WESCOM 452-FWA, E&M INBAND SIGNALING SYSTEMS
CIRCUIT DESCRIPTION

1. GENERAL

1.01 This section covers the WESCOM 452-FWA E&M Inband Signaling Systems as used in the WESCOM 45-type Station Terminating Assemblies.

1.02 Descriptive, operative, and maintenance information for this equipment is described in the attached WESCOM, Inc. Instruction Manual Section 452-101/3.

Attachment:

WESCOM, Inc. Instruction Manual Section 452-101/3.

Printed in U.S.A.

Addendum To
452-FWA, E&M Inband Signaling System

1. GENERAL

1.01 This addendum is issued to serve notification that the attached schematic diagram 191-045100 issue 1, has been updated to revision level K.

2. CHANGES

2.01 Changes resulting from revision K are in the 451 module. This change improves the capability of the 451 module to meet Wescom electrical specifications by replacing diode CR11, Wescom part number 1N4758A, with another diode, Wescom part number 1N4759A.

452-FWA, E&M Inband Signaling System

CONTENTS PAGE

1. GENERAL

1.01 This Section provides circuit description, installation, and basic testing information for the Wescom 452-FWA, E and M Inband Signaling System.

1.02 The 452-FWA E and M Inband Signaling System (Figure 1), comprised of the 451 Common and 452-FWA E and M plug-in modules, is designed for use with toll connecting and intertoll E and M trunk circuits. The System converts outgoing M-lead signals to SF signaling tone and reconverts incoming SF signaling tone to E-lead signals. In addition, this system is passive to multifrequency dialing and provides two-way supervision and dial pulsing over any four-wire, voice grade facility. Transmit and receive pulse correction, 1000-ohm M-lead sensitivity, and full duplex signaling are also provided by the 452-FWA system.

1.03 The universal wiring provided between modules in the 452-FWA system permits the 452-FWA, E and M module to be interchanged with either a 457-FSA Subscriber module or a 458-FLA Office module to derive foreign exchange signaling capability.

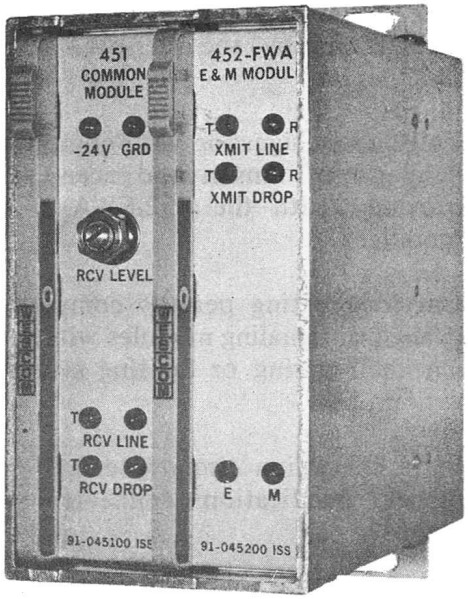


Figure 1. 452-FWA E and M Inband Signaling System

1.04 The 452-FWA, E and M Inband Signaling System provides the following features:

(a) Integrated circuits and other state-of-the-art components are used wherever possible to reduce space requirements, power consumption, and maintenance, while increasing reliability.

(b) The need for only one adjustment and the use of front panel test points minimize installation time, while the plug-in module substitution approach assures rapid service of equipment.

(c) Compatible with both Western Electric "E" and "F" type signaling units and similar units of independent manufacturers.

(d) Self-contained oscillator (specified frequency output of either 2600, 2400, 2280, or 1600 Hz).

(e) Voltage regulation allows the equipment to operate from any input voltage between −21 and −55 Vdc.

(f) Standard test tone levels of −16 dBm transmitting and +7 dBm receiving.

(g) M-lead sensitivity in excess of 1000 ohms is provided by the 452-FWA E and M module.

(h) Full duplex signaling with complete independence of transmit and receive signals is provided with the 452-FWA E and M module.

(i) Universal wiring permits complete interchange of signaling modules without altering shelf wiring or limiting system utilization.

(j) Pulse correction circuitry ensures performance specifications delineated in paragraph 2.

(k) Total capability concept provides for mounting the 452-FWA, E and M Inband Signaling System in the same shelf with any of the 400 type equipment.

2. SPECIFICATIONS

(a) SIGNALING FREQUENCY: 2600, 2400, 2280, or 1600 ±5 Hz, depending on the model number of the 451 common module. See table below.

MODEL	RCV	XMIT	PART NUMBER
451	2600 Hz	2600 Hz	91-045100
451/A	2400 Hz	2600 Hz	91-045101
451/B	2600 Hz	2400 Hz	91-045102
451/C	1600 Hz	1600 Hz	91-045103
451/D	2400 Hz	2400 Hz	91-045104
451/E	2280 Hz	2280 Hz	91-045105

(b) TOTAL HARMONIC DISTORTION: Less than 4%

(c) TEST TONE LEVELS: Transmit, −16 dBm; Receive, +7 dBm

(d) TRANSMIT TONE LEVELS: High Level, −24 ±2 dBm (−8 dBm0); Low Level, −36 ±2 dBm (−20 dBm0)

(e) FREQUENCY RESPONSE: 250 to 10,000 Hz, ±1 dB, (relative to 1000 Hz)

(f) RECEIVE SENSITIVITY: −22 dBm, minimum

(g) RECEIVE AMPLIFIER ADJUSTMENT: −10 dB to +2 dB

(h) SF TONE REJECTION: 55 dB, typical; 45 dB, minimum

(i) MAXIMUM LINE NOISE: 52 dBrnC0

(j) INPUT/OUTPUT IMPEDANCE: Four-wire transmit, 600 ohms ±5%; Four-wire receive, 600 ohms ±5%

(k) TRANSMIT DIAL PULSE CORRECTION Input at 10 pps: 35 to 75% break; Output at 10 pps: 57 to 59% break

(l) RECEIVE DIAL PULSE CORRECTION: Input at 10 pps: 35 to 75% break; Output at 10 pps: 57 to 59% break

(m) DIAL AND SUPERVISORY RANGE: M-lead (E and M units): 1000 ohms, minimum

(n) M-LEAD DELAY: 10 ms nominal

(o) HIGH LEVEL HOLD TIME: 400 ms nominal

(p) PULSING SPEED: 8.5 to 12.5 pps

(q) INPUT VOLTAGE: −21 to −55 Vdc

(r) DIMENSIONS: 7.0 x 3.3 x 7.2 inches

(s) MAXIMUM CURRENT DRAIN: 65 mA

(t) OPERATING ENVIRONMENT: Temperature, −5° to 150°F, (−20° to 65°C); Humidity, to 95%

(u) WEIGHT: 3.62 lbs

3. INSPECTION

3.01 Inspect the equipment thoroughly, as soon as possible after delivery. If any part of the equipment has been damaged in transit, report the extent of damage to the transportation company immediately. If the equipment is to be stored for some time before installation, make an operational check at once. The purpose of this check is to make sure that the equipment is in proper working order as received from the factory. If this check indicates satisfactory performance, the equipment may be stored for future installation. If the System is to be installed at once, make an operational check after the installation is completed.

3.02 Wescom equipment is specifically identified by the model number and final-assembly number silk screened on the front panel of the plug-in module. At the start of production, the final-assembly number is assigned an issue number of 1 which becomes an integral part of the final-assembly number. After the start of production, this issue number is advanced each time a major engineering change occurs. Therefore, be sure to use the model number and final-assembly number when making inquiries about the equipment. The issue number of the instruction manual and schematic diagram attached should be the same as the issue number assigned to the equipment. If a one-to-one correspondence does not exist between these items, request from Wescom the instruction manual required for your equipment.

4. MOUNTING

4.01 The 452-FWA System is designed to mount in two module positions of a Type 400 Mounting Assembly. Type 400 Mounting Assemblies are available in capacities of from 1 to 13 modules and may be factory-wired and equipped with any combination of modules from the Wescom product line.

KTU apparatus case mounting

4.02 Type 400-1 (one-module) through 400-5 (five-module) Mounting Assemblies may be installed in a 15A (equivalent to W.E.Co. 31B) KTU apparatus case. Type 400-1 through 400-13 Mounting Assemblies may be installed in a 16C (equivalent to W.E.Co. 16C) KTU apparatus case.

relay rack mounting

4.03 Type 400-1 through 400-9 Mounting Assemblies require the use of mounting bars, when mounted on either a 19- or 23-inch relay rack. 400-10 and 400-11 Mounting Assemblies are provided with mounting brackets for mounting directly across 19-inch relay racks. Type 400-12 and 400-13 Mounting Assemblies are also provided with mounting brackets for 23-inch relay rack mounting.

4.04 Because Type 400-1 through 400-9 Mounting Assemblies must be installed with mounting bars, 7 inches of vertical space (four-mounting spaces) are required for relay-rack mounting. Type 400-10 through 400-13 Mounting Assemblies, however, are provided with mounting brackets located on the sides of the mounting assemblies and require only 6 inches of vertical rack space. Install the mounting assembly in a KTU apparatus case or on a relay rack as described above with the mounting hardware provided.

universal shelf mounting

4.05 When a high degree of flexibility is required to provide for new circuit arrangements as well as circuit rearrangements, the 452-FWA may be mounted in a Wescom Universal Shelf. The Universal Shelf permits all intermodule wiring and installer connections to be made at the front of the mounting assembly and provides maximum accessibility to these connections when changes are required. The Type 400UA-11 and 400UB-11 Universal Shelves provide mounting positions for up to 11 modules and are designed for mounting in a 19-inch relay rack. Type 400UA-13 and 400UB-13 Universal Shelves provide mounting positions for up to 13 modules and are designed for mounting in a 23-inch relay rack.

5. INSTALLER CONNECTIONS

5.01 When the 452-FWA is installed in a Type 400 Mounting Assembly, each module makes electrical connection to associated equipment through a 56-pin, wire-wrap card connector provided as part of the mounting assembly. Make all installer connections to this connector in accordance with Table 1.

INSTRUCTION	SCHEMATIC DESIGNATION	56-PIN CONNECTOR ASSIGNMENT	
		451	452-FWA
CONNECT:	TO:	AT:	
transmit line T and R	XMIT LINE T & R	55 & 49	
transmit drop T and R	XMIT DROP T & R		55 & 49
receive line T and R	RCV LINE T & R	5 & 15	
receive drop T and R	RCV DROP T & R	7 & 13	
E-lead	E-LEAD		5
M-lead	M-LEAD		21 or 15
N-lead (when required)	N-LEAD		1
C-lead (when required)	C-LEAD		3
−21 to −55 Volt DC Battery	−21 to −55 Vdc IN	35	
positive ground	GRD	17	

Table 1. Installer Connections

5.02 Type 400UA-11 and 400UA-13 Universal Shelves provide terminal block locations above the mounting assembly, whereas Type 400UB-11 and 400UB-13 Universal Shelves provide terminal block locations below the mounting assembly. When the 452-FWA is installed in a universal shelf, make all installer connections to these terminal blocks in accordance with Table 1.

CAUTION: Do not make any connections with power applied to the equipment or modules installed in the mounting assembly.

strapping

5.03 No strapping options are provided on the 451 Common Module. However, strapping options provided on the 452 module must be considered. The strapping posts for the options discussed in the following paragraphs are located on the printed circuit side of the subject module. (Refer to Figure 2).

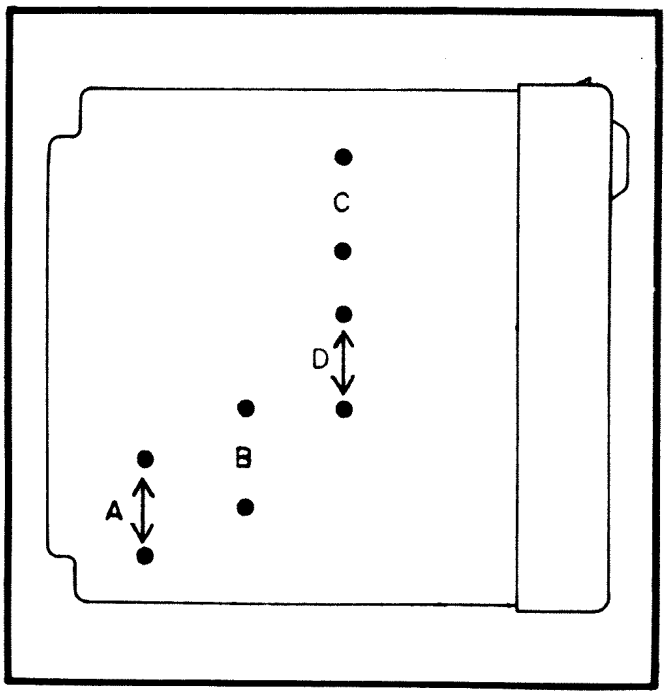


Figure 2. Strapping Post Location

CAUTION: When soldering straps, use insulated wire and not larger than 30-watt iron.

5.04 Three strapping options are provided. When used, these options provide for C-lead control, 24-volt M-lead, or disabled cut and terminate relay. Perform these strapping options as follows:

(a) For external C-lead control of E-lead ground, make certain that the "A" strap is removed. If C-lead control is not required, place a strap across the "A" strapping post.

(b) If a 24-volt M-lead is required, make certain the "B" and "C" straps are in place. In the same manner, if a 48-volt M-lead is required, make certain that the "B" and "C" straps are removed.

(c) If the cut and terminate (CO) relay is not required, disable the relay by removing the "D" strap. If the relay is required, make certain that the "D" strap is in place.

power requirements

5.05 The 452-FWA E and M Inband Signaling System requires approximately 65 mA at −21 to −55 Vdc. Apply power and fusing accordingly.

inserting modules

5.06 When all installer connections and strapping have been completed, insert the 451 and 452 modules into the mounting assembly. When provided as part of a prewired system, each 56-pin connector located at the rear of the mounting assembly is mechanically keyed so that the modules cannot be inserted into an incorrect module position. A small identification label is also provided: front, lower lip of the mounting assembly. Installing or removing the modules must be done with care. Ascertain that the module is upright and that the edges of the module are in the guide strips. Slide the module into position and exert firm pressure on the front panel of the module the last quarter-inch of travel, so that the module and connector make solid connection. If any bending or excessive resistance is encountered, remove the module and examine the card guides and connector for improper alignment, damage or foreign particles.

CAUTION: The 452 module uses a mercury-wetted relay. During shipment, excess mercury may collect on the relay contacts causing them to be "shorted". Therefore, the module should be gently tapped on a hard surface while being held in an upright position before inserting the module into the mounting assembly.

6. LINE-UP

6.01 The alignment procedure for the 452-FWA E and M Inband Signaling System consists of injecting tone into the transmit channel to adjust the transmit levels of the associated equipment and verify the operation of the 452 cut and terminate relay. Test tone is then injected into the receive channel to align the receive levels of the associated equipment and the receive gain in the 451 Common Module. Also refer to Figure 3.

test equipment

6.02 The test equipment required at both the local and distant terminals to properly align and test the System is as follows:

(a) Transmission Test Set (TMS): Northeast Electronics TTS 4AN or W.E.Co. 23A or equivalent.

(b) Variable Frequency Oscillator (VFO): Hewlett Packard 200 CD or equivalent.

NOTE: If the Northeast Electronics TTS 4AN is used and is equipped with the TTS 4XDV cover accessory, the VFO is not required.

(c) Multimeter: Simpson 260 or equivalent.

(d) Associated Test Cords: Two, 2-conductor test cords equipped with a Type 310 plug at one end and two, Type 59 cord tips at the other.

transmit alignment

6.03 Before performing the subsequent alignment procedure, verify that the local and distant terminals are properly connected. In addition, check the 452-FWA E and M module for correct strapping options (paragraph 5.03) and installer connections (Table 1).

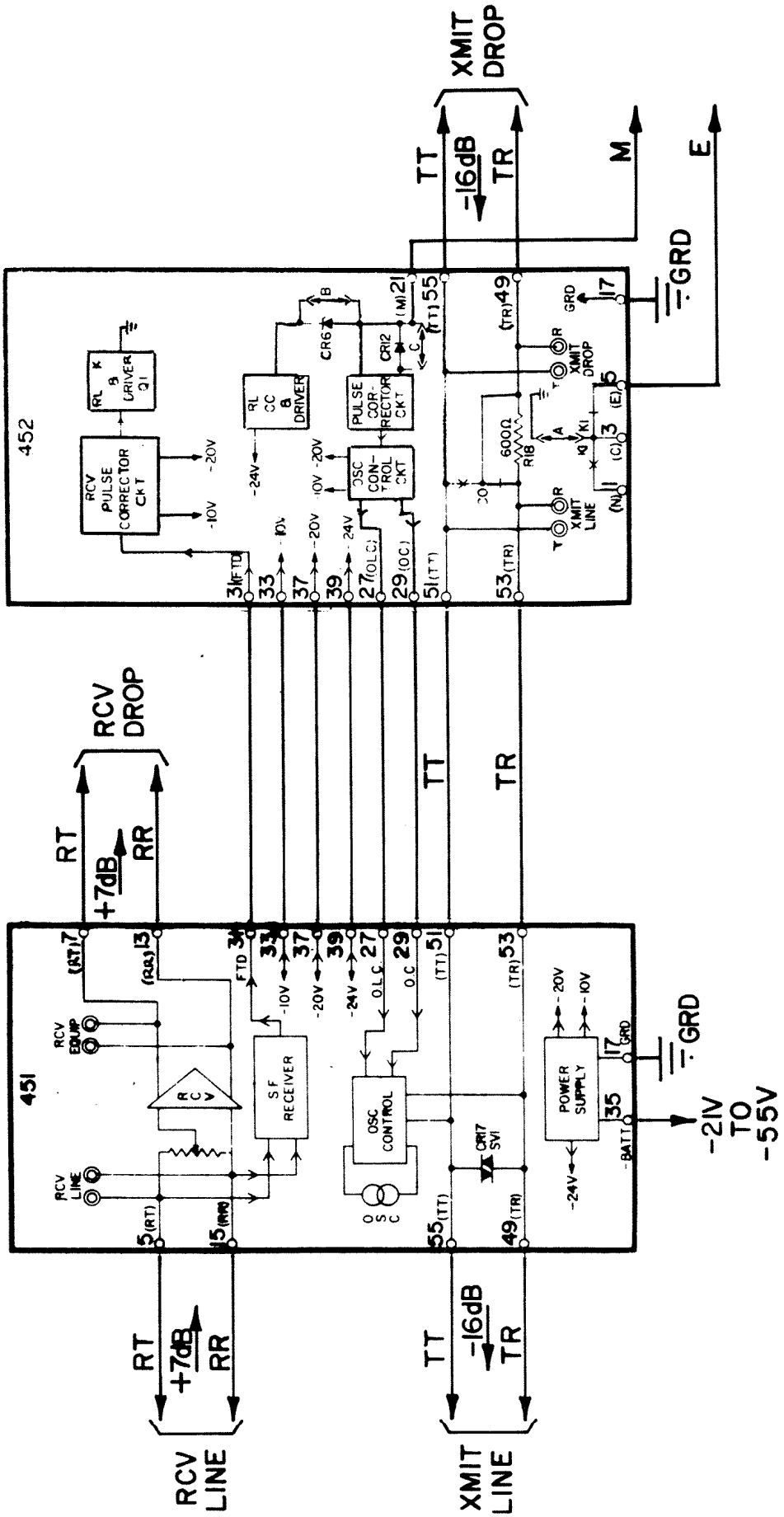


Figure 3. 452-FWA Line-Up Diagram

(1) Using the multimeter, verify power (−24 ± Vdc) is present across the −24 V and GRD test points of the 451 Common Module front panel. Do not attempt to use this point as a source of test battery or damage to the unit may result.

(2) With the terminals in the "on-hook" condition (ground on M-lead), arrange the TMS for bridging measurements and connect it to the XMIT LINE T and R test points on the 452 module front panel. The TMS should indicate −36 ±2 dBm.

(3) Condition the local VFO to apply a 1000 Hz test tone to the two-wire side of the associated term set. Connect the TMS arranged for a terminated reading to the four-wire transmit side of the associated term set. Adjust the term set transmit pad until a level of −16 dBm is obtained.

(4) Connect the TMS to the transmit line test jacks on the front panel of the 452 module. A tone level of −36 dBm should be observed. Condition the associated trunk circuit to off-hook (battery on M-lead) and observe that the TMS reading changes to −16 dBm.

receive alignment

6.04 Perform the receive alignment procedure as follows:

(1) Request the distant terminal to apply a 1000 Hz test tone at the required level and impedance specified on the CLR to the transmit channel.

(2) Make certain that equipment is still in a seized condition.

(3) If line amplifiers are used, adjust the output of the receive line amplifier to +7 ±0.25 dBm.

(4) Condition the TMS for bridging measurements and connect it to the RCV LINE T & R test points of the 451 common module front panel. Read and note this reading. Move the TMS to the receive drop T & R test points on the 451 module front panel.

(5) Adjust the receive level control on the 451 module until the TMS indicates the same reading observed in Step 4. (0 dB insertion loss).

(6) This completes the alignment procedure. Remove the test equipment and jumper wires and perform a talk test on the transmit and receive channels to verify overall facility performance.

7. CIRCUIT DESCRIPTION

general

7.01 The 452-FWA, E and M Inband Signaling System operates in the tone-on during idle mode. Dialing and supervisory signals originating as ground and −48 Vdc battery on the M-lead at the local terminal are converted to SF tone signals for transmission to the distant terminal via the four-wire line. Dialing and supervisory signals, transmitted by the distant terminal as SF tone signals, are received via the four-wire line at the local terminal where they are converted to E-lead open and ground supervisory signals.

7.02 Signaling tone, transmitted by the local terminal, is prevented from entering the transmit drop equipment by the operation of a cut and terminate relay which disconnects the transmit drop from the transmit line during the transmission of signaling tone.

7.03 Signaling tone, received by the local terminal is prevented from entering the receive drop equipment by a band-elimination filter, inserted at the input to the voice amplifier during the reception of signaling tone.

7.04 Refer to the 452-FWA Line-Up Diagram (Figure 3) and the attached schematic diagrams for the 451 Common and 452-FWA modules during the following discussion.

451 common module circuit operation

7.05 Speech energy or SF signaling tone energy received from the distant terminal over the 4-wire receive line enters the 451 Common Module on connector pins 5 and 15. Speech energy present on the receive line is amplified to provide 0 dB through loss by the RCV amplifier and connected to the receive drop through connector pins 7 and 13. Signaling tone energy, present on the receive line, is separated from

speech energy by filters and processed by the SF receiver, which converts signaling tone energy to a ground signal (from a −20V potential when signaling tone energy is not present). The ground signal thus developed is routed to connector pin 31 [FTD (First Threshold Detector) lead] for connection to the 452-FWA module and is also used within the 451 module to control the insertion of a band elimination filter, applied at the input of the RCV amplifier. This filter, inserted in the receive path only when SF signaling tone energy is received over the 4-wire line, provides a minimum of 45 dB attenuation to signaling tone energy with respect to speech energy at the receive drop. Signaling tone energy, therefore, does not enter equipment connected to the receive drop terminals. The full band-width of the voice channel is available however, during non-signaling intervals to permit the use of the 451 Common Module in data transmission links.

7.06 In addition to a receive line amplifier and SF receive and process circuitry, the 451 module contains an SF signaling tone oscillator. This oscillator, under the control of the 452-FWA module, applies signaling tone energy to the transmit portion of the 4-wire line, for transmission to the distant terminal. A ground signal (from −24 volts) applied to pin 29 (osc on-off control) by the 452-FWA module turns on the SF oscillator, which applies signaling tone energy at a level of −36 dBm to the 4-wire line. A ground signal, applied to connector pin 27 (osc level control) by the 452-FWA module, increases the level of the signaling tone energy to −24 dBm.

7.07 The 451 Common Module contains a power supply which provides regulated supply voltages to operate the circuitry contained in both the 451 and 452-FWA modules and permits the operation of both modules from battery potentials within the range of −21 to −55 Vdc.

452-FWA module receive circuit operation

7.08 Dialing pulses, received as SF signaling tone bursts via the receive portion of the four-wire line, are processed by the 451-CC module, which converts the received signaling tone bursts to ground signals (from −20 volts). A ground signal (derived from the tone-on condition) corresponds to the "break" portion of a received dial pulse.

7.09 Dial pulses, converted to ground signals by the 451-CC module enter the 452-FWA module on connector pin 31 and are routed to a dial pulse correction circuit which lengthens short "break" and "make" pulses to assure a minimum "break" pulse of 58-ms and a minimum "make" pulse of 42-ms. The dial pulse corrector energizes a relay during the "break" (tone-on) portion of each dial pulse to open (from ground) the E-lead, on connector pin 5, which provides dial and supervisory signaling at the local terminal.

452 module transmit circuit operation

7.10 The cut and terminate (CO) relay, located in the 452 module, in its de-energized condition connects the transmit portion of the four-wire line to the transmit drop. When energized, the CO relay disconnects the transmit drop from the transmit line, places a short circuit across the transmit drop and places a 600-ohm terminating resistor across the transmit line.

7.11 The CO relay is energized whenever tone is being transmitted and during M-lead changes of state when tone is being received. It is energized with the M-lead at ground (on-hook) by the ground signal from the 451-CC module applied to pin 31 during the reception of SF idle tone and dial pulse signaling. A 75-ms delay in the release of the CO relay holds it energized during the make (M-lead at battery) portion of a locally generated dial pulse train. Another delay of 500-ms in the de-energizing of the CO relay holds it energized during the break (M-lead at ground) portion of a locally generated dial pulse train and at the completion of a call, for 500-ms after the local terminal goes-on-hook (M-lead transfers to ground).

7.12 Dialing and supervisory signals to be transmitted to the distant terminal appear as battery and ground dc levels on the M-lead (pin 21). The M-lead "ground" condition corresponds to the local terminal on-hook condition and to the "break" portion of locally generated dial pulses. It results in a ground output on connector pin 29 which is routed to pin 29 of the 451-CC module to turn on the SF oscillator. Signaling tone is then transmitted to the distant terminal via the four-wire line. The M-lead "battery" condition corresponds to the local terminal off-hook condition and to the "make" portion of locally generated dial pulses. It results in a −24

volt output on connector pin 29 to turn-off the SF oscillator in the 451-CC module and discontinue transmission of signaling tone to the distant terminal. M-lead transitions on pin 21 are processed by the 452-FWA module which provides a 10-ms delay to allow the CO relay to energize before tone is applied to the transmit line. Additional processing within the 452-FWA module provides dial pulse correction to the oscillator on-off control signal on pin 29. Whenever the signal on pin 29 is at −24 volts (oscillator-off condition), a timing circuit is charged. When the signal on pin 29 returns to ground potential (oscillator-on condition) this timing circuit applies a ground to pin 27 which is maintained while pin 29 is at ground, up to a maximum of approximately 500-ms. If pin 29 is still at ground after this interval, the timing circuit times-out and removes the ground from pin 27. The ground signal on pin 27 is routed to 451-CC module to control the level of the tone applied to the transmit line. When the signal on pin 27 is at ground potential, the level of the tone transmitted to the distant terminal is increased from −36 dBm to −24 dBm. The high level tone thus obtained is maintained during the dial pulse train and for a 500-ms interval after the local terminal has returned to the on-hook condition.

8. TESTING

8.01 If trouble is encountered with the operation of the 452-FWA E and M module, verify that all installer connections (Table 1) and strapping options have been properly made. Ascertain that the proper voltage is applied to the system and that the modules are making good connection with their respective card connectors; snap modules out and in several times.

8.02 If the trouble persists, use the Line-Up procedure (part 6) to determine if signal continuity is provided. If this requirement is not met, further testing may be accomplished using the procedure at the bottom of this page.

TRANSMIT TEST PROCEDURE

STEP	ACTION	VERIFICATION
1	Verify that both local and distant terminals are in the on-hook condition.	A multimeter connected between the GRD test point (451 module) and the M test point (452) module) reads 0-Vdc, and a multimeter connected between the E lead test point and −24V indicates 0-V.
2	Connect a 1000 Hz tone at a level of 0-dBm to the two-wire side of the associated term set. Connect the TMS arranged for 600-ohm terminated measurements to the four-wire transmit line of the associated term set.	A reading of −16 dBm should be obtainable, using the transmit pad on the term set.
3	Connect the TMS set for bridging measurement to the four-wire transmit line T & R test jack on the 452 module front panel.	The TMS should read −36 ±2 dBm. If this condition is met, proceed to step 5; if not perform step 4.
4	Connect a multimeter between pins 29 and 39 - (+) lead to 29 and (−) lead to 39).	The multimeter should read 24 volts (approximately) indicating the presence of ground on the oscillator on-off control lead (pin 29). If this condition is met, replace the 451 module, and return to step 3. If this condition is not met, replace the 452 module and return to step 3.
5	Change the associated trunk circuit to the off-hook condition (battery on the M-lead).	The TMS should read −16 dBm, indicating that the CO relay in the 452 module has operated.

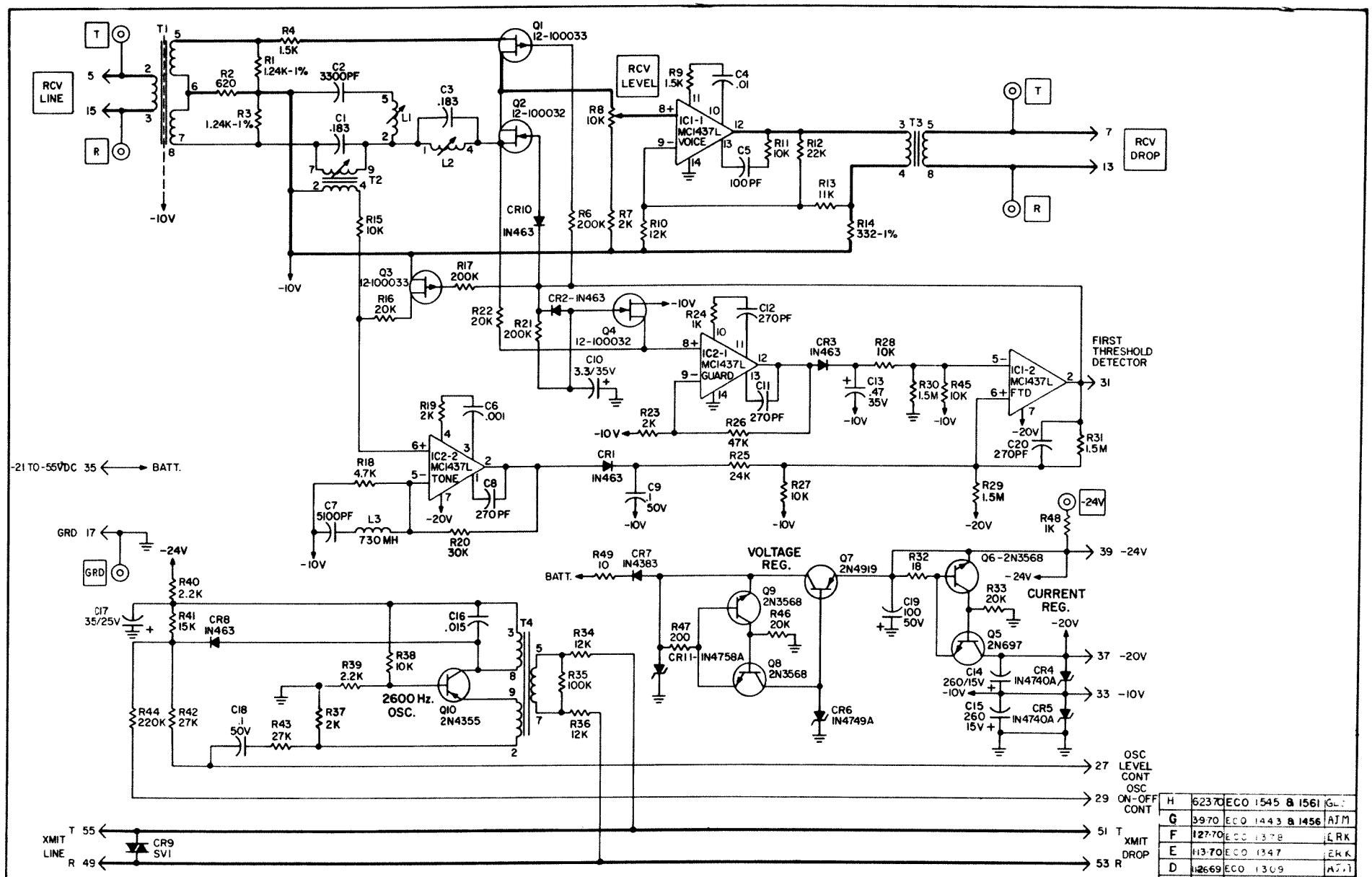
STEP	ACTION	VERIFICATION
6	If step 5 is not met, verify that strapping option D has not been removed.	The TMS should read −16 dBm. If strapping option D is in place and this condition is not met, replace the 452 module.
7	Place the associated trunk circuit in the on-hook condition. Connect the TMS (set for bridging measurement) to the XMIT LINE test points (452 module).	The TMS should indicate −36 ± 2 dBm.
8	If the 452 module is connected to a trunk circuit, key the trunk circuit off-hook and on-hook several times while observing the TMS. If the 452 is not connected to a trunk circuit, proceed to step 9.	When the trunk circuit is keyed to the off-hook condition, the TMS should drop off-scale. Each time the trunk is keyed to the on-hook condition, the TMS should deflect to −24 ± 2 dBm and then drop to a steady −36 ± 2 dBm.
9	If the 452 is not connected to a trunk circuit or the trunk circuit is not readily accessible, remove the wire-wrap connection at pin 21 (M-lead) on the 452 connector and connect a source of external battery to the M-lead test point on the 452 front panel while observing the TMS.	When the M-lead test point is connected to battery the TMS should drop "off scale." When connected to ground, the TMS should momentarily deflect to −24 ± 2 dBm and then return to a steady −36 ± 2 dBm.
10	Remove the leads to pins 49 and 55 on the 452-FWA module. With ground on the M-lead as in step 8 connect the VFO (set to 1000 Hz at −16 dBm and the proper impedance) and inject tone into the transmit channel via the XMIT DROP test jacks on the 452-FWA E and M module. Place insulated wire jumper (with stripped ends) across the RCV LINE test points. This will cut off the idle-circuit tone from the distant terminal and simulate seizure of the local terminal.	The cut and terminate relay (K2) should restore passing the test tone. The TMS should change from −36 ± 2 dBm to −16 ± 2 dBm. If this requirement is not met, determine that the cut and terminate relay has not been disabled.
11	Remove the wire jumper from the RCV LINE test points.	The TMS should change from −16 ±2 dBm to −36 ±2 dBm. If this requirement is met, proceed to step 13. If it is not met, proceed to step 12.
12	Connect a multimeter between pins 29 and 39 ((+) lead to 29 and (−) lead to 39).	The multimeter should read 24 volts (approximately) indicating the presence of ground on the oscillator on-off control lead (pin 29). If this condition is met, replace the 451 module, and return to step 10. If this condition is not met, replace the 452 module and return to step 10.
13	Reconnect any leads that have been removed from the connector for testing purposes. This concludes the transmit testing procedure. If additional testing is required, remove the VFO and proceed to paragraph 3.04. If no further tests are required, remove the test equipment and restore all equipment to normal	

RECEIVE TEST PROCEDURE

STEP	ACTION	VERIFICATION
1	Remove the lead from the wire-wrap connector, pin 5 on the 452 module. With both terminals in the idle circuit condition, connect the multimeter set for resistance measurement (R x 1) across the E and ground test point on the 452 front panel.	The multimeter should indicate infinity (open circuit). If this condition is not met, proceed to step 3.
2	Connect the TMS to the RCV LINE test points on the 451 module.	An indication of -13 ± 2 dBm should be obtained.
3	If the multimeter inserted between the E-lead and ground test points (step 1) indicates zero resistance, place the multimeter on the 50-volt DC scale between pins 31 and 17 on the 452 unit. (Negative to pin 31.)	When signaling tone is being received on the line no voltage should be observed on pin 31. If voltage is observed, the 451 module should be considered defective and should be changed out. If no voltage is present, and the E-lead does not indicate an open circuit, the 452 should be considered defective and changed out.
4	Connect a multimeter between pins 29 and 39 ((+) lead to 29 and (—) lead to 39).	The TMS should drop off scale. Under these conditions pin 31 should read approximately negative 20 volts. If it does not, the 451 module should be considered defective and should be changed out. If a reading of approximately 20 volts is obtained, the E-lead should indicate ground. If it does not, the 452 module should be considered defective and should be changed out.
5	This completes the testing procedure. Disconnect all test equipment and reconnect the lead previously removed from pin 5 on the 452 module.	

field repairs

8.03 Replacement of components within a module is not recommended. All Wescom systems and component boards are warranteed for 1 year from the date of purchase. Return to Wescom, Inc., 501 Rogers Street, Downers Grove, Illinois 60515. For technical assistance, call 312-971-2010 or TWX 910-695-4735.



NOTES:

1- UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE ±5%, 1/4 WATT.
ALL CAPACITORS ARE IN UF.

2- ← DENOTES WIRE-WRAP CONNECTOR.

3- (○) DENOTES FRONT PANEL TEST POINTS.

4- [XX] DENOTES FRONT PANEL DESIGNATION.

5- ——— DENOTES PRIMARY TRANSMISSION PATH.

NOTE:
RCV 2600Hz
XMIT 2600Hz

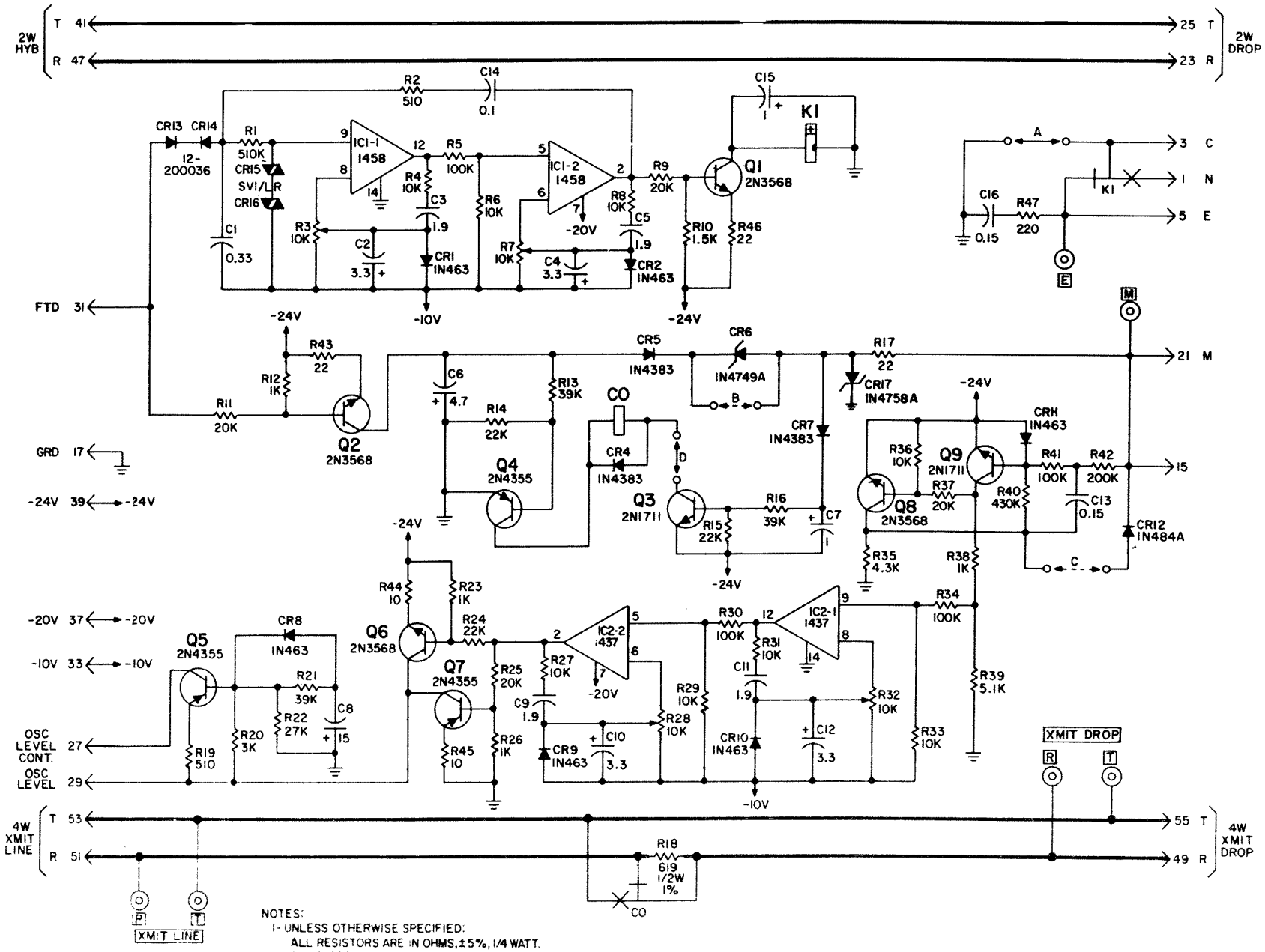
REV NO.	DATE	ECO NO.	BY
H	6-23-70	ECO 1545 & 1561	GL
G	3-9-70	ECO 1443 & 1456	AJM
F	12-7-70	ECO 1378	ERK
E	11-3-70	ECO 1347	ERK
D	10-26-69	ECO 1309	AJM
C	10-29-69	ECO 1276	ERK
B	10-9-69	ECO 1266	ERK
A	8-18-69	RELEASE FOR PROD	RH

SCHEMATIC DIAGRAM FOR MODEL 451
COMMON UNIT (F SIGNALING)

DRAWN	CHKD	APVD
RDV		
MODEL 451	ISS.1	SCALE
DATE 4-20-70		SIZE C

WESCOM INC. 501 ROGERS DOWNERS GROVE ILL 60515

DRW NO. 191-045100



NOTES:

1- UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, ±5%, 1/4 WATT.
ALL CAPACITORS ARE IN UF.

2- ← DENOTES P.C. CONNECTOR.

3- ⊙ DENOTES FRONT PANEL TEST POINTS.

4- [XXX] DENOTES FRONT PANEL DESIGNATIONS.

5- ◆—◆ DENOTES FACTORY STRAPPING OPTION

6- ◆- - -◆ DENOTES INSTALLER STRAPPING OPTION.

7- —✕— DENOTES NORMALLY OPEN RELAY CONTACT.

8 —| |— DENOTES NORMALLY CLOSED RELAY CONTAC

9- ——— DENOTES PRIMARY TRANSMISSION PATH.

REV NO.	DATE	ECO NO	BY
G	3-9-71	ECO #1723	JSP
F	12-8-70	#1434 IC1 WAS 1437	JSP
E	9-3-70	ECO #1611 ADDED CAIT	JSP
D	5-26-70	1502	ERK
C	3-31-70	1463	ERK
B	3-11-70	1439 & 1445	ERK
A	1-7-70	1346-ISS CHG	ERK
—	—	—	—

FWA SIGNAL APPLIQUE
SCHEMATIC DIAGRAM

TOLERANCES UNLESS NOTED		MAT'L
.X ± .020	P.C./MECH ± .010	FINISH
.XX ± .010	FRACTIONAL ± 1/32	
.XXX ± .005	ANGULAR ± 0°-30'	

WESCOM INC. 501 ROBERS DOWNERS GROVE ILL. 60515

DRAWN	CHKD	APVD
WPA		
MODEL 452	ISS: 2	SCALE
DATE 7-24-70		SIZE C

DRW NO. 191-045200