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fig. 1) ISDN-4 interface – front view

CS ISDN-4

Interfaccia per ISDN

ISDN Interface

1. ISDN-4 Interface

1. General

1.1. Introduction

The Test System **CS8014** “Automatic FFT telephone test System” was designed to test Telephone terminals for PSTN lines.

The **ISDN-4** Interface, here described, allows the **CS8014** to extend effectively toward the **ISDN** telephone terminals the functional testing. Especially it can operate on TE terminals (telephones) or on

1.2. Interface Structure

The **ISDN-4** Interface can be represented as in fig.2) block diagram.

1.2.1. TE or NT S-bus interface

See connectors of fig.6) and 7).

It is an ISDN four wires connection, where 2 wires are used for the sending (toward **CS8014** and named upstream), and other 2 wires used for receiving (from **CS8014** and named downstream).

The **S-bus** Interface supports two 64Kb channels, named **B1** and **B2**, used for voice communication or data transmission, other than a 16 Kb service

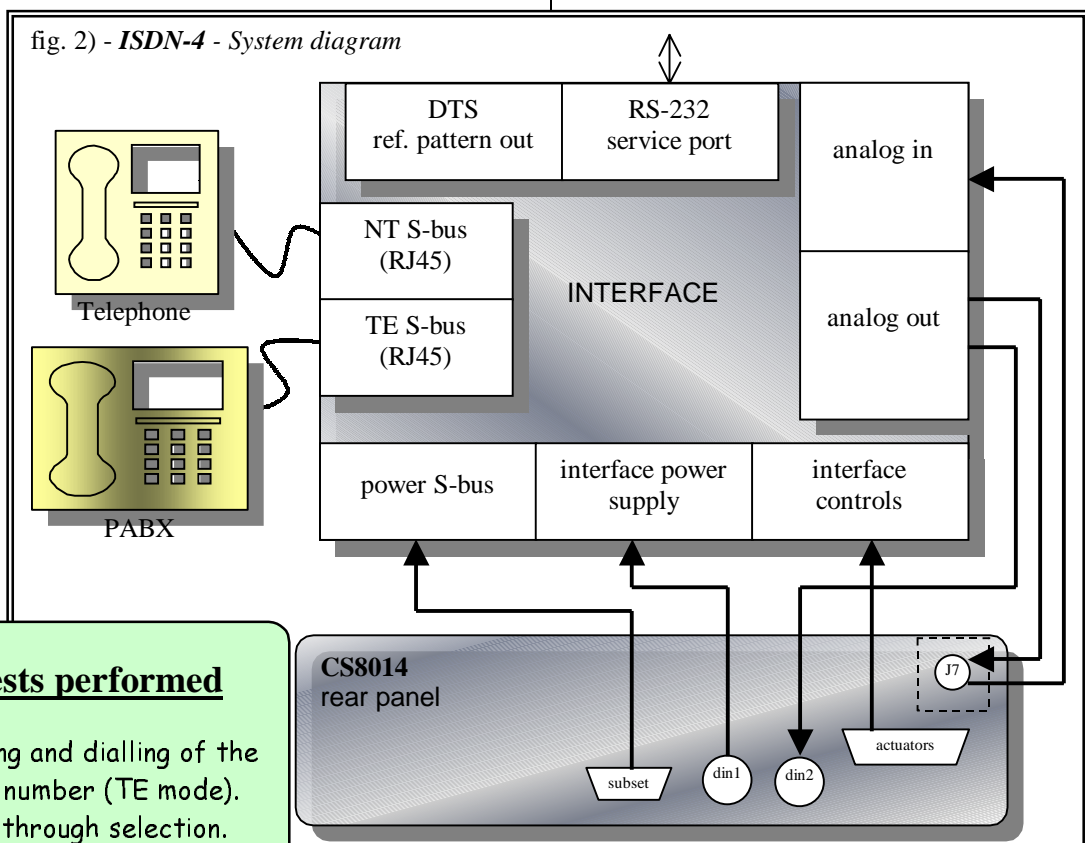


table 1)

Tests performed

- Calling and dialling of the user number (TE mode).
- Feedthrough selection.
- Measure of acoustic level of the ringer.
- Sensibility, frequency response and Loudness Rating for sending and receiving.
- Talker Sidetone (STMR).

possible to make the functional tests listed on the table 1).

PABX connected through the S Bus.

Through the **ISDN-4** interface connected to **CS8014** Test equipment will be

channel, named **D**, used for the protocol to/from **ISDN-4**. The protocol is standardized by ETSI¹ both for the level 2 and for the level 3 (ETSI 300-125 and ETSI 300-102).

ISDN-4 design is in according to ETSI TBR-8/A.1.3 rules, which give prominence to the characteristics of “Test equipment for digital telephone sets”. Particular attention was placed for CODEC specifications and frequency response curve of transmission and receive filters. For the purpose to check or to calibrate the conversion characteristic of D/A and A/D, the **ISDN-4** Interface has an internal generator of DTS (Digital Test Sequence). Qualified

¹ European Telecommunication Standard Institute

Laboratory can also certify such signal. A program for **CS8014**, supplied with the device, allows an easy and documentable operation.

1.2.2. Analog-in Interface

It is an analogue input circuit ($Z_{in}=600\Omega$) able to receive the test signals from **CS8014** (pin 4 connector J7 – fig.8).

1.2.3.Interface Analog-Out

It is an analog output ($Z_{out}=600\Omega$) of a signal, in the acoustic range, generated from **ISDN-4** to **CS8014** (pin 2 connector **trmz**, fig.8) or pin 4 connector **din**, fig.9).

1.2.4. Interface Power Supply

Power supply input for **ISDN-4**. Such supply voltage, is furnished on connector **din** (pins 1, 2 and 3, fig.9) from connectors **din1/din2** of **CS8014**.

1.2.5. Power S-bus

It is the voltage supplied to the device under test (if S-Bus arranged as **NT**) of +/- 40V (reversed polarity in the case of emergency condition test). This programmable voltage is obtained from the pins 1 and 2 of **subset** connector (fig.12).

1.2.6. Reference Pattern Out

The interface allows external use for calibration purpose, of the **DTS²** signal used inside the **ISDN-4**.

Two modes are preview:

- a. By **IOM-2** interface, if **ISDN-4** is in **TE** mode.
- b. By **PCM-4** interface.

1.2.7. Interface Control - Commands

The commands to change the operating mode of **ISDN-4**, are furnished by this interface.

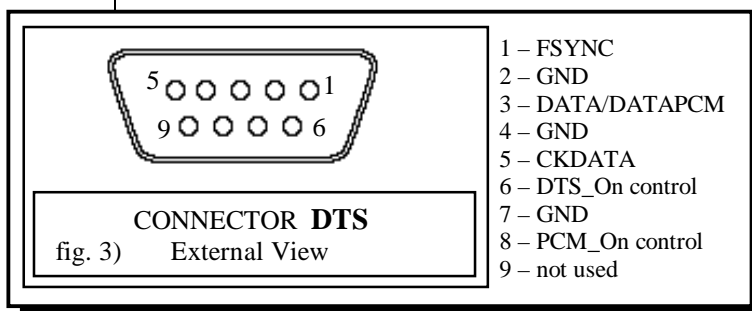
Commands are actives for low logic level (GND).

- 1. Calibration Mode
- 2. Operation as **NT** or **TE**
- 3. PCM laws choice (**A** or μ)

1.2.8. Interface Control - Information

By this interface are outputted on the **subset** connector, the information on the **ISDN-4** status.front Panel

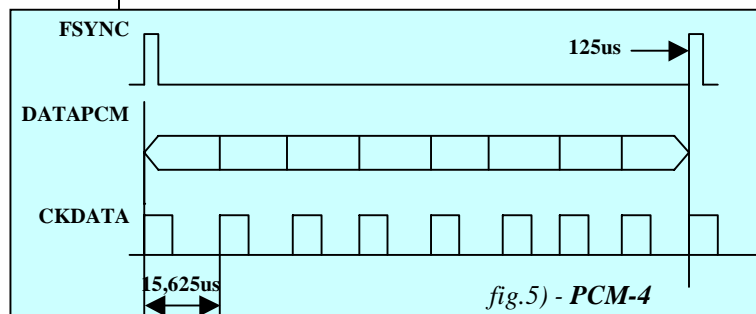
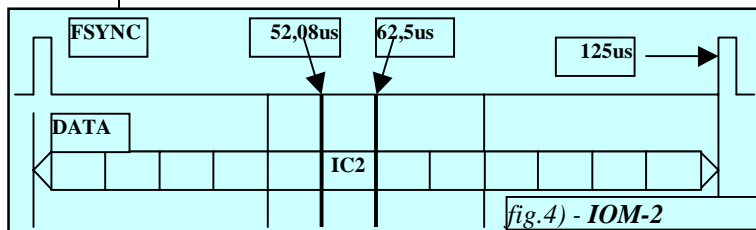
1.3. DTS Connector



On the DTS connector is available the **DTS** signal in according to the protocols indicated at § 1.2.6-Reference Pattern Out.

The purpose of this connector is to allow the Certification, by external instruments, that the digital reference signal used in **ISDN-4** for its calibration, is a 0 dBm signal, in according to the ITU G-711 recommendation.

Two mode are foreseen:



- b) By **IOM-2** interface, **TE** mode, outputting these signals:
 - i. FSYNC: 8KHz out sync;
 - ii. DATA: Data output upstream, where at the time slot IC2 is outputted the DTS (bit-rate is 768Kb/s).
- c) By **PCM-4** interface outputting these signals:
 - i. FSYNC: 8KHz out sync;
 - ii. DATAPCM: PCM Data output at 64Kb/s or DTS;
 - iii. CKDATA: Clock output at 64KHz rate for the DATAPCM.

To activate the generation of **DTS**, useful for **ISDN-4** calibration, must used the control lines of **DTS** connector, as indicated in the following table 2)

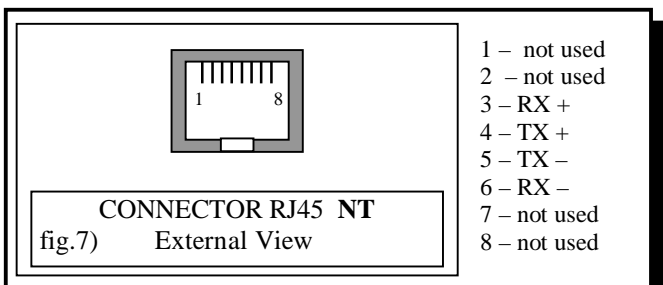
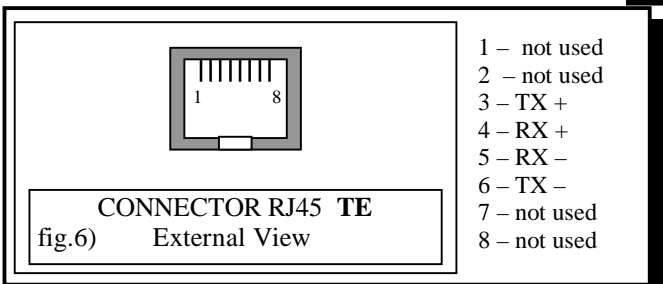
² Digital Test Sequence – Connector fig. 3)

Tab. 2: DTS activation

	DTS_On	PCM_On
none	NA	X
PCM-4	A	A
IOM-2	A	NA

1.4. NT and TE Sections

By the **TE/NT** switch, on the front panel, **ISDN-4** can be defined both **TE** (Terminal Equipment) and **NT** (Network Termination).



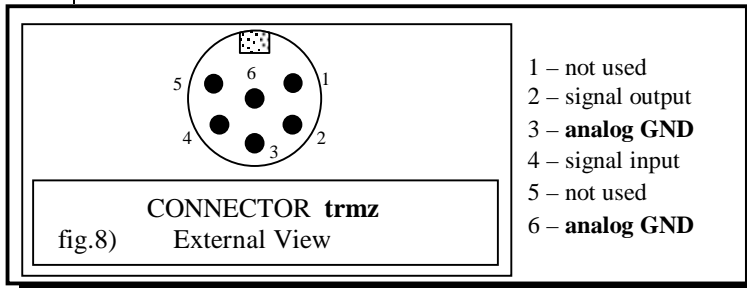
Two LED shown to which of the RJ45 connector must be connected the device under test –fig 6) and 7). The mode function changes only during the stand-by phase.

- ✓ **TE** - is foreseen for the connection with **NT** devices, where **ISDN-4** simulates a telephone terminal operation.
- ✓ **NT** – **ISDN-4** simulates an ISDN telephone line, allowing Terminals or Telephones testing. In **NT** mode, **CS8014** supplies an ISDN line voltage, programming a proper feeding bridge voltage value.

2. Rear Panel

2.1. trmz Connector

From the **trmz** connector, are received and sent to

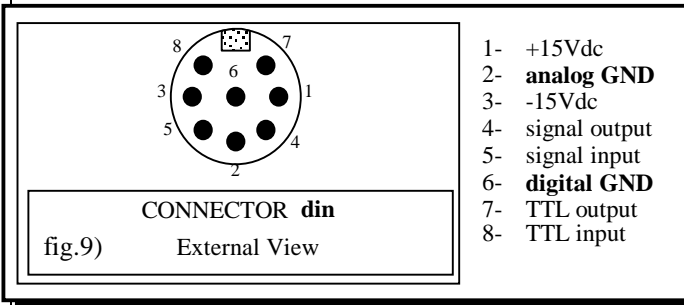


CS8014 the test signals for acoustic measures and DTMF codes, for dialling the device under test.

trmz connector must be connected to **J7**³ connector of **CS8014** or to the feeding bridge connector, for **CS8014 Rack**⁴ edition.

2.2. din Connector

This connector must be connected, by an **X109-2**



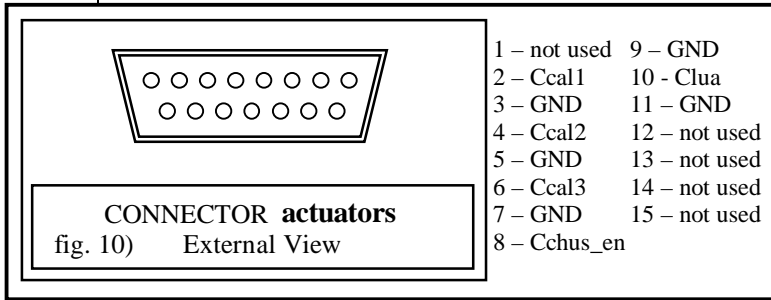
cable, to a **din** connector of **CS8014**.

It is used to feed the **ISDN-4** and to have the output signal in some test procedure.

2.3. actuators connector

It must be connected, by a **XISDN-1** cable, to the **actuators** connector of **CS8014**.

By the actuators relays of **CS8014** it is possible to drive all the operations of **ISDN-4**:



³ Use XISDN-2 cable

⁴ Use XISDN-2 cable and the adapter XISDN-2RACK

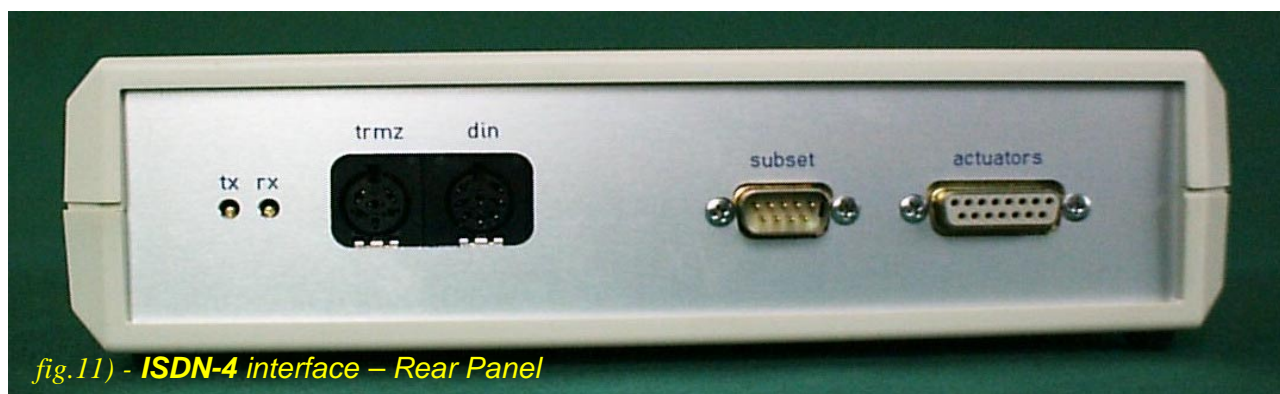


fig.11) - ISDN-4 interface – Rear Panel

- in calibration mode: to make a semiautomatic procedure of CODEC calibration for the two directions.
 - in testing mode: to activate the tests for the set **CS8014 / ISDN-4**.
1. # 2 (*Ccal1*) terminal:
 - ⇒ in **stand-by** mode: enter in calibration mode. **ISDN-4** operates as **TE**, activates the **DTS** and sends the Analog Out to pin 4 of **din** connector and to pin 2 of **trmz** connector. The non-active/active transition read the *Clua* control state, for the law definition (tab.5).
 - ⇒ In **NT** mode: after the connection procedure, operates as acknowledge of the off-hook for TE under test, it confirm to the **ISDN-4** the consent to proceed making the speech tests.
 2. # 4 (*Ccal2*) terminal:
 - ⇒ in **calibration** mode (*Ccal1* active): the DTS is stopped and a loop is made on the digital sections. The signal sent from the **CS8014** to Analog In is routed, through CODEC-TX and CODEC-RX, to the Analog Out;
 - ⇒ in **NT** mode: **ISDN-4** wait for a DTMF selection, the selected number will be converted and sent, during the call, to the PABX under test.
 3. # 6 (*Ccal3*) terminal:
 - ⇒ in **NT** mode: after the connection procedure, selects **B1** channel, otherwise default is **B2** channel;
 - ⇒ in calibration mode: set the PCM signal to be sent to **CS8014** (see tab. 3);

4. # 8 (*Cchus/Cchen*) terminal:
 - ⇒ in **NT** (or **TE**) mode: it is the start of the measure procedure that is the **ISDN-4** sends a calling to the **TE** (or a calling request to **NT/PABX**). The non-active/active transition read the *Clua* control state, for the law definition (tab.5);
 - ⇒ in calibration mode: set the PCM signal to be sent to **CS8014** (see tab. 3);
5. # 10 (*Clua*) terminal:
 - ⇒ in **NT** mode: choice of the compression law of PCM if **A** (European) or **μ** (USA). Default is **A**, if active is **μ**.
 - ⇒ in calibration mode: set the PCM signal to be sent to **CS8014** (see tab. 3);

Tab. 3: calibration mode

<i>Ccal1</i>	<i>Ccal2</i>	<i>Ccal3</i>	<i>Cchus</i>	<i>Clua</i>	Analog_out
A	NA	NA	NA	NA/A*	DTS(1KHz)
A	NA	A	NA	NA	0 Volt
A	NA	NA	A	NA	50Hz
A	NA	A	A	NA	200Hz
A	NA	NA	A	A	3150Hz
A	NA	A	NA	A	4000Hz
A	A	A	NA	NA	Loop su B1
A	A	NA	NA	NA	Loop su B2

Tab. 4: NT mode

<i>Cchus_en</i>	<i>Ccal3</i>	<i>Ccal2</i>	Operating Condition
A	A	A	Connected to PABX by B1
A	A	NA	Connected to TE by B1
A	NA	A	Connected to PABX by B2
A	NA	NA	Connected to TE by B2

Tab. 5: PCM law

<i>Clua</i>	PCM law
NA	A law -default
A	μ law

* defines the PCM law during calibration.

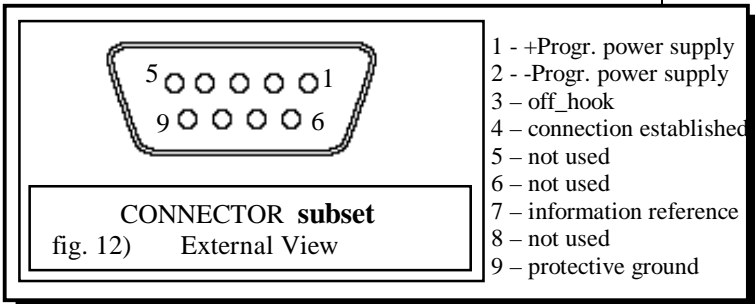
2.4. subset Connector

By this interface we have the information about the **ISDN-4** status. The following logic signals are at disposal on the **subset** connector (active if shorted vs. pin 7).

Use a **X110-4** cable to connect to **subset** connector of **CS8014**.

ATTENTION!

ISDN-4 is designed for point-to-point and for point multipoint operations. It is not allowed the use of the second connector of each Section. It is conceived for monitor purpose only.



3. Procedures

3.1. Calibration

The Calibration procedure has two separate phases:

- Calibration of the receiving channel.
The **DTS⁵** is injected into the digital section of the receiving channel to be verified or calibrated. The output analog signal is sent to **CS8014**.
- Calibration of the transmitting channel.
The digital sections of the transmitting and the receiving channel are internally looped. The test signal sent from **CS8014** is digitally converted then reinserted into the preceding calibrated receiving channel. The output analog signal is again sent to **CS8014**. Its level depends only from the transmitting channel, which can now calibrated.

- 6. #3 terminal (*Coffh*) – Off-Hook :
⇒ in **TE** mode: **ISDN-4** returns the Off-Hook information of the device under test and therefore the correct connection.
- 7. #4 terminal (*Cl3ok*) – Connection Established:
⇒ in **TE** mode (calling phase): changing from non-active to active the **ISDN-4** returns the information of activation of the levels 1, 2 and 3 of the ISDN connection, that is a calling was sent to the device under test and is ready to accept the DTMF digits. Changing from active to non-active the **ISDN-4** returns the information that the device under test is ringing (ALERT received).
⇒ in **TE** (called phase): become active if an incoming call is detected. When *Coffh* become active, *Cl3ok* active means the connection is established on B1 channel, otherwise (not active) on B2 channel.

Across pins 1 and 2 of this connector there is the supply voltage programmed in the **CS8014** tests. That voltage is the power supply for the device under test (only for **ISDN-4** set for **NT** mode). The value is +/- 40V (reversed polarity in the case of emergency condition test).

Tab. 6: Commands /Actuator-Relays CS8014 with cable XISDN-1

Command	pin actuators	relay CS8014
<i>Ccal1</i>	2	B
<i>Ccal2</i>	4	D
<i>Ccal3</i>	6	E
<i>Cchus/Cchen</i>	8	F
<i>Clua</i>	10	C

3.1.1. Calibration procedure – 1st step

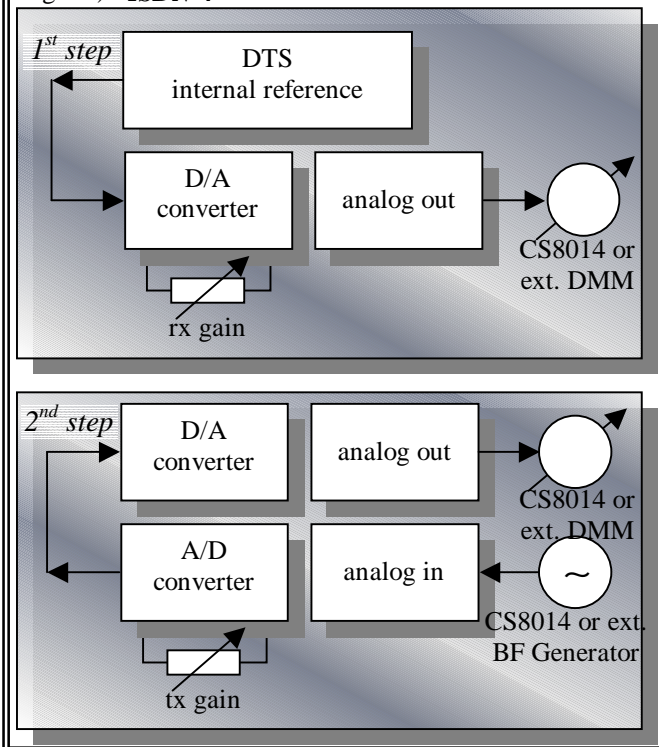
CS8014	Operations	ISDN-4
generates the start of the 1st of the procedure <i>Clua</i> defines the PCM law.	<i>Ccal1,2,3=1,0,0</i> <i>Cchusc,Clua=0, 0/1</i> Analog output ISDN-4 to DIN	enter into the 1st step of the D/A calibration procedure: ISDN-4 is set in TE mode and sends DTS (1KHz-0dBm0) to the D/A direction.
measure of the 1KHz level. Calibration of the D/A converter with the rx trimmer to 0 dBm. Request of the silence	<i>Ccal1,2,3=1,0,1</i> <i>Cchusc,Clua=0, 0</i> Analog output ISDN-4 to DIN	end of the 1KHz DTS. Start the silence signal in the same direction.
reading of 0 V. Request of 50 Hz DTS	<i>Ccal1,2,3=1,0,0</i> <i>Cchusc,Clua=1, 0</i>	Generates 50Hz DTS in the D/A direction.
reading of 0dBm @ 50 Hz. Request of 200 Hz DTS	<i>Ccal1,2,3=1,0,1</i> <i>Cchusc,Clua=1, 0</i>	Generates 200Hz DTS in the D/A direction.
reading of 0dBm @ 200Hz. Request of 3150Hz DTS	<i>Ccal1,2,3=1,0,0</i> <i>Cchusc,Clua=0, 1</i>	Generates 3150Hz DTS in the D/A direction.
reading of 0dBm @ 3150Hz. Request of 4KHz DTS	<i>Ccal1,2,3=1,0,1</i> <i>Cchusc,Clua=0, 1</i>	Generates 4KHz DTS in the D/A direction.
reading of 0dBm @ 4KHz.		end of 1 st step

3.1.2. Calibration procedure – 2nd step

CS8014	Operations	ISDN-4
generates the start of the 2 nd step procedure <i>Clua</i> now defines the B1 (0) or B2 (1) channel.	<i>Ccal1,2,3=1,1,1</i> <i>Cchuse,Clua=0, 0/1</i> <i>Analog output ISDN-4 to DIN</i>	enter into the 2 nd step of the A/D calibration procedure: ISDN-4 makes a digital loop on B1 (B2) channel.
<ul style="list-style-type: none"> generates a 0 DBm composite signal on transmit direction. measures the receive output. Calibration of the A/D converter with the tx trimmer to 0 dBm. 	<i>Ccal1=0</i>	terminates the calibration procedure. returns in stand-by mode.

You can import examples for calibration procedures, both for A-law and μ -law, from the default file **ISDN-4.DEF**, selected in the **WIN8014 Setup Menu**.

fig. 13) - **ISDN-4** – Calibration schematics



3.2. Tests in NT mode

The interface **ISDN-4** must be set in NT mode to let the connection toward Terminal Equipments. Switch the NT/TE control on NT and then connect the Terminal line cord on RJ45 connectors where a LED lights.

You can import examples for Test Procedures, both for A-law and μ -law, from the default file **ISDN-4.DEF**, selected in the **WIN8014 Setup Menu**.

3.2.1. Tests on Telephone Equipments

CS8014	Operations	ISDN-4
the line current increases to >1mA and detected by CS8014.		TE connected to the line.
demand of the connection with TE.	<i>Clua=0 [A-law]</i> <i>Cchus=1</i>	start the activation of levels 1, 2, 3. Outgoing call
Start of eventual ringer level measurements.	<i>DTMF figure "1" sent to CS8014</i>	outgoing call received. ALERTING received.
after the CONNECT criteria the acoustic measurements start.	<i>DTMF figure "2" sent to CS8014</i>	off-hook the handset. CONNECT received
end of the scheduled acoustic measurements	<i>all controls removed</i>	TE disconnected.

3.2.2. Tests on PABX

CS8014	Operations	ISDN-4
the line current increases to >1mA and detected by CS8014.		PABX connected to the line.
demand of the connection with PABX.	<i>Clua=0 [A-law]</i> <i>Cchus=1</i> <i>Ccal2=1</i>	wait for DTMF internal selection.
send DTMF figures to select the PABX output line	<i>Ccal2=0</i>	starts the activation of levels 1, 2, 3. Outgoing call on the selected output of PABX
Start of eventual ringer level measurements.	<i>DTMF figure "1" sent to CS8014</i>	outgoing call received. ALERTING received.
after the CONNECT criteria the acoustic measurements start.	<i>DTMF figure "2" sent to CS8014</i>	off-hook the handset. CONNECT received
end of the scheduled acoustic measurements	<i>all controls removed</i>	PABX disconnected.

3.3. Test in TE mode

The interface **ISDN-4** must be set in TE mode simulating digital Telephone Equipment. Switch the NT/TE control on TE and then connect the line cord on RJ45 connectors where a LED lights.

3.3.1. Outgoing call -TE calls PABX

CS8014	Operations	ISDN-4
detected by CS8014.		presence of almost 34V on the S-bus
request of connection to the PABX channel	<i>Clua=0 [A-law]</i> <i>Cchus=1</i>	activated levels 1,2,3. Wait state for SETUP-ACK.
sends DTMF dialling toward the PABX.	<i>CL3OK=1</i>	outgoing call allowed. Channel assigned.
CS8014 can activate ring level measure on the remote TE	<i>CL3OK=0</i>	remote called TE is ringing. ALERT phase
after the CONNECT criteria the acoustic measurements start.	<i>COFFH=1</i>	Remote TE become in off-hook. CONNECT phase
end of the scheduled acoustic measurements	<i>Cchen=0</i>	starts the disconnection from remote TE. DISCONNECT phase.
end of tests.	<i>Coffh=0</i>	The PABX confirm the remote TE disconnection. RELEASE phase.

⁵ Digital Test Sequence

3.3.2. Incoming call – TE called from PABX

CS8014	Operations	ISDN-4
detected by CS8014.	←	presence of almost 34V on the S-bus
CS8014 alerted	← $CL3OK=1$	PABX call the local TE. Activated levels 1,2,3. ALERT state
CS8014 defines the law and simulates the off-hook condition.	$Ctua=0$ [A-law] → $Cchus=1$	activates the response from the PABX. CONNECT phase.
the acoustic measurements start.	← $CL3OK=0$ [B2] or ← $CL3OK=1$ [B1]	PABX confirm the connection.
end of the scheduled acoustic measurements	→ $Cchen=0$	starts the disconnection from remote TE. DISCONNECT phase.
end of tests.	← $Coffh=0$ ← $CL3OK=0$	The PABX confirm the disconnection. RELEASE phase.

3.4. Base Access

With **ISDN-4** in **NT** mode, there are two categories of **ISDN S0** access:

- Point to Point
- Point to Multipoint

The first one is normally used to connect an **ISDN PABX** to a base access. In this case don't occurs any negotiation between the **NT** interface and the **PABX** to establish the connection. The point-to-point access let possible the crossing selection to address directly one internal telephone.

The private users normally use the second one. It allows the connection to the **S0** bus of more kind of terminals: that is Modems **ISDN**, telephones, FAX, etc...

The service supplier can schedules up to 8 telephone numbers.

3.4.1. Point to Point Setup

The setup of **ISDN-4** interface consists in launching the following procedure, one time only after the power-on.

CS8014	Operations	ISDN-4
CS8014 sends change commands	→ $Cal1=1$ for almost $100mS$	is waiting for the setup of the level 2.
CS8014 sends NT mode command	→ $Cal2=1$ for almost $200mS$	records the point to point mode
CS8014 sends end-of-configuration	→ $Cal1=0$ and after $100mS$ $Cal2=0$	locks the NT mode.

After the **ISDN-4** Interface remain in the last setup mode.

3.4.2. Point to Multipoint Setup

It is the default **NT** mode of the **ISDN-4** interface. After power-on the interface is normally in Point to Multipoint **NT** mode.

If you, in precedence, have set the interface for Point-to-Point mode, you must run the procedure similar to the above at the §3.4.1, where at the second step, you have changed the $Cal2$ value to 0.

CS8014	Operations	ISDN-4
CS8014 sends change commands	→ $Cal1=1$ for almost $100mS$	is waiting for the setup of the level 2.
CS8014 sends NT mode command	→ $Cal2=0$ for almost $200mS$	records the point to multipoint mode
CS8014 sends end-of-configuration	→ $Cal1=0$ and after $100mS$ $Cal2=0$	locks the NT mode.