



Tasarım, Danışmanlık, Mühendislik & Taahhüt Ltd. Şti.
DESIGN, CONSULTING & ENGINEERING SERVICES CO., LTD.

UniControl Pro®

TECHNICAL SPECIFICATIONS



1. GENERAL DESCRIPTION

UniControl Pro® v5.1.0 is an automotive-standard, CAN Bus-based, modular Advanced Driver Assistance System (ADAS) and universal control unit designed primarily for heavy-duty vehicles, commercial machinery, and motorhomes. Powered by the **ESP32-S3** microcontroller running on the **ESP-IDF (FreeRTOS)** framework, the system processes real-time data from multiple radar and ultrasonic sensors (Sensor Fusion), visualizes them on a HMI display (*not valid for this project*), and provides autonomous control over onboard hardware such as relays, MOSFETs, and buzzers.

2. ELECTRICAL SPECIFICATIONS

Parameter	Minimum	Typical	Maximum	Unit / Description
Input Voltage (V_{in} V_{in})	9.0	12.0 / 24.0	32.0	VDC (Automotive battery standard)
System Logic Voltage	—	3.3	—	VDC (ESP32-S3 & CAN Bus transceiver)



Tasarım, Danışmanlık, Mühendislik & Taahhüt Ltd. Şti.
DESIGN, CONSULTING & ENGINEERING SERVICES CO., LTD.

Display Supply Voltage	4.75	5.0	5.25	VDC (LM2596/MP1584 regulator output)
Total Current Consumption	—	350	1000	mA (With display and sensors active)
Standby Current (Sleep)	—	45	80	mA (In low-power standby mode)
Main Fuse Rating	—	3.0	—	A (Fast-blow blade fuse)
Reverse Polarity Protection	—	3.0 / 1000	—	A / V (1N5408 / 1N5400 Power Diode)

3. PROCESSOR & SYSTEM ARCHITECTURE

- **Microcontroller:** ESP32-S3 (WROOM-1 / DevKitC-1)
- **Processor Core:** Dual-Core 32-bit LX7 CPU (includes hardware Floating Point Unit - FPU)
- **Clock Frequency:** 240 MHz
- **Memory Configuration:** 16 MB SPI Flash, 8 MB Octal PSRAM, 512 KB SRAM
- **Operating System (OS):** FreeRTOS (Real-Time Operating System)
- **Development Framework:** ESP-IDF v5.x (Espressif IoT Development Framework)

4. COMMUNICATION PROTOCOLS & PORTS

A. CAN Bus (Controller Area Network)

- **Standard:** CAN 2.0A (11-bit) & CAN 2.0B (29-bit) compliant
- **Baud Rate:** 500 kbps (pre-configured static speed)
- **Physical Layer:** SN65HVD230 (3.3V Logic level transceiver)
- **Termination:** Internal 120 Ω

B. UART

- **Port:** UART1 (ESP32-S3 hardware UART)
- **Baud Rate:** 9600 bps (Default) / 115200 bps (High-speed mode)
- **Format:** 8 Data bits, No Parity, 1 Stop bit (8N1)
-

5. SENSOR SPECIFICATIONS

The system natively supports two distinct families of industrial Brigade safety sensors:

A. Brigade Backsense BS-9100 / BS-9100T (CAN Radar)

- **Technology:** FMCW (Frequency Modulated Continuous Wave) Radar
- **Operating Frequency:** 77 GHz
- **Detection Length:** 0.3 meters to 40.0 meters (Maximum theoretical range 60m)



Tasarım, Danışmanlık, Mühendislik & Taahhüt Ltd. Şti.
DESIGN, CONSULTING & ENGINEERING SERVICES CO., LTD.

- **Detection Width: 16 meters** at maximum width configuration
- **Horizontal Beam Angle: 140°**
- **Vertical Beam Angle: 16°**
- **Distance Resolution: 0.25 meters**
- **Multi-Object Tracking: Up to 16 simultaneous objects** per sensor (System processes the closest 6)
- **Environmental Protection: IP69K** (High-pressure water & dustproof)
- **CAN Protocol: 11-bit Standard ID, Base ID** configurable between 0x310 and 0x380

B. Brigade UDS (Ultrasonic Detection System)

- **Technology:** Ultrasonic echo reflection
- **Operating Frequency:** 40 kHz
- **Detection Length: 0.3 meters to 2.5 meters**
- **Distance Resolution: 0.1 meters**
- **Sensor Capacity:** Up to **4 ultrasonic sensor heads** per ECU
- **CAN Protocol:** 29-bit Extended ID (0x18FF5B8x series)
- **Host Requirement:** Requires cyclic 0x18FF5A54 active/detection request sent from host (ESP32) every 100ms.

C. BRIGADE AI-360 OUTPUT

12 or 24 VDC signal

D. BRIGADE AI CAMERA OUTPUTS

12 or 24 VDC signal

6. INPUT / OUTPUT (I/O) PORT SPECIFICATIONS

A. Optoisolated Digital Inputs - 3 Channels (IN1, IN2, IN3)

- **Interface Component: PC817 Optocoupler** (Optical Galvanic Isolation)
- **Input Voltage Range:** 12V to 24V DC automotive signals
- **Current Limiting:** Restricted via inline 2.2k 1/4W resistor (~5-10mA)
- **Logic Level:** Active LOW (Internal pull-up enabled on the ESP32 side; pulls to GND when triggered)

B. Power Outputs (High-Side MOSFET) - 3 Channels (OUT1, OUT2, OUT3)

- **Interface Components: IRF9540** (P-Channel Power MOSFET) + **BC546** (NPN driver transistor)
- **Switching Type: High-Side Switching** (Switches the positive +12V rail, standard automotive safety)
- **Maximum Drive Current:** up to **10A** per channel (With appropriate aluminium heatsink)
- **Gate Protection:** 100 Ω



Tasarım, Danışmanlık, Mühendislik & Taahhüt Ltd. Şti.
DESIGN, CONSULTING & ENGINEERING SERVICES CO., LTD.

series resistor to protect ESP32 pin; 10kΩ pull-up resistor between Gate and Source to prevent floating state.

- **Applications:** LED bars, external lighting, fan control (Supports PWM speed regulation).

C. Signal Outputs (Relays) - 3 Channels (REL1, REL2, REL3)

- **Interface Components:** Omron G6K-2F (5V DC Coil DPDT Signal Relay) + BC546 NPN driver
- **Coil Current:** ~21mA at 5V (Powered independently from the ESP32 logic rail)
- **Contact Capacity:** Maximum **1A @ 30V DC** / 0.3A @ 125V AC (Designed for low-power dry contact signalling)
- **Protection:** Equipped with inline **1N4007 flyback diodes** across the coils.
- **Contact Optimization:** Both poles (Pole 1 & Pole 2) are hardware-bridged in parallel to double reliability and current distribution.

7. SOFTWARE LIMITS & PARAMETERS

- **Maximum Simultaneous Tracked Objects:** 12 objects (6 Front, 6 Rear)
- **CAN Object Timeout:** 200 milliseconds (Objects not updated within 200ms are cleared from memory)
- **SD Card Logging Interval (Cooldown):** Minimum 1000 milliseconds (Saves card lifespan by restricting consecutive writes) (*not valid for this project*),
- **System Boot Time (Power-On to Ready):** < 1.0 seconds (Includes NVS read, GPIO initialization, and CAN start) [19]
- **Web Server Chunk Buffer Size:** 1024 bytes (Sends HTML in chunks to prevent heap memory fragmentation)

8. WIRELESS & CONNECTIVITY (IoT)

- **Wireless Standard:** 802.11 b/g/n (2.4 GHz)
- **Mode:** SoftAP (Independent Access Point)
- **SSID:** ADC_MASTER_S3
- **Security:** WPA2-PSK (12345678)
- **Local IP Address:** 192.168.4.1
- **Maximum Client Capacity:** 4 simultaneous devices (Phones, Tablets, etc.)
- **OTA (Over-The-Air) Support:** Native wireless firmware flashing via HTTP POST.

9. MECHANICAL & ENVIRONMENTAL

- **Operating Temperature:** -20°C to +60°C (Automotive and industrial grade components)
- **Ingress Protection (IP):**
 - **Sensors:** IP69K / IP67 (High-pressure wash, mud, and water immersion proof)
 - **Main Controller Box:** IP54 rated sealed enclosure with ruggedizing protector.
 - **Sensor Box:** IP67