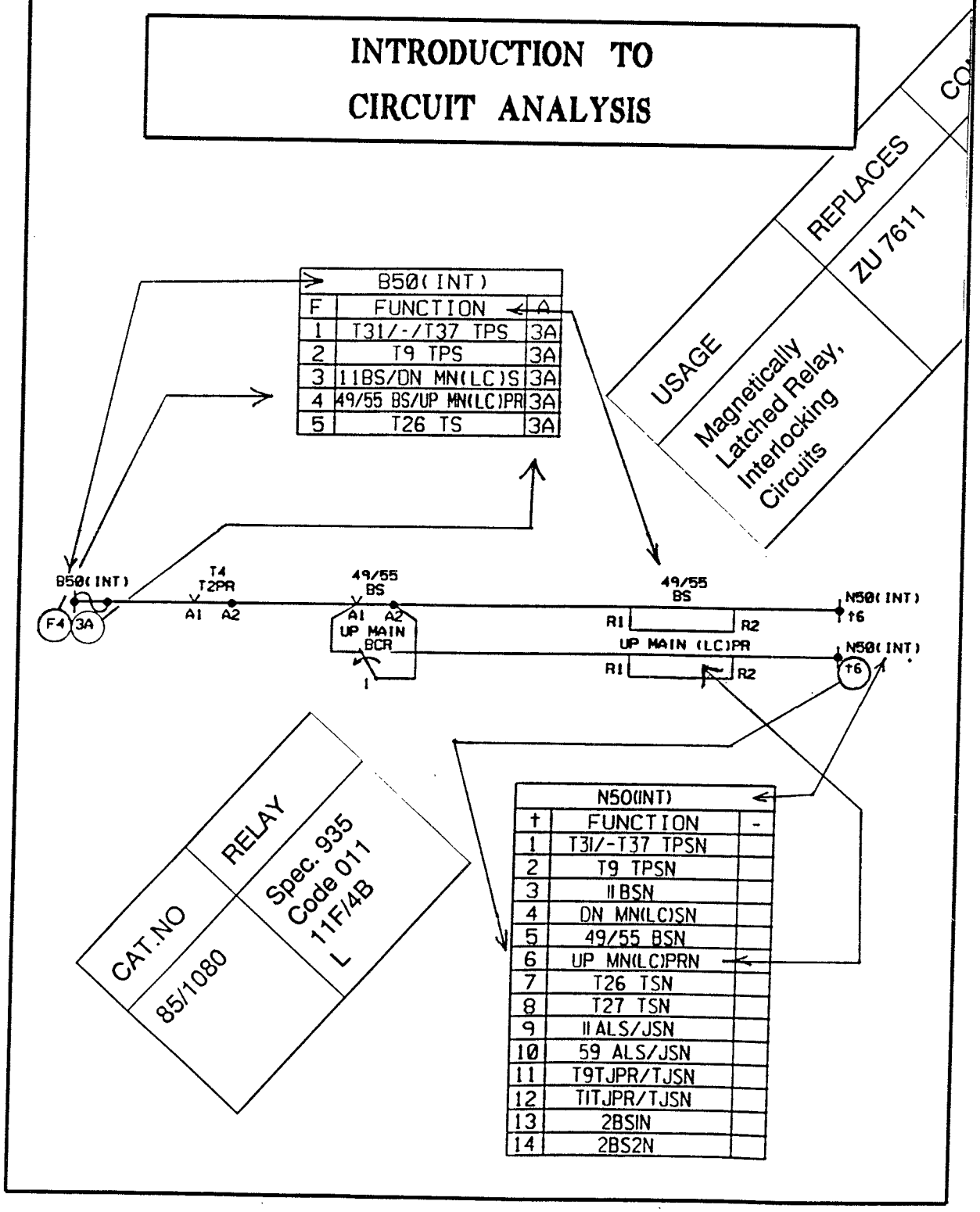
CENTRAL SERVICES
SIGNALLING PROJECTS GROUP

INTRODUCTION TO CIRCUIT ANALYSIS



INTRODUCTION TO CIRCUIT ANALYSIS

INTRODUCTION

In virtually every set of signalling wiring diagrams you will come across in your railway careers, you are likely to see some form of "analysis", whether it is "Lever Lock Analysis" or "Relay Contact Analysis".
To be able to apply circuit analysis you need to understand what analysis is and how and why it is provided.

To begin with, let us see where analysis comes in the chain of events leading to the issuing of the design details for a scheme.

After a plan for a particular scheme has gone through the necessary estimating and approval channels, it eventually ends up on the designer's desk. After familiarising himself with the job he will proceed to produce a set of Electrical Control tables and Interlocking Figures in accordance with the laid down principles.

When the designer is happy with the contents of the control tables he then designs the electrical circuitry to strictly adhere to them. The designer also has to take into account circuits that do not appear in the control tables, i.e. certain repeating circuits, illuminated diagrams, filament failure circuits, block bell circuits, signal and point indication circuits, power arrangements etc.

It is at this point that the designer now has to produce or amend any analysis affected by his wiring details such as fuses, terminals, cable links, etc.

Below is a list of the types of analysis you are likely to see/amend or produce:-

1. Relay Rack Profile Layout
2. Relay Contact Analysis
3. Lever Analysis
4. Fuse Analysis
5. Terminal Analysis
6. Cable Core Plan
7. Cable Distribution
8. Cable Analysis (incoming cable/signalbox to relay room).

The above is only a guide and you must appreciate that you may come across other forms of analysis at various interlockings (e.g. IDF tag block analysis - Trent/Saltley PSB's).

We will now attempt to proceed through the list of eight most common analysis sheets, what they tell the designer/installer or technician and how you amend or produce them.

continued

1. RELAY RACK PROFILE LAYOUT (FIGURE 1)

(A) Relay Space

This is the space allocated for each individual relay. In the relay space provided we write in:-

(a) Relay Name e.g. 354(1M) NLR
(b) Relay Spec e.g. 935
(c) Relay Code e.g. 011
(d) Relay Contact Configuration e.g. 11F 4B

(B) Relay Rack

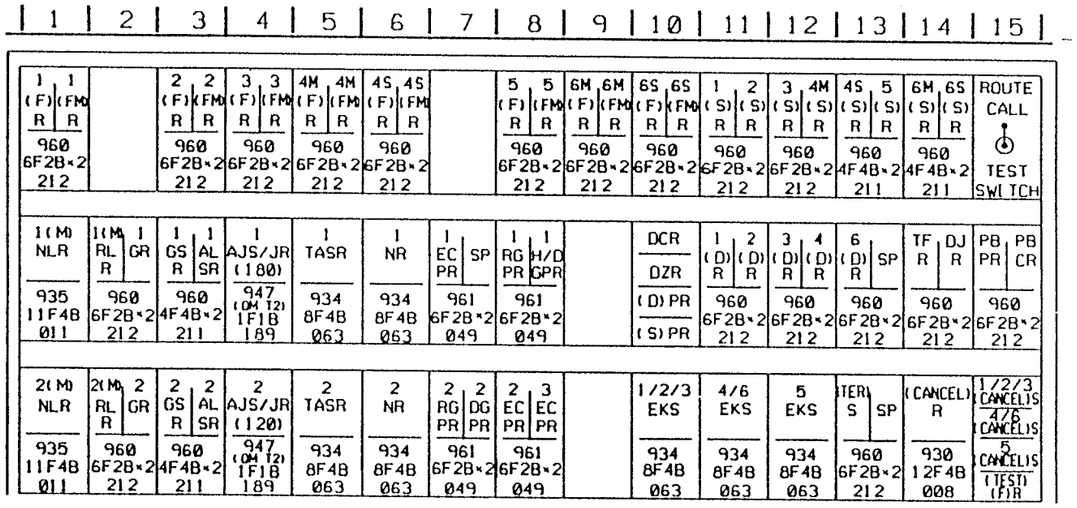
Figure 1 shows two relay racks and how they would be labelled:-
Rack A - Lefthand Rack
Rack B - Righthand Rack

The profile drawing is as viewed from the Relay Side of the Rack.

(C) ROW

Generally new Relay Racks have seven rows of relays. As a rule try to avoid using the bottom row until you have to.

Try to lay your relays out in some sort of sensible order. See the diagram opposite.



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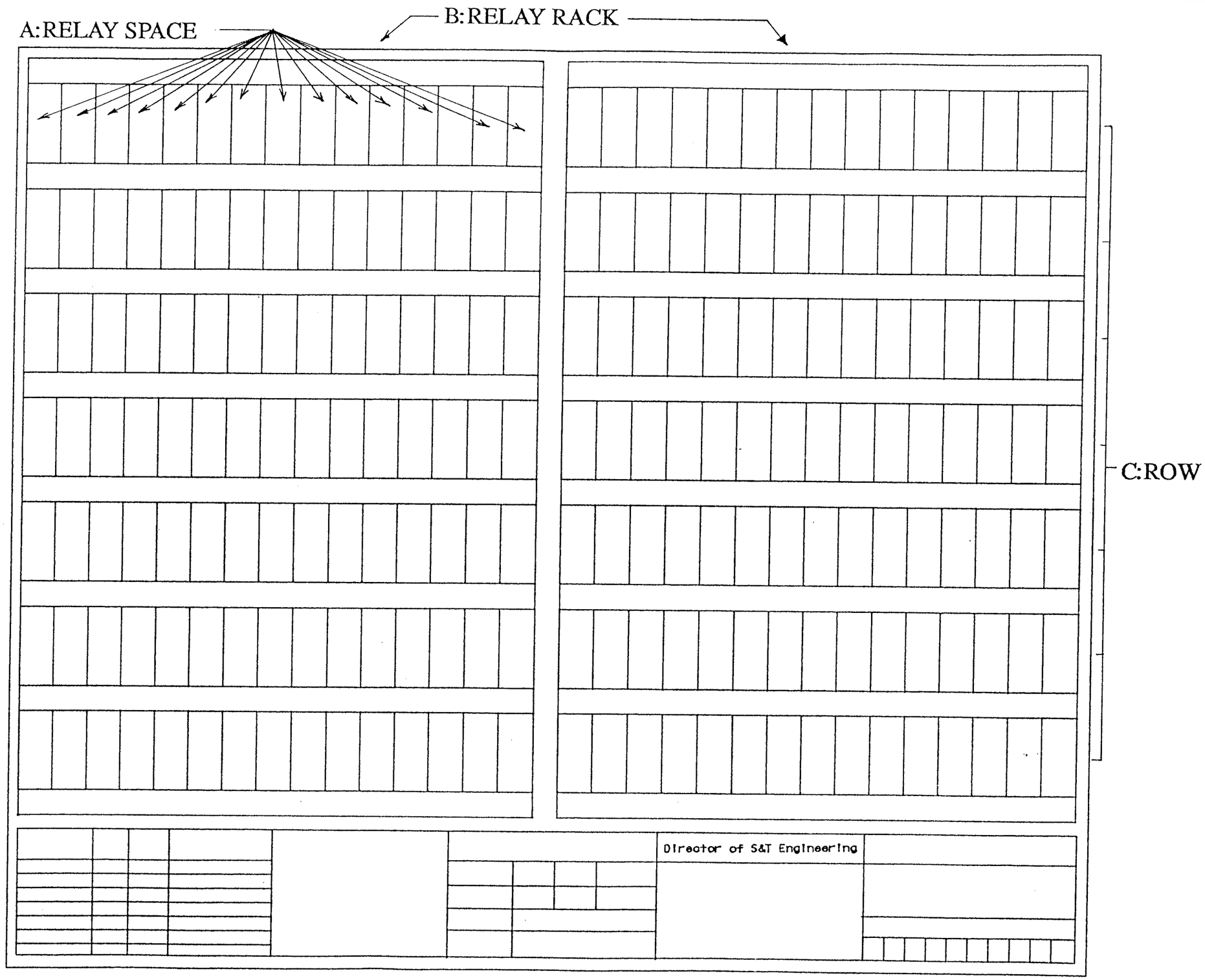

FIGURE 1

continued

2. RELAY CONTACT ANALYSIS (FIGURES 2 & 3)

(A) Name of Relay (e.g. 354 (1M)NLR)

Self-explanatory, just remember to duplicate information at both ends of the sheet.

(B) Specification of that Relay (e.g. 935)

In the spec column you fill in the BR Relay Specification Code. So, if in your wiring diagrams you have shown a slow to pick up relay, then you must choose the correct relay spec i.e. Spec 933. It is most important that you select the correct relay. One document to refer to when deciding what relay you need to use is the "Standard Signalling Equipment Catalogue Handbook". BR13439/85 (See the extract which follows).

A.1.5. 50V DC LATCHED RELAYS

CAT.NO	RELAY	USAGE	REPLACES	COMMENTS
85/1080	Spec. 935 Code 011 11F/4B L	Magnetically Latched Relay, Interlocking Circuits	ZU 7611	

Page A5

(C) Relay Pin Code (e.g. 011)

Relay plugboard bases are configured so that only relays of that type intended can be fitted.

The relay unit is configured by a number of pins protruding from it. Each type of relay has a different pattern of pins. The bases have corresponding holes. The patterns are chosen so that it is impossible to plug an unsafe type of relay into a particular base.

continued

FIGURE 2

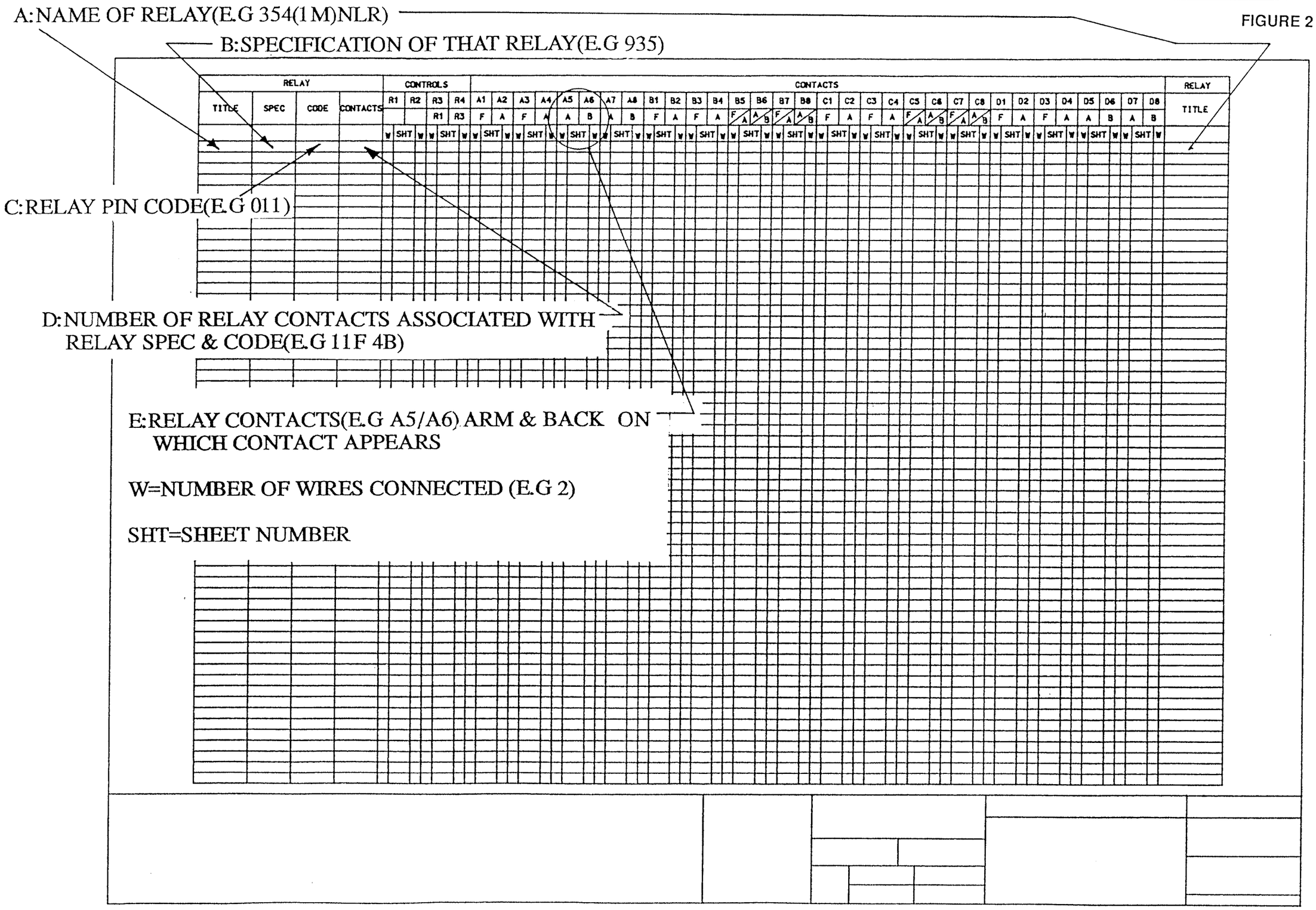

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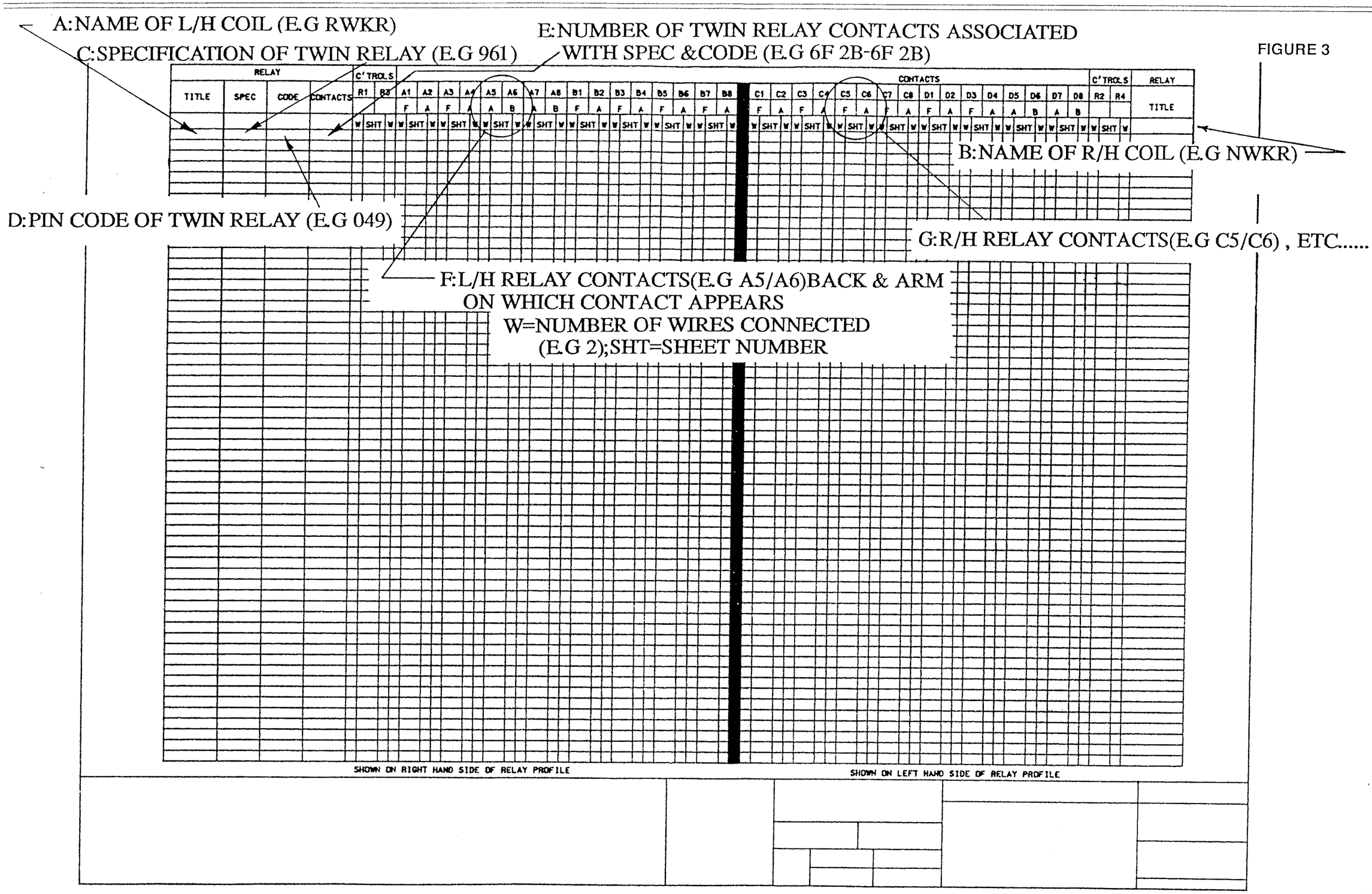
FIGURE 3



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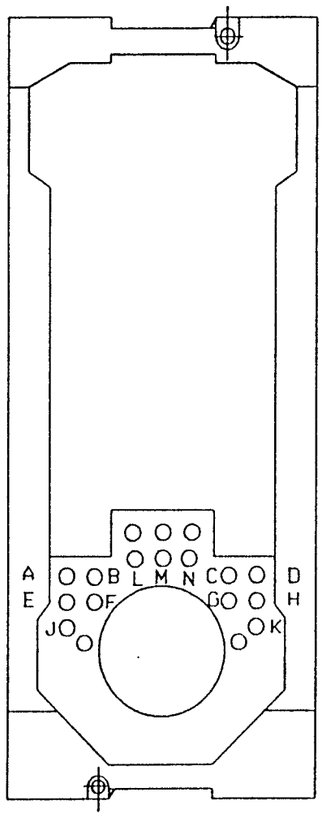
The diagram below (W.B and S.C º BR Standard Plugboard) shows the view of a base from the relay side. There are 13 hole positions. Each hole position has a letter code shown. The hole positions are marked on the relay bases by dimples which act as drilling guides for the installation staff.

The relay pin code takes the form of a three or four figure number. For example, the code for a 50 volt DC Neutral Line Relay (A.C. Immune) is 023.

The pin code number can be converted into the hole positions to be drilled by referring to the tabulations contained in the Signalling Installation Handbook BR 13439/75, an extract of which follows this text. For example, code 023 requires holes A, B, E, F, and H.

You will appreciate that there are a large number of registration codes for BR Miniature relays and you as the designer are putting information on the diagrams which will tell installation staff which holes are required to be drilled. Remember incorrect information could result in a lot of wasted relay plugboards.

HOLE LETTER CODES
W.B.& S.Co. (BR STANDARD PLUGBOARD)



VIEWED FROM FRONT (RELAY) SIDE

HOLES WITHOUT LETTERS ADJACENT ARE NOT USED FOR RELAY CODES.

BRITISH RAILWAYS — Signal & Telecommunications Engineering Department
SIGNALLING INSTALLATION HANDBOOK
No. SIH 2C 10
Page 02
Issue 01
Date 09/90

RELAYS : PLUGBOARD CONFIGURATION

REGISTRATION CODES FOR BR MINIATURE RELAYS

Code		Code		Code		Code	
001	ABCDE	051	A CDE J	101	A C FG K	151	BC GHJ
002	ABCD F	052	A CD F J	102	A C F H K	152	B DEF J
003	ABC EF	053	A CD G J	103	A C F JK	153	B DE G J
004	AB DEF	054	A CD HJ	104	A C GH K	154	B DE HJ
005	A CDEF	055	A C EF J	105	A C G JK	155	B D FG J
006	ABCD G	056	A C E G J	106	A C HJK	156	B D F HJ
007	ABC E G	057	A C E HJ	107	A DEF K	157	B D GHJ
008	ABC FG	058	A C FG J	108	A DE G K	158	B EFG J
009	AB DE G	059	A C F HJ	109	A DE H K	159	B EF HJ
010	AB D FG	060	A C GHJ	110	A DE JK	160	B E GHJ
011	AB EFG	061	A DEF J	111	A D FG K	161	B FGHJ
012	A CDE G	062	A DE G J	112	A D F H K	162	BCDE K
013	A CD FG	063	A DE HJ	113	A D F JK	163	BCD F K
014	A C EFG	064	A D FG J	114	A D GH K	164	BCD G K
015	A DEFG	065	A D F HJ	115	A D G JK	165	BCD H K
016	ABCD H	066	A D GHJ	116	A D HJK	166	BCD JK
017	ABC E H	067	A EFG J	117	A EFG K	167	BC EF K
018	ABC F H	068	A EF HJ	118	A EF H K	168	BC E G K
019	ABC GH	069	A E GHJ	119	A EF JK	169	BC E H K
020	AB DE H	070	A FGHJ	120	A E GH K	170	BC E JK
021	AB D F H	071	ABCD K	121	A E G JK	171	BC FG K
022	AB D GH	072	ABC E K	122	A E HJK	172	BC F H K
023	AB EF H	073	ABC F K	123	A FGH K	173	BC F JK
024	AB E GH	074	ABC G K	124	A FG JK	174	BC GH K
025	AB FGH	075	ABC H K	125	A F HJK	175	BC G JK
026	A CDE H	076	ABC JK	126	A GHJK	176	BC HJK
027	A CD F H	077	AB DE K	127	BCDEF	177	B DEF K
028	A CD GH	078	AB D F K	128	BCDE G	178	B DE G K
029	A C EF H	079	AB D G K	129	BCD FG	179	B DE H K
030	A C E GH	080	AB D H K	130	BC EFG	180	B DE JK
031	A C FGH	081	AB D JK	131	B DEFG	181	B D FG K
032	A DEF H	082	AB EF K	132	BCDE H	182	B D F H K
033	A DE GH	083	AB E G K	133	BCD F H	183	B D F JK
034	A D FGH	084	AB E H K	134	BCD GH	184	B D GH K
035	A EFGH	085	AB E JK	135	BC EF H	185	B D G JK
036	ABCD J	086	AB FG K	136	BC E GH	186	B D HJK
037	ABC E J	087	AB F H K	137	BC FGH	187	B EFG K
038	ABC F J	088	AB F JK	138	B DEF H	188	B EF H K
039	ABC G J	089	AB GH K	139	B DE GH	189	B EF JK
040	ABC HJ	090	AB G JK	140	B D FGH	190	B E GH K
041	AB DE J	091	AB HJK	141	B EFGH	191	B E G JK
042	AB D F J	092	A CDE K	142	BCDE J	192	B E HJK
043	AB D G J	093	A CD F K	143	BCD F J	193	B FGH K
044	AB D HJ	094	A CD G K	144	BCD G J	194	B FG JK
045	AB EF J	095	A CD H K	145	BCD HJ	195	B F HJK
046	AB E G J	096	A CD JK	146	BC EF J	196	B GHJK
047	AB E HJ	097	A C EF K	147	BC E G J	197	CDEFG
048	AB FG J	098	A C E G K	148	BC E HJ	198	CDEF H
049	AB F HJ	099	A C E H K	149	BC FG J	199	CDE GH
050	AB GHJ	100	A C E JK	150	BC F HJ	200	CD FGH

BR 13439/75

continued

(D) **Number of Relay Contacts Associated with Relay Spec and Code (e.g. 11F 4B)**

Self-explanatory, but be aware that different relay spec/codes have different contact configurations.

(E) **Relay Contacts (e.g.A6/A5) Back and Arm on which Contact Appears: W = Number of Wires Connected (e.g. 2): SHT = Sheet Number**

This indicates the contact number, whether it is a front contact or a back contact and also which relay contact number is the arm or contact. The W-SHT-W indicates on which sheet in the wiring diagrams the contact is used and also how many wires are connected to the arm/contact. A maximum of two wires per connection, any more and further investigation should be made.

All the text so far discussed on Relay Contact Analysis has been with regards to Figure 2. Figure 2 is a standard relay analysis sheet for single coil relays whereas Figure 3 is utilised for twin coil relays eg. BR Specification 961 Code 049. Contact Configuration 2 x 6F.2B.

continued

3. LEVER ANALYSIS (FIGURE 4)

(A) **Lever No of which the Electric Lock or Circuit Controller is attached.**

Self-explanatory.

(B) **Sheet No on which the Electric Lock Appears in the Wiring Diagrams.**

Self explanatory.

(C) **"Cut for" indicates how the Lock Slide is cut (e.g. NBDR, N, R, etc).**

(D) **Slide No indicates type of Lock (e.g. "H" type), in normal (I/N) or out normal (O/N) and finally the length of stroke (e.g. 6" etc)**

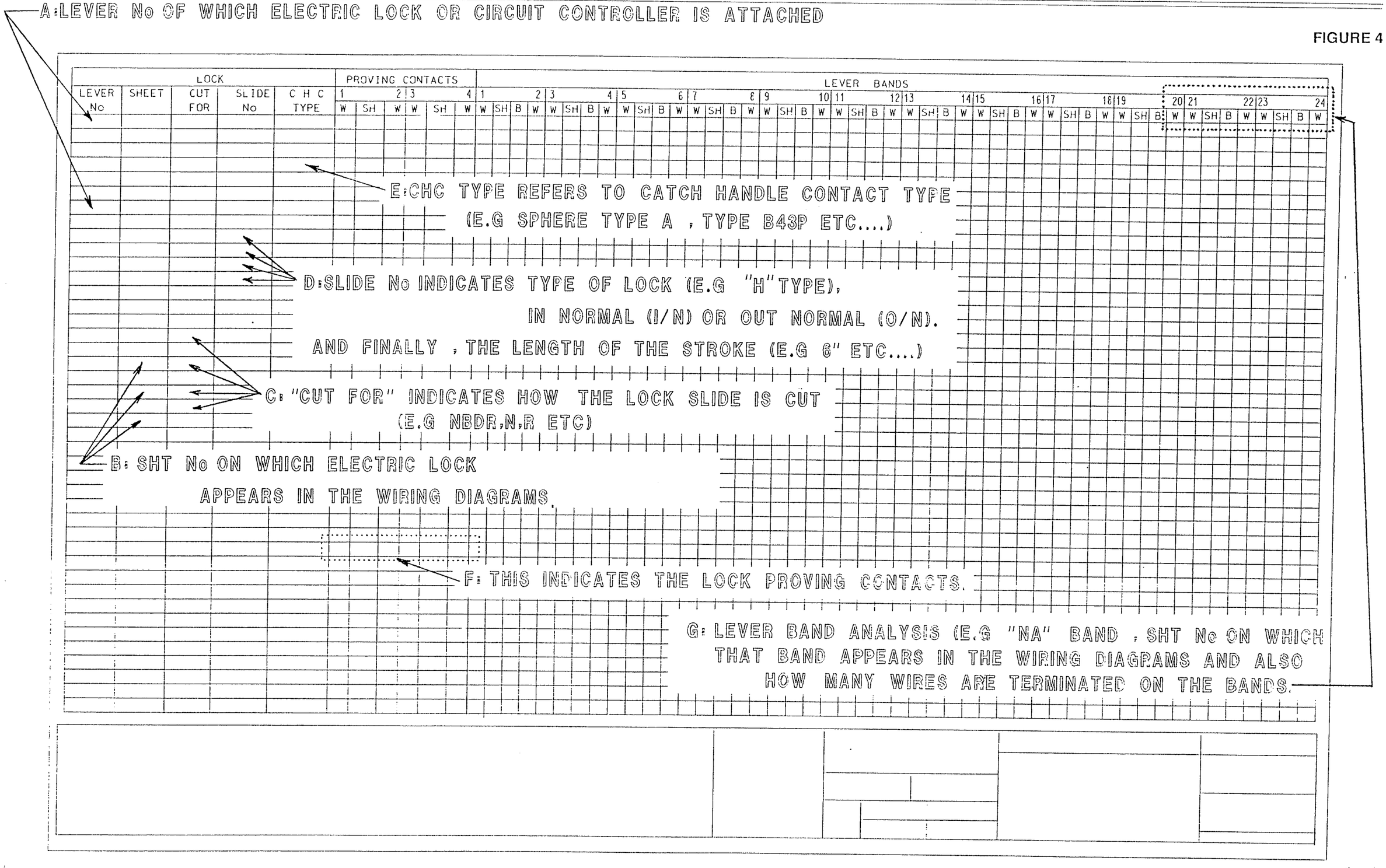
The table opposite lists the common slide numbers with their relevant information.

TABLE

HORIZONTAL "H" TYPE			VERTICAL "U" TYPE	
SLIDE	TYPE	STROKE	SLIDE	TYPE (ALL 8")
200	O/N OR I/R	6"	48	O/N OR I/R
201	O/C	6"	49	O/C
202	O/R OR I/N	6"	51	O/R OR I/N
203	I/C	6"	53	O/NR OR I/NR
204	OR I/NR	6"	55	O/NBDR OR I/NBDR
205	O/NBDR OR I/NBDR	6"	57	O/NB
206	O/NB	6"	58	I/C
207	I/NB	6"	60	I/B
208	O/N	9.5"	118	I/B & O/D
209	O/C	9.5"	119	O/B & I/D
210	O/R	9.5"	120	I/N B-R
211	I/C	9.5"	121	O/N B-R
212	O/NR	9.5"	122	O/NC
213	O/NBDR	9.5"	123	I/NC
214	O/NB	9.5"		
215	I/NB	9.5"		
216	I/B	6"		
217	O/B	6"		
218	I/B	9.5"		
219	O/B	9.5"		
220	I/N B-R	6"		
221	O/N B-R	6"		
222	I/N B-R	9.5"		
223	O/N B-R	9.5"		
224	O/NC	6"		
225	I/NC	6"		
226	O/NC	9.5"		
227	I/NC	9.5"		

continued

FIGURE 4



continued

Type B

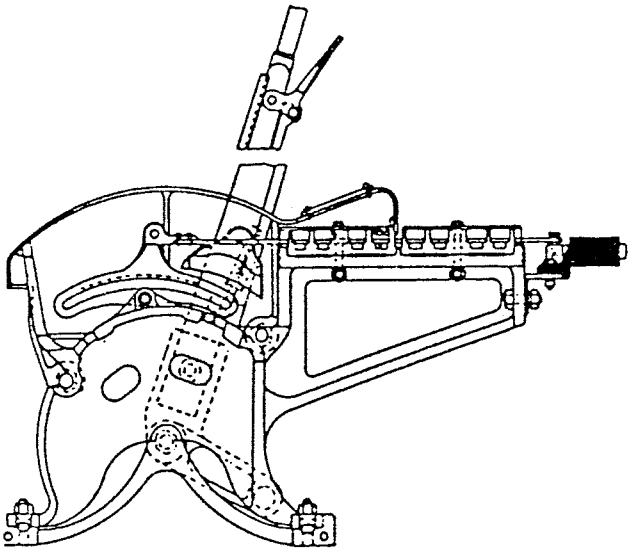
(Mounted behind tappet). Made "N to R" or "R to N" (catch handle grasped). Midland Tappet and Tumbler, and pre-1943 frame.

Type B43P

As Type B. Made "N to R", "R to N" - standard 1943 frame.

Type B43 NR

As type B43P but made one contact "N" and one contact "R" (catch handle not held).



Type B1

Made "N to R" or "R to N" (catch held down) LNW Tappet.

FRAME	(N) LOCK	(R) LOCK	(N&R) LOCK
LNW Tappet	C	B1	B1
LNW Tumbler	C	A	A
L&Y	C	A	A
Cheshire Lines	C	A	A
Midland Tappet	B	B	B
Midland Tumbler	B	B	B
Pre 1943 Frame	B	B	B
Standard 4 1/2 (1943)	B43	B43	B43

continued

(F) **This indicates the Lock proving contacts**

This column indicates the lock proving contacts in use, on which sheet in the wiring diagrams they are wired and as with the relay contact analysis, the number of wires terminated.

If the control tables make it necessary for electric lever locks to be provided, then that lock should **always** be proved effective by inclusion of lock down proving contacts in every route for which it seeks to provide protection.

Scrutinise your lock analysis sheet, if lever locks exist for which no lock provers have been used you have probably made an error!

By exception, there can be situations in which there is no place to prove lever locks, but remember this is fairly rare, and requires further investigation.

(G) **Lever band analysis (e.g. "NA" band, sheet No on which that band appears in the wiring diagrams and also how many wires are terminated on each individual lever band).**

Self-explanatory.

continued

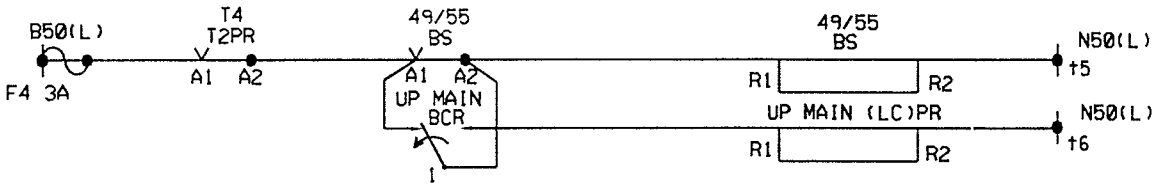
4. FUSE ANALYSIS (FIGURE 5)

(A) Supply (e.g. B50 (L))

This tells the person reading the diagrams what supply is on that particular "POSITIVE BUSBAR". You should have some fuse analysis for each "POSITIVE BUSBAR" at an installation.

(B) Size of Fuse Protecting Circuit (e.g. 3A)

In this column you fill in what size of fuse is protecting the circuit that has been designed. For example, the diagram below:-



B50(L)		
F	FUNCTION	A
1	T31/-/T37 TPS	3A
2	T9 TPS	3A
3	11BS/DN MN(LC)S	3A
4	49/55 BS/UP MN(LC)PR	3A
5	T26 TS	3A

shows a 3 AMP fuse, so this is what you would insert in the column for fuse No 4 on the B50(L) Busbar. Generally, signalling circuits are protected by 3A fuses but this is not always the case so beware!

(C) Name of Relay Function Which Fuse is Protecting (e.g. 2HR)

In the function column we fill in the name of the piece of signalling equipment to which the fuse is affording protection - i.e. 2HR, AATF, 6 (NBDR)L etc.

Attached is a typical example of a signalling circuit and how you would fill in the fuse analysis sheet once you have designed the circuit.

You should always try to leave a percentage of spare capacity for future work at the installation.

continued

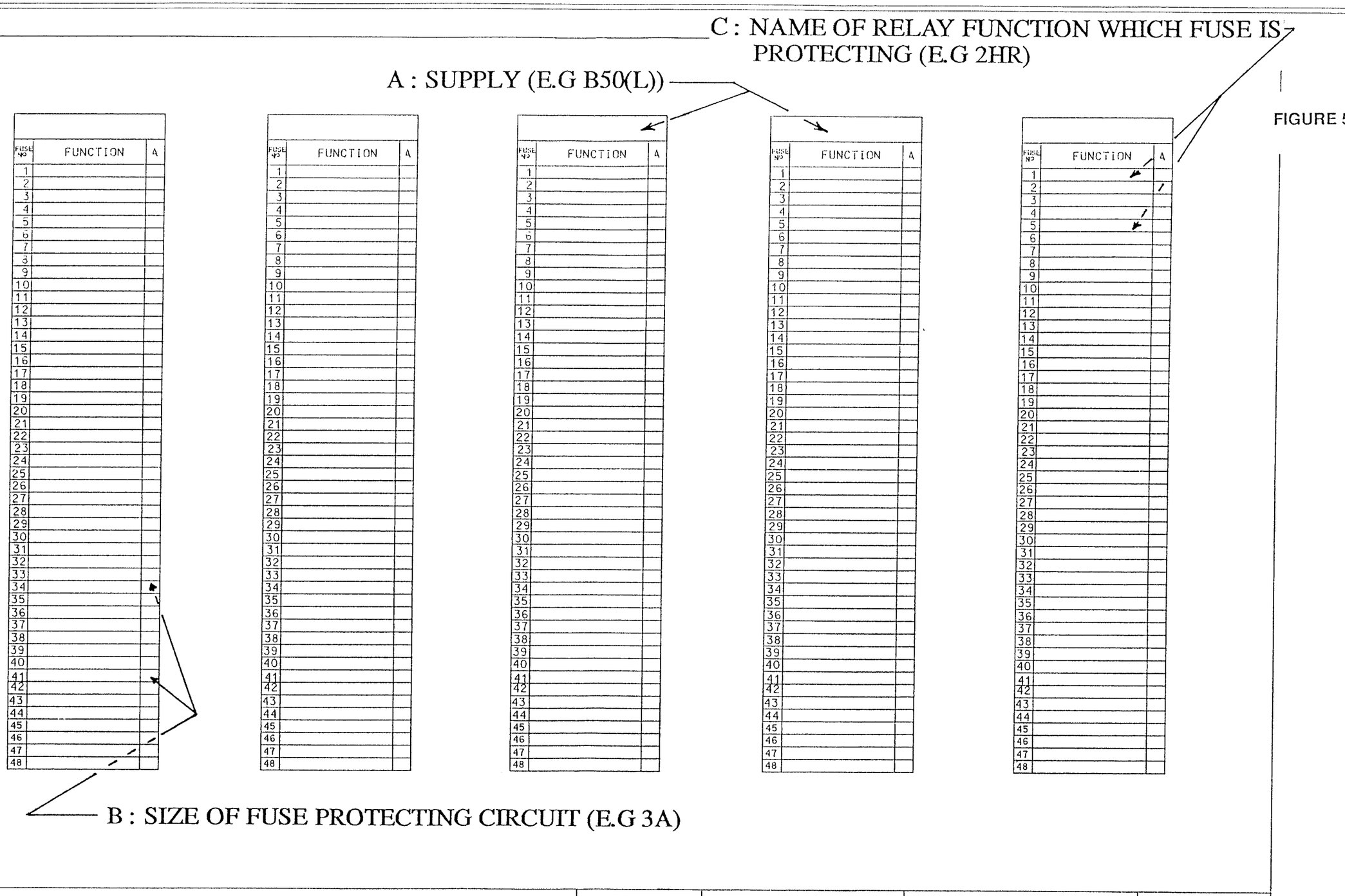


FIGURE 5

continued

5. TERMINAL ANALYSIS (FIGURE 6)

(A) Supply (e.g. NX110)

This tells the person reading the diagrams what supply is on that particular "NEGATIVE BUSBAR" and as with the fuse analysis you should have some terminal analysis for each "NEGATIVE BUSBAR" at an installation.

(B) Name of Relay Function to Which Negative is Connected (e.g.2 HRN)

The "FUNCTION" column on the terminal analysis relates the same information as on the fuse analysis except you should put an "N" at the end of each function to denote a "DC" Negative or NX to denote an "AC" negative.

(C) Number of Terminals on Negative Busbar

This is the number of terminals on the negative busbar and is usually made up in blocks of twelve so the number of terminals would be 12-24-36-48 etc.

You should always try to leave a percentage of spare capacity for future work at the installation.

N50(L)		
†	FUNCTION	-
1	T31/-T37 TPSN	
2	T9 TPSN	
3	II BSN	
4	DN MN(LC)SN	
5	49/55 BSN	
6	UP MN(LC)PRN	
7	T26 TSN	
8	T27 TSN	
9	II ALS/JSN	
10	59 ALS/JSN	
11	T9TJPR/TJSN	
12	T11TJPR/TJSN	
13	2BSIN	
14	2BS2N	

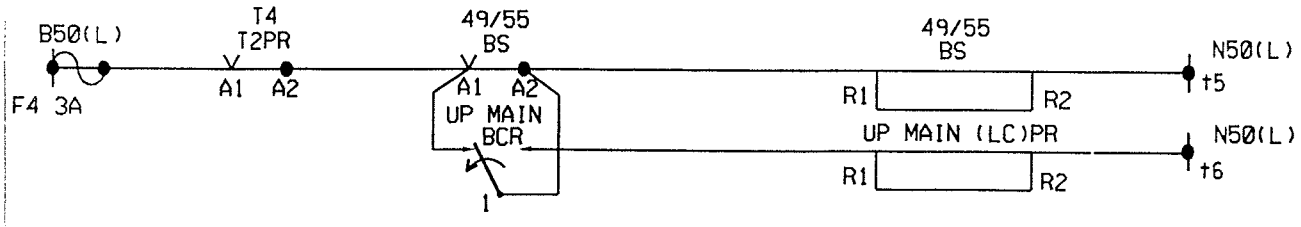


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FIGURE 6

A : SUPPLY (E.G NX110)

B : NAME OF RELAY FUNCTION WHICH NEGATIVE IS CONNECTED TO (E.G 2HRN)

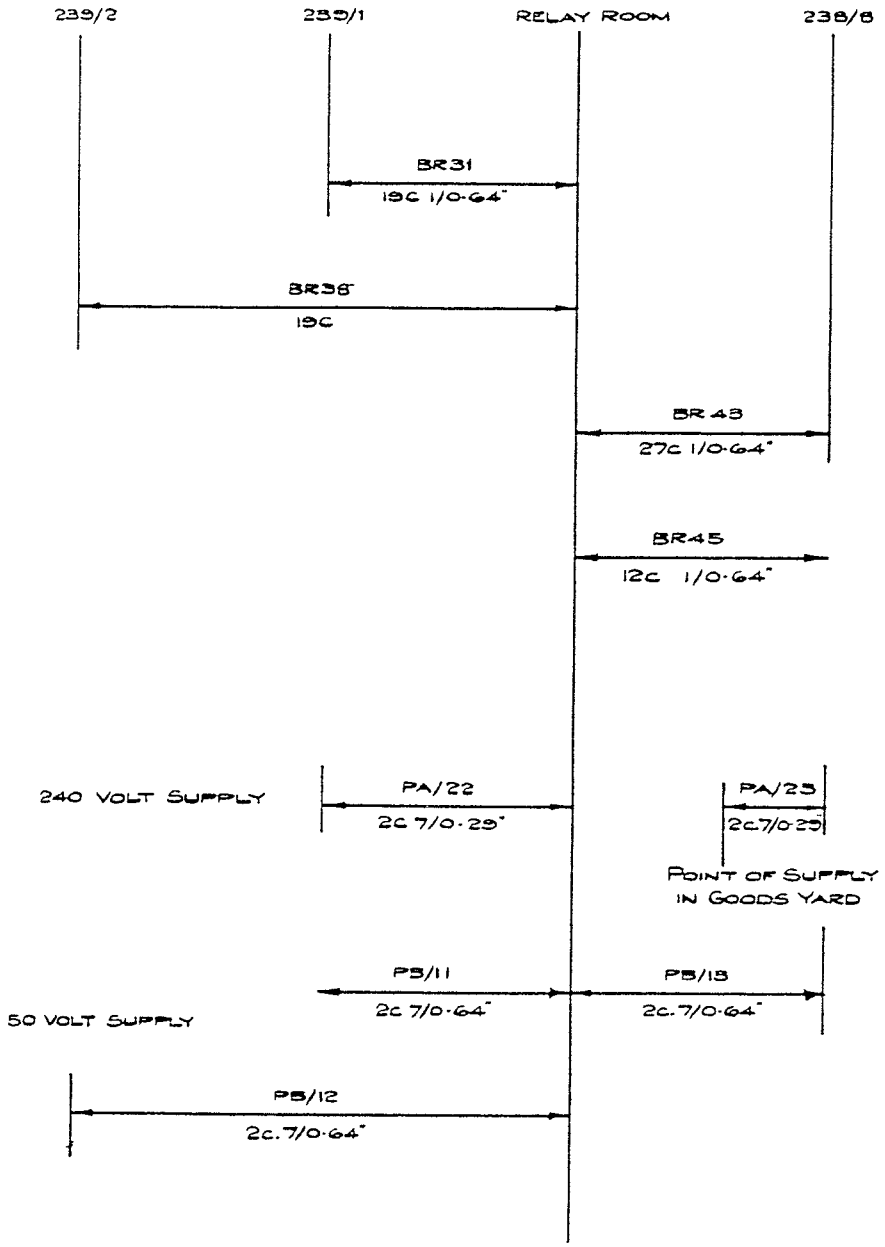
TERM NO	FUNCTION
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	
42	
43	
44	
45	
46	
47	
48	

C : Nº OF TERMINALS ON NEGATIVE BUSBAR.

continued

6. CABLE CORE PLAN

This gives an overall picture of all cables related to a particular signalbox i.e. Multicore lineside cables 37c, 27c, 19c etc and Power Distribution cables. We do not show "tail cables" on a cable core plan.



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7. CABLE DISTRIBUTION (FIGURE 7)

(A) Terminating Point of Cable (e.g. Signalbox, Location, R/R)

This is the point at which a lineside cable commences and/or terminates its route. In between the two points marked on Figure 7, there may be other points onto which the cable will be terminated - i.e. cut-section locations etc.

(B) Number of Conductors in Cable (e.g. 12, 19, 37 etc)

This is self-explanatory and requires no further comment.

(C) Signalling Function of Cable Conductor (e.g. AAT2PR)

Each cable conductor will carry some form of signalling circuit function, unless it is spare of course and, in the example shown, we mark on the cable distribution sheet what function is on a particular cable conductor.

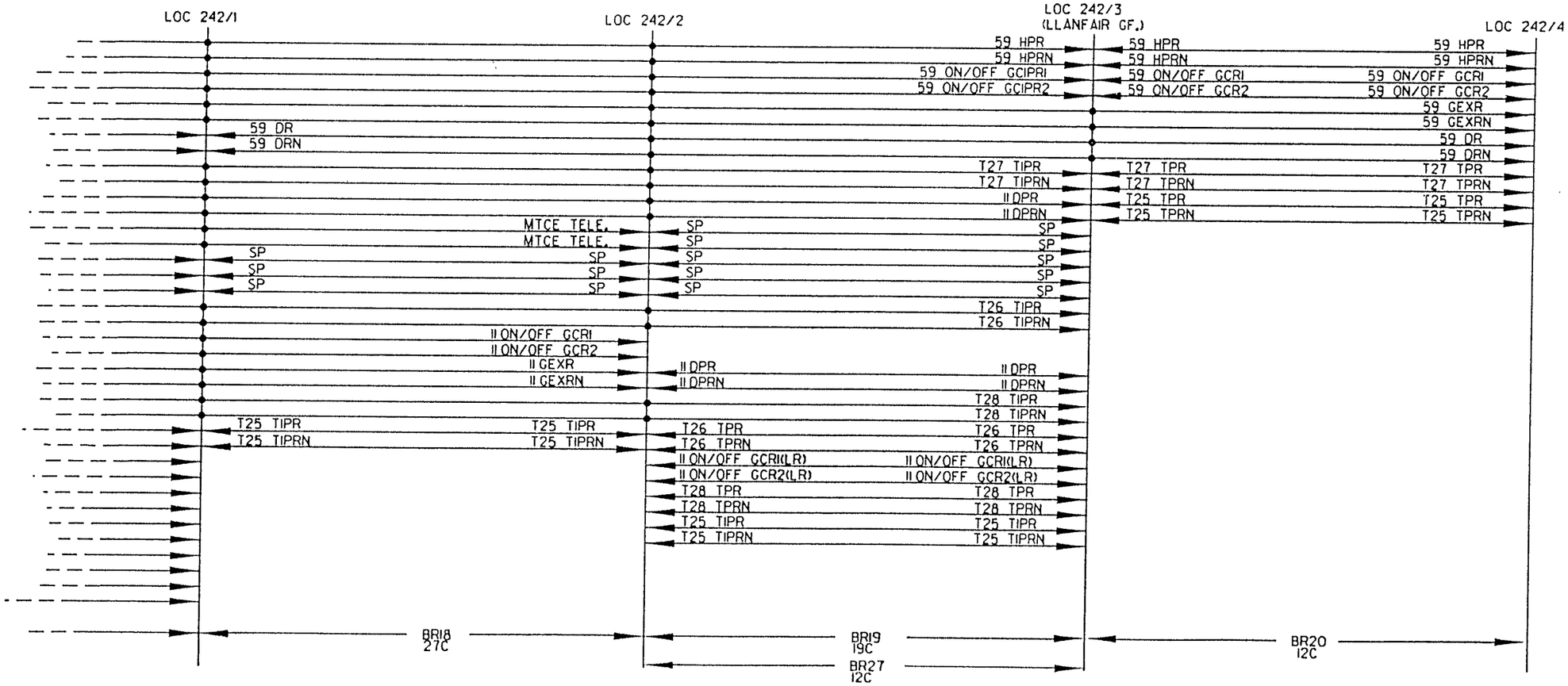

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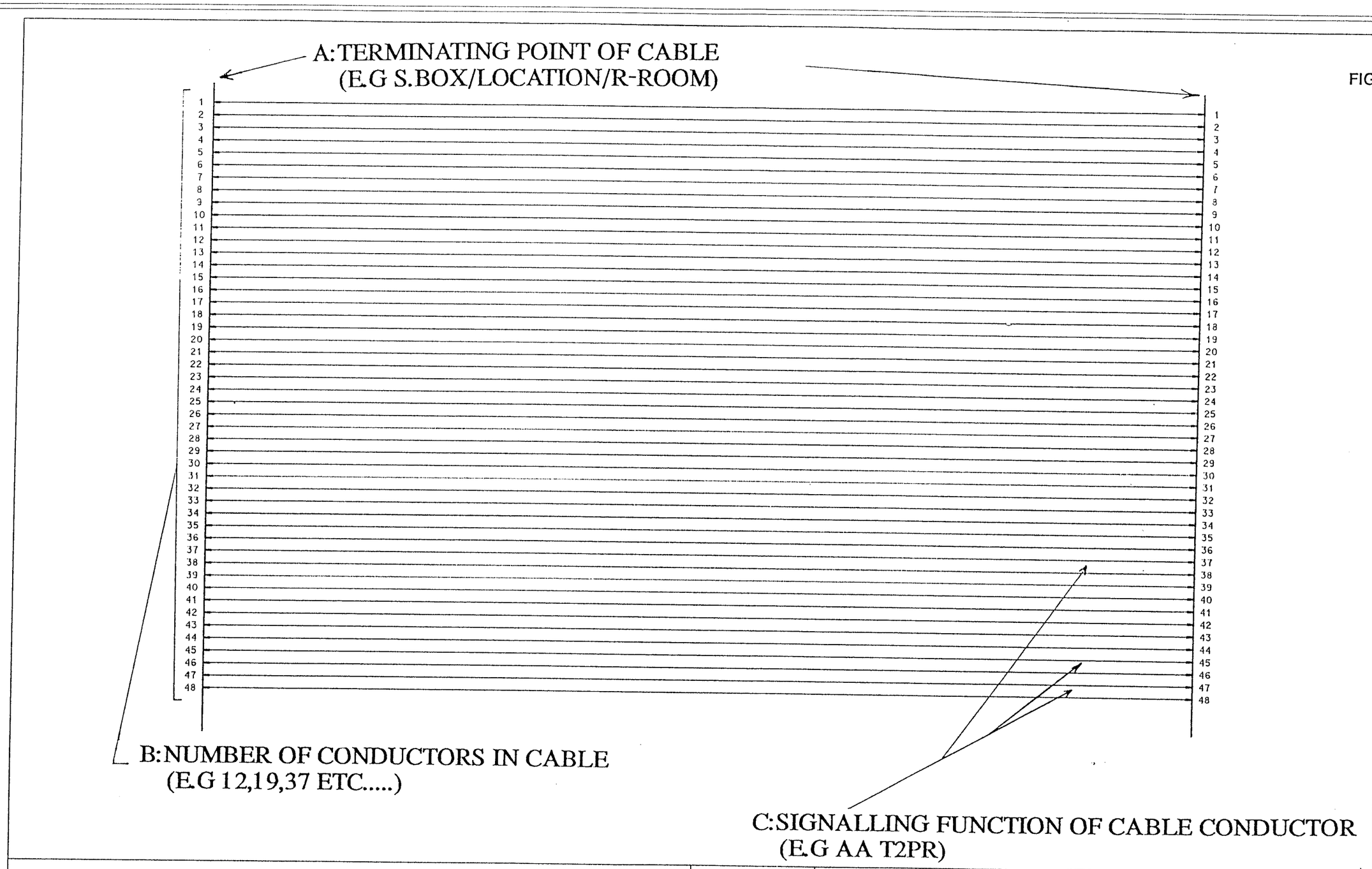
FIGURE 7



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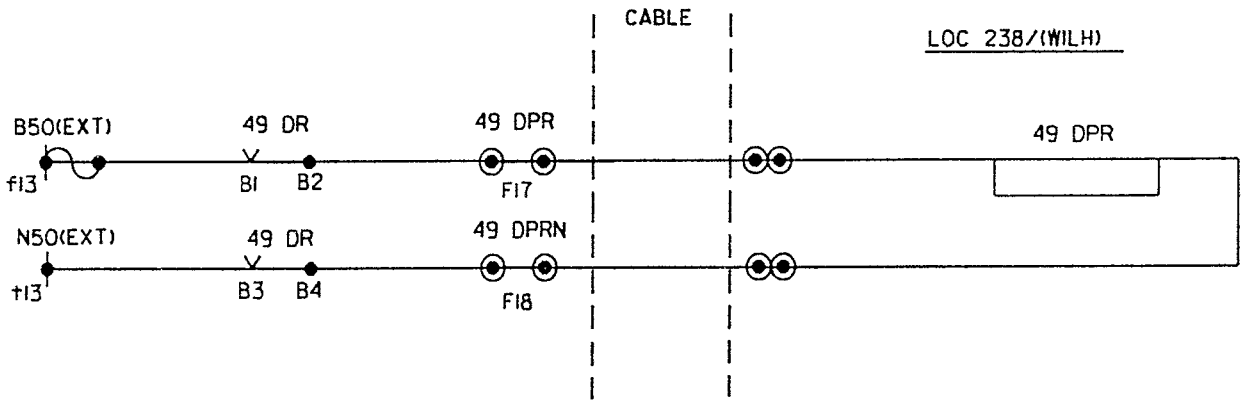
8. CABLE ANALYSIS (FIGURE 8)

Cable analysis shows any cable terminations and what the signalling functions of the conductors are in a particular installation. This is the only place where we indicate to installation/maintenance/testing staff which conductors of a multicore lineside cable are connected to which cable links.

(A) Termination Link Identification (e.g. A, B, C, AA, BB etc)

Cable links are identified in each installation by a unique letter at that particular installation. This is reflected in the wiring diagrams as shown in the example below:-



(B) Signalling Function of Cable Conductor (e.g. 2HR)

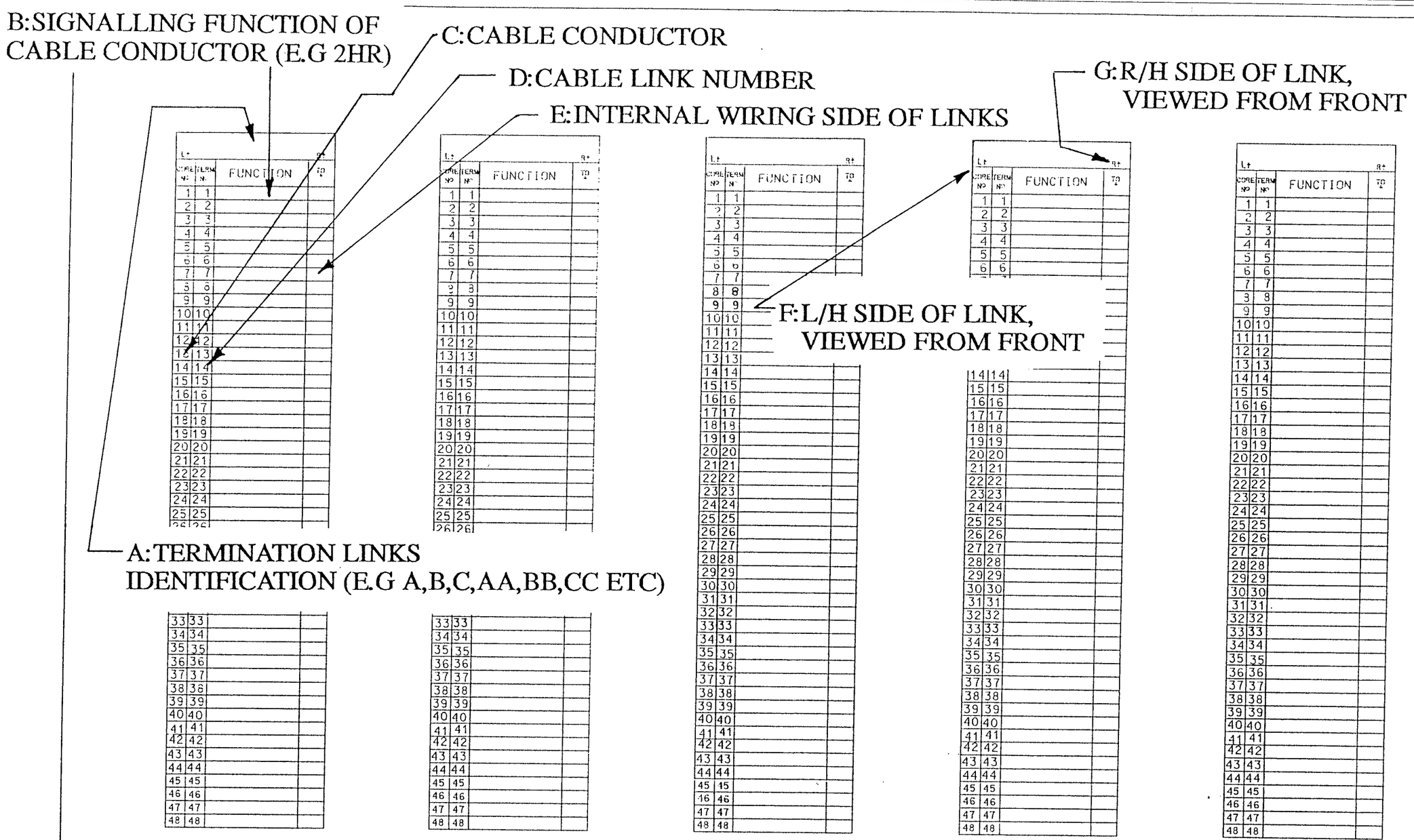
Each conductor in a cable, if in use and not spare, has to be identified as to what circuit is being used on that conductor. So in the function column we place that information.

(C) Cable Conductor

The core number refers to the conductor in a cable and enables the installation staff to know what conductor to terminate on which cable link.

continued

FIGURE 8



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(D) Cable Link Number

This is the link number to which the lineside/tail cable and the internal wiring is connected. (See example for how this is shown in wiring diagrams).

(E) Internal Wiring Side of Links

Under normal circumstances this column is not filled in unless the wiring from the link is being strapped to another link in which case we would have to fill in the link number of the link to which the wire was being run.

(F) L/H Side of Link, Viewed From Front

Self-explanatory

(G) R/H Side of Link, Viewed From Front

Self-explanatory.

With regards to "F" and "G", in any new installations the lineside/tail cable is always terminated on the left hand side of the links with internal wiring on the right.

This is not always the case with existing installations, so once again beware!

continued

LOCATION ANALYSIS (FIGURE 9)

So far the analysis we have looked at has been with regards to relay rooms/signalboxes.

Analysis is also contained within Location Wiring Diagrams. Typical location analysis is as follows:-

1. Fuse Analysis
2. Terminal Analysis
3. Relay Contact Analysis (only provided in new location cases)
4. Cable Analysis

The relay contact analysis sheet that is used is the same as previously mentioned in this module. The fuse, terminal and cable analysis is shown on a combined sheet as shown in figure 9.

(A) Terminal Analysis

Unlike the terminal analysis shown in relay-rooms which is just a numerical list the terminal analysis in a location case is a true representation of how the terminal block physically appears on site.

Note the way the terminals are labelled. This allows for additional terminal blocks to be added without destroying the numerical sequence.

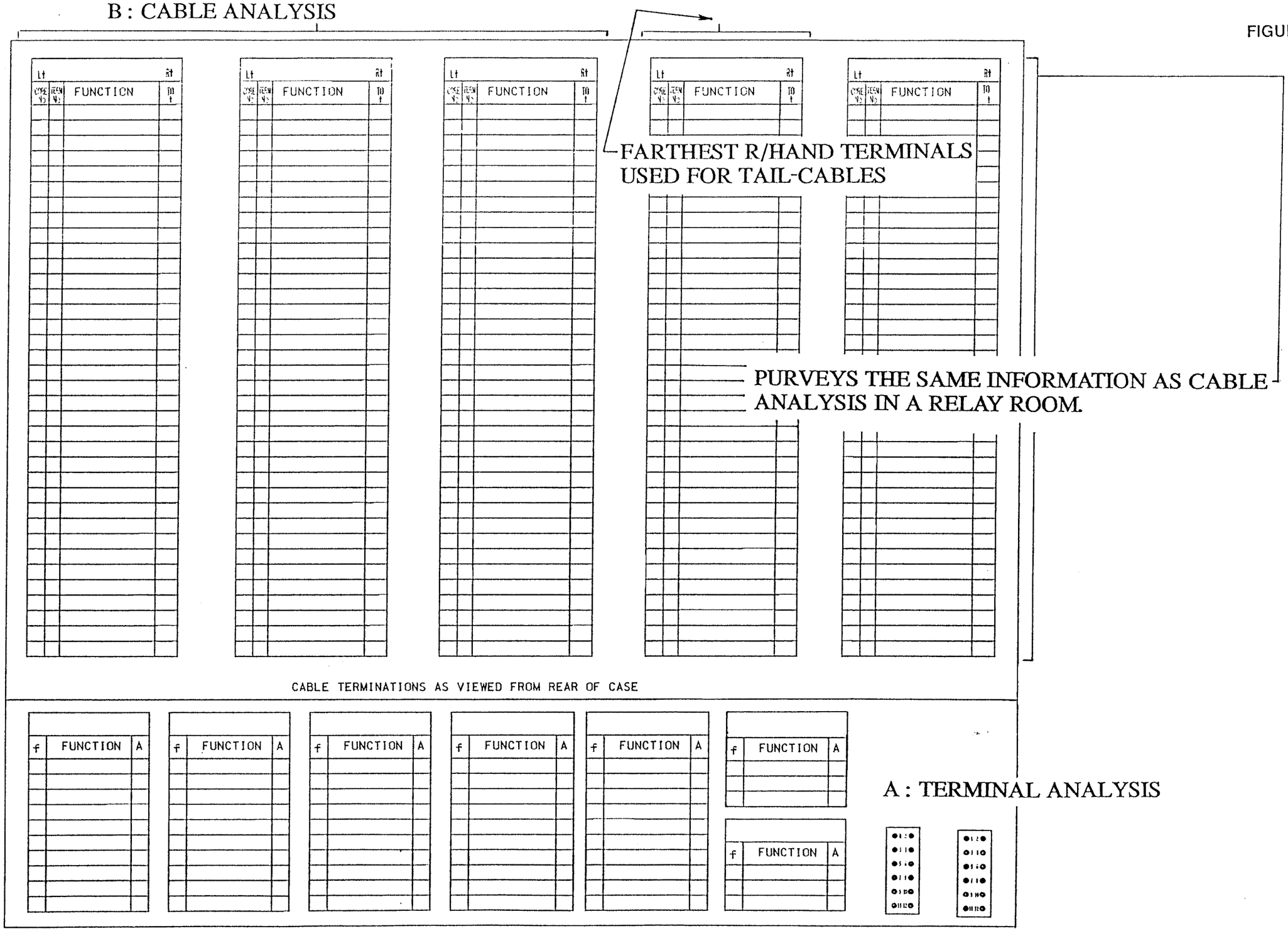
(B) Cable Analysis

The general rule when allocating cables in a location case is to allocate "Multi-core Cables" starting at the left-hand side of the location case and "Tail Cables" onto the farthest right-hand terminals after the multi-core cables have been allocated.

The Signalling Installation Handbook makes clear "that in any new installations, cables are to be fixed to the left hand side of their terminations so that the links or internal wires are to the right. At existing locations, follow the previous practice to avoid confusing mixtures of standards".

continued

FIGURE 9



continued

The analysis looked at so far has appertained to a more modern installation. In the older Electro-mechanical installations analysis is not on such a grand scale, as generally the box's control area was considerably smaller than today's power-box's.

The type of analysis is generally the same as the eight types previously mentioned. The exception to this is relay contact analysis.

The relay analysis mentioned so far in the module has assumed BR Spec 930 Plug-in relays. The older electro-mechanical installations utilised "Shelf Type" relays, such as Polar-Moving Iron, DC Neutral and DC Polar-Neutral relays. This involves a need for a different relay analysis format.

Figure 10 shows the relay analysis for a DC Polar neutral relay with the two contact arrangements 4F/B, 4N/R and 2F/B, 2N/R.

Figure 11 shows the relay analysis for a DC Polar moving iron with the contact arrangement 1N/R.

Figure 12 shows the relay analysis for a DC Neutral. Unlike Figures 10 and 11 where the analysis sheet is unique to the relay contact arrangement, the DC Neutral analysis can have various contact arrangements such as 2F/B, 4F/B and 6F/B.

As a result of this Figure 13 has been included in the module to help you decide which relay to use in a particular situation.

This module ends with Figures 14 and 15 which give a list of common BR 930 Spec relays used on British Rail and their usage, contact configuration and whether a particular contact is used as a back contact or a front contact on a particular type of relay.

continued

RELAY	TYPE	RESISTANCE IN OHMS	CONTACTS	CONTROL SHEET NO.	1		2		3		4		5		6		7		8	
					N	R	N	R	F	B	F	B	F	B	F	B	N	R	N	R
	DC POLAR NEUTRAL																			

RELAY	TYPE	RESISTANCE IN OHMS	CONTACTS	CONTROL SHEET NO.	1		2		3		4	
					N	R	F	B	F	B	N	R
	DC POLAR NEUTRAL											

FIGURE 10

continued

RELAY	TYPE	RESISTANCE IN OHMS	CONTACTS	CONTROL SHEET NO.	1	
					N	R
	DC POLAR MOVING IRON					

FIGURE 11

continued

FIGURE 12

RELAY	TYPE	RESISTANCE IN OHMS	CONTACTS	CONTROL SHEET NO.	1		2		3		4		5		6	
					F	B	F	B	F	B	F	B	F	B	F	B
	DC NEUTRAL →															

continued

FIGURE 13

RELAY	CLASS	RESISTANCE IN OHMS	CONTACTS	P.U. VOLTAGE	1		2		3		4		5		6	
					F	B	F	B	F	B	F	B	F	B	F	B
DC NEUTRAL	A	250	2 F/B	2.4												
DC NEUTRAL	A	250	4 F/B	2.9												
DC NEUTRAL	A	250	6 F/B	3.3												
DC NEUTRAL	B	250	2 F/B	3.0												
DC NEUTRAL	B	250	4 F/B	3.5												
DC NEUTRAL	B	250	6 F/B	4.1												
DC NEUTRAL	B	1000	2 F/B	5.2												
DC NEUTRAL	B	1000	4 F/B	6.2												
DC NEUTRAL	B	1000	6 F/B	8.4												

RELAY	CLASS	RESISTANCE IN OHMS	CONTACTS	P.U. VOLTAGE	1		2		3		4		5		6	
					N	R	N	R	F	B	F	B	N	R	N	R
DC POLAR NEUTRAL	A	250	2F/B 2N/R	2.81												

RELAY	CLASS	RESISTANCE IN OHMS	CONTACTS	P.U. VOLTAGE	1		2		3		4		5		6		7		8	
					N	R	N	R	F	B	F	B	F	B	F	B	N	R	N	R
DC POLAR NEUTRAL	A	250	4F/B 4N/R	3.35																
DC POLAR NEUTRAL	B	1000	4F/B 4N/R	7.1																

RELAY	CLASS	RESISTANCE IN OHMS	CONTACTS	P.U. VOLTAGE	1		2		3		4		5		6	
					N	R	N	R	F	B	F	B	N	R	N	R
DC POLAR MOVING IRON	A	250	1N/R	2.5												

CLASS A. THE ARMS AND CONTACTS OPERATE IN CIRCUITS WHERE THE VOLTAGE IS 12V

CLASS B. THE ARMS AND CONTACTS OPERATE IN CIRCUITS WHERE THE VOLTAGE IS 110V

continued

SPEC	RELAY	CONTACT	CODE	COILS R	COILS R	CONTACTS A 1/2	3/4	5/6	7/8	CONTACTS B 8/1	2/3	4/5	6/7	CONTACTS C 8/1	2/3	4/5	6/7	CONTACTS D 8/1	2/3	4/5	6/7	RATING	USAGE
																							*1
903/3	FILAMENT CHANGEOVER	2 F/B	*1	2	7	F/B	A															12v	
						F/B	F																
906	CONTACTOR DC DOUBLE POLE	2F		+	-	L+	L-															20A	MTCE ONLY
938	DC NEUTRAL QNI	8F 8B	802	1	2	F	B	B	F	B	F	B	F	B	F	B	F	B	F	B	F	24v	BARRIERS
931	DC NEUTRAL	8F 8B	822	1	2	F	B	B	F	B	F	B	F	B	F	B	F	B	F	B	F	24v	LEVEL CROSSING CONTROL CCTS
933	AC IMMUNE SLOW TO PICK UP	8F 4B	841	1	2	F	B			F	F	B						F	F	B		24v	LEVEL CROSSING CCTS
934	DC NEUTRAL SLOW TO RELEASE	8F 4B	861	1	2	F	B			F	F	B						F	F	B		24v	
936	DC POLARISED MAGNETIC STICK	8N 8R	814	1 3 / 2 4	N	N	R	R		N	N	R	R					N	N	R	R	24v	LINE RELAY
937	MINITURE DC NEUTRAL THERMAL TIMER	2F 1B	*7	1	3	F	B															*7	TIMER (30 TO 120 sec)
938	DC NEUTRAL TRACK RELAY	2F	101	1	2	F																4 ohms	TRS. LAMP PROVING
939	DC NEUTRAL TRACK RELAY	2F	105	1	2	F																20 ohms	TR
940	DC SINGLE WOUND	4F 2B	081	1	2	F	F															1.0 2.0A	LAMP PROVING
945	LY LAMP PROVING DC	4F	091	1	2	F	F															24v	LAMP PROVING & MTCE
946	TIME DELAY RELAY DC	1F 1B	*2	1	2	F	B															24v	REJR.COH JR
960	TWIN RELAY DC	4F 4B	057	1	3	F	B	B	F	B	F	B	B									24v	MTCE ONLY TWIN LINE RELAY
		4F 4B		2	4	F	B	B	F	B	F	B	B										
966	TRACK RELAY	2F	110	1	2	F																9 ohms	TR'S *6
966	DC CONTACTOR	2H4F 4B	167																			24v	CONTACTOR FOR BRB LIFTING BARRIER
966	SPECIAL (METAL->METAL)	8F 8B	1057	1	2	F	B	B	F	B	F	B	B									24v	SPECIAL BARRIER CIRCUIT
ORI	RECTIFIER RESISTANCE		*9	L	S													R	2			*5	LAMP PROVING ROUTE INDICATOR
ORI4	RECTIFIER RESISTANCE		*9	L	S													R	1			*4	MULTI LAMP ROUTE INDICATOR PROVING
QH3	LAMP PROVING	4F 2B	042	1	2	F	F	B										F	F	B		0.2 A	SHUNT SIGS * 8, 12 LAMP) STENCIL/POSITION LIGHT INDICATOR
		4F 2B	077	1	2	F	F	B										F	F	B		0.25A	
QSR3	LAMP PROVING	4F 2B	079	1	2	F	F	B										F	F	B		0.125A	MAIN ASPECT /LQS/PL/SHUNT
QECXI	LAMP PROVING	4F	SPEC 9.41A	1	2	F	F											F	F			35 ohms	MAIN/SUB
QHTI	TIMING RELAY (3-30 secs)	1F 1B	140	1	2					B												110v	MTCE
AGA-STAT	TIMING RELAY *6		7822																			24v	CROSSING JR
CW 44 /81	LAMP PROVING ECR UNIT			2	7	1 3 / F																15W 1A	ELECTRIC LIGHTING OF SEMAPHORES

FOR FURTHER DETAILS SEE DRAWING NO. CW 44/81

*1 USE WITH SL35 LAMPS 24V - FLASHING ASPECTS

*2 232 - 3 SECONDS 233 - 5 SECONDS 236 - 10 SECONDS
234 - 6 SECONDS 235 - 7.5 SECONDS

*3 191 - 2 - 30 SECONDS
189 - 3 - 240 SECONDS

*4 - 0 - 18 OHMS 155 - 0 - 10 OHMS
156 - 0 - 7.8 OHMS 157 - 0 - 6 OHMS

*5 18 OHMS OR 64 OHMS

*6 MCI - BARRIER FAILED JR 15 SECONDS (S RELAY)
MEI - OPEN CROSSING JR 2 MINUTES (S RELAY)

*7 123 - 24v MAX 15W
124 - 50v MAX 15W

*8 MAINTENANCE ONLY

*9 AI DI IN SERIES WITH LAMP CCT

FIGURE 14

continued

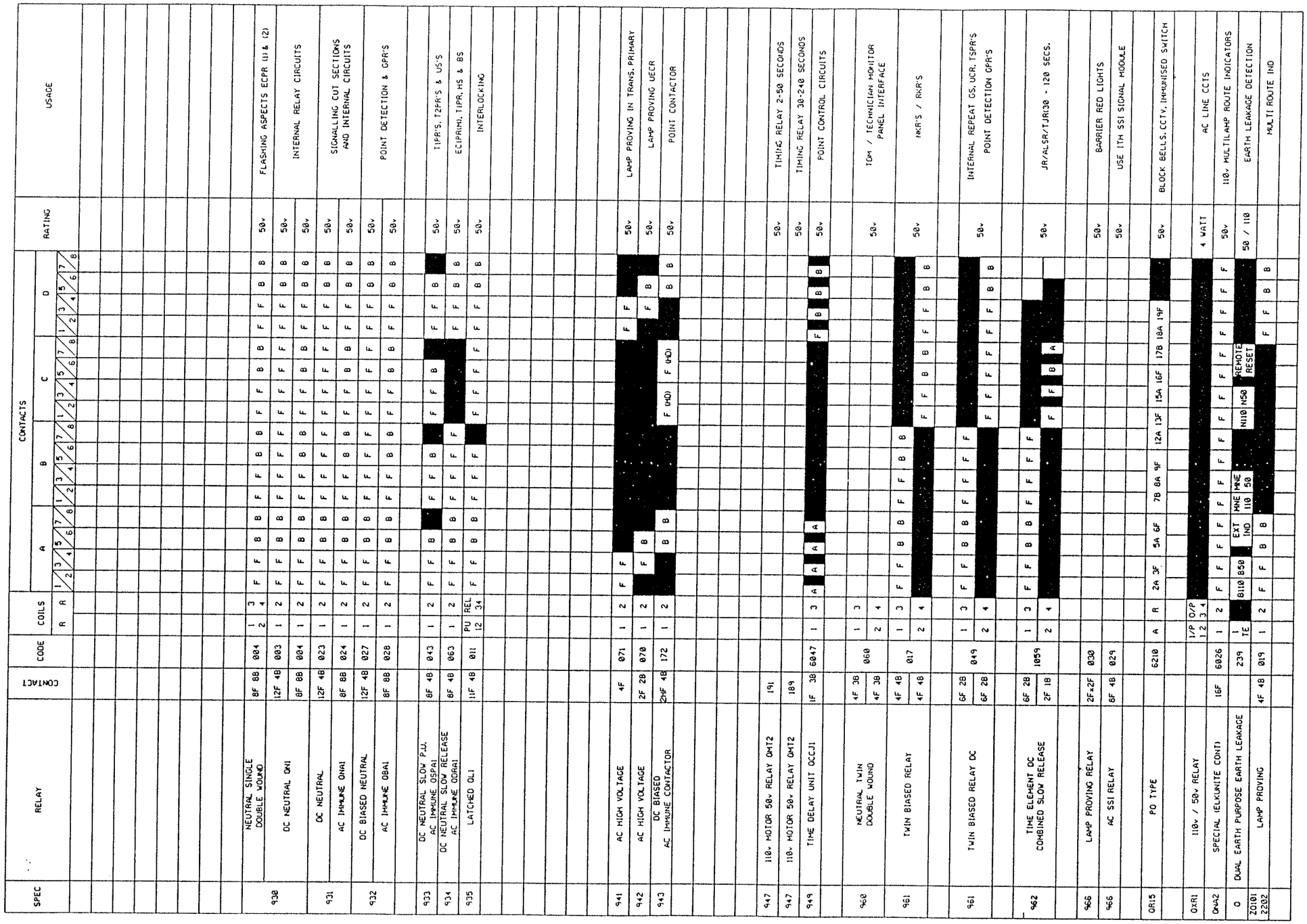


FIGURE 15

end