INTELLIGENT PHASE CONTROL
Eliminates The Phase Shift

Toshiba has developed Intelligent Phase Control technology (InPAC), the latest Toshiba control technology, that automatically adjusts phases of motor voltage and motor current. Using automatic phase adjustment, the optimal efficiency is achieved simply by initial setting in the used rotation range. The adjustment burden for optimization is reduced, which normally incurs at every rotation speed with the conventional technology. Accordingly customers’ development time can be shortened.

APPLICATIONS

- Cooling fans for servers and industrial motors
- Fans for home appliances (air cleaners, hot water supply machines, ventilation fans, electrical fans)

FEATURES

- Auto lead angle control
- Sine-wave drive

ADVANTAGES

- Automatically adjusting brushless motors’ current and voltage phases by comparing them
- Eliminating consumption current generated from the phase difference that depends on the rotation speed and the current value
- Smooth current waveform

BENEFITS

- Eliminating adjustment and evaluation
- Achieving highly efficient drive
- Contributing to motor-operation noise and vibration lower than for square-wave drive

PRODUCT LINEUP

<table>
<thead>
<tr>
<th>Product number</th>
<th>Supply voltage range</th>
<th>Output current</th>
<th>Drive method</th>
<th>Package</th>
<th>Other features</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC78B016FTG</td>
<td>6~30 V</td>
<td>3 A</td>
<td>Sine-wave drive</td>
<td>WQFN36 (5x5mm)</td>
<td>Auto lead angle (voltage and current: optimized phase control) Support for Hall devices and Hall ICs Speed control inputs: PWM inputs or analog voltage inputs Abnormal detection functions: Thermal shutdown, overcurrent detection, motor lock detection</td>
</tr>
</tbody>
</table>
**ADVANTAGE: Realizing highly efficient drive automatically adjusting current and voltage phases**

A conventional brushless DC motor driver feeds back and controls the rotor position by Hall signal. Phase difference is generated between motor voltage and motor current since motor speed changes because of motor impedance etc. Phase difference decreases driving efficiency. Adjustment is required to eliminate the difference and increase the efficiency.

Toshiba’s InPAC technology compares phase of motor current (current information) and phase of motor voltage (Hall signal). And the result is fed back to motor current control (control signal). Phase difference between motor voltage and motor current is adjusted automatically. This is the optimal system for achieving highly efficient drive.

**ADVANTAGE: Reducing development burden**

With conventional technology, repeated adjustments of differences between motor voltage and motor current for optimization are required in the rotation range to achieve the optimal efficient characteristics. Therefore, customers have been burdened with a complicated development process. Toshiba’s InPAC technology allows optimization throughout the rotation range simply by initial setting because phase difference between motor voltage and motor current is adjusted automatically. It reduces customers’ development burdens.

- **Conventional**
  - Adjusting phase difference
  - Repeated adjustment at each point for optimization

- **NEW InPAC**
  - Optimization through automatic phase difference adjustment simply by initial setting
  - Auto-adjustment
  - Efficiency confirmation
  - InPAC Lowest power consumption is achieved!!

<table>
<thead>
<tr>
<th>Connect IC to motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set rotation speed</td>
</tr>
<tr>
<td>Adjust lead angle</td>
</tr>
<tr>
<td>Adjust rotation speed</td>
</tr>
<tr>
<td>Adjustment at one point completed</td>
</tr>
<tr>
<td>Construct auto-lead angle circuit</td>
</tr>
<tr>
<td>Efficiency confirmation</td>
</tr>
<tr>
<td>Completed</td>
</tr>
</tbody>
</table>

- Low except at adjusted point
- Necessary many times

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<tr>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimized automatically</td>
</tr>
<tr>
<td>Unnecessary</td>
</tr>
</tbody>
</table>

**With conventional technology,**

- Set rotation speed
- Adjust lead angle
- Adjust rotation speed
- Adjustment at one point completed
- Construct auto-lead angle circuit
- Efficiency confirmation
- Completed

**InPAC**

- Low except at adjusted point
- Necessary many times

- Optimized automatically
- Unnecessary

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