High Energy Efficiency Power Design Solution

Motion SPM® Products

October, 2013

Solutions for Your Success™

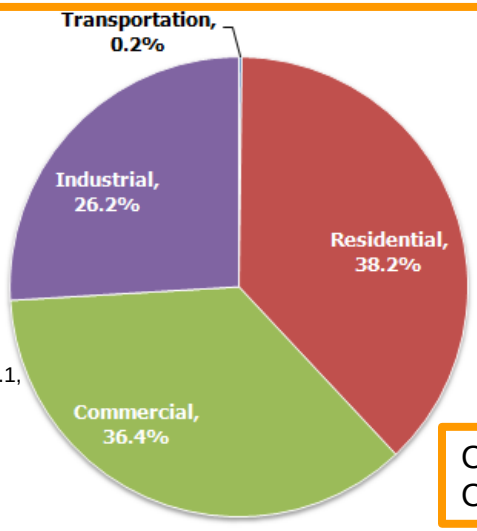
What We'll Cover

1. Market Trend for Motor Drive Applications
2. Inverter Technology as A Solution
3. What Are The Motion SPM® Module
4. Motion SPM® Products Introduction
5. How to Use Motion SPM® Products
    - 5-1. Technical Documents
    - 5-2. Evaluation Boards
    - 5-3. Motion Design Tool for Part Selection
    - 5-4. Technical Support Process
6. Conclusion

Chapter 1
Market Trend for Motor Drive Applications

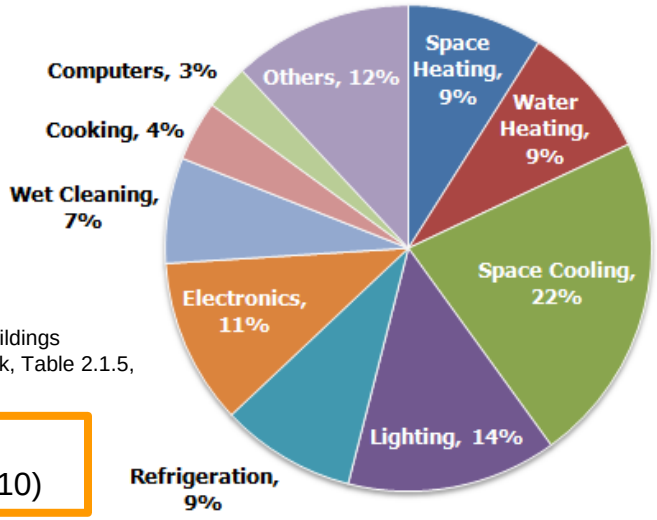
Energy Consumption

Retail Sales of Electricity to Ultimate Customers, Total by End Use Sector (2011)



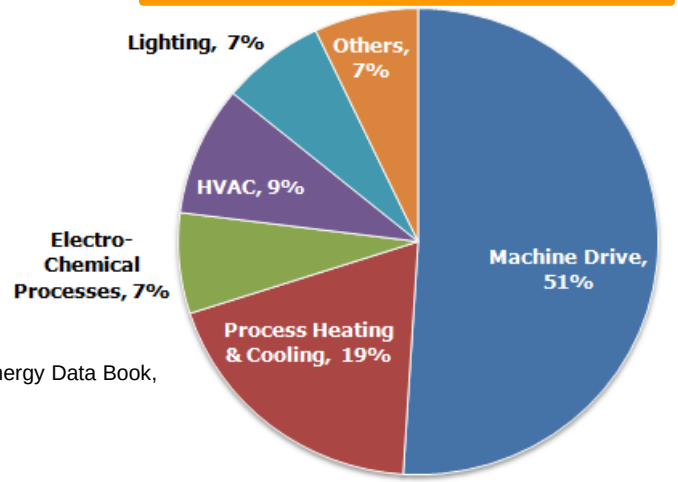
Source: EIA, Electric Power Monthly, Table 5.1, May 29, 2012.

Residential Electricity Consumption by End Use (2010)



Source: DOE, Buildings Energy Data Book, Table 2.1.5, March 2012.

Commercial Electricity Consumption by End Use (2010)



Source: DOE, Buildings Energy Data Book, Table 3.1.5, March 2012.

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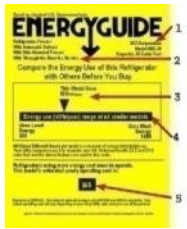
Energy Efficiency Regulations & Standards

- **Energy Labeling, Energy Efficiency**

  WW Eco-friendly policies drives all products

  → Driving adoption of inverters in all motor control applications

  → Prompting change from traditional lighting to LED, CFL

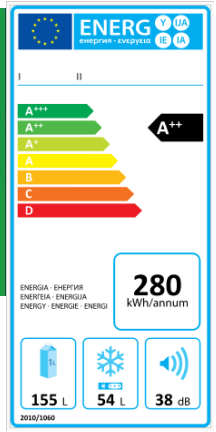


- **EU**
  - New Energy Labeling system

    : Newly applied new energy labeling form A ~ G to A^{+++} ~ D (Nov. 2011)

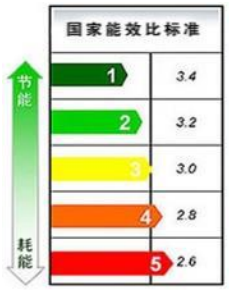
    → Prohibited the sale of below D grade products

    (Target Products : air conditioners, refrigerators, dishwashers, washing machines)



- **US**
  - Increased Energy Star requirements (e.g., SEER12 → SEER16 for A/C)
  - New Energy-Saving Standard for A/C (Set-up by ARI)

  → Introduced new Energy-Saving Standard - COP to IPLV (Integrated Part-Load Value)
- **China**
  - New Energy Labeling System as of June 2010
  - Increased Energy Efficiency Standards for A/C
    - For A/C, under 2 grade can't be sold as of July 2010
    - Only new 1 grade, old 1 & 2 grade A/C can be sold after July 2010.
- **Japan**
  - 'Top Runner' program since 2006.
  - Japan proposed APF (Annual Performance Factor) NWIP in 2006, and it was accepted in 2007.
    - Introduced new Energy-Saving Standard. (COP to APF)



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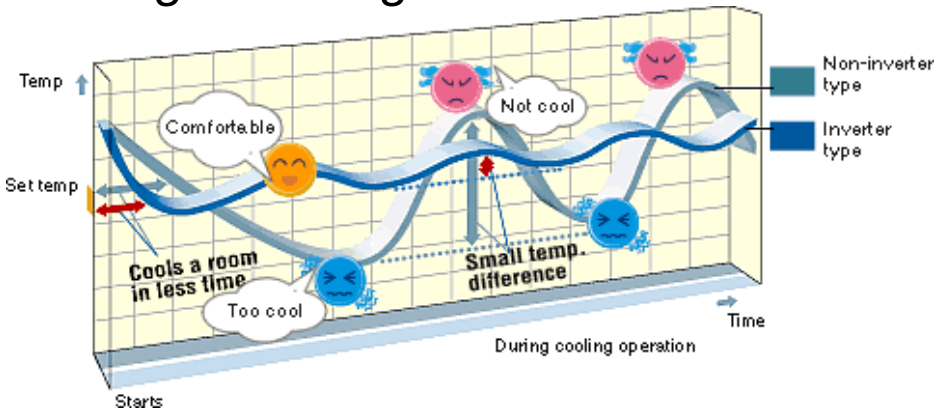
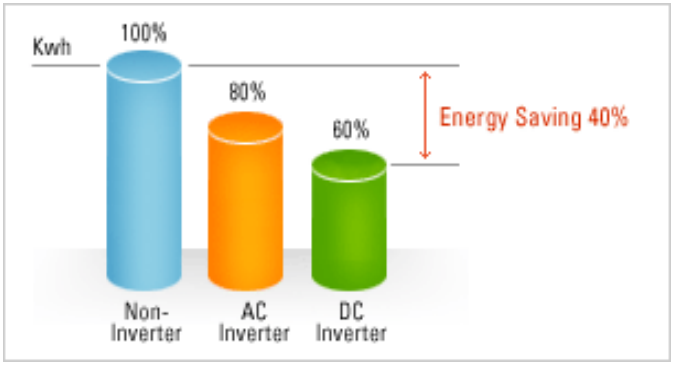
Chapter 2
Inverter Technology as a Solution

Inverter?

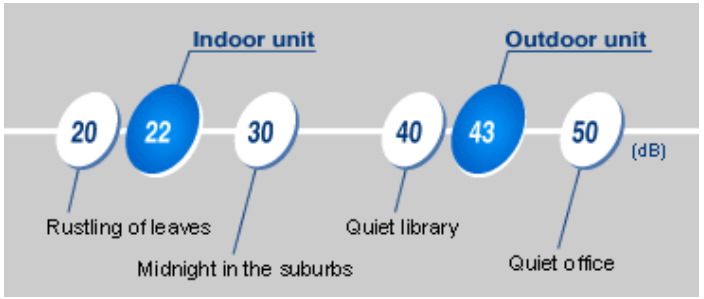
- *Inverter : Power conversion from DC to AC*
  - *For Energy Savings and High Performance!*





Energy Saving
Inverter control can save, on average, 40% of the electricity used when compared to conventional on/off controls

Comfortable
In air conditioners, Inverters can:
- save cooling time (50% faster)
- provide precise temperature control (±1ºC control)



Silent
In a fan motor, an Inverter can reduce audible noise

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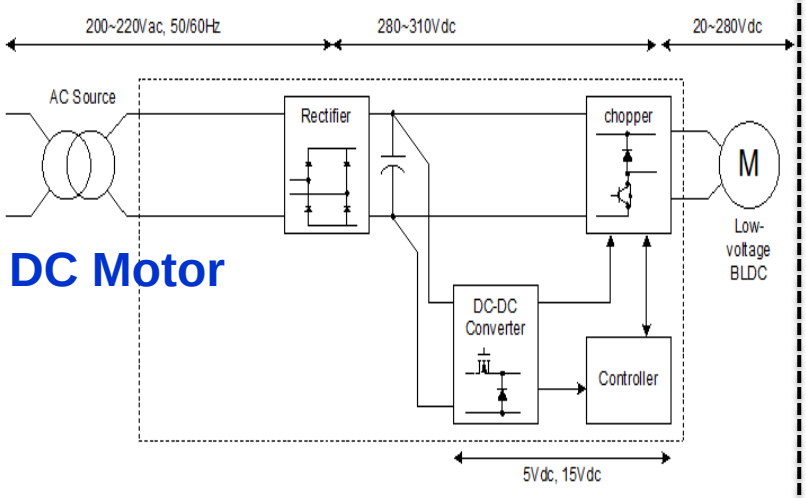
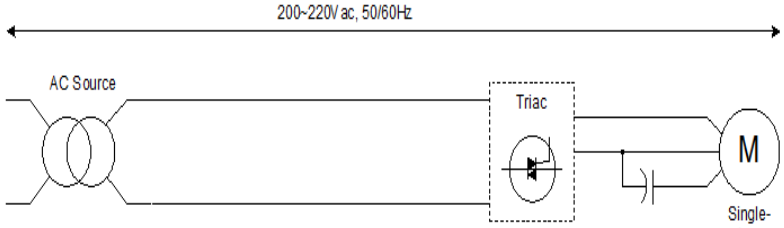
Inverter System

Non-inverter system

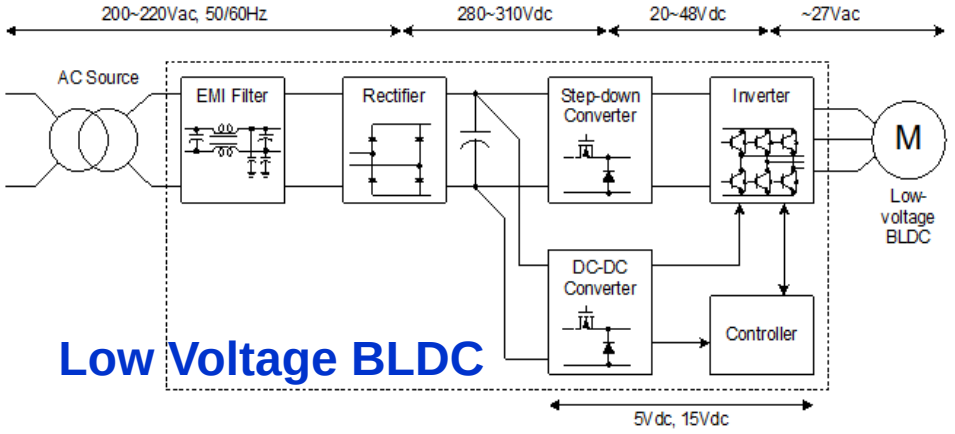


DC Motor

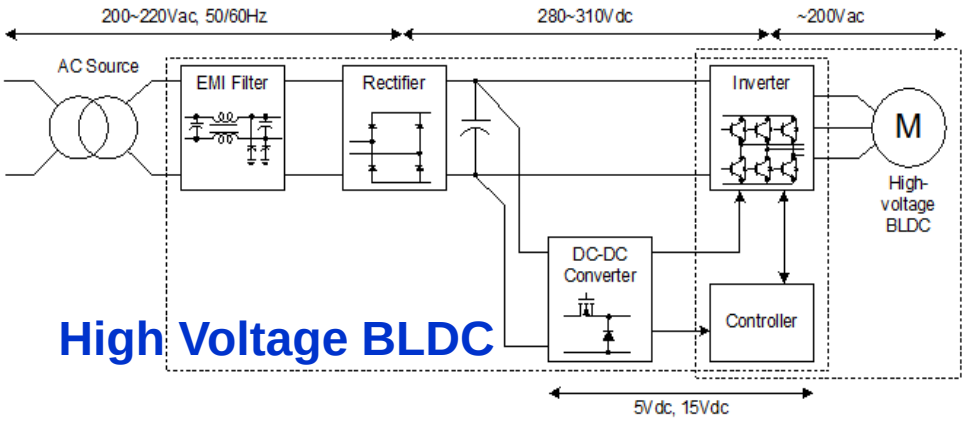


Induction Motor

Inverter system



Low Voltage BLDC



High Voltage BLDC

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How Long Payback

- Payback Period by saving Electricity Cost

Region	Type/ Application	**Regulation** *ErP(Energy-related Products)	**Electricity Price** [Cent/kWh] **average value*	**Extra Cost for Inverter System** [$]	**Payback Period** [Year]
Europe	Residential / Refrigerator (200 W)	*ErP Directives (Mandatory)	20.0	200	2.6
	Commercial / HVAC / System AC (7.5 kW)	ErP Directives (Mandatory)	17.0	2,000	1.2
	Industrial / Industrial Pump (20 kW)	ErP Directives (Mandatory)	10.0	10,000	1.1
North America	Residential / Refrigerator (200 W)	EER-Energy Efficiency Ratio	11.6	200	4.8
	Commercial / HVAC / System AC (7.5 kW)	SEER-Seasonal Efficiency Ratio (Mandatory)	9.9	2,000	2.3
	Industrial / Industrial Pump (20 kW)	N/A	6.5	10,000	2.2
China	Residential / Refrigerator (200 W)	GB (APF-Annual Performance Factor & EER) (Mandatory)	7.9	200	6.8
	Commercial / HVAC / System AC (7.5 kW)	GB (APF & SEER) (Mandatory)	13.0	2,000	1.7
	Industrial / Industrial Pump (20 kW)	N/A	10.0	10,000	1.3

Megatrend Consequences & Opportunities

Improving Energy Efficiency through Inverterization!

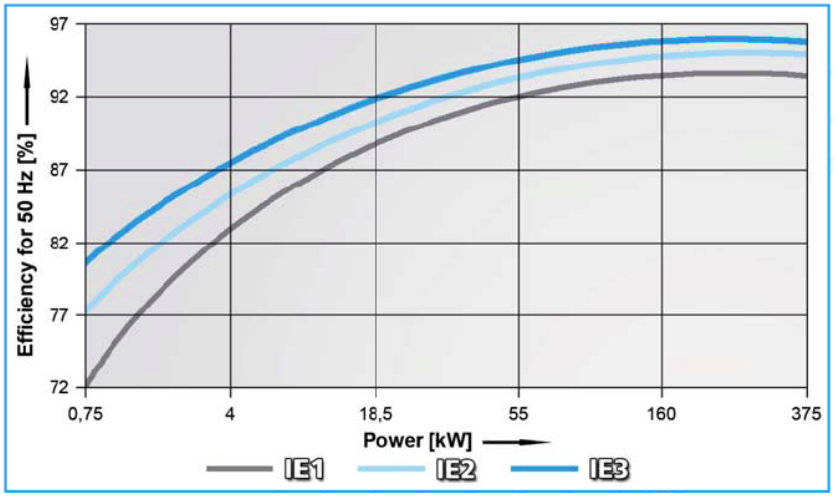
Inverterization is getting faster in HVAC & Home Appliances

- HVAC/System AC is moving to Inverter solution
  **U.S. SEER13 → SEER14 ('15) → SEER16 ('17)*
- BLDC inverter is spreading to low-end home appliances

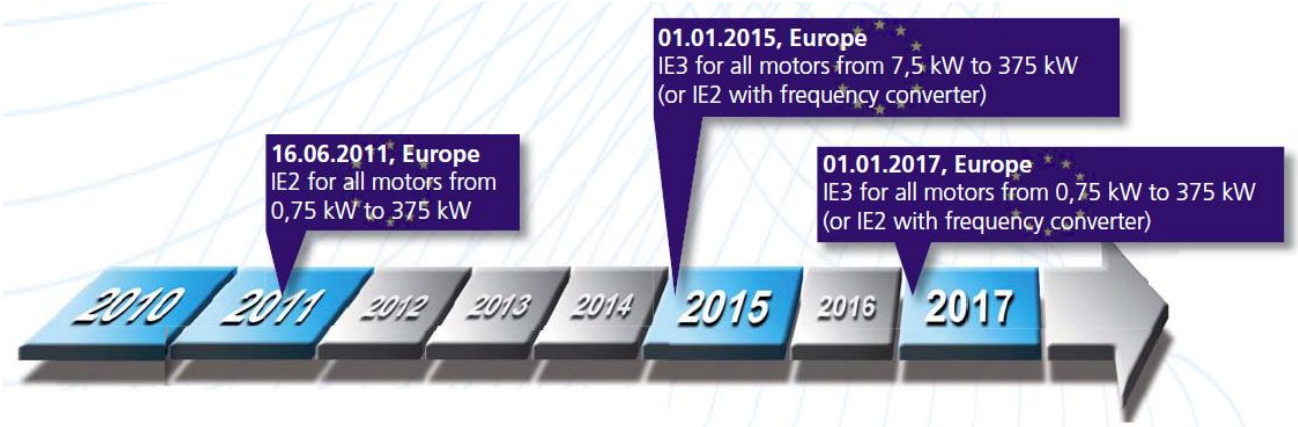
Pump is leading Inverterization in Industrial motor area

- All Industrial motors in EU should meet IE3 from 2017
  : Adopt 1. IE3 motor 2. IE2 + Inverter
- EU Government is forcing Inverterization of Pump because of its largest energy saving potential
  **All circulation pump should use BLDC inverter from 2013*
  - small power first, and expanding to mid - high power

Industrial Motor Efficiency Regulation in EU



- 2011 : IE2 motor (4~5% higher efficiency than normal induction motor)
- 2015 : IE3 motor (2~3% higher than IE2) or coupling an IE2 motor with inverter drives for 7.5 kW ~ 375 kW
- 2017 : will be expanded to 0.75 kW ~ 375 kW



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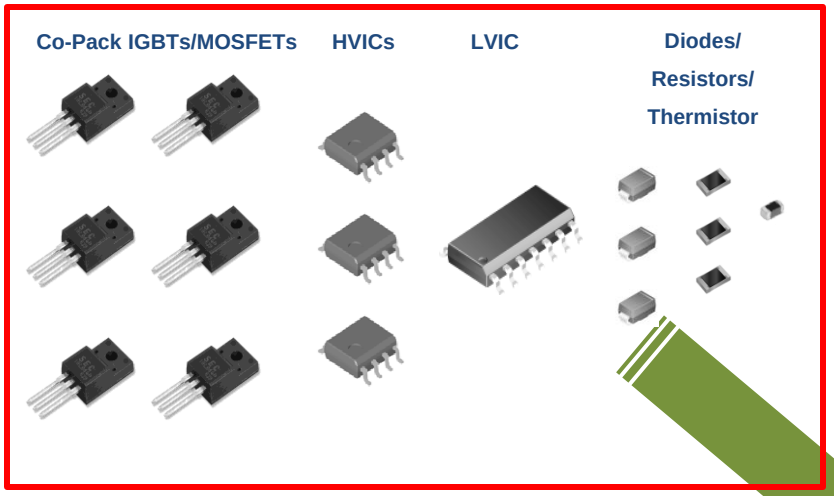
Chapter 3
What Are The Motion SPM® Products ?

Green Smart Solution

Integration of analog, discrete and package technology

Integration of discrete components



Protection Considerations

A protection circuit using analog components causes time delays and noise

Motion SPM products built-in HVIC and LVIC with protection circuit

Design Considerations

Needs optimization for switching and short-circuit dynamics using external components

Motion SPM products optimize driving characteristics for built-in power devices

Manufacturing Impact

Assembling these parts may increase manufacturing time and cause low yields.

Motion SPM® products, which integrates all diverse components, enhances productivity while simplifying manufacturing

-Reduced total system cost
-Reduced development time
-Easy management
-Optimized control flexibility
-Higher reliability

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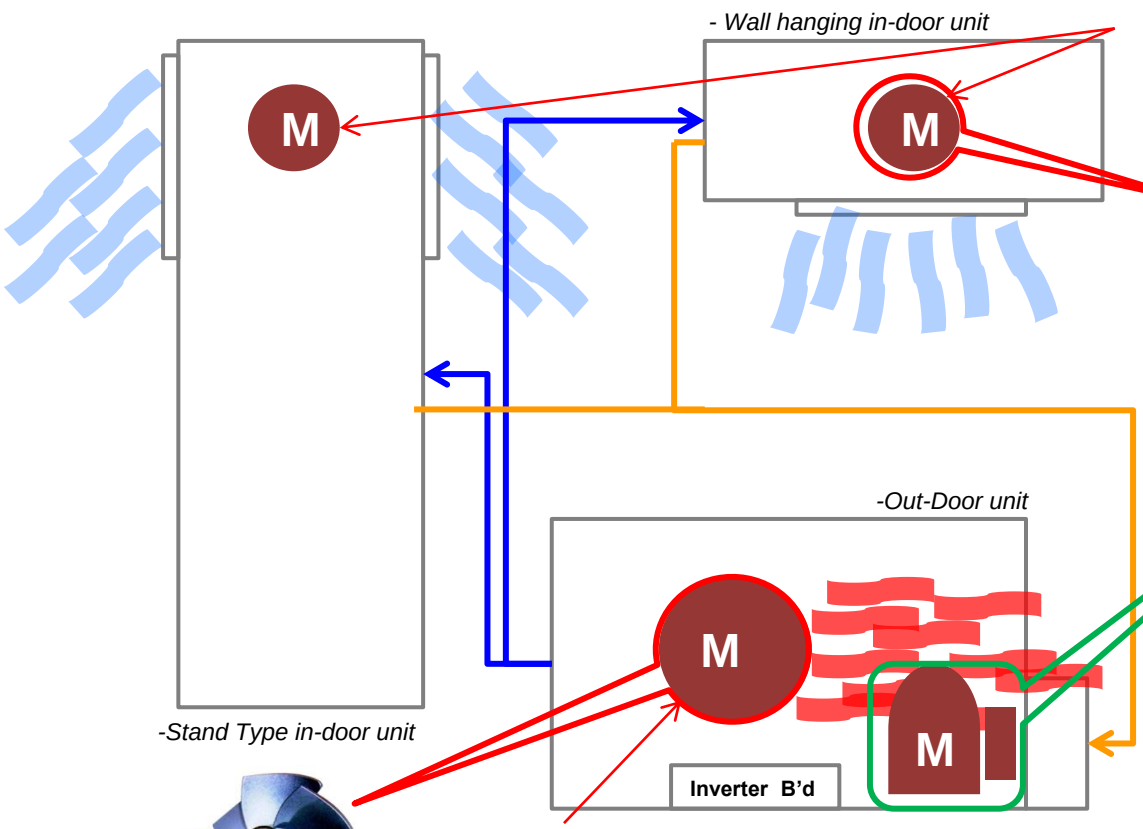
Benefits of Motion SPM® Products

- **Design and development**
  - Save space
  - Compact design
  - Easier to meet efficiency & EMI regulations
  - Save development time
  - Reduce time to the market
- **Manufacturing: Single component instead of several**
  - Easier procurement
  - Lower assembly cost (single placement, no special steps)
  - Higher yield (pre-tested, fewer connections)
- **The right technology for the future**
  - Cutting edge technology
  - Higher efficiency
  - High quality and reliability

Motor Application - Air Conditioner

***Most A/C systems have the same structure**

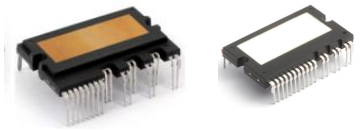


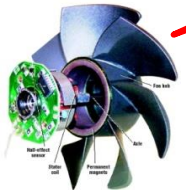
Indoor FAN

.AC or BLDC motor
.Normally using exclusive Fan controller
.Trend is Sensorless solution
.Around 30 ~ 50 W

Compressor

.1.0 KW ~ with 600 V / 1200 V system
.For harmonic & PF
,Using Active Passive PFC solution





Outdoor FAN

.Normally using exclusive Fan controller
.Trend is Sensorless solution
.Around 60 ~ 80 W

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Motor Application – Washing Machine

***Top loader & Front loader have similar structures**

Dry Fan

.Low or High Voltage Solution
.Sensor-less control
.Around 50 W

Heat Pump

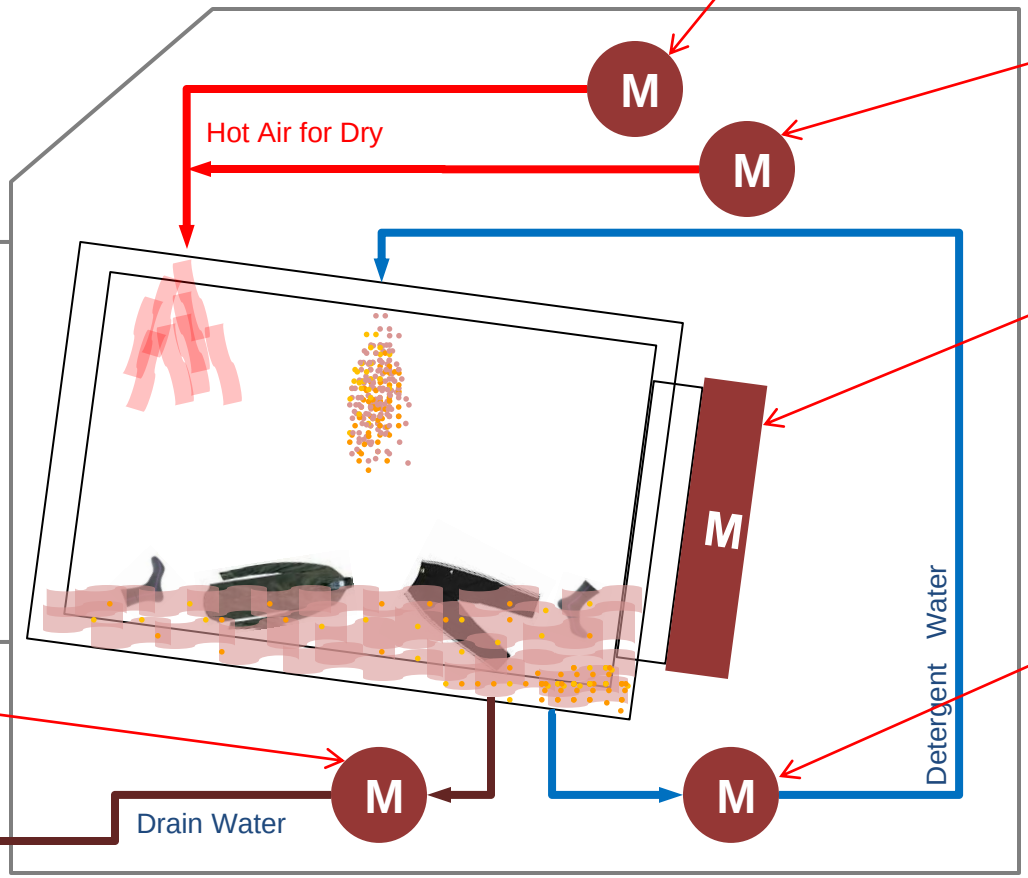
.High voltage solution
.Sensor-less control
.400 ~ 500 W

Main DD Motor

.High Voltage Solution
.Sensor or Sensor-less control
.500 ~ 800 W

Circulation Pump

.High Voltage Solution
.Sensor-less control
.50 ~ 80 W



Drain Pump

.High Voltage Solution
.Sensor-less control
.Around 80 W

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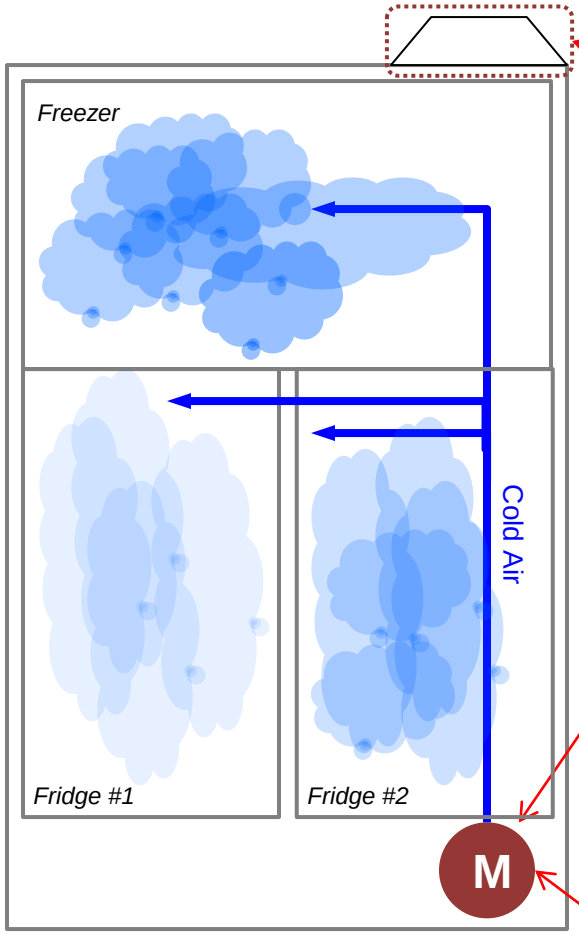
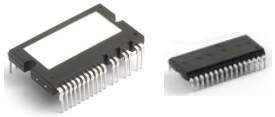
Motor Application - Refrigerator



Main Board & Control Board



Linear or Reciprocating Compressor

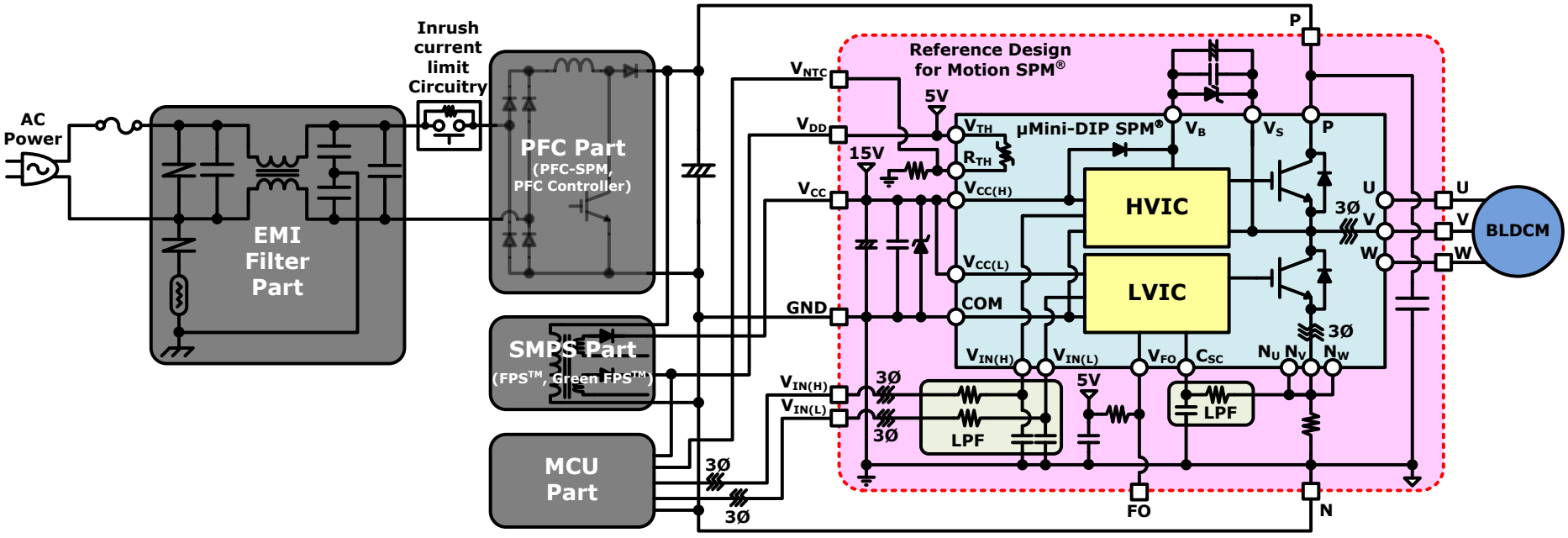
.High Voltage Solution

.200 ~ 250 W for below 400L model

300 ~ 400 W for over 400L model

Application of Motion SPM® Products

- Motion SPM® products are ideal for all types of motor driving solutions, especially 3-phase motor drive applications.



[Application Example]
Air-Conditioner System Block Diagram using Motion SPM® products

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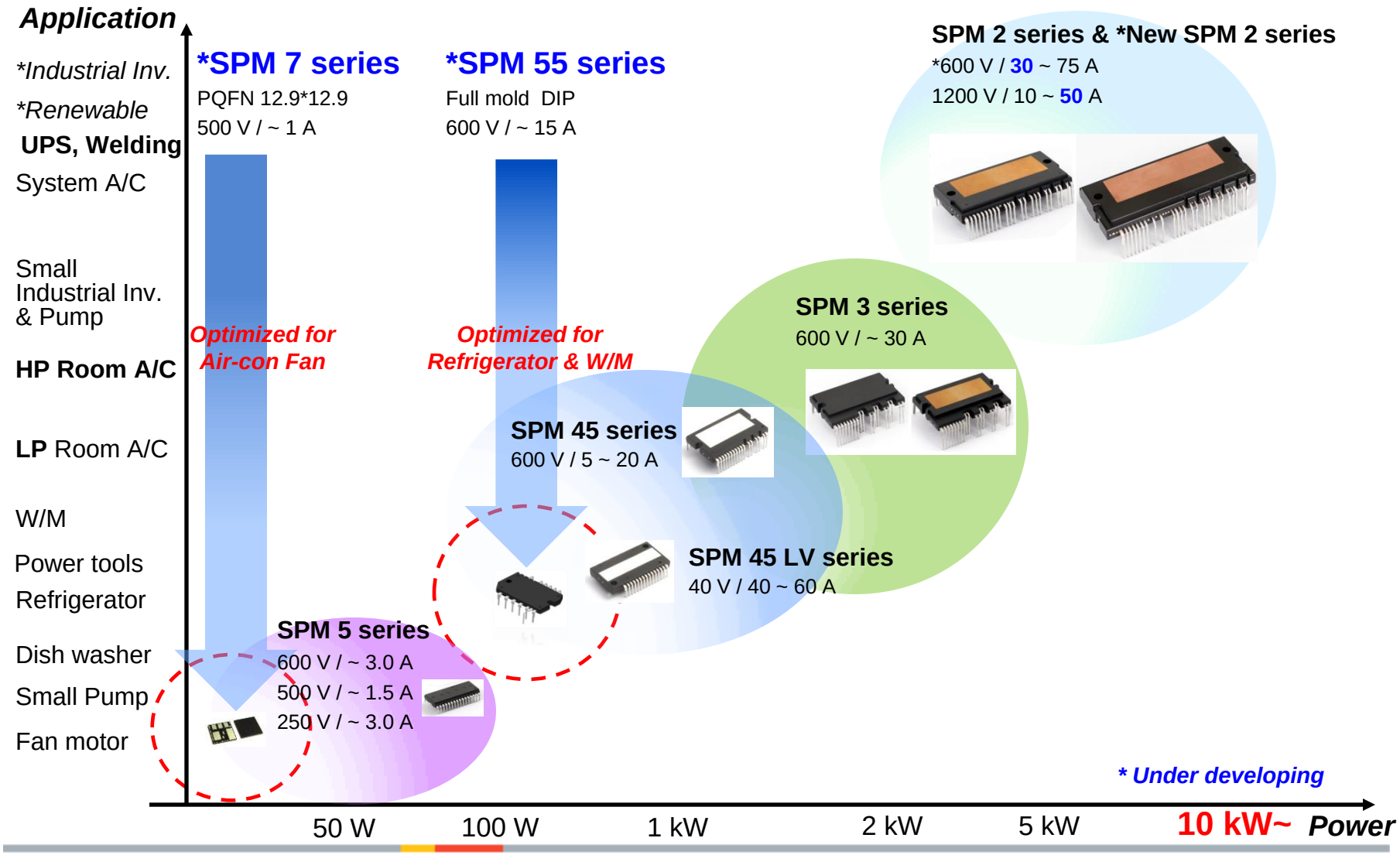
Motion SPM® Products Portfolio



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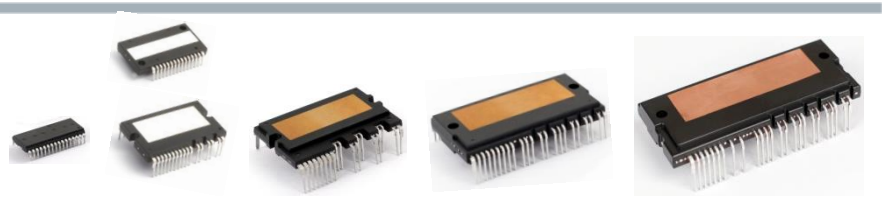
What We Have / Where It's Used?

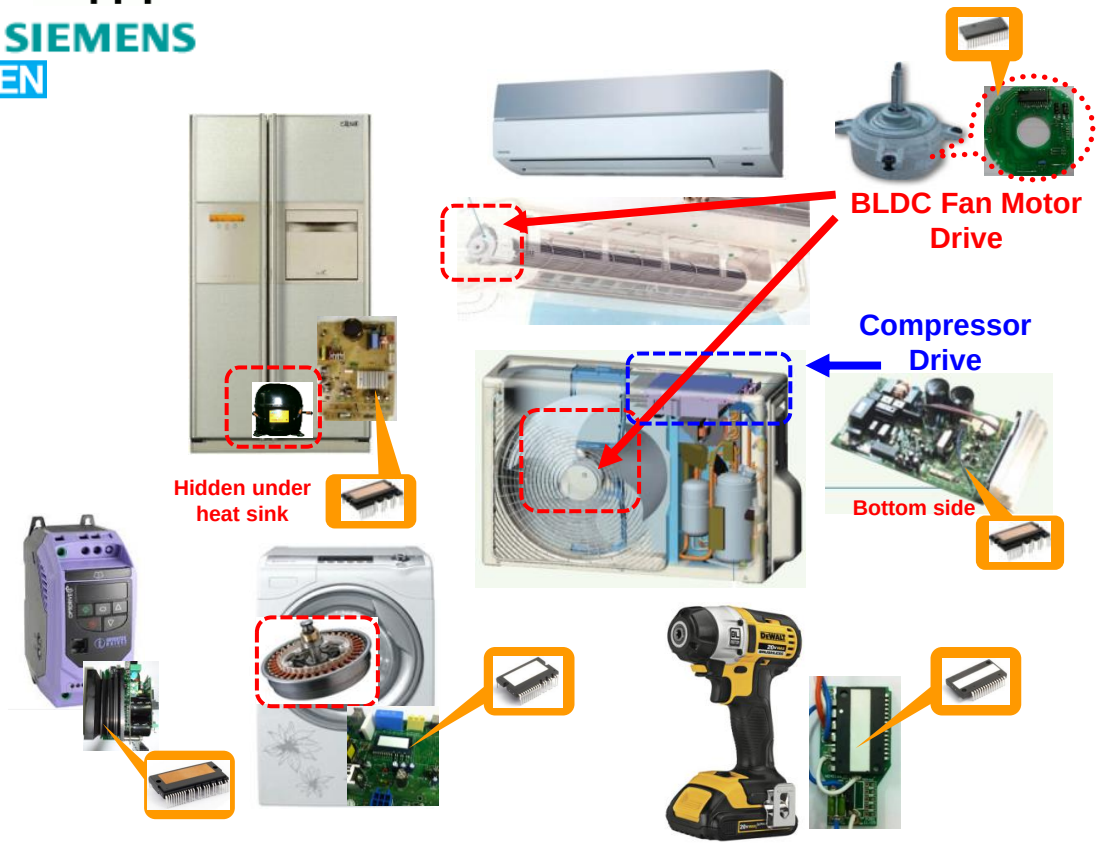
SAMSUNG, LG, DAIKIN, FUJITSU, HITACHI, DAEWOO ELECTRONICS, TOSHIBA, Panasonic, GREE, SANYO, Hisense, GRUNDFOS, Haier, Midea, ITT, SunStar, BOSCH SIEMENS, BLACK&DECKER, SANDEN, INVERTEK www.invertek.com.au, ebmpapst



SPM 5 Series ~ 0.1 kW | SPM 45 Series ~ 1.5 kW | SPM 3 Series ~ 2.2 kW | SPM 2 Series ~ 5 kW | New SPM 2 Series ~ 10 kW

We have : Motion SPM® Products (10 W ~ 10 kW solution)

Motion SPM® products used for : Room A/C, System A/C
- Heat-Pump
- Refrigerators
- Washing Machines
- Dish Washers
- Vacuum Cleaners
- Circulation Pumps
- Power Tools
- Sewing Machines
- Textile Machines
- Industrial Inverters
- …



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Chapter 4
Motion SPM® Products Introduction

1200 V Motion SPM® 2 Series (1)

Indus. Inverter

System A/C

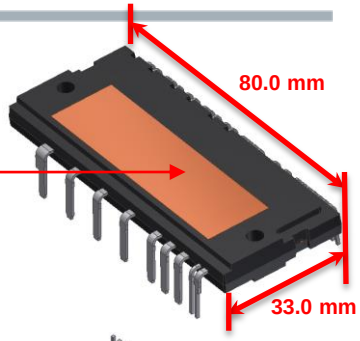
Competitive Advantage

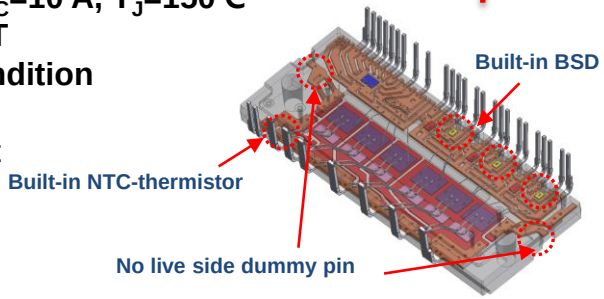
Performance/Reliability

- Higher thermal performance by DBC substrate
  .FCS (1.25℃/W) vs. Competitor (1.51℃/W) *1200 V / 10 A
- Advanced IGBT w/ lower loss
  .FCS ($V_{CE(SAT)}$=2.5 V, E_{OFF} =800 uJ) vs.
  .Competitor ($V_{CE(SAT)}$=2.36 V, E_{OFF}=1550 uJ) @ I_C=10 A, T_J=150℃
- Better electrical ruggedness with longer SCWT
  .FCS (10 us) vs. Competitor (5 us) @worst condition

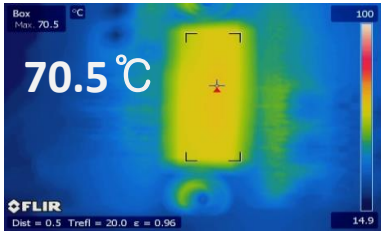
Design convenience

- Low side Sense-IGBT for easy OCP implement
- Built-in BSD, NTC thermistor
- No live side dummy



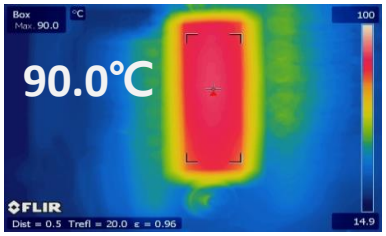


- Real load test result
  - 1200 V / 10 A device
  - Vdc=600 V
  - I_O=1.5 Arms
  - Switching freq. 15 kHz



Fairchild 1200 V / 10 A

VS.



Competitor 1200 V / 10 A

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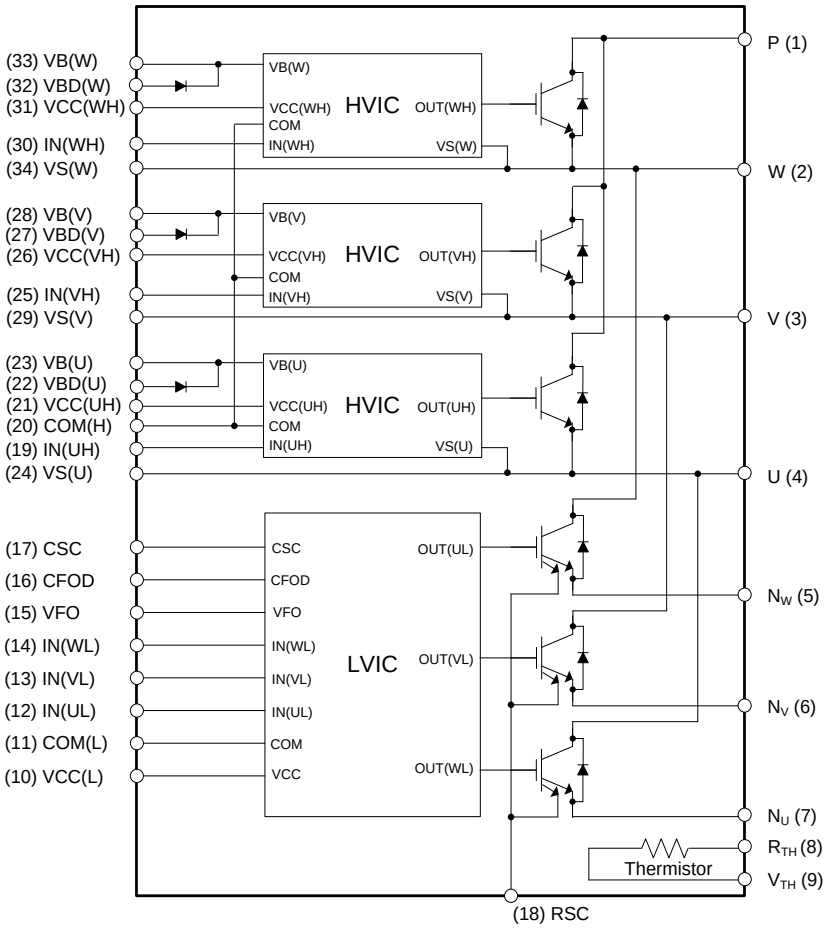
1200 V Motion SPM® 2 Series (2) - Overview



< Internal Block Diagram>

- ***Specification***
  - Sense IGBT in Low-side IGBT for SCP
  - High-side/Low-side UV protection
  - Fault out for SCP, UVLO
  - Thermal monitoring through real NTC thermistor
  - Very low thermal resistance through DBC (Al_2O_3) substrate
    $R_{\Theta JC,IGBT}$ = 1.33℃/W (10 A rating)
  - Robust & High performance through the latest IGBT tech.
  - Built-in Bootstrap Diode
  - UL Certified No.E209204

- Line up

** Under development*

Rating	***Product Name***
1200 V / 10 A	*TBD(*ER samples available)*
1200 V / 25 A	*TBD(*ER samples available)*
1200 V / 35 A	*TBD
1200 V / 50 A	**TBD

***Schedule is not fixed*

- Schedule

.1200 V / 10 A MP Schedule: P12, 2013
.1200 V / 25 A, 35 A : Q2, 2014

- Major Application

.High power inverter applications
→ System A/C, Pump and Industrial Inverter etc

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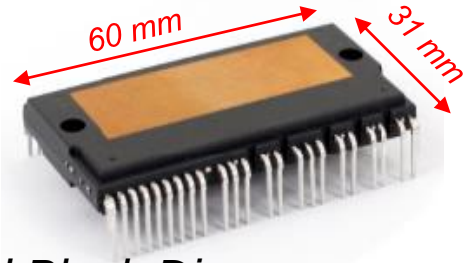
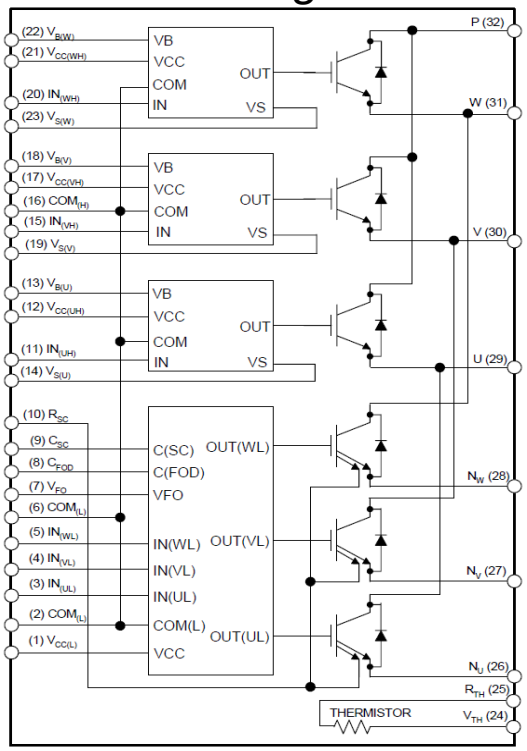
600 V Motion SPM® 2 Series - Overview

- *Appearance of the Package*



- *Internal Block Diagram*



- ***Specification***
  - Sense IGBT in Low-side IGBT for SCP
  - Active-Low input logic
  - High-side/Low-side UV protection
  - Fault out for SCP, UVLO
  - Thermal monitoring through real NTC thermistor
  - Very low thermal resistance through DBC(Al_2O_3, AlN) substrate
    $R_{\Theta JC,IGBT}$ = 0.56℃/W (75 A rating)
  - UL Certified No.E209204
  - New 600 V SPM 2 series will be changed as below
    .Package : Same to 1200 V SPM 2 package & Internal Structure
    .Silicon : Robust & High performance New IGBT
    .Signal Input : Active-High input logic

- ***Line up***

Rating	Product Name	
	Existing	New
600 V / 30 A	-	*TBD
600 V / 50 A	FSAM50SM60A	*TBD
600 V / 75 A	FSAM75SM60A	*TBD

** Under development*

- ***Schedule***
  .Mass Production : Q4, 2014

- ***Major Application***
  .High power inverter applications
  → System A/C and Industrial Inverter etc

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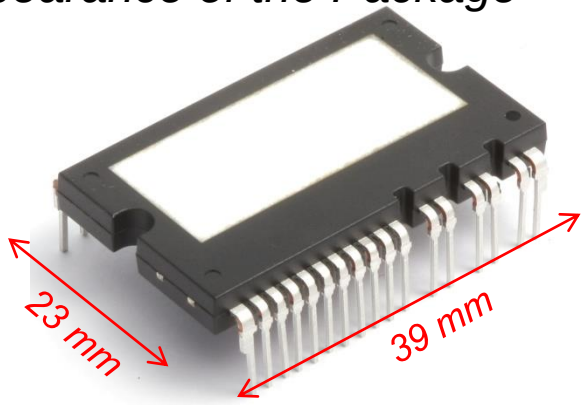
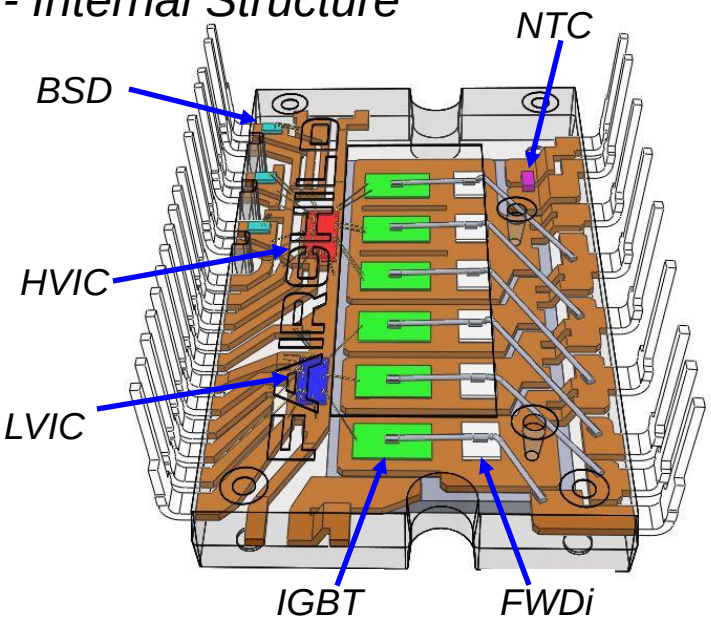
Motion SPM® 45 Series - Overview

- Appearance of the Package



- Internal Structure



- ***Specification***
  - Short-circuit Rated IGBT (SCWT: >10 uS @ 300 V / 15 V / 150℃)
  - Classify different series defending on carrier freq.
  - High-side/Low-side UV protection
  - Fault out for SC, UV
  - Thermal monitoring through real NTC thermistor
  - Low thermal resistance through ceramic substrate
    $R_{\Theta JC,IGBT}$ = 2.8℃/W (*20 A rating)
  - Built-in Bootstrap Diode
  - Various lead option : DIP, Double DIP, Short/Long Lead
  - UL Certified No.E209204

- Line up

Rating	Product Name	
	F_{SW} < 5 kHz	F_{SW} > 5 kHz
600 V / 5 A	FNA40560	FNB40560
600 V / 8 A	FNA40860	-
600 V / 10 A	FNA41060	FNB41060
600 V / 15 A	FNA41560	FNB41560
600 V / 20 A	FNC42060F	-
600 V / 30 A	*TBD	-

** Under development (MP : P09, 2014)*

- Major Application

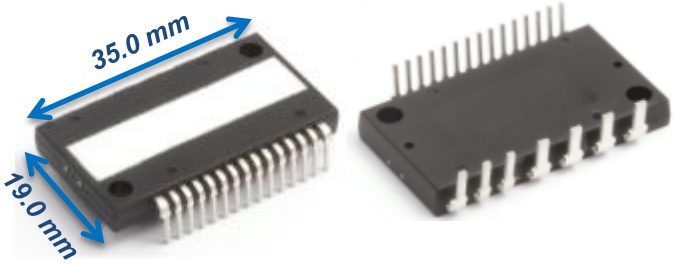
.Low/Medium power inverter applications

→ Refrigerator, Cloth Washer, Package A/C, Fan and Industrial Inverter etc

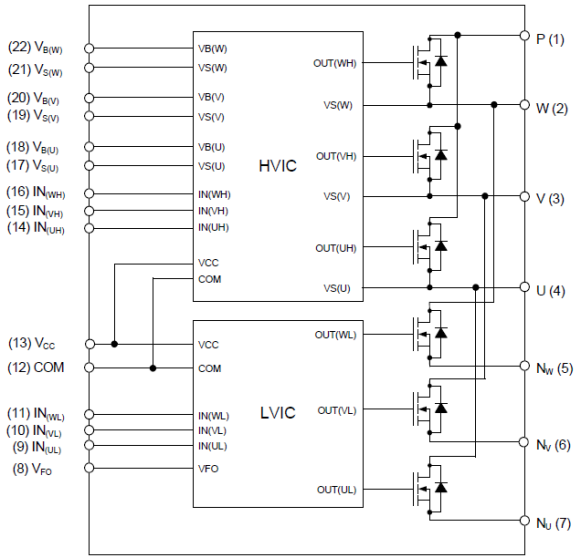
FAIRCHILD SEMICONDUCTOR®

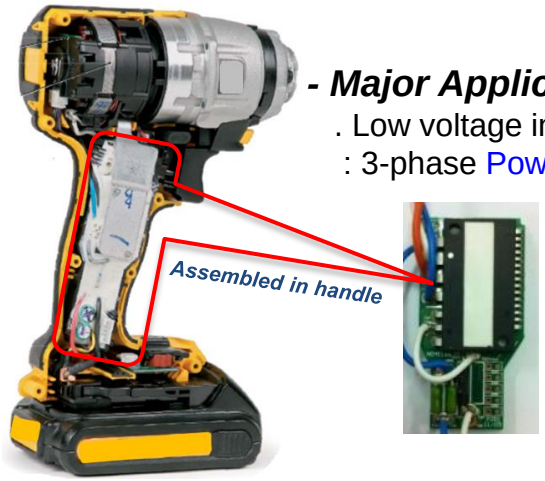
Motion SPM® 45 LV Series - Overview

- *Appearance of the package*



- *Internal Block Diagram*





• *Specification*

- Ultra low $R_{DS(ON)}$ through PowerTrench® MOSFET
- Superior Short Circuit Withstand Time
- High/Low side Under Voltage Lockout
- Low thermal resistance through ceramic substrate
  $R_{\Theta JC}$ = 3.92℃/W (*40 V, typ. 2.1 mΩ)
- 3-N terminal for current sensing
- UL Certified No.E209204

- *Line up*

Voltage Rating	Rds(on)	*Product Name*
40 V	typ. 3.0 mΩ	**TBD*
	typ. 2.1 mΩ	**TBD*

**Under development(MP : Q1, 2014)*
ER samples available

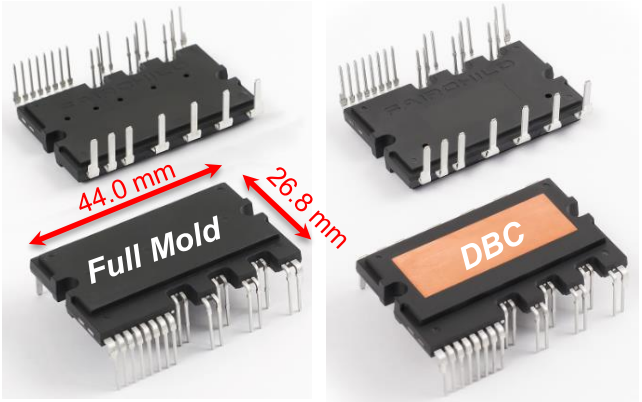
- *Major Application*

. Low voltage industrial 3-phase inverter
: 3-phase Power tools with low voltage **Cordless type*

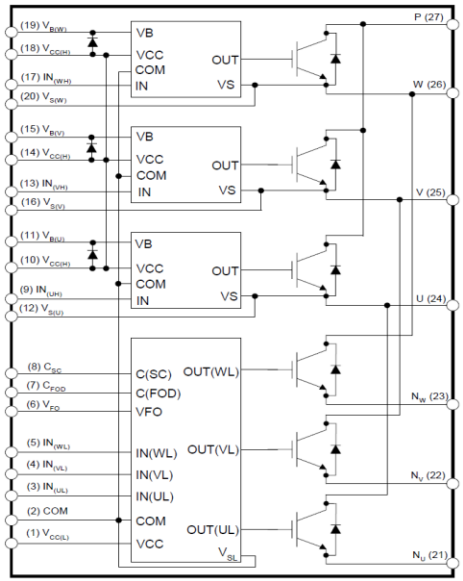
FAIRCHILD SEMICONDUCTOR®

Motion SPM® 3 V4 Series - Overview

- Appearance of the Package



- Internal Block Diagram



• *Specification*

- Short-circuit Rated IGBT (SCWT : >10 uS @ 300 V / 15 V / 150℃)
- High-side/Low-side UV protection
- Fault out for SC, UV
- Optimized 3 Kind of Substrate according to current rating
  - -Full package thermal resistance for low current rating (<15 A)
    $R_{\Theta JC}$ = 5.50℃/W (10 A), $R_{\Theta JC}$ = 4.90℃/W (15 A)
  - -DBC package thermal resistance for high current rating (>15 A)
    $R_{\Theta JC}$ = 2.00℃/W (20 A, Al_2O_3), $R_{\Theta JC}$ = 1.17℃/W (30 A, AlN)
- Built-in Bootstrap Diode
- UL Certified No.E209204

- Line up

Rating	*Product Name*	
	Full-Pack	DBC
600 V / 5 A	FSBF5CH60B	-
600 V / 10 A	FSBF10CH60B(T)	-
600 V / 15 A	FSBF15CH60BT	FSBB15CH60C
600 V / 20 A	-	FSBB20CH60C(T)
600 V / 30 A	-	FSBB30CH60C(T)

-Whole Products are under mass production

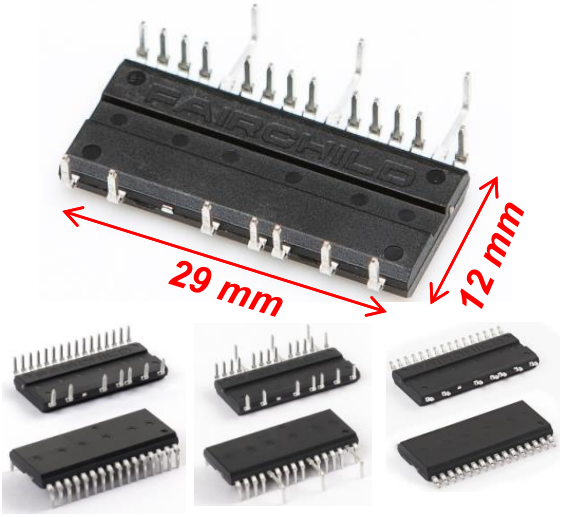
- Major Application

.Low/Medium power inverter applications
→ Refrigerator, Cloth Washer, Package A/C, Fan and Industrial Inverter etc

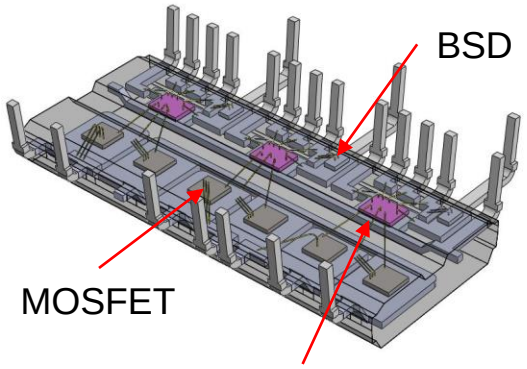
FAIRCHILD SEMICONDUCTOR®

Motion SPM® 5 V2 Series - Overview

- *Appearance of the package*



- *Internal Structure*



- ***Specification***
  - Robust & High Performance FRFET® MOSFET
  - High/Low side Under Voltage Lockout
  - Thermal detecting function
    - V_{TS} →Analog voltage output by temp.
  - Built-in Bootstrap Diode
  - Various lead option : DIP, Double DIP, SMD
  - UL Certified No.E209204

- ***Line up***

Voltage Rating	Rds(on)	***Product Name***
500 V	typ. 2.6 Ω	FSB50250A
	typ. 1.9 Ω	FSB50450A
	typ. 1.0 Ω	FSB50550A
250 V	typ. 1.1 Ω	FSB50325A
	typ. 0.33 Ω	FSB50825A

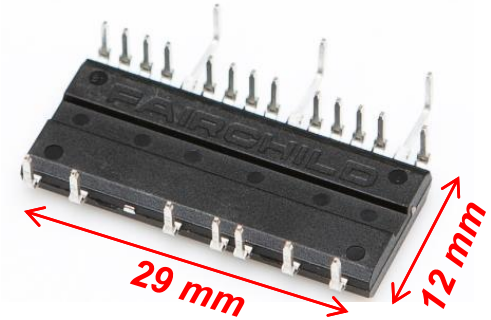
-Whole Products are under mass production

- ***Major Application***
  - . Low power inverter application
  - → Fan, Dish Washer and Pump etc

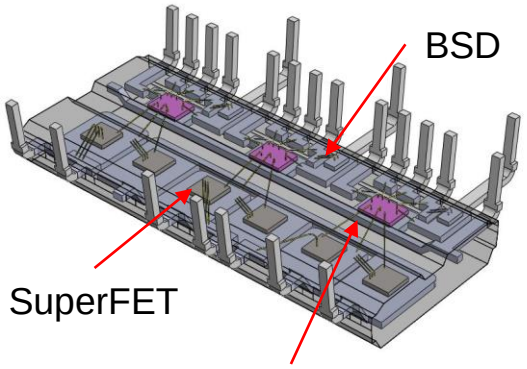
FAIRCHILD SEMICONDUCTOR®

Motion SPM® 5 SuperFET® Series - Overview

- Appearance of the package



- Internal Structure



- ***Specification***
  - Robust & High Performance FRFET® SuperFET® (Super-Junction MOSFET)
  - High/Low side Under Voltage Lockout
  - Thermal detecting function
    - Vts →Analog voltage output by temp.
  - Built-in Bootstrap Diode
  - Various lead option : DIP, Double DIP, SMD
  - UL Certified No.E209204

- Line up

Voltage Rating	Rds(on)	***Product Name***
600 V	typ. 0.62 Ω	FSB50250A
	typ. 0.40 Ω	FSB50450A

-Whole Products is under mass production

- Major Application

. Low power inverter application
→ Refrigerator, Fan and Pump etc

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Chapter 5
How to use Motion SPM® Products

Technical Documents (Application Note)

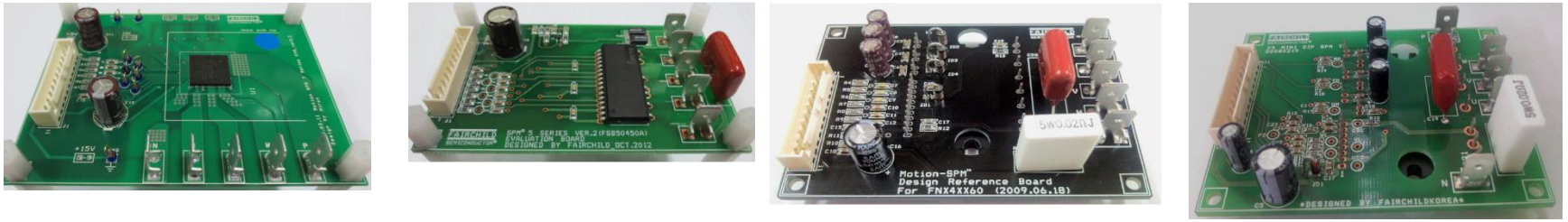
- 1200 V Motion SPM® 2 Series
  - AN-9075 : User Guide
  - AN-9076 : Mounting Guide
  - AN-9079 : Thermal Performance by Mounting Torque
- Motion SPM 3 Series, Version 4
  - AN-9044 : User Guide
- Motion SPM 45 Series
  - AN-9070 : User Guide
  - AN-9071 : Thermal Performance
  - AN-9072 : Mounting Guide
- Motion SPM 5 Series, Version 2
  - AN-9080 : User Guide
  - AN-9082 : Mounting Guide by Contact Pressure

Technical Documents (Reference Design)

- 1200 V Motion SPM® 2 Series
  - RD-354
- Motion SPM 45 Series
  - RD-344
  - RD-345
- Motion SPM 5 Series
  - RD-FSB50450A
- Motion SPM 5 SuperFET® Series
  - RD-402

Evaluation Boards & Test Boards

[Evaluation Boards for Motion SPM® Products]



[Test Board for Motion SPM Products]

For detail information, please contact to www.fairchildsemi.com

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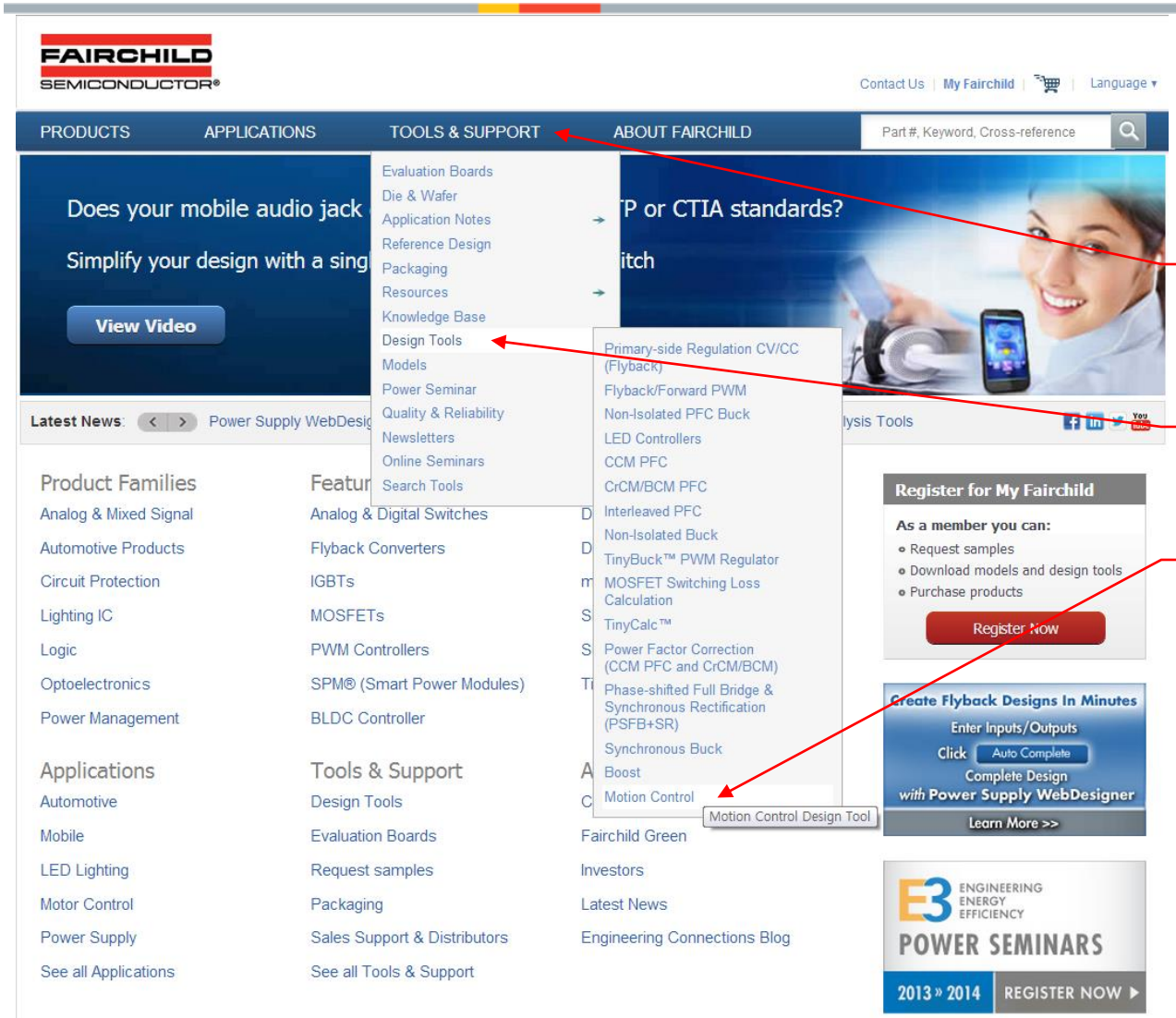
Motion Control Design Tool for Part Selection (1)



1. Select "Tools & Support"

2. Select "Design Tools"

3. Click "Motion Control"

FAIRCHILD SEMICONDUCTOR

Motion Control Design Tool for Part Selection (2)

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PRODUCTS APPLICATIONS TOOLS & SUPPORT ABOUT FAIRCHILD Part #, Keyword, Cross-reference

Home » Design Tools & Support » Design Tools » Motion Control Design Tool

Motion Control Design Tool

Download the Motion Control Design Tool PDF Help Guide

This design tool provides motion control design engineers with efficient means of calculating the power losses and temperature rise in Fairchild motion SPM modules. The tool addresses three-phase inverter sinusoidal modulation for variable speed drive applications powering permanent magnet synchronous motors (PMSM) and AC induction motors.

Launch the Motion Control Design Tool - *MyFairchild account required

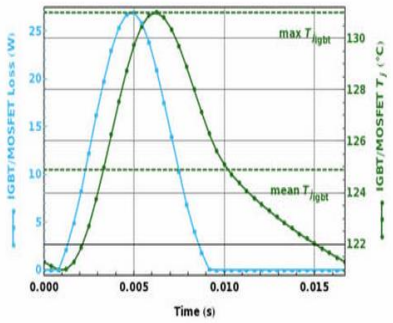
1. Click "Launch the Motion Control Design Tool"

See examples below of tabular and graphical evaluation results.

FSBS3CH60 3A 600V		
Parameter	Value	Units
DC input Bus	340	Volts
RMS Motor Phase Current	5	Amps
Motor Power Factor	95	Percent
Modulation Depth	90	Percent
Ambient Temperature	60	Celsius
Switching Frequency	8	KHz
Output Modulation Frequency	60	Hz

Parameter	Value	Units
Drive Output Power	2.07	Horsepower
Drive Output Power	1542	Watts
Output Vac line-2-line	187.4	Volts
Loss Per IGBT or MOSFET	7.3	Watts
Loss Per Diode	0.7	Watts
Total Module Loss	47.9	Watts
Max Case Temperature	95.2	Celsius
Max HS Temperature	92.3	Celsius
Max case Temp Limited by ?	Tj max	-

Graph 1 - IGBT or MOSFET losses and junction temperature versus time for full load conditions specified below. MOSFET losses include body diode conduction losses for MOSFET based modules.



Graph 2 -Copacked diode losses and junction temperature versus time for full load conditions specified below. Graph will straight line for MOSFET based modules since diode conduction losses are included in MOSFET.

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PRODUCTS APPLICATIONS TOOLS & SUPPORT ABOUT FAIRCHILD Part #, Keyword, Cross-reference

My Fairchild Account

2. If you have no account, Please follow below process

Registered User? Log in Here

If you have already registered for a My Fairchild account, you may login below to get access to free samples, tools, and other resources.

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Log in

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Not Registered? Registration is Easy!

Register for a My Fairchild account today and get personalized access to free samples, tool and model downloads, technical information, newsletters and more.

* Indicates required fields

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This Email Address is your login ID and username

* Create Password:

* Confirm Password:

* First Name:

* Last Name:

* Company:

* Your Country: -Select One-

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Registering for a My Fairchild account allows you to:

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- Access models
- Order free samples

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Motion Control Design Tool for Part Selection (3)

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Color Key: Input / Output

3-Phase PWM Inverter Loss & Temperature Analysis

Download the: Motion Control Design Tool PDF Help Guide

Disclaimer: [+](Show)

1. Motor RMS Phase Current

5 [A]

Enter the RMS motor phase current at the operating point to be analyzed. This rating is used to calculate the SPM losses and heatsink thermal resistance requirements. Three phase currents are assumed to be sinusoidal and balanced.

2. Modulation Index

.9

Modulation Index is defined as peak of sinusoidal phase voltage divided by a half of DC bus voltage. This value must be between 0 and 1 for Sine PWM and between 0 and 1.1547 for all other PWM methods. Over-modulation is not supported in this simulation.

1. Fill 16 items in the green blank

3. Power Factor [°C/W]

Enter the sink-to-ambient thermal resistance, $R_{th(S-A)}$, if you have selected the manual option in step 13.

15. Case-to-heatsink Thermal Resistance

.06 [°C/W]

Enter the thermal resistance from the SPM case to the heatsink, $R_{th(C-S)}$. This is used for all three options in step 13.

16. PWM Method Selection

- (•) SPWM (Sine PWM)
- ( ) SVPWM (Space Vector PWM)
- ( ) DPWM120LS (Discontinuous PWM with 120° co
- ( ) DPWM120HS (Discontinuous PWM with 120° co
- ( ) DPWM60 (Discontinuous PWM with 60° continuo
- ( ) DPWM60-30 (Discontinuous PWM with 60° continuous conduction periods phase displaced 30° lagging reference to the peak of the phase voltage)

Select a PWM method for the application. Refer to the Graph 12 in the results.

1. Click "Evaluate"

2. If you need results as PDF file, please click "Export PDF"

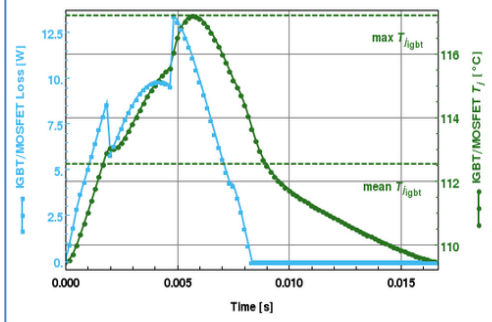
Evaluate | Export to PDF

FNA41560 15A 600V		
Parameter	Value	Unit
DC Bus Voltage	310	V DC
RMS Motor Phase Current	5	A RMS
Motor Power Factor	0.95	
PWM Method	DPWM60	
Modulation Index	0.9	
Ambient Temperature	40	°C
Switching Frequency	8	kHz
Inverter Output Frequency	60	Hz

◆ **Can see a power loss simulation result and graph 1 to 12.**

Parameter	Value	Unit
Drive Output Power	1.88	Horsepower
Drive Output Power	1.41	kW
Inverter Output line-to-line Voltage	170.9	V RMS
Max Heatsink Temperature	100	°C
Max Case Temperature	101.5	°C
Max Heatsink Temp Limited by	Entered T_{sink_max} Value	
Max Heatsink $R_{th(S-A)}$	2.32	°C/W
Heatsink $R_{th(S-A)}$ Determined by	Calculated $R_{th(S-A)}$	

Parameter	High-Side	Low-Side	Unit
Loss per IGBT or MOSFET	3.67	3.67	W
Loss per Diode	0.64	0.64	W
Total Module Loss		25.83	W
Average Tj IGBT or MOSFET	112.6	112.6	°C
Peak Tj IGBT or MOSFET	117.2	117.2	°C
ΔTj IGBT or MOSFET	7.7	7.7	°C
Average Tj Diode	104.3	104.3	°C
Peak Tj Diode	105.9	105.9	°C
ΔTj Diode	2.4	2.4	°C



Graph 1 High-Side IGBT or MOSFET losses and junction temperature versus time for full load conditions specified above. MOSFET losses include body diode losses for MOSFET based modules.

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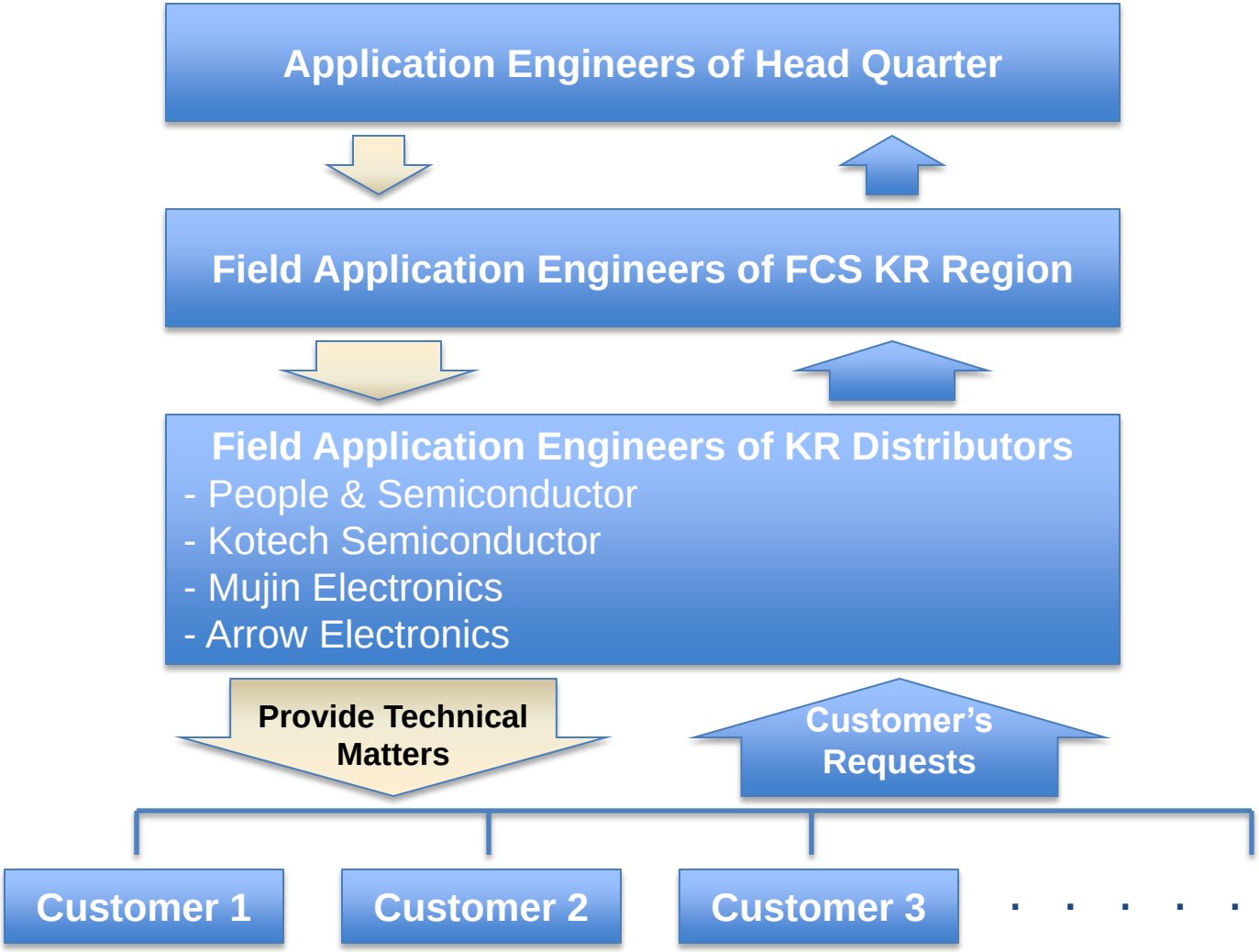
Technical Support Process



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Conclusion

- Energy regulation is enhancing all over the world for conservation. For motor drive household/industrial electric appliances, inverterization is right solution of high energy efficiency. Therefore, Motion SPM® products are best way for inverterized household/industrial electric appliances.
- A benefits of Motion SPM products are as below,
  - Design and Development
    - Save space
    - Compact design
    - Easier to meet efficiency & EMI regulations
    - Save development time
    - Reduce time to the market
  - Manufacturing: single component instead of several
    - Easier procurement
    - Lower assembly cost (single placement, no special steps)
    - Higher yield (pre-tested, fewer connections)
- Fairchild Semiconductor is providing several kind of technical support to customers for easier usage.

Thank You

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