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Find the *Microsemi / Symmetricom / Datum bc635PCI-V2* at our website: *Click HERE*

# bc637PCI-V2

**GPS Synchronized, PCI Time & Frequency Processor**

### KEY FEATURES

- GPS synchronized with 170 nanosecond RMS accuracy to UTC
- IRIG A, B, G, E, IEEE 1344, NASA 36, XR3 & 2137 Time Code Inputs and Outputs
- Simultaneous AM or DCLS Time Code Inputs
- Simultaneous AM and DCLS Time Code Outputs
- 100-nanosecond clock resolution for time of day requests
- Programmable <<1 PPS to 100 MPPS DDS Rate Synthesizer Output/Interrupt
- 1, 5, or 10 MPPS Rate Generator Output
- 1 PPS or 10 MHz Inputs
- External Event Time Capture/Interrupt
- Programmable Time Compare Output/Interrupt
- Zero Latency Time Reads
- Battery Backed Real Time Clock (RTC)
- PCI Local Bus Operation
- Universal Signaling (3.3V or 5.0V Bus)
- CE(RoHS) Compliant
- Linux, Solaris & Windows Software Drivers/SDKs available

The Symmetricom® GPS referenced bc637PCI-V2 timing module provides precise time and frequency to the host computer and peripheral data acquisition systems. Precise time is acquired from the GPS satellite system or from time code signals. GPS synchronization provides 170 nanosecond RMS accurate time to UTC (USNO) and enables the bc637PCI-V2 to be an ideal master clock for precisely synchronizing multiple computers to UTC.

Central to the operation of the module is a disciplined 10 MHz oscillator that is either an on-board TCXO (or optional OCXO) or an off-board External oscillator that can provide the timing module's 100-nanosecond clock. Current time (days to 100 nanoseconds) can be accessed across the PCI bus with no PCI bus wait states, which allows for very high-speed time requests. The selected on-board or off-board 10 MHz oscillator drives the module's frequency and time code generator circuitry. If the input reference is lost, the module will continue to maintain time (flywheel) based on the selected 10 MHz oscillator's drift rate. If power is lost, a battery-backed real time clock (RTC) is available to maintain time.

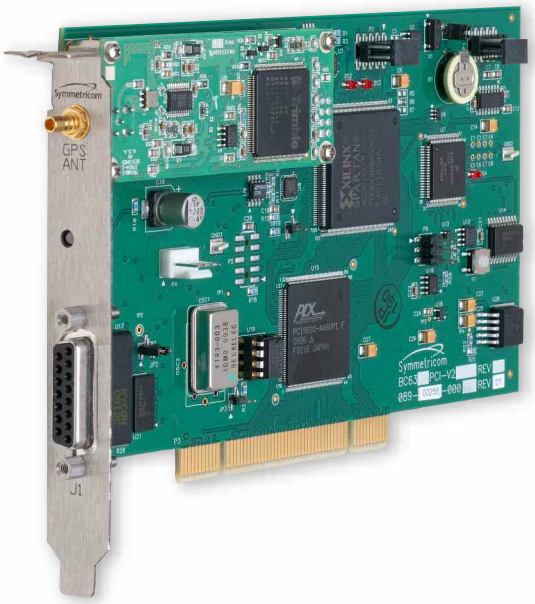
Extensive time code generation and translation are supported. The generator outputs either IRIG A, B, G, E, IEEE 1344, NASA 36, XR3 or 2137 in both amplitude modulated (AM) and DC level shift (DCLS) formats. The translator reads and may be used to discipline the 10 MHz oscillator to either the AM or DCLS format of IRIG A, B, G, E, IEEE 1344, NASA 36, XR3 or 2137 time codes.

The module also has a state-of-the-art DDS rate synthesizer capable of 0.0000001 PPS to 100 MPPS. The module may also be programmed to generate a single interrupt at a predetermined time based on a time compare (Strobe). An Event Time Capture feature provides a means of latching time of an external event.

A key feature of the bc637PCI-V2 is the ability to generate interrupts on the PCI bus at programmable rates. These interrupts can be used to synchronize applications on the host computer as well as signal specific events.

The external frequency input is a unique feature allowing the time and frequency of the bc637PCI-V2 to be derived from an external oscillator that may also be disciplined (DAC voltage controlled) based on the selected input reference. The module may be operated in generator (undisciplined) mode where an external 10 MHz from a Cesium or Rubidium standard is used as the frequency reference. This creates an extremely stable PCI based clock for all bc637PCI-V2 timing functions.

The bc637PCI-V2 automatically supports both 3.3V and 5.0V signaling of the PCI bus. Integration of the module is easily facilitated with optional drivers for Windows 2000/XP, Linux, or Solaris.

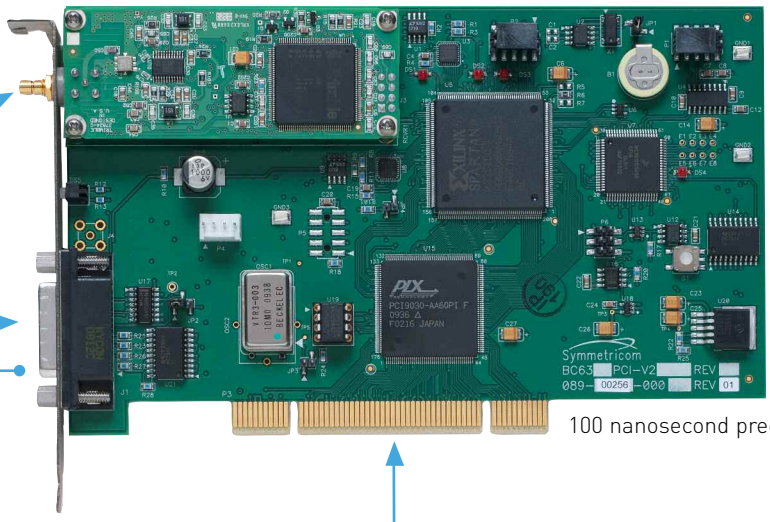



bc637PCI-V2 GPS Synchronized, Time & Frequency Processor.

EASY System Integration

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## Precision Time & Frequency in the PCI Form Factor




**Inputs**
- GPS
- AM Time Codes
- DCLS Time Codes
- External Events (3x)
- 10 MHz
- 1PPS

**Outputs**
- AM Time Codes
- DCLS Time Codes
- Programmable Alarm (Strobe/Time Compare)
- <<1PPS to 100 MPPS rates
- 1PPS
- 1,5,10 MPPS
- Oscillator Control Voltage

100 nanosecond precision

**Over the PCI Bus**
- Precise time
- Event Interrupts
- Alarm interrupts (time compare/strobe)
- Programmable interrupt rates
- Configuration & Control

### Reading the Precise Time
The bc637PCI-V2 provides precise time on request and extremely fast response to host applications. This request for time is simply and quickly done using the included SDK software functions. Time can be provided in binary or decimal form.

### A Multitude of Time Codes
The bc637PCI-V2 has the widest time code input and output support available in any bus level timing card. Over 30 different time codes including IRIG A, B, G, E, IEEE 1344, NASA 36, XR3, 2137 in AM and DCLS formats.

### Measure Events – External or Internal
Measure the exact time up to three independent external events occur. Bus interrupts instantly notify the CPU the measurements are made and waiting. Similarly, host application generated interrupts to the bc637PCI-V2 card over the bus can be precisely time stamped for precise host application based processes.

### Flexible Rate Generation
The Direct Digital Synthesizer on board the bc637PCI-V2 can be programmed to generate rates up to 100 MPPS or as little as once every 115 days. These rates are available as timing signal outputs or as interrupts on the bus. The rate adjustment resolution is as small as 1/32 of a hertz.

### Frequency Outputs
Precise clocks are excellent sources of frequency outputs. The bc637PCI-V2 offers 1, 5 or 10 MPPS outputs directly from the steered internal oscillator of the clock.

### External Frequency Inputs and DAC Control
The external frequency input is a unique feature allowing the time and frequency of the bc637PCI-V2 to be derived from an external oscillator such as a 10 MHz from a Cesium or Rubidium standard. This creates an extremely stable PCI based clock for all bc637PCI-V2 timing functions. For closed loop control, an external oscillator may be disciplined via DAC voltage control output from the bc637PCI-V2.

### Time Compare/Strobe/Alarm
A useful feature of any precise clock is the ability to be notified when a particular time is reached (like an alarm clock). When the preset time matches precisely matches the actual time an external signal is instantly generated as well as an interrupt to the bus signaling an application that point in time has just occurred.

### Over the Bus Features
Aside from precise time stamps, the bc637PCI-V2 can provide very precisely timed interrupts on the bus at fixed rates, predetermined times, or to signal an event has occurred on the card. These interrupts can be integrated into user applications requiring more deterministic behavior or application synchronization with other computers. Similarly, user applications can use interrupts as markers in time and later retrieve exactly when the interrupt occurred.

### Configuration and Control
The bc637PCI-V2 includes easy-to-use programs to easily configure the card and validate operations. This software is also included with the SDKs and driver software.



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## PCI CARD INTEGRATION MADE EASY WITH INCLUDED SDKs & DRIVERS

**Windows, Linux and Solaris Software Development Kits Speed PCI Integration**
These full-featured software development kits, included standard with the PCI card, speed the integration of Symmetricom PCI cards into any application.

Using an SDK is an easy-to-integrate and highly reliable alternative to writing lower-level code to address a card's memory registers directly with just a driver. The function calls and device drivers in the SDKs make interfacing to a Symmetricom PCI card straightforward and help keep your software development focused on the end application.

**SDKs Save Time and Money**
Programmers will find the SDK an invaluable resource in accelerating the integration of Symmetricom PCI cards into applications, saving both time and money. The SDK functions address each Symmetricom PCI timing card feature, and the function names and parameters provide insight into the capability of each function.

By using the SDK, you can leverage Symmetricom's timing expertise and confidently integrate a Symmetricom PCI card into your application.

**License Free**
Distribution of embedded Symmetricom software in customer applications is royalty free.




### Windows SDK and Driver

- Windows XP/Vista/7
- Windows Server 2003/2008
- 32 & 64 bit support
- Kernel Mode Driver
- Code Examples
- Test Application Program
- Complete Documentation
- Time Keeping Utility Program

The Windows SDK for bc637PCI-V2 cards includes a Windows XP/Vista/Server/7 kernel mode device driver for the 32 and 64 bit PCI interface. The SDK includes .h, .lib, and DLL files to support both 32 and 64 bit applications development.

The target programming environment is Microsoft® Visual Studio (Microsoft Visual C++ V6.0 or higher). Both Visual C++ 6.0 and Visual Studio 2008 project files are supplied with the source code.

Also included is Symmetricom's bc637PCIcfg application program, which can be used to ensure proper operation of the PCI card, as well as the TrayTime application allowing the user to update the system clock in which the card is installed. Source code for these programs as well as smaller example programs are included.

**MINIMUM SYSTEM REQUIREMENTS**
**Operating System:**
Windows XP/Vista/7
Windows Server 2003/2008

**Hardware:**
PC-compatible system with a Pentium or faster processor.

**Memory:** 24 Mb

**Development environment:**
Microsoft Visual Studio (Visual C++) 6 or higher.

### Linux SDK and Driver

- Linux 2.4 & 2.6 Kernel
- 32 & 64 bit kernel support
- Code Examples
- Test Application Program
- Complete Documentation

The Linux® SDK for bc637PCI-V2 cards includes PCI kernel mode device drivers for both 32-bit and 64- bit kernels, an interface library accessing all bc637PCI-V2 features, and example programs with source code.

The target programming environment is the GNU Compiler Collection (GCC) and the C/C++ programming languages.

Also included is Symmetricom's bc63xPCIcfg application program to ensure proper operation of the PCI card in the host computer. The example program includes sample code, exercising the interface library, and conversion examples of the ASCII format data objects passed to and from the device into a binary format suitable for operation and conversion. The example program was developed using discrete functions for each operation, allowing the developer to copy any useful code and use it in their own applications.

**MINIMUM SYSTEM REQUIREMENTS**
**Operating System:**
Linux Kernels 2.4, 2.6.

**Hardware:**
x86 processor.

**Memory:** 32 MB

**Development environment:**
GNU GCC recommended.

### Solaris SDK and Driver

- Solaris Kernel Mode Driver
- 64-bit Solaris 8-10
- Code Examples
- Test Application Program
- Complete Documentation

Symmetricom's Solaris SDK includes bc63xPCIcfg, an application program to ensure proper operation of the PCI card in the host computer. The example program includes sample code and conversion examples of the ASCII format data objects passed to and from the device into a binary format suitable for operation and conversion.

The target programming environment is the Solaris application development tool chain and the C/C++ programming languages.

The Solaris SDK includes the Solaris device driver source code. Applications access the features of the hardware through the standard 'ioctl' Solaris system function. The IOCTL codes are defined for all the features of the card. The bc63xPCIcfg program shows how to use most IOCTL codes. Developers can copy any useful code from the bc63xPCIcfg source code and use it in their own applications.

**MINIMUM SYSTEM REQUIREMENTS**
**Operating System:**
Solaris versions 8, 9 and 10.

**Hardware:** SPARC & x86_64.

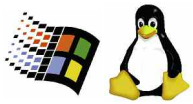
**Memory:** 32 MB

**Development environment:**
Solaris compilers.



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## SDK FUNCTION REFERENCE LIST



### Windows and Linux
### SDK Function Reference List (Partial)*

**Basic Time And Frequency Processor (TFP) Functions**

| | |
|---|---|
| • bcStartPCI/ bcStopPCI | Opens/Closes underlying device layer. |
| • bcStartInt/ bcStopInt | Starts/stops the interrupt thread to signal interrupts. |
| • bcSetInt/ bcReqInt | Enables/ Returns enabled interrupt. |
| • bcShowInt | Interrupt service routine. |
| • bcReadReg/ bcWriteReg | Returns/Sets requested register contents. |
| • bcReadDPReg/ bcWriteDPReg | Returns/Sets requested Dual Port RAM register contents. |
| • bcCommand | Sends SW reset command to board. |
| • bcReadBinTime/ bcSetBinTime | Reads/ sets TFP major time in binary format. |
| • bcReadDecTime/ bcSetDecTime | Reads/ sets TFP major time in BCD format. |
| • bcReqTimeFormat | Returns selected time format. |
| • bcSetTimeFormat | Sets the major time format to binary or grouped decimal. |
| • bcReqYear/ bcSetYear | Returns/ sets year value. |
| • bcSetYearAutoIncFlag | Included for backward compatibility to the bc635/637PCI-U card. |
| • bcSetLocalOffsetFlag | Enables or disables local time offset in conjunction with bcSetLocOff. |
| • bcSetLocOff | Sets board to report time at an offset relative to UTC. |
| • bcSetLeapEvent | Inserts or deletes leap second data (in non-GPS modes). |
| • bcSetMode | Sets TFP operating mode. |
| • bcSetTcIn | Sets time code format for time code decoding mode. |
| • bcSetTcInEx | Sets time code and subtype for time code decoding mode. |
| • bcSetTcInMod | Sets time code modulation for time code decoding mode. |
| • bcReqTimeData | Returns selected time data from the board. |
| • bcReqTimeCodeData | Returns selected time code data from the board. |
| • bcReqTimeCodeDataEx | Returns selected time code and subtype data from the board. |
| • bcReqOtherData | Returns selected data from the board. |
| • bcReqVerData | Returns firmware version data from the board. |
| • bcReqSerialNumber | Returns board serial number. |
| • bcReqHardwareFab | Returns hardware fab part number. |
| • bcReqAssembly | Returns assembly part number. |
| • bcReqModel | Returns TFP model identification. |
| • bcReqTimeFormat | Returns selected time format. |
| • bcReqRevisionID | Returns board revision. |

**Event Functions**

| | |
|---|---|
| • bcReadEventTime | Latches and returns TFP time caused by an external event. |
| • bcReadEventTimeEx | Latches and returns TFP time caused by an external event with 100 nanosecond resolution. |
| • bcSetHbt | Sets a user programmable periodic output. |
| • bcSetPropDelay | Sets propagation delay compensation. |
| • bcSetStrobeTime | Sets strobe function time. |
| • bcSetDDSFrequency | Sets DDS output frequency. |
| • bcSetPeriodicDDSSelect | Selects periodic or DDS output. |
| • bcSetPeriodicDDSEnable | Enables or disables periodic or DDS output |
| • bcSetDDSDivider | Sets DDS divider value. |
| • bcSetDDSDividerSource | Sets DDS divider source. |
| • bcSetDDSSyncMode | Sets DDS synchronization mode. |
| • bcSetDDSMultiplier | Sets DDS multiplier value. |
| • bcSetDDSPeriodValue | Sets DDS period value. |
| • bcSetDDSTuningWord | Sets DDS turning word value. |

**Oscillator Functions**

| | |
|---|---|
| • bcSetClkSrc | Enables or disables on-board oscillator. |
| • bcSetDac | Sets oscillator DAC value. |
| • bcSetGain | Modifies on-board oscillator frequency control algorithm. |
| • bcReqOscData | Returns TFP oscillator data. |

**Generator Mode Functions**

| | |
|---|---|
| • bcSetGenCode | Sets time code generator format. |
| • bcSetGenCodeEx | Sets time code and subtype generator format. |
| • bcSetGenOff | Sets an offset to the on-board timecode generation function. |

**GPS Mode Functions**

| | |
|---|---|
| • bcGPSReq/ bcGPSSnd | Returns/Sends a GPS receiver data packet. |
| • bcGPSMan | Manually sends and retrieves GPS receiver data packets. |
| • bcSetGPSOperMode | Sets the GPS receiver to function in static or dynamic mode. |
| • bcSetGPSTmFmt | Sets TFP to use GPS or UTC time base. |

**Real Time Clock (RTC) Functions**

| | |
|---|---|
| • bcSyncRtc | Synchronizes RTC to current TFP time. |
| • bcDisRtcBatt | Sets RTC circuit and battery to disconnect after power is turned off. |

* See manual for complete listing

### Solaris
**SDK Function Reference List**

The Solaris SDK uses custom IOCTL commands to facilitate easy communication and control of the bc637PCI-V2 card. The commands cover basic operational functions, event management, oscillator controls, and mode related functions.

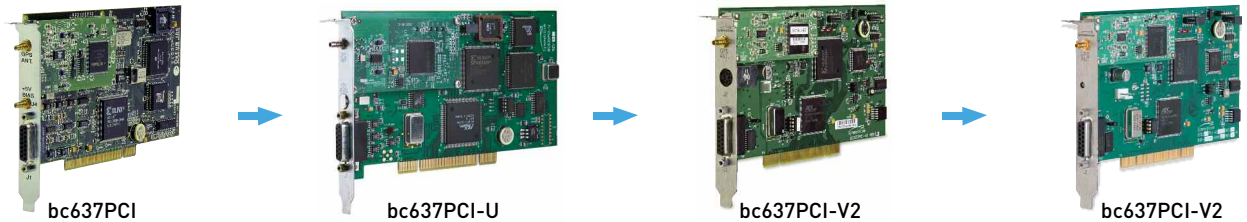
An over view of the IOCTL functions include

- Interrupt Management
- Read/write Dual Port RAM. Send command to timing engine for processing
- Read and write time
- Timing mode and time format
- Read and write the card control register
- Input time code format and modulation selection
- Set local time
- Leap seconds control
- Read various version information and miscellaneous data
- Reset the board
- Clock source, jamsync management
- DAC control
- On-board oscillator frequency control
- Advance or retard the internal clock
- Read event time latched by external event
- Read event time latched by software event
- Event source/ sense control
- Set propagation delay
- Periodic output and output frequency control
- Strobe control
- DDS frequency output control
- Set output time code format
- Set offset for output time code generation
- GPS control
- Sync Real Time Clock
- Disconnect between RTC and battery after power off



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## BACKWARDS COMPATIBILITY PROVIDES SEAMLESS MIGRATION PATHS



**bc637PCI**
Mid-1990's
1st PCI timing
card Introduced

**bc637PCI-U**
2003
3.3V & 5.0V Universal Signaling
backward compatibility retained

**bc637PCI-V2**
2008
Electronics updated
backward compatibility retained

**bc637PCI-V2**
2010
Electronics updated
backward compatibility retained

The PCI based bc637 cards have long product lifecycles since the first introduction of PCI timing cards in the mid 1990's. To preserve the customer investment of time and money to integrate bc637PCI cards into their systems, Symmetricom has maintained the features and software interface to the bc637PCI cards while keeping them current with respect to changing bus signaling, form factors, and new features.

This commitment to backwards compatibility and current bus architectures assures the bc637PCI cards integrate smoothly in the latest workstations available in the market with little to no impact on customer application software.

## OPTIONAL ACCESSORIES SPEED TEST AND SIMPLIFY INTEGRATION

Breakout cables with BNC connectors simplify access to the in and out timing signals of the PCI card. These labeled cables mitigate the need to create special cables during project development and assure the correct timing signals are being accessed.

For more integrated rack mount systems needing easy access to timing signals, the 1U patch panel and high frequency signal breakout exposes all available signals. The panel provides an organized and professional appearance to the external timing I/O of the PCI card functions. The 1U panel fits with standard or half rack size chassis. The high frequency breakout adapter exposes the high frequency signal as well as the external DC DAC control signal and ground.

| Timing Input/Output Breakout Cable and Patch Panel BNC Map | "D" to 5-BNC (BC11576-1000) | "D" to 5-BNC BC11576-9860115 | "D" to 6-BNC | Patch/Breakout |
|---|---|---|---|---|
| **Outputs** | | | | |
| Time Code (AM) | ✓ | ✓ | ✓ | ✓ |
| Time Code (DCLS) | | | ✓ | ✓ |
| 1, 5, 10 MPPS | | | | ✓ |
| Periodic/DDS | | | | ✓ |
| Strobe | | | | ✓ |
| 1 PPS | ✓ | ✓ | ✓ | ✓ |
| Oscillator Control Voltage | | | | ✓ |
| **Inputs** | | | | |
| Time Code (AM) | ✓ | ✓ | ✓ | ✓ |
| Time Code (DCLS); Event2 | | | | ✓ |
| External Event1 | ✓ | ✓ | ✓ | ✓ |
| External 1 PPS; Event3 | | ✓ | ✓ | ✓ |
| External 10 MHz | | | | ✓ |



Input/Output signals "D" to BNC connector breakout cables




1U patch panel of Input/Output and high frequency signals
for standard rack mount size chassis

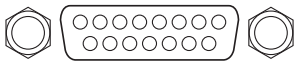


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# bc637PCI-V2 SPECIFICATIONS

## ELECTRICAL SPECIFICATIONS

- GPS Receiver/Antenna
  - 12 channel parallel receiver
  - GPS time traceable to UTC(USNO)
  - Accuracy: 170 ns RMS, 1 µsec peak to peak to UTC(USNO), at stable temperature and 4 satellites tracked.
  - Maximum Belden 9104 cable length: 150' (45 m). For longer cable runs see Options.
- Real Time Clock
  - Bus request resolution: 100 nanoseconds BCD
  - Latency: Zero
  - Major time format: Binary or BCD
  - Minor time format: Binary 1 µS to 999.999 mS
- Synchronization sources: GPS, Time code, 1 PPS
- Time code translator (inputs)
  - Time code formats: IRIG A, B, E, G, IEEE 1344, NASA 36, XR3, 2137
  - Time accuracy: <5 µS (AM carrier frequencies 1 kHz or greater) <1 µS (DCLS)
  - AM ratio range: 2:1 to 4:1
  - AM Input amplitude: 1 to 8V p-p
  - AM Input impedance: >5kΩ
  - DCLS Input: 5V HCMOS >2V high, <0.8V low, 270Ω
- Time code generator (outputs)
  - Time code format: IRIG A, B, E, G, IEEE 1344, NASA 36, XR3, 2137
  - AM ratio: 3:1 +/- 10%
  - AM amplitude: 3.5V p-p +/- 0.5V into 50Ω
  - DCLS amplitude: 5V HCMOS, >2V high, <0.8V low into 50Ω
- Timing functions (outputs are rising edge on time)
  - DDS rate synthesizer
    - Frequency range: 0.0000001 PPS to 100 MPPS
    - Output amplitude: 5V HCMOS, >2V high, <0.8V low into 50Ω, square wave
    - Jitter: <2 nS p-p
  - Legacy pulse rate synthesizer (Heartbeat, aka Periodic)
    - Frequency range: <1 Hz to 250 kHz
    - Output amplitude: 5V HCMOS, >2V high, <0.8V low into 50Ω, square wave
  - Time compare (Strobe)
    - Compare range: 1 µS through days
    - Output amplitude: 5V HCMOS, >2V high, <0.8V low into 50Ω, 1 µS pulse
  - 1 PPS Output: 5V HCMOS, >2V high, <0.8V low into 50Ω, 60 µS pulse Accuracy the same as GPS Receiver specification above, or relative to the input time code.
  - 1 PPS Input: 5V HCMOS, >2V high, <0.8V low, 270Ω
  - External Event Input: 5V HCMOS, >2V high, <0.8V low, 270Ω, zero latency
  - External 10 MHz oscillator: Digital 40% to 60% or sine wave, 0.5 to 8Vp-p, >10kΩ
  - Oscillator Control Voltage: Jumper selectable 0-5VDC or 0-10VDC into 1kΩ
- On-board disciplined oscillator
  - Frequency: 10 MHz
  - 1, 5, or 10 MPPS output: 5V HCMOS, >2V high, <0.8V low into 50Ω
  - Stability:
  - Standard TCXO: 5.0E-8 short term 'tracking' 5.0E-7/day long term 'flywheeling'
- Real-time clock (RTC) battery backed time and year information
- PCI local bus™
  - Specification: 2.2 compliant, 2.3 compatible, PCI-X compatible
  - Size: Single-width (4.2" x 6.875")
  - Device type: PCI Target, 32 bit, universal signaling
  - Data transfer: 8-bit, 32-bit
  - Interrupt levels: Automatically Assigned (PnP)
  - Power: TCXO: +5V @ 700 mA OCXO: +5V @ 800 mA, 1.1 A at start-up +12V @ 50 mA
- Connectors
  - GPS Antenna: SMB socket
  - Firmware update port: 6 pin, PS2 mini-DIN J2
  - Timing I/O: 15-pin 'DS' J1



| Pin | Direction | Signal |
|---|---|---|
| 1 | input | External 10 MHz |
| 2 | | Ground |
| 3 | output | Strobe |
| 4 | output | 1 PPS |
| 5 | output | Time Code (AM) |
| 6 | input | External Event |
| 7 | input | Time Code (AM) |
| 8 | | Ground |
| 9 | output | Oscillator Control Voltage |
| 10 | input | Time Code (DCLS) |
| 11 | output | Time Code (DCLS) |
| 12 | | Ground |
| 13 | output | 1, 5, 10 MPPS |
| 14 | input | External 1 PPS |
| 15 | output | Heartbeat/DDS |




- Complete specifications can be found in the manual located at http://www.symmetricom.com

## ENVIRONMENTAL SPECIFICATIONS

- Environment

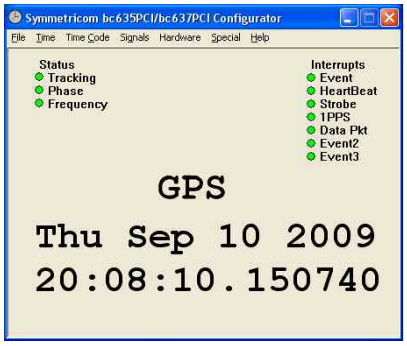
| | Module | GPS Antenna |
|---|---|---|
| Temperature: | | |
| Operating: | 0ºC to 70ºC | -40ºC to 70ºC |
| Storage: | -30ºC to 85ºC | -55ºC to 85ºC |
| Humidity: | | |
| Operating: | 5% to 95% non-condensing | 100% condensing |
| Operating altitude: | Up to 18,000 meters MSL | |

- Certifications: FCC, CE(RoHS)

## SOFTWARE

- The bc637PCI-V2 includes the Symmetricom bc635pci demo and bc637PCI GPS Demo application programs for Windows 2000/XP. Using this program you can review the bc637PCI-V2 card status and adjust board configuration and output parameters. Bc637pcidemo provides direct access to the GPS receiver used on the bc637PCI-V2 board. An additional clock utility program, TrayTime, is provided that can be used to update the Host computer's clock.

## PRODUCT INCLUDES




- bc637PCI-V2 GPS synchronized Time & Frequency Processor board, L1 GPS antenna, 50' (15 m) Belden 9104 coaxial cable, 1 ft. antenna mounting mast (30 cm) with two clamps, one year warranty, PCI User's Guide CD, Windows software CD.

## OPTIONS

- D' connector (J1) to BNC adapter
- SDK (Software Development Kit) for: Windows 2000/XP, Linux, Solaris (Contact factory for additional drivers)
- GPS antenna in-line amplifier for cable runs to 300' (90 m)
- GPS antenna down/up converter for cable runs to 1500' (457 m)
- Lightning arrestor

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