SIEMENS

ICs for Communications

Enhanced ISDN Data Access Controller
ISAR

PSB 7110

Version 1.0
Software Version #4

Data Sheet 07.96 **T7110-XV10-D3-7600**

PSB 7110 Revision History:	Fehler! Textmarke nicht definiert.
Previous Releases:	
Page	Subjects (changes since last revision)

Published by Siemens AG, Bereich Halbleiter, Product Definition, Balanstraße 73, D-81541 München
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General Information

The ISAR PSB 7110, ISDN Data Access Controller forms an advanced solution for ISDN applications communicating with remote ISDN as well as analog terminals. The ISAR is designed for applications on PC- or workstation platforms, but can also be used in ISDN/analog combining terminals.

It integrates two data formatting units which support binary framing, HDLC and ASYNC, which is an asynchronous data formatting according to ITU-T V.14. The data from the formatting units is than input data to a fax/modem modulation or V.110 or transparent framing towards the IOM-2 timeslots.

The PSB 7110 operates on the IOM-2 interface in terminal mode (1.536 MHz DCL). It is also designed to operate on line-card IOM-2 interfaces (4 MHz DCL).

The ISDN Data Access Controller uses external RAM to implement a 61 byte FIFO structure between the host and the data formatting unit. The DSP program is also executed from external memory.

The PSB 7110 ISDN Data Access Controller is a 0.5 micron CMOS device offered in a thin quad-flat pack package. It operates from a single 3.6V supply with the option to drive the interface lines by a 5V supply.

As ISAR Version 1.0 ensures firmware safety through its program download mechanism, a ROM version will be following that will only require external SRAM of reduced size. This device will be ISAR Version 1.1.

Important Note: **Software Version #4**

The ISAR V1.0 requires download software which is provided separately with the device.
This specification describes the functionality of the device with the software download version number 4.

See chapter 3.9.4 Software Version Response: SVN (Software Version Number) = 04h

1 Features

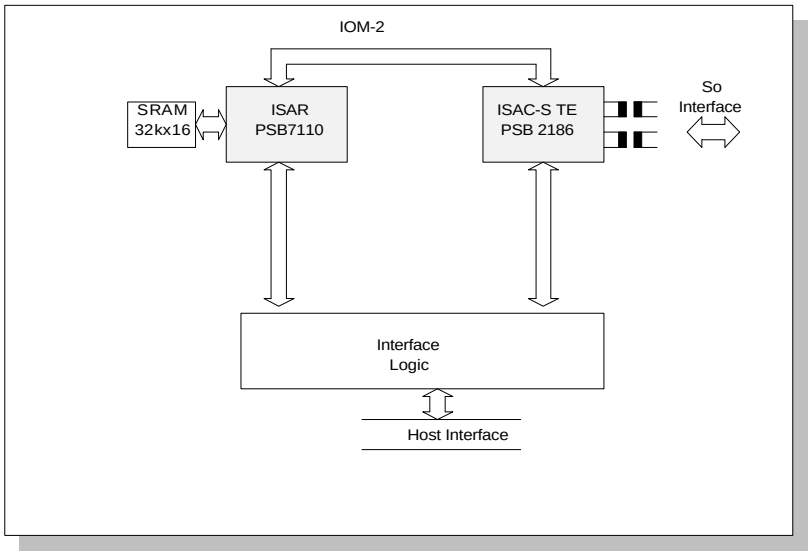
* Two universal formatter supporting ASYNC (ITU-T V.14), HDLC and binary framing of data for B-channel applications
* Bit rate adaptation according to V.110 for both B-channels (except during datamodem modulation)
* IOM-2 terminal mode (1.536 MHz), line card mode (4 MHz)
* Fax/Modemmodulation up to 14400 bps (V.32 bis, V.17) including fallback modes
* DTMF generation / detection
* 61 byte FIFO per direction for host interface communication
* External memory interface to connect external SRAM with a size of 32K x 16 for program and data
* Mailbox interface for host communication
* 3.6V power supply with separate 5V supply for interface pins
* Thin QFP-package
* Advanced CMOS technology

Type	Ordering Code	Package
PSB 7110F V1.0	Q67101-H6748	P-TQFP-100-1

1.1 System Integration

1.1.1 ISDN PC / Workstation Adapter with So interfaces

The ISDN PC or Workstation Adapter is based on the ISAR. A PSB 2186, ISAC-S TE forms the So-transceiver and provides the HDLC controller to perform the D-Channel signalling protocol. External circuitry is required for the So interfaces which includes the transformer and protection circuitry. The host interface of the ISAR is connected to the host bus.



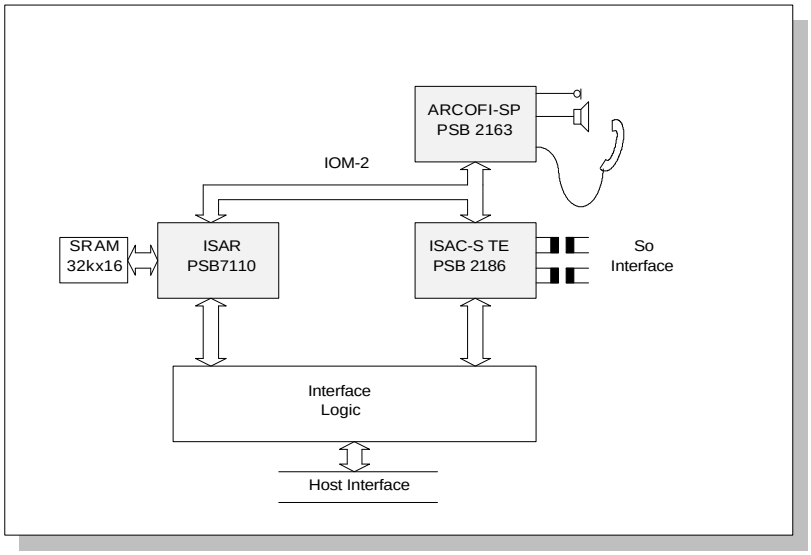
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Figure 1 ISDN PC / Workstation Adapter

The ISAR supports HDLC based applications like file transfer, access to packet switches (X.75, V.120, PPP). It also supports communication to terminal adapters which perform bit rate adaptation according to V.110.
A special feature of the ISAR is its support for analog fax/modem applications. Therefore, PCM data is converted to linear data and handled by a V.32bis / V.17 data pump to support data rates up to 14400 bps.

1.1.2 ISDN Voice/Data Terminal

Figure 2 shows a voice data terminal developed on a PC card, where the ISAR provides its fax and modem functionality within a three chip solution. During ISDN calls the ARCOFI-SP PSB 2163 provides for speakerphone functions and includes a DTMF generator.

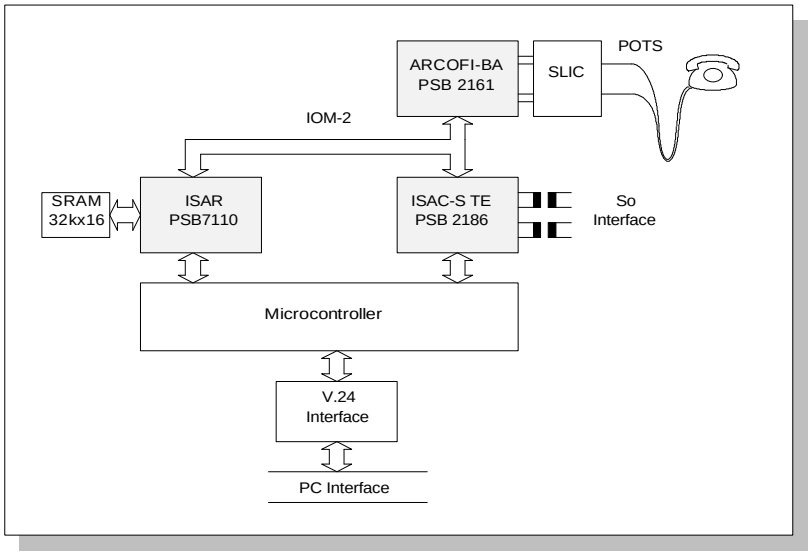


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Figure 2 ISDN Voice/Data Terminal

1.1.3 ISDN Standalone Terminal with POTS Interface

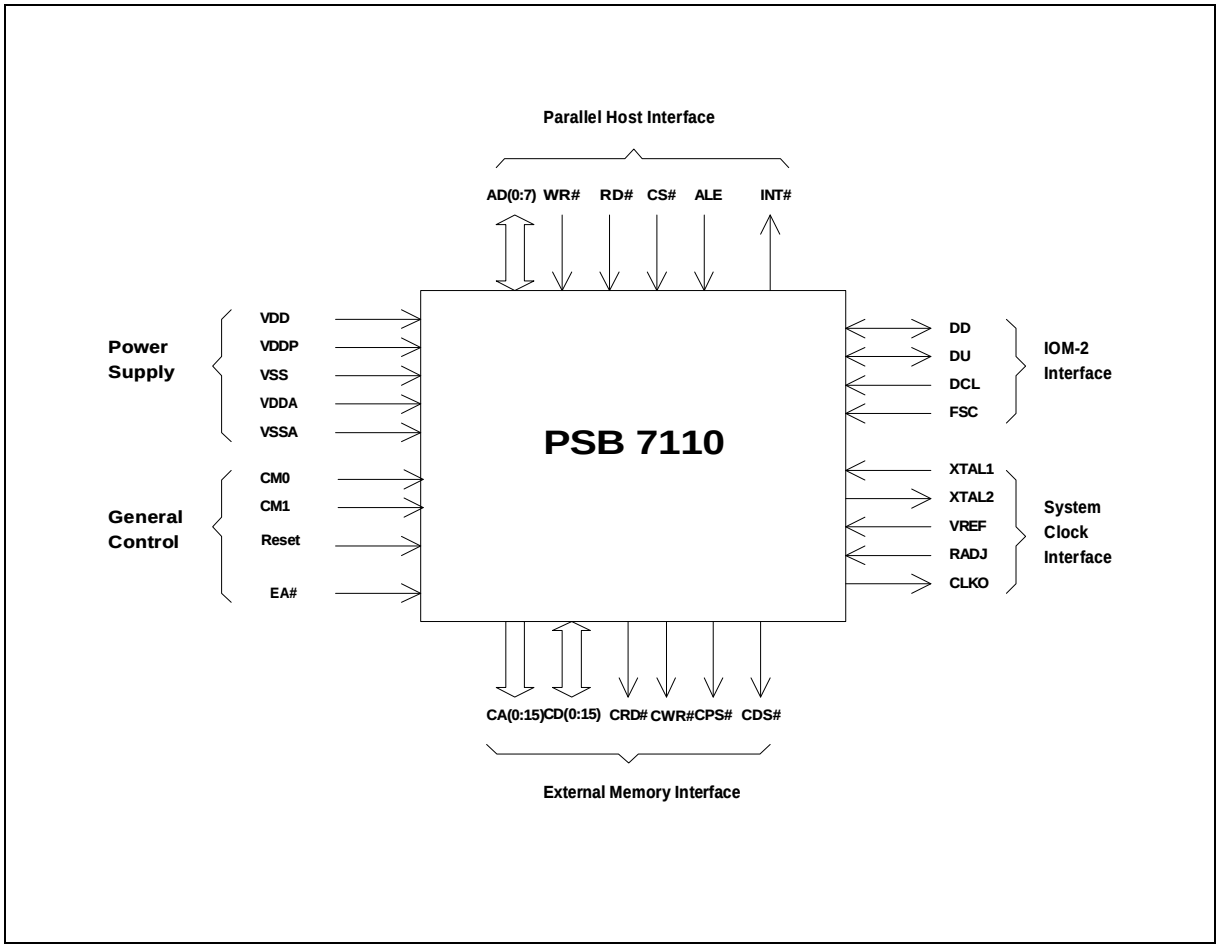
Figure 3 shows a standalone terminal that may be connected to the communications interface of a PC providing ISAR's fax and modem functionality within a microcontroller based solution. The ARCOFI-BA PSB 2161 enables connection of analog terminals, e.g. telephones, to the POTS interface.



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Figure 3 ISDN Standalone Terminal with POTS Interface

1.2 Logic Symbol

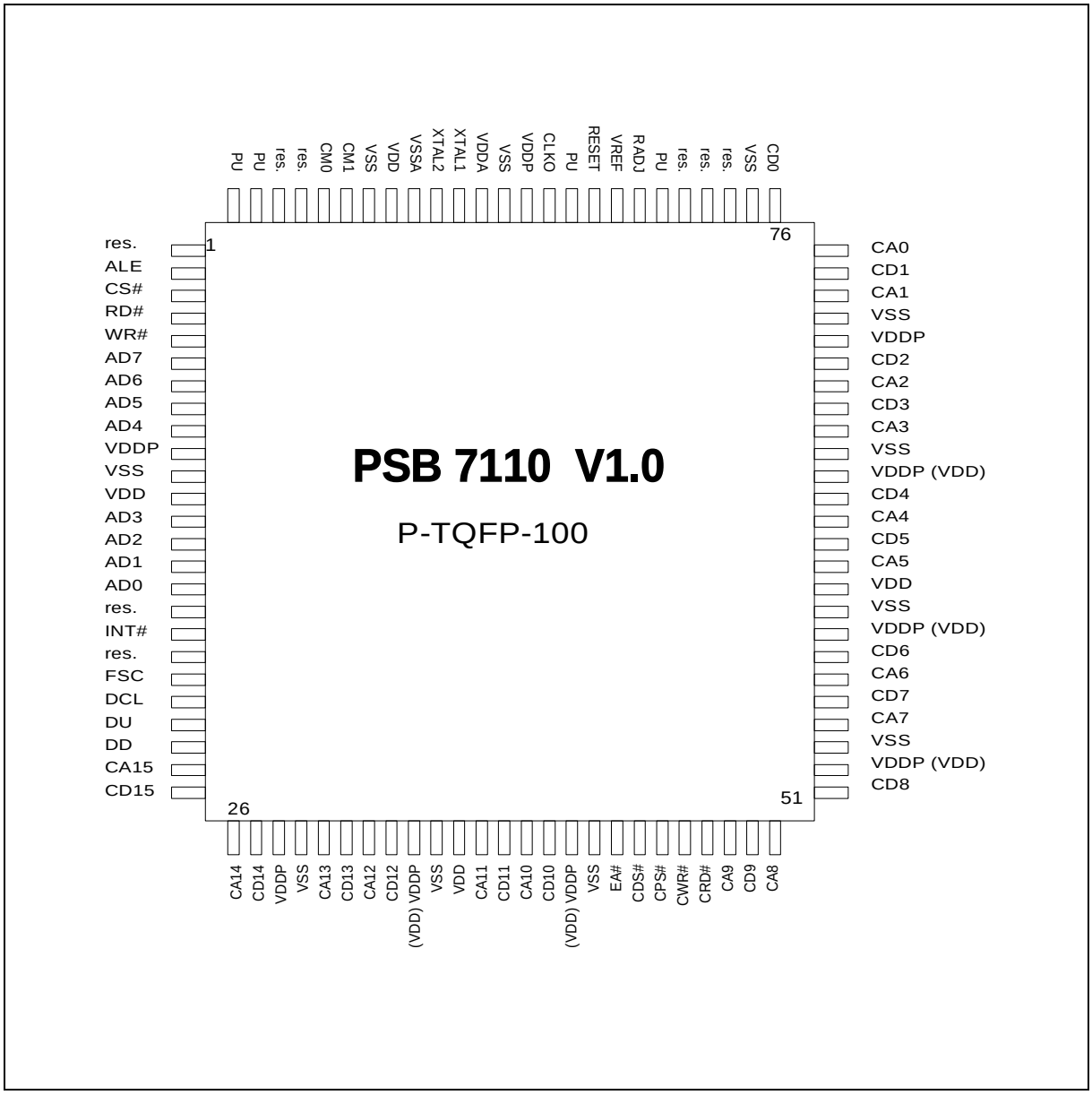


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Figure 5 Logic symbol

1.3 Pin Configuration

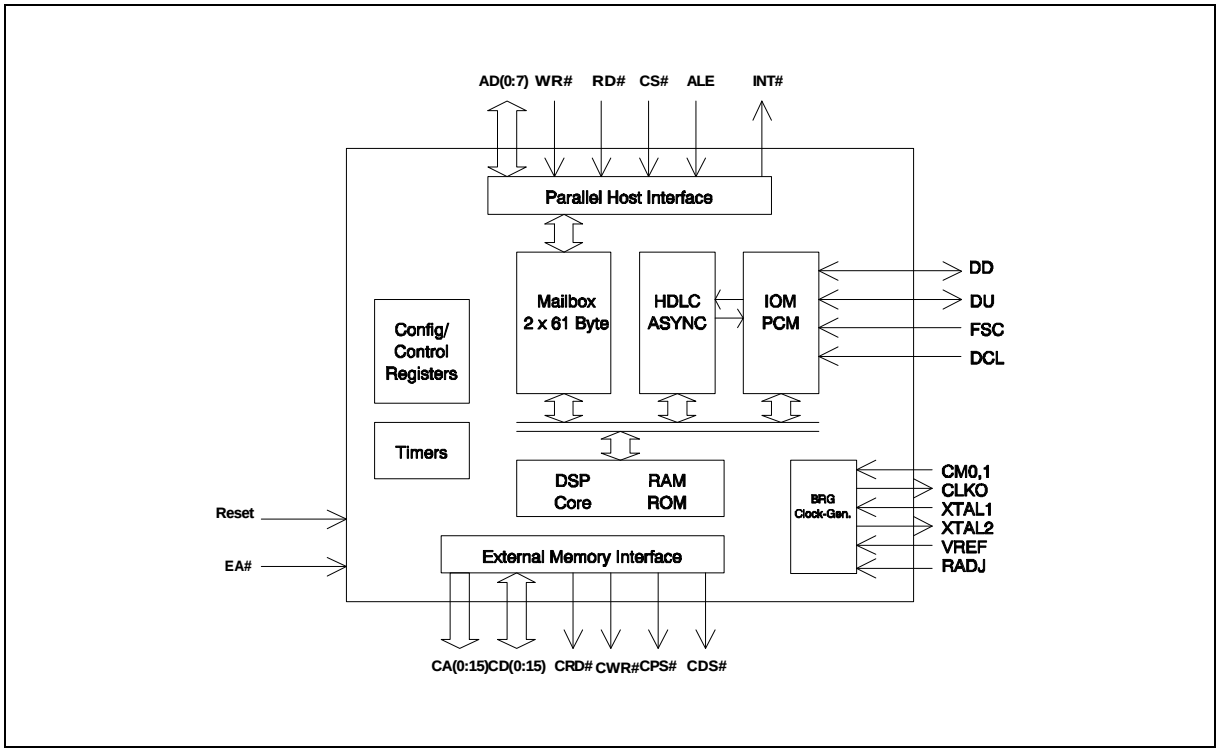
As for the ROM version ISAR V1.1 some of the 5 V pins are changed to 3.6 V, the system layout should be designed in a way, that a change from V1.0 to V1.1 only requires a different jumper setting. So pins 34, 41, 52, 58 and 65 can be set either to VDDP (V1.0) or VDD (V1.1).



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Figure 6 Pinout

1.4 Device Architecture



(7110_15)

Figure 7 Device Architecture

1.5 Pin Description

Parallel Host Interface

Pin No.	Symbol	In (I) Out (O)	Function
16 15 14 13 9 8 7 6	AD0 AD1 AD2 AD3 AD4 AD5 AD6 AD7	I/O I/O I/O I/O I/O I/O I/O I/O	**Address/Data Bus** Transfers addresses and data between the host and the ISAR PSB 7110.
4	RD#	I	**Read** This signal indicates a read operation.
5	WR#	I	**Write** This signal indicates a write operation.
3	CS#	I	**Chip Select**
2	ALE	I	**Address Latch Enable** A "high" on this line indicates an address on AD(0:7), that will be latched by the ISAR. This allows the ISAR to be directly connected to a host with multiplexed address/data bus.
18	INT#	O (OD)	**Interrupt Request** This signal is activated, when the ISAR requests an interrupt. This pin is an open drain output only.

IOM-2 Interface

Pin No.	Symbol	In (I) Out (O)	Function
23	DD	I/O	**Data Downstream** on IOM-2/PCM interface.
22	DU	I/O	**Data Upstream** on IOM-2/PCM interface.
21	DCL	I	**Data Clock** Clock frequency is twice the data rate, or equal to the data rate.
20	FSC	I	**Frame Sync** Marks the beginning of a physical IOM-2 or PCM frame.

System Clocks

Pin No.	Symbol	In (I) Out (O)	Function
90	XTAL1	I	**Crystal In or Clock In** If a crystal is used, it is connected between XTAL1 and XTAL2. If a clock signal is provided (via an external oscillator), this signal is input via XTAL1. In this case the XTAL2 output is to be left non-connected.
91	XTAL2	O	**Crystal Out** Left unconnected if a crystal is not used.
83	VREF	I	not used, connect to VSSA or VDDA.
82	RADJ	I	not used, connect to VSSA, VDDA or leave open.

86	CLKO	O	**Clock Out** Output clock of frequency equal to an internal reference frequency divided by a programmable factor. This function is currently not supported.

External Memory Interface

Pin No.	Symbol	In (I) Out (O)	Function
75 73 69 67 63 61 56 54 50 48 39 37 32 30 26 24	CA0 CA1 CA2 CA3 CA4 CA5 CA6 CA7 CA8 CA9 CA10 CA11 CA12 CA13 CA14 CA15	O O O O O O O O O O O O O O O O	**C-Bus Address** Used for addressing ROM or RAM external to the chip. For the recommended external memory configuration two 32Kx8 SRAMs are connected to CA0 to CA14.
76 74 70 68 64 62 57 55 51 49 40 38 33 31 27 25	CD0 CD1 CD2 CD3 CD4 CD5 CD6 CD7 CD8 CD9 CD10 CD11 CD12 CD13 CD14 CD15	I/O I/O I/O I/O I/O I/O I/O I/O I/O I/O I/O I/O I/O I/O I/O I/O	**C-Bus Data** Data bus for external ROM or RAM. For the recommended external memory configuration one 32Kx8 SRAM is connected to CD0 to CD7 and the second SRAM is connected to CD8 to CD15.
43	EA#	I	**External program Access enable** Must be connected to VDD for regular operation.
47	CRD#	O	**C-Bus Read to external memories** This signal must be connected to the RD# input of the external SRAM.
46	CWR#	O	**C-Bus Write to external memories** This signal must be connected to the WR# input of the external SRAM.
45	CPS#	O	**C-Bus Select line for external program memory** This signal must be connected to the CS# input of the external SRAMs.
44	CDS#	O	**C-Bus Select line for external program memory** This signal is not used in ISAR V1.0 and must be left n.c.

General Control

Pin No.	Symbol	In (I) Out (O)	Function
96 95	CM0 CM1	I I	**Clock Mode** Connecting these pins either to VSS or VDD will select one of four different options for the generation of the output clock at pin CLKO
84	RESET	I	**Reset input**

Power Supply

Pin No.	Symbol	In (I) Out (O)	Function
11 29 35 42 53 59 66 72 77 88 94	VSS VSS VSS VSS VSS VSS VSS VSS VSS VSS VSS	I I I I I I I I I I I	**Ground** (common to VDD and VDDP)
12 36 60 93	VDD VDD VDD VDD	I I I I	**Positive power supply voltage** (3.4-3.8 V)
10 28 34 41 52 58 65 71 87	VDDP VDDP VDDP VDDP VDDP VDDP VDDP VDDP VDDP	I I I I I I I I I	**Positive power supply voltage** (4.5 - 5.5 V) for external interfaces. In ISAR V1.1 the following VDDP pins are changed to VDD (3.6 V): Pin no. 34, 41, 52, 58, 65
92	VSSA	I	**Separate Ground** (0V) for Clock Generation Unit.
89	VDDA	I	**Separate positive power supply voltage** (3.4 - 3.8 V) for Clock Generation Unit.

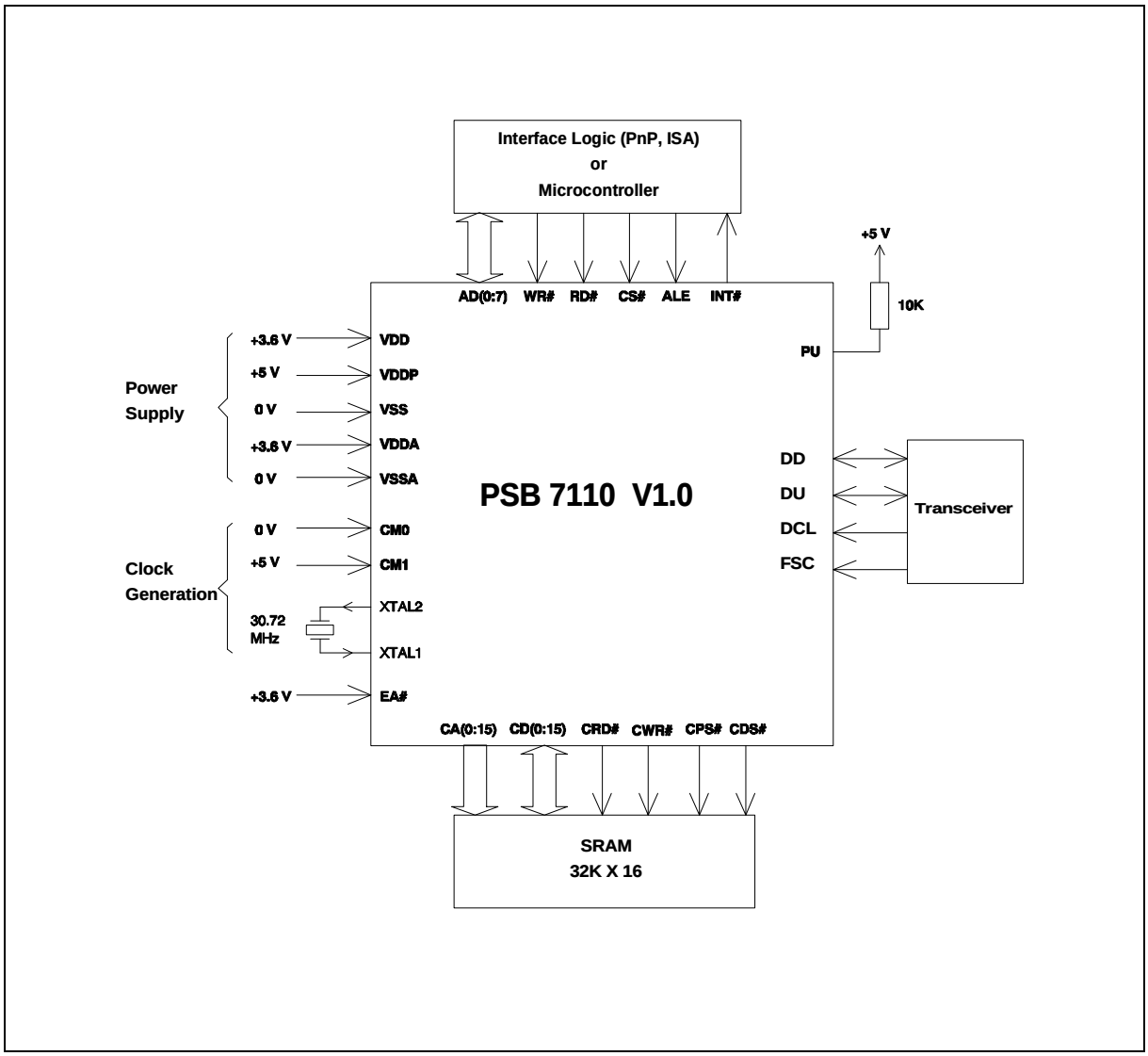
Reserved Pins

Pin No.	Symbol	In (I) Out (O)	Function
1	res.		reserved, not to be connected
17	res.		reserved, not to be connected
19	res.		reserved, not to be connected
78	res.		reserved, not to be connected
79	res.		reserved, not to be connected
80	res.		reserved, not to be connected
81	PU		**Pull up** must be connected to VDDP accross a 10k pull up resistor.
85	PU		**Pull up** must be connected to VDDP accross a 10k pull up resistor.
97	res.		reserved, not to be connected
98	res.		reserved, not to be connected
99	PU		**Pull up** must be connected to VDDP accross a 10k pull up resistor.
100	PU		**Pull up** must be connected to VDDP accross a 10k pull up resistor.

1.6 Clock Generation

The chip internal clocks are derived from a crystal connected across XTAL1 and XTAL2 or from an external clock input via pin XTAL1.

In the ISAR V1.0 no PLL is available. Therefore, for the internal DSP clock an external crystal of 30.72 MHz is required and the clock mode pins have to be connected as shown in the figure below, i.e. CM1 = 1 , CM0 = 0 .



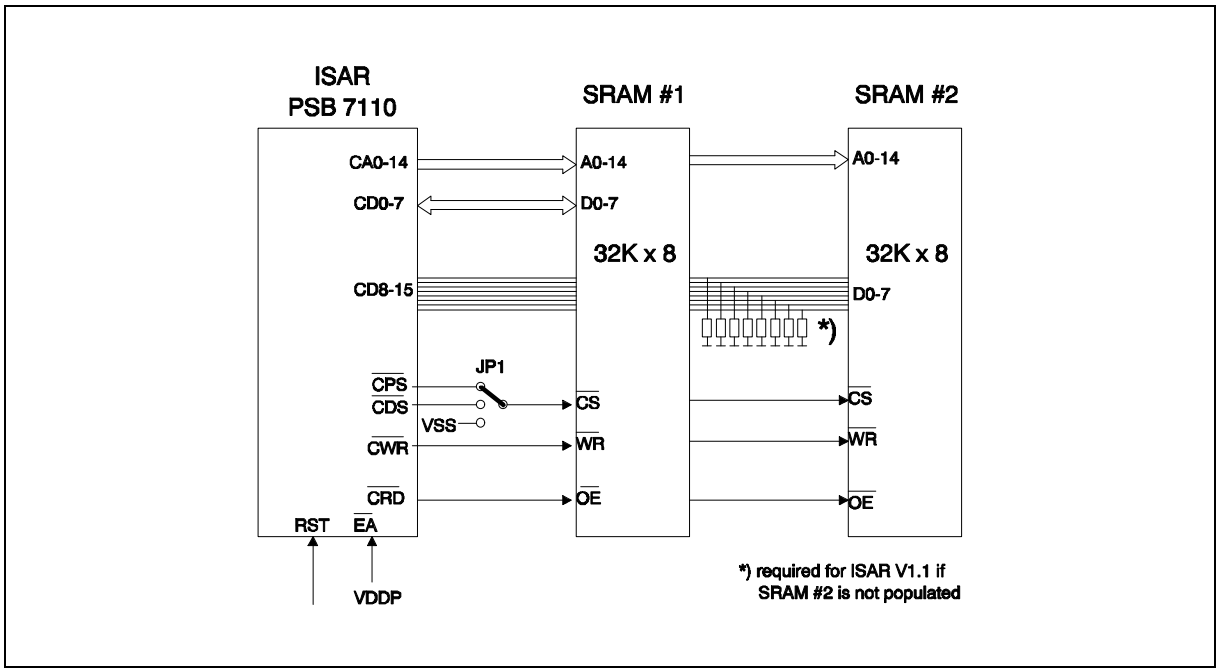
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Figure 8 Clock generation

1.7 Memory Configuration

The ISAR requires external memory with a configuration of 32K x 16 and with 10 ns access time to store operational data and the DSP program which is downloaded after a hardware reset.

The figure below shows the recommended configuration with two 32K x 8 SRAMs. Since there is a common layout, no additional changes are required when converting to the ISAR ROM version V1.1.



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Figure 9 ISAR Memory Interface

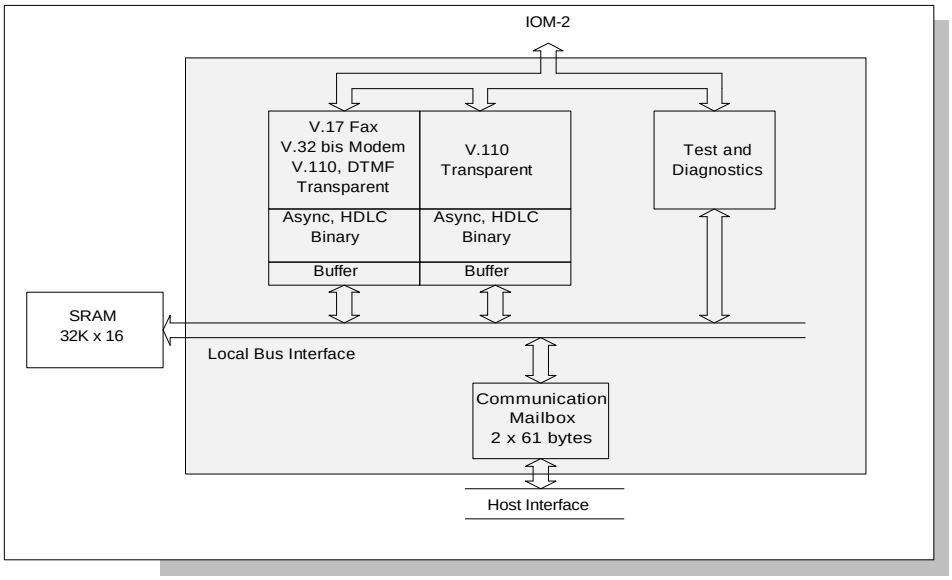
For both ISAR Versions 1.0 and 1.1 the jumper JP1 has to be set to connect CPS# to the CS#-inputs of the SRAMs.
To enable compatibility with future versions of the ISAR, the layout should be designed to enable the different ways to connect the CS#-lines of the SRAMs.

2 Functional Description

2.1 General Functions

Figure 10 depicts the detailed architecture of the PSB 7110 ISDN Data Access Controller:

* One Fax/Modem engine for V.32 bis, V.17 (14400 bps), including fallback modes
* DTMF receiver / transmitter
* Two V.110 formatter (except during datamodem modulation)
* Two universal formatters supporting ASYNC (ITU-T V.14), HDLC and binary modes
* External SRAM interface for program and data memory
* Communications Mailbox with 61 bytes per direction
* IOM-2 interface for terminal or line-card application



(7110_21)

Figure 10 Functional Blockdiagram of the ISDN Data Access Controller

2.1.1 Clock Generation

The clock generator provides the internal master clock for the fax/modem engine derived from an input clock or crystal at pins XTAL(1:2).
Other blocks derive their clock signal directly from the IOM-2 interface.

2.1.2 Interfaces

The PSB 7110 provides two physical interfaces: The IOM-2 interface and the host interface.

2.1.2.1 IOM-2 Interface

The IOM-2 interface is a 4-wire interface with two open drain data lines (DU and DD), a data clock input (DCL) and a frame sync signal input (FSC), of which the rising edge indicates the start of an IOM-2 frame (8 kHz). For IOM-2 applications the data clock is typically set to twice the data rate.
The PSB 7110 supports the IOM-2 terminal and line-card mode.

IOM-2 Driver

The output driver of the DD and DU pins is open drain. The output drivers are active for the selected time-slot bits and remain tri-state during the rest of the frame.
The control lines FSC and DCL are input.

IOM-2 Timeslots used by the PSB 7110

The ISAR separates IOM-2 terminal mode from IOM-2 line card mode. In terminal mode, the three channel IOM-2 structure is used. In line-card mode, eight IOM channels can be programmed with flexible time-slot assignment of the B-channel data.

The PSB 7110 is able to make extensive use of the IOM-2 channels as it is able to access all user data timeslots by programming the timeslot number and bit shift.
For detailed information refer to the "IOM-2 Interface Reference Guide".

2.1.2.2 Host Inter face

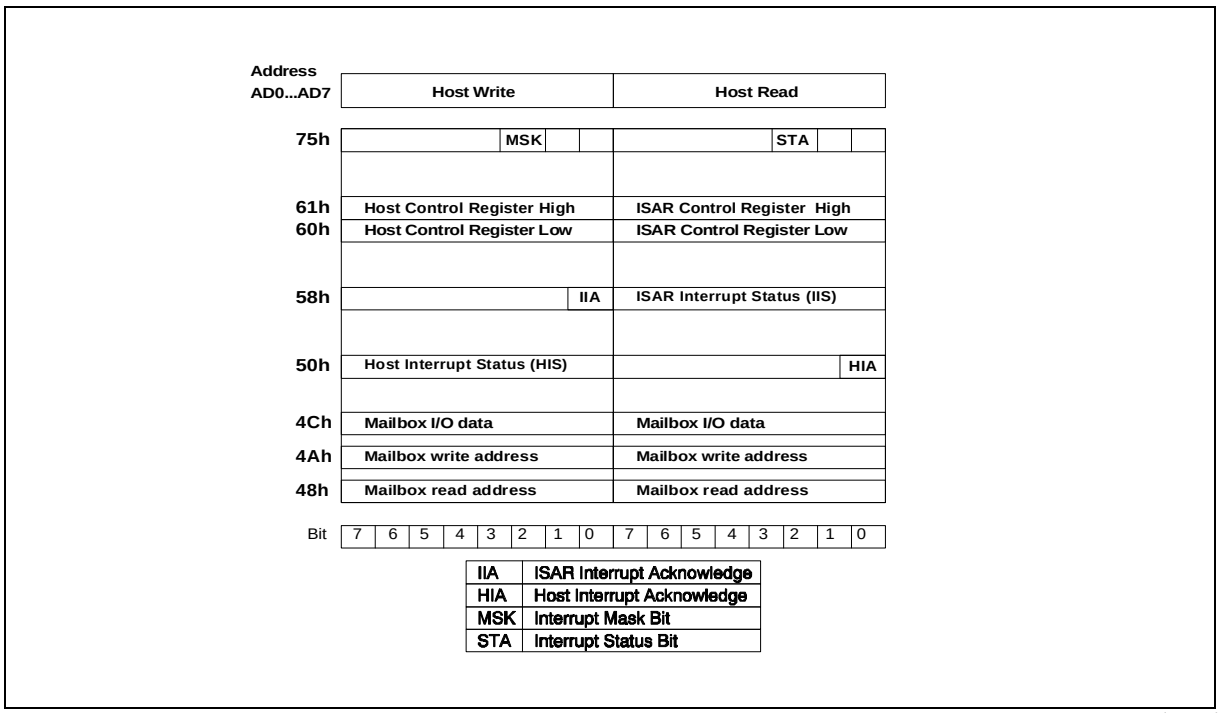
The PSB 7110 provides a host interface which consists of an 8-bit multiplexed address/data bus. Data transfer is controlled by a chip select signal and read or write control signals.
An interrupt line may be activated to indicate to the host that service is required.

Symbol	In (I) Out (O)	Function
AD(0:7)	I/O	Address/Data Bus. Transfers addresses and data between the host and the ISAR PSB 7110.
RD#	I	Read. This signal indicates a read operation.
WR#	I	Write. This signal indicates a write operation.
CS#	I	Chip Select.
ALE	I	Address Latch Enable. A "high" on this line indicates an address on AD(0:7).
INT#	O (OD)	Interrupt Request Interrupt output line for all mailbox interrupt status.

Data transfer between the host and the PSB 7110 is performed by use of a 61 byte mailbox per direction.

2.1.2.3 Communications Interface

The ISAR provides a communication interface in terms of a 61 byte mailbox per direction, a 16 bit control word and an 8 bit interrupt register.
Besides that, there is an interrupt mask/status bit (bit 2 of register 75h) and two interrupt acknowledge bits (LSB of address location 50h and 58h respectively).
The address map is shown in figure 11 . All other address locations are reserved for further use.



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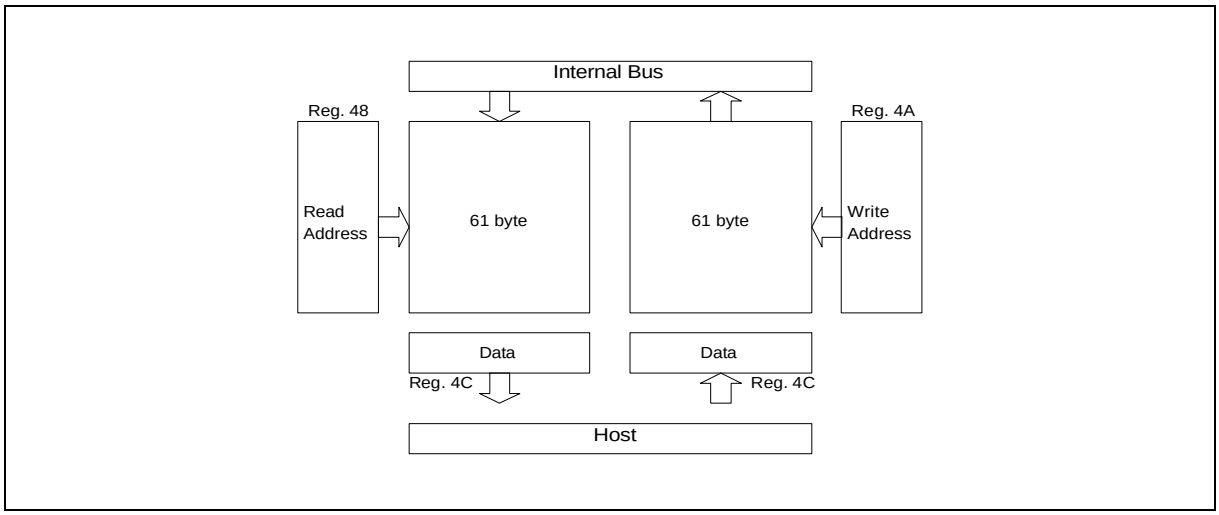
Figure 11 Host Interface Registers

Interrupt Mask / Status Bit (75h Write/Read)

All interrupt sources can be masked by setting the MSK-bit to "0", so that no interrupt is indicated to the host. In such a case the status STA-bit can be polled to check whether an interrupt occurred. After reset the interrupt is masked, however, the mask bit affects only the generation of the interrupt, but not the interrupt status bit from being set.
When setting the MSK-bit, all other bits in reg. 75h are not don't care, but must be set to "0". After reset all interrupts are masked (MSK = 0).

Mailbox

The mailbox is implemented as physically two separate 61-byte memory blocks. As for the ISAR V1.1 (ROM version) the mailbox size will be increased, the host can request information about the mailbox size from the ISAR and so allow for software compatibility with future versions.
The mailbox is seen from the host as an I/O device. Thus, to read/write a byte from/to the Mailbox, the host accesses a single location (Mailbox I/O data), which is the same address but physically separate location for read and for write direction.
The address is given by an address register directly programmable by the host (Mailbox read/write address). This address is autoincremented every time an access by the host to Mailbox I/O data is performed. Thus, for sequential, fast access, the host only needs to set the start address for the first message byte and all subsequent data bytes can be read/written without reprogramming its address.
For random access to the Mailbox the Host has to reprogram the address register(s).

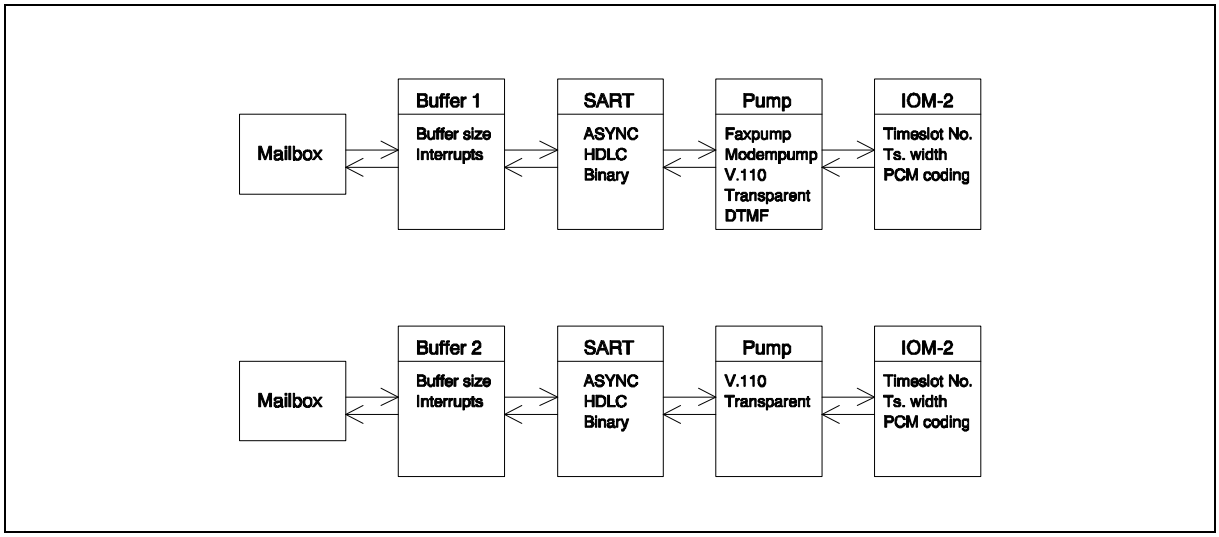


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Figure 12 Mailbox Interface

Communication Buffers

The ISAR host interface provides for merging/splitting of two data paths and a test/diagnostics path. Each path is buffered both in read- and write-direction.
The mailbox is used to access these three buffers. Two of them are related to the two ISDN B-channels and one channel is mainly used for test purposes.



(7110_24)

Figure 13 Communication Buffers

Buffer 1 is used to access the fax/modem engine, a V.110 formatter, a DTMF generator/detector or for transparent access to the IOM timeslots.

Buffer 2 is used to access a V.110 formatter or it provides transparent access to the IOM timeslots.

Buffer 1 and 2 use a SART (Synchronous Asynchronous Receiver Transmitter) which supports ASYNC, HDLC and binary mode. In ASYNC mode, the characters are formatted according to the ITU-T V.14 standard by start, parity and stop bits. In HDLC mode, the HDLC bit level functions (Flag, CRC, Zero-bit handling) are performed.
Binary mode describes a synchronous, transparent mode without formatting.

Each buffer is controlled by a set of operations which relate to:

- Configuration data
- Status data
- User data transfer

Transmit direction

For consistent data transfer from the host to the ISAR, the following protocol should be used. Additionally the internal procedure at the ISAR is shown as well.

HOST	ISAR
* read HIA-bit, wait until HIA=0 (indicates that the host write mailbox registers are available) reset mailbox write address to 0 (only if data is written to the mailbox) * write to Host control word and to mailbox * write command to HIS-register, that causes setting of HIA-bit * polling for HIA=0 (see first entry)	* polling HIS-register periodically * read HIS-register, Host control word and mailbox * write HIA=0 (indicates that the ISAR has read all mailbox registers, i.e. the host may start a new data transfer)
HIS Host Interrupt Status HIA Host Interrupt Acknowledge	

In transmit direction, these operations are performed by the host by writing the corresponding interrupt status byte into the Host Interrupt Status register (HIS). Additional information may be written to the Host control word and to the mailbox if required.
The general format of the Host control word is for the high byte to contain control, configuration or status information (additionally to the host interrupt status byte) while the low byte is used to indicate the number of valid bytes in the mailbox.

Once the Interrupt Status byte as well as control word and mailbox have been written, the Host Interrupt Acknowledge bit (HIA) will be set automatically (when writing the Host Interrupt Status) to indicate the new contents to the ISAR.

After ISAR has completed the evaluation of the mailbox contents, the mailbox is released by the ISAR when resetting the Host Interrupt Acknowledge bit (HIA), so the host may enter new mailbox data.

Receive direction

For data transfer from the ISAR to the host, the following protocol at the host should be used. Additionally the internal procedure at the ISAR is shown as well.

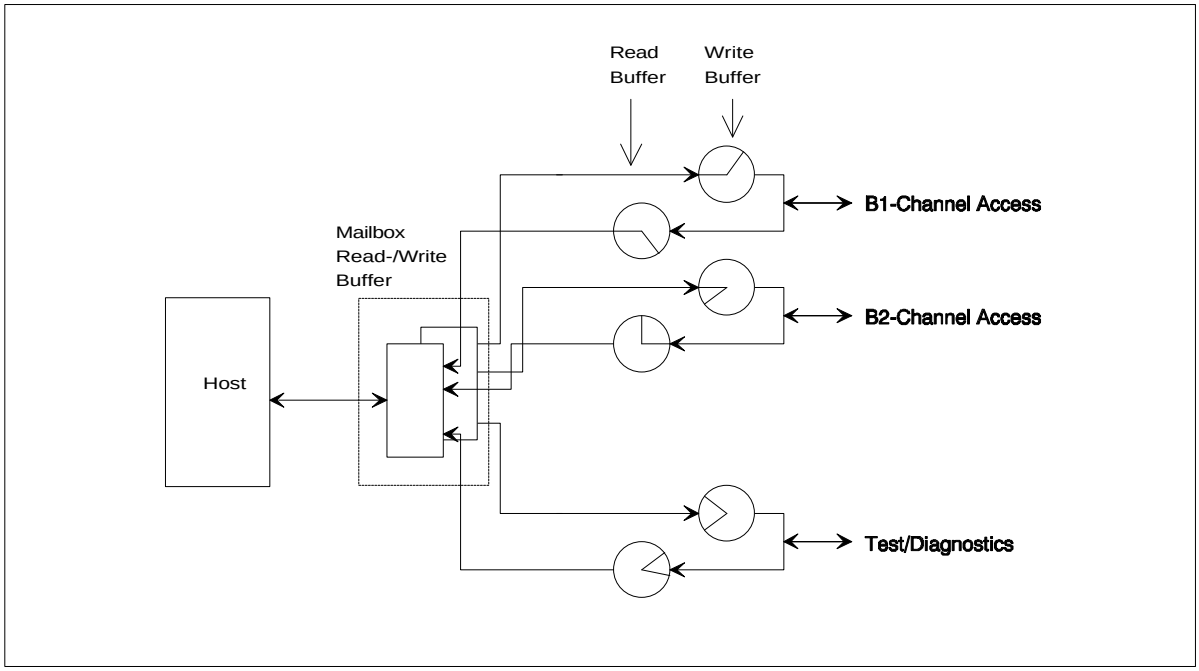
ISAR	HOST
* read IIA-bit, wait until IIA=0 (indicates that the host can receive another message) * write to ISAR control word and to mailbox * write command to IIS-register, that causes setting of IIA-bit and INT-line * polling for IIA=0 (see first entry)	* receives interrupt request from INT-line or poll STA bit periodically * read IIS-register, ISAR control word reset mailbox write address to 0 (only if data is read from the mailbox) read mailbox contents
	* write IIA=0 (indicates that the host has read all mailbox registers, i.e. the ISAR may start a new data transfer)
IIS ISAR Interrupt Status IIA ISAR Interrupt Acknowledge	

In receive direction, an interrupt is generated by the ISAR if enabled (MSK=1) or the host can poll the interrupt status in the STA bit if the interrupt is masked (MSK=0). The host reads the ISAR Interrupt Status register (IIS) and the ISAR control word as well as the mailbox if necessary. After data processing is completed, the mailbox is released by the host when resetting the Interrupt Acknowledge Bit (IIA).

The most significant byte of the ISAR control word is used to transfer additional control, configuration or status data. The least significant byte is used to indicate the number of valid bytes in the mailbox.

2.2 Buffer Config uration

The mailbox represents the common host interface for all data paths, which are the two B-Channel paths and the test diagnostics path. For each data path the read and write direction is buffered with a FIFO. The FIFO buffers reside in external memory.



(7110_26)

Figure 14 Buffer Configuration

Buffer control

After the host has written a message to the write buffer, the ISAR will issue a buffer available interrupt to the host if there is still enough free buffer space for another message of the programmed length (i.e. another message may be written to the mailbox). If the host enters messages into the mailbox which exceed the configured message length, the FIFO buffer may overflow and data might be lost.

If there is no free space available, the host must not write new data to the mailbox. In this case the ISAR will release a buffer overflow indication and data in the FIFO buffers will not be overwritten, i.e. new data get lost.

The buffers can be set a priority to determine the sequence of service if several read buffers request for mailbox service simultaneously.

2.3 SART Configuration

The SART (Synchronous Asynchronous Receiver Transmitter) can be configured for ASYNC character formatting, HDLC bit level formatting and binary mode. i.e. no bit level formatting.

2.3.1 ASYNC Mode

ASYNC denotes an asynchronous formatting of data according to ITU-T specification V.14.
In ASYNC mode, the SART adds start, parity and stop bits to each data byte. The following options are programmable:

Character Length:	5,6,7,8 Bit
No. of stop bits:	1,2
Parity:	No, odd, even, stick parity
Overspeed range:	12.5 or 25 % (stop bit deletion: 1 of 8, 1 of 4)

The ASYNC formatter performs overspeed handling according to V.14. Therefore a stop bit may be deleted according to the overspeed range.

The ASYNC formatter is able to generate a break signal and to detect a break signal of a minimum length of 2M+3 bits of start bit polarity.
A special option is included to generate V.42 detection timing.

In receive direction the character format is controlled and errors are reported via the mailbox. These errors may be framing error (missing stop bit) and parity error.

In receive direction, the character data is extracted, format check is performed and the character data is written to the buffer. If a framing or parity error has been detected or if a break signal has been received, a message can be read from the mailbox by the host even though the programmed message length may not yet be complete, i.e. the new message may be shorter than the programmed length.

For configuration setup the host has to distinguish two ASYNC modes which do not differ in functionality, but depend on the selected pump mode.

2.3.2 HDLC Mode

In HDLC mode, the SART generates/handles the HDLC frame formatting. This includes opening and closing flag, CRC generation/detection and zero-bit insertion.

Programmable features are:

CRC:	16 Bit
Inter frame timefill:	'1' or flags
Bit stream coding:	regular, inverse
Data underrun operation:	Abort generation / frame end (CRC+flag) generation

In transmit direction a frame is started after SART data is available in the transmit FIFO buffer. The frame is continued until a frame end mark has been set in a mailbox command. In this case, the HDLC frame is closed by the CRC value and a closing flag. In case a buffer underrun occurs, the current HDLC frame is closed either by an abort sequence or by CRC and closing flag (programmable).

In receive direction, HDLC frames exceeding the programmed message length are transferred to/from the buffer in data blocks of the configured message length. A message of reduced length may be transferred if a frame start, frame end or error condition is detected. In this case the control word contains the result of the CRC check, verification of integer number of bytes and check of frame end condition.

2.3.3 Binary Mode

In binary mode no character formatting is performed. Octets are transferred with the least significant bit or most significant bit transferred first.

Programmable Features are:
Idle character on data underrun
Bit swapping (LSB/MSB first)

In transmit direction, data from the transmit buffer is transmitted with the LSB or MSB first. In case of data underrun, i.e. if there's no more data in the transmit buffer, a programmable byte or the last data byte is continuously transmitted.

In receive direction, the data stream is received in octets. Their contents is transferred to the receive buffer .

2.4 Pump Configuration

Pump in general describes the additional formatting of the SART data which is then forwarded to the IOM-2 interface.

The pump options are:
- Fax modulations
- Datamodem modulations
- Halfduplex modulations
- V.110
- DTMF
- DTMF transmission
- Bypass (transparent data)

All pump modes except V.110 and bypass are only available in channel 1. Both modes, V.110 and bypass, are available in channel 1 and 2.

It must be noted that V.110 operation is not possible in channel 2, if channel 1 is operating with datamodem modulations (fullduplex modulations).
However V.110 can be operated in one channel, if the other channel is configured to any other mode except datamodem modulations, which is fax modulations, V.110, DTMF, DTMF transmission, bypass or halfduplex modulations (without option of fullduplex modulations).
The host must ensure that the pump is not configured to datamodem modulations and V.110 simultaneously, which would cause malfunctions for both channels.

In DTMF mode the pump is transfering data between the SART unit and the IOM-2 interface transparently (like bypass mode) while a DTMF receiver is active to detect DTMF signals.

For transmission of DTMF tones the pump must be reconfigured to "DTMF transmission".

2.4.1 Fax Modulations

The mode fax modulations allows modulation up to V.17 (14400 bps).

Programmable parameters are:
- Enabling/disabling of answer/calling tone
- Transmitter output attenuation
- Modulation scheme (V.17, V.29, V.27ter, V.21 channel 2) set by control commands

2.4.2 Datamodem Modulations

The mode datamodem modulations allows modulation up to V.32 bis (14400 bps).

Programmable parameters are:
- Enabling/disabling of answer/calling tone
- Transmitter output attenuation
- Automode (EIA/TIA PN-2330) or dedicated mode
- Automode options:
  - Fallback options
  - Guard tone options
  - Mode permission
- Dedicated Mode options:
  - Fallback options
  - Guard tone options
  - Modulation mode (V.32bis, V.32, V.23, Bell 202, Bell 212, V.22 bis, V.22, Bell 103, V.21 ch2, V.21)

2.4.3 Halfduplex Modulations

The halfduplex modulations allow modulation up to V.17 (14400 bps).

Programmable parameters are:
- Enabling/disabling of receive/transmit direction
- Enabling/disabling of echo protector tone
- Transmitter output attenuation
- Modulation scheme (V.17, V.29, V.27ter, V.21)

2.4.4 V.110

The V.110 mode allows the framing of SART data according to the V.110 protocol.

The programmable features are:
- Frame format/data rate
- E-, X-, S-bit control
- Transmitter flow control (X-bits)
- Remote DTE status detection
- Delay of synchronisation

In transmit direction, the V.110 frame is combined with SART data and the state of E-, X- and S-bits. Transmission of the last data byte in the mailbox is indicated to the host (buffer empty condition), which may set control bits.
Flow control by means of the X-bits is supported, which means that data transfer to the SART unit is stopped if indicated by the remote side.

In receive direction, frame synchronization is monitored while the number of frames for synchronisation (normally 1) is programmable. The D-bits are forwarded to the SART and E-, X- and S- bits are forwarded to the host as status events any time they change their state.
Status conditions of the remote DTE can be detected and indicated to the host.

2.4.5 DTMF

DTMF mode allows transparent data transfer between SART unit and data pump while a DTMF detector is active, which indicates received DTMF tones to the host.

A programmable feature is the signal rejection level below which a DTMF tone will not be detected by the pump.

2.4.6 DTMF Transmission

In transmit direction, a DTMF tone can be programmed which is output on the timeslot.

In this mode no data is transfered between SART unit and IOM-2 interface. However, during normal operation (DTMF mode) the pump only needs to be configured to DTMF transmission for the duration of the transmitted DTMF digit, right after that the pump can be reconfigured to normal operation mode.

The transmitter output attenuation is programmable.

2.4.7 Bypass Mode

The bypass mode allows the transfer of SART data without additional treatment.

In transmit direction, the data from the SART it transfered to the IOM timeslot. Octet data (binary mode) can be octet aligned to the IOM-2 timeslot if programmed (8-bit timeslot length).
In receive direction, the data from the IOM-2 timeslot is directly transfered to the SART.

2.5 IOM-2 Configuration

The IOM-2 configurations are separate for each datapath. Via datapath 1 and 2, any timeslot for the output of pump data can be selected.

The following programmable functions are available for each datapath :

- Start of timeslot
- Length of timeslot (8 or 16 bit)
- Switching of DU/DD lines
- Coding (A-law, µ-law or 16-bit linear)

It must be noted that the programmed timeslots for both datapaths must not overlap.

3 Operational Description

3.1 General Information

3.1.1 Configuration After Reset

The proceeding after hardware reset is shown in figure 15.
The DSP program must be downloaded to the external memory of the ISAR V1.0. As further ISAR versions will not require the program download, the ISAR version should be checked first before the download mechanism is started.
After download is finished, an automatic selftest is started for memory errors and to check if the clocks from the IOM-2 interface are present. The result of this selftest should be requested by the host.
Before configuration for data transmission/reception is done, the version number of the DSP software should be verified to check which functionality is available.

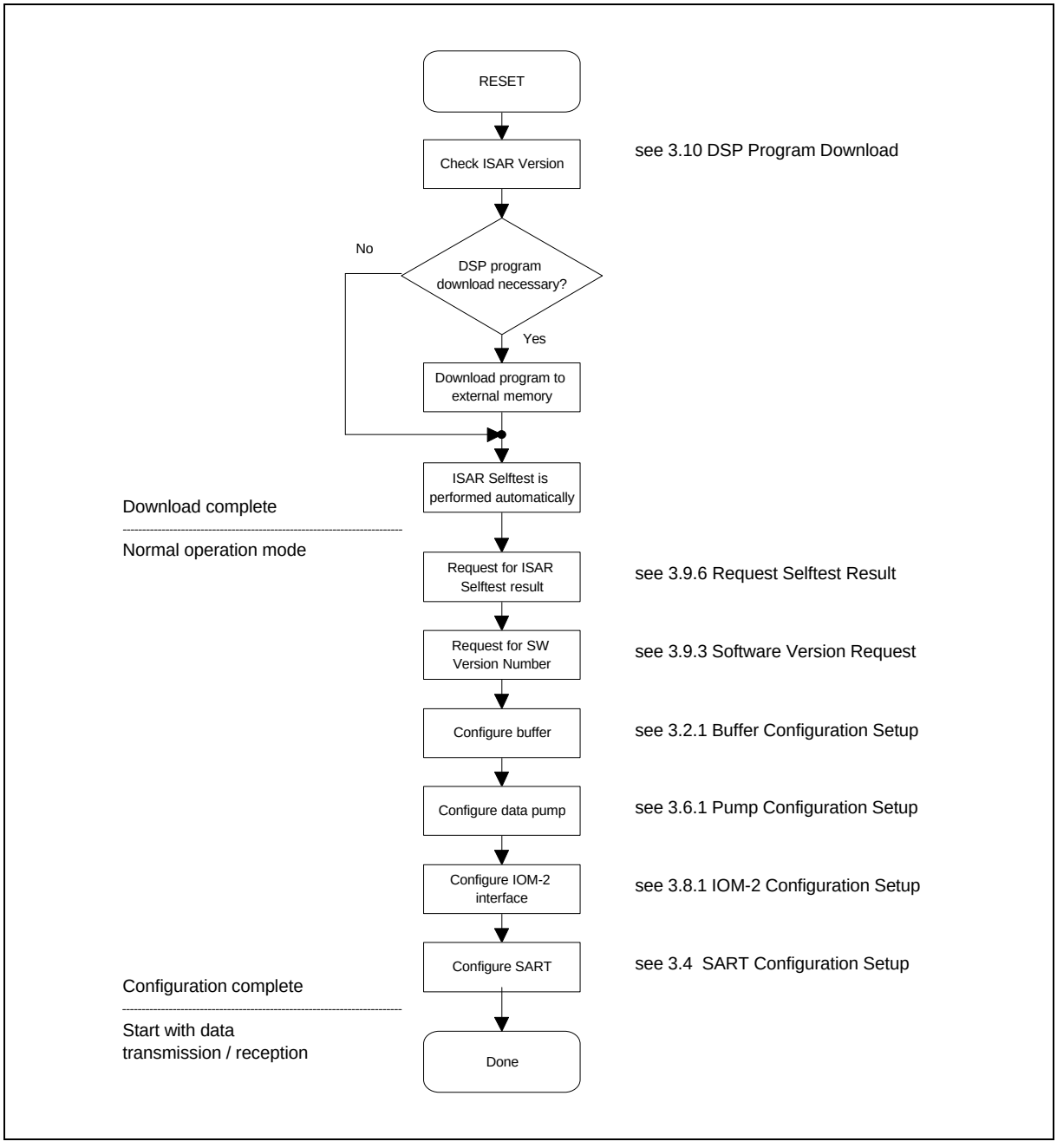


Figure 15 Initialisation procedure

To establish a link on a data path, the four functional blocks, buffer, SART, data pump and IOM-2 interface must be configured first. Since the configuration of the data pump will reset the whole data path except buffer configuration, the pump should be configured right after buffer configuration.
It is recommended to follow this sequence to provide for proper operation.

The table below shows the configuration parameters for each of the four blocks and the reference to the corresponding parameter setting.
Detailed information about the individual parameters is provided with the corresponding configuration setup messages.

Functional block	**Configuration parameter**	**Parameter setting**
Buffer	• Buffer base priority	BBP
	• Maximum message length	MML
Data pump	• Pump mode (fax, datamodem, halfduplex modulation, V.110, DTMF, DTMF transmission or bypass)	PMOD
	• Originating / answering mode	OAM
	• Transmitter output attenuation	TOA
	• Calling and answer tones	ATN, CTN
	• Echo protector tone	EPT
	• Guard tone selection	GTS
	• Modulation scheme	V23, V23R, ...
	• Automode operation	AMOD
	• Data rate (V.110)	VDR
	• Flow control (V.110)	FCT
	• Rejection level (DTMF)	REL
IOM-2 interface	• IOM-2 access enable/disable	IOM
	• Time slot position	RTSO, RCS TTSO, TCS
	• Time slot length	TSL
	• Switching of DU/DD lines	TXD, RXD
	• Coding (PCM A-law, μ-law)	COD
	• Rate conversion	RCV
SART	• SART mode (V.14, HDLC, binary, FSK V.14)	SMODE
	• Receive / transmit channel disable (halfduplex modulation)	HDMC
	• HDLC formatting (HDLC regular/inverted, Interframe fill, FCS length, enable/disable FCS, data underrun operation)	HIO IFF FLEN EDF, DUO
	• V.14/FSK V.14 formatting (overspeed range, stop bits, parity bits, character size, buffer flush timeout)	OVSP, SNP, EOP, EDP NSB, CHS, BFT
	• Binary formatting (data underrun operation, bit swapping, data underrun fillword)	DUO BSW DUFW

3.1.2 Message Transfer from Host to ISAR

The procedure to write a message to the ISAR mailbox is shown in figure 16.
The mechanism to access the ISAR mailbox is the same for all messages, which are:

- Configuration setup
- Configuration request
- Status request
- Control commands
- Control commands along with transmit data

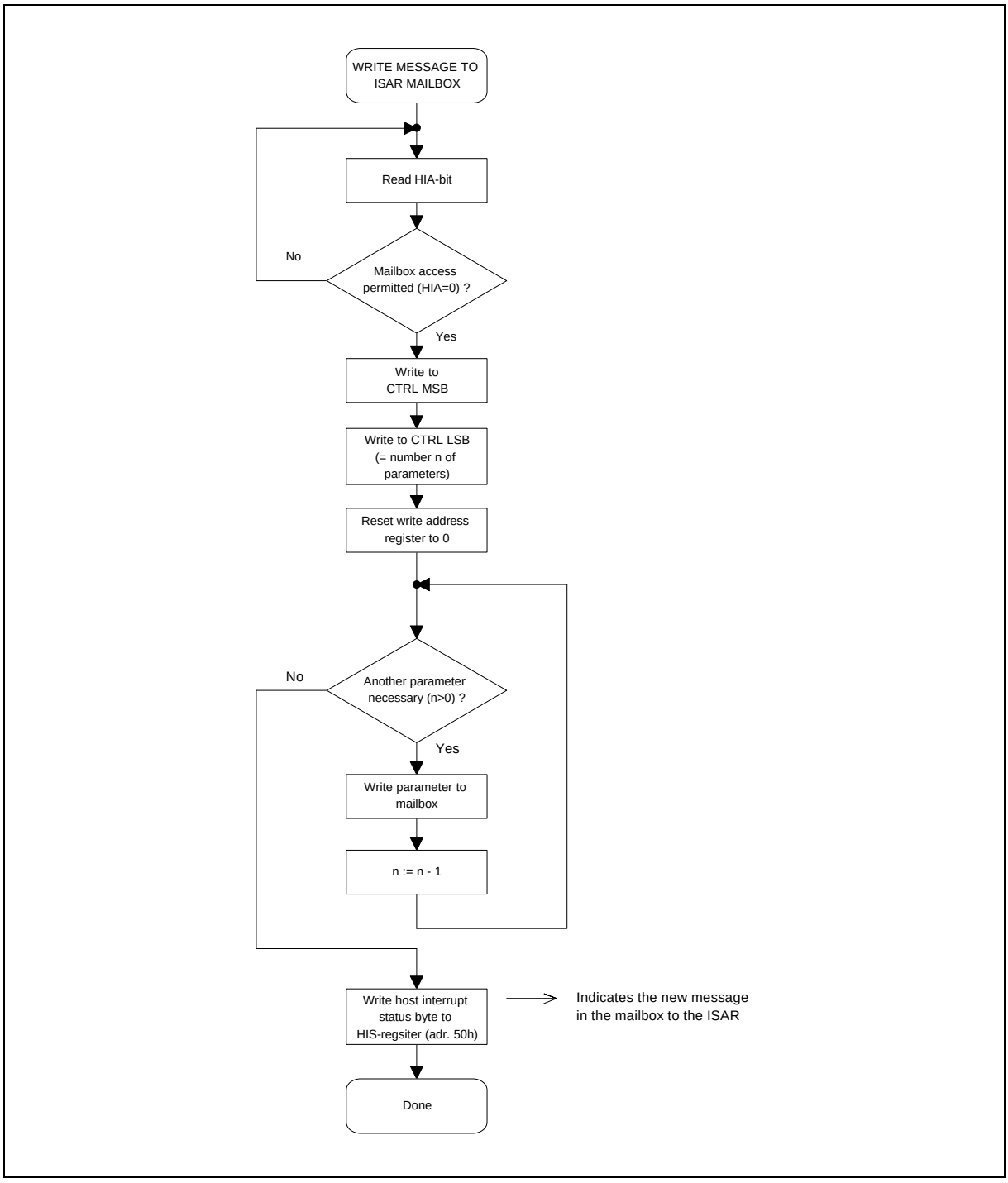


Figure 16 Write message transfer

When a message is written to the mailbox, the ISAR will transfer the whole message to the destination buffer which is indicated in the host interrupt status byte (HIS). During that time another message must not be entered by the host, however due to the mailbox structure, the message transfer is performed rather fast and will not delay any host access.
Therefore, before any access to the mailbox is done, the host should read the host interrupt acknowledge bit (HIA), to verify that the registers are available again (HIA=0) and a new message may be written to the mailbox.

The control registers (CTRL MSB and LSB) should be written first, where the CTRL LSB contains the total number of bytes which will be entered to the mailbox.

Before any data is written to the mailbox (address 4Ch), the write pointer (address 4Ah) must be reset to 0. After a byte is written to the mailbox, the write address pointer is autoincremented and doesn't need to be reprogrammed. This allows for fast access to the mailbox.

If there are successive messages with the same mailbox contents, the mailbox data does not need to be written again, as this data is still available in the mailbox memory from the previous message. It allows the host to flexibly reprogram the write pointer and its respective memory location only for those mailbox contents which are different from the previous message.

Important note:

It is important to note that the HIS byte must be entered as the very last byte of the message as this will indicate the new register and mailbox contents to the ISAR.

An access to the HIS register will terminate the message transfer and automatically set the HIA bit which is reset again by the ISAR as soon as new data can be entered to the mailbox.

3.1.3 Message Transfer from ISAR to Host

The procedure to read a message from the ISAR mailbox is shown in figure 17.
The mechanism to access the ISAR mailbox is the same for all messages, which are:

- Configuration response (initiated by configuration request message)
- Status response (initiated by status request message)
- Status events
- Status events along with receive data

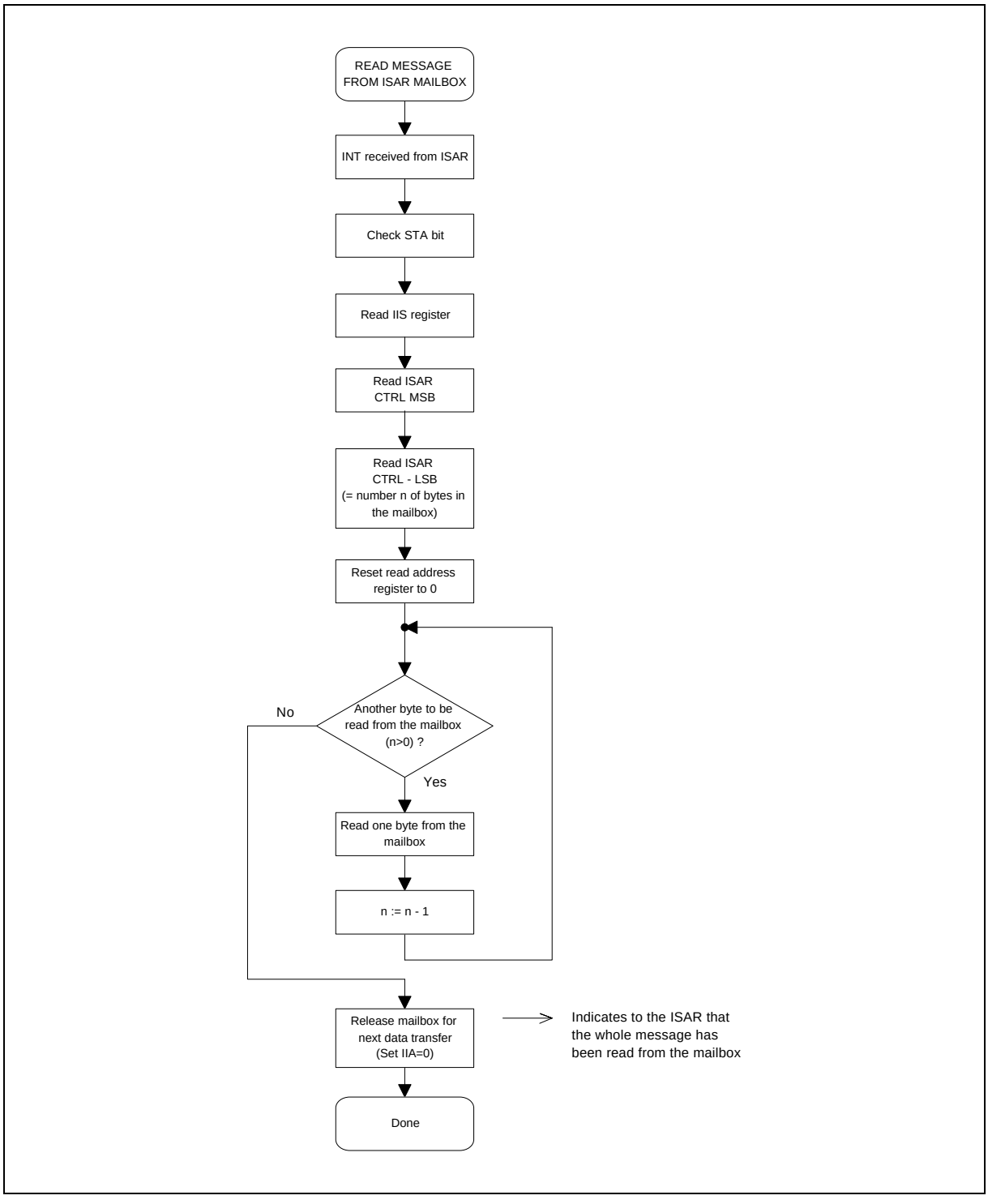


Figure 17 Read message transfer

If the ISAR has a message available in the mailbox to be read by the host, it will activate the INT-line. To ensure, the interrupt line was not activated due to a hardware malfunction, the interrupt status bit STA should be checked.
For the message transfer the ISAR interrupt status register (IIS) should be read first. It defines the type of message and indicates the source where the message was initiated.

Then the CTRL MSB and LSB are read by the host, where the LSB indicates the total number of bytes which are available in the mailbox .

Before data is read from the mailbox (address 4Ch), the read pointer (address 48h) must be reset to 0 to read the data starting with the first byte in sequence. For each read access to the mailbox the read address pointer is autoincremented and does not need to be reprogrammed by the host.
This allows for fast access to the mailbox.

Important note:

It is important to note that the IIA bit must be reset as the very last register access of the message, as this will indicate to the ISAR that the message has been completely read. The mailbox is released and may be filled with new contents.

It is not necessary to read the mailbox if its content is not required by the host, e.g. if data is not valid. The host can discard the contents by just writing the IIA bit as this will release the whole mailbox.

A response message is always initiated by the host releasing a request message to the ISAR (see figure 18). The other messages are initiated by the state machine residing on the host side (messages from host to ISAR) or residing on the ISAR (messages from ISAR to host).

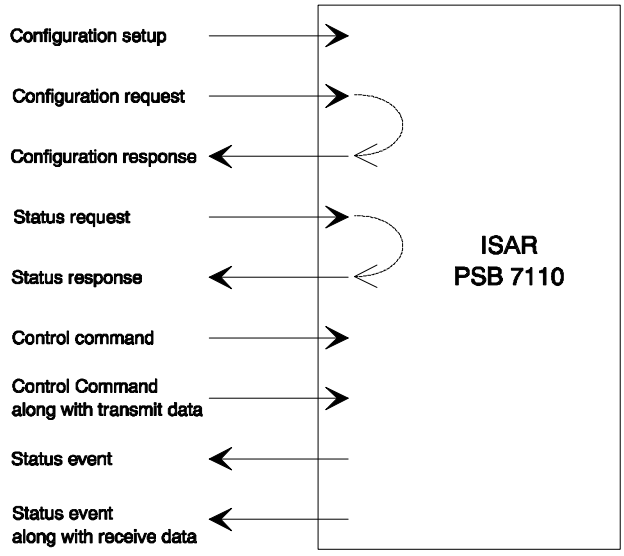


Figure 18 Message directions

The ISAR releases an interrupt request to the host to indicate that a message must be read from the mailbox. The host can mask the interrupt source (bit MSK=0) to avoid any interrupt state being indicated to the host by activating the INT-line. However, the mask bit affects only the generation of the interrupt, but not the interrupt status from being set (STA bit) which can be polled by the host.

3.1.4 Message Overview

The data path for the B-channel consists of FIFO buffer, SART, data pump and IOM-2 interface. Transmit/receive data and configuration, status and control information is exchanged between the host and the ISAR by a set of messages.

Buffer Configuration

- Configuration setup — Host ⇒ ISAR

The host sets the priority at which each buffer's request will be serviced by the host and the message length at which data will be transfered between the host and the mailbox.

- Configuration request — Host ⇒ ISAR

The host can request the current configuration, i.e. parameter settings such as base priority and message length.

- Configuration response — Host ⇐ ISAR

After a configuration request by the host, the ISAR will respond with the current parameter settings.

- Control commands — Host ⇒ ISAR

The host sends control commands to the ISAR in order to clear or reset buffers.

Buffer Status

- Status request — Host ⇒ ISAR

The host can request the current status of the buffers, i.e. number of messages and free locations in the buffers. Two different types of status responses can be requested.

- Status response — Host ⇐ ISAR

After a status request by the host, the ISAR will respond with the current status information.

- Status events — Host ⇐ ISAR

During data transfer the ISAR indicates to the host, whether the buffer is able to store another message, i.e. if new data can be entered.

SART Messages are defined for each of the three modes (HDLC, ASYNC and Binary).

SART Configuration

- Configuration setup — Host ⇒ ISAR

The host configures the mode (Binary, HDLC, ASYNC) for the SART and sets further parameters depending on the mode.

SART Data

- Status events with receive data — Host ⇐ ISAR

During data reception the ISAR indicates to the host, when error conditions or mode specific events occur, e.g. when the end of an HDLC frame was detected.

- Control commands with transmit data — Host ⇒ ISAR

During data transmission the host controls mode specific functions e.g. the HDLC framing (frame start, frame end) and the generation of break signals in ASYNC mode.

Pump messages are defined for all of the seven pump modes (fax modulations, datamodem modulations, halfduplex modulations, V.110, DTMF, DTMF transmission and bypass).

Pump Configuration

- Configuration setup — Host ⇒ ISAR

The host configures the mode (fax modulations, datamodem modulations, halfduplex modulations, V.110, DTMF, DTMF transmission or bypass) for the data pump and sets further parameters depending on the mode.

- Control commands — Host ⇒ ISAR

The host sends control commands to the ISAR in order to enable/disable the pump and to set mode specific control commands (e.g. DTMF tones to be generated).

Pump Status

- Status request — Host ⇒ ISAR

The host can request the current configuration of the data pump (pump mode, originating/answering mode).

- Status response — Host ⇐ ISAR

After a configuration request by the host, the ISAR will respond with the current parameter settings.

- Status events — Host ⇐ ISAR

The ISAR indicates to the host mode specific events that occur during data transfer, such as DTMF tones received or control bit change in V.110.

IOM-2 Configuration

- Configuration setup — Host ⇒ ISAR

The host configures the length and position of the IOM-2 timeslots.

- Configuration request — Host ⇒ ISAR

The host can request the current IOM-2 configuration, i.e. the current setting of timeslot-length and position.

- Configuration response — Host ⇐ ISAR

After a configuration request by the host, the ISAR will respond with the current configuration setting.

- Control commands — Host ⇒ ISAR

The host sends control commands to the ISAR for IOM-2 control during normal operation.

Additional messages are available within the test/diagnostics path for general configuration and for DSP program download

3.1.5 Message Structure

The messages to transfer configuration, status and control information between the host and ISAR are described in detail in the next chapters. Depending on the kind of message, the structure and message length may be different.

All messages consist of:

- Interrupt status byte (HIS or IIS)
- Control register MSB (CTRL MSB)
- Control register LSB (CTRL LSB)

For some messages a certain number of additional bytes must be written to/read from the mailbox:

- 1st Parameter
- 2nd Parameter
  :
- N-th Parameter

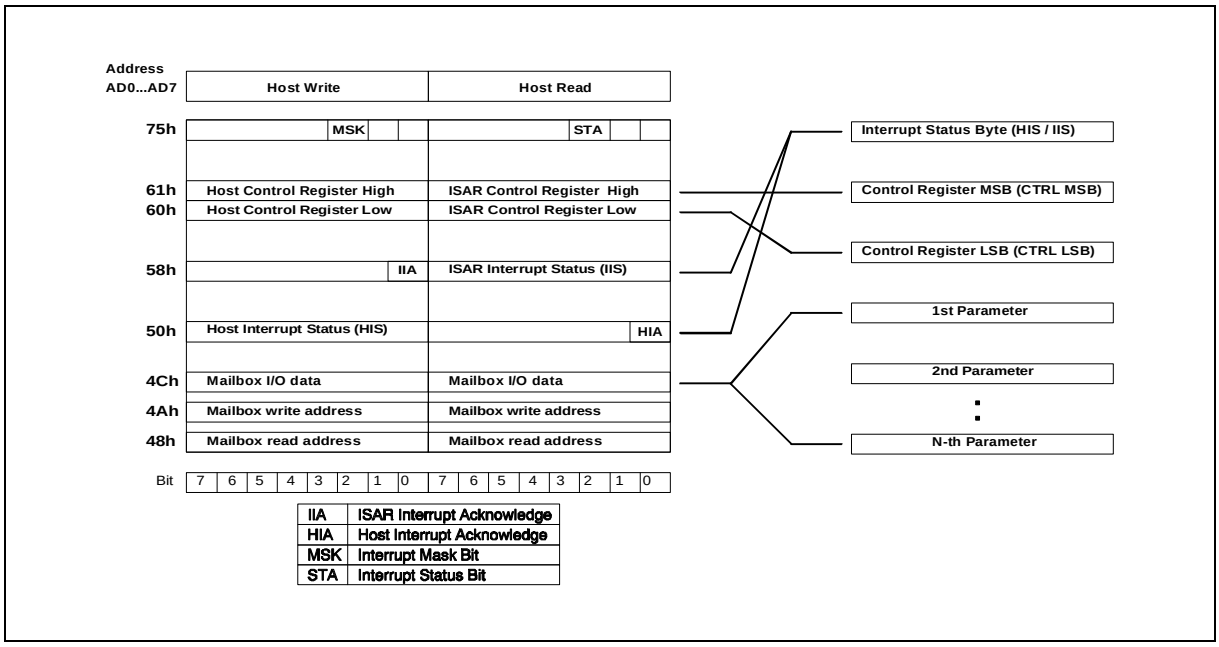


Figure 19 Message transfer

3.1.5.1 Interrupt Status Byte

The interrupt status byte has a structure that defines the type of message, i.e. it contains information to which buffer the message is related to, the kind of message and to which functional block of the ISAR the message is related to:

	7	6	5	4	3	2	1	0
HIS / IIS	DPS		MSC				MDS	

DPS ... Datapath selection

One of the three data paths (0, 1 or 2) of the ISAR is selected.

MSC ... Message coding

MSC defines the type of command (e.g. configuration request, configuration response, status event, control command, ...) to perform a certain function.

MDS ... Message destination/source

Selects one of the four functional blocks on the ISAR (buffer, SART, data pump and IOM-2) to which the message is sent (host $\rightarrow$ ISAR) or from which a message is originated (ISAR $\rightarrow$ host).

The coding for the HIS and IIS registers are listed below. It should be noted, that not all combinations of buffer selection (DPS), message coding (MSC) and message destination/source (MDS) are available at the programming interface.

It is important to note that the coding for test/diagnostics messages (DPS=00) does not conform to the above shown structure of MSC and MDS. Instead these bits fully specify an individual message function.
Some of the test/diagnostics messages are only used for DSP download and are not valid after regular operation has started (see 3.10 DSP Program Download)

Host Interrupt Status Byte (HIS Host → ISAR)

The structure for the HIS byte is shown below. It should be noted, that not all combinations of buffer selection, message coding and message destination are available at the programming interface.

Regular Operation (B-channel paths 1 and 2):

7	6	5	4	3	2	1	0	
								Datapath Selection (DPS)
0	1							Path 1
1	0							Path 2
								Message Coding (MSC)
		1	0	0	0	0	0	Control command and transmit data
		0	0	0	1			Request for configuration
		0	0	1	1			Request for status
		1	0	0	1			Configuration setup
		1	0	1	0			Control command
								Message Destination /Source (MDS)
						0	0	Command for Buffer
						0	1	Command for SART
						1	0	Command for Pump
						1	1	Command for IOM-2

Test/Diagnostics Operation (buffer 0):

Some of the message codings related to the DSP program download procedure (see table below) can only be used before the DSP program has been started and are not valid after regular operation has started.

7	6	5	4	3	2	1	0	
								Datapath Selection (DPS)
0	0							Buffer 0
								Message Coding (MSC)
		1	1	1	1	0	0	Configuration setup
		1	1	1	1	1	0	Control command
		0	1	1	1	0	1	Status request
		1	0	0	1	1	1	Mailbox contains general configuration (wait state setting)
		1	0	0	1	0	1	Mailbox contains general configuration (timer interrupt on/off)
		0	0	0	1	0	1	Request selftest result
		0	0	0	1	0	1	Request for software version number
The following message codings are only valid before the DSP program has been started:								
		0	1	0	1	0	0	Request for chip version number
		0	0	0	0	1	0	Transfer of D-key
		0	1	1	1	1	0	Transfer of program data
		0	0	1	0	0	0	Start of DSP program

ISAR Interrupt Status Byte (IIS)

The structure for the IIS byte is shown below. Also for IIS not all combinations of buffer selection, message coding and message destination are available at the programming interface.
One message does not conform to the described structure of DPS, MSC and MDS. It has a general code (IIS=0), which is used for normal operation and not for test/diagnostics functions.

Regular Operation (B-channel paths buffer 1 and 2):

7	6	5	4	3	2	1	0	
								Request For Data
0	0	0	0	0	0	0	0	Indication for Buffer available (general code)

7	6	5	4	3	2	1	0	
								Datapath Selection (DPS)
0	1							Path 1
1	0							Path 2
								Message Coding (MSC)
		1	0	0	0	0	0	Mailbox contains SART status event and receive data
		1	0	0	1			Mailbox contains configuration data
		1	0	1	0			Mailbox contains status event
		1	0	1	1			Mailbox contains status information
								Message Destination/ Source (MDS)
						0	0	Indication from Buffer
						0	1	Indication from SART
						1	0	Indication from Pump
						1	1	Indication from IOM-2

Test/Diagnostics Operation (buffer 0):

Some of the message codings related to the DSP program download procedure (see table below) can only be used before the DSP program has been started and are not valid after regular operation has started.

7	6	5	4	3	2	1	0	
								Datapath Selection (DPS)
0	0							Buffer 0
								Message Coding (MSC)
		1	1	1	1	0	1	Status response
		1	1	1	1	1	0	Status event
		1	0	1	0	1	0	Timer interrupt request
		1	1	1	1	1	1	Invalid message received
		1	0	0	1	0	1	Selftest response
		1	0	0	1	0	1	Software version number response
The following message codings are only valid before the DSP program has been started:								
		0	1	0	1	0	1	Chip version number response
		0	0	0	0	1	1	Response for transfer of D-key
		0	1	1	1	1	1	Response for transfer of program data
		0	0	1	0	0	1	Response for start of DSP program

3.1.5.2 Control Registers and Parameters

The most significant byte of the control register (CTRL MSB) contains configuration, status or control information which depends on the type of message.

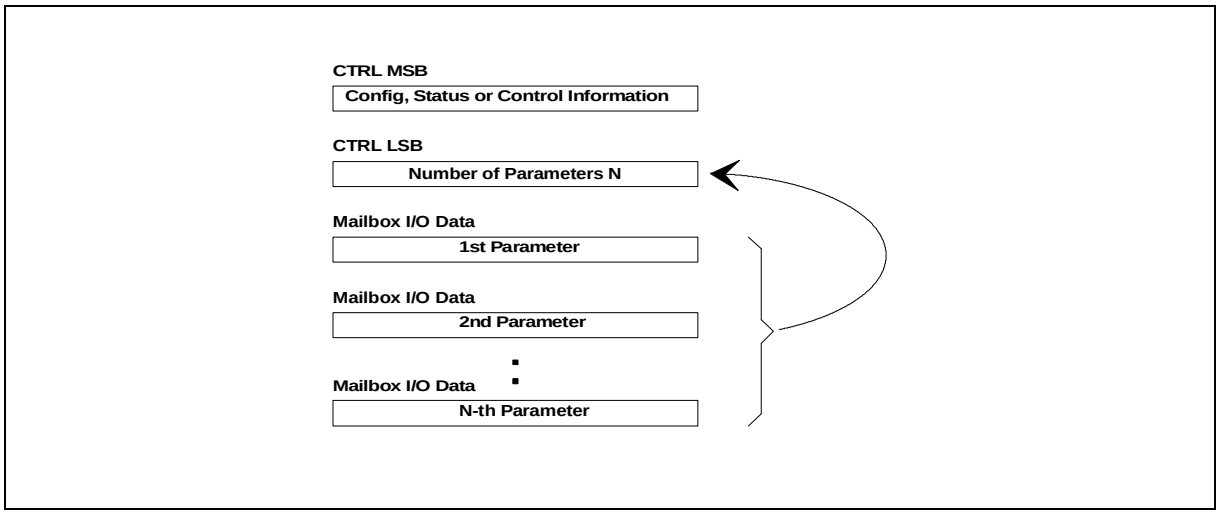


Figure 20 Control registers and parameters

The least significant byte of the control register (CTRL LSB) is used to indicate the number of bytes transfered via the mailbox (Mailbox I/O Data). These mailbox data may contain additional configuration, status or control information as well as receive/transmit data (figure 20).

Important note:

ISAR V1.1 (ROM version) will be software compatible to the ISAR V1.0 (download version), however it should be noted that the length of some messages may differ in a way, that additional parameters may be provided.
The message parameters and their sequence within the message specified herein is identical, but a higher value of the CTRL LSB may indicate that further parameters are provided through the mailbox.

For some of the messages no additional data is written to/read from the mailbox, in this case the CTRL LSB is set to 0.
The structure of the parameters is depending on the type of message being transfered and has no fixed format. Therefore it is described with each individual message.

3.2 Buffer Configuration

3.2.1 Buffer Configuration Setup (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS							0	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	BBP		

	7	6	5	4	3	2	1	0
CTRL LSB	1							

	7	6	5	4	3	2	1	0
1. Parameter	MML							

DPS ... Datapath selection

00: path 0
01: path 1
10: path 2

MSC ... Message coding

The message coding is different for datapath 0 and datapath 1, 2.
1111: configuration setup for data path 0 (DPS=00)
1001: configuration setup for data path 1 or 2 (DPS=01 or 10)

BBP ... Buffer Base Priority

000: priority is not changed by the configuration command
001: change base priority to 1 (lowest priority)
: :
111: change base priority to 7 (highest priority)

Reset value: BBP = 4 datapaths 1 and 2 (DPS = 01, 10)
BBP = 5 datapath 0 (DPS = 00)

MML ... Maximum Message Length

The maximum message length is limited to 61 byte.

The buffer priority determines the sequence of service if more than one read buffer request for mailbox service at the same time. In such a case the buffer with highest priority is served first and the priority of all pending buffers is increased by one. After being served, the priority of the serviced buffer is reset to its base value, which is selected by the above given configuration command.
So a buffer with a higher base priority will be served more often than a buffer with a lower base priority, moreover, the higher the difference of two priority values the more often the one buffer will be serviced first.

If the additional value (maximum message length) is omitted (CTRL LSB = 0), only the base priority is changed. In this way the buffer base priority can be reconfigured to a different value during normal operation without any loss of data consistency.
By changing the base priority, the current priority is reset to the new base value.

For highest throughput and best internal performance it is recommended to use the highest value for MML.

3.2.2 Buffer Configuration Request (Host → ISAR)

The current configuration can be requested by the host. The request is fully specified by the Host Interrupt Status register (HIS), i.e. the mailbox control registers are not used (set to 0) and no parameters are required.

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS							0	0

	15	14	13	12	11	10	9	8
CTRL MSB	0							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

DPS ... Datapath selection

00: path 0
01: path 1
10: path 2

MSC ... Message coding

The message coding is different for datapath 0 and datapath 1, 2.
0111: configuration request for datapath 0 (DPS=00)
0001: configuration request for datapath 1 or 2 (DPS=01 or 10)

3.2.3 Buffer Configuration Response (ISAR → Host)

The ISAR provides the configuration data, which was requested by the host, via the mailbox. The coding is similar to the configuration setup.

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
IIS							0	0

	15	14	13	12	11	10	9	8
CTRL MSB	-	-	-	-	-	BBP		

	7	6	5	4	3	2	1	0
CTRL LSB	2							

	7	6	5	4	3	2	1	0
1. Parameter	MML							

	7	6	5	4	3	2	1	0
2. Parameter	MPL							

DSP ... Datapath selection

00: path 0
01: path 1
10: path 2

MSC ... Message coding

The message coding is different for datapath 0 and datapath 1, 2.
1111: configuration response from datapath 0 (DPS=00)
1001: configuration response from datapath 1 or 2 (DPS=01 or 10)

BBP ... Current Buffer Base Priority

000: not used
001: base priority of 1 (lowest priority)
: :
111: base priority of 7 (highest priority)

MML ... Currently Selected Maximum Message Length

MML contains the maximum message length that has been configured by the host.
If this value has not been programmed by the host, MML contains the reset value for the maximum possible message length.

MPL ... Maximum Possible Message Length

MPL contains the maximum possible message length that can be configured.
MPL is 29 for data path 0 and 61 for data paths 1 and 2.

In receive direction the ISAR gathers all received data words from the SART up to the selected message length, before the message is passed to the mailbox. Messages of reduced length may be passed on certain events such like error conditions or HDLC frame end (see 3.5.1 SART Status Events with Receive Data).

In transmit direction it's the responsibility of the host that transmit messages do not exceed the selected message length, to avoid a buffer overflow and loss of data.

If MML exceeds MPL in the configuration setup message (see 3.2.1), MML is internally limited to MPL. Therefore it is recommended to issue a buffer configuration request message to verify the currently selected and the maximum possible message length. Moreover, this enables the software to automatically adapt to the hardware platform, as the ISAR V1.1 (ROM version) will provide enlarged mailbox and FIFO buffers, which will also increase the maximum possible message length that can be read with MPL.

3.2.4 Buffer Control Command (Host →ISAR)

The IO-buffer control commands are interpreted immediately after being received by the ISAR.

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS								

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	0	CRB	

	7	6	5	4	3	2	1	0
CTRL LSB	0							

DPS ... Datapath selection

00: path 0
01: path 1
10: path 2

MSC ... Message coding

The message coding is different for datapath 0 and datapath 1, 2.
1111: control command for datapath 0 (DPS=00)
1010: control command for datapath 1 or 2 (DPS=01 or 10)

MDS ... Message destination/source

The destination coding is different for datapath 0 and datapath 1, 2.
10: message is addressed to buffer (for DPS=00)
00: message is addressed to buffer (for DPS=01 or 10)

CRB ... Clear / Reset Buffers

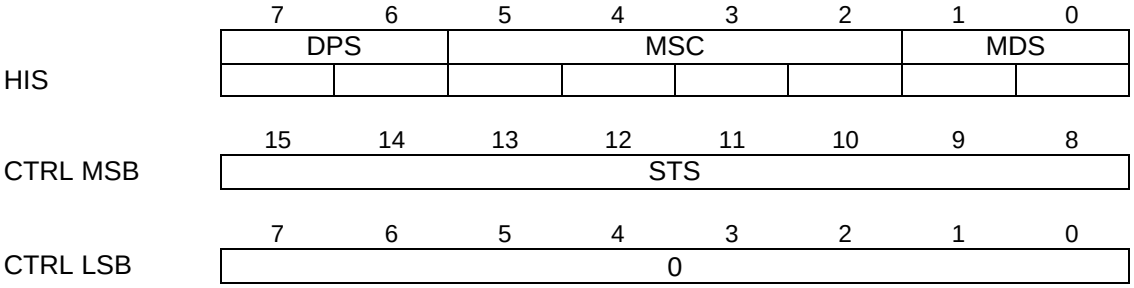
00: clear receive buffer
01: clear transmit buffer
1x: reset read and write buffers to their initial values (note: bit8 is don't care)

The buffer clear commands do not change the settings of the base priority or the message length.
The reset command clears both, read and write buffers, and reset them to their initial factory settings.

3.3 Buffer Status

3.3.1 Buffer Status Request (Host → ISAR)

The request is fully specified by the Host Interrupt Status register (HIS) and the mailbox control registers, i.e. additional parameters are not used. The IO-buffer status request is serviced immediately after being received by the ISAR.



DPS ... Datapath selection

00: path 0
01: path 1
10: path 2

MSC ... Message coding

The message coding is different for datapath 0 and datapath 1, 2.
0111: status request for datapath 0 (DPS=00)
0011: status request for datapath 1 or 2 (DPS=01 or 10)

MDS ... Message destination/source

The destination coding is different for datapath 0 and datapath 1, 2.
01: message is addressed to buffer (for DPS=00)
00: message is addressed to buffer (for DPS=01 or 10)

STS ... Status Type Select

The status request will cause the generation of ...
0: ... a status response with additional information about the buffers
≠ 0: ... a buffer available indication

The status response with additional information about messages and free locations in the receive and transmit buffers is described in chapter 3.3.2.

The second option allows the host to force the generation of a buffer available indication as specified in chapter 3.3.3. However there is a slight difference in the functionality of the resulting indication message:

A buffer available indication that is initiated by the ISAR, only contains information about those buffers where a transition from "not enough free space" to "enough free space for another message" occurs. All buffers that are not serviced by that time, will not be indicated in a following buffer available indication that results from the status transition of a different buffer.
However, a status request with STS ≠ 0 forces the ISAR to generate a buffer available indication for the transmit buffer of the selected datapath (specified in the HIS register), even if there is no state transition for that buffer.

This command is useful to force a first data request message from the ISAR after a datapath is fully configured, although the first request message is automatically generated after SART configuration.

3.3.2 Buffer Status Response (ISAR → Host)

The ISAR returns status information about the buffers if requested by the host (see 3.2.1).

	7	6	5	4	3	2	1	0
IIS	DPS		MSC				MDS	

	15	14	13	12	11	10	9	8
CTRL MSB	-	-	-	-	RDM3	RDM2	RDM1	RDM0

	7	6	5	4	3	2	1	0
CTRL LSB	6							

	7	6	5	4	3	2	1	0
1. Parameter	NBRL							

	7	6	5	4	3	2	1	0
2. Parameter	NBRM							

	7	6	5	4	3	2	1	0
3. Parameter	NMR							

	7	6	5	4	3	2	1	0
4. Parameter	NBTL							

	7	6	5	4	3	2	1	0
5. Parameter	NBTM							

	7	6	5	4	3	2	1	0
6. Parameter	NMT							

DPS ... Datapath selection

00: path 0
01: path 1
10: path 2

MSC ... Message coding

The message coding is different for datapath 0 and datapath 1, 2.
1111: status response from datapath 0 (DPS=00)
1011: status response from datapath 1 or 2 (DPS=01 or 10)

MDS ... Message destination/source

The source coding is different for datapath 0 and datapath 1, 2.
01: message is originated from the buffer (for DPS=00)
00: message is originated from the buffer (for DPS=01 or 10)

RDM3, RDM2, RDM1, RDM0 ... Request for next Data Message from Channel 3, 2, 1 or 0

If RDM0, RDM1 or RDM2 is set, the corresponding channel 0, 1 or 2 requests for a new data message from the host, i.e. there is enough free buffer space for another message.
RDM3 is always set to "1". It is currently not supported but reserved for further use.

NBRL ... Number of free bytes in the receive buffer - LSB

NBRM ... Number of free bytes in the receive buffer - MSB

NMR ... Number of messages in the receive buffer

NBTL ... Number of free bytes in the transmit buffer - LSB

NBTM ... Number of free bytes in the transmit buffer - MSB

NMT ... Number of messages in the transmit buffer

The control register contains additional information about all buffers that currently have buffer space available for a new message. The information is similar as provided in the general status event message which is a kind of "Indication for Buffer available" (see 3.3.3.2). However, here the current status of all buffers is indicated regardless whether there is a state transition in the individual buffer.

Detailed information about free locations in receive and transmit buffers and about the number of messages currently stored in the buffers are available from the mailbox. These parameters only refer to the buffer which is associated to the selected data path in IIS register.

Comment:

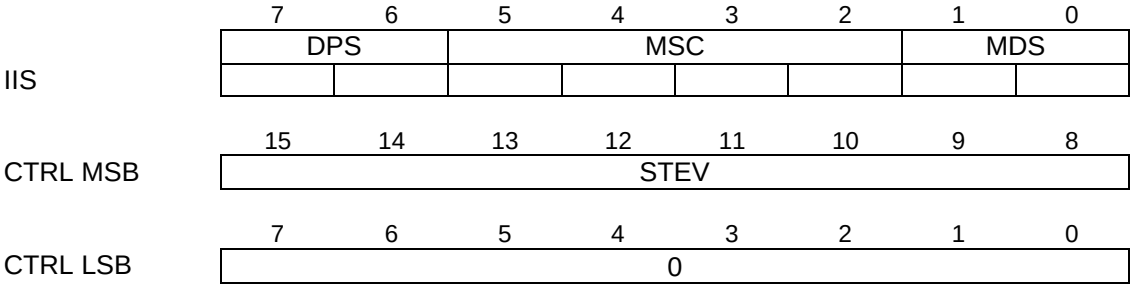
As the HIS register and the control word are internally also written to the buffers, a message of length n will always require (n+3) buffer locations.

3.3.3 Buffer Status Event (ISAR → Host)

There are two message types for status events from the buffer:

- Status event that is related to a certain buffer (see 3.3.3.1)
- Indication for buffer available - general code for all buffers (see 3.3.3.2)

3.3.3.1 Buffer Specific Status Event (ISAR → Host)



DPS ... Datapath selection

00: path 0
01: path 1
10: path 2

MSC ... Message coding

The message coding is different for datapath 0 and datapath 1, 2.
1111: status event from datapath 0 (DPS=00)
1010: status event from datapath 1 or 2 (DPS=01 or 10)

MDS ... Message destination/source

The source coding is different for datapath 0 and datapath 1, 2.
10: message is originated from the buffer (for DPS=00)
00: message is originated from the buffer (for DPS=01 or 10)

STEV ... Status Event Code

1Fh: Transmit Buffer Overflow
2Fh: Receive Buffer Overflow

3.3.3.2 Buffer General Status Event (ISAR → Host)

If a data path is online and the associated write buffer has space available for a new message, the status event message “buffer available” is generated to request new data from the host.

The IO-buffer control unit generates write buffer status event messages that cover information about all buffers, thus the IIS register contains a general code (IIS = 0). In this way the load for transfering messages is decreased significantly, as a single message may request data for more than one datapath. It is the responsibility of the host to dispatch RDMx to the controller routines of the relevant datapath.

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
IIS	0	0	0	0	0	0	0	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	RDM3	RDM2	RDM1	RDM0

	7	6	5	4	3	2	1	0
CTRL LSB	0							

RDM3, RDM2, RDM1, RDM0 ... Request for next Data Message from Channel 2, 1 or 0

If bit RDM2, RDM1 or RDM0 is set, the corresponding channel 0, 1 or 2 requests for a new data message from the host.
RDM3 is currently not supported but reserved for further use.

A status event is generated by the control unit and indicated to the host when

- at least one of the write buffers changes its state from "not enough free space" to "enough free space for another data message", or when
- at least one of the write buffers has still enough free space for another message immediately after a new message was written into this buffer.

Only when either of these two states is met, the status event message is generated. If the request is not serviced by the host, the ISAR will not generate a new status event message to request data for that path.
It should be noticed that the corresponding bit for that buffer remains not set in the control register each time another buffer generates an interrupt to request new data.
However a status request message (see 3.3.1) can force the generation of an indication for buffer available for a certain buffer.

The general proceeding for data transfer from the host to the transmit buffer would be:

- after Reset the ISAR will release an initial status event message with RDM0=RDM1=RDM2=RDM3=1
- the host configures buffer, data pump, IOM-2 interface and SART
- the host writes the first message to the buffer (buffer is empty after reset)
- if the remaining buffer space is greater than the programmed message length, there will be an immediate interrupt to the host, who in turn can transfer the next message.
- if the remaining buffer space is smaller than the programmed message length, there will be no interrupt to the host until data is transmitted from the buffer and enough space is available to accept one complete message.
- if there is a request for message to the host and the host has no new message to send, the host should store the request information, so for new data it can immediately continue with transfering it to the buffer.
- the host can force the generation of an indication for buffer available for a certain buffer (see 3.3.1).

3.4 SART Configuration

Depending on the SART mode (HDLC, ASYNC or binary) the message requires a specific coding, which is described in the following three chapters.

For SART configuration all parameters have to be set for the corresponding SART mode even though a single parameter may not be different from the previous setting.

Important note:

After configuration of the pump, the configuration information of the SART gets lost, therefore the SART unit must be configured after the pump configuration.

3.4.1 SART Configuration Setup - HDLC (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	0	1	0	1

	15	14	13	12	11	10	9	8
CTRL MSB	HDMC		0	0	SMODE			

	7	6	5	4	3	2	1	0
CTRL LSB	1							

	7	6	5	4	3	2	1	0
1. Parameter	0	0	0	HIO	IFF	FLEN	EDF	DUO

DPS ... Datapath selection

01: path 1
10: path 2

HDMC ... Halfduplex Mode Configuration

00: Receive and transmit channel are enabled (default)
01: Receive channel is disabled
10: Transmit channel is disabled
11: not used

In halfduplex mode the pump would transfer idle bits in the direction that is currently not in use, so the corresponding receive or transmit channel can be selectively disabled to reduce the interrupt load for not valid data.
For all other pump modes except halfduplex mode, HDMC must be set to its default value 00.

SMODE ... SART Mode

0000: Disable SART
0010: V.14 mode
0011: HDLC mode
0100: Binary mode
0101: FSK V.14 mode
all other codes reserved

HIO ... HDLC Input / Output

0: regular
1: inverted
"Inverted" describes a mode where all bits are changed from "0" to "1" and from "1" to "0" after HDLC formatting.

IFF ... Interframe Fill

0: flags
1: "1"

FLEN ... FCS length

0: 16 bit FCS
1: 32 bit FCS (not implemented in ISAR V1.0)

EDF ... Enable / Disable FCS

0: enable FCS (regular HDLC operation)
1: disable FCS
This refers to FCS generation in transmit direction and FCS checking in receive direction.

DUO ... Data Underrun Operation

For data underrun in TX direction ...
0: ... Abort is generated (default)
1: ... Frame End (FCS and final flag) is generated

3.4.2 SART Configuration Setup - ASYNC (Host → ISAR)

ASYNC denotes an asynchronous formatting of data according to ITU-T V.14. Two separate modes are distinguished for ASYNC which depends on the selected modulation scheme at the data pump

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	0	1	0	1

	15	14	13	12	11	10	9	8
CTRL MSB	HDMC		0	0	SMODE			

	7	6	5	4	3	2	1	0
CTRL LSB	2							

	7	6	5	4	3	2	1	0
1. Parameter	0	OVSP	SNP	EOP	EDP	NSB	CHS	

	7	6	5	4	3	2	1	0
2. Parameter	BFT							

DPS ... Datapath selection

01: path 1
10: path 2

HDMC ... Halfduplex Mode Configuration

00: Receive and transmit channels are enabled (default)
01: Receive channel is disabled
10: Transmit channel is disabled
11: not used

In halfduplex mode the pump would transfer idle bits in the direction that is currently not in use, so the corresponding receive or transmit channel can be selectively disabled to reduce the interrupt load for not valid data.
For all other pump modes except halfduplex mode, HDMC must be set to its default value 00.

SMODE ... SART Mode

0000: Disable SART
0010: V.14 mode (used for pump modes V.110, V.32, V.32bis, V.22, V.22bis)
0011: HDLC mode
0100: Binary mode
0101: FSK V.14 mode (used for pump modes V.21, V.23, Bell 103, Bell 202)
all other codes reserved

There is a difference in the pump modes FSK V.14 and V.14:
For FSK V.14 the bit alignment during an idle sequence gets lost, since there is only one frequency for the mark bit and therefore there's no fixed baud rate at the data pump during the idle sequence.
For V.14 mode there is a data stream that has a fixed bit alignment, since the modulation scheme provides a fixed baud rate even during idle sequence.

Important Note:

FSK V.14 mode must not be used for any other pump modes than V.21, V.23, Bell 103 and Bell 202.

OVSP ... Overspeed Range (Valid only for transmit direction)

Number of stop bits to be deleted
0: 1 of 8
1: 1 of 4
Stop bit deletion during data transmission is initiated by a control command, otherwise all stopbits are generated independent of OVSP setting.

It is only valid for V.14 mode and not supported for FSK V.14.

Overspeed range for the transmitter is an option that can be used to increase the data rate in ASYNC mode by means of the overspeed mechanism that is actually defined for compensating different data rates due to missing synchronism between an AYSNC-receiver and transmitter.
The ISAR will just omit stopbits and therefore gain a 12.5 or 25% higher data rate.

SNP ... Stick / Normal Parity

0: normal parity
1: stick parity

EOP ... Even / Odd Parity

0: Odd parity
1: Even parity

EDP ... Enable / Disable Parity Bit

0: disable parity
1: enable parity

NSB ... Number of Stop Bits

0: 1 Stop bit
1: 2 Stop bits

CHS ... Character Size

00: 5 bit
01: 6 bit
10: 7 bit
11: 8 bit

BFT ... Buffer Flush Timeout (valid for receive direction only)

0: Default value (Flush timeout = 32 ∗ symbolrate)
1: Flush timeout = 2 ∗ symbolrate
2: = 4 ∗ symbolrate
: :
254: = 508 ∗ symbolrate
255: Flush timeout disabled

The Buffer flush counter determines the length of a timer that is started when after a single character an idle sequence is being received. This is to ensure, that ASYNC characters are indicated and transfered to the host in case of a long idle sequence even though the message length is not yet complete. If the timeout is disabled, the last datawords remain in the receiver buffer - even during a long idle sequence - until the message length is complete which is then indicated to the host.

For fast data rates a value in the range BFT = 10 ... 50 is suitable, whereas for slow data rates (V.21 / 300 bps) a lower value is recommended. The BFT-value should be selected high enough to avoid a too early buffer flush, which would increase the mailbox load.
The symbolrate refers to the selected modulation scheme which is selected for pump configuration.

3.4.3 SART Configuration Setup - Binary (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	0	1	0	1

	15	14	13	12	11	10	9	8
CTRL MSB	HDMC		0	0	SMODE			

	7	6	5	4	3	2	1	0
CTRL LSB	2							

	7	6	5	4	3	2	1	0
1. Parameter	0	0	0	0	0	0	DUO	BSW

	7	6	5	4	3	2	1	0
2. Parameter	DUFW							

DPS ... Datapath selection

01: path 1
10: path 2

HDMC ... Halfduplex Mode Configuration

00: Receive and transmit channel are enabled (default)
01: Receive channel is disabled
10: Transmit channel is disabled
11: not used

In halfduplex mode the pump would transfer idle bits in the direction that is currently not in use, so the corresponding receive or transmit channel can be selectively disabled to reduce the interrupt load for not valid data.
For all other pump modes except halfduplex mode, HDMC must be set to its default value 00.

SMODE ... SART Mode

0000: Disable SART
0010: V.14 mode
0011: HDLC mode
0100: Binary mode
0101: FSK V.14 mode
all other codes reserved

DUO ... Data Underrun Operation

For data underrun in TX direction ...
0: ... previous databyte in TX buffer is continuously transmitted
1: ... fillword in mailbox (2nd parameter) is continuously transmitted

The fillword functionality can be used to transmit "1" or "0" or any other 8 bit value without continuous message transfer between host and ISAR.

BSW ... Bit Swapping

0: MSB is transmitted/received first
1: LSB is transmitted/received first

DUFW ... Data Underrun Fill Word

This fillword is transmitted continuously if a data underrun condition occurs in transmit direction.
It is only valid if the DUO bit in the first parameter is set.

3.4.4 SART Configuration Setup - Disable SART (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	0	1	0	1

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	SMODE			

	7	6	5	4	3	2	1	0
CTRL LSB	0							

DPS ... Datapath selection

01: path 1
10: path 2

SMODE ... SART Mode

0000: Disable SART
0010: V.14 mode
0011: HDLC mode
0100: Binary mode
0101: FSK V.14 mode
all other codes reserved

If the SART is disabled, the data received by the pump is not forwarded to the receive buffer.
In transmit direction, a continuous sequence of "1" (marks) are forwarded to the pump if the SART is disabled.

3.5 SART Data

Data together with status information or control commands is exchanged by 2 types of operation, which are described in the following two chapters.

The parameter MDS = 00 indicates that the message is related to the buffer as the user data is transfered to and from the buffers.
However, the whole message is described as a SART message, since status information, originated from the SART control unit and control information which is meant for the SART unit is transfered along with it.

3.5.1 SART Status Events with Receive Data (ISAR → Host)

The SART receiver status, which is always data related, is passed to the host along with any data transfer via the mailbox.
The SART status is coded in the CTRL MSB, while the CTRL LSB indicates the number of data available in the mailbox .
Certain SART receive state changes cause an immediate buffer flush event to the associated interface buffer, i.e. any time when such a state changes, all data in the internal FIFO buffer is transfered to the host even if the buffer was not yet filled up to the programmed message length.
Most status bits are related to the last databyte of the mailbox (e.g. parity error). Others, like "frame start" in HDLC mode are related to the first databyte in the mailbox.
If no bit is set, messages of the predefined length are transfered.

3.5.1.1 SART Status Events with Receive Data - HDLC (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
IIS			1	0	0	0	0	0

	15	14	13	12	11	10	9	8
CTRL MSB	-	FED	FSD	FAD	RER	CER	-	NMD

	7	6	5	4	3	2	1	0
CTRL LSB	NOM							

	7	6	5	4	3	2	1	0
1. Parameter	1st databyte of the message							
:								
	7	6	5	4	3	2	1	0
N. Parameter	N-th databyte of the message							

DPS ... Datapath selection

01: path 1
10: path 2

A status information is valid, if the corresponding bit is set to "1":

FED ... Frame End detected

FSD ... Frame Start detected

FAD ... Frame Abort detected

RER ... Residue Error detected

Received data is not multiple of 8 bits.

CER ... CRC Error detected

Mailbox contains all received data.

NMD ... No More Data (only valid with fax modulations pump mode)

NMD indicates that the carrier of the remote fax modem is no longer available.

NOM ... Number of Valid Bytes in the Mailbox

Indicates the number N of valid data bytes to be read from the mailbox.

For the "Frame End"-condition, the FCS is contained in the HDLC frame as the last 2 octetts of the message (16 bit FCS).

For all conditions indicated in bit 14 - bit 10 (CTRL MSB), valid data in the buffer is indicated to the host although the message length may not yet be complete. Incomplete HDLC frames indicated in bit 12 - 10 are available in the mailbox including the erroneous data word. However, the host does not need to read such a frame from the buffer, it can skip this frame by only setting the ISAR Interrupt Acknowledge bit (IIA).

For all conditions indicated in bits 12 -10, data in the mailbox is to be skipped by the host.

3.5.1.2 SART Status Events with Receive Data - ASYNC (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
IIS			1	0	0	0	0	0

	15	14	13	12	11	10	9	8
CTRL MSB	-	-	BRE	BRS	DSD	PER	-	-

	7	6	5	4	3	2	1	0
CTRL LSB	NOM							

	7	6	5	4	3	2	1	0
1. Parameter	1st databyte of the message							

:

	7	6	5	4	3	2	1	0
N. Parameter	N-th databyte of the message							

DPS ... Datapath selection

01: path 1
10: path 2

A status information is valid, if the corresponding bit is set to "1":

BRE ... Break Signal End detected

BRS ... Break Signal Start detected

DSD ... Deleted Stopbit Detected

It is up to the host to decide whether this indicates a frame error or an allowed stop bit deletion due to overspeed range.

PER ... Parity Error

NOM ... Number of Valid Bytes in the Mailbox

Indicates the number N of valid data bytes to be read from the mailbox.

Break End occurs with the first character in the mailbox, which is not valid. If the message contains more than one character, all characters starting from the second are valid.
All other status indications (bit 12 - 10) refer to the last character of the message, so the last character is not valid if one of these bits is set.
For all conditions indicated in bit 12 to 10, valid data in the buffer is indicated to the host although the message length may not yet be complete.

For characters with a length of 5, 6 or 7 bits the parity bit is transfered together with the character in bit position 5, 6 or 7 respectively. It is not available for 8 bit characters.

3.5.1.3 SART Status Events with Receive Data - Binary (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
IIS			1	0	0	0	0	0

	15	14	13	12	11	10	9	8
CTRL MSB	-	-	-	-	-	-	-	NMD

	7	6	5	4	3	2	1	0
CTRL LSB	NOM							

	7	6	5	4	3	2	1	0
1. Parameter	1st databyte of the message							

:

	7	6	5	4	3	2	1	0
N. Parameter	N-th databyte of the message							

DPS ... Datapath selection

01: path 1
10: path 2

NMD ... No More Data (only valid with fax modulations pump mode)

NMD=1 indicates that the carrier of the remote fax modem is no longer available.

NOM ... Number of Valid Bytes in the Mailbox

Indicates the number N of valid data bytes to be read from the mailbox.

3.5.2 SART Control Commands with Transmit Data (Host → ISAR)

The SART transmitters control commands, which are data related, are passed to the ISAR along with any data transfer via the mailbox.
The SART control command is coded in the CTRL MSB, while the CTRL LSB indicates the number of data available in the mailbox for transmission.

Messages without data bytes, i.e. messages with CTRL LSB = 0, will be discarded by the ISAR.

3.5.2.1 SART Control Commands with Transmit Data - HDLC (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	0	0	0	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	FED	FST	GFA	0	0	0	NMD

	7	6	5	4	3	2	1	0
CTRL LSB	NOM							

	7	6	5	4	3	2	1	0
1. Parameter	1st databyte of the message							
:								
N. Parameter	N-th databyte of the message							

DPS ... Datapath selection

01: path 1
10: path 2

The control command is valid if the corresponding bit is set to "1":.

FED ... Frame End

The last databyte in the mailbox is indicated as the last of the HDLC frame.

FST ... Frame Start

The first databyte in the mailbox is indicated as the first of the HDLC frame.

GFA ... Generate Frame Abort

Initiates the generation of an abort sequence.

NMD ... No More Data (only for fax modulations pump mode)

Indicates the end of the data stream and initiates the termination of the current modulation. NMD has the similar effect as the command CMD_ESCAPE, the difference is, that NMD will cause the fax pump to turn off the modulation right after the last valid data and so enable to cope with timings related to certain protocols.
NMD must not be set, if there is another HDLC frame to be sent right after the current FED, as this would cause the flag sequence to be turned off.

After the last message of an HDLC frame has been sent (with FED set), immediately another separate message with NMD must be issued by the host, containing one dummy databyte (CTRL LSB=1), that will be discarded by the ISAR.

NOM ... Number of Valid Bytes in the Mailbox

Indicates the number N of valid data bytes in the mailbox to be transmitted.

3.5.2.2 SART Control Commands with Transmit Data - ASYNC (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	0	0	0	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	SOB	SAB	DSB	V42	0	0

	7	6	5	4	3	2	1	0
CTRL LSB	NOM							

	7	6	5	4	3	2	1	0
1. Parameter	1st databyte of the message							

:

	7	6	5	4	3	2	1	0
N. Parameter	N-th databyte of the message							

DPS ... Datapath selection

01: path 1
10: path 2

The individual control function is valid if the corresponding bit is set to "1":

SOB ... Stop Break Signal

SAB ... Start Break Signal

DSB ... Delete Stopbits

V42 ... Generate V42 detect sequence

NOM ... Number of Valid Bytes in the Mailbox

Indicates the number N of valid data bytes in the mailbox to be transmitted.

With SAB a sequence of at least 2M+3 start bits is initiated and SOB enables the host to generate a variable sequence length. If both, SAB and SOB are set within one message, a break signal of exactly 2M+3 start bits is generated.

If DSB is set, every 4th or 8th stopbit is omitted as configured in the SART configuration setup (see 3.4.2).

Setting of V42 causes the generation of 12 stopbits between each character in the mailbox.

3.5.2.3 SART Control Commands with Transmit Data - Binary (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	0	0	0	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	0	0	NMD

	7	6	5	4	3	2	1	0
CTRL LSB	NOM							

	7	6	5	4	3	2	1	0
1. Parameter	1st databyte of the message							

:

	7	6	5	4	3	2	1	0
N. Parameter	N-th databyte of the message							

DPS ... Datapath selection

01: path 1
10: path 2

The control function is valid if the corresponding bit is set to "1":

NMD ... No More Data (only for fax modulations pump mode)
Indicates the end of the data stream and initiates the termination of the current modulation. NMD has the similar effect as the command CMD_ESCAPE, the difference is, that NMD will cause the fax pump to turn off the modulation right after the last valid data and so enable to cope with timings related to certain protocols.

After the last message of a binary data stream has been sent, immediately another separate message with NMD must be issued by the host, containing one dummy databyte (CTRL LSB=1), that will be discarded by the ISAR.

NOM ... Number of Valid Bytes in the Mailbox

Indicates the number N of valid data bytes in the mailbox to be transmitted.

3.6 Pump Configuration

3.6.1 Pump Configuration Setup (Host → ISAR)

The pump is configured by the host. The Host Interrupt Status register (HIS) indicates that a new pump configuration is available in the mailbox registers.

Important note:

It is important to note that configuration of the pump will reset the whole data path except buffer configuration, i.e. any configuration of the SART and IOM-2 is invalid, therefore the pump should be configured right after buffer configuration and precede SART and IOM-2 configuration.

The LSB of the control register holds the number of additional parameter words which are passed via the mailbox . The maximum number N of parameter words depends on the pump path mode.
The message coding of configuration setup for some of the pump modes is similar in a few of the parameters, however the total message coding is described separately for each of the pump modes which are:

Pump Mode	PMOD
• Fax modulations • Datamodem modulations • Halfduplex modulations • V.110 • DTMF • DTMF transmission • Bypass	001 010 011 100 101 110 111

As the modulation based pump modes (001, 010, 011) are not available in datapath 2 , the second channel must not be configured to these pump modes.
The table below shows to which of the pump modes datapath 2 can be configured.

Datapath 1 (DPS=01)	Datapath 2 (DPS=10)
Fax modulations	
Datamodem modulations	
Halfduplex modulations	
V.110	V.110 (see note)
DTMF	
DTMF transmission	
Bypass	Bypass

Important note:

It is important to note that datapath 2 must not be configured to V.110 if path 1 is configured to datamodem modulations at the same time.

3.6.1.1 Pump Configuration Setup - Fax Modulations (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	0	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	OAM		0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	2							

	7	6	5	4	3	2	1	0
1. Parameter	0	0	0	TOA				

	7	6	5	4	3	2	1	0
2. Parameter	0	0	0	0	0	ATN	0	CTN

OAM ... Originating / Answering Mode

0x: Pump is set to answering mode
1x: Pump is set to originating mode

(note: x=don't care)

PMOD ... Pump path mode select

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

TOA ... Transmitter Output Attenuation

0: 0 db
1: 1 db
: :
31: 31 db

ATN ... Answer Tone

Enables or disables the generation of an answer tone when fax procedures are performed.
0: Answer tone is disabled
1: Answer tone is enabled

CTN ... Calling Tone

Enables or disables the generation of a calling tone when fax procedures are performed.
0: Calling Tone is disabled
1: Calling Tone is enabled

3.6.1.2 Pump Configuration Setup - Datamodem Modulations (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	0	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	OAM		0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	6							

	7	6	5	4	3	2	1	0
1. Parameter	0	0	0	TOA				

	7	6	5	4	3	2	1	0
2. Parameter	0	V23R	V22A	V22B	V22C	0	V21	BEL

	7	6	5	4	3	2	1	0
3. Parameter	AMOD	0	0	0	0	0	V32B	V23B

	7	6	5	4	3	2	1	0
4. Parameter	V32R (LSB)							

	7	6	5	4	3	2	1	0
5. Parameter	V32R (MSB)							

	7	6	5	4	3	2	1	0
6. Parameter	0	0	0	0	GTS		ATN	CTN

OAM ... Originating / Answering Mode

0x: Pump is set to answering mode
1x: Pump is set to originating mode

(note: x=don't care)

PMOD ... Pump path mode select

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

TOA ... Transmitter Output Attenuation

0: 0 db
1: 1 db
: :
31: 31 db

V23R ... V.23 reverse, 75 bps / 1200 bps

0: is not permitted
1: is permitted

V22A ... V.22bis, 2400 bps

0: is not permitted
1: is permitted

V22B ... V.22bis, 1200 bps

0: is not permitted
1: is permitted

V22C ... V.22 / Bell 212, 1200 bps

0: is not permitted
1: is permitted

V21 ... V.21 / Bell 103, 300 bps

0: is not permitted
1: is permitted

BEL ... Bell 103, 202 and 212 select

BEL selects whether in parameters V22C, V21 and V23B the V.xx or the Bell xxx modulation is selected.
0: Bell modulation is not permitted
1: Bell modulation is permitted

AMOD ... Automode operation according to EIA/TIA PN-2330

0: is disabled
1: is enabled

V32B ... V.32bis modulation

0: is not permitted
1: is permitted

V23B ... V.23 / Bell 202, 1200 bps / 75 bps

0: is not permitted
1: is permitted

V32R ... V.32 / V.32bis available rates

V32R determines the rate signal (specified in ITU V.32bis) that is used in the start-up, retrain and renegotiate procedures. The coding is the same as in the above mentioned recommendation, however some of the most commonly used codings are given below.

0000 0101 0001 0001:	V.32, 4800 bps
0000 1101 0001 0001:	V.32, up to 4800 bps
0000 0011 0001 0001:	V.32, 9600 bps
0000 1111 0001 0001:	V.32, up to 9600 bps
0000 1001 1101 0001:	V.32bis, 7200 bps
0000 1101 1101 0001:	V.32bis, up to 7200 bps
0000 1011 1001 0001:	V.32bis, 9600 bps
0000 1111 1101 0001:	V.32bis, up to 9600 bps
0000 1001 1011 0001:	V.32bis, 12000 bps
0000 1111 1111 0001:	V.32bis, up to 12000 bps
0000 1001 1001 1001:	V.32bis, 14400 bps
0000 1111 1111 1001:	V.32bis, up to 14400 bps

GTS ... Guard Tone Select (for V.22 / V.22bis)

00:	Guard tone disabled
01:	550 Hz guard tone enabled
10:	1800 Hz guard tone enabled

ATN ... V.25 answer tone

0:	disabled
1:	enabled

CTN ... V.25 calling tone

0:	disabled
1:	enabled

The selection of the modulation scheme is contained from the 2nd to the 6th parameter.
If automode is selected, any modulation which is masked (set to "0") in one of the parameters, is not tested/used in automode operation.
For non automode the permitted modulation parameters are used to select the data modulation. If more than one modulation is permitted, the highest data rate is selected.

3.6.1.3 Pump Configuration Setup - Halfduplex Modulations (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	0	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	OAM		0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	3							

	7	6	5	4	3	2	1	0
1. Parameter	0	0	0	TOA				

	7	6	5	4	3	2	1	0
2. Parameter	V17C	V17D	V29A	V29B	V29C	V27A	V27B	V21

	7	6	5	4	3	2	1	0
3. Parameter	0	0	0	EPT	0	0	V17A	V17B

OAM ... Originating / Answering Mode

00: not used
01: Pump is receiving only
10: Pump is transmitting only
11: Pump is receiving and transmitting

PMOD ... Pump path mode select

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

TOA ... Transmitter Output Attenuation

0: 0 db
1: 1 db
: :
31: 31 db

V17C ... V.17, 9600 bps

0: is disabled
1: is enabled

V17D ... V.17, 7200 bps

0: is disabled
1: is enabled

V29A ... V.29, 9600 bps

0: is disabled
1: is enabled

V29B ... V.29, 7200 bps

0: is disabled
1: is enabled

V29C ... V.29, 4800 bps

0: is disabled
1: is enabled

V27A ... V.27ter, 4800 bps

0: is disabled
1: is enabled

V27B ... V.27ter, 2400 bps

0: is disabled
1: is enabled

V21 ... V.21 Channel 2, 300 bps

0: is disabled
1: is enabled

EPT ... Echo Protector Tone

0: is disabled
1: is enabled

V17A ... V.17, 14400 bps

0: is disabled
1: is enabled

V17B ... V.17, 12000 bps

0: is disabled
1: is enabled

The selection of the modulation scheme is contained in the 2nd and 3rd parameter. If more than one modulation is enabled, the highest data rate is selected.

3.6.1.4 Pump Configuration Setup - V.110 (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	0	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	2							

	7	6	5	4	3	2	1	0
1. Parameter	VDR							

	7	6	5	4	3	2	1	0
2. Parameter	0	0	0	0	0	0	0	FCT

DPS ... Datapath selection

01: path 1
10: path 2

PMOD ... Pump path mode select

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

VDR ... V.110 Data Rate

6: 600 bps
7: 1200 bps
8: 2400 bps
9: 4800 bps
12: 9600 bps
16: 19200 bps
24: 38400 bps
32: 48000 bps
40: 56000 bps (default)
41: 56000 bps (alternative)
48: 64000 bps

The default and alternative adaptation of 56 kbps to 64 kbps are specified in the ITU-T V.110 recommendation.

FCT ... Flow Control (X-bits)

0: disabled
1: enabled

If enabled, the received X-bits are evaluated by the pump control and data from the mailbox is not forwarded to the SART unit for transmission if indicated by the remote side. Additionally, the X-bit change is indicated to the host by means of status events.
Flow control is only supported for SART mode V.14.

Important note:

In contrast to the recommended initialisation procedure described in chapter 3.1.1, the sequence for configuration with pump mode V.110 is slightly different than for all other modes:

If the pump should operate in V.110 mode, the IOM-2 interface must be configured as the last functional block, i.e. the sequence for configuration setup should be

1. Buffer configuration
2. Pump configuration (V.110)
3. SART configuration
4. IOM-2 configuration

3.6.1.5 Pump Configuration Setup - DTMF (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	0	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	1							

	7	6	5	4	3	2	1	0
1. Parameter	REL							

PMOD ... Pump path mode select

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

REL ... Rejection Level

A DTMF signal level which is below REL is not detected by the DTMF receiver. The equation for REL is given below (LEVEL is to be inserted without its unit dBm0):

$$REL = 253^{\frac{LEVEL+30}{20}}$$

As an example, for some of the most commonly used values REL is given below. It is recommended to choose a level between -50 and -40 dBm0 to provide for proper operation.

REL	LEVEL
25:	-50.1317 dBm0
28:	-49.1474 dBm0
31:	-48.2633 dBm0
35:	-47.2092 dBm0
40:	-46.0493 dBm0
45:	-45.0263 dBm0
50:	-44.1111 dBm0
56:	-43.1268 dBm0
63:	-42.1037 dBm0
71:	-41.0653 dBm0
80:	-40.0287 dBm0
90:	-39.0057 dBm0
101:	-38.0041 dBm0
113:	-37.0289 dBm0
127:	-36.0144 dBm0
142:	-35.0447 dBm0
160:	-34.0081 dBm0
179:	-33.0335 dBm0
201:	-32.0266 dBm0
226:	-31.0083 dBm0
253:	-30.0281 dBm0

In DTMF mode the octetts received from the IOM-2 timeslot are passed transparently through the pump without data formatting, similar to bypass mode.

The DTMF receiver is active to detect DTMF tones in the received data stream and to indicate received DTMF digits to the host. The DTMF receiver interprets the octetts received from the IOM-2 timeslot as A-law or μ-law PCM samples, depending on the IOM-2 configuration.

In transmit direction data is forwarded similar as in bypass mode.

No DTMF transmission is possible in this mode. To transmit DTMF digits the pump has to be configured to DTMF transmission.

3.6.1.6 Pump Configuration Setup - DTMF Transmission (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	0	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	1							

	7	6	5	4	3	2	1	0
1. Parameter	0	0	0	TOA				

PMOD ... Pump path mode select

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

TOA ... Transmitter Output Attenuation

0: 0 db
1: 1 db
: :
31: 31 db

3.6.1.7 Pump Configuration Setup - Bypass Mode (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	0	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	0							

DPS ... Datapath selection

01: path 1
10: path 2

PMOD ... Pump path mode select

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

3.6.2 Pump Control Command (Host → ISAR)

3.6.2.1 Pump Control Command - Fax Modulations (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	1	0	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	FCMD							

	7	6	5	4	3	2	1	0
CTRL LSB	NOM							

	7	6	5	4	3	2	1	0
1. Parameter	MODC							

or:

	7	6	5	4	3	2	1	0
1. Parameter	SLD							

FCMD ... Fax Command

Contains the one of the fax commands listed below. For some of the commands one additional parameter must be written to the mailbox.

A7h:	CMD_FTH	(NOM=1, Parameter: MODC)
A5h:	CMD_FRH	(NOM=1, Parameter: MODC)
A8h:	CMD_FTM	(NOM=1, Parameter: MODC)
A6h:	CMD_FRM	(NOM=1, Parameter: MODC)
ACh:	CMD_SIL_DET_ON	(NOM=1, Parameter: SLD)
A2h:	CMD_CONTINUE	(NOM=0)
A4h:	CMD__ESCAPE	(NOM=0)
ABh:	CMD_SIL_DET_OFF	(NOM=0)
A9h:	CMD_HALT	(NOM=0)

NOM ... Number of additional parameters in the mailbox

MODC ... Modulation Code

This parameter indicates the particular facsimile modulation and speed selected for the next procedure.

3:	300 bps	(V.21 Ch2)
24:	2400 bps	(V.27ter)
48:	4800 bps	(V.27ter)
72:	7200 bps	(V.29)
73:	7200 bps	(V.17)
74:	7200 bps	(V.17 with short train)
96:	9600 bps	(V.29)
97:	9600 bps	(V.17)
98:	9600 bps	(V.17 with short train)
121:	12000 bps	(V.17)
122:	12000 bps	(V.17 with short train)
145:	14400 bps	(V.17)
146:	14400 bps	(V.17 with short train)

SLD ... Silence Duration

This parameter determines the silence detect duration associated with the wait for silence procedure.

0:	0
1:	10 ms
2:	20 ms
:	:
255:	2550 ms

Command description:

CMD_FTH	Starts transmission of HDLC frames. The additional parameter (NOM=1) contains the modulation mode at which data is to be transmitted. If no parameter is provided (NOM=0), previous setting of this parameter will be used.
CMD_FRH	Starts reception of HDLC frames. The additional parameter (NOM=1) contains the modulation mode at which data is to be received. If no parameter is provided (NOM=0), previous setting of this parameter will be used.
CMD_FTM	Starts transmission of binary data. The additional parameter (NOM=1) contains the modulation mode at which data is to be transmitted. If no parameter is provided (NOM=0), previous setting of this parameter will be used.
CMD_FRM	Starts reception of binary data. The additional parameter (NOM=1) contains the modulation mode at which data is to be received. If no parameter is provided (NOM=0), previous setting of this parameter will be used.
CMD_SIL_DET_ON	Starts to wait a determined length of time. The additional parameter (NOM=1) contains the silence duration which is to be waited. If no parameter is provided (NOM=0), previous setting of this parameter will be used.
CMD_CONTINUE	Handshake message from the host to indicate that the host is ready to do the task (transmit/receive) which it selected before.
CMD_ESCAPE	This command is a regular escape in receive modes and a break in transmit modes.
CMD_SIL_DET_OFF	Break of silence detection.
CMD_HALT	Shut down from fax pump idle state.

3.6.2.2 Pump Control Command - Datamodem Modulations (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	1	0	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	DCMD							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

DCMD ... Datamodem Command

Contains one of the following datamodem commands, which are mainly used for debug purposes:

CEh:	LOCAL_RENEGOTIATE	(only for V.32bis)
CFh:	LOCAL_RETRAIN	(only for V.32bis, V.32 and V.22bis)

Command description:

LOCAL_RENEGOTIATE	Initiates a V.32bis renegotiation.
LOCAL_RETRAIN	Initiates a V.32bis, V.32 or V.22bis retrain respectively (depending on the selected modulation scheme).

3.6.2.3 Pump Control Command - Halfduplex Modulations (Host → ISAR)

There are no control commands defined for this mode.

3.6.2.4 Pump Control Command - V.110 (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	1	0	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	VCMD							

	7	6	5	4	3	2	1	0
CTRL LSB	NOM							

	7	6	5	4	3	2	1	0
1. Parameter	0	0	0	0	X	SB	SA1	SA0

or:

	7	6	5	4	3	2	1	0
1. Parameter	0	E1	E2	E3	E4	E5	E6	E7

or:

	7	6	5	4	3	2	1	0
1. Parameter	FRC							

DPS ... Datapath selection

01: path 1
10: path 2

VCMD ... V.110 Command

Contains one of the V.110 commands listed below. For some of the commands one additional parameter must be written to the mailbox.

10h: Remove clamp .
Data from the mailbox is transmitted (NOM=0).

11h: Set clamp to 0.
Instead of data, continuous 0-bits are transmitted as D-bits (NOM=0).

13h: Set clamp to 1.
Instead of data, continuous 1-bits are transmitted as D-bits (NOM=0).

30h: Set S-,X-bits (for transmitter).
The S- and X-bit setting is transfered in the 1. parameter (NOM=1).

40h: Set E-bits (for transmitter).
The E-bit setting is transfered in the 1. parameter (NOM=1).

50h: Delay of synchronisation (for receiver).
By default, frame synchronisation is achieved with the first V.110 frame that is received correctly.
This command tells the pump control, that more than one V.110 frame must be received correctly to achieve synchronism. The 1. parameter defines the number of additional frames to be received (NOM=1).

90h: Enable mailbox buffer empty indication (for transmitter)
If enabled, the ISAR will release a status event to the host as soon as the last data in the mailbox buffer is transmitted and the host can set control bits after the last valid data has been transmitted. The status event will only be released once for a buffer empty condition, for a further state transition from "not empty " to "empty", the indication has to be reenabled again (NOM=0).

A0h: Disable DTE control messages
A status change of the remote DTE is not indicated by status events (NOM=0). However, the host can get status information by releasing a status request message (see 3.7.1).

A1h: Enable DTE control messages (default after pump configuration)
Remote DTE status changes are indicated to the host by means of status events (NOM=0).

For the V.110 commands "Set clamp to 0 / 1" (VCMD = 11h / 13h) data must not be entered to the mailbox for transmission. If a clamp is set and continuous 0-bits or 1-bits are transmitted, mailbox data will be discarded by the ISAR.

NOM ... Number of additional parameters in the mailbox

For some of the commands one additional parameter must be written to the mailbox .

The value 0 or 1 for each control bit is directly written to the corresponding bit position within the frame:

X ... X-bit

SB ... S4-, S9-bit

SA1 ... S3-, S8-bit

SA0 ... S1-, S6-bit

E1-7 ... E1-, .. E7-bit

For the 600 bps data rate bit E7 is don't care in the message coding, but is controlled by the pump for multiframe synchronisation.

FRC ... Frame Counter

Denotes the number of additional frames that must be received correctly in order to achieve synchronism. As default (FRC=0), one V.110 frame must be received correctly to get synchronised and e.g. if FRC=3, four frames are to be received correctly, before data is transfered to the receive buffer.

3.6.2.5 Pump Control Command - DTMF (Host → ISAR)

No control commands are defined for DTMF mode.

To transmit DTMF tones, the pump has to be reconfigured to DTMF-transmission mode (PMOD = 110).

3.6.2.6 Pump Control Command - DTMF Transmission (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	1	0	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	DCMD							

	7	6	5	4	3	2	1	0
CTRL LSB	1							

	7	6	5	4	3	2	1	0
1. Parameter	TDIG							

DCMD ... DTMF Command

5Ah: Transmit DTMF digit (contained in 1. Parameter)
all other codes not supported

TDIG ... Transmit DTMF Digit

10h: "0"
11h: "1"
12h: "2"
13h: "3"
14h: "4"
15h: "5"
16h: "6"
17h: "7"
18h: "8"
19h: "9"
1Ah: "A"
1Bh: "B"
1Ch: "C"
1Dh: "D"
1Eh: "∗"
1Fh: "#"

The DTMF transmitter is controlled in this mode only. It should be noted that the IOM-2 interface must be configured with rate conversion enabled before any DTMF digits can be transmitted.

3.6.2.7 Pump Control Command - Bypass Mode (Host → ISAR)

There are no control commands defined for this mode.

3.7 Pump Status

3.7.1 Pump Status Request (Host → ISAR)

A status register which holds the current status of the data pump path is available on request. The pump status request is fully specified with the Host Interrupt Status register (HIS). The mailbox control register is not used and should be written to 0.

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			0	0	1	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	0							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

DPS ... Datapath selection

01: path 1
10: path 2

3.7.2 Pump Status Response (ISAR → Host)

3.7.2.1 Pump Status Response - Fax Modulations (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	1	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	OAM		0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	2							

	7	6	5	4	3	2	1	0
1. Parameter	RIL							

	7	6	5	4	3	2	1	0
2. Parameter	RIM							

OAM ... Originating / Answering Mode

0x: Pump is in answering mode
1x: Pump is in originating mode

(note: x=don't care)

PMOD ... Selected pump path mode

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

RIL ... Rate Index - LSB

RIL contains the data rate at which the pump is currently operating.

0: no speed defined
5: 300 bps
8: 2400 bps
9: 4800 bps
10: 7200 bps
11: 9600 bps
13: 12000 bps
14: 14400 bps

RIM ... Rate Index - MSB

RIL contains the modulation scheme at which the pump is currently operating, the specific data rate is given in RIL. If RIM is 0, the preceding pump configuration setup was not successful.

0: no modulation scheme configured
41h: V.21 asynchronous (FSK V.14 mode)
82h: V.17
92h: V.29
A2h: V.27ter

All other codes not supported.

3.7.2.2 Pump Status Response - Datamodem Modulations (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	1	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	OAM		0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	4							

	7	6	5	4	3	2	1	0
1. Parameter	RIL							

	7	6	5	4	3	2	1	0
2. Parameter	RIM							

	7	6	5	4	3	2	1	0
3. Parameter	-	-	RRT	LRT	-	RRP	CON	NEG

	7	6	5	4	3	2	1	0
4. Parameter	-	CLD	RTY	TMO	-	-	RRN	LRN

OAM ... Originating / Answering Mode

0x: Pump is in answering mode
1x: Pump is in originating mode

(note: x=don't care)

PMOD ... Selected pump path mode

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

RIL ... Rate Index - LSB

RIL contains the data rate at which the pump is currently operating.

0: no speed defined
1: 1200 bps (transmitter), 75 bps (receiver)
3: 75 bps (transmitter, 1200 bps (receiver)
5: 300 bps
6: 600 bps
7: 1200 bps
8: 2400 bps
9: 4800 bps
10: 7200 bps
11: 9600 bps (no trellis)
12: 9600 bps (trellis)
13: 12000 bps
14: 14400 bps

All other codes not supported.

RIM ... Rate Index - MSB

RIL contains the modulation scheme at which the pump is currently operating, the specific data rate is given in RIL. If RIM is 0, the preceding pump configuration setup was not successful.

0: no modulation scheme configured
20h: V.32/V.32bis
40h: V.22
41h: V.21 asynchronous (FSK V.14 mode)
51h: Bell 103
61h: V.23
71h: Bell 202
82h: V.17
92h: V.29
A2h: V.27ter

All other codes not supported.

The status information is valid, if the corresponding bit is set:

RRT ... Remote Retrain

The pump is in a retrain phase that is initiated by the remote station.

LRT ... Local Retrain

The pump is in a retrain phase that is initiated by the local station.

RRP ... Retrain / Renegotiate Phase

The pump is in a retrain or renegotiate phase. More details are contained in the status bits RRT, LRT, RRN and LRN.

CON ... Connection

The pump has established a logical connection to the remote subscriber, i.e. it has passed the training phase and will continue with data transmission/reception..

NEG ... Negotiation

The pump is in the first training phase to establish the modulation.

CLD ... Cleardown

This bit is set if there is a reason to terminate and restart the modulation. A reason could be a rate signal without any permitted data rate or a timeout condition for bulk delay (together with setting of TMO).

RTY ... Retry

During training phase the remote station has requested for a retrain (V.32bis only).

TMO ... Timeout

During training phase the timing conditions for bulk delay were violated.

RRN ... Remote Renegotiation

The pump is in a renegotiate phase that is initiated by the remote station.

LRN ... Local Renegotiation

The pump is in a renegotiate phase that is initiated by the local station.

3.7.2.3 Pump Status Response - Halfduplex Modulations (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	1	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	OAM		0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	2							

	7	6	5	4	3	2	1	0
1. Parameter	RIL							

	7	6	5	4	3	2	1	0
2. Parameter	RIM							

OAM ... Originating / Answering Mode

00: not used
01: Pump is receiving only
10: Pump is transmitting only
11: Pump is receiving and transmitting

PMOD ... Selected pump path mode

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

RIL ... Rate Index - LSB

RIL contains the data rate at which the pump is currently operating.

0: no speed defined
5: 300 bps
8: 2400 bps
9: 4800 bps
10: 7200 bps
11: 9600 bps (no trellis)
12: 9600 bps (trellis)
13: 12000 bps
14: 14400 bps

All other codes not supported.

RIM ... Rate Index - MSB

RIL contains the modulation scheme at which the pump is currently operating, the specific data rate is given in RIL. If RIM is 0, the preceding pump configuration setup was not successful.

0: no modulation scheme configured
41h: V.21 asynchronous (FSK V.14 mode)
82h: V.17
92h: V.29
A2h: V.27ter

All other codes not supported.

3.7.2.4 Pump Status Response - V.110 (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	1	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	6							

	7	6	5	4	3	2	1	0
1. Parameter	RIL							

	7	6	5	4	3	2	1	0
2. Parameter	RIM							

	7	6	5	4	3	2	1	0
3. Parameter	-	-	-	ROF0	ROF1	RON1	ROFX	RONX

	7	6	5	4	3	2	1	0
4. Parameter	-	-	-	-	X	SB	SA1	SA0

	7	6	5	4	3	2	1	0
5. Parameter	-	E1	E2	E3	E4	E5	E6	E7

	7	6	5	4	3	2	1	0
6. Parameter	FRC							

DPS ... Datapath selection

01: path 1
10: path 2

PMOD ... Selected pump path mode

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

RIL ... Rate Index - LSB

RIL contains the data rate at which the pump is currently operating.

0: no speed defined
6: 600 bps
7: 1200 bps
8: 2400 bps
9: 4800 bps
12: 9600 bps
16: 19200 bps
24: 38400 bps
32: 48000 bps
40: 56000 bps (default)
41: 56000 bps (alternative)
48: 64000 bps

All other codes not supported.
RIL=0 is indicated in V.110 mode if not synchronised.

RIM ... Rate Index - MSB

RIL contains the modulation scheme at which the pump is currently operating, the specific data rate is given in RIL. If RIM is 0, the preceding pump configuration setup was not successful, e.g. a wrong data rate was selected for V.110.

0: no modulation scheme configured
C0h: V.110

All other codes not supported.

ROF0, ROF1, RON1, ROFX, RONX ... Remote DTE status

Contains information about the status of the remote DTE. The received D- and SA-bits are sampled and compared against different possibilities. A status change is detected by a match of the comparison and indicated by setting the bits as shown below. Several bits in the parameter can be set simultaneously depending on the sampled data, e.g. if ROF0 is set, ROFX will be set, too.
It should be noted, that the status response is not data related, i.e. it contains the remote status that is currently received.

Status	Status Name	Sampled Data		
ROF0	Remote (0, OFF)	D	00000000	00000000
		SA	11111111	11111111
ROF1	Remote (1, OFF)	D	11111111	11111111
		SA	11111111	11111111
RON1	Remote (1, ON)	D	11111111	11111111
		SA	00000000	00000000
ROFX	Remote (X, OFF)	D	XXXXXXXX	XXXXXXXX
		SA	11111111	11111111
RONX	Remote (X, ON)	D	XXXXXXXX	XXXXXXXX
		SA	00000000	00000000

Note: X=don't care

The following parameters contain the value for each X-, S- and E-bit, which is currently received:

X ... X-bit

SB ... S4-, S9-bit

SA1 ... S3-, S8-bit

SA0 ... S1-, S6-bit

E1-E7 ... E1-bit - E7-bit

For the 600 bps data rate bit E7 is always set to 1.

FRC ... Frame Counter for delay of synchronisation

Denotes the number of additional frames, which was set by the host, that must be received correctly in order to achieve synchronism. As default (FRC=0), one V.110 frame must be received correctly to get synchronised and e.g. if FRC=3, four frames are to be received correctly, before data is transfered to the receive buffer.

3.7.2.5 Pump Status Response - DTMF (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	1	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	2							

	7	6	5	4	3	2	1	0
1. Parameter	RIL							

	7	6	5	4	3	2	1	0
2. Parameter	RIM							

PMOD ... Selected pump path mode

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

RIL ... Rate Index - LSB

RIL contains the data rate at which the pump is currently operating.

48: 64000 bps

RIM ... Rate Index - MSB

RIL contains the modulation scheme at which the pump is currently operating, the specific data rate is given in RIL.

C0h: DTMF mode

3.7.2.6 Pump Status Response - DTMF Transmission (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS	0	1	1	0	1	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	4							

	7	6	5	4	3	2	1	0
1. Parameter	0							

	7	6	5	4	3	2	1	0
2. Parameter	0							

	7	6	5	4	3	2	1	0
3. Parameter	0							

	7	6	5	4	3	2	1	0
4. Parameter	0							

PMOD ... Selected pump path mode

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

3.7.2.7 Pump Status Response - Bypass Mode (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	1	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	2							

	7	6	5	4	3	2	1	0
1. Parameter	RIL							

	7	6	5	4	3	2	1	0
2. Parameter	RIM							

DPS ... Datapath selection

01: path 1
10: path 2

PMOD ... Selected pump path mode

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

RIL ... Rate Index - LSB

RIL contains the data rate at which the pump is currently operating.

48: 64000 bps

RIM ... Rate Index - MSB

RIL contains the modulation scheme at which the pump is currently operating, the specific data rate is given in RIL.

C0h: bypass mode

3.7.2.8 Pump Status Response - Pump Disabled (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	1	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	0	0	0	0	0	PMOD		

	7	6	5	4	3	2	1	0
CTRL LSB	0							

DPS ... Datapath selection

01: path 1
10: path 2

PMOD ... Selected pump path mode

000: Disable all (no mailbox entry)
001: Fax modulations
010: Datamodem modulations
011: Halfduplex modulations
100: V.110
101: DTMF
110: DTMF transmission
111: Bypass

3.7.3 Pump Status Events (ISAR → Host)

Status events are released to the host by the data pump during data transmission/reception and contain dynamic information specific for the selected pump mode.

3.7.3.1 Pump Status Events - Fax Modulations (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
IIS	0	1	1	0	1	0	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	FEVT							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

FEVT ... Fax Event

Contains the one of the following fax events:

02h: 10 ms timer interrupt (if enabled; see 3.8.2 Timer Interrupt Request)
BCh: RSP_READY
B3h: LINE_TX_HDLC
B2h: LINE_TX_BINARY
B1h: LINE_RX_HDLC
B0h: LINE_RX_BINARY
B5h: RSP_CONNECT
B7h: RSP_DISC
B9h: RSP_FCERROR
BEh: RSP_SIL_DET
ABh: RSP_SIL_DET_OFF
BAh: FLAGS_DETECT

Fax event description:

RSP_READY — Response to configuration fax mode originator or answerer.

LINE_TX_HDLC — Response to CMD_FTH in order to indicate that the modulation has been established.

LINE_TX_BINARY — Response to CMD_FTM in order to indicate that the modulation has been established.

LINE_RX_HDLC — Response to CMD_FRH in order to indicate that the modulation has been established.

LINE_RX_BINARY — Response to CMD_FRM in order to indicate that the modulation has been established.

RSP_CONNECT	Indication that the fax pump is ready to receive or transmit data.
RSP_DISC	Indication that the fax pump has turned off modulation after transmitting all pending data / after the host issues the command CMD_ESCAPE.
RSP_FCERROR	Indication that the fax pump has detected a "wrong" modulation before it releases the event RSP_CONNECT.
RSP_SIL_DET	Indication that the prior selected duration of silence time has occured.
RSP_SIL_DET_OFF	Indication that the fax pump has received an "abandon silence time detection" command from the host.
FLAGS_DETECT	Indication that the fax pump has detected flags.

3.7.3.2 Pump Status Events - Datamodem Modulations (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
IIS	0	1	1	0	1	0	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	DEVT							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

DEVT ... Datamodem Automode Event

Contains the one of the following datamodem events:

02h: 10 ms timer interrupt (if enabled; see 3.8.2 Timer Interrupt Request)
18h: CONNECTION_ON
19h: CONNECTION_OFF
20h: V24_OFF
21h: CTS_ON
22h: CTS_OFF
23h: DCD_ON
24h: DCD_OFF
25h: DSR_ON
26h: DSR_OFF
CCh: REMOTE_RETRAIN
CDh: REMOTE_RENEGOTIATE
D4h: GSTN_CLEARDOWN

3.7.3.3 Pump Status Events - Halfduplex Modulations (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
IIS	0	1	1	0	1	0	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	HEVT							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

HEVT ... Halfduplex modulations Event

Contains the one of the following datamodem events:

02h: 10 ms timer interrupt (if enabled; see 3.8.2 Timer Interrupt Request)
18h: CONNECTION_ON
19h: CONNECTION_OFF
20h: V24_OFF
21h: CTS_ON
22h: CTS_OFF
23h: DCD_ON
24h: DCD_OFF
25h: DSR_ON
26h: DSR_OFF
D4h: GSTN_CLEARDOWN

3.7.3.4 Pump Status Events - V.110 (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
IIS			1	0	1	0	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	VEVT							

	7	6	5	4	3	2	1	0
CTRL LSB	NOM							

	7	6	5	4	3	2	1	0
1. Parameter	-	-	-	-	X	SB	SA1	SA0

or:

	7	6	5	4	3	2	1	0
1. Parameter	-	E1	E2	E3	E4	E5	E6	E7

or:

	7	6	5	4	3	2	1	0
1. Parameter	-	-	-	ROF0	ROF1	RON1	ROFX	RONX

DPS ... Datapath selection

01: path 1
10: path 2

VEVT ... V.110 Event

Contains one of the following V.110 events. For some of the events one additional parameter is provided via the mailbox.

02h: 10 ms timer interrupt (if enabled; see 3.8.2 Timer Interrupt Request)
30h: Change in S-bits received (NOM=1).
The S-bits are specified in the first parameter.
40h: Change in E-bits received (NOM=1).
The E-bits are specified in the first parameter.
60h: Synchronisation lost (NOM=0).
This event is released for a change from synchronised to not synchronised.
61h: Synchronisation achieved (NOM=0).
This event is released for a change from not synchronised to synchronised.
70h: Change in X-bit from 1 → 0 received (NOM=0).
71h: Change in X-bit from 0 → 1 received (NOM=0).
90h: Mailbox buffer empty (NOM=0)
This event indicates to the host, that the last data is transmitted and that the mailbox transmit buffer is empty. This event must be enabled by the host (see 3.6.2.4 Pump Control Command - V.110) and it is generated only once, i.e. for further state transitions from "not empty" to "empty", the generation of the status event must be reenabled again.
A0h: DTE status (NOM=1)
The first parameter contains information about the status of the remote DTE. The received D- and SA-bits are sampled and compared against different possibilities. A status change is detected by a match of the comparison and indicated to the host. The generation of DTE status events can be enabled/disabled by control commands (see 3.6.2.4 Pump Control Command - V.110).

NOM ... Number of Valid Bytes in the Mailbox

For certain status events one additional parameter is provided via the mailbox.

For the following parameters the received value 0 or 1 for each bit is indicated in the corresponding bit position. The control bits do not represent the real time value that is currently received, but they are data related, i.e. the S-, X- and E-bits are transfered to the host with the corresponding data that was received at the same time.
Information about control bits that are currently received can be requested by the host (see 3.7.1 Pump status request), additionally the real time value for X, which is needed for flow control, is indicated by two separate status events (VEVT = 70h and 71h).

X ... X-bit

SB ... S4-, S9-bit

SA1 ... S3-, S8-bit

SA0 ... S1-, S6-bit

E1-E7 ... E1-bit - E7-bit

For the 600 bps data rate bit E7 is always set to 1.

FRC ... Frame Counter for delay of synchronisation

Denotes the number of additional frames, which was set by the host, that must be received correctly in order to achieve synchronism. As default (FRC=0), one V.110 frame must be received correctly to get synchronised and e.g. if FRC=3, four frames are to be received correctly, before data is transfered to the receive buffer.

ROF0, ROF1, RON1, ROFX, RONX ... Remote DTE status

Contains information about the status of the remote DTE. The received D- and SA-bits are sampled and compared against different possibilities. A status change is detected by a match of the comparison and indicated by setting the bits as shown below. Several bits in the parameter can be set simultaneously depending on the sampled data, e.g. if ROF0 is set, ROFX will be set, too.

Status	Status Name	Sampled Data		
ROF0	Remote (0, OFF)	D SA	00000000 11111111	00000000 11111111
ROF1	Remote (1, OFF)	D SA	11111111 11111111	11111111 11111111
RON1	Remote (1, ON)	D SA	11111111 00000000	11111111 00000000
ROFX	Remote (X, OFF)	D SA	XXXXXXXX 11111111	XXXXXXXX 11111111
RONX	Remote (X, ON)	D SA	XXXXXXXX 00000000	XXXXXXXX 00000000

Note: X=don't care

It should be noted that the DTE status information is data related and may not represent the value currently be received.

Comment:

After reset the remote DTE status logic is in no state and all status bits (ROF0, ROF1, RON1, ROFX and RONX) are set to 0. The pump will start to search for frame synchronisation.

When synchronisation is achieved, the host will receive the remote DTE status and the S-, X- and E-bits from the pump by means of status events. This information is related to the last V.110 frame that was received for synchronisation, as this frame was received without any sync error. Starting with the subsequent frame, the D-bits of the frame are transfered as valid user data to the SART.

The same mechanism for resynchronisation is used if frame synchronisation is temporarily lost.

3.7.3.5 Pump Status Events - DTMF (ISAR → Host):

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
IIS	0	1	1	0	1	0	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	RDIG							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

RDIG ... Received DTMF Digit

One of the following DTMF digits was detected by DTMF receiver:

10h: "0"
11h: "1"
12h: "2"
13h: "3"
14h: "4"
15h: "5"
16h: "6"
17h: "7"
18h: "8"
19h: "9"
1Ah: "A"
1Bh: "B"
1Ch: "C"
1Dh: "D"
1Eh: "∗"
1Fh: "#"

3.7.3.6 Pump Status Events - DTMF Tran smission (ISAR → Host):

No status events defined for this mode.

3.7.3.7 Pump Status Events - Bypass Mode (ISAR → Host):

No status events defined for this mode.

3.8 IOM-2 Configuration

The following commands, requests and responses are used to setup/control the network access of the data paths.
The configuration/status/commands of both modem/V.110 channels are similar.
The D-channel path IOM-2 commands are different and therefore described separately.
Global IOM-2 setup is done by using the „IOM-2 configuration“ codes of the Test/Diagnostics commands.

3.8.1 IOM-2 Configuration Setup (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	0	1	1	1

	15	14	13	12	11	10	9	8
CTRL MSB	IOM	0	0	0	COD			RCV

	7	6	5	4	3	2	1	0
CTRL LSB	5							

	7	6	5	4	3	2	1	0
1. Parameter	0	0	0	TXD	RXD	TSL		

	7	6	5	4	3	2	1	0
2. Parameter	0	0	RTSO					

	7	6	5	4	3	2	1	0
3. Parameter	0	0	0	0	0	RCS		

	7	6	5	4	3	2	1	0
4. Parameter	0	0	TTSO					

	7	6	5	4	3	2	1	0
5. Parameter	0	0	0	0	0	TCS		

DPS ... Datapath selection

- 01: path 1
- 10: path 2

IOM ... IOM-2 data access

- 0: disabled
- 1: enabled

COD ... Coding

000: no PCM coding
001: A-law coding
010: µ-law coding
all other codes reserved

A-law and µ-law coding is selected for all modulation related pump modes (fax, datamodem and halfduplex modulation, DTMF and DTMF transmission). For all other modes (V.110 and bypass mode) "no PCM coding" must be selected.

RCV ... Rate Conversion

RCV refers to internal operation of the device and must be set depending on the pump mode.
0: disabled (for all other pump modes)
1: enabled (for pump modes 001, 010, 011, 101)

TXD ... Transmit path switched to

0: DD-line
1: DU-line (reset value)

RXD ... Receive path switched to

0: DD-line (reset value)
1: DU-line

TSL ... Timeslot length for Receive / Transmit path

00x: 8 bit wordlength (reset value)
010: 16 bit wordlength (used to operate with 16 linear codec, e.g. ARCOFI)
011: 16 bit wordlength, splitted into two 8-bit words
all other codes currently not supported

RTSO ... Receive Time Slot Offset to FSC

0: 0 bit
1: 8 bit
: :
63: 504 bit

Reset value: RTSO = 0 for path 1
RTSO = 1 for path 2

RCS ... Receive Clock Shift

0: 0 bit
1: 1 bit
: :
7: 7 bit

Reset value: RCS = 0 for path 1 and 2

TTSO ... Transmit Time Slot Offset to FSC

0:	0 bit
1:	8 bit
:	:
63:	504 bit

Reset value: TTSO = 0 for path 1
TTSO = 1 for path 2

TCS ... Transmit Clock Shift

0:	0 bit
1:	1 bit
:	:
7:	7 bit

Reset value: TCS = 0 for path 1 and 2

3.8.2 IOM-2 Configuration Request (Host → ISAR)

The current configuration can be read on request by the host. The request is fully specified by the Host Interrupt Status register (HIS), i.e. the control registers and the mailbox are not used for the request command and must be set to 0.

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			0	0	0	1	1	1

	15	14	13	12	11	10	9	8
CTRL MSB	0							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

DPS ... Datapath selection

01: path 1
10: path 2

3.8.3 IOM-2 Configuration Response (ISAR → Host)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
IIS			1	0	0	1	1	1

	15	14	13	12	11	10	9	8
CTRL MSB	IOM	0	0	0	COD			RCV

	7	6	5	4	3	2	1	0
CTRL LSB	5							

	7	6	5	4	3	2	1	0
1. Parameter	0	0	0	TXD	RXD	TSL		

	7	6	5	4	3	2	1	0
2. Parameter	0	0	RTSO					

	7	6	5	4	3	2	1	0
3. Parameter	0	0	0	0	0	RCS		

	7	6	5	4	3	2	1	0
4. Parameter	0	0	TTSO					

	7	6	5	4	3	2	1	0
5. Parameter	0	0	0	0	0	TCS		

DPS ... Datapath selection

01: path 1
10: path 2

IOM ... IOM-2 data access

0: disabled
1: enabled

COD ... Selected Coding

000: no PCM coding
001: A-law coding
010: μ-law coding
all other codes reserved

A-law and μ-law coding is selected for all modulation related pump modes (fax, datamodem and halfduplex modulation, DTMF and DTMF transmission). For all other modes (V.110 and bypass mode) "no PCM coding" must be selected.
The transcoding modes (A-law to μ-law and reverse) are intended for future applications.

RCV ... Selected Rate Conversion

RCV refers to internal operation of the device and must be set depending on the pump mode.
0: disabled (for all other pump modes)
1: enabled (for fax modulations, datamodem modulations, halfduplex modulations and DTMF-transmission)

TXD ... Transmit path switched to

0: DD-line
1: DU-line (reset value)

RXD ... Receive path switched to

0: DD-line (reset value)
1: DU-line

TSL ... Timeslot length for Receive / Transmit path

00x: 8 bit wordlength (reset value)
010: 16 bit wordlength
011: 16 bit wordlength, splitted into two 8-bit words
all other codes currently not supported

RTSO ... Receive Time Slot Offset to FSC

0: 0 bit
1: 8 bit
: :
63: 504 bit

Reset value: RTSO = 0 for buffer 1
RTSO = 1 for buffer 2

RCS ... Receive Clock Shift

0: 0 bit
1: 1 bit
: :
7: 7 bit

Reset value: RCS = 0 for buffer 1 and 2

TTSO ... Transmit Time Slot Offset to FSC

0: 0 bit
1: 8 bit
: :
63: 504 bit

Reset value: TTSO = 0 for buffer 1
TTSO = 1 for buffer 2

TCS ... Transmit Clock Shift

0: 0 bit
1: 1 bit
: :
7: 7 bit

Reset value: TCS = 0 for buffer 1 and 2

3.8.4 IOM-2 Control Commands (Host → ISAR)

	7	6	5	4	3	2	1	0
	DPS		MSC				MDS	
HIS			1	0	1	0	1	1

	15	14	13	12	11	10	9	8
CTRL MSB	ICMD							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

DPS ... Datapath selection

01: path 1
10: path 2

ICMD ... IOM-2 Control Command

00h: Stop IOM-2 channel
All activities on the IOM-2 interface are frozen. In transmit direction all bits are written to "1" on the IOM-2 timeslot and in receive direction all bits received from the IOM-2 timeslot are "1".

01h: Restart IOM-2 channel
After IOM-2 activities were stopped (ICMD=00), data transfer with from/to the IOM-2 timeslots is restarted again with the current configuration settings.
This command must not be used before the IOM-2 interface is configured.

11h: Loop ON
Transmit data is looped back to the receiver input. In this case the configuration for the timeslot position of the receiver is without any effect.
Additionally, the transmit data itself is written to the programmed transmit timeslot if IOM-2 data access is enabled (IOM=1). If IOM-2 data access is disabled (IOM=0), transmit data will not be written to the IOM-2 timeslot but only looped back to the receiver input.

10h: Loop OFF
The loop of transmit data to the receiver input (activated by ICMD=11h) is switched off. Regular read/write access to the IOM-2 is performed according to the configuration setting.

Important note:

The control commands "Stop / Restart IOM-2 channel" have a different effect than "IOM-2 data access enable / disable" (IOM-bit) in configuration setup.
The current configuration setting is not affected by "Stop IOM-2 channel", only transfer of user data between the pump and the IOM-2 timeslots is stopped, which is resumed by the command "Restart IOM-2 channel".

3.9 Test / Diagnostics Path

The test/diagnostics path is used for test and diagnostics, general configuration and control (not related to a specific data path) and as an answer channel for certain status / configuration requests to the data channels.

3.9.1 General Configuration (Host → ISAR)

There are two types of general configuration setup. It is programming of

- waitstates for the internal DSP operations,
- a timer interrupt generated by the ISAR.

Waitstate

	7	6	5	4	3	2	1	0
	DPS		MSC					
HIS	0	0	1	0	0	1	1	1

	15	14	13	12	11	10	9	8
CTRL MSB	WSS							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

WSS ... Wait State Setting

Sets the waitstates for the internal DSP operations
30h: 15 waitstates
31h: 14 waitstates
: :
3Fh: 0 waitstates

Timer Interrupt

	7	6	5	4	3	2	1	0
	DPS		MSC					
HIS	0	0	1	0	0	1	0	1

	15	14	13	12	11	10	9	8
CTRL MSB	CMD							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

CMD ... Command for general configuration

20h: Timer interrupt off
21h: Timer interrupt on

If enabled, a 10 ms timer interrupt is generated to the host. This can be used for certain driver software implementations that require hardware interrupts. As this is normally used in applications with data modulations, the interrupt request message is coded as a message related to buffer 1 (see 3.9.2), however, it can be used for purposes within other buffers, too. Using the timer interrupt increases the message load between the ISAR and the host significantly.

3.9.2 Timer Interrupt Request (ISAR → Host)

The "Timer Interrupt Request" message" is generated once per 10 ms if enabled by the "General Configuration" message in chapter 3.9.1.

	7	6	5	4	3	2	1	0
	DPS		MSC					
IIS	0	1	1	0	1	0	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	2							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

3.9.3 Software Version Request (Host → ISAR)

The host can request the version number of the DSP software by the following request message.

	7	6	5	4	3	2	1	0
	DPS		MSC					
HIS	0	0	0	0	0	1	0	1

	15	14	13	12	11	10	9	8
CTRL MSB	10h							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

3.9.4 Software Version Response (ISAR → Host)

The ISAR returns the version number of the DSP software if requested by the host.

	7	6	5	4	3	2	1	0
	DPS		MSC					
HIS	0	0	1	0	0	1	0	1

	15	14	13	12	11	10	9	8
CTRL MSB	10h							

	7	6	5	4	3	2	1	0
CTRL LSB	1							

	7	6	5	4	3	2	1	0
1. Parameter	SVN							

SVN ... Software Version Number

Contains the version number of the DSP software on the device.
04h: Download firmware V1.0

all other codes currently not supported.

3.9.5 Invalid Message Received (ISAR → Host)

If the host issues a message to the ISAR with an HIS coding that is not specified, the ISAR will respond with the following error message to indicate that an invalid message coding was detected.

	7	6	5	4	3	2	1	0
	DPS		MSC					
IIS	0	0	1	1	1	1	1	1

	15	14	13	12	11	10	9	8
CTRL MSB	INV							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

INV ... Invalid HIS coding

Contains the invalid HIS register coding of the message which was released by the host.

3.9.6 Request Selftest Result (ISAR → Host)

After download of the DSP program the ISAR automatically performs a selftest, which will check for memory errors or missing IOM-2 clocks.
The result of the selftest can be requested by the host and possible error conditions are contained in the "Selftest Response" message (see 3.9.7).

	7	6	5	4	3	2	1	0
	DPS		MSC					
HIS	0	0	0	0	0	1	0	1

	15	14	13	12	11	10	9	8
CTRL MSB	40h							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

3.9.7 Selftest Response (ISAR → Host)

The selftest result requested by the host (see 3.9.6) will result in a response message containing information about possible error conditions.

	7	6	5	4	3	2	1	0
	DPS		MSC					
IIS	0	0	1	0	0	1	0	1

	15	14	13	12	11	10	9	8
CTRL MSB	40h							

	7	6	5	4	3	2	1	0
CTRL LSB	1							

	7	6	5	4	3	2	1	0
1. Parameter	0	0	0	0	PRR	MB1	MB0	IOC

PRR ... Program RAM/ROM error

MB1 ... Internal memory error (bank 1)

MB0 ... Internal memory error (bank 0)

IOC ... IOM-2 clock not available

No clock from the IOM-2 interface is detected. It is recommended to reset the hardware. Without clocks on the IOM-2 interface no operation is possible.

3.10 DSP Program Download

In the ISAR PSB 7110 V1.0 (Development Chip) the DSP program is downloaded through the host interface into the external memory.
The mechanism is divided into several steps after which the ISAR is set to normal operation mode.

Step 1	ISAR hardware reset
Step 2	Enable host interrupt (MSK-bit in register 75h) (only if interrupt operation is intended)
Step 3	Verify Chip Version Number (no program download for ROM Versions)
Step 4	Download of program code
Step 5	Start of DSP Software, switch from program download to normal operation

3.10.1 Hardware Reset

After a hardware reset the ISAR is started in a download mode, i.e. it is not capable to perform any functions of the normal operating mode. Therefore none of the mailbox coding for configuration, status and data exchange is valid. The external access pin EA# must be set to "1", to enable the boot program in internal ROM for program download.

3.10.2 Host Interrupt Enable

If interrupt operation is intended, the mask bit MSK (bit 2) in register 75h has to be set to "1" (all other bits set to "0"), to enable the indication of interrupts to the host.

The program download can also be performed by polling since the reaction time of the ISAR is very short. In this case setting of the MSK bit can be omitted and instead the host has to poll the status bit STA of register 75h.

3.10.3 Verify Chip Version Number

In this step the chip version number must be checked.
The host should make sure that there is Version 1.0 of the ISAR and not a ROM-Version of it, as in the latter case no program download is necessary and should be done.
In this way only one version of a host software is necessary for an ISAR system that could use the functionality of either the download version or the ROM version.

Version Number Request

The host requests the chip version number by the following command:

	7	6	5	4	3	2	1	0
	DPS		MSC					
HIS	0	0	0	1	0	1	0	0

	15	14	13	12	11	10	9	8
CTRL MSB	0							

	7	6	5	4	3	2	1	0
CTRL LSB	3							

	7	6	5	4	3	2	1	0
1. Parameter	20h							

	7	6	5	4	3	2	1	0
2. Parameter	0							

	7	6	5	4	3	2	1	0
3. Parameter	1							

Version Number Response

The ISAR provides the chip version number by the following response:

	7	6	5	4	3	2	1	0
	DPS		MSC					
IIS	0	0	0	1	0	1	0	1

	15	14	13	12	11	10	9	8
CTRL MSB	0							

	7	6	5	4	3	2	1	0
CTRL LSB	1							

	7	6	5	4	3	2	1	0
1. Parameter	VER							

VER ... Version number

xxxx 0001 : ISAR V1.0
(x = don't care)

After a read request by the host, the ISAR will immediately respond with the version number, however, a timeout of 100ms can be installed to protect from software malfunctions resulting from system errors.

3.10.4 Program Code Download

The program code is available in a binary file in which data is stored in 16 bit words. This file is provided together with the ISAR V1.0 device itself.

The file has a logical structure where data is divided into individual blocks of program code and a header belonging to it. Each block consists of contiguous program data and a header with the start address, the length of the block and a specific key word.
If the DSP code consists of several blocks, the header of a new block follows right after the last word of the preceding block.

The structure of several blocks would have the following format (each word is 16 bit). The byte sequence in each word is Lowbyte / Highbyte:

1. word	Startaddress block 1	Block 1
2.	Length L of block 1	
3.	D-key of block 1	
4.	1st program word	
5.	2nd program word	
:	:	
(L+3).	L-th program word	
(L+4).	Startaddress block 2	Block 2
(L+5).	Length M of block 2	
(L+6).	D-key of block 2	
(L+7).	1st program word	
(L+8).	2nd program word	
:	:	
(L+M+6).	M-th program word	
(L+M+7).	Startaddress of block 3	Block 3
:	:	

Note: Only the 8 LSBs of the D-key are valid.

Transfer of D-key

To start the download of one block, the key word (only LSB is valid) has to be written to the mailbox first, which is acknowledged by a response.

	7	6	5	4	3	2	1	0
	DPS		MSC					
HIS	0	0	0	0	0	0	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	DKEY							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

DKEY ... D-key word

The third word of the blockheader contains the D-key. Only the least significant byte is written to the mailbox.

Acknowledgement for Transfer of D-key

The ISAR will acknowledge the transfer of D-key by the following message:

	7	6	5	4	3	2	1	0
	DPS		MSC					
HIS	0	0	0	0	0	0	1	1

	15	14	13	12	11	10	9	8
CTRL MSB	0							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

After the transfer of the D-key by the host, the ISAR will immediately send a response.

Transfer of Program Blocks

Following the D-key and the appropriate response, the program block can be written to the mailbox. In one message up to 126 Codewords (= 252 byte) of the program block can be transfered, so if the program block is larger than 126 words, it has to be divided into messages of a length between 1 and 126 words.
The start address in every new message must be corrected in a way that it indicates the start address of the first program codeword of this message.

	7	6	5	4	3	2	1	0
	DPS		MSC					
HIS	0	0	0	1	1	1	1	0

	15	14	13	12	11	10	9	8
CTRL MSB	0							

	7	6	5	4	3	2	1	0
CTRL LSB	NOM							
1. Parameter	SAM							
2. Parameter	SAL							
3. Parameter	NOC							

16-bit program codewords starting from here in the sequence first MSB, then LSB:

	7	6	5	4	3	2	1	0
4. Parameter	MSB of first program word							
5. Parameter	LSB of first program word							

NOM ... Number of Valid Bytes in the Mailbox

The number of bytes in the mailbox = 2∗number of codewords + 3

The following parameters contain the startaddress, the number of program codewords in this message and the program codewords. The start address refers to the first program word (4th and 5th parameter).

SAM ... Start address MSB

Contains the MSB of the program block start address.

SAL ... Start address LSB

Contains the LSB of the program block start address.

NOC ... Number of codewords

Number of 16-bit program words which follow, starting with the 4th parameter. One word means two entries to the mailbox as they are written separately in the sequence MSB first and then LSB.
The maximum number for NOC is 126.

Acknowledgement for Transfer of Program Blocks

The transfer of program data is acknowledged by the following response:

	7	6	5	4	3	2	1	0
	DPS		MSC					
IIS	0	0	0	1	1	1	1	1

	15	14	13	12	11	10	9	8
CTRL MSB	0							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

After the transfer of program data by the host, the ISAR will immediately send a response, however, a timeout of 100ms can be installed to protect from software malfunctions resulting from system errors.

All successive program blocks from the binary file are transfered in the same way by first writing the D-key of this block and then writing the codewords in messages of 1 to 126 words length.

3.10.5 DSP Program Start

After the program download is completed, the DSP program is started and the ISAR is switched from download mode to normal operation. This is performed by the following command:

	7	6	5	4	3	2	1	0
	DPS		MSC					
HIS	0	0	0	0	1	0	0	0

	15	14	13	12	11	10	9	8
CTRL MSB	0							

	7	6	5	4	3	2	1	0
CTRL LSB	2							

	7	6	5	4	3	2	1	0
1. Parameter	FFh							

	7	6	5	4	3	2	1	0
2. Parameter	FEh							

The parameters contain the startaddress FFFEh of the DSP program.

Acknowledgement to DSP Program Start

The ISAR sends the following response to the download finished indication.

	7	6	5	4	3	2	1	0
	DPS		MSC					
HIS	0	0	0	0	1	0	0	1

	15	14	13	12	11	10	9	8
CTRL MSB	0							

	7	6	5	4	3	2	1	0
CTRL LSB	0							

After the download finished indication by the host, the ISAR will immediately send a response, however, a timeout of 100ms can be installed to protect from software malfunctions resulting from system errors.

Download Complete

After that, the download is completed and normal operation mode is reached. From that point on the above given message codings are no longer valid.

3.11 Fax Class 1 Implementation

This chapter gives more details on the implementation of fax group 3 on the ISAR PSB 7110. It is expected that the controlling protocol residing on the host is either an implementation of the Service Class 1 Command Set (EIA/TIA-578) or ITU-T T.30.

It must be noted that for pump mode "Fax Modulations", the SART unit is not to be configured as described in 3.4 SART Configuration. Transmission and reception of HDLC framed and binary data is only controlled by pump control commands (see 3.6.2) and pump status events (see 3.7.3), i.e. the SART must not be reconfigured to HDLC or binary mode.
However, data is transfered by use of SART data messages together with framing dependent control commands and status events (see 3.5 SART Data).

Fax Pump Control

Pump control commands	Host → ISAR	3.6.2
Pump status events	ISAR → Host	3.7.3

Fax Data Transfer

SART control commands - along with transmit data	Host → ISAR	3.5.2
SART status events - along with receive data	ISAR → Host	3.5.1

For configuration of the whole data path, first the buffer should be configured and then the pump and the IOM-2 interface. Configuration of SART and pump to the required framing and modulation scheme (e.g. HDLC framing and 300 bps/V.21Ch2) is set by single pump control commands as mentioned above. Further configuration data (modulation and silence duration) is passed by additional parameters to the pump control commands.

3.11.1 Summary of ISAR Fax Control Commands

CMD_FTH	Starts transmission of HDLC frames. The additional parameter contains the modulation mode at which data is to be transmitted. It is not mandatory and can be omitted, if the previous setting of this parameter is still valid.
CMD_FRH	Starts reception of HDLC frames. The additional parameter contains the modulation mode at which data is to be received. It is not mandatory and can be omitted , if the previous setting of this parameter is still valid.
CMD_FTM	Starts transmission of binary data. The additional parameter contains the modulation mode at which data is to be transmitted. It is not mandatory and can be omitted, if the previous setting of this parameter is still valid.
CMD_FRM	Starts reception of binary data. The additional parameter contains the modulation mode at which data is to be received. It is not mandatory and can be omitted, if the previous setting of this parameter is still valid.
CMD_SIL_DET_ON	Starts to wait a determined length of time. The additional parameter contains the silence duration which is to be waited. It is not mandatory and can be omitted , if the previous setting of this parameter is still valid.
CMD_CONTINUE	Handshake message from the host to indicate that the host is ready to do the task (transmit/receive) which it selected before.
CMD_ESCAPE	This command is a regular escape in receive modes and a break in transmit modes.
CMD_SIL_DET_OFF	Break of silence detection.
CMD_HALT	Shut down from fax pump idle state.

3.11.2 Summary of ISAR Fax Status Events

RSP_READY	Response to CMD_ANSWER and CMD_ORIGINATE
LINE_TX_HDLC	Response to CMD_FTH in order to indicate that the modulation has been established.
LINE_TX_BINARY	Response to CMD_FTM in order to indicate that the modulation has been established.
LINE_RX_HDLC	Response to CMD_FRH in order to indicate that the modulation has been established.
LINE_RX_BINARY	Response to CMD_FRM in order to indicate that the modulation has been established.
RSP_CONNECT	Indication that the fax pump is ready to receive or transmit data.
RSP_DISC	Indication that the fax pump has turned off modulation after transmitting all pending data / after the host issues the command CMD_ESCAPE
RSP_FCERROR	Indication that the fax pump has detected a "wrong" modulation before it releases the event RSP_CONNECT.
RSP_SIL_DET	Indication that the prior selected duration of silence time has occured
RSP_SIL_DET_OFF	Indication that the fax pump has received an "abandon silence time detection" command from the host.
FLAGS_DETECT	Indication that the fax pump has detected flags.

3.11.3 Procedure Termination

In response to control commands generated by the host, the fax pump invokes various procedures. Another procedure cannot be invoked until the previous procedure has been terminated. Procedure termination may either be indicated by the fax pump or commanded by the host. The table below shows the termination indications and commands for each of the procedures.

Prodedure	Indication of procedure termination (ISAR → Host)	Command for procedure termination (Host → ISAR)
Start as Originator	RSP_READY	CMD_ESCAPE
Start as Answerer	RSP_READY	CMD_ESCAPE
HDLC Transmit	RSP_DISC	CMD_ESCAPE
HDLC Receive	RSP_FCERROR	CMD_ESCAPE
Binary Transmit	RSP_DISC	CMD_ESCAPE
Binary Receive	RSP_FCERROR	CMD_ESCAPE
Wait for Silence	RSP_SIL_DET RSP_SIL_DET_OFF	RSP_SIL_DET_OFF

When no procedure is currently active, the fax pump is in an idle state. During the idle state, the command CMD_ESCAPE will be ignored by the fax pump, however, the host may issue the command CMD_HALT to shut down the fax pump. This is normally done when a fax session has ended and the telephone connection is released.

3.11.4 Fax Pump Startup Procedure

The host configures the fax pump either as originator or answerer when a physical connection has been established. After initialisation, the fax pump responds with RSP_READY, indicating, that it is ready for the next procedure.

At this point the host must issue either a command CMD_FRH or CMD_FTH depending upon if the host is answering or originating a facsimile connection. The interaction of the host and the faxpump is as shown in the flow charts for transmission and reception of HDLC and binary data.

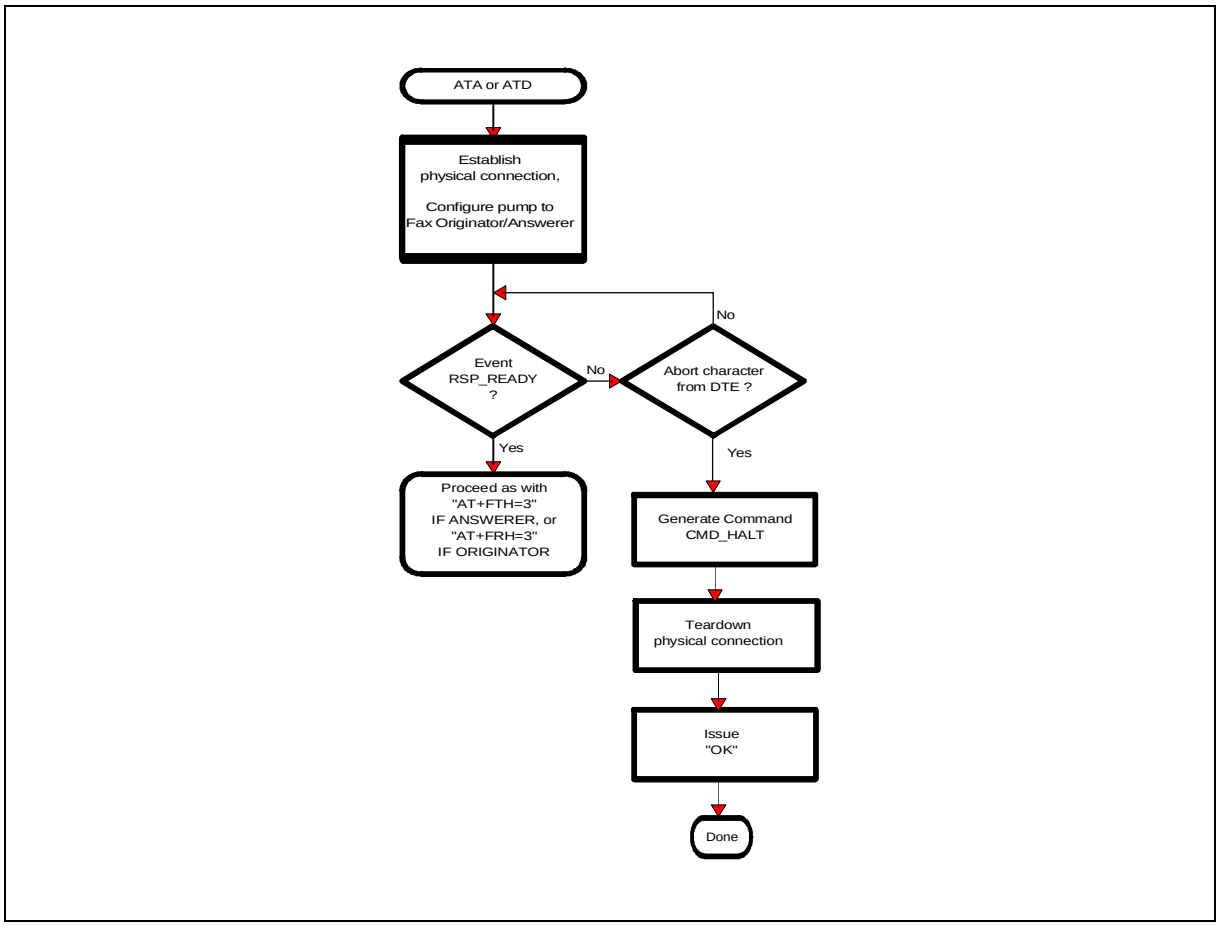


Figure 21 Startup procedure

3.11.5 HDLC Transmission

A host can control HDLC frame transmission during a fax group 3 session by issuing the command CMD_FTH to the fax pump. HDLC transmission is specified by the T.30 procedure during the exchange of control information. Some applications may alternatively implement HDLC framing directly, they would then use binary transmission for the transmission of their HDLC bit stream.

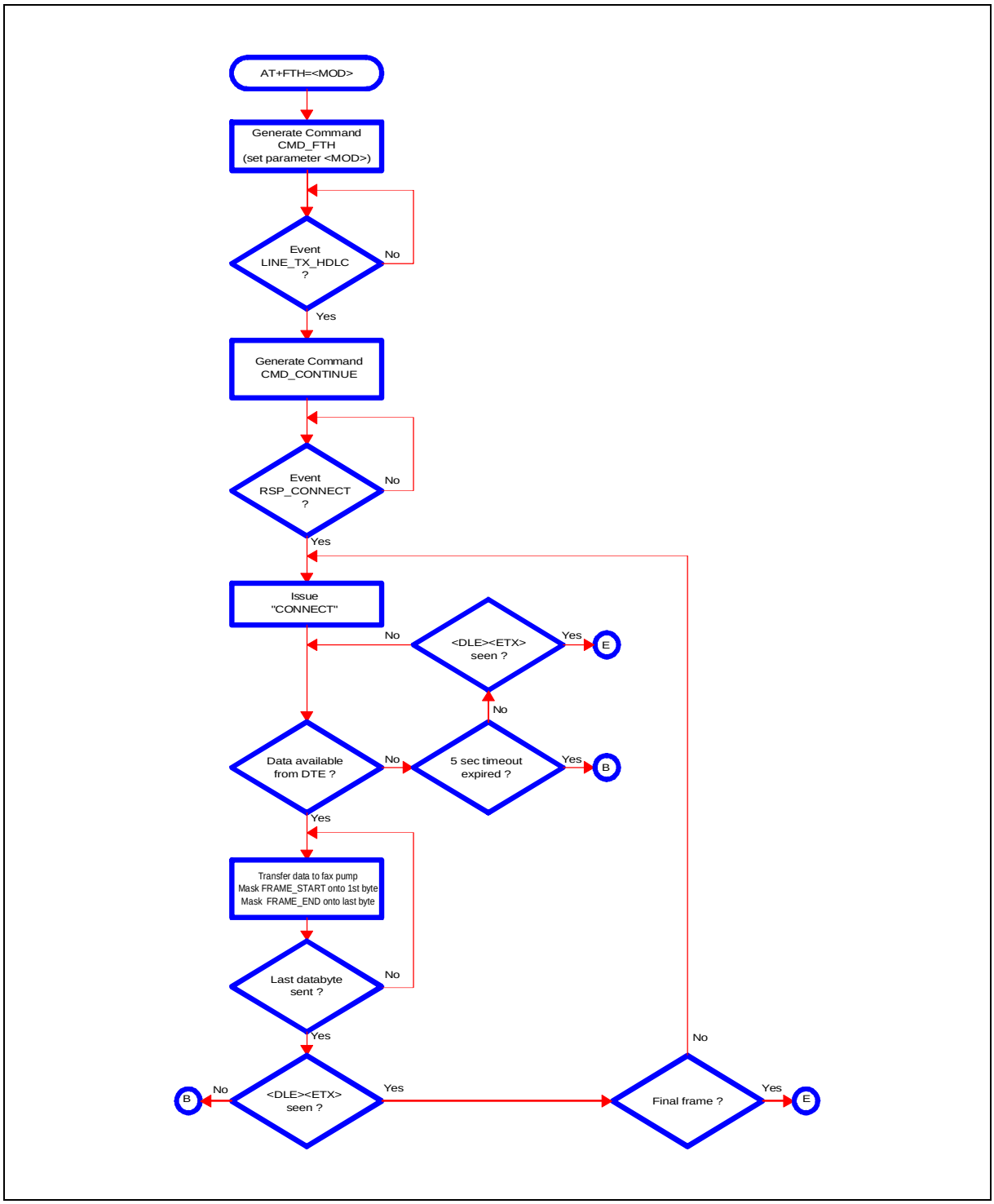


Figure 22 HDLC transmission

3.11.6 Binary Transmission

A host can control binary transmission during a fax group 3 session by issuing the command CMD_FTM to the fax pump. Binary transmission is specified by the T.30 procedure during the exchange of image.

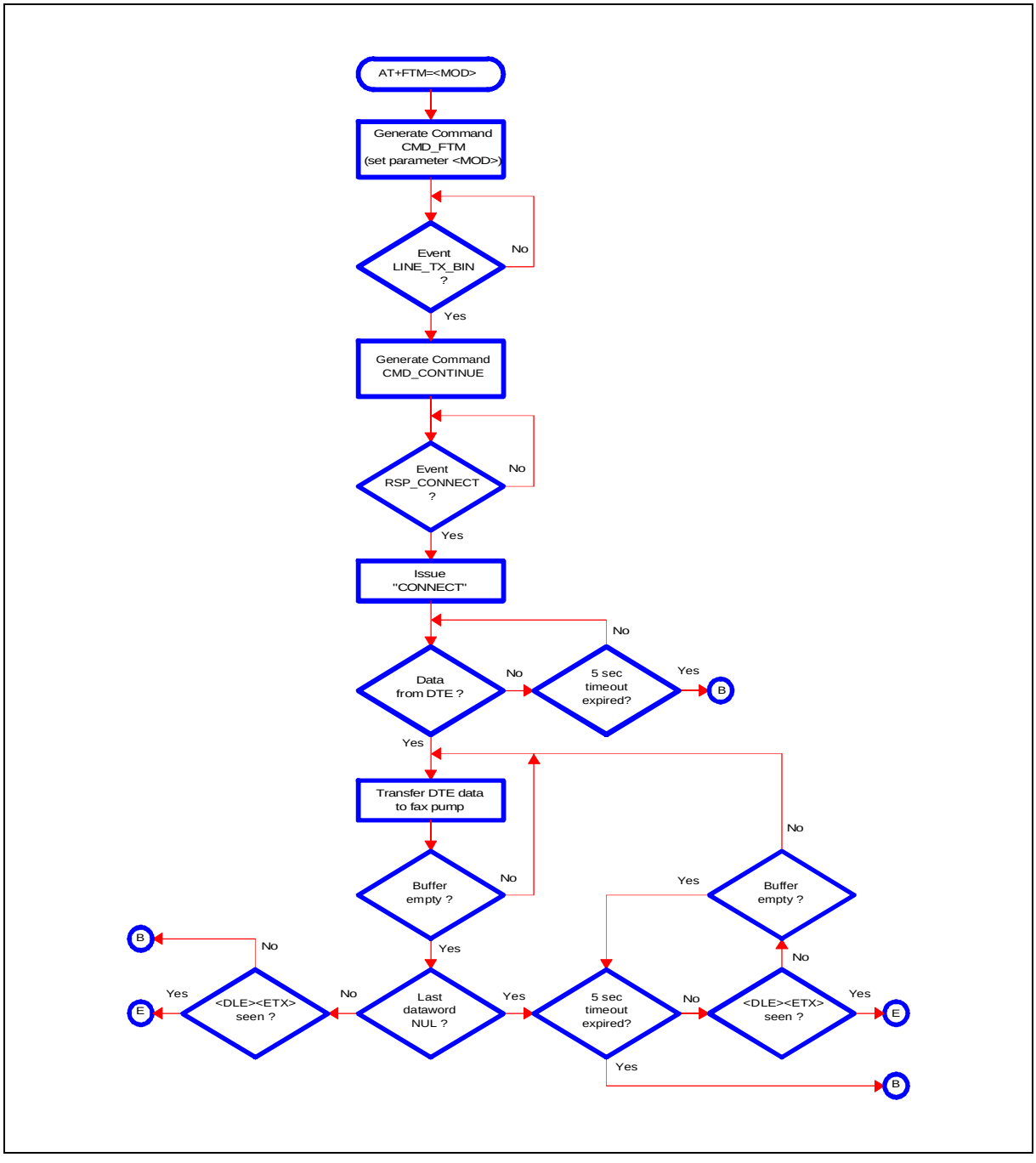


Figure 23 Binary transmission

3.11.7 HDLC Reception

A host can control HDLC frame reception during a fax group 3 session by issuing the command CMD_FRH to the fax pump. HDLC reception is specified by the T.30 procedure during the exchange of control information. Some applications may alternatively implement HDLC framing directly, they would then use binary reception for the reception of their HDLC bit stream.

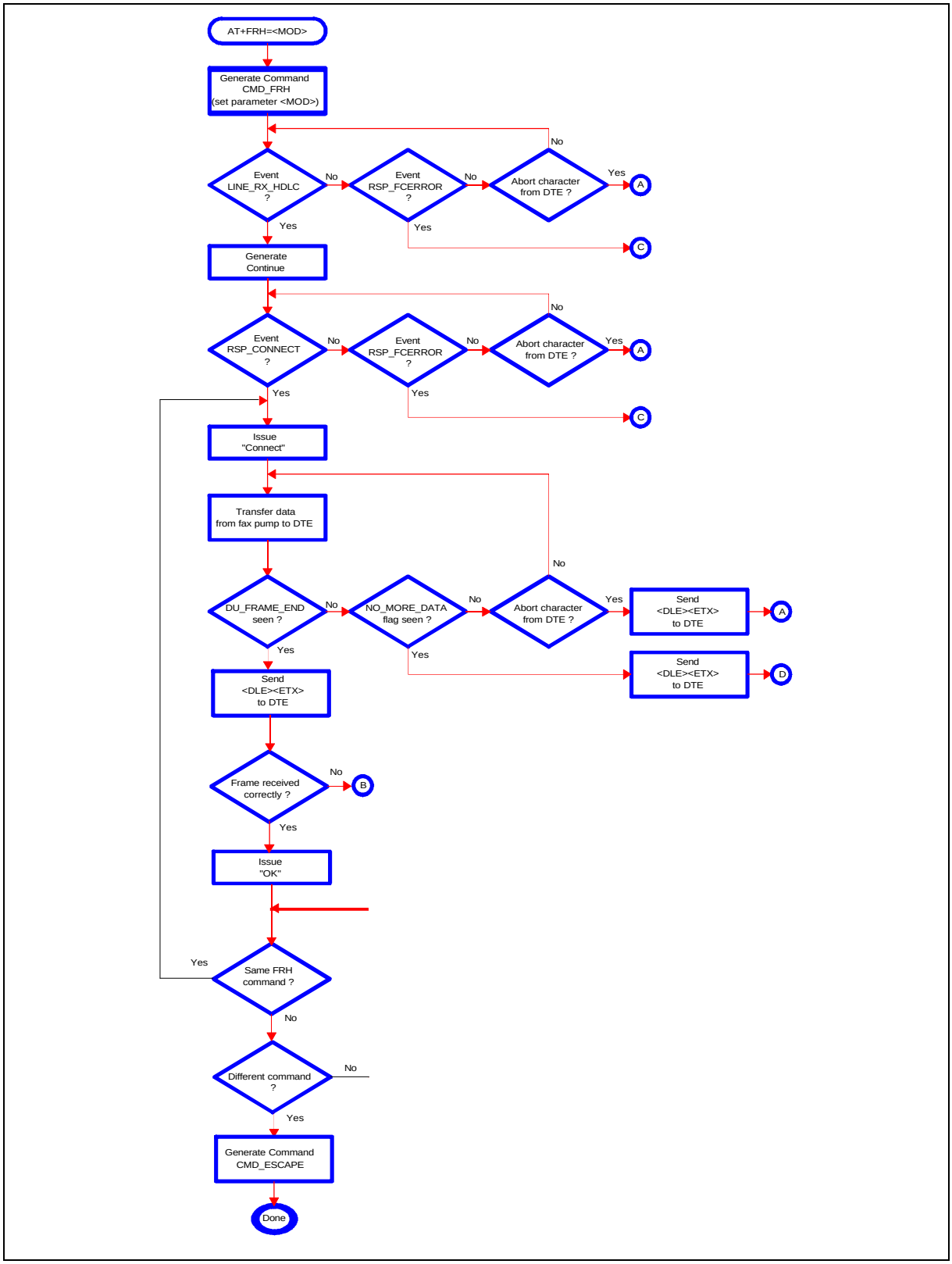


Figure 24 HDLC reception

3.11.8 Binary Reception

A host can control binary reception during a fax group 3 session by issuing the command CMD_FRM to the fax pump. Binary reception is specified by the T.30 procedure during the exchange of image.

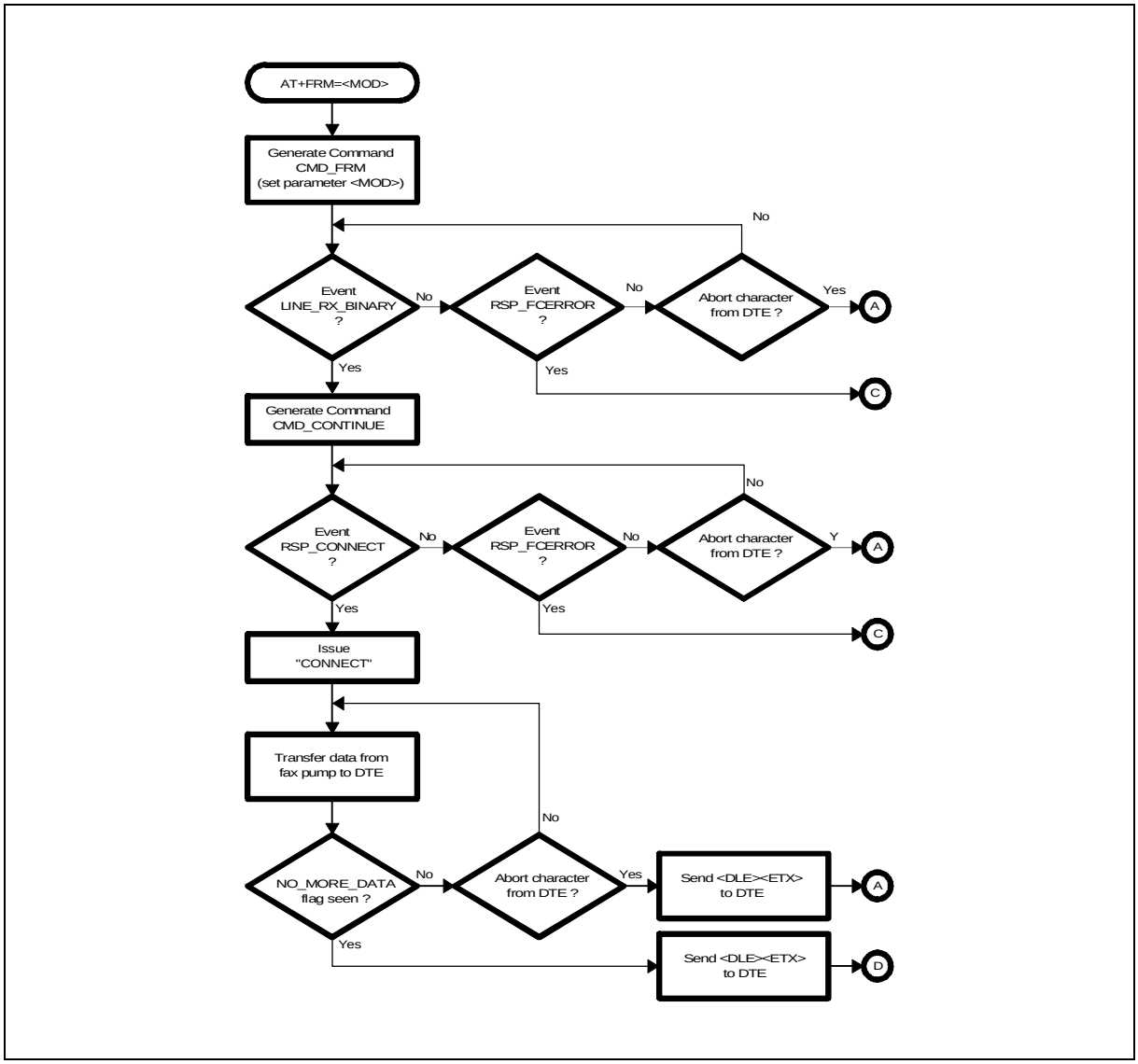


Figure 25 Binary reception

3.11.9 Call Termination

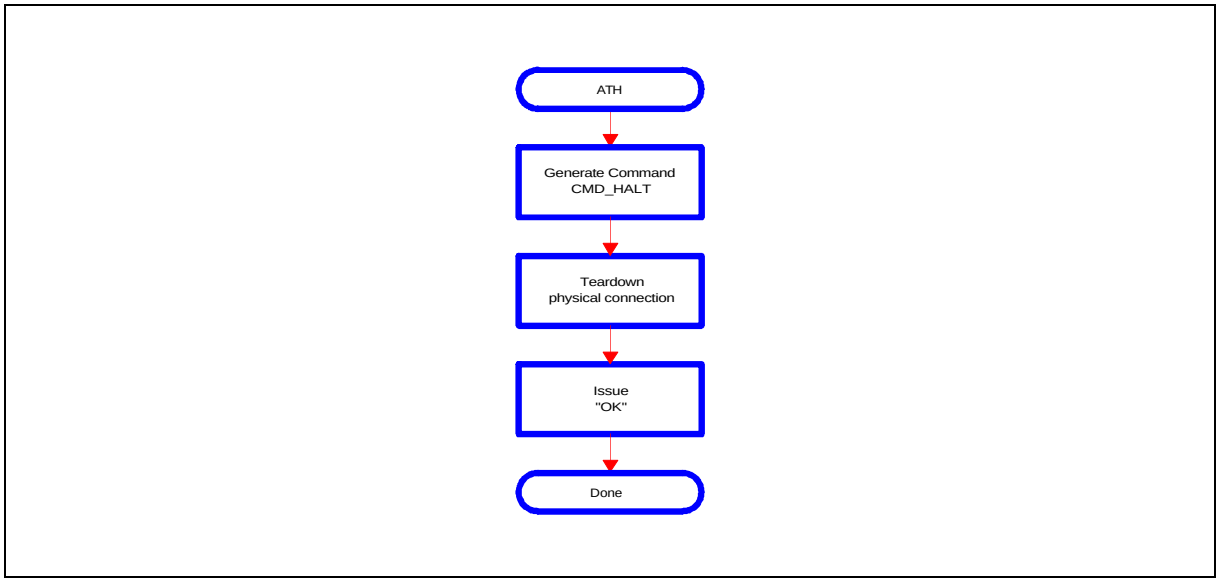


Figure 26 Call termination

3.11.10 Procedure Terminations

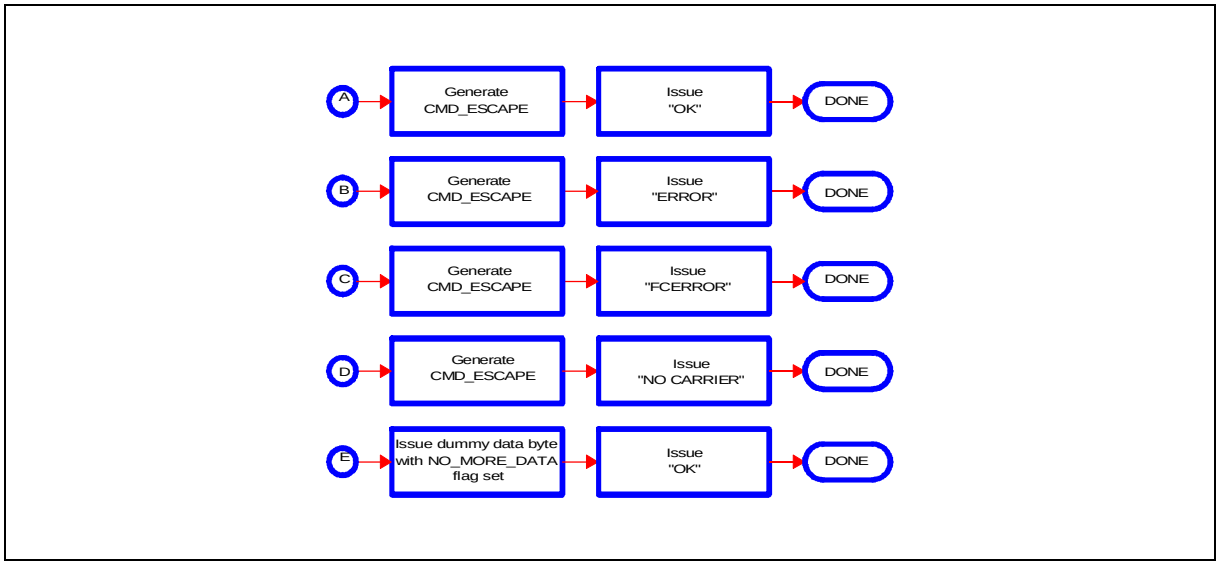


Figure 27 Procedure terminations

3.12 Datamodem Automode Operation

Automode selection is available based on EIA/TIA PN-2330.
When enabled, the datapump will determine the communication standard supported by the remote modem and configure itself according. That means the modulation scheme and the data rate is automatically set without any host control.
The following figures show the flowcharts corresponding to the DSP algorithm used in supporting automode originating and answering mode.

After the host configures the datapump to datamodem modulations with automode enabled, it can request the selected modulation scheme from the ISAR as soon as the modulation has been established between both modems.

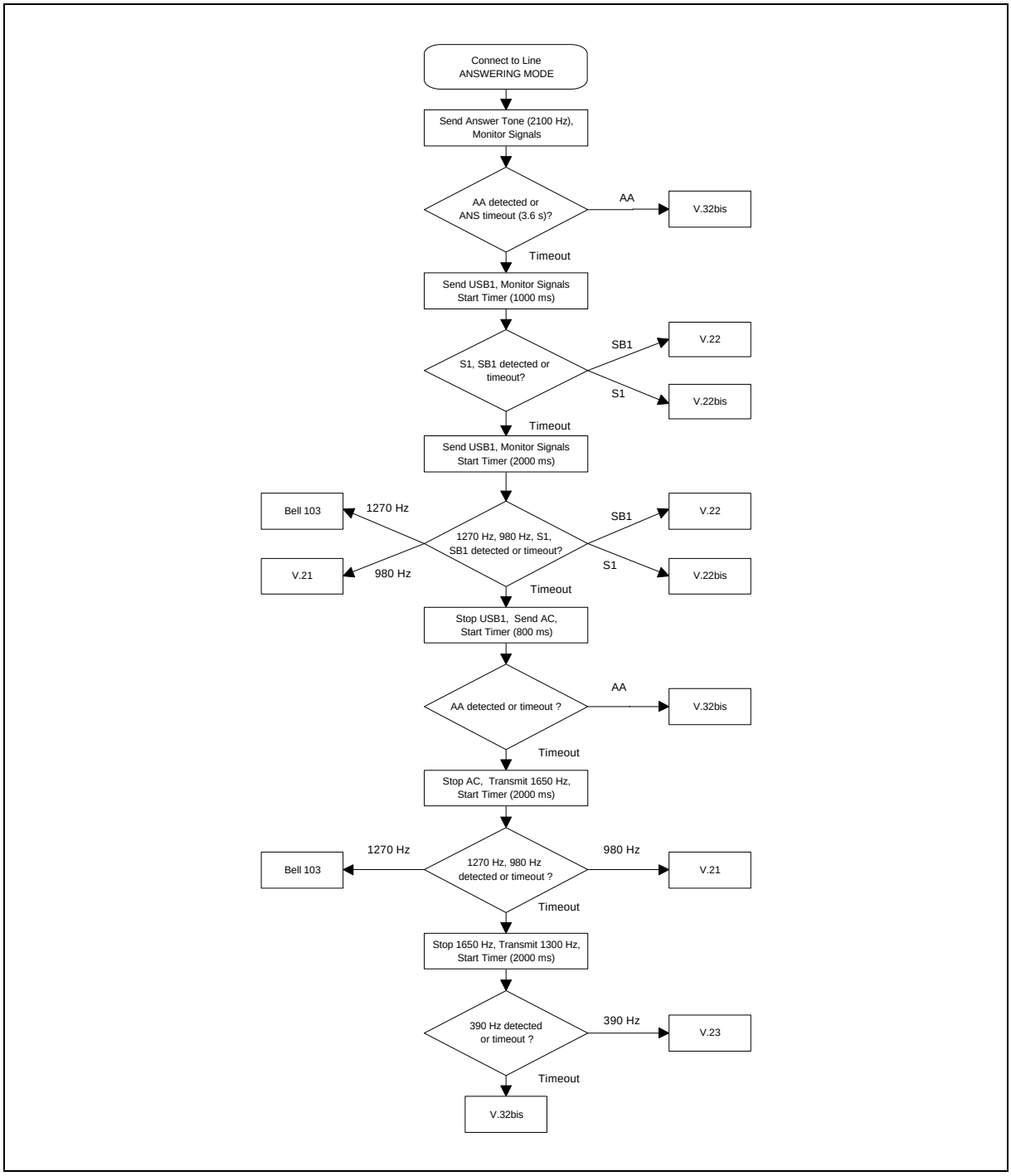


Figure 28 Automode answerer

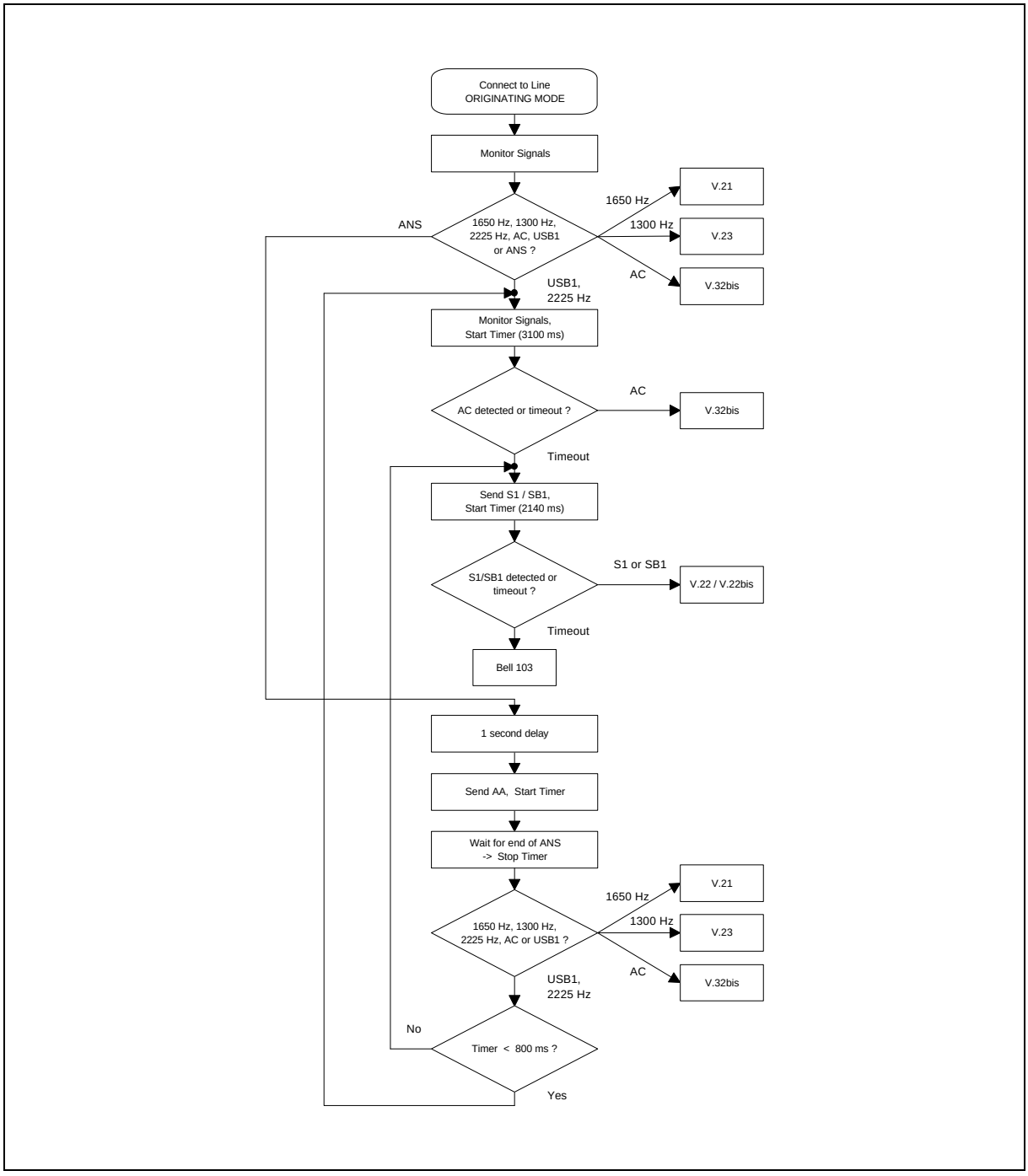


Figure 29 Automode originator

Note: The signals indicated in both figures relate to the ITU-T V.32bis specification.

4. Summary of Messages

Functional Block	Mode	Message Type	Read/ Write	HIS / IIS	CTRL MSB	CTRL LSB	1. Parameter 4. Parameter	2. Parameter 5. Parameter	3. Parameter ... Parameters
Buffer		Configuration Setup	WR	DPS MSC 0 0	0 0 0 0 0 BBP	1	MML		
Buffer		Configuration Request	WR	DPS MSC 0 0	0	0			
Buffer		Configuration Response	RD	DPS MSC 0 0	- - - - - BBP	2	MML	MPL	
Buffer		Control Command	WR	DPS MSC MDS	0 0 0 0 0 0 CRB	0			
Buffer		Status Request	WR	DPS MSC MDS	STS	0			
Buffer		Status Response	RD	DPS MSC MDS	RDM3 RDM2 RDM1 RDM0	6	NBRL	NBRM	NMR
							NBTL	NBTM	NMT
Buffer		Status Event (Specific)	RD	DPS MSC MDS	STEV	0			
Buffer		Status Event (General)	RD	0 0 0 0 0 0 0	RDM3 RDM2 RDM1 RDM0	0			
SART	HDLC	Configuration Setup	WR	DPS 1 0 0 1 0 1	HDMC 0 0 SMODE	1	0 0 0 HIO IFF FLEN EDF DUO		
SART	ASYNC	Configuration Setup	WR	DPS 1 0 0 1 0 1	HDMC 0 0 SMODE	2	0 OVSP SNP EOP EDP NSB CHS	BFT	
SART	Binary	Configuration Setup	WR	DPS 1 0 0 1 0 1	HDMC 0 0 SMODE	2	0 0 0 0 0 0 DUO BSW	DUFW	
SART	Disabled	Configuration Setup	WR	DPS 1 0 0 1 0 1	0 0 0 0 SMODE	0			
SART	HDLC	Status Event with Receive Data	RD	DPS 1 0 0 0 0 0	- FED FSD FAD RER CER - NMD	NOM	1st data byte	2nd data byte	.... data bytes
SART	ASYNC	Status Event with Receive Data	RD	DPS 1 0 0 0 0 0	- - BRE BRS DSD PER - -	NOM	1st data byte	2nd data byte	.... data bytes
SART	Binary	Status Event with Receive Data	RD	DPS 1 0 0 0 0 0	- - - - - - - NMD	NOM	1st data byte	2nd data byte	.... data bytes
SART	HDLC	Control Command with Transmit Data	WR	DPS 1 0 0 0 0 0	0 FED FST GFA 0 0 0 NMD	NOM	1st data byte	2nd data byte	.... data bytes
SART	ASYNC	Control Command with Transmit Data	WR	DPS 1 0 0 0 0 0	0 0 SOB SAB DSB V42 0 0	NOM	1st data byte	2nd data byte	.... data bytes
SART	Binary	Control Command with Transmit Data	WR	DPS 1 0 0 0 0 0	0 0 0 0 0 0 0 NMD	NOM	1st data byte	2nd data byte	.... data bytes
Pump	Fax Modulations	Configuration Setup	WR	0 1 1 0 0 1 1 0	OAM 0 0 0 PMOD	2	0 0 0 TOA	0 0 0 0 0 ATN 0 CTN	
Pump	Datamodem Modulations	Configuration Setup	WR	0 1 1 0 0 1 1 0	OAM 0 0 0 PMOD	6	0 0 0 TOA	0 V32BR V32A V22B V22C 0 V21 SEL	AMOD 0 0 0 0 0 V32B V23B
							V32R (LSB)	V32R (MSB)	0 0 0 0 GTS ATN CTN
Pump	Halfduplex Modulations	Configuration Setup	WR	0 1 1 0 0 1 1 0	OAM 0 0 0 PMOD	3	0 0 0 TOA	V17C V17D V29A V29B V29C V27A V27B V21	0 0 0 EPT 0 0 V17A V17B

Functional Block	Mode	Message Type	Read/ Write	HIS / IIS	CTRL MSB	CTRL LSB	1. Parameter 6. Parameter	2. Parameter 7. Parameter	3. Parameter ... Parameters
Pump	V.110	Configuration Setup	WR	DPS 1 0 0 1 1 0	0 0 0 0 0 PMOD	2	VDR	0 0 0 0 0 0 0 FCT	
Pump	DTMF	Configuration Setup	WR	0 1 1 0 0 1 1 0	0 0 0 0 0 PMOD	1	REL		
Pump	DTMF Transmission	Configuration Setup	WR	0 1 1 0 0 1 1 0	0 0 0 0 0 PMOD	1	0 0 0 TOA		
Pump	Bypass	Configuration Setup	WR	DPS 1 0 0 1 1 0	0 0 0 0 0 PMOD	0			
Pump	Fax Modulations	Control Command	WR	0 1 1 0 1 0 1 0	FCMD	NOM	MODC or SLD		
Pump	Datamodem Modulations	Control Command	WR	0 1 1 0 1 0 1 0	DCMD	0			
Pump	Halfduplex Modulations	Control Command	WR	not defined					
Pump	V.110	Control Command	WR	DPS 1 0 1 0 1 0	VCMD	NOM	X-/S-bits or E1-7 or FRC		
Pump	DTMF	Control Command	WR	not defined					
Pump	DTMF Transmission	Control Command	WR	0 1 1 0 1 0 1 0	DCMD	1	TDIG		
Pump	Bypass	Control Command	WR	not defined					
Pump	(all modes)	Status Request	WR	DPS 0 0 1 1 1 0	0	0			
Pump	Fax Modulations	Status Response	RD	0 1 1 0 1 1 1 0	OAM 0 0 0 PMOD	2	RIL	RIM	
Pump	Datamodem Modulations	Status Response	RD	0 1 1 0 1 1 1 0	OAM 0 0 0 PMOD	4 - CLD RTY TMO - - RRN LRN	RIL	RIM	- - RRT LRT - RRP CON NEG
Pump	Halfduplex Modulations	Status Response	RD	0 1 1 0 1 1 1 0	OAM 0 0 0 PMOD	2	RIL	RIM	
Pump	V.110	Status Response	RD	DPS 1 0 1 1 1 0	0 0 0 0 0 PMOD	6	RIL	RIM	- - - ROPI ROFI RONI ROFX RONX
							- - - - X SB SA1 SA0	- E1 E2 E3 E4 E5 E6 E7	FRC
Pump	DTMF	Status Response	RD	0 1 1 0 1 1 1 0	0 0 0 0 0 PMOD	2	RIL	RIM	
Pump	DTMF Transmission	Status Response	RD	0 1 1 0 1 1 1 0	0 0 0 0 0 PMOD	4 0	0	0	0
Pump	Bypass	Status Response	RD	DPS 1 0 1 1 1 0	0 0 0 0 0 PMOD	2	RIL	RIM	
Pump	Disabled	Status Response	RD	DPS 1 0 1 1 1 0	0 0 0 0 0 PMOD	0			

Functional Block	Mode	Message Type	Read/ Write	HIS / IIS	CTRL MSB	CTRL LSB	1. Parameter 6. Parameter	2. Parameter 7. Parameter	3. Parameter ... Parameters
Pump	Fax Modulations	Status Events	RD	0 1 1 0 1 0 1 0	FEVT	0			
Pump	Datamodem Modulations	Status Events	RD	0 1 1 0 1 0 1 0	DEVT	0			
Pump	Halfduplex Modulations	Status Events	RD	0 1 1 0 1 0 1 0	HEVT	0			
Pump	V.110	Status Events	RD	DPS 1 0 1 0 1 0	VEVT	NOM	X-/S-bits or E1-7 or ROx		
Pump	DTMF	Status Events	RD	0 1 1 0 1 0 1 0	RDIG	0			
Pump	DTMF Transmission	Status Events	RD	not defined					
Pump	Bypass	Status Events	RD	not defined					
IOM-2		Configuration Setup	WR	DPS 1 0 0 1 1 1	IOM 0 0 0 COD RCV	5	0 0 0 TXD RXD TSL	0 0 RTSO	0 0 0 0 0 RCS
							0 0 TTSO	0 0 0 0 0 TCS	
IOM-2		Configuration Request	WR	DPS 0 0 0 1 1 1	0	0			
IOM-2		Configuration Response	RD	DPS 1 0 0 1 1 1	IOM 0 0 0 COD RCV	5	0 0 0 TXD RXD TSL	0 0 RTSO	0 0 0 0 0 RCS
							0 0 TTSO	0 0 0 0 0 TCS	
IOM-2		Control Command	WR	DPS 1 0 1 0 1 1	ICMD	0			

Functional Block	Mode	Message Type	Read/ Write	HIS / IIS	CTRL MSB	CTRL LSB	1. Parameter 6. Parameter	2. Parameter 7. Parameter	3. Parameter ... Parameters
Test/Diag.		General Configuration (Waitstates)	WR	0 0 1 0 0 1 1 1	WSS	0			
Test/Diag.		General Configuration (Timer Interrupt)	WR	0 0 1 0 0 1 0 1	CMD	0			
Test/Diag.		Timer Interrupt Request	RD	0 1 1 0 1 0 1 0	2	0			
Test/Diag.		Software Version Request	WR	0 0 0 0 0 0 1 0 1	10h	0			
Test/Diag.		Software Version Response	RD	0 0 1 0 0 1 0 1	10h	1	SVN		
Test/Diag.		Invalid Message Received	RD	0 0 1 1 1 1 1 1	INV	0			
Test/Diag.		Start Selftest	WR	0 0 0 0 0 0 1 0 1	40h	0			
Test/Diag.		Selftest Response	RD	0 0 1 0 0 1 0 1	40h	1	0 0 0 0 PRR MB1 MB0 IOC		
The following messages are not valid after the DSP program is started:									
Test/Diag.		Hardware Version Request	WR	0 0 0 1 0 1 0 0	0	3	20h	0	1
Test/Diag.		Hardware Version Response	RD	0 0 0 1 0 1 0 1	0	1	VER		
Test/Diag.		Transfer of D-Key	WR	0 0 0 0 0 0 1 0	DKEY	0			
Test/Diag.		Acknowledge for Transfer of D-Key	RD	0 0 0 0 0 0 1 1	0	0			
Test/Diag.		Transfer of Program Block	WR	0 0 0 1 1 1 1 0	0	NOM	SAM Progr. Word - MSB	SAL Progr. Word - LSB	NOC ... Progr. Word
Test/Diag.		Acknowledge for Transfer of Program Block	RD	0 0 0 1 1 1 1 1	0	0			
Test/Diag.		DSP Program Start	WR	0 0 0 0 1 0 0 0	0	2	FFh	FEh	
Test/Diag.		Acknowledgement for DSP Program Start	RD	0 0 0 0 1 0 0 1	0	0			

5. Example Configuration Settings

To give a better understanding how to program each of the parameters, some examples are given below for each of the functional blocks.
The mechanism to transfer messages from the host to the ISAR is described in chapter 3.1.2. It should be noted, that the host interrupt status register (HIS) must only be written as the last register access for the message.

Buffer Configuration

Set channel 1 to buffer base priority 5 and maximum message length of 32:

Control Reg. MSB	=	05h
Control Reg. LSB	=	01h
1. Parameter	=	20h
HIS	=	64h

Set channel 2 to buffer base priority 3 without changing the maximum message length:

Control Reg. MSB	=	03h
Control Reg. LSB	=	0
No parameters		
HIS	=	A4h

Set channel 2 to maximum message length 32 without changing the buffer base priority:

Control Reg. MSB	=	0
Control Reg. LSB	=	1
1. Parameter	=	20h
HIS	=	A4h

SART Configuration

Set channel 1 to HDLC mode with regular I/O, "1" as interframe fill16 bit FCS length. In case of data underrun, FCS and final flag should be generated automatically (TX direction):

Control Reg. MSB	=	03h
Control Reg. LSB	=	01h
1. Parameter	=	09h
HIS	=	65h

Set channel 2 to V.14 mode (synchronous modulation) with 25% overspeed range, even parity, two stop bits, 6 bit character size and a buffer flush timeout of 32:

Control Reg. MSB	=	02h
Control Reg. LSB	=	02h
1. Parameter	=	5Dh
2. Parameter	=	20h
HIS	=	A5h

Pump Configuration

Set channel 1 to faxmodulations in originating mode, 6 db transmitter output attenuation and calling tone enabled:

Control Reg. MSB	=	81h
Control Reg. LSB	=	02h
1. Parameter	=	06h
2. Parameter	=	01h
HIS	=	66h

Note: If the pump is set to faxmodulations, the SART must not be configured as this is controlled by fax control commands which support implementation of fax class1 (see 3.11 Fax Class 1 Implementation).

Set channel 1 to automode data modulation in answering mode with 8 db transmitter output attenuation with answer tone enabled and all modulation schemes are disabled except V.32bis with data rates up to 12000 bps only:

Control Reg. MSB	=	02h
Control Reg. LSB	=	06h
1. Parameter	=	08h
2. Parameter	=	0
3. Parameter	=	82h
4. Parameter	=	0Fh
5. Parameter	=	F1h
6. Parameter	=	02h
HIS	=	66h

IOM-2 Configuration

Set channel 1 to the first timeslot on the IOM-2 interface with 8-bit timeslot length and regular switching of TX/RX paths. PCM data is A-law encoded and rate conversion is enabled (typical IOM-2 configuration for pump modes fax, datamodem and halfduplex modulations):

Control Reg. MSB	=	83h
Control Reg. LSB	=	05h
1. Parameter	=	10h
2. Parameter	=	0
3. Parameter	=	0
4. Parameter	=	0
5. Parameter	=	0
HIS	=	67h

Set channel 2 to the third timeslot on the IOM-2 interface with 8-bit timeslot length and mapping of transmitter and receiver to DD and DU of IOM-2 respectively. PCM data is µ-law encoded. This configuration might be used e.g. for pump mode DTMF:

Control Reg. MSB	=	84h
Control Reg. LSB	=	05h
1. Parameter	=	08h
2. Parameter	=	02h
3. Parameter	=	0
4. Parameter	=	02h
5. Parameter	=	0
HIS	=	A7h

The configuration of the IOM-2 interface has to make sure the the selected timeslots for channel 1 and 2 do not overlap, even if one of the channels is currently disabled by setting the IOM-bit to 0.

6. Detailed Register Description

6.1 Register Address Map

Address (hex)	READ								WRITE							
	b7	b6	b5	b4	b3	b2	b1	b0	b7	b6	b5	b4	b3	b2	b1	b0
75	-	-	-	-	-	MSK	-	-	-	-	-	-	-	STA	-	-
61	Host Control Register High								ISAR Control Register High							
60	Host Control Register Low								ISAR Control Register Low							
58	-	-	-	-	-	-	-	IIA	ISAR Interrupt Status (IIS)							
50	Host Interrupt Status (HIS)								-	-	-	-	-	-	-	HIA
4C	Mailbox I/O data															
4A	Mailbox write address															
48	Mailbox read address															

6.2 Register Description

Interrupt Mask Bit Write Address 75h

Value after Reset: xxxx x0xx

7	6	5	4	3	2	1	0
-	-	-	-		MSK	-	-

MSK ... Interrupt mask

All internal interrupt sources can be masked by setting MSK to "0". In this case the interrupt is not indicated by activating the interrupt line, however it remains internally stored and pending until the MSK bit is set to "1".

Interrupt Status Bit Read Address 75h

Value after Reset: xxxx x0xx

7	6	5	4	3	2	1	0
-	-	-	-		STA	-	-

STA ... Interrupt status

The STA bit indicates an interrupt status of the ISAR. If set to "1", an internal interrupt is pending.

Host / ISAR Control Register High Write / Read Address 61h

7	6	5	4	3	2	1	0

The MSB of the control word contains configuration, status or control information, depending on the message specified by the HIS / IIS register.

Host / ISAR Control Register Low Write / Read Address 60h

7	6	5	4	3	2	1	0

The LSB of the control word contains the number of additional bytes in the mailbox, which depends on the message specified by the HIS / IIS register.

ISAR Interrupt Acknowledge Bit Write Address 58h

7	6	5	4	3	2	1	0
-	-	-	-	-	-	-	IIA

IIA ... ISAR Interrupt Acknowledge

After reading a complete message from the ISAR mailbox, the host sets IIA to "1" to indicate to the ISAR, that the current message transfer is complete and a new message transfer may be started.

ISAR Interrupt Status Read Address 58h

7	6	5	4	3	2	1	0
IIS							

The ISAR interrupt status register (IIS) contains the source of the interrupt, i.e. buffer 0, 1 or 2, the kind of indication (configuration, status or received data) and the indication source (buffer, SART, pump or IOM-2).

Host Interrupt Status Write Address 50h

7	6	5	4	3	2	1	0
HIS							

The host interrupt status register (HIS) contains the destination of the transfered message, i.e. buffer 0, 1 or 2, the kind of command (request message, configuration, control or transmit data) and the functional block (buffer, SART, pump or IOM-2).

Host Interrupt Acknowledge Bit Read Address 50h

7	6	5	4	3	2	1	0
-	-	-	-	-	-	-	HIA

HIA ... Host Interrupt Acknowledge

When transfering a message to the ISAR mailbox, the final write access to the host interrupt register will automatically set the HIA bit. The ISAR will reset HIA as soon as the ISAR is capable to accept another message.

Mailbox I/O data Write / Read Address 4Ch

7	6	5	4	3	2	1	0

The mailbox contains configuration, status and control information in addition to the control register MSB as well as transmit and receive data. The number of bytes in the mailbox is indicated in the control register LSB.

Mailbox write address Write / Read Address 4Ch

7	6	5	4	3	2	1	0

This register indicates the current write address on the mailbox buffer.
Before any data is written to the mailbox , the write address must be reset to 0 by the host. For any access to mailbox I/O data, the address pointer will be autoincremented and does not need to be programmed. This is the recommended way for sequential, fast access to the mailbox.
For random access, the host has to reprogram the write address pointer.

Mailbox read address Write / Read Address 48h

7	6	5	4	3	2	1	0

This register indicates the current read address on the mailbox buffer.
Before the mailbox contents of a message are read, the read address must be reset to 0 by the host. For any access to mailbox I/O data, the address pointer will be autoincremented and does not need to be programmed. This is the recommended way for sequential, fast access to the mailbox.
For random access, the host has to reprogram the read address pointer.

7. Hardware and Software Support

For system development based on ISAR PSB 7110, SIEMENS provides a hardware and software package to allow for quick design and fast product to market.
Moreover, certain software protocols especially related to fax and modem or ISDN protocols require very specific knowledge that could cause a long term development phase.

The ISAR reference board package provides a complete Software/Hardware solution for ISDN and analog data communication under Windows 95 and Windows 3.x . It consists of:

- ISAR Reference Board

The ISA slot card (see figure 30) shows a complete HW solution for S- and U-interface together with Plug and Play host interface.

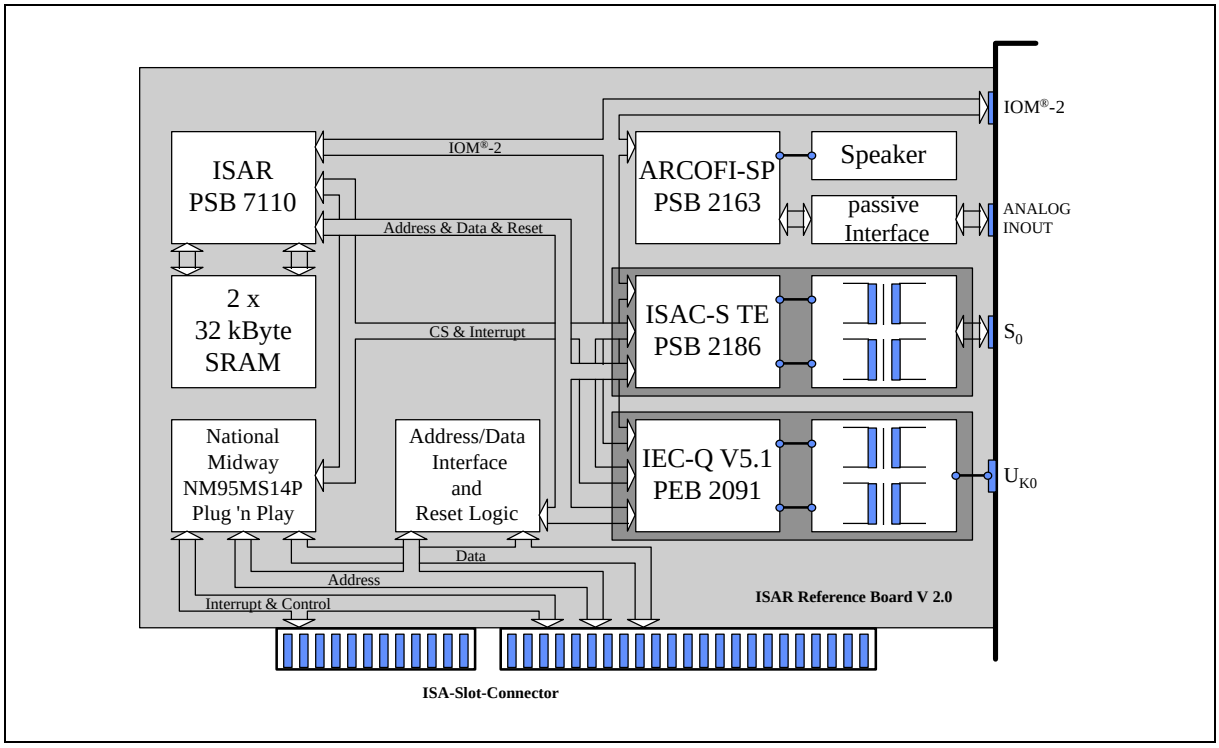


Figure 30 ISAR Reference Board

- CAPI (Common ISDN Applications Interface)

The CAPI provides a hardware independent interface to control the dialling and the B channel protocol. Today, this message based interface is the mandatory standard for ISDN PC-Cards in Europe. The SIEMENS CAPI includes some extensions to control some special hardware features over this interface.

- COM Driver

This driver simulates an old FAX Class 1 or data modem on two COM ports. One COM port can be used for digital and analog connections. The other COM port can only be used for digital connections. The COM driver is designed for ISAR-boards. The driver includes the modem datapump controlling for the ISAR. Therefore the driver uses the Direct Chip Access Addendum of the CAPI (defined by the SIEMENS AG). On HW designs without an ISAR (e.g. boards based on HSCX-TE PSB 21525) the COM driver accesses only digital connections. The digital protocol handling is realised in the CAPI driver.

- Tools

The software is ready to use on the ISAR reference board with installation and configuration tools. Additionally there is an example source code for the download of the DSP software.

Please contact your SIEMENS sales office to get further information on the hard- and software package which is available for ISAR PSB 7110.

8. Electrical Specification

8.1 Absolute Maximum Ratings

Parameter	Symbol	Limit values	Unit
Ambient temperature under bias	T_A	0 to 70	°C
Storage temperature	T_{stg}	-65 to 125	°C
Supply Voltage	V_{DD}	-0,5 to 4,2	V
Supply Voltage	V_{DDA}	-0,5 to 4,2	V
Supply Voltage	V_{DDP}	-0,5 to 6,0	V
Voltage of pin with respect to ground: XTAL1, XTAL2, VREF, RADJ	V_S	-0,4 to V_{DD}+0,5	V
Voltage of any other pin with respect to ground	V_S	If V_{DDP}<3V: -0,4 to V_{DD}+0,5 If V_{DDP}>3V: -0,4 to V_{DDP}+0,5	V V

Note: Stresses above those listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

8.2 Recommended Operating Conditions

V_{DD} = 3,4 to 3,8 V; V_{DDP} = 4,5 to 5,5 V, V_{SS} = 0 V
V_{DDA} = 3,4 to 3,8 V, V_{SSA} = 0 V;

8.3 DC Characteristics

Conditions: see above (Recommended Operating Conditions); T_A = 0 to +70°C.
All pins except XTAL1, XTAL2, VREF, RADJ:

Parameter	Symbol	Limit values		Unit	Test condition
		Min	Max		
High-Level Input Voltage	V_{IH}	2,0		V	
Low-Level Input Voltage	V_{IL}		0,8	V	
High-Level Output Voltage	V_{OH}	2,4		V	I_{OH}=-400 µA
Low-Level Output Voltage	V_{OL}		0,45	V	I_{OL}=7 mA pins DU, DD (50 pF) I_{OL}=5 mA pins CA(0:15), CD(0:15), CRD#,CWR#,CPS#,CDS# (30 pF) I_{OL}=2 mA all others (30 pF)
Input leakage current	I_{LI}	-1 mA	2 µA		0 V < V_{IN} < V_{DDA} (RADJ)
Input leakage current	I_{LI}	- 1	2	µA	0 V < V_{IN} < V_{DDA} (VREF)
Input leakage current	I_{LI}	-11	11	µA	0 V < V_{IN} < V_{DDA} (XTAL1)
Input leakage current	I_{LI}	-1	6	µA	0 V < V_{IN} < V_{DDP} (CM1)
Input leakage current	I_{LI}	-6	1	µA	0 V < V_{IN} < V_{DDP} (ALE, WR#)
Input leakage current	I_{LI}	-80	1	µA	0 V < V_{IN} < V_{DDP} (RESET)
Input leakage current	I_{LI}	-1	1	µA	0 V < V_{IN} < V_{DDP} (all other pins)
Output leakage current	I_{LO}	-1	1	µA	0 V < V_{OUT} < V_{DDP}
VDD+VDDA supply current	IDDS		170	mA	
VDDP supply current	IDDPS		120	mA	

The power supply on voltage on V_{DD}-V_{SS} and V_{DDA}-V_{SSA} can be applied before or after the power supply on V_{DDP}/V_{SSP} without any damage to the circuit. Applying voltages to signal pins when power supply is not active (circuit not under bias) may cause damage - refer to paragraph "Absolute Maximum Ratings".

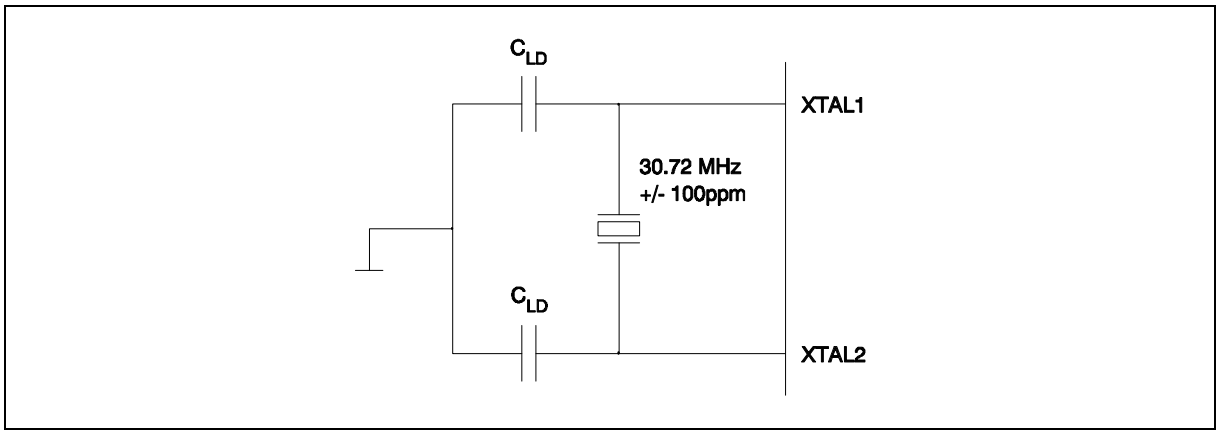
When power supply is switched on, the pads do not reach their stable bias until after 2 µs (maximum).

8.4 Capacitances

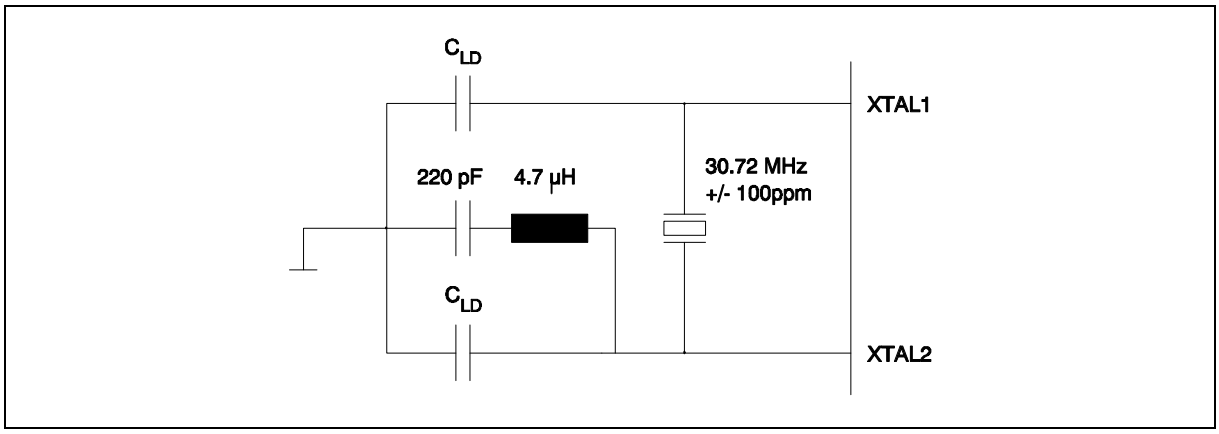
Parameter	Symbol	Limit values		Unit	Test condition
		Min	Max		
Input capacitance	C_{IN}		7	pF	
I/O capacitance	$C_{I/O}$		7	pF	
Load capacitance	C_L		50	pF	XTAL1,2

8.5 Oscillat or Circuit

Mode of vibration: Basic Harmonic



Mode of vibration: 3rd Harmonic



The value for C_{LD} depends on the parameters of the selected crystal and is derived from the following equation:

$$C_{LD} = 2 \times C_L - C_{IN}$$

where C_L is the crystal specific load capacitance (see 8.6) and C_{IN} is the input capacitance for XTAL1 (see 8.4).

Example: $C_L = 20$ pF $\rightarrow$ $C_{LD} = 33$ pF

8.6 XTAL1,2 Recommended Typical Crystal Pa rameters

Mode of vibration: Basic Harmonic

Parameter	**Symbol**	**Limit values**	**Unit**
Motional capacitance	C_1	17	fF
Shunt	C_0	5	pF
Load	C_L	≤ 20	pF
Resonance resistor	R_r	≤ 50	Ohm

Mode of vibration: 3rd Harmonic

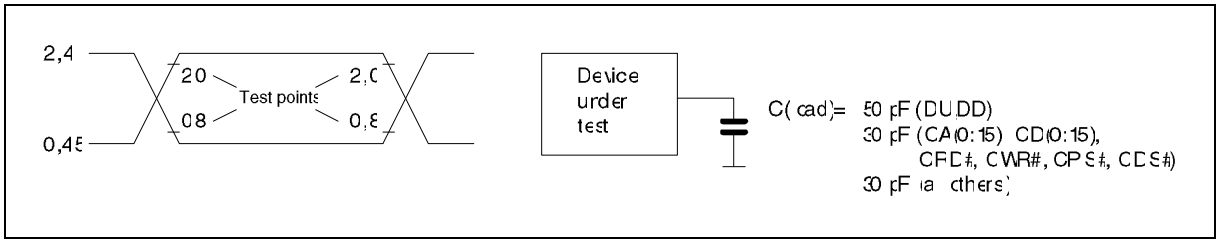
Parameter	**Symbol**	**Limit values**	**Unit**
Motional capacitance	C_1	0.9	fF
Shunt	C_0	3	pF
Load	C_L	≤ 20	pF
Resonance resistor	R_r	≤ 70	Ohm

8.8 AC Characteristics

8.8.1 Testing Waveform

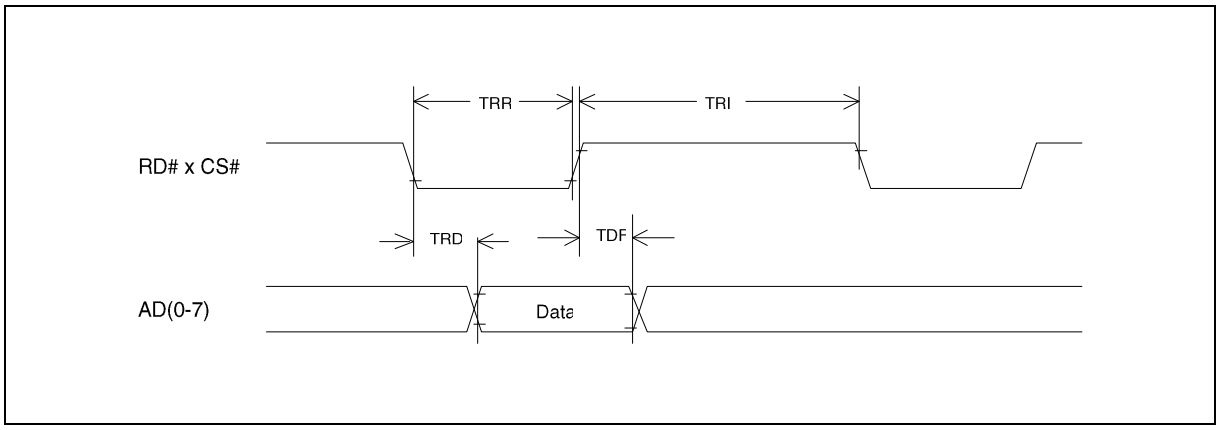
Conditions as above (Recommended Operating Conditions) at T_A = 0 to 70 °C.

Inputs are driven to 2,4 V for a logical "1" and to 0,4 V for a logical "0". Timing measurements are made at 2,0 V for a logical "1" and 0,8 V for a logical "0". The AC testing input/output waveforms are shown in the figure below.

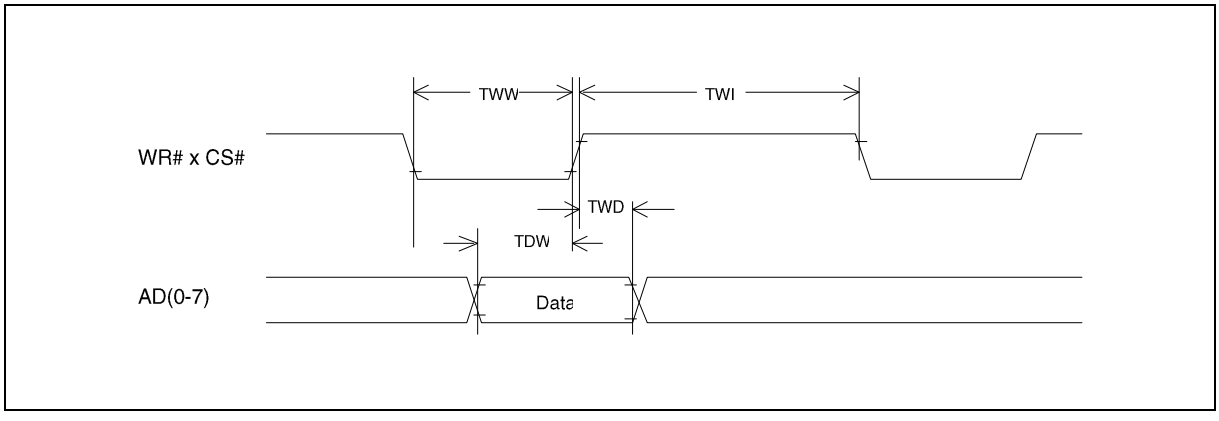


8.8.2 Parallel Host Interface Timing

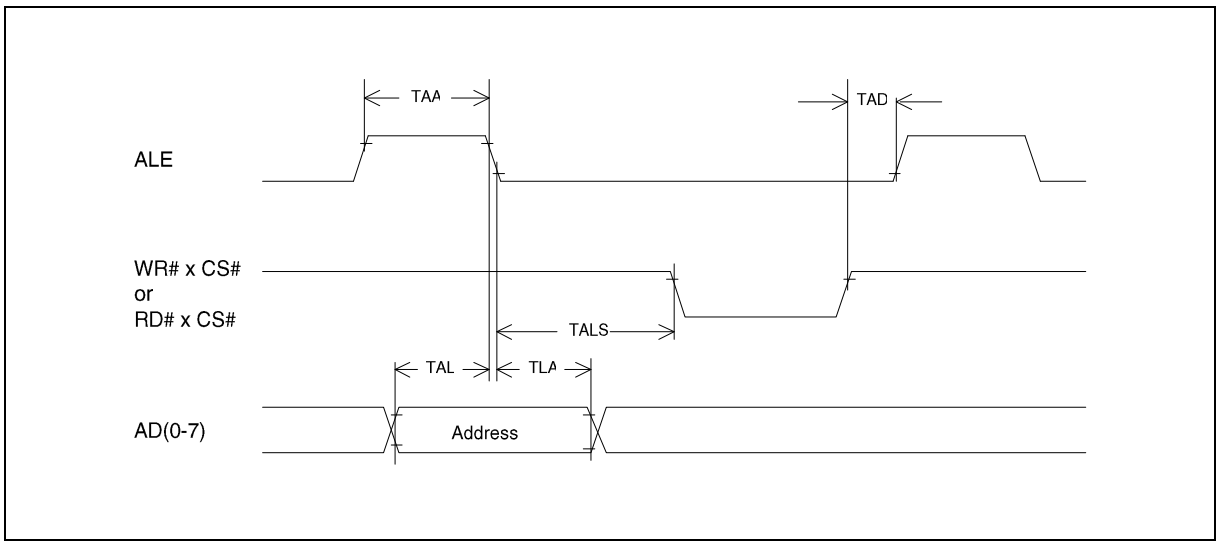
Host Interface Read Cycle



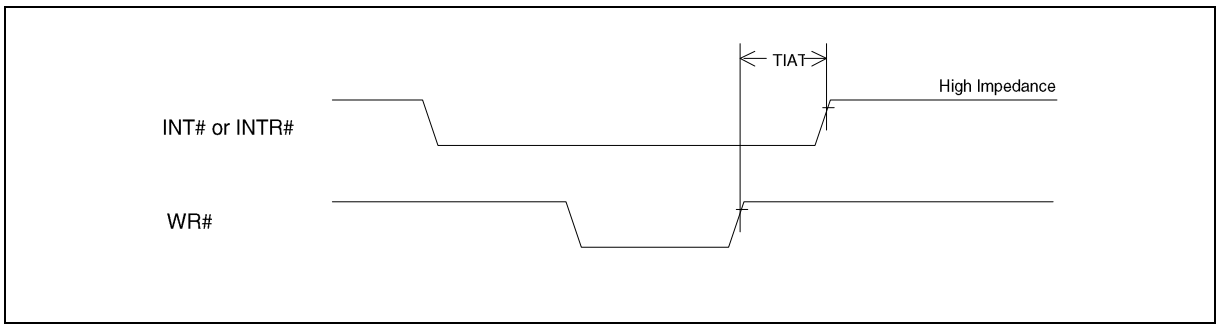
Host Interface Write Cycle



Address Timing



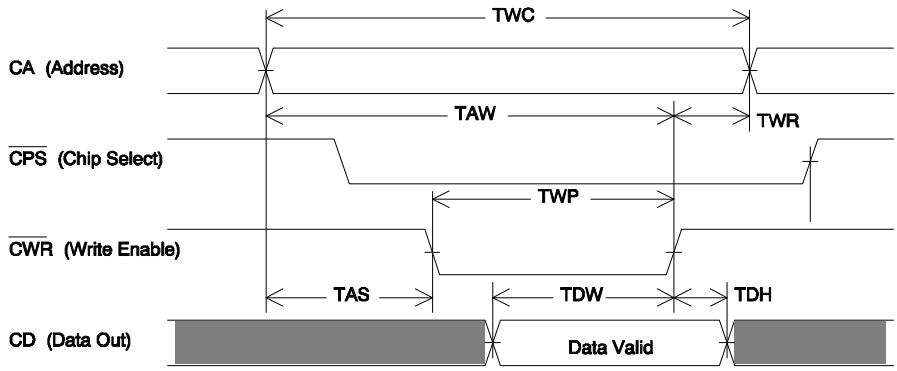
Interrupt Release Timing



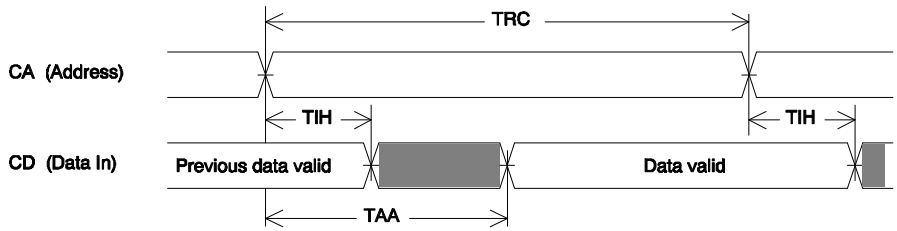
Parameter	Symbol	Limit values		Unit
		Min	Max	
ALE pulse width	TAA	50		ns
Address setup time from ALE	TAL	15		ns
Address hold time from ALE	TLA	10		ns
Address latch setup time to WR#, RD#	TALS	0		ns
ALE guard time	TAD	15		ns
RD# pulse width	TRR	110		ns
Data output delay from RD#	TRD		110	ns
Data float from RD#	TDF		25	ns
RD# control interval	TRI	70		ns
WR# pulse width	TWW	60		ns
Data setup time to WR# x CS#	TDW	35		ns
Data hold time from WR# x CS#	TWD	10		ns
WR# control interval	TWI	70		ns
Interrupt acknowledge to high-impedance	TIAT		100	ns

8.8.3 External Memory Interface Timing

External Memory Interface Write Cycle



External Memory Interface Read Cycle



Parameter	Symbol	Limit values		Unit
		Min	Max	
Write Cycle Time	TWC	10		ns
Address Setup Time	TAS	0		ns
Address Valid to End of Write	TAW	9		ns
Write Pulse Width	TWP	9		ns
Write Recovery Time	TWR	0		ns
Data Valid to End of Write	TDW	5		ns
Data Hold Time	TDH	0		ns
Read Cycle Time	TRC	10		ns
Address Access Time	TAA		10	ns
Input Hold from Address Change	TIH	0		ns

Notes:
1. Test conditions shown below assuming output loading specified in figure 31
2. Tested with the loading in figure 32.

AC Test Conditions:

Parameter	Unit
Input Pulse Level	0.45V to 2.4V
Input Rise and Fall Times	3 ns
Input and Output Timing and Reference Levels	1.5V
Output Load	see figures below

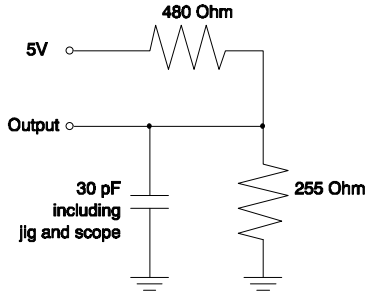


Figure 31

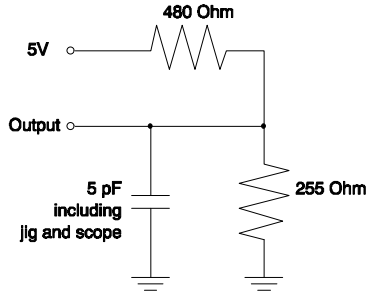
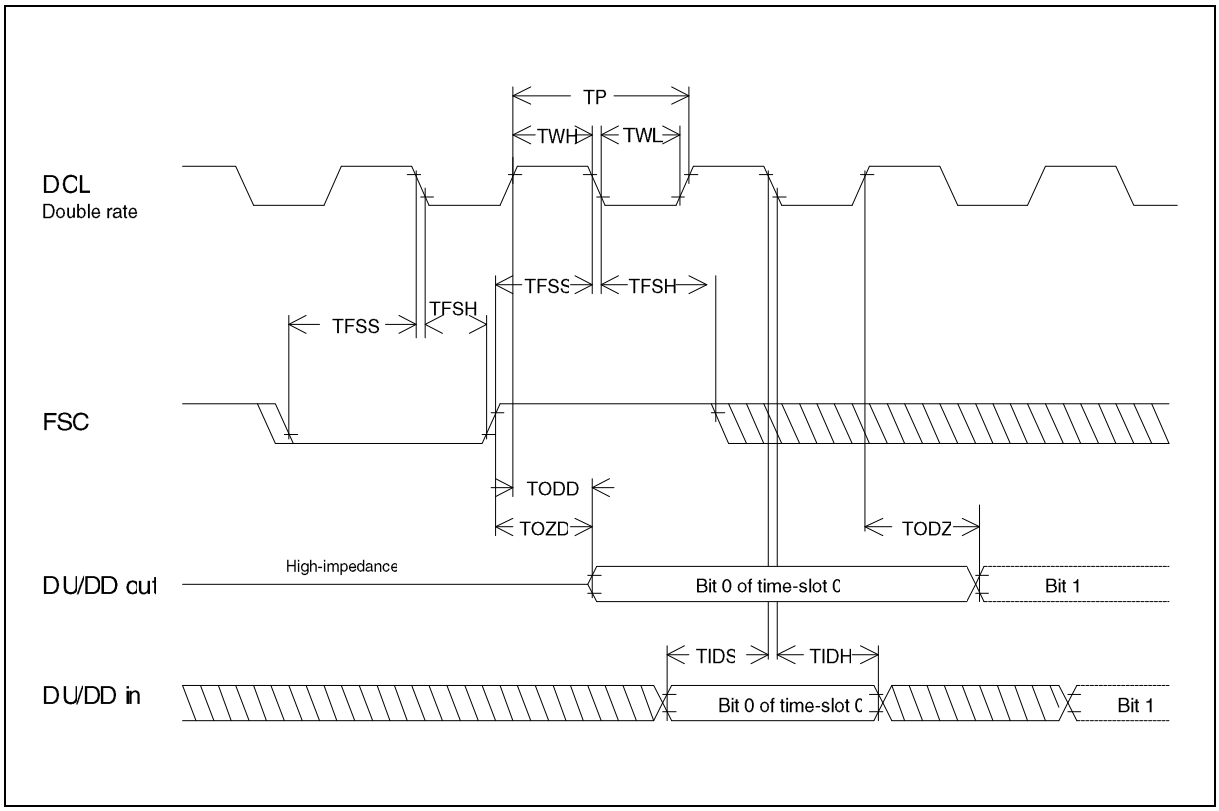


Figure 32

8.8.4 IOM-2 Interface Timing

IOM-2 timing with double rate DCL:



Parameter	Symbol	Limit values		Unit
		Min	Max	
DCL period	TP	244		ns
DCL high	TWH	100		ns
DCL low	TWL	100		ns
Frame sync setup	TFSS	40		ns
Frame sync hold	TFSH	40		ns
Output data from high impedance to active	TOZD		100	ns
Output data delay from clock	TODD		100	ns
Output data from active to high impedance	TODZ		80	ns
Input data setup	TIDS	20		ns
Input data hold	TIDH	40		ns

8.9 ESD Capability

In contrast to the general Siemens quality profile, the ISAR V1.0 pins are only capable of 1kV ESD (electro static discharge).

9. Package Outline

P-TQFP-100 package with size 14 x 14 mm, pitch 0.5 mm, height 1.4 mm.

