DATA SETS 201A3, A4 AND 201B3, B4
TRANSMITTER-RECEIVER
SUPPLEMENTARY INFORMATION

1. GENERAL

1.01 This section contains information concerning the testing and alignment of the BT2, BT3, or BT4 card groups in data sets 201A and 201B. Also, a tuning and alignment procedure for the 4029A and B networks is contained here. The information in this section supplements information contained in other sections and is not required for installation, maintenance, or service under normal circumstances.

1.02 This section is reissued to add a tuning and alignment procedure for the 4029A and B networks. This procedure replaces the timing check which has been deleted.

1.03 Data sets 201-type are 4-phase transmitter-receivers designed to operate over voiceband facilities. Data sets 201A-type operate on the switched message network or private lines and are capable of transmitting and receiving at 2000 bps. Data sets 201B-type are for use on private lines and are capable of transmitting and receiving at 2400 bps.

1.04 Data sets 201A3, A4 and 201B3, B4 contain certain circuit boards which must be matched together. The circuit boards in positions R1, R2, and R3 make up group code BT1. The circuit boards in positions R13, R14, R15, and R16 make up group code BT2 (for data sets 201A3, A4), group code BT3 (for data sets 201B1, B2), or group code BT4 (for data sets 201B3, B4). The circuit boards in a group code are a matched set and if any card of the group is to be replaced, the entire group must be tested and aligned as specified in this section.

1.05 The timing recovery circuits in data sets 201A and 201B may become misaligned due to component aging in the 4029A and 4029B networks. To assure satisfactory performance of the data set, the 4029A and 4029B networks should be retuned and the phase of the timing signal should be readjusted whenever this trouble is suspected. For 4029A and B networks older than 200 days, these adjustments should not be needed more than once for the life of the data set.

2. AUTOMATIC GAIN CONTROL (AGC) TEST AND ALIGNMENT

2.01 The following tests are for matching circuit boards in group code BT1. The test for the AGC circuit (group code BT1) can be performed without referring to the timing recovery test and alignment.

2.02 The following test equipment is required to perform this test:

1—TEKTRONIX 535A Oscilloscope or equivalent

1—TEKTRONIX Probe P6006 (10X) or P6011 (1X)

1—Hewlett Packard 400EL ac Voltmeter (or equivalent)

1—KS-14510 Volt-ohm-milliammeter or equivalent

1—914-Type data test set ***or***

1—901B Data test set cover

1—66E3 Connector block

1—D25D Cord

2—717A Adapters (card extenders)

1—Decade resistance box

1—5A Attenuator.

2.03 The test is performed as follows:

(1) Connect the attenuator to jack J1 (TEL SET) on the data set using the connector cord as follows:

(a) With D25C cord:

From Cord Lead	To Attenuator
white-brown, brown-white	INPUT
slate-white, white-slate	OUTPUT

(b) With D25D cord:

From 66E3 Block	To Attenuator
Terminals 14, 16	INPUT
Terminals 18, 20	OUTPUT

(2) Set the attenuator to 20 dB.

(3) On card L2 on the data set, make the following strap connections:

22 to 24 to 25	5 to 7
20 to 21 to 23	11 to 12
13 to 16	31 to 30

(4) On card L1 on the data set, make the following strap connections:

6 to 10	3 to 8
7 to 15	11 to 16

(5) If the 901B data test set (DTS) cover is used, connect the cord of the cover to connector J2 (CUST EQPT) on the back of the data set. Connect a strap from terminal 9 (+12V) to terminal 4 (RS) and a strap from terminal 10 (−12V) to terminal 2 (SD) on the 901B DTS cover.

(6) If the 914-type DTS is used, connect it to connector J2 (CUST EQPT) on the back of the data set. Place a matrix pin in 4-S1, 2-S2, and 7-SG. Move the INTERFACE MODE switch to VOLTAGE, move S1 to ON, and S2 to OFF. Apply power to the data set and 914B DTS.

(7) Remove the R1 and R2 cards from the data set and install the 717A adapters (card extenders) in place of each. Insert the R1 and R2 cards into the card extenders.

(8) Connect the oscilloscope to terminal 12 on the card extender in position R1. Set the TIME/CM to 200 μsec/cm. Set the vertical sensitivity to 5 volts per cm. Connect the TRIGGER INPUT to terminal 16 (DCT) on the 901B DTS cover. Set the TRIGGER SLOPE to EXT +.

(9) The waveform displayed on the scope shall appear as shown in Fig. 1.

Requirement: +6.0 (±0.7) volts

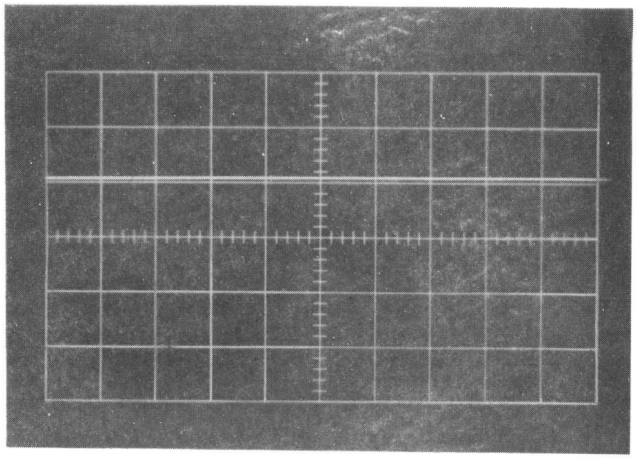


Fig. 1—Waveform on Card R1, Terminal 12

(10) Connect a strap between terminals 10 and 16 on the card extender in position R1.

(11) Connect a dc voltmeter (KS-14510 or equivalent) from terminal 12 to terminal 2 on the card extender in position R1 (positive lead to terminal 12).

(12) Measure the room temperature. Check the voltmeter for a voltage as shown in

Table A. If the voltage requirement is met (±0.1 volt), remove the meter and proceed to (16). If the voltage is outside these limits, resistors R6A and R6B on the card in position R2 must be changed.

TABLE A

ROOM TEMP. (°F)	VOLTAGE (VDC)
50	+0.23
60	+0.16
70	+0.10
80	+0.04
90	−0.01
100	−0.04
110	−0.06
120	−0.07

(13) Remove resistors R6A and R6B. Insert the decade resistance box between terminals 5 and 7 on the card extender in position R2. Adjust the resistance box for a voltage as shown in Table A. This voltage should be within ±0.03 volts on the 0.3-volt scale.

(14) Remove the resistance box. Select two standard value 221A resistors whose sum is equal to the value indicated on the resistance box (±100 ohms).

(15) Insert these resistors in the spaces designated for R6A and R6B on card R2. After soldering, allow the resistors to cool and then recheck the voltage to be sure it is within the specified limits. Remove the meter.

(16) Connect the scope to terminal 2 on the card extender in position R1. The waveform shall appear as shown in Fig. 1.

Requirement: +6.0 (±0.7) volts

(17) Set the dc voltmeter to the 3-volt dc scale. Connect the negative lead to terminal 8 and the positive lead to terminal 18 on the card extender in position R1.

Requirement: +0.95 (±0.15) volt dc

(18) Remove the meter. Remove the strap placed between terminals 10 and 16 on the card extender in position R1.

(19) Connect an ac voltmeter between terminals 10 and 16 on the card extender in position R1 (ground to terminal 10). Adjust the attenuator to give a reading of 52 (±5.0) mv rms on the meter.

(20) Disconnect the voltmeter from terminal 16 and connect it to terminal 5 on the card extender in position R1. The voltmeter shall read between −16 and −24 dBm.

(21) Disconnect the voltmeter from terminal 5 and connect it to terminal 6 on the card extender in position R1. The voltmeter shall read between −16 and −24 dBm. Record this reading in dBm.

(22) Disconnect the voltmeter from terminal 6 and connect it to terminal 16 on the card extender in position R1. Adjust the attenuator to give a reading of 2.5 (±0.05) mv rms on the meter.

(23) Disconnect the voltmeter from terminal 16 and connect it to terminal 6 on the card extender in position R1. The meter shall read within 3.0 dB of the reading obtained in 2.03 (20).

(24) Disconnect the voltmeter from terminal 6 and connect it to terminal 16. Set the attenuator to give a reading of 52 (±5.0) mv rms on the meter.

(25) Disconnect the voltmeter. Remove the card extenders in positions R1 and R2. Replace the R1 and R2 cards in the data set. Remove the R3 card from the data set and insert a card extender in its place. Insert the R3 card into the card extender.

(26) Connect the voltmeter to terminals 7 and 9 on the card extender in position R3 (ground to terminal 9). The reading should be 3.0 (±0.3) volts rms. If this voltage requirement is met, remove the meter and proceed to (30). If the voltage is outside these limits, resistor R1 on card R3 must be replaced.

(27) Remove resistor R1 on card R3. Connect the decade resistance box between terminals 13 and 16 on the card extender.

(28) Adjust the decade resistance box until the voltmeter reads 3.0 (±0.15) volts rms.

Note: The decade box setting should be less than 1000 ohms. If the setting exceeds 1000 ohms, card R3 is defective.

(29) Disconnect the decade resistance box. Solder a 221A resistor whose value is equal to that obtained from the decade resistance box (±100 ohms) into the space designated for R1 on card R3.

(30) After allowing the resistor to cool, check the voltage on the voltmeter to be sure it is within the limits specified previously.

(31) Set the attenuator to 10 dB. Connect the scope to terminal 7 on the card extender in position R3. The waveform must appear as shown in Fig. 2 (for a data set 201B) or Fig. 3 (for a data set 201A).

Requirement: 12.0 (±2.0) volts peak-to-peak

(32) Remove the card extender from position R3 and replace the R3 card in the data set.

Note: The R1, R2, and R3 cards just tested must remain together as a matched set.

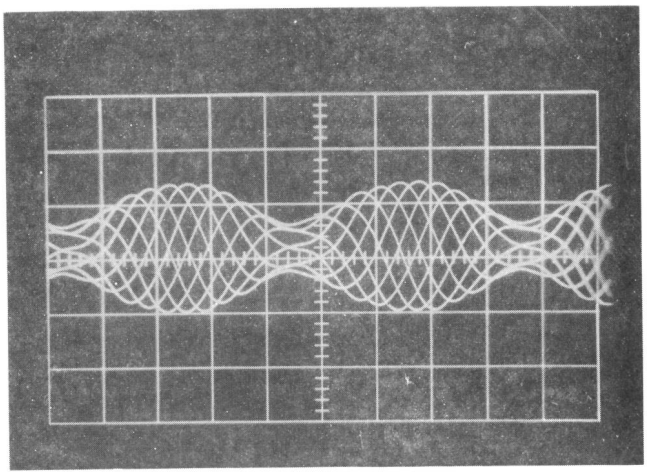


Fig. 2—Waveform on Card R3, Terminal 7 (Data Set 201B)

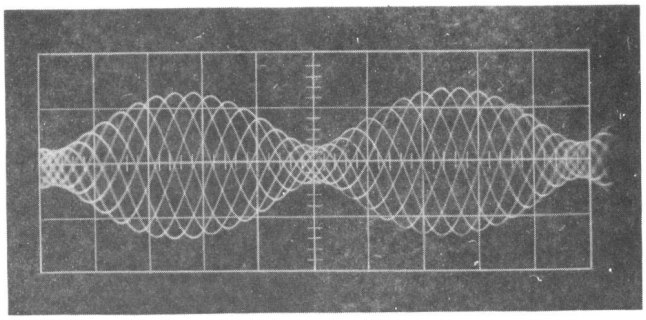


Fig. 3—Waveform on Card R3, Terminal 7 (Data Set 201A)

3. TIMING RECOVERY TEST AND ALIGNMENT

3.01 The following test is for matching circuit boards in group codes BT2, BT3, or BT4. In addition, procedure is given for retuning the 4029-type network in these group codes.

3.02 The following test equipment is required to perform this test:

1—TEKTRONIX 453A Oscilloscope or equivalent (The equivalent must have a dual vertical input with sensitivity of 50 millivolts per centimeter.)

2—TEKTRONIX Probe P6006 (X10) or P6011 (X1) (If X10 probes are used, verify that they have been calibrated.)

1—914-Type data test set ***or***

1—901B Data test set cover

1—66E3 Connector block

1—D25D Cord

1—717A Adapter (card extender)

1—Decade resistor box (0 to 90,000 ohms with 10-ohm resolution)

1—Decade capacitance box (0 to 0.1 microfarad with 0.001 microfarad resolution)

1—Timing source for externally timed data sets (2000 Hz ±0.01 percent for data set 201A; 2400 Hz ±0.01 percent for data set 201B).

Note: A 201A or 201B internally timed set may be used for the timing source SCT signal.

A. Tuning the Timing Recovery Circuit

3.03 Prior to performing this test, remove the circuit pack in position R15. If there is a 3480-ohm resistor across terminals 1 and 3 of the network, remove it. This resistor is part of a modification made per Engineering Memorandum (EM) 1203. The test is set up and performed as follows:

(1) Strap the data set to have receiver signal level option N (receive level −32 to −2 dBm with compromise equalizer out of circuit). This is done by connecting (on L2) 1 to 7, 3 to 6, and 4 to 5.

(2) If the 914-type DTS is used, set the matrix and switches as follows:

INTERFACE MODE—VOLTAGE
Matrix pins in 4-S1, 2-S2, 7-SG
S1 to ON
S2 to OFF.

(3) If the 901 DTS cover is used, strap 9 to 4 (+12 to RS) and 2 to 10 (−12 to SD).

(4) If the data set is externally timed, connect the appropriate timing source to interface lead 24 (SCTE) on the 901 DTS cover or interface selector switch panel on the 914-type DTS (whichever is used).

(5) Connect the cord from the customer interface to the connector on the 901 DTS cover or 914-type DTS. If the 914-type DTS is used, press the POWER button to apply power.

(6) Connect the 66E3 block to the telephone interface connector on data set 201 using the D25D cord.

(7) On the 66E3 block, strap 7 to 9 (T1 to T) and 8 to 10 (R1 to R).

(8) Remove the R15 card and unsolder the ground side of capacitor C1 (0.25 microfarad, type 542C).

(9) Connect the unsoldered capacitor lead in series with a decade resistance box (set initially to 40,000 ohms) to terminal 16 (DCT) of the customer interface.

(10) Using the card extender, connect the R15 board to the data set and connect the decade capacitance box (set initially to zero microfarads) across terminals 1 and 3 of the 4029 network.

(11) Connect terminal 15 (sync 1) of the board to ground.

(12) Trigger the oscilloscope (external, positive slope) from interface lead 16 (DCT) on the 901 or 914-type DTS.

(13) Set the time base on the oscillscope to 0.1 milliseconds per centimeter. Set both vertical inputs to 50 millivolts per centimeter and set input to "chop" mode.

Note: If X10 probes are used, 50 millivolts per centimeter is realized by using 5 millivolts per centimeter range on the oscilloscope.

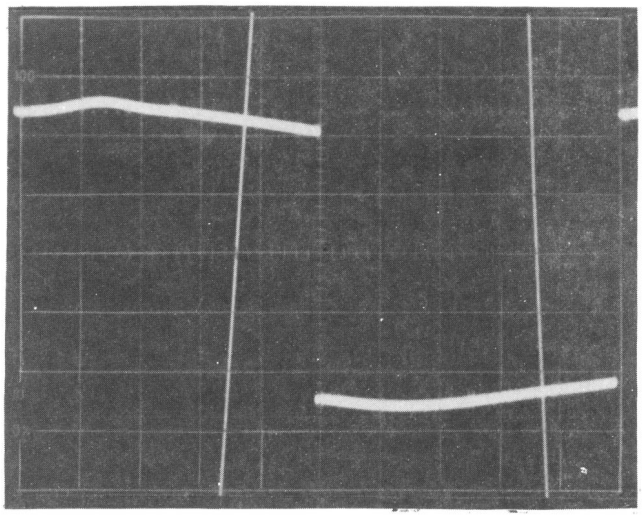
(14) Connect both probes to reference ground and adjust the vertical position on the oscilloscope to align the traces to a zero volt reference point (use a horizontal line on the graticule of the oscilloscope that is approximately in the center of the display tube).

(15) Connect one of the probes to the junction of C1, R1, R2 (the terminal of C1 which was not unsoldered) and adjust the decade box until the amplitude of the displayed square wave is approximately 225 millivolts peak-to-peak.

(16) Connect the remaining probe to terminal 7 of the R15 card. The resulting display will be similar to that shown in Fig. 4.

Note: The phase relationship between the two waveforms may be different from that

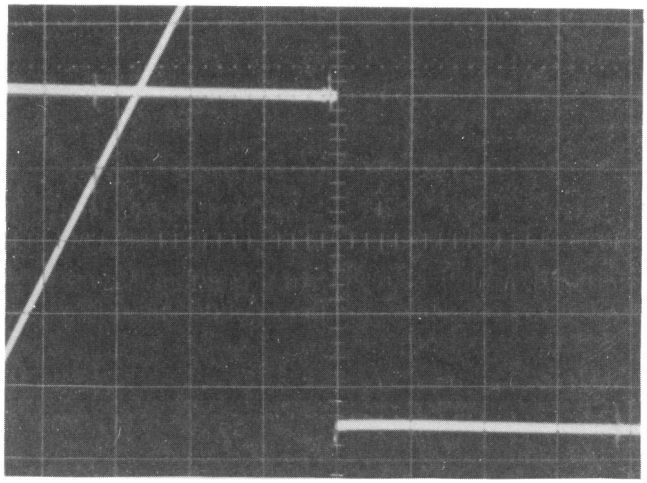
shown in the figure because it is a function of the mistuning of the network.



VERT. SCALE 50 MV/CM
HORIZ. SCALE 0.1 MSEC/CM

Fig. 4—Waveform on Card R15

(17) Magnify the scope display by activating the X10 magnification switch on the oscilloscope. The display will be similar to that shown on Fig. 5.



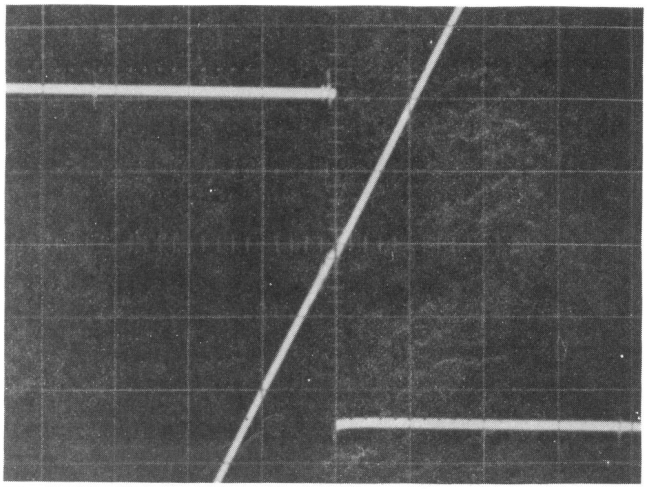
VERT. SCALE 50 MV/CM
HORIZ. SCALE .01 MSEC/CM
(10X MAGNIFICATION)

Fig. 5—Waveform on Card R15 (10X Magnification)

(18) Observe the point at which the two curves intersect. If the intersection lies below the zero volt reference, it will be necessary to remove the padding capacitor soldered across terminals 1 and 3 of the 4029 network before proceeding.

(19) Adjust the decade capacitance box until the two curves intersect at the zero volt reference (refer to Fig. 6). Select a capacitor whose value is within $\pm$20 percent of the reading on the decade capacitance box and solder it across terminals 1 and 3 of the 4029 network. If there is an existing padding capacitor across the terminals, do not remove it.

Note: The capacitor recommended for this purpose is a type 570 polystyrene or KS-13367-L27 molded mica capacitor. Typical values will be from 500 to 10,000 picofarads.



VERT. SCALE 50 MV/CM
HORIZ. SCALE .01 MSEC/CM
(10X MAGNIFICATION)

Fig. 6—Waveform on Card R15 (10X Magnification)

(20) Recheck the value of the intersection of the curves. The intersection must be 0 $\pm$50 millivolts.

(21) Remove the connection between pin 15 of the board and ground. Reconnect the unsoldered side of capacitor C1 to ground on the circuit board and return the circuit board to the set.

3.04 The purpose of this part is to adjust the phase of the recovered timing signal so that it is in alignment with the demodulators. If the 3480-ohm resistor was removed in 3.03, replace it now. If the data set is to be used in a polling application and has not been modified per EM 1203, modify as follows:

(a) ***Circuit Board CPS AN9—Location R2 (Data Set 201A or 201B):*** Add a 601A capacitor in parallel with C3 which is also coded 601A.

(b) ***Circuit Board CPS AN11–Location R15 (Data Set 201A):*** Add a 238A resistor (3480 ohms) across terminals 1 and 3 of network Z1.

(c) ***Circuit Board CPS AN12—Location R15 (Data Set 201B):*** Add a 238A resistor (3480 ohms) across terminals 1 and 3 of network Z1.

3.05 The alignment procedure is as follows:

(1) Remove card R16 and unsolder and remove R5A and R5B.

(2) Using the card extender, place the R16 board into the data set and connect a decade resistance box between terminals 5 and 6 of the board. Set the decade resistance box to 3,000 ohms.

(3) Trigger the oscilloscope (external positive slope) from interface lead 16 (DCT) on the 901 or 914-type DTS.

(4) Set the time base on the oscilloscope to 50 microseconds per centimeter (for 201B) or 10 microseconds per centimeter (for 201A).

Be certain that oscilloscope display is not in the magnify mode as was required in the previous test.

(5) Connect the probe to interface lead 18 (DCR) on the 901 or 914-type DTS.

(6) Adjust the decade resistance box until the positive transition of DCR occurs at 210 microseconds (for 201B) or 80 microseconds (for 201A).

(7) Select two resistors whose sum is within $\pm$50 ohms (for 201B) or $\pm$15 ohms (for 201A) of the setting on the decade resistance box. Solder these resistors as R5A and R5B on card R16.

(8) After allowing the resistors to cool, disconnect the decade resistance box and verify that the positive transition of DCR is within the following limits:

For data set 201B: 210 $\pm$10 microseconds

For data set 201A: 80 $\pm$10 microseconds.

(9) Replace R16 in the data set. The R13, R14, R15, and R16 cards just tested are a matched set and must remain together as such.