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ST motor control ecosystem and system solutions

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Motor Control Competence Center, APAC
STMicroelectronics

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ST motor control ecosystem

Easy STM32 adoption for motor control

- Providing development platform: MC-SDK (MC firmware lib + MC Workbench), MC pilot, MC profiler, hardware boards, documents, etc.

Products/peripherals and software algorithms

- Advanced Motor Control timer
- Rich and advanced analog peripherals embedded in the STM32
- Motor profiler
- STM32 ZeST and HSO / sensorless algo, …

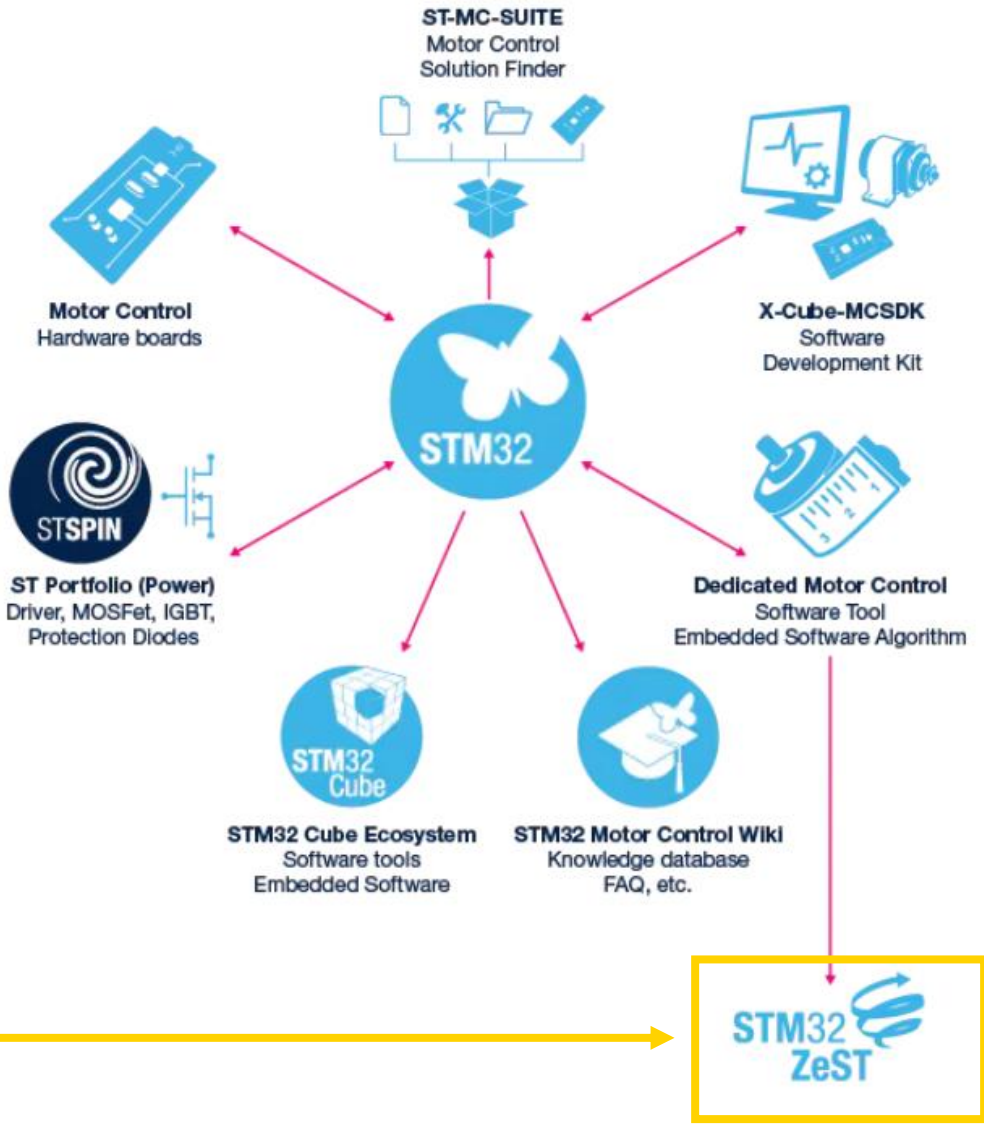
Leverage on ST portfolio

- Large choice of power components and STM32 to create complete Motor Control solutions

STM32 ZeST

Software algorithm which allows to provide full torque at zero speed for any kind of BLDC/PMSM motors in sensorless mode (in addition to the new observer HSO)

NEW

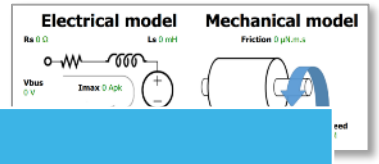


From hardware to final motor control applications

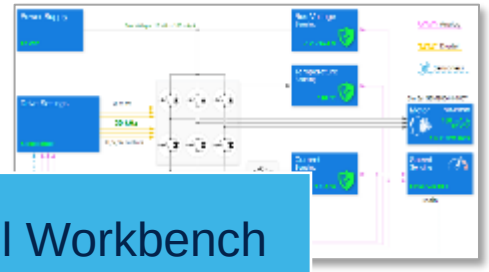
Use ST-MC-SUITE online tool to identify the most suitable board

1 **Hardware setup**

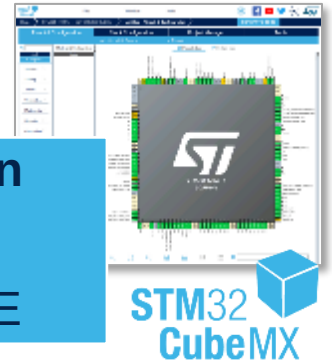
2 **Motor characterization**



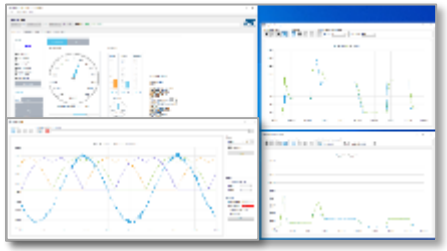
3 Motor Control Workbench
System configuration



4 **Project configuration**
Project build
STM32CubeMX & IDE



5 **Motor drive tuning**
Motor Pilot



6 **Final application development**

User code

```
#include "MC.h"
{
    CMCI oMCI = GetMCI(M1);
    MCI_ExecSpeedRamp(oMCI, final speed, ramp duration);
    MCI_StartMotor(oMCI);
}
```

STM32 Cube

STM32 CubeIDE

iar

KEIL Tools by ARM

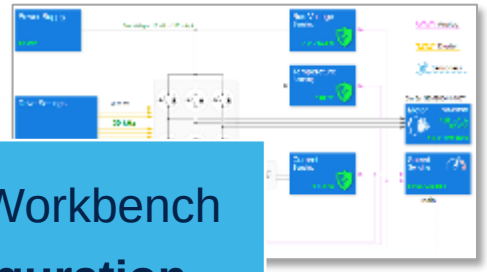
Hardware modification flow

From ST board to your real application board

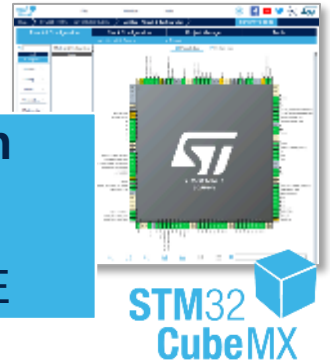
1 **Hardware modification**

2 **Hardware board description**

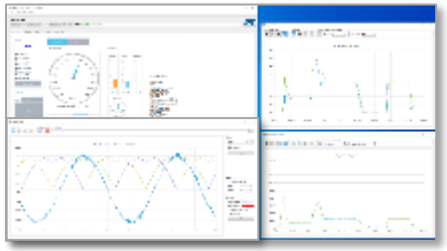
3 Motor Control Workbench
System configuration



4 **Project configuration**
Project build
STM32CubeMX & IDE



5 **Motor drive tuning**
Motor Pilot



6 **Final application development**

User code

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    MCI_ExecSpeedRamp(oMCI, final speed, ramp duration);
    MCI_StartMotor(oMCI);
}
```

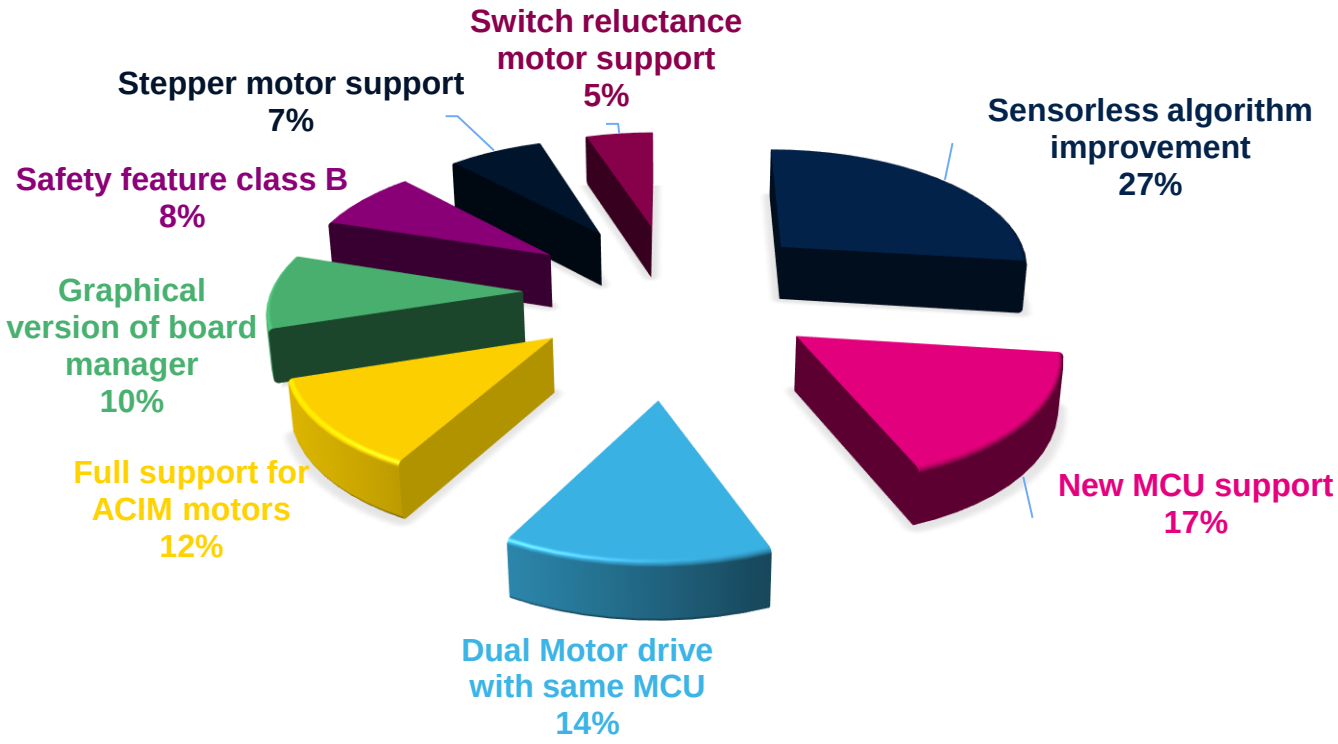
STM32 Cube

STM32 CubeIDE

iar

KEIL Tools by ARM

X-CUBE-MCSDK: What are the most important features for you?



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Key solutions for focus segments

Home appliances & air con

Highlight:
“AI MC washing machine”

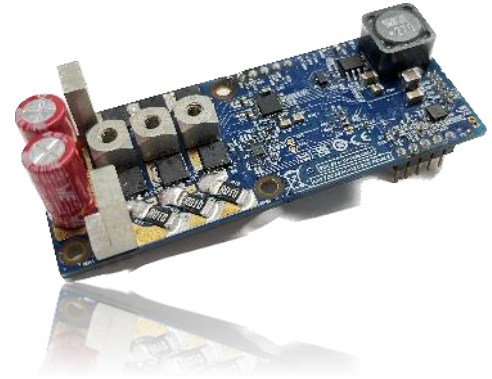
World-class efficiency and saving

Motor drives & servo drives

Highlight:
“Servo drives orchestra”

#1 ensemble in industry
STM32, SiC, GaN, MEMS, IoT

Power tools & high-end consumer



Highlight:
“Sensorless drill power tools”

Impossible made possible
More powerful & more integrated

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Air con, heat pumps, BSS

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Solutions for air con, heat pumps, and BESS

Complexity / energy efficiency

STM32

Part numbers in this slide are just example: final BOM to be agreed with marketing

FOC Vienna

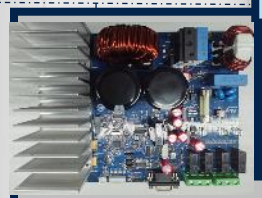
3xFOC d-IntPFC

2xFOC d-IntPFC

2xFOC d-PFC

FOC d-PFC

Available @ MCCC



2 kW RAC STM32G0 +STGIF10 + dPFC

Available @ MCCC and (F3-based) as STEVAL-CTM010V1

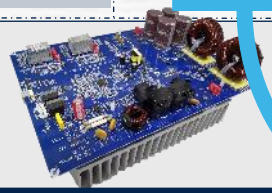
2 kW RAC STM32G4 + STGIB10x DualMC + d-PFC

Available @ MCCC

4 kW commercial STM32G4 + STGIB30 SLLIMM™ DualMC + d-I-PFC

3 new patents

Available @ MCCC



7 kW commercial STM32G4 + STGIK50 TripleMC + d-IPFC

24H2

10 kW commercial STM32G4 / compressor + 3-phase PFC Vienna

New patent

Completed

Ongoing and roadmap

1 kW

2 kW

4 kW

7 kW

10 kW

STPOWER

Part numbers are indicative only. Final BOM to be agreed with ST's Sales & marketing local representatives

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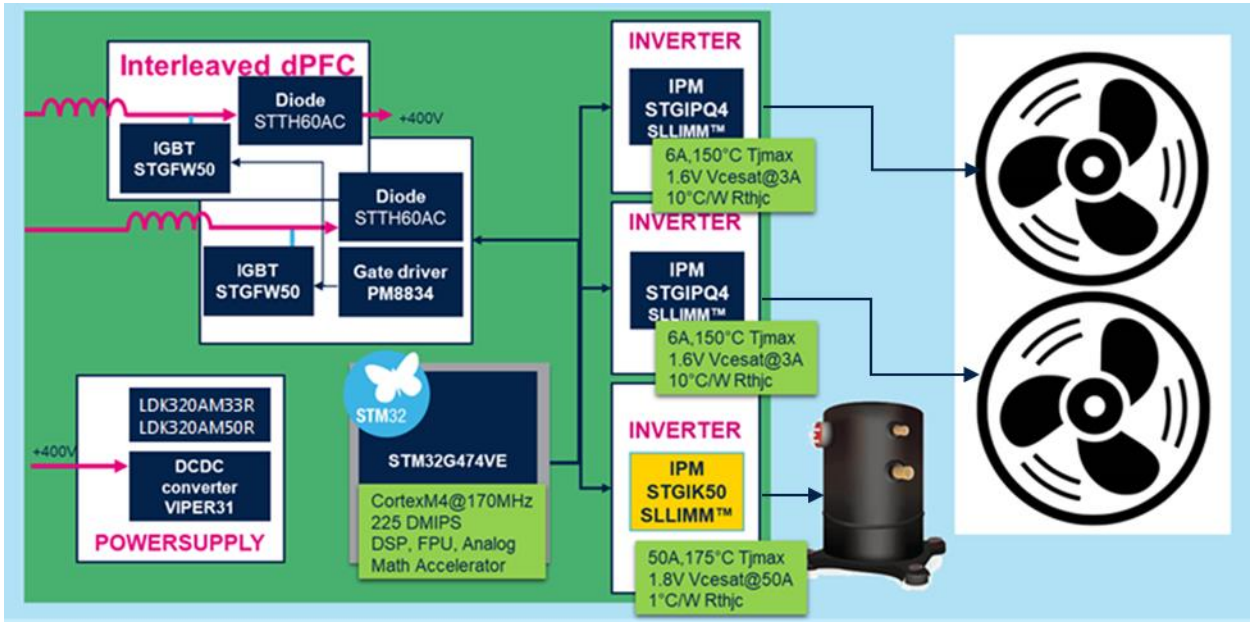
ST patent: triple FOC + d-I-PFC
7 kW STM32G4 world class commercial air con



Suggested ST products	
• STM32G474VE	• ULN2003D1013TR
• STGIK50CH65T	• VIPER318HDT
• 2x STGIPQ4C60T-HZ	• PM8834
• 2x STGWA50HP65FB2	• LMV339IDT
• 2x STFW40N60M2	• TS391RILT
• 2x STTH30M06S	• LD1117S33TR
• 2x TSV914IPT	• LD1117S50TR

- STM32G4 MCU drives all functions
  - Reduced number of components
  - No sync between controllers needed
  - Single firmware workspace
  - MC SDK v5.Y
- New ST HP SLLIMM 50A
  - High energy efficiency
- High frequency d-i-PFC 60kHz
  - SJ MOSFET, SiC diodes
  - New patented single shunt

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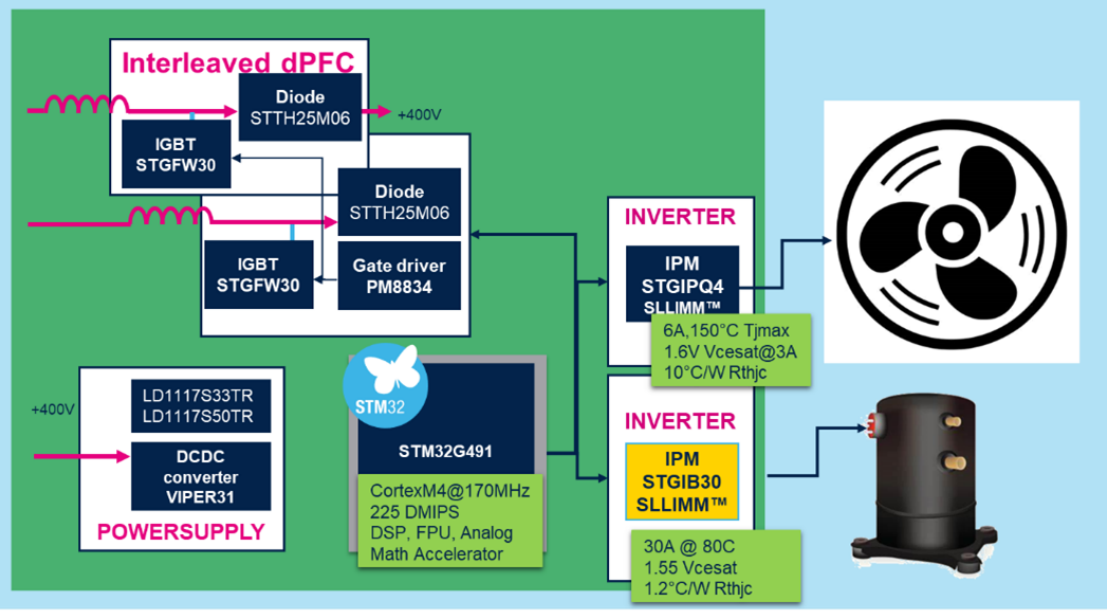
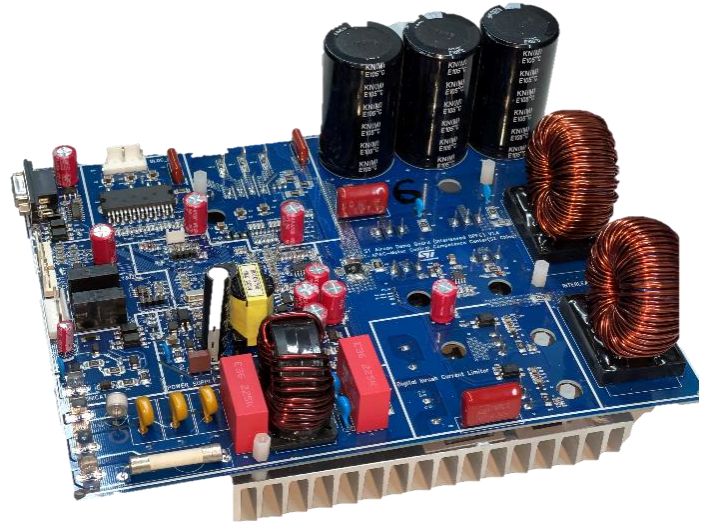
ST patent: dual FOC + d-I-PFC 4 kW STM32G4 commercial air con





Suggested ST products

- STM32G491RC
- STGIB30M60TS-L or STGIB20M60TS-L
- STGIPQ3H60T-HZ
- 2x STGFW30H65FB
- 2x STTH25M06FP
- ULN2003D1013TR
- VIPER318HDT
- PM8834
- TSV911RILT
- TSV912A
- LMV339IDT
- LDK320ADU33R
- LDK320ADU50R

- STM32G4 MCU drives all functions
  - Reduced number of components
  - No sync between controllers needed
  - One firmware workspace only
  - MC SDK v5.Y
- ST SLLIMM IPM
  - High energy efficiency
- High frequency d-i-PFC 60 kHz
  - SJ MOSFET, SiC diodes
  - New patented single shunt

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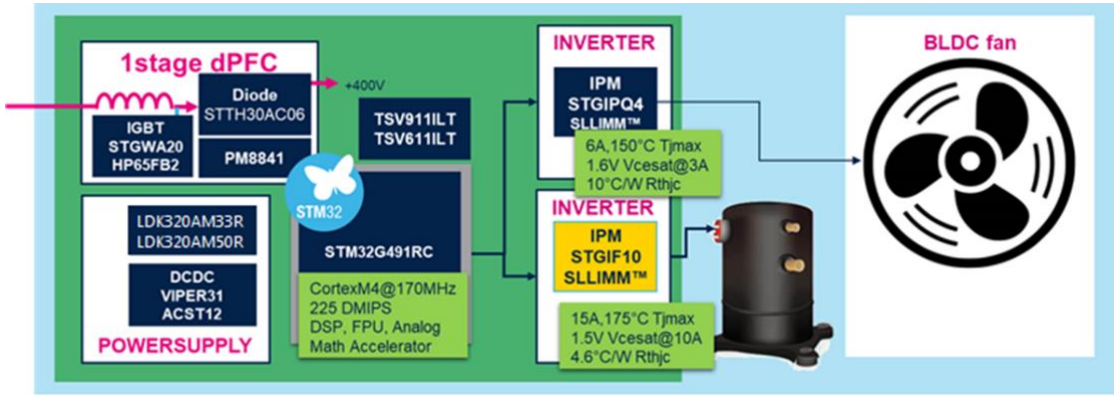
New dual FOC + d-PFC 2 kW STM32G491 room air con solution



Suggested ST products	
• STM32G491RC	• VIPER318HDTR
• STGWA30HP65FB2	• LDK320ADU33R
• STTH15AC06CWL	• M24C16-RMN6TP
• PM8841D	• TSV911ILT
• TS391RILT	• TSV611ILT
• STGIB10CH60TS-L	• ULN2003D1013TR
• TS391RILT	• STPS1L30A
• STGIPQ4C60T-HZ	• STPS2200U

- STM32G4 MCU drives all functions
  - Reduced number of components
  - No sync between controllers needed
  - One firmware workspace only
  - MC SDK support
- ST SLLIMM IPM
  - High energy efficiency
- High frequency d-i-PFC 60 kHz
  - SJ MOSFET/IGBT
  - SiC diodes

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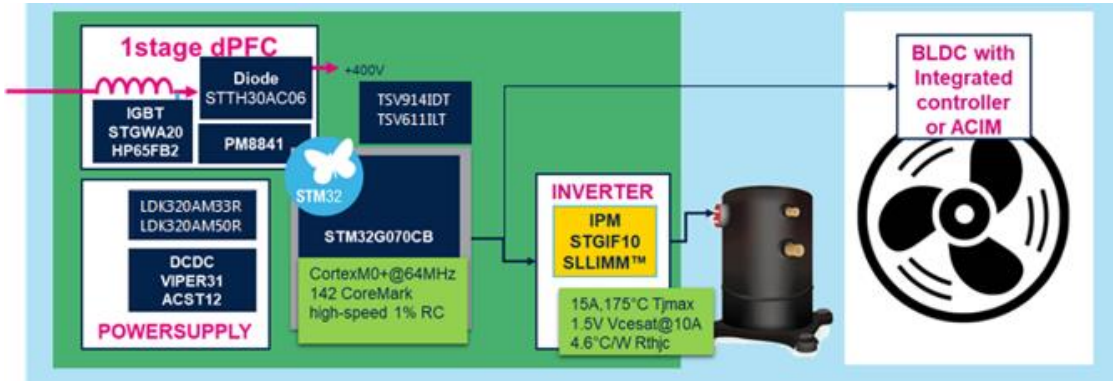
Patent: STM32G0-SLLIMM 2 kW air con solution FOC motor control & dPFC embedded FW



Suggested ST products

- STM32G070CBT6
- STGIF10CH60TS-L
- STGWA30HP65FB2
- T1610T-8
- T835T-8I
- T810T-8G
- Z0107MN / Z0107MUF
- STTH30M06SPF
- STTH1R02U
- STTH108A
- VIPER318HD
- PM8841D
- TS391RILT
- TSV914IDT
- LDK320ADU33R
- LDK320AM50R
- LMV339IDT
- ST3232BDR
- ULN2003D1013
- TMMBAT48

- STM32G0 MCU drives all functions
- Compatible with all architectures
  - BLDC fan with 5 wires
  - ACIM fan
- Innovative firmware architecture for integration of MC and dPFC
- All AC loads by triacs (no relay)
- Inrush current control by triac
- ST SLLIMM IPM
  - High energy efficiency
  - DBC / FM wide portfolio
- High frequency 40 kHz dPFC
  - Trench gate field-stop IGBT
  - Ultrafast rectifier

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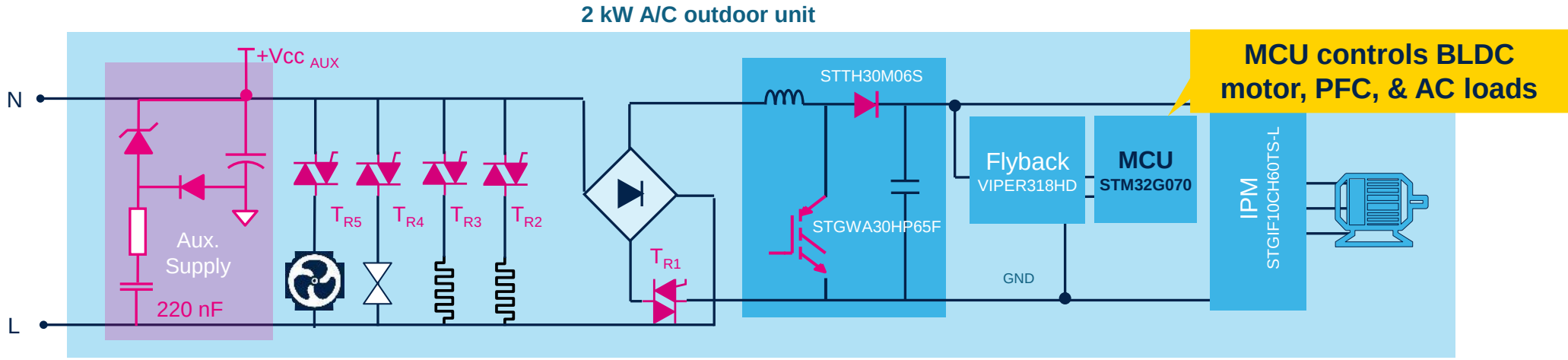
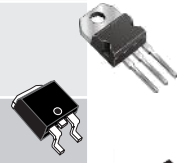
2 kW solution without electromechanical relays
AC load triacs supplied from a cheap capacitive supply

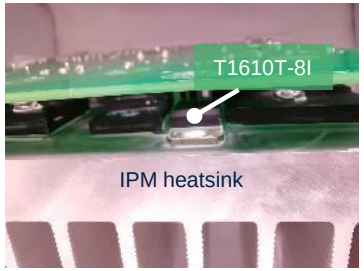


Ref.	Load	Max RMS current	Solution
T_{R1}	Inrush-current limiter – 2 kW @ 190 V	10.5 A	T1610T-8I mounted on IPM heatsink
T_{R2}	Compressor heater – 500 W	3 A	T835T-8I TO-220 (24°C/W heatsink is enough)
T_{R3}	Condenser heater – 250 W	1.5 A	T810T-8G, D2PAK with 1 cm² Cu
T_{R4}	4-way valve – 50 W	0.3 A	Z0107MUF, SMBFlat with 1 cm² Cu
T_{R5}	AC fan – 100 W	0.3 A	Z0107MUF, SMBFlat with 1 cm² Cu

Tamb max= 50°C



21°C/W heatsink



Same topology can be used in white appliances (washing machine, dishwasher, fridge, etc.)

Refrigerators

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Solutions for refrigerators

Part numbers in this slide are just example: final BOM to be agreed with marketing

BOM value

Completed
Available solution & kit

Available @ MCCC
300 W

STM32G0 +VIPER
3xL638x+TSVx+
6xTG IGBT/DM2

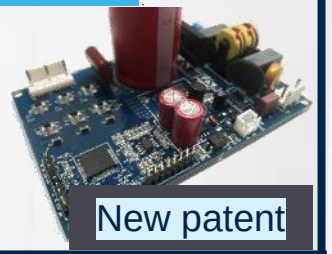
14 IC

Available @ MCCC
300 W

STM32G0 +VIPER
STDRIVE601 +TSVx
6x TG IGBT/DM2

11 IC

Available @ st.com
STEVAL-CTM011V1
STEVAL-CTM012V1
300 W



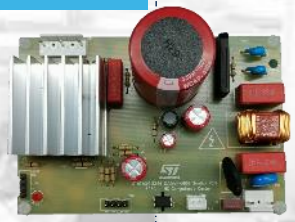
New patent

STSPIN32F0601 +
VIPER /LDO + TSVx
+ 6x IGBT/DM2

Ref. solution for
STSPIN32G0
In 24H1

10 IC

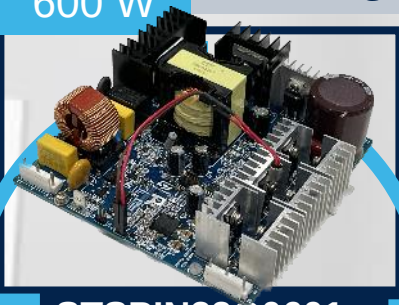
Available @ MCCC
300 W



STM32G0
VIPER/LDO + TSVx
SLLIMM™ nano IPM

5 IC

600 W
Available @ MCCC



STSPIN32G0601
VIPER/LDO + TSVx
6x IGBT/DM2
+ dPFC

Completed
Ongoing and roadmap

STM32 STSPIN

Integration

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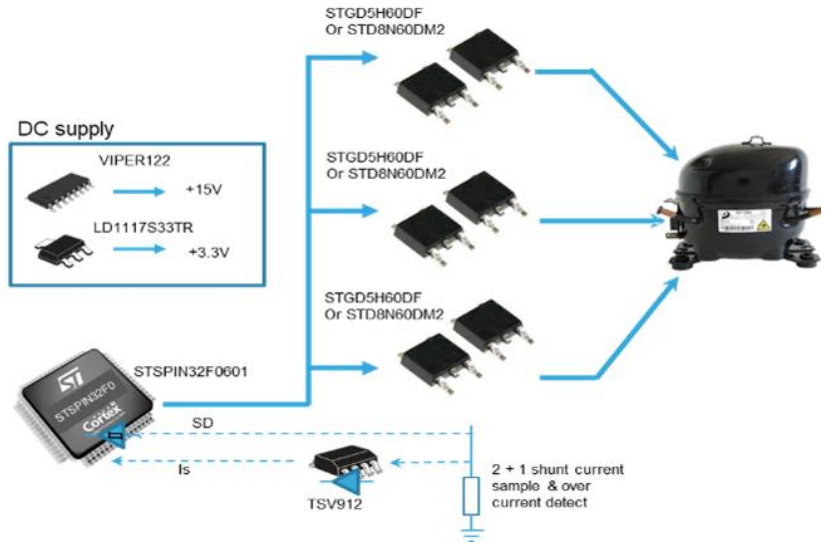
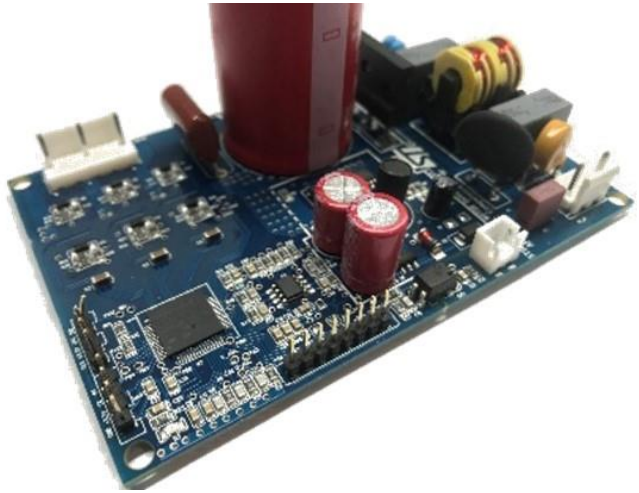
STSPIN32F0601 + TGFS IGBT / SJ MOS 250 W MC fridge solution



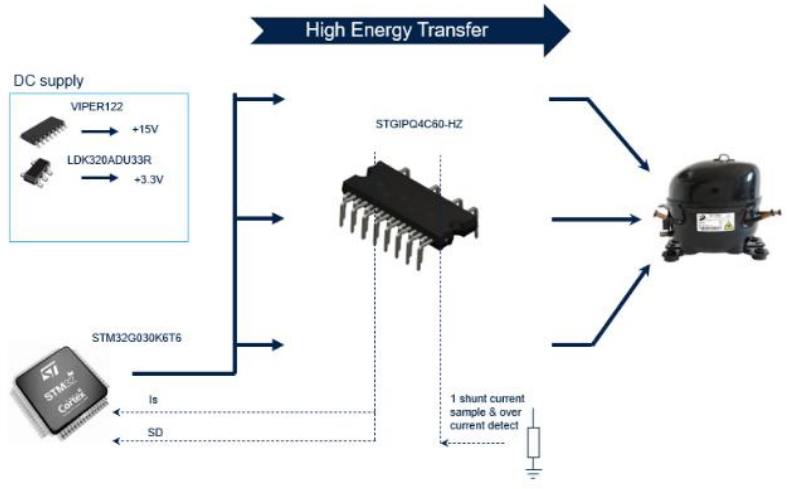


Suggested ST products

- STSPIN32F0601
- 6x STGD5H60DF Or STD8N60DM2
- VIPER122
- TSV912
- LD1117S33TR

- High integration SiP with embedded OCP & UVP protections
- High energy efficiency with TGFS IGBT / SJ MOSFET
- STSPIN32F0601 -40°C to 125°C
- Standby power <30 mW @ 230 VAC

STM32G0 + SLLIMM nano IPM 250 W fridge platform



Suggested ST products

- STM32G030K6T6
- STGIPQ4C60T-HZ
- VIPER122
- LDK320ADU33R

- Highly integrated fridge solution STM32G0 + SLLIMM 6A IPM
- Embedded OCP & op amp embedded in SLLIMM nano
- High energy efficiency with TGFS IGBT
- Switching frequency 4~6.6 kHz
- Single-layer PCB

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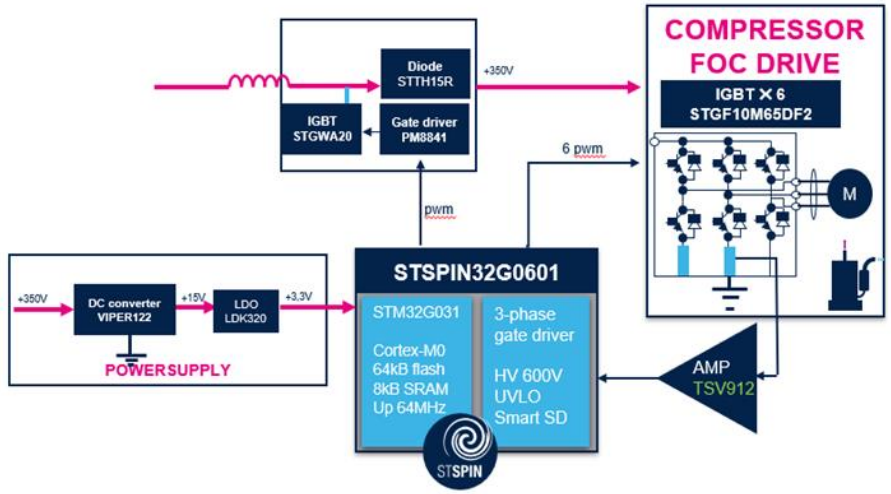
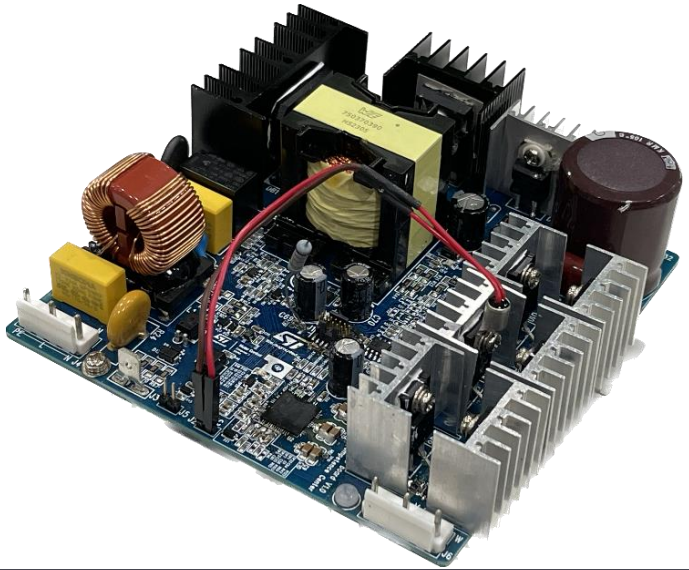
STSPIN32G0601 + TGFS IGBT
700 W commercial fridge MC & dPFC CCM





Suggested ST products

- STSPIN32G0601
- 6x STGF10M65DF2
- STGWA20HP65DF2
- STTH15RQ06D
- PM8841
- TSV912; TS391
- VIPER122
- LDK320ADU33R

- STSPIN32G0 drives all functions: MC and CCM dPFC
- Qualified dPFC IEC 61000-3-2
- Innovative firmware for integration of MC & dPFC @40kHz
- High integration SiP with embedded hardware protections
- High energy efficiency with TGFS IGBT and ultrafast rectifier
- MC switching frequency 4~6.6 kHz
- Standby power <30 mW @ 230 VAC

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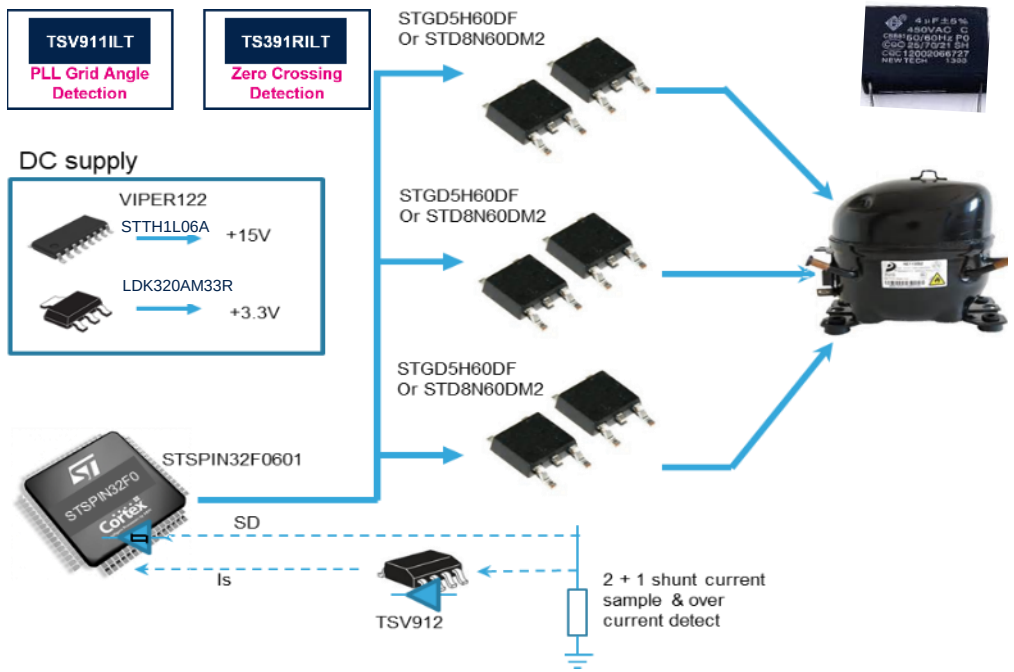
STSPIN32G0601 + TGFS IGBT / SJ MOS 300 W MC fridge solution



Suggested ST products

- STSPIN32G0601
- VIPER122
- TSV912
- TS391RILT
- LDK320AM33R
- 6x STGD5H60DF

In 2024 H2

- High integration SiP with embedded OCP & UVP protections
- High power factor & Low THD
- PCB size reduction (CBB<EC)
- Increase system life (CBB>EC)
- BOM cost reduction (CBB<EC)
- High energy efficiency with TGFS IGBT / SJ MOSFET
- STSPIN32G0601 -40°C to 125°C
- Standby power <30 mW @ 230 VAC

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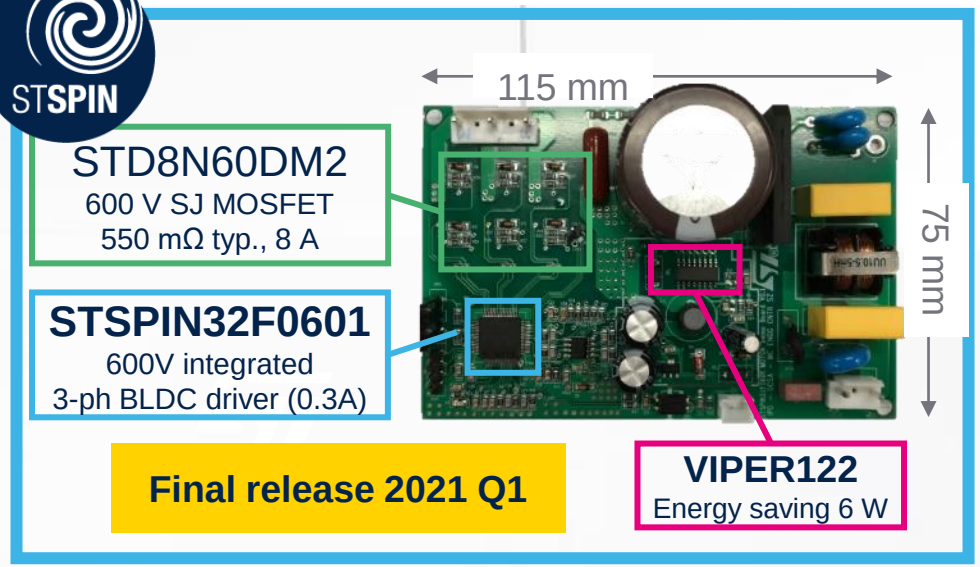
Fridge solution 250 W
STSPIN32F0 and discrete products



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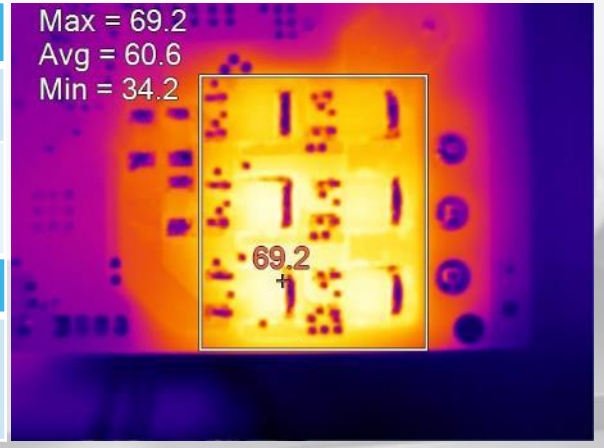
"ST shows best energy efficiency and COP on the market" *

Power and thermal measurements*	
Max power	240 W
Max temperature on MOSFETS (steady state):	69.2°C

Reliability test
15 seconds RUN 3 seconds STOP Continuous repetition, 500k cycles



Compressor 1 test				
Board	Speed	COP	Inverter efficiency (%)	Inverter power loss (W)
ST solution	1600	2.08	96.336	1.546
	2000	2.079	96.62	1.79
Competitor 1	1600	2.072	96.302	1.549
	2000	2.076	96.579	1.807

Compressor 2 test				
Board	Speed	COP	Inverter efficiency (%)	Inverter power loss (W)
ST solution	1600	1.979	95.89	1.774
	3000	1.945	96.74	2.702
Competitor 2	1600	1.91	93.31	2.94
	3000	1.919	95.24	4.01

* according to leading manufacturer

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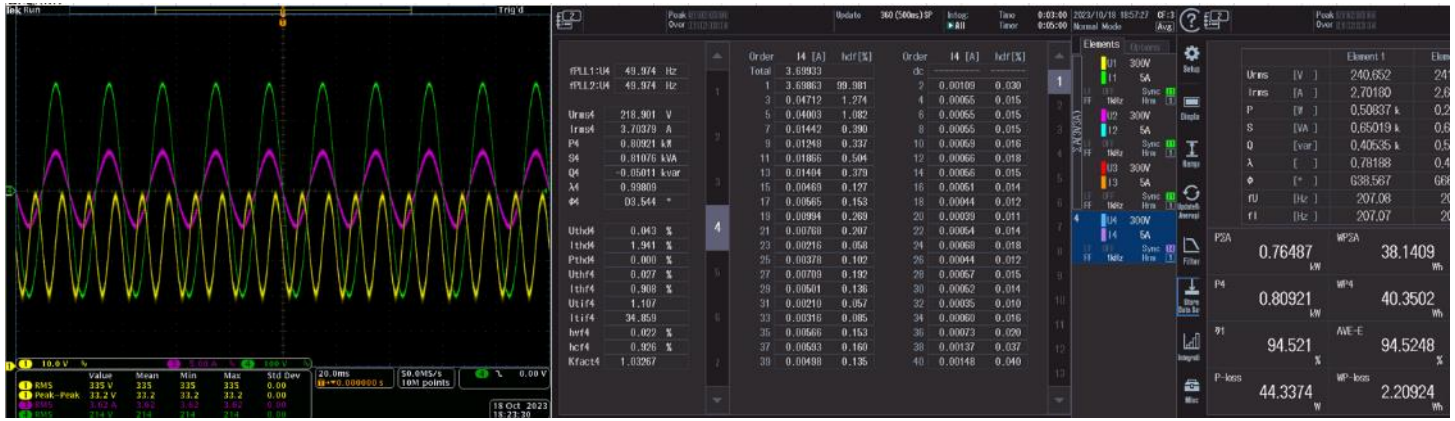
600 W &1.2 kW commercial fridge platform PF & THD benchmarks

Orders of Harmonic Current (h)	Maximum allowable harmonic current (A)
Odd Harmonic	
3	2.30
5	1.14
7	0.77
9	0.40
11	0.33
13	0.21
15≤h≤39	0.15 X 15 /h
Even Harmonic	
2	1.08
4	0.43
6	0.30
8≤h≤40	0.23 X 8 /h

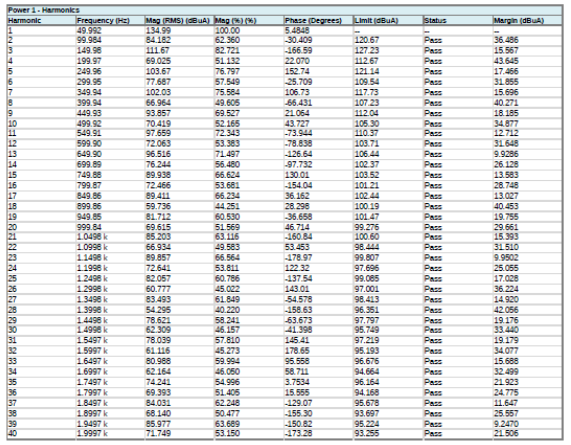
New GB THD standard for fridge ≥ 600 W

Key features

- Compatible PFC platform for both **110** & **220 VAC**
- Boost PFC voltage: **380 VDC** for both **110** & **220 VAC**
- PF & THD for **new GB** standards



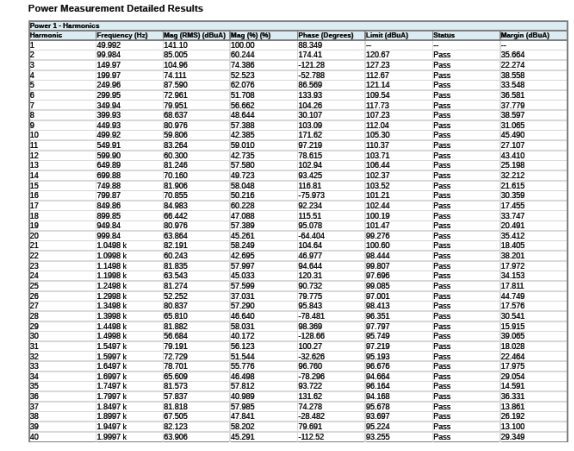
800 W benchmarks for PF & THD



Power Measurement Detailed Results

Power 1 - Harmonics

Harmonic	Frequency (Hz)	Mag (RMS) (dBuA)	Mag (%) (%)	Phase (Degrees)	Limit (dBuA)	Status	Margin (dBuA)
1	49.982	134.99	100.00	5.4848	--	--	--
2	99.984	84.182	62.360	-30.409	120.67	Pass	36.486
3	149.98	111.67	82.721	-166.59	127.23	Pass	15.567
4	199.97	69.026	51.132	22.070	112.67	Pass	43.645
5	249.96	103.67	76.797	152.74	121.14	Pass	17.466
6	299.95	77.687	57.549	-25.709	109.54	Pass	31.855
7	349.94	102.03	75.584	106.73	117.73	Pass	15.696
8	399.94	66.964	49.605	-66.431	107.23	Pass	40.271
9	449.93	93.857	69.527	21.064	112.04	Pass	18.185
10	499.92	70.419	52.165	43.727	106.30	Pass	34.877
11	549.91	97.659	72.343	-73.944	110.37	Pass	12.712
12	599.90	72.063	53.383	-78.838	103.71	Pass	31.648
13	649.90	96.516	71.497	-126.64	106.44	Pass	9.9286
14	699.89	76.244	56.480	-97.732	102.37	Pass	26.128
15	749.88	89.938	66.624	130.01	103.52	Pass	13.583
16	799.87	72.466	53.681	-154.04	101.21	Pass	28.748
17	849.86	89.411	66.234	36.162	102.44	Pass	13.027
18	899.86	59.736	44.251	28.298	100.19	Pass	40.453
19	949.85	81.712	60.530	-36.658	101.47	Pass	19.755
20	999.84	69.615	51.569	-46.714	99.276	Pass	29.661
21	1.0498 k	88.203	63.116	-160.84	100.60	Pass	15.393
22	1.0998 k	66.934	49.583	53.453	98.444	Pass	31.510
23	1.1498 k	89.857	66.564	-178.97	99.807	Pass	9.9502
24	1.1998 k	72.641	53.811	122.32	97.696	Pass	25.055
25	1.2498 k	82.057	60.786	-137.54	99.085	Pass	17.028
26	1.2998 k	60.777	45.022	143.01	97.001	Pass	36.224
27	1.3498 k	83.493	61.849	-54.578	98.413	Pass	14.920
28	1.3998 k	54.295	40.220	-158.63	96.351	Pass	42.056
29	1.4498 k	78.621	58.241	-63.673	97.797	Pass	19.176
30	1.4998 k	62.309	46.157	-41.398	95.749	Pass	33.440
31	1.5497 k	78.039	57.810	145.41	97.219	Pass	19.179
32	1.5997 k	61.116	45.273	178.65	95.193	Pass	34.077
33	1.6497 k	80.988	59.994	95.558	96.676	Pass	15.688
34	1.6997 k	62.164	46.050	58.711	94.664	Pass	32.499
35	1.7497 k	74.241	54.996	3.7534	96.164	Pass	21.923
36	1.7997 k	69.393	51.405	15.595	94.168	Pass	24.775
37	1.8497 k	84.031	62.248	-129.07	95.678	Pass	11.647
38	1.8997 k	68.140	50.477	-155.30	93.697	Pass	25.557
39	1.9497 k	86.977	63.689	-150.82	95.224	Pass	9.2470
40	1.9997 k	71.749	53.150	-173.28	93.255	Pass	21.506



Power Measurement Detailed Results

Power 1 - Harmonics

Harmonic	Frequency (Hz)	Mag (RMS) (dBuA)	Mag (%) (%)	Phase (Degrees)	Limit (dBuA)	Status	Margin (dBuA)
1	49.962	141.10	100.00	88.349	--	--	--
2	99.984	85.005	60.244	174.41	120.67	Pass	35.664
3	149.97	104.96	74.386	-121.28	127.23	Pass	22.274
4	199.97	74.111	52.523	-52.788	112.67	Pass	38.558
5	249.96	87.590	62.076	86.569	121.14	Pass	33.548
6	299.95	72.961	51.708	133.93	109.54	Pass	36.581
7	349.94	79.951	56.662	104.26	117.73	Pass	37.779
8	399.93	68.637	48.644	30.107	107.23	Pass	38.597
9	449.93	80.976	57.388	103.09	112.04	Pass	31.065
10	499.92	59.806	42.385	171.62	105.30	Pass	45.490
11	549.91	83.264	59.010	97.219	110.37	Pass	27.107
12	599.90	60.300	42.735	78.615	103.71	Pass	43.410
13	649.89	81.246	57.580	102.94	106.44	Pass	25.198
14	699.88	70.160	49.723	93.425	102.37	Pass	32.212
15	749.88	81.906	58.048	116.81	103.52	Pass	21.615
16	799.87	70.855	50.216	-75.973	101.21	Pass	30.359
17	849.86	84.983	60.228	92.234	102.44	Pass	17.455
18	899.85	66.442	47.088	115.51	100.19	Pass	33.747
19	949.84	80.976	57.389	95.078	101.47	Pass	20.491
20	999.84	63.864	45.261	-84.404	99.276	Pass	35.412
21	1.0498 k	82.191	58.249	104.64	100.60	Pass	18.405
22	1.0998 k	60.243	42.695	46.977	98.444	Pass	38.201
23	1.1498 k	81.835	57.997	94.644	99.807	Pass	17.972
24	1.1998 k	63.543	45.033	120.31	97.696	Pass	34.153
25	1.2498 k	81.274	57.599	90.732	99.085	Pass	17.811
26	1.2998 k	52.252	37.031	79.775	97.001	Pass	44.749
27	1.3498 k	80.837	57.290	95.843	98.413	Pass	17.576
28	1.3998 k	65.810	46.640	-78.481	96.351	Pass	30.541
29	1.4498 k	81.882	58.031	96.399	97.797	Pass	15.915
30	1.4998 k	56.684	40.172	-128.66	95.749	Pass	39.065
31	1.5497 k	79.191	56.123	100.27	97.219	Pass	18.028
32	1.5997 k	72.729	51.544	-32.626	95.193	Pass	22.464
33	1.6497 k	78.701	55.776	96.760	96.676	Pass	17.975
34	1.6997 k	65.609	46.498	-78.296	94.664	Pass	29.054
35	1.7497 k	81.573	57.812	93.722	96.164	Pass	14.591
36	1.7997 k	57.837	40.989	131.62	94.168	Pass	36.331
37	1.8497 k	81.818	57.985	74.278	95.678	Pass	13.861
38	1.8997 k	67.505	47.841	-28.482	93.697	Pass	26.192
39	1.9497 k	82.123	58.202	79.691	95.224	Pass	13.100
40	1.9997 k	63.906	45.291	-112.52	93.255	Pass	29.349

THD test result 1200 W @110/220 VAC
IEC 61000-3-2 THD standard (PASS)

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Washing machines

Motor Control Competence Center

AI Competence Center

MC + AI washing machine

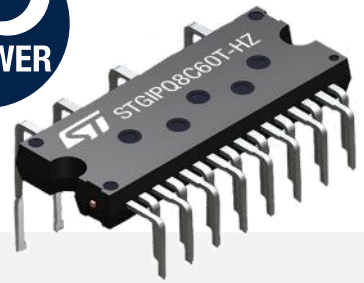
=

STM32

New patent

+

STPOWER



STM32G4 MCU
1 firmware workspace only

STM32 MC SDK + NANOEDGE AI STUDIO

SLLIMM nano 2nd series IPM
High-performance motor drive

STM32 ZeST + STPOWER Studio

100 gr accurate load measurement

Shorter wash time
with less water

Water & energy saving

Perfect sensorless startup

Smaller current amplitude
Better fit IPM rating

Double-digit energy saving

Suggested ST products

- STM32G431CB
  - 48-pin, 128 KB flash,
  - -40°C to 85°C
- STGIPQ8C60T-HZ
  - 8 A @ 25°C
  - 2 V Vce_sat @ 8 A
- VIPER122
  - 730 V, 40 mW no load
- LDK320 LDO
  - 200 mA max,
  - 100 mV dropout

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Servo drives, motor drives, robot joints

life.augmented

Motor Control
Competence
Center

LV servo drive solutions roadmap

GaN based

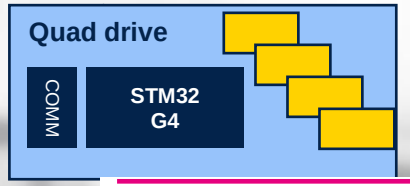
Quad axis

Dual axis

Single axis

2021 2022 2023 2024 2025

GaN-STM32G4
1 kW multimotor drive



STM32G4
multimotor drive

2 NEW PATENTs

Available @ MCCC

STSPIN32G4 /
STM32G4 dual drive

EVALKIT-ROBOT-1

STEVAL-
ETH001V1

Available @ MCCC

EtherCAT

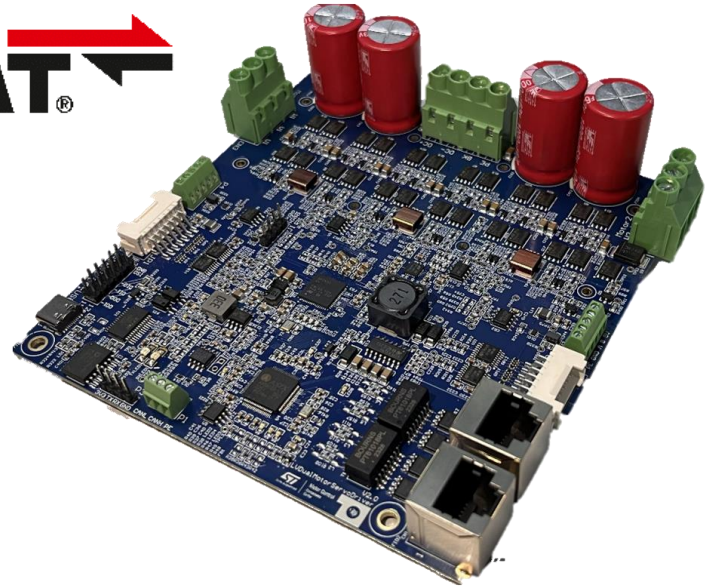
STSPIN32G4
LV servo with EtherCAT

EtherCAT

STSPIN32G4 / STM32G4
1 kW dual servo with EtherCAT

STSPIN32G4 LV servo
High power density version

ST low voltage 48 V nominal, EtherCAT Dual motor servo drive solution, 2x 1 kW



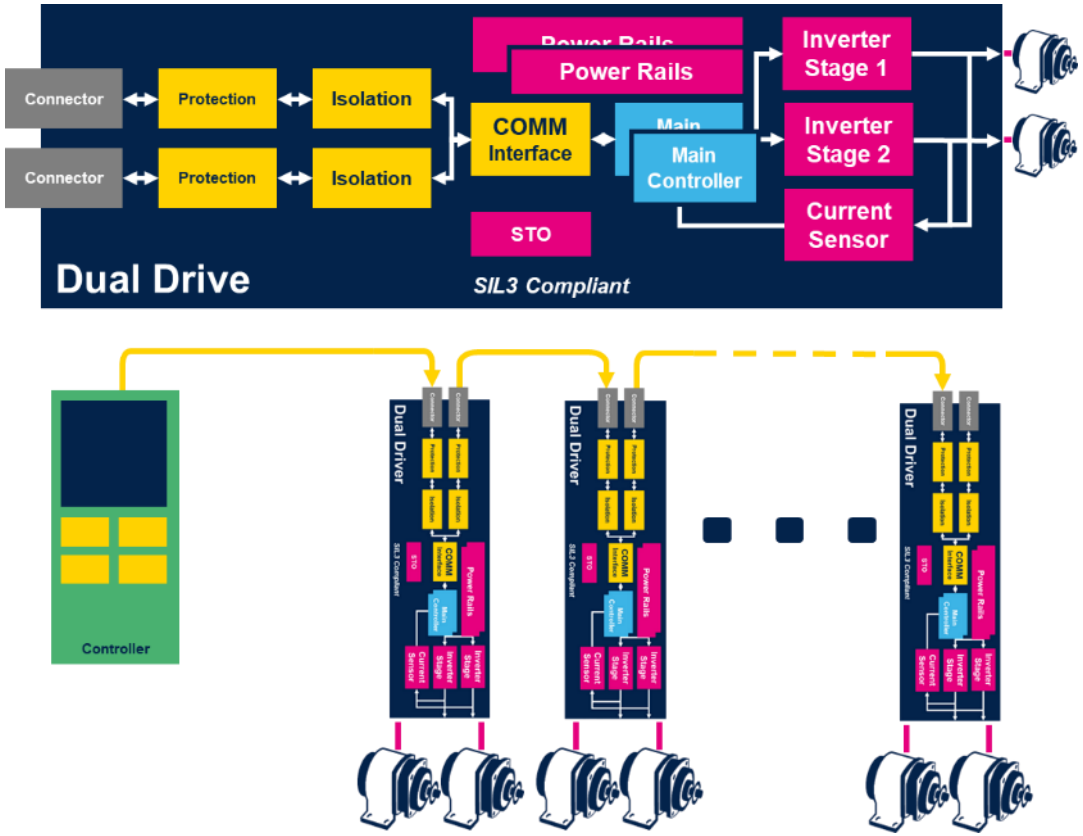
- Dual motor drive with single STSPIN32G4 STDRIVE101
- Rating current up to dual 20 Arms
- Shared current sensing network
- Dual encoder interface: Incremental and absolute
- EtherCAT or CAN comm interface
- Optimized layout for unbalance load

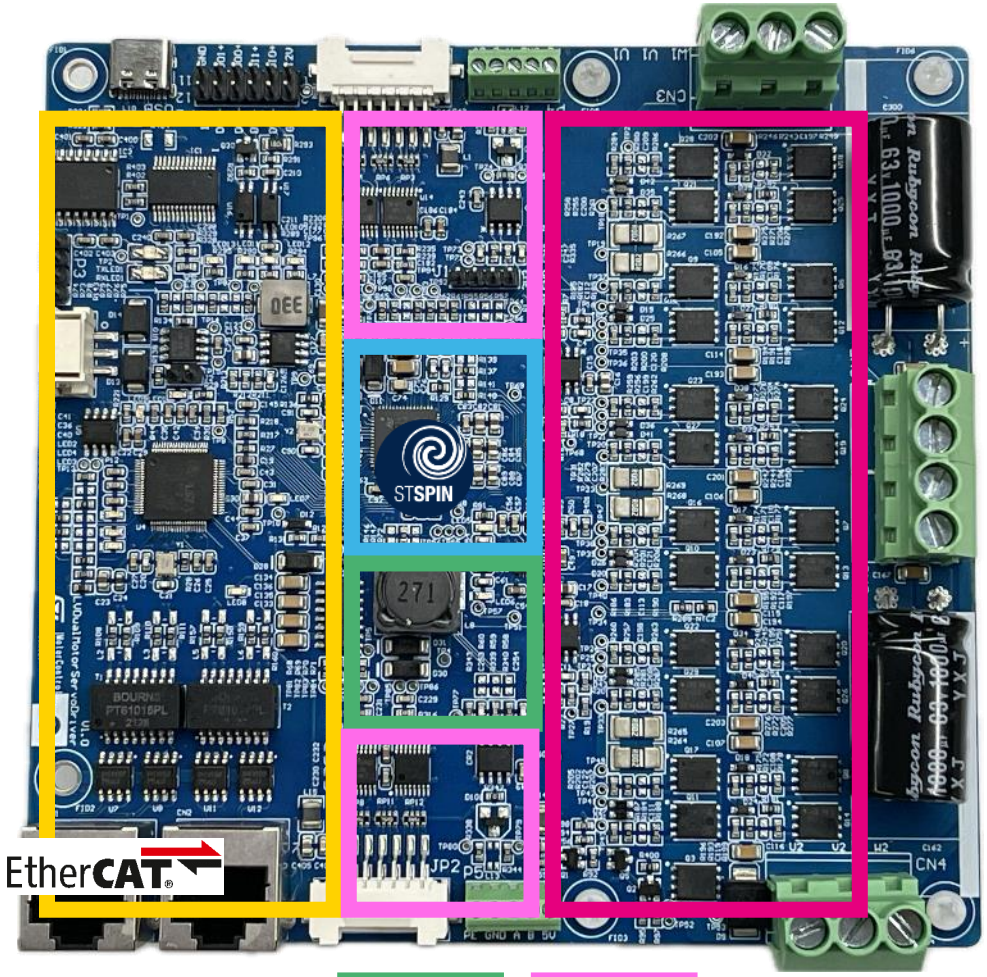
- Full firmware stack for industrial motor control (MCSDK+CiA402+EtherCAT stack)
- Improved encoder alignment (microshake, no need for index or Hall sensor)
- Improved scheduler (synchronized task timing)

Suggested ST products

- STSPIN32G4
- STDRIVE101
- STL90N10F7x25
- M24M01-RMN6P
- VIPER319HDTR
- LD39015M12R
- LD56100DPU33R
- L6981CDR
- ST26C32ABDRx4
- ESDA14V2BP6x2
- SMBJ6.0CA
- HSP051-4M10x2

ST solution for Dual motor servo drive, SIL2/3



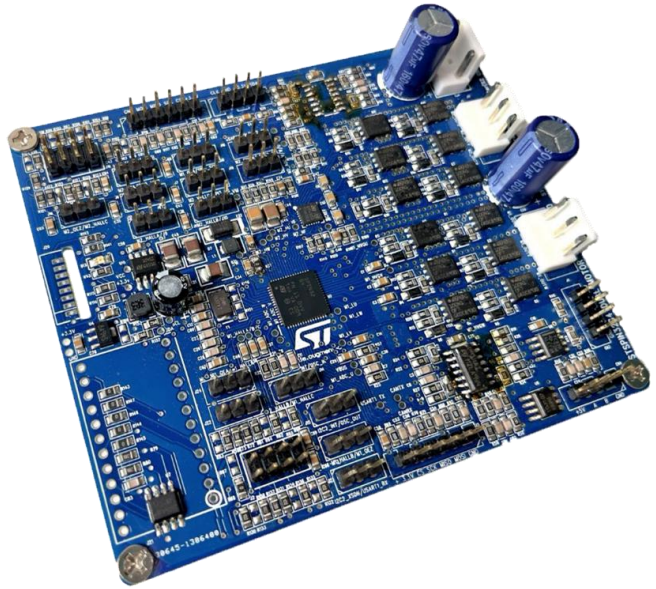


Size: 13 x 13 cm

Aux. power mgmnt

ABS & QIE

ST dual motor control, MEMS, ToF STSPIN32G4 development platform



- High integration SiP
- 5-75 V, 200 W
- Firmware & hardware support for
  - Dual motor FOC sensorless/sensor
  - Magnetic encoder/QEI
  - Hall sensors
  - Position control
- IMU data acquisition
- ToF data acquisition
- CAN, RS485 protocols

Suggested ST products	
• STSPIN32G4	• LD56100DPU33R
• STDRIVE101	• L6981CDR
• STL90N10F7x25	• ST26C32ABDRx4
• M24M01-RMN6P	• ESDA14V2BP6x2
• VIPER319HDTR	• SMBJ6.0CA
• LD39015M12R	• HSP051-4M10x2

STSPIN32G4 dual drive solution

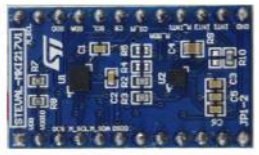
ToF sensor board

VL53L3CX-SATEL

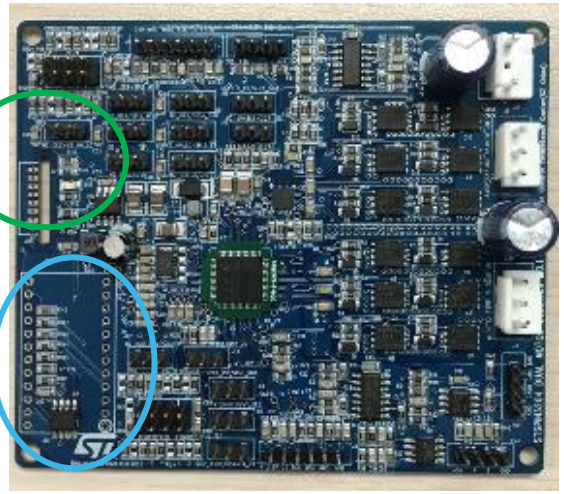
IMU sensor board

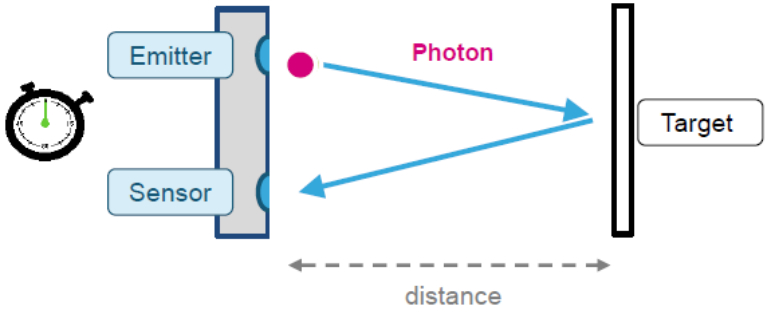
STEVAL-MKI207V1(6 axis)

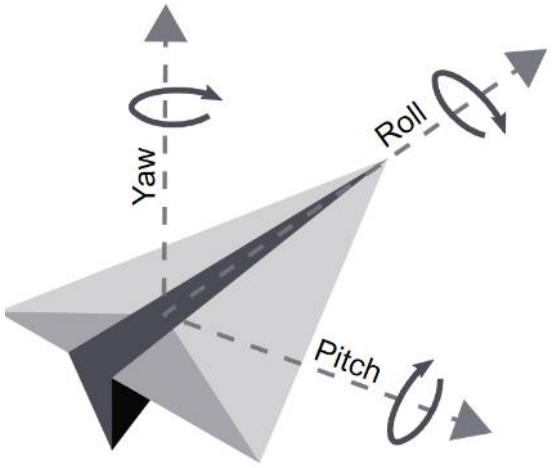
OR

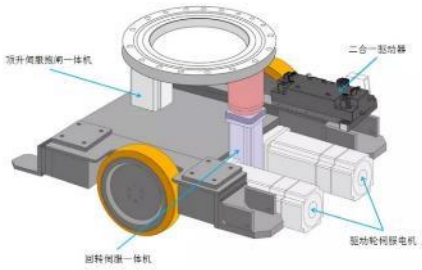


STEVAL-MKI217V1(9 axis)









Motor Control
Competence
Center

HV servo drive solutions roadmap

GaN based

SiC based

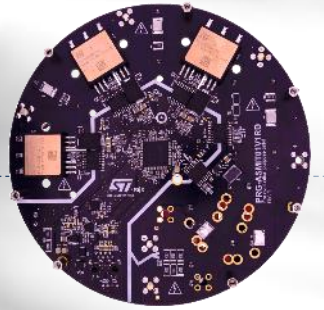
Dual axis

Single axis

Available @ MCCC @ ASP

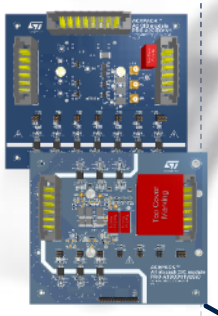
STi2GaN based HV servo board

High bandwidth & efficiency 220 VAC, 600 W, STM32H750, STDRIVEG611, STi2GaN 650 V



Infield servo driver platform based on SiC MOSFET 650 VDC 15 kW peak power, STM32H743, 1200 V 25 mΩ SiC SMIT package, encoder, PoE

Dual axis HV servo platform 1.5 kW 220 VAC RS485 ABS encoder single core: STM32H730 IPM: STGIB15CH60TS-X 2



High-voltage, high-power testing platform STM32H743 + ACEPACK, IGBT, SiC MOSFETs version 380 VAC 3-ph 10 kw

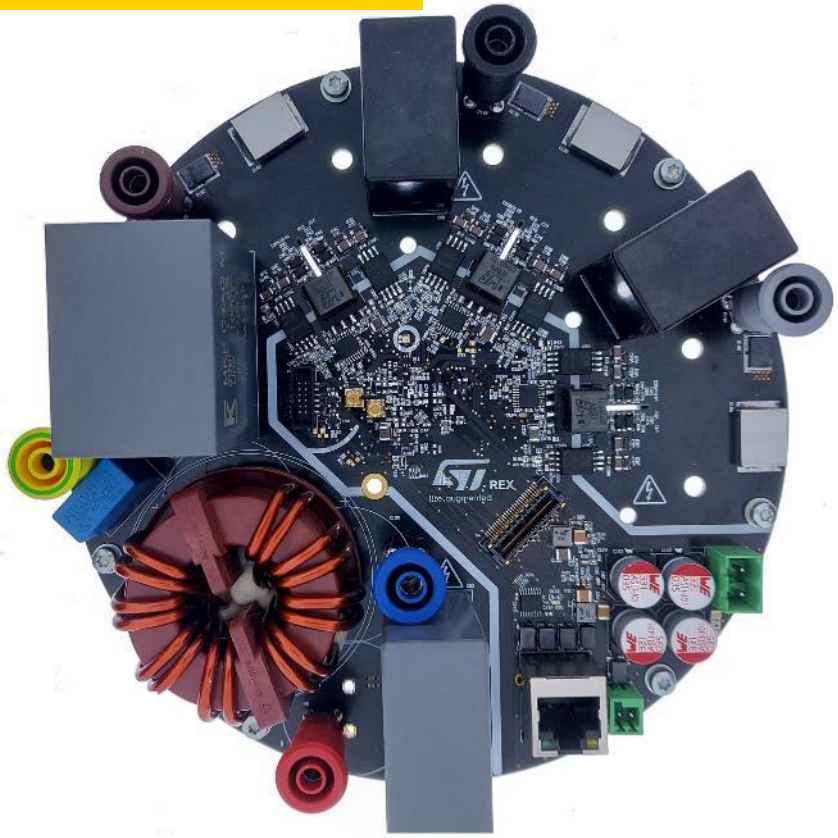
High-end servo drive with real-time connectivity and safety functions- SIL2 750 VDC 22 kW STM32H743 + ACEPACKSMIT

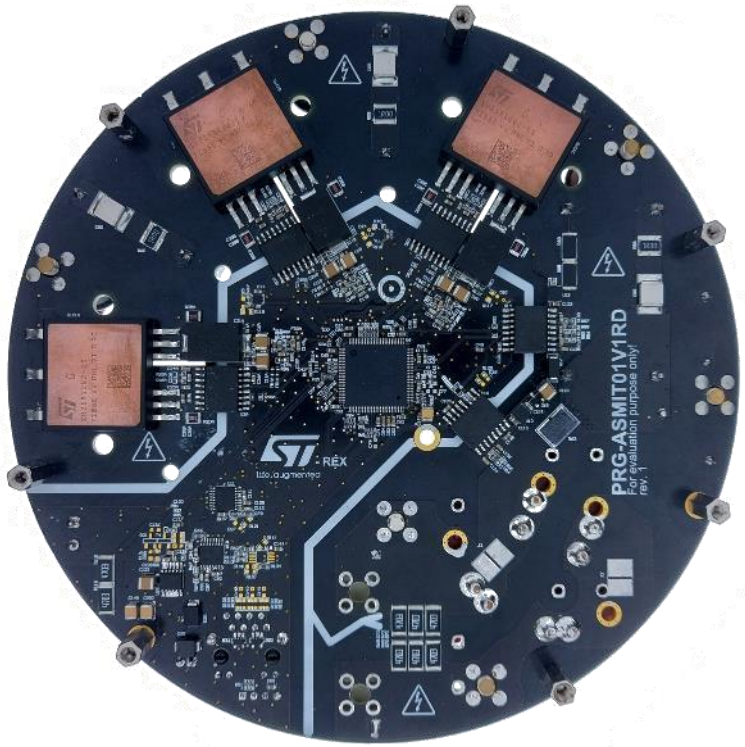
Value line HV servo motor control modular platform 1 kW single axis, STM32H5 + SJ-MOS IPM, STGAP

2021 2022 2023 2024 2025

SiC MOSFET 15 kW infield servo drive
Input voltage: 650 VDC factory grid + PoE

Available on request





ST BOM

- 3x SH16M12W3AG
- 6x STGAP2HSICS
- 5x ISOSD61
- 3x L6986I
- 2x L6986F
- 2x STTS22H
- 1x STM6322
- 1x IPS160H
- 5x ESDALC6V1W5
- 1x STM32H743

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SiC MOSFETs in motor control
Solving dVdt impact on the motor

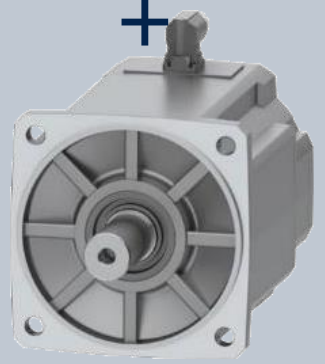
Conventional topology

Inverter

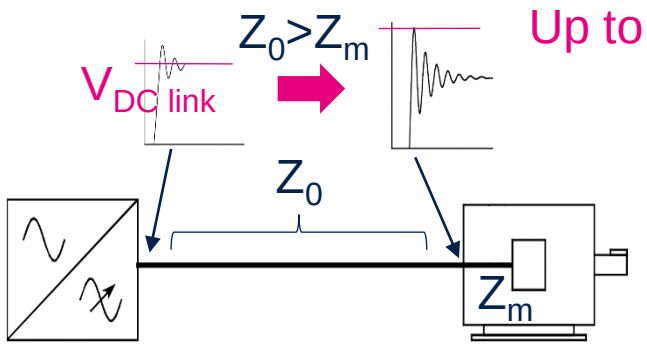
+

Cable

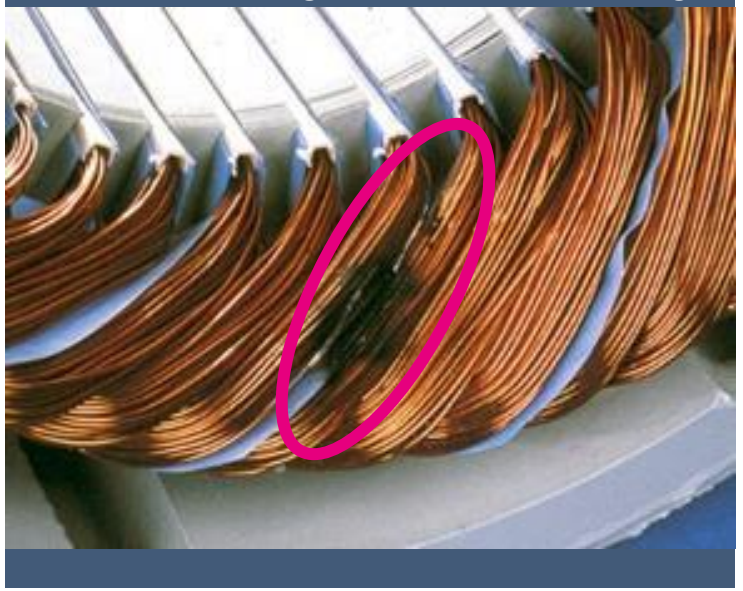
+



Motor



Partial discharge burns the windings



SiC MOSFETs in motor control
Solving dVdt impact to the motor

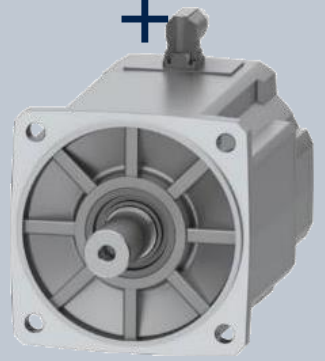
Conventional topology

Inverter

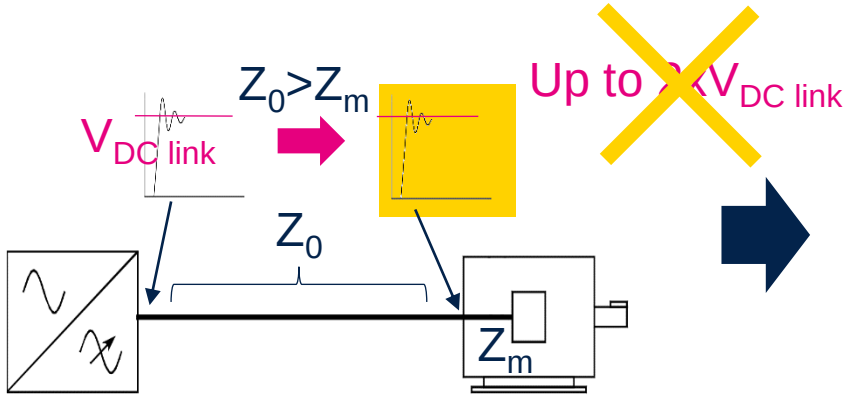
+

Cable

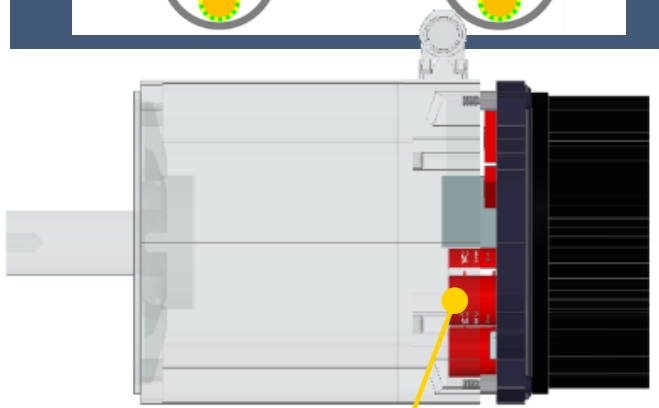
+



Motor

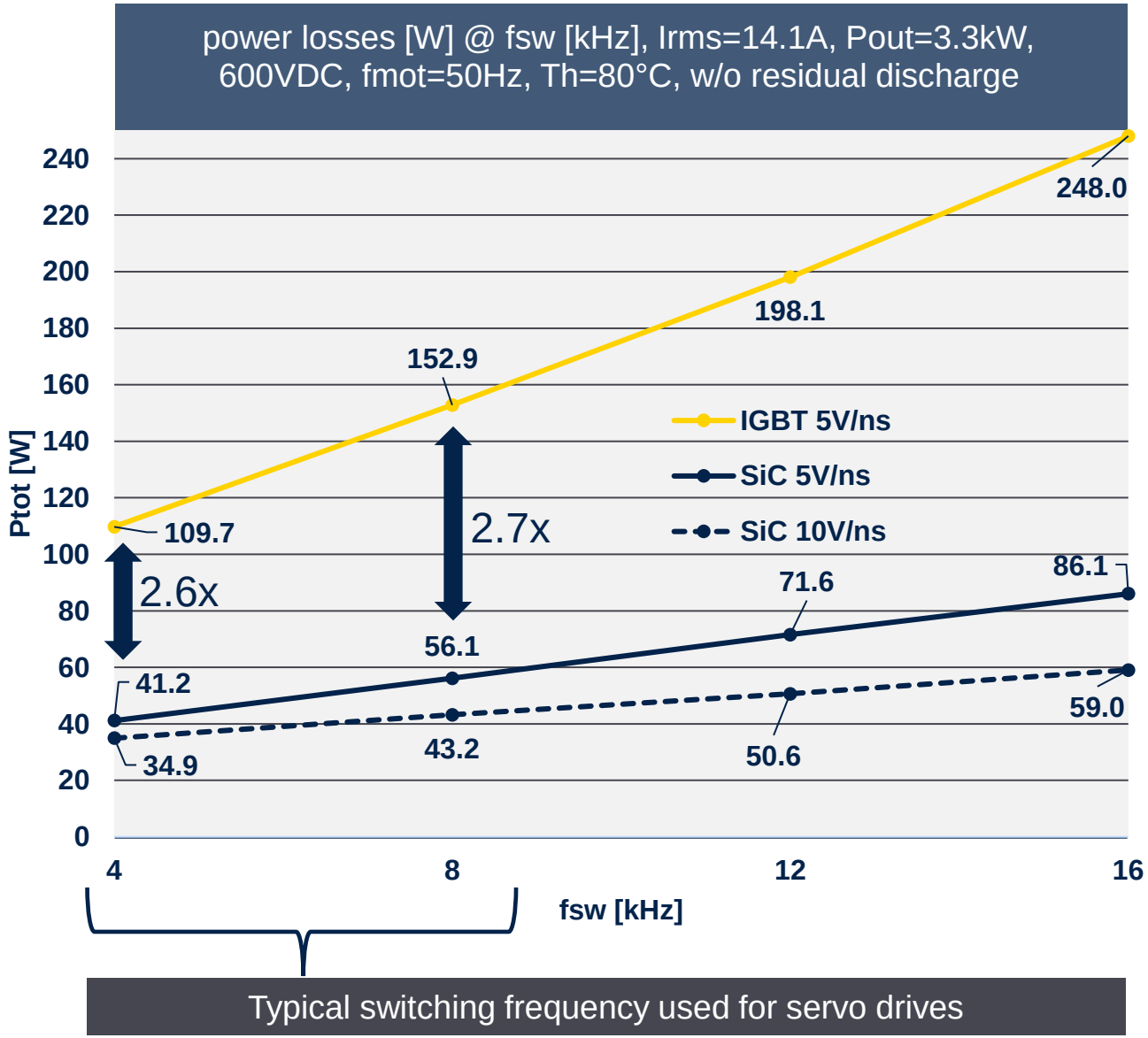


Simplified connecting cable



Built-in inverter

Inverter loss measurements in the lab



SiC MOSFETs efficiency @ same dV/dt

- +1.9% at 4kHz
- +2.7% at 8kHz

165 days duty to pay back delta price

SiC MOSFETs losses @ same dV/dt

- 2.6x lower at 4kHz
- 2.7x lower at 8kHz

Opportunity:

- Increase power density
- Reduce frame size

Motor Control
Competence
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500 W high-voltage motor drives based on GaN

GaN high voltage servo motor drive

Available on demand

Key features:

- GaN ready solution for motion control
- 10 V dV/dt both hard-on and hard-off
- Overcurrent protection integrated in the gate driver
- FOC supported
- Designed for 230 V AC mains
- HEMT GaN 650 V, 75 mΩ typ R_{DSon}

Specifications:

- 500 W+ max output power without cooling fan
- RS485 for absolute position encoder
- SPI, I²C
- Hall sensor & encoder

Key products	• **STDRIVEG611** • **SGT120R65AL** • **TSV791ILT** • **VIPER06HS**	• **STM32H730VBT6** • **LDK320ADU33R** • **ST715MR** • **ST3485EBDR**
Applications	• **Home appliances** • **Servo drives** • **High speed motors & tools** • **Miniaturized motors**	

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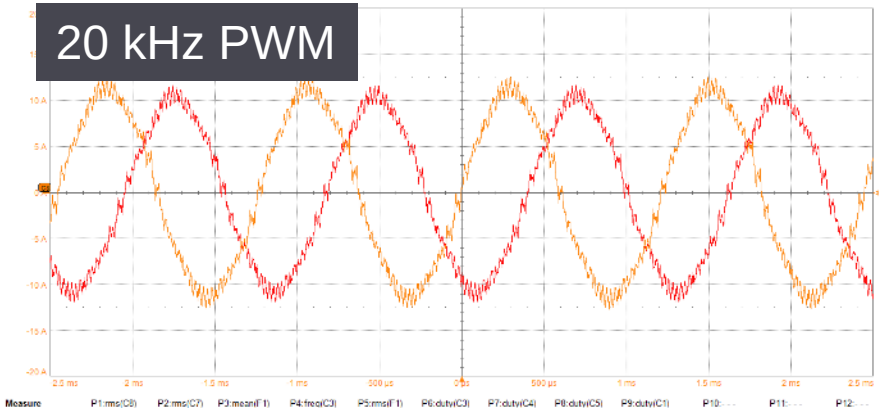
Overall efficiency improvement increasing the PWM frequency

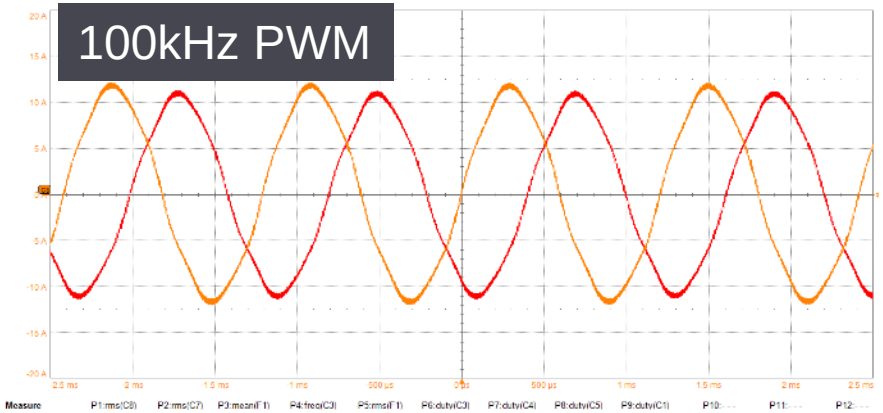
20 kHz PWM



Peaks	Frequency	Amplitude
1	750 Hz	6.5713 A
2	40.75 kHz	269.4 mA
3	39.25 kHz	248.8 mA
4	3.76 kHz	248.1 mA
5	21.50 kHz	159.0 mA
6	18.50 kHz	135.4 mA
7	122 Hz	115.7 mA
8	17.00 kHz	113.4 mA
9	23.00 kHz	102.3 mA
10	1.46 kHz	98.8 mA

Not producing active torque

100kHz PWM

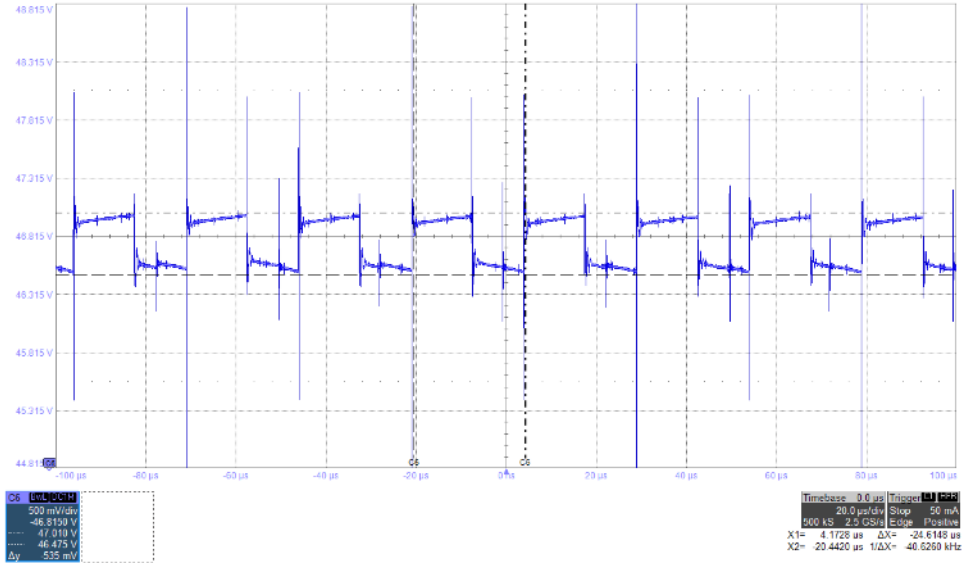


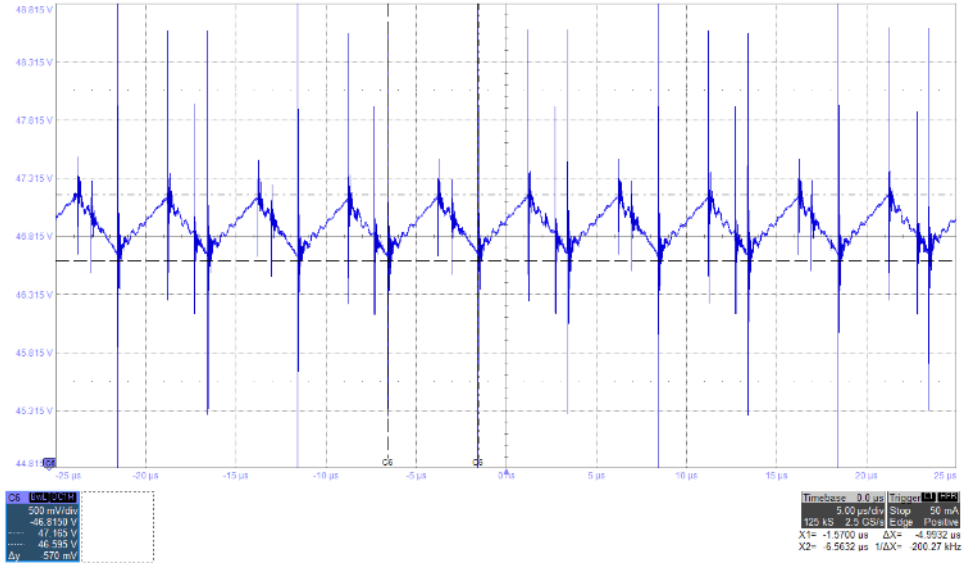
Peaks	Frequency	Amplitude
1	750 Hz	6.6455 A
2	3.75 kHz	251.8 mA
3	199.24 kHz	85.2 mA
4	5.25 kHz	74.2 mA
5	98.50 kHz	44.4 mA
6	101.49 kHz	37.8 mA
7	103.00 kHz	31.1 mA
8	97.00 kHz	28.6 mA
9	196.24 kHz	11.4 mA
10	49.24 kHz	7.7 mA

	Si @20kHz	GaN @100kHz
Inverter efficiency	98.28%	98.68%
Motor efficiency		+4%
Overall efficiency		+4.12%

Motor Control
Competence
Center

VDC ripple comparison





Prototype 1:

- Fpwm 20 kHz
- 2 X 330 µF electrolytic capacitor (20 x 40 x 16.5 mm)
- Ripple voltage 0.53 V @40 kHz

Prototype 2:

- Fpwm 100 kHz
- 2 X 22 µF ceramic capacitor (8 x 13 x 5 mm)
- Ripple voltage 0.57 V @200 kHz

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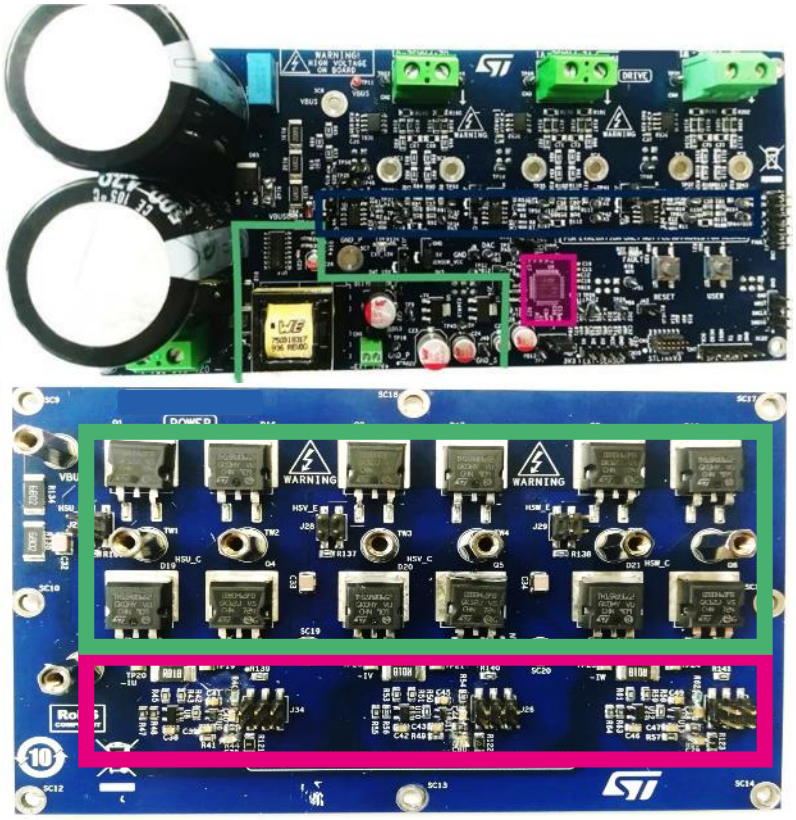
1 kW switched reluctance motors control system solution



STEVAL-CTM015V1

- Driver board (STEVAL-CTM015A1)
  - 3x L6395D high-voltage single-chip high and low-side gate drivers, independent control of high and low-side
  - STM32F303CBT6 microcontroller
  - Support for quadrature incremental encoder and Hall effect rotor position sensor
- Power board (STEVAL-CTM015A2)
  - Insulated metal substrate (IMS)
  - Hosts six STGB30H60DFB IGBTs and six STTH15RQ06 diodes in a D2PAK-2 package
  - Decoupling gate resistors
  - NTC sensing network for overheat protection
  - Heat sink for heat dissipation featuring a thermal resistance of 1 kW

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