

# Doppler Vor Test Rack



## About us:

Neometrix Defence Celebrating 20 Years of Excellence! For the past two decades, Neometrix Defence has maintained its position as a premier provider of advanced test benches and rigs.

Our accreditation by the Directorate General of Aeronautical Quality Assurance, India (DGAQA) and Defence Research & Development Organization, India (DRDO) underscores our commitment to upholding the highest international defence industry standards.

Counting the Indian Air Force/Army/Navy, Ministry of Defence, Hindustan Aeronautical Limited, and DRDO among our esteemed clientele, we are recognized for delivering state-of-the-art solutions and unwavering performance reliability.

## Strengths & Capabilities:

Neometrix Defence is a powerhouse of engineering brilliance, proudly serving every Indian Air Force station and partnering with the Indian Army, Navy, Railways, BARC, NPCIL, and ISRO. With a team of over 100 elite engineers and visionary founders from IIT Kanpur and IIT Delhi, we harness cutting-edge technology to set the gold standard in mechanical engineering.

## We Don't Just Meet Industry Demands – We Define Them!



- We have established our presence in all Air Force stations across India. With the Indian Air Force as our leading customer, we are dedicated to upholding the highest standards of excellence in the aerospace industry.
- Our extensive clientele extends beyond the defence industry, including projects with the Indian Army, Navy, Railways, BARC, NPCIL, ISRO, and more. In essence, we excel in all aspects of mechanical engineering!
- Our team comprises over 100 graduate engineers, supported by a cutting-edge manufacturing site equipped with state-of-the-art machinery, enabling us to meet the highest Engineering standards.
- The founders of our company are distinguished graduates from IIT Kanpur and IIT Delhi, bringing extensive expertise and a wealth of engineering knowledge to Neometrix Defence.

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## Introduction:

The TB\_DVOR is a purpose-built, rack-mount test bench that delivers complete end-to-end validation of Doppler VHF Omnidirectional Range (DVOR) beacon modules—the critical ground-station transmitters that provide azimuth information for civil and military aircraft. Housed in a rugged IP65-rated enclosure, the system automates every phase of the test cycle, from Built-In Test Equipment (BITE) self-checks at startup to RF stimulus sweeps and DC power sequencing, ensuring no manual intervention introduces variability or error.

At its heart, a 15" capacitive-touch Human-Machine Interface (HMI) paired with an industrial-grade Intel i5 PC runs a drag-and-drop GUI that lets technicians configure complex multi-stage test scripts in minutes rather than hours. Live dashboards display real-time amplitude, phase, and power measurements during Doppler simulation—so any drift or out-of-tolerance condition is immediately flagged, reducing mean-time-to-repair by up to 40%.

Once the test completes, comprehensive results—including waveform captures, numerical logs, and pass/fail summaries—are compiled into a standardized PDF report and can be printed or archived to your network in one click. By combining precise ICAO Annex 10-compliant RF generation (960–1250 MHz at  $\pm 0.1$  MHz) with true-RMS metering, PC-based oscillography, and UPS-backed continuity, the TB\_DVOR ensures your maintenance, repair, and certification workflows meet the highest international standards for accuracy, traceability, and uptime.



## Purpose & Applications:

The TB\_DVOR Test Bench is engineered first and foremost for DVOR module certification, providing a standardized, repeatable platform that mirrors live Doppler-VOR ground-station behavior. By synthesizing Doppler-shifted RF carriers across the full 960–1250 MHz band and routing them through actual keyer/interface units, RF splitters, power supplies, and antenna interfaces, the bench reproduces every electrical and timing characteristic a field beacon would exhibit. This level of fidelity ensures that each shop-replaceable unit meets stringent ICAO Annex 10 performance thresholds before being re-installed in an operational station.

In maintenance and repair facilities, the TB\_DVOR transforms what was once a highly manual troubleshooting process into an automated, guided workflow. Technicians simply mount the UUT, select the appropriate test script, and let the bench's built-in test equipment (BITE) perform power-up self-checks, full Doppler sweeps, and DC stress sequences without further intervention. Any deviation—whether a marginal RF amplitude, phase drift, or power-supply ripple—is immediately highlighted on the live dashboard, allowing faults to be pinpointed in minutes rather than hours and cutting mean-time-to-repair by up to 40 %.

For avionics R&D teams, the TB\_DVOR offers unparalleled measurement traceability and flexibility. Its high-precision instruments (0.05 % DMM accuracy, 200 MS/s oscilloscope,  $\pm 0.1$  % AC analyzer) capture subtle performance characteristics of prototype modules, supporting iterative design improvements. Custom Doppler profiles and environmental compensation (temperature and humidity) can be programmed to simulate real-world conditions, enabling rigorous validation of next-generation DVOR components under development.

Finally, in the context of regulatory compliance, the TB\_DVOR generates fully timestamped, tamper-evident PDF reports that document every measurement, waveform capture, and pass/fail decision. These reports align with DGAQA/DRDO audit requirements and international airworthiness standards, providing maintenance managers and certification authorities with clear, unambiguous proof that each module has passed its acceptance tests before deployment.

## Key Features:

### Universal LRU Coverage

- The TB\_DVOR accommodates every shop-replaceable unit used in modern DVOR ground stations—from intelligent modules such as keyer/interface and status indicator units to passive “slave” assemblies like RF splitters, pulse filters, and power supplies. With a single bench capable of testing over 15 distinct LRUs, maintenance facilities no longer need multiple, siloed testers; instead, one rack consolidates all module types, reducing footprint, training overhead, and changeover time between tests.

### Automated BITE & Fault Finding

- Built-In Test Equipment (BITE) routines launch immediately at power-up, exercising internal power rails, communication buses, and safety interlocks without manual intervention. Should a failure occur, the system’s guided fault-locator walks the technician through pinpoint diagnostics—highlighting suspect connectors, sub-assemblies, or component values via on-screen schematics—so repairs focus on the root cause rather than chasing misleading symptoms.

### Wideband RF Generation

- A high-stability synthesizer delivers Doppler-modulated RF carriers across the full 960–1250 MHz band with  $\pm 0.1$  MHz frequency accuracy and up to +8 dBm output power. This precision allows the bench to emulate the Doppler shift caused by a rotating VOR antenna, sweeping 30 Hz subcarriers in real time to verify bearing accuracy, signal purity, and channel isolation exactly as they would occur in the field.

### High-Precision Instruments

- Measurement fidelity is ensured by a suite of traceable instruments: a True-RMS digital multimeter with 0.05 % basic accuracy for voltage, current, and resistance checks; an 8-bit, 200 MS/s PC-controlled oscilloscope for detailed time-domain and FFT analyses; a  $\pm 0.1$  % AC power analyzer for mains quality, power factor, and harmonic content; and a 0–30 V, 700 W programmable DC supply with slew-rate control and over-voltage/current protection. These tools combine to guarantee every reading is repeatable and compliant with ISO/IEC 17025 calibration standards.

## Rugged, IP65 Design

- Encased in a powder-coated steel cabinet rated IP65, the TB\_DVOR withstands dust, spray, and occasional workshop impacts. All front-panel instruments and connectors use MIL-grade cabling and ferrules, while the 15" anti-glare capacitive touchscreen resists fingerprints and reflections. An integrated UPS provides up to 20 minutes of battery backup, so a momentary power glitch will never corrupt a live test sequence or your critical data.

## Modular Expansion

- Future-proof your investment with an open backplane that supports hot-swap I/O cards for GPIB, LXI, Ethernet, or custom protocols. Whether you need to integrate new RF standards, add environmental sensors, or interface with proprietary factory automation systems, the bench's modular architecture lets you plug in the next generation of test capabilities—no full-system overhaul required.



## Technical Specifications:

Parameter	Specification
Frequency Range	960 MHz – 1250 MHz
RF Output Power	Up to +8 dBm
DC Power Supply	0–30 V DC, 700 W programmable; slew-rate & OVP/OCP protection
UPS Backup	20 minutes battery-backed operation
Enclosure Rating	IP65, powder-coated steel; MIL-grade connectors
Industrial PC	Intel i5, 8 GB RAM, 256 GB SSD, Windows 10 IoT Enterprise
Display	15" capacitive multi-touch; anti-glare IP65 front
Multimeters	True-RMS; V/I/R/F measurement
Oscilloscope	8-bit, 2-channel, 200 MS/s; triggers, FFT, USB interface
AC Power Analyzer	±0.1 % accuracy, power factor & harmonics analysis
Circuit Breaker	16 A manual/auto protection
Operating Conditions	0 °C – 50 °C; ≤ 95 % RH non-condensing
Dimensions (H×W×D)	2000 × 600 × 800 mm (19" rack)
Weight	≈ 250 kg (fully loaded)

## System Components & Architecture:

The TB\_DVOR is built around three tightly integrated subsystems, each optimized for compactness, reliability, and ease of use:

### Control & HMI Unit

- 15" IP65 Touch Display: Anti-glare, 10-point capacitive screen for drag-and-drop test setup and real-time dashboards.
- Operator Console: Fold-down shelf with backlit keyboard and optical mouse.
- Industrial PC: Intel i5, 8 GB RAM, 256 GB SSD running Windows 10 IoT GUI that manages multi-stage scripts, user accounts, and audit logs.
- Remote Access: Gigabit Ethernet (with optional VPN) for secure diagnostics, firmware updates, and data export.

### Instrumentation Rack

- RF Doppler Generator: Synthesizer covering 960–1250 MHz at  $\pm 0.1$  MHz, with built-in Doppler emulation.
- Measurement Suite: True-RMS DMM (0.05 % acc.), 2-ch PC-oscilloscope (200 MS/s), and AC power analyzer ( $\pm 0.1$  %).
- Power Modules: 0–30 V/700 W programmable DC supply; EMI-filtered 230 VAC input with surge protection.
- Modular Backplane: Hot-swap slots for GPIB, LXI, Ethernet I/O—auto-detected on boot.
- Maintenance Panel: Quick-access rear panel for calibration ports and cabling, reducing downtime.

### Safety & Diagnostics

- Emergency-Stop & Interlocks: Front-panel E-stop latches all outputs; keyed rear door lock disables high-voltage rails when open.
- Visual & Audible Alerts: Tri-color tower light and buzzer map test status and fault codes at a glance.
- Health Monitoring: Built-in sensors for temperature, fan speed, and UPS battery status log continuously to the GUI.
- Self-Test Routines: Automated BITE on cold start checks power rails, comms, and I/O modules, with on-screen pass/fail summary.

Each subsystem slots into a single 19" rack, delivering drag-and-drop scripting, precision Doppler-VOR validation, and built-in safety—all within an IP65, UPS-backed enclosure.

## Installation & Maintenance

### Site Requirements

- Mains: 230 VAC  $\pm 10\%$ , 15 A; filtered & surge-protected
- Ambient: 0 °C – 50 °C, indoor, dust-controlled

### Routine Maintenance

- Daily: Visual inspection of connectors, UPS status
- Monthly: Verify calibration stickers; clean air filters
- Quarterly: Run full self-test; back up database
- Annually: Instrument calibration per ISO 17025; replace UPS batteries

## Operational Workflow

- Setup: Power on bench; connect UUT via MIL-grade harness; confirm UPS health.
- Configuration: Load SRU profile in GUI; adjust environmental offsets.
- Execution: Start automated test; system applies RF/DC stimuli, monitors safety interlocks.
- Monitoring: Live plots of amplitude, phase, frequency; threshold alarms.
- Reporting: Auto-generate PDF/print report; archive data to network drive.
- Shutdown: Safely vent outputs; disconnect UUT; log maintenance.

## Safety, Compliance & Quality:

- Standards: ICAO Annex 10, ISO 4413, ISO 13849-1 Cat 3, IEC 60204-1
- Relief Protection: Built-in over-pressure relief and burst-disc fail-safe
- Operator Safety: Emergency-stop, key-lock isolation, mechanical interlocks
- Traceability: Serialized bench ID; digital QA/QC logs; weld radiography records
- Environmental: CE marked; MIL-STD-810 shock & vibration certified