Level Crossing Interface

Railway Interface Unit Installation and Testing

Roads and Traffic Authority

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Revision history

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1 Introduction

1.1 Purpose

This document defines the steps necessary to install and test a Railway Interface Unit within a PSC or TSC/4 traffic signal controller housing and its interface to a rail level crossing.

1.2 Scope

This document covers all aspects of the railway interface unit installation in a PSC or TSC/4 housing. In addition it covers all aspects of testing once fitted into a traffic signal controller.

This document does not cover the detailed testing of the interface with a connected rail signalling system as this is dependant on which Rail Authority is responsible for the level crossing and the indications being convey.

In addition, it does not cover the operating principles or design considerations of the railway-road interface. This information can be found in Level Crossing Interface – Concept of Operations, [1] and Level Crossing Interface – Design Guidelines, [3].

1.3 Warning

Due to the facilities provided by the different types of controllers there are issues which need to be considered when upgrading or replacing the traffic signal controller. Refer to section 5.

1.4 Definitions and abbreviations

Term	Meaning
ARTC	Australian Rail Track Corporation
PSC	Phillips Signal Controller – main stream traffic signal controller prior to TSC/4 controllers.
RailCorp	Rail Corporation New South Wales
RIU	Railway Interface Unit
RTA	Roads and Traffic Authority
TD	Train Demand – an indication from the level crossing to the traffic signal controller indicating a train is approaching. (This signal ends when the train has cleared the crossing.) It is inferred from the TDNC and TDNO signals.
TDNC	Train Demand Normally Closed signal, from the level crossing equipment to the traffic signal controller that indicates that a train is proceeding towards the level crossing, which is normally closed when there is no train demand.
TDNO	Train Demand Normally Open signal, from the level crossing equipment to the traffic signal controller that indicates that a train is proceeding towards the level crossing, which is normally open when there is no train demand.
TLR	Traffic Light Response – indication from the traffic signal controller to the level crossing indicating that the traffics signal controller is ready for the level crossing to commence operating. (This signal remains active while the Train Demand signal is present.)
TLRFB	Traffic Light Response Feedback – an indication from the level crossing to the traffic signal controller confirming that the level crossing has received the Traffic Light Response indication.

Term	Meaning
TLRH	Traffic Light Response High relay
TLRL	Traffic Light Response Low relay
TMB	Traffic Management Branch
TSC	Traffic Signal Controller
TSC/4	A TSC manufactured to the TSC/4 specification
XE	Crossing Operating – indication from the level crossing to the traffic signal controller indicating the level crossing flashing lights are operating. It is inferred from the XENC and XENO signals.
XENC	The half of the crossing operating signal which is normally closed when the crossing is not operating.
XENO	The half of the crossing operating signal which is normally open when the crossing is not operating.

1.5 References

[1] RailCorp – Roads and Traffic Authority, Level Crossing – Traffic Light Design Interface Agreement, 30 May 2008

[2] LX-CO-001, Level Crossing Interface – Concept of Operations

[3] LX-DG-001, Level Crossing Interface – Design Guidelines

[4] LX-SP-001, Level Crossing Interface – Railway Interface Unit Design

[5] VE516-57, Traffic Signal Controller Railway Interface Unit Circuit Diagram, Issue H

2 Interface Circuit Operation

This section provides an overview of the operation of the Railway Interface Unit (RIU). A full description of its design and operation can be found in Railway Interface Unit Design [4].

The RIU consists of two distinct areas. The first area provides communication signals from the railway signalling system to the RTA traffic signal controller. The second area of the circuit provides a signal from the RTA traffic controller to the railway signalling system.

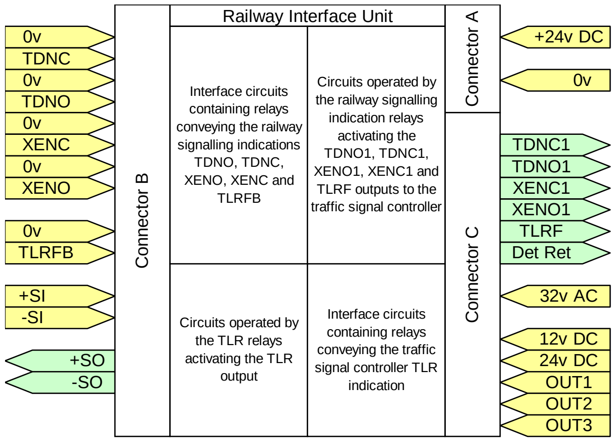

Figure 1 Connection diagram of the railway interface unit

A complete circuit diagram of the RIU is provided in the Railway Interface Unit Circuit Diagram [5] and reproduced at Appendix C.

Pin	Label	Function
1	+12v DC	+12v DC TRACO power supply for relay circuits conveying railway signals
2	0v	0v DC TRACO power supply for relay circuits conveying railway signals

Table 1 Connector A pin description

Pin	Label	Function
1	0v	0v terminal for TDNC circuit
2	TDNC	+12v terminal for TDNC circuit
3	0v	0v terminal for TDNO circuit
4	TDNO	+12v terminal for TDNO circuit
5	0v	0v terminal for XENC circuit
6	XENC	+12v terminal for XENC circuit
7	0v	0v terminal for XENO circuit
8	XENO	+12v terminal for XENO circuit
9	0v	0v terminal for TLRFB circuit
10	TLRFB	+12v terminal for TLRFB circuit
11	+SI	Nominal +12v DC power supply for TLR circuit
12	-SI	Nominal +0v DC power supply for TLR circuit
13	+SO	+12v TLR circuit
14	-SO	0v TLR circuit
15	-	Unused - spare

Pin	Label	Function
16	-	Unused - spare

Table 2 Connector B pin description

Pin	Label	Function
1	TDNC1	TDNC indication via detector input circuit
2	TDNO1	TDNO indication via detector input circuit
3	XENC1	XENC indication via detector input circuit
4	XENO1	XENO indication via detector input circuit
5	TLRF	TLRF indication via detector input circuit
6	DETR	Detector return path for detector input circuits
7	DETS	32v AC detector power supply for detection circuits
8	12v DC Supply	Power supply for TLR relay circuits (PSC controller connection)
9	24v DC Supply	Power supply for TLR relay circuits (TSC/4 controller connection)
10	COUT1	TLRL control (active low)
11	COUT2	TLRH disable (active low)
12	COUT3	TLRH control (active low)

Table 3 Connector C pin description

For the signals from railway signalling system to the RTA controller, the components of interest on the RIU are the following five relays:

- TDNC – monitors the state of the normally closed contacts of the railway signalling system TDR relay. This TDNC relay is energised when there is no train in the vicinity and therefore no train demand.
- TDNO – monitors the state of the normally open contacts of the railway signalling system TDR relay. The TDNO relay is released when there is no train demand.

  (By monitoring both contacts the RIU and traffic signal controller have a double check on the condition of the Railway TDR relay contacts, so that if these contacts are not in the reverse state of each other under steady conditions, then the controller has an indication of a failure of the train detection circuitry.)
- XENC – monitors the condition of the normally closed circuit of the level crossing warning signals. The XENC relay is energised when the signals are inactive.
- XENO – monitors the condition of the normally open circuit of the level crossing warning signals. The XENO relay is released when the signals are inactive.

  (Once again there is a double check on the condition of level crossing equipment circuits).
- TLRFB – monitors a contact in the railway signalling system, which confirms, (for the interface and traffic signal controller), that the railway signalling system has received the traffic signals ready or "all clear" from the RTA signal controller.

For communication in the opposite direction from RTA controller to the railway signalling system there are two relays of interest TLRL and TLRH.

TLRL and TLRH are energised by outputs of the traffic signal controller when the controller has the intersection signals in a condition where it is safe for the train to proceed onwards through the level crossing. That is, the traffic signals are set such that no road traffic should be queued across the level crossing and all lanes of traffic, which are directed over the crossing have a red signal display.

TLRL and TLRH provide a double cut circuit which completes the railway signalling circuits and provides the redundancy required by railway signalling systems. These relays are controlled by the traffic signal controller wait or special facility outputs and are switched, as mentioned above, by the active low operation of the outputs. TLRL is energised by the one output while TLRH is energised by another. Under abnormal conditions the traffic signal controller can interrupt the indication provided by these two outputs by shunting the supply from TLRH via a third output thereby forcing TLRH to release.

On board diagnostics are provided by LEDs as follows:

- Green LED (D1) when on indicates RTA relay supply (12 V TRACO) is operational.
- Green LED (D3) when on indicates that the RIU is receiving an indication that the railway signalling circuits have received the TLR.
- Red LED (D5) when on indicates that the RIU is receiving discrepant or contradictory XENO / XENC indications from the railway signalling system or alternately a fault condition with either: the relay XENO or XENC; or the cable; or the connections. When it is off it indicates that conditions are normal while the level crossing is inactive.
- Green LED (D6) when off indicates that the level warning lights are not flashing. When it is on it indicates that the warning lights are flashing.
- Red LED (D9) when on indicates a discrepant or contradictory indication from the railway signalling system or alternately a fault condition with either: the relay TDNO or TDNC; or the cable; or the connections. When it is off it indicates that conditions are normal while is there is no train demand.
- Green LED (D10) when off indicates that there is no train demand. When it is on it indicates that a train demand is present.
- Green LED (D12) when on indicates that the controller 32 Volt detector supply is present.

The interface *switches five* external controller inputs. These inputs are allocated in the adaptive information for the controller. TDNC and TDNO should always be in opposite states unless undergoing a transition caused by the detection of a train.

When there is no train present in the area, the first external input driven by TDNC1 should be actuating the first external traffic signal controller input, while TDNO should not be actuating the second external input. The opposites are true when a train demand occurs.

Likewise XENC and XENO should always be in opposite states unless undergoing a transition. When the level crossing warning lights are flashing XENC1 should not be actuating the third external traffic signal controller input, while XENO1 should be actuating the fourth external input under the same conditions. When the level crossing warning lights are not flashing the reverse should be the case for these external inputs.

TLRF1 should only be actuating the fifth external input when the TLR relay in the railway signalling system is active. This confirms that the TLRH and TLRL relays have closed the circuit to the railway signalling system and that the traffic signals ready signal has been received by railway.

3 Installation Requirements

The RIU can be fitted within either a PSC or TSC/4 controller. (If any other controller is to be used contact should be made with Traffic Systems Integration section, Traffic Management Branch to determine compatibility, obtain approval and special directions for the controller.)

Irrespective of either a PSC or TSC/4 controller certain components are required. These are stipulated below.

3.1 Hardware

1. An 8 pair, "Olex Dekoron" cable, with overall screen, nylon jacket and a sacrificial PVC sheath as supplied by railway. (Pairs to be terminated at the interface are all twisted, coloured black with white mate and are individually numbered having 1.5 mm2 multi-strand conductors sized 7/0.50 mm).
2. A "TRACO" Model TPM 10112C, DC power supply module of 12V - 10 Watt rating.
3. Connection cabling suitable for the permanent wiring of RTA traffic controller detector inputs and either the wait or special facility outputs. (This may include a D25 and D37 plug for the wait outputs, special facility outputs, detector inputs and voltage supplies.)
4. Standard RTA - railway interface unit in accordance with Railway Interface Unit drawing [5].
5. A short length of DIN rail may be required.

The TSC/4 controllers are provided in a basic configuration with optional modules. Due to manufacturer's decisions the basic offerings from each manufacturer differ. The following paragraphs aim to provide details to aid the installation process with regard to securing a basic controller with the relevant optional modules.

It is recommended that when a TSC/4 controller is used then the special facility outputs should be used in preference to the WAIT outputs. Use of the WAIT outputs may cause issues at a later date if it becomes necessary to swap one TSC/4 controller with another from a different manufacturer.

3.1.1 ATSC4 Controller

The use of the ATSC4 controller will require the provision of supplementary modules.

- An external interface module and XEA connector will be required for the external detector inputs.

and

- If special facility outputs are being used a special facility module and XSF connector will be required.
- If WAIT outputs are being used an external interface module and XDY connector will be required.

3.1.2 Eclipse Controller

The use of the Eclipse controller will require the provision of supplementary modules.

- A loop detector module and XEA connector will be required for the external detector inputs.

and

- Special facility outputs are available on the power supply module (fitted as standard). An XSF connector will be required.
- The Eclipse controller does not support the use of WAIT outputs as proposed in this specification.

3.1.3 QTC Controller

The use of the QTC controller will require the provision of supplementary modules.

- A loop / input module and XEA connector will be required for the external detector inputs.

and

- If special facility outputs are being used a special facility module and XSF connector will be required.
- If WAIT outputs are being used a loop / input module and XDY connector will be required.

3.2 RIU Monitoring and Control

The RIU is monitored and controlled by tables in the controller personality supplied by the RTA Adaptive Group, Engineering Technology Branch for RTA traffic signals at the location.

4 Installation and Set-up

These notes assume that in all circumstances that the activities will be undertaken by appropriately trained, experienced and competent traffic signals staff.

It is assumed that in all circumstances a TSC/4 controller will use the special facility outputs and the PSC will use the WAIT outputs. If it is necessary for a TSC/4 controller to use the WAIT outputs advice and support should be sought from the Manager, Traffic Systems Integration, Traffic Management Branch and the Manager, Adaptive Engineering, Engineering Technology Branch.

It is also likely that the interface will be installed at various times with both new and in situ controllers. For this reason instructions have been provided for both the newer TSC/4 series of controllers and the commonly deployed PSC controllers.

Should it become necessary to retrofit the interface to other controllers, advice must be sought from the Traffic Systems Integration section, Traffic Management Branch.

The steps needed to install the RIU fall into two sets or phases. The first phase of steps will ordinarily be performed at the depot, while the second phase of steps will be usually conducted at the intersection.

Occasionally, however, it will be necessary to retrofit the product and in these cases both phases will need to be performed at the intersection. When being installed as a retrofit, more work will need to be performed at the intersection and at least two competent staff will need to be present while the works are underway. The "depot" works should always be performed first.

Unless there is already spare available DIN rail in the controller, it will be necessary to fit a short length of rail to provide secure mounting for the RIU and the TRACO Power supply. Whenever this is necessary, particular care should be taken to ensure that metal filings and swarf do not fall within the controller housing. In the first instance always consider using any existing drilled and tapped holes in the back of the controller as a means of mounting the DIN rail.

4.1 Phase One

If this work has to be done as a retrofit in the field, exercise extreme caution. It may be necessary to arrange the works to occur during the night at times of very light traffic or to arrange special traffic control measures for the duration of the works. *(Before opening any connections, satisfy yourself that there will not be any compromising of pre-existing safety critical features at the intersection which are reliant on either, wait outputs, daily event outputs, special facility outputs or pre-emption inputs, such as hurry calls for emergency services as an example).*

Installation details are provided for both TSC/4 controllers and PSC controllers.

4.1.1 Installation

4.1.1.1 TSC/4 Controller

Before commencing work at the depot:

1. Ensure all AC power is removed from the traffic signal controller. (If 240V AC has already been connected to the controller, then switch the supply power off at the main switch supplying the controller, test to prove that it has been properly isolated and tag the breaker or switch to ensure that it is not inadvertently closed by some other party).
2. Identify and carefully make note of the terminal numbers of all the connection points that will be used in the installation, including those on the TRACO power supply module and the controller the auxiliary power source. (If necessary make a sketch or series of sketches to assist in the installation process).
3. Locate and identify the five external detector inputs on the controller as allocated in the supplied adaptive information and also identify a spare 32 V AC detector supply connection point.

On **TSC/4 controllers** the allocated inputs will be found on the field terminals of E block and the 32 V AC detector supply can be obtained from terminal 37 of terminal block E.

4. Locate and identify, on the controller, the three outputs as allocated in the adaptive information, either special facility or wait outputs.

   For **TSC/4 controllers** the special facility outputs are on the XSF (D37) connector socket and the power supply will be found on pins 34, 35, 36 or 37 of the same socket. It may be necessary to wire up a D37 connector plug.

   However, if there is already a partially wired D37 plug in the XSF connection socket of the controller, then the wiring may have to be added to it. *(In this eventuality before unplugging the connector, determine exactly what else is connected to it and be certain that you are not disrupting a critical service. Bear in mind that it may be necessary to make some special interim arrangements, for traffic control. Also, in some circumstances it may be advantageous to create a second XSF connection cable, with pre-wired plug, which duplicates (in parallel) any existing wiring and has all special facility outputs already terminated at both plug and the RIU ends. The plug could then be quickly swapped at an opportune moment, (when there is no traffic in the vicinity) and the pre-existing cable could finally be removed once everything is restored to normal).*

   On completion of the special facility output connections, for a TSC/4 series controller, double check to ensure that a direct connection exists between pins 28 and 29.

5. Locate the detector supply return.

   On the **TSC/4 controllers**, this can be found on terminal 3 or 4 of terminal block E.

6. Mount RIU and 12v dc power supply.

   (a) If necessary mount a short length of DIN rail to support the RIU and the TRACO power supply in a secure and suitable location within the controller housing.

   (b) Mount the TRACO power supply.

   (c) Mount the standard RIU conveniently close to the TRACO power supply.

7. Wire 12v dc power supply.

   (a) Connect the "AC" terminals of the TRACO power supply to the auxiliary 240 V AC supply within the controller using single insulated 2.5mm2 flexible cable of suitable colour. (Suitable colour means matching the insulation colouring to that of conductors which are already in use on the same circuit and using colours compliant with Australian Standards. For example, it is usual to use brown or red for active and light blue or black for neutral. Doing this will make maintenance easier at a later date).

   The **TSC/4 controllers** have a designated "auxiliary" supply which will be used as the supply source.

   (For standardisation, pin 7 of the TRACO power supply should connect to the active of the auxiliary supply and pin 6 of the TRACO module should connect to the neutral).

   (b) Using a twisted pair made up of red and black 2.5mm2 flexible cables connect the TRACO power supply to the RIU. It is sensible to twist the pair since it will reduce the potential effects of noise on the RIU power supply. (Connect pin 5, (+V) of the TRACO power supply to pin 1 (+V) of connector plug A at the RIU using the red conductor and connect pin 4, (0V) of the TRACO power supply to pin 2, (0V) of the same plug of the RIU using the black conductor.

8. Wire RIU outputs.

   (a) Create a 7 wire loom using 2.5 mm2 multi-strand flexible cable and use it to connect up the five allocated external detector inputs via the connector plug C at the RIU. The external inputs were identified in step (3) above and these are to connect to the XENO1, XENC1, TDNO1, TDNC1, TLRF1 terminals, (pins 4, 3, 2, 1 and 5) of connector plug C of the RIU.

On **TSC/4 controllers** connect the sixth wire of the loom between pin 7 of connector plug C of the RIU, (32 V ac) and 32 V AC detector supply from terminal 37 of terminal block E. Finally, the seventh wire of the loom must connect between pin 6 of connector plug C of the RIU, and terminal 3 or 4 of terminal block E (detector return).

9. Wire RIU inputs.

   (a) Create a 4 wire loom using 2.5mm2 multi-strand flexible cable and use it to connect between the three allocated special facility or wait outputs and the pins 10, 11 and 12 of connector plug C of the RIU.

   For **TSC/4 controllers** the allocated special facility outputs will be located on D37 connector XSF and unless there are other special facility outputs used at the intersection, they are likely to be pins 11, 12 and 13. Check also to ensure that there is electrical continuity between pins 28 and 29 of the XSF connector. If there is no connection, then solder a permanent connection between the terminals using 2.5mm2 multi-strand cable).

   (b) For **TSC/4 controllers**, the special facility supply will also be obtained from the 24 Volt supply on the XSF connector at pins 34, 35, 36 or 37 and the 24 Volt connection should be made from one of these to pin 9 of connector plug C of the RIU.

Function	RIU Connector	Pin		Connected to	Pin / Terminal
Isolated power	A	1	–	TRACO Power supply	5
Isolated power	A	2	–	TRACO Power supply	4
TDNC	C	1	–	Terminal block E	5*
TDNO	C	2	–	Terminal block E	6*
XENC	C	3	–	Terminal block E	7*
XENO	C	4	–	Terminal block E	8*
TLR	C	5	–	Terminal block E	9*
Detector return	C	6	–	Terminal block E	3 or 4
32v detector supply	C	7	–	Terminal block E	37
---	C	8	–	*Not connected*	
24v DC supply	C	9	–	XSF connector	34, 35, 36 or 37
OUT1	C	10	–	XSF connector	11*
OUT2	C	11	–	XSF connector	12*
OUT3	C	12	–	XSF connector	13*

* – This assumes that no other external detector inputs or special facility outputs are in use. The adaptive information sheet must be consulted for correct inputs and outputs to use. Complete listing of relevant input and output pins are at Appendix A.

Table 4 TSC/4 to RIU wiring connections

Record of the fitment should be signed by the installation engineer and filed.

4.1.1.2 PSC Controller

Before commencing work at the depot:

1. Ensure all AC power is removed from the traffic signal controller. (If 240V AC has already been connected to the controller, then switch the supply power off at the main switch supplying the controller, test to prove that it has been properly isolated and tag the breaker or switch to ensure that it is not inadvertently closed by some other party).
2. Identify and carefully make note of the terminal numbers of all the connection points that will be used in the installation, including those on the TRACO power supply module and the controller

the auxiliary power source. (If necessary make a sketch or series of sketches to assist in the installation process).

3. Locate and identify the five external detector inputs on the controller as allocated in the supplied adaptive information and also identify a spare 32 V AC detector supply connection point.

   On **PSC controllers**, the allocated inputs will be found on the field terminals of EA block and the 32 V AC supply can be obtained from terminal 7 of terminal block H.

4. Locate and identify, on the controller, the three outputs as allocated in the adaptive information, either special facility or wait outputs.

   For **PSC controllers** the wait outputs 1 to 3 will be found at terminals 1, 2 and 3 of terminal Block J and the wait supply is 12V. The wait supply will be obtained from terminal Block H, terminal 10 unless a better option exists). An alternative is to pick up the controller wait outputs from Pins 11, 12 and 13 of Connector XH4 D37 connector on the PIF board, but this will mean adding cable to an existing plug which already has a large number of wires on it.

5. Locate the detector supply return.

   On **PSC controllers** this is distributed from hole number 7 on the earth link and appears at several locations. It is suggested that a sensible point to make the connection is at pin 12 of terminal block H or terminal 3 of the E block..

6. Mount RIU and 12v dc power supply.

   (a) If necessary mount a short length of DIN rail to support the RIU and the TRACO power supply in a secure and suitable location within the controller housing.

   (b) Mount the TRACO power supply.

   (c) Mount the standard RIU conveniently close to the TRACO power supply.

7. Wire 12v dc power supply.

   (a) Connect the "AC" terminals of the TRACO power supply to the auxiliary 240 V AC supply within the controller using single insulated 2.5mm2 flexible cable of suitable colour. (Suitable colour means matching the insulation colouring to that of conductors which are already in use on the same circuit and using colours compliant with Australian Standards. For example, it is usual to use brown or red for active and light blue or black for neutral. Doing this will make maintenance easier at a later date).

   The **PSC controllers** have a "GPO" supply which will be used as the supply source.

   (For standardisation, pin 7 of the TRACO power supply should connect to the active of the GPO supply and pin 6 of the TRACO module should connect to the neutral).

   (b) Using a twisted pair made up of red and black 2.5mm2 flexible cables connect the TRACO power supply to the RIU. It is sensible to twist the pair since it will reduce the potential effects of noise on the RIU power supply. (Connect pin 5, (+V) of the TRACO power supply to pin 1 (+V) of connector plug A at the RIU using the red conductor and connect pin 4, (0V) of the TRACO power supply to pin 2, (0V) of the same plug of the RIU using the black conductor.

8. Wire RIU outputs.

   (a) Create a 7 wire loom using 2.5 mm2 multi-strand flexible cable and use it to connect up the five allocated external detector inputs via the connector plug C at the RIU. The external inputs were identified in step (3) above and these are to connect to the XENO1, XENC1, TDNO1, TDNC1, TLRF1 terminals, (pins 4, 3, 2, 1 and 5) of connector plug C of the RIU.

   On **PSC controllers** connect the sixth wire of the loom between pin 7 of connector plug C of the RIU, (32 V ac) and 32 V AC detector supply from terminal 7 of terminal block H. Finally, the seventh wire of the loom must connect between pin 6 of connector plug C of the RIU, and pin 12 of terminal block H.

9. Wire RIU inputs.

(a) Create a 4 wire loom using 2.5mm2 multi-strand flexible cable and use it to connect between the three allocated special facility or wait outputs and the pins 10, 11 and 12 of connector plug C of the RIU.

For **PSC controllers** the allocated wait outputs will be found at terminals 1, 2 and 3 of terminal Block J and unless there are other wait outputs used at the intersection, they are likely to be connected to pins 10, 11 and 12 (COUT1/2/3) of connector XH4. An alternative is to pick up the controller wait outputs from Pins 11, 12 and 13 of connector XH4 D37 connector on the PIF board, but this will mean adding cable to an existing plug which already has a large number of wires on it.

(b) For **PSC controllers** the 12Volt supply for this purpose may be obtained from the H field terminal block, pin 10 and so a connection must be made between terminal 10 of terminal block H and pin 8 (+12 V) of connector plug C of the RIU.

Function	RIU Connector	Pin	Connected to		Terminal
Isolated power	A	1	–	TRACO Power supply	5
Isolated power	A	2	–	TRACO Power supply	4
TDNC	C	1	–	Terminal block E	5*
TDNO	C	2	–	Terminal block E	6*
XENC	C	3	–	Terminal block E	7*
XENO	C	4	–	Terminal block E	8*
TLR	C	5	–	Terminal block E	9*
Detector return	C	6	– or –	Terminal block E Terminal block H	3 12
32v detector supply	C	7	–	Terminal block H	7
12v DC supply	C	8	–	Terminal block H	10
---	C	9	–	*Not connected*	
OUT1	C	10	–	Terminal block J	1*
OUT2	C	11	–	Terminal block J	2*
OUT3	C	12	–	Terminal block J	3*

* – This assumes that no other external detector inputs or special facility outputs are in use. The adaptive information sheet must be consulted for correct inputs and outputs to use. Complete listing of relevant input and output pins are at A.3.

Table 5 PSC to RIU wiring connections

Record of the fitment should be signed by the installation engineer and filed.

4.1.2 Functional Testing

To perform functional test the following are required:

- a suitable screwdriver,
- four 10 ohm, 1 Watt resistors,
- some multi-strand cable,
- a 12 V DC supply,
- two multimeters are needed and
- the RIU test box.

NOTE (1): Due to differences in the manufacturer's implementation of TSC/4 it should be noted that in the following section all references to 32v AC, could in actuality be 32v AC, 30v AC or 28v AC, see section A.3.

NOTE (2): All Voltage measurements on connector C should be with respect to PIN 6.

1. Connect 10 ohm resistors between pins:
   - 1 and 2, (0V to TDNC),
   - 3 and 4, (0V to TDNO),
   - 5 and 6, (0V to XENC) and
   - 7 and 8, (0V to XENO)

   of connector B. (This is the plug and socket connector, that the railway Dekoron cable will be connected once at site).

2. Set the bench power supply to 12 volt and connect it between pins 11 and 12 of the same connector, (TLRL 4 and TLRH 4), with the positive supply lead connected to pin 11.

3. Connect the first multimeter as a Volt-meter, on nominally the 20 Volt DC range, between pins 13 and 14, (TLRL 9 and TLRH 9), with the positive meter lead to pin 13.

4. Turn on 240 V power at both the main switch and the auxiliary supply breaker. Turn on the bench power supply. The following LEDs should all be illuminated:
   - Green LEDs "RELAY SUPPLY", "30V AC", "TD" and "XE"; and
   - Red LEDs, "TD FAULT" and "XE FAULT".

   Using a multimeter on a 50 v AC range, the detector input pins 1, 2, 3 and 4 on the RIU connector C, should all measure close to the 0 Volt AC detector return voltage. Detector input pin 7 on the RIU connector C should measure close to the 32 Volt AC detector supply voltage.

5. Open 10 ohm resistor between pins 1 and 2 at pin 2 (TDNC) of connector B. Red "TD FAULT" LED should extinguish and Green "TD" LED should remain illuminated. Detector input voltage at pins 1of connector C (TDNC1) of the RIU should now read close to 32 V ac.

   Restore the 10 ohm resistor connection at pin 2. Red "TD FAULT" LED should illuminate. Voltage measured at detector input pin 1, of connector C should now have changed to read close to 0V AC once again.

6. Open 10 ohm resistor between pins 5 and 6 at pin 6, (XENC) of connector B. Red "XE FAULT" LED should extinguish and green "XE" LED should remain illuminated. Detector input voltage at pin 3 of connector C (XENC1) of the RIU should now read close to 32 V ac.

   Restore 10 ohm resistor connection at pin 6. Red "XE FAULT" LED should illuminate. Voltage measured at detector input pin 3, of connector C should now have changed to read close to 0V AC once again.

7. Open 10 ohm resistor between pins 3 and 4 at pin 4, (TDNO) of connector B. Red "TD FAULT" and green "TD" LED should extinguish. Detector input voltage at pin 2 of connector C of the RIU should now read close to 32 V ac.

   Restore 10 ohm resistor connection at pin 4 of connector B. Red "TD FAULT" LED should illuminate again. Voltage measured at detector input pin 2, of connector C, should now have changed to read close to 0V ac.

8. Open 10 ohm resistor between pins 7 and 8 at pin 8, (XENO) of connector B. Red "XE FAULT" and green "XE" LED should extinguish. Voltage at detector input pin 4 of connector C of the RIU should read close to 32V ac.

   Restore 10 ohm resistor connection at pin 8 of connector B. Red "XE FAULT" LED should illuminate. Voltage measured at detector input pin 4 of connector C of the RIU should read close to 0V ac.

9. Briefly bridge pins 10 and 12 on connector C, (COUT1 and COUT3), directly to ground (available at terminal 4 of E block, the earth link or the chassis). 12 v dc should be seen on the voltmeter

connected between pins 13 and 14, of connector B of the RIU and approximately 0V AC should be measured between pin 5 of detector input connector C of the RIU and detector return.

10. Remove all four 10 ohm resistors from connector B, the bridges between pins 1 and 3 of connector C, the temporarily fixed 12 volt power supply and the temporarily fixed voltmeter from connector B of the RIU.
11. Using one of the removed 10 ohm resistors, bridge pins 9 and 10 of connector B. Green "TLRFB" LED should illuminate and voltage at detector input connector pin 5 of connector C should be approximately 0V ac, while voltage at pins 1, 2, 3 and 4 of connector C should all be close to 32 V ac.
12. Remove 10 ohm resistor from connector B, pins 9 and 10.

Functional testing of board is now complete and the interface is ready to be tested in concert with the controller personality and the railway system.

Test records should be signed by the installation engineer and filed.

4.1.3 Pre-Site test

1. Switch on controller and wait for controller to start up. After several seconds green "TD" LED, (D10), red "TD FAULT" LED, (D9), green "XE" LED, (D6), red "XE FAULT" LED, (D5) and green "30V AC" LED, (D12) should all illuminate. These are all driven by the 32V detector supply.
2. Set the controller to isolated mode using any appropriate means.
3. Switch on the auxiliary power supply/GPO supply breaker/switch. Green "RELAY SUPPLY" LED should illuminate.
4. Ensure that all switches of the test box are in the off position. Connect the railway plug of the test box to connector B.
5. If all is well, the red fault LEDS should extinguish. The green "RELAY SUPPLY" LED and "30V AC" LED should remain illuminated.
6. Operate the TD switch followed by the XE switch on the controller test box. Controller should service the railway demand remaining in the railway phase until the XE and TD switches are restored.
7. If only one or other of TD and XE is either operated, or restored, after a time delay an alarm should be generated.

Test records should be signed by either the installation engineer or Test Engineer and filed.

4.2 Phase Two

4.2.1 Pre-Commissioning Tests

1. Ensure all AC power is removed from the traffic signal controller. *(If 240V AC has already been connected to the controller, then switch the supply power off at the main switch and test to prove that it has been properly isolated).*
2. Test by measurement to ensure that there are no stray or induced voltages present on the railway cables other than possibly a 12-18 volt dc potential on pair 5, *(this should occur only if the cable has already been connected at the railway end).*
3. Carefully feed the Olex Dekoron cable up through the bottom of the controller housing and route it to the point where it is intended to mount the RIU. *(Be careful to ensure that there is sufficient spare cable available (approx. 2.5 m) to re-terminate it at some time in the future if necessary after an accident, so that signal service can be quickly restored in that event).*
4. Carefully identify all pairs of the railway cable pairs and terminate railway cable on connector plug B as outlined below. *(Cable pairs are printed with the numbers and words, that is "1" (and "one") through "8" (and "eight"), on the individual conductor sheathings).*

Pair one (1 White and 1 Black) to be connected to pins 1, (0V) and 2, (TDNC) of the RIU.

Pair two (2 White and 2 Black) to be connected to pins 3, (0V) and 4, (TDNO) of the RIU.

Pair three (3 White and 3 Black) to be connected to pins 5, (0V) and 6, (XENC) of the RIU.

Pair four (4 White and 4 Black) to be connected to pins 7, (0V) and 8, (XENO) of the RIU.

Pair five (5 Black and 5 White) to be connected to pins 11, (+S1) and 12, (-S1) of the RIU.

Pair six (6 White and 6 Black) to be connected to pins 13, (+S0) and 14, (-S0) of the RIU.

Pair seven (7 White and 7 Black) to be connected to pins 9, (0V) and 10, (TLRFB) of the RIU.

5. Switch on auxiliary supply circuit.
6. Test for satisfactory traffic signal operation in accordance with the adaptive information by simulating the train demand and within all phases in all controller modes used at the intersection. (That is train demands should be applied to the controller when in Masterlink, Flexilink, Flexi-Isolated and Isolated modes).

Controller should always move to the fully isolated mode on receipt of a train demand regardless of which mode it is in at the time of the train demand occurrence.

Test records should be signed by the Test Engineer and filed.

4.2.2 Commissioning Tests

Testing of the interface between the rail equipment and the traffic signals is to be conducted at commissioning. Both railway and RTA representatives will be required and radio communications set up between the testers.

The commissioning tests of the interface are to take the form of a correspondence test and a functional test as a final validation of the interface design.

The purpose of these tests is to prove that the railway system outputs operate the correct RTA signal controller inputs. (This shows that the interconnection cable has been correctly wired between the two systems).

To perform these tests at the controller, the controller should be switched on and the TRACO power supply should be connected at the RIU.

(This work has to be done in the field, exercise extreme caution. It may be necessary to arrange the works to occur during the night at times of very light traffic and/or to arrange special traffic control measures for the duration of the test.)

TEST 1	Railway	RTA	
TD	With TDR energised	Observe	“TD LED off and “TD fault” LED off
	Remove link on TDR relay Observe TDR relay de-energised	Observe	“TD LED on and “TD fault” LED off
	Replace link. Observe TDR relay energised	Observe	“TD LED off and “TD fault” LED off
	Repeat test to confirm		

TEST 2	Railway	RTA	
XE (SSER)	With SSER and CSER energised	Observe	“XE LED off and “XE fault” LED off
	Remove link on SSER, Observe SSER relay de-energised	Observe	“XE LED on and “XE fault” LED off

	Replace link		
	Observe SSER relay energised	Observe	"XE LED off and "XE fault" LED off
	Repeat test to confirm		

TEST 3	Railway	RTA	
XE (CSER)	With SSER and CSER energised	Observe	"XE LED off and "XE fault" LED off
	Remove link on CSER		
	Observe CSER relay de-energised	Observe	"XE LED on and "XE fault" LED off
	Replace link		
	Observe CSER relay energised	Observe	"XE LED off and "XE fault" LED off
	Repeat test to confirm		

4.2.3 Operational Tests

These tests are to validate the holistic operation of the rail level crossing and traffic intersection interface. The minimum and maximum Clearance Phase start delay is checked to ensure that the traffic signal clearance phase does not terminate before the booms commence to descend. Manual operation of the rail crossing is checked to ensure that the intersection controller responds correctly.

4.2.3.1 Minimum Clearance Phase Start Delay

The RTA is to establish the phase giving the shortest delay to clearance phase operation, and advise railway to de-energise the Train Demand Relay (TDR).

Observe traffic signals and boom operation and check:

- the Clearance Phase commences before the level crossing starts;
- TLRFB LED is lit before the booms commence to fall (the TLRFB LED may be lit before the level crossing commences to operate); and
- the Clearance Phase does not start to terminate before the booms commence to fall.

Repeat test to confirm.

4.2.3.2 Maximum Clearance Phase Start Delay

The RTA is to establish the phase giving the longest delay to clearance phase operation, and advise railway to de-energise the Train Demand Relay (TDR).

Observe traffic signals and boom operation and check:

- the Clearance Phase commences before the level crossing starts;
- TLRFB LED is lit before the booms commence to fall (the TLRFB LED may be lit before the level crossing commences to operate); and
- the Clearance phase does not start to terminate before the booms commence to fall.

Repeat test to confirm.

4.2.3.3 Manual Operation Switch and Test Switch

Turn the Manual Operation Switch 'on' to operate the level crossing and observe:

- the level crossing commences to operate immediately,
- the traffic signals proceed through the Clearance Phase and the Train Demand Phase, and
- the Train Demand Phase concludes and the level crossing stops operating when the manual operation switch is turned 'off'.

Repeat test using the Test Switch.

4.3 Test Documentation

Commissioning and operational test results are to be recorded on the Test Plan and signed by the Commissioning Engineers or delegated testers of both railway and the RTA.

5 TSC Replacement/Upgrade Issues

Differences in the four controllers (PSC, Eclipse, QTC and ATC) in use within NSW may cause difficulties when one controller needs to be replaced or upgraded by a controller of another type. This section describes the difficulties and the methods for surmounting them.

The controller manufacturers may provide supplementary modules and/or functionality in the future so this document may require validation.

5.1 Capability

The four traffic signal controllers provide the capabilities identified in Table 6. The provision is discussed in detail in the subsection following.

	PSC	Eclipse	QTC	ATSC/4
Wait outputs	Y	n/a	Y	Y
Special facility outputs	n/a	Y	Y	Y

n/a – not available

Table 6 Traffic signal controller capability

5.1.1 PSC Controller

Within a PSC controller the RIU is connected to the WAIT outputs at terminal Block J.

5.1.2 Eclipse Controller

Within an Eclipse controller the RIU is connected to the special facility outputs available at connector XSF / XXF. The XSF connector is located on the power supply module. The XXF connector is located on the special facility module.

5.1.3 QTC Controller

Within a QTC controller the RIU can be connected to either:

- The WAIT outputs available at connector XDY. The XDY connector is located on the loop/input supply module; or
- The special facility outputs available at connector XSF / XXF. The XSF / XXF connectors are located on the special facility module.

It is possible to use the XDY connector to provide special facility outputs by changing an entry in the site Personality to allow alternative use of the WAIT outputs. This distinctive use of the XDY connector is not advised.

5.1.4 ATSC/4 Controller

Within an ATSC/4 controller the RIU can be connected to either:

- The WAIT outputs available at connector XDY. The XDY connector is located on the external interface module; or
- The special facility outputs available at connector XSF / XXF. The XSF / XXF connectors are located on the special facility module.

5.2 Upgrade

When it becomes necessary to replace a PSC traffic signal controller with a TSC/4 controller then there are certain issues which need to be considered. In all cases the wiring of the RIU to the controller needs to be changed. Refer to section 4.

If the PSC is being replaced by a QTC or an ATSC/4 controller, and it is still proposed to use the WAIT outputs and no other changes to the intersection geometry or operation are being implemented then it may be possible to still use the controller Personality (although it will need to be transferred to a CardBus).

If the PSC is being replaced by an Eclipse, QTC or an ATSC/4 controller and it is proposed to use the Special Facility outputs, the controller Personality will need to be reviewed and updated to facilitate this operation.

5.3 Replacement

If due to damage (accidental or otherwise) it becomes necessary to replace a particular TSC/4 controller with a different type of TSC/4 controller then consideration is required of the specific facilities of each controller (see sections 3.1.1, 3.1.2 and 3.1.3) and the way in which the Personality has been configured (see section 3.2).

Appendix A TSC/4 Controller

A.1 Terminal Block E Connections

The relevant pin connections for external inputs on terminal block E are:

Pin	Function	
5	external detector input	1
|	-do.-	nn
36	external detector input	32

A.2 XSF Connections

The relevant pin connections for special facility outputs on the XSF connector are:

Pin	Function
11	Special Facility output 1
12	Special Facility output 2
13	Special Facility output 3
14	Special Facility output 4
15	Special Facility output 5
16	Special Facility output 6
17	Special Facility output 7
18	Special Facility output 8
30	Special Facility output 9
31	Special Facility output 10
32	Special Facility output 11
33	Special Facility output 12
34	Output Supply (+24V)
35	Output Supply (+24V)
36	Output Supply (+24V)
37	Output Supply (+24V)

A.3 Nominal 32v Supply

Differences in the manufacturer's implementation of TSC/4 mean that the 32v AC power supply may not be 32v AC, see Table 7 below.

Controller		Nominal 32v AC supply
ATSC/4	–	28v AC
Eclipse	–	30v AC
QTC	–	32v AC

Table 7 TSC/4 nominal 32v AC supply

Appendix B PSC Controller

B.1 Terminal Block E Connections

The relevant pin connections for external inputs on terminal block E are:

Pin	Function	
5	external detector input	1
↓	-do.-	nn
36	external detector input	32

B.2 Terminal Block J Connections

The relevant pin connections for wait outputs on terminal block J are:

Pin	Function
1	Wait output 1
2	Wait output 2
3	Wait output 3
4	Wait output 4
5	Wait output 5
6	Wait output 6
7	Wait output 7
8	Wait output 8

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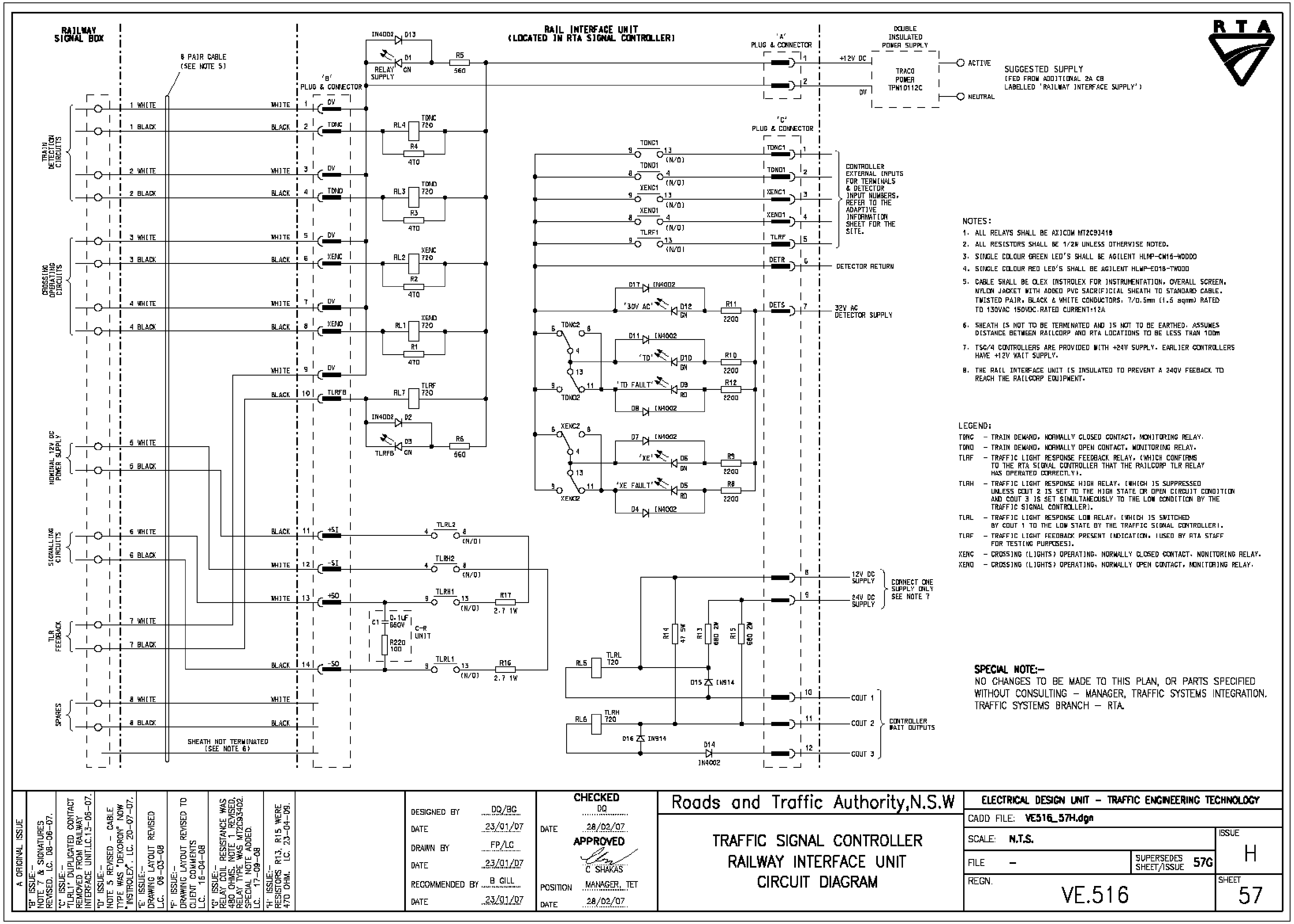
Appendix C RIU Circuit Diagram



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