



life.augmented



ST Robotics Solutions

SMART INDUSTRIALS

ST provides solutions for a wide range of robotics applications today

Industrial robots and cobots



Manipulators
Object detection
Industry 4.0

Robots in Medical & healthcare



Surgical robots
Actuated & sensory prostheses
Exoskeletons

Service robots



Quadruped
AGV/AMR
Co-robot

Drone and marine robots



Agriculture
Inspection
Undersea exploration

ST enabling technology solutions

Sensors

Power
management

Security and Safety

Motor drivers,
actuator, control

Connectivity

Edge AI

Service Robots





Smart Infrastructure Robotics Segment

Humanoid



Personal Assistant
Elderly Care
Food and Beverage Pre
Education / Entertainment

Quadruped



Building & Infrastructure Mapping
Delivery
Surveillance
Agriculture Tasks

Wheeled Robot -AGV/AMR



Quadruped
AGV/AMR
Co-robot

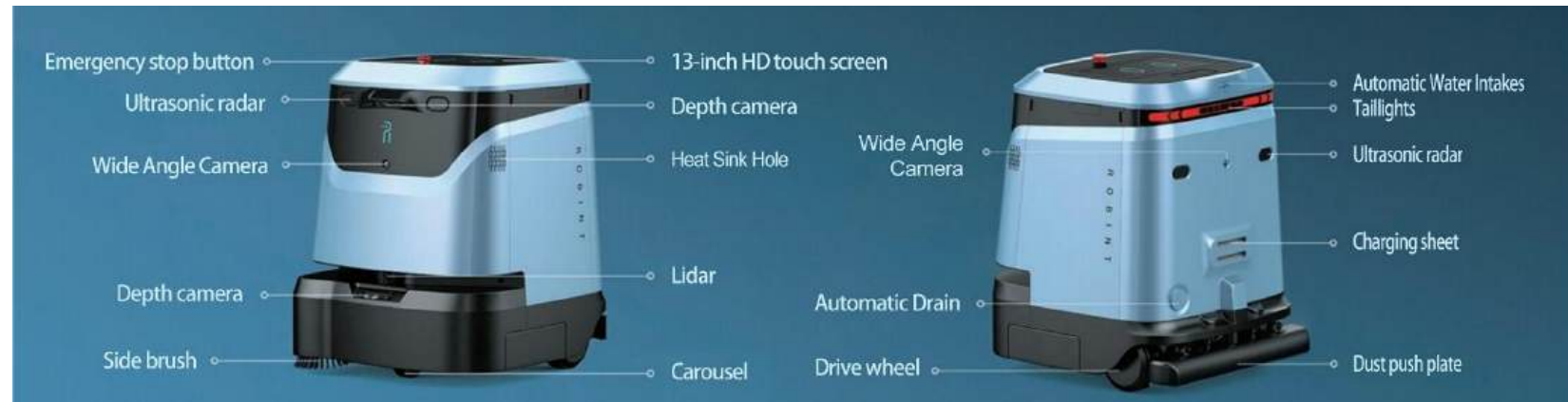
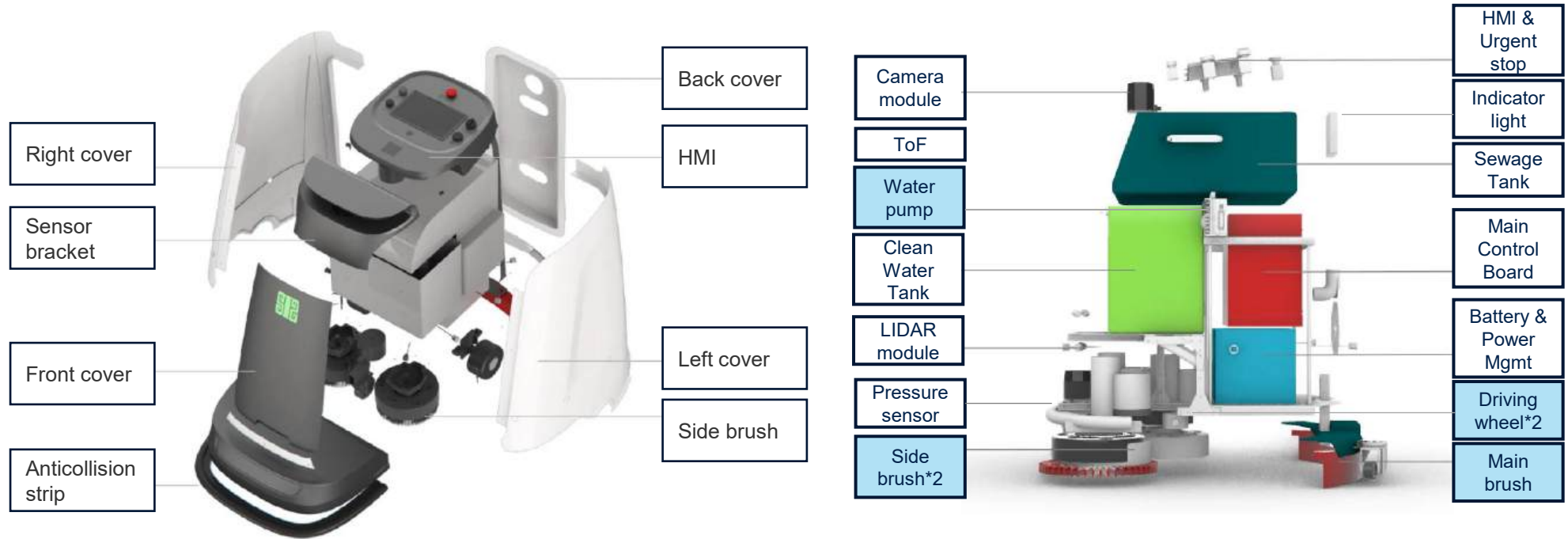
Drone and marine robots



Agriculture
Inspection
Undersea exploration



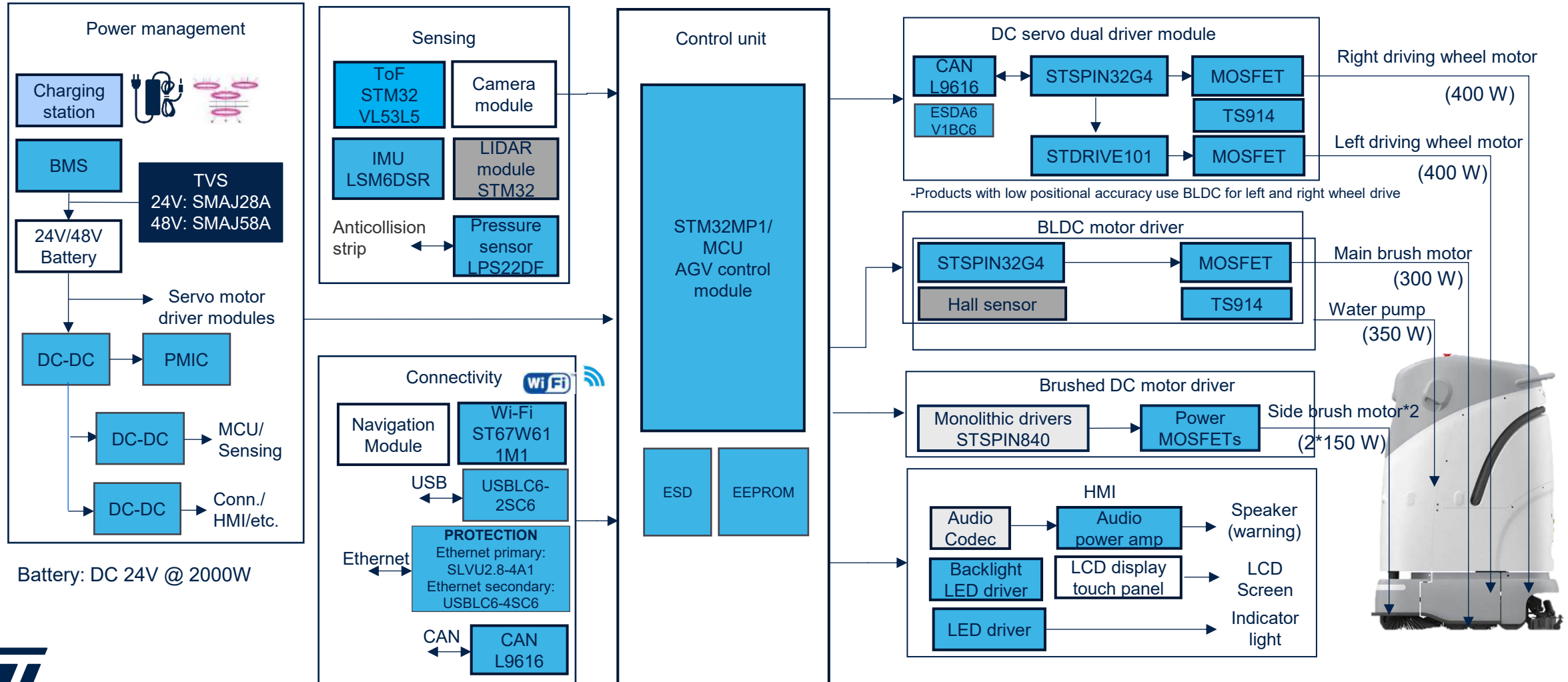
Professional Cleaning Service Robots





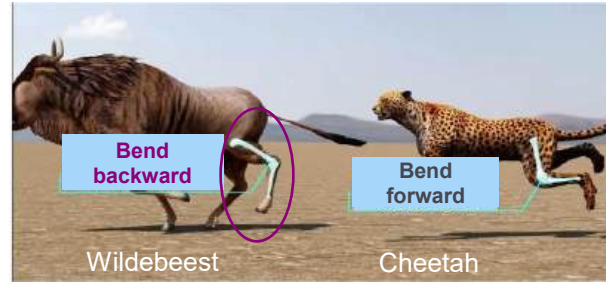
Service Robot

Mobile Execution Robots

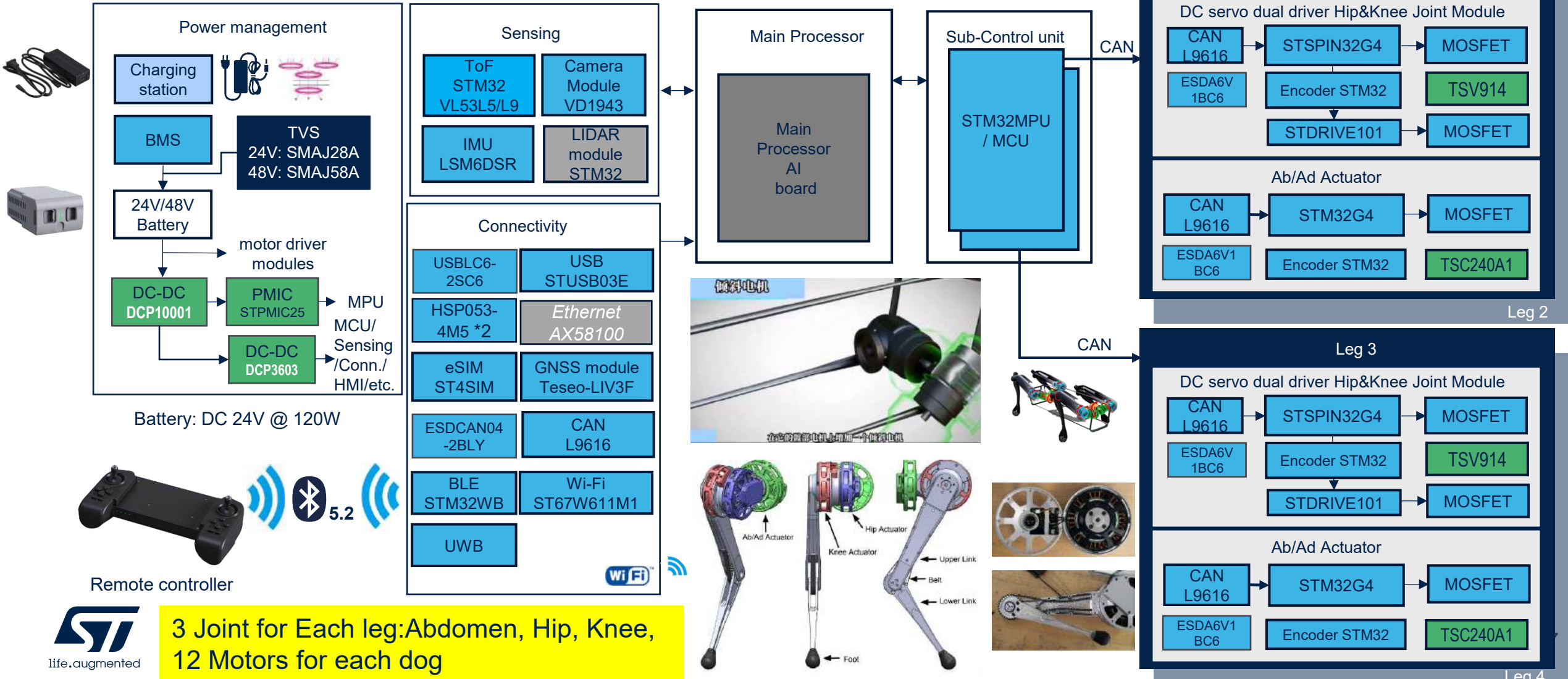




Quadruped block diagram



Avoid collisions when climbing stairs

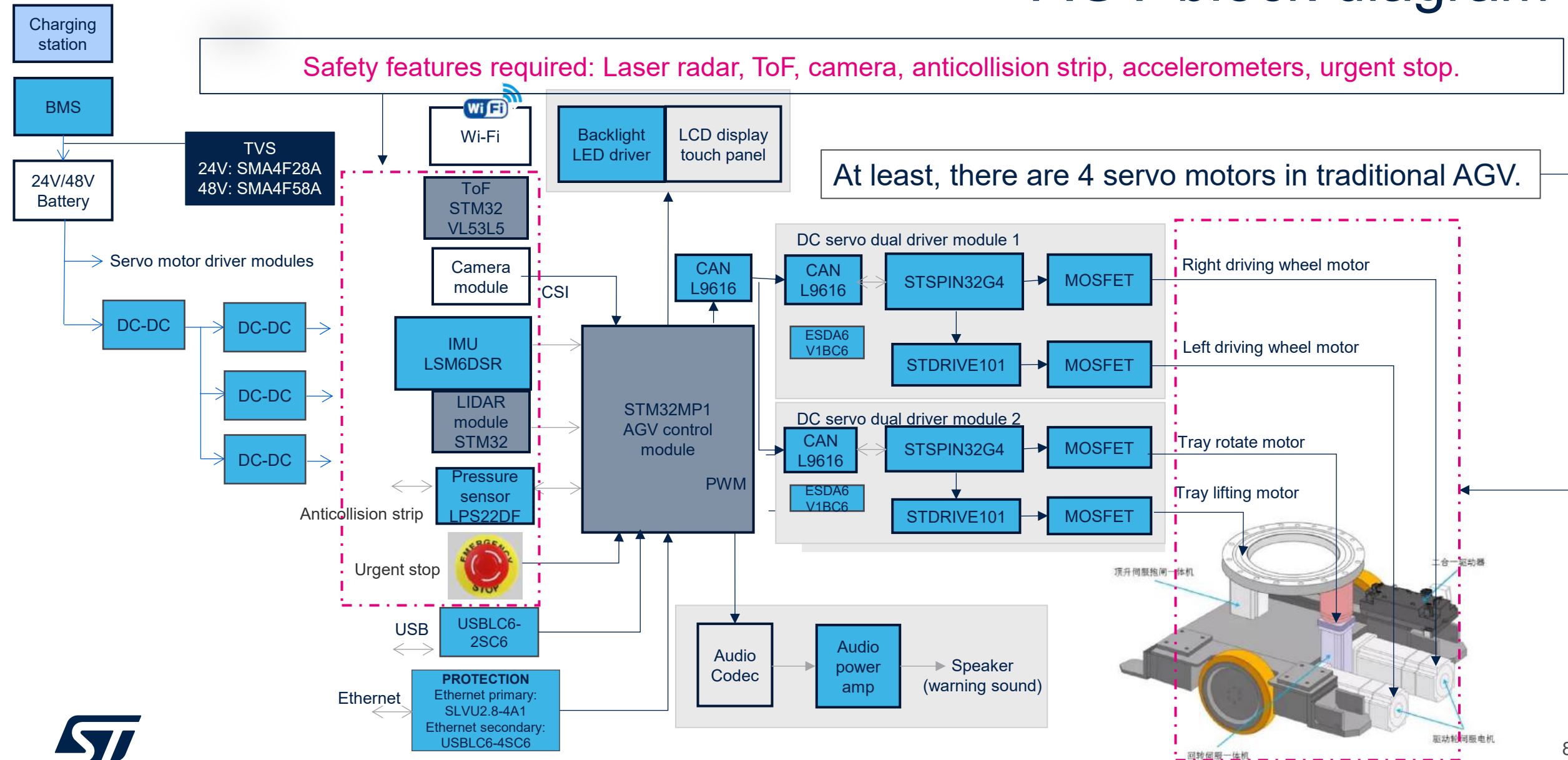




AGV block diagram

Safety features required: Laser radar, ToF, camera, anticollision strip, accelerometers, urgent stop.

At least, there are 4 servo motors in traditional AGV.





Typical AGV servo solution in market

Typical Spec for dual driver:

- Low voltage servo:
- Input Voltage: 20~70V DC
- Power level: 100W~1000W
- Dual Axis Servo Supported
- Support interface:
 - Modbus\Canopen\EtherCAT
 - \RS485

Two in One Motor Driver

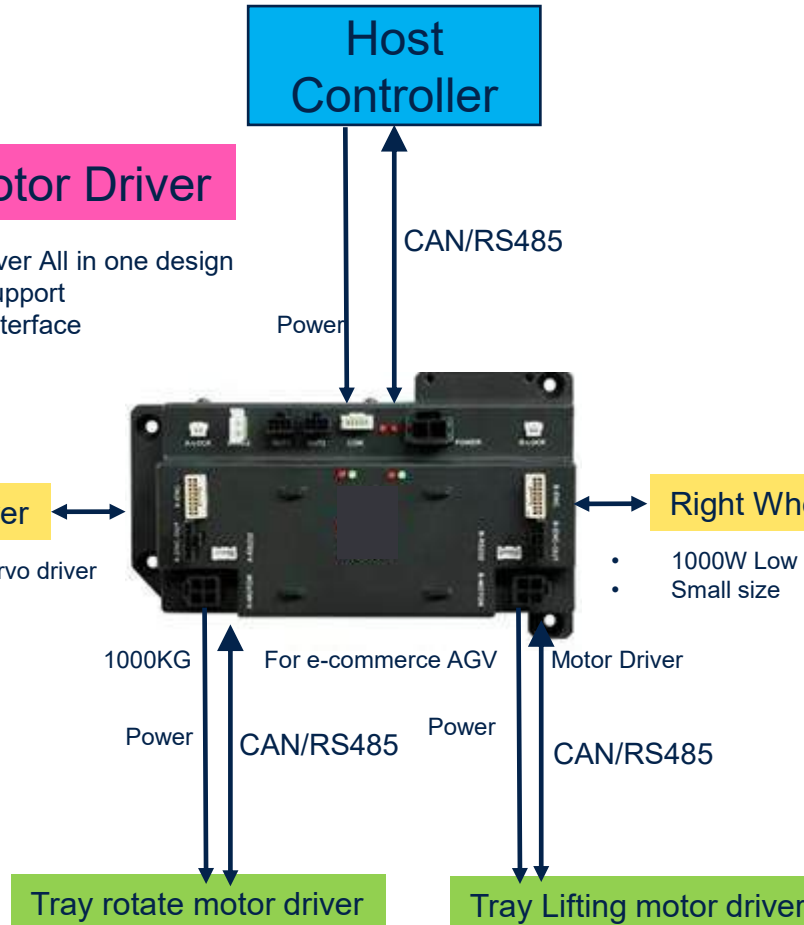
- One Controller Two driver All in one design
- STO Function safety support
- Support CAN/RS485 interface

Left Wheel Motor Driver

- 1000W Low Voltage Servo driver
- Small size

Right Wheel Motor Driver

- 1000W Low Voltage Servo driver
- Small size



- One Controller Two driver All in one design;
- 600W, 1500~3000RPM/
- STO Function safety support
- Support CAN/RS485 interface

Humanoid Robot

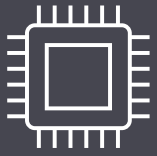




Potential application scenarios

Potential Application Scenarios for Humanoid Robots





Robotics Systems



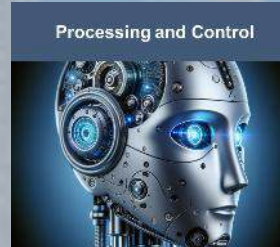
“Mid-Long Term
Attack Plan”

Leverage on
Automation Systems
knowhow and
Address Robotics
system painpoints

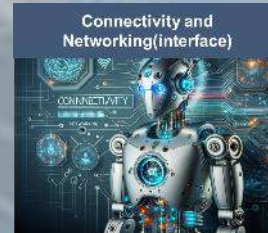
Co-Define Product Definition@system: Robotics System



Visualization



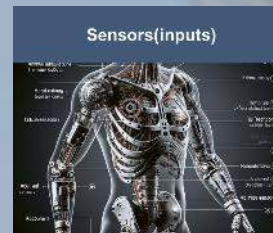
Processing
& Control



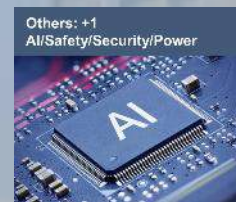
Connectivity



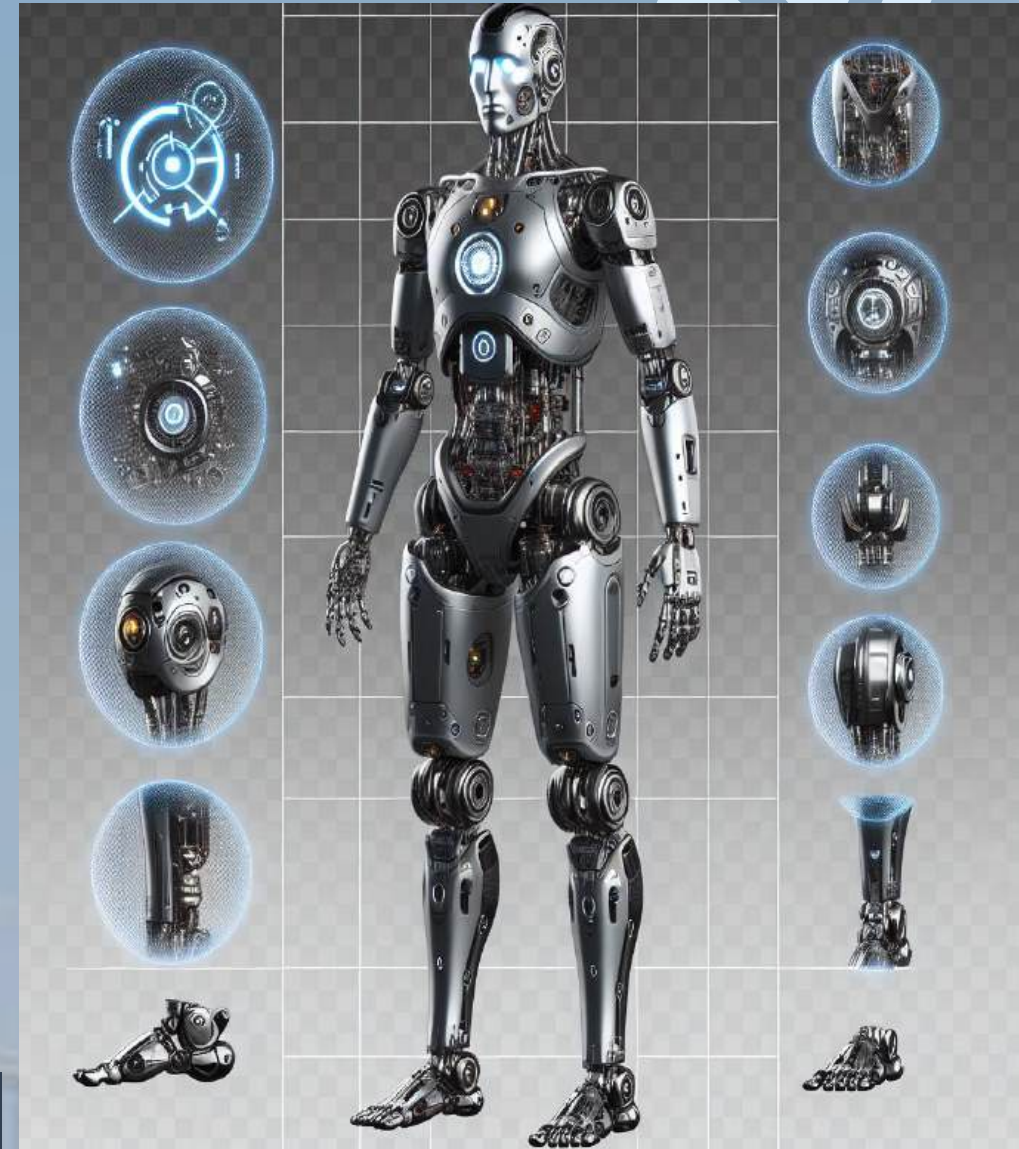
Actuator



Sensing



Others





Translating AI-Language to Automation Language

21 finger points via LVTTTL-RS485-PLCcodesys-CANFD to 15 Servo motors

WE support Market Trend: like Artificial Intelligence

21 finger key points' data (X, Y, Z)



PLC Data Processing



Wireless
Information and
Power Transfer



15 servo motors'
position data

Sensing

Connectivity

Camera Module:
VD66GY(Fox)

AI
Competence
Center



UART

RS-485

CANFD

CANFD

IO-Link Wireless
Bluetooth
Sub-1GHz
UWB...

STM32N6 EVM Board

STM32MP257 PLC Board

Robot Hand

Visualization

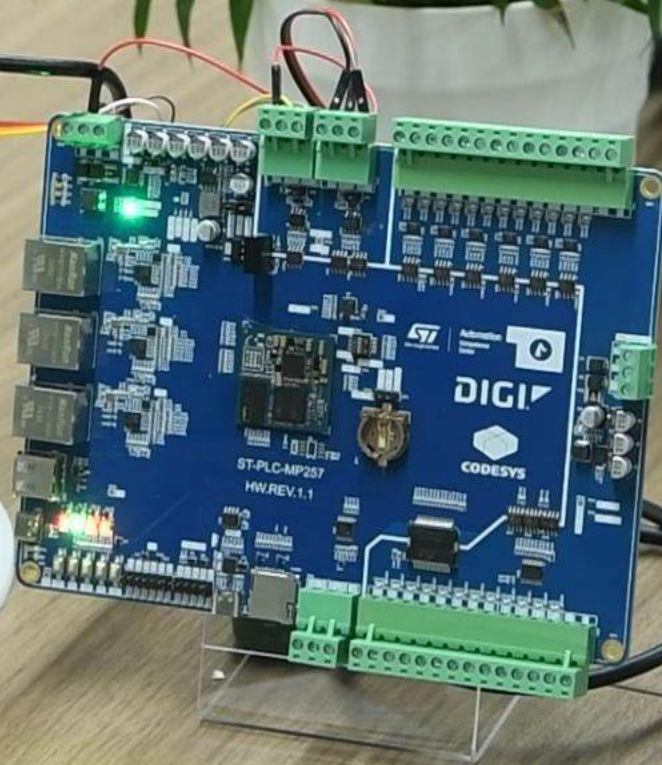
Others: AI

Processing & Control

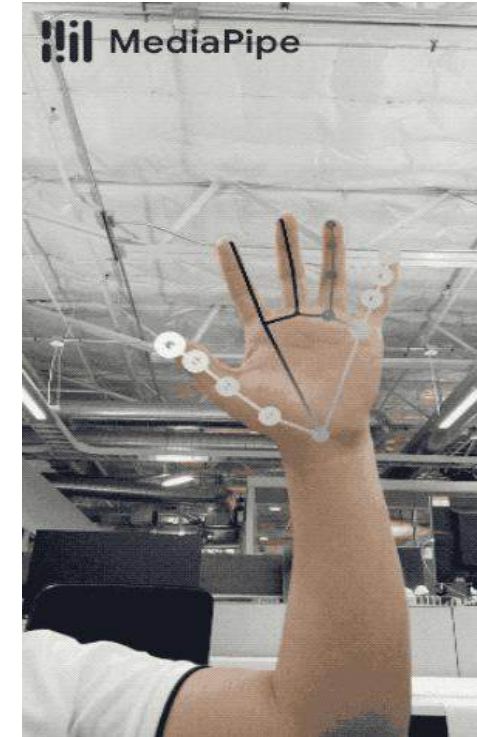
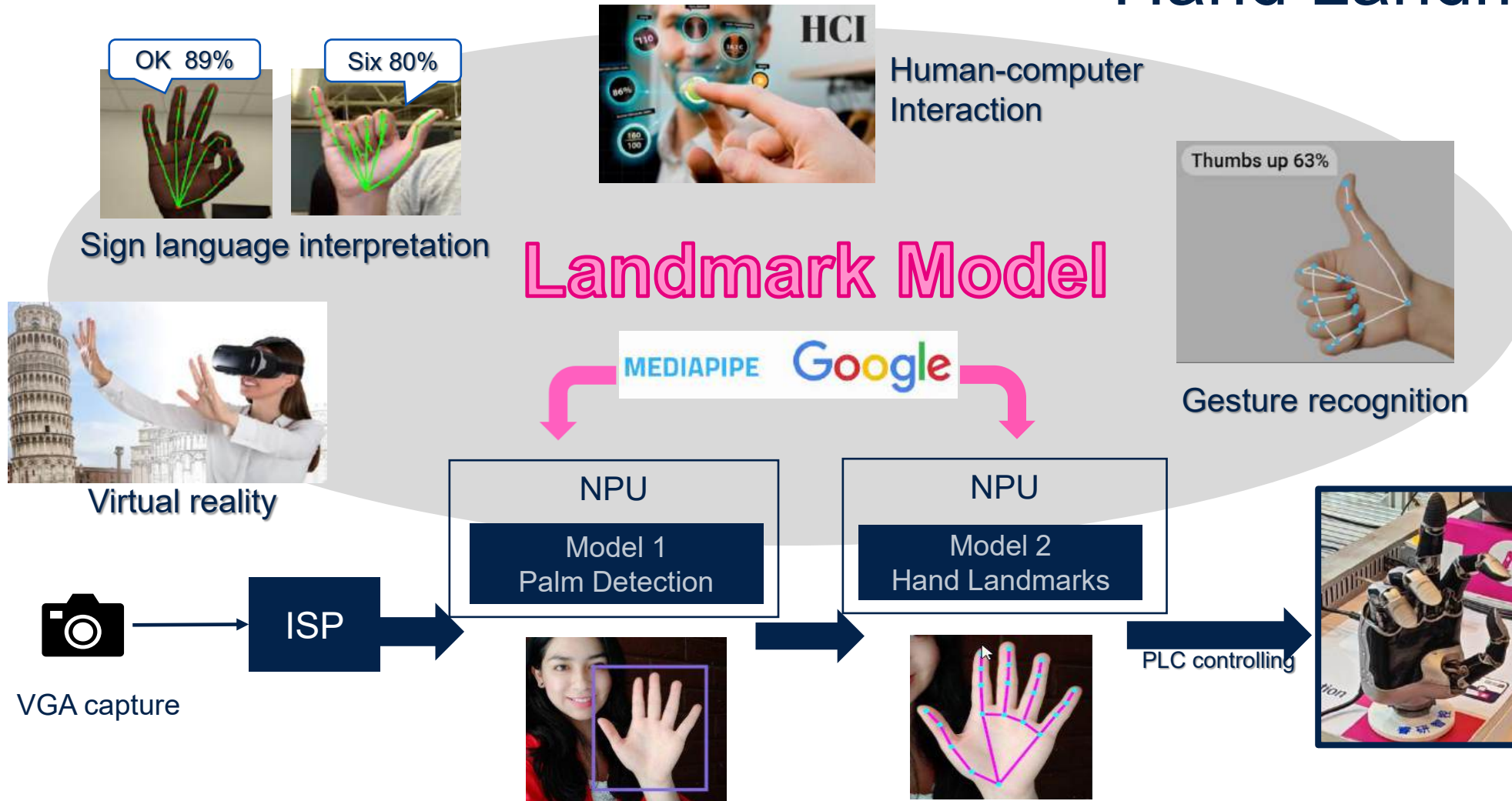
Actuator



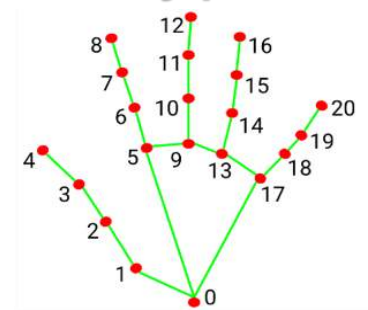
WIRELESS POWER
CONSORTIUM



Hand Landmark Model



21 Key points



Model Name	Pixel 6 CPU Latency	Pixel 6 GPU Latency	STM32N6 Latency
Hand Landmarker (Full)	17.12ms	12.27ms	31ms (29fps)

Half-Body Humanoid Robot

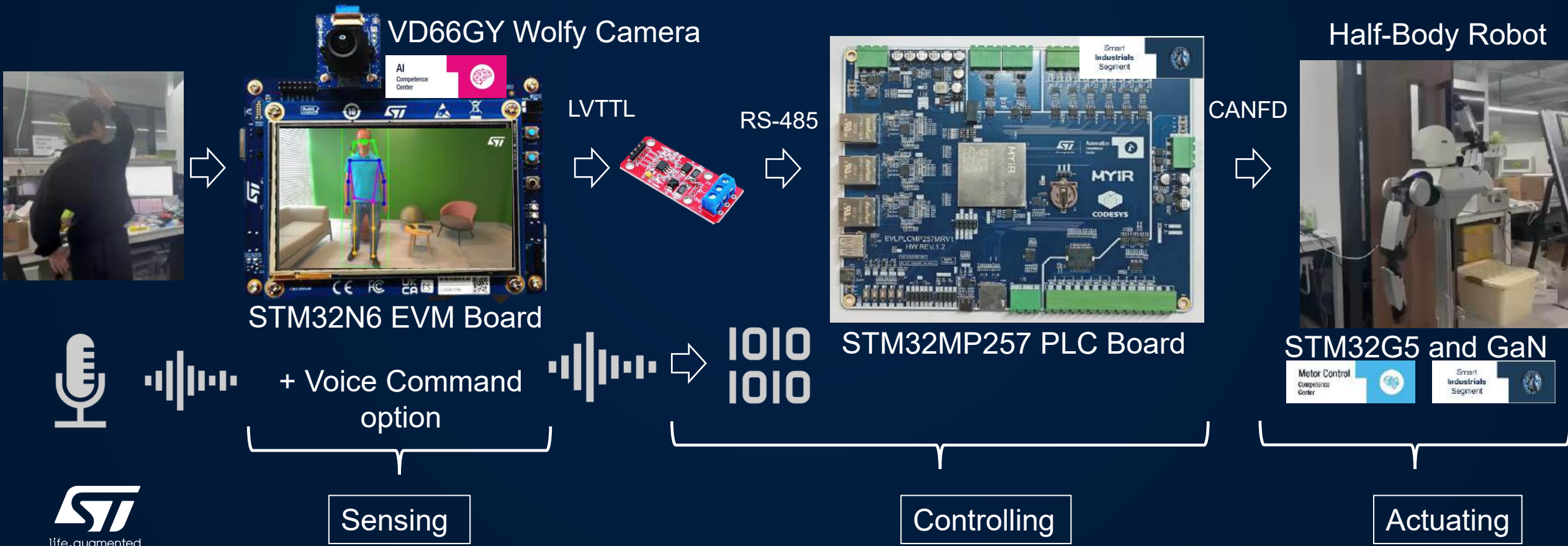
17 Landmarks Data (X, Y)



PLC Data Processing
6-of-17 landmarks



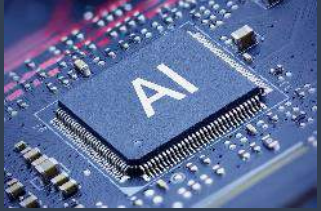
Dual-Arms Follow-up Action



Robotics System Platform: (System Building Blocks)

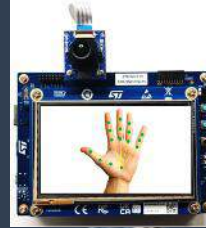
AI: STM32N6

21 finger key points' data (X, Y, Z)



Visualization

Sensing

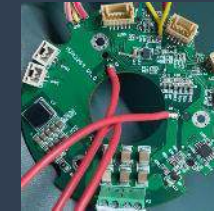


Connectivity

Processing &
Control



PLC Data Processing



Actuator



15 servo motors' position data

Humanoid Robot System Breakdown:

- **Total 44 +Motors with controller in each robot.**
- Head: Camera, Laser Lidar, AI processor, Sensor;
- Body+ two Hands: 14 Motors + Controller, Sensor;
- Two Legs: 14 Motors+ Controller, Sensors;
- Two Smart Palm: 5-15 Servo Motors+ Controller, Tactile Sensors, Touch sensor;
- Communication module: BLE, Wifi, RF, 2.5GHz, 5GHz..
- Battery Power 48~52V.

STM32N6 Open-up new horizons

600x

ML performance uplift*


STM32N6

MPU-level AI performance

MCU power consumption and cost

- **Dedicated Embedded Neural Processing Unit**

- 600GOPS NPU
- 3TOPS/W power consumption

- **Arm cortex®- M55 core**

- 1280 DMIPS / 3360 CoreMark
- New DSP extensions (MVE)

- **Embedded RAM**

- 4.2 MB embedded RAM

- **Computer vision pipeline**

- Parallel and serial camera I/F
- Dedicated image processor (ISP)

- **Extended security features**

- arm TrustZone for the Cortex-M55 core and the NPU

ST Neural-ART
accelerator

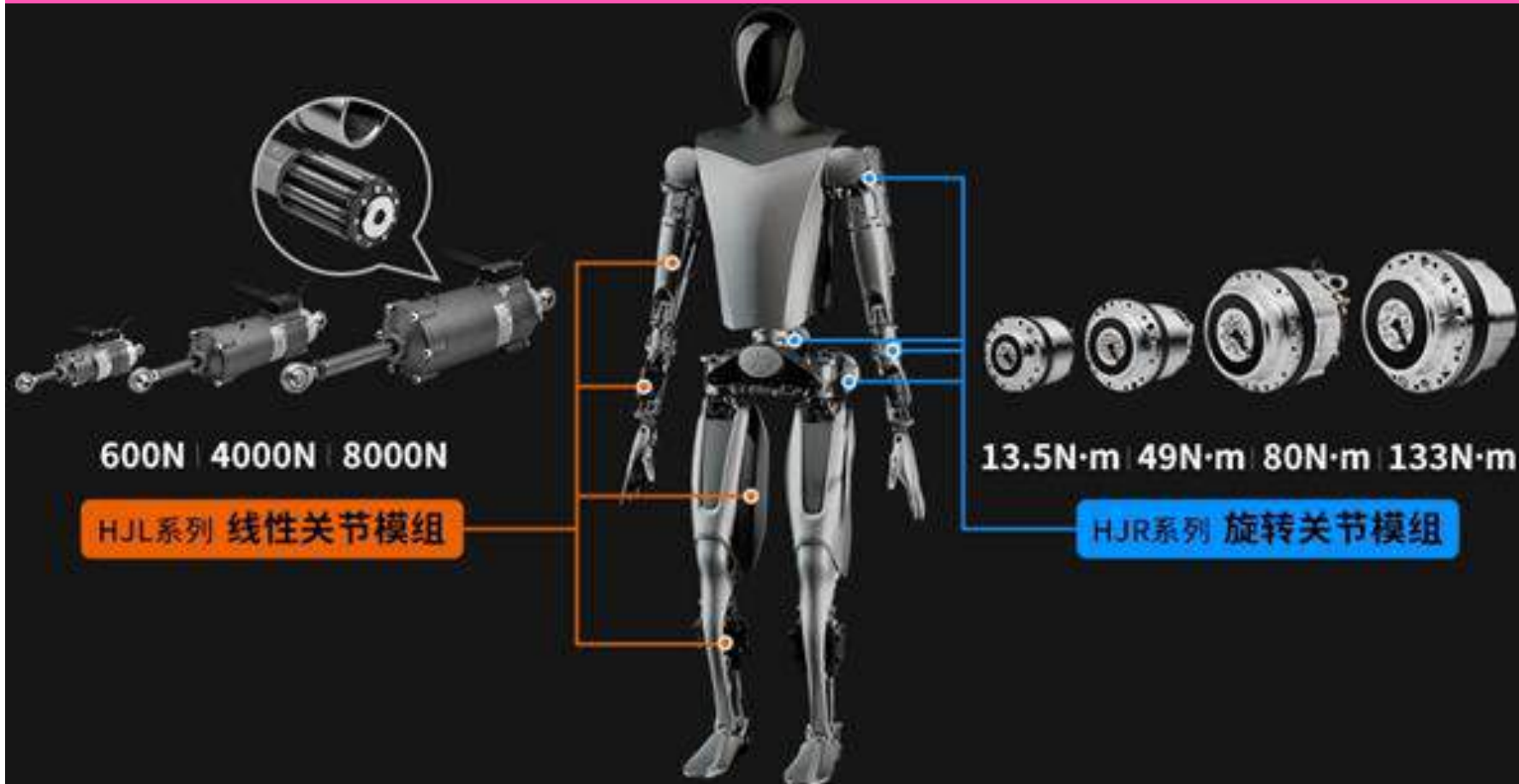


600GOPS
3TOPS/W

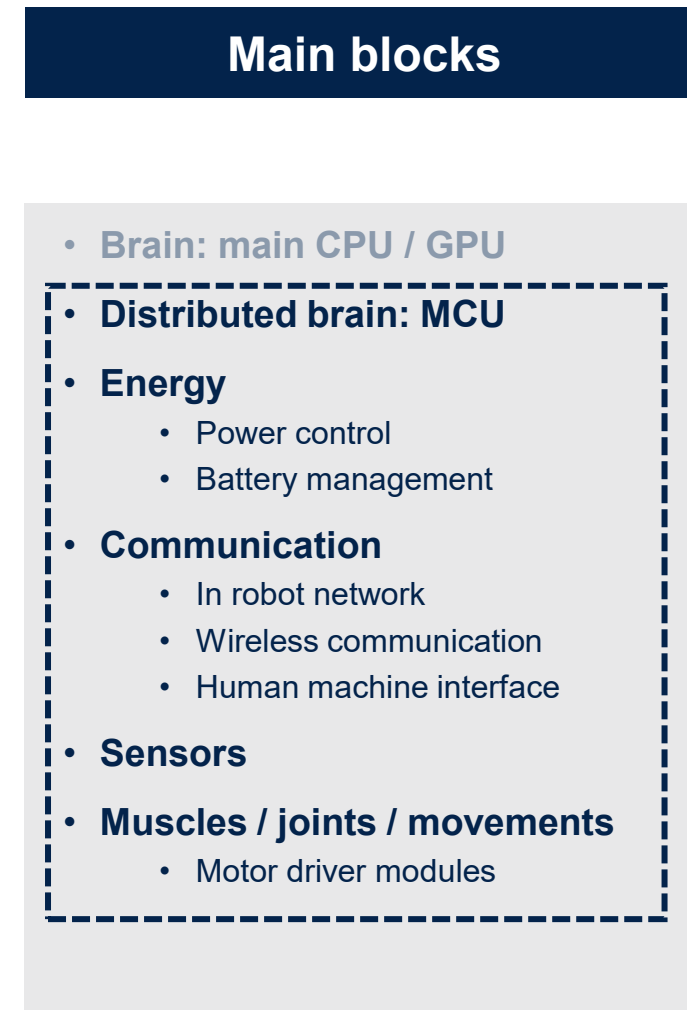
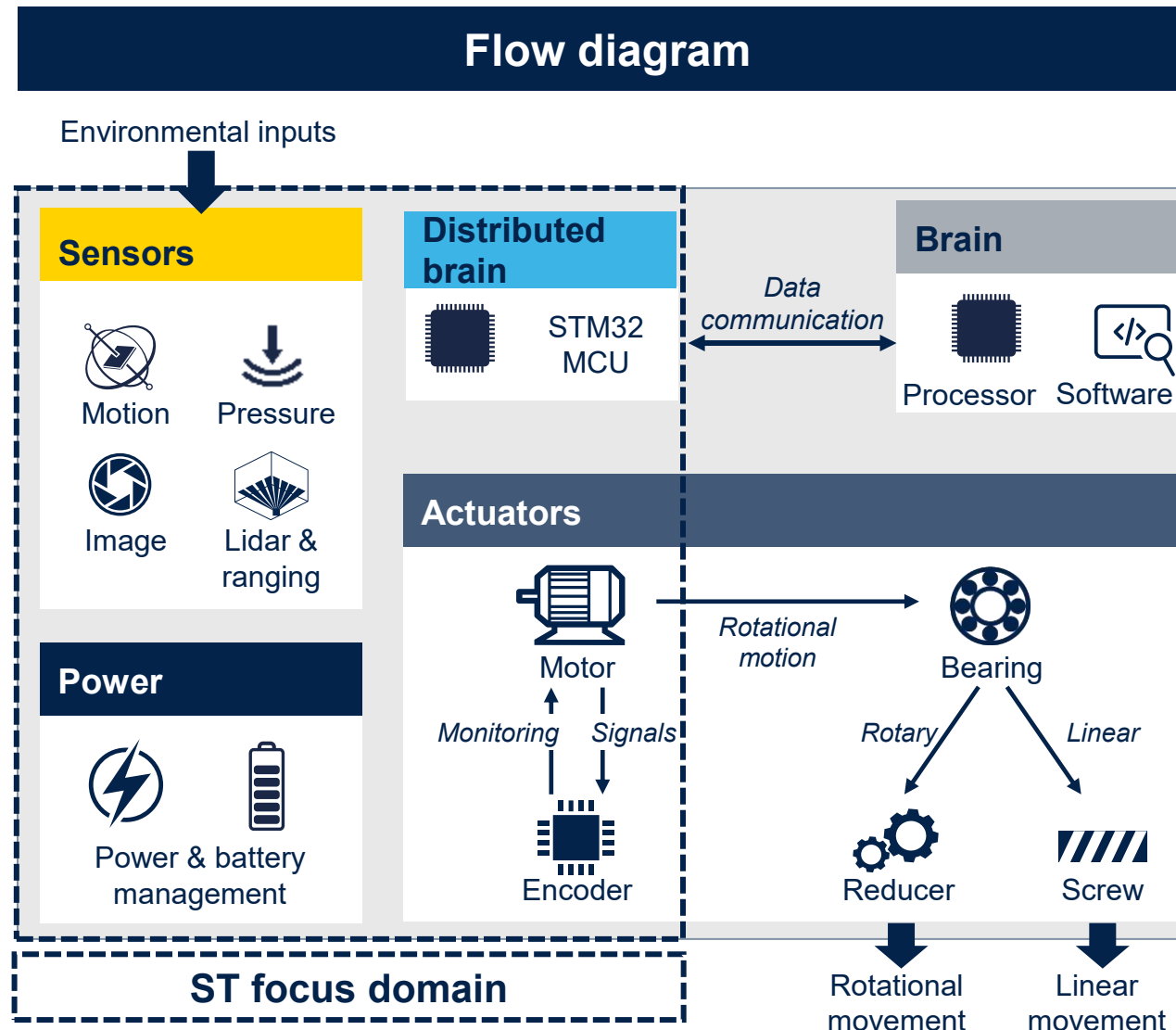
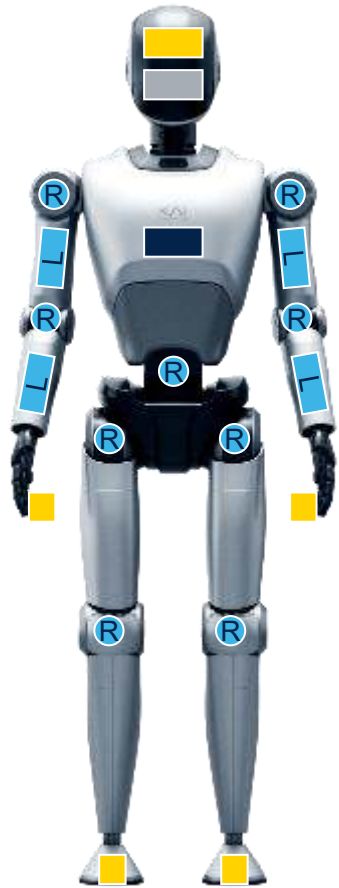


Legs and Hands: Servo Drive

There are two kind Joint movement module:
Prismatic Joint module and Revolute Joint module



Where ST offers solutions for humanoid robots



ST targets / BOM list



Connectivity

BLE **STM32Wx**
WIFI/BT **ST67W611M**
60Ghz RF link **ST60** joint replacement



BMS – DC/DC

STM32G0, STM32G4



Sensing

Plus innumerable sensor for touch, temperature and Plan.

STM32U3 with AI
IMU: **LSM6DSV16X** / **ISM330DHCX**



Encoder

Optical/Magnetic encoder: **STM32G4**
OP AMP: TSV772IST
DC/DC: DCP3601
RS485: ST4E1216
LDO: STLQ015, LDLN025



Edge AI

NPL(Noise/echo cancellation)/Camera/Vision
STM32N6/STM32MP2/STM32V8
Camera: **VD1943/VB1940, dToF VL53L9**



Switch/Gateway

STM32H5:Single Pair Ethernet, PLAy
STM32V8:Ethernet with TSN,CAN-FD
STM32N6:Ethernet with TSN, CAN-FD,NPU
STM32MP2:Eth TSN w/ switch, Mult-core, NPU
STPMIC25: PMIC

Motor - Arms&Joints&Finger



Frameless motors: **STM32G4/G5, STM32H7, STDRIVEG211, GaNSPIN1102**
Coreless motor: **STM32G4/G5, STSPIN32G4**
Joints&Fingers: **STSPIN830/93X**
Current Sensing: **TSC2020IST/TSC240**
DC/DC: DCP10001
MOS:SGT1D5R10MEA /STO350N10F8

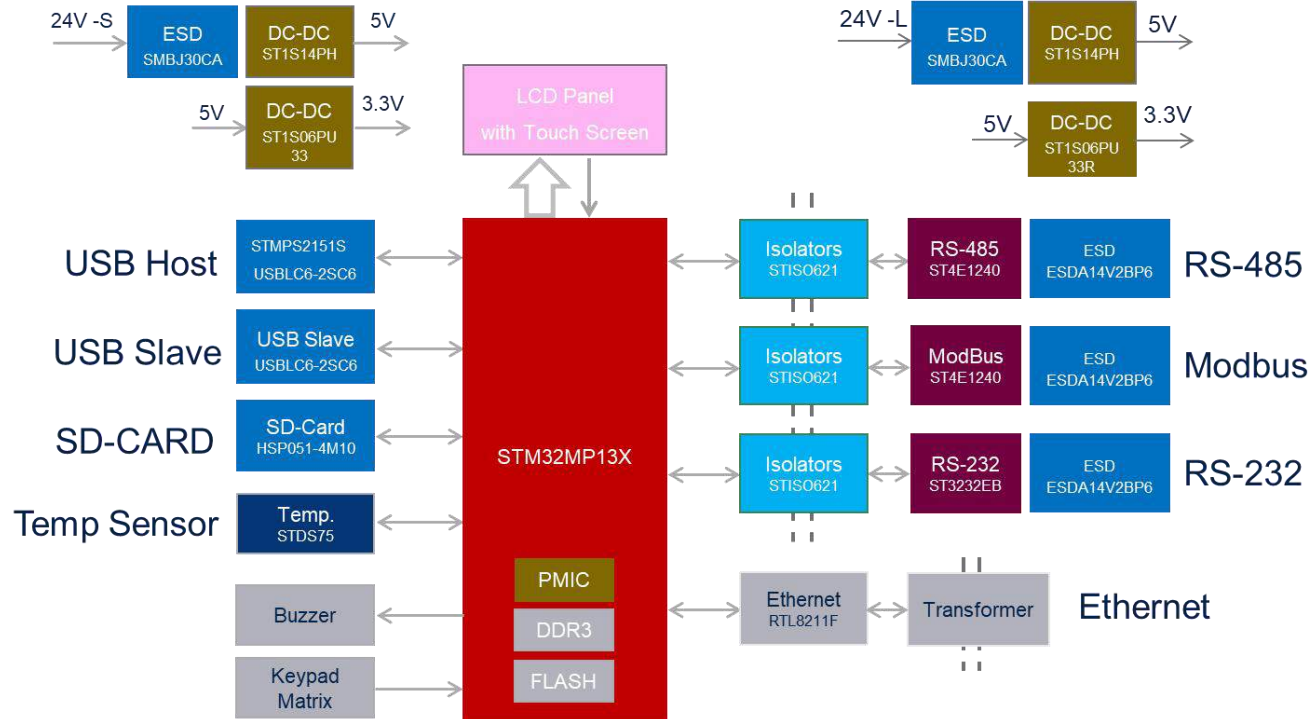
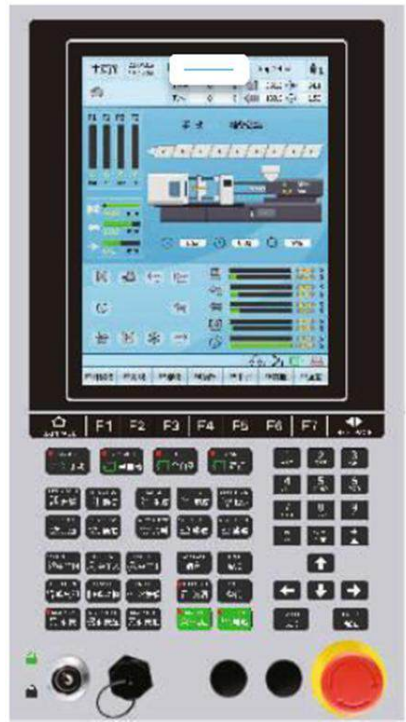
Visualization (HMI/Display, Vision...)





Human Machine Interface: Reference Design

HMI reference design(expandable and configurable) platforms:



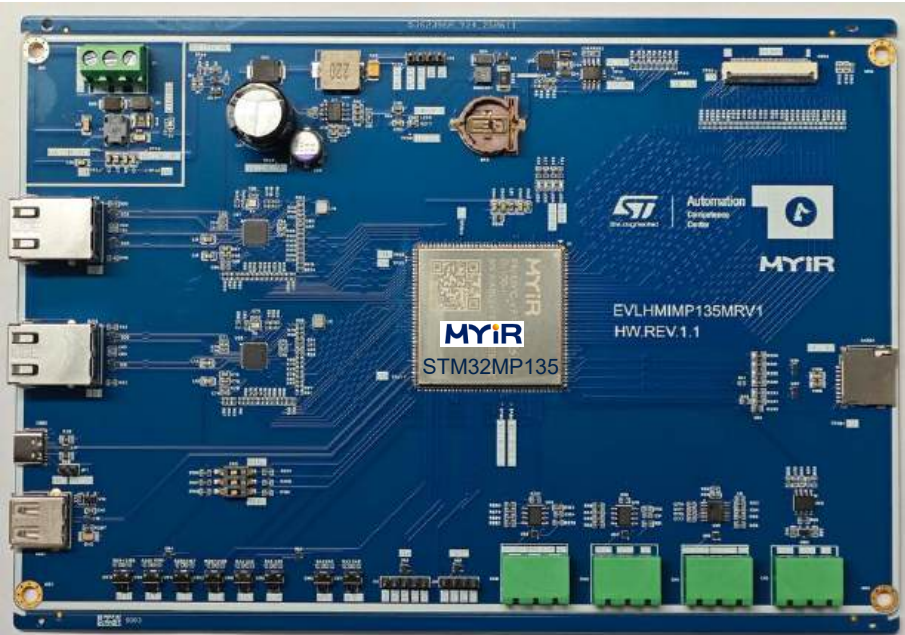
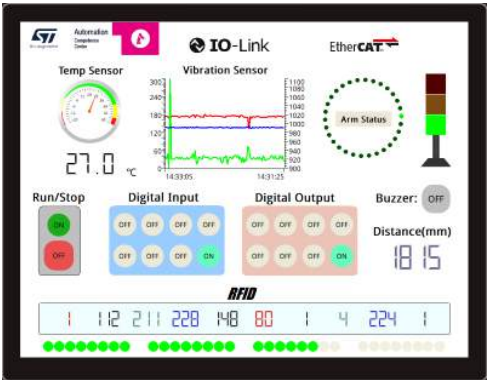
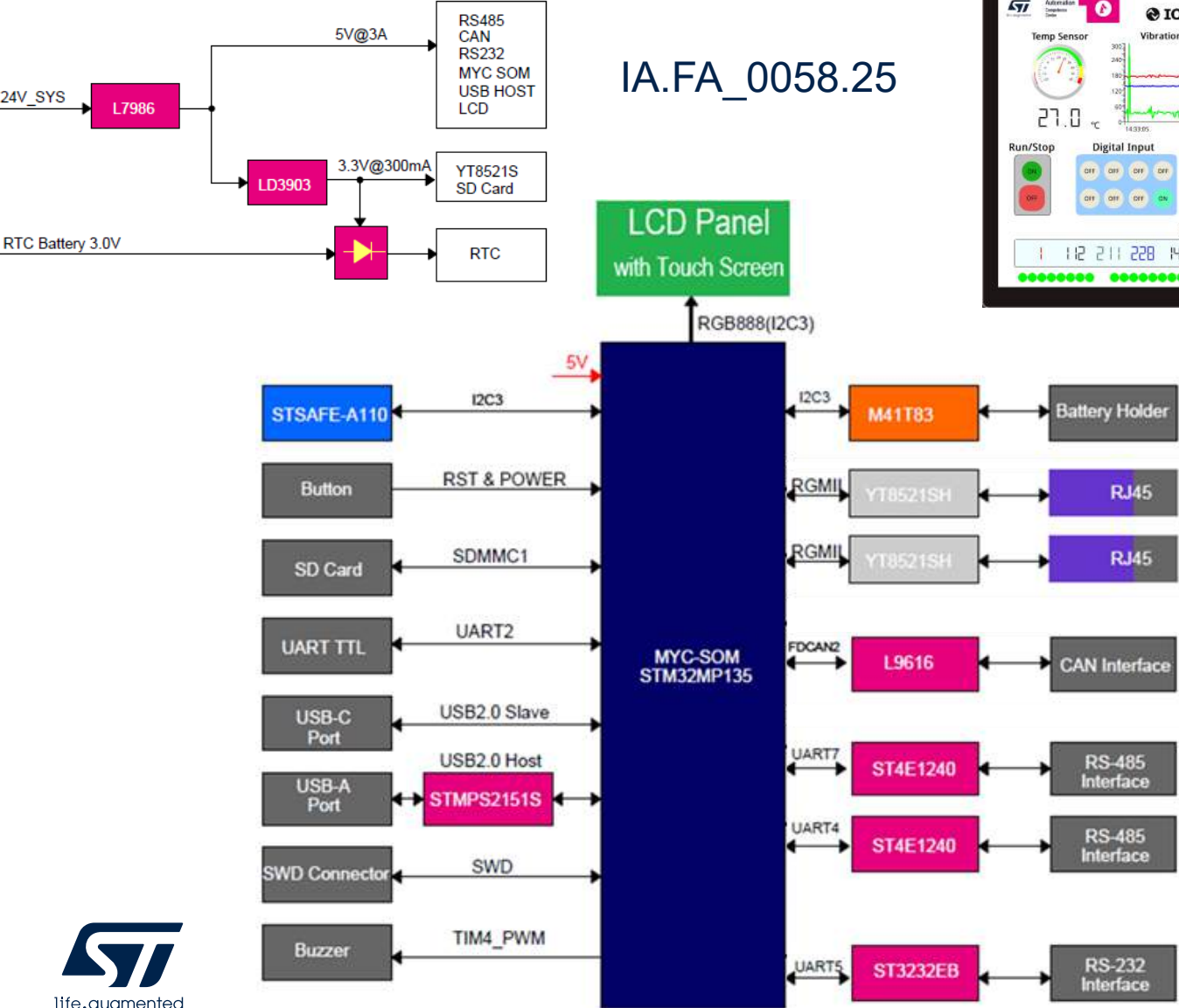
Human Machine Interface



8-10 inch Touch Screen HMI
Custom-development for a System Integrator in India

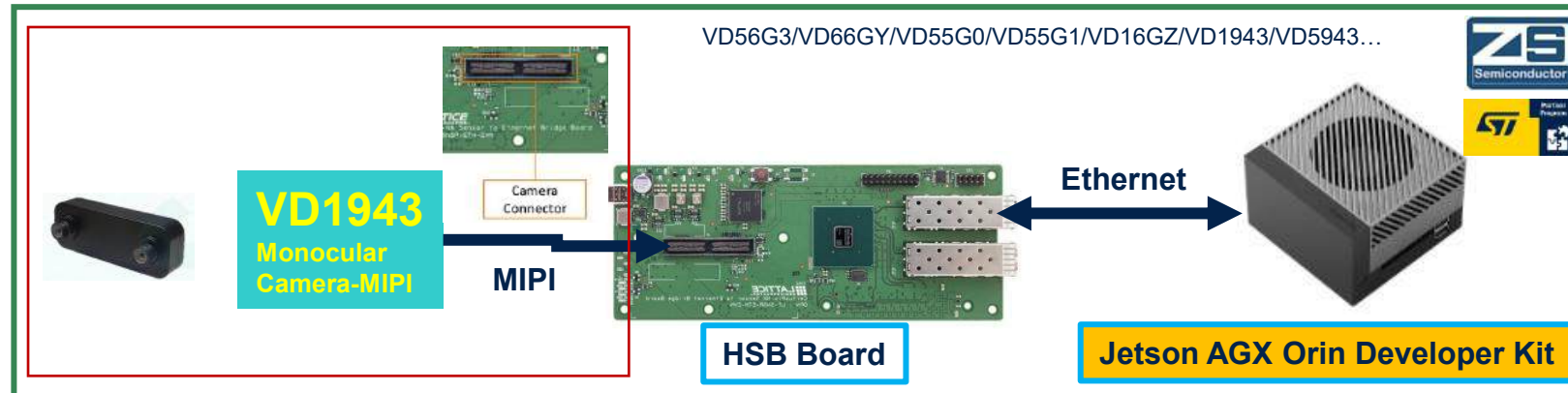
HMI Solution Based STM32MP135 (MYiR SoM)

- High Performance STM32MP135 MPU
- 1280*720 LCD Panel with Touch Screen
- 2 Ethernet Ports
- RS-232 Interface
- RS-485 Interfaces
- CAN Interface
- USB Host / Slave Interface
- MicroSD™ Card Interface
- 24VDC Power Supply





HSB and Camera solution



- [VD16GZ camera module](#)
- [VD55G0 camera module](#)
- [VD55G1 camera module](#)
- [VD56G3 camera module](#)
- [VD66GY camera module](#)

- MAX100dB HDR
- Global Shutter
- GMSL2
- 25*25mm
- External Synchronization
- 5MP * 2 60fps
- HFOV130 degree

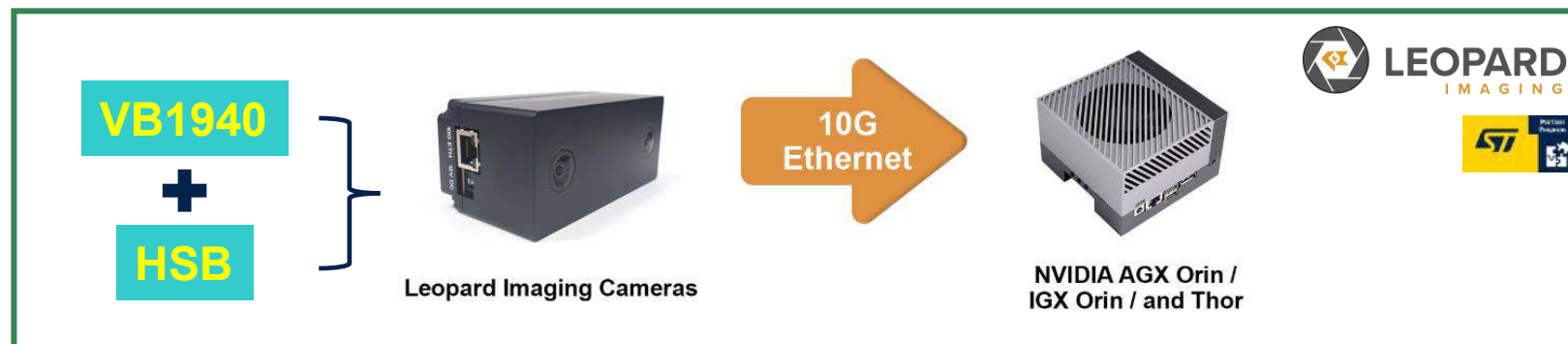


SHW5G



S56

- 940nm Wavelength
- 1/2.5"
- 2.25 x 2.25 μm
- 10GigE
- RGB-IR
- 2560 (H) x 1984 (V)
- HFOV120 degree
- 12VDC power supply



[LI-VB1940-VCL-ST80-10GigE-120H](#)

ST BrightSense portfolio

A broad and growing CMOS image sensors offer

Partner with an experienced and reliable industry leader



Patented technologies awarded by top players



Proven supply chain with billions of units shipped



Comprehensive imaging portfolio (CIS, ALS, dTOF, iTOF)

Build smart and power-efficient vision systems



Extend battery time with low power & auto-wake up



Optimize processing through smart in-sensor features



Maximize ergonomics and size with slim sensor designs





ST 2D image sensors

Tiny and best quality image sensors from 0.4 MP to 5.1 MP to enhance the robot's vision

Sensitivity & compactness

VD55G0

0.38 MP | 644 x 604
1/9" format (2.3 mm)
Monochrome
MIPI CSI-2

VD56G3

1.5 MP | 1124 x 1364
1/4" format (4.6 mm)
Monochrome
MIPI CSI-2

VD66GY

1.5 MP | 1124 x 1364
1/4" format (4.6 mm)
RGB
MIPI CSI-2

VD16GZ

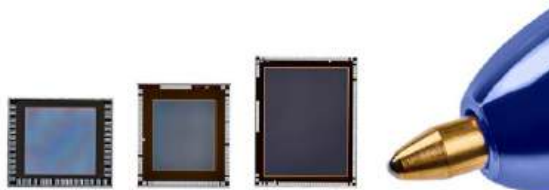
1.5 MP | 1124 x 1364
1/4" format (4.6 mm)
RGB-IR
MIPI CSI-2

Smart & low-power

VD55G1

0.56 MP | 804 x 704
1/9" format (2.3 mm)
Monochrome
MIPI CSI-2 & I3C

And more soon...including **5.1MP monochrome** and **RGB-IR**



Leading imaging foundry



Patented technologies





VL53L9 | Lidar & 3D module for humanoid robots

Lidar for robotics: room / environment mapping

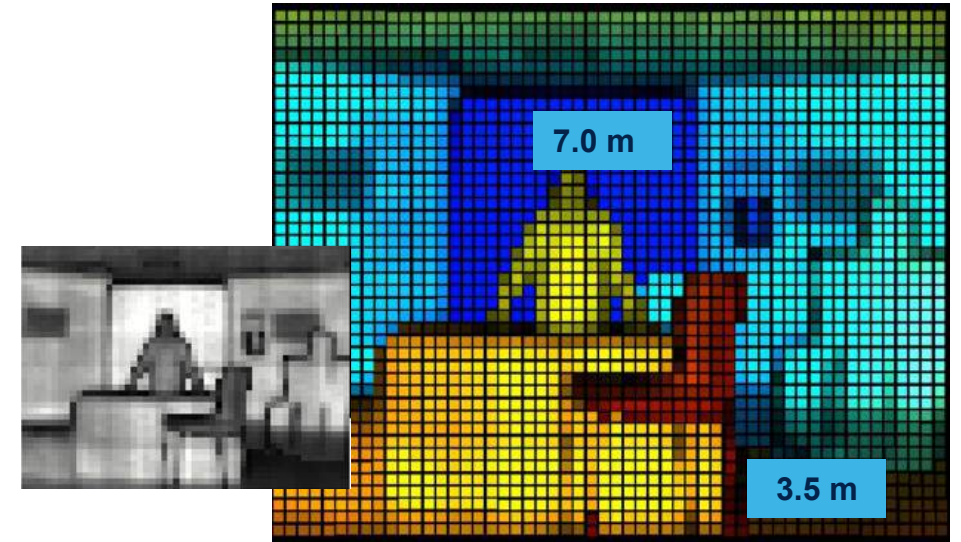
- 2.3k zones | 1° per zone angular resolution
- **Long distance detection 9.3 m** | High frame rate **60 fps** | **Excellent accuracy**
- **150 mW** total system power, with on-chip depth processing

Beyond sensing: object & gesture detection, segmentation, and classification

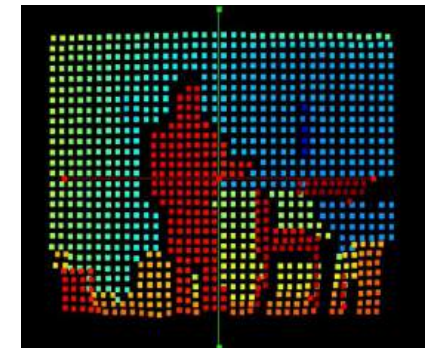
- **Flood illumination** for thin edges and objects detection
- **2D IR + depth output** for AI or analytic processing
- **Motion artifacts robustness** from fast-moving scenes

True All-In-One lidar dToF module

- On-chip dToF processing & distance over MIPI or I³C
- **Calibration free, no extra system cost**
- **Reflowable module** for easy integration



Room mapping & 2D images

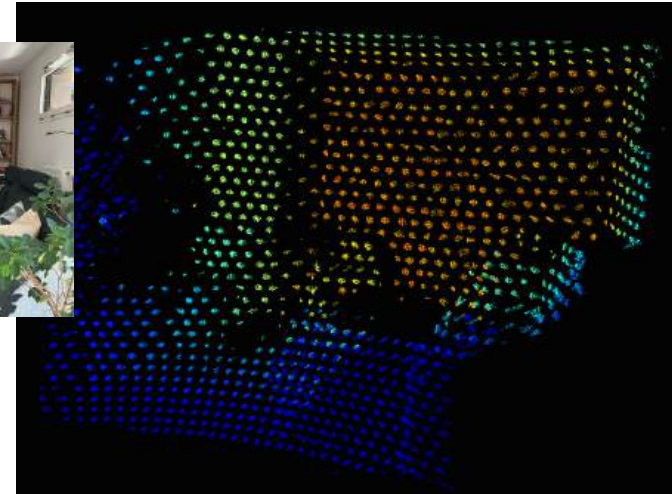
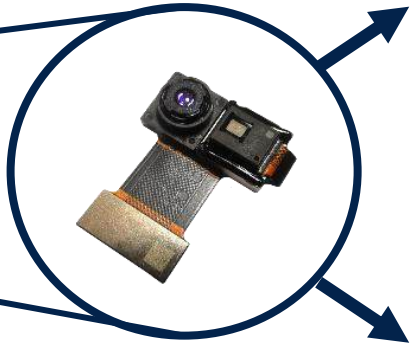


Chair legs & edge detect



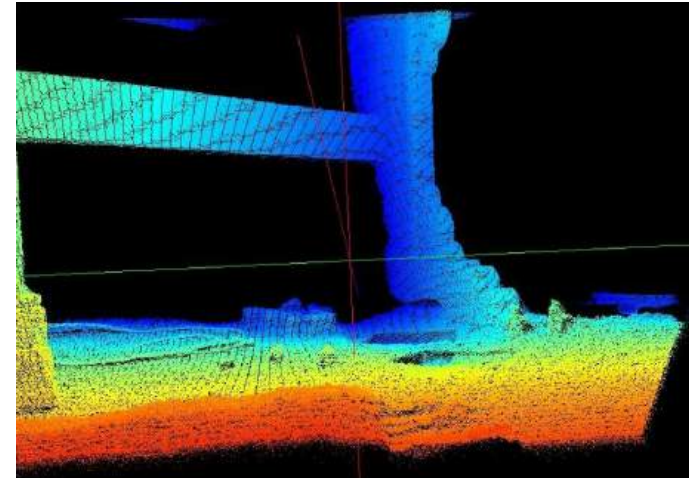
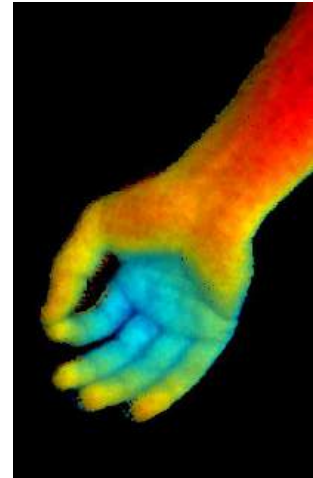
VD55H1 | iToF sensor for humanoid robots

1 sensor for 2 use cases



Low resolution

Room mapping
3D audio management
Dot or SW binning solution



High resolution

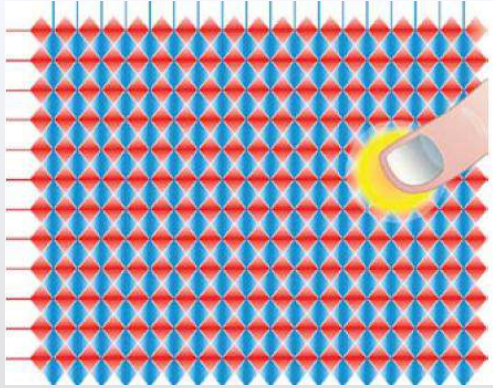
672 x 804 px
Obstacle & clearance detection
Object 3D scan
Hands modeling & gesture
Support to SLAM

iToF benefits

- Live 3D videos with RGB sensor fusion
- SLAM with wide FoV, up to 130x110
- Low module's power consumption

Capacitive Sensing

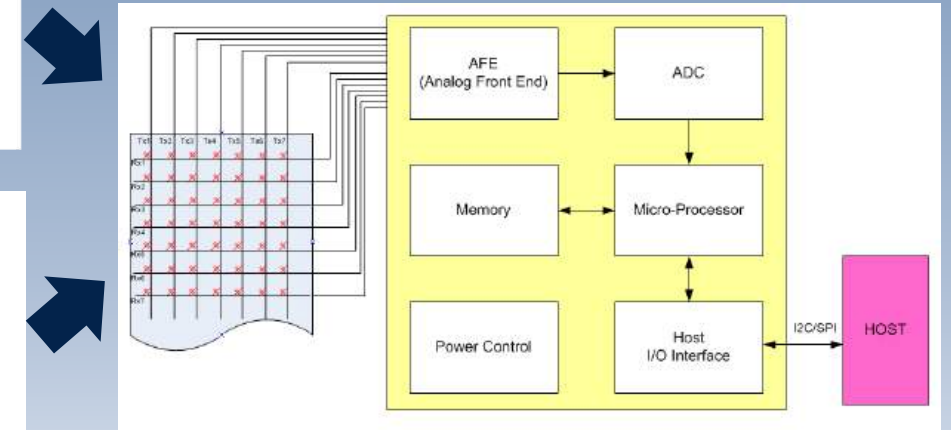
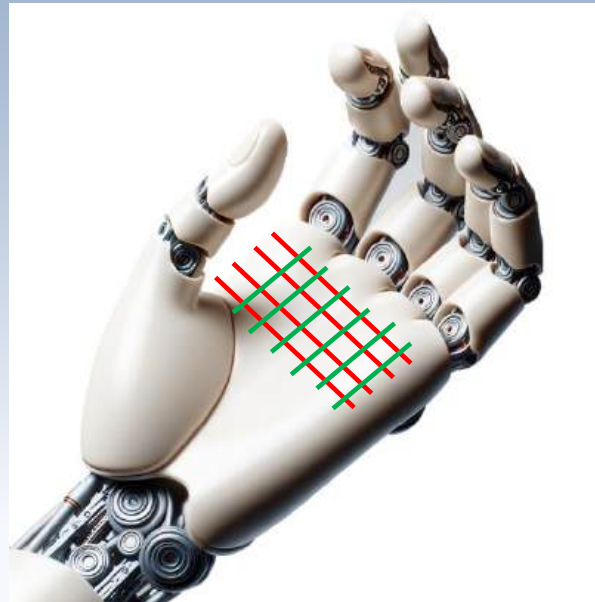
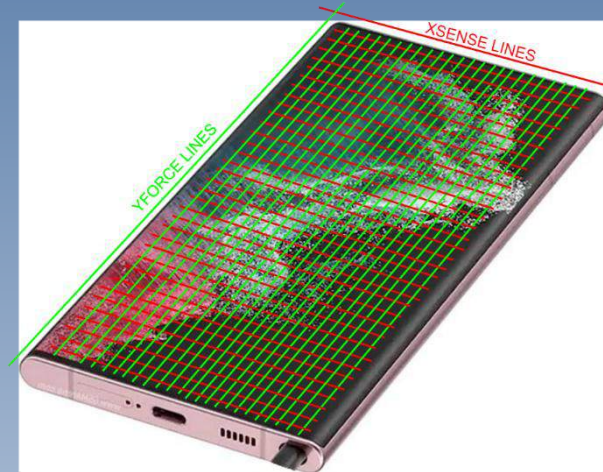
ST FingerTip support Capacitive tactile Sensing



Touch



No-Touch

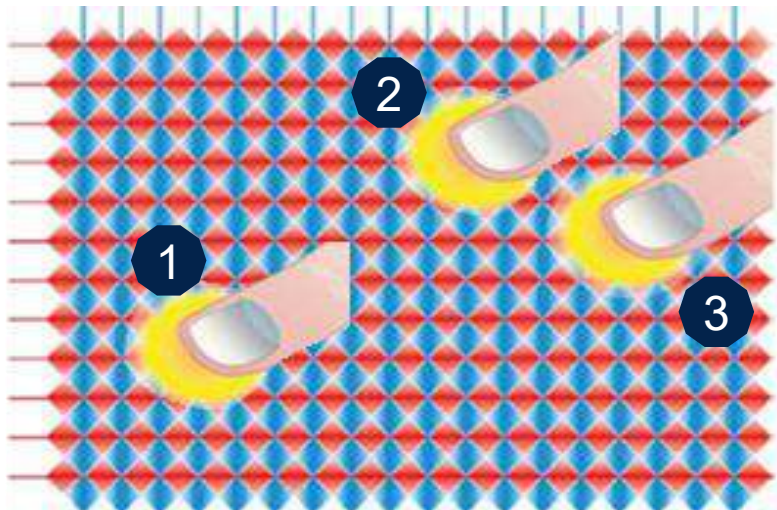


ST FingerTip Touch IC

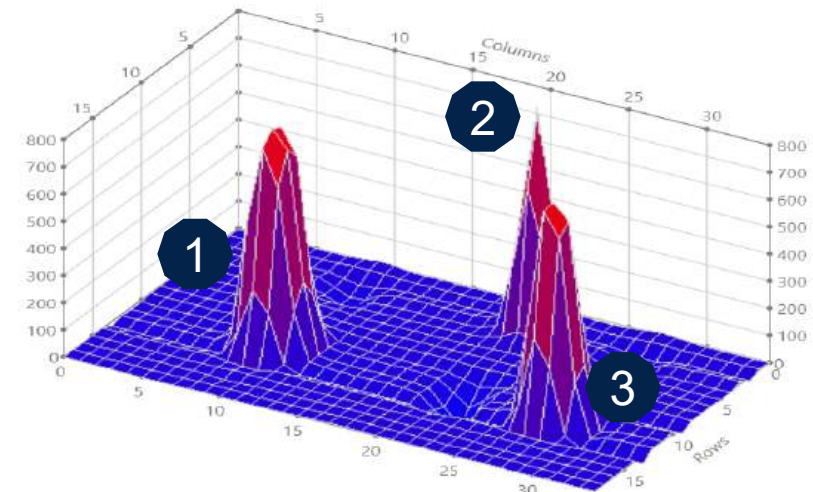
Versatile Sensing method

Mutual Scan / Self Scan

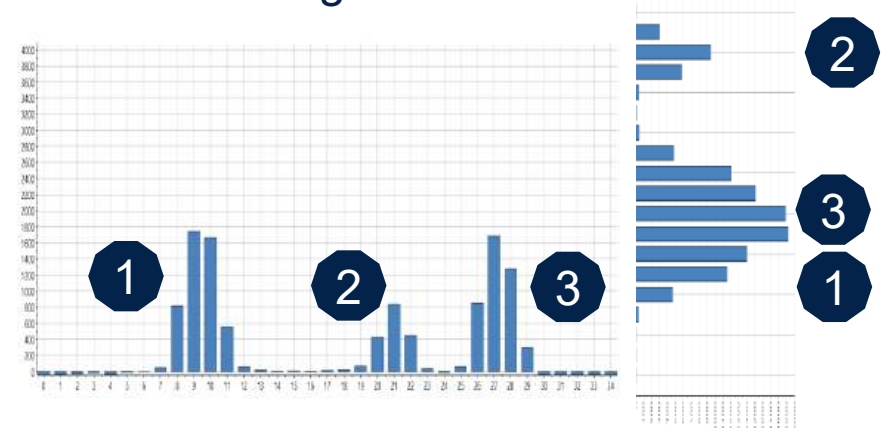
Touch Sensor & Finger



Mutual Sensing



Self Sensing



FingerTip Products Comparison

	Alix FTM5CU56A	SalixPlus FST2BA61C	Spruce FST2CA78Y	Angsana FST3CA60Y	Angsana FST3CA67Y	Casuarina FT3CA84Y	Osier and Osier-L FST4CA66Y /FST4CA84F
Tech node	TSMC 90nm	TSMC 90nm	TSMC 90nm	E40ULP 40nm	E40ULP 40nm	E40ULP 40nm	E40ULP 40nm
Core clock	64MHz	96MHz	96MHz	150MHz	150MHz	150MHz	192MHz
Core	M3	M4 SIMD	M4 SIMD	M4 SIMD	M4 SIMD	M4 SIMD	M33 SIMD
Main Flash/RAM	128KB/96KB	192KB/128KB	192KB/160KB	224KB/160KB	224KB/160KB	224KB/160KB	448KB/224KB
Tx, Rx channels	22Tx, 34Rx	21Tx, 40Rx	36Tx, 42Rx	18Tx, 42Rx	22Tx, 45Rx	39Tx, 45Rx	40Tx, 44Rx
Capacitive Load (Typ)	200pF	500pF	500pF	500pF	500pF	500pF	840pF
Package	BGA84 5x5	BGA87 7x4.2	BGA117 7x5	BGA87 7x4.2	BGA100 5x5	BGA117 7x5	BGA100 5x5 & BGA121 5.5x5.5
TX driving scheme	1x,4x	1x,4x,8x	1x,4x,8x	1x,4x,8x,16x	1x,4x,8x,16x	1x,4x,8x,16x	CDMA
Charge pump	6V	6V	6V	6V	6V	6V	-3V to 6V

Processing and Control





ST Automation PLC system Solution Matrix

Hardware Platform



STM32MP2



STM32MP1



STM32H7



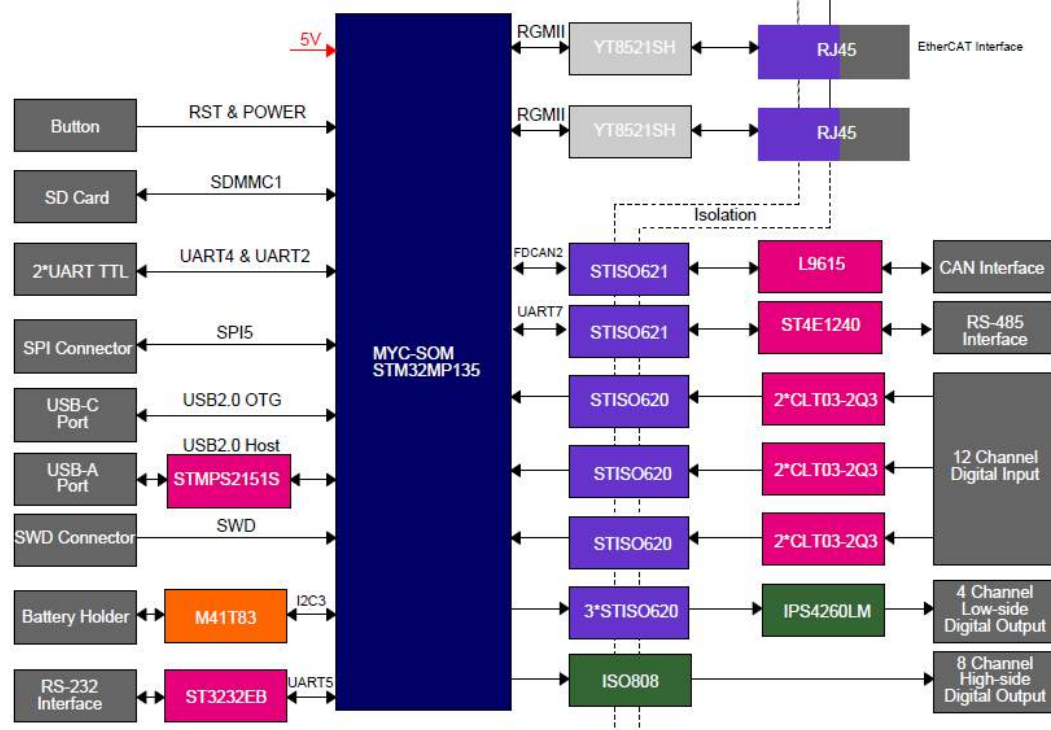
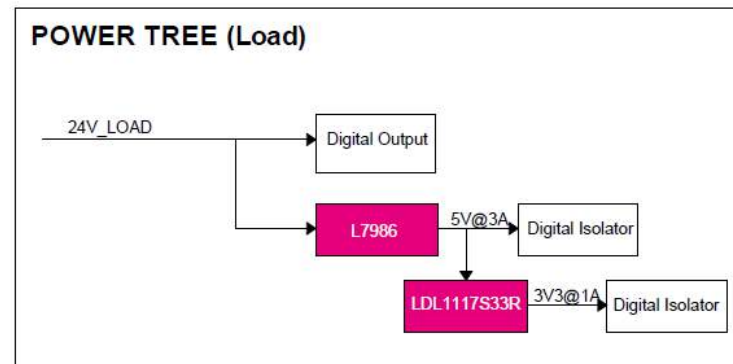
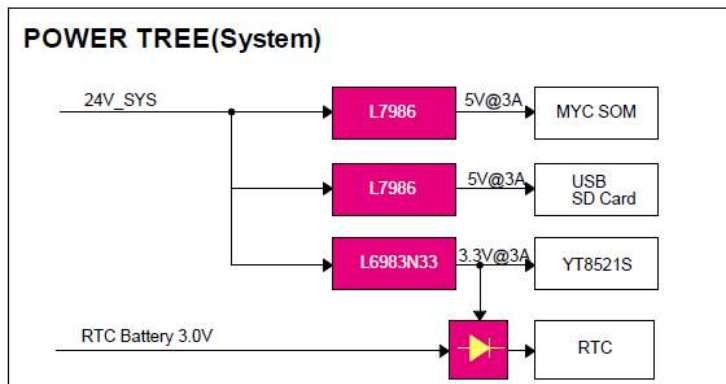
Software Platform



PLC Solution based on STM32MP135



- High Performance STM32MP135 MPU
- 8-ch Isolated High-side IPS for DO
- 4-ch Isolated Low-side IPS for DO
- 12-ch Isolated Digital Input
- 1 EtherCAT Master Port
- RS-232 /RS-485 /ModBus interfaces
- CAN Interface
- USB, MicroSD™ Card Interface



- Logic Unit
- Power Discrete & Driver
- Isolation
- Power Switch
- RTC
- Interface & Connectors
- Non-ST device

BoM List

STM32MP135	1
HDMIULC6-4SC6	4
SMBJ30A-TR	2
SMBJ6.5CA-TR	29
LM293DT	1
TL431BL3T	1
L7986ATR	3
LDL1117S33R	1
STMP2151STR	1
M41T83RQA6F	1
STISO621TR	2
ST3232EBTR	1
STISO620	10
L9615D	1
ISO808	1
IPS4260LM	1
L6983N33QTR	1
STPS5L40	3
ESDA14V2BP6	3
STPS2170AF	2
ST4E1240	1
CLT03-2Q3	6

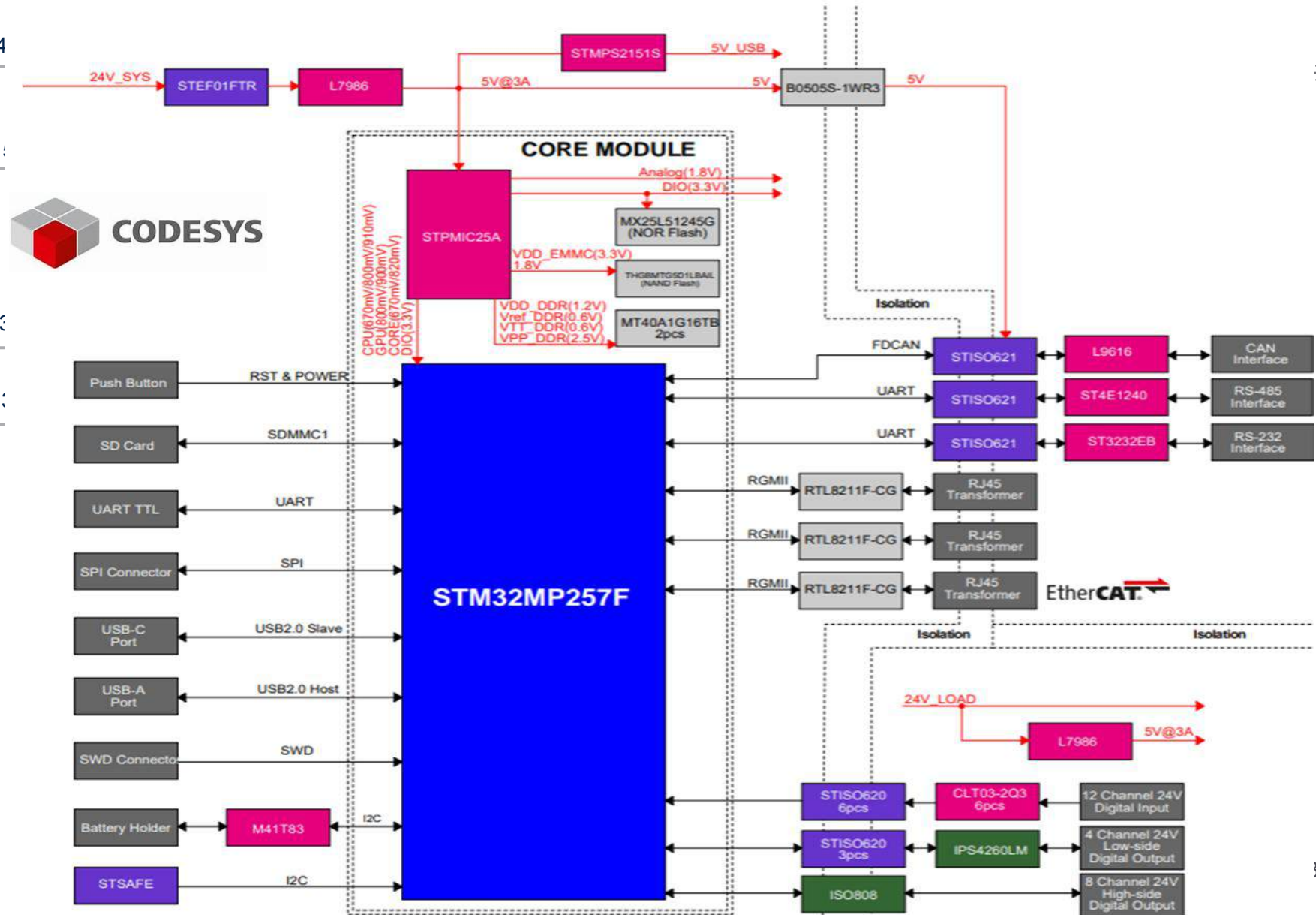


ST PLC+Motion control reference design

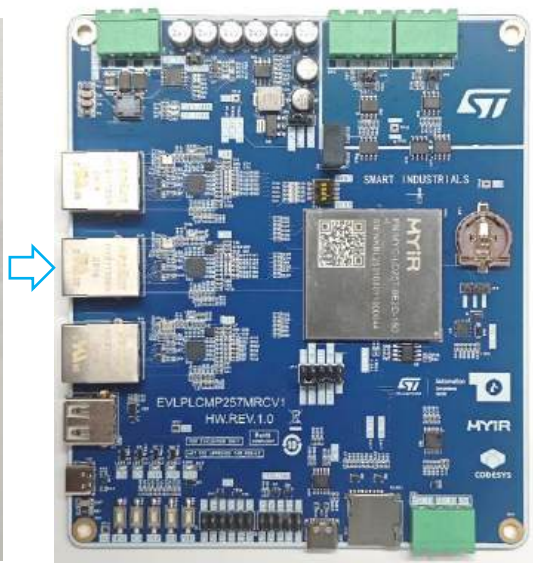
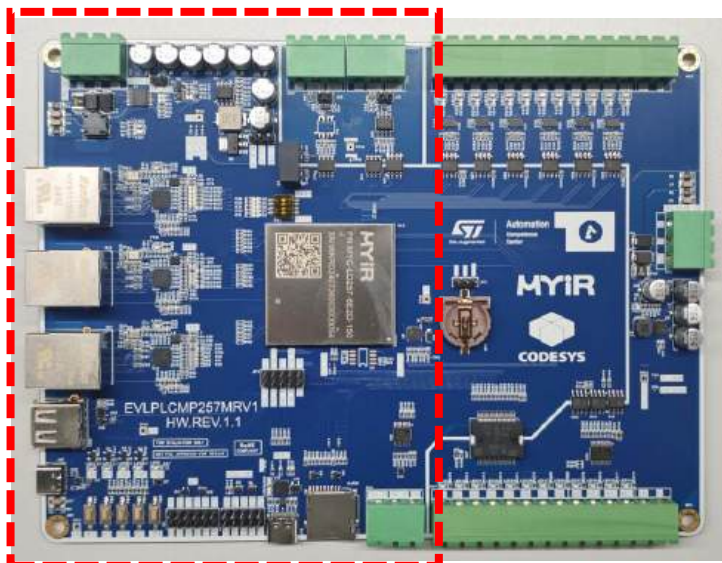


- High performance STM32MP257 MPU
- 8-ch isolated high-side IPS for DO
- 4-ch isolated low-side IPS for DO
- 8-ch isolated digital input
- 3 Ethernet port support EtherCAT controller interface
- RS-485/ModBus CAN, RS-232
- USB, microSD™ card interface

24

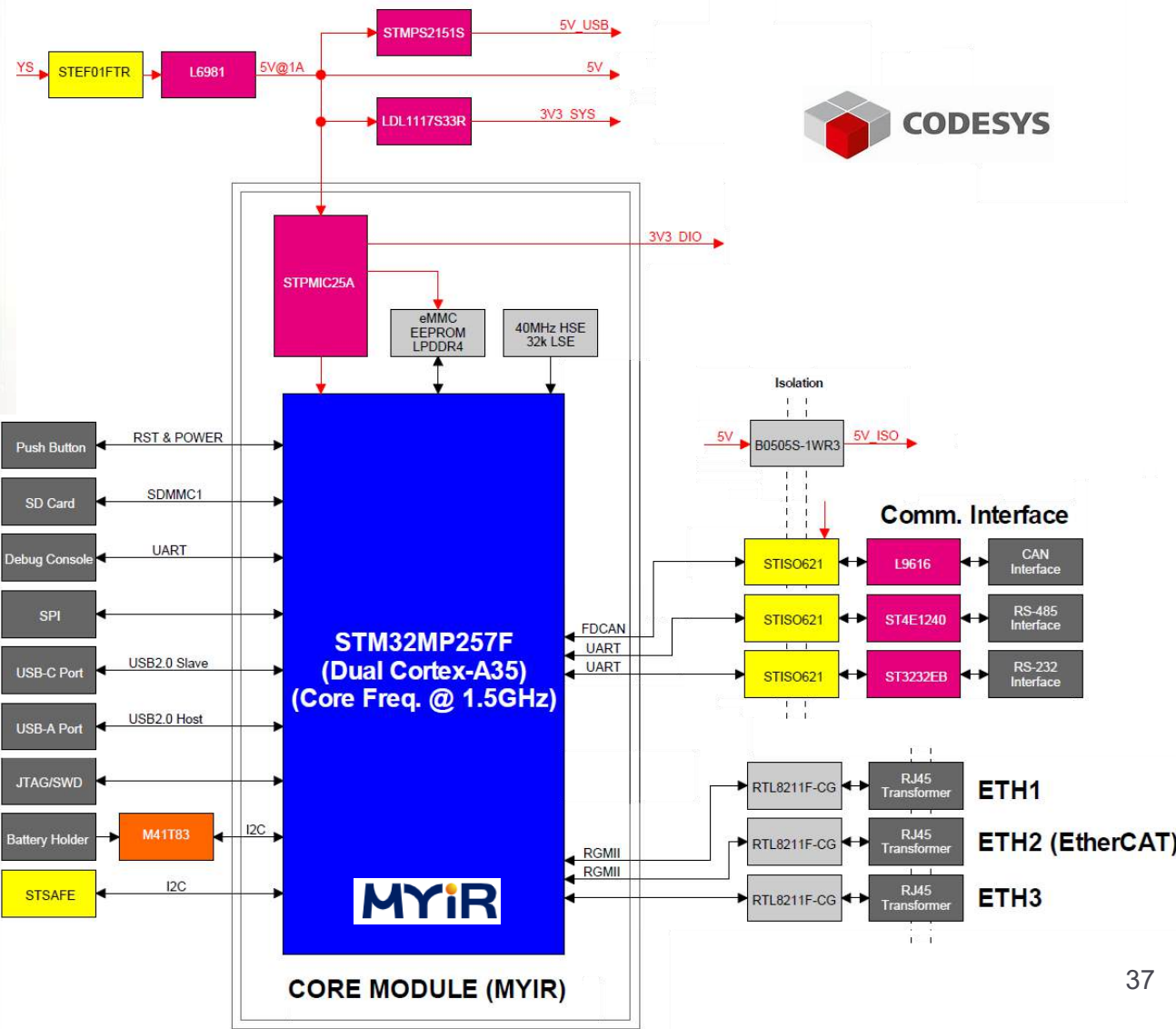


Compact MP257 PLC reference design: High-end with CodeSys Runtime

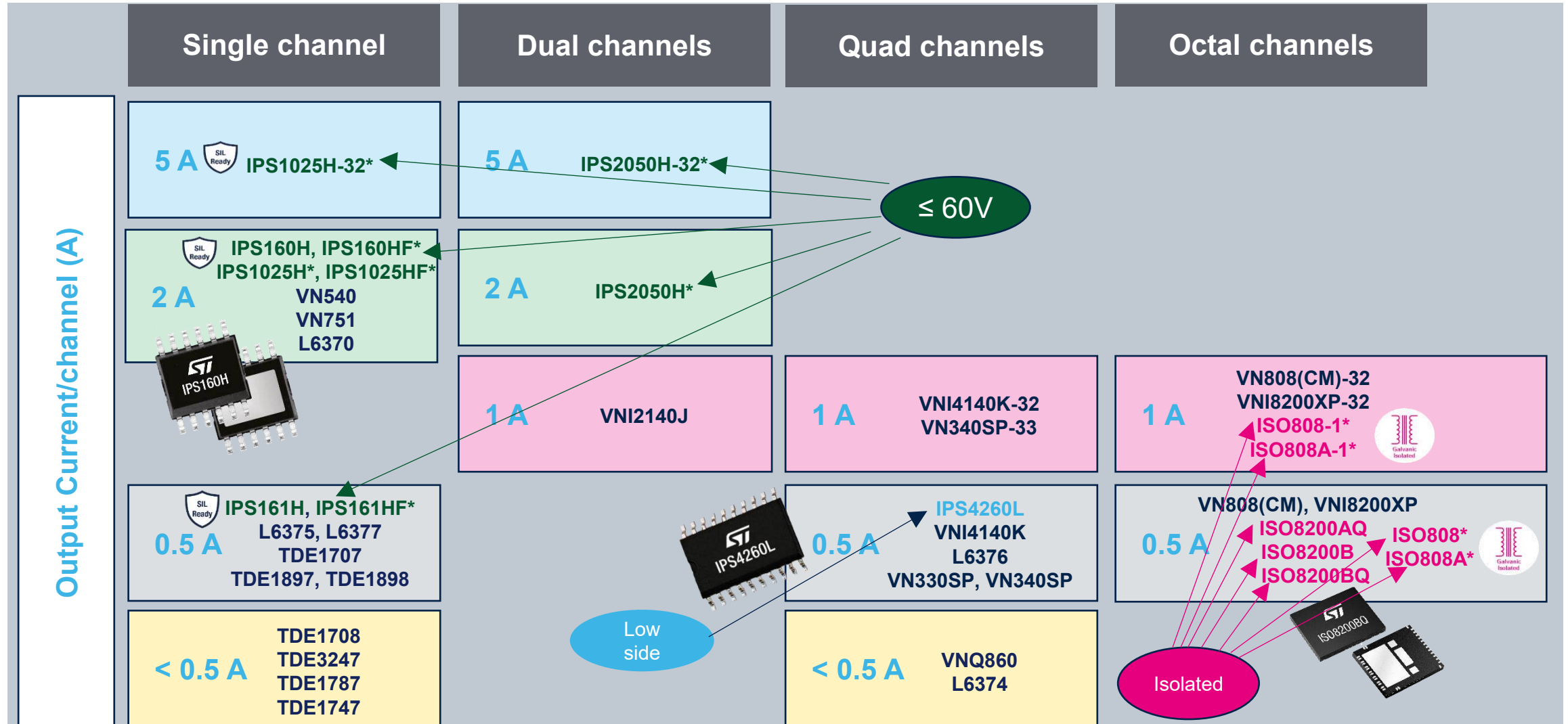


Compact type PLC

- High performance STM32MP257F MPU
- 2 Ethernet Ports
- 1 EtherCAT Master Port
- RS-232 /RS-485 /ModBus interfaces
- CAN Interface
- USB, microSD™ Card interface

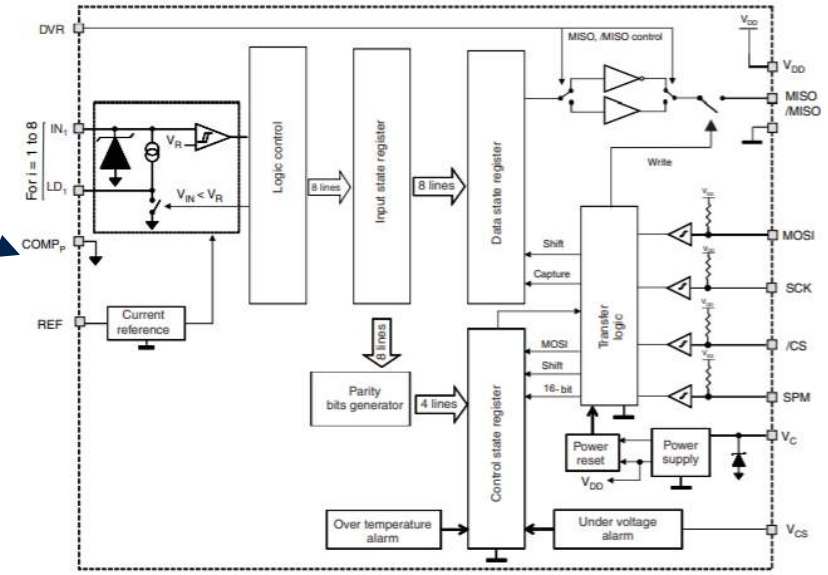


Intelligent power switch family



(*) in development

Current limiters for Digital input

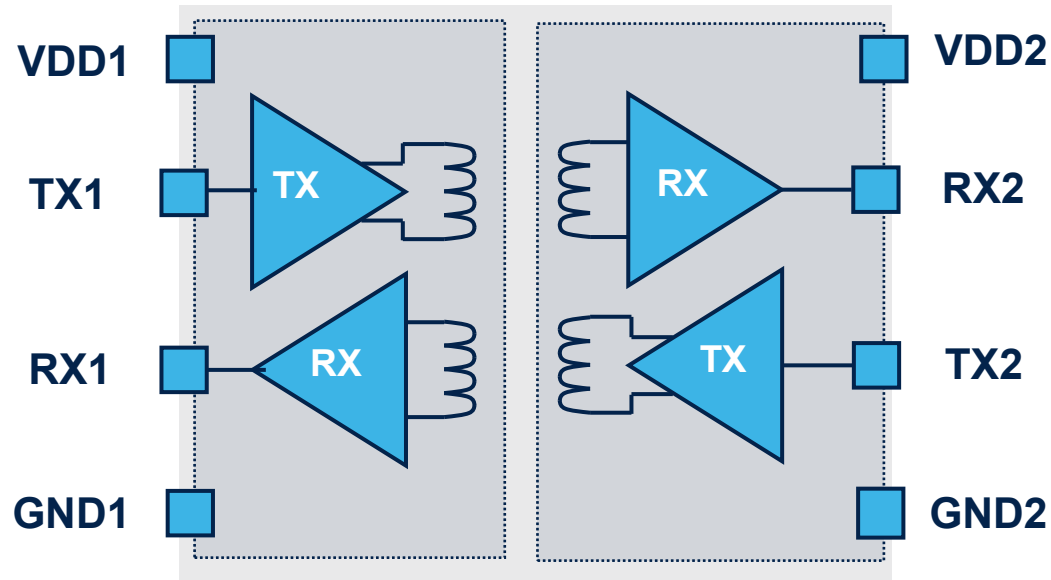


- Up to 8 protected integrated channels available
- Up to 2 MHz data interface speeds, 400kbps input rate, SPI available
- 600 W overvoltage protection integrated
- Highly-immune solutions such as those described in IEC 61000-4
- Power dissipation halved for more integrated modules

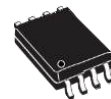
Digital isolator STISO620 & STISO621 / STIO621W

Robust 6 kV galvanic dual-channel 2/0 and 1/1 digital isolator

-Low Power, high speed UART I/F



- SO8W In Production
- SO8N qualification Dec '20



SO8W



SO8N

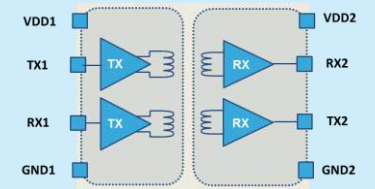
6kV galvanic isolation , 100Mbps rate and low pulse distortion (<3ns) for safe and fast data transfer between isolated domains

10mA power consumption at max data speed for ultra-low power and high performing operation

CMTI = 65kV/us typ, Propagation Delay 25 ns typ

High flexibility with 3.3V and 5V supply ratings and with SO8N and SO8-W package options

Dual channel, one direction
(**STISO620**) under development



<https://www.st.com/en/interfaces-and-transceivers/stiso621.html>

Prod. evaluation board EVALSTISO62XV1 available

GPCA Key Devices in Robotics



ST CLOUDPWR

VR CTL + SPS (Powering Cerebrum)

PM6780/3/4: VR CTL, 8/12/16 phases, 2/3/4 rails
PM7080B/PM70x1D: SPS, 50A/80A/90A



Buck Converter (Powering DSP)

DCP3601/3: 36V/1 or 3A SOT23
DCP10001Y: 100V/1A 1 MHz SO8



LDO

LDO (Powering for MCU)

LDQ40MR: 40V, 250mA SOT23-5
STLQ015: 5V, 150mA, I_{lq}=1uA
LDLN025: 5V, 250mA, Ultra-low output noise:6.5μVRMS



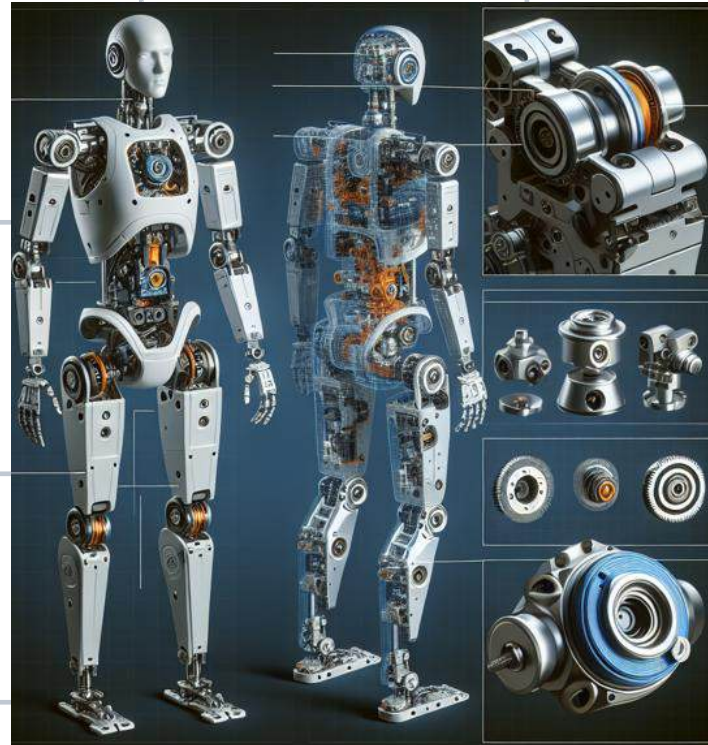
eFuse

eFuse

STEF48H28: 48V-54V 30A Electronic Fuse

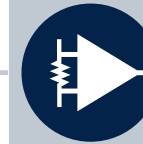


life.augmented



RS485

ST4E1216/40: ±12 kV IEC 61000-4-2 contact. 16 or 40 Mbps data rate, Hot-swap



Current Sensor

TSC240A1: Motor inline current sensing
TSC21x: Motor inline current sensing
TSC199: Motor inline current sensing



OP AMP

TSV772: 20MHz Vos≤200uV
Encode Module OP AMP



Buck Controller

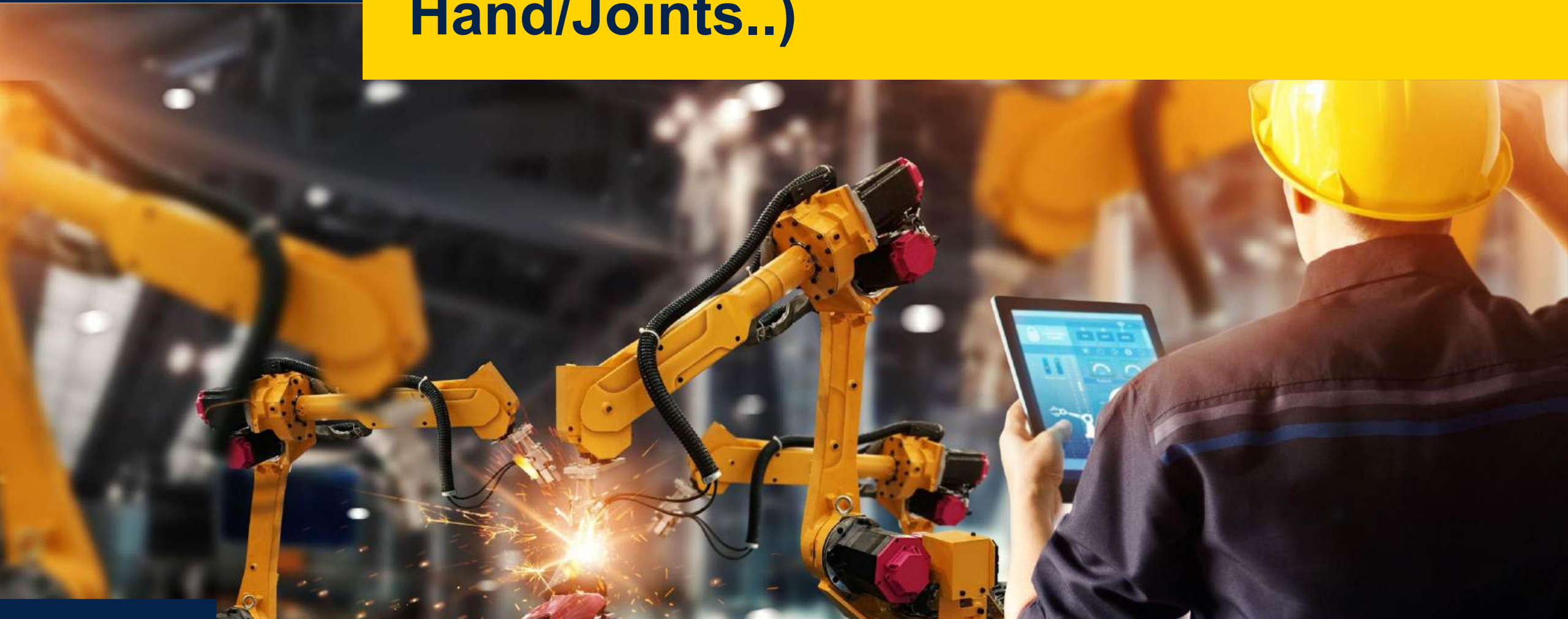
DCP85: VIN,Max=85V, Up to 20A I_{out}
48V Battery Voltage Converter



VREF (VREF for ADC)

TS33xx: Precision +/- 0.15% @ 25 °C
LM4040A: Precision +/- 0.1% @ 25 °C

Actuator(Motor Control, Sound, Robot Hand/Joints..)

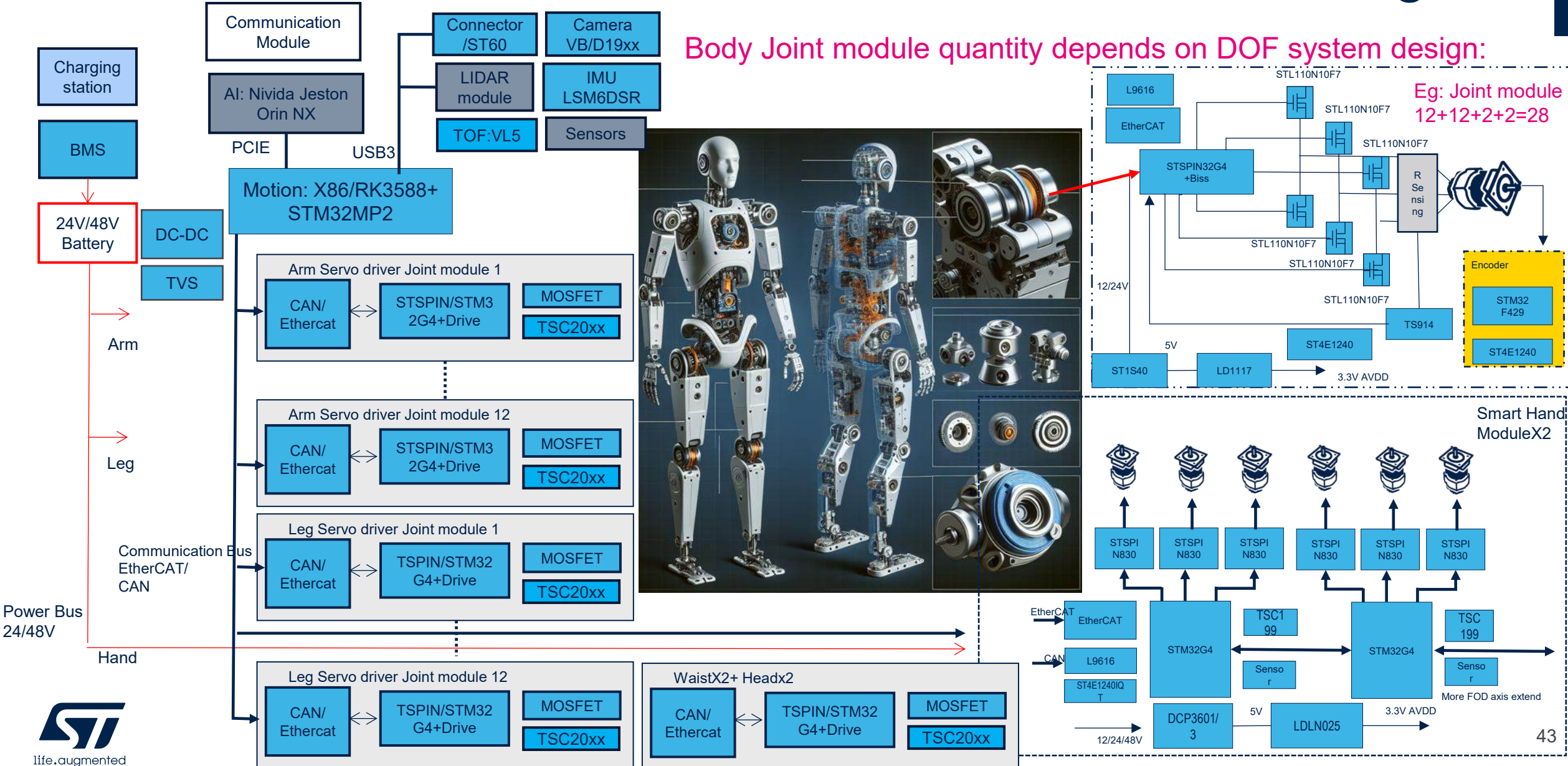


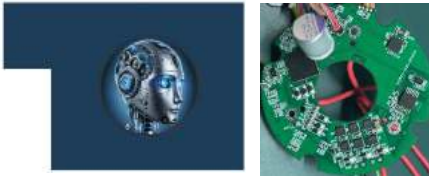


ST Humanoid Robot Block diagram

Body Joint module quantity depends on DOF system design:

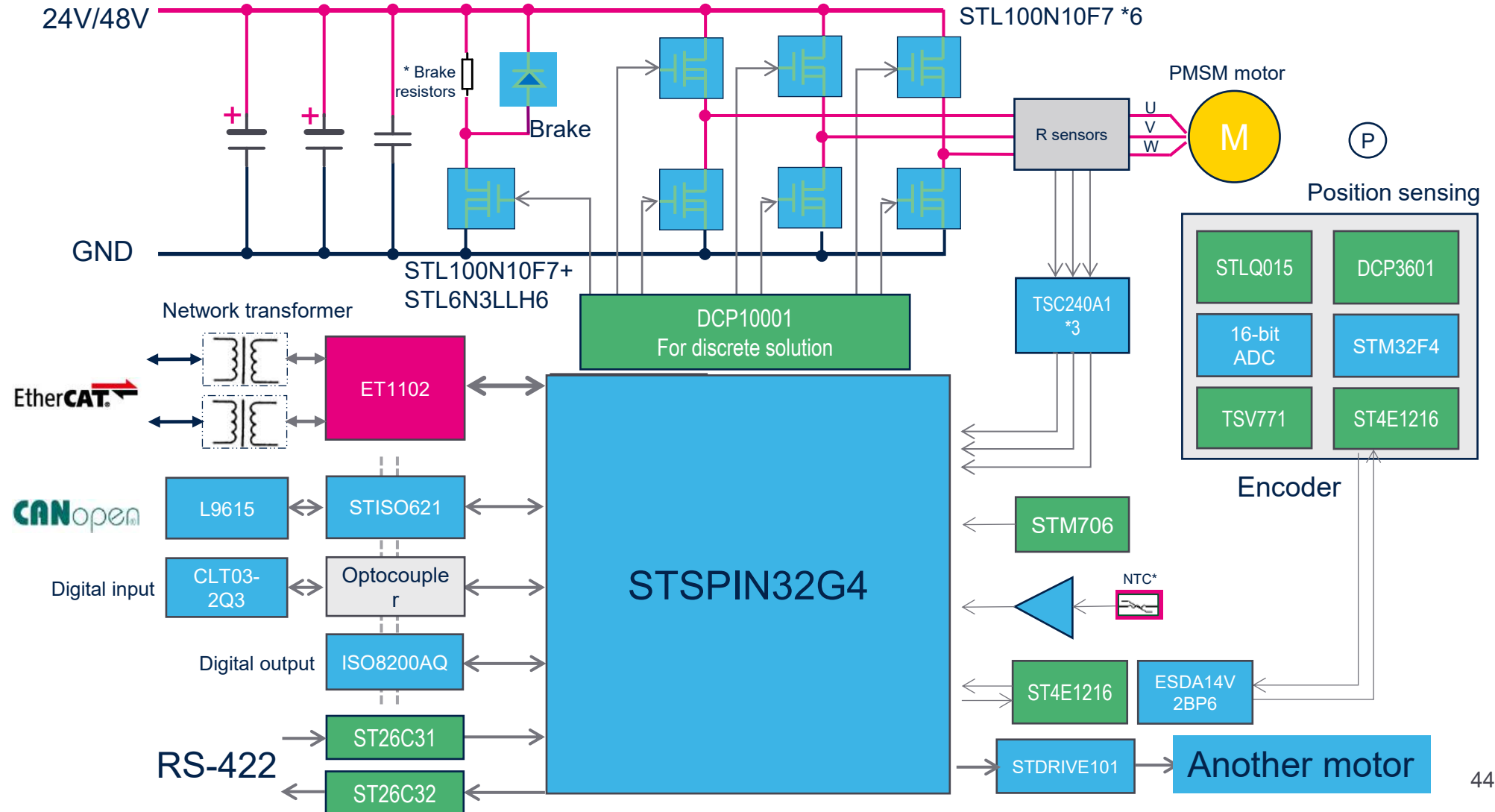
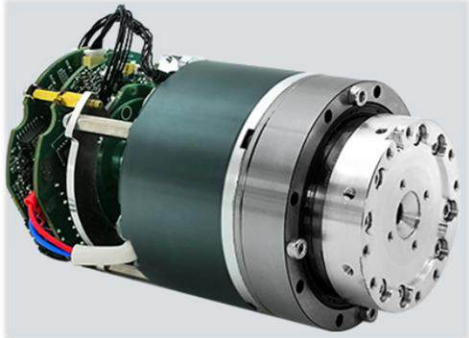
Eg: Joint module
 $12+12+2+2=28$





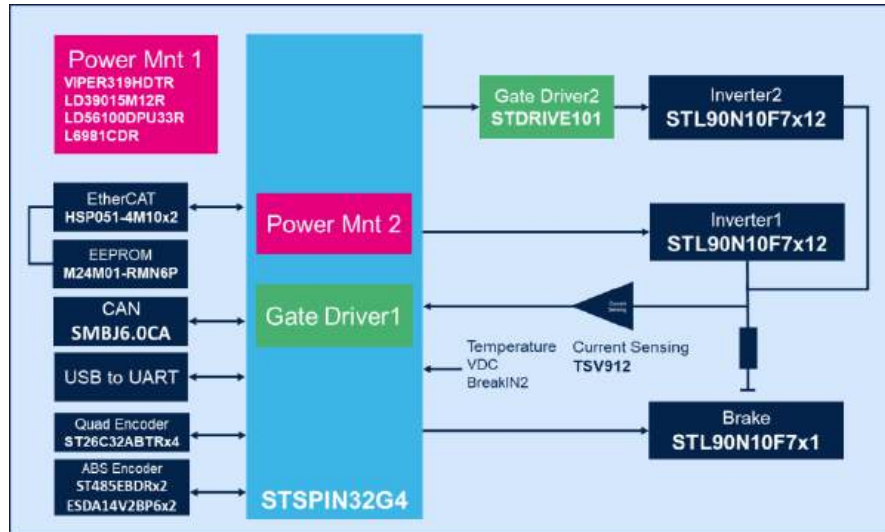
Servo driver in co-robot

Co-robot demo system: robot arm





STSPIN32G4 Dual Drive Solution V2



Specs:

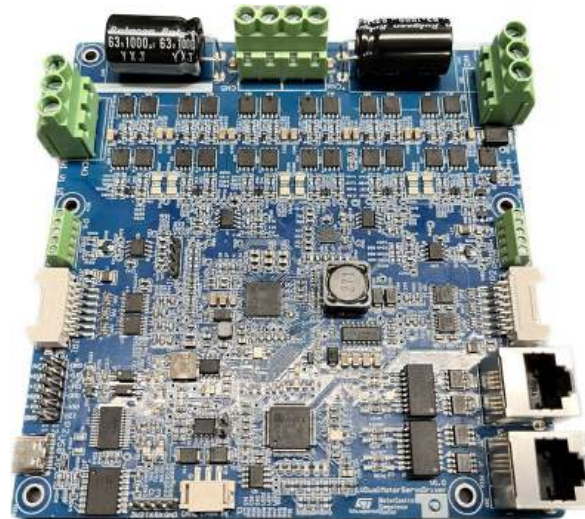
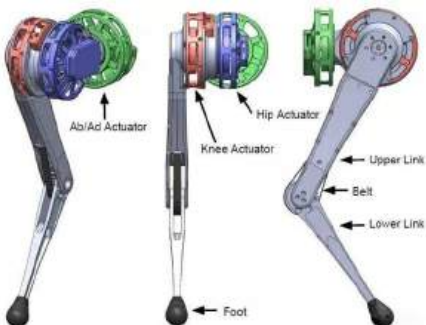
- 130x130mm dimension
- 1000W output power each
- 20 ~ 60VDC supply, 20Arms rating, 50A peak

Features:

- Shared current sensing network
- 2 Switches in parallel per switch arm
- EtherCAT or CAN Onboard
- RS232 Onboard
- Multiple selectable configuration:
 - Dual differential ABZ+Hall encoder
 - Dual ABS encoder
 - Isolated digital output x2
 - Isolated digital input x2

Applications:

- Robotic, AGV or other position control applications

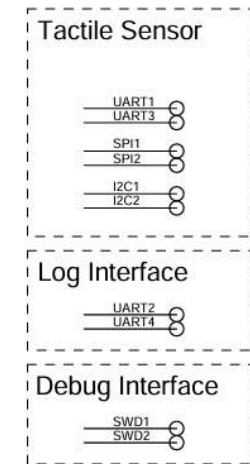
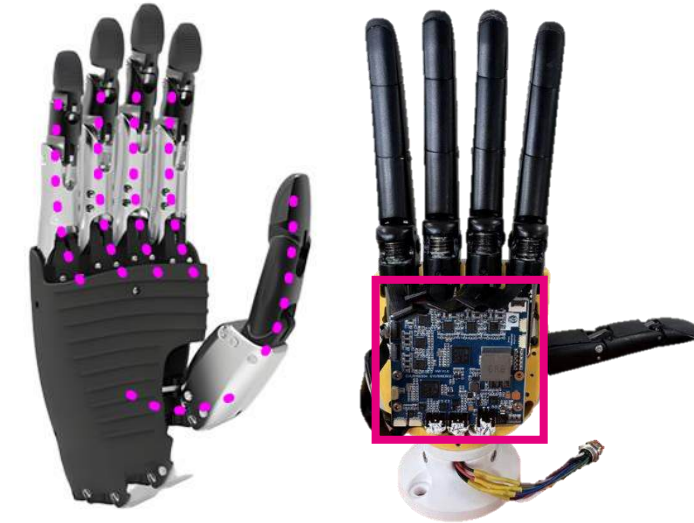
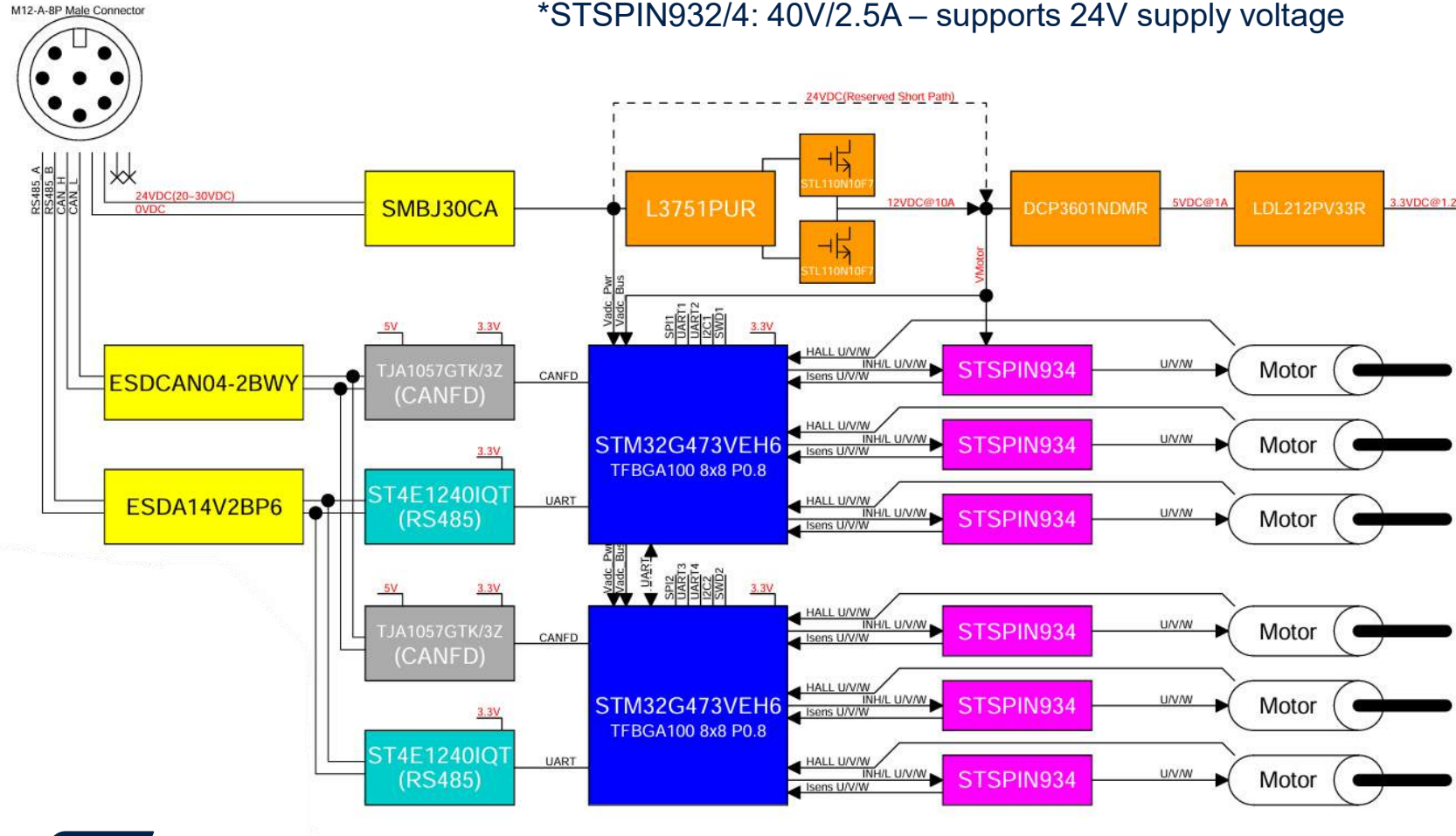




Robotic Hand : Full System Reference Design

6-Servo Robotic Hand: Reference Design (mecha platform in dev't with partner)

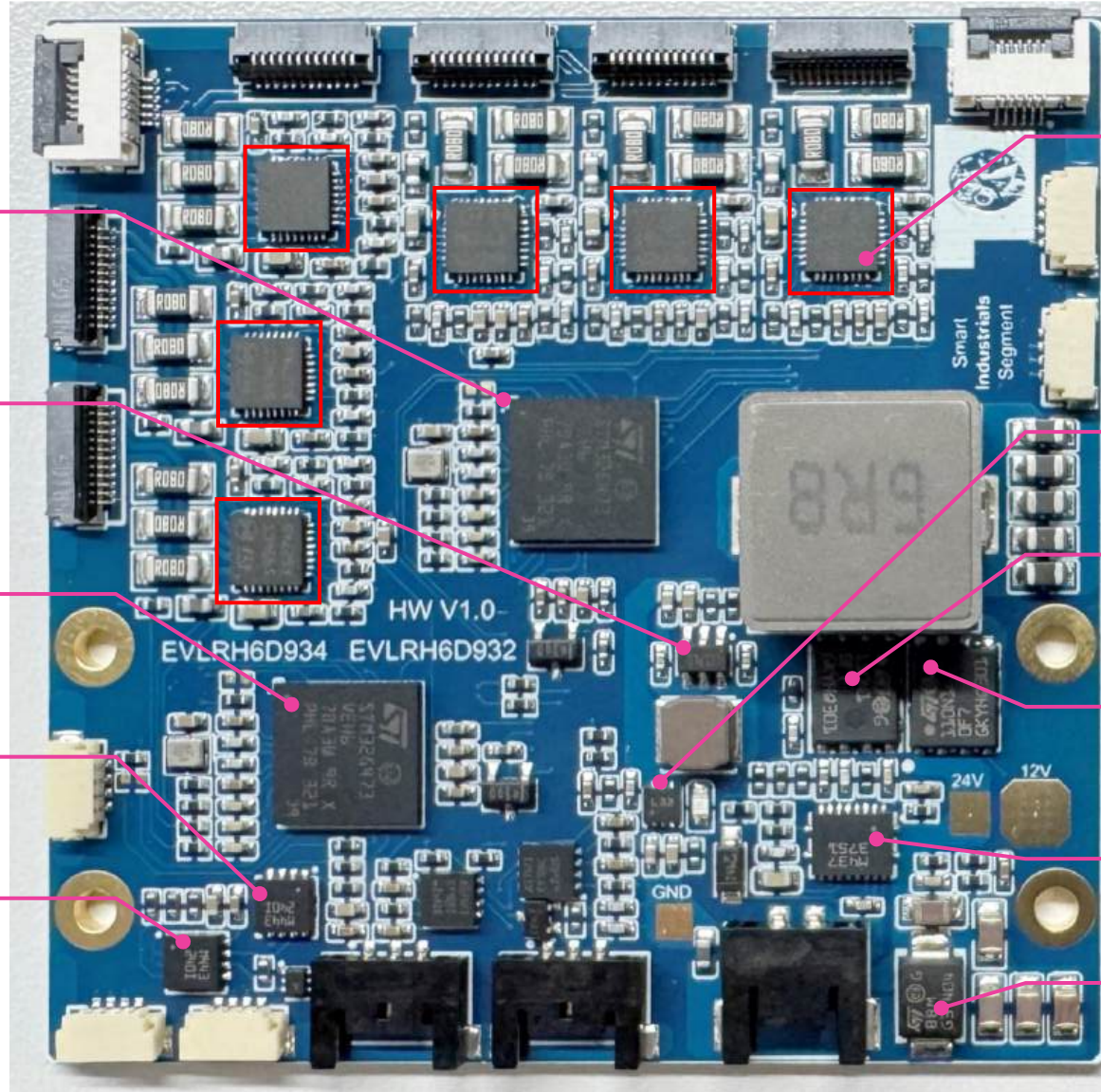
*STSPIN932/4: 40V/2.5A – supports 24V supply voltage



*Orderable NO# from RUIYAN: RY-H2R-0611-C0-ST-00 (Right hand) , RY-H2L-0611-C0-ST-00 (Left hand)



6-Joint Robotic Hand Solution PCBA



STM32G473VEH6

DCP3601NDR

STM32G473VEH6

ST4E1240IQT

ST4E1240IQT

STSPIN830/93
x * 6

LDL212PV33R

STL110N10F7

STL110N10F7

L3751PUR

SMBJ30CA

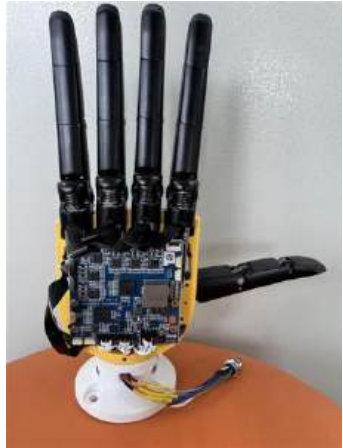
6-Joint Robotic
Hand Solution



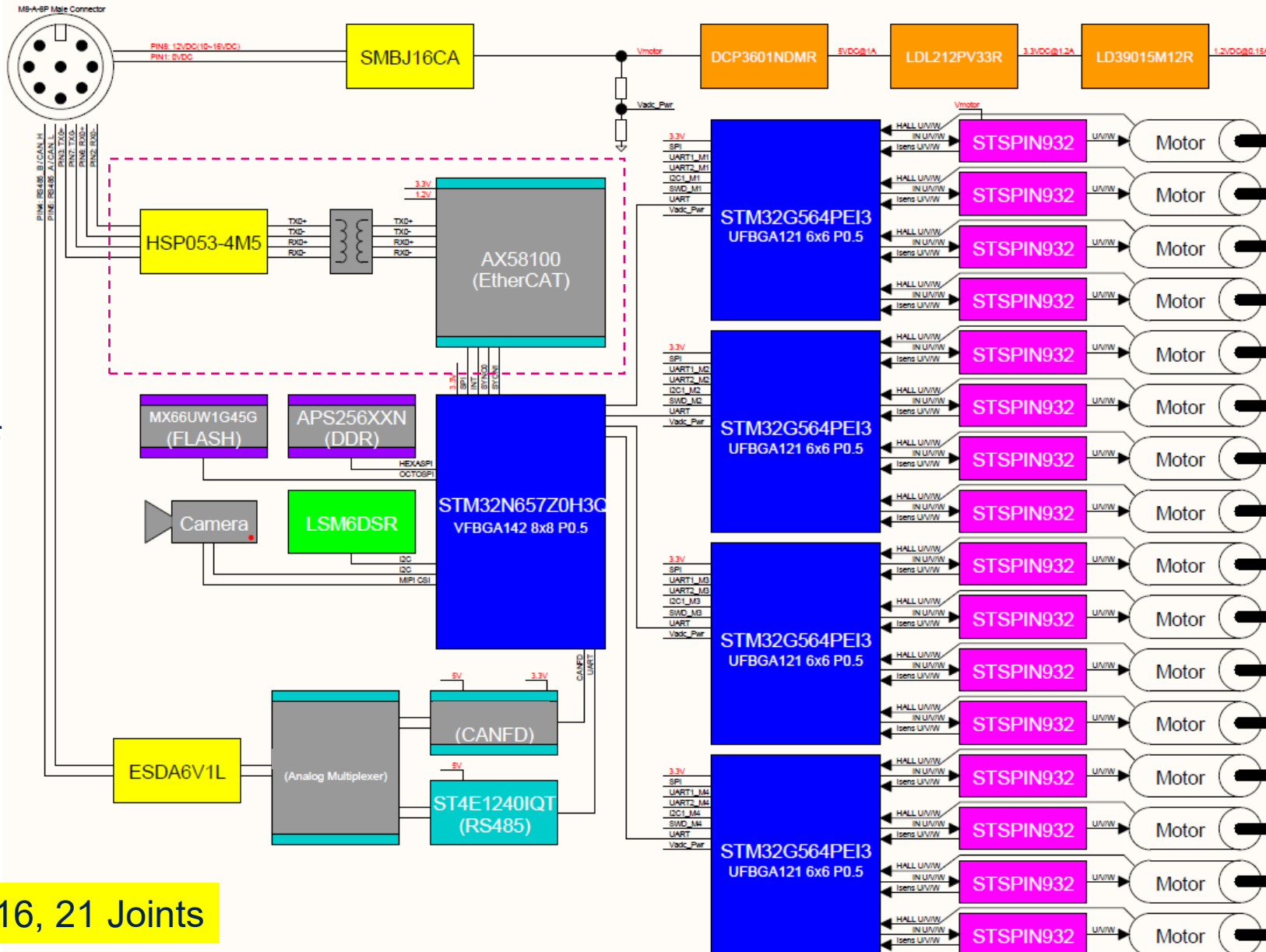
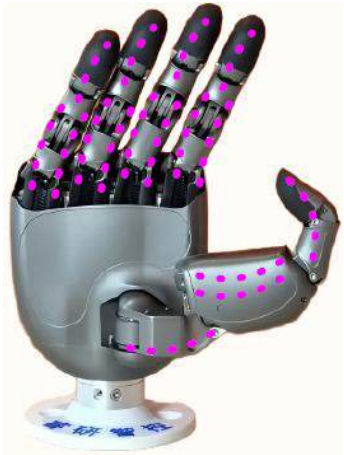


Robotic Hand

Starting Point: Hand module



From 6-DOF to 16-DOF



24VDC

15 / 16 Joint

IMU

STM32N6

Camera Module

EtherCAT

CAN FD

RS-485

6, 15, 16, 21 Joints

Discrete MCU+STDRIVE+GaN

100VDC MAX

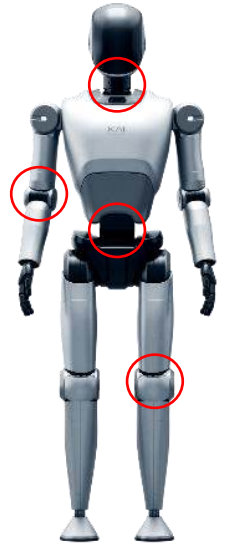
800-1000W

DC/DC

100VDC max → DCP10001Y → 5V

5V → LD39100 PU33R → 3.3V

3.3V → LD39015 M12R → 1.2V



Dual Encoder

OP-Amp

Current Sensing

TSC2020

VM

Current Sensing

TSC2020 * 3pcs

1~3 Shunt Current

ADC

ADC

PWM

GPIO

STM32G564RET6

Current Loop

Speed Loop

Position Loop

UART

CAN

UART

SPI

I2C

CAN OPEN

ESDCAN03-2BWY

CAN FD Transceiver

RS-485 / Modbus

ESDA14V2 BP6

ST4E1240IQT

EtherCAT

HSP053-4M5 *2

AX58100

M24C16-RMN6P

IMU

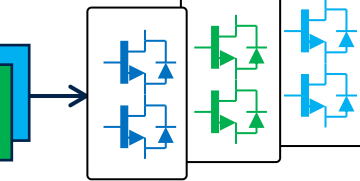
ISM330 DHCXTR

STDRIVE G210/1/2

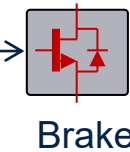
GaN Drivers

Gate Driver

PM8841D



Discrete LV GaN *6pcs
SGT1D5R10MEA



Brake

GaN: SGT1D5R10MEA
MOSFET: STL125N10LF8AG

ST4E1240 IQT *4pcs

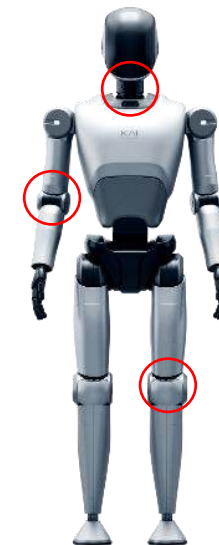
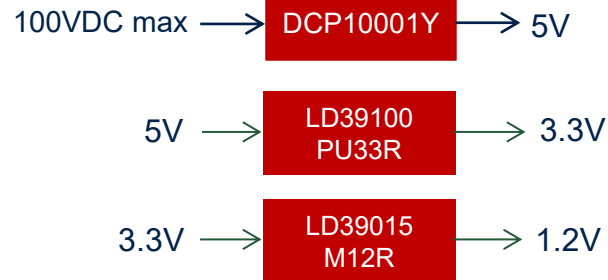
ESDA14V2 BP6 *2

TOMOGAWA or Biss-C Encoder Interface

100VDC MAX

200W

MCU+ Integrated STDRIVE+GaN



Dual Encoder

OP-Amp

Current Sensing

TSC2020

VM

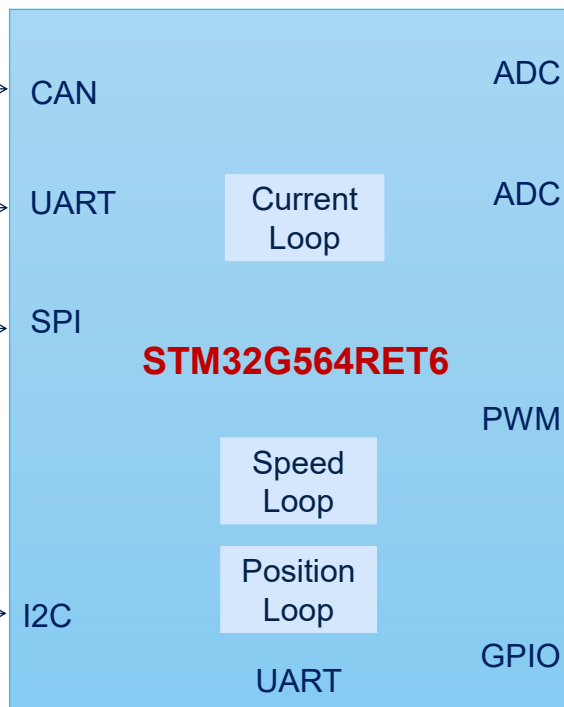
Current Sensing

TSC2020 * 3pcs

1~3 Shunt Current

ADC

ADC



PWM

GaN Driver

GaNSPIN1100 *3pcs

U,V,W

Gate Driver

PM8841D

Brake

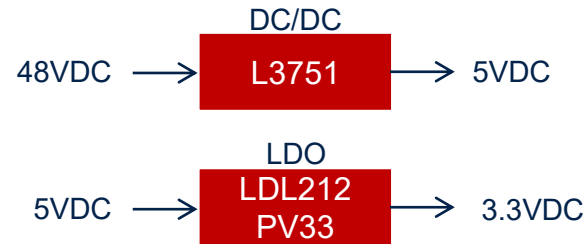
GaN: SGT1D5R10MEA
MOSFET: STL125N10LF8AG

ST4E1240
IQT *4pcs

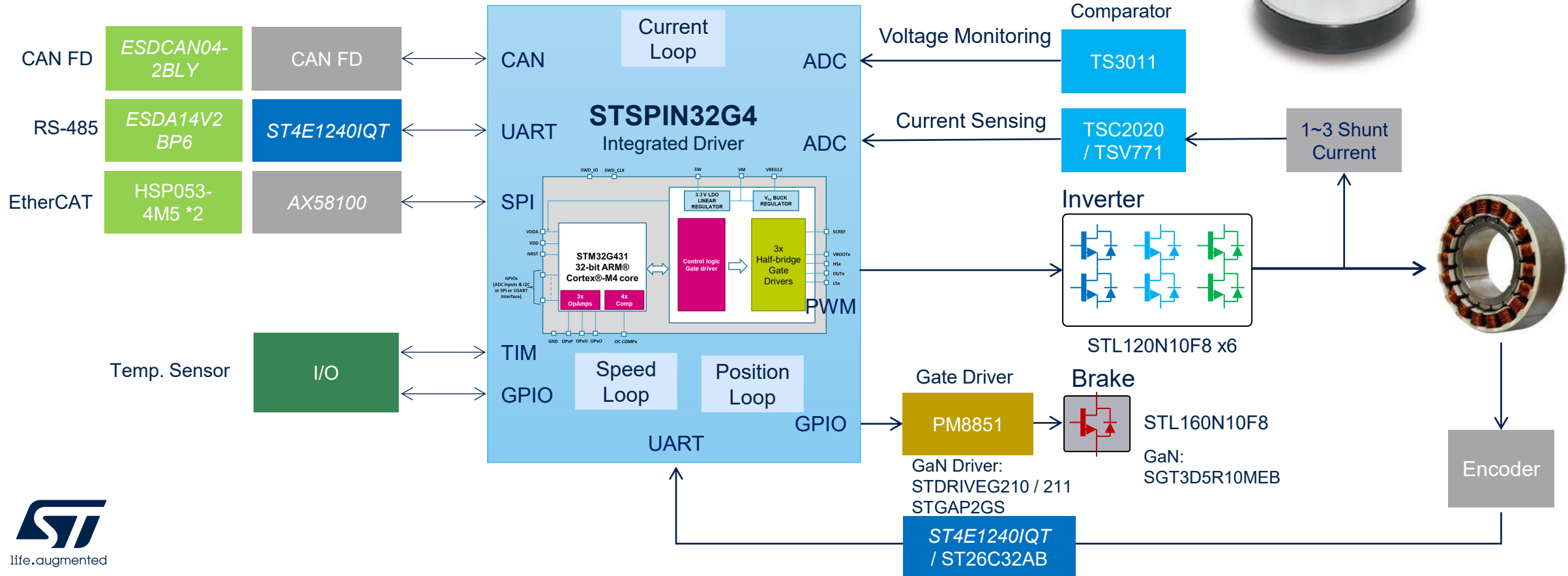
ESDA14V2
BP6 *2

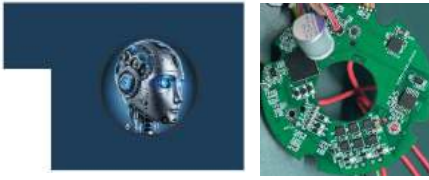
TOMOGAWA or Biss-C Encoder Interface

Integrated MCU&Driver+MOSFET



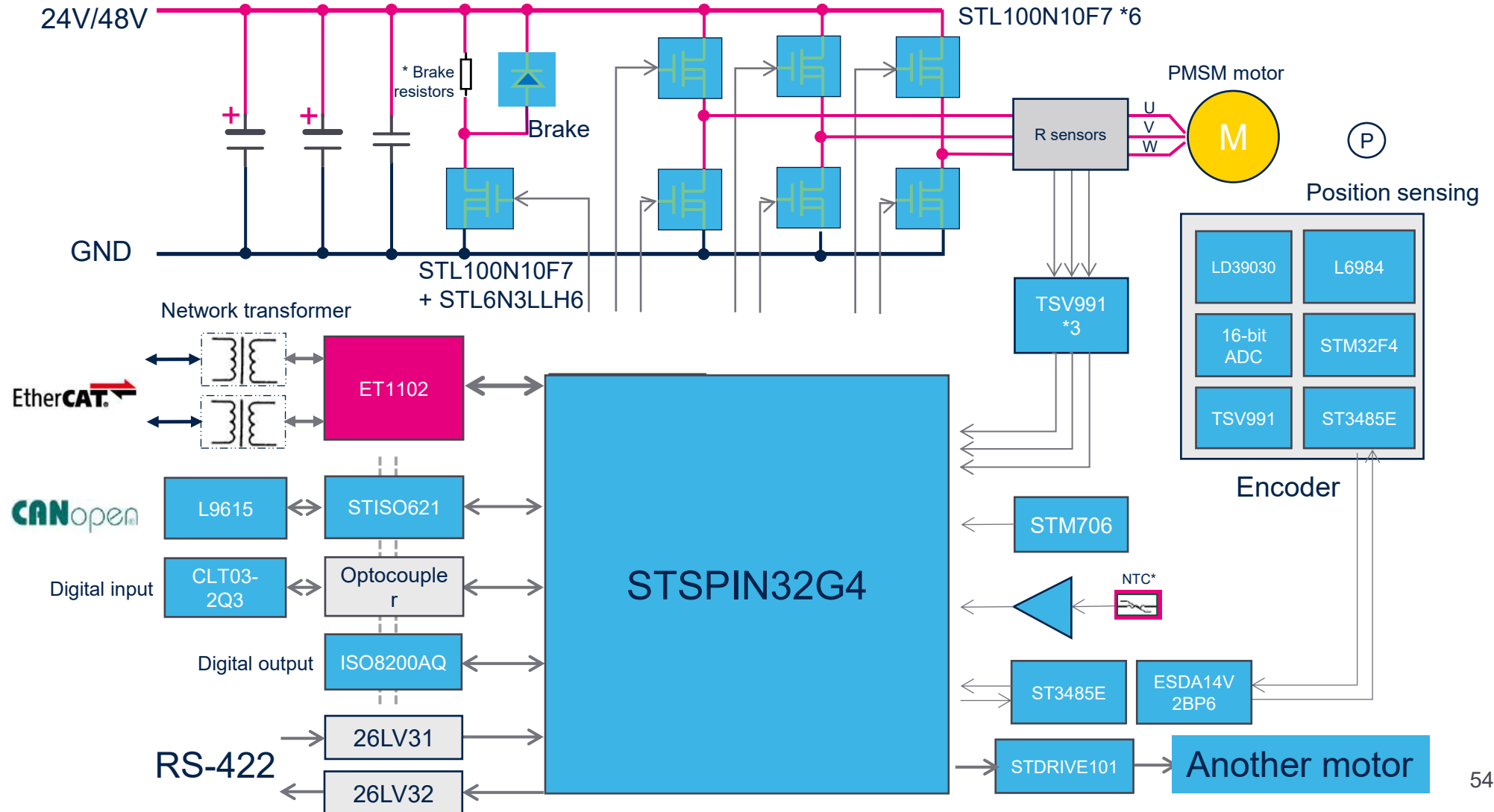
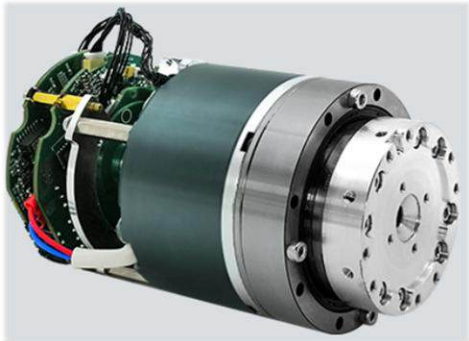
75VDC MAX





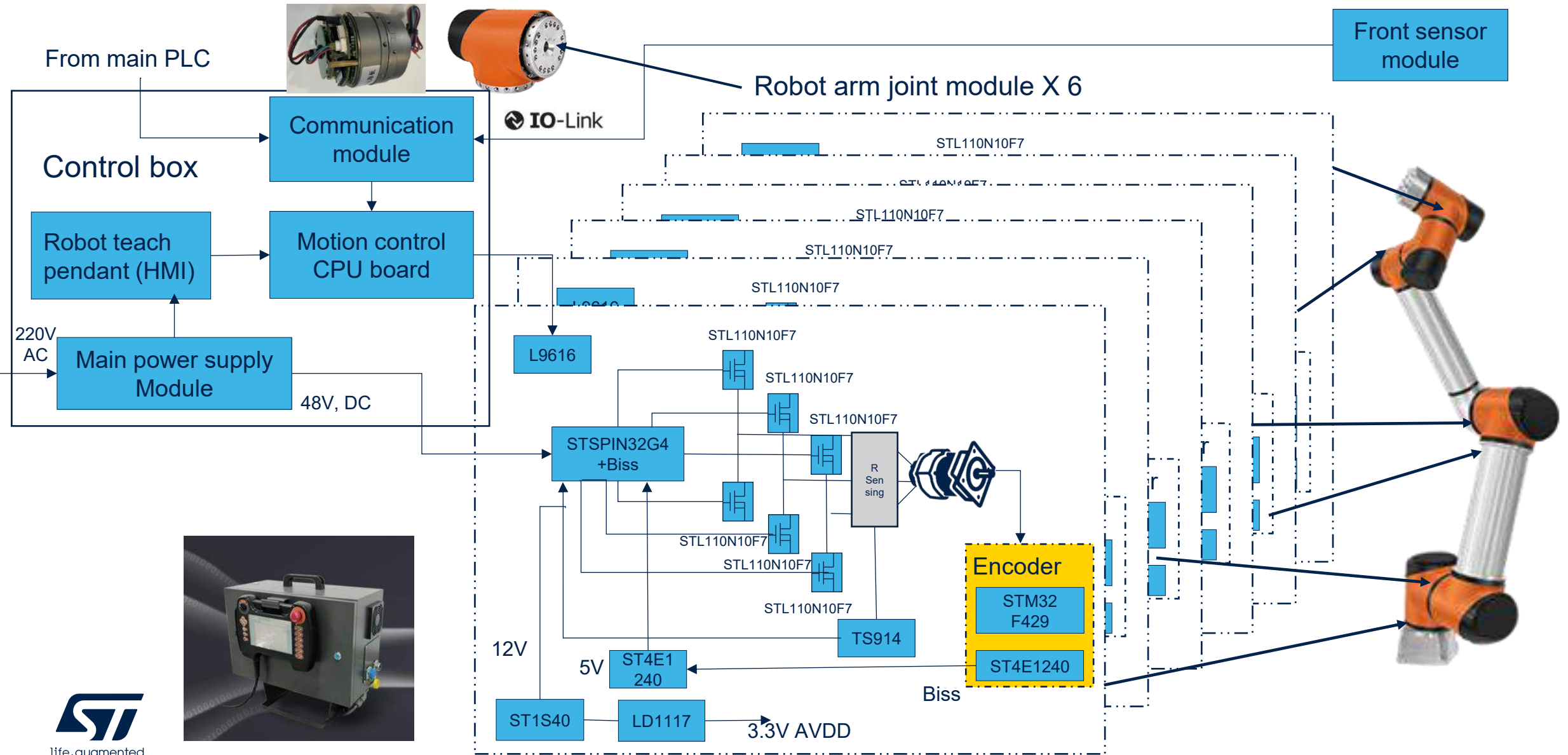
Servo driver in robotic arm

Co-robot demo system: robot arm



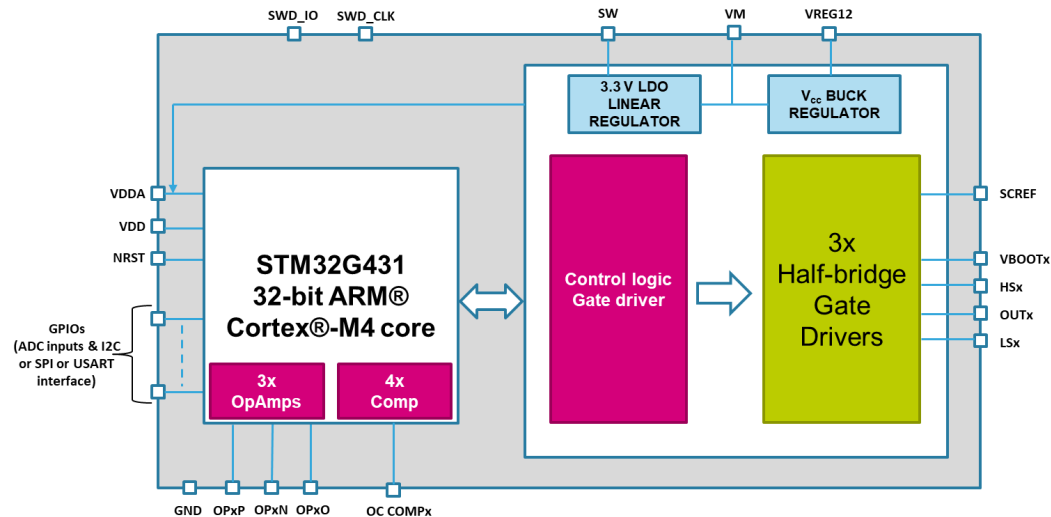


Joint servo module solution for robot arm



STSPIN32G4

Advanced 75V 3-phase BLDC Driver with embedded Cortex M4 STM32 MCU



KEY APPLICATIONS:

- Industrial automation & Robotics
- Battery powered Home Appliances
- Power tools
- Drones and aeromodelling
- Fans and pumps



Key Features

- **STM32 Cortex M4 + 3-phase Driver**
- **Fully compatible with STM32 ecosystem**
- **6step & FOC sensorless / sensed algorithms**
- **V_{cc} (200mA) Buck & 3.3V (150mA) Linear reg**
- VS = 5.5V – 75 V, I = 1A driving capability
- 170 MHz, 128k Flash & 32k SRAM
- 2x 16 bit ADCs & 4x 12 bit DAC channels
- I2C / UART / SPI / CAN; **up to 40GPIOs**
- **Low-power in stand-by**
- **MOSFET V_{DS} Monitoring protection**
- Up to 4x Comparators & 3x OpAmps
- Fully protected (UVLO, Short-circuit, OCP)
- Fully configurable thru I2C
- 9x9 QFN package

STSPIN32G4 Preview

57

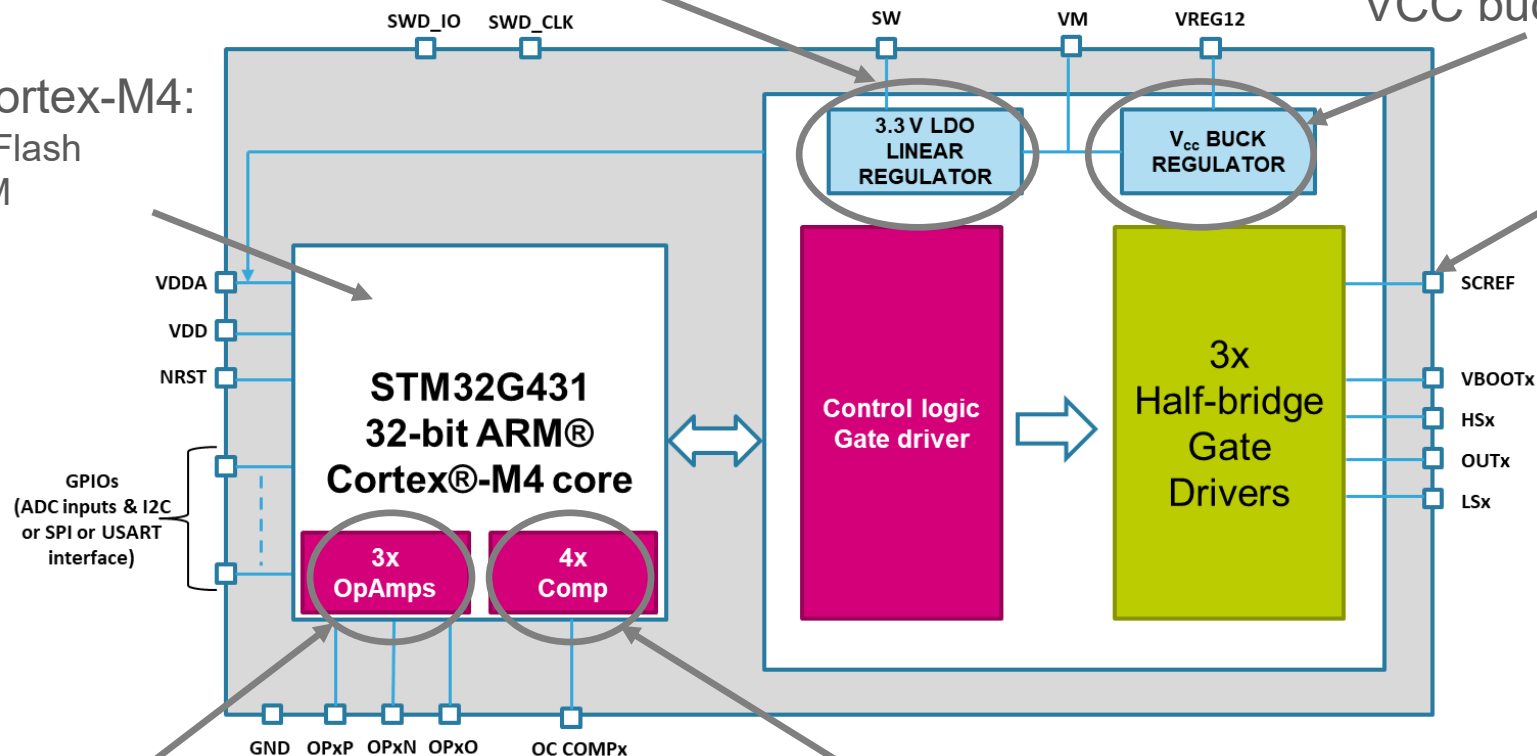
Advanced 75V 3-phase BLDC Driver with embedded Cortex M4 STM32 MCU

3.3 V LDO linear regulator up to 150 mA / 0.5 W

VCC buck converter up to 200 mA

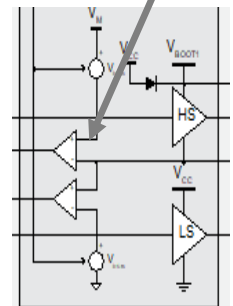
Mainstream Arm Cortex-M4:

- 128 Kbytes of Flash
- 32 Kbytes RAM
- 170 MHz CPU
- 4x USART
- timers
- ADC
- DAC
- comm. I/F
- 1.7-3.6V



Desat (SCREF) pin:
Ref V (0.2V-2.5V) for
embedded short-circuit
protection which monitors
external MOS V_{DS} :

$$V_{DSth} = V_{SCREF}$$



3x rail-to-rail operational amplifiers

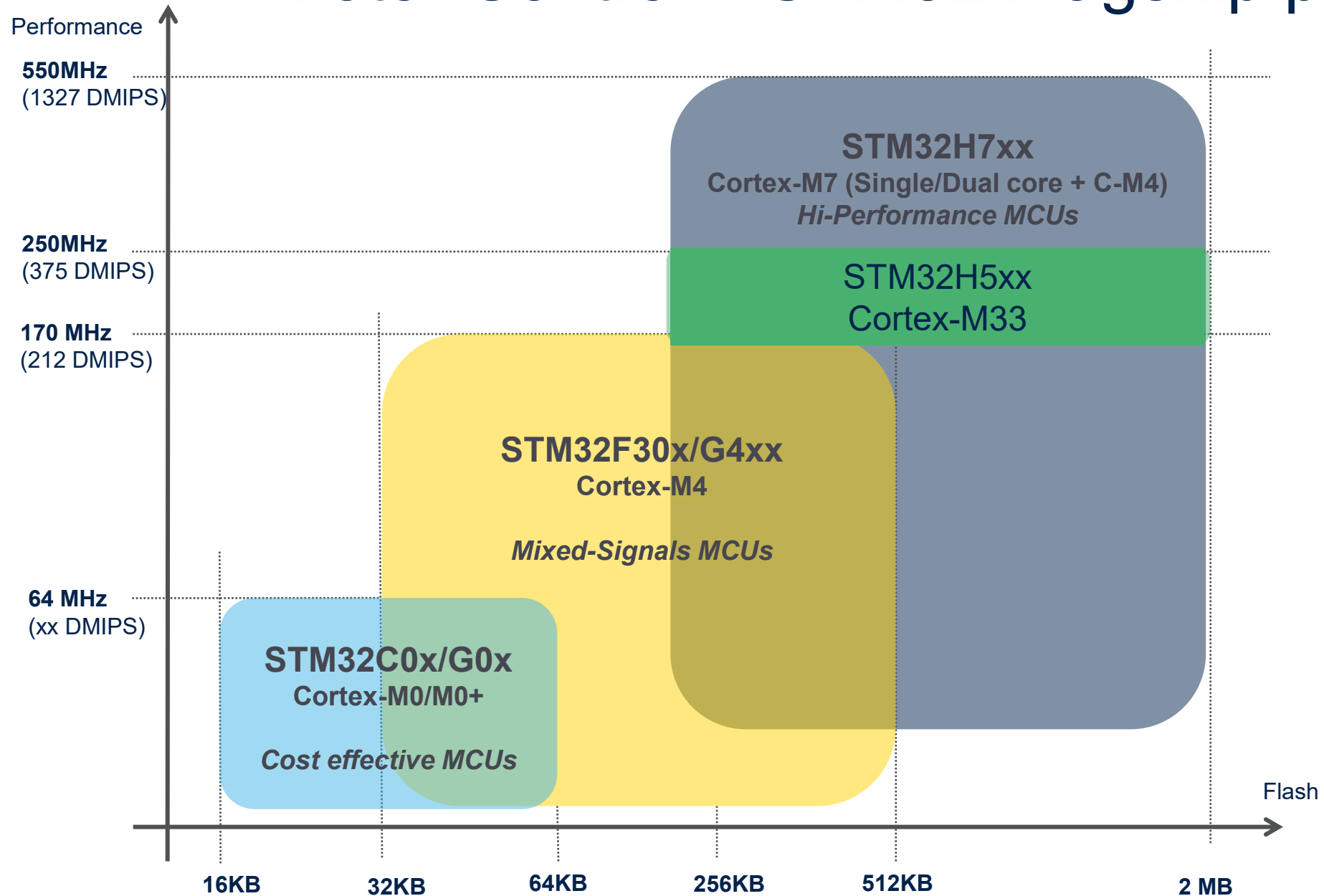
15 MHz bandwidth

Rail-to-rail input/output

PGA (2, 4, 8, 16, 32, 64, -1, -3, -7, -15, -31 or -63)

4x fast comparators ($t_D < 35$ nS)

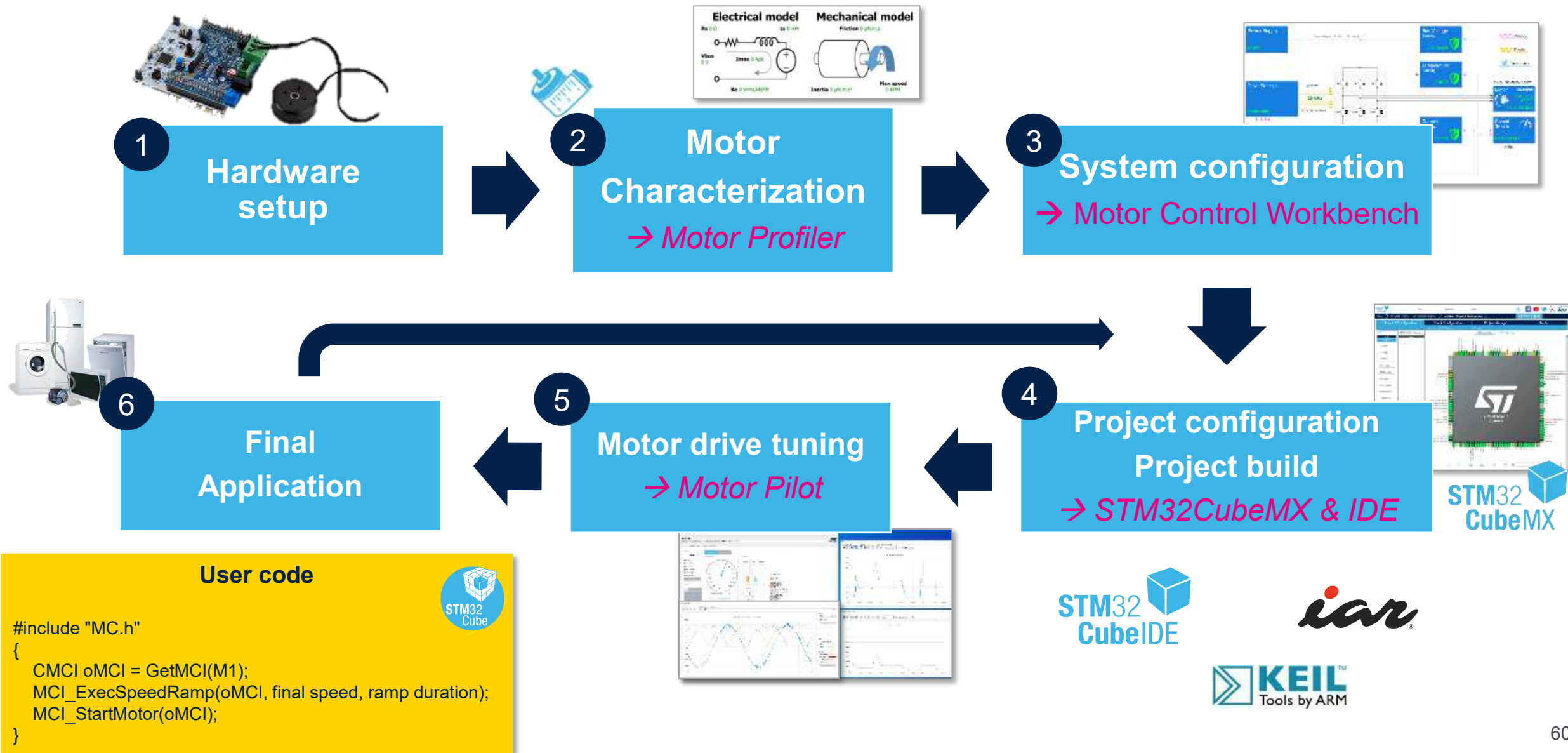
Motor Control – STM32 Flagship products



MC SDK Functions

STM32	STM32 F0	STM32 F1	STM32 F3	STM32 F4	STM32 F7	STM32 L4	STM32 G0	STM32 G4	STM32 H7	STM32 H5	STM32 C0
Single FOC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dual FOC		✓	✓	✓				✓	✓	✓	
1 & 3 Shunt	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
ICS		✓	✓	✓	✓			✓	✓	✓	
Hall Sensor	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Encoder	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sensorless	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
OCP/OVP/UVP	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Feed Forward	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Flux Weaken	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MTPA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Position(Encoder)		✓	✓	✓	✓	✓		✓	✓	✓	

From hardware to final motor control application



Connectivity





Wireless Motor Diver

Ultra-high bandwidth, ultra-low power consumption, close range, point-to-point based on 60GHz RF transceiver



60GHz Contactless connection

- -40,+105°C
- BGA 2.2x2.2 mm²
- 44 mW Tx, 27 mW Rx
- 3.5uW in Sleep

Contactless connectivity up to 6.25 Gbps

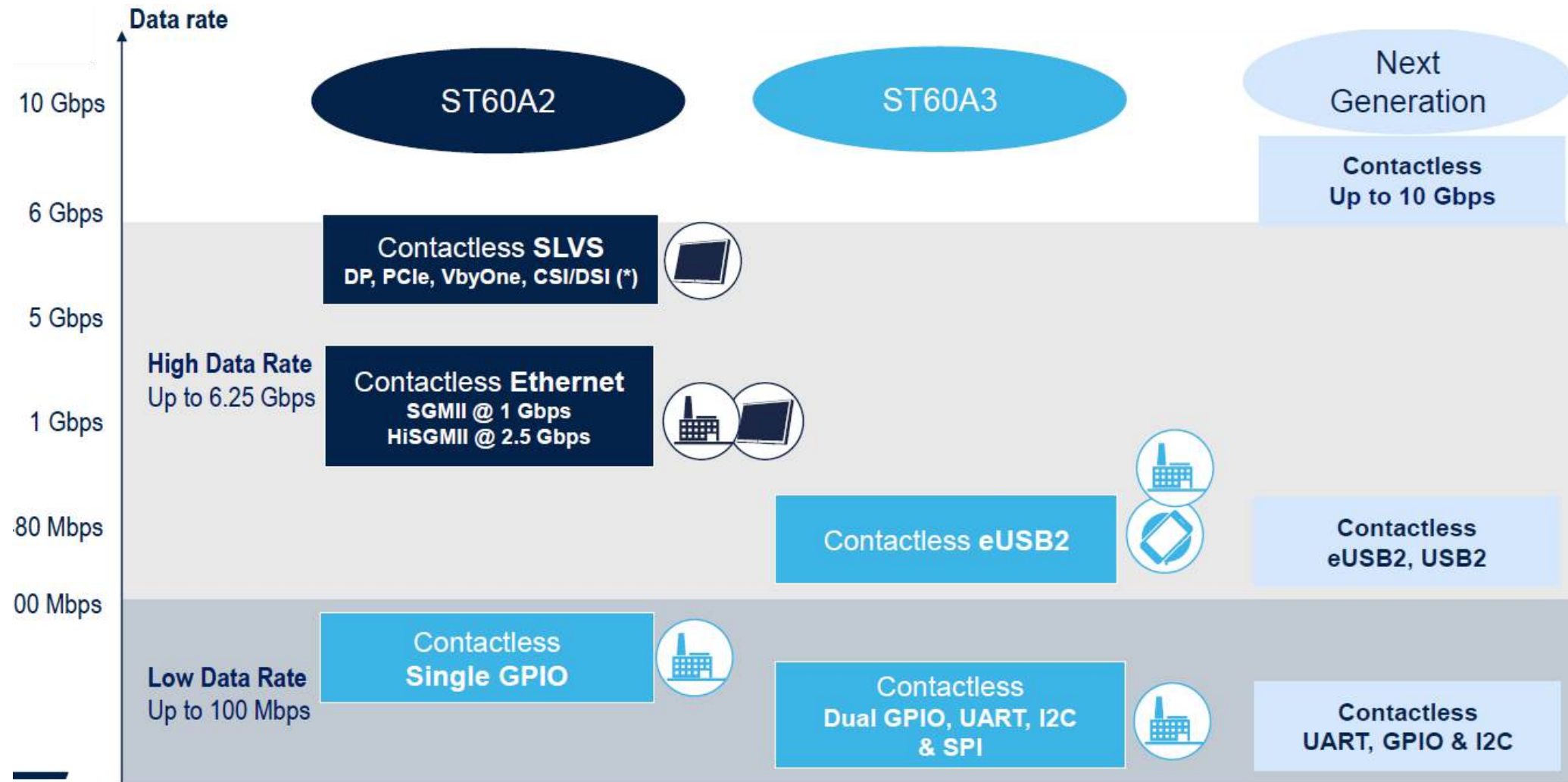
Industrial-grade temperature range

Flexible antenna configuration

Cost-optimized bill of materials and small space size



ST60 Products





ST60 short range connectivity

Compact solution integrating full 60 GHz RF transceiver
Enabling wireless data connectivity across Robot Joints

Product example:
RoProxCon® by Rosenberger



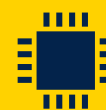
BGA 2.2 x 2.2 mm²



Contactless gigabit Ethernet bridge (SLVS/HDR)



Up to 6.25 Gbps contactless connectivity



Cost optimized BOM & miniature footprint
Flexible antenna configurations



Ultralow power – 55 mW Tx, 30 mW Rx*

(*) Typical power consumption in FDR 3.125 Gbps with dual power supply



Industrial temperature range [-40 , +105°C]

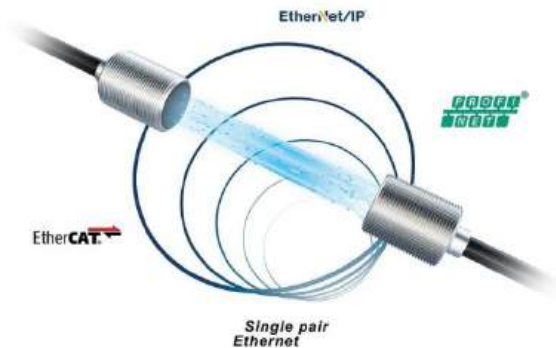
Contactless Data(ST60) & power transmission

Rosenberger Proximity Connectors (RoProxCon)

Rosenberger



- Products that benefit from contactless technology are becoming increasingly popular
- Contactless transmission opens up a variety of new applications



- Smart Factory
- Medical Technology
- Safety
- Connected Devices
- Intelligent Home
- Office Equipment
- Conveyor Technology
- Renewable Energy

Wired connectivity

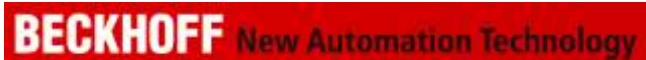
ST products enabled

Real-time Ethernet (IEEE1588) support

TSN supported on STM32MP2x family

CAN supported on processing ICs and at physical level

RTE / EtherCAT – Our partners



Application solutions

STEVAL-ETH001V1



700 W / 48 V servo drive

Position control with FOC algorithm

Hall sensor interface

RTE / EtherCAT stack by Hilscher

RS-485 physical layer

STEVAL-CTM022A1



1 kW dual motor solution

48 V servo drive

Position control with FOC algorithm

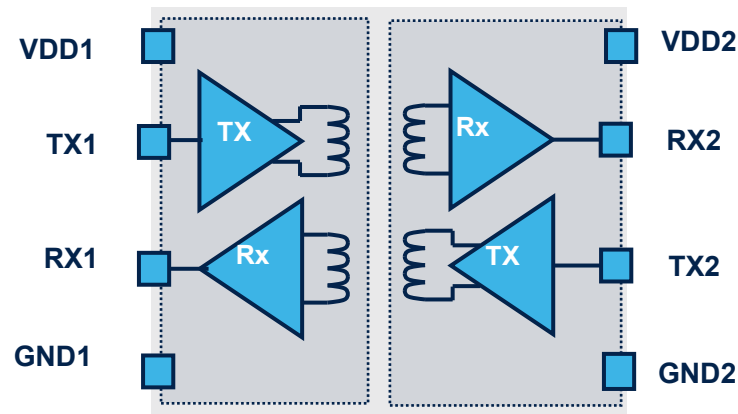
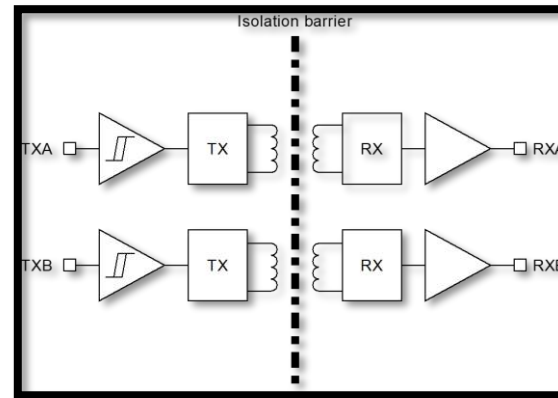
Hall sensor interface

RTE communication supporting CoE stack

CAN physical layer

Digital isolator STISO620 & STISO621 / STIO621W

Robust 6 kV galvanic dual-channel 2/0 and 1/1 digital isolator



Low PCB area and high flexibility
(2-0 and 1-1 channels integrated)

Very fast data communication
(Common-mode transient > 50 kV / μ s and data rate up to 100 Mbps)

Data transfer robustness
(Pulse width distortions < 3 ns)

Final application standard compliancy
(UL1577 recognition)

Higher robustness, reliability, and lifetime
than opto-isolators



SO-8W

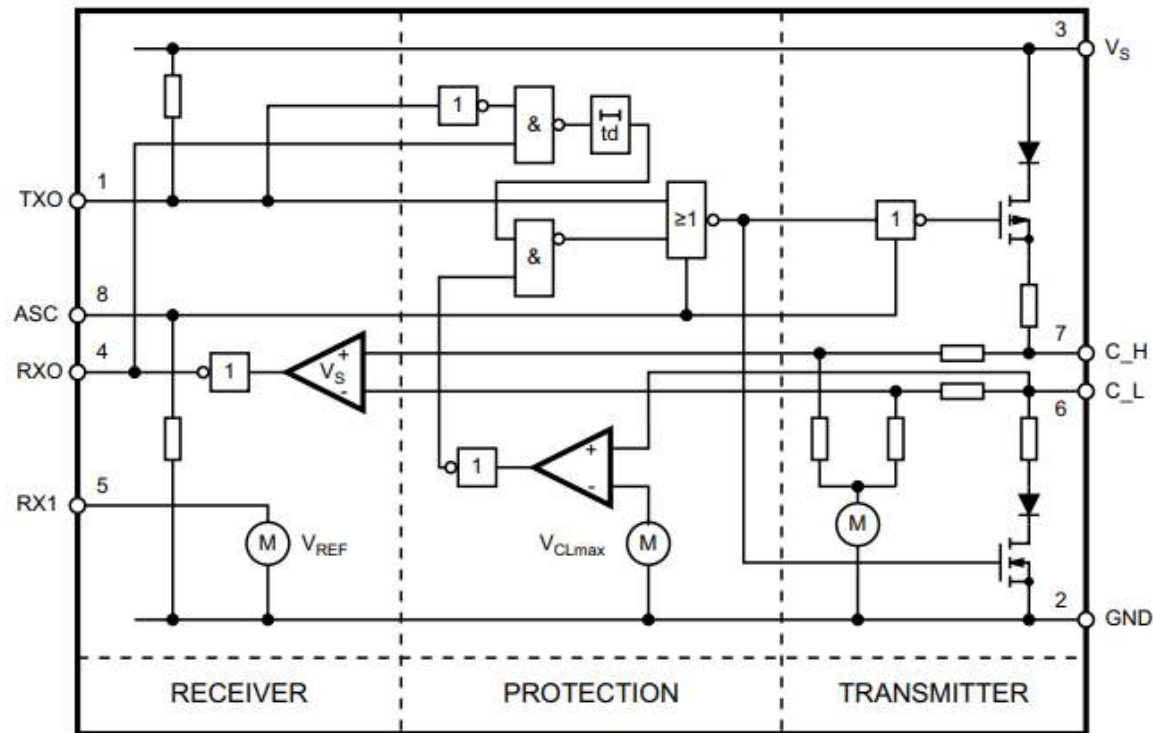


SO8N



L9615/16 high speed CAN bus transceiver

Up to 1 Mbaud CAN bus interface with embedded short-circuit and electrical transient protection



Key features

- AEC-Q100 qualified
- ISO/DIS 11898 up to 1 Mbaud
- 10 ms max. delay to prevent destruction and high current consumption

Transmitter

- Differential output signals
- From -5 V to 36 V short circuit protection, detection and shutdown
- Slope control to reduce RFI and EMI
- Two states adjustable slope control (≤ 1 Mbaud / ≤ 250 Kbaud)

Receiver

- Differential input with high interference suppression
- Common-mode input voltage range (VCOM) from -2 V to $V_S + 3$ V
- ESD protection level up to 4 kV



STM32 portfolio for 2.4 GHz connectivity

STM32WB series



MCUs

STM32WB55

STM32WB35

STM32WB15

STM32WB50

STM32WB30

STM32WB10

Modules

STM32WB5M

STM32WB1M

STM32WBA series



amazon sidewalk

MCUs

STM32WBA54/55

STM32WBA63/64/65

STM32WBA52

STM32WBA62

BlueNRG series



System
on Chips

BlueNRG-1

BlueNRG-2/2N

Module

BlueNRG-M2SP/SA

STM32WB0 series



MCUs

BlueNRG-LPS >>>

STM32WB05xZ

BlueNRG-LP >>>

STM32WB06 / STM32WB07

STM32WB09

Network
coprocessor

STM32WB05xN

STM32WB1M module

Small form factor

6.5 x 10 mm

Everything inside (antenna, crystals...)

Option: internal or external antenna

Extended battery life

DC-DC configuration

Standby ultralow power mode while radio activities

Reduced cost

Down to 2 PCB layers

Everything inside (single cap outside)

Free radio stack

Certifications FCC, CE, NCC, JRF, KC, SRRC, ISCED



Bluetooth® LE

Proprietary 2.4 GHz



Rich feature set

Dual core* based

320 Kbytes flash / 48 Kbytes RAM

ADC, COMP, TSC

Security

OTA (application, radio)

*Dual Core: One core dedicated to Radio and protocols stack and One core dedicated for application

Connectivity expansion board

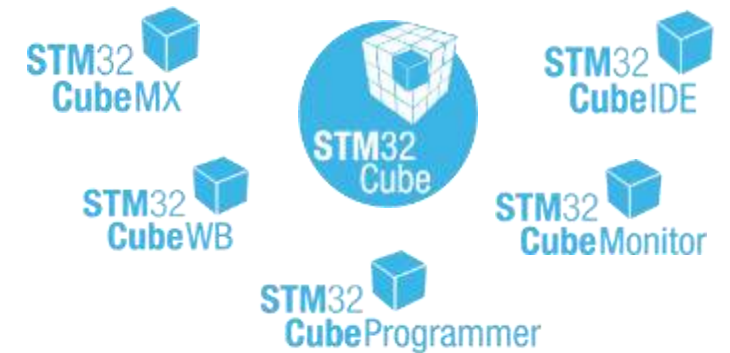


STM32WB1 module

B-WB1M-WPAN1

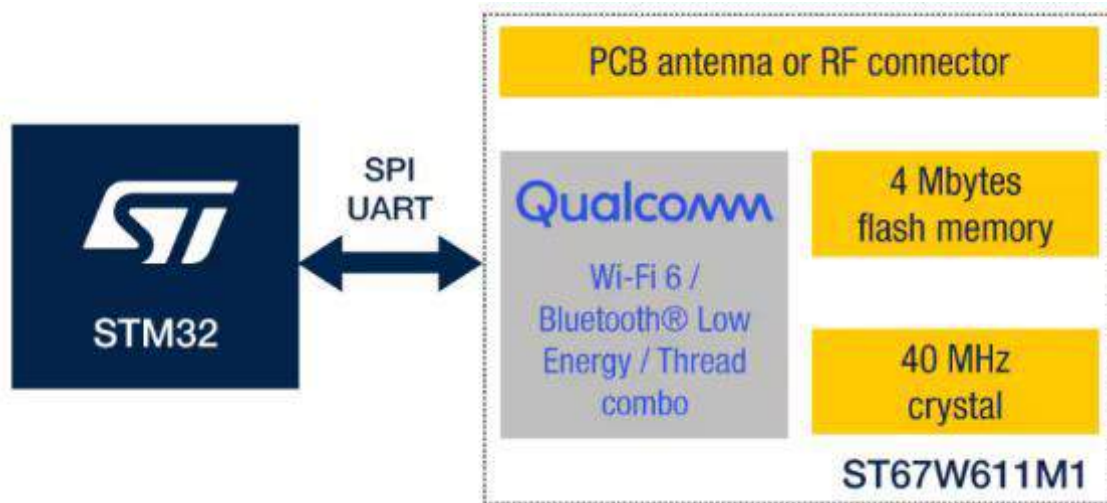
SMA connector not assembled by default

STM32 ecosystem



ST67W611M1: Wi-Fi 6 network coprocessor modules

Wi-Fi 6 / Bluetooth® LE 5.3 / Thread combo
Supports Matter protocol over Wi-Fi for future-proof



Connectivity

- Up to 20 dBm output power
- MCS9, HE20 / HE40
- 2 Mbps for Bluetooth® LE

Integration

- Embedded 4 Mbytes of flash memory with OTA capability
- Embedded 40 MHz crystal
- Antenna integration

Advanced hardware security

- Integrated hardware cryptographic acceleration
- Security services (secure boot, secure debug, and more)
- PSA Certified Level One

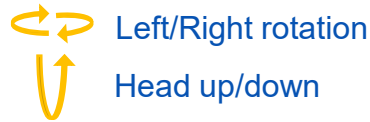
Robotics SSP Summary



Humanoid Robot System Block Diagram

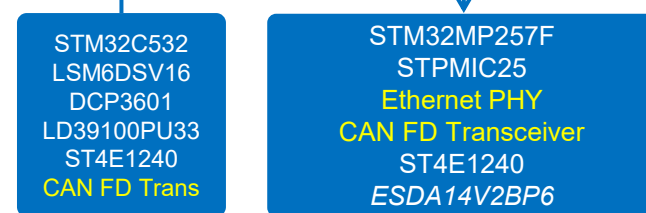
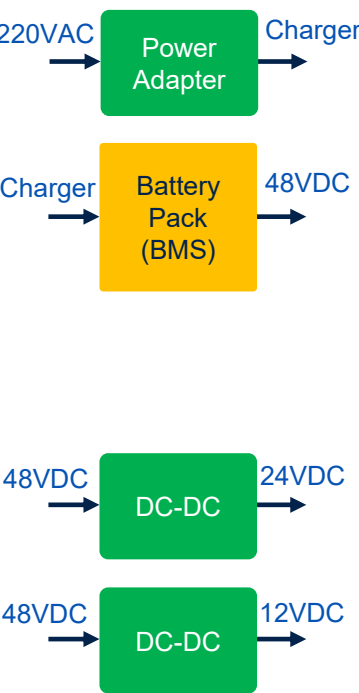
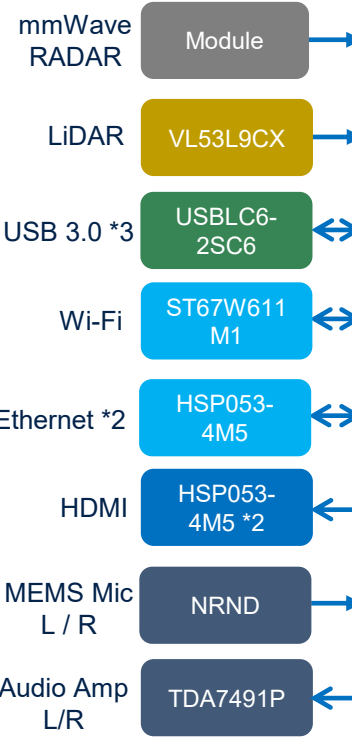
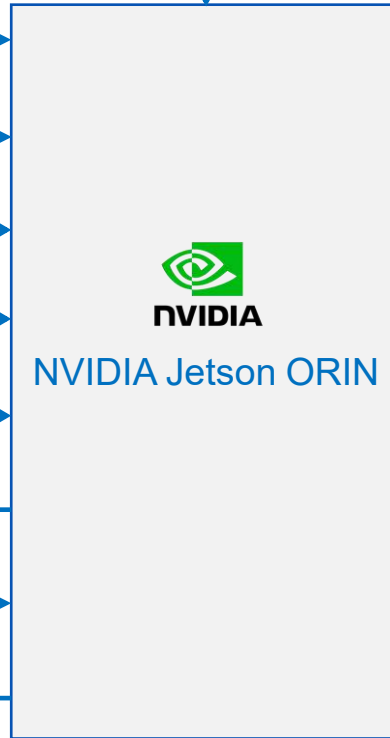


Stereo Depth Camera Module with HSB



IMU - LSM6DSV16X
dToF - VL53L9CX
Image - VB1940 *2pcs

Ethernet

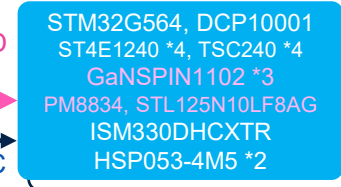


EtherCAT to CANFD 1

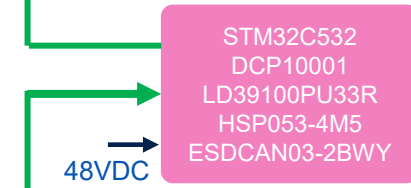
48VDC

CAN FD 1-2

48VDC



Joint Servo Motor
Head /Neck /Waist /Hips1-2

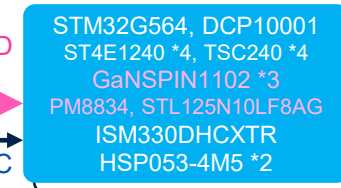


EtherCAT to CANFD 2

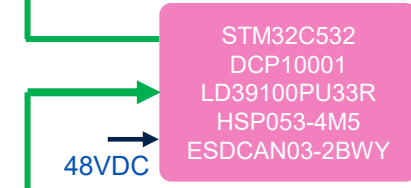
48VDC

CAN FD 3-4

48VDC



Joint Servo Motor
Arm L1-7 / R1-7

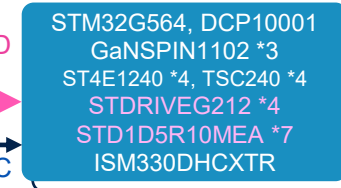


EtherCAT to CANFD 3

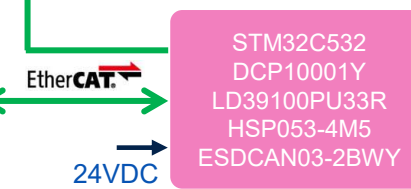
48VDC

CAN FD 5-6

48VDC



Joint Servo Motor
Leg L1-6 / R 1-6

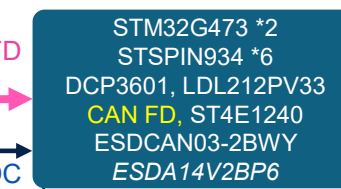


EtherCAT to CANFD 4

24VDC

CAN FD 7-8

24VDC



Robotic Hand 1-2





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