MPQ6653-AEC1/MP6653

35V/32V Single-Phase BLDC Motor Driver with Integrated MOSFETs and Hall Sensor

July 2024

MPQ6653-AEC1/MP6653 – Target Applications

- **Automotive Seat Fans**
- **Cooling Fans**
- **Blowers**



Automotive Seat Fans



Cooling Fans



Blowers

Why Use These Parts?

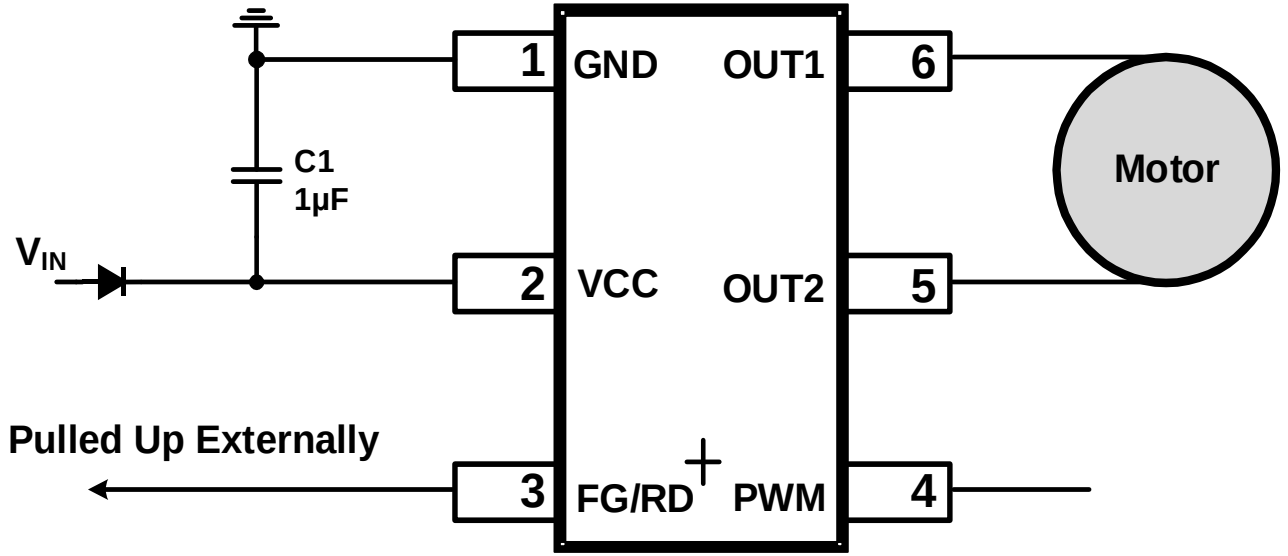
It’s Simple and Easy!

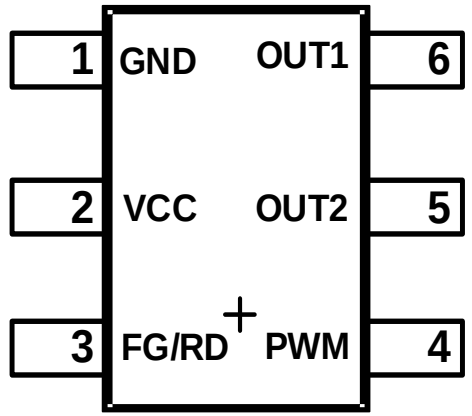
- Wide 5.5V to 35V (MPQ6653-AEC1) or 5.5V to 32V (MP6653) Input Voltage (V_{IN}) Range, Support 12V/24V Applications
- As Low As 960mΩ On Resistance ($R_{DS(ON)}$) (HS-FET + LS-FET)
- Embedded, High-Sensitivity Hall Sensor
- Supports 50Hz to 100kHz Pulse-Width Modulation (PWM) Input Frequency or DC Input
- Fixed 24kHz Output Frequency
- Supports Open-Loop or Closed-Loop Speed Control and Curve Configuration
- Available in a TSOT23-6 (2mmx3mm) Package

MPQ6653-AEC1/MP6653 – 35V/32V, Single-Phase BLDC Motor Driver

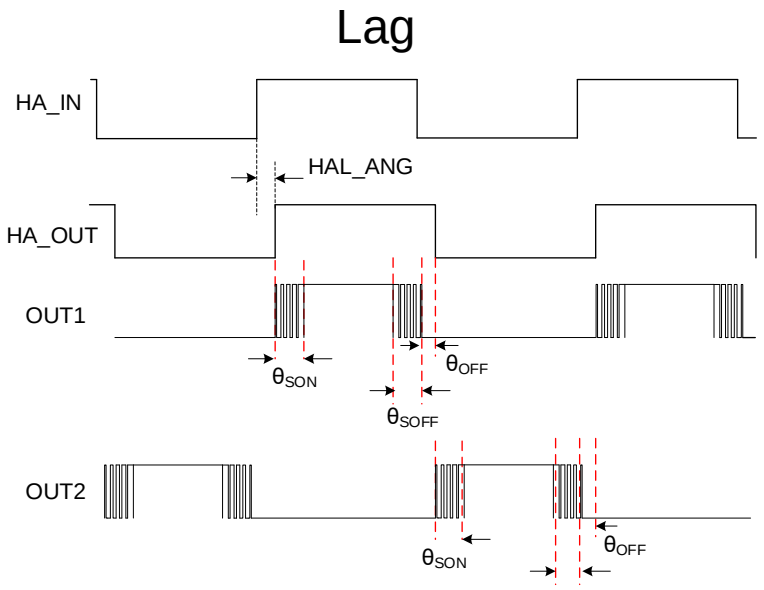
FEATURES

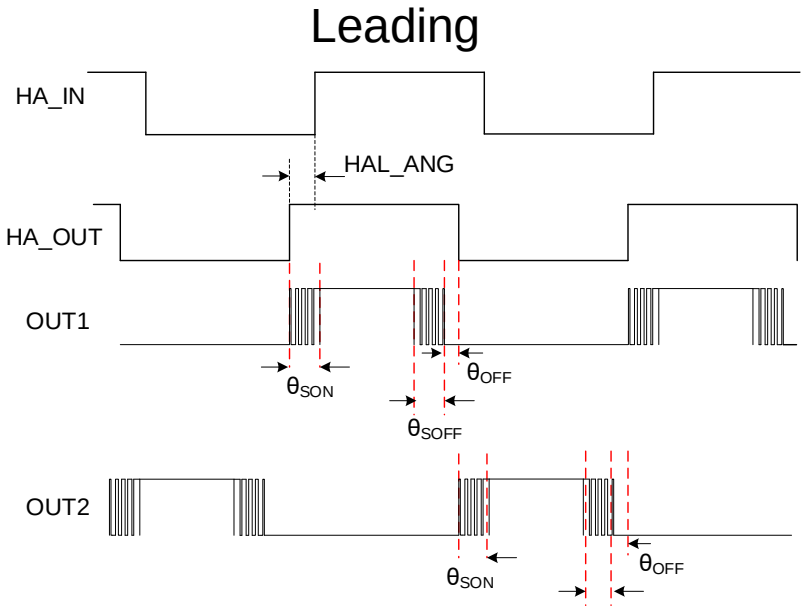
- 5.5V to 35V/32V V_{IN}, Up to 1.2A Configurable Current Limit
- On-Chip Hall Sensor
- MOSFET On Resistance: HS-FET + LS-FET = 960mΩ
- Configurable Speed Curve (4 Points) and Soft Acceleration Time
- Starting Duty Set with Hysteresis
- Selectable Open-Loop or Closed-Loop Speed Control
- Power saving mode((IST TYP = 75uA)
- Selectable FG and RD Output
- Configurable Soft-On/Off Commutation Angle (Max 90°)
- Configurable Hall Offset Angle, Lag/Leading
- Supports 50Hz to 100kHz PWM Input Frequency or DC Input
- Fixed 24kHz Output Switching Frequency
- One-Time Programmable (OTP) Memory for Spec Setting
- Locked Rotor Protection and Automatic Recovery
- SCP, OVP, UVLO, OCP, OTP, and Automatic Recovery
- Available in a TSOT23-6 (2mmx3mm) Package





MPQ6653-AEC1/MP6653 – Soft Commutation and Hall Offset Angle





HAL_ANG: Hall Offset Angle Leading/Lag Original Hall Signal

θ_{SON}: Soft-On Angle, Duty Increases to the Target Following the Sine Wave

θ_{SOFF}: Soft-Off angle, Duty Drops from the Target to 0 Following the Sine Wave

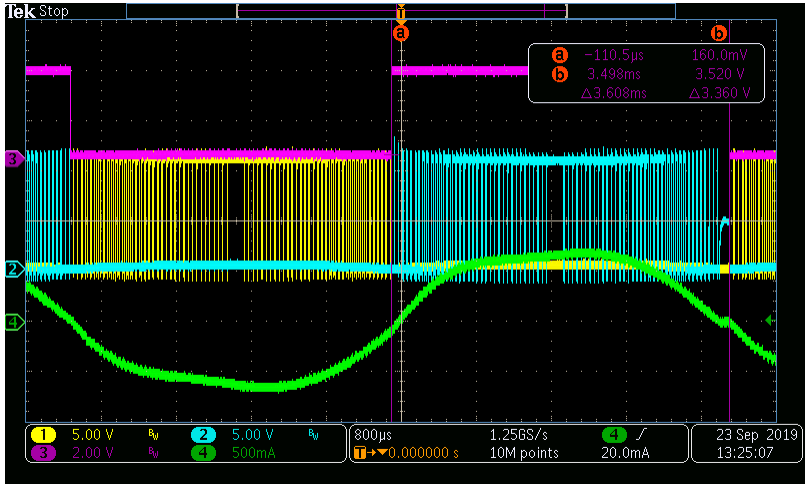
θ_{OFF}: Auto-Off Section Angle, Adjustment Based on Zero-Current Detection (ZCD) to Improve Efficiency

Benefits:

- Hall Offset Angle: Flexible for PCB Layout, Helps Optimize Efficiency
- Soft Commutation: Low Noise, No Vibration
- Auto-Off Section Angle Adjustment: Eliminates Reverse Current, Improves Efficiency

MPQ6653-AEC1/MP6653 – Soft Commutation

Soft-On/Off Angle = 90°



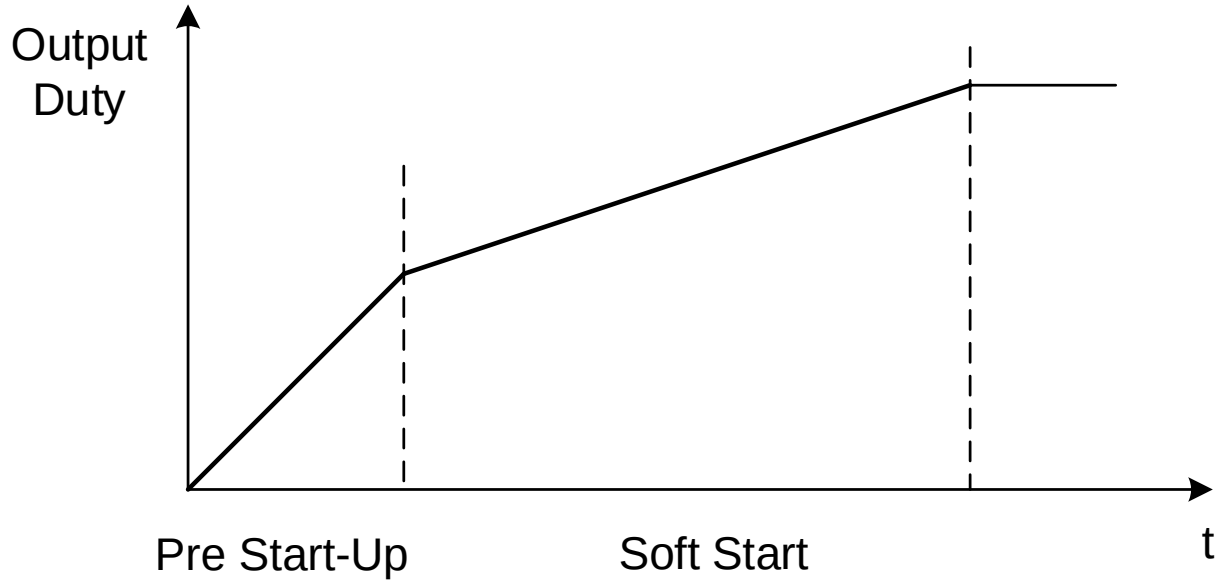
Soft-On/Off Angle = 45°



Benefits:

- Configurable Soft Commutation, Up to 90°, Lower Noise
- Larger Commutation Angle, Lower Speed and Improved Noise Performance

MPQ6653-AEC1/MP6653 – Soft Start-Up and Soft Transition

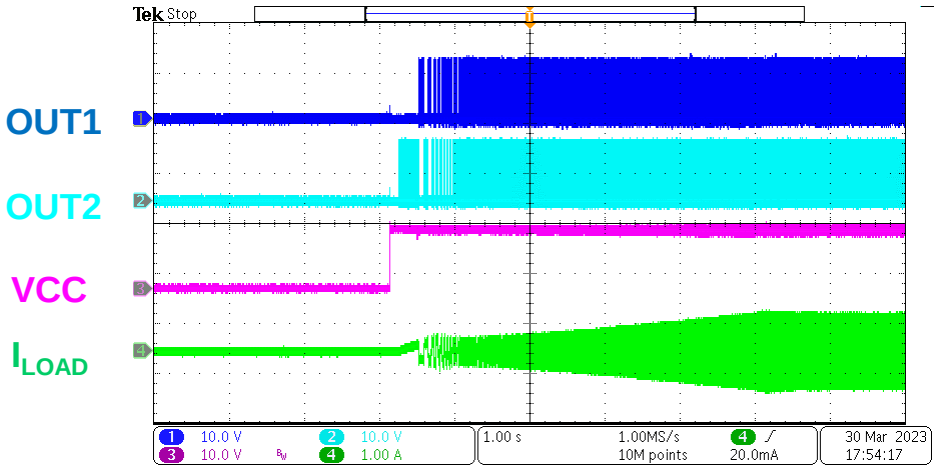


Start-Up Is Divided into Two Stages:

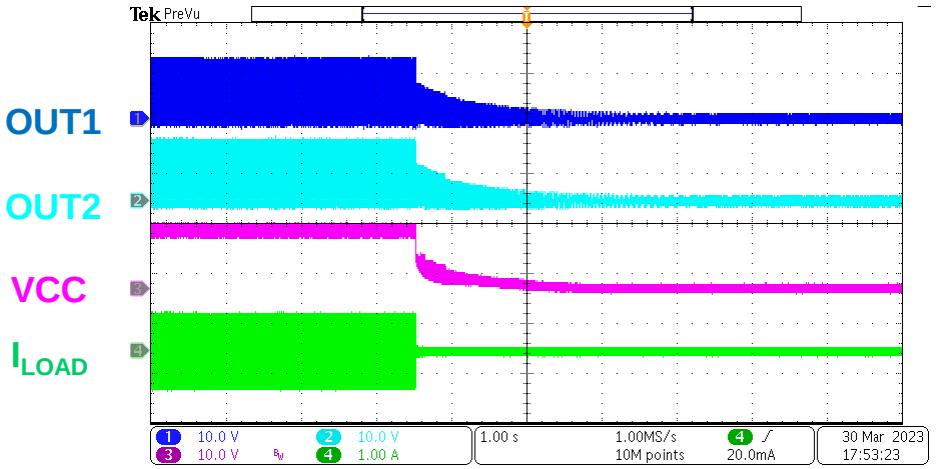
- Pre Start-Up: The output duty increases step by step by ignoring the target output duty cycle to ensure a robust start-up. The step time is set by a pre start-up timer.
- Soft Start (SS): The output duty increases/decreases to the target output duty cycle to ensure a smooth start-up. The timer is set by the soft-start time (t_{SS}).

MPQ6653-AEC1/MP6653 – VCC Voltage Suppression

V_{CC} No Spike Start-Up



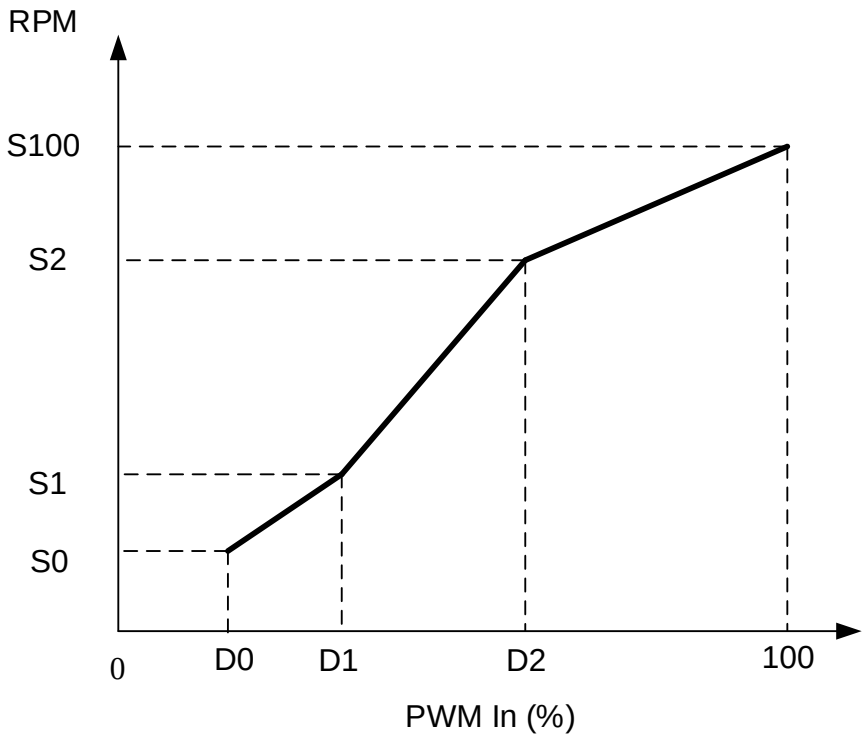
V_{CC} No Spike Shutdown

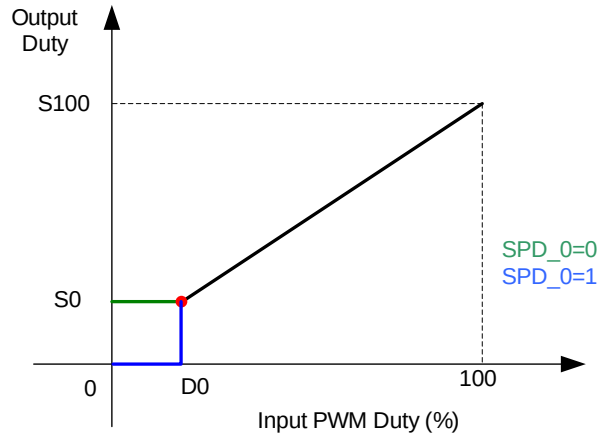


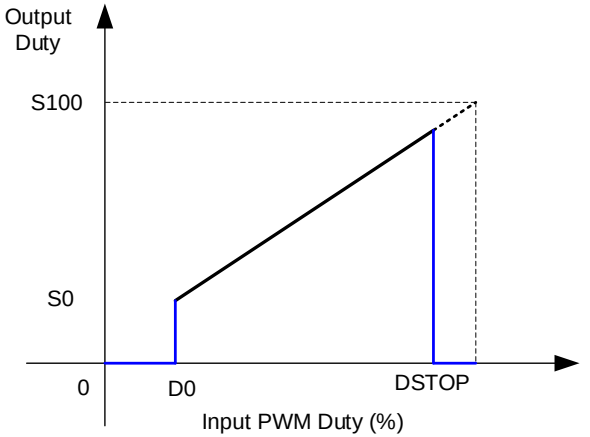
Benefits：

- No V_{CC} Spike Observed during Start-Up or Shutdown
- Load Current Increases Smoothly during Start-Up

MPQ6653-AEC1/MP6653 – Curve Configuration



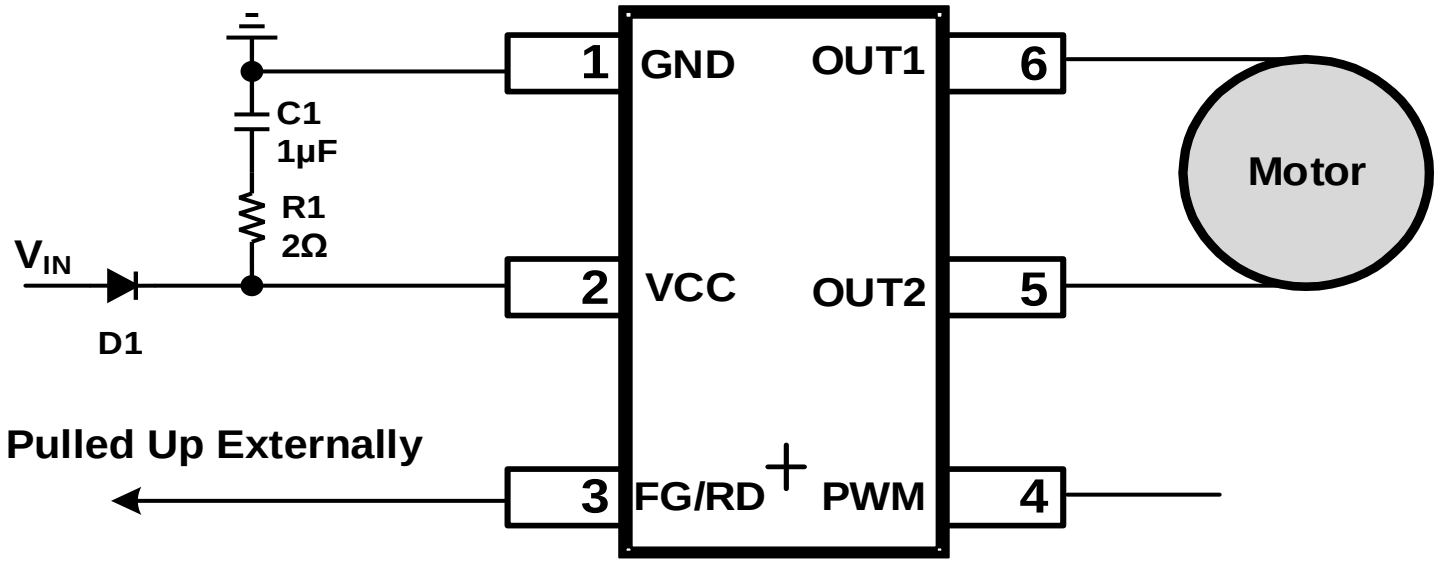




- D0: Sets the Starting Duty Cycle with a 1.2% Hysteresis
- S0, S1, and S2: Sets the Output Duty (Open-Loop) and Speed (Closed-Loop) when the Input Duty Cycle is D0, D1, and D2
- S100: Sets the Output Duty Cycle (Open-Loop) and Speed (Closed-Loop) when the Input Duty Cycle Is 100%
- Keeps Minimum Speed or Stops when the Input Duty Cycle Is Below the Starting Duty Cycle
- Stops when the Input Duty Cycle Exceeds DSTOP

MPQ6653-AEC1/MP6653 – Application Circuit Guide

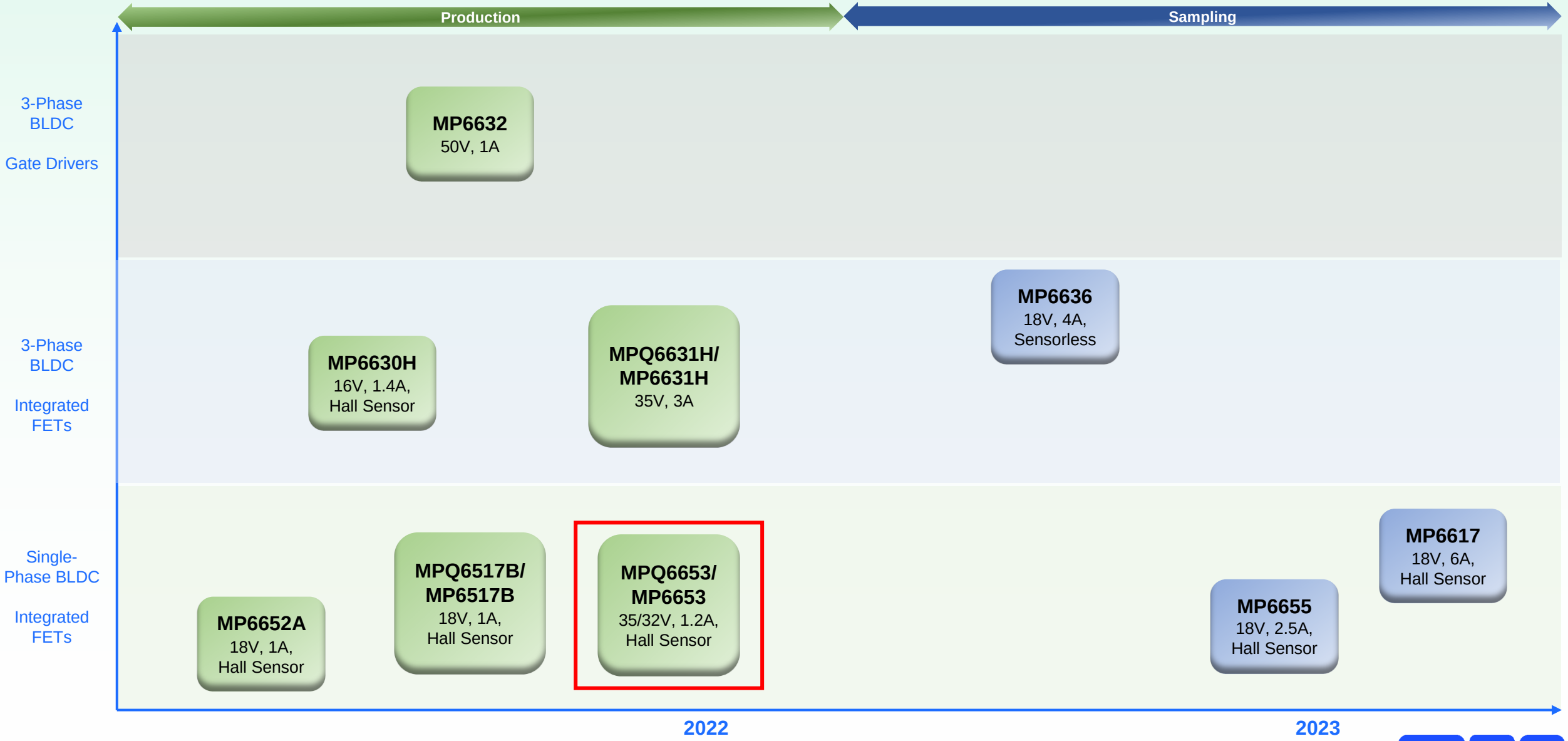
- C1: ≥1μF, Place Close to the VCC Pin
- 2Ω Snubber Is Recommended for 24V Applications
- FG/RD: Open-Drain, Must Be Pulled Up Externally
- PWM: Pulled Up Internally; Float or Apply PWM Input Signal
- Reverse Block Diode Is Required



Motor Driver with Algorithm Solutions

→ Home page

MP: Consumer Grade
MPQ: AEC-Q100 Grade



CUSTOMER USE ONLY

Single-Phase BLDC with Algorithm Solutions Key Features

Home page

Production
Sampling



MP6652A
3V to 18V, 1A Peak

- HS-FET + LS-FET = 850mΩ
- On-Chip Hall Sensor
- Configurable Speed Curve (8 Points)
- Configurable Starting Duty Cycle
- Selectable FG and RD Outputs
- Soft-On/Off Phase Commutation (Max 90°)
- Configurable Soft Start
- 1kHz to 100kHz f_{PWM} Input
- Fixed 27kHz f_{SW} Output
- OTP Memory for Spec Setting
- TSOT23-6

MPQ6517B/6517B
3.3V to 16V, 2A Peak

- HS-FET + LS-FET = 850mΩ
- On-Chip Hall sensor
- Configurable Speed Curve
- Configurable Starting Duty Cycle
- Selectable FG and RD Outputs
- Soft-On/Off Phase Commutation (Max 45°)
- Configurable Soft Start
- 12kHz to 48kHz f_{PWM} Input
- Fixed 26kHz f_{SW} Output
- OTP Memory for Spec Setting
- TSOT23-6

MPQ6653/MP6653
5.5V to 35/32V, 1.2A Peak

- HS-FET + LS-FET = 960mΩ
- On-Chip Hall Sensor
- Closed/Open-Loop Speed Control
- Configurable Speed Curve (5 Points)
- Configurable Starting Duty Cycle
- Selectable FG and RD Outputs
- Soft-On/Off Phase Commutation (Max 90°)
- Configurable Soft Start
- 50Hz to 100kHz f_{PWM} Input
- DC input
- Fixed 27kHz f_{SW} Output
- OTP Memory for Spec Setting
- TSOT23-6
- TSOT23-6-L
- TSOT23-6-SL

MP6616
3.3V to 32V, 4A Peak

- HS-FET + LS-FET = 100mΩ
- On-Chip Hall Sensor
- Closed/Open-Loop Speed Control
- Configurable Speed Curve
- Configurable Starting Duty Cycle
- Selectable FG and RD Outputs
- Soft-On/Off Phase Commutation (Max 45°)
- Configurable Soft Start
- 1kHz to 100kHz f_{PWM} Input
- Fixed 27kHz f_{SW} Output
- OTP Memory for Spec Setting
- QFN-10 (2x3)
- SOIC-8 SL
- Version: 6551 (SOIC-8 SL) Package

MP6655
3.3V to 18V, 2.5A Peak

- HS-FET + LS-FET = 350mΩ
- On-Chip Hall Sensor
- Closed/Open-Loop Speed Control
- Configurable Speed Curve (5 Points)
- Selectable FG and RD Outputs
- Configurable Soft Acceleration Time
- I_{ST} ≤ 50μA
- 60Hz to 100kHz f_{PWM} Input
- Fixed 27kHz f_{SW} Output
- OTP Memory for Spec Setting
- TSOT23-6

MP6617
3.3V to 18V, 6A Peak

- HS-FET + LS-FET = 350mΩ
- On-Chip Hall Sensor
- Closed/Open-Loop Speed Control
- Configurable Speed Curve (5 Points)
- Selectable FG and RD Outputs
- Configurable Soft Acceleration Time
- I_{ST} ≤ 50μA
- 60Hz to 100kHz f_{PWM} Input
- Fixed 27kHz f_{SW} Output
- OTP Memory for Spec Setting
- QFN10 (2.5x3)

CUSTOMER USE ONLY