26   CHANNEL UNIT REMOTE WORKSTATIONS

LIST OF ILLUSTRATIONS

26.1 CHRW IDENTIFICATIONS

Type-number: PTS-6896
Test-Program: TERTST4.2 and higher releases
Channel: Hardware Channel (DMA is implemented in channel unit)
Devices: Those devices with a Remote Workstation interface, viz.
(also Secondary-,   Work Station Controller, PTS-6911/12
Work-stations,   Terminal Printer, TP 6371
Main modules)   Modular Device Adaptor, MDA 6411

Power-Consumption   +5 Volt   : 3.8A   +/-380mA
                      -18 Volt   : 50 mA   +/- 5mA
                      +18 Volt   : 130 mA +/- 13mA

Transmission Information:

Line Configuration: Multidrop, 4 lines
Number of Workstations: 8 on each line, typical 2-3 per line
Line: 2 or 4 wire leased lines
Type of transmission: A-synchronous, modem-clocked serial data, half or
                          full duplex
Line procedure: HDLC/V24-V28, with polling
Max. Packet length: 259 bytes (3 bytes in Packet Header plus 256
                          characters
Character format: 8 bits, without parity
Speed of transmission   Up to 19.200 bits per second,typical 4800 bps.
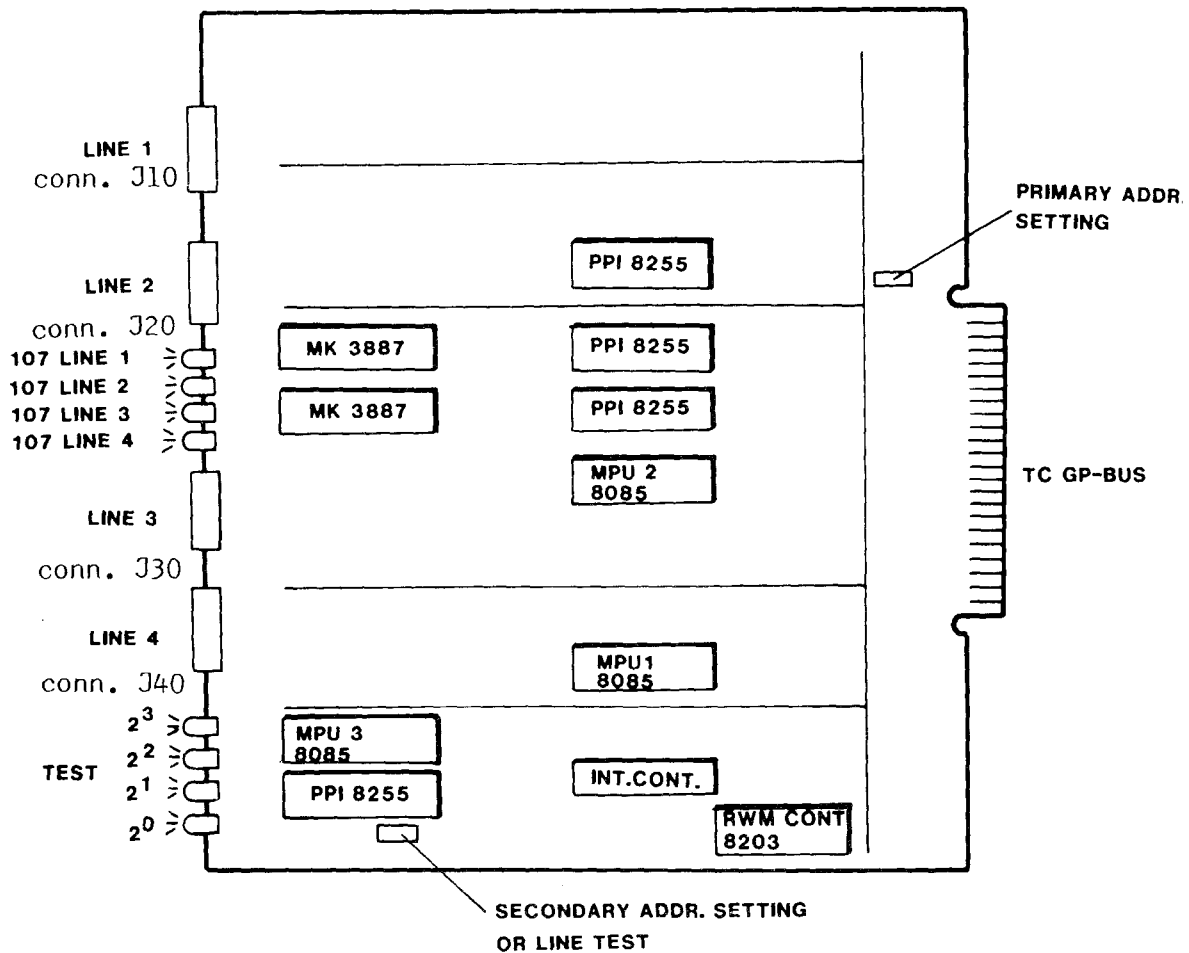
Figure 26.1 LAYOUT OF CHRW

STRAP-SETTING   CONTROL UNIT ADDRESS

CHRW used as Primary: Prim. Addr. switches: CHRW1   /3A
                                                CHRW2   /3B
                                                CHRW3   /2A
                                                CHRW4   /2B
                          Second Addr. switches: Don't care
CHRW used as Secondary: Prim. Addr. switches: Don't care
                          Second Addr. switches: 0-32, depending on software

The Secondary address set on the switches may be overruled by a Secondary
address setting from the software.
The Secondary address is only applicable for Line 1 (channel 0)

INTERRUPT LEVEL:

No straps are available for setting the interrupt level.
This level is software set.

The Interrupt level can be: (decimal)

CHRW1: 18
CHRW2: 19
CHRW3: 20
CHRW4: 21

MAD 10   MAD 15

Location 18A

Open=0
Closed=1

MAD	Closed	Open	
10	X		2^5
11	X		2^4
12	X		2^3
13		X	2^2
14	X		2^1
15		X	2^0

Example:
Primary
Address 3A
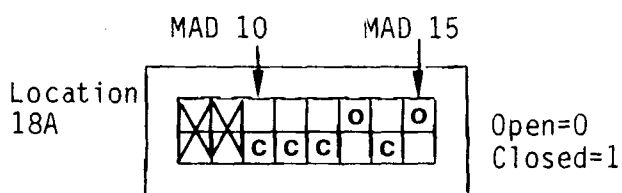
Primary Address: 3A CHRW1
                  3B CHRW2
                  2A CHRW3
                  2B CHRW4

Decimal Interrupt Level: 18 CHRW1
(Software Set)   19 CHRW2
                          20 CHRW3
                          21 CHRW4

See off-line test

8   5   1

Location 1H

Open=1
Closed=0

Secondary Address: 00 - 1F
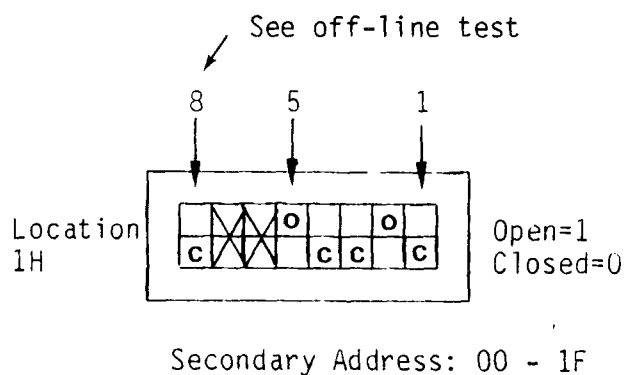
	Closed	Open	
8	X		Off Line TEST
7			
6			
5		X	2^4
4	X		2^3
3	X		2^2
2		X	2^1
1	X		2^0

Off Line TEST

Example:
Work
station
address/12

Figure 26.2 EXAMPLES OF PRIMARY & SECONDARY ADDRESS SETTING

Number Indicator

J10

J20

1
2
3
4

107
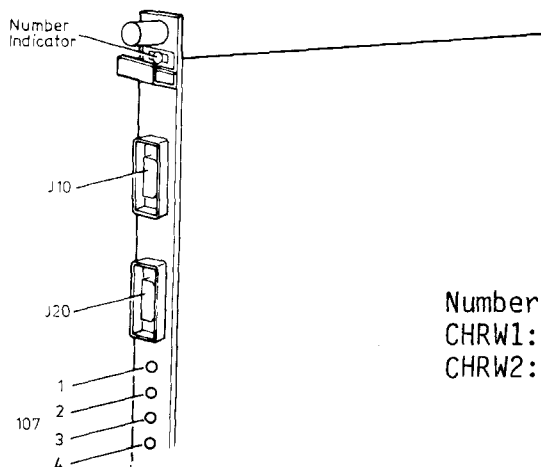
Number Indicator:
CHRW1: slide to show 1
CHRW2: slide to show 2

Figure 26.3 NUMBER INDICATOR

OKO-OKI SIGNALS

As a Direct Memory (DMA) function is implemented in CHRW, the control unit is a master during transfers of information between the TC's main memory and the memory of the CHRW.
For this reason this control unit must be connected in the Master priority chains, the OKO-OKI line-.

The priority level must be according the following table:

Priority level	Master	Remark
0	DMA (CUHD 80 Mb Disc.)	Highest priority
1	IOP 1 (Dev. Addr. 08-0F)	
2	CHRW	
3	CHRW	
4	CPU	Not wired

The bus priority line OKO/OKI originates from the Bus Controller, located on the board, and the line is wired in the following way:

CPU-Rack pos. 1   Master 0   Master 1

3A 16 ───────────── 3B 16
                         3A 16 ──────── 3B 16

In case a master with higher priority is not used the others are advanced one level.

┌───────────────────────── CAUTION ─────────────────────────┐
│ If a CHRW is removed from the rack the OKO/OKI on that rack position must │
│ be linked in order not to break the line for masters with lower priority. │
└──┘

26.3 INTERFACE CONNECTIONS

Connectors J10, J20, J30 & J40
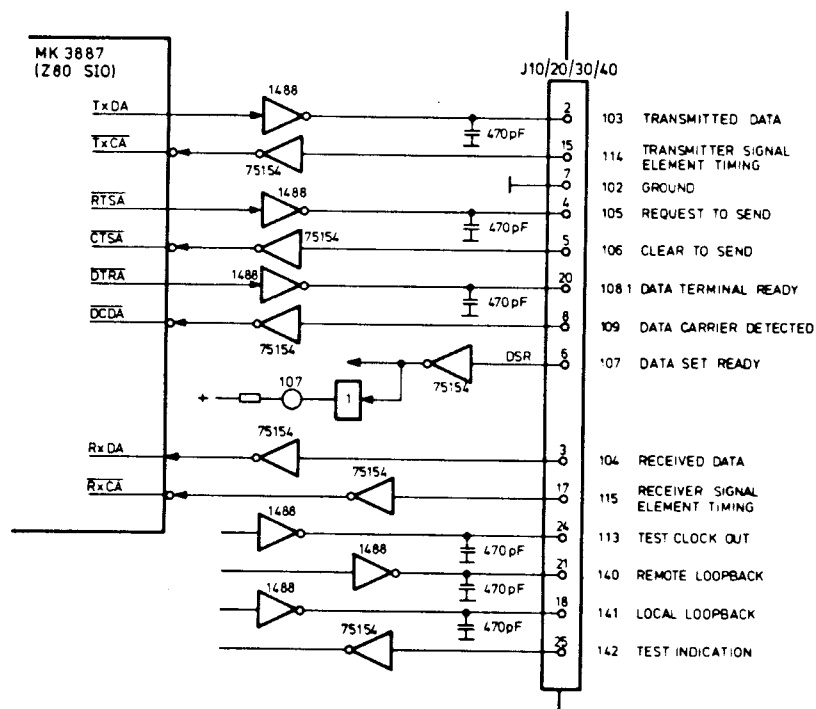
Figure 26.4 LINE INTERFACE
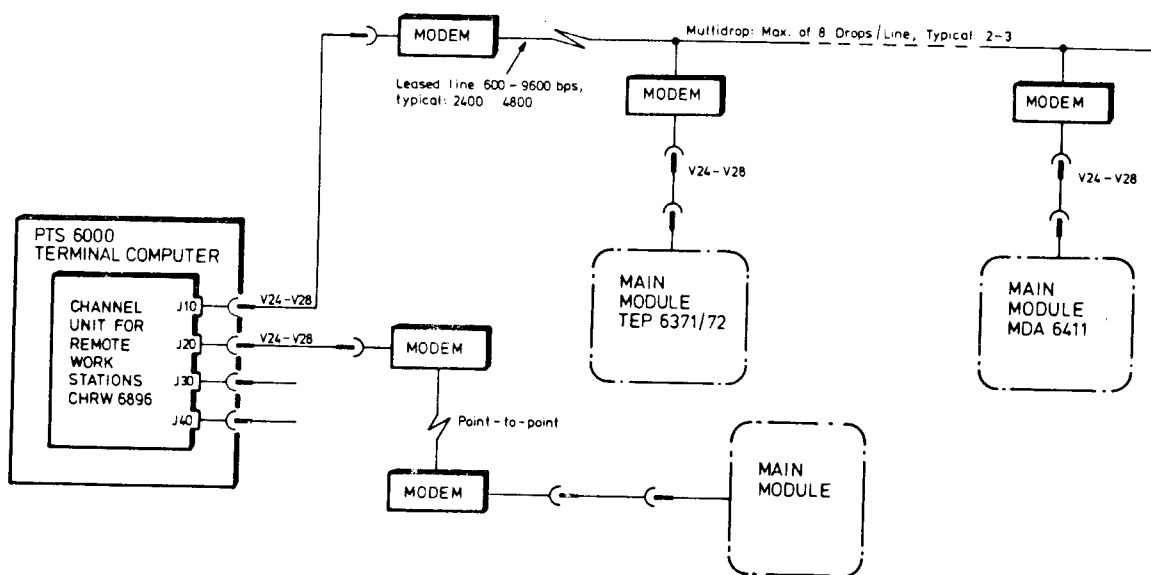
Figure 26.5 RWSI CONFIGURATION

LINE TRANSFER SPEED

The total sum of bits per second over the four lines may not exceed 30.000 bps.
As the transfer speed may be different for the four channels the lines should be
connected in the order shown below.

Example: If four lines with respective transfer speeds of 19.200 bps, 4.800 bps,
         1.200 bps and 600 bps are to be connected, it should be done as
         follows:

Transfer speed: Connect line to:

19.200 bps   Channel 2
 4.800 bps   Channel 3
 1.200 bps   Channel 0
   600 bps   Channel 1
Total: 25.800 bps

The channels are scanned by the CHRW in a priority order.
Channel 2 has the highest priority and next is channel 3.
These channels should be used for high speed data transfer.
The lower speed lines should be connected to channel 1 or channel 0 which are
treated with a low priority.

For cabling see chapter 2 " Installation"
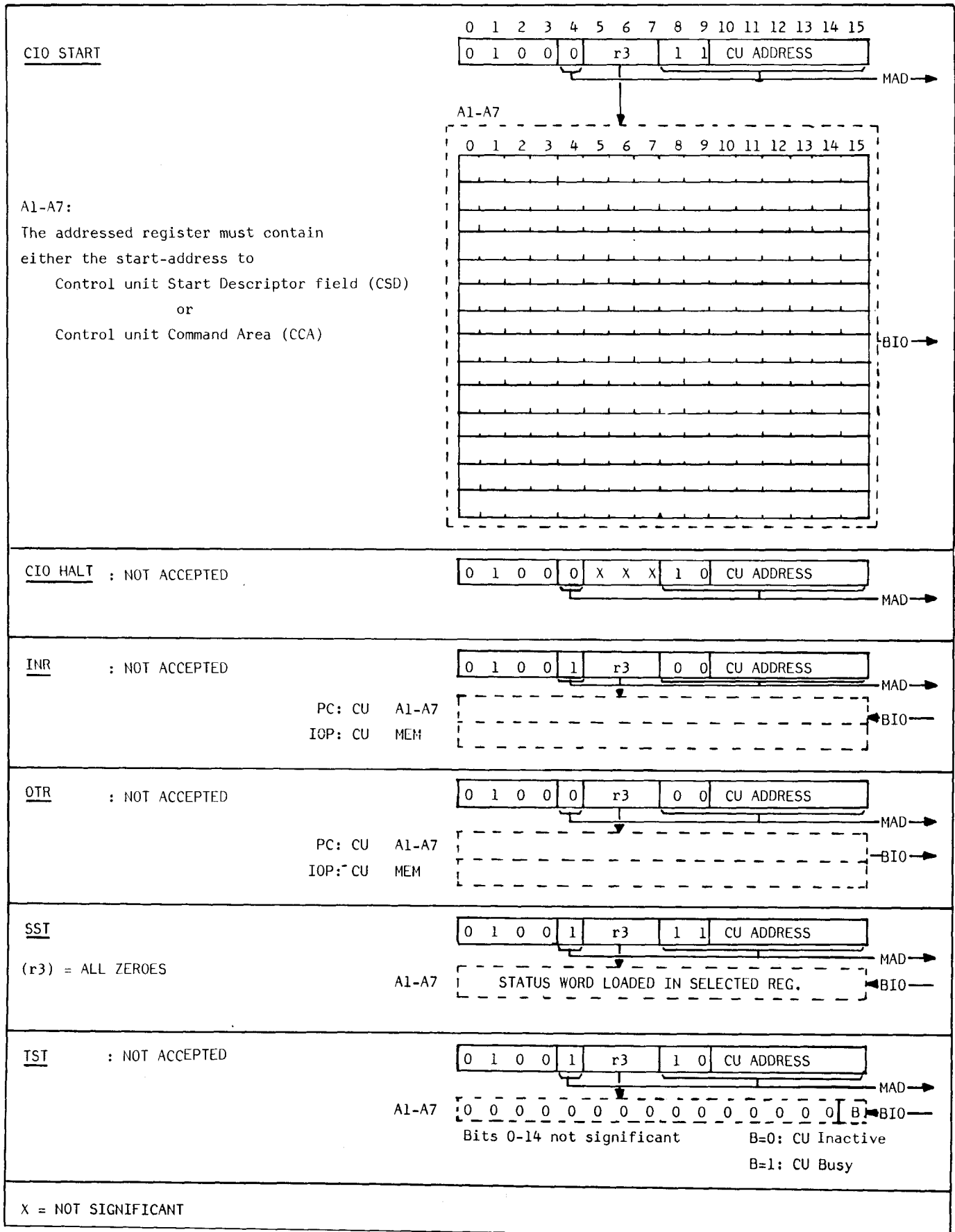
Figure 26.6 INSTRUCTION -/COMMAND-WORD FORMATS

COMMAND/RESPONSE INTERFACE BLOCKS

INITIALIZATION OF CHRW

After power-on the CHRW is in the RESET state and has to be initialized.
During initialization three control blocks are transferred from main memory to
CHRW, viz. Control unit Start Descriptor (CSD), Control unit Interface Descrip-
tor (CID) and Control unit Command Area (CCA). Before the CCA is transferred to
CHRW the control unit tests itself. (See Diagnostic tests)
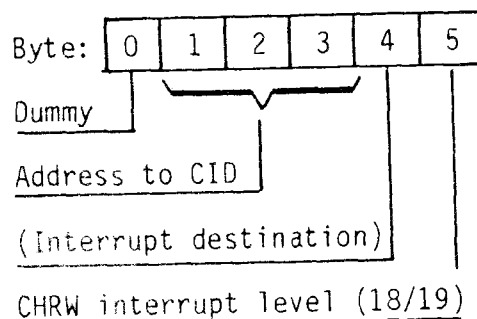
Figure 26.7 LAYOUT OF CSD
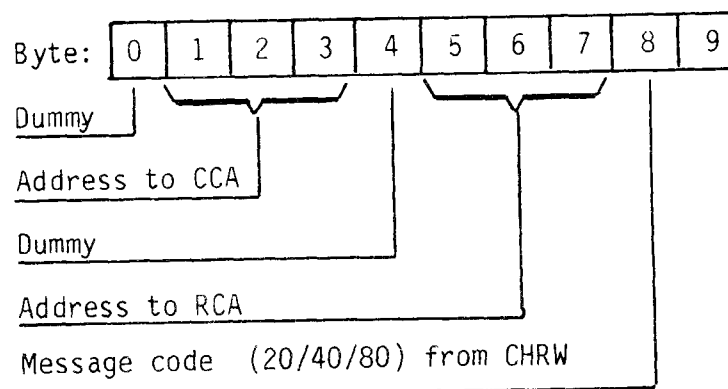
Figure 26.8 LAY-OUT OF CID

After the CHRW has completed a command it transfers a message code to byte 8
of CID in main memory, an updated CCA to Response Communication Area (RCA) in
main memory and interrupts the CPU at a level as stated in byte 5 of CSD.
(Software set Interrupt level of CHRW).
The start address of RCA is stated in CID.
For transfer of the blocks see figure 26.11, Data Flow Initialization, Output,
Input, Attention Message.

```
        BYTE │ 0 │ 1 │ 2 │ 3 │ 4 │ 5 │ 6 │ 7 │ 8 │ 9 │10 │11 │12 │13 │14 │15 │
```

WS No (0-1F)

Command Code

Sub-command 1

Sub-command 2

Status 1 (e.g. Warnings)

Status 2 (Hardware error)

Command Ident (used by responses)

Block address

1 = Data Chaining
0 = No Data Chaining

Block Length

6 bytes, repeated
in case of Data
Chaining
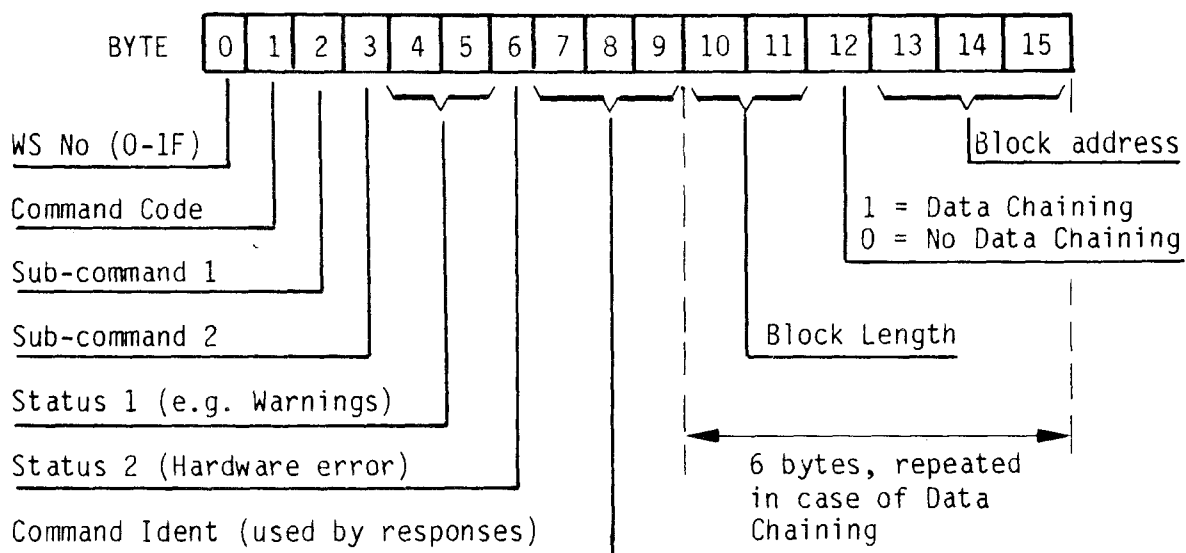
Figure 26.9 LAYOUT OF CCA/RCA

Three different message codes can be received from CHRW:

- Release: /40
- I/O Completion Code: /20
- Attention Code   /80

CHRW sends the Release code if CSD or if CCA is transferred to the memory of the
CHRW. Customer software now can fill these blocks with new information.
CHRW sends I/O Completion Code after a command is completely executed. The
Attention Code is send by CHRW if there has been a change in the hardware,
somewhere in the network or at the CHRW. This code has no relation to any
command.
Directly after transfer of one of these codes the CHRW interrupts the CPU via
the BIEC lines. These interrupts must be reset by means of an SST instruction.

All transfer between TC's main memory and the CHRW are controlled by the Direct
Memory Access part of the CHRW. (Hardware Channel).
As the CHRW is acting as a Master, the control unit must be taken into the
Master priority chain by means of the OKO-OKI signal. The priority order is set
by the Customer's application.

The CHRW recognizes the following command codes set in byte 1 of CCA. There are three types of command codes, with some commands additional information has to be sent in special formatted information blocks.

Command Code Hex	Command	Command Type	Remark
20	General Read	Input	From any WS
21	Specific Read	"	From addressed WS
40	Standard Write	Output	To addressed WS
41	Fast Write	"	To addressed WS with high priority
80	Test CU	Supervisory	Starts CHRW internal tests
81	Terminate (Not used)	"	Software Reset of CHRW
82	Close Line	"	Resets line parameters
83	Get DLS Statistics	"	Statistics for an addressed WS are transferred to TC.
84	Get Line Statistics	"	Statistics for the line counters are fetched to TC.
85	Open Data Link	"	Establishes a connection to a specified WS.
86	Open Line	"	Defines the type of line and sets the line parameters.
87	Read Local Memory	"	Read from RWM1 on CHRW to specified memory area in TC.
88	Cancel	"	Cancels a previously sent Read command.
89	Close Data Link		Closes the data link for a specific WS.

Figure 26.10 COMMAND CODES FOR CHRW

WS = Work Station

```
          Terminal Computer                                              CHRW
 TC-CPU       | MAIN-MEMORY    |   GP-BUS      |    MPU-2  | RWM-1  | MPU1    |   LINE
             |                |               |          |        | Z80CIO  |
Initialization:
 +--->CIO-START & CSDaddress ----------------------->  +     |        |         |
             |    + ---- CSD (DMA)----->              |     +        |         |
             |    +---- CID (DMA)----->           |         +        |         |

             |    + -->   CCA (DMA)------------------------------+   |         |
             |    +----<---- Release Code (/40) (DMA)--+         |   |         |
 +------------------ Interrupt (BIEC)----<----------------+      |   |         |
 +-->SST ----------------------------------------------+        |   |         |

             |    +---<-- Updated CCA to RCA (DMA)------------------+   |
             |    +--< I/O Completion code (/20) (DMA) to CID
 +--------------- Interrupt (BIEC)----<------------------+       |   |         |
 +-->SST-------------------------------------------+            |   |         |

Output:
 +--->CIO-START & CCAaddress----------------------->  +         |   |         |
             |    + ----CCA (DMA)---->                         +   |         |
             |    +----Release Code (/40) to CID (DMA)--<--+   |   |         |
 +--------------Interrupt (BIEC)----<-----------------.+         |   |         |
 +-->SST-------------------------------------->-----+          |   |         |
             |    +----Data Block (DMA)-->                |  -Data Block>|
                                                         +-Data Block>+ |
                                                         +-- Output-->+ --
                                                         +- 'ACK' --<+ --
             |    +------ Updated CCA to RCA (DMA)-----<----+       |   |
             |    +--<- to CID:I/O Completion code (/20)--+ |
 +--------------Interrupt (BIEC)----<-----------------+         |   |         |
 +-->SST---------------------------------------->------+        |   |         |

Input:                                                    +-Poll----------
 +--->CIO-START & CCAaddress------------------->  +       |   +-- Input--<+ --
             |    +----CCA (DMA)--->                         +  |  <Input frame+
             |    +----Release Code (/40) to CID (DMA)--<-+   |  +-- 'ACK' -->+ --
 +-------------- Interrupt (BIEC)----<-----------------+        |   |         |
 +-->SST-------------------------------------->------+         |   |         |
             |    +---Input Data to Data Block (DMA)--<--------+   |   |
             |    +----Updated CCA to RCA (DMA)----<--+        +   |   |
             |    +--<- to CID: I/O Completion code (/20)--+    |   |
 +-------------- Interrupt (BIEC)----<-----------+         |   |         |
 +-->SST-------------------------------------->-----+          |   |         |

Attention-Message: (=not related to any command: status change :=Status-1 in CCR)
                                                                 +Status change +
                                                   +Status change+
             |    +--Control Parameters to RCA (DMA)--<--------+    |
             |    +--<-To CID: Attention Code (/80) (DMA)--+        |
 +-------------- Interrupt (BIEC)----<-----------------+        |   |         |
 +-->SST-------------------------------------->-----+          |   |         |
```

Following messages can be given:
If the WS is disconnected: No Connection
If the CHLW has reset the Link: Link Reset
If the CHLW has re-established the data link: Communication Re-established
The information is put in Status-1 of RCA.

Figure 26.11   DATA-FLOW INITIALIZATION, OUTPUT, INPUT, ATTENTION MESSAGE

26.5 DIAGNOSTIC TESTS

In the software of the CHRW are implemented 4 diagnostic test types:

- Start-up test
- In-line test
- On-line test
- Off-line test (= Start-up test)

The outcome of the test is displayed in hex. format on four leds at the front of the CHRW, at the bottom.
The modem-signal Data Set Ready (107), for each line separately, is displayed with a led positioned between the connectors J20 and J30.
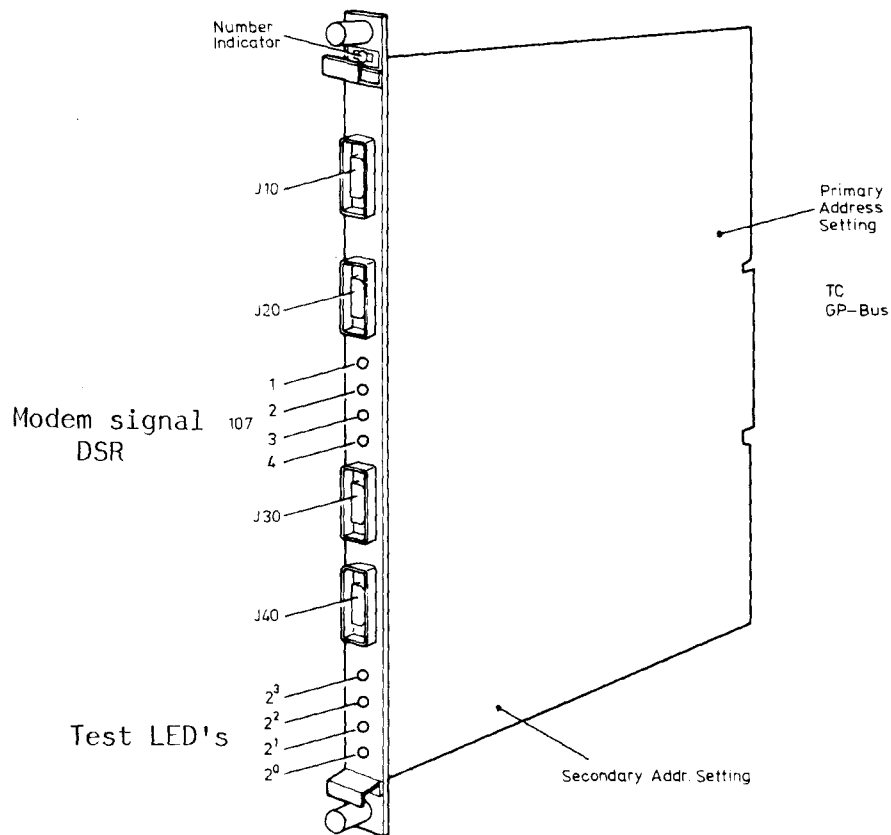

Figure 26.12 POSITION OF LEDS

START-UP TEST AND OFF-LINE TEST

The Start-up test and the Off-line test are exactly the same but intitiated in different ways.

The start-up test is started by "power-up".
The Off-line test is started when the IPL button or the Master-Clear button are pressed. The test-codes are shown in the figure below.

In case of an error the LEDs for the corresponding code are flashing.
If the LEDs are flashing the CHRW will not respond to any command from the host program because it put itself into NOT OPERABLE state.
The test can be started again by means of Power off/on, IPL- or MCL-button.
The following internal logic are tested in the test:

- MPU 1
- ROM1 (all data LRC checked)
- RWM1 (all location are written into, read and reset)
- MPU2
- ROM2 (all data is LRC checked)
- RWM2 (all locations are written into, read and reset)
- MPU3
- ROM3 (all data is LRC checked)
- RWM3 (all locations are written into, read and reset)

TEST CODE Hex	2^3	2^2	2^1	2^0	Meaning
0	0	0	0	0	No error, and "TEST CU"-command received
1	0	0	0	⊕	ROM 1 error, MPU 1
2	0	0	⊕	0	ROM 2 error, MPU 2
3	0	0	⊕	⊕	ROM 3 error. MPU 3
4	0	⊕	0	0	RWM 1 error, bit 0/1, MPU 1
5	0	⊕	0	⊕	RWM 1 error, bit 2/3, MPU 1
6	0	⊕	⊕	0	RWM 1 error, bit 4/5, MPU 1
7	0	⊕	⊕	⊕	RWM 1 error. bit 6/7, MPU 1
8	⊕	0	0	0	RWM 2 error, MPU 2
9	⊕	0	0	⊕	RWM 3 error, MPU 3
A	⊕	0	⊕	0	HDLC error/Data loop error, not flashing
B	⊕	0	⊕	⊕	RWM 1 error, MPU 2
C	⊕	⊕	0	0	RWM 1 error, MPU 3
D	----				Not used
E	⊕	⊕	⊕	0	Test OK, but no "Test CU" yet, not flashing.
F	⊕	⊕	⊕	⊕	Hardware reset received, not flashing.

Figure 26.13 TEST CODES START-UP OFF-LINE TEST

To switch the CHRW from the RESET to NORMAL OPERATION mode the TEST-CU command must be given by the host program.
This command is only accepted if no error was detected in the Start-up test.
The TEST-CU command starts the Start-up test all over again.
It takes about 10 seconds between a reset and accepting the TEST-CU command.
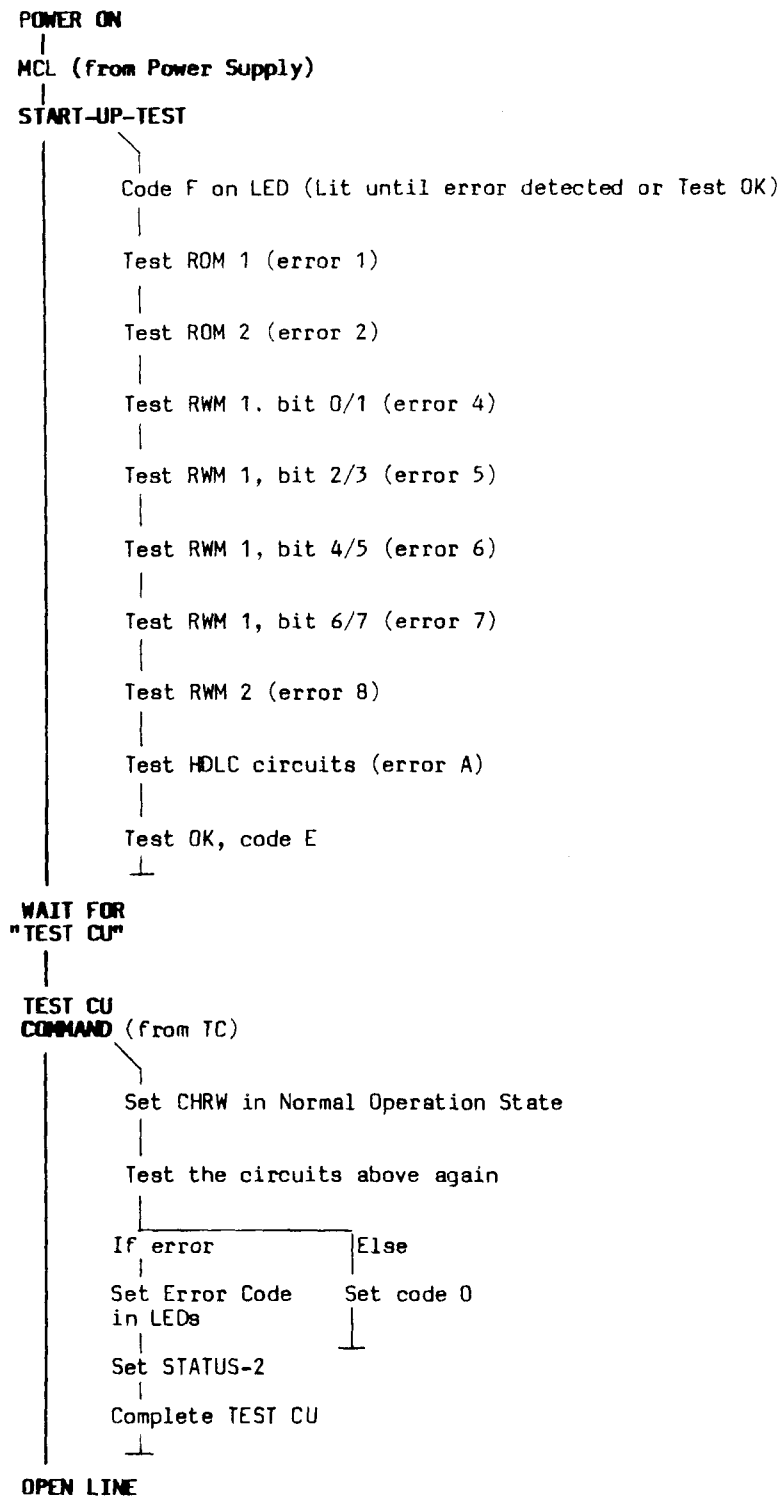
```
POWER ON
 |
MCL (from Power Supply)
 |
START-UP-TEST
 |      \
 |       \
 |        Code F on LED (Lit until error detected or Test OK)
 |        |
 |        Test ROM 1 (error 1)
 |        |
 |        Test ROM 2 (error 2)
 |        |
 |        Test RWM 1. bit 0/1 (error 4)
 |        |
 |        Test RWM 1, bit 2/3 (error 5)
 |        |
 |        Test RWM 1, bit 4/5 (error 6)
 |        |
 |        Test RWM 1, bit 6/7 (error 7)
 |        |
 |        Test RWM 2 (error 8)
 |        |
 |        Test HDLC circuits (error A)
 |        |
 |        Test OK, code E
 |        ⊥

WAIT FOR
"TEST CU"
 |

TEST CU
COMMAND (from TC)
 |      \
 |       \
 |        Set CHRW in Normal Operation State
 |        |
 |        Test the circuits above again
 |        |
 |        ┌───────────────┐
 |        If error         |Else
 |        |                |
 |        Set Error Code   Set code 0
 |        in LEDs          |
 |        |                ⊥
 |        Set STATUS-2
 |        |
 |        Complete TEST CU
 |        ⊥

OPEN LINE
```

Figure 26.14 FLOW OF TEST-PROGRAM

IN-LINE TEST

The In-Line test is activated several times by CHRW during run-time without affecting the user's application.

The /B and /C in the figure below indicate that an error has been detected. The CHRW however, will continue its normal execution in order to allow the host program to detect the error by means of a TEST-CU command.

TEST CODE Hex	2^3	2^2	2^1	2^0	Meaning
B	⊕	0	⊕	⊕	MPU 1 error, not flashing
C	⊕	⊕	0	0	MPU 2 error, not flashing
D	⊕	⊕	0	⊕	MPU 3 error, not flashing

Figure 26.15 ERROR CODES IN-LINE TEST

ON-LINE TEST

The On-Line test is activated by means of a TEST-CU command during the time the CHRW is in NORMAL OPERATION mode.

The following actions are taken:

- If the In-Line test previously has detected an error, the TEST-CU command is immediately executed.
- A ROM2 and a simple RWM1 test is performed.
  If an error is detected the appropriate LEDs, as shown in the figure below, are lit.
- A ROM1 and a simple RWM1 test is performed.
  If an error is detected the appropriate LEDs, as shown in the figure below, are lit.
- If no error is detected the TEST-CU command is completed with the fields STATUS-2 in the RCA set to zero.

In case of an error the Test code is duplicated in the 4 least significant bits of the STATUS-2 field after the TEST-CU command has been completed.

TEST CODE Hex	2^3	2^2	2^1	2^0	Meaning
1	0	0	0	⊕	ROM 1 error, MPU 1
2	0	0	⊕	0	ROM 2 error, MPU 2
3	0	0	⊕	⊕	Not used
4	⊕	0	0	0	RWM 1, bit 0/1, MPU 1
5	0	⊕	0	⊕	RWM 1, " 2/3, MPU 1
6	0	⊕	⊕	0	RWM 1, " 4/5, MPU 1
7	0	⊕	⊕	⊕	RWM 1, " 6/7, MPU 1
8	⊕	0	0	0	RWM 2 error, MPU 2

Figure 26.16 TEST-CODES ON LINE TEST

OFF-LINE TEST:

To activate the Off-Line test the DIP-switch number 8 in the Primary Address Field must be opened (= set to '1'). (If this switch is set to '0' the Secondary address is enabled. Also a data loop must be set up before the test is started (on one or more channels).

This is possible in two different ways:

1. By looping the data with a specially prepared connector on the board.
   Also the interface circuits must be looped.
2. By setting the LOOP-3 button on the site modem or the LOOP-2 button on one or more of the remote modems.

The Off line test first verifies the internal logic in the CHRW (Start-up test) and then checks the data channel(s) with the Data-Channel test.

The DIP-switches for the Secondary Address are used to select the different test modes:

Dipswitch No.	Open (1)	Closed (0)
1	-	Test of channel 0
2	-	Test of channel 1
3	-	Test of channel 2
4	-	Test of channel 3
5		
6	Single Test	Loop test
7	Stop on error	No stop on error (without error detection and error code display, intended for signature testing) However, stop on start up test error.
8	Off-Line Test Selected	Second.Workstation Number

Figure 26.17 SECONDARY DIP-SWITCH SETTING/TEST MODE

The error codes displayed are the same as for the Start-up/Off-line test (see figure 26.13. Test codes Start-up/Off-line test)

If no error is detected during the Data-Channel test, code/E is displayed, code /A indicates a data loop error.
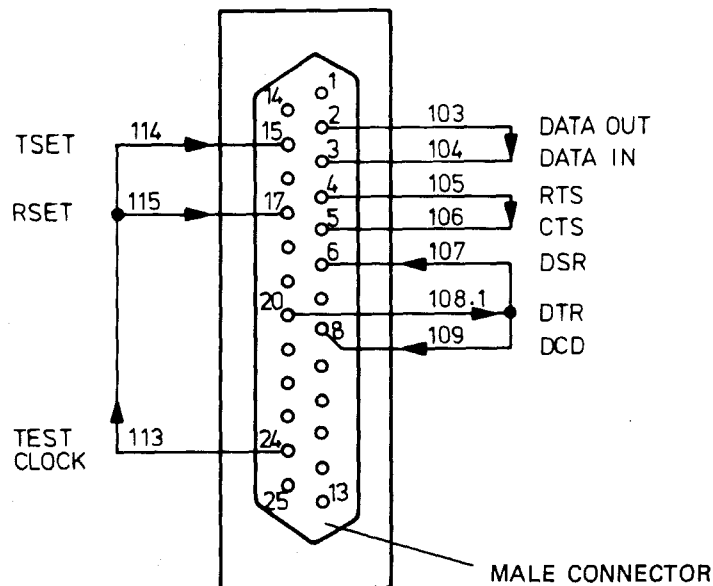
Figure 26.18   LINE LOOP TEST CONNECTOR

FAULT FINDING AIDS

TEST AND 107-LEDs

The fault symptoms that can be discovered during run time are shown in the flowchart together with the advised remedy.

Use the Test LEDs and the 107-LEDs (one for each channel) on the CHRW board to trace the faults. Besides, watch the operation of the devices during the Off-Line test when the Test-switch is set ON at respective Main Module of the workstations.

TEST PROGRAM

To test the network and the connected terminals the test-program TERTST4.2 and higher releases may be used.
See detailed description of TERST4.x.

MODEM TEST

The data modem is provided with extensive test facilities.
Line and interface loops can be set.
These loops are according to CCITT recommendation V54, controlled via certain CCITT interchange circuits or by TEST switches on the modem front.

With a remotely controlled test loop a rapid location of a faulty transmission element can performed by the operator at the local station in a 'point-to-point' link, without any assistance from the remote station.

However, control signals for the setting of this loop must be transmitted on the backward channel. (= not for data transfer used frequency band in the total frequency band of the line).

Test-procedure of Local modem:
To test the local modem, the loop test "LOOP-3" is used.
It is a full duplex test which can be set by:

Switch "LOOP-3" on the modem front panel.

When the loop is set, the test is started when the reset button on TC is
pressed. The result of the test is displayed on the TEST LEDs of the CHRW board.
(See figure 26.13. Test codes Start-up/Off-line test)

An /E is displayed when the internal test of the CHRW board is finished and no
errors are detected.
Hereafter the loop test starts at the channel selected by the switch set in the
Secondary Address field (see figure 26.17. Secondary DIP-switch setting/Test
mode).
An /A is displayed if the channel is faulty, otherwise code /E remains
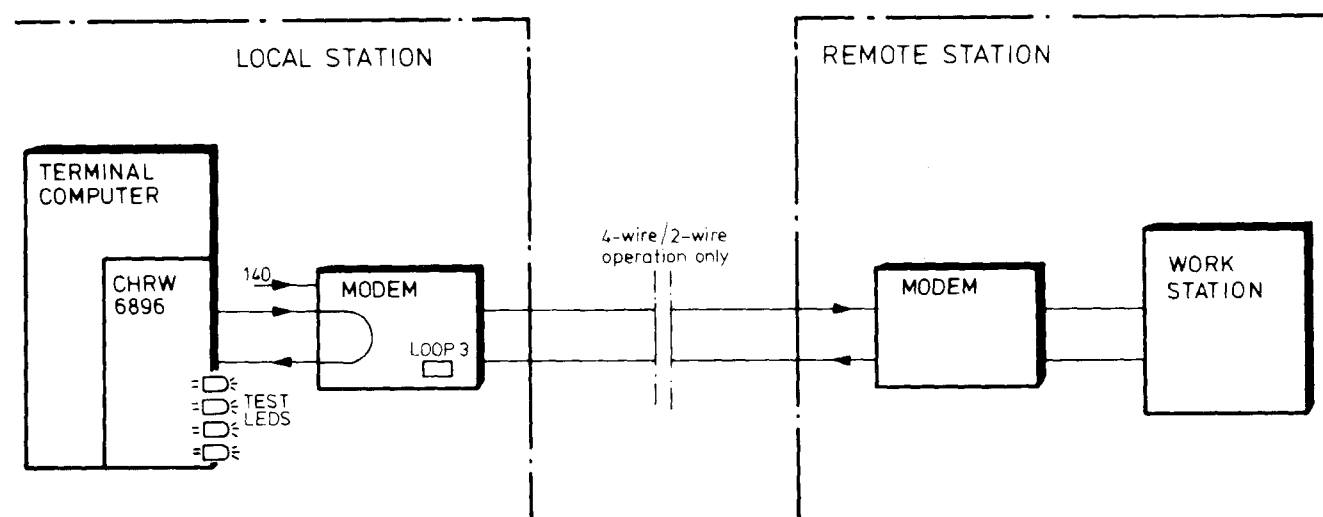displayed.

Figure 26.19 LOCAL MODEM TEST

TEST-PROCEDURE OF THE REMOTE MODEM

The remote modem at the other end of the telephone line, as well as the local modem, can be tested by setting the test "LOOP-2".

The test is set by either 1 or 2.

1. Switch "LOOP-2" on the front panel of the Remote modem. See figure 26.21. Remote modem test, LOOP-2, remote set.
2. Switch "REMOTE LOOP-2" on the front panel of the Local modem.
   With this test the backward channel, implemented in the modem is used.
   See figure 26.20 Remote modem test, LOOP-2, local set.

The result of the test is displayed by the LEDs at the front panel of the CHRW. See figure 26.13. Test codes Start-up/Off-line test.
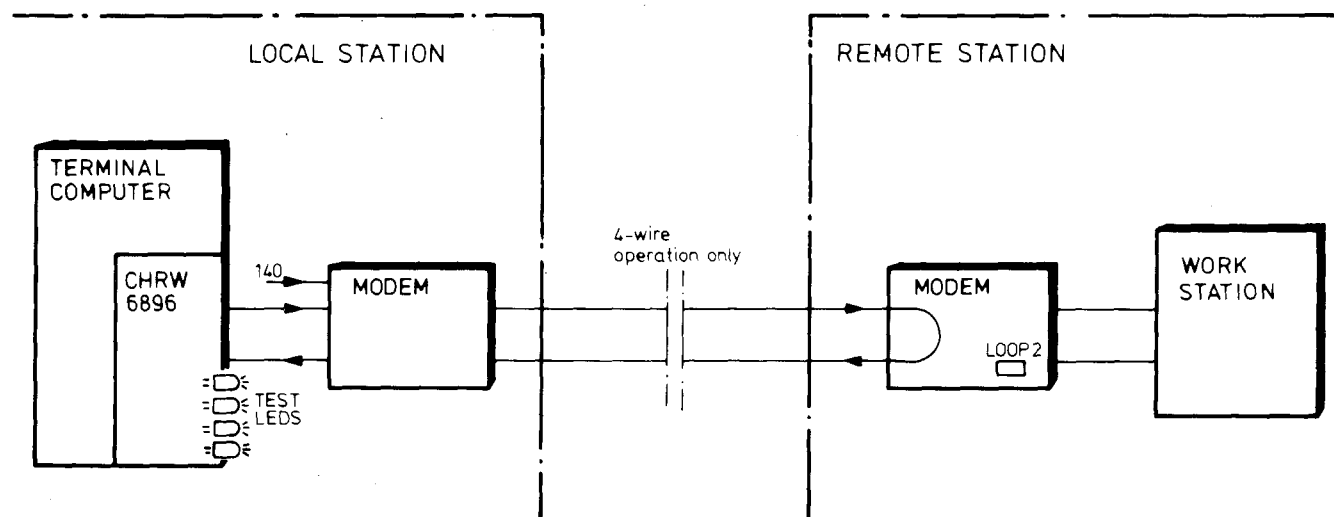

Figure 26.20 REMOTE MODEM TEST, LOOP-2, LOCAL SET
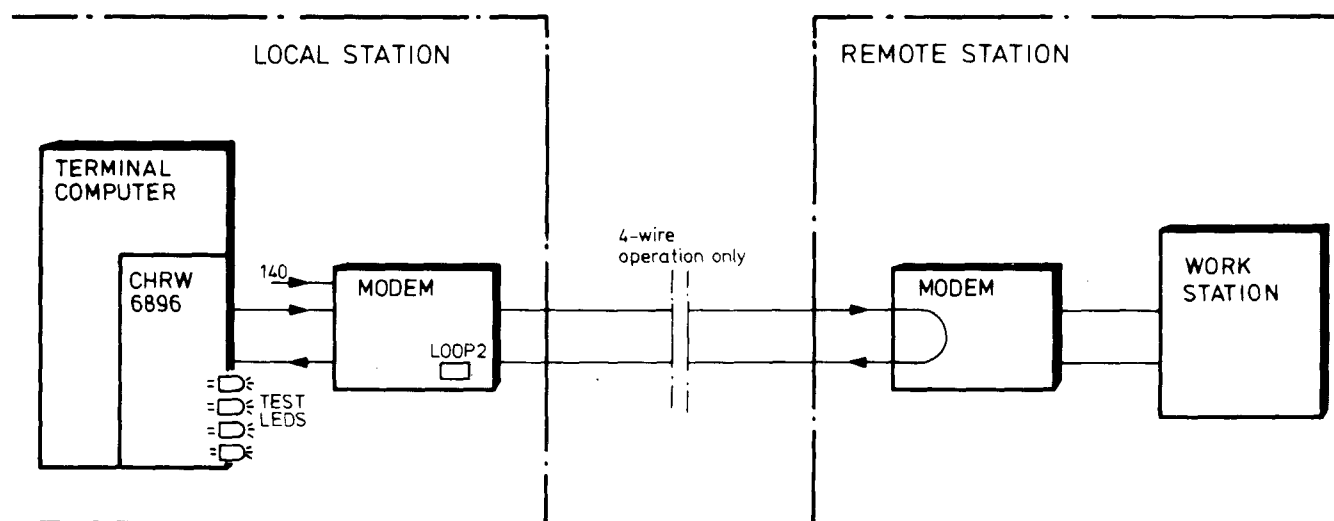

Figure 26.21 REMOTE MODEM TEST, LOOP-2 REMOTE SET

SIMULATED MODEM TEST

With a special wired connector, simulating the modem, each channel can be tested. The connector is shown in figure 26.18. Line-loop Test connector.

(At customer site)

CHECK WHICH WORKSTATIONS (WS) OPERATE BADLY OR NOT AT ALL

SELECT CASE

ONLY ONE WS FAULTY → SEE TROUBLESHOOTING FOR THIS MAIN MODULE

TWO (OR MORE) WSs FAULTY, LOCATED ANYWHERE → CHECK THE WS ADDRESSES ON BOTH WSs

ALL WSs FAULTY → CHECK LED 107
- ON → CHECK CHRW
- OFF → CHECK LOCAL MODEM CONNECTION

READ THE LEDs (after power-on test)
```
0 2³
0 2²
0 2¹
0 2⁰
```
TEST see 3.8 DIAGNOSTIC TEST

LED INDICATION
- 0 → SOFTWARE IS OK → TRANSM./READ LEDs FLASHING?
  - Yes → REPLACE CHRW
  - No → CHECK HEAD LINE
- E → FIRMWARE IS OK → CHECK CHRW ADDRESS → IF STILL ERROR CHECK MASTER PRIORITY CHAIN (0K0-0K1)
- 1-D → NOTIFY THE ERROR CODE ON THE BOARD → REPLACE THE CHRW
- F → REPLACE CHRW

MAKE A LOOP 3 TEST ON FAULTY CHANNEL → OK?
- Yes →
- No → MAKE A LOOP 2 TEST

RUN TC TEST PROGRAMS → OK?
- YES →
- NO → REPAIR TC

STILL ERROR?
- YES → TC PROGRAM ERROR
- NO →

ANY ERROR FOUND?
- YES → IF ERROR CORRECTED, REPEAT THE TROUBLE-SHOOTING PROCEDURE TO TEST THE WHOLE SYSTEM
- NO → CALL THE SPECIALIST
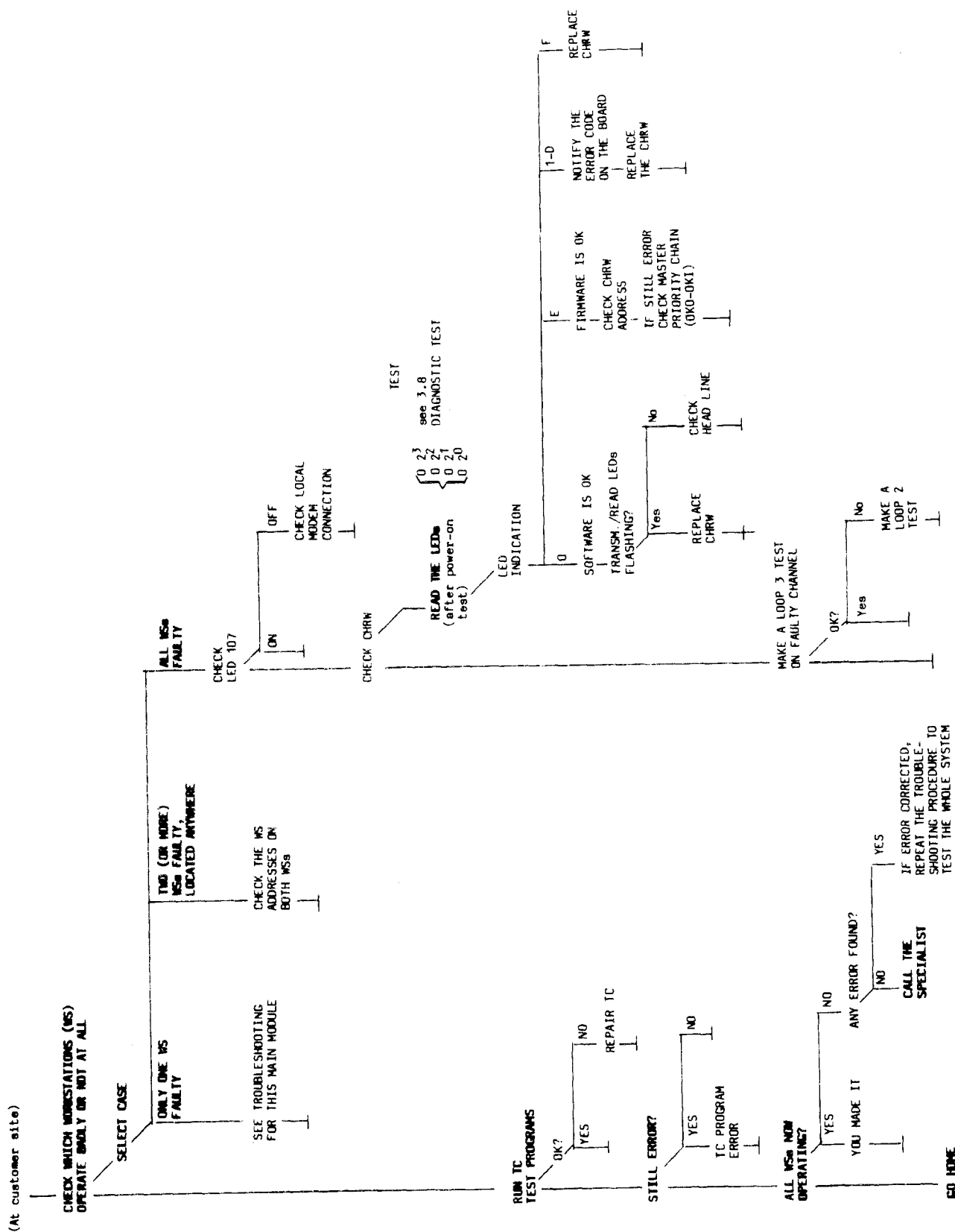
ALL WSs NOW OPERATING?
- YES → YOU MADE IT
- NO →

GO HOME

Figure 26.22   RWSI TROUBLE SHOOTING PROCEDURE