

**AUTOMATIC MONITOR TROUBLE RECORDER CARDS  
ASSOCIATED WITH ORIGINATING REGISTERS  
ANALYSIS  
NO. 5 CROSSBAR OFFICES**

1. GENERAL

1.01 This section outlines methods of analyzing certain types of trouble recorder cards produced by the automatic monitor when it detects that the dial pulsing information it has recorded differs from that recorded in the associated originating register.

1.02 This section is divided into the following parts:

- (A) Erratic Dialing
- (B) Switchhook Flashing
- (C) AC Voltage on Line
- (D) Line Troubles Other than AC Voltage
- (E) General Analysis Rules

1.03 When a dial tone call is served by a marker and the automatic monitor is available for monitoring on originating registers, the marker assigns the monitor to the particular register selected which results in the operation of a monitoring relay in the register. This relay furnishes a channel for passing the pulsing information received over the line to the automatic monitor and is used later for signaling the marker that the call is monitored. When the register has recorded a sufficient number of digits, a marker is selected in the usual manner. The marker is informed that the call is monitored and after recording the called number as passed by the register, the marker transfers this and other information through the master test frame connector to the automatic monitor, completes the connection and releases. The monitor, which has recorded the pulses from the line by means of a dial pulse amplifier, checks this information against the information passed by the marker. If the two sets of information differ, a "mismatch" occurs and the monitor gains access to the

trouble recorder through the master test frame connector. Both sets of information are perforated on a trouble recorder card which is distinctively marked by a punch in the MOR (S8-9) position to indicate that the card is the result of a monitor "mismatch" on an originating register. The call is not held up and proceeds on its way in the usual manner in accordance with the information furnished by the register. The information provided by the trouble recorder card is as follows:

(a) The dialed number recorded by the register and passed by the marker to the monitor on a 2/5 basis. Digits A to J indicate this information and appear on Lines S0 and R7 of the left portion of the trouble card.

(b) The dialed number recorded by the dial pulse amplifier and counter of the monitor, on a 2/5 basis. Digits A' to J' indicate this information and appear on Lines R8 and R6 of the left portion of the trouble card.

(c) The originating register marker connector and the position of the originating register in this connector. This information appears on Line S6 as FR 0-9 (Connector Frame, CN 0-3 (Connector Number on Frame) and RG 0-9 (Register Number in Connector)). A local office record indicates the originating register frame and unit number associated with the connector information.

(d) The calling subscriber line equipment location information in terms of line link frame, vertical group, horizontal group and vertical file. This is shown on Line R1 of the left portion of the trouble card as FT (Frame Tens), FU (Frame Units), VG (Vertical Group), HG-SW (Horizontal Group - Switch) and VF (Vertical File).

(e) The marker units number as shown by the DR 0-9 punches on Line S8 of the left portion of the card, and the marker tens number as shown by DRT 0 and 1 punches on Line S7, positions 19 and 20.

(f) The prefix 11, if recorded in the register is shown on Line S4, punch position 4. If recorded in the monitor it is shown as M11 on Line R5, punch position 21.

(g) The digit relay (-7) punch is perforated in the position after the last recorded digit.

(h) The time and day information will be shown on cards in AMA offices and those equipped with time of day circuits. This information appears on Line R0, punch positions 30 to 59.

1.04 The automatic monitor provides an automatic check of the pulse receiving features of the originating registers. Due to the fact that the monitor must work with all possible variations of loop and leak conditions, it may not be quite as precise a device in some instances as a test circuit which can introduce controlled conditions close to the pulsing circuit capabilities and thereby detect marginal failures. It also differs from an automatic test frame since the troubles or mismatches detected by the monitor must be carefully analyzed on a repeater basis to determine whether the register circuit is in trouble. Experience has indicated that a number of conditions independent of register circuit troubles may produce mismatches. Because of the extensive testing and conditioning prior to placing an office in service, the register pulsing circuits may be in excellent condition and the appearance of mismatches following cutover tends to be misleading. It is believed however that a week's accumulation of such records may reveal significant line troubles provided certain misleading records are eliminated as due to faulty customer dial operation and switchhook flashing. In the event that Fig. 15 of the automatic monitor dial pulse register is modified per SD-25680-01, Issue 15-D which covers the substitution of the 19TM type RAA resistance with a 1900 ohm (+1%) 18FN type resistance, the trouble records due to improper dial and switchhook manipulation may be relatively few.

## 2. APPARATUS

2.01 No apparatus is required.

## 3. METHOD

### (A) Erratic Dialing

3.01 Troubles of this kind are caused by interference with the free return of the dial to normal. This distorts the make and break intervals to the point where one of the make intervals is interpreted as the end of the digit. Since the interdigital timing of the monitor is shorter (when equipped with a 19TM type RAA resistance) than that of most registers, the monitor may split a digit which a register records correctly. The succeeding digits in the monitor will then be displaced from those in the register. As an example, if the monitor splits the C digit then the dialed D digit will appear in the D digit position in the originating register but in the E digit position in the monitor. When the monitor is equipped for only the same number of digits as the originating register, there will then be no register in the monitor on which to record the final digit. However, if the 2 out of 5 code for the final digit contains a -7, this will be recorded on the final -7 relay in the monitor.

3.02 The numbers on the trouble card for a typical case of this trouble follow:

ABC DEFG H

Originating Register 636 4441 -7

Automatic Monitor 635 7444

For several reasons the two parts of the split digit, in this case a 6, do not always add up to give the actual digit. Some cases of 3 out of 5 registrations will also be found at the split digit positions.

### (B) Switchhook Flashing

3.03 Switchhook flashing provides very erratic closures to the pulsing relay. This tends to register 1's or low numbers after the preliminary pulse gate has been passed. As

result, X11 codes are often registered. Calls with 3 or 4 out of 5 registrations are also common. A typical case follows:

	ABC	DEF	G	H
Originating Register	412	111	(0-1-2-4)-7	
Automatic Monitor	412	111	1	

### (C) AC Voltage on Line

3.04 These troubles occur principally on calls from the tip party of 2-party lines where charging systems are used. The monitor is more sensitive to AC potential on the tip during pulsing than the originating register is and the tip party ringer forms a path for introducing AC to the tip. AC troubles may also be caused by unbalance of the parties on a multi-party line. A particular case occurred where five subscriber sets with ringers were connected from the ring to ground and two were connected from the tip to ground. This line showed a history of complaints from subscribers of noise and false bell ringing. Trouble record cards from AC voltage on the line indicated mismatches in many of the digits with practically no 3 out of 5 registrations. A typical case follows:

	ABC	DEFG	H
Originating Register	636	1269	-7
Automatic Monitor	315	7123	-7

### (D) Line Troubles Other than AC Voltage

3.05 Mismatches are experienced as a result of crosses between lines and leakage to ground. The leakages may fluctuate from an open circuit to a low resistance of one or two thousand ohms. Many of these cases result in the register and monitor receiving more than 10 pulses in a train. These are probably due to crosses which expose the line to ringing, pulsing and signaling from the other line through the cross. Where the originating register receives more than 10 pulses in the A digit it always registers a 2-4-7 condition due to the (OP) relay operating and backing up its locking ground to hold the (P4) relay and thus prevent further counting. However, the monitor will continue counting and usually register a number over 6. The exception is where the monitor splits the train and registers it as two digits. The (OP) relay causes the register to select a marker after the train of pulses ends. A typical case follows:

	A	B	C
Originating Register	(2-4-7)	-7	
Automatic Monitor	9	2	-7

### (E) General Analysis Rules

3.06 Insufficient records of mismatches due to originating register trouble have been available for investigation and therefore typical patterns have not been developed. It is probable that the pattern will vary depending on the location of the trouble. There is some evidence that, if the (L) relay in the register is splitting pulses, cards of the following type will be produced.

	A	B
Originating Register	(2-4-7)	-7
Automatic Monitor	0	-7

3.07 Inspection of the records for lines or registers indicating a repetition of trouble is an important aspect of the analysis technique. It is the usual experience that the trouble will be located in the circuit showing an irregularity on a repetitious basis. If the trouble is in the originating register, the particular register should be revealed within a day or two, usually in a few hours. In the case of line troubles, some may repeat within a week while other troubles may only occur during wet weather periods. It may, therefore, prove productive to hold repeater records between two successive wet spells. This may not be necessary however, where dry weather testing is done on a routine basis and the line troubles cleared on this basis. Generally, the interval of the repeater record period should be established by experience with the particular central office concerned.

3.08 Some further conclusions can be drawn from the office codes dialed and whether a complete number is registered. For instance, if the monitor and register both record unused codes and the call ends as a partial dial, it is reasonably certain that the cause is line trouble or switchhook flashing. However, if the monitor records a satisfactory code and number and the register records a few digits only and the call ends as a partial dial, the trouble is probably in the register.

3.09 Table 1 gives actual field cases of monitor records on dial pulse originating registers and the analysis of the trouble in broad respects.

3.10 Should the adjustment of the dial pulse amplifier change, "mismatches" may be experienced on monitored originating register calls. This change or "drifting" of the adjustment may be overlooked as a cause of trouble. It has been observed that improper adjustments or "drifting" is first noticed more particularly on dial pulse incoming registers

TABLE 1  
 Typical Examples of Originating Register  
 Monitor Trouble Records

Information Recorded In	Digits Registered								Cause of Mismatch					
	A	B	C	D	E	F	G	H	Erratic Dialing	Switch-hook Flashing	Line Trouble	AC on Register Line Trouble		
OR	2	2	6	4	4	4	4	1	*-7	✓				
M	2	2	5	7	4	4	4	4	-					
OR	3	3	4	7	8	3	9	9	-7	✓				
M	3	3	4	7	8	2	1	1	-7					
OR	4	5	6	2	3	1	6	6	-7	✓	✓			
M	4	5	6	2	3	1	0-1-2	-	-					
OR	5	3	8	1-2-4	4	3	6	6	-7	✓				
M	5	3	8	3	1	4	3	3	-					
OR	2	6	5	2	1	2	0	0	-7	✓	✓			
M	2	6	5	1	1	1	0-1-2	-7	-7					
OR	2	1	1	-7						✓		✓		
M	3	1	1	-7						✓				
OR	4	3	5	1	5	1	1	1	-7	✓				
M	4	3	4	1	1	5	1	1	-					
OR	6	2	8	5	4	8	7	7	-7	✓				
M	6	3	8	5	4	8	7	7	-7					
OR	5	2	5	4	7	1	1	1	-7		✓			
M	5	2	5	4	7	1	1	1	-					
OR	2	4	7	-7								✓		
M	8	-7											✓	
OR	4	0-1-2-4	0-1-2-4	7	-7							✓		
M	5	3	5	0-1-2	2	3	-7						✓	
OR	2-4-7	-7										✓		
M	4	2	1	3	-7								✓	
OR	2	1	1	-7								✓	Note 1	
M	2	4	3	1	2	2	-7							
OR	X	X	X	X	X	X	X	-7				✓		
M	X	X	X	X	X	X	X	-7					✓	
OR	2-4-7	-7										✓		
M	0	-7											✓	
OR	-	-	-	-	-	-	-	-					Note 2	
M	X	X	X	X	X	X	X	X						
OR			Legitimate code and number						-7					Note 3
M	X	X	X	X	X	X	X	X					✓	
OR	0	-7											✓	
M	X	X	X	-7									✓	
OR	0	-7											✓	
M	-	-												
OR	0	-7								✓			Note 4	
M	9	-7												
OR	2	-	-7								✓		Note 5	
M	2	1	-7											

Symbols

- OR Originating Register Recorded Information.  
 M Monitor-Recorded Information.  
 X Indicates any number from 0 to 9 may have been registered.  
 \* (-7) End signal.

Notes

- 1 - This type of record does not apply if Xll code does not call in marker immediately.  
 2 - Register timed out.  
 3 - Either (-7) or nothing may appear in the H' digit of the monitor in this case.  
 4 - This occurs where zero or other single digit is used to call in the marker for routing to the assistance operator or a straightforward operator trunk.  
 5 - In this case the single pulse was recorded in the B digit as the register timed out.

rather than on originating registers. For this reason, Table 2 is furnished to indicate this type of failure when experienced on incoming registers of the dial pulse type. In this connection, the precaution with regard to frequent checks of the amplifier bias adjustments of the B1 and B2 potentiometers specified in 218-217-301 should be followed. Section 218-217-301 indicates that weekly checks should be made in the first month of operation and monthly checks thereafter. In addition, adjustments may be required if a high humidity condition is experienced for an extended period due to leakages in the bias amplifier circuit.

3.11 In some instances, it has been found productive to make a voltmeter test of the line immediately on receipt of a trouble card indicating a line trouble condition.

TABLE 2

Typical Examples - Incoming Register - Monitor Trouble Records

Information Recorded In	Digits Registered								See Note
	A	B	C	D	E	F	G	H	
IR	1	3	1	3	-7				1
M	6	4	4	2	-7				
IR	2	7	3	9	-7				1
M	1	0	5	2	-7				
IR	5	4	2	1	-7				2
M	1	5	4	2	1	-7			
IR	3	4	4	9	-7				3
M	3	4	4	8	1	-7			
IR	3	9	0	5	-7				4
M	3	9	0	5	1	-7			

Notes

1 - Monitor Dial Pulse Amplifier bias not adjusted correctly.

2 - Preliminary pulse recorded by the monitor. It was ultimately found that a false pulse was being transmitted from the bridged impedance type repeaters in a step-by-step tandem center. In some instances the false pulse would be recorded in the incoming register, resulting in a wrong number. To avoid the false pulse condition, the start dial feature of the incoming dial pulse register was changed on Issue 9-B of SD-25729-01. Similarly, the monitor was corrected on Issue 19-B of SD-25680-01.

3 - Slow dial speed.

4 - Surge or dial pulse after register goes for the marker and before the monitor is cut off.

4. REPORTS

4.01 Selected offices will be requested to furnish data on the effectiveness of the analysis methods outlined in this Section. In the event that data are requested, Form E-3862 (Fig. 1) will be supplied at that time since this form is not available from Western Electric Company stock. The completed form should be forwarded through lines of organization. In the offices selected, the various categories of found and not found monitor trouble cards should be properly allocated and the details of found troubles entered. Troubles of particular interest or obscurity may be explained in detail, if desired, so that this information can be broadly disseminated throughout the Bell System.

NO. 5 CROSSBAR OFFICES  
AUTOMATIC MONITOR TROUBLE RECORDER RECORDS  
ORIGINATING REGISTERS

<u>Condition</u>	<u>Total Cards</u>	<u>Found Tbl.</u>	<u>Not Found Tbl.</u>
Erratic Dialing			
Switchhook Flashing			
AC Voltage on Line			
Line Troubles Other than AC Voltage			
Originating Register Troubles			
Troubles in Monitor Circuit			
Other Found Troubles			
Other Not Found Troubles			
<u>Details of Found Troubles</u>			

(Size of Form 10-7/8" x 8-3/8". Not available from  
Western Electric Company stock.)