

**MPS BLDC Solution w/ High Efficiency & Accuracy  
Controller and Position Sensor**

**Hongqiang Qin**

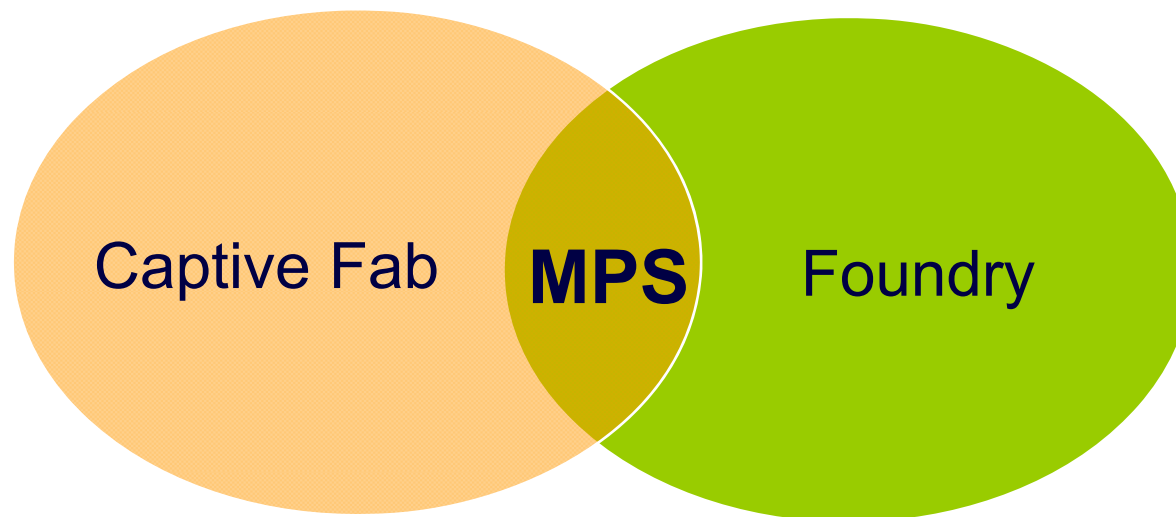
**2016.4.3**

**MPS Confidential – Don't Distribute**

## Leading BCD Process

### Superior Performance:

- Monolithic
- Higher Operating Voltage
- Superior Power Density
- High CP Solution



Stepper



Single-Phase



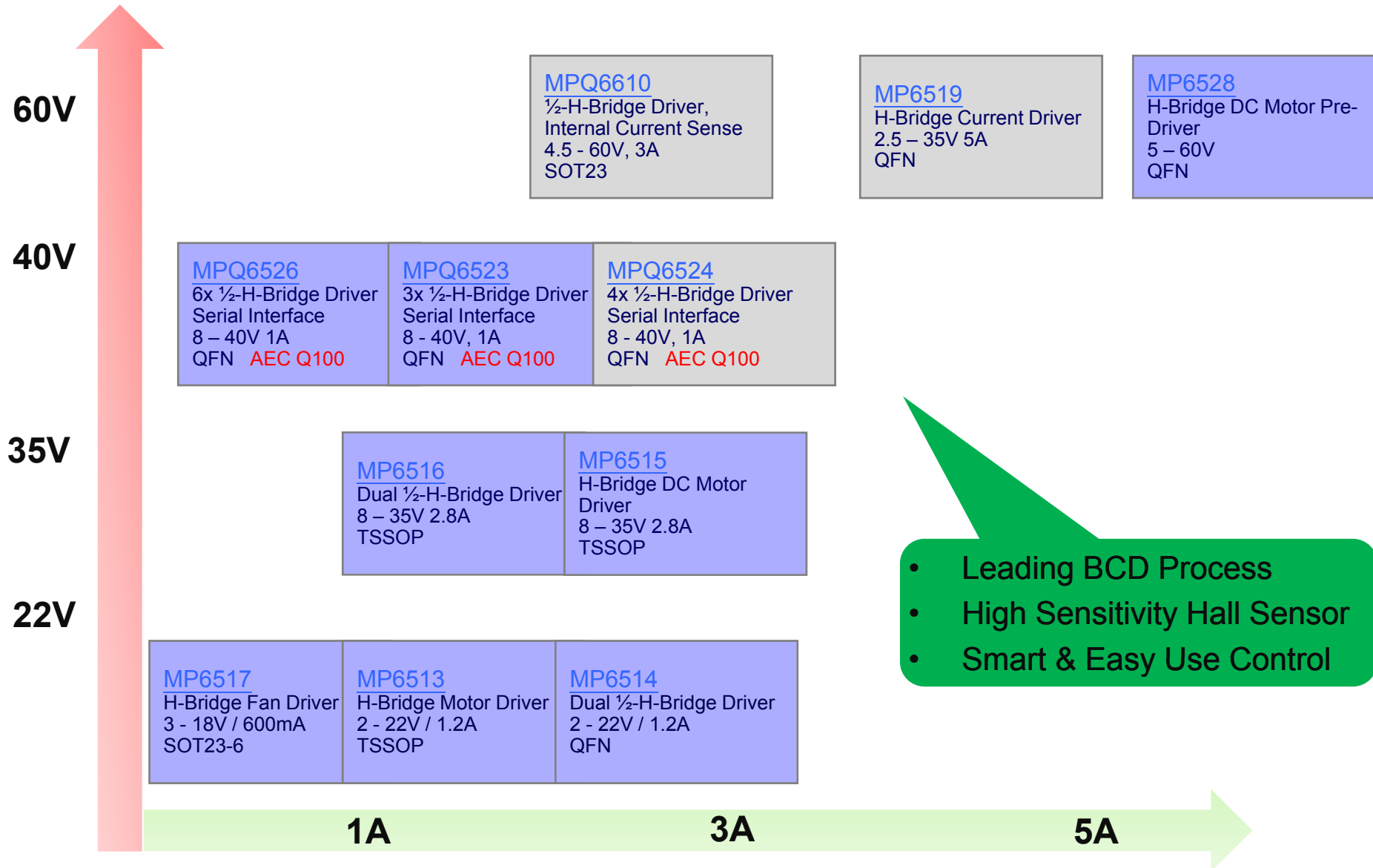
3-Phase



- Single Phase BLDC Solution
- 3-Phase BLDC & PMSM Solution
- MPS High Accuracy Position Sensor
- Robot Ball-Tossing Demo w/ MPS solution

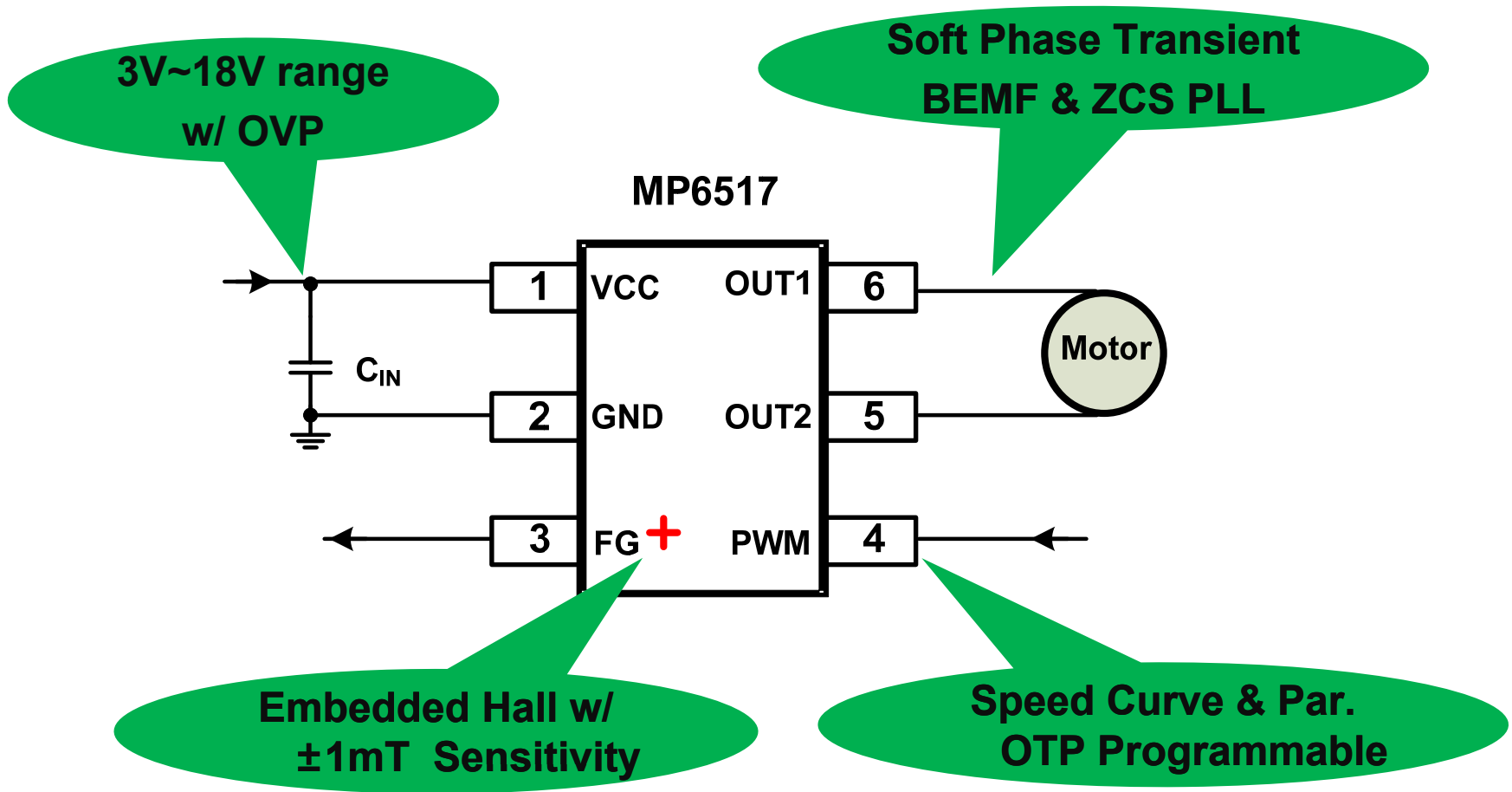


# Single Phase BLDC Solution



- Leading BCD Process
- High Sensitivity Hall Sensor
- Smart & Easy Use Control

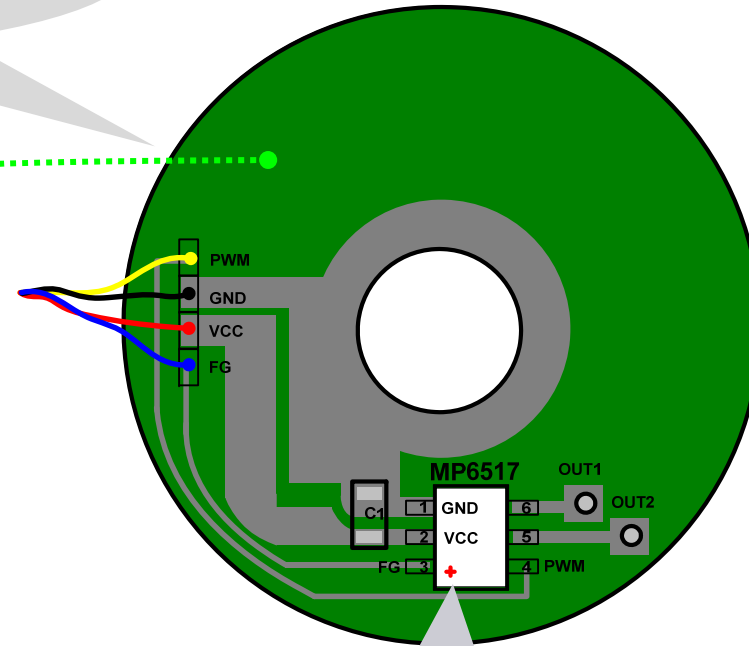
- Smart & Easy Use Digital Controller for Fan Driver





# Single Phase BLDC Solution

1ps 1uF/0603 cap!  
Up to 600mA@single-layer!



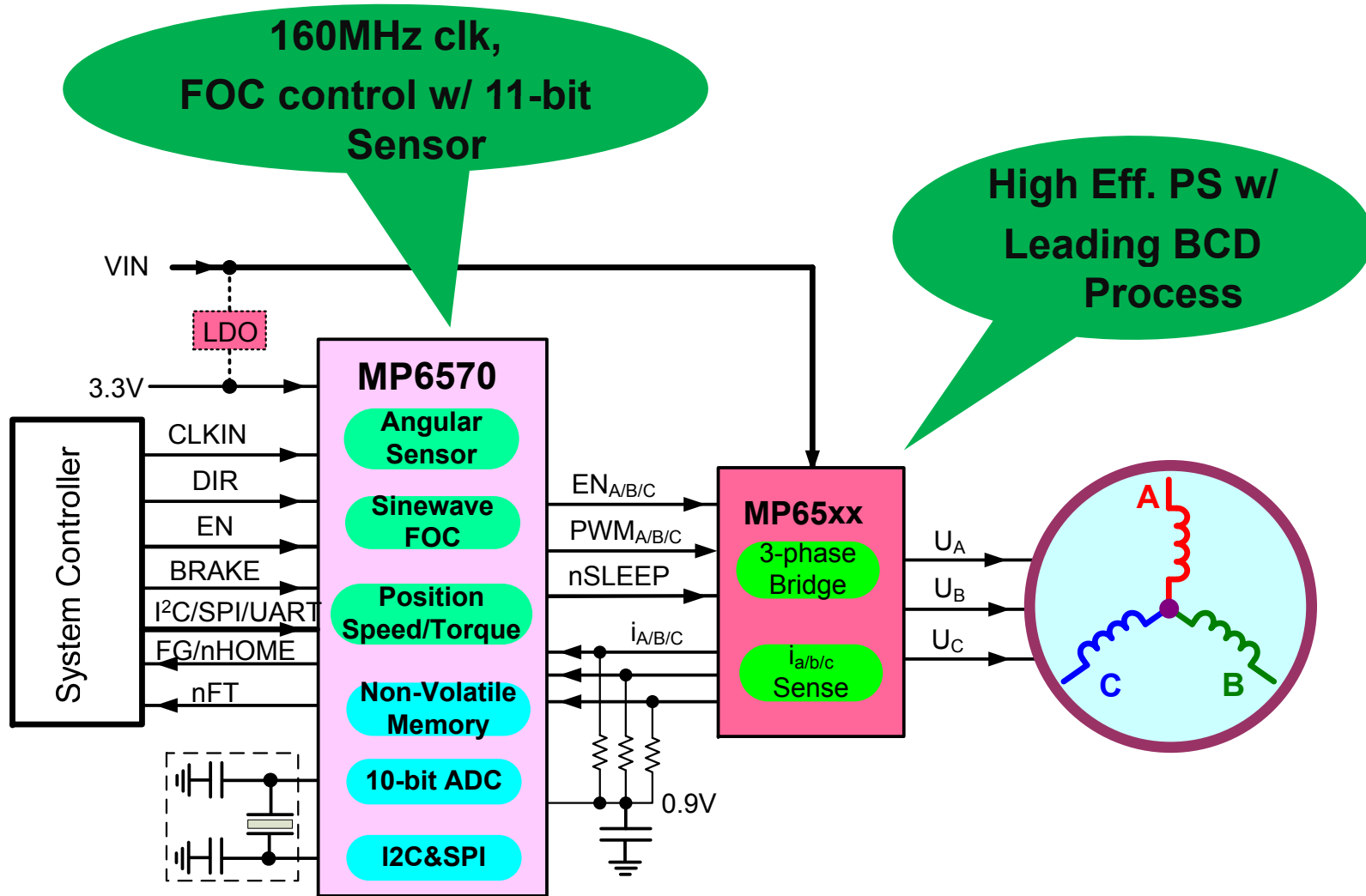
Straight Lead TSOT23-6



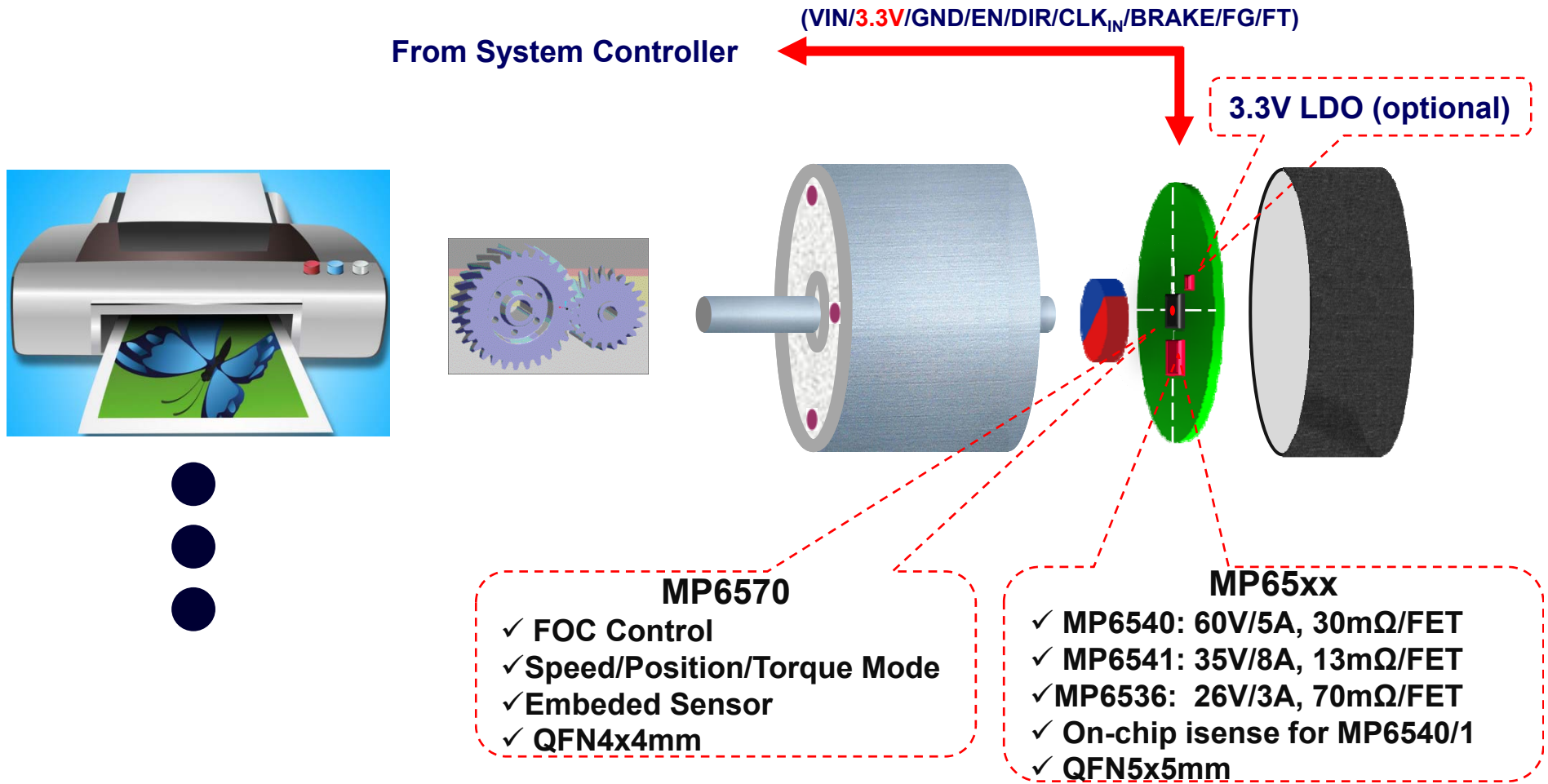
Rotor Magnet

- Single Phase BLDC Solution
- 3-Phase BLDC & PMSM Solution
- MPS High Accuracy Position Sensor
- Robot Ball-Tossing Demo w/ MPS solution





# 3-Phase BLDC Solution





## 3-Phase BLDC Solution

### ◆ MP6570 : Parameters programmable with non-volatile memory

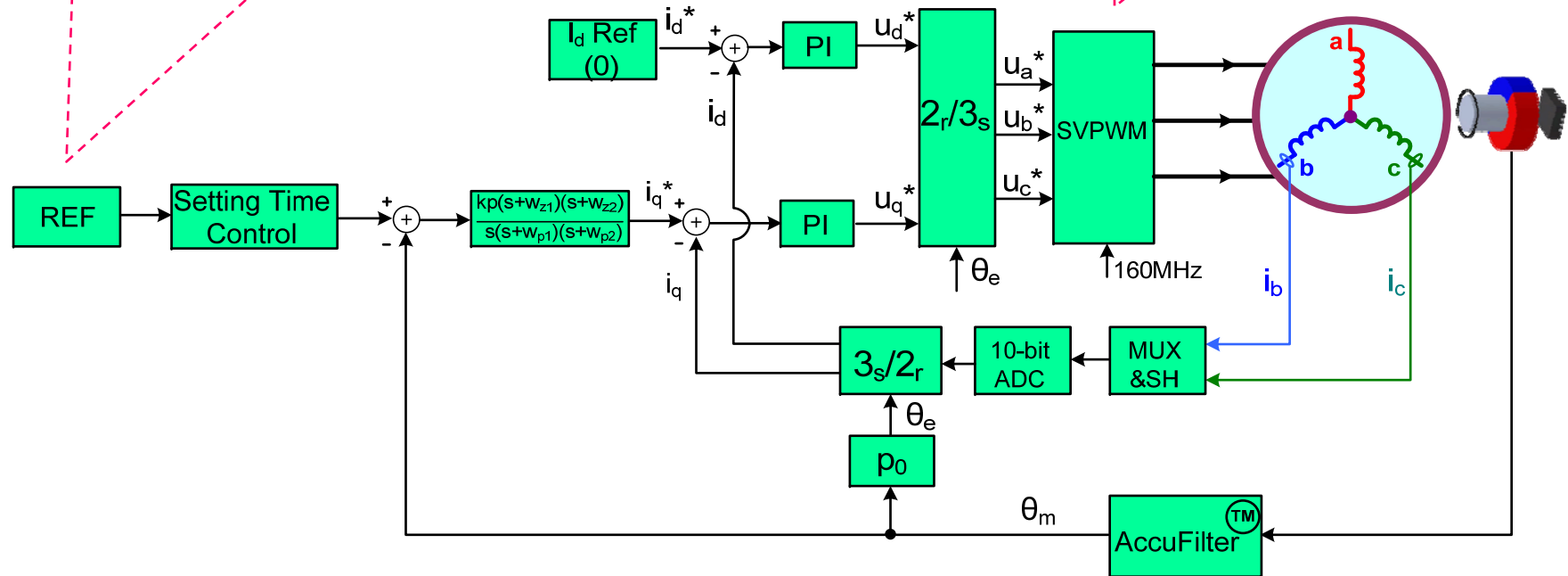
| Motor                                | Control   | Protection                           |
|--------------------------------------|---|--------------------------------------|
| $L_d$ : d axis inductance            | <b>mode</b> : Position/Speed/Torque select        | <b>locp</b> : current limit          |
| $L_q$ : q axis inductance            | $k_{p_i}, k_{i_i}$ : torque loop spec             | $t_{dec}/t_{lock}$ : lock timer      |
| $\psi_r$ : rotor flux                | $k_{p_w}, k_{i_w}$ : speed/position loop spec     | $t_{dec}$ : lock detection time      |
| $p_0$ : stator pole-pair             | <b>period</b> : switching frequency               | <b>brk_iq</b> : brake current        |
| <b>spd_min</b> : min. speed          | <b>pos_step/spd_step</b> : ref slope              | $lin_{max}/Vin_{max}$ : max. Vin/lin |
| <b>speed_cmd</b> : speed ref         | <b>com_mod</b> : interface select                 | $t_{retry}$ : Fault retry timer      |
| <b>theta_cmd</b> : position ref      | <b>exang</b> : sensor source select               | $I_{max}$ : max. torque current      |
| $I_d_{ref}/I_q_{ref}$ : torque ref   | <b>ad_mod/ad_gain</b> : AD control                | <b>brk_mod</b> : brake mode          |
| <b>theta_bias</b> : initial position | <b>bct/kalman/resolution</b> : sensor filter ctr. |                                      |
|                                      | <b>data_comp</b> : Accufilter 32 data set         |                                      |
|                                      | <b>pwm_mod</b> : PWM output mode                  |                                      |
|                                      | <b>sam_mod</b> : 1/2/3 phase current ctr.         |                                      |



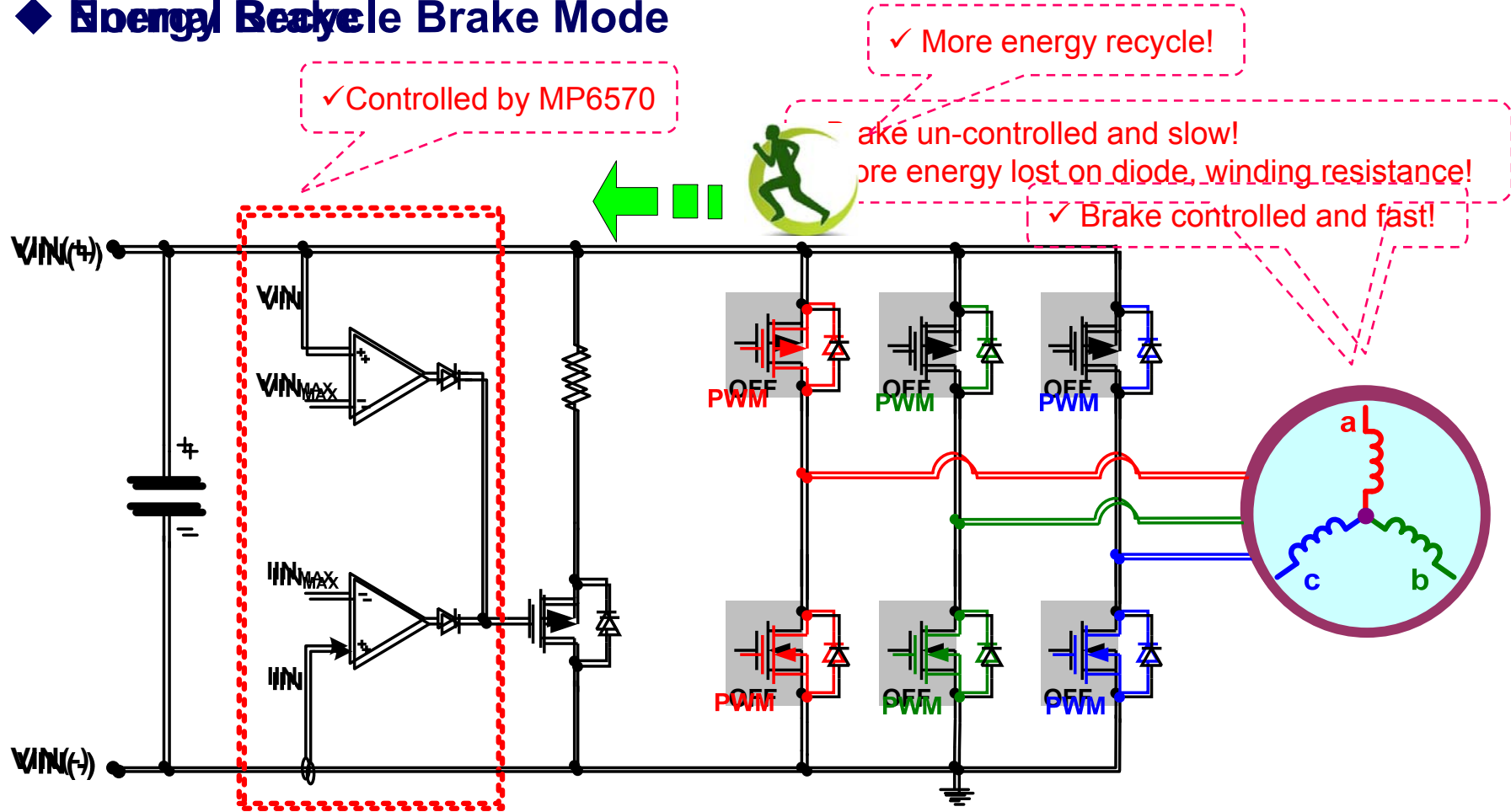
# 3-Phase BLDC Solution

- Position Mode:  $\pm 0.2^\circ$  res., up to @31 rounds
- Speed Mode: 20-50000 rpm,  $\pm 0.1\%$  Accuracy
- Torque Mode: 10-bit res. current

160M clk, 12-bit PWM res. @20kHz



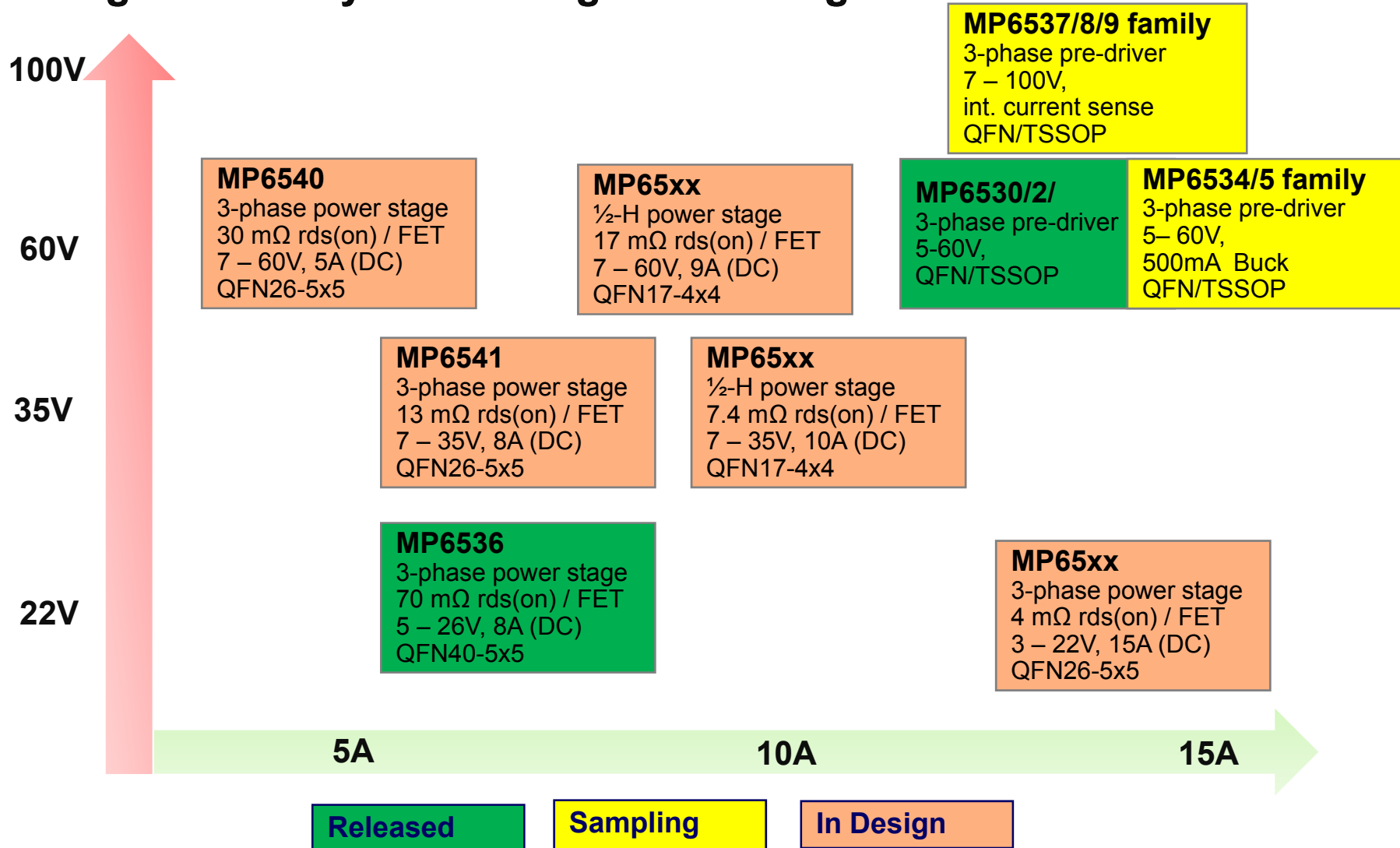
### ◆ Energy Recycle Brake Mode



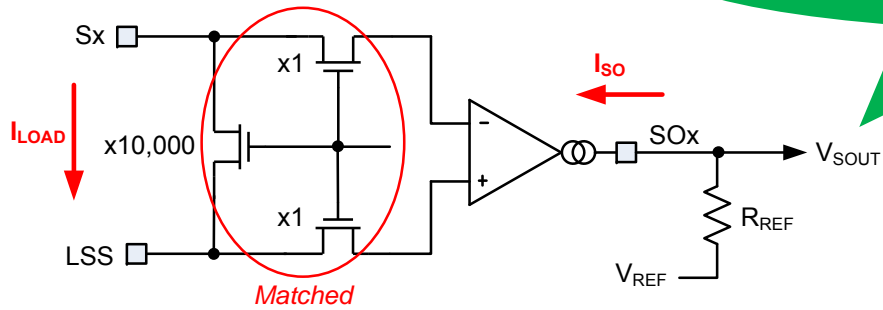


# 3-Phase BLDC Solution

- High Efficiency Power Stage w/ Leading BCD Process



# 3-Phase BLDC Solution

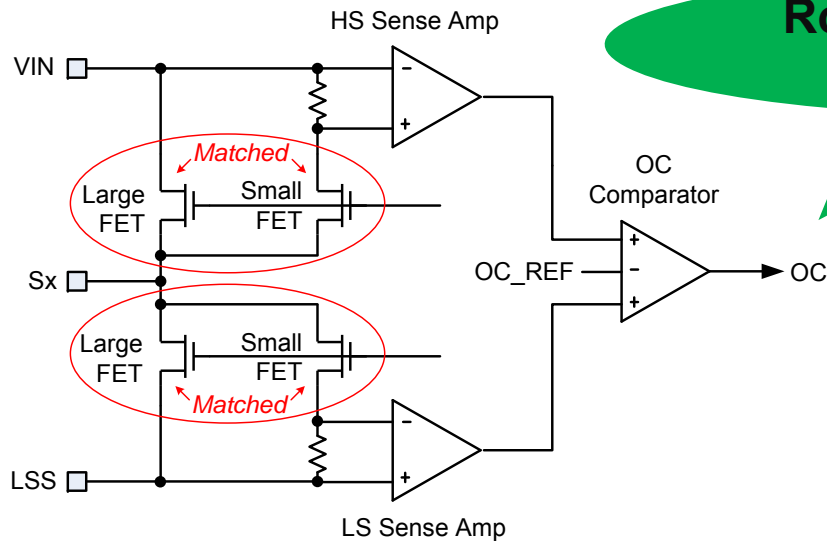


**Accurate Current Sense w/ phase LSMOS**

$$I_{SO} = I_{LOAD} / 10,000$$

$$V_{SO} = V_{REF} + (I_{SO} * R_{REF})$$

$$= V_{REF} + ((I_{LOAD} * R_{REF}) / 10,000)$$

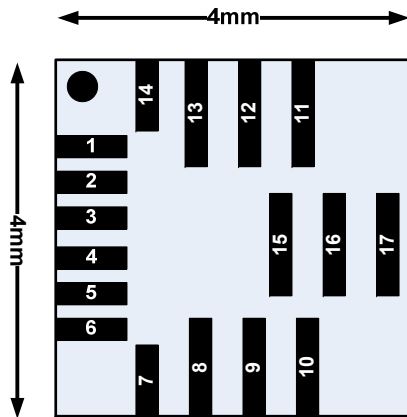


**Robust OCP w/ Each MOS**

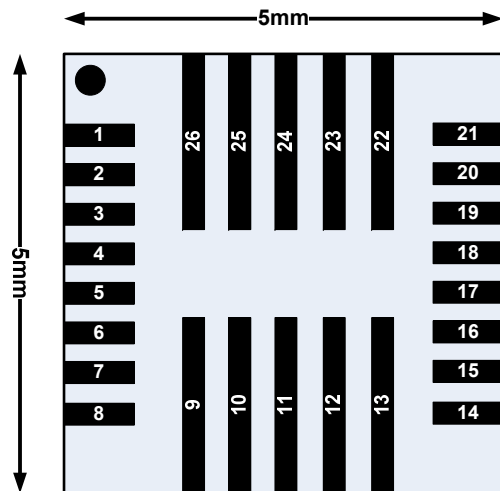


# 3-Phase BLDC Solution

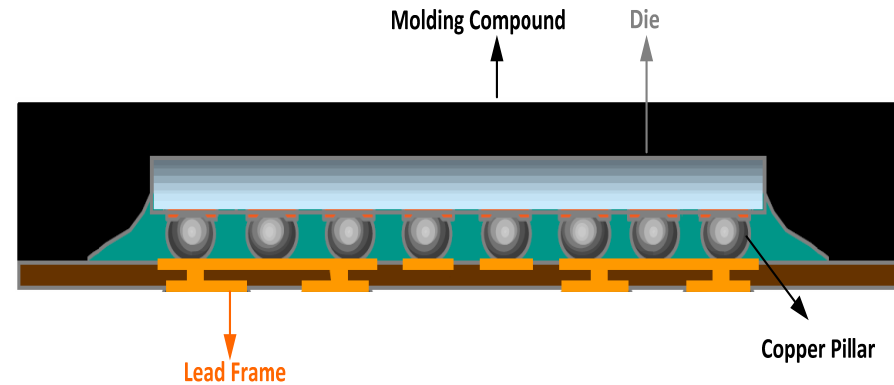
1/2-H: 17 pads, 4mm x 4mm,  
2.8 Watts @ 25°C



3-phase: 26 pads, 5mm x 5mm,  
3.5 Watts @ 25°C



## Mesh Connect™ (No Wire Bond)



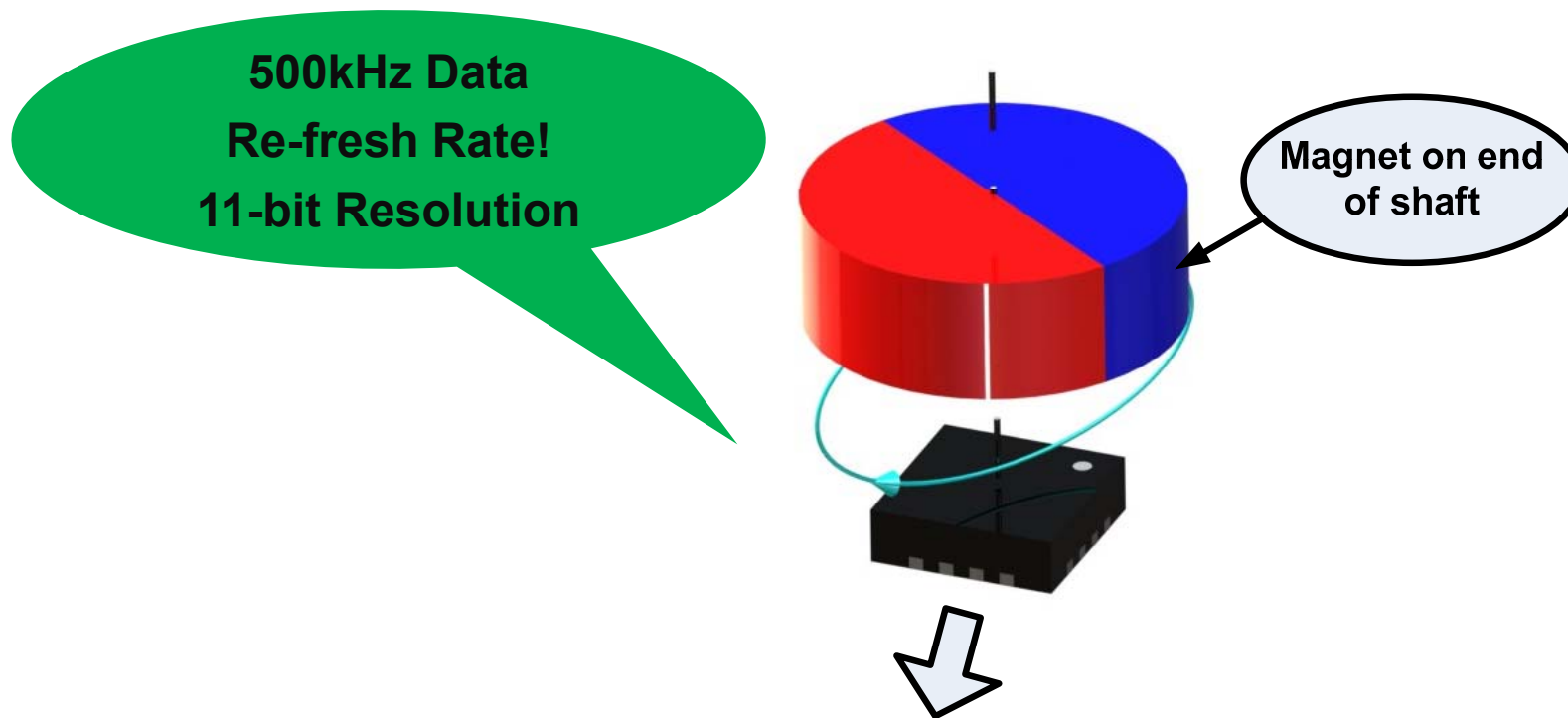
### • Advantages over standard packages:

- Very low parasitic resistance
- Very low inductance
- Reduced thermal resistance
- Small size
- Low cost



- Single Phase BLDC Solution
- 3-Phase BLDC & PMSM Solution
- **MPS High Accuracy Position Sensor**
- Robot Ball-Tossing Demo w/ MPS solution

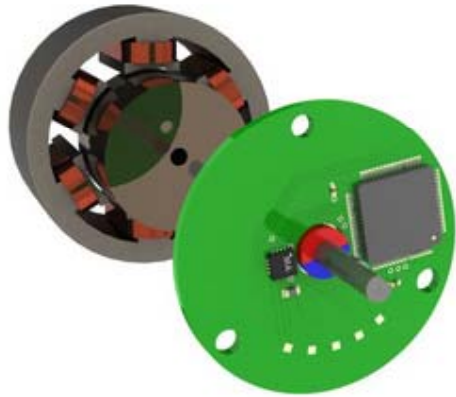
- **What is MPS Magnetic Angel Sensor?**



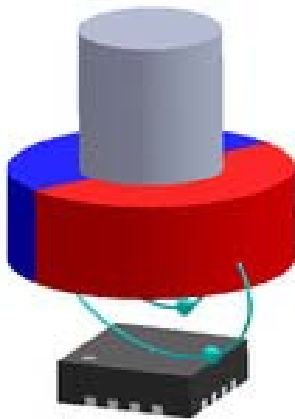
**Angle information:**

- U, V, W like Hall sensors
- A, B, Z like optical encoder
- SPI readout

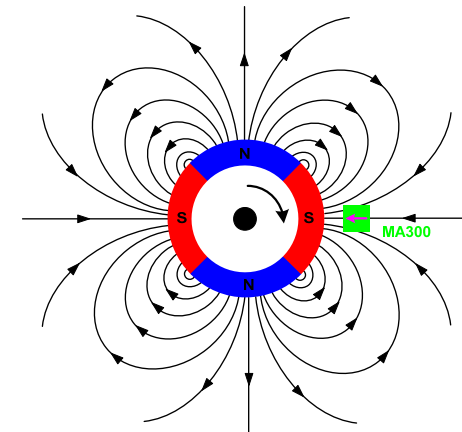
- **Direct Sensing Rotor Position**



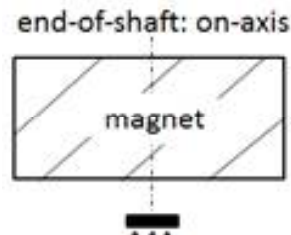
Side-shaft w/  
Ring Magnet



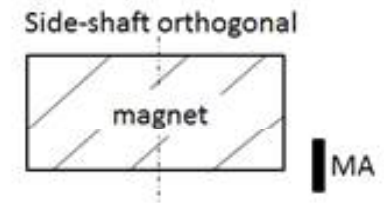
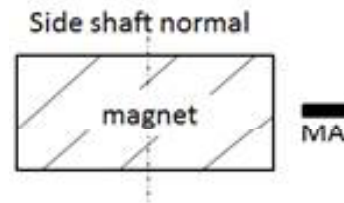
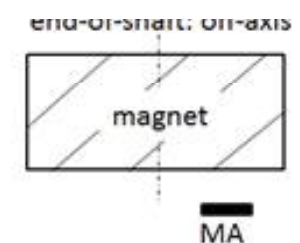
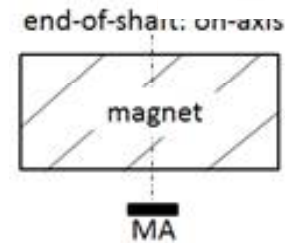
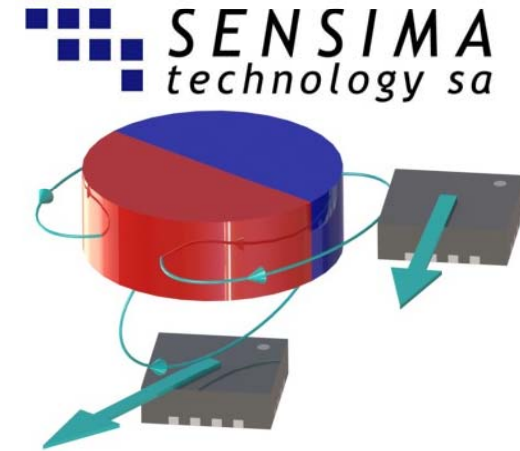
Side-shaft w/  
Disc Magnet



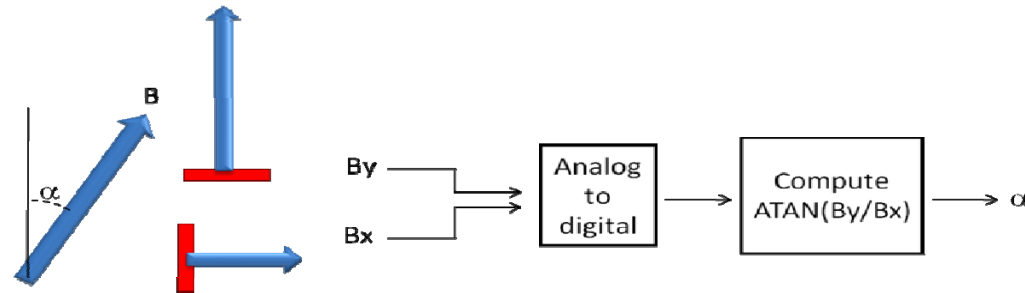
- What is the difference?



VS

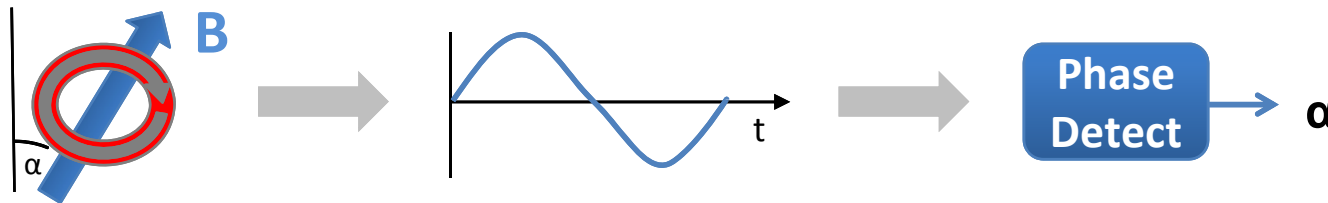


- **What is common in all competitors' sensors?**
  - Based on (X,Y) measurement and conversion to digital domain
  - Angle computed w/ complex arctan algorithm

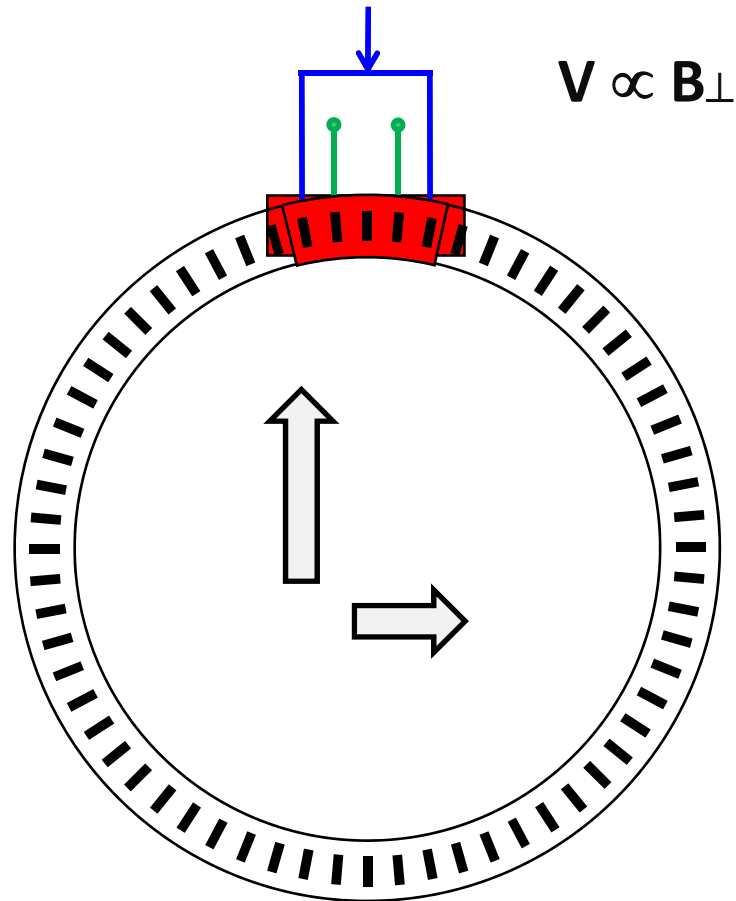


- **MPS Spinaxis Solution**

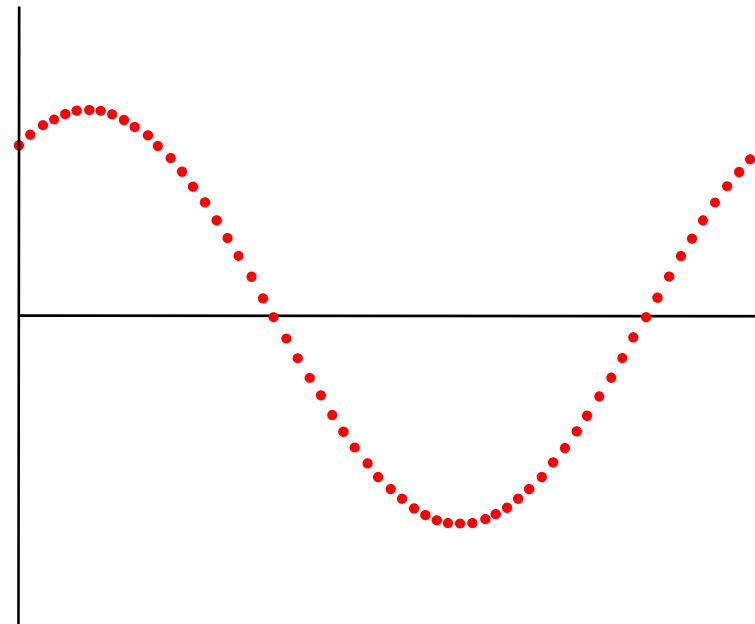
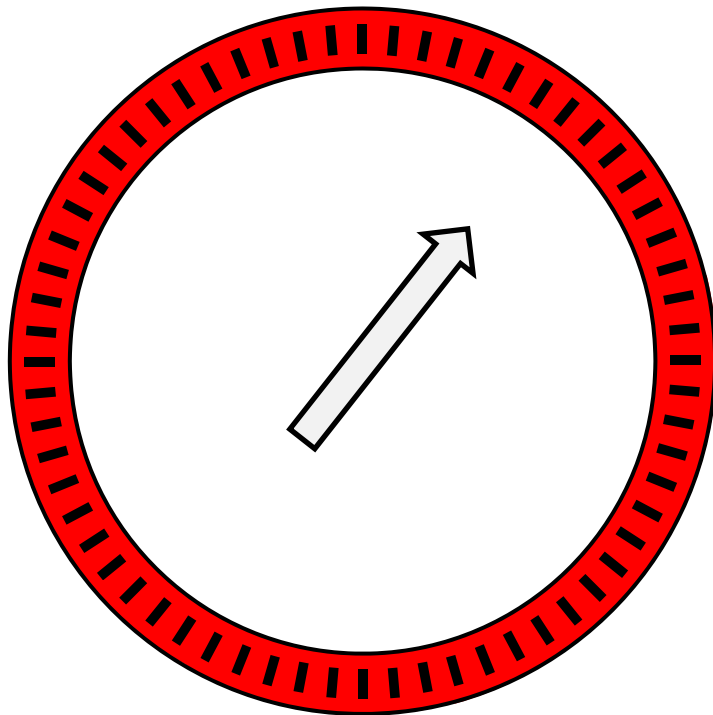
- No complex and time-consuming digital arctan algorithm
- Measure the angle through a Phase Detection.



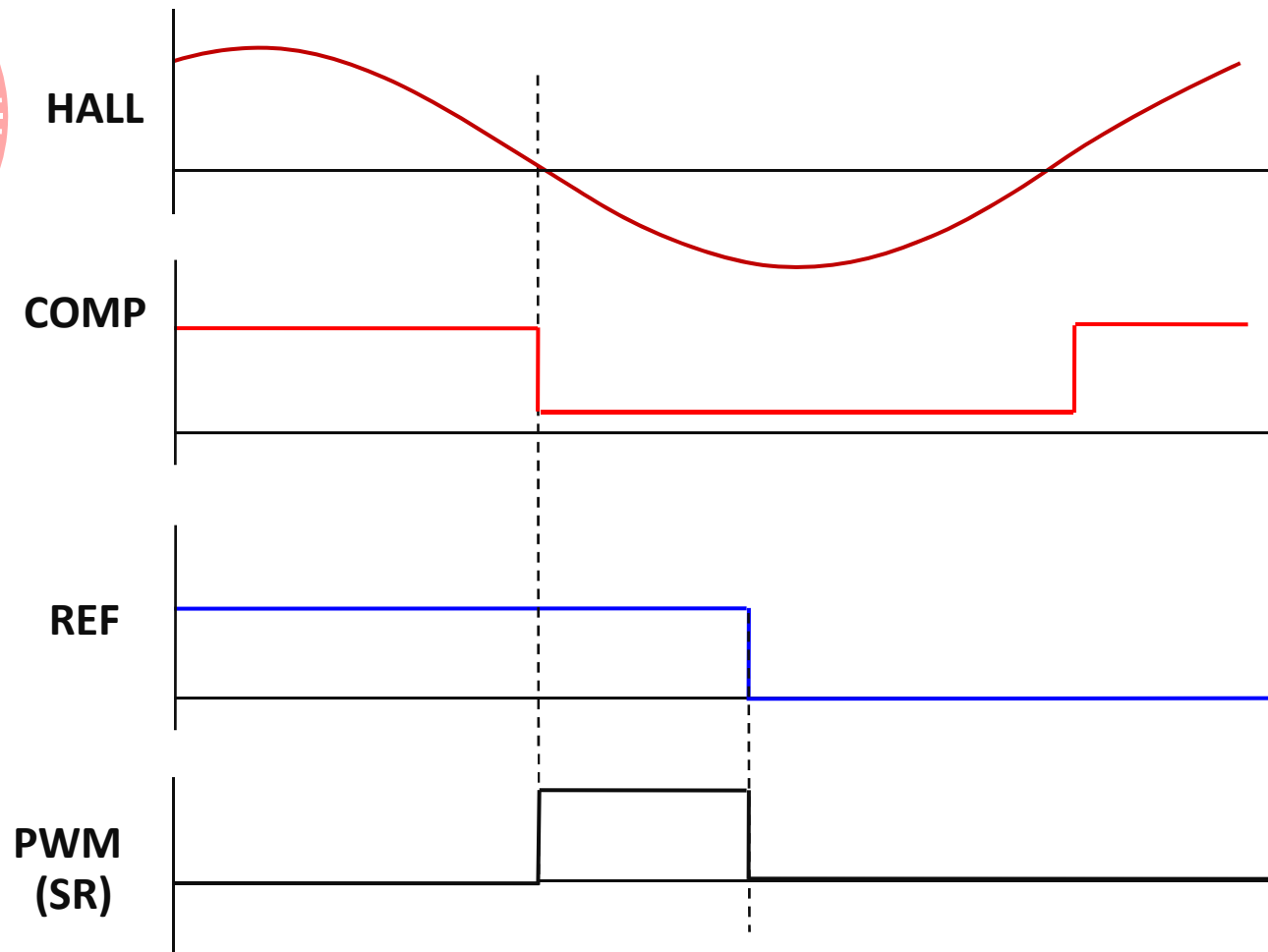
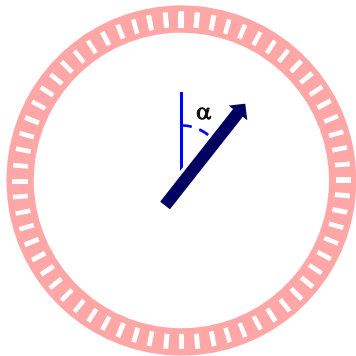
- **Spin-axis Principle**



- **Spin-axis Principle**



- **Spin-axis Principle**





- Single Phase BLDC Solution
- 3-Phase BLDC & PMSM Solution
- MPS High Accuracy Position Sensor
- Robot Ball-Tossing Demo w/ MPS solution



- **Robot Arm Ball Tossing System w/ MPS Solution**





# Q & A

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