WESCOM 455 DATA ACCESS INBAND SIGNALING SYSTEM CIRCUIT DESCRIPTION

1. GENERAL

1.01 This section covers the WESCOM 455 Data Access Inband Signaling System used in WESCOM 45D-type Station Terminating Assemblies.

1.02 Descriptive, operative, and maintenance information for this equipment is described in the attached WESCOM, Inc. Instruction Manual Section 455-101/3.

Attachment:
WESCOM, Inc. Instruction Manual Section 455-101/3

455 Data Access Inband Signaling System

CONTENTS PAGE

1. GENERAL

1.01 This Section provides circuit description, installation, and basic testing information for the Wescom 455 DATA ACCESS Inband Signaling System.

1.02 The 455 DATA ACCESS Inband Signaling System (Figure 1) is comprised of a 451 Common Module and 455 Data Signaling Module mounted in two positions of any Wescom Type 400 Mounting Assembly. This 455 system is normally used at a station (subscriber) port of a "400 Data Package" four-wire facility. Conversion of supervisory only signals to SF for transmission is accomplished by the 455 system. Additionally, either LOOP START or GROUND START operation is provided.

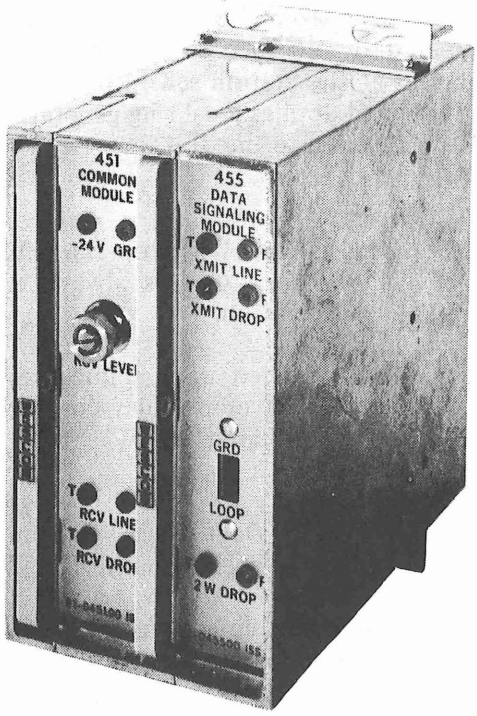


Figure 1. 455 Data Signaling System

"400 data package"

1.03 Developed by Pacific Telephone Company, the "400 Data Package" is a specialized four-wire, private line voice band data system with one or more four-wire switches. Each switcher has 10 ports minimum, 60 ports maximum, growth increments are 10 ports. A typical application might be Law Enforcement with multiple switchers at computer locations and numerous station ports (Highway Patrol, Sheriff Dept., State Police, City and County agencies) with interface to a 100 series data set at each station. Data is primary and voice, if provided, is secondary. 2600 Hz SF inband signaling is utilized for supervisory signaling. Inband MF (Touch Tone) is used for dialing. At the switchers, a supervision only E&M type inband SF unit is required for each equipped port.

1.04 Each station port of the "400 Data Package" network may be equipped with a Wescom 455 Data Access System with optional 44V4 (401) to interface the four-wire cable extension and either an optional 4WTS-1 type (441, 442 or 443) for a 2W drop with HALF DUPLEX data; OR 4W Pad/Transformer (412B) for a 4W drop with FULL DUPLEX data. Typically the 451/455 is mounted on the station premise. "A and B" leads are required.

1.05 Under idle "ON-HOOK" circuit conditions, standard low level (20 dBm0) 2600 Hz tone is present on the 4W facility in both directions. An "OFF-HOOK" supervisory request for service from the station removes 2600 Hz SF toward the switcher. Dial information is passed thru the voice band as MF tones. SF tone is off during all circuit conditions except idle. An incoming ring from the switcher to the station is indicated by absence of SF from the switcher. The 455 at the station senses this signal (absence of tone) and applies local ring generator interrupted (2 sec/4 sec) to the drop.

1.06 While the 451/455 operates from −21 to −55 Vdc, −48V is always required for proper loop operation.

1.07 Higher speed data applications or those needing envelope delay correction may require special considerations.

features

1.08 The 455 Data Access 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) Self-contained 2600 Hz oscillator.

(d) A "LOOP/GRD" front panel switch on the 455 module provides either LOOP Start or GROUND Start mode of operation.

(1) LOOP Start for station ports.
(2) GROUND Start for Computer Interface ports.

(e) Universal wiring permits complete interchangeability of signaling modules without altering shelf wiring or limiting system utilization within the 450 series SF.

(f) Total capability concept provides for mounting the 451/455 in the same shelf with any other 400 type equipment.

2. SPECIFICATIONS

2.01 Specifications of the system comprised of the 455 Data Signaling Module and the 451 Common Module are as follows:

(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 (−3 dBm to +9 dBm).

(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) RINGING DELAY: Operate delay, 260 ms ±25%, with 1160 ms of protection; Release delay, 170 ms ±25%, with 1100 ms of protection.

(l) GROUND START DELAY: From removal of tone to closure of two-wire tip lead, 260 ms ±25%; From onset of tone to opening of two-wire tip lead, 170 ms ±25%.

(m) TRANSMIT VOICE PATH (under control of "B" lead): Off-hook to removal of tone, 28 ms ±25%; On-hook to transmission of tone, 28 ms ±25%.

(n) HIGH LEVEL HOLD TIME: 400 ms ±25% (at the beginning of SF tone transmission).

(o) RING INTERRUPTER: 2 seconds on; 4 seconds off.

(p) RING GENERATOR REQUIREMENT: Biased ring generator; 16 - 66 Hz, 85 to 130 Vac superimposed on negative office battery potential.

(q) INPUT VOLTAGE: −21 to −56 Vdc input to 451 module (−48V is required for proper 2-W loop operation).

(r) CURRENT DRAIN: 100 mA, nominal, with 451 module (plus loop current).

(s) OPERATING ENVIRONMENT: Temperature, 35 to 120°F; Humidity, 10 to 100% (no condensation).

(t) DIMENSIONS: 7-inches high, 3.3-inches wide and 7.2-inches deep, including the 400-2 (two-module) Mounting Assembly.

(u) MOUNTING: KTU apparatus case or relay rack.

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 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 schematic diagram required for your equipment.

4. MOUNTING

4.01 The 451/455 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.

station premise

4.02 Typically the 451/455 is mounted on the station premise in one of the following configurations:

(a) 71D – One or two circuits in a KTU apparatus case equivalent to W.E.Co. 31B; 600/900 ohm 2W drop or 4W drop (optional); includes 401, 451, 455, 441-2-3 or optional 412B P/T, 840 −48V power and 850 30Hz ring generator; tested and wired to 66 type connecting block.

(b) 45D – One circuit; 400-5 mounting; includes 401, 451, 455, 443 4WTS; tested and wired to A25B type female connector. Requires external −48 Vdc and ring generator.

(c) 451/455 – 400-2 mounting interwired. Requires external dual line amp, term set or pad/transformer, −48 Vdc and ring generator.

KTU apparatus case mounting

4.03 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

4.04 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.

4.05 Because Type 400-1 through 400-9 Mounting Assemblies must be installed on 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 extensions 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 mounting hardware provided .

universal shelf mounting

4.06 When a high degree of flexibility is required to provide for new circuit arrangements as well as circuit rearrangements, the 455 module 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 451/455 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.

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 451/455 is installed in a universal shelf, make all installer connections to these terminal blocks in accordance with Table 1.

Table 1. Installer Connections

INSTRUCTION	SCHEMATIC DESIGNATION	56-PIN CONNECTOR ASSIGNMENT	
		451	455
Connect:	To:		
transmit line T&R	XMIT LINE T&R	55 & 49	
transmit drop T&R	XMIT DROP T&R		55 & 49
receive line T&R	RCV LINE T&R	5 & 15	
receive drop T&R	RCV DROP T&R	7 & 13	
two-wire drop T&R	2W DROP T&R		25 & 23
two-wire hybrid T&R	2W HYBRID T&R		41 & 47
A lead	"A" LEAD		43
B lead	"B" LEAD		45
ring generator in	RING GEN		9
−21 to −55 Vdc Battery	−21 to −55 VDC In		35
ground (positive)	GRD	17	

5.03 When the 71D or 45D packages are provided, refer to the appropriate Section for detailed external connections.

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

strapping options

5.04 No strapping options are provided on the 451 Common Module or 455 Data Signaling Module.

NOTE: The 455 module has a front panel LOOP/-GRD switch. Determine the required mode of operation and place the switch in the correct position. LOOP = Loop start; GRD = Ground start. When part of the "400 Data Package," each station port is operated in the loop start mode and each switching port is operated in the ground start mode.

power requirements

5.05 The 451/455 Signaling System requires a maximum current of 100 mA at −21 to −55 Vdc. Apply power and fusing accordingly. −48V is standard for drop loop.

inserting modules

5.06 When all installer connections and strapping have been completed, insert the 451 Common Module and the 455 Data Signaling Module into the mounting assembly.

5.07 When provided as part of a prewired system, each 56-pin connector (rear mounted) is mechanically keyed to prevent modules from being inserted into an incorrect position. A small identification label is placed on the front lower lip of the mounting.

5.08 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.

CAUTION: Do not force any module into place. If you encounter excessive resistance while installing a module, remove the module and check the card guides and connector for improper alignment or the presence of foreign particles.

6. LINE-UP

6.01 The line-up procedure for the 455 Data Signaling System consists of: (1) injecting tone into the transmit channel to adjust the transmit levels of the associated equipment and, (2) injecting test tone into the receive channel to align the receive levels of the associated equipment and the 451 Common Module.

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 TTS4C, W.E.Co. 23A or equivalent.

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

NOTE: If the Northeast Electronics TTS4C is used, 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 455 module for correct positioning of the GRD/LOOP switch.

(1) Using the multimeter, verify that power (−24 ±3 Vdc) is present across the −24 Vdc and GRD test points of the 451 Common Module front panel. Because of the internal regulating circuitry in the 451, THIS IS CORRECT EVEN WITH −48 to −55 Vdc applied.

CAUTION: Do not attempt to use these test points or 451/455 56-pin connec-

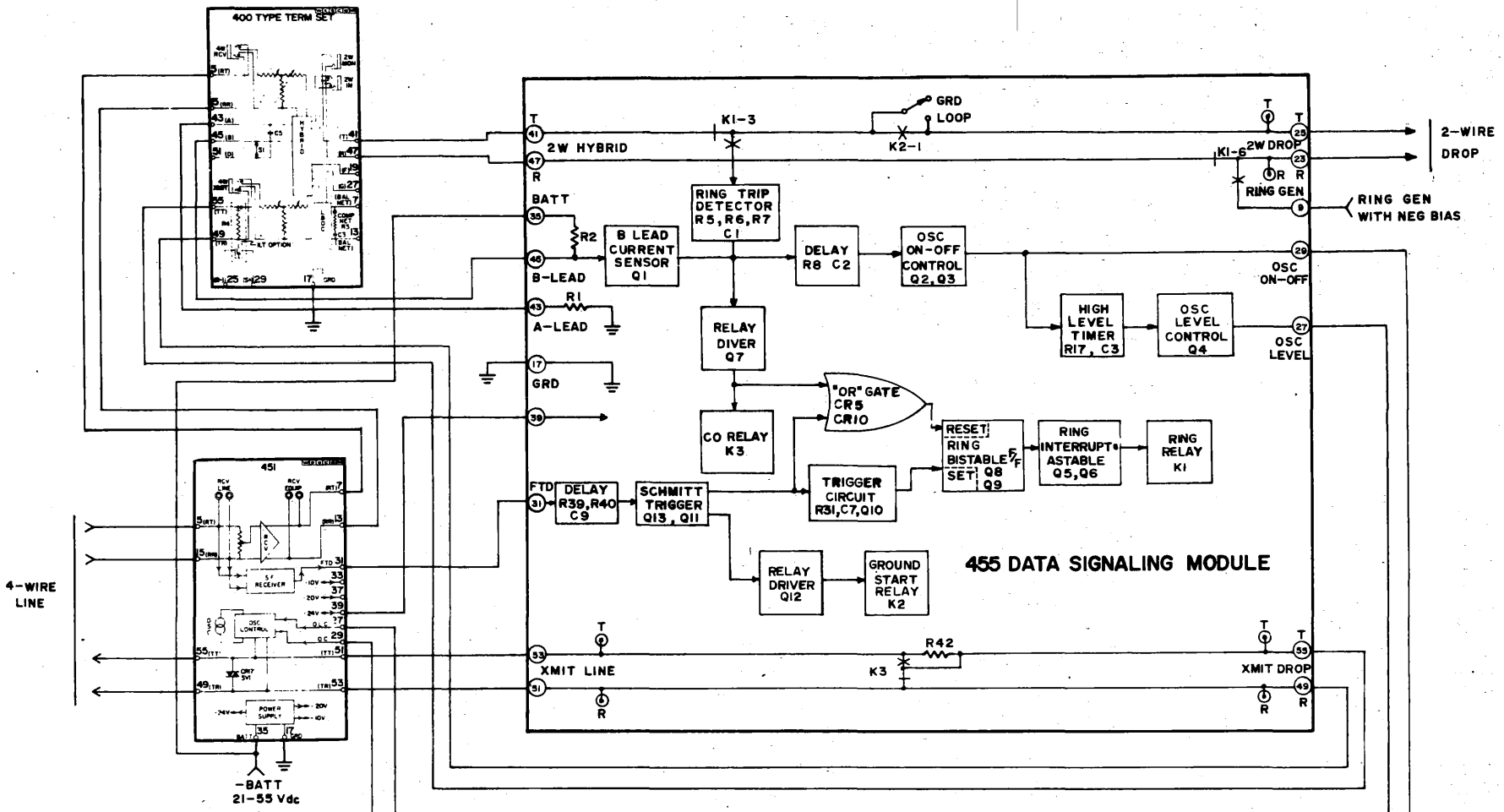


Figure 2. 455 System Functional Schematic Diagram

tors 33 , 37 or 39 as a test battery source or damage to the 451 may result.

(2) At the local terminal, place the signaling equipment in the on-hook condition. Condition the TMS for bridging measurement and connect it to the XMIT LINE T and R test points on the 455 module front panel. The TMS should indicate −36 ±2 dBm.

(3) Condition the local VFO to apply a 1000-Hz test tone at the level and impedance specified on the Circuit Layout Record (CLR) card to the two-wire drop of the local two-wire to four-wire terminating set, and adjust the terminating set transmit level to −16 ±0.25 dBm.

(4) If line amplifiers are used, adjust the transmit line amplifier for the level specified on the CLR.

(5) This completes the transmit alignment procedure; disconnect the test equipment.

receive alignment

6.04 Perform the receive alignment procedure as follows:

(1) If the circuit is established, have the distant end send 1000-Hz at the proper transmitting level and adjust the input to the 451 module to +7 dBm. Proceed with step 4. If the circuit has not been established, proceed with steps 2 or 3.

(2) If line amplifiers are used, insert 1000-Hz tone at the level specified on the CLR card into the input of the receive line amplifier and adjust the amplifier output to a level of +7 dBm.

(3) If line amplifiers are not used, insert the 1000-Hz tone at +7 dBm into the associated receive drop test jack if provided. If test jacks are not provided, connect 1000-Hz tone at +7 dBm to connector terminals 5 and 15 on the 451 module.

(4) Arrange the TMS for bridging measurements and connect to the RCV LINE test jacks on the 451 front panel. Read and note the level at this point.

(5) Move the TMS to the RCV DROP test jacks on the 451 front panel and adjust the RCV LEVEL control for an identical reading on the TMS (0-dB insertion loss).

(6) Remove the TMS, condition it for a terminated reading, and connect it to the drop side of the associated terminating equipment. Adjust the receive pad to obtain the level specified on the CLR card.

(7) This completes the alignment procedure. Remove the test equipment and restore all connections. Perform ringing, ring trip and data transmission tests on the channel to verify over-all facility performance.

7. CIRCUIT DESCRIPTION

455 data access system operation

7.01 The 455 DATA ACCESS Inband Signaling System is normally used at the station (subscriber) port of a 400 DATA PACKAGE four-wire private line facility. The 455 system does not contain an internal 4W-2W term set. Use a Wescom 441, 442 or 443 (or equivalent) term set to provide a 2W termination with A and B leads. Use a Wescom 412B (or equivalent) Pad/-Transformer to provide a 4W termination with A and B leads.

7.02 Loop start or ground start operation may be selected with the front panel switch on the 455 module. Loop start is normally used at a station port while ground start is used at a computer interface port.

7.03 Signaling tone, transmitted by the local terminal is prevented from entering the two-wire drop equipment through the transmit port on the terminating set by the operation of a cut and terminate relay which disconnects the transmit drop from the transmit line during the transmission of signaling tone. Signaling tone, received by the local terminal is prevented from entering the two-wire 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 455 DATA ACCESS Functional Schematic (Figure 2) and the attached schematic diagrams for the 451

Common Module and 455 Data Signaling Module during the following discussion.

451 common module circuit operation

7.05 Data energy or SF signaling tone energy received from the distant terminal over the four-wire receive line enters the 451 Common Module on connector pins 5 and 15. Data energy present on the receive line is amplified to provide zero insertion loss and connected to the receive drop through connector pins 7 and 13. Signaling tone energy, present on the receive line, is separated from data energy and processed by the SF receiver, which converts signaling tone energy to a ground signal (from a −20 V potential when signaling tone energy is not present). The ground signal thus developed is routed to connector pin 31 for connection to the 455 DSM module and is also used within the 451 Common 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 four-wire line, provides a minimum 45 dB attenuation to signaling tone 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 data channel is available however, during nonsignaling intervals as the filter is removed when signaling tone is removed.

7.06 In addition to a receive line amplifier and SF receiving and processing circuitry, the 451 Common Module contains an SF signaling tone oscillator. This oscillator, under the control of the 455 module, applies signaling tone energy to the transmit portion of the four-wire line, for transmission to the distant terminal. A ground signal (from −24 volts) applied to pin 29 by the 455 module turns on the SF oscillator, which applies signaling tone energy at a level of −36 dBm to the four-wire line. A ground signal, applied to connector pin 27 by the 455 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 Common Module and the 455 module and permits the operation of both modules from battery potentials within the range of −21 to −55 Vdc. A battery reversal diode CR7 prevents damage if polarity is accidentally reversed. Loop requirements call for −48V operation.

455 data signaling module circuit description

7.08 The 455 module contains the following three relays: (1) a ring relay, K1, to switch the output of the ringing generator to the two-wire drop, (2) a ground start relay, K2, to hold open the tip lead toward the two-wire drop during idle, and (3) a cut and terminate (CO) relay, K3, to terminate the transmit line and place a short across the transmit drop during the transmission of SF signal tone; i.e., during idle. It also contains the necessary logic and control circuitry to (1) convert two-wire loop current or B-lead current (ground start) to SF oscillator control signals for the 451 module, (2) to respond to an FTD input from the 451 module to apply ringing voltage to the two-wire drop, and (3) to sense ring trip.

idle circuit condition

7.09 With the local and distant terminals in the "on-hook" condition, SF signal tone is transmitted to the distant terminal and is received from the distant terminal over the four-wire line. During this time, the ring relay, K1 is released, the cut and terminate relay, K3, is released, and the ground start relay, K2, is released, holding the tip lead open towards the two-wire drop, unless bypassed by the GRD/LOOP switch in the LOOP position.

incoming call

7.10 The data set at the distant location, reverting to the "off-hook" condition, causes two-wire loop seizure at the distant 455 module. The 455 module responds by removing the turn-on signal from its associated 451 module, which ceases the transmission of SF signal tone. At the local terminal, the loss of received SF tone causes the FTD output, pin 31, of the 451 Common Module to revert from the ground state to the −20 volt state. This signal, routed to pin 31 of the 455 module, operates through the delay circuit, the Schmitt trigger and relay driver Q12 to operate ground start relay K2. Relay K2, operated, closes the tip lead towards the two-wire drop, if K2 is not bypassed by the GRD/LOOP switch in the loop position.

7.11 At the same time, a second output from the Schmitt trigger produces a pulse at the output of the trigger circuit, Q10, that sets bistable FLIP-FLOP Q8-Q9, enabling the ring interrupt astable FLIP-FLOP Q5-Q6. The ring interrupt, thus enabled, pulses the ring relay K1 in a

cycle of two-seconds on, four seconds off. Relay K1 applies interrupted ringing voltage to the two-wire drop.

7.12 When the local data set goes "off-hook" in response to ringing, ring generator bias voltage appears at the input to the ring trip detector. The ring trip detector, in turn, produces an output that turns on relay driver Q7, whose output operates through "OR" gate CR5-CR10 to reset the ring bistable FLIP-FLOP Q8-Q9. The ring bistable FLIP-FLOP in its reset state, disables the ring interrupter which releases relay K1 to remove ringing voltage from the two-wire drop. The path for two-way data communication is now complete.

local terminal releases at the end of a call

7.13 When the local terminal returns to the "on-hook" condition, the loss of B-lead current produces a turn-on signal at the output of the oscillator on-off control, Q2-Q3, which appears at pin 29 and at the input to the high level timer, R17-C3. The turn-on signal on pin 29 turns on the SF oscillator in the 451 module to resume transmission of SF tone towards the distant terminal. At the same time, the high level timer begins to time out, placing a 400-ms ground pulse on pin 27. This pulse, routed to pin 27 on the 451 module, increases the level of the SF tone from −36 dBm to −24 dBm for the first 400-ms after SF tone transmission is resumed. This sequence also takes place at the distant terminal when its associated equipment returns to the "on-hook" condition.

abandoned call

7.14 If, in the case of a call initiated by the distant terminal, the call is abandoned before the local terminal answers, the transmission of SF tone by the distant terminal resumes. This results in the return to the ground state of the signal at pin 31 of the 455 module. This in turn causes the outputs of the Schmitt trigger, Q11-13, to change state, which releases ground start relay K2 and operates through "OR" gate, CR5-CR10, to reset the ring bistable. Relay K1, therefore, releases and removes ringing voltage from the two-wire drop.

local terminal initiates call

7.15 The local terminal going "off-hook" completes the path for B-lead current between ring (23) and tip (25), in the case of loop start, or between ring (23) and ground (17), in the case of ground start, at the two-wire drop. B-lead current is sensed by transistor Q1, whose output operates relay K3 through driver Q7. Relay K3, operated, removes the short across the transmit drop and connects the transmit drop to the transmit line.

7.16 The output of the B-lead sensor, Q1, also operates through the delay circuit, R8-C2, and the oscillator on-off control Q2-Q3 to remove the turn-on signal from pin 29, causing the SF oscillator in the 451 Common Module to turn off. Transmission of SF signal tone to the distant terminal, therefore ceases.

7.17 At the distant terminal, the loss of received SF tone causes ringing at the associated two-wire equipment. If ringing is answered, the resulting two-wire loop seizure causes the transmission of SF tone towards the local terminal to cease. If the local terminal is a station port, dial tone will be transmitted towards the local terminal at this time.

7.18 The loss of received SF tone at the local terminal causes the signal at the FTD output of the 451 Common Module, pin 31, to revert from ground to the −20 volt state. This signal, routed to pin 31 on the 455 module, operates the ground start relay, K2, which closes the tip lead to the two-wire drop. In the ground start mode; i.e., with the GRD/LOOP switch in the GRD position, this completes the path for two-way data communication. In loop start K2 operates without effect since its contacts are bypassed. When the local terminal is a station port, dial pulse information from the data set is then passed on an MF (Touch Tone) basis thru the voice path of the 451/455. SF tone remains off in both directions during MF dial pulsing and subsequent data communications.

7.19 Upon completion of the call, the station returns to "on-hook" and "B-lead" current ceases to flow. Q1 (loop current sensor) causes Q2 and Q3 (osc ON-OFF timing circuit), after a 28 ms delay, to turn on the 2600 Hz oscillator in the 451 module. Q4 provides a positive 400 ms high level (8 dBm0) 2600 Hz burst, then steady low level (20 dBm0) 2600 Hz continues to be sent to the distant SF equipment.

8. TESTING

8.01 If trouble is encountered with the operation of the 455 Data Signaling System,

verify that all installer connections have been properly made, in accordance with Table 1, and that the GRD/LOOP switch is in the proper position. With power removed, make certain that the module is making good connection with the mounting-assembly card connector; remove and reinsert the module. If the trouble persists, perform the following test procedure to determine whether the fault is internal or external to the module. If technical assistance is required, contact Wescom Customer Service Department by calling 312-971-2010 or TWX 910-695-4735.

test equipment required

8.02 The following test equipment is required to properly test the 455 Data Signaling System:

(a) Multimeter: Simpson 260 or equivalent.

(b) Transmission Measuring Set: Northeast Electronics TTS4C or equivalent.

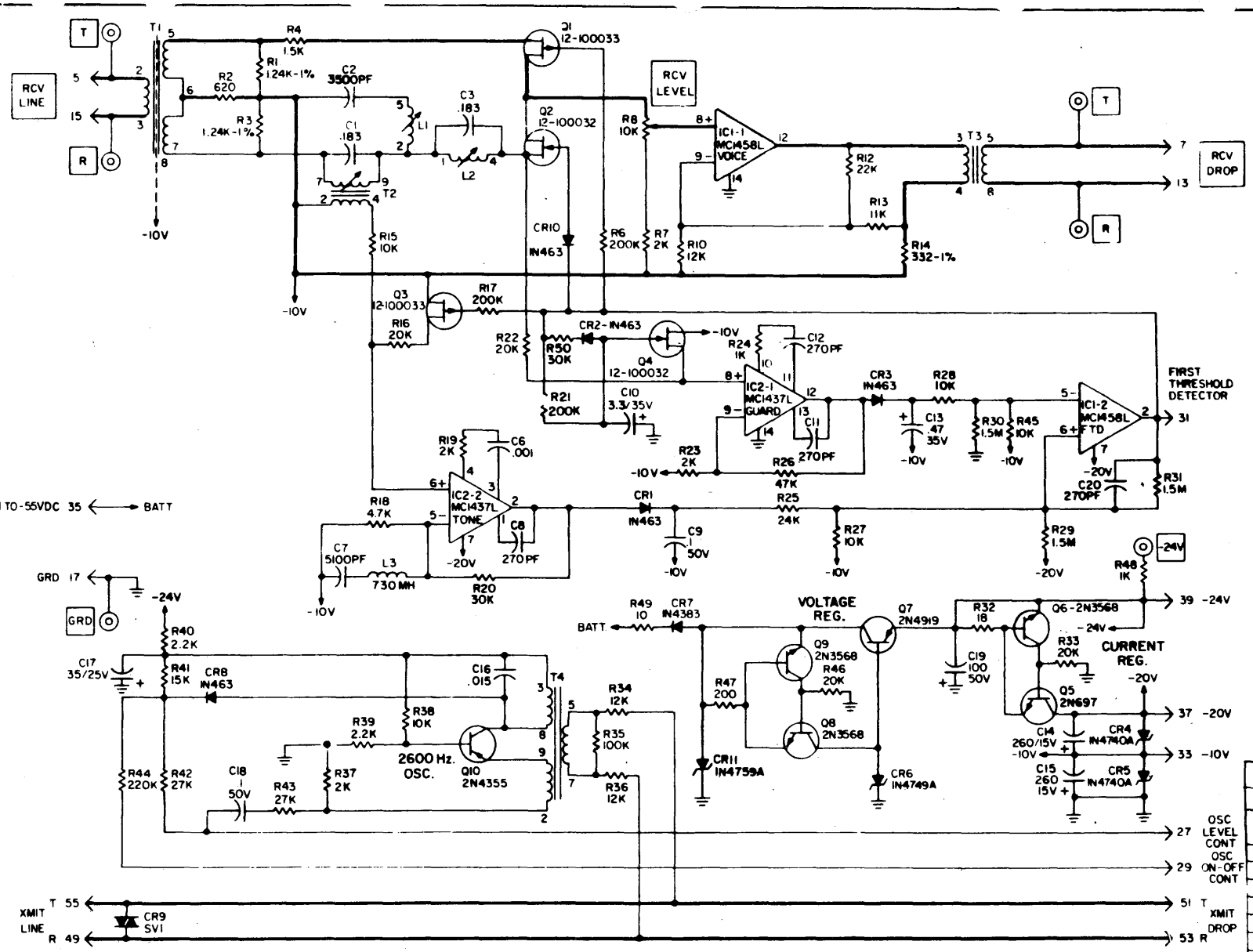
(c) Miscellaneous Test Leads: As required.

TEST PROCEDURE

STEP	ACTION	VERIFICATION
1	Connect the positive multimeter lead to ground (pin 17 on 451 or 455 modules). Connect the negative lead to pin 35 on the 451 module.	The multimeter should read between 21 and 55 volts. If this condition is met, proceed to step 2.
2	Remove the negative multimeter lead from pin 35 and reconnect it to pin 39.	The multimeter should read between 23 and 25 volts. If this condition is met proceed to step 3; if not, replace the 451 module and repeat step 2.
3	Place both local and distant terminals in the "on-hook" condition.	
4	Condition TMS for bridging measurement and connect across the RCV LINE T and R test points on the front panel of the 451 module.	The TMS should indicate the presence of SF signal tone at a level of -13 ± 2 dBm. If this condition is not met, check the facility and the equipment at the distant terminal. If this requirement is met, proceed to step 5.
5	Temporarily short the RCV LINE T and R test points on the 451 module front panel, to simulate loss of received SF tone.	The data set on the local two-wire drop should begin ringing. If this condition is met, proceed to step 9; if not, proceed to step 6.
6	Set multimeter to 250 Vac scale. Connect the multimeter between pins 17 (positive) and 31 (negative) on the 451 Common Module.	With conditions as in step 5, the multimeter should read approximately 20 volts. If this condition is met, proceed to step 7; if not, replace the 451 module and repeat step 6.
7	Connect the multimeter between pins 9 and 17 on the 455 module, to test for ring generator voltage.	The multimeter should read ring generator voltage. If this condition is met, proceed to step 8; if not, check ring generator and replace if necessary. Repeat step 5.
8	Connect the multimeter between 2W DROP T and R test points on the 455 module to test for the presence of ring generator voltage.	The multimeter should read ring generator voltage. If this condition is met, check the equipment on the two-wire drop. If this condition is not met, replace the 455 module and repeat step 5.
9	While the data set on the local two-wire drop is ringing, momentarily short the 2W DROP T and R test points on the 455 front panel.	This should accomplish ring trip and the local data set should cease ringing. If this condition is met, proceed to step 10; if not, replace the 455 module and repeat step 9.

10	Remove the short and the TMS placed across the RCV LINE T and R test points on the 451 module. Connect the TMS, set for bridging measurement to the XMIT LINE T and R test points on the 455 module.	The TMS should read −36 dBm ±2, indicating that SF signal tone is being transmitted toward the distant terminal. If this condition is met, proceed to step 12; if not, proceed to step 11.
11	Connect the multimeter between pins 17 (positive) and 29 (negative) on the 455 module.	Multimeter should read less than 2-volts. If this condition is met, replace the 451 module and repeat step 10. If this condition is not met, replace the 455 module and repeat step 10.
12	Place a grounded test lead on the 2W DROP R test point.	The TMS should drop off-scale, indicating that transmission of SF tone towards the distant terminal ceases. If this condition is met, proceed to step 13. If this condition is not met, connect a multimeter to pin 29 and verify a reading of approximately −20 V. If this is not present, change the 455 module. If it is present and the TMS does not drop off-scale, change 451.
13	Remove the test lead applied in step 12.	The TMS should rise to −24 dBm for a fraction of a second, and then fall back to a steady −36 dBm, indicating the initial high level tone burst and the transmission of low level SF tone during idle. If this condition is met, proceed to step 14; if not, replace the 455 module and repeat step 12.
14	This completes the test procedure for the 455 Data Signaling System. Remove all test equipment and test connections.	

8.03 Field repairs involving the replacement of components within a module are not recommended. If a module is found to be defective it will be replaced free of charge. Replacement modules may be obtained by contacting Wescom by telephone or TWX and they will be shipped the fastest way. Upon receipt of a replacement module, return the defective module, using the shipping label provided, to Wescom, Inc., 501 Rogers Street, Downers Grove, Illinois 60515.



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
L	4-22-71	ECO 1770 C2 WAS 3300PF	JSP
K	3-9-71	1710 CR11 WAS IN4738A	JSP
J	3-9-71	ECO 1665. IC1 WAS 1437. R11, R9, C4, C5 DELETED	JSP
I	1-14-71	ADDED R50 PER ECO # 1589	TKM
H	6237C	ECO 1545 & 1561	GL
G	3970	ECO 1443 & 1456	AJM
F	127-70	ECO 1378	ERK
E	113 70	ECO 1347	ERK
D	12669	ECO 1309	AJM
C	109-69	ECO 1276	ERK
B	109-69	ECO 1266	ERK
A	9-8-69	RELEASE FOR PROD	RK

SCHEMATIC DIAGRAM FOR MODEL 451
COMMON UNIT (F SIGNALING)

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

WESCOM INC. 501 ROGERS DOWNERS GROVE ILL 60515

DWG NO 191-045100

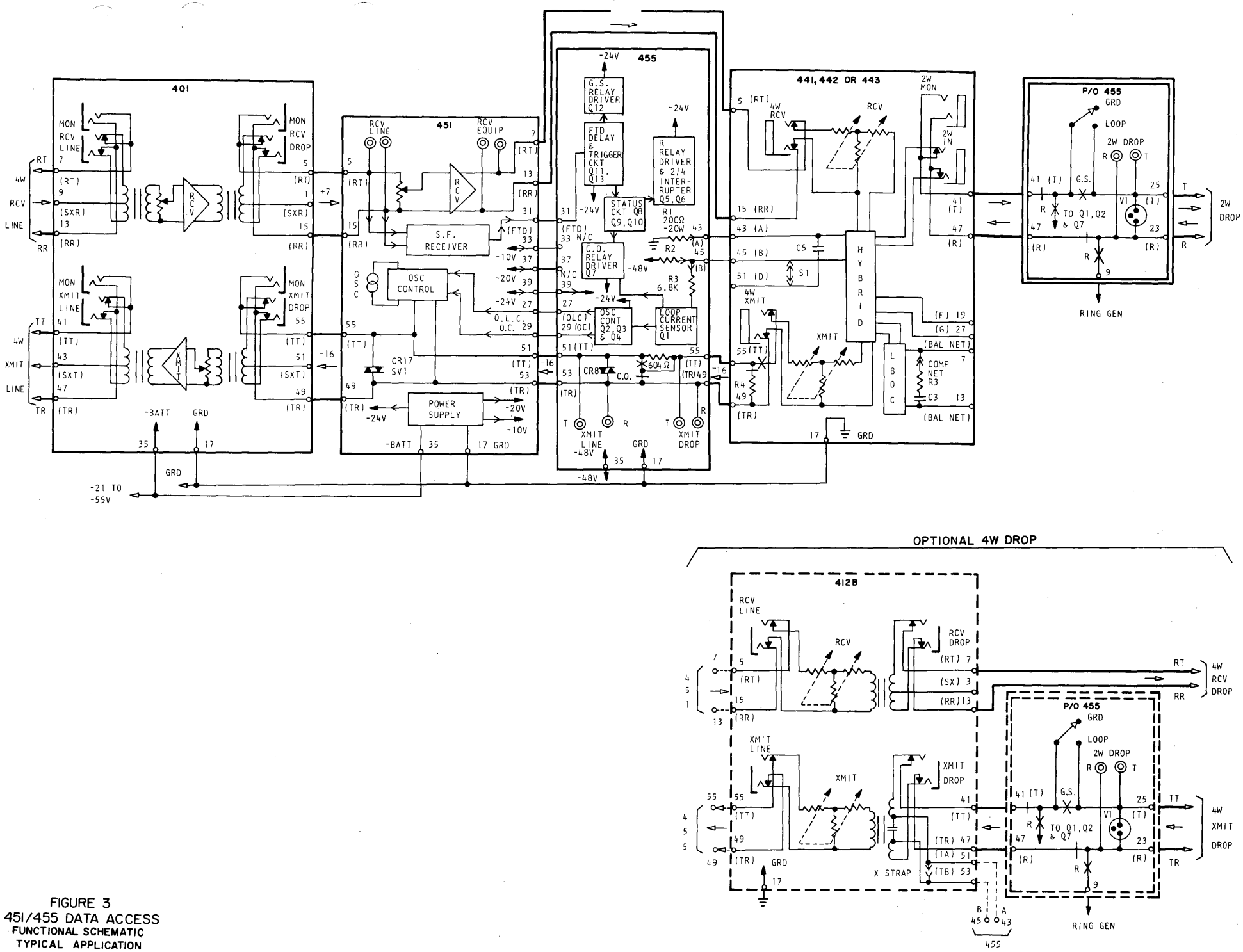
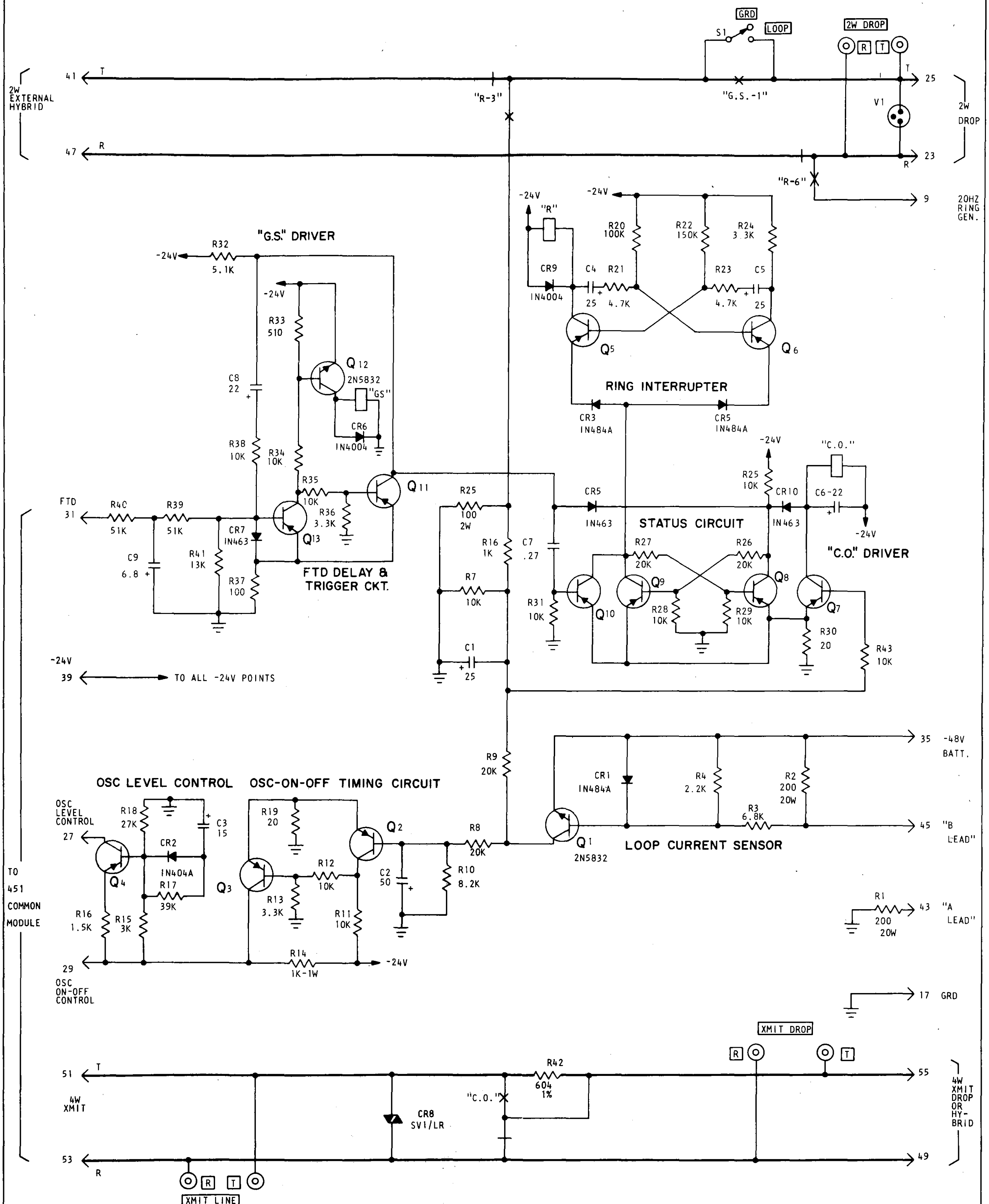


FIGURE 3
451/455 DATA ACCESS
FUNCTIONAL SCHEMATIC
TYPICAL APPLICATION



NOTES:

1. UNLESS OTHERWISE SPECIFIED RESISTORS ARE IN OHMS, ± 5%, 1/4W. CAPACITORS ARE IN MICROFARADS.
2. ← PC BOARD CONNECTOR.
3. —— PRIMARY TRANSMISSION PATH.
4. ◎ FRONT PANEL TEST POINTS (BRIDGING).
5. [XXX] FRONT PANEL DESIGNATIONS.
6. ✕ ┼ N.O., N.C. RELAY CONTACTS.
7. Q2-Q11 AND Q13 ARE 2N4355

A	6-24-71	REL TO PROD	
EDD	JEC	JEC	
455	ISS 1		
6-11-71			

455 DATA SIGNALING MODULE SCHEMATIC DIAGRAM

WESCOM INC.

191-045500