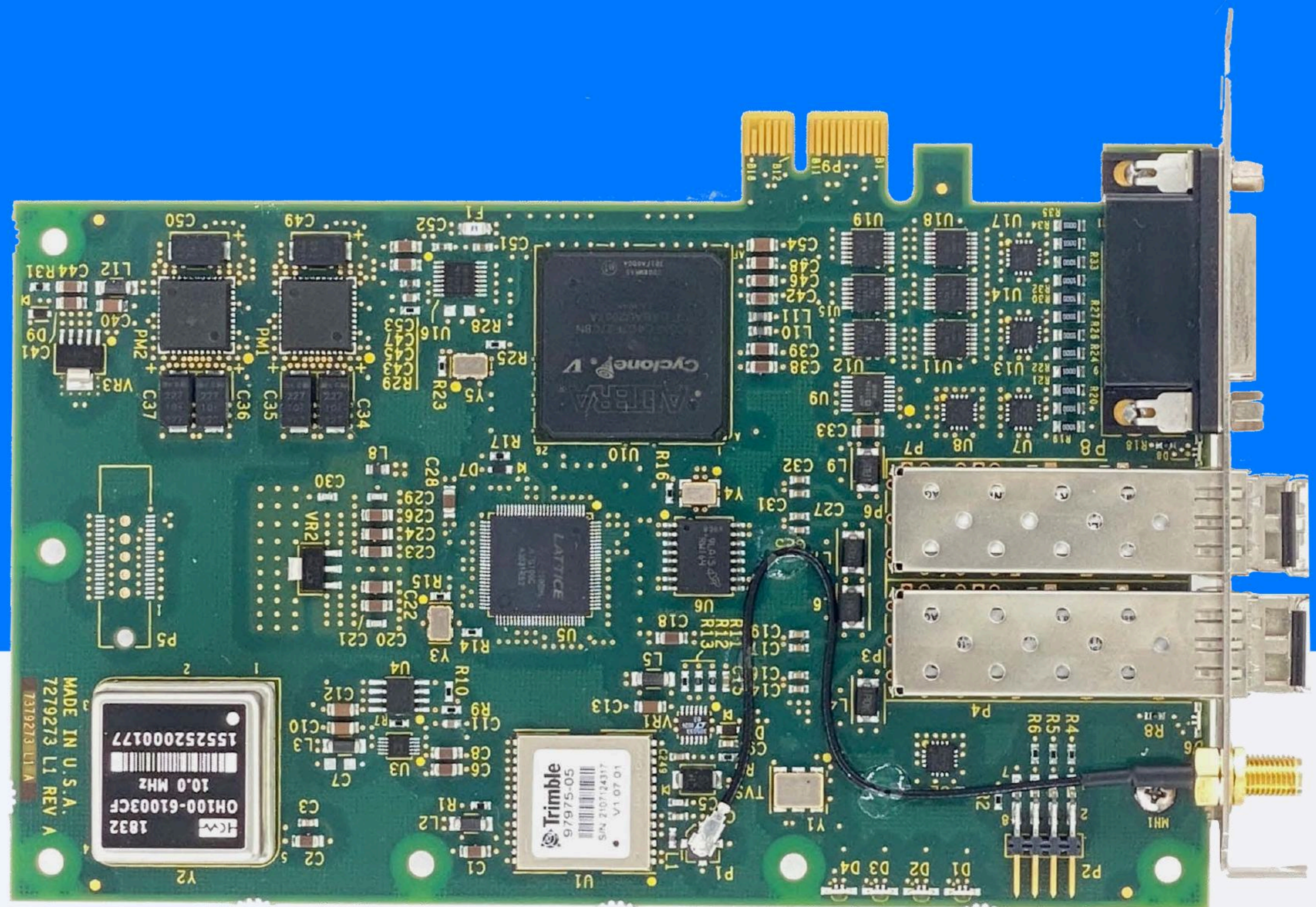


## Real-Time Clock & Interrupt Module (RCIM IV)

The Real-Time Clock & Interrupt Module (RCIM IV) is a multifunction card designed for time-critical applications on Concurrent Real-Time's iHawk™ multiprocessing systems. The RCIM provides key functionality for single system as well as multiple system applications. Ideally suited for simulation, data acquisition and industrial control solutions, the RCIM includes a synchronized clock, eight programmable real-time clocks, and twelve input or output external interrupt lines. The RCIM mounts in a standard iHawk PCIe slot and is fully supported by Concurrent's RedHawk™ Linux® real-time operating system.



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## Features:

- ◆ Deterministic event synchronization among multiple CPUs and systems
- ◆ Synchronized clock readable by all application tasks
- ◆ Eight interrupt-generating real-time clocks
- ◆ Clock synchronization to external time sources
- ◆ Twelve edge-triggered input or output external interrupt lines
- ◆ Twelve inter-CPU interrupts generated by real-time clocks or software
- ◆ GPS synchronization option
- ◆ IRIG B timecode option
- ◆ High-accuracy Stratum 3E OCXO crystal-controlled oscillator option
- ◆ RedHawk Linux and NightStar™ tool support
- ◆ Custom-engineered solutions

## Real-Time Clocks

The RCIM includes eight 32-bit, programmable, POSIX-compliant, real-time clocks. The clocks are programmable to several different resolutions which, when combined with a clock count value, provide a wide range of timing intervals. The minimum resolution is one microsecond. The real-time clocks are decrementing counters that generate an interrupt each time they reach zero. Real-time clocks may be one-shot or periodic. If periodic, the original clock value is automatically reloaded into the counter each time zero is reached and the clock again begins decrementing. This feature makes the real-time clocks ideal for running processes at a given frequency (e.g., 600 Hz)

## External Interrupts

Each RCIM board has twelve input or output external interrupt lines individually selectable as input or output by an application. Input interrupts are called Edge Triggered Interrupts (ETIs), so named after their most common mode of operation. These lines permit users to provide their own interrupt sources to an iHawk system. The RCIM processes and delivers these interrupts to the host system and, if configured to do so, routes and delivers interrupts to all other RCIMs in the chain as distributed interrupts.

Each ETI can be configured independently of the others. An ETI may treat the incoming signal as an edge or level sensitive interrupt. If edge sensitive, it may raise an interrupt on either the rising or the falling edge. If level sensitive, it may raise interrupts for either the high or the low signal value. Configuration parameters are selected when the RCIM board and driver are initialized, and remain constant for the life of the driver. Applications can dynamically arm or disarm, enable or disable, select edge or level sensitivity and select the polarity of each ETI individually, as appropriate to the needs of the application.

## Processor Synchronization

The RCIM provides fully deterministic event synchronization for applications that utilize multiple iHawk systems. The RCIM allows these systems to be chained together so that applications can direct both external and clock interrupts to other CPUs for fast inter-CPU event notification. RCIM interrupts can be triggered by hardware events or be generated by user software. The synchronized clock on each RCIM can be initialized by a designated master to provide a common, high-resolution time base for processes running on all connected systems. On-the-wire time stamps allow Red-Hawk Linux to provide for high resolution NTP synchronization between systems.

## Synchronized Clock

The RCIM's synchronized clock is a 64-bit, non-interrupting, free-running counter that uses the POSIX 1003.1 format. The synchronized clock's high order 32 bits are encoded in seconds, and the low-order 32 bits are encoded in nanoseconds. The clock ticks at 400 nanoseconds. Upon boot load of an RCIM-connected network, a designated master RCIM clears the synchronized clock on all RCIMs and issues an enable signal that simultaneously starts each clock. Application programs on all CPUs are then able to read a common time value. Individual RCIMs can be programmed to ignore the master synchronization signal and use their own synchronized clocks independently..

## Distributed Interrupts

Distributed interrupts are signals sent from one RCIM to another via the RCIM synchronization cable. Each RCIM has twelve distributed interrupt inputs and twelve distributed interrupt outputs. Distributed interrupts can be generated by an RCIM's real time clocks, by its external edge-triggered input lines or by software. This feature allows an external event received by one CPU to be sent to one or more other CPUs.

## Optional GPS Synchronization

An optional, on-board GPS module is available for aligning the RCIM's synchronized clock to GPS standard time. One GPS-equipped RCIM can synchronize all iHawks in an RCIM chain. GPS and Multi-GNSS antenna modules are also available for direct input of signals to multiple systems. Multiple RCIMs equipped with the GPS module can provide a common time base without any cable connections between iHawk systems. POSIX timers based on absolute GPS time can be used to simultaneously start

## IRIG Timecode Option

RCIM offers an IRIG time code option for transferring timing information in accordance with IRIG Standard 200-16. The RCIM IRIG option supports IRIG-B formats 024 or 124. Timing information can be distributed as a DC level shift (DCLS) pulse-width coded signal or as an amplitude-modulated signal based on a sine wave carrier with a frequency of 1 KHz.

## Connectors and Cabling

RCIM options include optical synchronization cables for daisy chaining a master RCIM to one or more slave RCIMs. Any number of iHawk systems can be linked by RCIM synchronization cables. A connector is mounted on each RCIM for connection to external interrupts. Customized connectors and cable lengths are configurable upon request.

## Software Support

Concurrent's RedHawk Linux allows application developers to take full advantage of RCIM features. Users can read the synchronized clock, disable and enable individual interrupt lines, send interrupts to external locations, and direct incoming interrupts to user-specified application code. In multiple system applications, Concurrent's NightTrace™ analyzer tool can utilize the RCIM's synchronized clock to log system events using a single clock source. Concurrent's NightSim application scheduler can also make use of RCIM realtime clock interrupts to synchronize frequency-based scheduling among application modules running on multiple CPUs and systems.

## Custom Engineering Support

Concurrent Real-Time's Custom Engineering group is available to design and deliver solutions for customers who require features and functionality not included in Concurrent catalog products. Concurrent engineers can build special packaging, integrate third-party boards, develop drivers, and provide hardware and software designed to exact customer specifications.

## Specifications

### Synchronized Clock

Length: 64 bits (two 32-bit words) Resolution:

- High-order 32 bits - 1 second
- Low-order 32 bits - 400 nanoseconds

Accuracy:  $\pm 2.5$  PPM

OCXO Frequency Stability Option:  $\pm 10$  PPB

### Real-Time Clocks

Number: 8

Length: 32 bit

Resolution: 1 microsecond (programmable to larger values)

Accuracy:  $\pm 2.5$  PPM

### External Interrupts

12 External edge-triggered input or output  
3.3V or 5V TTL signals  
Standard DB-26 connectors  
Switchable 100 Ohm termination

### Distributed Interrupts

12 Input  
12 Output

### Interrupt Response Time

Interrupt to user process: <8 microsec-

### GPS Antenna Options

GPS-only  
Multi-GNSS (supports GPS, GLONASS, Galileo & Beidou)

### Irig Interface

Format: IRIG-B 024 or 124  
AM (amplitude modulated) or DCLS (DC level shift)

Input Specifications: \*

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- AM 1 to 10V peak-to-peak (auto ranging)
- AM 1KHz 2:1 to 6:1 ratio
- AM 4K ohm load AC coupled
- DCLS 3.3/5V TTL >2V high <0.8V low
- DCLS 100 ohm switchable termination

### Output Specifications:

- AM 2.5, 5 or 8V peak-to-peak (selectable) into 50 ohms
- AM 1KHz at 3:1 ratio
- AM Accuracy +/-10uS
- DCLS 0.5V Vol (max) and 2V Voh (min) into 100 ohms
- DCLS Accuracy +/-1uS
- DCLS Up to twelve outputs
- Reference offset adjust range 0 to -65uS (400nS resolution)

### PACKAGING

Form Factor: Full-height, half-length PCIe

Performance:

PCIe 1.0 x1

Maximum cable length between RCIMs: >100 feet

### ENVIRONMENTAL

Operating Temp: 10° to 55° C

Storage Temp: -40° to 70° C

Relative Humidity: 10 to 90% (noncondensing)

RoHS compliant

## Ordering Information:

- ◇ **CPRC4-4**  
RCIM IV Real-Time Clock & Interrupt Module
- ◇ **CPRC4-4GPS**  
RCIM IV w/GPS Option
- ◇ **CPRC4-4GPS-IRG**  
RCIM IV w/GPS and IRIG Options
- ◇ **CPRC4-4GPS-PPM**  
RCIM IV w/GPS and Oscillator Options
- ◇ **CPRC4-4GPS-PPM-IRG**  
RCIM IV w/GPS, IRIG and Oscillator options
- ◇ **CPRC4-4IRG**  
RCIM IV w/IRIG Option
- ◇ **CPRC4-4PPM**  
RCIM IV w/Oscillator Option
- ◇ **CPRC4-4PPM-IRG**  
RCIM IV w/Oscillator and IRIG Options
- ◇ **CX-DB26-4**  
RCIM IV Interface Assembly
- ◇ **CX-DB26-DIN-4**  
RCIM IV Interface Assembly with DIN Mounting
- ◇ **HS002-4CBL-IRG**  
RCIM IV IRIG Breakout cable
- ◇ **HS002-3CBL-x**  
RCIM Optical Synchronization Cables

### About Concurrent Real-Time:

Concurrent Real-Time is the industry's foremost provider of high-performance real-time computer systems, solutions and software for commercial and government markets.