MOTOROLA INC.
Communications Sector

MSF 5000™ AND PURC 5000™ OPTION C565 REMOTE DIAGNOSTIC RS-232 INTERFACE

1. DESCRIPTION

1.1 The C565 Option provides a remote diagnostic capability to any *MSF 5000* Base or Repeater Station or *PURC 5000* Paging Station. The option consists of those items listed in Table 1. The option allows the owner/operator to use an EIA standard RS-232-C, Type-D serial data link to communicate with the station's internal serial bus. The internal serial bus is the Inter-Processor Communications Bus (IPCB). The communication link between the station and the owner/operator's monitoring location may be either via the Public Switched Telephone Network (PSTN), or a dedicated wireline.

Table 1. Option C565AA/AC Breakdown Chart

KIT	DESCRIPTION
TKN8421A	RS-232 Interface Cable Kit
TRN9422A	RS-232 Interface Board

1.2 The Model TRN9422A RS-232 Interface Board plugs onto the Model TRN9754A Wildcard Module, which is part of Option C232 or C233. The wildcard module provides the required MUXbus decoding and dc power necessary for the RS-232 board to operate. A Model TKN8421A RS-232 Interface Cable Kit interconnects the RS-232 board to the station Junction Box. One end of the cable is assembled to an 8-pin inline connector, which connects to the interface board. The other end of the cable is assembled to a DB-25 female connector, which is wired per the RS-232-C convention. The female DB-25 connector is mounted through one of the rectangular openings in the Junction Box. Refer to the attached schematic diagram for cabling details.

2. REMOTE DIAGNOSTIC SYSTEM DESCRIPTION

2.1 The remote diagnostic system consists of three elements. First, the diagnostic data gathering equipment at the station installation site. Second, a communications link between the station and the monitoring location. Third, the diagnostic equipment required to control and access the station.

2.2 The stations have built-in diagnostic capabilities that can be remotely accessed. The access is accomplished through the use of the RS-232 interface board. It converts the base station IPCB logic levels into the voltage levels required by the RS-232 communications data link, and the RS-232 levels into those required by the IPCB.

2.3 Signals to and from the interface board are routed through an asynchronous 300 or 1200 baud, auto-answer modem. By using a standard EIA modem, and connecting it between the station and a dial-up PSTN phone line, the remote diagnostic data link to the station installation site is completed. Refer to Figure 1.

3. TRN9422A RS-232 BOARD

3.1 DESCRIPTION

3.1.1 The Model TRN9422A RS-232 Interface Board provides remote data link capability by accessing the station's IPCB line. The IPCB signal line is the station's internal serial data bus. It connects every microprocessor-based module in the station. Each microprocessor continuously monitors the IPCB looking for commands addressed to it and ignoring the rest. When it sees a command, it responds by sending the requested information back down the same shared IPCB line. The RS-232 board accesses the IPCB, converts the signals to EIA voltage levels, and provides a true RS-232 connection to the outside world, via a customer supplied cable to the site located modem.

3.1.2 Connection to the IPCB gives immediate access to all of the station's microprocessors, even to those that may be added in the future, so long as it connects to the IPCB. Each microprocessor can be individually interrogated, and all of the station's status, memory, and I/O is available through the serial port provided by the RS-232 interface board. Even the diagnostic display information is retrievable from any of the microprocessor-based modules. A comparison of this information will show if signals are properly reaching each module, by asking for the same information from different microprocessor-based modules.

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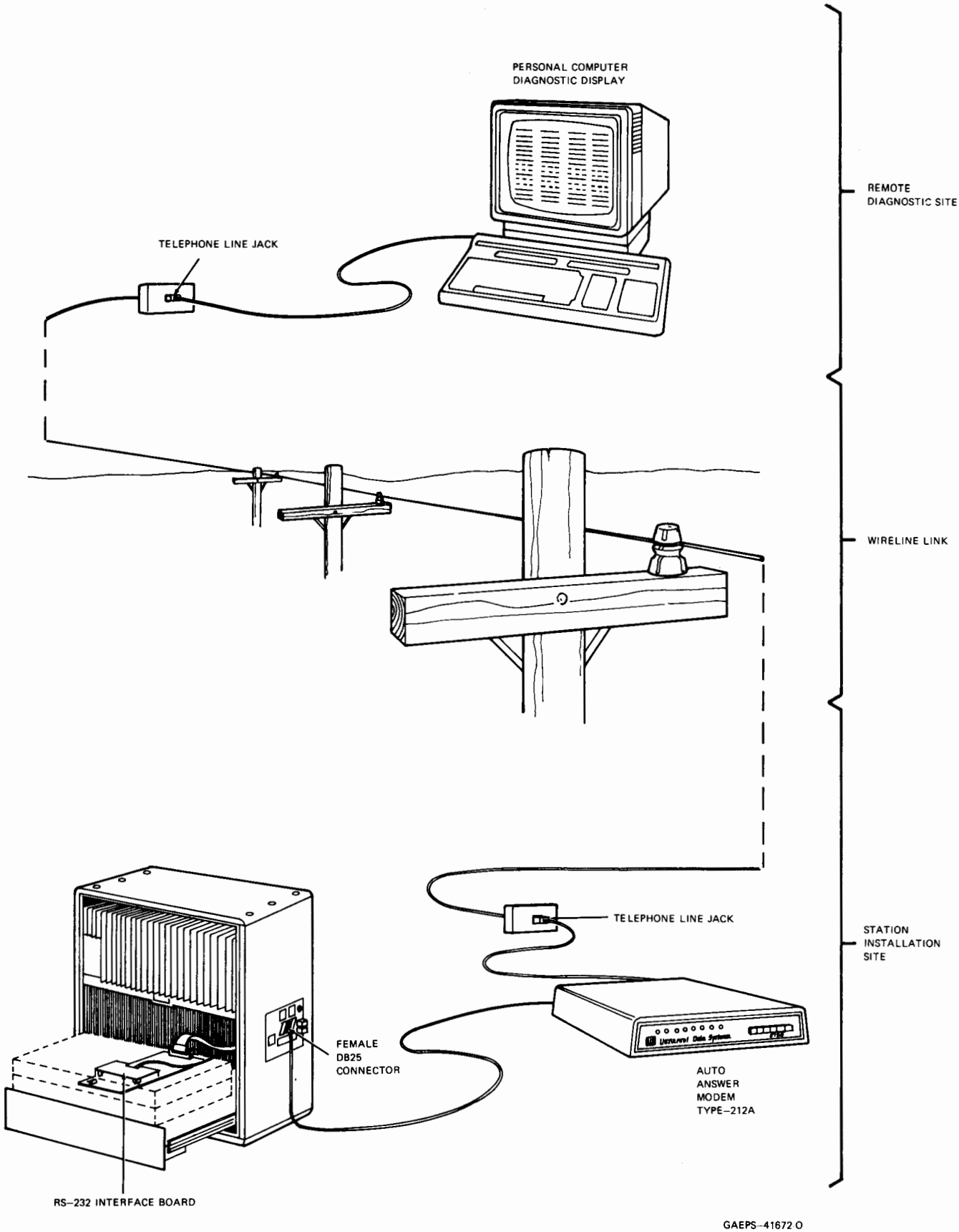


Figure 1. Typical Remote Diagnostic Data Link Hook-Up

3.1.3 At the monitoring location, any personal computer with a modem compatible with the equipment at the installation site can be used to communicate with the site. The main requirement is that the computer be capable of sending and receiving ASCII characters to the modem, under control of a high level language, such as BASIC. By using one of the new "intelligent" modems, the computer can be programmed to automatically dial each system installation site, at preset times, to perform housekeeping functions. Manual dialing is also possible, by using existing telephone equipment. Consult your Motorola sales representative for information regarding the types of remote diagnostic software that are currently available.

3.2 THEORY OF OPERATION

3.2.1 Baud Rate Control

The RS-232 interface board monitors the SCF circuit Secondary Received Line Signal Detector control line (pin-12 of the DB-25 connector) from dual rate type-212A modems, and configures the station for either 300 or 1200 baud operation. As shipped from the factory, the RS-232 interface board is set-up for automatically selected operation at either 300 or 1200 baud. The installation of jumper JU2201 will force the board to function at 300 baud only, should such operation be a requirement for a particular system.

NOTE

When 300 baud operation is employed, the MUXbus has that information placed onto it at BD0 by the RS-232 board, via P2205-3. A C668 Diagnostic Metering Panel (DMP) Option may be used to visually indicate that 300 baud operation is in effect. When properly connected to the station, the DMP will cause the LED at Address 7, Data Line 0 to be lit to signify 300 baud operation.

3.2.2 Static Control Lines

Board mounted pull-up resistors are provided on the Request-To-Send (RTS) and Data-Terminal-Ready (DTR) control lines. These pull-up resistors are provided in the event that the modem being used at the installation site requires a signal on these lines to operate. Additionally, a place is provided for the field installation of a pull-up resistor on the spare output line at P2206-5. This line normally corresponds to the Ring Indicator (RI) line of a modem.

3.2.3 Active Control Lines

The following paragraphs describe only the interchange circuits used by the Model TRN9422A RS-232 Interface Board. Any interchange circuits not used by this board are described in other publications, such as the EIA Standard RS-232-C: "Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange."

3.2.3.1 Transmit Data **Tx Data**

The signals on this line are either outbound signals, created by the station and routed to the RS-232 interface board via the station's IPCB signal line; or, are the inbound receive data signals echoed back to the modem. The RS-232 interface board uses a differential input operational amplifier (U2203) to convert the 0 to +5 V IPCB signal into RS-232 compatible voltage levels. The RS-232 interface board will force the Tx Data line to the LO state or MARK condition (-3 V to -15 V), whenever no data is being sent or during the intervals between characters and words.

3.2.3.2 Receive Data **Rx Data**

The signals on this line are created by the remote monitoring equipment that is sending data to the station. The inbound signal to the RS-232 interface board is translated from RS-232-C compatible voltage levels (+15 to -15 V), by transistor Q2202, into the 0 to +5 V signal levels required by the IPCB line of the station.

3.2.3.3 Carrier Detect **CD**

The signal on this line is created by the remote monitoring equipment and sent to the RS-232 interface board. The presence of the CD signal indicates that the remote monitoring device is sending data to the RS-232 interface board, via the Rx line.

NOTE

In order to condition the station to operate at a 300 baud communication rate, the CD signal must be in the HI state or SPACE condition (+3 V to +15 V), and the Baud Rate control line (if used) must be in the LO state or MARK condition. If the Baud Rate control line is not used, then JU2201 must be installed on the RS-232 interface board.

3.2.4 IPCB Interface Circuit Delay Timer

The circuitry that includes U2202A, U2201B, and Q2204 prevents the remote monitoring equipment from placing its data onto the IPCB line whenever any of the following conditions occur.

1) A station $\overline{\text{RESET}}$ occurs, due to either AC power-up, or system reset, or manual station reset.

2) The Wildcard OPERATE/RESET switch (S1301) is toggled from the operate position, to the reset position, and then back to the operate position.

The timing sequence shown in Figure 2 assumes that the reset condition was initiated by the station control board and not by the wildcard module. When a station RESET is initiated, an 8 msec. positive going reset pulse occurs approximately 0.7 sec. later. Its rising edge activates timer U2201B, via the inverting action of U2202A. The output signal from the timer at U2201B-9 causes Q2204 to conduct for no less than 9 Sec. (typically 12 sec.). Any Receive Data signals that might be present at J2206-1 will be shunted to ground by Q2204, thus preventing any interference of station housekeeping tasks by inbound data. Station housekeeping tasks are the self diagnostic tests required by the microprocessor based modules present in the station. In the case of the wildcard reset, the RS232 interface board delay timer trigger input (U2201B, pin 8) will not activate until the rising edge of the RESET line at P2204, pin 2 occurs. When this happens, the delay timer output (U2201B, pin 9), is pulled high, turning on transistor Q2204 and preventing inbound RX DATA from reaching the IPCB line. This allows the station approximately 12 seconds to complete its self-diagnostic routines.

3.3 INSTALLATION AND SET-UP

Certain modem types require internal DIP switch settings as shown in Table 2.

NOTE

If your particular installation requires 300 baud rate communications and the modem is not capable of providing an RS232 interface voltage of between -3 and -25 volts at pin 6 of connector J2206, then jumper JU2201 on the RS232 interface board must be installed. This will cause the station to change to 300 baud operation when a valid carrier detect occurs.

NOTE (Cont'd.)

IMPORTANT

The newer version wildcard OPERATOR/RESET toggle switch (S1301) has a spring loaded "return to center" type of action that causes the toggle switch to automatically return to the center position after the switch is depressed into the RESET (down) position. Normal wildcard and RS232 interface board operation will resume with switch S1301 in either the center or up position. On older version wildcards using the 2-position type switch, care must be taken to assure that the switch is not left in the RESET position. Otherwise, the RS232 interface board delay timer trigger input will not allow a station reset to restart the delay timer. If this situation occurs while data is being sent to the station via the RX DATA line, it may disrupt the IPCB line and cause a station diagnostic failure.

Table 2. Modem Internal DIP Switch Settings

Modem Type	DIP Switch Settings*
UDS 212 A/D	Switch Band S1: No. 3 and No. 7 must be off. Switch Bank S2: No Changes. Switch Band S3: No. 4 must be on.
Hayes Smartmodem 1200	Switch No. 1 and No. 6 should be up. (Switches are located directly behind the front bezel of the modem).

*It is assumed that the modem used in your application has its internal DIP switches and/or jumper settings in their original positions as shipped from the factory prior to making the changes indicated in Table 2. Consult your modem owner's manual for details.

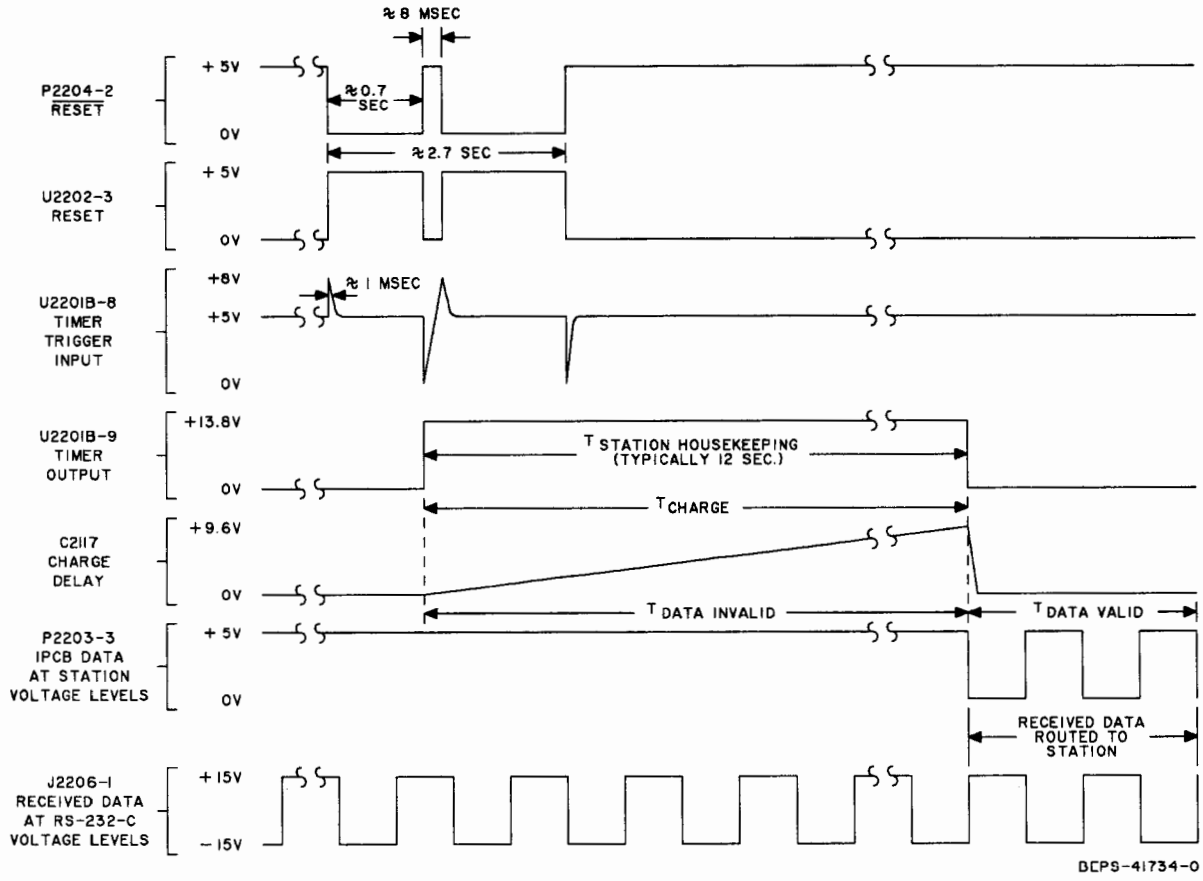


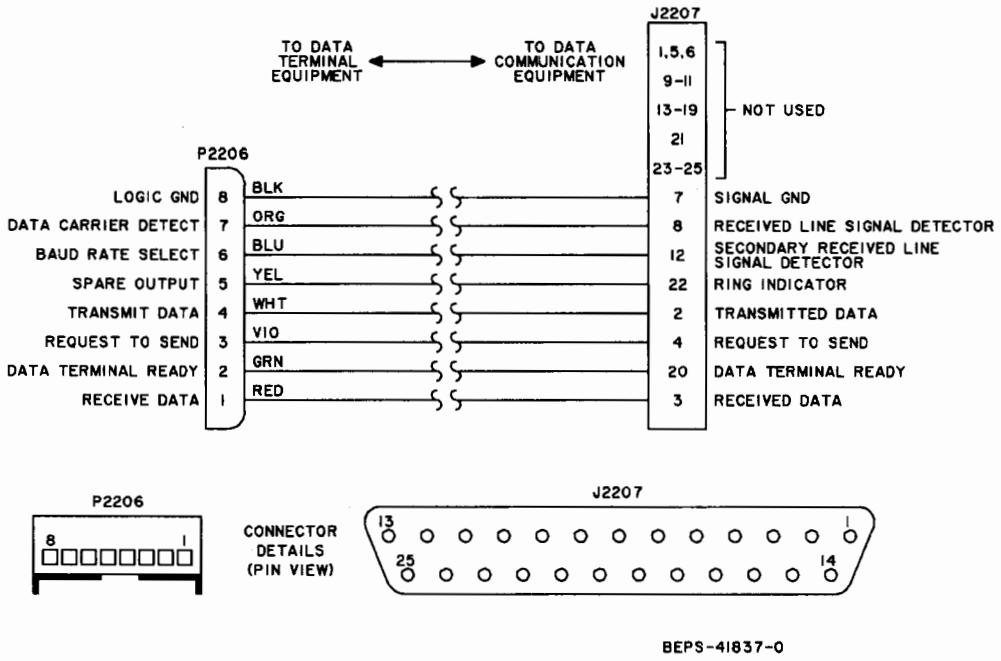
Figure 2. IPCB Interface Circuit Delay Timing Diagram

RS-232 INTERFACE CABLE KIT
MODEL TKN8421A

parts list

TKN8421A RS-232 Interface Cable Kit — PL-9597-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector,receptacle:
P2206	15-83142M09	female; 8-contact
P2207	15-84256L01	female, 25-contact; DB-25 type
		mechanical parts
	2-82009R01	NUT, hex: 4-40; 2 used
	39-82717M01	CONTACT, lug; 8 used (P2206)
	39-84257L01	CONTACT, lug; 8 used (P2207)
	42-10217A02	STRAP, tie; 12 used
	42-10217A30	STRAP, tie: .091 × 3.62"; 2 used
	43-10646A08	SPACER, hex; 2 used



Schematic Diagram and Parts List
Motorola No. ***PEPS-41861-A***
12/10/86- UP

RS-232 INTERFACE BOARD
MODEL TRN9422A

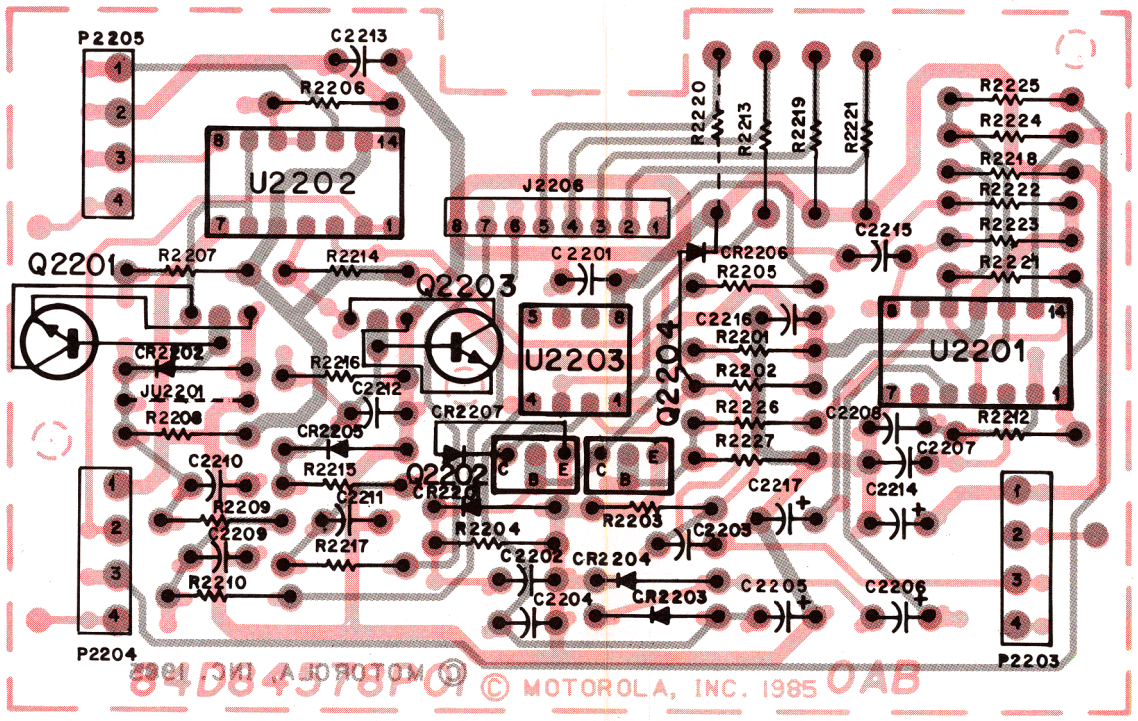
parts list

TRN9422A RS-232 Interface Board — PL-9596-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF ±5%; 50 V: unless otherwise stated
C2201	8-11044A11	.033; 63 V
C2202, 2203	21-11014H32	20 pF; 100 V
C2204	8-11044A11	.033; 63 V
C2205, 2206	23-11019A46	100 ±20%; 25 V
C2207	21-11021G07	.01 +100-o%
C2208	8-11017A01	.001
C2209	8-11044A27	0.1
C2210	21-11014H32	20 pF; 100 v
C2211	8-11044A27	0.1
C2212	21-11014H32	20 pF; 100 V
C2213	21-11021G07	.01 +100-0%
C2214	23-11019A09	1 ±20%
C2215	8-11044A27	0.1
C2216	21-11021G07	.01 +100-0%
C2217	23-11019A46	100 ±20%; 25 V
		diode: (see note)
CR2201-2205	48-11034A01	silicon
CR2206	48-83654H01	silicon
CR2207	48-11034D01	silicon
		connector, receptacle:
J2206	28-82041P02	male: 8-contact; right angle
		connector, plug:
P2203, 2204, 2205	9-83445L07	female; 4-contact
		transistor: (see note)
Q2201 thru 2204	48-869528	NPN: type M9528
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R2201	6-11009A75	12k
R2202	6-11009A93	68k
R2203	6-11009A65	4.7k
R2204	6-11009A75	12k
R2205	6-11009A65	4.7k
R2206, 2207	6-11009A73	10k
R2208	6-11009A77	15k
R2209	6-11009A57	2.2k
R2210	6-11009A61	3.3k
R2211	6-11009A64	4.3k
R2212	6-11009A88	43k
R2213	6-125A53	1.5k ±10%; 1/2 W
R2214	6-11009A73	10k
R2215	6-11009A57	2.2k
R2216	6-11009A83	27k
R2217	6-11009A61	3.3k
R2218	6-11009A07	18
R2219	6-125A59	2.7k; 1/2 W
R2220		NOT USED
R2221	6-125A59	2.7k; 1/2 W
R2222, 2223	6-11009A73	10k
R2224	6-11009A25	100
R2225	6-11009B05	200k
R2226	6-11009A65	4.7k
R2227	6-11009A73	12k
		integrated circuit: (see note)
U2201	51-84371K76	dual timer
U2202	51-84371K83	quad 2-input NAND with o/c outputs
U2203	51-83629M16	dual low-power operational amplifier

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

Circuit Board Detail and Parts List
*Motorola No. **PEPS-41838-A***
(Sheet 1 of 2)
12/10/86- UP



COMPONENT SIDE
SOLDER SIDE

BD - BEPS - 41736 - O
BD - BEPS - 41737 - O
OL - BEPS - 41738 - O

SHOWN FROM SOLDER SIDE

J2206

1	RECEIVE DATA
2	DATA TERMINAL READY
3	REQUEST TO SEND
4	TRANSMIT DATA
5	SPARE OUTPUT
6	BAUD RATE SELECT
7	DATA CARRIER DETECT
8	LOGIC GND

P2205

1	$\overline{A7}$
2	+5V
3	$\overline{BD\ 6}$
4	SPARE

P2203

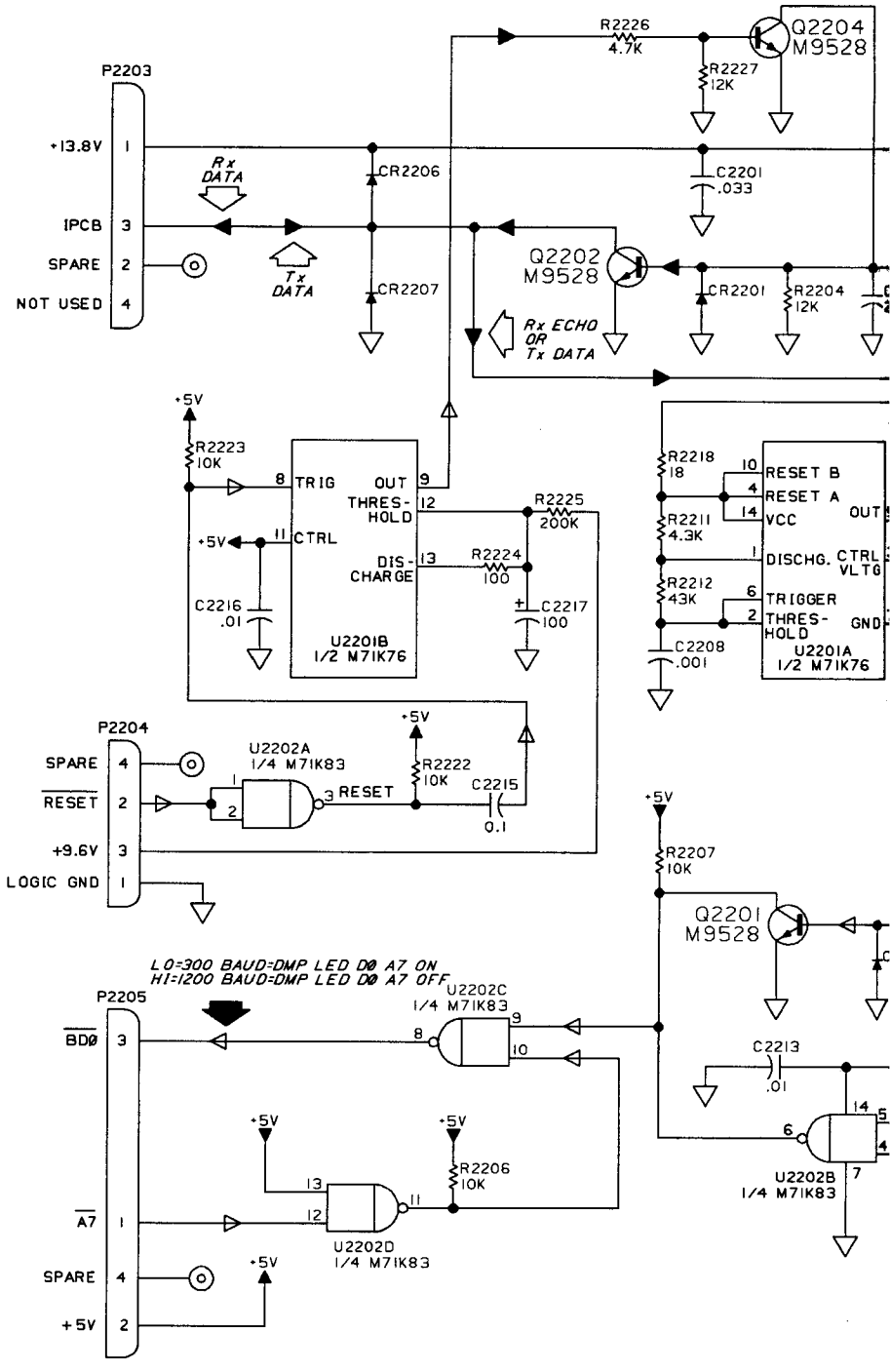
1	+13.6V
2	SPARE
3	IPCB
4	NOT USED

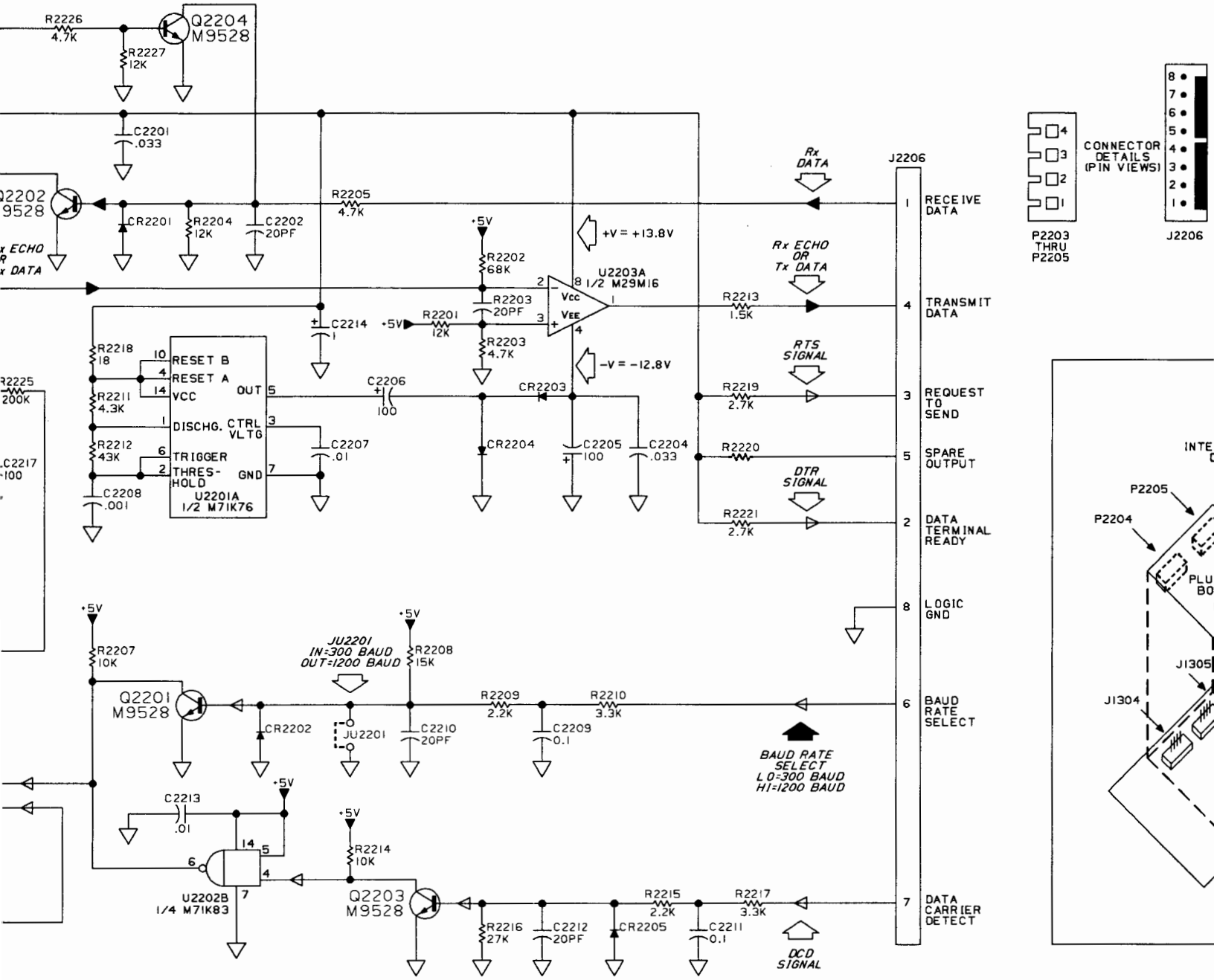
P2204

1	LOGIC GND
2	$\overline{RESET}$
3	+ 9.6V
4	SPARE

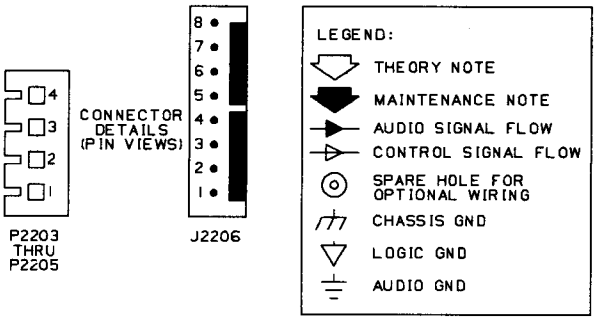
PIN VIEW

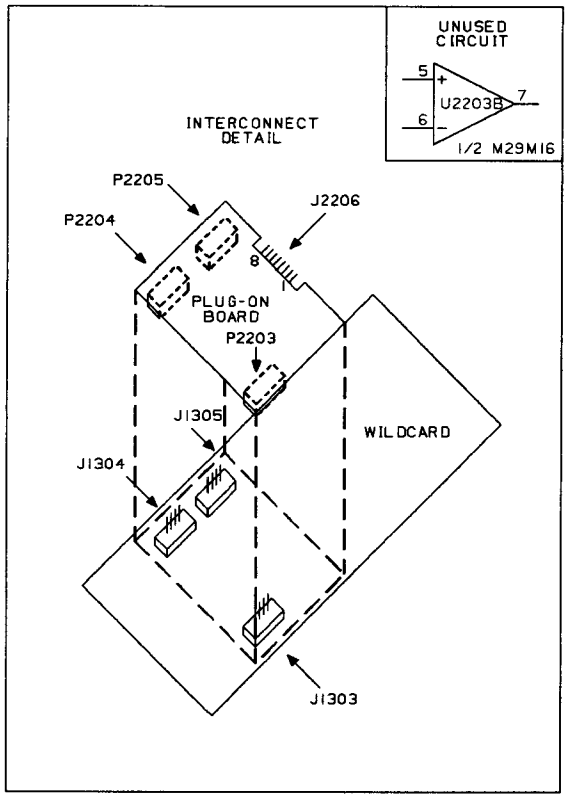
C B E
Q2201 - Q2204


P2203
+13.8V
IPCB
SPARE
NOT USED
Rx DATA
Tx DATA
CR2206
CR2207
R2226
4.7K
Q2204
M9528
R2227
12K
C2201
.033
Q2202
M9528
CR2201
R2204
12K
Rx ECHO OR Tx DATA
+5V
R2223
10K
TRIG
OUT
THRES-HOLD
CTRL
DIS-CHARGE
R2225
200K
R2224
100
C2216
.01
C2217
100
U2201B
1/2 M71K76
R2218
18
RESET B
RESET A
VCC
R2211
4.3K
DISCHG.
CTRL VLTG
R2212
43K
TRIGGER
THRES-HOLD
GND
C2208
.001
U2201A
1/2 M71K76
P2204
SPARE
RESET
+9.6V
LOGIC GND
U2202A
1/4 M71K83
R2222
10K
C2215
0.1
L0=300 BAUD=DMP LED D0 A7 ON
HI=1200 BAUD=DMP LED D0 A7 OFF
P2205
BD0
A7
SPARE
+5V
U2202C
1/4 M71K83
R2206
10K
U2202D
1/4 M71K83
R2207
10K
Q2201
M9528
C2213
.01
U2202B
1/4 M71K83


R2226 4.7K
Q2204 M9528
R2227 12K
C2201 .033
R2205 4.7K
CR2201
R2204 12K
C2202 20PF
Rx DATA
J2206
1 RECEIVE DATA
+5V
+V = +13.8V
R2202 68K
U2203A 1/2 M29M16
Vcc
VEE
R2203 20PF
R2203 4.7K
R2201 12K
C2214 1
Rx ECHO OR Tx DATA
R2213 1.5K
4 TRANSMIT DATA
-V = -12.8V
RTS SIGNAL
R2218 18
R2211 4.3K
R2212 43K
C2208 .001
RESET B
RESET A
VCC
DISCHG.
TRIGGER
THRES-HOLD
CTRL VLTG
OUT
GND
U2201A 1/2 M71K76
C2206 100
CR2203
C2207 .01
CR2204
C2205 100
C2204 .033
R2219 2.7K
3 REQUEST TO SEND
R2220
5 SPARE OUTPUT
DTR SIGNAL
R2221 2.7K
2 DATA TERMINAL READY
8 LOGIC GND
R2207 10K
JU2201 IN=300 BAUD OUT=1200 BAUD
R2208 15K
Q2201 M9528
CR2202
JU2201
C2210 20PF
R2209 2.2K
R2210 3.3K
C2209 0.1
6 BAUD RATE SELECT
BAUD RATE SELECT LO=300 BAUD HI=1200 BAUD
C2213 .01
R2214 10K
U2202B 1/4 M71K83
Q2203 M9528
R2215 2.2K
R2217 3.3K
R2216 27K
C2212 20PF
CR2205
C2211 0.1
7 DATA CARRIER DETECT
DCD SIGNAL
P2203 THRU P2205
CONNECTOR DETAILS (PIN VIEWS)
J2206
P2205
P2204
J1305
J1304

RS-232 INTERFACE BOARD
MODEL TRN9422A





EEPS-41735-O

NOTES:

1. Unless otherwise specified, all resistor values are in ohms and capacitor values are in microfarads.
2. The Model TRN9422A RS-232 Interface Board circuitry fits the EIA definition of "data terminal equipment (DTE)."
3. J2206 Signal Definitions:

J2206-1 RECEIVE DATA (**Rx Data**)
Direction: FROM data communication equipment (DCE).
Signals on this line are generated by the site located modem (DCE) in response to data signals sent from remote monitoring equipment, via the remotely located modem.

J2206-2 DATA TERMINAL READY (**DTR**)
Direction: TO data communication equipment.
The signal on this line is used to control connection of the DCE to the communication channel. The HI signal condition prepares the DCE to be connected to the communication channel, and maintains the connection established by external means (e.g., manual call origination, manual answering, or automatic call origination).

J2206-3 REQUEST TO SEND (**RTS**)
Direction: TO data communication equipment.
The signal on this line is used to condition the site located modem (DCE) for data transmission and, on a half-duplex channel, to control the direction of data transmission via the local DCE.

J2206-4 TRANSMIT DATA (**Tx Data**)
Direction: TO data communication equipment.
Signals on this line are generated by this DTE board, in response to signals from the station, and are transferred to the site located modem (DCE) for transmission of data to the remote monitoring equipment, via the remotely located modem.

J2206-5 SPARE OUTPUT
Direction: TO data communication equipment.
When used, this line provides a pulled-up HI signal to site located DCE equipment. The line normally floats open, and is activated by the field installation of a 2.7k ohm, 1/2 W resistor as R2220.

J2206-6 BAUD RATE SELECT
Direction: FROM data communication equipment.
The signal on this line conditions the DTE to inform the station of the baud rate employed by a dual-rate site located modem (DCE). A HI condition selects the 1200 baud rate. A LO condition selects the 300 baud rate. A single-rate site located modem requires the use of JU2201 for proper DTE operation, as they do not normally provide a baud rate select signal.

J2206-7 DATA CARRIER DETECT (**DCD**)
Direction: FROM data communication equipment.
The signal on this line is HI when the site located modem (DCE) is receiving a signal which meets its suitability criteria. These criteria are established by the DCE manufacturer. A low signal on this line indicates the condition of no signal being received, or that the received signal is unsuitable for demodulation.

J2206-8 LOGIC GND
Direction: Not applicable.
This conductor establishes the common ground reference potential for all interchange circuits, except for protective (earth) ground.

NOTE
The protective ground conductor, if used, is electrically bonded to the station equipment frame at the station Junction Box. It is further connected to external grounds as required by applicable regulations.

Jumper Table

JU2201	IN	OUT
Data Rate	300 Baud	1200 Baud

Schematic Diagram
Motorola No. PEPS-41838-A
(Sheet 2 of 2)
12/10/86- UP