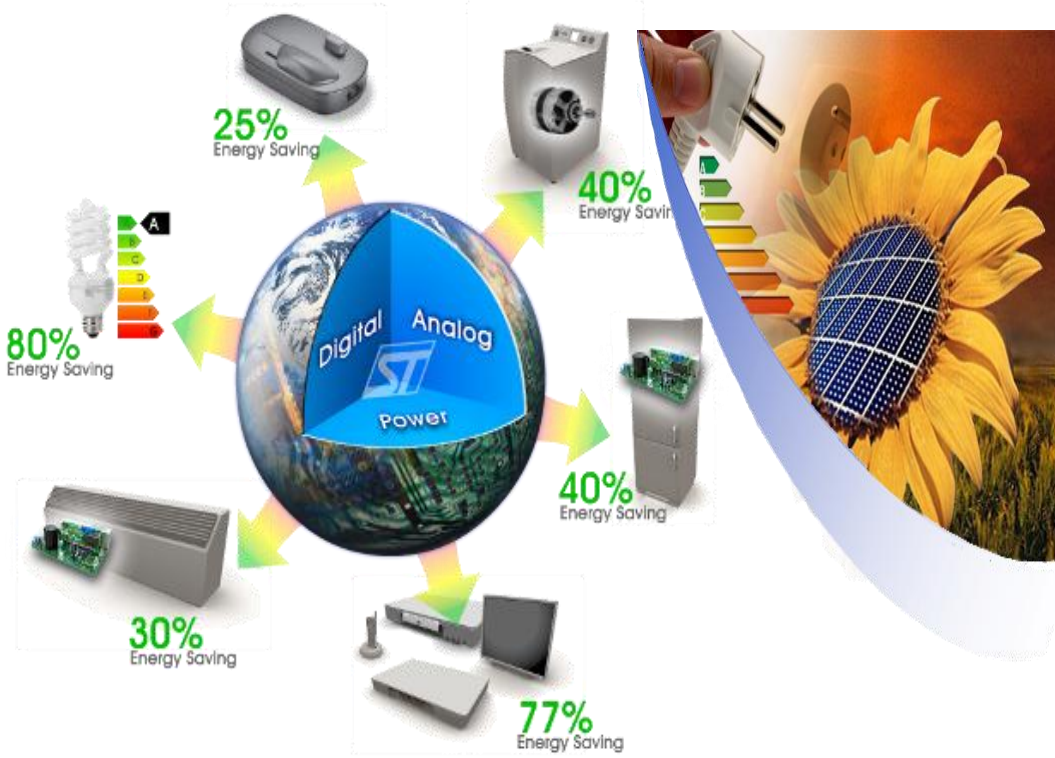


Microelectronics

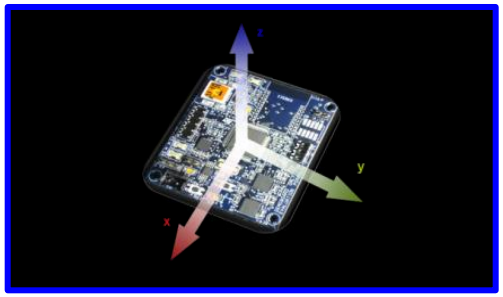
STMicroelectronics Applications

Pwr conversion

Solar

Motor control

Signal acq & Mems



Industrial automation

Automotive

Lighting

High Voltage motor control

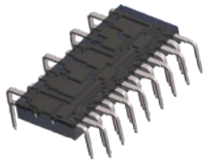
Industrial & Power Conversion Division

Off Line Power Supply Business Unit

SLLIMM™ family

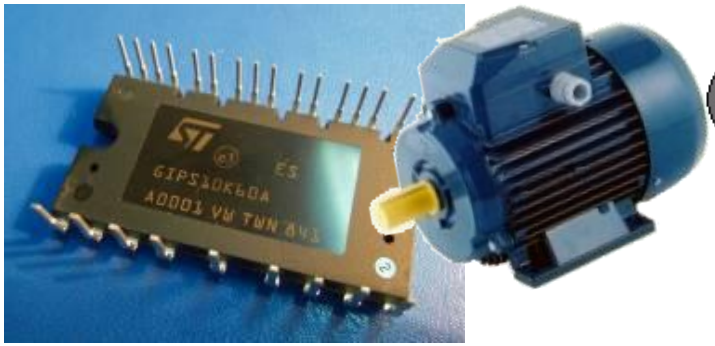
Small Low Loss Intelligent Molded Module

SLLIMM™ proposal for simple and compact solution for motor drive up to 2kW



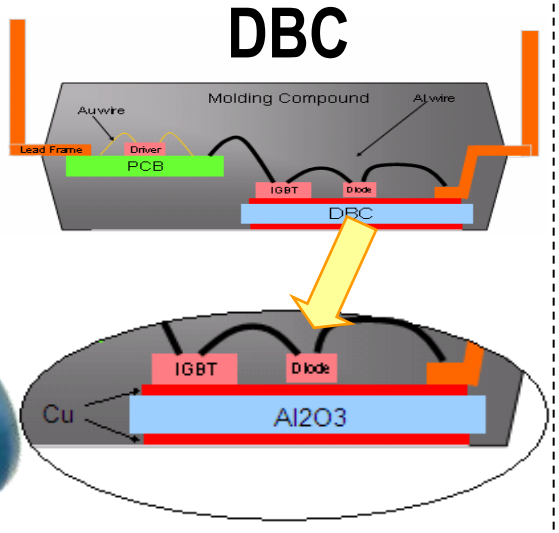
SLLIMM Package Technology (DBC vs. Ceramic)

Highest Integration Level Driving powerful BLDC motors



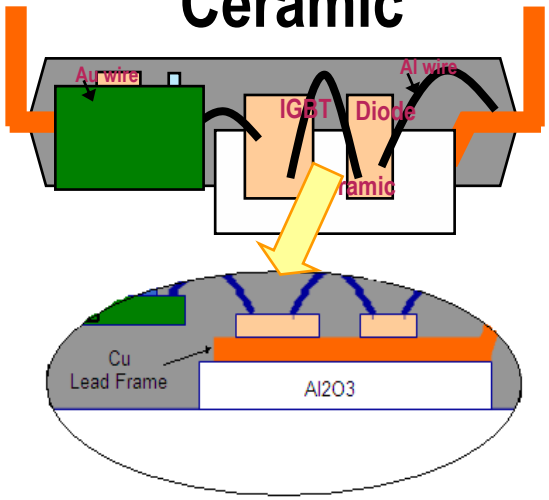
6 IGBT &
3 Drivers inside
with thermal management
Integrated Op-Amp and Comparator for sensing & protection

DBC



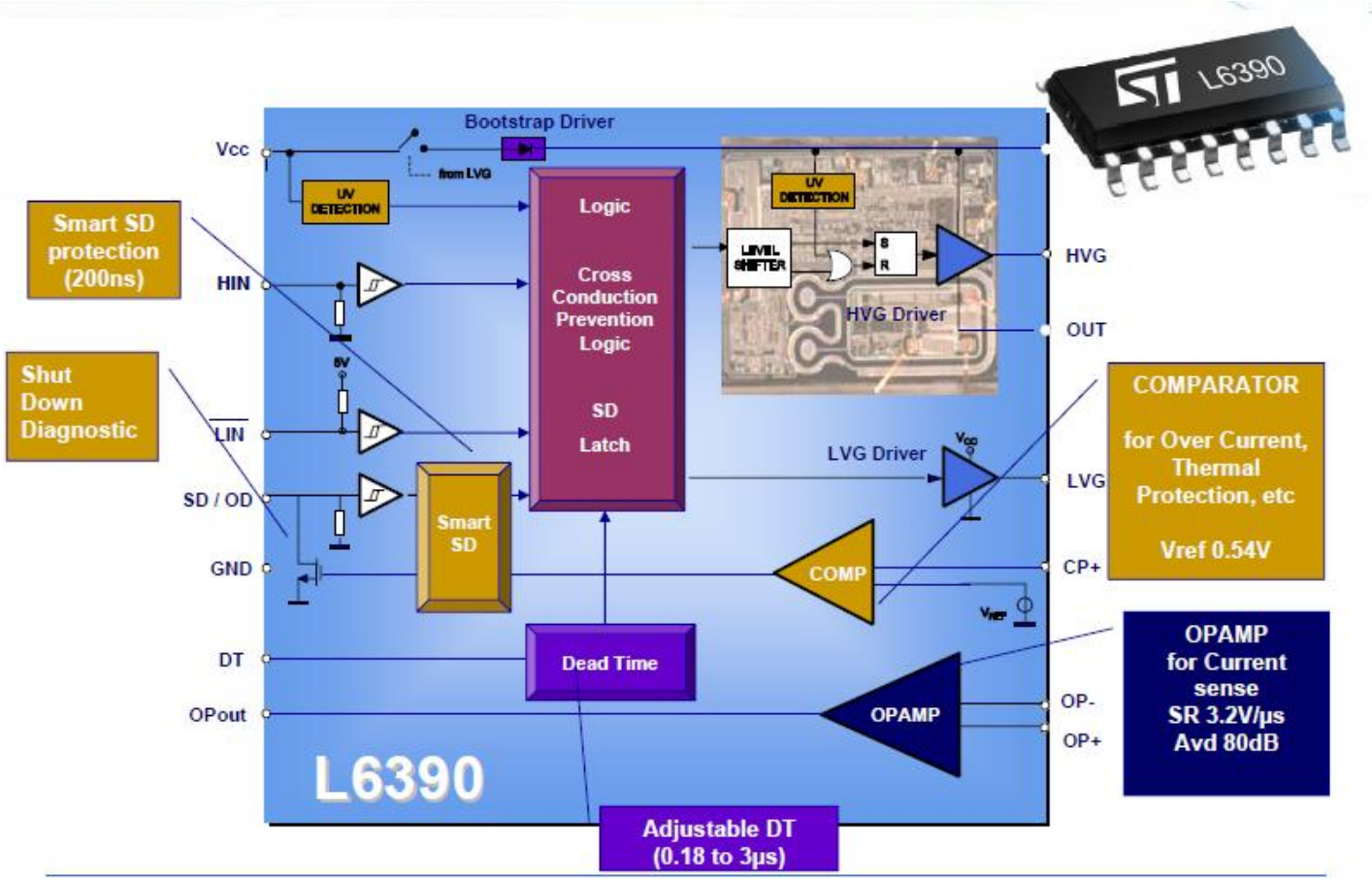
- DIP Molded Package
- PCB for drivers & SMD
- DBC (Direct Bond Copper) for power stage (copper surface exposed)

Ceramic



- DIP Molded Package
- PCB for drivers & SMD
- Lead frame and exposed ceramic sink for power stage

SLLIMM Drivers



SLLIMM Road Map

PART NUMBER	STGIPS10K60A	STGIPS10K60T	STGIPS14K60T	STGIPS14K60	STGIPL14K60	STGIPS20K60	STGIPL20K60
Pin Count	25	25	25	25	38	25	38
Pkg Size [mm]	44.4*22.0*5.4	44.4*22.0*5.4	44.4*22.0*5.4	44.4*22.0*5.4	49.6*24.5*5.4	44.4*22.0*5.4	49.6*24.5*5.4
DBC substrate	yes	yes	yes	yes	yes	yes	yes
Voltage [V]	600	600	600	600	600	600	600
Current @ Tc=25°C [A]	10	10	14	14	15	18	20
Rth (max) [°C/W]	3.8	3.8	3	3	2.8	2.4	2.2
NTC	yes	yes	yes	no	yes	no	yes
Integrated Bootstrap diode	yes	yes	yes	yes	yes	yes	yes
Smart shutdown function	no	no	no	yes	yes	yes	yes
SD function	no	yes	yes	yes	yes	yes	yes
Op-amps for Advanced current sensing	no	no	no	no	yes	no	yes
Comparator for fault protection	no	no	no	yes (1pin)	yes (3pin)	yes (1pin)	yes (3pin)

SLIMM Thermal Features

Part number	R_{TH} (°C/W)
STGIPS10K60A	3.8
STGIPS14K60	3
STGIPL14K60	2.8
STGIPS20K60	2.4
STGIPL20K60	2.2

SLLIMM Motor Control Power

STGIPS20K60

STGIPL20K60

STGIPL14K60

STGIPS14K60

STGIPS14K60T

STGIPS10K60A

STGIPS10K60T

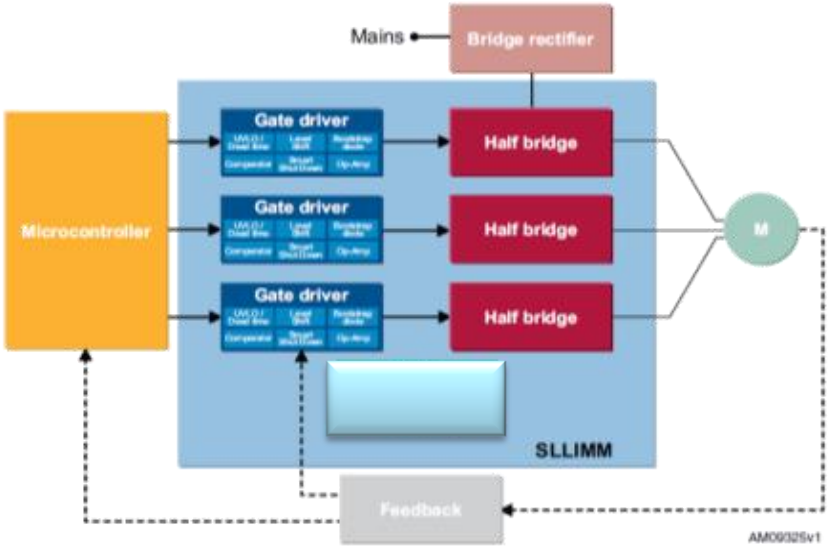
1kW

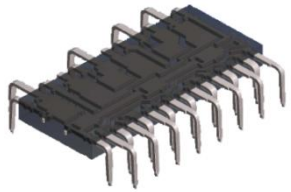
1.5kW

2kW

Output Power

NEWS !!! SLLIMM NANO Motor drive up to 100W





Tj = from -40ºC to 150ºC

Benefits

- High quality and Reliability
- Advanced protection function
- Improved efficiency
- Reduce EMI and noise
- Reduce total system cost
- Easy Layout

Main features and integrated functions

- 600 V, 3 A ratings
- 3-phase IGBT inverter bridge including:
  - 6 low-loss and short-circuit protected IGBTs
  - 6 low forward voltage drop and soft recovery freewheeling diodes
- Three control ICs for gate driving and protection including:
  - smart shutdown function
  - comparator for fault protection against overcurrent and short-circuit
  - op amp for advanced current sensing
  - three integrated bootstrap diodes
  - interlocking function
  - undervoltage lockout

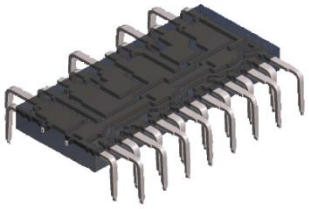
Main Applications

- General purpose Low power motor drives
- Dish washers
- Compressor drives
- Refrigerators
- Pumps
- Air Con
- Fans

NEWS!!!!!!!! 2012

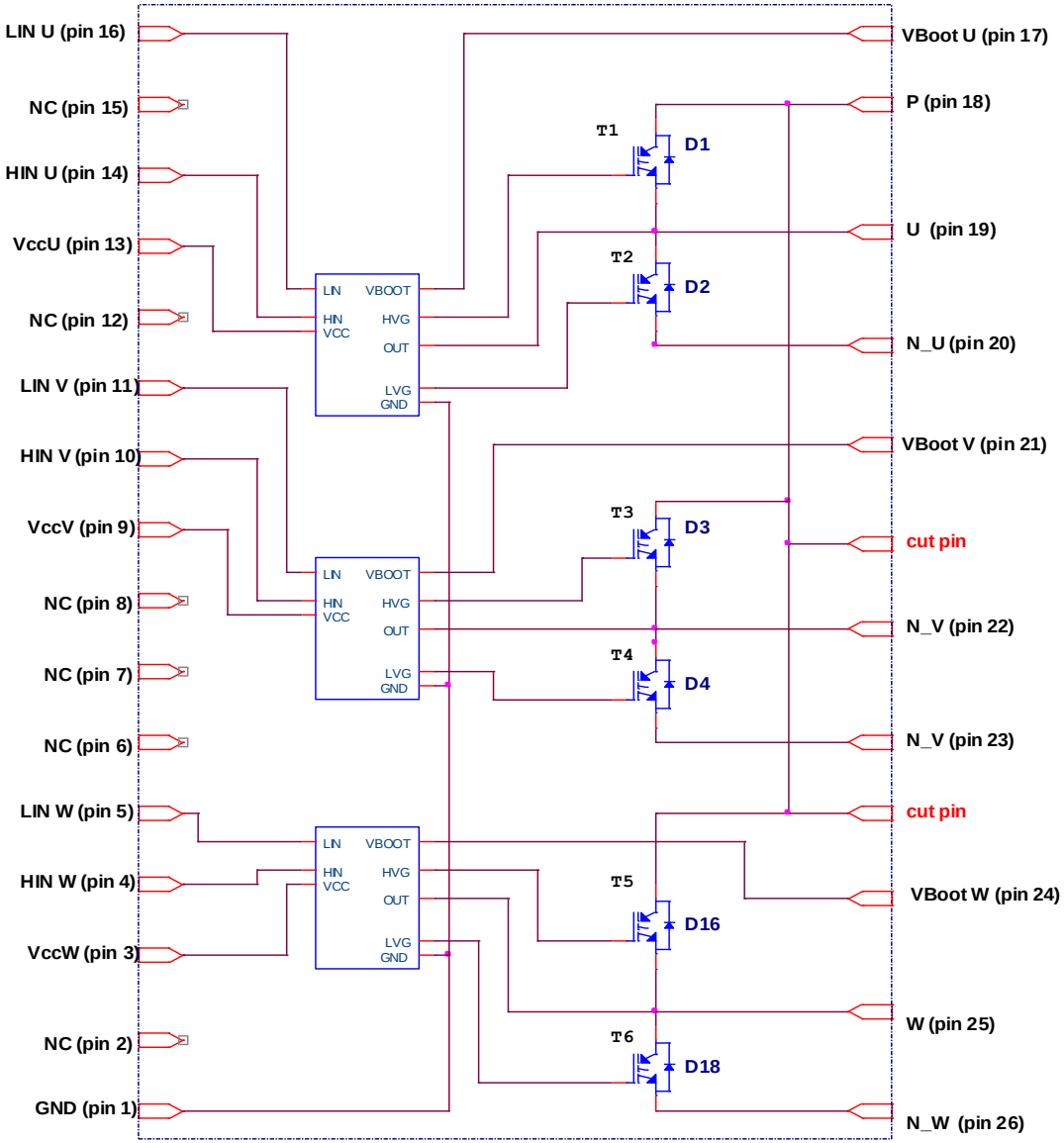
Samples available

SLLIMM NANO Features



PART NUMBER	STGIPN3H60A	STGIPN3H60
Pin Count	26	26
Pkg Size [mm]	29,5x12.5X3.1	29,5x12.5X3.1
Voltage [V]	600	600
Current @ Tc=25°C [A]	3	3
$R_{TH(J-A)}$ [°C/W]	50	50
Integrated bootstrap diode	✓	✓
Smart shutdown function	✗	✓
SD function	✗	✓
Op-amps for advanced current sensing	✗	✓
Comparator for fault protection	✗	✓
3.3/5V input interface compatibility	✓	✓
Interlocking function	✓	✓
Under Voltage Lock Out (on both Vcc and Vboot)	✓	✓

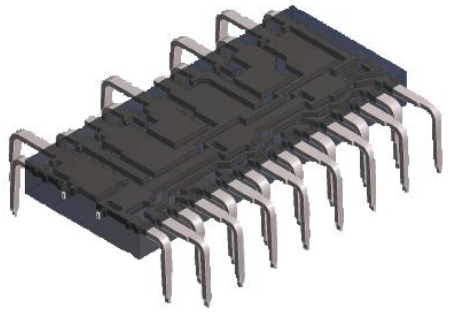
SLIMM NANO STGIPN3H60A Basic Features



6x 4A/600V IGBTs with ultra- soft fast recovery diode.

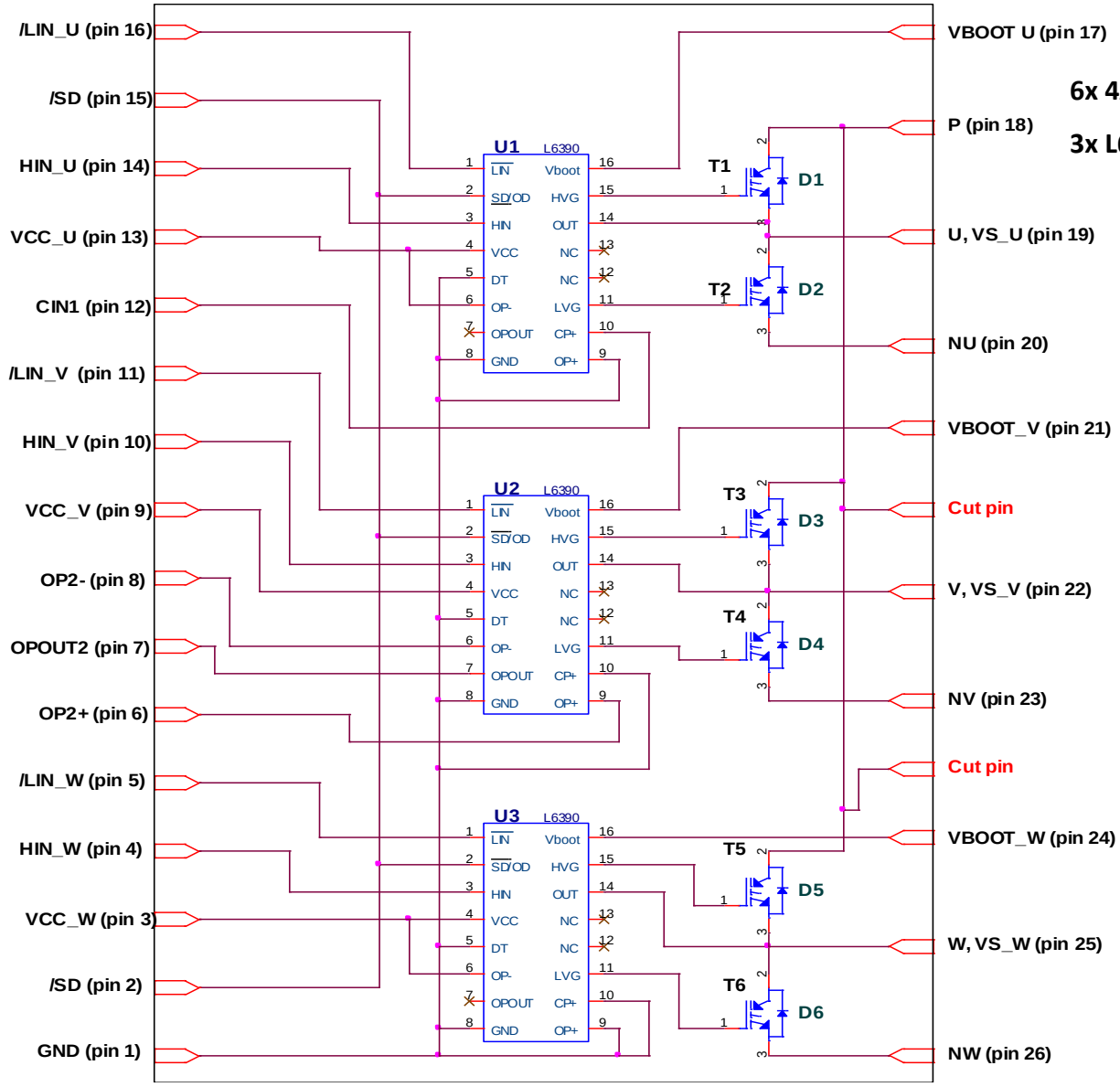
3x L6388 (High voltage gate driver)

- ✓ **Dead time and interlocking function**
- ✓ **Internal bootstrap diode**
- ✓ **3.3V, 5V and 15V CMOS/TTL compatible inputs**



29,5x12.5X3.1

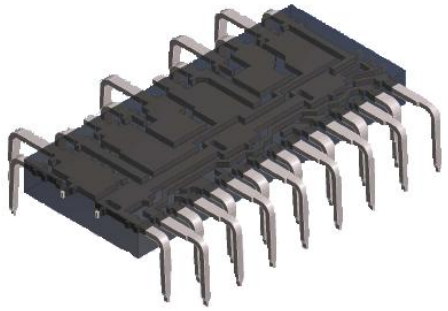
SLIMM NANO STGIPN3H60 Full Features



6x 4A/600V IGBTs with ultra-soft fast recovery diode.

3x L6390 (High voltage gate driver)

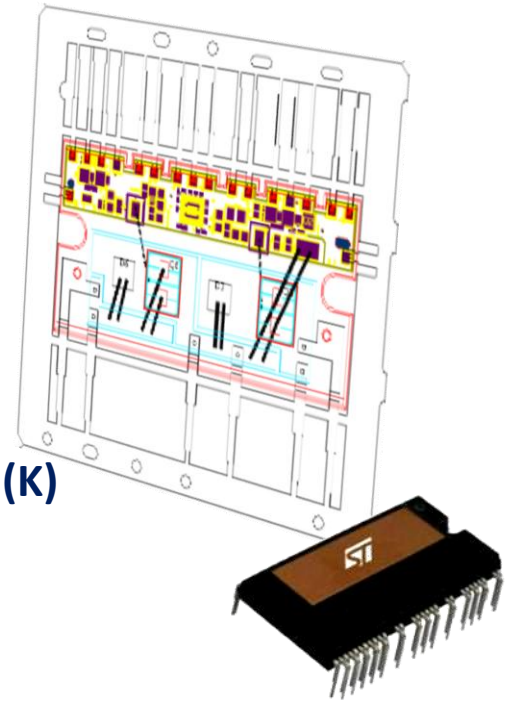
- ✓ **L6388 features plus:**
- ✓ **Shutdown pin and Smart shutdown**
- ✓ **Comparator for fault detection**
- ✓ **OpAmp for advanced current sensing**

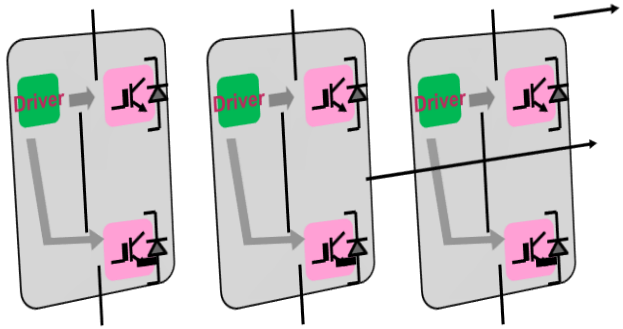


29,5x12.5X3.1

NEWS!!!!!!!! 2012
Samples available

1. It includes several innovative features:
   - Modular and expandable solution
   - Better Thermal behavior than a six-pack solution
   - Improved board layout
   - Several “smart” functions embedded
   - Silicon options offered for both PFC (W) and Motor Control (K)





PN	BV_{CES} @ 25°C	I_C @ 25°C	Features	NTC	Package
STGIPS35K60L1	600 V	35 A	L6390 based	Y	SDIP 22L
STGIPS40W60L1	600 V	40 A	L6390 based	Y	SDIP 22L

SLIMM SINGLE LEG Features

L6390 Driver available features	35A 600V
Pkg Size [mm]	49.6*24.5*5.4
DBC substrate	yes
Voltage [V]	600
Current @ Tc=25°C [A]	35
Rth (max) [ºC/W]	1.25
Embedded Thermal Resistor (NTC)	Yes
Integrated Bootstrap diode	Yes
Smart shutdown function	Yes
SD function	Yes
Op-amps for Advanced current sensing	Yes (3 pins)
Comparator for fault protection	Yes
3.3/5V input interface compatibility	Yes
Interlocking Function	Yes
Under Voltage lockout (on Vcc and Vboot)	yes

Integrated bootstrap diodes mean:

component cost saving easy layout

Thanks to Smart Shutdown function, ST HV gate driver can turn off the IPM in a faster (T:200ns) and safer way during abnormal state (Over Current or Over Temperature)

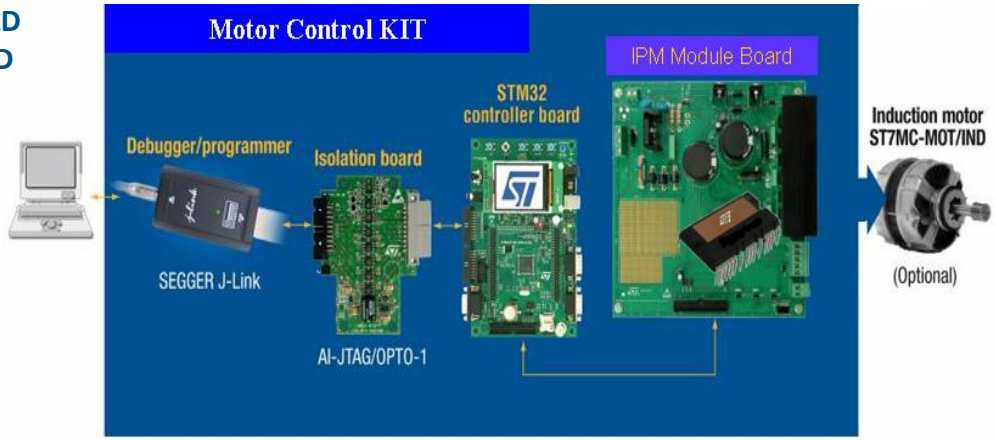
SD function available for an efficient connection with micro-controller

Integrated interlocking function can avoid any malfunctioning coming from overlapped input signals

SLIMM Motor Control Evaluation Board

STEVAL-IHM025V1

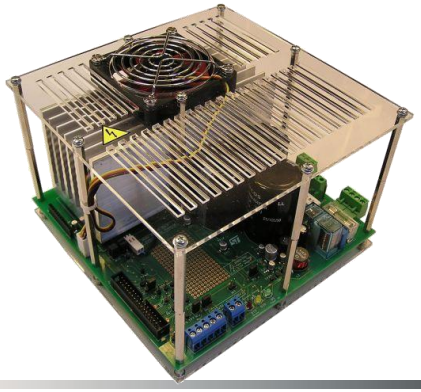
- 1 x IGBT IPM STGIPL14K60
- 1 x PWM SMPS smart driver VIPer16LD
- 1 x IGBT power switch STGP10NC60KD



STEVAL-IHM027V1

- 1 x IGBT IPM STGIPS10K60A
- 1 x buck converter based on Viper16
- 1 x IGBT power switch STGP10NC60KD

- Three-phase power stage with shunt-based current reading
- Complete source files software libraries for 3-PH Induction and PMSM motors provided



STEVAL-IHM028V1

- 1 x IGBT IPM STGIPS20K60
- 1 x PWM SMPS smart driver VIPer26LD
- 1 x IGBT power switch STGW35NB60SD

1KW Power Inverter STGIPL14K60

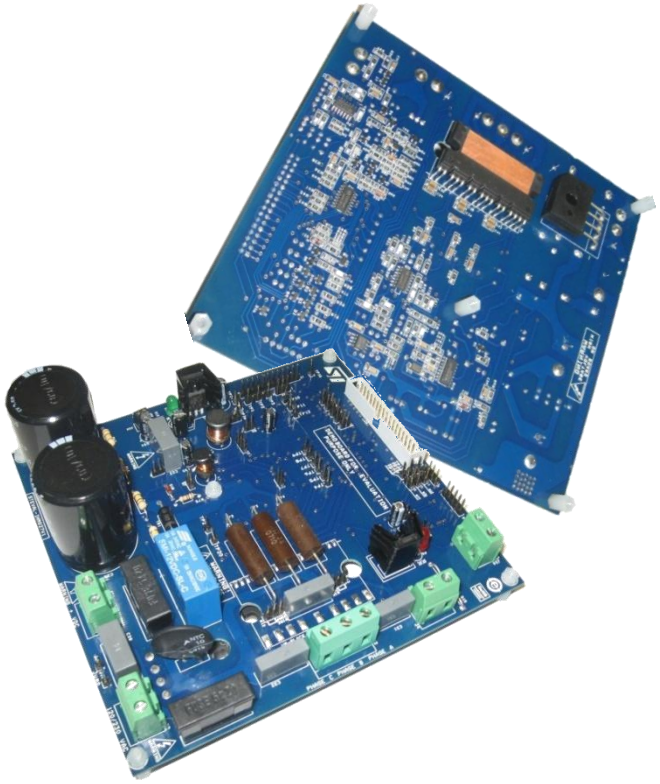
- Single phase connecting - supply voltage from 125VDC to 400VDC
- Possibility to use PMAC motors, 3-phase asynchronous motors,
  bi-phase AC motors or BLDC motors
- Input in-rush limiter with by-passing relay
- Brake switch with over-voltage comparator
- Hall sensor or encoder input feature, tachometer input feature
- Over-temperature and over-current hardware protection
- Compact and safety design

- 1 x IGBT IPM STGIPL14K60
- 1 x PWM SMPS smart driver VIPer16LD
- 1 x IGBT power switch STGP10NC60KD

Ordering code: STEVAL-IHM025V1

Evaluation boards available at: http://www.st.com/evalboards

1KW Power Inverter STGIPS10K60A



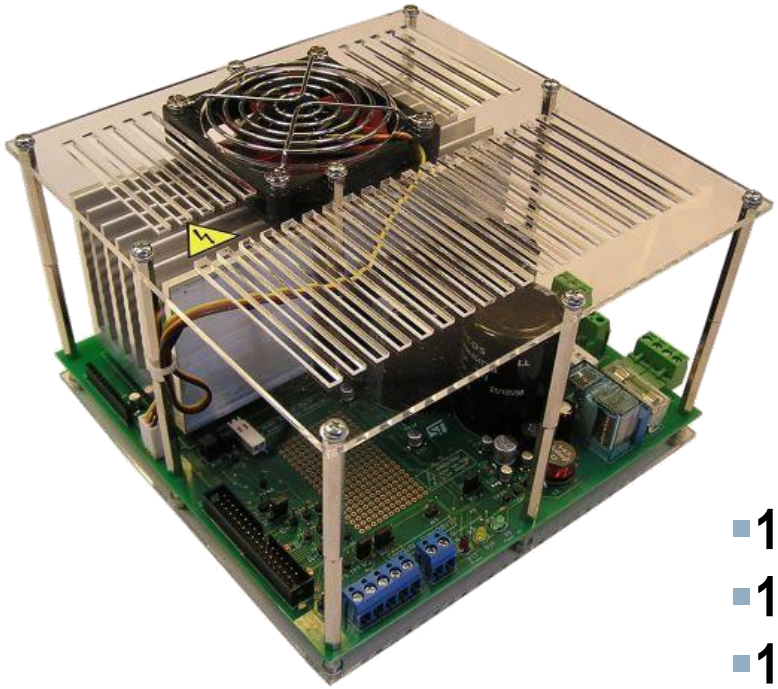
- Single phase connecting - supply voltage from 125VDC to 350VDC
- Motor control connector for interface with STM3210B-EVAL board
- Possibility to use induction motor or PMSM motors up to 1000 W
- Regenerative brake control feature
- Input inrush limitation with bypassing relay
- Hall\Encoder inputs
- Possibility to connect BEMF daughter board for sensor-less six-step control of BLDC motors
- Tachometer input
- Compact and safety design

- **1 x IGBT IPM STGIPS10K60A**
- **1 x buck converter based on Viper16**
- **1 x Low Voltage Bipolar 2STR1230**

Ordering code: STEVAL-IHM027V1

Evaluation boards available at: http://www.st.com/evalboards

2 KW Power Inverter STGIPS20K60



- HV supply mode -voltage 90VAC to 285VAC or direct DC line 125VDC to 400VDC
- Input voltage range extended to +400V to be compliant with PFC
- Input inrush limiter with bypassing relay
- Brake feature with over-voltage comparator
- Single or three shunt resistors current sensing method
- Hall sensor or encoder input feature
- Tachometer input feature
- Over-temperature and over-current hardware protection
- Active fan with automatic over-temperature switching
- Relative compact and safety design

- 1 x IGBT IPM STGIPS20K60
- 1 x PWM SMPS smart driver VIPer26LD
- 1 x IGBT power switch STGW35NB60SD

Ordering code: STEVAL-IHM028V1

Evaluation boards available at: http://www.st.com/evalboards

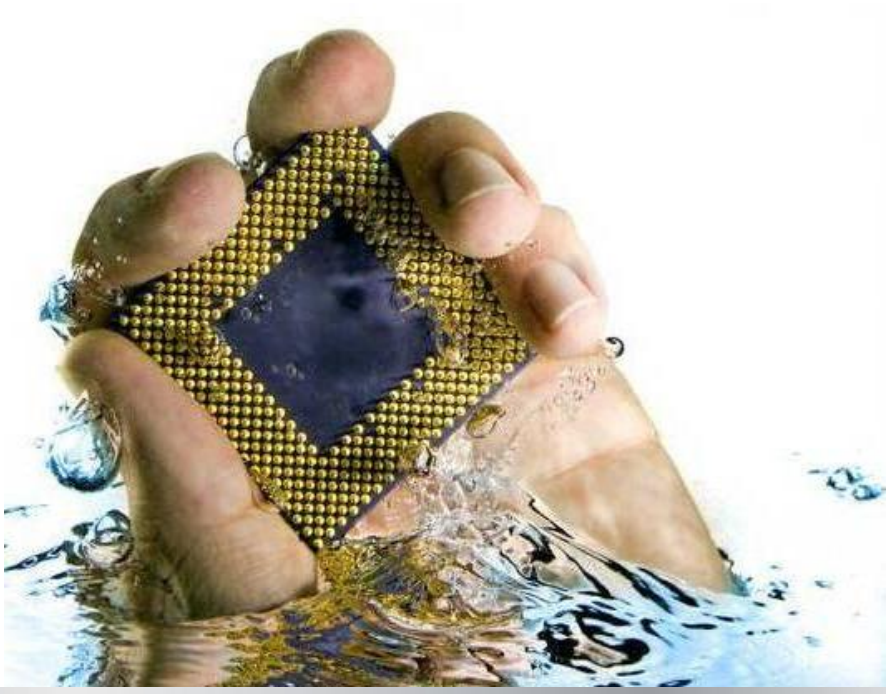
Stepper motor control L6470 DSPIN & L6480 CSPIN

Industrial & Power Conversion Division

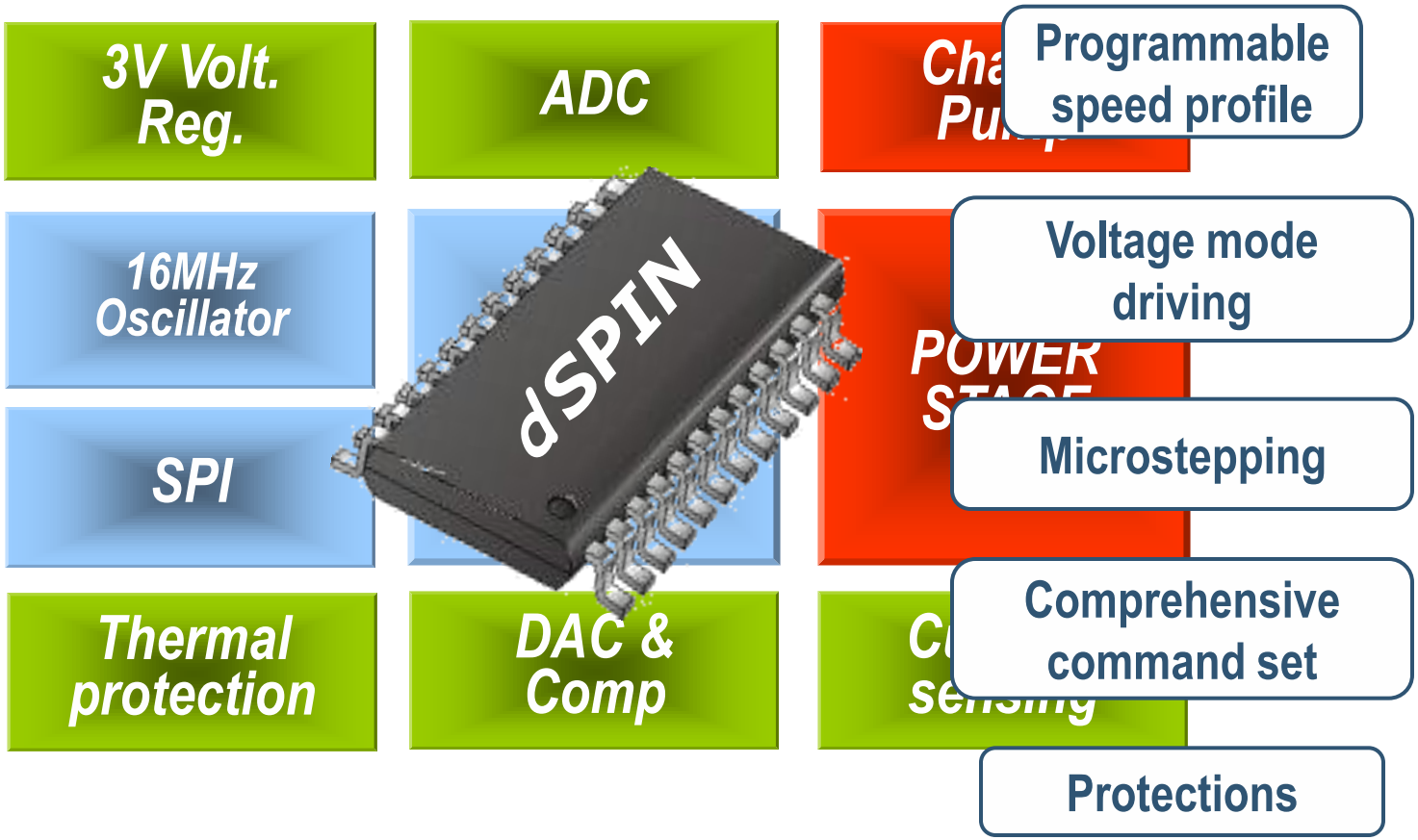
Off Line Power Supply Business Unit

DSPIN & CSPIN

The new *State of the Art* in *µstepping Drivers*

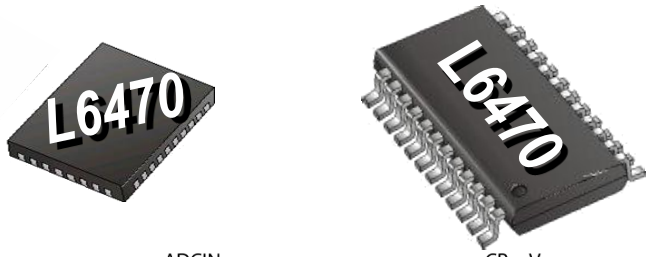


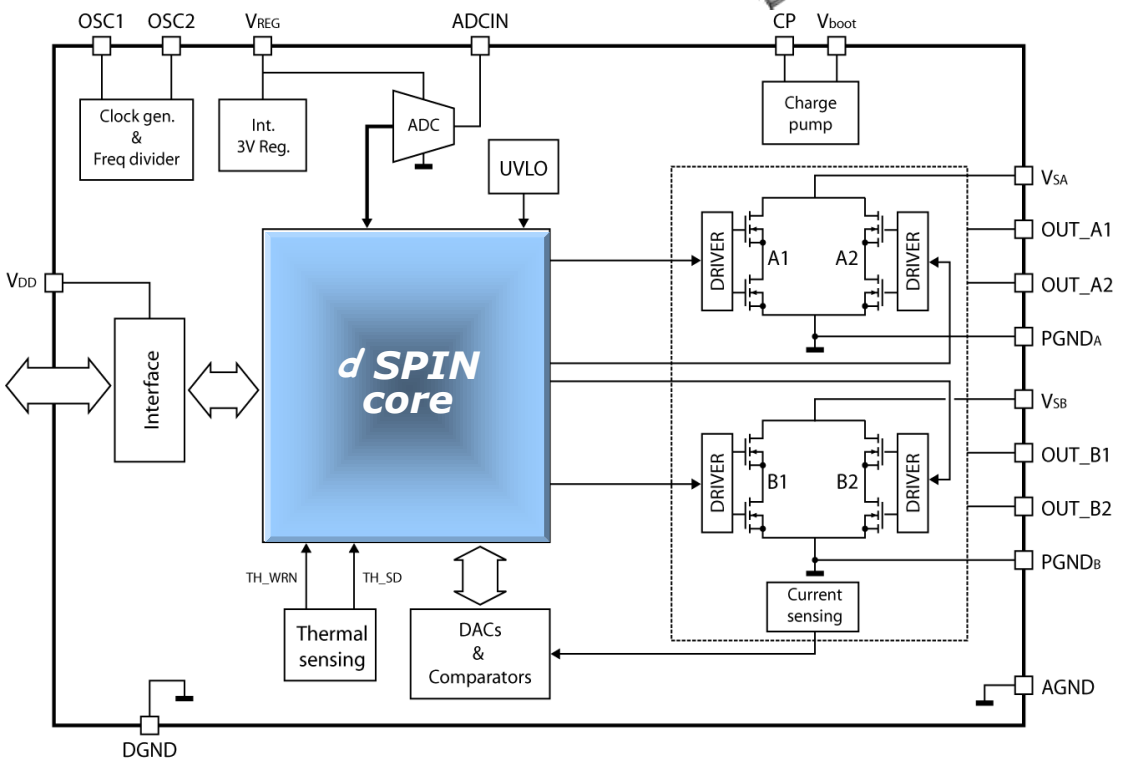
L6470 DSPIN Functional Block



L6470 DSPIN Features

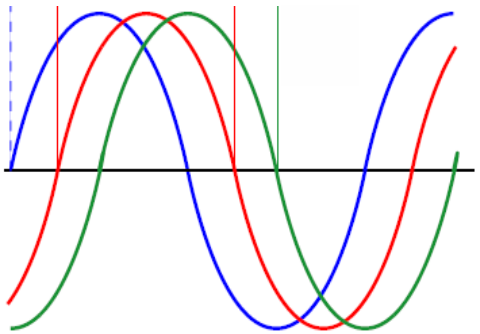
- Supply voltage 8V – 45V
- 3Arms (7A peak)
- $R_{DS,ON}$ = 0.28 Ω
- Integrated Current Sensing (no external shunt)
- Up to 128 microsteps
- Voltage mode operation
- Sensorless Stall Detection
- Programmable speed profile
- Programmable positioning
- 8bit 5Mhz SPI interface (Daisy Chain compatible)
- Integrated 16MHz oscillator
- Integrated 5bit ADC
- Integrated 3V voltage regulator
- Over Current, Over Temperature and Under Voltage protections
- QFN and HTSSOP package





“Out of the Box” Driving Solution

- “Voltage Mode” brings *Outstanding* Performances
- Fully *digital* implementation
- Sine-Wave profile is achieved much more accurately than in current mode
- *128* µsteps/step beats 32 µsteps of competition
- *Higher* position resolution
- Reduced resonances (instability, pole slipping), mechanical noise and vibrations at low speed
- Reduced torque & speed ripple at low speeds
- in a word… ***smoother*** operation

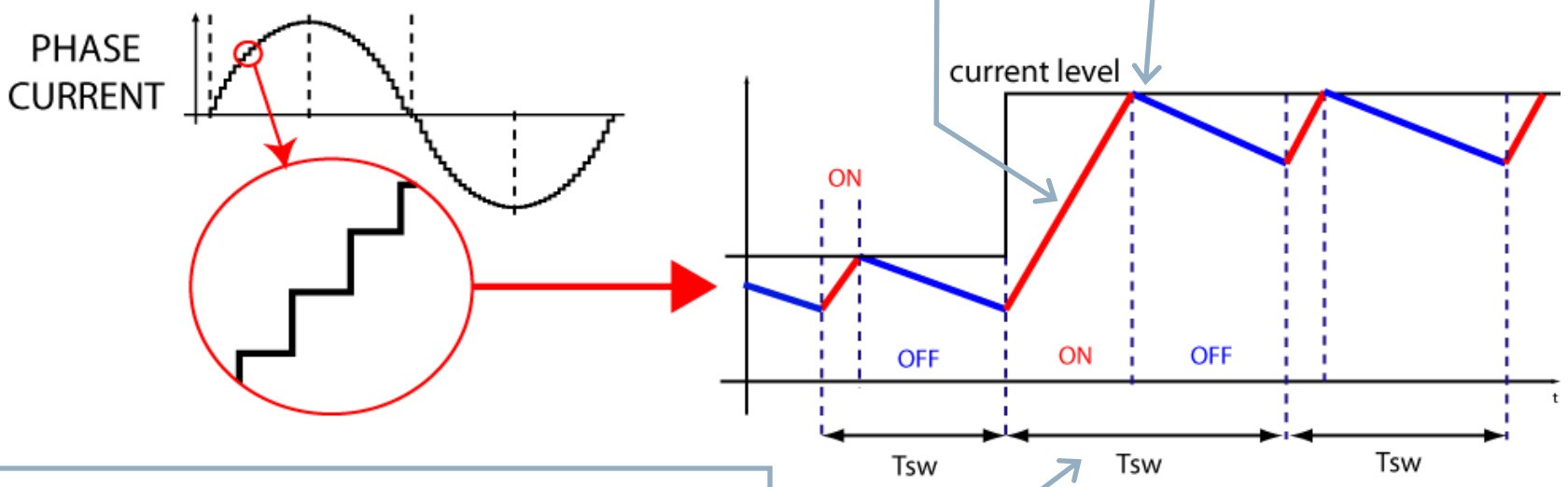


L6470 DSPIN Voltage mode vs Current Mode

1. Abrupt current changes cause strong mechanical vibrations.
Current mode tries to follow even non idealities (reference voltage quantization and sampling)
Noisy and jerky motion.

2. Peak current is controlled.
Average current value is different from target one.
Inaccurate positioning

CURRENT MODE

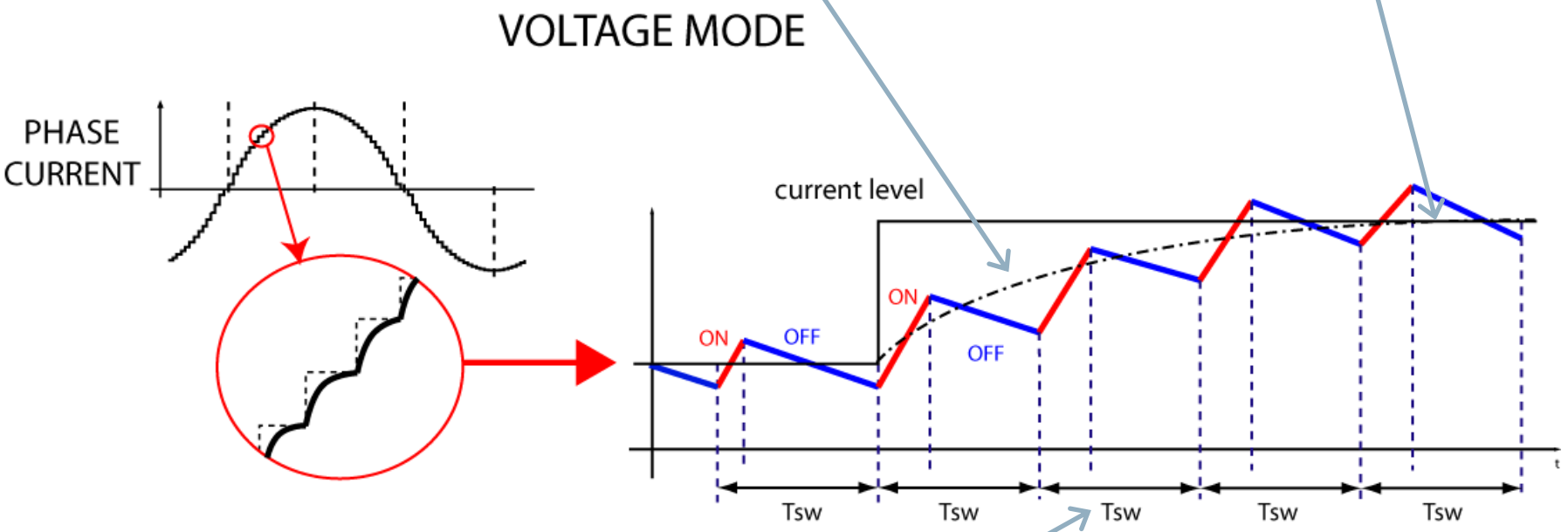


3. Non constant switching freq.
Torque ripple and EMI are difficult to control.

L6470 DSPIN Voltage mode vs Current Mode

Smooth current transient reduces mechanical vibrations.
Motor movement is soft and silent!

Average current is controlled.
Accurate positioning.

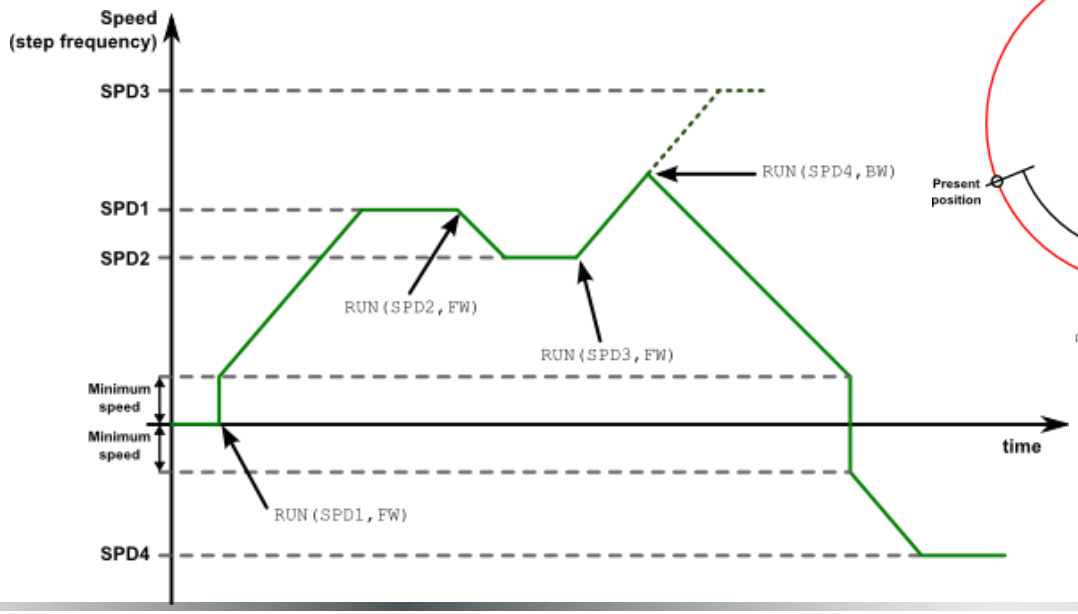


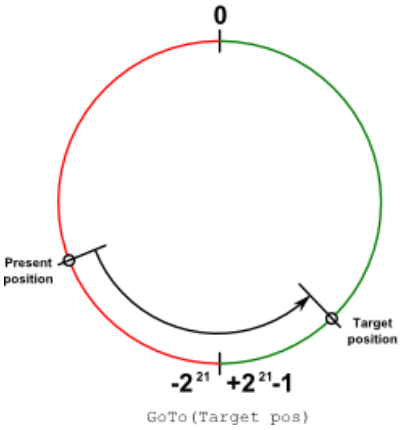
Constant switching freq.
Torque ripple and EMI are under control.

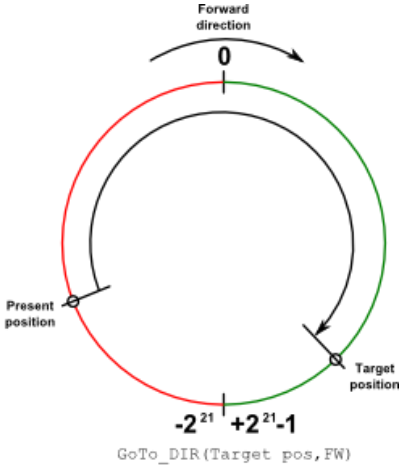
Intelligence integration

Speed and position profiles required complex µcontroller routines

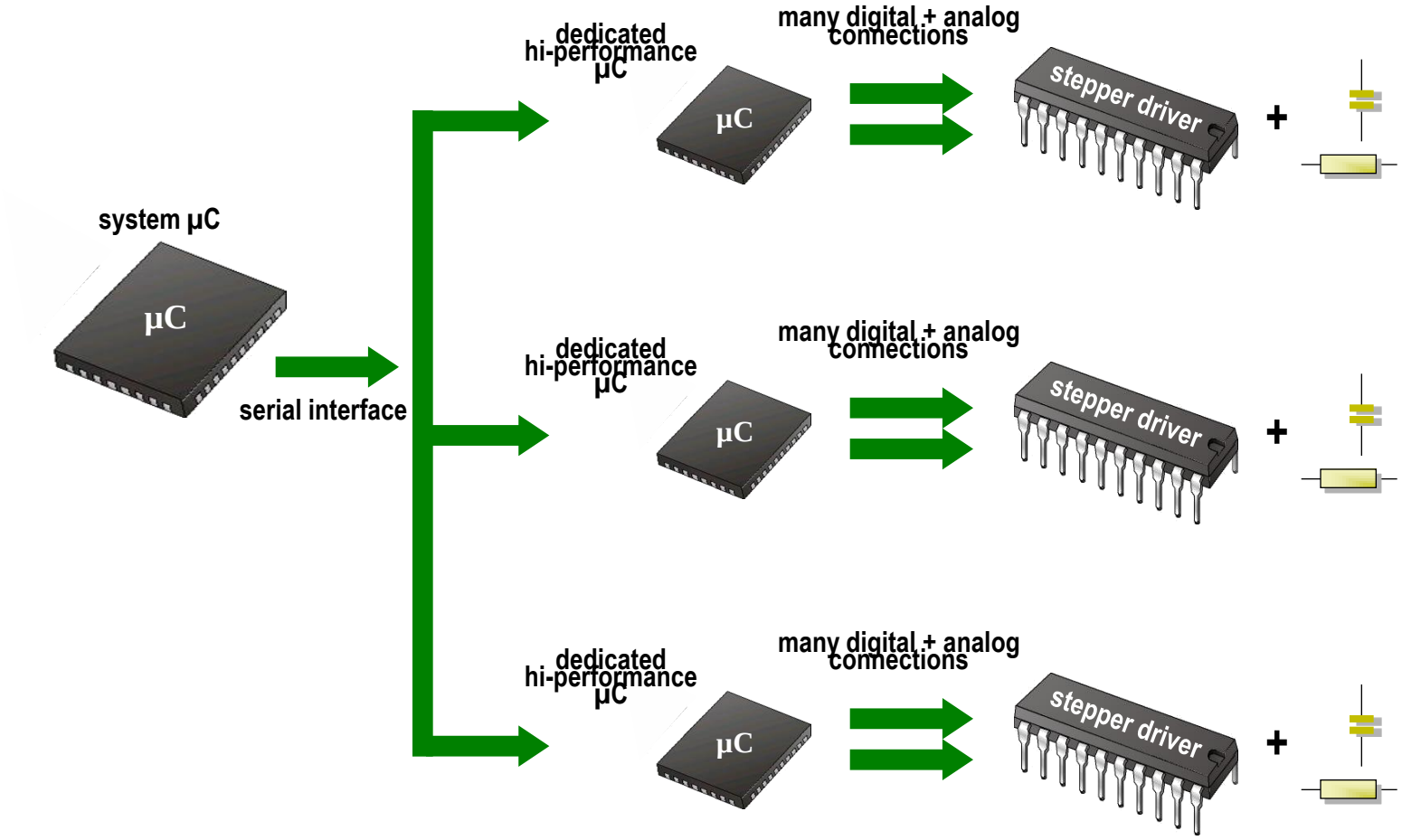
d *SPIN* does the whole tricky job, listening to simple high level SPI commands







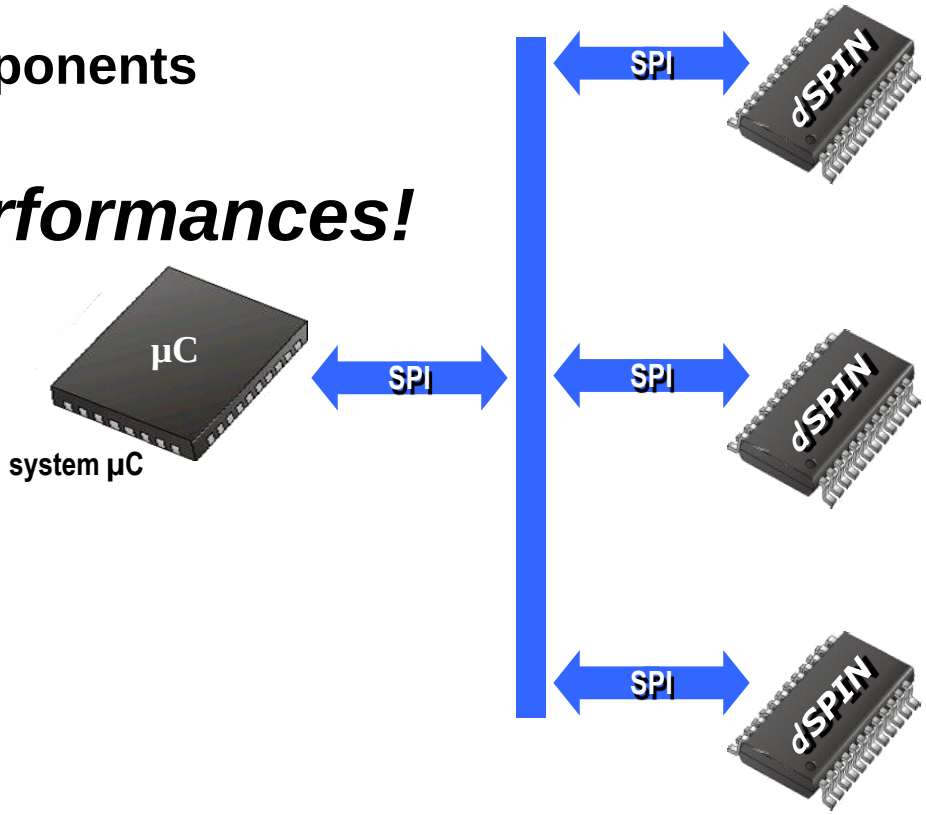
before dSPIN...



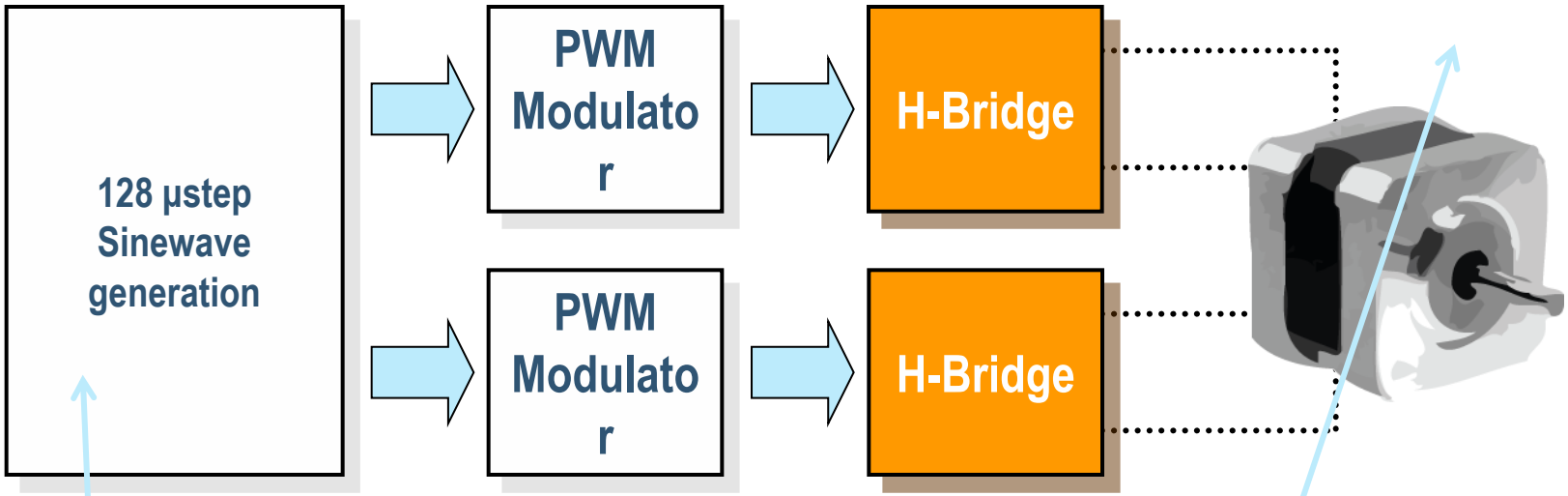
...after dSPIN !

- System is heavily simplified
- No more dedicated µC to perform speed profile and positioning calculations
- A lot less passive components

and... ***far better performances!***



L6470 DSPIN Technical Details



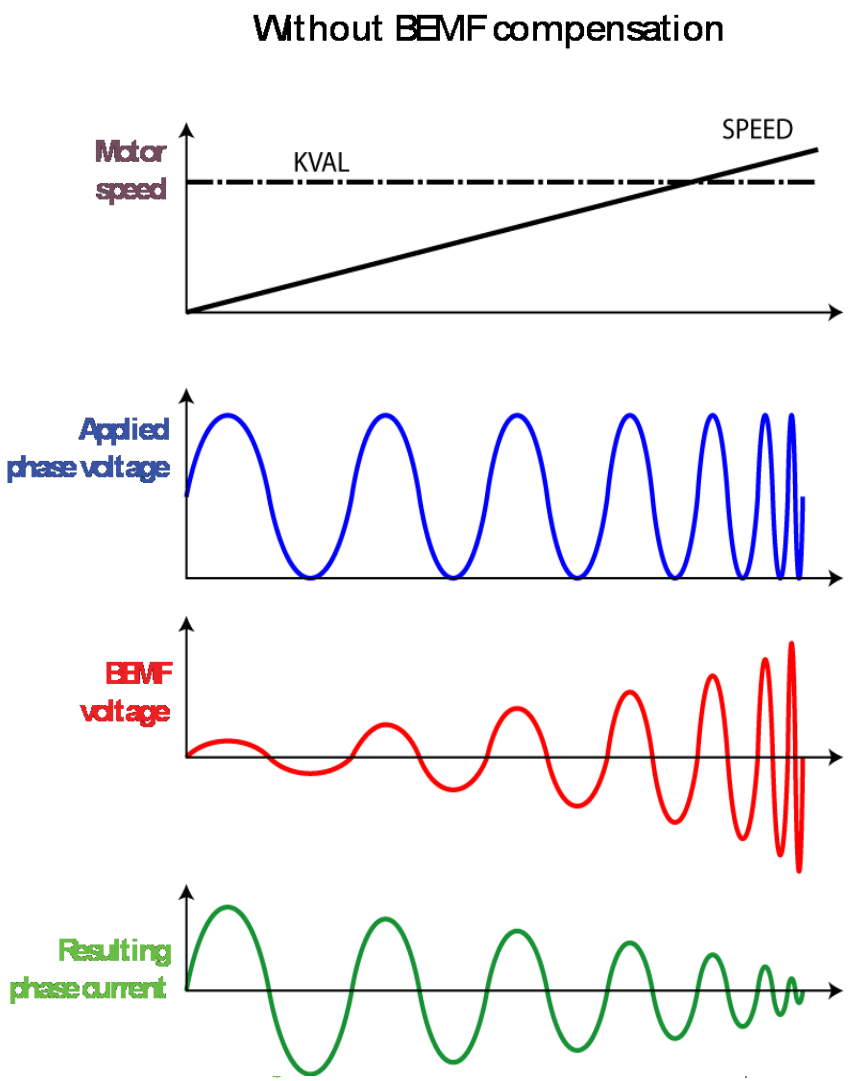
Optimal resolution is 128 µsteps (0.78% of a step)

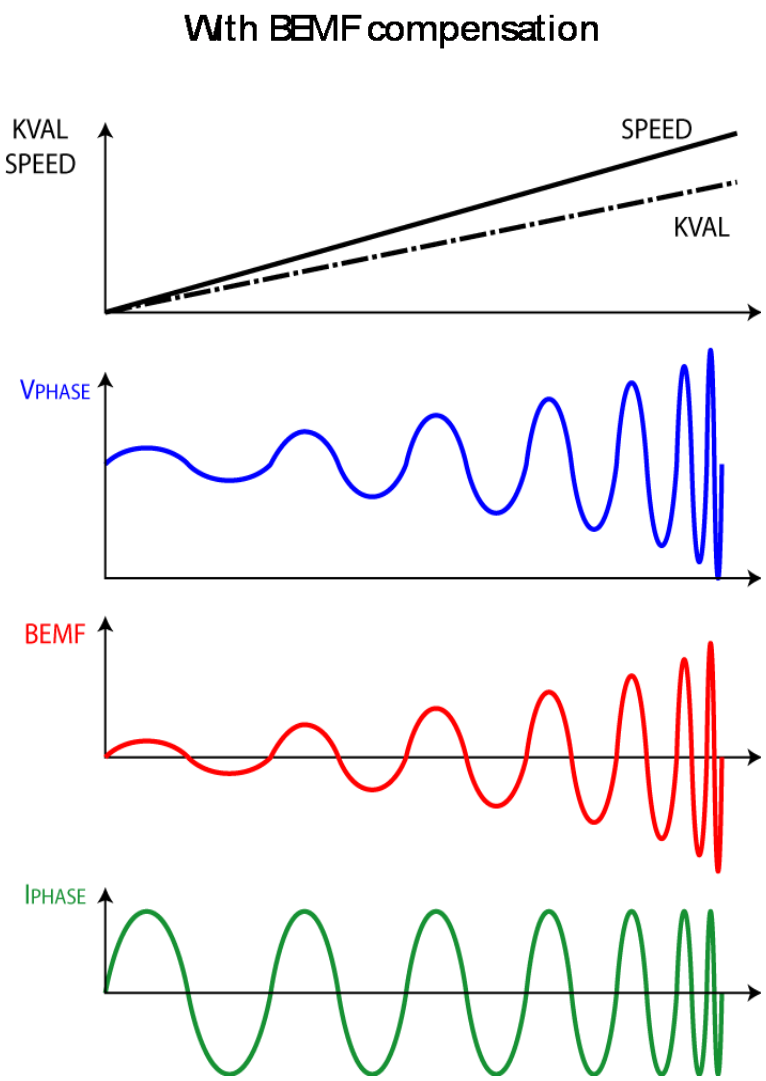
Typical motor precision: 5% of a step

Voltage mode drawbacks and solutions

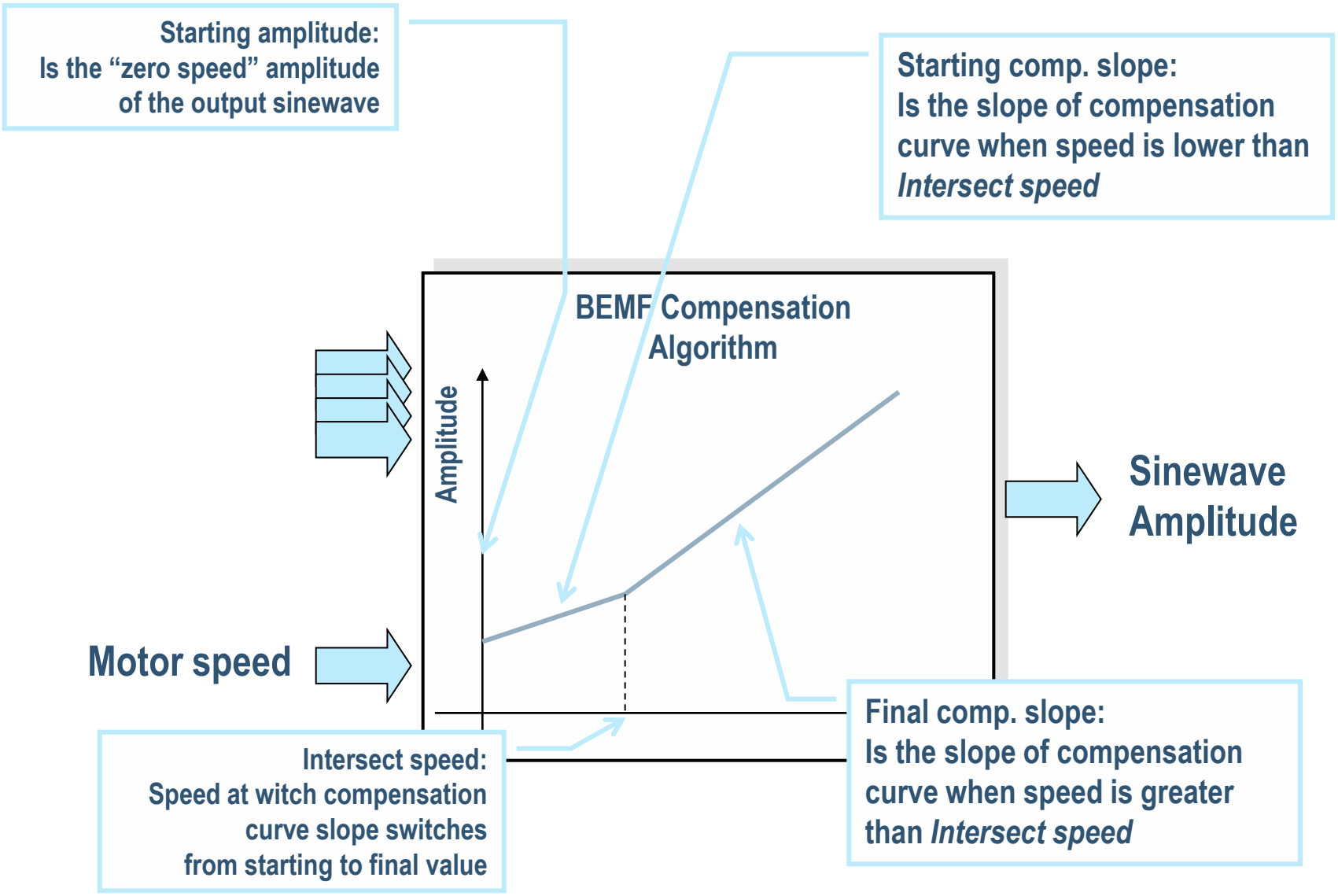
✗ *Back-Electro Motive Force heavily influences voltage to current relation*	✓ Effective and flexible BEMF compensation system
✗ Windings applied voltages are perturbed by supply voltage fluctuations	✓ Supply voltage compensation though integrated 5bit ADC
✗ Phase resistances vary with temperature	✓ Phase resistance compensation register

L6470 DSPIN BEMF Compensation



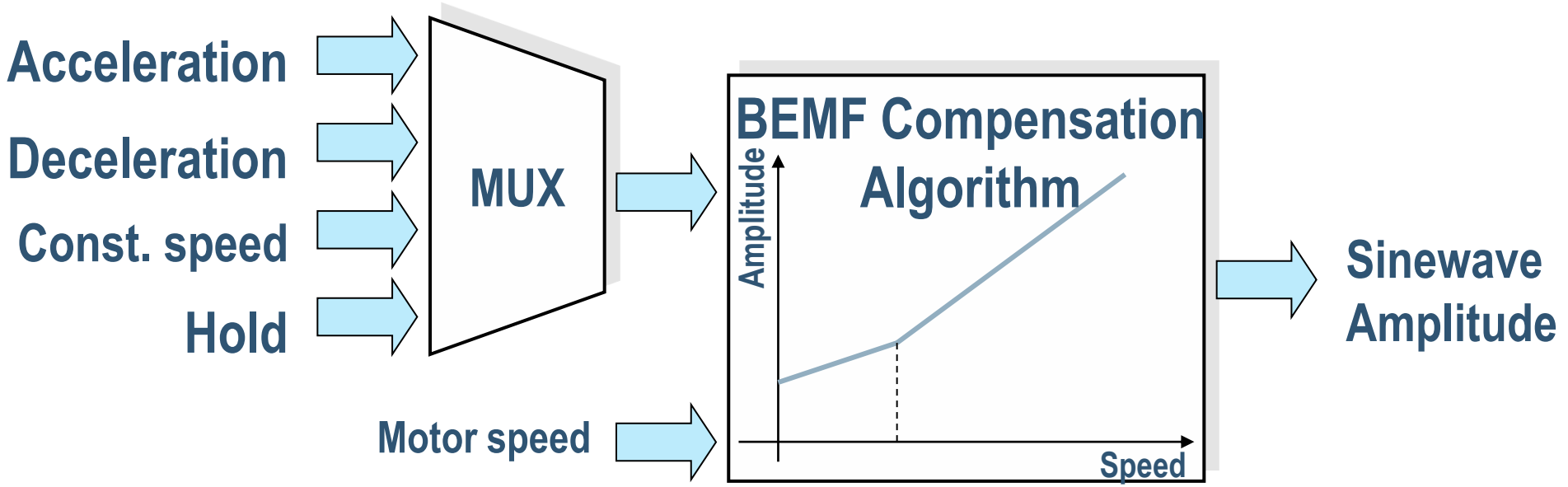


L6470 DSPIN BEMF Compensation

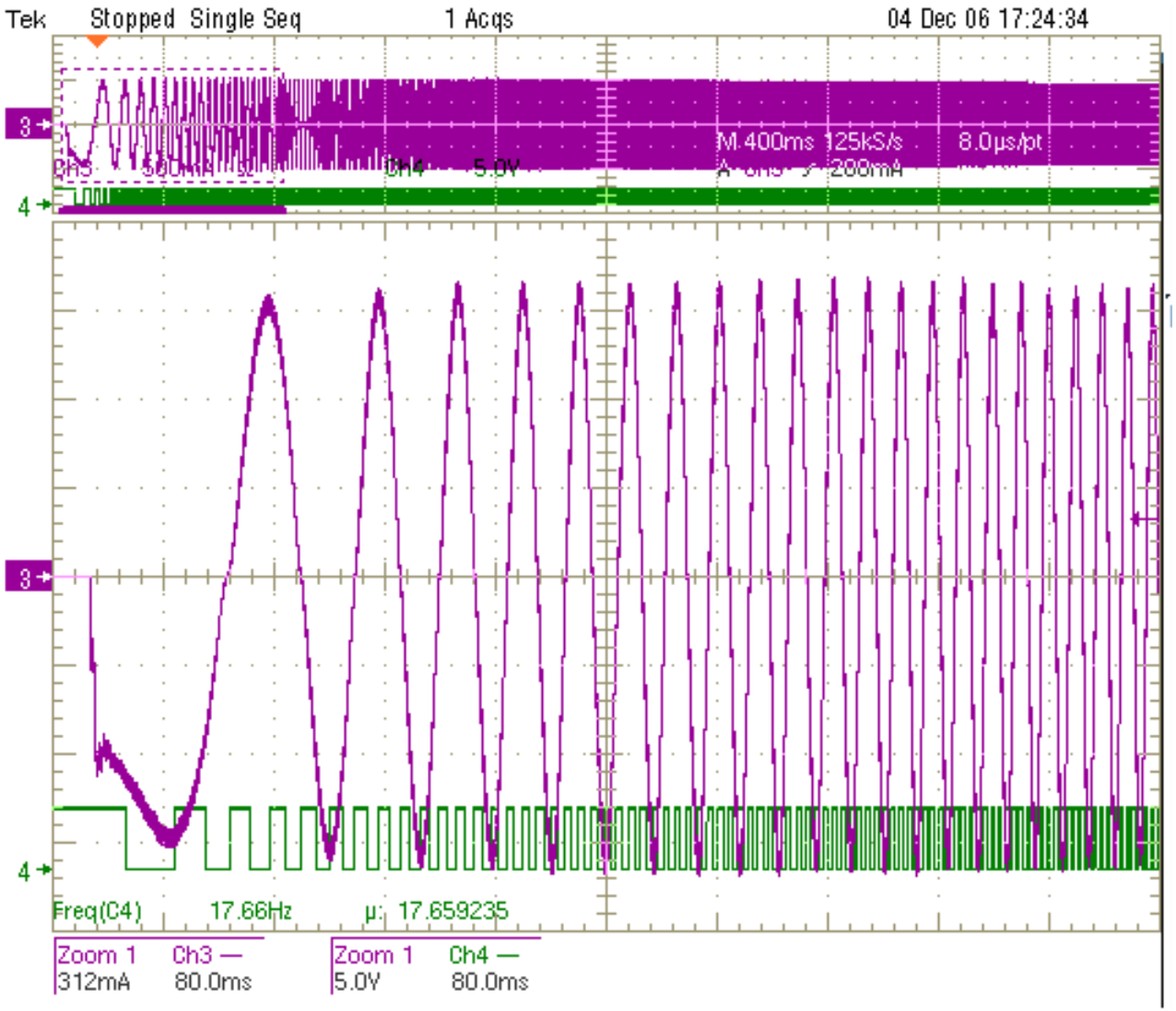


According to motor conditions (acc/deceleration, constant speed, hold) a different torque, and then current, could be needed

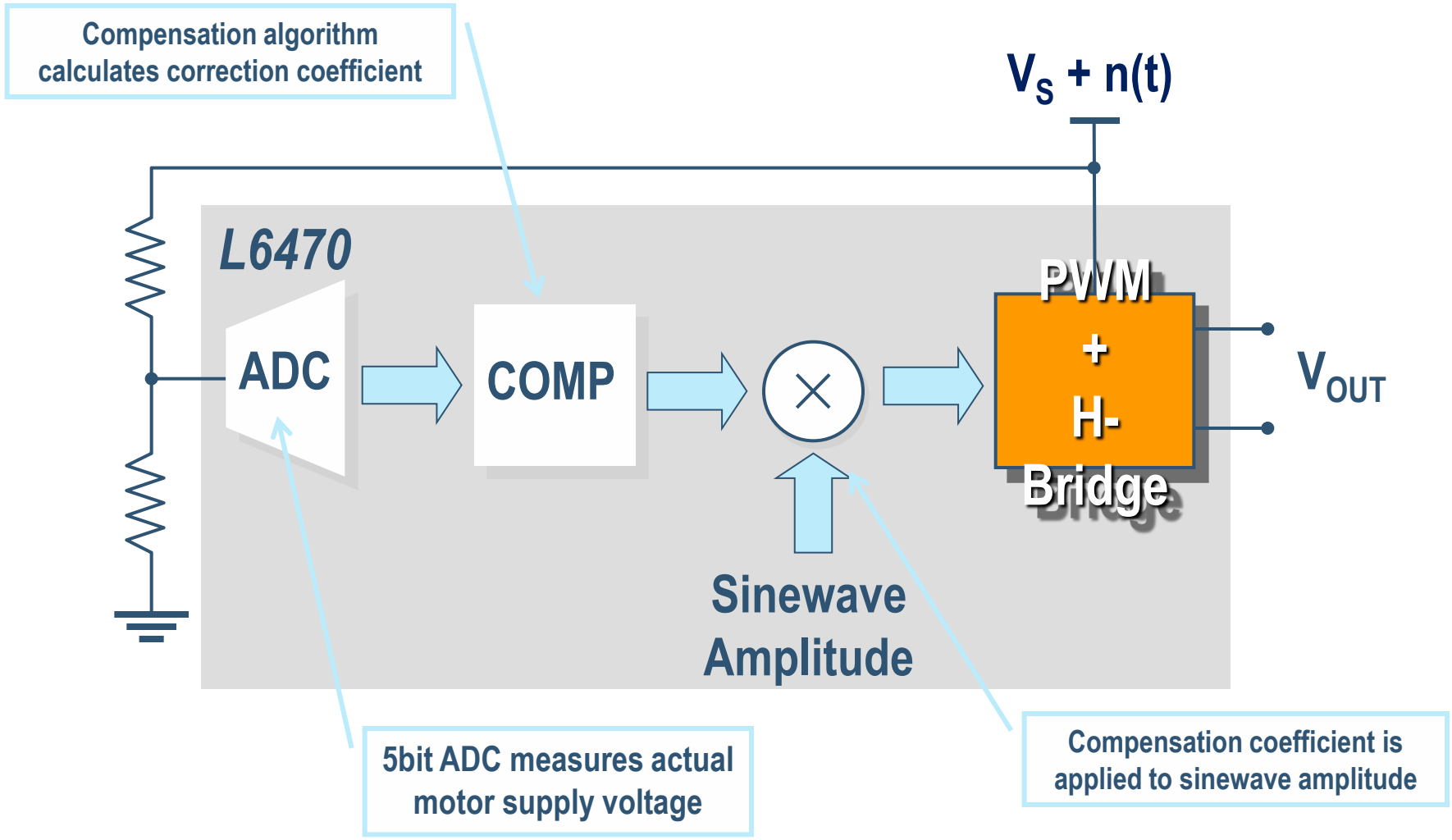
d *SPIN* logic switches from different compensation parameters sets according to motor status



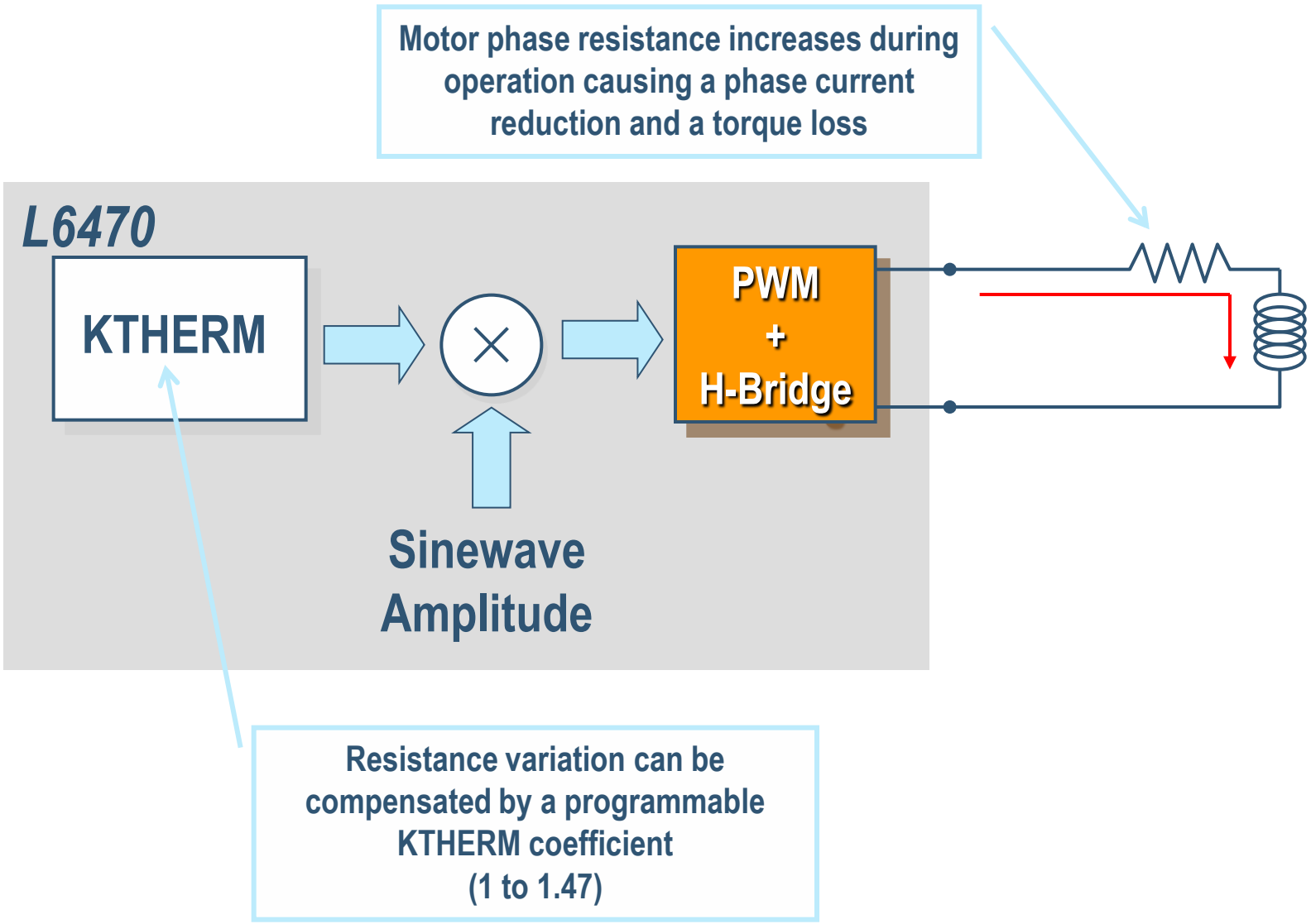
L6470 DSPIN Current with BEMF compensation



L6470 DSPIN Supply voltge compensation



L6470 DSPIN Phase resistance variation compensation



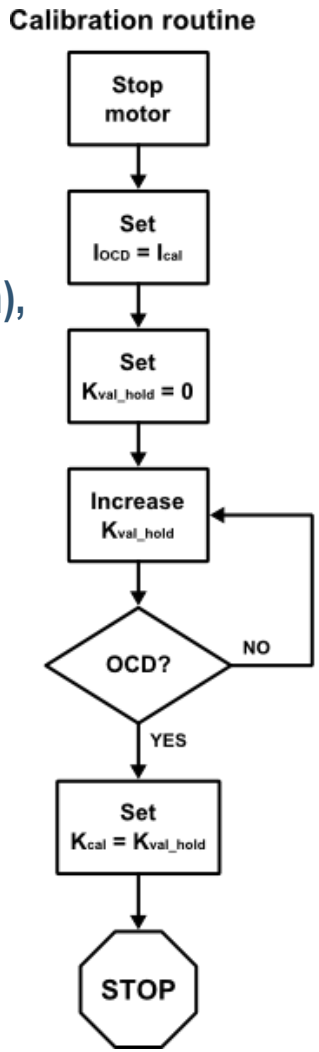
L6470 DSPIN Phase resistance variation compensation

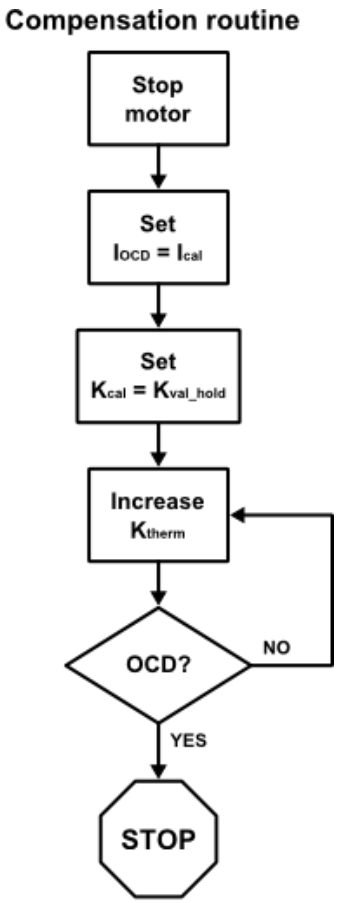
Calibration can be performed through the following steps:

- Stop the motor,
- Overcurrent threshold is set to a calibration value (Ical),
- Out voltage is increased at a low rate,
- When the calibration current is reached (FLAG notification), the related Kval value has to be stored (KCAL) into the µC memory

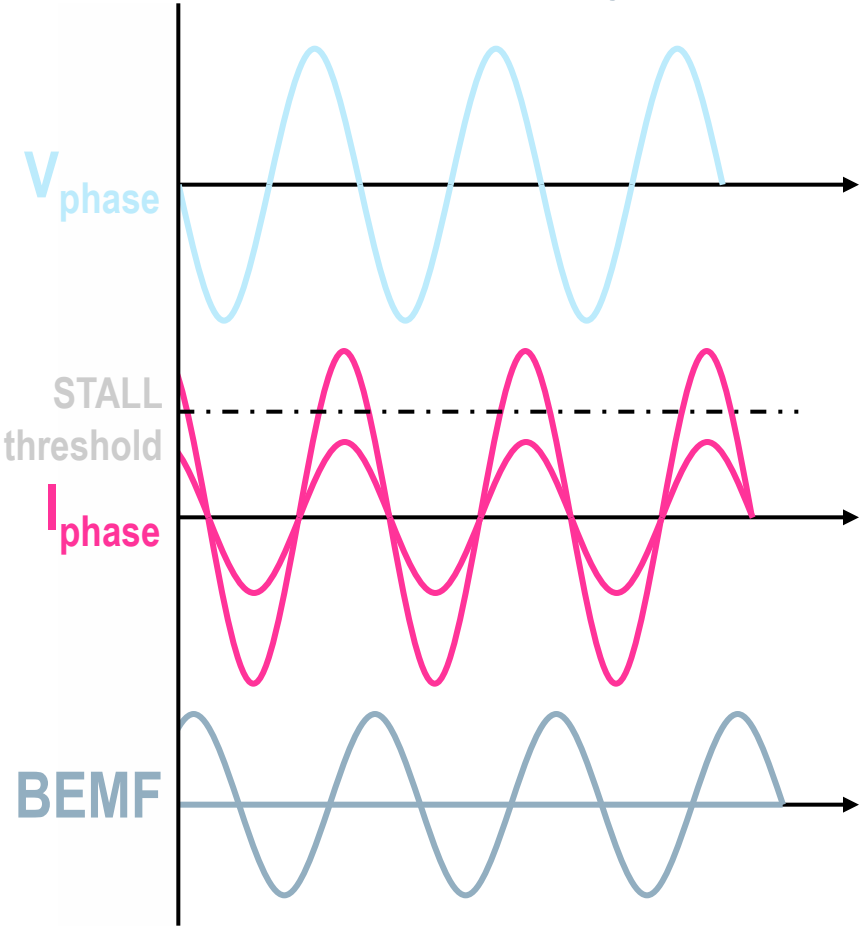
Winding resistance drift compensation can be performed via the following steps:

- Stop the motor,
- Overcurrent threshold is set to a calibration value (Ical),
- Kval value is set to KCAL,
- Compensation coefficient (K_THERM reg.) is increased or decreased to reach the calibration current (FLAG notification)



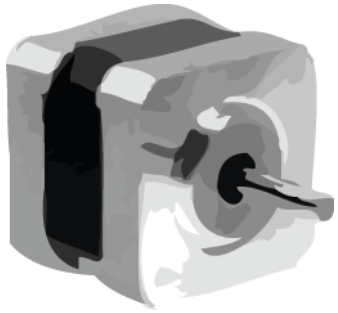


Using integrated current sensing and the adjustable STALL current threshold a cheap and easy stall detection can be implemented



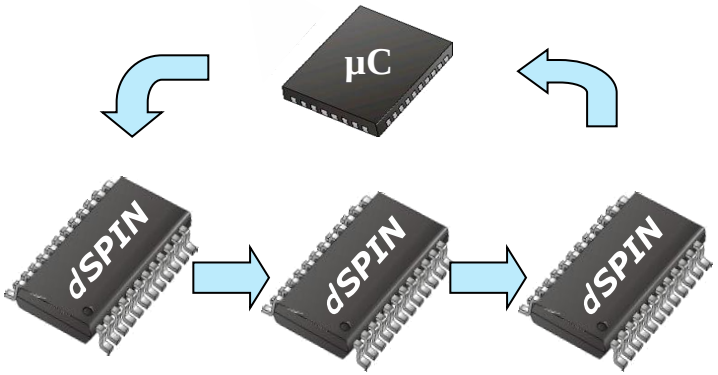
STALL!
BEMF is null and current is suddenly increased

Normal operation



L6470 DSPIN a complete digital interface

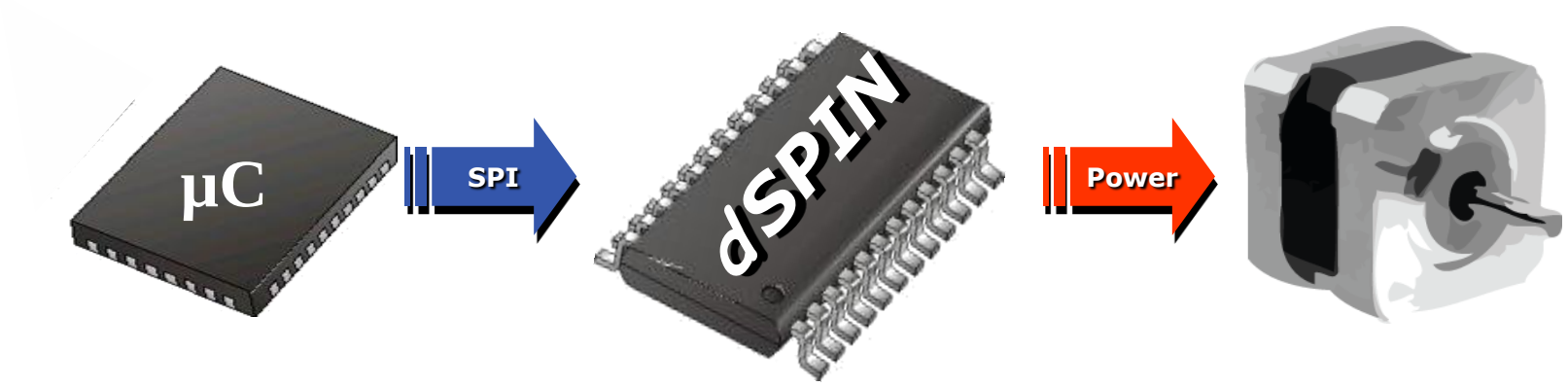
- **The fast SPI interface with *daisy-chain* capability allows a single MCU to manage multiple devices**



- ✓ Programmable alarm *FLAG* open drain output for interrupt-based FW
  In daisy-chain configuration, *FLAG* pins of different devices can be or-wired to save host controller GPIOs

- ✓ *BUSY* open drain output allows the MCU to known when the last command has been performed
  In daisy-chain configuration, *BUSY* pins of different devices can be or-wired to save host controller GPIOs

L6470 DSPIN Positioning & Speed profile



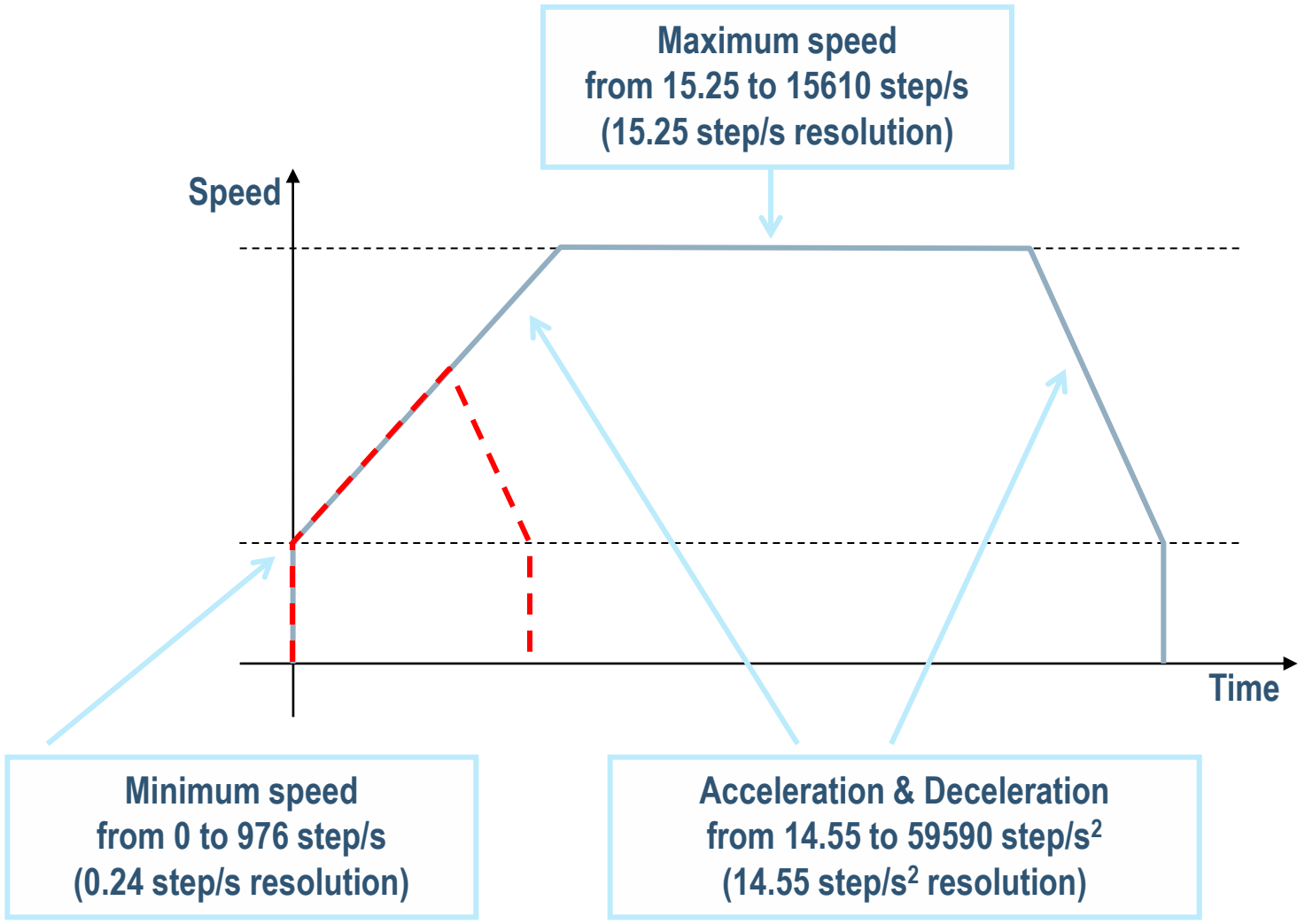
µC sends dSPIN high level commands…

Free-run → run at constant speed

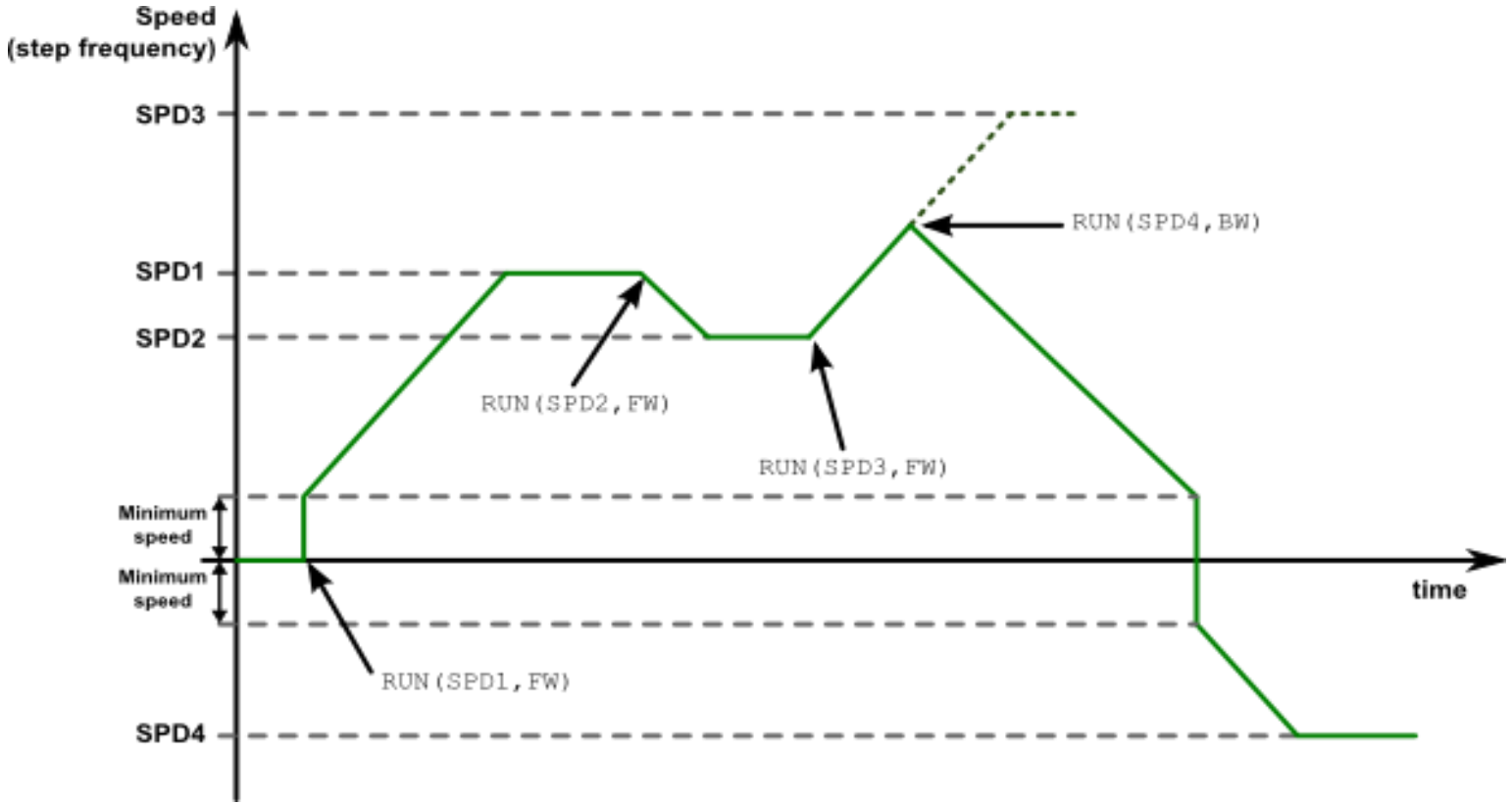
Positioning → reach the desired position

… and dSPIN does the tricky job!

L6470 DSPIN Fully progammable speed profile

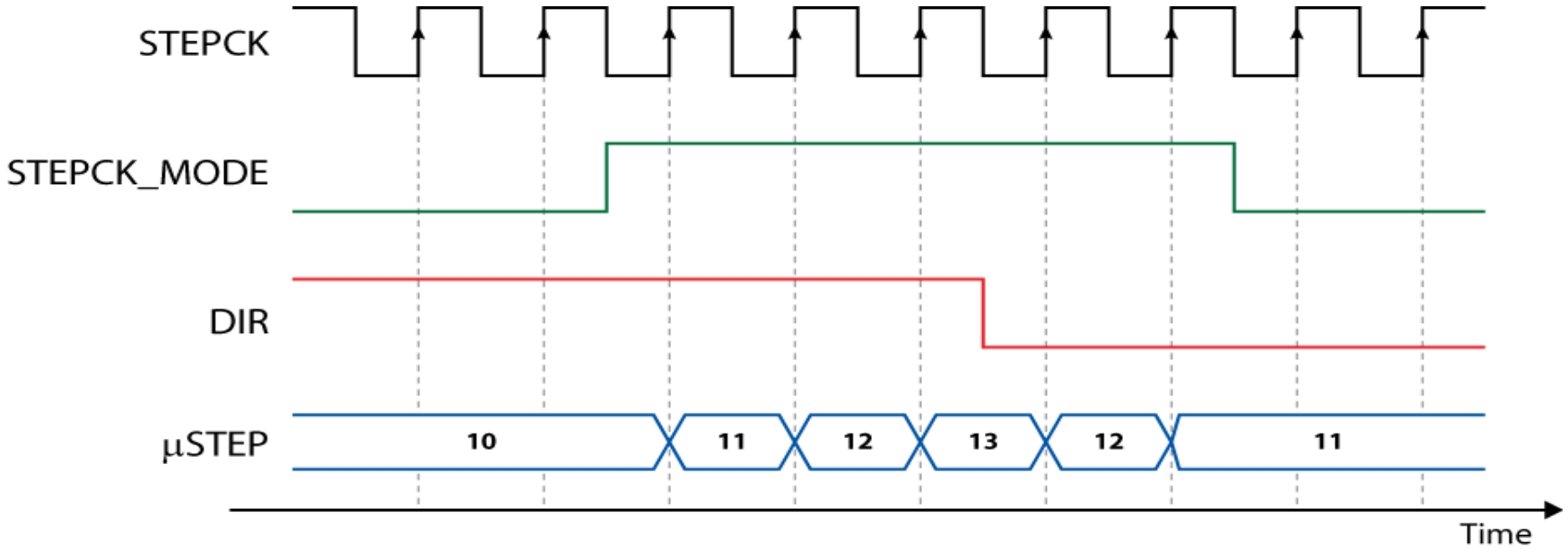


Run(SPD, DIR) command drives the motor to reach the target speed SPD in the selected direction. Target speed and direction can be changed anytime



Very slow motion can be achieved enabling step-clock mode through the StepClock(DIR) command

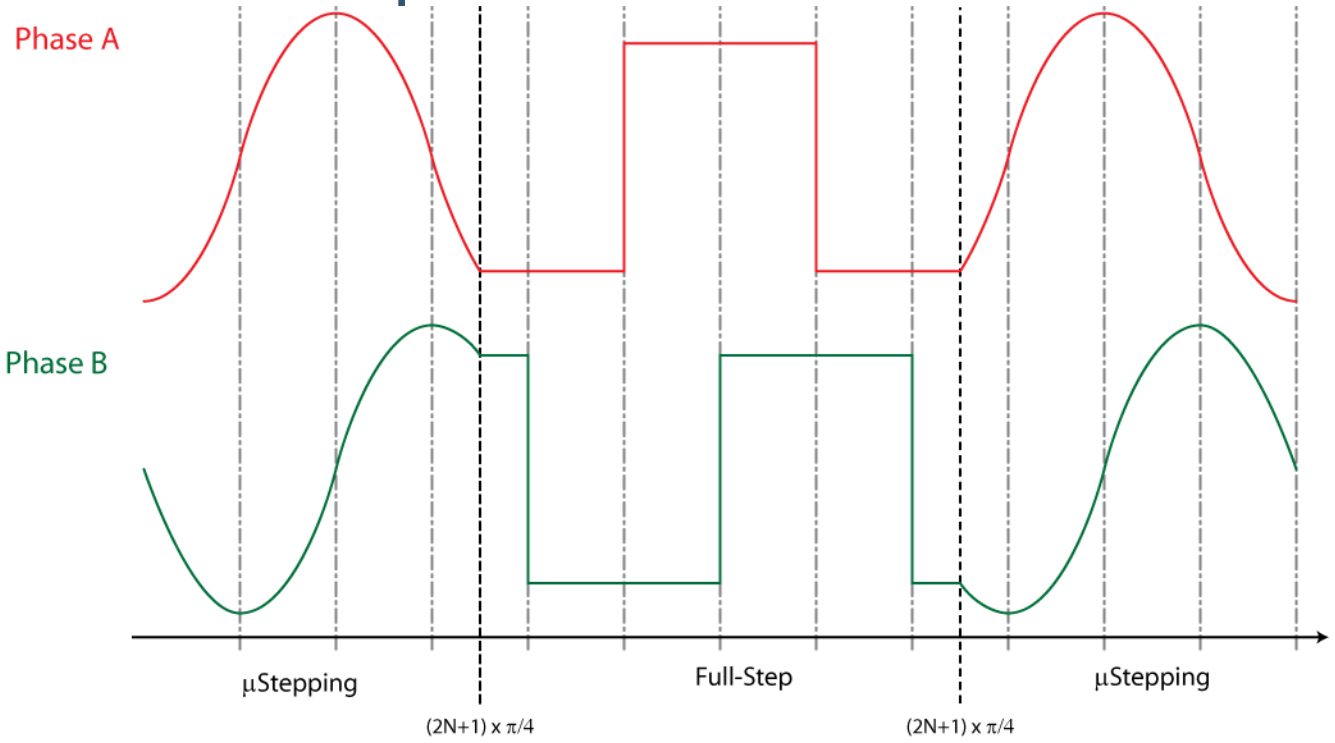
When L6470 is in step-clock mode, internal µstep logic is clocked through the external STCK pin instead of internal motion engine



L6470 DSPIN Automatic Microstepping Full Step

Control system automatically switches from microstep to full- step mode when the speed is greater than a programmable threshold

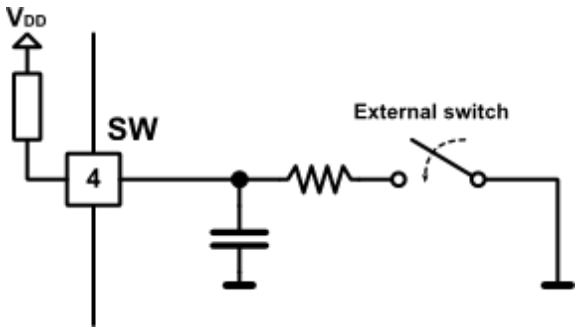
Switching from microstep to full-step allows increasing the torque at high speed with a low impact on motion smoothness



Device can manage an external switch to:

– immediately stop the motor

– init home position through GoUntil command

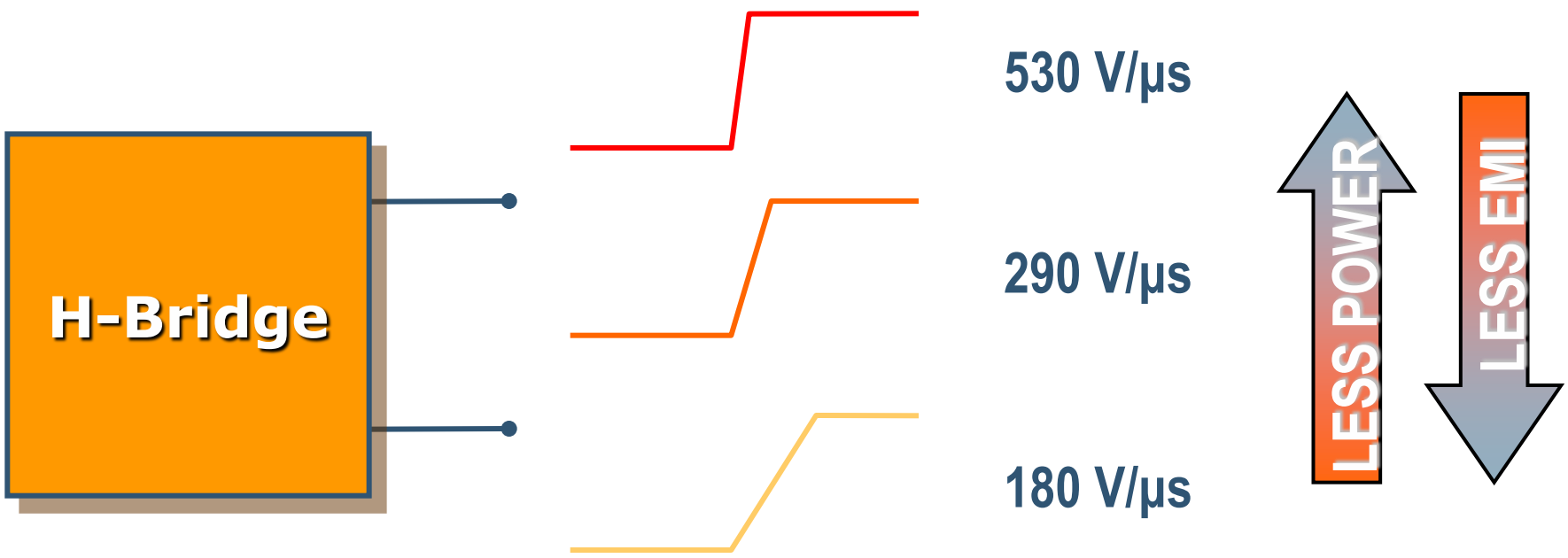


GoUntil command moves the motor with a selected constant speed and stops the motor when the switch is closed; at that time one of the following actions can be taken:

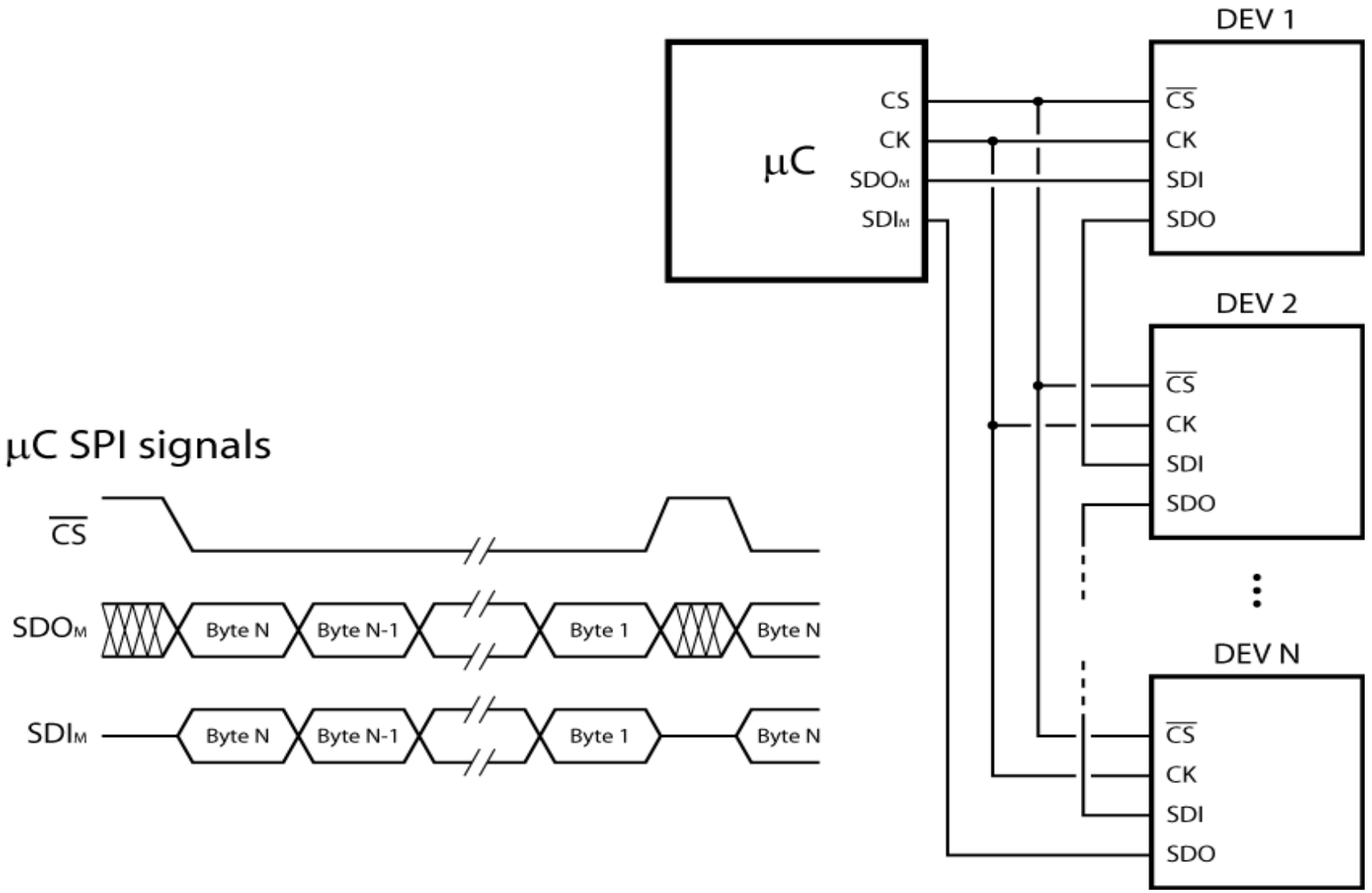
– absolute position register is reset to zero

– current absolute position is stored into MARK register

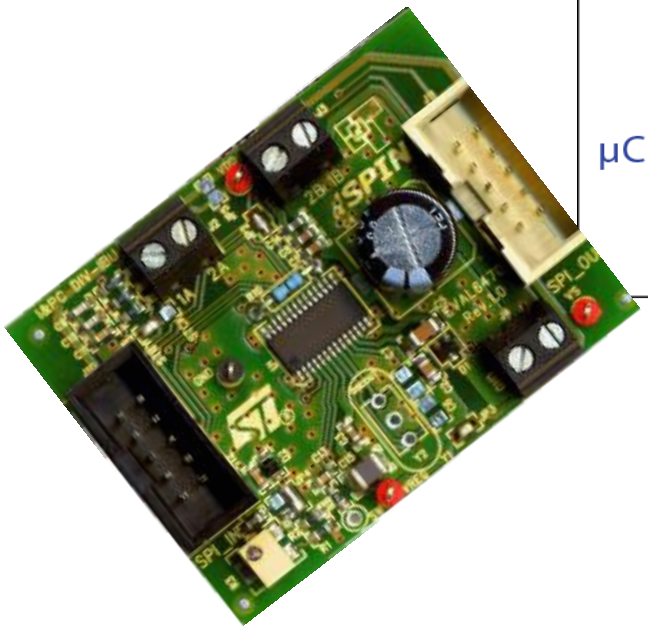
L6470 DSPIN Progammable Output Slew Rate

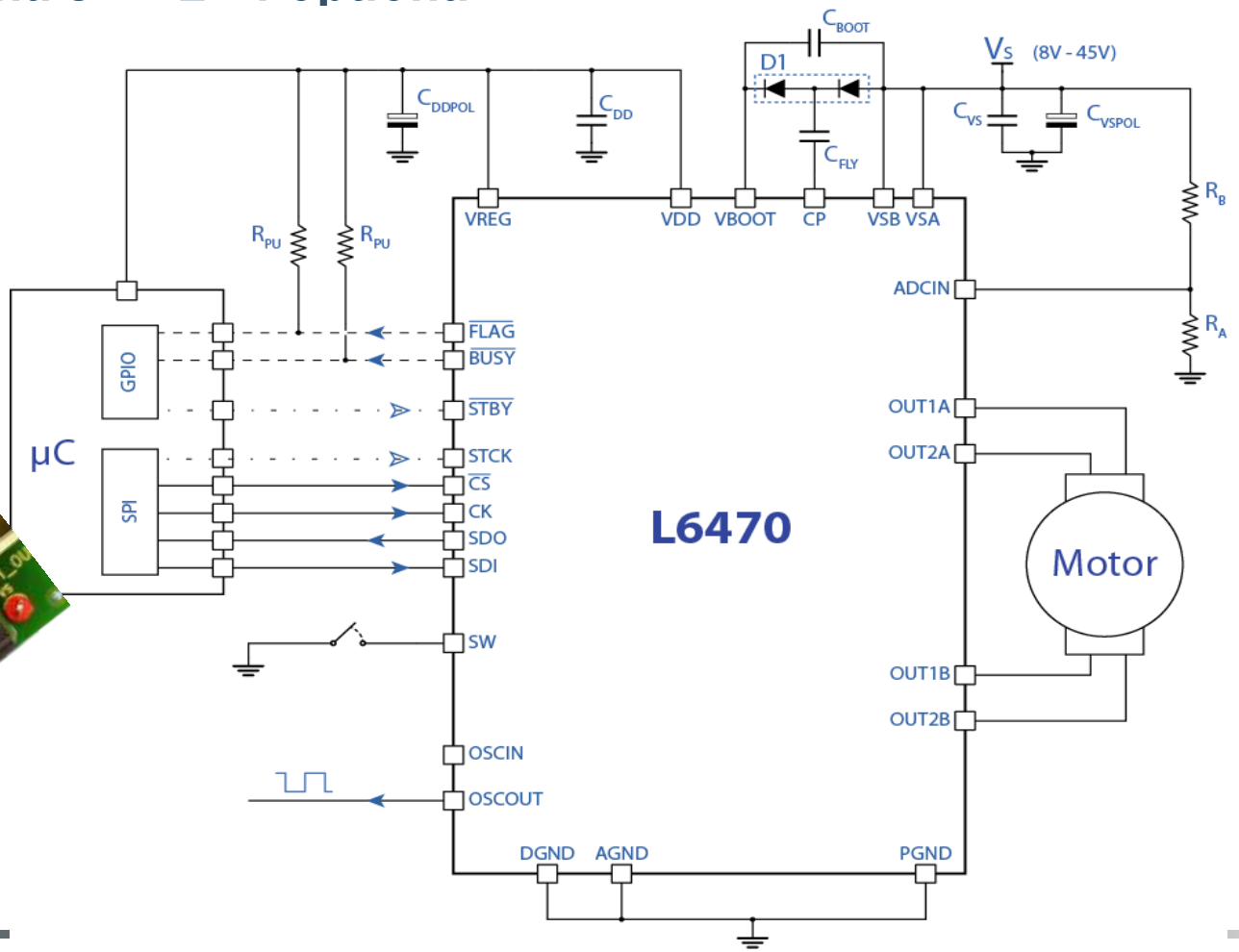


L6470 DSPIN Daisy Chaining



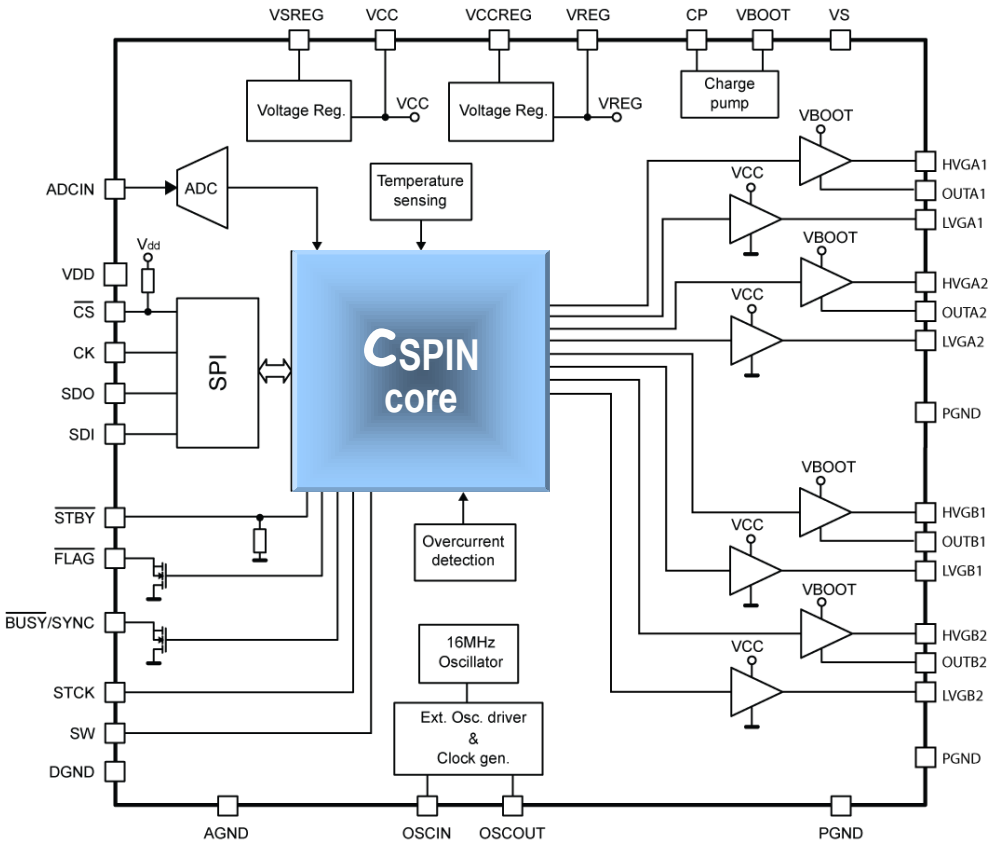
- ✓ Minimal component count
- ✓ µC: only 4 SPI signals + 2÷4 optional GPIOs





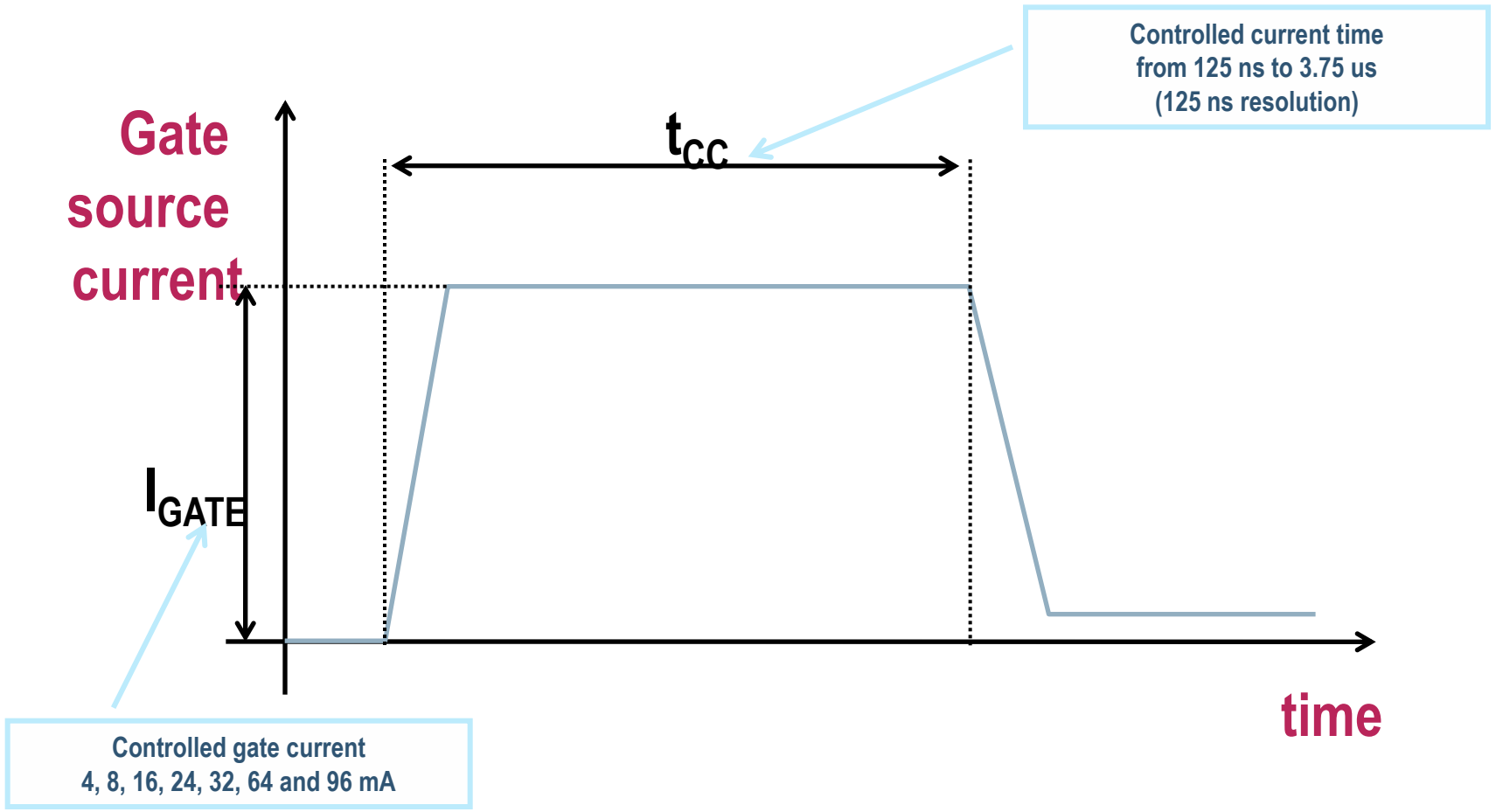
NEWS!!!! L6480 CSPIN Features

- Supply voltage 7.5V – 85V
- Dual full-bridge gate drivers
- Fully programmable gate driving
- Embedded miller clamp
- Up to 128 microsteps
- Voltage mode operation
- Sensorless Stall Detection
- Programmable speed profile
- Programmable positioning
- 8bit 5Mhz SPI interface
  (Daisy Chain compatible)
- Integrated 16MHz oscillator
- Integrated 5bit ADC
- Integrated 3.3V voltage regulator
- Integrated 15V/7.5V voltage regulator
- Full set of protection
  - Over Current
  - Over Temperature
  - Under Voltage protections

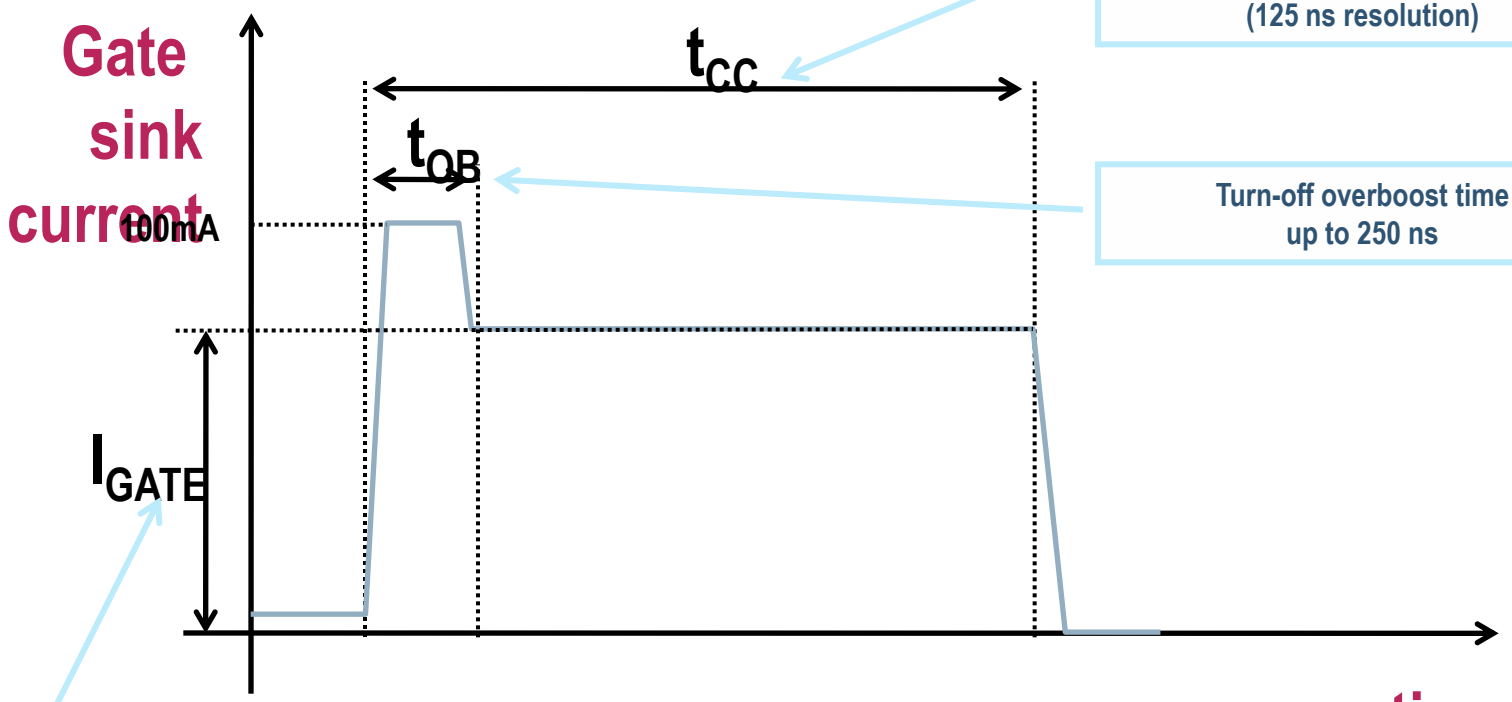


ES available
SOP H1 2012

L6480 CSPIN Programmable Gate Driver Turn ON



L6480 CSPIN Programmable Gate Driver Turn Off



Controlled current time
from 125 ns to 3.75 us
(125 ns resolution)

Turn-off overboost time
up to 250 ns

Controlled gate current
4, 8, 16, 24, 32, 64 and 96 mA

Try the new cSPIN with our demonstration board!

L6480 + STD10NF10
Up to 85 V
Up to 10 A

Available NOW!

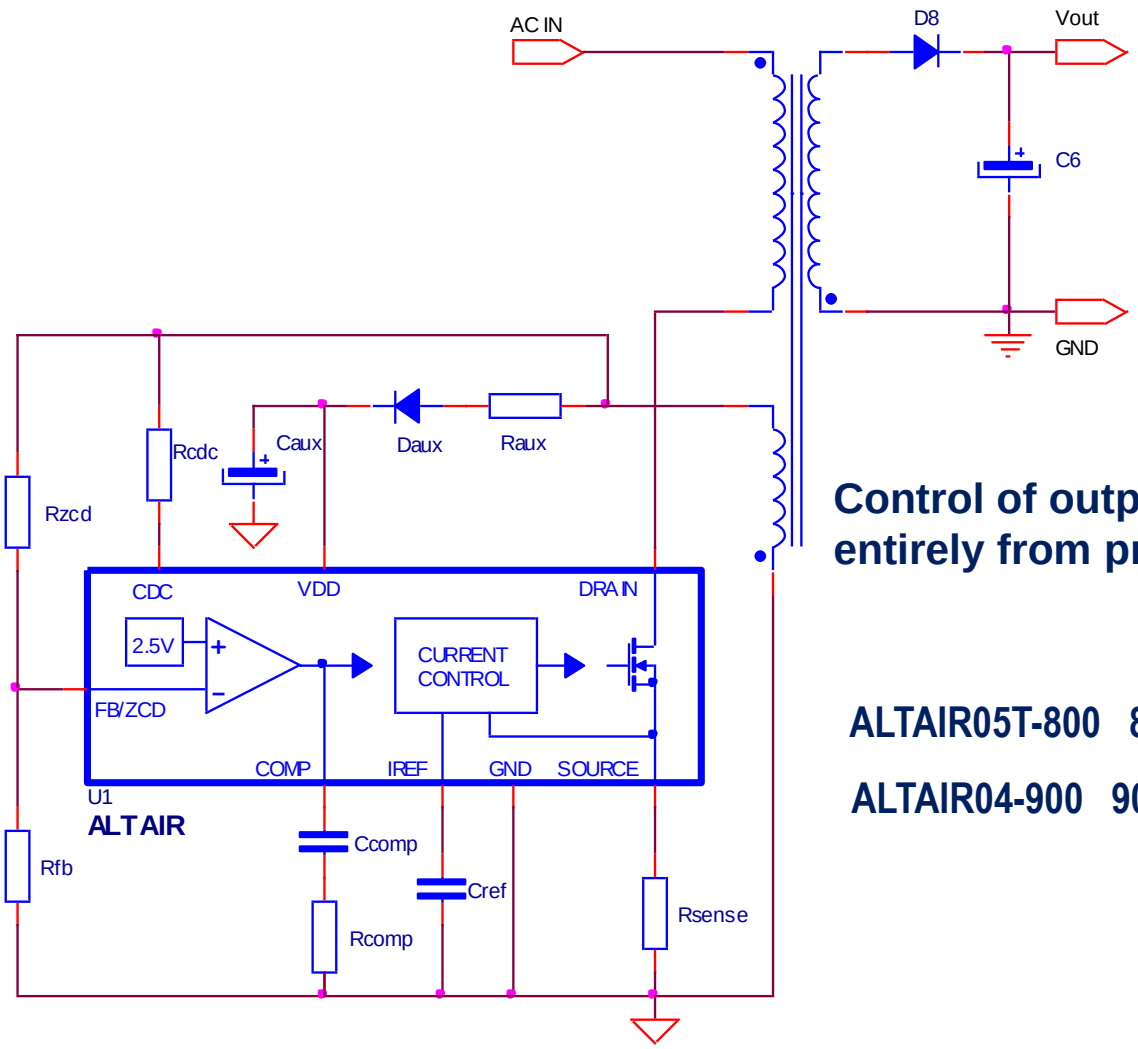
AC DC PWR SUPPLY

Industrial & Power Conversion Division

Off Line Power Supply Business Unit

AC DC PWR SUPPLY ALTAIR FAMILY

ALTAIR05T-800 & ALTAIR04-900 Schematic



No Optocoupler!!!!!!!

No secondary side voltage reference & error amplifier(s)

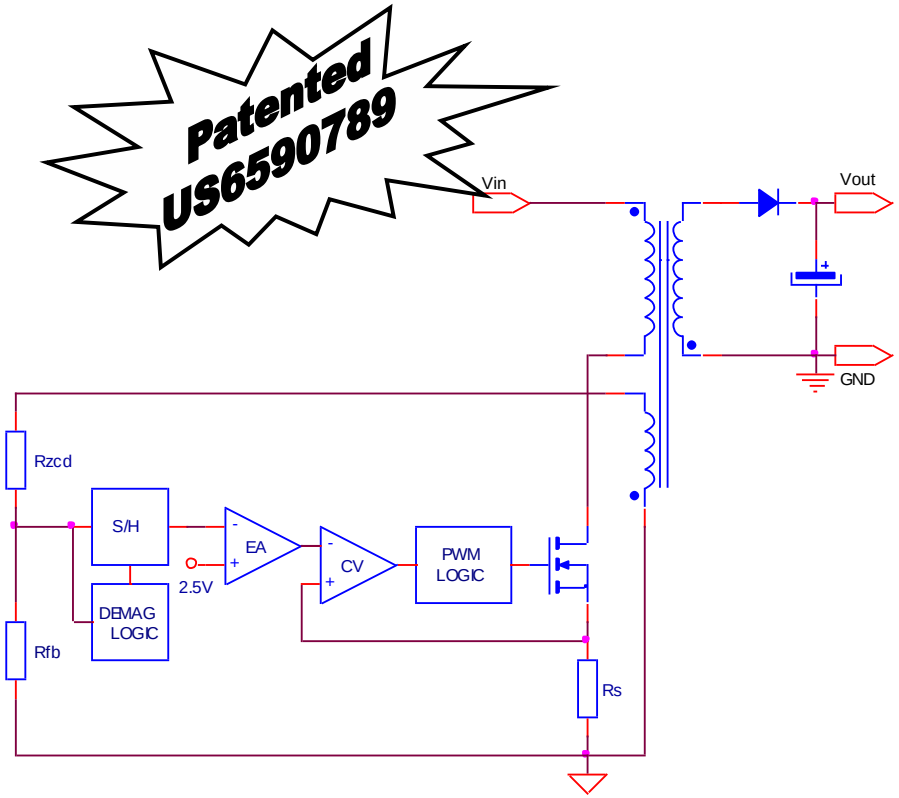
No secondary sense resistor

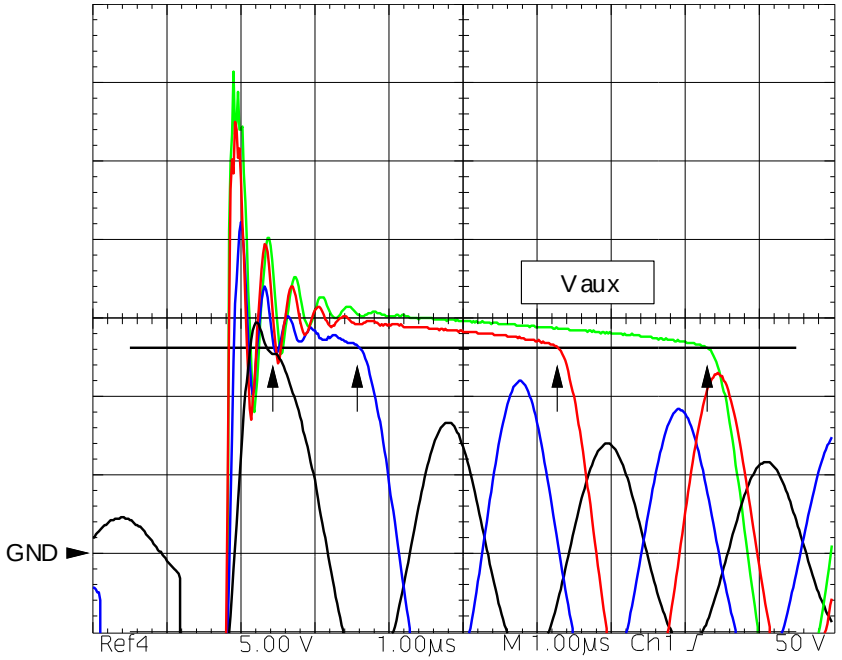
Control of output voltage and current entirely from primary side 5% accuracy

ALTAIR05T-800 800V 11 ohm Typ 25°C

ALTAIR04-900 900V 16 ohm Typ 25° C

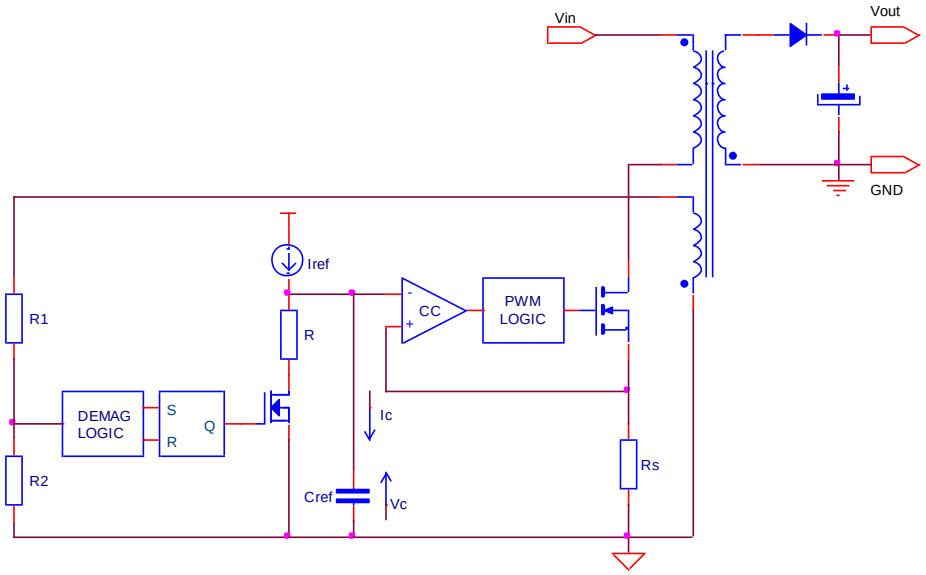
ALTAIR Costant Voltage Mode

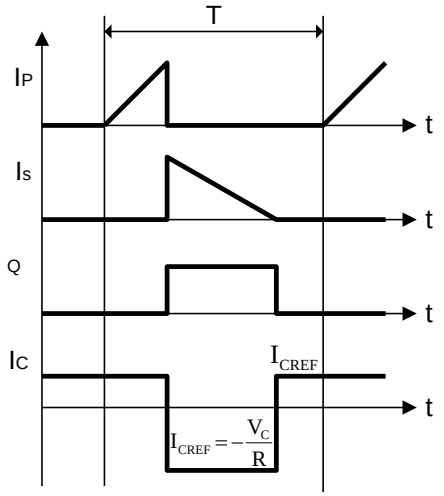




An accurate image of the output voltage can be obtained by sampling the voltage of the auxiliary winding right at the end of transformer's demagnetization. We use our proprietary technique to do the job.

ALTAIR Costant Current mode





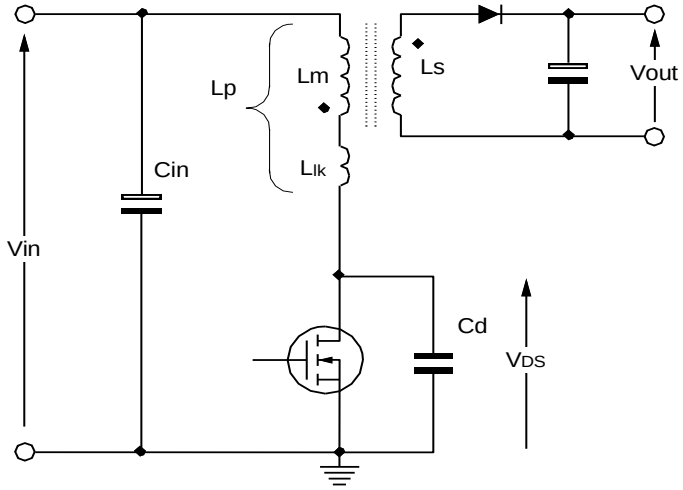
$$I_{OUT} = \frac{n \cdot I_P}{2} \cdot \left(\frac{T_{ONSEC}}{T} \right) \qquad I_P = \frac{V_C}{R_{SENSE}}$$

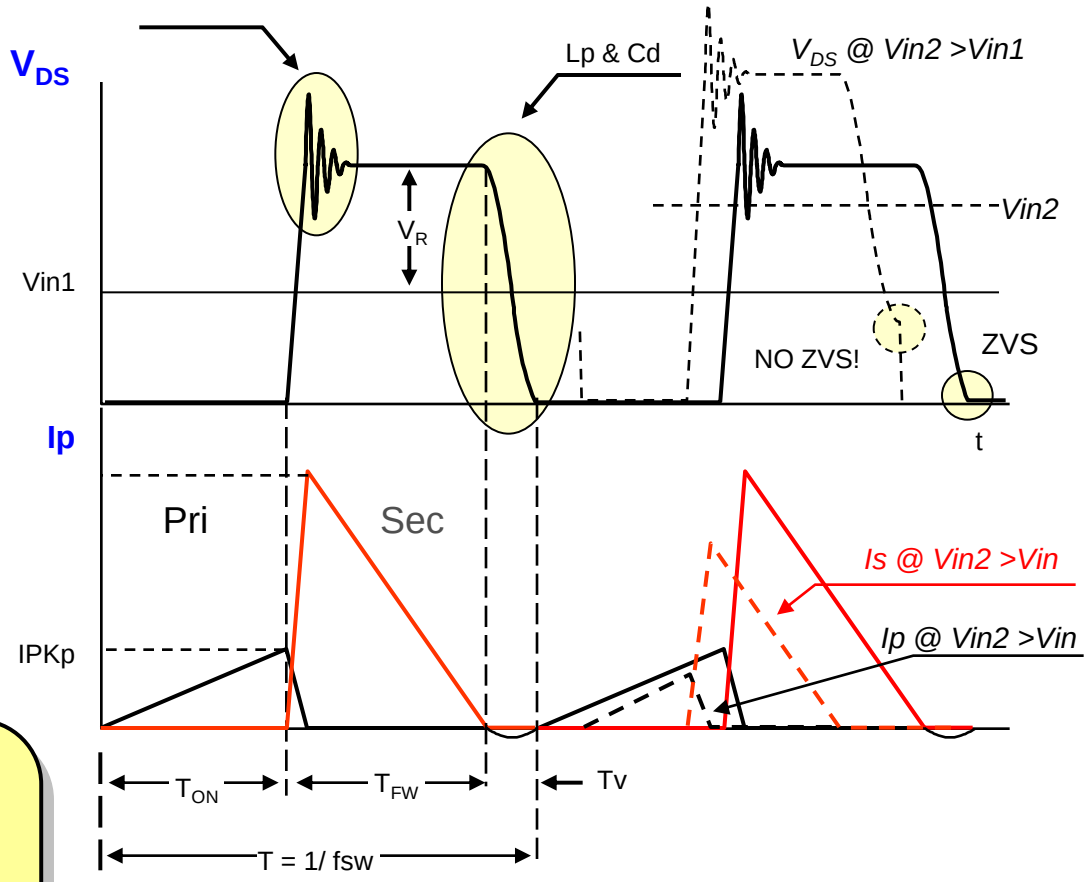
$$I_{REF} \cdot \left(T - T_{ONSEC} \right) + \left(I_{REF} - \frac{V_C}{R} \right) \cdot T_{ONSEC} = 0$$

$$I_{OUT} = \frac{n}{2} \cdot \frac{R \cdot I_{REF}}{R_{SENSE}}$$

- ✓ Valid in DCM only
- ✓ Iout not depend on either Vin, Vout or Fsw

ALTAIR QR Commutation





- ✓Operation close to the boundary between CCM and DCM
- ✓Zero Voltage/Zero Current Switching at turn-on achievable
- ✓Less EMI generated
- ✓Variable Frequency spreads spectrum

ZVS condition: Vin < VR

STMicroelectronics WEB SITE Support

STMicroelectronics

Analog

Home » Sense & Power » Analog

- Amplifiers & Comparators
- ASSP for Industrial
- Clocks & Timing Circuits
- Interface, Filtering & Signal ..
- Power Management
- Sensors & MEMS

Highlights | Search

- ST introduces a new family of single- and two-axis MEMS gyroscopes
- ST's MEMS enables motion sensing in Openmoko mobile handsets
- ST promotes green power for electronics
- Faster broadband amplifiers from ST accelerate multimedia networking
- ST increases power output of

Overview | Design

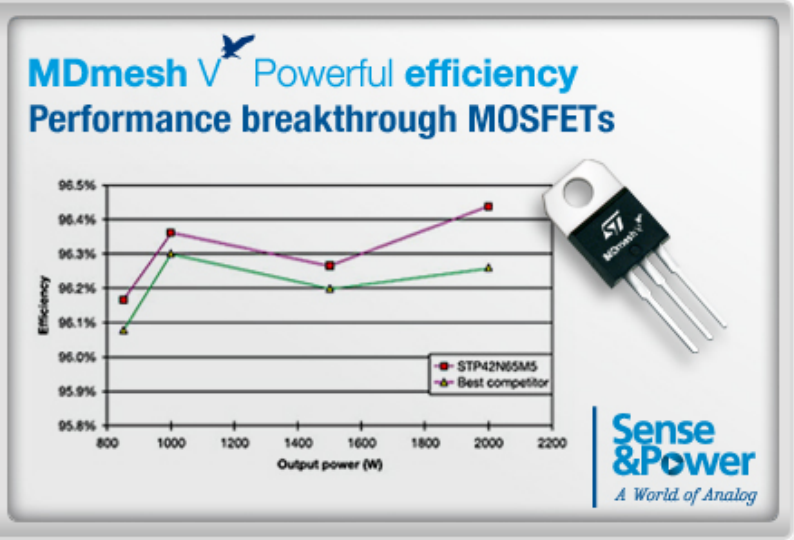
From signal to power Analog ICs, ST's portfolio covers practically all Analog functions.

Our World of Analog products include sensors and MEMS, amplifiers, interfaces, analog front-end and back end, and power management devices, among many others.

STMicroelectronics

Power

Diodes
Power Conversion Modules
Protection Devices
Thyristors & AC Switches
Transistors



Highlights | Search

STs' MDmesh™ V power-MOSFET technology achieves the industry's best on-resistance per area for the high..

New power AC switches featuring built-in surge protection deliver the competitive edge for appliances

ST advances IGBT switching performance and reduces size in energy-saving ballasts and converters

Overview | Design

STMicroelectronics continues its history of leadership in power semiconductors, with one of the industry's most extensive portfolios. A rich array of energy-efficient power products and solutions reflects ST's commitment to be at the forefront of this field through innovation.

MOSFETs: the new performance breakthrough offered by the latest with its latest MDmesh™ V technology achieves the best on-resistance with substantial cost advantages.

IGBT: the latest series of ignition products achieves unrivalled low voltage drop combined with high energy capability for a more efficient system design.

STMicroelectronics WEB SITE Support

SILICA An Avnet Company