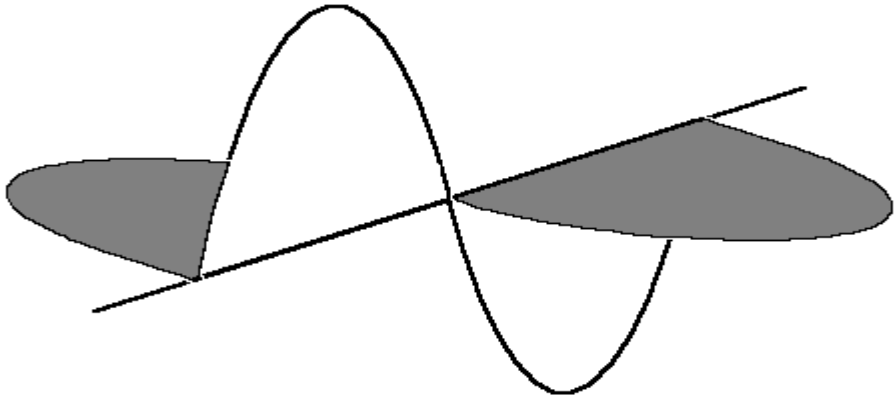
AGECODAGIS S.A.R.L.

SEISMOLOGICAL RECORDERS

TITAN

USER MANUAL



AGECODAGIS S.A.R.L.
16 rue D'Auriac 31310 Rieux
Tel: 05.61.97.84.52 Fax: 05. 61.97.84.51

A Pascale,
A Georges , à Denis,
A Paul et à Virginie,
A Bernardin et à St Pierre,
A St Pierre et à Miquelon,
A mon dernier souci, à ma première chemise,
A Léa jacta est,
Agecodagis et
Addis-Abéba.

Il me faut du nouveau, n'en fut il point au monde.
(La Fontaine)

1. INTRODUCTION

The TITAN recorder is a recorder which is meant to be used on all data acquisition settings where the following conditions are met :

- Simplicity of use,
- Continuous recording,
- Large dynamic,
- Low weight range, small physical dimension,
- Small power consumption,
- Use in the field,
- Precision of the samples dating to the millisecond.

Heureux qui veut comprendre l'origine des choses.
(Virgile)

2. OPERATING PRINCIPLE

2.1. OPERATING COMPOSITION

The different products of the TITAN range differ by their capacity of realizing certain functions. The variable functions are described below.

The data flow within the TITAN recorder is as follows :

(In the following paragraph, the words in bold type represent the functions changing from one range product to another.)

The seismological channels (**number of ways** that the recorder can manage) are converted into digital streams by the **Analogical/Numerical converter(s)**. 16 **auxilliary channels** can also be added with low conversion rate versus seismological one. The data are then **dated** and sent to the RS232 link. The time setting of the recorder is automatic if the recorder has a **safeguarded-calendar**. At the same time, data are sent to the triggering algorithm STA/LTA and then to the recording manager which decides to record everything or to keep only the periods of signal which have provoked the trigger (**Recording-continuous/triggered**). The data are then transmitted to the **Flash-memory** which buffers them with a capacity of 8 Mb. These data are then copied on to the **DAT**, or to a **modem** or on the **parallel-link** of the recorder.

The TITAN recorders differ at the level of the operating blocks described above which can be different from a product to another or even absent.

NUMBER OF SESIMOLOGICAL CHANNELS : 1, 3 or 6 Cf. paragraph SAMPLING.

TYPE OF SEISMOLOGICAL A/D CONVERTER : the A/D converters can be of the Crystal brand or of the Analog Device brand. Best performances are obtained with the Crystal converters. Cf. paragraph SAMPLING.

DATING : The sample dating can be simple or corrected. See paragraph DATING below.

SAFEGUARD-CALENDAR : Can be present or not. Continues to run the internal clock stream in case of power failure.

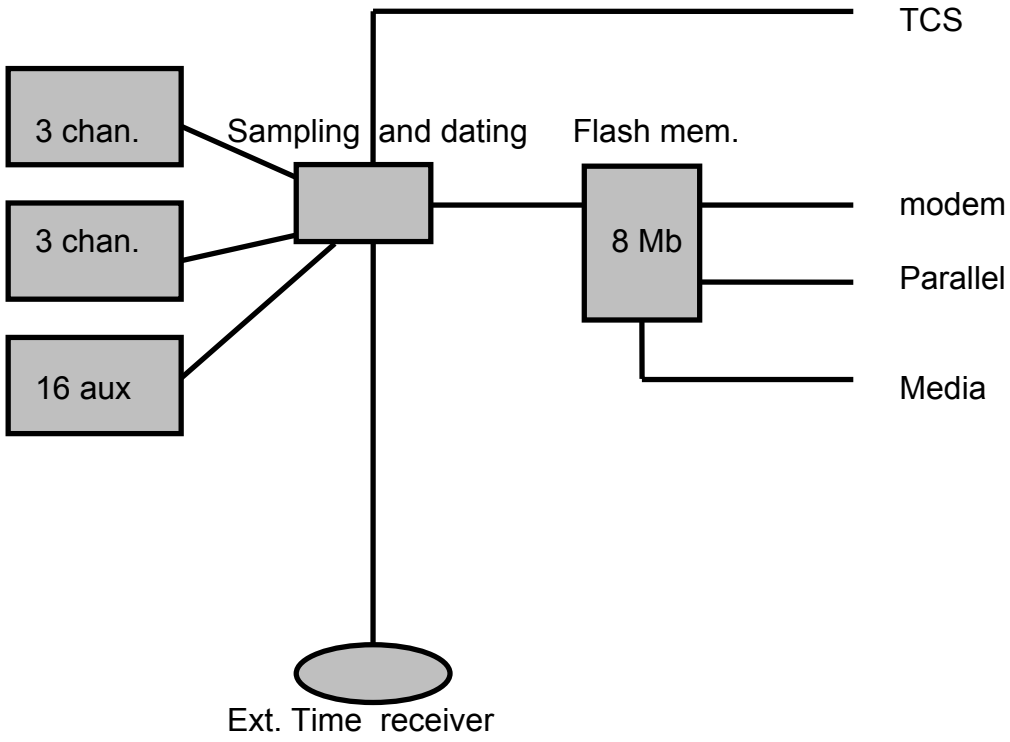
TYPE OF RECORDING : Continuous , triggered internal or media triggered. See below in paragraph named « TYPE OF RECORD » for details.

FLASH-MEMORY : Can be present with a capacity of 8 Mb or absent.

MEDIA: Without media, with DAT or Hard disk.

MODEM: Every TITAN station can accept an external communication link. This link can be a modem based one, a satellite one or GSM modem one. The communication protocol used to communicate is a packet oriented one: ATLAS PROTOCOL. This communication protocol is implemented in the ATLASNET SOFTWARE that makes your PC a central site to manage a field stations network. The set of commands the station is able to process depends of course of the hardware configuration of the station. For example, a TITAN DAT is unable to download recorded data because of his sequential access media (DAT cartridge). ATLAS protocol is described in the « ATLAS RUGGED PC USER MANUAL » document.

PARALLEL-LINK : Allows quick dumping of the Flash-memory to the PC terminal when internal trigger records.



The spreadsheet below describes the operating composition of the different products.

	DIGIT 6 channels	DIGIT 3 channels	TITAN DAT	ATLAS LIGHT	MINITITAN
NB channels	6	3	3	3	3*
Type A/D	Crys	Crys.	0=Crys.	0=Crys.	1=A. D.
Auxilliary (16*16 bits)	no	no	no	no	no
Dating	simple	simple	0=simple	0=simple	0=corrected
Time keeper	with	with	with	with	with
Record.	cont.	cont.	cont.	trig .	trig.
Flash	0 Mb	0 Mb	8 Mb	8 Mb	8 Mb
Soring	-	-	no cycle	cycle	cycle
Media	Without	Without	DAT	Without	Without
Paral.Link.	without	without	without	with	with

	MINITITAN 3XT	DIGIT 6 (Geos)
NB channels	3	6
Type A/D	Crys	Crys
Auxilliary (16*16 bits)	no	2*HI7188
Dating	simple	simple
Time keeper .	with	with
Rec. Type.	media trig.	cont.
Flash	8 Mb	0 Mb
Soring	no cycle	-
Média	HD	Without
Paral.Link.	with	without

Configuration spreadsheet of the TITAN set

*: MINITITAN3 can generate a 1 component data stream if wanted.

Informations describing the configuration of a recorder are hept in the data. Cf. paragraph FRAME INFORMATIONS.

2.1.1. SAMPLING :

SEISMOLOGICALS CHANNELS

Two types of converters are used. Both converters are of the sigma delta high dynamic type. However, the Analog Device models do not have a flat answer in the band pass. This inconvenience must be corrected, if needed, during data processing. See technical data sheet of manufacturer (Analog Device, AD7710, Crystal, CS5322/CS5323).

The propagation time of the converters is :

- 29 samples for Crystal,
- 4 samples for Analog Device.

The TITAN recorders can receive, depending on the model, 1, 3 or 6 analogical channels. The 1, 3 or 6 converters work all at the same sampling frequency called primary frequency.

The frequency of primary sampling can be chosen among the following values :

- 250 Samp/sec
- 125 Samp/sec
- 62.5 Samp/sec
- 31.25 Samp/sec.

See restrictive conditions at paragraph : PARAMETER COMMAND 2.

The seismological data are grouped together in triplet. The 3 channels models group data in a single primary triplet. 6 channels models in two triplets. The 1 channel model is specific (see size of the outgoing link). However, we will talk about triplet in the rest of the manual for the 1 channel models even if the word is, in this case, not appropriate.

From each of the primary triplet also results a secondary triplet, obtained by filtering/decimation of the primary triplet. The decimation ratio can be chosen among the values 1/2, 1/4 ... 1/128= 1/DECIM.

The propagation time of the decimation filter is constant in the band pass. It depends on the decimation ratio and on the primary frequency.

TPG= (127/2)*(DECIM-1)/(Fsprim)

Each of the triplets can be part of the final data or taken out from it by user command.

The sampled data are given in the format 24 bits per channel.

AUXILLIARY CHANNELS

When 16*16 bits converter is implemented a set of 16 channels are sampled one time every 128 seismological primary channel sample. These auxilliary data are sampled at quite the same time the last primary seismological sample is (refer to Time frames paragraph for details).

The Auxilliary data cannot be switched off.

DATING

The data are dated after sampling and decimation filtering. It is then advisable to correct the dating for the propagation time of sampling and decimation filtering (Cf. paragraph SAMPLING).

The internal clock is set on time with the command TIME SETTING. The received hour must indicate the reception time of the next clock pulse. At the reception of this pulse, the received hour is loaded in the internal clock. If no pulse is received after 1 minute, the recorder automatically sets the right time by taking as internal time, the received hour + 1 minute. This time out clock setting will be signaled in the TIME frames.

Recorders that have an internal calendar continue to run the internal clock when the power is OFF. The time charged in internal, in case of time out, is then hour of the safeguarded calendar. If the pulse is received, the safeguarded calendar is set on time with the received time, at the reception time of the pulse.

The external reference can be a receiver of the TELECODE, OMEGA type, or any other clock. AGECODAGIS proposes a GPS receiver in an **external waterproof case** form integrating the antenna, low consumption (400 mW) and which delivers pulses of the same kind as the TELECODE (**TITANGPS**) minute pulses. The recorder has to be informed to adapt itself to all kinds of external references in function :

- the number of pulses per minute,
- the width of the correct pulse (min. = few ms),
- the validity condition of the pulse (length superior or inferior to a correct duration)

All these parameters are automatically determined by the TCS configuration software according to the type of time receiver used.

The TCS software suggests two of them to you : TELECODE (or TITAN GPS) or OMEGA. See paragraph TCS.

After initial time setting, datation continues to evolve thanks to an internal clock. It is an oscillator which has a stability of a few 10-7. The gap between this internal time and an external reference is measured and regularly memorized (at each reception of correct length pulse time signal or of satellite synchronization in the case internal GPS) This gap is maintained with the sampled data. The dating is given with a 1 millisecond resolution. The dating of a sample is then the reunion of the two following informations :

- the internal time of the recorder at the moment of sampling

- the reception time of the last time signal pulse which allows to determine the existing gap between the internal time and the external reference.

2.2. DATA MANAGEMENT

Sampled and dated data are transfered to the triggering algorithm and triggered data are added. This sum of data is then given permanently and in real time on the RS232 link.

The same data are also stored in the storage media.

2.2.1. SUPPORTED MEDIA

The storage hardware can be one of the following:

- internal 8 Mb Flash memory
- A 2 Gb DAT tape
- An external hard disk.

See at the end of this document the description of the data format « MEDIA DATA FORMAT ».

The 8 Mb flash memory, when used as media storage can be downloaded via telephone link or parallel link.

The 2 Gb DAT tapes can't be read in the station. So, the only way to get data is to remove the cartridge. Data can then be read on a PC with a DAT drive and the SEETITAN software.

The external hard disk are also to be removed and be read on a PC. These hard disk are DOS formatted.

2.2.2. RECORD AND STORAGE

It is to be distinguished the recording and storing ways to do.

Recording:

2 types of recording can be used depending on the station: continuous record or triggered.

Continuous record:

Data are continuously sampled and stored. Triggered event are also computed and the result is kept in the internal data indexes.

Triggered record:

Data are continuously sampled but they are only kept when a triggered event is detected. See « TRIGGER ALGORITHM » to get more details about triggered event management.

Storing:

Two kinds of data are stored: the seismological data and the triggered indexes.

There are 2 ways to do manage storage capacity.

Storing with cycle: This way to do is used for fixed and remote controled stations. When the storage capacity is reached, the data storage media is cycled and data overwritten. Indexes are not cycled. When max length is reached, the oldest half part of the indexes are erased.

Storing without cycle: This way is used for portables stations or when cycling the buffer is not possible (DAT tape for example). When the data storage capacity is reached, recording stops.

2.2.3. DAT SPECIAL MANAGEMENT

The data are temporarily stored in the Flash memory. The DAT drive is then off. The recorder power consumption is low. When the memory is full, the recorder switches on the DAT and writes down the data on the tape. Then it erases the flash memory and turns off the DAT drive. The recording is not interrupted during this operation. The Flash memory has a 8 mega bytes capacity and allows to turn on of DAT once every 2.5 hours at 250 samples/sec (a little more than once a day at 31.25 sam/sec).

In case of a problem with the DAT drive, the emptying of the Flash memory can be abandonned. The number of lost emptyings is given in the TCS Information window seen with SEETITAN. If the batterry voltage is too low (<12 Volts) the correct DAT DRIVE functioning can not be provided. This can destroy the tape and damage the DAT DRIVE. The DAT DRIVE switches to off and the emptying is lost. The number of dumpings lost due to DAT DRIVE anomalies and too low voltage is indicated in the TCS Information window and SEETITAN. If more than 16 dumpings are lost due to DAT DRIVE anomalies, the tape is ejected.

The filling threshold of the Flash memory that provokes the beginning of the DAT DRIVE for a dumping depends on the filling rate of the tape and on the sampling frequency. This threshold goes down when the tape fills itself and the sampling frequency increases.

The DAT DRIVE storage capacity is 2 Giga bytes for a 90 - meter tape. This enables to obtain a recording capacity of :

Fs (Hz)	Length (month)
31.25	4
62.5	2
125	1
250	0.5

DAT DRIVE recording length

The filling rate of the tape is directly linked to the recording time for a given sampling frequency.

The filling rate indicated by TCS and SEETITAN is calculated according to a 2 Gb capacity.

However, abnormal use of the tape can reduce its storage capacity. This may result from the fact that the DAT DRIVE repeats the writing of defective blocks. It is therefore important not to reach 100% filling if one wants to avoid the data losses

VERY IMPORTANT:

NEVER TURN OFF THE RECORDER DURING THE WRITING PROCEDURE ON THE DAT TAPE. THE TAPE CAN BE DAMAGED AND BECOME UNUSABLE

2.3. TRIGGER ALGORITHM

A STA/LTA algorithm always tags the data when a STA/LTA trigger event occures.

The STA/LTA algorithm is applied to the vertical channel of each of the triplets.

The STA/LTA algorithm has the following parameters :

- Time constant for LTA,
- Time constant for STA,
- Triggering threshold.

These parameters are introduced into the recorder by the TCS configuration software.

The STA/LTA algorithm is present in all TITAN recorders but its function depends on the product.

CONTINUOUS RECORD: It generates a data flow including the trigger information in real time.

TRIGGERED RECORD: Trigger algorithm output is used to trigger record. The stored data begin Pre-event duration before the trigger time. Data are stored until the time out duration is reached or if the end of the event is detected before. Event end detection is based on the following principle.

The LTA value just after triggering is kept in memory as LTA0. The following STA values are compared to the 2.5*LTA0 value. When STA values stay End duration second under the 2.5*LTA0 value, then the event is declared as ended and recording is halted.

Pre-event duration can be set very large but station can only recover data that are still in a 100 Kb RAM buffer. Equivalent time is difficult to calculate because is dependant of compression rate, sampling frequency. The buffer is deep enough to satisfy every usual requests. When a too long pre event duration is specify, software feeds the maximum data it is possible (and not more!!!).

2.4. MONITORING OF BATTERY VOLTAGE

When media is installed, software exploits the battery measurement and stops the media turns on dumpings as long as battery voltage is less than 12 volts. Low battery voltage indicates a battery discharge that would get even worse if Media is switched on. The Media dumpings are therefore blocked by the recorder until the battery voltage exceeds 12 volts. During all this period, the recorded data are lost but the recorder still functions and resumes recording as soon as the battery voltage allows it.

2.5. PARAMETERS SAFEGUARD DURING OFF-TIME

Recorders equiped with a FLASH memory internally save all parameters. As said before the clock is also safeguarded and continues to run during the time when tation is turn OFF.

2.6. SEISMOMETER BAND PASS WIDENER

The recorders running software release >= 23 can run a digital band pass widener enabling to reduce the cutting frequency of a seismometer. The TCS software enables to define the characteristics of the used seismometer but also the one you would like to simulate. This digital widener can be used, far example to open a 2 Hz (L22 type) seismometer to a 5 sec equivalent one. Widener can be activated with TCS software. You need to know before activation:

- natural frequency of the seismometer (f0)
- the seismometer's damping factor when loaded with station,
- the corner frequency you wish (f1).

The maximum f1/f0 ratio is ten for proper operation.

Please contact AGECODAGIS to get more details.

2.7. OFFSET MEASUREMENT

The offset affecting data on each of the channels is continuously measured by the recorder. The offset is measured during a period whose length depends on the frequency of the primary sampling. The value of the offset on each of the channels is regularly provided with data in the offsets frames.

2.8. FRONT FACE LED

All the products of the range have a flashing LED in front face. This blinking LED blinks one time per seconde and tells the user some useful informations as follows:

- the cycle ratio gives an idea of the filling rate of the station: when the blink is very short , the filling ratio is quite null. When the LED stays on quite a second per second, the media or flash is quite full.

- each time a trigger condition is achieved, the LED stay ON for 4 seconds. Then knocking the ground with your foot will instruct you on the good connection of the seismometer to the station.

- each time an external pulse time receiver is seen by the station, the led forget to blink. Looking at the led for 1 minute can make you sure that time receiver is well connected to station (most of time receivers send one pulse per minute.

- when problem are encountered with media the blinking period of the led's blink is turn to 1 blink every 4 seconds (slow).

- when Media is in use, the led's blink is turned to 4 blinks every second (fast).

Le fou se croit sage, et le sage reconnait lui-même qu'il n'est qu'un fou.
(Shakespeare)

3. RECORDER CONFIGURATION

The TITAN recorder dialogues with the outside through the RS232 link. This dialogue enables to configure the parameter of recording, to control the recorder and its operating. The recorder is delivered with a DOS software intended to be a user-friendly dialogue (TCS). It allows to : :

-send the recording parameters : sampling frequency, time setting, time constants for LTA and STA, and threshold for triggering.

- visualize in real time the data and recorder setting : visualization of sampled signals, sampling frequency, detection marks of earthquakes, internal clock, time shift measurements on the time receiver, the parameters in the process, the filling rate of the DAT DRIVE tape and of the Flash, the identification number of the recorder as well as the one of the software version.

- remove of the DAT tape or dump the Flash memory.

Savoir que l'on sait ce que l'on sait
et savoir que l'on ne sait pas ce que l'on ne sait pas,
voilà la véritable science.
(Confucius)

4. DATA RETRIEVAL AND PROCESSING

4.1. IN REAL TIME

The recorder provides in real time the sampled data on the serial link. This enables a monitoring of the recording function. Details on the provided flow of data can be found in the chapter : TECHNICAL SPECIFICATIONS

4.2. IN DEFFERED TIME

The recuperation of data contained in the recorder (in the Flash or the DAT DRIVE) cassette can be done by :

- Removing of DAT tape,
- Dumping by parallel link,
- By activating Modem or local serial link.

4.2.1. DAT TAPE

TCS proposes the replacement of the DAT DRIVE tape. **BEWARE ! From the time when the user has decided to withdraw the tape, TCS will not accept new commands until the procedure of tape withdrawal is finished, that is when a new tape is introduced into the recorder.** This is to avoid false manipulations which could result in letting the recorder work without tape in the DAT DRIVE. It is useful to remember that the tape changing does not stop acquisition.

DAT TAPES, LIKE COMPUTER DISKETTES, MUST BE FORMATED BEFORE BEING LOADED IN THE RECORDER. Cf. FMTTITAN software.

Tape replacing must be performed as fast as possible in order to avoid data loss by overflowing of the FLASH memory. **Prepare a formated tape before launching the tape replacement procedure.**

The tape extracted from the computer can then be exploited in a lab on a PC (DOS) equiped with a DAT drive (+ SCSI card) using the SEETITAN software (Cf. paragraph TOOLS SOFTWARES).

BEWARE : A tape wears out ! Do not use a tape twice in the DAT recorder.The cycle " Formating, recording, reading, reformating, recording .... " is to be banned unless the first recording phase was very partial (filling rate less than 30%). It is better to use only new tapes in the recorder.

4.2.2. PARALLEL LINK

TCS proposes the dumping of the content of the Flash memory on a quick parallel link. The obtained data are stored on the PC hard disk. The Flash memory should be erased at the end of the transfer.

4.2.3. BY THE MODEM OR THE LOCAL LINK

TBD

La machine a gagné l'homme,
l'homme s'est fait machine, fonctionne,
et ne vit plus.
(Mahatma Ghandi)

5. SOFTWARE TOOLS

The TITAN recorders are delivered with a DOS 3"1/2 1.44 Mb diskette which contains all the TITAN softwares. These softwares are divided into two parts : FIELD softwares and LAB softwares depending on where these tools are meant to be used (in the field or in a lab.)

5.1. IN THE FIELD

5.1.1. REQUIRED PC CONFIGURATION

Any kind of PC is suitable as long as it has a RS232 link SUBD 9 Points.

5.1.2. SOFTWARE INSTALLATION

Introduce the diskette in your PC drive. Create a directory on your disk (e.g :md C:\TITAN). Copy all diskette files in the created directory (e.g : copy a: FIELD * * C:\TITAN). The installation is finished.

5.1.3. TCS

The TCS software allows the configuration of the recorder. Link your field PC to the recorder by using the dialogue cable. Launch the TCS software. If the data are correctly received from the recorder, the data line appears. This software allows you to :

- introduce the recording parameters,
- control of the good operating of the recorder,
- read the operating parameters,
- identify the recorder,
- read DAT and Flash filling rate,
- replace DAT tape, dump the Flash.

It could be useful to write on your tape the name of the recorder that recorded the data contained in the tape. However, remember that the information is included in the recorded data. The source of the data is then always identifiable.

The name of a recorder is defined in the factory. It is composed of 9 letters describing the recorder owner followed by a number.

The name of a recorder can be read under TCS or SEETITAN in the Information window.

TITAN DAT DRIVE:

BEWARE : Sending commands to the recorder is blocked during the transfer of the FLASH memory data to the DAT tape (= when DAT is on). The time needed dumping depends on the filling rate of the DAT DRIVE and can vary from 1 minute to almost 7 minutes. If a time setting command has been jammed, check the time setting.

5.1.3.1. INTRODUCTION OF THE PARAMETERS

The Parameter window enables you, for each of the triplets, to adjust the values of the following parameters :

- Time constant for LTA,
- Time constant for STA,
- Triggering threshold,
- Sampling frequency or decimation factor,
- On/off switch of the triplet,
- Duration of pre and post event (triggered recording)

At the end of the Parameter Menu, TCS will ask you to confirm the sending of the parameters to the recorder.

TCS displays the parameters in use before asking you to modify them. TCS must then have received these informations before allowing you to modify them.The acquisition of the parameters is signaled at the bottom of the TCS screen. Before the "YES", the parameter modification is impossible.

5.1.3.2. TIME INTRODUCTION AND CHOICE OF RECEIVER TYPE

Valid if no internal GPS. When an internal receiver is installed, the time setting is automatic.

The recorder time setting is a fundamental procedure for subsequent correct data. **Always check after a time setting operation that the recorder has the right time.**

ATTENTION : Link your time receiver to the recorder WHEN TITAN RECORDER IS OFF.

The use of a time receiver is accompanied by the positioning of a switch placed on the front face of the recorder. This switch enables the recorder to adapt itself to different types of electrical interfaces.

For the two types of receivers proposed by TCS the switch must be set in the following position :

TELECODE: Positive pulse ...
OMEGA: Negative pulse ...

ATTENTION : The switch selecting the type of time receiver must be manoeuvred WHEN TITAN RECEIVER IS OFF.

Before launching TCS, check that your field PC has really time TU +-20 seconds.

The TCS software proposes two types of time receiver :
TELECODE or OMEGA.

The configurations selected by TCS are the following :

(Cf. DATING paragraph)

Length of the pulse	NB pulses/Mn	Test selection
TELECODE (TITAN GPS)	300 ms	OK if <
OMEGA	5 seconds	OK if >

The time transmitted by the PC to the recorder is the time of the next full minute. This time is memorized in the recorder until the reception of a time pulse.

ATTENTION : Do not forget to check that the time has really been taken into account by the recorder by returning to the main window. At the first received time pulse, the recorder must be correctly set on time.

The time of the last resychronisation which is indicated in the window is always one minute late compared to the correct time. In fact, a received pulse is only validated on its descending front. It is signaled only during the rising front of the next pulse. This information indicates that at the indicated time there has been one correct pulse and no other since, except perhaps during the last minute ... In case there is no pulse, the recorder is set on time by time out. (Cf.DATING paragraph)

If the drift of the internal clock in comparaison to the external reference (> +-25ms/day) is too important, the oscillator must be turned. A tune potentiometer can be found on the front face of the recorder. There is also a 2.048 MHz port. The potentiometer enables to tune the oscillator to its nominal frequency.
WARNING : the oscillator is stable at 5 10-7. It is then necessary to use a 2.048 reference frequencemeter with a precision better than 5 10-8 in order to tune the oscillator. (Cf. also paragraph IN CASE OF TROUBLE)

5.1.3.3. DATA RETRIEVAL

This paragraph does not concern the digitizers. We will examine the TITAN DAT DRIVE and MINITITAN cases.

5.1.3.3.1. REPLACEMENT OF DAT TAPE (TITAN DAT)

5.1.3.3.1.1. NORMAL CASE AND CLEANING OF THE HEADS

The normal case consists in replacing a tape which is still in the DAT drive. Its filling rate approaches 100% for example or we would like to take this tape out and replace it with an empty one in order to be able to take the data back to the laboratory.

Before starting the procedure of tape replacement be sure to have an empty and FORMATED tape. Try really to have this tape close by. The replaccement of the tape must be done as fast as possible in order to avoid the capacity exceeding of the FLASH memory which would result in a data loss. In order to avoid these data losses, start by launching a "FLUSH" of the FLASH memory data to the tape by using the "flushing" window of the TCS. Wait for the end of the dumping (extinction of the DAT). Depending on the filling rate of the DAT DRIVE, this operation can take 1 to 7 minutes.

Once this operation is finished, launch "Cassette removal" under TCS. The tape will automatically come out of the DAT DRIVE about one minute later. Take the tape out and place it in its box.

The head cleaning procedure of the DAT DRIVE which follows is optional. This cleaning must be realized periodicaly (every 10 recorded tapes).

The the head cleaning is done with a specific tape called "cleaning tape". (Cf list of the accessories at the end of this document) The procedure is simple and fast. Just introduce the tape in the DAT DRIVE. It is automatically ejected when the cleaning is finished, about 10 seconds later.

Take the cleaning tape out and replace it with the empty tape.

All these operations are commented during their execution in the TCS window.

Then follows an automatic phase where the data recorder imposes a flush of the data towards the new tape. The filling rates of the new tape appears.

The tape replacement procedure is finished.

At the end of its first automatically forced Flush, check in the Information window that the fields indicating the filling rates of the new tape are filled (removal of the "going to be known"). If this is not the case, the tape is defective and must be replaced.

5.1.3.3.1.2. CASE OF FAULT

Sometimes the tape may be ejected from the recorder during the recording. This fact can have two origins :

- the tape is fulll,

- too many problems have occurred with the DAT DRIVE or the tape. After the 16 th problem, the recording is abandonned and the tape is ejected.

The TCS Information window tells you the nature of the problems and indicates you the number of FLASH- >DAT that have been lost until the ejection of the tape (Cf. "Info window" paragraph).

Launch a "cassette removal" as if the tape had not been ejected by itself and proceed to the replacement of the cassette.

Another problem can happen : the recorder may have had more than 16 problems but was unable to eject the tape. Even if TCS indicates that the tape has been ejected, the tape is still in the DAT DRIVE.

In order to change the cassette, launch a "cassette removal". It can be normal that the tape still does not come out. Relaunch a "Cassette removal" when the DAT is off. The tape must be ejected.

A last problem can arise when a recorder has been switched on without a tape in the DAT DRIVE. Launch a "Cassette removal". The recorder will try to eject the tape without success and will then invite you to introduce a new tape.

5.1.3.3.2. DUMPING THROUGH THE PARALLEL LINK

When parallel link is present, data can be downloaded via the parallel link. This link is connected to the printer port of a PC. Tcs runs the download. Data are stored on the hard disk of the PC. 8 Mb downloading takes 4 minutes.

5.1.3.4. INFOS WINDOW

The "Infos" window provides many information on the recorder working. The informations are divided into two successives screens.

Information meant to be displayed are periodically received from the recorder on the serial link. The last line of the screen indicates if new informations are available since the last reading (opening of the Infos window).

Data are received only under the spy mode (visualization of 3 channels). So these screens do not change until leaving spy mode.

FIRST SCREEN :

The first screen tells you which parameters the recorder uses.

It also gives all available information on the working of the DAT DRIVE and of the flash card, like the filling rate, the number of stored triggers, the stage of the dumping process (Cf. IN CASE OF PROBLEM paragraph) and indicates, if needed, the presence of a DAT DRIVE problem as well as its nature.

Finally this first screen informs on the software release and the recorder identification.

SECOND SCREEN :

The second screen describes the configuration of the recorder and informs on describing the time receiver as well as the time of the latest time synchronization.

5.2. IN THE LABORATORY

5.2.1. REQUIRED PC CONFIGURATION

Any compatible PC can be used.

The DAT tapes recorded by the DAT TITAN can be read on a PC equiped with a DAT 2Gb HP SCSI drive. The laboratory PC must be equiped with a SCSI compatible ASPI (ADAPTEC, TRANTOR ...) interface. It must also be equiped with a VGA screen. See the manufacturers' manual for installation procedures as well as the MAINTENANCE paragraph.

5.2.2. SOFTWARE INSTALLATION

Introduce the TITAN diskette in your PC drive. Create a directory on your hard disk (e.g : md c:\TITAN). Copy all the diskette files in the created directory (e.g : copy a:\LAB* * C:\TITAN). The installation is finished. For DAT installation, see the paragraph below : LIST OF ACCESSORIES.

5.2.3. SEETITAN

SEETITAN enables the visualization and the extraction of data recorded on the TITAN recorders. These data can be read from the DAT or from the PC hard disk.

- Visualization, zoom, back and front displacement, entirely corrected dating of each sampling,

- Visualization of the triggering marks,

- Extraction of DAT data onto a hard-disk file,

- Visualization of the parameters used during recording,

- For the visualization of a DAT DRIVE tape, index visualization of the triggering marks (display of the corresponding hours), selection of an index and direct jump to this index. The jump and the data visualization corresponding to any one of the indexes or to any time can be realized in less than a minute. The XTRACT function also provides the possibility of automatic data extraction from a list of hours provided in a file by the user.

A DAT tape can contain a big quantity of data (2 Gb). The deffered processing of these data is really made easier with the index management. These indexes are dependant on the STA, LTA, and THRESHOLD parameters that you have used to record the data. One must carefully choose these parameters at the time of the recorder installation.

A large threshold or too large LTA or STA constants can mess the recorder and therefore limit the number of triggers. Interesting signals are not marked. Their search and extraction of the 2Gb mass can be long and tedious (unless an exterior source of information has given you the approximative times of the events).

On the contrary, an over-sensibilization of the recorder will result in an increase of the number of triggers. The extraction of interesting data could also become annoying.

However, in all cases, no data is lost ; the recorder records continuously. But a good selection of the trigger parameters, enables you not to loose too much time when processing the data.

Thanks to SEETITAN, the interesting data on the tape can easily be extracted and stored on hard disk files. The hard disk files can also be visualized by SEETITAN or be transmitted on a bigger processing computer by ETHERNET for example.

The entirely corrected dating of each sample corrects :

- The gap between the internal time and the last received correct time pulse,

- The propagation time of the digitizer anti-aliasing filter.

This dating represents the exact time when the signal has been presented to the recorder input for the primary triplets.

The TITAN recorder permanently indicates the amplitude of the continuous component on each of the channels (offset). The amplitude of this offset is transmitted on the data frames. The raw signal can therefore always be recentered. The processing of information contained in the offset frames enables the user to bring back the signal around zero for visualization. SEETITAN does this work. The offset is corrected at the visualization each time one presses the "R" button.

5.2.4. FMTTITAN (TITAN DAT)

FMTTITAN has only to be used with old generation of TITAN DAT recorder. Please contact AGECODAGIS for more informations.

5.2.5. TITANREL

The TITANREL software, standing for "TITAN RELease", enables the up-grade of a recorder internal software. This device is only possible for recorders that possess Flash memory.

This software charges in the recorder the TITAN _IN file which was delivered to you. TITANREL expects to find the TITAN _IN file under the current directory. After having indicated the version release which it is ready to charge, TITANREL will ask you to indicate the type of your target recorder. TITANREL will then indicate you which are the different operation to be realized on your recorder in order to carry the software leveling through to a successful conclusion. This leveling requires no internal intervention on the recorder. Working on the recorder must be interrupted and switched off in order to realize the leveling.

5.2.6. SPLIT

Split software is used to split 2 Gb files of data recorded in continuous manner on hard disk. Hard disk shows 2 major files:

- DATA.DAT
- DATA.NDX

Seismological datas are stored in the big DATA.DAT file. DATA.NDX keeps the triggered time.
Split ask you to define the beginning and end adress of DATA.DAT you want to extract and the path name of the DATA files (without extension). You also have to supply the path name of the file you want to create with extracted data.
2 files are then generated: the new target.dat and target.ndx files. Indexes have been translated accordingly with the beginning adress specified that is now the beginning of the new file.

Split is useful to make 640 Mb large files for CD ROM archive purpose.

Si j'étais Roi, je me mettrais en colère!
(Louis XIV)

6. INSTALLATION OF A RECORDER IN THE FIELD

Check that you have all the following accessories :

- TITAN recorder,
- Power supply cable,
- Dialogueue cable,
- Time receiver and/or GPS antenna
- Seismometer + cable,
- 12V supply source (battery + solar panels),
- DAT tape (if TITAN DAT DRIVE),
- Field PC set on time + field softwares.

Check that the ON/ OFF switch of the recorder is OFF. Link the recorder to the seismometer, to the supply source, to the time receiver. Position correctly the time receiver switch of the recorder according to the polarity of the pulse provided by the external reference clock (except if internal GPS) (Cf. TIME SETTING paragraph in TCS).

REMARK : The recorder provides a 12 volts output for the possible supply of an active seismometer. Use this supply for the seismometer rather than a direct battery connection.

ATTENTION : Do not let the recorder work directely under a blazing sun. The protection with a solar panel is sufficient to limit excessive temperature increases.

DIGITIZER CASE :

Start the recorder (ON/OFF switch on the front face). Launch TCS software. The recorder is ready to receive a TCS command. The serial link is operational a few seconds after the switch is ON.

Proceed to the recorder configuration (Cf TCS paragraph).

TITAN DAT DRIVE case :

Start the recorder (ON/OFF switch on the back face). If the recorder does not contain a tape, the DAT DRIVE starts a few seconds later and turns off. Immediately introduce a formated tape. The DAT will turn on a few seconds later.
Wait for the DAT DRIVE extinction and launch TCS software. The recorder is ready to receive a TCS command as soon as the DAT DRIVE extinction is done. However all TCS observation functions are operational when the DAT DRIVE is turned on.

Proceed to the recorder configuration (Cf. TCS paragraph).

Belle, sans ornement, et dans le simple appareil
D'une beauté qu'on vient d'arracher au sommeil.
(Racine)

7. TECHNICAL SPECIFICATIONS

7.1. GENERAL TECHNICAL SPECIFICATIONS

Consumption	DIGITIZER and DAT DRIVE <2.5 Watts MINITITAN 700 mW
Tension supply	9..18 Volts
Baud rate of the RS232 link	38400
Internal clock stability	5 10-7
Weight/ physical dimension	DIGITIZER AND DAT DRIVE: 4 Kg, 260*190*150 MINITITAN: TBD
Watertighness	IP65

Crystal A/D :

Sensibility	.6 uV / lsb
Dynamic range	>120 dB
Cross talk	>80 dB
Common mode rejection	>60 dB
Input impedance	25 K
Band pass	0..(Fs/2.43)
Max amplitude	+-5V

Analog Device:

Sensibility	Cf. Analog Device documentation
Dynamic range	depends on gain and Fs
Cross talk	-
Common mode rejection	TBD
Input impedance	very large
Band pass	0..(Fs/4)
Max amplitude	+-5V with a gain = 1

7.2. DETAILED TECHNICAL SPECIFICATIONS

The specifications of the TITAN recorders are described in the following paragraphs :

- Sensor interface,
- Dating and time receiver,
- RS232 link,
- Media Data format,
- Pinout.

7.2.1. SENSOR INTERFACE I

The sensor interface depends on the type of digitizer.

Crystal A/D:

The recorder has the sensor differencial inputs referenced to the minus pole of the supplying system. The characteristics of the input are the following :

Input impedance :	25 Kohms
Max amplitude :	+-5 V
Gain with ADC :	1, fixed.
No highpass filter	

Analog Device A/D:

The recorder has the sensor differencial inputs referenced to the minus pole of the supplying system. The characteristics of the input are the following :

Input impedance :	very large
Max amplitude :	0-5 V
Gain with ADC :	1, 2, 4, 8 or 16.
No highpass filter	

7.2.2. DATING AND TIME RECEPTION

The recorder has an internal oscillator form which is obtained the internal clock and the sampling frequency. Its stability is of the order of 5 10-7.

The internal time is managed with a 1 ms resolution.

The internal clock is set on time by the RS232 link (Set on time command). The internal time is replaced by the time received through the command at the time of the reception of the first time pulse following the complete reception of the command. The effective time setting is realized whatever the length of the time pulse may be.

From now on, the recorder counts the successive time pulses and checks in the length of a pulse on N where N can be parametrized. N must represent the number of time pulses received in a minute. It is therefore important to send the Set on time command just before receiving a time pulse carrying the quality information of time reception. N can take any value except zero. The most interesting values are :

- N=1 for a receiver providing only minute pulses,

- N=60 for a receiver providing only second pulses,

- N=59 for a receiver providing second pulses but from which one pulse per minute is masked.

Time pulses from the external reference should have a proper length to be accepted for synchronizing the internal clock. It is possible that a correct pulse has a length above or below to the length of reference. The test selection as well as the length of the reference pulse are provided in the parameter of the Time setting command.

The time is carried by the first front of the time receiver pulse. When its length is correct, the internal time of the first front is memorized by the recorder. It indicates the gap which exists between the internal time and the received time pulse. This information is provided with each sample dating. The internal time + internal time corresponding to the last received time pulse constitute the complete dating of a sample. The time of the last external time receiver synchronization is available for the dating of the samples at the time of the next time pulse reception (one minute after for the receivers providing only minute pulses, 1 second after for the receivers providing second pulses).

The electrical interface of the time receiver can be of the open Collector type (OMEGA, negative pulse) or supplying source (TELECODE, positive pulse). The selection is done with a switch on the front face of the recorder.

The internal time and the hour of the last external time receiver synchronization are initialized at 0 when ON is switched. If an internal calendar exists (case of Flash present), it is the hour of the calendar which is charged in internal when ON is switched. On the other hand the field "hour of time shift measurement" is equal to zero until the reception of the first PULSE. Note that MINITITAN only accepts receivers of the TELECODE type.

The hours are encoded in seconds + milliseconds. The number of seconds is encoded in a long integer (32 bits) in the UNIX format or C language (number of seconds gone by since midnight January 1 1970). The milliseconds are encoded in an integer of 10 bits (Cf. format of the time frames).

7.2.3. RS232 LINK

7.2.3.1. OUTPUT LINK

Data are grouped in 12 bytes frames. Ther are different types of frames. Each frame has a byte reserved for frame synchronization.

7.2.3.1.1. SAMPLE FRAMES

Channels are grouped in triplets. Ech triplet has a number 0..15. Numbers 0..7 are reserved for seismological high dynamic data. 8..15 triplets are used for special purposes described below.

Triplets 0..7

There are two types of sample frames : the 1 channel frames and the 3 channels ones. The distinction between the two types is done with the bit 4 of the Rate byte.

3 channels frames :

They contain sequentially the numerized data as well as useful information : sampling frequency of triplets and compression rate.

24 bits=3 bytes per channel. ex: C01 C02 C03 for the channel 0 (C01 = most significant byte).

C01 C02 C03 C11 C12 C13 C21 C22 C23 Fs Rate SYN

Fs = indication byte of the sampling frequency used to obtain this sample and number of the triplet concerned.

b3210: =f ; Fs code. f 2's complement on 4 bits.

1/ if bit 22 of byte M1 in time frames=0 Fs = 31.25 Hz* 2^(f).
2/ if bit 22 of byte M1 in time frames=1 Fs = 20 Hz* 2^(f).

b7654: Number of the triplet (0..15)

SYN= synchro frame:

bits 76543210

b3=0

b210 bits indicating the type of frame

000: Sample frame trigger condition not fulfilled
001: Sample frame trigger condition (STA/LTA>THRESHOLD)

b7654 bits synchro, reversed 1 frame out of 2.

1010 ou 0101

Rate : Compression rate

b3210: compression rate from 1 to 8

b4 : 0 (indicator 3 channels frames)
b765: =primary frequency ;. f 2's complement on 3 bits.

1/ if bit 22 of byte M1 in time frames=0 Fs = 31.25 Hz* 2^(f).
2/ if bit 22 of byte M1 in time frames=1 Fs = 20 Hz* 2^(f).

xThe compression principle for 3 components frames is as follows :

- first frame of this triplet following the last dating frame is coded in absolute, rate=undefined,

- following frames of this triplet until the next dating frame in delta coding, Un-(Un-1). If the amplitude of N consecutive delta samples allows it, storage of N delta samples in 1*24 bits per packs of :

-24 bits if rate=1,
-12 bits if rate=2,
-8 bits if rate=3,
-6 bits if rate=4,
-4 bits if rate=6,
-3 bits if rate=8.

Arranged in a 24 bits word in the order : oldest to most recent, most significant byte to least significant byte ; coding in complement at 2.

As usually defined, the triplet numbers are attributed as follows :

0: primary seismometer 1
1: primary seismometer 2
2: secondary seismometer 1
3: secondary seismometer 2

4..15: not attributed

1 channel frames :
Exactly the same except for:

Rate : Compression rate

b3210: compression rate from 1 to 8

b4 : 1 (indicator 1 channels frames)
b765: =primary frequency ;. f 2's complement on 3 bits.

1/ if bit 22 of byte M1 in time frames=0 Fs = 31.25 Hz* 2^(f).
2/ if bit 22 of byte M1 in time frames=1 Fs = 20 Hz* 2^(f).

The compression principle for 1 components frames differs from the 3 components one as follows :

The first frame is absoluted coded but the only first 3 bytes contains data. Other are 0.

For following frames:

rate= 0: The only 3 first bytes carry informations, delta coded, 24 bits.
rate=1: 3 samples on the 3*24 bits, delta coded
rate=2: 6 samples on the 3*24 bits, 12 bits each, delta coded
rate=3: 9 samples on the 3*24 bits, 8 bits each, delta coded
rate=4: 12 samples on the 3*24 bits, 6 bits each, delta coded
rate=6: 18 samples on the 3*24 bits, 4 bits each, delta coded
rate=8: 24 samples on the 3*24 bits, 3 bits each, delta coded

Triplets 8..15

Only 13 and 12 ones are today assigned.

Triplet 12:

Used to encode up to 16 auxilliary 1 component channels**.** When triplet number is 12, Fech and rate signification is modified as follows:

Fs:	
b7654:	d12
b3=0	
b210	Auxilliary pair of channel number we speak about (0..7)
Rate:	same as 0..7 triplet sample frame except compression ratio is always 0

Auxilliary channel are grouped 2 channels in a frame.
Data are located and absolutely encoded as 16 bits on 24 on the two first locations as follows

X X x Y Y y 0 0 0

XXx are the 16 bits of the sampled data for the channel b210 sign extended to 24 bits.
YYy are the 16 bits of the sampled data for the channel b210 +8 sign extended to 24 bits.

No sampling frequency is defined for these channels. One sample is read every time frame.

Triplet 13:

Triplet 13 is reserved for special purposes. When triplet number is 13, Fech and rate signification is modified as follows:

Fs:	
b7654:	d13
b3210	Triplet we speak about
Rate:	
b7654	unchanged
b3210	0, 1 or 2 (type of informations)

Depending on type of information, carried information is as follows:

0: The first 6 bytes indicate the max LTA value for the whole time ellapse since the last time frame for the indicated triplet. Encoded with 48 bits

1: the same for STA exepted byte 7=0.

2: 3*24 bits indicating the max value reached for the 3 components of the specified triplet since the last time frame.

The Triplet n° 13 frames are designed for internal software purposes.

7.2.3.1.2. TIME FRAMES

These frames indicate the time of the last sample of a primary triplet contained in the sample frame above.

H1 H2 H3 H4 R1 R2 R3 R4 M1 M2 M3 SYN

H1..H4: Current time in seconds.

H1234: time in seconds size UNIX /C langage (32 bits)

H1=most significant word

R1..R4: Time of the last external time receiver synchronization (same size as H1234)

M1M2M3: 24 bits

Millisecond is a general word as well used for 1/1000 sec or 1/640 secs.

b23..b16 M1
b15..b8 M2
b7 ..b0 M3

b23	0 Time setting validated by a time pulse 1 Time setting by time out of time pulse reception
b22	0 1/1000 sec unit 1 1/640 sec unit
b21	must be set to 0
b20	spare=0
b19..b10	Millisecond of the hour of the last correct pulse
b9..b0	Millisecond of the internal time

SYN = synchro frame:

b3=0
b210 bits indicators type of frame

010: time frame

b7654 bits synchro, reversed in comparison to the synchro frame of the previous frame... ($A or $5)

To get fully corrected time for primary channels, time has to be corrected with:

- the shift of the internal time versus external reference.
- the propagation time of the A/D converter that depends of the converter implemented (see sampling paragraph)

A third correction has to be applied for secondary channels: The propagation delay of the decimation filter has to be computed. See sampling paragraph to get formula.

Auxilliary channels datation cannot be known very precisely. The channels are scanned and converted less than 5 mS before the last primary channel before a time frame is.

7.2.3.1.3. OFFSET FRAMES

Two types of offset frames can be found. The 1 channel frames and the 3 channels frames. The distinction between both types is done at the level of the byte T bit 4.

3 channels frames case :

These frames indicate the offset amplitude on each of the channels and for each of the triplets.

O1 O2 O3 O4 O5 O6 O7 O8 O9 Fs T SYN

24 bits=3 bytes per channel. ex : O1O2O3 for the channel 0 (O1 = most significant word)

Fs: idem Fs bytes of the samples frames

T: Type of frame

b3210: Unused
b4 : 0 (indicator frames 3 channels)
b5 : Type of offset 0: Differential offset correction
1: Absolute

The frames of differential offset correction give the gap between the offset affecting the transmitted data before and after this frame. This offset is suddenly modified, when this frame is transfered, so that the raw data are alchannels centered around 0.
The frames of absolute offset give the value of the offset measured by the recorder and affecting the raw data from this frame.
The two types of offset frames are always transmitted in bulk.

b76 : Unused

SYN = synchro frame:

bits 76543210
b3=0
b210 bits indicators type of frame

011: OFFSET Frame

b7654 bits synchro, reversed in comparison to the synchro frame of the previous frame... ($A or $5)

1 channel case :

Same as 3 channels case but information is only carried by the 3 first bytes of the frame and b4=1.

7.2.3.1.4. INFORMATION FRAMES

These frames are periodically placed in the data and provide informations on the internal functioning of the digitizer. The format of the frames is as follows :

I0 I1 I2 I3 I4 I5 I6 I7 I8 I9 NUM SYN

NUM : sequence number of the information frame. The meaning of the Ii bytes depends on the number of information frames. This number is between 0 and 31.

Infomation bytes : Ii

FRAMES : 0 to 15 : last received i command. Frames initialized at 0 when ON is press. The first byte of the command is placed in NUM (shift of the previous bytes towards the first byte).

Rem about frame 15.

The b0 bit of the time out byte when 1 indicates that the frame gives the last reboot time. When this bit is 0 it gives the last time set. Refer to TIME SET COMMAND.

FRAME 16 : ASCII Owner bytes 10 to 18 of the frame,
Number 0..255 coded in binary on byte 19.

FRAME 17 : Software version ASCII bytes 10 to 19 of the frame.

FRAME 18 : I0,I1 msb first, number of detections,
When I2345=$FFFF it means “unknown”
I2,3,4,5 msb first number of Media DRIVE bytes. Nb bytes = I2345* 32768. When I2345=$007FFFFF it means “unknown”.
I6 Battery voltage : Vbat=16*20.163/256 volts
I7,8 Msb first number of lost dumpings due to low bat tension
I9 unused null

FRAME 19 : I0,I1 msb first, number of failed Media DRIVE Flushs
I2, number of cycles written in Flash when trigger mode
=0 if not.
I3,I4,I5 msb first number of bytes in the Flash
I6 State of flush process

0	Not Running
1	Loading Tape
2	Going to EOT
3	Writing DATA
4	Rewinding Tape
5	Writing index
6	Unloading Tape

other Reserved
I7 Triggered event record in process when 1
I8 Indicator of DAT Problem
I9 Indicator of DAT dumping in progress (1 if in progress)

Detail of I8 :
b0: Time out access DAT
b1: Problems link SCSI DAT
b2: Low bat detected
b3: Unexpected SCSI answer of the DAT DRIVE
b4: Problem with changing the DAT cassette
b5: Full DAT DRIVE tape
b6: Reserved (=0)
b7: Ejected tape

FRAME 20 : Configuration 1 of the recorder
I0: nb of channels
I1: type of A/D digitizer
B210
000= Crystal 5323/22
001= Analog Device AD7710
010= Harris HI7190
011= Crystal 5321/22
other= not till assigned
b7 0= no Auxilliary channels
1=16*16 bits Auxilliary channels
I2: Internal info
b0= 0 => Radio Mode Off
b0=1 => Radio Mode On

b1=0 => Continuous GPS not resquested
b1=1 => Continuous GPS resquested
I3: Sampling frequencies set
b2 0 -> 250 Hz
1 -> 160 Hz
I4: Time keeper
0=none
1=Installed
I5: Type of recording
b0
0=continuous
1=on trigger STA/LTA
b321 (if media byte is not 0)

000=DAT
001=SCSI DISK

I6: Flash memory
0=no Flash
x=x mega bytes Flash (usually 8)

I7: Media storage capacity
0=no one
2=2 Gb DAT/DISK DRIVE

I8: Internal info (boot switch Automatic Eprom)

I9: Parallel link
0=no parallel link
1=parallel link.

FRAME 21 : Configuration 2 of the recorder
All li bytes void, reserved for future developments.

FRAMES 22 to 29 : Last widener commands received

FRAMES 30 et 31 : reserved factory

SYN = synchro frame :

bits 76543210
b3=0
b210 bits indicators type of frame

100: Informations frame

b7654 bits synchro, reversed in comparison to the synchro frame of the previous frame ... ($A or $5)

Information frames are all transmitted one after the other ; periodicity : each 8 Time frames (Cf. FRAME SUCCESSION)

7.2.3.1.5. CORRECTED TIME FRAMES

(Implemented if Corrected Dating)
These frames indicate the corrected time of the last sample of a primary triplet contained in the previous sample frame.

H1 H2 H3 H4 R1 R2 R3 R4 M1 M2 M3 SYN

H1..H4 : Corrected current time in seconds

H1234: time in seconds format UNIX /C langage (32 bits)

H1=most significant byte

R1..R4 : Gap between the two pulses of external time receiver synchronization (same format as H1234).

M1M2M3: 24 bits

b23..b16 M1
b15..b8 M2
b7 ..b0 M3

b23	0	Time setting validated by a time pulse
	1	Time setting by time out of time pulse reception.

b22.b20	spare=0
b19..b10	Millisecond of the gap between the two last pulses.
b9..b0	Millisecond of the corrected internal time.

SYN = synchro frame:

b3=0
b210 bits indicators type of frame

101: Corrected time frame

b7654 bits synchro, reversed in comparison to the synchro frame of the previous frame ... ($a or $5)

7.2.3.1.6. MISCELLANEOUS FRAMES

These frames are used to multiplex miscellaneous informations with data.
The frame's structure is the following:

MF1 MF2 MF3 MF4 MF5 MF6 MF7 MF8 MF9 IT NU SYN

MF1..MF9 : Miscellaneous informations
IT : Information type: 0..255 and give the meaning of MF1 ..MF10 bytes
NU: Null byte. Set to 0

IT=0: GPS LATITUDE AND LONGITUDE
MF1..MF4: LATITUDE, Long msb first.
LATITUDE (+-PI/2) = MF1..MF4*10-8
MF5..MF8: LONGITUDE, Long msb first.
LONGITUDE (+-PI/2) = MF5..MF8*10-8
MF9=0

IT=1: GPS HEIGHT
MF1..MF4: HEIGHT, Long msb first.
HEIGHT (meters = MF1..MF4*10-2
MF5..MF9=0

IT=2: AMOUNT OF TRACKED SATELLITES
MF1= AMOUNT OF SATELLITES
MF2..MF9=0

SYN = synchro frame:

b3=0
b210 bits indicators type of frame

110: Miscellaneous frame

b7654 bits synchro, reversed in comparison to the synchro frame of the previous frame ... ($a or $5)

7.2.3.1.7. FILLING FRAMES

These frames do not carry informations but can be found in the data.

S0 S1 S2 S3 S4 S5 S6 S7 S8 S9 S10 SYN

Bi=$FF

SYN = synchro frame:

b3=0
b210 bits indicators type of frame

111: Stuffed frame

b7654 bits synchro, reversed in comparison to the synchro frame of the previous frame ... ($A or $5)

7.2.3.1.8. FRAME SUCCESSION

The time frames are sent out one time each N primary samples frames. The first frame transmitted after switching ON is a time frame.

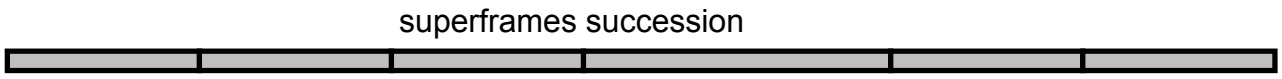
The INFORMATION frames are sent out each 8 TIME frames.

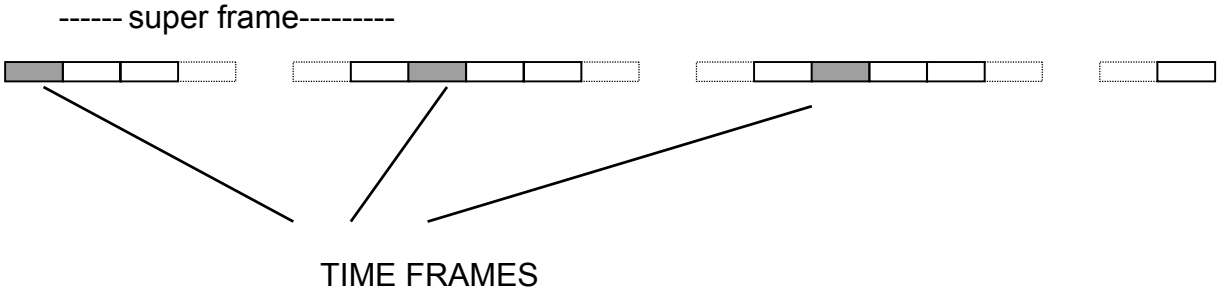
The offset frames are transmitted every 256 time frames.

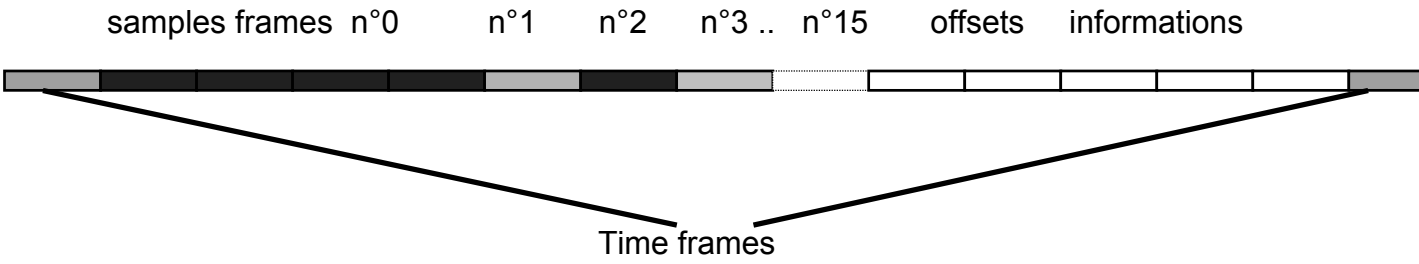
The periodicity of the INFORMATION and OFFSET frames is as follows :

	31.25 Hz	62.5 Hz	125 Hz	250 Hz
INFOS	32 secs	16 secs	8 secs	4 secs
OFFSET	17 Mns	8 Mns	4 Mns	2 Mns

All these informations are prone to be modified. The software developed by the user should not take it into account.







Relative position of frames in a super frame is not important. The only important thing is the succession sequence of frames related to the same triplet number.

7.2.3.2. INPUT LINK

This link is composed of fixed size messages (12 bytes). The content of the message corresponds to the following list of parameters :

- COMMAND (1 byte),
- data bytes (10 bytes)
- chksum (1 bytes).

The COMMAND byte defines the type of the 10 data bytes.

7.2.3.2.1. SENDING OF A COMMAND

The sending of a command is done as follows :

Before sending a command, the transmitter must be sure that the CTS signal is not in action.

The transmitter activates the RTS signal. It waits for the CTS signal to become active .

The command transmitter must then turn down the RTS signal down and send the command bytes to the chksum. The CTS signal becomes inactive after the reception of the chksum and the end of the possible execution of the command, thus indicating that the recorder is available to receive a new command.

The reception of the chksum by the recorder is followed by :

- Checking of the chksum

- Taking into account the command if the chksum is correct.

The chksum must be equal to the Boolean sum of the 11 first bytes of the command (OR EXCLUSIVE) with the bit of most significant word forced to 1

The advised dialogue procedure is the following :

- Test inactive CTS
- Activate the RTS,
- Wait for the CTS activation
- Deactivate RTS

- Send the command
- Wait for the CTS deactivation (end of command execution)

During the periods of dumping of data towards the DAT DRIVE, the recorder cannot accept commands. The CTS does not turn to 1 following the RTS increase until the end of the dumping.

7.2.3.2.2. RESYNCHRONIZATION OF THE INPUT LINK

This paragraph describes the actions that should be undertaken if one wants to send a command while the CTS signal of the recorder is active. It can happen when one connects the RS232 link to the recorder while the recorder is ON. The recorder can then start receiving parasitic data and may activate its CTS.

In this case, the execution of the following actions brings the recorder back, awaiting another command.

- transmit 12 void bytes (0)
- the CTS must decrease.

If the CTS does not return to zero, the recorder has a defect

7.2.3.3. COMMAND NUMBERING

Each command has a number. The numbers given to the digitizer are 0 to 31.

The choice for the numbering is as follows :

0: PARAMETER 0
1: PARAMETER 1
2: PARAMETERS 2
3: PARAMETERS 3
4: WIDENER
5: TRIGGER
6: DUMP
7: IDENT
8: SEISMOMETER CALIBRATION
9: DIAL SPECIFICATIONS
10: FLUSH
11: DAT DRIVE LOAD/ ALERT ALGORITHM PARAMETERS
12: DAT DRIVE EJECT
13: MISCELLANEOUS INFORMATIONS
14: spare
15: DIGITIZER TIME SETTING

Each of these commands is described in the following paragraphs.

7.2.3.3.1. PARAMETERS 0 COMMAND

(triplet # 0, primary, seismo 0)

COMMAND=0 : Parameter 0.

- COMMAND=0 (1 byte),
- LTA constant (3 bytes),
- STA constant (3 bytes),
- sampling frequency (1 byte),
- STA/LTA threshold (1 byte),
- ON_OFF (1 byte),
- Offset management suppression (1 byte),
- chksum (1 byte).

The parameters are immediatly taken into account except the sampling frequency parameter which will only be taken into account after the next time frame.

STA and LTA constants :

The STA and LTA computation is based on the computation of a first order recursive filter. The response of such a filter to a step input is an exponential function with a time constant T. This time constant depends on :

- Fs,
- The constant of time STA= KSTA (or KLTA)

The relationship between T, KSTA and Fs is :

T = -1/(Ln(1-KSTA) * Fs)

The equation of the filter is :

Yn = Yn-1 + (Xn - Yn-1)*(KSTA)

The KSTA and KLTA constants are positive numbers smaller than 1.

The KSTA or KLTA constants are coded in 24 bits :

B0 B1 .. B23

B0 represents the most significant word (sign bit)
The coded number is equal to :

KSTA= B1*2^-1 + B2*2^-2 + B3*2^-3 ....

Such a filter reaches 90% of its asymptotic value after a 10*T time.

Sampling frequency :

b76543210

b210 Sampling frequency

000: Fs= 31.25 Hz or 20 Hz
001: Fs= 62.5 Hz or 40 Hz
010: Fs= 125 Hz or 80 Hz
011: Fs= 250 Hz or 160 Hz
other: unused

b76543 must be set to 0 when param0

See restrictive conditions at paragraph PARAMETERS 2 COMMAND

Warning: When primary Sampling frequency is changed using parameter0 or parameters1 command, the sampling frequency is applied to both channels at the same time.
KSTA, KLTA constants (that depend of The primay sampling frequency) for parameter0, parameters1 and Alert parameters commands have to be re-computed accordingly and resent.
The secondary sampling frequency will also be changed then the parameter2 and prameter3 commands have also to be re-computed and resent accordingly.

Warning : Only the above values are accepted by the station. If different values for the primary channels are sent, the station may behave in an unpredictable channel.

There is only one same primary frequency for the two primary triplets. The frequency which is taken into account is the last one received by PARAMETERS 0 or 1.

LTA/STA threshold :

This byte enables to encode the launching threshold of the STA/LTA algorithm. The threshold is 1/2 of the byte value. It enables to obtain all the thresholds between 0 and 128 (excluded) by steps of 0.5.

A sample frame bit continuously indicates the result of the "STA/LTA > threshold ?" test.

ON/OFF :

Byte indicating if this triplet will be present or not in the output data.

b0 0 OFF
1 ON
b7654 must be set to 0 when param0

OFFSET MANAGEMENT SUPPRESSION:

Byte indicating if this triplet will manage offset measurment. If not, offset frames will not be generated and no offset correction will be apply to data.
To be noted:
This parameter applies to triplet 0 and 2 (the primary and the associated secondary)

b0 0 Offset correction managed
1 offset correction not managed
b7654 must be set to 0 when param0

7.2.3.3.2. PARAMETERS 1 COMMAND

(triplet # 1, primary, seismo 1)

COMMAND=1 : Parameter 1.

Idem Parameter 0 but destined to the triplet 1.

7.2.3.3.3. PARAMETERS 2 COMMAND

(triplet # 2, secondary, seismo 0)

COMMAND=2 : Parameter 2.

- COMMAND=2 (1 byte),
- LTA constant (3 bytes),
- STA constant (3 bytes),
- DECIM (1 byte),
- STA/LTA threshold (1 byte),
- ON_OFF (1 byte),
- Unused (1 byte),
- chksum (1 byte).

Parameters identical to the primary triplets except for Fs replaced by DECIM.

DECIM:

Encodes the decimation rate of this triplet in comparison to its primary channel. This rate is encoded on 3 lsb bits of this byte from 0 to 7.

DECIM 210	0	Rate=1
	1	Rate=1/2
	2	Rate=1/4
	3	Rate=1/8
	4	Rate=1/16
	5	Rate=1/32
	6	Rate=1/64
	7	Rate=1/128

Beware : The user has to check if the primary frequency and the requested decimation rates can be down loaded by the station digitizer on its serial link using a 38400 baud rate.

Each triplet generates 12 bytes per sampling periods.

The following combination is correct :

triplet	0	1	2	3
Fs	125	125	1/128	1/64

The following combination is impossible :

triplet		0	1	2	3
Fs	125	125	1/2	1/4	

All configurations are accepted by the station. The forbidden configurations may generate unpredictable behaviour.

TCS forbids sending impossible combinations to the recorder.

7.2.3.3.4. PARAMETERS 3 COMMAND

(triplet # 3, secondary, seismo 1)

COMMAND=3: Parameter 3.

Idem Parameter 2 but destined to the triplet 1.

7.2.3.3.5. WIDENER COMMAND

COMMAND=4 : Widener coefficients .

Command enabling to transmit the widener filter coefficients.

Information Reserved Factory. Contact AGECODAGIS to get more informations.

7.2.3.3.6. TRIGGER and GAIN COMMAND

(Implemented only if Recording type is triggered)

COMMAND=5: Definition of the durations of pre and post event in the case of a triggered recordings.

- COMMAND=5 (1 byte),
- Duration of the pre-event (2 bytes),
- Duration of the time out (2 bytes),
- Gain (1 byte),
- End duration (2 bytes),
- Cycles (1 byte),
- unused (2 bytes),
- chksum (1 byte).

Every duration: Msb First, duration in seconds

Gain= 2^gain byte. Gain 1..128
Gain not applicable except for Analog Devices AD

Look at « TRIGGER ALGORITHM » paragraph for pre-event duration limitations.

Cycles:

B0=0	Flash will point to beginning if end reached. Flash cycles are managed
B0=1	Records stop when flash end is reached
B1..7	unused. Must be set to 0

7.2.3.3.7. DUMP COMMAND

COMMAND=6: Runs parallel dump of data when it exists or FLASH clear when authorized:

.

- COMMAND=6 (1 byte),
- Dump/erase (1 byte),
- unused (9 bytes),
- chksum (1 byte).

Dump b0 0 -> Dump
1-> Erase

7.2.3.3.8. IDENT COMMAND

COMMAND=7: Enters a 9 chars ident for the station.

.

- COMMAND=7 (1 byte),
- Ident (9 bytes),
- chksum (1 byte).

Care must be taken for the length of IDENT. When used in Tcs software, the only 3 first chars are used to make the extension field of the generated file during dump.

7.2.3.3.9. COMMAND SEISMOMETER CALIBRATION

COMMAND=8: Send 0-5V pulses, to seismometer for calibration purpose (see seismometer connector pin-out below).

- COMMAND=8 (1 byte),
- Calibration type (1 byte),
- Duration (3 bytes),
- Go/Stop (1 byte)
- spare (0) (5 bytes),
- chksum (1 byte).

Calibration type:
Type = 0: generates a 5V pulse for 10000 milliseconds or 1/640 seconds (see bit22 value in output time frame)
Go/stop and duration bytes not used

Type = 1: generates a random pulse 0 or 5 V. The output is changed every duration milliseconds. The new bit is the exclusif or result of the bits 17, 4, 1 and 0 of the random word. The word is then shifted one bit left and the new bit is the lsb bit.
The initial value for the random word is set to -911.
Go/stop: 0= Stop (the output pulse is set to 0)
1= Go (the random word is set to -911 and changed every Duration milliseconds ou 1/640 seconds (see bit22 value in output time frame)

Duration: unsigned 3 bytes integer expressed in milliseconds or 1/640 seconds, lsb first.

7.2.3.3.10. COMMAND DIAL SPECIFICATION

COMMAND=9: Receive alert Phone number

- COMMAND=9 (1 byte),
- informations (9 bytes)
- Spare =0 (1 byte),
- chksum (1 byte).

Phone number:
6 bytes: phone number
3 bytes: spare=0

phone number bytes:

2 numbers per byte: b7654 first number binary encoded
b3210 Second number binary encoded
The number not included in the [0..9] range are ignored

If the first number is set to $F, then Alert fucntions are disabled.

These are valid values for the following phone number: 05 61 08 05 62

(Hexadecimally expressed)
byte 1..6: $05 $61 $08 $05 $62 $FF

See Alert parameters command below for alert parameters and alert algorithm description.

When an alert is triggered, the modem is swithed on and dialled. If a carrier detection is acchieved within 1 minute, the alert is defined as sent. It'is up the the called station to ask questions and to hang up.

If no carrier is gotten within a minute, the modem is hanged up and another try will be performed using a random delay between 20 seconds and 2 minutes.

These tries will be performed 6 times max.

7.2.3.3.11. FLUSH COMMAND

NOT EXECUTED WHEN MODEM LINK USED

COMMAND=10 : FLUSH .

- COMMAND=10 (1 byte),
- Reset (1 byte),
- unused (9 bytes),
- chksum (1 byte).

This command forces a dumping of the FLASH memory towards the MEDIA .

The CTS decrease as soon as the dumping is launched. The recorder cannot respond to a new command as long as the dumping is not finished (the CTS does not increase when the RTS does).

The Reset byte is only used when hard disk media is implemented. When Reset is 1 the data and index pointers are reset to 0 before flush. The hard disk is then emptied before the present flush

7.2.3.3.12. TAPE LOADING AND FORMATTING COMMAND

COMMAND=11 : TAPE LOADING

- COMMAND=11 (1 byte),
- Formatting request (1 bytes),
- unused (9 bytes),
- chksum (1 byte).

Formatting request: 0= no tape format
1= tape format is process.

To execute once the tape has been introduced in the DAT DRIVE. This loading is followed by an automatic FLUSH of the FLASH memory data towards the new tape.

The CTS decreases again right after the end of the command reception.

The DAT DRIVE turns off at the end of this command.

The recorder cannot accept new commands as long as the following dumping is not finished (The CTS does not increase if the RTS does).

7.2.3.3.13. TAPE EJECTION / ALERT AGORITHM PARAMETERS COMMAND

Depends if a DAT is installed or not in the recorder:

IF DAT INSIDE:

COMMAND=12 : TAPE EJECTION

- COMMAND=12 (1 byte),
- unused (10 bytes),
- chksum (1 byte).

The CTS decreases again only after the end of the ejection.
The DAT DRIVE stays on at the end of this command.

IF no DAT INSIDE:

COMMAND=12 : ALERT ALGORITHM PARAMETERS

- COMMAND=12 (1 byte),
- LTA constant (3 bytes),
- STA constant (3 bytes),
- spare = 0 (1 byte),
- threshold (1 byte),
- Weight (1 byte),
- Spare = 0 (1 byte),
- chksum (1 byte).

Alert algorithm is design to generate alert only on strong earthquake.
It runs only on the primary channels with the same parameters set.
It also only runs when an alert phone number is defined (see DIAL SPECIFICATIONS COMMAND).

KSTA, KLTA: idem Parameter 0 KSTA, KLTA. The sampling frequency is the primary one (parameter0-1)

Typically: KLTA=300 secs, KSTA=60 secs.

Threshold: Byte 1..255. Typically 60 when weight is 5
Weight: Byte 1..255 Tipycally 5

Algorithm description:

STA and LTA are only computed when an alert phone number is defined.

This computation is achieved only on the channel 0.

LTA is computed in regular manner, see parameter0
STA is computed with min (abs(signal), weight*LTA) as input.

Then the ratio 10*Weight*LTA/STA is compared to threshold. When higher , then an alert is generated and the alert phone number is dialled.

The quescient value of the ratio is 50 as STA=LTA.
When a short spurious signal is seen, the LTA will stay quite constant and the STA will grow. Then the ration will fall down to the min value of 10 (when STA=Weight*LTA). Then the signal disappears and the STA return to quescient value= LTA. Then the 50 threshold is not over.

For high level signal that grow up and falled down slowly, the STA fall down and the ratio too. But, as LTA follows STA, the ratio stays to quite 50. When signal disappear slowly, it stays to 50 and no alert is generated.

When a strong earthquake is recorded, the STA falls down and the ration is 10. Then, the LTA gets time to grow up. Then signal disappear and STA come back to quescient value. But, as LTA has grown up, the ration override the 50 value. Then a threshold can be reached to trigger an alert.

7.2.3.3.14. COMMAND MISCELLANEOUS INFORMATIONS

COMMAND=13 : Miscellaneous informations.

- COMMAND=13 (1 byte),
- Hour MF1 (1 byte),
- Hour MF2 (1 byte),
- Hour MF3 (1 byte),
- Hour MF4 (1 byte),
- Hour MF5 (1 byte),
- Hour MF6 (1 byte),
- Hour MF7 (1 byte),
- Hour MF8 (1 byte),

- Hour MF9 (1 byte),
- IT (1 byte),
- chksum (1 byte).

Significations for Mfx bytes are given in Miscellaneous output frames paragraph.

7.2.3.3.15. COMMAND RECORD 14

COMMAND=14 : Record.

- COMMAND=14 (1 byte),
- =0 (10 bytes),
- chksum (1 byte).

When this command is received, the station triggers an event in the same way the STA/LTA algotihm does.

7.2.3.3.16. TIME SETTING COMMAND

COMMAND=15 : Time setting.

- COMMAND=15 (1 byte),
- Hour H1 (1 byte),
- Hour H2 (1 byte),
- Hour H3 (1 byte),
- Hour H4 (1 byte),
- Correct pulse length (ms) (2 bytes),
- Selection of the length test (1 byte),
- Nb of time pulses per minute (1 byte),
- Time out definition (1 byte),
- unused 1 (must be set to 0) (1 byte),
- chksum (1 byte).

H1234 : Same format as H1234 in the time frames.

The length of a correct pulse indicates the length of a time shift measurement pulse when reception is good. This value must take into account the possible variations in the puls widths.

Ex: TELECODE: good reception pulse length = 250 ms
bad reception pulse length = 500 ms

=>take as correct pulse length = 300 ms

The length is encoded in a 16 bits integer, msb in the first place.

Test selection :

-b0 : 0 correct pulses if length inferior to correct pulse length,
: 1 correct pulses if length superior to correct pulse length.

-b7654321 unused=0

Nb of time pulses/minute :

8 bits integer.

Time out definition

8 bits integer.

- b0 :0 time setting true command. Regular value. Time will be set on next RX pulse.
:1 No time setting occurs. The Hour is set in the station to be loaded as internal time + 60 seconds if a time out to external top reception occurs (time out length is 60 seconds). This command has to be sent as close as possible of the true time setting command. The transmitted hour has to be the current one.

This command is taken into account by the recorder right after its reception.

Cf. **"DATING"** paragraph above

Note: when read in infos frames, when the unused byte is 1, then the encodede date is the date of the last reboot of the station. After a time setting of the station, this byte indicates the last time setting and this byte is 0.

7.2.4. BIT RATE AND FORMAT OF THE RS232

The characteristics of the RS232 link are the following :

- Asynchronous type,
- Transfer rate at 38 400 baud rate,
- 8 bits DATA, 1 start, 1 stop, no parity.

7.2.5. PINOUT

Two types of connectors exist. You will find here the to pinout and connectors reference for each output.

To be noticed: new release of hardware will implements Clipper connectors.
In each case, are given the reference of the cable side connector.
Don't forget, for CLIPPER connector, to supply the appropiate number of female connector pins which reference is:

Q=100 SOURIAU CF16SC10RF

7.2.5.1. SUPPLY CONNECTOR

HE301:

Reference connector SOURIAU (for cable) : 851 06 J 106 P 50

B 0 V Recorder supply (in)

C +12 V Recorder supply (in)

CLIPPER:

Reference connector SOURIAU (for cable): CL1F1101 + CL101021

1 +12V
2 0V

7.2.5.2. SEISMOMETER SUPPLY CONNECTOR

This connector provides 12 volts for an active seismometer
The seismometer supply is cut off by the ON/OFF switch of the recorder.

HE301:

Reference connector SOURIAU (for cable) : 851 06 J 83 S 50

A Seismometer supply ground (out)

C +12 V Seismometer supply (out)

CLIPPER:

No CLIPPER release, this function is integrated in SEISMOMETER CONNECTOR when Clipper.

7.2.5.3. SEISMOMETER CONNECTOR

HE301:

Reference connector SOURIAU : 851 06 J 128 P 50

A	SHIELD and DIGITAL GROUND
B	Sensor calibration pulse output (0..5 V, 1 second, CMOS output)
G	Vertical +
H	Vertical -
C	North +
D	North -
E	East +
F	East -

CLIPPER:

Reference connector SOURIAU (for cable): CL1F3101 + CL103021
(11 to 16 are only implemented when DIGI6V-G, otherwise not connected)

1	Vertical -	(seismo 0)
2	Vertical +	(seismo 0)
3	North-	(seismo 0)
4	North+	(seismo 0)
5	East-	(seismo 0)
6	East+	(seismo 0)
7	Calibration pulse (Cmos level)	
8	ground for Calibration pulse	
9	+12V seismometer supply	
10	0V Seismometer supply	
11	Vertical -	(seismo 1)
12	Vertical +	(seismo 1)
13	North-	(seismo 1)
14	North+	(seismo 1)
15	East-	(seismo 1)
16	East+	(seismo 1)
17	Signal ground	
18	Ground shield	

For TITAN recorders, seismometer supply is a 9..18V power supply input, 12V regulated output, 3W.
For MINITITAN after April 1997 recorders, seismometer supply is internally connected to power supply (not 12V regulated).
For MINITITAN before April 1997, these pins are not connected.

7.2.5.4. TIME RECEIVER CONNECTOR

Index type BNC

The function of this connector depends on the presence or not of an internal GPS receiver.

Recorder Without internal GPS :

This connector enables the linking of the external time receiver.

Recorder with internal GPS :

This connector enables the linking of the external antenna coming from the GPS integrated in the recorder.

7.2.6.4 DIALOGUE CONNECTOR

Reference connector SOURIAU : 851 06 J 107 S 50

A	RxD (by PC)
B	TxD (by PC)
C	CTS
D	RTS
E	Ground
F	DCD
G	ON/OFF RS232

The G and E pins must be reconnected together inside the plug.

CLIPPER:
Reference connector SOURIAU (for cable):CL1F3101 + CL103021 + 18* contacts CF16SC10RF

Parallel link:

–	**3**	**masse**	
–	**4**	**hs_in**	**(in)**
–	**5**	**hs_out**	**(out)**
–	**6**	**d 3**	**(out)**
–	**7**	**d 2**	**(out)**
–	**8**	**d 1**	**(out)**
–	**9**	**d 0**	**(out)**

Serial link:

–	**10**	**ground (serial link)**
–	**11**	**_off (in)**
–	**12**	**rxd (By external PC) => (out)**
–	**13**	**cts (out)**
–	**14**	**txd (By external PC)=> (in)**
–	**15**	**rts (in)**
–	**16**	**dcd modem (in)**

Titangps interface:

–	**17**	**12V TITAN GPS supply**
–	**1**	**Time pulse GPS output**
–	**2**	**Gps ground**

Spare:

–	**18**

7.2.5.5. MINITITAN PINOUT

7.2.5.6. 16*16 bits CONNECTOR

CLIPPER:
Reference connector SOURIAU (for cable): CL1F4201 + CL124021

1	Channel 15 -
2	Channel 15 +
3	Channel 14 -
4	Channel 14 +
5	Channel 13 -
6	Channel 13 +
7	Channel 12 -

8	Channel 12 +
9	Channel 11 -
10	Channel 11 +
11	Channel 10 -
12	Channel 10 +
13	Channel 9 -
14	Channel 9 +
15	Channel 8 -
16	Channel 8 +
17	Channel 7 -
18	Channel 7 +
19	Channel 6 -
20	Channel 6 +
21	Channel 5 -
22	Channel 5 +
23	Channel 4 -
24	Channel 4 +
25	Channel 3 -
26	Channel 3 +
27	Channel 2 -
28	Channel 2 +
29	Channel 1 -
30	Channel 1 +
31	Channel 0 -
32	Channel 0 +
33..39	NC
40	Shield

7.2.5.6.1. DATA MEDIA FORMAT (HARD DISK)

This paragraph describes how data are places on the media. There are two set of data; in one hand, the seismological data and the indexes in the other hand.
The farmat of the seismological data is the same as described in the OUTPUTING SERIAL LINK paragraph above.

The general format of the indexes is as follows:

(always msb first encoded)
bytes 0..3 : time
byte 4 : B4
byte 5 : Index type
byte 6..31 : Bytes 6 to 31

time : the same format as the 4 first bytes in time frames. time at which the index has been generated
index type : Signification of other bytes depends on this byte

0: true index.
b4: Channel number that triggered
b5: 0
b6..b7:0
b8..11: End Address when triggered record, 0 if continuous
b8= flash memory cycle number
b9..11= physical address in flash memory
b12..b15: Begin Address where index is pointing to.
Continuous:
Absolute address in file (0..2Go), Lsb first
And if triggered:
b12= flash memory cycle number
b13..15= physical address in flash memory
b16..b31: 0 if continuous record
if trigerred:
b16:0
byte 17..19 : spare 0
bytes 20..22 : record duration (sec)
bytes 23..25 : Max value reach on channel 0 (counts)
bytes 26..28 : Max value reach on channel 1 (counts)
bytes 29..31 : Max value reach on channel 2 (counts)

1: Dummy index.
b4: 0
b5: 1
b6..b7:0

b8..11: 0
b12..b15: Address where index is pointing to.
b16..b31: 0

2: Log file index.

b4: 0
b5: 2
b6..b31:0

3: RX Time measurement index.

b4: 0
b5: 3
b6..b17:Last time frame with new pulse measurement
(12 bytes, see time frame paragraph)
b18..31:0

ON DAT TAPE:

The tape is formatted in 2 partitions.

The main partition is partition 0. It contains the sequential recording of the data transmitted on the serial link. The data are written in blocks of 32768 bytes.

Partition 1 has a maximum size of 1 megabytes. It contains sequentially the indexes (triggering marks). The data are written in 16 bytes blocks. Each block of 16 bytes is an index.

ON HARD DISK:

The disk contains two files.

DATA.DAT = seismological data

DATA.NDX= indexes (32 bytes indexes).

TITANFMT creayes and sized these two files at the maximum one versus hard disk size.

The third file named size.siz gives the adress of the last byte recorded in the two files.
This file is 512 bytes long and only the 8 first five are used as follows
D0D1D2D3I0I1I2I3
D0D1D2D3 (lsbyte first) = last written adress in the data file
I0I1I2I3 (lsbyte first) = last written adress in the data.ndx file

AFTER FLASH MEMORY DUMP:

When downloaded using the parallel link, data are placed on the hard disk of the PC running TCS. There is 2 files created:

MMDD_XXX.DAT
MMDD_XXX.NDX

M as month , D as day . XXX is the 3 first letters of the IDENT (see IDENT COMMAND).

7.3. MAINTENANCE

The heads of the DAT DRIVE must be regularly cleaned, every 10 recorded tapes or when DAT DRIVE access problems are signaled on the recorder. Use a cleaning tape and do what is said in the paragraph TCS/TAPE REPLACEMENT.

The recorder has a bag which absorbs humidity (except MINITITAN). This bag is placed on the front face of the recorder. This bag must be replaced periodically. The "damp" bag can be regenerated with heat, in a oven at 120°C during 1 hour and then be reused.

7.4. LIST OF ACCESSORIES

You can contact AGECODAGIS SARL for the supply of the following TITAN accessories.

FUSE :

5*20 4 Amperes.

DAT TAPES :

Use DDS 4 mm, 90 meters tapes. Avoid "No Name" products.

DDS 4 mm cleaning tape.

SCSI INTERFACE ON PC :

Any ASPI compatible solution is possible. For example : TRANTOR, ADAPTEC. TRANTOR solution is recommended.

ADAPTEC: AHA 1542

To install in the laboratory PC. Supply the AHA 1540 or AHA 1542 reference. Contact AGECODAGIS SARL in case of supply difficulties. Follow the installation instructions delivered with the card.

TRANTOR: T348

This is an interface print port to SCSI and it can be installed on any PC, even in the field PC. Attention : it is conceived to dialogue with so called external units and is therefore delivered with a SCSI Centronics connector. Follow the instructions concerning the installation of the software.

DAT DRIVE :

Install it on the laboratory PC in order to read the DAT TITAN tapes. We recommend the External ARCHIVE PYTHON DAT 4350XT model. Contact AGECODAGIS SARL in case of supply difficulties. Follow the installation instructions delivered with the DAT DRIVE.

Give it a SCSI address which is not already used by another drive on the SCSI bus. Modify or create the TIT_ASPI.CFG file in order to describe the localization of your DAT drive. A PC can manage several SCSI BUS. It has then several "Host adapters". These "Host adapters" are numbered in the order in which they have been recognized by the system at the time of the boot. Consult your Config.sys file in order to determine the number of the host adapter to which your DAT drive is affected. The numbering starts at 0. The first line of the TIT_SCSI.CFG file must contain the number of the host adapter to which the DAT DRIVE is affected. The second line indicates the SCSI address of the DAT DRIVE on its bus. This ASCII is read by FMTITAN and SEETITAN. If it is absent, Host adapter=0 and SCSI Adress=4 are taken.

AGECODAGIS can provide the complete kit : DAT DRIVE and SCSI Interface. Consult us.

The 4350 XT + TRANTOR solution constitutes a universal solution, that can be installed on any PC without opening the computer.

Un jour, tout sera bien.
Voilà l'espérance.
Tout est bien aujourd'hui.
Voilà l'illusion.
(Voltaire)

8. IN CASE OF PROBLEMS

THE TAPE IS NOT EJECTED BY THE NORMAL EJECTION PROCEDURE :

(even after pressing on the ejection button)
The DAT drive has a problem with this tape which prevents its ejection (Mechanical problem). After having launched the ejection procedure, the DAT drive stays on. Try an ejection by pressing the DAT DRIVE ejection button. If the tape is ejected, continue in sequence the tape replacement procedure. If it is not ejected, try to help the tape ejection by pushing the DAT DRIVE door and by **"CAREFULLY"** trying to lift the back of the tape up with a finger. This procedure is an urgent one. Do not repeat it.

Proceed if possible to a cleaning of the DAT heads.

If the problem happens with a new tape, it means that the problem comes from the DAT drive and that the recorder must be sent for repair.

THE ACCESS TO THE TAPE TAKES A VERY LONG TIME WITH LOTS OF TURNING ON/OFF OF THE DAT DRIVE.

When the DAT DRIVE is turned on (for a flush for example), the recorder tests the proper initial loading of the tape. This loading can sometime fail. The recorder then turns the DAT drive off and turns it on again to provoke a new loading. If the recorder does not correctly charge the band in 3 minutes, the dumping is abandoned. The problem is signaled to the user under TCS / Infos window by "loading problem". The tape may be damaged. Replace the tape. Clean the DAT heads. If the problem persists, the recorder must be sent for repair.

Wait for the end of the dumping before doing anything (launching of the "tape removal"). The recorder will always let you command again after 6 minutes at the most.

THE RECORDER SIGNALS AN IMPORTANT NUMBER OF FAILED DUMPINGS.

BECAUSE OF DAT PROBLEMS :
Exceptionally a DAT DRIVE dumping can fail. The causes can be the following :

- defect located on the band,
- temporary dysfunction of the DAT.

In any case, the cause of data loss is explained in the TCS "Infos" window.

If, for a same tape, the number of failed dumpings exceeds 16, the tape is automatically ejected. In case of serious problems, the DAT DRIVE may sometimes not be able eject the tape. TCS indicates then that the tape is ejected whereas it is still in the DAT DRIVE.

An important number of failed dumpings can have the following origins :

- Lots of defects on the band,
- Dirty DAT DRIVE heads.

LOW BATTERY CAUSE :
If the battery voltage is inferior to 12 volts, the recorder decides not to turn the DAT drive on and to stop the dumping in order to protect the tape and DAT drive. The number of lost dumpings for this reason is written in the TCS or SEETITAN Info window. If the number of lost dumpings is too important, the user should check the recorder supply system (increase of the number of batteries or solar panels, the best solution depending on the installation setting).

Note that the number of lost dumpings due to low battery is not limited to 16 as is the case in the number of dumpings lost due to DAT drive problems.

THE RECORDER DOES NOT SET ITSELF ON TIME

One minute after the time setting by TCS, the field "hour" indicates "(time-out)".

The recorder has not received time pulse validating the Time Setting command.

Is the time receiver connected to the recorder ?
Did you correctly position the selection switch of the time receiver type in the right position corresponding to your external reference ?

BIG SHIFT BETWEEN THE RECORDER TIME AND THE EXTERNAL REFERENCE.

If you are sure of your external reference, the internal recorder oscillator must be retuned . The recorder (except MINITITAN) has on the front face a "TEST" connector as well as a hole behind which you can find the adjustment screw of the

internal oscillator. The TEST plug provides 2.048 MHz. A 1/4 tourn clockwise provokes a -13 10-8 variation of the oscillator frequency.

TCS ANSWERS " Time out reached ... "

The stream of data coming out of the recorder is lost.

Is the RS232 cable correctly connected ?

Did you wait a few seconds after having switched the recorder ON before launching TCS (blincking of the front face LED) ?

Is the recorder ON ?

YOU TURN ON A DAT DRIVE RECORDER WHICH DOES NOT CONTAIN A TAPE.

This case is developed at the TAPE REPLACEMENT paragraph.

THE RECORDER TAKES TIME TO RESPOND TO CERTAIN TCS COMMANDS.

The dialogue with the exterior can be put on hold by one of the following events :

- The DAT drive is realizing a dumping.

The user must avoid launching a command during a dumping.

HOW DOES THE RECORDER OPERATES TOWARDS THE DAT DRIVE ACCESS ?

When the recorder is turned on, it enters an initialization phase which takes a few seconds. At the end of this phase, the DAT drive turns on and carries out an initial data dumping. Its goal is the initialization of the tape informations given in "Infos". During this period, the recorder provides the flow of serial data but does not accept commands.

Once the dumping is performed, the recorder can be programmed (time setting, parameters introduction etc).

The Flash memory fills up in a continuous way. When it reaches a threshold (about 7.5 Mb), a data dumping is automatically launched. Infos TCS indicates the stage of the dumping in process as long as this dumping is not finished. During this

whole phase, you cannot send any command to the recorder. This dumping time can be longer if problems show up with the tape. Its normal length depends on the filling rate of the tape (from 1 to 7 mn). The recorder will always give you back the control after 7 minutes at the most (management of a time out).

The different stages of an dumping are the following :

Charging of the band. The DAT drive puts itself at the begining of the band. This stage typically takes 30 seconds and is systematic after each turning on of the DAT drive (for a "Flush" or "tape removal"). If the charging fails, the recorder turns the DAT drive off and turns it back on for a new try. The recorder has 3 minutes at the most to charge the band. If the charging is not realized in 3 minutes, the dumping is abandonned.

Going to EOT as "End Of Tape". The DAT DRIVE winds the band until it finds the last written data. This operation can take up to one minute when the band is really full.

Writing DATA. The DAT drive transfers the content of the FLASH card on the band. The length depends of course on the quantity of data contained in the FLASH card. The time needed to transfer 8 Mb is 3 minutes.

Rewinding the Tape. After writing the data, the DAT rewinds the tape to its beginning in order to write down the triggering indexes. The time needed is the same as the one of the "Going to EOT" stage.

Writing Index. Writing of the indexes at the beginning of the tape. Very fast stage.

Unloading Tape. The DAT drive unloads the tape before turning itself off.

All those stages are indicated simultaneously in the TCS or SEETITAN Infos window.

The dumping can also be interrupted after the charging of the tape if the DAT drive has a serious problem of accessing the tape. Each command is protected by a 3 minute time out. The failure of a command brings the dumping to a halt. That is why the recorder cannot be jammed during dumping.

When the dumping is finished, the two LED of the DAT turn off.

UNMOUNTING THE TITAN CARDS (WITH DOOR BOXES)

Recorder dismantling should normally not be done by the user. However who knows what kind of suprises a recording campaign in a remote and unfriendly place can bring
So here is the TITAN card dismantling procedure.

First, if TITAN DAT recorder, unmount the DAT drive; unscrew the 4 fixing scews on the back face of the bow and unconnect the SCSI cable and supply cable from the back of the DAT drive. Unscrew the front face of the DAT drive and take it out by pushing it forward (by passing your hand through the back of the recorder).

Go on then by unmounting the supply card which is under the front face carrying the ON/OFF switch. Undo the 4 fixing screws of the front face and pull its handle. The supply card is firmly attached to its front face.

Do the same thing (but imperatively after the extraction of the supply card for TITAN DAT) with the second front face. This front face is more difficult to take off by pulling its handle because it carries several cards plugged in the back of the basket.

TITAN USER MANUAL

SUMMARY

1. INTRODUCTION 3

2. OPERATING PRINCIPLE 4

2.1. OPERATING COMPOSITION 4
2.1.1. SAMPLING : 7

DATING 8

2.2. DATA MANAGEMENT 9
2.2.1. SUPPORTED MEDIA 10
2.2.2. RECORD AND STORAGE 10
2.2.3. DAT SPECIAL MANAGEMENT 12

2.3. TRIGGER ALGORITHM 14

2.4. MONITORING OF BATTERY VOLTAGE 15

2.5. PARAMETERS SAFEGUARD DURING OFF-TIME 15

2.6. SEISMOMETER BAND PASS WIDENER 15

2.7. OFFSET MEASUREMENT 16

2.8. FRONT FACE LED 16

3. RECORDER CONFIGURATION 17

4. DATA RETRIEVAL AND PROCESSING 18

4.1. IN REAL TIME 18

4.2. IN DEFFERED TIME 18
4.2.1. DAT TAPE 18
4.2.2. PARALLEL LINK 19
4.2.3. BY THE MODEM OR THE LOCAL LINK 19

5. SOFTWARE TOOLS 20

5.1. IN THE FIELD 20
5.1.1. REQUIRED PC CONFIGURATION 20
5.1.2. SOFTWARE INSTALLATION 20
5.1.3. TCS 20

5.2. IN THE LABORATORY 27
5.2.1. REQUIRED PC CONFIGURATION 27
5.2.2. SOFTWARE INSTALLATION 27
5.2.3. SEETITAN 28
5.2.4. FMTTITAN (TITAN DAT) 30
5.2.5. TITANREL 30
5.2.6. SPLIT 30

6. INSTALLATION OF A RECORDER IN THE FIELD 31

7. TECHNICAL SPECIFICATIONS 33

7.1. GENERAL TECHNICAL SPECIFICATIONS 33

7.2. DETAILED TECHNICAL SPECIFICATIONS 34

7.2.1. SENSOR INTERFACE I 35

7.2.2. DATING AND TIME RECEPTION 35

7.2.3. RS232 LINK 37

7.2.4. BIT RATE AND FORMAT OF THE RS232 72

7.2.5. PINOUT 73

7.3. MAINTENANCE 82

7.4. LIST OF ACCESSORIES 82

8. IN CASE OF PROBLEMS 84