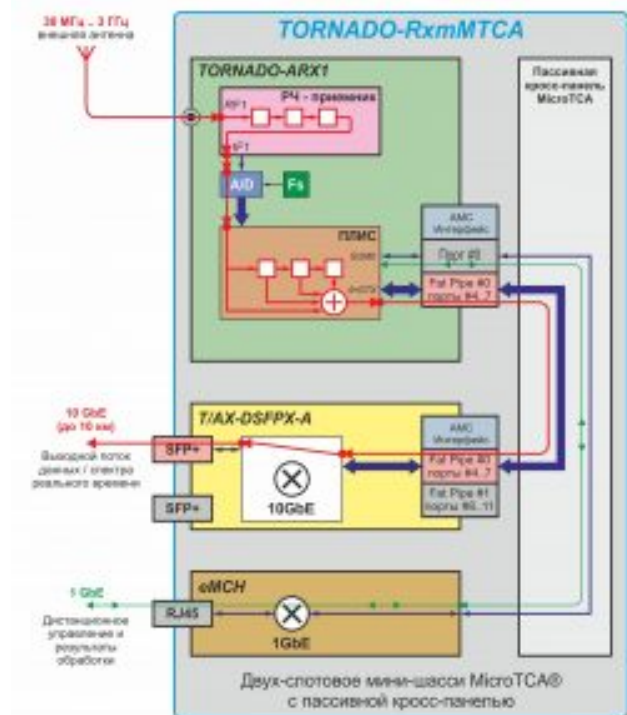


One of the most advanced approaches to design of distributed multichannel wideband systems of radio control, radio monitoring and radio intelligence is a modular approach implemented according to a certain international standard.

Meeting the modern requirements, *Radioservice* and *MicroLAB Systems* companies have developed a totally new equipment of radio monitoring – *TORNADO-RxMTCA®* with a modular design, which allows a customer himself to define the structure of a multichannel distributed system according to the tasks to perform.

TORNADO—RxMTCA® radio monitoring equipment is designed on the basis of the newest *TORNADO-ARX1®* AMC-module made in PICMG AMC.0 R2.0 (Advanced Mezzanine Card) standard, 12GHz and 24 GHz optional and external controlled converters of *Radioservice*, ultra-high performance DSP/FPGA *TORNADO-A6678®* AMC-modules and *T/AX-DSFPX* AMC-modules of long-range network 10GbE fiber-optic communication of *MicroLAB Systems*. The system can also use standard infrastructure components of module systems of PICMG MicroTCA.0 R1.0 (Micro Telecommunications Computing Architecture) standard, including different MicroTCA chassis, modules of management controllers MCH and eMCH with built-in switches and modules of power supply (PM). For today, PICMG 3.0, AMC.0 and MicroTCA.0 industrial standards intended for a modular design of telecommunications equipment are considered to be the most advanced in terms of compact design, modularity, hardware and speed of inter-module serial interfaces (10Gbps, 40Gbps, 100Gbps), and highly reliable due to redundancy and hot swapping. The hardware of MicroTCA® standard is widely used for design of base stations of mobile service and 3G and 4G wireless access.



Picture 1 (click on
photo to zoom)



Photo 1 (click on photo to zoom)

TORNADO-ARX1® AMC-module (pic. 1) contains a submodule of monitoring RF-receiver (30MHz...3GHz) developed by *Radioservice* and a carrier AMC-module developed by *MicroLAB Systems*.

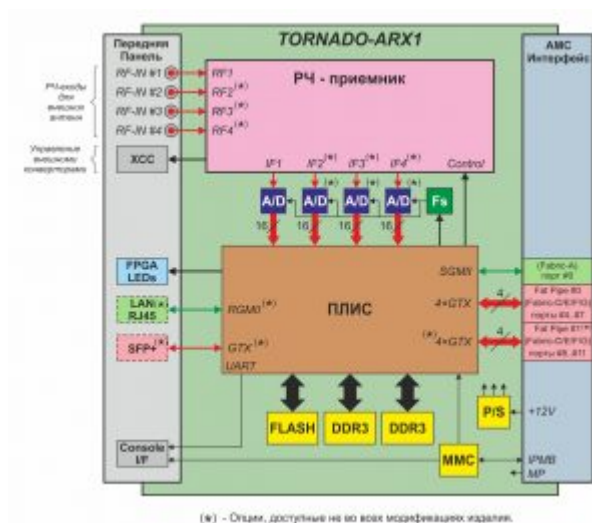
The RF-receiver has the structure of a classic superheterodyne receiver with double frequency conversion and IF bandwidths of 24MHz or 32MHz, including the system of preselectors

The carrier AMC-module includes up to four 16-bit ADC, controlled generator of sample rate with low noise and high stability, FPGA, optional external ports 10+GBps SFP+ and LAN 1GbE RJ-45, as well as MMC (module management controller) and secondary power supply sources. FPGA performs functions of a high-speed DSP processor, management controller for DSP processor and RF-receiver, two fast AMC-interfaces of inter-module communication (Fabric-D/E/F/G AMC.2 10GBASE-BX4 and 40GBASE-CX4, AMC.4 4x 5Gbps Serial RapidIO, AMC.1 4x 5Gbps PCIe), management LAN-port #0 Fabric-A 1GbE of AMC-interface, and optional external SFP+ and LAN ports

Speed of monitoring of *TORNADO-ARX1*® AMC-module reaches 160 GHz/s, which allows registering short RF-signals and then analyzing them remotely from the module's memory

The application software of *TORNADO-ARX1*® AMC-module is designed on the basis of module principle and includes program modules of spectral analysis, detectors of different signals and measurement of their parameters, demodulators, etc. Modules for software operation are loaded to the FLASH-memory of AMC-module through any of LAN ports and are started automatically in the needed configuration upon switching the power supply on. Software modules are configured according to the functional purpose of a certain device. If it is necessary, a customer can purchase additional software modules.

On the basis of *TORNADO-ARX1*® AMC-module it is rather easy to develop multichannel systems of radio monitoring and multiposition direction finding of signal sources.



Picture 2 (click on photo to zoom)



Photo 2 (click on photo to zoom)

Design of a basic compact device of remote multichannel radio monitoring is presented in pic.2. The device includes *TORNADO-ARX1*® AMC-module with optional external converters of 12GHz and 24GHz, *T/AX-DSFPX-A* AMC-module of long-range network 10GbE fiber-optic communication, Micro-TCA® two-slot mini chassis with passive cross-panel without switch of streams. Device dimensions are W240xD320x4H3mm, weight is about 2kg. It is controlled remotely via IP-network and 1GbE LAN-port chassis (including via Wi-Fi), and RF-data is transmitted through one or two 10GbE fiber-optic connections at a distance of up to 10km with a help of *T/AX-DSFPX* ACM-module.

It is possible to unite an unlimited number of such devices into one system of radio monitoring with common processing center. As *TORNADO-ARX1*® and *T/AX-DSFPX* AMC-modules support PTP protocol, the whole system synchronizes at the same time with nanosecond accuracy, which allows creating direction finding systems on their basis.

The device described above is rather simple but using it we can create a more sophisticated ultra-high performance radio monitoring equipment with powerful local DSP. The device and its design are presented in pic. 4. It is controlled remotely and includes two AMC-

modules of *TORNADO-ARX1*® multichannel radio monitoring with optional external converters of 12GHz and 24GHz, ultra-high performance DSP/FPGA *TORNADO-A6678*® AMC-module, *T/AX-DSFPX* AMC-module of long-range 10GbE fiber-optic communication, 6-slot 19" 1U MicroTCA® chassis, module of management controller (MCH) with 10GbE stream switch and power supply module (PMU). This device is also controlled remotely via IP-network and 1GbE LAN-port chassis, and real-time data and processing results are transmitted through four 10GbE fiber-optic connections at a distance of up to 10km with a help of *T/AX-DSFPX* AMC-module and SFP+ ports of management controller (MCH).

TORNADO-ARX1® AMC-module is considered to be unique because it is capable of operating in autonomous mode without any other AMC-modules and components of MicroTCA systems, even without chassis. It is required to install *TORNADO-ARX1*® module into a special compact housing, which contains only a power supply source, and connect AMC-module to the local IP-network through optional LAN-port. In case of real-time reception of unprocessed RF-data, it is also necessary to connect to a 10GbE SFP+ port of AMC-module using a 10Gbps SFP+ module of fiber-optic transceiver at a distance of up to 100m. An unlimited number of such autonomous compact devices of local radio monitoring can also be united into one system.

All the described devices of radio monitoring on the basis of *TORNADO-ARX1*® AMC-module use the same software of AMC-module, and a customer can redesign the system combining the needed number of *TORNADO-ARX1*® AMC-modules with other AMC-modules and infrastructure components of MicroTCA systems depending on the tasks to perform.

Thus, it is possible to create a radio system as a set of modules that operate autonomously and are connected by high-speed communication channels for long distances. We consider the system a single and unique organism that features standard components, the number of which is unlimited. For additional information, please refer to the website of our partners: <http://mlabsys.ru>