

Evolution of RF Testing Requirements in the Automobile Industry

Becker Nachrichtentechnik GmbH

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Introduction

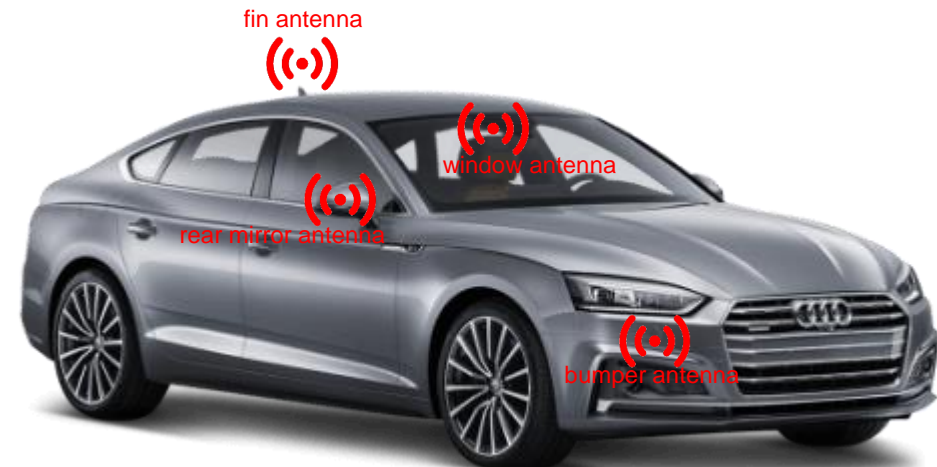
- Over the last 20 years the complexity of radio frequency equipment in automobiles has dramatically increased. Not only the number of radio systems has exploded, but also the communication expanded from broadcast to bidirectional voice and data.



- single antennas
- DIN housing
- 75 Ohm technology
- AM/FM only

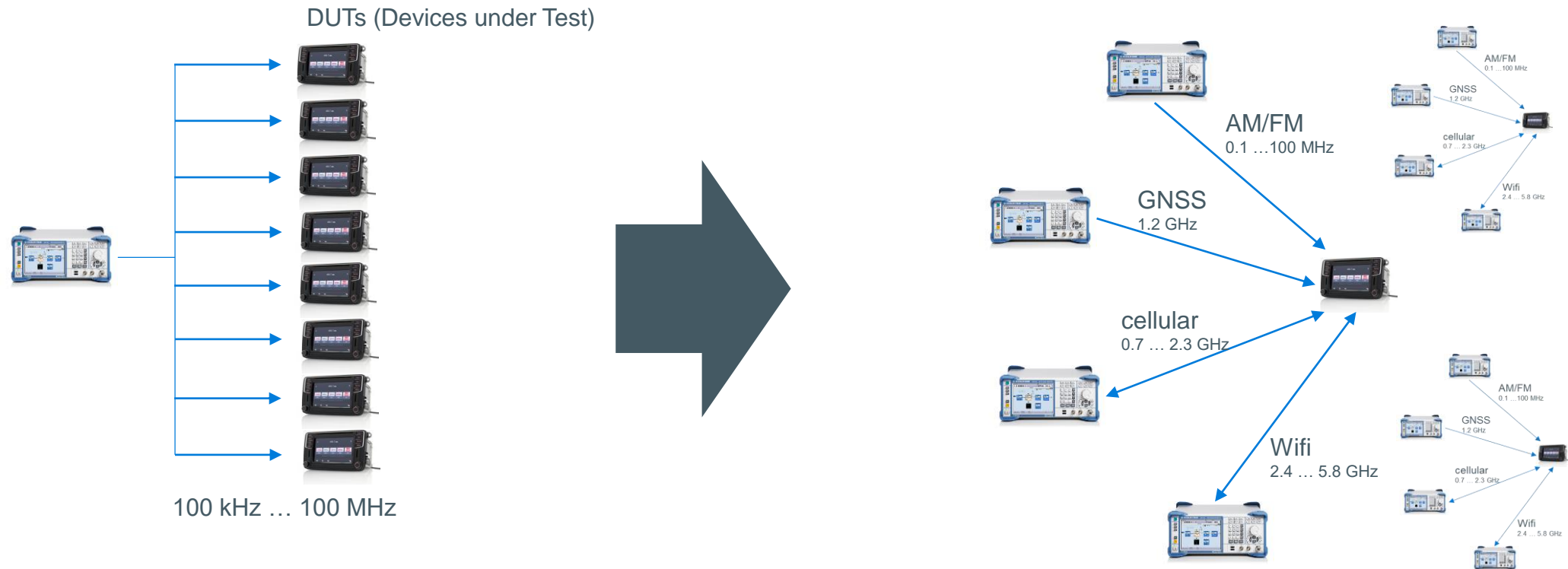


- many antennas
- dash-board built-in
- 50 Ohm technology
- broadcast/cellular/connectivity



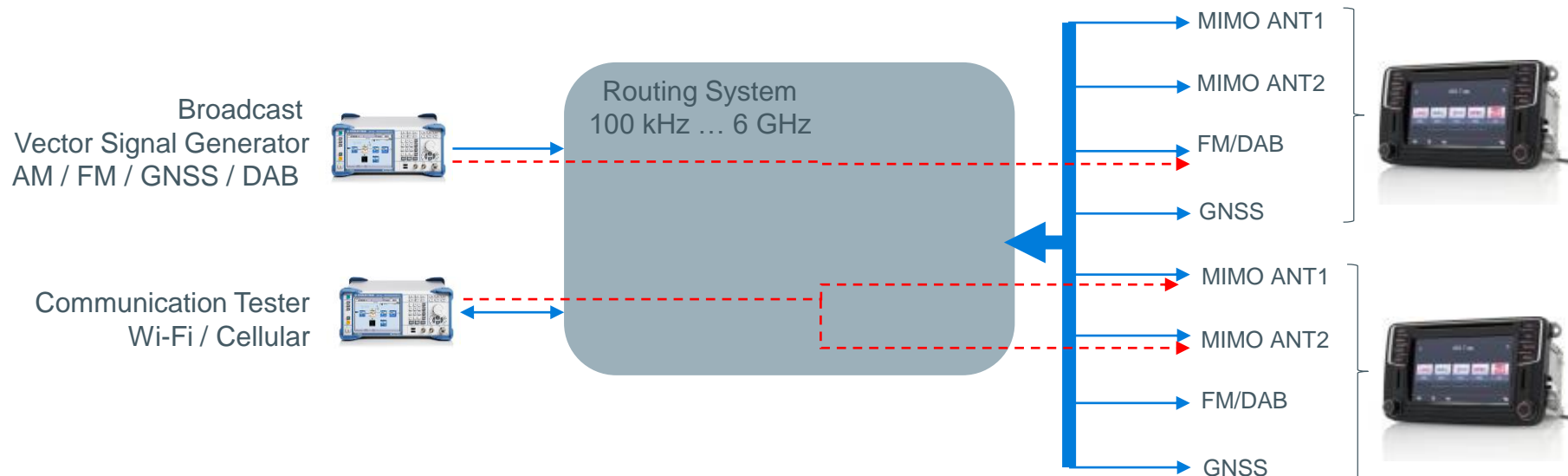
Impact on end of line testing

- End of line testing reflects the complexity of the system. Additional complexity comes from the huge range of frequencies to support (from AM 100 kHz to Wifi & LTE at 5GHz) as well from the fact that some systems are broadcast, some systems frequency duplex, some time duplex.



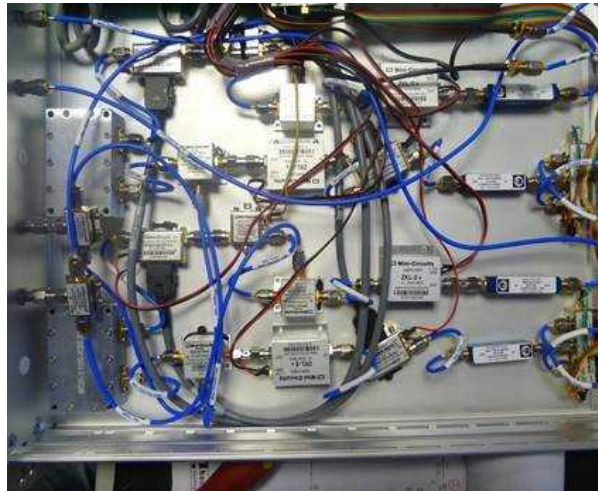
Complexity has reached the mass market

- Even basic cars support eCall, navigation, multiple radio systems (XM, FM), thus cost pressure in the industry requires a simplification of the test setup.
- Measurement equipment is expensive. New equipment supports multiple communication systems in one device.
- Cost saving comes from sharing expensive equipment among multiple DUTs. “utilization time” of the measurement equipment must be optimized by parallel usage.



Routing challenge

- The classical way to implement the routing of RF signals from measurement equipment to DUT (and back in the case of bidirectional communication) often looks like this:



Example RF routing.

- Wilkinson splitters
- BIAS-Ts
- RF Switches

and LOTS of RF, power and control cables

- One-time design, one time use. Effort-intensive to create, maintenance-unfriendly in case of failure. But absolute freedom of design with respect to the routing requirements.

Two modern solutions

Flexible modular approach

- Combining more complex functions into macro building blocks assembled in system rack (19" 6U)
- Addressing high complexity applications including signal conditioning (attenuators, amplifiers, filters)
- Integrating power supply and LAN connectivity
- Easy assembly and maintenance
- Lossless in signal level for broadcast.



Each slot contains a functional unit often containing parallel paths: e.g. 4 channel programmable current sinks

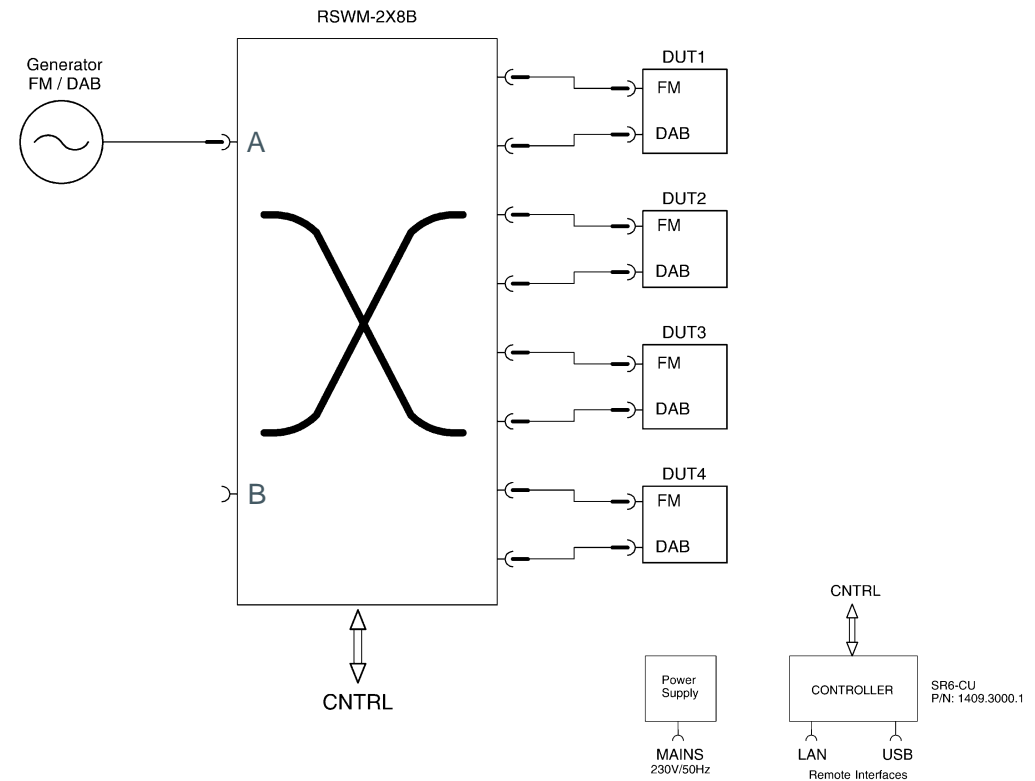
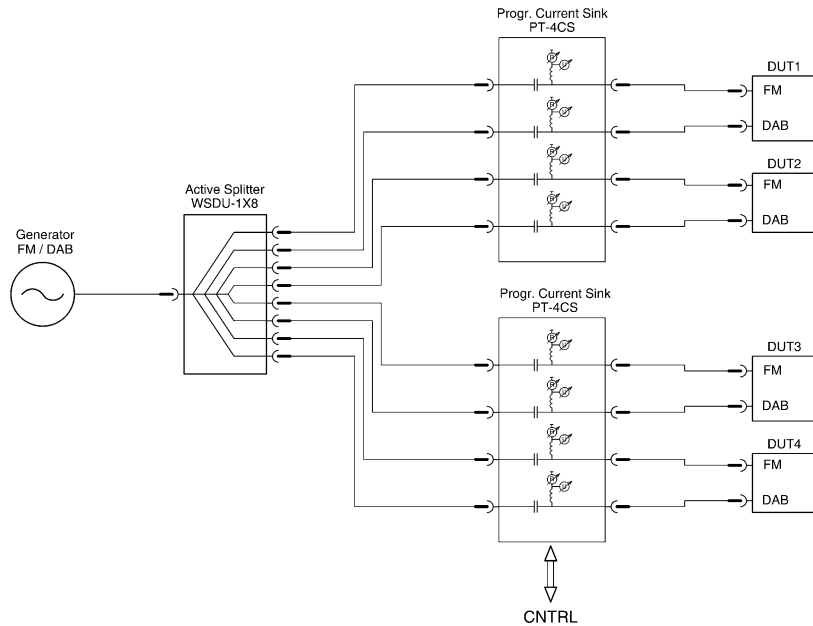
Compact (19", 1U) single unit routing approach

- Non-blocking passive cross matrix, 100 kHz ... 6 GHz
- Integrating power supply and LAN connectivity
- Absolute flexibility in routing two measurement devices to 8 infotainment unit antenna ports, covering many simple scenarios
- Compact form factor integrating voltage independent antenna loads and phantom voltage measurement, DAKKS calibration.
- Each antenna port can be individually selected for MIMO applications: connected to A, B, or no source (50 Ω)
- All unused ports are automatically impedance matched
- Typical insertion loss 30 dB, typical isolation between ports 35 dB.

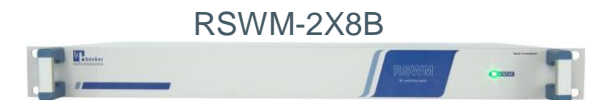
RSWM-2X8B



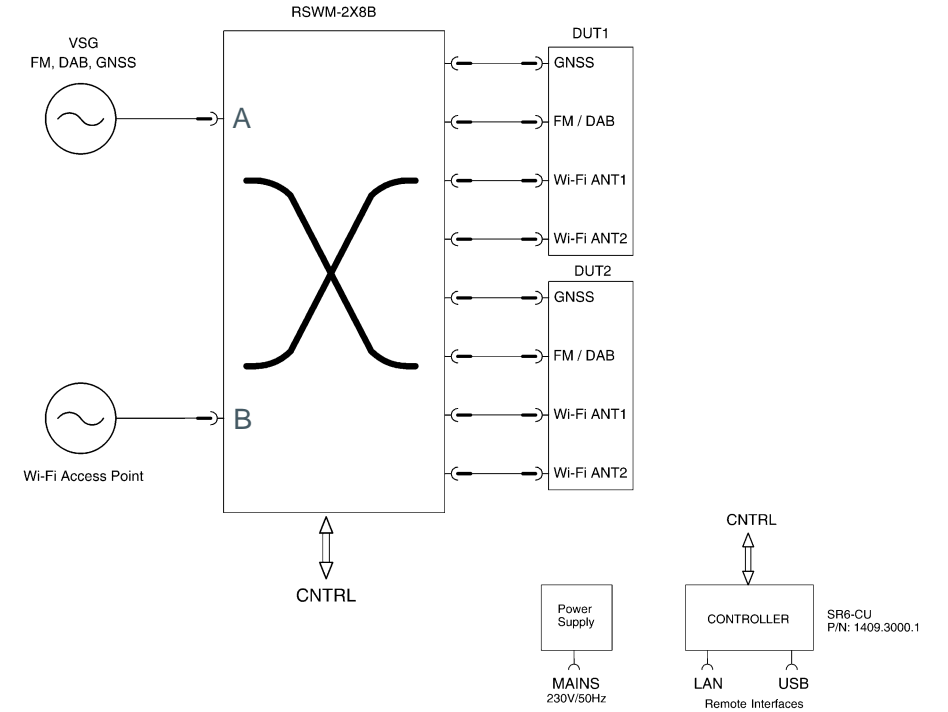
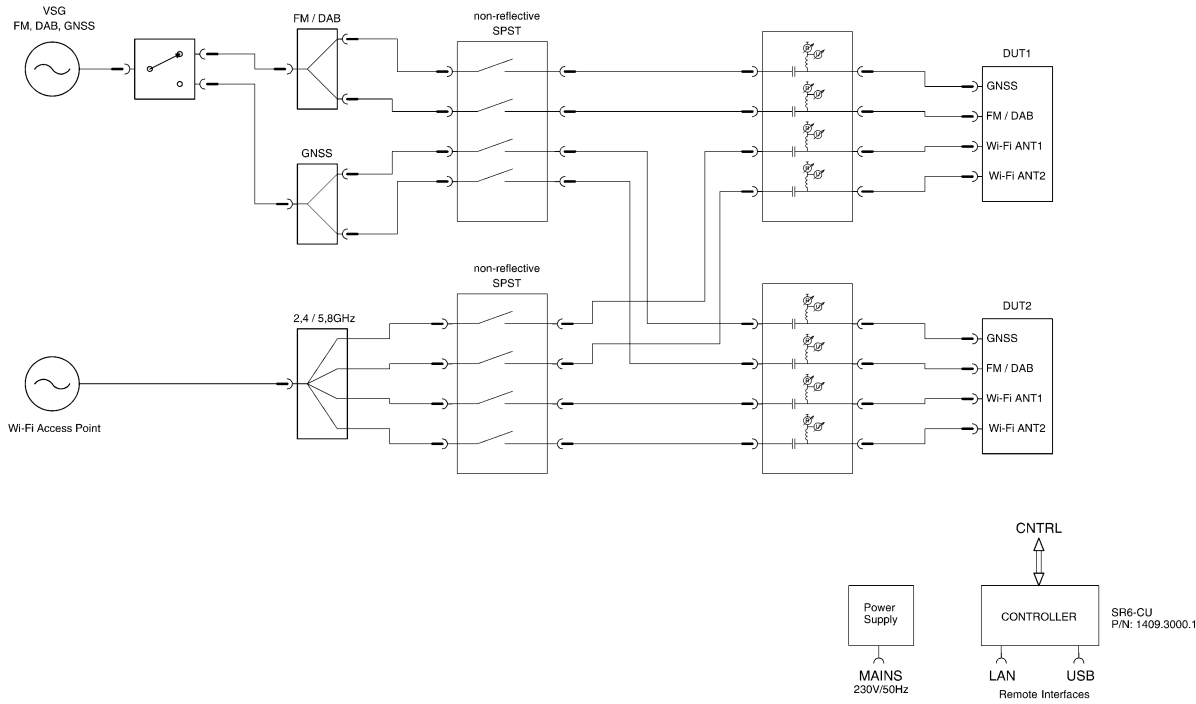
Application: broadcast-only application



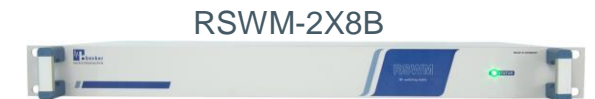
Can be extended with
signal conditioning units



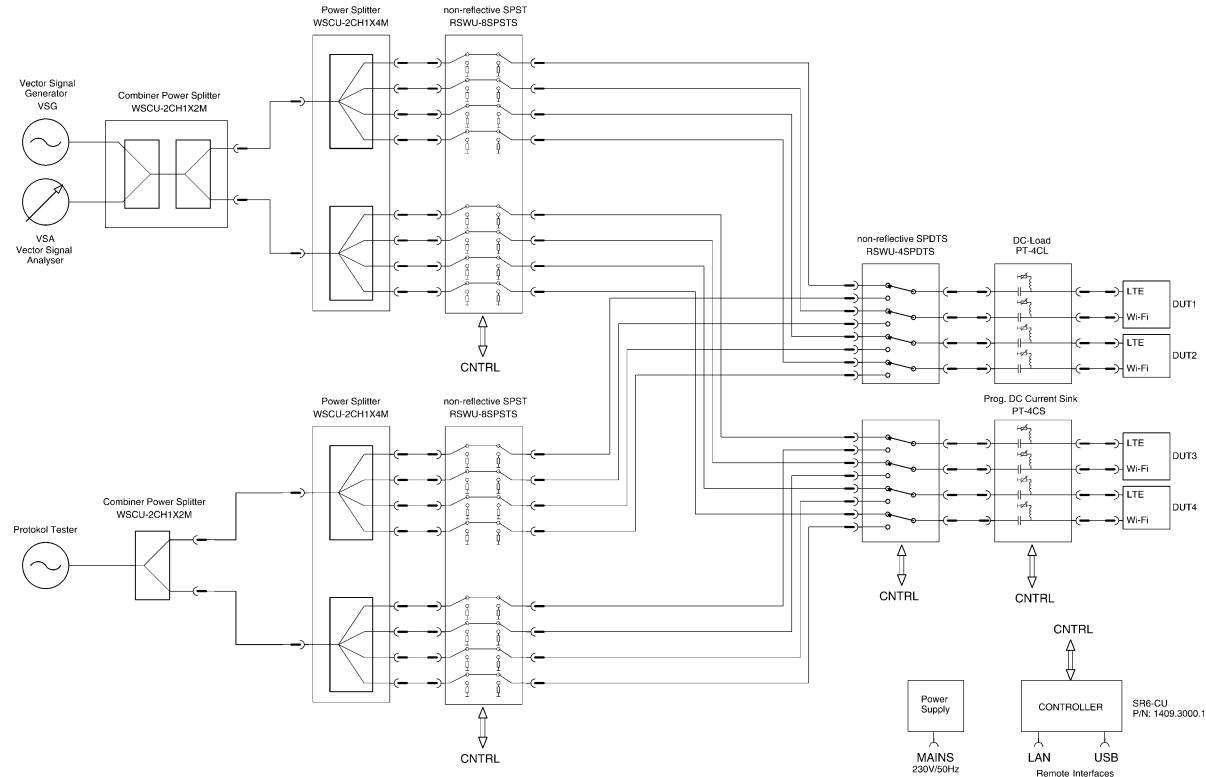
Application: mixed broadcast / connectivity application



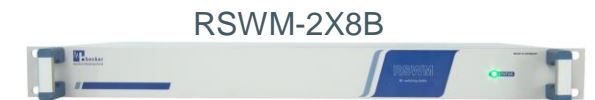
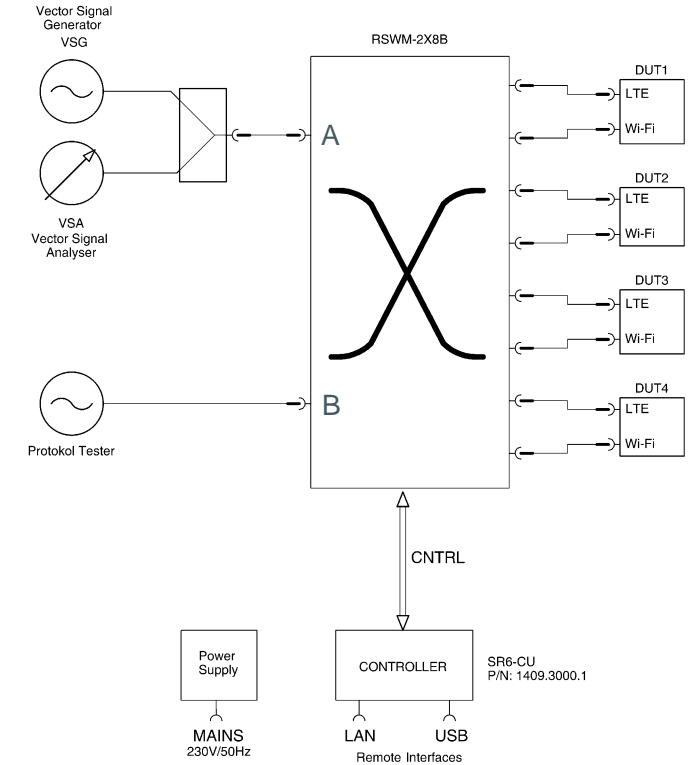
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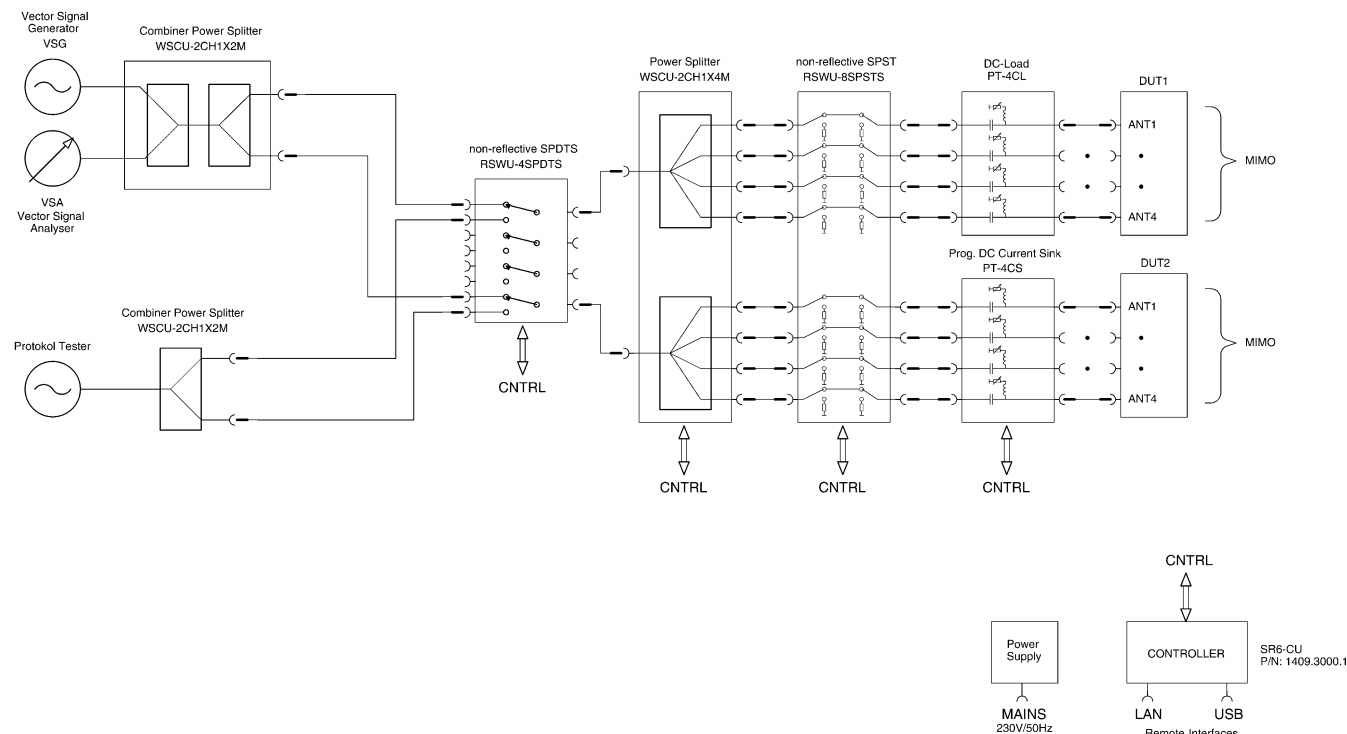
Application: Wifi + cellular testing setup



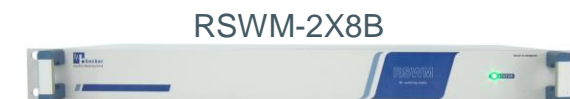
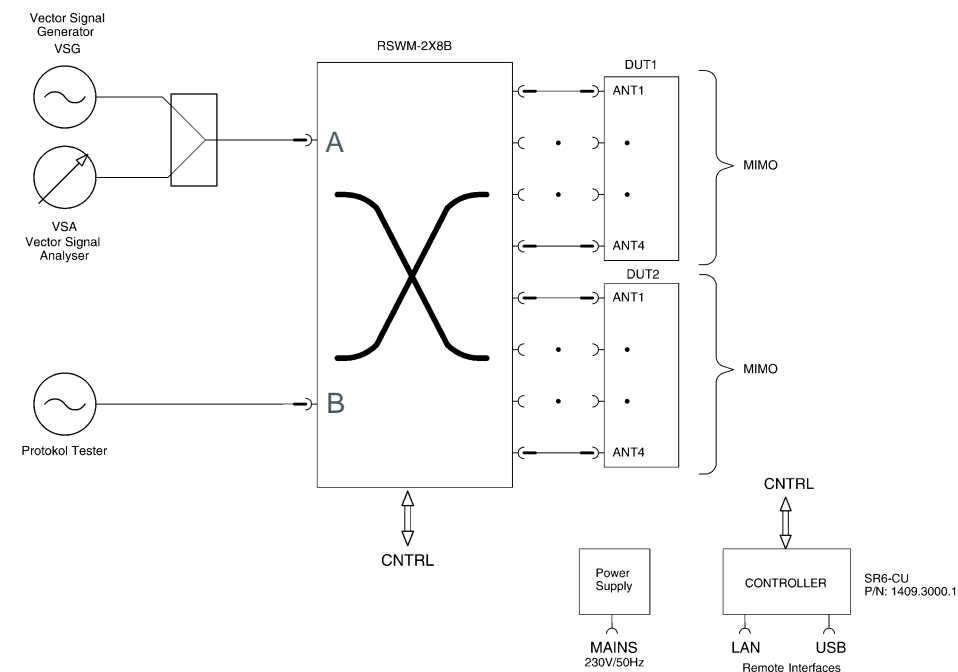
Can be extended with
signal conditioning units



Application: cellular MIMO testing setup



Can be extended with
signal conditioning units





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