



Based on Dual-Core
Arm® Cortex®-M52 Architecture

G32R501 Real-Time MCU/DSP **& Solutions** in Mass Production

High-Performance Computing | Responsive Sensing | Precise Control



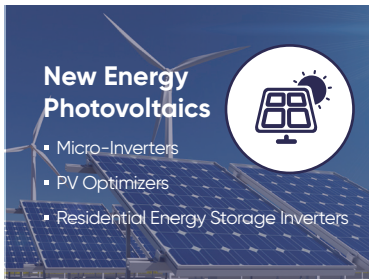
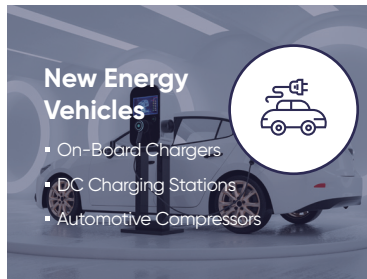
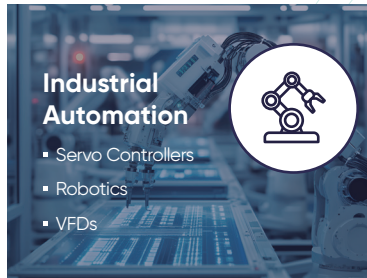
► Introduction

Born for Real-Time Control, Empowering Edge AI Applications



Driven by Industry 4.0, smart energy, and autonomous technologies, the demand for high-performance chips continues to grow. Real-time MCUs are increasingly vital, offering enhanced cores and peripherals that deliver fast, accurate signal acquisition, efficient computation, and robust closed-loop control, ensuring system stability, reliability, and improved energy efficiency.

Typical Applications



Higher Power Density



Higher Efficiency



Higher Accuracy



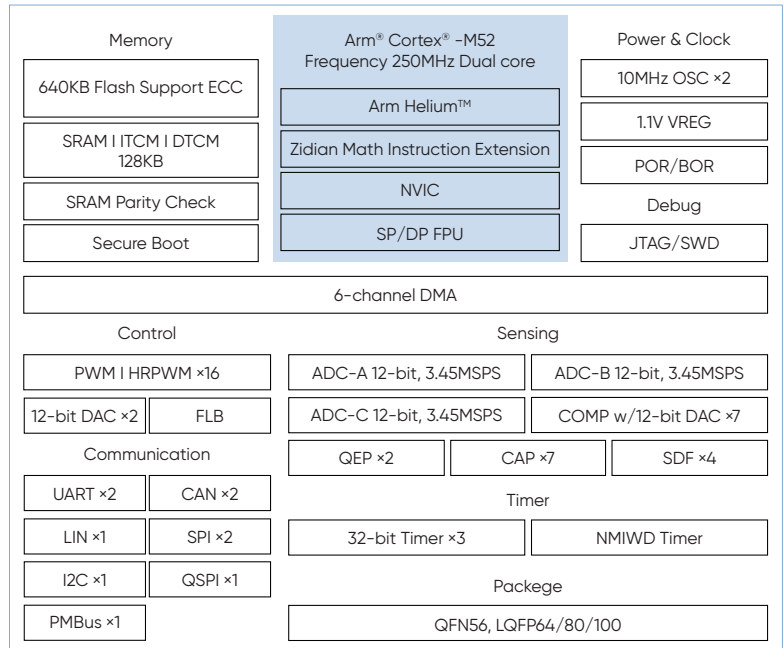
Higher Safety & Reliability

G32R501 Real-Time MCUs/DSPs



Addressing Real-Time Control System Design Challenges at the Chip Level

Powered by the Arm® Cortex®-M52 core with Arm v8.1-M architecture, this MCU supports Arm Helium™ technology and Geehy's Zidian math instruction extension unit. It delivers high-performance sensing, advanced control peripherals, and a flexible interconnect system. With an operating range of -40°C to 105°C/125°C and compliance with IEC 61508 SIL2 and AEC-Q100 Grade 1, it is ideal for main control in power converters such as Vienna PFC, LLC, DAB, PSFB, and HSFB.



System

Dual-core Cortex-M52 @ 250 MHz with single/dual-precision FPU, Arm Helium™ technology, and Geehy's Zidian math instruction extension unit

Memory

Up to 640 KB Flash (dual banks for simultaneous programming and execution) and 128 KB SRAM with configurable TCM

Power & Clock

Operating voltage: 3.1V–3.6V, two 10 MHz oscillators, POR/BOR

Communication Interfaces

UART ×2, CAN ×2, LIN ×1, SPI ×2, I²C ×1, QSPI ×1, PMBus ×1

Protection

Flash with ECC, SRAM with parity check, clock failure detection, windowed watchdog

High Safety

Unique Identifier (UID), code protection, secure boot

High Reliability

IEC 61508 SIL2, AEC-Q100 Grade 1

Package

QFN56, LQFP64/80/100



G32R501 Real-Time MCUs/DSPs

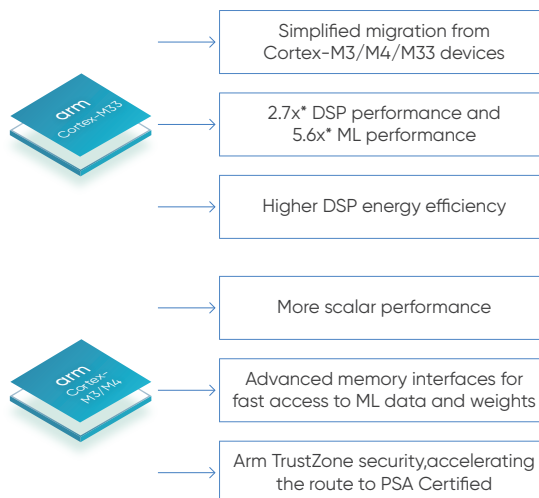
Superior Real-Time Performance for Intelligent Systems

Arm® Cortex®-M52 Dual-Core

- Next-gen high-efficiency processor on Arm v8.1-M
- Easy migration from Cortex-M4F/M33
- Enhanced DSP & ML capabilities
- Single/dual-precision FPU
- Custom instruction set extensions
- Arm Helium™ technology
- Tightly coupled memory interface

Arm Helium™ Technology

- Vector instruction set based on vector linking
- Enhances signal processing and machine learning computations
- 5× signal processing boost
- 10× machine learning boost
- Simplifies edge AI application development



Energy-efficient CPU Based on Arm Helium™ Technology

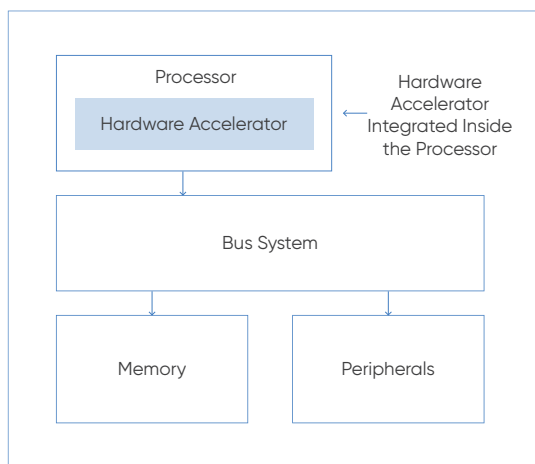
Geehy's Proprietary Zidian Math Instruction Extension Unit

It speeds up key math operations like trigonometric functions, Fourier transforms, and complex calculations, reducing computation time and CPU delay to enhance real-time performance.

CDE interface supports:

- | | |
|-------------------------------------|---------------------------|
| ▪ ICAU (31 instructions) | ▪ FCAU (11 instructions) |
| • FFT operations | • Trigonometric functions |
| • Complex mathematical computations | • Square Root |
| • CRC operations | • Division |
| • SIMD operations | |

Processor Hardware Acceleration



G32R501 Real-Time MCUs/DSPs



Advanced Peripheral Integration for Innovative Applications

High-Performance Control Modules Support Various Power Topologies

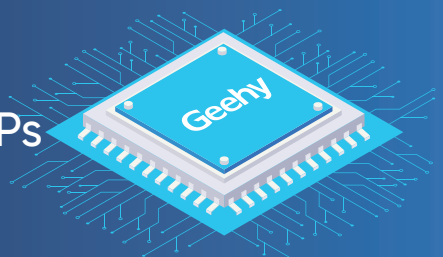
- 16× PWM channels (150 ps resolution)
 - Precise period, duty, phase shift, and dead zone
 - Multiple modes: CBC, One-Shot
 - Flexible loading: immediate, scheduled, global
- 4× FLB modules for encoder decoding and PWM protection
 - Specialized control pulse logic
 - Enhanced signal detection and protection
 - Custom serial data protocol



Optimized Signal Acquires Sensitive Sensing Input Units

- Analog System
 - Three 12-bit ADCs (3.45 MSPS)
 - Up to 31 external channels, each with four hardware post-processing units
- Advanced Signal Acquisition & Generation
 - Comparator with integrated 12-bit DAC for ramp compensation
 - 4× Σ - Δ filter module (SDF) input channels
 - 7× enhanced Capture (CAP) modules
 - 2× enhanced Quadrature Encoder Pulse (QEP) modules

G32R501 Real-time MCUs/DSPs



G32R501 Real-Time MCUs/DSPs

Part No.	Core	Zidian Math Instruction Extension	Frequency(MHz)	DMA Channels	FLASH(KB)	SRAM(KB)	FPU	I/O	Voltage(V)	Operating Temperature(°C)	Timer			Analog				Control				Communication								Package
											GPTMR(32-bit)	NMIWD	WWDT	ADC 12-bit Cell	ADC 12-bit Channels	T-sensor	COMP (DAC 12-bit Cell Embedded)	CAP(HRCAP)	PWM (HRPWM Channels)	QEP	SDF Channels	SPI	QSPI	I2C	UART	CAN	LIN	PMBus	USB Device	
G32R501DNYU7	Dual Core	✓	250	6	640	128	✓	25	3.1~3.6	-40~105	3	✓	✓	3	14	2	1	6(12)	7(2)	16(16)	2	2	2	1	2	2	1	1	0	QFN56
G32R501DRY77	Dual Core	✓	250	6	640	128	✓	26	3.1~3.6	-40~105	3	✓	✓	3	16	2	1	7(14)	7(2)	16(16)	2	2	2	1	2	2	1	1	0	LQFP64
G32R501DMYT7	Dual Core	✓	250	6	640	128	✓	44	3.1~3.6	-40~105	3	✓	✓	3	16	2	1	7(14)	7(2)	16(16)	2	4	2	1	2	2	1	1	0	LQFP80
G32R501DPY77	Dual Core	✓	250	6	640	128	✓	44	3.1~3.6	-40~105	3	✓	✓	3	16	2	1	7(14)	7(2)	16(16)	2	4	2	1	2	2	1	1	0	LQFP80*
G32R501DYY77	Dual Core	✓	250	6	640	128	✓	42	3.1~3.6	-40~105	3	✓	✓	3	31	2	1	7(14)	7(2)	16(16)	2	4	2	1	2	2	1	1	0	LQFP100
G32R501NYU7	Single Core	✓	250	6	640	128	✓	25	3.1~3.6	-40~105	3	✓	✓	3	14	2	1	6(12)	7(2)	16(16)	2	2	2	1	2	2	1	1	0	QFN56
G32R501RY77	Single Core	✓	250	6	640	128	✓	26	3.1~3.6	-40~105	3	✓	✓	3	16	2	1	7(14)	7(2)	16(16)	2	2	2	1	2	2	1	1	0	LQFP64
G32R501MYT7	Single Core	✓	250	6	640	128	✓	44	3.1~3.6	-40~105	3	✓	✓	3	16	2	1	7(14)	7(2)	16(16)	2	4	2	1	2	2	1	1	0	LQFP80
G32R501Y77	Single Core	✓	250	6	640	128	✓	42	3.1~3.6	-40~105	3	✓	✓	3	31	2	1	7(14)	7(2)	16(16)	2	4	2	1	2	2	1	1	0	LQFP100
G32R501NCU7	Single Core	✓	250	6	256	128	✓	25	3.1~3.6	-40~105	3	✓	✓	3	14	2	1	6(12)	7(2)	16(16)	2	2	2	1	2	2	1	1	0	QFN56
G32R501RCT7	Single Core	✓	250	6	256	128	✓	26	3.1~3.6	-40~105	3	✓	✓	3	16	2	1	7(14)	7(2)	16(16)	2	2	2	1	2	2	1	1	0	LQFP64
G32R501MCT7	Single Core	✓	250	6	256	128	✓	44	3.1~3.6	-40~105	3	✓	✓	3	16	2	1	7(14)	7(2)	16(16)	2	4	2	1	2	2	1	1	0	LQFP80
G32R501VCT7	Single Core	✓	250	6	256	128	✓	42	3.1~3.6	-40~105	3	✓	✓	3	31	2	1	7(14)	7(2)	16(16)	2	4	2	1	2	2	1	1	0	LQFP100
G32R501DNCU7	Dual Core	✓	250	6	256	128	✓	25	3.1~3.6	-40~105	3	✓	✓	3	14	2	1	6(12)	7(2)	16(16)	2	2	2	1	2	2	1	1	0	QFN56
G32R501DRC77	Dual Core	✓	250	6	256	128	✓	26	3.1~3.6	-40~105	3	✓	✓	3	16	2	1	7(14)	7(2)	16(16)	2	2	2	1	2	2	1	1	0	LQFP64
G32R501DMCT7	Dual Core	✓	250	6	256	128	✓	44	3.1~3.6	-40~105	3	✓	✓	3	16	2	1	7(14)	7(2)	16(16)	2	4	2	1	2	2	1	1	0	LQFP80
G32R501DVC77	Dual Core	✓	250	6	256	128	✓	42	3.1~3.6	-40~105	3	✓	✓	3	31	2	1	7(14)	7(2)	16(16)	2	4	2	1	2	2	1	1	0	LQFP100
G32R501DNYU8	Dual Core	✓	200	6	640	128	✓	25	3.1~3.6	-40~125	3	✓	✓	3	14	2	1	6(12)	7(2)	16(16)	2	2	2	1	2	2	1	1	0	QFN56
G32R501DRYT8Q	Dual Core	✓	200	6	640	128	✓	26	3.1~3.6	-40~125	3	✓	✓	3	16	2	1	7(14)	7(2)	16(16)	2	2	2	1	2	2	1	1	0	LQFP64
G32R501DMYT8Q	Dual Core	✓	200	6	640	128	✓	44	3.1~3.6	-40~125	3	✓	✓	3	16	2	1	7(14)	7(2)	16(16)	2	4	2	1	2	2	1	1	0	LQFP80
G32R501DWT8Q	Dual Core	✓	200	6	640	128	✓	42	3.1~3.6	-40~125	3	✓	✓	3	31	2	1	7(14)	7(2)	16(16)	2	4	2	1	2	2	1	1	0	LQFP100

*G32R501DPY77-LQFP80; 10×10mm

Comprehensive G32R501 Ecosystem



Offers a complete product package and professional services

Extensive Documentation

- Datasheet
- User Manual
- Errata Sheet
- Application Note
- Migration Guide
- Getting Started Guide

Comprehensive Library

- Driver Library
- Math Library
- Security Library
- Application Library
- Intermediate Library

Multiple Software Development Tools

- IAR System
- Arm Keil
- Eclipse

Mass Production-Ready Designs

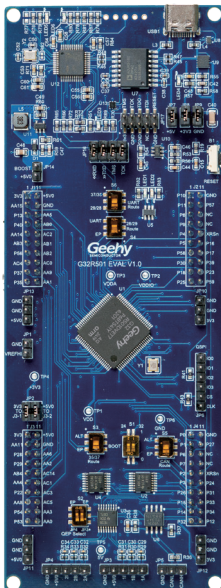
- Bidirectional Power Supply
- Communication/Server Power Supply
- Microinverters
- Variable Frequency Drives (VFDs)
- Servo Controllers
- Low-Voltage Sensorless Dual Motors

Flexible Hardware Debugging Tools

- Evaluation Boards
- Emulators
- Programmers
- Solution Boards

Professional Technical Support Team

- Fast product consultation
- Application-level technical support



G32R501 EVAL Board



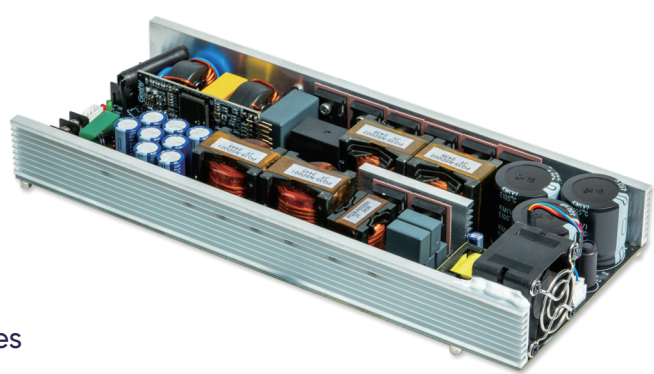
G32R501 Dual Motor Debugging Board



G32R501 EtherCAT Bus Debugging Board

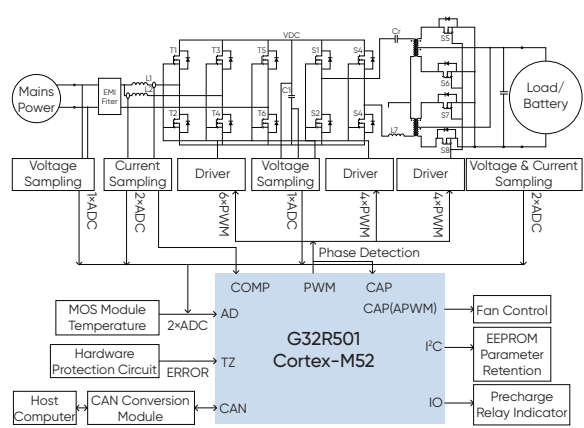


G32R501 48V/50A Bidirectional Digital Power Supply Solution



Solution Advantages

- Delivers Titanium-level efficiency using silicon MOSFETs in CCM mode—comparable to SiC/GaN performance, ideal for server power supplies
- Integrates dual-phase interleaved totem-pole PFC (CRM) and LLC full-bridge topology, supporting single-phase AC-DC conversion and bidirectional battery charging/discharging
- Enables bidirectional functionality with a single G32R501 chip, supporting charging and inversion for portable energy storage
- Eliminates the need for external zero-crossing detection, reducing system cost
- Applications: Communication power, AI servers, portable energy storage, brick power modules



Specifications							
Rectifier Mode							
AC Voltage	90~265V			AC Frequency	47~53Hz (50Hz Nominal)		
Rated AC Input Current	≤16A			Maximum Rectification Efficiency	> 96.5%		
Total Harmonic Distortion (THD)	≤5% (at 50% load)			Power Factor	≥0.99 (at 100% load)		
Voltage Regulation Accuracy	≤±0.5%Vo			Ripple & Noise	≤500mVp-p (Bandwidth ≤20MHz)		
DC Output Voltage	45~58V (53.5V Nominal)			DC Output Current	0~50A		
Linear Power Derating	2675W (208~265V AC)			Dynamic Response	25~50%, 50%~75% Load Step: Overshoot: ≤±5% Recovery Time: ≤1ms (±1% Vo)		
	1250~2675W (90~208V AC)				10~90% Load Step: Recovery Time: ≤2ms (±1% Vo)		
Standby Power Consumption	≤5W			Startup Time	≤5s		
Inverter Mode				Protection			
DC Input Voltage	51.5~58V			AC Overvoltage Protection	Trigger: >275V, Reset: 265~275V		
Rated DC Input Current	37.5A			AC Undervoltage Protection	Trigger: <80V, Reset: 80~90V		
Rated AC Output Power	2000W (AC 208~230V)			DC Overvoltage Protection	Configurable (56~60V), locks at internal overvoltage faults or external voltage >63V sustained for 500ms		
AC Output Voltage	90~240V	Maximum Inversion Efficiency	> 96.5%	DC Short Circuit Protection	Supports prolonged short circuits; auto-recovers upon resolution	Overtemperature Protection	Supported
Operating Environment							
Operating Temperature	-25°C~+75°C			Relative Humidity	5%~95% (Non-condensing)		
Storage Temperature	-40°C~-+75°C			Altitude	≤5000m (Derate 1°C per 200m above 3000~5000m)		



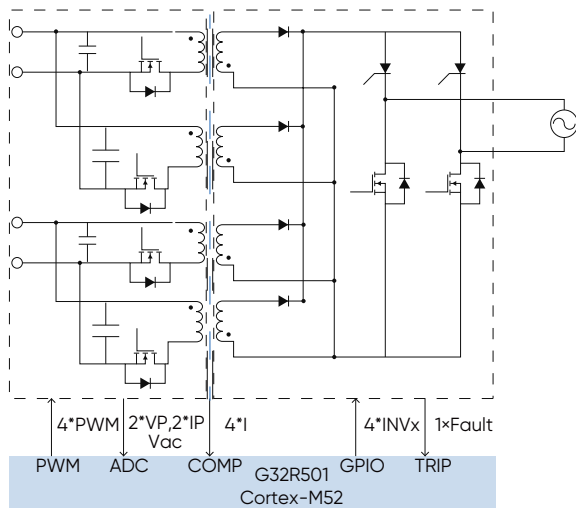
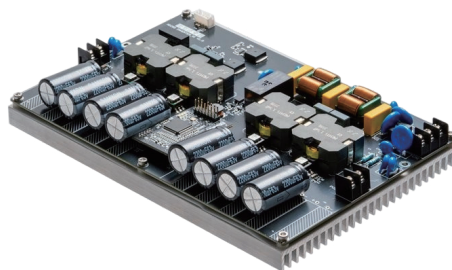
G32R501 2-in-1 Micro-Inverter Solution

Solution Advantages

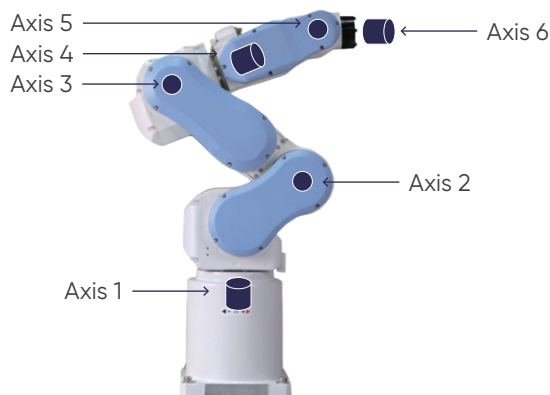
- Based on the G32R501 real-time MCU/DSP
- Supports two solar inputs with independent MPPT control
- Automatically adapts to grid frequency
- Applications: Micro-inverters, inverters, and portable energy storage

Specifications

- MPPT Range: DC 16V–60V
- AC Output: 230V (180V–275V)
- Power Factor: >0.99
- Max Efficiency: 94%
- MPPT Efficiency: 99.80%

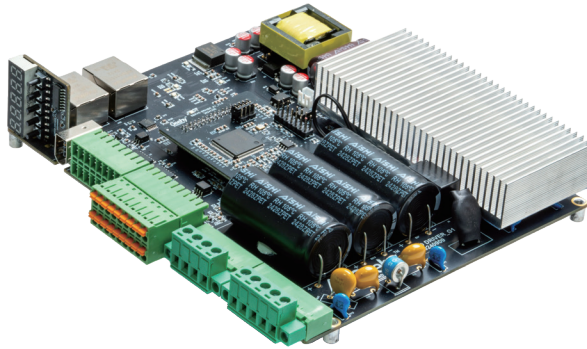


G32R501 Six-Axis Robotic Arm Control Solution



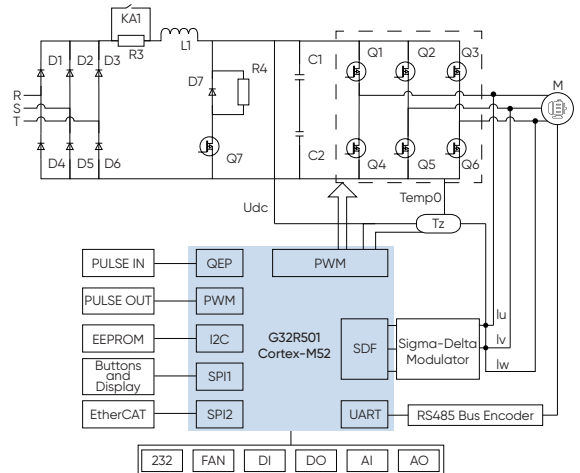
Application	Chip Model	Performance
Servo Main Control Chip	G32R501	<ul style="list-style-type: none"> ▪ Panel: SPIA ▪ Encoder: UARTB (2.5 Mbps) ▪ Host PC: UARTA (38.4 kbps) ▪ External EEPROM: I2C ▪ Pulse input: QEP ▪ Voltage sampling: ADCA ▪ Analog input: ADCC ▪ Current sampling: SDFM1 (20 MHz) ▪ PWM output: EPWM3/5/6 and TZ ▪ 485 dir: EPWM4B ▪ I/Os: 5 digital inputs, 2 digital outputs, 2 analog inputs
EtherCAT Communication Chip	-	<ul style="list-style-type: none"> ▪ EtherCAT: 100 MHz ▪ PDI: SPI (20 MHz) or Parallel (8/16-bit) ▪ Distributed Clock: 64-bit, <1μs sync accuracy ▪ Ports: 2–4 ▪ FMMUs: 8 ▪ Sync Managers: 8 KB

G32R501 High-Voltage Servo Controller Solution



Solution Advantages

- Dual-core architecture for parallel processing:
 - CPU0 handles interrupts in as little as 13.6us
 - CPU1 processes encoder data and current loops in as little as 8.6us
- Versatile servo control functions:
 - Position, speed, and torque control
 - 400W EtherCAT communication
 - 5 digital inputs, 2 digital outputs, 2 analog inputs
- Full-featured PC debugging tools:
 - 400+ parameter settings, JOG debugging, fault diagnosis, waveform analysis
- Applications
 - Industrial robots, digital printers, machine tools, and automated production lines



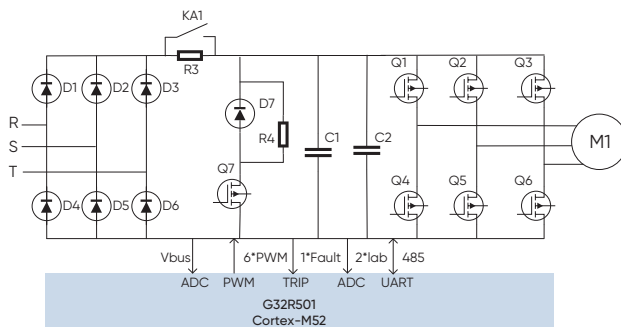
Specifications							
Main Power Supply	Single/Three-phase AC 200V~240V (-15% to +10%), 50/60Hz						
Control Circuit Power Supply	Single-phase AC 200V~240V (-15% to +10%), 50/60Hz						
Encoder Feedback	RS485 protocol with ABZ quadrature pulse support						
Control Method	Sine wave current drive			Communication	ModBus and EtherCAT protocols		
Performance							
Speed variation rate	Load variation rate		±0.03% or lower (at rated speed, 0~100% load)				
	Voltage variation rate		±0.1% or lower (at rated speed, ±10% voltage variation)				
	Temperature variation rate		±0.1% or lower (at rated speed, 0~50°C)				
Frequency response	400Hz	Speed range	±7000rpm	Thrust control accuracy	±1%	Overload capacity	3x
Protection Features							
Core Protection	Overcurrent, overload, overvoltage, undervoltage, and overheating.			Fault Protection	Output/input phase loss, short circuits, and other faults.		
Motor Protection	Motor overloads, stalls, encoder faults, overspeed, and runaway conditions.			Hardware Protection	Failures in communication, circuits, EEPROM, relays, and fans.		

G32R501 2.2kW General-Purpose Vector VFD Solution



Solution Advantages

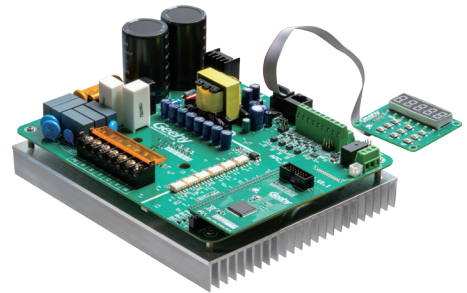
- High-performance vector control for strong low-speed torque and fast response User-programmable with communication bus support
- Zero-speed switching and instant stop without shutdown
- Static motor parameter identification (resistance, inductance, flux)
- Drives synchronous motors with adjustable overload capacity
- Easy maintenance with a user-friendly, modular design
- Applications: Conveyors, cranes, machine tools, and extruders



Specifications

- Input: 3-phase 220/380V AC ($\pm 10\sim 15\%$)
- Carrier Frequency: 0.8–16 kHz adaptive
- PI Auto-tuning: Model reference adaptive
- Control Frequency: $\geq 1\text{Hz}$
- Control Modes: SVC, V/F
- Starting Torque: 0.25Hz/150% (SVC)

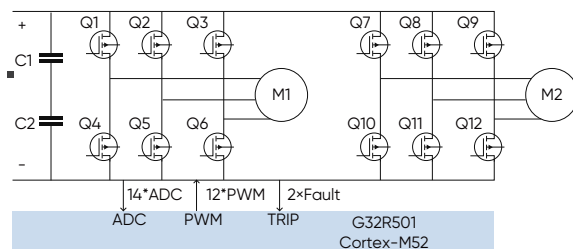
Speed Accuracy: $\pm 0.5\%$ @ 5Hz



G32R501 Low-Voltage Sensorless Dual-Motor Solution

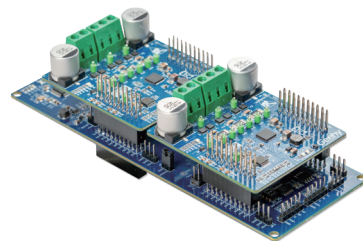
Solution Advantages

- Full-torque sensorless startup at 4Hz
- Automatic PI tuning and one-click motor adaptation
- Integrated comparator reduces PCB size and cost
- Full-stack hardware/software solution with GEAST motor algorithm library
- Applications: Drones, EVs, wind turbines, water pumps, appliances



Specifications

- Input Voltage: DC 12V–48V
- Max Output: 20A
- PWM & Current Loop: 20kHz
- Speed Loop: 2kHz
- Current Loop Execution Time: 12.4 μs
- Min Control Frequency: 1Hz



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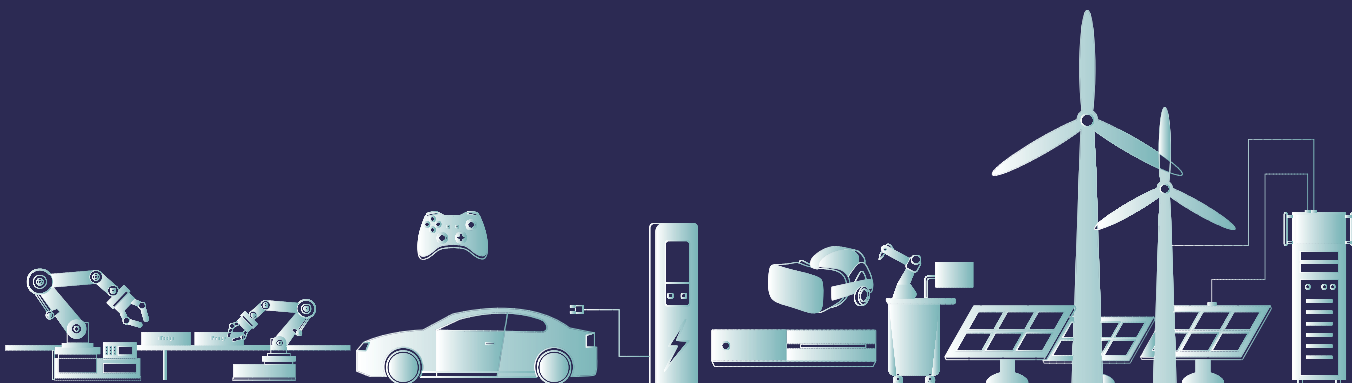
Hackster



Geehy Community



Wechat Official Accounts



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