

TRANSMITTER CONTROL ARRANGEMENT
MASTER STATION
FAST INTER-LINE NON-PRINTING ACTIVATE CONTROL
"FINAC"
DESCRIPTION, OPERATION, AND TESTS

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Full Duplex operation requirements		2.03 Speed of operation may be 60, 75, or 100 WPM.
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2.06 The basis of functional operation is the carriage return (CR) character which is required at the end of each line of page copy, and is also used in the End of Message coding.

2.07 (A) Inasmuch as TSCs are sent during transmission of messages, a means of preventing the printing of these code characters is necessary.

(B) This non-printing is provided in a blinding arrangement controlled by the stuntboxes of all outlying station machines.

(C) On receipt of every CR, any machines in the print condition will be blinded during the one character following.

(D) This one character after each CR will be either a valid TSC or an nonvalid BLANK signal.

2.08 This TSC or BLANK character is generated by the coding circuit in association with an eleven step selector.

2.09 (A) Whenever a CR is transmitted on the sending line, the Control circuit will automatically follow it with either a TSC character or a BLANK depending upon the idle or busy condition of the receiving circuit.

(B) When both the sending and receiving circuits are idle, the control circuit will automatically generate both the CR and TSC character.

2.10 There are four operating conditions under which it is necessary to send valid or nonvalid TSCs to obtain transmissions on the receiving circuit without interfering with any existing transmission or causing any extraneous printing on outlying stations' received copy.

2.11 These four conditions are as follows:

- (A) Master station transmitting - Outlying station transmitting
- (B) Master station transmitting - Outlying stations idle
- (C) Master station idle - Outlying station transmitting.
- (D) Master station idle - Outlying stations idle.

2.12 (A) Under condition (2.11 A) the TSC circuit will automatically transmit a BLANK character after each CR in the Master station tape.

(B) Outlying station receiving units are blinded on receipt of the CR for the one next following character, therefore there is no interference with any copy being received.

(C) The BLANK character being a nonvalid TSC will have no effect on any transmitters thus causing no interference with any existing outlying station transmission.

(D) The BLANK character will be transmitted after each CR until circuit operating conditions are as in 2.11 (B), (C), or (D).

2.13 (A) Under condition (2.11 B) the TSC coding circuit will now automatically transmit a new valid TSC after each CR in the Master station tape.

(B) The blinding feature is still effective on outlying station receiving equipment to prevent copying these TSCs, and a tape-available condition will result in a transmitter start when that station's TSC is received.

(C) The TSC's will continue to be sequentially transmitted after each CR until circuit operating conditions are as in 2.11 (A), (C), or (D).

2.14 (A) Operation under condition (2.11 C) requires no valid or nonvalid TSCs to be transmitted inasmuch as transmission on the receiving circuit already exists.

(B) The Coding circuit becomes deactivated until either the Master station starts transmission or the receiving circuit becomes idle.

(C) Transmission of valid or nonvalid TSCs then resumes as in (2.11 A), (B), or (D).

- 2.15 (A) With both the sending and receiving circuits idle as in (2.09 D) the Coding and Control circuit will now generate a CR and a valid TSC in order to effect a transmitter start for any station with tape-available.
- (B) Blinding features remain effective.
- (C) The CR and TSC will continue to be generated and transmitted until conditions become such as in (2.11 A), (B), or (C).
- 2.16 Coding - TSC
A TSC can be only one of the following characters: Y,B,A,X,Z,J,S,D,W,F or E, each preceded by a CR.
- 2.17 (A) TSCs are assigned and pre-wired in accordance with the Table or Drawing EA-12616ED and no change in the sequence should be attempted without referring to the Equipment Design group.
- (B) The assignment of TSCs as shown on the Table assures maximum efficiency and distribution.
- 2.18 The number of TSC codes assigned limit outlying sending stations to eleven, but a lesser number may be employed by assigning multiple codes to some stations. All eleven codes must be assigned.
- 2.19 For economic reasons it is not feasible to operate less than four sending stations on a circuit.
- 2.20 No TSC is required for the Master station as it is the only transmitting station on the send circuit and transmits at will.
- 2.21 Coding - CDC
Outlying station receiving units are connected by a Code Directing Character (CDC) inserted in the Master station tapes to effect normal stuntbox operation.
- 2.22 (A) Any station's CDC is restricted to one two-letter combination.
- (B) This one CDC limitation precludes the use of broadcast or group codes.
- (C) Any number of additional, outlying, receiving only stations may be employed.
- 2.23 Coding - End of Address (Lock-Out) LINEFEED (LF) is the End of Address code. It prevents all non-selected stations from printing, and conditions all stuntboxes so that fortuitous combinations of CDC characters in text will not connect any unselected station.
- 2.24 Coding - End of Message (Disconnect) FIGS H CR is the Disconnect Code. It will:
- (A) Disconnect all stations previously connected until a new CDC is sent.
- (B) Restore all stuntboxes to select nonprint in preparation for receipt of subsequent CDCs.
- 2.25 Station Equipment
(A) The FINAC circuit is designed for use with 28 type equipment.
- (B) Master station equipment consists of 1-28ASR for tape perforation, transmission, and transmission monitoring; and 1-28RO for the receiving circuit.
- (C) Outlying station equipment consists of 1-28ASR. Supplemental 28ROs are optional.
- 2.26 (A) Control circuit equipment consists of 1-KS16201-L1 Selector, 1-KS 15898 Rectifier, 20 wire spring relays, 1-376B vacuum tube, associated resistors and capacitors, and a Jones socket.
- (B) All of the above control equipment is mounted inside the 28ASR cabinet.

3. THEORY OF OPERATION

(A) Operation with no outgoing traffic

- 3.01 (A) In case there is no outgoing traffic from the Master station and the receiving relay (RD) in Fig. 1 EA-12615SD is on its marking contact due to no incoming traffic, the trigger tube (RX) will fire after its associated condenser is

charged to a sufficient difference of potential to trigger off this gas tube.

(B) The discharge of this tube is through the No. 6 break contact of the (BK) relay and its winding to battery, so that it operates and locks up through its No. 6 make contact, the (BK) resistance, and over the No. 8 lead to Fig. 2, and then through break contact No. 8 of the (KZ) relay back over the No. 2 lead to Fig. 1 and ground through break contact No. 10 of the (Z) relay.

(C) The (BK) relay operated, discharges the timing condenser (RX) of the (RX) trigger tube to ground through its No. 1 make contact, connects to ground top winding of the (CX) break contacts No. 6 of the (MJ) relay and break contacts No. 6 of the (CX) relay.

(D) The (CX) relay operates and locks up through its bottom winding, break contact No. 10 of the (EC) relay, and make contacts No. 6 of the (CX) relay. As long as the (CX) relay is operated, there is no possibility of the (MJ) relay being operated, since the ground that would be used for that purpose has been disconnected by means of the No. 6 break contact on the (CX) relay.

(E) The operation of the (CX) relay also connects ground through its No. 1 make contacts, the No. 3 break contacts of the (EC) relay to the winding of the (KB) relay which operates. This action shorts out L-4 of the receiving relay over leads L-1 and L-4 by make contacts No. 11 of this relay so that the monitoring printer does not copy the TSC.

(F) Distributor contacts S1 to S5 inclusive shown on Fig. 3 are connected through break contacts on the (DC) relay in Fig. 1, the break contacts of the (Z) relay, the break contacts of the (B) relay, the break contacts of the (KR)

relay, and then to Fig. 3 over leads R1 to R5 inclusive to the transmitter contacts.

(G) The (DS) relay in Fig. 1 has now lost the ground on its winding by means of the No. 8 break contact on the (CX) relay so that it releases. With the release of the (DS) relay, a short is presented to the (BB) and (DC) leads through break contacts No. 2 of the (DS) relay, make contacts 3 of the (CX) relay, break contacts 3 of the (EX) relay. These two leads (BB) and (DC) go to Fig. 3, and the short across these two leads energizes the distributor clutch magnet.

(H) The operation of this distributor magnet permits the teletypewriter sending equipment to transmit the carriage return teletypewriter character to the line since the sending contacts S1 to S5 inclusive are now connected through the make contacts of the (KR) relay, which was operated through No. 3 break contacts of the (EC) relay and the No. 1 make contacts of the (CX) relay to the air through the break contacts of the (KZ) relay with the exception of the S-4 contact which goes to ground.

(I) This ground is fed back over the (KB) lead to the sending relay (SD) so that only the No. 4 unit is marking. This connection permits the distributor to send a carriage return teletypewriter character to the line.

(J) During the transmission of this teletypewriter character, the distributor auxiliary contact closes and connects ground over the (DX) lead from Fig. 3 to Fig. 1 and then through make contact No. 9 of the (CX) relay, break contact No. 10 of the (DS) relay and over the No. 16 lead to Fig. 2 through break contact No. 12 of the (KZ) relay to the winding of the (KO) relay causing it to operate.

- (K) As soon as the carriage return character has been transmitted to the line, the auxiliary contact opens up and permits the operation of the (KZ) relay in series with the (KO) relay so that leads S1 to S5 are connected to the (SE) selector with the exception of the S1 lead which has a permanent ground on it.
- (L) The code transmitted to the line is therefore dependent upon the strappings on the (SE) selector and also upon what step this selector may be at that particular time. During the transmission of this character the auxiliary contact which is closed during this transmission connects ground through the top make contacts of the (KZ) relay over lead 17 to Fig. 1 to the winding of the (EX) relay through break contacts No. 12 of the (EC) relay so that the (EX) relay operates.
- (M) As soon as this (EX) relay operates, it breaks the distributor magnet circuit by its No. 3 break contacts. When this transmitter distributor start signal character has been transmitted to the line, the distributor auxiliary contact on opening up will permit the (EC) relay to operate, which locks up through the varistor (VP) and ground through the No. 6 make contact on the (CX) relay.
- (N) It also locks up over lead 9 to ground through the No. 12 make contact of the (KO) relay in Fig. 2. It will be noticed that the locking circuits of the (CX), (KZ), and (KO) relays are broken by the operation of the (EC) relay.
- (O) The reason for the (VP) varistor is so that a locking ground for the (EC) relay coming back from a number of relays in this system will not inadvertently operate the (CX) relay.
- (P) The locking circuit of the (BK) relay is broken by the operation of the (KZ) relay, so that it is released. The (CX) released, places ground by means of its No. 8 break contacts on the winding of the (DS) relay so that it operates and removes ground from the magnet of the distributor.
- (Q) As soon as the (CX) relay is released, a ground is placed on the operating winding of the (SD) relay through No. 4 break contacts of the (CX) relay and the No. 8 break contacts of the (MJ) relay. This is to hold the outgoing circuit closed.
- (R) Since it is desirable to step the selector (SE) every time an attempt is made to start a transmitter distributor, a ground is applied through make contact No. 10 of the (KZ) relay, the break contact of the (SE) selector to the winding of the coil, thus permitting the selector to operate and hold through the (SE) resistance.
- (S) This selector will step upon the release of the (KZ) relay. This means that the system will send a different start code for every position of the (SE) selector including the No. 11 step.
- (T) Sending relay (SD) is kept on marking by a ground through break contact No. 11 of the (SP) relay and make contacts No. 12 of the (DS) relay until the (DS) relay releases.
- (B) Operation With Both Incoming and Outgoing Traffic.
- 3.02 (A) In case incoming traffic is being handled, the intermittent ground applied to the timing circuit of the (RX) tube by the (RD) relay will not permit the tube to time out, so that the (BK) relay will remain in its released position.
- (B) The transmitter contacts are connected over the R1 to R5 leads inclusive and back to the distributor contacts over the S1 to S5 leads inclusive through the break contacts of relays (DC), (Z), (B), and (KR).

(C) In order to start sending from the Master station, it is necessary to place tape in the gate of the transmitter distributor and also to operate the manual switch. The operation of the manual switch operates the (MS) relay in Fig. 1, so that the tape in the gate will hold the sixth pin closed and operate the (SP) relay through the No. 4 make contacts on the (MS) relay. The (SP) relay on operating locks through its contacts No. 9 to the sixth pin contact in the transmitter distributor so that if the manual switch was opened by means of tight tape, the (SP) relay would not fall down and release the circuit.

(D) The (MJ) relay now operates since ground is connected through No. 6 break contacts of the (CX) relay, No. 6 break contact of the (MJ) relay and the No. 10 make contact of the (SP) relay to the primary winding of the (MJ) relay. This relay operates and locks up by means of its bottom winding through the No. 8 make contacts of the (SP) relay, the No. 6 make contacts of the (MJ) relay and the No. 6 break contacts of the (CX) relay to ground.

(E) The operation of the (MJ) relay, by means of its break contact No. 2, releases the (ST) relay. Rectifier voltage is now applied to the winding of the transmitter clutch magnet. The circuit for energizing the transmitter clutch magnet comes over the lead (TC) through make contact No. 12 of the (SP) relay, make contact No. 1 of the (MS) relay, break contact No. 2 of the (Z1) relay, break contact No. 2 of the (B1) relay, break contact No. 2 of the (ST) relay and back to the rectifier over the (BB) lead.

(F) Traffic is now handled in the normal manner until the end of the line, when a carriage return character is transmitted over the system from the Master station. At this time the (CR) relay operates to its No. 4 contact due to its associated resistance reading circuit which is connected to the 5 leads be-

tween the transmitter contacts and the distributor contacts.

(G) This relay operated, places ground on the (QA) relay which operates, and by means of its No. 10 make contact completes a circuit so that the battery is now applied through break contacts No. 6 through the (X) relay, through contact No. 6 of the (BL) relay, No. 10 make contacts of the (QA) relay to the winding of the (BL) relay which operates and locks up by means of its bottom winding through the break contact No. 8 of the (EC) relay, the No. 6 make contact of the (BL) relay and the No. 6 break contact of the (X) relay to ground.

(H) As soon as the auxiliary contact of the distributor closes, ground is connected over the (DX) lead through the No. 8 make contact to the (QA) relay, the No. 9 make contact of the (BL) relay, No. 12 break contact of the (B) relay, the No. 2 break contact of the (X) relay to the winding of the (B1) relay which operates.

(I) The operation of the (B1) relay opens the transmitter magnet circuit by means of its No. 2 break contacts so that the transmitter sets up one more teletypewriter character and then comes to rest.

(J) The distributor continues to send the carriage return teletypewriter character to the line and at its completion when the distributor auxiliary contacts open up, the (B) relay operates in series with the (B1) so that the distributor contacts are now connected through the make contacts of the (B1) relay to the air. Since there is nothing connected to these make contacts, the BLANK teletypewriter character will be sent to the line. The BLANK character is not included as a station start code so no station will be started.

(K) Since the 28F multicontact transmitter distributor has set up a teletypewriter character that has not been transmitted to the

line it is desirable that the sending equipment take care of this character before the transmitter magnet is closed. In order to do this, relays (DC) and (DX) are provided, and during the transmission of the BLANK teletypewriter character, the auxiliary contact connects its ground through make contacts 11 of the (BL) relay, make contact 11 of the (B) relay, break contacts 12 of the (DC) relay to the winding of the (DX) relay.

(L) Relay (DX) operates and remains in that condition during the transmission of the BLANK teletypewriter signal.

(M) At the end of this character, it will be noted that the (DC) relay operates in series with the (DX) relay connecting transmission leads S1 to S5 directly to transmission leads R1 to R5 inclusive so that on its next trip around, the distributor sends the character that was set up by the machinery but never transmitted to the line.

(N) During the transmission of this last teletypewriter character, the ground from the auxiliary contact continues through make contact 12 of the (DC) relay, break contact 12 of the (EC) relay to the winding of the (EX) relay which operates. At this time the transmitter magnet is again closed by make contact 9 of this (EX) relay.

(O) With the (EX) operated, the distributor magnet circuit is opened up by break contacts No. 3 on this relay, so that when it completes this operation it will come to a halt.

(P) At the conclusion of the transmission of this character, however, the (EC) relay operates in series with the (EX) relay so that the locking grounds of all relays with the exception of the (EC) and (EX) are opened.

(Q) These relays release, and on their release, the locking circuit of the (EC) and (EX) is opened so they release and the circuit is normal. The transmitter distributor now operates normally.

(R) The locking path of the (EC) and (EX) relay to the (BL) relay is through the (VQ) varistor. This diode is in the circuit so that relay (BL) will not be operated from some other ground such as make contacts No. 12 on the (Z1) relay

(C) Operation With Outgoing Traffic - Receiving Circuit Idle

3.03 (A) In case outgoing traffic is being handled, and the receiving circuit remains in the marking condition, the trigger tube (RX) will time out and fire, thus operating the (BK) relay which operates and locks up as mentioned previously. Under this condition when the carriage return is transmitted by the multicontact transmitter distributor, the (QA) relay operates from the (CR) relay which is activated by the carriage return character.

(B) However, this time the (X) relay is operated as soon as the (BK) relay comes up since path from the primary winding of the (X) relay is continuous now through the No. 8 break contact of the (ST) relay, make contact No. 11 of the (BK) relay, break contact No. 6 of the (BL) relay to ground through No. 6 break contact of the (X) relay.

(C) This (X) relay operates and locks up by means of its bottom winding through the break contact 11 of the (EC) relay, break contact No. 10 of the (CX) relay to ground through the No. 6 make contacts of the (X) relay.

(D) Under this set of conditions the closure of the distributor auxiliary contact connects ground through the No. 8 make contact of the

(QA) relay, the No. 9 make contact of the (X) relay, the No. 12 break contact to the (Z) relay, No. 2 break contact of the (BL) relay to the winding of the (Z1) relay which operates.

(E) As soon as the carriage return character has been transmitted, the ground from the auxiliary contacts of the distributor is lost and the (Z) relay operates in series with the (Z1) relay, so that all of the leads from the distributor side of the transmitter distributor are connected to the (SE) selector with the exception of (S1) which goes to a permanent ground. The start character transmitted is therefore dependent upon this permanent ground and also the strappings on the (SE) selector.

(F) At the conclusion of the transmission of this start signal, the operation is the same as described when a BLANK teletypewriter signal was transmitted to the line except that the (DX) lead is connected to the winding of the (DX) relay through make contacts 11 of the (X) relay, make contacts 11 of the (Z) relay and break contacts 12 of the (DC) relay.

(G) The monitor machine does not copy the TSC since leads L1 and L4 to the receiving relay are shorted through make contacts 6 of the (Z) relay, and break contacts 11 of the DC relay.

4. TESTS

4.01 To make tests on Master station equipment, a release of the complete service should be obtained as normal operation will be interrupted.

4.02 Co-ordination is required with the Serving Test Center (STC) for most of the tests.

4.03 Before making tests the STC should remove the Master station sending and receiving loops and terminate them in separate dummy circuits.

4.04 When perforating torn tape it is advisable to include seven to ten LTRS characters at both the beginning and end of the tape. This provides easier latching at the start and insures that the complete message will be transmitted before 6th pin operation deactivates the transmitter.

4.05 Receiving - 28RO

- A. The 28RO is "on-line" at all times and requires no selection.
- B. It is not equipped with a LINE-TEST Key.
- C. Orientation limits may be checked by having the STC transmit the automatic FOX test in accordance with P30.002.

4.06 Sending (28ASR)

- A. The transmitter and typing unit of the 28ASR are normally "on line".
- B. There is no provision for selective connection by a CDC or transmitter start by TSC.
- C. A LINE-TEST key is provided.

4.07 Transmitter

The following conditions are required for tests of the transmitter.

- A. LINE-TEST key in LINE position - Power ON.
- B. Open receive loop to simulate a busy receiving circuit condition which will prevent the Control circuit from transmitting valid TSCs.
- C. Place a test tape in the transmitter, lock Tape Lid, and operate START-STOP switch to the RUN position (right).
- D. The STC should now receive the transmitted signals and make a Telegraph Transmission Measurement.
- E. The transmitter should be deactivated after the tape has fed through and operated the 6th pin.

- F. Assuming the STC to be using a monitor which prints all functions, the received copy should read exactly as sent including FIGS, LTRS, CR, LF, and BLANK.*
- G. The station ASR should have copied only the text of the message, but performed all functional operations while disregarding the BLANK which has no useful purpose.
- *This BLANK character will have been transmitted by the Control circuit after each CR in the tape.
- 4.08 To test signals from the TSC Control circuit:
- A. Have both sending and receiving loops closed and idle.
 - B. Tape Lid latched down.
 - C. START-STOP switch in RUN position.
 - D. No tape in transmitter.
 - E. The Control circuit should now operate and transmit the TSC sequence of CR Y, CR B, CR A, CR X, CR Z, CR J, CR S, CR D, CR W, CR F, and CR E.
 - F. These TSCs should be generated at one second intervals, and the complete cycle should be repeated as long as both loops are closed and idle.
 - G. Telegraph Transmission Measurements should be made by the STC.
- 4.09 To test keyboard signals:
- A. Open receiving loop.
 - B. Tape-Lid position is immaterial.
 - C. START-STOP switch in STOP (LOAD, left) position.
 - D. K-KT-T switch in K (Keyboard) position.
- E. Signals may now be typed directly to the sending loop for measurement by the STC, and a check of home copy.
- 4.10 To test orientation limits of typing unit per P32.002:
- A. Have receiving loop open.
 - B. No tape in transmitter.
 - C. START-STOP switch in STOP (left) position.
 - D. Have STC transmit automatic FOX test on sending loop per P32.002.
 - E. Make orientation tests.
- 4.11 LINE-TEST key
- A. If it is desired to make tests on the 28ASR locally it can be placed in the TEST condition by operating the LINE-TEST key to TEST.
 - B. When in the LINE condition, the ASR is arranged as follows:
 1. The transmitter is connected to the send loop.
 2. The typing unit is connected to the send loop.
 3. The keyboard is connected to the send loop when the K-KT-T switch is in either the K or KT positions.
 4. The TSC generator circuit is connected to the send loop.
- (C) When in the TEST position, the ASR in its entirety, and the TSC generator, are removed from the send loop and placed in a local battery circuit. A short is placed on the send loop to keep that circuit closed.
- 4.12 Transmitter Start Code Generator Circuit.
- The TSC generator circuit should be checked for proper operation under varying sending and receiving circuit-idle and busy conditions as follows:

A. Sending and receiving circuits idle.

1. Automatically generate a CR and the second character of a TSC in sequence.
2. Pause for one second to allow time for the outlying station transmitter to start.
3. Automatically repeat steps 1 and 2, sending a different second character according to the polling sequence.
4. Automatically and continuously generate the polling sequence with a one second pause between each CR (TSC) as long as the receiving circuit remains idle.
5. Stop polling if the receiving circuit is made busy, and automatically resume if an idle condition again prevails.

(B) Sending and receiving circuits busy.

1. Make the receiving circuit busy by having the STC transmit the automatic FOX.
2. Make the sending circuit busy by transmitting a long tape made up of short test sentences.
3. After each CR sent by the station transmitter from the test tape the TSC generator should send a BLANK character.
4. The BLANK character should continue to be sent after each CR in the test tape as long as the receiving circuit is kept busy.
5. Removal of the FOX on the receiving circuit should cause the TSC circuit now to generate a valid TSC character after each CR sent from the station transmitter.

(C) Sending circuit busy-Receiving circuit idle.

1. Make the sending circuit busy by transmitting short test sentences.
2. After each CR sent from the transmitter, the TSC generator should send a new valid TSC character.
3. These TSC characters should continue to be sent after each CR as long as the receiving circuit is idle.
4. It should be noted that inasmuch as it takes one second to generate a new TSC character, too rapid transmission of CRs in the test tape will not result in an equal number of TSCs.
5. To insure generation of a TSC, the CR character should not appear in the tape closer than every tenth character which is equivalent to approximately one second.

(D) Send circuit idle - Receiving circuit busy.

1. Have the STC transmit the automatic FOX on the receiving circuit.
2. With a "no-tape" condition at the Master station, no TSCs should be generated.
3. If the FOX is removed and the receiving circuit remains idle for one second or more, valid TSCs will then be generated and transmitted on a one a second basis.

4.13 Line HOLD feature

- A. The line HOLD feature is provided to permit tape servicing in case of taut, tangled or torn tape during transmission.

B. The TSC generator is prevented from sending TSCs while the transmitter is stopped. This prevents overlining, and extraneous characters from being printed, during text at outlying stations that have been selected.

C. Test of the HOLD feature is made with the sending circuit busy and the receiving circuit idle as follows:

Action	Results
1. Master station transmits tape.	Signal received at STC.
2. During transmission operate the START-STOP switch of the transmitter to the STOP position (left).	Transmission halted. No signals received at STC.
3. Remove tape from transmitter.	No signals received at STC. No TSCs transmitted.
4. Re-insert tape in transmitter. START STOP switch in LATCH (center) position.	No response.
5. Operate START-STOP switch to RUN (right) position.	Transmitter restarts. Signals received at STC.

4.14 If trouble is suspected in the relay circuit of the Master station transmitting and TSC coding arrangement, the tests outlined below should indicate which relays, if any, are involved.

- 4.15 (a) No loop connections are required.
 (b) Lift black ground strap from terminal C88 in the 28ASR cabinet.
 (c) Operate the LINE-TEST key to TEST.
 (d) Turn power switch ON.
 (e) Observe that (DS) and (ST) relays are operated.

Action	Result
4.16 a. Hold arature of (RD) relay to right until (RX) tube fires.	(BK), (CX), and (KR) relays operate. (D8) relay releases. Distributor shaft rotates.

b. Ground terminal C87 once only. Release the ground. (KO) relay operates. (KZ) relay operates. (BK) relay releases. (SE) magnet pulls up.

c. Repeat "b". (EX) and (EC) relays operate and release. (CX), (KR), (KO), and (KZ) relays release. (D8) relay operates. (SE) selector steps.

d. Operate STOP-RUN lever to RUN. (MS) relay operates.

e. Prepare a test tape containing the sequence CR-SPACE-SPACE-SPACE repeated 20 or 30 times. Insert in gate and close lid to depress 6th pin. (SP) and (MJ) relays operate. (ST) relay releases. Tape feeds through transmitter.

f. Note transmission of CR from tape. (CR) and (QA) relays operate and release. (BL) relay operates.

g. Ground terminal C87 until the (B1) relay operates. Release the ground. Transmitter stops. (B) relay operates.

h. Operate STOP-RUN tape lever to STOP. Momentarily ground terminal C87 again. (DX) and (DC) relays operate.

i. Repeat "h". (EX) and (EC) relays operate and release (B), (B1), (DX), (DC) and (BL) relays release.

- j. Prepare a test tape containing the sequence CR LF-fifteen SPACES repeated ten or twelve times.
 Insulate the M10 contact of relay (QA). Insert test tape in gate. (SP) and (MJ) relays operate. (ST) relay releases. Transmitter starts.
- k. Hold armature of (RD) relay to right until (RX) tube fires. (BK) and (X) relays operate.
- l. Ground terminal C87 until the (Z1) relay operates. Release the ground. Transmitter stops. (Z) relay operates. (BK) relay releases. (SE) magnet pulls up.
- m. Operate STOP-RUN tape lever to STOP. Momentarily ground terminal C87 again. (DX) and (DC) relays operate.
- n. Repeat "m". (EX) and (EC) relays operate and release. (Z), (Z1), (DX), (DC), and (X) relays release. (SE) selector steps.

4.17 The above tests should be made for each feature or condition over at least a ten minute period to insure proper operation.

4.18 In the event of finding and clearing any troubles, all tests should be repeated, and special attention given the faulty feature to prevent a recurrence.

5. REFERENCES

- EA12616SD 28ASR Teletypewriter-Full Duplex Outlying Station Arranged for FINAC
- E12.762 28ASR Teletypewriter - Full Duplex Outlying Station Arranged for FINAC-Office

Responsibilities, Operating, and Testing Procedures.

P70.924	28ASR Teletypewriter - Full Duplex Outlying Station Arranged for FINAC-Description Operation, and Tests
P34.101	28ASR - Description
P34.102	" "
P34.103	" "
P34.004	" "
	Requirements and Procedures
P34.614	" Requirements and Procedures
P34.631	" Requirements and Procedures
P34.632	" Requirements and Procedures
P34.301	" Wiring
P34.304	" Wiring