
	Benämning	Nr	Sida
	INSTALLATION MANUAL Private Automatic Exchange type ARD 624	G 1555 - 170 Ue	1
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		Tillhör	Datum
		ARD 624	1.6.67
		Godkänd (tjst och namn)	Korr.
		G/FhC W Adenstedt	A 22.12.69

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Origram	Översatt	Andra utgåvor	Uppgj. (tjst och sign)	Kontr. (tjst och sign)	
R			Fhr	Fhr Lö	G 1555 - 170 Ue

	benämning	nr	side
	CIRCUIT DIAGRAM 363972, rev. B	G 1551 - 373 Ue	1(16)
	Private Automatic Exchange, ARD 624	tilhör	datum
	Circuit Description	godkänd (tjst. och namn)	korr.
		G/Xn bac	A 20.3.67

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origram	översett	andra utgåvor	uppgj. (tjst. o. sign.)	kontr. (tjst. o. sign.)	nr
R			Xn bac	Xg ES	G 1551 - 373 Ue



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1. GENERAL DESCRIPTION

The P. A. X. consists of a complete unit and is built up on a relay rack type BDC 59101 for wall mounting. The operating voltage is obtained from a current supply set, which also delivers buzzer tone and ringing voltage.

Capacity: 16 extensions and 2 connecting circuits

Operating voltage: normally 48 V  
permissible variation 42-56 V

Ringing signal: open circuit voltage (approx. 90 V)  
frequency 50 c/s  
character: 0,7 s on, 4 s off

Dial tone: frequency 100 c/s

Ringing tone: frequency 100 c/s  
character: see ringing signal

Busy tone: frequency 100 c/s  
character: 0,2 s on, 0,3 s off

Intrusion tone: frequency 2 c/s

Line resistance: max. 1100 ohms including resistance of telephone instrument

Leakage resistance: min. 25000 ohms

Feed: 2 x 400 ohms, alternatively 2 x 250 ohms

Pulse speed: 8-12 pulses per second

Pulse ration: make/break 33/67 - 50/50

Numbering scheme: 2-9, 11-18

Extension line numbers 1 - 16 alone are shown on circuit diagram 363972. The following relation exists between extension numbers and line numbers (dial numbered 1-9, 0).

Extension no.	2	3	4	5	6	7	8	9	11	12	13	14	15	16	17	18
Line no.	2	3	4	5	6	7	8	1	9	10	11	12	13	14	15	16

Calls between the P. A. X extensions are made via the connecting circuits. The feed is individual for the conversing extensions. As soon as an extension replaces, his line is free for a new call. The connecting circuit is cleared when both extensions have replaced. If a called extension is engaged the caller hears busy tone from the connecting circuit. If a call is not completed within a given time the register is released and the caller hears busy tone from the connecting circuit as above.

Any number of extensions can be given priority.

The following separate equipments can be added to the P. A. X.:

The lines FDR-X to another switchboard

Paging unit PSR for audible paging via loudspeakers

Conference equipment KFR

FDR-X and PSR terminate on one of the extension lines 1, 6, 7 or 8.

In addition to the switching functions of the P. A. X., diagram 363972 and a B-extension the called party.

In the following description an A-extension denotes the caller and a B-extension the called party.

## 2. SWITCH FUNCTIONS

### 2.1 Components

#### Extension equipment and identifier

B1-B16	Cut-off relays, one per line
BP	Cancels priority marking on an outgoing call via a tie line
D1-D4	Identification of individual extension
D5-D8	Identification of group of 4-extensions
D9	Supervisory relay used in connection with identification and connection to B-extension
La-s (D8)	Rectifiers which prevent tinkling of unengaged extensions <sup>*)</sup> bells owing to voltage changes on the lines during identification

#### Register

R1	Indicates that the A-extension has priority
R2	Time supervision of the register
R3	Indicates that pulsing is complete and starts transmission of the B-extension's number from the register to the connecting circuit selector
R4	Follows the impulses from the A-extension's dial
R5	Holding of the register
R6	Pulse train relay
R7-R12	Relay chain for reception of dial pulses
R13	Indicates that the first digit of a two-digit number has been dialled

\*)

Connections in rest position

### Connecting circuit (SNR)

- S1 . Feed to A-extension
- S2 Prepares priority connection when B-extension is engaged
- S3 Holding of connecting circuit
- S4 Interrupts ringing, supplies feed to the B-extension when the latter answers, and holds the connecting circuit during a priority connection
- S5 Register connection
- S6 Through-connection of SNR on calls to FDR-X and PSR

### Crossbar switch

- H1-H9 Horizontals for indication of extension position on the multiple
- HA, HB
- V1, V3 Verticals for connection of A-extension to SNR1 and SNR2
- V2, V4 Verticals for connection of B-extension to SNR1 and SNR2

### Signal relays

- G1 Determine the character of the busy tone
- G2, G3 Determine the character of the ring tone and intermittent ringing signal

## 2.2 Miscellaneous Symbols

### Signal wires

- SU, SU2 Continuous buzzer tone (dial tone)
- SU1 Busy tone
- SU3 Ringing tone
- RG Continuous ringing signal
- RGi Intermittent ringing signal
- RGst Start of pole changer if charging unit and battery are used instead of a current supply set
- TT Intrusion tone which indicates that a priority extension is on the line

### Auxiliary equipments

- FDR-X Tie line to other switchboards
- PSR Relay set for connection of loudspeaker installation for audible paging

KFR Relay set for connection of a third extension to a conference call

### 2.3 Strapping

Lines 1, 6, 7 and 8

When extensions are to be connected to these lines, strap 4 for the respective line must be inserted.

#### Priority

Two straps are required for an extension to have priority: strap 1 for the units digit of the extension number and, in addition, strap 2 (extensions 2-9) or strap 3 (extensions 11-18).

Example: Extension 7 (line 7) is to be given priority.

Insert strap 1 between terminals F3 and F4 and strap 2 according to the circuit diagram.

#### Connection of FDR-X and PSR

FDR-X or PSR is to be connected to one of lines 1, 6, 7 or 8. Remove strap 4 for the line selected.

Placing of strap 4:

Line	Strap between terminals
1	G1 and G2
6	G3 and G4
7	G5 and G6
8	G7 and G8

Strap 5 corresponding to the selected code number should be inserted as follows:

Code number	Line	Strap between terminals
6	6	H1 and H2
7	7	H3 and H4
8	8	H5 and H6
9	1	H7 and H8

### 3. SWITCHING FUNCTIONS

The figures within brackets refer to the circuits listed numerically under point 4.

#### 3.1 Initiation of Call

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### 3.11 Identification of A-extension

A calling extension line is identified by the relay chains D1-D4 and D5-D8. To each relay in a chain there are four lines connected on a given principle. Line 1 is connected to D1 and D5, line 2 to D1 and D6, and so on.

For identification to have taken place the register and one of the connecting circuits must be free. The identification is effected in two steps. First the line group of the A-extension is identified by D5-D8 and then the individual line by D1-D4. In the event of simultaneous calls within the same relay chain a relay with higher number has precedence over a relay with lower number.

Example: Call from extension 4 (line 4).

When the extension initiates a call, a loop is formed through the extension telephone. D8 operates (1). D9 operates secondarily to D8 and removes the short-circuit on the winding of D1-D4. D1 operates in series with D8 (2). The line is now identified and its position in the multiple is marked by the operation of HA and H4 (3 and 4). After the operation of D8, hunting of a free connecting circuit starts (see 3.12).

If the A-extension has priority, R1 operates (5) and holds to its own contact.

#### Waiting circuit

The circuit (1) for operation of D5-D8 is supervised via the register connection relay S5 in the connecting circuits and via verticals V1 and V3. This means, as already pointed out, that the identification cannot start if any other extension is already connected to the register or if both connecting circuits are engaged. The caller must thus wait until pulsing in the register is completed and until a connecting circuit becomes free.

### 3.12 Connection to Register and Connecting Circuit

As soon as D9 has operated the register is seized. R4 and R5 operate to positive from D9. The relays D5-D8 extend negative to S5 in the connecting circuits. If both connecting circuits are free, S5 in SNR2 has precedence.

Example: Connection to SNR1.

On identification, S5 in SNR1 operates (6). When R5 operates it overtakes the holding of S5 (7). S1 and V1 operate (8 and 9). V1 holds to its own contact with positive from S1. The B-relay of the extension operates to positive via the c-wire and contacts 43 or 46 of V1, depending on whether the HA or HB horizontal is actuated. The B-relay opens the operate circuit of the identification relay. Operated D-relays release and actuated horizontals in the switch are restored. R4 is now held operated via the extension loop (10). The extension hears dial tone from the current supply set via wire SU and the buzzer winding of R4 (11).



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On the operation of S1 positive is extended via its buzzer winding and via S43 to G2. G2 and G3 operate. These relays, however, have no function to fulfil at this stage on the switching.

On the operation of R5 the circuit to the time supervision relay R2 is opened but, being slow to release, the relay does not release until about 6 seconds later. For the function of R2 see 3.9.

Stable phase: During the release time of R2 the following relays and verticals are operated: A-extension B-relay, (R1), R2, R4, R5, S1, S5 and V1 (V3). G2 and G3 operate and release alternately.

### 3.2 The A-extension Dials the Wanted Number

#### 3.21 Digit Reception

The digit pulses are received by R4, which releases on every interruption (pulse) caused by the extension dial in the loop (10). The pulses are transmitted by R4 to the pulse chain R7-R12.

##### 1st break pulse

R4 releases, whereupon R6 operates and connects the pulse contact of R4 to the pulse chain R7-R12. On the operation of R6 its upper winding is short-circuited. This makes the relay slow to release, so that it does not release between the pulses in a pulse train. On the release of R4 the circuit is opened to R5, but the latter also remains operated during the entire pulse train owing to its slow release action.

##### 1st make pulse

R4 operates. R7 thereafter operates (12) and holds to its own contact.

##### 2nd break pulse

R4 releases. R8 operates in series with the lower winding of R7 (13).

##### 2nd make pulse

R4 operates and opens the circuit through the lower winding of R7. Before R7 has had time to release, R8 is held to circuit 14 and thereafter to circuit 15.

The pulse chain advances in the same way on the following pulses. If the digit comprises six or more pulses, R7 reoperates to the sixth pulse but this time in parallel with R12 (19). R12 holds to its own contact with positive from R5 and remains operated until the register is cleared.

The following table, shows the relation between received pulses and operated relays R7-R12 on completion of a pulse train:

The figures within brackets indicate the operate circuits.



Pulse (Digit)	R7	R8	R9	R10	R11	R12
1	x (12)					
2		x (13)				
3			x (16)			
4				x (17)		
5					x (18)	
6	x (19)					x (19)
7		x (13)				x
8			x (16)			x
9				x (17)		x

### 3.22 Digit Recording

#### Single digit extension number

Example: Call to extension 2 (line 2).

On the release of R6 at the end of the pulse train R3 operates (20) and holds to its own contact with positive from R5. The B-extension line, which in this example is represented by the horizontal combination HA plus H2 in the switch, is identified via make contacts on R3 and R8. The horizontals operate (21).

According to whether the B-extension is free or engaged the connection of the connecting circuit now continues as under 3.3 or 3.6.

#### Two digit extension number

Example: Call to extension 18 (line 16).

First digit:

On the release of R6, R13 operates to positive from R5 and holds to its own contact. R13 opens the holding circuit of R7. R7 releases.

Stable phase: During the release time of R2 the following relays and verticals are operated: A-extension B-relay, (R1), R2, R4, R5, R13, S1, S5 and V1 (V3). G2 and G3 operate and release alternately.

Second digit:

R3 operates (22) and holds to its own contact with positive from R5. On the release of R6 at the end of the pulse train the B-extension line is identified, in the example represented by the horizontal combination HB plus H8, via make contacts on R3, R9, R12, and R13. HB and H8 operate (23).

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According to whether the B-extension is free or engaged the setting up of the connecting circuit now continues as under 3.3 or 3.6.

### 3.3 The B-extension is Free

The free condition of the B-extension is indicated by the fact that the B-relay associated with the line is not operated.

When the B-extension number has been recorded on the horizontals as under 3.2, D9 operates and initiates connection of the extension to the connecting circuit.

Example: Call to textension 18 (line 16) via SNR1.

D9 (24), V2 (25), and B16 (26) operate. V2 holds to its own contact with positive from V1. R4 and D9 release since the positive to these relays is cut off by V2 and B16 respectively. R6 operates. D9 opens the positive circuit to R5, which releases with delay. (R1), R3, R6, R9, R12, R13, S5, HB and H8 thereafter release.

During the moment from the operation of V2 to the release of S5 (about 200 ms) the first ringing signal is sent to the B-extension (27). S4, which is slow to operate since its upper winding is short-circuited, is not actuated by the ringing current. An intermittent ringing signal is then sent to the B-extension via G2 and wire RGi. At the same time ringing tone is sent to the A-extension via G2, wire SU3 and the buzzer winding of S1. For the function of the G-relays see 3.8.

Stable phase: The following relays and verticals are operated: the B-relay for the A- and B-extensions, R2, S1, V1 (V3), and V2 (V4). G2 and G3 operate and release alternately.

### 3.4 Answer and Speech Connection

When the B-extension answers, S4 operates via the loop which is closed through the telephone instrument (28). S3 operates to current through winding 1/2 and cuts off the ringing tone SU3 to the A-extension. G2 and G3 release.

Speech connection is now established.

The A-extension feed comes from S1 (29) and the B-extension feed from S4 (30).

Stable phase: The following relays and verticals are operated: the B-relay for the A- and B-extension, R2, S1, S3, S4, V1 (V3) and V2 (V4).

### 3.5 Clearing

The PAX is so designed that when an extension replaces he is immediately released from the connecting circuit and can then receive or make a new call. The connecting circuit is released after both extensions have replaced.

The A-extension replaces first

When A replaces, S1, V1 (V3) and the extension B-relay release. V2 is now held to positive from S4. On the release of S1, G1 is started by positive via

the buzzer winding of S1 and via SU1. The B-extension hears busy tone. For the function of the G-relays see 3. 8.

When the B-extension preplaces, S4, V2 (V4), S3, G1 and the extension B-relay release.

The connecting circuit is now free for a new call.

#### The B-extension replaces first

When B replaces, S4, V2 (V4) and the extension B-relay release. On the release of S4, G1 is started and the A-extension hears busy tone.

When the A-extension replaces, S1, V1 (V3), S3, G1 and the extension B-relay release.

The connecting circuit is now free for a new call.

### 3.6 The B-extension is Engaged

Engaged condition is indicated by the fact that the B-extension cut-off relay is operated. If a non-priority extension calls, i. e. if R1 is not operated, the process is as follows:

When the B-extension number has been recorded on the horizontals as under 3. 2, S3 operates (31) and holds to its own contact with positive from V1. S1 initiates clearing of the register by opening the circuit to R4. All operated R-relays except R2 release. S5 releases and operated horizontals in the switch are restored. On the release of R4, R6 operates momentarily.

On the operation of S3, G1 is started by positive via the buzzer winding of S1 and via SU1. The A-extension hears busy tone. For the function of the G-relays see 3. 8.

Stable phase: The following relays and verticals are operated: A-extension B-relay, R2, S1, S3 and V1 (V3). G1 operates and releases.

When the A-extension replaces, S1 V1 (V3), the extension B-relay, S3 and G1 release.

The connecting circuit is now free for a new call.

### 3.7 Priority

#### 3.71 Initiation of Call

On identification of a priority extension R1 operates (see 3.11).

Switching process as under 3.3 - 3.5.

### The B-extension is engaged

When the number has been registered on the horizontals as under 3.2, D9 can operate and initiate connection to the B-extension even though the latter is engaged.

Example: Call to extension 18 (line 16) via SNR1.

D9 operates (32). During the operating time of D9, S2 has time to operate (33) and hold to its own contact with positive from V1. S3 is energized through windings 3/4 and 5/6 in parallel with S2. S3:s windings, however, oppose one another and the relay can therefore not operate. V2 (25) and S4 (34) operate. Positive to winding 3/4 on S3 is now obtained from V1 (35). V2 is held by positive from V1 and opens the circuit of R4. R4 releases whereupon R6 operates and opens the operate circuits of actuated horizontals. Thereafter D9 and all operated R-relays except R2 release.

On the operation of S2, G1 is started by positive via the buzzer winding of S1 and via SU1. The priority extension (A) hears busy tone. For the function of the G-relays see 3.8.

Stable phase: The following relays and verticals are operated: A-extension B-relay, R2, S1, S2, S4, V1 (V3) and V2 (V4). G1 operates and releases.

If the priority extension replaces, the connecting circuit is cleared in the normal way.

### 3.72 Entry into Engaged Circuit

The priority extension can enter an engaged circuit by dialling one pulse. At the break pulse S1 releases since its holding circuit (29) is broken by the dial. S1 opens the circuit to winding 3/4 of S3, with the result that S3 operates to the current through winding 5/6 and holds to its own contacts. S4, which is in parallel with a capacitor (S5), remains operated owing to its slow release action. V1 is now held by positive from S4. On the make pulse S1 operates.

The priority extension is now connected to the conversing extensions via capacitor C1 in the speech circuits. S4 is disconnected from the speech wires on the B-side through the fact that S2 is operated. Via the buzzer winding of S1 an intrusion tone (TT) is sent to the conversing extensions.

Stable phase: The following relays and verticals are operated: A-extension B-relay, R2, S1, S2, S3, S4, V1 (V3) and V2 (V4). G1 operates and releases.

When the priority extension replaces, the connecting circuit used for the priority connection is released.

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### 3.8 Function of G-relays

#### Busy tone SU1 and intrusion tone TT

From the connecting circuits positive is extended via the buzzer winding of S1, contacts on S2 and S3, wire SU1 to G1. During the time taken to charge the 50  $\mu$ F capacitor, G1 is energized through both windings. The windings are in opposition and, not until the capacitor has been charged, does G1 operate to current through the upper winding. G1 opens its own operate circuit. The capacitor is discharged through both windings, which are now cooperating. After discharge of the capacitor, G1 releases. The operate circuit is reclosed and the process is repeated until the positive from the connecting circuit disappears. G1 is thus slow both to operate and to release. When G1 is operated, buzzer tone is sent from the current supply set to the connecting circuit via wire SU1.

Signal ratio: 0.2 sec. on, 0.3 sec. off.

When S2 and S3 are operated, i. e. when a priority extension is connected to an engaged circuit, negative is extended via the resistor (G2) and wire TT to the buzzer winding of S1. Each time this circuit is opened and closed a click is heard in the receivers of the conversing parties.

#### Ringling tone SU3 and intermittent ringing signal RG1

From the connecting circuits positive is extended via the buzzer winding of S1, contacts of S3, S2 and S1, wire SU3 to G2, which operates. G3 operates secondarily to G2 and shunts G2. G3 then releases. G2 reoperates and the process is repeated until the positive from the connecting circuit disappears. G3 is slow both to operate and to release (cf. function for G1). When G2 is operated, buzzer tone and ringing signal are sent from the current supply set to the connecting circuits via wires SU3 and RG1 respectively.

Signal ratio: approx. 0.7 sec. on, approx. 4 sec. off.

### 3.9 Time Release of Register

If dialling is not started within about 6 sec. after the A-extension has received dial tone from the register, or if the delay between digits exceeds 6 sec., the register is released and the A-extension hears busy tone from the connecting circuit.

On the operation of R5 on seizure of the register, the positive circuit to R2 is opened. If now R6 does not operate within the specified time, R2 (and R1) release. S3 then operates (36) and removes the hold on R4. All operated R-relays, S5, G2 and G3 release. On the release of R4, R6 operates momentarily. On the release of R5, R2 operates.

When S3 has operated G1 is started by positive via the buzzer winding of S1 via SU1. The A-extension hears busy tone.

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Stable phase: The following relays and verticals are operated: A-extension B-relay, R2, S1, S3, and V1 (V3). G1 operates and releases.

### 3.10 Call to Auxiliary Equipments FDR-X and PSR

FDR-X or PSR must be terminated on one of lines 1, 6, 7 or 8. Strap 4 for the selected line must not be inserted. Instead the c-wire for FDR-X or PSR must be connected to the terminals for strap 4. On the other hand strap 5 corresponding to the call number must be inserted.

Example: Call via SNR1 or FDR-X connected to line 6 (call number 6).

On a call to PSR the switching process is the same as on a call to FDR-X.

When the A-extension dials 6 to call FDR-X, the digit is received by the register in the ordinary way as described under 3.21. On the release of R6 at the end of the pulse train, R3 operates (20) and holds to its own contact with positive from R5. Line 6, to which FDR-X is connected in this example, is represented in the switch by the horizontal combination HA plus H6. These horizontals operate (37). BP operates (38). If the A-extension has priority, R1 is operated. R1 releases since its operate circuit is opened by BP.

#### FDR-X is free

D9 (39) and V2 (V5) operate. BP releases. S6 operates (40). A relay in FDR-X operates in series with S6 via the c-wire (41). In FDR-X the c-wire is through-connected (direct connection between terminals G3 and G4). This causes B6 to operate in series with S6 (42). R4 and D9 release since the positive to these relays is cut off by V2 and S6 respectively. R6 operates. D9 breaks the positive circuit to R5. S5 and all operated R-relays except R2 release. HA and H6 release. When S6 has operated, S1, G2 and G3 release. V1 and V2 are held operated by positive from S6.

Via contacts on S6 the speech wires of the connecting circuit are now connected from V1 directly to V3. In other words the connecting circuit is through-connected. The feed for the A-extension comes from the FDR-X(43). The connecting circuit is held from FDR-X via the c-wire (42).

Stable phase: The following relays and verticals are operated: A-extension B-relay, B-relay for FDR-X, R2, S6, V1 (V3) and V2 (V4).

When the A-extension releases, S6 releases owing to the release of FDR-X. The B-relays and verticals concerned release.

#### FDR-X is engaged

The engaged condition is indicated by the fact that the B-relay (in this example B6) for FDR-X is operated. For the switching process see 3.6. If the A-extension has priority, this facility cannot be used in this case.



#### 4. CIRCUITS

Designations:

R2 23/24 = contact springs 23 and 24 of relay R2.

S5 1/2 = winding connected to terminals 1 and 2 of relay S5. The underlining indicates that the relay operates.

Resistors functioning as contact protectors are not referred to in the circuits.

1. +, D9 12/11, B4 12/11, La, A-extension telephone, Lb, B4 13/14, Lp 34/33, D8 1/2, D8 14/15, D9 34/33, D5 12/13, D6 12/13, D7 12/13, D8 12/13, R6 11/12, SNR2: S5 13/12, SNR1: rectifier (S5) 12/11, V1 11/12, -  
SNR1: S5 13/12, SNR2: rectifier (S5) 6 /11, V3 11/12, -
2. +, D4 13/12, D3 13/12, D2 13/12, D1 13/12/15/14, D1 1/2, B4 12/11, La, A-extension telephone, Lb etc. as per circuit 1.
3. +, D1 31/32, HA 1/2, -
4. +, D1 31/33, D8 31/32, H4 1/2, -
5. -, strap 1 between E7-E8, H4 16/15, strap 2, HA 15/16, R3 17/18, BP 14/13, R2 24/23, R1 2/1, +
6. -, D5-D8 22/21, SNR2: S5 16/15, SNR1: S5 16/15/18/17, S5 2/1, V1 14/13, S3 14/13, V2 11/12, +
7. -, R5 31/32, SNR2: S5 16/15, SNR1: S5 16/14, S5 2/1, S5 23/21, +
8. +, S5 21/22, S6 15/14, S1 3/4, motståndet (S2) 3/4, -
9. +, D9 15/16, BP 11/12, R5 23/24, S5 24/25, R3 12/11, V1 1/2, -
10. Example: Line 4 has called  
+, S5 21/22, V1 strip 42, Lb, telephone, La, V1 strip 41, S5 35/36, S3 11/12, V2 14/15, R4 1/2, -
11. Battery eliminator, wire SU, R13 12/11, R11-R7 32/31, R6 14/13, R4 4/3, R5 18/16, +
12. +, R5 12/13, R6 32/33, R4 26/24, R7 26/25, R11 22/21, R10 12/11, R9 12/11, R8 12/11, R6 35/34, R7 3/4, -
13. +, R5 12/13, R6 32/33, R4 26/25, R7 22/23, R11 33/34, R7 1/2, R8 3/4, -
14. +, R5 12/13, R6 32/33, R4 26/24, R7 26/24, R8 12/13, R8 3/4, -



15. +, R5 12/13, R6 32/33, R4 26/24, R7 26/25, R11 22/21, R10 12/11, R9 12/11, R8 12/13, R8 3/4, -
16. +, R5 12/13, R6 32/33, R4 26/25, R7 22/21, R8 15/16, R8 1/2, R9 3/4, -
17. +, R5 12/13, R6 32/33, R4 26/25, R7 22/21, R8 15/14, R9 15/16, R9 1/2, R10 3/4, -
18. +, R5 12/13, R6 32/33, R4 26/25, R7 22/21, R8 15/14, R9 15/14, R10 16/17, R11 3/4, -
19. +, R5 12/13, R6 32/33, R4 26/25, R10 14/15, R11 24/25, R11 1/2, R7 3/4, -  
R11 24/26, R12 34/35, R12 1/2, -
20. +, R5 12/13, R6 32/31, R8 37/38, R3 1/2, -
21. +, R5 12/13, R3 35/37, R2 27/28, R6 15/16, R13 14/13, HA 1/2, -  
R12 12/11, R8 18/17, H2 1/2, -
22. +, R5 12/13, R6 32/33, R13 34/35, R3 1/2, -
23. +, R5 12/13, R3 35/37, R2 27/28, R6 15/16, R13 16/17, HB 1/2, -  
R12 12/13, R9 36/35, H8 1/2, -
24. +, HB 11/12, H8 11/12, B16 16/15, rectifier (D7) 4/3, D9 1/2, -
25. +, D9 15/16, BP 11/12, R5 23/24, S5 24/25, R3 12/13, V2 1/2, -
26. +, S6 34/33, V2 strip 46, B16 1/2, -
27. Current supply set, wire RG S5 33/32, S1 16/15, S3 17/18, S4 16/17, resistor (S4) 17/4, S4 4/3, S2 32/31, S6 32/31, V2 strip 45, Lb, B-extension telephone, La V2 strip 44, S6 11/12, S2 21/22, S4 31/32, +
28. -, G2 11/12, wire RGi, S5 31/32, S1 16/15 etc. as per circuit 27
29. +, resistor (S1) 5/1, S1 1/2, S6 17/18, S5 34/35, V1 (V3) strip 41 (44), La, A-extension telephone, Lb, V1 (V3) strip 42 (45), S6 15/14, S1 3/4, resistor (S2) 3/4, -
30. +, resistor (S4) 32/1, S4 1/2, S2 22/21, S6 12/11, V2 (V4) strip 41 (44), La, B-extension telephone, Lb, V2 (V4) strip 42 (45), S6 31/32, S2 31/32, S4 3/4, resistor (S4) 4/17, S4 17/15, -
31. Example: Call to no. 18 via SNR1.  
+, HB 11/12, H8 11/12, B16 16/17, R3 34/33, rectifier (R1) 33/3, D9 36/35, S5 37/38, R1 12/11, S2 24/25, S3 1/2, -
32. +, HB 11/12, H8 11/12, B16 16/17, R3 34/33, R1 33/34, rectifier (D9) 4/3, D9 1/2, -
33. +, HB 11/12, H8 11/12, B16 16/17, R3 34/33, rectifier (R1) 33/3, D9 36/35, S5 37/38, R1 12/13, S2 37/38, S2 1/2, -

- 34. +, S1 33/34, S2 34/35, S4 5/6, -
- 35. +, V1 17/16, S3 16/15, S2 17/18, S1 32/31, S3 24/25, S3 4/3, -
- 36. +, R1 31/32, R2 21/22, rectifier (R1) 33/3, D9 36/35, S5 37/38, R1 12/11, S2 24/25, S3 1/2, -
- 37. +, R5 12/13, R3 35/37, R2 27/28, R6 15/16, R13 14/13, HA 1/2, -  
R12 12/13, R7 11/12, H6 1/2, -
- 38. +, R5 12/13, R3 35/37, R2 27/28, R6 15/16, R13 16/15, R12 31/32, R7 34/33, bygel 5, D9 22/21, BP 1/2, -
- 39. +, HA 11/12, H6 11/12, B6 16/15, rectifier (D7) 4/3, D9 1/2, -
- 40. +, R5 12/13, R3 35/37, R2 27/28, R6 15/16, R13 16/15, R12 31/32, R7 34/33, bygel 5, D9 22/23, S5 27/26, S6 3/4, -
- 41. +, S6 1/2, V2 strip 43, terminal G3, c-wire, relay in FDR-X, -
- 42. +, S6 1/2, V2 strip 43, terminal G3, FDR-X, terminal G4, B6 1/2, -
- 43. +, from FDR-X, La for line 6, V2 strip 41, S6 16/18, S5 34/35, V1 (V3) strip 41 (44), La for extension line, A-extension telephone, Lb for extension line, V1 (V3) strip 42 (45), S6 15/13, V2 strip 2, Lb for line 6, to negative on FDR-X.