



**Technologies**

**ARINC 664p7 End Systems  
Product Overview**

In partnership with TTEch



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## Avionics Interface Technologies ARINC 664p7 Product Overview

### GENERAL FEATURES

Avionics Interface Technologies offers advanced ARINC 664p7 products designed to reduce system complexity and ease integration. Our PMC664, XMC664, PCI-C664, PCIe-C664 and cPCI-C664 modules are full function ARINC 664p7 test and monitoring end systems. The innovative board design includes maximum processing capability, powerful memory resources, and customized ARINC 664p7 MACs. This provides users with optimum capability for demanding ARINC 664p7 applications. The boards can be configured for standard ARINC 664p7 or for the Boeing 787 mode of operation.

Each AIT ARINC 664p7 board includes two ARINC 664p7 ports that can be configured separately or as one dual redundant port. Each port can operate as a 10/100/1,000 Mbit full duplex Ethernet interface. The two ports can operate concurrently in Traffic Generator and Receiver/Monitor modes.

Each AIT ARINC 664p7 board supports up to 128 simultaneous Transfer (Tx) Virtual Link (VL's). Special care has been taken to making sure the board supports the ARINC 664p7 Tx VL requirement for 40msec latency from the time an application writes to a port until the message actually comes out on the network. The boards also supports up to 512 simultaneous Receive (Rx) VLs. This includes ARINC 664p7 port-related monitoring features including time-stamping each captured packet.

AIT's ARINC 664p7 architecture is based on two field-proven FPGA hardware (NIOS) processors and large onboard memory to implement large receive buffers and complex Tx scenarios onboard. Two ARINC 664p7 SFPs implement two full duplex copper or fibre optic ports for connection to ARINC 664p7 networks.

### SOFTWARE

Each AIT ARINC 664p7 board is shipped with an application programmer interface and drivers for Linux, Windows, or VxWorks. For test purposes, AIT has developed a powerful Graphical User Interface (GUI) Analyzer as well as an ARINC 664p7 end system test and validation tool.

The boards also work with the TTEch software tools suite for planning, loading, and verifying the End System on an ARINC 664p7 network.

### STANDARDS COMPLIANCE

- ♦ ARINC 664 Part 7
- ♦ IEEE 802.3
- ♦ SAE AS6802
- ♦ ARINC 653 (IMA applications) Queuing & Sampling
- ♦ RTCA DO-254 DAL A NIC Controller
- ♦ RTCA DO-178B DAL A Embedded Software
- ♦ RTCA DO-160F Environmental Ratings

### IP/UDP, QUEUING AND SAMPLING PORTS

The IP, UDP, and Queuing & Sampling ports are processed onboard in the embedded NIOS processors. Each board has two embedded NIOS processors. One is dedicated to receiving data and the other devoted to generation.

A flight-ready future release will replace the NIOS processors with IP/UDP/Queuing & Sampling all in FW (VHDL). This is necessary to certify the ARINC664 p7 end system for in-flight use.

### TRAFFIC GENERATION

- ♦ Superior performance: 1 Gbit/s data rate is ten times faster than the industry standard
- ♦ Traffic shaping using VL and Bandwidth Allocation Gap (BAG)
- ♦ Programmable BAG down to 500  $\mu$ sec
- ♦ Onboard BAG flow control
- ♦ Up to 128 Tx VL's and 512 Queuing & Sampling ports
- ♦ Simulation of multiple end systems via simulation of multiple source MAC addresses
- ♦ UDP port simulation and automatic sequence numbering
- ♦ Support for ARINC 653 sampling and queuing
- ♦ Transmit MAC, IP, and UDP statistics accessible locally via software application programmer interface and remotely via SNMP

### RECEIVE OPERATION

- ♦ ARINC 664p7 compliant integrity checking and redundancy management
- ♦ Up to 512 Rx VL's and 2048 Queuing & Sampling ports
- ♦ 1  $\mu$ sec frame time-stamp resolution
- ♦ Inter-frame gap measurements down to 40 nanosecond resolution
- ♦ Receive MAC, IP, and UDP statistics accessible locally via software application programmer interface and remotely via SNMP
- ♦ Verification of MAC, IP, and UDP headers
- ♦ Chronological Bus Monitor (BM) for receiving frames in time ordered sequence

### PHYSICAL INTERFACE

- ♦ Two physical ports
- ♦ Twisted pair or bi-directional fibre optic SFP transceivers
- ♦ Fixed 10/100/1,000 Mbit/s transmit rate or auto-negotiate
- ♦ Optional Rear I/O support

**ARINC 664p7 Development Switch, 100 Mbit/s, 8 Ports**

- ◆ Configurable time-triggered schedule for deterministic real-time communication
- ◆ Guaranteed real-time delivery and microsecond synchronization
- ◆ Standard Ethernet devices can synchronize to network time base without knowing about ARINC 664p7 network
- ◆ Concurrent operation of ARINC 664p7 messages with bag checking and standard Ethernet messages with IEEE 802.3 flow control
- ◆ Standard TCP/IP-based protocols and applications can be used
- ◆ Routing of ARINC 664p7 transmissions to non-ARINC 664p7 devices possible



**ARINC 664p7 Development Switch, 1 Gbit/s, 12 Ports**

- ◆ High-speed ARINC for development applications
- ◆ Concurrent operation of ARINC 664p7 messages with bag checking and standard Ethernet messages with IEEE 802.3 flow control
- ◆ 12 full-duplex 1Gbit/s ports
- ◆ Full power of the ARINC 664p7 switch IP
  - ◆ Eight subschedules
  - ◆ 16 clock sync masters
  - ◆ 4096 VL IDs
  - ◆ 256 shared BAGs
- ◆ Clock synchronization at sub-μs level
- ◆ 24 Gbit/s cross-sectional bandwidth (12 x full-duplex ARINC 664p7 links)
- ◆ Configuration is data programmable via the network with <sup>TTE</sup>Load
- ◆ Front panel JTAG connector



**Test & Simulation Module for Design/Development Programs**

**PMC664 TS  
PCI-C664 TS**

- ◆ Supports IEEE 802.3 10/100/1000 Mbit/s Full-Duplex Ethernet links
- ◆ Onboard integrity checking and redundancy management
- ◆ Onboard BAG flow control
- ◆ Supports up to 128 simultaneous Transfer VLs and 512 Receive VLs at full line rates
- ◆ 1024 Transfer COM ports, 4096 Receive ports
- ◆ Transfer and Receive MIB statistics available via SNMP
- ◆ Optional Rear I/O support
- ◆ Supports ARINC 653/IMA applications



**PMC664 TS**

**Gigabit Rugged Network End System**

**PMC664 ES  
XMC664 ES  
PCI-C664 ES  
PCIe-C664 ES  
cPCI-C664 ES**

- ◆ Supports 10/100/1000 Mbit/s full duplex ARINC 664p7 links
- ◆ Up to three channels using SFP connectors
- ◆ The NIC controller implements the ARINC 664 end system chip IP with two channels
- ◆ Three configurable traffic classes:
  - ◆ Time-Triggered traffic (TT), compliant with AS6802
  - ◆ Shaped traffic, compliant with ARINC 664 Part 7
  - ◆ Best-Effort traffic (BE), compliant with IEEE 802.3
- ◆ 128 send Virtual Links (VL), 512 receive VLs
- ◆ 1024 send COM ports, 4096 receive ports
- ◆ Flexible configurable periods (μs granularity)
- ◆ Profiled IP/UDP, sampled, and queued ports
- ◆ IP/UDP handled on hardware
- ◆ ICMP handling
- ◆ Diagnosis and status registers
- ◆ PCI bridge (PLX) and DMA support
- ◆ Optional Boeing 787 Operation Mode



**PCI-C664 ES**

## Deterministic Time-Triggered Ethernet Software Tools Suite



### **TTEBuild**

**The Tool for Producing Configuration Files for End Systems and Development Switches**

TTEBuild is a software tool that supports the generation of hardware-dependent device configuration data for TTEDevelopment Switches and End Systems. It takes a device configuration XML file as input and generates the binary configuration image as output ready for download. The XML schemas used to describe these specifications are fully documented and allow a high level of flexibility when TTEBuild is integrated with third-party tools or customer-specific tool chains. The XML schema was designed to make manual editing of the configuration file easy. TTEBuild is a batch tool that is integrated in the Eclipse IDE and packaged as a plug-in. It is also usable as a stand-alone command line tool.



### **TTEView**

**Protocol Dissector for Wireshark**

TTEView is capable of monitoring, recording, and dissecting Ethernet traffic, including ARINC 664p7 and Ethernet data. It is a plug-in to Wireshark™, an open-source Ethernet protocol analyzer that has been enhanced to dissect and display TTEthernet-specific frames. It supports recording and analysis of more than 300 Ethernet and Internet protocols. With the TTEFrame Dissector plug-in for Wireshark™, users can monitor Ethernet traffic in a proven and high-performing low-cost environment. It is best used in conjunction with the TTEMonitoring Switch and the TTEMonitoring System for high-performance traffic monitoring and displaying without frame loss.



### **TTELoad**

**The Tool for Downloading Configuration Files into Network Components**

TTELoad is capable of configuring the TTEDevelopment Switch by downloading the binary configuration image to the switch. TTELoad connects to the management interface of the switch and performs a safe unlocking procedure before reprogramming the static configuration memory of the TTEDevelopment Switch. It also supports bootstrap configurations of TTEDevelopment Switches and can be used as a batch tool.



### **TTEVerify**

**The Tool for Automating Reviews of Configuration Implementations**

TTEVerify is a verification tool for automating reviews of configuration implementations against their requirements. This software tool ensures that the binary configuration file has been assembled exactly according to the bit-level specification defined in the device configuration XML file. A traceability report that is sufficient to satisfy automation of DO-178B "code review" requirements for the configuration files is generated. The tool is applicable to both switch and end system configurations.

### **ARINC 615A Data Loader**

AIT's ARINC 615A Data Loader (A615A-LDR) is a software tool supporting TFTP/615A data loading with AIT's ARINC 664p7 modules or via the network interface of a standard PC/Laptop.

- ◆ Easy to use GUI for Windows 2000/XP
- ◆ Multiple, Simultaneous Data Loading Operations
- ◆ Supports Data Loading over standard Ethernet and ARINC 664
- ◆ Support for ARINC 615A-1 and 615A-2
- ◆ Save and Load Configuration and Download Files
- ◆ Configurable connections to Target at TFTP and 615A Levels
- ◆ TFTP Message Logging
- ◆ DLP Protocol File Logging
- ◆ Quick Look Download Status Displays/ Error Warnings

# TTTech

Time-Triggered Ethernet products offered  
in partnership with TTTech North America

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