CMIRIG-B

Reference Manual

Contents

Preface

The purpose of this reference manual is to familiarize users with the *CMIRIG-B* interface unit and to show how to properly use it. It contains important tips on how to use the *CMIRIG-B* safely, properly, and efficiently. Its purpose is to help you avoid danger, repair costs, and down time as well as to help maintain the reliability and life of the interface unit *CMIRIG-B*.

This reference manual is to be supplemented by existing national safety standards for accident prevention and environmental protection. It should always be available at the site where the *CMIRIG-B* is used, and it should be read by all personnel operating it.

In addition to the reference manual and the applicable safety regulations in the country and at the site of operation, the usual technical procedures for safe and competent work should be heeded.

Note: This reference manual is limited to the *CMIRIG-B* hardware. In order to obtain more information about the interfacing of IRIG-B with *Test Universe* applications, please refer to the related *Test Universe* application manual and/or the online help system of the *Test Universe* software.

Safety Instructions

Before operating the *CMIRIG-B* interface unit, carefully read the following safety instructions.

Only operate the *CMIRIG-B* after you have read this reference manual and fully understood the instructions herein.

The *CMIRIG-B* may only be operated by trained personnel.

Conventions and Symbols Used

In the context of operational safety, the following symbols are used throughout the manual to indicate instructions relevant for avoiding hazards.

Rules for Use

* The *CMIRIG-B* may only be used in a safe technical condition taking into account its defined purpose, safety requirements and possible risks as well as the operating instructions! Faults that could affect safety are to be immediately eliminated (by specialized personnel or otherwise)!

* The *CMIRIG-B* is exclusively intended for the application areas specified in chapter 1 "Designated Use" on page 7. The manufacturer/ distributors are not liable for damage resulting from unintended usage. The user alone assumes all responsibility and risk.

* Complying with the conditions outlined in the operating instructions of this manual is part of the defined use of the device.

* Do not open the *CMIRIG-B* or remove any of its housing components.

Orderly Practices and Procedures

- This reference manual should always be available on site where the *CMIRIG-B* is used.

- Personnel assigned to using the *CMIRIG-B* must have read this reference manual and fully understood the instructions herein, in particular the chapter about safety requirements, before starting work. This particularly applies to personnel not working with the *CMIRIG-B* on a regular basis.

- Do not undertake any modifications, extensions, or adaptations to the *CMIRIG-B*.

Operator Qualifications

- Testing with the *CMIRIG-B* should only be carried out by authorized and qualified personnel. The user is responsible for safe operation of the equipment. Please contact your OMICRON representative for dedicated product training support.

- Personnel receiving training, instruction, direction, or education on the *CMIRIG-B* should remain under the constant supervision of an experienced operator while working with the equipment.

Safe Operation Procedures

- The *CMIRIG-B* is to be set into operation in accordance with the information provided in chapter 5 "Operating the CMIRIG-B".

- Do not open the *CMIRIG-B*. Opening the device invalidates all warranty claims!

- Do not operate the *CMIRIG-B* under wet or moist conditions (condensation).

- Do not operate the *CMIRIG-B* when explosive gas or vapors are present.

- The electric equipment of the *CMIRIG-B* is to be checked regularly. Any faults such as loose connections or defective cables have to be repaired immediately.

- The *CMIRIG-B* is an SELV device (**S**afety **E**xtra **L**ow **V**oltage). It may only be connected to external devices that fulfill the SELV requirements according to the standards EN 61010-1 or IEC 61010-1.

1 Designated Use

CMIRIG-B is an interface box enabling the connection of devices sending or receiving the IRIG-B protocol or PPS signals with CMC test sets. *CMIRIG-B* performs the level conversion between the CMC and the sources or receivers. The actual IRIG-B decoding and the coding functionality is implemented in the CMC test set. An OMICRON synchronization unit *CMGPS* can optionally be used as source of a synchronizing trigger pulse or PPS signal.

Typical applications for *CMIRIG-B* are:

* Synchronization of the analog outputs of two or more CMC test sets with an external IRIG-B protocol or 1PPS signal.

  Example: End-to-end testing.

* Testing of wide area protection with IRIG-B functionality using the IRIG-B time protocol generated by the CMC test set.

  Example: Testing of phasor measurement units (PMUs). Supported standard (IRIG-B extension): IEEE C37.118 (Synchrophasor standard).

* Master/Slave Operation: A CMC test set (master) generates an IRIG-B protocol and synchronizes other CMC test sets (slaves) at the same location.

Test Universe software modules supporting *CMIRIG-B*: State Sequencer, Pulse Ramping, Advanced TransPlay, Advanced Differential, NetSim, PQ Signal Generator, GroundFault, and EnerLyzer.

Any other use of the *CMIRIG-B* is considered improper and will not only invalidate all customer warranty claims but also exempt the manufacturer from its liability to recourse in case of damage to property or persons.

Observance of the operating instructions and compliance with the precautions given in this reference manual is part of the designated use.

NOTICE

All output and input connectors of the *CMIRIG-B* are SELV interfaces (**S**afety **E**xtra **L**ow **V**oltage). Do not connect any of the *CMIRIG-B* connectors to circuits carrying hazardous voltages.

2 Introduction

2.1 What is IRIG-B?

IRIG-B is a commonly used variant of a set of time protocol definitions issued by the **I**nter **R**ange **I**nstrumentation **G**roup of the Range Commander's Council (USA). Its purpose is to offer a standardized way for time information propagation from a master clock (typically connected to a GPS receiver for worldwide time synchronicity) to the connected slave devices. This allows wide-area time synchronization and device compatibility at interface level.

2.2 About the IRIG-B Standard

IRIG-B is comprehensively covered in IRIG standard revision 200-04[1]. The protocol consists of a 1 s frame containing 100 pulses of 10 ms. Each of these pulses represents one bit of the telegram. The bit types are: data bit, index bit, and position identifier. The 1 s frame carries the full time information with a numerical resolution of 1 s plus optional control bits. At the beginning of a 1 s frame the rising edge of the position identifier bit Pr is synchronous with the seconds change of the UTC time (**U**niversal **T**ime, **C**oordinated) represented by the telegram. The pulse width marks the data bit value (0 or 1) or the bit type.

The IRIG protocol format B comes in different sub-variants, indicated by three digits following the letter B.

Figure 2-1:
Example: Format B00x
(undulated, DCLS[2])
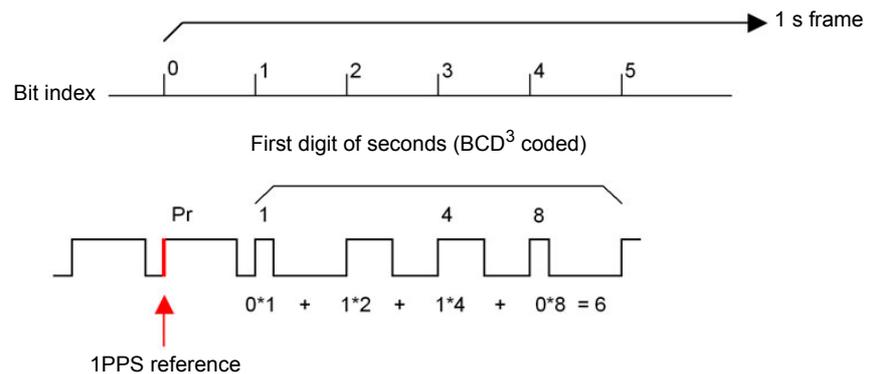
Pr = Reference bit

Example for BCD coding:
First digit of seconds = 6_{dec} corresponds to 0110_{bin}

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1. See the following related links (valid in 2007):
   https://wsmrc2vger.wsmr.army.mil/rcc/manuals/200-04/TT-45.pdf;
   https://wsmrc2vger.wsmr.army.mil/rcc/PUBS/oldoc.htm
2. DCLS = DC Level Shift
3. BCD = Binary Coded Decimal

Fixed components of the 1 s frame:

- second (00 to 59, or 60 for leap second)
- minute (00 to 59)
- hour (00 to 23)
- day (001 to 366)

Optional components (depending on x: "Coded Expression" - B00x):

- Control Function Bits (with or without IEEE C37.118 extension)
- year (00 to 99)
- SBS (0 to 86400, "Straight Binary Seconds", an alternative way to code the time of day)

The *CMIRIG-B* supports the following digital code formats (5 V TTL level) to be generated or decoded by the CMC test set:

- B00x (pulse width coded, demodulated, DC Level Shift (DCLS)).
- The support of other formats (for example, B20x - Manchester II coding) by the CMC test set depends on the *Test Universe* software version.

2.3   IEEE C37.118 (Synchrophasor Standard)

This IEEE standard (revision 2005, "Synchrophasors for Power Systems") replaces the former standard IEEE Std 1344-1995. It defines synchronized phasor measurements used in power system applications and a related data communication protocol, using a part of the Control Function Bits of the *CMIRIG-B* definition.

The OMICRON *Test Universe* software supports this extension of the *CMIRIG-B* standard (control function extensions, see IEEE C37.118 Annex F).
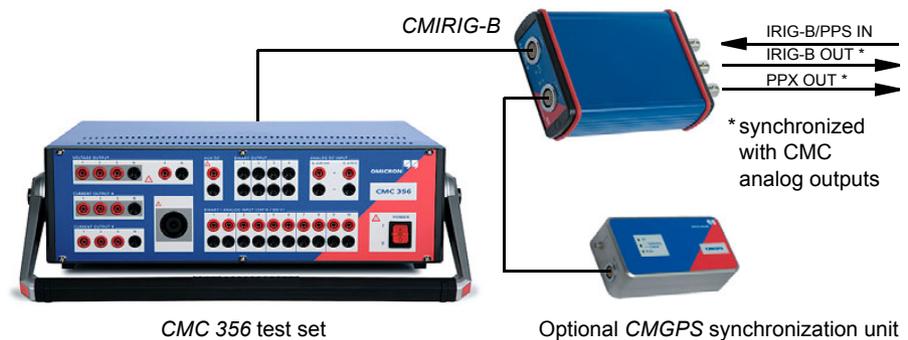
3 Setup and Function

3.1 System Overview: CMC with CMIRIG-B

The system extension *CMIRIG-B* enables the connection of devices that are able to send or receive the IRIG-B protocol to CMC test sets. The *CMIRIG-B* itself performs the level conversion from the CMC to the sources or receivers of IRIG-B or PPS signals. The actual IRIG-B decoding and coding functionality is implemented in the CMC test set. Furthermore it is possible to integrate an OMICRON *CMGPS* synchronization unit in the test setup as a source for the synchronizing time or the synchronous PPS signal.

In combination with the OMICRON *Test Universe* software, the *CMIRIG-B* is thus able to provide easy solutions for new test tasks.

Applying an IRIG-B time reference requires a CMC test set equipped with a **NET-1B**, a **NET-1C** or a **NET-2** interface board.

Figure 3-1:
IRIG-B system overview

CMIRIG-B

IRIG-B/PPS IN
IRIG-B OUT *
PPX OUT *

* synchronized with CMC analog outputs

*CMC 356* test set

Optional *CMGPS* synchronization unit

The decoding and/or generation (encoding) of the IRIG-B protocol is performed by the CMC test set. If required, the protocol extensions according to the IEEE C37.118 standard are also supported.

The most significant functional extension for those OMICRON *Test Universe* test modules that support IRIG-B is the ability to perform state changes (test signal output) in synchronism with the IRIG-B protocol or the PPS/PPX signal.

• While the *CMIRIG-B* is connected to the CMC, the binary transistor outputs 11 to 14 and the counting inputs (for meter testing) usually available on the "ext. Interf." connector of CMC test sets cannot be used.

• If connected to the *CMIRIG-B*, the *CMGPS* synchronization unit is not powered by the CMC. Therefore, the external plug-in power supply has to be used to supply the *CMGPS* with power.

• The *CMIRIG-B* provides galvanic separation between the connectors "CMC" and "CMGPS" on the front side and the BNC sockets "IRIG-B OUT", "PPX OUT" and "IRIG-B/PPS IN" on the rear side. However, this is only intended as a functional insulation and does not represent a safety-relevant insulation.

3.2   Internal Connection Logic

Figure 3-2:
Simplified representation
of *CMIRIG-B* signal paths
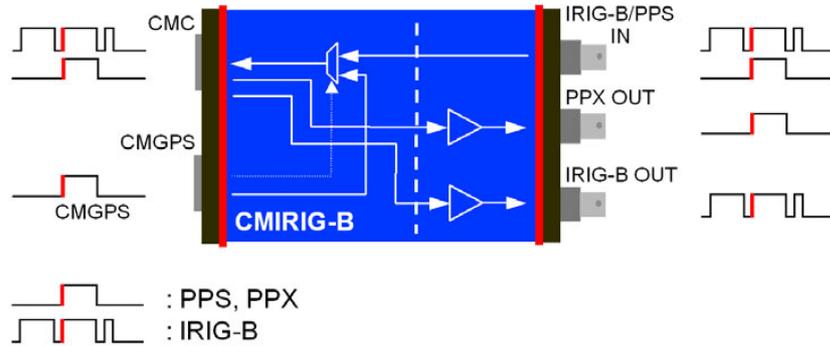
The signals "IRIG-B OUT" and "PPX OUT" from the CMC are directly routed to the related BNC sockets via the output drivers.

If a *CMGPS* synchronization unit is connected to the *CMIRIG-B*, the PPS/PPX signal from the *CMGPS* is routed to the CMC. In this case, a signal connected to the BNC socket "IRIG-B/PPS IN" is ignored.

Note: The socket "IRIG-B/PPS IN" is also deactivated if the *CMGPS* connected to the *CMIRIG-B* is switched off.

If no *CMGPS* is connected to the *CMIRIG-B*, the IRIG-B or PPS signal applied to the BNC socket "IRIG-B/PPS IN" is routed to the CMC.

3.3   Block Diagram

Figure 3-3:
CMIRIG-B block diagram
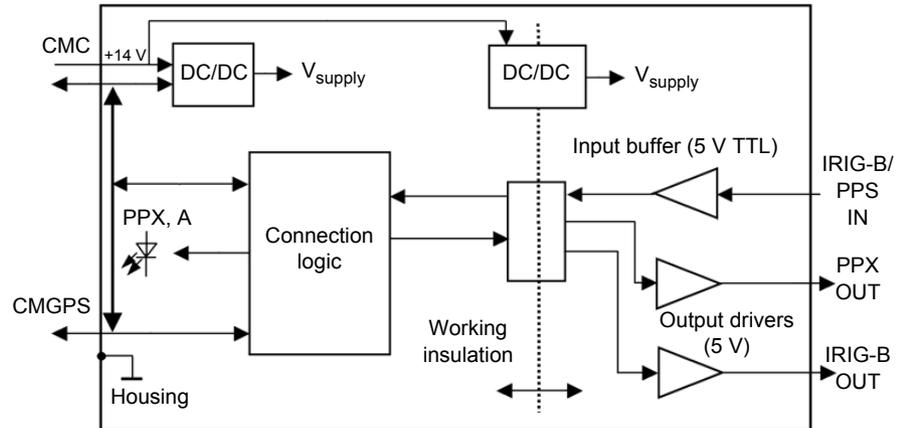
Front side   Rear side

The *CMIRIG-B* consists of two galvanically insulated groups as shown in the block diagram. The connectors, indicators and internal circuits or components of the *CMIRIG-B* are described below:

Front side of the unit (for more details, please refer to section 4.1):

• "CMC" connector:

 Socket for connection of the CMC test set. Connects the IRIG-B or PPS signal to the CMC and carries the power supply for the *CMIRIG-B*.

• "CMGPS" connector:

 Socket for connection of an optional *CMGPS* synchronization unit. The connected *CMGPS* unit is not powered by the CMC (separate plug-in power supply required).

• LED "PPX"

 This green LED flashes with the time interval of the configured PPS/PPX signal.

• LED "A"

 Status indication LED. For more information please refer to section 4.1.

Rear side of the unit (for more details, please refer to section 4.2):

• "IRIG-B OUT" and "PPX OUT":

 BNC sockets for connection of an IRIG-B / PPS receiver.

• "IRIG-B/PPS IN":

 BNC socket for connection of an IRIG-B/PPS source.

Internal circuits and components:

- The connection logic manages the signal routing between the connectors "CMC" and "CMGPS" on the front side and the BNC connectors on the rear side of the unit.

- The DC/DC power supply for the *CMIRIG-B* hardware is fed with 14 V DC voltage from the CMC.

- The output drivers are able to provide a signal voltage of 5 V at a maximum output current of 150 mA for the BNC output sockets "IRIG-B OUT" and "PPX OUT".

- The input buffer provides signal adaptation and buffering for the 5 V IRIG-B/PPS input signal applied to BNC socket "IRIG-B/PPS IN".

4 Connectors and Indicators

Note: All output and input connectors of the *CMIRIG-B* are SELV interfaces (**S**afety **E**xtra **L**ow **V**oltage). Do not connect any of the *CMIRIG-B* connectors to circuits carrying hazardous voltages.

4.1 Front Side Connectors and Indicators

Figure 4-1:
Front view of the
CMIRIG-B

Connector "CMC"

16-pole Lemo socket for connection of the CMC test set. Connects the *CMIRIG-B* or PPS signal to the CMC and carries the power supply for the *CMIRIG-B*.

Use the delivered connection cable VEHK0003 to connect this socket to connector "ext. Interf." on the rear side of the CMC.

Connector "CMGPS"

16-pole Lemo socket for connection of an optional *CMGPS* synchronization unit. The connected *CMGPS* unit is not powered by the CMC; the separate plug-in power supply is required for the *CMGPS*).

A connected *CMGPS* synchronization unit affects the behavior of the internal *CMIRIG-B* connection logic (see section 3.2 "Internal Connection Logic").

LED "PPX"

This green LED flashes with the time interval of the configured PPS/PPX signal.

LED "A"

This LED indicates the status of the *CMIRIG-B*

Red   *CMIRIG-B* not in use by the *Test Universe* software/CMC.

Green   *CMIRIG-B* configured and in use by the *Test Universe* software/CMC.

Off   No supply voltage for the *CMIRIG-B*.

4.2   Rear Side Connectors

Figure 4-2:
Rear view of the *CMIRIG-B*

The three connectors on the rear side are standard 50 Ω BNC connectors. They have a common ground. These connectors are galvanically separated (working insulation) from the connectors "CMC" and "CMGPS".

Connector "IRIG-B OUT"

If configured accordingly, this BNC connector outputs the IRIG-B telegram.

The output driver delivers a 5 V (TTL) signal with a maximum current of 150 mA suitable for distribution via 50 Ω wiring.

Connector "PPX OUT"

This BNC connector outputs a pulse sequence that is synchronous to the IRIG-B telegram. The rising signal edge (0 V to 5 V) is synchronous to the rising edge of the 1PPS signal of the IRIG-B telegram or *CMGPS*.

The output driver delivers a 5 V (TTL) signal with a maximum current of 150 mA suitable for distribution via 50 Ω wiring.

Connector "IRIG-B/PPS IN"

This BNC connector is a 5 V (TTL) input for reception of the IRIG-B protocol or a 1PPS signal (for example, for encoding). If configured accordingly, the received signal is forwarded to the CMC.

A connected *CMGPS* synchronization unit influences the behavior of this input (see section 3.2 "Internal Connection Logic" on page 12).

5 Operating the CMIRIG-B

5.1 Taking the CMIRIG-B into Operation

Before operating the *CMIRIG-B*, please verify the availability of all components by means of the packing list. Standard scope of delivery:

- *CMIRIG-B* unit
- Connection cable *CMIRIG-B* ⟺ CMC (VEHK0003)
- *CMIRIG-B* reference manual.

To apply IRIG-B functionality, the following additional equipment is required:

- A CMC test set equipped with a **NET-1** or a **NET-2** interface board.
- *Test Universe* software version 2.20 or higher
- IRIG-B source and/or receiver with
   - 5 V (TTL) signal level
   - demodulated DC Level Shift protocol (IRIG-B00x).
- The distribution of the IRIG-B signal or the PPS signal over distances of more than 1 m should be done as suggested in section 5.2 "IRIG-B, PPS Signal Distribution" on page 19 (using 50 Ω coax cable with corresponding termination).
- For particular tasks a *CMGPS* synchronization unit is required.

The *CMIRIG-B* operating instructions are based on the precondition that the CMC test set has been set up in accordance with the instructions described in its manual, and is ready for use.

Proceed as follows to take the *CMIRIG-B* into operation (refer to Figure 5-1: "Typical test setup with a CMIRIG-B" on page 18):

- Connect the *CMIRIG-B* to the CMC test set using the delivered connection cable VEHK0003.
- Proceed with section 5.3 on page 20 to select the desired configuration. Connect the *CMIRIG-B* to the IRIG-B source or receiver accordingly.

   For particular tasks (see below) it is necessary to connect a *CMGPS* synchronization unit to the *CMIRIG-B*. In this case, also connect the GPS antenna to the *CMGPS*. Place the antenna at a suitable position that provides sufficient open sky.

NOTICE
Do **not** place the *CMGPS* antenna to an exposed position **above the lightning rod** or any other location endangered by lightning. Do **not** position the antenna in a control cabinet in the vicinity of **flashover-endangered spots**.

Figure 5-1:
Typical test setup with a
CMIRIG-B

CMIRIG-B

VEHK0003

IRIG-B/PPS IN
IRIG-B OUT *
PPX OUT *

* synchronized
with CMC
analog outputs

Antenna

CMC 356 test set
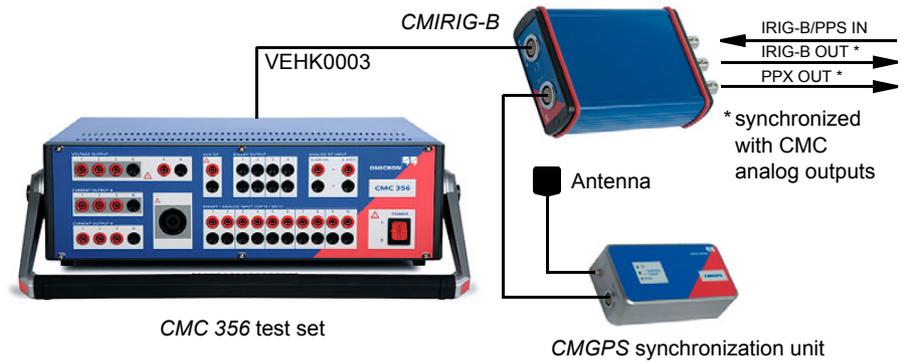
CMGPS synchronization unit

Figure 5-1 shows a typical constellation with IRIG-B functionality. You can select the required configuration in the *Test Universe* software. The *Test Universe* software detects connected *CMIRIG-B* hardware and supports the test configuration selection (see section 5.3 "Test Configurations / Operating Modes" on page 20).

5.2   IRIG-B, PPS Signal Distribution

The IRIG-B (and 1PPS/PPX) signal distribution is most commonly realized using coaxial cables or shielded twisted pair cables. The *CMIRIG-B* output drivers are unbalanced and designed for signal distribution on cables with a characteristic impedance of 50 Ω (coaxial cable, for example RG 58).

For reliable operation, the cable length should not exceed 50 m for applications with the *CMIRIG-B*. To avoid problems caused by signal reflections and ringing, we highly recommend to terminate the cable end using a 50 Ω termination resistor.

Figure 5-2:
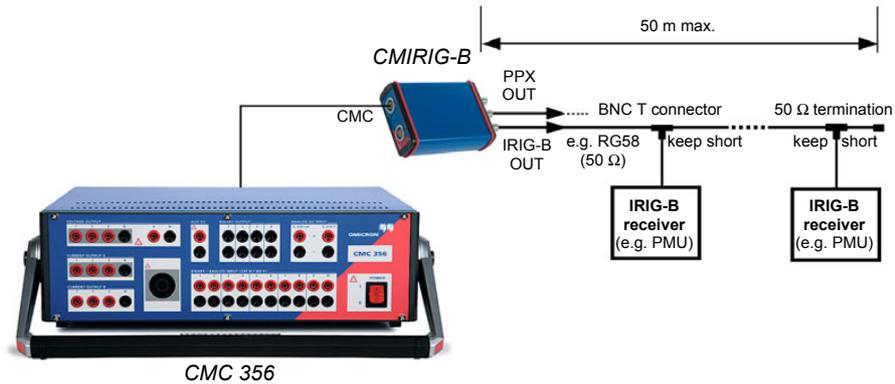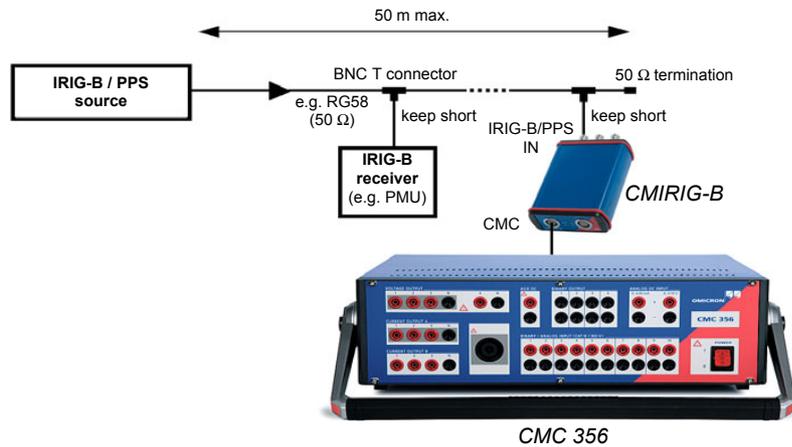CMC & *CMIRIG-B* operating as IRIG-B and/or PPX source

Figure 5-3:
CMC & *CMIRIG-B* operating as *CMIRIG-B* or PPS receiver

5.3 Test Configurations / Operating Modes

After setting up the test equipment, turning on the CMC test set and launching the *Test Universe* software, a connected *CMIRIG-B* is recognized by the software automatically.

After this, the possible configurations are available for selection in the Hardware Configuration of the *Test Universe* software[1].

Figure 5-4:
Trigger mode selection in the *Test Universe* software
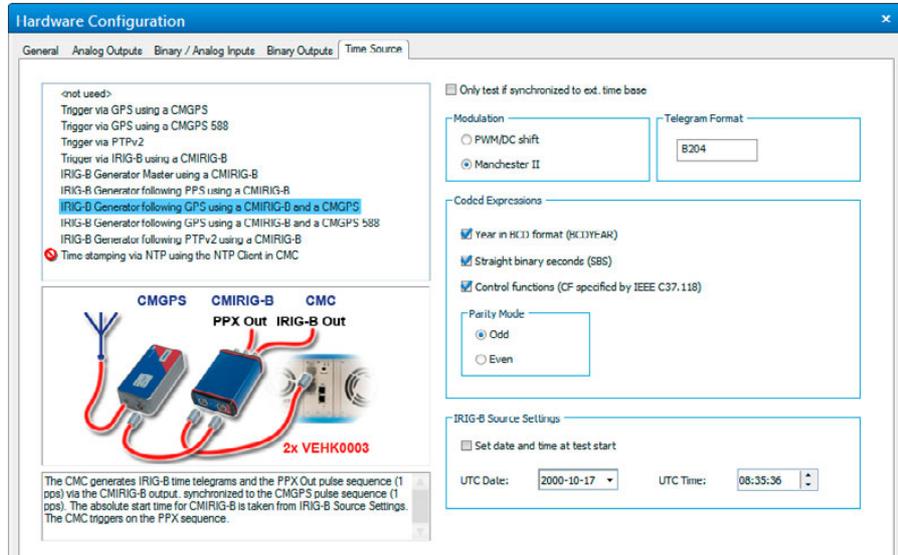
Further test module-related configuration options (for example, the test start time) can be accessed in the corresponding test module using **Time Trigger Configuration**. For more information, refer to the **--- Synchronizing CMC Test Sets ---** section of the *Test Universe* Help.

The IRIG-B configurations currently supported by the *Test Universe* software are described in the following subsections.

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1. For configuration details please refer to the online help of the *Test Universe* software. Screens shown in this manual may differ from the actual screens shown by the software depending on the software version.

5.3.1 Trigger via IRIG-B using a CMIRIG-B

Figure 5-5:
Configuration "Trigger via
IRIG-B using a CMIRIG-B"

The CMC test set works as IRIG-B decoder. An IRIG-B generator (a third party product; for example, a satellite synchronizing clock) is connected to the CMC test set's external Interface input via a *CMIRIG-B*. The IRIG-B generator is connected to **IRIG-B/PPS IN**, the test object to **PPX OUT**, the CMC test set to CMC.

The trigger is generated from the received IRIG-B time reference. The PPX OUT pulse sequence is in synchronization with the *CMIRIG-B* input on **IRIG-B/PPS IN**.

You can find basic information about the IRIG time codes standard in the **--- Synchronizing CMC Test Sets ---** section of the *Test Universe* Help, topic "Basic Information about the IRIG Time Codes Standard". For a comprehensive covering of IRIG-B and its parameterization refer to the "IRIG standard revision 200-04".

5.3.2 IRIG-B Generator Master using a CMIRIG-B

Figure 5-6:
Configuration "IRIG-B
Generator Master using a
CMIRIG-B"

The CMC test set works as IRIG-B generator and provides its generated time reference to the *CMIRIG-B* input **CMC**. At the *CMIRIG-B* output **IRIG-B OUT** the time reference is available for the test object (for example, a phasor measurement unit).

The pulse sequence at **PPX OUT** (fixed to 1 pulse per second) is in synchronization with CMC's internal time base.

Operating the CMC test set as IRIG-B generator enables the IRIG-B parameters section at the right.

5.3.3   IRIG-B Generator following PPS using a CMIRIG-B

The CMC test set works as IRIG-B generator following an external pulse sequence (1 pulse per second) fed into the **IRIG-B/PPS IN** input. The CMC provides its generated time reference to the *CMIRIG-B* input CMC. At the *CMIRIG-B* output **IRIG-B OUT**, the time reference is available for the test object.

The pulse sequence at **PPX OUT** (fixed to 1 pulse per second) is in synchronization with the external pulse sequence.

The absolute start time for the *CMIRIG-B* output is generated from the **IRIG-B Source Settings** set in the **Hardware Configuration** window. The CMC triggers on PPX sequence.

5.3.4   IRIG-B Generator following GPS using a CMIRIG-B and a CMGPS

The CMC test set works as IRIG-B generator following a 1 pps pulse sequence from a *CMGPS* synchronization unit fed into the **CMGPS** input. The CMC provides its generated time reference to the *CMIRIG-B* input CMC. At the *CMIRIG-B* output **IRIG-B OUT**, the time reference is available for the test object.

The pulse sequence at **PPX OUT** (fixed to 1 pulse per second) is in synchronization with the 1 pps pulse sequence from the *CMGPS* synchronization unit.

The absolute start time for the *CMIRIG-B* output is generated from the **IRIG-B Source Settings** set in the **Hardware Configuration** window. The CMC triggers on PPX sequence.

If you use the *CMIRIG-B* in combination with the *CMGPS* synchronization unit, make sure to connect the 100 - 240 VAC/18 VDC power supply unit to the *CMGPS*. Else, *Test Universe* cannot detect the *CMGPS*.

5.3.5 IRIG-B Generator following GPS using a CMIRIG-B and a CMGPS 588

Figure 5-9:
Configuration "IRIG-B Generator following GPS using a CMIRIG-B and a CMGPS 588"

The CMC test set works as IRIG-B generator following a synchronization signal from a *CMGPS 588* synchronization unit fed into the test set's ETH1 or ETH2 Ethernet port. The CMC provides its generated time reference to the *CMIRIG-B* input CMC. At the *CMIRIG-B* output **IRIG-B OUT**, the time reference is available for the test object.

IRIG-B and its parameterization is comprehensively covered in IRIG standard revision 200-04. For the PTP settings, refer to the *Test Universe* **Hardware Configuration** Help, topic "Time Source Tab", subheader "Trigger via PTPv2".
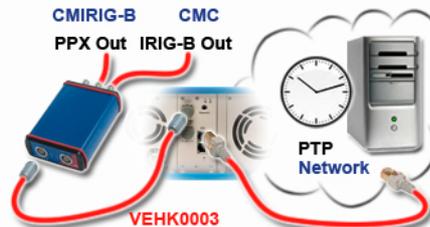
The usage of PTP requires a CMC test set equipped with a **NET-1B**, a **NET-1C** or a **NET-2** board.

To learn more about the NET-1x and NET-2 interface boards, refer to the section "How do CMC Test Sets Communicate with a Test Universe computer?" of the *Test Universe* Help. Alternatively, launch the relevant CMC test set PDF manual from the "User Manuals > CMC Test Sets and Amplifiers" topic.

5.3.6 IRIG-B Generator following PTPv2 using a CMIRIG-B

Figure 5-10:
Configuration "IRIG-B Generator following PTPv2 using a CMIRIG-B"

The CMC test set works as IRIG-B generator following a synchronization signal from a PTPv2 time source fed into the test set's **ETH1** or **ETH2** Ethernet port. The CMC provides its generated time reference to the *CMIRIG-B* input CMC. At the *CMIRIG-B* output **IRIG-B OUT**, the time reference is available for the test object.

IRIG-B and its parameterization is comprehensively covered in IRIG standard revision 200-04. For the PTP settings, refer to the *Test Universe* **Hardware Configuration** Help, topic "Time Source Tab", subheader "Trigger via PTPv2".

The usage of PTP requires a CMC test set equipped with a **NET-1B**, a **NET-1C** or a **NET-2** board.

To learn more about the NET-1x and NET-2 interface boards, refer to the section "How do CMC Test Sets Communicate with a Test Universe computer?" of the *Test Universe* Help. Alternatively, launch the relevant CMC test set PDF manual from the "User Manuals > CMC Test Sets and Amplifiers" topic.

6 Technical Data

Guaranteed values indicated in this chapter are valid for 1 year from the date of delivery. The specifications given below apply to CMC test sets equipped with a **NET-1B**, a **NET-1C** or a **NET-2** interface board.

6.1 Power Supply

The *CMIRIG-B* is powered via the "ext. Interf." connector on the CMC test set.

Table 6-1:
Power supply data

Power supply	
Supply from CMC	14 VDC
Power consumption	3 W max.
Connection	Lemo connector labeled "CMC"

A connected *CMGPS* unit is not powered by the CMC (i.e., the separate plug-in power supply is required for the *CMGPS*).

6.2 Insulation Coordination

Table 6-2:
Insulation coordination

Insulation coordination	
Circuit group A	BNC connectors on the rear side: "IRIG-B OUT", "PPX OUT", "IRIG-B/PPS IN" (common ground)
Circuit group B	16-pole Lemo connectors on the front side: "CMC" and "CMGPS" (ground connected to housing)
Insulation type group A to group B	- Working insulation - Clearance: > 1 mm - Creepage: > 1 mm - Test voltage: 1000 VDC
Insulation resistance group A to group B	1 MΩ

The *CMIRIG-B* is an SELV device (**S**afety **E**xtra **L**ow **V**oltage). It may only be connected to external devices that fulfill the SELV requirements according to the standards EN 61010-1 or IEC 61010-1. Do not connect any of the *CMIRIG-B* connectors to circuits carrying hazardous voltages.

6.3 Outputs

6.3.1 IRIG-B OUT

Table 6-3:
Output **IRIG-B OUT**

Output IRIG-B OUT	
IRIG Standard	200-04
Data format[1]	B00x (demodulated, dc level-shift) B20x (Manchester, modulated, dc level-shift)
Output characteristic	5 V (TTL), 150 mA, for 50 Ω coaxial signal distribution
Synchrophasor (PMU) testing	Configurable with or without IEEE C37.118 extensions
Connector	BNC

1. IRIG-B functionality requires a CMC test set equipped with a **NET-1B**, a **NET-1C** or a **NET-2** interface board. The support of other formats (for example, B20x - Manchester II coding) by the CMC test set depends on the *Test Universe* software version.

6.3.2 PPX OUT

PPX OUT is a configurable pulse output (X describes the pulse rate) where the active (rising) edge is in coincidence with the start of an UTC second).

Example: 1PPS (1 pulse per second: pulse rate = 1s).

Table 6-4:
Output **PPX Out**

Output PPX OUT	
Output characteristic	5 V (TTL), 150 mA, for 50 Ω coaxial signal distribution
Minimum pulse length	1 ms
Pulse rate	IRIG-B encoder: 1 s IRIG-B decoder: 0 = single, 1 ... 65535 s
Connector	BNC

6.4 Inputs

This input can be used with two different functions:

* IRIG-B input; for configuration "Trigger via IRIG-B using a CMIRIG-B" (IRIG-B decoder), see section 5.3.1 on page 21.

* PPS input; for configuration "IRIG-B Generator following PPS using a CMIRIG-B" (IRIG-B encoder); see section 5.3.3 on page 22. That is, an external PPS source is connected and IRIG-B encoder is configured.

The input is without function if a *CMGPS* synchronization unit is connected to the *CMIRIG-B*.

Table 6-5:
Input **IRIG-B/PPS IN**

Input IRIG-B/PPS IN	
IRIG Standard	200-04
Data format IRIG-B IN[1]	B00x (demodulated, dc level-shift)
Input characteristic	5 V (TTL)
Min. high level	2.0 V
Max. low level	0.8 V
Input impedance	1.5 kΩ || 1 nF
Max. input voltage	6 V
Min. input voltage	-0.5 V
Min. input PPS pulse length (PPS IN)	3 µs
Synchrophasor (PMU) testing	Configurable with or without IEEE C37.118 extensions
Connector	BNC

1. IRIG-B functionality requires a CMC test set equipped with a **NET-1B**, a **NET-1C** or a **NET-2** interface board.

6.5 Timing Specifications

There are six possible configurations that select the time reference source accordingly. For details, refer to the following sections:

- 5.3.1 "Trigger via IRIG-B using a CMIRIG-B" on page 21
- 5.3.2 "IRIG-B Generator Master using a CMIRIG-B" on page 21
- 5.3.3 "IRIG-B Generator following PPS using a CMIRIG-B" on page 22
- 5.3.4 "IRIG-B Generator following GPS using a CMIRIG-B and a CMGPS" on page 22
- 5.3.5 "IRIG-B Generator following GPS using a CMIRIG-B and a CMGPS 588" on page 23
- 5.3.6 "IRIG-B Generator following PTPv2 using a CMIRIG-B" on page 23

The analog amplifier outputs of the CMC test set can be re-synchronized anytime with an adjustable phase relative to the time reference edge. During the time between the synchronization edges, the CMC test set uses its internal high-precision time base for signal generation.

Figure 6-1:
CMIRIG-B timing overview
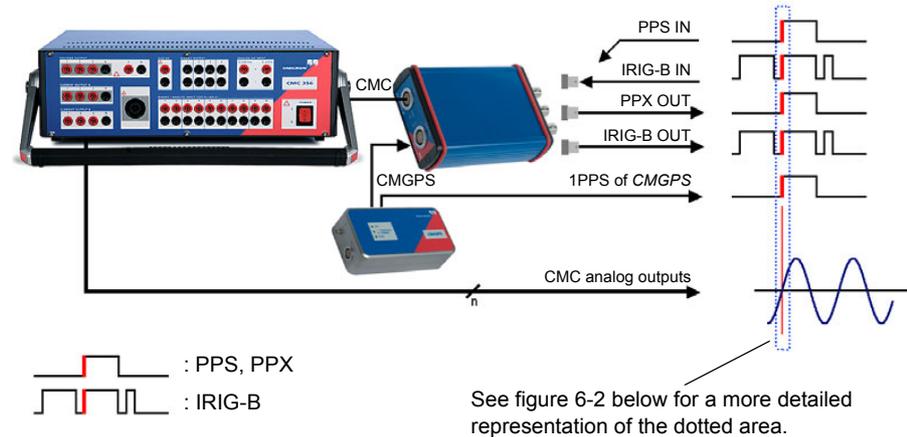
Figure 6-2:
CMIRIG-B timing in detail
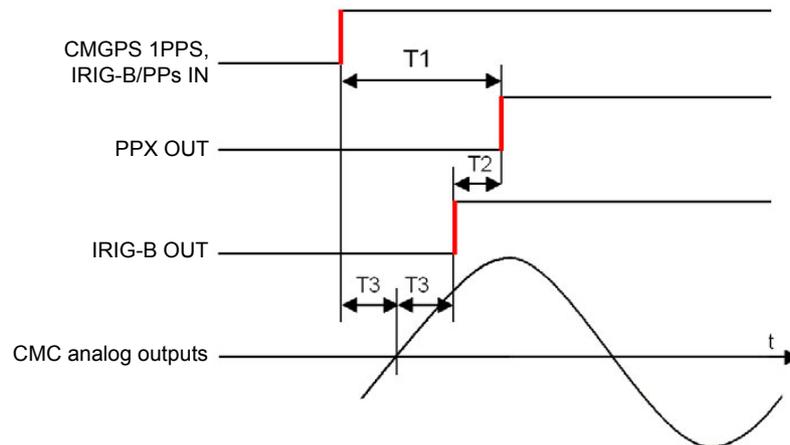
Table 6-6:
Timing specifications

Timing specifications	
T1 (delay time PPS source to PPX OUT)	< 1 µs typ., 1.5 µs max.
T2 (time skew PPX OUT to IRIG-B OUT)	< 0.1 µs typ., ± 0.5 µs max.
T3 (time error of time reference source to analog outputs)[1]	< ± 1 µs typ., ± 5 µs max.[2]

1.   Applies to CMC output frequencies < 100 Hz and re-synchronized analog output signals.
2.   CMC 356: < ± 5 µs typ., ± 20 µs max.

Some details regarding the timing specification:

The achievable synchronization precision of the analog CMC outputs is mainly governed by the analog signal path of the CMC hardware (analog output filters, power amplifier).

These components, together with the non-negligible but well-defined processing time in the processing unit, cause a time delay of approx. 420 µs between the numerical signal generation and the actual analog output signals. This is why the CMC output signals react with delay to the time reference (PPS, IRIG-B).

This time delay is taken into account in the signal processing in a way that (after the unavoidable initial delay) the output signals show the proper time relation (i.e., phase angle) to the time reference.

Example A: Initial synchronous start

Ch1 / blue: Amplitude step from 0 V to 40 V / 90 ° / 50 Hz

Ch2 / red: Amplitude step from 0 V to 40 V / -90 ° / 50 Hz

Ch4 / magenta: PPS (trigger)

Figure 6-3:
Example A
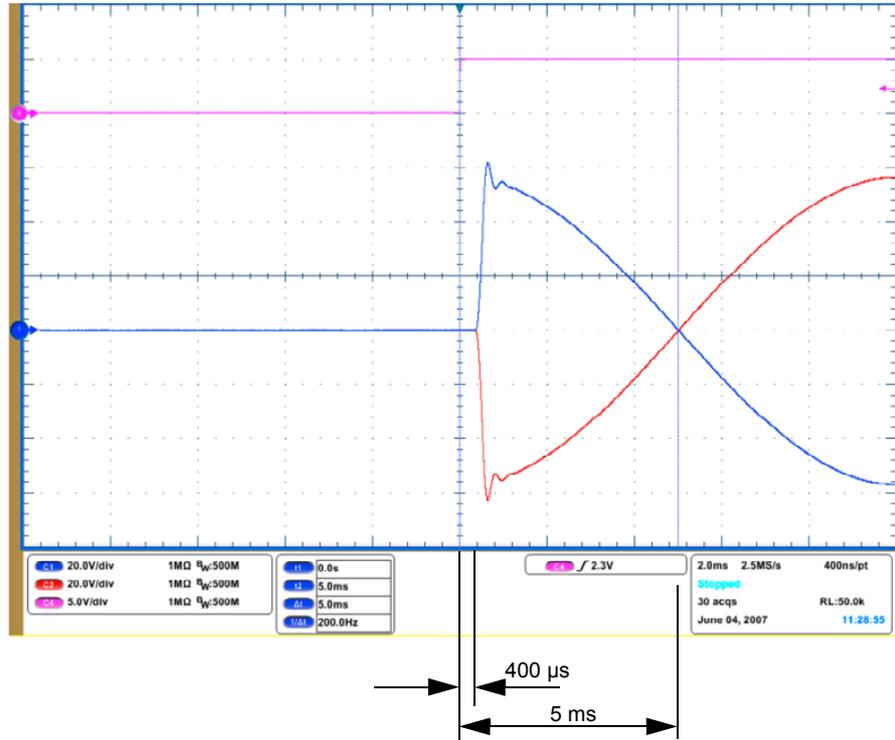
The time delay of approx. 400 µs caused by the analog signal path can be seen in example A (compare the amplitude step with the trigger edge). Yet the required time relation of the outputs to the reference time (PPS signal) stays untouched: The zero crossing of the analog signals occurs 5 ms after the synchronization time which is the expected behavior for a 50 Hz signal with ± 90 ° offset.

Example B: Re-synchronization with amplitude step

Ch1 / blue: Amplitude step from 50 V to 40 V / 90 ° / 50 Hz

Ch2 / red: Amplitude step from 50 V to 40 V / -90 ° / 50 Hz

Ch4 / magenta: PPS (trigger)

Figure 6-4:
Example B
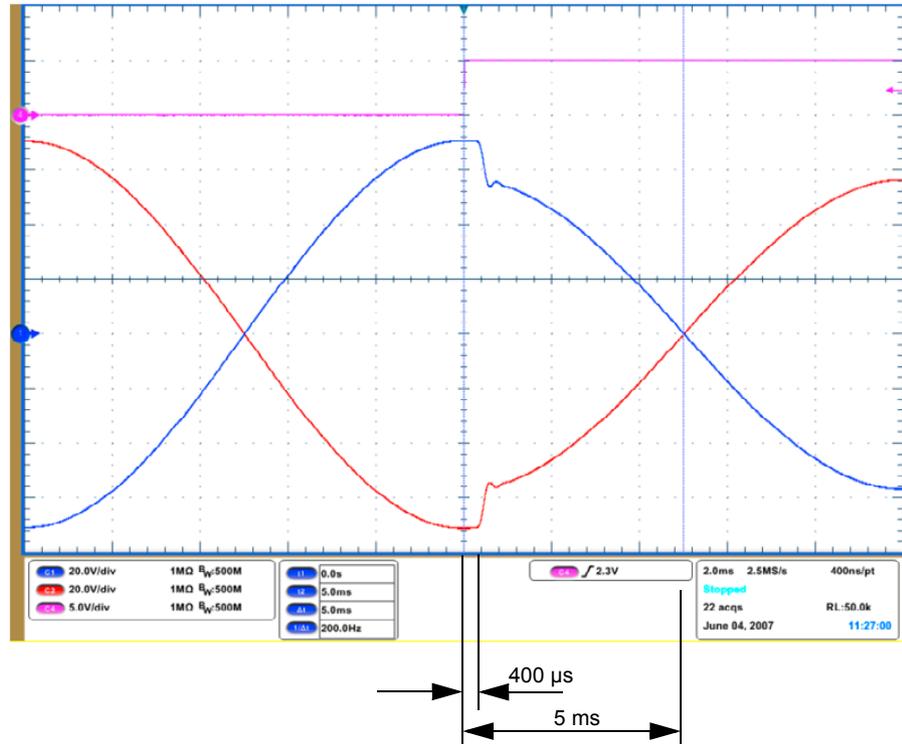
The time delay of approx. 400 µs caused by the analog signal path can be observed here, too. Again, this has no influence on the phase relation between the output signals and the trigger time.

6.6   Environmental Conditions

Table 6-7:
Climate conditions

Climate	
Operating temperature	0 to +50 °C (32 to +104 °F)
Storage and transportation	-25 to +70 °C (-13 to +158 °F)
Humidity	5 to 95 % relative humidity, no condensation
Max. altitude	2000 m

Table 6-8:
Electromagnetic
compatibility

EMC	
CE conformity, requirements	The product adheres to the guidelines of the council of the European Community for meeting the requirements of the member states regarding the electromagnetic compatibility (EMC Guidelines 89/336/EEC).
	EN 61326-1

Table 6-9:
Fulfilled safety standards

Safety standards	
European standard	EN 61010-1:2001
International standard	IEC 61010-1:2001
ISO standard	This product is designed and manufactured under an ISO9001 registered system.

6.7   Mechanical Data

Table 6-10:
Mechanical data

Size, weight and protection	
Weight	260 g (0.57 lb.)
Dimensions W x H x D	83 x 35 x 130 mm (3.3 x 1.4 x 5.1 ")
Housing	IP40 according to EN 60529

6.8   Cleaning

To clean the *CMIRIG-B* interface unit, use a cloth dampened with isopropanol alcohol or water.

7   Ordering Information

Table 7-1:
Order numbers for
CMIRIG-B components

Designation	Order no.
CMIRIG-B interface unit with all accessories	VEHZ1150
CMIRIG-B interface unit without accessories	VEHZ1151
Connection cable *CMIRIG-B* ⟺ CMC test set	VEHK0003
CMIRIG-B reference manual	VESD1150

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