

APPENDIX III

R2 SIGNALING SPECIFICATION

m R2 SIGNALING SYSTEM IN CTC NETWORK

1. GENERAL

This document contains the specifications of the R2 signaling system, to be used in equipments of Compania de Telefonos de Chile S.A. (CTC).

The application of this system is based on the dispositions contained in the Plan Tecnico Fundamental de Seflalizacion Telefonica [Technical Fundamental Plan of Phone Signaling] (Decree N° 225, December 16th, 1982, published in Diario Oficial de la Republica de Chile, on May 4th, 1983) and on the CCITT recommendations, Q.400 series.

The line signaling, depending on the transmission means, is:

- R 2 digital version in MIC links.
- E-M in analogical links.

The signaling between recorders uses the multifrequency combinations, MFC-R2 type.

2. LINE SIGNALING

E-M line signaling

2.1 Introduction

The E-M line signaling specified below considers the use of signaling among MFC-2 recorders.

The line signals are transmitted link by link.

This line signaling foresees the uni and bidirectional operation of the circuits.

2.2 E-M line signaling code

Chart N°1 shows the codification of E and M wires for the E-M line signaling, under normal operational conditions.

CHART N°1 E-M line signaling

Signal Codification under normal operational conditions.

| N° | CIRCUIT'S OPERATIONAL CONDITIONS | SIGNAL CODE | | | | |
|----|----------------------------------|--------------|----------|-----------|--------------|---|
| | | Outgoing End | | Direction | Incoming End | |
| | | M | E | | M | E |
| 1 | Resting | 0 | 0 | | 0 | 0 |
| 2 | Seizing | 1 | 0 | | 0 | 1 |
| 3 | Seizing Acknowledgment | 1 | | | (2) | 1 |
| 4 | Recorder signals (1) | 1 | 0 | | 0 | 1 |
| 5 | (New) answer after N° 4 and N°6. | 1 | 1 | | 1 | 1 |
| 6 | Called Subscriber hangs up | 1 | 0 | | 0 | 1 |
| 7a | Release after N° 3,4 ,6. | 0 | 0 | | 0 | 0 |
| 7b | Release after N°5 | 0 | 1 | | 1 | 0 |
| | | 0 | 0 | | 0 | 0 |
| 8 | Blocking (3) | 0 | 1 | | 1 | 0 |
| 9 | Blocking Ending (3) | 0 | 0 | | 0 | 0 |

REMARKS:

(1) Signaling among MFC-R2 recorders.

(2) Duration pulse 100 to 200 ms.

1: Ground presence (current) 0:

Ground absence (no current)

(3) Only in unidirectional operation.

2.3 Flow chart for automatic communications

(1) Only in unidirectional operation.

2.4 Identification periods of a signaling state change.

The identification period of a state change (from ground presence to ground absence in E wire or vice versa) is 40 ± 10 ms. The identification period is defined as the minimum period in which the ground presence or absence in E wire should remain so that it can be identified like a condition of valid signaling by the incoming equipment of the central network.

2.5 Regulations corresponding to the different signaling conditions in unidirectional operation,

a) Outgoing end

A switching equipment operating as an outgoing end emits signals on its M wire and receives signals on its E wire.

Chart N°2 shows the states corresponding to each identified signaling code and the measures to be taken in the outgoing end of a circuit operating with E-M line signaling.

CHARTN°2 E-M LINE SIGNALING. UNIDIRECTIONAL OPERATION

Operational conditions in outgoing end

| N° | NORMAL CONDITION IN OUTGOING END | SENT CODE | RECEIVED | |
|----|-------------------------------------|-----------|--------------------------------------------|------------------------------------------------|
| | | | E=0 | CODE E=1 |
| 1 | Resting | M=0 | Resting | Blocking |
| 2 | Seizing | M=1 | Seizing (see remark 1) | Seizing Acknow- ledgement |
| 3 | Seizing Acknowledgment | M=1 | Recorder Signals (MFC-R2) | Seizing Acknow- ledgement (See remark 2) |
| 4 | Recorder Signals (MFC-R2) | M=1 | Recorder Signals (MFC-R2) | Answer |
| 5 | Answer/ new answer | M=1 | Called subs, hangs up (See remark 3) | Answer |
| 6 | Called subscriber hangs up | M=1 | Called subs, hangs up (See remark 3) | New answer |
| 7 | Release | M=0 | Release (See remark 4) | Release (See remark 4) |
| 8 | Blocking | M=0 | Blocking Ending | Blocking |
| 9 | Blocking end | M=0 | Resting (See remark 5) | Blocking |

Remarks:

(1) The absence of identification of seizing acknowledgment signal 1 second after the seizing signal transmission will cause an alarm and a new attempt in order to establish the call. The outgoing end will avoid new circuit seizings as long as it remains in the "seizing" state. When the seizing acknowledgment signal is identified after the 1 second-term, the release signal will be sent.

(2) The E = 1 code permanence during the seizing state, for a period more than 500 ms, will cause an alarm and a new attempt in order to establish a call. The circuit should be switched to a blocking state.

(3) If the call charging is carried out behind the switching equipment of the outgoing end, the called subscriber hangs up condition shall be immediately established in the previous link.

If the call charging is carried out in the switching equipment of the outgoing end, the reception of the called subscriber hangs up signal shall cause the timing of the calling subscriber's delay on hanging (See Specification N° 100, Chapter n, item 12.5.3). If after this timing neither a new answer signal from the incoming end nor a release signal of the previous link has been received, the outgoing end switching center should establish the called subscriber hangs up condition (release request signal) in the previous link and the ending condition in the outgoing end.

If the charging is carried out in front of the switching equipment of the outgoing end, the called subscriber hangs up condition (release request signal) shall be established in the previous link and states the condition of the releasing outgoing end.

(4) The release condition should compulsorily be kept during 500 ms. before returning to the resting state.

(5) The blocking ending condition should be kept for at least 100 ms. before returning to the resting state,

b) Incoming end

A switching equipment operating as an incoming end emits signals on its M wire and receives signals on its E wire.

Chart N°3 shows the states corresponding to each identified signaling code and the measures to be taken in the incoming end of a circuit operating with E-M line signaling.

CHARTN°3 E-MLINE SIGNALING. UNIDIRECTIONAL OPERATION

Operational conditions in incoming end

| N° | NORMAL CONDITION IN OUTGOING END | SENT CODE | RECEIVED CODE | |
|----|----------------------------------|-----------|-----------------|----------------------------------------|
| | | | E=0 | E=1 |
| 1 | Resting | M=0 | Resting | Seizing (See remark 1) |
| 2 | Seizing Acknowledgment | M=0/1/0 | Release | Seizing Acknowledgement (see remark 2) |
| 3 | Recorder signals(MFC-R2) | M=0 | Release | Numbering Reception |
| 4 | Answer/ new answer | M=0 | Release | Answer |
| 5 | Call is hung up | M=0 | Release | Call is hung up |
| 6 | Release | M=0 | Resting | Abnormal (See remark 3) |
| 7 | Blocking | M=1 | Blocking | Abnormal (See remark 4) |
| 8 | Blocking end | M=0 | Pass on resting | Abnormal (See remark 3) |

REMARKS:

- (1) Once the seizing signal is identified, the incoming end shall turn into the seizing acknowledgment condition.
- (2) The seizing acknowledgment condition (transmission of $M=1$ code), should be kept for a period equivalent or superior to 100 ms., and not greater than 200 ms.
- (3) The reception of $E=1$ code in the incoming end during the releasing or blocking ending condition, before returning to the resting condition, will cause the incoming end blocking condition (transmission of $M=1$ code), until the transmission of the $E=0$ code is recognized (resting condition).
- (4) The reception of the code $E= 1$ in the incoming end during blocking condition will cause the holding of the $M = 1$ code transmission, while the reception of the $E= 1$ code lasts. The return to $E=0$ code will cause the return to the normal blocking condition.

2.6 Regulations corresponding to the different signaling conditions in bidirectional operation, a)

Outgoing end.

In case of bidirectional operation of the resting circuits, it is not specified whether the ends are functioning as outgoing or incoming ends. Therefore, in resting condition, both ends should be considered as outgoing ends, until the establishment direction for that communication is defined by the appearance of a signal

A switching equipment operating as an outgoing end emits signals on its M wire and receives signals on its E wire.

Chart N°4 shows the states corresponding to each identified signaling code and the measures to be taken in the outgoing end of a circuit operating with E-M line signaling, in bidirectional operations of links.

CHARTN°4 E-MLINE SIGNALING. BIDIRECTIONAL OPERATION

Operational conditions in outgoing end

| N° | NORMAL CONDITION IN OUTGOING END | SENT CODE | RECEIVED | |
|----|----------------------------------|-----------|--------------------------------------------|----------------------------------------------------------------|
| | | | E=0 | CODE E=1 |
| 1 | RESTING | M=0 | RESTING | Seizing on contrary direction(See remark 1) |
| 2 | SEIZING | M=1 | SEIZING (see remark 2) | SEIZING ACKNOWLEDGEMENT |
| 3 | SEIZING ACKNOWLEDGMENT | M=1 | RECORDER SIGNALS | SEIZING ACKNOWLEDGEMENT OR SIMULTANEOUS SEIZING (See remark 3) |
| 4 | RECORDER SIGNALS(MFC-R2) | M=1 | RECORDER SIGNALS | ANSWER |
| 5 | ANSWER/ NEW ANSWER | M=1 | CALLED SUBS. HANGS UP (see remark 4) | ANSWER |
| 6 | CALLED SUBSCRIBER HANGS UP | M=1 | CALLED SUBS. HANGS UP | NEW ANSWER |
| 7 | RELEASE | M=0 | RELEASE (see remark 5) | RELEASE (See remark 7) |
| 8 | SIMULTANEOUS SEIZING | M=1 | SIMULTANEOUS SEIZING | SIMULTANEOUS SEIZING |
| 9 | SIMULTANEOUS SEIZING ENDING | M=0 | SIMULTANEOUS SEIZING ENDING (See remark 6) | SIMULTANEOUS SEIZING ENDING (See remark 7) |
| 10 | BLOCKING (after 3 or 9) | M=0 | BLOCKING ENDING (See remark 8) | BLOCKING |

REMARKS:

- (1) When a seizing on the contrary direction is detected, it will cause this end to turn into a incoming end (see Chart 5).
- (2) The absence of identification of E=1 code 1 second after the "seizing" signal transmission will cause an alarm and a new attempt in order to establish the call. The outgoing end will avoid new circuit seizings while it remains in the "seizing" state. When E=1 code is recognized after the 1 second-term, the release signal will be sent.

(3) The permanence of the E = 1 code during the "seizing acknowledgment" state, for a period more than 300 ms should cause a change in the "simultaneous seizing" condition.

(4) If the call charging is carried out behind the switching equipment of the outgoing end, the called subscriber hangs up condition shall be established immediately in the previous link. If the call charging is carried out in the switching equipment of the outgoing end, the called subscriber hangs up signal reception shall cause the timing of the calling subscriber's delay on hanging (See Specification N° 100.00, Chapter n, item 12.5.3). If after this timing neither a new answer signal from the incoming end nor a release signal of the previous link has been received, the outgoing end switching center should establish the "forward release" condition and the "Called Subscriber hangs up" (release request signal) in the previous link.

If the charging is carried out in front of the switching equipment of the outgoing end, the "called subscriber hangs up" condition (release request signal) shall be established in the previous link and shall establish the "release" condition of the outgoing end.

(5) The release condition should compulsorily be kept during 500 ms. before returning to the resting state.

(6) The condition of simultaneous seizing ending should be kept during 500 ms. before returning to the resting state.

(7) Permanence of E-1 code after the transmission of either releasing signals or simultaneous seizing ending, during 500 ms, shall originate the blocking condition.

(8) Reception of E=0 code in blocking condition shall originate the resting condition.

(b) Incoming end

When a seizing signal on the contrary direction is detected (see Chart N°4) this switching equipment shall turn into an incoming end.

The incoming end emits signals on its M wire and receives signals on its E wire.

Chart N°5 shows the states corresponding to each identified signaling code and the measures to be taken in the incoming end of a circuit operating with E-M line signaling in bidirectional operation.

CHARTN°5 E-M LINE SIGNALING. BIDIRECTIONAL OPERATION

Operational conditions in incoming end

| N° | NORMAL CONDITION IN OUTGOING END | SENT CODE | RECEIVED | |
|----|----------------------------------|-----------|----------|----------------------------------------|
| | | | E=0 | E=1 |
| 1 | SEIZING | M=0 | RELEASE | Seizing (See remark 1) |
| 2 | SEIZING ACKNOWLEDGMENT | M=0/1/0 | RELEASE | SEIZING ACKNOWLEDGEMENT (See remark 2) |
| 3 | RECORDERS SIGNAL RECEPTION | M=0 | RELEASE | RECORDER SIGNALS(MFC-R2) |
| 4 | ANSWER/ NEW ANSWER | | RELEASE | ANSWER/ NEW RELEASE |
| 5 | CALLED SUBSCRIBER HANGS UP | | RELEASE | CALLED SUBS. HANGS UP |
| 6 | RELEASE | | RESTING | ABNORMAL (See remark 3) |

REMARKS:

(1) Once the seizing signal is identified, the incoming end shall turn into the seizing acknowledgment condition.

(2) The transmission of M=1 code in seizing acknowledgment condition should be kept for a period equivalent or superior to 100 ms., and not greater than 200 ms.

(3) The reception of E=1 code during the release condition should cause the transmission of M=1 code until the reception of E=0 code is recognized (pass on resting).

2.7 E-M signaling with metering signals (telecharging)

a) Introduction

The metering signals described below are specified to be used in links with E-M line signaling in either uni or bidirectional operation of the circuits.

The metering signals are sent during the answer state (conversation). For other conditions corresponding to different signaling conditions for either uni or bidirectional operations, regulations described in items 2.1.1 and 2.1.6, respectively, are valid.

b) Normal operational conditions of metering signals. The metering signals are ground absence pulse type in M wire sent by the incoming end and recognized in the E wire of the outgoing end.

The metering pulses shall follow the following values:

- In transmission: 150 ms. + - 30 ms.
- in transmission: 150 ms. -t- - 150 ms.
- Identification time among identified operations: minimum 60 ms.
- Intervals between pulses: minimum 150 ms.

In the (incoming) transmission end, the time between the answer signal (transmission of M=1 code) and the beginning of the first metering signal (M=0 code), and between the end of the last metering signal and the beginning of the release request (Called subscriber hangs up) shall be more than 150 ms.

In the outgoing end, the identification time of the request release signal (reception of E=0 code) shall be more than 300 ms.

When the central network controlling the charging of the call (in this case, the outgoing end) receives by the next link the called subscriber hangs up signal, it shall cause the timing of the calling subscriber's delay on hanging (See Specification N° 100.00, Chapter n, item 12.5.3) and keep the transmission of metering signals. If after this timing neither a new answer signal from the called subscriber nor a release signal from the outgoing end has been received, the incoming end shall interrupt the transmission of the metering signals, send the release signal by the next link and send the release signal (called subscriber hangs up) to the previous outgoing end.

Once the release request signal is identified in the source central network (called subscriber hangs up) a forward release condition shall be transmitted.

2.8 Abnormal signaling states

a) If a central network with an outgoing R2 recorder identifies a premature answer signal, before receiving a A-6 complete address signal or a B-group signal, it will cause an alarm condition and the repetition of the attempt to establish a call. The outgoing end will send the release signal by an idle circuit.

b) In cases of no reception of the answer signal, delay in the release by the calling subscriber in automatic operation, and no reception of the clearing signal from the incoming central network after the transmission of the clear-back signal, the abnormal operational timing and release regulations detailed in Chapter n, item 12.5, Specification 100.00.

2.1.9 New attempts to establish a call

Two new attempts are allowed to establish a call, due to any of the specified conditions shown in previous items 2.1.5 to 2.1.8. If after two new attempts one of these conditions arises, the outgoing end shall send a congestion signal to the calling subscriber, an alarm signal to the technical staff and shall release the connection forward.

2.2 R2 Line Signaling, Digital version

2.2.1 Introduction

R2 line signaling, digital version, is based on the CCITT's Recommendations Q.421, Q.422 and G.732. This version of R2 line signaling uses two signaling channels (bits) in each transmission direction by telephone circuit.

This signaling channels are called ar and bf for the outgoing direction (or forward) and at and bb in the return direction (backwards).

In normal conditions:

Channel ar identifies the operational condition of the outgoing switching equipment and displays the line condition of the calling subscriber. Channel bf provides a tool to indicate a failure in the forward direction to the incoming switching equipment.

Channel ab displays the called subscriber line condition (switch hook is in a on-hook or off-hook condition).

bb channel indicates the resting condition or the busy condition of the incoming switching equipment. Additionally, for subscribers with telecharging or previous-payment devices, a signal has been defined in the backward channel level (Q,) which comprises 150 ms. pulses, for a new transmission of the charging pulses from the charging center to the calling subscriber's central network.

The line signals are transmitted link by link.

The signaling system is specified for bidirectional operation of the telephone circuits.

2.2.2 Signaling code for digital line

Chart N°6 shows the interval 16 signaling code for the R2 line signaling, digital version, in normal operational conditions.

Chart N°6

R2 Line Signaling. Digital
Signaling code for time interval 16.

| Signals | Transmission Direction | Forward | Backwards |
|---------------------------------------------------|------------------------|-------------|--------------------------|
| | | ar bf Cf df | ab bb Cb 4 |
| Resting | | 1 0 0 1 | 1 0 0 1 |
| Seizing | | 0 0 0 1 | 1 0 0 1 |
| Seizing Acknowledgment | | 0 0 0 1 | 1 1 0 1 |
| MF Numbering | | 0 0 0 1 | 1 1 0 1 |
| Answer | | 0 0 0 1 | 0 1 0 1 |
| Rate pulse (1) | | 0 0 0 1 | 0 1 0/1/0 1 |
| Called subscriber hangs up or release request (2) | | 0 0 0 1 | 1 1 0 1 |
| Ending | | 1 0 0 1 | 0 1 0 1 or 1 1 0 1 |
| Guard Release | | 1 0 0 1 | 1 0 0 1 |
| Blocking | | 1 0 0 1 | 1 1 0 1 |
| Blocking Ending | | 1 0 0 1 | 1 0 0 1 |

(1) 150ms. pulse. Minimum pause between two successive pulses: 150ms.

(2) "Called subscriber hangs up", if charging is generated behind the center in consideration.
"Release request", if charging is generated in front of the center in consideration.

2.2.3 Flow chart for automatic communications

1. RESTING
2. SIMULTANEOUS SEIZING
3. SEIZING
4. SIMULTANEOUS SEIZING ENDING
5. SEIZING ACKNOWLEDGMENT
6. SIGNALS AMONG RECORDERS (MF NUMBERING)
7. NEW ANSWER
8. CALLED SUBSCRIBER HANGS UP.
9. ENDING
10. BLOCKING
11. GUARD RELEASE
12. BLOCKING ENDING.

2.2.4 Clauses related to the central network's line signaling equipment

(a) Change identification in a the signaling condition

a-1) Transitions in the signaling channel

The identification time for the transition from 0 to 1 or vice versa in a signaling channel is 20 ± 10 ms.

a-2) Change in the signaling condition

The change identification of the signaling condition is defined from one of these two items:

- Identification of a detected transition in a signaling channel, if it has not been detected a transition in the second signaling channel during the identification time.
- Identification of a detected transition in the second signaling channel during the identification period already applied to the first signaling channel.

In this case, a signaling change is detected only when the two timing periods for identification have passed.

b) Tolerance of signal transmission time

The transmission time difference between two targeted transitions to be applied simultaneously to two signaling channels in the same transmission direction should not be greater than 2 ms.

2.2.5 Regulations corresponding to the different signaling conditions

Chart N° 7 Digital R2 Line Signaling.

Operational conditions in the outgoing end.

| NORMAL CONDITION IN THE OUTGOING END | Sent Code | | Received | Code | |
|-----------------------------------------------|-----------------------|-----------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|
| | | ab=0bb=0 | ab=0bb=1 | a _b =1 bb=0 | at=1 bb=1 |
| RESTING/GUARD RELEASE | aplbpO | Seizing in the contrary direction (see remark 1) | Abnormal (see remark 2) | Resting (see remark 3) | Blocking (see remark 4) |
| SEIZING | apObfK) | Simultaneous seizing (see remark 5) | Abnormal (see remark 6) | Seizing (see remark 6) | Seizing acknowl. |
| SEIZING ACKNOWLED. | ar=Obf=0 | Abnormal (see remark 7) | Answer | Abnormal (see remark 7) | Seizing Acknowl. |
| ANSWER/NEW ANSWER | afObpO | Abnormal (see remark 8) | Answer | Abnormal (see remark 8) | Called subs, hangs up (see remark 9) |
| CALLED SUBS. HANGS UP | ar=Obf=0 | Abnormal (see remark 8) | New answer | Abnormal (see remark 8) | Called subs, hangs up |
| ENDING | arlbfO | Abnormal | Ending | Guard release | Blocking (see remark 10) |
| BLOCKING | arlbpO | Abnormal (see remark 2) | Abnormal (see remark 2) | Blocking ending= turn into resting | Blocking (see remark 10) |
| ENDING OF OF SIMULTANEOUS SEIZING | af=lb _f =0 | Ending of simultaneous seizing (see remark 11) | Ending of simultaneous seizing (see remark 11) | Ending of simultaneous seizing (see remark 11) | Ending of simultaneous seizing (see remark 11) |

REMARKS:

- (1) The identification of a seizing on the contrary direction will cause this end to operate as an incoming end (see chart N°8).
- (2) Under these normal conditions, the outgoing end will avoid new circuit seizings and will maintain the transmission of the $ar=bf=0$ code, while the $ab=0$ $bb=1$ condition is kept. The circuit will turn into the resting condition (available) when the outgoing end turns again into the $ab=1$ $bb=0$ condition.
- (3) A seizing can take place only when $ab=1$ $bb=0$ is identified.
- (4) The end starting with a manual or automatic blocking will turn to operate as an incoming end ($ab=1$ $bb=1$ transmission)
- (5) A simultaneous or double seizing is produced if the outgoing equipment is in seizing condition and the signaling $ab=0$ $bb=0$ condition, instead of $ab=1$ $bb=1$ (seizing acknowledgment) is identified. In such a case, the attempt to establish the call in both ends should be repeated. The signaling equipment in each end of the circuit taken simultaneously should keep for at least 100 ms. the seizing signaling state, after detecting the simultaneous seizing.
- (6) When the seizing acknowledgment signal is not recognized in a parametric term between 100 and 1000 ms. after the seizing signal transmission, this condition will cause an alarm and a new attempt to establish a call. The outgoing end will avoid new seizings of this circuit. Once the acknowledgment seizing signal is identified (once the parametric term is finished) an ending signal will be sent.

While the "waiting for acknowledgment signal" state lasts, the outgoing end must keep the $ar=0$ $bf=0$ transmission. Meanwhile, if a release is produced the ending signal will only be emitted after the identification of the seizing acknowledgment signal. In order to prevent an abnormal blocking of the circuits, in case of no identification of the seizing acknowledgment signal, it is allowed to wait for the identification of this signal before starting the signaling among recorders.

- (7) The identification of $bb=0$ in the outgoing end, during 1 to 2 seconds after the identification of the seizing acknowledgment signal and before the identification of the answer signal will cause an alarm and a new attempt to establish a call. The outgoing end will avoid new seizings of this circuit. Once the $bb=1$ code is identified again after the end of the 1-to-2 second term, an ending signal will be sent.

(8) When $bb=0$ is recognized while an answer or a called subscriber hangs up condition is held, an immediate measure will not be necessary. When a release of the previous link is received, the ending signal will not be sent until $bb=1$ signal is restored.

(9) If the call charging is carried out behind the switching equipment of the outgoing end, the Called subscriber hangs up condition must be immediately established in the previous link.

If the call charging is carried out in the switching equipment of the outgoing end, the reception of the called subscriber hangs up signal shall cause the timing of the calling subscriber's delay on hanging (See Specification N° 100.00, Chapter n, item 12.5.3) If after this timing neither a new answer signal from the incoming end nor a release signal of the previous link has been received, the outgoing end switching center should establish the "Called Subscriber hangs up" condition (release request signal) in the previous link and the ending condition in the outgoing end.

If the charging is carried out in front of the switching equipment of the outgoing end, the called subscriber hangs up condition (release request signal) shall be established in the previous link and state the condition of ending in the outgoing end.

(10) While the blocking condition lasts, the outgoing end shall keep the transmission of a $bf=0$ code.

(11) The simultaneous seizing ending condition shall be kept during at least 100 ms., in order to ensure that condition had been identified in the other end. Only after this time interval, each end can turn into the resting condition.

b) Incoming end

When a seizing signal on the contrary direction is detected (see Chart N°7) or when this circuit, in the resting condition, has to block the circuit, this switching equipment shall turn into an incoming end logic.

A switching equipment operating as incoming end emits the signaling channels ab and bb and receives the signaling channels $3f$ and bf .

Chart N°8 shows the states corresponding to each identified signaling code and the measures to be taken in the incoming end of a circuit operating with R2 line signaling, digital version.

Chart N° 8

Digital R2 Line Signaling.
Operational conditions in the incoming end.

| NORMAL CONDITION IN THE INCOMING END | SENT CODE | | RECEIVED CODE | | |
|-----------------------------------------------|------------------------|-----------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| | | | apObpO | af=0bf=1 | ar=1bf=0 |
| SEIZING | ab=1bb=0 | Seizing | Abnormal (see remark 1) | Ending (see remark 6) | Abnormal (see remark 1) |
| SEIZING ACKNOW- LEDGMENT | a _b =1 bt=1 | Seizing Acknowledgment | Abnormal (see remark 1) | Ending (see remark 6) | Abnormal (see remark 1) |
| ANSWER | ab=0bb=1 | Answer | Abnormal (see remark 2) | Ending (see remark 6) | Abnormal (see remark 2) |
| CALLED SUBS. HANGS UP | a _b =1 M1 | Called subscriber hangs up | Abnormal (see remark 3) | Ending (see remark 6) | Abnormal (see remark 3) |
| GUARD RELEASE | 8 [^] =1 bt=1 | Guard release (see remark 7) | Guard release (see remark 7) | Guard release (see remark 7) | Guard release (see remark 7) |
| BLOCKING | ab=1 bb=1 | Abnormal (see remark 4) | Abnormal (see remark 5) | Blocking | Abnormal (see remark 5) |
| BLOCKING ENDING | ab=1bb=0 | Blocking Ending (see remark 8) | Blocking Ending (see remark 8) | Blocking Ending (see remark 8) | Blocking Ending (see remark 8) |

REMARKS:

(1) Under these conditions, the incoming end emits backwards the ab=1, bb=0 condition while the bf=1 signal is received. When bf turns again into "0", the incoming end should send the ab=1, bb=1 seizing acknowledgment signal.

(2) In these cases, no action is performed until the called subscriber hangs up. At that moment, the next connection from the defective circuit is immediately released. When the incoming end detects the ending condition (apl, bf=0), it shall send backwards the guard release condition.

(3) Under these conditions, the next link will be immediately released. When the incoming end detects the ending condition (af=1, bf=0), it shall send backwards the guard release condition.

(4) In this case, the incoming end shall send, at least during 3 seconds, the condition ab=1, bb=0. Then, the incoming end shall return to the ab=1, bb=1 blocking condition.

(5) Under these conditions, no measure is taken.

(6) Once the ending signal is identification and as long as the guard release signal has not been sent, the transitions in the received codes will not be taken into account.

(7) The incoming end should keep the guard release condition at least during 100 ms. Only after this interval, the incoming end can turn into the resting condition, that is to say, it returns to operation as resting outgoing end.

(8) The incoming end should keep the blocking ending condition at least during 100 ms, before turning into the resting condition. That is to say, before returning to operation as resting outgoing end.

2.2.6 Abnormal conditions a)

Special release regulations

a-1) If a central network with an outgoing R2 recorder identifies a premature answer signal, before receiving a A-6 complete address signal or a B-group signal, it shall release the connection and the repeat the attempt to establish a call.

a-2) In cases of no reception of the answer signal, delay in the release by the calling subscriber in automatic operation, and no reception of the clearing signal from the incoming central network after the transmission of the clear-back signal, the abnormal operational timing and release condition regulations detailed in Specification 100.00, Chapter II, item 12.5 shall be applied.

b) Protection against failure

The MIC equipment and line signaling equipment of the central network shall be designed so as to, at least the type of failures frequently arisen in these equipments or in the interconnection cables, produce the circuit blocking from the outgoing end and the release of the connection further than the incoming switching equipment.

This can be achieved, as much as possible, sending it through a=l, b=l line, after:

- The disposal of the MIC or switching equipment by the technical staff.
- The appearance of abnormal conXditions (for example, stripped wire, low tension) in the switching equipment.

2.2.7 New attempts to establish a call

Two new attempts are allowed to establish a call, due to any of the conditions specified in previous items 2.2.5 and 2.2.6. If after two new attempts one of these conditions arises, the outgoing end shall send a congestion signal to the calling subscriber, an alarm to the technical staff and shall release the forward connection.

2.2.8 Alarms assigned to technical staff

According to CCITT's Q.I 17 Recommendation, there will be an alarm for the technical staff when detecting abnormal conditions.

There will be a deferred alarm in the outgoing end when the blocking condition arises or due to any of the following reasons:

- a) When the circuit does not return to the resting condition once transmitted the ending signal.
- b) When the seizing acknowledgment is identified in the parametric term between 100 and 1000 ms. after the seizing signal transmission.

- c) When after two new attempts communication can not be established, as stated in item 2.2.7.
- d) When $bt > 0$ is received during 1 or 2 seconds, after recognizing the acknowledgment seizing signal and before recognizing the answer signal.

A deferred alarm will be sent in accordance with failure conditions for MIC equipments specified in Recommendations G732 of CCITT.

2.2.9 Protection against the effects of a defective transmission. MIC equipment working at 2048 Kbit/s.

Defective transmission conditions in MIC systems can reduce signaling failures and telephone channels quality. In the case of primary MIC multiplex equipment, working at 2048 Kbit/s, failures generated by lay or multi-lay alignment loss and/or failure of any other important function, generates in both MIC terminals the alarm condition in accordance with CCITT's Recommendations G.732 and G. 734.

Both MIC terminals apply the corresponding state to state 1 in MIC line for every "reception" signaling channel in interfaces with the switching equipment, as indicated in Chart N°4, Recommendation G.732. In this way, the incoming switching equipment receives an equivalent of $ap = 1$, $bf = 1$ through MIC line and the outgoing switching equipment receives an equivalent to $ab = 1$, $bb = 1$.

These characteristics are considered in the current specifications (see 2.2.5), so that:

- a) In the outgoing end (see chart N°7), a MIC system failure produces a blocking condition, an acknowledgment seizing condition or a release condition by the called subscriber. This means that every resting circuit in a defective MIC multiplex will be blocked against the seizing and that the seized circuits will by turn into or will stay in the release or the acknowledgment seizing condition by the called subscriber.
- b) In the outgoing end (see Chart N°8), a MIC equipment failure can be identified and the proper measure can be taken.

3. Signaling among MFC-R2 recorders. 3.1

General

3.1.1 Introduction

Signals among recorders are multifrequency type and use a 2 Code among 6 frequencies within the transmission band in both directions. Multifrequency combinations are transmitted and received by means of multifrequency signaling equipments which are supposed to be associated with the recorders controlling the switching equipment in both ends of the link between central networks.

In general, its operation is based on the use of the end-to-end signaling method and on the signals interchange in a compulsory sequence between the outgoing central network recorder and the incoming and transit central network recorders which successively intervene. It can operate in circuits at 2 or 4 wires unidirectionally or bidirectionally operated.

In order to shorten the waiting period after dialing, the R2 system should be used according to the method of operation superposed to the subscriber's dialing.

3.1.2 Definitions.

a) Outgoing R2 recorder

Outgoing R2 recorder is the one located in the outgoing end of a signaling section, in which signaling R2 recorders are used, according to the current specifications. It controls the communication establishment, transmits MF signals forward and receives MF signals backwards. Outgoing R2 recorder receives information of the communication previous links, in the way used by the system in the last link. This system can be R2 type, decimal by direct current or any signaling between recorders used in the Company's networks, included the one used in the interconnection with other companies. The previous link can be a subscriber line as well.

b) Incoming R2 register

Incoming R2 register is the one located in the incoming end of a link, in which a signaling between R2 recorders is used, according to the current specifications. It receives the MF signals forward of one or more previous links and transmits MF signals backwards. Information received is completely, or partially, used to control the selection stages and can be completely or partially transmitted to the subsequent equipment. R2 type signaling is never used for retransmission. Therefore, there is an interoperation between R2 system and the other system.

Thus, every recorder not located in the outgoing end of a signaling section using R2 system is called incoming R2 recorder, regardless of the central network type.

c) End-to-end signaling method.

In the end-to-end signaling method, signals are transmitted by one or more successive links, without regeneration in the intermediate central networks. In this way, the outgoing recorder transfers to the incoming recorders only enough address information to route the calls through intermediate central networks. In these networks, the conversation circuit is immediately connected, being released the incoming recorder, while outgoing recorder can directly exchange information with the incoming recorder of the following central network.

In some cases, it will be necessary to store all the information about the call establishment in an intermediate section.

Multilink complete connection is divided into two or more end-to-end signaling sections. The transit central recorder, which leads the second or following end-to-end signaling section, is composed of an outgoing R2 recorder (see Figure 3.1)

FIG.3.1

- 1 FIRST MF-R2 SIGNALING SECTION
- 2 SECOND MF-R2 SIGNALING SECTION
- 3 SUBSCRIBER "A"
4. OUTGOING R2 RECORD IN SOURCE CENTRAL NETWORK
5. INCOMING R2 RECORD IN TRANSIT CENTRAL NETWORK
- 6 OUTGOING R2 RECORD IN TRANSIT CENTRAL NETWORK
- 7 INCOMING R2 RECORD IN TRANSIT CENTRAL NETWORK
- 8 OUTGOING R2 RECORD IN DESTINATION CENTRAL NETWORK
- 9 SUBSCRIBER "B"

10 FIG 3.1 LINK WITH MF-R2 SIGNALING (TWO END-TO-END SIGNALING SECTIONS)

d) Compulsory sequence signaling method of R2 system.

The compulsory sequence signaling operates as follows (see Figure. 3.2)

d-1) Once a link has been seized, the outgoing R2 recorder begins to transmit automatically the first signal between forward recorders.

d-2) As soon as an incoming or transit R2 recorder has identified this signal, it transmits a signal between backwards recorders which has an own meaning and, at the same time, it operates as acknowledgment signal.

d-3) The outgoing R2 recorder interrupts the signal transmission between forward recorders as soon as it identifies the acknowledgment signal.

d-4) The incoming or transit R2 recorder interrupts the signal transmission between backwards recorders as soon as it identifies that the signal among forward recorders has disappeared.

d-5) As soon as the outgoing R2 recorder identifies that the backwards acknowledgment signal among recorders has disappeared, it can begin, when necessary, the sending of the next forward signal.

1. Outgoing recorder
2. Incoming recorder
3. Forward signal
4. Backwards acknowledgment signal
5. Time
6. Next forward signal
7. Backwards acknowledgment signal
8. Transmission
9. Reception.

e) Operational method superposed to dialing

In this operational method, the outgoing R2 recorder is able to begin the establishment of the communication as soon as it has received the minimum information necessary. That is to say, the signal transfer begins before the reception of the complete address, i.e. before the calling subscriber finishes to dial the number. This also can be applied to transit calls with tandem mode operation.

This method is opposite to the block record signaling, that is to say, the transmission of the total address information in one sequence, which begins only when the outgoing recorder has received the complete address information.

f) Transit call with transit mode operation.

A transit call is operated in "transit mode" when the central network recorder in which the routing information is being analyzed operates as an incoming R2 recorder. That is, the R2 recorder requests exactly the necessary information for call routing, makes the connection of the incoming circuit to the corresponding outgoing circuit (pass on conversation) and then releases it, end-to-end signaling.

g) Transit call with tandem mode operation

A transit call is operated in "tandem mode" when the central network recorder in which the routing information is being analyzed operates as an outgoing R2 recorder.

That is, the R2 recorder requests the transmission of all the selection information corresponding to the call, and regenerates, complete or incompletely, this information through the outgoing circuit, thus originating a new signaling section.

3.2 Multifrequency combinations

Every signal among recorders is carried out by means of the simultaneous transmission of two selected frequencies among six or five frequencies in a band (multifrequency combination).

Two different groups of six frequencies each are defined for the forward and backwards signals' composition.

Chart N°1 indicates all the multifrequencies combinations that may be obtained with a maximum number of six frequencies.

CHART N°1: Multifrequency combinations

| Combinations | (FREQUENCIES Hz) | | | | | | |
|--------------|------------------|-------|-------|-------|-------|-------|-------|
| | Forward | 1.380 | 1.500 | 1.620 | 1.740 | 1.860 | 1.980 |
| | Backwards | 1.140 | 1.020 | 900 | 780 | 660 | 540 |
| 1 | X | X | | | | | |
| 2 | X | | | X | | | |
| 3 | | | X | X | | | |
| 4 | X | | | | X | | |
| 5 | | | X | | X | | |
| 6 | | | | X | X | | |
| 7 | X | | | | | X | |
| 8 | | | X | | | X | |
| 9 | | | | X | | X | |
| 10 | | | | | X | X | |
| 11 | X | | | | | | X |
| 12 | | | X | | | | X |
| 13 | | | | X | | | X |
| 14 | | | | | X | | X |
| 15 | | | | | | X | X |

3.3 Meaning of the signals among MFC-R2 recorders.

3.3.1 Forward signals-Group I

The main meaning of the forward signals of Group I is presented in the following chart:

CHART N° 2 Meaning of the signals -Group I

| Combination (a) | Name of the signal (b) | Meaning of the (c) | signal (d) |
|--------------------|---------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| 1 | 1-1 | Digit 1 | 1 Digit |
| 2 | 1-2 | 2 | 2 |
| 3 | 1-3 | 3 | 3 |
| 4 | 1-4 | 4 | 4 |
| 5 | 1-5 | 5 | 5 |
| 6 | 1-6 | 6 | 6 |
| 7 | 1-7 | 7 | 7 |
| 8 | 1-8 | 8 | 8 |
| 9 | 1-9 | 9 | 9 |
| 10 | 1-10 | 0 | 0 |
| 11 | 1-11 | - Reserve to indicate the necessary outgoing echosuppressor. | -Reserve |
| 12 | 1-12 | - Reserve to indicate the unnecessary echosuppressor. | - Non-accepted request |
| 13 | 1-13 | - Indicator of test call (automatic tests device calls) | -Link indication via satellite non-included |
| 14 | 1-14 | - Reserve to indicate the necessary outgoing echosuppressor inserted | - Reserve to indicate the necessary incoming echosuppressor. -Link indication via satellite included |
| 15 | 1-15 | - Non-usable signal | - Numbering ending Ending of identification |

The meaning of the signals in columns c) and d) in Chart 2, is as follows:

- Column C: First signal forward in a domestic link
- Column d: A signal different from the first one in a domestic link

a) All signals from I-1 to I-10 are numeric and indicate:

- The necessary address to establish the communication and an outgoing recorder transmits them spontaneous and immediately after a link seizing or as an answer for signals A-1, A-2, A-7 or A-8.

- The calling subscriber's telephone number. This signal by the recorder as an answer for signal A-5.

b) Signal 1-11 is a non-numeric signal. The meaning of the signal as first signal is kept in reserve to indicate:

- Communication demands echosupressor.
- Outgoing semiechosupressor must be inserted.

The meaning of the signal as second signal is kept in reserve.

c) Signal 1-12 is a non-numeric signal. The meaning of the signal as first signal is kept in reserve to indicate that the communication does not demand echosupressors.

Its meaning as second signal indicates "non-accepted request". Under these circumstances, when an outgoing recorder receives any signal it cannot answer, the recorder must indicate it cannot give an answer to the request, transmitting signal 1-12. When this signal is answered with signal A-4, connection is released and the congestion tone is applied to the calling subscriber.

d) Signal 1-13 is a non-numeric signal and its meaning are:

d-1) When signal 1-13 is transmitted as a first signal, it means it is used as a test call indicator and must be followed by the complete address information of the test device, in accordance with CCITT's Q.490 Recommendation for domestic services. If the incoming end does not have the automatic test device, a A-4 signal must be sent.

d-2) When the signal 1-13 is transmitted as a second signal, as an answer to A-13 signal, it will mean that up to the outgoing R2 recorders, the connection does not include any link via satellite.

e) Signal 1-14 is a non-numeric signal. The meaning of the signal will be kept in reserve to control echosuppressors, either as first or second signal for these purposes.

When signal 1-14 is transmitted as a second signal, as an answer to signal A-13, it means that up to outgoing R2 recorder, the connection includes a link via satellite.

f) Non-numeric signal 1-15 indicates the end of a signal sequence among recorders forward. It is never transmitted as first signal, and its meanings are:

f-1) Numbering end, to indicate that no address signals are to follow.

f-2) Identification end, as an answer to signal A-5 to indicate that the sequence transmission identifying the calling subscriber's telephone number has finished.

3.3.2 Forward signal, Group n

The meaning of the forward signals in group n are specified in the following chart:

CHART N°3 Meaning of the signals- Group

| COMBINATION | NAME OF THE SIGNAL | MEANING OF THE SIGNAL |
|-------------|--------------------|---------------------------------------------------------|
| 1 | II-1 | Subscriber without priority |
| 2 | II-2 | Subscriber with priority |
| 3 | II-3 | Maintenance equipment |
| 4 | II-4 | Subscriber with telecharging |
| 5 | II-5 | Operator |
| 6 | II-6 | Data transmission |
| 7 | II-7 | These signals are used only in international operation. |
| 8 | H-8 | |
| 9 | II-9 | |
| 10 | 11-10 | |
| 11 | 11-11 | Non-identified subscriber |
| 12 | 11-12 | Reserve for the domestic service |
| 13 | 11-13 | |
| 14 | 11-14 | |
| 15 | 11-15 | |

The signal of Group n are calling subscriber category signal and are transmitted by outgoing recorders as an answer to signals A-3 or A-5.

- a) Signal n-1. Subscriber without priority. This signal n-1 indicates that the call comes from a subscriber's line and it does not have priority.
The local central network, to which the subscriber with this category is connected, has to be able to send the calling subscriber's identification number, whenever requested.
- b) Signal n-2. Subscriber with priority. This signal indicates that the call comes from a subscriber's line whose calls do have a priority to establish communications during an emergency period or partial congestion.
The local central network, to which the subscriber with this category is connected, has to be able to send the calling subscriber's identification number, whenever requested.
- c) Signal n-3. Maintenance equipment. This signal indicates that the call comes from a maintenance equipment, or test line, that can emit test calls between two telephone central networks. Every incoming call arriving into this kind of maintenance equipment is established after verifying this category. For any other category, the call is rejected.
There is no identification number of the demanding subscriber that has this category. This kind of calls do not require charging.
- d) Signal n-4. Subscriber with telecharging. This signal indicates that the call comes from a subscriber's line, for which the charging pulses have to be retransmitted from the charging center like, for instance, coin-box telephones., subscribers with telecharging equipments, etc. For any other purposes, the call has to be considered as category n-1, subscriber without priority.
- e) Signal n-5. Operator. This signal indicates that the call comes from an operator's position. The call charging is carried out in the operator's central network, either automatically or through tickets. So, no charging in the automatic network is made.

f) Signal n-6. Data transmission. This category comprises all the subscriber's line that have data transmission equipment, whose routing is guaranteed by means of the best quality transmission links in the network. For any other purposes, the call has to be considered as category H-1, subscriber without priority.

g) From signal H-7 to H-10. The meanings of these signals are defined by international standards and are used exclusively for international operations. All other signals in Group H are applied to domestic operations and shall be translated into signals H-7 to H-10 in the outgoing R2 international recorders (see Recommendation Q.480).

h) Signal n-11, non-identified subscriber. Signals n-11, non-identified subscriber is used to identify calls, originated from a subscriber line, connected to a local central network that does not have automatic identification. This assignment is necessary due to the fact that this facility does not exist in the switching centers.

When receiving this category, calls are considered as the ones under category H-1, Subscriber without priority, but in this case, the calling subscriber's identification does not have to be requested.

In the case of the charging center CAMA, calls within this category are not charged.

j) Signals H-12 to n-15. These signals will be kept under reserve for domestic service. Its reception in an incoming R2 recorder has to be acknowledged with a A-4 signal.

3.3.3 Backwards signals- Group A

The main meanings of the backwards signals in Group A are specified in Chart N°4:

Chart N°4: Meaning of the signals-Group A

| COMBINATION | NAME | MEANING OF THE SIGNAL |
|-------------|------|---------------------------------------------------------------------|
| 1 | A-1 | Send the next digit (n+1) |
| 2 | A-2 | Send the penultimate digit (n-1) |
| 3 | A-3 | Complete address, pass on the reception of Group B signals. |
| 4 | A-4 | Congestion in domestic central network |
| 5 | A-5 | Send the category of the calling subscriber |
| 6 | A-6 | Complete address with charging, pass on the conversation position. |
| 7 | A-7 | Send the antepenultimate digit (n-2) |
| 8 | A-8 | Send the digit which precedes the antepenultimate digit (n-3) |
| 9 | A-9 | Reserve for domestic use |
| 10 | A-10 | Reserve for domestic use |
| 11 | A-11 | International use (See Recommendation Q.441) |
| 12 | A-12 | International use (See Recommendation Q.441) |
| 13 | A-13 | Send circuit's nature |
| 14 | A-14 | Reserve for requesting information about the use of echosuppressors |
| 15 | A-15 | International use |

a) Signal A-1: Send the next digit (n+1). This signal requests the transmission of the (n+1) digit after the reception of the n digit.

b) Signal A-2. Send the penultimate digit (n-1). This signal requests the transmission of the digit (n-1) after then digit. This signal shall not be used in a link via satellite.

c) Signal A-3. Complete address. Pass on the reception of Group B signals. This signal indicates that the incoming recorder of the incoming end does not need any additional address and that it is about to turn into the transmission of a Group B signal.

d) Signal A-4. Congestion in the domestic network. This signal indicates:

- Congestion in domestic links.

- Congestion in selection stages

- Timing or abnormal release of a recorder by any reason (see item 6.2).

- As an answer to signal 1-12, when it means "request not accepted" and it is not convenient to establish the communication.

- As a forward answer, whose meaning is kept under reserve, when no other answer procedure has been specified to it.

The transmission procedure after signal A-4, complementary information on the existing conditions in the incoming end, must follow the specifications described in Appendix B of Recommendation Q.490. This complementary information comprises, as a whole, Group C, which represents the third meaning of the backwards signals; as long as group C signals are not implemented, it shall be sent a tone of congestion or of a recorded oral announcement, after A-4 signal reception.

The meaning of signals belonging to Group C shall be kept under reserve and will be assigned conveniently by Subsecretaria de Telecomunicaciones de Chile.

e) Signal A-5. Send the category of the calling subscriber

This signal requests the transmission of a Group n signal. When the outgoing recorder receives the first A-5, it sends a Group n signal, corresponding to the category of the calling subscriber

Every time signal A-5 is repeated, the outgoing recorder sends 1-1 to 1-10 signals, corresponding to the telephone number of the calling subscriber.

When an outgoing recorder completes the telephone number of the calling subscriber, it will answer to the next A-5 signal with a 1-15 signal. In case the outgoing recorder sends another A-5 signal, as an answer to 1-15, the outgoing recorder should send 1-12 signal.

If by any reason the outgoing recorder cannot send the requested information, it will always answer with signal 1-12, "request not accepted".

When identifying the telephone number of the calling subscriber is not necessary, the Group n signal will be answered by any backwards signal, other than A-5.

f) Signal A-6. Complete address with charging. Pass on the conversation position. This signal indicates that the R2 recorder of the incoming end does not need an additional digit and will not send Group B signals. Communication shall be charged when answering.

g) Signal A-7. Send the antepenultimate digit (n-2). This signal requests the transmission of the digit (n-2) after the reception of the n digit. This signal shall not be used in a link via satellite.

h) Signal A-8. Send the digit which precedes the antepenultimate digit (n-3). This signal requests the transmission of the digit (n-3) after the reception of the n digit. This signal shall not be used in a link via satellite.

i) Signal A-9 and A-10. These signals will be kept under reserve for domestic use and will be taken as the A-4 signal.

j) Signals A-11 and A-12. They are used only in international operation, according to Recommendation Q.441.

The reception of any of these signals by an outgoing national recorder will be taken as the A-4 signal.

k) Signal A-13. Send circuit's nature. This signal requests the circuit nature's indication (link via satellite included or not included), and it is sent in those communications in which it is necessary to know this nature; otherwise, it is interpreted as A-4 signal.

l) Signal A-14. Information request about the use of echosuppressors. This signal will be kept under reserve for requesting information on the use of echosuppressors.

m) Signal A-15. Congestion in an international central network or in its outgoing end. This signal is used only in international operation. Its reception by a domestic recorder will be understood as A-4 signal.

3.3.4 Backwards signals - Group B

The main meaning of backwards signals, Group B, is shown in chart N° 5.

Chart N°5 Backwards signals - Group B

| COMBINATION | NAME OF THE SIGNAL | MEANING OF THE SIGNAL |
|-------------|--------------------|--------------------------------------------------------------------|
| 1 | B-1 | Reserve for domestic use |
| 2 | B-2 | Send special report tone |
| 3 | B-3 | Subscriber's busy line |
| 4 | B-4 | Congestion (after passing from Group A signals to Group B signals) |
| 5 | B-5 | NOH- assigned number |
| 6 | B-6 | Subscriber free line with charging |
| 7 | B-7 | Subscriber free line without charging |
| 8 | B-8 | Subscriber line out of order |
| 9 | B-9 | Reserve for domestic use |
| 10 | B-10 | Reserve for domestic use |
| 11 | B-11 | Reserve for international use |
| 12 | B-12 | |
| 13 | B-13 | |
| 14 | B-14 | |
| 15 | B-15 | |

Every Group B backwards signal, which is always preceded by the complete address signal A-3, should acknowledge a Group n forward signal.

The Group B signals transmit information about the condition of the switching equipment of the incoming central network or about the called subscriber's line to the outgoing R2 recorder.

a) Signal B-1. Reserve for domestic use. B-1 signal is kept under reserve for domestic use and its meaning will be consistent with signal B-6. This signal reception must be taken as B-4 signal in the outgoing recorder

b) Signal B-2. Sending information special tone. This signal indicates that the information special tone must be sent back to the calling subscriber. This tone indicates that the called number cannot be obtained due to reasons not indicated by other specified signals and that this number will not be available for a long period.

Incoming R2 recorder sends B-2 signal in the following circumstances:

- When the number of the called subscriber has been changed.
- When, simultaneously, three of the following conditions are met:
 - The state of the called subscriber's line is not consistent with any meaning of the current Group B signals;
 - It does not route to the conversation circuit's establishment;
 - And it is consistent with the transmission of the information special tone to the calling subscriber.

After identifying B-2 signal, outgoing recorder releases forward and causes only the transmission of the special information tone.

c) Signal B-3. Subscriber busy line. This signal indicates that the line (s) connecting the subscriber to the central network are busy.

When identifying this signal, the recorder releases the connection and causes the busy tone transmission.

d) Signal B-4 Congestion. This signal indicates that there is a congestion condition after Group A signals have passed onto Group B signals.

B-4 signal is transmitted in the specified conditions for A-4 signal. B-4 signal identification always causes the communication release and the congestion tone transmission to the calling subscriber.

e) Signal B-5. Non-assigned number. This signal indicates that the received number is not in use. After identifying B-5 signal, the outgoing recorder releases the communication and causes the transmission of the information special tone to the calling subscriber, or an oral recorded announcement alternated with the information special tone.

f) Signal B-6. Subscriber free line, with Charging. This signal indicates that the called subscriber line is free and that the communication has to be charged when answering. After identifying B-6 signal, the outgoing recorder guarantees the progression into the conversation condition, to cause the calling subscriber to hear calling tone. In this case, the subsequent answer signal will set in operation the charging device.

g) Signal B-7. Subscriber free line, without charging. This signal indicates that the called subscriber's line is free, but communication does not have to be charged when answering. After identifying B-7 signal, the outgoing recorder guarantees the progression into the conversation condition, to cause the calling subscriber to hear calling tone. In this case, the subsequent answer signal will not set in operation the charging device.

h) Signal B-8. Subscriber line out of order. This signal indicates that the called subscriber's line is out of order, defective, suspended or any other equivalent condition. After identifying B-8 signal, the outgoing recorder releases forward and causes the transmission of the information special tone to the calling subscriber, or an oral recorded announcement alternated with the information special tone.

i) Signals B-9 to B-15 shall be kept under reserve and they shall be given the corresponding meanings. If an outgoing recorder receives one of these signals, the communication must be released and it must be taken as follows:

- B-9 and B-10 signals as B-2 signal.
- B-11 to B-15 signals as B-4 signal.

4. SIGNALING PROCEDURES AMONG MFC-R2 RECORDERS

4.1 General

The definition "signaling procedure among MFC-R2 recorders" will be given to the signals exchange among recorders, according to the compulsory sequence method of the R2 signaling system, among those switching equipments operating with this signaling system.

The exchange of signals among recorders always begins with the transmission of a signal forward from Group I by the R2 outgoing recorder. This signal must be acknowledged through a backwards signal from Group A, thus completing the compulsory sequence cycle. The first forward signal corresponds to the first numbering digit that the outgoing R2 recorder requires to characterize the call (routing analysis, charging, numbering format, etc).

The exchange development is controlled from the incoming R2 recorder, which demands the requested information sending backwards signals.

4.2 Information exchange normal procedures among MFC-R2 recorders.

4.4 Interoperation with signaling by decimal pulses (DP)

-Communications going from DP to MFC-R2 signaling.

Decimal Pulses

MCF-

R2

- a) AT link "s seizing causes the addition of a T recorder and the possible return of the A "proceed to-send-signal" transmits the numeric signals as decimal pulses.
- b) As soon as there are digits enough in T, routing and TB section seizing begin. Thus, the information is transmitted from T to B, according to the compulsory sequences signaling procedure of R2 system (see procedures in Item 4.2). For this purpose, T central network records outgoing R2.
- c) When receiving the calling subscriber's category (A-5 backwards signal), central network T will answer emitting code n-11 in the case of a normal incoming bunch (AT) and code n-5 in the case of an operator's incoming bunch.
- d) In B, forward signal 1-15 or the last digit in the called subscriber's number, is acknowledged by means of one of the following signals:
 - d-1) A-3 The outgoing T R2 recorder emits to B the n-11 or n-5- signal, when corresponding, which is acknowledged by means of a Group B signal (backwards). B-2, B-5 and B-8 signals release TB link and re-route

the call to the recorded announcement in T.

B-3 and B-4 signals release TB link and send a busy or congestion tone by TA link (*)

B-6 and B-7 signals cause the connection of the conversation circuit in T. The B-6 signal indicates that the answer signal must be repeated (line signal) in the TA link immediately after the answer signal is detected in the TB link. The B-7 signal indicates that the answer signal in the TA link must be sent one more time only when the line signaling in that link is E and M type; in case TA line signaling is direct current loop type, the answer signal must be inhibited in the T central network.

d-2) A-4 This signal causes the TB link release and the sending of a congestion tone through the TA link (*).

d-3) A-6 This signal produces the connection of the conversation circuit and the release of the outgoing R2 recorder in T.

In case of congestion in T, a congestion tone through TA(*) link is transmitted.

In A, the recorder is released after the transmission of the decimal pulses corresponding to the last digit.

In T and B, the recorder is released when some of the conditions shown in chapter 6 are met.

(*) Remark: If the TA link signaling allows it, the conditions of busy or congestion subscriber will be sent one more time by means of a electric signal towards the A central network (for example, line signal). After this, the TA link is released and the corresponding tone is sent to the subscriber from the nearest central network.

4.4.2 Communication going from MFC-R2 signaling to PD.

MFC-R2

PD

- a) The direction information is transmitted from A to T, according to the R2 system's compulsory sequences signaling procedure (see procedure in Item 4.2, case 3). The tandem exchange in T acknowledges the last address digit with the A-6 backwards signal (Complete address- pass on conversation state).
- b) As soon as enough digits have been received, routing and next TB section seizing begin. T starts the transmission of digits by decimal pulses to B.
- c) In case of congestion in T, the signal A-4 must be sent to A.
- d) In A, the recorder is released when some of the conditions shown in chapter 6 are met (R2 recorder release).
- e) In T, the recorder must be released when some of the conditions shown in Item 6.2.2, second part, are met (R2 outgoing recorder abnormal release).or when the digit transmission in decimal pulses is finished.
- f) In B, the recorder is released after the selection and connection, if a local center, or digits are sent forward one more time, if a tandem exchange.

5 TRANSMISSION AND RECEPTION EQUIPMENT REQUIREMENTS

5.1 Transmission part in multifrequency signaling equipment.

5.1.1 Signaling frequencies

The composition of multifrequency combinations is specified in item 3.2.2 of this document.

The frequencies transmitted forward are:

$f_0=1380$; $f_1=1500$; $f_2=1620$; $f_3=1740$;
 $f_4=1860$; $f_5=1980$ Hz.

The frequencies transmitted backwards are:

$f_0=1140$; $f_1=1020$; $f_2=900$; $f_3=780$;
 $f_4=660$; $f_5=540$ Hz.

The frequency variation in the transmission point shall not be greater than ± 4 Hz, in relation to nominal value.

5.1.2 Transmitted power level

The power level of each nonmodulated signaling frequency, transmitted by the transmission part of the multifrequency signaling equipment of the specified central network, shall have a -8 dBmO nominal value, with ± 1 dB tolerance.

The level difference between the two signaling frequencies comprising a multifrequency combination shall be less than 1 dB.

5.1.3 Residual level of signaling frequencies.

The global power level of the on-line transmitted signaling residuals shall be, as a minimum:

- a) 50 dB inferior to the nominal value of just one signaling frequency, when the multifrequency combinations are not transmitted;
- b) 30 dB inferior to the level of any signaling frequency, when a multifrequency combination is transmitted. Besides, any signaling residual shall have a level at least 34 dB inferior in comparison to any of the signaling frequencies, when a multifrequency combination is transmitted.

5.1.4 Harmonic distortion and intermodulation

The global level of all the frequencies arisen from both harmonic distortion and intermodulation within a 300 to 400 Hz band will be as minimum 37 dB less than only one of the signaling frequencies.

5.1.5 Time tolerance for multifrequency combinations

The time interval between the instants in which the transmission of each of the two frequencies composing a multifrequency combination begins shall not be greater than 1 ms.

5.2 Reception part of the multifrequency signaling equipment

5.2.1 Sensitivity Range

The power level detailed below make reference to a 600 Ohms nominal impedance.

The sensitivity range of the reception part of the multifrequency signaling equipment will be -35 dBm to -5dBm.

5.2.2 Conditions connected to operational and release periods

Operational and release periods of the reception part of the multifrequency signaling equipment depend on their origin, and, in case of a specified origin, they depend on:

- a) The time difference between reception periods of each of the two frequencies which compose a multifrequency combination.
- b) The level of each of the two frequencies.
- c) The level difference between the two frequencies.
- d) The level, spectrum and the instant in which noise starts.

All these elements vary according to transmission conditions.

In certain switching equipments, it may be convenient to introduce devices in order to oppose the low-frequency disturbances in the multifrequency signaling equipment.

Time conditions are set for two different Types (A and B) of test multifrequency combinations, applied to the incoming end of the reception part of the multifrequency signaling equipment, in presence of disturbance signals, specified later on.

When both test combinations and disturbance frequencies are applied to reception part terminals of the multifrequency equipment, as specified in following items a) to c), the time conditions will be:

_ For A-type test combinations: $T_0 + T_R$ equal to or less than 70 ms;

- _ For B-type test combinations:
 $T_0 + T_R$ equal to or less than 80 ms;

- For A or B type test combinations:
 $(T_0 + T_R)$ equal to or less than $(T_0 + T_R) + 5$ ms

Where:

T_0 = Time interval between the instant in which the two frequencies are applied simultaneously to the incoming end of the reception part and the instant in which the multifrequency combination is acknowledged.

T'_0 = Time interval between the instant in which the second frequency is applied to the incoming end of the reception part and the instant in which the multifrequency combination is acknowledged, if one of the two frequencies composing the combination is applied with a certain delay in comparison to the other frequency.

T_R = Time interval between the moment in which the two frequencies are disconnected simultaneously from the reception part and the moment in which the multifrequency combination end is acknowledged.

$T'R$ =Time interval between the disconnection of the second frequency of the incoming end of the reception part and the moment in which the multifrequency combination end is acknowledged, if one of the two frequencies composing the combination is disconnected with a certain delay in comparison to other frequency.

- The absolute power level of each of the two frequencies of multifrequency combination is between -5 dBm and -35dBm.

- The difference between the levels of both frequencies is equal to or less than 7dB for non-adjacent frequencies,

c) Disturbing frequencies

Disturbing frequencies that must be applied are:

- In every case when no multifrequency combinations are applied, one or several frequencies for which the test reception part was created, with a total power level of -55 dBm or less.

-When a test multifrequency combination is applied, one or several of the (n-2) other frequencies, with a power total level 20dB less than the high level test combination frequency, during the application of the test combination.

5.2.3 Conditions in which the equipment neither works nor identifies the signals.

The reception part in the multifrequency signaling equipment must remain in the non-operating state when the following disturbing signals, individually or simultaneously are applied to the incoming terminals:

a) Any pure sinusoidal wave or any combination of two pure sinusoidal wave, each one with a power level of -42 dBm in the band from 300 to 3400 Hz.

b) Any combination of two pure sinusoidal wave, each one with a power level of -5 dBm in the band from 1300 to 3400 Hz for the frequencies reception set used in the backwards direction and in the bands from 330 to 1150 Hz and from 2130 to 3400 Hz for the frequencies reception set used forward.

Moreover, when the signaling frequencies have activated the reception part of the multifrequency signaling equipment, this one shall pass onto the non-operating state, if, existing one of these disturbances, the signaling frequencies are suppressed individually or simultaneously in both terminals.

The reception part of the multifrequency signaling equipment shall not identify a combination composed of any two signaling frequencies, chosen among the ones normally used in the specified direction and transmitted with a -5dBm level, during a period less than 7 ms.

The reception part of the multifrequency signaling equipment shall not identify a combination composed of two signaling frequencies, used in the specified direction with a -5dBm level difference of 20 dB or more.

5.2.4 Influence of the temporary disturbances.

The identification of mistaken signals due to short-lasting temporary conditions if a multifrequency combination is identified just after a specified minimum period, in which two, and only two individual receivers are activated, and if the absence of multifrequency combinations is identified just after a minimum period in which every individual receiver is resting. These periods are included in the operational and release times T_0 and T_R . The characteristic temporary disturbances as snaps, polarity reversal, etc. generated by the switching equipments, do not have to modify the signal transmitted to the record by the reception part of the signal equipment.

6 R2 recorders release

6.1 Normal release of the outgoing and incoming R2 recorders

An outgoing R2 recorder shall be released when receiving an appropriate backwards signal among recorders finishing the signaling among recorders, or when receiving an ending signal (line signal) by the previous link, which can be the calling subscriber's line.

An incoming R2 recorder shall release when it has carried out the necessary control to the switching operations and when the necessary signaling among recorders has finished, or when receiving an ending signal (line signal) by a previous link.

The last identified signal among recorders, previous to the conversation position establishment, shall normally be a backwards signal; for example, the A6 complete address signal or the B6 or B7 free subscriber signals.

The receivers of multifrequency combinations of both ends shall disconnect before the switching equipment passes onto the conversation position; thus avoiding every operation possibility or use under the influence of conversation or line signals. It is important to respect the following conditions related to the length of the following stages:

- a) The multifrequency signaling equipment of the incoming R2 recorder shall be disconnected before 30 ms. from the moment in which the transmission end of the last backwards signal is identified.
- b) The multifrequency signaling equipment of outgoing R2 recorder shall be disconnected before 30 ms from the moment in which the transmission end of the last backwards signal is identified.
- c) In the outgoing central network the conversation position shall be reestablished in a 30 to 60 ms term after the identification of the last backwards signal ending.
- d) In the incoming central network, at least 75 ms minimum shall go by between transmitting end of the last backwards signal and passing onto the conversation position.

6.2 Abnormal release of the incoming and outgoing R2 recorders

In order to limit the holding time of the R2 recorders when the signaling among recorders is interrupted, by a failure or any other cause, every R2 recorder shall have devices for the continues supervision of the length of the different stages of the signaling among recorders. The timing period of these devices shall be as short as possible, but. long enough not to interrupt the normal operation.

6.2.1 Outgoing R2 recorder timing

In an outgoing R2 recorder are supervised separately the intervals in which a forward multifrequency combination is transmitted and the intervals in which these combinations are not transmitted.

a) Supervision during the forward multifrequency combination transmission.

The inferior limit of the timing period is function of the necessary period for the switching procedures in a transit central network.

For this reason, a timing period of 15 ± 3 seconds is specified.

The supervision device starts operating when it starts transmitting a forward multifrequency combination and comes back to the initial state when deactivating the corresponding signals transmitters. It will start again when the transmission of the next forward multifrequency combination begins.

b) Supervision during intervals in which no forward multifrequency combination is transmitted.

The inferior limit of the timing period is function of:

b-1) The maximum time interval between two dialings of successive digits by the subscriber b-2) The specified timing period for the incoming R2 recorders (see item 6.2) On this basis, a timing of 24 ± 1 seg is specified.

c) Procedure to be applied if the timing period ends.

If the timing period ends, the supervision devices mentioned in a and b, shall cause:

c-1) the transmission of a proper signal and/or audible tone to inform the calling subscriber;

c-2) The outgoing R2 recorder and connection release, unless keeping that release is necessary for the previous operation.

The failure record equipments have to be set in operation and/or give a deferred alarm to the technical staff 6.2.2

Incoming R2 recorder timing.

The timing device will supervise not only the interval length between the recorder seizing and the identification of the first forward multifrequency combination, but also the length between the identification of two successive forward multifrequency combinations.

a) Timing period

The inferior limit of the timing period is function of:

a-1) The maximum admissible time interval between the identification of two successive forward multifrequency combinations; this time interval may be affected by the maximum time available for the subscriber to dial two successive digits;

a-2) The maximum tie necessary to establish the communication in conditions that may slow the signaling between recorders.

It is also convenient to set a superior limit in order to release the incoming R2 recorder before the timing period for the incoming recorder specified in item 6.2.1 b expires.

For that purpose, a timing period of 22+-1 seg is specified.

b) Procedure to be applied if the timing period ends.

If the timing period ends the supervising device will cause:

b-1) the release of the incoming R2 recorder and other central network incoming equipments.

b-2) the establishment of the incoming circuit blocking condition until the (line) end signal is received.

The failure record equipments have to be set in operation and/or give a deferred alarm to the technical staff