

**SINGLE-FREQUENCY SIGNALING SYSTEM**  
**SIGNALING TESTS**  
**TYPES E AND F**  
**USING 4A SIGNALING TEST SET (J94743)**

**1. GENERAL**

**1.01** This section describes procedures for making pulsing and supervisory tests on single-frequency (SF) signaling systems using the 4A signaling test set SD-1C244-01 (J94743). This section also provides the terminating end procedures required (using the 4A test set) when assisting the originating end performing Tests, A, B, and C.

**1.02** The tests covered are:

**A. Pulsing on Loop:** This test checks pulsing of SF signaling system when the SF signaling unit requires loop pulsing.

**3**

**B. Pulsing on M lead:** This test checks pulsing of SF signaling system when the SF signaling unit requires M lead pulsing.

**6**

**C. Supervisory and Miscellaneous Tests—E&M Units Only:** This test checks the supervision during the idle, seizure, answer, and pulsing conditions. It also checks miscellaneous functions of the SF units. This test is intended to be made at the signaling unit location. This test is performed only on SF units using E & M signaling.

**8**

**Terminating end procedures:**

**AA. Testing on Loop:**

**11**

**AB. Testing on E & M:**

**11**

**AC. Supervisory and Miscellaneous Tests—E&M Units Only:**

**12**

**1.03** Tests A, B, and C in this section require assistance at the terminating end. Since it is possible to use either the 2B or the 4A signaling test set at the terminating end and the procedures for connecting and setting up the two test sets are quite different, no attempt is made to provide terminating end connection procedures in Tests A, B, and C. These terminating end procedures are written separately as AA, AB, and AC in this section if the 4A test set is used and as AA, AB, and AC in Section 179-302-501 if the 2B test set is used at the terminating end. The assistant at the terminating end should obtain the proper section to make the initial set-up. From that point on, the test is under the control of the originating end as provided in Tests A, B, and C.

**1.04** Table A contains minimum and maximum input and output test limits applicable to various combinations of SF units for pulse periods of 83 milliseconds (12 PPS) and 125 milliseconds (8 PPS). The output values to be used at the terminating end will be determined by the combination of test sets being used—that is, one set of values for originating 4A and terminating 2B or originating 2B and terminating 4A or another set of values for originating and terminating 2B or originating and terminating 4A.

**1.05** Fig. 1 and Fig. 2 show the extender test jack and cord to be used with each SF unit. The jack listed is used for both originating and terminating end testing. E-type units may be tested with the E extender only. The FWA and FWB units may be tested with either the FTA or the FTB extender. The other Type F units may be tested with the FTB extender only. When checking the SF tone pulses leaving the originating SF unit, the SF interface unit is to be connected a set forth in lettered steps of each test and as shown by the dashed connections on Fig. 1 and Fig. 2.

## SECTION 179-302-502

- 1.06** The single-frequency signaling circuit is referred to in this section as SF unit.
- 1.07** The resistance of the E and M lead connections between the SF unit and the signaling test set should not exceed 25 ohms for E-type units because of M lead limitations. For type F units, the M lead limitation is a maximum of 500 ohms.
- 1.08** Perform Test C without application of the 1000-Hz tone if -16 dBm 600Ω is not available. These tone values are for application at the SF unit location.
- 1.09** The test of the cross-control cut in Test C cannot be performed on E1A or E1B units unless these units are equipped with transmission path cut circuit SD-99778-01.
- 1.10** To make certain that service will not be interrupted, monitor the originating and terminating SF units by means of a high-impedance bridged monitoring arrangement before removing either unit from its in-service position or making any other test connection to it. For E-type SF unit, use bay-mounted monitoring circuit SD-96519-02 per Section 179-314-501. For type F SF unit, use a 1023A headset (equipped with a 354A plug) and connect it to the LINE RCV and LINE TRMT pin jacks on the face of the SF unit.
- 1.11** All tests in this section assume that the transmission requirements of the trunk are satisfied.
- 1.12** A signaling link, over which all pulsing is MF only, requires tests at 8 pps only (Tests *c* and *d* in Table A).
- 1.13** **Lettered Steps:** A letter a, b, c, etc, added to a step number in Part 3 or 4 of

### 3. PREPARATION

#### STEP

#### ACTION

#### VERIFICATION

#### All Tests

- 1 Make arrangements with terminating office to perform these tests.

**Note:** Set-up procedures for the terminating end are found in AA, AB, and AC of this

this section indicates an action which may or may not be required depending upon local conditions. The condition under which a lettered step or a series of lettered steps should be made is given in the ACTION column, and all steps governed by the same condition are designated by the same letter within a test. Where a condition does not apply, all steps designated by that letter should be omitted.

### 2. APPARATUS

#### All Tests

- 2.01** 4A signaling test set SD-1C244-01 (J94743A) equipped with E & M (J94743AD) or LOOP (J94743AB) interface unit and, optionally, SF (J94743AA) interface unit.
- 2.02** Monitoring circuit per SD-96519-02 and operators headset (E-type SF units) or a 1023A head set equipped with a 354A plug (type F SF units); see 1.10.
- 2.03** Extender, E-type, SD-99384-01 (J98613DM) for E-type units or type F, SD-1C241-01 (J-99335TA) for FWA and FWB units only or type F, SD-1C241-02 (J-99335TB) for any type F unit.
- 2.04** 3P7A cords, which consists of a P3E cord, 6 feet long, equipped with 310 plugs on each end. See Fig. 1 or Fig. 2 for number of cords required.

#### Test C

- 2.05** Source of 1000-Hz tone -16 dBm or lower level.

STEP	ACTION	VERIFICATION
	section for the 4A test set and Section 179-302-501 for the 2B test set.	
2	Make busy the circuit associated with SF unit to be tested.	
	<i>Note:</i> If testing an E1R unit normally arranged for A and B lead control, the loop must be open to assure proper testing over the M lead, as provided in this section.	
3	Connect 4A test set to 110 volts AC, operate POWER switch to ON.	
4	Release OPERATE-CLEAR and STOP-START keys on 4A.	
	<i>Note:</i> The OPERATE-CLEAR key and the START-STOP key are released when the lamp behind the key is extinguished and operated when the lamp is lighted.	
5	Unplug SF signaling unit associated with circuit to be tested from bay jack.	
6	Insert proper extender between SF signaling unit and bay jack.	

#### A. Pulsing on Loop

7	Equip 4A test set with LOOP interface unit.
8	Using 3P7A cord, connect S jack of 4A test set to extender per Fig. 1.
9	At 4A test set— Set SEND switch to LP.
10	Set PULSE MODE switch to CONT.
11	Operate GEN SUPV key to OFF HK.
12	Set PULSE PERIOD switch per Table A, Test <i>a</i> for PULSE PERIOD under INPUT TEST VALUES.
13	Set PULSE WIDTH switch per Table A, Test <i>a</i> for PULSE WIDTH (Loop) under INPUT TEST VALUES.
14	Operate all LOOP RES keys to OUT.

**SECTION 179-302-502**

STEP	ACTION	VERIFICATION
15	Set FUNCTION switch on LOOP unit to LP. Set LEAK switch to SF1.	
16	Operate TALK key to PULSE.	SUPV lamp momentarily lighted indicating seizure of distant end. At terminating end— SUPV lamp extinguished (4A test set) or LINE lamp extinguished (2B test set).
17a	If it is desired to check the tone pulses leaving the originating SF unit— Equip the 4A test set with the SF interface unit.	
18a	Set RECEIVE switch to SF.	
19a	Set MS RANGE switch to 99.9.	
20a	Set FUNCTION switch on 4A main unit to % Bk.	
21a	Using a 3P7A cord, connect FR EQPT jack of SF interface unit to SF LT jack (E and FTA type extender) or SF TRMT OUT jack (FTB type extender) of test extender.	
22a	Using 3P7A cord, connect to LINE jack of SF interface unit to L IN jack (E and FTA type extender) or FAC TRMT IN jack (FTB type extender) of test extender.	
23a	Operate PULSE/MEAS key to EQPT.	
24a	Operate TWD EQPT and TWD LINE keys to MON.	
25a	Set NB-BB switch to NB.	
26a	Operate START-STOP key.	
	<b>Note:</b> SF output tone pulses (% break) can now be monitored each time pulsing is applied at the originating SF unit, as long as the RECEIVE switch is in the SF position, by observing the display. The expected measured values are found in Table A under SF OUTPUT for the corresponding test.	
27	Operate OPERATE-CLEAR key.	At terminating end— Pulses received on loop at percent break equal

STEP	ACTION	VERIFICATION
		to or greater than indicated in Table A, Test <i>a</i> under OUTPUT TEST LIMITS.
28	At 4A test set— Release OPERATE-CLEAR key.	
29	Operate 100, 200, 400, and 800 LOOP RES keys.	
30	Set LEAK switch to OUT.	
31	Operate OPERATE-CLEAR key.	At terminating end— Pulses received on loop at percent break equal to or less than indicated in Table A, Test <i>b</i> under OUTPUT TEST LIMITS.
32	At 4A test set— Release OPERATE-CLEAR key.	
33	Restore all LOOP RES keys.	
34	Set LEAK switch to SF1.	
35	Set PULSE PERIOD switch per Table A, Test <i>c</i> for PULSE PERIOD under INPUT TEST VALUES.	
36	Set PULSE WIDTH switch per Table A, Test <i>c</i> for PULSE WIDTH (LOOP) under INPUT TEST VALUES.	
37	Operate OPERATE-CLEAR key.	At terminating end— Pulses received on loop at percent break equal to or greater than indicated in Table A, Test <i>c</i> under OUTPUT TEST LIMITS.
38	At 4A test set— Release OPERATE-CLEAR key.	
39	Operate 100, 200, 400, and 800 LOOP RES keys.	
40	Set LEAK switch to OUT.	
41	Operate OPERATE-CLEAR key.	At terminating end— Pulses received on loop at percent break equal to or less than indicated in Table A, Test <i>d</i> under OUTPUT TEST LIMITS.
42	At 4A test set— Release OPERATE-CLEAR key.	

**SECTION 179-302-502**

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
43b	If no further tests are to be made— Restore all circuits to normal.	
<b>B. Pulsing on M Lead</b>		
7	Equip 4A test set with E&M interface unit.	
8	Using 3P7A cord, connect LINE/R jack of 4A test set to extender per Fig. 2.	
9	At 4A test set— Set SEND switch to EM.	
10	Set PULSE MODE switch to CONT.	
11	Operate GEN SUPV key to OFF HK.	
12	Set PULSE PERIOD switch per Table A, Test <i>a</i> for PULSE PERIOD under INPUT TEST VALUES.	
13	Set PULSE WIDTH switch per Table A, Test <i>a</i> for PULSE WIDTH (M LEAD) under INPUT TEST VALUES.	
14	Operate PULSE/MEAS key to LINE.	
15	Operate TWD DROP key to ON HK.	
16	Set E&M/CX-S/R switch to E&M/CX.	
17	Operate TWD LINE key to OFF HK.	LINE lamp momentarily lighted indicating seizure of distant end. At terminating end— SUPV lamp extinguished (4A test set) or LINE lamp extinguished (2B test set).
18b	If it is desired to check the SF tone pulses leaving the originating SF unit— Equip the 4A test set with the SF interface unit.	
19b	Set RECEIVE switch to SF.	
20b	Using 3P7A cord, connect FR EQPT jack of SF interface unit to the SF LT jack (E and FTA type extender) or SF TRMT OUT jack (FTB type extender) of test extender.	
21b	Using 3P7A cord, connect to LINE jack of SF interface unit to L IN jack (E and FTA	

STEP	ACTION	VERIFICATION
	type extender) or FAC TRMT IN jack (FTB type extender) of test extender.	
22b	Operate TWD EQPT and TWD LINE keys to MON.	
23b	Operate PULSE/MEAS key to EQPT.	
24b	Set NB BB switch to NB.	
25	Operate START-STOP key.	
	<i>Note:</i> SF output tone pulses (% break) can now be monitored each time pulsing is applied at the originating SF unit, as long as the RECEIVE switch is in the SF position, by observing the display. The expected measured values are found in Table A under SF OUTPUT for the corresponding test.	
26	Operate OPERATE-CLEAR key.	At terminating end— Pulses received on E lead at percent break equal to or greater than indicated in Table A, Test <i>a</i> under OUTPUT TEST LIMITS.
27	At 4A test set— Release OPERATE-CLEAR key.	
28	Set PULSE PERIOD switch per Table A, Test <i>b</i> for PULSE PERIOD under INPUT TEST VALUES.	
29	Set PULSE WIDTH switch per Table A, Test <i>b</i> for PULSE WIDTH (M LEAD) under INPUT TEST VALUES.	
30	Operate OPERATE-CLEAR key.	At terminating end— Pulses received on E lead at percent break equal to or less than indicated in Table A, Test <i>b</i> under OUTPUT TEST LIMITS.
31	At 4A test set— Release OPERATE-CLEAR key.	
32	Set PULSE PERIOD switch per Table A, Test <i>c</i> or PULSE PERIOD under INPUT TEST VALUES.	
33	Set PULSE WIDTH switch per Table A, Test <i>c</i> for PULSE WIDTH (M LEAD) under INPUT TEST VALUES.	

**SECTION 179-302-502**

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
34	Operate OPERATE-CLEAR key.	At terminating end— Pulses received on E lead at percent break equal to or greater than indicated in Table A, Test <i>c</i> under OUTPUT TEST LIMITS.
35	At 4A test set— Release OPERATE-CLEAR key.	
36	Set PULSE PERIOD switch per Table A, Test <i>d</i> for PULSE PERIOD under INPUT TEST VALUES.	
37	Set PULSE WIDTH switch per Table A, Test <i>d</i> for PULSE WIDTH (M LEAD) under INPUT TEST VALUES.	
38	Operate OPERATE-CLEAR key.	At terminating end— Pulses received on E lead at percent break equal to or less than indicated in Table A, Test <i>d</i> under OUTPUT TEST LIMITS.
39	At 4A test set— Release OPERATE-CLEAR key.	
40c	If no further tests are to be made— Restore all circuits to normal at both ends.	

**C. Supervisory and Miscellaneous Tests—E&M Units Only**

7	Equip 4A test set with E&M interface unit.	
8	Using 3P7A cord, connect LINE/R jack of 4A test set to extender per Fig. 2.	At terminating end— LINE lamp lighted (4A test set) or L lamp lighted (2B test set).
9	At 4A test set— Operate PULSE/MEAS key to LINE.	
10	Set E&M/CX-S/R key to E&M/CX.	
11	Operate TWD LINE key to OFF HK.	At terminating end— LINE lamp extinguished (4A test set) or L lamp extinguished (2B test set).
12	At 4A test set— Operate TWD LINE key to ON HK.	At terminating end— LINE lamp lighted (4A test set) or L lamp lighted (2B test set).

STEP	ACTION	VERIFICATION
<b>High Level Tone and Transmission Cut Circuits</b>		
<i>Note:</i> See 1.08 through 1.10.		
13	At SF unit— Connect 1000-Hz tone to SF-ET jack (type F or SF-ET/2W jack (E-type) of test extender.	
14	If E-type signaling— Connect operators headset through monitoring circuit to monitor LINE XMT jack.	
15d	If Type F signaling— Connect 1023A headset to LINE TRMT pin jacks of SF unit.	
16	At originating and terminating test sets— Operate TWD LINE key (or TWD L key on 2B test set) to OFF HK.	On headset at terminating end— 1000-Hz tone heard.
17	At 4A test set— Operate TWD LINE key to ON HK.	On headset at originating end— 1000-Hz tone cut off and 2600-Hz tone heard at high level. After about 1/2 second— 2600-Hz tone drops to normal low level and 1000-Hz tone is restored.
18	At terminating end— Operate TWD LINE key (or TWD L key on 2B test set) to ON HK.	On headset at originating end— 1000-Hz tone cut off, then either remains cut off or is restored after about 1/2 second; 2600-Hz tone remains at low level throughout.
19	At SF unit— Remove monitoring connections.	
<b>Terminating End Broadbanding</b>		
20	At originating and terminating test sets— Operate TWD LINE key (or TWD 2 key on 2B test set) to OFF HK.	On headset at terminating end— 1000-Hz tone heard. On terminating end test set— LINE lamp extinguished (4A test set) or L lamp extinguished (2B test set)
21	At 4A test set— Operate TWD LINE key to ON HK.	On headset at terminating end— 1000-Hz tone cut off and high level spurt of 2600-Hz tone heard. 1000-Hz tone restored after about 1/2 second. 2600-Hz tone remains cut off or at very low level after initial high level spurt. On terminating test set— LINE lamp lighted (4A test set) or L lamp lighted (2B test set) and remains lighted.

**SECTION 179-302-502**

STEP	ACTION	VERIFICATION
22	Remove 1000-Hz tone.	
23	At terminating end— Remove monitoring connections.	
<b>Flashing and Rering Test</b>		
24	At 4A test set— Set SEND switch to EM.	
25	Set PULSE MODE switch to CONT.	
26	Operate GEN SUPV key to OFF HK.	
27	Set PULSE PERIOD switch to 200.	
28	Set PULSE WIDTH switch to 100.	
29	Operate TWD LINE key to OFF HK.	At terminating end— LINE lamp extinguished (4A test set) or L lamp extinguished (2B test set). Percent break measurement of between 40 and 60.
30c	If no further tests are to be made— Restore all circuit to normal on both ends.	

**5. TERMINATIONS END PROCEDURES**

STEP	ACTION	VERIFICATION
<b>Procedures AA, AB, and AC</b>		

**Note:** These procedures AA, AB, and AC are required when the user of this section is requested to provide assistance in performing overall pulsing tests that are being originated at the distant end using Tests A, B, or C of either this section or Section 179-302-501. Procedures AA, AB, and AC provide the terminating end set-up for Tests A, B, and C, respectively.

- 1 Make busy the circuit associated with SF unit to be tested.

**Note:** If testing on an E1R unit normally arranged for A and B lead control, the loop must be open to assure proper testing over the M lead, as provided in this section.

STEP	ACTION	VERIFICATION
2	Connect 4A test set to 110 volts ac, operate POWER switch to ON.	
3	Unplug SF signaling unit associated with circuit to be tested from bay jack.	
4	Insert proper extender between SF signaling unit and bay jack.	

**AA. Testing on Loop**

- 5 Equip 4A test set with LOOP interface unit.
- 6 Using 3P7A cord, connect S jack of 4A test set to extender per Fig. 1.
- 7 At 4A test set—  
Set MS RANGE switch to 99.9.
- 8 Set FUNCTION switch on 4A main unit to % Bk.
- 9 Set RECEIVE switch to LP.
- 10 Operate START-STOP key.
- 11 Set FUNCTION switch on LOOP unit to LP.
- 12 Operate TALK key on LOOP unit to DET SUPV.

**Note:** The percent break of the pulses received on the loop can now be measured and displayed and line supervision can be observed via the SUPV lamp.

- 13 After tests are completed—  
Restore all circuits to normal.

**AB. Testing on E&M**

- 5 Equip 4A test set with E&M interface unit.
- 6 Using 3P7A cord, connect LINE/R jack of 4A test to extender per Fig. 2.
- 7 At 4A test set—  
Set MS RANGE switch to 99.9.
- 8 Set FUNCTION switch to % BK.
- 9 Set RECEIVE switch to EM.

**SECTION 179-302-502**

<b>STEP</b>	<b>ACTION</b>	<b>VERIFICATION</b>
10	Set E&M/CX—S/R switch to E&M/CX.	
11	Operate PULSE/MEAS key to LINE.	
12	Operate TWD DROP key to ON HK.	
13	Operate TWD LINE key to ON HK.	
14	Operate START-STOP key.	
	<i>Note:</i> The percent break of pulses received on the E lead can now be measured and displayed and line supervision can be observed via the LINE lamp.	
15	After tests are completed— Restore all circuits to normal.	

**AC. Supervisory and Miscellaneous Tests—E&M Units Only**

5	Equip 4A test set with E&M interface unit.	
6	Using 3P7A cord, connect LINE/R jack of 4A test set to extender per Fig. 2.	
7	Set E&M/CX-S/R switch to E&M/CX.	
8a	If testing E-type signaling units— Connect head telephone set to MON OUT TEL SET jacks of monitoring circuit (SD-96519).	
9a	Using a P3E cord, patch from LINE REC jack to AMPL IN jack on monitoring circuit.	
10a	Using P8E monitoring cord, patch from S1 connector of monitoring circuit to the S connector of the SF unit under test.	
11b	If testing type F signaling units— Connect 1023A headset to LINE RCV pin jack of the SF unit under test.	
	<i>Note:</i> Audible tones can now be monitored via the head telephone set and supervision can be observed via the LINE lamp of the E&M interface unit.	
12	After tests are completed— Restore all circuits to normal.	

TABLE A

	TYPE OF UNIT		TEST	ORIGINATING SF UNIT					TERMINATING SF UNIT OUTPUT TEST LIMITS IN %BK			
	ORIG	TERM		INPUT TEST VALUE IN MS			SF OUTPUT IN %BK		ORIG 4A & TERM 2B OR ORIG 2B & TERM 4A		ORIG 4A & TERM 4A	
				PULSE PERIOD	PULSE WIDTH				ON E-LEAD	ON LOOP	ON E-LEAD	ON LOOP
					M-LEAD	LOOP	MIN	MAX				
1.	E() E1A	E() E1A	a	83	45		48	62	51		52	
			b	83	58		63	76	71		72	
			c	125	45		32	42	33		34	
			d	125	96		72	82	74		73	
2.	E() E1A	E2D E4D	a	83	45		48	62		56		52
			b	83	62		66	82		82		75
		E5D	c	125	45		32	41		38		36
			d	125	105		79	90		82		84
3.	E() E1A	E2L	a	83	45		48	62		56		52
			b	83	64		69	87		87		78
			c	125	45		32	42		35		36
			d	125	105		79	90		88		84
4.	E() E1A	E1P	a	83	43		46	60	44		45	
			b	83	60		65	78	55		54	
			c	125	43		30	40	45		46	
			d	125	100		75	86	57		56	
5.	E() E1A	FWA FA() FB()	a	83	43		46	60	52		53	
			b	83	60		65	78	84		83	
			c	125	43		30	40	34		35	
			d	125	98		74	84	92		88	
6.	E() E1A	FDA	a	83	43		46	60		49		53
			b	83	60		65	78		95		82
			c	125	43		30	40		32		35
			d	125	98		74	84		95		88
7.	E() E1A	FDB FL() FPA	a	83	43		46	60	50*	47	49*	49
			b	83	60		65	78	62*	72	63*	63
			c	125	43		30	40	51*	49	50*	50
			d	125	100		75	86	61*	71	62*	62
8.	E2C E4C	E() E1A	a	83		33	54	66	51		52	
			b	83		61	59	74	71		70	
			c	125		35	36	44	33		34	
			d	125		100	72	88	74		73	

TABLE A (Cont)

	TYPE OF UNIT		TEST	ORIGINATING SF UNIT					TERMINATING SF UNIT OUTPUT TEST LIMITS IN %BK			
	ORIG	TERM		INPUT TEST VALUE IN MS			SF OUTPUT IN %BK		ORIG 4A & TERM 2B OR ORIG 2B & TERM 4A		ORIG 4A & TERM 4A	
				PULSE PERIOD	PULSE WIDTH							
					M-LEAD	LOOP	MIN	MAX	ON E-LEAD	ON LOOP	ON E-LEAD	ON LOOP
9.	E2C	E2D	a	83		33	54	66		56		52
	E4C	E4D	b	83		61	59	74		82		70
		E5D	c	125		35	36	44		36		36
			d	125		101	72	88		82		73
10.	E2C	FWA	a	83		33	54	66	52		53	
	E4C	FA()	b	83		61	59	74	77		76	
	E2S	FB()	c	125		35	36	44	34		35	
			d	125		100	72	88	87		86	
11.	E2C	FDA	a	83		33	54	66		49		53
	E4C		b	83		61	59	74		89		76
			c	125		35	36	44		32		35
			d	125		100	72	88		95		82
12.	E2C	FDB	a	83		33	54	66		47		49
	E4C		b	83		61	59	74		72		63
			c	125		35	36	44		49		50
			d	125		100	72	88		71		62
13.	E2S	E2L	a	83		33	54	66		56		52
			b	83		61	59	74		87		76
			c	125		35	36	44		35		34
			d	125		100	72	88		88		73
14.	E2S	E1P	a	83		33	54	66	44		45	
			b	83		61	59	74	55		54	
			c	125		35	36	44	45		46	
			d	125		100	72	88	57		56	
15.	E2S	FL()	a	83		33	54	66	50*	47	49*	49
		FPA	b	83		61	59	74	62*	72	63*	63
			c	125		35	36	44	51*	49	50*	50
			d	125		100	72	88	61*	71	62*	62
16.	E1R	E2L	a	83	30*	35	54	63		56		52
	FS()		b	83	64*	62	64	84		87		76
	FRA		c	125	30*	35	36	44		35		36
			d	125	103*	100	68	84		88		73

TABLE A (Cont)

	TYPE OF UNIT		TEST	ORIGINATING SF UNIT					TERMINATING SF UNIT OUTPUT TEST LIMITS IN %BK			
	ORIG	TERM		INPUT TEST VALUE IN MS			SF OUTPUT IN %BK		ORIG 4A & TERM 2B OR ORIG 2B & TERM 4A		ORIG 4A & TERM 4A	
				PULSE PERIOD	PULSE WIDTH				ON E-LEAD	ON LOOP	ON E-LEAD	ON LOOP
					M-LEAD	LOOP	MIN	MAX				
17.	E1R FS() FRA	E1P	a	83	30*	35	54	63	44		45	
			b	83	64*	62	64	84	55		54	
			c	125	30*	35	36	44	45		46	
			d	125	103*	100	68	84	57		56	
18.	E1R FS() FRA	FWA FA() FB()	a	83	30*	35	54	63	52		53	
			b	83	64*	62	64	84	84		83	
			c	125	30*	35	36	44	34		35	
			d	125	103*	100	68	84	92		90	
19.	E1R FS() FRA	FL() FPA	a	83	30*	35	54	63	50*	47	50*	50
			b	83	64*	62	64	84	62*	72	63*	63
			c	125	30*	35	36	44	51*	49	50*	50
			d	125	103*	100	68	84	61*	71	62*	62
20.	FWA FWB	E()B E1A	a	83	44		47	60	51		52	
			b	83	60		66	78	71		70	
			c	125	44		29	40	33		34	
			d	125	100		76	84	74		73	
21.	FWA FWB	E2D E4D E5D	a	83	44		47	60		56		52
			b	83	60		66	78		80		72
			c	125	44		29	40		38		36
			d	125	100		76	84		80		73
22.	FWA FWB	E2L	a	83	44		47	60		56		52
			b	83	60		66	78		87		72
			c	125	44		29	40		35		34
			d	125	100		76	84		88		73
23.	FWA FWB	E1P	a	83	41		43	55	44		45	
			b	83	60		66	78	55		54	
			c	125	41		29	37	45		38	
			d	125	100		76	84	57		56	
24.	FWA FWB	FWA FA() FB()	a	83	41		43	55	52		53	
			b	83	60		66	78	80		78	
			c	125	41		29	37	34		35	
			d	125	100		76	84	88		88	

TABLE A (Cont)

	TYPE OF UNIT		TEST	ORIGINATING SF UNIT					TERMINATING SF UNIT OUTPUT TEST LIMITS IN %BK			
	ORIG	TERM		INPUT TEST VALUE IN MS			SF OUTPUT IN %BK		ORIG 4A & TERM 2B OR ORIG 2B & TERM 4A		ORIG 4A & TERM 4A	
				PULSE PERIOD	PULSE WIDTH		MIN	MAX	ON E-LEAD	ON LOOP	ON E-LEAD	ON LOOP
					M-LEAD	LOOP						
25.	FWA FWB	FDA	a	83	41		43	55		49		53
			b	83	60		66	78		92		78
			c	125	41		29	37		32		35
			d	125	95		72	80		95		83
26.	FWA FWB	FDB FL() FPA	a	83	41		43	55	50*	47	49*	49
			b	83	60		66	78	62*	72	63*	63
			c	125	41		29	37	51*	49	50*	50
			d	125	100		76	84	61*	71	62*	62
27.	E()B, E1A, FW() with MPC; FA() FB()	E()B E1A	a	83	25		54	64	51		52	
			b	83	70		64	75	71		70	
			c	125	31		36	42	33		34	
			d	125	110		76	82	74		73	
28.	E()B, E1A, FW() with MPC; FA(), FB()	E2D E4D E5D	a	83	25		54	64		56		52
			b	83	70		64	75		82		70
			c	125	31		36	42		38		36
			d	125	110		76	82		82		76
29.	E()B, FW() with MPC; FA(), FB()	E2L	a	83	25		54	64		56		52
			b	83	70		64	75		87		76
			c	125	31		36	42		35		34
			d	125	110		76	82		88		73
30.	E()B, FW() with MPC; FA(), FB()	E1P	a	83	25		54	64	44		45	
			b	83	70		64	75	55		54	
			c	125	31		36	42	45		46	
			d	125	110		76	82	57		56	
31.	E()B, E1A, FW() with MPC; FA(), FB()	FWA FA() FB()	a	83	25		54	64	52		53	
			b	83	70		64	75	80		80	
			c	125	31		36	42	34		35	
			d	125	110		76	82	88		87	
32.	E()B, E1A, FW() with MPC; FA(), FB()	FDA	a	83	25		54	64		49		53
			b	83	70		64	75		92		80
			c	125	31		36	42		32		35
			d	125	110		76	82		95		83

TABLE A (Cont)

	TYPE OF UNIT		TEST	ORIGINATING SF UNIT					TERMINATING SF UNIT OUTPUT TEST LIMITS IN %BK			
	ORIG	TERM		INPUT TEST VALUE IN MS			SF OUTPUT IN %BK		ORIG 4A & TERM 2B OR ORIG 2B & TERM 4A		ORIG 4A & TERM 4A	
				PULSE PERIOD	PULSE WIDTH				ON E-LEAD	ON LOOP	ON E-LEAD	ON LOOP
					M-LEAD	LOOP	MIN	MAX				
33.	E()B, FW() with MPC, FA(), FB()	FDB FL() FPA	a	83	25		54	64	50*	47	49*	49
			b	83	70		64	75	62*	72	63*	63
			c	125	31		36	42	51*	49	50*	50
			d	125	110		76	82	61*	71	62*	62
34.	FCA	E()B E1A	a	83		28	55	64	51		52	
			b	83		61	64	72	75		75	
			c	125		28	37	42	33		35	
			d	125		100	72	82	73		72	
35.	FCA	E2D E4D E5D	a	83		28	55	64		56		52
			b	83		61	64	72		81		72
			c	125		28	37	42		38		36
			d	125		100	72	82		83		74
36.	FCA	FWA FA() FB()	a	83		28	55	64	52		53	
			b	83		61	64	72	82		82	
			c	125		28	37	42	34		35	
			d	125		100	72	82	92		90	
37.	FCA	FDA	a	83		28	55	64		49		53
			b	83		61	64	72		94		82
			c	125		28	37	42		32		35
			d	125		91	64	77		95		82
38.	FCA	FDB	a	83		28	55	64		47		52
			b	83		61	64	72		72		63
			c	125		28	37	42		49		53
			d	125		102	72	82		71		61
39.	FS() FRA*	FL() FPA*	a	83	30*	35	57	64	50*	47	49*	49
			b	83	64*	62	64	75	62*	72	63*	63
			c	125	30*	35	38	42	51*	49	50*	50
			d	125	103*	100	68	82	61*	71	62*	62

\* These values apply only to the E1R, E1P, FRA, and FPA units. When testing these units, measurements should be made on their E leads and pulsing applied to their M leads. A and B lead operation with the 4A LOOP unit is not recommended.

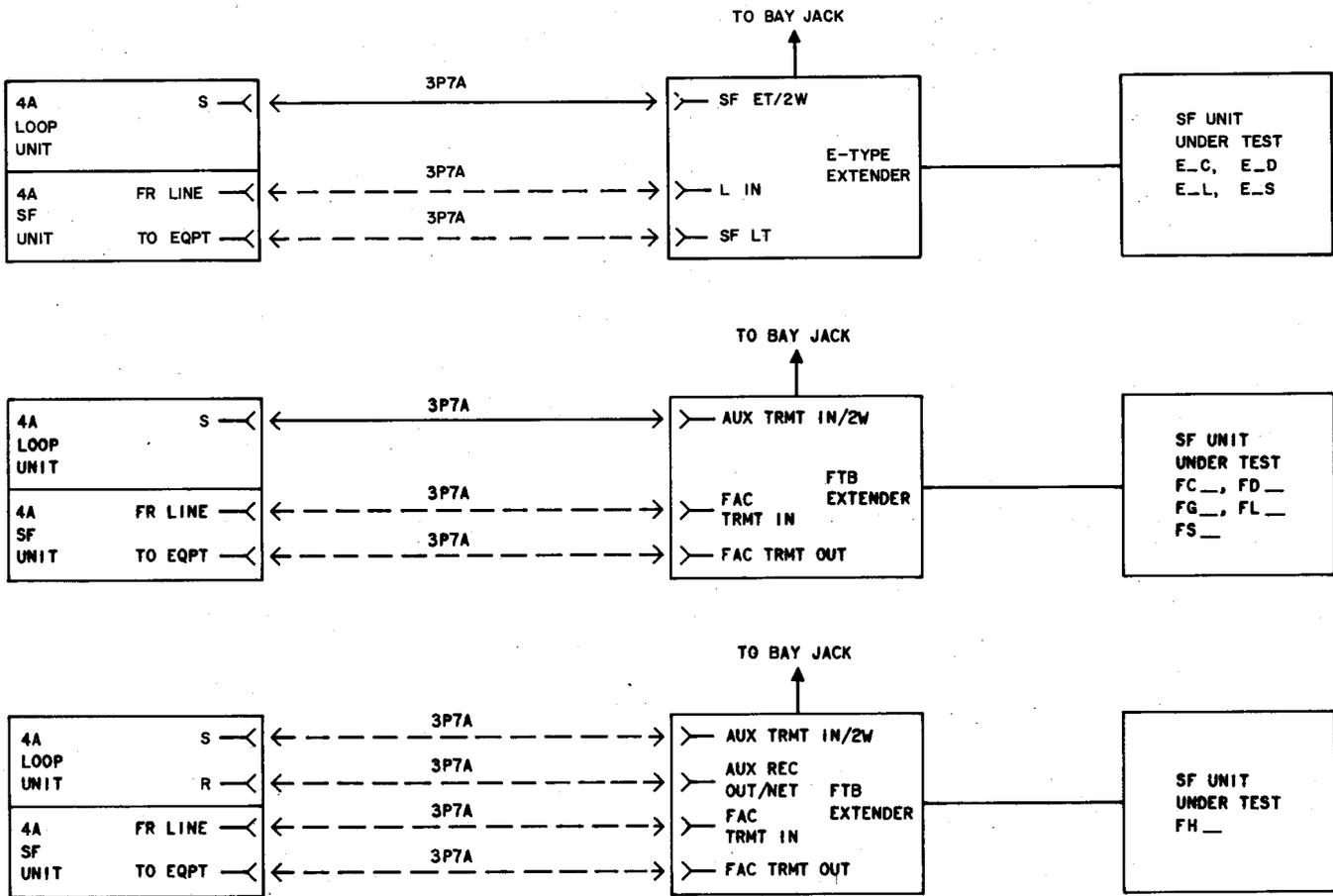


Fig. 1—Connections For Loop Pulsing

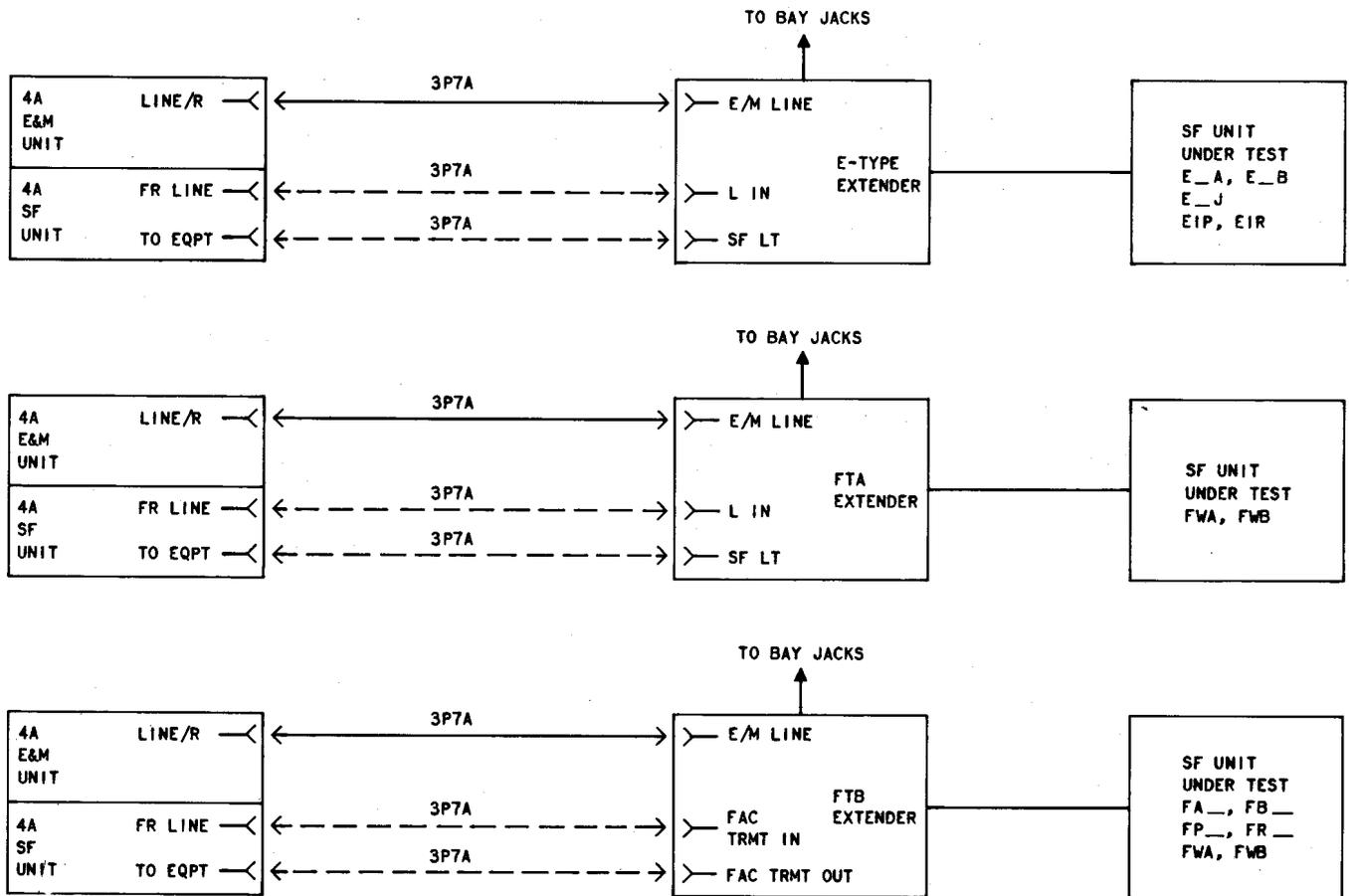


Fig. 2—Connections For E&M Pulsing