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EBI Track 200/300/400

Application Note: Points and Crossings

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1 INTRODUCTION

FOREWORD

This application note describes the application of the Bombardier **EBI** Track 200/300/400 Track Circuits through points and crossings with either single rail traction return, double rail traction return or non-electrified areas.

Companion manuals, M125401A4, M5800006264A4, M580000169A4, M580001232A4, M580001317A4, and M580001318A4 [1][2][3][5][6][7] describe ET200, ET300, ET400 OL and ET400 SA applications respectively. The complete design is protected by patents and the copyright of this document belongs to Bombardier Inc. or its subsidiaries.

Bombardier Transportation pursues continuous product development and hence equipment supplied may differ in detail from the description in this application note.

SAFETY CONSIDERATIONS

If there is concern that the parameters specified in this application note cannot be met for a particular intended installation, please contact the manufacturer. It may still be possible to apply **EBI** Track if full details of the intended application are provided. Some extreme combinations may require additional safety and monitoring measures, of which the manufacturer will advise.

It is a condition of any alterations to the generic application that the manufacturer is consulted (for which it reserves the right to make a charge to the operator).

In no other circumstances but those described above will the manufacturer accept liability for any adverse consequences arising from the operation of the EBI Track Equipment.

2 REVISION HISTORY

Issue					
From	To	Date	Reason for Change	ECR No	Sig.
-	0.1	6/12/2012	First draft	-	-
0.1	1	18/12/12	Formal issue	6-52961	AM
1	2	23/05/13	Basic rules for turnouts added. Corrections to TZ lengths.	6-61750	AM
2	3	02/07/13	References to shorting strap tuned zones removed, tuned zone dimensions corrected.	6-66293	JPS
3	4	04/11/13	Double rail SA – Single rail OL tuned area application corrected. Minor typos and doc structure corrected.	6-74860	CM
4	5	09/01/14	Sections 5,6,7 and 8 updated. Section 10 deleted. Drawing at section 5.4 updated.	6-79042	JPS
5	6	05/08/14	Un-electrified and single rail application rules separated in section 6.	6-94507	CM
6	6.2	02/10/14	Sections 5, 6.1.2 and 6.2.2 updated. Another crossing example added to section 8.1.	-	MA
6.2	7	14/10/14	Clarifications after review and formal issue.	6-99121	JPS
7	8	24/12/14	Section added for single rail crossing in double rail areas. Section added for short spur in a straight line Minor corrections	6-101554	JPS

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3 TERMINOLOGY

The abbreviations and terms listed below may appear in this application note.

Ac, AC	Alternating Current
dc, DC	Direct Current
EBI Track 200, ET200, 200	EBI Track 200 main line FSK track circuit
EBI Track 300, ET300, 300	EBI Track 300 mass transit FSK track circuit
EBI Track 400, ET400	EBI Track 400 Coded Track Circuit (Consists of ET400 OL & ET400 SA)
OL	EBI Track 400 Open Line Track Circuit
SA	EBI Track 400 Station Area Track Circuit
ETU	End Termination Unit
IRJ	Insulated Rail Joint
RX	Receiver
CU	Track Coupling Unit
TU	Tuning Unit
TX	Transmitter
Single Rail	Only one rail used for traction return (the other is reserved exclusively for track circuit use).
Double Rail	Both rails are used for both traction return & track circuit.
Common Rail	One rail of a double rail track circuit which is connected to one rail of another double rail track circuit at the boundary between track circuits within points & crossings.
Impedance bond	A ferrite-cored, tuned impedance bond designed to operate with traction return current in electrified areas where EBI track circuits are fitted. Provides low impedance path for traction current & high impedance for EBI track circuit frequency.
Parallel bond	Connection between running rails on the same line for traction return.
Cross bond	Connection of traction return between adjacent lines.
Z bond	Cable used to provide tuned area for SA/300 track circuit boundaries &/or cable used to provide mixed tuned area for between OL/200 and SA/300 track circuits boundaries.
Spur	Rail deviating from a series bonded track section.

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4 References

- [1] **EBI** Track 400 Coded Track Circuit – Technical Manual Supplement for Open Line Single Rail Applications M5800001317A4.
- [2] **EBI** Track 400 Coded Track Circuit – Technical Manual Supplement for Station Areas M580001318A4
- [3] **EBI** Track 400 Coded Track Circuit – Technical Manual Supplement for Open Line Applications M580001232A4
- [4] **EBI** Track 200 TI21 Track Circuits – Guidance Notes for Traction Bonding IS580001109A4
- [5] **EBI** Track 200 Track Circuit – Technical Manual M125401A4
- [6] **EBI** Track 200 Track Circuit – Single Rail Technical Manual M580006264A4
- [7] **EBI** Track 300 Track Circuit – Technical Manual M58000169A4

5 Types of Track Circuit Separation

The standard tuned areas for **EBI** Track equipment can be used (see sections 5.2 & 5.3 below).

By combining the use of OL/200 and SA/300 track circuits it is possible to use the Mixed Tuned Area, as detailed in the Technical Manuals Ref [2] and Ref [7] (see section 5.5 below).

There is also the option of using a tuning unit with shorting strap and an end termination unit for double rail to single rail interface. (see section 5.4 below).

If a spur is within the permitted lengths, the separation can be by means of IRJ's at the end of the spur without the need for an additional RX & ETU/CU. If the spur exceeds the max permitted length, then an additional RX & ETU/CU must be provided. This arrangement is suitable for all **EBI** Track Circuits of any frequency. Note that two IRJs (one in each rail) avoids a common rail between the two tracks.

Any Tuned Area can be replaced by IRJ's, ETU's/CU's & Impedance Bonds, as required. Refer to relevant technical manual for details.

Note that the lengths quoted in this document for tuned areas are based on 1435mm gauge track and in territory where rails are required to run on sleepers.

5.1 Application Rules

Note: information regarding cable dressing and related dimensions can be found in the relevant manuals. Mixed Tuned Area Application Rules are given in Table 5-1.

Ref	Constraint
1	Any OL/200 frequency may be paired with any SA/300 frequency EXCEPT: Frequency B must not be used with F3 Frequency C must not be used with F1 Frequency D must not be used with F2
2	The tuned area dimensions given in the SA/300 manuals must be strictly followed.
3	Tuning Unit and Z Bond installation must be in accordance with the requirements given in the SA/300 manual.
4	The OL/200 track circuit abutting a mixed tuned area must not exceed 500m in length.

Table 5-1 Mixed Tuned Area Application Rules (ref: ET400 SA manual M580001318A4)

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5.1.1 Track Connection Cables

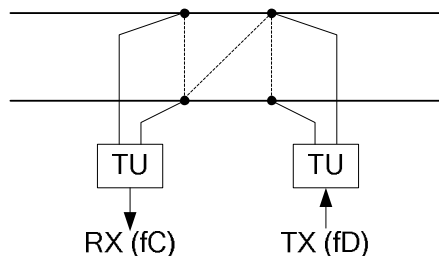
All **EBI** Track Circuit track connection cables from TUs, CUs, ETUs and SPETUs shall be in accordance with the relevant technical manual.

5.1.2 Check rails

Check rails and spare rails in tuned areas may have an effect on tuned area because of the Loading of the tuned area rail inductance. Tuned Area installation within check railed sections should be avoided as much as possible. It is banned to leave spare rails in the SA/300 Tuned Areas. Short check rails (less than 30m) must be bonded at both ends to the adjacent running rail. In addition, any joints must be bonded out and long check rails must be bonded every 30m. If check rails span an IRJ, then the check rail must also contain an IRJ to prevent a bypass path. These rules apply for both single rail and double rail applications of ET200/300/400 track circuits.

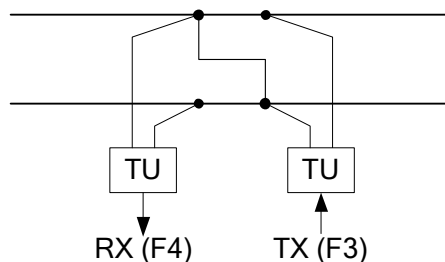
5.2 OL/200 Standard Tuned Area

Please check **EBI** Track manuals Ref [3] and Ref [5] for details.



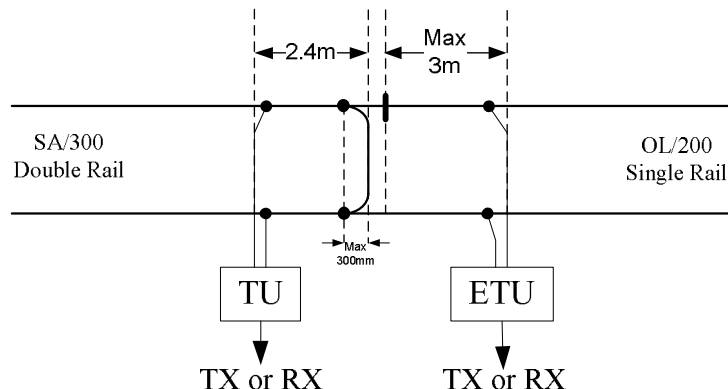
5.3 SA/300 Standard Tuned Area

Please check **EBI** Track manuals Ref [2] and Ref [7] for details.



5.4 SA/300 Double Rail to OL/200 Single Rail Tuned Area

Can be used as SA/300 double rail to OL/200 single rail traction interface.



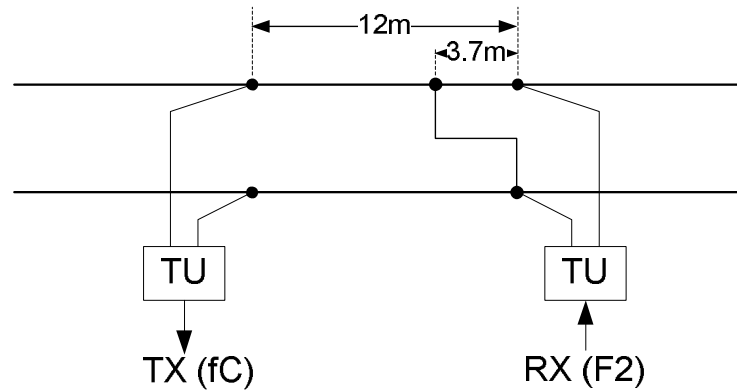
Note that the distance between the IRJ and shorting strap shall be kept minimum.

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5.5 SA/300 to OL/200 Mixed 12m Tuned Area

For use between SA/300 and OL/200 track circuits only.

Note that 3 frequency pairs are prohibited; refer to application rules in section 0.
Track circuit length limits are reduced for this configuration.



Preferred/Non-Preferred Mixed Tuned Area Applications

OL/200 End	SA/300 End	
TX	TX	Preferred
TX	RX	
RX	RX	
RX	TX	Non-preferred

Note: The OL/200 RX and SA/300 TX mixed tuned area is defined as non-preferred in order to minimize degradation of **EBI** Track tolerance to wide band interference. The non-preferred mixed tuned area application still can be used.

Track Circuit Length Limits Mixed Tuned Area Applications

Track Circuit Frequency Type	No. Of RX	Track circuit Length (m)
OL/200	1	30-500m
	2	30-500m
	3	30-500m
SA/300	1	30-250m
	2	30-200m
	3	30-200m

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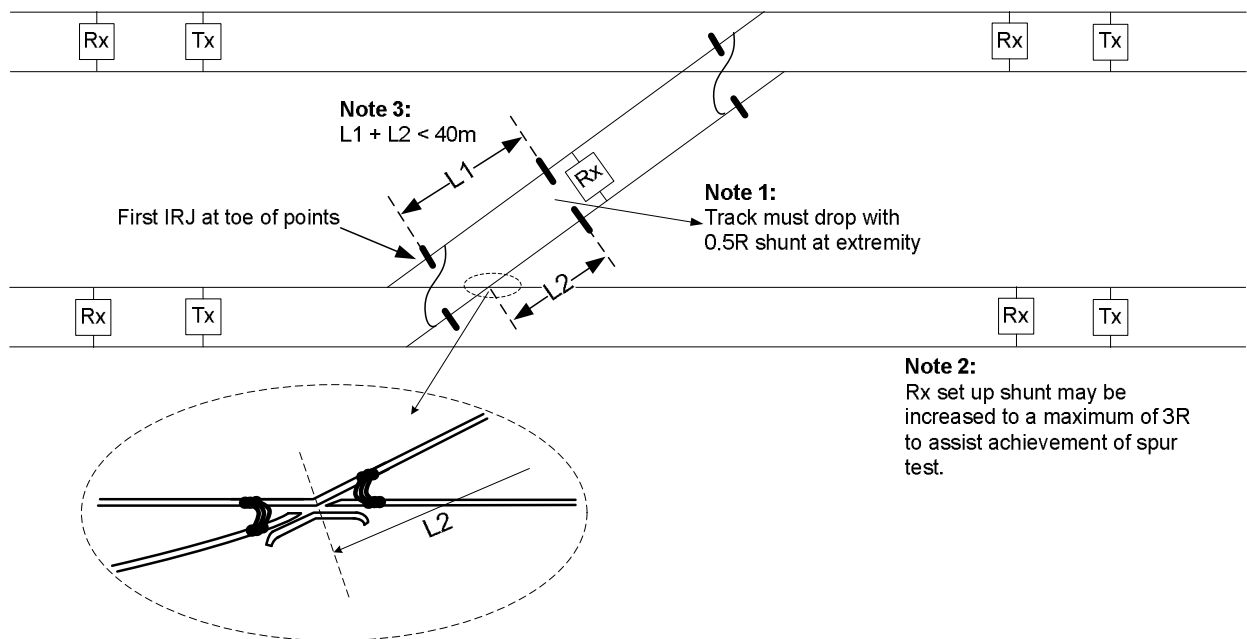
6 Basic Rules for a Turnout using OL/200 Frequencies

6.1 Simple Case: Short Spurs Terminated by IRJs (OL/200 Frequencies)

6.1.1 Non-electrified Configurations

Rule	Comment
Where the sum of the length of the rails (L1 + L2) from the first set of IRJs at the toe of the points to the terminating IRJ(s) is less than 40m; an ETU/SPETU and its associated receiver is not required.	See Figure 6.1.1 for definition of L1 & L2
Spur shall be Terminated by two IRJs – one in each rail	
Traction Continuity (crossing area)	N/A
Cross Bonding	N/A

Figure 6.1.1a: Short Spur Terminated with IRJs (OL/200 Frequencies – Non-electrified)



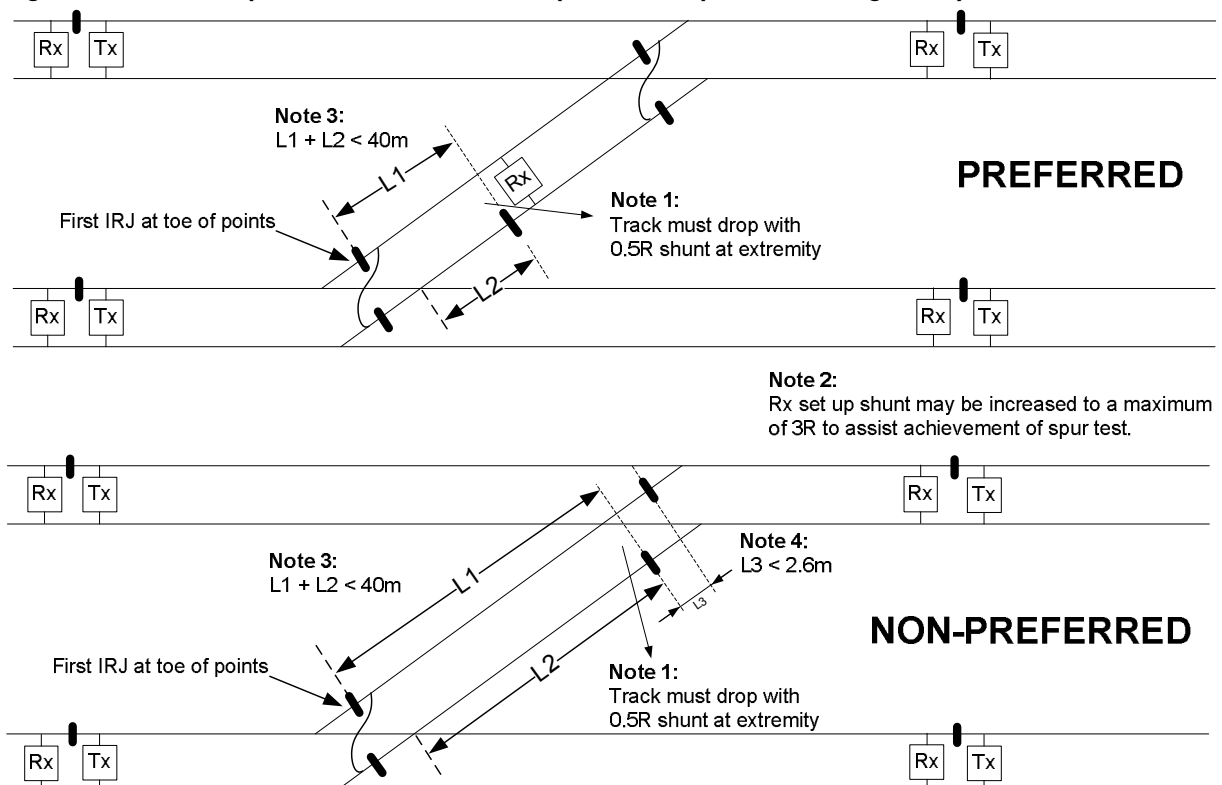
Please note that, the detail of L2 start point above applies to all drawings in Section 6 and Section 7 of this document.

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6.1.2 Single Rail Configurations

Rule	Comment
Where the sum of the length of the rails ($L1 + L2$) from the first set of IRJs at the toe of the points to the terminating IRJ(s) is less than 40m; an ETU/SPETU and its associated receiver is not required.	See Figure 6.1.2 for definition of $L1$ & $L2$
Spur shall be Terminated by one IRJ on signalling rail.	
Traction Continuity (crossing area)	Frequent bonding rules defined in relevant ET400 OL or ET200 single rail manual must be followed.
Cross Bonding	<p>Safety Critical bonding rules shall be applied to the cross bonding since loss of continuity will result in loss of train detection.</p> <p>Please check relevant OL/200 single rail manual for restrictions on Cross Bonding. This shall be applied in accordance with rail authority Standards.</p>

Figure 6.1.2: Short Spur Terminated with IRJs (OL/200 Frequencies – Single Rail)



SAFETY WARNING:

Depending on the location of IRJs, a train within the crossing area may pass the fouling point and stop within the kinetic envelope of one track without being detected by the track circuit. In this case safe operation of the signalling system needs to be assured by interlocking system.

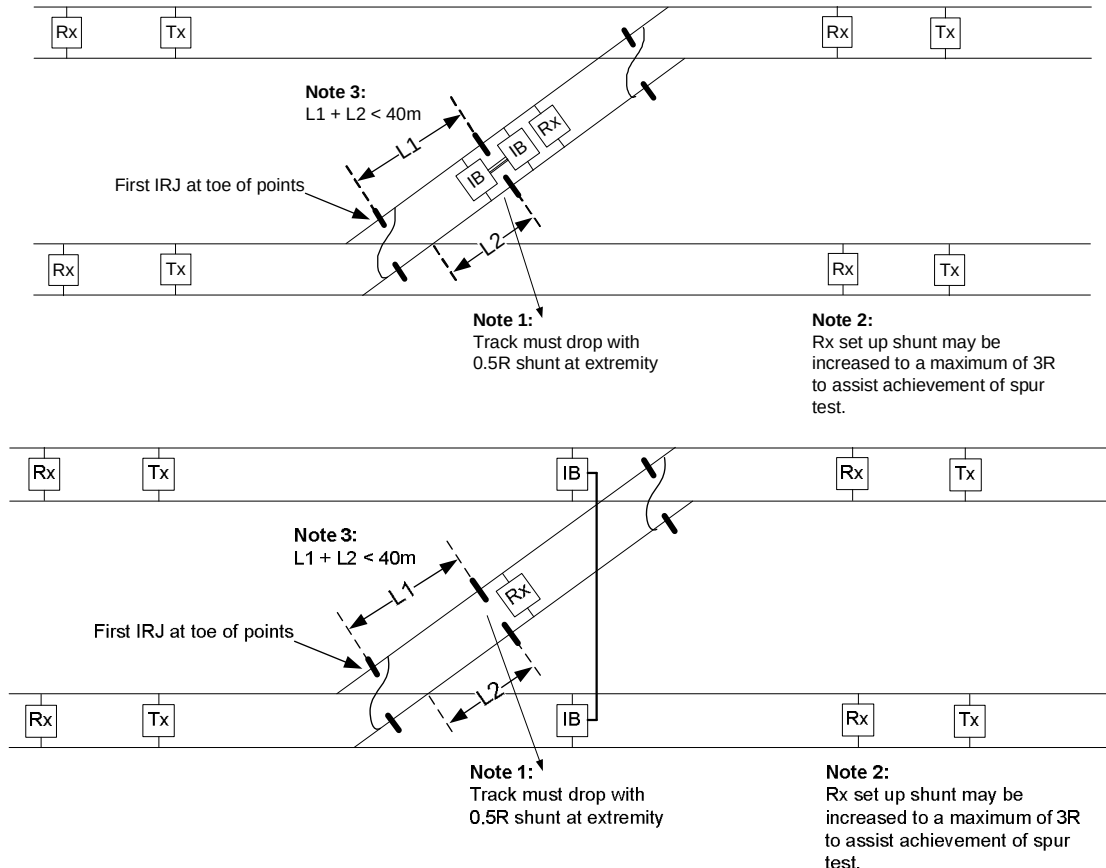
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6.1.3 Double Rail Configuration

Rule	Comment
Where the sum of the length of the rails (L1 + L2) from the first set of IRJs at the toe of the points to the terminating IRJ(s) is less than 40m; an ETU/SPETU and its associated receiver is not required.	See Figure 6.1.3 for definition of L1 & L2
Spur shall be Terminated by two IRJs – one in each rail	
Traction Continuity (crossing area)	Traction continuity through the crossing area can be implemented with an impedance bond on each side of the track circuit separation IRJs.
Cross Bonding – Parallel Bonding	<p>Safety Critical bonding rules shall be applied to the cross bonding since loss of continuity will result in loss of train detection.</p> <p>Please check relevant OL/200 manual for restrictions on Cross and Parallel Bonding. This shall be applied in accordance with rail authority Standards.</p>

Figure 6.1.3: Short Spur Terminated with IRJs (OL/200 Frequencies – Double Rail)



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6.2 Simple Case: Long Spurs Terminated by IRJs (OL/200 Frequencies)

6.2.1 Non-electrified Configurations

Rule	Comment
Where the sum of the length of the rails ($L1 + L2$) from the first set of IRJs at the toe of the points to the terminating IRJ(s) is greater than 40m; an ETU/SPETU and its associated receiver must be used.	See Figure 6.2.1 for definition of L1 & L2
The TX to RX distance on the shortest limb must be longer than 30m. The Ratio of the relative track lengths TR1 and TR2 shall be less than 5:1.	30m is the minimum OL/200 track length. Note that there is no requirement for the TX to be adjacent to the toe of the points. Swapping the TX and RX positions on the longest limb will generally ease any restrictions caused by the 5x rule.
Spur shall be Terminated by two IRJs – one in each rail	
Traction Continuity (crossing area)	N/A
Cross Bonding – Parallel Bonding	N/A

Figure 6.2.1: Long Spurs Terminated by IRJs (OL/200 Frequencies – Non-electrified)

