DIGSI 5 QUICK NOTES

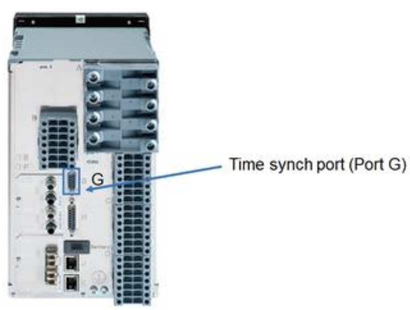
DIGSI-5-QN0003: IRIG-B Time Synchronisation of SIPROTEC 5 Relays:

Siemens SIPROTEC 5 devices use a flexible system of time-synchronisation that allows multiple different types of time synchronisation input. Suitable signal formats include NTP, PTP, IRIG-B and DNP3. Two different sources can be selected, if the first is no longer available, the relay will automatically switch to using the second.

The configuration of the relay for time synchronisation is usually very straightforward with just a few simple settings. These are well described in the Siemens document: **SIP5-APN-022: Time synchronization settings** and **SIP5-APN-028 Time synchronization via IEEE 1588 (PTP)**. This Quick Note provides some additional detail for cases where IRIG-B is selected as one of the timing sources.

QUICK GUIDE TO: Physical connections

The IRIG-B connection to a SIPROTEC 5 relay is via port G, a DB9 connection on the rear of the base unit, as described in the SIPROTEC 5 hardware manual [and Figure 1].



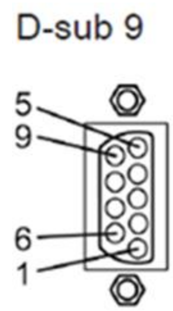


Figure 1. Location and pinout of the time synchronisation port 'Port G' on a SIPROTEC 5 relay base module.

The IRIG standard does not define a standard voltage level. SIPROTEC 5 relays can accept DC Level Shifted (DCLS) signals at 5V, 12V or 24V – different pins in port G are used for each voltage level [Table 1]. The most common DCLS voltage used is 5V which is also referred to as 'TTL' or 'logic level'. In the case of 5V DCLS, pins 2 & 3 are used, with pin 5 available for connection of the screen as required.

Pin	Signal Name	Description
1	P24 TSIG	Input for 24V IRIG signal
2	**P5 TSIG**	**Input for 5V IRIG signal (+ve)**
3	**M TSIG**	**Return line for the IRIG signal**
4	*M T SYNCH*	*Return line for PPS synch*
5	Screen	Screen potential
6	-	-
7	P12 TSIG	Input for 12V IRIG signal
8	*P TSYNC*	*24V Input for PPS Synchronisation*
9	Screen	Screen potential

Table 1. Port G pin signal description.

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(A Tekron IRIG-B Analyzer, available from HV Power, can be used to measure the IRIG-B voltage being delivered by your clock. Note that IRIG-B is digital signal transmitted at a rate of 100 pulses per second. If attempting to measure this using the DC voltage range of a multimeter, the voltage will typically appear in the range of about 1.6 to 2.1V).

SIPROTEC 5 relays do not accept AM modulated IRIG signals, however the use of AM IRIG in New Zealand substations is uncommon. Even where coaxial cables may be used, the signal being transmitted is usually DCLS.

The P TSYNC input is the one-pulse-per-second (1PPS) input (at 24 Vdc) that is only used for legacy protection data interface applications such as line differential protection where two or more relays need synchronisation due to different tx and rx communication delays. Even with 1PPS input, IRIG-B (or other) is required for synchronisation of the relay real-time-clock.

QUICK GUIDE TO: Relay settings

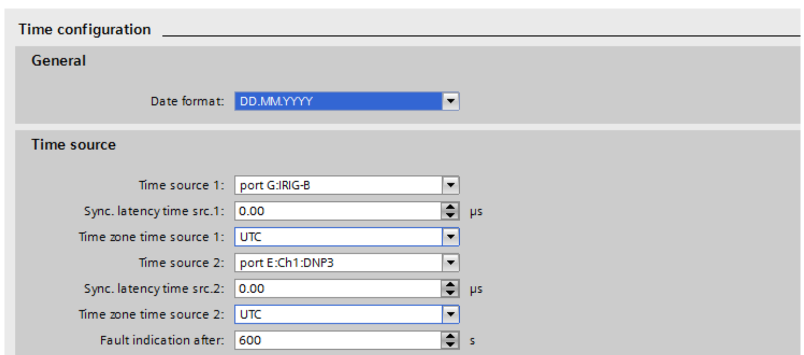

Figure 2. Time Synch settings for IRIG-B. Here IRIG-B is used as the first time source, DNP3 is selected as the second time source.

To set the relay to use IRIG-B as a timing source, select either *Time source 1* or *Time source 2* as '*port G:IRIG-B*'.

The *Time zone time source* should be set to describe whether the received signal is in UTC time or local time. However, when IRIG signals include the time-zone information in the Control Function fields, the *Time zone time source* settings are ignored. Time signals are either considered to be in UTC format, or to have the time-zone and daylight saving adjustment settings sent with the signal – the relay uses these to convert back to UTC.

While the Time Zone and daylight saving time setting information in the relay may not be required (as this information should be included in the IRIG-B code), it is recommended to always set the appropriate values (as shown in Table 2) in the relay. Thus if the clock outputs are changed in the future – there is a higher likelihood of the relay settings remaining valid.

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Time zone offset to UTC	720 mins
Start of daylight savings time	Last Sunday in September at 02:00 am
End of daylight savings time	First Sunday in April at 03:00 am
Offset daylight savings time	60min

Table 2. Time zone and daylight saving time settings for New Zealand.

It is possible to compensate for the propagation delay of the signal between the clock and the relay using the parameter *Sync. latency time src.* For the level of accuracy required for event log synchronisation, this is not usually necessary.

The *Fault indication after* parameter is used to set the delay before a time synch error is reported after failure of a time synch signal.

Figure 3. Time zone and daylight saving time settings. These are common to all time sources.

QUICK GUIDE TO: GPS clock settings

The output of the clock needs to be set to DCLS IRIG-B (not AM IRIG-B).

A number of different variants of IRIG-B signals are available, a variant that is compatible with the relay must be selected in the clock. The basic signal just includes the elapsed time since the beginning of the year. Other variants include the year, local time offset and daylight savings time switching. The signal types that SIPROTEC 5 relays can accept are described in Table 3.

Format	Description
B002/B003	The most basic format. The year must be set manually in the relay. Control Functions are not transmitted.
B004/B005	Control functions are transmitted – the relay interprets these and automatically adjusts for time zone and daylight savings
B006/B007	Year is transmitted, but other Control Functions not transmitted

Table 3. IRIG-B formats accepted by SIPROTEC 5 relays.

Control Functions are extra information sent from the clock as part of the IRIG signal. Where control functions are sent, they must be in 'IEEE C37.118-2005' format. This is commonly referred to as 'IEEE extensions' (IEEE 1344 1995 was an earlier iteration of this standard in which the sign of the UTC offset is opposite of IEEE C37.118-2005. It was changed due to implementation confusion. NB: many manufacturers refer to being compliant with IEEE 1344 1995 despite the fact that they actually don't, and instead comply with C37.118-2005). If a clock is capable of transmitting IEEE extensions then this should be selected as the relay can use these in the calculation of the local time. In some clocks this is referred to as *Extended format.*

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If the extensions are sent, then it must be with Even parity. Usually this is automatic, but with some clocks this must be manually selected.

The 2004 update of the IRIG-B standard added the year (BCDyear) information into the basic protocol, so there can be some confusion if this is being output by a clock with B002 format. The Tekron IRIG-B Analyzer is a handy tool to monitor an IRIG signal and report on the presence (or not) of the different control/extensions.

Figure 4. Tekron IRIG-B Analyzer screen example.

If it's not clear that the clock is outputting IEEE extensions then bench-testing of the system is recommended to ensure local time offset is calculated as expected. Make sure this testing includes a simulation to or from daylight savings.

Further information

How the relay calculates local time:

Each different type of time signal has different ways of handling local time zones and daylight-savings time. For example NTP signals are UTC only, local and daylight savings conversions are done by each client device. To enable seamless switching between each source, the relay makes a two stage process at calculating the local time for use in the relay display and event log. First, each time signal is converted back to UTC. The method for this varies depending on the type of time signal. The relay then converts this common UTC time back to local time for use in event and fault logs and on the relay display. The conversion back to local time relies on either the information available in the time signal or the 'Time zone and daylight saving time' settings entered in the relay.

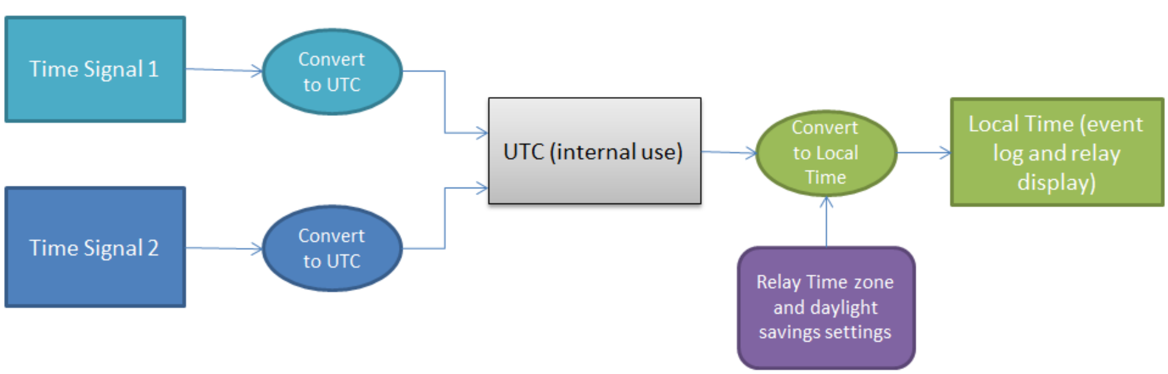

Figure 5. Time zone and daylight saving time settings. These are common to all time sources.

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Trouble-shooting

The following relay signals are available for mapping to the event log:

- *Clock Fail*
- *Daylight saving Time*
- *Clock set manually*
- *Status Time Source 1*
- *Status Time Source 2*
- *Time sync. Error*
- *High accuracy*

These are each described in detail in the *Date and Time Synchronisation* section of each relay manual.

The signal *Time sync. Error* will be indicated in the event of failure of a timing signal, delayed by the time set in parameter *Fault Indication After*. This signal is also internally linked to the alarm signal *Group Warning*.

More detailed information is available when connected online to a device using DIGSI 5.

Additional information is available for viewing online using DIGSI 5 in the Device Information->Time Information tab [Figure 6] .

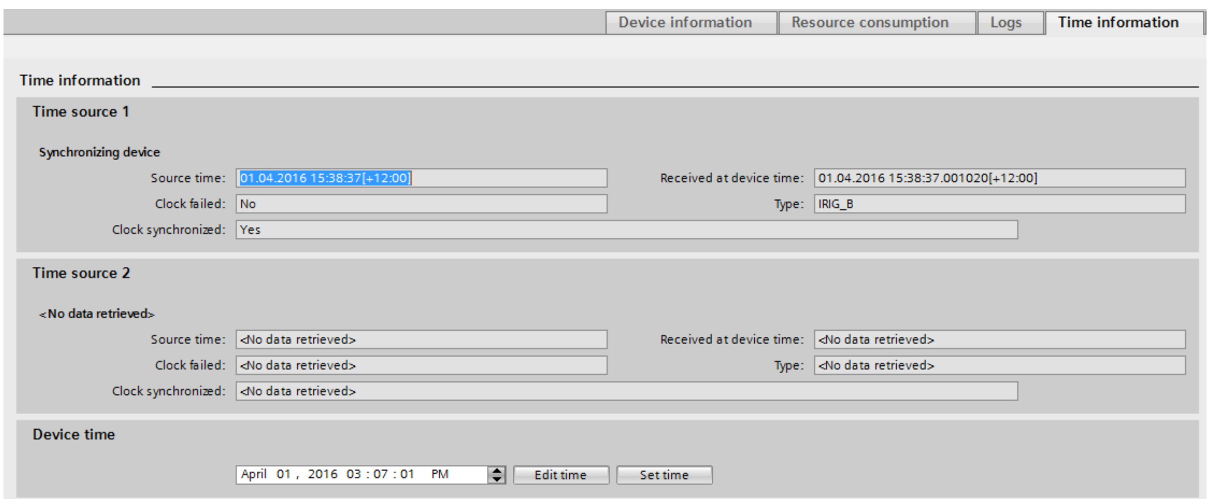

Figure 6. Timing information available in DIGSI 5 when connected to a relay.

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