

## DATA QUALITY MONITORS

### DQM-8 SERIES

### DESCRIPTION, INSTALLATION, AND MAINTENANCE

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transmission difficulty, and its resultant bad copy may be determined to be caused by either equipment or line trouble. An internal alarm relay in the Data Quality Monitor may be used to signal the central office over another path when undesirable signal distortion is present. The alarm relay may also be used to activate customer provided alarm circuits.

**1.04** The service improvement aspects, which may be realized through proper use of the DQM-8, should be pointed out to the customer at the time of installation. Since maximum benefit of the monitor can be derived only by accurate reporting by the customer, his concurrence should be obtained before the unit is installed.

#### 1. GENERAL

**1.01** This section provides a physical and functional description as well as operating theory and procedures necessary for effective installation, calibration, and maintenance of Data Quality Monitors, DQM-8-5 and DQM-8-8, manufactured by the Atlantic Research Corporation of Alexandria, Virginia.

**1.02** Issue 1 of this section covered Data Quality Monitor DQM-8-5 only. The primary purpose for this reissue is to provide coverage for the DQM-8-8; however, the entire format of the text and illustrations has been altered so that subsequent reissues for coverage of additional models may be processed more expediently. Since this reissue constitutes a general revision, arrows ordinarily used to indicate changes have been omitted.

**1.03** When installed at or near teletypewriter station apparatus, the Data Quality Monitor DQM-8 Series provides a local visual indication when signal distortion exceeds a preselected amount. Because the DQM-8 monitors signals in both directions on a half-duplex data transmission circuit,

#### 2. PHYSICAL DESCRIPTION

**2.01** Data Quality Monitor DQM-8 is encased in a gray metal housing measuring 6-3/4 inches high, 1-3/8 inches wide, and 5-1/4 inches deep (Fig. 1). The unit weighs 23 ounces.

**2.02** The DQM-8 is equipped with two lamp indicators. An amber lamp designated DSTN glows when signal distortion is of a shortened pulse nature and is above a preselected threshold. A white lamp designated SIGS glows continuously when a steady SPACING signal is received, is dark when a steady MARKING signal is received, and flickers when data is received.

**2.03** The data quality monitor is also equipped with a monitor jack which is in series with the transmission loop and may be used for such purposes as distortion measurement or test signal insertion. A loop current test is provided by the DQM-8 when monitoring current signal input. The DQM-8 is also available with a high impedance characteristic for checking loop continuity for voltage signal input.

## SECTION 103-819-100

**2.04** Two holes in the front panel of the DQM-8 provide access to two variable resistors (R16 and R18) which allow calibration of the mark (M) and space (S) distortion thresholds.

**2.05** Circuit connections to the set are accomplished by passing the connecting wires through the rubber grommet on the rear of the unit and making the applicable attachments to terminal board TB1 shown in Fig. 2.

**2.06** Also at the rear of the unit is a 3-conductor AC power cord with the ground lead connected to the case of the DQM-8.

**2.07** For mounting purposes, the DQM-8 is furnished with two No. 10 binding-head screws (1-3/4 inches long), two lockwashers, and two No. 10 brass acorn nuts.

**2.08** The DQM-8 requires 115-volt ac  $\pm 10\%$  power at a frequency of  $60 \pm 0.1$  Hz. The unit is fused internally by two 1/16 ampere fuses. The DQM-8 operates efficiently in an environment with an ambient temperature range of from 40 to 120° F and a relative humidity of from 0 to 95 percent.

### 3. FUNCTIONAL DESCRIPTION

**3.01** All data quality monitors in the DQM-8 Series use solid state techniques throughout, except for the alarm relay and the indicator lamps. Their basic design permits operation on neutral currents (either 20.0 or 62.5 milliamperes), polar currents, or polar voltages. Choice of a particular model of the DQM-8 should be based on the following criteria:

- (a) Transmission speed of data to be monitored
- (b) Type of signal to be monitored (neutral current, polar current, or EIA voltage).

**3.02** Variations in the operating characteristics of the different DQM-8 models covered by this section are:

- TRANSMISSION SPEED

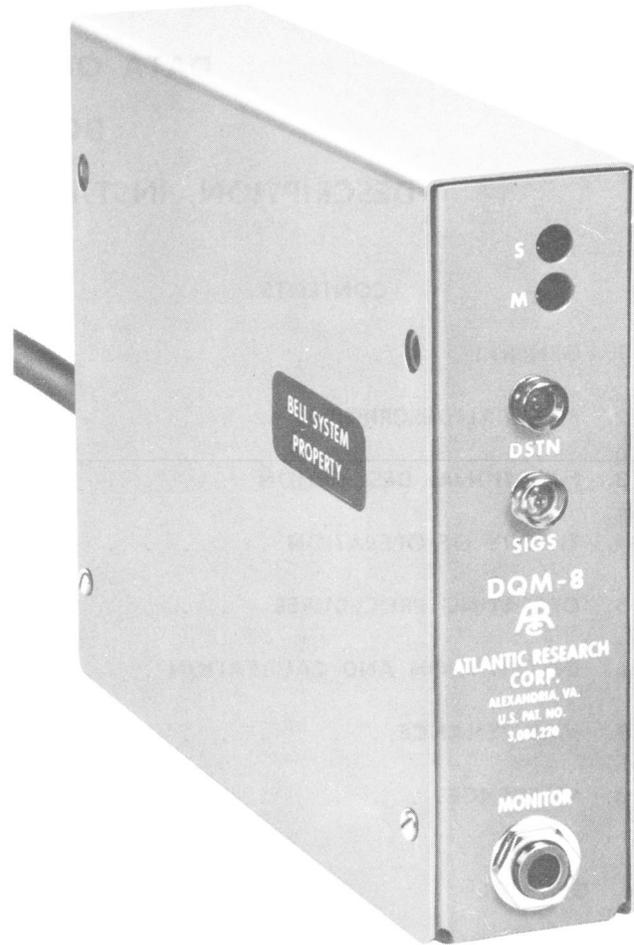


Fig. 1—Data Quality Monitor DQM-8, Front View

Speed range is continuously variable over these ranges:

DQM-8-5—45.45 to 110 bauds

DQM-8-8—56.9 to 150 bauds

- SIGNALS ACCEPTED

DQM-8-5 } neutral (20.0 mA or 62.5 mA)  
DQM-8-8 } current

DQM-8-5-1 } Polar or neutral (20.0 mA or  
DQM-8-8-1 } greater) current



DQM-8-5-2 } EIA polar voltage  $\pm 3$  volts  
 DQM-8-8-2 } or greater

● DISTORTION THRESHOLD SELECTION

Depending on the transmission speed to be monitored, the percentage of distortion that the DQM-8 Series is capable of detecting is as follows (since the selection range is continuously variable, any intermediate selection is possible):

DQM-8-5—From 15 to 50% at 45.45 bauds to 0 to 35% at 110 bauds. DQM-8-8—From 20 to 50% at 56.9 bauds to 0 to 30% at 150 bauds.

**3.03** All teletypewriter codes, either start-stop or synchronous, are monitored by the DQM-8.

**3.04** The input impedance of the set for neutral and polar current monitoring is 100 ohms noninductive shunted by 10 microfarads which is connected in series with the dc loop. Impedance for EIA polar voltage signals is 15,000 ohms for bridging on a single EIA voltage lead which is normally the receive data (BB) lead.

**3.05** The DQM-8 operates on the shortest pulse principle. The received signal (on the loop for current signals or at the receive data lead for voltage signals) is monitored on a full time-in-service basis. The set measures the shortening of unit length mark and space pulse. When the shortening exceeds a preset level, an amber (DSTN) lamp is illuminated and will remain so for about 1-1/2 seconds; after which time, it will be extinguished. The process will be repeated automatically for succeeding shortened length pulses. The white (SIGS) lamp will be illuminated intermittently on data signals and constantly on an open circuit condition.

**3.06** Since the data quality monitor looks for shortened unit elements, distortion indications cannot be obtained if the received signal does not contain unit elements, eg, Baudot code signals made up exclusively of the characters I, O, M, and V would not be suitable for monitoring by the DQM-8 Series since they contain no unit length elements. Distortion resulting in the lengthening of all pulses such as would be produced by a speed

error will not be recognized by the monitor. Also, positive characteristic distortion resulting in a lengthening of unit elements will not be recognized. Experience has shown that since the above mentioned difficulties represent such a small percentage of total transmission problems, they do not noticeably reduce the effectiveness of the monitor.

**3.07** The DQM-8 Series provides a loop continuity checking circuit consisting of diode CR1 and resistor R1 (Fig. 3) for the current input models only. On voltage input models, a bridging jack for monitoring voltage levels or measuring signal characteristics is provided. This circuit is so arranged that under normal conditions, with correct polarity applied to the loop, the diode is back-biased and will not affect normal circuit operation. Resistor R1 also provides a high impedance circuit so that polar signals will not be affected. When a loop appears to be open, the testboard may reverse the battery polarity and check for loop continuity. In this case, diode CR1 would be forward biased and, if the loop were closed, would provide continuity. In this manner, it may be determined at the testboard if an open condition is caused by the loop or the station equipment.

**3.08** Relay K1 operates and releases as the DSTN lamp is lighted and extinguished (Fig. 3). The return leg of a one-way service line (or spare line) can be used to transmit the alarm received at the teletypewriter station back to a central office. The relay also may be used to actuate customer provided alarm circuits.

**4. THEORY OF OPERATION**

**4.01** Refer to Fig. 3 for a schematic diagram of DQM-8 Series. All transistor states are shown as "N" for nonconducting or "C" for conducting, which represent a mark input signal containing no distortion.

**4.02** The input signal is sampled and amplified by Q1 which, in turn, drives Q2. Transistors Q1 and Q2 switch at the one-half current point of the input signal. Bias resistors R5, R6, and R7 allow selection of 31.25 mA, 10 mA, or essentially 0 mA (polar) operation. Voltage input signals are bridged by the DQM-8 which presents a 15,000-ohm bridging impedance to the signal. Q1 switches at approximately 0 volts, and will respond to any voltage signal of greater than  $\pm 3$  volts.

**4.03** A square wave from Q3 drives the MARK measuring circuits C5 and R16. Q2 drives the space measuring circuits C4 and R18. Q4 drives the SIGS (DS101) lamp ON for a space input. No input signal (an open circuit) will also produce a space indication. The SIGS lamp is shorted by Q4 for a marking input signal.

**4.04** Measuring circuits are charged during the opposite sensed pulse and are discharged for the measured pulse. If the circuit is not discharged before the pulse terminates, as would be the case for a short distorted pulse, the remaining charge is passed through CR7 and CR8 to trigger the alarm one-shot multivibrator composed of Q6 and Q7. Any negative spike through CR7 or CR8 will turn on Q6, which energizes K1. Transistor Q5 turns on providing a -20 volt path to alarm lamp DSTN (DS102) which causes the lamp to glow.

**4.05** Isolated power for the DQM-8 circuitry is provided by transformer T1. The bridge rectifier, comprised of CR10 and CR13, produces approximately 25 volts. Transistor Q8 functions as an emitter follower, providing an output emitter voltage equal to its base voltage which is provided by reference zener diode CR15 (20 volts). A high voltage winding produces approximately 110 volts from the half-wave rectifier CR14 and filter capacitor C11. The ripple voltage on both supplies is negligible.

**4.06** The various baud rates are determined by the resistor and capacitor values in the measuring circuits. Tables I and II shown in Fig. 3 reflect component values required for various models of the DQM-8. Intermediate speeds are feasible by using other component values in the measuring circuits.

## 5. OPERATING PROCEDURES

**5.01** The Data Quality Monitor DQM-8 Series is connected to the circuit on a full-time basis. No operator action is required. The DQM-8 is normally mounted on the side of a teletypewriter so that the alarm (distortion) light may be seen easily.

**5.02** Presence of transmission troubles is detected by the monitor which provides visual alarms.

The following are possible alarm indications and the difficulties that they indicate:

- Bad copy with the alarm lamp dark indicates machine trouble.
- Bad copy with alarm lamp on indicates bad signal reception.
- Signal light on continuously and alarm light dark indicates an open circuit (spacing).

## 6. INSTALLATION AND CALIBRATION

**6.01** Preparing the data quality monitor for usage involves four steps:

- Strapping for loop current to be monitored (for voltage input models, no strapping is required).
- Interconnection to loop and teletypewriter or data equipment
- Mounting
- Calibration

**6.02** Refer to Fig. 4 for information concerning strapping options, input terminations, and calibration controls. The cover of the DQM-8 is retained by four captive screws. After these screws have been removed, slide the cover off, and using the clip provided, strap terminal marked "COM" to one of the three terminals in accordance with the loop current condition to be monitored.

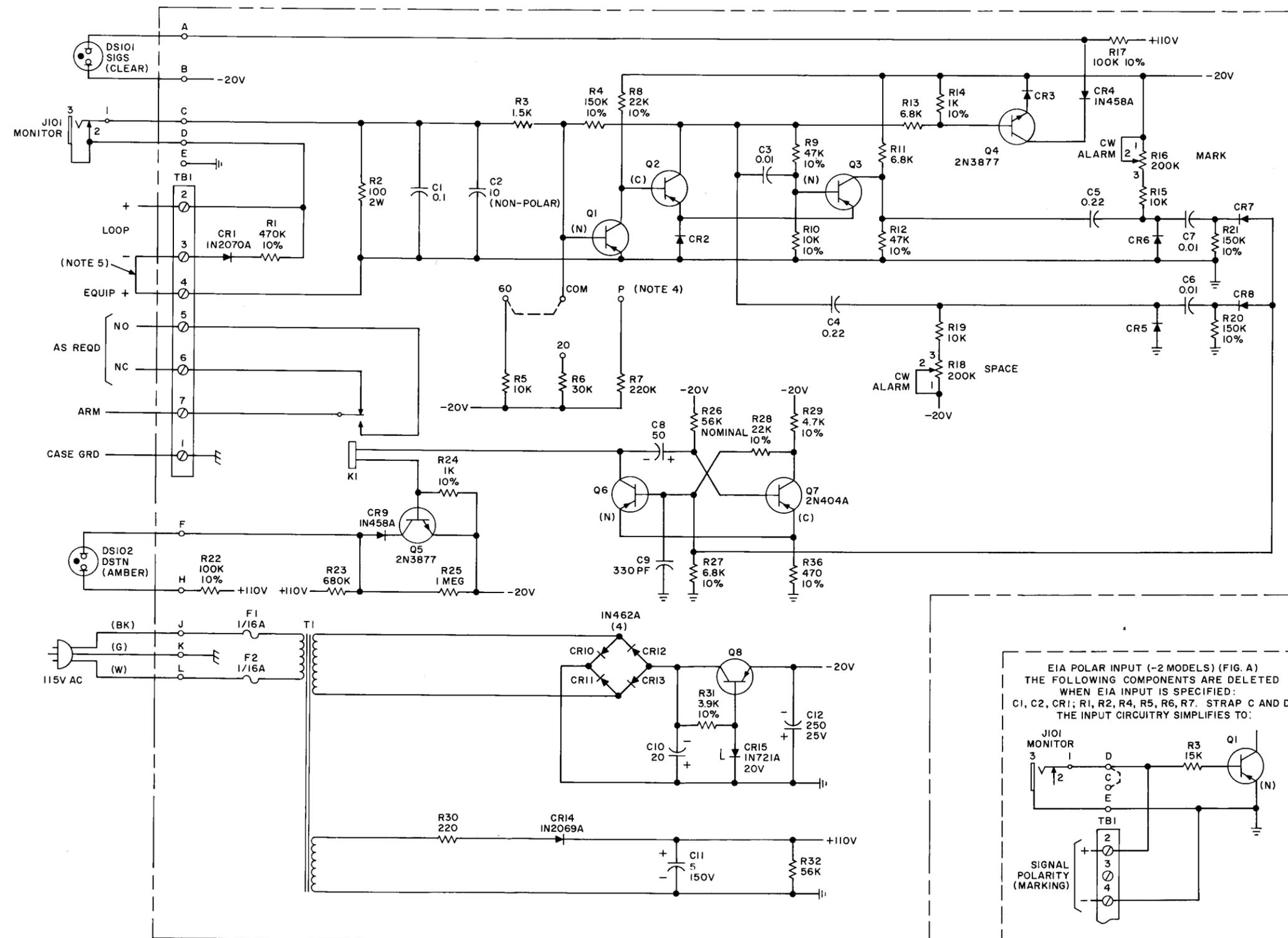
(a) NEUTRAL CURRENT, 62.5 mA, COM to 60

(b) NEUTRAL CURRENT, 20 mA, COM to 20

(c) POLAR CURRENT, COM to P

**6.03** The DQM-8 is provided with a 3-conductor AC power cord with the ground lead connected to the case. If a 3-wire outlet is not available, it is necessary to run a ground lead to terminal 1 (GRD) of terminal board TB1 (Fig. 4).

**6.04** Interconnection methods for the DQM-8 are variable. Depending upon the model used and the options desired, select a method in accordance with those shown in Fig. 5.



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
  - A. ALL RESISTANCE VALUES ARE IN OHMS, 1/2 W, ±5%.
  - B. ALL CAPACITANCE VALUES ARE IN MICROFARADS.
  - C. ALL DIODES ARE IN461A.
  - D. ALL TRANSISTORS ARE 2N404.
2. C INDICATES TRANSISTOR CONDUCTING.  
N INDICATES TRANSISTOR NONCONDUCTING WHEN INPUT SIGNAL IS MARK (POS).
3. SYMBOLS:  
 ⚡ CIRCUIT GRD    ⚡ FRAME GRD
4. STRAP FOR DESIRED INPUT AT TIME OF INSTALLATION, (-I MODELS).
5. STRAP WHEN EQUIPMENT IS NOT IN LINE.
6. CURRENT DRAIN DATA -0% 60MA SIGNALS.  
 -20V- - 10.3MA  
 +110V- - 2.7MA
7. SCHEMATIC VALUES NOTED REPRESENT MODEL DQM-8-5.
8. FOR MODELS DQM-8-5-1 AND DQM-8-8-1, USE THE BASIC SCHEMATIC AND TABLE I.
9. FOR MODELS DQM-8-5-2 AND DQM-8-8-2, USE THE BASIC SCHEMATIC, FIG. A, AND TABLE II.

TABLE I  
20, 60 MA, NEUTRAL, OR POLAR INPUT

MODEL	C4	C5
DQM-8-5-1	.22	.22
DQM-8-8-1	.15	.15

TABLE II  
EIA POLAR INPUT (±5 VOLTS, OR GREATER)

MODEL	C3	C4	C5	C6	C7	R3	R15	R16	R18	R19
DQM-8-5-2	0.01	0.22	0.22	0.01	0.01	15K	10K	200K	200K	10K
DQM-8-8-2	0.01	0.15	0.15	0.01	0.01	15K	10K	200K	200K	10K

Fig. 3—Data Quality Monitor DQM-8, Schematic Diagram

**6.05** The DQM-8 monitors are equipped with a relay (K1) which may be used to drive audible alarms, counters, etc, at remote locations such as the central office or on the customer's premises. Refer to Fig. 6 for the method of interconnection for this option.

**6.06** After interconnection has been completed, replace the cover and attach the DQM-8 to the teletypewriter cabinet using the hardware provided.

**6.07** Before the DQM-8 can be used to monitor distortion, it must be calibrated. The calibration may be performed prior to installation, at any location, with a controlled distortion generating set such as the 911 or equivalent.

**6.08** The monitor may also be calibrated at the station after installation by sending distorted signals to the unit from the serving test center (STC). In this case, the signal distortion at the monitor consists of that sent from the STC plus that contributed by the loop. To determine distortion

to be sent from the test center for calibrating the monitor, subtract algebraically the loop distortion from the threshold setting desired.

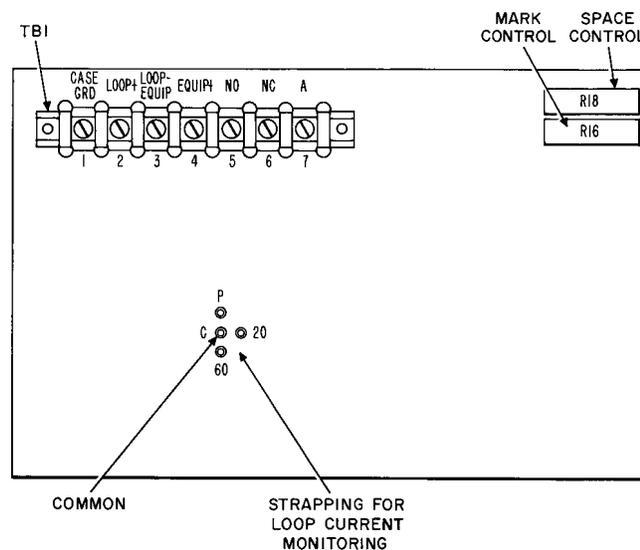
Example:

(a) Request that the STC apply a steady MARK and adjust the loop current to the exact operating requirements.

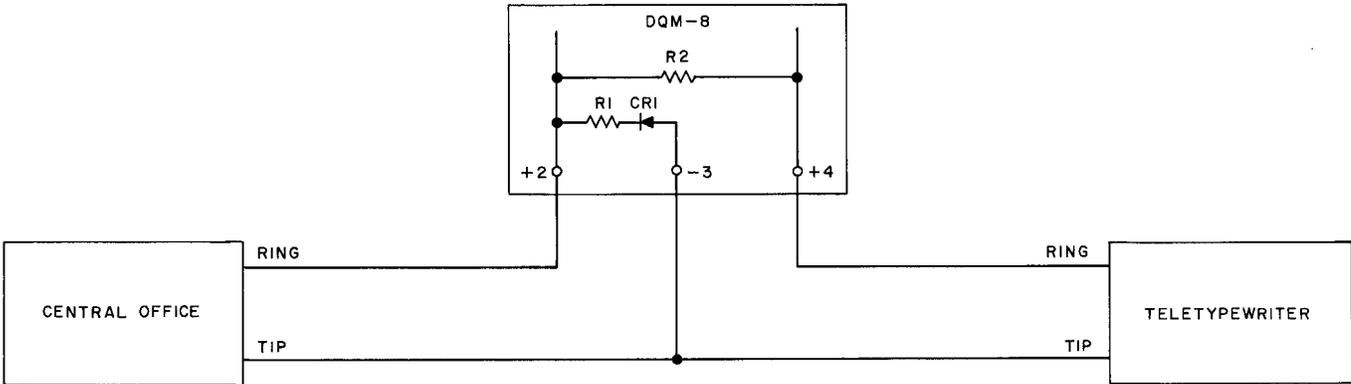
(b) Assume the desired threshold setting is:

25% MARKING, 25% SPACING

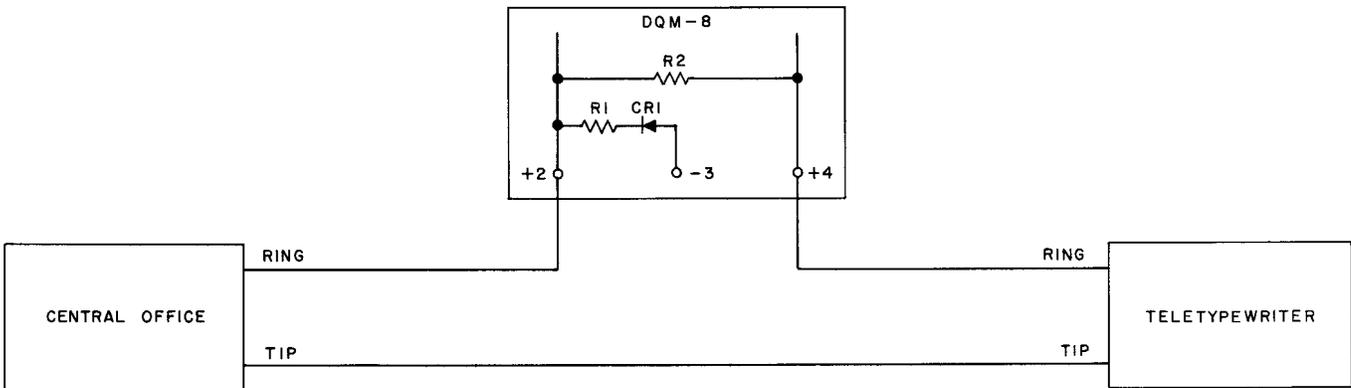
(c) Request that ZERO NO BIAS be sent from the STC and measure the distortion at the station where the monitor is to be located. For current signal input models, this measurement is made by connecting the distortion generating set 911 in series with the loop via the monitor jack on the DQM-8. For voltage input models, the 911 is bridged on the EIA receive data lead. Assume this measurement shows 8% spacing bias.



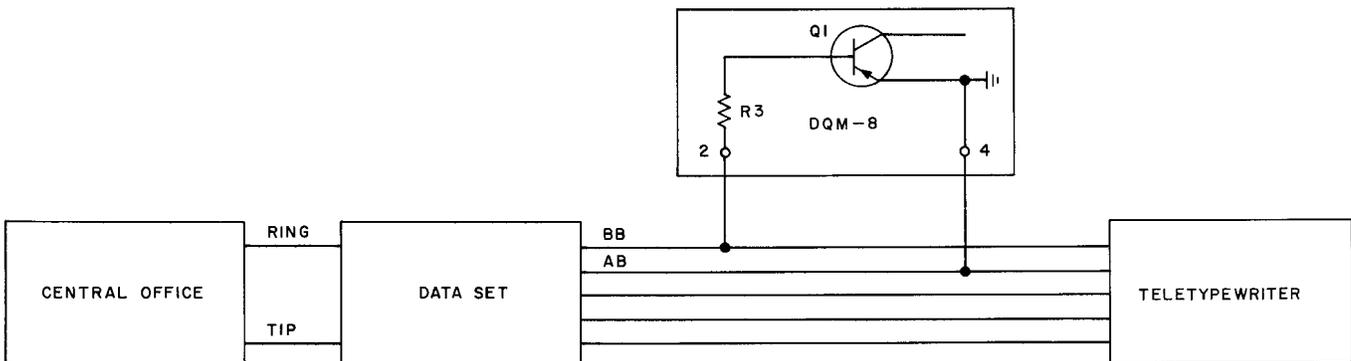
**Fig. 4—Data Quality Monitor DQM-8, Strap Options, Input Terminations, and Calibration Controls**



A. DQM-8 INTERCONNECTION LOOP; CONTINUITY CHECK FEATURE ACTIVATED.  
DQM-8-( )-1 MODELS.



B. DQM-8 INTERCONNECTION LOOP; CONTINUITY CHECK FEATURE DEACTIVATED.  
DQM-8-( )-1 MODELS.



C. DQM-8-( )-2 (EIA) MODELS INTERCONNECTION LOOP.

**Fig. 5—Data Quality Monitor DQM-8, Interconnections Methods**

(d) Algebraically *subtract* the loop distortion from the desired threshold setting, which in this example is:

$$\begin{array}{r} +25 \\ -(-8) \\ \hline +33 \end{array} \text{ MARKING} \qquad \begin{array}{r} -25 \\ -(-8) \\ \hline -17 \end{array} \text{ SPACING}$$

**Note:** MARKING BIAS is positive. SPACING BIAS is negative. Following installation, the values of MARKING and SPACING bias should be recorded on the loop record card to facilitate testing (see 7.01).

**6.09** With the MARK and SPACE potentiometers adjusted fully counterclockwise and the current mode properly strapped per 6.02, make the following adjustments:

- (a) Send a test sentence from the STC with the proper MARKING bias as determined per 6.08(c), and adjust the MARK potentiometer clockwise until the DSTN lamp just lights.
- (b) Send a test sentence from the STC with the proper SPACING bias as determined per 6.08(c), and adjust the SPACE potentiometer clockwise until the DSTN lamp just lights.
- (c) After the above adjustments have been made, request the STC to reduce the distortion 5% and check that the DSTN lamp remains dark on both signals with MARKING and SPACING distortion. If the lamp lights, repeat Steps (b) and (c).
- (d) The DSTN lamp automatic reset feature will be operational during the adjusting procedure and should be checked visually for proper operation.

**6.10** Unless otherwise stipulated all data quality monitors should be adjusted to indicate 25% distortion.

## 7. MAINTENANCE

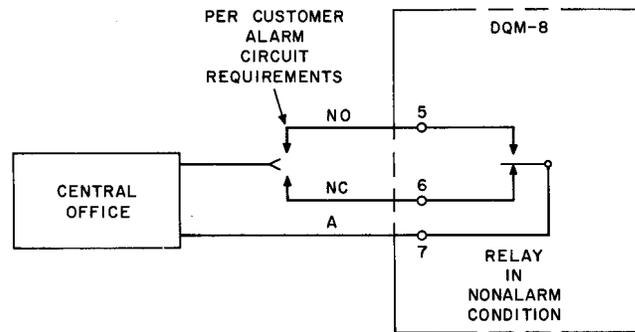
**7.01** The data quality monitor should be checked periodically for proper calibration and operation. It is assumed that the units described in the following tests have been previously adjusted for MARKING and SPACING distortion threshold indications.

- (a) On customer maintained equipment, it is recommended that a 6-month test interval be established. Customer assistance will be required for these tests. Send test sentences from the data test center with the MARKING and SPACING bias as computed in 6.08 plus 5%. Check with the customer to assure that the DSTN lamp lights. Send test sentence from the data test center with the MARKING and SPACING bias computed in 6.08 minus 5%. Check with the customer to assure that the DSTN lamp remains dark. If either test indicates trouble in the monitor, a maintenance employee will be required to clear it.
- (b) On Telephone Company maintained equipment, it is recommended that the monitor be tested for proper operation, as above, at each routine maintenance check of station apparatus.

**7.02** All data quality monitors covered by this section carry a 5-year warranty. This warranty provides for all labor and materials required to repair a defective unit for the first year after date of delivery. During the next four years, only parts and material are guaranteed. All defective units should be returned to Atlantic Research Corporation's plant in Alexandria, Virginia, for repair.

## 8. REFERENCES

**8.01** Information contained in this section was obtained from an instruction manual issued December 1966 which has been copyrighted by the Atlantic Research Corporation. The Data Quality Monitor DQM-8 Series is covered by U.S. Patent No. 3,084,220.



**Fig. 6—Data Quality Monitor DQM-8, Interconnection Remote Alarm, or External Control Feature**