

DIAGRAM NOTES (ISSUE 2)

concerning

GBW.13910

titled

U.A.X. N.Z. 13 LINE FINDER AND LINE CIRCUITGENERAL

This diagram shows the circuit of a Line Finder and Subscriber's Line Circuit at a U.A.X. N.Z. 13.

Diagrams to be considered in conjunction with the above circuit include:

GBW 13890	Group Selector Circuit.
GBW 13980	Incoming Junction from Parent or Non Dependent Exchange.

All contacts not included under the operation or release of a component at a particular stage are ineffective at that stage.

FACILITY SCHEDULE.

The facilities provided by this circuit include:-

- .1 Finding of the calling line and connection to a Group Selector.
- .2 Connection of a call from a Junction through the control set to the Group Selector whilst the line finder search is continuing to reduce the risks of premature dialling on such calls.
- .3 Pre-operating a Group Selector circuit whilst Line Finder is hunting for a Local subscriber.
- .4 Extension of a discriminating signal to the Group Selector when the call is from a C.C.B. or Multi-party Subscriber.
- .5 Extension of a discriminating signal over the M wire on incoming Junction calls.
- .6 Congestion metering when all Line Finders are engaged.
- .7 Control set Lock out when faulty and operation of Alarm Circuit.
- .8 Selector lock out on failure of Vertical stepping.
- .9 Release alarm should the Line Finder fail to restore.
- .10 Pre-selection of Free Line Finder by the control relay set.
- .11 Prevention of Allotter Search when all Line Finders are engaged.
- .12 Routine testing.

CIRCUIT OUTLINE

This circuit is employed at a U.A.X. N.Z. 13 for the finding and direct connection to a Group Selector of all calls whether originated by a local subscriber or over a junction.

Each group of Line Finders serves a maximum of 50 local subscribers of which 10 may be C.C.B. and/or multi-party lines, and in addition 10 incoming junctions. The junctions are associated with levels 9 and 8 and the levels over which the call is routed being dependant upon the control relay set taken into use. Ordinary subscribers are distributed over levels 4 to 6 with multi-party line subscribers on level 3, but should C.C.B. subscribers require to be accommodated provision is made to connect them to level 2 in place of those ordinary subscribers normally connected to Level 3. Level 1 is employed for routine testing purposes.

On the initiation of a call a start signal is passed to one of the control relay sets, which allots a free Line Finder and controls the search of the selector for the calling party. When the calling party is found, the Line circuit is extended to a Group Selector and the control relay set is released, the allotter being stepped to the next free Finder.

1. CIRCUIT DETAIL

Call from Ordinary Local Subscriber

LS Relay Operating to calling loop from Subscribers instrument

- LS1 extends 150 ohm battery to operate relay ST in Control relay set via batt. R3, LS1, VMB/MR1 TB1, relay ST, RS6 to Earth.
- LS2 extends relay P circuit to the M lead.
- LS3 loops the appropriate P bank contact to the V.M.B. level to provide a rotary testing circuit.
- LS4 disconnects the K relay from the Final Selector multiple.

ST Relay Operating

- ST1 provides a stepping circuit for the allotter magnet.
- ST2 maintains the circuit for relay HA or HB in I/C Junction relay set subsequent to the operation of relay RS until the Line Finder has found the calling junction.
- ST3 transfers the control of the allotter from relay G to direct stepping under its own interrupters.
- ST4 completes a circuit for (testing) relay LK.
- ST5 completes the Ringer start Equipment.
- ST6 completes the "S" pulse circuit to relay TA.
- ST7 provides a hold circuit for relay TA.

The allotter next self-drives through its interrupters until a Free Line Finder is found and relay LK operates to the 150 ohm battery on the Group Selector Private.

LK Relay Operating

- LK1 prevents further energisation of the allotter magnet, holds relay LK and operates relay VR.

VR relay Operating

- VR1 operates relay H in the Line Finder circuit via earth VR1, VT1, RS3, allotter arc A4, rectifier MR1, NR2 springs, relay H, N2 springs, H3, RM magnet to batt.
- VR2) effective only on I/C junction calls.
- VR6)
- VR3 holds relay ST on its 6000 ohm winding.
- VR4 completes the vertical testing circuit (Relay VT).
- VR5 pre-operates the Group Selector A relay via earth JD3, VR5, allotter arc A1 over-wire to the Group Selector.
- VR7 provides for the handling of junction calls by the partner allotter during the period that the control set is engaged.
- VR8 disconnects the Control set from the TA Junction lead to prevent the Switching of other Junction equipment to it whilst it is engaged.

H relay Operating

- H1 completes the Vertical magnet circuit via earth VR1, VT1, RS3, allotter arc A4, H1, NR1 springs, VM1 springs, VM magnet to batt.
- H2 disconnects the testing battery from the P wire and connects an earth to the allotter arc A3 to busy the selector to other users.
- H3 provides an alternative circuit for relay H against the operation of the N springs.
- H4)
- H5) switch the -, +, M & P wires to the Group Selector
- H6) on the completion of finding.
- H7)

The line finder steps vertically under control of the Vertical Interrupter springs until the V.M.B. wipers arrive at the level from which the call has originated. On reaching the marked level relay VT operates to the 150 ohm R3 battery.

VT Relay Operating

- VT1 disconnects the vertical magnet circuit and operates relay RS.

RS relay operating

- RS1 provides an earth for the Rotary Testing circuit.
- RS2 ensures that relay JD shall hold until VR has released to preclude the possibility of an earth from JD3 being connected to the - wire during impulsing.
(Junction calls)
- RS3 releases relay H and provides a circuit for releasing relay ST on the Switching of the call.
- RS4 provides a holding circuit for relay RS on the release of relay VT.
- RS5 prevents the allotter being seized on an incoming junction call before relay JD has released.
- RS6 disconnects relay ST operate circuit and completes the Release Alarm Earth.

H relay releasing

- H3 extends the control of the Rotary Magnet to the Rotary Interrupter Springs.

The Rotary Magnet operates and steps the wipers into the bank.

The Rotary Interrupter Springs operating

RM1 disconnects the Magnet operate circuit and extend a battery via the rotary magnet to the V.M.B. wiper.

The line finder steps horizontally until the calling line is encountered whereupon battery from the Rotary magnet is extended via H3, N2 spring, RM1 spring, V.M.B. wipers, V.M.B., LS3, P arc/wipers 10 ohm H relay, A6 allotter arc/wipers, RS1 to Earth.

H relay operating

H1 extends an earth via NR springs to short circuit relay ST and energise the allotter magnet.
H3 provides a hold circuit for relay H over its 2000 ohm winding.
H4)
H5) switch the Private, M, -, +, leads to seize
H6) the Group Selector.
H7)

P relay operating to the earth returned over the M wire from the Group Selector.

P1 holds relay P on the release of relay LS.
P2 earths the P wire. (Final Bank.)
P3 operates relay K in series with the 10 ohm winding of relay H.
P4 prepares a circuit for holding relay P to the negative line in the Permanent Loop or Faulty Line Condition.

K relay operating

K1 disconnects relay LS operate path.
K2 disconnects earth from the positive line and extends earth to the subscriber's meter.
K3 holds relay P for the duration of the call and disconnects P.G. alarm condition.

LS relay releasing

LS1 disconnects the Line Finder start condition and releases relay VT.
LS2 prevents the operating cct. of relay P from short circuiting the meter.
LS3 disconnects the RM battery.

ST relay releasing (due to short circuiting condition being applied via H1 contact).

ST1 releases relay LK & VR.
ST3 completes a circuit for relay G to operate via earth, N3, allotter arc/wiper, A3, relay LK, Relay G, TJ7/8, ST3, OFR2, TB7, Adm, R4 to batt.

VR relay releasing

VR1 releases relay RS.
VR5 disconnects the pre-operate path of relay A in the Group Selector.

RS relay releasing

RS1 disconnects relay H hold path. Relay H now holds to the earth returned over the P wire from the Group Selector.
RS3 breaks the circuit for the allotter magnet which thereupon takes a step. If the allotter should step to an engaged Line Finder relay G operates to the earth present on the allotter banks.

G relay operating

G1 energises the allotter magnet.

The Allotter will then be stepped to the next Free Line Finder by the interaction of relay G and the allotter interrupter springs.

At this point the control set is positioned for the receipt of a further call, the switching of the original call being complete.

The Line Finder H relay and the Line Circuit K relay are held in series from the group selector guarding earth which is under the control of the calling Loop.

2. CALL FROM A C.C.B. SUBSCRIBER OR MULTI-PARTY SUBSCRIBER

C.C.B. subscribers are connected to outlets on level 2 of the Line finder. Multi-party subscribers connected as required to level 2 or 3.

The finding of the calling party proceeds in a similar manner to that described for ordinary subscribers. Normal post level springs operate on the Finder reaching level 2 and cause C.C.B. discriminating conditions to be extended from the 150 ohm R1 to the Group Selector via both springs NPA, NPB to the CBMP, and CBO leads respectively.

Multi-party subscriber calls proceed as above except that either level 2 or 3 can be used, and cause discrimination on the CBMP wire only.

3. INCOMING JUNCTION CALL

on receipt of an incoming Junction call a resistance loop is applied by the incoming equipment to terminals T and TA of Control Relay Set No. 1 and T and TB of Control Relay Set No. 2. Assuming that both control relay sets are disengaged, that Control Set which has been determined by the strapping of the incoming equipment as "First Choice" will be taken into use for the finding of the call.

In the junction relay set a low resistance earth is thereupon extended to the T lead. The leads ST and STR, are looped and the calling loop is connected across negative and positive leads to the control set.

JD relay operating (to low resistance earth)

JD1 prepares a holding circuit for relay JD.
JD2 prevents current drain on Junction calls.
JD3 changes over the 'A' relay pre-operate path to the pre-dial path on junction calls.

ST relay operating

ST1 provides a hold path for relay LK and an operating cct for relay VR.
ST4 operates relay LK.
ST5 connects a start earth to the ringing machine.
ST6 completes an operate circuit for relay TA to the 'S' pulse.
ST7 prepares a hold cct for relay TA

VR relay operating

- VR1 operates relay H (via earth, VR1, VT1, RS3, A4 allotter arc A4, MR1 rectifier, NR2 springs, 2000 H, N2 springs, H3, RM magnet to Batt.)
- VR2 extends marking conditions to the appropriate Vertical Marking Bank Level.
- VR3 completes a hold cct for relay ST.
- VR4 completes the vertical testing circuit
- VR5) extend the calling loop over the allotter arcs to the
- VR6) Group Selector.

The negative and positive lines of the junction are thus connected via the control relay set to a group selector, and dialling can be received while the Line Finder is searching for the calling line.

The search is controlled as described above for a Local Subscriber. The position of the calling equipment in the Finder Multiple is indicated by loop conditions between the "RM" common and the appropriate P wire and when encountered the K relay of the calling equipment operates to eth from group selector via 'M' wire and holds to the 'P' wire. The connection is established directly to the Group Selector over the Line Finder mutiple and the Control relay set is released.

4. OVERFLOW CONDITIONS

Relay OFB is held operated to the battery present on the Group Selector P wire as long as free Line Finders are available. When all are engaged relay OFB releases and providing the condition has not arisen due to artificial conditions applied during routine testing as evidenced by any one of keys KRT 1-0 being operated relay OFR will operate.

OFR relay operating

- OFR1 prepares a holding circuit for the congestion meter LFOM
- OFR2) disconnect the circuits of the allotter magnet and
- OFR4) prepare a circuit for the operation of the congestion meter on receipt of start signal.
- OFR3) disconnects the earth from the incoming junction TA lead.

ST relay operating at the start of a call

- ST1 operates the overflow meter which will thereupon hold until one or more line finders become disengaged.

5. C.S.H. AND PERMANENT LOOP CONDITIONS

Under the above conditions Time Pulse release of the Selector train is obtained and the circuit for relay K over the P wire is disconnected.

K relay releasing

- K1) maintain relay P via the subscriber's loop or
- K2) fault
- K3 operates the PG alarm

6. OPERATION UNDER FAULT CONDITIONS

Should a faulty control relay set fail to find or step a free Line Finder, relay TA will operate on the receipt of an 'S' pulse.

TA Relay operating

- TA1 provides a holding circuit for relay TA after the 'S' pulse period
- TA2 prevents the busying of the Line Finder under Control Set fault conditions. Its "make" action maintains relay VR operated during the operation of relay TB to the 'Z' pulse in order to prevent relay TA becoming locked at TB5.
- TA3 provides an operating circuit for relay TB to the 'Z' pulse
- TA4 prevents the operation of relay JD on incoming calls

TB relay operating (to 'Z' pulse)

- TB1 releases relay ST of the Faulty Allotter and operates relay ST of the partner allotter
- TB2 disconnects the holding circuit of relay ST
- TB3 holds relay TB at the completion of the 'Z' pulse if the other Control Set is not faulty.
- TB4 prepares a circuit for relay H on the release of relay TA.
- TB5 busies the Control Set to the incoming junction equipment and holds relay TA on release of relay ST
- TB6 completes a loop of the TA and TB leads to the partner control to allow the incoming junction equipment to test and switch on the partner allotter only.
- TB7 disconnects the pre-stepping circuit of the allotter in case the failure should be due to a faulty magnet.

7. FAULTY LINE FINDER SEIZED

Should a Line Finder be seized by the control set and fail to step, relay TA will operate on the receipt of the 'S' pulse; and relay TB will operate on the receipt of the 'Z' pulse.

TB relay operating

- TB1 releases relay ST
- TB4 prepares a circuit for the operation of relay H on the release of relay TA.

ST relay releasing

- ST6)
- ST7) release relay TA

TA relay releasing

- TA2 operates relay H in the line finder via earth, TA2, TB4, R3, relay VT, allotter arc/wiper A5, NR2 springs, relay H, N2 springs, H3, RM magnet to batt.

H relay operating

- H2 applies an earth to allotter arc A3 to prevent the faulty line being picked up by the partner allotter.

The faulty Line Finder and the control relay set are now locked out of service until maintenance attention is received.

8. ALLOTTER FUSE BLOWS

Each control set with associated allotter is served with an individual fuse and should the fuse blow due to a steady earth being maintained on the battery common the following circuit operations are obtained.

The earth is extended over the battery common through the allotter alarm lamp LP1, rectifier MRA, relay TB, to battery on the partner allotter.

TB relay operating

- TB1 transfers the start lead common to the ST relay in the partner allotter.
- TB4 operates relay H in the Line finder on which the allotter is standing in order to busy the selector.

Should the fuse have been blown by a momentary earth relay TB will not be operated until a call is received when an earth, via ST1 on to the battery common via the R4 resistor, will then be extended to operate relay TB as described above.

9. INCOMING CALL TO SUBSCRIBER

After the called party's line has been tested by the Final selector an earth is extended from the Final Selector to operate relay K in the Line circuit.

K relay operating

- K1 disconnects relay LS from the negative line
- K2 disconnects earth from the positive line

10. ROUTINE TESTING

Five "two-way" keys (KRT) are provided to enable all the levels of the Line Finder to be tested for satisfactory operations.

Routine Tests are normally carried out on level 1. While the associated KRT Key is held operated start conditions for relay ST are provided and the level marked on the Vertical Marking Bank.

The control set and Line Finder function as described above in the case of an ordinary subscriber, the Line Finder being stepped to the 11th contact of the marked level.

H relay operating (due to the VMB being strapped to the 11th P bank contact)

- H1 energises the allotter magnet
- H3 disconnects the Rotary magnet circuit
- H4)
- H5) extend the Line Finder wipers to the
- H6) Group Selector
- H7)

Should it be desired to hold the Line Finder of complete a test call a loop from the tester will have been applied to LF test springs 3 and 4. This loop will hold the Group Selector which in turn will hold relay H.

If no loop is applied to the test jacks relay H will release causing the selector to release and the allotter to step to the next free Line Finder which is similarly routined. This sequence of operation is maintained until Key KRT is restored.

11. TESTING OF ALLOTTER

The allotter is tested by transferring the Link from Test Jacks 5 and 6 to Test Jacks 1 and 2 and the connection of a tester to allotter test jacks at 1 and 2.

The allotter will drive continuously, operate and non-operate conditions being carried out from the tester during routing without interference to the normal working of the allotter. Should the control relay set be seized by a calling subscriber during the test the allotter will continue the search until a free Line Finder is encountered when relay LK will operate.

Relay LK operating

LK1 disconnects the Routine test circuit.

12. DESIGN DETAILS

- (a) The reasons for the employment of slow to release relays are as follows:-

Relay TA is required to cover the release of relays HA & HB in the Junction equipment under fault conditions. These would otherwise hold over TA⁴ and prevent the returning of signals from the junction equipment to the calling party.

Relay P is required to hold during the transit time of the K relay contacts and also to hold to Junction fault conditions etc.

- (b) The reason for the employment of rectifiers are as follows:-

Group Start rectifiers MR1, MR2, MR3, MR4 are required to prevent the start condition battery from being fed back via the start common to mark other levels on the VMB control relay set.

MR1 is employed to prevent the operation of relay TB in series with the lamp LP1 should an earth fault cause the blowing of the fuse on the partner allotter.

Line Finder

MR1 prevents the operation of the Vertical Magnet by earth from VR4 under fault conditions.

(c) The reasons for the use of diodes are as follows:

Diode D1 is used to prevent the erosion of contacts of relay B of selectors other than the associated group selector (GBW 13890-B5; GBW 15960-B3). If for some reason the relay P fails to operate, relay LS does not release, the allotter times out, and another linefinder drives vertical. The rotary magnet of the second L/F holds to the earth on the "P" wire.

This sequence recurs until all L/F are locked up. The diode D1 prevents the release of the relay H when the L/F vertical drive has stopped.

A simple test to detect faulty diodes D1 is as follows:

- (1) Plug relay "P" in the unoperated condition in a selected line-circuit.
- (2) Loop the selected line-circuit.
- (3) Allotted L/F will step vertical and rotary to the selected line (Note L/F No.).
- (4) Allotter will time-out because relay "VT" has not released.
- (5) 2nd L/F will step vertical only to the desired level, if the diode in it is satisfactory. If the diode is faulty, the L/F will step vertically to the desired level and then take one rotary step and the rotary magnet will remain operated.
- (6) This sequence recurs until all the L/Fs have been engaged.
- (7) If no L/F have gone rotary, release the line-circuit and repeat sequences (1) to (5), but commencing the test on a different L/F.
- (8) If one or more L/F have gone rotary, before releasing the line-circuit remove TJ 11 and 12 and insert into TJ 1 and 2 on the first L/F seized, this is to prevent damage to the seized G/S B3 contacts. Release the line-circuit then replace TJ 11 and 12. Diodes in these L/F should be changed.

Also, if B3 (B5) contacts are burning, all line-circuits in the "A" unit should be tested for proper operation of relays "LS" and "P".

Diode D2 is used to prevent the shunting down of the ANI identification +ve batt on local register systems.

END