bc635PCI-V2

PCI Time and Frequency Processor

Summary

The Microchip bc635PCI-V2 timing module provides unparalleled precise time and frequency to the host computer and peripheral data acquisition systems. Time is typically acquired from time code signals such as IRIG B.

Central to the operation of the module is a disciplined TCXO 10 MHz oscillator that can provide the timing module's 100-nanosecond clock. Current time (days to 100 ns) can be accessed across the PCI bus with no PCI bus wait states, which allows for 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 Direct Digital Synthesizer (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 bc635PCI-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 bc635PCI-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 bc635PCI-V2 timing functions.

The bc635PCI-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® or Linux®.

Features

- IRIG A, B, G, E, IEEE 1344, NASA 36, XR3 and 2137 time code inputs and outputs
- Simultaneous AM and DCLS time code inputs and outputs
- 100 ns clock resolution for time requests
- Programmable << 1 PPS to 100 MPPS DDS rate synthesizer output/interrupt
- 1, 5 or 10 MPPS rate generator output
- 1 PPS and 10 MHz inputs
- Three external event time capture/interrupts
- External event time capture/interrupt
- Programmable time compare output/interrupt
- Zero latency time reads
- Battery-backed RTC
- PCI local bus operation
- Universal signaling (3.3V or 5.0V bus)
- CE RoHS compliant
- Linux and Windows software drivers/SDKs included

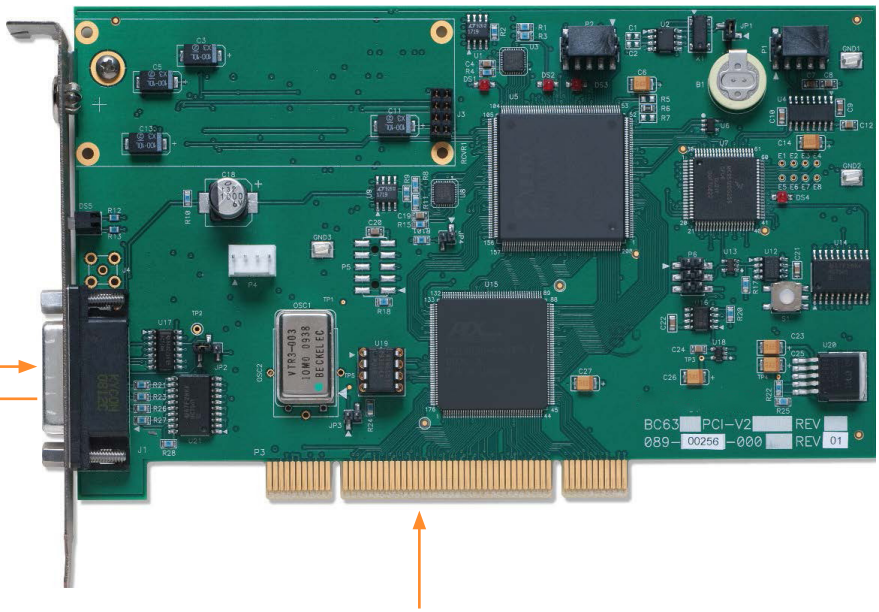
Precision Time and Frequency in the PCI Form Factor (100-Nanosecond Precision)

Inputs

- AM time codes
- DCLS time codes
- External events (3x)
- 10 MHz
- 1 PPS
- GPS (bc637PCIe model)

Outputs

- AM time codes
- DCLS time codes
- Programmable alarm
- (strobe/time compare)
- <<1 PPS to 100 MPPS rates
- 1PPS
- 1, 5 or 10 MPPS
- Oscillator control voltage



Over the PCI Bus

- Precise time
- Event interrupts
- Alarm interrupts (time compare/strobe)
- Programmable interrupt rates
- Configuration and control

Reading the Precise Time

The bc635PCI-V2 provides precise time on request and extremely fast responses to host applications. This request for time is made using the included SDK software functions. Time can be provided in binary or decimal form.

A Multitude of Time Codes

The bc635PCI-V2 has the widest time code input and output support available in any bus-level timing card. Support is available for 30 different time codes including IRIG A, B, G, E, IEEE 1344, NASA 36, XR3 and 2137 in AM and DCLS formats.

Measure External or Internal Events

Measure the exact time up to the occurence of three independent external events occur. Bus interrupts instantly notify the CPU that the measurements are made and waiting. Similarly, host application-generated interrupts to the bc635PCI-V2 card over the bus can be precisely time stamped for precise host application-based processes.

Flexible Rate Generation

The DDS on board bc635PCI-V2 can be programmed to generate rates up to 100MPPS 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 Hz

Frequency Outputs

Precise clocks are excellent sources of frequency outputs. The bc635PCI-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 that allows the time and frequency of the bc635PCI-V2 to be derived from an external oscillator such as a 10 MHz Cesium or Rubidium standard. This creates an extremely stable PCI-based clock for all bc635PCI-V2 timing functions. For closed loop control, an external oscillator may be disciplined using DAC voltage control output from the bc635PCI-V2.

Time Compare/Strobe/Alarm

A useful feature of any precise clock is the ability to notify when a particular time is reached (like an alarm clock). When the preset time precisely matches the actual time, an external signal and an interrupt to the bus are instantly generated, signaling an application that point in time has just occurred.

Over-the-Bus Features

In addition to precise time stamps, the bc635PCI-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 bc635PCI-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.

PCI Card Integration Made Easy With Included SDKs and Drivers

Windows and Linux SDKs Speed PCI Integration

The PCI card includes standard full-featured software development kits, speeding the integration of Microchip 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 Microchip PCI card straightforward and help keep the software development focused on the end application.

SDKs Save Time and Money

Programmers find the SDK an invaluable resource in accelerating the integration of Microchip PCI cards into applications, saving both time and money. The SDK functions address each Microchip 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 Microchip's timing expertise and confidently integrate a Microchip PCI card into your application.

License Free

Distribution of embedded Microchip software in customer applications is royalty free.

Driver Comparison

Windows SDK and Driver

- Windows XP/Vista/7/10
- Windows Server 2003/2008/2019
- 32- and 64-bit support
- Kernel mode driver
- Code examples
- Test application program
- Complete documentation
- Timekeeping utility program

The Windows SDK for bc635PCI-V2 cards include a Windows XP/Vista/Server/7/10 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 Microchip's bc637PCIcfg application program that can be used to ensure proper operation of the PCI card, and the TrayTime application that allows the user to update the system clock in which the card is installed. Source code for these programs and smaller example programs are included.

Minimum System Requirements

Operating System

- Windows XP/Vista/7/10
- 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 kernel up to 5.7.1
- 64-bit kernel support
- Code examples
- Test application program
- Complete documentation

The Linux SDK for bc635PCI-V2 cards includes PCIe® kernel mode device drivers for 64-bit kernels, an interface library accessing all bc635PCI-V2 features and example programs with the source code.

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

Also included is Microchip's bc63xPCIcfg application program which ensures 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 is 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 kernel 5.7.1 or lower
- Hardware
- ×86 processor
- Memory
- 32 MB
- Development environment
- GNU GCC recommended

Windows and Linux SDK Function Reference

Note: For complete list of functions, see the manual.

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 ns 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

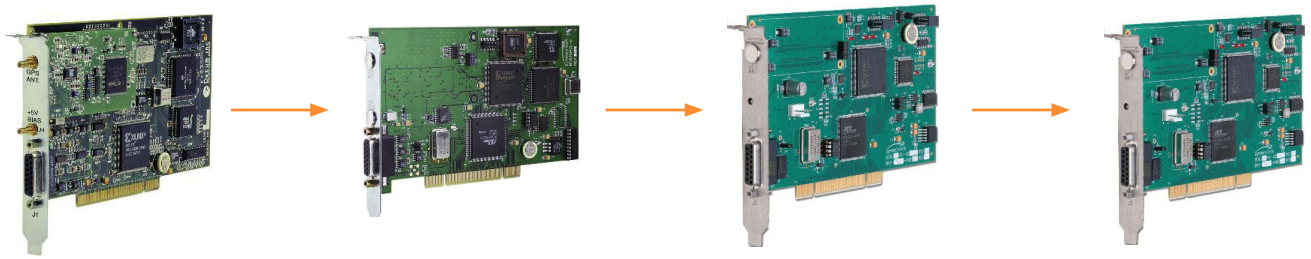
• bcSyncRtc	Synchronizes RTC to current TFP time.
• bcDisRtcBatt	Sets RTC circuit and battery to disconnect after power is turned off.

Backwards Compatibility Provides

Seamless Migration Paths

The PCI-based bc635 cards have long product lifecycles since the first introduction of PCI timing cards in the mid 1990s. To preserve the customer's time and money investments in integrating bc635PCI cards into their systems, Microchip has maintained the bc635PCI cards' existing features and software interface while adding new features and keeping their bus signaling and form factors up to date. This commitment to backward compatibility and current bus architectures assures the bc635PCI cards integrate smoothly into any workstation currently available in the market with little to no impact on customer application software.

PCI Card Developments



bc635PCI

- Mid-1990s
- First PCI timing card introduced

bc635PCI-U

- 2003
- 3.3V and 5.0V universal signaling backward compatibility retained

bc635PCI-V2

- 2008
- Electronics updated backward compatibility retained

bc635PCI-V2

- 2010
- Electronics updated backward compatibility retained

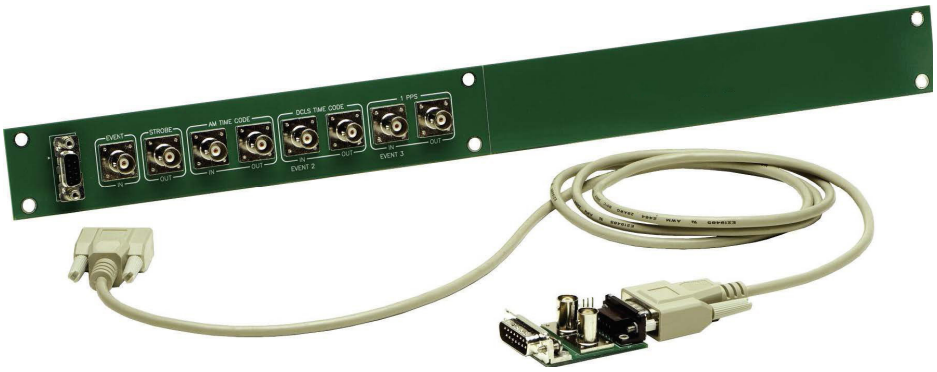
Optional Accessories to Speed, Test and Simplify Integration

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 ensure that the correct timing signals are being accessed.

For more integrated rack mount systems that require 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 Input/Output (I/O) of the PCI card functions. The 1U panel fits with a 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.

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



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				✓

Specifications

Electrical

- Real-time clock (RTC)
  - Bus request resolution — 100 ns BCD
  - Latency — Zero
  - Major time format — Binary or BCD
  - Minor time format — Binary 1 µS to 999.999 mS
- Synchronization sources — Time code, 1 PPS
- Time code translator (inputs)
  - Time code formats — IRIG A, B, G, E, 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 V_{PP} to 8 V_{PP}
  - AM input impedance — >5 kΩ
  - DCLS input — 5V HCMOS >2V high, <0.8V low, 270Ω
- Time code generator (outputs)
  - Time code format — IRIG A, B, G, E, IEEE 1344, NASA 36, XR3, 2137
  - AM ratio — 3:1 ±10%
  - AM amplitude — 3.5 V_{PP} ±0.5 V_{PP} 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
  - 1PPS output — 5V HCMOS, >2V high, <0.8V low into 50Ω, 60 µs pulse
  - 1PPS 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, V0.5 pp to 8 V_{PP}, > 10 kΩ
  - Oscillator control voltage — Jumper selectable 0 V_{DC}-5 V_{DC} or 0 V_{DC}-10 V_{DC} into 1 kΩ
- 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: — 5.0×10^{-8} short term tracking 5.0×10^{-7}/day long term flywheeling
  - Real-Time Clock (RTC) — Battery-backed time and year information
- PCI specification — 2.2 compliant 2.3 compatible PCI-X compatible
- Size — Single-width (4.2" × 6.875")
- Device type — PCI target, 32-bit, universal signaling
- Data transfer — 8-bit, 32-bit
- Interrupt levels — Automatically assigned (PnP)
- Power — 12V at 50 mA TCXO: 5V at 700 mA
- Connector
  - Firmware update port — 6-pin, PS2 mini-DIN J2
  - Timing I/O — 15-pin 'DS' J1

Environmental

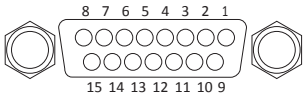
- Temperature
  - Operating 0ºC to 65ºC
  - Storage –30ºC to +85ºC
- Humidity
  - Operating 5% to 95% non-condensing
- Certifications
  - FCC Part 15, Subpart B. Emissions
    EN 55022
- Immunity EN 55024
- RoHS compliance
  - EU RoHS 6/6
  - China RoHS

Complete specifications can be found in the manual located at www.microchip.com.

Pin Description

Pin	Direction	SIgnal
1	Input	External10 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, or 10 MPPS
14	Input	External 1 PPS
15	Output	Heartbeat/DDS

Pin Diagram

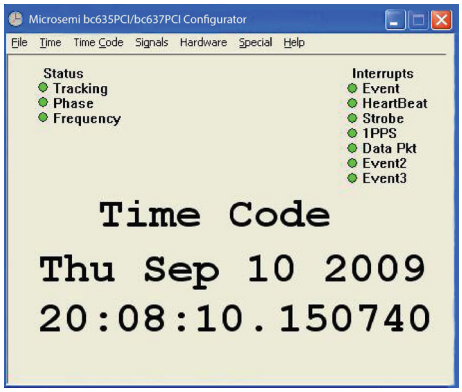


Standard Cover Panel

Software

The bc635PCI-V2 includes the Microchip bc635pcidemo.exe application program for Windows. Using this program, you can review the bc635PCI-V2 card status and adjust board configuration and output parameters. An additional clock utility program, TrayTime, is provided to update the host computer's clock.

Control Panel Interface



Additional Features

This product also includes a bc635PCI-V2 time and frequency processor board, standard height cover panel, one-year warranty and an insert sheet that explains how to download the user guide and SDK/driver software.

Ordering Information

Part Number: bc635PCI-V2 PCI time and frequency processor

Connector accessories that can be ordered:

- D connector to x5-BNCs adapter (provides TC in, TC out, 1PPS out, event in, periodic out) p/n BC11576-1000
- D connector to x5-BNCs adapter with 1PPS in (provides TC in, TC out, 1PPS in, 1PPS out, event in) p/n BC11576-9860115
- D connector to x6-BNCs adapter (provides TC in, TC out, 1PPS in, 1PPS out, event in, DCLS out) p/n PCI-BNC-CCS

For GPS synchronization, see bc637PCI-V2 PCI Express Time and Frequency Processor datasheet.

Contact Microchip for pricing and availability.

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