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Corporate telecommunication Networks (CN); CEPT signalling systems (L1 and L2) for analogue inter-PABX lines

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ETSI Secretariat

Postal address
F-06921 Sophia Antipolis Cedex - FRANCE

Office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16
Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

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c= fr; a=atlas; p=etsi; s=secretariat

Internet
secretariat@etsi.fr
http://www.etsi.fr

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Foreword

This Technical Specification (TS) has been produced by the ETSI Project Corporate telecommunication Networks (CN).

Introduction

During the late 1970's / early 1980's Working Group T/WG 11 "Switching and Signalling" (CS) of the CEPT (European Conference of Postal and Telecommunications Administrations) drafted 10 CEPT Recommendations on the subject of "CEPT signalling systems (L1 and L2) for analogue inter-PABX lines". Responsibility for these Recommendations passed to ETSI in 1993.

Since these signalling systems are still in use in some European countries, it is not yet appropriate to withdraw the Recommendations. So that they can be maintained as publicly available documents, ETSI has collected the 10 Recommendations together and published them as this Technical Specification.

1 Scope

The present document collects together (as annexes) 10 former CEPT Recommendations on the subject of "CEPT signalling systems (L1 and L2) for analogue inter-PABX lines".

2 References

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or

d) publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

2.1 Normative references

The former CEPT Recommendations refer extensively to one another. Each of these references is itself an annex (A - J respectively) of the present document.

[1] CEPT Recommendation T/CS 49-01 (1984): "System Ll line signalling over international inter-private automatic branch exchange lines".

[2] CEPT Recommendation T/CS 49-02 (1984): "System Ll decadic pulsing interregister signalling".

[3] CEPT Recommendation T/CS 49-03 (1984): "System Ll decadic pulsing call control signalling procedures".

[4] CEPT Recommendation T/CS 49-04 (1984): "System Ll multifrequency push-button interregister signalling".

[5] CEPT Recommendation T/CS 49-05 (1984): "System Ll multifrequency push-button unidirectional call control signalling procedures".

[6] CEPT Recommendation T/CS 49-06 (1984): "System Ll multifrequency push-button bidirectional call control and service control signalling procedures".

[7] CEPT Recommendation T/CS 49-07 (1984): "System L1 MFC interregister signalling".

[8] CEPT Recommendation T/CS 49-08 (1982): "System L1 MFC call control signalling procedures".

[9] CEPT Recommendation T/CS 49-09 (1985): "System L1 Multifrequency code supplementary services".

[10] CEPT Recommendation T/CS 49-12 (1985): "System L2 signalling on extra long lines between a telephone instrument or equivalent and a public exchange or private automatic branch exchange".

2.2 Other normative references

The following publications are also referred to:

[11] CCITT Recommendation G.171 (1984): "Transmission characteristics of leased circuits forming part of a private telephone network".

[12] CCITT Recommendation H.34 (1984): "Subdivision of the frequency band of a telephone-type circuit between telegraphy and other services".

[13] CCITT Recommendations M.1010 to M.1060 (1984): "International leased circuits".

[14] CCITT Recommendation Q.l (1984): "Signal receivers for manual working".

[15] CCITT Recommendation Q.2 (1984): "Signal receivers for automatic and semi-automatic working, used for manual working".

[16] CCITT Recommendation Q.15 (1984): "Nominal mean power during the busy hour".

[17] CCITT Recommendation Q.25 (1984): "Splitting arrangements and signal recognition times in "in-band" signalling systems".

[18] CCITT Recommendation Q.441 (1984): "Signalling code".

[19] CCITT Recommendation Q.442 (1984): "Pulse transmission of backward signals A-3, A-4, A-6 or A-15. Multifrequency signalling equipment ".

[20] CCITT Recommendations Q.450-458 (1984): "Specifications of signalling system R2".

[21] CCITT Recommendation Q.479 (1984): "Echo-suppressor control - signalling requirements".

[22] CCITT Recommendation Z.101 (1984): "General explanation of the specification and description language (SDL)".

[23] CCITT Recommendation Z.102 (1984): "Symbols and rules".

[24] CCITT Recommendation Z.104 (1984): "Semantics".

[25] CEPT Recommendation T/CS 20-09 (1980): "Register recall".

[26] CEPT Recommendation T/CS 34-08 (1985): "Automatic sender for push-button multifrequency signalling".

[27] CEPT Recommendation T/CS 41-01 (1985): "Signal and signalling message names and meanings".

[28] CEPT Recommendation T/CS 42-02 (1985): "System R2 line signalling, analogue version".

[29] CEPT Recommendation T/CS 46-02 (1985): "Multifrequency signalling system to be used for push-button telephones".

3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ANI	Automatic Number Identification
CCBS	Completion of Calls to Busy Subscriber
CEPT	European Conference of Postal and Telecommunications Administrations
CLI	Calling Line Identity
COS	Class Of Service
CSA	Class of Service (A-Party)
CSB	Class of Service (B-Party)
DDI	Direct Dialling-In
DGT	DiGiT
DPS	Dialogue E-Phase Signal
EOB	End Of Block
ESU	Exchange Signalling Unit

IDP	InterDigit Pause
ISDN	Integrated Services Digital Network
ISU	Instrument Signalling Unit
MF	MultiFrequency
MFC	MultiFrequency Code
MFPB	MultiFrequency Push-Button
PABX	Private Automatic Branch eXchange
pps	pulses per second
PSTN	Public Switched Telephone Network
RCL	ReCaLl
SDL	Specification and Description Language
SOD	State Of Destination
SPC	Stored Program Control
TC	Type of Call
TOS	Temporarily Out-of-Service
vf	voice frequency

4 Overview and explanation

4.1 Text of the former CEPT Recommendations

Annexes A - J respectively contain the text of former CEPT Recommendations from the T/CS 49-xx series of Recommendations. Each Recommendation appears as a separate annex.

The text of each Recommendations has been reproduced in accordance with what was approved and published by CEPT. A number of minor editorial errors, detected during the reproduction process, have been corrected. In addition, some minor changes (such as removal from cross-references of the words "section" and "paragraph") have been made to better align the text with the style rules for ETSI publications.

Numbering of subclauses in the Recommendations remains as per the original documents; except that each subclause number has been prefixed with a letter. This letter identifies the annex in the present document in which the former Recommendation has been placed, and has the effect of make subclause references unique throughout the Specification.

References to other documents from within each Recommendation have been taken out of the individual Recommendations and placed in a common subclause (2.2) of the present document. This avoids duplication of references.

In some cases references are made to documents no longer available or to CEPT work in progress at the time of publication of the original Recommendation. Where this occurs an appropriate note has been inserted.

4.2 Diagrams of the former CEPT Recommendations

4.2.1 Numbering and cross-references

All diagrams in the original Recommendations have been re-drawn. Each figure / table number has been prefixed with a letter identifying the annex in the present document in which the figure / table occurs. This has the effect of making figure / table references unique throughout the Specification.

Some figure numbering has changed from that in the original Recommendations. Some figures also now consist of multiple sheets, denoted by: sheet "x" of "y"

In particular, this affects the figures in annex H (former Recommendation T/CS 49-08) and references to them. Table 1 below summarizes the equivalence between the old and new figure numbers for this case.

Table 1: Figure number equivalence for T/CS 49-08 & annex H

Old figure number in T/CS 49-08	New figure number in annex H
1 - 25	1 - 25 (note)
26	26 sheets 1 - 2
27	26 sheet 3
28	26 sheets 4 - 5
29	27 sheets 1 - 3
30	27 sheets 4 - 6
31	27 sheets 7 - 8
32	28
33	29
34	30
35	31
36	32 sheets 1 - 2
37	32 sheets 3 - 4
38	32 sheets 5 - 6
39	33 sheets 1 - 4
40	33 sheets 5 - 7
41	34
42	35
43	36
44	37
45	38
46	39
NOTE: No change apart from introduction of multiple sheets in some instances.	

Within the figures, cross-references between figures have been updated accordingly. This affects, in particular, cross-references from annex I (T/CS 49-09) to annex H (T/CS 49-08). Table 2 specifies these changes.

Table 2: Figure number equivalence for references to annex H (T/CS 49-08) by annex I (T/CS 49-09)

Old figure number in T/CS 49-08	New figure number in annex H
29	27 sheet 2
31	27 sheets 7 & 8
39	33 sheets 2 & 3
40	33 sheet 7

4.2.2 SDL diagram symbols

The SDL diagrams of the former Recommendations have been re-drawn using a specialized SDL design tool. This has limited the extent to which the SDL could be reproduced faithfully from the original due to the use within the original diagrams of constructs that are syntactically invalid. Consequently, although functionally identical to the original, the re-drawn SDL in this re-published version of the CEPT Recommendations is not graphically identical with the SDL in the original Recommendations.

SDL symbols in the present document have the meanings shown in figure 1.

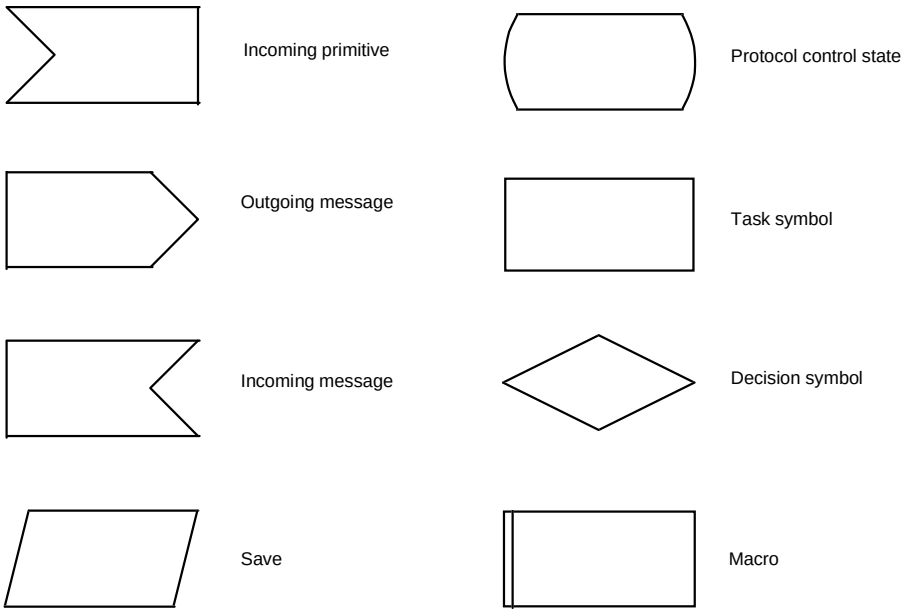


Figure 1: SDL legend

4.2.3 SDL diagram state names

Where a state symbol occurs with connections both after and before the state it denotes an instance of a protocol state that has no meaning beyond the point at which it occurs. Thus, the same state name (e.g. Wait) may appear many times throughout the SDL, but in each case it is a different instance of the state.

However, in some cases in annex H (T/CS 49-08) a state has significance at several different points in the SDL. In these cases, and where the state name is not already unique, a number has been added to the state name (e.g. Wait CEPT Recommendation T/CS 49-01 [1]) to make the name unique throughout the SDL block (either the Originating_PABX block or the Terminating_PABX block) in which it occurs.

Annex A:
CEPT Recommendation T/CS 49-01

Recommendation T/CS 49-01 (Ostend 1979, revised in Vienna 1982 and Montpellier 1984)

Edition of May 15 1986

SYSTEM L1 LINE SIGNALLING OVER INTERNATIONAL INTER-PRIVATE AUTOMATIC BRANCH EXCHANGE LINES

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Revised text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

- that there is an increasing need for the interconnection of private automatic branch exchanges located in different countries by means of international leased lines;
- that these international connections between private automatic branch exchanges should permit a fully automatic service between extensions connected to the private automatic branch exchanges concerned and authorized for international traffic;
- that CCITT Recommendations Q.1 [14] and Q.2 [15], since they are not directly applicable to international leased circuits, cannot cover the automatic service either;
- that a proliferation of private systems designed by suppliers tends to make operation and maintenance more difficult,

recommends

that the members, when introducing international interconnections over links between analogue transmission interfaces of private automatic branch exchanges, use the System L1 line signalling, which comprises the signals, equipment functions and procedures specified in the following. The requirements refer to the interfaces between the link and the outgoing or incoming private automatic branch exchange. The private automatic branch exchanges at both ends are regarded as functional units and no specifications are included on the ways and means for the provision of the functions concerned."

A.1 Principles and fields of application

A.1.1 The line signalling system is to provide automatic and semi-automatic working between private automatic branch exchanges (PABXs) in different countries, via terrestrial circuits. The use of the system over satellite circuits and over composed terrestrial satellite circuits is possible, provided that echo-suppressors or echo-cancellers needed are installed on the customer side between the hybrid and the 2 280 Hz sending and receiving equipment.

A.1.2 The signalling system is a *single voice frequency (1 vf) tone-on-idle line signalling system* using a signalling frequency of 2 280 Hz.

The use of voice frequency signals renders the system suitable for all voice transmission media, except those using speech interpolation.

A.1.3 The system is intended for use on both-way inter-PABX circuits.

A.1.4 Either decadic pulsing or multifrequency interregister signalling may be used with the system (see *Explanatory notes on Group 49 Recommendations (note)* preceding this Recommendation). The provision of particular line signals will depend upon the requirements of the associated interregister signalling system.

NOTE: The Explanatory Notes referred to are missing from the original text of the Recommendation.

A.1.5 The system operates on a four-wire basis, forward and backward signals being segregated by utilizing the four-wire circuit as two separate signalling paths. The send pair to which signals are applied is the receive pair at the distant end. Figure A.1 (T/CS 49-01) shows a termination at one end.

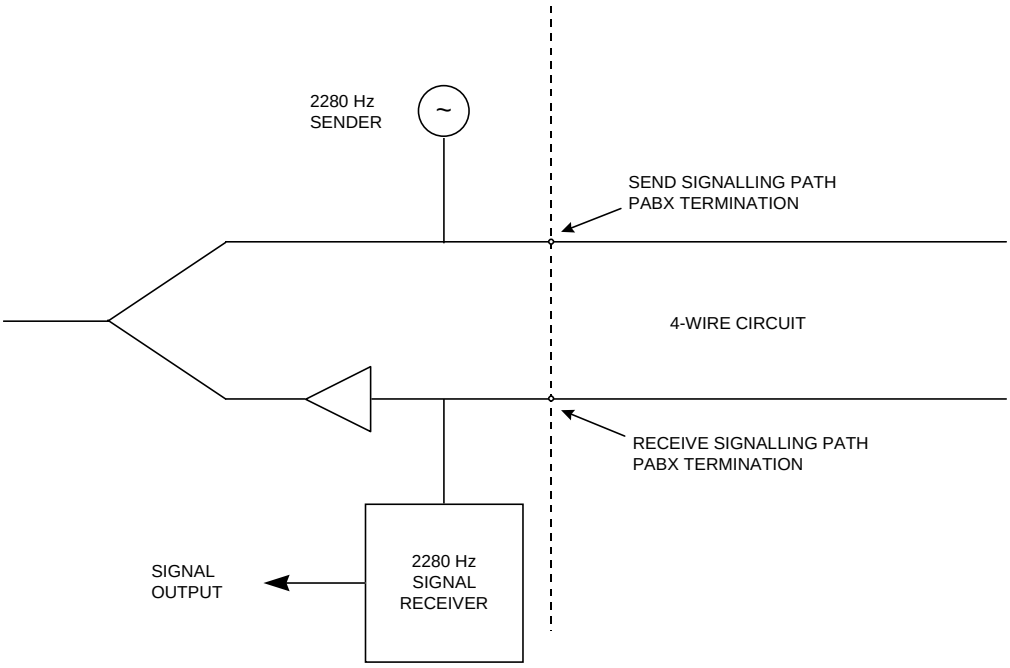


Figure A.1 (T/CS 49-01): Four-wire private automatic branch exchange termination

A.1.6 In addition to the application or removal of signalling frequency (tone-on and tone-off) in continuous form, the transmission of pulses of signalling frequency is applied.

A.1.7 When in the idle condition, the signalling frequency applied to the line is reduced in power level to conform to the transmission loading requirements of CCITT Recommendation Q.15 [16].

A.1.8 The line signalling operates on a link-by-link basis and may be used to establish a multi-link tandem connection using one or more private automatic exchange(s) as a transit switch. In accordance with CCITT Recommendation Q.25 [17], the signals are contained within the appropriate link and are not allowed to spill over into subsequent or preceding links.

A.1.9 The maximum number of tandem connections over which a call may be set-up is determined by the type of interconnecting circuits and is subject to mutual agreement by the parties concerned. However, all circuits used in a tandem connection should be to the standard of CCITT Recommendations G. 171 [11] and M.1010 to M.1060 [13].

A.1.10 Forward signals may be passed while speech or audible indications (tones or recorded announcements) are being received in the backward direction. A through speech path shall be provided in the backward direction of transmission during call set-up.

A.2 System L1 line signals

The names and meanings of the signals specified for System L1 line signalling are in accordance with Recommendation T/CS 41-01 [27]. The following signals may be provided:

- seizing signal;
- seizing-acknowledgement/Proceed-to-send signal (see subclause A.5.2.);
- clear-forward signal;
- clear-back signal;
- cleared signal;
- answer signal;
- forward-service-request-recall signal;
- forward-link-recall signal;
- backward-service-request-recall signal;
- backward-link-recall signal;
- intrusion signal;
- end-of-intrusion signal.

All signals above, except the proceed-to-send signal, are supervisory signals.

A.3 Line sending and detecting requirements

A.3.1 General

With the tone-on-idle signalling method, a signalling tone is sent continuously over the transmission channels in both directions when the circuit is idle. The presence of the tone indicates to both ends that the circuit is available and free to accept calls. This idle *line signal condition* represents the idle state of the circuit.

The tone is removed in the forward direction at the moment of seizure and in the backward direction when the first backward signal needs to be transferred. Restoring tone in the forward direction creates a total of four line signal conditions. The transition from one line signal condition to another one corresponds to the transfer of a line signal, according to the specifications referred to in clause A.2 above.

The use of these transitions only, however, does not provide for a sufficient number of signals. Therefore, as a call proceeds, each signal condition on the line may be repeated, and also single and double tone-on pulses may be used. Distinction between different signals having the same characteristics shall be made by the position of the signal in the sequence of the signalling procedure.

A.3.2 Line signal conditions and signalling codes

The line signal conditions and the signalling codes shall be as shown in table A.1 (T/CS 49-01). Signal sending and detection requirements are given in subclauses A.3.3. and A.3.4.

Table A.1 (T/CS 49-01): Line signal conditions and signalling codes

Signal	Outgoing PABX	Incoming PABX
Idle (pro memoriam)	Continuous tone-on	Continuous tone-on
Seizing	Continuous tone-off	--
Seizing-acknowledgement or proceed-to-send	--	Continuous tone-off
Answer	--	Single tone-on pulse
Clear-forward	Continuous tone-on	--
Clear-back	--	Continuous tone-on
Cleared signal	--	Continuous tone-on
Forward-service-request-recall	Single tone-on pulse	--
Backward-service-request-recall	--	Single tone-on pulse
Intrusion	Single tone-on pulse	--
End-of-intrusion	Single tone-on pulse	--
Forward-link-recall	Double tone-on pulse	--
Backward-link-recall	--	Double tone-on pulse
Legend: "--" indicates that the signal is intended to be received by the PABX referred to at the top of the column.		

All signals sent shall give a true indication of the state the call-handling procedure has reached in the PABX concerned.

The provision and use of particular line signals, some of which are optional, will depend upon the requirements of the associated type of inter-register signalling (see Recommendations on System L1 call control signalling procedures [2], [4], [7]).

A.3.3 Sending of signals

Tone-on and tone-off conditions referred to in subclauses A.3.1 - A.3.3 shall conform to the line signalling transmission requirements set out in clause 4.

Signals are sent by applying either a tone-on or a tone-off condition to the send signalling path in continuous or pulsed form as defined below.

A.3.3.1 Continuous tone-on condition

A continuous tone-on condition shall be the application of the signalling frequency to the send signalling path for a period exceeding 300 ms.

A.3.3.2 Continuous tone-off condition

A continuous tone-off condition shall exist when any signalling frequency is absent from the send signalling path for a period exceeding 80 ms.

A.3.3.3 Single tone-on pulse signal

A single tone-on pulse signal shall be the application of a tone-on condition to the send signalling path for a period of 45 - 135 ms. This signal shall not be sent within 250 ms of a previous tone-on condition in the same direction.

A.3.3.4 Double tone-on pulse signal

A double tone-on pulse signal shall be the application of two pulses of tone-on condition to the send signalling path, each persisting for a period of 45 - 135 ms, separated by a tone-off condition for a period of 30 - 70 ms. This signal shall not be sent within 250 ms of a previous tone-on condition in the same direction.

A.3.4 Detection of signals

Electrical conditions conforming to the line signal transmission requirements specified in subclause A.4.2 applied to the PABX termination, shall be regarded as a potential signal.

Signals are received in a continuous or pulsed form, as either a tone-on or a tone-off line signal condition on the receive signalling path.

To discriminate between signals having similar characteristics and between signals and spurious electrical conditions, it is necessary to state the minimum persistence time for a potential signal.

A potential signal is not recognized until the electrical condition proper to the signal (i.e. tone-on or tone-off) has persisted for a stated period. Until that period expires, only an electrical condition exists.

Subclauses A.3.4.1 - A.3.4.4 detail the minimum persistence of a defined electrical condition before it may be recognized as a signal i.e. an electrical condition persisting for less than the stated period shall not be recognized as a signal. The period after which a potential signal must be recognized as a signal is a function of the PABX logic and is not given in these specifications. However, recognition should occur as soon as possible following expiration of the stated persistence check period, and the splitting and spill-over requirements (see clause A.4) shall be met.

A.3.4.1 Continuous tone-on condition

A tone-on condition applied to the receive signalling path PABX termination may be recognized as continuous tone-on condition for signalling when it has persisted for 150 ms.

A.3.4.2 Continuous tone-off condition

A tone-off condition applied to the receive signalling path PABX termination may be recognized as continuous tone-off condition for signalling when it has persisted for 40 ms.

A.3.4.3 Single tone-on pulse signal

A tone-on condition applied to the receive signalling path PABX termination and persisting for a period of 35 - 150 ms, followed by a tone-off condition of longer than 200 ms, may be recognized as a single tone-on signal. A tone-on condition persisting for less than 25 ms followed by a tone-off condition for less than 80 ms, shall not be recognized as a single tone-on pulse signal.

A.3.4.4 Double tone-on pulse signal

Two pulses of tone-on condition applied to the receive signalling path PABX termination, each persisting for a period of 35 - 150 ms, separated by a tone-off condition for a period of 20 - 80 ms and followed by tone-off condition for longer than 200 ms, may be recognized as a double tone-on pulse signal.

Two tone-on pulses persisting for less than 25 ms, or separated by a tone-off condition for more than 200 ms, or followed by tone-off condition for less than 80 ms, shall not be recognized as a double tone-on pulse signal.

A.4 Line signalling transmission requirements

A.4.1 Signal sender

Signals are sent by the application of a tone-on condition or a tone-off condition or a combination of both to the transmit signalling path.

A.4.1.1 Tone-on condition

Tone-on condition shall be a signalling tone conforming to the following parameters and shall attain a stable state within 5 ms of application.

A.4.1.1.1 Signal tone frequency

The signalling tone shall be at a frequency of 2 280 ± 5 Hz.

A.4.1.1.2 Signal tone power

The tone-on condition shall have two power levels: a high level and a low level.

A high level tone shall be sent for the duration of the signal or for a minimum of 300 ms (whichever is shorter) and for a maximum of 550 ms after which it should be reduced to low level.

a) A high level tone-on condition shall be a signalling tone transmitted at a level of -10 dBmO ± 1 dB.

b) A low level tone-on condition shall be a signalling tone transmitted at a level of -20 dBmO ± 1 dB.

A.4.1.1.3 Long-term mean power during signalling

a) In the frequency band 300 - 3 400 Hz, the long-term mean power applied to the transmit path, excluding the signalling tones, shall be at least 35 dB below the signalling tone power.

b) At frequencies in the range 3,4 - 50 kHz, the short-term mean power level of any spectral component shall not lie above the line shown on figure A.2 (T/CS 49-01).

NOTE 1: Short-term here refers to a period not greater than 1 ms.

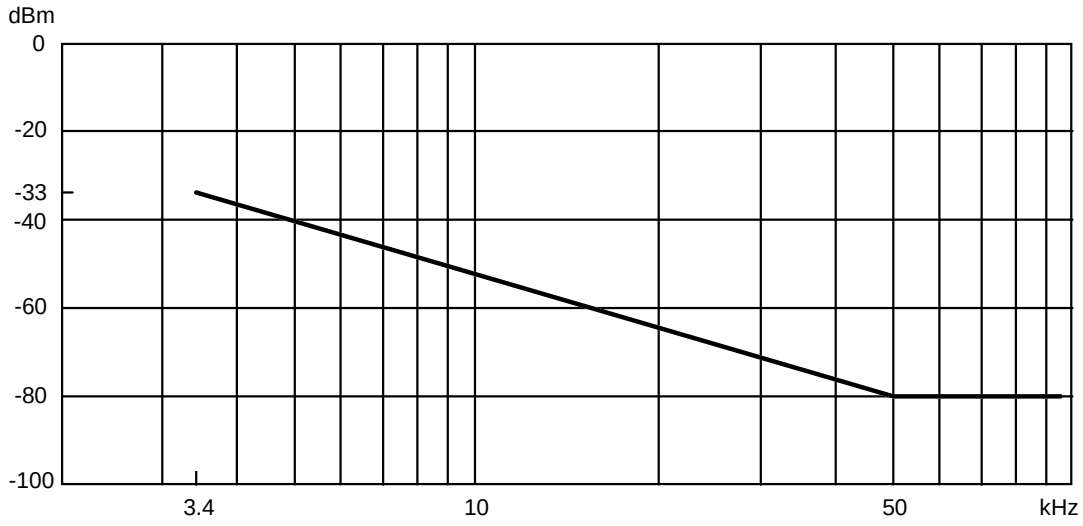


Figure A.2 (T/CS 49-01)

c) In any 3 kHz band contained above 3,4 kHz, the long-term mean power shall not exceed the level which would be permitted in accordance with (b) above for a spectral component at the mid-frequency of that band.

NOTE 2: The requirements for the long-term mean power exclude any near end noise prior to splitting, according to 4.1.3 in CCITT Recommendation Q.25 [17], but include noise attributable to the action of splitting.

A.4.1.2 Tone-off condition

A tone-off condition requires the absence of signal tone and shall conform to the following:

- the stable state shall be attained within 5 ms of the commencement of the tone-off condition; and

- the total power of any signalling tone that may be present in the tone-off condition (i.e. the signal frequency leak) shall not exceed -70 dBmO.

A.4.1.3 Sending-end splitting arrangements

When a signal is to be sent on the line, the transmission path shall be split in accordance with CCITT Recommendation Q.25 [17], from any source of near end speech or noise. Transmission path splitting shall occur within a period from 20 ms before to 15 ms after application of a tone-on condition.

The transmission path restoration requirements may differ depending upon whether or not a speech path is provided while the tone-on signal condition exists on the line.

A.4.1.3.1 No speech path provided during sending tone-on

The transmission path remains split until a tone-off signal condition is to be established, in which case the transmission path shall be restored within a period of 75 - 160 ms after establishment of the tone-off condition.

A.4.1.3.2 Speech path provision during the tone-on signal condition on the line

a) The transmission path splitting shall be maintained for a period of at least 350 ms following the application of a tone-on condition, after which it may be restored, unless a tone-on condition is being detected on the receive signalling path.

b) If a tone-on condition is detected on the receive signalling path during a tone-on condition existing in the sending direction, the transmission path shall be split within 250 ms.

c) When a tone-off condition is to be established, transmission path splitting shall occur within a period from 20 ms before to 15 ms after the start of the tone-off condition and shall remain split for 75 - 160 ms.

A.4.1.4 Signal direction

When a tone-on condition is established in the forward direction, any period of signalling tone attributable to that, that is applied to the preceding link, shall not exceed 15 ms.

When a tone-on condition is established in the backward direction, any period of signalling tone attributable to that, that is applied to the succeeding link, shall not exceed 15 ms.

A.4.2 Signal receiver

All electrical conditions applied to the receive signalling path shall be recognized as either tone-on or tone-off conditions.

A.4.2.1 Signal conditions

A.4.2.1.1 Tone-on condition

A frequency within the range 2 280 ± 15 Hz at an absolute level N, within the range $(-30 + n \leq N \leq -4 + n)$ dBm, shall be recognized as a tone-on condition; where n is the relative power level at the receive signalling path PABX termination (see CCITT Recommendation G.171 [11]).

A.4.2.1.2 Tone-off condition

Any frequency or combination of frequencies having a total absolute power level of less than $(-40 + n)$ dBm shall be recognized as a tone-off condition; where n is the relative power level at the receive signalling path PABX termination as in subclause A.4.2.1.1.

A.4.2.2 Interference and simulation

The conditions defined in subclause A.4.2.1. shall be recognized as potential signals subject to the following requirements.

A.4.2.2.1 Signal recognition interference

a) The recognition of tone-on and tone-off conditions shall not be affected by the presence of noise at a maximum level of -35 dBmO and having uniform spectral energy over the range of 300 Hz to 10 kHz.

b) The recognition of tone-on and tone-off conditions in the backward direction shall not be affected by speech or signalling frequency transmitted simultaneously in the forward direction.

c) The recognition of tone-on and tone-off conditions in the forward direction shall not be affected by speech or other electrical signals such as supervisory audible indications and signalling frequency transmitted simultaneously in the backward direction.

A.4.2.2.2 Signal simulation

a) False signal (simulation) rates shall not exceed one false recognition of a clear-forward or clear-back signal in 1 500 hours of normal speech and one false recognition of any other forward or backward signal of table 1 (T/CS 49-01) in 70 hours of normal speech.

b) Speech or other electrical signals such as supervisory audible indications, at power levels up to + 10 dBmO, shall not cause any false recognition of a tone-off condition.

c) A frequency outside the range 2 280 ± 75 Hz shall not cause any false recognition of a tone-on condition.

d) A frequency within the range 2 280 ± 75 Hz shall not cause any false recognition of a tone-on condition, if the total power in the range 2 280 ± 75 Hz does not exceed the total power in any accompanying frequencies by more than is shown in table A.2 (T/CS 49-01).

Table A.2 (T/CS 49-01)

Accompanying frequency (Hz)	500	750	1 000	1 250	1 500	1 750	2 000	3 000
Total power level by which 2 280 ± 75 Hz exceeds accompanying frequencies (dB)	7	10	12	12	12	12	7	9

A.4.2.3 Receiving-end splitting arrangements and spill-over

CCITT Recommendation Q.25 [17] applies. On receipt of a tone-on condition, any through-transmission to a subsequent inter-PABX circuit shall be attenuated by at least 35 dB within 20 ms.

Through-transmission shall be restored within 300 ms of the cessation of the tone-on condition.

Through-transmission shall not be restored during the tone-off periods of double tone-on pulse signals.

A.4.2.4 Through-transmission interference

The following requirements shall apply subsequent to the recognition of tone-off condition.

A.4.2.4.1 Speech immunity

Through-transmission attenuation (see subclause A.4.2.3.) shall not occur for more than one 20 ms period in two continuous speech hours and one 50 ms period in ten continuous speech hours. A continuous speech hour is one hour of speech and does not include those quiescent periods that occur in normal conversation.

A method of testing speech immunity has been given in Recommendation T/CS 46-02, annex [29].

A.4.2.4.2 Data immunity

Through-transmission attenuation (see subclause A.4.2.3.) shall not occur if the total power in the range 2 280 ± 75 Hz does not exceed the total power in the accompanying frequencies by more than the amount shown in table A.2 (T/CS 49-01).

A.5 General line signal transfer procedures

A.5.1 Seizure

The seizing signal is sent by the outgoing PABX upon selection of the inter-PABX circuit for an outgoing call. On recognition of the seizing signal, the incoming PABX bars access for outgoing calls to the circuit and prepares to receive address information. The incoming PABX takes a finite time to bar outgoing access. An outgoing call, originated at the incoming PABX during this unguarded period, would cause a tone-off condition to be established which then would be recognized by the outgoing PABX as either a seizing-acknowledgement or a proceed-to-send signal (dual-seizure situations).

A.5.2 Seizing-acknowledgement or proceed-to-send

Depending upon the capabilities of the incoming PABX, recognition of the seizing signal will initiate either a seizing-acknowledgement or a proceed-to-send procedure.

A.5.2.1 Seizing-acknowledgement

In this case, when the incoming PABX recognizes the seizing signal, it returns a seizing-acknowledgement signal. The sending of this signal does not imply that the incoming PABX is ready to receive address information, and provision must be made to prevent premature sending by the outgoing PABX, e.g. by agreeing to use dialling tone or a pre-sending pause.

A.5.2.2 Proceed-to-send

In this case, when the incoming PABX recognizes the seizing signal, it maintains the tone-on line signal condition until it is ready to receive address information, it then applies a proceed-to-send signal which is an interregister signal (see Recommendations T/CS 49-02 [2], 49-04 [4] and 49-07 [7]]).

A.5.2.3 Discrimination between seizing-acknowledgement and proceed-to-send signal

As the seizing-acknowledgement and proceed-to-send signals are electrically identical, the meaning of the signal and the procedures must be mutually agreed upon by the parties involved, taking into account dual-seizure situations.

A.5.3 Clear-forward

A clear-forward signal is sent by the outgoing PABX to release the connection and the incoming PABX. Both PABXs bar access to the inter-PABX circuit until the clear-forward and the cleared or clear-back signal have been exchanged. If the incoming PABX sends the interregister clear-request signal the clear-forward signal is returned as an acknowledgement, see Recommendation T/CS 42-02 [28].

A.5.4 Clear-back

A clear-back signal is sent by the incoming PABX upon change of the called party extension line to an on-hook state, provided no clear-forward signal has yet been recognized. Upon recognition of the clear-back signal, the outgoing

PABX sends a clear-forward signal. Both PABXs bar access to the inter-PABX circuit until the two signals have been exchanged.

A.5.5 Cleared signal

A cleared signal is applied by the incoming PABX upon recognition of a clear-forward signal if the call has not been answered. Both PABXs bar access to the inter-PABX circuit until the two signals, clear-forward and cleared, have been exchanged. The cleared signal is also applied by the incoming PABX if the called party extension line is still in the off-hook state at the moment the clear-forward signal is recognized.

A.5.6 Optional signals and procedures

Provision of the following optional signals and procedures depends on network requirements and is subject to mutual agreement by the parties involved.

A.5.6.1 Answer

Where the facility is provided and when the called party answers, the incoming PABX sends an answer signal on the signalling path.

Some PABXs do not use the answer signal, others require it for correct operation.

Where the answer signal is required by the outgoing PABX but the incoming PABX is unable to provide it, the signal must be artificially generated at the outgoing PABX. However, the signal may be generated at the incoming PABX by agreement between the parties involved.

A genuine answer signal will be necessary where calls are established end-to-end using multifrequency interregister signalling (see Recommendations T/CS 49-04 [4] and T/CS 49-07 [7]).

A.5.6.2 Recall signalling

Service-request-recall and link-request-recall signals are used, subsequent to call set-up or the establishment of speech conditions, when a PABX requires another PABX to prepare to receive further address signals or information. The signals are used for forward and backward signalling and depend upon the requirements of the associated type of interregister signalling (see Recommendations on System L1 call control signalling [2], [4], [7]).

Annex B:
CEPT Recommendation T/CS 49-02

Recommendation T/CS 49-02 (Ostend 1979, revised in Vienna 1982 and Montpellier 1984)

Edition of May 15 1986

SYSTEM L1 DECADIC PULSING INTERREGISTER SIGNALLING

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Revised text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

- that rotary dial telephones are still widely used on private automatic branch exchange extension lines;
- that equipment located at subscriber's premises and used for private networks may be based on decadic pulsing techniques,

recommends

that the members, in conditions requiring decadic pulsing over links between analogue transmission interfaces of private automatic branch exchanges located in different countries, use System L1 signalling as specified below."

B.1 General

B.1.1 Line signalling

System L1 decadic pulsing signalling is used in conjunction with System L1 line signalling according to Recommendation T/CS 49-01 [1]. The individual line signals to be provided and their uses are specified in Recommendation T/CS 49-03 on the System L1 decadic pulsing call control signalling procedures [3].

B.1.2 Principles and field of application

B.1.2.1 The decadic pulsing interregister signalling system is to provide automatic and semi-automatic working between Private Automatic Branch eXchanges (PABXs) via terrestrial circuits.

B.1.2.2 The system is a single voice frequency (1 VF) in-band signalling system, using the same signalling frequency of 2 280 Hz as System L1 line signalling, according to Recommendation T/CS 49-01 [1]. The use of voice frequency signals renders the system suitable for all voice transmission media.

B.1.2.3 The system is for use on four-wire circuits, and the PABX termination arrangements set-out in Recommendation T/CS 49-01 [1] apply.

B.1.2.4 The decadic pulsing call control signalling operates on a link-by-link basis and may be used to set-up multi-link tandem connections. In accordance with CCITT Recommendation Q.25 [17], the signals are contained within the appropriate link and are not allowed to spill-over into subsequent links.

B.1.2.5 The maximum number of tandem connections over which a call may be set-up is determined by the type of interconnecting circuits and is subject to mutual agreement by the parties concerned. All circuits used in System L1 links should be to the standard of CCITT Recommendations G.171 [11] and M.1010 to M.1060 [13].

B.1.2.6 Forward signals may be passed while speech or audible indications are being received in the backward direction.

B.1.3 Signals for decadic pulsing

For System L1 decadic pulsing signalling, the following signals in accordance with Recommendation T/CS 41-01 [27] are specified.

B.1.3.1 Forward signals

- Address signal.
- Proceed-to-send-on-recall signal.

B.1.3.2 Backward signals

- Proceed-to-send signal.
- Address-complete signal.
- Address-complete, extension-free signal.
- Address-complete, extension-busy signal.
- Busy-extension-changed-to-free signal.
- Clear-request signal.
- Proceed-to-send-on-recall signal.

B.1.3.3 Clear-request when common-control equipment or switching equipment is released

A clear-request signal shall be applied, prior to the answer signal when, after recognition of a seizing signal, no address or incomplete address information is received and the incoming PABX times-out, dismissing any common-control equipment.

A clear request signal may be applied prior to the answer signal when an incoming PABX encounters congestion or an engaged extension and releases the switching equipment.

B.2 Decadic pulsing sending and detecting requirements

B.2.1 Signal codes

Address signals (routing digits and extension number) are sent as pulses of signalling tone character-by-character in a non-compelled mode of operation in the sequence required by the numbering arrangements. The interregister signals shall be coded as shown in Table B.1 (T/CS 49-02).

Table B.1 (T/CS 49-02): Decadic pulsing interregister signal codes

Forward signals	
Signal	**Code**
Address Digit 1	one tone-on pulse
2	two tone-on pulses
3	three tone-on pulses
4	four tone-on pulses
5	five tone-on pulses
6	six tone-on pulses
7	seven tone-on pulses
8	eight tone-on pulses
9	nine tone-on pulses
0	ten tone-on pulses
Proceed-to-send-on-recall (optional)	double tone-on-pulse
Reconnect (optional)	single tone-on pulse

Backward signals	
Proceed-to-send (optional)	continuous tone-off
Address-complete (optional)	single tone-on pulse
Address-complete-extension-free (optional)	single tone-on pulse
Address-complete-extension-busy (optional)	double tone-on pulse
Busy-extension-changed-to-free (optional)	single tone-on pulse
Clear-request	continuous tone-on
Proceed-to-send-on-recall (optional)	single tone-on pulse
Reconnect (optional)	double tone-on-pulse

Adjacent address signals are separated by an Inter-Digit Pause (IDP). This pause is a function of the type of PABX concerned and the source of the digits, e.g. whether generated within the outgoing PABX or repeated by the PABX under the control of a dial. The inter-digit pause, which will differ depending upon the Administration concerned and the type of PABX, is not specified in this Recommendation and must be mutually agreed upon by the parties involved. During the inter-digit pause the through-connection of the backward speech path is re-established.

Signals having the same coding shall be distinguished by their position in the sequence of the signalling procedure.

The provision and use of particular interregister signals, some of which are optional, will depend upon the requirements of the call control signalling procedures (see Recommendation T/CS 49-03 [3]).

B.2.2 Sending of address signals

The break periods of dial pulses shall be applied to the send signalling path as pulses of tone-on condition within the limits of Table B.2 (T/CS 49-02).

Table B.2: (T/CS 49-02)

Speed (pulses per second)	7		9		11		12	
Break pulse	Min	Max	Min	Max	Min	Max	Min	Max
Duration (ms)	45	112	45	81	45	61	45	52

Where address signals are generated within the PABX, the speed and break pulse duration applied to the signalling send path shall be either:

a) 10±0,5 pulses per second, with break pulse limits of 60 - 68 %; or

b) 10±1 pulses per second, with break pulse limits of 58 - 66 %.

B.2.3 Detecting of address signals

Electrical conditions, conforming to the line signal transmission requirements referred to in clause B.4 and applied to the PABX termination, shall be regarded as a potential signal.

To discriminate between address signals and signals having similar characteristics, or between address signals and spurious electrical conditions, it is necessary to state the minimum persistence time for a potential signal.

A potential signal is not recognized until the electrical condition proper to the signal (i.e. tone-on or tone-off) has persisted for a stated period. Until that period expires, only an electrical condition exists.

The paragraphs below detail the minimum persistence of a defined electrical condition before it may be recognized as a signal, i.e. an electrical condition persisting for less than the stated period shall not be recognized as a signal. The period after which a potential signal must be recognized as a signal is a function of the PABX logic and is not given in these specifications. However, recognition should occur as soon as possible following expiration of the stated persistence check period and the splitting and spill-over requirements (see clause B.4) must be met.

Pulses of tone-on condition applied to the receive signalling path PABX termination and consistent with the speed and duration limits of Table B.3 (T/CS 49-02 (note)), are break periods of dial pulses (address signal).

NOTE: In the original text of the Recommendation the reference here appears to have been made erroneously to T/CS 49-04;.

Each break pulse is separated from the next by a make pulse, i.e. tone-off condition.

Within an address signal, adjacent pulses may differ in speed and duration and any combination of break pulses within the limits of Table B.3 (T/CS 49-02) shall be accepted as dial pulses (address signal).

Table B.3 (T/CS 49-02)

Speed (pulses per second)	7		9		11		12	
Break pulse	Min	Max	Min	Max	Min	Max	Min	Max
Duration (ms)	35	122	35	91	35	71	35	62

Break pulses persisting for less than 25 ms applied to the PABX termination shall not be accepted as dial pulses.

Adjacent address signals are separated by an inter-digit pause, see subclause B.2.1 above.

B.2.4 Tone-on pulses

The sending and detecting requirements of Recommendation T/CS 49-01 [1] apply.

B.3 Register-recall signalling

Register-recall provides the means for control information transfer after termination of the call set-up. Register-recall can, as forward or backward recall, be initiated in either direction, regardless of the direction of the original call set-up.

When the register at the destination PABX is required to be recalled, the forward or backward service-request-recall signal shall be sent. The service-request-recall signal shall not recall the registers of transit switches.

When the transit register is required to be recalled, the forward- or backward-link-recall signal shall be sent to the adjacent transit switch.

Upon recognition of a register-recall signal, the proceed-to-send-on-recall signal is sent to indicate that the responding PABX is ready for System L1 decadic pulsing interregister signalling.

Upon recognition of a register recall signal, the reconnect signal is sent to indicate that the responding PABX:

- does not allow a register-recall to be extended; or
- wishes the initiating PABX to switch-through the connection.

B.4 Signal transmission requirements on the line

B.4.1 Signal sender and receiver

The signal transmission requirements on the line which are specified in Recommendation T/CS 49-01 [1] apply for all signals.

B.4.2 Splitting and spill-over

CCITT Recommendation Q.25 [17] and Recommendation T/CS 49-01 apply.

Through-transmission shall not be restored during the tone-off periods of address signals.

Annex C:
CEPT Recommendation T/CS 49-03

Recommendation T/CS 49-03 (Vienna 1982. revised in Montpellier 1984)

Edition of May 15 1986

SYSTEM L1 DECADIC PULSING CONTROL SIGNALLING PROCEDURES

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Revised text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

- that decadic pulsing interregister signalling may be employed on exchange links connecting private automatic branch exchanges;
- that various forms of decadic pulsing call control signalling procedures are widely used in private national networks and on extension lines,

recommends

that members use the System L1 signalling procedures specified below, if decadic pulsing interregister signalling is applied between private automatic branch exchanges (PABXs) in different countries."

C.1 General

C.1.1 Field of application

The signalling procedures specified in this Recommendation cover the standard call set-up and call clear-down. Enhancements such as additional functions for recall and intrusion are included. Arrangements for routing a multi-link connection are also specified. In this case the link-by-link operation inherent to System L1 is used.

C.1.2 Signals

System L1 decadic pulsing interregister signalling in accordance with Recommendation T/CS 49-02 [2] is used in conjunction with System L1 line signalling as specified in Recommendation T/CS 49-01 [1].

Table 1 (T/CS 49-03) shows all the signals used for the recommended decadic pulsing signalling procedures. The meanings of the signals comply with Recommendation T/CS 41-01 [27]. The requirements for the transmission of the signals are set out in Recommendations T/CS 49-01 [1] and T/CS 49-02 [2].

Table C.1 (T/CS 49-03): Signals used in L1 decadic pulsing call control signalling procedures

Signal	Option	Recommendation
Seizing	M	T/CS 49-01
Proceed-to-send	M	T/CS 49-02
Seizing-acknowledgement	1	T/CS 49-01
Address	M	T/CS 49-02
Clear-request	M	T/CS 49-02
Address-complete	2	T/CS 49-02
Address-complete, extension-free	4	T/CS 49-02
Address-complete, extension-busy	4	T/CS 49-02
Busy-extension-changed-to-free	4	T/CS 49-02
Answer	3	T/CS 49-01
Clear-forward	M	T/CS 49-01
Clear-back	M	T/CS 49-01
Cleared	M	T/CS 49-01
Intrusion	5	T/CS 49-01
End-of-intrusion	5	T/CS 49-01
Service-request-recall	6	T/CS 49-01
Link-recall	6	T/CS 49-01
Proceed-to-send on recall	6	T/CS 49-02
Reconnect	6	T/CS 49-02
Legend: 1, 2, 3, 4, 5, 6 = options 1, 2, 3, 4, 5, 6 M = Mandatory		

Option 1 provides for the use of the seizing-acknowledgement signal instead (note) of the proceed-to-send signal.

NOTE: The word "instead" is missing from the original text of the Recommendation.

The use of the address-complete signal and the answer signal is subject to options 2 and 3 respectively. The three signals address-complete, extension-free; address-complete, extension-busy and busy-extension-changed-to-free may be chosen instead of the address-complete signal (option 4). If the signals, intrusion and end-of-intrusion are used (option 5), option 4 must be applied. The four recall signals represent option 6.

All options 2 to 6 must be mutually agreed upon by the parties involved.

C.2 Signalling procedures

C.2.1 General

When, under option 1, the seizing-acknowledgement signal is used, premature sending of address signals is prevented either by the detection of dial tone or by means of a pre-sending pause. The length of the pre-sending pause should be determined by mutual agreement. When using the proceed-to-send signal, transmission of the address signals is withheld until the proceed-to-send signal has been received. The recommended signalling procedures do not specify actions to be taken in the case of double seizure.

The signalling procedures are described by means of SDL diagrams in accordance with CCITT Recommendations Z.101 [22], Z.102 [23] and Z.104 [24], and narrative comments. Table D.4 in Recommendation T/CS 49-04 [4] includes abbreviations used in the SDL diagrams.

NOTE 1: The SDL diagrams are included in this Recommendation (see note 2) to assist in the understanding of the technical text and must only be used in association with the text.

NOTE 2: The SDL diagrams referred to are not present in the original text of the Recommendation. This note is probably erroneous, as reference is made in the next subclause and later to SDL diagrams in another Recommendation (T/CS 49-05 [5]).

C.2.2 Set-up and clear-down of standard calls

Figures E.1, E.2 and E.9 in Recommendation T/CS 49-05 [5] apply. They show the signalling sequence at the outgoing and incoming PABX line interface for set-up and clear-down of standard calls.

In the case of multi-link calls, the address signals are transferred link-by-link. The registers in the transit switches should preferably work in an overlap mode of operation.

The selection phase is terminated with the transmission of the address-complete signal from the incoming to the outgoing PABX, by address information analysis or by an internal time-out.

The address-complete signal releases the registers in the terminating PABXs and transit switches, initiates through-connection of the speech path and causes the transition to the end-of-selection state at the reference interfaces. In the end-of-selection state an additional signal interchange e.g. covering option 4 or 4 + 5 may take place and cause transition to another state. In the SDL diagrams this state is called post-dialling state.

C.2.3 Intrusion

The procedures for intrusion require the provision of options 4 and 5. Figures E.7 and E.8 in Recommendation T/CS 49-05 [5] apply.

C.2.4 Recall procedures

When option 6, register-recall, is provided, figures E.3 to E.6 of Recommendation T/CS 49-05 [5] apply.

C.2.5 Clear-request on non-receipt of address information

When, after recognition of a seizing signal, no address information or incomplete address information is received, the PABX shall time-out and dissociate the inter-PABX circuit from any common equipment.

Under these conditions the incoming PABX shall:

a) apply the clear-request signal;

b) bar access to the inter-PABX circuit for outgoing calls until a clear-forward signal is recognized.

C.2.6 Clear-request on encountering congestion or an engaged extension

This procedure is optional. When an incoming PABX encounters congestion or an engaged extension, it may release the switching equipment, apply the clear-request signal and perform the procedures specified in subclause C.2.5 (b) above.

C.2.7 Audible indications

Provision should be made by the parties involved to ensure that the correct audible indications are returned to the caller when C.2.5 or C.2.6 above apply.

Annex D:
CEPT Recommendation T/CS 49-04

Recommendation T/CS 49-04 (Vienna 1982, revised in Montpellier 1984)

Edition of May 15 1986

SYSTEM L1 MULTIFREQUENCY PUSH-BUTTON INTERREGISTER SIGNALLING

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Revised text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

- that multifrequency push-button (MFPB) subscriber's line signalling may enable faster call setup than decadic pulse signalling;
- that MFPB signalling provides more codes than decadic pulse signalling;
- that MFPB signalling employs in-band signals making possible end-to-end interregister signalling between private automatic branch exchanges (PABXs);
- that, as a system that is also used for simple data communication, MFPB signalling is suitable for a dialogue-like interchange of signalling information;
- that MFPB telephones are being used more and more on extension lines;
- that equipment located on the subscriber's premises and used for private networks may be based on MFPB signalling techniques,

recommends

that members, in conditions favouring MFPB signalling over links between analogue transmission interfaces of PABXs located in different countries, use System L1 multifrequency push-button interregister signalling as specified below. "

D.1 General

D.1.1 Line signalling

System L1 MFPB interregister signalling is used in conjunction with system L1 line signalling according to Recommendation T/CS 49-01 [1]. The individual line signals to be provided and their uses are specified in Recommendations T/CS 49-05 [5] and T/CS 49-06 [6] on System L1 MFPB call control signalling procedures.

D.1.2 Principles and field of application

D.1.2.1 MFPB interregister signalling is suitable for automatic and semi-automatic working between PABXs via terrestrial circuits.

D.1.2.2 System L1 MFPB interregister signalling may be used to setup multi-link-tandem connections. Depending on the signalling procedures concerned, link-by-link or end-to-end signalling applies. In the case of link-by-link working, the signals, in accordance with CCITT Recommendation Q.25 [17], are contained within the appropriate link and are not allowed to spillover into subsequent or preceding links.

D.1.2.3 The maximum number of tandem connections over which a call may be setup is determined by the type of interconnecting circuits and is subject to mutual agreement between the parties concerned. All circuits used in a tandem connection should be according to the standard of CCITT Recommendations G.171 [11] and M.1010 to M.1060 [13].

D.1.2.4 On international leased lines, System L1 MFPB is used on four-wire circuits and the PABX termination arrangements set out in Recommendation T/CS 49-01 [1] apply. Special arrangements enable System L1 to be used on (national) two-wire circuits, if necessary.

D.1.3 Structure

D.1.3.1 The System L1 MFPB signalling provides the signalling capability for the interchange of additional information during a dialogue phase following the selection phase. During the dialogue phase, the full range of MFPB codes in the forward as well as in the backward direction is used. In this case, the System is called System L1 MFPB bidirectional. It is suitable for the implementation of an increased range of services. The signalling procedures are specified in Recommendation T/CS 49-06 [6]

D.1.3.2 System L1 MFPB signalling is designed, however to allow the use of a simplified subsystem, called System L1 MFPB unidirectional. It provides the signalling capability for call establishment (selection phase) using the character set of the 12-button array according to Recommendation T/CS 46-02 [29] in the forward direction only. The signalling procedures are specified in Recommendation T/CS 49-05 [5].

D.1.3.3 A signalling compatibility check is included in the System L1 MFPB bidirectional signalling to enable interworking with System L1 MFPB unidirectional.

D.2 Interregister signals

D.2.1 Use of line signalling frequency signals

In System L1 MFPB, five line-signalling-frequency-backward signals are used for interregister type signalling, the proceed-to-send signal, the proceed-to-send-on-recall signal, the address-complete signal, the clear-request signal and the reconnect signal. The five signals are introduced in the system as specified in Recommendation T/CS 49-02 [2].

D.2.2 Signal codes

Table D.1 (T/CS 49-04) shows the MFPB forward signals used in System L1 signalling. Table D.2 (T/CS 49-04) shows the MFPB backward signals, which occur only in the dialogue phase, e.g. in bidirectional MFPB signalling.

Table D.1 (T/CS 49-04): MFPB forward signals

Character indicating the MFPB code used	Addr. Signal in the selection phase	(note 2)	Dialogue phase forward signals (note 1)	
			Type of call (TC) (note 3)	Class of service of calling party (CSA) (note 4)
1	Digit 1	Prohibited as a first dialogue phase forward signal	Extension originated	PSTN access, not data protected, group a
2	Digit 2		Enquiry call, PSTN call held	PSTN access, not data protected, group b
3	Digit 3		Transfer from night extension	PSTN access, not data protected, group a; intrusion privileged
4	Digit 4		Data	PSTN access, data protected, group b; intrusion privileged
5	Digit 5		Enquiry call, call held via restr. Signalling link	PSTN access, data protected, group a
6	Digit 6		PSTN call	PSTN access, data protected, group b
7	Digit 7		Operator assisting extension	PSTN restr., not data protected, group a
8	Digit 8		Operator assisting PSTN call	PSTN restr., not data protected, group b
9	Digit 9		Extension via restricted signalling link	PSTN restr., data protected, group a
0	Digit 0		Enquiry call, extension call held	PSTN restr., data protected, group b
*	*		Reserved for end-of-block	Reserved for end-of-block
#	#		Operator assisting restr. Signalling	Incoming calls barred
A	Spares	Not diverted	Spares	No restrictions
B		Diverted		Fully restricted
C		Network orig.		Operator, not assisting a call
D		Op. & M.	Reserved for escape (note 5)	Reserved for escape (note 5)

NOTE 1: Calling-line-identification is part of the dialogue phase. The characters 1 to 0 directly represent the address signals, digits 1 to 0, in the calling-line-identification procedure (see subclause D.2.4.3).
NOTE 2: First signal to be transmitted forward following the selection phase, used for checking the bidirectional signalling capability and start of the dialogue phase.
NOTE 3: Second signal to be transmitted forward in the dialogue phase.
NOTE 4: The class-of-service signal follows the type-of-call signals.
NOTE 5: An escape set is at present being considered for class-of-service signals only (see subclause D.2.4.2).

Legend:
restr. Restricted
Network orig. Network originated call
Op. & M Operation and Maintenance
i/c incoming
CSA)
CSB)
DDI) For abbreviations see Table 4 (T/CS 49-04)
SOD)
TC)

Table D.2 (T/CS 49-04): Dialogue phase backward signals

Character indicating the MFPB code used (note 1)	Signals		
	Class of service of called party (CSB) (note 2)	Reason for call refusal (note 3)	State of destination (SOD) (note 4)
1	PSTN access, not data protected, group a	Call diversion to outside of i/c PABX	Free
2	PSTN access, not data protected, group b	Divert call to intercept service	Engaged on internal call
3	PSTN access, not data protected, group a; intrusion privileged	Divert call to operator	Engaged on PSTN call
4	PSTN access, data protected, group b; intrusion privileged	Unallocated number	Engaged on conference call
5	PSTN access, data protected, group a	Congestion encountered	Engaged on data call
6	PSTN access, data protected, group b	Call failure	Line out of service
7	PSTN restr., not data protected, group a	Spares	No meaning
8	PSTN restr., not data protected, group b		PSTN encountered
9	PSTN restr., data protected, group a		Engaged, call waiting
0	PSTN restr., data protected, group b		Spares
A	No restriction		
B	Fully restricted		
C	DDI calls barred		
#	Incoming calls barred		
D	Escape	Reserved for escape (note 5)	Reserved for escape
*	Call refusal	End-of-block	End-of-block

NOTE 1: The characters shown directly represent the address signal, digit 1 to 0, in the called-line-identification procedure (see subclause D.2.5.3).
NOTE 2: A signal from this column shall be the first dialogue phase signal to be transmitted backwards.
NOTE 3: The reason for call-refusal may be transmitted after the call-refusal signal.
NOTE 4: A state-of-destination signal may follow the class-of-service or the called-party-line-identification.
NOTE 5: An escape set is at present being considered for class-of-service signals only (see subclause D.2.5.1).

Legend: restr. Restricted
Network orig. Network originated call
Op. & M Operation and Maintenance
i/c incoming
CSA)
CSB)
DDI) For abbreviations see Table 4 (T/CS 49-04)
SOD)
TC)

The multifrequency codes used are in accordance with Recommendation T/CS 46-02 [29]; they are designated by the characters 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, *, #, A, B, C, and D allocated as specified therein.

All signal names are in accordance with Recommendation T/CS 41-01 [27]. Signals having the same coding shall be distinguished by their position in the sequence of the signalling procedure.

The range of transmitted signalling information may in certain cases be extended by the use of the escape signal indicating the change-over to another set of meanings valid only for the following signal, or be reduced by the end-of-block signal indicating that no more signals will be transmitted.

D.2.3 Signalling sequence

System L1 MFPB signalling begins with the transmission of address signals (routing digits and extension number) which are sent character-by-character in a non-compelled mode in the sequence required by the numbering arrangements. This phase, called selection phase, may be followed by an additional information interchange, making up the dialogue phase. By means of the register-recall procedure, further MFPB signalling is possible after completion of the call set-up (see clause D.3).

D.2.3.1 Selection phase

The address signals are coded in accordance with Recommendation T/CS 46-02 [29] and comprise the characters 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, * and #. In transit working, the signals are transmitted link-by-link. Under normal conditions, the selection phase is terminated with the transmission of an address-complete signal. In the simplified subsystem (MFPB unidirectional), this signal also concludes the multifrequency set-up signalling. However, register-recall signalling may follow (see clause D.3).

D.2.3.2 Dialogue phase

In the System L1 MFPB bidirectional signalling, multifrequency signalling continues after the selection phase with forward and backward signals as described in subclauses D.2.4 and D.2.5. The dialogue phase signals are transmitted en-bloc in a non-compelled mode, exception being made for the first forward signal, see subclause D.2.3.3.

Under normal conditions, the dialogue phase is terminated non-compelled by the transmission of the dialogue phase end-of-block signals in both directions.

In transit working, the dialogue phase signals are transmitted end-to-end.

D.2.3.3 Signalling compatibility check

The first MFPB dialogue phase forward signal, see Table D.1 (T/CS 49-04), requires as a response a first MFPB dialogue phase backward signal, see Table D.2 (T/CS 49-04), before forward signalling continues. If that MFPB backward signal has not been recognized within 200 ms, the outgoing PABX shall assume that the dialogue phase is not possible.

D.2.4 Dialogue phase forward signals

The descriptions for the dialogue phase forward signals listed below are set-out in the sequence in which the signals will be transmitted to the destination PABX. See also D.2.4.4.

D.2.4.1 Type-of-call signals

Two type-of-call signals are used and transmitted one after the other. In principle, both signals can be freely combined. However, not all combinations are reasonable, e.g. an operator-assisted call will not be network originated.

D.2.4.2 Class-of-service signals

A set of fourteen calling party class-of-service signals is given in Table D.1 (T/CS 49-04).

Other class-of-service indications are possible by the transmission of the escape signal followed by a signal from Table D.3 (T/CS 49-04).

Table D.3 (49-04): Allocation of class-of-service of the calling party signals to MFPB codes

MFPB	Signal
1 2 3 4 5 6 7 8 9 0 A B C #	These signals are not yet allocated

If a transit switch indicates with a restricted-signalling-capability signal that the originating PABX is connected over a link with restricted signalling capability, the class-of-service signal will not be transmitted.

D.2.4.3 Calling-line-identity signals

The calling-line-identity is transferred from the outgoing PABX to the incoming PABX after the class-of-service information. If a transit switch indicates with a restricted-signalling-capability signal that the originating PABX is connected over a link with restricted signalling capability the calling-line-identification procedure is omitted.

The calling-line-identity signals are the numerical characters of the MFPB code (see table D.1 (T/CS 49-04), note 1).

D.2.4.4 End-of-block signal

The end-of-block signal terminates the dialogue phase forward en-bloc signal sequence.

D.2.4.5 Forward escape signal

The escape signal is at present envisaged for extension of the range of class-of-service signals only.

D.2.5 Dialogue phase backward signals

The sequence of dialogue phase backward signals depends on whether or not the call offered to the incoming PABX can be accepted. If the call is accepted, the first backward signal, a called party class-of-service signal will indicate this. Called-line-identification and state-of-destination information may follow. If the call is not accepted the first MFPB backward signal will be the call-refusal signal and further signals may follow, indicating the reason for the refusal.

D.2.5.1 Class-of-service signals

A set of fourteen called party class-of-service signals is given in Table D.2 (T/CS 49-04). The number of class-of-service indications can be extended by the transmission of the escape signal followed by a signal from Table D.3 (T/CS 49-04).

For a PABX each extension is characterized by a class-of-service indication. The same class-of-service applies irrespective of whether the call is outgoing or incoming to the extension. Consequently, the class-of-service signals given in Tables D.1 (T/CS 49-04) and D.2 (T/CS 49-04) are identical. Table D.3 (T/CS 49-04), including the note (note), applies also for backward signalling.

NOTE: The note referred to is missing from the original text of the Recommendation.

If a transit switch indicates with a restricted-signalling-capability signal that the destination PABX is connected over a link with restricted signalling capability, the class-of-service signal will not be transmitted.

D.2.5.2 Reason for refusal

After transmission of the call-refusal signal, detailed reasons or advice to be taken by the outgoing PABX may be transferred by the next backward signal.

D.2.5.3 Called-party's-line-identification

The called-party's-line-identity will only be indicated by the incoming PABX if it differs from the address as it has been transmitted during the selection phase, e.g. under all conditions where call diversion has taken place at the destination PABX. This information can, however, not be provided if the destination PABX is reached via a link of restricted signalling capability.

Called-party's-line-identification may be transmitted in both cases, either when the call is accepted or when the call is refused by the incoming PABX.

The called-party's-line-identity signals are the numerical characters of the MFPB code (see Table D.2 (T/CS 49-04), NOTE 1).

D.2.5.4 State-of-destination signals

The state-of-destination signal indicates the current state of the destination actually reached. If this state changes, a different state-of-destination signal may then be transmitted.

D.2.5.5 End-of-block signal

The end-of-block signal terminates the dialogue phase backward signalling sequence.

D.2.5.6 Backward escape signal

The escape signal is at present envisaged for extension of the range of class-of-service signals only.

D.3 Register-recall signalling

Register-recall provides the means for control information transfer after dismissal of common-control equipment. Register-recall can, as forward or backward recall, be initiated in either direction, regardless of the direction of the original call set-up.

When the common-control equipment at the destination or originating PABX is required to be recalled, the forward or backward service-request-recall signal shall be sent. The service-request-recall signal shall not recall the common-control equipment of transit switches. However, certain call states may require response by a transit switch on recognition of a service-request-recall signal, e.g. in a three-party call where branching occurs at a transit switch. In the case of Multi Frequency Push Button (MFPB) unidirectional, the proceed-to-send-on-recall signal using the line signalling frequency and specified in Recommendation T/CS 49-02 [2] shall be used. In the case of MFPB bidirectional, the proceed-to-send-on-recall signal is coded as the character *. The initiating PABX will continue with the signalling capability check. Register-recall signalling depends on the supplementary services it is used for.

When the common-control equipment of a transit switch is required to be recalled, the forward- or backward-link-recall signal shall be sent to the adjacent transit switch. In this case, the proceed-to-send-on-recall signal using the line signalling frequency and specified in Recommendation T/CS 49-02 [2] shall be used.

MFPB signalling after a link-recall signal starts with the selection phase as described in subclause D.2.2.1.

In case of unidirectional MFPB:

Upon recognition of a register-recall signal, the reconnect signal is sent to indicate that the responding PABX

- does not allow a register-recall to be executed; or
- wishes the initiating PABX to switch-through the connection.

D.4 System L1 MFPB signalling sending and detecting requirements

D.4.1 Sending of MFPB interregister codes

The sending requirements for System L1 MFPB signalling shall be in accordance with Recommendation T/CS 34-08 [26].

For co-operation of low level senders (option 1) with receivers expecting high level signals (option 2) the level range of the receivers must be changed to a 3 dB higher sensitivity to guarantee the full signalling range.

D.4.2 Detecting of MFPB interregister codes

The detecting requirements for System L1 MFPB signalling shall be in accordance with Recommendation T/CS 46-02 [29].

Table D.4 (T/CS 49-04): Abbreviations frequently used in System L1 multifrequency signalling procedures

CLI	CALLING-LINE-IDENTITY
CSA	CLASS-OF-SERVICE (A-PARTY)
CSB	CLASS-OF-SERVICE (B-PARTY)
DDI	DIRECT DIALLING-IN
DGT	DIGIT
DPS	DIALOGUE E-PHASE SIGNAL
EOB	END-OF-BLOCK
IDP	INTERDIGIT-PAUSE
ISDN	INTEGRATED SERVICES DIGITAL NETWORK
MFC	MULTIFREQUENCY CODE
MFPB	MULTIFREQUENCY PUSH-BUTTON
PABX	PRIVATE AUTOMATIC BRANCH EXCHANGE
PSTN	PUBLIC SWITCHED TELEPHONE NETWORK
RCL	RECALL
SOD	STATE-OF-DESTINATION
TC	TYPE-OF-CALL
TOS	TEMPORARILY OUT-OF-SERVICE

Annex E:
CEPT Recommendation T/CS 49-05

Recommendation T/CS 49-05 (Vienna 1982, revised in Montpellier 1984)

Edition of September 15 1986

SYSTEM L1 MULTIFREQUENCY PUSH-BUTTON UNIDIRECTIONAL CALL CONTROL SIGNALLING PROCEDURES

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Revised text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

- that multifrequency push-button (MFPB) subscribers' line signalling may provide faster call set-up than decadic pulsing signalling;
- that equipment located at subscribers' premises and used in private networks more and more employs MFPB signalling techniques;
- that MFPB interregister signals as specified in Recommendation T/CS 49-04 [4] may be used either in the forward direction only or in both the forward and the backward direction;

recommends

to the members that the call control signalling procedures specified below are used, when MFPB interregister signalling is applied in the forward direction only (unidirectional) between private automatic branch exchanges (PABXs), in different countries."

E.1 General

E.1.1 Field of application

In the System L1 MFPB unidirectional call control signalling procedures, MFPB interregister signals are only used in the forward direction of call set-up, e.g. the MFPB character set of the 12-button array according to Recommendation T/CS 46-02 [29] is used for address signalling and service control. The signalling procedures specified in this Recommendation cover the standard call set-up and call clear-down. Enhancements providing the interchange of additional information are given as options, e.g. for recall and intrusion.

E.1.2 Signals

On international leased lines, System L1 MFPB unidirectional, in accordance with Recommendation T/CS 49-04 [4], is used in conjunction with System L1 line signalling as specified in Recommendation T/CS 49-01 [1].

The signals actually used with System L1 MFPB call control procedures contained in this Recommendation are given in Table E.1 (T/CS 49-05). The meanings of the signals comply with Recommendation T/CS 41-01 [27]. The requirements for the transmission of the signals are set-out in Recommendations T/CS 49-01 [1], T/CS 49-02 [2] and T/CS 49-04 [4].

Table E.1 (T/CS 49-05): Signals used in System L1 MFPB unidirectional call control signalling

Signal	Option	Recommendation
Seizing	M	T/CS 49-01
Proceed-to-send	M	T/CS 49-02
Seizing-acknowledgement	1	T/CS 49-01
Address	M	T/CS 49-04
Clear-request	M	T/CS 49-01
Address-complete	2	T/CS 49-02
Answer	3	T/CS 49-01
Clear-forward	M	T/CS 49-01
Clear-back	M	T/CS 49-01
Cleared	M	T/CS 49-01
Address-complete, extension-free	4	T/CS 49-02
Address-complete, extension-busy	4	T/CS 49-02
Busy-extension-changed-to-free	4	T/CS 49-02
Intrusion	5	T/CS 49-01
End-of-intrusion	5	T/CS 49-01
Forward-service-request-recall	6	T/CS 49-01
Backward-service-request-recall	6	T/CS 49-01
Backward-link-recall	6	T/CS 49-01
Proceed-to-send on recall	6	T/CS 49-02
Reconnect	6	T/CS 49-02
Legend: 1, 2, 3, 4, 5, 6 = options 1, 2, 3, 4, 5, 6 M = Mandatory		

The use of the address-complete signal and the answer signal is subject to options 2 and 3, respectively.

The three signals, address-complete, extension-free; address-complete, extension-busy and busy-extension-changed-to-free, may be chosen instead of the address-complete signal (option 4). If the signals intrusion and end-of-intrusion are used (option 5), then option 3 must be applied.

The four recall signals represent option 6.

All options must be mutually agreed upon by the parties involved.

Option 1 provides for the use of the seizing-acknowledgement signal instead of the proceed-to-send signal.

NOTE: If option is provided, the seizing-acknowledgement procedure must be used instead of the proceed-to-send procedure.

E.2 Signalling procedures

E.2.1 General

E.2.1.1 The signalling procedures are described by means of SDL diagrams in accordance with CCITT Recommendations Z.101 [22], Z.102 [23] and Z.104 [24], and narrative comments. Table 4 in Recommendation T/CS 49-04 [4] includes abbreviations used in the SDL diagrams.

NOTE: The SDL diagrams are included in this Recommendation to assist in the understanding of the technical text and must only be used in association with the text.

Where a service demand requires inter-PABX MFPB signalling, the request is handled by the responding PABX on an accept or reject basis, depending upon the availability of the service at that PABX.

E.2.2 Set-up and clear-down of standard calls

Figures E.1, E.2 and E.9 (T/CS 49-05) show the signalling sequences at the outgoing and incoming PABX line interfaces for set-up and clear-down of standard calls.

Following the proceed-to-send signal, the register of the outgoing PABX sends the address signals.

In the case of multi-link calls, the address signals are transferred link-by-link. The registers in the transit switches should preferably work in an overlap mode of operation.

The selection phase is concluded by the address-complete signal sent backwards from the destination PABX by address information analysis or internal time-out. The address-complete signal releases the registers in the terminating PABX and transit switches, initiates through-connection of the speech path and causes the transition to the end-of-selection state at the reference interfaces. In the end-of-selection state an additional signal interchange (e.g. covering options 3 or 3 and 4) may take place and cause transition to another state. For the SDL diagrams, this state is called post-dialling state.

E.2.3 Register-recall

When option 5, register-recall, is provided, figures E.3 to E.6 (T/CS 49-05) apply.

In the case of a service-request recall, no address-complete signal will be returned. Subsequently, the signalling process reverts to the appropriate post-dialling state.

E.2.4 Intrusion

The procedure for intrusion requires the provision of options 3 and 4. Figures E.7 and E.8 (T/CS 49-05) apply.

E.2.5 Clear-request on non-receipt of address information

When after recognition of a seizing signal, no address or incomplete address or incomplete information is received, the incoming PABX shall time-out and dissociate the inter-PABX circuit from any common equipment.

Under these conditions the incoming PABX shall:

a) apply the clear-request signal;

b) bar access to the inter-PABX circuit for outgoing calls until a clear-forward signal is recognized.

E.2.6 Clear-request on encountering congestion or an engaged extension

This procedure is optional. When an incoming PABX encounters congestion or an engaged extension, it may release the switching equipment, apply the clear-request signal and perform the procedures specified in subclause E.2.5 (b).

E.2.7 Audible indications

Provision must be made by the parties involved to ensure that the correct tones are returned to the caller when subclauses E.2.5 or E.2.6 above apply.

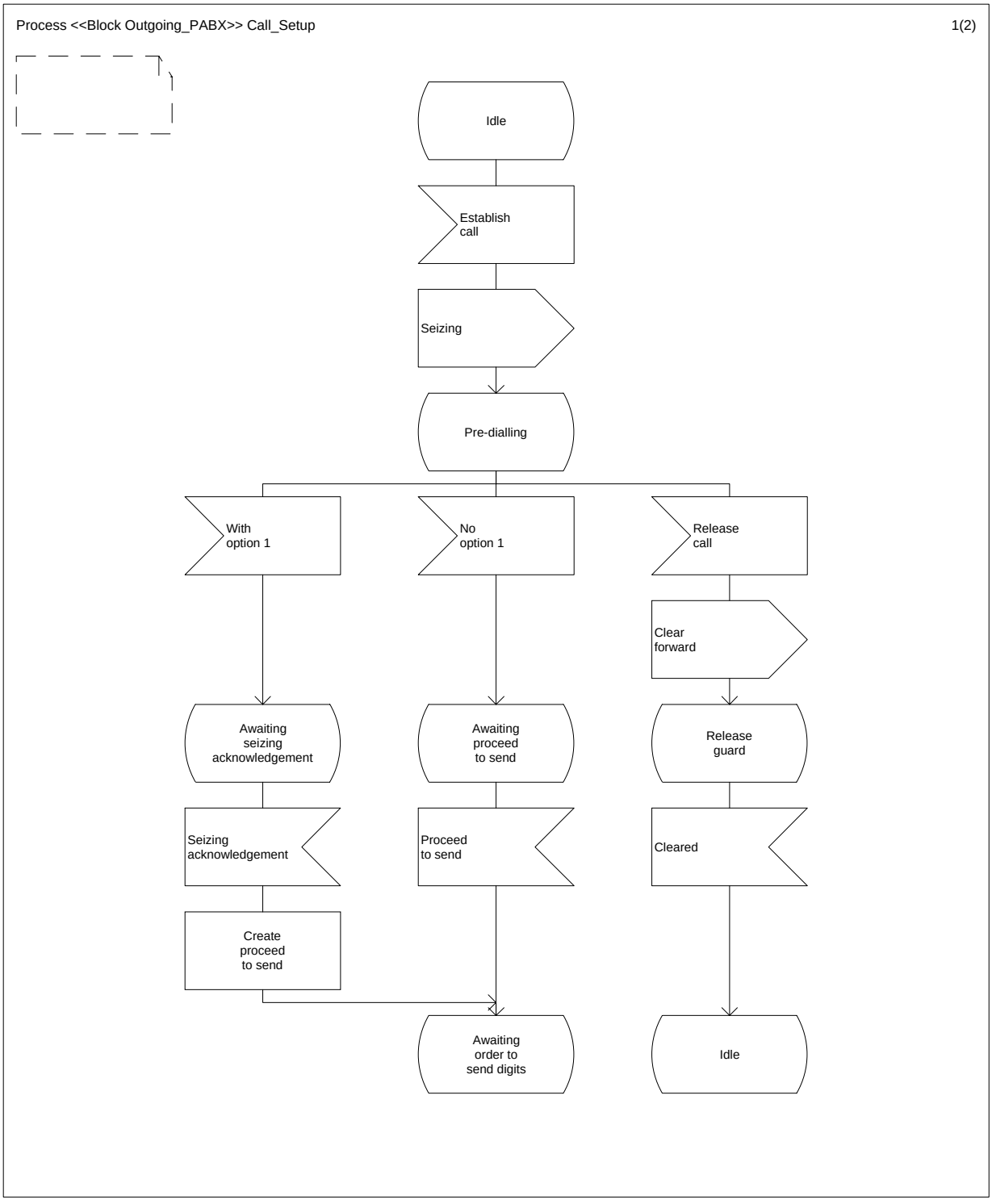


Figure E.1 (T/CS 49-05): Call set-up (outgoing PABX) (sheet 1 of 3)

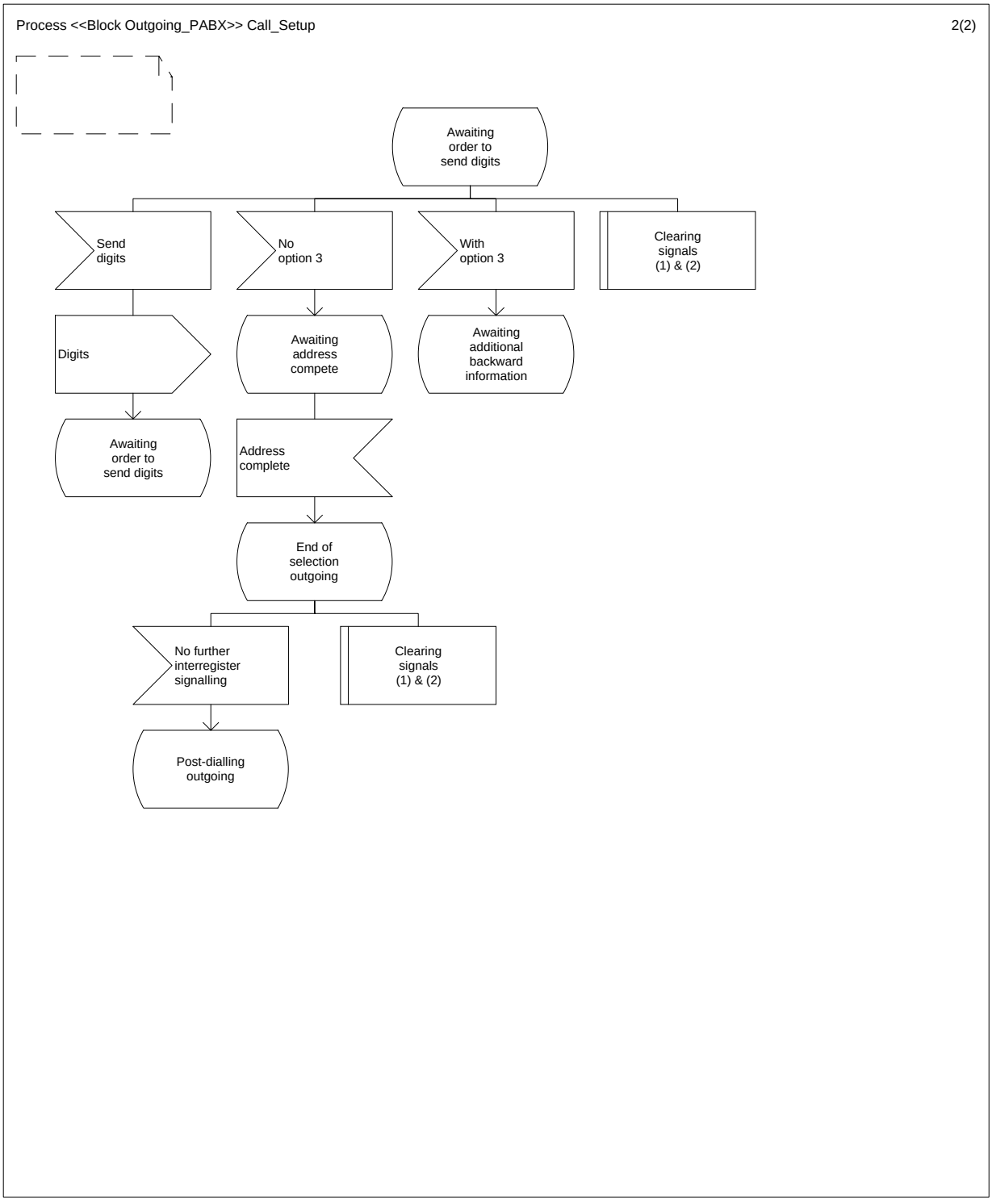


Figure E.1 (T/CS 49-05): Call set-up (outgoing PABX) (sheet 2 of 3)

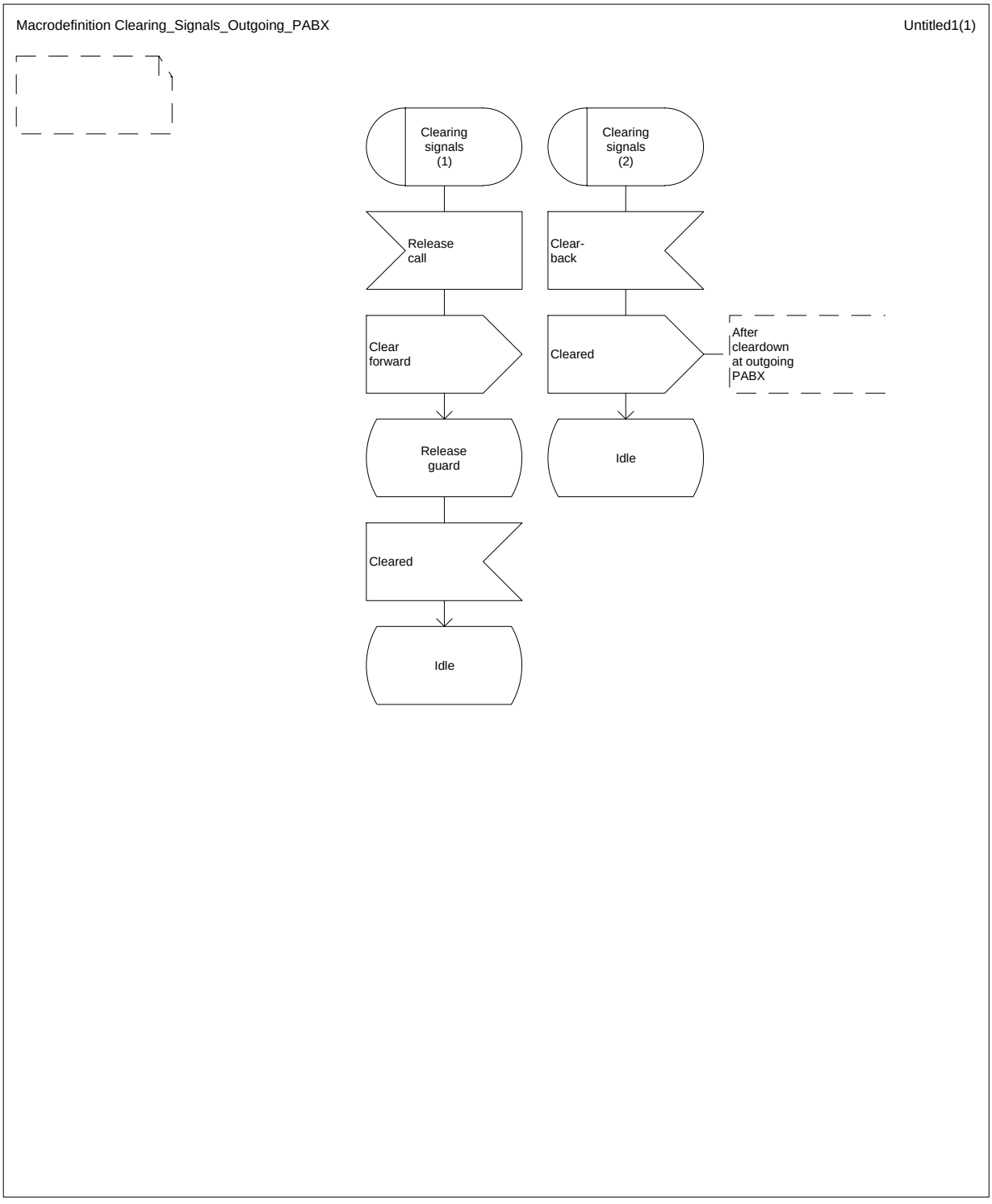


Figure E.1 (T/CS 49-05): Call set-up (outgoing PABX) (sheet 3 of 3)

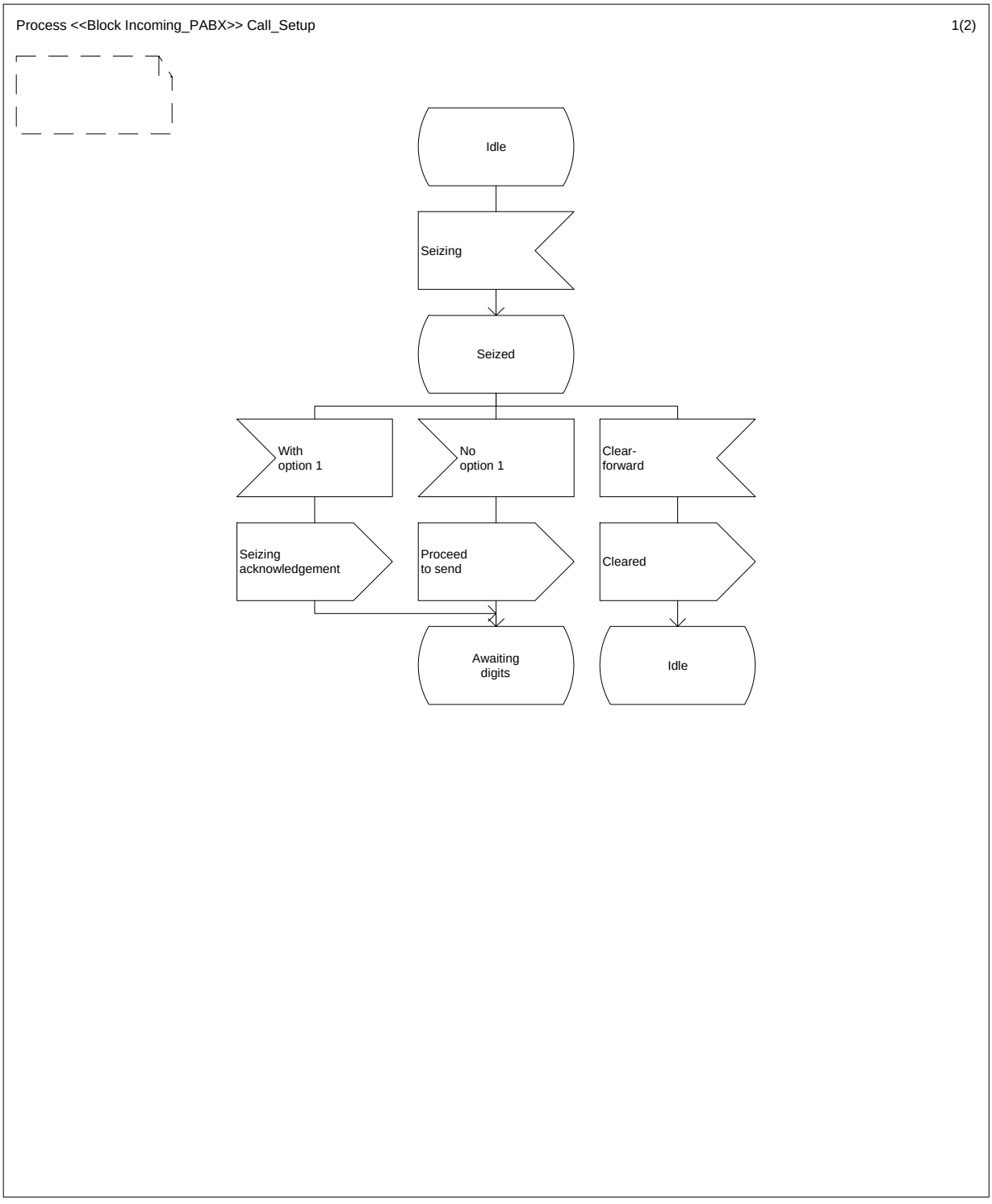


Figure E.2 (T/CS 49-05): Call set-up (incoming PABX) (sheet 1 of 3)

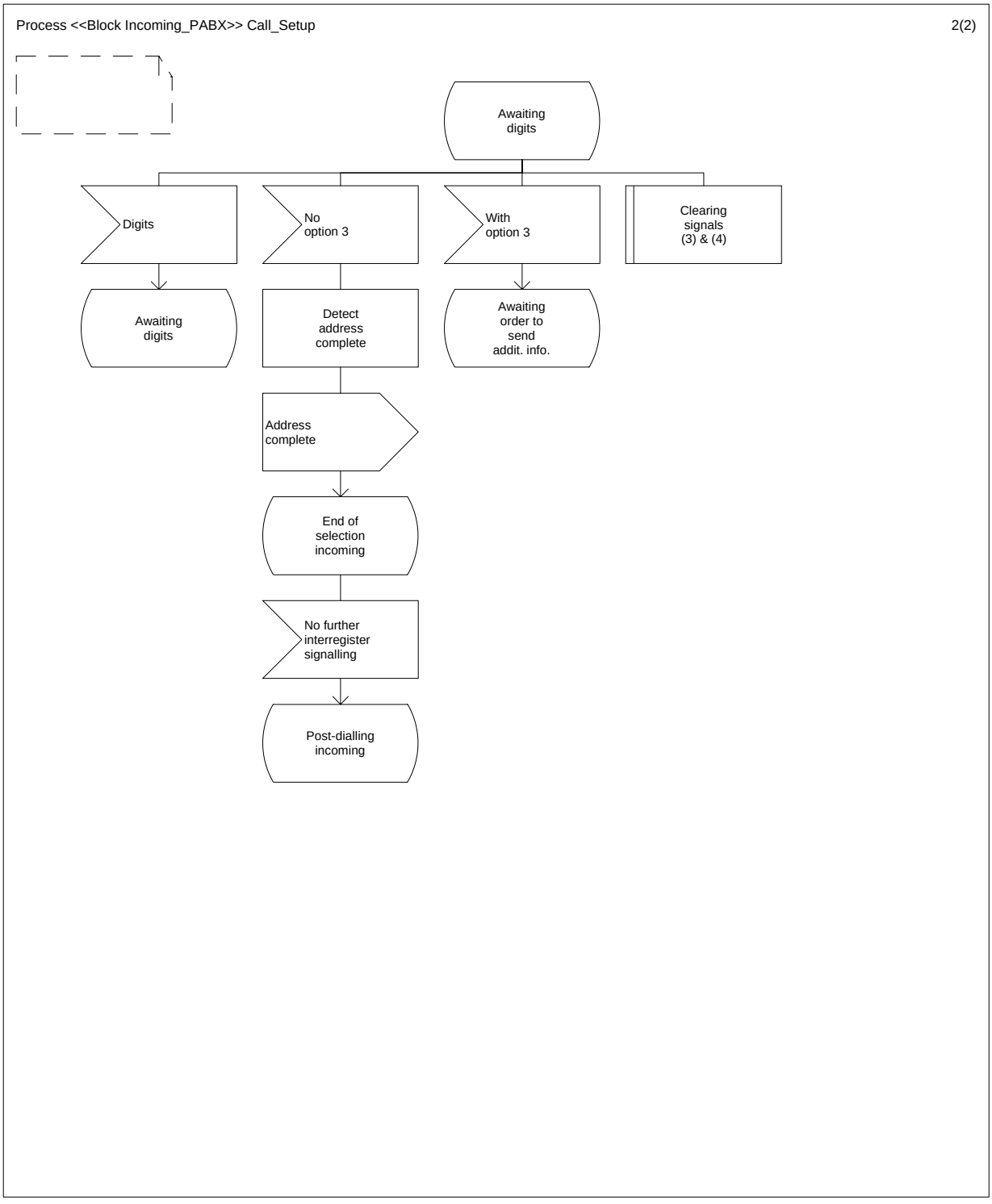


Figure E.2 (T/CS 49-05): Call set-up (incoming PABX) (sheet 2 of 3)

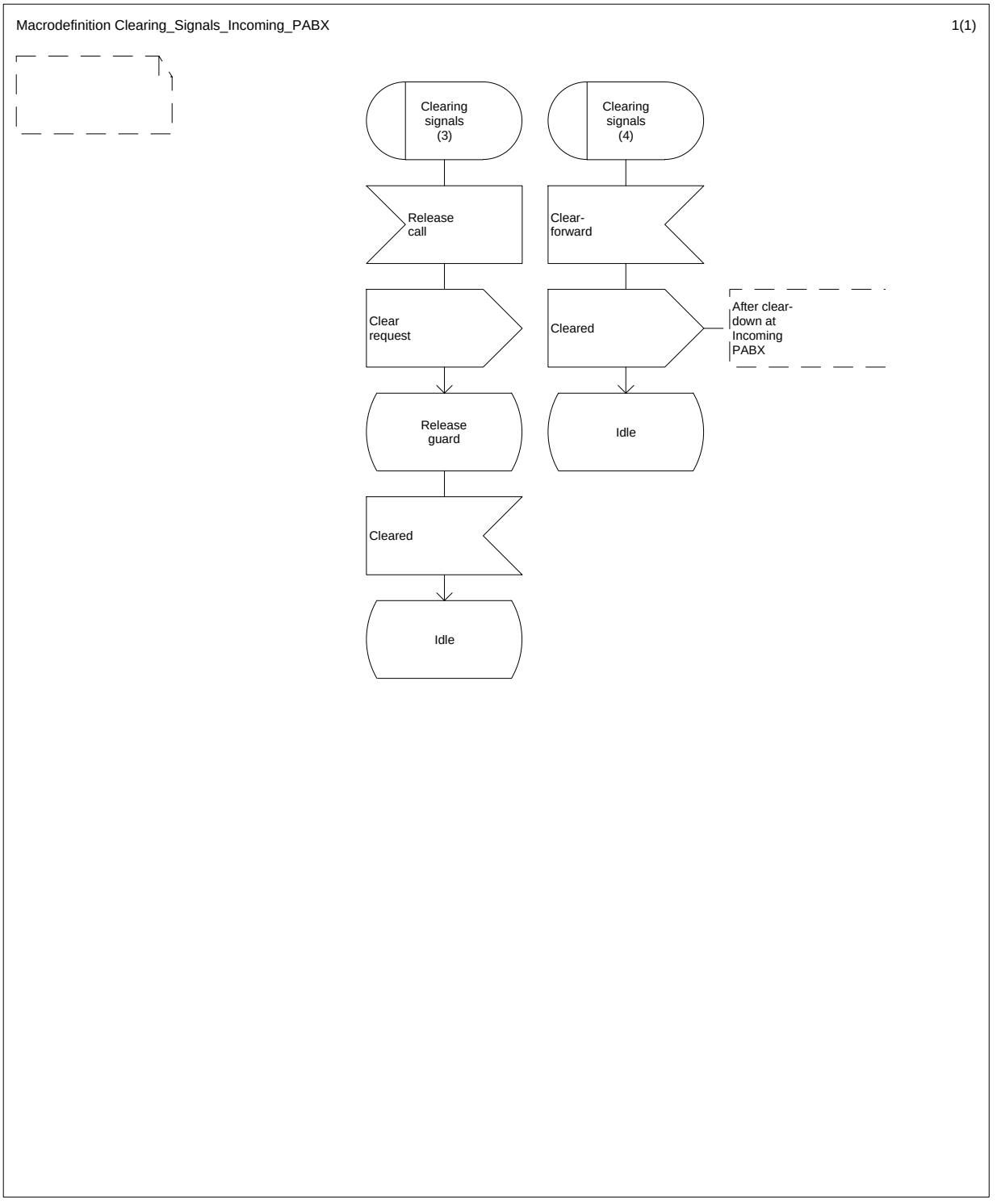


Figure E.2 (T/CS 49-05): Call set-up (incoming PABX) (sheet 3 of 3)

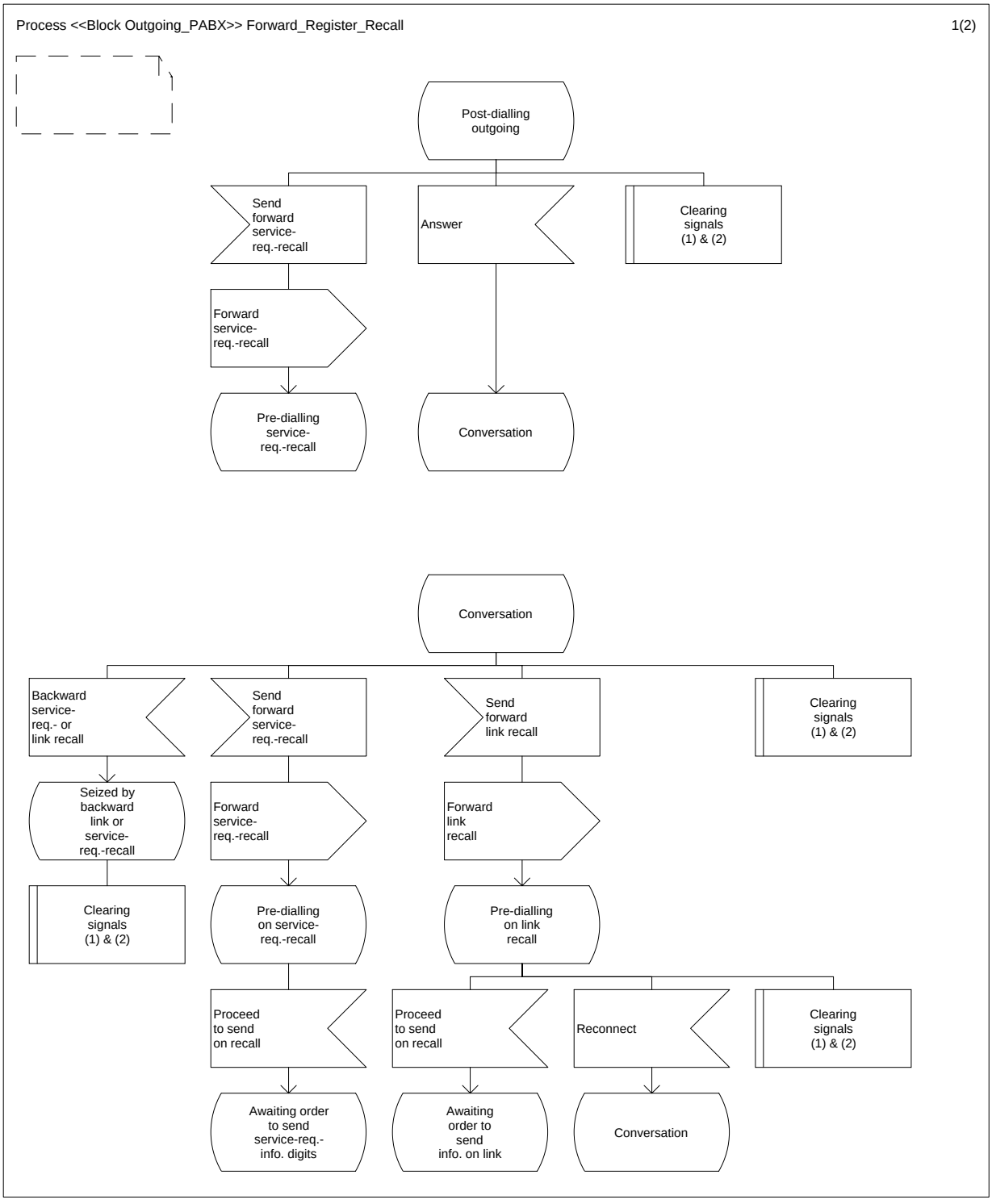


Figure E.3 (T/CS 49-05): Forward register-recall (outgoing PABX) (sheet 1 of 2)

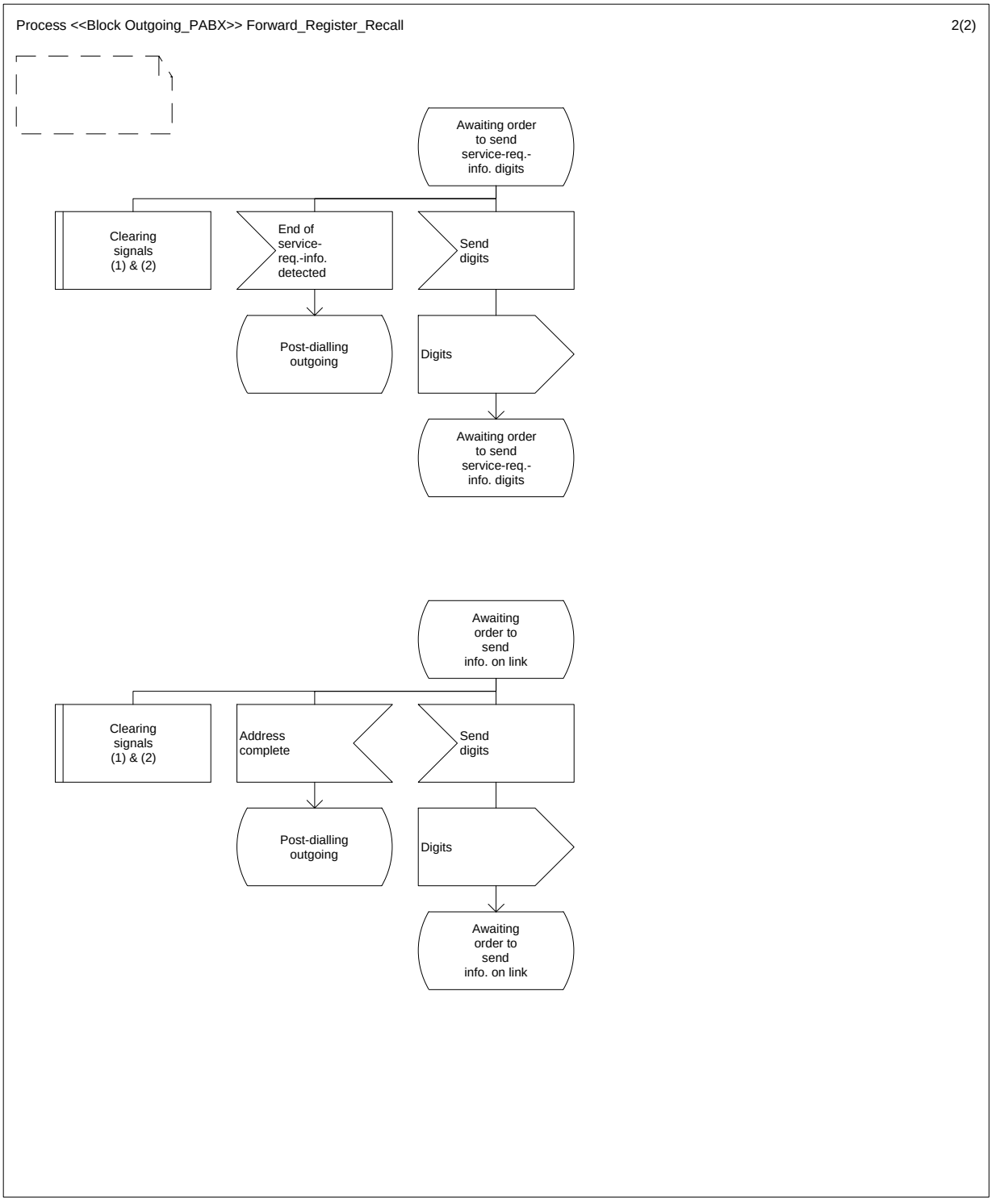


Figure E.3 (T/CS 49-05): Forward register-recall (outgoing PABX) (sheet 2 of 2)

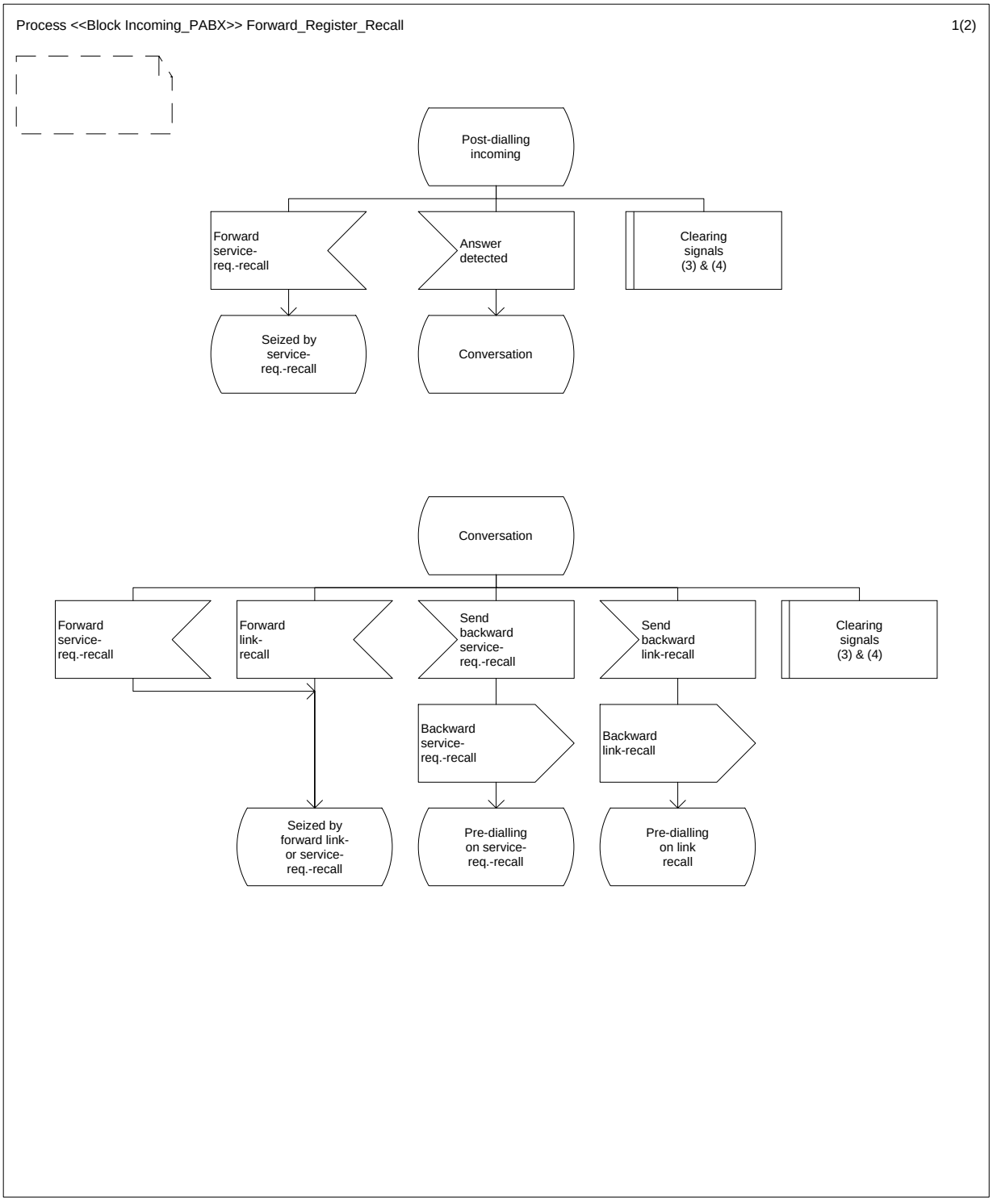


Figure E.4 (T/CS 49-05): Forward register-recall (incoming PABX) (sheet 1 of 2)

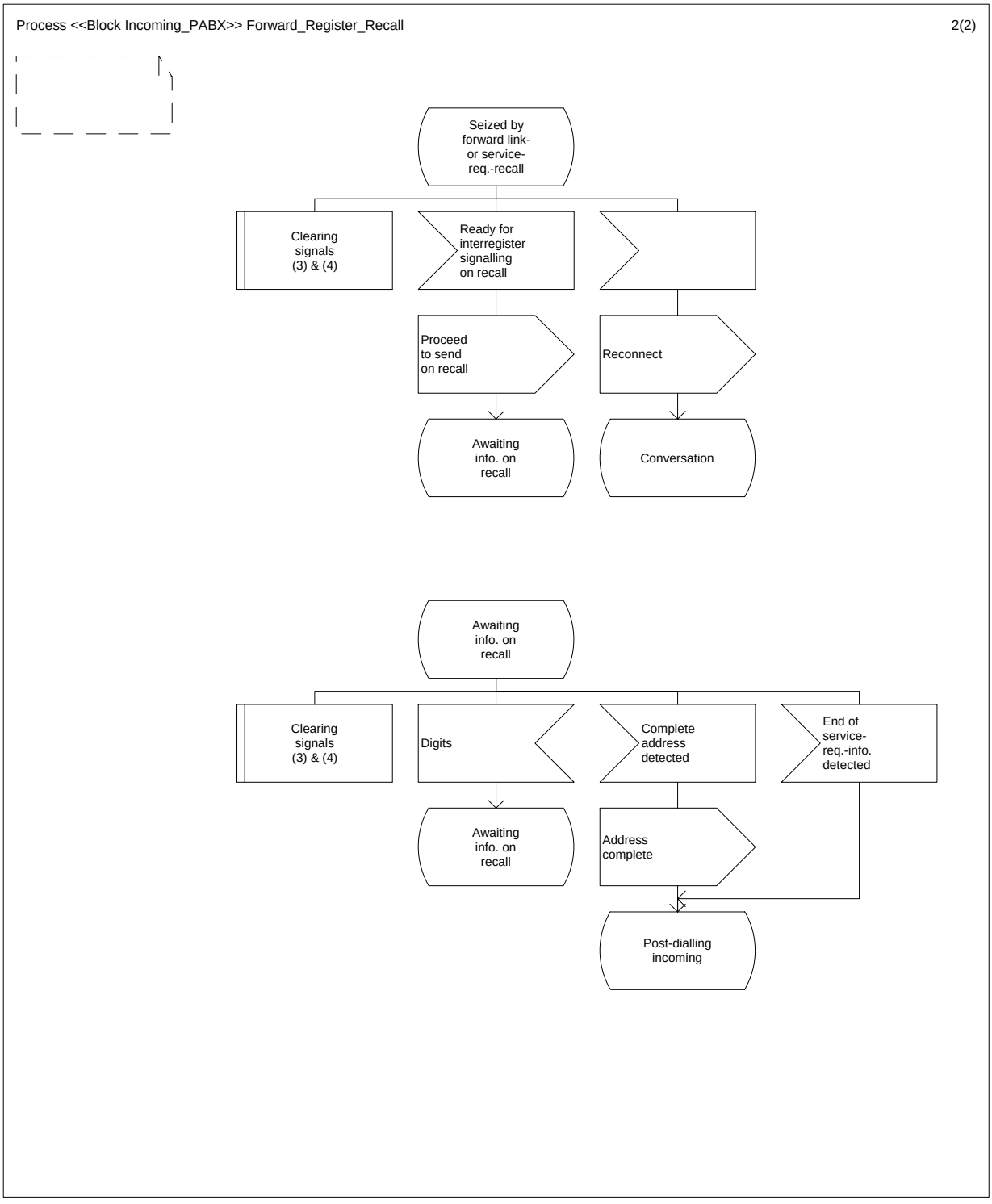


Figure E.4 (T/CS 49-05): Forward register-recall (incoming PABX) (sheet 2 of 2)

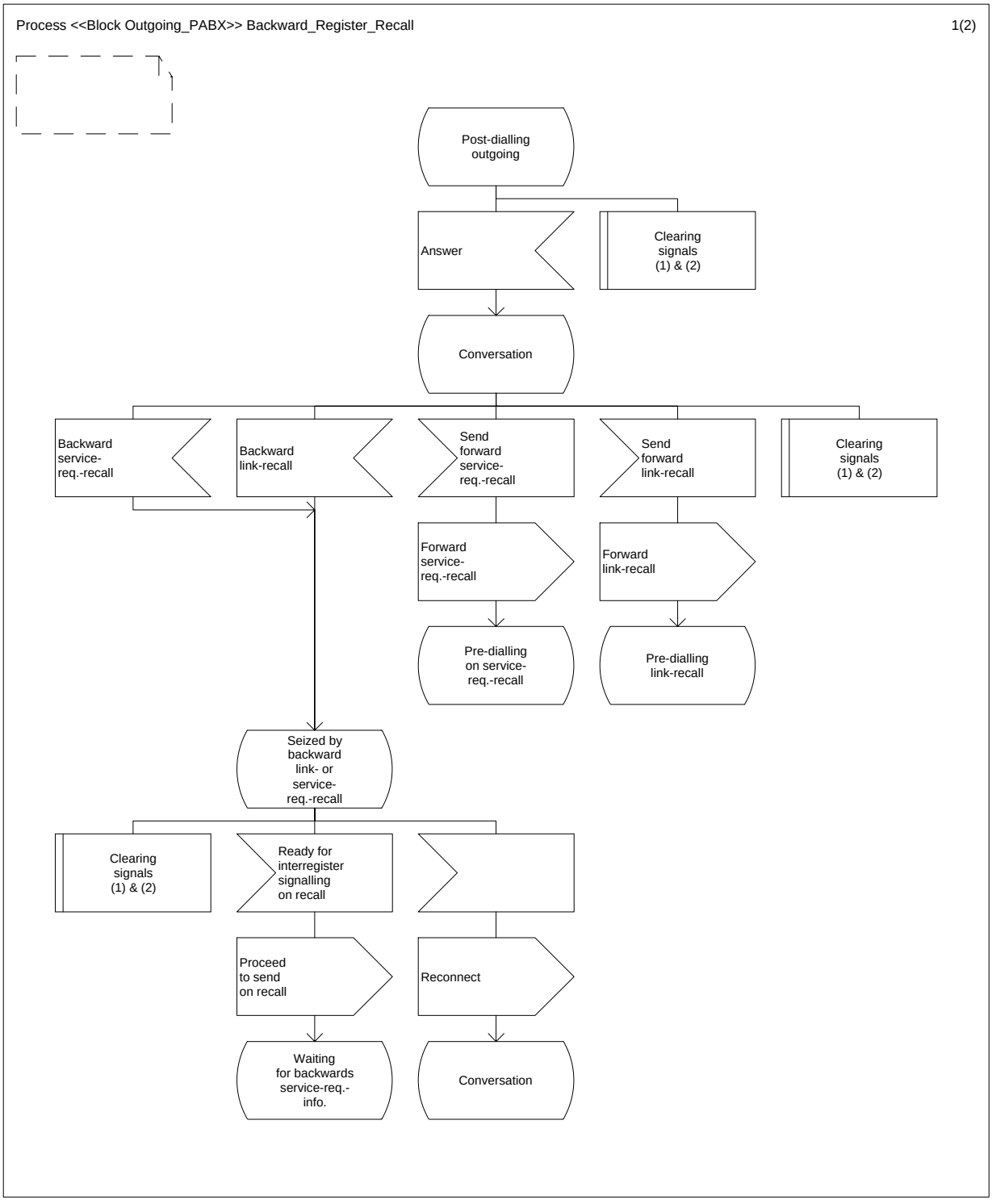


Figure E.5 (T/CS 49-05): Backward register-recall (outgoing PABX) (sheet 1 of 2)

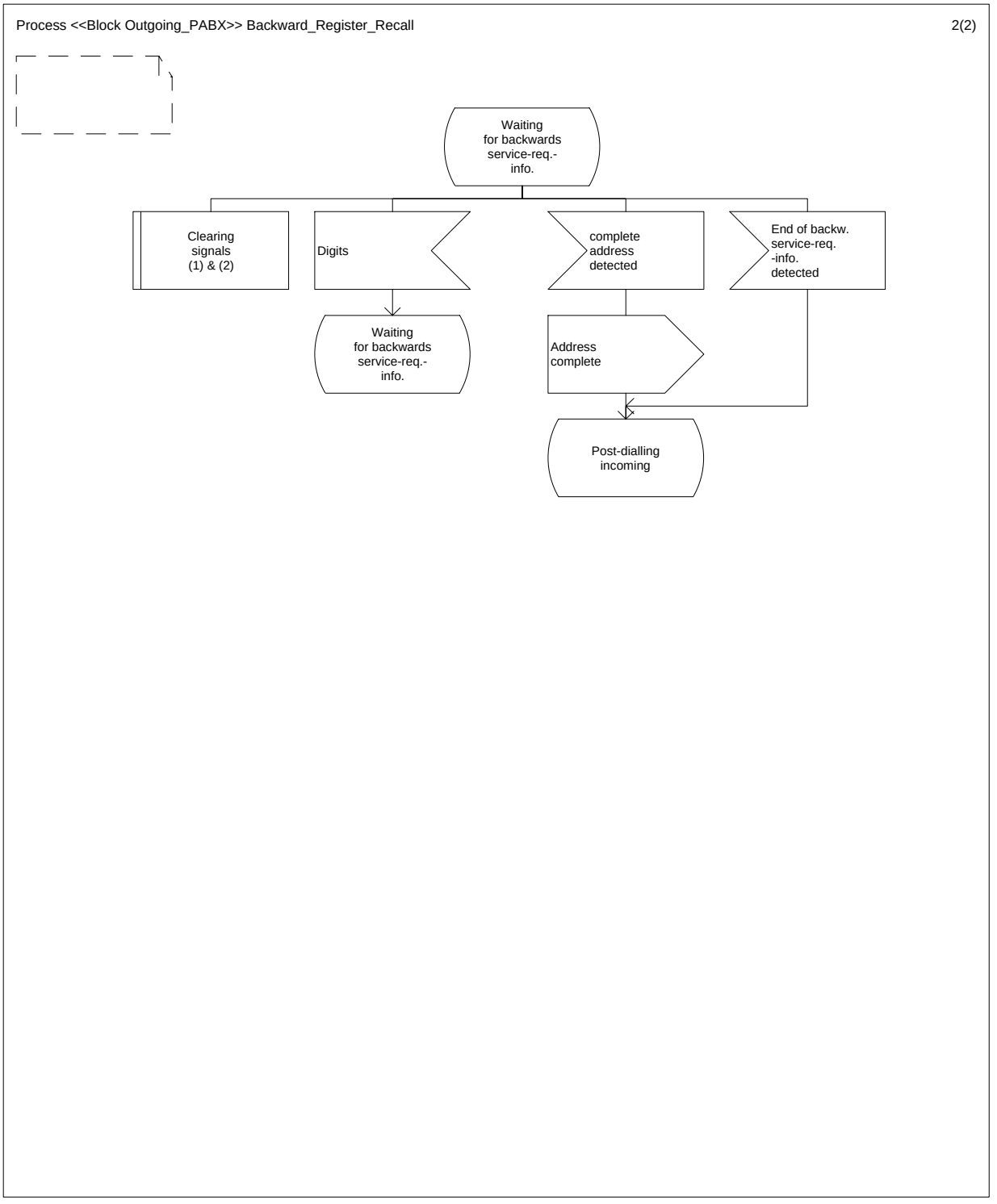


Figure E.5 (T/CS 49-05): Backward register-recall (outgoing PABX) (sheet 2 of 2)

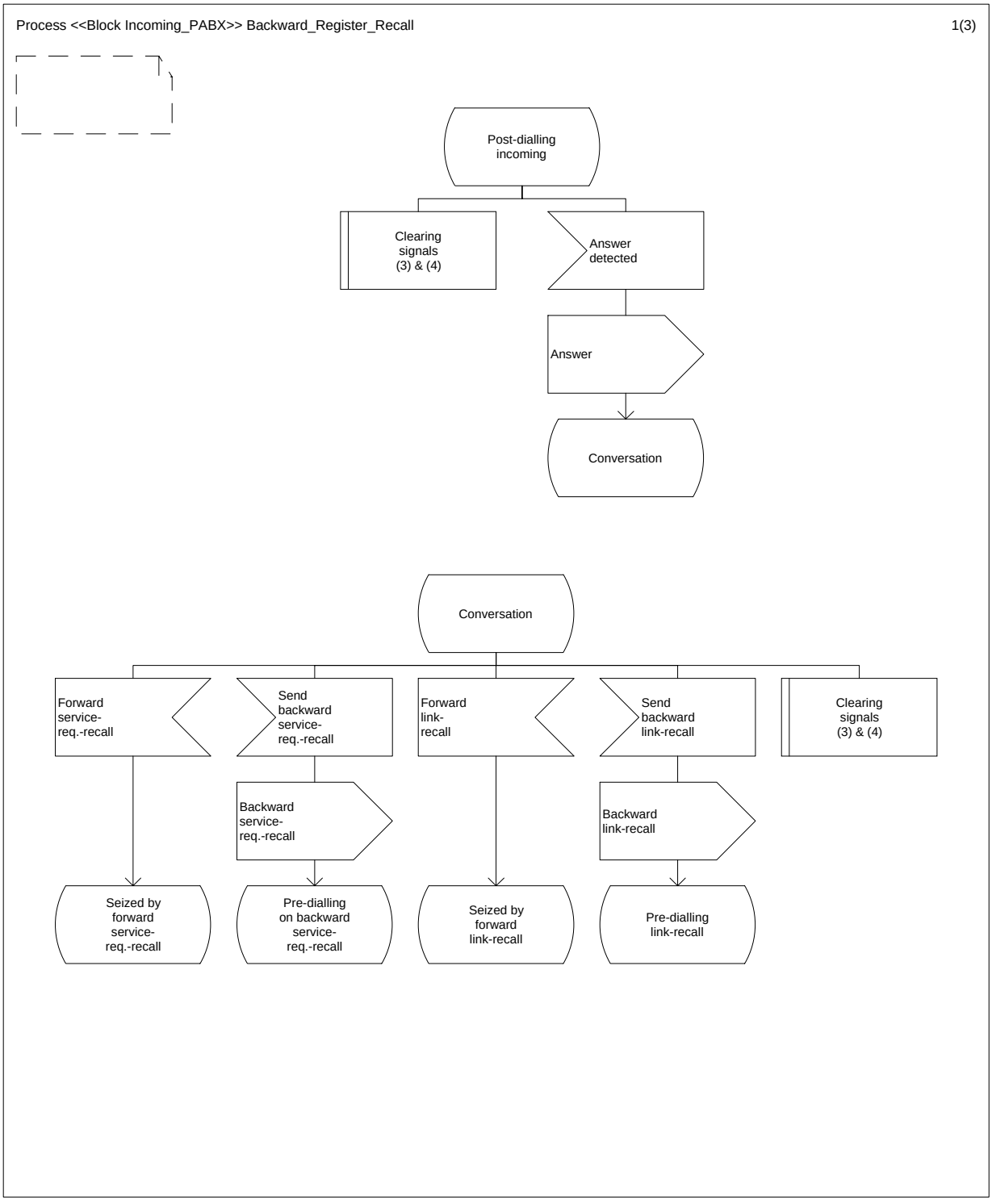


Figure E.6 (T/CS 49-05): Backward register-recall (incoming PABX) (sheet 1 of 3)

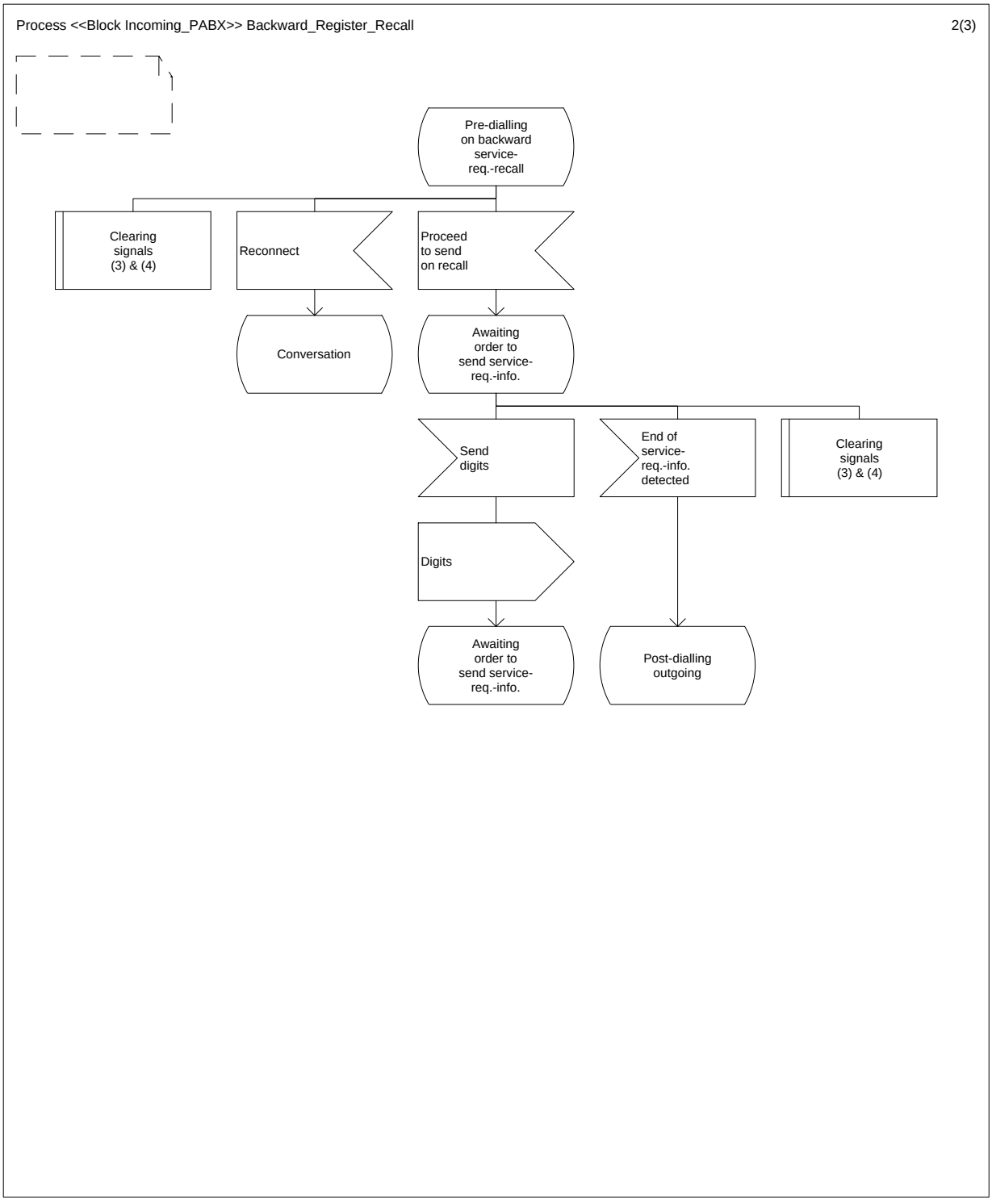


Figure E.6 (T/CS 49-05): Backward register-recall (incoming PABX) (sheet 2 of 3)

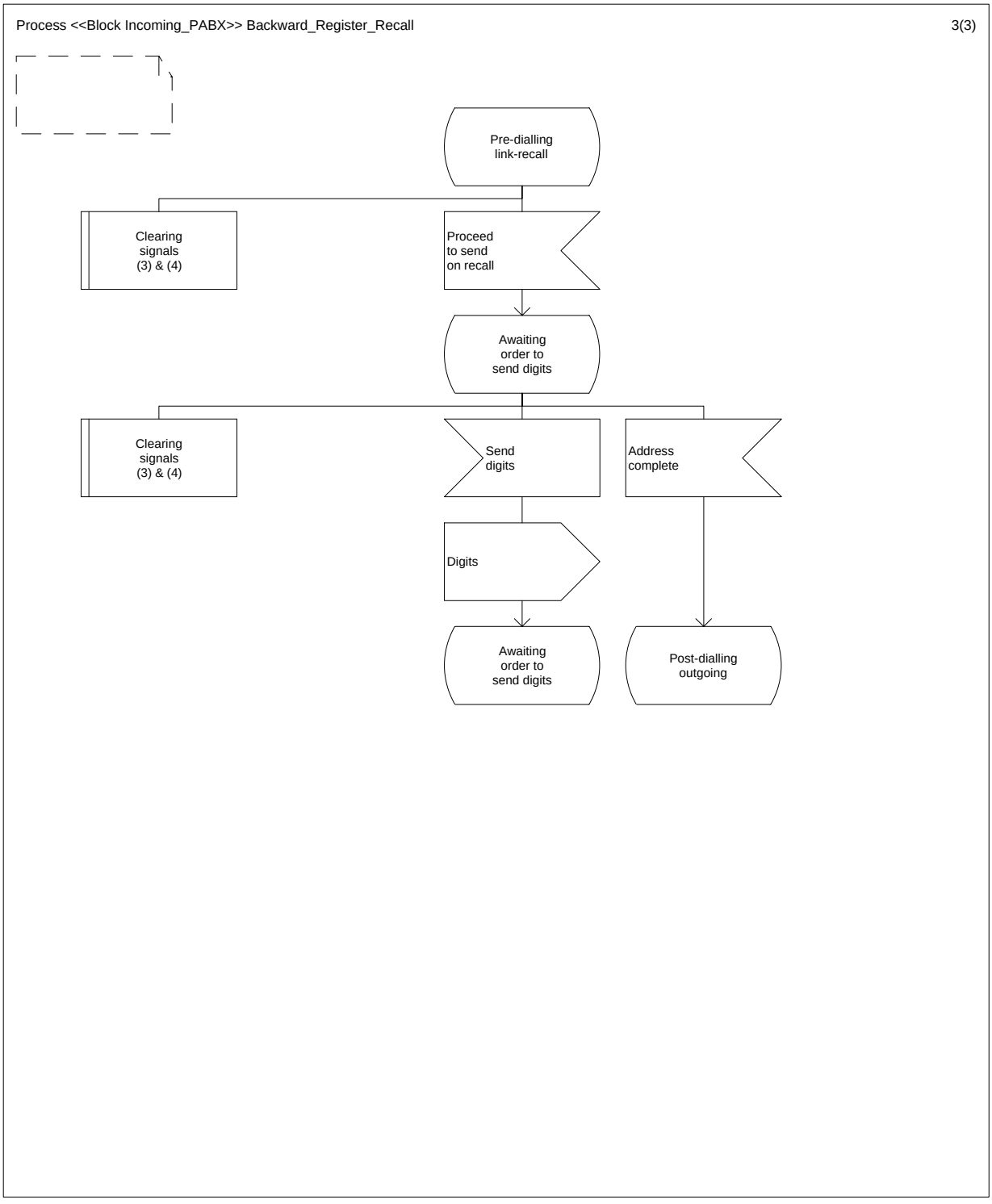


Figure E.6 (T/CS 49-05): Backward register-recall (incoming PABX) (sheet 3 of 3)

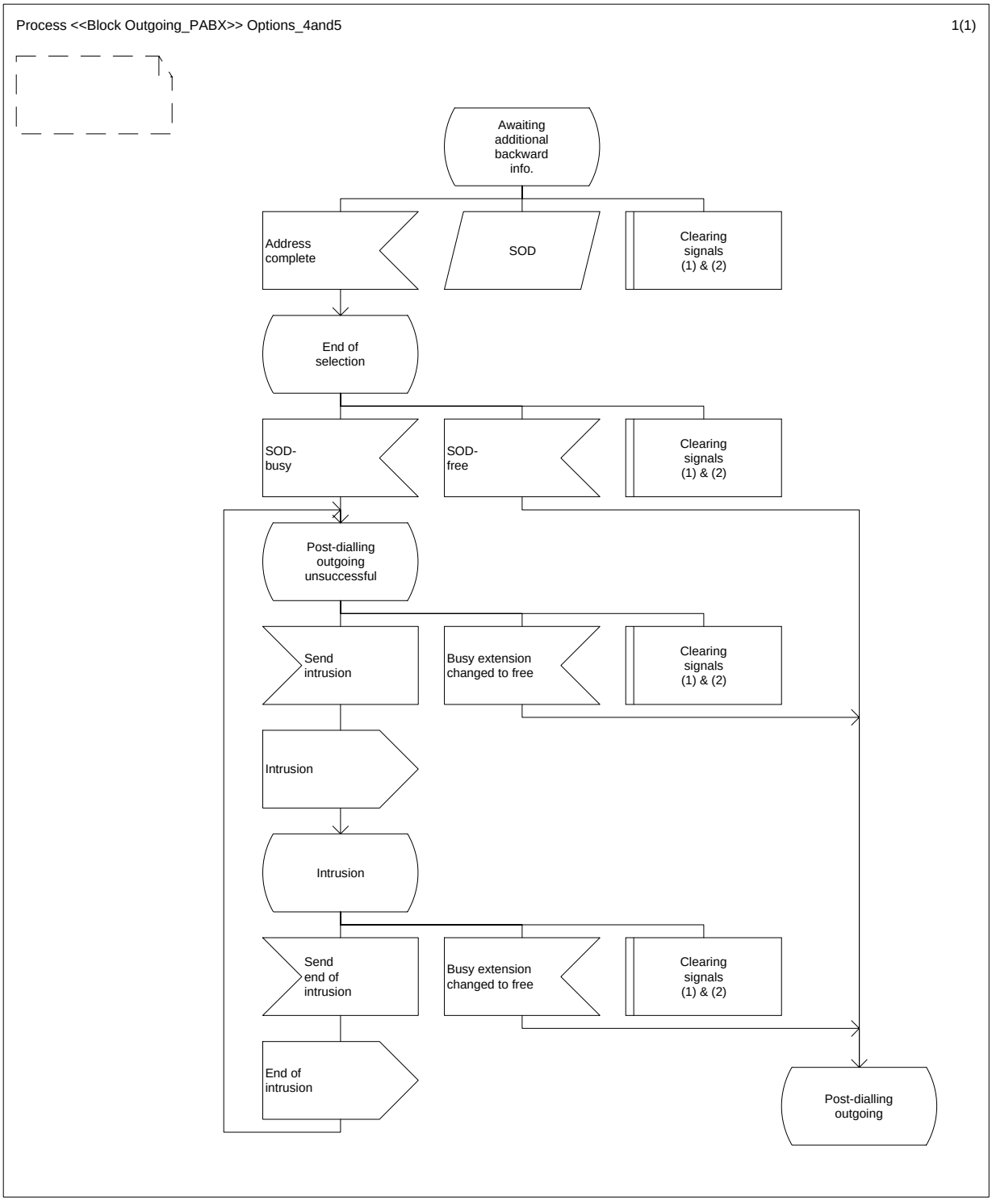


Figure E.7 (T/CS 49-05): Options 4 and 5 (outgoing PABX) (sheet 1 of 1)

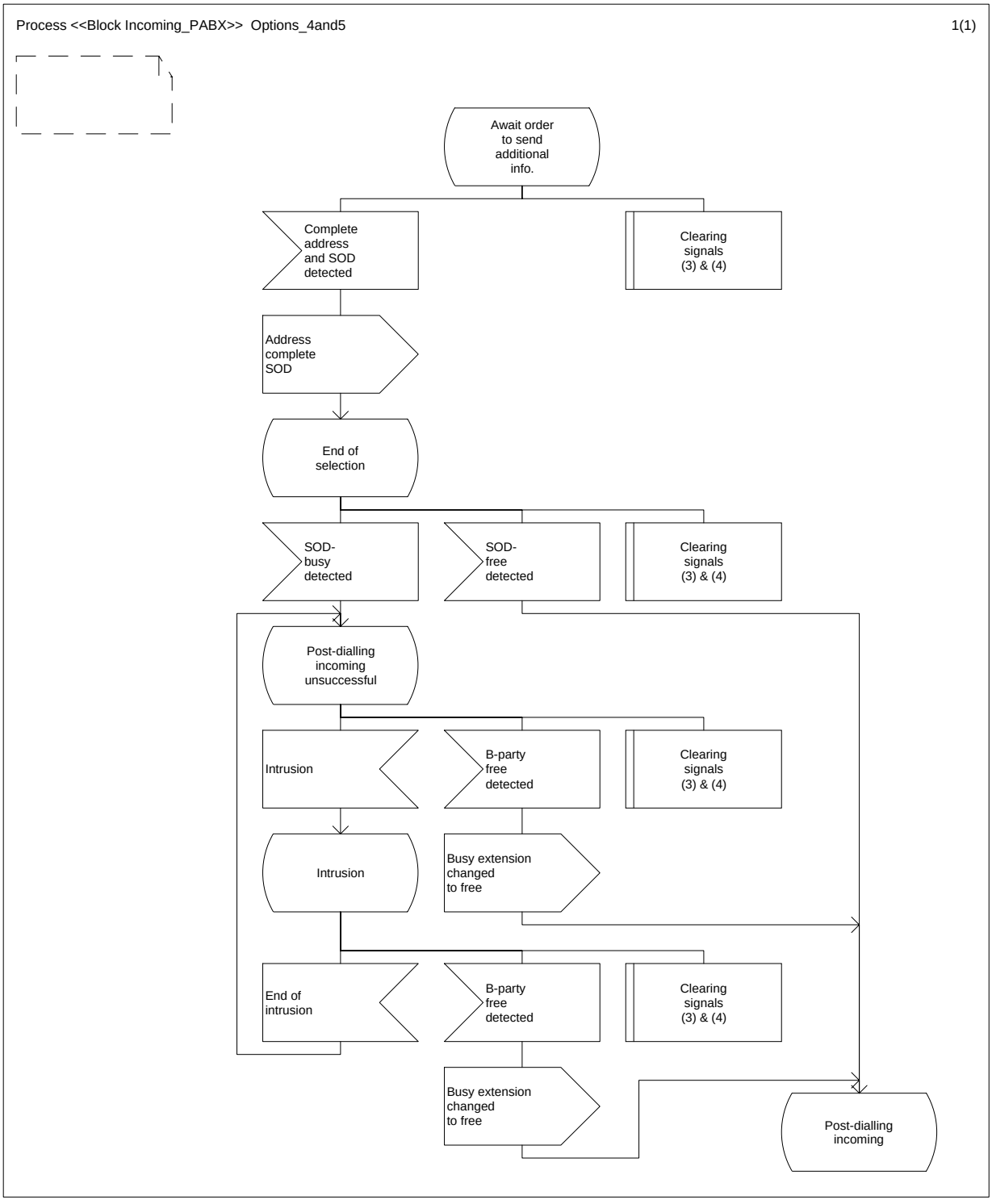


Figure E.8 (T/CS 49-05): Options 4 and 5 (incoming PABX) (sheet 1 of 1)

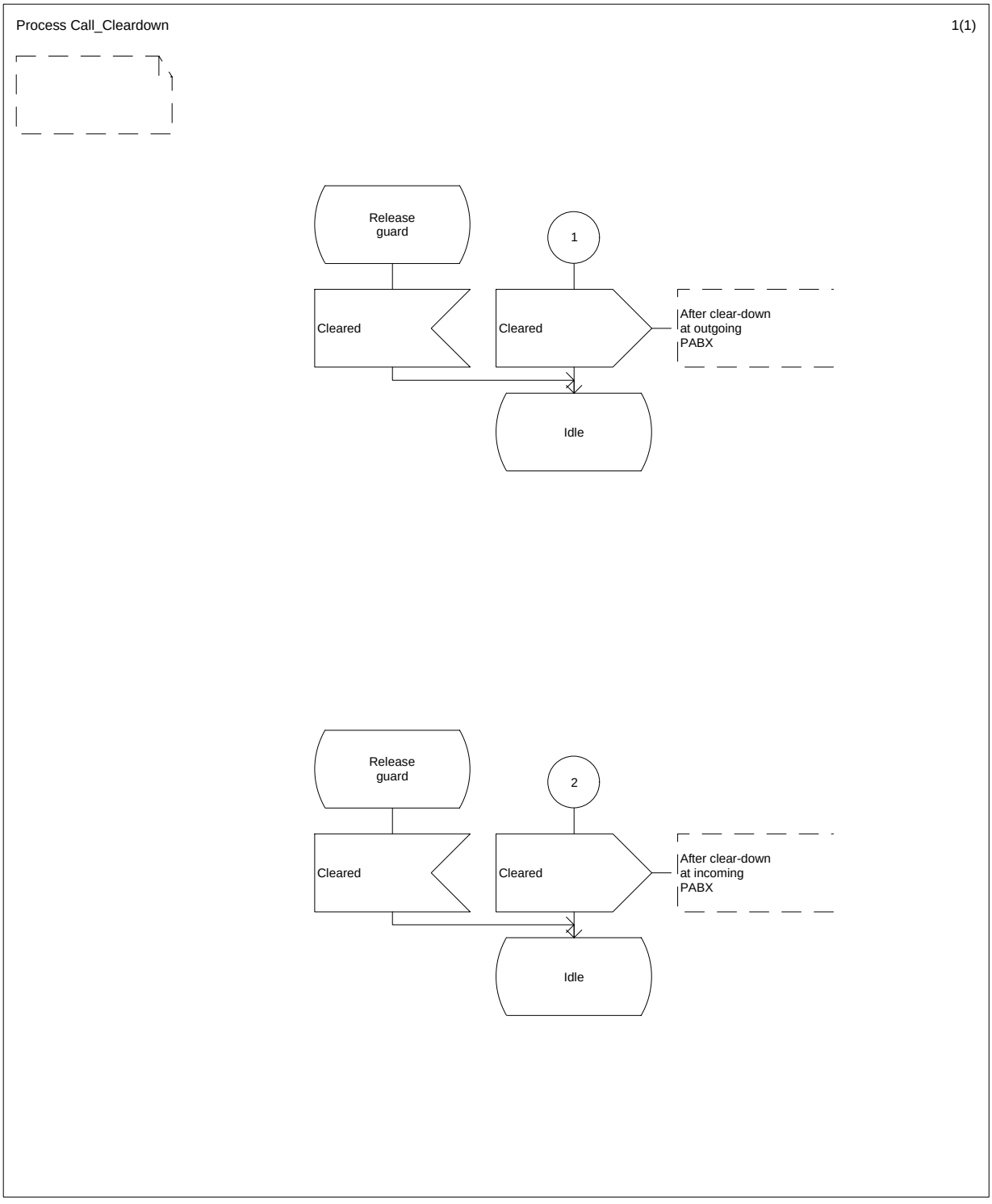


Figure E.9 (T/CS 49-05): Call clear-down (sheet 1 of 1) (note)

NOTE: There appears to be no path to either connector (1) or (2) from any other SDL diagram in this Recommendation.

Annex F:
CEPT Recommendation T/CS 49-06

Recommendation T/CS 49-06 (Vienna 1982, revised in Montpellier 1984)

Edition of September 15 1986

SYSTEM L1 MULTIFREQUENCY PUSH-BUTTON BIDIRECTIONAL CALL CONTROL SIGNALLING PROCEDURES

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Revised text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

- that multifrequency push-button (MFPB) subscriber's line signalling may provide faster call set-up than decadic pulsing signalling;
- that equipment located at subscriber's premises and used in private networks employs MFPB signalling techniques more and more;
- that MFPB interregister signals, as specified in Recommendation T/CS 49-04 [4], may be used either in the forward direction only or in both the forward and the backward direction;

recommends

to the members that the call control signalling procedures specified below are used when MFPB interregister signalling is applied in both the forward and backward direction (bidirectional) between private automatic branch exchanges (PABXs) in different countries."

F.1 General

F.1.1 Field of application

In System L1 MFPB bidirectional call control signalling procedures, MFPB interregister signals are used in the forward and backward direction of call set-up. The MFPB character set of the 16-button array, according to Recommendation T/CS 46-02 [29], is applied for address signalling and service control. The signalling procedures specified in this Recommendation cover the interchange of additional information possible as compared with System L1 MFPB unidirectional signalling.

Interworking with System L1 MFPB unidirectional is inherent in system L1 MFPB bidirectional, providing that System L1 MFPB unidirectional uses appropriate options.

F.1.2 Signals

On international leased lines, System L1 MFPB bidirectional in accordance with Recommendation T/CS 49-04 [4] is used in conjunction with System L1 line signalling as specified in Recommendation T/CS 49-01 [1].

The signals actually used with System L1 MFPB bidirectional call control procedures, contained in this Recommendation, are given in Table F.1 (T/CS 49-06). The meanings of the signals comply with Recommendation T/CS 41-01 [27]. The requirements for the transmission of the signals are set-out in Recommendations T/CS 49-01 [1], T/CS 49-02 [2] and T/CS 49-04 [4].

Table F.1 (T/CS 49-06): Signals used in system L1 MFPB bidirectional call control signalling procedures

Signals	Recommendation
Seizing	T/CS 49-01
Proceed-to-send	T/CS 49-02
Address	T/CS 49-04
Clear-request	T/CS 49-01
Address-complete	T/CS 49-02
Answer	T/CS 49-01
Clear-forward	T/CS 49-01
Clear-back	T/CS 49-01
Cleared	T/CS 49-01
Busy-extension-changed-to-free	see subclause F.2.6
Forward-service-request-recall	T/CS 49-01
Forward-link-recall	T/CS 49-01
Backward-service-request-recall	T/CS 49-01
Backward-link-recall	T/CS 49-01
Proceed-to-send-on-recall	T/CS 49-02 and T/CS 49-04
Type-of-call	T/CS 49-04
Class-of-service	T/CS 49-04
Calling-line-identity	T/CS 49-04
End-of-block	T/CS 49-04
Call-refusal	T/CS 49-04
Called-line-identity	T/CS 49-04
State-of-destination	T/CS 49-04

F.2 Signalling procedures

F.2.1 General

F.2.1.1 The description of the call and service control signalling procedures are described by means of SDL diagrams, in accordance with CCITT Recommendations Z.101 [22], Z.102 [23] and Z.104 [24], and narrative comments. Table D.4 in Recommendation T/CS 49-04 includes abbreviations used in System L1 MFPB SDL diagrams.

NOTE: The SDL diagrams are included in this Recommendation to assist in the understanding of the technical text, and must only be used in association with the text.

F.2.1.2 In System L1 MFPB bidirectional, the use of backward MFPB signals begins with the dialogue phase. In multi-link connections, the address-complete signal will cause the registers of the transit switches to release and switch through the speech paths, preparing for the subsequent end-to-end transmission of MFPB codes in both directions. The registers of the originating and the terminating PABXs will not yet be released. When a service demand requires inter-PABX MFPB signalling, the request is handled by the responding PABX on an accept or reject basis, depending upon the availability of the service at that PABX.

F.2.2 Duplex and semi-duplex transmission mode

If (national) two-wire links are included in a given inter-PABX network, the interchange of the dialogue phase signals will be in either a duplex or a semi-duplex transmission mode. This requires mutual agreement by the parties involved (the line signalling for two-wire links is not covered by System L1 Recommendations).

In the duplex mode, the outgoing PABX will continue sending dialogue phase forward signals, without awaiting the backward end-of-block signal.

In the semi-duplex mode, the outgoing PABX refrains from sending en-bloc dialogue phase forward signals until the outgoing PABX has indicated the end of the dialogue phase backward en-bloc signal sequence by the transmission of the end-of-block signal. Separate SDL diagrams are included for semi-duplex mode (see subclause F.2.4).

F.2.3 Signalling compatibility check

By means of the signalling compatibility check (see Recommendation T/CS 49-04 [4]) the outgoing PABX determines whether the incoming PABX is capable of System L1 MFPB bidirectional, or only System L1 MFPB unidirectional signalling. If the outgoing PABX receives MFPB dialogue phase backward signals, the result of the signalling compatibility check is positive.

If the incoming PABX is not capable of System L1 MFPB bidirectional signalling, it would have already released the register and not reacted to the dialogue phase forward signals. This state is shown on the SDL diagrams as the post-dialling state.

If the outgoing PABX does not recognize a first dialogue phase backward signal in accordance with Recommendation T/CS 49-04 [4], it changes to its post-dialling state, too.

F.2.4 Interchange of additional information (dialogue phase)

Figures F.1 (T/CS 49-06) and F.2 (T/CS 49-06) show the signalling sequence at the outgoing and incoming PABXs' line interfaces for the duplex mode of signal transmission. Figures F.9 (T/CS 49-06) and F.10 (T/CS 49-06) refer to the semi-duplex mode. The four state transition diagrams start with the end of selection state and include the signalling compatibility check.

The additional information interchange shall be based on the dialogue phase signals specified in Recommendation T/CS 49-04 [4].

Upon recognition of the end of the dialogue phase (i.e. upon transmission of the relevant forward and backward end-of-block signals), the originating and terminating PABXs shall release their registers, and change to the state referred to as post-dialling state in the SDL diagrams.

F.2.5 Register-recall

Figures F.5 (T/CS 49-06) to F.8 (T/CS 49-06) show the register-recall procedures at the PABX line interfaces.

The form of proceed-to-send-on-recall signal (2 280 Hz signal or MFPB signal) indicates that the responding transit switch is capable of System L1 MFPB unidirectional or bidirectional interregister signalling. In System L1 MFPB bidirectional working, the initiating PABX will continue with the signalling compatibility check.

F.2.6 Intrusion

The called-party-changed-to-free signal in the intrusion procedure after call set-up requires the use of the backward-service-request-recall signal. Upon recognition of the MFPB proceed-to-send-on-recall signal sent in response, the called-party-changed-to-free signal, coded as the character *, is transmitted backwards, figures F.3 (T/CS 49-06) and F.4 (T/CS 49-06) refer.

F.2.7 Clear-request on non-receipt of address information

After recognition of a seizing signal, if no address information or incomplete address information is received, the incoming PABX shall time-out and dissociate the inter-PABX circuit from any common equipment.

Under these conditions, the incoming PABX shall:

a) apply the clear-request signal;

b) bar access to the inter-PABX circuit for outgoing calls until a clear-forward signal is recognized.

F.2.8 Clear-request on encountering congestion or an engaged extension

Due to supplementary services providing the possibility of changing from an unsuccessful to a successful call situation, this procedure is not foreseen with System L1 MFPB interregister signalling. It may, however, still occur when the incoming PABX has indicated that it is capable of System L1 MFPB unidirectional signalling only, and executes the procedure specified in Recommendation T/CS 49-05 [5]. The outgoing PABX has to comply with that procedure after the signalling compatibility check.

F.2.9 Audible indications

Provisions must be made by the parties involved to ensure that the correct audible indications are returned to the caller when subclauses F.2.7 or F.2.8 above apply.

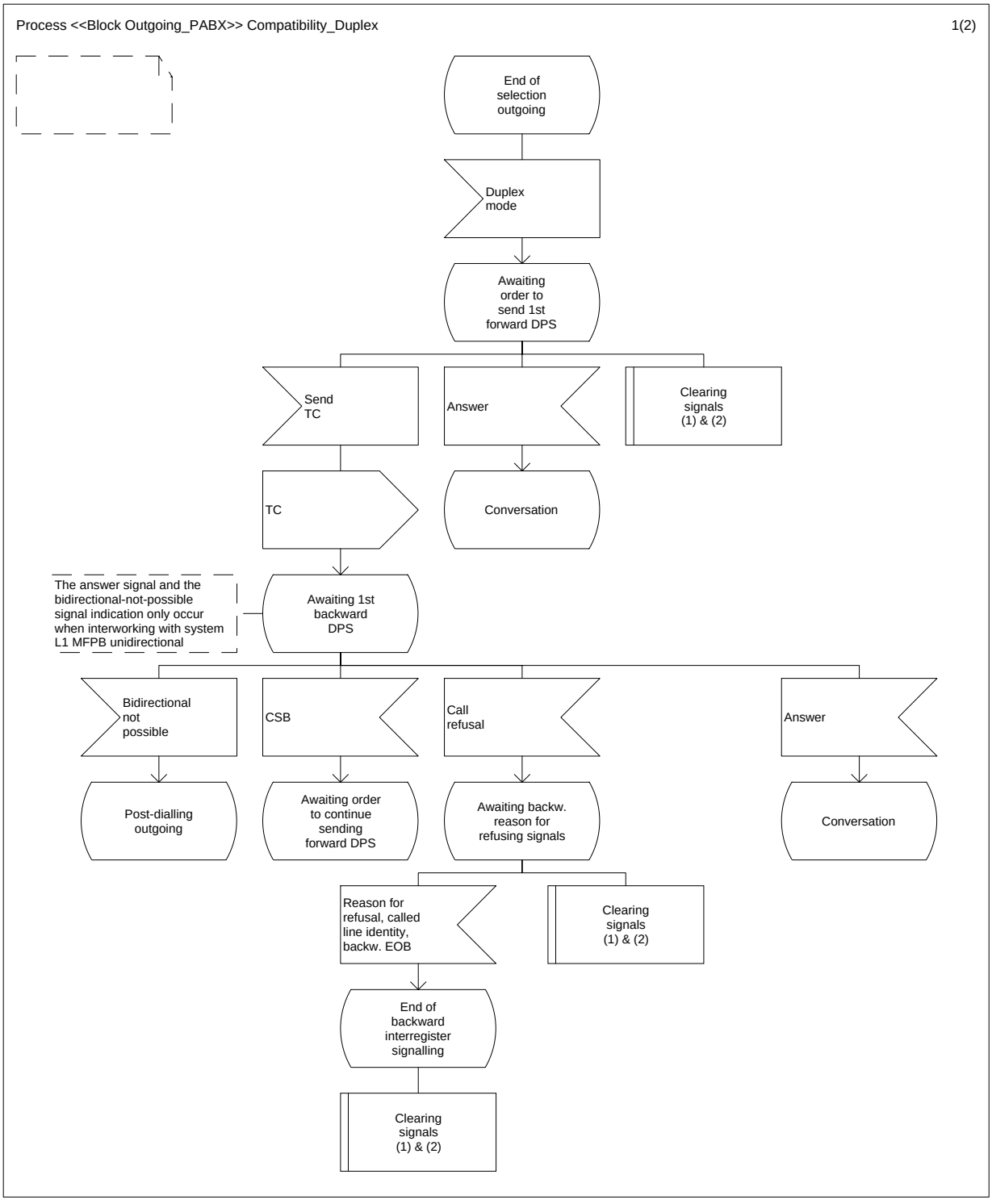


Figure F.1 (T/CS 49-06): Signalling compatibility check and duplex interchange of dialogue phase signals (outgoing PABX) (sheet 1 of 3)

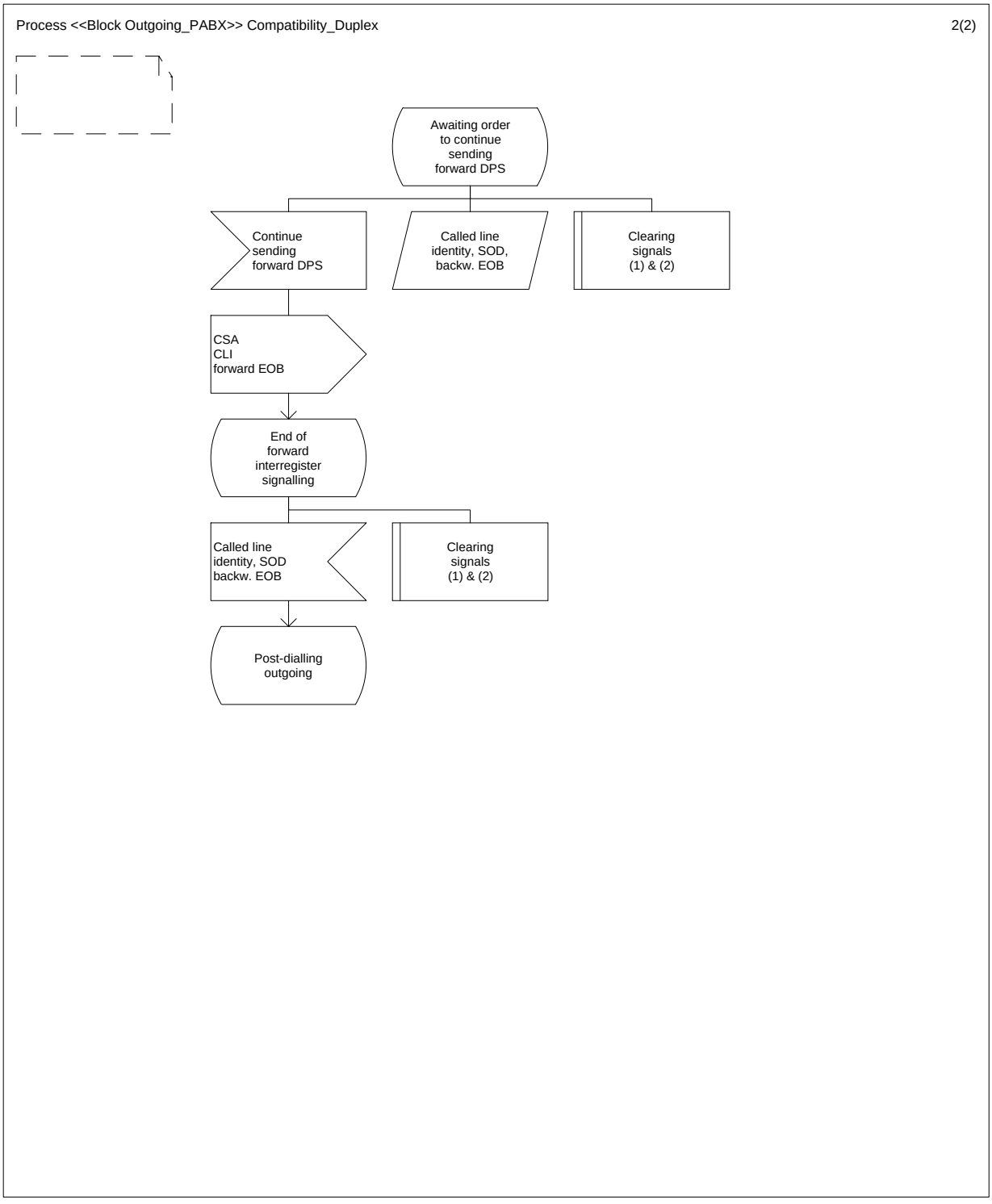


Figure F.1 (T/CS 49-06): Signalling compatibility check and duplex interchange of dialogue phase signals (outgoing PABX) (sheet 2 of 3)

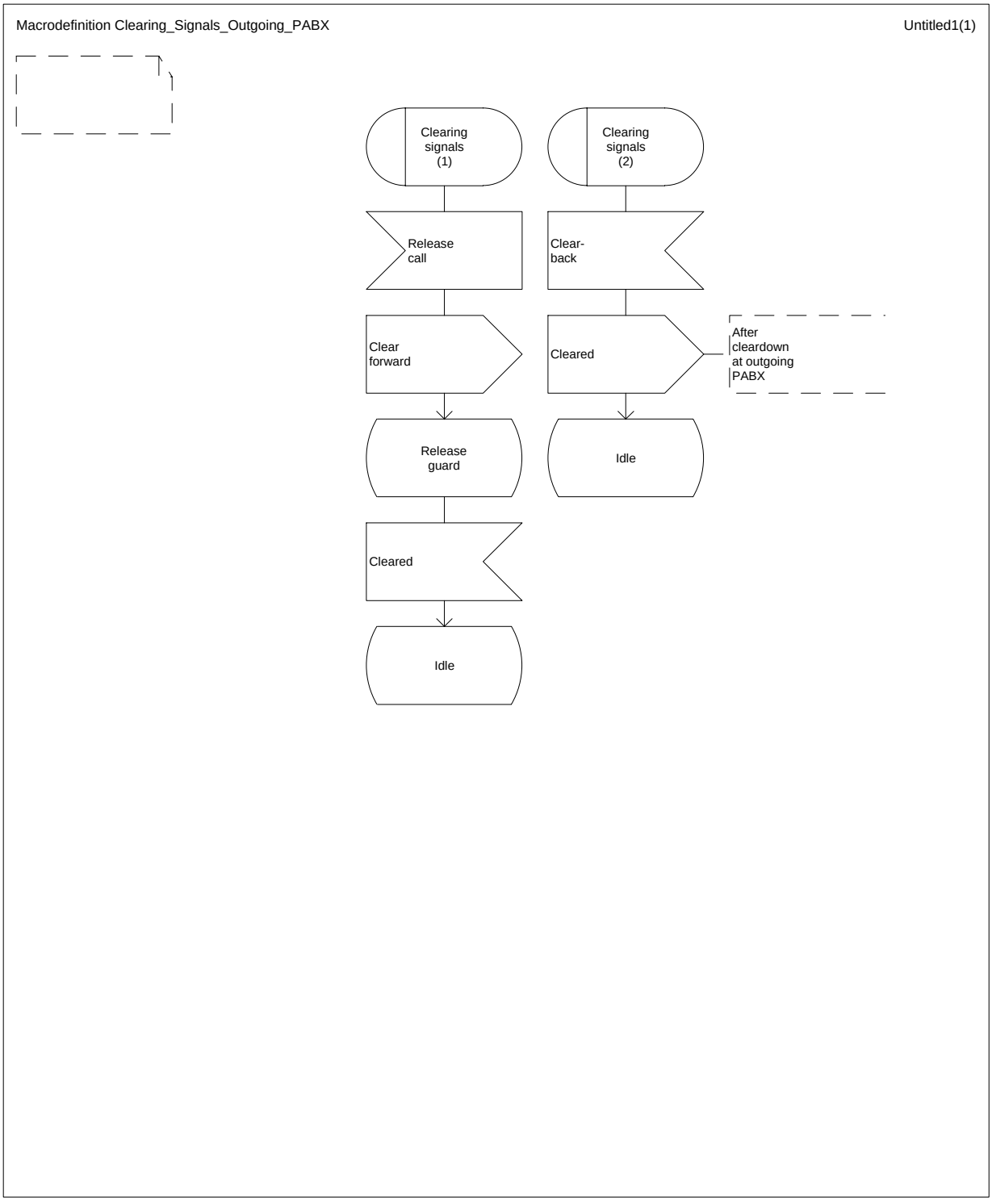


Figure F.1 (T/CS 49-06): Signalling compatibility check and duplex interchange of dialogue phase signals (outgoing PABX) (sheet 3 of 3)

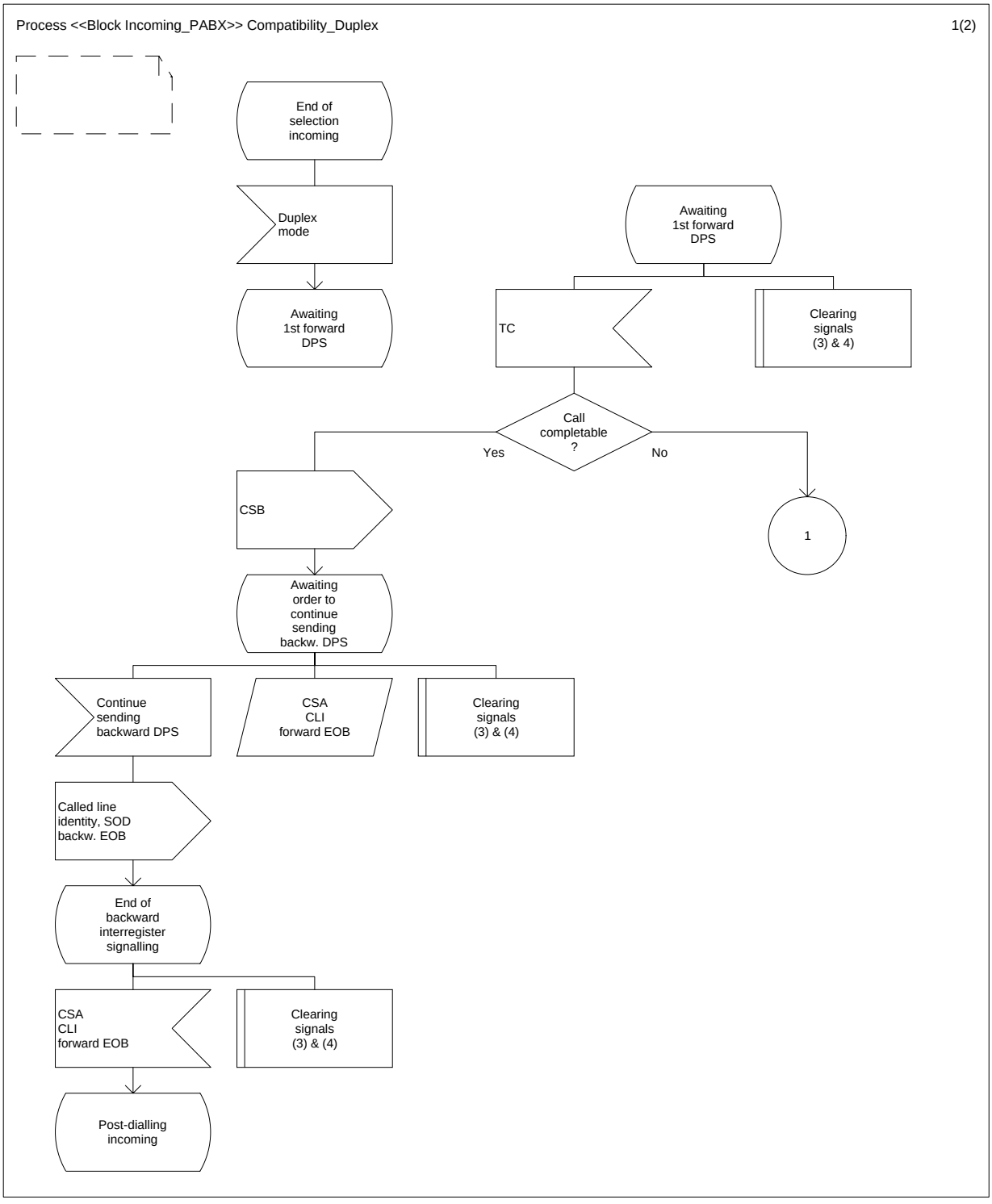


Figure F.2 (T/CS 49-06): Signalling compatibility check and duplex interchange of dialogue phase signals (incoming PABX) (sheet 1 of 3)

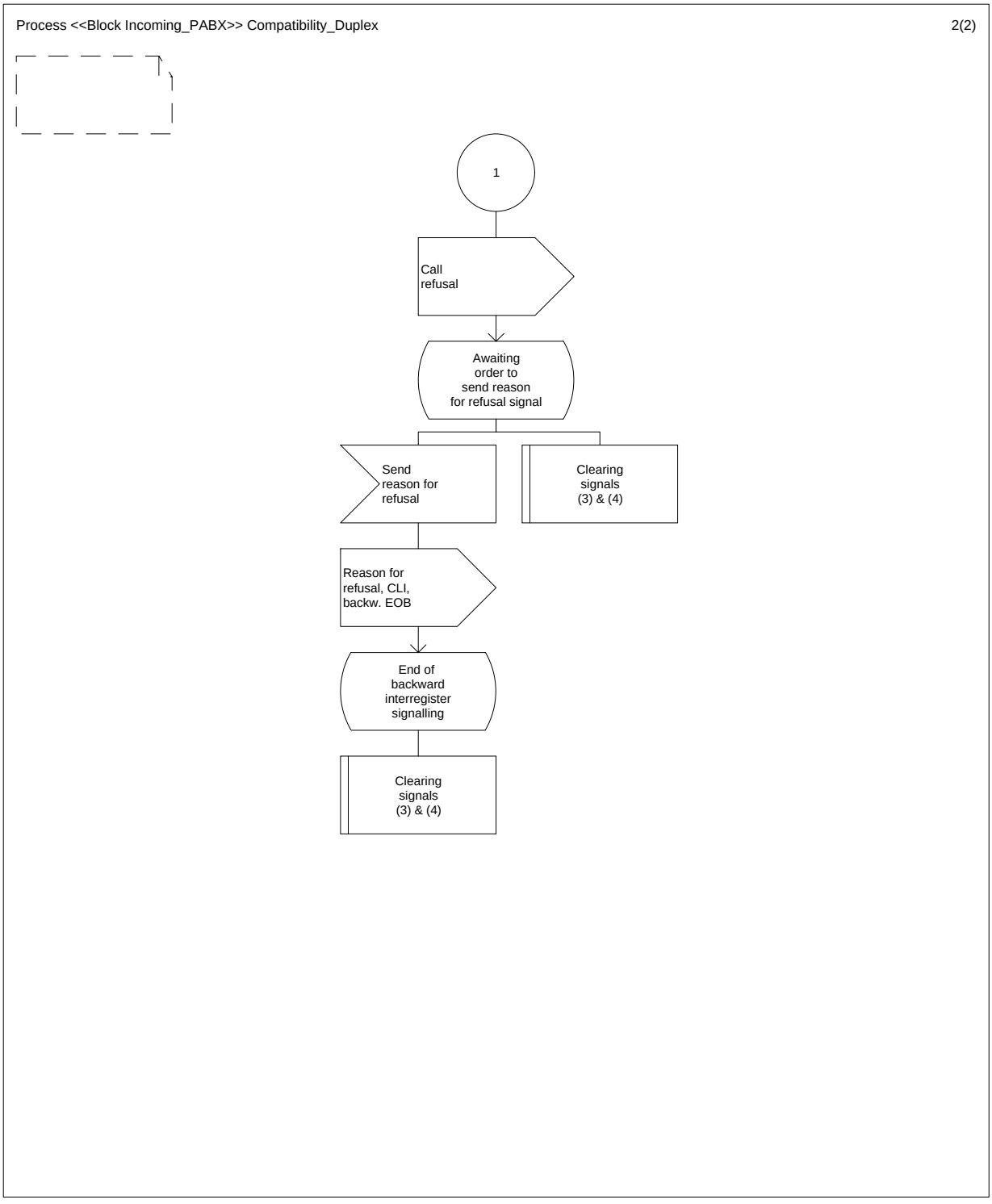


Figure F.2 (T/CS 49-06): Signalling compatibility check and duplex interchange of dialogue phase signals (incoming PABX) (sheet 2 of 3)

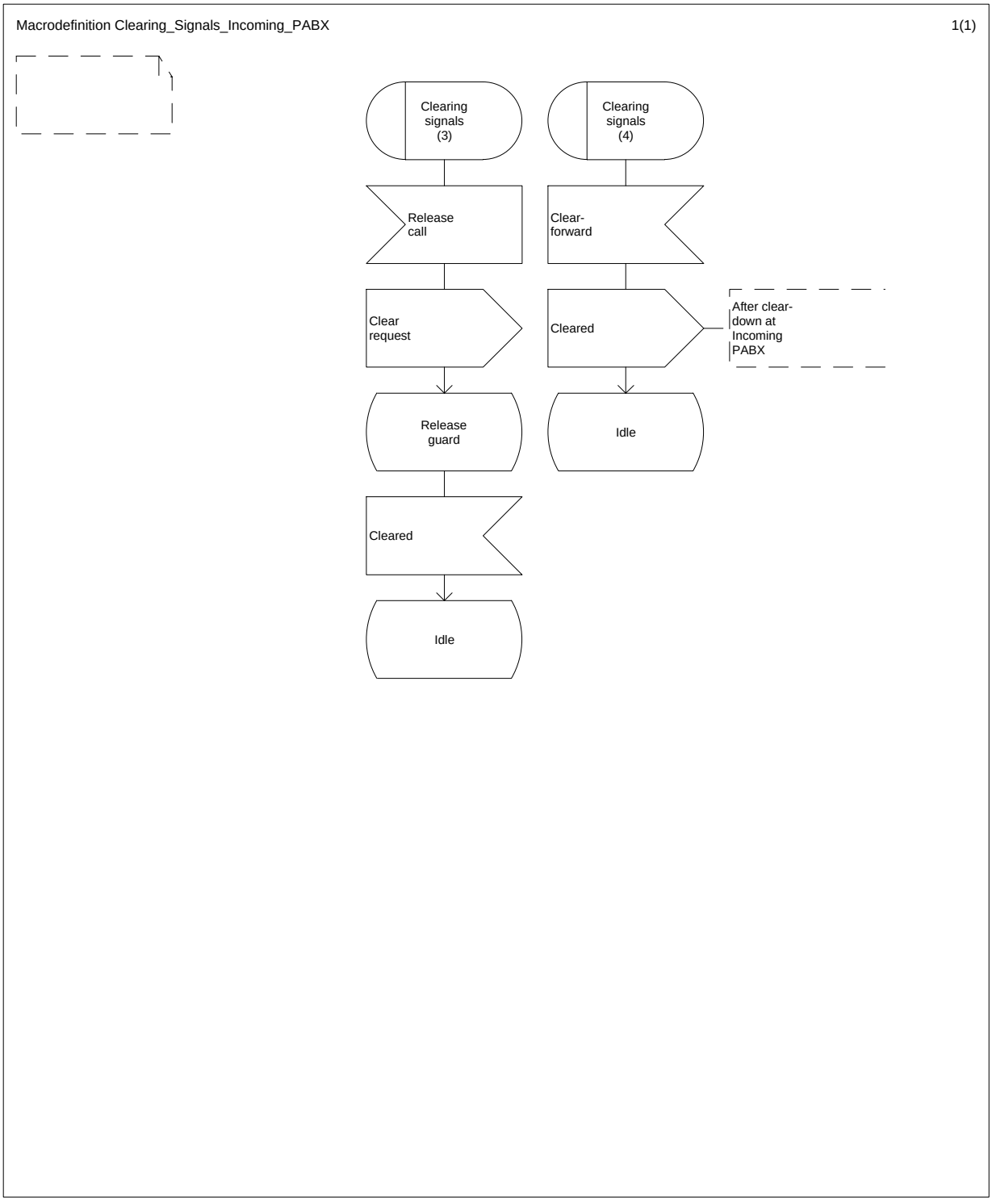


Figure F.2 (T/CS 49-06): Signalling compatibility check and duplex interchange of dialogue phase signals (incoming PABX) (sheet 3 of 3)

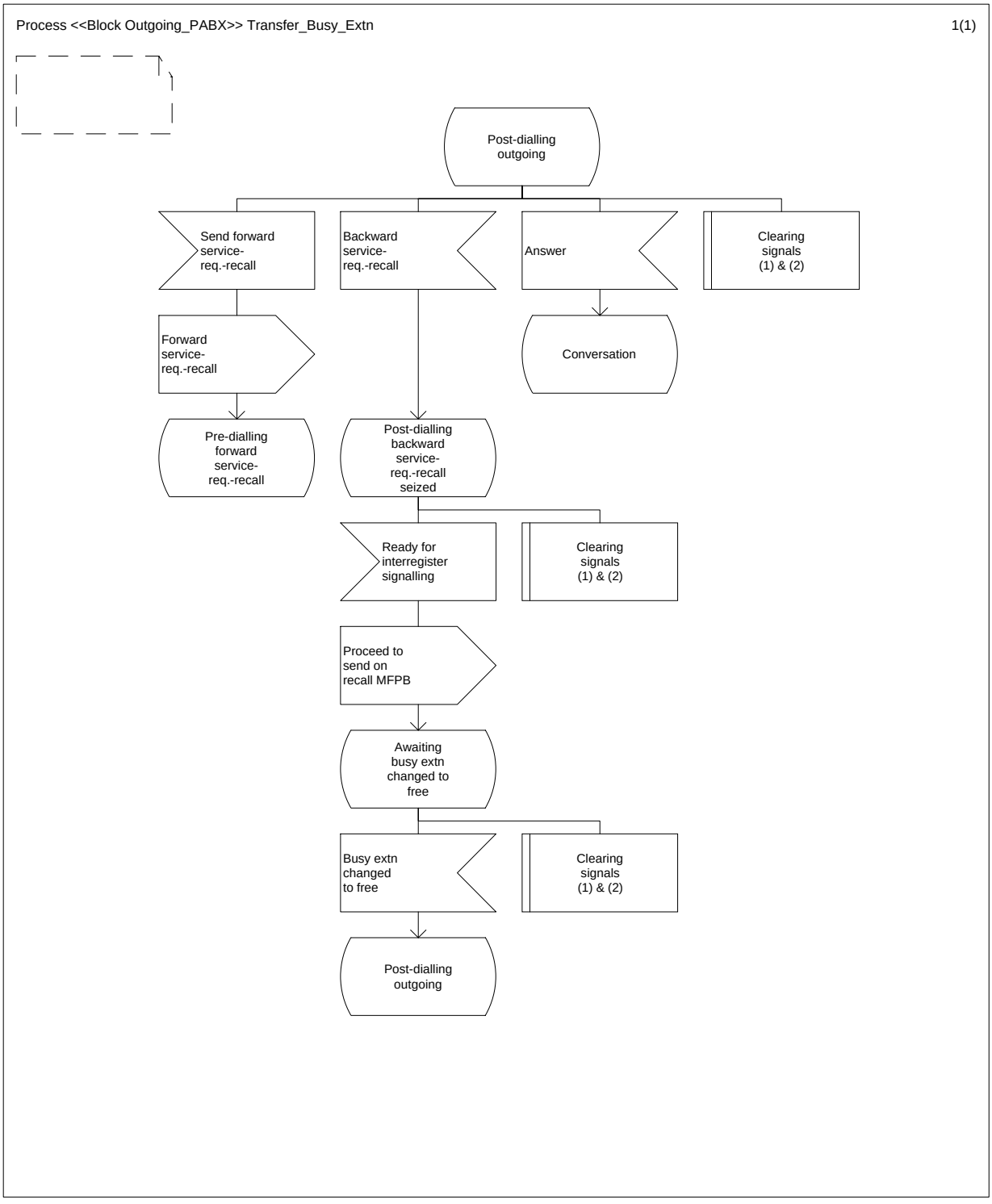


Figure F.3 (T/CS 49-06): Transfer of busy-extension-changed-to-free signal during an unsuccessful call situation (outgoing PABX) (sheet 1 of 1)

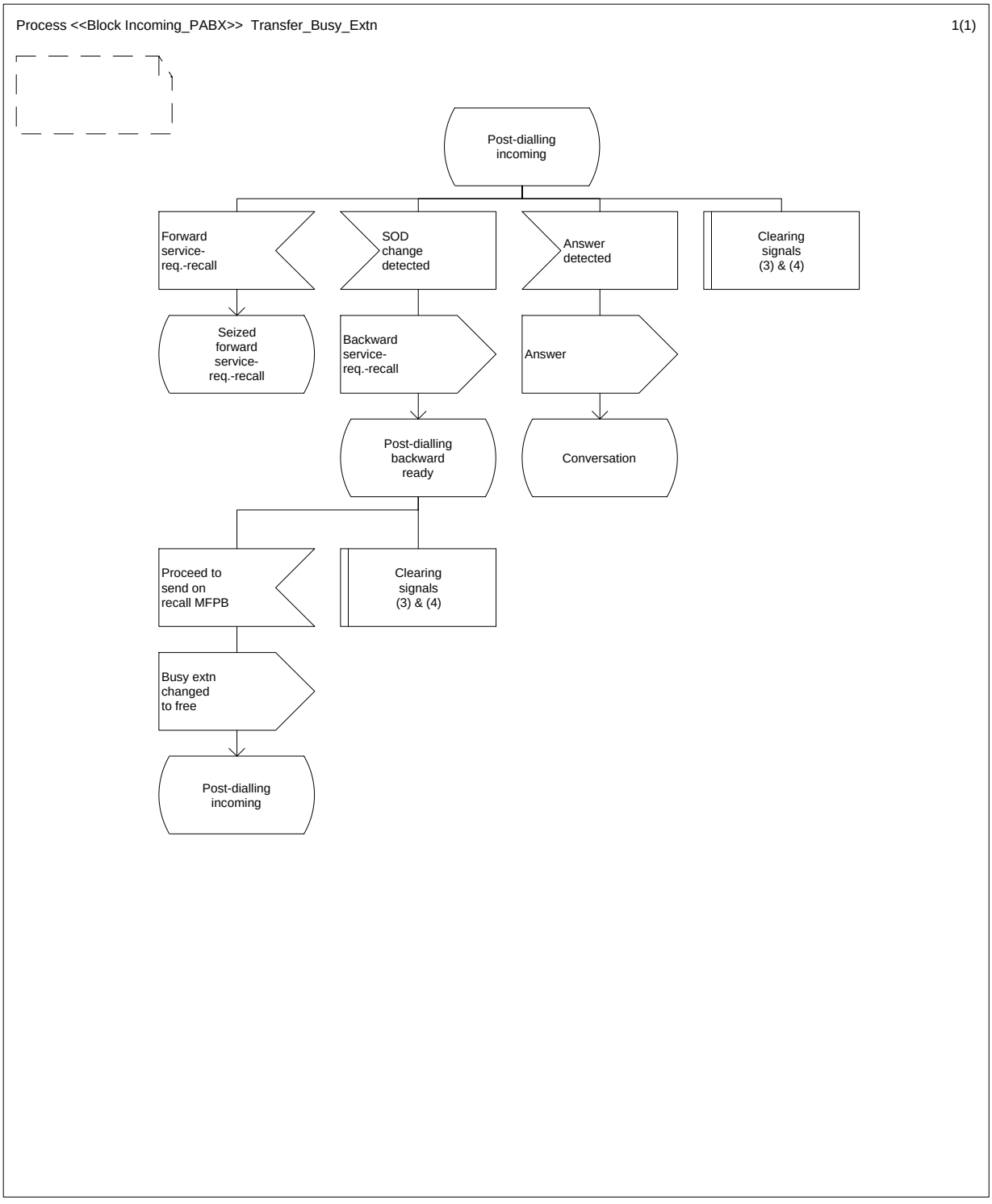


Figure F.4 (T/CS 49-06): Transfer of busy-extension-changed-to-free signal during an unsuccessful call situation (incoming PABX) (sheet 1 of 1)

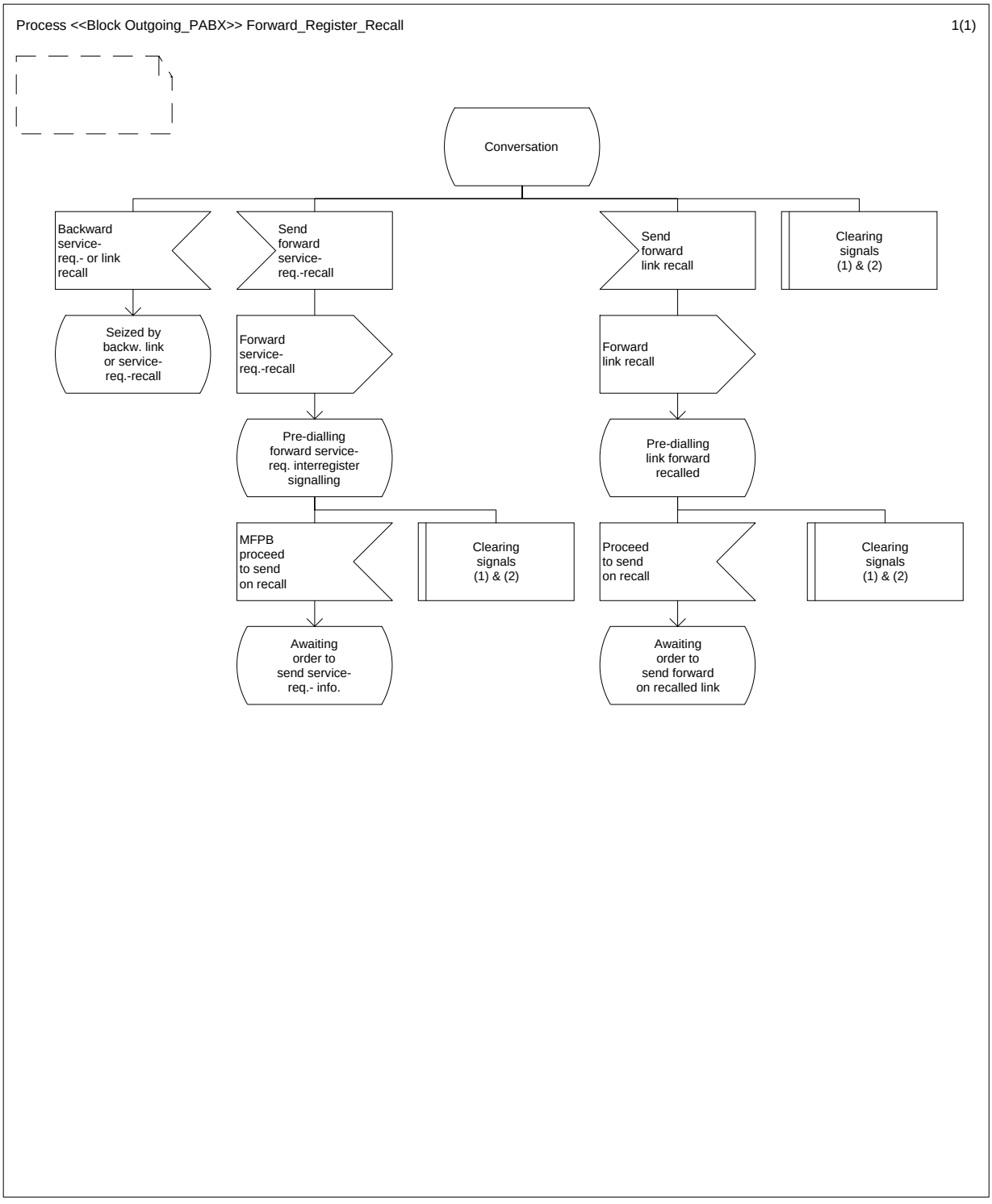


Figure F.5 (T/CS 49-06): Forward register-recall (outgoing PABX) (sheet 1 of 1)

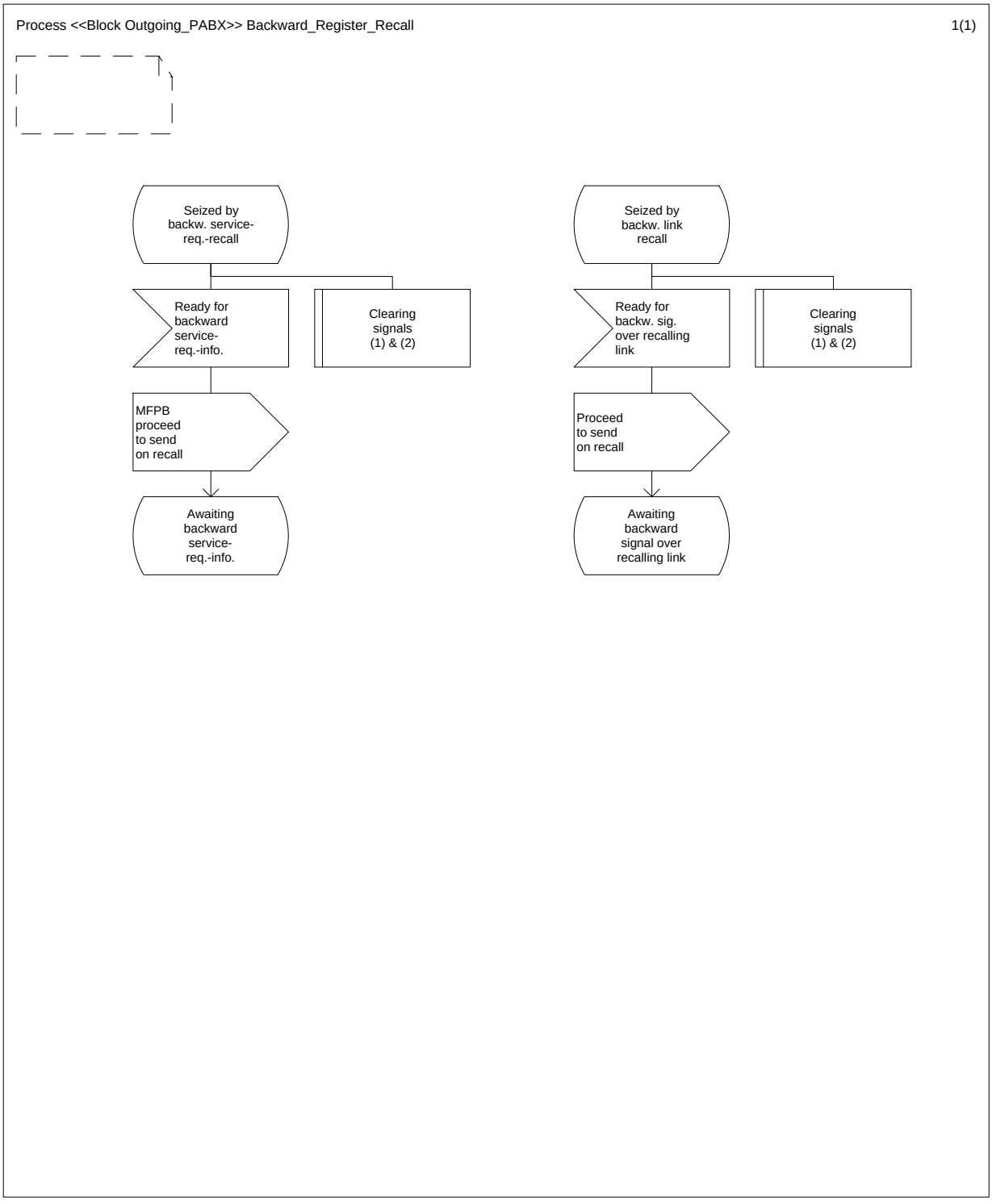


Figure F.6 (T/CS 49-06): Backward register-recall (outgoing PABX) (sheet 1 of 1)

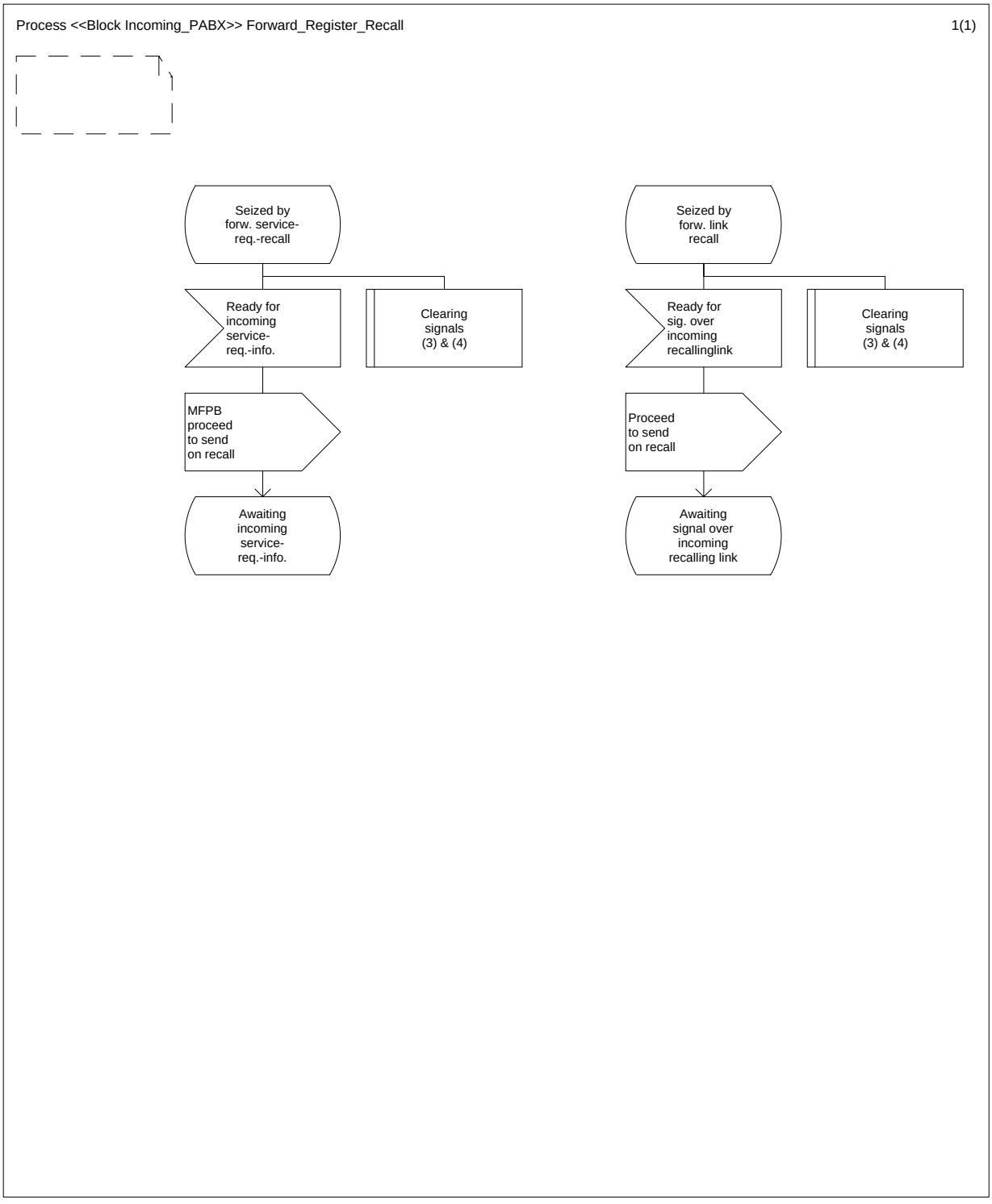


Figure F.7 (T/CS 49-06): Forward register-recall (incoming PABX) (sheet 1 of 1)

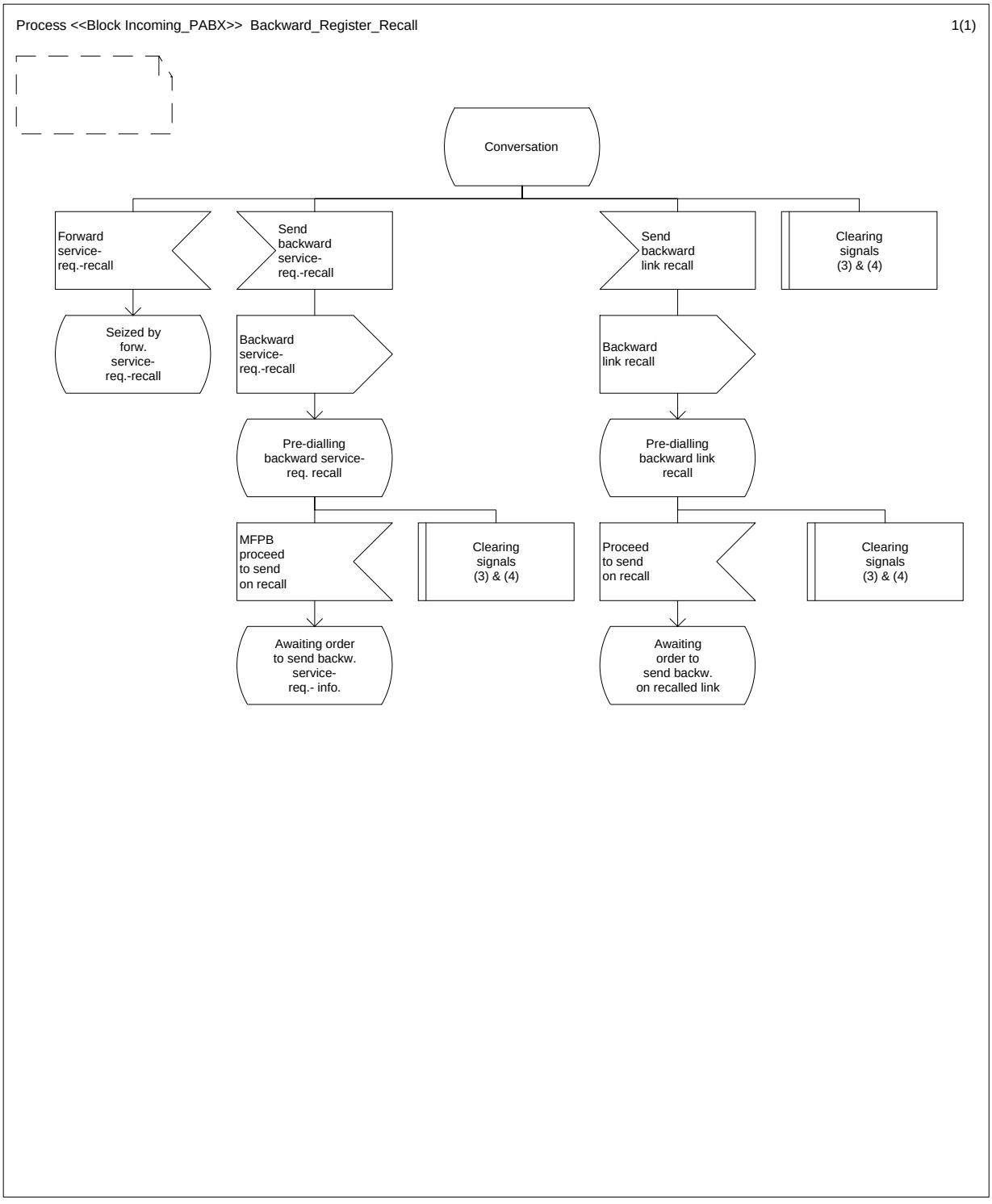


Figure F.8 (T/CS 49-06): Backward register-recall (incoming PABX) (sheet 1 of 1)

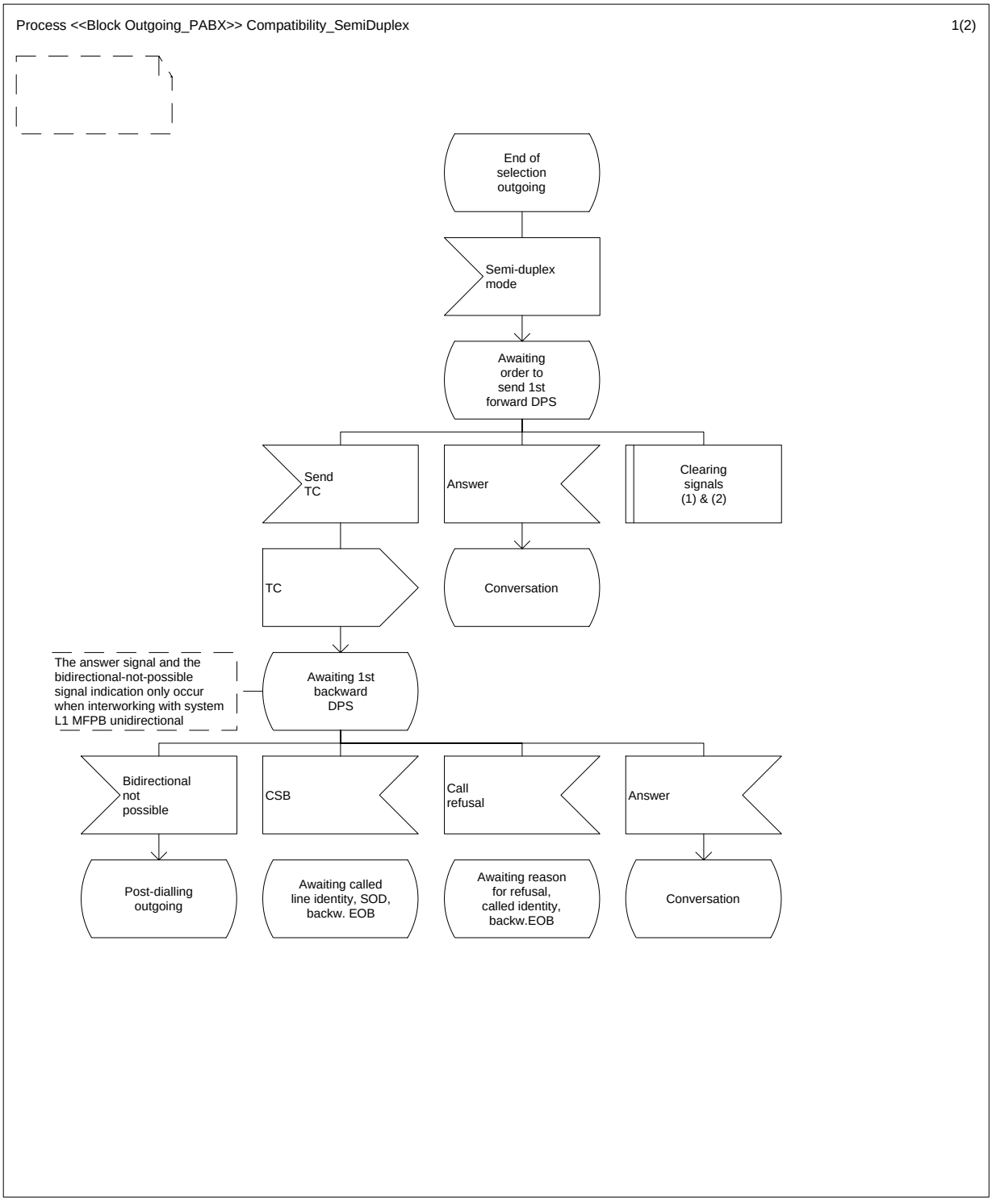


Figure F.9 (T/CS 49-06): Signalling compatibility check procedure and semi-duplex interchange of dialogue phase signals (outgoing PABX) (sheet 1 of 2)

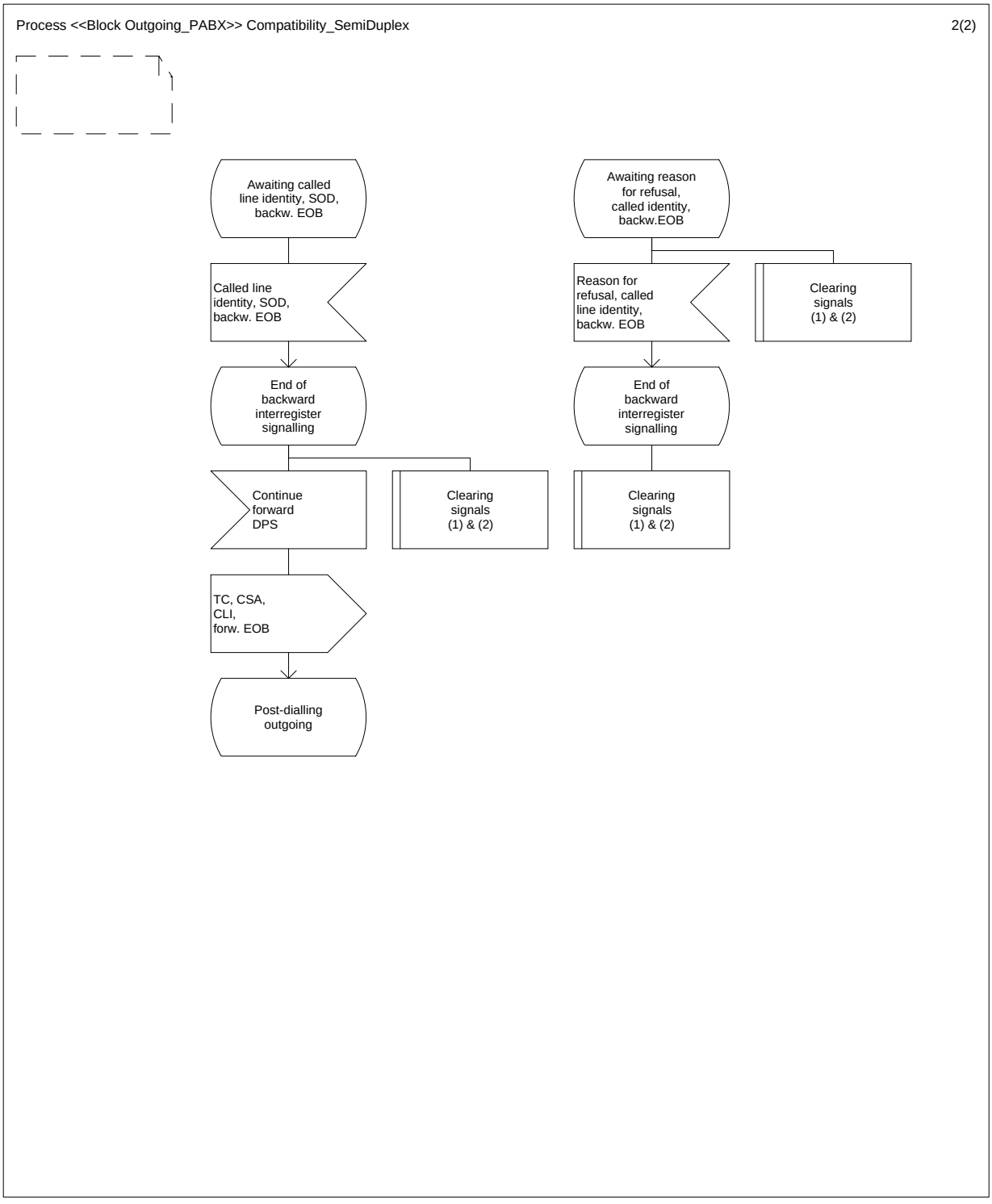


Figure F.9 (T/CS 49-06): Signalling compatibility check procedure and semi-duplex interchange of dialogue phase signals (outgoing PABX) (sheet 2 of 2)

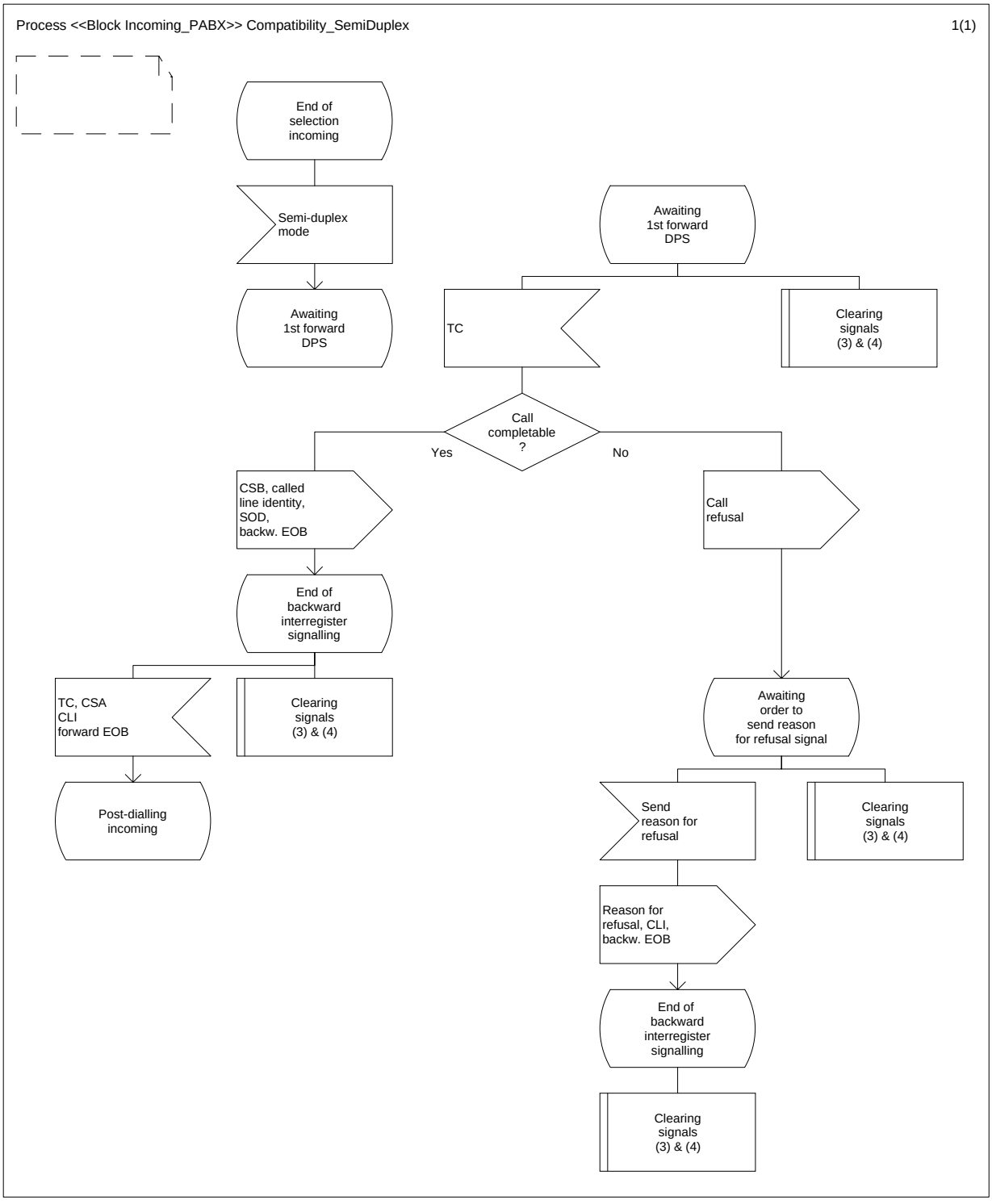


Figure F.10 (T/CS 49-06): Signalling compatibility check procedure and semi-duplex interchange of dialogue phase signals (incoming PABX) (sheet 1 og 1)

Annex G:
CEPT Recommendation T/CS 49-07

Recommendation T/CS 49-07 (Vienna 1982, revised in Montpellier 1984)

Edition of September 15 1986

SYSTEM L1 MULTIFREQUENCY CODE INTERREGISTER SIGNALLING

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Revised text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

- Multifrequency Code (MFC) signalling may enable faster call set-up than decadic pulse signalling;
- that MFC signalling provides more codes than decadic pulse signalling;
- that MFC signalling employs in-band signals, and is thus suitable for use between private automatic branch exchanges (PABXs) for end-to-end interregister signalling;
- that MFC signalling is suitable for a dialogue-like interchange of signalling information;
- that the compelled nature of MFC signalling provides a secure means of exchanging information,

recommends

that members, in conditions favouring MFC signalling over links between analogue transmission interfaces of private automatic branch exchanges located in different countries, use System L1 MFC interregister signalling as specified below."

G.1 General

G.1.1 Line signalling

System L1 MFC interregister signalling is used in conjunction with System L1 line signalling according to Recommendation T/CS 49-01 [1]. The individual line signals to be provided, and their use, are specified in Recommendation T/CS 49-08 [8] on System L1 MFC call control signalling procedures.

G.1.2 Principles and fields of application

G.1.2.1 System L1 MFC is suitable for automatic and semi-automatic working between private automatic branch exchanges (PABXs), via terrestrial circuits. When a satellite circuit is used in the connection, the echo-suppressor control principles as described in Recommendation Q.479 [21]] are applicable.

G.1.2.2 System L1 MFC can be used in private networks containing PABXs of different capability, which may range from the set-up of simple calls to a wide variety of supplementary services.

G.1.2.3 System L1 MFC is specified in terms of a standard selection procedure, followed by one of a number of alternative subsets of signalling procedures for transfer of additional information.

The available subsets are:

- simple calls only, called basic subset;
- simple calls and access to supplementary services, called enhanced subset;
- specific procedures defined by the PABX providers, called manufacturer subset.

Signals have been reserved to provide access to an enhanced routeing subset, which may be specified when necessary.

G.1.2.4 The procedure subset used on a call after the standard selection procedure depends upon the capabilities of the interconnected PABXs, and is determined by a compatibility check procedure. The specified signalling procedures include selection, compatibility checking and transfer of additional information (see Recommendation T/CS 49-08 [8]).

G.1.2.5 A PABX, for which System L1 MFC is used, must be capable of providing at least the selection procedure, plus the basic subset of procedures for additional information transfer. This ensures a minimum level of interworking if compatibility using the optional enhanced or manufacturer subsets cannot be achieved.

G.1.2.6 The system is for use on four-wire circuits, and the PABX termination arrangements set out in Recommendation T/CS 49-01 [1] apply. The maximum number of tandem connections over which a call may be setup is determined by the type of interconnecting circuits, and is subject to mutual agreement by the parties concerned. All circuits used in System L1 links should be to the standard of CCITT Recommendations G.171 [11] and M.1010 to M.1060 [13].

G.2 Interregister signals

G.2.1 Line signalling frequency interregister signals

In System L1 interregister signalling, a line frequency (2 280 Hz) backward signal is used for initiating MFC signal transfer, the proceed-to-send signal. This signal is introduced in accordance with Recommendation T/CS 41-01 [27] and T/CS 49-02 [2].

G.2.2 MFC interregister signals

System L1 MFC is based on System R2, the multifrequency codes used are in accordance with CCITT Recommendation Q.441, Table 3/Q.441 [18].

When using the enhanced subset, the number of signal groups in each direction is extended. Forward signal groups are designated groups I, II, III, etc., and backward signal groups A, B, C, etc.

Tables G.1 (T/CS 49-07) to G.8 (T/CS 49-07) show the interregister signals specified in System L1 MFC.

All signal names are in accordance with Recommendation T/CS 41-01 [27].

Table G.1 (T/CS 49-07): Group I forward signals

Frequency combination	Name of signal	Abbrev.	Note
1	Address, digit 1	I-1	
2	Address, digit 2	I-2	
3	Address, digit 3	I-3	
4	Address, digit 4	I-4	
5	Address, digit 5	I-5	
6	Address, digit 6	I-6	
7	Address, digit 7	I-7	note 1
8	Address, digit 8	I-8	
9	Address, digit 9	I-9	
10	Address, digit 0	I-10	
11	Address, character *	I-11	
14	Address, character #	I-14	
15	End-of-digits	I-15	
13	Change-over-to-enhanced-routeing-subset	I-13	note 2
12	Request-rejected	I-12	note 3
NOTE 1: Signals used for selection. NOTE 2: Signals used to enable special actions during the selection phase. NOTE 3: Signal for subset compatibility check, e.g. for rejection of a manufacturer-request.			

Table G.2 (T/CS 49-07): Group A backward signals

Frequency combination	Name of signal	Abbrev.	Note
1	Send-next-digit	A-1	
13	Send-next-digit, PSTN-encountered	A-13	
14	Send-next-digit, transit-encountered	A-14	
2	Transit-encountered, send-first-digit	A-2	note 1
8	Transit-encountered, alternatively-routed, send-first-digit	A-8	
4	Call-failure	A-4	
9	Routing-congestion	A-9	
5	Send-calling-party's-category	A-5	
10	Enhanced-routeing, information-ready	A-10	note 2
12	Enhanced-routeing, no-information	A-12	
3	Address-complete, basic, change-over-to-groups-II-and-B	A-3	
6	Address-complete, no-MFC	A-6	
7	Change-over-to-manufacturer-subset Address-complete, request-manufacturer-identity	A-7	note 3
11	Address-complete, enhanced, change-over-to-groups-II-and-B	A-11	
15	Spare	A-15	
NOTE 1: Signals used during the selection phase. NOTE 2: Signals used to enable special actions to be taken during the selection phase. NOTE 3: Signals used for the subset compatibility check.			

Table G.3 (T/CS 49-07): Group II forward signals

Frequency combination	Name of signal	Abbrev.	Note
1	Ordinary-extension	II-1	
2	Private-circuit, restricted-signalling capability	II-2	
3	Maintenance-equipment	II-3	
4	Public-switched-telephone-network (PSTN)	II-4	
5	Operator	II-5	note 1
6	Data-transmission-equipment	II-6	
7	Operator-assisting, ordinary-extension	II-7	
8	Operator-assisting, PSTN	II-8	
9	Operator-assisting, restricted-signalling	II-9	
10	Network	II-10	
11	Ordinary-extension, holding-PSTN	II-11	note 2
13	Extraordinary-extension	II-13	
14	ISDN	II-14	
12	Enhanced-subset-request-rejected	II-12	note 3
15	Spare	II-15	

NOTE 1: Signals used in both the basic and the enhanced subset.
NOTE 2: These signals shall not be used in the basic subset.
NOTE 3: Signal used for the subset compatibility check.

Table G.4 (T/CS 49-07): Group B backward signals

Frequency combination	Name of signal	Abbrev.	Note
1	Parked	B-1	
2	Call-failed, PSTN-barred	B-2	
3	Busy, intrudable	B-3	
4	Destination-PABX-call-failure	B-4	
5	Unallocated-number, temporarily-out-of-service	B-5	note 1
6	Free, intrudable	B-6	
7	Free, non-intrudable	B-7	
8	Call-failed, incoming-call-barred	B-8	
9	Destination-PABX-congestion	B-9	
10	Busy, non-intrudable	B-10	
11	Free, operator	B-11	
12	Busy, partially-intrudable	B-12	
13	Free, partially-intrudable	B-13	note 2
14	State-of-destination-indeterminable	B-14	
15	Spare	B-15	

NOTE 1: Signals used in both the basic and enhanced subset.
NOTE 2: These signals shall not be used in the basic subset.

Table G.5 (T/CS 49-07): Group III forward signals

Frequency combination	Name of signal	Abbrev.	Note
1	Simple call	III-1	
2	Simple call, diverted	III-2	
3	Simple call, non-intrudable	III-3	
4	Simple call, diverted, non-intrudable	III-4	note 1
9	Simple call, partially-intrudable	III-9	
10	Simple call, diverted, partially-intrudable	III-10	
15	No-further-supplementary-services-required	III-15	
5	Supplementary-service	III-5	
6	Supplementary-service, diverted	III-6	
7	Supplementary-service, non-intrudable	III-7	
8	Supplementary-service, diverted, non-intrudable	III-8	note 2
11	Supplementary-service, partially-intrudable	III-11	
12	Supplementary-service, diverted, partially-intrudable	III-12	
13	Spare	III-13	
14	Spare	III-14	

NOTE 1: These signals indicate that the originating PABX has no further need for MFC signalling
NOTE 2: These signals indicate that the originating PABX wishes to request a forward supplementary service, and that further MFC signalling is required beyond this group.

Table G.6 (T/CS 49-07): Group C backward signals

Frequency combination	Name of signal	Abbrev.	Note
1	Conclude-MFC, no-additional-information	C-1	
2	Conclude-MFC, PSTN barred	C-2	note 1
3	Conclude-MFC, no-additional-information, non-intrusion-request-rejected	C-3	
4	Call-failure	C-4	
5	Conclude-MFC	C-5	
7	Supplementary-service, non-intrusion-request-rejected	C-7	
8	Supplementary-service	C-8	
10	Supplementary-service, PSTN-barred	C-10	
13	Supplementary-service, PSTN-barred, non-intrusion-request-rejected	C-13	
9	Send-calling-line identity (CLI)	C-9	note 2
11	Send-CLI, PSTN-barred	C-11	
12	Send-CLI, non-intrusion-request-rejected	C-12	
14	Send-CLI, PSTN-barred, non-intrusion-request-rejected	C-14	
15	Request-forward-supplementary-service category	C-15	
6	Spare	C-6	

NOTE 1: These signals conclude MFC signalling and return control of the call to System L1 line signals.
NOTE 2: These signals cause change-over to groups IV and D signalling.

Table G.7 (T/CS 49-07): Group IV forward signals

Frequency combination	Previous backward signal which determines the group IV signal meaning					
	Request forward-suppl.-service category, C-15 or register recall	**Request forward-suppl.-service identity, D-15 note 1**	**Suppl. -service, C-7, C-8, C-10 or C-13**	**Backward suppl.-service category, D-1 to D-15**	**Backward suppl.-service-identity digit, D-1 to D-15**	**Send-CLI, C-9, C-11, C-12 or C-14 or send-next-CLI-digit, D-15**
1	Forward service category digit	Suppl. service category digit	Invalid	Spare (NOTE 3) Must not be sent in response to the escape signal D-10	Signals provided for suppl. service procedures, see note 2	CLI-digit 1
2						2
3						3
4						4
5						5
6						6
7						7
8						8
9						9
10	Escape					10
11					OK, no-further-MFC-required	CLI-digit *
12			Request-rejected, no-further-MFC-required			Invalid
13			Invalid	Spare (note 3)	OK, no-further-MFC-possible	Invalid
14			Request-rejected, further-MFC-possible			CLI-digit #
15			Request-backw. Suppl.-service-category	Request-backw. Suppl.-service-identity (note 1)	Spare	End-of-digits

NOTE 1: Request-suppl.-service-identity signal equals send-next-suppl.-service-identity-digit signal, see Recommendation T/CS 41-01 [27].
NOTE 2: See annexes to Recommendation T/CS 49-08 [8] or manufacturer documentation.
NOTE 3: NOTE 3, although referred to from the table, does not appear in the original text of the Recommendation.

Table G.8 (T/CS 49-07): Group D backward signals

<table>
<tr><th rowspan="2">Frequency combination</th><th colspan="6">Previous forward signal which determines the group D signal meaning</th></tr>
<tr><th>Suppl.-service category IV-1 to 15</th><th>Suppl.-service identity-digit IV-1 to 15</th><th>Request-backward-suppl.-service-category IV-15</th><th>Request-backward-suppl.-service-identity IV-15</th><th>CLI-digit, IV-1 to 10 or end-of-digits, IV-15</th><th>OK or request-rejected, IV-11, -12, -13, -14</th></tr>
<tr><td>1
2
3

4
5
6
7
8
9</td><td rowspan="3">Spare (note 3)
Can never be sent in response to escape signal IV-10</td><td rowspan="2">Signals

provided for suppl. Service procedures, see note 2</td><td>Suppl.-service

category digit</td><td>Suppl.-service

identity digit</td><td>Invalid</td><td>Invalid</td></tr>
<tr><td>10</td><td colspan="2">Escape</td><td></td></tr>
<tr><td>11</td><td>OK, conclude MFC</td><td rowspan="6" colspan="2"></td><td>OK, conclude MFC</td><td>Accept-acknowledged, conclude MFC</td></tr>
<tr><td>12</td><td colspan="2">Request-rejected, conclude MFC</td><td>Invalid</td><td></td></tr>
<tr><td>13</td><td>Spare (note 3)</td><td>OK, change-over-to-group-III-and-C</td><td>OK, change-over-to-group-III-and-C</td><td>Accept-acknowledged, change-over-to-group-III-and-C</td></tr>
<tr><td>14</td><td colspan="2">Request-rejected, change-over-to-group-III-and-C</td><td>Invalid</td><td>Reject-acknowledged, change-over-to-group-III-and-C</td></tr>
<tr><td>15</td><td>Request-for-ward-suppl.-service</td><td>Spare</td><td>Send-next-CLI-digit</td><td>Invalid</td></tr>
<tr><td colspan="7">NOTE 1: Request-suppl.-service- identity signal equals send-next-suppl.-service-digit signal, see Recommendation T/CS 41-01 [27].
NOTE 2: See annexes to Recommendation T/CS 49-08 [8] or manufacturer documentation.
NOTE 3: NOTE 3, although referred to from the table, does not appear in the original text of the Recommendation.</td></tr>
</table>

G.3 System L1 MFC signalling group structure

The signals are allocated to the 15 MFC codes in five forward and five backward signal groups. The signal group represented by the MFC codes is changed at defined points in the call; the same MFC code will therefore represent a different signal, depending on its position in the sequence of the call.

Each signal group is used for a particular part of the call.

- Groups I and A are used for selection, network control and subset compatibility checks.
- Groups II and B are used to exchange calling and called party information.
- Groups I and A, plus part of groups II and B, provide the necessary signals for establishing a simple call using the basic subset for the transfer of additional information.
- The remaining groups II and B signals, and the groups beyond, are only provided when enhanced procedures for the transfer of additional information are used.
- Groups III and C are provided to exchange additional calling and called party information, and to gain access to the supplementary services request procedures.

- Groups IV and D are provided to convey supplementary service request information and provide calling-line-identification.

- Groups V and E are for the enhanced routeing subset. The enhanced routeing subset is still under study.

G.4 Pulsed signalling

A pulsed signal is a signal sent in the backward direction for the period specified in CCITT Recommendation Q.442 [19].

Signals assigned for use in the pulsed mode are backward signals A-4, A-6, A-9, B-4, B-9, C-4, and D-12, see Tables G.2 (T/CS 49-07), G.4 (T/CS 49-07), G.6 (T/CS 49-07) and G.8 (T/CS 49-07).

A pulsed signal may be sent when either of the following conditions arise:

1) when the time-out on non-receipt of a signal matures before the first forward signal is received;

2) following completion of a compelled signalling cycle, if no subsequent forward signal has been recognized, and at least 100 ms have elapsed since the end of transmission of a backward signal.

The initiating PABX shall terminate any forward signal in the course of transmission, on receipt of a pulsed signal.

It is desirable that reception of a forward signal by the responding PABX during transmission of a pulsed signal shall cause that PABX to complete the signalling cycle in the compelled mode. However, the responding PABX shall not act upon the information contained in such a forward signal.

A pulsed signal shall have the same meaning as the corresponding signal within the compelled mode, and shall be interpreted accordingly by the initiating PABX.

G.5 Signal group changing

This clause given details of the signal group changing procedures that occur at various points in the progress of signalling procedures.

5.1 On seizure, the MFC codes represent groups I and A.

5.2 The forward signal change-over-to-enhanced-routeing-subset (I-13) will cause a change to groups V and E. Signals in group V will change back to groups I and A on completion of the enhanced signal interchange.

5.3 The backward signal send-calling-party-category (A-5) causes change-over to group II for one signal only, then signalling reverts to groups I and A. The group II signal will belong to the basic subset (II-1 to II-9). During this signal interchange, the originating PABX will receive group A signals only.

5.4 On completion of call selection the destination PABX initiates change-over to groups II and B by sending either:

- Address-complete, basic, change-over-to-groups-II-and-B (A-3); or

- Address-complete, enhanced, change-over-to-groups-II-and-B (A-11).

5.5 When working enhanced, the groups II and B will be followed by group III and group C signals, except for conditions such as call-failure.

5.6 Supplementary service or calling-line-identity (CLI) indication in groups III and C will cause change-over to groups IV and D.

5.7 Certain group IV and D signals cause change-over to III and C.

G.6 Register-recall signalling

Register-recall provides the means for control information transfer after dismissal of common-control equipment. Register-recall can, as forward or backward recall, be initiated in either direction, regardless of the direction of the original call set-up.

When the common-control equipment at the destination or originating PABX is required to be recalled, the forward or backward service-request-recall signal shall be sent. The service-request-recall signal shall not recall the common-control equipment of transit switches. However, certain call states may require response by a transit switch on recognition of a service-request-recall signal, e.g. in a three-party call where branching occurs at a transit switch.

When the common-control equipment at a transit switch is required to be recalled, the forward or backward link-recall signal shall be sent to the adjacent transit switch.

On receipt of a register-recall signal, the MFC codes will represent group IV and D signals. MFC signalling shall start with a forward group IV signal sent by the PABX that initiated the register-recall. No proceed-to-send-on-recall signal is used.

There will be a finite period following the sending of a recall signal before the responding PABX isolates the line from the user. To reduce the possibility of interference from voice during this period it is recommended that the originating PABX delays application on (note) the MFC receiver for a period of approximately one second after sending a recall signal.

NOTE: The word "on" at this point in the original text of the Recommendation appears incorrect; the word "of" seems to be more appropriate.

G.7 Transit working

When a transit switch in a private network recognizes a seizing signal, it responds by returning the proceed-to-send signal. The originating PABX will send the first address signal (routeing digit) appropriate to that transit switch. On receipt of this address signal, the transit switch will request further address signals until sufficient signals have been received to route the call. When sufficient information has been received, a suitable circuit is seized, the tandem-encountered or alternatively-routed-call signal is returned, the MFC registers are released and switch-through is initiated. The transit switch will then be ready for System L1 MFC end-to-end signalling through its switch path.

If no idle circuit can be found, the routeing-congestion signal is returned, and MFC signalling with the transit switch concerned is ended.

G.8 System L1 MFC signalling sending and detecting requirements

The sending and detecting requirements for System L1 MFC signalling shall be in accordance with CCITT Recommendations Q.450 to Q.458 [20].

Annex H:
CEPT Recommendation T/CS 49-08

Recommendation T/CS 49-08 (Vienna 1982)

Edition of September 15 1986

SYSTEM L1 MULTIFREQUENCY CODE CALL CONTROL SIGNALLING PROCEDURES

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Text of the Recommendation adopted by the "Telecommunications" Commission:

"The European Conference of Postal and Telecommunications Administrations,

considering

- that Recommendation T/CS 49-07 [7] provides for multifrequency code (MFC) signalling functions between private automatic branch exchanges (PABXs), which are suitable for the fast set-up of calls and the provision of supplementary services,
- that supplementary services already available to extension users within a single PABX need to be extended to extension users on others PABXs within a private network,

recommends

to the members, that the signalling procedures specified below are used when MFC interregister signalling is applied between private branch exchanges in different countries."

H.1 General

H.1.1 Outline

H.1.1.1 On international inter-PABX lines, System L1 MFC interregister signalling, as specified in Recommendation T/CS 49-07 [7], is used in conjunction with L1 line signalling, as specified in Recommendation T/CS 49-01 [1].

H.1.1.2 System L1 MFC provides, in principle, the inter-PABX signalling capability to enable a wide range from set-up of simple calls to a variety of supplementary services to be made available to extension users and operators.

H.1.1.3 The range of supplementary services provided by a PABX is optional, and depends upon customer requirements and PABX capability. In any given private network, PABXs of differing capability will be encountered, and the procedures specified for System L1 MFC in this Recommendation take this into account. During the initial set-up of the call, an interchange of terminal status information takes place between originating and terminating PABXs. This enables certain subsequent supplementary service demands, from either the interconnected terminals or a third party, to be processed locally without recourse to inter-PABX signalling.

H.1.1.4 Where a supplementary service demand requires inter-PABX signalling, the request is handled by the responding PABX on an accept or reject basis, depending upon the availability of the service at that PABX.

H.1.1.5 PABXs that do not provide any supplementary services, but require System L1 MFC signalling capability for fast call set-up and private network compatibility reasons, can utilize a subset of System L1 MFC signalling procedures referred to as *basic*. The basic subset provides, as a minimum, the necessary repertoire of signals to establish an extension-to-extension call, with an optional procedure to provide locally applied supervisory tones and limited class-of-service information.

H.1.2 Signals

H.1.2.1 Interregister signals

The System L1 MFC interregister signals, as well as the 2 280 Hz signal for the initiation of the MFC signalling, are specified in Recommendation T/CS 49-07 [7]. This includes their allocation to the multifrequency codes and the abbreviations used

H.1.2.2 Line signals

Table H.1 (T/CS 49-08) shows the System L1 line signals which are used in conjunction with System L1 MFC interregister signalling. The meanings of these signals comply with Recommendation T/CS 41-01 [27]. The requirements for the transmission of these signals are given in Recommendation T/CS 49-01 [1].

Table H.1 (T/CS 49-08): Line signals used for System L1 MFC

Seizing
Answer
Clear-forward
Clear-back
Cleared
Forward-service-request-recall
Forward-link-recall
Backward-service-request-recall
Backward-link-recall

H.2 Signalling procedures

H.2.1 General

This subclause gives the signalling procedures in three parts:

- outline of call control procedures;
- description of the signalling procedures for selection, subset compatibility check and dialogue phases;

NOTE 1: This part requires further study. See contribution T/CS (82) 109 (see note 2).

NOTE 2: This document is no longer available.

- signal flows in arrow chart form and SDL sequence charts according to CCITT Recommendation Z.101 [22], Z.102 [23] and Z.104 [24].

NOTE 3: The SDL diagrams are included in this Recommendation to assist in the understanding of the technical text, and must only be used in association with the text.

H.2.2 Outline of call control procedures

H.2.2.1 Establishment of a call by means of System L1 MFC can be considered in three main phases: the selection phase, the subset compatibility check phase, and the dialogue phase.

H.2.2.2 The selection phase, which includes access to an enhanced routing subset (note), is standard in all System L1 MFC applications. It enables establishment of an ordinary call.

NOTE: In the original text, there is a footnote here that says "under study".

H.2.2.3 The dialogue phase is carried out by one of the following signalling procedures subsets:

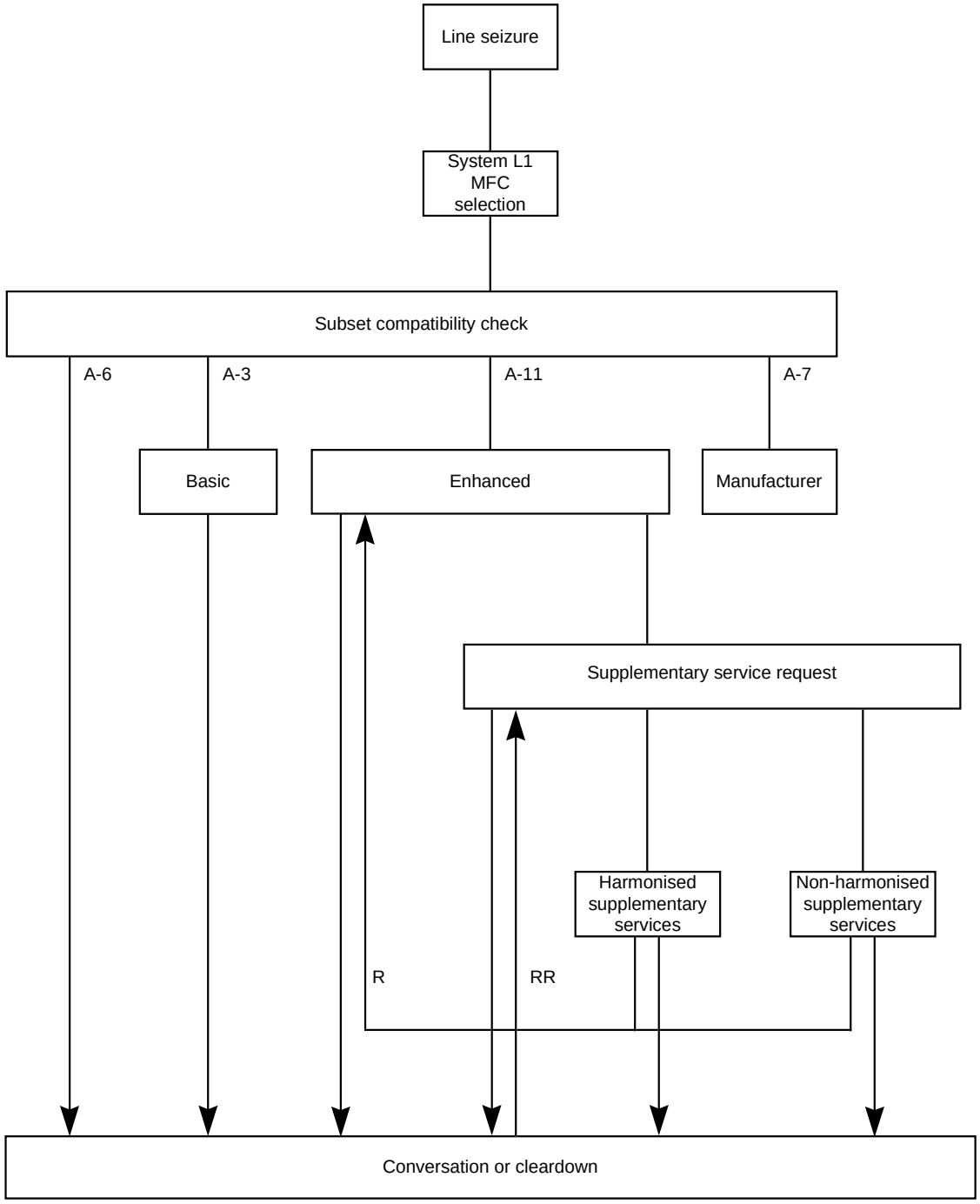
- Basic: provides a minimum interworking capability to enable simple call set-up;
- Enhanced: provides capability for call set-up plus access to supplementary service procedures;
- Manufacturer: subsets enabling specific manufacturer's procedures to be used (see subclause H.2.5.3).

Where part of a multi-link call is routed via a non-MFC private circuit, no dialogue phase will take place.

H.2.2.4 The particular subset used will depend upon the capabilities of the interconnected PABXs, and is determined by the subset compatibility check, which is carried out after the selection phase and before possibly entering the dialogue phase.

H.2.2.5 When the dialogue phase has been entered, both PABXs exchange information regarding the originating and destination parties in either basic or enhanced working.

H.2.2.6 The signalling procedures structure in figure H.1 (T/CS 49-08) shows the relationship between the subsets.



Legend: R = revert
RR = register-recall
A = group A backward signal

Figure H.1 (T/CS 49-08): System L1 signalling procedures structure

H.2.2.7 In basic working, the dialogue phase interchange is limited to one signal in each direction.

H.2.2.8 In enhanced working, the interchange involves at least two signals in each direction and, if a supplementary service is involved, may extend to many more, except for states such as parked where only one signal interchange need take place.

H.2.2.9 The signal exchange for a supplementary service is a function of the service concerned. The procedures based on supplementary services harmonized by CEPT are specified in annexes (note) to this Recommendation. Procedures required for other categories of supplementary services, e.g. defined for national use or marketed by PABX providers, are not covered in this Recommendation. However, provisions are made in System L1 MFC to gain access to such procedures (see subclause H.2.5.2.3.).

NOTE: This Recommendation makes several references to annexes to the Recommendation; no such annexes appear to exist. Details of the signalling flows for specific supplementary services are given in CEPT Recommendation T/CS 49-09 [9].

H.2.2.10 In basic working, the service-request-recall and link-recall signals are not used.

H.2.2.11 PABXs with transit functions should be capable of repeating a service-request-recall signal to the next link. If a transit switch is not capable of using a link-recall signal, it will take no action on its recognition.

H.2.3 Signalling procedures for the selection phase

The selection phase covers all signalling necessary to establish a connection between the originating and destination PABXs, including the forwarding of the required extension number to the destination PABX.

The selection phase is entered, following the application of the seizing signal by the originating PABX. On recognition of the seizing signal, the responding PABX prepares to receive MFC signals and applies the proceed-to-send signal.

As a multi-link call is progressively set-up across a network (see Recommendation T/CS 49-07 [7]), each transit switch applies a seizing signal to the subsequent link, and each responding PABX applies the proceed-to-send signal.

To facilitate network management, backward MFC signals are used during the selection phase to:

i) request address signals (routing digits and extension number) one after the other from the originating PABX, as required by the transit switch or terminating PABX; when all address digits have been sent, the originating PABX responds if it receives a further send-next-digit signal by sending the no-further-digit signal (I-15);

ii) inform the originating PABX of the progress of the call, e.g. how many transit switches have been encountered;

iii) inform the originating PABX of alternative routing that has occurred at a transit switch;

iv) inform the originating PABX that access to the PSTN is about to occur;

v) request entry into the optional enhanced routeing subset (note) in order to influence the routing of the call, e.g. special quality circuits for data.

NOTE: In the original text, there is a footnote here that says "under study".

Figure H.2 (T/CS 49-08) shows the selection phase in arrow chart form.

Figure H.3 (T/CS 49-08) shows the entry into the enhanced routing subset in arrow chart form.

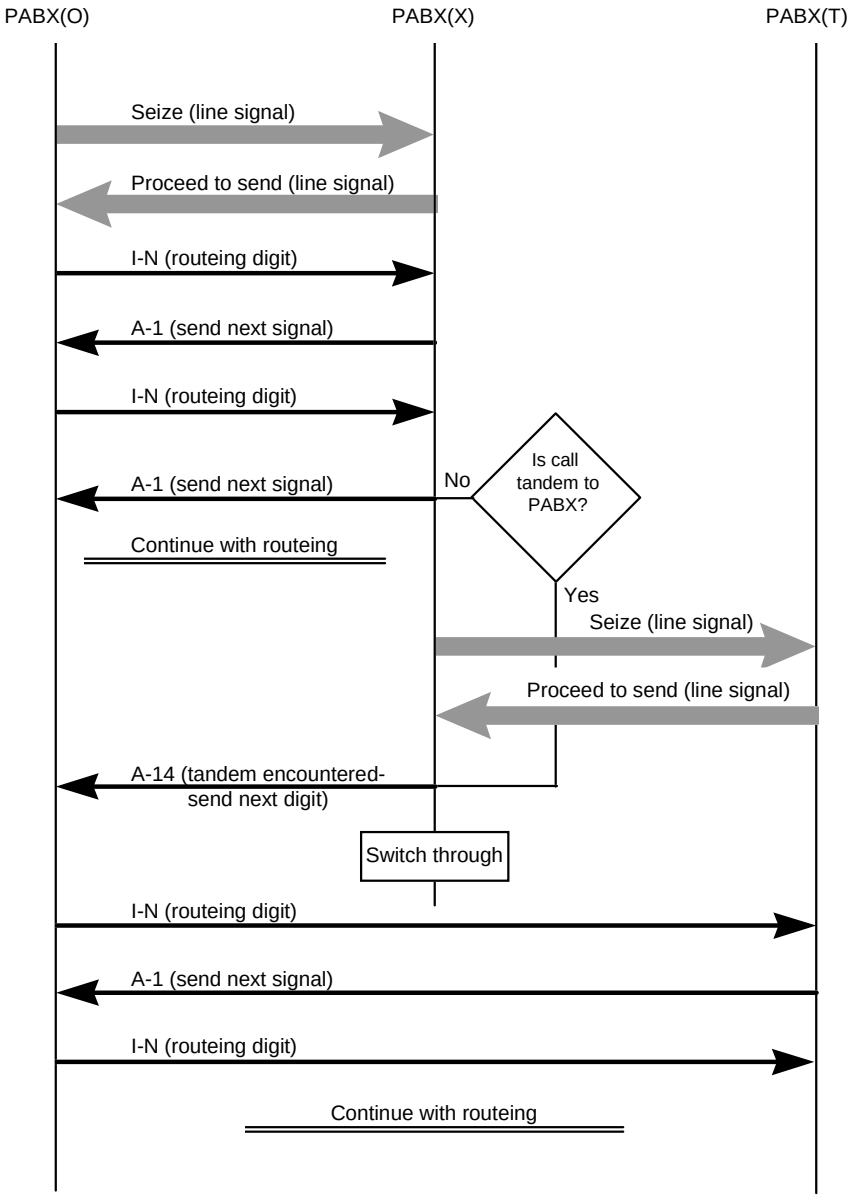


Figure H.2 (T/CS 49-08): Routeing via a transit PABX

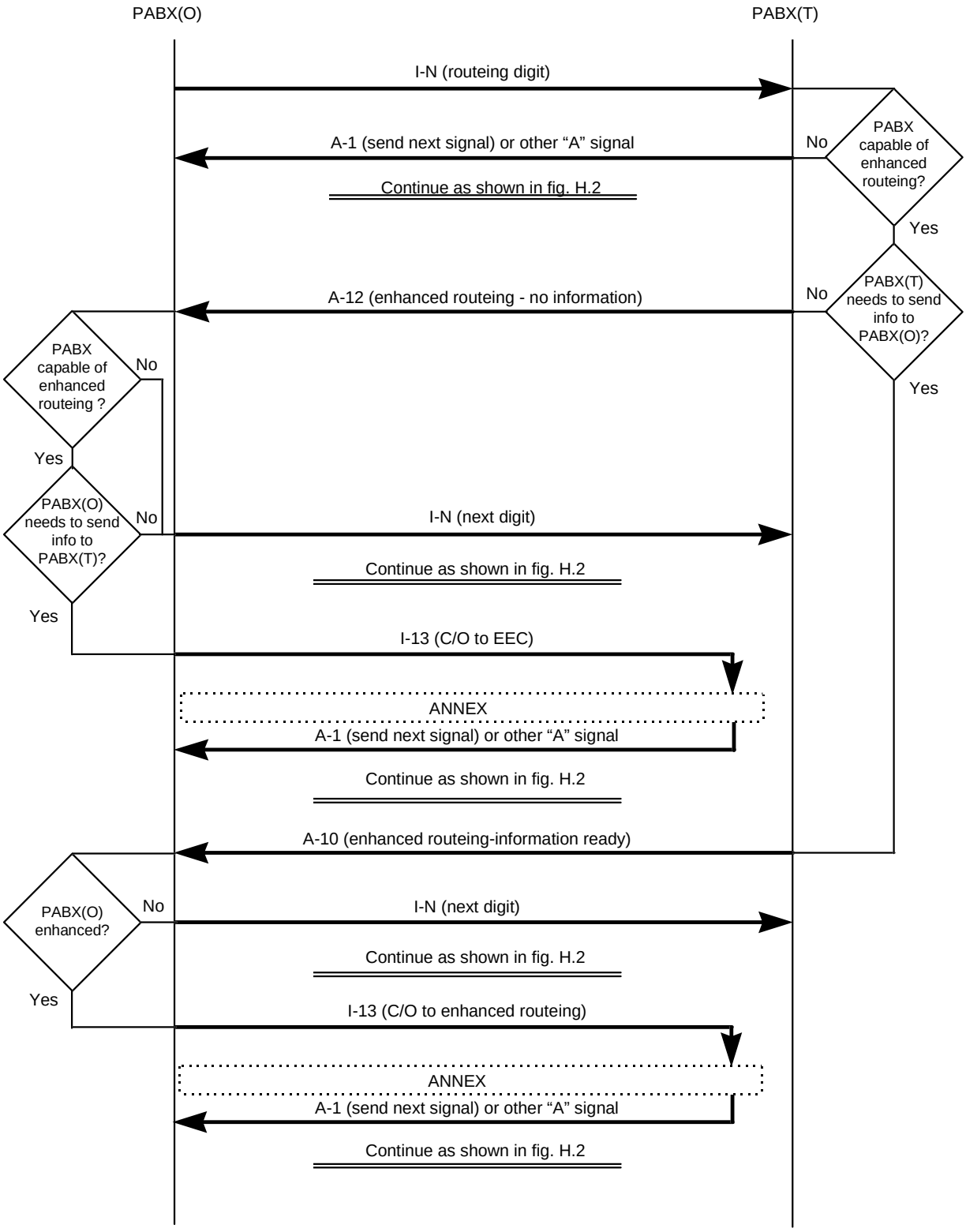


Figure H.3 (T/CS 49-08): Enhanced routeing procedure

H.2.4 Signalling procedures for subset compatibility check

On completion of selection, it is necessary for the originating and destination PABXs to determine whether MFC signalling is going to continue, and if so, which procedure subset is to be used for the remainder of the call handling.

If no further MFC signalling is possible (e.g. a non-MFC route or a PSTN has been encountered by a transit switch), an address-complete, no-MFC, set-up-speech-path signal will be sent (A-6).

Where further MFC signalling is possible, the subset compatibility check is initiated by the destination PABX, which applies one of the following signals (see figure H.1 (T/CS 49-08)):

i) Address-complete, enhanced, change-over-to-reception-of-group-B signals (A-11);

ii) Address-complete, request-subset-identity (A-7);

iii) Address-complete, basic, change-over-to-reception-of-group-B signals (A-3).

The originating PABX responds by either:

a) implicitly accepting the proposed subset (enhanced or basic) by sending forward information as shown in subclause H.2.5; or

b) implicitly agreeing to attempt entry into a manufacturer subset by sending forward its subset identity digit(s) for subset compatibility checking (the range required and the allocation of subset identity digits is under study); or

c) rejecting the proposed subset by sending either the enhanced-request-not-accepted or the manufacturer-request-not-accepted signal.

The originating PABX cannot reject a request to enter basic.

On receipt of either a request-not-accepted signal or an incompatible manufacturer subset identity, the destination PABX will offer another subset. This interaction will continue until a common subset is found (usually enhanced or basic). Figure H.4 (T/CS 49-08) shows the subset compatibility check in arrow chart form.

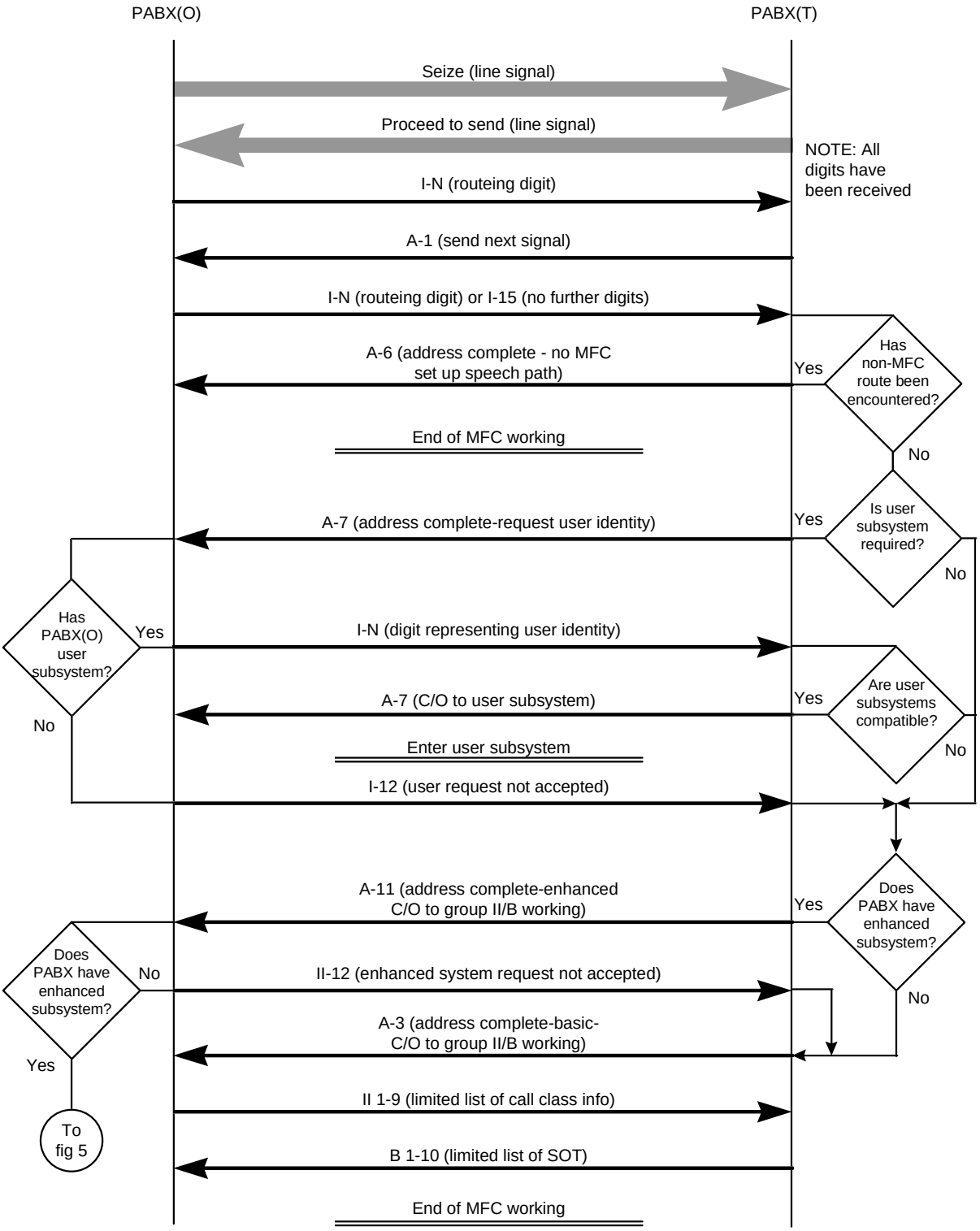


Figure H.4 (T/CS 49-08): Compatibility check procedure

H.2.5 Signalling procedures for the dialogue phase

On completion of the subset compatibility check, both PABXs enter one of the following procedures subsets.

H.2.5.1 Basic subset

The basic subset provides a single signal interchange in which one of the following pieces of information can be sent:

Forward information:

Call originates from:

- an ordinary extension;
- a restricted signalling capability private circuit;
- maintenance equipment;
- the public switched telephone network (PSTN);
- an operator position;
- data transmission equipment;
- an operator assisting an ordinary extension;
- an operator assisting a PSTN caller;
- an operator assisting a restricted signalling capability private circuit.

Backward information:

The destination is

- in a parked state;
- barred PSTN calls;
- busy with intrudable status;
- temporarily out-of-service, unallocated number;
- free with intrudable status;
- barred to incoming calls;
- busy with non-intrudable status.

In addition there are signals to indicate:

- destination PABX congestion;
- destination PABX call failure.

The exchange of additional information using basic is shown as the last two signals in figure H.4 (T/CS 49-08).

H.2.5.2 Enhanced subset

H.2.5.2.1 Exchange of calling and called party information

In enhanced working, the exchange of calling and called party information is by means of two signal interchanges. The first signal interchange (groups II and B) conveys the following pieces of information, in addition to the items listed in subclause H.2.5.1.

Forward direction:

Call originates from,

- the network;
- an ordinary extension holding a PSTN call;
- an executive extension;
- the ISDN.

Backward direction:

The destination is,

- an operator position;
- busy with partially-intrudable status;
- free with partially-intrudable status;
- in a state with no applicable state of destination.

The second signal interchange (groups III and C) enables further qualifying information to be exchanged, such as whether the call has been diverted, whether or not it may be partially intruded upon; whether the called party is barred access to the PSTN; and whether further MFC signalling is required by either PABX, e.g. supplementary service control information, or calling line identity.

The exchange of additional information using enhanced is shown in figure H.5 (T/CS 49-08) in arrow chart form.

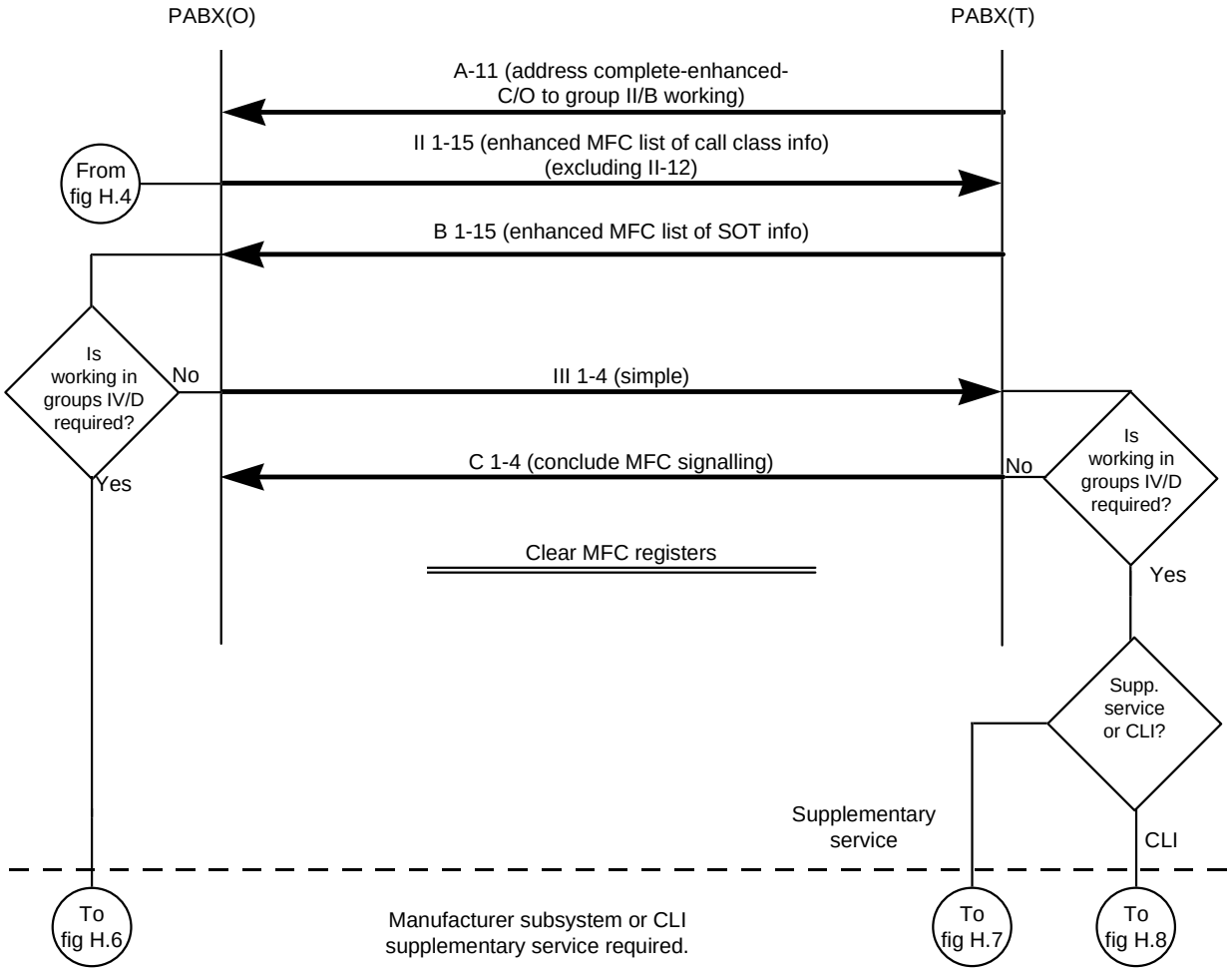


Figure H.5 (T/CS 49-08): Exchange of SOT/COS information (enhanced MFC subsystem)

H.2.5.2.2 Simple call

Following the exchange of additional information, and assuming that no supplementary services are required, the MFC registers release and leave the connection under the control of line signals.

H.2.5.2.3 Supplementary services

In addition to establishing a call, System L1 MFC enhanced signalling procedures are specified to provide access to supplementary services during the exchange of additional information before the MFC registers release. The supplementary service category concerned will be determined by a *supplementary service request procedure*.

Forward supplementary service request

When the originating PABX requires a supplementary service, it indicates this with a group III signal (III-5 to III-12). Upon recognition of this signal, the destination PABX responds with the request-forward-supplementary-service-category signal (C-15). This provokes change-over-to-group-IV-and-D signals, which are used for two compelled MFC cycles dedicated to the category and supplementary service identification.

Backward supplementary services request

The destination PABX changes-over to group IV and D signals by transmission of one of the signals C-7 to C-14. The response on C-7, C-8, C-10 and C-13 shall be the signal IV-I5, requesting the backward supplementary service category and identity. As in forward supplementary service request, two cycles are used. The signals C-9, C-11, C-12 and C-14 initiate the sending of the calling-line-identity, see subclause H.2.5.2.4.

The above arrangements allow transmission of at least 15 x 15 codes in both directions. By using code 10 as an escape, extension is possible. Further study is required on the allocation of the codes to identify category groups and specific supplementary services.

Forward supplementary service requests are given priority over backward requests and, depending upon the capability of the PABXs concerned, any number of requests can be processed sequentially until neither PABX has an outstanding requirement for further MFC signalling (see revert on figure H.1 (T/CS 49-08) and H.2.5.2.8.).

Signal flows for forward and backward supplementary service requests are shown in figure H.6 (T/CS 49-08) and H.7 (T/CS 49-08) respectively.

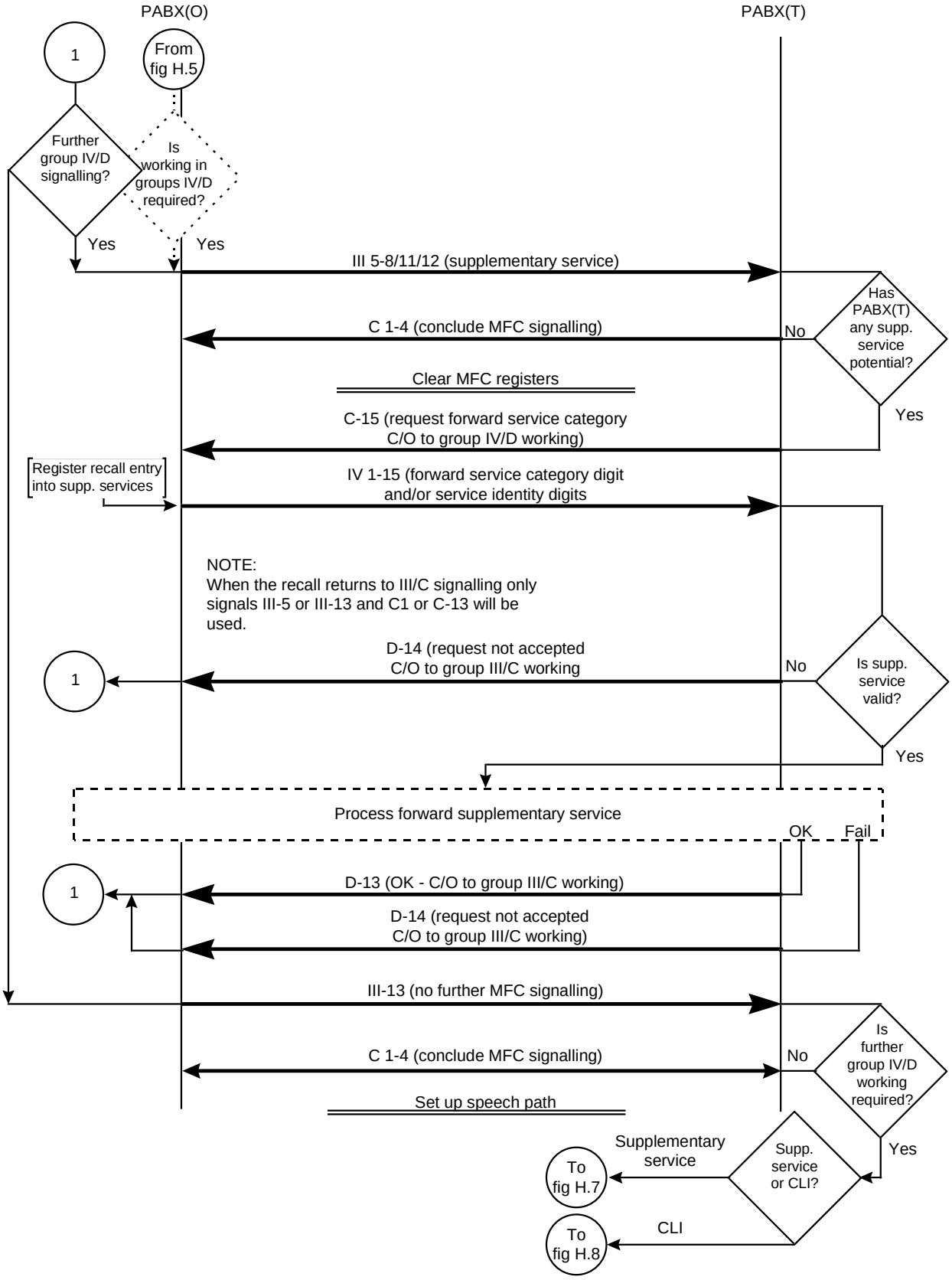


Figure H.6 (T/CS 49-08): Forward supplementary service request

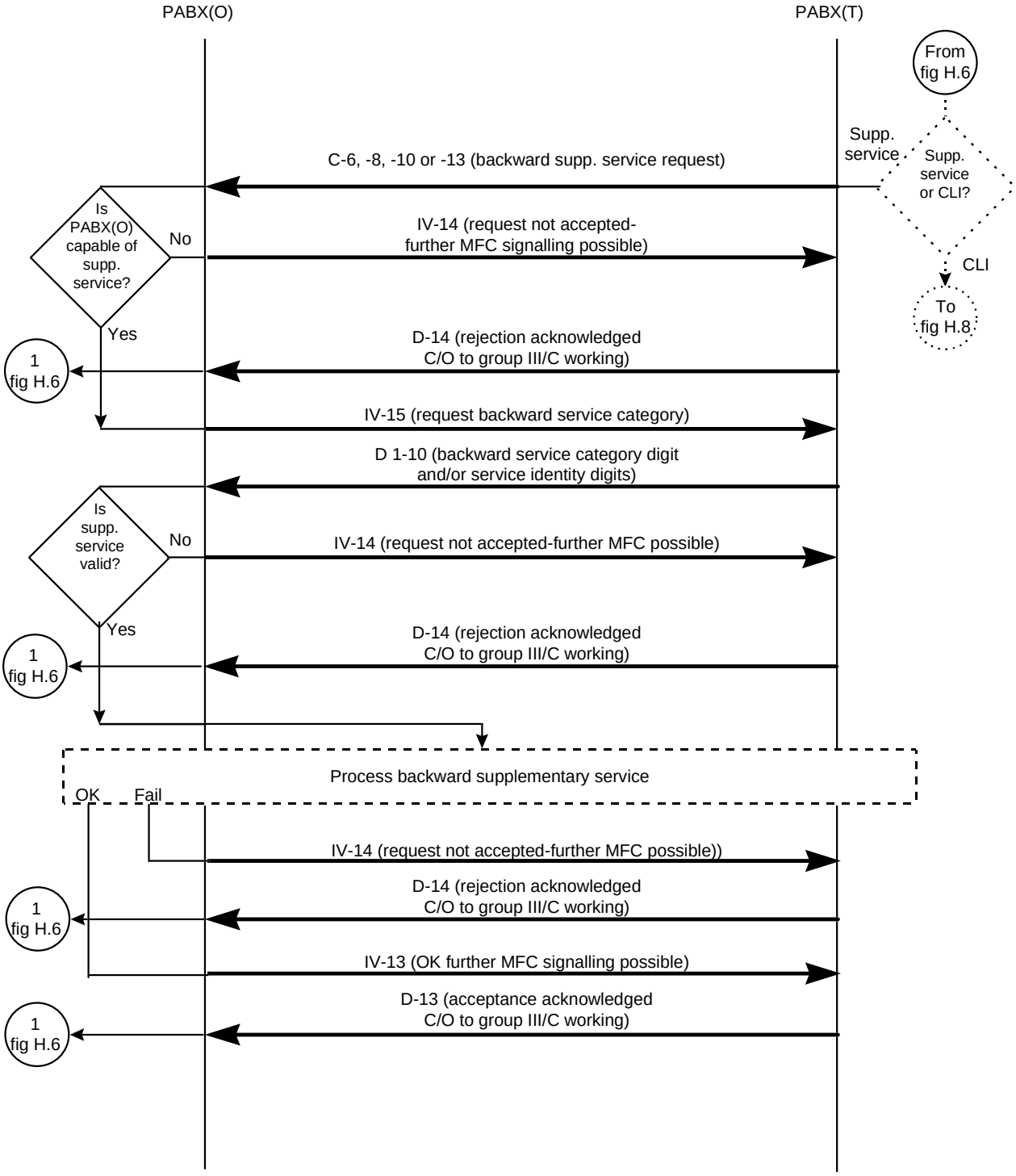


Figure H.7 (T/CS 49-08): Backward supplementary service request

Supplementary service requests can also occur after the release of MFC registers, either before or after answer (see subclause H.2.5.2.5.).

Signalling procedures specifications for non-harmonized supplementary services in national use or defined by a manufacturer, are not shown in this Recommendation. The relevant documentation should be provided by the Administration or manufacturer concerned.

H.2.5.2.4 Calling-line-identity

Calling-line-identity (CLI) requests occur normally as a part of the call establishment procedure by means of one of the following backward signals:

- Send-CLI (Signal C-9);
- Send-CLI, PSTN-barred (Signal C-11);
- Send-CLI, non-intrusion-request-rejected (Signal C-12);
- Send-CLI, PSTN-barred, non-intrusion-request-rejected (Signal C-14).

Since the calling-line-identity request is liable to occur on a large number of calls, the necessary signals are included in the main MFC signalling procedures, and are not included in an annex like other supplementary services. This reduces the number of signals required and, consequently, shortens the post-dialling delay.

On completion of the calling-line-identity request, the responding PABX, dependent upon its capability, either concludes MFC signalling, or retains its MFC registers to offer a subsequent supplementary service (see subclause H.2.5.2.9). Signal flows for calling-line-identity request are shown in figure H.8 (T/CS 49-08).

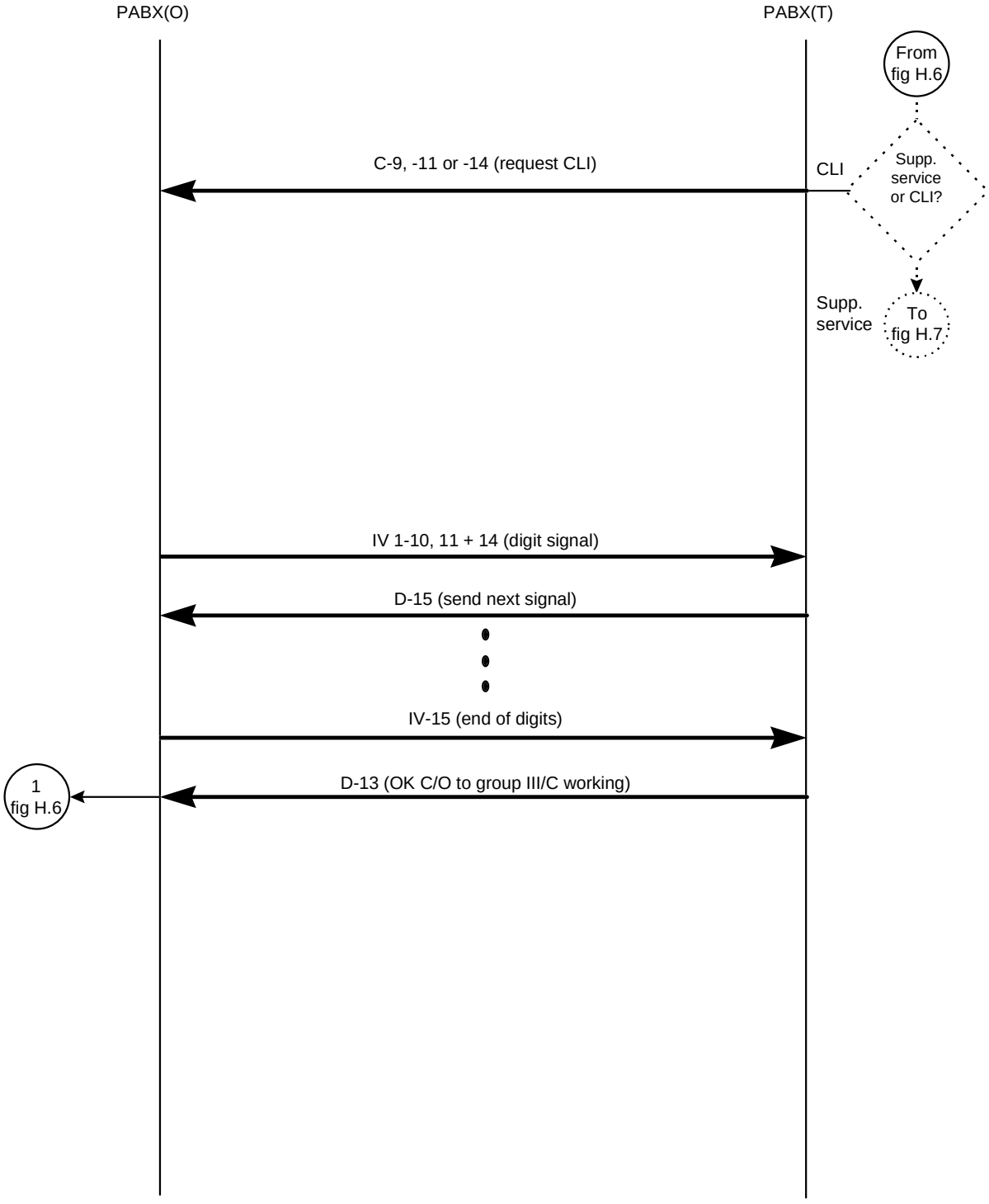


Figure H.8 (T/CS 49-08): Calling line identity request (CLI)

H.2.5.2.5 Supplementary services after register release

Where a supplementary service is required after the MFC registers have released, a register-recall signal will be used. Following a register-recall signal, both PABXs will automatically commence signalling in groups IV and D. The PABX that sends the register-recall signal will be considered the initiating PABX in terms of MFC, and will commence the signalling procedure by sending a group IV signal.

H.2.5.2.6 Signalling within supplementary services

The subsequent signalling flows within a supplementary service depend upon which supplementary service is requested. Details will be given in the relevant annex to the present document as they are agreed upon.

H.2.5.2.7 Rejection of supplementary service requests

Where a PABX cannot provide the service that has been requested, it shall return a request-no-accepted signal and, depending upon its capability, either concludes MFC signalling, or retains the MFC register to give an opportunity for an alternative service to be requested (see subclause H.2.5.2.9).

H.2.5.2.8 Sequential processing of supplementary service requests

During a call it is possible, although improbable, that more than one service demand will need to be processed at a given time. Examples of this are listed below.

i) Clash of supplementary services: an incoming call has diversion-override capability and the called party has diversion activated.

ii) Second attempt: a supplementary service or calling line identification is required, following an unsuccessful attempt to change-over to manufacturer.

iii) Enhancement of a supplementary service: following a supplementary service request, the PABX wants to change-over to manufacturer for a specific enhancement.

To enable a number of supplementary service requests to be processed sequentially, the following signals are included in groups IV and D:

- OK/acceptance-acknowledged, change-over-to-groups-III-and-C D- 13
- Request-not-accepted/rejection-acknowledged, change-over-to-groups-III-and-C D- 14
- OK, further-MFC-signalling-possible IV-13
- Request-not-accepted, further-MFC-signalling-possible IV-14

These signals, which may be used either on completion of a supplementary service or on rejection of a service request, return the signalling to groups III and C allocations, thus enabling the PABXs to either request a further service or conclude MFC signalling. On each return to groups III and C signalling, the originating PABX has priority. When the originating PABX has no further requests to make, it sends a no-further-supplementary-service-request signal (III-I5). The responding PABX, on receipt of this signal, either sends a supplementary service request or concludes MFC signalling by sending a conclude-MFC-signalling signal C-1.

H.2.5.3 Manufacturer subset

When the subset compatibility check has identified a common manufacturer subset, call handling continues in accordance with the appropriate specifications. However, once manufacturer subset procedures have been entered, it is still possible to revert back to standard System L1 MFC working.

The signalling procedures within manufacturer subsets are not given in this Recommendation, and the relevant documentation should be provided by the manufacturer concerned.

H.3 SDL diagrams

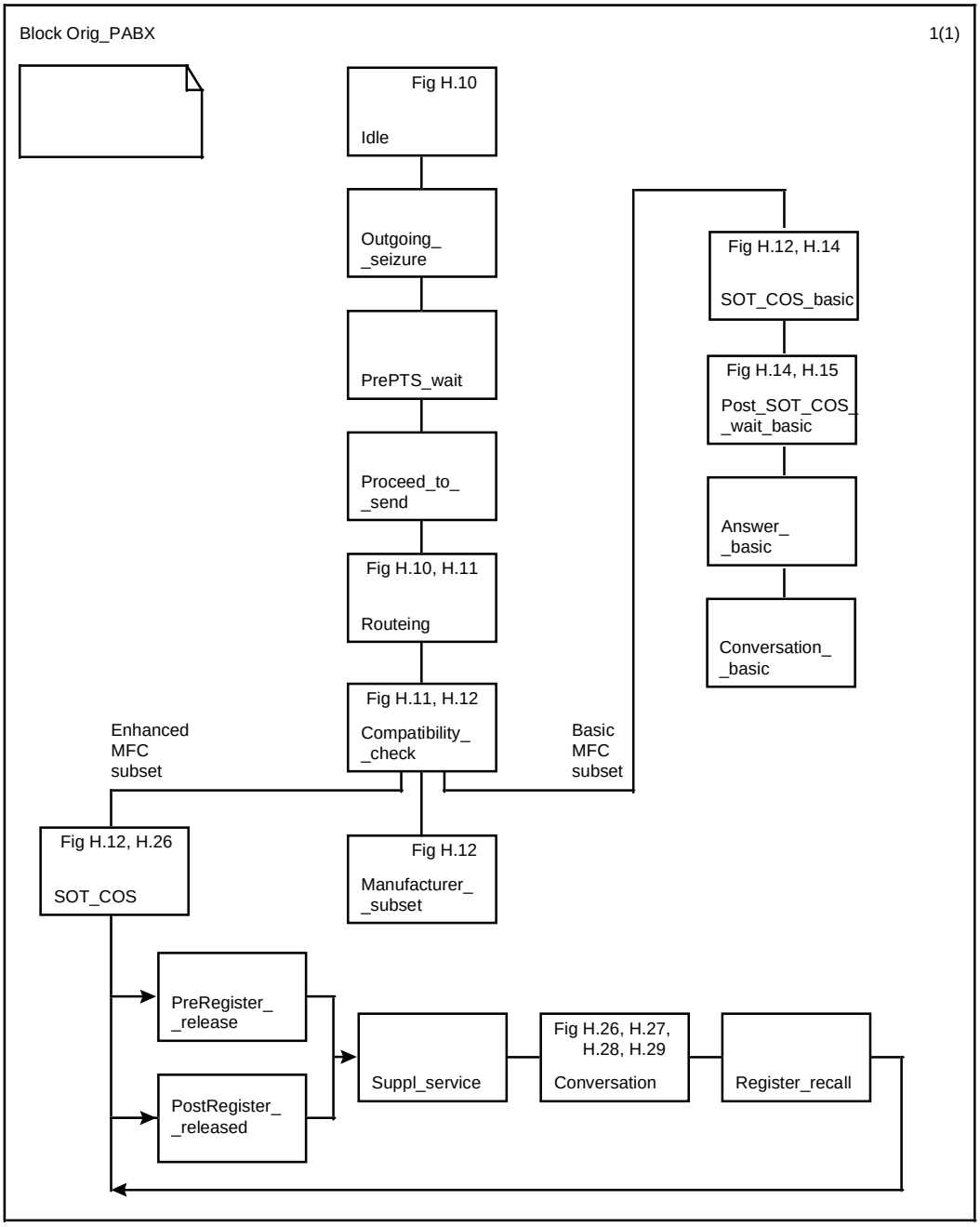


Figure H.9 (T/CS 49-08): Functional block description of originating PABX (sheet 1 of 1)

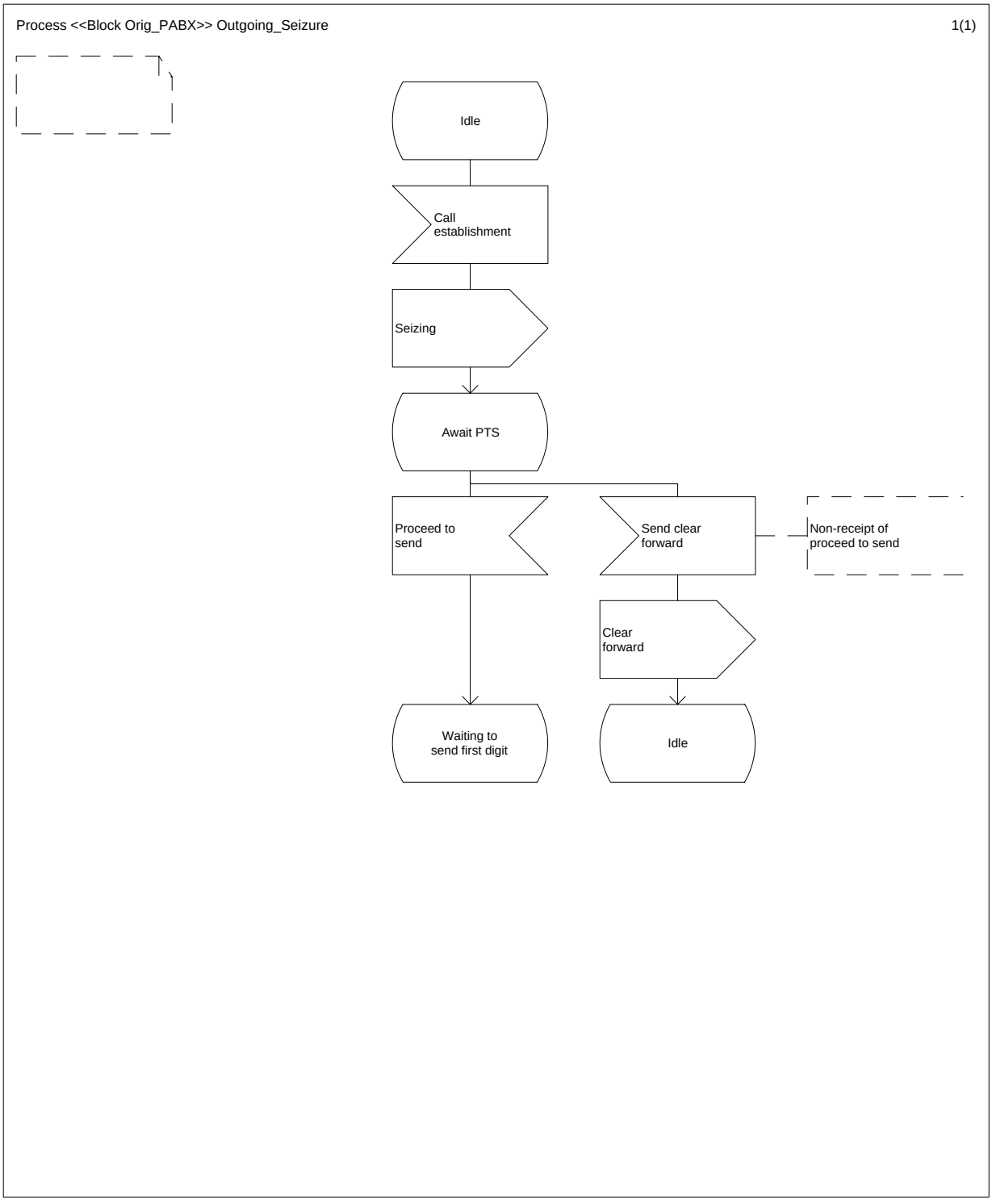


Figure H.10 (T/CS 49-08): Originating PABX circuit seizure (sheet 1 of 1)

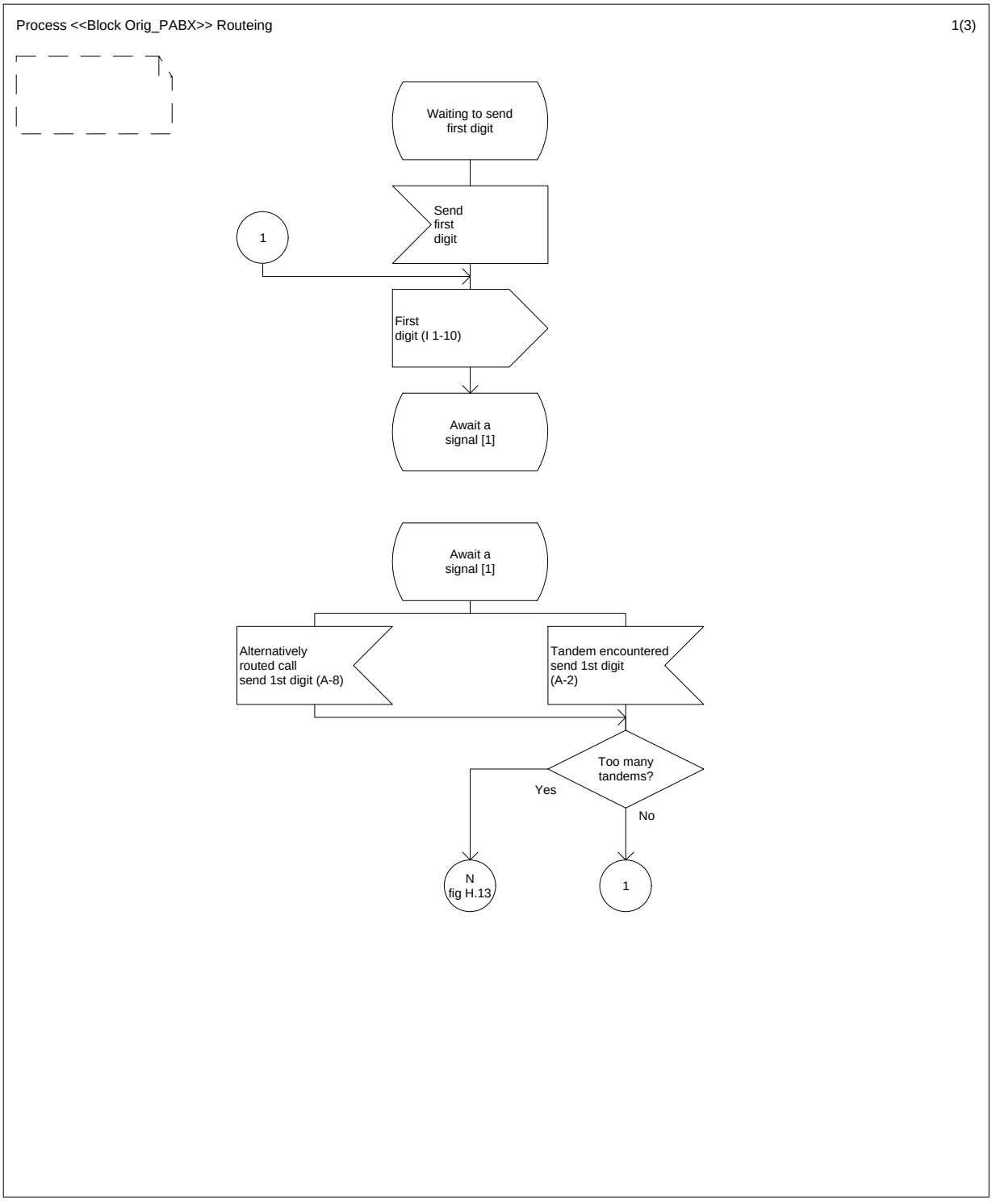


Figure H.11 (T/CS 49-08): Originating PABX routeing (sheet 1 of 3)

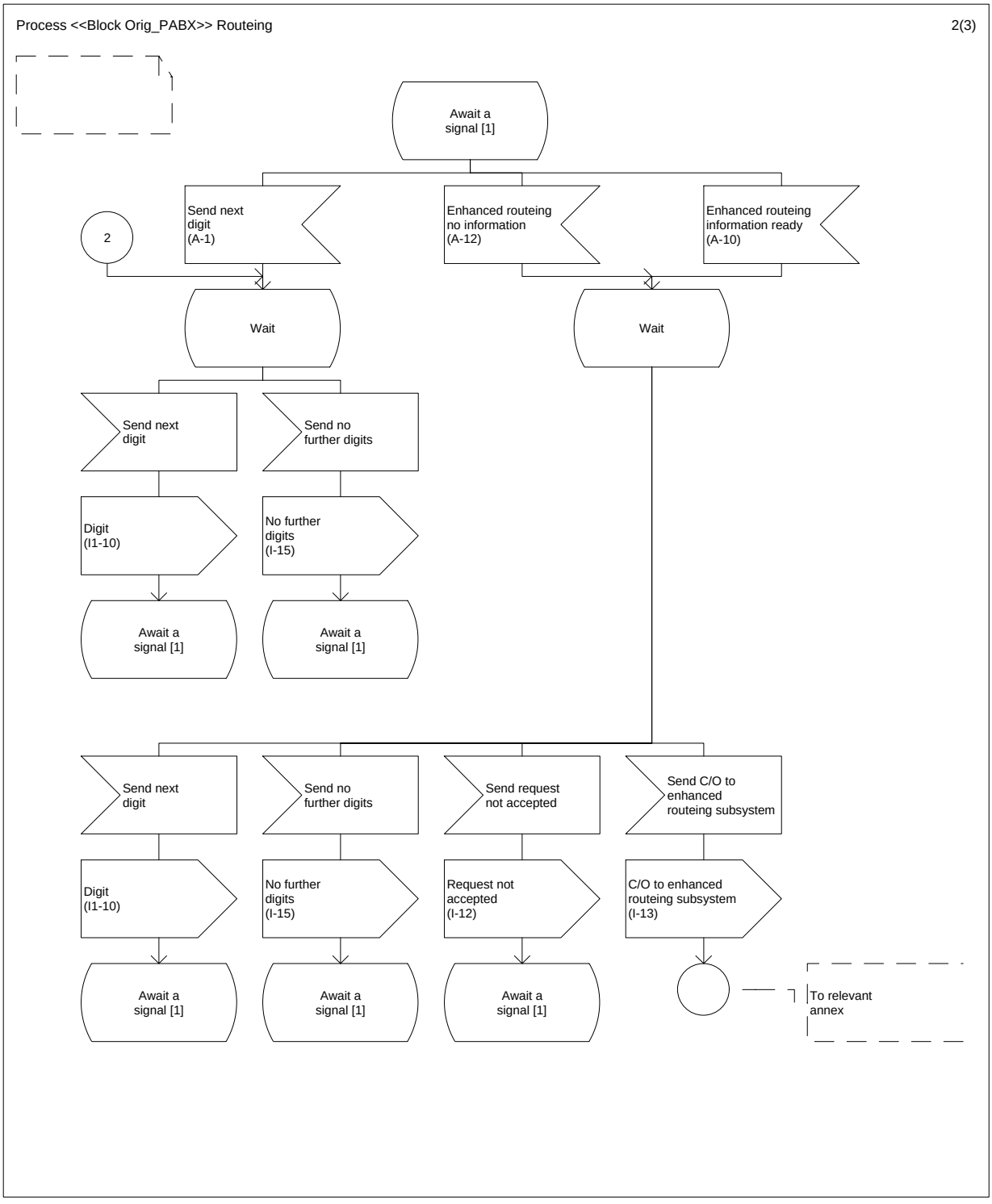


Figure H.11 (T/CS 49-08): Originating PABX routeing (sheet 2 of 3)

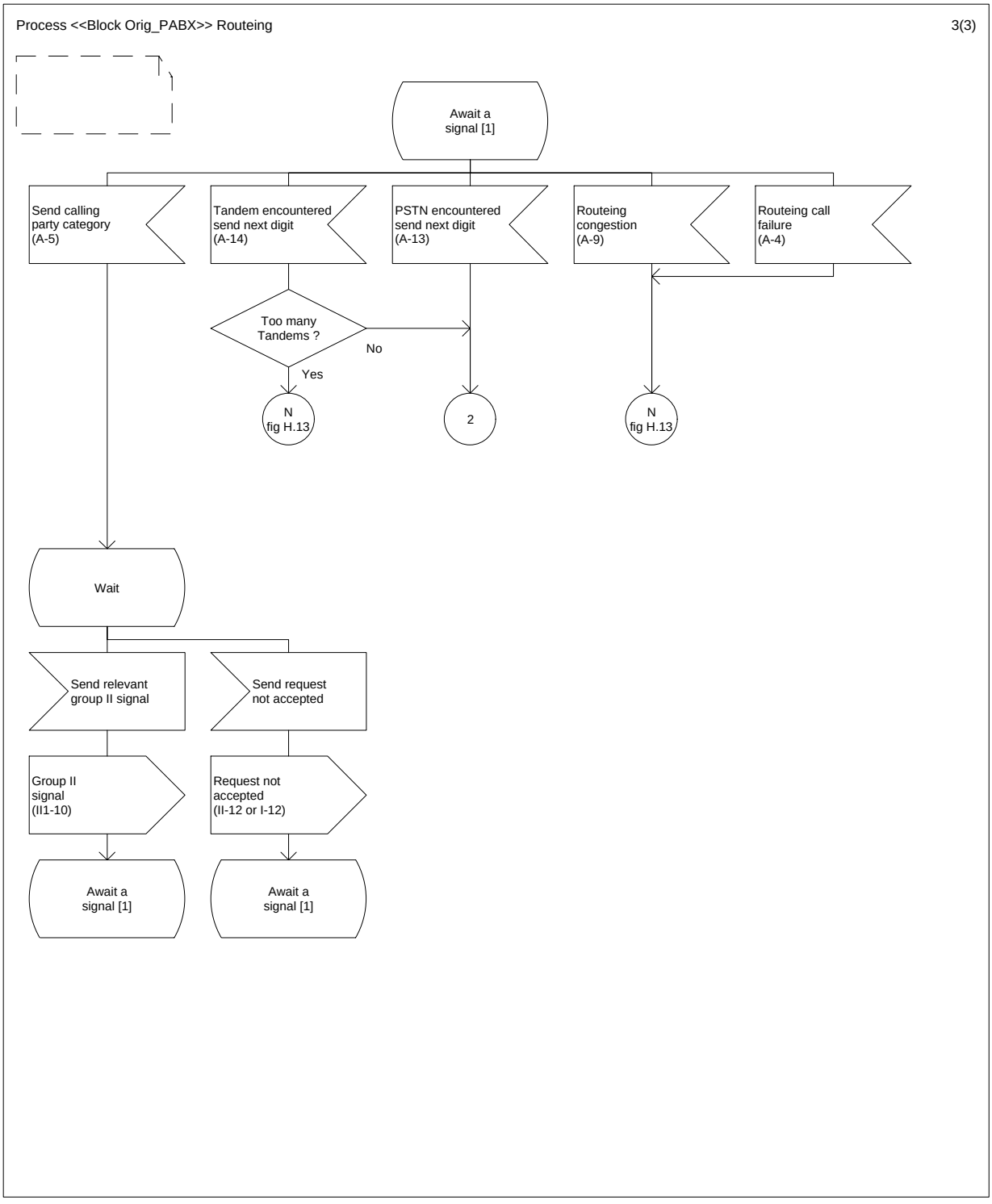


Figure H.11 (T/CS 49-08): Originating PABX routeing (sheet 3 of 3)

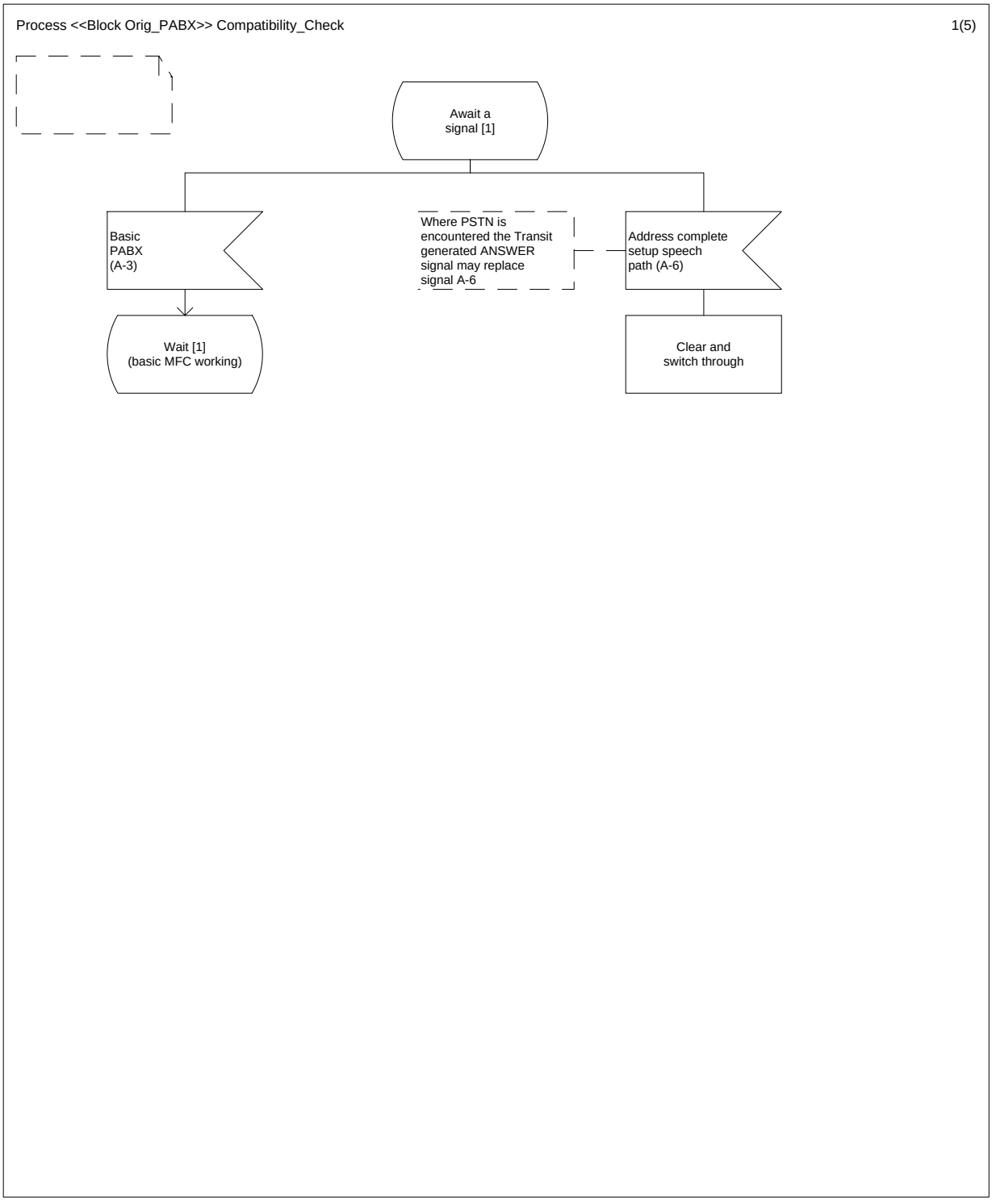


Figure H.12 (T/CS 49-08): Originating PABX compatibility procedure (sheet 1 of 5)

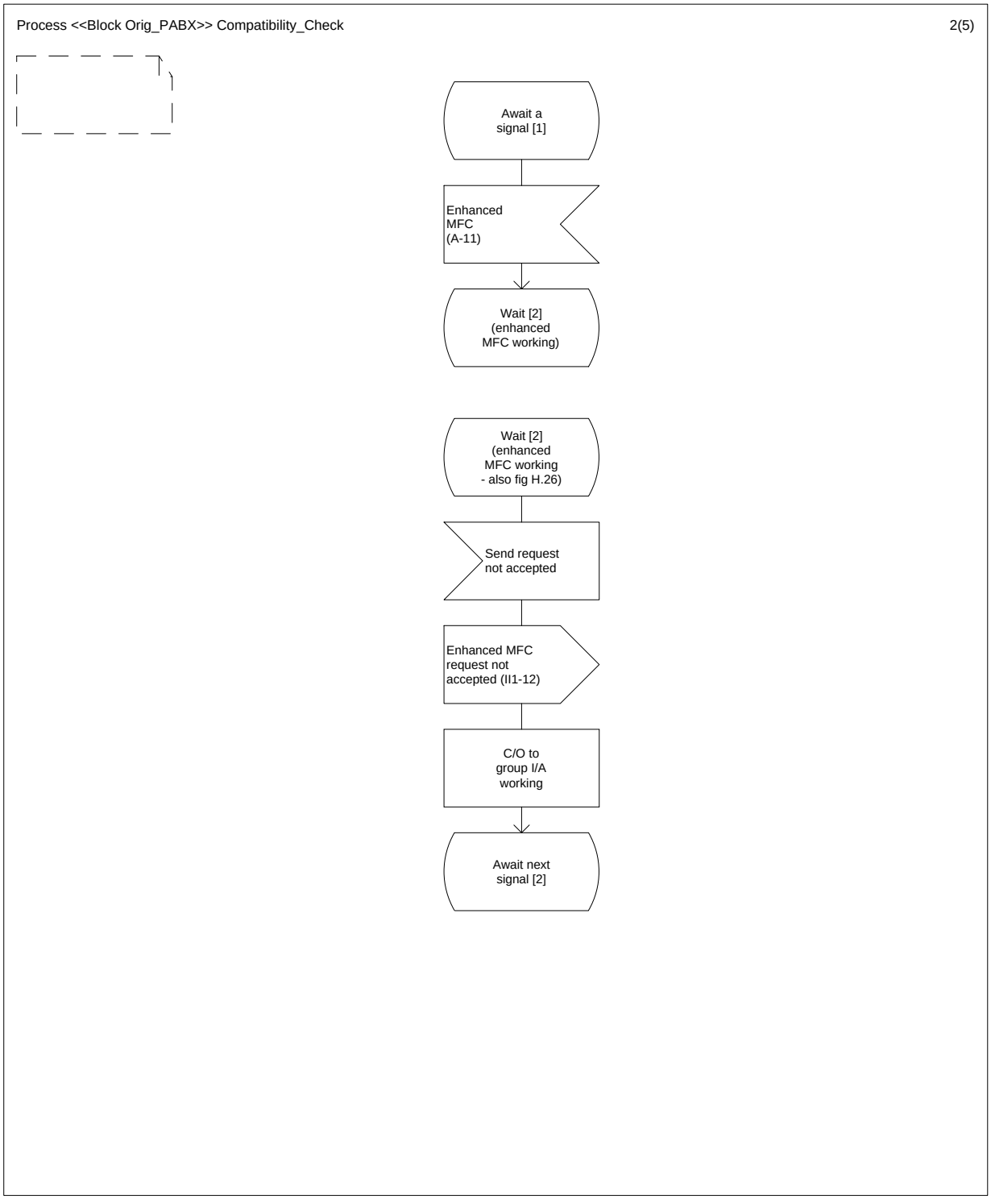


Figure H.12 (T/CS 49-08): Originating PABX compatibility procedure (sheet 2 of 5)

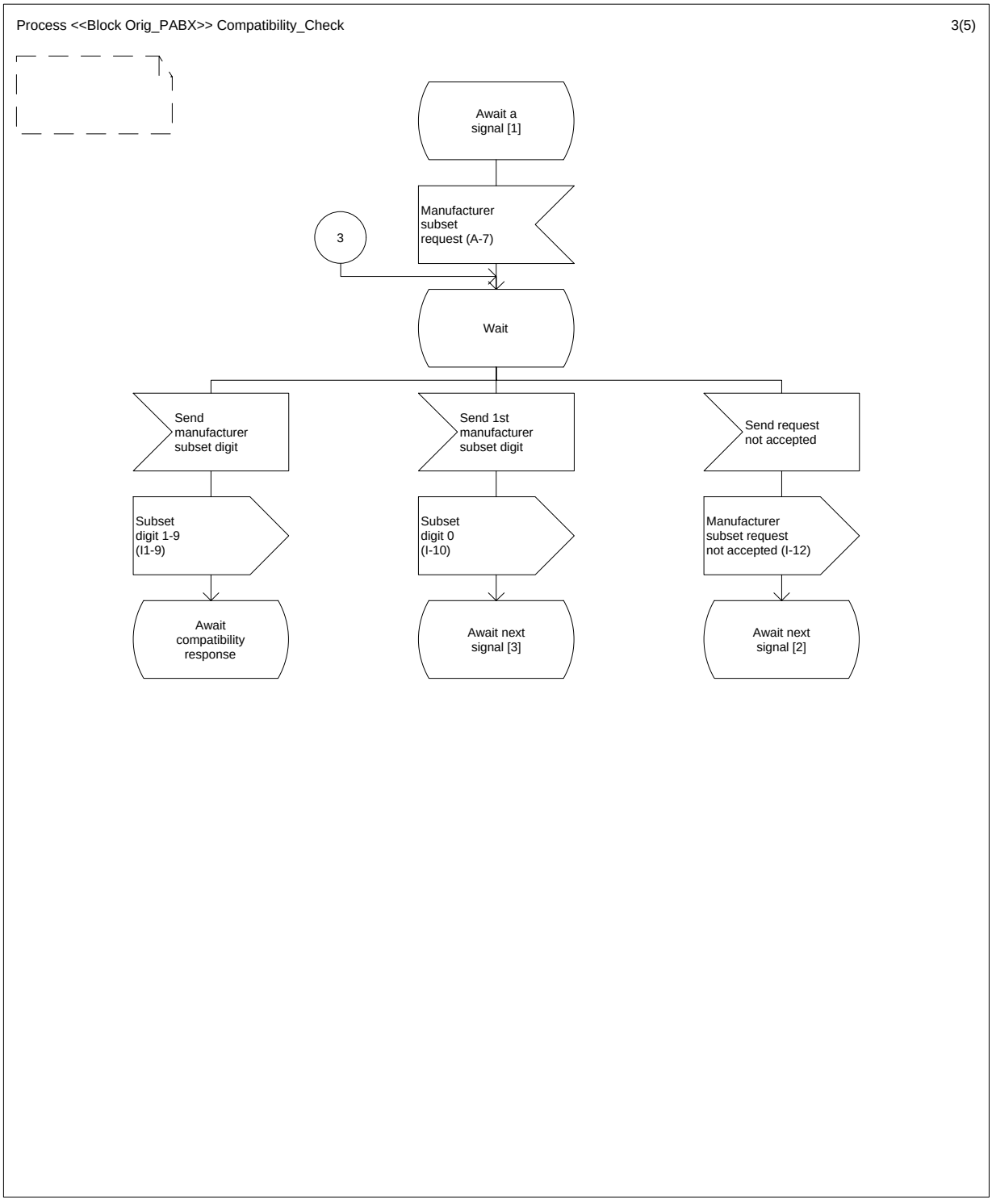


Figure H.12 (T/CS 49-08): Originating PABX compatibility procedure (sheet 3 of 5)

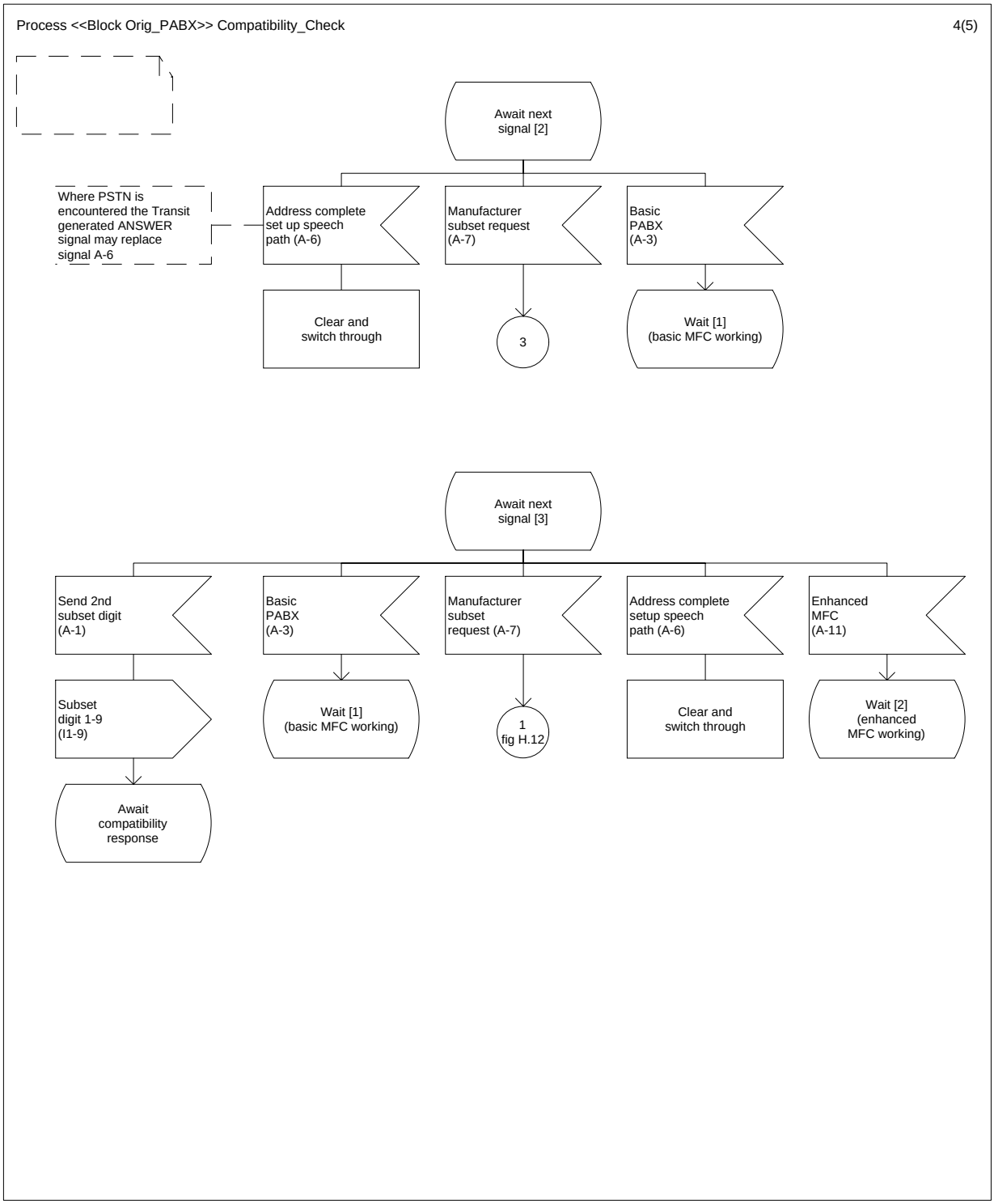


Figure H.12 (T/CS 49-08): Originating PABX compatibility procedure (sheet 4 of 5)

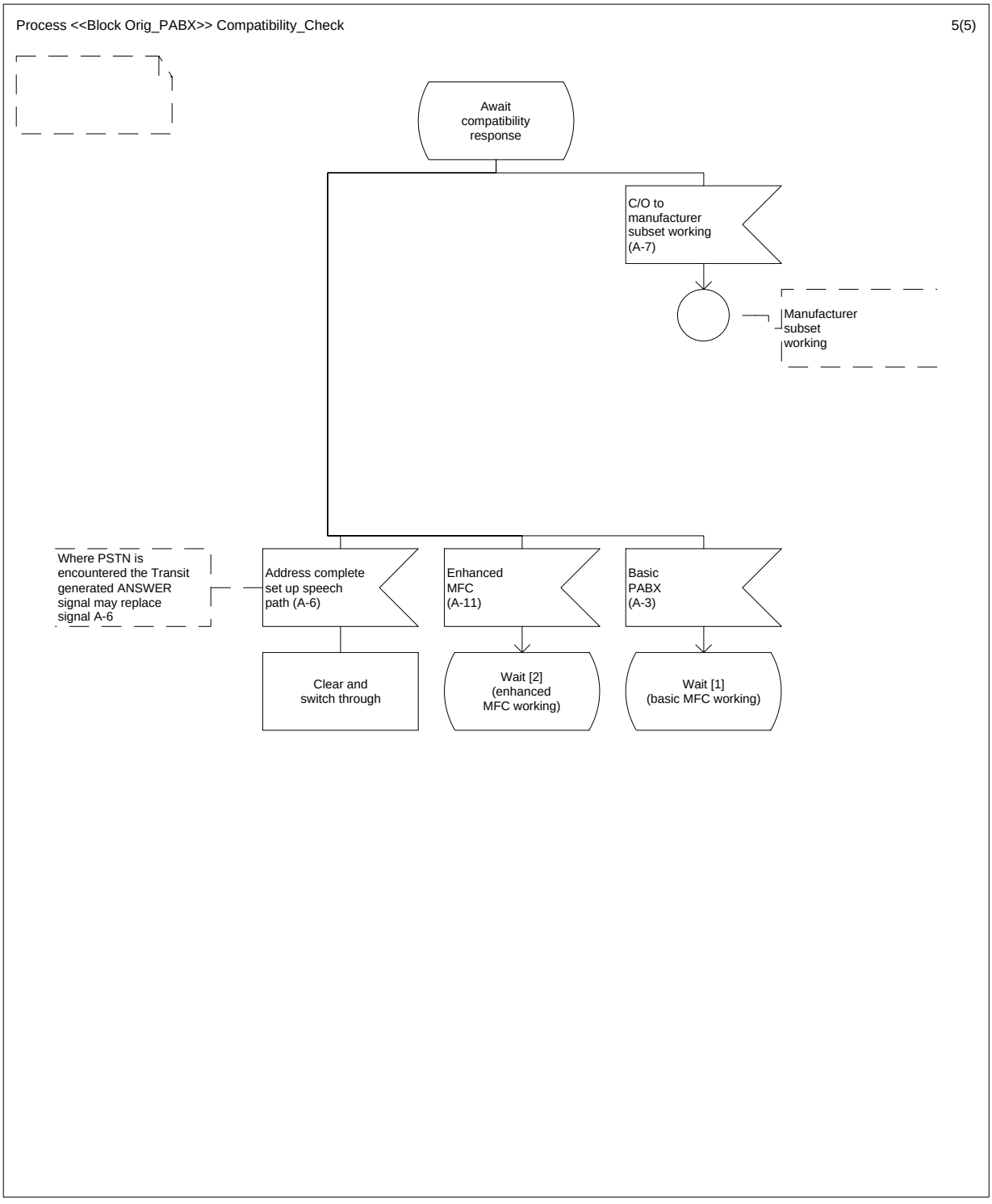


Figure H.12 (T/CS 49-08): Originating PABX compatibility procedure (sheet 5 of 5)

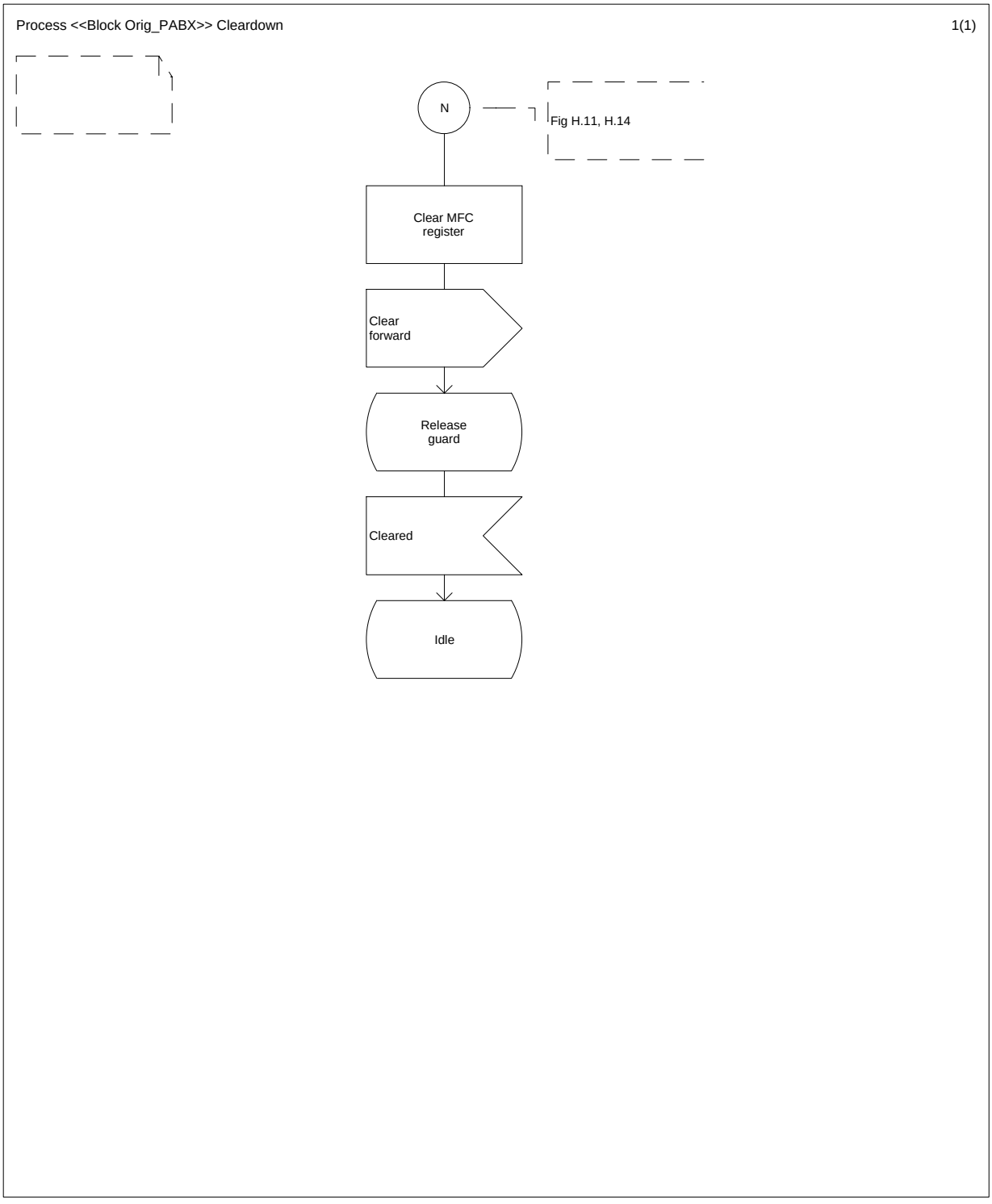


Figure H.13 (T/CS 49-08): Originating PABX clear-down sequence (basic subset) (sheet 1 of 1)

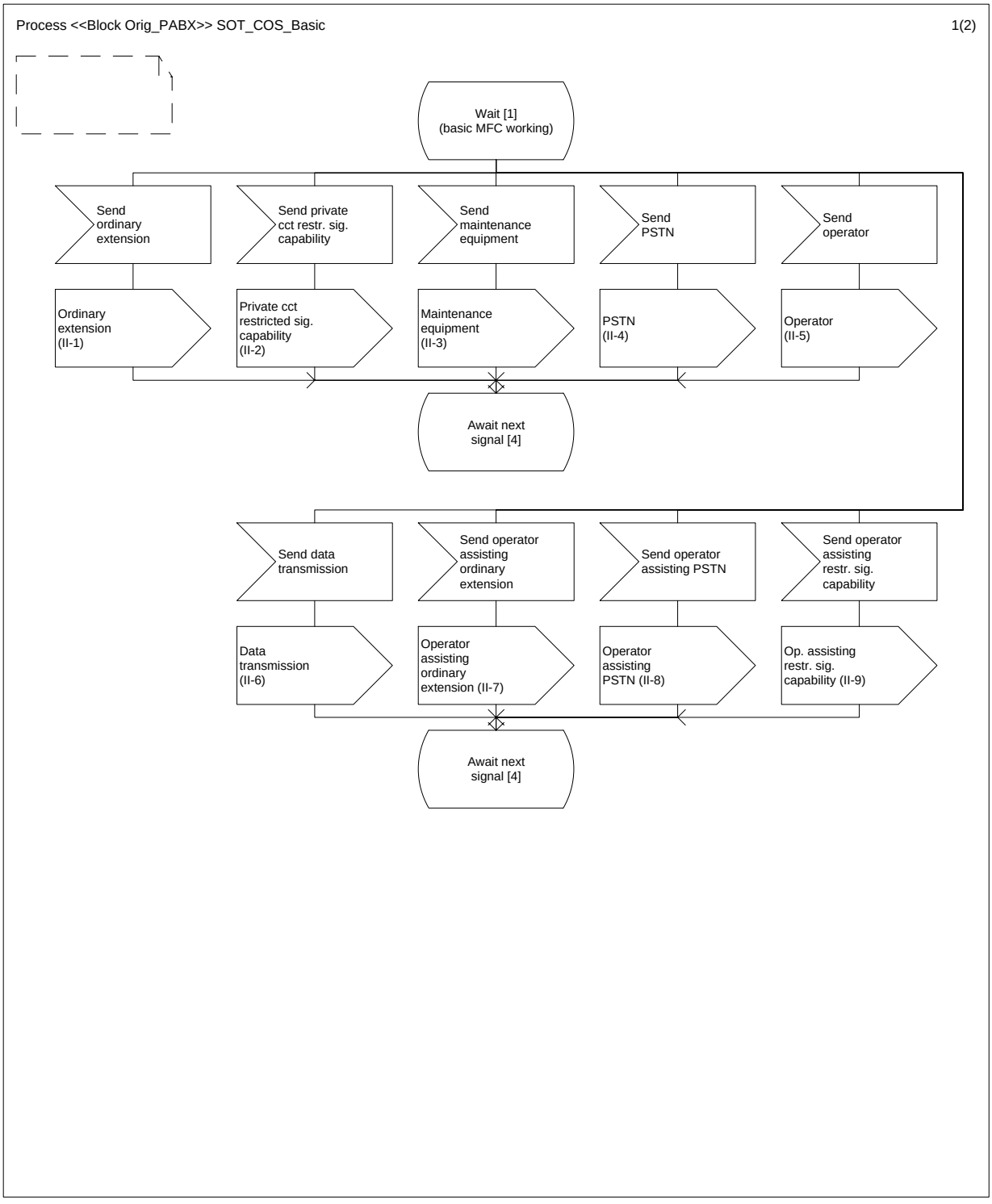


Figure H.14 (T/CS 49-08): Originating PABX SOT/COS procedure (basic subset) (sheet 1 of 2)

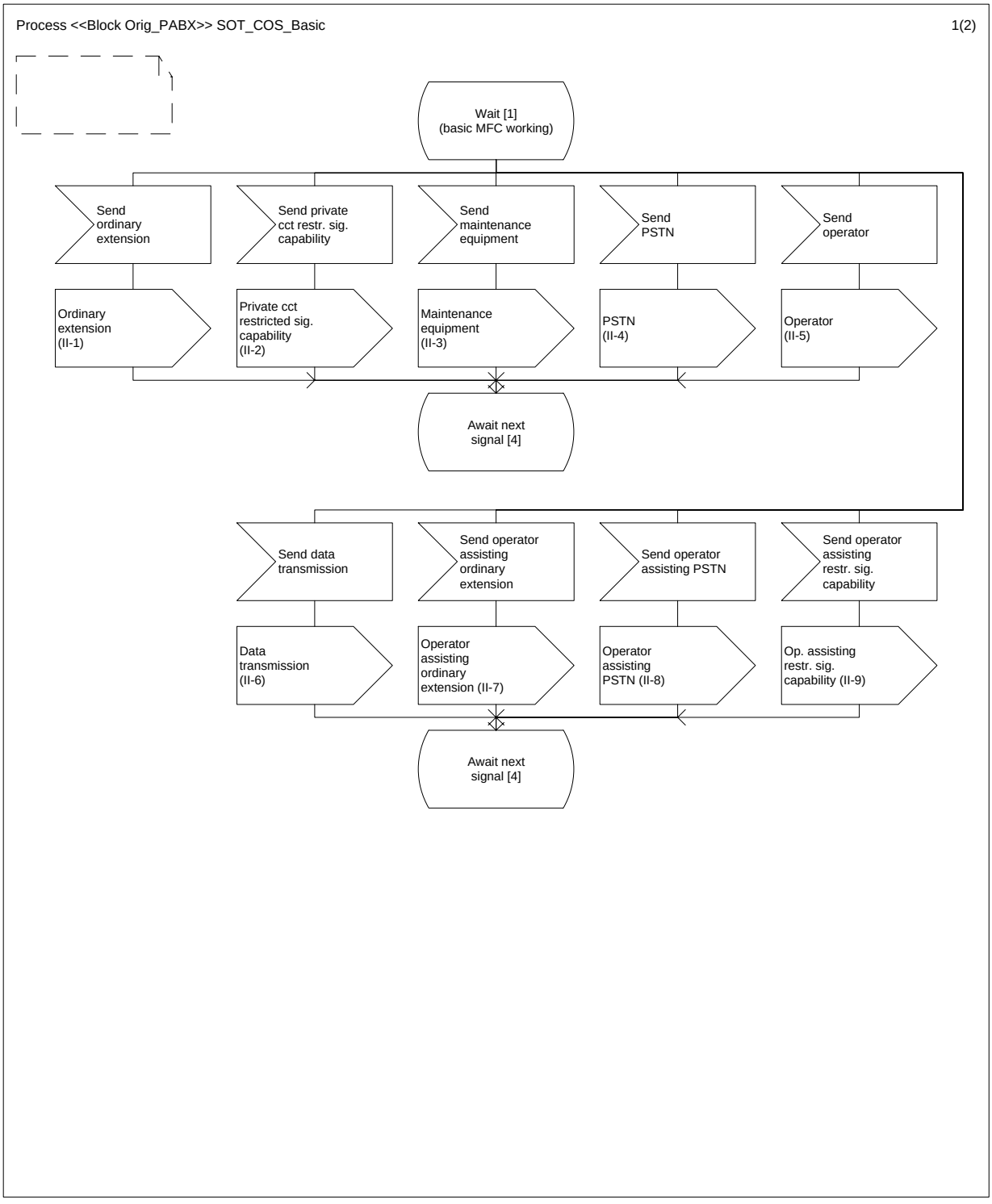


Figure H.14 (T/CS 49-08): Originating PABX SOT/COS procedure (basic subset) (sheet 2 of 2)

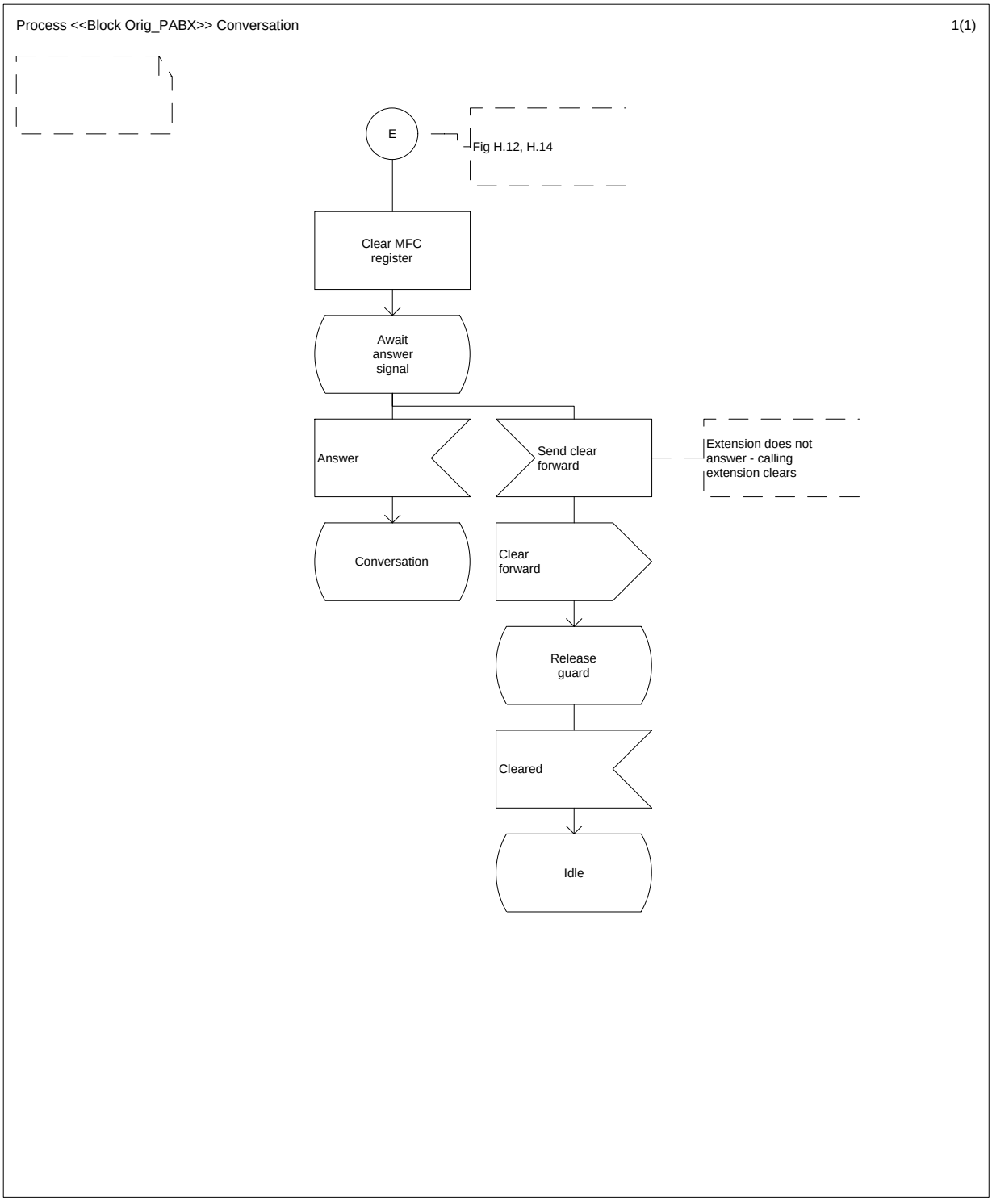


Figure H.15 (T/CS 49-08): Originating PABX answer and conversation (basic subset) (sheet 1 of 1)

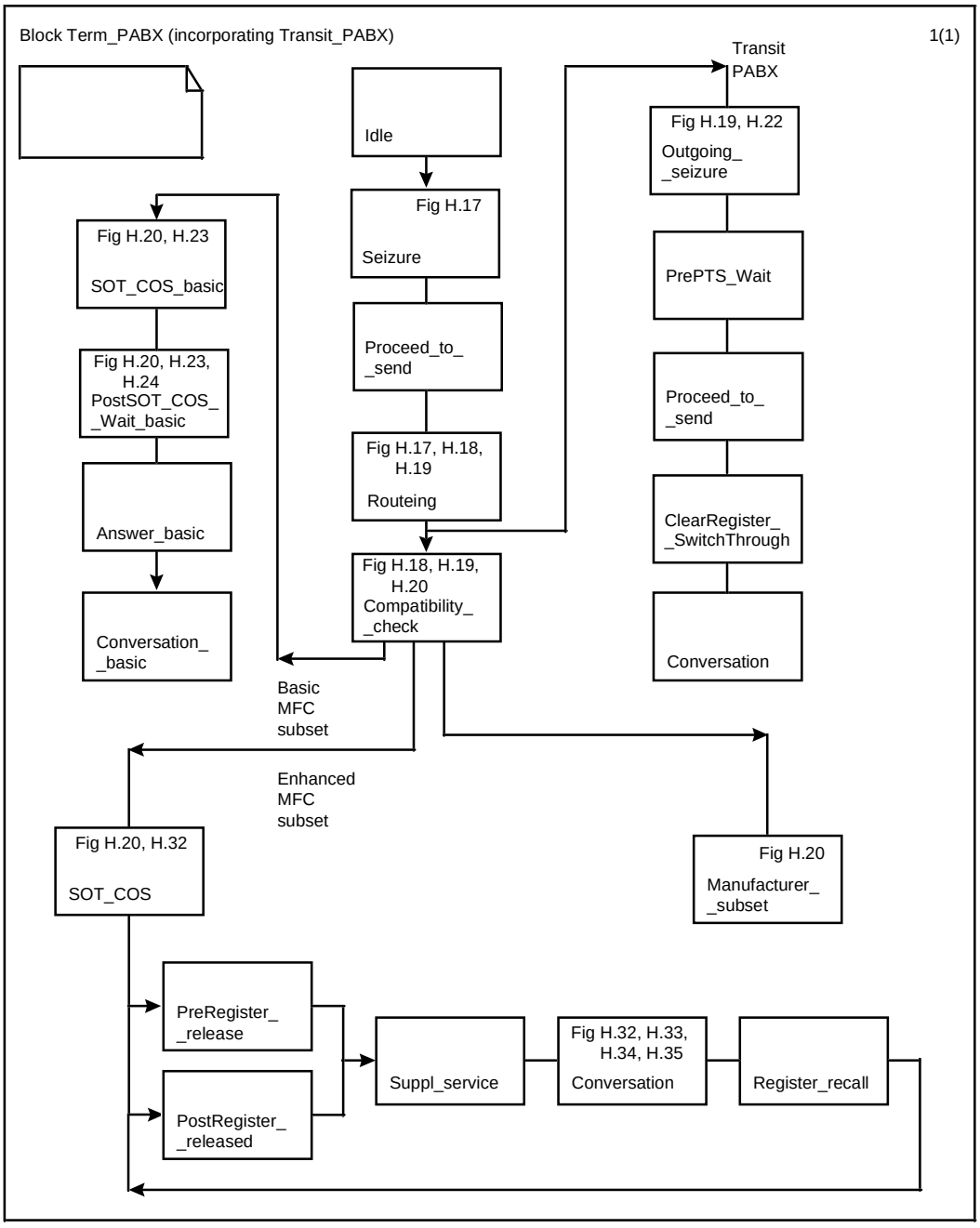


Figure H.16 (T/CS 49-08): Functional block description of terminating and transit PABX (sheet 1 of 1)

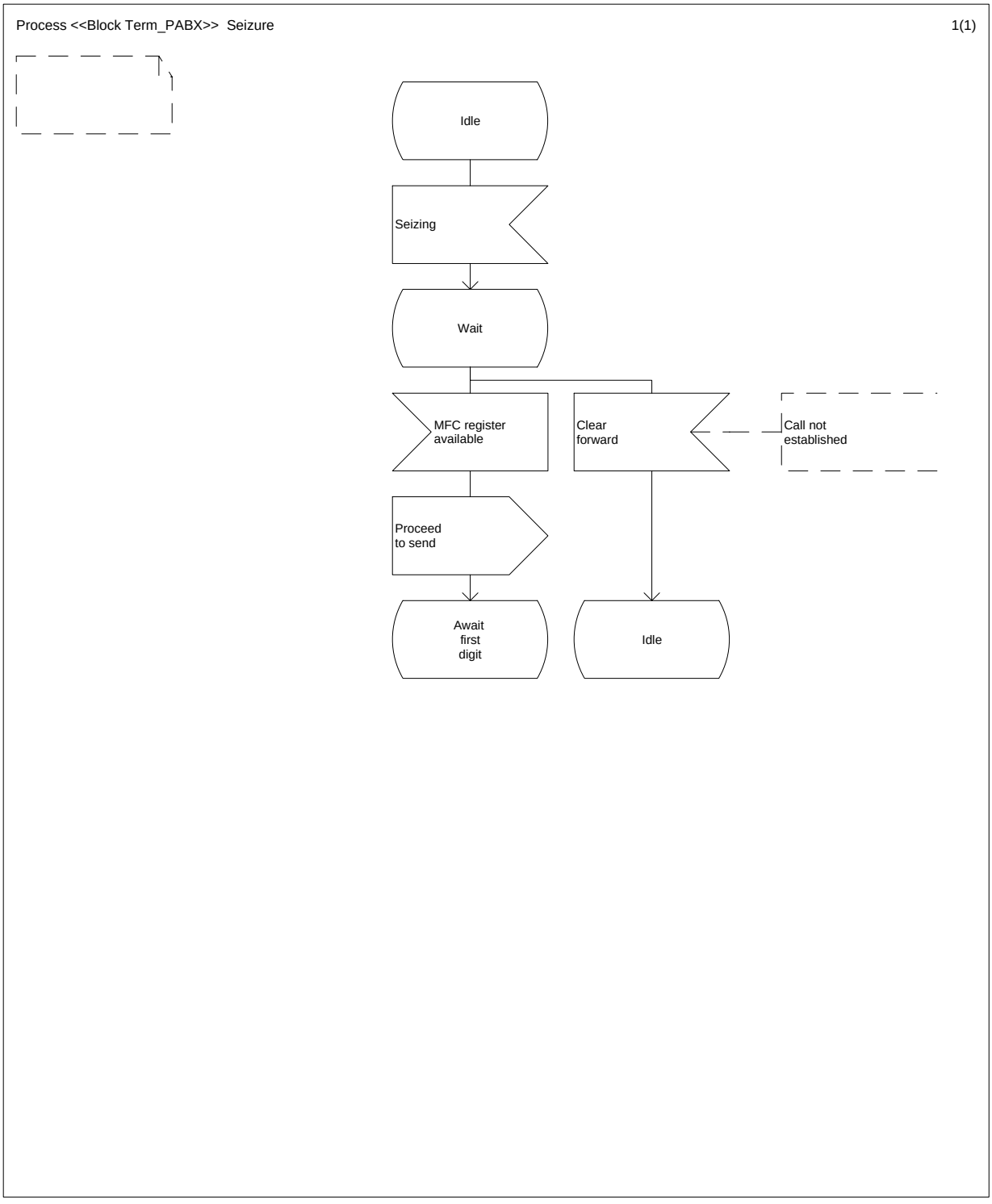


Figure H.17 (T/CS 49-08): Terminating PABX circuit seizure (sheet 1 of 1)

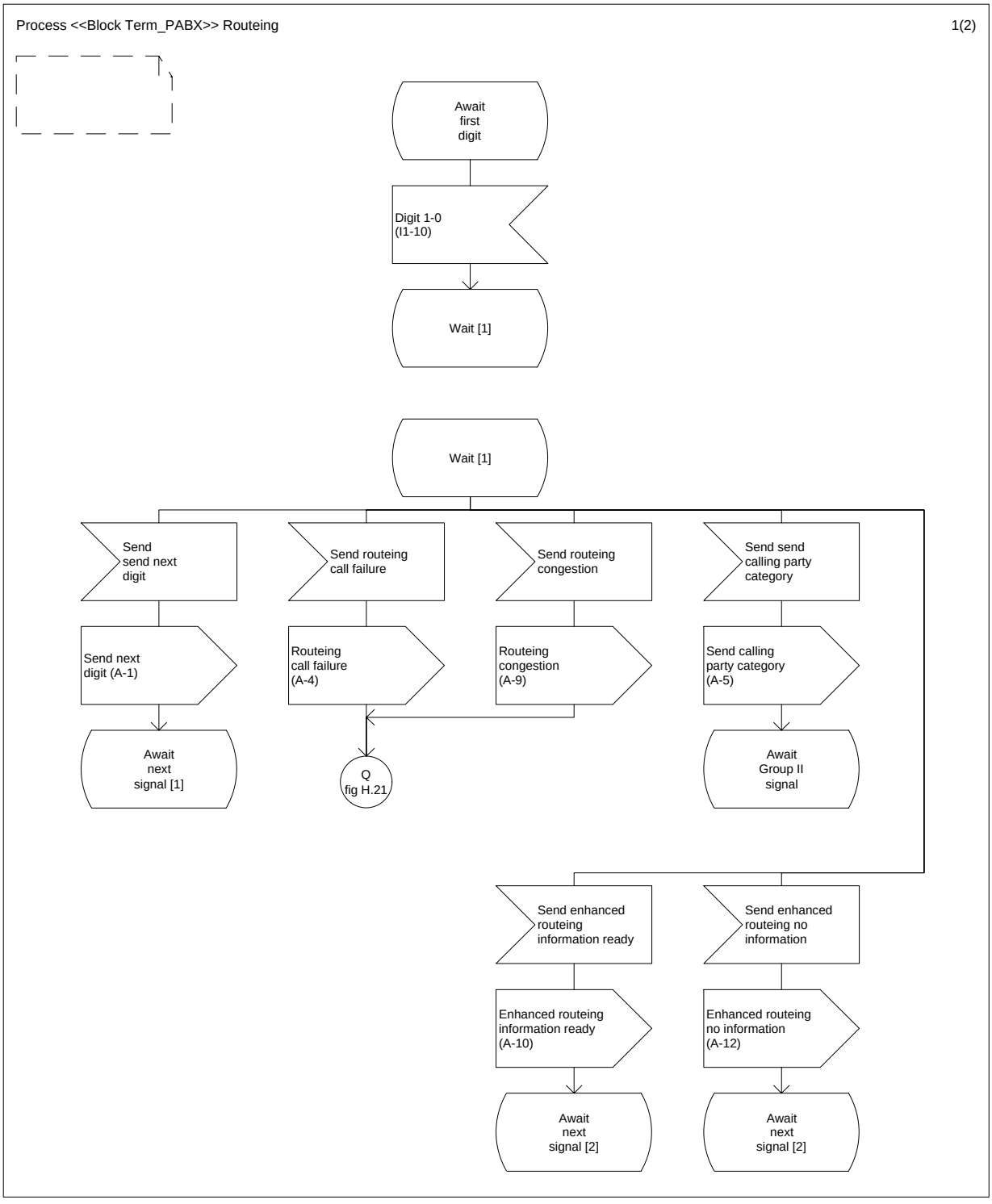


Figure H.18 (T/CS 49-08): Terminating PABX routing including enhanced routeing (sheet 1 of 2)

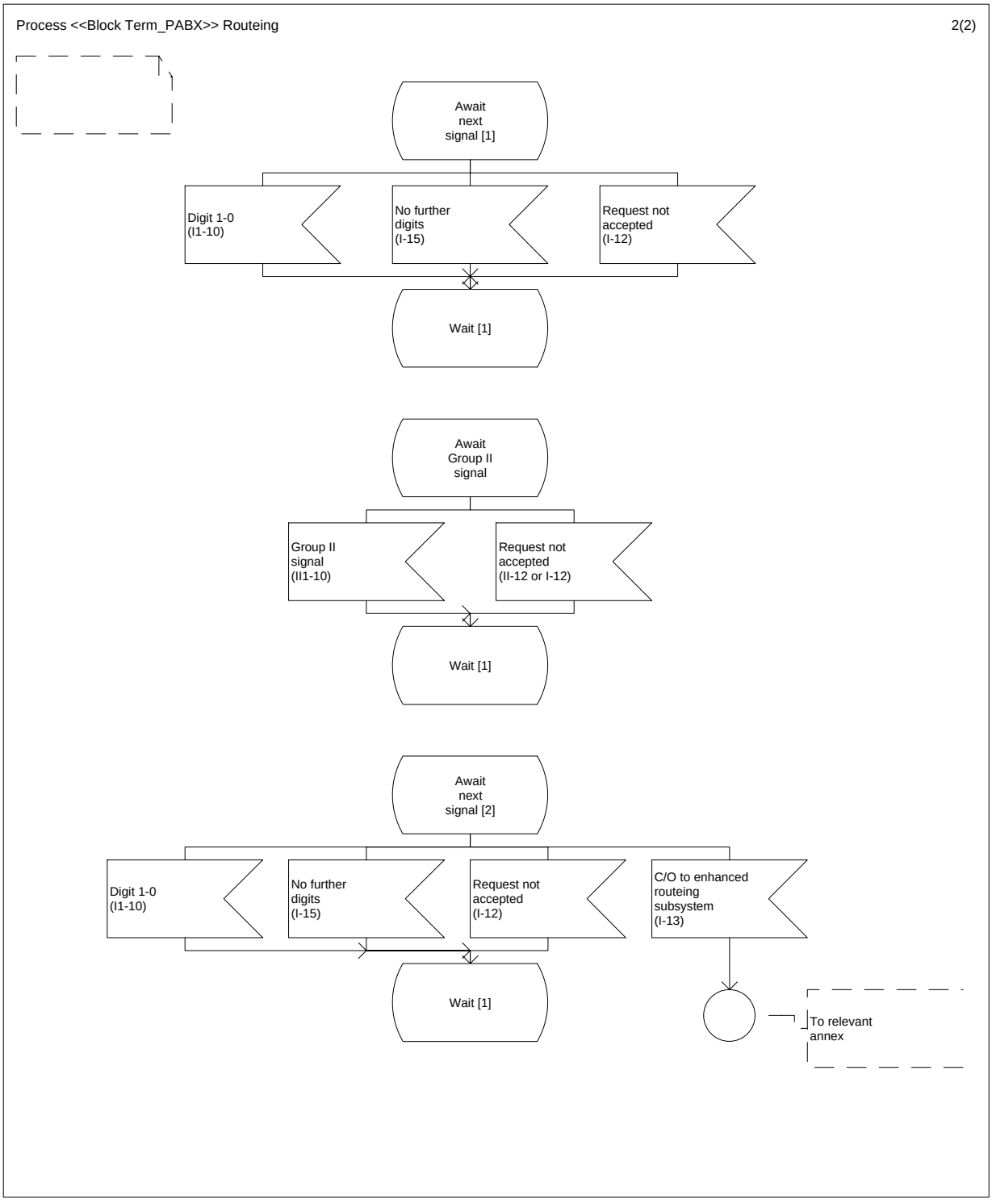


Figure H.18 (T/CS 49-08): Terminating PABX routing including enhanced routeing (sheet 2 of 2)

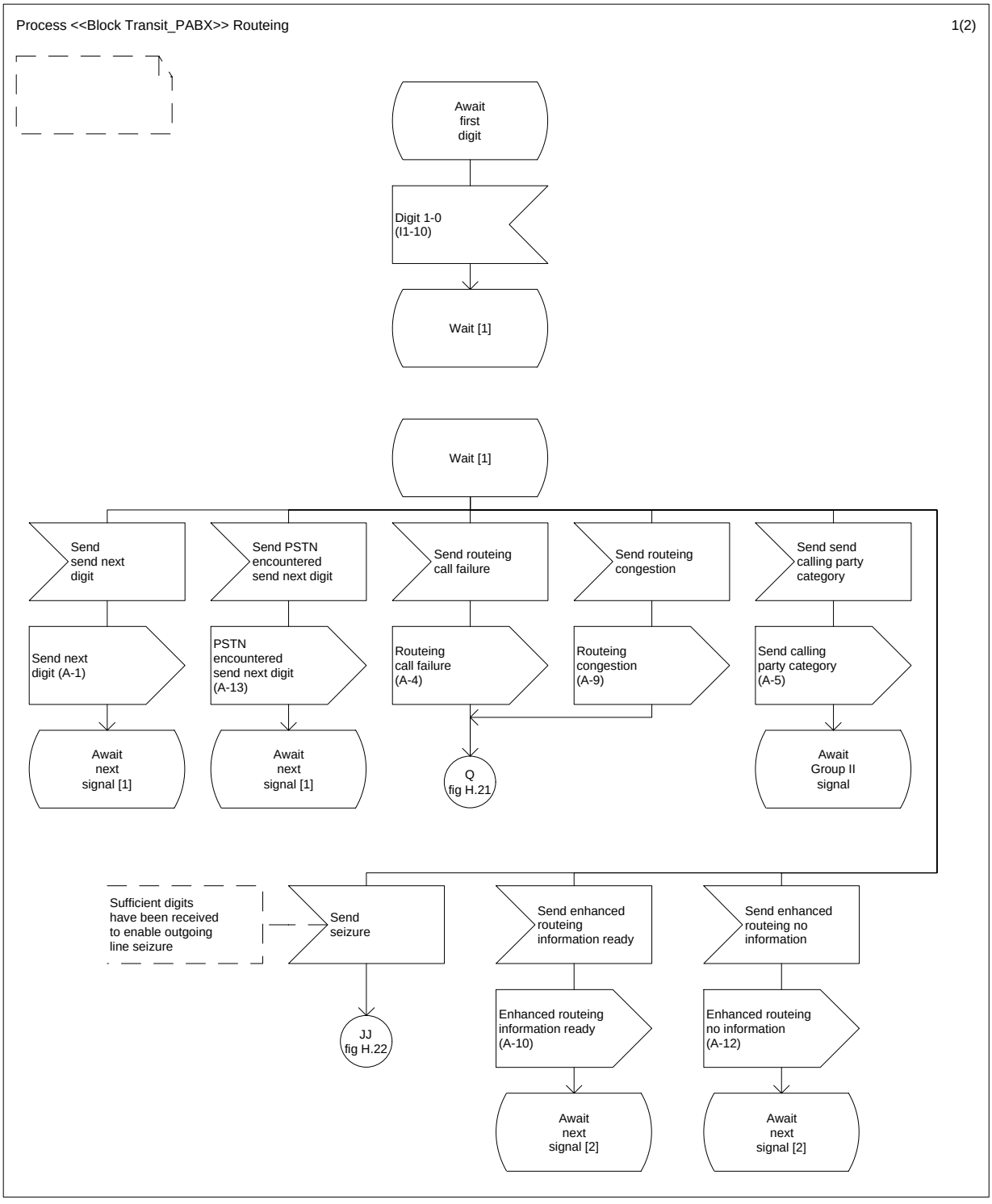


Figure H.19 (T/CS 49-08): Transit PABX routing including enhanced routeing (sheet 1 of 2)

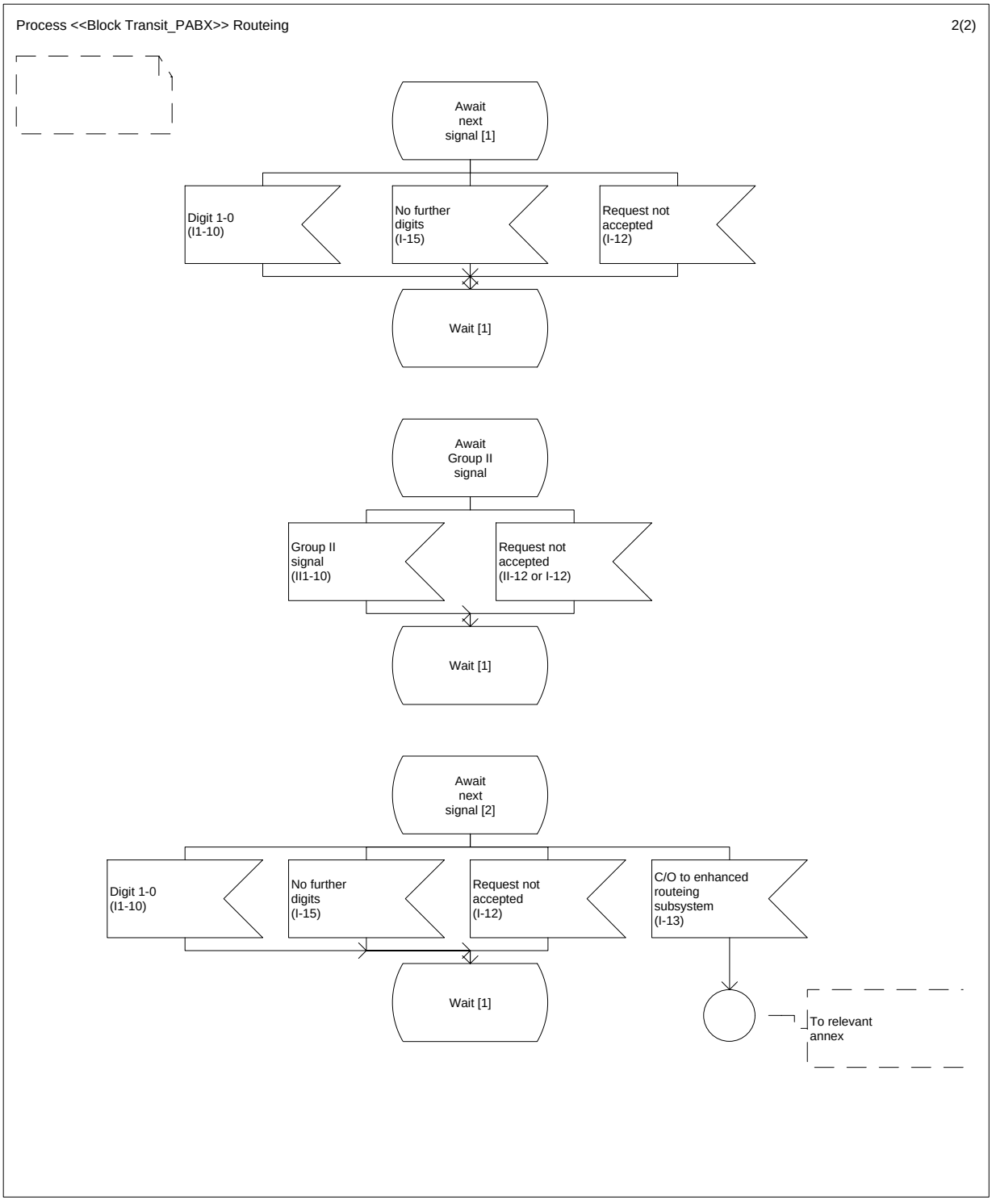


Figure H.19 (T/CS 49-08): Transit PABX routing including enhanced routeing (sheet 2 of 2)

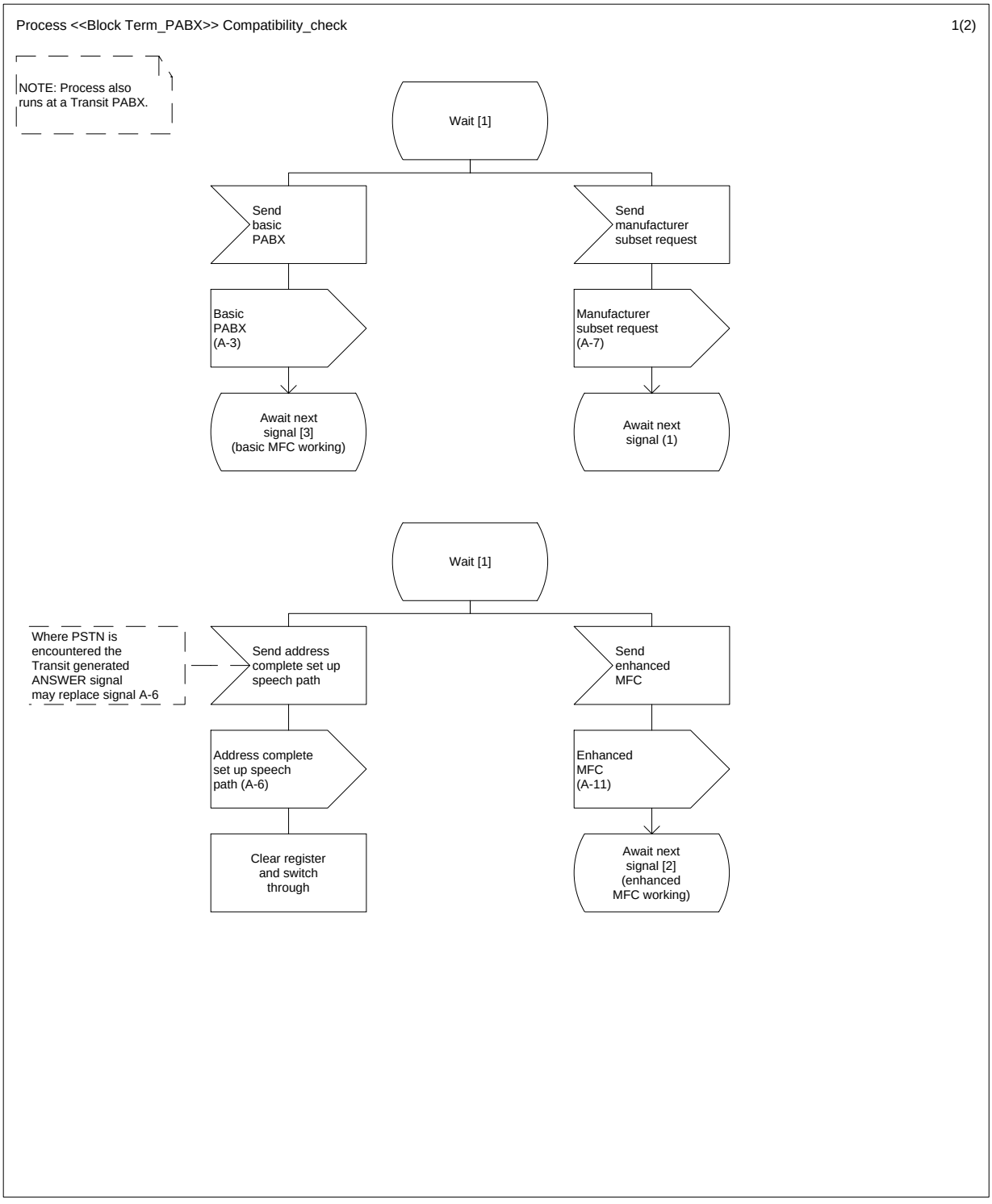


Figure H.20 (T/CS 49-08): Terminating PABX compatibility procedure (sheet 1 of 2)

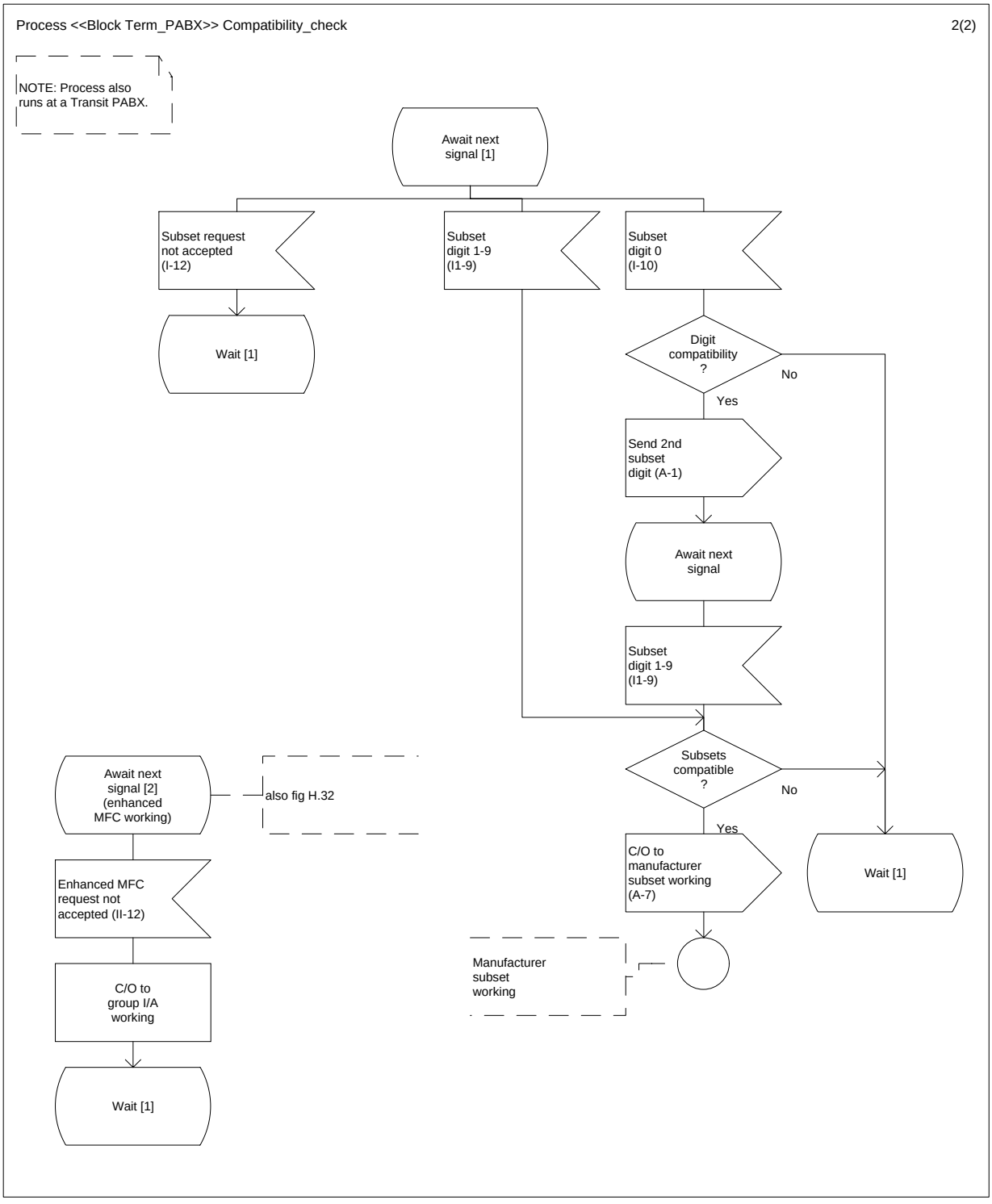


Figure H.20 (T/CS 49-08): Terminating PABX compatibility procedure (sheet 2 of 2)

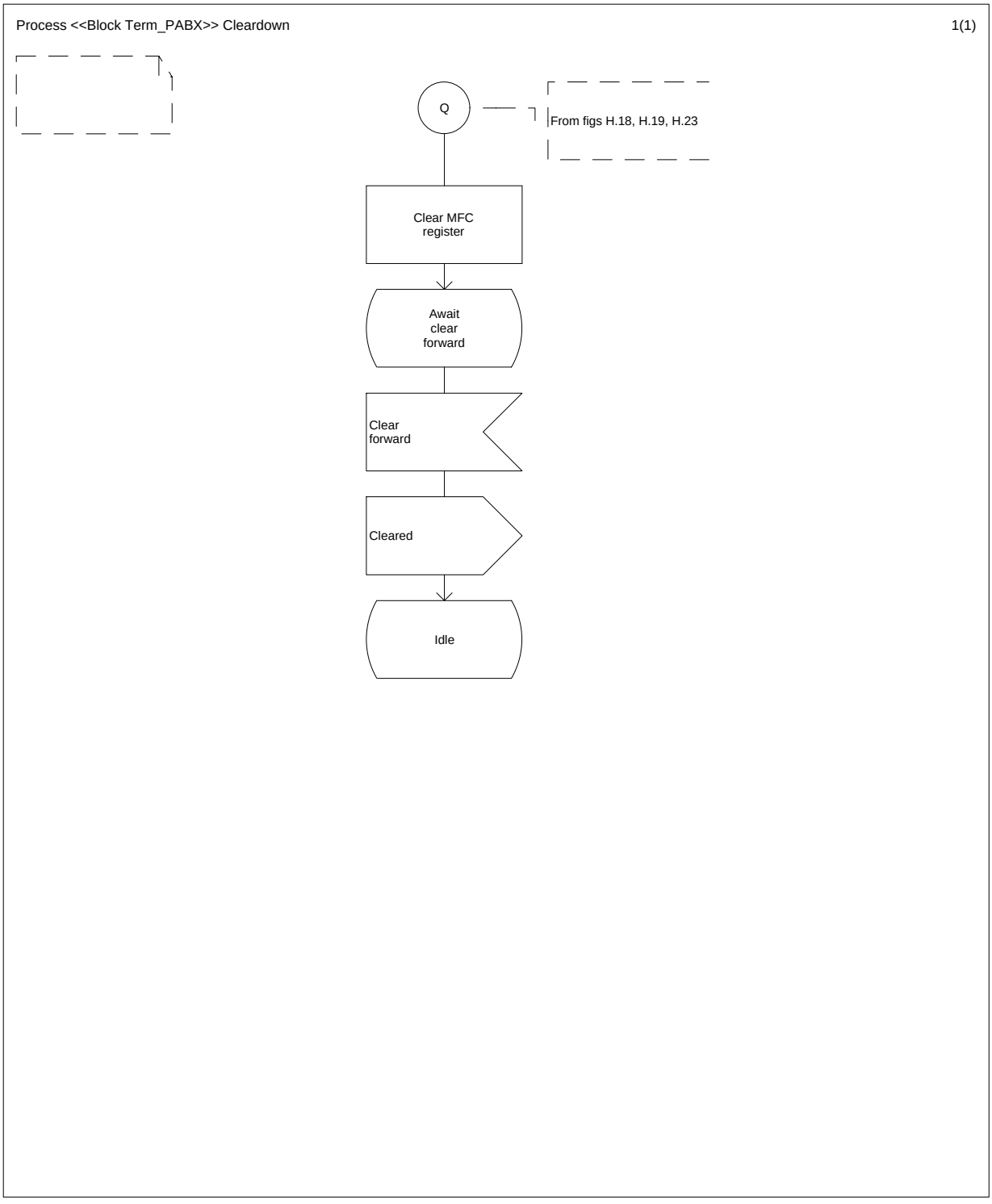


Figure H.21 (T/CS 49-08): Terminating PABX clear-down sequence (basic subset) (sheet 1 of 1)

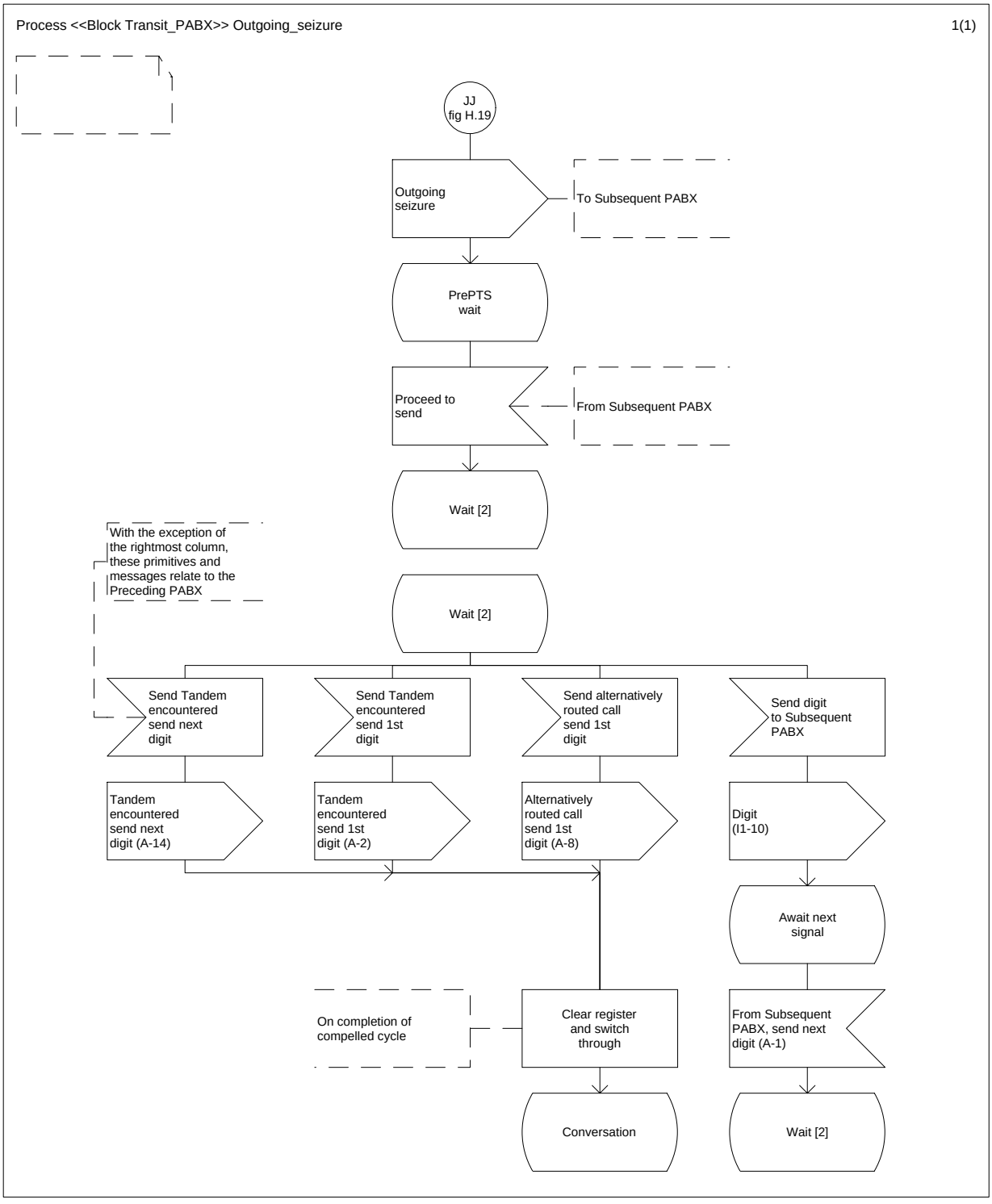


Figure H.22 (T/CS 49-08): Transit PABX circuit seizure (O/G) (sheet 1 of 1)

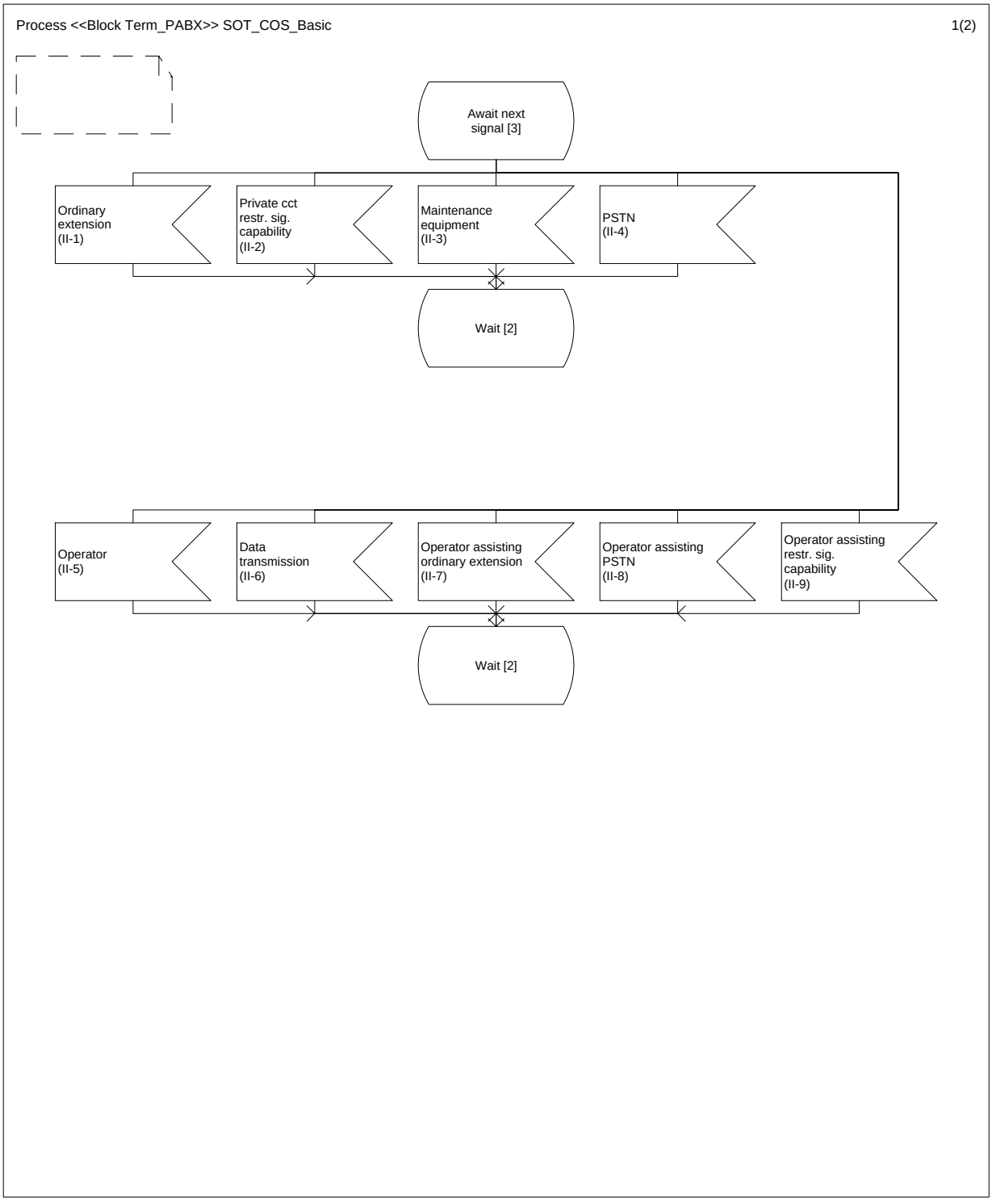


Figure H.23 (T/CS 49-08): Terminating PABX SOT/COS procedure (basic MFC subset) (sheet 1 of 2)

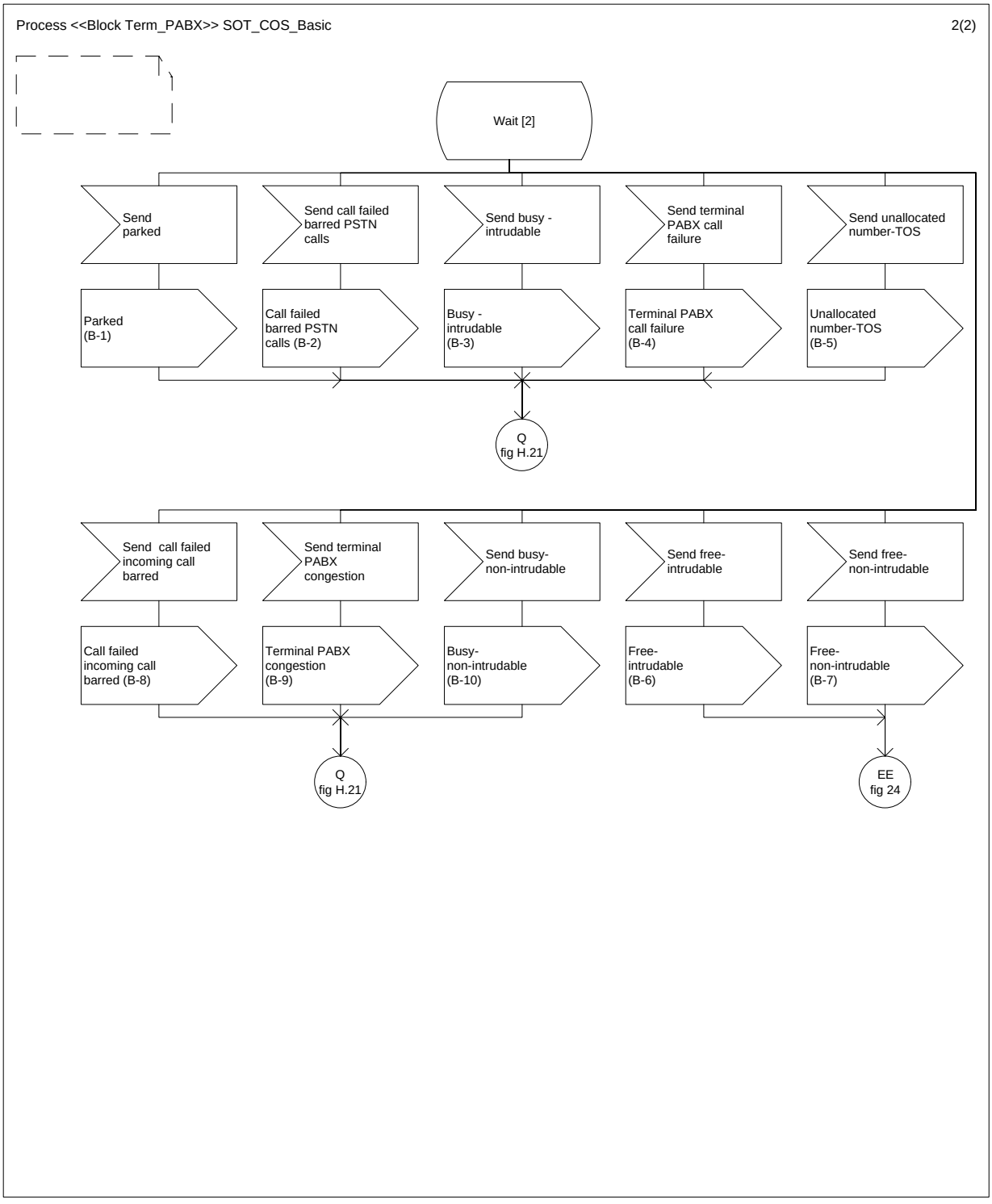


Figure H.23 (T/CS 49-08): Terminating PABX SOT/COS procedure (basic MFC subset) (sheet 2 of 2)

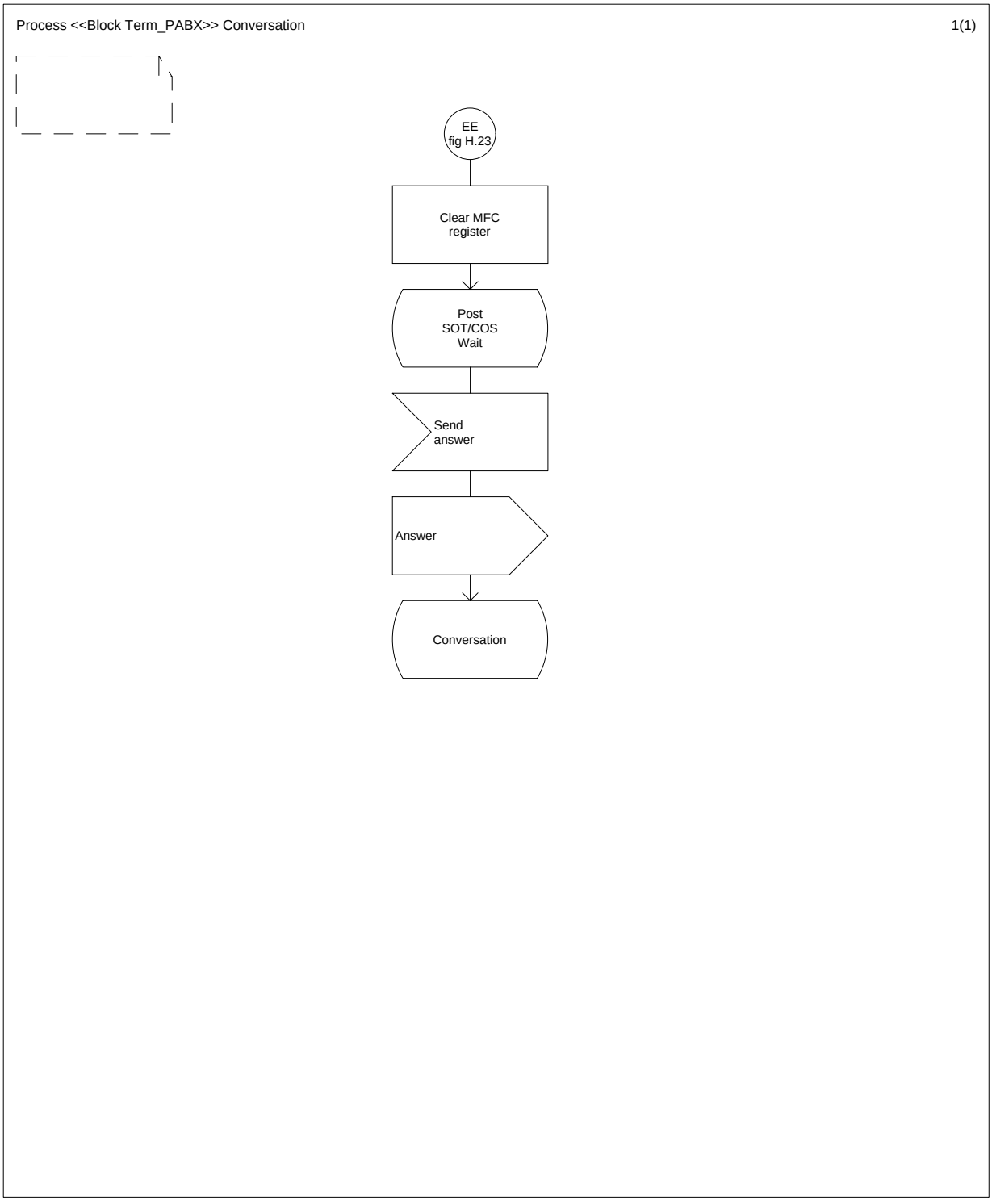


Figure H.24 (T/CS 49-08): Terminating PABX answer and conversation (basic MFC subset) (sheet 1 of 1)

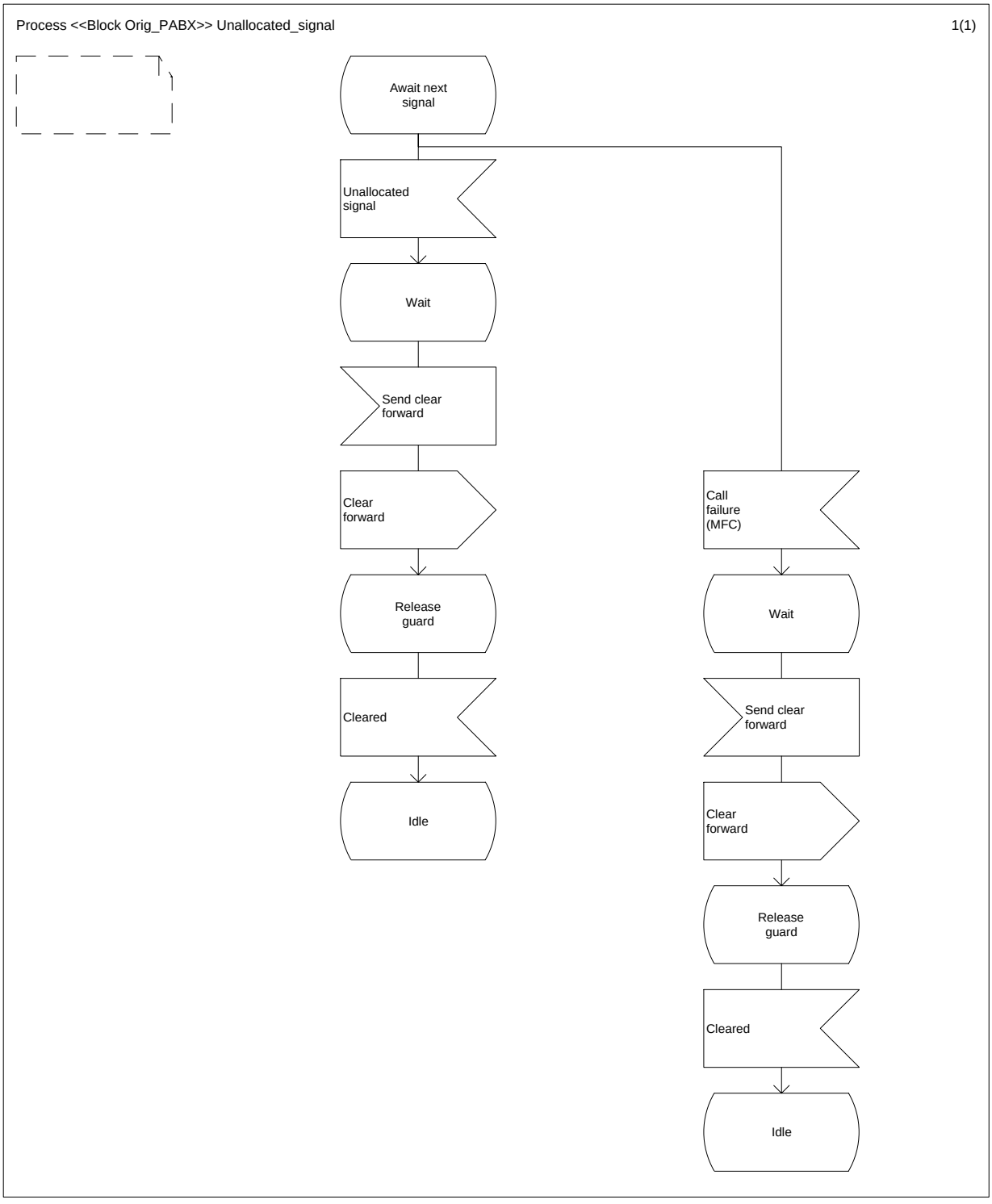


Figure H.25 (T/CS 49-08): Action on receipt of unallocated signal (sheet 1 of 2)

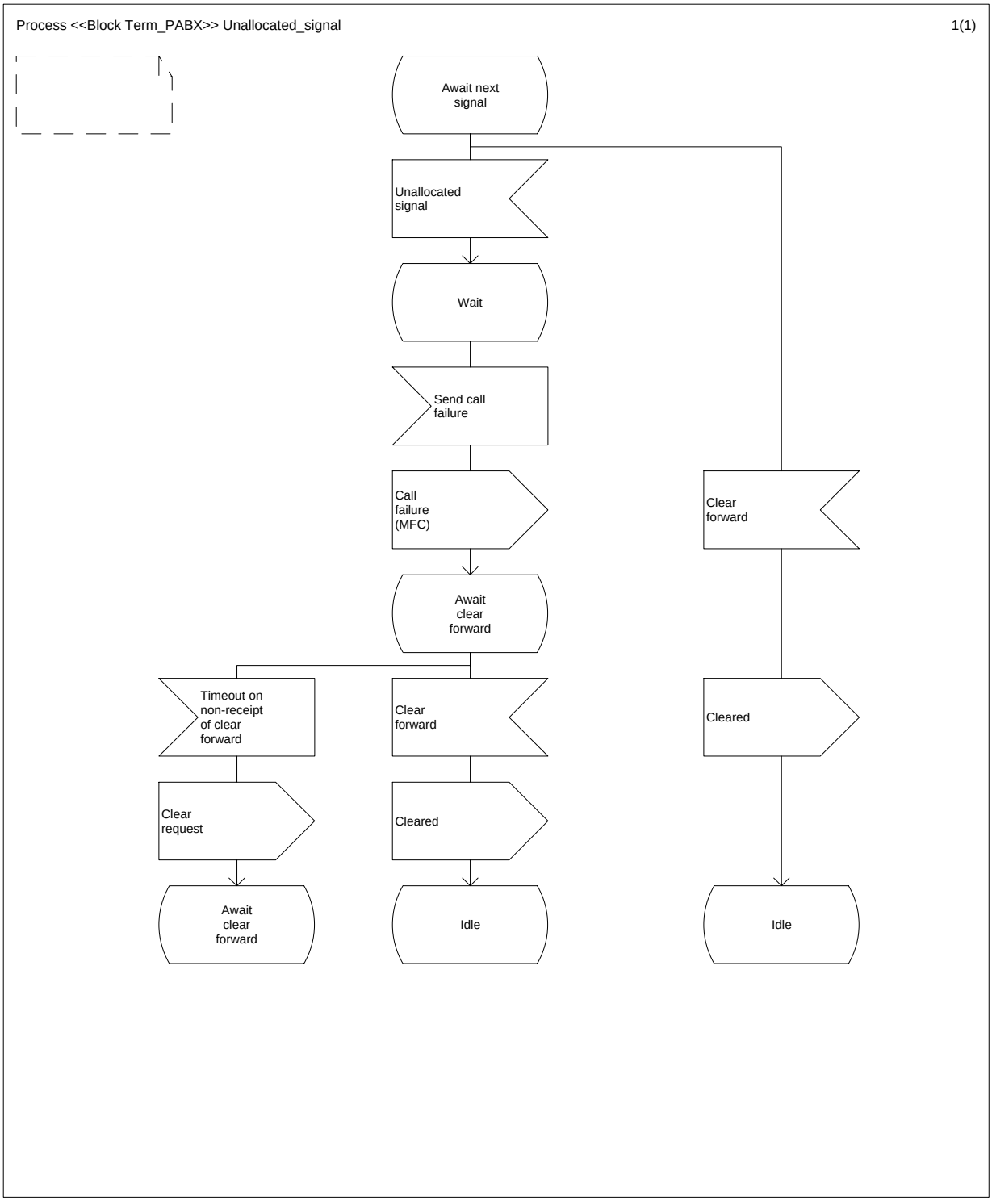


Figure H.25 (T/CS 49-08): Action on receipt of unallocated signal (sheet 2 of 2)

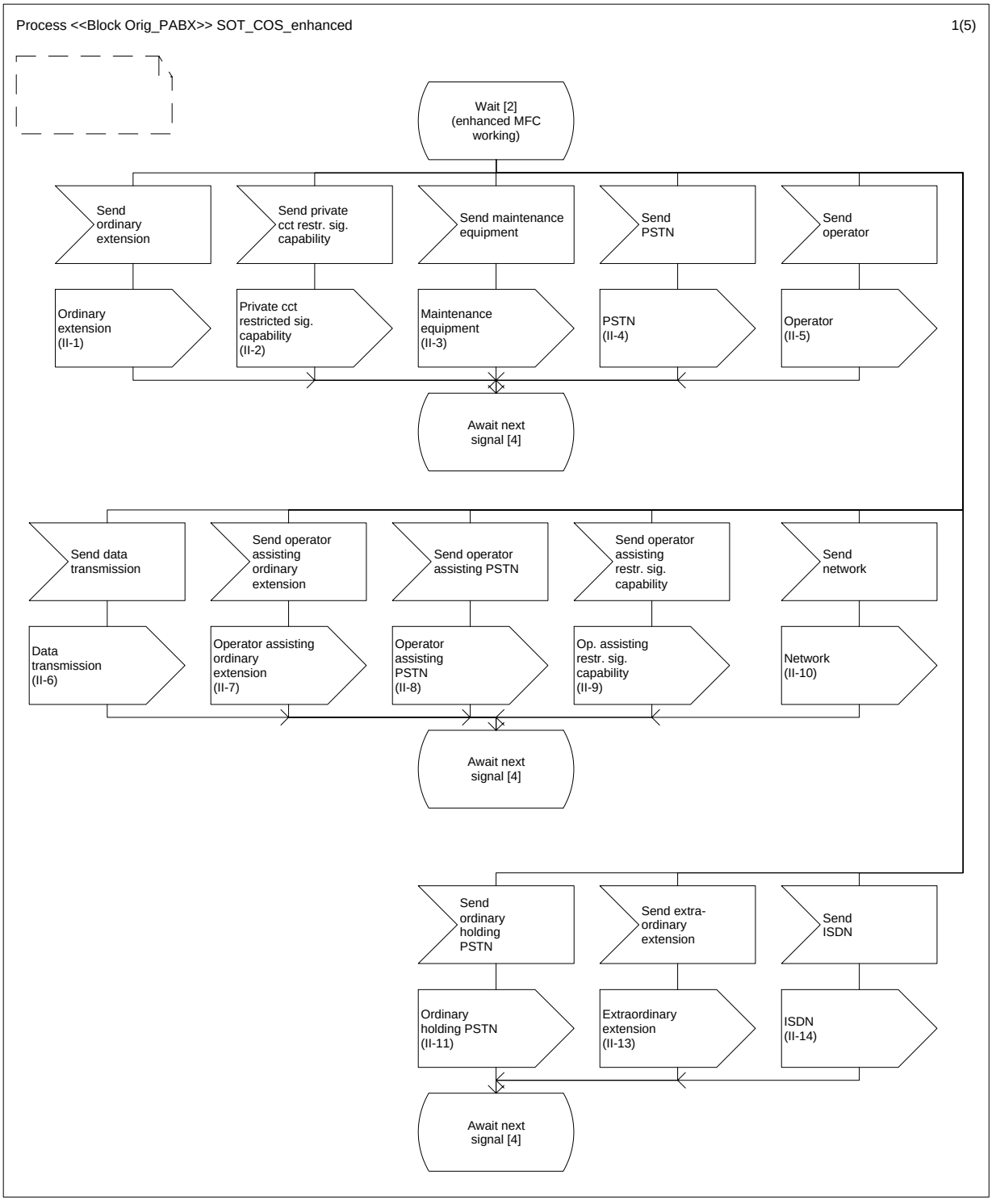


Figure H.26 (T/CS 49-08): Originating PABX SOT/COS procedure (enhanced MFC subset) (sheet 1 of 5)

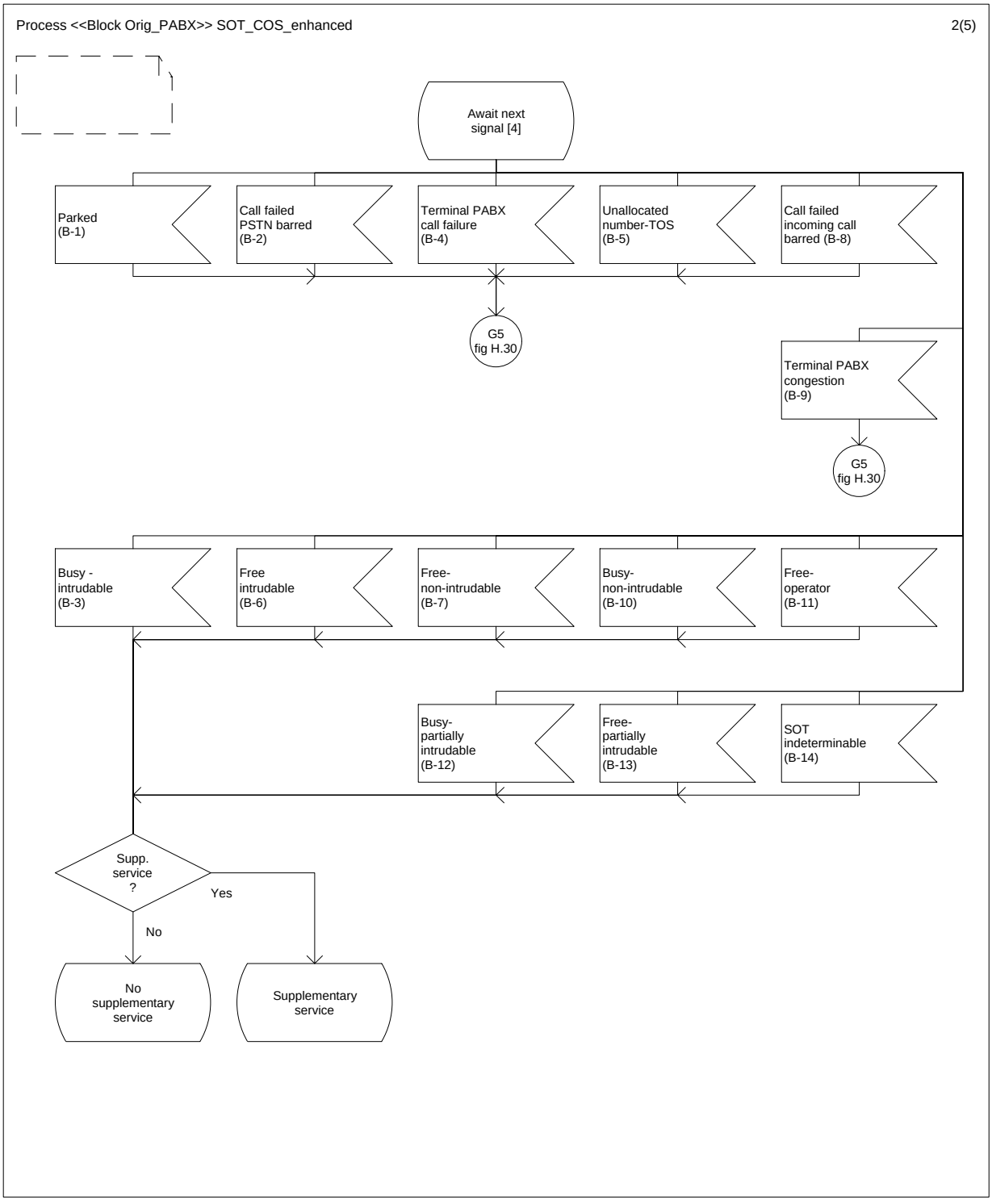


Figure H.26 (T/CS 49-08): Originating PABX SOT/COS procedure (enhanced MFC subset) (sheet 2 of 5)

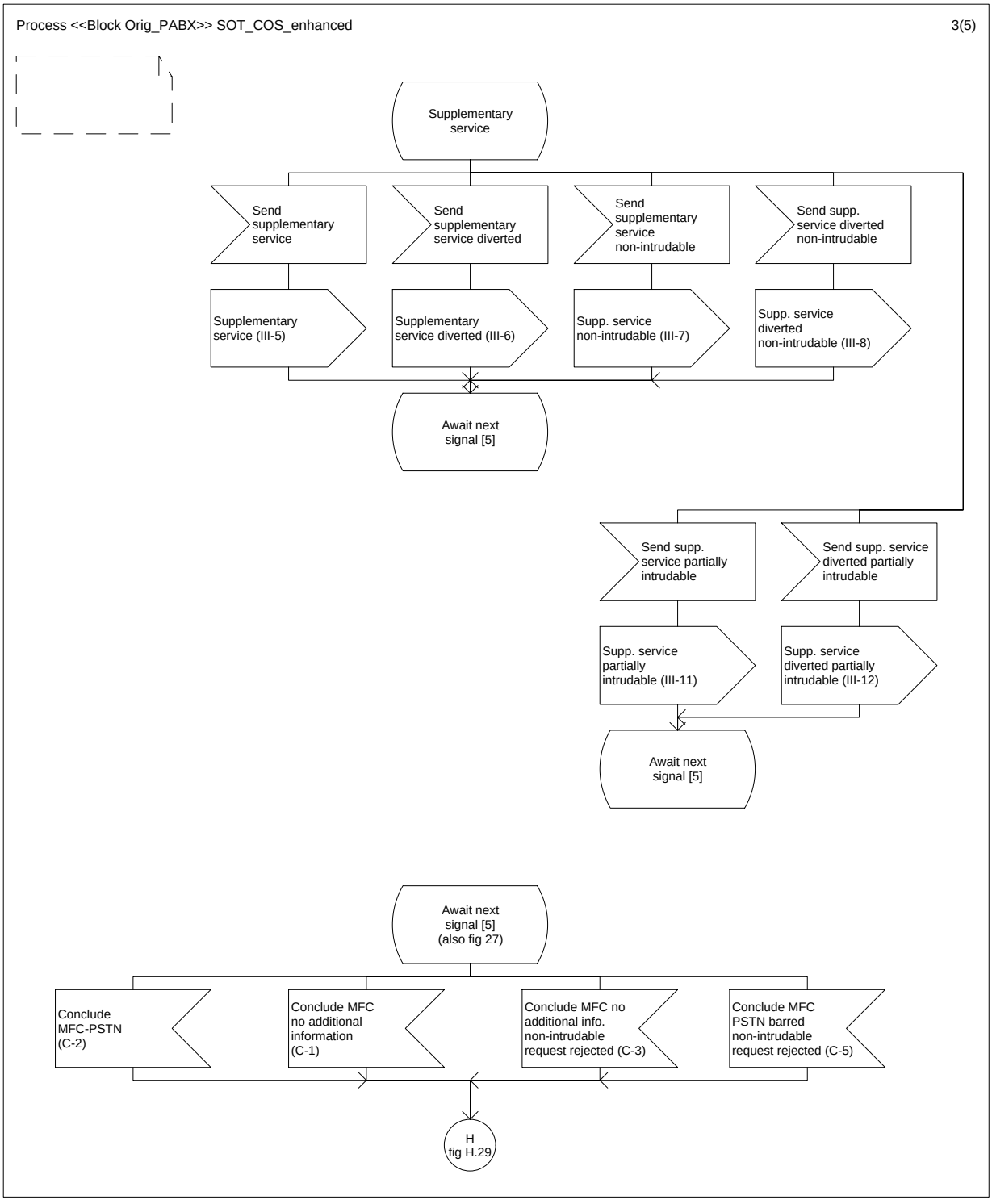


Figure H.26 (T/CS 49-08): Originating PABX SOT/COS procedure (enhanced MFC subset) (sheet 3 of 5)

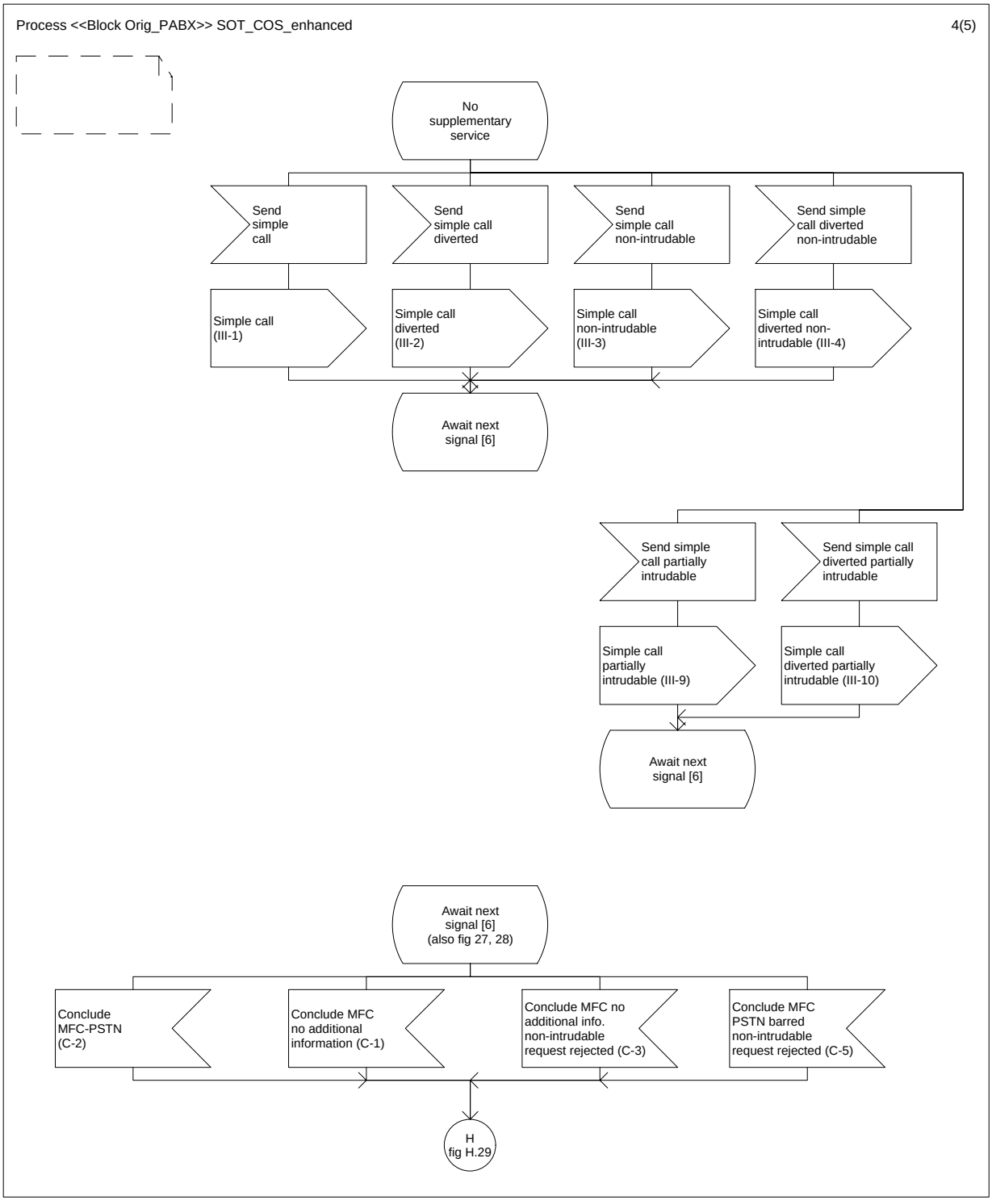


Figure H.26 (T/CS 49-08): Originating PABX SOT/COS procedure (enhanced MFC subset) (sheet 4 of 5)

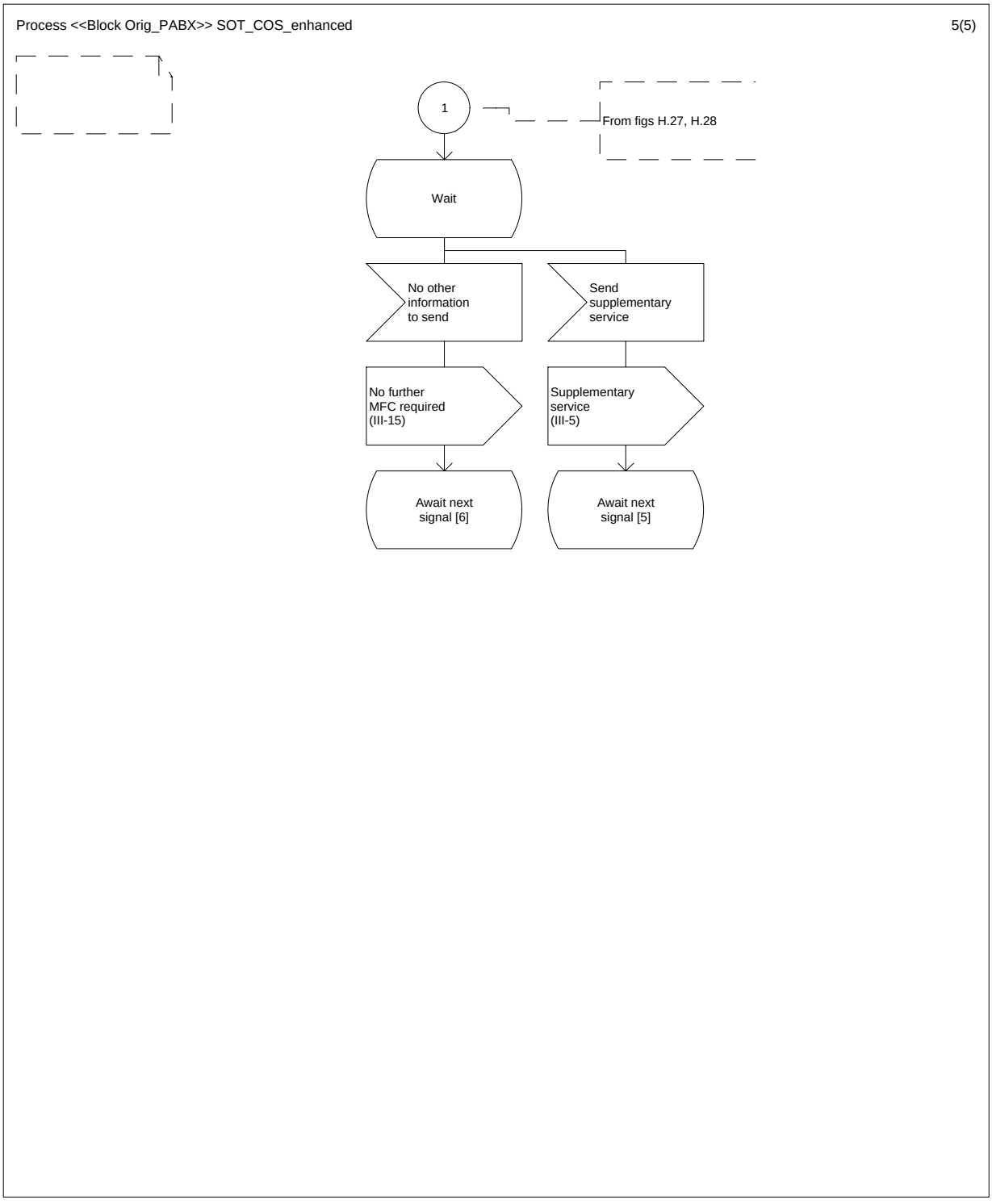


Figure H.26 (T/CS 49-08): Originating PABX SOT/COS procedure (enhanced MFC subset) (sheet 5 of 5)

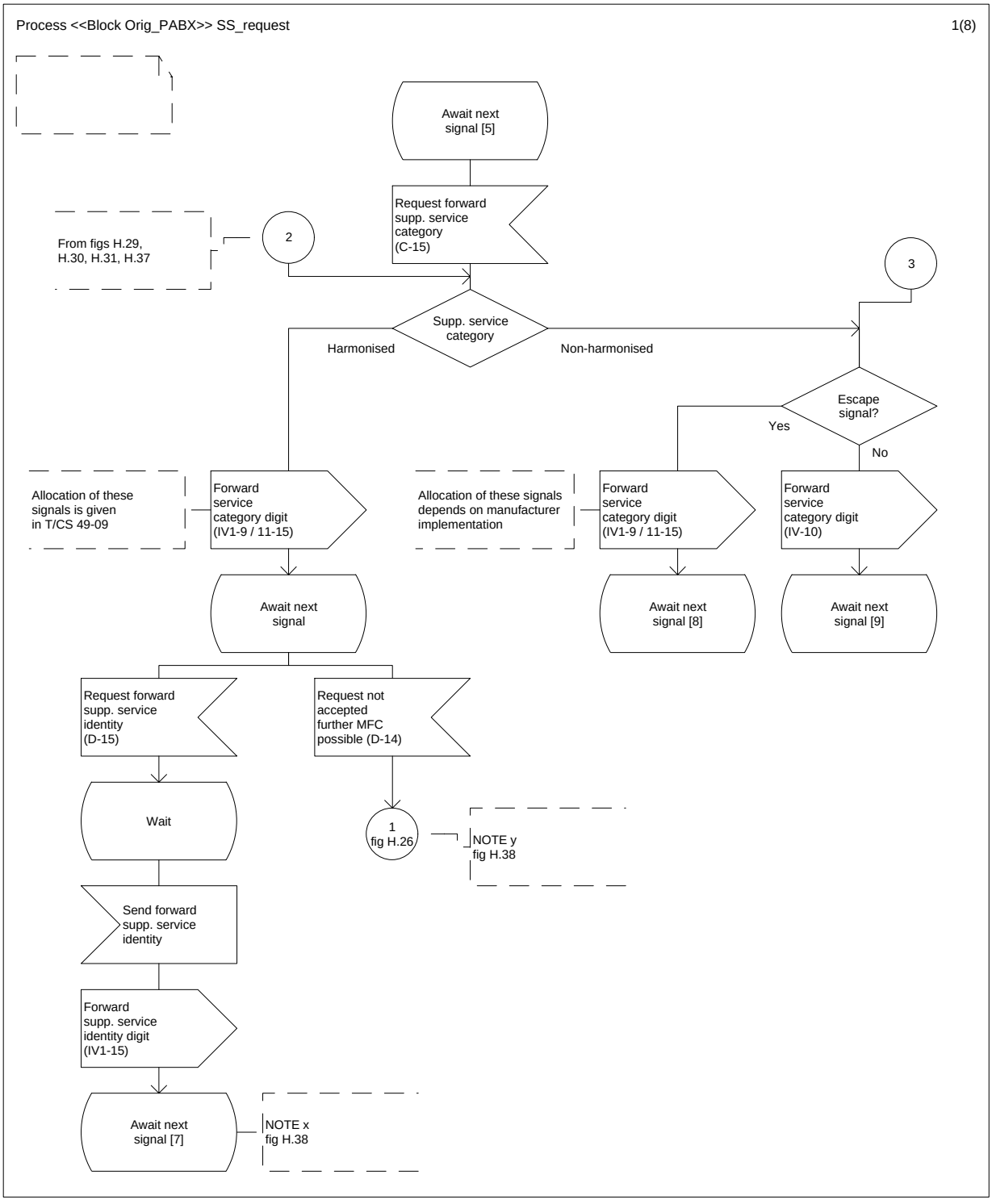


Figure H.27 (T/CS 49-08): Originating PABX supplementary service request procedure (enhanced MFC subset) (sheet 1 of 8)

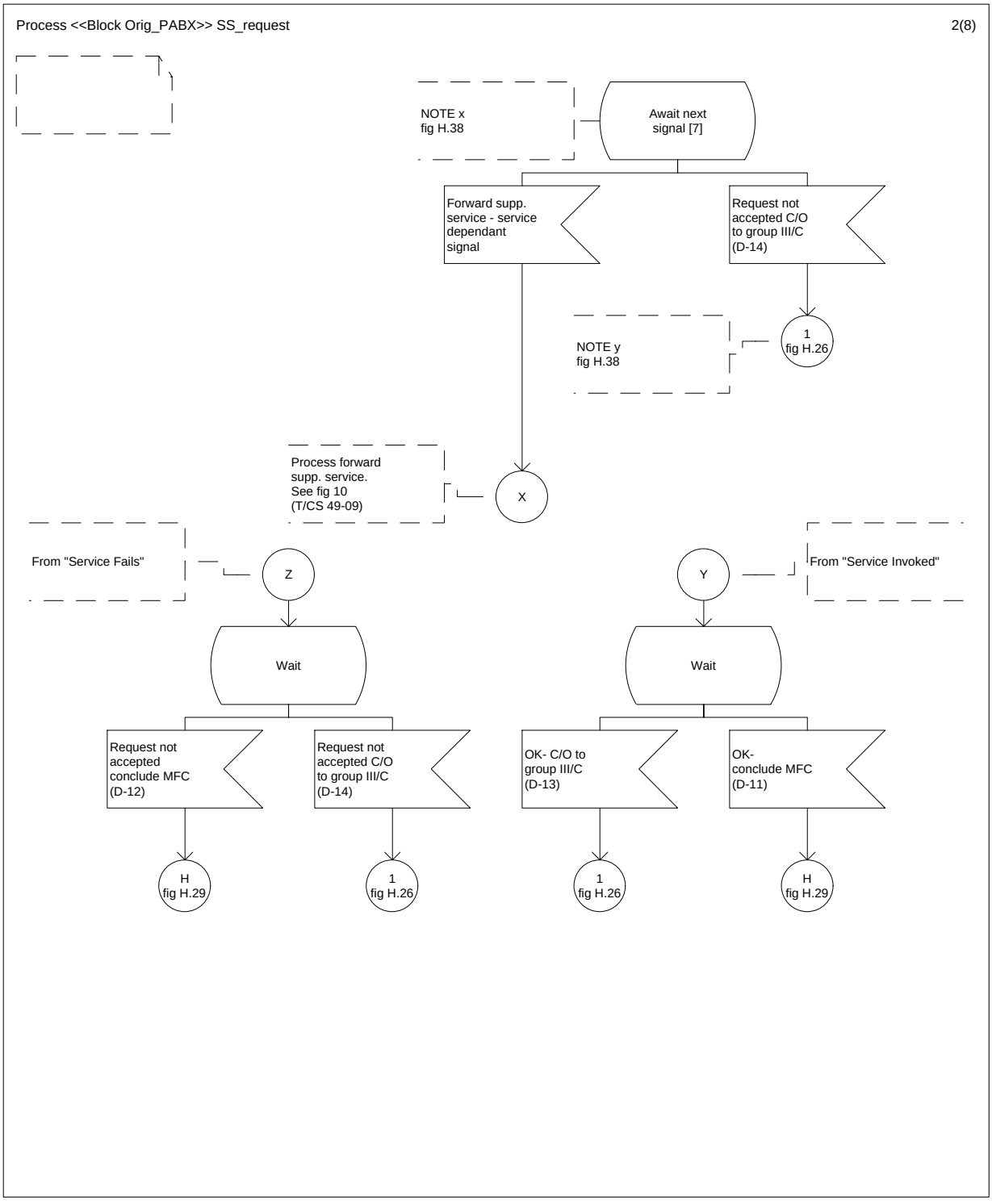


Figure H.27 (T/CS 49-08): Originating PABX supplementary service request procedure (enhanced MFC subset) (sheet 2 of 8)

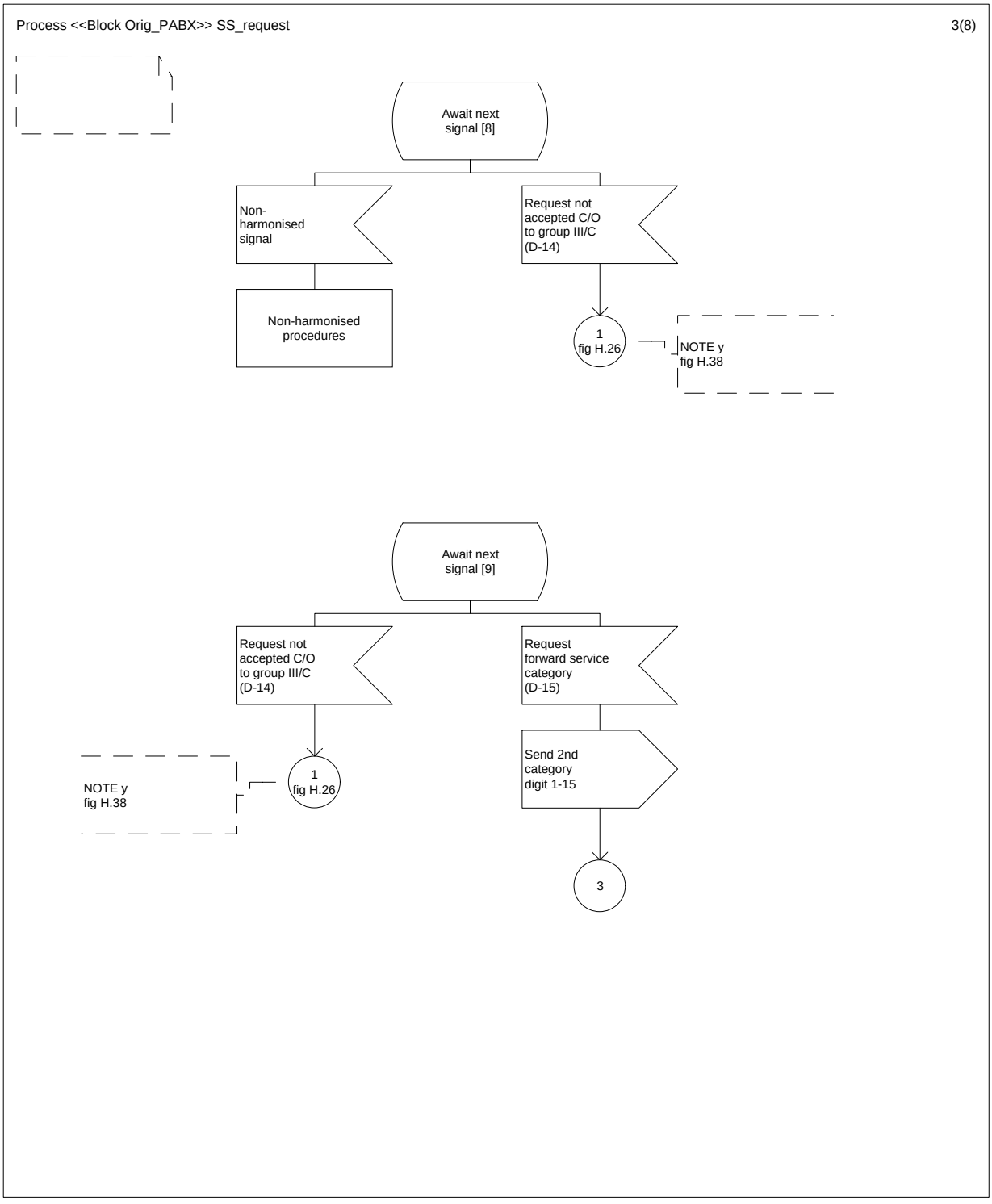


Figure H.27 (T/CS 49-08): Originating PABX supplementary service request procedure (enhanced MFC subset) (sheet 3 of 8)

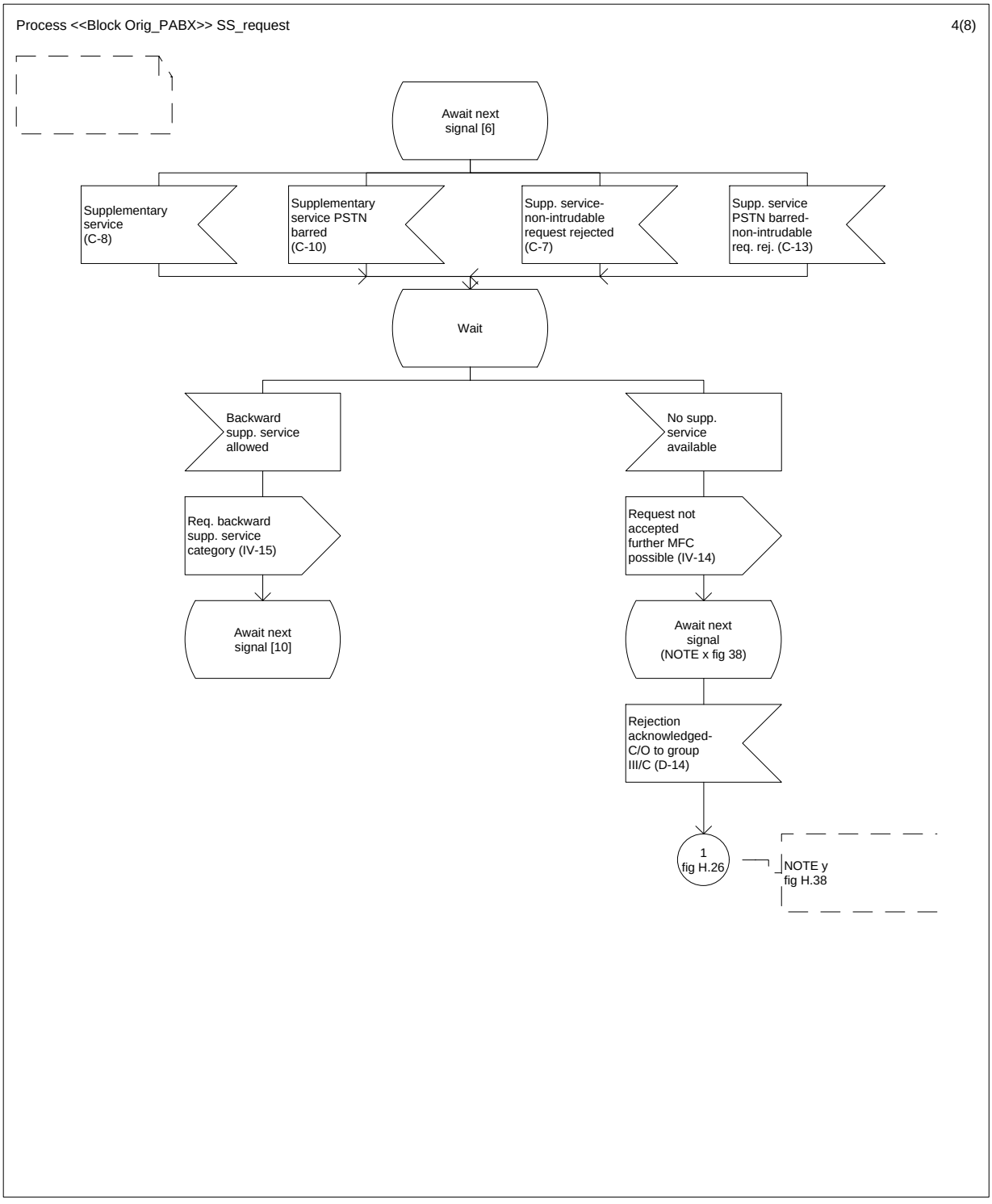


Figure H.27 (T/CS 49-08): Originating PABX supplementary service request procedure (enhanced MFC subset) (sheet 4 of 8)

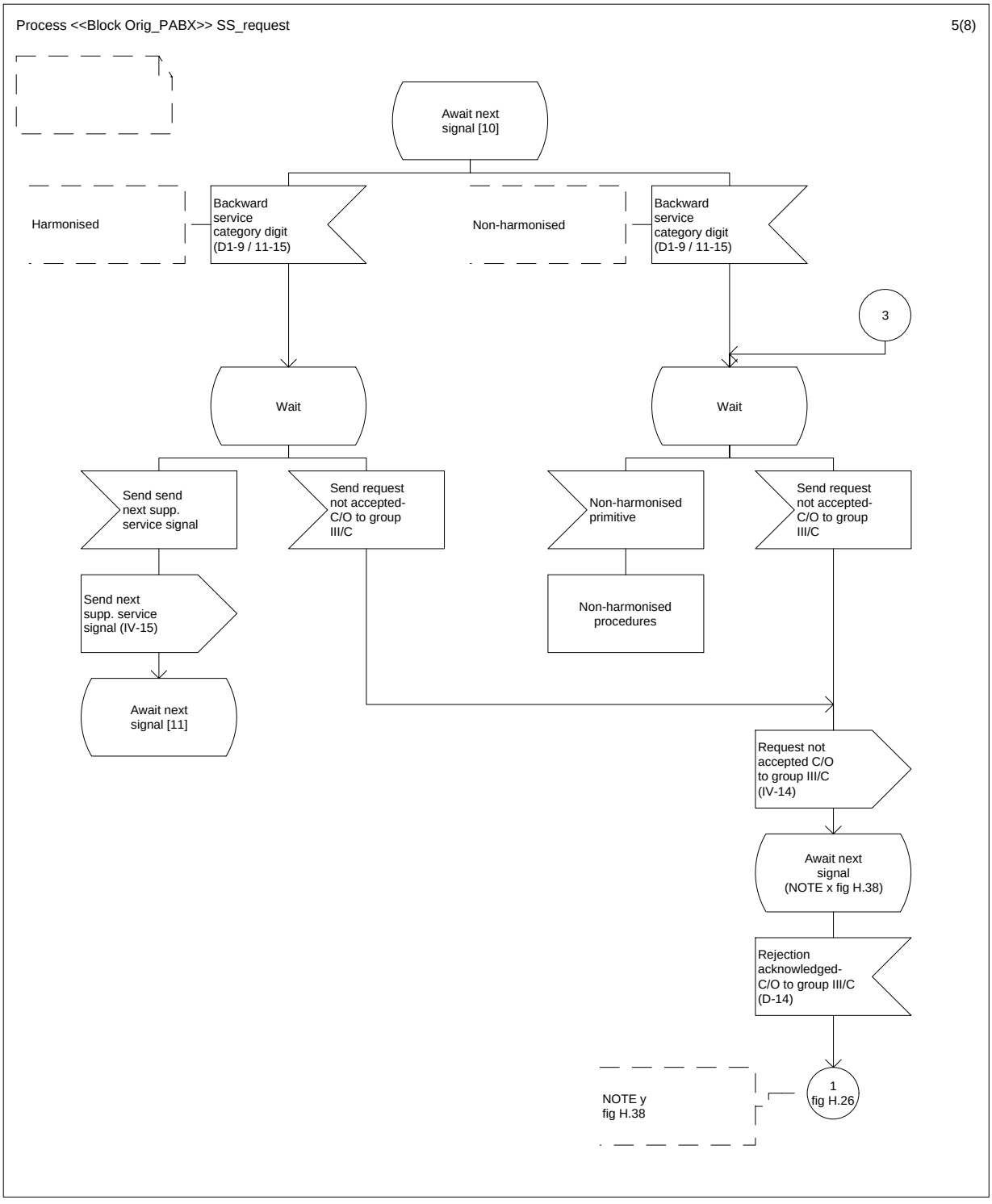


Figure H.27 (T/CS 49-08): Originating PABX supplementary service request procedure (enhanced MFC subset) (sheet 5 of 8)

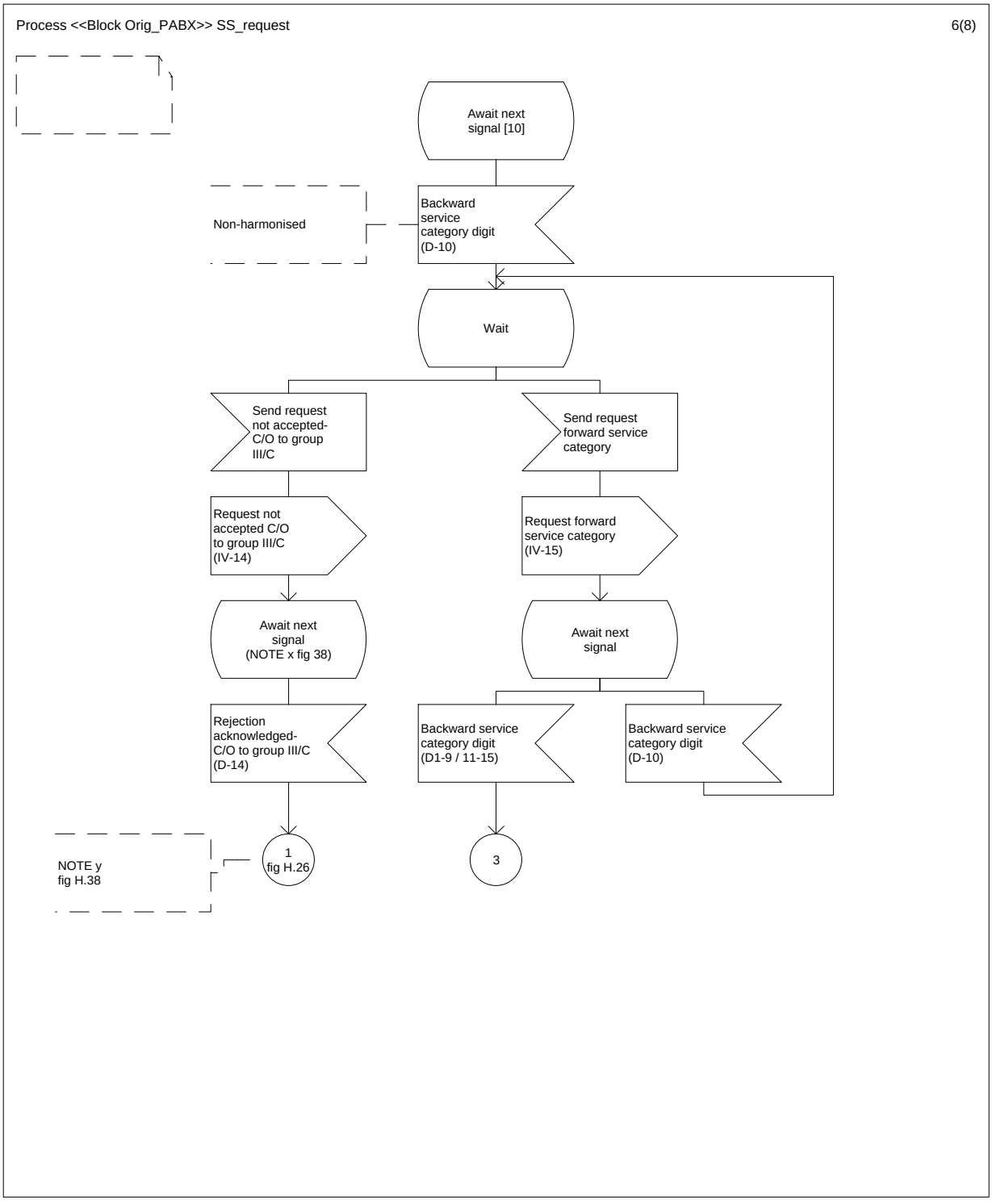


Figure H.27 (T/CS 49-08): Originating PABX supplementary service request procedure (enhanced MFC subset) (sheet 6 of 8)

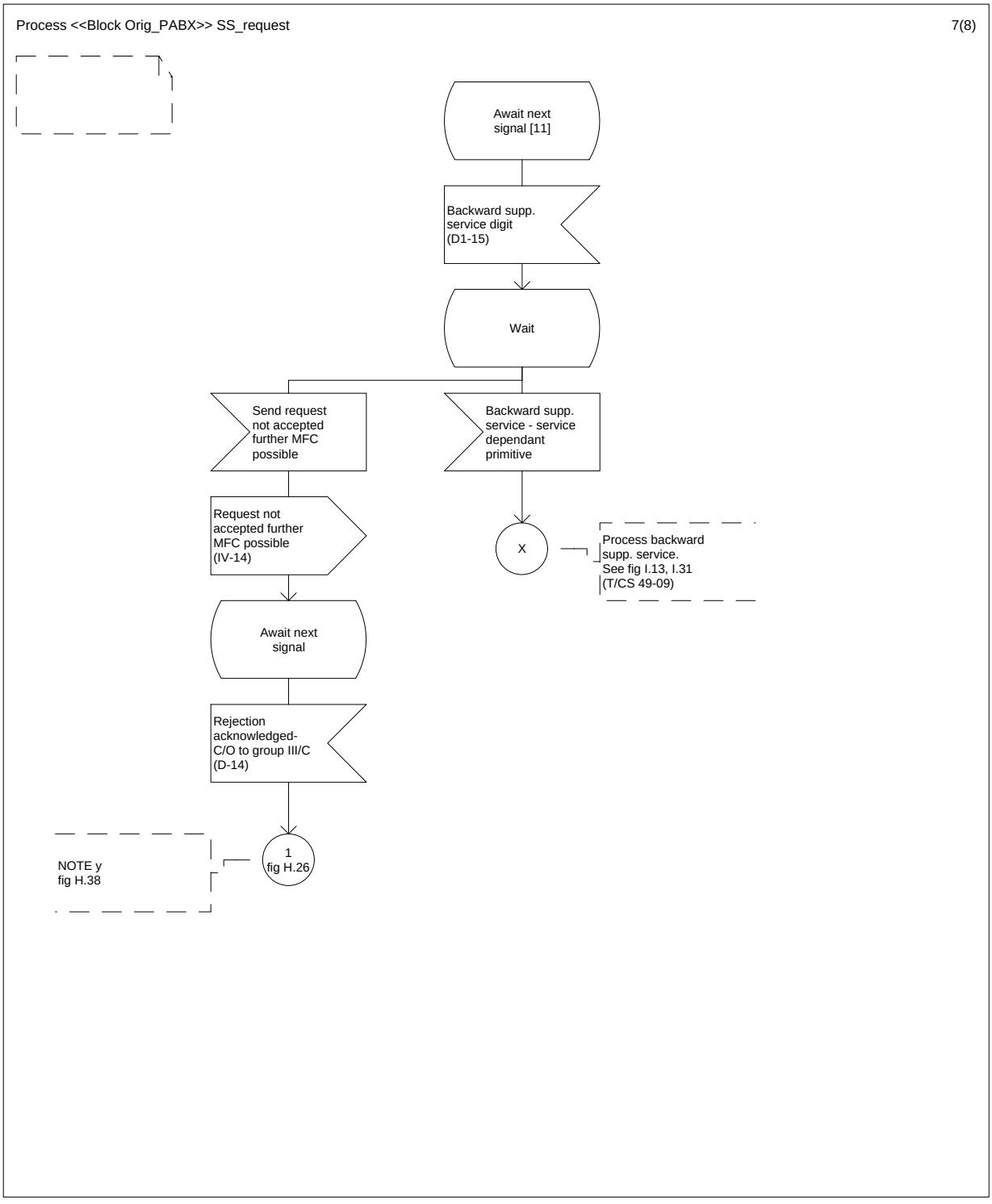


Figure H.27 (T/CS 49-08): Originating PABX supplementary service request procedure (enhanced MFC subset) (sheet 7 of 8)

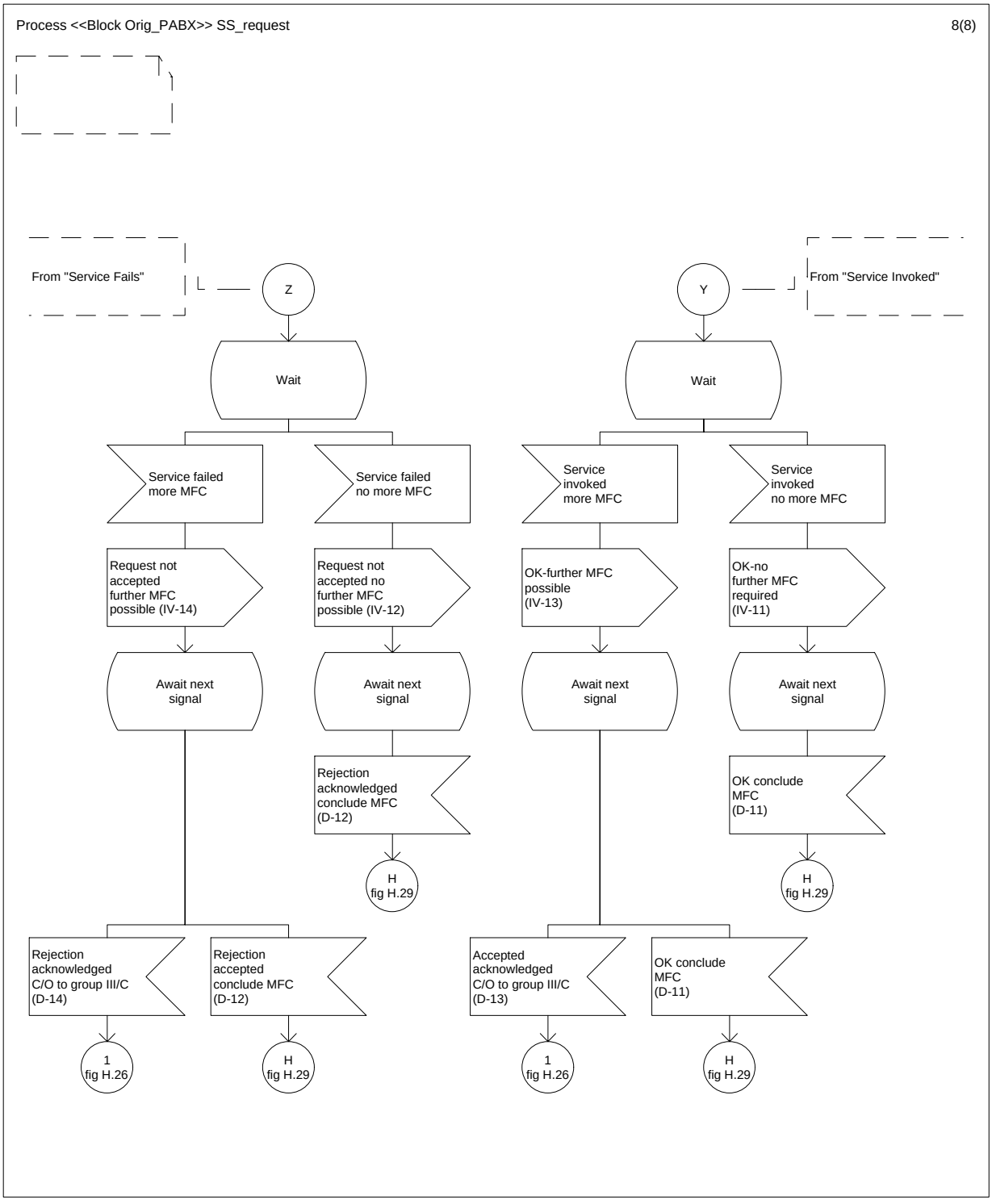


Figure H.27 (T/CS 49-08): Originating PABX supplementary service request procedure (enhanced MFC subset) (sheet 8 of 8)

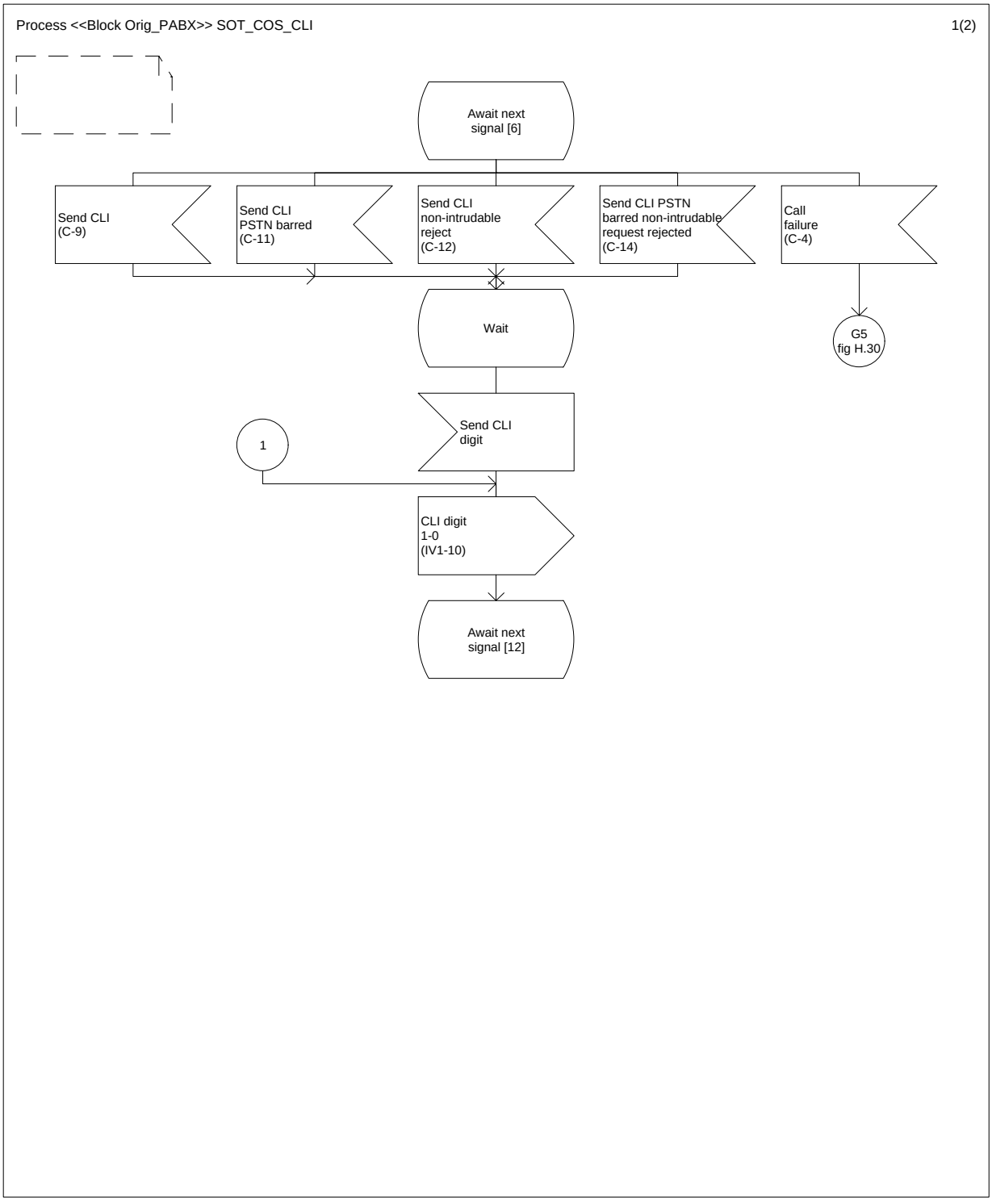


Figure H.28 (T/CS 49-08): Originating PABX SOT/COS procedure + calling line identity (CLI) (enhanced MFC subset) (sheet 1 of 2)

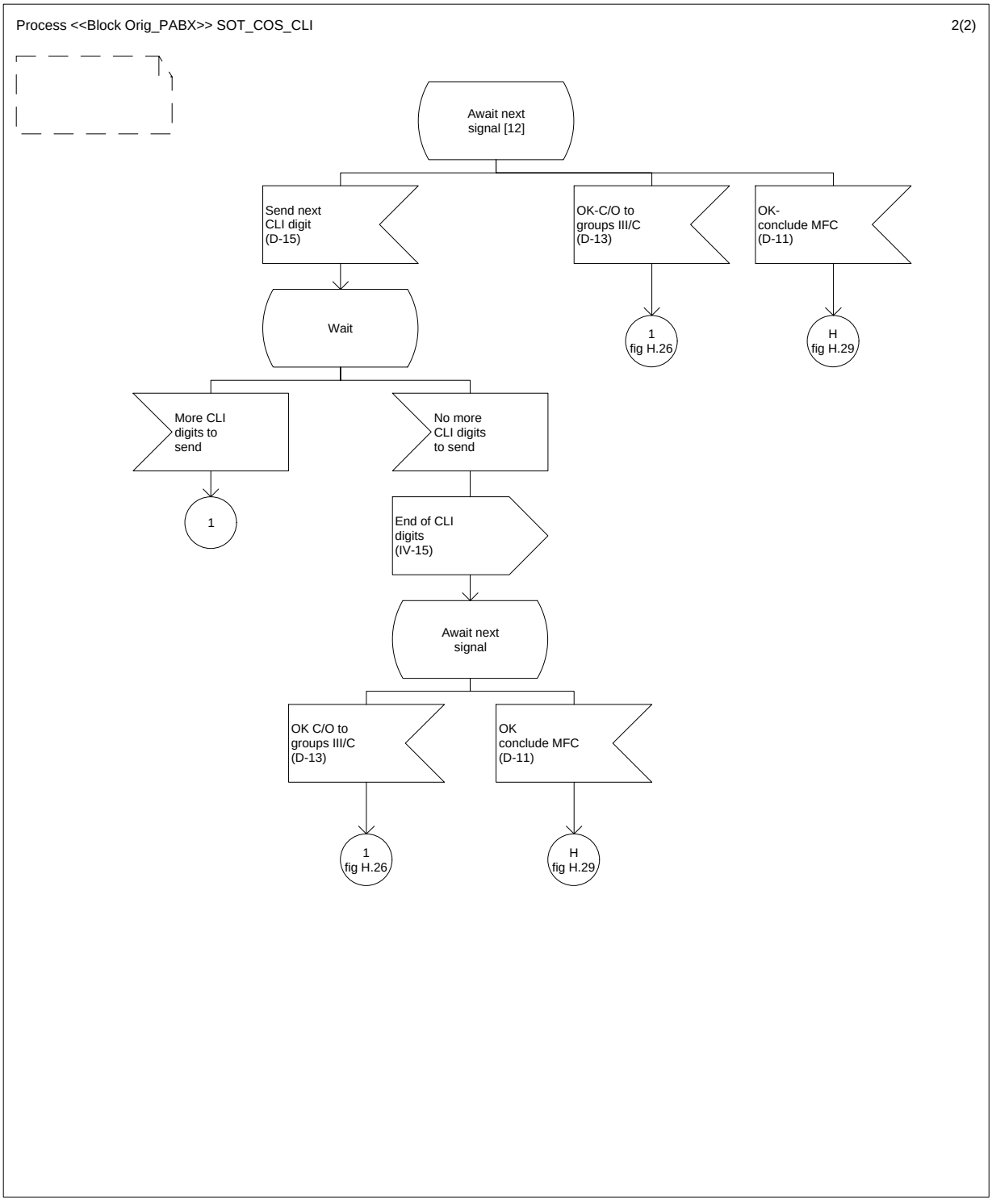


Figure H.28 (T/CS 49-08): Originating PABX SOT/COS procedure + calling line identity (CLI) (enhanced MFC subset) (sheet 2 of 2)

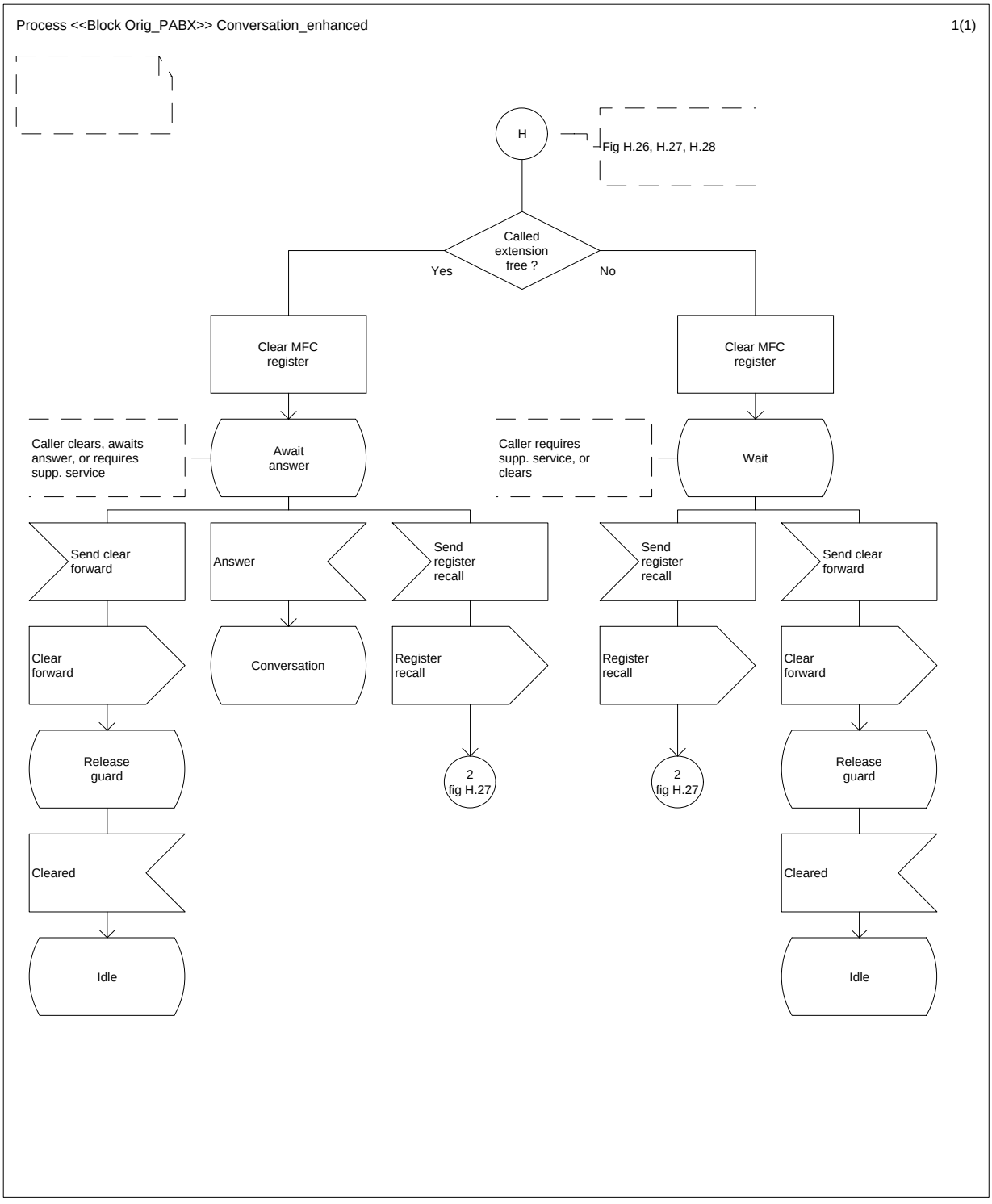


Figure H.29 (T/CS 49-08): Originating PABX answer and conversation (enhanced MFC subset) (sheet 1 of 1)

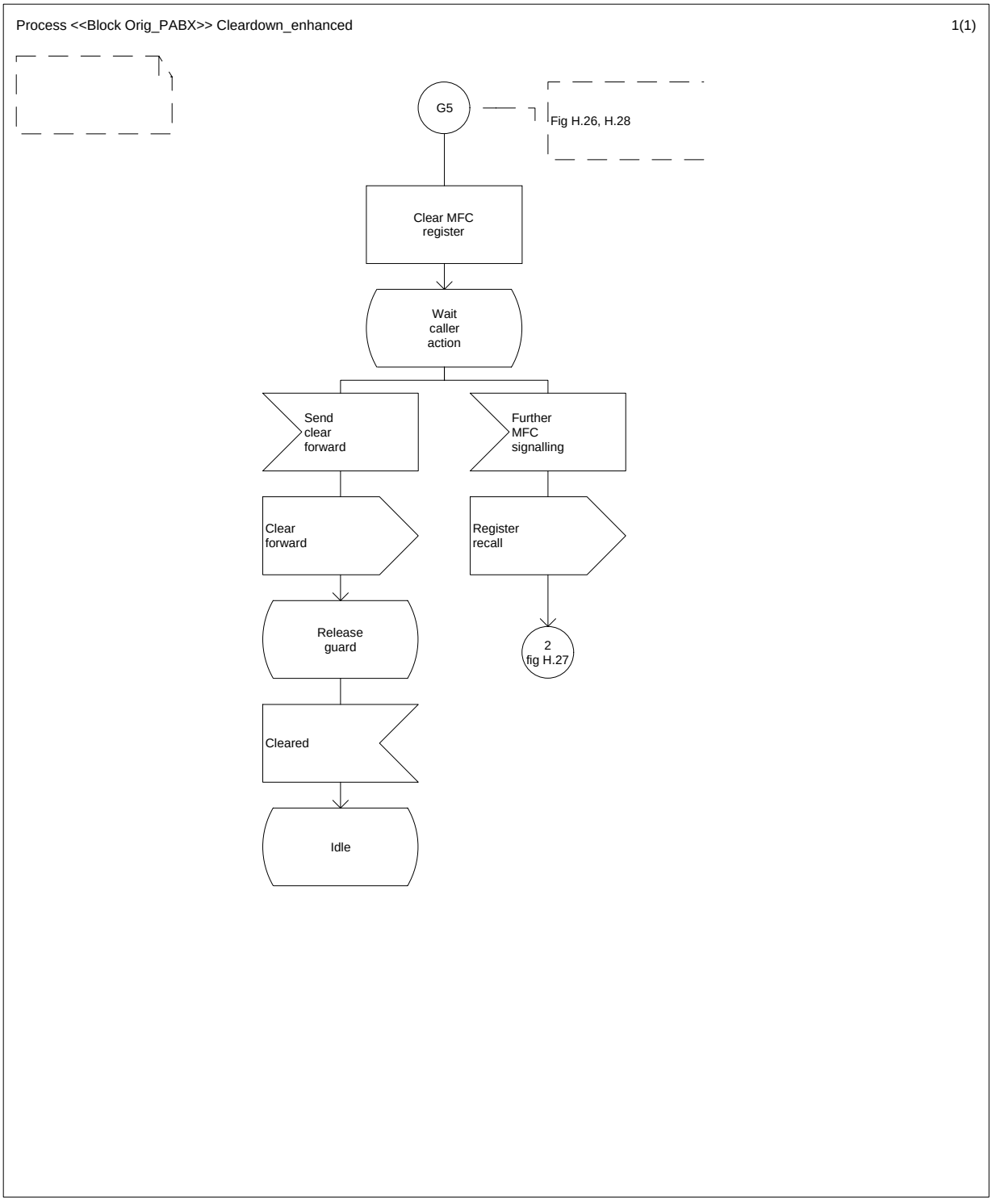


Figure H.30 (T/CS 49-08): Originating PABX cleardown sequence (enhanced MFC subset) (sheet 1 of 1)

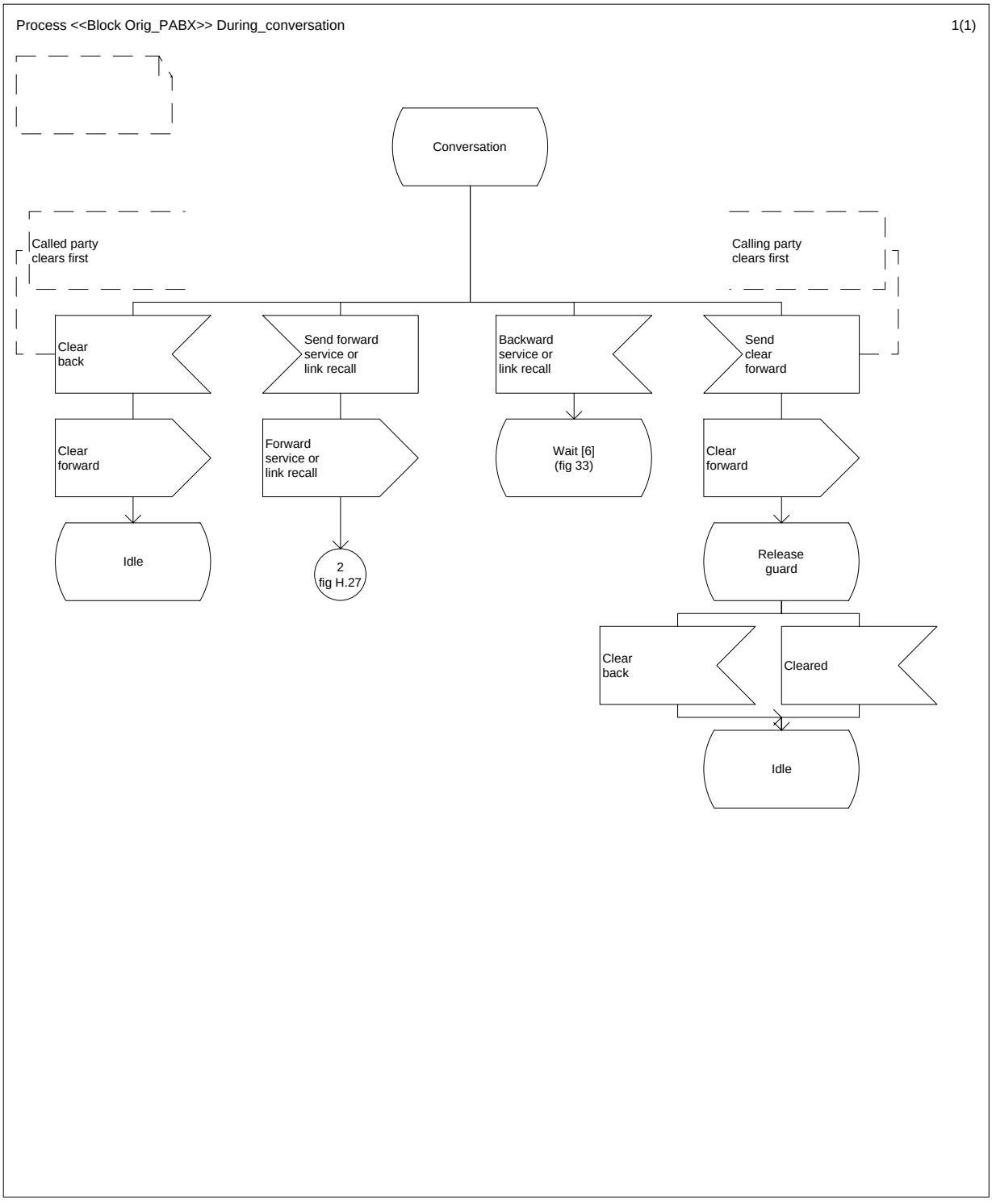


Figure H.31 (T/CS 49-08): Cleardown or register recall during conversation (originating PABX enhanced MFC subset) (sheet 1 of 1)

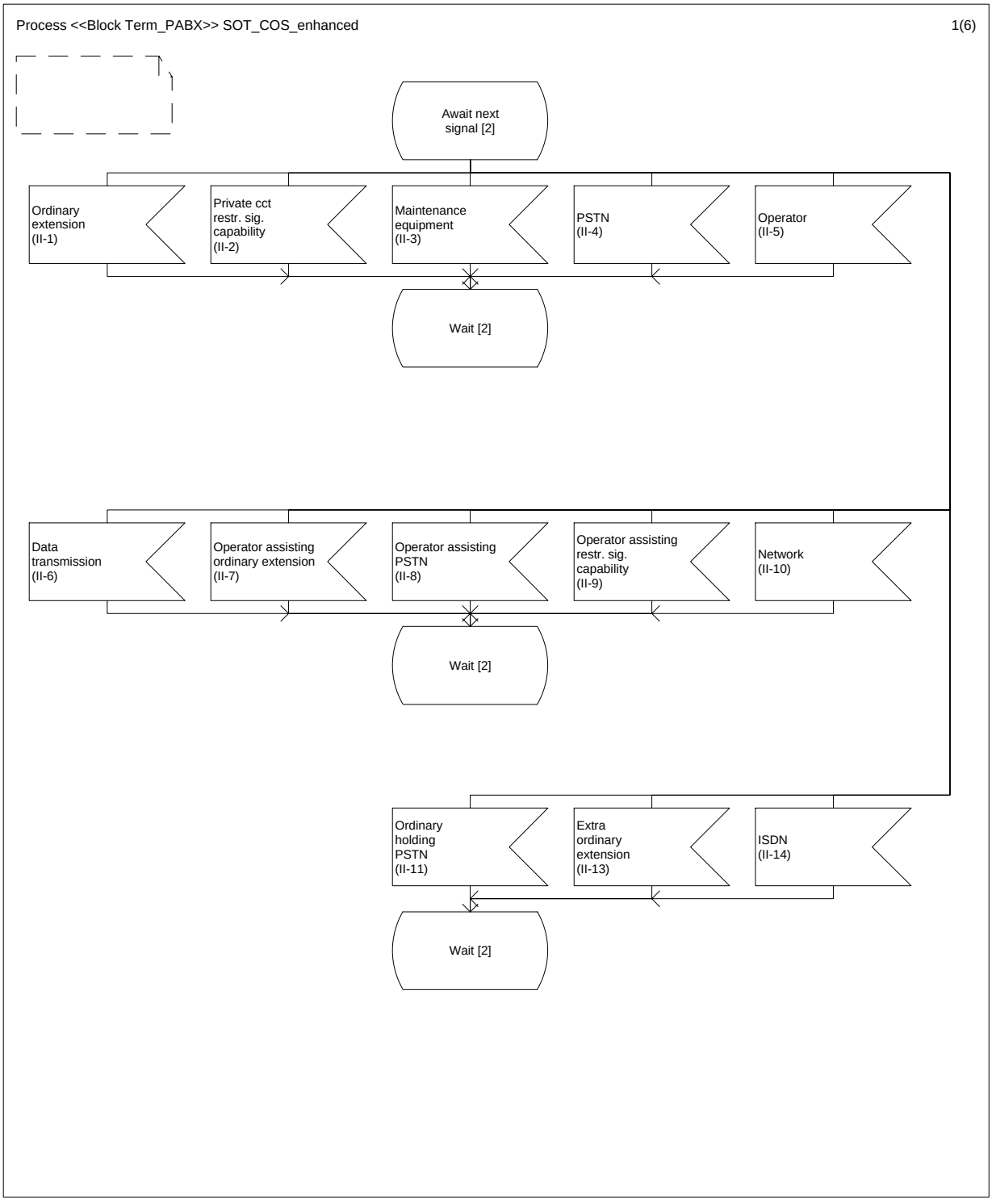


Figure H.32 (T/CS 49-08): Terminating PABX SOT/COS procedure (enhanced MFC subset) (sheet 1 of 6)

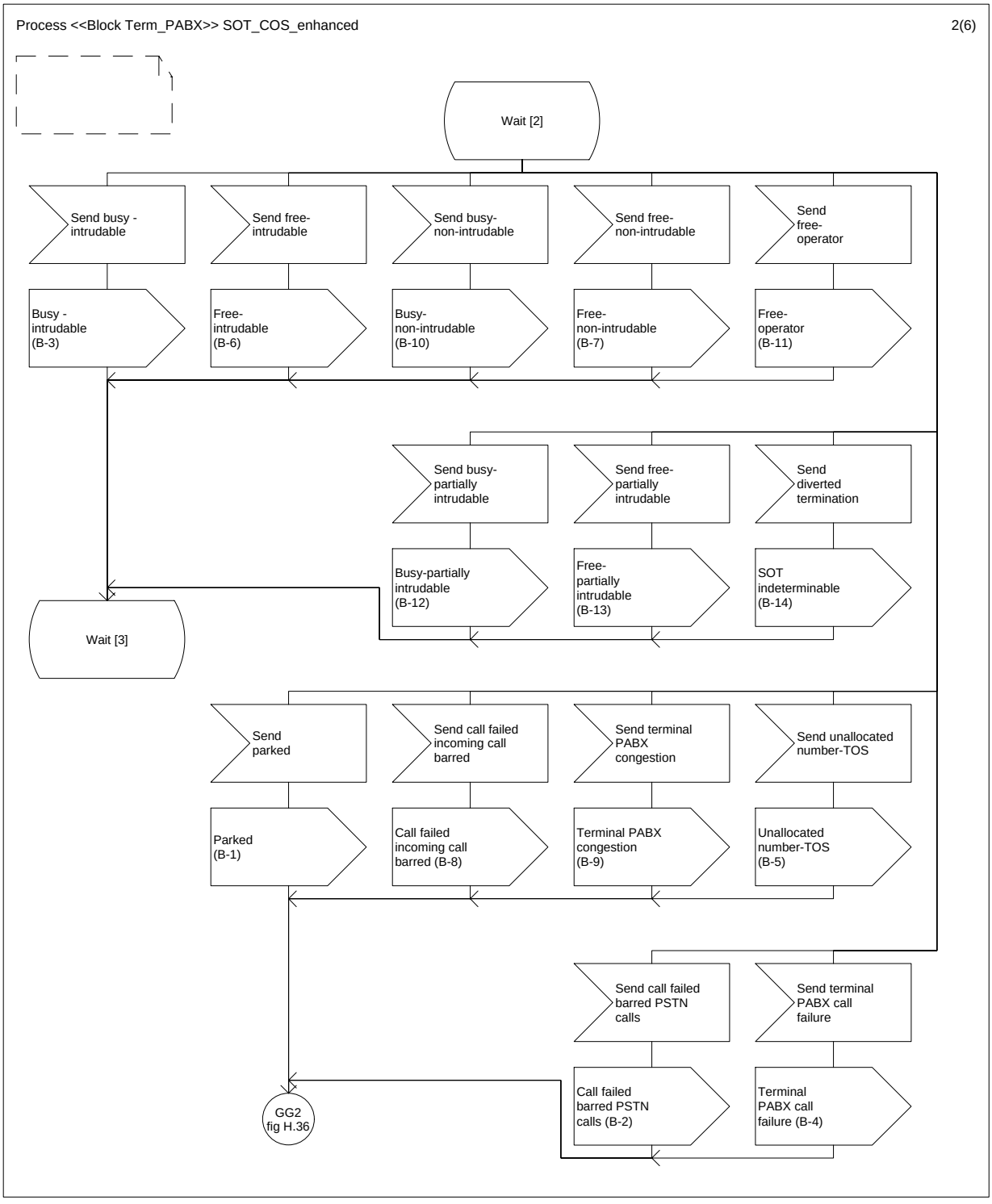


Figure H.32 (T/CS 49-08): Terminating PABX SOT/COS procedure (enhanced MFC subset) (sheet 2 of 6)

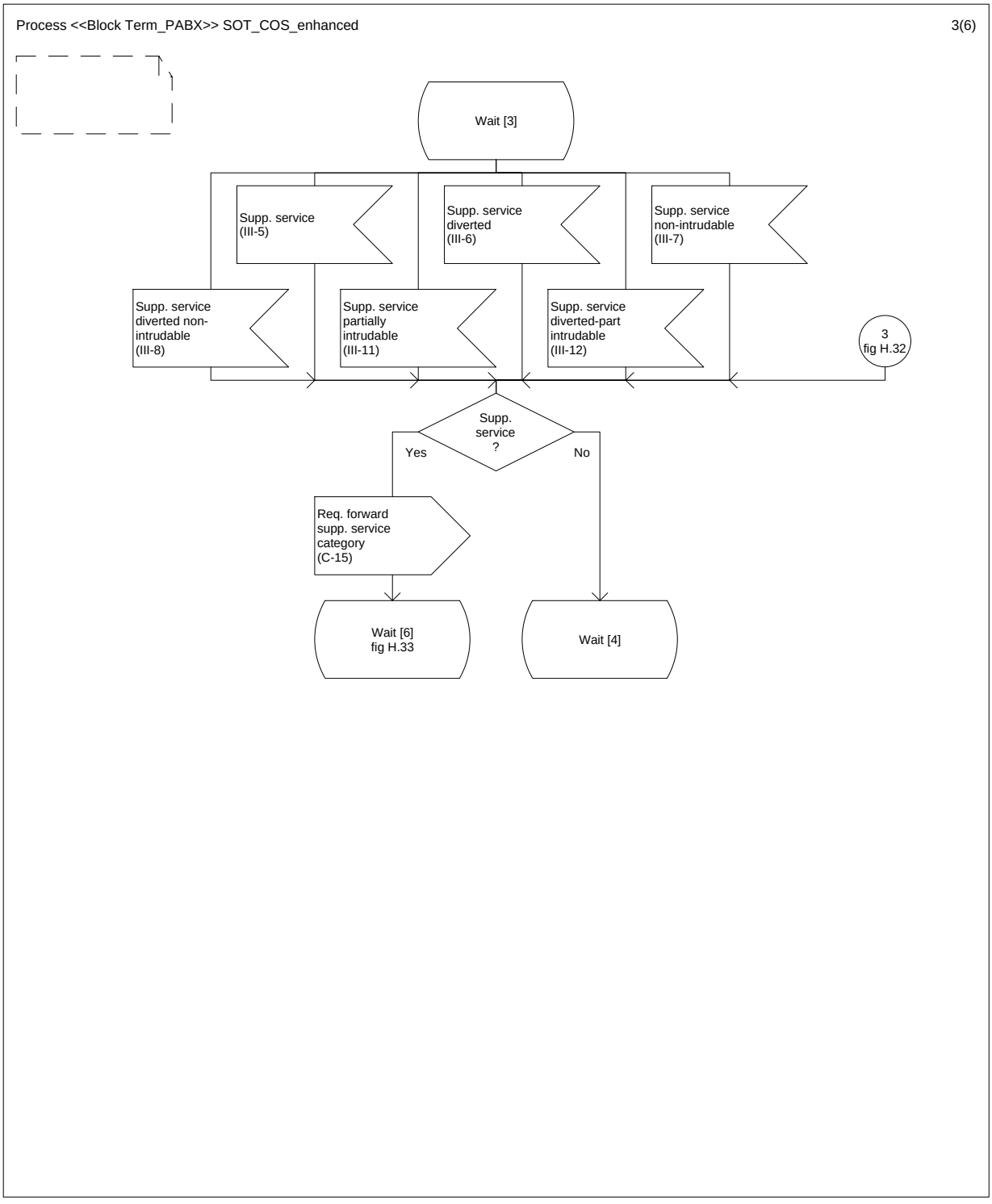


Figure H.32 (T/CS 49-08): Terminating PABX SOT/COS procedure (enhanced MFC subset) (sheet 3 of 6)

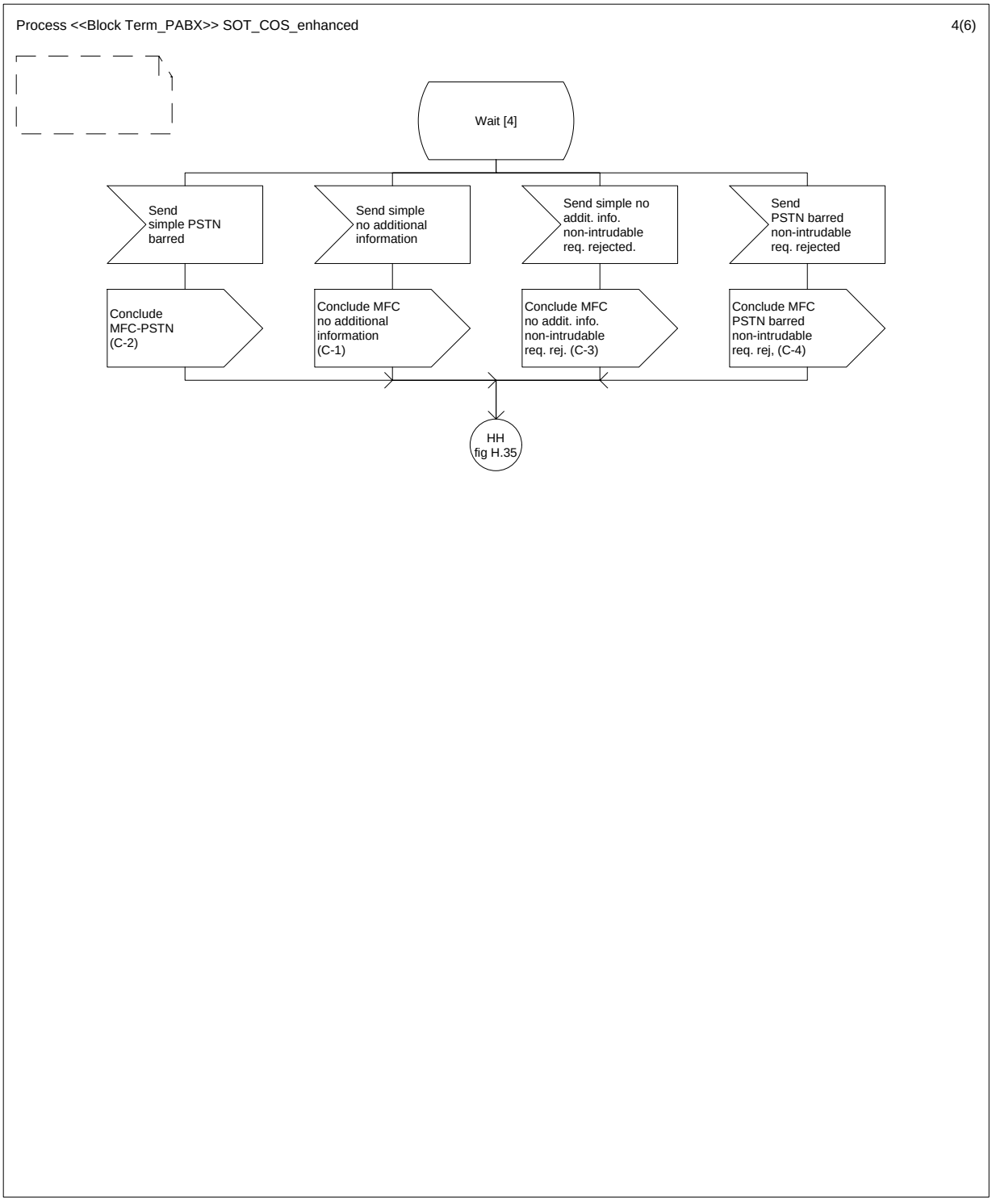


Figure H.32 (T/CS 49-08): Terminating PABX SOT/COS procedure (enhanced MFC subset) (sheet 4 of 6)

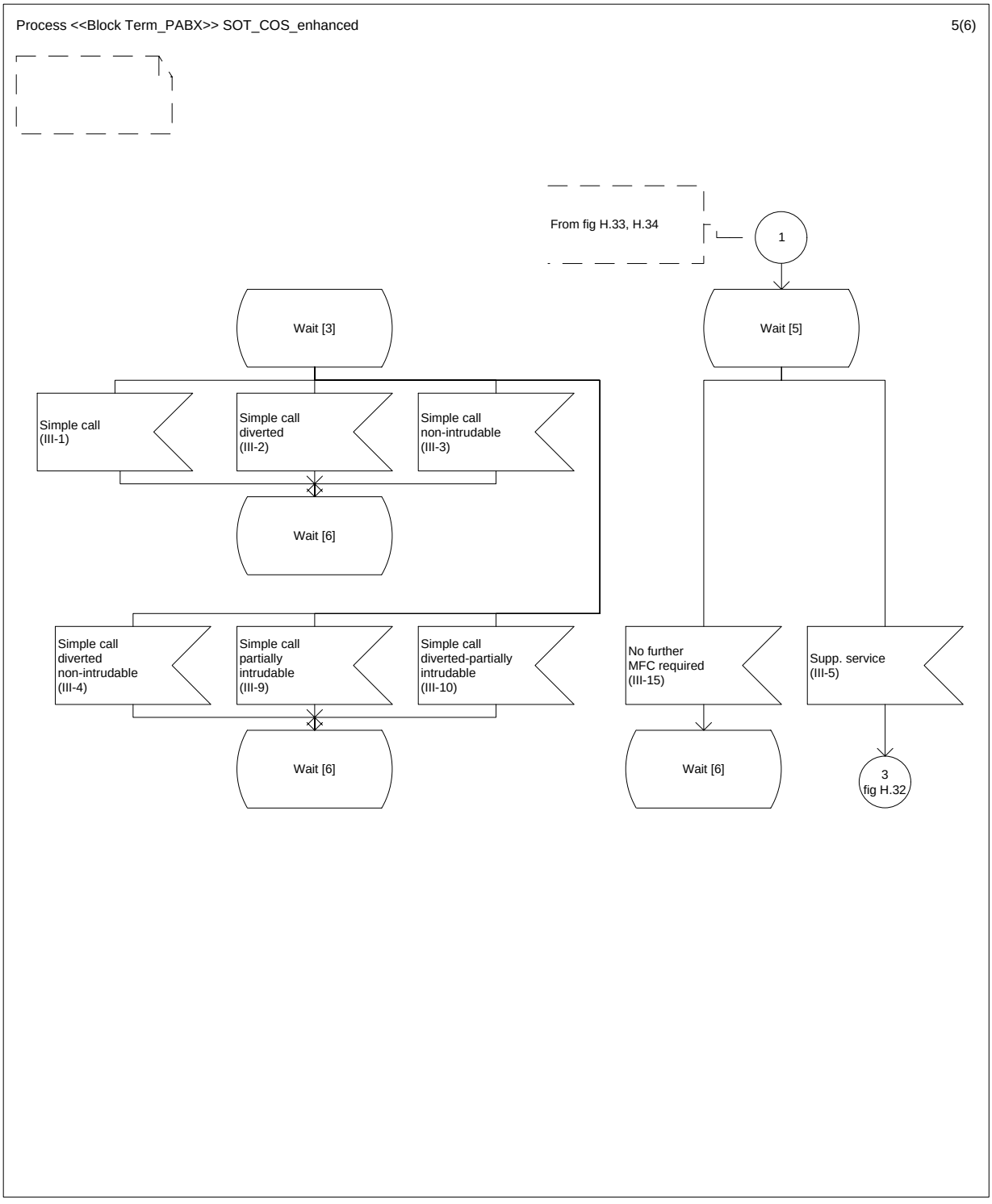


Figure H.32 (T/CS 49-08): Terminating PABX SOT/COS procedure (enhanced MFC subset) (sheet 5 of 6)

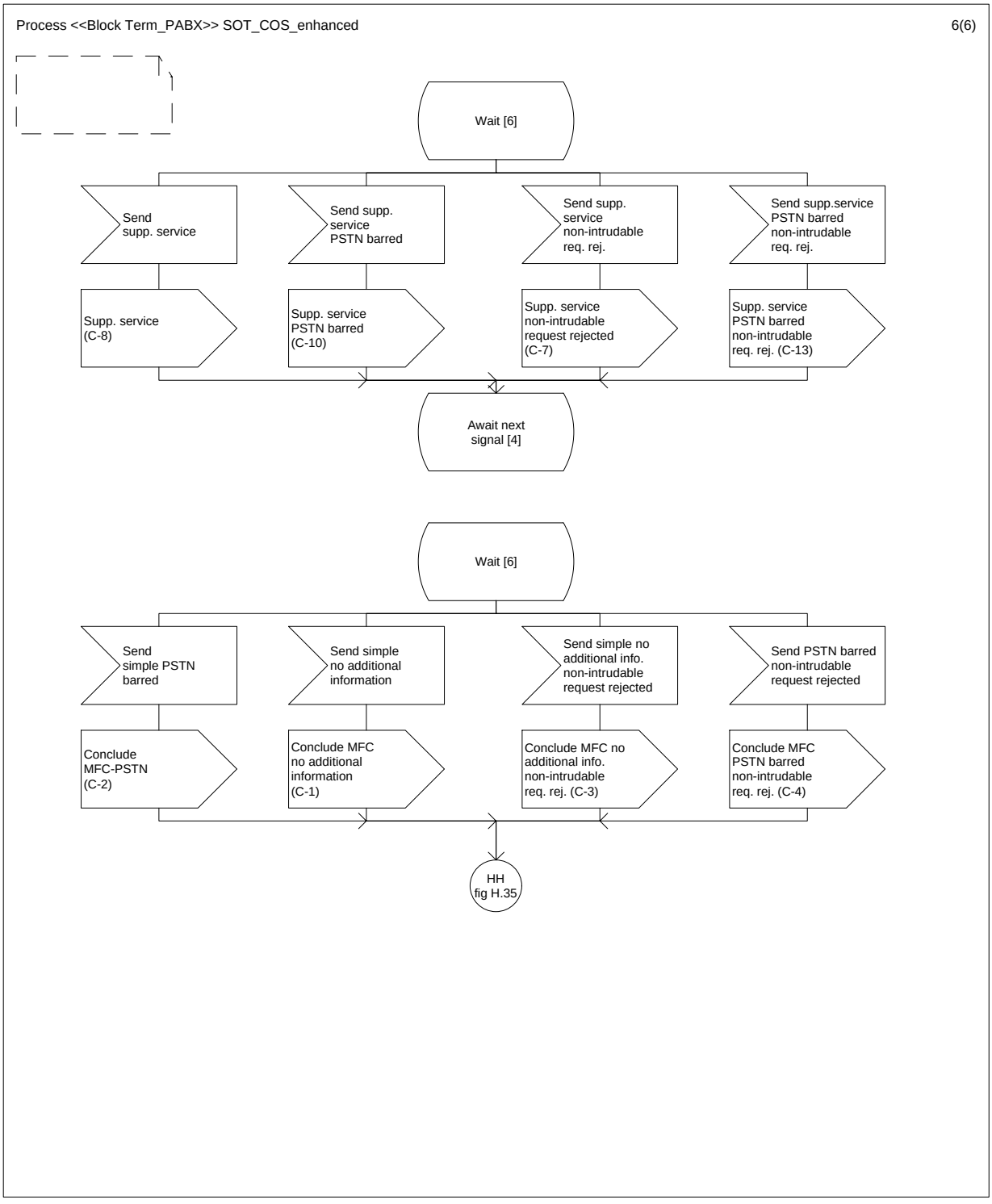


Figure H.32 (T/CS 49-08): Terminating PABX SOT/COS procedure (enhanced MFC subset) (sheet 6 of 6)

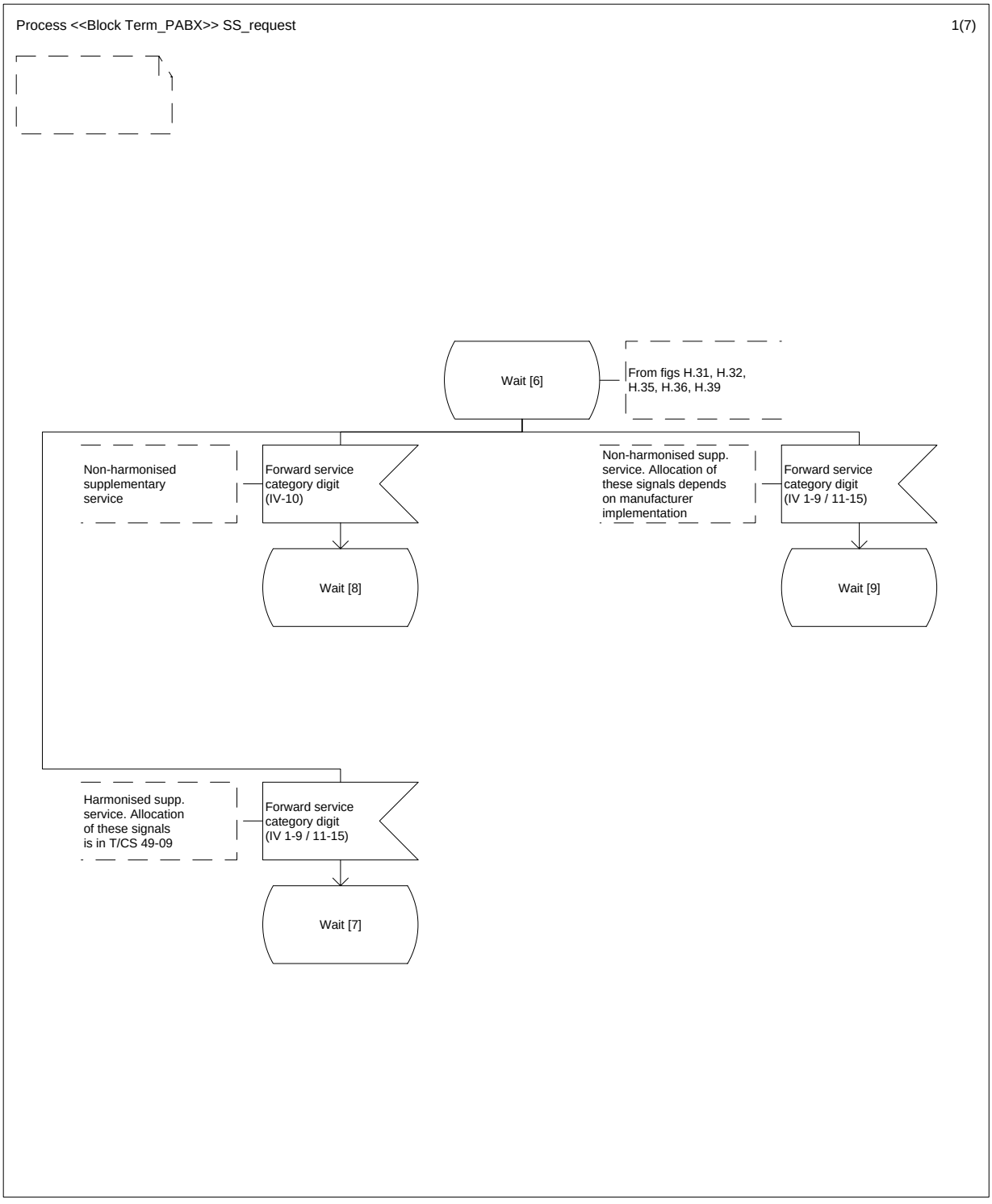


Figure H.33 (T/CS 49-08): Terminating PABX supplementary service request procedure (enhanced MFC subset) (sheet 1 of 7)

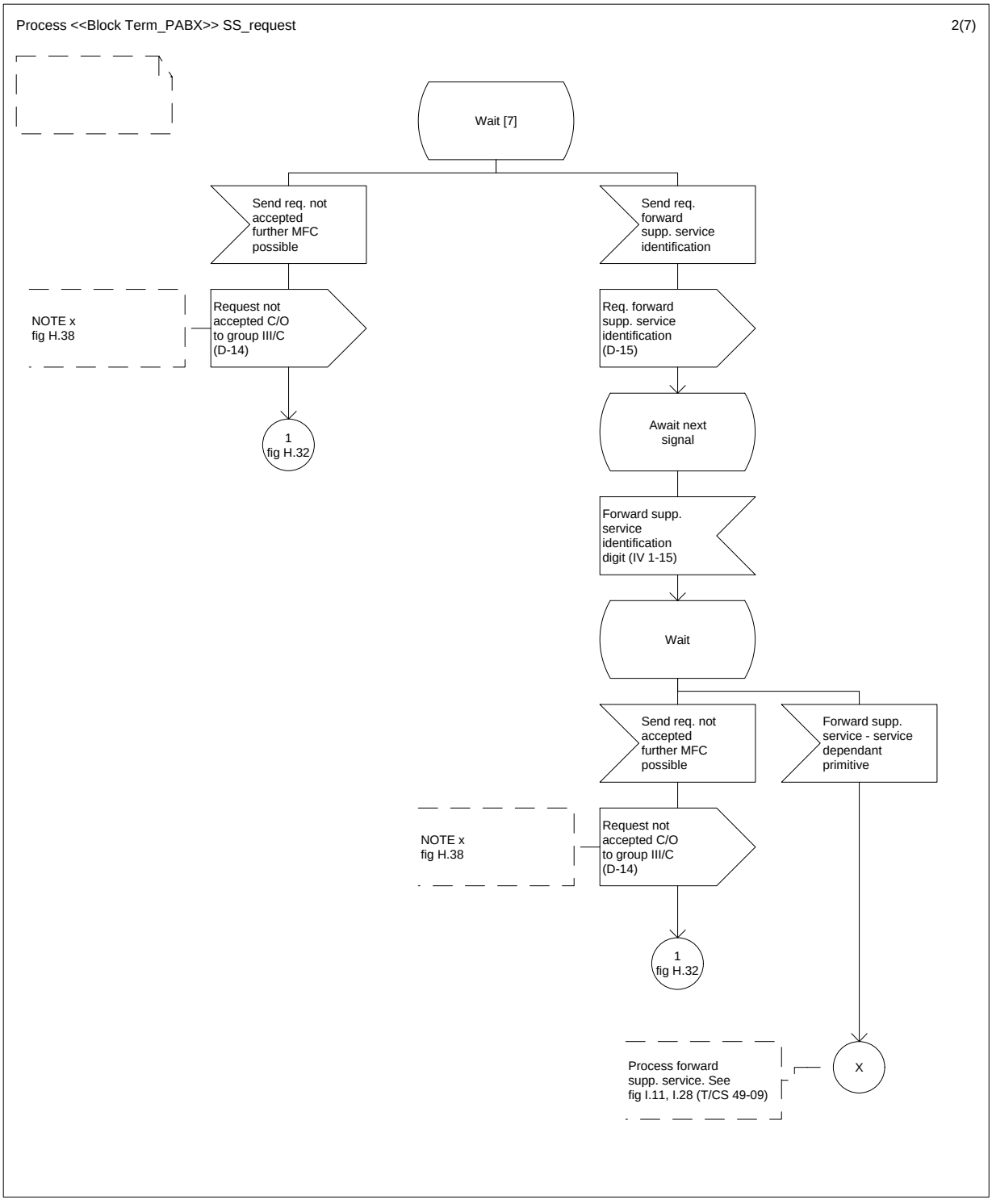


Figure H.33 (T/CS 49-08): Terminating PABX supplementary service request procedure (enhanced MFC subset) (sheet 2 of 7)

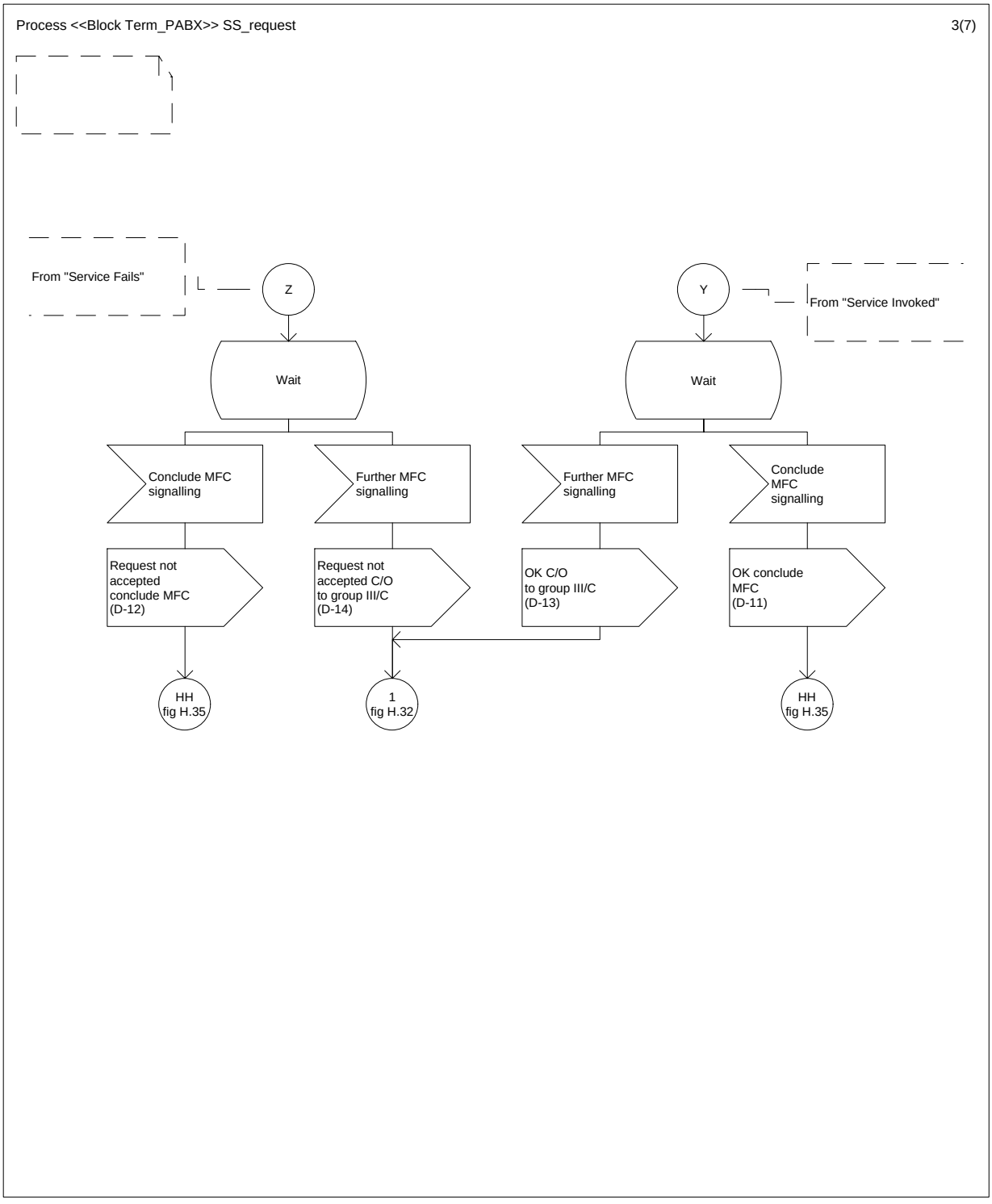


Figure H.33 (T/CS 49-08): Terminating PABX supplementary service request procedure (enhanced MFC subset) (sheet 3 of 7)

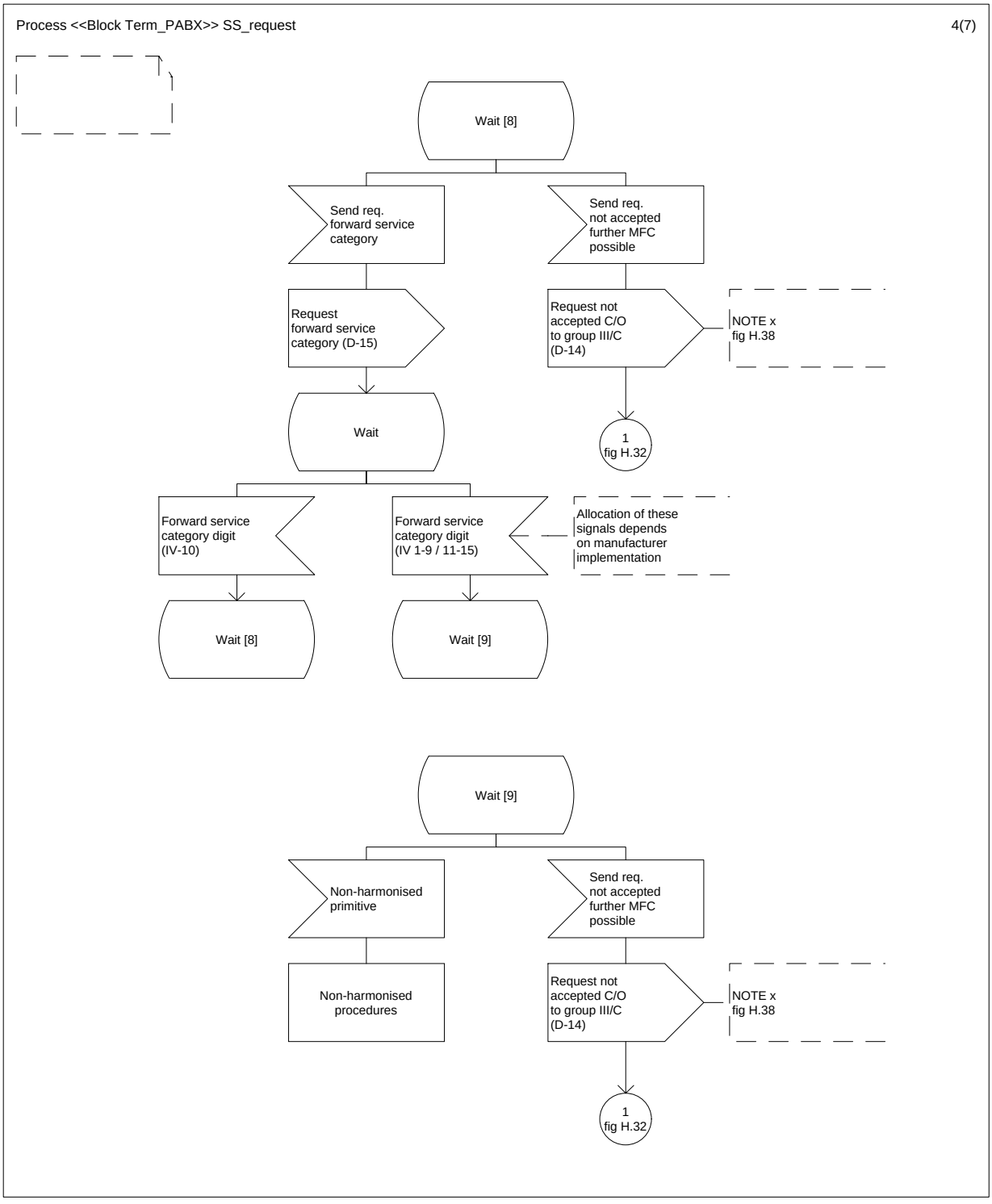


Figure H.33 (T/CS 49-08): Terminating PABX supplementary service request procedure (enhanced MFC subset) (sheet 4 of 7)

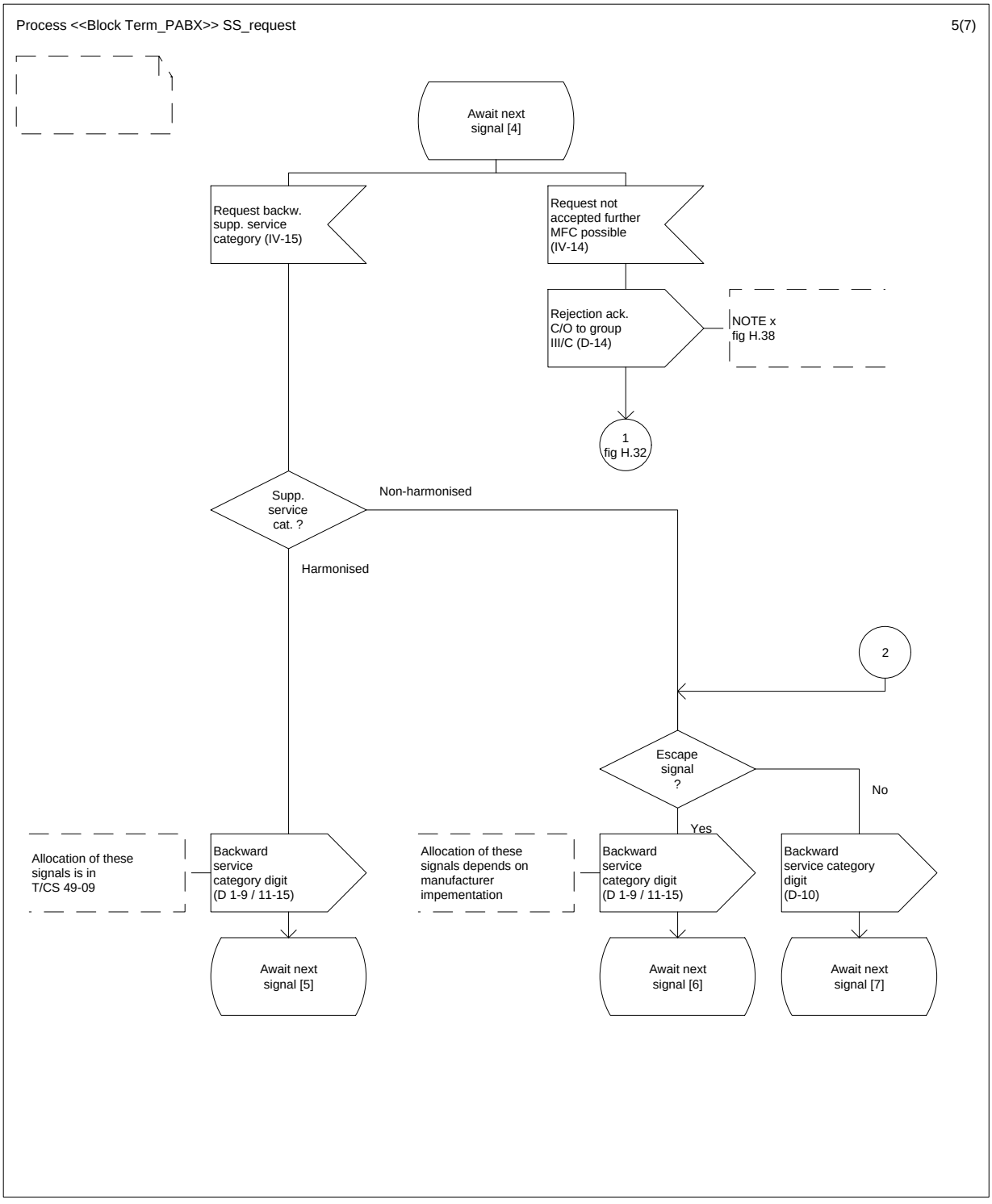


Figure H.33 (T/CS 49-08): Terminating PABX supplementary service request procedure (enhanced MFC subset) (sheet 5 of 7)

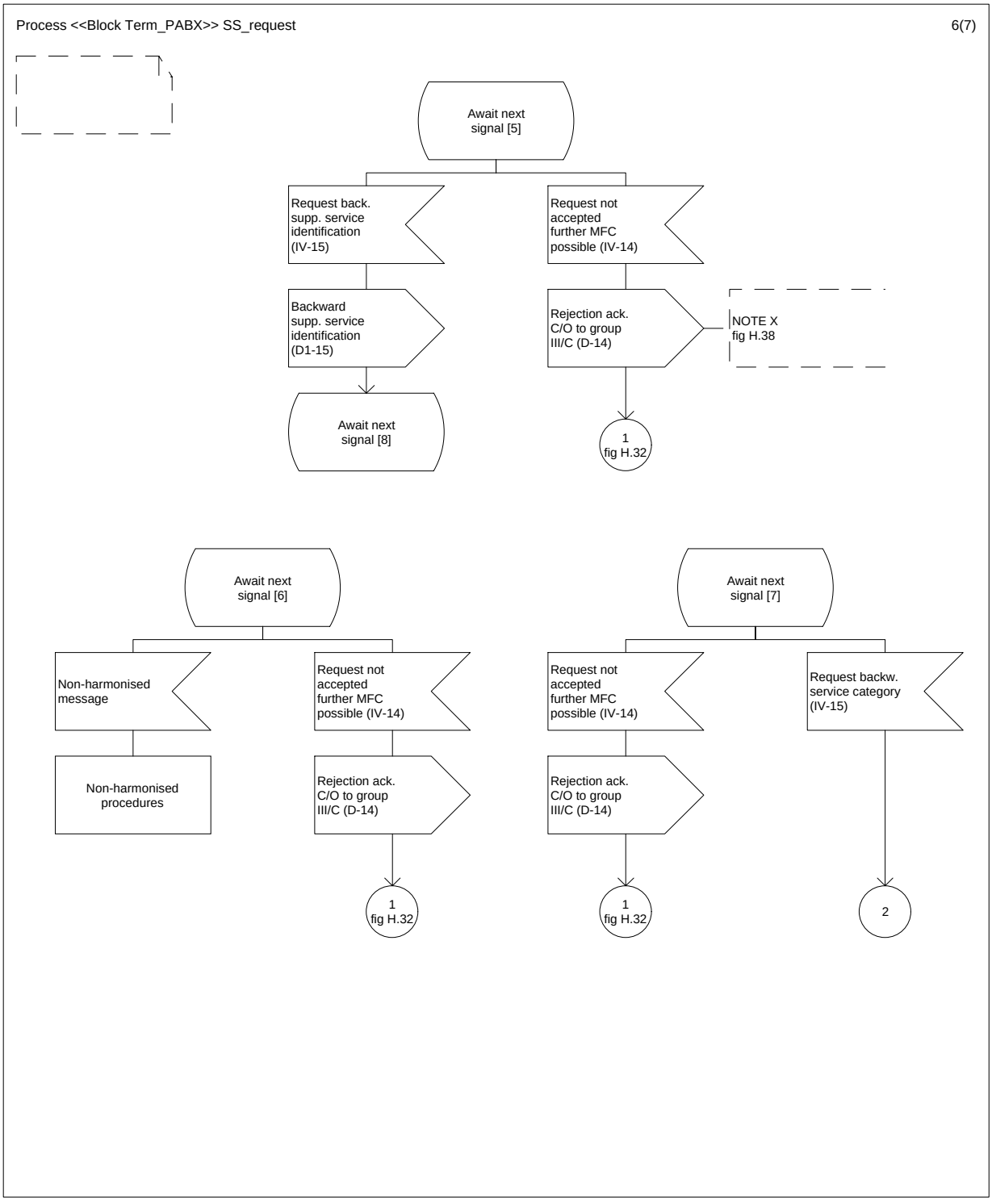


Figure H.33 (T/CS 49-08): Terminating PABX supplementary service request procedure (enhanced MFC subset) (sheet 6 of 7)

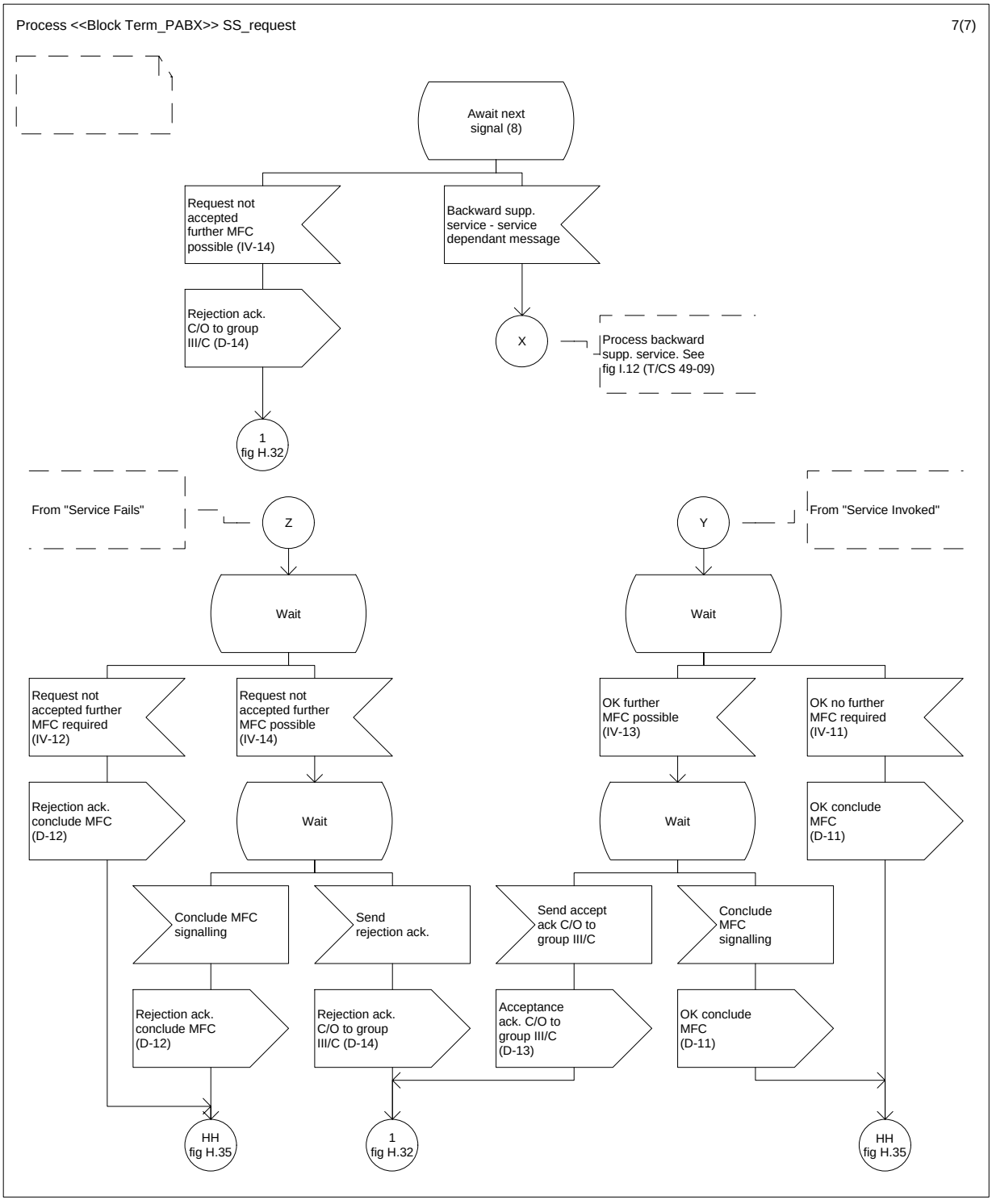


Figure H.33 (T/CS 49-08): Terminating PABX supplementary service request procedure (enhanced MFC subset) (sheet 7 of 7)

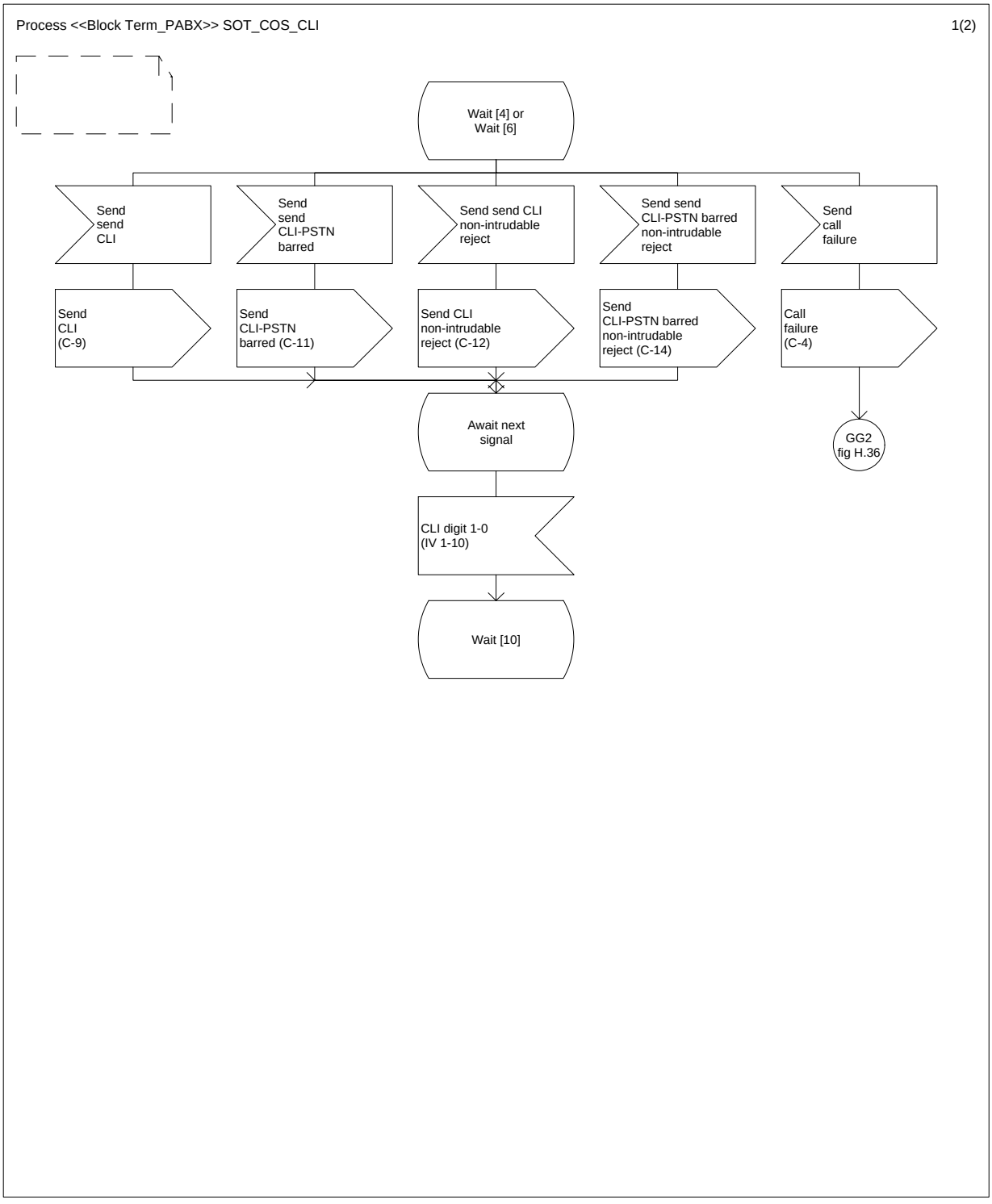


Figure H.34 (T/CS 49-08): Terminating PABX SOT/COS procedure + calling line identity (CLI) (enhanced subset) (sheet 1 of 2)

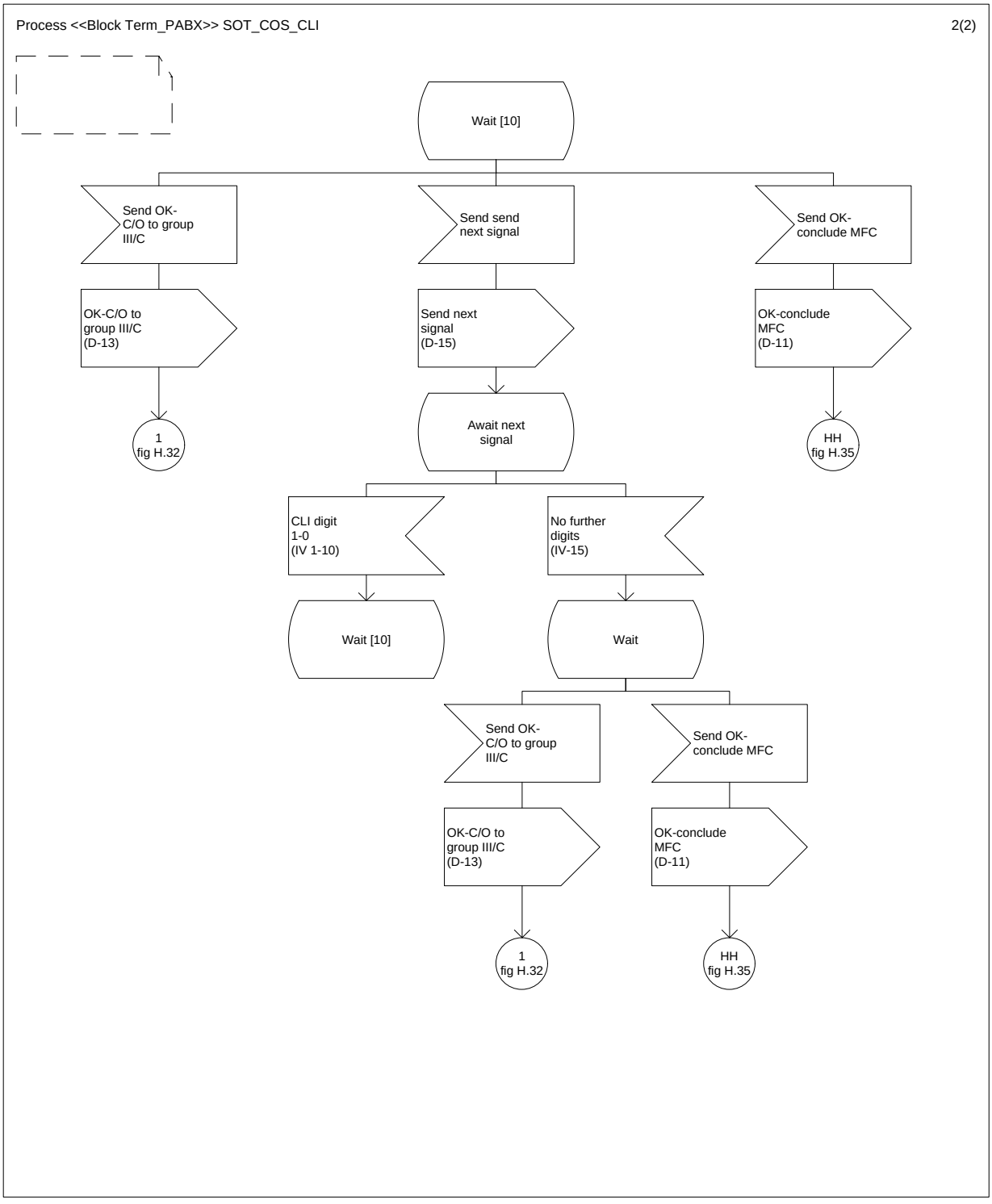


Figure H.34 (T/CS 49-08): Terminating PABX SOT/COS procedure + calling line identity (CLI) (enhanced subset) (sheet 2 of 2)

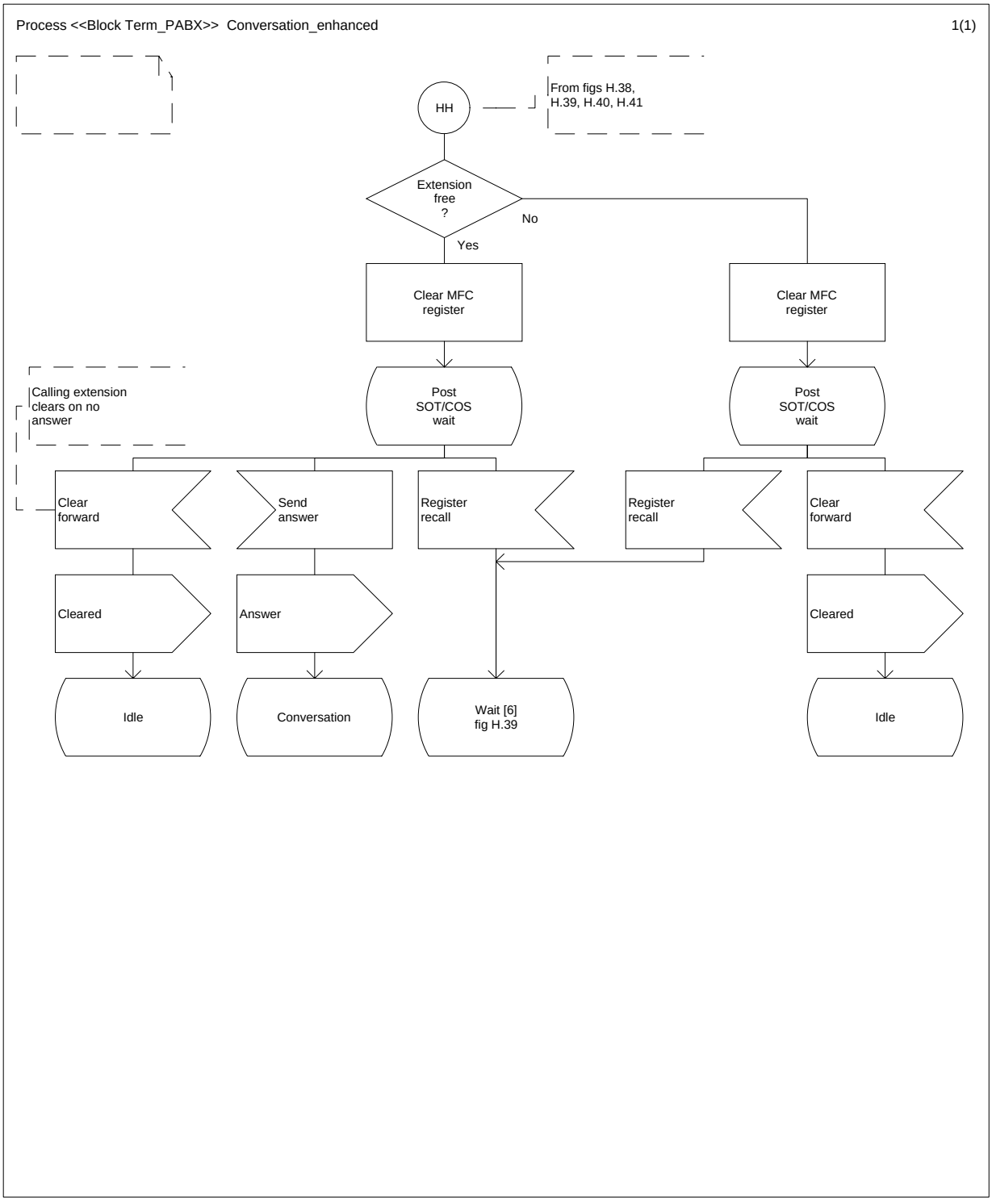


Figure H.35 (T/CS 49-08): Terminating PABX answer and conversation (enhanced MFC subset) (sheet 1 of 1)

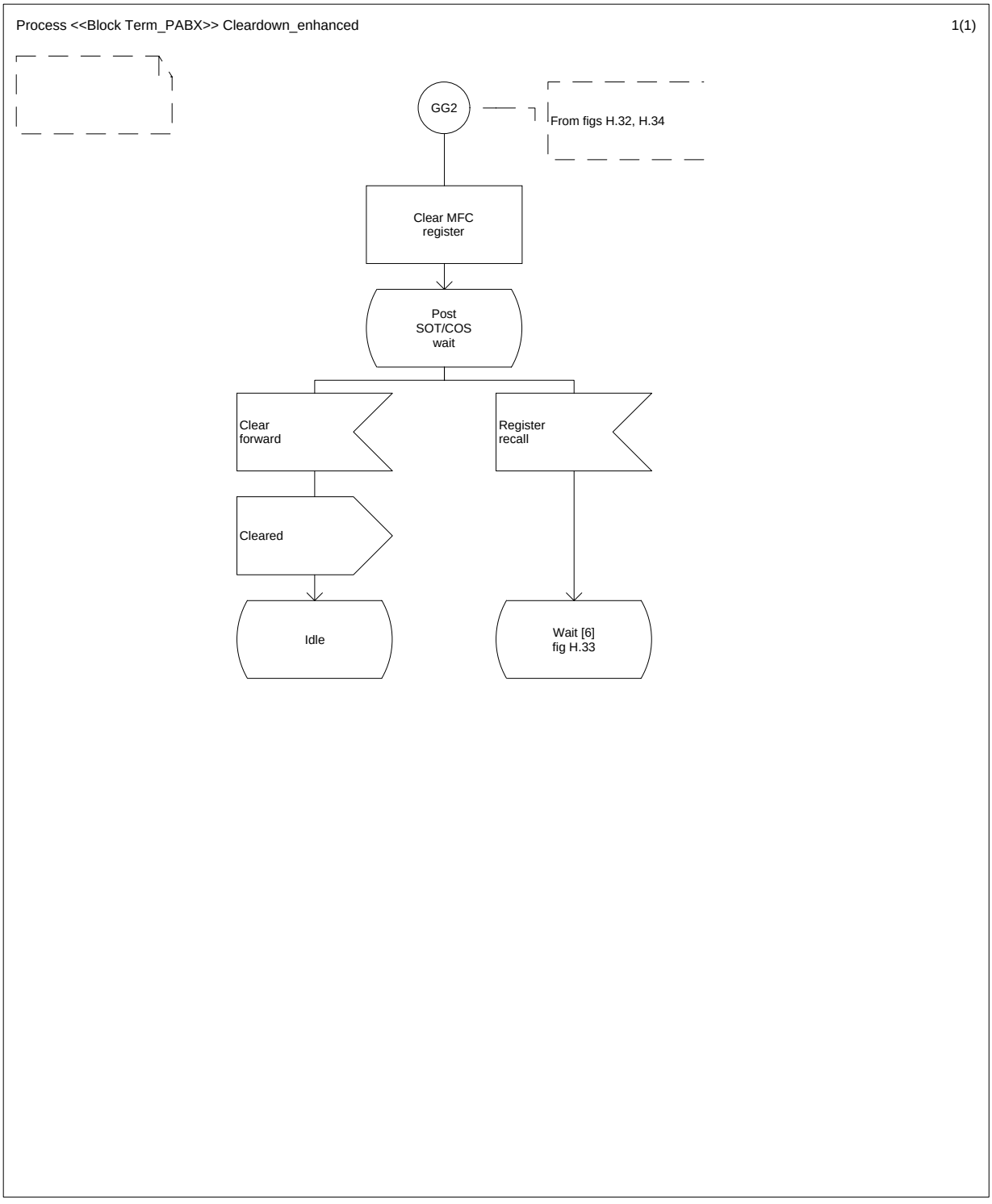


Figure H.36 (T/CS 49-08): Terminating PABX cleardown sequence (enhanced MFC subset) (sheet 1 of 1)

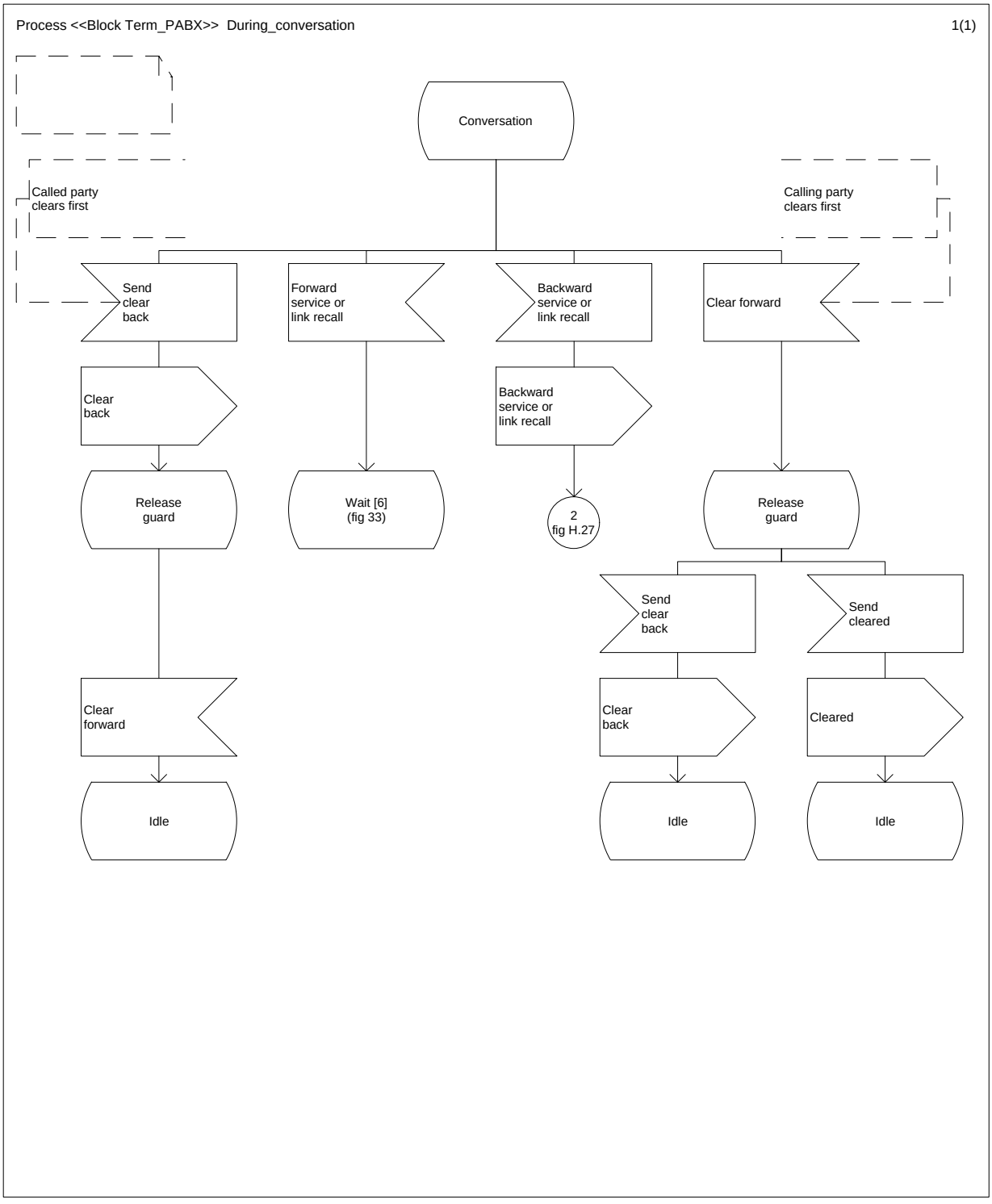


Figure H.37 (T/CS 49-08): Cleardown or register recall during conversation (terminating PABX enhanced MFC subset) (sheet 1 of 1)

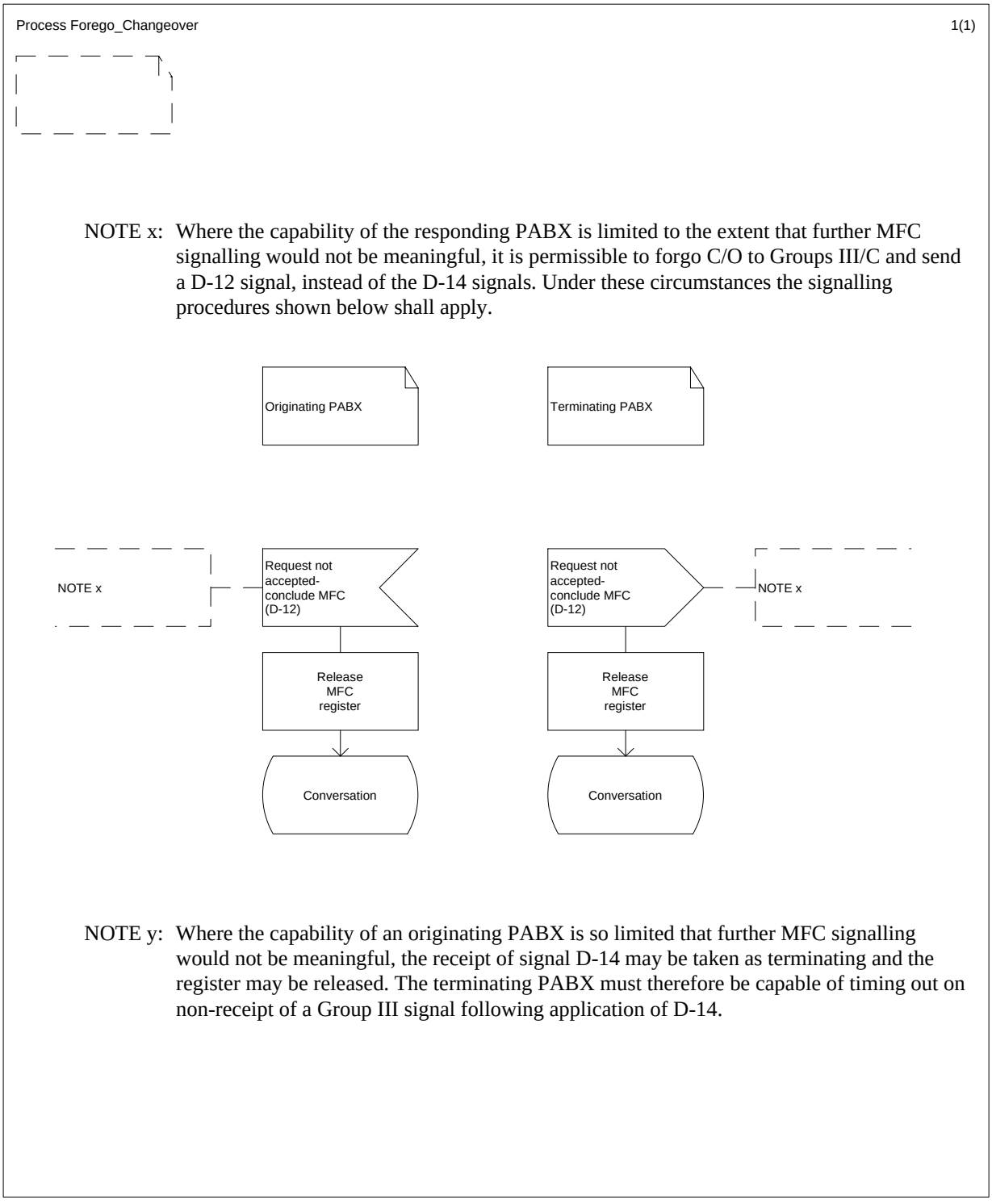


Figure H.38 (T/CS 49-08) (sheet 1 of 1)

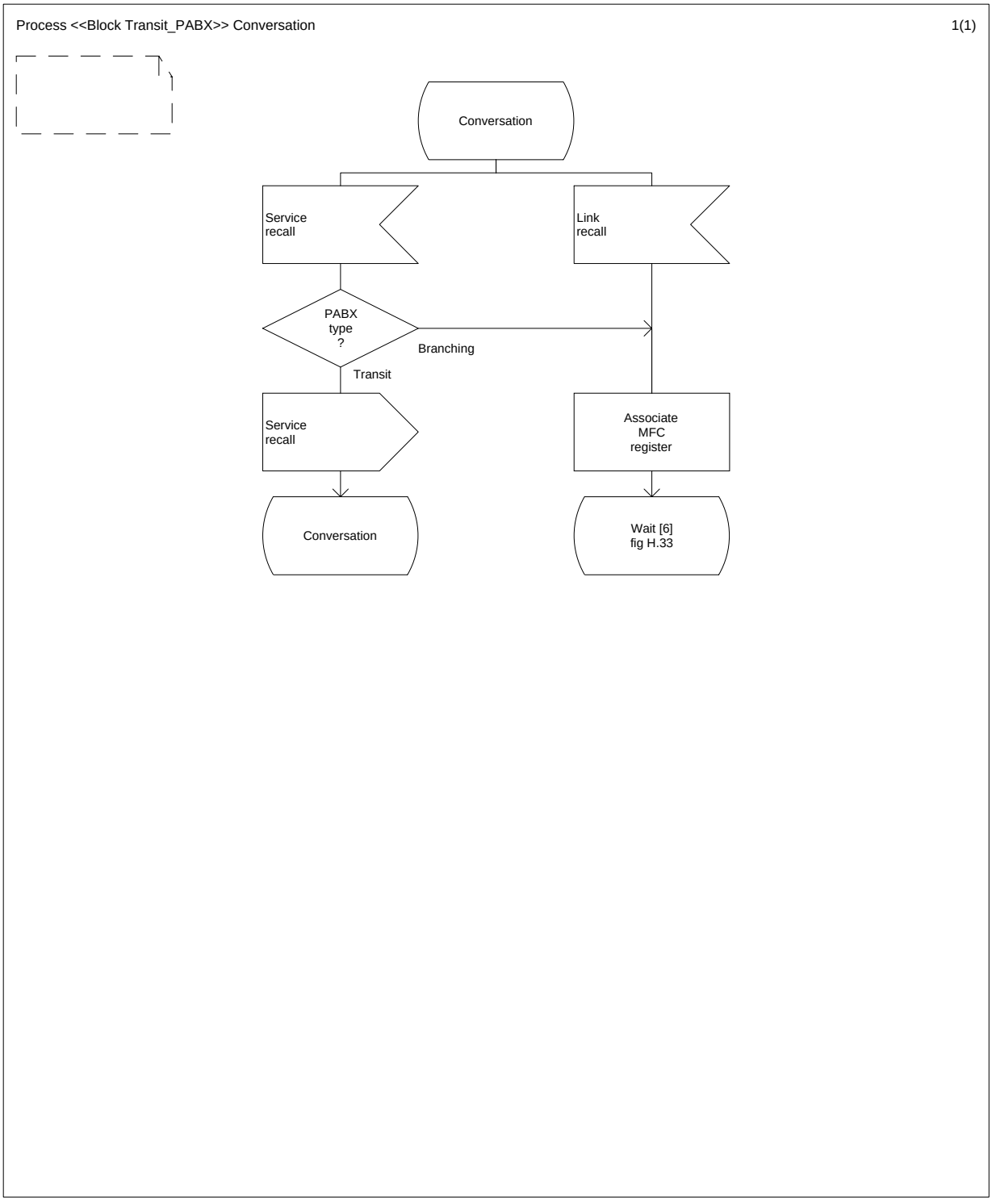


Figure H.39 (T/CS 49-08): Action of a transit PABX on receipt of a recall signal during conversation (sheet 1 of 1)

Annex J:
CEPT Recommendation T/CS 49-09

Recommendation T/CS 49-09 (Cannes 1983, revised in Nice 1985)

Edition of November 15 1986

SYSTEM L1 MULTIFREQUENCY CODE SUPPLEMENTARY SERVICES

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Text of the Recommendation adopted by the "Telecommunications" Commission.

"The European Conference of Postal and Telecommunications Administrations,

considering

- that supplementary services:
  - Automatic Number Identification (ANI);
  - Completion of Calls to Busy Subscriber (CCBS);
  - Call waiting;
  - Call diversion,

  are commonly used in private automatic branch exchanges (PABXs);
- that SPC PABXs allow a flexible introduction of these supplementary services;
- that signalling system L1 with multifrequency code interregister signalling is in use for the signalling over leased lines between PABXs;
- that in accordance with the principles of Multifrequency code interregister signalling outlined in Recommendations T/CS 49-07 [7] and T/CS 49-08 [8] sufficient codes are provided to support the signalling for supplementary services;
- that standardization of the signalling for supplementary services between PABXs favours harmonization of user control procedures, systems and equipment,

recommends

the procedures specified in this Recommendation when using the L1 multifrequency code interregister signalling system to transmit supplementary service information."

J.1 General

J.1.1 Introduction to supplementary services

Supplementary services detailed within this Recommendation provide facilities in addition to fast call set-up to the user of a PABX. A supplementary service request may be made during call set-up, prior to conversation, or during

conversation by means of a register recall procedure. Details of the request procedures are shown in Recommendations T/CS 49-07 [7] and T/CS 49-08 [8].

Request for a supplementary service is made by means of a two signal message.

There are three types of supplementary service requests:

a) Forward Service Request, indicated by a two signal message within Group IV during call set-up;

b) Service Request on Recall, indicated by a two signal message from Group IV following either a Forward or Backward register recall;

c) Backward Service Request, indicated by a two signal message within Group D during call set-up.

The signalling requirements for each service are detailed within the relevant service description (see Tables I.1 and I.2 T/CS 49-09).

The meanings of Group IV/D signals following the two signal supplementary service request will differ depending on the service concerned and are given in the relevant service description.

Some services require more signals than are available in Group IV/D, in which case additional groups are allocated within the service (e.g. Groups VI/F).

The signals allocated in Group VI/F, etc. are specific for the service concerned and may differ between services.

On completion of a supplementary service the signalling is normally returned to Group III/C of Recommendation T/CS 49-08 [8] where further supplementary services can be requested, or the call completed.

An exception to the above is the two signal message IV-12, IV-12, which causes immediate changeover to Group I and A signalling and does not enter into service specific signalling procedures. This message is used subsequent to "Link Recall" to establish an enquiry call via the same private circuit as the original call.

Entry and exit points between the SDL diagrams in a service and the SDL diagrams of Recommendation T/CS 49-08 [8] are shown by means of connectors, designated X, Y and Z, see figures I.5 - I.8 (T/CS 49-09).

The signalling procedure for rejection of a Supplementary Service within the services is common. The procedures are shown in figures I.1 - I.4 (T/CS 49-09) and are applicable at any point within the service.

J.1.2 Allocation of two signal messages

The first signal of a two signal message indicates the category of the Supplementary Service as shown below.

Signals 1-9	Manufacturer Specific signalling procedures. Each manufacturer has a unique category number.
Signal 10	An escape to a second category digit.
Signals 11-14	Procedures specified by Administrations.
Signal 15	Procedures originated by CEPT.

Where a service, initially specified by individual Administrations, is subsequently adopted by CEPT the original two signal message (i.e. in the range 11-14) will be retained.

The allocations are listed within this Recommendation.

Table J.1 (T/CS 49-09): Two signal messages for forward supplementary service requests

1st Group IV Signal	2nd Group IV Signal	Message	T/CS 49-09 Section
11	1	Request Call Back	I.3
»	2	Call Back Attempt	I.3
»	3	Diversion Bypass	
»	4	Free Notification Request	I.3
»	5	Request ANI	I.2
»	6		
»	7	Request Executive Intrusion	*
»	8	Call Waiting	I.4
»	9		
»	10		
»	11		
»	12	Operator Intrusion	
»	13		
»	14		
»	15		
12	1	Request Override	*
»	2	Operator Recall	*
»	3	Request Re-Ring	*
»	4	Request Camp-on	*
»	5	Free Notification	I.3
»	6	Request Called Party Identity	*
»	7	Cancel Call Back	I.3
»	8	Reverted Call Back Attempt	I.3
»	9	Diversion Activation on Ring Tone No Reply	*
»	11		
»	12	Revert to Selection Phase; Changeover to GPI/A	I.1
»	13		
»	14		
»	15		
*	Reserved.		

Table J.2 (T/CS 49-09): Two signal messages for forward supplementary service requests

1st Group IV Signal	2nd Group IV Signal	Message	T/CS 49-09 Section
13	1		
»	2		
»	3		
»	4	ANI Request	I.2
»	5	Request Immediate Diversion (own PABX)	*
»	6		
»	7	Request Immediate Diversion (off PABX)	*
»	8	Request Diversion on RTNR	*
»	9		
»	10		
»	11		
»	12		
»	13		
»	14		
»	15		
14	1		
»	2		
»	3		
»	4		
»	5		
»	6		
»	7		
»	8		
»	9		
»	10		
»	11		
»	12		
»	13		
»	14		
»	15		
* Reserved.			

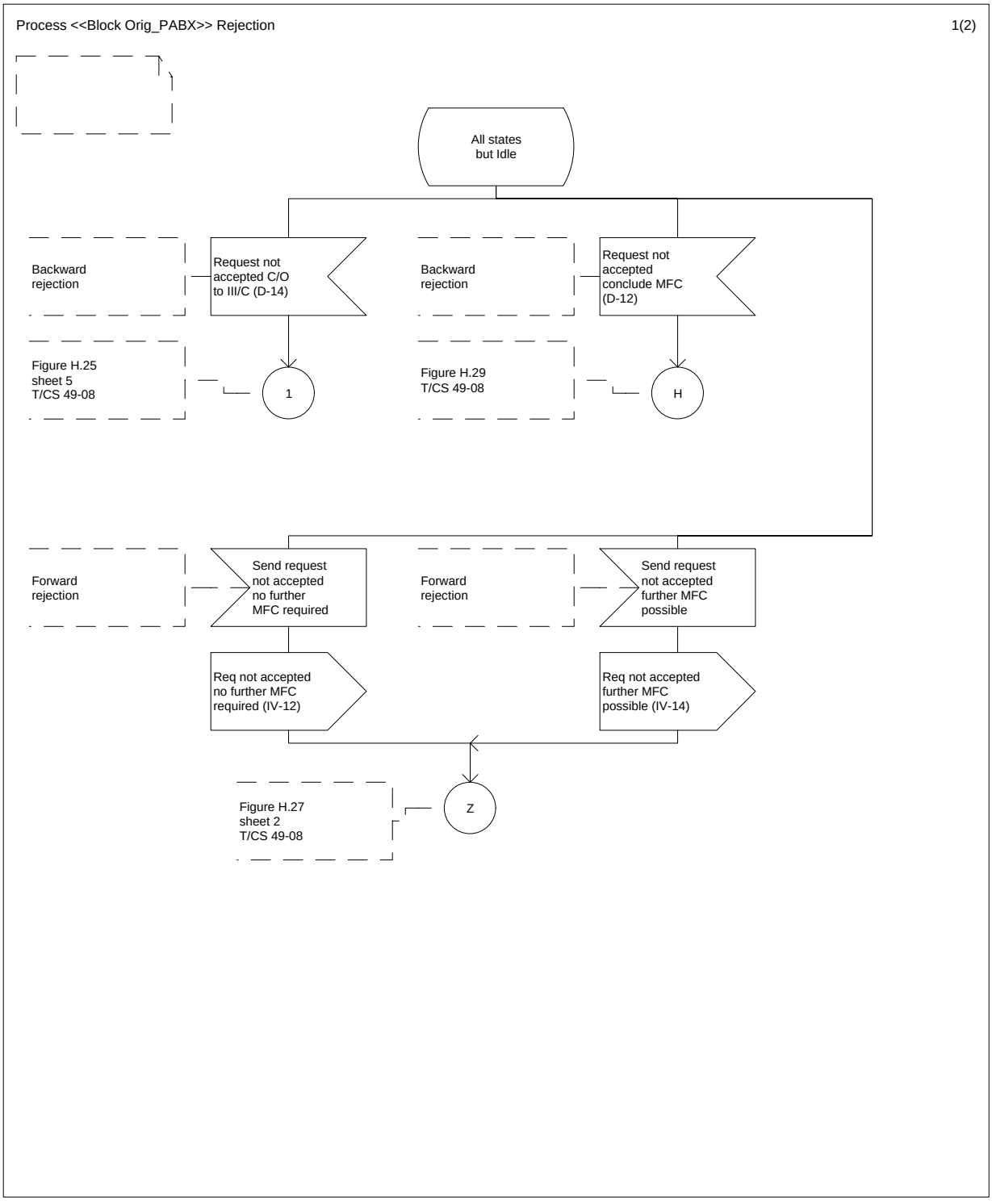


Figure J.1 (T/CS 49-09): Rejection of service within service signalling (Groups IV/D) (sheet 1 of 2)

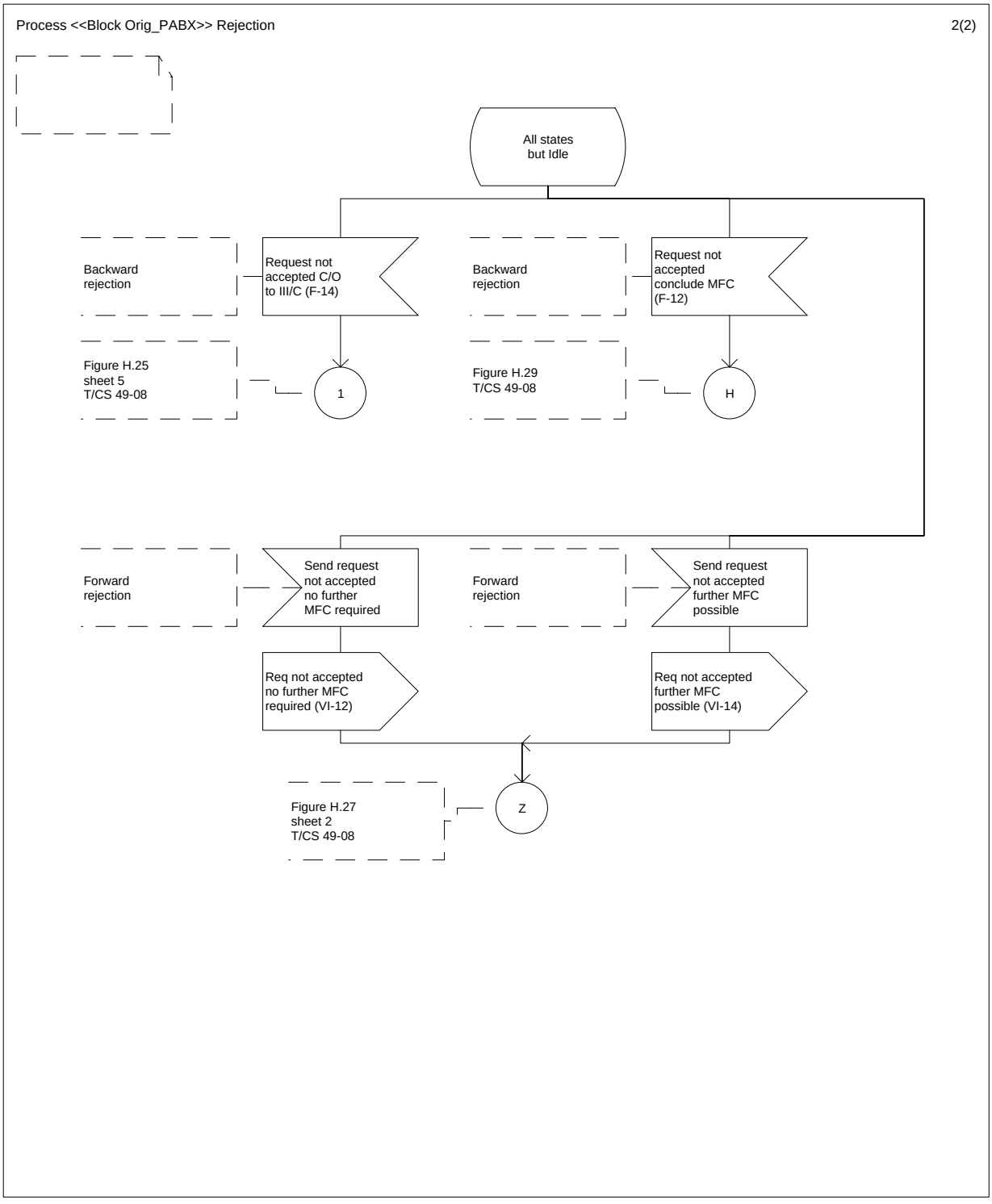


Figure J.1 (T/CS 49-09): Rejection of service within service signalling (Groups VI/F) (sheet 2 of 2)

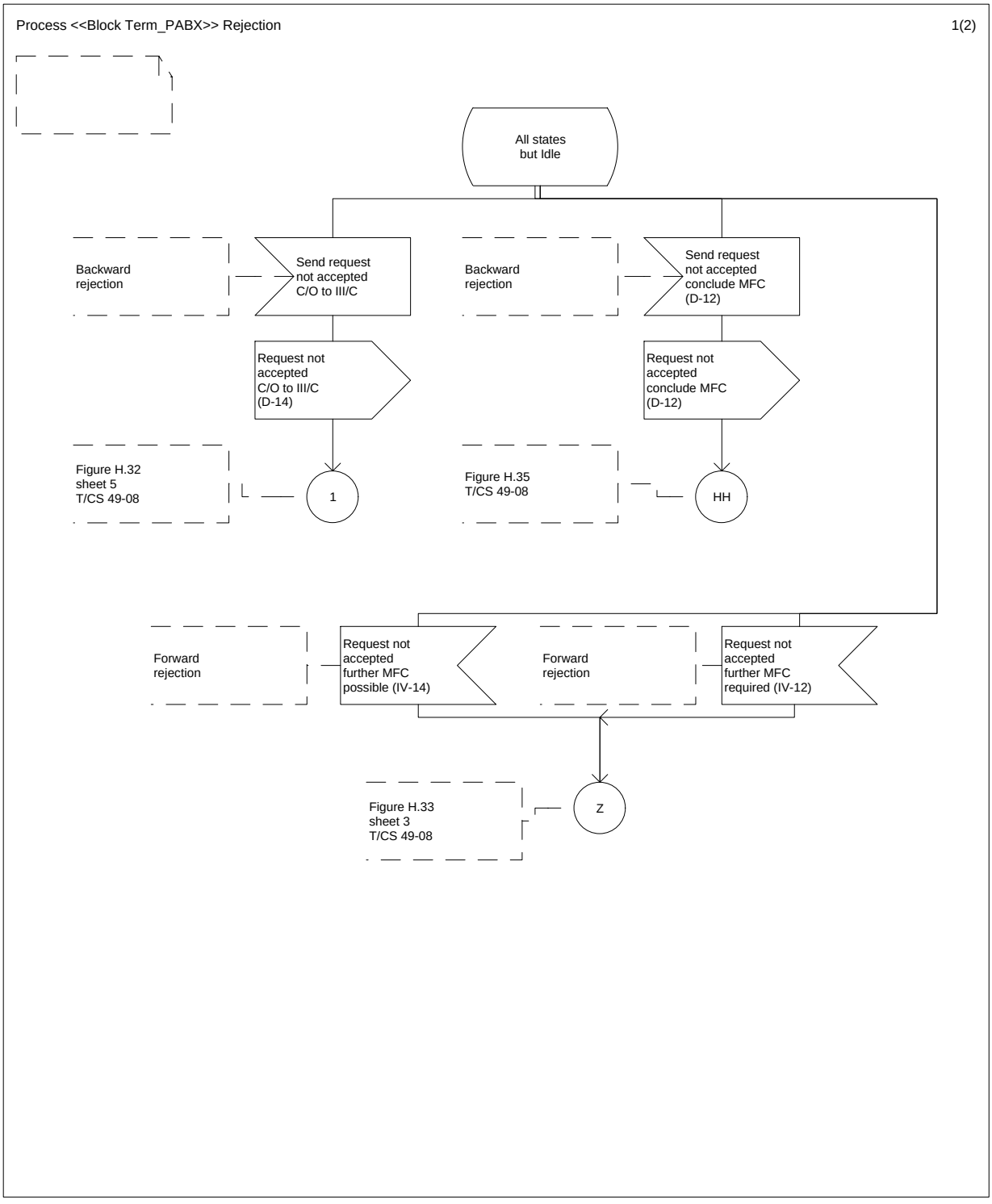


Figure J.2 (T/CS 49-09): Rejection of service within service signalling (Groups IV/D) (sheet 1 of 2)

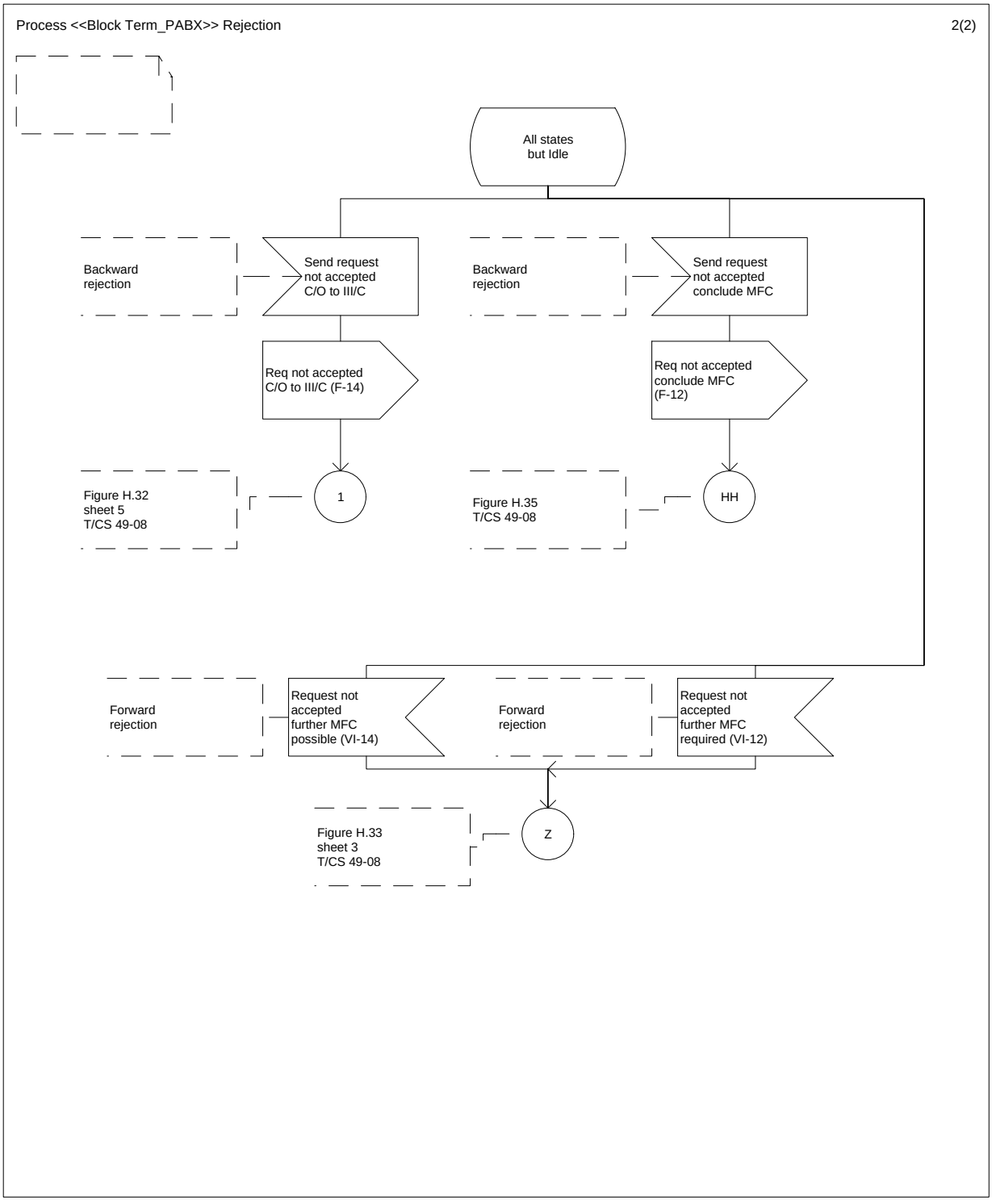


Figure J.2 (T/CS 49-09): Rejection of service within service signalling (Groups VI/F) (sheet 2 of 2)

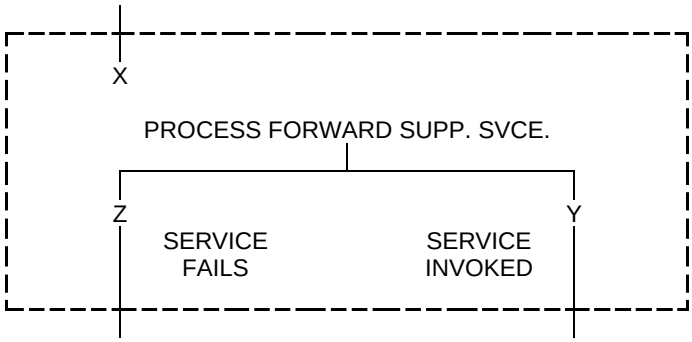


**Figure J.3 (T/CS 49-09): Extract from figure H.27 sheet 2 (T/CS 49-08)
(Originating PABX supplementary service request procedure)**

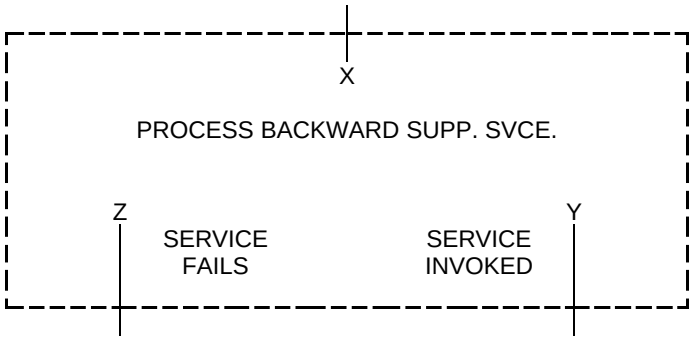


**Figure J.4 (T/CS 49-09): Extract from figure H.27 sheets 7 & 8 (T/CS 49-08)
(Originating PABX supplementary service request procedure)**

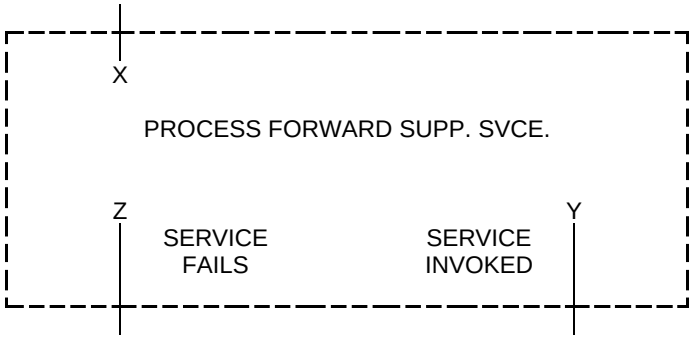


**Figure J.5 (T/CS 49-09): Extract from figure H.33 sheets 2 & 3 (T/CS 49-08)
(Terminating PABX supplementary service request procedure)**

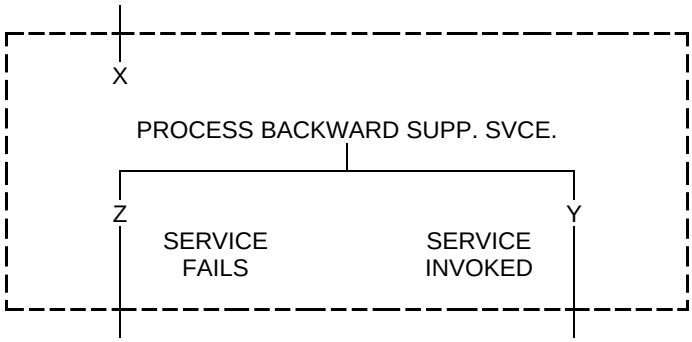


**Figure J.6 (T/CS 49-09): Extract from figure H.33 sheet 7 (T/CS 49-08)
(Terminating PABX supplementary service request procedure)**

I.2 Supplementary service - Automatic Number Identification

J.2.1 General

The ANI service enables a user to request the identity of either the called or calling party (whichever is relevant), and to send its own identity at the same time. The information received by each PABX must be sufficient to enable a return call to be made (i.e. the ANI digits should comprise of the directory numbers needed to make a call to the destination extension). ANI could be requested where the identity of a party changes (e.g. following Immediate Diversion - own PABX).

J.2.2 Outline of control procedures

The signalling procedures within this service are based on an interleaving method, whereby the receipt of an ANI digit signal in one direction implies the request to send the next ANI digit in the other direction.

The signal codes used to request the service are as follows:

Forward Request	IV-11/IV-5
After Recall	IV-11/IV-5
Backward Request	D-13/D-4

Following the two signal ANI request the responding PABX will send a Group IV signal (if the request was in the forward direction or following recall) or Group D signal (if the request was in the backward direction). This signal shall return the 1st ANI digit or indicate that there are no ANI digits to send, and changeover signalling to Groups VI/F. Signalling within Groups VI/F will continue until all address information has been sent.

Where number lengths differ the PABX with the smaller number will continue requesting ANI digits from the responding PABX, by sending "End of Digits" signals, until it in turn receives an "End of Digits" signal.

If a PABX cannot send ANI digits it shall respond to the receipt of an ANI digit signal by sending an "End of Digits" signal, and when necessary continue to request further digits by sending the "End of Digits" signals.

After the "End of Digits" signal has been transmitted in both directions the signalling will revert back to Groups IV/D where completion of the service will be indicated. Subsequent to Group IV/D signalling, reversion back to Group III/C signalling will occur, where further supplementary services may be requested, or the call completed.

During signalling in Groups VI/F, any failure prior to completion of the service will cause a "Changeover to Group III/C" signal to be sent. Further signalling will depend on whether the failure signal is concluding or enabling further signalling within MFC.

J.2.3 Allocation and description of signals

a) 1st ANI Digit/Send Next Signal/C/O to Groups VI/F (Code IV-10 and D1-10)

These signals have composite meanings and convey the following information:

- 1st Address digit of the calling/called party
- Request C/O to Group IV/F
- Send Next Signal

The 1st ANI Digit/Send Next Signal/C/O to Groups VI/F signal is allocated to MF Code IV1-10 after a Backward request, or D1-10 after a forward request.

b) ANI Digit/Send Next Digit (Code VI1-10 and F1-10)

This signal shall convey the address digits of the called/calling party identity (except the first digit of the responding PABX), and request the next signal from the other PABX.

The ANI Digit/Send Next Digit signal is allocated to MFC Code VI1-10 in the forward direction, and Code F1-10 in the backward direction.

c) No ANI Digits/Send Next Digit (Code IV-15 and D-15)

This signal shall only be used when the responding PABX, on receipt of a Request ANI signal message, is unable to return address digits. The No ANI Digits signal requests the next signal from the service originating PABX.

The No ANI Digits/Send Next Digit signal is allocated to MFC code IV-15 in the forward direction, and code D-15 in the backward direction.

d) End of Digits/Send Next Digit (Code VI-15 and F-15)

This signal shall be used to inform the responding PABX that all of the ANI digits have been conveyed to it. This signal shall also request the next signal from the responding PABX.

The "End of Digits/Send Next Digit" signal is allocated to MFC Code VI-15 in the forward direction, and Code F-15 in the backward direction.

e) Changeover to Groups IV/D (Code VI-11 and F-11)

This signal shall be used when either:

1) The service has failed during Group VI/F signalling; or
2) The service has been completed following an "End of Digits" signal from both PABXs.

This signal allows re-entry to signalling procedures defined in Recommendation T/CS 49-08 [8] where acceptance or rejection signalling occurs.

The "Changeover to Groups IV/D" signal is allocated to MFC Code VI-11 in the forward direction, and code F-11 in the backward direction.

Table J.3 (T/CS 49-09): Following IV-11 + IV-5 Request ANI

GROUP D SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1	ANI Digit 1/Send Next/C/O to Groups VI/F	
2	ANI Digit 2/Send Next/C/O to Groups VI/F	
3	ANI Digit 3/Send Next/C/O to Groups VI/F	
4	ANI Digit 4/Send Next/C/O to Groups VI/F	
5	ANI Digit 5/Send Next/C/O to Groups VI/F	
6	ANI Digit 6/Send Next/C/O to Groups VI/F	
7	ANI Digit 7/Send Next/C/O to Groups VI/F	
8	ANI Digit 8/Send Next/C/O to Groups VI/F	
9	ANI Digit 9/Send Next/C/O to Groups VI/F	
10	ANI Digit 10/Send Next/C/O to Groups VI/F	
11	OK - Conclude MFC	
12	Request Not Accepted - Conclude MFC	
13	OK - Changeover to Group III/C	
14	Request Not Accepted - C/O to Group III/C	
15	No ANI Digits/Send Next Digit/C/O to Groups VI/F	

Table J.4 (T/CS 49-09): Following IV-11 + IV-5 Request ANI + Group D Signal

GROUP VI SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1	ANI Digit 1/Send Next/C/O to Groups VI/F	
2	ANI Digit 2/Send Next/C/O to Groups VI/F	
3	ANI Digit 3/Send Next/C/O to Groups VI/F	
4	ANI Digit 4/Send Next/C/O to Groups VI/F	
5	ANI Digit 5/Send Next/C/O to Groups VI/F	
6	ANI Digit 6/Send Next/C/O to Groups VI/F	
7	ANI Digit 7/Send Next/C/O to Groups VI/F	
8	ANI Digit 8/Send Next/C/O to Groups VI/F	
9	ANI Digit 9/Send Next/C/O to Groups VI/F	
10	ANI Digit 10/Send Next/C/O to Groups VI/F	
11	C/O to Group IV/D	
12	Request Not Accepted - No further MFC required	
13		
14	Request Not Accepted - Further MFC possible	
15	No ANI Digits/Send Next Digit/C/O to Groups VI/F	

Table J.5 (T/CS 49-09): Following IV-11 + IV-5 Request ANI + Group D Signal

GROUP F SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1	ANI Digit 1/Send Next Digit	
2	ANI Digit 2/Send Next Digit	
3	ANI Digit 3/Send Next Digit	
4	ANI Digit 4/Send Next Digit	
5	ANI Digit 5/Send Next Digit	
6	ANI Digit 6/Send Next Digit	
7	ANI Digit 7/Send Next Digit	
8	ANI Digit 8/Send Next Digit	
9	ANI Digit 9/Send Next Digit	
10	ANI Digit 10/Send Next Digit	
11		
12	Request Not Accepted- Conclude MFC	
13		
14	Request Not Accepted - C/O to Group III/C	
15	End of Digits/Send Next Digit	

Table J.6 (T/CS 49-09): Following D-13 + D-4 (Request ANI)

GROUP IV SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1	ANI Digit 1/Send Next Digit	
2	ANI Digit 2/Send Next Digit	
3	ANI Digit 3/Send Next Digit	
4	ANI Digit 4/Send Next Digit	
5	ANI Digit 5/Send Next Digit	
6	ANI Digit 6/Send Next Digit	
7	ANI Digit 7/Send Next Digit	
8	ANI Digit 8/Send Next Digit	
9	ANI Digit 9/Send Next Digit	
10	ANI Digit 10/Send Next Digit	
11		
12	Request Not Accepted - No further MFC required	
13		
14	Request Not Accepted - Further MFC possible	
15	No ANI Digits/Send Next Digit/C/O to Groups VI/F	

Table J.7 (T/CS 49-09): Following D-13 + D-4 Request ANI + Group IV Signal

GROUP F SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1	ANI Digit 1/Send Next Digit	
2	ANI Digit 2/Send Next Digit	
3	ANI Digit 3/Send Next Digit	
4	ANI Digit 4/Send Next Digit	
5	ANI Digit 5/Send Next Digit	
6	ANI Digit 6/Send Next Digit	
7	ANI Digit 7/Send Next Digit	
8	ANI Digit 8/Send Next Digit	
9	ANI Digit 9/Send Next Digit	
10	ANI Digit 10/Send Next Digit	
11	C/O to Group IV/D	
12	Request Not Accepted - Conclude MFC	
13		
14	Request Not Accepted - C/O to Groups III/C	
15	End of Digits/Send Next Digit	

Table J.8 (T/CS 49-09): Following D-l 3 + D-4 Request ANI + Group IV Signal

GROUP VI SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1	ANI Digit 1/Send Next Digit	
2	ANI Digit 2/Send Next Digit	
3	ANI Digit 3/Send Next Digit	
4	ANI Digit 4/Send Next Digit	
5	ANI Digit 5/Send Next Digit	
6	ANI Digit 6/Send Next Digit	
7	ANI Digit 7/Send Next Digit	
8	ANI Digit 8/Send Next Digit	
9	ANI Digit 9/Send Next Digit	
10	ANI Digit 10/Send Next Digit	
11		
12	Request Not Accepted - No further MFC required	
13		
14	Request Not Accepted - Further MFC possible	
15	End of Digits/Send Next Digit	

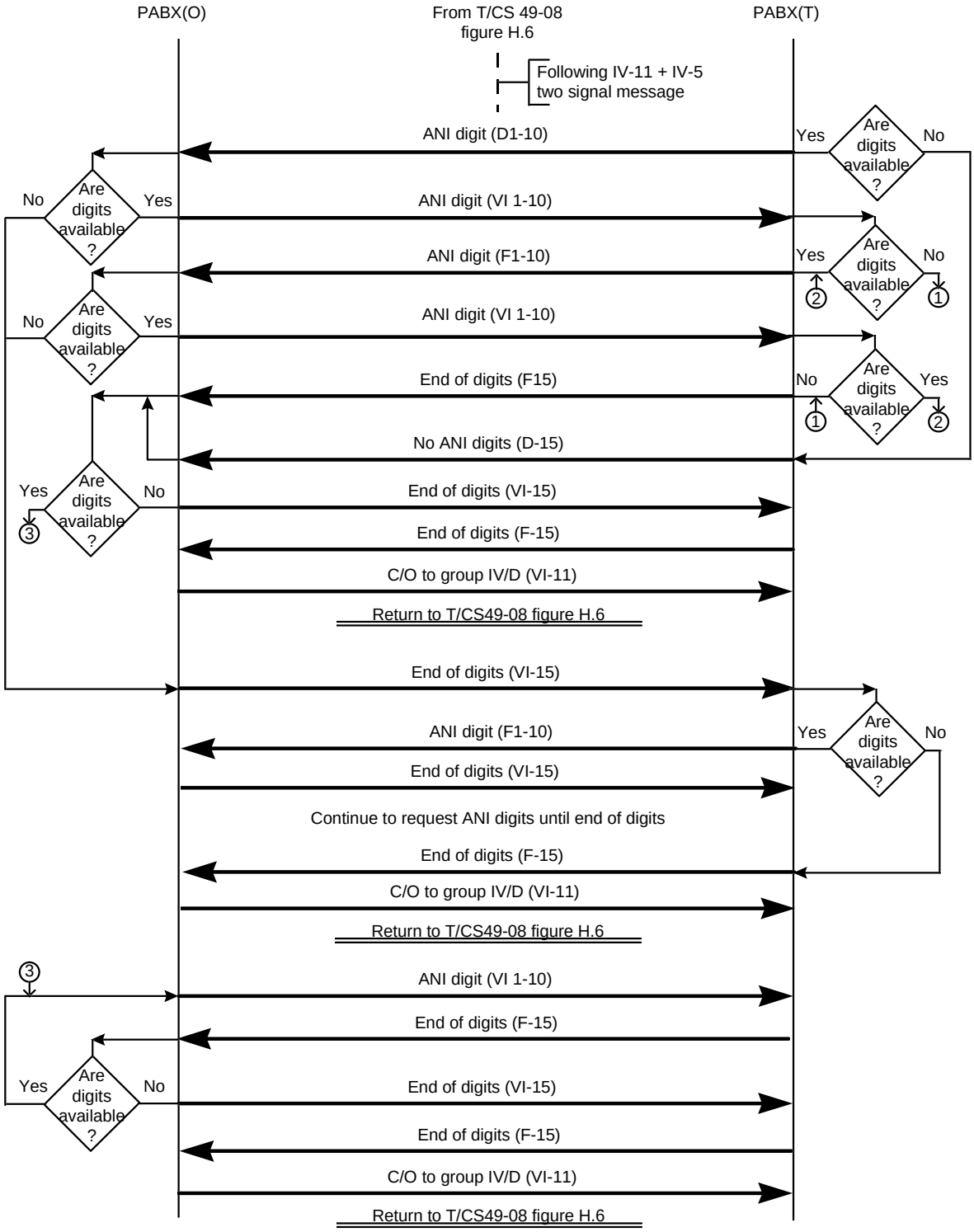


Figure J.7 (T/CS 49-09): ANI supplementary service

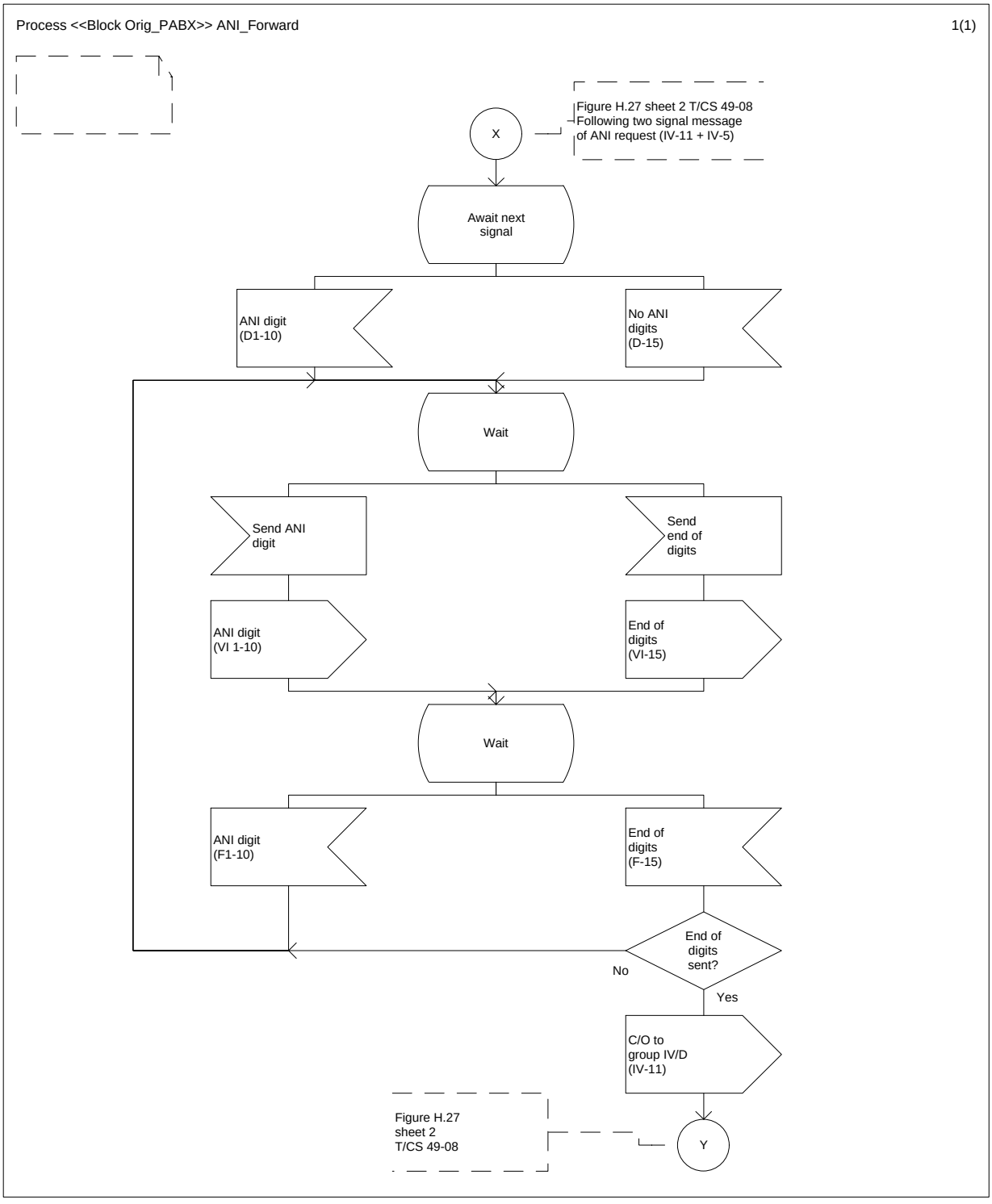


Figure J.8 (T/CS 49-09): ANI supplementary service (originating PABX) Forward direction during call set up or after register recall (sheet 1 of 1)

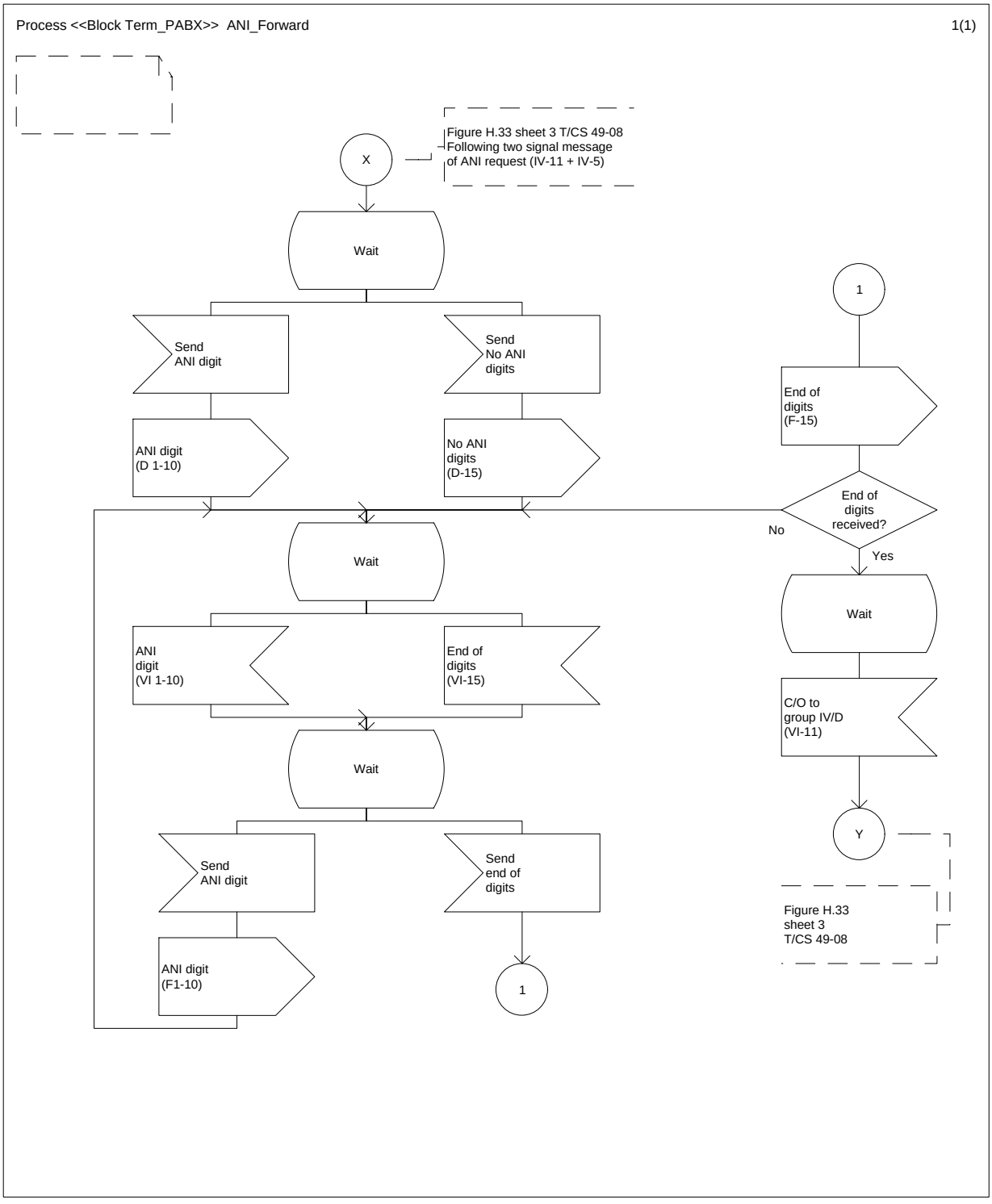


Figure J.9 (T/CS 49-09): ANI supplementary service (terminating PABX) Forward direction during call set up or after register recall (sheet 1 of 1)

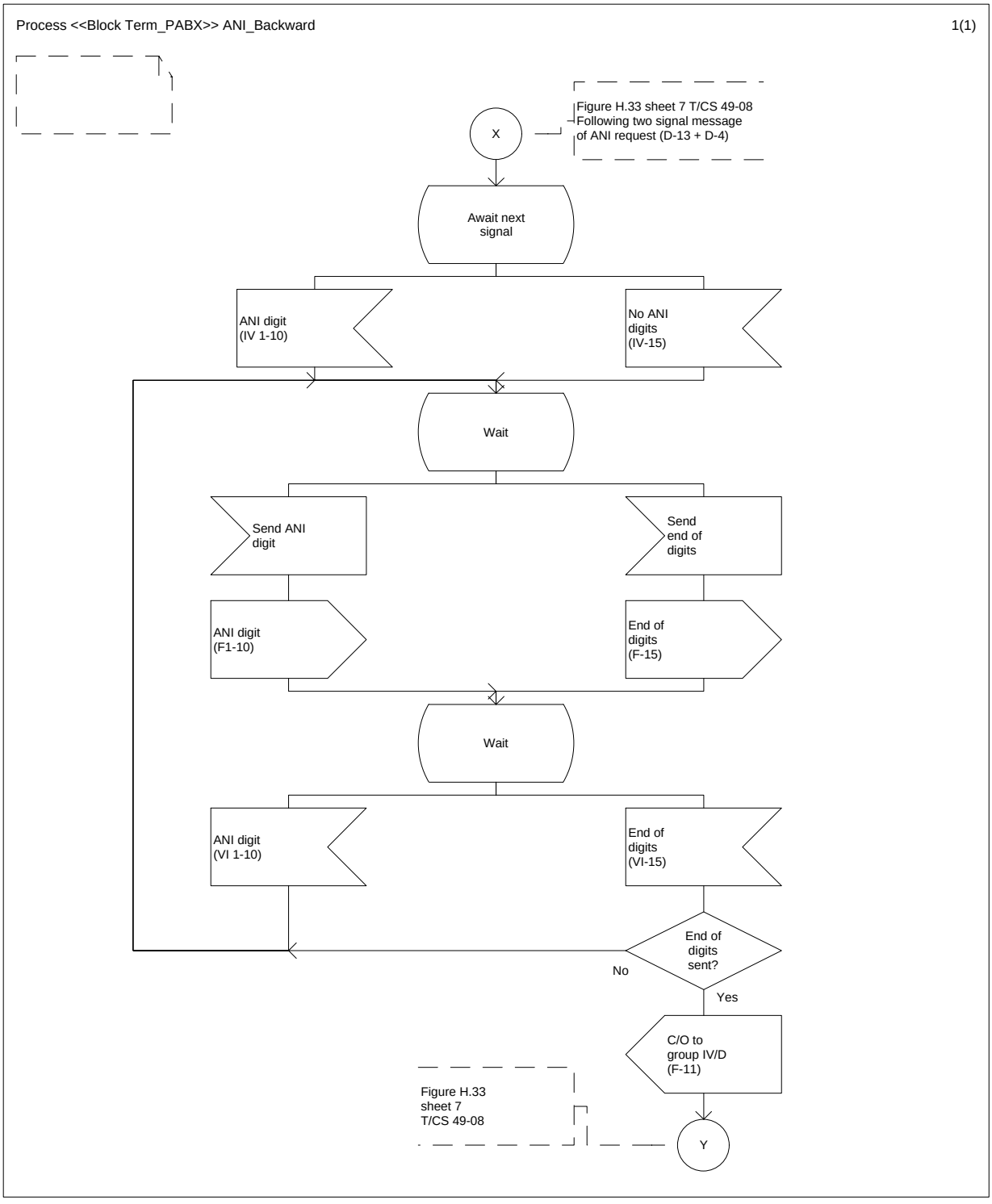


Figure J.10 (T/CS 49-09): ANI supplementary service (terminating PABX) Backward direction during call set up (sheet 1 of 1)

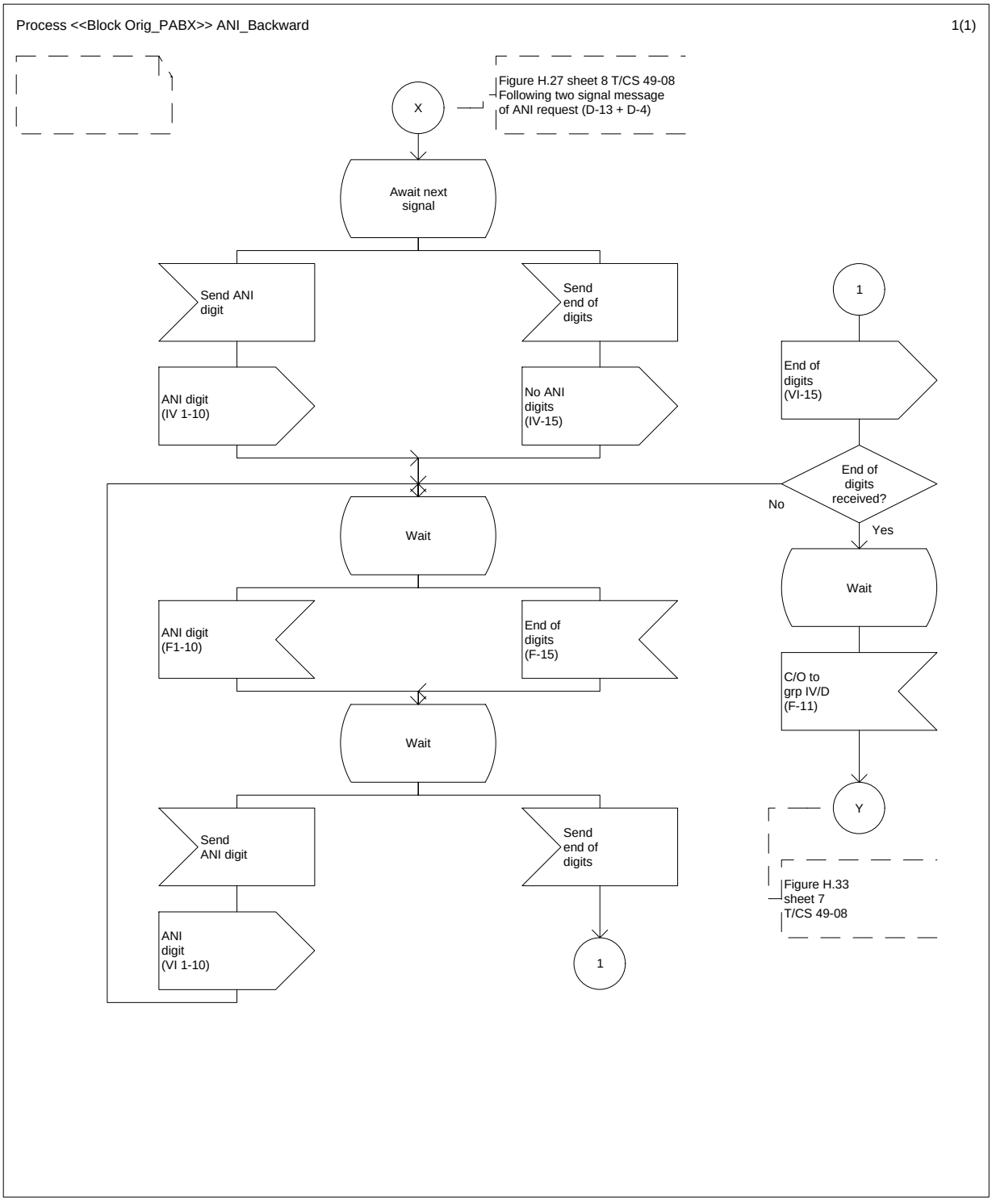


**Figure J.11(T/CS 49-09): ANI supplementary service (originating PABX)
Backward direction during call set up (sheet 1 of 1)**

J.3 Supplementary service - Completion of Calls to Busy Subscribers (CCBS)

J.3.1 General

The CCBS service is used to enable an extension user who, on meeting a busy extension, wishes that extension to call back when free, or the unattended extension to call back when next used.

A caller encountering an engaged extension may request a Call Back or Free Notification by dialling a specific code within a short period of receiving engaged tone.

Confirmation or rejection of the Call Back Request shall be indicated to the calling party.

Following receipt of the Call Back Request, when the called party becomes free an automatic call back attempt is made. If the requesting party has subsequently become busy, control of the service may be transferred to the requesting PABX (this is called Revert).

The CCBS Service may be cancelled either by the requesting extension, or automatically after a specific number of call back attempts have been made. The Call Back Service may only be provided in Networks where there is a common linked numbering scheme.

J.3.2 Outline of control procedures

As there are a number of separate services within the CCBS family, the control procedure for each service is dealt with individually.

The signal codes used to request the service are as follows:

a) Request Call Back	IV-11 + IV-1
b) Call Back Attempt	IV-11 + IV-2
c) Request Call Back Reversion	(Associated with IV-11 + IV-2)
d) Reverted Call Back Attempt	IV-12 + IV-8
e) RequestFreeNotification	IV-11 + IV-4
f) Free Notification	IV-12 + IV-5
g) Cancel Call Back	IV-12 + IV-7

a) Request Call Back

At the end of normal call set-up the MFC registers release leaving the caller listening to busy tone. On receipt of a Call Back request from the extension user the outgoing PABX applies a Register Recall followed by the two signal message IV-11 + IV-1.

Following the Request Call Back two signal message (IV-11 + IV-4), the responding PABX will request the address digits of the calling line by returning the Send Next Digit signal. The originating PABX will send the address digits in response to the Send Next Digit signal until all digits have been sent, at which time it will send the End of Digits signal. Signalling will then re-enter procedures as defined in Recommendation T/CS 49-08 [8] where acceptance or rejection of the service will occur.

The originating extension user will receive an indication that the service has been accepted or rejected, and then replace their handset.

b) Call Back Attempt

When the Call Back Attempt is made the initial call set up is carried out as if a normal call is being made, except that the Group II Signal signifying the Class of Service is a "Network signal". If the extension to which the call back is being

made is free it is guarded against further incoming calls, and the signalling procedure continues in accordance with T/CS 49-08 until the Call Back attempt two signal message (IV-11 + IV-2) is sent.

Following this two signal message, the first signal from the responding PABX will request the address digits of the calling party by returning the Send Next Digit Signal. The originating PABX will send the address digits in response to the Send Next Digit signal until all digits have been sent, at which time it will send the End of Digits signal.

Signalling reverts to the procedures defined in Recommendation T/CS 49-08 [8] where indication of acceptance or rejection of the service will occur. On acceptance of the service the extension which requested Call Back is rung, and upon answer a line signal "Requesting party answer" (single tone on pulse) is transmitted to the calling back PABX. The calling back extension is then rung and ring tone is applied to the requesting extension. The call is now processed in the normal way.

c) Request Call Back Reversion

If the extension to which a Call Back attempt has been made is busy, the calling PABX may wish to transfer control to the PABX which originally requested the Call Back Service by simply continuing with the Call Back attempt as detailed in subclause J.3.2 (b) The called PABX, having received the Network class of service followed by the two signal message IV-11 + IV-2 earlier in the call, will interpret the service as Request Call Back Reversion.

d) Reverted Call Back Attempt

When Call Back has been returned to the PABX which originally requested the service (i.e. Reversion) the requesting extension is monitored and when free a Reverted Call Back Attempt is made.

The originating PABX sets up a call using the signalling procedures defined in T/CS 49-08 [8], except that the Group II Class of Service signal Network is sent. If the extension to which the Call Back is being made is free it is guarded against any further incoming calls, and the signalling procedure continues in accordance with Recommendation T/CS 49-08 [8] until the two signal message for the Reverted Call Back attempt, with the exception that the extension which requested the Call Back Service shall be rung first, as shown in the Arrow Chart (figure J.11 (T/CS 49-09)).

e) Request Free Notification

As an alternative to the Call Back request a user may request Notification of the called party becoming free.

Following the Request Free Notification two signal message (IV-11 + IV-4) signalling for the service is the same as that for Request Call Back.

f) Free Notification

When the Free Notification indication is made the initial call set up is normal except that the Group II signal "Network" is sent. Following the two signal message (IV-2 + IV-5) signalling for the service is the same as that for Call Back attempt but signalling concludes when address information is completed.

Following the Free Notification, the PABX receiving the indication may either inform the service requesting party that the called party has become free, enabling the user to make a new call, or automatically set up a call in the same manner as a Reverted Call Back attempt.

g) Cancel Call Back

When Cancel Call Back is indicated the initial call set up is normal except that the Group II signal "Network" is sent. Following the two signal message (IV-12 + IV-7) the signalling is the same as that for Request Call Back. Signalling reverts to procedures defined in Recommendation T/CS 49-08 [8] where acceptance or rejection of the service occurs. On acceptance of the cancellation, records of the service shall be cancelled. However, if the service is rejected the originating PABX memorizes the call back cancellation and a subsequent Call Back attempt shall be rejected.

The Free Notification Service is cancelled at the requesting PABX only, so that receipt of the Free Notification indication removes the records of the service.

J.3.3 Allocation and description of signals

Because of the nature of the call back service it is necessary to describe signals applicable to each service individually.

a) Request Call Back

i) Digits 1-0 (Code IV 1-0) These signals shall be used to convey the address digits of the extension requesting call back. The "Digit" signals are allocated to MFC Codes IV 1-10.

ii) End of Digits (Code IV-15) This signal shall be used to inform the responding PABX that all address digits of the extension requesting Call Back have been sent, and that no further supplementary service signalling within the service is required. The "End of Digits" signal is allocated to MFC Code IV-15.

iii) Send Next Digit (Code D-15) This signal shall be used to request the next address digit of the extension requesting Call Back. The "Send Next Digit" signal is allocated to MFC Code D-15.

b) Call Back Attempt

i) Digits 1-0 (Code IV 1-10) As for (i) in "Request Call Back"

ii) Send Next Digit (Code D-15) As for (iii) in "Request Call Back"

iii) End of Digits (Code IV-15) This signal shall be used to inform the responding PABX that

- all Address digits of the calling party have been sent and providing the service is available,
- signalling within the service is complete. The End of Digits signal is allocated to MFC Code IV-15.

c) Request Call Back Reversion

Signals for this service are as for the Call Back Attempt.

d) Reverted Call Back Attempt

Signals for this service are as for the Call Back Attempt.

e) Request Free Notification

Signals for this service are as for the Request Call Back.

f) Free Notification

Signals for this service are as for Call Back Attempt.

g) Cancel Call Back

Signals for this service are as for Request Call Back.

Table J.9 (T/CS 49-09): Following
IV-11 + IV-1 (Request Call Back)
IV-11 + IV-4 (Request Free Notification)
IV-11 + IV-7 (Cancel Call Back)

GROUP IV SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1	Digit 1	
2	Digit 2	
3	Digit 3	
4	Digit 4	
5	Digit 5	
6	Digit 6	
7	Digit 7	
8	Digit 8	
9	Digit 9	
10	Digit 0	
11		
12	Request Not Accepted - No further MFC required	
13		
14	Request Not Accepted - Further MFC possible	
15	End of Digits	

Table J.10 (T/CS 49-09): Following
IV-11 + IV-1 (Request Call Back)
IV-11 + IV-4 (Request Free Notification)
IV-12 + IV-7 (Cancel Call Back)

GROUP D SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11	OK - Conclude MFC	
12	Request Not Accepted - Conclude MFC	
13	OK - Changeover to Group III/C	
14	Request Not Accepted - C/O to Groups III/C	
15	Send Next Digit	

Table J.11 (T/CS 49-09): Following
IV-11 + IV-2 (Call Back Attempt or Request Call Back Reversion)
IV-12 + IV-8 (Reverted Call Back Attempt)
IV-12 + IV-5 (Free Notification)

GROUP D SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11	OK - Conclude MFC	
12	Request Not Accepted - Conclude MFC	
13	OK - Changeover to Group III/C	
14	Request Not Accepted - C/O to Groups III/C	
15	Send Next Digit	

Table J.12 (T/CS 49-09): Following
IV-11 + IV-2 (Call Back Attempt or Request Call Back Reversion)
IV-12 + IV-8 (Reverted Call Back Attempt)
IV-12 + IV-5 (Free Notification)

GROUP IV SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1	Digit 1	
2	Digit 2	
3	Digit 3	
4	Digit 4	
5	Digit 5	
6	Digit 6	
7	Digit 7	
8	Digit 8	
9	Digit 9	
10	Digit 0	
11		
12	Request Not Accepted - No further MFC required	
13		
14	Request Not Accepted - Further MFC possible	
15	End of Digits	

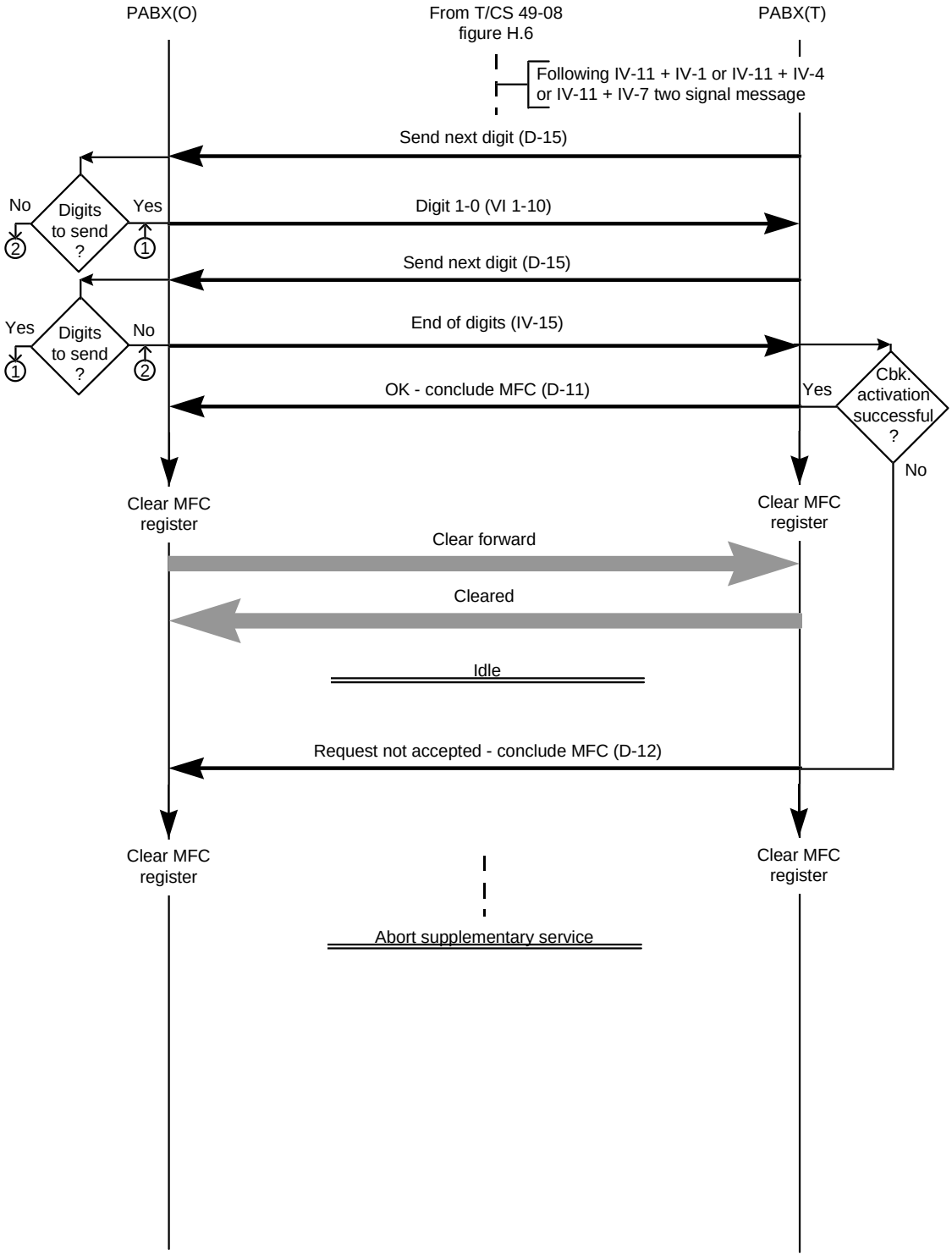


Figure J.12 (T/CS 49-09): Request callback, Request Free Notification, Cancel Callback

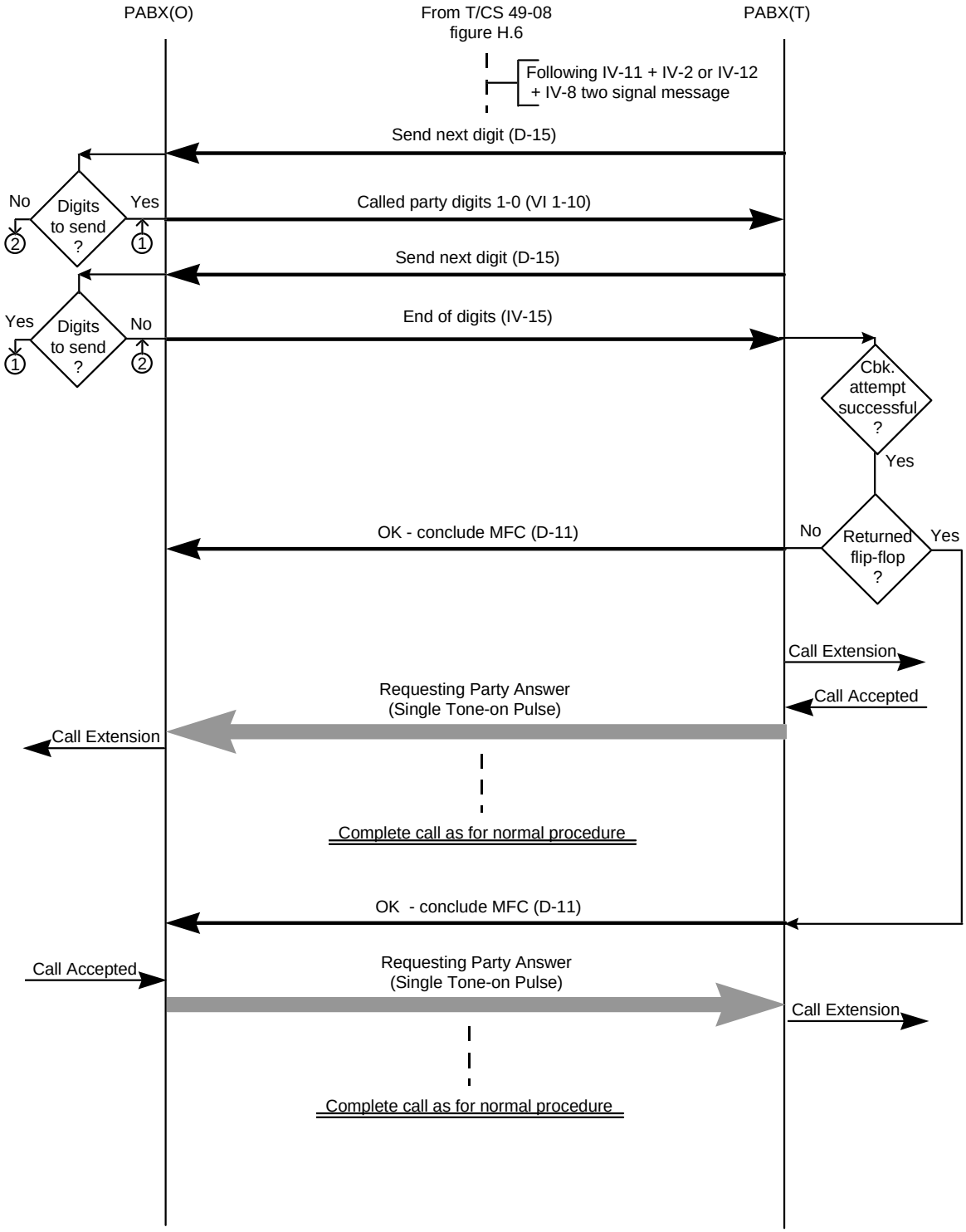


Figure J.13 (T/CS 49-09): Call Back/Reverted Call Back Attempt

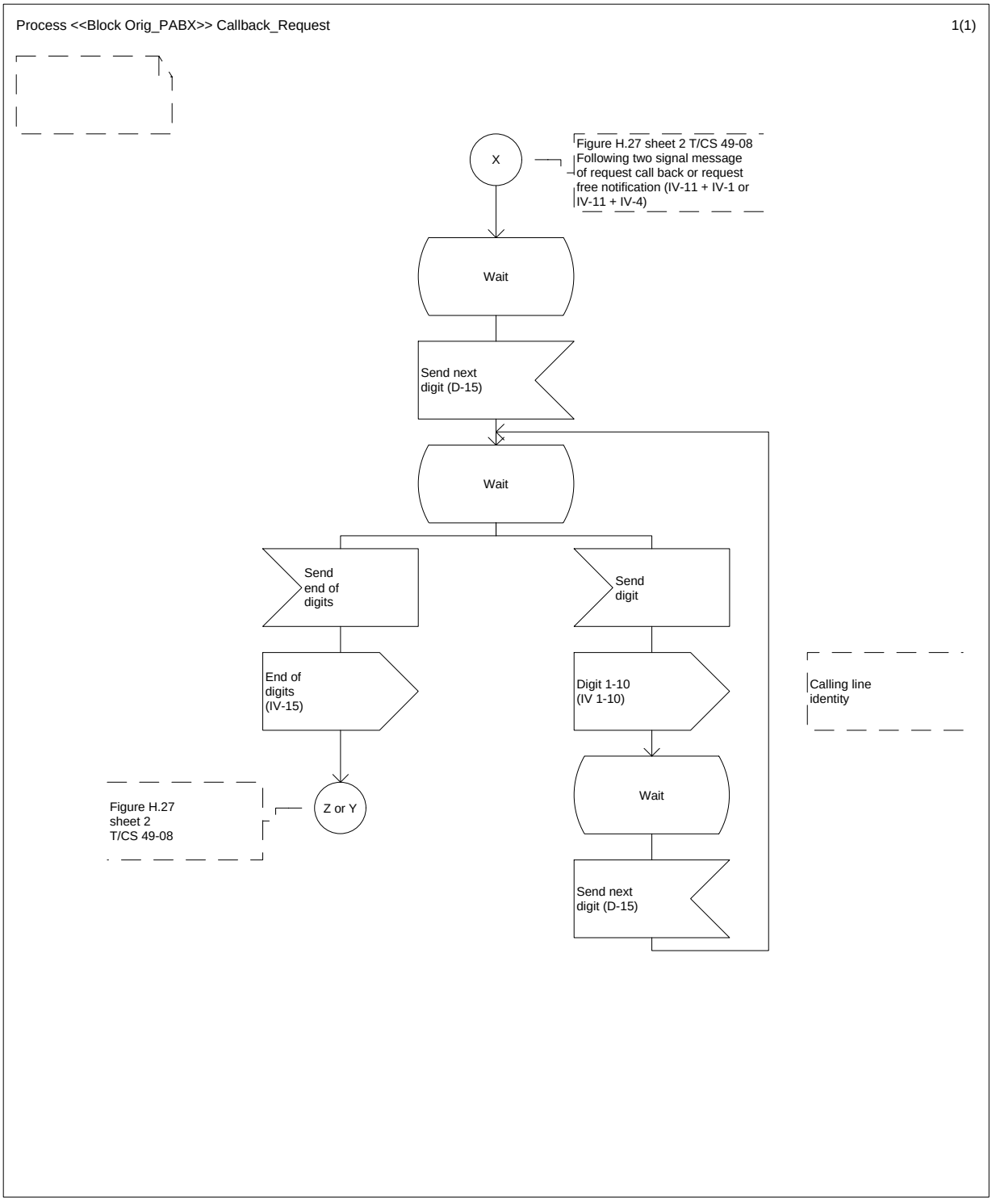


Figure J.14 (T/CS 49-09): Request call back (originating PABX) (sheet 1 of 1)

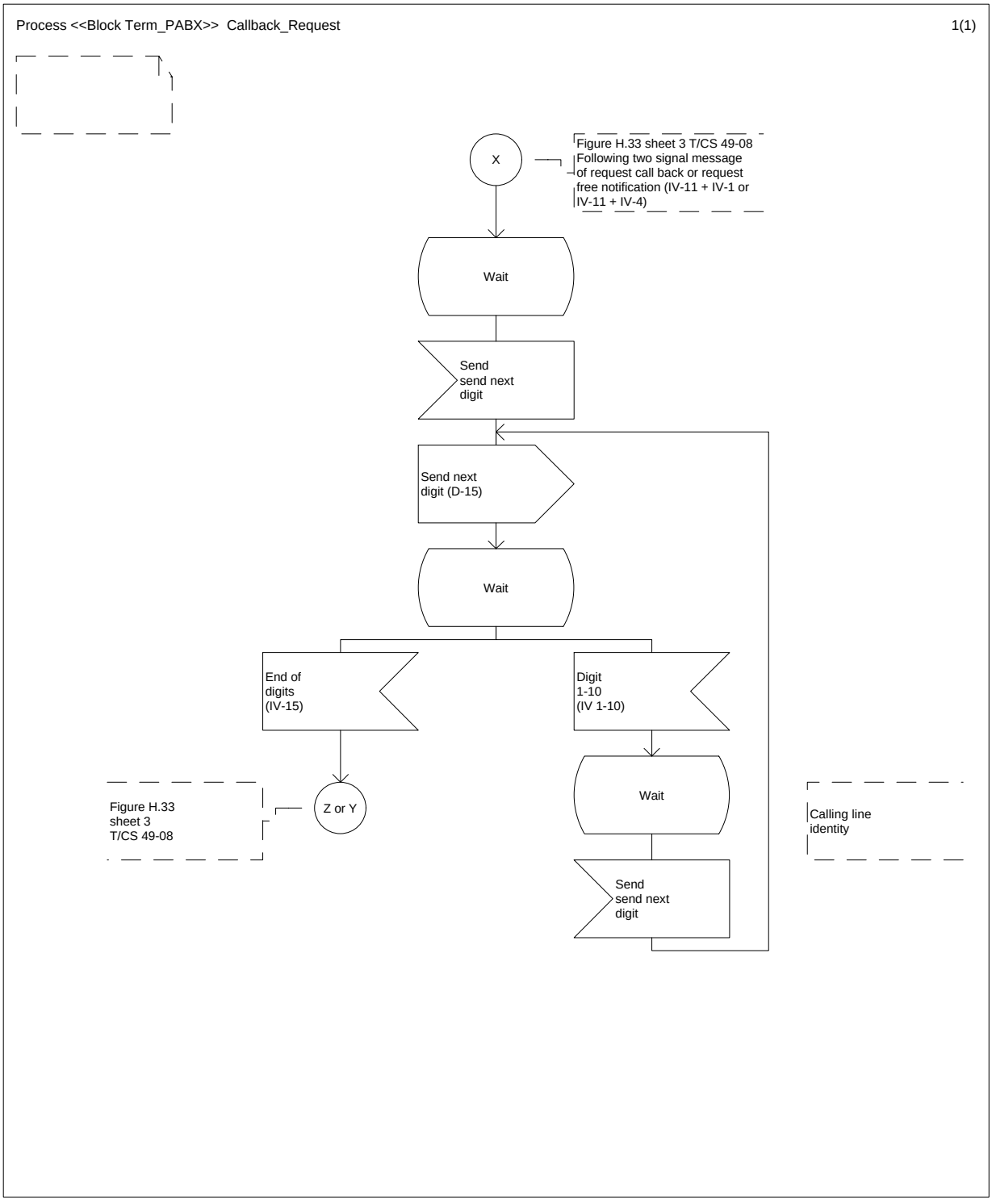


Figure J.15 (T/CS 49-09): Request call back (terminating PABX) (sheet 1 of 1)

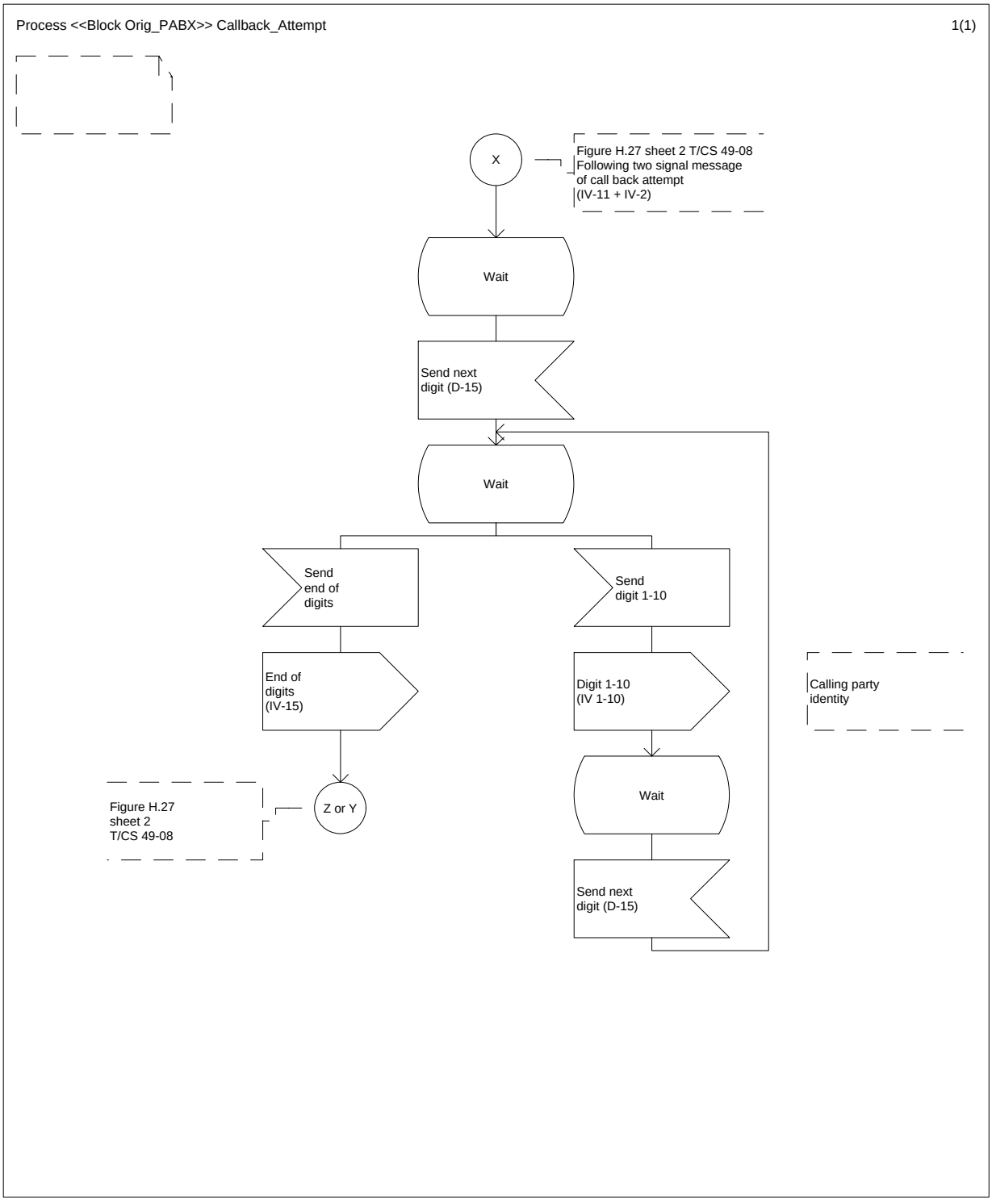


Figure J.16 (T/CS 49-09): Call back attempt (originating PABX) (sheet 1 of 1)

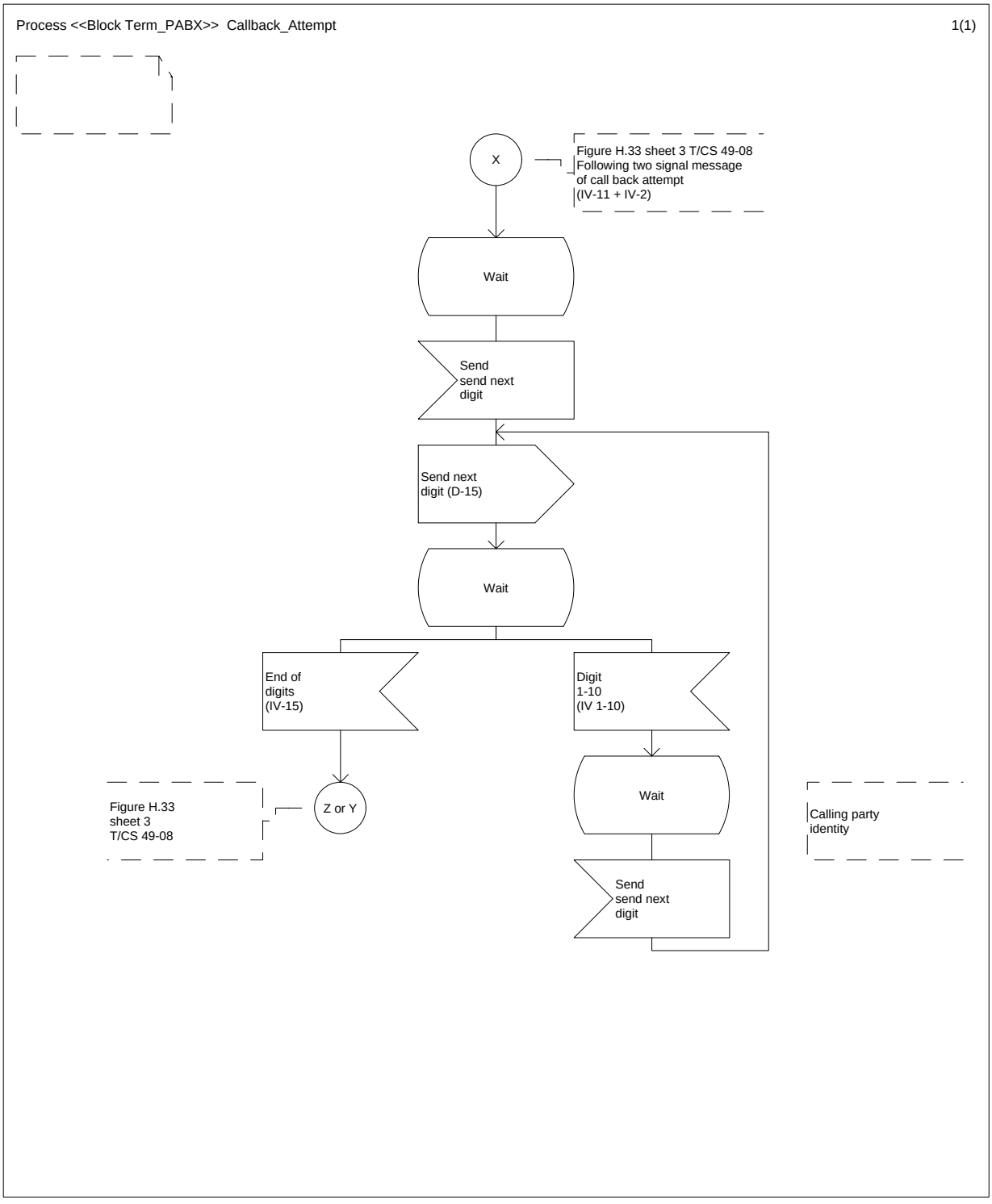


Figure J.17 (T/CS 49-09): Call back attempt (terminating PABX) (sheet 1 of 1)

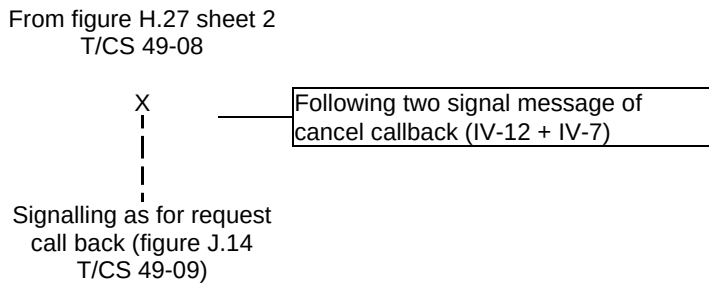


Figure J.18 (T/CS 49-09): Cancel call back from originating extension (originating PABX)

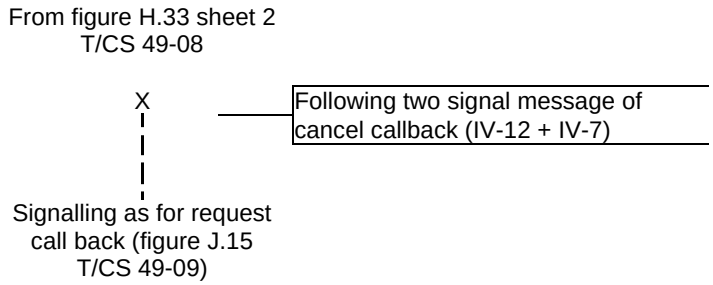


Figure J.19 (T/CS 49-09): Cancel call back from originating extension (terminating PABX)

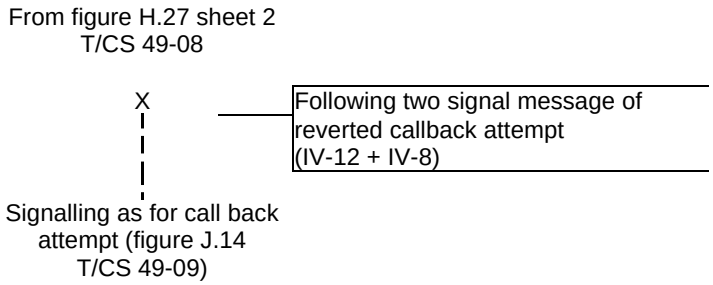


Figure J.20 (T/CS 49-09): Reverted call back attempt (originating PABX)

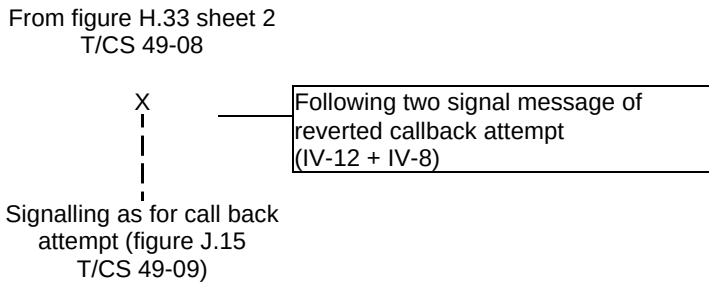


Figure J.21 (T/CS 49-09): Reverted call back attempt (terminating PABX)

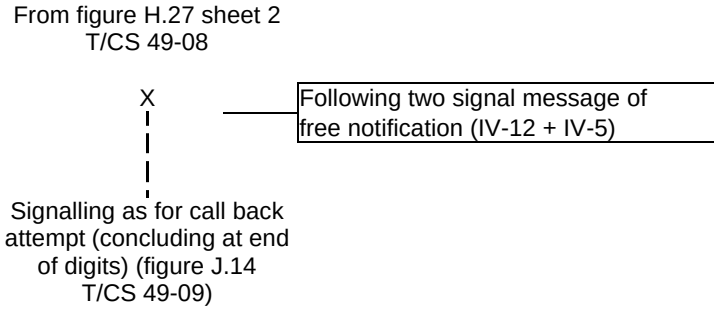


Figure J.22 (T/CS 49-09): Free notification (originating PABX)

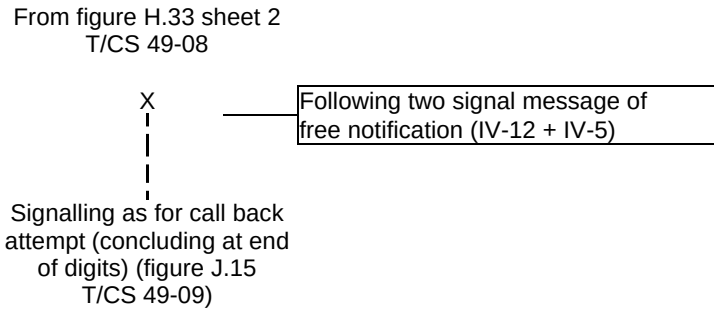


Figure J.23 (T/CS 49-09): Free notification (terminating PABX)

J.4 Supplementary service - call waiting

J.4.1 General

When a calling party meets an extension that is busy, it may be possible for that caller to offer the call to the busy extension. The busy extension may then either ignore the new call, go on-hook and be automatically re-rung, or answer the new call by parking the previous connection. Call Waiting is indicated to the engaged extension by means of call waiting tone.

The calling extension invokes the call waiting request, subsequent to receiving the busy signal, by dialling the relevant code, thus initiating a register recall procedure.

The calling line identity may be sent to the called PABX, if it is requested.

J.4.2 Outline of control procedures

Following the two signal message offering the call to the busy extension (IV-11 + IV-8) the responding PABX may either request the identity of the calling extension, or offer the call to the extension required immediately. If the calling extension identity is required, the responding PABX will return the Send Next Digit signal, and address information will be forwarded as for the Request Call Back Service (T/CS 49-09, I.3.). Once the End of Digits signal has been sent, no further supplementary service signalling is required within the service, and acceptance or rejection of the service occurs within the signalling defined in T/CS 49-08 [8].

If the calling extension identity is not required, then acceptance or rejection of the service occurs within the signalling defined in T/CS 49-08 [8].

The called extension will have a call waiting tone applied to it, and any subsequent action will depend on whether or not the called extension accepts the call.

If the called party accepts the offered call, the responding PABX returns an Answer Signal to the original PABX, and a speech path is established between both parties.

The signal code used to request the service is: Call Waiting IV-11 + IV-8.

J.4.3 Allocation and description of signals

a) Digits 1-0 (Codes IV1-10)

These signals shall be used to convey the address of the calling extension to the extension to which the call is being offered, where required.

The "Digit" signals are allocated to MFC Codes IV1-10.

b) End of Digits (Code IV-15)

This signal shall be used to inform the responding PABX that all address digits of the calling extension have been sent and that no further supplementary service signalling within the service is required.

The "End of Digits" signal is allocated to MFC Code IV-15.

c) Send Next Digit (Code D-15)

This signal shall be used to request the address digits of the calling extension, when the called PABX requires the calling line identity.

The "Send Next Digit" signal is allocated to MFC Code D-15.

Table J.13 (T/CS 49-09): Following IV-11 + IV-8 (Call Waiting)

GROUP IV SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1	Digit 1	
2	Digit 2	
3	Digit 3	
4	Digit 4	
5	Digit 5	
6	Digit 6	
7	Digit 7	
8	Digit 8	
9	Digit 9	
10	Digit 10	
11		
12	Request Not Accepted - No further MFC required	
13		
14	Request Not Accepted - Further MFC possible	
15	End of Digits	

Table J.14 (T/CS 49-09): Following IV-11 + IV-8 (Call Waiting)

GROUP D SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11	OK - Conclude MFC	
12	Request Not Accepted - Conclude MFC	
13	OK - Changeover to Group III/C	
14	Request Not Accepted - C/O to Groups III/C	
15	Send Next Digit	

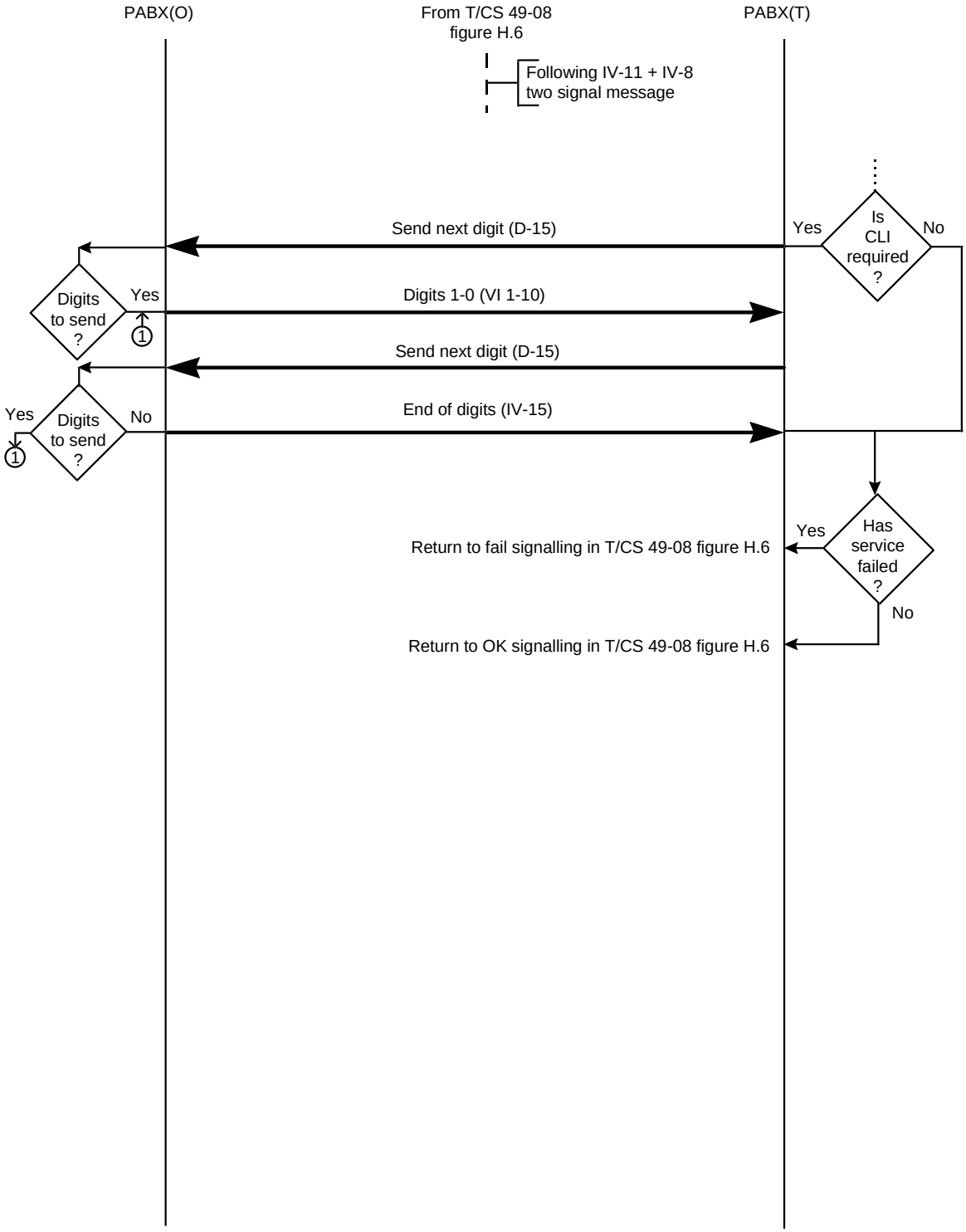


Figure J.24 (T/CS 49-09): Call waiting

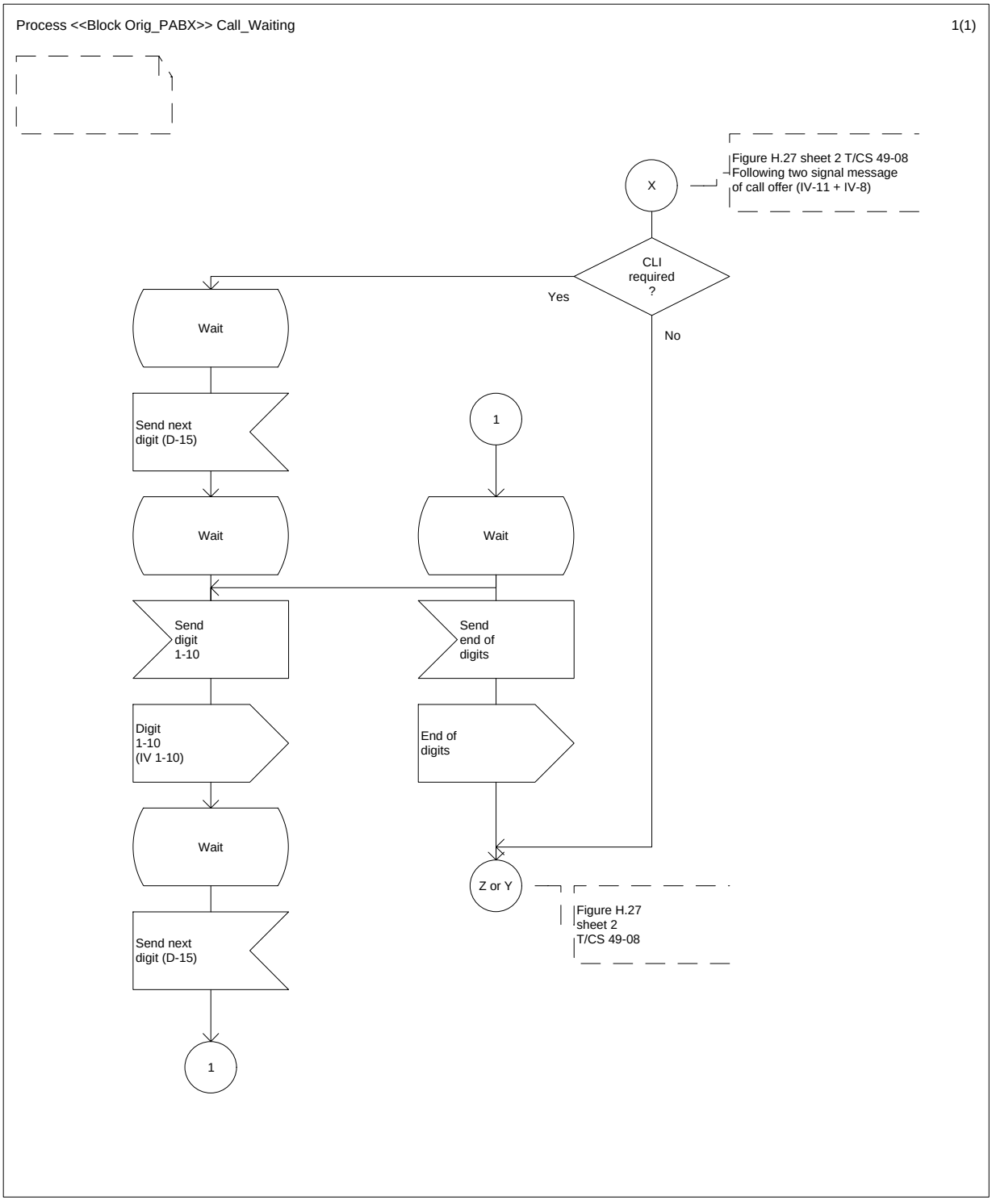


Figure J.25 (T/CS 49-09): Call waiting (originating PABX) (sheet 1 of 1)

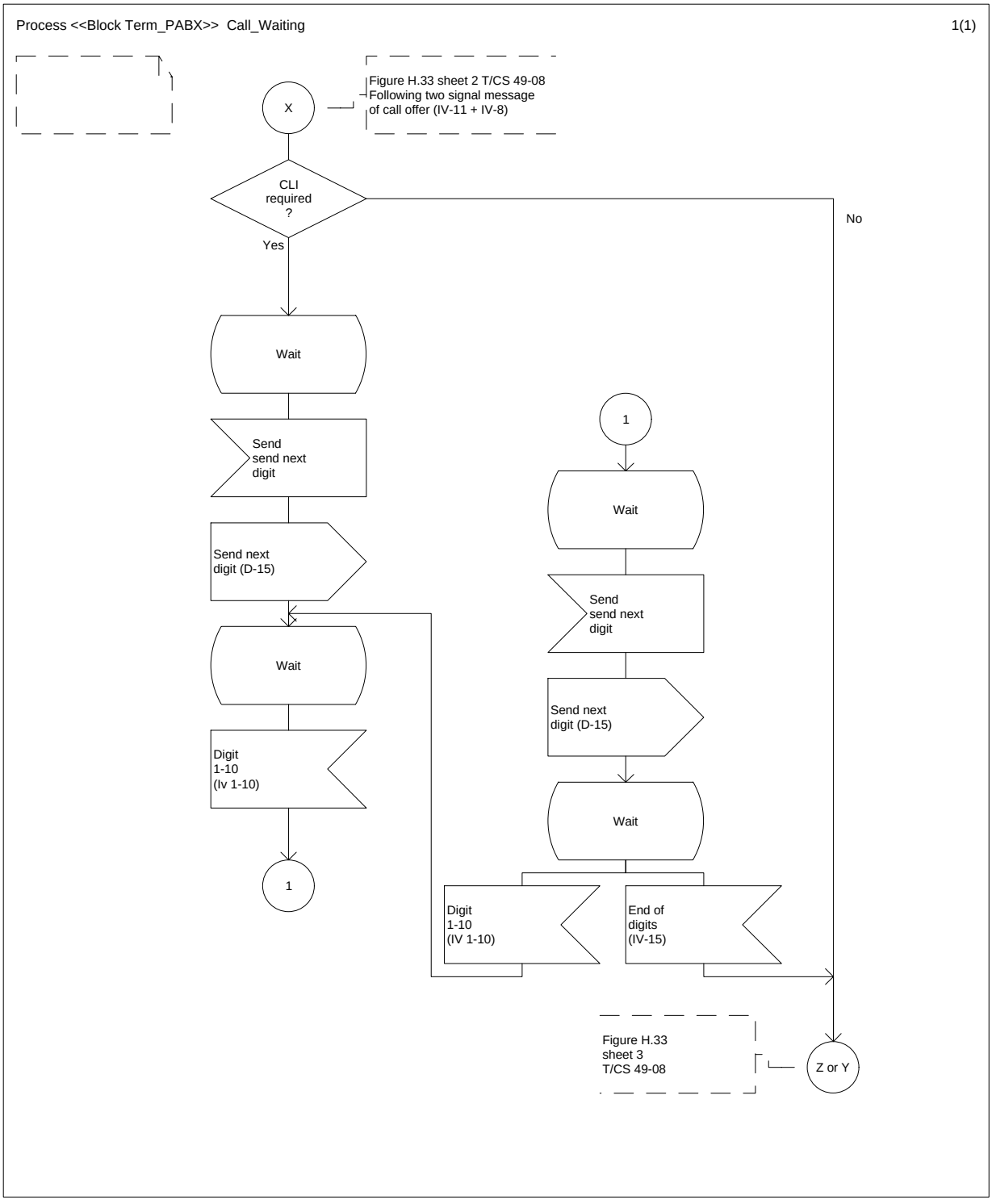


Figure J.26 (T/CS 49-09): Call waiting (terminating PABX) (sheet 1 of 1)

J.5 Supplementary service - diversion on busy / immediate diversion

J.5.1 General

The Diversion on Busy / Immediate Diversion service enables users, who know they may be absent and unable to answer their extension, or may not receive calls because their extension is busy, to divert a caller to another extension or a recorded announcement. When an Incoming Call encounters an extension which has the Diversion service active upon it, the call is diverted to the nominated extension which may be either on the same or another PBX.

J.5.2 Outline of control procedures

As the Diversion may be either ON or OFF PBX, the control procedure for each is dealt with separately. The Signal Codes used to request the service are as follows:

Request ON PBX	D-13/D-5
Request OFF PBX	D-13/D-7

J.5.2.1 ON PBX diversion

Following the backward two signal message indicating "ON PBX" diversion (Signal Codes D-13 and D-5), the calling PBX will request the diverting PBX to send either the Group B State of Destination signal of the extension to which call is being diverted, or the address followed by the State of Destination (SOD) of the "diverted to" extension. The responding PBX will return the "diverted to" extension address if requested, and the relevant SOD of that extension. Subsequent to Group IV/D signalling, reversion back to Group III/C signalling will occur.

J.5.2.2 OFF PBX diversion

Following the backward two signal message indicating "OFF PBX" diversion (Signal Codes D-13 and D-7), the calling PBX will request the "diverted to" extension address from the diverting PBX, digit by digit. The diverting PBX will return the address of the "diverted to" extension in response to the "Send Next Digit" signal until all digits have been sent. At this point the End of digits signal will be returned, informing the calling PBX that the full address has been sent. Providing no subsequent forward supplementary service is requested which may prevent diversion from occurring (e.g. Diversion Bypass) then the signalling will be concluded, the MFC Registers released, and the circuit cleared. A new call will be made from the calling PBX to the "diverted to" extension, which shall include the information that the call has been diverted.

J.5.3 Allocation and description of signals

a) Change-over to Group B (Code IV-1)

This signal is used following an ON PBX Diversion signal (D-2). On receipt of this signal the responding PBX will send one Group B signal conveying the State of Destination of the "diverted to" extension and revert to Group IV/D signalling. The PBX sending this signal will changeover to receiving Group B signals for one signal only and then revert to Group IV/D signalling.

The "Changeover to Group B" signal is allocated to MFC Code IV-1.

b) Send Next Signal (Code IV-15)

This signal shall be used to request the next signal following either the End of Digits signal (D-15) or SOD information.

The "Send Next Signal" signal is allocated to MFC Code IV-15.

c) End of Digits (Code D-15)

This signal is used to inform the responding PBX that all address digits of the "diverted to" extension have been sent.

The "End of Digits" signal is allocated to MFC Code D-15

Table J.15 (T/CS 49-09): Following D-13 + D-5 (Request Diversion ON PABX) or D-13 + D-7 (Request Diversion OFF PABX)

GROUP IV SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1	Changeover to Group B	
2		
3		
4		
5		
6		
7		
8		
9		
10		
11	OK - No Further MFC Required	
12	Request Not Accepted - No Further MFC Required	
13	OK - No Further MFC Possible	
14	Request Not Accepted - Further MFC Possible	
15	Send Next Digit	

Table J.16 (T/CS 49-09): Following D-13 + D-5 (Request Diversion ON PABX) or D-13 + D-7 (Request Diversion OFF PABX)

GROUP IV SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1	Digit 1	
2	Digit 2	
3	Digit 3	
4	Digit 4	
5	Digit 5	
6	Digit 6	
7	Digit 7	
8	Digit 8	
9	Digit 9	
10	Digit 0	
11	OK - Conclude MFC	
12	Request Not Accepted - Conclude MFC	
13	OK - C/O to Group III/C	
14	Request Not Accepted - C/O to Group III/C	
15	End of Digits	

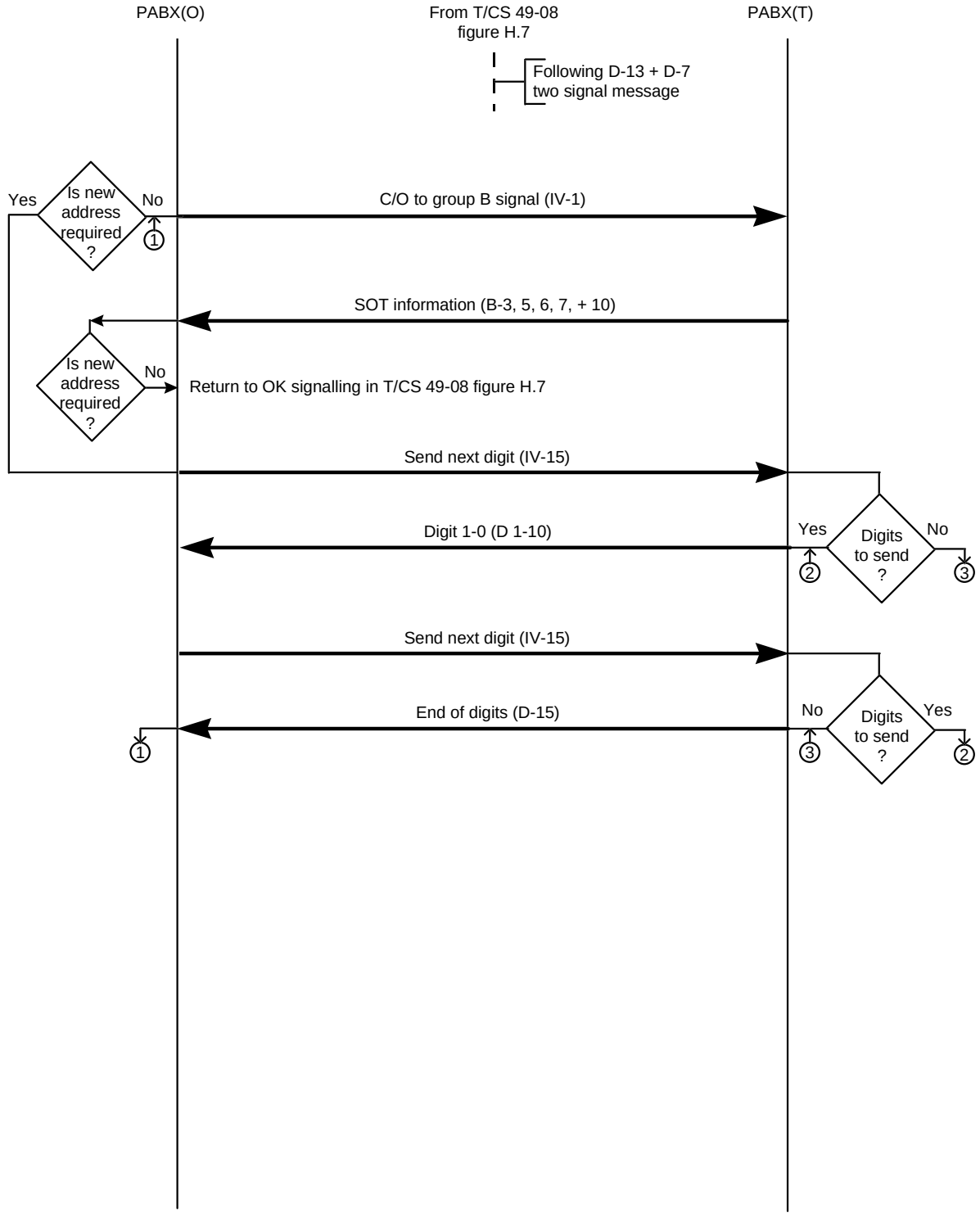


Figure J.27 (T/CS 49-09): Immediate / busy diversion (own PABX)

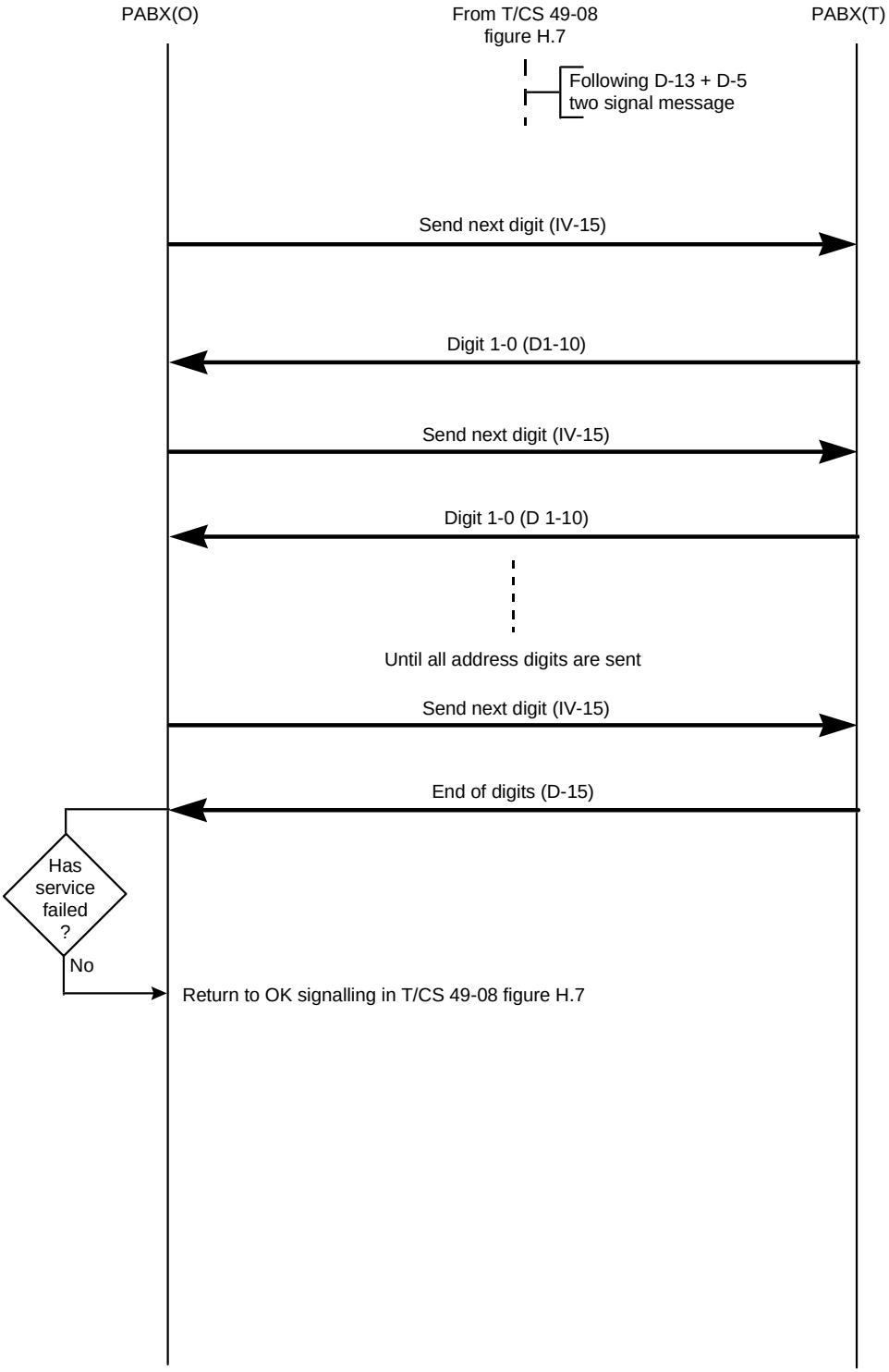


Figure J.28 (T/CS 49-09): Immediate / busy diversion (off PABX)

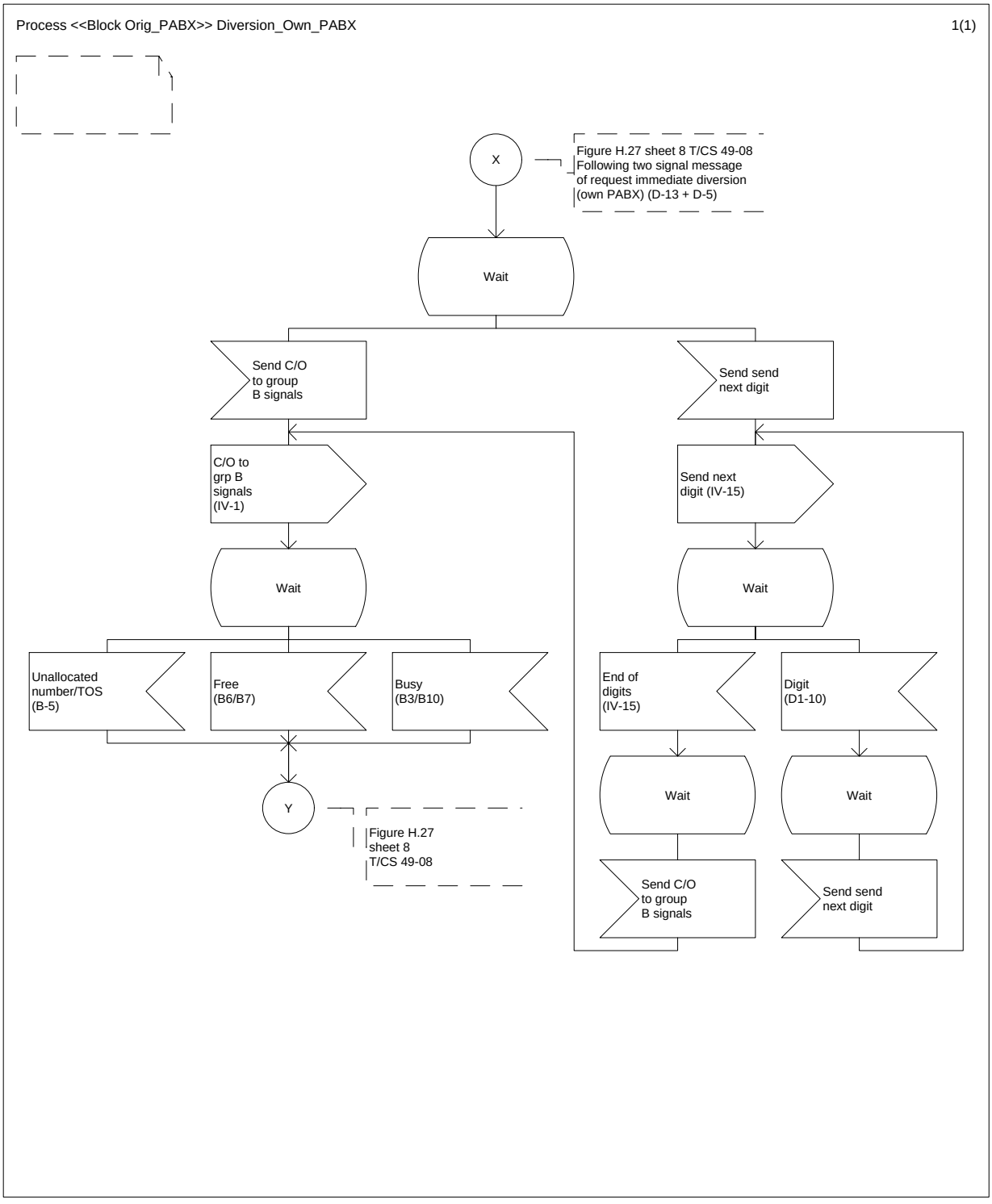


Figure J.29 (T/CS 49-09): Immediate / busy diversion (own PABX) (originating PABX) (sheet 1 of 1)

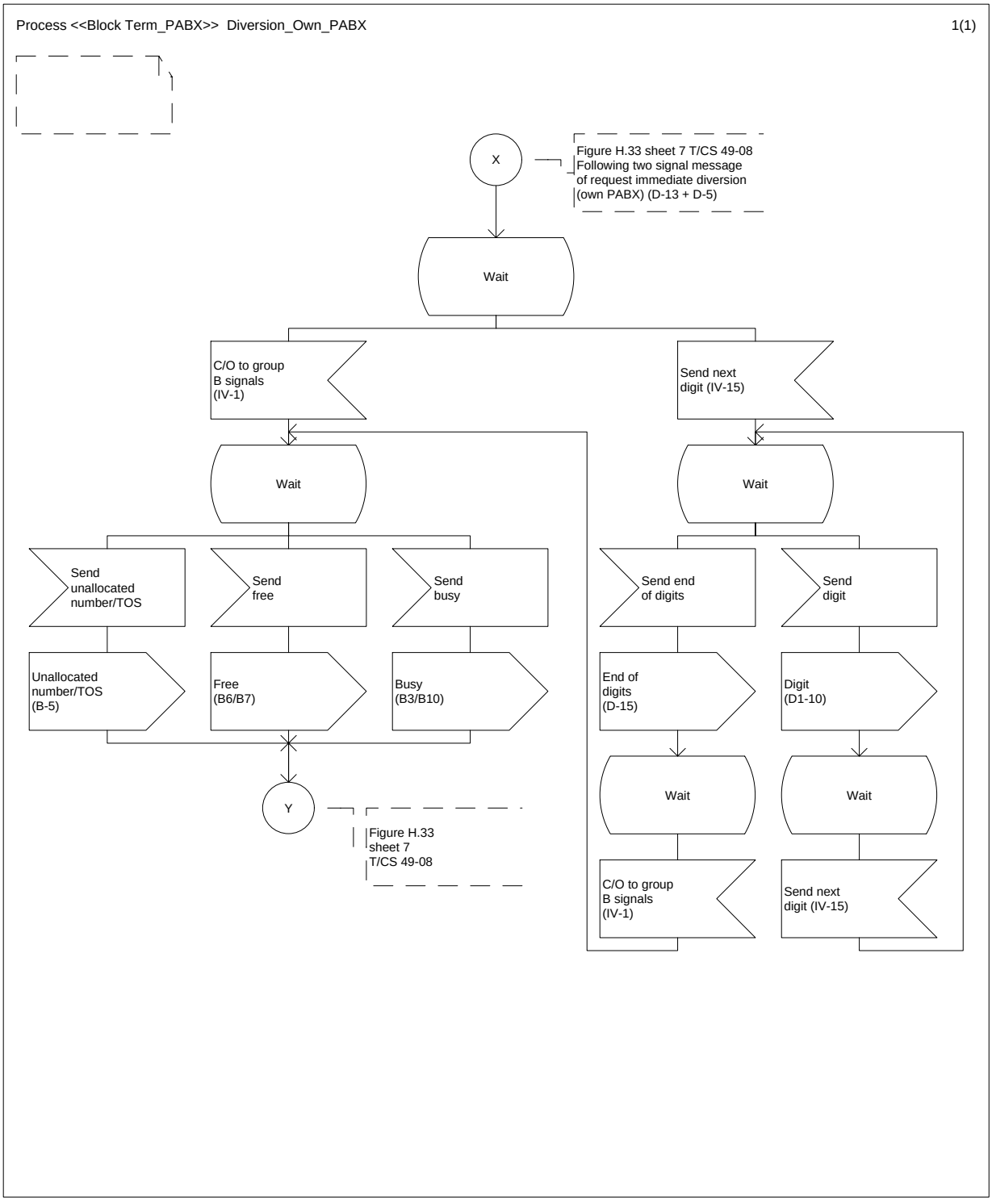


Figure J.30 (T/CS 49-09): Immediate / busy diversion (own PABX) (terminating PABX) (sheet 1 of 1)

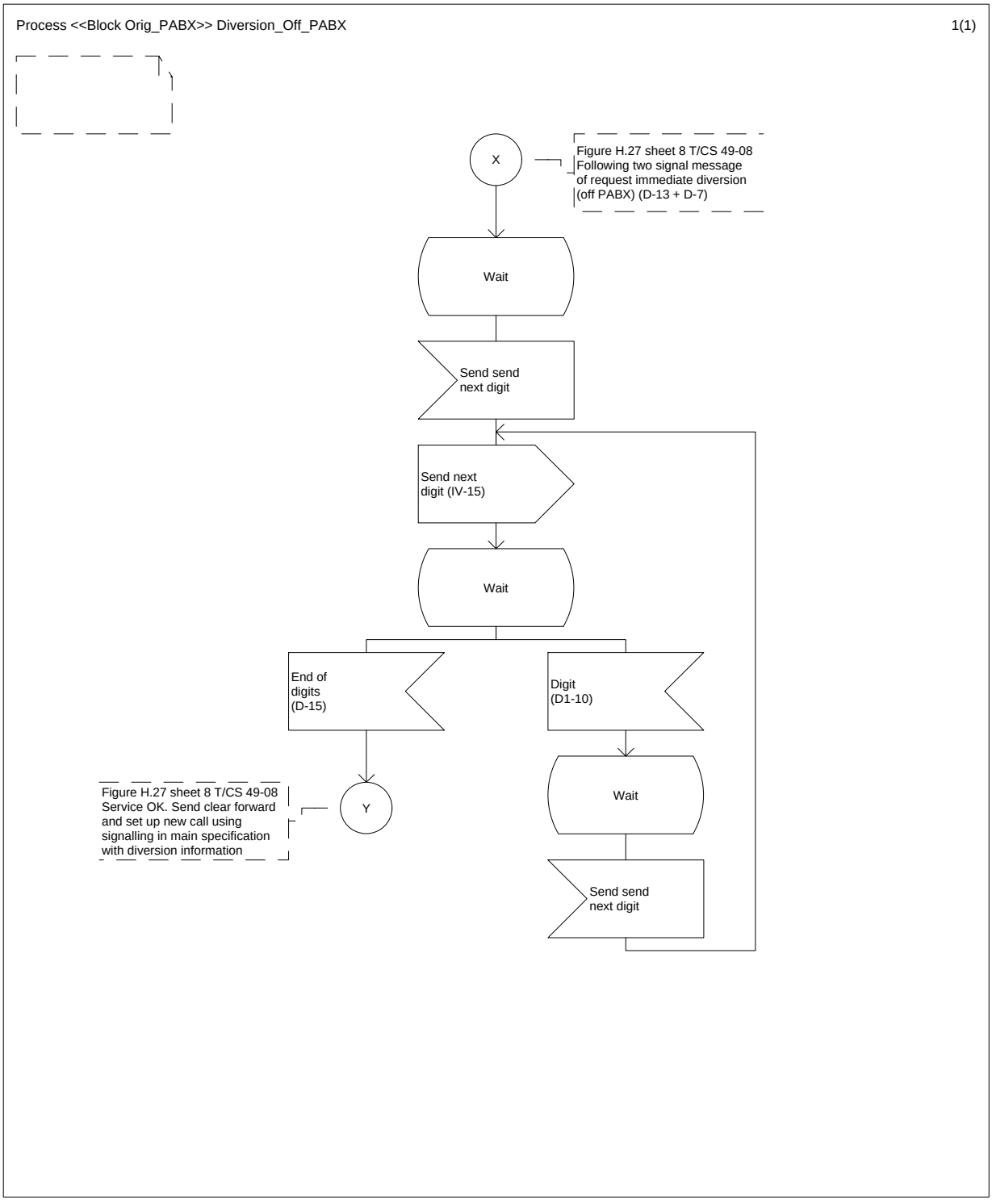


Figure J.31 (T/CS 49-09): Immediate / busy diversion (off PABX) (originating PABX) (sheet 1 of 1)

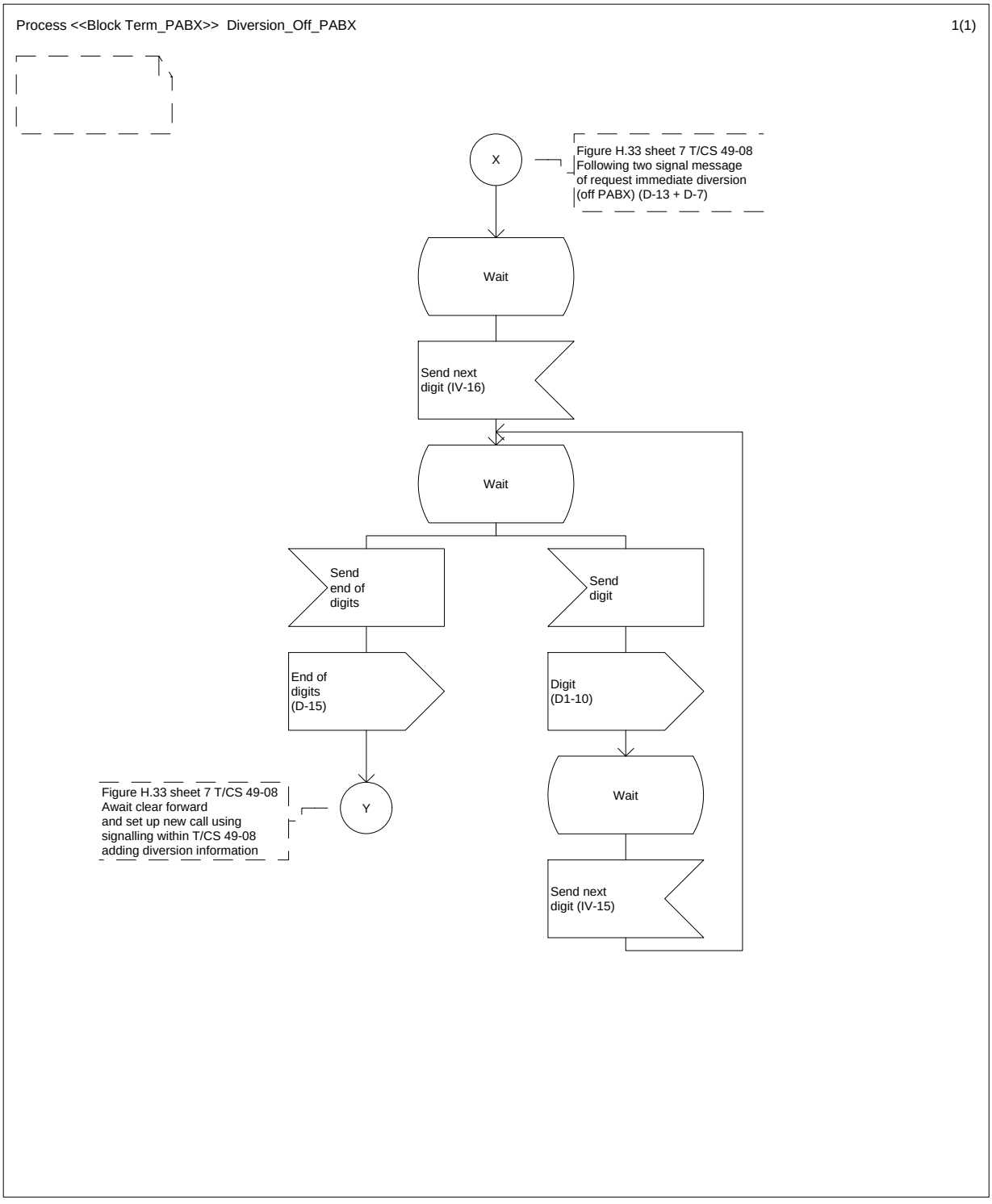


Figure J.32 (T/CS 49-09): Immediate / busy diversion (off PABX) (terminating PABX) (sheet 1 of 1)

J.6 Supplementary service - diversion bypass

J.6.1 General

Whenever a call is made to an extension where diversion has been registered, the State of Destination signal in Group B is B-14.

If the calling party has the Diversion Bypass facility, the calling PBX will request a forward supplementary service following receipt of signal B-14. As all forward supplementary services take precedence over backward supplementary services, the Diversion Bypass request will be made immediately.

J.6.2 Outline of control procedures

The signal codes used for the Diversion Bypass service are:

Request Diversion Bypass IV-11/IV-3.

Following the Request Diversion Bypass two signal message, the called PBX will return the State of Destination of the originally called extension. Providing Bypass is acceptable subsequent to Group IV/D signalling, the reversion back to Group III/C signalling will occur.

Table J.17 (T/CS 49-09): Following IV-11 + IV-3 (Diversion Bypass c/o to Group B)

GROUP IV SIGNALS		
Frequency combination	**Name of Signal**	**Remarks**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12	Request Not Accepted - No Further MFC required	
13		
14	Request Not Accepted - Further MFC Possible	
15	Send Next Signal	

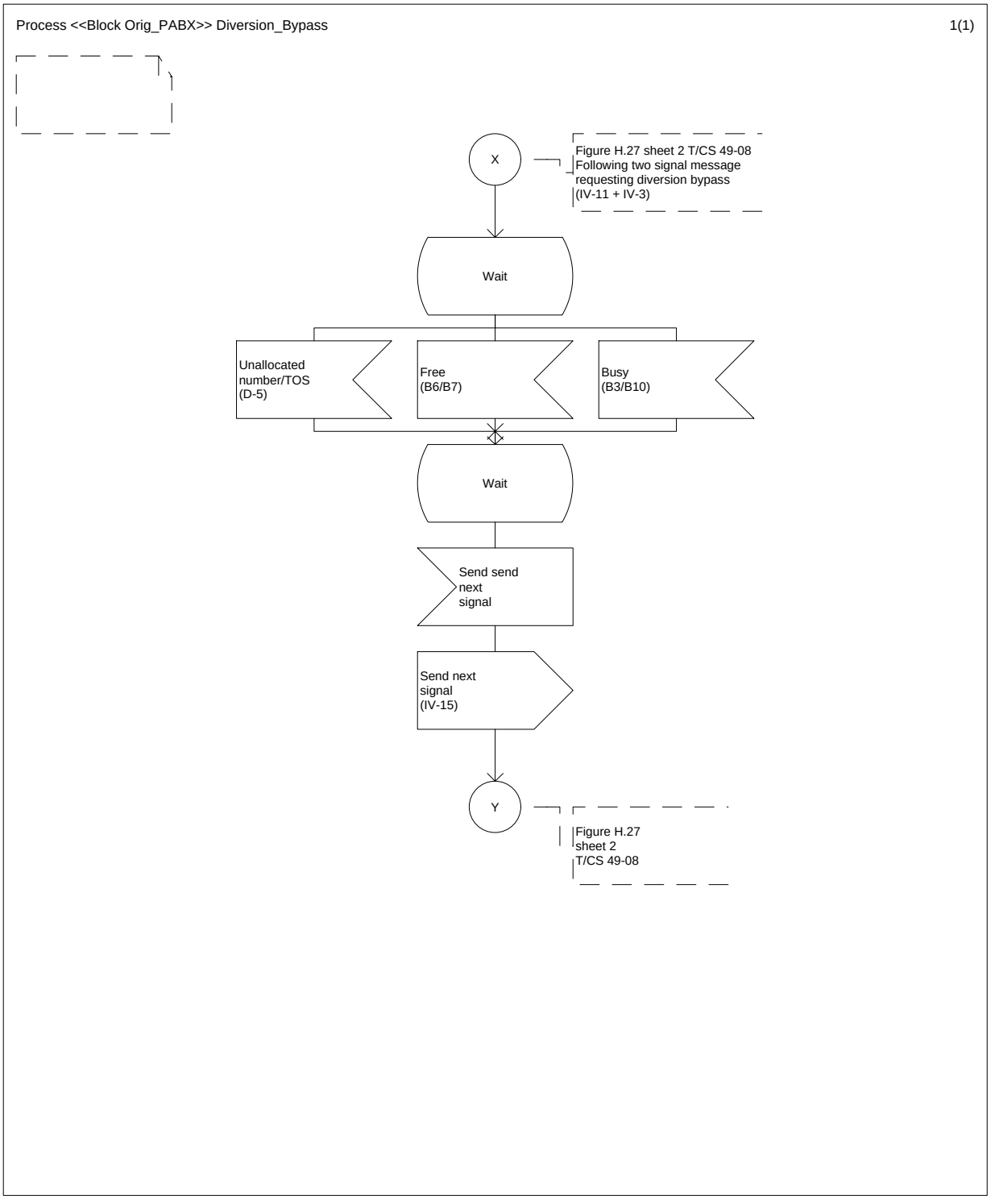


Figure J.33 (T/CS 49-09): Diversion bypass (originating PABX) (sheet 1 of 1)

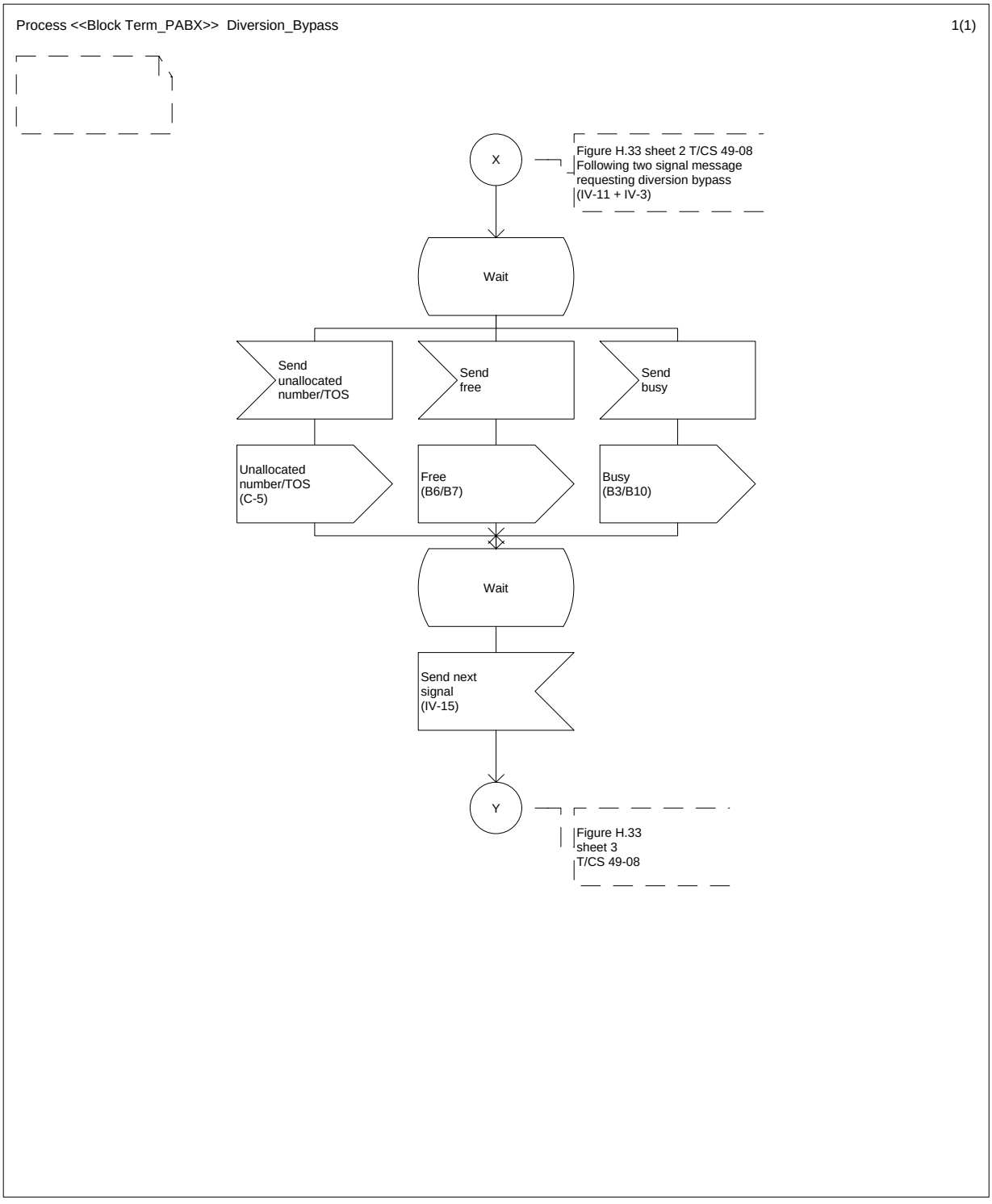


Figure J.34 (T/CS 49-09): Diversion bypass (terminating PABX) (sheet 1 of 1)

Annex K:
CEPT Recommendation T/CS 49-12

Recommendation T/CS 49-12 (Vienna 1982, revised in Montpellier 1984)

Edition of May 15 1986

SYSTEM L2 SIGNALLING ON EXTRA LONG LINES BETWEEN A TELEPHONE INSTRUMENT OR EQUIVALENT AND A PUBLIC EXCHANGE OR PRIVATE AUTOMATIC BRANCH EXCHANGE

Recommendation proposed by Working Group T/WG 11 "Switching and Signalling" (CS)

Revised text of the Recommendation adopted by the "Telecommunications" Commission.

"The European Conference of Postal and Telecommunications Administrations,

considering

- that there is an increasing need for connection of a telephone instrument or its equivalent to an exchange (public or private automatic branch exchange) where the normal loop limits are exceeded;
- that in certain cases telephone instruments or their equivalent in one country have to be connected to exchanges in another;
- that these extra long connections should permit a fully automatic operation from telephone instruments or their equivalent to exchanges,

recommends

that members, when introducing international connections of telephone instruments or their equivalent in one country to public exchanges or private automatic branch exchanges (PABXs) in another, use the signalling System L2, which is comprised of the signals, signalling procedures, and equipment functions specified in the following."

K.1 Principles and fields of application

K.1.1 The system is to provide line supervisory signalling (e.g. loop signalling in one direction and ringing in the other direction) between a telephone instrument or its equivalent and a public exchange or PABX via an extra long line, either in the same or different countries. The use of the system over satellite circuits and over composed terrestrial satellite circuits is possible, provided that echo-suppressors or echo-cancellers needed are installed on the customer side between the hybrid and the 2 280 Hz sending and receiving equipment.

K.1.2 For the purpose of description, the present document refers to an ISU and an exchange ESU. This does not imply that the signalling equipment cannot form an integral part of either the telephone or the exchange.

K.1.3 The system is intended for use over four-wire circuits but, as an option for national use, may be used over two-wire circuits.

In the four-wire case, forward and backward signals are segregated by utilizing the four-wire circuit as two separate signalling paths. The send pair which the signals are applied to is the receive pair at the distant end. Signals shall be sent on the send path and received on the receive path. Figure K.1 (T/CS 49-12) shows a termination at one end.

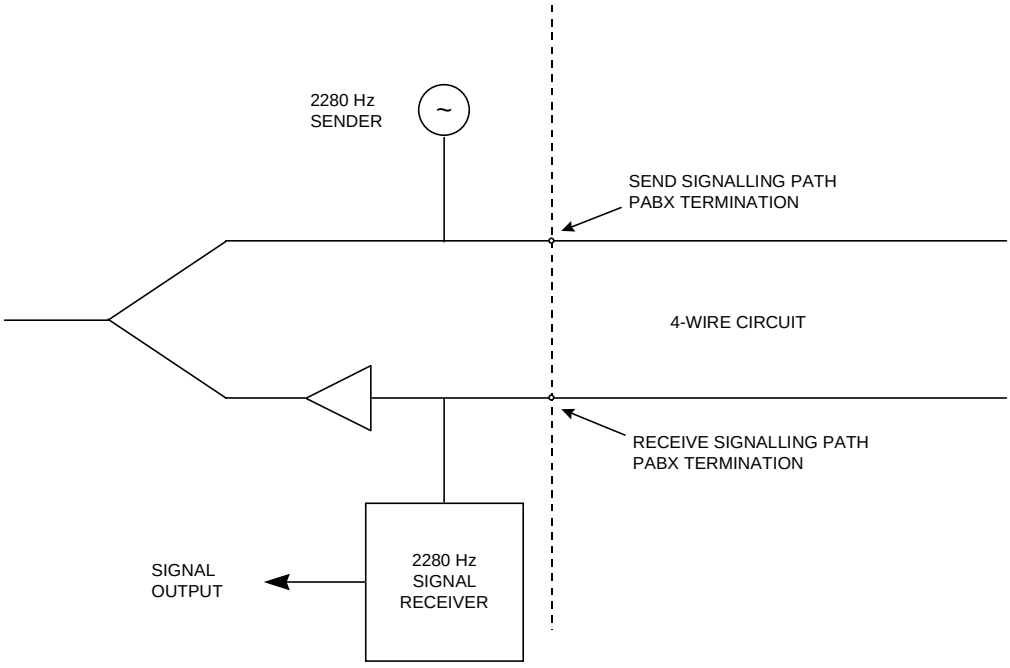


Figure K.1 (T/CS 49-12)

K.1.4 The system is a single voice frequency (1 vf) line signalling system using a signalling frequency of:

- 2 280 Hz in both directions on four-wire circuits;
- 2 280 Hz in the direction ISU to ESU and 2 400 Hz in the direction ESU to ISU on two-wire circuits.

The use of voice frequency signals renders the system suitable for all voice transmission media, except those using speech interpolation.

K.1.5 The line supervisory system may be used to convey digit signals at 10 pulses/second (pps), or as an adjunct to MFPB signalling.

K.1.6 Signals are sent as either application of signalling frequency *tone-on* or removal of signalling frequency *tone-off* in continuous or pulsed form.

K.1.7 When in the idle condition, the signalling frequency applied to the line by the ISU is reduced in power level to conform to the transmission loading requirements of CCITT Recommendation Q.15 [16].

K.1.8 The signalling system allows through dialling of 10 pps or multifrequency push-button type (MFPB) to subsequent circuits, e.g. to another PABX or public exchange. The line supervisory signals are contained within the ISU-ESU link and not allowed to spill over into the next link.

K.1.9 When making an outgoing call, a through speech path shall be provided in the ESU-ISU direction of transmission during call set-up.

K.1.10 Signals may be passed in the direction ISU to ESU while speech or audible indications are being received in the direction ESU to ISU.

K.1.11 These specifications define the signalling requirements of the system in terms of electrical conditions, and their persistence before they may be regarded as valid signals.

K.2 System L2 signals

K.2.1 General

The names and meanings of the signals specified for System L2 are in accordance with Recommendation T/CS 41-01 [27]. According to their use in signalling System L2, some special functions may apply. Therefore, a further description is given in subclause K.2.3. below.

K.2.2 Line signals

The signals transmitted over the line are shown in table K.1 (T/CS 49-12). They are divided into two categories:

i) signals that are essential in a basic version: Mandatory (M);

ii) signals which could be used to supply optional facilities when required: Optional (O).

Table K.1 (T/CS 49-12): System L2 signals

Signals	ISU to ESU	ESU to ISU
Idle	M	--
Calling	--	M
Seizing	M	--
Address information	M	
Answer	M	--
Recall	O	--
Metering	--	O
Clear	M	--

K.2.3 Functions of the signals and states

K.2.3.1 Signals sent from ISU to ESU

K.2.3.1.1 Mandatory signals

Idle signal In the idle state the ISU applies a tone-on condition to the line to indicate it is free to accept calls (see Tables K.2 (T/CS 49-12) and K.3 (T/CS 49-12)).

Seizing signal When the telephone instrument changes from on-hook to off-hook, the ISU applies a seizing signal to the signalling path.

On recognition of the seizing signal, the ESU informs the exchange that the telephone instrument is off-hook.

Address information Address information (routing digits and telephone number) is sent either in the form of signalling tone pulses (decadic pulses) or as MFPB signals.

Answer signal When the called telephone instrument changes from the on-hook to the off-hook condition, the ISU applies an answer signal to the signalling path.

On recognition of the answer signal, the ESU informs the exchange that the telephone instrument is in the off-hook condition and that ringing must be stopped.

Clear signal When the telephone instrument is put in the on-hook condition, the ISU applies a clear signal to the signalling path.

On recognition of the clear signal, the ESU informs the exchange that the telephone instrument has been put on-hook.

K.2.3.1.2 Optional signals and procedures

Provision of the following optional signals and procedures depends on network requirements, and is subject to mutual agreement by the parties involved.

Recall signals — On receipt of a recall signal from the telephone, the ISU applies a recall signal in the form of a tone-on pulse to the signalling path.

The length of tone-on pulse applied by the ISU depends upon the type of recall employed by the associated telephone, e.g. timed break or earthed loop.

K.2.3.2 Signals sent from ESU to ISU

K.2.3.2.1 Mandatory signals

Calling signal — The calling signal is sent by the ESU to indicate that ringing current is being sent by the exchange.

The calling signal is sent by the ESU as a series of tone-on pulses, in step with the periods of ringing current that are sent by the exchange.

On recognition of each tone-on pulse of the calling signal, the ISU applies ringing current to the telephone instrument.

K.2.3.2.2 Optional signals

Provision of the following optional signals and procedures depends on network requirements and is subject to mutual agreement by the parties involved

Answer signal — The answer signal is sent by the ESU to indicate that the called party has answered.

Metering signals — If the public exchange can send metering pulses for call charging, these pulses may be:

i) sent during speech in the voice band with appropriate safeguards to prevent the pulses from being heard;

ii) sent during speech by application of channel splitting equipment (see CCITT Recommendation H.34 [12]), using one of the telegraph channels;

iii) stored or sent, possibly on demand, at the end of the call.

However, the handling of metering signals is outside the scope of this Recommendation.

K.3 Line signalling sending and detecting requirements

K.3.1 Signalling code

The signalling code shall be as shown in Tables K.2 (T/CS 49-12) and K.3 (T/CS 49-12). Signal sending and detection requirements are given in subclauses K.3.2. and K.3.3.

Table K.2 (T/CS 49-12): Calls originated by the telephone instrument

Signal	Conditions from ISU	Conditions from ESU
Idle	Continuous tone-on	Continuous tone-off
Seizing	Continuous tone-off	--
Address information	Decadic pulsing of MFPB	--
Answer (optional)	--	Tone-on pulse
Recall (optional)	Recall tone-on pulse	--
Clear	Continuous tone-on	--

Table K.3 (T/CS 49-12): Calls from the exchange

Signal	Conditions from ESU	Conditions from ISU
Idle	Continuous tone-off	Continuous tone-on
Calling	Calling tone-pulse	--
Answer	--	Continuous tone-off
Recall (optional)	--	Recall tone-on pulse
Clear	--	Continuous tone-on

K.3.2 Sending of signals

Tone-on and tone-off conditions referred to in this paragraph shall conform to the requirements in subclauses K.4.1. and K.4.3.

Signals are sent by applying either a tone-on or a tone-off condition to the transmit signalling path in a continuous or pulsed form.

K.3.2.1 Continuous tone-on signal

A continuous tone-on signal shall be the application of a tone-on condition to the transmit signalling path for a period exceeding 350 ms.

K.3.2.2 Continuous tone-off signal

A continuous tone-off signal shall be the application of a tone-off condition to the transmit signalling path for a period exceeding 80 ms.

K.3.2.3 Address information

Address information is conveyed in decadic pulsing or MFPB form, see Recommendation T/CS 46-02 [29].

K.3.2.3.1 Decadic pulsing

The break periods of decadic pulses shall be applied to the transmit signalling path of the ISU, as pulses of tone-on condition within the limits of Table J.4 (T/CS 49-12).

Table K.4 (T/CS 49-12)

Speed (pulses per second)	7		9		11		12	
Break pulse	Min	Max	Min	Max	Min	Max	Min	Max
Duration (ms)	45	112	45	81	45	61	45	52

Where decadic pulses are generated within the ISU, the speed and break pulse duration applied to the transmit signalling path shall be either:

a) 10 ± 0,5 pps with break pulse limits of 60-68 %; or

b) 10 ± 1 PPS with break pulse limits of 59-66 %.

Inter-digit pause: Adjacent digits are separated by an inter-digit pause (IDP). The inter-digit pause is a function of the source of the digits, i.e. under control of a dial, or repeated, or generated by a signalling unit.

This period, which will differ depending upon the Administration concerned and the type of equipment, is not specified in this Recommendation and should be mutually agreed upon by the parties involved. During the inter-digit pause. the backward speech path should be re-established.

K.3.2.3.2 MFPB signals

See CEPT Recommendation T/CS 46-02 [29].

K.3.2.4 Tone-on pulse signal

A tone-on pulse signal shall be the application of a tone-on condition to the send signalling path for a period of 45 to 135 ms.

K.3.2.5 Recall tone-on pulse signal

The length of recall tone-on pulse signal will depend on the type of recall applied by the associated telephone.

A recall tone-on pulse signal, as a consequence of a timed break recall signal from the telephone (see subclause K.2.3.1.2), shall be the application of tone-on condition to the transmit signalling path for a period of 50-130 ms, see Recommendation T/CS 20-09 [25].

A recall tone-on pulse signal, as a consequence of an earthed loop recall from the telephone (see subclause K.2.1.2.1), shall be the application of tone-on condition to the transmit signalling path for a period of 210-240 ms.

K.3.2.6 Calling tone-on pulse signals

Calling tone-on pulse signals shall be the application of tone-on condition to the send signalling path, in step with the ringing period of the ringing cadence.

K.3.3 Detection of signals

Electrical conditions conforming to the requirements in subclauses K.4.2 and K.4.4 applied to the line termination shall be regarded as a potential signal and referred to in the following as tone-on condition or tone-off condition.

Signals are received as either a tone-on or a tone-off condition on the receive signalling path in a continuous or pulsed form.

To discriminate between signals having similar characteristics and between signals and spurious electrical conditions, it is necessary to state the minimum persistence time for a potential signal.

A signal is not valid until the electrical condition proper to the signal (i.e. tone-on or tone-off) has persisted for a stated period. Until that period expires, only an electrical condition exists.

Paragraphs K.3.3.1 to K.3.3.6 detail the minimum persistence of a defined electrical condition before it becomes a signal, i.e. a valid electrical condition persisting for less than the stated period shall not be recognized as a signal. The period in which a validated electrical condition must be recognized as a signal is a function of the ISU logic and is not given in these specifications. However, recognition should occur as soon as possible following expiration of the stated persistence check period.

K.3.3.1 Continuous tone-on signal

A tone-on condition applied to the receive signalling path line termination is a continuous tone-on signal for signalling, when it has persisted for 250 ms.

K.3.3.2 Continuous tone-off signal

A tone-off condition applied to the receive signalling path line termination is a continuous tone-off signal for signalling, when it has persisted for 40 ms.

K.3.3.3 Address information

Address information is conveyed in decadic or MFPB form.

K.3.3.3.1 Decadic pulsing

Pulses of tone-on condition applied to the receive signalling path line termination of the ESU, consistent with the speed and duration limits of Table J.5 (T/CS 49-12), are break periods of decadic pulses.

Each break pulse is separated from the next by a make pulse, i.e. tone-off condition.

Within a digit, adjacent pulses may differ in speed and duration and any combination of break pulses within the limits of Table J.5 (T/CS 49-12) shall be accepted as decadic pulses.

Table K.5 (T/CS 49-12)

Speed (pulses per second)	7		9		11		12	
Break pulse	Min	Max	Min	Max	Min	Max	Min	Max
Duration (ms)	35	122	35	91	35	71	35	62

Break pulses persisting for less than 25 ms applied to the line termination shall not be accepted as decadic pulses.

Adjacent digits are separated by an inter-digit pause.

K.3.3.3.2 MFPB signals

See Recommendation T/CS 46-02 [29].

K.3.3.4 Tone-on pulse signal

A tone-on condition applied to the receive signalling path line termination, and persisting for a period of 35-150 ms, is a tone-on pulse signal for signalling. A tone-on condition persisting for less than 25 ms shall not be accepted as a tone-on pulse signal.

K.3.3.5 Recall tone-on pulse signal

A tone-on condition applied to the receive signalling path line termination, and persisting for a period of 35-135 ms, is a recall tone-on pulse signal, as a consequence of a timed break recall signal (see subclause K.2.3.1.2).

A tone-on condition persisting for less than 25 ms shall not be accepted as a recall tone-on pulse signal, as a consequence of a timed break recall signal.

A tone-on condition applied to the receive signalling path line termination, and persisting for a period of 200-250 ms, is a recall tone-on pulse signal as a consequence of an earthed loop recall signal.

K.3.3.6 Calling tone-on pulse signal

A tone-on condition applied to the receive signalling path line termination during the unanswered state, persisting for a period of more than 35 ms, is a calling tone-on pulse signal (for each burst of ringing current).

K.4 Line signalling transmission requirements (four-wire working)

K.4.1 Signal sender, ESU

Signals are sent by the ESU as either tone-on or tone-off condition applied to the send signalling path.

K.4.1.1 Tone-on condition

Tone-on condition shall be a signalling tone conforming to the following parameters and shall reach a stable state within 5 ms of application.

K.4.1.1.1 Signal tone frequency

The signalling tone shall be at a frequency of 2 280 ± 5 Hz.

K.4.1.1.2 Signal tone power

The tone-on condition shall have two power levels - a high level and a low level.

A high level tone shall be sent for the duration of the signal or for a minimum of 300 ms (whichever is shorter), and for a maximum of 550 ms after which it must be reduced to low level.

a) A high level tone-on condition shall be a signalling tone transmitted at a level of -10 dBmO ± 1 dB;

b) A low level tone-on condition shall be a signalling tone transmitted at a level of -20 dBmO ± 1 dB.

K.4.1.1.3 Long-term mean power during signalling

a) In the frequency band 300-3 400 Hz, the long-term mean power applied to the send path, excluding the signalling tones, shall be at least 35 dB below the signalling tone power.

b) At frequencies in the range 3.4 to 50 kHz, the short-term mean power level of any spectral component shall not lie above the line shown on figure K.2 (T/CS 49-12).

NOTE 1: Short-term here refers to a period not greater than 1 ms.

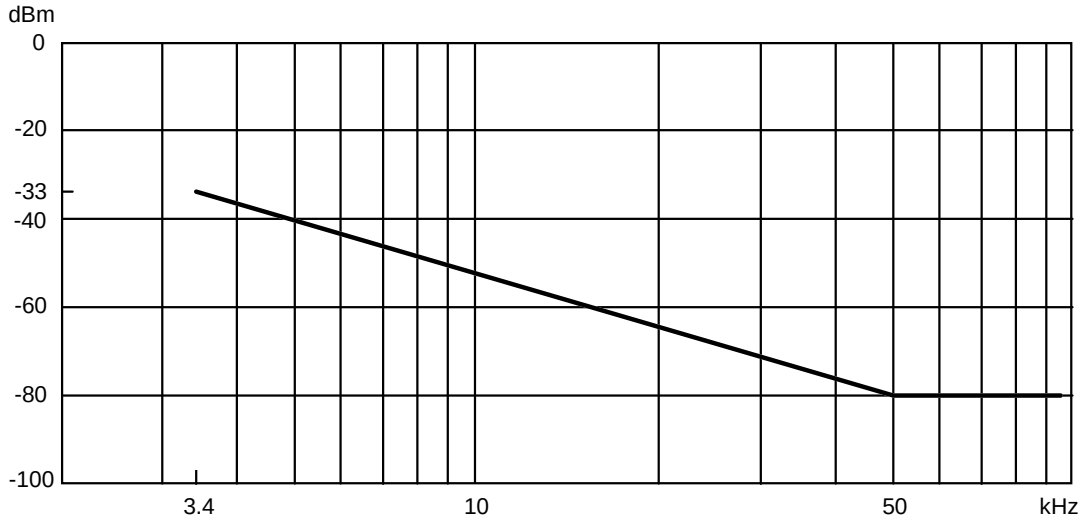


Figure K.2 (T/CS 49-12)

c) In any 3 kHz band contained above 3.4 kHz, the long-term mean power shall not exceed the level which would be permitted in accordance with (b) above for a spectral component at the mid-frequency of that band.

NOTE 2: The requirements for the long-term mean exclude any near end noise prior to transmit path isolation, see subclause K.4.1.3, but include noise attributable to the action of transmission path isolation.

K.4.1.2 Tone-off condition

A tone-off condition is the removal of signal tone and shall conform to the following.

K.4.1.2.1 Stable state

A stable state shall be attained within 5 ms of commencement of the tone-off condition.

K.4.1.2.2 Signal frequency leak

The total power of any signalling tone that may be present in the tone-off condition shall exceed -70 dBmO.

K.4.1.3 Transmission path isolation

When a signal is to be sent, the transmission path shall be isolated from any source of near end speech or noise.

Transmission path isolation shall occur within a period from 20 ms before to 15 ms after application of a tone-on condition.

The transmission path remains isolated until a tone-off signal is to be sent, in which case the transmission path shall be restored within 75 ms-160 ms of the application of a tone-off condition.

NOTE: As an alternative to the above requirement, the transmission path may be isolated during idle, and when sending the calling signal.

K.4.1.4 Signal direction

When sending a tone-on signal, any period of signalling tone attributable to that signal, that is applied towards the exchange, shall not exceed 15 ms.

K.4.2 Signal receiver, ESU

All electrical conditions applied to the receive signalling path shall be accepted as either tone-on or tone-off signals.

K.4.2.1 Signal condition

K.4.2.1.1 Tone-on condition

A frequency within the range 2 280 ± 15 Hz at an absolute level N within the range $(-30 + n \leq N \leq -4 + n)$ dBm shall be accepted as a tone-on condition; where n is the relative power level at the receive signalling path line termination (see CCITT Recommendation G.171 [11]).

NOTE: Each tone-on signal is sent as described in subclause K.4.1.1.2.

K.4.2.1.2 Tone-off condition

Any frequency or combination of frequencies having a total absolute power level of less than (-40 + n) dBm is a tone-off condition; where n is the relative power level at the receive signalling path line termination as in subclause K.4.2.1.1.

K.4.2.2 Signal interference and simulation

The conditions defined in subclause K.4.2.1 shall be accepted as potential tone-on or tone-off signals subject to the following requirements.

K.4.2.2.1 Signal recognition interference

a) The recognition of tone-on and tone-off signals shall not be affected by the presence of noise at a maximum level of -35 dBmO and having uniform spectral energy over the range of 300 Hz to 10 kHz.

b) The recognition of tone-on and tone-off signals at the ESU shall not be affected by speech or other electrical signals, such as audible indications (tones and announcements) and tone-on signals sent simultaneously to the ISU.

K.4.2.2.2 Signal simulation

a) False signal simulation rates shall not exceed one false recognition of a clear signal in 1 500 hours of normal speech, and one false recognition of a pulsed signal in 70 hours of normal speech.

b) Speech or other electrical signals such as audible indications (tones and announcements) at power levels up to + 10 dBmO shall not cause any false simulation of a tone-off signal.

c) A frequency outside the range 2 280 ± 75 Hz shall not cause any false simulation of a tone-on signal.

d) A frequency within the range 2 280 ± 75 Hz shall not cause any false simulation of a tone-on signal, if the total power in the range 2 280 ± 75 Hz does not exceed the total power in any accompanying frequencies by more than as shown in Table K.6 (T/CS 49-12).

Table K.6 (T/CS 49-12)

Accompanying frequency (Hz)	500	750	1 000	1 250	1 500	1 750	2 000	3 000
Total power level by which 2 280 ± 75 Hz exceeds accompanying frequencies (dB)	7	10	12	12	12	12	7	9

K.4.2.3 Spill-over

On receipt of tone-on condition, any through-transmission to the exchange shall be attenuated by at least 35 dB within 20 ms.

Through-transmission shall be restored within 300 ms of the cessation of the tone-on condition.

Through-transmission shall not be restored during the tone-off periods of multiple pulse signals, e.g. digit pulses.

K.4.2.4 Through-transmission interference

Through-transmission attenuation (see subclause K.4.2.3) shall not occur for more than one 20 ms period in 2 continuous speech hours, and one 50 ms period in 10 continuous speech hours.

A continuous speech hour is one hour of speech and does not include those quiescent periods that occur in normal conversation.

A method of test is given in Recommendation T/CS 46-02, annex 1 [29].

K.4.2.4.1 Data immunity

Through-transmission attenuation (see subclause J.4.2.3) shall not occur if the total power in the range 2 230 ± 75 Hz does not exceed the total power in the accompanying frequencies by more than shown in Table K.6 (T/CS 49-12).

K.4.3 Signal sender, ISU

The signal sender requirements of the ISU are the same as those for the ESU with the following exceptions.

K.4.3.1 Transmit and receive path isolation

When a signal is to be sent, the transmit path shall be isolated from any source of speech or noise, and the receive path shall be isolated from the telephone instrument.

Transmit and receive path isolation shall occur within a period of 20 ms before to 15 ms after application of tone-on condition.

The paths remain isolated until a tone-off signal is to be sent, in which case the paths shall be restored within 75 ms-160 ms of application of tone-off condition.

K.4.3.2 Signal direction

When sending a tone-on signal, any period of signalling tone attributable to that signal and applied towards the telephone shall not exceed 15 ms.

K.4.4 Signal receiver, ISU

The signal receiver requirements of the ISU differ depending upon whether or not the optional signals in the direction ESU to ISU are provided.

Where the optional signals are provided, the requirements in subclause K.4.2 apply, i.e. same as ESU.

Where the optional signals are not provided, tone-on signal detection during speech is not required, and the ISU signal receiver may be simplified as detailed below. When the receiver is simplified as detailed, provision shall be made to prevent application of ringing current toward the telephone instrument when it is off-hook.

When the receiver is simplified as detailed, all electrical conditions applied to the receive signalling path when the associated telephone is on-hook shall be accepted as either tone-on or tone-off signals.

K.4.4.1 Signal condition

K.4.4.1.1 Tone-on condition

A frequency within the range 2 280 ± 15 Hz at an absolute level N within the range $(-30 + n \leq N \leq -4 + n)$ dBm shall be accepted as a tone-on condition; where n is the relative power level at the receive signalling path line termination (see CCITT Recommendation G.171 [11]).

NOTE: Each tone-on signal is sent as described in subclause K.4.1.1.2.

K.4.4.1.2 Tone-off condition

Any frequency or combination of frequencies having a total absolute power level of less than (40 + n) dBm is a tone-off condition; where n is the relative power level at the receive signalling path line termination as in subclause K.4.2.1.1.

K.4.4.2 Signal interference and simulation

The conditions defined in subclause K.4.2.1 shall be accepted as potential tone-on or tone-off signals, subject to the following requirements.

K.4.4.2.1 Signal recognition interference

a) The recognition of tone-on and tone-off signals shall not be affected by the presence of noise at a maximum level of 35 dBmO, and shall have uniform spectral energy over the range of 300 Hz to 10 kHz.

b) The recognition of tone-on and tone-off signals at the ISU shall not be affected by tone-on signals transmitted simultaneously to the ESU.

K.4.4.2.2 Signal simulation

A frequency outside the range 2 280 ± 75 Hz shall not cause any false simulation of a tone-on signal.

K.5 Line signalling transmission requirements (two-wire working)

K.5.1 Signal sender, ESU

The signal sender requirements are the same as those given in subclause K.4.1, except that the frequency 2 280 Hz is replaced by the frequency 2 400 Hz.

K.5.2 Signal receiver, ESU

The signal receiver requirements are the same as those given in subclause K.4.2.

K.5.3 Signal sender, ISU

The signal sender requirements are the same as those given in subclause K.4.3.

K.5.4 Signal receiver, ISU

The signal receiver requirements are the same as those given in subclause K.4.4, except that the frequency 2 280 Hz is replaced by the frequency 2 400 Hz.

History

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