

Chapter H: Timing Constraints, Failures, and Related Documentation

I Timing Constraints On Data Complexity

As described in SSI8003-10B Section 2, the Central Interlocking transmits and receives messages to the Trackside Functional Modules at a minimum interval of 9.5 ms (the Interlocking "minor cycle"), so that each Trackside Functional Module is addressed at a nominal interval of 608 ms (the "major cycle"). These minimum times are increased to a minimum of 12.85 ms and 822 ms respectively where a Long Line Link is employed, but this does not affect data processing capacity. To ensure that all the geographic data is processed once per major cycle, the following data is processed every minor cycle.

- I trackside input telegram
- I trackside output telegram
- I Internal Data Link input or output telegram (in 30 out of 64 minor cycles)
- I/64 of the flag operations

Where there is a large amount of data to be processed, the time taken may exceed the minimum minor cycle period, and this in turn will extend the overall major cycle time. To allow for this, the Central Interlocking and Trackside Functional Modules have been designed to allow the extension of individual minor cycles up to **a maximum of 30 ms**, and the overall major cycle up to **a maximum of 1000 ms**. Outside these limits, diagnostic messages are output on the Technician's Terminal which report minor and major cycles which are too long. Such diagnostic messages are normally only encountered while testing new or altered data on a SSI Design Workstation and indicate that corrective action is required. These diagnostic facilities must not be used as a substitute for proper data design, guidance for which is given in SSI8003-52: Timing Constraints on Interlocking Data Complexity. Excessive minor and major cycles should not occur in a commissioned interlocking with properly designed and tested data, but may, unusually, happen where there is a large quantity of data which is only processed when particular combinations of conditions occur in the "state of the railway".

The Technician's Terminal fault messages provided for excessive length minor and major cycles can "jam" other fault messages and prevent Technician's controls being applied, if they occur on every major cycle.

If the minor cycle limit is exceeded, there is a risk that some of the Trackside Functional Modules will interpret the gaps between the messages as evidence of Trackside Data Link faults, causing the Modules to reject the messages from the Central Interlocking and enter the "red retaining" mode of operation. In some cases, clusters of excessively long minor

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cycles may be masked by the inability to report more than one error, and synchronisation between MPMs may be unable to maintain correct timing. This behaviour is an indication that the MPM is operating outside specified limits and its security fuse may be blown. It is possible that this can occur in more than one MPM, resulting in the shutdown of an Interlocking.

If the major cycle limit is exceeded, the ability to tolerate occasional missing messages on the Trackside Data Links is reduced, and the track circuit, approach locking and elapsed timers will run slow (these need to be updated every second, but cannot be updated more than once per major cycle).

In practice, these limits will only be reached in the most complex Interlocking areas, and so in most cases the signal engineer need not consider the timing constraints when writing geographic data. For this reason, detailed guidelines for estimating the timing consequences of complex data and methods of containing processing time when this becomes critical are described in SSI8003-52: Timing Constraints on Interlocking Data Complexity.

2 Failures

Generally, all the standard data arrangements included in SSI8003 incorporate safeguards against SSI system failures, but the data producer must consider such failures when designing other data arrangements. Failures to be considered:

(i) Power failure affecting Interlocking (including use of Emergency Signals On Control).

Start-up states of RAM must be considered. See Chapter B Section 3.7.

Consideration must be given to latches which after a Mode 3 Startup have their state preserved, rather than being put to their most restrictive state. Likewise, any timers which need to be set to a specific value after such a Startup need to be considered. This is amplified in Chapter F Section 1.6.

After a Mode 1 or 2 start-up all latches are unset (this state must be considered the most restrictive).

Generally, the use of sub-routes locked to bypass controls (such as in route away) should be avoided; this is amplified in Chapter F Section 1.4.

(ii) Interlocking Disabled

This can occur after a Mode 1 or 2 start-up (see Chapter B Section 3.7) or after the Technician has disabled the Central Interlocking. Until the Central Interlocking is enabled by use of the Technician's Terminal "start" command, the following applies:

All requests are ignored, whether from the Panel Processor or other Interlockings.

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All output telegram bits to Points and Signal Modules and other Interlockings are held at state '0' except that those bits identified in data with the most restrictive signal aspects are put to '1'.

All conditional statements in the OPT file are not processed (see Chapter G Section 1).

(iii) Failures affecting Points and Signal Modules

These can be:

- (a) Trackside Functional Module has disabled its outputs:

Here the Trackside Functional Module is still replying to the Central Interlocking and giving the state of its inputs, but all outputs have been switched off, except those designated by wiring in the plug coupler of a Signal Module as red retained (which will be energised). The output interface status bit in the reply telegram is set to '0'.

- (b) Trackside Functional Module is not receiving messages from the Central Interlocking (typically due to Trackside Data Link failure) or the Module has shut down:

The effect on outputs is as above. As no reply message is being received from the Module, the Central Interlocking assumes that all data and status bits in the reply messages are at '0'.

- (c) Power failure at Trackside Functional Module:

All outputs are extinguished, otherwise as above.

- (d) Trackside Functional Module sends replies but these are not received by the Central Interlocking (typically due to limited Data Link repeater or Long Line Link failure):

There is no effect on outputs, but as no reply message is being received from the Module, the Central Interlocking assumes that all data and status bits in the reply messages are at '0'.

Thus allowance has to be made for outputs being switched off by the Trackside Functional Module whilst the Interlocking is asking the Module to switch them on, and vice-versa for outputs designated as red retained. For all the above failures, the output interface failure status bit is perceived as at zero by the Interlocking, and this status bit can be tested if required. This is done automatically to maintain correct aspect sequencing where the data construct "Input telegram for signal" (in Chapter E Section 1.1) and aspect sequence data (in Chapter G Section 1.2.7) are employed, but where there are no reply