

DIAGRAM NOTES (ISSUE 1)
for
NZPO 31864 Issue J
titled
BOTHWAY JUNCTION RELAY SET
OUT-OF-BAND
UAX NZ 13 (LIMITED FACILITY)

An explanation of the above circuitry is covered under the following headings:

1. GENERAL.
2. FACILITY SCHEDULE.
3. OUTLINE CIRCUIT OPERATION.
4. OPERATIONAL DETAILS.
5. CIRCUIT DESIGN NOTES.

1 GENERAL.

1.1 This diagram shows the circuit of a relay set used between an out-of-band system (MB Parent) and a UAX 13.

1.2 The diagram should be considered in conjunction with the following:

GBW 16660 or equiv.	UAX Final Selector
NZPO 29413 or equiv.	B/W Par. Term. RAX or UAX, OBS or Rural, Local Battery (Magneto) BMSB.
NZPO 33001 or equiv.	B/W Par. Term. OBS GS3 to UAX.
NZPO 32548 or equiv.	B/W Par. Term. OBS Central Battery BMSB

1.5 These notes describe the 4-wire version (sheet 6) which is a development of the original 2-wire relay set (sheet 1). While these notes apply directly to the 4-wire type relay set, they will also give guidance as to the principle of operation of the 2-wire relay set - bearing in mind possible changes in facilities or contact numbering, etc. Note that the 2-wire version does not provide for manual hold of a junction from a dependent remote "R" or "M" unit.

1.4 When used in association with a parent relay set (NZPO 29413 or equivalent) which requires pulsed type signals on the "M" (send) wire relay RT is used. Refer to Note 6.5 (sheet 6) of the circuit diagram.

2. FACILITY SCHEDULE.

Provision is made for:

- (a) An included 4-wire hybrid.
- (b) A 600-ohm hybrid 2-wire termination.
- (c) Seizure in the incoming direction via the "E" (receive) wire.
- (d) Seizure in the outgoing direction from selector level access.
- (e) Converting break-earth dial pulses on the "E" wire to loop-disconnect pulses.
- (f) Supervision.
- (g) Converting "trunk offer" and "re-ring" pulses on the "E" wire to an earth of appropriate duration on the "-1" wire.
- (h) A distinctive signal (ring tone) to indicate to the operator when a call is from a CCB subscriber.
- (i) Operator "Manual Hold".
- (j) Pulsed on continuous earth signals via the "M" (send) wire.

3. OUTLINE CIRCUIT OPERATION.

3.1 Outgoing Call.

A subscriber dials the required access digit and the group selector seizes a free outlet to this relay set. The "+2" and "-2" wires are looped, the "P2" and "ring start" wires are earthed.

The subscriber hears "ring tone". A "seize" earth signal is forwarded on the "M" (send) wire.

The operator answers and an earth signal is received on the "E" wire, the "ring start" earth and "ring tone" is removed and the circuit is made ready for conversation.

When the calling subscriber clears, a "clear" earth signal is forwarded on the "M" (send) wire.

The operator clears and an earth signal is removed from the "E" wire to initiate the release of this circuit.

If the operator clears before the calling subscriber, the circuit is forcibly released after a timed delay.

When a call is originated from a coin box, "ring tone" continues after the operator has answered the call, and the "ring" key must be operated momentarily to cut off this tone before speaking.

3.2 Incoming Call.

An earth signal is received on the "E" wire and the circuit prepares to receive dial pulses.

When dialling pulses are received, they are converted and forwarded as loop-disconnect pulses.

Supervisory Tones are heard without any change in this circuit. When the called subscriber answers, the polarity of the "+1" and "-1" wires is reversed, and a supervisory signal is forwarded to the distant CB type manual parent exchange. When the distant manual parent exchange is of the LB (magneto) type, the supervisory signal occurs when the called subscriber restores the polarity on the "+1" and "-1" wires.

The operator clears and the earth signal is removed from the "E" wire to initiate the release of this circuit.

If the called subscriber is "busy" and the operator "trunk offers", a "trunk offer" timed dis-earth pulse is received on the "E" wire. This circuit prepares for supervision and unbalances the loop to the UAX equipment and the call may be offered.

When the called subscriber clears, the reversal on the "+1" and "-1" wires is removed and a "ring off" signal is sent on the "M" (send) wire. The operator causes a "re-ring" earth pulse to be received on the "E" wire and this circuit unbalances the loop again and ringing is sent to the subscriber.

The circuit now functions as already described.

4. OPERATIONAL DETAILS.

(NOTE: The absence of relay contacts signifies that they are ineffective at that stage, or are spare.)

4.1 Outgoing Call (Regular Subscriber).

4.1.1 Seizure.

A subscriber dials the required access digit and the group selector seizes a free outlet to this relay set. The "-2" and "+2" wires are looped.

RELAY LA operates,

LA1 prepares "ring tone" for operator (for call from CCB), and preoperates relay LC.

LA2 connects "ring tone" to 570-ohm windings of relay LA and retard I.

RELAY LC operates,

LC1 connects earth "seize" signal to the "M" (send) wire (via D7); operates relays BA (via D6) and RT when used (via D8).

LC2 disconnects 600-ohm termination from transformer T1/T2.

Relay BA operates,

BA1 prepares relay BA hold circuit.

BA2 fast guards "P2" wire of selector bank(s) and disconnects picking battery from "P2".

BA3 completes earth to "ring start" wire.

BA4 prepares relay CB "hold" circuit (for call from CCB).

BA5 on CCB call, operates relay CB.

BA8 disconnects the "-1" and "+1" wires. (This prevents seizure of UAX equipment by the operator answering.)

Relay RT operates (slowly), (see para. 1.4)

RT2 disconnects the "seize" pulse, and prepares the "M" (send) wire for the "clear" pulse.

RT3 prepares relay PR holding circuit.

The "ring start" and "P2" wires are earthed; a "seize" signal has been forwarded to the distant manual board and the subscriber hears "ring tone".

Relays operated: LA, LC, BA and RT.

4.1.2 Operator Answers.

The operator plugs into the jack at the distant manual board and causes an earth "answer" signal to be received on the "E" wire.

Relay A operates (to the "answer" signal),

A2 operates relay B.

Relay B operates,

- B1 operates relay BC.
- B2 operates relay IG, and prepares operate circuit of relay RP.
- B3 completes relay BA hold circuit.
- B4 further opens picking battery "P2" wire.

Relay BC operates,

- BC2 operates relay BB (but not on CCB calls).
- BC3 further prepares the "M" (send) wire circuit (for "clear" pulse).
- BC6 prepares relay CD operate circuit.

Relay IG operates (slowly),

- IG1 prevents premature operation of relay TC.

Relay BB operates,

- BB2 disconnects earth from "ring start" wire.
- BB3 opens relay CB operate circuit, and provides holding circuit for relay BB.
- BB4) extends "-2" and "+2" wires to transformer T1/T2, and maintains
- BB5) relay LC from subscribers loop. A reversal of the potentials connected to the -ve and +ve wires is provided.
- BB6) } release relay LA.
- BB7) }

Relay LA releases,

- LA2 disconnects "ring tone" from 570-ohm winding of relay LA.

Earth is disconnected from the "ring start" wire and "ring tone" is disconnected from the calling subscriber and the circuit is prepared for speech.

Relays operated: LC, BA, RT, A, B, BC, IG and BB.

4.1.3 Calling Subscriber Clears.

When the calling subscriber clears, relay LC releases.

Relay LC releases,

- LC1 connects earth "clear" pulse to the "M" (send) wire, and releases relay RT.
- LC2 connects 600-ohm termination to T1/T2.

Relay RT releases (slowly),

RT2 disconnects the earth "clear" pulse from the "M" (send) wire.

A "clear" pulse has been sent to the distant manual board and this circuit remains in this "Manual Hold" condition until the operator releases.

Relays operated at this stage: A, B, BC, BA, BB and IG.

4.1.4 Operator Clears.

The operator removes the cord circuit plug from the distant manual board jack and causes the earth signal on the "E" wire to be disconnected.

Relay A releases,

A2 releases relay B, and operates CD.

Relay CD operates,

CD1 makes relay CD slow-releasing.

CD3 releases relay IG.

Relay IG releases (slowly), but its contacts have no function.

Relay B releases (slowly),

B1 releases relay BC.

B2 further releases relay IG (and prepares to operate TM if operator clears first).

B3 releases relay BA.

B4 prepares the picking battery on the "P2" wire for next call.

Relay BC releases,

BC2 opens relay BB operate circuit.

BC6 releases relay CD.

Relay BA releases,

BA2 disconnects guard earth to selector "P2" bank terminal and completes the picking battery.

BA5 releases relay BB.

Relay BB releases,

BB1 opens relay TM operate circuit.

BB3 prepares relay CB operate circuit (if next call CCB).

BB4) disconnect the transformer T1/T2 from

BB5) the "-2" and "+2" wires

BB6) connect relay LA to the

BB7) "-2" and "+2" wires.

Relay CD releases (slowly), but its contacts are ineffective.

The circuit is now normal.

4.1.5 Operator Clears First.

Relays operated during speech: LC, BA, RT, A, B, BC, IG and BB. Should the operator clear first, the earth signal on the "E" wire is disconnected.

As in para. 4.1.4 (Operator Clears), relay A releases and CD operates; relays IG, B and BC (and CD) release.

Relays operated at this stage: LC, BA, BB and RT.

After a timed interval, relay TM is operated from the "time pulse start" wire, via contacts BB1 and B2.

Relay TM operates,

TM1 connects relay TM to the "time pulse hold" wire.

TM2 connects relay PR to the "time pulse release" wire.

Approximately three minutes later, an earth on the "time pulse release" wire momentarily operates relay PR.

Relay PR operates,

PR1 holds relay PR to earth on contact RT3.

PR2 keeps relay A operate circuit open.

PR3 force released the calling subscriber.

The calling subscriber is forced released and held in the PG condition, isolated from this relay set. The earth on the "time pulse release" ceases (but PR is held to RT3) and relay IC releases.

Relay IC releases,

IC1 releases relays BA and RT.

IC2 connects 600-ohm termination to T1/T2.

Relay BA releases,

BA2 disconnects guard earth to selector "P2" bank terminal and prepares picking battery circuit.

BA4 disconnects relay CB holding earth (for call from CCB).

BA5 releases relay BB.

Relay BB releases,

BB1 releases relay TM.

BB3 prepares relay CB operate circuit (if next call CCB).

BB4) disconnect "-2" and

BB5) "+2" from T1/T2.

BB6) connect relay LA to

BB7) the "-2" and "+2" wires.

Relay RT releases (slowly) (LC1),

RT3 releases relay PR.

Relay PR releases,

PR2 prepares relay operate circuit.

PR3 completes picking battery on the "P2" wire for next call.

4.1.6 Outgoing Call (Coinbox Subscriber).

As described in para. 4.1.1, except that in this case, instead of a 2000-ohm battery, a 150-ohm battery is connected to the "M" (SCA1(21)) wire. This 150-ohm battery prepares the operate circuit of relay CB.

Relay CB operates,

CB2 completes relay CB hold circuit and disconnects relay BB operate circuit.

The circuit continues as in para. 4.1.1

When the operator answers the circuit functions as in para. 4.1.2 except that relay BB does not operate when relay BC operates, because relay (CB2) is operated. "Ring tone" is maintained to indicate to the operator that the call is from a coin box.

Relays operated: LA, LC, BA, RT, CB, A, V, BC and IG.

Before speaking, the operator must ring on the junction which causes a timed dis-earth pulse on the "E" wire to release relay A which in turn operates relay CD, which releases IG, and operates relay TC.

Relay TC operates,

TC1 prepares hold circuit for relay TC.

TC2 opens relay CB hold circuit.

Relay CB releases,

CB2 releases relay CB and operates relay BB.

When the timed dis-earth pulse ceases, relay A operates, relay RP operates and relays CD, RP and TC release and the call proceeds as in the normal manner.

4.2 Incoming Call.

4.2.1 Seizure.

When an operator plugs into the line jack at the distant exchange, a "seize" earth signal is received on the "E" wire.

Relay A operates (to the "seize" signal),

A2 operates relay B.

Relay B operates,

B1 operates relay BC.

B2 operates relay IG, and prepares operate circuit of relay RP.

B4 disconnects picking battery from "P2" wire.

Relay BC operates,

BC2 operates relay BB.

BC3 prepares the "M" (send) wire circuit (for "clear" pulse).

BC4 completes loop to the UAX equipment.

BC5 prepares to earth "-1" wire (for "trunk offer").

BC6 prepares relay CD operate circuit.

Relay IG operates (slowly),

IG1 prevents relay TC operating on first pulse.

IG2 removes the short circuit from contact A1 to allow pulsing.

Relays operated: A, B, BC and IG.

4.2.2 Dialling.

By dialling, the operator causes break-earth pulses to be received on the "E" wire and contact A1 pulses the UAX equipment. Relay CD operates on the first pulse and contact CD4 short circuits the hybrid transformer T1/T2.

Relay CD operates (during pulsing),

CD1 makes relay CD slow-releasing.

CD3 further prepares relay RP operate circuit.

CD4 short-circuits transformer T1/T2 to reduce pulse distortion.

As soon as contact A2 operates after the first break-earth pulse, the earth is removed from RPB and relay RP operates (via contact CD3).

Relay RP operates,

RP1 holds relay IG (IG's release lag prevents its release during the first dial pulse).

RP5 disconnects A2 earth from RPB, and makes relay RP slow-releasing.

At the end of the pulse train, relay A remains operated and relay CD releases slowly.

Relay A remains operated,

A1 holds the UAX loop.

A2 holds relay B.

Relay CD releases (slowly),

CD1 removes short circuit from CD to give fast-operate feature.

CD3 disconnects relay RP and maintains IG.

CD4 removes short circuit from transformer T1/T2.

Relay RP releases (slowly), but contacts have no function.

Relays operated: A, B, BC and IG.

Supervisory Tones are heard without any change in this circuit.

4.2.3 Called Subscriber Answers.

When the called subscriber answers, the polarity of the "-1" and "+1" wires is reversed by the UAX final selector.

Relay DA operates,

DA1 prepares to maintain the "M" (send) wire open, and operates relay RT. When RT is not used, DA1 connects earth to the "M" (send) wire.

DA2 disconnects 600-ohm termination from T1/T2.

Relay RT operates,

RT2 prepares the "M" (send) wire.

RT3 prepares relay PR hold circuit (if operator "clears" first).

Conversation takes place.

Relays operated: A, B, BC, IG, DA and RT.

4.2.4 Called Subscriber Clears.

When the called subscriber clears, the reversal is removed from the "-1" and "+1" wires.

Relay DA releases,

DA1 completes the "clear" earth signal to the "M" (send) wire, and releases relay RT. When RT is not used, DA1 removes the earth from the "M" (send) wire.

DA2 reconnects 600-ohm termination to T1/T2.

Relay RT releases (slowly),

RT2 disconnects the earth "clear" pulse from the "M" (send) wire.

A "clear" signal has been sent to the distant manual board and this circuit remains in this "Manual Hold" condition until the operator releases.

Relays operated: A, B, BC and IG.

4.2.5 Operator Clears.

The operator removes the cord circuit plug from the line jack at the distant exchange. The earth signal is removed from the "E" wire.

Relay A releases,

A1 opens the loop to the UAX equipment.

A2 releases relay B; operates CD, and short-circuits RP.

Relay CD operates,

CD3 releases relay IG.

CD5 prevents a "clear" signal to the "M" (send) wire if the operator clears first.

Relay IG releases (slowly), but its contacts have no function.

Relay B releases (slowly),

B1 releases relay BC.

B2 further releases relay IG (and prepares to operate TM if operator "clears" first).

B4 prepares the picking battery on "P2" for next call.

Relay BC releases,

BC2 releases relay BB.

BC6 releases relay CD.

Relay BB releases,
BB1 opens relay TM operate circuit.
BB3 prepares relay CB operate circuit (for CCB call).
BB4) disconnect the transformer T1/T2 from the
BB5) "-2" and "+2" wires.
BB6) connect relay LA to the
BB7) "-2" and "+2" wires.
Relay CD releases (slowly), but its contacts have no function.
The circuit is now normal.

4.2.6 Trunk Offer.

Relays operated at this stage: A, B, BC and IG.

If the called subscriber is "busy" and the operator "trunk offers", a "trunk offer" timed dis-earth pulse is received on the "E" wire. This pulse is sufficient to release relay IG but not B.

Relay A releases,
A2 operates relay CD and short-circuits RP.
Relay CD operates,
CD1 makes relay CD slow-releasing.
C 2 prepares relay TC operate circuit.
CD3 prepares relay RP operate circuit and releases IG.

Relay IG releases (slowly),
IG1 completes circuit to operate relay TC.
IG2 maintains loop to UAX.

Relay TC operates,
TC1 prepares hold circuit for relay TC.
TC3 further prepares to earth the "-1" wire.

As soon as the timed dis-earth pulse ceases, relay A operates.

Relay A operates,
A2 removes the earth from RPb and allows relay RP to operate; holds relay B, and releases relay CD.

Relay RP operates,
RP1 reoperates relay IG.
RP2 completes earth to the "-1" wire.
RP3 completes relay TC hold circuit.
RP5 makes relay RP slow-releasing.

Relay IG operates (slowly), but its contacts have no function.

Relay CD releases (slowly),
CD3 releases relay RP and holds IG.
CD4 removes short-circuit from transformer T1/T2.
CD5 prepares circuit for "clear" earth pulse to the "M" (send) wire.

Relay RP releases (slowly),
RP2 disconnects earth from the "-1" wire.
RP3 opens relay TC hold circuit.
RP5 removes short-circuit from RP to give fast operate feature.

Relay TC releases, but its contacts have no function.

The earth on the "-1" wire unbalances the loop to the UAX final selector and causes it to "trunk offer". Relays DA and RT will operate due to the reversed polarity from the UAX final selector on the "-1" and "+1" wires.

Relays operated: A, B, BC and IG.

The operator offers the call.

4.2.7 Re-ring.

When the subscriber clears, the reversal is removed on the "-1" and "+1" wires.

Relay DA releases,
DA1 completes the "clear" earth to the "M" (send) wire, and releases relay RT. When RT is not used, DA1 removes the earth from the "M" (send) wire.
DA2 reconnects 600-ohm termination to T1/T2.

Relay RT releases (slowly),

RT2 disconnects the "clear" earth pulse from the "M" (send) wire.

A "clear" signal has been sent to the distant manual board, and this circuit is now in "Manual Hold" condition.

The operators cord circuit supervisory lamp glows and the "ring" key is operated again and a "re-ring" timed dis-earth pulse is received on the "E" wire. As before, this pulse is sufficient to release relay IG but not B. Relay A releases.

The circuit functions as already described in para. 4.2.6 (Trunk Offer).

The earth on the "-1" wire unbalances the loop to the UAX final selector and causes it to "re-ring".

The circuit proceeds as already described in para. 4.2.3, etc.

5. CIRCUIT DESIGN DETAILS.

Relay B.

Slow releasing, to hold during pulsing.

Relay CD.

Slow releasing (due to short-circuit winding), to hold during pulsing.

Relay IG.

Slow operating, to prevent pulses being forwarded to the UAX in the event of the "seize" pulse being missed.

Slow releasing, to guard against release of exchange equipment on "trunk offer" and "re-ring" without unnecessarily "clipping" dial pulses.

Relay RP.

Slow releasing (due to short-circuit winding), to time "trunk offer" and "re-ring" pulse to exchange equipment (in conjunction with relay CD release lag).

Fast operate (without short-circuit) to guard against release of IG due to a series of pulses.

Relay RT

Only used when pulsed type signals are required (see para. 1.4). Slow operating, to time the "seize" and "clear" pulses to the "M" (send) wire.

Diode D2.

To isolate relay CB from any positive battery which in some circumstances may be connected to the "M" (SCA 1(21)) wire.

Diodes D3 and D4.

Allow the passage of current for seizure and holding purposes while short-circuiting relay DA(D3); and allows the operation of relay DA because of the reversed potential on the "+1" and "-1" wires when the called subscriber answers (D4).

Diode D5.

Makes relay BA slow releasing.

Diodes D6, D7 and D8.

Prevent interaction between respective circuits when contact IC1 is unoperated.

RX1 and RX2.

Non-linear resistors; provided to reduce sparking on contacts A2.

Design Line Limits.

The maximum resistance of the Rec ("E" wire) is 725 ohms.

The maximum resistance of the 4-wire "send" and "receive" speech wires and the "send" ("M") wire is determined by the carrier equipment.

END OF DIAGRAM NOTES