

FS2550 5K System

Providing a safe, reliable track circuit system for both ac and dc electrified

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Features

- Developed within a ISO9001 quality system
- Meets European EMC Directive ENV50121-4
- Operates over wide input supply range
- Modular construction
- Simple installation and interlocking of modules
- All cable terminations on rear mounting plate
- Direct interface to WESTRACE
- Mains powered, no separate PSU required
- Modules protected to IP20



Description

FS2550 equipment provides a safe and reliable jointless and jointed track circuit system for ac and dc electrified tracks, where it gives greater immunity to traction current interference than other available systems. It is designed to be an ideal, low cost replacement for updating existing systems and for use on new installations.

FS2550 equipment has been developed from, and is compatible with, the successful FS2500 equipment which has been used for many years on Metro and Mainline installations in Great Britain, Europe, Australia and the Far East.

The track circuit signal consists of a complex waveform produced by a transmitter at one end of the track circuit and accepted by a receiver at the other end. Unless the receiver detects the correct complex waveform, the track circuit is considered to be occupied.

By using a complex waveform for track signal and microprocessor-driven algorithms to process the signal in the receiver, the FS2550 system minimises the possibility of electrical interference being accepted as a valid track clear signal.

Track Circuit Operation

In the FS2550 track circuit system a transmitter carrier signal is fed into the rails. This signal passes to one or more receivers in the track circuit and is then analysed to determine whether the track circuit is unoccupied. The receiver performs a series of tests on the detected signal. If the tests are satisfactory, the receiver maintains a track relay in an energised state, or it may be directly interfaced to a WESTRACE (Westinghouse Train Radio and Advanced Control Equipment) interlocking.

If a train enters the circuit, or any of the components of the system fail, then the signal can no longer be detected satisfactorily and the system interprets this as a track circuit occupied state. THEREFORE THE CIRCUIT IS ALWAYS CONSIDERED OCCUPIED UNLESS THE SYSTEM PROVES THAT IT IS CLEAR.

Modulation

The signal injected into the rails is frequency shift keyed, which is generated in the transmitter by switching between two frequencies at a fixed rate termed the modulation frequency. The modulation frequency may be produced within the transmitter itself or it may be derived from external equipment such as WESTRACE. The track circuit system can be used to transmit Automatic Train Protection (ATP) signals to trains by use of externally modulated transmitters where the modulation frequency conveys the ATP information.

Requirements

The basic requirements of a track circuit system are means of:

- Defining the limits of the track circuit.
- Supplying a signal to the rails.
- Extracting the signal from the end of the circuit and proving that it is the correct signal.

FS2550 Systems

The FS2550 track circuit system is available in two ranges; '5k', which uses carrier frequencies between 4080 Hz and 6000 Hz and '2k' which uses carrier frequencies between 1700 Hz and 2600 Hz. This data sheet is primarily concerned with the 5k range, but includes information on the differences between the two ranges.



Track Circuit Architecture

The system has a number of different architectures to meet the different track circuit configurations required. These are:

- Plain Line, a track circuit with only two ends. The track signal may be fed into one end and received at the other, or may be fed into the centre and received at both ends. The ends may be :
 - Jointless - Each running rail is continuous and track circuits are separated from each other electronically

or

- Jointed - There are instances where physical constraints make it impossible to separate track circuits electronically, so Insulated Rail Joints are used.

- Points and Crossings, a track circuit with more than two ends; two or more terminations may be used dependent on if series bonding is employed. Terminations may be:

- Jointless

or

- Jointed

In each case there will be the following equipment :

Transmitting Equipment

- Transmitter
- Transmit end Disconnection Box (optional)
- Transmit end track connection which is either:
 - Tuning Unit and Track Terminating Bond

OR

- Track Termination Unit and one or more Insulated Rail Joints.

Receiving Equipment

- Receiver and Relay
 - Receive end Disconnection Box (optional)
 - Receive end track connection which is either
 - Tuning Unit and Track Terminating Bond
- or
- Track Termination Unit (TTU) and one or more Insulated Rail Joints.

The architecture of the system is illustrated in Figure 1 and Figure 2 for jointless configurations.

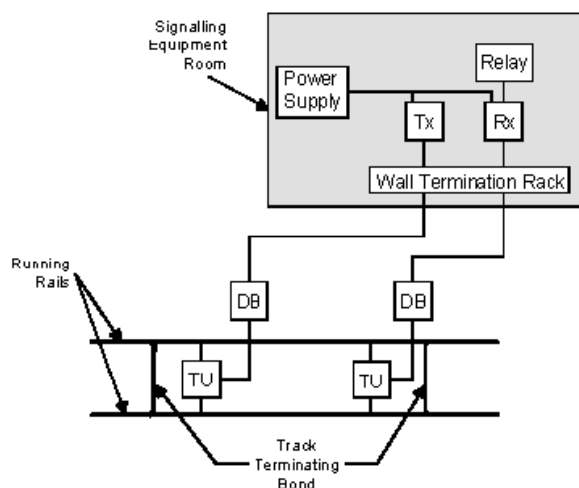


Figure 1 - Plain Line 5k Jointless Track Circuit

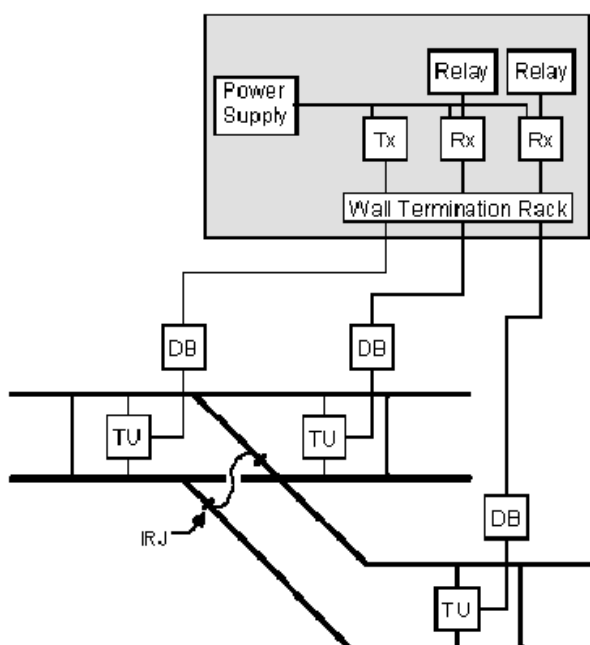


Figure 2 - Points and Crossing 5k Jointless Track Circuit

Key to Figures :

DB - Disconnection Box

IRJ - Insulated Rail Joint

Rx - Receiver

TU - Tuning Unit

Tx - Transmitter

Use of FS2550 Equipment

The decision as to which frequency range (2k or 5k) and which track circuit boundary (jointless or jointed) to use is dependent on the application. However, certain general guidelines exist as follows:

- Where the FS2550 equipment forms part of an ATP system and provides ATP codes, the following is required :
 - FS2550 5k jointless/jointed in plain line.
 - FS2550 2k jointed in Points and Crossing areas.
 - FS2550 5k ATP loops in Points and Crossing areas.
- The choice of jointless or jointed is primarily determined by track length; short tracks cannot be jointless (5k < 40m, 2k < 50m).
- 5k or 2k may be used in Points and Crossing, however, the allowable lengths of spurs or other parallel rail sections is less for 5k than for 2k.
- Jointless may be used through Points and Crossings, but IRJs will be needed in the body of the track circuit to keep the two running rails isolated.
- The choice between 5k and 2k jointless is determined primarily by track length, longer track circuits can be achieved with 2k jointless. The trade-off is that the boundary is longer e.g. 20m as opposed to 10m, thus the resolution of the train detection is better with 5k.
- 5k tuned areas remove the need for impedance bonds.

FS2550 Safety Considerations

Users should be aware that FS2550, like any other track circuit, has limitations to its use. It is therefore important that the design of the overall signalling system, incorporating FS2550 track circuits, ensures that the necessary system level safety and reliability requirements are achieved. There may be instances where these requirements exceed that which can be provided by track circuits alone.

General

The system uses digital signal processing techniques that ensure a high level of safety.

The transmitter provides accurate and consistent generation of a phase-continuous, frequency-modulated carrier signal of frequency shift keyed form. A receiver using a microprocessor and validated software ensures, with a high level of integrity, that the following parameters are met :

- The incoming signal is the correct complex waveform.
- The incoming signal is above a fixed threshold level.
- The track circuit cannot be shown as unoccupied by failure modes, noise or interference.

Fail Safe

The overriding safety consideration for a track circuit is that at no time should an unoccupied indication be present when the track circuit is occupied. The FS2550 track circuit system uses a method for detecting the occupancy of the track circuit which relies upon safely proving whether the track circuit is clear. Any failure that prevents a transmitter signal of adequate power from reaching the receiver will cause an occupied condition indication:

- Severed feed/reception cable(s).
- Poor rail cable connections.
- Power supply failure.
- Tuning Unit failure.
- Broken rail (but only under certain circumstances, depending on how the track circuit system is applied).



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Printed in the United Kingdom

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X1306/39/000179 Revision 07

Track Circuit Parameters

The following system parameters are typical values based on 1435mm gauge track constructed from 46-60 kg/m rail, laid over conventional ballasted track with wooden or concrete sleepers.

It is important to note, however, that actual values need to be specified for each installation.

- Minimum ballast resistance : $2 \Omega \text{km}$
- Maximum shunt value : 0.5Ω
- Track circuit length based on above figures :
 - Using 'S'TUs : 40m to 100m
 - Using 'L'TUs with maximum length cables : 100m to 400m
 - Using TTU at both ends : 20m to 150m (up to 270m for non-ATP applications)
 - Non-ATP operation only, configured for 'back-to-back'Tx operation: 30 to 270m (with a maximum length differential of the composite 'back-to-back' track circuits of 165m).
- Receiver/Transmitter to Disconnection Box, Max length : 3km.

Associated Data Sheets

This product data sheet is one of a series that provide an overview of the FS2550 Track Circuit System. The data sheets in the series are as follows:

FS2550	Data Sheet
5k System	11-3
2k System	11-4
Transmitter and Mounting Base	11-5
Receiver and Mounting Base	11-6
Transformer and Line Choke Unit	11-7
5k Tuning Unit	11-8
Track Termination Unit	11-9
Track Feed Unit & Track Connection Unit	11-10
Disconnection Box	11-11
Loop Feed Unit and Resistor Box	11-12

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The information within this document contains general descriptions of the technical options available, which do not always have to be present in individual cases. The required features should therefore be specified in each individual case at the time of closing the contract.