

# FIVE Intelligent Controller Unit (ICU)



## Motor Control Applications

2002 Edition



[five.support@st.com](mailto:five.support@st.com)

<http://www.st.com/five>



## FIVE Intelligent Controller Unit (ICU) 408 Family in Motor Control

### T440

Comparator

1/2/4/8Kb Otp  
128/256b Ram  
2x 8-Bit Timer/Pwm  
Triac Drive/ZCD  
Comparator+Timer  
20/28 pin Dip/So

### T420

8-Bit ADC

1/2/4Kb Otp  
128b Ram  
3x 8-Bit Timer/Pwm  
8-Bit Adc  
28 pin Dip/So

- V/F and Slip Control
- Std or Fuzzy PID
- Fuzzy Control
- Decision Systems
- Virtual Sensoring
- Data Fusion
- ...

### T400

Basic

1/2/4/8Kb Otp  
128/256b Ram  
2x 8-Bit Timer/Pwm  
Triac Drive/ZCD  
20/28 pin Dip/So

### T410

Basic Super Pwm

1/2/4Kb Otp  
128b Ram  
3x 8-Bit Timer/Pwm  
28 pin Dip/So

### T430

8-Bit ADC & SCI

2/4/8Kb Otp  
128/256b Ram  
3x 8-Bit Timer/Pwm  
8-Bit Adc - Sci  
32 pin SDip/Tqfp  
34 pin SSo

- Universal, AC Monophase
- Phase Angle with Triac Driver
- Burst control with Triac driver
- PWM control

- Induction, Brushless, Universal Motors
- Six-step or chopper mode
- PWM Control

- Induction and Universal motors
- Six-step or chopper mode
- PWM Control
- Serial link (UART)





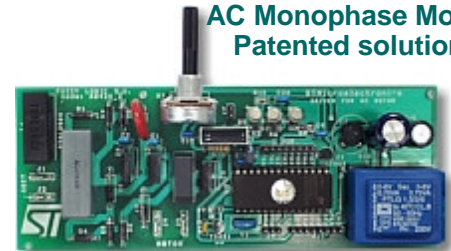
# FIVE Intelligent Controller Unit (ICU) Application Boards

Motor Type	Board Features
Universal	Triac + VIPER12 voltage regulator
AC 1 phase	Triac + Low Cost Voltage reg
	"Low Noise – Low Cost" Patented Driver (Choppered Voltage)
	H-Bridge
AC 3 phases	3-ph Inverter Bridge
Brushless DC	Mono Sensor Inverter Bridge
	Sensorless Inverter Bridge
Switched Reluctance 3-phases	n+1 switches topology
Switched Reluctance 4-phases	2n switched topology

Universal & AC Monophase Motor



AC Monophase Motor Patented solution



AC Three-Phase Motor



- 3 Motor Control Boards available as *Evaluation Boards*
- *Portable Demos for All listed Motors*
- *Application Notes with Visual Five project and PCB Gerber file at <http://www.st.com/five>*

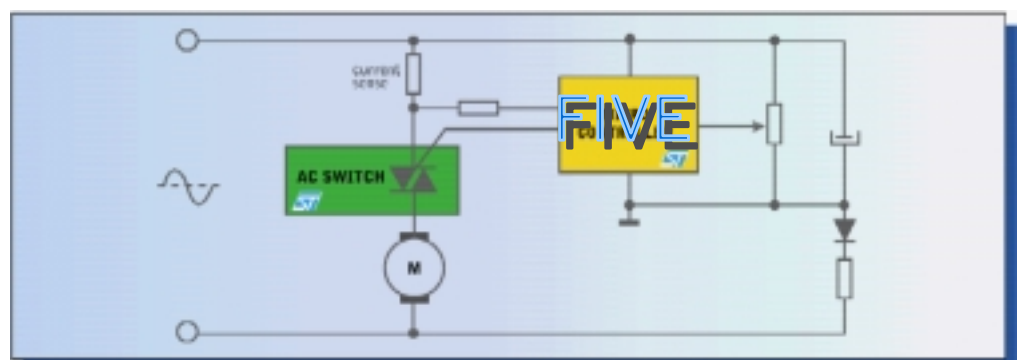
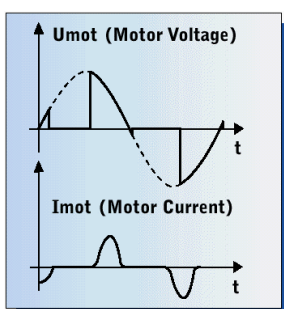


# FIVE Intelligent Controller Unit (ICU) Universal & AC Monophase MC (1/3)

## TRIAC BOARD

The motor is connected to the mains through an AC switch. AC Voltage across the motor varies in **phase-angle partialization control** mode by means of FIVE which sets the triac triggering time

Phase Angle Principle

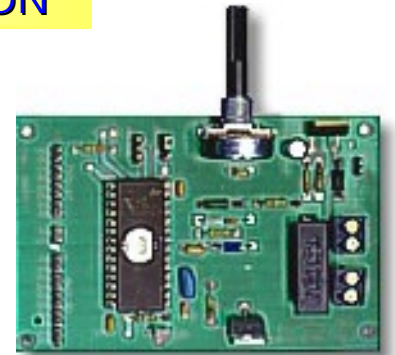
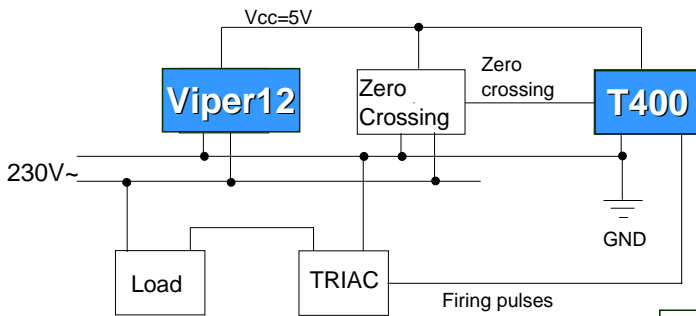




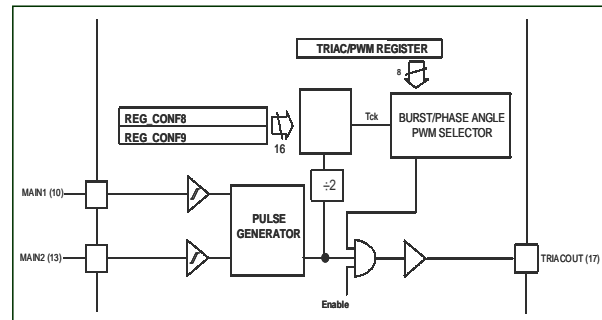
# FIVE Intelligent Controller Unit (ICU) Universal & AC Monophase MC (2/3)

## Solution I

### TRIAC BOARD - 2<sup>nd</sup> GENERATION



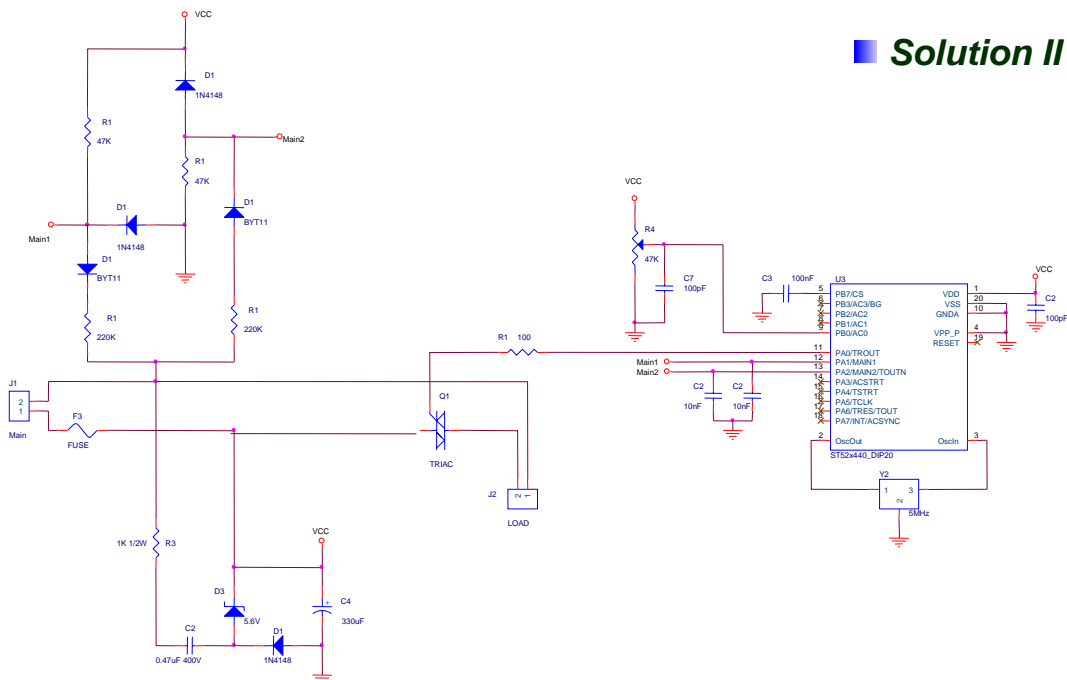
**T400: ICU with Integrated Hardware Triac Driver**



# FIVE Intelligent Controller Unit (ICU) Universal & AC Monophase MC (3/3)

### TRIAC BOARD - Low Cost Power Supply

## Solution II

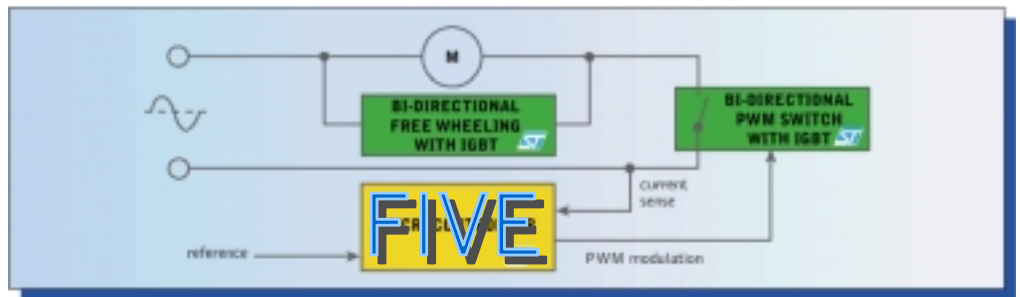
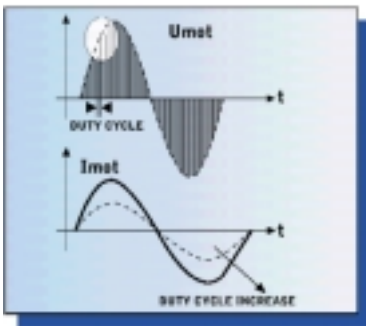




# FIVE Intelligent Controller Unit (ICU) AC Monophase Low Noise MC (1/6)

## AC Monophase IGBT Board

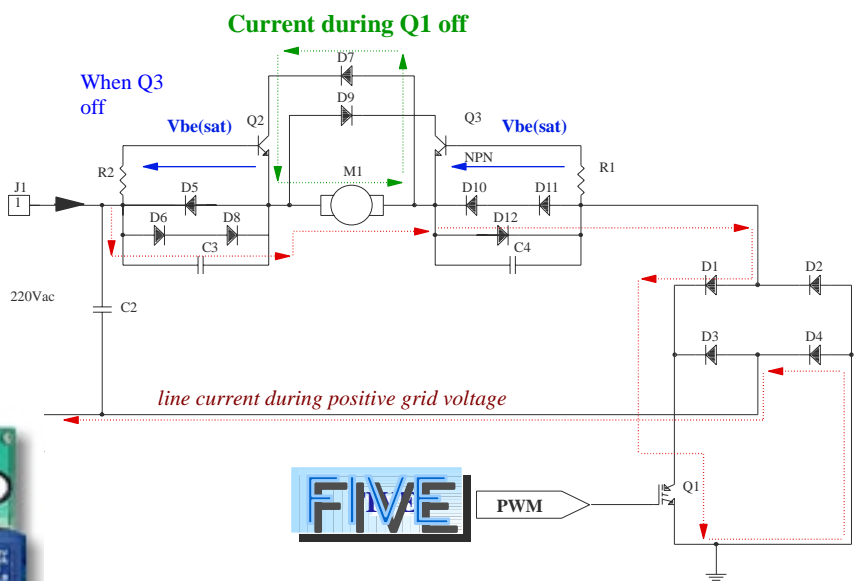
The induction motor is driven in high frequency mode by an innovative single switch topology, which delivers a **silent** and **cost effective** variable speed drive. The speed is controlled by the motor voltage: the power switch is driver with **PWM modulation** and its duty cycle changes linearly to control the speed versus the torque.



# FIVE Intelligent Controller Unit (ICU) AC Monophase Low Noise MC (2/6)

## AC Monophase IGBT Board

### ST Patented Solution



**For Motor Power < 300 W**







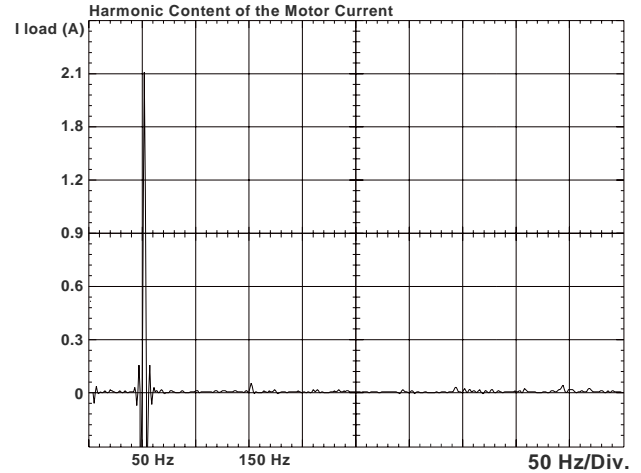
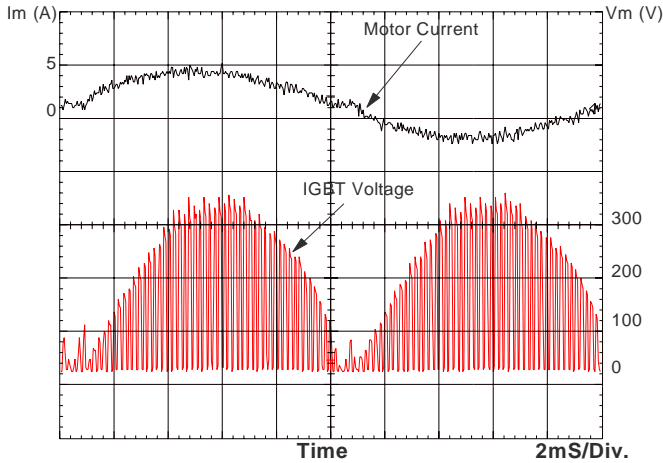
# FIVE Intelligent Controller Unit (ICU) AC Monophase Low Noise MC (3/6)

## AC Monophase IGBT Board

with proposed noiseless driver and PWM modulation

Motor Current

Current Harmonic Content



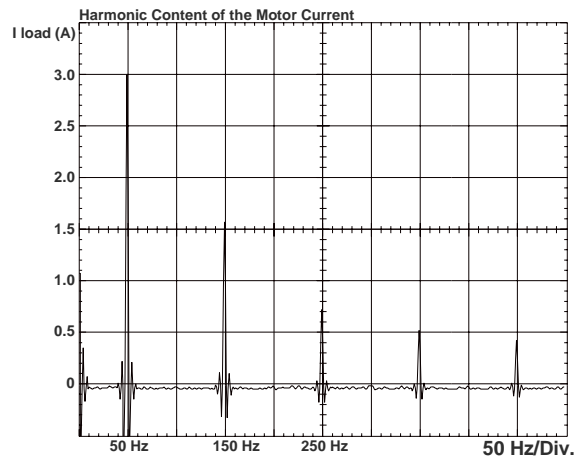
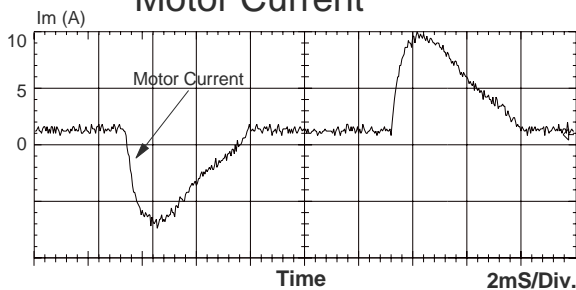
# FIVE Intelligent Controller Unit (ICU) AC Monophase Low Noise MC (4/6)

## AC Monophase IGBT Board

with TRIAC driver and Phase Angle Partialization

Motor Current

Current Harmonic Content



Comparing  
Harmonics Power Content  
between the two solutions

	1 st (Watt)	3 rd (Watt)	5 th (Watt)
Triac Solution	500	68	32
Proposed Solution	400	0.1	0.0



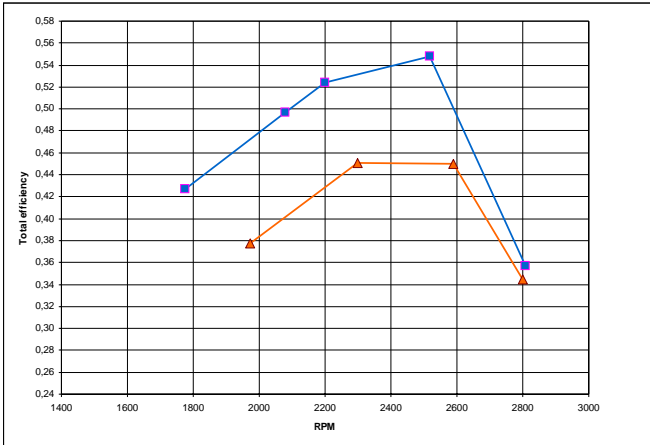


# FIVE Intelligent Controller Unit (ICU) AC Monophase Low Noise MC (5/6)

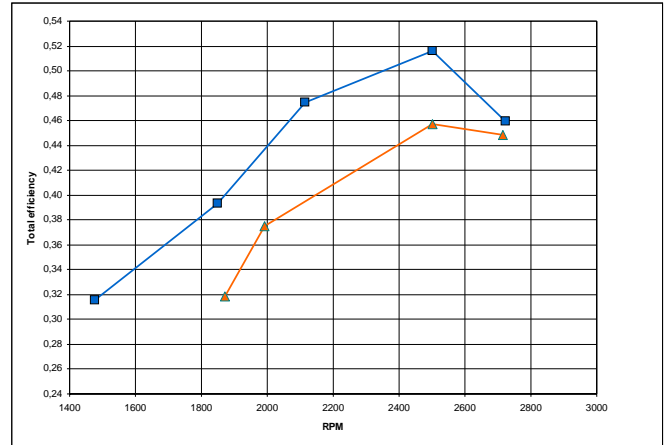
## AC Monophase IGBT Board

with TRIAC driver (in red) and ST PWM solution (in blue)

Efficiency @ 0,1Nm

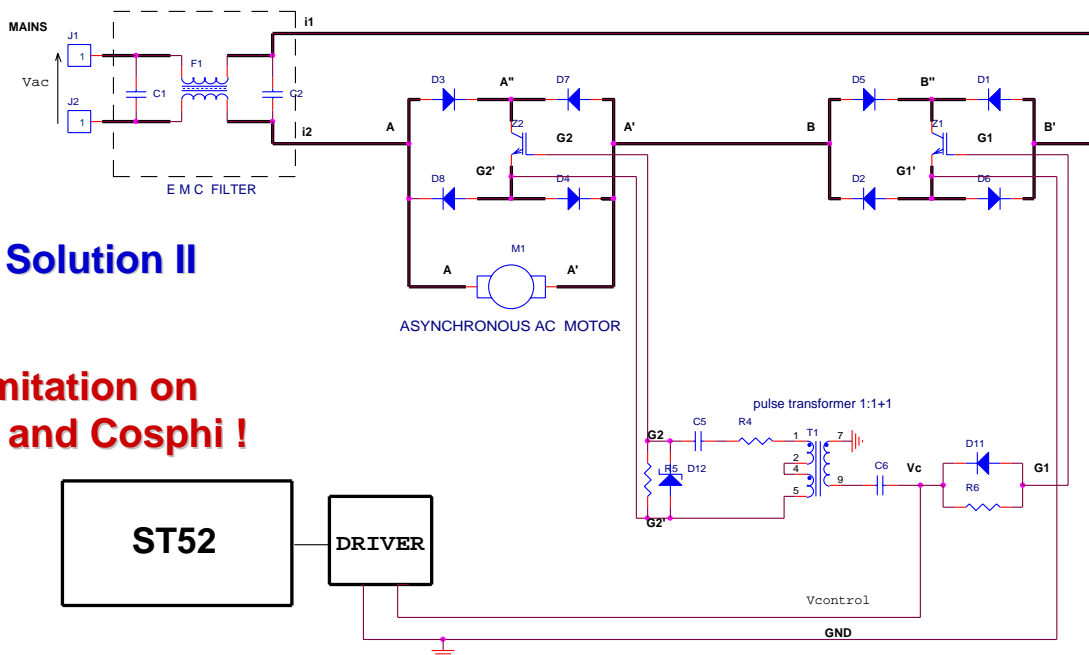


Efficiency @ 0,15Nm



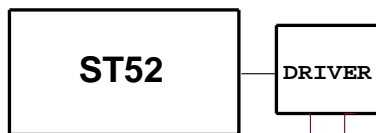
# FIVE Intelligent Controller Unit (ICU) AC Monophase Low Noise MC (6/6)

## AC Monophase Enhanced Board



ST Patented Solution II

With no limitation on  
Motor Power and Cosphi !



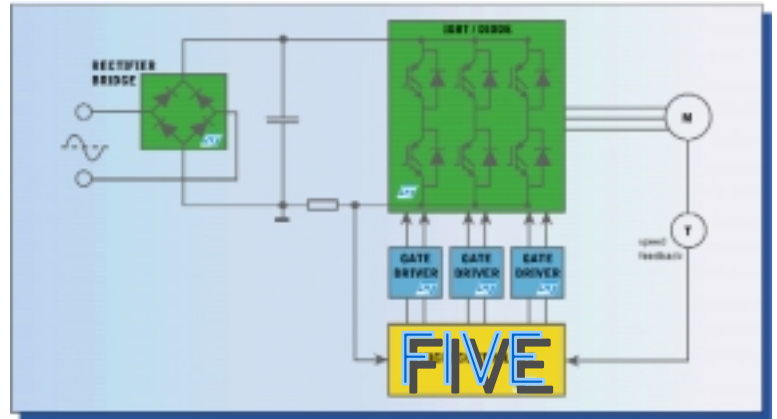


# FIVE Intelligent Controller Unit (ICU) AC 3 Phase Motor Control

## Inverter Bridge Board

Scalar control achieved by constant **V/F (voltage to frequency) ratio** in open or closed loop (AN).

**Slip control** using a fuzzy algo for slip calculus has been developed (AN)



**PCB gerber + software free download**

FIVE Intelligent Controller Unit (ICU)

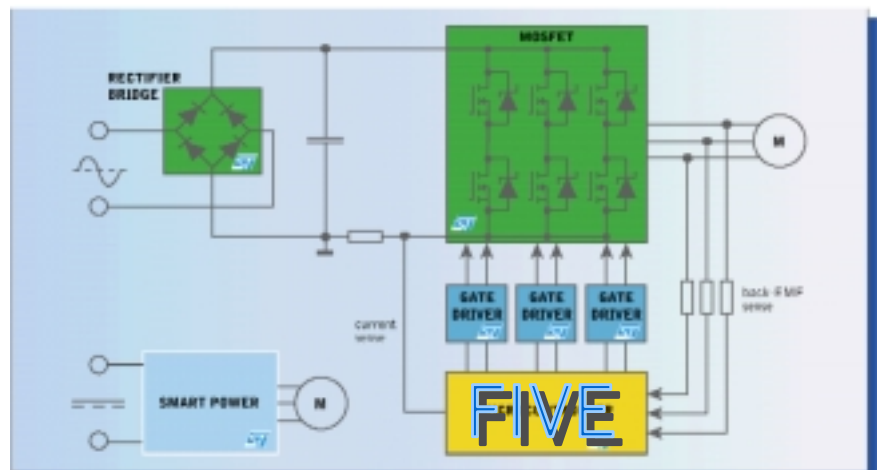
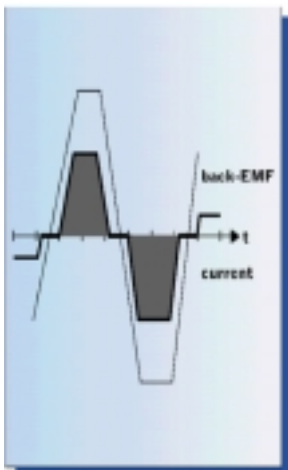
<http://www.st.com/five>



# FIVE Intelligent Controller Unit (ICU) Brushless DC Motor Control (1/2)

## Brushless DC Boards

The motor is supplied by three trapezoidal 6-step waveforms with **PWM modulation**. Sensor and sensorless mode algorithms have been developed (AN).



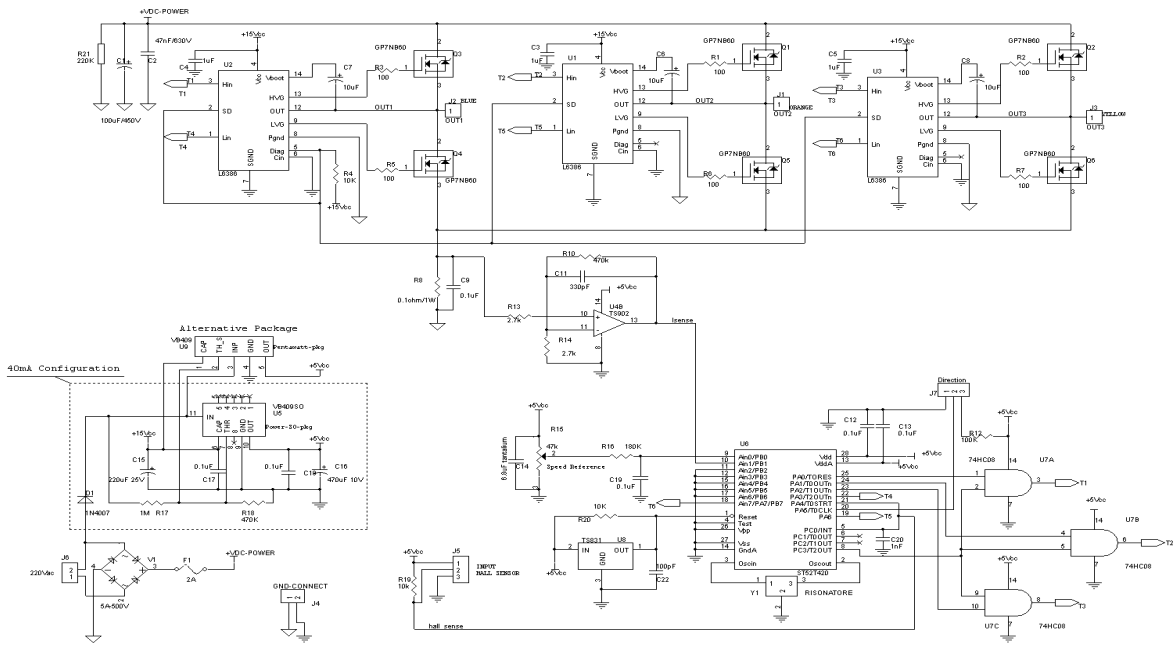
FIVE Intelligent Controller Unit (ICU)

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# FIVE Intelligent Controller Unit (ICU) Brushless DC Motor Control (2/2)



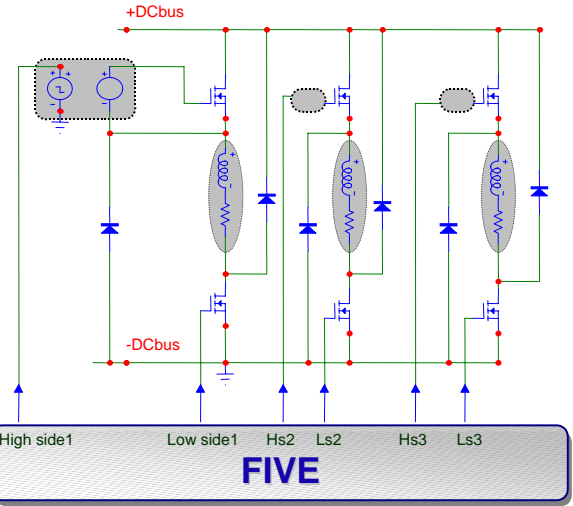
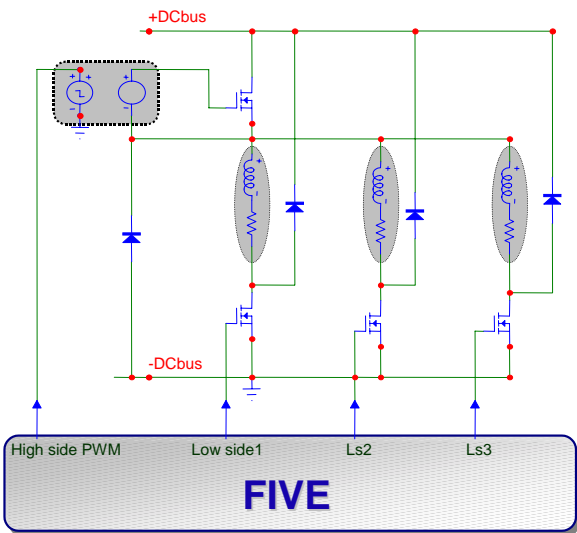
One Hall Sensor Brushless DC Board



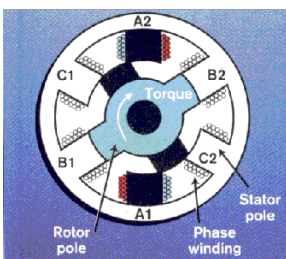
# FIVE Intelligent Controller Unit (ICU) Variable Reluctance Motor Control

Two Boards Topologies

## n+1 Switches Inverter Driver



## 2n Switches Inverter Driver







# FIVE Intelligent Controller Unit (ICU) Application Notes and Support

- AN1112 - THREE-PHASE MOTOR CONTROL BY USING ST52X301
- AN1113 - BRUSHLESS MOTOR FUZZY CONTROL BY USING ST52X301
- AN1114 - BURST MODE TRIAC CONTROL BY USING ST52X301
- AN1115 - ST52X301 FOR STEPPER MOTORS FUZZY CONTROL
- AN1146 - I2C COMMUNICATION BETWEEN ST52X301 AND EEPROM
- AN1147 - HIGH RESOLUTION DIGITAL CONVERSION OF AN NTC BY ST52X301
- AN1221 - A SIMPLE METHOD TO DRIVE A TRIAC WITH ST52X420 DIRECTLY FROM THE MAIN
- AN1222 - I2C COMMUNICATION BETWEEN ST52X420 AND EEPROM
- AN1254 - HOW TO MEASURE THE PERIOD OF AN EXTERNAL SIGNAL WITH ST52X420
- AN1255 - NEW CIRCUITAL SOLUTION TO EFFICIENTLY DRIVE AN AC MONOPHASE MOTOR BY ST52X420
- AN1264 - SERIAL COMMUNICATION RS232 WITH ST52X420
- AN1291 - SLIP CONTROL OF AN ASYNCHRONOUS THREE-PHASE MOTOR WITH ST52X420
- AN1295 - A DEVELOPMENT BOARD TO DRIVE A TRIAC WITH ST52X420 DIRECTLY FROM THE MAINS
- AN1298 - PID CONTROLLER USING ST52X420 MCU
- AN1327 - BRUSHLESS DC MOTOR: SENSORLESS FUZZY CONTROL BY ST52X420
- AN1328 - I2C COMMUNICATION PROTOCOL WRITTEN IN FUZZYSTUDIOTM4.0 FOR ST52X430
- AN1362 - SWITCHED RELUCTANCE MOTOR CONTROL BY ST FIVE
- AN1512 - ST FIVE CONTROL OF AN AC MONOPHASE MOTOR WITHOUT HARMONIC DISTORTION
- AN1525 - I2C COMMUNICATION BETWEEN ST52X520 AND EEPROM
- AN1548 - HIGH RESOLUTION SINGLE SLOPE CONVERSION WITH THE ANALOG COMPARATOR OF THE ST52X440

Information and support on line: [five.support@st.com](mailto:five.support@st.com)

