

SIGNAL CONVERTER CIRCUIT SD-5G149-01

TESTS

1. GENERAL

1.01 This section describes the method of testing a toll systems signal converter SD-5G149-01 for intercontinental trunk supervision with a signal converter test set KS-21057. The signal converter test set verifies the correct functioning of a signal converter by automatically simulating the logical sequences and conditions which are normally encountered while in service. The test set has the capabilities of performing tests in three modes of operation: automatic, semiautomatic, and manual.

1.02 This section affects the Equipment Test List.

1.03 The tests covered are:

A. Automatic: The test set performs 38 separate tests (Table A) sequentially on the signal converter.

B. Semiautomatic: The test set performs any of the 38 tests (Table A), one at a time, on the signal converter.

C. Manual: The test set has individual control of the signal converter input leads to perform manual tests (Table B).

1.04 The toll systems signal converter for intercontinental trunk supervision SD-5G149-01 will be referred to as signal converter throughout this section.

1.05 The signal converter test set KS-21057 will be referred to as test set throughout this section.

1.06 Testing is to be done on an *out-of-service* basis. The signal converter under test should be selected in an idle state as indicated by the signal converter BS lamp being extinguished.

1.07 The signal converter transmission paths are all terminated into 600 ohms by the test set. The TB lead is grounded toward the overseas trunk circuit to indicate a busy condition.

1.08 The test set has a dummy converter circuit which will receive any incoming seizure signals, return a busy flash, and return to idle through the clear forward-release guard sequence.

Signal Converter Idle State

1.09 The idle state between the test set and the signal converter is identified by all CVTR STATUS lamps (Fig. 1) being extinguished. Since the idle state is a prerequisite to most automatic and semiautomatic tests, one of the following three methods of returning the signal converter to an idle state can be used. Before attempting either method the toggle switches M, CT, F1, and F2 should be returned to their normal (up) positions.

(a) Operate and hold MANUAL key for a full second. This will automatically cause the signal converter to return to an idle state.

(b) While operating in the manual or semiautomatic modes, operate the FORCE ALM key momentarily. This forces a converter alarm which is released by operating the CVTR ALM key.

(c) While operating in the manual mode with the signal converter in a nonalarm status, operate the F1 and F2 toggle switches simultaneously for at least a second and simultaneously restore them.

J, K Option Decision

1.10 When power is initially applied to the test set, neither the J or K OPTION lamps will be lighted. The first time a test which lies in

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the ALM SEQ group of tests (Fig. 1) is attempted in automatic or semiautomatic mode, the test set will automatically determine the signal converter option by inserting an outgoing seizure time out sequence and observing the signal converter's action. If this decision is successfully made, the appropriate lamp will light and remain lighted until power is removed from the test set. If the decision cannot be made automatically, both the J and K OPTION lamps will flash on and off. The option decision can be overridden at any time by operating either the J or K OPTION key. Once the signal converter option is established, the tests in the ALM SEQ group will be modified automatically according to the option established.

Avoiding Invalid Tests In Semiautomatic Mode

1.11 Many tests do not leave the signal converter in an idle state at their completion. Also, any test failure does not cause the signal converter to return to idle. It is, therefore, necessary that many of the tests be provided with the capability of starting both from an idle and a distinct nonidle state. The semiautomatic mode has the flexibility of simulating different in service conditions by varying the order in which tests are performed. Therefore, the possibility of attempting an invalid sequence of tests exists. For example: the ORIG END BFL test cannot be exercised twice in succession without first returning the signal converter to an idle state.

1.12 To avoid invalid testing when performing a sequence of tests in the semiautomatic mode, the following rules should be followed.

- (a) Any test may be performed starting with the signal converter in an idle state.
- (b) An invalid sequence of tests will not occur if after a test is performed, the remainder of the tests on a given row are performed sequentially from left to right. There is no restriction on the order that rows are selected.

Manual Tests

1.13 In the manual mode of operation, control of the signal converter input variables (M, CT, F1, and F2) is obtained by means of the four toggle switches M, CT, F1, and F2 (Fig. 1). In addition, the binary status of the M and CT variables may be inverted for 100 ms by operating the M

or CT keys respectively. The status of the signal converter input variables is shown by the M, CT, F1, and F2 lamps while the status of the output variables is shown by the E, OA, TB, f1, and f2 lamps.

Remote Switches and Keys

1.14 A small switch box with a belt clip and a ten-foot length of cable (Fig. 2) is provided to give the craftsman limited control of the signal converter while working on a ladder. The remote switch box contains AUTO and CVTR ALM keys which are identical to those on the test set. It also contains a MAN key which gives control to four small toggle switches (M, CT, F1, and F2) while denying manual control to the four toggle switches on the test set. Operation of the MANUAL key on the test set will transfer control back to the test set.

Abbreviated Time Out Feature

1.15 The testing for the ALM SEQ group of tests can be significantly reduced by adding a single wire to the signal converter on a Class B change basis (A option). With this modification, the test set will require the full time out interval for tests T.O. INT. 1 and T.O. INT. 2, but for all other time out sequences this interval will be shortened to two seconds. A toggle switch located inside the top cover, ABBREVIATED T.O., is used to enable or disable this feature as desired. This toggle switch has no effect on unmodified signal converters.

Functional Designations

1.16 A brief description of the keys, toggle switches, lamps, and jacks on the test set is contained in Tables A, C, D, E, and F. Except where noted, the keys are of the momentary make pushbutton-type with independent lamp circuits. Reference is made to Fig. 1 for the control panel and to Fig. 3 and 4 for the jack panel and internal switch assembly.

Testing Method

1.17 A general technique for testing could be as follows.

- (a) Perform the automatic tests.

- (b) Use the semiautomatic mode to verify any failures.
- (c) The manual mode is then used whenever possible to simulate the automatic sequence of a failed test, one step at a time, in order to determine at what point the failure takes place.

1.18 Detailed troubleshooting on the level of individual relay contacts would require an experienced craftsman with the SD of the signal converter and relay sequence charts. When all other tests are completed, the 2- to 3-minute thermal timer can be checked.

1.19 *Lettered Steps:* A letter a, b, c, etc, added to a step number in Part 3 or 4 of

this section indicates an action which may or may not be required depending on 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

2.01 Signal converter test set KS-21057 equipped with one test set connector cable and one remote switch box equipped with one 10-foot cable.

3. PREPARATION

All Tests

STEP	ACTION	VERIFICATION
1	Insert power cord of test set in 115V ac supply.	
2	At signal converter bay— Check to see that signal converter to be tested is idle.	Signal converter BS lamp extinguished.
3	Remove multipin connector plug (shorting plug) from the signal converter to be tested.	
4	Using test set connector cable, connect test set CONVERTER TEST connector to the signal converter multipin access connector.	
5	At test set— Operate POWER key.	AC POWER lamp lighted. f1, f2 lamps momentarily lighted.
6	Restore M, CT, F1, F2 toggle switches to the up position.	
7a	If signal converter is not in an idle state— Place signal converter in idle state using procedure covered in 1.08.	
8b	If normal time out is to be used during testing— At internal switch and key assembly inside top right of test set— Operate ABBREVIATED TIME OUT toggle switch to OFF position.	

STEP	ACTION	VERIFICATION
9c	If abbreviated time out is to be used during testing— At internal switch and key assembly inside top right of test set— Operate ABBREVIATED TIME OUT toggle switch to ON position.	
10d	If during either of the three modes of testing the J, K OPTION lamps flash on and off— Operate either J or K OPTION key per 1.09.	J, K OPTION lamps cease flashing. J or K OPTION lamp lighted depending on which key operated.
11e	If at any time the DUMMY CVTR ALM lamp lights— Operate DUMMY CVTR ALM key.	DUMMY CVTR ALM lamp extinguished. <i>Note:</i> If DUMMY CVTR ALM lamp continues to light, see Section 100-268-501.

4. METHOD

A. Automatic

STEP	ACTION	VERIFICATION
12	Operate AUTO key.	AUTO lamp lighted. Test set will sequentially perform 38 separate automatic tests (Table A). A lamp representing each test will light to indicate test being performed. Lamp will extinguish as each test is satisfactorily completed. If no test failures— TEST SAT lamp lighted after last test. If a test failure occurs— Lamps of tests failed remain lighted. At first test failure TEST FAIL lamp lighted. At end of automatic testing when failures occur, a record of the test failures is indicated by the test lamps which remain lighted. <i>Note:</i> Where several tests in succession fail, it is advisable to retest these tests in the semiautomatic mode to determine if the tests failed due to a preceding test failure.
13f	If automatic testing is to be aborted at any time during testing— Operate and hold MANUAL key for at least 1 second.	MANUAL lamp lighted. Test set ceases automatic testing. Signal converter returns to an idle state.
14g	If automatic tests performed satisfactorily— Operate THERM T.O. key.	THERM T.O. lamp lighted. Test set automatically places itself in semiautomatic mode. SEMI AUTO lamp lighted.

STEP	ACTION	VERIFICATION
		F1, f2 lamps momentarily lighted. E, TB, CT lamps lighted. In 1 to 3.2 minutes if test completed satisfactorily— TEST SAT, CVTR ALM lamps lighted. E lamp extinguished. If test failed in less than 3.2 minutes— TEST FAIL, CVTR ALM lamps lighted. E lamp extinguished. If test has not completed in 3.2 minutes— TEST FAIL lamp lighted.
15h	If no other tests are to be made— Restore POWER key.	All lamps extinguished.
16h	Remove test set connector cable from signal converter multipin access connector of signal converter under test.	
17h	Insert multipin connector plug (shorting plug) in the signal converter under test.	
18h	Remove power plug of test set from 115V ac supply.	
B. Semiautomatic		
12	Operate SEMI AUTO key (after returning to idle if necessary).	SEMI AUTO lamp lighted.
13	Operate test key (Table A) of test to be performed.	Lamp of test being performed lighted. If test satisfactory— Lamp extinguished. TEST SAT lamp lighted. If the signal converter is left in a nonidle state when the test is completed, one or more of the following CVTR STATUS lamps will remain lighted (E, OA, TB, M, CT). If test failed— Lamp remains lighted. TEST FAIL lamp lighted. Status lamps extinguished.
14f	If test is to be repeated— Verify signal converter is in an idle state (1.08).	TEST SAT lamp or TEST FAIL lamp and lamp of test failed extinguished.
15f	Operate test key of test to be repeated.	Lamp of test being performed lighted. If test satisfactory— Lamp extinguished. TEST SAT lamp lighted. If the signal converter is left in a nonidle

SECTION 179-300-501

STEP	ACTION	VERIFICATION
16g	If a sequence of tests are to be made— Operate first test key of tests in the sequence to be performed (Table A). <i>Note:</i> Follow the rules described in 1.11 to avoid invalid testing when performing a sequence of tests.	state when the test is completed, one or more of the following CVTR STATUS lamps will remain lighted (E, OA, TB, M, CT). If test failed— Lamp remains lighted. TEST FAIL lamp lighted. Status lamps extinguished.
17g	Operate second test key of tests in the sequence to be performed.	Lamp of test being performed lighted. If test satisfactory— Lamp extinguished. TEST SAT lamp lighted. If the signal converter is left in a nonidle state when the test is completed, one or more of the following CVTR STATUS lamps will remain lighted (E, OA, TB, M, CT). If test failed— Lamp remains lighted. TEST FAIL lamp lighted. Status lamps extinguished.
18g	Repeat Step 17g for each test in the sequence to be performed.	TEST SAT lamp or TEST FAIL lamp and lamp of previous test failed extinguished. Lamp of test being performed lighted. If test satisfactory— Lamp extinguished. TEST SAT lamp lighted. If the signal converter is left in a nonidle state when the test is completed, one or more of the following CVTR STATUS lamps will remain lighted (E, OA, TB, M, CT). If test failed— Lamp remains lighted. TEST FAIL lamp lighted. Status lamps extinguished.
19h	If no other tests are to be made— Restore POWER key.	All lamps extinguished.
20h	Remove test set connector cable from signal converter multipin access connector of signal converter under test.	
21h	Insert multipin connector plug (shorting plug) in the signal converter under test.	
22h	Remove power plug of test set from 115V ac supply.	

STEP	ACTION	VERIFICATION
C. Manual		
12	Operate MANUAL key.	MANUAL lamp lighted.
13	See MANUAL TEST CHART (Table B) for Steps 14 through 146.	
147e	If no other tests are to be made— Restore POWER key.	All lamps extinguished.
148e	Remove test set connector cable from signal converter multipin access connector of signal converter under test.	
149e	Insert multipin connector plug (shorting plug) in the signal converter under test.	
150e	Remove power plug of test set from 115V ac supply.	

TABLE A
TEST SEQUENCE FOR AUTOMATIC AND SEMIAUTOMATIC MODES

KEY AND LAMPS	TEST DESCRIPTION
	<i>Note:</i> The manual test steps listed in parentheses are the manual operations listed in Table B.
ORIG END SZE	Converter transmits seizure and receives proceed to send signal. (Manual Test Steps 15, 16, 17, 18)
ORIG END BFL	Converter receives and acknowledges the busy flash signal. (Manual Test Steps 19, 20)
ORIG END CLF-RLS	Converter transmits clear forward and receives release guard signal. (Manual Test Steps 21 through 25)
ORIG END ANS	Converter receives and acknowledges the answer signal. (Manual Test Steps 27, 28)
ORIG END FT	Converter transmits the forward transfer signal. (Manual Test Steps 29#, 32#)
ORIG END CLB	Converter receives and acknowledges the clear back signal. (Manual Test Steps 30, 31)
ORIG END DUAL SZE	Converter receives a 2400-Hz tone during transmission of outgoing seizure. (Manual Test Steps 34 through 37)
TERM END SZE	Converter receives seizure and transmits proceed to send signal. (Manual Test Steps 43, 44, 45)
TERM END BFL	Converter transmits the busy flash signal. (Manual Test Steps 46, 47, 48)
TERM END CLF-RLS	Converter receives clear forward and transmits the release guard signal. (Manual Test Steps 49, 50, 51)
TERM END ANS	Converter transmits the answer signal. (Manual Test Steps 56, 57, 58)
TERM END FT	Converter receives the forward transfer signal. (Manual Test Steps 53#, 54# or 59 60#)

TABLE A
TEST SEQUENCE FOR AUTOMATIC AND SEMIAUTOMATIC MODES (Cont)

KEY AND LAMPS	TEST DESCRIPTION
TERM END CLB	Converter transmits the clear back signal. (Manual Test Steps 66, 67, 68)
TERM END DUAL SZE	Converter receives clear forward while transmitting outgoing seizure. (Manual Test Steps 38 through 42)
BEF	Verifies that the converter inserts a band elimination filter in the receiver path during incoming signaling.
LINE SPLIT	Verifies that the transmission path is cut between CVTR XMT IN and CVTR XMT OUT during outgoing signaling.
RCVR LOSS	Verifies that the converter receiver has little or no loss to a 1000-Hz tone.
SIG/GD	Verifies that the converter will detect incoming signaling at -2 dBm in the presence of guard energy at -18 dBm.
HIGH TONES	Verifies that the converter will properly detect incoming signaling at a tone level of +5 dBm.
LOW TONES	Verifies that the converter will properly detect incoming signaling at a tone level of -12 dBm.
TWIST	Verifies that the converter will properly detect a double tone with one level at +3 dBm and the other level at -2 dBm. <i>Note:</i> Most of the following nominal timer values in parentheses can be increased by 10 ms due to filter buildup time.
QUIET INT	Verifies that a quiet interval of at least 64 ms is observed between separate tones transmitted by the converter (Timer 3, 83 ± 4 ms).
START STOP	During dual seizure, verifies that the start-stop open on the E lead exceeds 64 ms (Timer 2, 90 ± 5 ms). (Manual Test Steps 34, 35, 36, 37)

TABLE A
TEST SEQUENCE FOR AUTOMATIC AND SEMIAUTOMATIC MODES (Cont)

KEY AND LAMPS	TEST DESCRIPTION
EARLY ABAND	Verifies that the duration of outgoing seizure during early abandon lies between 576 ms and 1020 ms (Timer 1, 838 ±50 ms).
DBS	During dual seizure, verifies that the delayed busy interval exceeds 224 ms (Timer 2, 240 ±12 ms). (Manual Test Steps 38, 39, 40, 41, 42)
INVALID ANS	Verifies that if battery on the M lead does not exceed 80 ms, the answer tone is removed without waiting for acknowledgment (Timer 1, 77 ±4 ms). (Manual Test Step 55#)
TIME FT	Verifies that the duration of a forward transfer signal lies in the interval between 576 ms and 1020 ms (Timer 2, 850 ±50 ms). (Manual Test Steps 29# or 32#)
EARLY RECOG	Verifies that the converter recognizes an incoming seizure signal within 80 ms (Signal timer, 40 ±10 ms).
T. O. INT. 1	Verifies that the time out for an outgoing seizure signal lies in the interval 15 ±5 sec for a J option converter and 12 ±2 sec for a K option converter (Timer 4, 15 ±5 sec, 12 ±2 sec). (Manual Test Steps 71 through 77d)
T. O. INT. 2	Verifies that the time out for a proceed to send signal lies in the interval 6 ±2 sec for a J option converter and 18 ±2 sec for a K option converter (Timer 4, 6 ±2 sec, 18 ±2 sec). (Manual Test Steps 95 through 103d)
SZE T. O.	Verifies the time out and alarm when an outgoing seizure signal is not removed. (Manual Test Steps 71 through 77d)
ANS. ACK. T. O.	Verifies the time out and alarm when the outgoing answer acknowledgment signal is not removed. (Manual Test Steps 80 through 89d)

TABLE A
TEST SEQUENCE FOR AUTOMATIC AND SEMIAUTOMATIC MODES (Cont)

KEY AND LAMPS	TEST DESCRIPTION
CLF T. O.	Verifies the time out and alarm when an outgoing clear forward signal is not removed. (Manual Test Steps 90 through 94)
P. T. S. T. O.	Verifies the time out and alarm when an outgoing proceed to send signal is not removed. (Manual Test Steps 95 through 103d)
BFL T. O.	Verifies the time out and alarm when an outgoing busy flash signal is not removed. (Manual Test Steps 104 through 112d)
ANS T. O.	Verifies the time out and alarm when an outgoing answer signal is not removed. (Manual Test Steps 113 through 121d)
CLB T. O.	Verifies the time out and alarm when an outgoing clear back signal is not removed. (Manual Test Steps 122 through 131d)
RLS T. O.	Verifies the time out and alarm when an outgoing release guard signal is not removed. (Manual Test Steps 132 through 135)

TABLE B
MANUAL TEST CHART

TEST STEP	TEST SET OPERATION	SIGNAL CONVERTER FUNCTION	CONVERTER STATUS LAMPS (X Indicates lamp lit) (* Indicates lamp on or off for timed interval.)										CVTR ALM	REMARKS (Test steps indicated by a # may be omitted without loss of signalling synchronism.) (SC numbers refer to sequence charts from SD-5G 149-01.)	
			INPUTS				OUTPUTS								
			M	CT	F1	F2	E	OA	TB	f1	f2				
14	M, CT, F1, F2 toggle switches unoperated. Operate MANUAL key. If delays in testing are expected— Operate T.O. key.	Idle state.													If signal converter does not go to idle state, operate FORCE ALM and CVTR ALM keys in succession.
15	Operate M toggle switch.	Transmit SZE.	X				X		X	X					ORIG END SZE (SC1).
16	Operate F2 toggle switch.	Receive PTS.	X			X	X		X	X					
17	Operate CT toggle switch.	Cease SZE.	X	X		X			X						
18	Restore F2 toggle switch.	Remove PTS.	X	X					X						
19	Operate F2 toggle switch.	Receive BFL. Transmit BFL ACK.	X	X		X		X	X	X					ORIG END BFL (SC2).
20	Restore F2 toggle switch.	Cease BFL ACK.	X	X				X	X						
21	Restore M toggle switch.	Transmit CLF.		X					X	X	X				ORIG END CLF and ORIG END RLS (SC7, SC9). (1) F1 or F2 lamp lighted during operation of the corresponding key.
22#	Operate and restore F1 or F2 toggle switch.	No effect.		X	(1)	(1)			X	X	X				
23	Operate F1 and F2 toggle switches.	Receive RLS. Cease CLF.		X	X	X			X						
24	Restore F1 and F2 toggle switches.	Remove RLS.		X											
25	Restore CT toggle switch.	True idle.													

TABLE B
MANUAL TEST CHART (Cont)

TEST STEP	TEST SET OPERATION	SIGNAL CONVERTER FUNCTION	CONVERTER STATUS LAMPS										REMARKS (Test steps indicated by a # may be omitted without loss of signalling synchronism.) (SC numbers refer to sequence charts from SD-5G149-01.)	
			INPUTS				OUTPUTS					CVTR ALM		
			M	CT	F1	F2	E	OA	TB	f1	f2			
26	Repeat Steps 15 through 18.	ORIG END SZE.	X	X						X				
27	Operate F1 toggle switch.	Receive ANS. Transmit ANS ACK.	X	X	X		X			X	X			ORIG END ANS (SC3).
28	Restore F1 toggle switch.	Cease ANS ACK.	X	X			X			X				
29#	Operate M key. (3)	Transmit FT.	*(1)	X			X			X		*(2)		ORIG END FT (SC7, SC8). (1) M lead is grounded for 100 ms and M lamp flickers and remains on. (2) f2 is transmitted for 850 ms. (3) When using remote switch box, rapidly release and reoperate M toggle switch.
30	Operate F2 toggle switch.	Receive CLB. Transmit CLB ACK.	X	X		X				X	X			ORIG END CLB (SC4).
31	Restore F2 toggle switch.	Cease CLB ACK.	X	X						X				
32#	Operate M key. (3)	Transmit FT.	*(1)	X						X		*(2)		ORIG END FT (SC7, SC8). (1) M lead is grounded for 100 ms and M lamp flickers and remains on. (2) f2 is transmitted for 850 ms. (3) When using remote switch box, rapidly release and reoperate M toggle switch.
33	Repeat Steps 21, 23, 24, 25.	Return to idle.												
34	Operate M, F1 toggle switches.	Dual seizure I.	X		X		X			X	X			ORIG END DUAL SIZE (1) START-STOP (SC1, SC5, SC6).
35	Operate CT toggle switch.	Start-stop signal on E lead.	X	X	X		*(2)			X	*(3)			(1) The "ORIG END" label above is artificial and results from a convenient grouping of automatic tests on the test set control panel. (2) The E lamp is extinguished for 100 ms and is relighted. (3) For G option signal converters, the f1 lamp is on until the M toggle switch is restored. For other signal converters, the f1 lamp turns off after the CT toggle switch is operated.
36	Restore M toggle switch.			X	X					X				
37	Restore F1, CT toggle switches.	Return to idle.												
38	Operate M, CT toggle switches.	Transmit SZE.	X	X			X			X	X			TERM END DUAL SZE (1) DBS (SC1, SC5, SC6).

TABLE B
MANUAL TEST CHART (Cont)

TEST STEP	TEST SET OPERATION	SIGNAL CONVERTER FUNCTION	CONVERTER STATUS LAMPS										REMARKS (Test steps indicated by a # may be omitted without loss of signalling synchronism.) (SC numbers refer to sequence charts from SD-5G149-01.)	
			INPUTS				OUTPUTS					CVTR ALM		
			M	CT	F1	F2	E	OA	TB	f1	f2			
39	Operate F1, F2 toggle switches.	Dual seizure II.	X	X	X	X	*(2)		X					(1) The "TERM END" lable above is artificial and results from a convenient grouping of automatic tests on the test set control panel. (2) The E lamp is extinguished for 100 ms and is relighted. (3) The TB lamp remains on for 250 ms after f1 and f2 lamps are extinguished.
40	Restore M toggle switch.			X	X	X			X	X	X			
41	Restore F1, F2 toggle switches.	Return to idle (DBS).		X					*(3)					
42	Restore CT toggle switch.	True idle.												
43	Operate F1 toggle switch and then operate CT toggle switch.	Receive SZE.		X	X		X		X				TERM END SZE (SC11). (1) Battery on M1 lead for 100 ms. (2) When using remote switch box, rapidly operate and release M toggle switch.	
44	Operate M Key. (2)	Transmit PTS.	*(1)	X	X		X		X		X			
45	Restore F1 toggle switch.	Cease PTS.		X			X		X					
46	Operate CT Key. (2)	Transmit BFL.		*(1)			X		X		X		TERM END BFL (SC13). (1) Ground on CT lead for 100 ms and CT lamp flickers and remains on. (2) When using remote switch box, rapidly release and reoperate CT toggle switch.	
47	Operate F1 toggle switch.	Cease BFL.		X	X		X		X					
48	Restore F1 toggle switch.	Remove BFL ACK.		X			X		X					
49	Operate F1, F2 toggle switches.	Receive CFL. Transmit RLS.		X	X	X			X	X	X		TERM END CLF-RLS (SC14).	
50	Restore F1, F2 toggle switches.	Cease RLS.		X										
51	Restore CT toggle switch.	True idle.												
52	Repeat Steps 43, 44, 45.	TERM END SZE.		X			X		X					

TABLE B
MANUAL TEST CHART (Cont)

TEST STEP	TEST SET OPERATION	SIGNAL CONVERTER FUNCTION	CONVERTER STATUS LAMPS										REMARKS (Test steps indicated by a # may be omitted without loss of signalling synchronism.) (SC numbers refer to sequence charts from SD-5G149-01)		
			(X Indicates lamp lit)				(* Indicates lamp on or off for timed interval)								
			INPUTS				OUTPUTS							CVTR ALM	
M	CT	F1	F2	E	OA	TB	f1	f2							
53#	Operate F2 toggle switch.	Receive FT.		X		X	X	X	X						TERM END FT (SC11).
54#	Restore F2 toggle switch.	Remove FT.		X			X		X						
55#	Operate M key. (3)	Transmit invalid answer.	*(1)	X				X		X		*(2)			(SC12). (1) Battery on M lead for 100 ms. (2) f1 lamp may flicker but does not come on and M4 relay momentarily operated and then released. (3) When using remote switch box, rapidly operate and release M toggle switch.
56	Operate M toggle switch.	Transmit ANS.	X	X				X		X	X				TERM END ANS (XC12).
57	Operate F1 toggle switch.	Cease ANS.	X	X	X			X		X					
58	Restore F1 toggle switch.	Remove ANS, ACK.	X	X				X		X					
59#	Operate F2 toggle switch.	Receive FT.	X	X		X	X	X	X						TERM END FT (SC11).
60#	Restore F2 toggle switch.	Remove FT.	X	X				X		X					
61#	Operate M key. (2)	Transmit CLB.	*(1)	X				X		X		X			(SC12, SC15). (1) Ground on M lead for 100 ms and M lamp flickers and remains on. (2) When using remote switch box, rapidly release and reoperate M toggle switch.
62#	Operate F1 toggle switch.	Receive CLB ACK.	X	X	X			X		X					
63#	Restore F1 toggle switch.	Transmit ANS.	X	X				X		X	X				
64#	Operate F1 toggle switch.	Cease ANS.	X	X	X			X		X					
65#	Restore F1 toggle switch.	Remove ANS ACK.	X	X				X		X					
66	Restore M toggle switch.	Transmit CLB.		X				X		X		X			TERM END CLB (SC15).

TABLE B
MANUAL TEST CHART (Cont)

TEST STEP	TEST SET OPERATION	SIGNAL CONVERTER FUNCTION	CONVERTER STATUS LAMPS										REMARKS (Test steps indicated by a # may be omitted without loss of signalling synchronism.) (SC numbers refer to sequence charts from SD-5G-149-01.)	
			(X Indicates lamp lit) (* Indicates lamp on or off for timed interval)									CVTR ALM		
			INPUTS				OUTPUTS							
M	CT	F1	F2	E	OA	TB	f1	f2						
67	Operate F1 toggle switch.	Cease CLB.		X	X		X		X					
68	Restore F1 toggle switch.	Remove CLB ACK.		X			X		X					
69	Repeat Steps 49, 50, 51.	Return to idle.												
70	Restore T. O. toggle switch of signal converter if previously operated. Avoid delays of more than 10 seconds during steps in which the signal converter is transmitting tones unless time out is desired. (See 1.18)													Enable signal converter time out and alarm.
71	Operate M toggle switch.	Transmit SZE.	X				X		X	X				SZE T. O. [J option signal converters (SC1, SC5, SC16)] [K option signal converters (SC1, SC5, SC17, SC18)]
72c	If J option signal converters are being tested—	After 15 seconds— Time out of SZE.	X				*(1)		X				X	(1) After time out, E lamp extinguishes for approximately 100 ms. (2) When using remote switch box, operate CVTR ALM key.
73c	Restore all toggle switches.	Test set idle.							X				X	
74c	Operate CVTR ALM key. (2)	Release alarm. True idle. (Proceed to Step 80.)												
75d	If K option signal converters are being tested—	After 12 seconds— Time out of SZE.	X				*(1)		X					
76d	Restore M toggle switch.	Transmit CLF.							X	X	X			

TABLE B
MANUAL TEST CHART (Cont)

TEST STEP	TEST SET OPERATION	SIGNAL CONVERTER FUNCTION	CONVERTER STATUS LAMPS										REMARKS (Test steps indicated by a # may be omitted without loss of signalling synchronism.) (SC numbers refer to sequence charts from SD-5G 149-01.)	
			(X Indicates lamp lit)				(* Indicates lamp on or off for timed interval)							
			INPUTS				OUTPUTS				CVTR ALM			
M	CT	F1	F2	E	OA	TB	f1	f2						
77d	Operate CT, F1, F2 toggle switches.	Receive RLS.		X	X	X				X				(1) When using remote switch box, operate CVTR ALM key.
78d	Restore CT, F1 F2 toggle switches.	Alarm.								X			X	
79d	Operate CVTR ALM key. (1)	True idle												
80	Repeat Steps 15, 16, 17, 18.	ORIG END SZE.	X	X						X				ANS ACK T. O. [J option signal converters (SC3, SC10, SC16)] [K option signal converters (SC3, SC17, SC18)]. (1) When using remote switch box, operate CVTR ALM key. (2) Alarm will occur at Step 87d if Step 88d is not performed within approximately 10 seconds. Test set operation is the same in either case.
81	Operate F1 toggle switch.	Receive ANS. Transmit ANS ACK.	X	X	X		X		X	X				
82c	If J option signal converters are being tested—	After 6 seconds— Time out of ANS ACK.	X	X	X					X			X	
83c	Restore all toggle switches.	Test set idle.								X			X	
84c	Operate CVTR ALM key. (1)	True idle. (Proceed to Step 90.)												
85d	If K option signal converters are being tested—	After 12 seconds— Time out of ANS-ACK.	X	X	X					X				
86d	Restore all toggle switches.	Transmit CLF.								X	X	X		
87d	Operate CT, F1, F2 toggle switches. (2)	Receive RLS.		X	X	X				X				
88d	Restore all toggle switches	Alarm.								X			X	
89d	Operate CVTR ALM key. (1)	True idle.												

TABLE B
MANUAL TEST CHART (Cont)

TEST STEP	TEST SET OPERATION	SIGNAL CONVERTER FUNCTION	CONVERTER STATUS LAMPS (X Indicates lamp lit) (* Indicates lamp on or off for timed interval)										REMARKS (Test steps indicated by a # may be omitted without loss of signalling synchronism.) (SC numbers refer to sequence charts from SD-5G149-01.)
			INPUTS				OUTPUTS					CVTR ALM	
			M	CT	F1	F2	E	OA	TB	f1	f2		
90	Operate M toggle switch (for less than 12 seconds).	Transmit SZE.	X				X		X	X			CLF T. O. [J option signal converter (SC1, SC7, SC9, SC16)] [K option signal converters (SC1, SC7, SC9, SC17, SC18)] (1) When using remote switch box, operate CVTR ALM key.
91	Restore M toggle switch.	Transmit CLF.							X	X	X		
92c	If J option signal converters are being tested—	After 15 seconds— Time out of CLF. (Proceed to Step 94.)							X			X	
93d	If K option signal converters are being tested—	After 12 seconds— Time out of CLF.							X			X	
94	Operate CVTR ALM key. (1)	True idle.											
95	Operate F1 toggle switch and then operate CT toggle switch.	Receive SZE.		X	X		X		X				PTS T. O. [J option signal converters (SC1, SC7, SC9, SC16)] [K option signal converters (SC1, SC7, SC9, SC17, SC18)] (1) Battery on M lead for 100 ms. (2) When using remote switch box, rapidly operate and release M toggle switch. (3) When using remote switch box, operate CVTR ALM key.
96	Operate M key. (2)	Transmit PTS.	*(1)	X	X		X		X		X		
97c	If J option signal converters are being tested—	After 6 seconds— Time out of PTS.		X	X				X			X	
98c	Restore all toggle switches.	Test set idle.							X			X	
99c	Operate CVTR ALM key. (3)	True idle. (Proceed to Step 104.)											
100d	If K option signal converters are being tested—	After 18 seconds— Time out of PTS.		X	X				X				
101d	Operate F2 toggle switch.	Receive CLF. Transmit RLS.		X	X	X			X	X	X		

TABLE B
MANUAL TEST CHART (Cont)

TEST STEP	TEST SET OPERATION	SIGNAL CONVERTER FUNCTION	CONVERTER STATUS LAMPS (X Indicates lamp lit) (* Indicates lamp on or off for timed interval)										REMARKS (Test steps indicated by a # may be omitted without loss of signalling synchronism.) (SC numbers refer to sequence charts from SD-5G149-01.)	
			INPUTS				OUTPUTS							CVTR ALM
			M	CT	F1	F2	E	OA	TB	f1	f2			
102d	Restore all toggle switches.	Alarm.								X			X	
103d	Operate CVTR ALM key. (3)	True idle.												
104	Repeat Steps 43, 44, 45.	TERM END SZE.		X			X		X					BFL T. O. [J option signal converters (SC11, SC13, SC16)] [K option signal converters (SC11, SC13, SC18, SC19)]. (1) Ground on CT lead for 100 ms and CT lamp flickers and remains on. (2) When using remote switch box, rapidly release and reoperate CT toggle switch. (3) When using remote switch box, operate CVTR ALM key.
105	Operate CT key. (2)	Transmit BFL.		*(1)			X		X		X			
106c	If J option signal converters are being tested.	After 15 seconds— Time out of BFL.		X					X				X	
107c	Restore all toggle switches.	Test set idle.												
108c	Operate CVTR ALM key. (3)	True idle. (Proceed to Step 113.)												
109d	If K option signal converters are being tested—	After 18 seconds— Time out of BFL.		X						X				
110d	Operate CT, F1, F2 toggle switches (if not already operated).	Receive CLF. Transmit RLS.		X	X	X			X	X	X			
111d	Restore all toggle switches.	Alarm.							X				X	
112d	Operate CVTR ALM key.	True idle.												
113	Repeat Steps 43, 44, 45.	TERM END SZE.		X			X		X					ANS T. O. [J option signal converters (SC11, SC12, SC15, SC16)] [K option signal converters (SC11, SC12, SC15, SC18, SC19)]. (1) When using remote switch box, operate CVTR ALM key.
114	Operate M toggle switch.		X	X			X		X	X				

TABLE B
MANUAL TEST CHART (Cont)

TEST STEP	TEST SET OPERATION	SIGNAL CONVERTER FUNCTION	CONVERTER STATUS LAMPS										REMARKS (Test steps indicated by a # may be omitted without loss of signalling synchronism.) (* Indicates lamp on or off for timed interval) (SC numbers refer to sequence charts from SD-5G149-01.)	
			INPUTS				OUTPUTS				CVTR ALM			
			M	CT	F1	F2	E	OA	TB	f1		f2		
115c	If J option signal converters are to be tested—	After 15 seconds— Time out of ANS.	X	X						X			X	
116c	Restore all toggle switches.	Test set idle.								X			X	
117c	Operate CVTR ALM key. (1)	True idle. (Proceed to Step 122.)												
118d	If K option signal converters are to be tested—	After 18 seconds— Time out of ANS.	X	X						X				
119d	Restore M toggle switch and operate F1, F2 toggle switches.	Receive CLF. Transmit RLS.		X	X	X				X	X	X		
120d	Restore all toggle switches.	Alarm.								X			X	
121d	Operate CVTR ALM key. (1)	True idle.												
122	Repeat Steps 43, 44, 45.	TERM END SZE.		X				X		X				
123	Repeat Steps 56, 57, 58.	TERM END ANS.	X	X				X		X				
124	Restore M toggle switch.	Transmit CLB.		X				X		X		X		
125c	If J option signal converters are to be tested—	After 15 seconds— Time out of CLB.		X						X			X	
126c	Restore all toggle switches.	Test set idle.								X			X	
127c	Operate CVTR ALM key. (1)	True idle. (Proceed to Step 132.)												

CLB T. O. [J option signal converters (SC11, SC12, SC15, SC16)]
[K option signal converters (SC11, SC12, SC15, SC18, SC19)].
(1) When using remote switch box, operate CVTR ALM key.

TABLE B
MANUAL TEST CHART (Cont)

TEST STEP	TEST SET OPERATION	SIGNAL CONVERTER FUNCTION	CONVERTER STATUS LAMPS										REMARKS (Test steps indicated by a # may be omitted without loss of signalling synchronism.) (SC numbers refer to sequence charts from SD-5G149-01.)		
			(X Indicates lamp lit) (* Indicates lamp on or off for timed interval)												
			INPUTS				OUTPUTS							CVTR ALM	
M	CT	F1	F2	E	OA	TB	f1	f2							
128d	If K option signal converters are to be tested—	After 18 seconds— Time out of CLB.		X						X					
129d	Operate CT, F1, F2 toggle switches (if not already operated).	Receive CLF. Transmit RLS.		X	X	X				X	X	X			
130d	Restore all toggle switches.	Alarm.								X				X	
131d	Operate CVTR ALM key. (1)	True idle.													
132	Operate F1, F2 toggle switches.	Receive CLF. Transmit RLS. After 6 to 18 seconds (1) — Time out of RLS.			X	X				X	X	X			RLS T. O. (SC14, SC16). (1) Time out interval is 6 seconds for J option signal converters and 18 seconds for K option signal converters. (2) When using remote switch box, operate CVTR ALM key.
133	Restore all toggle switches.	Test set idle.			X	X				X				X	
134	Operate CVTR ALM key. (2)	True idle.								X				X	
135	Repeat Steps 43, 44, 45.	TERM END SZE.		X				X		X					THERM T. O. (SC11, SC13, SC16). (1) When using remote switch box, operate CVTR ALM key.
136	Repeat Steps 46, 47, 48.	TERM END BFL. After 2 to 3 minutes — Thermal relay times out.		X				X		X				X	
137	Restore CT toggle switch.			X						X				X	
138	Operate CVTR ALM key. (1)	Release alarm. True idle.								X				X	

TABLE B
MANUAL TEST CHART (Cont)

TEST STEP	TEST SET OPERATION	SIGNAL CONVERTER FUNCTION	CONVERTER STATUS LAMPS										REMARKS (Test steps indicated by a # may be omitted without loss of signalling synchronism.) (SC numbers refer to sequence charts from SD-5G 149-01.)	
			INPUTS				OUTPUTS							CVTR ALM
			M	CT	F1	F2	E	OA	TB	f1	f2			
139	Operate FORCE ALM key. (1)	Forced alarm.								X			X	(1) Steps 141 through 146 cannot be performed on the remote switch box. (2) Lamp lighted while M toggle switch operated. (3) Battery on M lead for 100 ms and M lamp is lighted for 100 ms and then extinguished.
140	Operate and release M toggle switch.	No action except operation of converter M relay.	(2)							X			X	
141	Operate F1, CT toggle switches.	No action except operation of converter E4, CT relays.		X	X					X			X	
142	Operate CVTR ALM key.	Clear alarm. Process incoming SZE.		X	X		X			X				
143	Operate M key.	Transmit PTS.	*(3)	X	X		X			X		X		
144	Operate FORCE ALM key.	Forced alarm.		X	X					X			X	
145	Restore all toggle switches.	Test set idle.								X			X	
146	Operate CVTR ALM.	Release alarm. True idle.												

LIST OF ABBREVIATIONS			
ABBREVIATION	DEFINITION	ABBREVIATION	DEFINITION
ACK	Acknowledgment	PTS	Proceed-to-Send or Start Dial
ALM	Alarm	RCV	Receive
ANS	Answer or Off Hook	RCVR	Receiver
BEF	Band Elimination Filter	RLS	Release Guard or Disconnect
BFL	Busy Flash or Electrical Busy		Acknowledgment
CLB	Clear Back or On Hook	SIG/GD	Signal to Guard Ratio
CLF	Clear Forward or Disconnect	SZE	Seizure
DBS	Delayed Busy Sequence	T. O.	Time Out
FT	Forward Transfer or Rering	XMT	Transmit

TABLE C
CONTROL PANEL KEYS AND LAMPS

KEYS AND LAMPS	FUNCTION
	<i>Note:</i> The manual test steps listed in parentheses are the manual operations listed in Table B.
POWER	An alternate action locking key that connects and disconnects the test set from the ac line voltage, from voltages supplied from the signal converter under test, and from voltages from internal power supplies.
DUMMY CVTR ALM	Lamp is on when the dummy signal converter circuit has caused a tone to be transmitted for 16 seconds into the LINE XMT IN port. Operating the key will release the alarm and return the dummy converter circuit to an idle state.
CVTR ALM	Lamp is on when the signal converter is in an alarm condition. Operating the key will release the alarm and allow the signal converter to return to an idle state.
M	Lamp is on when -48 volt battery is applied to the M lead. Operating the key will cause a 100 ms reversal in the current status of the M lead (battery or ground).
CT	Lamp is on when the CT lead is open. Operating the key will cause a 100 ms reversal in the current status of the CT lead (open or ground).
F1	Lamp is on when a 2400-Hz tone is being delivered to the signal converter RCV IN port.
F2	Lamp is on when a 2600-Hz tone is being delivered to the signal converter RCV IN port.
TEST LAMPS	Causes all control panel lamps to light.
FORCE ALM	Momentarily grounds the converter AR lead to cause an alarm condition.
THERM T. O.	Automatically tests the 2- to 3-minute time out feature (M option). (Manual Test Steps 136 through 140)
AUTO	Initiates a complete automatic test of a signal converter.

TABLE C
CONTROL PANEL KEYS AND LAMPS (Cont)

KEYS AND LAMPS	FUNCTION
SEMI AUTO	Places the test set in a semiautomatic mode so that individual tests may be performed automatically one at a time.
MANUAL	Places the test set in a manual mode so that the signal converter inputs are controlled by four toggle switches. Operation of this key for a full second will normally return the signal converter to its idle state.
J	Lamp indicates that a J option signal converter is being tested. This decision is made automatically although the operation of this key will light the lamp and overrule the automatic decision.
K	Lamp indicates that a K option signal converter is being tested. This decision is made automatically although the operation of this key will light the lamp and overrule the automatic decision. The J and K OPTION lamps will both flash on and off if the option decision cannot be made automatically.

TABLE D
CONTROL PANEL TOGGLE SWITCHES

SWITCH	FUNCTION
M	In the manual mode this switch applies either ground or -48 volt battery to the M lead.
CT	In the manual mode this key applies either ground or an open circuit to the CT lead.
F1	In the manual mode this key applies a balanced 2400-Hz tone at -2 dBm to the signal converter RCV IN port.
F2	In the manual mode this key applies a balanced 2600-Hz tone at -2 dBm to the signal converter RCV IN port.

TABLE E
CONTROL PANEL LAMPS ONLY

LAMPS	FUNCTION
TEST SAT	Lamp indicates that a satisfactory test has been performed in the automatic mode, semiautomatic mode, or thermal time out test.
TEST FAIL	Lamp indicates that a test has failed in the automatic mode, semiautomatic mode, or thermal time out test.
E	Lamp is on when the signal converter E lead is grounded.
OA	Lamp is on when the signal converter OA lead is grounded.
TB	Lamp is on when the signal converter TB lead is grounded.
f1	Lamp is on when the signal converter is transmitting a 2400-Hz tone.
f2	Lamp is on when the signal converter is transmitting a 2600-Hz tone.

TABLE F
REMOTE KEYS, SWITCHES, AND LAMPS

KEYS, SWITCHES, AND LAMPS	FUNCTION
MAN, AUTO, CVTR ALM	Identical to the MANUAL, AUTO, and CVTR ALM keys and lamps on the control panel.
M, CT, F1, F2	Identical to the M, CT, F1, F2 toggle switches on the control panel.

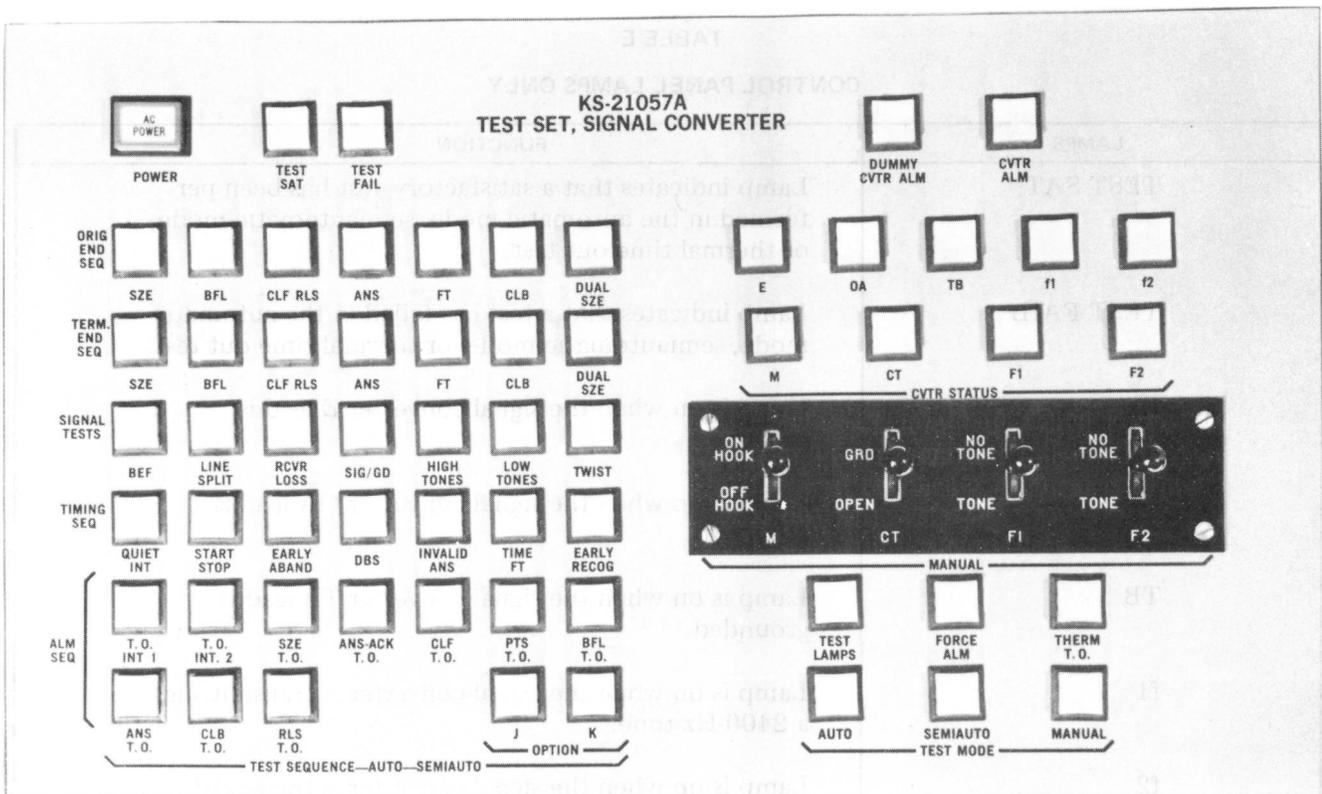


Fig. 1—Control Panel

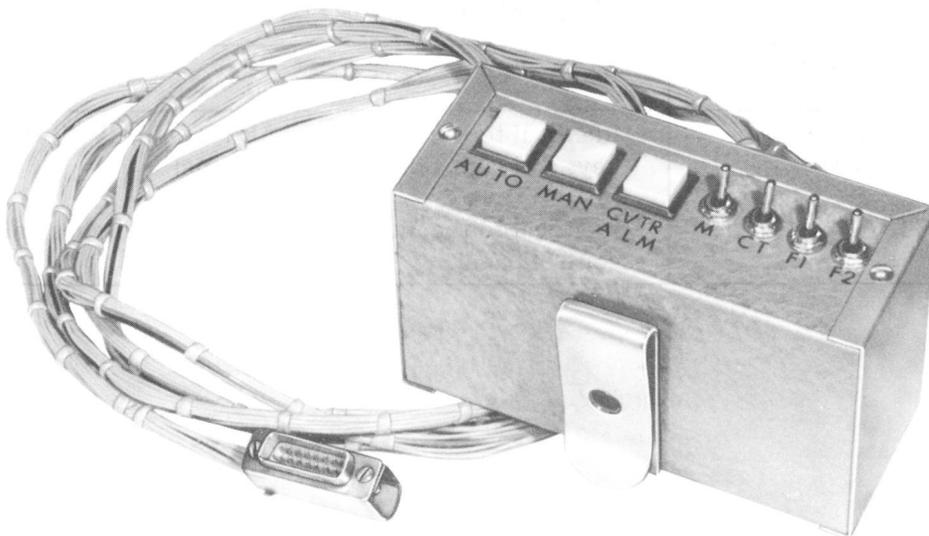


Fig. 2—Remote Switch Box

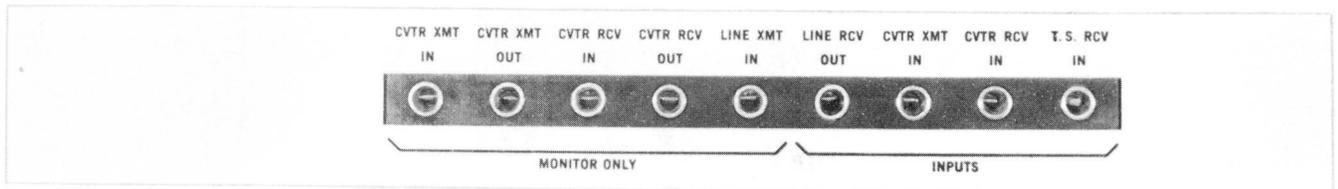


Fig. 3—Jack Panel

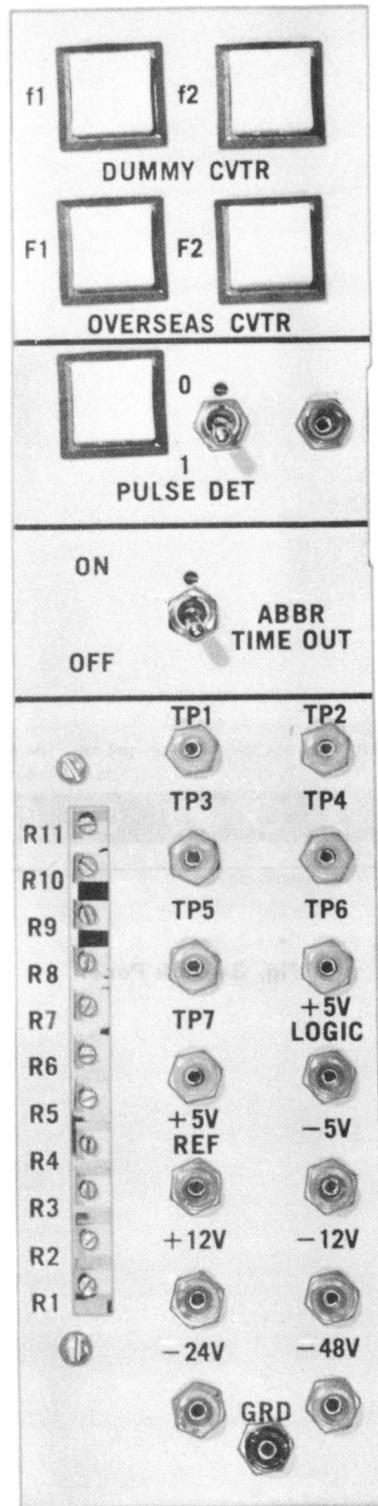


Fig. 4—Test Points and Internal Switch Assembly