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Author	Issue	Document number	Save Date	File
Andy Millar	01	IS580012852A4	20/09/10	IS580012852A4-01.doc

Information Sheet

EBI Track Track Circuit Condition Monitoring

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Date: 31/03/10

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Full document details: NR NR-L3-SIG-11761-D210 ISSU 2010

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1 INTRODUCTION

Effective condition monitoring is a matter of great interest to many railway authorities at present for two reasons in particular:

- To reduce the total cost of ownership of assets by reducing downtime costs, and
- To improve the overall reliability of the rail network i.e. to reduce train-minute delays.

There are many root causes of train delays. However, due to their critical position in the rail network, track circuits are a particular cause for concern. For example a typical study described in reference [1] showed that 23% of the reported delay minutes were recorded as due to 'track circuit failure'. It is readily apparent that reducing these failures would make a major contribution to train delays and consequent costs.

The Digital Receivers used in the *EBI* Track 200, 300 and 400 track circuits include a data key and a serial data port which provide access to a range of monitoring and diagnostics data. This Information Sheet describes how this interfaces can be used in a system context to provide effective track circuit condition monitoring.

2 REVISION HISTORY

Issue					
From	To	Date	Reason for Change	ECR No	Sig.
-	0.1	25/03/10	Draft	-	-
0.1	1	31/03/10	First issue (minor typographical corrections)	6-11008	JPS

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3 BACKGROUND TO TRACK CIRCUIT MONITORING

3.1 Track Circuit Fault Conditions

Assuming that the track circuit has been installed and commissioned correctly, track circuit failure modes fall into the following broad categories:

3.1.1 Track circuit equipment faults

This typically forms a fairly minor proportion of failures. The vast majority are sudden and catastrophic, and hence inherently unpredictable.

3.1.2 Infrastructure faults

Seasonal and weather related issues on the infrastructure are a major cause of track circuit failures. Changes in ballast conductance due to ground water has a very significant effect. This is, of course often seasonal, but local conditions such as blocked drainage can additionally aggravate the conditions for particular tracks.

Seasonal and weather issues are also behind the most significant wrong side failure mode of modern track circuits: track contamination, which prevents the train wheels effectively shunting the track. This may be due to leaf fall, icing of the track, or other contamination including de-icing sprays. Drying out ballast can also result in wrong side failure modes as the track becomes harder to shunt.

Track circuits may be interrupted due to a break in the track connection. This may be caused by the failure in bond wire connections bypassing fishplate or expansion joints (typically in the Cadweld connection to the track), or by rail breaks. Alternatively the track circuit may be shunted by failure of the sleeper insulation on steel or reinforced concrete sleeper. All these faults can be hard to diagnose, frequently resulting in intermittent failures triggered by the passing of a train or by thermal expansion and contraction.

3.1.3 Associated equipment and connection faults

The predominant known issue is cable damage during, e.g., tamping activities and rail relaying. This can result in catastrophic or intermittent failures. A further important issue is loose connections of tuning units and impedance bonds. Excellent connection quality here is vital for correct operation, and diagnosis of poor connections can be difficult due the intermittent nature of the failures, the fact that poor tuning unit connections can affect the adjacent track circuit more than the associated circuit, and the fact that completely replacing the equipment generally clears the fault whilst incurring the unnecessary expense of replacing and repair cycling No Fault Found equipment. Under this section we should also consider temperature effects on the track circuit components, particularly tuning units. Where the track circuit is set up near the limits of operation, solar heating can cause very significant changes in track circuit performance, taking the system to the point of failure. It is not unknown for presumed faulty equipment to be replaced with cold equipment from the van, this will apparently cure the problem which will then of course reoccur when the replacement equipment itself warms up.

Finally, the quality and availability of the power supply to the track circuit is, of course, critical. This regularly results in track circuit equipment being misdiagnosed as faulty.

3.2 The Role Of Condition Monitoring

At present, the first notification of a track circuit failure will be an unexpected ‘track occupied’ indication on the signalling system which will almost inevitably result in train delays. The following key roles for potential track circuit condition monitoring systems have been indicated to either aid rapid resolution of such problems, or prevent their occurrence altogether.

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