



NEW ZEALAND POST OFFICE

TECHNICIANS TRAINING SCHOOL

UAX NZ TYPE 13 SYSTEM TRAINING
PART 1

ENGINEER-IN-CHIEF'S OFFICE
GENERAL POST OFFICE
WELLINGTON

(FOR OFFICIAL USE ONLY)

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SECTION 1 - CALLS BETWEEN ORDINARY SUBSCRIBERS

<u>Remarks</u>	<u>GBW 13910</u> <u>L/F & Control Cct</u>		<u>GBW 13890</u> <u>Group Selector</u>		<u>GBW 13900</u> <u>Final Selector</u>		<u>GBW 13910</u> <u>Called Sub</u>	
	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>
<u>Dial Tone. Relays Op:-</u>		P,K,H		A,B,CD,CC				
1st Digit - <u>V</u> of Selr Steps								
End of pulse train			CD					
<u>R</u> hunts for free final			CC					
Final selr picked; R dis				HX				
Caller extended to final				H,CC				
(HX rel by s/c)			HX			A		
P wire guarded by final			B			B		
(B (selr) slow to release)			CC			CD		
 <u>Await 2nd Fig: Relays Op</u>								
2nd Digit - <u>V</u> of Final steps			P,K,H		H			A,B,CD
End of pulse train								
(<u>CD</u> by s/c removed)						CD		E
								CD
 <u>Await 3rd Fig: Relays Op</u>								
3rd Digit - <u>R</u> of Final steps			P,K,H		H			A,B,CD,E
End of pulse train - called line tested.								
						CD		

SECTION 1 - CALLS BETWEEN ORDINARY SUBSCRIBERS

<u>Remarks</u>	<u>GBW 13910</u> <u>L/F & Control Cct</u>		<u>GBW 13890</u> <u>Group Selector</u>		<u>GBW 13900</u> <u>Final Selector</u>		<u>GBW 13910</u> <u>Called Sub</u>	
	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>
<u>1.1.1 Called Subscribers Line free</u>								
Called line guarded						H HR		K
(E slow to release)					E			
R.T. to caller; I.R to line; Ring Start						J,CD		
<u>Ringin; Relays Op</u>		P,K,H		H		A,B,CD,H,HR,J		K
Called Sub Answer; R.T and I.R dis						F		
TM dis								
(M - Subs Meter)		M						
Ring Start dis	M				J			
<u>Talking; Relays Op</u>		P,K,H		H		A,B,CD,D,E,F,H,HR		K
<u>1.1.2 Called Subscribers Line Busy</u>								
Called Line tested; Relays op		P,K,H		H		A,B,E		
Line Busy, H does not op								
(E slow to release)					E			
B.T to caller; Ring Start						G, CD		
(H & R dis)								
<u>Busy. Relays Op</u>		P,K,H		H		A,B,CD.G		

SECTION 1 - CALLS BETWEEN ORDINARY SUBSCRIBERS

1.2.3 Release from Talking (Assume Calling Sub releases first).

<u>Remarks</u>	<u>GBW 13910</u> <u>L/F & Control Cct</u>		<u>GBW 13890</u> <u>Group Selector</u>		<u>GBW 13900</u> <u>Final Selector</u>		<u>GBW 13910</u> <u>Called Sub</u>	
	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>
<u>Talking Relays Op</u> Calling Sub Release		P,K,H		H		A,B,CD,D,E,F,H,HR		K
L/F, G/S & F/S restore (P slow to release) (E & F slow to release)	K,H P		H		CD,H,HR,D E,F		K	

Conditions normal - If called sub has not release a 1st group self is seized and dial tone sent to line.
 For forced release from PG conditions see sections 3.1.2, 3.2,3 & 4.12

1.2.4 Release from Talking (Assume Called Sub releases first).

<u>Talking Relays Op</u> Called sub release; polarity of I/C line rev. <u>TM</u> from time pulse <u>G</u> from time pulse		P,K,H		H,	D	A,B,CD,D,E,F,H,HR TM G		K
L/F & G/S restore (E & F slow to release)	K, H		H		A B CD,H,HR E, F TM G		K	
F/S restore								

Conditions normal - If calling sub has not released when K releases, P holds on slow release feature.
 For forced release feature from PG conditions see also sections 3.1.2 & 4.12

END OF SECTION 1

SECTION 2 - CALLS TO PBX SUBSCRIBER

First read NOTE 6 for drawing re P2 multi-connections.

<u>Remarks</u>	<u>GBW 13900</u> <u>Final Selector</u>		<u>GBW 13910</u> <u>Called Sub</u>	
	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>
For earlier operations see Section 1.1				
<u>2.1 Assume First Line is Free</u> <u>Relays Operated on testing 1st Line (After 3rd Digit)</u>		A,B,E,HS		
Called Line guarded		H		K
(E slow to release)	E	HR		
		CD		
R.T to Caller; I.R. to Line; Ring Start	HS	J		
<u>Ringling Condition Relays Op</u>		A,B,CD,H,HR,J		
<u>2.2 Assume 1st Line Busy, Intermediate Line Free</u> <u>Relays Operated on testing 1st Line (after 3rd Digit)</u>		A,B,E,HS		
(E slow to release)	E	CD		
<u>R</u> of Final Selr operates and steps to 2nd line		G,H		K
(<u>G</u> when <u>RI</u>); R dis; Ring Start; Called Line Guarded	G	HR		
	HS	J		
R.T. to Caller, I.R. to Line		A,B,CD,H,HR,J		
<u>Ringling Condition Relays Op</u>				

SECTION 2 - CALLS TO PBX SUBSCRIBER

<u>Remarks</u>	<u>GBW 13900</u> <u>Final Selector</u>		<u>GBW 13910</u> <u>Called Sub</u>	
	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>
<u>2.3 Assume Last Line only Free</u> <u>Relays Operated on testing 1st Line (after 3rd Digit)</u> (E slow to release) <u>R</u> of Final Selr operates and steps to 2nd line (<u>G</u> when <u>RI</u>); R dis <u>R</u> of Final Selr operates and steps to 3rd line (last) (<u>G</u> when <u>RI</u>); R dis; Called Line Guarded R.T. to Caller; I.R. to Line <u>Ringin Condition Relays Op</u>	E G G HS	A,B,E,HS CD G G,H HR J A,B,CD,H,HR,J		
<u>2.4 Assume All Lines Busy</u> On last Line (<u>G</u> when <u>RI</u>) R dis H & G dis to P1; B.T. to Caller <u>"Busy" Condition Relays Op</u>	HS	A,B,CD,HS,G A,B,CD,G		

END OF SECTION 2

SECTION 3 - MISC FEATURES, SUBS LINE CCT, L/F & CONTROL CIRCUIT, GROUP & FINAL SELECTORS

3.1 Sub's Line Circuit, Linefinder & Control Circuit

Remarks

3.1.1 Overflow Conditions

Remain Operated as long as one selr is free
 All Selrs Busy
 Junction TA wire dis; A25 drive circuit dis
 Next call while all selrs busy
 Overflow Meter operates
 When a Selr becomes free
 A25 drives to free Selr & call proceeds normally
 Overflow Meter releases and O/F condition is registered

3.1.2 C.S.H. (Calling Sub Held) and Permanent Loop Conditions

Relays Op before release

Forward switch release (P wire disconnected)
 (P slow to release - held by subs loop); Earth to PG alarm circuit

"PG" Condition Relays Op

3.1.3 Faulty Control Relay Circuit

Progress of Call - TA to "S" pulse lead
 ("S" pulse earth) JD dis; TB to "Z" pulse
 ("Z" pulse earth) Faulty Allotter busied for all calls; A25 of faulty allotter dis
 Call proceeds using alternative Control Circuit

Relays Operated in Faulty Control Circuit

(If both TB's operated, cct closed to alarm by CA relay; both TB's release and first Control Circuit is tried again)

GBW 13910 Line Finder & Control Set	
<u>Rel</u>	<u>Op</u>
	OFB
OFB	OFB OFR ST LF/OM OFB
OFR LF/OM	
	K,P,H
K,H	
	P
	L,ST TA TB,LP
ST	ST (Alternate Control Circuit) TA,TB

SECTION 3 - MISC FEATURES, SUBS LINE CCT, L/F & CONTROL CIRCUIT, GROUP & FINAL SELECTORS

Remarks

3.1.4 Faulty Linefinder Seized

Progress of Call
 (From "S" and "Z" pulses)
 Call proceeds using alternative Control Circuit
 If 2nd TB operates, 1st TB releases after CA has operated
 Afterwards they interact when faulty Linefinder seized.
 Linefinder busied on A-3 arc until fault cleared
Relays Operated in Faulty Control Circuit & Linefinder

3.1.5 Allotter Fuse Blows

Fuse blows, TB operates to earth fault on battery common
 Linefinder and Control Circuit busied until fuse replaced
Relays Operated in Faulty Control Circuit & Linefinder
 When fuse replaced and link in TJ5-6 removed
 Conditions normal

<u>GBW 13910</u>	
<u>Line Finder & Control Set</u>	
<u>Rel</u>	<u>Op</u>
ST	L,ST,LK,VR
TA	TA,TB,LP
VR,LK	ST (Alternate Control Circuit)
	H
	TB,H
	TB
	H
TB	TB,H
H	

If fuse pulls, breaks or left out nothing happens until an attempt is made to call. Then ST operates, ST1 eth is extended to A25 or R4 500 ohms through to the battery common and control set light to the TB relay battery in the other control set. If the control set in connected to a free pre-selected free linefinder, LK operates and ST1 earth is extended through the LK and VR relays to the battery common.

3.1.6 Routine Testing

Five 2-way keys are provided (KRT's) for testing on any level required. Test are usually carried out on level 1 for routine tests.
KRT Control set and linefinder function as summarised in Section 1. SI operates. KRT marks the associated vertical level. P tags of the 11th step outlets are wired to the VMB. The routine test - & + wires on level 1 are wired to TJ3 and TJ4. If a test call is to be held, TJ3-4 must be looped with a buttinski when vertical stepping is competed to maintain the A relay in the group selector. If TJ3-4 are not looped, the call releases and the allotter steps to the next free linefinder for testing. Testing continues as long as KRT is operated. The continuity of the M wire is checked by a flash of the "LF TEST LAMP" when the call is extended to the group selector.

SECTION 3 - MISC FEATURES, SUBS LINE CCT, L/F & CONTROL CIRCUIT, GROUP & FINAL SELECTORS

3.1.7 Allotter Test

Transfer the link from TJ7-8 to TJ1-2 and connect tester to At1-2. A25 drives (if call comes in while testing, drive is disconnected at LK1 and call is extended. Test continues when control circuit is free after withdrawing link from TJ1-2 to release VR and LK, the replacing link).

3.1.8 Operation of Rotary Magnets

(i) Calling Conditions

When RS - RB (rack alarms) from RS6. RB - RA 0.4 ohm winding provides low resistance earth to RLSE ALARM EARTH common to operate rotary magnets when required.

(ii) Release Conditions

During calls H (Linefinder and Group Selector) and CD (Final Selector) are operated and RB (rack alarms) is energised. On release of call H and CD release. RB (rack alarms) is slow to release and remains operated long enough to maintain low resistance earth for rotary magnets of linefinder, group selector and final selector long enough for the switches to home.

NOTE If a switch is taken off normal in a rotary position when no call is being set up or is established, the switch will remain off normal until RB (rack alarms) is next operated when it will release normally.

3.2 Group Selector

Remarks

3.2.1 All outlets on a level engaged

Rotary Hunting Relays Op

R to 11th rotary step. R dis

O/F B.T. to Caller (via S springs); O/F condition registered

"O/F Busy" Relays Op

<u>Rel</u>	<u>GBW 13890</u> <u>Group Selector</u>	<u>Op</u>
	A,B	
	HX	
	CC	
	OF/M	
	A,B,CC,HX	

SECTION 3 - MISC FEATURES, SUBS LINE CCT, L/F & CONTROL CIRCUIT, GROUP & FINAL SELECTORS

Remarks

3.2.2 Spare Level Dialled

Vertical Stepping Relays Op

At End of pulse train CC held via VMB; R dis, NU Tone to Caller

"NU Tone" Relays Op

3.2.3 Forced Release

(a) From Permanent Loop - Relays Op

(CC - TP to TP Start lead)

(from TP Release)

V takes 1 step; N springs operate

R homes selector; when earth off P wire - K relay & P (calling sub) in PG condition

	<u>Rel</u>	<u>GBW 13890 Group Selector</u>	<u>Op</u>
		A,B,CC,CD	
	CD	A,B,CC	
		A,B,CC,CD	
		TM	
		H	
	A		
	B		
	CC		
	CD		
	TM		

SECTION 3 - MISC FEATURES, SUBS LINE CCT, L/F & CONTROL CIRCUIT, GROUP & FINAL SELECTORS

Remarks

(b) From "NU Tone" - Relays Op
 (CC - TP to TP Start lead)
 (from TP Release)

R homes selector; when earth off P wire - K relay & P (calling sub) in PG condition

(c) From "O/F Busy Tone" - Relays Op
 (CC - TP to TP Start lead)
 (from TP Release)

R homes selector; when earth off P wire - K relay & P (calling sub) in PG condition

	<u>Rel</u>	<u>GBW 13890</u> <u>Group Selector</u>	<u>Op</u>
		A,B,CC	
		TM	
		H	
A			
B			
CC			
TM			
		A,B,CC,HX	
		TM	
		H	
A,HX			
B			
CC			
TM			

3.2.4 Also see Section 3.1.8

- (i) When setting up calls, contact B4 maintains RB (rack relays).
- (ii) On release RB holds on its slug long enough to restore the selector.

SECTION 3 - MISC FEATURES, SUBS LINE CCT, L/F & CONTROL CIRCUIT, GROUP & FINAL SELECTORS

3.3 Final Selector (GBW 13900)

3.3.1 PBX "Night Service Calls"

- (i) Calls to the second or later line(s) are called direct so that PBX hunting conditions are not switched in.

3.3.2 Operation of Rotary Magnet

- (i) When setting up calls, contacts CD2 maintain the RB relay (rack relays).
- (ii) On release TB holds on its slug long enough to restore the selector.

END OF SECTION 3

SECTION 4 - COMMON EQUIPMENT, RINGING, TONES AND PULSES

Remarks

GBW 13720 Ringing Tones and Pulses

<u>Rel</u>	<u>Op</u>
------------	-----------

4.1 Relay Timing Chain

Earth on Ring Start wire; TA or TN

All timing relays attempt to operate - assume X & Z

1st series of operation in regular cyclic chain commence

Z	MS X,Z (<u>X</u>)
---	---------------------------

X	Y (<u>X,Y</u>) (<u>Y</u>)
---	-------------------------------------

Y	Z (<u>Y,Z</u>) (<u>Z</u>)
---	-------------------------------------

1st series of operation in regular cyclic chain concludes

2nd series commences

(One cycle of operations takes 200 mSec)

Z	X (<u>X,Z</u>) (<u>X</u>)
---	-------------------------------------

4.2 Ringing Current & Ring Tone

Earth on Ring Start wire.

± to CONT RING commons via TR6 (VB self interrupts)

(MP50 steps from X)

RE & RO on multiples of MP1 and MP2 arcs

Ringing alternately to ODD & EVEN INT RING commons;

R.T. and ringing leak to INT RING TONE via TR4

Ringing & R.T. dis; earth connected

RO,RE	MS Cyclic Chain VB,V3 MP50 RE,RO
-------	--

4.3 Dial Tone

Earth on TP Start wire

Dial Tone to DIAL TONE common

	TA MS V1
--	----------------

4.4 Busy Tone

Earth on MS wire

(MP50 steps from X)

XB on multiples of O/L's 4-5 of MP9 & MP10 arcs

Busy Tone to BUSY TONE commons

Tone dis; earth connected

(Cadence 500 mSec on/off)

XB	MS Cyclic Chain V1 & V2 MP50 XB
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SECTION 4 - COMMON EQUIPMENT, RINGING, TONES AND PULSES

<u>Remarks</u>	<u>GBW 13720</u>	
	<u>Rel</u>	<u>Op</u>
<p><u>4.5 NU Tone</u> Earth on TP start wire</p> <p>(MP50 steps from <u>X</u>) On multiples of O/L's 1-3 of MP9 & MP10 arcs ; NU tone to NU TONE commons (75 mSec on) NU tone dis (100 mSec off) NU tone to NU TONE commons (75 mSec on) NU tone dis (100 mSec off) NU tone to NU TONE commons (75 mSec on) NU tone dis (100 mSec off) NU tone to NU TONE commons (75 mSec on) NU dis (400 mSec off) (Cycle is repeated commencing on the next operation of PA)</p>	<p>PB PB PB PB PB PA</p>	<p>TA MS Cyclic Chain V1 & V2 MP50 PA PB PB PB</p>
<p><u>4.6 Overflow Busy Tone</u> Earth on TP start wire</p> <p>(MP50 steps from <u>X</u>) <u>XB</u> on multiples of O/L's 4-5 of MP9 & MP10 arcs O/F Busy Tone to O/F BUSY TONE commons Tone dis; earth connected (Cadence 500 mSec on/off)</p>	<p>XB</p>	<p>TA MS Cyclic Chain, V4 MP50 XB</p>
<p><u>4.7 Test Number Circuit</u> Test number cct is seized by dialling 811 for A-units 1 - 4 or 611 for A-units 5 - 8 or 411 for A-units 9 - 12</p> <p>(MP50 steps from <u>X</u>) (Tones as summarised above)</p>		<p>TN MS Cyclic Chain MP50</p>

If no fault, ringing tone voltages induced in TT & heard as inverted ringing tone by testing officer. If fault exists "all clear" tone is dis & tones as indicated in Table 1 are heard.

SECTION 4 - COMMON EQUIPMENT, RINGING, TONES AND PULSES

<u>Remarks</u>	<u>GBW 13720</u>		<u>GBW 13730</u>	
	<u>Ringling Tones and Pulses</u>		<u>Rack Alarms</u>	
	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>
<p><u>4.8 Release Alarm</u> (When a selector is in use) Selector release circuit completed (R of selr in series) Selector does not release; RB kept dis ("All Clear" tone dis; NU tone connected alarm lamp cct prep. The slow release of RB (GBW 13730) prevents the interruption of "All Clear" tone for normal releases.</p>			RB	RB RA
<p><u>4.9 Fuse Alarm</u> Fuse blows "All Clear" tone dis; NU tone connected</p>		RA FA		FA

Positive battery fuse and positive battery control fuses operate PFA or MFA. These in turn operate FA. Blown fuses in A-units & B-units have local fuse alarm relay FA. Blown fuses in C-unit operates MFA. Any operation of FA - "All Clear" tone dis; NU tone connected. Relative alarm lamp cct prepared in C-unit.

4.10 Control Alarm - CA (Local A-unit) operates LO (C-unit). "All Clear" tone dis; Ringing tone connected. Relative alarm lamp cct prepared in C-unit

4.11 PG Alarm - No relays. Direct Lamp indication when press button operated.

	<u>GBW 13720</u>	
	<u>Rel</u>	<u>Op</u>
<p><u>4.12 Forced Release</u> TM (Selr or Final) does not operate in series with 10000 ohm winding of TA TP25 steps (from MP arc)</p>		TA MS Cyclic Chain

When TP on O/L 3 - TM from TP2 arc and holds on TP HOLD wire; when TP on O/L 9 - H (selr), G (final), PR (junc) or B (revertive call cct) cause release to be effected from CSH condition.

SECTION 4 - COMMON EQUIPMENT, RINGING, TONES AND PULSES

<u>GBW 13720</u>	
<u>Ringing Tones and Pulses</u>	
<u>Rel</u>	<u>Op</u>
<p><u>4.13 Charge Fail</u> Charge fail from power panel "All Clear" tone dis, O/F Busy Tone Connected; CF alarm lamp cct prepared</p>	CF
<p><u>4.14 Lines Ceased, Unallotted or Temporarily Out of Service</u> Number picked by final. NUA trips ringing but D relay in final does not operate. NU Tone to caller <u>FA</u> to NUA contact</p>	TS NUA FA
<p><u>4.15 Meter Routine Test</u> Meter of line to be tested is patched to meter test set (when subs line free)(also <u>K</u> of subs set); NU tone to Test No. Cct Cyclic chain steps MP50; Tones & Ringing started <u>KOP</u> (when battery pulses from MP5 & 6 broken) ST locked (MP 5 - 6 pulse made)</p>	T MS,MTL,lamp RC,MRT relay ST A,(Sub's Meter)
<p>(MP 5 - 6 pulse broken) (MP 5 - 6 pulse made)</p>	<p>MTL,MRT relay, (Subs Meter),A</p> <p>MRT relay,MTL A,(Subs Meter)</p>
<p>(MP 5 - 6 pulse broken) For 10 pulses sub's meter operates 10 times while MTL flashes correspondingly. When 10 steps have been taken MRT relay releases ST, A & Subs Meter dis.</p>	<p>MTL,MRT relay, (Subs Meter),A</p> <p>MRT relay,MTL</p>
<p><u>KNP</u> remaining operations are the same as already summarised except that sub's meter should not operate with R4 resistance (1000 ohms) in series.</p>	MRT relay
<p>After 10 steps MRT contact breaks to release ST. A cannot operate & MRT holds until key KOP restored. MRT is forward acting.</p>	

SECTION 4 - COMMON EQUIPMENT, RINGING, TONES AND PULSES

TABLE 1

	Classification	Tone Signal	Alarm
1	Prompt	NU Tone Absence of Tone	Release alarm or fuse alarm or meter routine test cord left in
2	Alert No. 1	O/F Busy Tone	Charge Fail alarm
3	Alert No. 2	Ringing Tone	Control Set lock-out
4	Alerts No. 1 & 2	Busy Tone	Charge Fail alarm & Control Set lock-out
5	All Clear	Inverted Ringing Tone	All Clear

END OF SECTION 4

SECTION 5 - BOTHWAY JUNCTION TO MAGNETO PARENT EXCHANGE

<u>Remarks</u>	<u>GBW 14450</u>					
	<u>Rel</u>	<u>Op</u>				
<u>5.1 Ordinary Sub Calls Parent Exchange</u>						
Calls sub hears Dial Tone and Dials '0' - Group Selr hunts for and seizes a B/W junction on P wire.						
(<u>CC</u> in group selr)		WS				
JH banks P wire dis; CB does not op to 2000 ohm batt.						
(<u>LC</u> from subs loop)		DA,LC				
P wire to group selr guarded & held; WS held		B,DB				
Earth to Ring Start & Bal Ring Start; Ringing to line; DA dis but slow to rlse; PR dis from IDF & P1 wire earthed.		BA,DC				
CD locks and made slow to rlse; TM dis; Ring Tone to caller; Earth to Ring Start duplicated		CD				
(DA slow to release)	DA					
(DB & DC slow to release) Ringing dis from line; Ring Tone maintained.	DB,DC					
<u>Awaiting Operator to Answer - Relays Op</u>		WS,LC,B, BA,CD				
<u>Parent Exchange Answers</u>		A				
Earth of Ring Start wire; Ring Tone dis; TM still Dis	CD	BX				
DD locks		DB,DD,CJ				
CM locks		CM				
O/G call registered on count meter	CJ					
<u>Talking Condition - Relays Op</u>		WS,LC,B, BA,A,BX, DB,DD,CM.				

SECTION 5 - BOTHWAY JUNCTION TO MAGNETO PARENT EXCHANGE

Remarks

GBW 14450

Rel

Op

5.2 Releasals

5.2.1 Calling Party Clears first

Talking Condition - Relays Op

WS,LC,B,
BA,A,BX,
DB,DD,CM.

Calling Sub clears

LC

Earth to Ring Start; ring-off signal to line

DC

(DB slow to release)

DB

(DC slow to release) ring-off signal dis

DC

Awaiting operator to withdraw - Relays Op

WS,A,B,
BA,A,BX,
DD,CM

Operator Releases

A

(BX slow to release)

BX

(B slow to release) P wire dis & selr train released

B

P wire from JH banks normal

DD,
WS,
CM

(BA slow to release)

BA

SECTION 5 - BOTHWAY JUNCTION TO MAGNETO PARENT EXCHANGE

Remarks

GBW 14450

Rel

Op

5.2.2 Operator clears first

Talking Condition - Relays Op

A

WS,LC,B,
BA,A,BX,
DB,DD,CM.

Operator Clears

(BX slow to release) TM to Time Pulse wire

(DB slow to release)

(TM from TP Start & holds to TP Hold wire)

(PR from TP Release wire) P wire dis & selr train release

(LC release when subs loop is force released)

A

BX

DB

TM

PR

LC

B

CM,
WS,
DD

(BA slow to release)

BA

TM

Calling Sub left in PG condition

PR

SECTION 5 - BOTHWAY JUNCTION TO MAGNETO PARENT EXCHANGE

<u>Remarks</u>	<u>GBW 14450</u>					
	<u>Rel</u>	<u>Op</u>				
<u>5.3 Subscriber "Flashes" Operator</u>						
Talking Condition - Relays Op		WS,LC,B, BA,A,BX, DB,DD,CM.				
Subs' loop broken. Ring Off signal to line (for details see section 5.2.1. Relay left Operated		WS,A,B, BA,BX,DD, CM				
Subs' Loop remade		LC DB				
<u>Waiting for Operator to bridge connection - Relay Op</u>		WS,LC,A, B,BX,DD, BA,CM,DB				
<u>5.4 Coin-Box Caller (CCB)</u>						
Operation is similar to ordinary sub calling except that following the operation of <u>WS</u> and <u>B</u> , <u>CB</u> operates from the additional 150 ohm battery on the M wire. CB locks. Operation of call from ordinary sub is described in section 5.1						
<u>CCB Sub Calling - Relays Op</u>		WS,CB,LC, B,BA,CD				
Operator answers		A				
TM maintained dis	CD	BX				

SECTION 5 - BOTHWAY JUNCTION TO MAGNETO PARENT EXCHANGE

<u>Remarks</u>	<u>GBW 14450</u>		<u>GBW 13910</u>		<u>GBW 13890</u>		<u>GBW 13900</u>	
	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>
<u>5.5 Incoming Calls from Parent Exchange (Continued)</u>								
<u>R(L/F) hunts for calling trunk</u>			H			CC		
Trunk picked; R dis; -, +, P & M wires extnd to Grp Selr				H				
(K from M wire & holds via P wire) L/F Control set release started (See Part 1 for details) P wire to Grp Selr & J/H banks maintained dis; DD locks	HA,LS	K P,BX RC,DD	ST					
<u>Operator Hears Dial Tone - Relays Op</u>		A,K,BX,P, RC,DD		H		A,B,CC,CD		
<u>Operator Dials three digits required for local call</u>								
Operations are similar to those described in Part 1 Section 1.1 with the following additions :-								
(a) during each pulse train CD operates in junct cct to improve dialling conditions								
(b) Relay <u>TO</u> in final selr operates from pos batt on M wire from junc and locks. TO removes s/c from OC which is differentially connected and does not operate.								
<u>Ringin Condition - Relays Op</u> (Assume line Free)		A,K,BX,P, RC,DD		H		H		A,B,CD,H, HR,J,TO
Called Sub answer; Ringing & R.T. dis								F
Polarity on - & + wire from final selr reversed								D
(<u>D</u> from polarity reversal)		D DB CJ CM					J	E
Call registered on I/C Count Meter	CJ							
<u>Talking Condition - Relays Op</u>		A,K,BX,P, D,DD,DB, CM,RG		H		H		A,B,CD,D,E, F,H,HR,TO

SECTION 5 - BOTHWAY JUNCTION TO MAGNETO PARENT EXCHANGE

Remarks

5.6 Releasals

5.6.1 Called Sub clears first

(D releases from reversal of polarity from final selr
Ring Start wire earthed; Ring Off signal to Parent
Exchange; A held via DC4

(DB slow to release)

(DC slow to release) Ring Off signal dis

Awaiting operator to release - Relays Op

Operator Releases

Selr's Release

(BX & P slow to release)

If operator does not release, final selr releases on forced
release; L/F, G/S & Final release; P (junc) which is slow
to release hold to A which is held by operator

	<u>GBW 14450</u>		<u>GBW 13910</u>		<u>GBW 13890</u>		<u>GBW 13900</u>	
	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>
							D	
	D							
		DC						
	DB							
	DC							
		A,K,P,CM, RC,BX,DD		H		H		A,B,CD,E,F, H,HR,TO
	A						A	
							B	
	K		H		H		CD,HR	
	CM,DD						H,TO,	
	BX,P						E,F	
	RC							

SECTION 5 - BOTHWAY JUNCTION TO MAGNETO PARENT EXCHANGE

<u>Remarks</u>	<u>GBW 14450</u>		<u>GBW 13910</u>		<u>GBW 13890</u>		<u>GBW 13900</u>	
	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>
<p><u>5.6.2 Operator Releases First</u> Talking Condition - Relays Op</p> <p>Operator Releases BX slow to release; Loop held over BX2</p> <p>(DB slow to release); Selr's Release - See Section 1.2.3 for details. (P slow to release)</p> <p>Note : D does not release until after BX so that DC will not operate before DB releases and send Ringing to line.</p>		A,K,P,D, DD,DB,CM, RC,BX		H		H		A,B,CD,E,F, H,HR,TO
<p><u>5.7 Subscriber "Flashes" operator</u> Talking Condition - Relays Op</p> <p>Subs loop broken (D releases from reversal of polarity from final selr Ring Start wire earthed; Ring Off signal to Parent Exchange; A held via DC4 (DB slow to release) (DC slow to release) Ring Off signal dis Subs loop remade (<u>D</u> from reversal of polarity from final selr)</p>	A BX D DB,K CD,DD P,RC		H		H		A B	A,B,CD,E,F, H,HR,TO
		A,K,P,D, DD,DB,CM, RC,BX		H		H		A,B,CD,E,F, H,HR,TO
	D						D	
		DC						
	DB							
	DC							
		D						D
		DB						

SECTION 5 - BOTHWAY JUNCTION TO MAGNETO PARENT EXCHANGE

<u>Remarks</u>	<u>GBW 14450</u>		<u>GBW 13910</u>		<u>GBW 13890</u>		<u>GBW 13900</u>	
	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>
<u>5.8 Trunk Offering</u>								
Operator Calls Busy Subscriber - Relays Op		A,K,P,RC BX,DD		H		H		A,B,CD,G, TO
Operator operates ringing key to offer call (A is held by RS1)		RR RS						
+ & - wires to final self unbalanced (OC from unbalanced condition)	RC							OC F HR D,J
Busy Tone Dis; R.S. maintained; Polarity from Final Rev (D from polarity reversal)		D DB CJ CM					G OC	
I/C Call Count Meter operates	CJ							
Operator releases ringing key	RR RS							
Call Offered - Relays Op		RC A,K,P,RC, BX,D,DB, CM,DD		H		H		A,B,CD,D,F HR,J,TO
Call accepted & subs clears; called line seized Polarity reversed from final (D released by polarity reversal)	D						D	H
Ringing to Parent to indicate Called sub seized (DB Slow to release)	DB	DC						

SECTION 5 - BOTHWAY JUNCTION TO MAGNETO PARENT EXCHANGE

Remarks

5.8 Trunk Offering Continued)

(DC slow to release) Ringing to Parent dis
Operator operates ringing key to re-ring Called Sub

(A held by RS1)

+ & - wires to final selr unbalanced

(OC from unbalanced condition)

Ring Tone to junc; Ringing to Called Sub

Operator releases ringing key

(OC releases from balanced condition)

Ringling Called Line - Relays Op

Call proceeds from ringing to talking conditions as
described in section 2.1 with the exception that the I/C
Call Count Meter operated when the operator offered the
call.

<u>GBW 14450</u>		<u>GBW 13910</u>		<u>GBW 13890</u>		<u>GBW 13900</u>	
<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>	<u>Rel</u>	<u>Op</u>
DC							
	RR						
	RS						
RC							OC
						F	
RR							
RS							
	RC					OC	
	A,K,P,RC, BX,CM,DD	H		H			A,B,CD,H, HR,J,TO

SECTION 5 - BOTHWAY JUNCTION TO MAGNETO PARENT EXCHANGE

5.9 Barred Access (from other junction routes)

See drawing GBW 14450 Note 4. Relay WA can only operate from the positive battery of another trunk. Assume barred access is wired ie., T31 is strapped to T32. Operator using calling trunk obtains Dial tone from the UAX and dials barred access route - Group selr picks trunk and call proceeds until CC releases in group selr when pos battery from calling trunk operates WA in called trunk which locks - P wire opens and selr's released; DC dis to prevent ringing being sent on barred route. Calling operator will hold to PG condition until plug is withdrawn.

5.10 Operator Calling on Trunk - 1st Control R/S Busy

Assume No. 1 control R/S is wired for 1st preference. When call is made HA cannot operate as No. 1 R/S is already engaged. HB operates via VR7 or TB6 contacts of No.1 R/S; HB locks and HA dis. Call proceeds normally using No.2 R/S

5.11 Operator Calling on Trunk - Both Control R/S Busy

Call will wait until one control R/S becomes free when call will proceed using free Control R/S

5.12 Tandem Working

The remaining operations of bothway junction circuit GBW 14450 concern tandem working to dependant UAX's which are summarised in Part 3 of UAX No.13 literature prepared for Technicians Training Schools.

END OF SECTION 5

SECTION 6 - REVERTIVE CALL RELAY SETS

		<u>GBW 13770</u>	
		<u>Revertive Call Relay Set</u>	
		<u>Rel</u>	<u>Op</u>
<u>General</u>			
When 2-party line revertive calling only is required the code ringing equipment GBW 13760 is not equipped. During ringing periods the common equipment is maintained operated from the time pulse circuit. Subscriber bells are connected from earth to either the -ve or +ve wire.			
<u>6.1 Subscriber Calls Revertive Number (990)</u>			
Test Batt for HX or 1 grp selr from 150 ohm batt via TJ links 7 - 8			A
Calling Subs loop extended			B
P wire held and guarded; picking batt dis			BR
NU dis; TM connected to time pulse			CD
Ten's digit dialled; A follows pulse; CS to O/L 2; End of train			
TM dis	CD		
Alternative guard and hold on P wire; FD locks			FD
TM connected to time pulse			CD
			E
Unit's digit dialled; A follows pulses; CD to O/L 12; End of train			
TM dis	CD		
Calling Subs hangs up	A		
	B		
	BR		
<u>H</u> locks; line wires to ringing via F; <u>RS</u> to REV RING PULSE			H
TM connected to time pulse			
(E slow to release)	E		
<u>CONT RING to - wire - Relays Op</u>			FD,H
<u>CONT RING to + wire - Relays Op</u>			FD,H,RS
RS operates and releases to Rev Ring Pulse; Parties rung alternately.			
Called Sub Answers; Ringing dis; F locks			F
			A
			B
			BR
TM dis	H		
	F		
<u>Talking Condition - Relays op</u>			A,B,BR,FD

SECTION 6 - REVERTIVE CALL RELAY SETS

		<u>GBW 13770</u>	
		<u>Revertive Call Relay Set</u>	
		<u>Rel</u>	<u>Op</u>
<u>6.2 Release</u>			
Both parties restore	A B BR FD		
CS homes; guard earth of P wire to release selr train; P wire batt reconnected when CS normal			
<u>6.3 Wrong Ten's digit dialled (0 - 8)</u>			
Condition when ten's dialled (A pulsing and CS stepping)			A,B,BR,CD
End of impulse train	CD		
TM to time pulse; NU tone to caller			NU
<u>6.4 Wrong Unit's digit dialled (1 - 9)</u>			
Condition when units dialled (A pulsing abd CS stepping)			A,B,BR,CD,FD, E
End of impulse train	CD		
TM to time pulse; NU tone to caller			NU
<u>6.5 Time Pulse Release</u>			
(i) Sub does not dial ten's digit - Relays Op			A,B,BR,CD
(<u>TM</u> from Time Pulse Start & Hold wire)			TM
(<u>TMR</u> from Time Pulse Release wire)	B BR FD CD A,TM TMR		TMR
Guard earth of P wire to release selr train			
(ii) Sub does not dial unit's digit - Relays Op			A,B,BR,CD,FD, E
(<u>TM</u> from Time Pulse Start & Hold wire)			TM
(<u>TMR</u> from Time Pulse Release wire)	B FD CD A,E TM TMR		TMR
Guard earth of P wire to release selr train			
(E slow to release)			
CS homes			

SECTION 6 - REVERTIVE CALL RELAY SETS

(iii) Called Sub does not answer - Relays Op
 (TM from Time Pulse Start & Hold wire)
 (TMR from Time Pulse Release wire)
 TM dis
 Guard earth of P wire to release selr train
 CS homes

<u>GBW 13770</u>	
<u>Revertive Call Relay Set</u>	
<u>Rel</u>	<u>Op</u>
	FD,H
	TM
	TMR
H	
TM,FD	
TMR	

END OF SECTION 6

SECTION 8 - LINE TESTER (GBW 13870)

7.1 RANGE OF UAX SUBSCRIBER NUMBERS

Units A1 & A2	800 - 899	
Units A3 & A4	700 - 799	
Units A5 & A6	600 - 699	
Units A7 & A8	500 - 599	or 'R' Unit Subscribers
Units A9 & A10	400 - 499	} Wall Type MDF
Units A11 & A12	300 - 399	} Wall Type MDF

7.1.1 TYPE 13R UNIT

A type 13R-Unit, attached or unattached, can be installed by using Level 5.

7.1.2 SUBSCRIBERS LINE CIRCUITS

Any number on a UAX can be jumpered on the IDF to use any subscriber's line circuit.

Any number can be used for CCB or MP line connections by jumpering it on the IDF to a subscriber's line circuit of a fifth relay plate in any A-Unit (ie., Line Finder Level 2 & 3). In the case of M-Lines on flat rate, any line circuit could be used.

Meters are numbered consecutively and subscriber's line circuits are directly associated. When metering is used, it is usual to have numbering of ordinary subscribers straight.

2-Party, with separate metering (Shared Service), is the normal facility (written in Specs as 2-party as distinct from multi-party). Shared Service uses two subscribers line circuits for separate metering, but when flat-rate (no metering) a 2-party line can use one-line circuit and two numbers on the final selector multiple.

Shared service line numbers are allotted so that the "X" party is an even number and the "Y" party the next odd number. Adjacent subscriber's line circuit's on the same relay plate should be utilised either vertically or horizontally.

This implies that while it is possible to ascertain the particular calling subscriber's line circuit from the position stepped to by a line finder, number allocation charts must be prepared to indicate the number of the calling line (or trunks on levels 8 & 9).

7.1.3 PBX NUMBERS

Individual numbers making up PBX groups are selected from any adjacent numbers on any one level of any "one hundred" group.

At present all Final Selectors are PBX type, but as there are so few PBX groups in UAX's ordinary finals will be used in future, unless specifically required.

SECTION 8 - LINE TESTER (GBW 13870)

7.1.4 SERVICE TELEPHONE, FAULT TEST NUMBERS & ROUTINE TEST NUMBERS

Units A1 & A2

810	Service Telephone Number	} Also used as Routine Test Numbers
811	Fault Test Number (For Units A1 - A4)	
812	Routine Test Number	

Units A3 & A4

710	} Routine Test Numbers
711	
712	

Units A5 & A6

610	Routine Test Number	} Also used as Routine Test Number
611	Fault Test Number (For Unit A5 - A8)	
612	Routine Test Number	

Units A7 & A8

510	} Routine Test Numbers
511	
512	

For units 13R dial all except the last figure of any R-Unit Number then Trunk Offer. Alarm tone will be heard. The Standard fault test number is 59.

7.2 EXPLANATION OF LINE FINDER AND GROUP SELECTOR LEVELS

7.2.1 LINE FINDER LEVELS

0	Not Used	
1	Special and Routine Test (11th Step)	
2	} Alternatives of :-	CCB ; CCB ; MP
3		ORD ; MP ; ORD
4	} Ordinary Subscribers	
5		
6		
7		
8	I/C calls from Parent Exchange via B/W Junc Relay Sets or	
9	I/C calls from 13R-Unit via I/C Junc Relay Sets	

ODD-numbered levels normally use No. 1 Control Set as first choice.
EVEN-numbered levels normally use no. 2 Control Set as first choice.

SECTION 8 - LINE TESTER (GBW 13870)

7.2.1 LINE FINDER LEVELS

0	"0" Calls to Parent Toll
1	"1" Calls to Parent Auto
2	}
3	} Auxiliary Junction Routes or Subs Final Selr Groups
4	}
5	500 - 599 Subs Final Selr Group or 13R-Unit
6	600 - 699 Subs Final Selr Group
7	700 - 799 Subs Final Selr Group
8	800 - 899 Subs Final Selr Group
9	2-Party or M-Party Revertive Relay Sets

7.3 EXAMPLES OF LEVEL "0" TRUNK SELECTION AND ALLOCATION OF I/C TRUNKS

EXAMPLE 1

Outgoing Calls (Level 0)	Shelf E	Trunks 1, 2, 3,10
	Shelf F	Trunks 2, 1, 3,10
Incoming Calls	Unit A1	Trunk 1
	Unit A2	Trunk 2
	Unit A3	Trunk 3
	Unit A4	Trunk 4
	Unit A5	Trunk 5
	Unit A6	Trunk 6
	Unit A7	Trunks 7, 10
	Unit A8	Trunks 8, 9

Light Traffic between UAX and Parent Exchange.

EXAMPLE 2

Outgoing Calls (Level 0)	Shelf E	Trunks 1, 3, 5,12
	Shelf F	Trunks 2, 4, 5,12
Incoming Calls	Unit A1	Trunks 1, 12
	Unit A2	Trunks 2, 11
	Unit A3	Trunks 3, 10
	Unit A4	Trunks 4, 9
	Unit A5	Trunks 5, 8
	Unit A6	Trunks 6, 7

Only 6 A-Units provided but traffic between UAX and Parent Exchange heavier than Example 1.

Note : ODD-numbered trunks wired for LEVEL 9 and for first preference use No. 1 Control Set.
EVEN-numbered trunks wired for LEVEL 8 and for first preference use No. 2 Control Set.

END OF SECTION 7

SECTION 8 - LINE TESTER (GBW 13870)

Test	TESTER KEYS															REMARKS
	IN	OUT	REV	TEST BELL	RING IND/2P	ETHG	RING MP	VM	VM BATT OFF REC NEG	VM REV	SPK BATT	DIAL TEST	TEST CCT SPEAK	HOLD SERV LINE	HOLD TEST	
1.													√			Normal Test of lines All Keys normal; patch line to be tested to line tester using tester cord and plug. From service telephone (810) check that line is free
2.	√												√			D.T. heard; test bell across service line. 810 dialled - R.T. heard; test bell rings.
3.								√								A reading on meter indicates an earth on the B wire
4.		√	√					√								A reading on meter indicates an earth on the A wire
5.		√	√			√		√								A reading on meter indicates a loop. Operating REV key should give a momentary meter reading
6.		√						√	√							A reading on meter indicates a foreign battery on B wire
7.		√	√					√	√							A reading on meter indicates a foreign battery on A wire
8.																<u>Ring Sub of Line Under Test :-</u>
8.1		√			√											Ringing to Individual line
8.2		√			√											Ringing to "X" sub of 2-Party line
8.3		√	√		√											Ringing to "Y" sub of 2-Party line
8.4		√					√									Ringing to M-Party line (Operate KMP by hand to send correct code)
9.		√									√		√			When sub answers check quality of ring received and speech bothways
10.		√									√	√	√			Sub dials "0" - 10 impulses registered; check dial speed is 9 to 11
11.																All keys normal. Sub dials 810 and is answered on service telephone

SECTION 8 - LINE TESTER (GBW 13870)

Test	TESTER KEYS															REMARKS
	IN	OUT	REV	TEST BELL	RING IND/2P	ETHG	RING MP	VM	VM BATT OFF REC NEG	VM REV	SPK BATT	DIAL TEST	TEST CCT SPEAK	HOLD SERV LINE	HOLD TEST	
1.		√		√												Test Bell Rings if line looped or B wire earthed
2.										√						To be used when a reverse reading is shown on meter
3.															√	Hold condition across test circuit while telephone is used to answer incoming call on 810
4.														√		Hold condition across service line while telephone is used across test circuit
5.																<u>Tests to Measure Loop Resistance</u> S/C OUT terminals of tester; VM = "D" in formula below Line looped (Telephone loop or S/C where reqd) VM = "D1" in formulae : Loop $R = 5000 \left(\frac{D}{D1} - 1 \right)$
5.1		√				√		√								
5.2		√				√		√								
6.																<u>Tests to Measure Line Leakage Resistance</u> S/C OUT terminals of tester; VM = "D" in formula below VM = "D1" in formula; Test of B wire insulation VM = "D1" in formula; Test of A wire insulation VM = "D1" in formula; Test insulation between wires Insulation $R = 5000 \left(\frac{D}{D1} - 1 \right)$
6.1		√				√		√								
6.2		√						√								
6.3		√		√				√								
6.4		√				√		√								
7.	<u>Calculation of Earth Connection Resistance</u>															
7.1	S/C at Lightning Guard and measure loop resistance (as in test 5 above)															
7.2	Calculate resistance of B wire by dividing value received in 7.1 by 2															
7.3	Remove S/C at Lightning Guard and measure resistance of B wire and earth (B wire earthed at Lightning Guard)															
7.4	Calculate resistance of earth by subtracting value from test 7.2 from value from test 7.3															

END OF SECTION 8

SECTION 9 - LINE TESTER (GBW 13710)

Test	TESTER KEYS										REMARKS	
	IN	OUT	RING	REV	ETHG	VM	VM B.C.O	VM REV	DIAL TEST	SPEAK		
1.												Normal Test of lines All Keys normal; patch line to be tested to line tester using tester cord and plug. From service telephone check that line is free
2.	√											Handset lifted and button depressed on telephone & D.T. heard. 810 dialed (if attached R-Unit) R.T. heard and bell of 810 rings. If not on attached R-Unit another No. on R-Unit should be dialed and Called No. advised "Exchange is Testing"
3.		√				√						A reading on meter indicates an earth on B wire
4.		√		√		√						A reading on meter indicates an earth on A wire
5.		√			√	√						A steady reading indicates continuity of line & telephone instrument. The correct reading for each line should be recorded. A high reading which slowly subsides to normal indicates low insulation between wires
6.		√				√	√					A reading on meter indicates a foreign battery on the B wire
7.		√		√		√	√					A reading on meter indicates a foreign battery on the A wire
8.		√	√								√	Operate RING key to send correct code to subscriber required. Check quality of ring received and speech bothways. Ask sub to depress button on telephone and by means of test 3 & 4 above check that earth indications on both wires are the same. Have sub prepare for test 9
9.		√							√	√		Sub dials "0" - 10 impulses registered; check dial speed is 9 to 11
10.												All keys normal. Sub dials service line number (810 if an attached R-Unit) or any other number if available. Tests complete.
11.												<u>Tests to Measure Loop Resistance</u>
11.1		√			√	√						S/C OUT terminals of tester; VM = "D" in formula below
11.2		√			√	√						Line looped (Telephone loop or S/C where required); VM = "D1" if formula below Loop R = $5000 \left(\frac{D}{D1} - 1 \right)$

SECTION 9 - LINE TESTER (GBW 13710)

TESTER KEYS											REMARKS
Test	IN	OUT	RING	REV	ETHG	VM	VM B.C.O	VM REV	DIAL TEST	SPEAK	
12.		√			√	√					S/C OUT terminals of tester; VM = "D" in formula below VM = "D1" in formula; Test of B wire insulation VM = "D1" in formula; Test of A wire insulation VM = "D1" in formula; Test of insulation between wires Insulation $R = 5000 \left(\frac{D}{D1} - 1 \right)$ NOTE : Subscribers instruments should be disconnected during tests for line leakage and tested separately if required
12.1		√				√					
12.2		√		√		√					
12.3		√			√	√					
13.	<u>Calculation of Earth Connection Resistance</u>										
13.1	S/C at Lightning Guard and measure loop resistance (as in test 11 above)										
13.2	Calculate resistance of B wire by dividing value received in 13.1 by 2										
13.3	Remove S/C at Lightning Guard and measure resistance of B wire and earth (B wire earthed at Lightning Guard)										
13.4	Calculate resistance of earth by subtracting value from test 13.2 from value from test 13.3										

END OF SECTION 9

SECTION 10 - ROUTINE TEST SET (GBW)