

Integrated Vibration Controller - Datasheet

The Integrated Vibration Controller (IVC) combines a motor driver, a precision 3-axis MEMS, and a Wi-Fi enabled microcontroller for standalone vibration measurement and control.

Specifications

Parameter	Value
Sensor	3-axis MEMS DC-coupled accelerometer, $\pm 10/\pm 20/\pm 40$ g, 20-bit, 75 $\mu\text{g}/\sqrt{\text{Hz}}$ spectral density, anti-alias -3 dB ~ 1.5 kHz
Actuator	voice-coil / brushed / BLDC, 2.5 A peak per half-bridge
Control	4 kHz sample rate; uploadable discrete-time state-space controller (JSON, ≤ 16 states, validated on upload)
Compute	ESP32-S3 module (dual core, 8 MB flash + 8 MB PSRAM)
Connectivity	WiFi 2.4 GHz (own access point + joins existing network), mDNS <code>irma.local</code>
Interface	Built-in web dashboard (any browser); REST API; OTA firmware update
Power	2.5A @ 12–48 VDC nominal, 2.1 × 5.5 mm barrel jack (center positive)
Dimensions	Ø 87 mm x 25mm tall

Hardware Configurations

Application	Function	Configuration
Damping	add damping to structural modes (TMD)	local or remote
Absorbing	reduce tonal or band-limited disturbances (TVA)	local or remote
Cancellation	cancel disturbances	combined

The system can be reconfigured based on application:

- **Local:** the controller is colocated with the actuator and accelerometer for vibration sensing; all reside on the vibrating target.
- **Remote:** the controller uses the remote sensor/actuator board for sensing and control; the controller itself is not on the vibrating target.
- **Combined:** the controller uses both the local and remote accelerometers for sensing, and the actuator can be either local or remote.

Operational States

State	LED	Meaning
INIT	White	Booting / self-test
MONITOR	Blue	Idle, safe
EXCITE	Amber	Test running

State	LED	Meaning
CONTROL	Green	Feedback engaged
FAULTED	Red	See dashboard fault banner

Protection & safety behavior

Mechanism	Behavior
Idle brake	Whenever the loop is not driving, all actuator phases short to ground - a voice coil is passively damped, never floating
Duty limit	Configurable hard clip on commanded drive (default 50 %)
Instability guard	Sustained drive RMS above a configurable ceiling (default 10 %) for 0.5 s -> drive off, fault latched
Driver faults	Overcurrent / overtemperature / undervoltage from the driver IC -> drive off, fault latched
Board overtemp	Configurable threshold (default 50 °C) -> fault latched
Sensor loss	Data-ready timeout while driving -> drive off, fault latched
Watchdog	Control-task stall while driving -> drive off, fault latched
Bounded tests	All excitation runs hard-capped at 5 s and return to a safe state
Fault latching	Faults persist across power cycles; cleared only from the dashboard, which forces a full self-test