GFELLER SUBSCRIBER LINE CONCENTRATOR 49-9-2

INITIAL PREPARATION AND LINE-UP

1. GENERAL

1.01 This is one of a group of sections, pertaining to the Gfeller line concentrator, having the base numbers A804.901 and C85.010. This section contains various tests to be performed at the time of initial preparation and line-up.

1.02 The tests covered are:

A. **Manual Test of Relays and Vertical and Horizontal Bars:** This test checks the mechanical condition of all relays, bars, and bar magnets.

B. **Test of Resistors RI, RII, RIII, and Relays RA through RF:** This test provides for adjusting resistors RI, RII, and RIII to suit particular cable conductor resistance and verifies that relays RA through RF meet electrical requirements.

C. **Test of Resistors R1, R2, R5, R11, R12, R13, and R14:** This test checks the resistance requirements and provides adjusting methods where required.

D. **F- and G- Relay Test:** This test checks the operating requirements for these relays and verifies that the proper numbered relays operate in accordance with the marking control pattern.

E. **Hold Winding Test of Vertical Bar Lift Magnets:** This test checks that the vertical bar lift magnets hold operated in accordance with circuit requirements.

F. **Test of M and N Relays:** This test checks the adjustment of these relays using a pulse checking test set.

G. **Walking Circuit Test:** This test checks the sequence of operation of relays VB1 through 9 and their associated vertical bars.

H. **Test of V Relay Release Time:** This test checks the slow release time of the V relay in relation to the charged voltage maintained on the two 1750 MF capacitors in the subscriber unit between successive calls.

I. **Test of All-Trunks-Busy Register Feature:** This test checks that, when all nine vertical bars are engaged with service calls, a lead is grounded to the all-trunks-busy register.

J. **Test of All-Trunks-Busy Applique Circuit, Step-by-Step Offices:** This test verifies that the all-trunks-busy feature will activate the applique circuit and cause all line equipment sleeves connected to the concentrator to be grounded.

1.03 *Caution: When blocking any relays nonoperated, avoid dislodging the residual separator that may be installed.*

1.04 Performing tests prior to the actual installation of the units, as covered in Parts 3 and 4, is efficient for the following reasons:

(a) The Gfeller line concentrators are most often used in locations where there are a minimum of spare cable facilities, which necessitates rearrangements of working circuits to connect the two units.

(b) When the central office and subscriber units are set up next to each other, access for performing the tests is convenient.

(c) This method reduces the number of tests required after installation and consequently reduces the time required for placing the concentrator in service.

1.05 Fig. 2 and 3 show the terminal strip arrangement for the line concentrators covered by schematics S10460-3, S10461-3, and S10460-4, S10461-4, respectively.

2. APPARATUS

Test A

2.01 No. 74D gauge (for measuring the air gap of horizontal and vertical bar magnets).

2.02 No. 70J gram gauge (for measuring the tension of relay and vertical bar contact springs and the pressure required to move horizontal and vertical bars).

Tests B, C, D, E and H

2.03 KS-14510 meter, portable volt-ohm-milliammeter, or equivalent (for measuring dc voltage, resistance, and dc current).

Test B

2.04 Ac ammeter (for measuring ac current over a 0-100 ma range).

Tests B through F

2.05 22 variable wire-wound resistors (10 watt) (for simulating cable conductor resistance if units are tested side by side).

Test F

2.06 Pulse checking test set, J94723A (SD-96362-01).

2.07 Testing cord W2W cord, 6 feet long, equipped with one No. 310 plug, No. 360B tool and No. 360C tool (No. 2W17A cord), two KS-6278 connecting clips (for connecting pulse checking test set to line concentrator MA jack).

2.08 Testing cord, W3M cord, 6 feet long, equipped with one No. 310 plug, No. 360A tool, No. 360B tool, and No. 360C tool (No. 3W4A cord), two KS-6278 connecting clips (for connecting battery and ground to pulse checking test set BAT-G jack).

Tests I and J

2.09 Test receiver, No. 716C receiver attached to a W2AB cord equipped with two No. 360A tools (No. 2W21A cord), one KS-6278 connecting clip and one No. 411A (test pick) tool (for use in checking for the presence of ground).

Tests C, D, E, and F

2.10 Gfeller test leads, equipped with banana type plugs (to facilitate connecting test equipment to line concentrator test jacks).

3. PREPARATION

STEP	ACTION	VERIFICATION
Tests B through J		
1	Determine from records or by measurement the loop resistance of one of the cable pairs to be used as a trunk or for control leads. To measure the loop resistance — Strap together the tip and ring at the remote end and connect an ohmmeter across the tip and ring at the central office. Record reading and remove strap.	
2	At the central office unit — With each conductor selected in Step 1 grounded at the remote end — Using an ac voltmeter — Measure the ac potential from each conductor to ground.	Max 10 volts on each conductor.

STEP	ACTION	VERIFICATION
3	Measure the dc ground potential for the conductors as arranged in Step 2 by connecting a dc voltmeter from ground to one conductor of the pair.	
4a	If a negative voltage is obtained in Step 3 — Determine the negative dc ground potential effect on the loop resistance by multiplying each negative volt obtained in Step 3 by 15 ohms. **Note:** Disregard any positive voltage.	
5	With the loop resistance obtained in Step 1 corrected for 68° nominal temperature, add any resulting product from Step 4a. This sum becomes the effective loop resistance.	
6	Determine the dc voltage requirements as follows: Loop resistance or effective loop resistance 750 ohms or less use 48-volt operation; 751 to 1200 ohms use 72-volt operation.	
Tests B through F		
7b	If preliminary tests are to be made with the units located side by side prior to their being installed— Simulate the effective cable resistance of the control leads and trunk conductors by interconnecting both units using the variable 10 watt resistors adjusted to one half the resistance value obtained in Step 5 as follows: Connect a resistor in series with each simulated control lead. Connect a resistor in series with the ring and tip side of each simulated trunk pair.	
Tests B through J		
8c	If Tests B through J are to be made after the units are installed — Connect the control leads 1 through 4 as follows: Use first control pair for leads 1 and 4 and connect them to the tip and ring, respectively. Use second control pair for leads 2 and 3 and connect them to the tip and ring, respectively.	
9c	Connect the nine trunks to their respective cable pairs.	
10	Connect power to the central office unit as covered in Section A804.901.05, C85.010.05.	

4. METHOD

STEP	ACTION	VERIFICATION
	A. Manual Test of Relays and Vertical and Horizontal Bars	
	Note: This test applies to both units except that all reference to bar 50 is omitted for the subscriber unit.	
1	Manually operate each relay in turn.	Armature moves freely. Fiber separators are positioned correctly between the springs. All contacts have — Min .005 inch follow Min .005 inch clearance when opened.
2	Manually lift each vertical bar in turn.	Vertical bar moves freely and is positioned correctly. Fiber separators of vertical bar contacts are positioned correctly between the springs. All contacts have — Min .005 inch follow Min .005 inch clearance between springs when normal.
3	Manually move each horizontal bar to the right in turn.	Bar moves freely and is positioned correctly.
4	Lift each vertical bar in turn.	Flag contacts clear all contact fingers by .004 inch (gauge by eye).
5	Lift vertical bar 1.	
6	Move horizontal bar 1 to its operated position.	
7	Slowly lower vertical bar 1.	Contact fingers first contact the sloping portion of the flag contacts. When flag contacts are fully engaged — Horizontal bar cutoff contacts opened.
8	Repeat Steps 5 and 7, substituting vertical bars 2 through 9.	Same as Step 7.
9	Restore horizontal bar to its normal position.	
10	Repeat Steps 5 through 9, substituting horizontal bars 2 through 50 in turn.	Same as Step 7.
11	Using a 74D nest of gauges — Measure the air gap between the armature and pole face of each horizontal bar magnet in turn.	Max .002 inch. **Note:** It is permissible for the armature to touch the pole face in the operated position.

STEP	ACTION	VERIFICATION
12	Using a 70J gram gauge applied to the front right-hand end of each horizontal bar — Measure pressure required to move horizontal bar from its normal position.	As horizontal bar just moves from its normal position — 25 to 40 grams.
13	Using 74D nest of gauges — Measure air gap between the lift magnet 9 armature and pole face in its operated position.	.004 to .012 inch.
14	Lift vertical bars 1 through 8, in turn, and gauge by eye air gap between pole face and armature by comparing with gap for No. 9.	.004 to .012 inch.
15	Manually load eight vertical bars on bar 50.	Horizontal bar 50 still touches the positioning rod.
16	Using a 70J gram gauge applied at bottom of vertical bar — Measure pressure required to lift each vertical bar from its normal position.	As vertical bar just leaves its normal position — Central office unit Min 70 grams. Subscriber unit Min 50 grams.
17	Using a 70J gram gauge — Measure the pressure of the make and break contacts associated with each vertical bar as specified.	Make contact: 17-35 grams. Break contact: 20-30 grams.

B. Test of Resistors RI, RII, RIII, and Relays RA through RF

11	At central office unit — Divide the resistance used in Step 6 by 2 to get the individual conductor resistance. Subtract this resistance from 600 to get the compensating resistance. Round to the nearest 20 ohms. For example, loop resistance or effective loop resistance 750 ÷ 2 = 375 ohms conductor resistance: 600 — 375 = 225 ohms (Round to 220 ohms).	
12	Remove associated ac power fuse.	
13	With all ac power removed from unit — Using an ohmmeter for verification — Remove or add straps as required to obtain resistance value obtained in Step 11.	
14	Remove ohmmeter from resistor RI.	
15	Repeat Steps 13 and 14 substituting resistors RII and RIII in turn.	
16	Replace ac power fuse.	
17	Remove plug from test jacks MC1.	Relays RA and RD release.
18	Replace plug.	Relays RA and RD operate.
19	Remove plug from test jacks MC2.	Relays RB and RE release.

STEP	ACTION	VERIFICATION
20	Replace plug.	Relays RB and RE operate.
21	Repeat Steps 19 and 20, substituting test jacks MC3 and Resistor RIII.	Same as Steps 19 and 20 except that relays RC and RF release and operate.
22	Check the operate and release requirements of relays RA through RF as specified in the circuit requirement table of Section A804.901.06, C85.010.06.	
23	At subscriber unit — Repeat Step 22.	

C. Test of Resistors R1, R2, R5, R11, R12, R13, and R14

11	At the central office unit — Remove all fuses.	
12d	If units are powered for 48-volt dc operation — With straps wired between the rear and slide terminals of resistors R2, R5, R11 and R13 — Connect an ohmmeter, in turn, to resistors R2, R5, R11, and R13 between the front and rear terminals.	
13d	Adjust slide terminal for each resistor as required.	Ohmmeter should read as follows: R2 — 50 ohms ± 2 ohms R5 — 6 ohms ± .5 ohms R11 — 350 ohms ± 10 ohms R13 — 225 ohms ± 10 ohms
14e	If units are powered for 72-volt dc operation — With straps removed between the rear and center terminals of resistors R2, R5, R11, and R13 — Connect an ohmmeter, in turn, to resistors R2, R5, R11, and R13 between the front and rear terminals.	Ohmmeter should read as follows: R2 — 500 ohms ± 20 ohms R5 — 20 ohms ± 1 ohm R11 — 500 ohms ± 20 ohms R13 — 450 ohms ± 15 ohms
15d	At the subscriber unit — If unit is powered for 48-volt dc operation — With a strap wired between the rear and slide terminals of resistor R1 — Connect an ohmmeter to the front and rear terminals of resistor R1.	
16d	Adjust slide terminal as required.	Ohmmeter should read 6 ohms ± .5 ohm.
17e	If unit is powered for 72-volt dc operation — With straps removed between the rear and center terminals of resistor R1 — Connect an ohmmeter to the front and rear terminals.	Ohmmeter should read 20 ohms ± 1 ohm.

STEP	ACTION	VERIFICATION
18	At the central office unit — Manually load vertical bars 1 through 9 on bar 50.	
19	Replace all fuses.	Circuit functions to cause vertical bar 1 to be selected and held operated.
20	Remove plug from test jacks MC4.	
21	Connect dc milliammeter to test jacks MC4.	
22	Block operated relays C and AB1.	
23	At the subscriber unit — Block operated any TN- relay.	
24	At central office unit — Adjust slide of resistor R12 to obtain reading in accordance with Table A.	
25	Momentarily release and then block operated relay C.	Circuit advances to select and hold operated next higher numbered vertical bar. Milliammeter should read in accordance with reading obtained in Step 24 ± 2 ma.

TABLE A

Outside Temperature Degrees Fahrenheit	Current Flow R-12	R-14
105-114	67 ma	53 ma
95-104	68 ma	54 ma
85-94	69 ma	55 ma
75-84	71 ma	56 ma
65-74	72 ma	57 ma
55-64	74 ma	58 ma
45-54	76 ma	60 ma
35-44	78 ma	61 ma
25-34	80 ma	62 ma
15-24	82 ma	64 ma

26	Repeat Step 25 until all vertical bars have been tested.	Same as Step 25.

STEP	ACTION	VERIFICATION
27	Remove blocking tools and meter and replace plug in test jacks MC4.	
28	Remove plug from test jacks MC5.	
29	Connect dc milliammeter to test jacks MC5.	
30	Adjust slide of resistor R14 to obtain a reading in accordance with Table A.	
31	Momentarily operate relay F1.	Circuit functions to select and operate next higher numbered vertical bar. Milliammeter should read in accordance with reading obtained in Step 30 ± 2 ma.
32	Repeat Step 31 until all vertical bars have been tested.	Same as Step 31.
33	Remove meter and replace plug in jacks of MC5.	
34	Remove block from relays C and AB1.	

D. F- and G- Relay Test

11	At the central office unit — Remove plug from test jacks MC4.	
12	Connect dc milliammeter to test jacks MC4.	
13	Block operated relays C and AB1.	
14	At the subscriber unit — Hold operated relay TN1.	Milliammeter reads 70 to 75 ma. At the subscriber unit — Relays F- and G- are operated in accordance with Table B.
15	Release relay TN1.	
16	Repeat Steps 14 and 15, substituting relays TN2 through 49.	Same as Step 14.
17	At the central office unit — Hold operated relay TN1.	Milliammeter reads 70 to 75 ma. Relays F- and G- are operated in accordance with Table B.
18	Release relay TN1.	
19	Repeat Steps 17 and 18, substituting relays TN2 through 49.	Same as Step 17.
20	Remove block from relays C and AB1.	
21	Remove meter from test jacks MC4 and replace plug.	

STEP	ACTION	VERIFICATION

TABLE B

TN-	G-	F-	TN-	G-	F-
1	5	1	26	6	4
2	6	1	27	7	4
3	7	1	28	8	5
4	8	2	29	1	5
5	1	2	30	2	5
6	2	2	31	3	5
7	3	2	32	4	5
8	4	2	33	5	5
9	5	2	34	6	5
10	6	2	35	7	5
11	7	2	36	8	6
12	8	3	37	1	6
13	1	3	38	2	6
14	2	3	39	3	6
15	3	3	40	4	6
16	4	3	41	5	6
17	5	3	42	6	6
18	6	3	43	7	6
19	7	3	44	8	7
20	8	4	45	1	7
21	1	4	46	2	7
22	2	4	47	3	7
23	3	4	48	4	7
24	4	4	49	5	7
25	5	4	AK	6	7

E. Hold Winding Test of Vertical Bar Lift Magnets

11	At the central office unit — Connect a dc milliammeter between the MA jack and ground.	
12	Block operated relay V.	
13	Block nonoperated relay A.	
14	Manually lift vertical bar 1.	Milliammeter reads 55 to 60 ma. Vertical bar 1 remains operated.
15	Momentarily disconnect milliammeter from jack MA.	Vertical bar 1 releases.

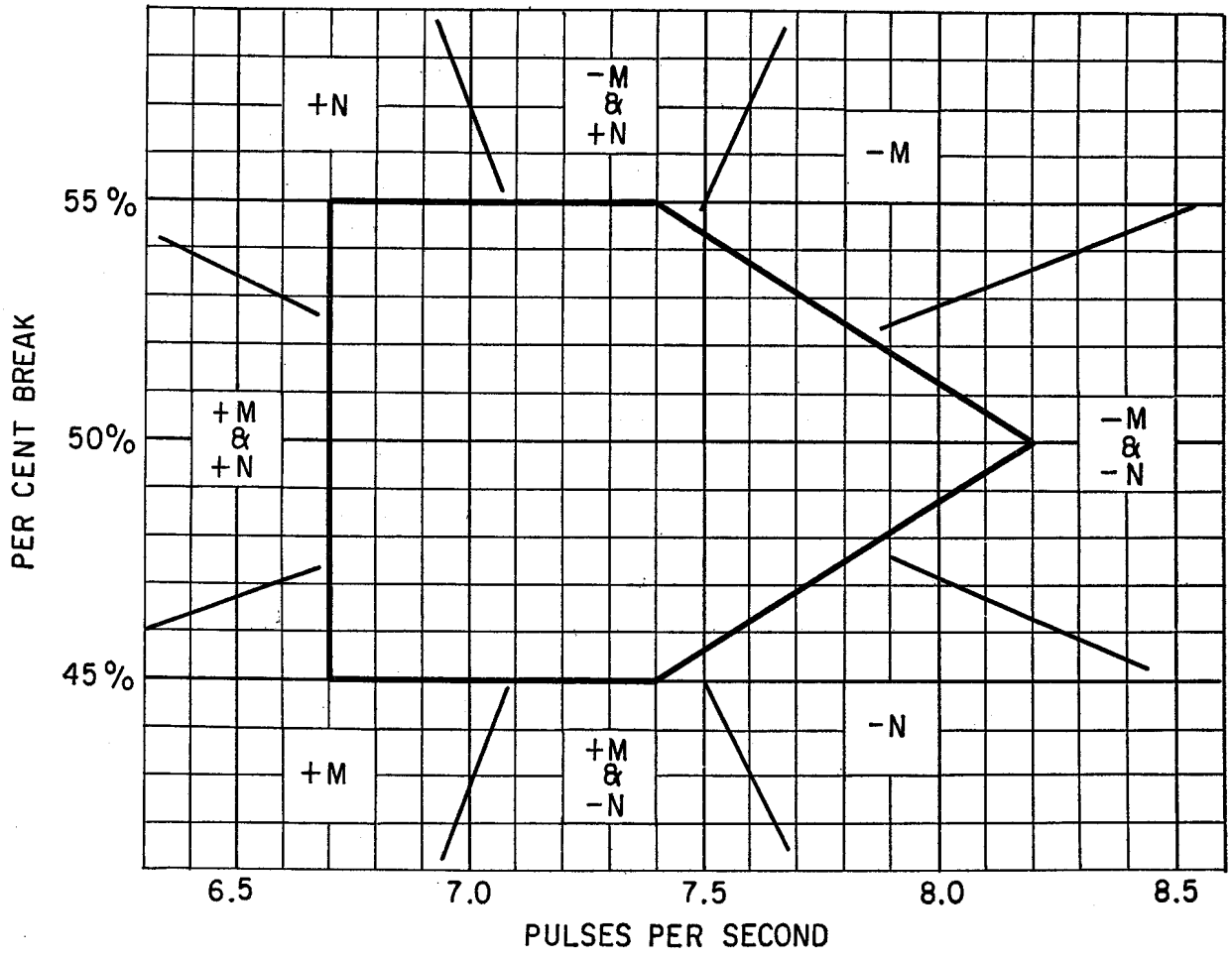
STEP	ACTION	VERIFICATION
16	Repeat Steps 14 and 15, substituting vertical bars 3, 5, 7, and 9.	Same as Steps 14 and 15, except vertical bars 3, 5, 7, and 9 are substituted.
17	Disconnect meter from jack MA.	
18	Connect milliammeter to jack MR.	
19	Manually lift vertical bar 2.	Milliammeter reads 55 to 60 ma. Vertical bar 2 remains operated.
20	Momentarily disconnect meter from jack MR.	Vertical bar 2 releases.
21	Repeat Steps 19 and 20, substituting vertical bars 4, 6, and 8.	Same as Steps 19 and 20 except vertical bars 4, 6, and 8 are substituted.
22	Disconnect meter from jack MR.	
23	Remove block from relays V and A.	

F. Test of M and N Relays

11	With no connections made to pulse checking test set and all keys normal — Turn CAL potentiometer fully counterclockwise.	
12	Adjust screw of break meter as required.	Meter reads 100% break.
13	Using the W3M cord — Insert plug in BAT G jack and connect tip (white conductor) to battery and sleeve (red conductor) to ground.	
14	Turn CAL potentiometer clockwise as required.	Meter reads 0% break.
15	At the central office unit — Using the W2W cord — Insert plug in P jack of test set and connect tip to the MA jack of line concentrator.	
16	At test set — Set scale key on 0-20 PPS.	
17	At central office unit — Hold relay D operated and then lift and release each vertical bar.	Walking circuit hunts for an idle trunk.
18	At test set — Operate PPS key.	Meter reading indicates pulses per second.
19	Release PPS key.	
20	Operate PCB key.	Meter reading indicates per cent break.
21	Release PCB key.	
22	Plot the readings obtained in Steps 18 and 20 using the two ordinates on Pulse Requirement Chart, Fig. 1.	The coordinates should intersect within the heavy lined center figure of the Pulse Requirement Chart.

STEP	ACTION	VERIFICATION
23d	If requirement is not met — Adjust M and/or N relay as required and as specified on chart to move coordinates toward the center of heavy lined figure.	The two readings intersect within the heavy lined center figure of the Pulse Requirement Chart.
24	Manually load vertical bars 1 to 9 on bar 50.	Walking circuit functions and operates a vertical bar. Walking action ceases.

PULSE REQUIREMENTS
"M" & "N" RELAYS



\+ INCREASE SPRING TENSION
− DECREASE SPRING TENSION

Fig. 1

STEP	ACTION	VERIFICATION
	G. Walking Circuit Test	
11	At central office unit — While holding relay D operated — Momentarily lift each vertical bar.	All vertical bars unloaded. M and N relays operate and release continuously. Relays VB1 through 9 and W operate and release in sequence.
12	Load vertical bar 1 on bar 50.	Relay BSU operates. Vertical bar 1 operates. Walking circuit hunts.
13	Load vertical bar 2 on bar 50.	Relay BSG operated. Walking circuit action ceases.
14	Momentarily operate relay D.	Vertical bar 1 releases. Vertical bar 2 operates. Walking circuit hunts.
15	Repeat Steps 12 through 14, substituting for vertical bars 1 and 2 the following combinations: 2-3, 3-4, 4-5, 5-6, 6-7, 7-8, 8-9, and 9-1.	Correct vertical bars operate and release. Walking circuit functions as in Steps 12 through 14.
16	Manually load all nonloaded vertical bars on bars 50.	
17	Insulate contact 2 of relay PIRS.	
18	Hold operated DISENGAGEMENT (AK) key.	At central office unit — Relays VB1 through 9 operate and release in sequence. No vertical bar is operated.
19	After two cycles of VB- relay sequence — Release DISENGAGEMENT (AK) key.	
20	Remove insulator from relay PIRS.	At each unit — A correspondingly numbered vertical bar is operated. Walking circuit action ceases.
21	At the central office unit — Remove plug from jacks MC5.	At the central office unit — The vertical bar operated in Step 20 releases. All vertical bars operate and release in sequence. At the subscriber unit — Vertical bar operated in Step 20 releases. All vertical bars operate and release in sequence.

STEP	ACTION	VERIFICATION
22	After two cycles of sequence — Replace plugs in jacks MC5.	At each unit — A correspondingly numbered vertical bar is operated.
23	Load any nonloaded vertical bars on bar 50.	

H. Test of V Relay Release Time

11	At the central office unit — Strap winding terminals 2, 3, and 4, of the V relay.	
12	At distributing frame — At GLC connector block — Strap the sleeves of any eight horizontal bars to terminals associated with R16 battery (shown as SB terminal on Fig. 1 and 2).	
13	Load eight vertical bars on the horizontal bars selected in Step 12.	
14	At subscriber unit — Connect a dc voltmeter to jacks + and —.	
15	Hold operated DISENGAGEMENT (AK) key.	Peak voltage reaches Min 40 volts between successive vertical bar operations.
16	Release DISENGAGEMENT (AK) key.	
17d	If peak voltage requirement in Step 15 is not met — Remove strap between winding terminals 3 and 4.	
18d	Repeat Steps 13, 15, and 16.	Same as Step 15.
19e	If peak voltage requirement is not met in Step 18d — Remove strap from winding terminals 2 and 3.	
20e	Repeat Steps 13, 15, and 16.	Same as Step 15.
21	Disconnect voltmeter.	

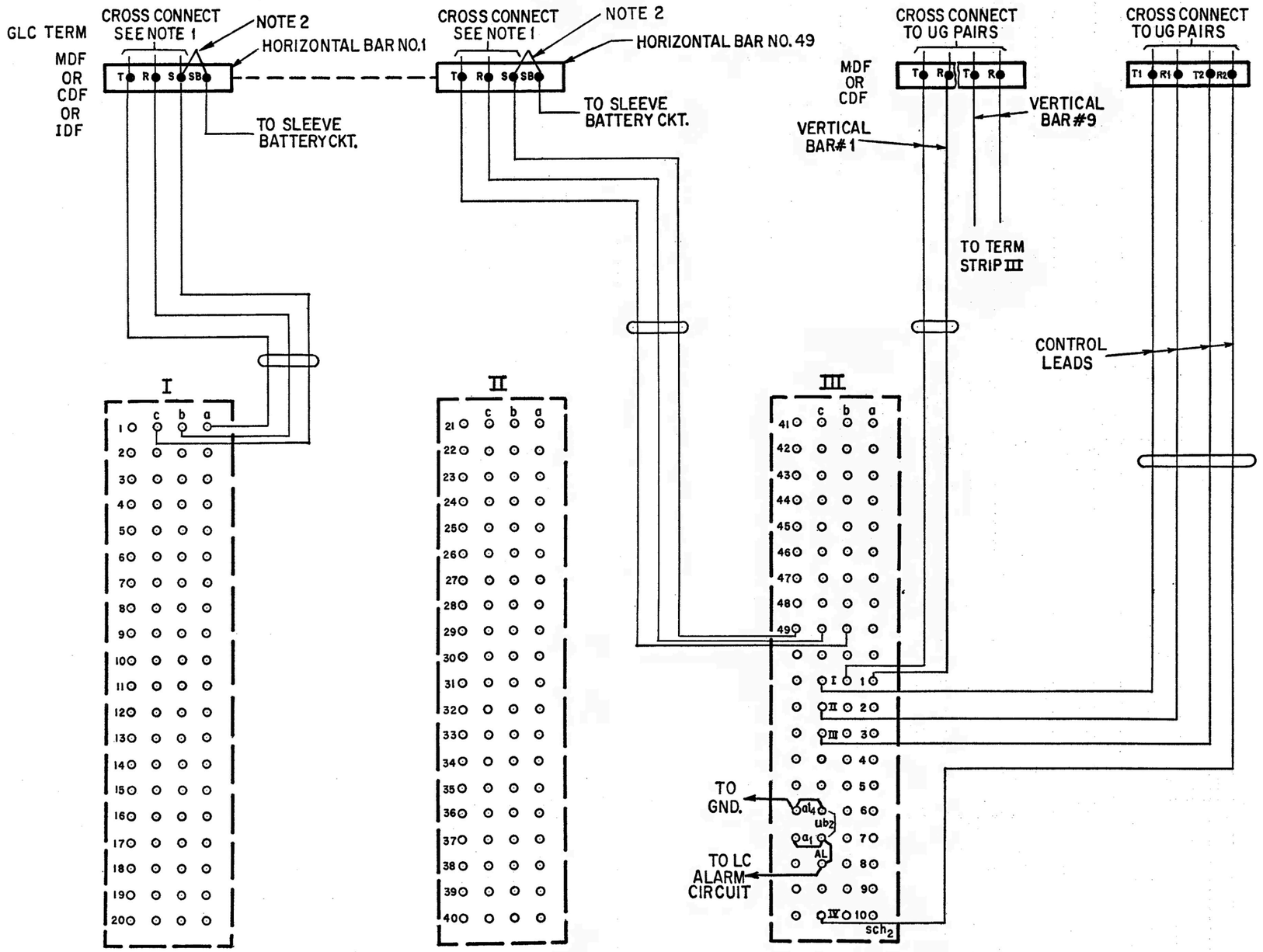
I. Test of All-Trunks-Busy Register Feature

11	At the central office unit — Unload eight vertical bars.	
12	At terminal strip III (See Fig. 3) — Connect a test cord between ground and punching $V1_1$.	
13	Connect a test receiver between battery and punching $AB1_3$.	

STEP	ACTION	VERIFICATION
14	Operate any TN- relay.	When relay V1 releases — Ground present at punching $AB1_3$. When relay V1 reoperates — Ground absent from punching $AB1_3$.
15	Release TN- relay.	
16	Remove connections from terminal strip III.	
17	Manually load all vertical bars on bar 50.	

J. Test of All-Trunks-Busy Applique Circuit, Step-by-Step Offices

11	With the applique circuit connected at the central office unit — Block nonoperated relay V1.	At applique circuit — Relay VO1 through 9 operates.
12	Connect test receiver to battery.	
13	At terminal strip III — Using test pick — Test for presence of ground at terminals d1 through d49.	Ground present on each terminal.
14	Remove block from relay V1.	
15	Disconnect test receiver.	



NOTES:

1. **No. 1 Crossbar Offices**
   Cross-connect T and R to line equipment terminals T and R for assigned lines. Extend sleeves S of assigned line equipments from the LDF, via cable or tie cable, to the HMDF and cross-connect to the line concentrator S terminals.

   No. 5 Crossbar Offices

   Cross-connect T, R and S to line equipment terminals T, R and LS for assigned lines.

   Panel BCO and SXS Offices

   Connect T, R, S, to T, R, S for assigned line numbers. Where GLC block is located on the MDF the line equipment S leads must be extended by tie cable from the IDF to the MDF.

   Panel GCO

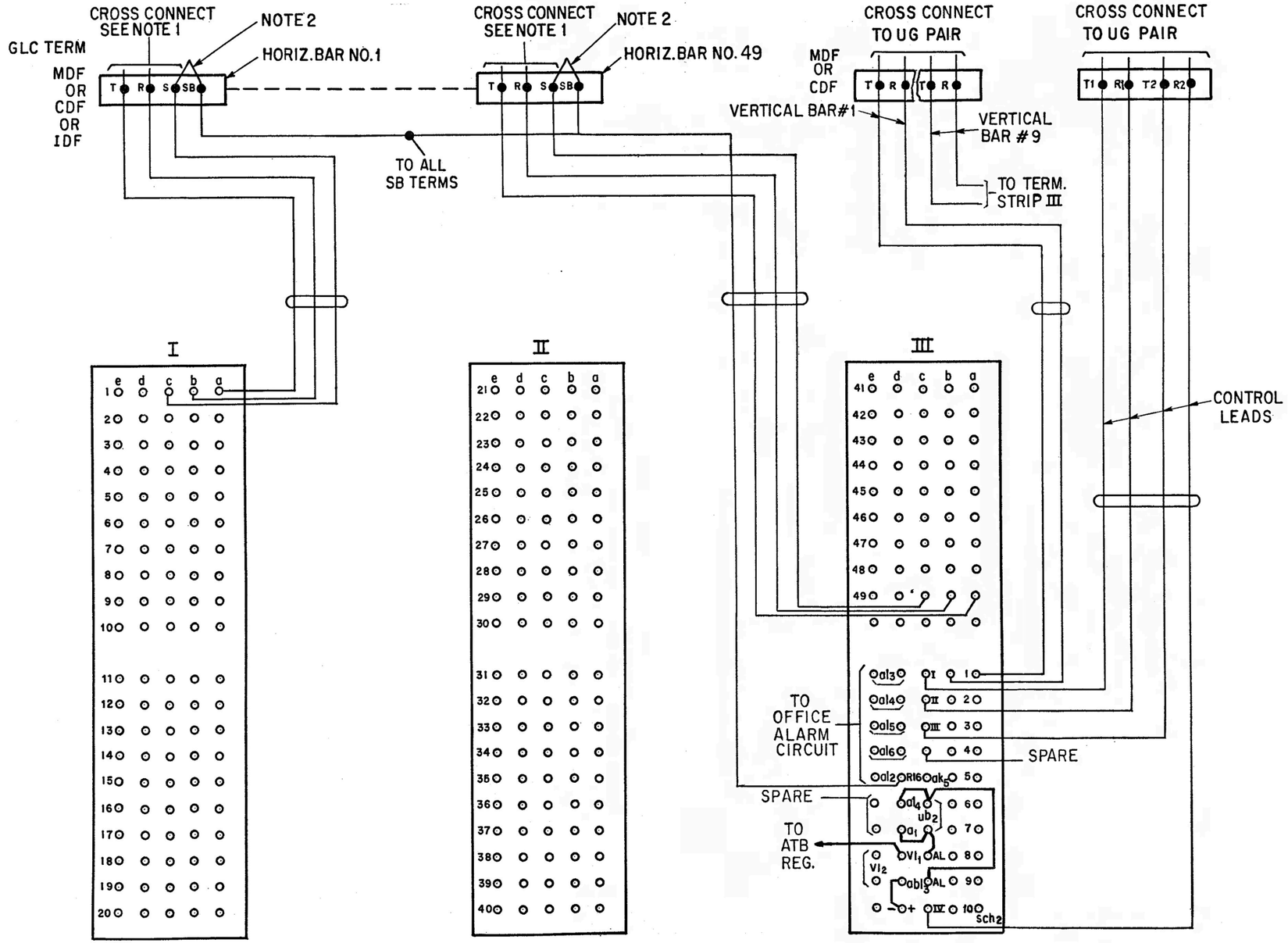
   Connect T, R, to T, R, for assigned line numbers. Connect S leads to applique circuit as covered in Section A804.901.03, C85.010.03.

2. Place strap for all unassigned horizontal bars.

3. For conversion to 72 volt operation refer to Section A804.901.03, C85.010.03.

TERMINAL STRIPS
FOR
SCHEMATIC NO. S10460-3

FIG. 2



NOTES:

1. **No. 1 Crossbar Offices**
   Cross-connect T and R to line equipment terminals T and R for assigned lines. Extend sleeves S of assigned line equipments from the LDF, via cable or tie cable, to the HMDF and cross-connect to the line concentrator S terminals.

   No. 5 Crossbar Offices

   Cross-connect T, R and S to line equipment terminals T, R and LS for assigned lines.

   Panel BCO and SXS Offices

   Connect T, R, S, to T, R, S for assigned line numbers. Where GLC block is located on the MDF the line equipment S leads must be extended by tie cable from the IDF to the MDF.

   Panel GCO

   Connect T, R, to T, R, for assigned line numbers. Connect S leads to applique circuit as covered in Section A804.901.03, C85.010.03.

2. Place strap for all unassigned horizontal bars.

TERMINAL STRIPS
FOR
SCHEMATIC NO. S10460-4

FIG. 3