

UTP 7033 RF RACK

A COST-EFFECTIVE PARALLEL TEST SOLUTION FOR MODERN AUTOMOTIVE TELEMATIC CONTROL UNITS

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Introduction

In the past automobile radio equipment was primarily focused on reception of audio broadcast. In the meantime, broadcast includes also video and position/navigation information. The future vision is a “connected car”, fully integrated in the global data networks. Mid-to-high end cars are already equipped with cellular modems for telematic services. In addition, eCall is mandated in Europe for all new automobiles, proliferating cellular modems to the entire car portfolio. Technically this is a major change as communication devices become bidirectional, receivers become transceivers (transmitting and receiving). The two-way communication will not only be used towards the external world for cellular, telematic and V2X services, but also inside the car for multi-media, entertainment and safety functions. The whole automobile industry needs to follow this trend throughout all stages of development, integration, validation and production, as in each stage test equipment is deployed to ensure overall quality.

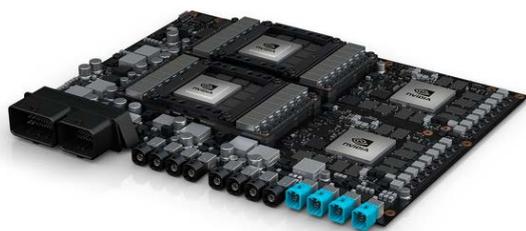


Figure 1 - Generic unit under test - Nvidia Drive AGX Pegasus¹

Technology overview

Modern automotive units already cover the newest technologies and standards all at once. Typical are two network access devices (DSDA) for cellular communication up to 5G new radio, at least one device for global positioning (GNSS including RTK), one or two V2X/C-V2X devices and multiple devices for connectivity and wireless network access (WLAN/BT/BTLE). The amount of different communication

devices on a single automotive unit and the development of multi-antenna technologies (MIMO) increase the number of RF channels that derive from the devices to the automotive unit's connectors. New physical connection interfaces like a quad-mini-FAKRA allow a high channel count occupying only small spaces resulting in overall RF interface numbers of currently up to sixteen per unit under test.

Validation test solution

Specialized on a validation test environment, where multiple units are tested in parallel for long time periods enduring different environmental factors, but also for development or production scenarios, NOFFZ Technologies GmbH and Becker Nachrichtentechnik GmbH have closely collaborated to create a turn-key solution for modern automotive units with high channel count and high technology bandwidth - the UTP 7033 RF Rack.

Core components of the test rack (600x1600x800mm) are the NOFFZ sUTP 5018 Base Station Emulator (with optional WLAN/BT/BTLE and V2X/C-V2X extensions) for parallel cellular signaling testing, the NOFFZ sUTP 5017 GNSS Simulator for positioning signal streaming and the compact RF distribution for high channel counts with included antenna diagnosis functionalities from Becker Nachrichtentechnik GmbH.



Figure 2 - UTP 7033 RF Rack

¹ <https://www.nvidia.com/en-us/self-driving-cars/drive-platform/hardware/>



Figure 3 - sUTP 5018 BSE

NOFFZ sUTP 5018 Base Station Emulator

Covering cellular technologies from 2G to 4G by default, also software extensions for 5G and C-V2X are available. Four individual streams allow

multi antenna scenarios and high data throughput. Together with the external signal distribution, multiple units can be verified in parallel. The hardware is extendable to also cover wireless connectivity technologies.



Figure 4 - sUTP 5017 GNSS

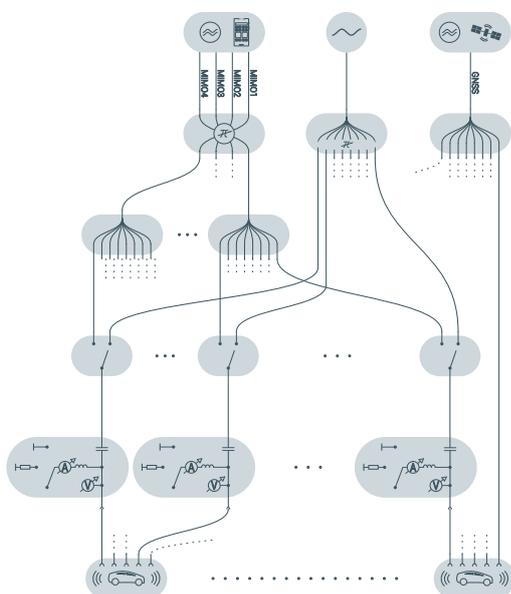
NOFFZ sUTP 5017 GNSS Simulator

Next to multi band GNSS signals for GPS, GLONASS, Galileo and Beidou, also additional signals for SBAS or RTK can be generated. Additional interference and jamming options can optionally be used for security evaluation.

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Extended RF distribution

To connect both main signaling devices to the multiple units under test, a combination of three essential building blocks are chosen for the overall design.



BECKER AIE-4X4ER Air Interface Emulator

The AIE-4X4ER Air Interface Emulator enables real emulation of RF levels for radio communication between a cellular network and mobile devices. It covers four ports for base station and four ports for unit under test streams. Each of the unit ports can be fed with a composite RF signal that is individually composed of a programmable mix of the four signals coming from the sUTP 5017 Base Station Emulator. The variation of levels can be done in a wide dynamic range with internal precision attenuators. The AIE-4X4ER allows to recreate a realistic air interface with varying propagation losses for e.g. simulation of handover or fading scenarios.

BECKER RSWU-8SPDT-CS Modules

The module RSWU-8SPDT-CS is an eight channel SPDT RF switch with integrated DC test functions for the verification of antenna diagnosis functionalities. All RF channels are non-reflective, offer high isolation and a wide frequency range from 100kHz to 7.5GHz. Each DC channel provides test circuits for antenna phantom supplies, using wear free, solid state switches, which allow the simulation of OPEN, SHORT to GND and two additional external LOAD conditions. Alternatively, the external LOAD connectors can be used to feed in a supply voltage to enable a SHORT to VBAT test. An overload circuit protects the module against damages caused by current overloads. Via the internal volt and ampere meter, the phantom DC voltage and the current flow can be measured simultaneously in all channels. Having high impedance inputs, a negligible influence to the current flow occurs in the BIAS-Ts.

Additional distribution components

Apart from specifically created products, a careful selection of high-quality commercial of the shelf components is essential to keep the signal distributions performance on a high level. Apart from coaxial cables and connectors, multi-port Wilkinson power dividers play an important role since their characteristics determine the signal equality between the different units under test.

Advantages and conclusion

In comparison to other test solutions on the market, the UTP 7033 RF Rack provides a compact design for a fully automated parallel test of multiple units with high RF channel counts, covering all modern technologies at once. The integrated switching, step attenuation and antenna diagnosis functionalities provide flexible and easily extendable signaling scenarios, occupying only a small footprint. Due to the parallel test capabilities of all included signaling and distribution devices, the price keeps reasonable even for high unit and channel counts.