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Engineering Standard – NSW

Category
Signalling

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Westinghouse FS 2600 Manual

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The technical content of this document has been approved by the relevant ARTC engineering authority and has also been endorsed by the ARTC Safety Committee.

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About This Standard

This manual details the theory of operation, module specifications, maintenance requirements, set-to-work and fault finding procedures for Westinghouse type FS2600 Track circuits installed for the Australian Rail Track Corporation in the Flemington Goods Junction area.

This manual has been written specifically for the special configuration developed for the Flemington project. This configuration is essentially a low power double-rail arrangement, with a single fixed receiver gain setting equal to the standard FS2600 'single rail' gain setting. The Flemington configuration is applicable to all double-rail tracks fitted with non-resonated 1000 amp/rail impedance bonds (Westinghouse MJS or similar), up to 400 metres in length.

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1.1	14/03/2005	Disclaimer	Minor editorial change

Contents

1. Introduction

The Australian Rail Track Corporation has recently had installed and commissioned FS2600 Track circuits in the Flemington Goods Junction area. This manual details the theory of operation, module specifications, maintenance requirements, set-to-work and fault finding procedures.

The FS2600 track circuits have been installed with a special configuration developed for this project. This configuration is essentially a low-power double-rail arrangement, with a single fixed receiver gain setting equal to the standard FS2600 'single rail' gain setting. The Flemington configuration is applicable to all double-rail tracks fitted with non-resonated 1000 amp/rail impedance bonds (Westinghouse MJS or similar), up to 400 metres in length.

This manual has been written specifically for the Flemington configuration.

The FS2600 track circuit may also be installed as a single-rail track circuit, or as a double rail track circuit of length up to 1200 metres long. These configurations are not used on ARTC lines at this stage.

For a detailed description of generic design, installation, set-up and maintenance procedures, refer to the "FS2600 Track Circuit Technical Manual", published by Westinghouse Signals Limited.

2. The FS2600 Track Circuit Configuration

2.1 General

The FS2600 track circuit was developed as a modern, traction-immune replacement for a traditional double rail 50 Hz AC track circuit.

It has the equivalent of a feed (transmitter) and relay (receiver), uses the existing MJS or equivalent 1000A impedance bonds, and associated bonding and rail connections. The configuration is slightly different from an AC circuit, with the feed end pot head replaced by a track interface unit which contains a matching transformer.

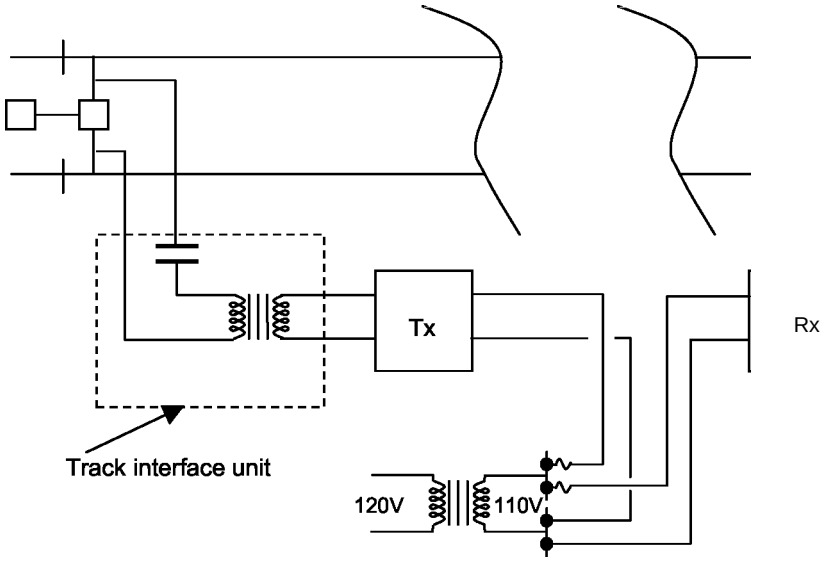

Figure 1 – FS2600 Track Circuit – Flemington Configuration

To provide discrimination and prevent false energisation by adjacent track circuits, the FS2600 comes in a range of 10 frequencies (channels).

On the more common 'jointless' audio frequency track circuits, the 'even' frequencies are usually allocated to Up direction lines, and 'odd' frequencies allocated to the Down direction lines. There is no such allocation for the FS2600, but users must be aware that there are frequency allocation design rules which must be strictly adhered to. This is described in detail in the Westinghouse FS2600 Technical Manual.

Table 1 below lists transmitter channels and the actual output frequency of each.

Channel Number	Allocated Frequency Hz
1	388.8
2	403.2
3	417.6
4	432.0
5	441.6
6	456.0
7	470.4
8	484.8
9	494.4
10	508.8

Table 1 - FS2600 Channel Frequency allocation

2.2 Transmitter

The transmitter replaces the feed transformer and resistor of the AC track circuit. It generates an audio frequency signal, at a frequency between 388.8 and 508.8 Hz. It requires a power supply of 110 volts AC. This is derived from the 120 volts AC signalling supply via a dedicated step-down transformer.

In the standard Flemington area configuration, the transmitter has been mounted on a high density fibre board, identical in size to the Westinghouse Store 50 feed set it replaces, to simplify conversion and minimise the amount of rewiring required. Together with the Transmitter this board is fitted with all ancillary other ancillary components such as surge arrestor, Bx110 / Nx110 fuse and link, and track circuit disconnect links.

The transmitter's output is FSK (Frequency Shift Keying) modulated, with the output frequency of the transmitter alternating or shifting between two frequencies at a predetermined rate (the modulation frequency). To achieve this, the transmitter contains three oscillators, the first two generating the upper and lower output frequencies, and the third generating the modulation frequency which switches the output between the upper and lower frequencies.

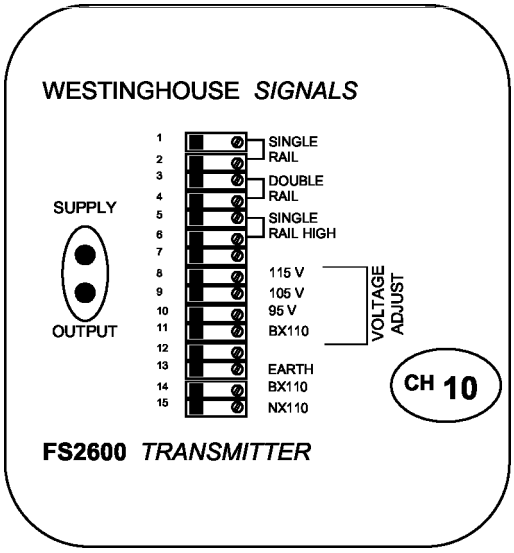

Figure 2 – FS2600 Transmitter – Front panel layout

Two LED indicators on the front panel show the Transmitter's status. The upper indicates that power is available and the lower indicates an output is present.

The transmitter output level can be selected for different track circuit configurations. For the Flemington installation, all transmitter outputs are connected for the 'Double Rail Low' transmitter output, on terminals 3 & 4.

The transmitter can operate reliably over a supply voltage range of 88v-121v AC.

NOMINAL SUPPLY VOLTAGE	VOLTAGE AT WHICH CUT-OUT OPERATES	VOLTAGE AT WHICH FUSE RUPTURES
95		113
105		125
115	121	137

Table 2 - FS2600 Operating voltage limits

Note that the allowable supply voltage range is below the ARTC standard signalling supply voltage of 120v AC. Irregular operation of the Transmitter can be expected when the input voltage exceeds 120 Volts. The symptoms of this are that the power supply LED is lit but the Output LED is off.

There is also an internal fuse in the transmitter, which will fail permanently if the supply voltage exceeds 137 volts when the input wiring is set for 115 volt operation, or 125 volts with the input set for 105 volt operation.

In each ARTC location, a 300VA transformer has been provided to step the voltage down to approximately 110 Volts, to provide a Bx110 bus to power the FS2600 track circuit equipment.

Always ensure the transmitter supply voltage link is connected between the Bx110 terminal and the 115v terminal, or a more suitable terminal if the voltage is lower than 110v AC.

The output of the transmitter is known as a quantised sine wave, which is actually an approximation of a true sine wave. Figure 1 shows a sample of transmitter output waveform.

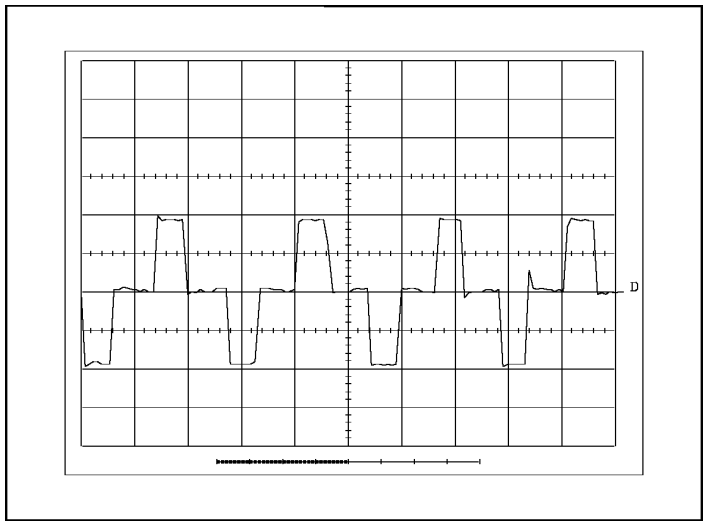

Figure 3 – FS2600 Transmitter output waveform

2.3 Track Interface Unit

The track interface unit matches the output impedance of the transmitter to the impedance of the track. Each track interface unit

is able to be used on one of two channels. For example a channel 1,2 unit can be used for track circuit channels 1 or 2.

The track interface unit also acts as a filter and attenuates unwanted harmonics produced by the transmitter. The net result of this is that the output of the track interface unit to track is approximately sinusoidal. See figure 2 for a sample waveform of the output voltage to track.

The track interface unit is designed to directly replace the existing feed end pot head. It includes terminals for terminating both the tail cable from location to pot head, and the Hypalon rail connection, on standard RSA studs.

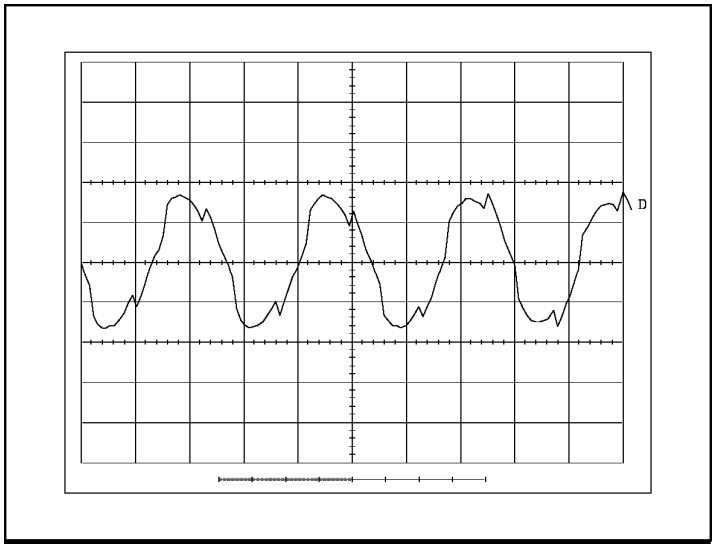

Figure 2 - Output of FS2600 Track interface unit to track

2.4 Receiver

The FS2600 receiver is similar in size and shape to the VT1 AC track relay it was designed to replace, and plugs into a standard VT1 8F-4B relay base. All wiring connections are made to the rear of the plugboard in the usual manner. The receiver provides only a 4F-2B contact configuration.

The receiver houses all the necessary electronics and a standard QNND1 twin element relay used to control (switch) the circuits that are wired through it.

Internally, the FS2600 receiver is comprised of two independent receivers, each driving the coil of one half of the QNND1 relay. The contacts on each half of the twin relay are internally wired in series. To have an output, both halves of the relay are required to be energised.

An input signal is deemed to be valid when both voltage and frequency (including the modulation frequency) are present and are of sufficient

magnitude.

The receiver incorporates a two second delay from receipt of a valid input signal to the energisation of the relay. This is a safety feature which prevents the track circuit 'bobbing' when a train shunt is intermittent.

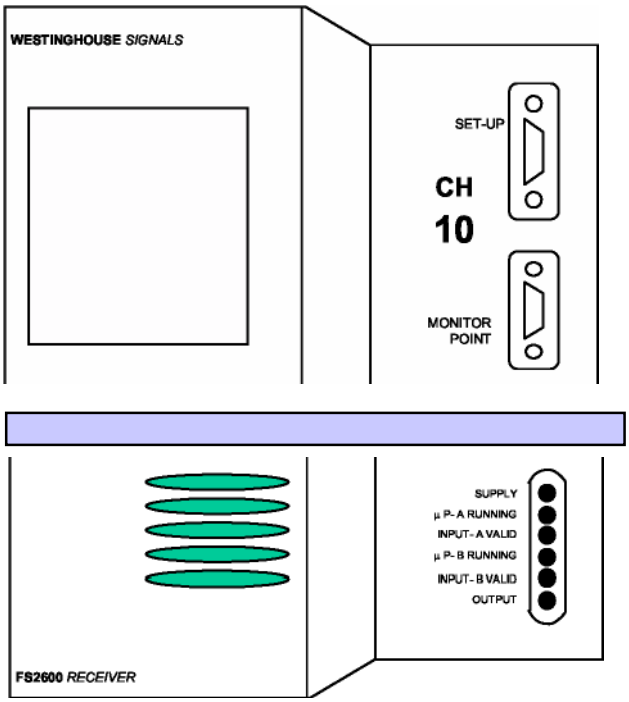

Figure 2 – FS2600 Receiver – Front panel layout

The receiver has six LED indicators located on the front panel. The first indicates that the supply is available. The second and fourth (flashing) indicate that the 'A' and 'B' sides of the receiver respectively are working. The third and fifth indicate that 'A' and 'B' sides of the receiver respectively are receiving a valid input signal, indicating that the track circuit is unoccupied. The sixth and final LED indicates that both halves of the receiver are driving the internal output relay.

Processor Shutdown

FS2600 receivers are microprocessor based, and perform numerous health checks to ensure continued integrity. If for some unknown reason the receiver develops a fault or detects a problem it will shut down. This is recognised by the Supply LED being On and one or both processor LEDs being either steady Off or steady On.

To rectify this fault the receiver is to be powered down by removing the NX110 pin and then re- apply power. If the receiver fails to energise its internal relay it is to be replaced with a known servicable spare. If the relay picks, an investigation is to be conducted for possible causes for the receiver shutting down in the first instance.

The Power up sequence on the receiver LED's is as follows:

- Supply LED turns On.
- Delay as the Rx performs some self testing.
- Both Processor LEDs commence flashing.
- Valid Input LEDs turn steady On.
- Delay, then Output LED turns On and the relay picks.

There are two sockets on the front of the receiver - a 'D15' and a 'D9'. The D15 socket is used to set the gain of the receiver, while the D9 is used to measure the monitor voltage.

Note that, for long term reliability, neither socket should be left uncovered, and should always be fitted with either the appropriate plug or dust cover.

For the installation at Flemington every track circuit is set to the same standard gain level, hence all D15 plugs are wired the same, to the 'single rail' gain setting. This differs from the standard adjustment procedure for double-rail track circuits outlined in the Westinghouse manual. The receiver will not energise unless the D15 plug is fitted. Periodic checks should ensure that the D15 is securely fitted to the receiver.

The D9 connector on the front of the receiver provides the monitor point for measuring the receiver's adjusted input voltage level. At Flemington, all monitor point sockets have been equipped with modified D9 plugs, fitted two 4 mm 'banana' sockets which enable standard meter leads to be plugged into the monitoring point.

If this modified plug is not present the monitor voltage can be measured directly on pins 1 & 2 of the socket.

The monitor point voltage is the main measurement of interest for routine maintenance, as this indicates the level of energisation on the receiver and hence from the history card the amount of change in receiver input level since the last maintenance visit.

3. Maintenance Procedures

3.1 Measurements

A ‘true RMS’ digital multimeter must be used when measuring and recording the track circuit parameters.

An averaging meter will give erroneous results because of the irregular (non-sinusoidal) shape of the transmitter output.

The transmitter frequency can be checked by using a digital multimeter with a frequency count capability. This measurement can be used as a valid indication of correct transmitter modulation, as is used on jointless audio frequency track circuits.

Since the FS2600 is a jointed track circuit, measurements can be taken using a standard multimeter. Frequency Selective meters and adaptors are not required.

3.2 Booking an FS2600 Track Circuit out of Use

After following the necessary safe working procedures for booking out track circuits, the following, details what is required to disconnect and adequately protect an FS2600 track circuit:

- Isolate the 110 volt supply at the NX110 common terminal on the Receiver.
- Remove both track disconnect pins on the incoming cable connections.
- Remove both track disconnect pins on the outgoing cable connections on the Transmitter.

Note: That it is necessary to remove power from the Receiver to prevent a situation where noise induced on the open circuited input wiring causes the Receiver to go into a lock out state. It is satisfactory to leave the Transmitter powered up with an open circuit output.

3.3 Booking the FS2600 Back into Use

To book back into use the connections is the reverse of the booking out procedure:

- It does not matter which end is reconnected first however it is recommended that the transmitter is the end first connected. This then allows the maintainer to visually see the receiver correctly energise once all connections have been made.
- Firstly reconnect all track wiring and bonding.

- Reconnect the track terminals at the Transmitter end and power up the Transmitter.
- Reconnect the NX110 of the receiver and ensure that it correctly powered up.
- Reconnect the track terminals and ensure the relay picks.

Reference is made to the relevant regulations concerning the booking out and restoration of equipment.

Prior to booking any track circuit back into use, testing is required to validate that the track circuit will operate as expected. The nature of the tests will be dependent on how the track was affected and to what extent.

The following is a list of what tests can be completed to ensure the correct operation of the track circuit. Some or all of these tests may be required in order to ensure correct operation.

3.4 Zero Current (Track Occupied Reading)

As was the case on a double rail AC track circuit, a satisfactory shunt could be confirmed when zero current was measured flowing through the track coils in the relay. This is not the case for an FS2600. To replace this important test, measure the monitor voltage with a train occupying the track circuit. The track circuit is considered shunted when measuring less than 100 mV AC at the monitor point.

3.5 Polarity Testing

The FS2600 is technically termed a jointed track circuit. Be this as it may, polarity cannot be checked in the same way as for conventional double rail 50 Hz AC track circuits. The reason for this is that each track circuit is of a different frequency. The exception is the case where two transmitters of like frequency are abutting each other and in this instance polarity is not of any concern.

Polarity or failed block joint detection is achieved in two ways. Firstly, by using different frequencies on any adjoining track circuit. This negates any chance of a wrong side failure in the advent of a failed block joint. Secondly the receivers also look for particular frequencies for which they can detect known as detection pairs (see table 2). That is a receiver in a group of frequencies can detect other frequencies associated with that group. When a block joint fails the adjacent track circuit is exposed to a certain amount of energy because of the auto-transformer effect of the impedance bonds. The adjacent receiver is exposed to this energy on its input and as a result the receiver will detect this energy and shut down failing one or both of the track circuits.

To ensure that block joint detection can be achieved short out one block joint and one or both of the tracks will fail. This simple test is enough to

prove

3.6 Single Railing

The nature and set up of the FS2600 means that the track circuit cannot be Single Railed in the advent of a block joint or impedance bond failure. If a failure of this nature occurs it will be necessary to rectify the fault.

3.7 Re-Railing

- Book out as above
- Power up
- Shunt test the track

Ensure the track shunts as per the zero feed section Record all values on the track circuit history card Book back into service.

3.8 Spark Gaps

In the advent of having a spark gap fail short circuit to earth the track circuit may behave erroneously. The following details some scenarios.

Earth rail drags monitor voltage down but does not fail the track. Track may fail on the approach of an electric powered train as traction current flows to earth unbalancing the impedance bond thereby lowering the bonds impedance.

The earth is of sufficient quality to fail the track in which case it can be found using a Clancy meter or RAS coil. **Note**: that if the earth is of sufficient quality other tracks may fail as a result of the circulating currents and receivers associated with that particular group detecting the current and shutting down.

3.9 Impedance Bonds

The FS2600 as they are currently commissioned use the MJS 1000A per rail impedance bond. The Macolo 1000A per rail impedance bond is suitable for these tracks as well. Any resonated bond will not work as the track interface unit is designed around the MJS impedance bond which does not have a secondary winding. Secondly, the capacitance units on 2000 Amp per rail rated impedance bonds are designed for a particular range of frequencies which the FS2600 is not part of.

3.10 Adjustments

Adjustment of the receiver is carried out by inserting links in different combinations into a 15 pin D type connector. This connector is then plugged into the setup socket on the receiver. The manufacturer of this equipment has found that by using a 'single rail' setting any track circuit up to 400m in length will be sufficiently energised to guarantee safe and reliable operation.

All the track circuits in the Flemington area are less than 400m in length and as such all use the Single Rail adjustment.

3.11 Operating Voltages

- Transmitter output is in the order of 120 volts.
- Transmitter voltage to track is in the order of 10 - 14 volts however this is dependent on track circuit length and ballast conditions.
- Rail current is in the order of 3 Amps.
- Receiver input voltage in the order of 10 - 13 volts once again depending on track circuit length and ballast conditions.
- Monitor voltage is usually in the order of 8 - 12 volts.

3.12 Changing of Failed Modules

Having identified a module that requires changing, it is necessary to first remove power from either the fuse or common terminal, isolate the module from the track by removing the track disconnect pins and then remove the wiring terminated on the module.

Note: Always remove power and input /output wiring before disconnecting any wiring.

Ensure the link on the transmitter is connected between the Bx110 terminal and the 115v terminal.

To power up a module firstly ensure that the wiring is correct then insert the fuse and or common disconnect pin then connect the module to track.

3.13 Adjustment Details of the D-15 Plug

The links for the standard Single Rail adjustment are as follows: **1 to 2, 4 to 14, 5 to 7, and 8 to 13.**

This bridging must not be changed for any double-rail track circuit not exceeding 400 metres ******

4. Fault Finding

4.1 Failure Modes

Because it is almost impossible to document every type of failure the following details some of the 'expected' types of failures which may occur over the life of the track circuit:

- Module failure
- Short circuit
- Open circuit
- Earth on one rail
- Loss of modulation
- Faulty track interface unit
- Short circuit block joints

It should also be recognised that using the values recorded on the history card for reference will be of assistance in tracing the cause of any fault.

4.2 Module Failure

4.2.1 Transmitter

As the output of the transmitter is held constant the output voltage should not vary to any major degree. The transmitter output can either fail completely or be low, or be normal output level but have failed modulation.

In the case of a low output to track, the cause may also be a failed track interface unit.

As the transmitters being the source of supply for the track circuit output a modulated signal which the receiver is expecting to detect a modulated input signal, the transmitter sometimes fail in a way that they do not modulate the output signal (the transmitter is not alternating between the upper and lower frequencies). The net result of this is a voltage input into the receiver but track circuit remains de-energised. The only way for the modulation to be checked is to use a multimeter which has the ability to measure frequency. A symptom of a transmitter having lost its modulation is the frequency of the track is 'out' by a large margin i.e. >7Hz.

Frequency measurement can be taken at any point on the track however it is important to note that because of the transmitter output not being a true sine wave any frequency measurement taken between the transmitter and the track interface unit may be misleading.

4.2.2 Receiver

As receivers are extremely complex they perform various health checks to ensure their integrity. If one of these checks detects a problem the end result is a receiver shut down.

If a receiver locks up, the maintainer should first attempt to recover it from the locked out state by performing a 'power-on reset', by removing the Nx110 disconnect link for a few seconds, and then reapplying power to the receiver. If this fails to restart the receiver, it should be replaced with a known working unit. If the problem persists after this, other causes should be investigated. When the cause is found and rectified, the maintainer should replace the original receiver, and if it works correctly, it should be left in its original place.

4.2.3 Track Interface Unit

The track interface unit is comprised of a transformer and a capacitor. Together they form a resonated circuit. It is expected that with age and normal wear and tear (voltage spikes from the traction supply), the transformer or more likely the capacitor will fail completely or become de-tuned to an extent which fails the track. A failed track interface unit can be identified either by a greatly attenuated output voltage from the transmitter, a change in the sound of the 'singing' noise emanating from the TIU, or a combination of these.

4.3 Impedance Bonds

The 1000A/rail MJS and Macolo Impedance bonds have proved to be very reliable over the life of the 50Hz tracks and they are not expected to fail. The rail connections should be maintained in good condition. As these cables are also used to carry traction return current any failure should be easily identifiable.

Unlike the 50Hz double rail AC track circuits they replaced, the FS2600 tracks are not at risk of wrong-side failure due to circulating 50Hz currents.

4.4 Short /Open Circuit on the Track

Either of these can be found by using a combination of volt meters and or a rail induction meter. A RAS coil can be used effectively on FS2600 track circuits.

It is important to note that because the transmitter has a constant output voltage its output will still remain fairly constant with a short or open circuit load.

4.5 Earth on One Rail

The presence of an earth on one rail can be found by using a Clancy meter or RAS coil. The symptoms will be a greatly attenuated monitor voltage. With earthed rails current can flow in any direction.

The earth can be found using a rail induction meter as would be the case in a traditional double rail AC track circuit. Spark Gaps where fitted should also be checked using a volt meter. (Any significant DC voltage proves the spark gap to be functional).

4.6 Failed Insulated Joint or Stray Currents

FS2600 receivers have the ability to detect an adjacent channel frequency. In the event of an earth or failed joint, the return path that the current may take could be via an adjacent FS2600 track circuit which can detect this circulating current. In extreme cases this may lead to a track circuit failing, as it would in the case of a short circuit block joint. To determine the cause of a failure in this instance isolate the transmitter and measure the 'Zero Feed' voltage. If some voltage is detected identify the particular frequency and then systematically try to find the source by removing the feed for each track identified by its frequency.

5. Commissioning/Certifying

To commission an FS2600 track in the double-rail configuration installed in the Flemington area, it is necessary to perform the following actions:

- Ensure the supply is approximately 110V AC.
- Ensure the protective Earthing is both connected and adequate.
- Ensure the Transmitter is set to Double Rail low (for track circuits up to 400m).
- Ensure the Track Interface Unit is installed correctly and is of the correct type for the track.
- Install code plugs in the VT1 base.
- Place supplied stickers in required position.
- Plug in Rx ensure the set-up plug is correctly wired (wired for a single rail configuration for double rail tracks under 400m).
- Shunts test the track at 0.5 Ohms.
- Record all voltages on the Test & Certify card Complete Track Circuit History Card.

TRACK CIRCUIT HISTORY CARD FS2600 TRACK CIRCUIT

☐ DOUBLE RAIL using Track Interface Unit with Impedance bond type MJS

☐ SINGLE RAIL

TRACK: _____

TRACK LENGTH: _____ m

CHANNEL: _____

TRANSMITTER	
Tx Serial Number	
Tx Output Terminals	
Tx Set to Double Rail-Low	

RECEIVER	
Rx Serial Number	
Rx Sensitivity	
Links on Configuration Plug	

DATE	TRANSMITTER			RECEIVER/RELAY END							CHECKS				Ballast Conditions	Signature Of Testing Officer
	BX110 Voltage (88-121V)	TX Output Voltage (V a.c)*	Track Voltage (3.3-20V)	BX110 Voltage (88-121V)	Track Voltage (V)	Rx Input Voltage (V)	Monitor Volts: Unoccupied (3-12V)	Monitor Volts: With 0.5Ω shunt on (V)	Monitor Volts: Zero Feed (<100mV)	Drop Shunt >0.6Ω	Test Shunt 0.5Ω	Bonds/Rail Connections (OK)	Insulated Joint Protection (OK)	Lightning Protection (OK)		

* Output voltages will vary: Single Rail-18V typical value; Double Rail-120V typical value.

TRACK: _____

DATE	TRANSMITTER			RECEIVER/RELAY END							CHECKS				Ballast Conditions	Signature Of Testing Officer
	BX110 Voltage (88-121V)	TX Output Voltage (V a.c)*	Track Voltage (3.3-20V)	BX110 Voltage (88-121V)	Track Voltage (V)	Rx Input Voltage (V)	Monitor Volts: Unoccupied (3-12V)	Monitor Volts: With 0.5Ω shunt on (V)	Monitor Volts: Zero Feed (<100mV)	Drop Shunt >0.6Ω	Test Shunt 0.5Ω	Bonds/Rail Connections (OK)	Insulated Joint Protection (OK)	Lightning Protection (OK)		

COMMISSIONING MASTER SHEET No.1 – SET TO WORK FS2600 TRACK CIRCUIT

CHANNEL	TRACK INTERFACE UNIT
1 OR 2	C50267/1
3 OR 4	C50267/2
5 OR 6	C50267/3
7 OR 8	C50267/4
9 OR 10	C50267/5

DATE: _____

LOCATION:_____

TEAM: _____

LEADER: _____

Track Name	Track Length (m)	Type[1] & Channel No.	BX110 Transformer Installed	TRANSMITTER		RECEIVER/RELAY END					CHECKS				Signature Of Testing Officer
				BX110 Voltage (88-121V)	TX Output Voltage (V a.c)[2]	TIU Channel	Check Labels	BX110 Voltage (88-121V)	Monitor Volts	Configuration Plus Installed (Bridges: 1-2,4-14, 5-7, 8-13)	Test Shunt 0.5Ω	Bonds/Rail Connections (OK)	Insulated Joint Detection (OK)	Lightning Protection (OK)	

TRACK	COMMENTS	ACTION BY	COMPLETE

1 D for Double Rail using Track Interface Unit with Impedance bond type MJS or S for Single Rail

2 Output voltages will vary: Single Rail-18V typical value; Double Rail-120V typical value.

COMMISSIONING MASTER SHEET No.2 – TEST AND CERTIFY FS2600 TRACK CIRCUIT

TEST EQUIPMENT TYPE	SERIAL NUMBER

DATE: _____

LOCATION:_____

TEAM: _____

LEADER: _____

Track Name	Track Length (m)	Type[1] & Channel No.	TRANSMITTER				RECEIVER/RELAY END										CHECKS				Ballast Conditions	History Card	Signature of Testing Officer
			Serial No.	BX110 Voltage (88-121V)	TX Output Voltage (V a.c)[2]	Track Voltage (3.3-20V)	Serial No.	BX110 Voltage (88-121V)	Track Voltage (V)	Rx Input Voltage (V)	Rail Current		Monitor Volts			Drop Shunt >0.6 Ω	Test Shunt 0.5Ω	Bonds/ Rail Connect. (OK)	Insulated Joint Detection (OK)	Lightning Protection (OK)			
											UP	DN	Unoccupied (3-12V)	With 0.5Ω shunt on (V)	Zero Feed (<100mV)								

TRACK	COMMENTS	ACTION BY	COMPLETE

1 D for Double Rail using Track Interface Unit with Impedance bond type MJS or S for Single Rail

2 Output voltages will vary: Single Rail-18V typical value; Double Rail-120V typical value.