

AUTOMATIC TRANSMITTER START UNIT  
ARRANGED FOR HALF DUPLEX OPERATION  
(DRAWING P92.911.02)

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## 1. GENERAL DESCRIPTION

1.01 This automatic transmitter start unit is a part of the Mark IV TAD system. It provides a means of dispatching traffic automatically on a half duplex teletypewriter circuit by a search of the various stations. Selective calling with teletype characters is employed. It is used in lieu of the previous arrangement per P92.911.01 when all stations are 19 A S & R or equivalent and the following additional features are required:

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- (a) Two-digit selection permitting up to 36 stations per line.
- (b) Circuit assurance.
- (c) Priority.
- (d) Two line cross-office.
- (e) Automatic activate.
- (f) Intercept.

Any of these features can be disabled by wiring options.

1.02 It is installed at the master station on a Teletypewriter Automatic Dispatch System (TADS) as described in P65.906. The selective calling units used at the stations are described in P65.907 and P65.910.

1.03 It is housed in the same apparatus cabinet as the controller per P92.911.01 and the basic circuitry is similar.

1.04 It is not feasible to convert from a P92.911.01 to an .02 arrangement.

## 2. LIMITATIONS

2.01 Not more than two different characters can be used as first CDC's for any one circuit.

2.02 H and S are not available as station call letters. FIGS H is normally used for motor shut-off. Letter S is normally used for broadcast or a group call letter.

2.03 T, O, M and V are not recommended as first or second CDC's.

2.04 This arrangement is limited to use on lines equipped entirely with No. 19 A S & R teletypewriter or the equivalent. (No keyboard transmission.)

2.05 It is suitable for 60 or 75 WPM service.

2.06 Engineering or technical people familiar with the limitations of this equipment should be consulted before service is offered involving special features.

2.07 All stations must be equipped with teletype code selector per P92.901.04 when priority and/or circuit assurance is required. This selector is also required for two digit calling, but in those cases where the circuit is already equipped with the P92.901.02 or .03 selector, the .04 selector need be furnished only at the stations which have the same second digit for instance YA and ZA.

### 3. FUNCTIONS

#### OPEN-CLOSE ACTIVATE

3.01 This is the same as used with the Mark III system. All stations disconnect from the line at end of transmission. This disconnect will take place as a result of the FIGS H, or automatically if the FIGS H is not received as option E in P92.901.04 is applied at all times.

3.02 The open-close transmitted by the controller. Unblinds all stations, and starts motors, if not running, prior to the transmission of automatic transmitter start codes.

3.03 Shifts all teletypes to upper case preceding each transmitter start code.

3.04 Transmits automatic transmitter start code for next station.

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- 3.05 Waits for each searched station to transmit traffic or give a circuit assurance signal.
- 3.06 Transmits FIGS H blinding all stations and stops searching for a period of 3 or 6 minutes or an indefinite time (key controlled) upon completion of a search cycle without a station transmitting. The motors will stop at all stations after 45 seconds of idle circuit if P option is applied in P92.901.04.
- 3.07 Allows time for transmission from automatic cross-office equipment, if provided.
- 3.08 Functions with the intercept or skip equipment, if provided, to give a visual and an audible alarm when a station fails to respond to a search.

### AUTOMATIC ACTIVATE

- 3.09 The automatic activate feature was developed for the Mark IV TAD System to increase circuit efficiency where the average length of message is short and the circuit usage high. Commercial experience has shown it to be very successful. It appears that this should be the normal arrangement of the Mark IV System. This feature reduces the interval from the time transmission stops until polling is resumed to about 3 seconds as compared with 6-1/2 seconds for open-close activate. This is accomplished by having all stations automatically reconnect to the line ready to receive transmitter start codes within 1/2 second after transmission stops.
- 3.10 The motors of all stations must run continuously during service hours. They must be turned on manually at start of service and turned off manually at close of service each day.
- 3.11 The BUSY lamp is normally lit and flashes during transmission.

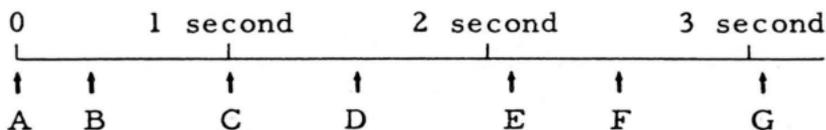
3.12 When the circuit is idle the teletypewriters are connected to the line ready to receive station codes.

3.13 The CR following the station codes deactivates the unselected machines as before but does not cause their motors to turn off.

3.14 Transmission stopping for 1/2 second will cause all machines to reconnect to the line in an activated condition. This usually follows the end-of-message code (FIGS H).

3.15 Automatic activate is compatible with all major features such as priority, circuit assurance, two-digit calling, intercept, automatic two-line cross-office switching and push-button calling.

3.16 Approximate sequence in time as generated by the controller, when the circuit goes idle following a FIGS H is as follows:



A. Circuit idle at end of message.

B. All stations reconnected.

C. Priority bid.

D. Transmitter at functional relay center starts if tape is available (special arrangement).

E. FIGS transmitted (searches cross-office).

F. Cross-office sends if tape is available.

G. Search codes sent.

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## MOTOR CONTROL

3.17 Three motor control options are available:

Type A - The motor turns off and the machine is disconnected from the line following each transmission. The motor turns on and the machine is reconnected when the controller sends an open-close signal prior to starting the search sequence.

Type B - The machine is disconnected from the line following each transmission and is reconnected in response to the open-close signal from the controller. The motor turns off following a circuit idle condition of 15 to 45 seconds. The motor restarts in response to the open-close signal from the controller.

Type C - The motor runs continuously during service hours. The machine must be turned on manually at start of service and turned off at close of service each day.

These motor control options are used as follows:

	Type <u>A</u>	<u>B</u>	<u>C</u>
Mark IV with open-close activate	X	X	
Mark IV with automatic activate			X

## 4. CONNECTING CIRCUITS

4.01 P92.901.04 Teletypewriter Code Selector to be installed at all stations when circuit assurance, priority or two-digit calling features are required.

4.02 Teletypewriter Code Selector P92.901.03 may be used when priority, circuit assurance or two-digit calling are not required.

4.03 Arrangement for connecting a TRP to a circuit in response to code directing characters per P92.902.01 or P92.902.02. Arrangement for automatic cross-office transmission between two circuits per P92.940.01. Arrangement for intercepting improperly directed message per P92.923.01 (M-D) or P92.923.02.

## 5. OPERATION - REF. TO FIG. 1 FOR KEYS & LAMPS

### OPEN-CLOSE ACTIVATE, CIRCUIT ASSURANCE AND PRIORITY

5.01 At the end of transmission the teletypewriters are normally blinded at all stations and all BUSY lamps extinguished.

5.02 After the circuit has been idle for four seconds, the controller will open the line for one second. This prepares the station selectors to remove the blind from the teletypewriter and lights all BUSY lamps.

5.03 The controller will then close the line for one second. The blind will be removed at all stations.

5.04 The controller will transmit FIGS shifting all teletypewriters upper case.

5.05 If the P relay is strapped to provide for automatic cross-office, a pause of up to 2 seconds is provided at this time to allow cross-traffic to be automatically picked up. The circuit assurance signal (CAS) and line propagation time, control the timing. If in 2 seconds a CAS is not received, the controller times out and proceeds with the search.

5.06 The two-digit call letters are next transmitted for the first station to be searched. If tape is available at that station it will be transmitted. When the transmission is finished, the above procedure will be repeated. If no tape is available, a CAS will be sent by the station.

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5.07 About 1/2 second after the CAS is received the controller will send FIGS and search the next station in sequence, that station will transmit tape or send a CAS.

5.08 On failing to receive a CAS or transmission, the search code will be transmitted a second time. A failure of the station to acknowledge this second search will cause the control unit to stop searching, a lamp to light and an audible alarm to sound in the intercept equipment. When the controller locks under these conditions the search cycle is discontinued until an intercept or skip key is operated at the master station.

5.09 Should the transmitter at a station be started, the code-directing characters for the station sending and the station or stations wanted shall be transmitted with a letters character between codes. The codes must be followed by LTRS CR LF LTRS which will blind unwanted stations and leave the called and calling stations connected to the line. The BUSY lamp will follow teletype signals.

5.10 The text of the message is then sent followed by FIGS H which stops the transmitter, the circuit goes idle, and all stations disconnect. The BUSY lamp is extinguished at all stations.

5.11 Any station wishing to introduce a priority message into the system places tape in the transmitter and operates the PRIORITY key momentarily. When a busy circuit becomes idle the station having a priority will send an open immediately following the open sent from the control equipment. The second open blocks all stations from transmitting except the one having the Priority. When two stations bid for priority they both open the line at the same time. The first station seeking priority that is encountered in search will send a message. At completion of this message search will automatically seek the second station bidding for priority and its message will then be sent.

If a PRIORITY key is operated while the controller is in the search cycle it is possible that one message will be transmitted ahead of the priority message. This is dependent on a station with a tape in its transmitter being polled before the station with the priority message. At the end of this message the priority takes over completely as described above.

5.12 The controller will discontinue searching, for a predetermined period (3 or 6 minutes), after having made a complete search without finding tape available at any station. It can be reactivated during this rest period by any station operating the control key to the ON position momentarily.

5.13 When the master station is provided with a manual key the controller can be disabled by its operation and the circuit controlled manually.

### AUTOMATIC ACTIVATE, CIRCUIT ASSURANCE SIGNAL, AND PRIORITY FEATURES

5.14 Performs same functions as open-close activate except BUSY lamp will be on at all times, plus the following rearrangements. (Cross references are given in ( ).

5.15 (5.01) at the end of transmitting a message, in approximately 1/2 second all connected stations will automatically disconnect. Then all the stations on the line will reactivate and be ready to receive TSC's.

5.16 (5.11) Any station wishing to introduce a priority message into the system places tape in the transmitter and operates the PRIORITY key momentarily. When a busy circuit becomes idle and all stations reconnected in an activated condition, the station having a priority message will transmit a 1/2 second open signal. This blocks all stations from transmitting except the one having the priority. When two stations bid for priority they both open the line at the same

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time. The first station seeking priority that is encountered in search will send a message. At completion of this message search will automatically seek the second station bidding for priority and its message will then be sent.

5.17 (5.04) The controller will transmit FIGS shifting all teletypewriters to upper case.

5.18 (5.05) If the P relay is strapped in to provide for automatic cross-office, a pause of up to 2 seconds is provided at this time to allow cross-office traffic to be automatically picked up. The CAS and line propagation time, control the timing. If in 2 seconds a CAS is not received, the controller times out and proceeds with the search.

5.19 (5.06) The two-digit call letters are next transmitted for the first station to be searched. If tape is available at that station it will be transmitted. When the transmission is finished, the above procedure will be repeated. If no tape is available, CAS will be sent by the station.

5.20 (5.07) About 1/2 second after the CAS is received the controller will send FIGS and search the next station in sequence, that station will transmit tape or send a CAS.

5.21 (5.08) Failure to receive a CAS or transmission the search code will be transmitted a second time. A failure of the station to acknowledge this second search will cause the control unit to stop searching, a lamp to light and an audible alarm to sound in the intercept equipment. When the controller locks up in this manner, nothing can cause it to continue its search, except the operation of an intercept or skip key at the master station.

5.22 (5.09) Should the transmitter at a station be started, the code directing characters for the station sending and the station or stations wanted shall

be transmitted with a letters character between codes. The codes shall be followed by LTRS CR LF LTRS which will blind unwanted stations and leave the called and calling stations connected to the line. The busy lamp will follow teletype signals.

5.23 (5.10) The text of the message is then sent followed by FIGS H which again is approximately 1/2 second, all connected stations will automatically disconnect. Then all the stations on the line will reactivate and be ready to receive TSC's.

5.24 (5.12) The controller will discontinue searching for a predetermined period (3 of 6 minutes) after having made a complete search without finding tape available at any station. It can be reactivated during this rest period by any station having tape available and operating the Control Key to the START position, starting their own Transmitter Distributor. At the conclusion of the message the controller will search all stations.

5.25 (5.13) When the Master Station is provided with MANUAL key the controller can be disabled by its operation and the circuit controlled manually.

## 6. DESIGNATION AND FUNCTION OF RELAYS

### DESIGNATION

### FUNCTION

L	Follows Line Signals. Operates L1 relay. Prevents BL relay from operating, as it releases AB relay. Lock path for T1, C1, P, and AB relays.
TR	Transfers Distributor face from sensing pins to the control unit. Opens lock path from L relay for T1 relay.

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DESIGNATION	FUNCTION
FG	Codes TD to send Figures to line. Operates P relay if required.
A	Prepares operate path for AB, C and C1 relays for single digit operation. Opens operate path of FG relay. Prepares operate path for FD and FD1 or FD2 relays for two-digit operation.
C	Prepares operate path for C2 and relay. Prepares path for TD to read codes wired on switch. Opens operate path of TD stop magnets.
C1	Removes blind from T1 tube. Stops tape feed out in intercept equipment. Prepares lock path for SK, RT1 and RT1A relays. Opens operate path for P relay. Prepares own lock path. Shorts SM and SM1 thermistors when CAS is provided.
C2	Blinds T1 tube. Opens operate path of C relay. Opens TD stop magnet circuit. Releases T1 relay.
T	Prepares T1 tube to operate. Opens line circuit. (When connected for open-close activate.) Opens lock path for P and RT relays. Prepares own lock path. Blinds intercept. Prepares secondary lock path for C1 and T1 relays.
T1	Blinds T and T2 tube. 4-5B (T1) release AB relay when CAS is not used.

12-13T (T1) prepares lock path for AB relay.  
 Prepares own lock path.  
 Operates SM relay.  
 Prepares lock path for A and FD relay.  
 Prepares operate path for P relay.  
 Closes line circuit. (When connected for open-close activate.)  
 Opens lock path for AB, T and SK relay.  
 Prepares operate path for C1 relay.

L1           Blinds T and T1 tubes.  
 Prepares secondary lock path for RT relay.  
 Releases the RT2 relay.

AB           Operates RM and AB1 relay.  
 Unblinds T2 tube.  
 Changes timing of T1 tube in accelerated search.  
 Prepares own lock path.

AB1          Operates FD3, FD4, and L1 relays.  
 Prepares operate path for AB3, AB4 and AB2 relays.

FD           Releases FD1 and FD2 relays.  
 Prepares operate path AB, C and C1 relays in two digit selection.

FD1          Codes TD for first digit Group 1.  
 Prepares operate path for RT1 relay.

FD2          Codes TD for first digit Group 2.  
 Prepares operate path for RT1A relay.

RM           Operates rotary switch.

SM           Operates stop magnets.  
 Prepares operate path for C2 and AB4 relays.  
 Operates tape with hold magnet.  
 Disconnects compensating load.  
 Shorts SM-SM1 thermistors to allow to cool.

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DESIGNATION	FUNCTION
RT	Blinds T1 tube. Re-times T tube. Prepares own lock path.
RT1	Prepares operate path for RT2 relay. Shunts out first lamp in intercept equipment. Prepares own lock path.
RT1A	Prepares own lock path. Prepares operate path for RT2 relay.
RT2	Releases FD4 relays. Re-times T tube. Disconnects path to compensating resistors. Opens lock path for C1 relay. Prevents FD4 from half stepping. Prepares operate path for AB3 relay in single digit.
FD3	Prepares operate path to half step FD4. Releases FD4 relay.
FD4	Prepares operate path for FD3, and FD1, or FD2 relays. Prepares own lock path. Prepares operate path for intercept equipment. Prepares operate path for AB3 relay in two digit with an odd station.
S	Operates S1 relay. Releases T1 and AB relays. Operates rotary magnet.
S1	Releases S relay. Blinds T and T1 tubes.

- AB2            Prepares operate and lock path AB4 and SK relays.  
                  Prepares own lock path.  
                  Releases L1 relay.
- AB3            Releases AB relay.
- AB4            Re-times T and T2 tube.  
                  Prepares own lock path.  
                  Prepares operate path for L1 relay.  
                  Operates alarm buzzer and lights alarm lamp in intercept.  
                  Provides secondary lock path for AB relay.  
                  Opens lock path of P relay.
- P                Unblinds and Re-times T tube.  
                  Prepares own lock path.  
                  Releases stop magnet.  
                  Releases BL relay.  
                  Prepares operate path for T and C relay.  
                  Blinds T1 tube.
- Switch         Codes TD for TSC's for single digit.  
                  Codes TD for 2nd TSC's for two digit.  
                  Provides lamp indications for intercept equipment.
- SK              Prepares own lock.  
                  Locks C1 relay operated.  
                  Re-times T and T1 tubes when connected for accelerated search.  
                  Operates AB3 relay when intercept equipment is used.
- BL              Prevents itself from operating when the L is on space and the AB relay released.  
                  Blinds T tube.  
                  Prepares operate path for L1 relay.  
                  Locks C1 and AB relays operated while CAS is being received.  
                  Unblinds T tube.  
                  Unblinds intercept equipment.

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## DESIGNATION

## FUNCTION

Tubes

T2 Operates AB2 relay in approximately 1 second and AB4 in approximately 1/2 second.

## OPEN-CLOSE ACTIVATE

T Operates T relay in approximately 4 seconds, 15 seconds, 3 minutes, or 6 minute intervals.

T1 Operates T1 relay in approximately 1-1/2 seconds.

## ACCELERATED SEARCH FOR AUTOMATIC ACTIVATE

T Operates T relay in approximately 1-1/2 seconds, 2 minute or 4 minute intervals.

T1 Operates T1 relay in approximately 1/4 seconds.

Power Supply

P Furnishes power for relays.

P1 Furnishes power for rotary switch magnet.

## 7. POWER SUPPLY

7.01 Power is furnished by two half wave rectifier supplies which are part of the controller. Supply P furnishes power to all relays. Supply P1 furnishes power for the selector rotary magnet RM. The Power supply is fused with a one ampere slow blow fuse, AC. A 5 Ohm current-limiting resistor P1 is used to reduce the peak current in the selenium stack P1. Each power

supply is filtered with one condenser. Transformer T acts as an autotransformer to reduce the voltage of the P supply.

7.02 The power ground and the water pipe ground are not wired together in the equipment, and must not be connected.

7.03 Nominal A.C. power line voltage is 117. Nominal D.C. supply voltage is 155 for supply P1 and 125 for supply P.

## 8. TIMING CIRCUITS, VARISTORS

8.01 The use of cold cathode tubes and thermistors for timing purposes is covered in P65.907.

8.02 The use of varistors for increasing the hold time of relays and for isolating circuits is covered in P65.907.

## 9. INSTALLATION

9.01 This equipment may be mounted on a wall or on a floor stand. The A.C. power should be obtained from the "G" recepticals on the table of the associated 19 teletype. This arrangement requires the two units to be located within 8 feet of each other. In special cases where this requirement cannot be met, a separate power outlet equipped with a switch should be furnished at the location of this automatic transmitter start circuit.

9.02 The terminals of this unit should be strapped in accordance with the wiring options shown on Sheet 1 of P92.911.02.

9.03 If two digit is to be used, the FD1 and FD2 relays must be strapped for the first digit character Note 103 on Sheet 1 of P92.911.02. If there are an odd number of stations the odd station must be assigned the first digit, same as that on the FD1 relay.

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9.04 The "A" TS of this unit should be cabled to the "E" TS of the 19 teletype table per CAD 1 on Sheet 2 of P92.911.02.

9.05 The normal straps, plus various option connections are shown in CAD's 2 through 11 on Sheet 2 of P92.911.02.

9.06 The power supply of this unit should be adjusted per Note 105 Sheet 1 of P92.911.02.

9.07 The plug end of the green wire in the power cord must be connected to earth ground or water pipe ground.

## 10. INSTALLATION AND TROUBLE TEST

10.01 When controller is first installed and if wired for single digit (R option) remove single digit straps and apply two digit straps (S option) also circuit assurance straps (V option). With S and V options applied it is possible to make a complete test of the controller. If controller is to be used on a single digit circuit, do not code the FD1 or FD2 relays.

When single digit operation is required and controller has been working on the circuit see paragraph 10.75 for the trouble test only.

10.02 For varistor test see paragraph 11.08.

10.03 Test the teletype and selector in accordance with P65.910 if test is not already done.

10.04 After all installation work is completed have the line terminated in a spare TLT in the Telegraph Test Room to furnish normal line current.

10.05 Test the controller in accordance with the following:

## OPERATION

## RESULTS

- |   |   |
|---|---|
| 10.06 Check for frame work ground.  | With a KS-14510 meter, check between frame-work and water pipe ground (Potential ground).   |
| 10.07 Turn the power switch on.   | Measure with a KS-14510 meter on the 300 VAC range between the frame and 5 of the PWR Terminal.<br>A reading of full AC line voltage indicates a reversal in the AC power connections. A reading of about 10 volts may exist due to a difference in ground potentials and is not a trouble condition. |
| 10.08 Turn power switch off.  |   |
| 10.09 Remove T tube. Set meter for 300 VDC and connect across 1 and 5 of the PWR terminal strip. Turn power switch on. Release RT2 relay if operated. | Meter should read 125 volts $\pm$ 5 volts.<br>Change 6-12-18V leads of transformer to obtain this reading. See Note 105 of P92.911.02.  |
| 10.10 Remove meter lead of meter from 1 PWR terminal and place on 3 PWR terminal.   | Meter should read 155 volts $\pm$ 15 volts.<br>If this reading or the reading in 10.09 cannot be met, the use of a constant voltage regulating transformer to regulate the power is suggested.  |

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OPERATION

RESULTS

10.11 Turn power off.  
Remove 1 amp.  
fuse, and replace with a 5  
amp. fuse. Block L1 relay  
operated. Block T1 relay  
released. Replace T tube.  
Turn power on.

BL relay operates.

10.12 Remove block  
from L1 relay.

For open and close acti-  
vate the T tube will fire  
in about 4 seconds.  
For automatic activate the  
T tube will fire in about  
1-1/2 seconds.  
T relay operates.  
T1 tube fires.

10.13 Turn power switch  
off. Remove block  
from T1 relay. Block L1  
relay operated. Block SM  
relay released. Remove T  
tube. Turn power switch  
on.

BL relay operates.

10.14 Manually operate  
T relay.

For open and close acti-  
vate the T1 tube will fire  
in about 1 second.  
For automatic activate the  
T1 tube will fire in about  
1/4 second.  
T1 relay operates.  
T relay releases.

10.15 Turn power switch  
off. Remove block  
from SM relay. Remove  
block from L1 relay. Re-  
place T tube. Remove T2

BL relay operates  
T tube fires.  
T relay operates.  
T1 tube fires.  
T1 and SM relay operates.

tube. Apply temporary strap between 14 and 21 of "C" TS if not connected. Turn power switch on.

Stop and TWH mag operate.

Transmitter Distributor rotates once.

TR, FG, A, C, C1 and P relays operate.

BL relay releases.

FG relay releases.

After 2 second pause the T tube fires.

T relay operates.

P relay releases.

BL relay operates.

10.16 Turn power switch off. Remove T and T1 tubes. Replace T2 tube. Block P relay released or remove temporary strap. Turn 19 TTY base power switch off (leave off for remainder of test).

PNUF

10.17 Turn power switch on operate and release "SEL TST" key until brush arm of switch is on position 22.

PNUF

10.18 Turn power switch off. Replace T1 tube. Turn power switch on.

BL relay operates.

FD4 relay 1/2 step.

All other relay should be released.

10.19 Block SM relay operated.

Stop and TWH mag. in Transmitter Distributor operates.

10.20 Block T1 relay operated.

PNUF

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OPERATION

RESULTS

10.21 Manually rotate Transmitter Distributor until carbon brush has just passed off the stop segment, and is completely on the start segment.

(If no relays operate in the controller the AUX contacts are out of adjustment. (See BSP-P35.631, paragraph M.)

10.22 Rotate motor until brush of TD is on white line of stop segment.

10.23 Rotate motor until brush of TD enters start segment.

10.24 Rotate motor until brush of TD is on stop segment.

10.25 Rotate motor until brush of TD is on start segment.

10.26 Rotate motor until brush of TD is on stop segment.

TR, FG, and L1 relays operate.

A relay 1/2 step.

FG and Li relays release. A relay full steps.

(L1 relay will operate and release in all the following steps when TD is rotated. Only the final results of stop and start segments are shown.)

L1 and FD2 relays operate. FD relay 1/2 step.

L1 and FD2 relays release. FD relay full steps.

L1, C, C1, AB, AB1 and AB3 relays operate. Rotary mag. operates. FD4 relay full steps. BL relay releases. Stop mag. in TD release.

C2 relay operates.

- |   |   |
|---|---|
| 10.27 Operate L relay to space (right) and hold.                  | AB, AB1 and AB3 relays release.<br>Rotary mag. releases.<br>Switch steps to position 1. |
| 10.28 Release L relay.  | E1 relay operates.<br>L1 relay releases.  |
| 10.29 Remove block from T1 relay.                                 | T1, FD and A relays release.  |
| 10.30 Remove block from SM relay.                                 | SM, TR, C and C2 relays release.<br>TWH mag. in TD releases.                            |
| (Watch paragraph 10.31 as soon as results are over in this step.) |   |
| 10.31 T1 tube operates.   | T1 relay operates.<br>SM relay operates.<br>Stop and TWH mag. in TD operate.            |
| 10.32 Block T1 relay operated.                                    | PNUF  |
| 10.33 Rotate motor until brush of TD is on start segment.         | TR, FG and L1 relays operate.<br>A relay 1/2 step.                                      |
| 10.34 Rotate motor until brush of TD is on stop segment.          | L1 and FD relays release.<br>A relay full step.   |
| 10.35 Rotate motor until brush of TD is on start segment.         | FD1, L1 and RT1 relays operate.<br>FD relay 1/2 step.                                   |
| 10.36 Manually operate FD2 relay and release.                     | RT1A relay operates.  |

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OPERATION	RESULTS
10.37 Rotate motor until brush of TD is on stop segment.	L1 and FD1 relays release. FD relay full step.
10.38 Rotate motor until brush of TD is on start segment.	L1, C, AB and AB1 relays operate. Stop mag. of TD releases. BL relay releases.
10.39 Rotate motor until brush of TD is on stop segment.	C2 relay operates.
10.40 Remove block from T1 relay..	T1, SM, C2, C, FD, A and TR relays release. TWH mag. in TD releases. T2 tube fires. AB2 relay operates. L1 relay releases. AB4 relay 1/2 step. T1 tube fires. T1 and SM relays operate. Stop and TWH mag. in TD operates.
10.41 Block T1 relay operated.	PNUF
10.42 Rotate motor until brush of TD is on start segment.	TR, FG and L1 relays operate. A relay full step.
10.43 Rotate motor until brush of TD is on stop segment.	FG and L1 relays release. A relay 1/2 step.
10.44 Rotate motor until brush of TD is on start segment.	FD1 and L1 relays operate. FD relay 1/2 step.

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| 10.45 Rotate motor until brush of TD is on stop segment.     | FD1 and L1 relays release.<br>FD relay full step.   |
| 10.46 Rotate motor until brush of TD is on start segment.    | C and L1 relays operate.<br>Stop mag. of TD releases.   |
| 10.47 Rotate motor until brush of TD is on stop segment.     | L1 relay releases.<br>C2 relay operates.  |
| 10.48 Remove block from T1 relay.                            | T1, TR, A and SM relays release.<br>TWH mag. in TD releases.<br>T2 tube fires.<br>AB4 relay full step.<br>C and C2 relays release.<br>L1 relay operates.<br>RT1A, RT1 and RT2 relays release. |
| 10.49 Manually operate and release AB3 relay.                | AB, AB1, AB2, AB4, and rotary mag. relays release.<br>BL relay operates.<br>L1 relay releases.<br>Switch steps to Position 2.   |
| 10.50 Operate SEL TST key until switch steps to position 21. | FD relay operates.  |
| 10.51 Operate SEL TST key until switch steps to position 22. | FD3 relay 1/2 step.<br>FD relay releases.   |
| 10.52 Operate SEL TST key until switch steps to position 1.  | FD3 relay full step.<br>FD4 relay releases.<br>FD3 relay releases.  |

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OPERATION	RESULTS
10.53 Block T1 relay released. Step switch to position 2.	PNUF
Manually operate C1, RT1 and RT1A relays.	
10.54 Operate SEL TST key until position 21.	FD relay operates.
10.55 Operate SEL TST key until position 22.	RT2 relay operates. C1, RT1 and RT1A relays release.
10.56 Operate L relay to space (right) and hold.	L1 relay operates. RT2 relay releases. FD4 relay 1/2 step.
10.57 Release L relay.	L1 relay releases.
10.58 Temporarily strap 31 and 32 of the D terminal strip.	PNUF
10.59 Manually operate AB2 relay.	SK relay operates.
10.60 Release AB2 relay.	SK relay releases.
10.61 (Not Used.)	
10.62 Manually operate C1 relay.	PNUF
10.63 (Not Used.)	
10.64 Remove block from T1 relay.	T1 relay operates. SK relay releases. SM relay operates. Stop and TWH mag. in TD operate.

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|---|---|
| 10.65 Release T1 relay manually.                                    | SM relay releases.<br>Stop and TWH mag. in TD releases.   |
| 10.66 Remove temporary strap from 31 "D" TS and place on 23 "B" TS. | S relay operates.<br>Rotary mag. operates.  |
| Block S1 relay released.  |   |
| 10.67 Block S relay operated.                                       | PNUF  |
| 10.68 Remove block from S1 relay.                                   | S1 relay operates.  |
| 10.69 Block S1 relay operated.                                      | PNUF  |
| 10.70 Remove block from S relay.                                    | S relay releases.<br>Rotary mag. releases.<br>Switch step to next position.   |
| 10.71 Remove block from S1 relay.                                   | The results of paragraph 10.66 through 10.70 to 10.66 through 10.70 etc. will continue, leave switch rotate three or more times. Watch the FD, FD3 and FD4 relay they will operate and release as switch steps on positions 21, 22 and 1. Remove temporary strap between 32 "D" TS and 23 "B" TS. |

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OPERATION

RESULTS

10.72 Block T1 relay released. Temporarily strap 32 "D" TS and 32 "B" TS.

RT relay operates.

Then remove.

10.73 Manually operate T relay.

RT relay releases.

10.74 Turnpower switch off.

All relays release.

If not needed remove strap between 14 "C" TS and 21 "C" TS. Replace or remove all straps that are needed to complete service order.

10.75 See paragraph 10.97 and remainder of paragraph for rest of test.

10.76 Trouble test for single digit without circuit assurance. Circuit assurance with single digit is similar to two digit with circuit assurance. See paragraph 10.25 through 10.27, 10.38 through 10.40, and 10.48 and 10.49.

10.77 Repeat steps 10.06 through 10.15. If controller does not have U option. Delete that position of test.

Same results as in 10.06 through 10.15

10.78 Turnpower switch off. Remove T Tubes.

BL relay operates. All other relay should be released.

Block P relay released or remove temporary strap.

Turn 19 TTY base power switch off.

Turn power switch on.

Operate SEL TST key until brush of switch is on position 22.

10.79 Block SM and T1 relays operated.

Stop and TWH mag. in TD operates when SM relay is block operated.

10.80 Repeat paragraph 10.21 and 10.22 (L1 relay will operate and release when TD brush rotates).

Same results as in paragraph 10.21 and 10.22.

10.81 Rotate motor until brush of TD is on start segment.

L1, C, C1, AB, AB1 and AB3 relays operate. Rotary mag. operates. BL relays release. Stop mag. in TD releases.

10.82 Rotate motor until brush of TD is on stop segment.

C2 relay operates.

10.83 Remove block from T1 relay.

T1 and A relays release.

10.84 Remove block from SM relay (Watch paragraph 10.85 as soon as results are over in this paragraph).

SM, TR, C and C2 relays release. TWH mag. in TD releases.

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## OPERATION

## RESULTS

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|---|---|
| 10.85 T1 tube operates.                                   | T1 relay operates.<br>AB, AB1 and AB3 relays release.<br>Rotary switch steps to position 1.<br>RT1 and RT1A relays operate.<br>SM relay operates.<br>Stop and TWH mag. in TD operate. |
| 10.86 Repeat paragraph 10.21 and 10.22.                   | Same results as in paragraph 10.21 and 10.22.   |
| 10.87 Rotate motor until brush of TD is on start segment. | L1, C, AB, AB1 and AB3 relays operate.<br>Rotary mag. operates.<br>BL relay releases.<br>Stop mag. in TD releases.  |
| 10.88 Repeat paragraph 10.82 through 10.84.               | Same results as in paragraph 10.82 through 10.84.   |
| 10.89 T1 tube operates.                                   | T1 relay operates.<br>AB, AB1 and AB3 relays release.<br>Rotary mag. steps to position 2.<br>SM relay operates.<br>Stop and TWH mag. is TD operated.                                  |
| 10.90 Repeat paragraph 10.82 through 10.83.               | Same results as in paragraph 10.82 through 10.83.   |
| 10.91 Block T1 relay released and repeat paragraph 10.84. | Same results as in paragraph 10.84.   |

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|-------|--|--|
| 10.92 | Operate L relay to space.                                    | AB, AB1, AB3, C1, RT1 and RT1A relays release. Rotary mag. switch steps to position 3.         |
| 10.93 | Repeat paragraph 10.58 through 10.65 if equipped.            | Same results as in paragraph 10.58 through 10.65.  |
| 10.94 | Repeat paragraph 10.66 through 10.71.                        | Same results as in paragraph 10.66 through 10.71 except the FD3 and FD4 relays do not operate. |
| 10.95 | Repeat paragraph 10.53 through 10.57.                        | Same results as in paragraph 10.53 through 10.57 except the FD and FD4 relays do not operate.  |
| 10.96 | Repeat paragraph 10.72 through 10.74 if equipped.            | Same results as in paragraph 10.72 through 10.74.  |
| 10.97 | Remove 5 amp. fuse and replace 1 amp. fuse removed in 10.11. |  |

Remove all other straps not needed.

10.98 Turn power off. Block T relay released. Turn power on. Operate SEL TST key until switch is on position 22. Turn power off. Operate RT2 relay and hold. Turn power on. Open line momentarily. RT2 relay releases. The unit should send a normal search pattern and after 1 revolution (single digit) or 2 revolutions (two digit) the RT2 relay should operate and the controller should go to rest.

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10.99 Check the printer copy to see that all station calls are printed in upper case in the correct order as specified in the service order. Check operation through at least 1 revolution of the rotary selector switch for single digit and 2 revolutions for two digit.

10.100 With the time control key in the "Short" position, and no tape in the transmitter, the unit should rest between search patterns two to three minutes. In the "Long" position, the rest should take about six minutes. In the "Rest" position, it should not start a search.

10.101 With open-close activate, time control key in rest position, after the controller has remained at rest for about 10 minutes, place a tape in the transmitter with FIGS H near the end. Operate the control key up until the Busy Lamp lights, down until the transmitter starts and release the key. After the tape is transmitted, the control unit should initiate a new complete search. If controller is used as a P92.911.01 and there are 15 TTY sending and receiving stations on the line. Terminals 24 and 25 "C" TS will be strapped. Following the transmission of preceding message the controller will continue in an idle position for 15 seconds then proceed with the normal search.

10.102 After paragraph 10.100 with accelerated search, and the controller has been at rest for about 10 minutes, place a tape in the transmitter with a FIGS H near the end. Operate the control key Down Only, until the transmitter starts and release the key. After the tape is transmitted, the control unit should initiate a new complete search.

10.103 Return time key to "Short" position.

10.104 The Master Station should now be suitable for operation on its regular circuit.

10.105 The preceding tests have all been of an out of service type. In case of trouble conditions

in the Control Unit that must be fixed while the Master Station remains on the circuit, the following procedure may be used:

Move the 21 contact Jones Socket on the rear of the Master Station table from the lower (line) position to the upper (test) position, Jones Plug.

10.106 The Control Unit may not be worked on without disturbing the circuit, and the Master Station may function on a manual basis.

## 11. ROUTINE TESTS AND ADJUSTMENTS

11.01 Adjustment of the relays in the control unit is accomplished in accordance with the Circuit Requirements table in P92.911.02. Adjusting procedure for the relays is found in the following references:

U Relays	A461.011	B461.011
Y Relays	A461.010	B461.010
280 Relay	A460.059	B460.059
209 Rotary Selector	A468.002	B468.002

11.02 The lubrication requirements for the 209 selector shall be carefully followed and checked at least as often as specified in the above BSP.

11.03 A special testing circuit has been built into this equipment for checking the action of the rotary selector. A push button located next to the selector applies low voltage operating conditions to the rotary magnet to step the switch.

11.04 Operate the test button so as to step the selector through one complete revolution of the switch while carefully observing for binding, snagging of the wipers and other defective conditions. If the selector operates properly in this test, it may be assumed to be in satisfactory operating condition.

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11.05 No routine tests are specified.

11.06 The 376B tubes may be tested on a J94731A Cold Cathode Tube Set in accordance with A493.151. If this set is not available, substitution of a new tube is suggested when the operating tube is suspected.

11.07 The selenium rectifiers used in this equipment normally have a long trouble-free life. However, a unit may occasionally become defective. Impending failure may be detected by the temperature of the stacks, after first turning off the power to prevent a shock. The stacks normally feel neither warm nor cold to the touch. As a selenium stack begins to deteriorate, it passes more reverse direction current which may be measured as follows: Use a KS-14510 meter on the 300 VAC range with a two or four microfarad condenser in series with one test lead. Connect to battery supply and ground. After an initial swing of the meter upscale, turn the range switch until a reading is obtained. A normal value of ripple voltage is 3 volts AC. A value appreciable above 3 volts would indicate that replacement of the selenium stack is required.

11.08 Two types of test A or B for 400E varistors are as follows:

A. If a KS-12054 test set is available the 400E varistors may be checked for the forward voltage or current characteristics in accordance with the section covering the test sets. The current through the varistor in the reverse direction shall be made with the rotary switch of the test set on the .5MA position. A varistor with a reading of .23 or less is acceptable for use in the TAD equipment.

B. Disconnect one lead from the circuit under test. If possible, use a long nose pliers to hold the lead wire as heat from the soldering iron can injure the varistor. Connect leads from a KS-14510 volt-ohm-milliammeter to the varistor, with the positive lead to the #1 end, and set the

selector to Ohms X10,000. The resistance measured would be at least 500,000 Ohms and may be as high as 1,500,000. The fingers must not touch both leads while marking this measurement. Reverse the connections so that the positive meter lead is connected to the #2 end of the varistor, and turn the selector to Ohms X10. The measured resistance should be between 150 and 250 Ohms.

CAUTION when using KS-14510 meter for testing Varistors.

1. The Ohms X-1 range should not be used as it passes sufficient current through the varistor to cause damage.
2. Maintain a small supply of spare 400E varistors, as during manufactory, they occasionally become damaged due to the soldering.
3. Do not substitute any of the other 400-type varistors, in any of the TAD circuitry as the 400E is the only one having the correct characteristics.
4. Do not substitute KS-15724-L1 and KS-15734-L2 varistors in any of the TAD circuitry as they do not have the correct characteristics. Use only the varistors specified.

11.09 The T tube timing circuit may be tested as follows: Connect negative lead from KS-14510 volt-ohm-milliammeter to terminal 2 or 29 of the A terminal strip. Set meter on 300 volts DC Scale. Connect positive lead to pin 3 of T tube. Reading should be 0. Remove Control Unit from line by a temporary jumper from 4 to 5 on the A terminal strip. L relay operates to space (right). Release all relays except L1 which will be operated. If RT tends to operate, block it non-operated. With a pick operate and hold the L relay to its left (mark) contact.

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The L1 relay will release. The voltmeter operates backwards. In about one second, the meter moves upscale to between 65 and 80 volts. The T tube fires and the T relay operates in about 4 seconds, (open-closed activate) about 1-1/2 second (accelerated search) after the release of the L1 relay. The firing of the tube is only momentarily visible. To see the tube fire, look directly at the top of the tube. The T1 tube fires and T1 relay operates. The meter returns to zero. If there is a question as to whether the tube fires, block the T relay non-operated and repeat the above test. In about three seconds the tube should glow continuously. The glow may be very difficult to see in tubes with a date number smaller than 439. Pull the block and the T relay should operate and the T tube extinguish. Remove jumper from 4 and 5 of "A" TS. The T1 timing circuit may be checked as follows:

Leave the negative lead of the meter connected to 2 or 29 of the A term strip. Leave the meter set for 300 VDC and connect the positive lead to pin 3 of the T1 tube. Remove the T tube. Release all relays except the L which should be operated to mark (left). Meter should read 0. Operate T relay manually. The meter then moves upscale to between 65 and 80 VDC. The T1 tube fires in about one second. The T1 relay operates. The firing of the tube is only momentary. The T relay releases and the meter returns to zero.

To see the tube fire look directly at the top of the tube. If it cannot be seen due to the manufacturing date of the tube, block the T1 relay non-operated and repeat the above test. The tube will glow continuously. If the glow cannot be seen from the top, look around the base of the glass and there will be a slight glow. When this is done remove the block from the relay. It will then operate and release the T relay. This will cause the T1 tube to extinguish and the meter to return to zero.