405-TYPE DATA SYSTEM

SUPPLEMENTARY INFORMATION

CONTENTS PAGE

1. GENERAL

1.01 Data set (DS) 405A is the transmitter and DS 405B is the receiver for the 405-type Data System. The transmitter samples inputs on 8, 20, or 32 data leads and loads the parallel data into a register. The transmitter then generates three sync pulses and sequentially adds pulses corresponding to the sampled data leads, thus converting the parallel data to serial format. The data "word" is composed of the 3 sync bits plus 8, 20, or 32 data bits (ie, the binary state of 8, 20, or 32 data leads). A block diagram of the 8-channel system is shown in Fig. 1. Transmission is at 700, 880, 1400 or 1760 bits per second (bps) over a voice grade private line. Transmission at 700 or 880 bps requires only a basic channel, while for 1400 bps transmission the line requires C1 conditioning, and for 1760 bps transmission, the line requires C2 conditioning. The receiver establishes synchronization, registers the serial data bits, and converts the serial data back to parallel form at the output. Both the transmitter and the receiver provide an alarm condition in case of some abnormalities. This practice provides supplemental information for data sets 405A and 405B which is not provided in the description, installation, and maintenance practices. One should be familiar with the contents of these practices, listed in Part 4, before reading this practice.

1.02 Data sets 405A and 405B are designed for use in a Central Office environment, and are powered from the −48 volt CO supply. Reverse-channel signaling is not provided in these data sets. Initially these sets were designed for Bell System application in remote reading of traffic registers and similar applications. They may also be used for other applications, such as eliminating or reducing the number of interoffice dc paths for alarm or control circuits, by use of a suitable interface circuit. Input and output interface information for the interface circuit to be used for traffic register remoting is contained in the 252-140- series practices.

1.03 The information contained in this practice is not required for normal installation, operation, and maintenance of the subject data sets, but should be a valuable aid in the selection of apparatus and options for specific installations.

2. OPTIONS

2.01 The options which are available for the DS 405A transmitter and the DS 405B receiver are explained in detail in the following paragraphs, and summarized in Tables A and B.

TRANSMITTER OPTIONS

Continuous Scan Mode (Option Y)

2.02 In the continuous scan mode, the transmitter sends out a continuous bit stream at a rate determined by option P, Q, R or S. The rate at which data leads are sampled in the continuous scan mode is a function of the number of bits per word; therefore, the sampling rate is slower for sets with a larger number of data input leads. Sampling rates are given in Table C.

Start-Step Mode (Option X)

2.03 This option can be installed instead of the continuous-scan option. With this option the transmitter samples the data leads and transmits each word on user command, instead of continuously and automatically as with option Y. The start command is in the form of a positive transition from 0 to 4.5 volts on the G1 ("go" or "start") lead. With this option, data can be transmitted at any rate convenient to the customer up to the continuous scan rate listed in Table C.

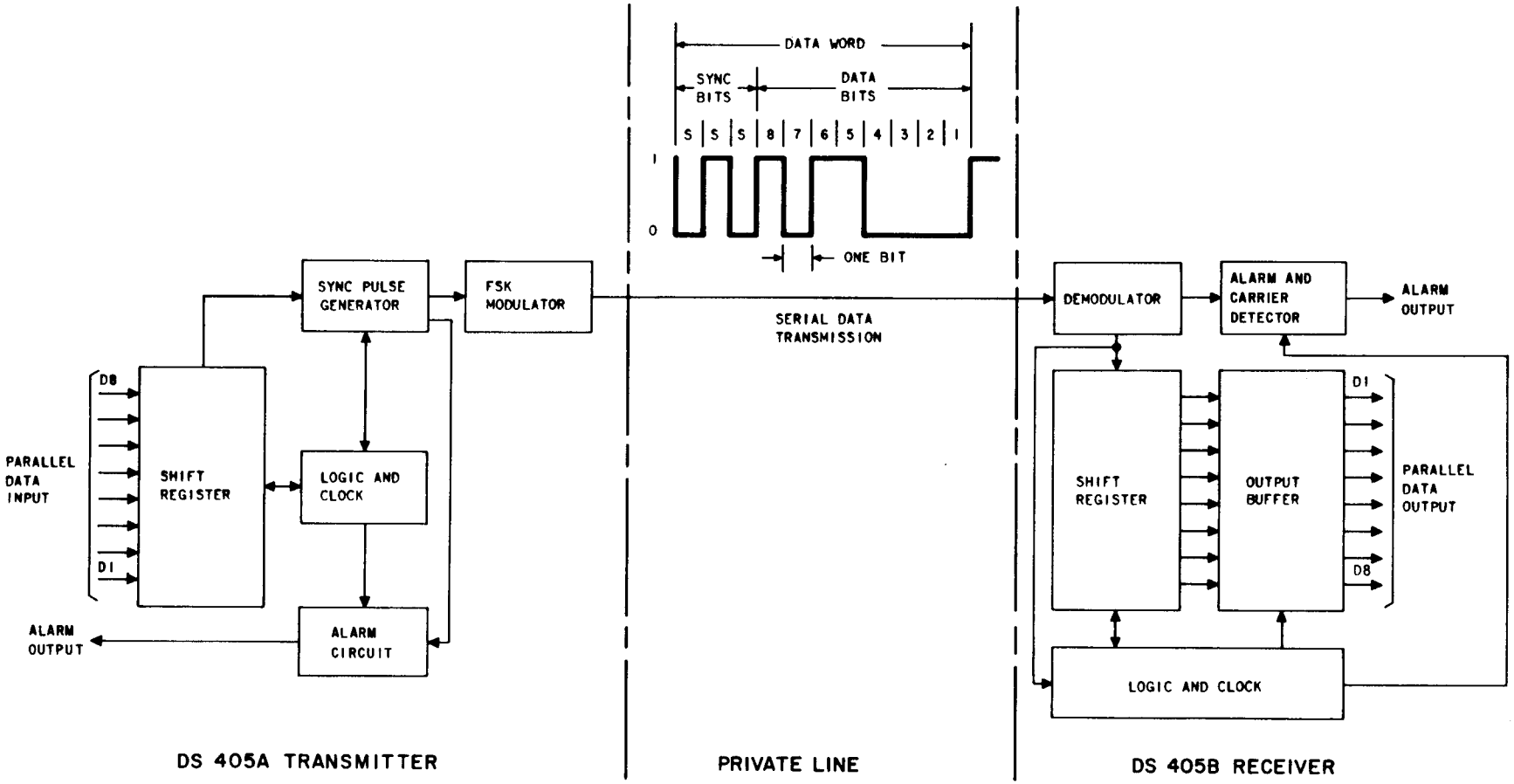

Fig. 1— Parallel-to-Serial Conversion, Serial Transmission, and Serial-to-Parallel Conversion

TABLE A

DATA SET 405A TRANSMITTER OPTIONS

OPTION		DATA SET 405A LIST NO.		
DESIGNATION	FUNCTION	L1A	L1/2	L1/3
Y	Continuous Scan	X	X	X
X	Start-Stop			
W in	8-Bit Word Only	X		
W out	More Than 8-Bit Word		X	X
S	700 bps Rate			
R	880 bps Rate	X	X	
Q	1400 bps Rate			X
P	1760 bps Rate			

Note: X denotes factory-furnished option. No X denotes customer-requested option.

TABLE B

DATA SET 405B RECEIVER OPTIONS

OPTION		DATA SET 405B LIST NO.		
DESIGNATION	FUNCTION	L1A	L1/2	L1/3
Y in	End-of-Word Check	X	X	X
Y out	No End-of-Word Check			
W in	8 Bits Only	X		
W out	More Than 8 Bits		X	X
S	Space Hold			
R	Mark Hold	X	X	X
S & R out	Hold Previous Outputs			
P	700 bps Rate			
N	880 bps Rate	X	X	
M	1400 bps Rate			X
K	1760 bps Rate			

Note: X denotes factory-furnished option. No X denotes customer-requested option.

Eight Bits Only (Option W)

2.04 This is a wired option in the DS 405A-L1A basic transmitter which accepts eight data inputs. This option is not wired into the basic transmitter when 20-bit or 32-bit service is requested by the customer.

Note: The transmitter and receiver for a given system ***must*** carry the same list number, in order to provide transmission and reception

TABLE C

SAMPLING RATES AND PERIODS OF DATA SET 405A TRANSMITTERS IN CONTINUOUS SCAN MODE

SPEED BITS/SEC	DS 405A CODE	SAMPLING RATE SAMPLES/SEC	SAMPLING PERIOD MILLISECONDS
700	L1A	63.636	15.714
	L1/2	30.438	32.857
	L1/3	20.000	50.000
880	L1A	80.000	12.500
	L1/2	38.261	26.136
	L1/3	25.143	39.773
1400	L1A	127.273	7.857
	L1/2	60.870	16.429
	L1/3	40.000	25.000
1760	L1A	160.000	6.250
	L1/2	76.552	13.068
	L1/3	50.286	19.886

of the same number of bits per word; ie, 8, 20, or 32.

2.05 In each of the following ***transmitter*** bit-rate options, the ***receiver*** must be provided with the corresponding bit-rate option.

700 Bits Per Second (Option S)

2.06 This option provides 700 bps transmission. Option P must be provided in the receiver.

880 Bits Per Second (Option R)

2.07 This bit rate option is factory-furnished in data set lists L1A and L1/2. Option N must be provided in the receiver.

1400 Bits Per Second (Option Q)

2.08 This bit rate option is factory-furnished in list L1/3 data sets. Option M must be provided in the receiver. Option Q can only be used when the interconnecting transmission channel is equivalent to a 3002 line with C1 conditioning.

1760 Bits Per Second (Option P)

2.09 This option may be chosen instead of one of the slower bit rates. Option K must be provided in the receiver. Option P can only be used when the interconnecting transmission channel is equivalent to a 3002 line with C2 conditioning.

RECEIVER OPTIONS

End of Word (Option Y)

2.10 This factory-furnished option may be used only when the transmitter is operated in the continuous-scan mode (transmitter option Y). It allows the receiver to check received signal format by monitoring its internally generated end-of-word (EOW) signal.

Eight Bits Only (Option W)

2.11 This option in the DS 405B-L1A basic receiver restricts the number of bits per word to eight.

Note: The transmitter and receiver for a given system ***must*** carry the same list number, in order to provide transmission and reception

of the same number of bits per word; ie, 8, 20, or 32.

Space Hold (Option S)

2.12 This option forces the data outputs to go to the space-hold state (closed) during an alarm condition which is caused by loss of carrier, loss of sync, or improper EOW if option Y is incorporated in the receiver.

Mark Hold (Option R)

2.13 This option forces the data outputs to go to the mark-hold state (open) during an alarm condition caused by loss of carrier, loss of sync, or improper EOW if option Y is incorporated in the receiver. Also, loss of −48 or +4.5 volt power causes the data outputs to immediately go to the mark-hold state, regardless of which options are installed. During a fault, the receiver does not shift new data to the output register; the previously received word remains in the output register for the duration of the fault. Thus if neither option R nor S is incorporated, the data prior to the fault condition remains at the data output for the duration of the fault; if an alarm results, the prior data also remains during the alarm condition.

700 Bits Per Second (Option P)

2.14 This option provides 700 bps reception, and must be used with the 700 bps transmitter option (option S).

880 Bits Per Second (Option N)

2.15 This option provides 880 bps reception in the DS 405B-L1A and -L1/2 receivers, and must be used with the 880 bps transmitter option (option R).

1400 Bits Per Second (Option M)

2.16 This option provides 1400 bps reception in the DS 405B-L1/3 receiver, and must be used with the 1400 bps transmitter option (option Q). It can only be used on channels equivalent to a 3002 line with C1 conditioning.

1760 Bits Per Second (Option K)

2.17 This option may be used instead of the slower bit rates, and must be used with the 1760 bps transmitter option (option P). It can only be used on channels equivalent to a 3002 line with C2 conditioning.

3. INTERFACE LEADS

3.01 The interface leads described herein provide for connecting inputs and outputs between the customer and the data set, and for interconnecting between the basic (8-bit word) transmitter or receiver and the expansion (20- or 32-bit word) transmitter or receiver.

Transmitter Using 8-Bit Word

3.02 For a DS 405A transmitter installation using an 8-bit word, refer to Fig. 2 and Table D for lead designations.

Transmitter Using 20-Bit Word

3.03 For a DS 405A transmitter installation using a 20-bit word, refer to Fig. 2 and Tables D, E, and G for lead designations. Tables D and E list all the customer interface leads. The leads listed in Table G carry intermodule signals which are internal to the data set and are not available to the customer.

Transmitter Using 32-Bit Word

3.04 For a DS 405A transmitter installation using a 32-bit word, refer to Fig. 2 and Tables D, F and G for lead designations. Tables D and F list all the customer interface leads. The leads listed in Table G carry intermodule signals which are internal to the data set and are not available to the customer.

Receiver Using 8-Bit Word

3.05 For a DS 405B receiver installation using an 8-bit word, refer to Fig. 3 and Table H for lead designations.

Receiver Using 20-Bit Word

3.06 For a DS 405B receiver installation using a 20-bit word, refer to Fig. 3 and Tables H, I, and K for lead designations. Tables H and I

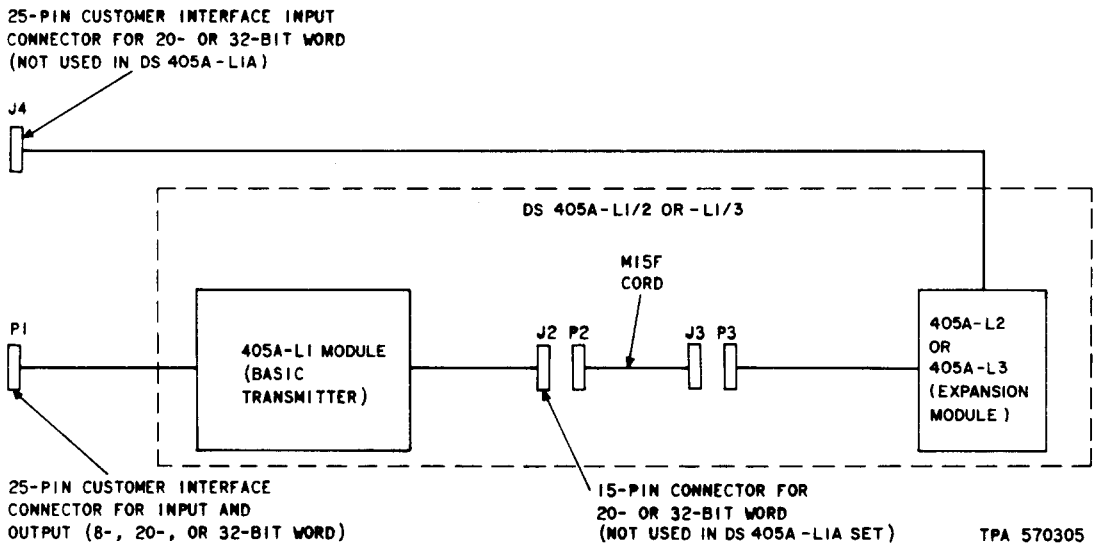

Fig. 2—Data Set 405A-Type—Interconnection Diagram

list all the customer interface leads. The leads listed in Table K carry intermodule signals which are internal to the data set and are not available to the customer.

Receiver Using 32-Bit Word

3.07 For a DS 405B receiver installation using a 32-bit word, refer to Fig. 3 and Tables H, J, and K for lead designations. Tables H and J list all the customer interface leads. The leads listed in Table K carry intermodule signals which are internal to the data set and are not available to the customer.

3.08 The following paragraphs provide a more detailed explanation of the signals present on the interface leads than the abbreviated information presented in Tables D through K.

TRANSMITTER

3.09 ***D1 Through D8 (Table D):*** These leads carry the first eight parallel data inputs from the customer interface to the data set. An open or a −48 volts is recognized as a logical 1; a ground through less than 20,000 ohms is recognized as a logical 0. The zero state should be provided through much less than 20,000 ohms to minimize effects of noise. Relay contact protection should be provided to protect the data set from transients.

3.10 ***−48V and GRD (Table D):*** These leads supply central office power to the basic transmitter.

3.11 ***G1 (Table D):*** This lead provides the start command when the transmitter is operated in the start-stop mode. Zero volt corresponds to a logical 0; +4.5 volts corresponds to a logical 1. This lead connects directly to a logic component of the data set, therefore the input voltage should not exceed the 4.5 volt level required for a logical 1.

3.12 ***Fault (Table D):*** The fault signal is an indication to the customer that the alarm timing circuit has been initiated, and is caused by either loss of transmitter or improper EOW in continuous-scan mode. Persistence of the fault signal for about 1 second causes an alarm indication. The fault output is similar to the data outputs of the 405B receiver except for one important difference. Any relay or register coil from fault to a negative voltage must have a ***diode*** across it to protect the data set from inductive transients. A fault will cause the relay or register to operate.

3.13 ***Alarm (Table D):*** These leads provide a contact closure between them to give an alarm during some trouble conditions, as follows:

- Fault indication for about 1 second

TABLE D

DATA SET 405A-L1A CUSTOMER INTERFACE CONNECTOR P1
LEAD DESIGNATIONS FOR BASIC TRANSMITTER
(8-, 20-, OR 32-BIT WORD)

P1 CONNECTOR PIN NO.	DESIGNATION	FUNCTION
Input Lead		
3	D8	Parallel data input leads from customer interface
4	D7	
5	D6	
6	D5	
8	D4	
9	D3	
10	D2	
11	D1	
14	−48V	CO power
16	Grd	CO power ground
24	G1	Start command for start-stop operation
Output Lead		
7	Fault	Auxiliary trouble indication
12	Alarm	Trouble indication requiring attention
13		
21	600 Ω	Serial data output
23		
25	EOW	End-of-word signal

Note: Pins not listed are not connected.

- Failure of CO −48 volt supply
- Failure of internal +4.5 volt supply.

An alarm indication requires immediate attention. The two alarm leads may be used to separate an audible and/or visual alarm in the central office. The alarm indication is removed if the fault indication is absent for about 2 seconds.

3.14 ***600Ω (Table D):*** These two leads carry the serial data output from the transmitter and connect to the private line pair for data transmission.

3.15 ***EOW (Table D):*** The end-of-word signal indicates whether a word is being transmitted. This lead is intended for use in future applications and is of no use in remoting traffic registers. EOW is generated by logic circuits within the transmitter. Zero volt indicates a logical 0; +4.5 volts indicates a logical 1. The EOW signal is zero during transmission of a word and 1 between words. In start-stop mode, EOW can be monitored by the customer to determine when the set is ready to transmit the next word. In continuous-scan mode, the EOW signal is a positive pulse of about 10-μs duration between words. EOW can be monitored by the customer to determine the maximum rate at which the input data can be changed and still be sampled. New data is loaded into the transmitter at the trailing edge of the EOW pulse.

3.16 ***D9 Through D20 (Table E) or D9 Through D32 (Table F):*** These leads provide parallel data inputs to DS 405A-L1/2 and DS 405A-L1/3,

TABLE E

DATA SET 405A-L1/2 CUSTOMER INTERFACE CONNECTOR J4
LEAD DESIGNATIONS (20-BIT WORD)

J4 CONNECTOR PIN NO.	DESIGNATION	FUNCTION
1	D9	Parallel Data Input Leads From Customer Interface
2	D10	
3	D11	
4	D12	
5	D13	
6	D14	
7	D15	
8	D16	
9	D17	
10	D18	
11	D19	
12	D20	

Note: Pins not listed are not connected.

respectively, for expanding the basic transmitter input capacity from 8 inputs to 20 or 32 inputs.

RECEIVER

3.17 ***D1 Through D8 (Table H):*** These leads provide the received data outputs to the customer interface. The output circuits consist of relay drivers for the respective data leads, so that a relay coil may be connected between each data output lead and a negative voltage not exceeding a nominal −48 volts. Operation of a relay indicates reception of the spacing frequency, and release of a relay indicates reception of the marking frequency. All data outputs are simultaneously updated immediately after reception of each word. Each data output is capable of delivering up to 90 mA; however, no internal current limiting is provided. Therefore, sufficient resistance should be provided between the relay driver circuit and the negative voltage supply to protect the circuit, ie, not to exceed the 90-mA limit of the relay drivers. This implies that a total of at least 600 ohms is necessary between each data output terminal of the data set and −48 volts. Thus, if message registers with coil resistance less than 600 ohms are used, additional resistance must be placed in series with each coil. The relay drivers are provided with transient voltage protection, so that the relay coils do not need protection circuitry.

3.18 ***Fault (Table H):*** A signal on this lead is an indication to the user that the alarm timing circuit has been initiated. It is caused by any one of the following trouble conditions:

- Loss of received carrier. Lost carrier is defined as when the received signal level drops below −48 dBm for about 15 ms, with intermittent restorals of less than 4 ms before the fault indication is removed.

- Loss of synchronization. The fault indication persists until sync is reestablished for three consecutive words.

- Improper end-of-word if option Y is installed (transmitter operating in continuous-scan mode only.) The fault signal is identical to that described in 3.12. A relay or register coil may be connected between the fault output and −48 volts; a fault indication will cause the relay to operate. A diode should be placed across the relay coil to protect against inductive transients. Data is not shifted to the customer during a fault condition. The data word received prior to

TABLE F

DATA SET 405A-L1/3 CUSTOMER INTERFACE CONNECTOR J4
LEAD DESIGNATIONS (32-BIT WORD)

J4 CONNECTOR PIN NO.	DESIGNATION	FUNCTION
1	D9	Parallel Data Input Leads From Customer Interface
2	D10	
3	D11	
4	D12	
5	D13	
6	D14	
7	D15	
8	D16	
9	D17	
10	D18	
11	D19	
12	D20	
13	D21	
14	D22	
15	D23	
16	D24	
17	D25	
18	D26	
19	D27	
20	D28	
21	D29	
22	D30	
23	D31	
24	D32	

Note: Pin 25 is not connected.

the fault is frozen in the output register of the receiver until the fault is removed or until an alarm indication occurs due to persistence of the fault indication for about 1 second. Once the alarm condition occurs, the output is dependent on the option installed (R, S, or neither R nor S). If the fault indication is absent for about 2 seconds, the alarm indication is removed. In the receiver, a fault indication does not require immediate attention but does give an indication of the quality of the received signal, while an alarm condition requires immediate attention.

3.19 ***Alarm (Table H):*** The alarm leads provide a contact closure during the following trouble conditions:

- Persistence of fault indication for about 1 second
- Loss of CO −48 volt supply
- Failure of the internal +4.5 volt supply

An alarm indication requires immediate attention. The two alarm leads may be used to operate an audible and/or visual alarm in the central office.

TABLE G

DATA SET 405A-L1A CONNECTOR J2
LEAD DESIGNATIONS (20 - OR 32-BIT WORD ONLY)

J2 CONNECTOR PIN NO.	DESIGNATION	FUNCTION
1	SD(8)	D1-D8 Data
2	SD	Total Serial Data
3	MT	"Empty" Indication
5	+4.5	Input Buffer 4.5-Volt Supply
6	+4.5	Logic Circuit 4.5-Volt Supply
7	GRD	Logic Circuit Ground
8	GRD	Input Buffer Ground
9	CLOCK	Clock
10	EOW	End-of-Word Signal
11	RDE	"Read" Command
14	−48 (QUIET)	Filtered −48 Volt Supply

Note 1: Connector J2 is not connected for 8-bit word service.

Note 2: Leads 5, 8, and 14 supply power to L1/2 and L1/3.

Note 3: Pins not listed are not connected.

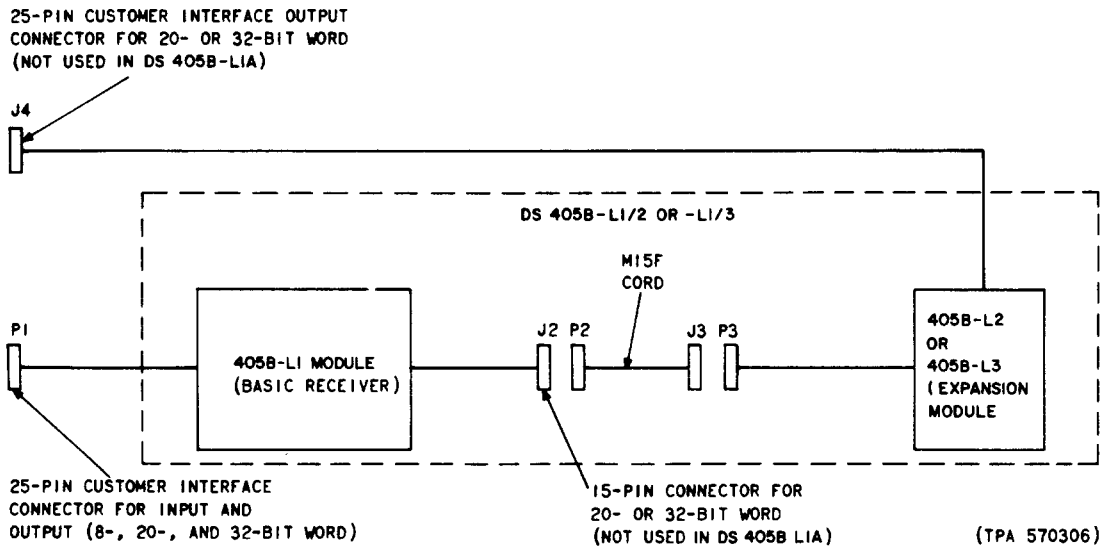

Fig. 3—Data Set 405B-Type—Interconnection Diagram

TABLE H

DATA SET 405B-L1A CUSTOMER INTERFACE CONNECTOR P1
LEAD DESIGNATIONS FOR BASIC RECEIVER
(8-, 20-, OR 32-BIT WORD)

P1 CONNECTOR PIN NO.	DESIGNATION	FUNCTION
Output Lead		
3	D8	Parallel Data Output Leads to Customer Interface
4	D7	
5	D6	
6	D5	
8	D4	
9	D3	
10	D2	
11	D1	
7	FAULT	Auxiliary Trouble Indication
12	ALARM	Trouble Indication Requiring Attention
13		
Input Lead		
14	−48V	CO Power
16	GRD	CO Power Ground
21	600 Ω	Serial Data Input
23		

Note: Pins not listed are not connected.

Data at the outputs of the receiver will be one of three ways during an alarm depending on option installed.

- With option R installed, all outputs will revert to mark hold during alarm (no current delivered by the relay drivers).
- With option S installed, all outputs will revert to space hold during alarm (current supplied from relay drivers).
- If neither option R nor S is incorporated, the word prior to the fault will remain frozen in the output register of the receiver.

3.20 ***−48V and GRD (Table H):*** These leads provide −48 volts from the CO supply to the receiver.

3.21 ***600Ω (Table H):*** These leads provide the input from the private line to the receiver.

3.22 ***D9 Through D20 (Table I) or D9 Through D32 (Table J):*** These leads provide parallel data outputs from the expansion modules (L2 and L3) of the DS 405B-L1/2 and DS 405B-L1/3 receivers, respectively, for expanding the basic receiver capacity from 8 outputs to 20 or 32 outputs.

TABLE I

DATA SET 405B-L1/2 CUSTOMER INTERFACE CONNECTOR J4
LEAD DESIGNATIONS (20-BIT WORD)

J4 CONNECTOR PIN NO.	DESIGNATION	FUNCTION
1	D9	Parallel Data Input Leads From Customer Interface
2	D10	
3	D11	
4	D12	
5	D13	
6	D14	
7	D15	
8	D16	
9	D17	
10	D18	
11	D19	
12	D20	

Note: Pins not listed are not connected.

TABLE J

DATA SET 405B-L1/3 CUSTOMER INTERFACE CONNECTOR J4
LEAD DESIGNATIONS (32-BIT WORD)

J4 CONNECTOR PIN NO.	DESIGNATION	FUNCTION
1	D9	Parallel Data Output Leads To Customer Interface
2	D10	
3	D11	
4	D12	
5	D13	
6	D14	
7	D15	
8	D16	
9	D17	
10	D18	
11	D19	
12	D20	
13	D21	
14	D22	
15	D23	
16	D24	
17	D25	
18	D26	
19	D27	
20	D28	
21	D29	
22	D30	
23	D31	
24	D32	

Note: Pin 25 is not connected.

TABLE K

DATA SET 405B-L1A CONNECTOR J2
LEAD DESIGNATIONS (20- OR 32-BIT WORD ONLY)

J2 CONNECTOR PIN NO.	DESIGNATION	FUNCTION
1	J8	Serial Output From 8-Bit Register
2	LB	Last Bit
3	G2	An End-of-Word Indication
4	CLR	Clear Command
5	+4.5	Logic Circuit 4.5-Volt Supply
6	—48	—48 Volt Supply
7	GRD	Logic Circuit Ground
8	GRD	Output Buffer Ground
9	READ	Read Command
10	CLOCK	Clock
11	SH	Space Hold
12	MH	Mark Hold
14	+4.5	Output Buffer 4.5-Volt Supply

Note 1: Connector J2 is not connected for 8-bit word service.

Note 2: Leads 6, 8, and 14 supply power to L1/2 and L1/3.

Note 3: Pins not listed are not connected.

4. REFERENCES

4.01 The following documents provide additional information on the DS 405-type data system.

SECTION	TITLE
312-809-100	405-Type Data System—Description
312-809-200	405-Type Data System—Installation
312-809-201	405-Type Data System and Interface Circuit for Message Register Remoting—Installation and Connections
312-809-301	405-Type Data System and Interface Circuit for Message Register Remoting—Maintenance
312-809-501	405-Type Data System and Interface Circuit for Message Register Remoting— Tests
252-140-101	Interface Circuit For Use Between 405-Type Data Sets and Message Registers in Remote Register Operation (SD-1C451-01)—Description
SD-&CD-1D203-01	Data Set 405A
SD-&CD-1D204-01	Data Set 405B