38 ELECTRICAL SERVICE UNITS

DESCRIPTION AND OPERATION

CONTENTS

1. GENERAL

1.01 This section provides the description and operation of the 38 electrical service units. It is reissued to make some additions and minor corrections. Marginal arrows indicate the changes and additions. If a detailed circuit description is required, refer to the appropriate WDP (Wiring Diagram Package).

1.02 Two types of electrical service units are covered in this section. The first unit to be covered (WESU001) provides both dc (current/no current), and EIA (Electronics Industries Association) Standard RS-232-C interfacing. The second unit to be covered (WESU002) uses FSK (Frequency Shifted Keying) to provide interfacing with a private telephone line or some data access arrangement. Both units can be mounted in the pedestal of the floor model or in a separate housing for the table model.

2. ELECTRICAL SERVICE UNIT PROVIDING DC AND EIA INTERFACE (WESU001)

DESCRIPTION

2.01 The physical make-up of the electrical service unit consists of a main baseplate on which is mounted a dc power supply and a circuit card assembly. Mounting facilities are also provided for various options such as a reader power pack or an elapsed timer.

2.02 A six-pushbutton cluster with internal indicator lamps, that is connected by cable to the electrical service unit, provides the operator with mode switching, break generation, and manual answer-back trip, and also a visual indication of the mode status or alarm condition. Two cables are supplied with the electrical service unit; one goes to the connector board at the rear of the printer, the other goes to the motor.

2.03 A connector assembly with spare terminals is provided for customer connection of dc signal lines. When EIA interface is used, the customer can provide his own connector or use an optional interface cable available from Teletype Corporation. There is an auxiliary connector on the circuit card that provides customer access to the "EOT" (End of Transmission) and "paper-out" contacts. The connector also provides for remote switching of the "answer-back" mechanism.

TECHNICAL DATA

A. Signal and Control Interface

2.04 The electrical service unit provides two basic types of interface to external signaling lines. The 20-60 ma type is used for special data set operations, or interoffice transfer. The EIA type is used with an external data set and may be used in a variety of applications. A control contact interface is provided that allows the customer access to certain internal control contacts.

DC Interface

2.05 Operation into a dc interface may be two-wire connected (half-duplex, Figure 1) or four-wire connected (full duplex, Figure 2).

Operating currents . . . . . .at 20 ma, reliable operation will be above 12 ma

at 60 ma, reliable operation will be above 35 ma

upper current limit, 75 ma max

NOTE: All operating currents are supplied from an external dc battery. The open circuit signal voltage on either loop must not exceed 125 volts.

2.06 The internal signal circuits of the electrical service unit do not affect the normal input (selector) distortion tolerance or output (distributor) distortion tolerance.

2.07 When the unit is to be operated without making any physical connection to an external line, it is advisable to disconnect connector J11. This will eliminate spurious printing as the key switch buttons are pressed.

EIA Interface

2.08 Operation into an EIA device is made at P11 in accordance with the standards set up in RS-232-C. A cable can be made using a "Molex" connector according to the information supplied in Figure 3 or an optional EIA interface cable 188724 can be used. The following chart is used to describe the EIA signals present at connector P11.

EIA INTERFACE SIGNALS AT CONNECTOR P11

PIN NO.	EIA SIGNAL	EXPLANATION
1	(AA) Protective Ground	Frame
2	(CB) Clear to Send	This lead is connected to circuit card paths which will permit adding a series resistor to "signal ground" if desired.
3	(BB) Received Data	An "ON" (+) input represents a space and an "OFF" negative voltage represents a mark.
4	(CA) Request to Send	This output is held high whenever power is applied to the set.
6	(CC) Data Set Ready	This lead controls the set motor: A (+) input voltage turns the motor "ON." A (-) input voltage turns the motor "OFF."
7	Signal Ground	Common Return
8	(BA) Send Data	A (+) output voltage represents a "SPACE." A (-) output voltage represents a "MARK."
12	(CF) Ring Indicator	See explanation for pin 2.

EIA INTERFACE SIGNALS AT CONNECTOR P11 (Continued)

PIN NO.	EIA SIGNAL	EXPLANATION
13	(CF) Receive Line Signal Detector	See explanation for pin 2.
15	(CD) Data Terminal Ready	This output is held "ON" (+) when any of the following conditions exists. a. The EOT switch (in the printer base) is not sensing an EOT. b. The LOCAL pushbutton has not been depressed. c. The OFF pushbutton has not been depressed. d. Paper is available on the printer (ie, paper-out switch is not sensing paper out). Option 2 shunts the paper-out contacts. The data terminal ready signal is then no longer dependent upon these contacts. By adding Option 3, the paper-out switch contacts are bypassed and the Data Terminal Ready signal is no longer dependent upon those contacts.

Control Contact Interface

2.09 Connector P20 on the circuit card assembly (Figures 4 and 5) affords access to the "paper-out" and "EOT" contacts and provides connection for a parallel "HERE IS" contact to operate the answer-back trip magnet.

NOTE: The circuit card assembly comes supplied with a dummy connector (J20) which completes the contact circuitry in those instances where the customer has no need for the contact interface provided at P20.

2.10 There is an additional "Option 2" (Figure 4) provided at P20. This option strap disables the normally closed "paper-out" contact (contact will be shunted). Using a dc interface, if this contact were not shunted, the set motors would turn off in the event of a "paper-out" (form-feed sets) a "low-paper" (friction feed sets) condition at the printer. Using a EIA interface, if this contact were not shunted, there would be an OFF signal at the "Data Terminal Ready" lead and the "Send Data" lead in the event of a paper-out condition.

B. Physical, Electrical, and Environmental Characteristics

(a) Weight . . . . . 18 pounds

(b) Input power . . . . . 115 v ac +10%, 47.5 to 63 Hz, single phase (3-wire)

(c) Power consumption . . . . maximum 300 watts

(d) Relative humidity . . . . . 2% to 95%

Temperature Ranges —

This equipment is intended to be operated in a room environment within the temperature range of 40°F to 110°F. Serious damage to it could result if this range is exceeded. In this connection, particular caution should be exercised in using acoustical or other enclosures.

OPERATION

2.11 The operation of this electrical service unit will be on a functional basis. At times, key electronic components will be discussed when knowledge of their operation is needed in understanding signal flow. This operation should be used in conjunction with the block diagram found in WDP0320.

Signal Circuits (Receive) 1194SD-B1

2.12 The signal input circuits respond to the incoming signals (received data) in the following manner. A marking signal input (minus voltage in EIA, "current on" in dc) is the equivalent of a low at the 3-input OR gate which represents the input circuit. Similarly, the closure of the LOCAL pushbutton switch contact will apply a ground (low) at the 3-input OR gate. Any low at the 3-input OR gate is inverted by transistor Q5 and will appear as a high at a "wired and" connection. The "wired and" combines the LINE pushbutton switch input with the inverted output from the 3-input OR gate. With the LINE pushbutton not depressed, the "wired and" out-

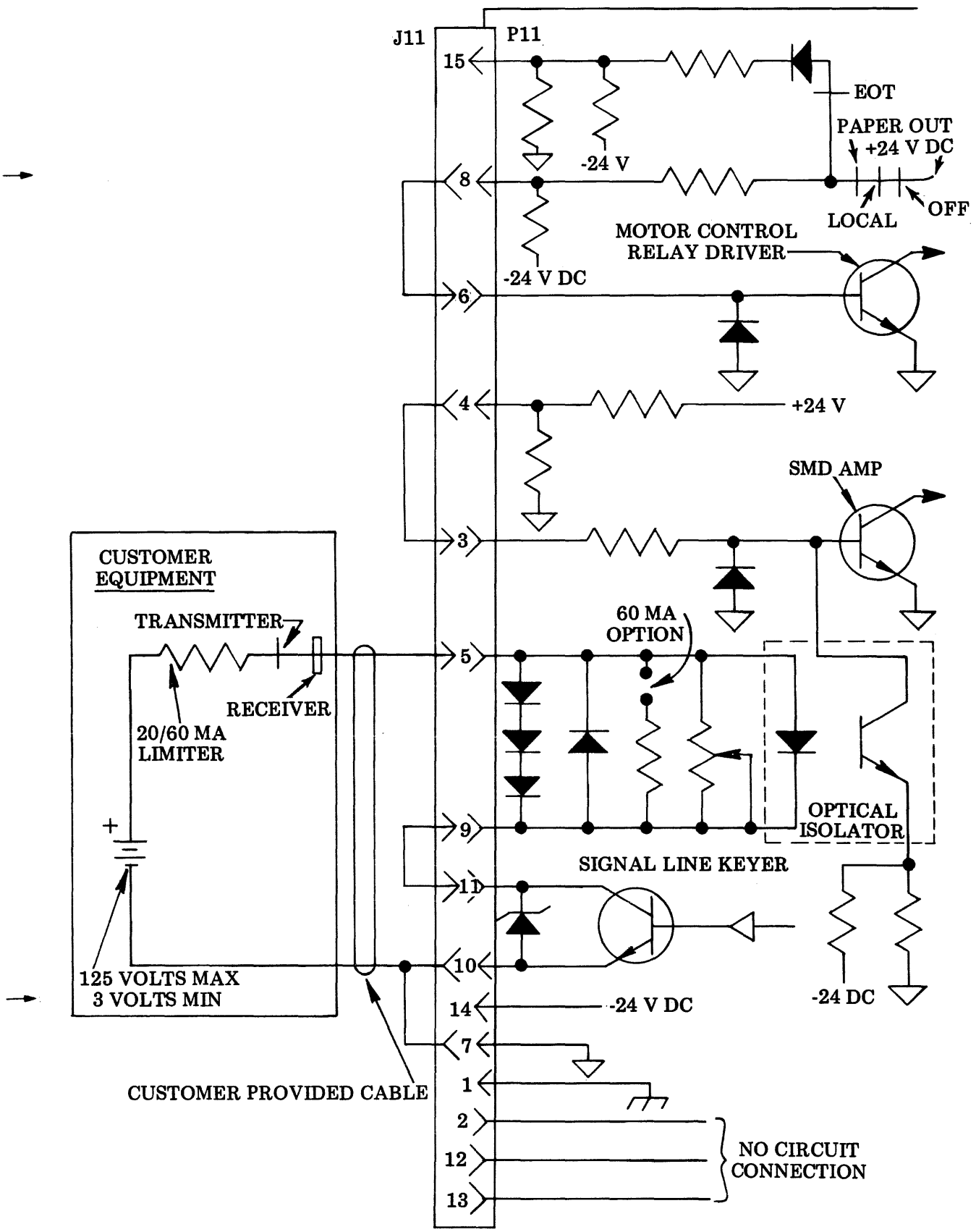

Figure 1 - Wiring for DC Half-Duplex
(2-Wire) Operation

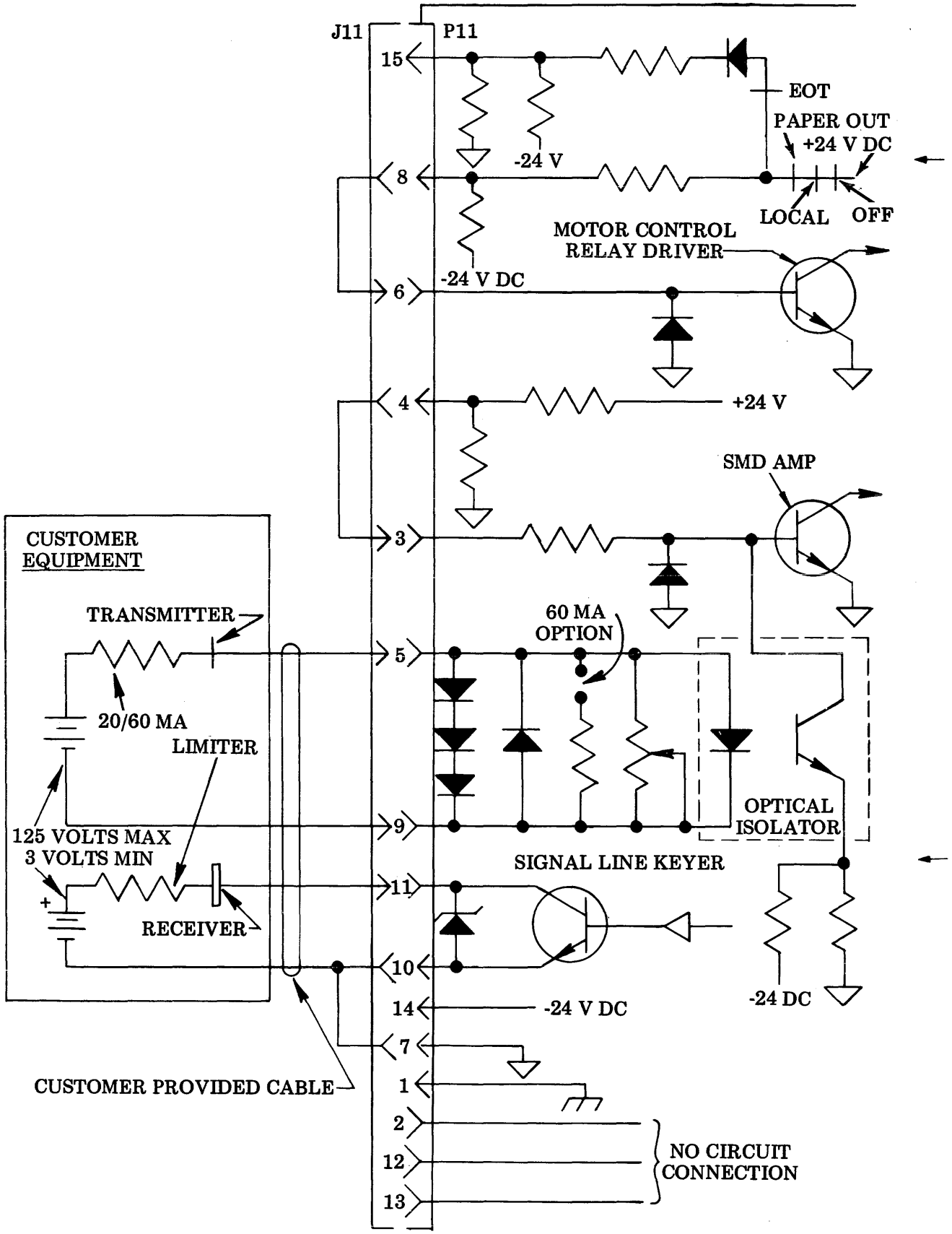

Figure 2 - Wiring for DC Full Duplex
(4-Wire) Operation

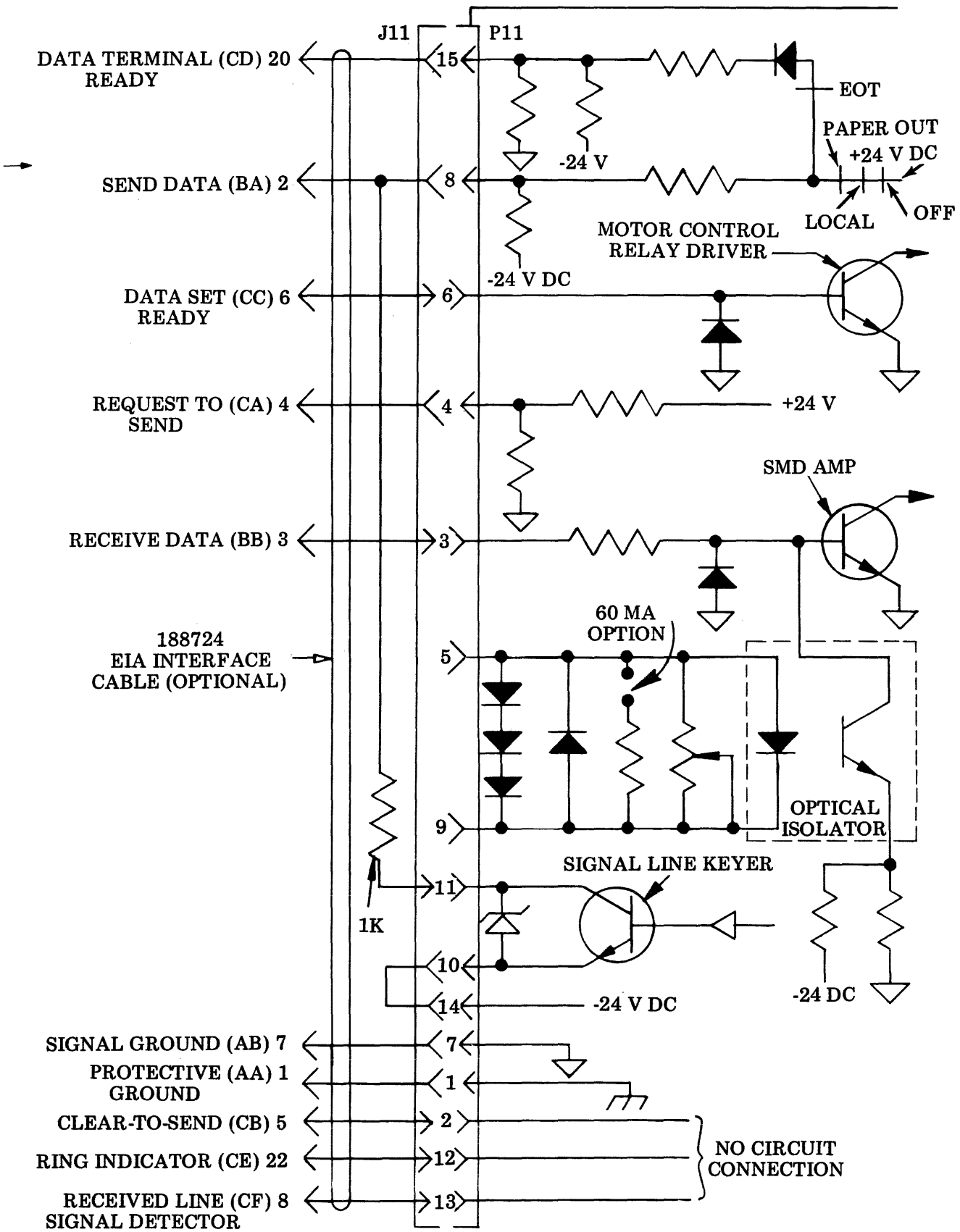

Figure 3 - Wiring for EIA Operation

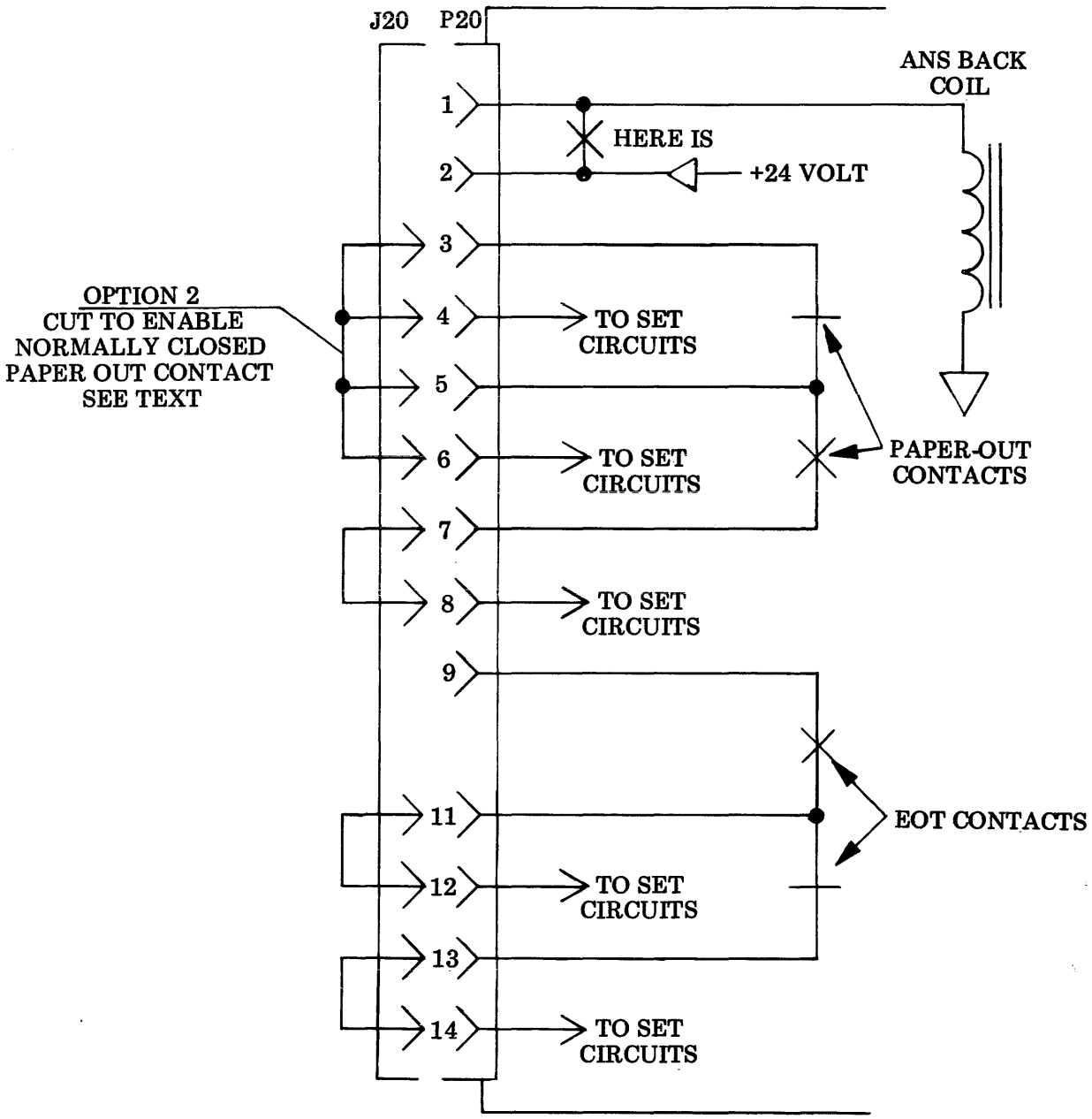

Figure 4 - Wiring for Control Contact Interface With Connector J-20 Installed

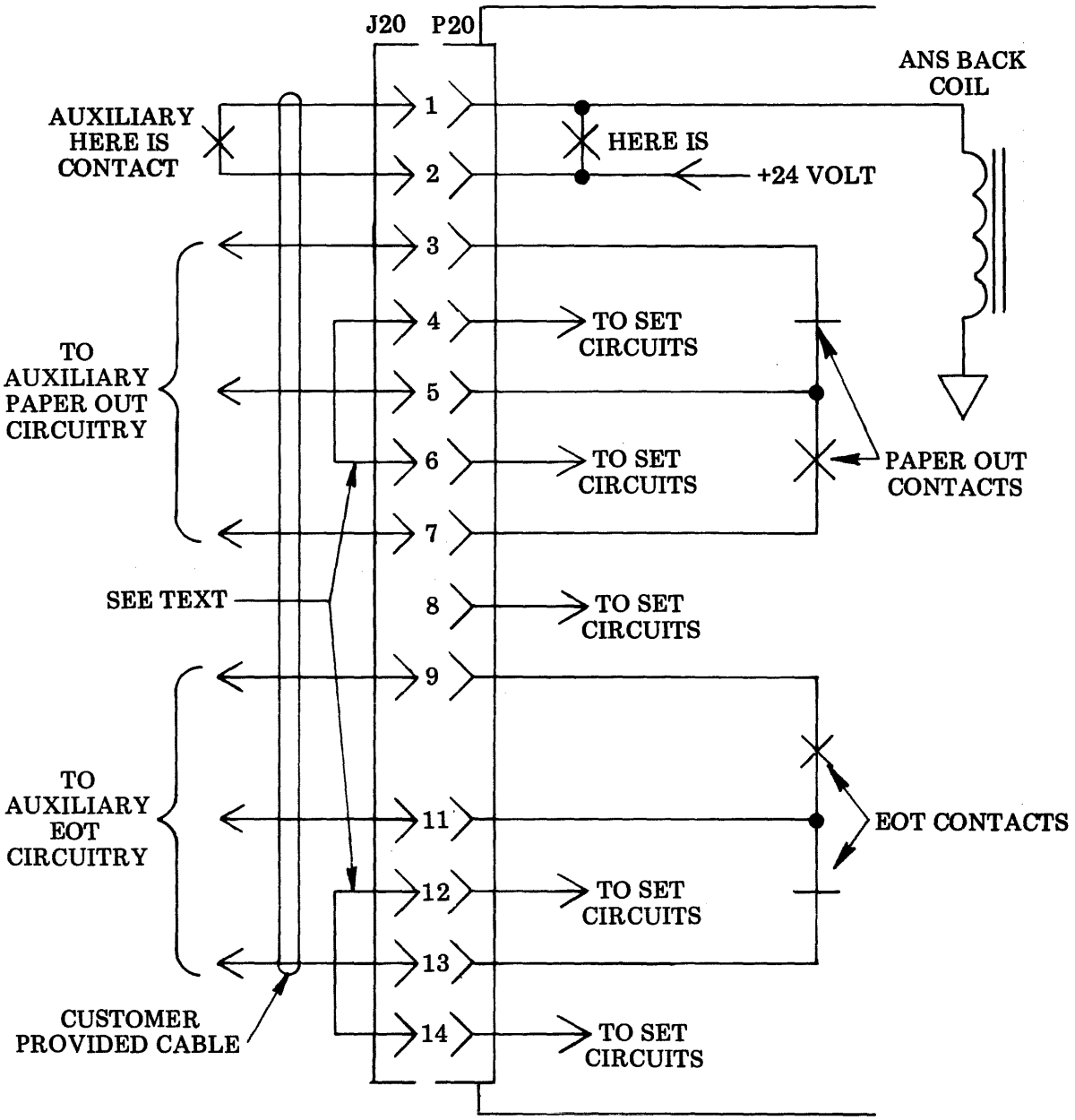

Figure 5 - Wiring for Control Contact Interface Showing Possible Customer Connection

put will be high when the input circuits are marking, and low when all the OR gate inputs are high.

2.13 The "wired and" output is inverted by transistor Q2 and applied to the selector magnet coils. The output of Q2 follows the 3-input OR gate output and therefore energizes the selector magnet (marking condition) whenever any input is low (marking).

NOTE: The high appearing at the input of Q2 must be supplied by the LINE FDX switch (either directly or from transistor Q3) or through the OFF switch contacts and paper alarm contact. The absence of a high at Q2 constitutes a space; therefore, in LOCAL the high or low input to Q2 is determined by the distributor contacts or BREAK switch contact.

Signal Circuits (Send) 1194SD-B3

2.14 The signal output circuits generate EIA or dc signals in the following manner. Interruption of the circuit common ground at inverter Q3 will present a low at the input of Q7 which will result in a high at the output of Q7. This high is transmitted as a spacing signal. Conversely, closure of the circuit common results in a marking signal. The signal line keyer (Q7) output is also dependent upon the LINE FDX contact and LINE contact so that whenever the set is in LOCAL or OFF mode, the +24 volt input through these contacts holds the keyer output marking.

Mode Control 1194SD-B4

2.15 The mode control circuits respond to the operator input (pushbuttons) which place the set into various modes of operation; OFF, LOCAL, LINE, and LINE FDX. The LOCAL, LINE, and LINE FDX lamps are lighted directly through closure of the associated switch contact. The ALARM lamp is lighted by closure of a "paper alarm" contact or "low-tape" (optional) contact to ground. The "data terminal ready" output provides a positive output (ready) only when the following conditions exist:

(1) The "paper alarm" contact is closed (paper not out or low).

(2) The OFF switch contact is closed (OFF pushbutton not depressed).

(3) The LOCAL switch contact is closed (LOCAL pushbutton not depressed).

(4) The EOT contact is closed (EOT contact opens momentarily when the set receives the EOT code character).

Reader and Answer-Back Controls 1194SD-B5

2.16 The operation of the reader is directly controlled by the distributor trip magnet. When the magnet is energized, it provides for the mechanical pulsing of the reader feed contact. It is the periodic opening and closing of this contact which pulses the reader feed magnet (stepping motor).

2.17 With the reader control lever in the START position, the TDC relay will energize through the paper alarm contacts, the OFF switch contact, the reader control switch contacts, and through the ENQ, DC-3, and EOT contacts. A set of relay contacts (TDC-2) shunts the start contact to hold the reader ON.

2.18 With the reader control lever in the ON position, the reader can be started remotely by receiving a DC-1 character. This provides a momentary shunt across the start contact. The TDC relay will energize, causing the reader to stop when the following conditions exist:

(1) Reader control in STOP or FREE position

(2) A tape-out or tight-tape condition

(3) A momentary opening of the EOT, DC-3, or ENQ contact

(4) A paper-out alarm condition.

2.19 Along with the control by the TDC-3 relay contact the distributor trip magnet is also directly controlled by a STEP contact on the reader control switch or by the form-feed contact within the printer. The STEP is closed when the reader control switch is placed in the STEP position. It will remain closed for one character cycle, opening automatically when the cycle is complete.

2.20 The answer-back trip magnet (which controls the starting and stopping of the answer-back mechanism) is dependent upon the contact of the HERE IS switch and (in sprocket feed sets) also upon the form-feed sets.

Motor Control

2.21 Contacts of the motor control relay turn the set motor ON when the relay is energized. The motor control relay is energized when a ground is applied to the coil through the LOCAL switch contact, the "forming out" contacts (in sets using sprocket feed printers), or through the OFF switch. A ground is developed

at Q4 (relay driver) in response to a "data set ready" input (EIA interface) or from internal circuitry (dc interface).

Power Distribution

2.22 Line power is applied from the power cord directly to a convenience receptacle, and through a set fuse F1 (A) to the remainder of the set. A second fuse F2 protects the dc power supply. A third fuse F1 (B) on the power supply rectifier regulator board is part of an overvoltage protection circuit associated with the 6 volt supply.

3. ELECTRICAL SERVICE UNIT PROVIDING FSK (FREQUENCY SHIFTED KEYING) INTERFACE (WESU002)

DESCRIPTION

3.01 The physical make-up of the electrical service unit consists of a main baseplate on which is mounted a dc power supply and two circuit card assemblies. Mounting facilities are also provided for various options such as a reader power pack or an elapsed timer.

3.02 Two six-pushbutton clusters with internal indicator lamps, that are connected by cable to the electrical service unit, provides the operator with mode switching and a visual indication of the mode status or alarm condition. Three cables are supplied with the electrical service unit; one goes to the connector board at the rear of the printer, one to the motor, and one provides connection to the telephone line or a data access arrangement.

TECHNICAL DATA

A. Interface

3.03 The interface cable connects to connector 16 on the circuit card. If an automatic DAA is used, the connections are as follows:

WIRE	DAA TERMINAL
Blue	-V) DC for DAA Operation
White	+V)
Black	DA) Data Transmission
Green	OH) Off Hook
Yellow	RI) Ring Indicator
Orange	DT) Data Tip
Red	DR) Data Ring

NOTE: For connection to a manual DAA or private line, only DT and DR leads are connected.

B. Carrier Frequencies

Originate (transmit — F1)	1070 Hz (space) 1270 Hz (mark) ±1-1/2 Hz
Originate (receive — F2)	2025 Hz (space) 2225 Hz (mark) ±1-1/2 Hz
Answer (transmit — F2)	2025 Hz (space) 2225 Hz (mark) ±1-1/2 Hz
Answer (receive — F1)	1070 Hz (space) 1270 Hz (mark) ±1-1/2 Hz

C. Signal Level

Transmit signal level	0 to -12 dBm (continuously variable)
Receive signal level	0 to -50 dBm (mean sensitivity)

D. Physical, Electrical, and Environmental Characteristics

(a) Weight . . . . . 18 pounds

(b) Input power . . . . . 115 v ac ±10%, 47.5 to 63 Hz, single phase (3-wire)

Power consumption . . . . maximum 300 watts

Relative humidity . . . . . 2% to 95%

Temperature Ranges —

This equipment is intended to be operated in a room environment within the temperature range of 40°F to 110°F. Serious damage to it could result if this range is exceeded. In this connection, particular caution should be exercised in using acoustical or other enclosures.

OPERATION

3.04 The operation of this electrical service unit will be on a functional basis. At times, key electronic components will be dis-

cussed when knowledge of their operation is needed in understanding signal flow. This operation should be used in conjunction with the block diagram found in WDP0344. The two circuit cards used in this electrical service unit will be covered individually.

A. Modem Card (322490) 1216SD

Modulator

3.05 The clock consists of an NPN transistor (Q9) Pierce crystal oscillator operating at 1000, 640 Hz, and another NPN transistor (Q8) used as a buffer amplifier. It is possible to use the collector output of Q8 which is available at terminal 10 of J2, as an external clock whenever +6 v dc is applied to terminal 2 of J2.

3.06 The collector output of Q8 drives the first of nine J-K flip-flops which are wired as a ripple-carry binary divider chain. The flip-flop outputs, together with the clock (which inhibit all outputs during the counting ripple), transmit band selection and dc data signal. These outputs selectively are programmed as inputs to the four sets of AND gates.

3.07 Depending on the control voltages from the logic card, terminals 1 and 4 of connector J2, one set of AND gates will have all its inputs high after the divider has progressed to the proper integer: 467 for 1070 Hz, 394 for 1270 Hz, 247 for 2025 Hz, and 225 for 2225 Hz. This number represents twice the frequency which is then divided by 2 by the 10th flip-flop to generate a square wave at the desired frequency.

NOTE: For clarity, the remainder of this description will refer only to the low band operation, ie, 1070 Hz and 1270 Hz, corresponding to divisors of 467 and 394. For high band operation, substitute 2025 Hz and 2225 Hz, corresponding to divisors of 247 and 225, respectively.

3.08 When the proper set of AND gates corresponding to 1070 Hz (F1) is made high, a low is presented to the trigger input of the 10th flip-flop, and also to the SD (Set Direct) terminals of the other nine flip-flops resetting the count to zero. The low at the SD terminals of the flip-flops is immediately removed by the reset action.

3.09 When the proper set of AND gates corresponding of 1270 Hz (F2) is made high, a low is transferred through two interposing NAND gates (normally effective as inverters) to the trigger input of the 10th flip-flop, and the SD terminals of the other nine flip-flops also resetting the count to zero.

Demodulator

3.10 The carrier signals received on terminals 12 and 15 of connector J2 are stepped up by transformer T1 to properly drive the input filter. When receiving the high band, the high-pass filter passes the received signals while attenuating the low band signals being transmitted. When receiving the low band, the low-pass filter passes the received signals for demodulation while blocking the transmitted high band.

NOTE: When the transmitted signal is high-pass filtered, the received signal is processed by the low-pass filter; when the transmitted signal is low-pass filtered, the received signal is passed by the high-pass filter.

3.11 Most of the demodulator gain and limiting is provided by a linear integrated circuit operational amplifier 709C. It is followed by three discrete NPN transistors: a phase-inverter Q4 and a class B push-pull pair Q2 and Q3, whose output drives the two discriminator transformers T2 and T3. Transformer T2 resonates at a frequency higher than mark (1270 Hz or 2225 Hz) while T3 resonates at a frequency lower than space (1070 Hz or 2025 Hz). Both T2 and T3 secondaries are center-tapped to provide full-wave detection, with the direct current outputs arranged in series so that spacing (T3) is negative and marking (T2) is positive. The sum of these two outputs is presented to the gate of the FET amplifier.

Carrier Detection

3.12 The secondary voltages of T2 and T3 are tapped by capacitors C36 and C35 respectively, and divided by capacitor C6 so that either marking or spacing carrier is rectified by the base emitter junction of transistor Q5. Transistor Q6 amplifies and inverts the output of Q5 so that terminal 8 of connector J2 is "high" when an adequate carrier is being received, and "low" when no carrier is being received.

B. Logic Card (322491) 1227SD

Send Data

3.13 In a marking state, transistor Q10 is "on" and resistor divider R28 and R30 provide a high at pin 9 of A3. During a space, transistor Q10 will be "off" and a low will be present at pin 9 of A3.

Receive Data

3.14 The receive and send data is coupled to the selector magnets through one of three gates and transistors Q11 and Q14. In a marking state, the outputs of the gates are all high. This will turn on transistors Q11 and Q14 and energize the selector magnets. Gate A2-4, A2-5, and A2-6 is used for local copy in the local mode. Gate B3-1, B3-2, and B3-3 is used to control local copy via the FDX and ECHO pushbuttons in the on-line mode. Gate B3-4, B3-5, and B3-6 monitors the demodulator. For a mark condition to occur, each of the three gates must have one input low. For a space condition, at least one of the three gates must have both of its inputs high.

Off-Hook, Tape Reader, and Motor Control

3.15 In the on-line mode gate A3-1 is low while A3-2 is high. Transistor Q13 is "on" which will energize the off-hook and motor control relays, enabling the tape reader control relay. In the local or clear modes gate A3-1 is high while A3-2 is low. Transistor Q13 is "off," therefore the off-hook, motor control, and tape reader control relays are de-energized.

On-Line and Modulator Control

3.16 The flip-flop C3-1, C3-2, C3-3, C3-4, C3-5, and C3-6 by a momentary low on pin 5 resets the flip-flop so that it can respond to one of three on-line modes: Automatic Answer, Manual Answer, and Manual Originate. During reset, C3-3 will be low and C3-6 will be high.

Automatic Answer

3.17 Automatic answering is accomplished by the RI (Ring Indicator) contact (in automatic DAA) closing in response to the ringing pulses of an incoming call. A low will then be present at gate C3-1 putting the flip-flop in the on-line mode.

Manual Answer

3.18 Normally, gate A1-13 is low causing A1-12 to be high; this has no effect on the flip-flop. When the answer key is depressed A1-13 goes high and A1-12 goes low which therefore causes the flip-flop to place the set in the on-line mode.

Manual Originate

3.19 Gate A1-1 monitors the originate/answer flip-flop. The answer mode presents a low to gate A1-1 and therefore a high on A1-2 which has no effect on the RS flip-flop. If the originate/answer flip-flop is set to the originate mode, A1-1 goes high, A1-2 goes low, which causes the RS flip-flop to place the set in the on-line mode.

3.20 Gate B3-8, B3-9, and B3-10 couples the send data in the on-line mode through gate A3-5 and A3-6 to the modulator. A low on B3-8 causes a high at A3-6 which is equivalent to a spacing condition. Gate B3-11, B3-12, and B3-13 is used to turn the demodulated signal around to the modulator in the echo mode. Input B3-12 monitors the ECHO key which is normally low. In the echo mode B3-12 goes high which will couple the modulator to the demodulator.

Originate/Answer Mode Control

3.21 The originate/answer flip-flop gates A2-8, A2-9, A2-10, A2-11, A2-12, and A2-13 determine the two on-line operating modes, originate or answer. The flip-flop is reset when a low is present on A2-9. When A2-8 is low, B2-12 will be high, and transistors Q8 and Q7 will be "on," thus energizing the originate relay. The flip-flop will remain in this state until the ANS pushbutton is depressed or a low is present on A2-9; the flip-flop is now in the answer mode.

Carrier Control, Originate/Answer Lamp Circuits

3.22 When gate B2-3 monitors a carrier detector, it will be high. Gate B1-1 monitors the originate/answer flip-flop and is high in the answer mode. Gate B1-2 goes high when a carrier is received; this presents a low at B1-12 forcing B1-11 high which will turn transistor Q1 on illuminating the answer lamp. In addition, the answer lamp will flash when the R1 contact (in an automatic DAA) responds to the ringing pulses of an incoming call.

3.23 When gate A2-2 monitors a carrier detector, it will be high. A2-1 will be high when the flip-flop is in the originate mode. Transistor Q9 which is normally "on," will turn "off" when A2-3 goes low. This allows capacitor C5 to charge and the monostable multivibrator C1 to time-out, before C1-6 goes high which turns "on" transistor Q2, and illuminates the originate lamp. At this time, C1-8 goes low causing C2-8 to flip and go low. This low is presented to B1-4 making B1-6 high which turns the local carrier "on."

3.24 If the remote carrier is lost or the set is switched out of the originate mode, the circuits will revert to its normal condition by turning Q9 "on" which causes C1-6 and C1-8 to toggle back to a reset state. However, C2-8 does

not revert back to the reset state until the on-line flip-flop is reset and a low is present at C2-10. In the answer mode, gate B1-8, B1-9, and B1-10 present a low to B1-5 causing the local carrier to turn "on."

Answer-Back Control

3.25 Gate B2-5 (which is normally high) will be low when a carrier has been received from a remote station. Gate B2-9 (which is normally high) will be low in the answer mode. When either or both gates B2-5 and B2-9 are high, C2-6 will be reset high. At this time C3-9 is high and C3-10 is low forcing a high at C3-8, C3-12, and C3-13; consequently, C3-11 will be low and transistor Q12 is "off."

3.26 When gates B2-5 and B2-9 are both low, C3-11 will be high, turning transistor Q12 "on," energizing the answer-back trip magnet. C2-1 monitors the send data and is low in the marking state. The first mark to space transition from the answer-back switches C2-6 low and as a result C3-11 goes low turning Q12 "off," de-energizing the answer-back trip magnet.

Power On — Reset

3.27 When power is applied to the card, capacitor C6 is allowed to charge through A1-11 holding this input low for a short period of time. This will keep A1-6 which is connected to the various circuit resets, low. After C6 charges high enough, A1-6 will go high leaving all points at reset. Diode CR2 limits the voltage that C6 can charge up to, while CR1 is used to discharge C6 during power shut down.

Abort Timer

3.28 The abort timer couples the low on Q5 drain to source, so that if the level on the drain does not go high in the abort time interval, a reset occurs. Normally, the on-line input to A3-13 is low when not in the "on" state, which allows transistors Q4, Q6, and Q3 to couple a -12 volts to the gate of Q5 which will keep it off. When the on-line condition is present at A3-13, Q5 will turn "on."

Local Reset

3.29 When in the local mode, a high is coupled to the input of A3-11 which will hold the reset circuits in a reset state. In the on-line mode, A3-11 will be low which will have no effect on the reset circuit.