WESCOM 457-FSA, FX INBAND SIGNALING SYSTEM CIRCUIT DESCRIPTION

1. GENERAL

1.01 This section covers the WESCOM 457-FSA, FX Inband Signaling System 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 457-101.

Attachment:

WESCOM, Inc. Instruction Manual Section 457-101

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457-FSA, FX INBAND SIGNALING SYSTEM

CIRCUIT DESCRIPTION

CONTENTS

1. GENERAL

1.01 This Section provides general information and circuit descriptions for the Wescom 457-FSA, FX Inband Signaling Systems. For installation and maintenance information relating to this system refer to Section 457-FSA-103.

1.02 The 457-FSA, FX Inband Signaling System (comprised of the 451 Common and 457-FSA Subscriber modules) is used at the subscriber end of a foreign exchange facility to convert supervisory and dial pulse signals to 2600-Hz tones for transmission over any four-wire, voice grade facility. In addition this system provides either loop start operation, or ground start operation when used on multi-party circuits.

features

1.03 The 457-FSA, FX 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) One adjustment and complementary test points minimize installation time, while the plug-in module substitution approach assures rapid service of equipment.

(c) Compatible with Western Electric ''E'' and ''F'' type signaling units and similar units of independent manufactures.

(d) Self-contained oscillator (specify 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) Switchable loop or ground start operation.

(h) Universal wiring permits complete interchangeability of signaling modules without alerting shelf wiring or limiting system utilization.

(i) Pulse correction circuitry provides the performance specification delineated in paragraph 2 at 12 pps.

(j) Total capability concept provides for mounting the 457-FSA, FX Inband Signaling System in the same shelf with any of the other 400 type equipment.

2. SPECIFICATIONS

(a) SIGNALING FREQUENCY: 2600, 2400, 2280, or 1600 ±5 Hz (as specified).

(b) TEST TONE LEVELS: Transmit, -16 dBm; Receive, +7 dBm.

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

(d) RECEIVE AMPLIFIER ADJUSTMENT: -10 dB ±2 dB.

(e) MAXIMUM LINE NOISE: 52 dBrnC0.

(f) TOTAL HARMONIC DISTORTION: Less than 4%.

(g) TRANSMIT TONE LEVELS: High Level, -24 ±2 dBm (-8 dBm0); Low Level, -36 ±2 dBm (-20 dBm0).

(h) RECEIVE SENSITIVITY: -22 dBm minimum.

(i) 2600-HZ REJECTION: 55 dB, typical; 45 dB, minimum.

(j) INPUT/OUTPUT IMPEDANCE: Four Wire Transmit, 600 ohms ±5%; Four Wire Receive, 600 ohms ±5%.

(k) TRANSMIT DIAL PULSE CORRECTION: Input at 12 pps: 20 to 80% Break; Output at 12 pps: 58 to 55% Break.

(l) HIGH LEVEL HOLD TIME: 400 ms.

(m) PULSING SPEED: 8 to 14 pps.

(n) INPUT VOLTAGE: -21 to -55 Vdc.

(o) DIMENSIONS: 7.0 x 3.3 x 7.2 inches.

(p) DIAL AND SUPERVISORY RANGE: DC Loop Resistance (Loop Dial Units): 1000 ohms (24 V operation); 2000 ohms (48 V operation).

(q) MAXIMUM CURRENT DRAIN: 457-FSA; 150 ma (plus loop current).

(r) OPERATING ENVIRONMENT: Temperature: -5 to 150° F (-20 to 65° C); Humidity: to 95%.

(s) WEIGHT: 457-FSA, 3.82 lbs.

3. 451 DETAILED CIRCUIT DESCRIPTION (Refer to 451 schematic diagram)

3.01 The 451 Common Control is designed to convert audio signaling tones to a potential of ground

or −20 Vdc. This output is then used by the 457-FWA module. In addition, the 451 module will also convert received d-c levels to a oscillator on-off control signal of 2600-Hz tone for transmission over 4/wire facilities. The 451 module also contains the power regulation circuitry required for the integrated circuits contained herein and on the 457-FWA used in conjunction with the 451.

3.02 When audio tone is present at pins 5 and 15, it is coupled across a differential hybrid transformer T1. One-half of T1 output is connected to a tuned filter network to determine whether the tone is a speech or signaling tone.

3.03 If signaling tone is detected by the tuned circuitry, an input will be routed to the tone amplifier IC2-1 from the secondary winding of T2. This tone amplifier is an integrated circuit differential amplifier which is tuned to the signaling tone frequency. The output provided by the amplifier is rectified to a positive potential by diode CR1 maintaining a positive voltage across capacitor C9. This voltage will be compared to the output voltage of the guard amplifier IC1-2 to determine whether there is sufficient signaling tone present to allow the first threshold detector to switch to its ''on'' state.

3.04 All frequencies other than the signaling tone frequencies will be present at the input of the guard amplifier pin 8. The guard amplifier is also an integrated circuit differential amplifier. Its output is rectified by diode CR3 and is used to change the threshold of differential amplifier IC2-2.

3.05 If there is a 2 dB or better signal-to-noise ratio present, the first threshold detector IC2-2 will produce a ground output. This output is directly fed back, turning field effect transistor Q2 ''on'', connecting the input of the voice amplifier to the output of the 2600-Hz injection filter circuit, and guaranteeing a 45-dB attenuation of the signaling tone frequency to be present on the receive drop. Simultaneously, the ground output of the first threshold detector IC2-2 will charge capacitor C10 (connected to the gate lead of Q4) through resistor R21 allowing field effect transistor Q4 to turn on in approximately 250 ms. With Q4 turned on, the guard circuit IC1-1 will be disabled, so any further voice or noise received on the 4/wire facility will not disable the first threshold detector ground output.

3.06 When the signaling tone is removed from the receive line, there will no longer be an output from the tone amplifier. As a result, the first threshold detector IC2-2 reverts back to its quiescent state (-20 Vdc output). The -20 Vdc output immediately enables guard amplifier IC1-2 by turning off field effect transistor Q4, lowers the gain of the tone amplifier by turning on field effect transistor Q3, and switches the input of the voice amplifier to the unfiltered side of the differential hybrid T1.

3.07 Voice amplifier IC1-1 is also a differential integrated circuit amplifier whose input is switched between the direct side or the filtered side of the differential hybrid T1 depending whether or not there is signaling tone present on the 4/wire receive line. This amplifer has a front panel mounted level control which has a range of +2 dB to -10 dB. It has an isolation transformer T3, which presents a 600-ohm output to the receive drop side.

3.08 The 451 Common Unit also contains a signaling tone oscillator circuit and spark suppression network. The oscillator is under control of the applique board via the oscillator level control lead pin 27 and the oscillator on off control lead pin 29. The oscillator is a tuned circuit whose frequency is determined by the resonance of transformer T4 and capacitor C16. It is designed to be a high impedance bridging device, which will apply a low level tone of -36 dBm, and a higher level tone of -24 dBm at a -16 dBm test tone point. The oscillator circuitry is isolated and filtered from the rest of the circuitry by resistor R40, a 2.2K-ohm dropping resistor, and filter capacitor C17.

3.09 The 451 Common Unit is designed to operate the entire Inband Signaling System on a battery potential of -21 to-55Vdc.This is done by a series regulating transistor Q7, which functions in accordance with the reference voltage set by zener diode CR6. The output of transistor Q7, which is controlled by the current generator circuit, is used as a 24-Vdc source for the oscillator on the 451 board and relay circuits on the applique module. The battery potential on the emitter of Q7 is further regulated and filtered by transistors Q5 and Q6 for operating the integrated circuits in the Inband Signaling System. Q5 and Q6 comprise a constant current generator, which feeds shunt regulator zener diodes CR4 and CR5, producing a -10 Vdc output via pin 33 and a -20 Vdc output via pin 37.

4. 457-FSA DETAIL CIRCUIT DESCRIPTION

4.01 The 457-FSA Subscriber Module is designed to be used in conjunction with a 451 Common module at the Station End of 4/wire foreign exchange facilities. The system converts d-c supervisory signals and dial pulses to audio signaling tones for voice facilities and converts incoming audio tones into ringing signals. The 457-FSA board can be used as ground or loop start. This option is under control by the front panel GRD/ LOOP selector switch.

5. RECEIVE CIRCUIT DESCRIPTION

loop start

5.01 With the GRD/LOOP selector switch SW1 in the LOOP start position, the 457 module converts the ground potential sent from the first threshold detector at the 451 module to 20-or 30-Hz ringing voltage on the 2/wire drop.

5.02 The ground potential sent from the FTD is applied via the closed contacts of SW1 to cause transistor Q3 to go into saturation after approximately a 300-ms delay due to the delay network comprised of resistor R7 and capacitor C3. With transistor Q3 conducting, the ''R'' relay solenoid becomes energized, applying 20 Hz to the ring side (pin 23) of the 2/wire equipment and ground to the tip side of the 2/wire equipment via the ring trip sensing network (dropping resistors R15, R16 and R17) and closed ''GS'' relay contacts. During the silent period, there will be a negative 20—Vdc input from the first threshold detector allowing transistor Q3 to turn-off after approximately a 300-ms delay. This will cause the ''R'' relay to release until tone is once again applied to the 451 module. When the signaling tone reappears at the 451 module, the first threshold detector circuit within the 451 module will again have a ground output, turning on transistor Q3 of the 452 module, activating the R relay. When the subscriber goes off-hook, sufficient current will flow through current sensing to saturate transistor Q5 in the ring trip circuit. The current required for this ring trip operation is strappable to three values; 25 ma, 40 ma, and 80 ma. With transistor Q5 saturated, transistor Q4 reverts to its off condition releasing ''R'' relay.

5.03 During this time, the subscriber is off-hook so as soon as the ''R'' relay releases, loop current will flow between the A and B leads, pins 43 and 45 respectively, through the hybrid to the instrument. This loop current is sufficient to turn on transistor Q14 which applies a negative potential to the base of Q5. As long as Q5 is conducting the ring trip relay remains deenergized.

ground start

5.04 With the 457 module conditioned for ground start operation (switch SW1 in the GRD START position), the 457 module is conditioned to receive a steady SF tone to hold the tip open on the subscriber's instrument. In this mode of operation, the absence of SF tone closes the tip lead from the 2/wire equipment to the tip lead of the hybrid and is then ready to accept modulated SF tone as ringing information to energize the ''R'' relay.

5.05 When a steady SF tone is being received, the first threshold detector on the 451 Common module routes a ground potential to and turns on transistor Q6 via pin 31 and closed contacts 4 and 1 of switch SW1. The ground output from conducting transistor Q6 energizes the ''GS'' relay. The associated contacts of the ''GS'' relay open to inhibit the circuit network between the tip connections of the hybrid and drop pins 41 and 25 of this module. When the SF tone is no longer being received, the first threshold detector has its output switched to a -20 Vdc causing transistor Q6 to revert back to its nonconducting state. As this occurs, the ''GS'' relay contacts are again closed ensuring the proper connection between the hybrid and drop tip connectors. If the 451 Common module receives a modulated SF tone, it processes this tone to provide a square wave to pin 31 of the 457 module. This input is then coupled to the base of transistor Q1 via capacitor C1 to alternately turn on and off transistor Q1. The switching action of transistor Q1 enables capacitor C2 to charge to a potential of -24 Vdc which is sufficient to saturate transistor Q2. The decay time of capacitor C2 is never long enough to stop the conduction of transistor Q2 during the negative half portion of the square wave input. Consequently transistor Q2 remains saturated during the entire ringing cycle. The ground potential existing at the collector of Q2 causes transistor Q3 to conduct, and Q3's output energizes ''R'' relay. The ring trip function is now accomplished as previously mentioned.

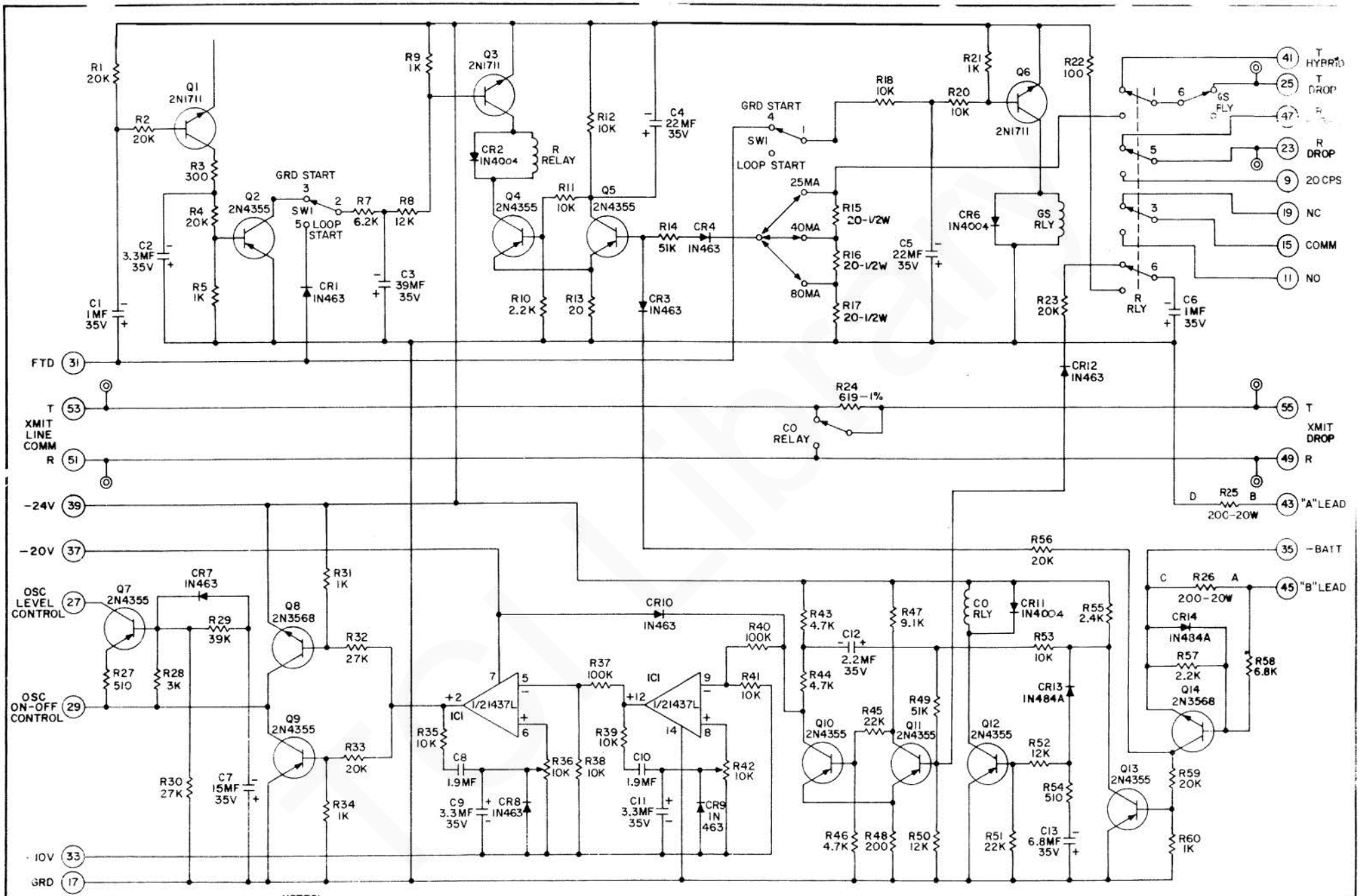
6. TRANSMIT CIRCUIT DESCRIPTION

6.01 The tone oscillator circuit within the 451 Common module is controlled by the circuitry of the 457-FSA module. The 457 module receives its supervisory capability from the current flowing in the ''B'' lead. If the 457 module is conditioned to the loop start mode of operation, the current that flows from the ''A'' to the ''B'' lead enables this module to turn off the tone oscillator circuit of the 451 Common module. However if the 457 module is conditoned to the ground start mode of operation, the SF tone is disabled by the ground potential that is applied to the ring lead of the 2 wire drop connection.

6.02 The 457-FSA module also has a cut and terminate relay which has a 500-ms holding delay and an 18-ms pre-cut feature. Whenever there is no ''B'' lead current present, transistor Q14 is cut-off. This circuit action allows transistor Q13 to cut-off immediately. As soon as this occurs, a base drive path is established for transistor Q12 which permits Q12 to energize the cut-terminate relay. The negative potential existing at the collector of Q13 fully charges capacitor C12 in approximately 18 ms. The potential build-up at the plate side of this capacitor supplies the necessary base drive voltage for transistor Q11, whose output causes Q10 to conduct. With transistor Q10 in its off condition, a negative 24V will be applied to the input circuitry of the first differential integrated circuit amplifier in the pulse corrector. This will cause a ground output from pin 12 of the amplifier, coupling a positive potential across capacitor C10, assuring that the amplifier's output remains at ground for 58 ms. The ground potential on pin 12 of the first differential amplifier IC1 will cause a negative 20-Vdc output at pin 2 of the second differential amplifier, turning on transistor Q9. With Q9 on, there will be a ground existing on the oscillator on-off control lead (pin 29). This ground turns on the tone oscillator circuit in the 451 Common Control module for approximately 500 ms. During this time capacitor C7 will discharge through resistor R29 and the base-emitter junction of transistor Q7, allowing transistor Q7 to turn off, lowering the level of the oscillator in the 451 Common module.

6.03 When loop current flows, the IR drop across resistor R26 is sensed, causing Q14 to go into saturation. The negative potential at the collector of transistor Q14 turns on transistor Q13, causing a ground

to appear at its collector. However, transistor Q12 will remain on until capacitor C13 discharges through resistor R52 and the emitter base junction of transistor Q12, keeping the cut and terminate relay pulled-in for 500 ms. The positive potential on the collector of transistor Q13 will also turn off transistor Q11, and approximately 18-ms delay after this time interval, transistor Q10 is turned on. Ground output on the collector of transistor Q10 will force a negative 20 Vdc at pin 12 of the first differential amplifier IC1 and the transmit pulse corrector. The negative charge carried across capacitor C10 will be shunted by diode CR9, thus eliminating the 58-ms holding delay. However, this negative change forces a ground output on pin 2 of the second differential amplifier coupling across capacitor C19 to the positive feedback loop connected to pin 6 of this amplifier. This ground ensures a 42-ms make holding delay. At the same time, this ground turns on transistor Q8, whose negative 24V output is routed to the oscillator on-off control lead to turn off the tone oscillator circuit in the 451 module. It will also charge the high level hold capacitor C7 through resistor R28 and diode CR7 so that it will once again be ready to put out a high level tone when the loop current ceases to flow.



NOTES;

1. ALL RESISTOR IN OHMS. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MFD.
3. ALL RELAYS ARE SHOWN DEENEGIZED.
4. FACTORY STRAPED FOR 40MA RING TRIP.
5. ◯ INDICATES 56 PIN CONNECTOR.
6. ◎ INDICATES FRONT PANEL TEST POINTS.

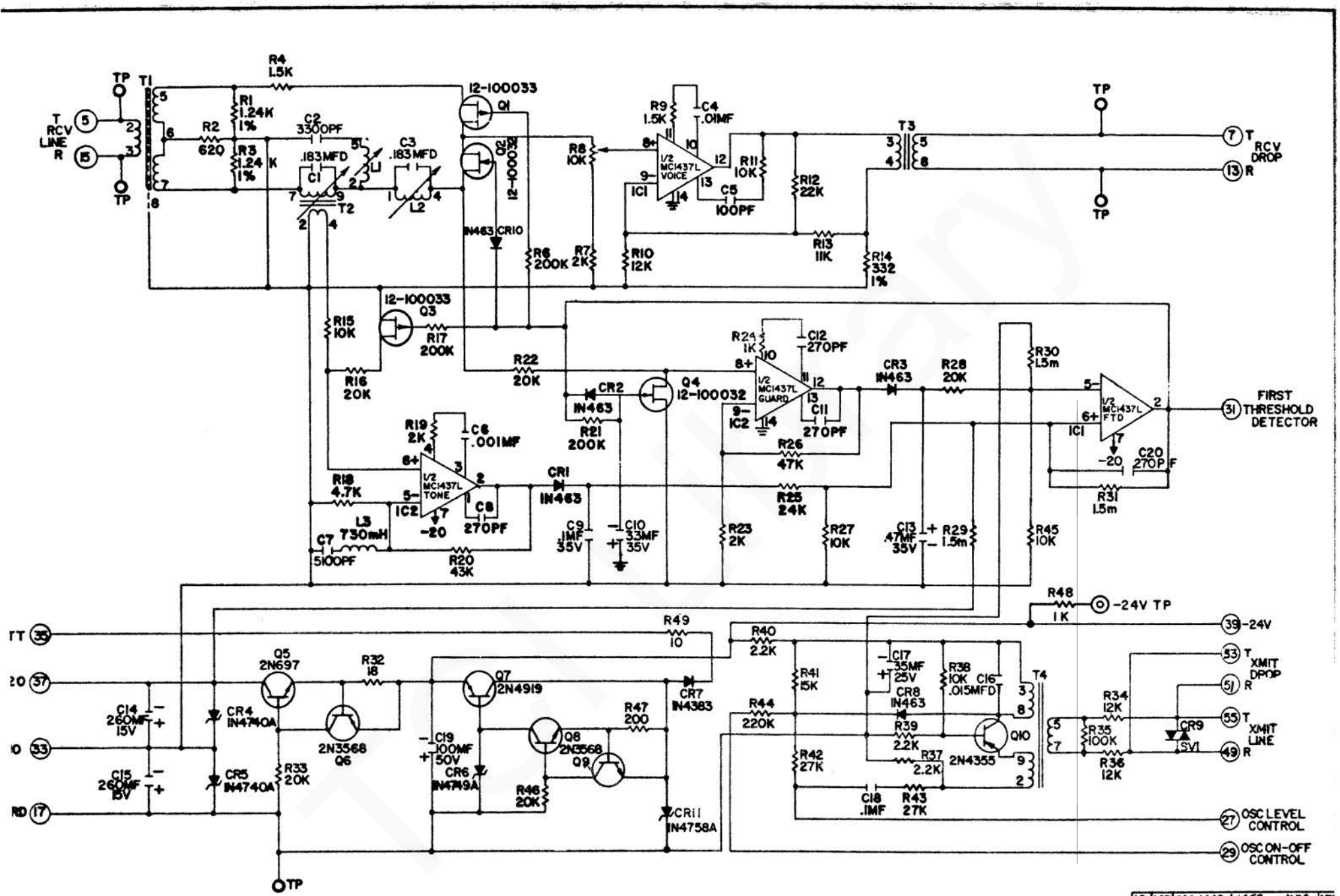
SCHEMATIC DIAGRAM FOR MODEL 457 FSA

191-045700

NONE 5-27-69

TWJ

101-052-01C



NOTES:
1- ALL RESISTORS IN OHMS AND CAPACITORS IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
2- ALL RESISTORS 1/4W UNLESS OTHERWISE SPECIFIED.

NOTE:
RCV 2600Hz
XMIT 2600Hz

1G	3-72	ECO 1443 & 1456 MJB AJK
1F	12-71	ECO 1378 EJK
	DATE	REVISION

SCHEMATIC DIA. FOR 451 COMMON UNIT (F SIGNALING)

191-045100 1

SCALE NONE 5-11-68

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