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P.A.B.X. EQUIPMENT APPROVAL TESTING

Engineering Works Division, Headquarters, Melbourne.

COMMONWEALTH OF AUSTRALIA

POSTMASTER-GENERAL'S DEPARTMENT
HEADQUARTERS

APO SPECIFICATION 1081 (ISSUE 1)
FOR
PABX EQUIPMENT APPROVAL TESTING

CONTENTS

CONTENTS (CONTD.)

PABX EQUIPMENT APPROVAL TESTING
SECTION 1. INTRODUCTION AND GENERAL

1.1 Scope

(i) This Specification standardises approval test conditions for the more important network interface standards stipulated in APO Specifications 1080 and 1105. Some other miscellaneous requirements of these Specifications are also covered. Reference should be made to Specifications 1080 and 1105 for the design objectives required.

(ii) The tests covered in this Specification are not for use during acceptance testing of complete installations in field situations; they are for use during examination of systems for compliance with design objectives.

(iii) Test circuits have been presented in 3 groups.

(a) Transmission Tests.

(b) Decadic Pulsing Tests.

(c) Other signalling Tests.

1.2 General Requirements

(i) The ambient temperature for all tests shall be recorded in degrees Celcius.

(ii) The voltage applied to equipment shall be the nominal voltage for the system (50V) unless otherwise specified. Where tests specify minimum and maximum voltages, they shall be the manufacturers minimum and maximum design voltages.

(iii) The accuracy of meters and components in the test arrangements shall be better than 1%.

(iv) The test circuits shall be protected from external interference using shields, earth connection, etc., where appropriate.

(v) The adjustments to components in the items under tests shall be in accordance with the manufacturer's design specification.

(vi) The mounting of items under test shall be equivalent to their normal operating position in working equipment.

(vii) Where two or more items may affect the results of a test, they shall be associated and tested simultaneously. Results shall not be synthesised from independent readings.

(viii) Where the results of a test are marginal, i.e. close to the acceptable limit, a second and third sample item of the same type shall be tested and all of the results recorded.

(ix) Where results are identical for tests on different classifications of exchange line circuits, one set of results may be recorded on the CE-99033 sheets provided that all different classifications are indicated on the same sheet.

(x) Where the following sections specify the testing of exchange line circuits, tie line circuits, shall also be tested accordingly.

SECTION 2. TRANSMISSION TESTS

2.1 Reference Equivalent of PABX Transmission Circuits

(i) Reference equivalents shall be measured either

(a) using the Bruel and Kjaer Electroacoustic Transmission Measuring Equipment, in accordance with "Bruel and Kjaer, Instructions and Applications Type 3350/51". or

(b) any other approved method.

(ii) Transmit, Receive and Sidetone reference equivalents of the operator's transmission circuit, shall be measured for line lengths 0, 0.5, 1, 2, and 3 miles of 41b/mile cables and graphed on CE-99033 Sheet 1.

(iii) The transmit Receive, Sidetone and Overall reference equivalent for an extension to extension connection shall be measured at a line length of 0.1 mile.

(iv) Results shall be recorded on CE-99033 Sheet 1 in dB.

2.2 Insertion Loss

(i) Insertion loss shall be measured for all types of exchange lines circuits. Test conditions shall be in accordance with Fig. 1.

(ii) Circuit conditions:-

(a) Speaking normal - extension to public exchange

(b) Speaking operator - operator only to public exchange, the operator's circuit replaced by the test circuit.

(c) Monitoring operator - the insertion loss between the extension line terminals and the exchange line terminals shall be measured whilst the operator's circuit is monitoring the call.

(d) Any other condition which may interpose the exchange line circuit between the public exchange and an extension line or operator shall be measured.

(iii) The accuracy of the readings is to be ±0.05 dB in 0.1 dB steps.

(iv) The results shall be tabulated on CE-99033 Sheet 2.

2.3 Impedance Regularity

(i) Return loss shall be measured for all types of exchange line circuits. Test conditions shall be in accordance with Fig. 2.

(ii) Circuit conditions:-

(a) Speaking normal - extension to public exchange.

(b) Speaking operator - operator only to the public exchange, the operator's circuits to be complete but the transmitter and receiver may be mechanically muted to prevent interference to the measurements. A suitable resistor may be used to replace the operator's transmitter.

(c) Monitoring operator - extension to public exchange with the operator's circuit monitoring (listening) to the call.

(d) Enquiry - whilst holding a public exchange call if it is possible for the extension to initiate another call to the operator or another extension or another exchange line, the terminating condition of the public exchange call shall be measured.

(e) Transfer - if it is possible to pass an established public exchange call from one transmission termination to another, i.e. between extensions, operators or hold circuits in any combination, a measurement shall be taken during the transfer.

(f) Holding - switchboard to public exchange with the operator's hold circuit operated.

(g) Any other exchange line terminating condition that may occur between the end of signalling of a public exchange call and clearing shall be measured.

(iii) The accuracy of readings shall be ± 0.25 dB in 0.5 dB steps.

(iv) The results shall be tabulated on CE-99033 Sheet 3.

2.4 Balance to Earth

(i) Test condition in accordance with Fig. 3.
Voltage measurements shall be taken across both sides of the transmission circuit, each being terminated in 600 ohm non-reactive impedances. Obtain voltage readings (EM) at BB and B_1B_1 whilst an e.m.f. (El) of 1.55 volts RMS and negligible internal impedance is applied between earth and the mid point of, first one then the other 600 ohm terminating impedance. The line dc on each side shall be varied within the range 10-100 mA and the frequency of El varied from 30 Hz to 50 KHz.

(ii) Circuit condition - All possible connecting circuits where transmission between extension and public exchange, and extension to extension is possible.

(iii) The accuracy of readings shall be ± 0.5 millivolts in 1 millivolt steps.

(iv) The smallest value of Impedance Balance ratio ($20 \log \frac{El}{EM}$) in each of the frequency ranges, 30 Hz to 600 Hz, 600 Hz to 3,400 Hz and 3,400 Hz to 50 kHz, shall be tabulated on CE-99033 Sheet 4.

2.5 Overlap Circuit

(i) Test conditions in accordance with Fig. 4. Outgoing, Bothway and Incoming exchange line circuits shall be tested.

(ii) Circuit condition - operator in overlap condition on one exchange line whilst attending an incoming or revertive outgoing call on another exchange line.

(iii) The accuracy of readings shall be

± 0.05 dB in 0.1 dB steps for Insertion Loss measurements
± 0.25 dB in 0.5 dB steps for Return loss measurements

(iv) The results shall be tabulated on CE-99033 Sheet 5.

2.6 Active and Non-linear Circuit Performance

Any circuit which contains amplifying or non-linear components shall be tested for harmonic distortion and intermodulation distortion as follows:-

(i) Test condition - in accordance with Fig. 5.

(ii) Circuit condition - normal operating conditions.

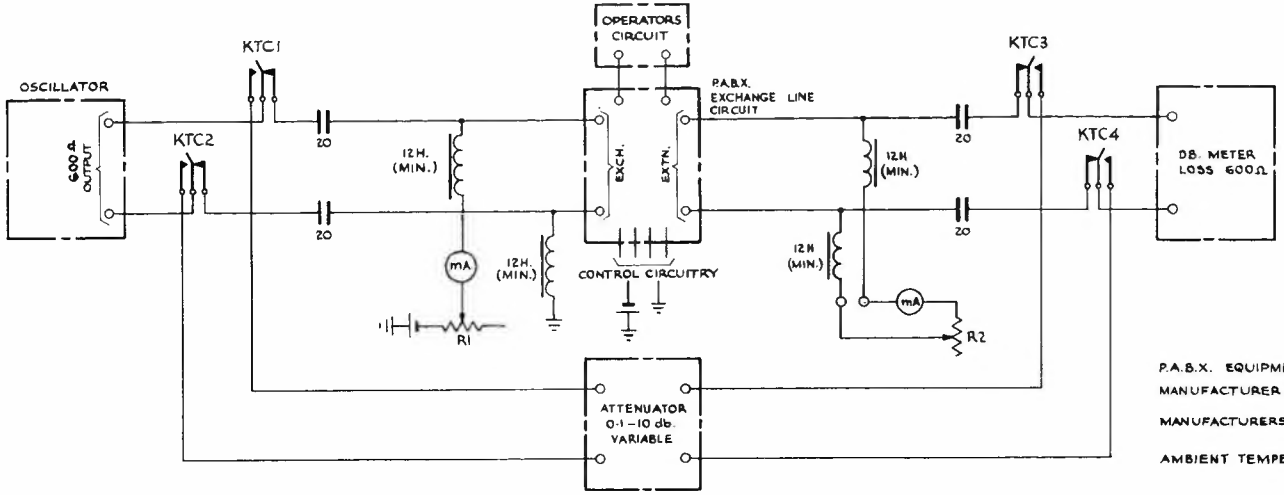
(iii) The accuracy of results shall be ± 0.5 dB in 1 dB steps.

(iv) Results shall be recorded on CE-99033 Sheet 15.

CIRCUIT CONDITION			SPEAKING - NORMAL					SPEAKING - OPERATOR					MONITORING - OPERATOR					NIGHT SWITCHED					TRANSFER					POWER FAIL									
RELAYS BY DESIGNATION	ELECTRICALLY OPERATED																																				
	MANUALLY OPERATED																																				
	TRANSITORY (C, CONTACTS, O/C.)																																				
	RELEASED CONDITION																																				
EXCHANGE AND EXTENSION LINE CURRENT (mA - DC) (NOTE 1)			10	25	45	65	100	10	25	45	65	100	10	25	45	65	100	10	25	45	65	100	10	25	45	65	100	10	25	45	65	100	10	25	45	65	100
INSERTION LOSS	TEST OSCILLATOR FREQUENCY Hz	300																																			
		400																																			
		600																																			
		800																																			
		1000																																			
		1600																																			
		2000																																			
		3000																																			
		3400																																			

FIG. 1. PABX APPROVAL TESTS
INSERTION LOSS.

TEST CIRCUIT



NOTE :-
1. ADJUST EXCHANGE AND EXTENSION LINE CURRENT TO REQUIRED VALUE WITH R1 AND R2.

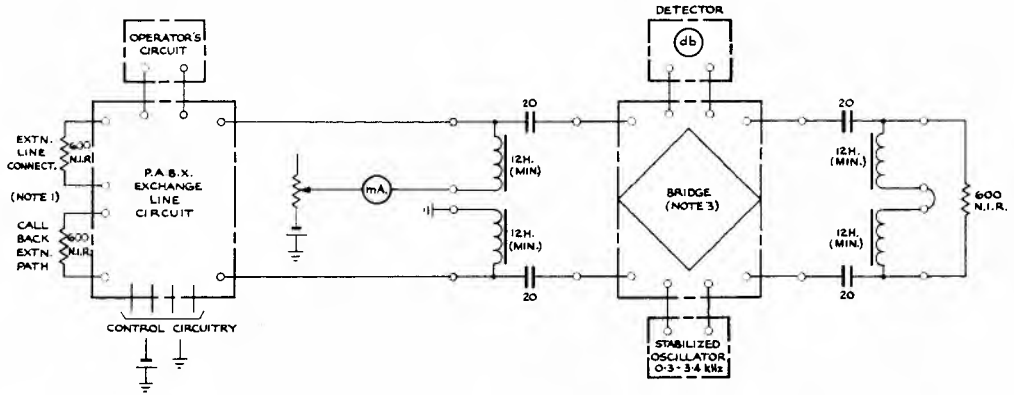
P.A.B.X. EQUIPMENT TYPE —
MANUFACTURER —
MANUFACTURERS DRG. Nº —
ISSUE Nº —

TEST AT —
BY —
DATE —
ACCEPTED / REJECTED —
DATE —

AMBIENT TEMPERATURE DURING TESTS WAS ____°C

CIRCUIT CONDITION (NOTE 2)			SPEAKING-NORMAL					SPEAKING-OPERATOR					MONITORING-OPERATOR					ENQUIRY					TRANSFER					HOLDING					NIGHT SWITCHED									
RELAYS BY DESIGNATION	ELECTRICALLY OPERATED																																										
	MANUALLY OPERATED																																										
	TRANSITORY (C, CONTACTS, O/C)																																										
	RELEASED CONDITION																																										
EXCHANGE LINE CURRENT (mA-D.C.)			10	25	45	65	100	10	25	45	65	100	10	25	45	65	100	10	25	45	65	100	10	25	45	65	100	10	25	45	65	100	10	25	45	65	100	10	25	45	65	100
RETURN LOSS-db AGAINST 600Ω N.I.R.	TEST OSCILLATOR FREQUENCY Hz	300																																								
		400																																								
		600																																								
		800																																								
		1000																																								
		1600																																								
		2000																																								
		3000																																								
		3400																																								

TEST CIRCUIT



NOTES :-

1. EXTENSION TELEPHONES ARE REPLACED BY 600Ω N.I.R. RESISTORS.
2. ALL LOOPED, HOLDING, ENQUIRY AND TRANSFER CONDITIONS OF THE P.A.B.X. EXCHANGE LINE CIRCUIT SHALL BE TESTED.
3. THE BRIDGE AND DETECTOR SHALL BE CAPABLE OF DIRECT READING OF VOICE FREQUENCY RETURN LOSS IN DECIBELS.

P.A.B.X. EQUIPMENT TYPE —
MANUFACTURER —

MANUFACTURERS DRG. Nº —
ISSUE Nº —

TESTED AT —
BY —
DATE —

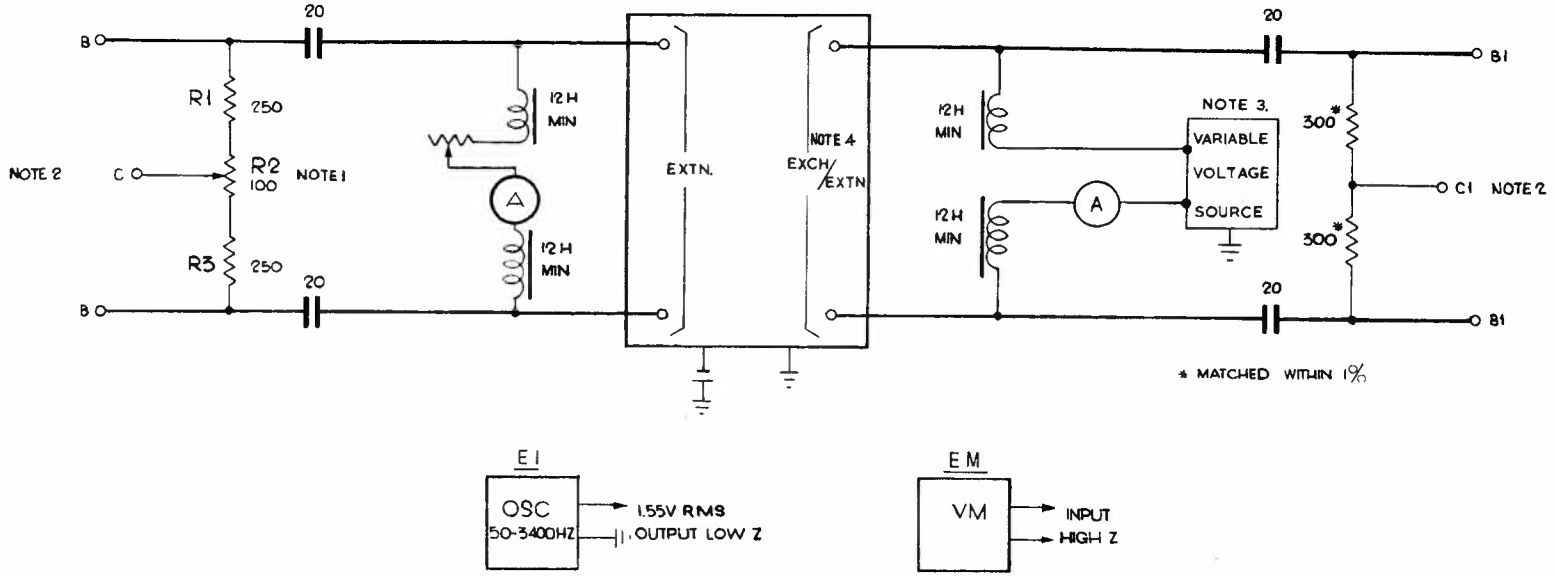
ACCEPTED / REJECTED —
DATE —

AMBIENT TEMPERATURE DURING TESTS WAS ____°C

FIG. 2. PABX APPROVAL TESTS
IMPEDANCE REGULARITY.

FIG. 3. PABX APPROVAL TESTS

BALANCE TO EARTH.



NOTES :— 1. ADJUST R2 TO ACHIEVE BEST NULL READING WITHOUT THE TRANSMISSION CIRCUIT INSERTED.

2. APPLY OSCILLATOR TO FIRST POINT C THEN C1 WITH OPPOSITE POINT CONNECTED TO GROUND, VARY DC FEED CURRENTS, OBTAIN READINGS BB & B1 B1. CALCULATE & RECORD IMPEDANCE BALANCE RATIO IN dB FROM BALANCE RATIO $20 \log \frac{E1}{EM}$

3. THE VARIABLE VOLTAGE SUPPLY SOURCE IS TO BE REPLACED BY A VARIABLE RESISTANCE WHEN A TRANSMISSION PATH FROM EXTENSION TO EXTENSION IS TESTED.

4. DELETE AS APPLICABLE.

OSCILLATOR OUTPUT=E1 1.55V R.M.S.			OVER THE RANGE OF FREQUENCY AND DC FEED CURRENTS SHOWN THE IMPEDANCE BALANCE RATIO WAS NOT LESS THAN.				
FREQUENCY RANGE	OSCILLATOR CONNECTED	READING	10mA	25mA	45mA	65mA	100mA
30 Hz TO 600 Hz	C	B B					
	"	B1 B1					
	C1	B B					
	"	B1 B1					
600Hz TO 3400 Hz	C	B B					
	"	B1 B1					
	C1	B B					
	"	B1 B1					
3400Hz TO 50 KHz	C	B B					
	"	B1 B1					
	C1	B B					
	"	B1 B1					

P.A.B.X. EQUIPMENT TYPE —
MANUFACTURER —
MANUFACTURERS DRNG.NO.—
ISSUE NO.—
AMBIENT TEMPERATURE DURING TEST WAS ____°C
TEST AT —
BY —
DATE —
ACCEPTED/REJECTED—
DATE —

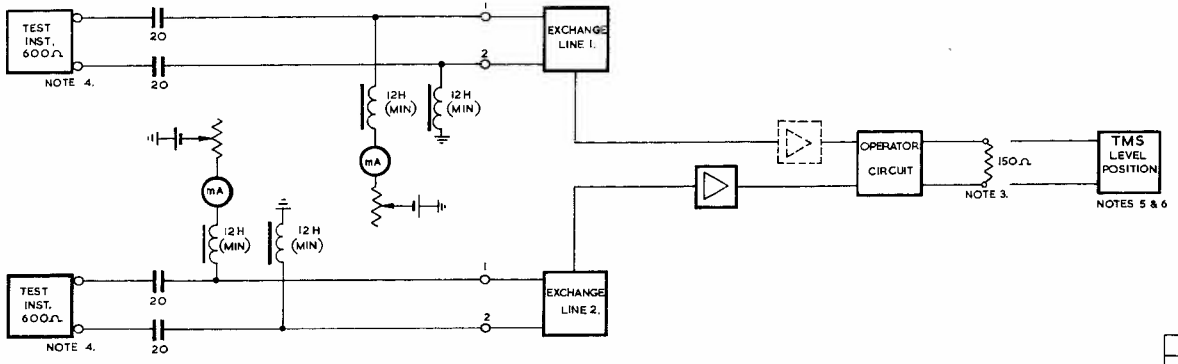


TABLE OF RELAY CONDITIONS.

TEST	RELAYS OPERATED	RELAYS RELEASED
A – B		
C – D		
G – K		

SET UP THE APPARATUS AS SHOWN ABOVE & CONDUCT THE FOLLOWING TESTS RECORDING RESULTS.

		FREQUENCY IN HERTZ								
		300	400	600	800	1000	1600	2000	3000	3400
A	MEASURE RETURN LOSS AGAINST 600Ω WHILST EXCHANGE LINE 1 IS IN THE OVERLAP CONDITION WITH AMPLIFIER GAIN MINIMUM.									
B	" " " " " " " " " " " " " " " " " " MAXIMUM.									
C	" " " " " " " " " " " " " " " " " " MINIMUM.									
D	" " " " " " " " " " " " " " " " " " MAXIMUM.									
E	INSERTION LOSS TO TERMINALS 1 & 2 OF EXCHANGE LINE 1 WHILST SENDING 0 dBm INTO TERMINALS 1 & 2 OF EXCHANGE LINE 2 WITH AMPLIFIER GAIN MINIMUM & WITH EXCHANGE LINE 1 CONNECTED EXCHANGE TO OPERATOR, EXCHANGE LINE 2 IN OVERLAP CONDITION.									
F	" " " " " 1 & 2 " " " " " " " " " " " " " " MAXIMUM.									
G	" " " " " 1 & 2 " " LINE 2 WHILST SENDING 0 dBm INTO TERMINALS 1 & 2 OF EXCHANGE LINE 2 WITH AMPLIFIER GAIN MINIMUM & WITH EXCHANGE LINE 1 CONNECTED EXCHANGE TO OPERATOR, EXCHANGE LINE 2 IN OVERLAP CONDITION.									
H	" " " " " 1 & 2 " " " " " " " " " " " " " " MAXIMUM.									
J	SEND 0 dBm INTO TERMINALS 1 & 2 OF EXCHANGE LINE 2 WHILST IN OVERLAP CONDITION & NOTE LEVEL READING ACROSS THE 150Ω RESISTOR WITH AMPLIFIER GAIN MINIMUM.									
K	" 0 " " " 1 & 2 " " " 2 " " " " " " " " " " " " MAXIMUM.									
L	" +5 " " " 1 & 2 " " " 2 " " " " " " " " " " " " MINIMUM.									
M	" +5 " " " 1 & 2 " " " 2 " " " " " " " " " " " " MAXIMUM.									

NOTES:

1. SET UP THE APPARATUS AS SHOWN ABOVE & CONDUCT TESTS A-K.
2. RECORD RESULTS IN THE TABLES AFTER APPLYING ANY CORRECTION FACTORS.
3. 150Ω TERMINATING RESISTANCE IN LIEU OF OPERATOR'S RECEIVER.
4. CIRCUITS TO BE TERMINATED IN 600Ω AT ALL TIMES & EXCHANGE LINE CURRENTS TO BE ADJUSTED TO 45mA.
5. ADD OR SUBTRACT CORRECTION FACTOR OF $10 \log \frac{R1}{R2}$ TO READINGS WHERE R1= CALIBRATION OF TMS, i.e. 0dBm = 1mW IN 600Ω, R2=TERMINATING RESISTANCE = 150Ω.

   EXAMPLE FOR NORMAL INSTRUMENTS CALIBRATED ACROSS 600Ω

   $= 10 \log \frac{R1}{R2} = 10 \log \frac{600}{150} = 10 \log 4 = 10 \times 0.6021 \simeq 6$ dB.
6. TMS USED WAS CALIBRATED TO 0dB= mW Ω
   CORRECTION FACTOR USED IS dB.

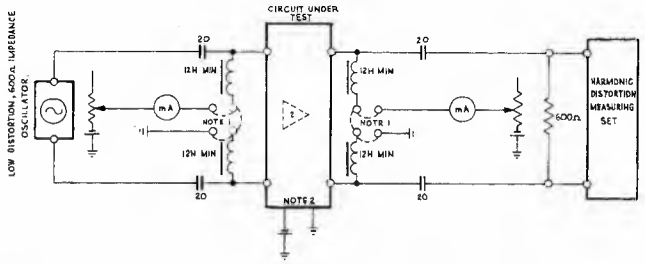
PABX EQUIPMENT TYPE——
MANUFACTURER——
MANUFACTURER'S DRG NO.——
ISSUE NO.——
AMBIENT TEMPERATURE TESTS WAS °C.

TEST AT——
BY——
DATE——
ACCEPTED/REJECTED——
DATE——

FIG. 4. PABX APPROVAL TESTS
OVERLAP CIRCUIT.

ACTIVE & NON-LINEAR CIRCUIT PERFORMANCE.

FIG. 5. PABX APPROVAL TESTS



NOTES :-
1 CONNECT AS REQUIRED
2 FOR AMPLIFIER CIRCUITS ADJUST GAIN TO THE MAX DESIGN VALUE

(NAME OF CIRCUIT TESTED)

MEASUREMENT OF TOTAL HARMONIC DISTORTION.

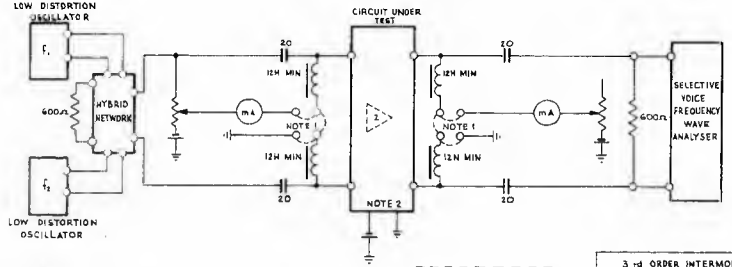
METHOD
1. SET LOW DISTORTION OSCILLATOR AT 400 Hz AND SEND (a) + 5 dBm INTO THE NON LINEAR CIRCUIT UNDER TEST OR (b) SUFFICIENT LEVEL AT THE INPUT TO ACHIEVE + 5 dBm ACROSS THE 600Ω TERMINATION RESISTOR FOR AMPLIFYING CIRCUITS.
2. MEASURE TOTAL HARMONIC DISTORTION ACROSS THE 600Ω OUTPUT TERMINATION FOR DC LINE CURRENTS IN THE RANGE 10 - 100 mA.
3. RECORD RESULTS AS dB BELOW THE FUNDAMENTAL

NON LINERR CIRCUIT					
DC LINE CURRENT	10 mA	25 mA	45 mA	65 mA	100 mA
TOTAL HARMONIC DISTORTION (dB)					

AMPLIFYING CIRCUIT					
DC LINE CURRENT	10 mA	25 mA	45 mA	65 mA	100 mA
TOTAL					

P A B X EQUIPMENT TYPE —
MANUFACTURER —
MANUFACTURER'S DRG Nº —
ISSUE Nº —
AMBIENT TEMPERATURE DURING TEST WAS. °C

TEST AT —
BY —
DATE —
ACCEPTED / REJECTED —
DATE —



NOTES :-
1 CONNECT AS REQUIRED
2 FOR AMPLIFYING CIRCUITS ADJUST GAIN TO THE MAX DESIGN VALUE.

(NAME OF CIRCUIT TESTED)

MEASUREMENT OF INTERMODULATION DISTORTION.

METHOD
1. SET THE LOW DISTORTION OSCILLATORS SO THAT TWO FUNDAMENTAL FREQUENCIES f_1 AND f_2 EACH AT -36 dBm ARE APPLIED TO THE INPUT TERMINALS OF THE CIRCUIT UNDER TEST
2. MEASURE INTERMODULATION DISTORTION LEVELS ACROSS THE 600Ω OUTPUT TERMINATION FOR DC LINE CURRENTS IN THE RANGE 10 - 100 mA
3. REPEAT THE ABOVE MEASUREMENT WITH FUNDAMENTAL FREQUENCIES EACH AT − 3 dBm.
4. RECORD RESULTS AS dB BELOW THE FUNDAMENTAL.

TABLE OF RELAY CONDITIONS

TEST	RELAYS OPERATED	RELAYS RELEASED

		3 rd ORDER INTERMODULATION						2nd ORDER INTERMODULATION						APPLICATION
		FREQUENCY (Hz)	LEVEL (dB)					FREQUENCY (Hz)	LEVEL (dB)					
	f_1 f_2 (Hz)	$f_1 \mp 2f_2$ $f_2 \mp 2f_1$	10 mA	25 mA	45 mA	65 mA	100 mA	$f_1 \mp f_2$ $f_2 \mp f_1$	10 mA	25 mA	45 mA	65 mA	100 mA	
FUNDAMENTALS SET AT -36 dBm	697, 770	624						1467						VF SIGNALS FOR PUSH BUTTON SENDING
		843												
	852, 1336	1826						625						
	770, 1477							707						
	660, 780	540												MFC FORWARD SIGNALLING FREQUENCIES
		900												
	900, 1020	780												MFC BACKWARD SIGNALLING FREQUENCIES
		1140												
	1380, 1500	1260												
		1620												
	1860, 1980	1740												

FUNDAMENTALS SET AT -3dBm	697, 770	624						1467						
		843												
	852, 1336	1826						625						
	770, 1477							707						
	660, 780	540												
		900												
	900, 1020	780												
		1140												
	1380, 1500	1260												
		1620												
	1860, 1980	1740												

SECTION 3. DECADIC PULSING TESTS

3.1 General.

The tests in the section shall apply to operator, extension and/or keysender dialling for all bothway and outgoing exchange line circuits.

3.2 Pulse Source Resistance.

(i) Test condition in accordance with Fig. 6 Pulse Source Resistance.

(ii) Circuit condition equivalent to the remake after a normal break pulse.

(iii) The accuracy of readings shall be ± 1 ohm in 2 ohm steps.

(iv) The results shall be entered on CE-99033 Sheet 6.

3.3 Peak Voltage on Line During Pulsing.

(i) Test condition in accordance with Fig. 6 Peak Voltage and Waveshape on Line During Pulsing. The cathode ray oscilloscope must have a high impedance balanced differential inputs. An earthed input cathode ray oscilloscope must not be used.

(ii) Circuit condition - continuous pulses applied to the extension side of the repeating bridge of the exchange line circuit.

(iii) The readings shall be the algebraic sum of the maximum peak voltage negative from zero and the maximum peak voltage positive from zero during any train of pulses.

(iv) The accuracy of the readings shall be ± 5 volts in 10 volt steps.

(v) The results shall be tabulated on CE-99033 Sheet 6.

3.4 Wave Shape on Line During Pulsing.

(i) Test condition in accordance with Fig. 6 Peak Voltage and Waveshape on Line During Pulsing. The cathode ray oscilloscope must have high impedance balanced differential inputs. An earthed input cathode ray oscilloscope must not be used. A high quality camera attachment is required.

(ii) Circuit condition-one train of pulses applied to the extension side of the repeating bridge of the exchange line circuit with the exchange line in the "A" condition.

(iii) One photographic print shall show the 1st break pulse wave shape and another shall show the 2nd break pulse wave shape against a grid scale background showing voltage and time. The trace lines shall be sharp and clear.

(iv) The photographic prints shall be approximately 8.5cm × 10.5cm each and shall be glued to CE-99033 Sheet 6.

3.5 Keysender Performance.

Keysenders shall be tested in accordance with sections 3.2, 3.3, 3.4 and also to the requirements of Fig. 7. Results shall be tabulated on CE-99033 sheets 6 and 7, and marked "keysender Performance".

3.6 Pulse Performance Using Digital Display Timer.

(i) Tests condition in accordance with Fig. 8. The pulse gate circuit shall be to CSK12219, or equivalent, employing the polarised relay as the pulse receiver.

(ii) The circuit condition of the exchange line circuit shall be equivalent to an extension telephone dialling out to the public exchange.

(iii) Separate tests shall be conducted with 50, 52 and the maximum and minimum volts applied to the PABX equipment.

(iv) The optimum target points (speed 10 pps, make ratio 34%) shall be tested first to check the repeating relay adjustments.

(v) The accuracy of the readings shall be ± 0.5 milliseconds in 1 millisecond steps.

(vi) For each measurement, five consecutive readings shall be taken and averaged to the nearest 0.5 millisecond except that, if there is a spread of 3 milliseconds or more between the shortest and longest readings a fault shall be said to exist.

(vii) The average of five consecutive readings rounded off to the nearest 0.5 millisecond shall be tabulated in the appropriate co-ordinate on CE-99033 Sheet 8.

(viii) For each setting of the adjustable pulse generator, its output should be fed to the pulse gate selector and timer and measured.

(ix) For each target point at each voltage the measurements should be made in the following order:-

(a) pulse generator output 1st make pulse.

(b) line condition "A" 1st make pulse,

(c) line condition "B" 1st make pulse.

(d) line condition "C" 1st make pulse.

(e) pulse generator output 5th make pulse.

(f) line condition "A" 5th make pulse.

(g) line condition "B" 5th make pulse.

(h) line condition "C" 5th make pulse.

(i) pulse generator output 9th make pulse.

(j) line condition "A" 9th make pulse.

(k) line condition "B" 9th make pulse.

(l) line condition "C" 9th make pulse.

(m) pulse generator output 1st break pulse.

(n) line condition "A" 1st break pulse.

(o) line condition "B" 1st break pulse.

(p) line condition "C" 1st break pulse.

(q) pulse generator output 2nd break pulse.

(r) line condition "A" 2nd break pulse.

(s) line condition "B" 2nd break pulse.

(t) line condition "C" 2nd break pulse.

(u) pulse generator output 6th break pulse.

(v) line condition "A" 6th break pulse.

(w) line condition "B" 6th break pulse.

(x) line condition "C" 6th break pulse.

(y) pulse generator output 10th break pulse.

(z) line condition "A" 10th break pulse.

(z_1) line condition "B" 10th break pulse.

(z_2) line condition "C" 10th break pulse.

(x) The aggregate make distortion for the 1st, 5th and 9th make pulses under each line condition is obtained by subtracting the appropriate pulse generator output make pulse tabulation. Thus, if the 5th make pulse is 34 milliseconds from the generator and 32 milliseconds from the exchange line circuit under line condition A, the aggregate make distortion for line condition A 5th make pulse is -2.

(xi) The aggregate break pulse distortion for the 1st, 2nd, 6th and 10th break pulses under each line condition is obtained by subtracting the appropriate pulse generator output break pulse tabulation from the appropriate line condition break pulse tabulation. Thus if the 10th break pulse is 66 milliseconds from the generator and 68 milliseconds from the exchange line circuit under condition C, the aggregate break distortion for line condition C 10th break pulse is +2.

(xii) A table of acceptable aggregate distortion of make and break pulses is shown on CE-99033 Sheet 8. Provided that all other pulses are within acceptable limits, 1st Breaks that are distorted by no more than +2 at the optimum point, +4 at design points 1, 2 and 3, and +12 at design point 4 may be accepted. (Refer also to APO Specification 1080 Section 9).

PEAK VOLTAGE AND WAVE SHAPE ON LINE DURING PULSING

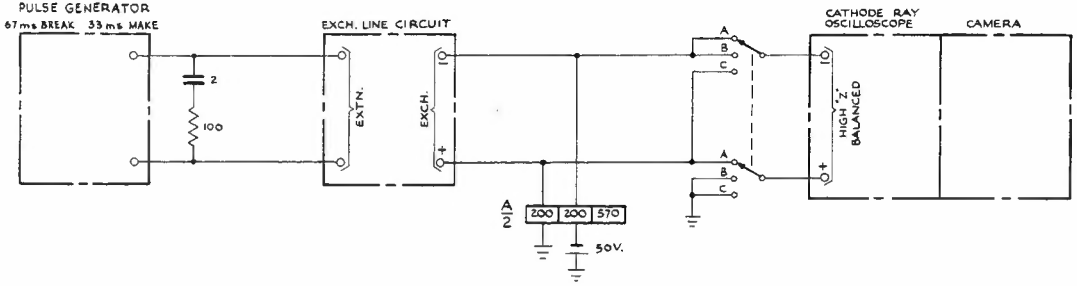
CONDITION		PEAK VOLTAGE
A	-VE. LEG TO +VE. LEG	
B	-VE. LEG TO EARTH	
C	+VE. LEG TO EARTH.	

PULSE SOURCE RESISTANCE

RELAYS OPERATED _____

_____

OHM METER READING _____ OHMS



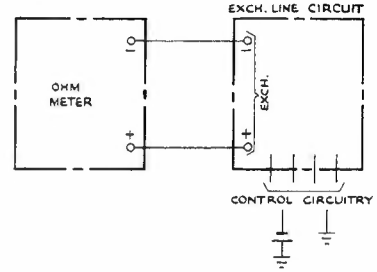
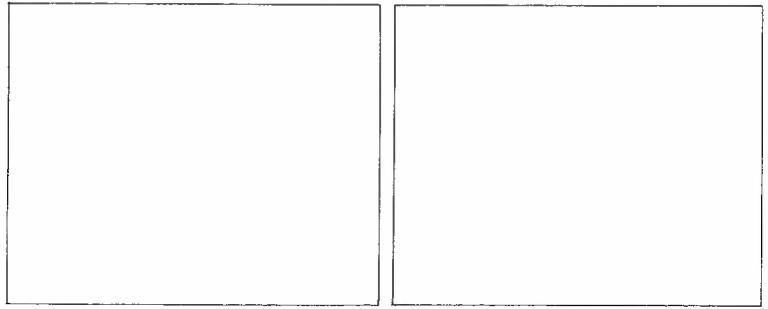


FIG. 6. PABX APPROVAL TESTS OUT-PULSING CIRCUIT.



WAVE SHAPES

1. RELAY A TO HAVE B.P.O. COIL CODE 10/SCO/452, ARMATURE Nº 8 WITH 11 MIL. RESIDUAL AND SPRINGSETS 4/SSP/804 AND 10/SSP/804.
2. CATHODE RAY OSCILLOSCOPE TO BE HIGH DEFINITION, DIRECT READING IN VOLTS WITH A HIGH IMPEDANCE BALANCED INPUT. THE CAMERA IS TO BE OF A TYPE FOR DIRECT ATTACHMENT TO THE CATHODE RAY OSCILLOSCOPE.

P.A.B.X. EQUIPMENT TYPE —
MANUFACTURER —
MANUFACTURERS DRG. Nº. —
ISSUE Nº. —
AMBIENT TEMPERATURE DURING TESTS WAS ____ °C

TESTED AT —
BY —
DATE —
ACCEPTED / REJECTED —
DATE —

MAXIMUM INTERDIGITAL PAUSE

SINGLE OPERATION OF KEY	1	5	9
___VOLTS. (MIN.)			
50 VOLTS.			
___VOLTS. (MAX.)			

1. OPERATE KEY NUMBER 1, ONCE.
2. MEASURE THE DURATION BETWEEN THE END OF THE LAST BREAK PULSE AND OCCURANCE OF LOCKOUT. THIS DURATION IS THE MAXIMUM INTERDIGITAL PAUSE FOR THE KEYSENDER.
3. REPEAT MEASUREMENTS FOR KEYS NUMBERED 5 AND 9.
4. RECORD RESULTS IN THE ABOVE TABLE TO THE NEAREST MILLISECOND.

MINIMUM INTERDIGITAL PAUSE

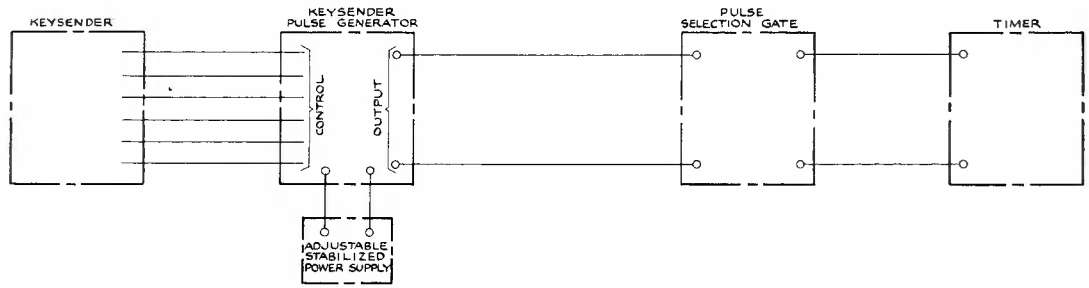
SUCCESSIVE OPERATION OF KEY	1	5	9
___VOLTS. (MIN.)			
50 VOLTS.			
___VOLTS. (MAX.)			

1. OPERATE KEY NUMBER 1 IN RAPID SUCCESSION.
2. MEASURE THE DURATION OF THE LAST MAKE PULSE (IN BETWEEN PULSE TRAINS). THIS DURATION IS THE MINIMUM INTERDIGITAL PAUSE FOR THE KEYSENDER.
3. REPEAT MEASUREMENTS FOR KEYS NUMBERED 5 AND 9.
4. RECORD RESULTS IN THE ABOVE TABLE TO THE NEAREST MILLISECOND.

OUTPULSING

POWER SUPPLY.		MAKE PULSE 1ST	MAKE PULSE 5TH	MAKE PULSE 9TH	BREAK PULSE 1ST	BREAK PULSE 2ND	BREAK PULSE 6TH	BREAK PULSE 10TH
___VOLTS. (MIN.)								
50 VOLTS.								
___VOLTS. (MAX.)								
ACCEPTABLE LIMITS	AT 50 VOLTS.	30-38 ms.			63-72 ms.			
	AT VOLTAGE LIMITS	29-40 ms.			60-74 ms.			

1. OPERATE KEY NUMBER 0, ONCE.
2. MEASURE THE DURATION OF THE 1ST, 5TH AND 9TH MAKE PULSES, AND THE 1ST, 2ND, 6TH AND 10TH BREAK PULSES OF THAT TRAIN.
3. REPEAT THE ABOVE PROCEDURE FOUR MORE TIMES USING THE SAME KEY.
4. FROM THESE MEASUREMENTS DETERMINE THE AVERAGE DURATIONS OF THE 1ST, 5TH AND 9TH MAKE PULSES AND THE 1ST, 2ND, 6TH AND 10TH BREAK PULSES.
5. RECORD AVERAGE VALUES IN THE ABOVE TABLE TO THE NEAREST MILLISECOND.



P.A.B.X. EQUIPMENT TYPE —
MANUFACTURERS —
TEST AT —
BY —
DATE —

MANUFACTURERS DRG. Nº —
ISSUE Nº —
ACCEPTED/REJECTED —
DATE —

AMBIENT TEMPERATURE DURING TESTS WAS ____°C.

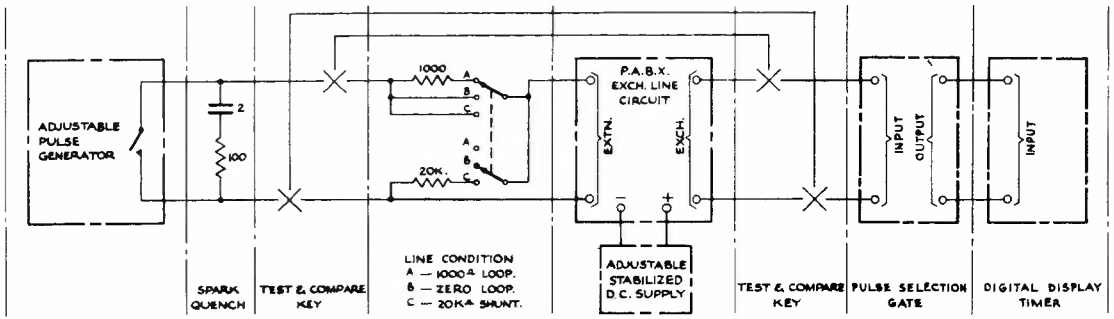
FIG. 7. PABX APPROVAL TESTS
KEYSENDER PERFORMANCE.

FIG. 8. PABX APPROVAL TESTS

PULSE PERFORMANCE USING DIGITAL DISPLAY TIMER.

SPECIFICATION CONDITION		TEST INPUT: NOMINAL PULSE TIME RATIO MILLISECONDS		TEST INPUT: PULSE GENERATOR OUTPUT						EXCHANGE LINE RELAY SET OUTPUT																				ACCEPTABLE AGGREGATE DISTORTION (NOTE 2)			
										LINE CONDITION "A" 1000Ω LOOP										LINE CONDITION "B" ZERO LOOP										LINE CONDITION "C" 20KΩ SHUNT											
				MAKE PULSE			BREAK PULSE			MAKE PULSE			BREAK PULSE			AGGREGATE MAKE DISTORTION			AGGREGATE BREAK DISTORTION																	MAKE		BREAK	
EXCHANGE LINE CIRCUIT TEST VOLTAGE.	TARGET POINT	BREAK	MAKE	1	5	LAST	1	2	6	LAST	1	5	LAST	1	2	6	LAST	1	5	LAST	1	2	6	LAST	1	5	LAST	1	2	6	LAST	1	5	LAST	1	2	6	LAST	FROM	TO	FROM	TO
MAXIMUM NORMAL WORKING __VOLTS.	OPTIMUM POINT	67	33																																				0	+4	-4	0
	DESIGN POINT 1	87	38																																				-2	+6	-10	+2
	" " 2	75	50																																				-10	+6	-6	+2
	" " 3	58	25																																				-2	+10	-6	+2
	" " 4	50	33																																				-2	+6	-6	+10
52 VOLTS.	OPTIMUM POINT	67	33																																				0	+4	-4	0
	DESIGN POINT 1	87	38																																				-2	+6	-10	+2
	" " 2	75	50																																				-10	+6	-6	+2
	" " 3	58	25																																				-2	+10	-6	+2
	" " 4	50	33																																				-2	+6	-6	+10
50 VOLTS.	OPTIMUM POINT	67	33																																				0	+4	-4	0
	DESIGN POINT 1	87	38																																				-2	+6	-10	+2
	" " 2	75	50																																				-10	+6	-6	+2
	" " 3	58	25																																				-2	+10	-6	+2
	" " 4	50	33																																				-2	+6	-6	+10
MINIMUM NORMAL WORKING __VOLTS.	OPTIMUM POINT	67	33																																				0	+4	-4	0
	DESIGN POINT 1	87	38																																				-2	+6	-10	+2
	" " 2	75	50																																				-10	+6	-6	+2
	" " 3	58	25																																				-2	+10	-6	+2
	" " 4	50	33																																				-2	+6	-6	+10

TEST CIRCUIT



NOTES :-

1. THE ENTRIES ON THIS SHEET ARE ALL TO BE IN MILLISECONDS. THEY ARE TO BE OBTAINED FROM FIVE CONSECUTIVE READINGS OF EACH INDIVIDUAL MAKE OR BREAK PULSE. THESE WILL BE AVERAGED AND THE RESULT ROUNDED OFF TO THE NEAREST WHOLE NUMBER.
2. FIRST BREAKS MAY BE LENGTHENED BY NO MORE THAN 2 mS..
3. RELAY ADJUSTMENTS :-

ARM. RESIDUAL ____ MILS OPERATE CURRENT ____ mA
" TRAVEL ____ " NON-OP. " ____ mA
RELEASE " ____ mA

SPRING TENSION IN GRAMS

11 ____	21 ____	31 ____
12 ____	22 ____	32 ____
13 ____	23 ____	33 ____
14 ____	24 ____	34 ____
15 ____	25 ____	35 ____

P.A.B.X. EQUIPMENT TYPE —
MANUFACTURER —
MANUFACTURERS DRG. Nº —
ISSUE Nº —

TESTED AT —
BY —
DATE —
ACCEPTED / REJECTED —
DATE —

AMBIENT TEMPERATURE DURING TESTS WAS ___°C.

SECTION 4. OTHER SIGNALLING TESTS

4.1 Incoming Ring

4.1.1 General.

The following tests apply to all incoming and bothway exchange line circuits, which respond to AC ring from the exchange. Tests shall be done at minimum, 50V and maximum power supply voltage, where indicated in Figs 9 and 10.

4.1.2 Effect of Exchange Line Polarity Reversal On Ring Detection Circuitry.

(i) Test conditions in accordance with Fig. 9

(ii) Circuit conditions - normal free condition

(iii) The effect of reversing the exchange line polarity shall be recorded on CE-99033 Sheet 9.

4.1.3 Ring Detection Sensitivity.

(i) Test conditions in accordance with Fig. 9. The variable resistor R1 shall be increased to the maximum value that permits satisfactory response of the ring detection circuit to the AC voltage from the test oscillator.

(ii) Circuit condition - normal

(iii) The accuracy of the readings shall be.

(a) ±5 ohms in 10 ohm steps.

(b) ±0.5 milliamps in 1 milliamp steps.

(c) ±0.5 volts in 1 volt steps.

(iv) Line resistance, line current and line voltage shall be measured and results tabulated on CE-99033 Sheet 9.

4.1.4 Preguard Delay After Seizure From Exchange.

(i) Test conditions in accordance with Fig. 10. The switch positions A and B similate the early guard signal sent from either a step by step or a crossbar exchange respectively. The AC signal from a crossbar exchange may arrive at any phase angle. The period between the first appearance of early guard voltage at the PABX MDF and the application of guard by the PABX is the Preguard Delay.

(ii) Circuit conditions - normal.

(iii) The accuracy of readings shall be $\pm$ 0.5 millisecond in 1 millisecond steps.

(iv) Results shall be recorded on CE-99033 Sheet 9.

(a) Preguard delay when the ring detection relay is operated manually.

(b) Preguard delay when the switch is in the A position.

(c) The shortest Preguard Delay of a series of at least ten tests, when the switch is in the B position.

(d) The longest Preguard Delay of a series of at least ten tests, when the switch is in the B position.

4.1.5 Ring Trip Resistance

(i) Test condition in accordance with Fig. 10

(ii) Circuit condition of the exchange line shall be equivalent to

(a) operator answering an incoming public exchange call

(b) extension answering an incoming nightswitched call.

(iii) The accuracy of readings shall be ± 1 ohm in 2 ohm steps.

(iv) The ring trip resistance shall be measured and results recorded on CE-99033 Sheet 9.

4.1.6 Duration of Ring Trip Conditions.

(i) Test conditions in accordance with Fig. 10

(ii) Circuit conditions - as in 4.1.5 (ii)

(iii) The accuracy of readings shall be ± 5 milliseconds in 10 millisecond steps.

(iv) The duration of ring trip shall be measured and results tabulated on CE-99033 Sheet 9.

4.2 INDIAL PERFORMANCE.

4.2.1 General.

All indial exchange line circuits and indial tie line circuits shall be tested.

4.2.2 Pick-up Sensitivity on Seizure by Exchange.

(i) Test condition in accordance with Fig. 11, Pick-up Sensitivity.

(ii) Circuit condition - normal. The indial exchange line pick-up circuit shall consist of a balanced circuit feeding 50 volt battery and earth to the exchange line.

(iii) The accuracy of the readings shall be:-

(a) ± 5 ohms in 10 ohm steps.

(b) ± 0.5mA in 1 milliamp steps.

(iv) The results shall be tabulated on CE-99033 Sheet 10.

4.2.3 Impulse Response of Address Signals.

(i) Test condition in accordance with Fig. 11, Impulse Response.

(ii) The circuit condition of the indial circuit shall be equivalent to the receiving of loop interrupted dial signalling from the public exchange. Before and after each test train of digits the circuit shall be looped via the appropriate test line condition to allow for normal functioning of the exchange line circuit.

(iii) The received dial pulse store shall have a visual display connected to the output marking circuits so as to accurately display the store count for each train of pulse received. For each test the result shown on this display shall be tabulated on CE-99033, Sheet 10.

(iv) For each setting of the adjustable pulse generator, its output shall be fed to speed and ratio meters and checked.

(v) Separate tests shall be conducted with the maximum volts, 50 volts and the minimum volts applied to the PABX equipment.

(vi) For each specified test pulse condition and at each voltage and for each line condition, trains of 3, 6 and 9 pulses, equivalent to the maximum number of digits that may be stored in the equipment, shall be applied. The interdigital pause between each train in a test shall be 1 second.

(vii) Any display which does not correspond to the pulses applied shall be a fault. However, if the incidence of the fault is dependant upon the setting of the pulse generator or train gate or line condition or equipment voltage, the tests shall be completed to show the full extent of the fault.

4.2.4 Maximum Pre-dialling Delay Response.

(i) Test condition in accordance with Fig. 12 Maximum Pre-dialling Delay Response.

(ii) The circuit condition of the indial circuit shall be equivalent to receiving a pick up loop signal from the public exchange.

(iii) The accuracy of the readings shall be ± 50 milliseconds in 100 millisecond steps.

(iv) Separate tests shall be conducted with the maximum, 50 and the minimum volts applied to the PABX equipment.

(v) For each voltage, the maximum pre-dialling delay response shall be measured and recorded on CE-99033, Sheet 10.

4.2.5 Minimum Inter-Digital Pause Response.

(i) Test condition in accordance with Fig. 12 Minimum Inter-Digital Pause Response, except that if this test is done after the successful completion of the impulse response test (refer to 4.2.3) the break pulse setting of the pulse generator is not critical and may be between 40 and 110 milliseconds.

(ii) The circuit condition of the indial circuit shall be equivalent to receiving of loop interrupted dial signalling from the public exchange. Before each test train of pulses the circuit shall be looped to allow for the normal functioning of the exchange line circuit.

(iii) The received dial pulse store shall have a visual display connected to the output marking circuits so as to accurately display the stored count of pulses and trains.

(iv) The pulse generator make pulse shall be increased in 5 millisecond steps, as measured on a timer, and applied to the indial circuit. The lowest value of make pulse that results in the break pulses being identified as single digits in successive trains is the minimum inter-Digital pause response.

(v) Separate tests shall be conducted with the maximum, 50 and the minimum volts applied to the PABX equipment.

(vi) For each voltage, the minimum inter-Digital pause response shall be recorded on CE-99033, Sheet 10.

4.2.6 Clear Forward Response.

(i) Test condition in accordance with Fig. 12 Clear Forward Response.

(ii) The circuit condition of the indial circuit shall be equivalent to receiving seizure signal from the public exchange. The seizure signal shall be interrupted periodically by the application of clear forward signals from the public exchange. A pulse generator shall be used to similate these conditions.

(iii) The accuracy of readings shall be ± 0.5 milliseconds in 1 millisecond step.

(iv) The smallest duration of clear forward signal that will enable the indial circuit to return release guard and blocking signal shall be measured and recorded on CE-99033 Sheet 10.

4.2.7 Reversal Blink Detection and Timing on Answer.

(i) Test condition in accordance with Fig. 12 Reversal Blink Detection and Timing.

(ii) Circuit condition of the indial circuit shall be equivalent to an indialled call;

(a) being answered by the called extension,

(b) unanswered and automatically signalled at the operator's console, being answered by the operator.

(iii) The accuracy of the readings shall be ±0.5 milliseconds in 1 millisecond steps.

(iv) The performance of the polarity on answer condition maintained through all enquiry and transfer functions of the PABX equipment and the presence of blink and its duration are to be recorded on CE-99033, Sheet 10.

4.2.8 Clear Back Delay.

(i) Test condition in accordance with Fig. 13 Timing Response.

(ii) The circuit condition of the indial circuit shall be equivalent to a disconnection by the extension (extension clearing signal), or the operator to whom the call has been switched. The time taken from the initial disconnection in each case until the application of clear back signal by the PABX is the clear back delay.

(iii) The accuracy of the readings shall be ±5 milliseconds in 10 millisecond steps for extension clearing, and ±0.5 milliseconds in 1 milliescond steps for operator clearing.

(iv) For each type of disconnection the clear back delay shall be measured and recorded on CE-99033 Sheet 11.

4.2.9 Release Guard and Blocking Delay.

(i) Test condition in accordance with Fig. 13 Timing Response.

(ii) The circuit condition of the indial circuit shall be equivalent to the application of clear back signal from the PABX. The time that elapses between the initial application of clear back signal until the application of release guard any blocking signal by the PABX is the release guard and blocking delay.

(iii) The accuracy of the readings shall be ±0.5 milliseconds in 1 millisecond steps.

(iv) Release guard and blocking delay shall be measured and results recorded on CE-99033 Sheet 11.

4.3 Guard Period and Release Delay After Clearing.

(i) Test condition in accordance with Fig. 13 for all outgoing exchange line circuits.

(ii) Circuit condition - the application of clearing signal by the extension or operator to a seized exchange line. The time that elapses between the application of clearing signal and the release of the guard from the outgoing exchange line circuit is the guard period. The time that elapses between the application of clearing signal and commencement of the PABX switching path release is the release delay.

(iii) The accuracy of readings shall be ±5 milliseconds in 10 millisecond steps.

(iv) The guard period and release delay shall be measured and results recorded on CE-99033 Sheet 11.

4.4 Drop Back During Interdigital Pause.

After an extension or operator dials a digit to the public exchange, there may also be sent a short transient pulse, occuring because of inductive components in the exchange line and PABX exchange line circuit. It is preferable that the exchange line circuit is designed so that no transient is produced, although a small duration transient may be acceptable.

(i) Test condition in accordance with Fig. 14 All outgoing and bothway exchange line circuits shall be tested.

(ii) Circuit condition - the interdigital pause following single pulses produced from a dial that has no inherent contact bounce.

(iii) The accuracy of readings shall be ±0.5 milliseconds in 1 millisecond steps.

(iv) Any transients occuring within the interdigital pause shall be measured and results recorded on CE-99033 Sheet 12.

4.5 AC Clearing Circuit.

4.5.1 General.

The following tests shall apply to all bothway exchange line circuits and they shall be tested under simulated crossbar and step by step public exchange conditions. Details on the AC clearing generator's performance shall be shown on CE-99033 Sheet 13. Relay data for these tests is given in Fig 15 and on CE-99033 Sheet 13.

4.5.2 AC Clearing Sensitivity.

(i) Tests condition in accordance with Fig. 15 Test Clearing Sensitivity.

(ii) Circuit condition - The AC Clearing circuit held in AC clearing conditions, but public exchange in the free unbalanced condition.

(iii) The accuracy of readings shall be

(a) ±0.5 milliamps in 1 milliamp steps

(b) ±0.5 volts in 1 volt steps

(iv) Line current and voltage shall be measured, AC clearing sensitivity (Z) determined. All results shall be recorded on CE-99033 Sheet 13.

4.5.3 AC Clearing Unbalance Sensitivity.

(i) Test conditions in accordance with Fig. 15 Test Sensitivity To Line Unbalance.

(ii) Circuit condition - public exchange to extension call with public exchange holding and extension instrument cleared.

(iii) The accuracy of readings shall be ±5 ohms in 10 ohm steps.

(iv) The results shall be tabulated on CE-99033 Sheet 13.

4.6 Enquiry Circuit.

(i) Test condition in accordance with Fig. 16 Enquiry Circuit. All relevant exchange line circuits shall be tested for

(a) maximum and minimum earth resistances which will initiate enquiry.

(b) minimum duration of the earth pulse which will initiate enquiry.

(ii) Circuit conditions - public exchange to extension, speaking normal.

(iii) The accuracy of readings shall be

(a) ±5 ohms in 10 steps

(b) ±0.5 milliseconds in 1 millisecond steps.

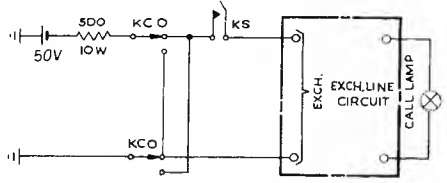
(iv) Results shall be recorded on CE-99033 Sheet 14.

FIG. 9. PABX APPROVAL TESTS

INCOMING RING.

RESPONSE OF RING DETECTION CIRCUIT TO POLARITY REVERSALS.

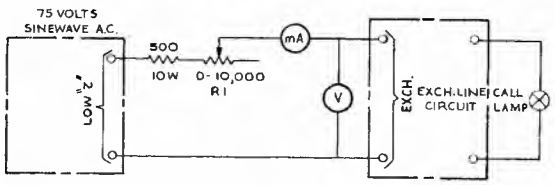
DID THE OPERATION OF KCO CAUSE THE CALL LIGHT TO BE LIT ? YES/NO



1. OPERATE KEY KS.
2. OPERATE KEY KCO FROM ONE POSITION TO ANOTHER. CALL LAMP SHOULD NOT LIGHT.

RING DETECTION SENSITIVITY

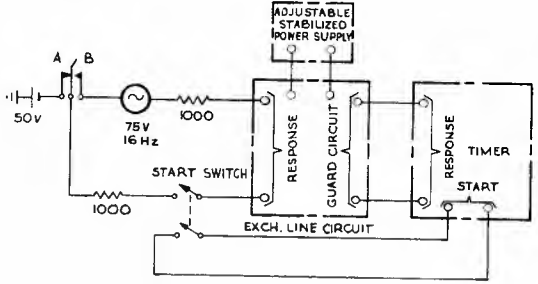
TEST FREQUENCY	LINE RESISTANCE OHMS	LINE CURRENT m.A. RMS	LINE VOLTAGE V (VOLTS) RMS
16 Hz			
33 Hz			
50 Hz			



1 METER TO HAVE ± 1% ACCURACY AND FLAT RESPONSE TO 15-60 Hz AND TO MEASURE R.M.S. VALUE.
2 RHEOSTAT TO BE CALIBRATED IN OHMS.
3 READINGS TO BE TAKEN AT HIGHEST VALUE OF R1 WHICH PERMITS THE RING DETECTION CIRCUIT TO SATISFACTORILY RESPOND.

PREGUARD DELAY AFTER SEIZURE FROM EXCHANGE

VOLTAGE ON EXCH. LINE CIRCUIT	RING DETECTION RELAY OPERATED			
	MANUALLY	A 5 X S	B CROSSBAR 16Hz AC	
		RING RETURN BATTERY	SHORTEST TIME	LONGEST TIME
VOLTS MIN.				
50 VOLTS				
VOLTS MAX.				



1. THE RESPONSE CIRCUIT OF THE TIMER SHOULD BE APPROPRIATE TO THE GUARD CIRCUIT CONDITION OF THE PABX. SYSTEM.
2. THE DELAY SHOULD BE READ TO THE NEAREST MILLISECOND.

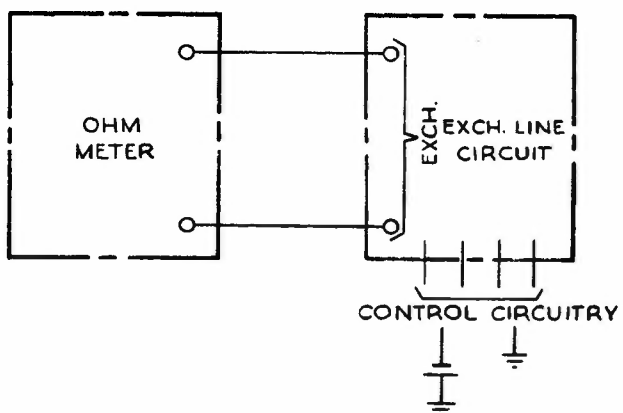
RING TRIP RESITANCE

RELAYS OPERATED _____

_____

OHM METER READING _____ OHMS (OPERATOR ANSWERING)

_____ OHMS (NIGHTSWITCH CONDITION)

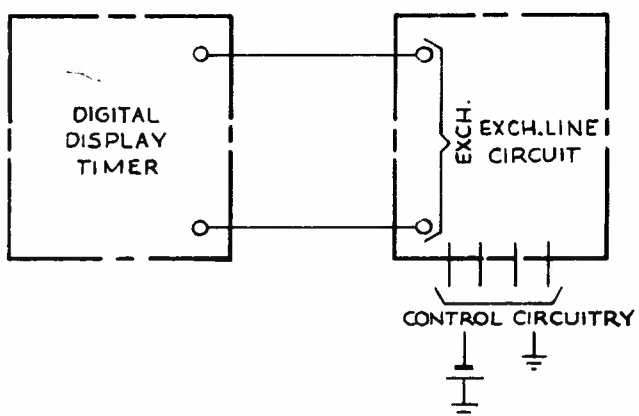


DURATION OF RING TRIP CONDITION

RELAYS OPERATED _____

_____

VOLTAGE ON EXCHANGE LINE CIRCUIT	TIMER READING	
	OPERATOR	N/S
___ VOLTS MIN.		
50 VOLTS		
___ VOLTS MAX.		



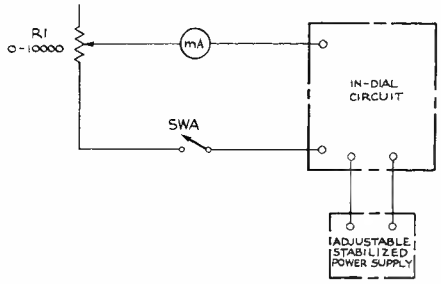
1. CONNECT TIMER TO READ PERIOD THAT THE LOW RESISTANCE RING TRIP CONDITION IS MAINTAINED. ACCURACY ± 5 ms

FIG. 10. PABX APPROVAL TESTS INCOMING RING.

FIG. 11. PABX APPROVAL TESTS
IN-DIAL SIGNALLING PERFORMANCE.

PICK-UP SENSITIVITY

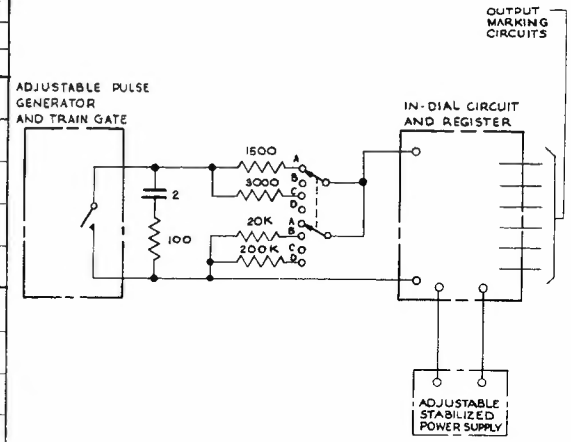
POWER SUPPLY	RESISTANCE OHMS	CURRENT mA.
___VOLTS. (MIN.)		
50 VOLTS.		
___VOLTS. (MAX.)		



1. VARIABLE RESISTOR RI IS CALIBRATED IN OHMS AND IS VARIED TO GIVE THE MAXIMUM READING WHICH WILL PERMIT THE IN-DIAL CIRCUIT TO CORRECTLY RESPOND WHEN THE SWITCH SWA IS CLOSED.

IMPULSE RESPONSE

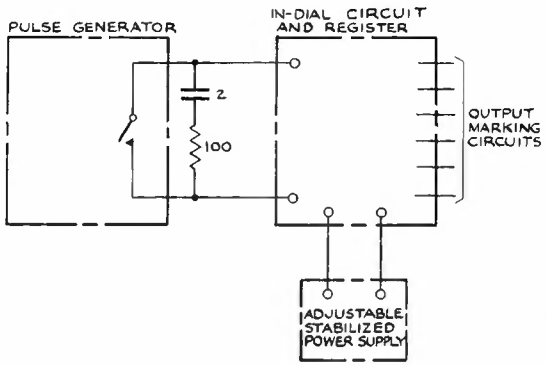
VOLTAGE	TEST PULSE CONDITION MILLISECONDS		CALLED NUMBER MARKING											
			NORMAL TYPE						EXTENDED TYPE					
			LINE CONDITION "A" 1500Ω LOOP			LINE CONDITION "B" 20KΩ SHUNT			LINE CONDITION "C" 3000Ω LOOP			LINE CONDITION "D" 200KΩ SHUNT		
			TEST TRAIN OF DIGITS											
	BREAK	MAKE	3	6	9	3	6	9	3	6	9	3	6	9
MAXIMUM SPECIFIED ___VOLTS.	37	18												
	40	60												
	80	20												
	92	75												
50 VOLTS.	37	18												
	40	60												
	80	20												
	92	75												
MINIMUM SPECIFIED ___VOLTS.	37	18												
	40	60												
	80	20												
	92	75												



1. AN APPROPIATE NUMBER OF TRAINS OF THE SPECIFIED TEST PULSES ARE APPLIED VIA EACH OF THE LINE CONDITIONS TO THE IN-DIAL CIRCUIT AND THE NUMBER SO REGISTERED IS DETECTED AND RECORDED.

MINIMUM INTERDIGITAL PAUSE RESPONSE

POWER SUPPLY	MAKE PULSE IDENTIFIED AS INTERDIGITAL PAUSE mS.
___VOLTS. (MIN.)	
50 VOLTS.	
___VOLTS. (MAX.)	



1. WITH THE BREAK PULSE AT 67ms, THE MAKE PULSE LENGTH IS INCREASED FROM 200 ms TILL THE IN-DIAL CIRCUIT CORRECTLY IDENTIFIES THE BREAK PULSES AS SINGLE DIGITS IN SUCCESSIVE TRAINS. THE MAKE PULSE LENGTH IS THEN RECORDED AS THE MIN. INTERDIGITAL PAUSE RESPONSE IN THE ABOVE TABLE.

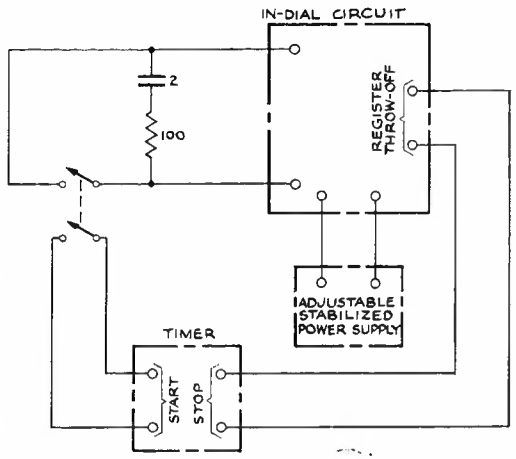
CLEAR FORWARD RESPONSE

1. SET THE PULSE GENERATOR TO SEND SINGLE BREAK PULSES OF 400 ms DURATION AND THEN SUCCESSIVELY REDUCE THE BREAK PULSE DURATION. RECORD IN THE TABLE BELOW THE MIN. DURATION OF THE BREAK PULSE SUCH THAT THE IN-DIAL CIRCUIT RECOGNISES THIS AS A CLEAR FORWARD SIGNAL.

POWER SUPPLY	MIN. DURATION OF CLEAR FORWARD SIGNAL. ms
VOLTS (MIN.)	
50 VOLTS	
VOLTS (MAX.)	

MAXIMUM PRE-DIALLING DELAY RESPONSE

POWER SUPPLY	DELAY mS.
___VOLTS. (MIN.)	
50 VOLTS.	
___VOLTS. (MAX.)	

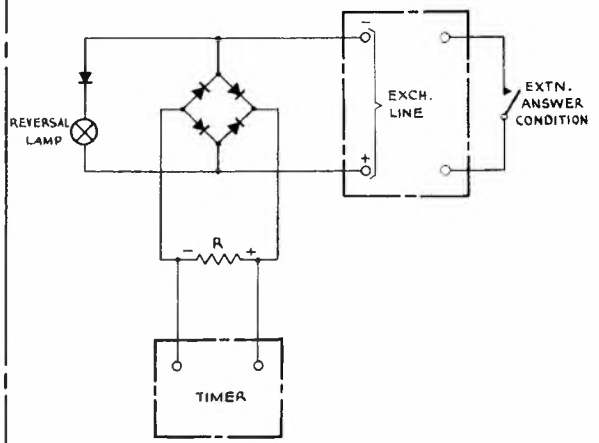


1. THE TIME TAKEN FROM SEIZURE OF THE IN-DIAL CIRCUIT TILL REGISTER THROW OFF OCCURS IS RECORDED.

REVERSAL BLINK DETECTION AND TIMING

REVERSAL :- SATISFACTORY
UNSATISFACTORY

BLINK :- DOES NOT HAPPEN
LENGTH OF ____ MILLISECONDS (EXTN. ANSWER)
DOES NOT HAPPEN
LENGTH OF____MILLISECONDS (OPERATOR ANSWER)



1. THE EXTENSION ANSWER CONDITION IS TO INITIATE A REVERSAL OF POLARITY OF THE BATTERY FEED TO THE LINE. THIS WILL BE DETECTED BY THE REVERSAL LAMP.
2. THE TIMER WILL BE OPERATED IN THAT MODE TO DETECT ANY LOSS OF POTENTIAL ACROSS THE RESISTOR R AND IF IT OCCURS, TO TIME THE DURATION OF THE BLINK WITH AN ACCURACY OF ±0·5 MILLISECONDS.

P.A.B.X. EQUIPMENT TYPE —
MANUFACTURER —

MANUFACTURERS DRG. Nº —
ISSUE Nº —

TEST AT —
BY —
DATE —

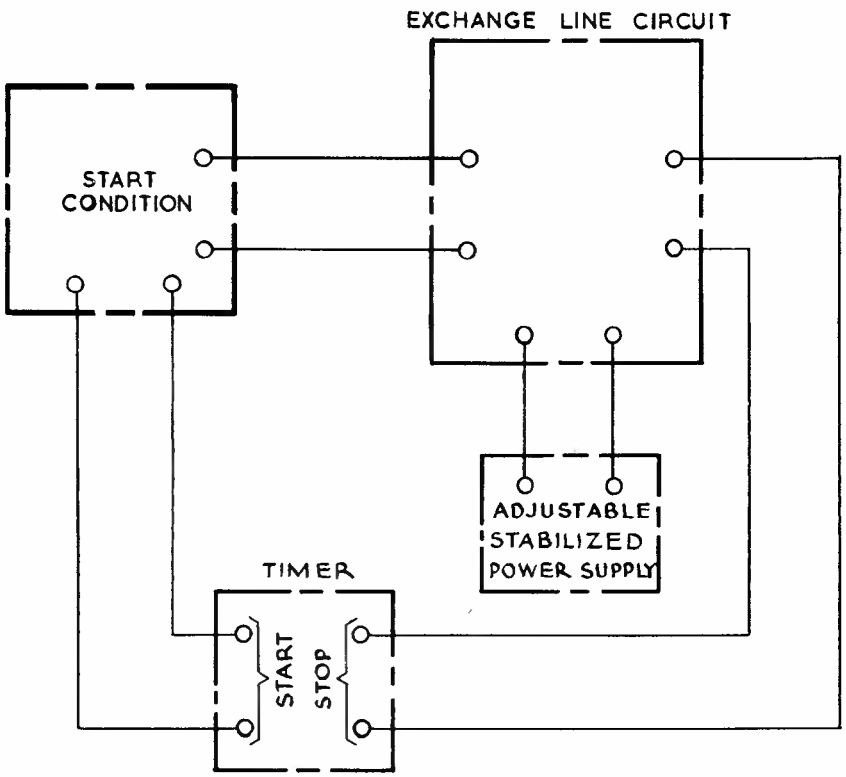
ACCEPTED/REJECTED —
DATE —

AMBIENT TEMPERATURE DURING TESTS WAS____°C

FIG. 12. PABX APPROVAL TESTS
IN-DIAL CIRCUIT PERFORMANCE.

NAME OF TEST _

POWER SUPPLY	TIME mS
_ _ _ VOLTS (MIN.)	
50 VOLTS	
_ _ _ VOLTS (MAX.)	



EXCHANGE LINE CIRCUIT CLASSIFICATION —

P.A.B.X. EQUIPMENT TYPE —

MANUFACTURER —

MANUFACTURERS DRG Nº —
ISSUE Nº —

AMBIENT TEMPERATURE DURING TESTS WAS _ _ _ °C.

TEST AT —
BY —
DATE —

ACCEPTED/REJECTED —
DATE —

FIG. 13. PABX APPROVAL TESTS
TIMING RESPONSE.

DROP BACK DURING INTERDIGITAL PAUSE

1. TEST CIRCUIT FALSE RELEASE DURING INTERDIGITAL PAUSE IS _____ MILLISECONDS IN LENGTH.
2. " " " " OCCURS _____ MILLISECONDS AFTER THE LAST DIALLED BREAK PULSE.

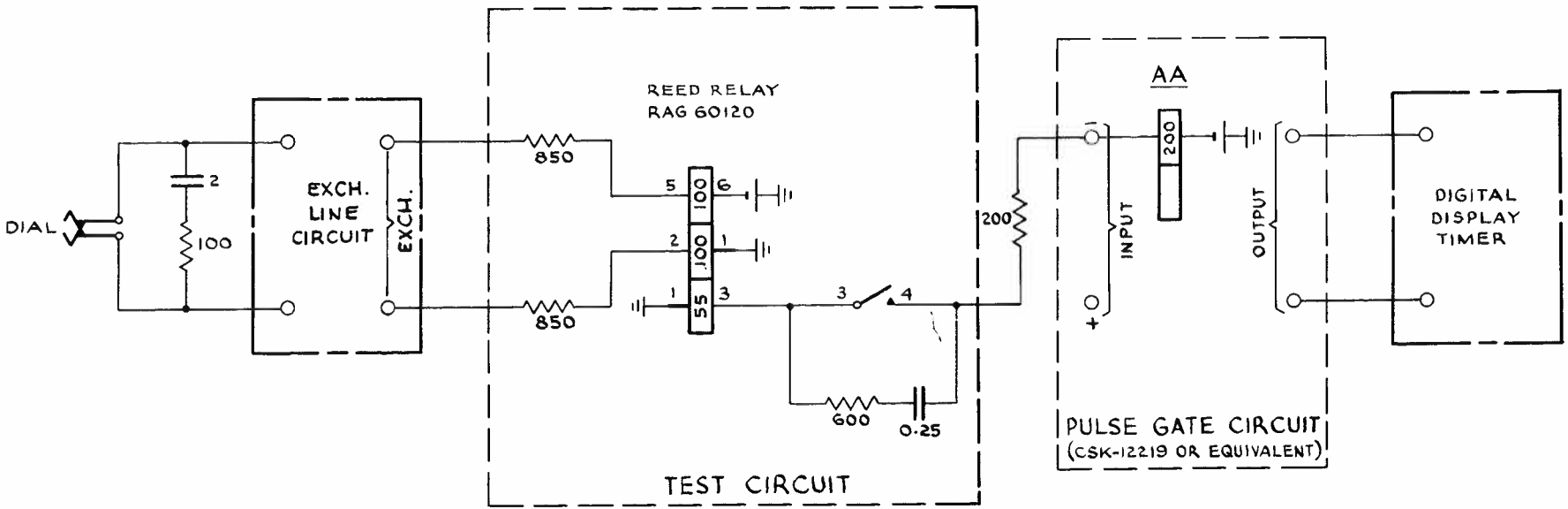


FIG. 14. PABX APPROVAL TESTS
DROP BACK DURING INTERDIGITAL PAUSE.

1. SET THE PULSE GATE CIRCUIT TO TRIGGER THE DIGITAL DISPLAY TIMER WITH A SECOND BREAK PULSE. DIAL A SINGLE BREAK DIGIT INTO THE EXCHANGE LINE CIRCUIT AND RECORD THE LENGTH OF ANY SECOND BREAK OUT OF THE "TEST CIRCUIT" WHICH MAY BE DISPLAYED ON THE TIMER.
2. IF A SECOND BREAK IS OBSERVED IN (1) ABOVE, RESET THE PULSE GATE CIRCUIT TO SELECT THE FIRST MAKE PULSE. DIAL A SINGLE BREAK DIGIT INTO THE EXCHANGE LINE CIRCUIT AND RECORD THE LENGTH OF THE FIRST MAKE PULSE OUT OF THE "TEST CIRCUIT" AS DISPLAYED ON THE TIMER.

FIG. 15. PABX APPROVAL TESTS
A.C. CLEARING CIRCUIT.

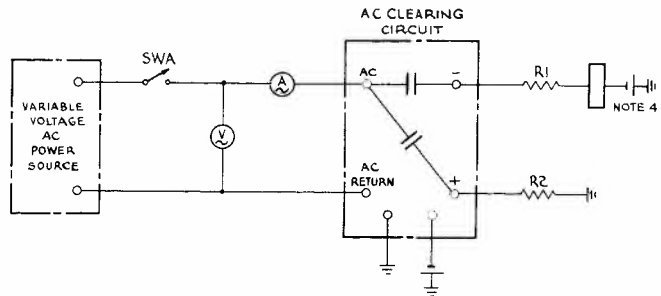
FIG.1 TEST CLEARING SENSITIVITY.

RELAY TYPE RAF RCA 212248 (SEE RELAY DATA)						
	R1 = R2 = 0			R1 = R2 = 750Ω		
INPUT	I(mA)	V	$2\times\frac{V}{I}\times1000$	I(mA)	V	$2\times\frac{V}{I}\times1000$
16 Hz						
35 Hz						

LINE RELAY CHATTER YES/NO.

RELAY 600 TYPE 12/SCO/434 (SEE RELAY DATA)						
	R1 = R2 = 0			R1 = R2 = 325Ω		
INPUT	I(mA)	V	$2\times\frac{V}{I}\times1000$	I(mA)	V	$2\times\frac{V}{I}\times1000$
16 Hz						
35 Hz						

LINE RELAY CHATTER YES/NO.



NOTES :-
1. OPERATE RELAY SET TO AC CLEARING CONDITIONS.
2. THROW SWITCH SWA AND INCREASE AC VOLTAGE FROM MINIMUM TO MAXIMUM UNTIL AC CLEARING OPERATES.
3. RECORD RESULTS.
4. THE LINE RELAY SHOULD NOT CHATTER.

AC CLEARING GENERATOR PERFORMANCE.

1. THE AC CLEARING GENERATOR IS CAPABLE OF CLEARING, UNDER BUSY HOUR CONDITIONS, A MAXIMUM OF_____EXCHANGE LINES OUT OF A TOTAL POSSIBLE CONNECTION OF_____EXCHANGE LINES.
2. THE AC CLEARING GENERATOR'S POWER RATING IS_____VA.
3. THE AC CLEARING GENERATOR'S MINIMUM FULL LOAD VOLTAGE MEASURED AT THE CONNECTION POINT TO THE EXCHANGE LINE CIRCUIT IS_____VOLTS.

FIG.2 TEST SENSITIVITY TO LINE UNBALANCE.

RELAY TYPE RAF RCA 92312 (SEE RELAY DATA)				
	VALUE R1		VALUE R2	
INPUT	MAX.(a)	MIN.(b)	MAX.(c)	MIN.(d)
16 Hz				
35 Hz				

16 Hz AVERAGE UNBALANCE SENSITIVITY = $\frac{a-b+c-d}{4}$ = _____ OHMS.

35 Hz " " " = " = _____ "

TRANSMISSION RELAY CHATTER NO/YES AT 16 Hz, R1=R2= _____ OHMS.

" " " NO/YES " 35 Hz, R1=R2= _____ "

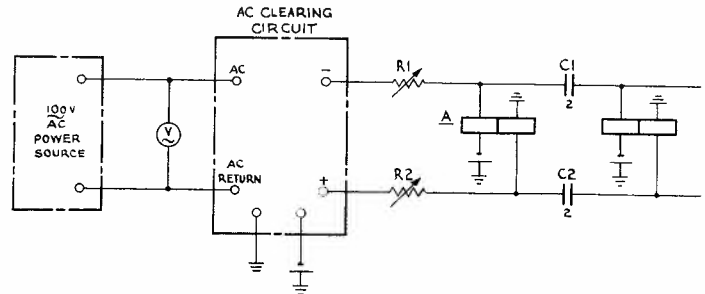
RELAY 3000 TYPE 33/SCO/451 (SEE RELAY DATA)				
	VALUE R1		VALUE R2	
INPUT	MAX.(a)	MIN.(b)	MAX.(c)	MIN.(d)
16 Hz				
35 Hz				

16 Hz AVERAGE UNBALANCE SENSITIVITY = $\frac{a-b+c-d}{4}$ = _____ OHMS.

35 Hz " " " = " = _____ "

TRANSMISSION RELAY CHATTER NO/YES AT 16 Hz, R1=R2= _____ OHMS.

" " " NO/YES " 35 Hz, R1=R2= _____ "



NOTES :-
1. SET R1 = R2 = 500 Ω. VARY R1 TO MAXIMUM AND MINIMUM VALUES AT WHICH THE AC CLEAR RELAY OPERATES.
2. RESTORE R1 TO 500 Ω. RETEST VARYING R2 AS ABOVE.
3. RECORD RESULTS.
4. REDUCE R1 AND R2 SIMULTANEOUSLY UNTIL EITHER THE TEST RELAY 'A' CHATTERS OR R1 AND R2 BECOME 0 Ω.

P A B.X. EQUIPMENT TYPE —
MANUFACTURER —
MANUFACTURERS DRG. Nº —
ISSUE Nº —
AMBIENT TEMPERATURE DURING TESTS WAS _____ °C.

TESTED AT —
BY —
DATE —
ACCEPTED / REJECTED —
DATE —

	RELAY DATA												
	TYPE	FUNCTION	DESIGN	COIL RES.(Ω)	COIL CODE	ARMATURE	RESID.	TRAVEL	SPRING SETS		CONTACT PRESSURE BUFFER	CONTACT PRESSURE LEVER	REMARKS
FIG. 1	CROSS BAR RAF	LINE RELAY	LR	1335 (+320)	RCA 212248	RAF	0.30 MM	1.0 MM	B PILE: RBF 10403 (B.M)	C PILE: RBF 10202 (B)	25 (20-30) GRMS	10 (5-15) GRMS	
	STEP BY STEP 600	" "	L	300	12/SCO/434	Nº12	B STUD	25 MILS	1/SSP/775	7/SSP/774	16-20 "	5-8 "	
FIG. 2	CROSS BAR RAF	TRANSM. BRIDGE	—	200+200 (+600)	RCA 92312	RAF	0.30 MM	1.0 MM	B PILE: RBF 10505 (C.M)	———	25 (20-30) "	10 (5-15) "	
	STEP BY STEP 3000	" "	—	200+200	33/SCO/451	Nº 2	B STUD	31 MILS	2/SSP/812	8/SSP/807	11-16 "	5-8 "	

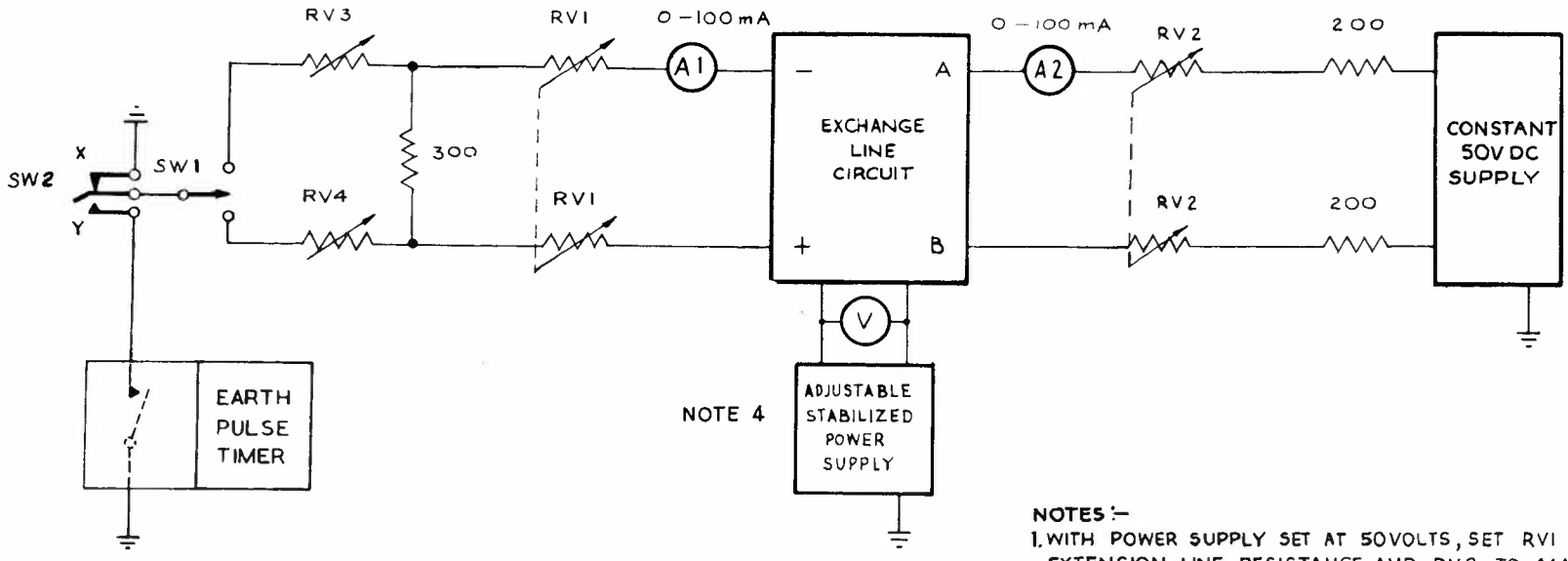


FIG. 16. PABX APPROVAL TESTS ENQUIRY CIRCUIT.

POWER SUPPLY	RV1 MAX.	A1 MIN.	RV2 MAX.	A2 MIN.	RV3 MAX.	RV3 MIN.	RV4 MAX.	RV4 MIN.	MINIMUM EARTH PULSE DURATION	WITH RV3 MAX. OF
____VOLTS MIN.										
50 VOLTS										
____VOLTS MAX.										

NOTES :–

1. WITH POWER SUPPLY SET AT 50VOLTS, SET RV1 TO MAXIMUM EXTENSION LINE RESISTANCE AND RV2 TO MAXIMUM EXCHANGE LINE RESISTANCE FOR WHICH THE P.A.B.X. FACILITIES WILL FUNCTION CORRECTLY.
2. WITH SWITCH SW2 IN THE X POSITION ADJUST RV3 & RV4 AND MEASURE THEIR MAXIMUM AND MINIMUM RESISTANCE VALUES FOR WHICH SWITCHING TO ENQUIRY CAN BE EFFECTED.
3. WITH SWITCH SW2 IN THE Y POSITION, SW1 CONNECTED TO RV3 AND RV3 SET AT ITS MAXIMUM VALUE (MEASURED IN 2, ABOVE), MEASURE TO THE NEAREST MILLISECOND, THE MINIMUM DURATION OF THE EARTHS PULSE FOR WHICH SWITCHING TO ENQUIRY CAN BE EFFECTED.
4. REPEAT ABOVE MEASUREMENTS WITH SYSTEM VOLTAGE AT MAXIMUM AND MINIMUM.
5. RECORD RESULTS.

P. A. B. X. EQUIPMENT TYPE —

MANUFACTURER —

MANUFACTURER'S DRG. NO. —
ISSUE NO. —

AMBIENT TEMPERATURE DURING TESTS WAS ..... °C.

TEST AT —
BY —
DATE —

ACCEPTED / REJECTED —
DATE —

ASSOCIATED REFERENCES AND DRAWINGS

APO SPECIFICATIONS

Number	Title
1080	PABX Design Objectives
1105	Signalling on Subscribers lines

DRAWINGS

Number	Title
CE-99033	PABX Approval Tests Proforma. Sheets 1-15

End of Specification.