Watts(TOP) : 2-Quad(TOP) : Rcst	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Case-to-Sink : Rcs : Air Gaps : Thermal Grease : Thermal Resistance	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Centrifugal Force Advantage : Inner Cup Magnets	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Circuit Example : UVLO / OVLO	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Clamped, Inductive-Switching Mode : Device Losses : Switching Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Closed Loop Speed Control	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
COASTS to a Low Speed : 2-Quad : Modified Controlled Deceleration	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
COASTS to a Low Speed at Low PWM : 2-Quadrant	BLDC Motor - Safe Direction Reversal	6	July '02
Cogging : Inner Current Loop : Number Of Phases	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Commercial(<125C) : Military(<100C) : Junction Operating Temp : Reliability	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Common Mode Noise : Independent Voltages : Ground Loops	BLDC Command Signal Isolation	8	September '02
Common Mode Noise Rejection : Isolation	BLDC Command Signal Isolation	8	September '02
Conduction Loss : Flyback Diodes : OFF-State (!) : Device Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Conduction Loss : Gate Drive MIN : MOSFET(10 to 12V) : IGBT(15 to 18V)	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Conduction Loss : Minimized at Larger Dies Sizes : ON-State	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Conduction Loss : MOSFET Rds : IGBT Vsat : Device Losses : ON-State	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Conduction, Convection and Radiation : Rsa = [T(surface) - T(ambient)]/Watts	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Constant Speed (or, Torque) : Meet Full Load Req'mnts : Duty (80%) Cycle	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Contact Bounce : Relay	BLDC Command Signal Isolation	8	September '02
Csa = 0.63 x (Measured Thermal Delay) / (3 x Rsa) : Thermal Capacitance	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Current : Voltage : Power (= Current x Voltage) : Energy Electrical	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Current Capacity Inverse to Blocking Voltage : Power Inverter : MOSFET	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Current Control : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Current Control : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Current Control Loop : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Current Control Stability : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Current Error Differential Amplifier : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Current Flow : Thermal Conduction : Electrical Conduction : Heat Flow	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Current Loop Transducers : Isolation	BLDC Command Signal Isolation	8	September '02
Current Mode Torque Control : Torque Control Current Mode	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Current Reversal Charges the DC Bus Capacitor : 4-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Current Reverses between PWM-ON vs PWM-OFF Cycles : 4-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Current Rises to Sum of Applied & BEMF Volts at Reversal : 2-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Current(0.33 to 0.5) : Derating : Built-In Design Margin : Voltage(0.6 to 0.75)	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Damping Torque : Torque(s) : Motor : Load : Frictional	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
DC Bus Current (MAX Average) : DC Bus Voltage MIN	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
DC Bus Voltage : Specifying	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
DC Bus Voltage MIN : DC Bus Current (MAX Average)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03

Key Phrases	Tech Tip Title	Issue #	Issue Date
DC Link Over-Voltage	BLDC Permanent Magnet Motor Braking Circuits	2	March '02
DC Side Dynamic Braking	BLDC Permanent Magnet Motor Braking Circuits	2	March '02
DC Side Dynamic Braking : 4-Quadrant	BLDC Motor - Safe Direction Reversal	6	July '02
DC to AC Power Inverter : BLDC Power Stage	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Demagnetize Rotor Magnet	BLDC Permanent Magnet Motor Braking Circuits	2	March '02
Derating : Built-In Design Margin : Voltage(0.6 to 0.75) : Current(0.33 to 0.5)	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Design of Power Inverter Stages : Power Inverter Stage Design	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Device Loss States : OFF-State : ON-State : Transitions (ON/OFF/ON)	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Device Losses : Conduction Loss : Flyback Diodes : OFF-State (!)	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Device Losses : Diode Reverse Recovery : Faster (2-3x) than Switch Turn-ON	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Device Losses : OFF-State : Orders of Mag Smaller than ON-State	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Device Losses : ON-State : Conduction Loss : MOSFET Rds : IGBT Vsat	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Device Losses : Operating Efficiency : T(a) Max : Mean Time To Failure	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Device Losses : Switching Losses : Clamped, Inductive-Switching Mode	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Device Losses : Turn-OFF Switching Time INCREASES Turn-OFF Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Dielectric Isolation	BLDC Command Signal Isolation	8	September '02
Digital Isolation	BLDC Command Signal Isolation	8	September '02
Diode Reverse Recovery : Faster (2-3x) than Switch Turn-ON : Device Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Discharge BUS Battery : Due to Excessive Drive Current	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Dissipation creates Heat Energy : Heat Flows to a Colder Temp : Heat Flow	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Doubling Tachometer Resolution : Tachometer Resolution	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
DPAKx SMD : Modular Bridge/Inverters : Power Packaging : TO-2xx 3-Pin	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Drive Excessively Discharges the BUS Battery	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Duty (80%) Cycle : Constant Speed (or, Torque) : Meet Full Load Req'mnts	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Dynamic Braking	BLDC Permanent Magnet Motor Braking Circuits	2	March '02
Efficiency : BLDC Motor : Estimating Efficiency	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Efficiency : Electrical Energy : Mechanical Energy	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Efficiency : Power Inverter : Estimating Efficiency	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Electrical Capacity (Farads) : Thermal Capacity (Thermal Inertia)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Electrical Conduction : Heat Flow : Current Flow : Thermal Conduction	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Electrical Energy : Mechanical Energy : Efficiency	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Electrical Flow (Amps) : Thermal-R : Electrical-R : Heat Flow (Watts)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Electrical Isolation : Isolation Pad : Isolation (Mica-Rubber-Kaptonä) : Rcs	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Electrical-R : Heat Flow (Watts) : Electrical Flow (Amps) : Thermal-R	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Electronic Commutation : Power Pole Switching : Pole Shoot-Thru	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Electronic Commutation : Rotor Position Decoding : Hall Sensors	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Electronic Commutation : Sync Stator Current Pulses : Rotor Torque	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Energy Electrical : Current : Voltage : Power (= Current x Voltage)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03

Key Phrases	Tech Tip Title	Issue #	Issue Date
Energy Mechanical : Torque : Speed : Power (= Torque x Speed)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Estimating Efficiency : Efficiency : BLDC Motor	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Estimating Efficiency : Efficiency : Power Inverter	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Excessive Current during Line Sags	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Excessive Transient Shut-Down Current	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Excessive Transient Start-Up Current	Motor Soft-Start	1	February '02
Excessive Transient Start-Up Current	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Faster (2-3x) than Switch Turn-ON : Device Losses : Diode Reverse Recovery	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Few Hundred Hz BW for Supply Rejection	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Few KHz BW for 4-Quadrant Servo	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Finite Switching Time w/ Finite Loss : Power Inverter REAL : ON/OFF/ON	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Flyback Diode in Hybrid TO-2xx : IGBT Die Smaller than Similar MOSFET :	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Flyback Diode(Internal)@LOW Volts : Not High(Volts+Power) : MOSFET	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Flyback Diodes : OFF-State (!) : Device Losses : Conduction Loss	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Flyback Diodes : Power Inverter Components : Power Transistor Switches	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Flyback Diodes : Protective/Anti-Parallel : Power Inverter Components	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Flyback Diodes Charge BUS Caps : Forced Deceleration	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Forced Deceleration : Flyback Diodes Charge BUS Caps	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Freewheeling Max Current = VBEMF/Rm : 2-Quadrant	BLDC Motor - Safe Direction Reversal	6	July '02
Freewheeling TOP Arm Current Limit : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Friction & Damping Losses : BLDC Dissipation : Motor Winding (Rm)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Friction Deceleration : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Frictional Torque : Damping : Torque(s) : Motor : Load	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Full Load Torque : Rated Speed : Pin(DC Bus) MAX	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Gate Drive MIN : MOSFET(10 to 12V) : IGBT(15 to 18V) : Conduction Loss	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Generator	BLDC Permanent Magnet Motor Braking Circuits	2	March '02
Ground Loops : Common Mode Noise : Independent Voltages	BLDC Command Signal Isolation	8	September '02
Hall Sensor signal : Number of Rotor Poles : Tachometer Freq	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Hall Sensors : Electronic Commutation : Rotor Position Decoding	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Heat Flow : Current Flow : Thermal Conduction : Electrical Conduction	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Heat Flow : Dissipation creates Heat Energy : Heat Flows to a Colder Temp	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Heat Flow in Materials Raises (their) Temp : Materials Raise Temp Differently	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Heat Flows to a Colder Temp : Heat Flow : Dissipation creates Heat Energy	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
High Bandwith : OptoCoupler Parasitic Capacitance	BLDC Command Signal Isolation	8	September '02
High Frequency PWM is Summed/Multiplexed with Position	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
High PWM Frequency : Low Winding Inductance : Low Torque Ripple	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Higher Drive Power than MOSFET/IGBT : Slow ON/OFF : Bipolar Transistor	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Higher Efficiency (TOP Arm) Speed Control	BLDC Motor Drive Power Stage Design - Part 1	11	February '03

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Higher Efficiency (TOP Arm) Torque Control	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Higher Losses dues to TOP and BOTTOM PWM : 4-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
IGBT & BIP : Turn-OFF : Snubber : Switching Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
IGBT & Bip Transistors : Turn-OFF Switching Time vs Deep Saturation	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
IGBT Die Smaller than Similar MOSFET : Flyback Diode in Hybrid TO-2xx	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
IGBT Losses : ON (= Eon x Fs) : OFF (= Eoff x Fs) : Scaled by Im & Vm	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
IGBT Losses are Scaled by Im AND Vm	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
IGBT Vsat : Device Losses : ON-State : Conduction Loss : MOSFET Rds	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
IGBT(15 to 18V) : Conduction Loss : Gate Drive MIN : MOSFET(10 to 12V)	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
IGBTs : Power Inverter Components : Bipolar Transistors : MOSFETs	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Inch-Pound/Amp : Motor Torque Const (Kt) : Ounce-Inch/Amp	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Increased Acceleration : Speed Control : Increased BLDC Voltage	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Increased BLDC Voltage : Increased Acceleration : Speed Control	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Independent Voltages : Ground Loops : Common Mode Noise	BLDC Command Signal Isolation	8	September '02
Inhibit BLDC Drive when BUS Voltage is Outside Operating Specs	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Inner Cup Magnets : Centrifugal Force Advantage	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Inner Cup Magnets : Rotor Structure : Outer Surface Magnets	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Inner Current (Torque) Loop : Outer Speed (Position) Loop : 4-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Inner Current Loop	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Inner Current Loop : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Inner Current Loop : Number Of Phases : Cogging	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Inner Loop Stability : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Inner Torque Loop	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Inner Torque Loop : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Input and Output : Operating Voltage and Currents : Power Inverter	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Input Electrical Power : BLDC Input : Voltage and Current	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Inrush Current : NTC Surge Limit Thermistor : Shunting Relay	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Instantly Switch w/ Zero Loss : Power Inverter IDEAL : ON/OFF/ON	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Instrumentation Amplifiers : Analog Isolation	BLDC Command Signal Isolation	8	September '02
Instrumentation Amplifiers : Isolation	BLDC Command Signal Isolation	8	September '02
Integrated Isolators	BLDC Command Signal Isolation	8	September '02
Isolate Control Signals from Drive	BLDC Command Signal Isolation	8	September '02
Isolate Drive from Control Signals	BLDC Command Signal Isolation	8	September '02
Isolated Digital Interfaces : Appliances	BLDC Command Signal Isolation	8	September '02
Isolation (Mica-Rubber-Kaptonä) : Rcs : Electrical Isolation : Isolation Pad	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Isolation : Analog	BLDC Command Signal Isolation	8	September '02
Isolation : Common Mode Noise Rejection	BLDC Command Signal Isolation	8	September '02
Isolation : Current Loop Transducers	BLDC Command Signal Isolation	8	September '02

Key Phrases	Tech Tip Title	Issue #	Issue Date
Isolation : Dielectric	BLDC Command Signal Isolation	8	September '02
Isolation : Digital	BLDC Command Signal Isolation	8	September '02
Isolation : Instrumentation Amplifiers	BLDC Command Signal Isolation	8	September '02
Isolation : Magnetic	BLDC Command Signal Isolation	8	September '02
Isolation : Mechanical Relay	BLDC Command Signal Isolation	8	September '02
Isolation : Optical	BLDC Command Signal Isolation	8	September '02
Isolation : PC Board Traces	BLDC Command Signal Isolation	8	September '02
Isolation : Voltage Level	BLDC Command Signal Isolation	8	September '02
Isolation Bandwidth	BLDC Command Signal Isolation	8	September '02
Isolation Example : Appliances	BLDC Command Signal Isolation	8	September '02
Isolation Pad : Isolation (Mica-Rubber-Kaptonä) : Rcs : Electrical Isolation	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Isolator Increases Thermal R : Material-Thickness-Torque : Precut Pads : Rcs	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Isolators : Integrated	BLDC Command Signal Isolation	8	September '02
JuncTempBOT = CaseTempBOT + Rjcb x Watts(BOT) : 2-Quad(BOT) : Rjcb	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
JuncTempTOP = CaseTempTOP + Rjct x Watts(TOP) : 2-Quad(TOP) : Rjct	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Junction (Safe) Operating Temp : Power Inverter Specs : Specified Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Junction (Safe) Operating Temp : Self-Heating : Self-Destruction	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Junction Oper Temp : Power Inverter : Thermal Response of BLDC Bridge	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Junction Operating Temp : Power Inverter : Thermal Analysis of BLDC Bridge	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Junction Operating Temp : Reliability : Commercial(<125C) : Military(<100C)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Junction Operating Temps above 125C are approaching imminent Failure	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Junction Temp = Case Temp + Rjc x (Transistor Watts) : 4-Quad : Rjc	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Junction-to-Case : Rjc : Package Type Choices : Thermal Resistance	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Kinetic Energy of the Running Motor : Overhauling Load	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Kinetic Energy Reduced by Increased Freewheeling : 2-Quadrant	BLDC Motor - Safe Direction Reversal	6	July '02
L/R Motor Winding Time Constant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Larger Area : Smaller Path Length : Rsa : Thermal Conductivity : Alum-Copper	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Lead Cancel Viscous Dampening Pole	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Lead-Lag Speed Control	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Limit PWM Duty Cycle at Start-Up	Motor Soft-Start	1	February '02
Limit PWM Duty Cycle at Start-Up	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Line Sags : Excessive Current	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Linear Torque/Speed : PM Brushed Motors : BLDC Motors	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Load BLDC Current : Motor Torque : Motor Torque Const (Kt)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Load Torque : Frictional : Damping : Torque(s) : Motor	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Locked Rotor Inhibits Power Inverter	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Locked Rotor Simulation : Simulate Locked Rotor	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Loop Compensation : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02

Key Phrases	Tech Tip Title	Issue #	Issue Date
Low Cost Isolation : Bipolar Signal Isolation : Analog Isolation	BLDC Command Signal Isolation	8	September '02
Low DC Bus Volts	Motor Soft-Start	1	February '02
Low Torque Ripple : High PWM Frequency : Low Winding Inductance	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Low Winding Inductance : Low Torque Ripple : High PWM Frequency	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Lower(< IGBT) Die Cost : Recent Gain/Switch Advances : Bipolar Transistor	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Magnetic Flux : Stator Winding Current : Rotor Torque	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Magnetic Isolation	BLDC Command Signal Isolation	8	September '02
Magnitude Drives the Inner Torque Loop : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Magnitude via Precision OpAmp Rectifier	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Material-Thickness-Torque : Precut Pads : Rcs : Isolator Increases Thermal R	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Mean Time To Failure : Device Losses : Operating Efficiency : T(a) Max	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Mechanical Energy : Efficiency : Electrical Energy	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Mechanical Relay Isolation	BLDC Command Signal Isolation	8	September '02
Meet Full Load Req'mnts : Duty (80%) Cycle : Constant Speed (or, Torque)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
MicroController Speed Reversal	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Military(<100C) : Junction Operating Temp : Reliability : Commercial(<125C)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Miller Cap (Cgd) is NON-Linear : Switching Losses : MOSFET & IGBT	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Min to Max BLDC Speed Range : Simulate BLDC Speed Range	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Minimized at Larger Dies Sizes : ON-State : Conduction Loss	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Minimum Speed Reversal Trip Point	BLDC Motor - Safe Direction Reversal	6	July '02
Minimum Speed Reversal Trip Point	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Mismatch across all 3-Phases : Common UVLO (Threshold)	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Modified Controlled Deceleration : COASTS to a Low Speed : 2-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
MOSFET & IGBT : Miller Cap (Cgd) is NON-Linear : Switching Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
MOSFET & IGBT : ON/OFF/ON Gate Currents : Switching Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
MOSFET : Current Capacity Inverse to Blocking Voltage : Power Inverter	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
MOSFET : Flyback Diode(Internal)@LOW Volts : Not High(Volts+Power)	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
MOSFET Rds : IGBT Vsat : Device Losses : ON-State : Conduction Loss	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
MOSFET(10 to 12V) : IGBT(15 to 18V) : Conduction Loss : Gate Drive MIN	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
MOSFETs : IGBTs : Power Inverter Components : Bipolar Transistors	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Motor BEMF (Voltage) Constant (Ke) : Back EMF Voltage : BEMF	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Motor BEMF Constant	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Motor Torque : Load : Frictional : Damping : Torque(s)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Motor Torque : Motor Torque Const (Kt) : Load BLDC Current	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Motor Torque Const (Kt) : Load BLDC Current : Motor Torque	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Motor Torque Const (Kt) : Motor Torque Proportional to Motor Current	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Motor Torque Const (Kt) : Ounce-Inch/Amp : Inch-Pound/Amp	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Motor Torque Constant	Introduction to BLDC Motor Torque Control - Part 3	5	June '02

Key Phrases	Tech Tip Title	Issue #	Issue Date
Motor Torque Proportional to Motor Current : Motor Torque Const (Kt)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Motor Winding (Rm) : Friction & Damping Losses : BLDC Dissipation	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Motor Winding (Rm) : Temperature Variation	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Motor/Load Time Constant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Motoring	BLDC Permanent Magnet Motor Braking Circuits	2	March '02
Motorless Test Fixture : 3-Phase Hall Emulator : BLDC Test Fixture	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Motorless Testing : WYE or DELTA Load Bank	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Motorless Testing :Simulate Large Power Range	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Mounting Torque : Surface Preparation : Thermal Grease : Rcs	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Multi-Phase : Multi-Pole : Stator Winding	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Multi-Phase : Variable Voltage : Variable Frequency : BLDC Drive	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Multiple Half-Bridges : One Power Pole per Phase : Power Inverter	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Multi-Pole : Stator Winding : Multi-Phase	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Not High(Volts+Power) : MOSFET : Flyback Diode(Internal)@LOW Volts	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
NTC Surge Limit Thermistor : Shunting Relay : Inrush Current	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Number Of Phases : Cogging : Inner Current Loop	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Number of Rotor Poles : Tachometer Freq : Hall Sensor signal	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
OC (Over Current) Inhibits Power Inverter	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
OFF (= Eoff x Fs) : Scaled by Im & Vm : IGBT Losses : ON (= Eon x Fs)	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
OFF-State (!) : Device Losses : Conduction Loss : Flyback Diodes	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
OFF-State : ON-State : Transitions (ON/OFF/ON) : Device Loss States	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
OFF-State : Orders of Mag Smaller than ON-State : Device Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
ON (= Eon x Fs) : OFF (= Eoff x Fs) : Scaled by Im & Vm : IGBT Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
ON/OFF/ON : Finite Switching Time w/ Finite Loss : Power Inverter REAL	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
ON/OFF/ON : Instantly Switch w/ Zero Loss : Power Inverter IDEAL	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
ON/OFF/ON : Specifies V&I at Specific Low Loss : Power Inverter Specs	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
ON/OFF/ON Gate Currents : Switching Losses : MOSFET & IGBT	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
One Power Pole per Phase : Power Inverter : Multiple Half-Bridges	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
ON-State : Conduction Loss : Minimized at Larger Dies Sizes	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
ON-State : Conduction Loss : MOSFET Rds : IGBT Vsat : Device Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
ON-State : Transitions (ON/OFF/ON) : Device Loss States : OFF-State	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Open Loop Speed Control	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Operating Efficiency : T(a) Max : Mean Time To Failure : Device Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Operating Voltage and Currents : Power Inverter : Input and Output	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Optical Isolation	BLDC Command Signal Isolation	8	September '02
OptoCoupler Parasitic Capacitance : High Bandwith	BLDC Command Signal Isolation	8	September '02
Orders of Mag Smaller than ON-State : Device Losses : OFF-State	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Ounce-Inch/Amp : Inch-Pound/Amp : Motor Torque Const (Kt)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03

Key Phrases	Tech Tip Title	Issue #	Issue Date
Outer Speed (Position) Loop : 4-Quad : Inner Current (Torque) Loop	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Outer Surface Magnets : Inner Cup Magnets : Rotor Structure	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Over Voltage BUS Lock Out	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Overhauling Load : Kinetic Energy of the Running Motor	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Override DC Side Dynamic Braking : OVLO	BLDC Power BUS Under/Over Voltage Protection	7	August '02
OVLO : Override DC Side Dynamic Braking	BLDC Power BUS Under/Over Voltage Protection	7	August '02
OVLO Inhibits Power Inverter	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Package Type Choices : Thermal Resistance : Junction-to-Case : Rjc	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Pass All Currents @ Zero-Drop : Power Inverter IDEAL : Switch-ON	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Passes a Max Currents @ Finite-Drop : Power Inverter REAL : Switch-ON	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Passes a Specific Range of Current : Power Inverter Specs : Switch-ON	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
PC Board Trace Isolation	BLDC Command Signal Isolation	8	September '02
Peak Winding Current Torque Control : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Pin(DC Bus) : Pout(Inverter) : Power Inverter : Power Inverter Efficiency	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Pin(DC Bus) MAX : Full Load Torque : Rated Speed	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
PM Brushed Motors : BLDC Motors : Linear Torque/Speed	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Pole BOTTOM Arms ONLY at PWM : 2-Quad : Speed Control	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Pole Shoot-Thru : Electronic Commutation : Power Pole Switching	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Pole TOP Arms at Comm Frequency ONLY : 2-Quad : Speed Control	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Pole TOP Arms at Comm Frequency ONLY : 2-Quad : Speed Control	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Pole TOP Arms at Comm Frequency ONLY : 2-Quad : Speed Control	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
PolyPhase Currents & Voltages : BLDC WYE & DELTA : Power Inverter	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Position Control Loop : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Pout(Inverter) : Pout(Motor) : BLDC Motor : BLDC Motor Efficiency	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Pout(Inverter) : Power Inverter : Power Inverter Efficiency : Pin(DC Bus)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Pout(Motor) : BLDC Motor : BLDC Motor Efficiency : Pout(Inverter)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Power (= Current x Voltage) : Energy Electrical : Current : Voltage	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Power (= Torque x Speed) : Energy Mechanical : Torque : Speed	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Power Inverter : Estimating Efficiency : Efficiency	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Power Inverter : Input and Output : Operating Voltage and Currents	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Power Inverter : MOSFET : Current Capacity Inverse to Blocking Voltage	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter : Multiple Half-Bridges : One Power Pole per Phase	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Power Inverter : PolyPhase Currents & Voltages : BLDC WYE & DELTA	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Power Inverter : Power Inverter Efficiency : Pin(DC Bus) : Pout(Inverter)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Power Inverter : Thermal Analysis of BLDC Bridge : Junction Operating Temp	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Power Inverter : Thermal Response of BLDC Bridge : Junction Oper Temp	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Power Inverter Components : Bipolar Transistors : MOSFETs : IGBTs	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter Components : Flyback Diodes : Protective/Anti-Parallel	BLDC Motor Drive Power Stage Design - Part 3	13	April '03

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Power Inverter Components : Power Transistor Switches : Flyback Diodes	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter Components : Transistor and Diode Selection Guidelines	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter Design Equations (Set of 19 Equations)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Power Inverter Efficiency : BLDC Motor Efficiency : BLDC Drive Efficiency	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Power Inverter Efficiency : Pin(DC Bus) : Pout(Inverter) : Power Inverter	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Power Inverter IDEAL : ON/OFF/ON : Instantly Switch w/ Zero Loss	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter IDEAL : Switch-OFF : Block All Volts @ Zero Current	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter IDEAL : Switch-ON : Pass All Currents @ Zero-Drop	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter Inhibited by Faults (OC, UV, UV, Locked Rotor)	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Power Inverter REAL : ON/OFF/ON : Finite Switching Time w/ Finite Loss	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter REAL : Switch-OFF : Blocks Voltage Range @ Low Current	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter REAL : Switch-ON : Passes a Max Currents @ Finite-Drop	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter Specs : ON/OFF/ON : Specifies V&I at Specific Low Loss	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter Specs : Specified Losses : Safe Junction Operating Temp	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter Specs : Switch-OFF : Blocks a Specific Range of Voltage	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter Specs : Switch-ON : Passes a Specific Range of Current	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Inverter Stage Design : Design of Power Inverter Stages	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Power Inverter Voltage OPPOSES BEMF Voltage	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Power ON	Motor Soft-Start	1	February '02
Power Packaging : TO-2xx 3-Pin : DPAKx SMD : Modular Bridge/Inverters	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power Pole Switching : Pole Shoot-Thru : Electronic Commutation	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Power Poles Driven by the Summed/Mutiplexed PWM Signal	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Power Transistor Switches : Flyback Diodes : Power Inverter Components	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Power-Down Supply Sequencing	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Power-Up Supply Sequencing	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Precut Pads : Rcs : Isolator Increases Thermal R : Material-Thickness-Torque	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Predetermined Brake Time	BLDC Permanent Magnet Motor Braking Circuits	2	March '02
Preventing Shoot-Thru During Reversal	BLDC Motor - Safe Direction Reversal	6	July '02
Preventing Shoot-Thru During Reversal	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Proportional plus Integral Speed Control	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Protective/Anti-Parallel : Power Inverter Components : Flyback Diodes	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
PWM (30%) Full Continuous : 4-Quad : Servo Peak Torque(Full Duty Cycle)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
PWM 100% Controls Torque Unidirectionally : 2-Quadrant	BLDC Motor - Safe Direction Reversal	6	July '02
PWM Controls Only the BOTTOM Arms : 2-Quadrant	BLDC Motor - Safe Direction Reversal	6	July '02
PWM Duty Cycle makes Average Voltage : 2-Quad : Speed Control	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
PWM Gain	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
PWM Modulator Stability : 2-Quadrant	Reference Information on Modulator Stability	4A	May '02
PWM Squarewave BLDC : BLDC PWM Squarewave : 2-Quadrant	BLDC Motor Drive Power Stage Design - Part 1	11	February '03

Key Phrases	Tech Tip Title	Issue #	Issue Date
PWM Squarewave BLDC : BLDC PWM Squarewave : 4-Quadrant	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
PWM-OFF (50%) Cycle Decelerates (or, Brakes) BLDC : 4-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
PWM-OFF Brake R Dissipates RMS Brake Current Squared : 4-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
PWM-OFF Dyn-Brake R Dissipation also gated by OVLO : 4-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
PWM-OFF Kinetic Energy Absorbed in Dynamic Braking R : 4-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
PWM-ON (50%) Cycle Accelerates (Motors) BLDC : 4-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Rated Load Testing : Testing without Heatsinking	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Rated Speed : Pin(DC Bus) MAX : Full Load Torque	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Rcs : Air Gaps : Thermal Grease : Thermal Resistance : Case-to-Sink	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rcs : Case Temp = Sink Temp + Rcs x (Transistor Watts) : 4-Quad	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rcs : Electrical Isolation : Isolation Pad : Isolation (Mica-Rubber-Kaptonä)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rcs : Isolator Increases Thermal R : Material-Thickness-Torque : Precut Pads	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rcs : Mounting Torque : Surface Preparation : Thermal Grease	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rcs : Surface Finish (63 - 125 m-inches) : Surface Flatness (5 - 8 mils/inch)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rcs : Thermal Websites for Materials : Thermal Websites on Surface Effects	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rcs x Ccs : Rsa x Csa : Thermal Steady State BLDC Bridge : Rjc x Cjc	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rcsb : CaseTempBOT = Sink Temp + Rcsb x Watts(BOT) : 2-Quad(BOT)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rcst : CaseTempTOP = Sink Temp + Rcst x Watts(TOP) : 2-Quad(TOP)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Recent Gain/Switch Advances : Bipolar Transistor : Lower(< IGBT) Die Cost	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Regenerative Braking	BLDC Permanent Magnet Motor Braking Circuits	2	March '02
Relay Contact Bounce	BLDC Command Signal Isolation	8	September '02
Reliability : Commercial(<125C) : Military(<100C) : Junction Operating Temp	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
ReStart	Motor Soft-Start	1	February '02
Reversal : Preventing Shoot-Thru	BLDC Motor - Safe Direction Reversal	6	July '02
Reversal : Preventing Shoot-Thru	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Reversal waits for Low (or Zero) Freewheel Current : 2-Quadrant	BLDC Motor - Safe Direction Reversal	6	July '02
Reversal waits for Low (or Zero) Freewheel Current : 2-Quadrant	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Reversal waits for Specified Minimum (or Zero) Speed	BLDC Motor - Safe Direction Reversal	6	July '02
Reversal waits for Specified Minimum (or Zero) Speed	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Rjc : Junction Temp = Case Temp + Rjc x (Transistor Watts) : 4-Quad	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rjc : Package Type Choices : Thermal Resistance : Junction-to-Case	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rjc x Cjc : Rcs x Ccs : Rsa x Csa : Thermal Steady State BLDC Bridge	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rjcb : JuncTempBOT = CaseTempBOT + Rjcb x Watts(BOT) : 2-Quad(BOT)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rjct : JuncTempTOP = CaseTempTOP + Rjct x Watts(TOP) : 2-Quad(TOP)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
RMS Current/Switch : Switching Currents : Average Current/Switch	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Rotor and Load Moment of Inertia	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Rotor Position Decoding : Hall Sensors : Electronic Commutation	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Rotor Structure : Outer Surface Magnets : Inner Cup Magnets	BLDC Motor Drive Power Stage Design - Part 1	11	February '03

Key Phrases	Tech Tip Title	Issue #	Issue Date
Rotor Torque : Electronic Commutation : Sync Stator Current Pulses	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Rotor Torque : Magnetic Flux : Stator Winding Current	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Rsa : Sink Temp = Ta + Rsa x (Total Inverter Watts) : 2-Quad	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rsa : Sink Temp = Ta + Rsa x (Total Inverter Watts) : 4-Quad	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rsa : Thermal Conductivity : Alum-Copper : Larger Area : Smaller Path Length	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rsa : Thermal Websites on Heat Sink Radiation and Convection	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rsa = [T(surface) - T(ambient)]/Watts : Conduction, Convection and Radiation	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Rsa x Csa : Thermal Steady State BLDC Bridge : Rjc x Cjc : Rcs x Ccs	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Run Time Under Voltage Lock Out Fault Detection	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Safe Direction Reversal : Single Chip BLDC	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Safe Junction Operating Temp : Power Inverter Specs : Specified Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Secondary Breakdown : Snubber : Bipolar Transistor	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Self-Destruction : Junction (Safe) Operating Temp : Self-Heating	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Self-Heating : Self-Destruction : Junction (Safe) Operating Temp	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Servo Control	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Servo Peak Torque(Full Duty Cycle) : PWM (30%) Full Continuous : 4-Quad	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Shunting Relay : Inrush Current : NTC Surge Limit Thermistor	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Sign Drives the Commutator : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Sign via a Voltage Comparator : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Sign-Magnitude Logic	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Simple Speed Control	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Simulate BLDC Speed Range : Min to Max BLDC Speed Range	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Simulate Large Power Range : Motorless Testing	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Simulate Locked Rotor : Locked Rotor Simulation	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Simulate Speed Reversal : Speed Reversal Simulation	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Single Chip BLDC : Tachometer	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Single Chip BLDC : Tachometer Calibration	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Single Chip BLDC Safe Direction Reversal	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Single Chip Hitachi BLDC Speed Reversal : 2-Quadrant	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Single Chip vs Bridge Driver : Speed Reversal Compatibility	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Sink Temp = Ta + Rsa x (Total Inverter Watts) : 2-Quad : Rsa	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Sink Temp = Ta + Rsa x (Total Inverter Watts) : 4-Quad : Rsa	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Slow ON/OFF : Bipolar Transistor : Higher Drive Power than MOSFET/IGBT	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Smaller Path Length : Rsa : Thermal Conductivity : Alum-Copper : Larger Area	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Smooth Transfer between Quadrants	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Snubber : Bipolar Transistor : Secondary Breakdown	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Snubber : Switching Losses : IGBT & BIP : Turn-OFF	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Soft-Start ReStarts Motor after a Speed Reversal	BLDC Motor - Safe Direction Reversal	6	July '02

Key Phrases	Tech Tip Title	Issue #	Issue Date
Soft-Start ReStarts Motor after a Speed Reversal	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Soft-Start ReStarts Motor after UVLO / OVLO	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Specified Losses : Safe Junction Operating Temp : Power Inverter Specs	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Specifies V&I at Specific Low Loss : Power Inverter Specs : ON/OFF/ON	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Specifying : BLDC Operating Power Level	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Specifying : DC Bus Voltage	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Speed (Voltage) Control : 2-Quadrant	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Speed : Power (= Torque x Speed) : Energy Mechanical : Torque	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Speed Control : Increased BLDC Voltage : Increased Acceleration	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Speed Control : Pole BOTTOM Arms ONLY at PWM : 2-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Speed Control : Pole TOP Arms at Comm Frequency ONLY : 2-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Speed Control : Pole TOP Arms at Comm Frequency ONLY : 2-Quad	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Speed Control : PWM Duty Cycle makes Average Voltage : 2-Quad	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Speed Control Loop	Motor Soft-Start	1	February '02
Speed Control Loop Output Controls PWM Duty Cycle	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Speed Control Loop Subtracts Tach from an External Speed Request	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Speed Control Voltage Mode : Voltage Mode Speed Control	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Speed Control with (TOP Arm) Higher Efficiency : 2-Quadrant	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Speed Reversal : 4-Quadrant	BLDC Motor - Safe Direction Reversal	6	July '02
Speed Reversal : Analog	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Speed Reversal : MicroController	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Speed Reversal Compatibility : Single Chip vs Bridge Driver	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Speed Reversal initiates a Motor Soft-Start ReStart	BLDC Motor - Safe Direction Reversal	6	July '02
Speed Reversal initiates a Motor Soft-Start ReStart	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Speed Reversal Simulation : Simulate Speed Reversal	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Squarewave BLDC Motor	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Start-Up Current	Motor Soft-Start	1	February '02
Start-Up Limit of the PWM Duty Cycle	Motor Soft-Start	1	February '02
Start-Up Limit of the PWM Duty Cycle	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Stator Winding : Multi-Phase : Multi-Pole	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Stator Winding Current : Rotor Torque : Magnetic Flux	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Sum/Multiplex Position with a High Frequency PWM	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Summed/Mutiplexed PWM Signal Drives the Power Poles	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Supply Sequencing during Power-Down	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Supply Sequencing during Power-Up	BLDC Power BUS Under/Over Voltage Protection	7	August '02
Surface Finish (63 - 125 m-inches) : Surface Flatness (5 - 8 mils/inch) : Rcs	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Surface Flatness (5 - 8 mils/inch) : Rcs : Surface Finish (63 - 125 m-inches)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Surface Preparation : Thermal Grease : Rcs : Mounting Torque	BLDC Motor Drive Power Stage Design - Part 4	14	May '03

Key Phrases	Tech Tip Title	Issue #	Issue Date
Switching Currents : Average Current/Switch : RMS Current/Switch	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Switching Losses : Clamped, Inductive-Switching Mode : Device Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Switching Losses : IGBT & BIP : Turn-OFF : Snubber	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Switching Losses : MOSFET & IGBT : Miller Cap (Cgd) is NON-Linear	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Switching Losses : MOSFET & IGBT : ON/OFF/ON Gate Currents	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Switching Losses Higher due to TOP and BOTTOM PWM : 4-Quad	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Switch-OFF : Block All Volts @ Zero Current : Power Inverter IDEAL	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Switch-OFF : Blocks a Specific Range of Voltage : Power Inverter Specs	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Switch-OFF : Blocks Voltage Range @ Low Current : Power Inverter REAL	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Switch-ON : Pass All Currents @ Zero-Drop : Power Inverter IDEAL	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Switch-ON : Passes a Max Currents @ Finite-Drop : Power Inverter REAL	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Switch-ON : Passes a Specific Range of Current : Power Inverter Specs	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Sync Stator Current Pulses : Rotor Torque : Electronic Commutation	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
T(a) Max : Mean Time To Failure : Device Losses : Operating Efficiency	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Tachometer Calibration : Calibrate Tachometer	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
Tachometer Calibration : Single Chip BLDC	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Tachometer Detects Minimum (or Zero) Speed	BLDC Motor - Safe Direction Reversal	6	July '02
Tachometer Detects Minimum (or Zero) Speed	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Tachometer for Hitachi Single Chip BLDC	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Tachometer Freq : Hall Sensor signal : Number of Rotor Poles	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Tachometer Gain	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Tachometer Resolution : Doubling Tachometer Resolution	Single Chip Safe Direction Reversal and Tach Pulse	9	October '02
Tachometer Speed Signal	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Temp changes slowly due to Thermal Mass(Inertia)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Temp Drop = Watts x (Deg C)/Watt = Deg C : Voltage Drop = I x R = Volts	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Temp Drop = Watts x Thermal-R : Voltage Drop = Current x Electrical-R	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Temperature Variation : Motor Winding (Rm)	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Testing without Heatsinking : Rated Load Testing	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02
The Power Inverter	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Thermal Analysis of BLDC Bridge : Junction Operating Temp : Power Inverter	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Capacitance : Csa = 0.63 x (Measured Thermal Delay) / (3 x Rsa)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Capacitance : Transient Overloads Safely above Rated Power	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Capacity (Thermal Inertia) : Electrical Capacity (Farads)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Conduction : Electrical Conduction : Heat Flow : Current Flow	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Conductivity : Alum-Copper : Larger Area : Smaller Path Length : Rsa	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Grease : Rcs : Mounting Torque : Surface Preparation	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Grease : Thermal Resistance : Case-to-Sink : Rcs : Air Gaps	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Model of 3-Phase, 6-Transistor Power Inverter : 2-Quadrant	BLDC Motor Drive Power Stage Design - Part 4	14	May '03

Key Phrases	Tech Tip Title	Issue #	Issue Date
Thermal Model of 3-Phase, 6-Transistor Power Inverter : 4-Quadrant	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Resistance : Case-to-Sink : Rcs : Air Gaps : Thermal Grease	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Resistance : Junction-to-Case : Rjc : Package Type Choices	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Response of BLDC Bridge : Junction Oper Temp : Power Inverter	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Steady State BLDC Bridge : BLDC Bridge Thermal Steady State	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Steady State BLDC Bridge : Rjc x Cjc : Rcs x Ccs : Rsa x Csa	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Websites for Materials : Thermal Websites on Surface Effects : Rcs	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Websites on Heat Sink Radiation and Convection : Rsa	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal Websites on Surface Effects : Rcs : Thermal Websites for Materials	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Thermal-R : Electrical-R : Heat Flow (Watts) : Electrical Flow (Amps)	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
TO-2xx 3-Pin : DPAKx SMD : Modular Bridge/Inverters : Power Packaging	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
TOP & BOTTOM Arm PWM Chopping	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
TOP Arm Switches at Commutation Rate : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
TOP could be IGBTs : BOTTOM could be MOSFETs : 2-Quad	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
TOP Transistors Dissipate LESS Watts than BOTTOM Transistors : 2-Quad	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
TOP Watts = Watts(TOP) : BOTTOM Watts = Watts(BOT) : 2-Quad	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Torque & Rotation in the Same Direction	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Torque : Speed : Power (= Torque x Speed) : Energy Mechanical	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Torque Control : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Torque Control : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Torque Control by Peak Winding Current : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Torque Control Current Mode : Current Mode Torque Control	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Torque Control Loop : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Torque Control Loop Output Controls PWM Duty Cycle	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Torque Control Loop Subtracts Torque from External Torque Request	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Torque Control Simplicity : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Torque Control Stability : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Torque Control with (TOP Arm) Higher Efficiency : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Torque Direction Limited by TOP Arm Freewheel : 2-Quad	BLDC Motor - Safe Direction Reversal	6	July '02
Torque Loop Freq-Comp in the Velocity Loop : 2-Quadrant	Introduction to BLDC Motor Torque Control - Part 2	4	May '02
Torque Only in the Rotating Direction : 2-Quadrant	BLDC Motor - Safe Direction Reversal	6	July '02
Torque(s) : Motor : Load : Frictional : Damping	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Transient Overloads Safely above Rated Power : Thermal Capacitance	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Transistor and Diode Selection Guidelines : Power Inverter Components	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Transistor Watts = (Total Inverter Watts) / 6 : 4-Quad	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Transitions (ON/OFF/ON) : Device Loss States : OFF-State : ON-State	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Turn-OFF : Snubber : Switching Losses : IGBT & BIP	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Turn-OFF Switching Time INCREASES Turn-OFF Losses : Device Losses	BLDC Motor Drive Power Stage Design - Part 3	13	April '03

Key Phrases	Tech Tip Title	Issue #	Issue Date
Turn-OFF Switching Time vs Deep Saturation : IGBT & Bip Transistors	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Under Voltage BUS Lock Out	BLDC Power BUS Under/Over Voltage Protection	7	August '02
UVLO (Threshold) Mismatch across all 3-Phases	BLDC Power BUS Under/Over Voltage Protection	7	August '02
UVLO / OVLO : Circuit Example	BLDC Power BUS Under/Over Voltage Protection	7	August '02
UVLO / OVLO : Soft-Start ReStarts Motor	BLDC Power BUS Under/Over Voltage Protection	7	August '02
UVLO Inhibits Power Inverter	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Variable Frequency : BLDC Drive : Multi-Phase : Variable Voltage	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Variable Voltage : Variable Frequency : BLDC Drive : Multi-Phase	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Velocity Control Loop : 4-Quadrant	Introduction to BLDC Motor Torque Control - Part 1	3	April '02
Velocity/Voltage Control Loops	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Voltage (Speed) Control : 2-Quadrant	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Voltage : Power (= Current x Voltage) : Energy Electrical : Current	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Voltage and Current : Input Electrical Power : BLDC Input	BLDC Motor Drive Power Stage Design - Part 2	12	March '03
Voltage Drop = Current x Electrical-R : Temp Drop = Watts x Thermal-R	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Voltage Drop = I x R = Volts : Temp Drop = Watts x (Deg C)/Watt = Deg C	BLDC Motor Drive Power Stage Design - Part 4	14	May '03
Voltage Level of Isolation	BLDC Command Signal Isolation	8	September '02
Voltage Mode Speed Control : Speed Control Voltage Mode	BLDC Motor Drive Power Stage Design - Part 1	11	February '03
Voltage(0.6 to 0.75) : Current(0.33 to 0.5) : Derating : Built-In Design Margin	BLDC Motor Drive Power Stage Design - Part 3	13	April '03
Winding Inductance	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
Winding Resistance	Introduction to BLDC Motor Torque Control - Part 3	5	June '02
WYE or DELTA Load Bank : Motorless Testing	Emulating 3-Phase Hall Signals for BLDC Testing	10	November '02

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For additional information and/or support, contact Rick Tonis, Sales Manager, (248) 203-6770

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