GEC-General Signal Limited

Edinburgh & East of Scotland Resignalling 24th September, 1979

Reed Jointless Track Circuits

The Edinburgh to Glasgow main line between Ratho and Polmont and the Bathgate and Dalmeny branches are equipped with Reed Jointless Track Circuits which were installed in 1977 and 1978 as part of Stage V of the Edinburgh and East of Scotland resignalling.

The Reed Jointless Track Circuit is available in both non-immune and immune versions, the immune version being the only immune jointless track circuit approved by BRB. The track circuits which are being demonstrated are however the non-immune version, but provision has been made for easy conversion in the future if the main line should be electrified.

Most of the Type RT equipment used is common to all Reed track circuits, both jointless and otherwise and has been well tried in service for some years now. The mechanically-tuned reed filter is used to determine the frequency of operation of the transmitter and a power amplifier provides the current required. In the non-immune track circuits the energy is fed to the track by way of a feed resistor. At the relay end the reed filter is again used, in this case to ensure that the receiver responds only to the correct frequency and its stability and narrow bandwidth contribute towards the immunity of the system. The relay is a standard miniature relay with a special coil designed to match the receiver.

In the jointless track circuit, the receiver is fed from a multiturn pick-up loop laid in the track. The loop serves to define the end of the track circuit, giving an accuracy of $\pm$ 1 metre. It is conveniently formed from multicore cable having the cores connected in series and laid in the track in the form

Continued/-...

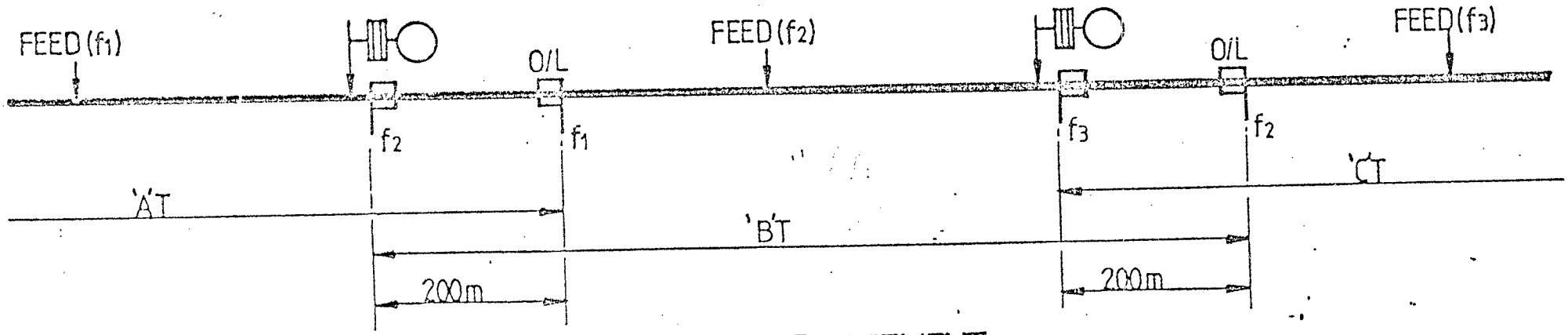
of a rectangle, the side lying along the rails being five metres long. The standard compound loop incorporates a connection between the rails, which is taken by way of the resistive shunt mounted in the location cupboard.

Each receiver has its own loop and because of the lack of insulated joints in the track adjacent track circuits can be overlapped. In the examples demonstrated the receiver loops for adjacent track circuits are placed one metre apart at the overlap point of the signal. Additional loops and receivers can be provided on track circuits to cater for requirements such as approach control and level-crossing protection, so that in automatically-signalled territory it is normally only necessary to provide one track circuit per section. On the Dalmeny and Bathgate branches jointless track circuits up to three kilometres long are used for very long cut sections.

Similar track circuits are in service on the Highland line between Kingussie and Culloden. Immune Reed jointless track circuits are being installed as part of the Southern Region's Victoria resignalling and also on the London Midland Region.

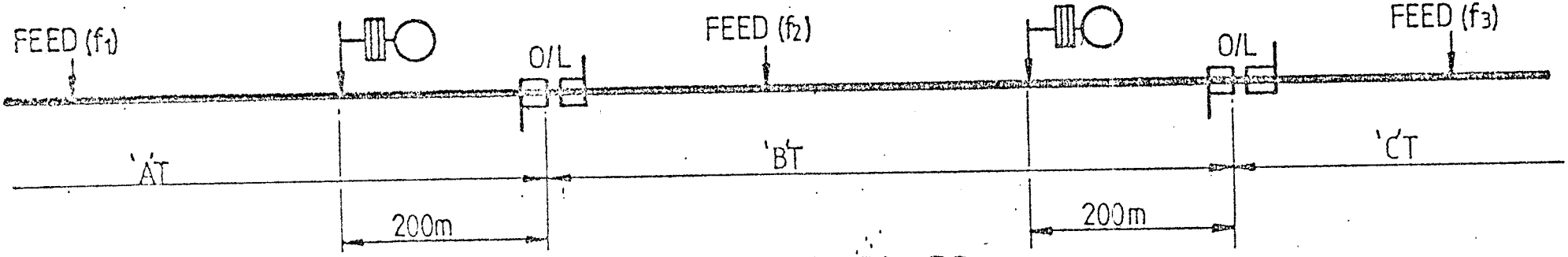
Many sets of equipment are in use in South Africa as well as Australia and further sets of equipment are currently being supplied to Brazil.

REED JOINTLESS TRACK CIRCUITS – ALTERNATIVE ARRANGEMENTS FOR AUTOMATIC SECTIONS

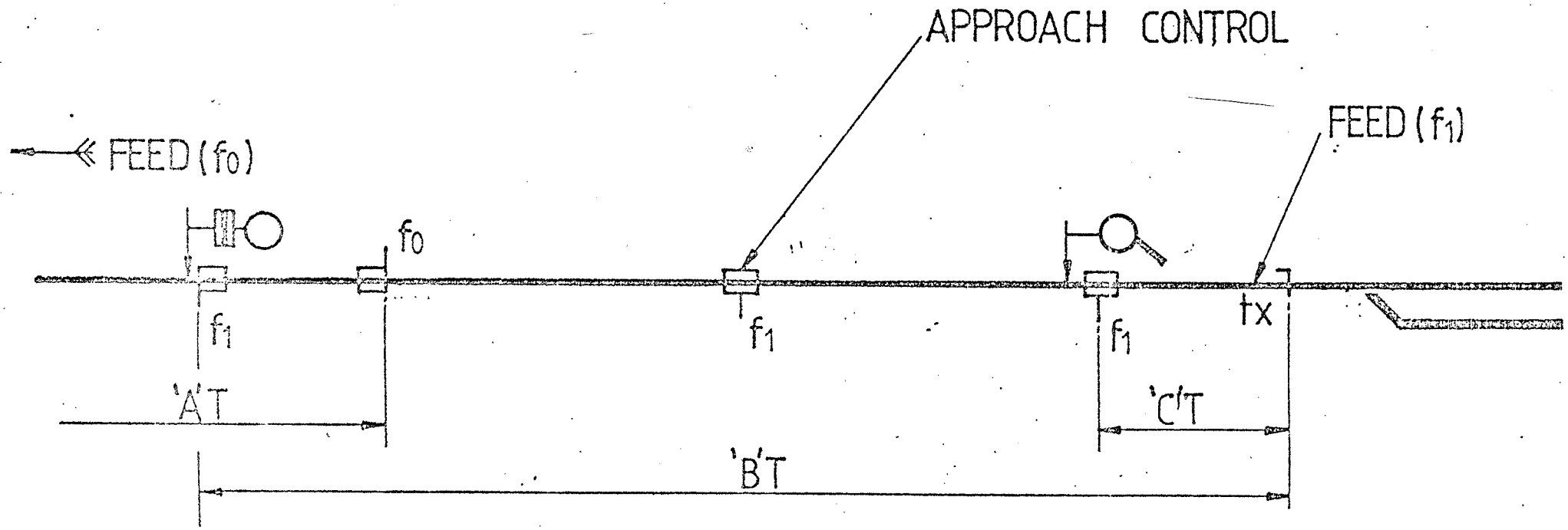


FIRST-AXLE REPLACEMENT

NOTE THAT THE TRACK CIRCUITS OVERLAP



INCLUSIVE OVERLAPS



REED JOINTLESS TRACK CIRCUITS

- USE OF FEED AT BLOCK JOINT, AND OF INTERMEDIATE LOOPS.

To: Signal Works Eng.
D. of S. & T. E., Project Office
Western Tower
Reading
(f.a.o. Mr. R. Spencer)

From: Proj. Eng. (Train Detection)
D. of S. & T. E., BR HQ
Room E605, Macmillan House
Paddington

tel: 002-6587

ref: 1/206-200-30/DNB

date: 4 October 1990

ARRANGEMENTS OF "REED" TRACK CIRCUITS IN POINTS AREAS
METHODS OF DESIGNING "BRANCHED" TRACK CIRCUITS

Following our telephone conversation of today, I am providing information as to the arrangements to be used for designing the "Reed" track circuits in points sections.

I am attaching a drawing labelled TCM-05-07 which indicates the situation.

After taking account the track circuit loading effects of the Track Circuit Equipment, I.R.J., and Ballast Resistance, the arrangements shown in TCM-05-07 are to be used.

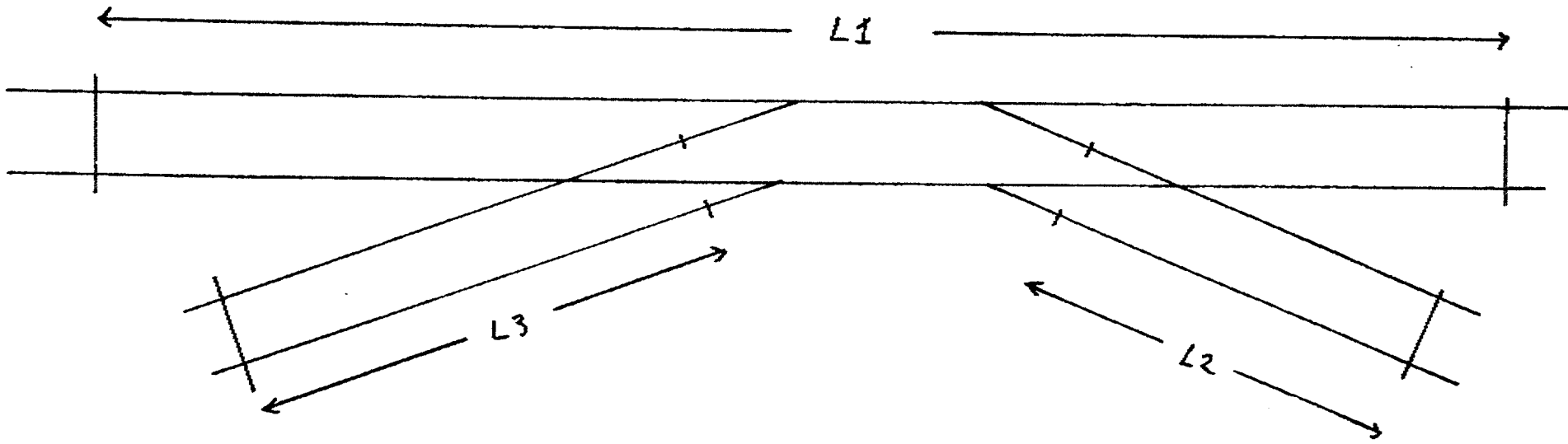
Basically, the maximum "Main" track section length is limited to 300 m. for prevention of interference, and shunt degredation with a broken traction return rail.

Extra length may be added such that the increased Ballast Resistance loading does not become excessive. This permits the "Total Length" of the "Main" section, plus all "Branch" sections does not exceed 400 m.

If the "Total Length" exceeds 400 m., then the track circuit must be Centre-Fed, up to a maximum "Total Length" of 500 m. Centre-Feeding lengths will need to be in accordance with the original instructions.

This information will be incorporated in the Track Circuit manual in due course, but will have to be issued as an additional letter of instruction at the moment.

D.Bradley



I). FOR "END-FEEDING" OF TRACK CIRCUIT

1). MAXIMUM LENGTH OF "MAIN" TRACK SECTION – L1 = 300 m.

2). TOTAL LENGTH, INCLUDING "BRANCHES" – L1+L2+L3 = 400m.

IF TOTAL LENGTH IS GREATER THAN 400m. – THEN "CENTRE-FEEDING" TO BE USED

II). TOTAL LENGTH, INCLUDING "BRANCHES" WITH "CENTRE-FEEDING" IS A MAXIMUM OF 500m.

"REED" TRACK CIRCUIT ARRANGEMENTS FOR "BRANCHED" TRACK CIRCUITS

TCM-05-07

R. SPENCER

Signalling Group Manager
Signalling Project Group
Western Tower CP402
Reading

F.A.O:- I.Harman 14.1.93

D of Eng. Research and Development
Signalling and Software Eng. Group
Signalling Systems Evaluation team
Macmillan House E605 CP7
Paddington

Copy to:-
Signalling Group Manager
Signalling Project Group
Network Technical Centre
Croydon

Signalling Equipment Engineer
Room 1103
Rail House
Crewe

Signalling Group Manager
Signalling Project Group
Hudson House
York

Signalling Group Manager
Signalling Project Group
Stanier House
Birmingham

Signalling Group Manager
Signalling Project Group (W Midlands)
The Rotunda
Birmingham

Signalling Group Manager
Signalling Project Group
Scotrail House
Glasgow

(F) TCE

Copy to: ~~G.Brown~~ CP 401
~~R.Spencer~~ CP 402
~~I.Oakes~~ CP 402

Return a copy to me

tel: 00 - 30179
fax: 00 - 30173
o/r: 206-200-30/JDN

date: 7 January 1993

REED TRACK CIRCUIT EQUIPMENT

Further to my letter of 16,10,92, I now enclose revised instructions for the High Performance Commissioning of Reed Track Circuits, revision date 7/1/93 .
This material will no doubt be eventually included in the Track Circuit Manual.

yours faithfully

J Noble

for M.G.Pollard
D of E R & D

MNE: REEDADJ3

DIR

Ref: 206-200-33

D.N.Bradley
Amended JDN

date: 19/8/92
date: 7/1/93

"REED" TRACK CIRCUITS
- "HIGH PERFORMANCE" ARRANGEMENT
- INSTRUCTIONS FOR COMMISSIONING

1). INTRODUCTION:

1.1 "Reed" track circuit equipment has been faced with a requirement to be:
- more tolerant of Traction Interference
- better at detecting Light Vehicles

To achieve this, the "Reed" track circuit equipment has been developed to provide:
- an "Adjustable Track Filter"
- the "High Performance" commissioning method

1.2 The "High Performance" arrangement of the "Reed" track circuit uses the standard Transmitter and the standard Receiver, and at the Transmitter end it may use the standard Track Filter. However, at the Receiver end the Adjustable Track Filter (RT72x3) must be used instead of the standard Track Filter, and this permits the commissioning of the Track Circuit to be more accurate. The Adjustable Track Filter has the same physical size, and external wiring orientation as the standard Track Filter, but incorporates an Adjustment Block, with Flying Leads, on its front face (permitting adjustment from the front of the unit).

1.3 The "High Performance" method of commissioning has the following features:
- adjusting the Transmitter end to give a pre-determined Feed Current (when the Rails are short-circuited)
- using a Shunt Box to adjust the Rail Voltage at the Receiver end, to a pre-determined voltage (simulating the minimum Ballast Resistance)
- adjusting the Adjustable Track Filter until the Track Relay just Picks-Up.

This method ensures that the track circuit will operate at the Minimum Ballast Resistance, while being least sensitive to Traction Interference, and most sensitive to Trainshunt.

1.4 This "High Performance" method of commissioning may be carried out without the need for Staff to be at both ends of the track circuit at the same time. The Feed End may be adjusted, and then left unattended, while the commissioning is completed at the Relay End. This should be an advantage for allocating Staff resources.

1.5 The "High Performance" arrangement is used for both "End-Fed", and "Centre-Fed" configurations.
There are three categories of configuration and length:-
- a/ Up to 300 metres End Fed.
- b/ Up to 600 metres End Fed or 500 metres Centre Fed.
- c/ Up to 1000 metres End Fed.

The Feed End arrangements and commissioning are the same for all configurations.
At the Relay Ends, there are differences in the Input Tapping connection, the Rail Voltage setting, and the Drop Shunt.

1.6 The basic Instructions for commissioning a "Reed" track circuit, as detailed in "SMS TC05", or sections 6.3.4, and 6.3.6 of the "S.R. Track Circuit Manual", or section 14 of the "BR HQ Code of Practice for Reed Track Circuits" remain, but with alterations for the new commissioning method.

1.7 A schematic plan of the testing arrangements is shown in fig.3.

2). COMMISSIONING THE FEED END (for all configurations and lengths) see fig.1:

2.1 When the Feed End is commissioned in accordance with "SMS TC05 Appendix A", the actions "A.2 - A.6" are ignored because there are no Impedance Bonds in use with the "High Performance" configuration, and actions "A.11 - A.15" are replaced by these new Instructions.
When the Feed End is commissioned in accordance with the "S.R. Track Circuit Manual", section 6.3.4., clause "e" is replaced with these new Instructions.
When the Feed End is commissioned in accordance with the "BR HQ Code of Practice" section 14.6, clauses e - g, are replaced with these new Instructions.

2.2 The new Instructions for commissioning the Feed End to the "High Performance" method are as follows:

2.2.1 Note the following equipment protection precautions
- avoid short-circuiting the output of the Power Amplifier ("RT7112" or "RT7111")
- a transient high back e.m.f. may occur if the circuit from the Adjustable Track Filter to the Rails is broken while the circuit is energised

2.2.2 If using the Adjustable Track Filter the Flying Leads to the adjustment resistances are not used at the Feed end, but may be conveniently left in the "Fine" and "Coarse" terminals Marked "0".

2.2.3 Install the wire from the Power Amplifier (terminal 1 of "RT7111" or terminal "11" of "RT7112") in the Terminal "22" of the Adjustable Track Filter.
Install a "strap" between Adjustable Track Filter Terminals "21", and "23".

2.2.4 Remove one Track Feed Link and insert a Meter capable of measuring A.C. current of up to 2 A across the link.

2.2.5 Short-circuit the Rails at the Feed End connections

2.2.6 Measure the Feed Current
- its desired value is 1.6 A.
- if it is below 1.5 A.
  - remove the "strap" between Terminals "21" and "23"
  - transfer the wire from Terminal "22" to Terminal "23" on the Adjustable Track Filter
- if it is more than 1.75 A.
  - remove the "strap" between Terminals "21" and "23"
- if it is still more than 1.75 A.
  - move the wire from Terminal "22" to Terminal "21"
- after adjustment check that the Feed Current is between 1.5 A. - 1.75 A.

2.2.7 Remove the Short-Circuit, and Meter, then replace the links.
Record the actual Feed Current and Terminal adjustment on the Track Circuit Record Card

2.3 COMMISSIONING THE RELAY END (separate values for various configurations and lengths) see fig.2:

2.3.1 When the track circuit is being commissioned in accordance with "SMS TC05 Appendix A", actions "A.20 - A.27" are omitted, and replaced with the following Instructions.
When the track circuit is being commissioned in accordance with the "S.R. Track Circuit Manual", the clauses 6.3.6 "f", "g", and "h" are omitted, and replaced by the following Instructions.
When the track circuit is being commissioned in accordance with the "B.R. HQ Code of Practice", clauses 14.7 "d", "e", and "f" are omitted, and replaced by the following Instructions.

2.3.2 Check that the Flying Lead from the Track Cable is connected to the Terminal appropriate to the Channel frequency.
Check that the other Flying Lead from the Track Cable is connected to the correct terminal:-

a/ Terminal "21" for the "END-FED" arrangement up to 300 metres.
b/ Terminal "22" for the "END-FED" arrangement up to 600 metres or the "CENTRE-FED" arrangement up to 500 metres.
c/ Terminal "23" for the "END-FED"arrangement up to 1000 metres.

2.3.3 Connect a Shunt Box between the Rails at the location of the Tail Cable connections.
Connect a Meter on an A.C. range capable of reading 3.0 V., between the rails at the same location.

2.3.4 Use the Shunt Box to adjust the Rail Voltage to the following nominal voltages:

END-FED up to 300 metres:- 2.2 V (not less than 2.2 and not more than 2.4)
END-FED up to 600 metres or CENTRE-FED up to 500 metres:-
1.5 V (not less than 1.5 and not more than 1.6)
END-FED up to 1000 metres:- 1.0 V (not less than 1.0 and not more than 1.1)

2.3.5 Use the Adjustment Resistances on the Adjustable Track Filter to make the Track Relay just Pick Up.

The Adjustment Resistances are in the form of two chains marked

"Fine"				"Coarse"				
"0"	"1"	"2"	"3"	"0"	"4"	"8"	"12"	"16"

The figures indicate the relative (but not actual) values of the Adjustment Resistance associated with that Terminal.

Initially the Flying Leads should be connected to the "Fine"-"0" and "Coarse"-"16" Terminals.
The Track Relay should not be picked up at this stage.

The "Coarse" Flying Lead is then stepped down to the "12", "8", "4", and "0" Terminals until the Track Relay picks up.

The "Fine" Flying Lead is then advanced from the "0" Terminal to the "1", "2", and "3" Terminals until the Track Relay fails to pick up.
The "Fine" Flying Lead is then stepped back to its previous Terminal, and the commissioning is completed.
In some circumstances the advance of the "Fine" Flying Lead will not prevent the Track Relay from picking up. In this case, the "Fine" Flying Lead is put back to the "0" Terminal, and the "Coarse" Flying Lead is stepped up to the next highest Terminal.

2.3.6 The track circuit is now Drop Shunt tested.

When being Drop Shunt tested, there is a delay in the response of "Reed" Track Circuits, especially near the operating thresholds.

The stepping of the shunt box resistances causes an overshoot in the recorded value.
Thus the recorded Drop shunt value is always lower than the actual value and the recorded Pickup Shunt is always higher than the actual value. This makes the "spread" between Pick Up and Drop Away seem higher than it actually is.

For best results step the shunt box quickly to take the initial readings. Then repeat measurements in the region of the drop shunt allowing 5 seconds between each step.

For the 300 metre END-FED arrangement, the Drop Shunt must be not less than 1.2 ohms and not more than 3 ohms.

For the 600 metre END-FED arrangement or the 500 metre CENTRE-FED arrangement, the Drop Shunt must not be less than 0.8 ohm and not more than 3 ohms.

For the 1000 metre END-FED arrangement, the Drop Shunt must be not less than 0.5 ohms and not more than 3 ohms.

It is quite possible that the previous adjustment will leave the track circuit with a Drop Shunt lower than that specified above. This might happen if the particular track circuit is short and in a good condition for energisation (high feed current, high ballast resistance, etc.)

In this case, the Drop Shunt is increased by increasing the value of the Adjustment Resistance, by moving the Flying Leads to higher value Terminals.

The Drop Shunt test is the governing criterion, and overrules any setting achieved with the Rail Voltage adjustment of the previous section.

2.3.7 The following information is recorded on the Track Circuit Record Card:

- Flying Lead Terminals
- Drop Shunt

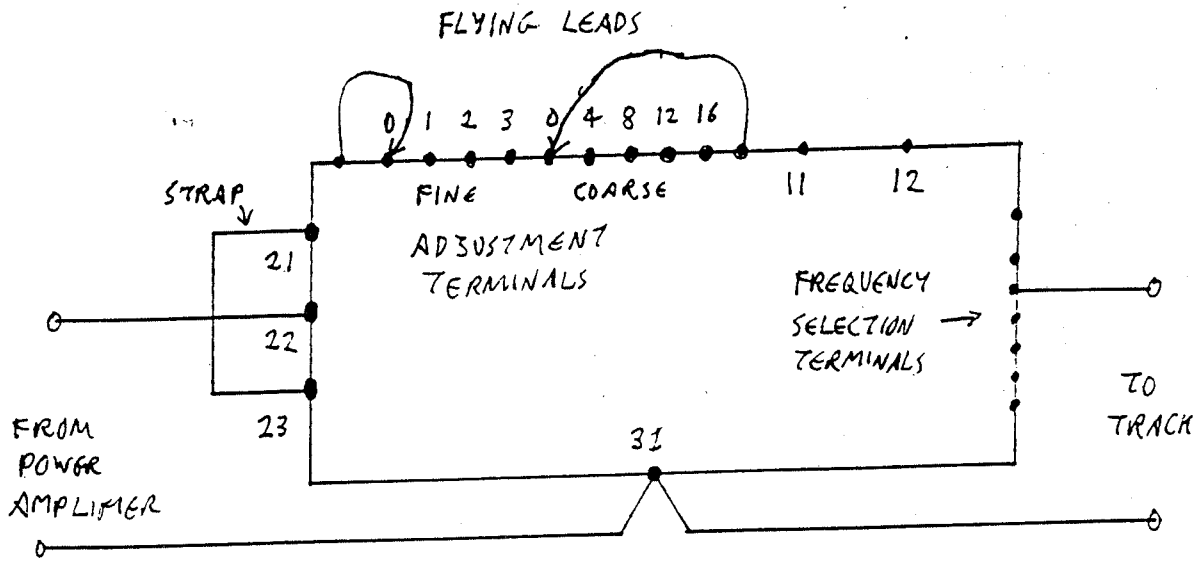


FIG. I. ADJUSTABLE TRACK FILTER ARRANGEMENT AT FEED END

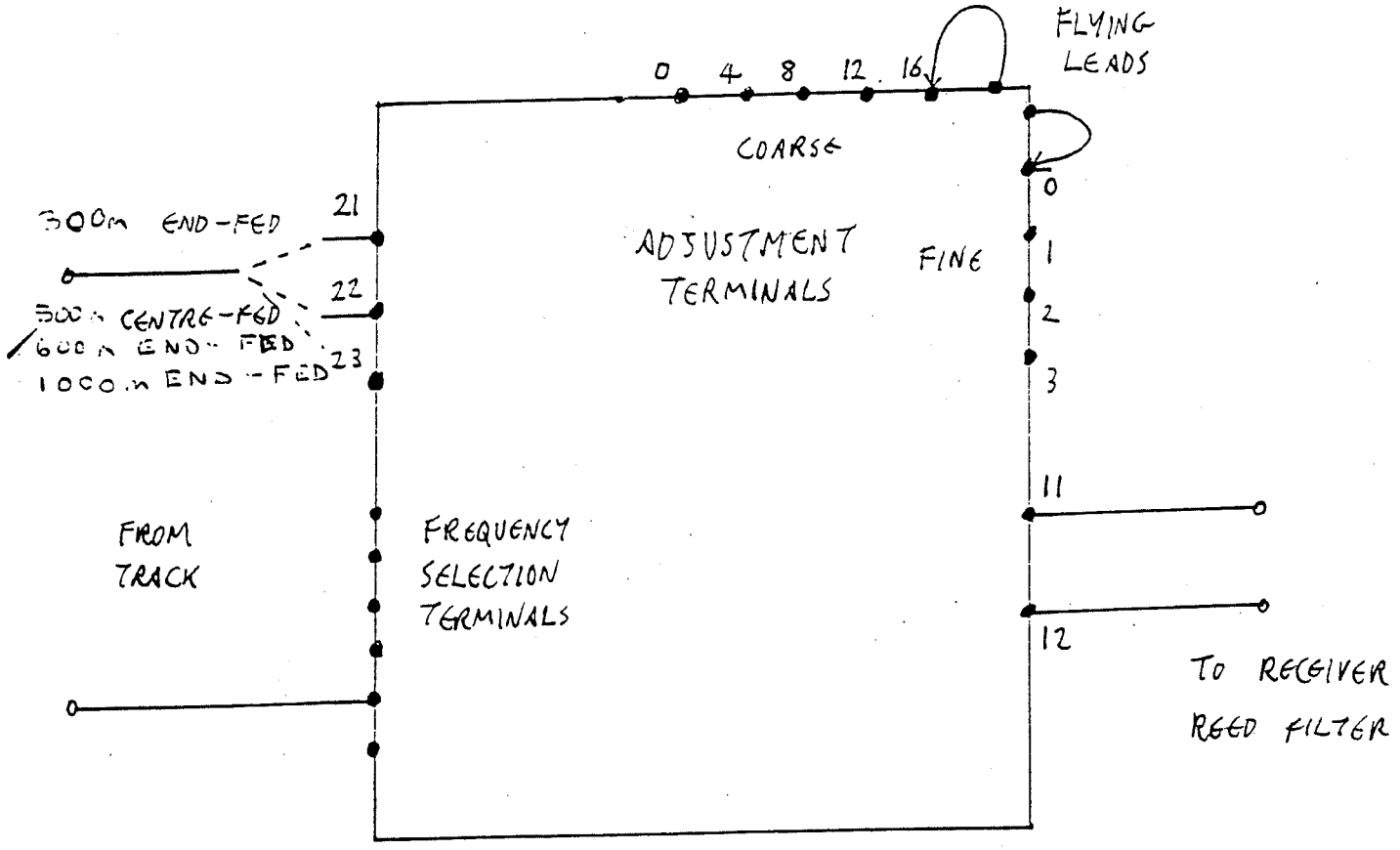


FIG. 2. ADJUSTABLE TRACK FILTER ARRANGEMENT AT RECEIVER END

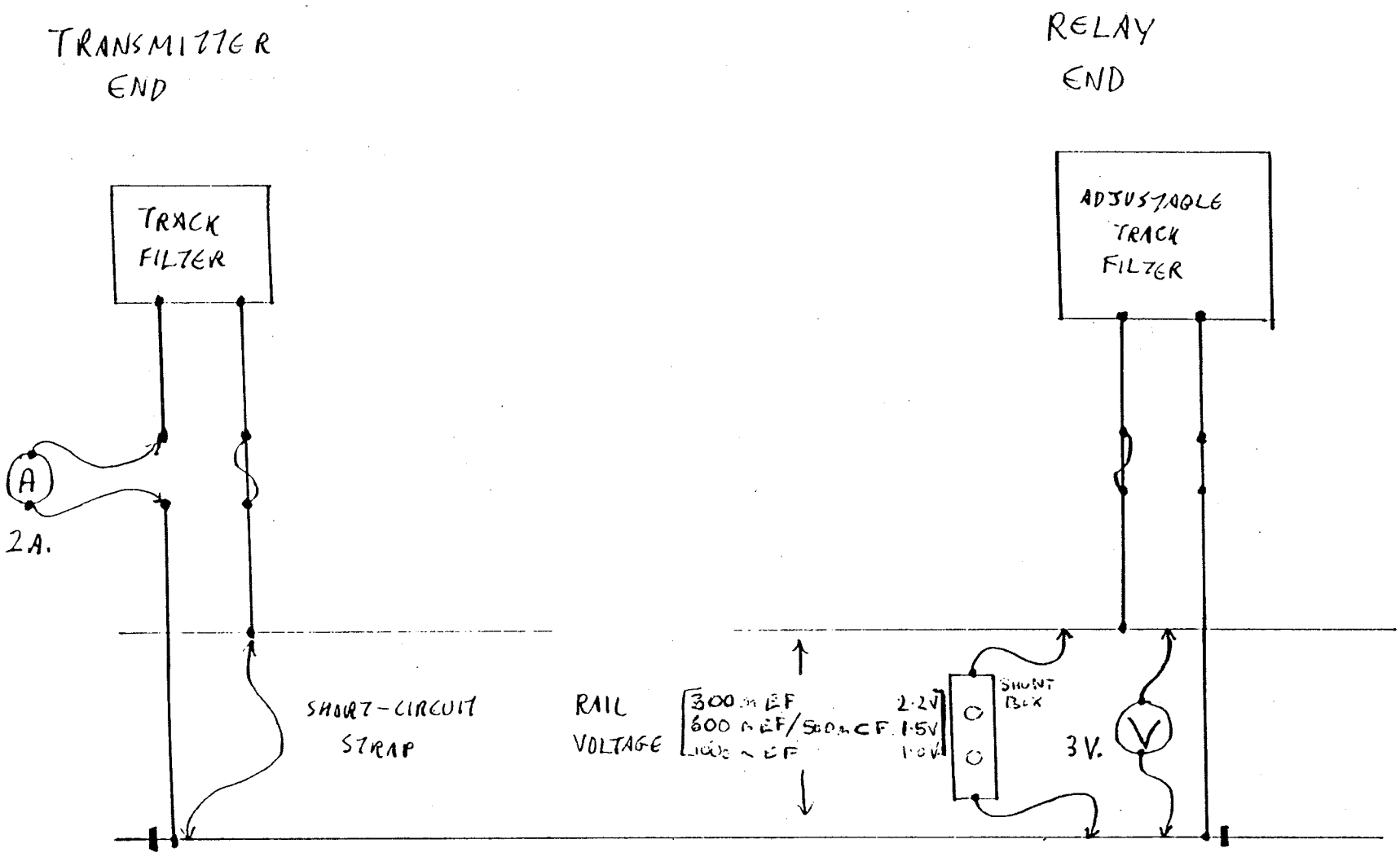
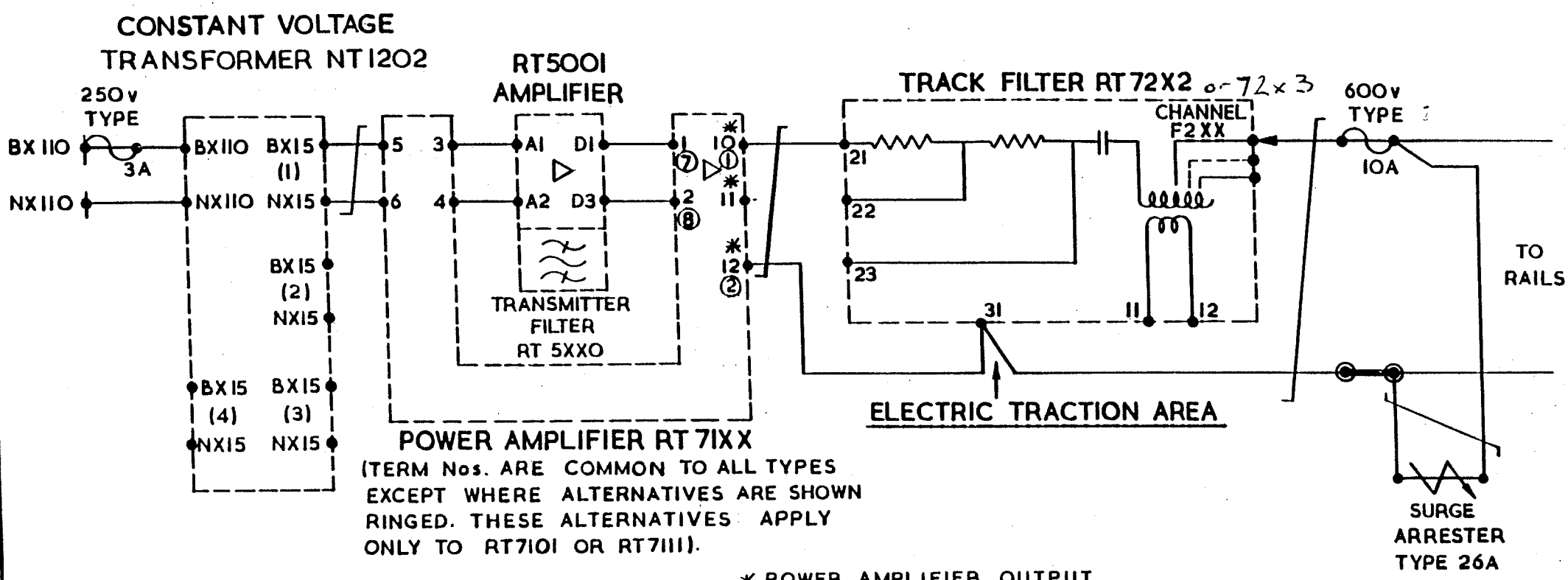


FIG.3. PRACTICAL COMMISSIONING ARRANGEMENTS



NOTES.

'X X' ON THE TRANSMITTER FILTER NUMBER DENOTES THE LAST TWO DIGITS OF THE CHANNEL NUMBER.

DENOTES TWISTED PAIR

THE CENTRE ELECTRODE OF THE SURGE ARRESTER MUST NOT BE EARTHED

* POWER AMPLIFIER OUTPUT

FOR DOUBLE RAIL OR IMPEDANCE BONDED TCS, USE TERMS 10 & 12 ON RT7112 OR 1 & 2 ON RT7101. FOR NON IMPEDANCE BONDED JOINTED TCS, USE TERMS 11 & 12 ON RT7112 OR 1 & 2 ON RT7111.

DRAWN BY.	
TRACED BY. JB.	
CHECKED BY. CJB	

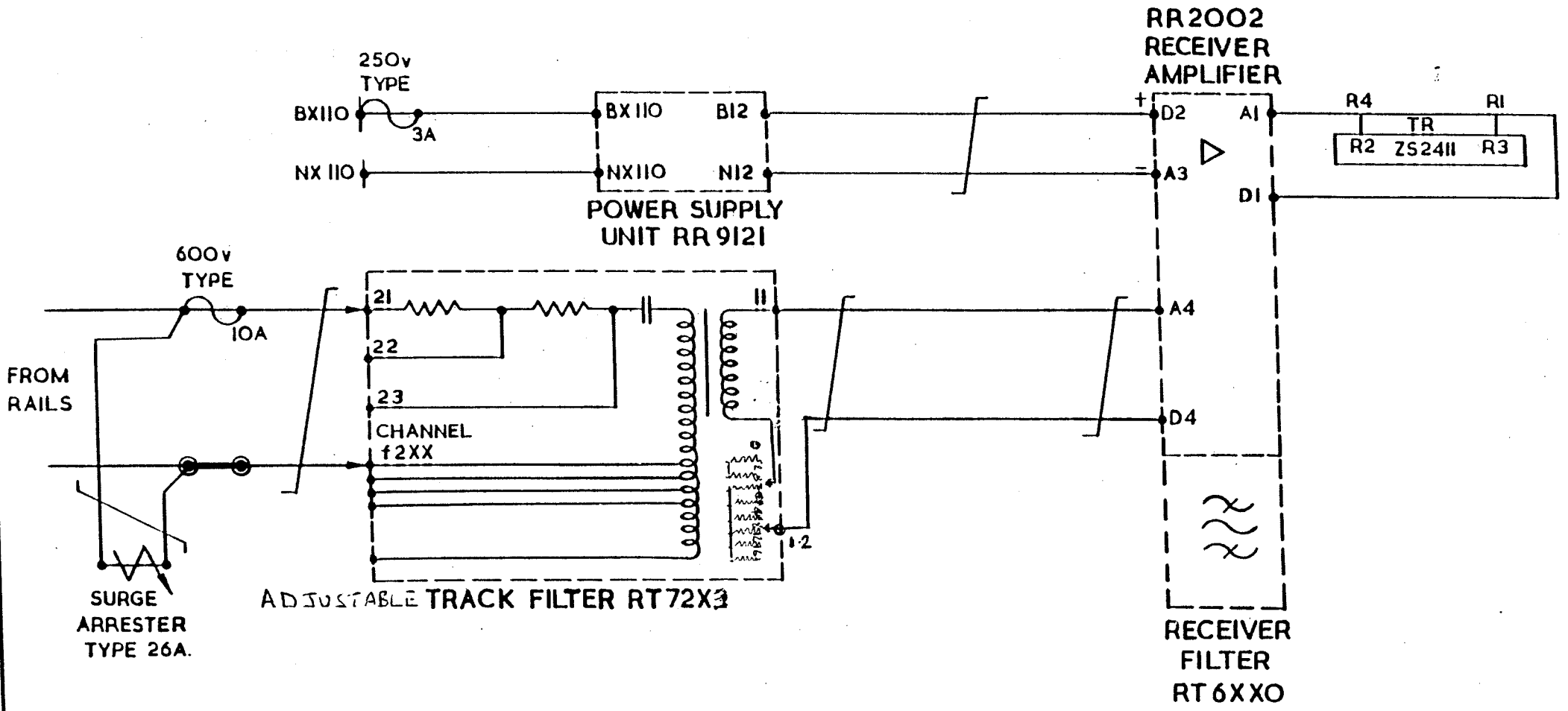
Southern Region
Chief Signal and Telecommunications Engineer

REED TRACK CIRCUITS
TRANSMITTER EQUIPMENT

British Rail

Asst Chief S & T Engineer

No. E39-52/1



NOTES:-

'XX' ON THE RECEIVER FILTER NUMBER DENOTES THE LAST TWO DIGITS OF THE CHANNEL NUMBER.

≠ DENOTES TWISTED PAIR.

THE CENTRE ELECTRODE OF THE SURGE ARRESTER MUST NOT BE EARTHED.

DRAWN BY.	Southern Region Chief Signal and Telecommunications Engineer
TRACED BY. JG.	
CHECKED BY. GH.	

REED TRACK CIRCUITS

JOINTED RECEIVER EQUIPMENT

HIGH PERFORMANCE COMMISIONING

British Rail

for Chief S & T Engineer

No. E 39-52/3

B