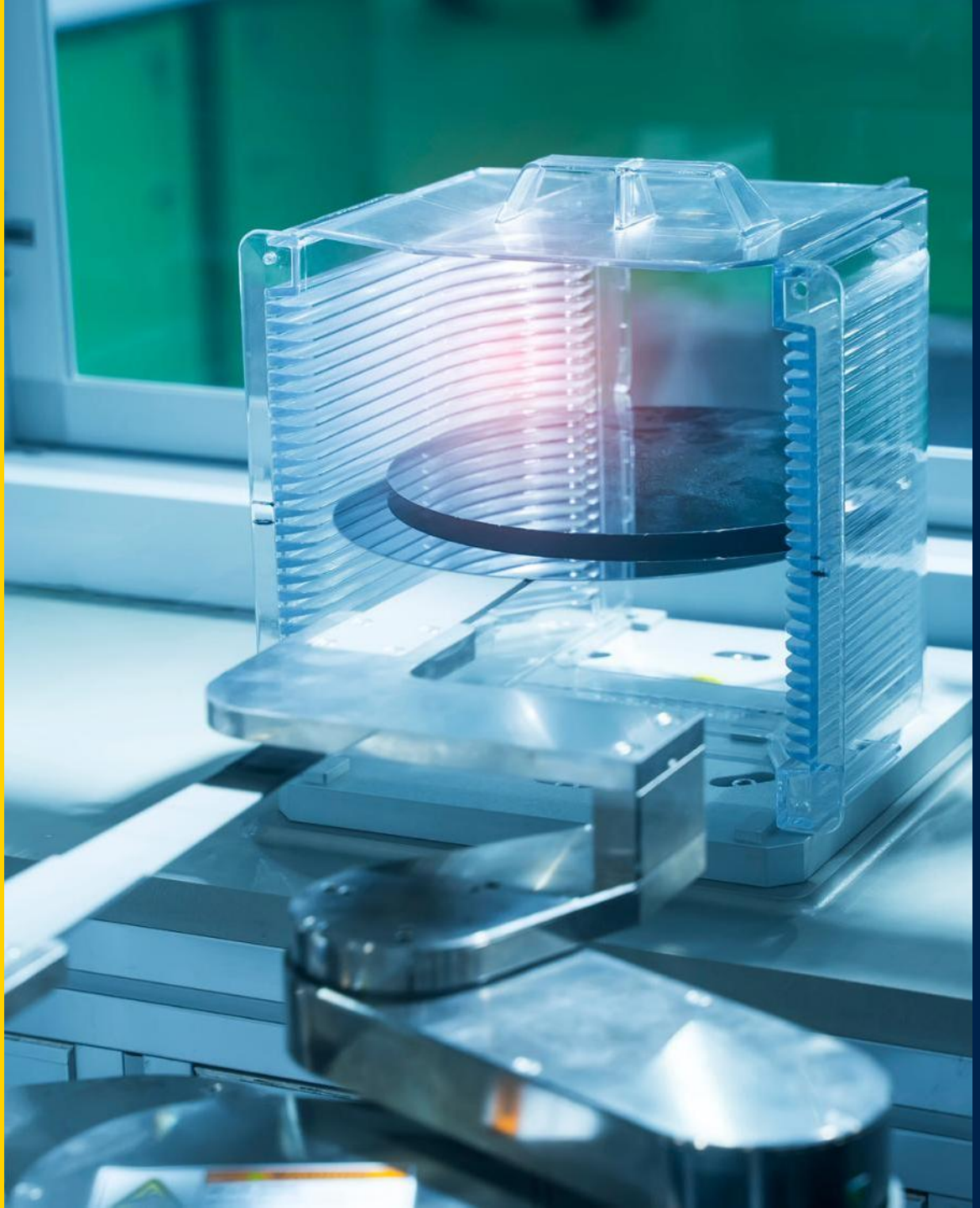

Highly-Integrated Dual FOC Drive solution for Robot-hands & Humanoid-Robots

Liam PARK

Motor Control Competence Center

STMicroelectronics

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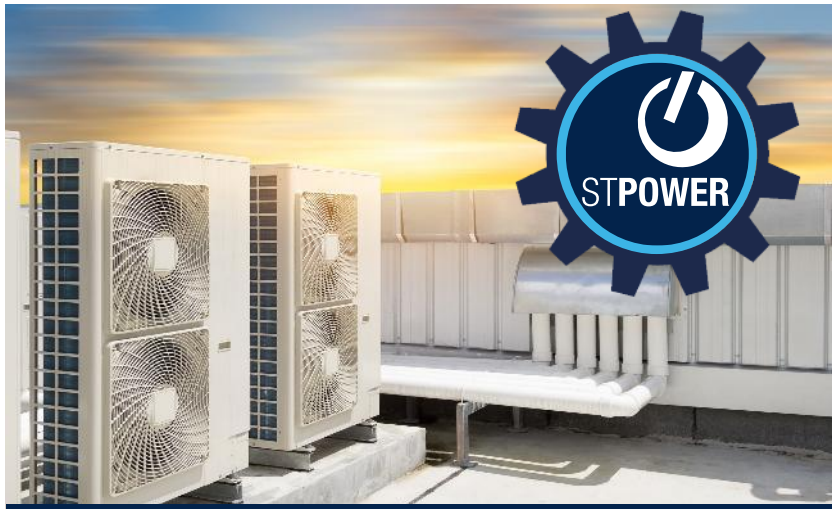
Focus Segments / Key solutions

Home appliances

High speed motors - new sensorless algo
High integration - energy efficiency

High power thermal management



High energy efficiency - high power
New algorithms - AI - reliability

Motor drives & servo drives & others

Position control
Functional safety - predictive maintenance

STDRIVE | VIPer | ST Op Amps | ST PROTECT | iNEMO | STGAP | Flight Sense

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Low-voltage servo drive solutions

Dual Axis

Single Axis

STSPIN32G4 /
STM32G4 dual drive

EtherCAT

STSPIN32G4 / STM32G4
1kW Dual Servo with EtherCAT

STSPIN32G4 /
2x100W
Robot JOINTS
Dual FOC

SERVICE

MOWERs

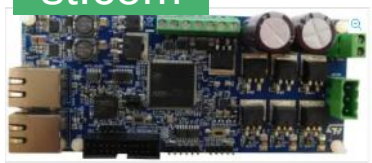
AGV

TOOLING MACHINEs

st.com

EVALKIT-ROBOT-1
STSPIN32F0

st.com



ETH001V1

EtherCAT

STSPIN32G4
LV Servo with EtherCAT

st.com

STSPIN32G4 LV Servo
High Power Density Version

2021 2022 2023 2024 2025

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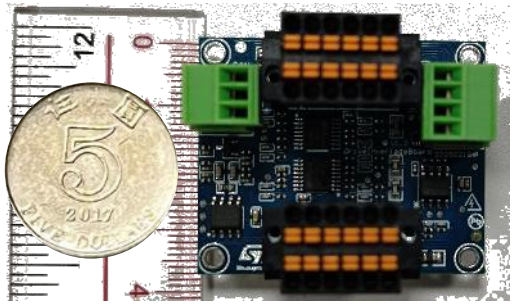
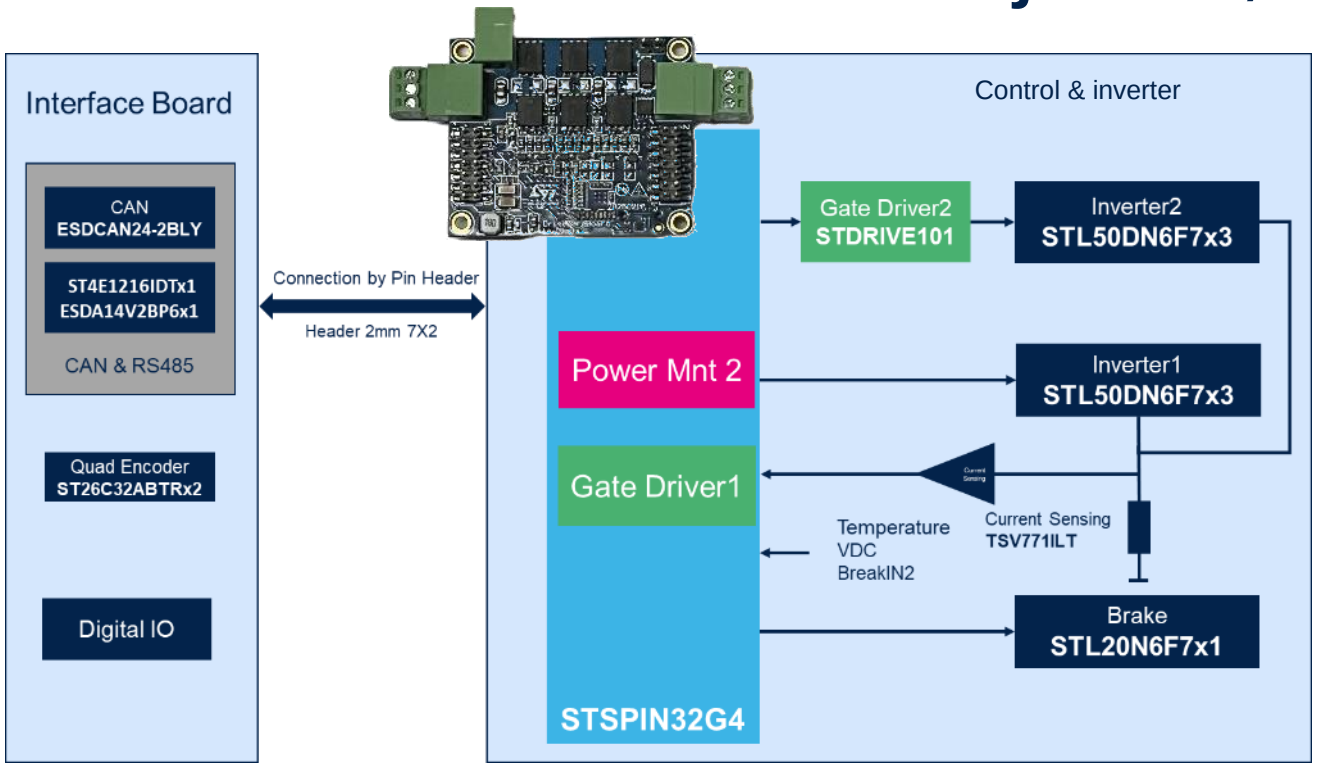
Compact low-voltage dual servo drive solution for robotic joints, robot hands



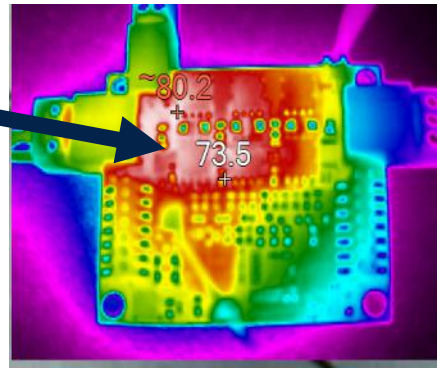


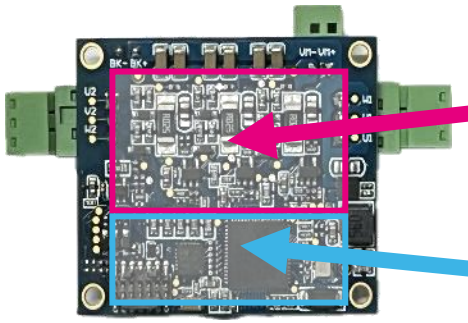
- Dual motor control
- 150W rating
- 4 x 4.5 cm size
- Patented Shared current sensing
- Shared connectivity CAN/MODBUS
- ABZ + Hall / SPI encoder interface
- 60% CPU load @ Dual FOC

ST products

- **STSPIN32G4**
- **STDRIVE101**
- **STL50DN6F7 x6**
- **STL20N6F7**
- **TSV771ILT x3**
- **ST4E1216IDT**
- **ESDA14V2BP6**
- **ESDCAN24-2BLY**
- **ST26C32ABTR x2**
- **PM8841D**
- **L7983PU50R**

Optimized heat dissipation with ST patent pending solution

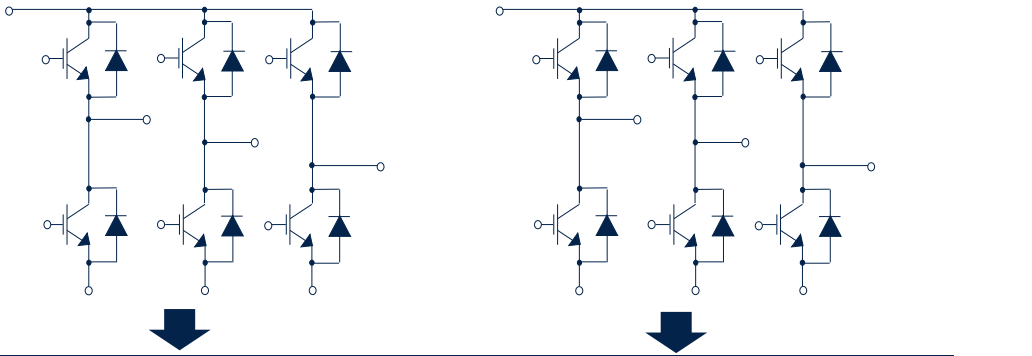


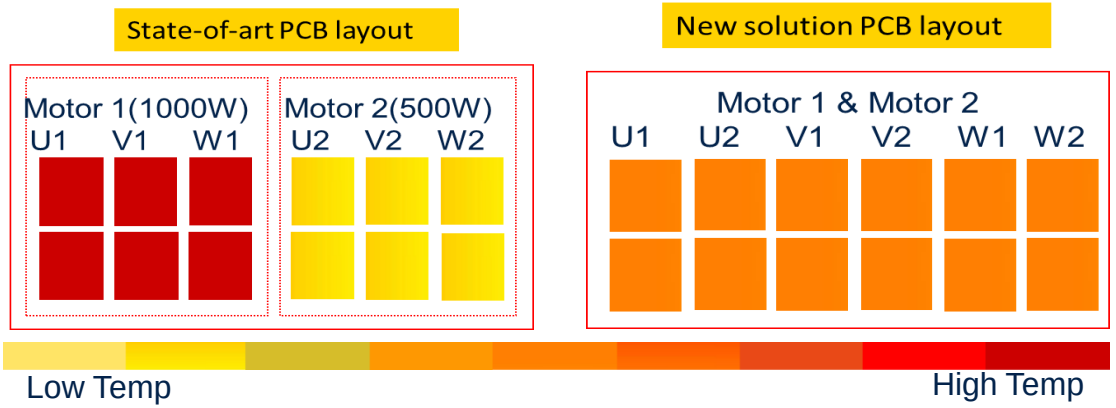


This PCB area would be double without the ST patented solution

This PCB area would be double if without STSPIN32G4

ST innovation in dual servo drive
Shared sensors, shared layout





(12) **United States Patent**
Costanzo et al.

(10) **Patent No.: US 11,757,345 B2**
(45) **Date of Patent: Sep. 12, 2023**

(54) **MOTOR CURRENT MEASUREMENT APPARATUS AND METHOD**

(56) **References Cited**
U.S. PATENT DOCUMENTS

Multi-Motor Shared Current Sensing IP

Achieves:
- **Savings on current sensors & network**
- **Savings on PCB space**
- **Savings on MCU pinout assignment**

(12) **United States Patent**
Costanzo et al.

(10) **Patent No.: US 12,264,976 B2**
(45) **Date of Patent: Apr. 1, 2025**

(54) **INVERTER AND METHOD TO MEASURE JUNCTION TEMPERATURE FOR THERMAL PROTECTION**

(58) **Field of Classification Search**
CPC G01K 7/01; G01K 3/005; G01K 7/183; G01K 7/16; G01K 3/00; G01K 7/18
See application file for complete search history.

Junction temperature measurement IP & innovative PCB layout for dual motor drive
Achieves :
- **Balanced heating distribution**
- **Longer system life cycle & reliability**
- **Precise overtemperature protection**

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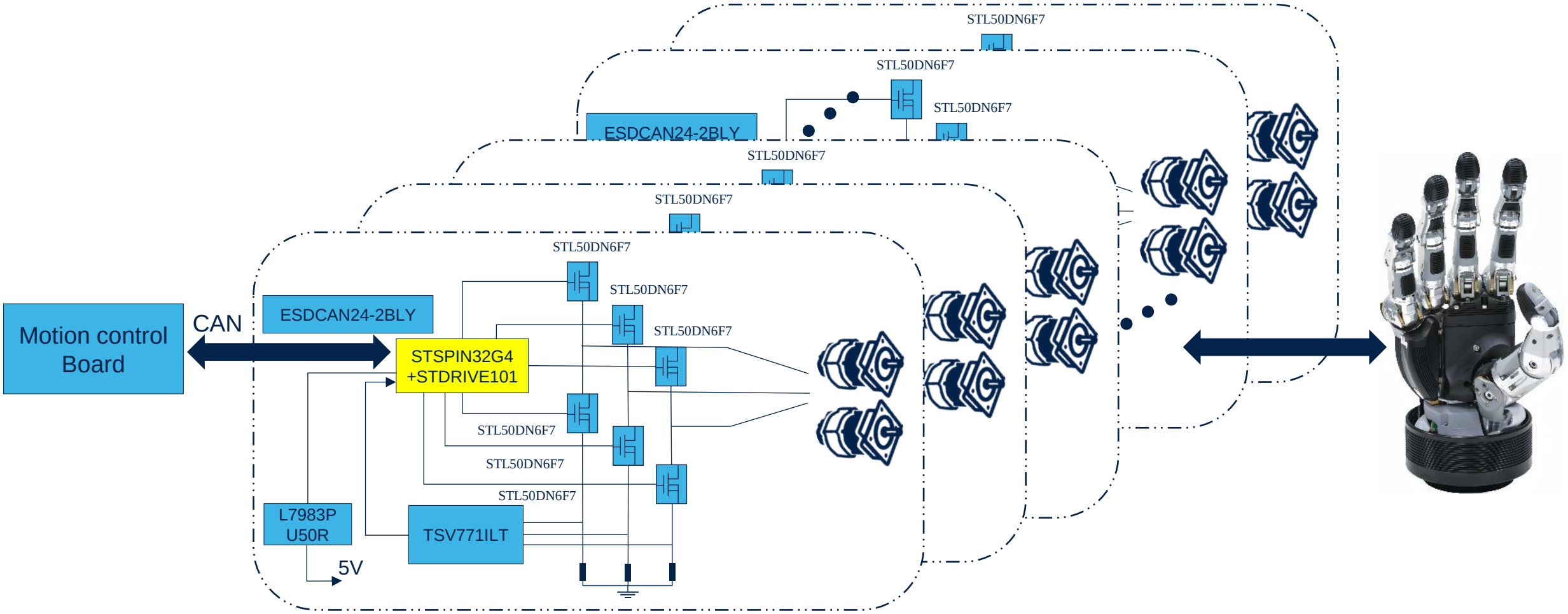
Compact low-voltage dual servo drive solution for robotic joints, robot hands

Robot finger motor control



Motor Control
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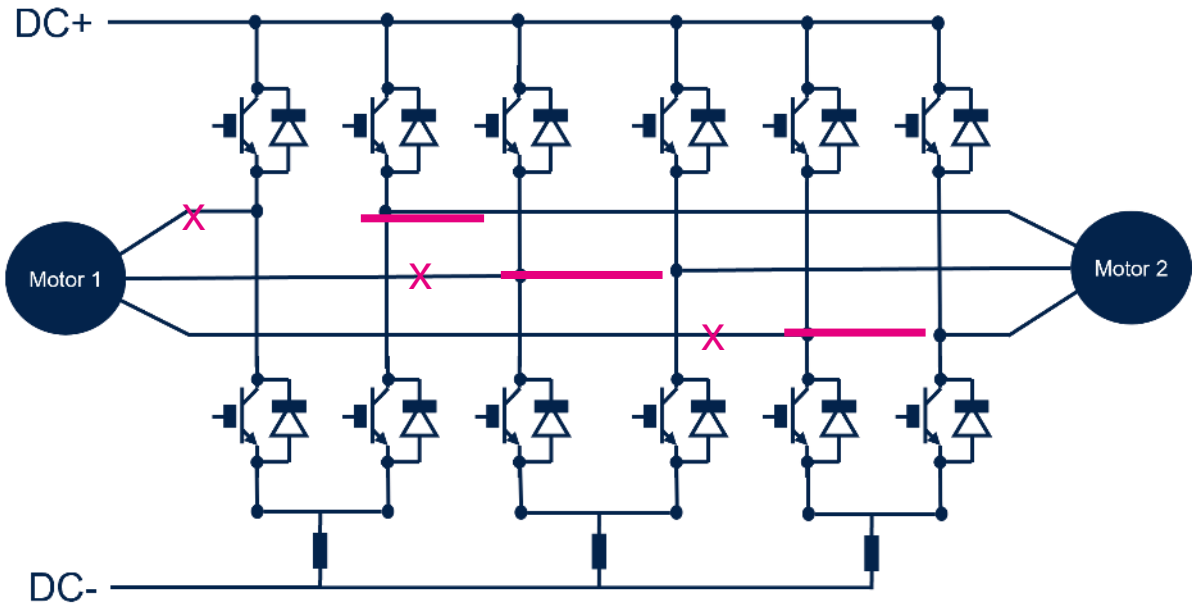
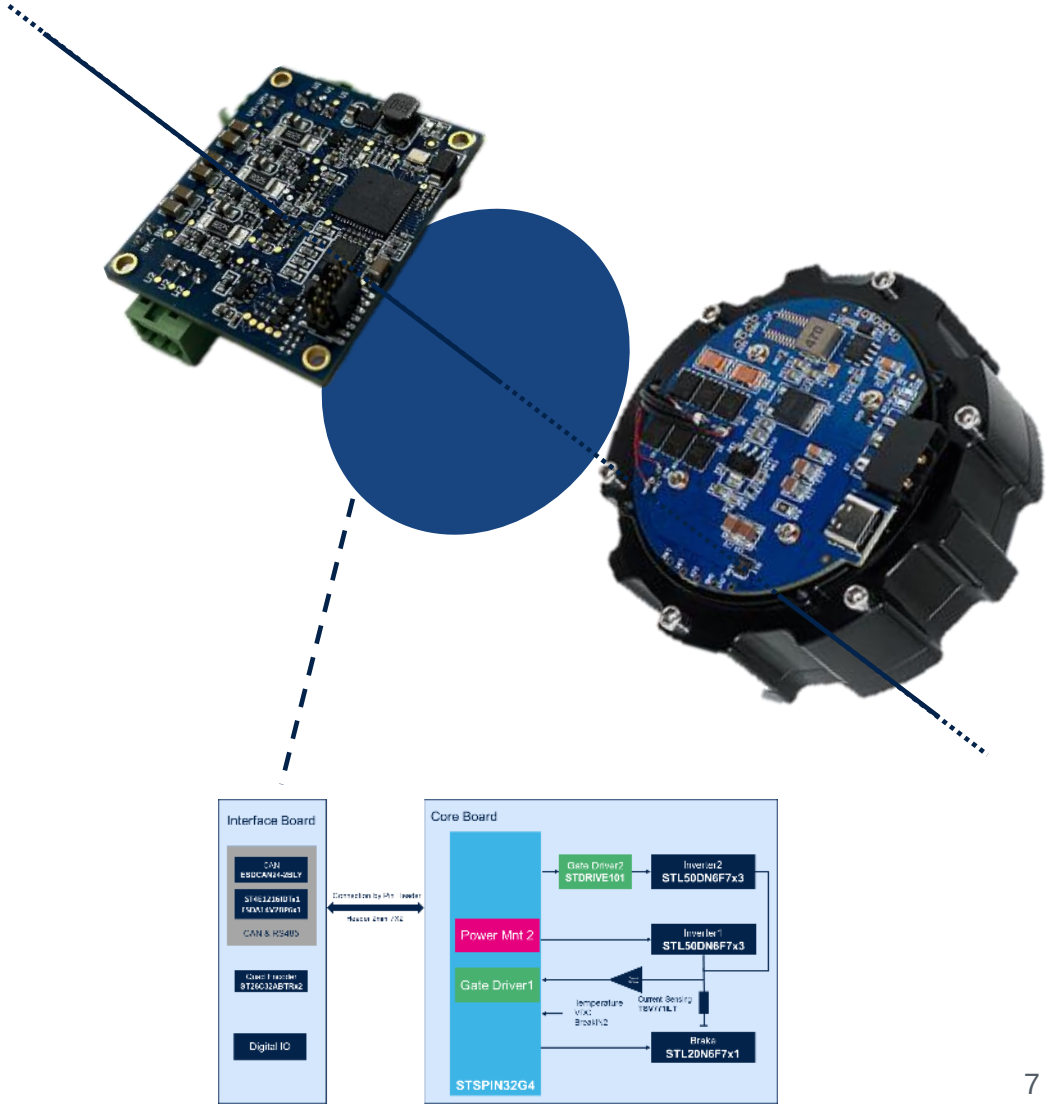
Center

Compact low-voltage dual servo drive solution for robotic joints, robot hands





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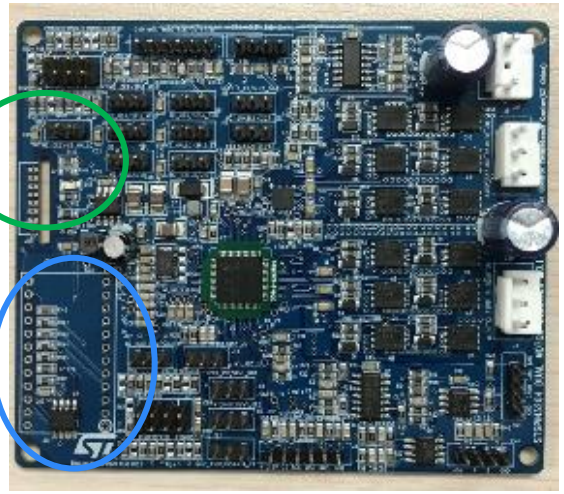
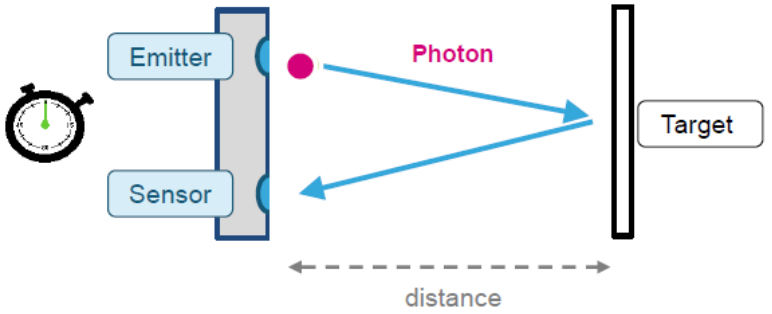
STSPIN32G4 dual drive solution for small service robots, mowers, etc.

ToF sensor board

VL53L3CX-SATEL

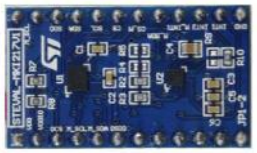




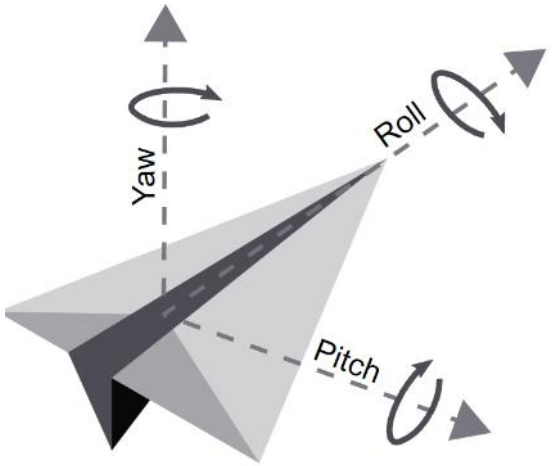
IMU sensor board

STEVAL-MKI207V1(6 axis)

OR



STEVAL-MKI217V1(9 axis)

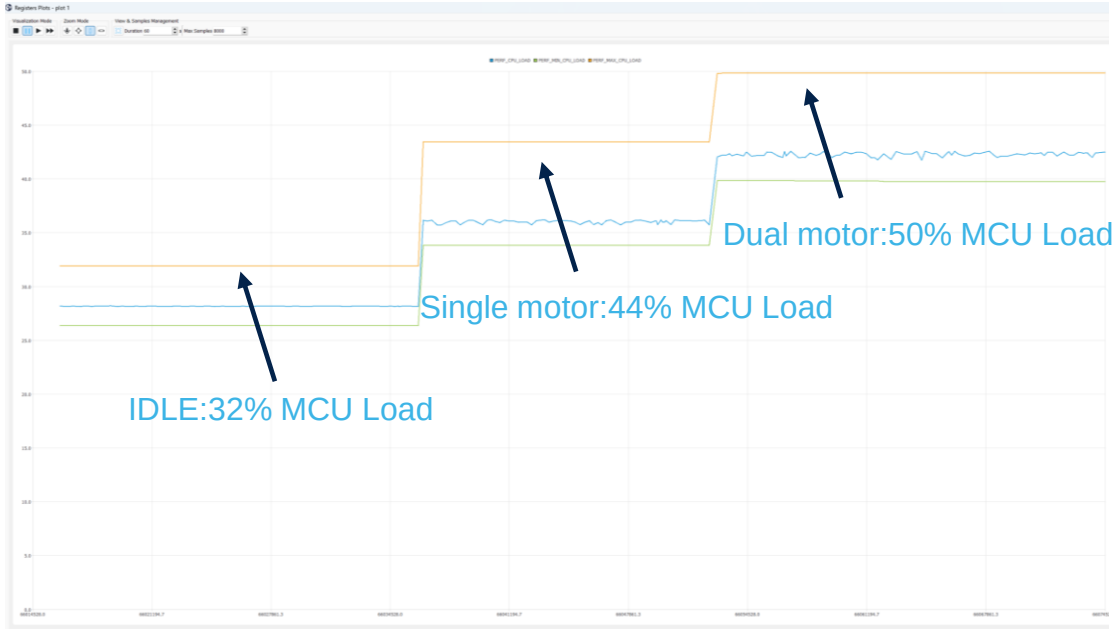


Very compact
Easy design

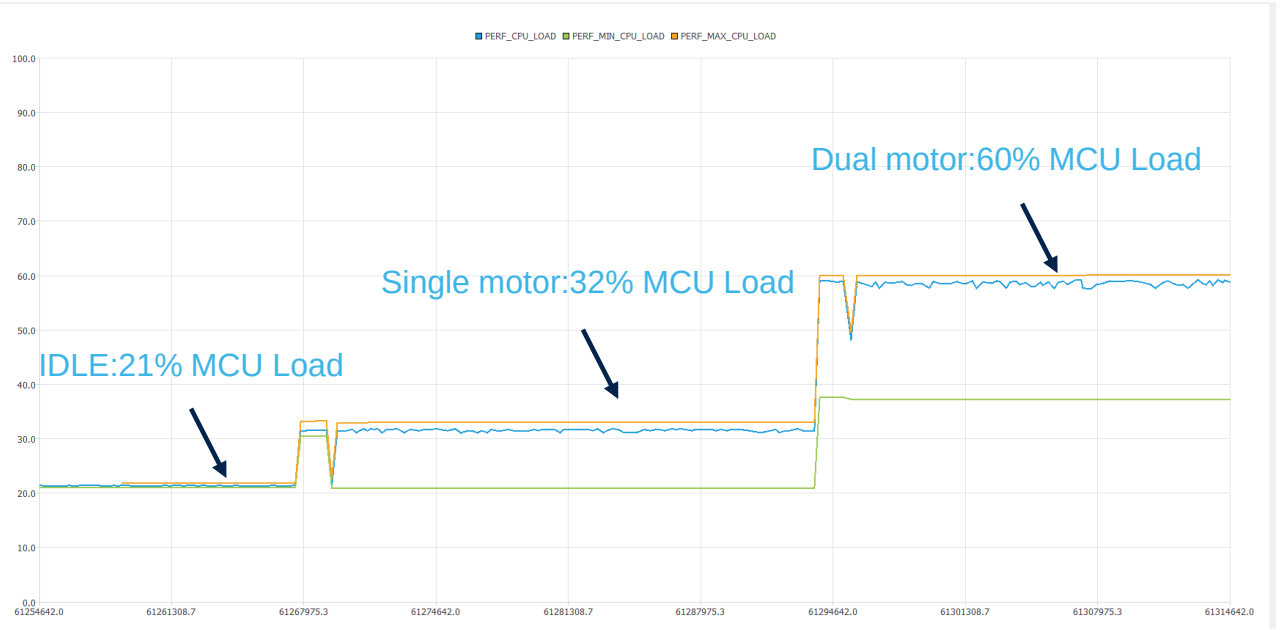
Dual servo drive test result
MCU load

MCU Load

Dual motor run:
Current loop 25K,
Speed loop 10K,
MUC maximum load 50%



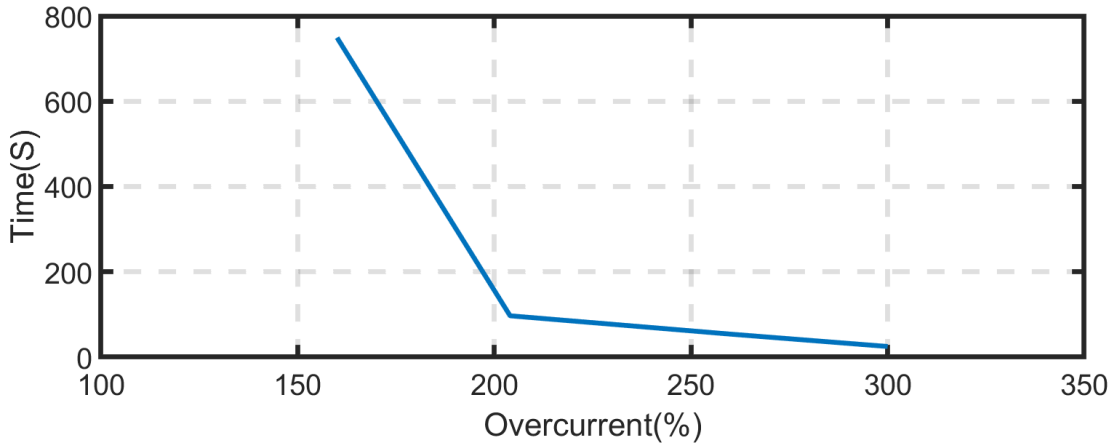
Dual motor run:
Current loop 40K,
Speed loop 2K,
MUC maximum load 60%



Dual servo drive test result
Performance test

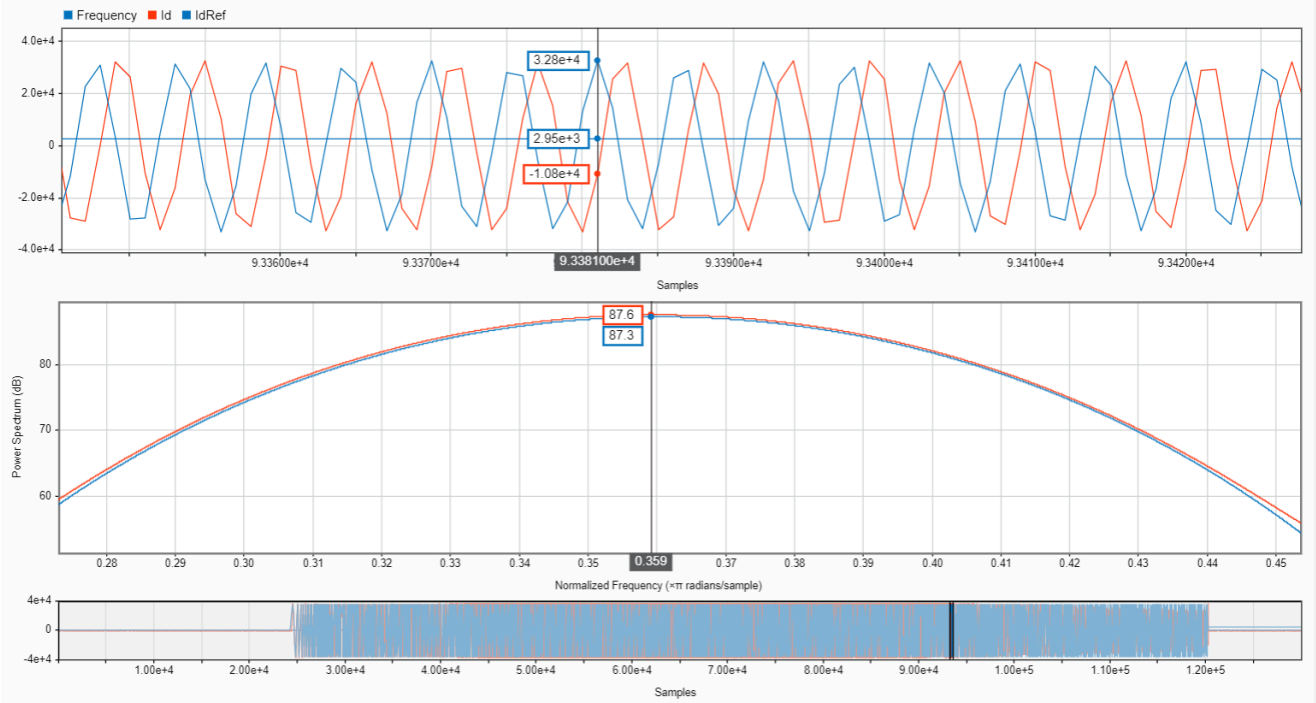
Performance test results

- **Motor overload and time curve**



Test condition:
Single motor
Rated current：3.2 A (RMS)
Mos maximum temperature: 100 ℃

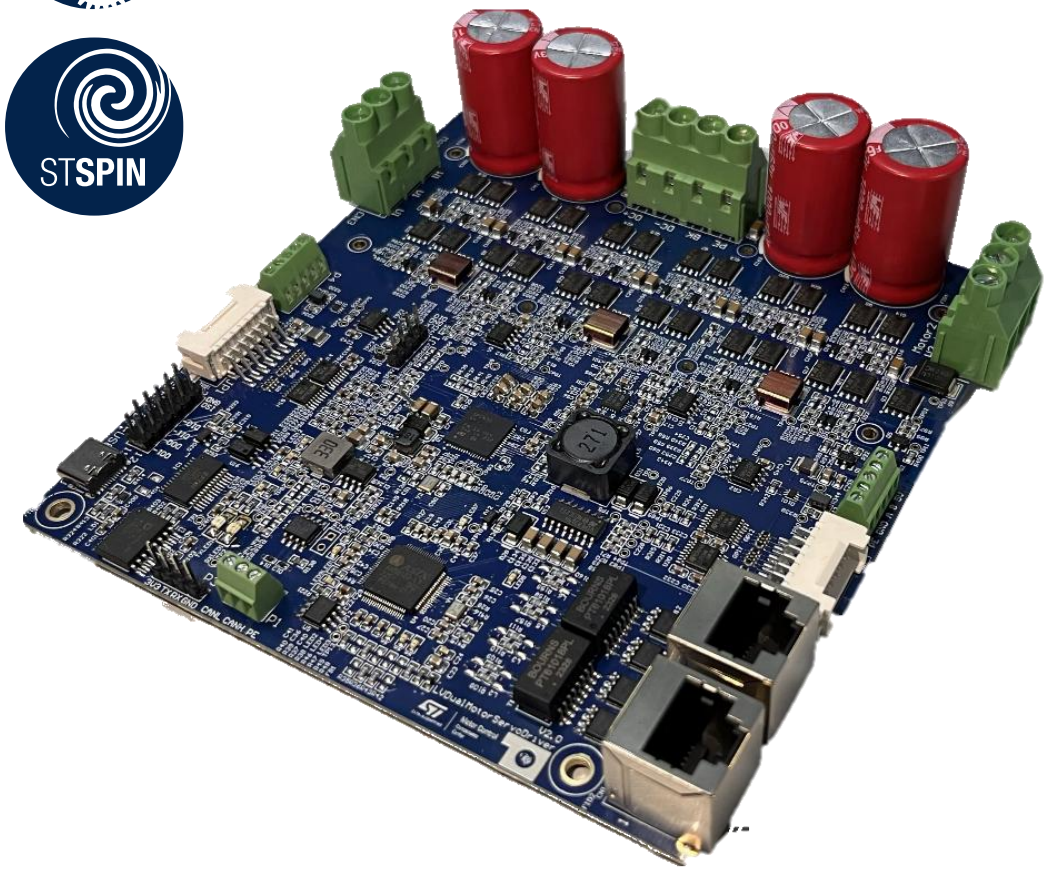
- **Current loop bandwidth**



Based on 16K PWM：

- Sweep from 1~4000Hz
- phase lag of 90° is 2952Hz

Dual motor servo drive with EtherCAT
2x 1kW, 48V nominal, turnkey solution

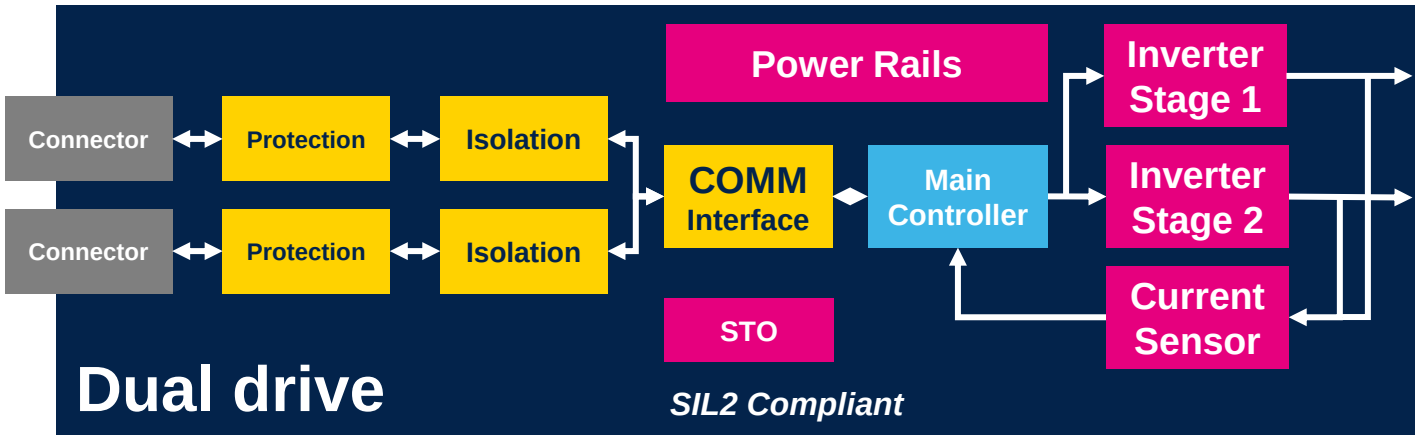


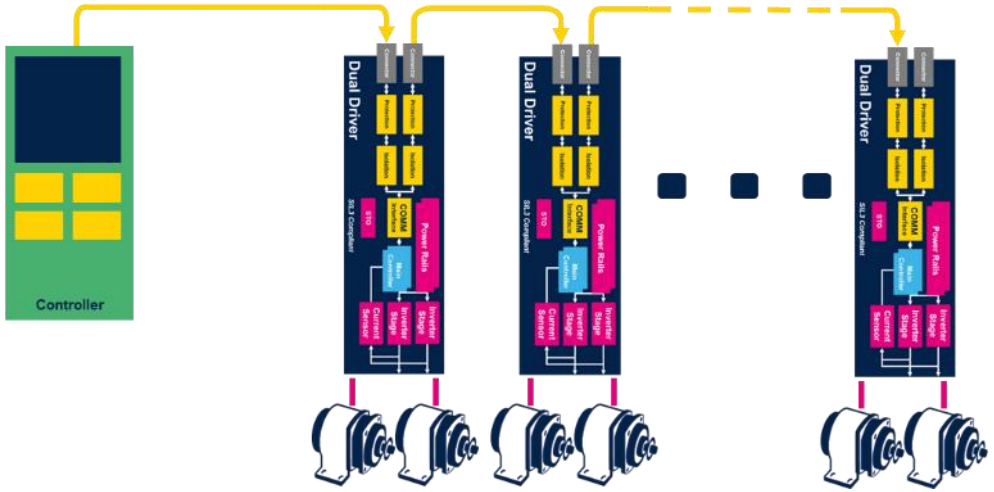
- Dual motor drive with Single STSPIN32G4 STDRIVE101
- Rating current up to dual 20Arms
- Shared current sensing network
- Dual encoder interface: Incremental and absolute
- EtherCAT or CAN comm interface
- Optimized layout for unbalance load
- ----------
- Full firmware stack for industrial motor control (MCSDK+CiA402+EtherCAT stack)
- Improved encoder alignment (Micro-shake, no need index or hall sensor)
- Improved scheduler (Synchronized task timing)

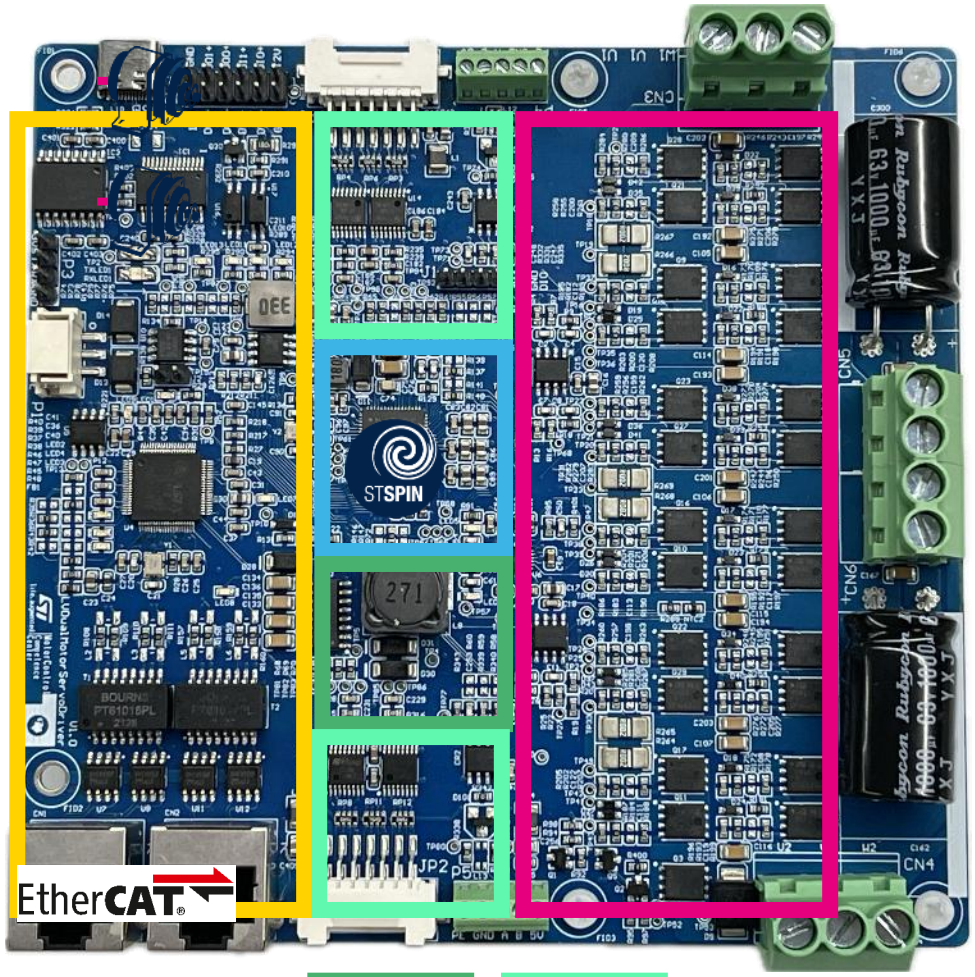
ST Products

- STSPIN32G4
- STDRIVE101
- STL90N10F7 x25
- TSV714 x3
- M24M01-RMN6P
- VIPER319HDTR
- LD39015M12R
- LD56100DPU33R
- L6981CDR
- ST26C32ABDR x4
- ESDA14V2BP6 x2
- SMBJ6.0CA
- HSP051-4M10 x2

ST Innovation in Dual Servo Drive Shared EtherCAT







Size:13cmx13cm

Aux Power Mnt

ABS & QIE

Fieldbus communication plug-in for MCSDK

EtherCAT

CANopen

EtherCAT Comm HW Interface
ESC/Protection/Isolator

MCU

EtherCAT Protocol Stack

CiA402 Drive Profile

MCSDK

Plugins

Power Stage
Gate Driver/Power Switches/Current Sensing/Power Management

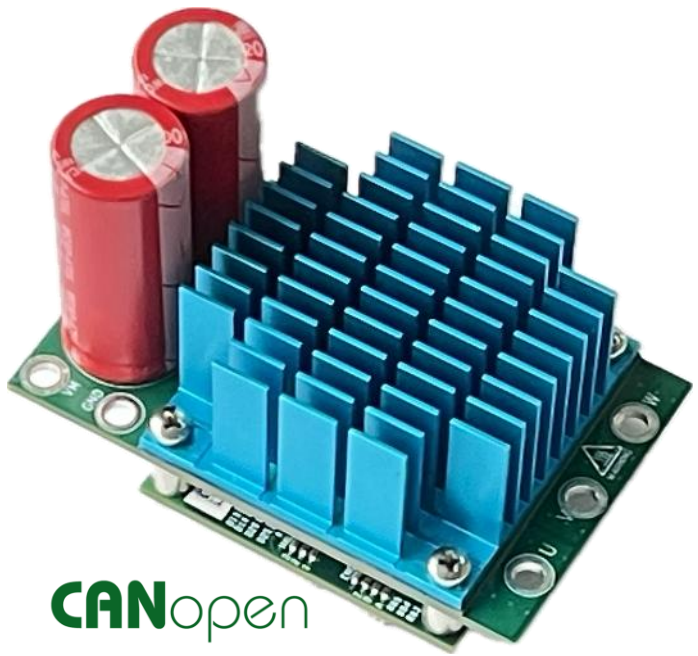
Low layer communication protocol handling

Unified industrial motor drive interface

Improved scheduler and extra features beyond MCSDK

STSPIN32G4 reference design for servo driving applications (Robot joints)

EVLSERVO1 (available also on st.com)



47 A rms – Natural convection

- Features:
  - **3kW** with active cooling, **2kW** with passive cooling;
  - Board dimension: **8cm x 5cm;**
  - **48V** applications optimized;
  - **STL160N10F8** paralleled power MOSFETs;
  - Current sensing: Triple-shunt differential;
  - speed/position sensing: **absolute encoder, incremental encoder, Hall sensors**; differential or single ended mode;
  - **CAN bus;**
  - **Protections:** Overcurrent, overvoltage and overtemperature;
  - **Regenerative braking** External resistor management;
  - **STO (Safe Torque Off)** Present
- Key applications
  - Industrial and home automation
  - Robot joints, Servo drives, e-bikes
  - Service and automation robots

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Condition monitoring with X-CUBE-MCSDK Predictive maintenance

How to access to these new features and evaluate / create a PoC

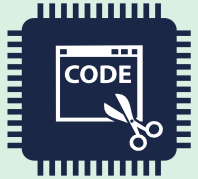
Motor Pilot from MC-SDK v6 with **record feature**

NanoEdge Studio Library generation

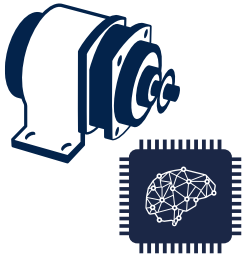
NANOEDGE AI STUDIO

NEAI libraries free of charge on STM32G4 dev boards

Integrate next to MC algorithm



Run MC and anomaly detection



MC-SDK | NanoEdge AI Studio | IDE

ST servo drives solutions takeaways

More industrial standard functionality included

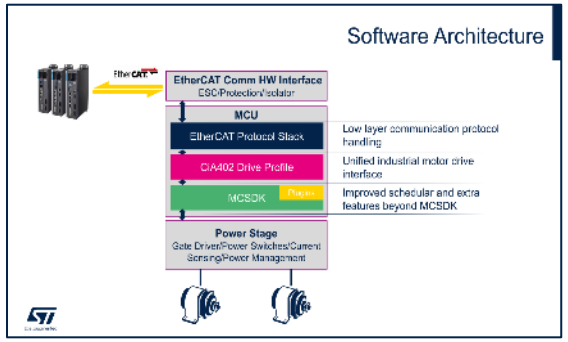
- Differential encoder interface with hall sensor
- Fieldbus present
- Isolated digital IO
- Multiple encoder interface

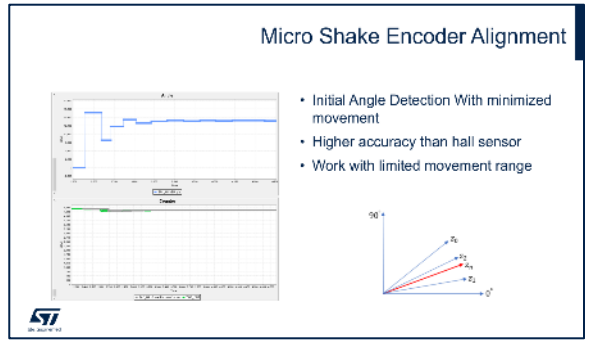
More firmware IPs:

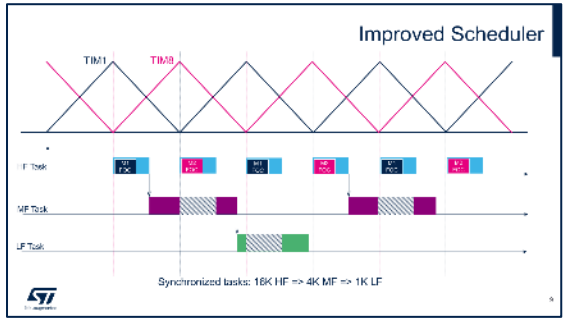
- Notch Filter
- Improved scheduler
- Device profile (CiA402)
- Shared Shunt Current sensing

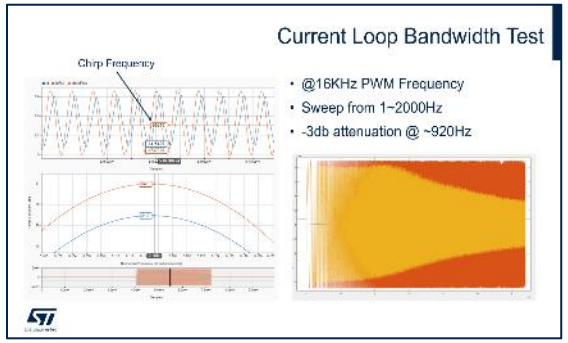
Performance qualification & Documentation:

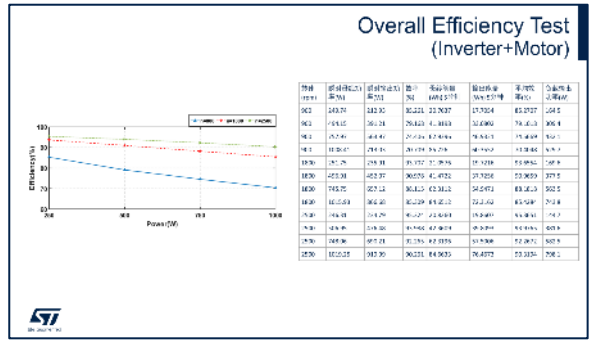
- Current loop Bandwidth Test
- Heat test &
- Efficiency test
- User manual Ready











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