EPSILON SYNCHRONIZATION SUPPLY UNIT(SSU)

INSTALLATION, OPERATING AND USER'S MANUAL

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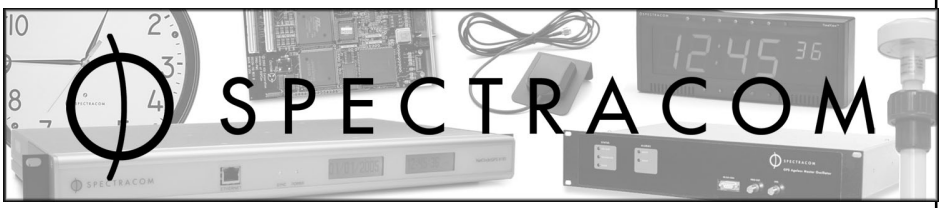

www.spectracomcorp.com

www.spectracom.fr
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SPECTRACOM LIMITED WARRANTY

LIMITED WARRANTY

Spectracom warrants each new product manufactured and sold by it to be free from defects in software, material, workmanship, and construction, except for batteries, fuses, or other material normally consumed in operation that may be contained therein AND AS NOTED BELOW, for five years after shipment to the original purchaser (which period is referred to as the "warranty period"). This warranty shall not apply if the product is used contrary to the instructions in its manual or is otherwise subjected to misuse, abnormal operations, accident, lightning or transient surge, repairs or modifications not performed by Spectracom.

The GPS receiver is warranted for one year from date of shipment and subject to the exceptions listed above. The power adapter, if supplied, is warranted for one year from date of shipment and subject to the exceptions listed above.

THE TIMEVIEW ANALOG CLOCKS ARE WARRANTED FOR ONE YEAR FROM DATE OF SHIPMENT AND SUBJECT TO THE EXCEPTIONS LISTED ABOVE.

THE TIMECODE READER/GENERATORS ARE WARRANTED FOR ONE YEAR FROM DATE OF SHIPMENT AND SUBJECT TO THE EXCEPTIONS LISTED ABOVE.

THE WIRELESS CLOCK SYSTEM TRANSMITTERS AND/OR TRANSCEIVERS AND CLOCKS ARE WARRANTED FOR TWO YEARS FROM DATE OF SHIPMENT AND SUBJECT TO THE EXCEPTIONS LISTED ABOVE.

THE EPSILON CLOCKS, BOARDS, AND SYNCHRONIZATION UNITS ARE WARRANTED FOR TWO YEARS FROM DATE OF SHIPMENT AND SUBJECT TO THE EXCEPTIONS LISTED ABOVE.

The Rubidium oscillator, if supplied, is warranted for two years from date of shipment and subject to the exceptions listed above.

All other items and pieces of equipment not specified above, including the antenna unit, antenna surge suppressor and antenna pre-amplifier are warranted for 5 years, subject to the exceptions listed above.

WARRANTY CLAIMS

Spectracom's obligation under this warranty is limited to in-factory service and repair, at Spectracom's option, of the product or the component thereof, which is found to be defective. If in Spectracom's judgment the defective condition in a Spectracom product is for a cause listed above for which Spectracom is not responsible, Spectracom will make the repairs or replacement of components and charge its then current price, which buyer agrees to pay.

Spectracom shall not have any warranty obligations if the procedure for warranty claims is not followed. Users must notify Spectracom of the claim with full information as to the claimed defect. Spectracom products shall not be returned unless a return authorization number is issued by Spectracom.

Spectracom products must be returned with the description of the claimed defect and identification of the individual to be contacted if additional information is needed. Spectracom products must be returned properly packed with transportation charges prepaid.

Shipping expense: Expenses incurred for shipping Spectracom products to and from Spectracom (including international customs fees) shall be paid for by the customer, with the following exception. For customers located within the United States, any product repaired by Spectracom under a "warranty repair" will be shipped back to the customer at Spectracom's expense unless special/faster delivery is requested by customer.

Spectracom highly recommends that prior to returning equipment for service work, our technical support department be contacted to provide trouble shooting assistance while the equipment is still installed. If equipment is returned without first contacting the support department and "no problems are found" during the repair work, an evaluation fee may be charged.

EXCEPT FOR THE LIMITED WARRANTY STATED ABOVE, SPECTRACOM DISCLAIMS ALL WARRANTIES OF ANY KIND WITH REGARD TO SPECTRACOM PRODUCTS OR OTHER MATERIALS PROVIDED BY SPECTRACOM, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Spectracom shall have no liability or responsibility to the original customer or any other party with respect to any liability, loss, or damage caused directly or indirectly by any Spectracom product, material, or software sold or provided by Spectracom, replacement parts or units, or services provided, including but not limited to any interruption of service, excess charges resulting from malfunctions of hardware or software, loss of business or anticipatory profits resulting from the use or operation of the Spectracom product or software, whatsoever or howsoever caused. In no event shall Spectracom be liable for any direct, indirect, special or consequential damages whether the claims are grounded in contract, tort (including negligence), or strict liability.

EXTENDED WARRANTY COVERAGE

Extended warranties can be purchased for additional periods beyond the standard five-year warranty for those products covered under five-year warranty. Contact Spectracom no later than the last year of the standard five-year warranty for

extended coverage.

Table of Contents

1 Introduction

This manual contains information and warnings that must be understood and followed by the customer to ensure reliable operation and long service life.

1.1 Safety Precautions

- **Before switching on** the unit, ensure that it is compatible with the local mains supply. (Refer to *Installation*).
- The plug must be inserted into a socket with earth connection. The safety connection must not be broken by using an extension cord without earth conductor.
- Before switching on the unit, if the unit is connected to measurement or control circuits, protective earth terminal(s) shall be connected to a protective conductor.
- If measurement or control circuits are without earth-ground protection terminal(s), the mains plug shall be inserted before connections are made to measurement or control circuits.

WARNING:

If the protective conductor's path to ground is broken or defeated, the danger of electrical shock to the operator may be present. Never break the connection on purpose.

Before disconnecting the unit from the main power supply, always switch it off. Failure to do may cause damage that voids your Spectracom warranty.

1.2 Safety during Adjustments, Maintenance, and Repair

When the unit is connected to the power supply, it may be dangerous to touch the terminals and parts that may be exposed when opening covers or removing components (except for plug-in components).

The unit must be disconnected from all power sources before carrying out any adjustments, replacements, maintenance, or repair.

When it is unavoidable to open the unit for maintenance and repair, such operations should be carried out only by qualified personnel who are properly informed of the hazards involved.

Only fuses with a suitable rating and of the specified type are to be used for replacement purposes. It is prohibited to use fuses that have been tampered with, or shorted fuse-holders.

WHENEVER IT IS LIKELY THAT PROTECTION HAS BEEN IMPAIRED, THE APPARATUS MUST BE SWITCHED OFF, DISCONNECTED, AND SECURED AGAINST ANY UNINTENDED OPERATION.

1.3 Inventory

Before installing your Spectracom product, please verify that all material ordered has been received. If there is a discrepancy, please contact Spectracom Customer Service. Customer service is available by telephone at +33 (0) 1.64.53.39.80 (France), or +1.585.321.5800 (United States). Updated contacts information are available on web site, see "Support" page.

CAUTION:  *Electronic equipment is sensitive to Electrostatic Discharge (ESD). Observe all applicable ESD precautions and safeguards when handling the Spectracom equipment.*

NOTE: If equipment is returned to Spectracom, it must be shipped in its original packing material. Save all packaging material for this purpose.

1.4 Inspection

Unpack the equipment and inspect it for damage. If any equipment has been damaged in transit, please contact Spectracom Customer Service. Customer service is available by telephone at +33 (0) 1.64.53.39.80 (France), or +1.585.321.5800 (United States). Updated contacts information are available on web site, see "Support" page.

The basic shipment comprises the following items:

- The SSU
- Two 48 VDC power plugs
- This manual
- CD-ROM containing SSUWIN (SSU Ethernet Local Manager Software).

1.5 General Description

The main function of an SSU is to regenerate a synchronization signal from several possible reference sources and with a determined quality level. If all the sources disappear, the SSU maintains the synchronization rate with a built-in high-stability oscillator. Critical elements are backed up so that any failure on a module does not interrupt the clock distribution.

The SSU operating environment is currently based on 2048 kHz or 2048 kbit/s rates (E1 frames), with additional capabilities of synchronization and distribution in 10 MHz.

The EPSILON SSU family has three types of clocks meeting the needs of the various performance levels as described in ITU-T and ETSI recommendations. The unit common to these three platforms is the SSU. The difference is in the performance of built-in oscillators.

EPSILON PRC:
Level 1 Reference Clock

The PRC delivers a synchronization reference signal to all or part of a network.

EPSILON STNe:
Transit Node level-2 resynchronization clock (enhanced stability)

The SSU-STNe is intended for transit nodes interfacing with other nodes.

EPSILON STN:
Transit Node level-2 resynchronization clock

The SSU-STN is intended for transit nodes interfacing with other nodes.

EPSILON SLN:
Local Node level-2/3 resynchronization clock

The SSU-SLN is intended for synchronization nodes interfacing directly with terminal equipment.

Optionally, a GPS receiver provides long-term stability of the distributed frequency.

	Accuracy in GPS Slaving	Holdover Stability	Holdover Short-term Stability
PRC	$< \pm 1x10^{-12}$ (24h)	$< \pm 1x10^{-11}$ /day (Rb)	$< \pm 1x10^{-11}$ /10 sec $< \pm 3x10^{-12}$ /100 sec
STNe	$< \pm 2x10^{-12}$ (24h)	$< \pm 1x10^{-10}$ /day	$< \pm 2x10^{-11}$ /10 sec
STN	$< \pm 2x10^{-12}$ (24h)	$< \pm 3x10^{-10}$ /day	$< \pm 1x10^{-10}$ /10 sec
SLN	$< \pm 2x10^{-11}$ (24h)	$< \pm 1x10^{-9}$ /day	$< \pm 1x10^{-10}$ /10 sec

Table 1 - 1. Frequency Accuracy and Stability.

1.6 Subassemblies

The breakdown into subassemblies ensures modularity sufficient to meet all customer needs and provide change possibilities.

A unit comes in two configurations: with INPUT module and without INPUT module. The configuration is set at the restart of the MANAGEMENT module. That means that if you add an INPUT module while the SSU is running the reference signal path will not be modified. Instead, to make the INPUT module known, it is necessary to perform a reset on the MANAGEMENT module, unplugging and plugging back the module or short circuit the two pins at the front of the module (open the cover), or by SSUWIN software, activating the updated version of Management module (which is equivalent to a software reset of the module).

Modules are hot plugged, without the need to cut mains supplies. Modules have their own power supply converters.

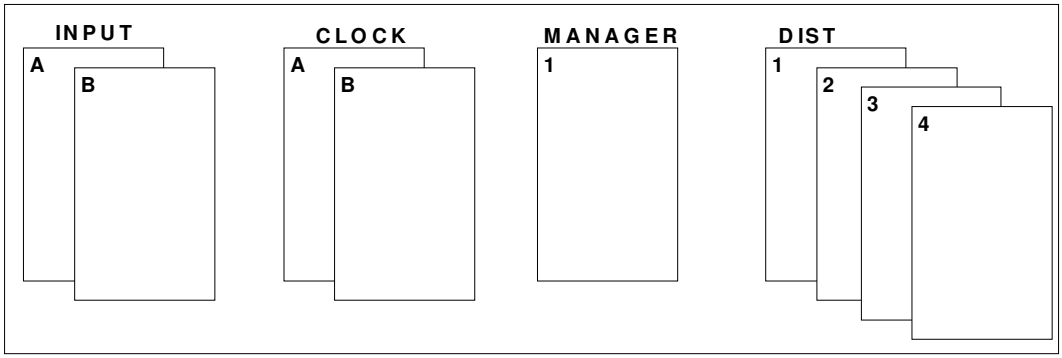


Figure 1 - 1. SSU Modules.

INPUT A and B Modules (2 locations):
These accept synchronization inputs at **2048 kHz** (4 per module) and/or **2.048 Mbit/s** (2 per module). One of the modules performs the function and the other ensures concurrently the redundancy. The SSU is fitted with 2 modules or 1 module (no redundancy) or no INPUT module if the input is direct to CLOCK module.

CLOCK A and B Modules (2 locations):
These are fitted, as chosen, with four versions of local oscillators in CLOCK-OCXO (STN), CLOCK-OCXO (STNe), CLOCK-OCXO (SLN), and CLOCK-Rubidium (PRC). The role of the module is to provide a stable clock from the synchronization inputs of the INPUT boards or from its own inputs (channel A at 2048 kHz/10 MHz and channel B at 2048 kHz) if INPUT boards are not installed. Each of the modules is fitted, optionally, with a GPS receiver. Two modules operating concurrently ensure redundancy. CLOCK modules exist in two versions (factory configuration): channel A is designed to receive either 10 MHz or 2048 kHz.

DIST Modules (4 locations):
These are available in three versions: DIST-2048 kHz, DIST-2048 kbit/s, DIST T/F (pps-tod-10 MHz), distributing respectively eight 2048 kHz outputs, or eight 2048 kbit/s outputs, or two

10 MHz and two 1PPS outputs and two ToD outputs. Output amplifiers are backed up so as to deliver output signals even in case one of the amplifiers is failing, as the level, in this case, is only subjected to level decrease.

MANAGEMENT Module (1 location):
This manages configuration parameters and collects states, but is not essential for the SSU operation in "Running" mode.

1.7 Maintenance and Supervision Software

The SSU apparatus is delivered accompanied by maintenance software SSUWIN running on PC in Windows environment. This PC is fitted with standard Ethernet RJ45 network interface and is connected direct to the Ethernet RJ45 connector of the SSU through a crossover cable or via IP network.

In order to constitute a complete synchronization network, network supervision software EPSYNC MANAGER is supplied separately. This software is remote controlled from one (or more) PC / Windows supervision station(s) connected to the SSU via IP network.

Functions of supervision with the SSU are described in the EPSYNC MANAGER user's manual. Menus and functions of the SSUWIN software are included in the EPSYNC MANAGER software.

1.8 Front Panel Connectors

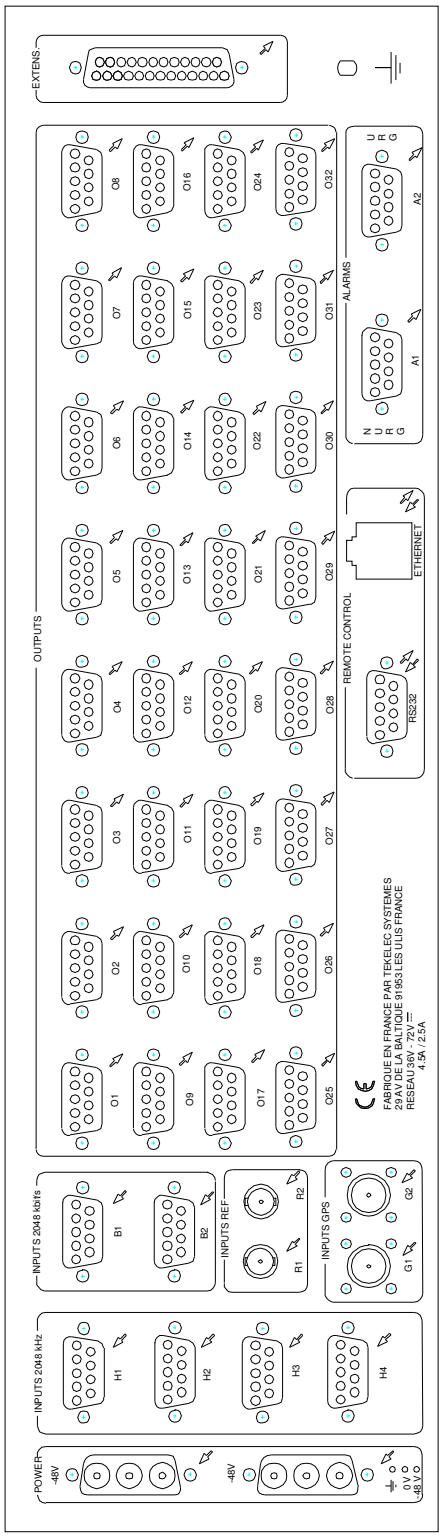


Figure 1 - 2. Front Panel - Connectors.

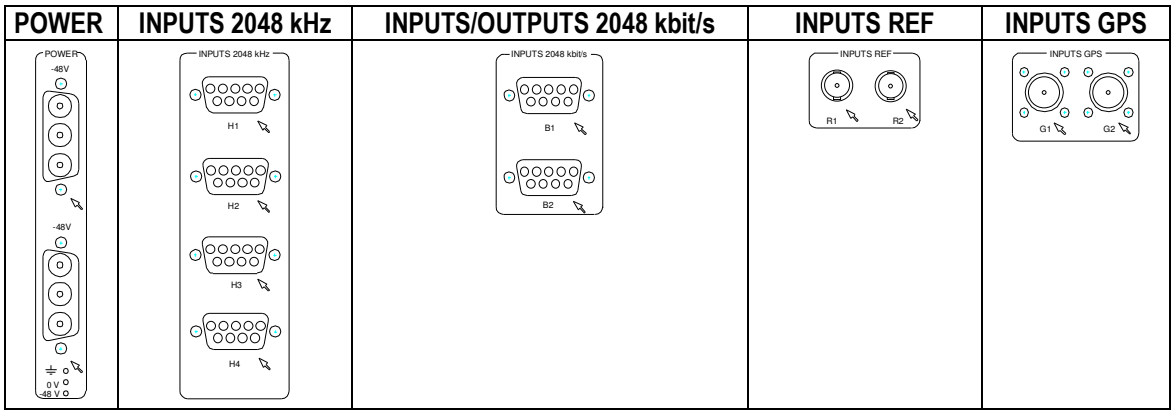


Figure 1 - 3. Front Panel - Connectors (2).

POWER

–48 V DC power supply backed-up input. Paths of both –48 V power supplies are separate up to powered modules.

INPUTS 2048 kHz (H1, H2, H3, H4)

Inputs from synchronization clocks G.703 at 2048 kHz for INPUT boards (H1, H2, H3, H4) or for CLOCK boards (H1 and H2 on different pins) without INPUT board.

Each connector powers concurrently both INPUT boards or both CLOCK boards.

H1 is the direct input to CLOCK board (in its 2048 kHz version) and H2 is the direct input, in 2048 kHz, to CLOCK board (in both versions). See, in Appendix, H1 and H2 pin assignments in the case of an input to INPUT modules, or direct to CLOCK modules without INPUT board.

INPUTS/OUTPUTS 2048 kbit/s (B1, B2)

Inputs from synchronization frames G.704 at 2048 kbit/s for INPUT boards. Each connector powers concurrently both INPUT boards. Input signals are duplicated through a line interface circuit and output from the same connector.

INPUTS REF (R1, R2)

Inputs from synchronization clocks at 10 MHz for CLOCK boards (in their 10 MHz version), CLOCK A receiving signals from R1 and CLOCK B from R2. Only used if reference clock inputs are direct without INPUT board.

INPUTS GPS (G1, G2)

Antenna inputs for GPS receivers on CLOCK boards.

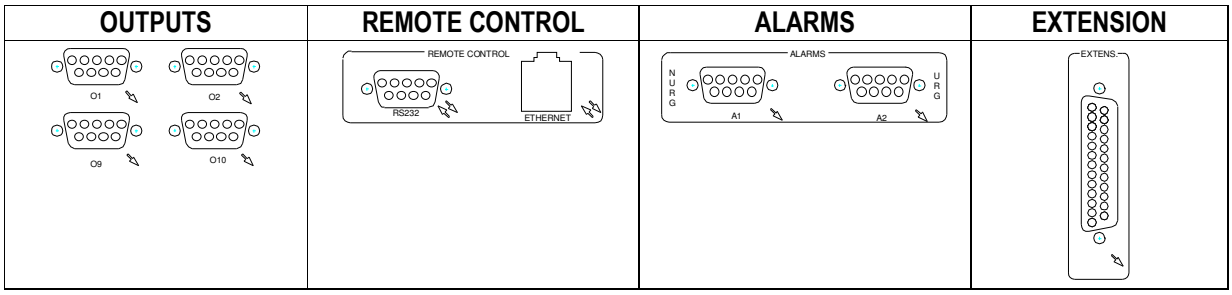


Figure 1 - 4. Front Panel - Connectors (3).

OUTPUTS (01 to 032)

Outputs from regenerated clocks (8 receptacles per DIST module) or frames G.704 at 2048 kbit/s (8 receptacles per DIST module) or reference signals at 10 MHz, 1PPS and ToD (6 receptacles per module). One line of connectors corresponds to one DIST Module with the same numbering.

REMOTE CONTROL (RS232, ETHERNET RJ45)

Access via Ethernet Network to supervision and maintenance functions of the SSU and RS232 access for network-parameter configuration.

ALARMS (A1, A2)

Outputs of alarm-indicating signals generated by **MANAGEMENT board.**

EXTENSION

Access to an extension unit for DIST modules for a larger number of outputs.

GROUND

Casing grounding.

1.9 Warning Lights

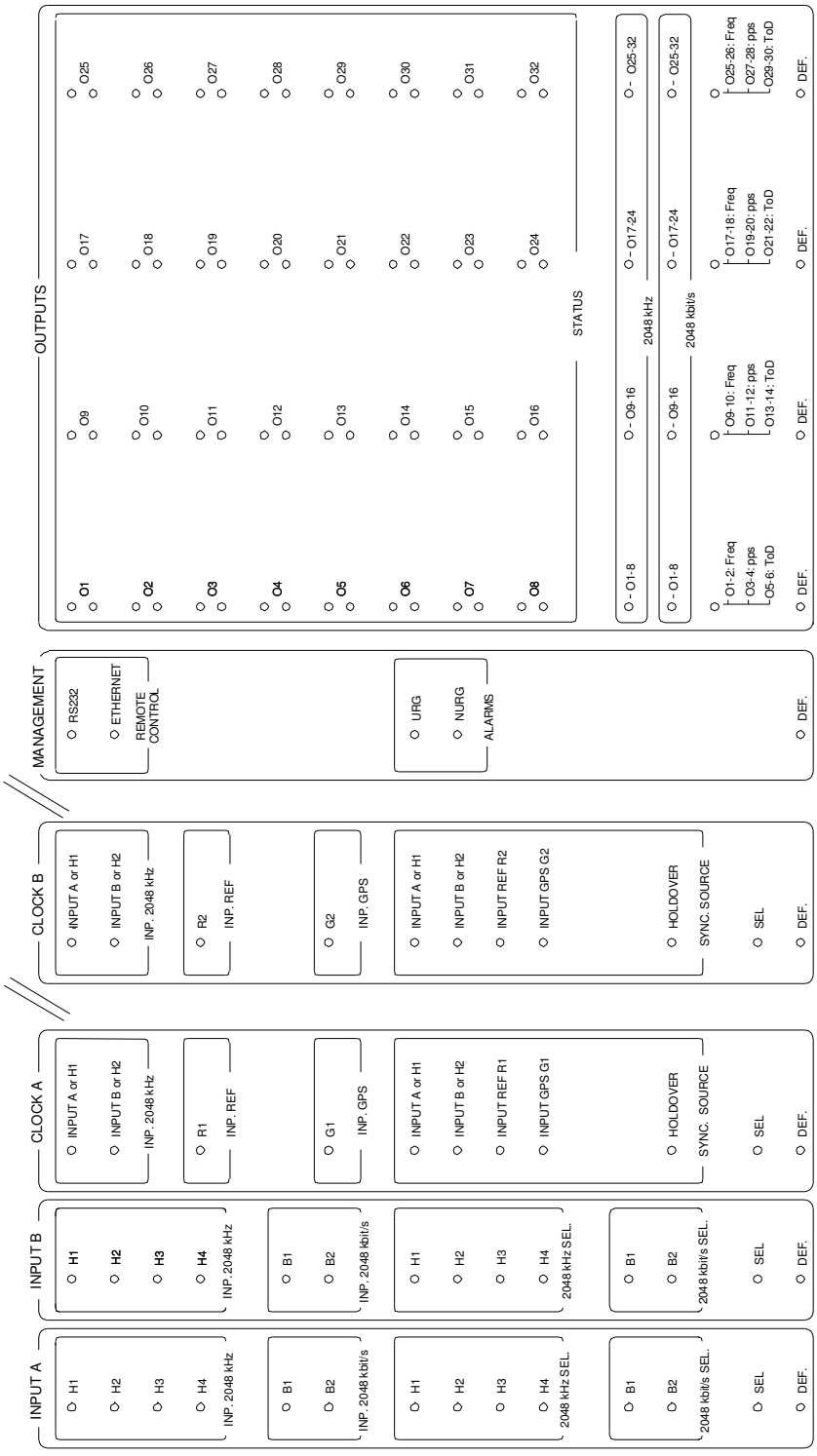


Figure 1 - 5. Front Panel – Warning Lights.

WARNING LIGHTS ON (R: RED OR G: GREEN OR Y: YELLOW)

SEL (G) – DEF. (R)

○ SEL The LED indicates that module A or B is selected to perform the function (INPUT and CLOCK). The other module is available as a backup.

○ DEF. The module is not in its normal operating condition, either for technical incident, or for lack of synchronization signal, or for search for tracking (CLOCK module).

Input 2048 kHz – Input 2048 kbit/s (R)

Absence of signal on corresponding inputs, while they are declared as operating. With a 2048 kbit/s signal, a Loss Of Frame Synchronization Alarm is equivalent to a Loss Of Signal.

2048 kHz SEL – 2048 kbit/s SEL (V)

Indicates the input that provides the module with synchronization reference.

INP. 2048 kHz – INP. REF – INP. GPS (R)

Absence of signal on corresponding inputs, while they are declared as operating.

SYNC. SOURCE (V)

Shows the source selected for synchronization.

REMOTE CONTROL (V)

In RS232, lights up on traffic transiting via the corresponding connector. In Ethernet, lights up if the link is established.

ALARMS (R)

Lights up on certain global criteria of the SSU status concerning the slaving and achieved distribution. Concurrently with LED states, alarm signals are activated on connectors A1 and A2.

STATUS (V)

Output in operation OK.

2048 kHz – 2048 kbit/s – Freq – pps – ToD (V)

Shows the type of DIST module.

1.10 Function Backups, Reliability

In order to ensure maximum availability, INPUT and CLOCK modules are backed up.

Reference input signals are distributed over both INPUT modules, which work concurrently. Each INPUT module produces a different output for the two CLOCK modules.

CLOCK modules work concurrently from the signals delivered by both INPUT boards. They each transmit their processed signals to distribution modules.

If one INPUT module or CLOCK module fails, the second takes over from it automatically.

Output buffers on DIST boards are backed up to keep supplying minimum signal level in the event that either of them fails.

Once the SSU has been initialized, the **MANAGEMENT** module is not essential for the clock regeneration and distribution operation. Should this module fail, this does not cause the SSU base function to stop.

1.11 Hot-Plugging

In order to ensure maximum availability, INPUT and CLOCK modules are backed up.

When the SSU unit is powered on, it is possible to perform plugging and extractions of the various modules without stopping the synchronization distribution.

NOTE: In order to ensure distribution continuity, the Master CLOCK must be forced to "Slave" mode using the maintenance PC before being removed.

2 Technical Features

2.1 Dimensions and Weight

- Width: 19" (441 mm), without bracket
- Height: 9 U (365mm).
- Depth: 277mm.
- Weight: < 15 kg.

2.2 Operating Environment

- Operating temperature: 0 to 50°C.
- Storage temperature: -40 to 85°C.
- Relative humidity: 95 % non-condensing.
- Electromagnetic compatibility: in accordance with EN30386/EN55022/EN60950.

2.3 Power Supply

- Nominal DC input voltage: -48 Volts.
- Normal variation: -40 to - 57 Volts.
- Transitory variation: -36 to - 72 Volts.

- Two parallel input connectors.
- Protection against polarity reversal.
- 0 Volt DC input is not case grounded.
- Every module protected by a PolySwitch fuse (automatically rearmed)

2.4 Power Consumption on -48 VDC

- Nominal DC input voltage conditions: -48 Volts DC.
- INPUT Module: 0.12 A.
- CLOCK (OCXO +GPS) Module: 0.22 A typical.
- CLOCK (OCXO +GPS) Module: 0.3 A during start-up.
- CLOCK (Rubidium +GPS) Module: 0.35 A typical.
- CLOCK (Rubidium +GPS) Module: 0.7 A during start-up.
- MANAGEMENT Module: 0.12 A.
- DIST (No load): 0.06 A.
- Maximum Total Power consumption: < 150 W.

2.5 2048 kHz Synchronization Input

- Port type: 120 Ω symmetrical pair or 75 Ω coaxial pair
  (configuration achieved by strap presence in mating plug).

- Interface specifications according to G.703 ITU-T.
- Attenuation of level in √f: 6 dB max at 2048 kHz.
- One 9-pin SubD connector per input.

2.6 2048 kbit/s Synchronization Input

- Port type: 120 Ω symmetrical pair or 75 Ω coaxial pair (configuration achieved by strap presence in mating plug).

- Line coding: HDB3.
- Interface specifications according to G.703 ITU-T.
- Attenuation of level in √f: 6 dB max at 2048 kHz.
- Frame structure complying with G.704 and G.706 ITU-T.
- CRC-4 operation mandatory.
- Decoding of SSM messages according to definitions from ETSI EN 300 417-6-1 (§ 4.4 and 4.5).
- One 9-pin SubD connector per input.

2.7 2048 kbit/s Synchronization Loopback

Loopback of G.704 2048 kbit/s link by extracting clock and data from input signal and recombining them without any data modification (including CRC, SSM).

AIS Alarm is sent when a LOS (loss of signal) or LOF (loss of frame alignment) is detected on the incoming signal.

- Port type: 120 Ω symmetrical pair or 75 Ω coaxial pair
(configuration achieved by strap presence in mating plug).

- Line coding: HDB3.
- Pulse mask according to G.703 ITU-T specifications.
- Level 2.37 Volts (75 Ω) or 3 Volts (120 Ω) ± 10%.
- Frame structure complying with G.704 and G.706 ITU-T.

2.8 10 MHz Synchronization Inputs

Option, without Input Module:
- Quantity: 2, one per CLOCK module.
- Level: > 0 dBm.
- Input impedance: 50 Ω.
- Jitter: < 5 ns.
- Connector: female 50 Ω BNC.

2.9 GPS Reception

Options

- Quantity:	2, one per CLOCK module.
- Connector:	Antenna female 50 Ω TNC.
- Core:	GPS signal Input (L1).
- Power supply to active antenna:	5V/75 mA max.
- Fold Back protection:	the power supply is cut in the event of a short-circuit in the antenna input.

2.10 Timing Characteristics of SSU-PRC

- Type of local oscillator: Rubidium.
- According to ETSI EN 300 462-1,2,3,5 or ITU-T G.811, G.812.

2.10.1 Noise Generation in Locked Mode from GPS

- According to §5.1 & 5.2 EN 300 462-6-1 fig. 1 & 2.
- Loop filter type: Kalman predictive algorithm.

2.10.2 1 pps/UTC Accuracy in GPS Mode

- ± 50 ns (1 σ).

2.10.3 Pull-in Range

- Minimum pull-in range: ± 1.2×10^{-8}.

2.10.4 Noise Generation in Locked Mode from Ideal Reference

- Wander according to §5.1 EN 300 462-6-1 fig. 1 & 2.
- Jitter according to §5.2 EN 300 462-6-1.

2.10.5 Holdover Mode

- According to §9.2 EN 300 462-4-1.
- Stability < ± 5×10^{-11}/month.
- Short term stability < ± 1×10^{-11}/10 s.

2.10.6 Phase Noise Tolerance

- According to §7 EN 300 462-4-1.

2.10.7 Transfer Characteristics

- According to §8 EN 300 462-4-1.
- Loop filter type: Kalman predictive algorithm.
- Time constant: 100-300-1000-3000-10000 s (nominal: 1000 s).

2.10.8 Phase Response During Input Reference Switching

- Phase response according to §6 EN 300 462-6-1.

2.10.9 Phase Transient Due to CLOCK Module Switching

- < 10 ns.

2.11 TimingCharacteristics of SSU-STNe

- Enhanced OCXO configuration.
- Type of local oscillator: Double–oven crystal oscillator (OCXO Model 2).
- According to ETSI EN 300 462-1,2,3,4 or ITU-T G.811, G.812.

2.11.1 Pull-in Range

- Minimum pull-in range: $\pm 2 \times 10^{-8}$ mini.

2.11.2 Noise Generation in Locked Mode from Ideal Reference

- Wander according to §6.1 EN 300 462-4-1 fig. 1 & 2.
- Jitter according to §6.3 EN 300 462-4-1.

2.11.3 Holdover Mode

- According to §9.2 EN 300 462-4-1.
- Stability < $\pm 1 \times 10^{-10}$/jour.
- Short-term stability < $\pm 2 \times 10^{-11}$/10 s.

2.11.4 Phase Noise Tolerance

- According to §7 EN 300 462-4-1.

2.11.5 Transfer Characteristics

- According to §8 EN 300 462-4-1.
- Loop filter type: Kalman predictive algorithm.
- Time constant: 100-300-1000-3000-10000 s (nominal: 1000 s).

2.11.6 Phase Response During Input Reference Switching

- Phase response according to §9 EN 300 462-4-1.

2.11.7 Phase Transient due to CLOCK Module Switching

- < 10 ns.

2.11.8 Noise Generation in GPS Locked Mode

- According to §5.1 & 5.2 EN 300 462-6-1 fig. 1 & 2 (PRC performance).
- Loop filter type: Kalman predictive algorithm.
- Time constant: 100-300-1000-3000-10000 s (nominal: 1000 s).

2.11.9 1 pps/UTC Accuracy in GPS Mode

- ± 50 ns (1σ).

2.12 Timing Characteristics of SSU-STN

- Standard OCXO configuration.
- Type of local oscillator: Oven controlled crystal oscillator (OCXO Model 1).
- According to ETSI EN 300 462-1,2,3,4 or ITU-T G.811, G.812.

2.12.1 Pull-in Range

- Minimum pull-in range: ± $3x10^{-7}$.

2.12.2 Noise Generation in Locked Mode from Ideal Reference

- Wander according to §6.1 EN 300 462-4-1 fig. 1 & 2.
- Jitter according to §6.3 EN 300 462-4-1.

2.12.3 Holdover Mode

- According to §9.2 EN 300 462-4-1.
- Stability < ± $3x10^{-10}$/jour.
- Short-term stability < ± $1x10^{-10}$/10 s.

2.12.4 Phase Noise Tolerance

- According to §7 EN 300 462-4-1.

2.12.5 Transfer characteristic

- According to §8 EN 300 462-4-1.
- Loop filter type: Kalman predictive algorithm.
- Time constant: 100-300-1000-3000-10000 s (nominal: 1000 s).

2.12.6 Phase Response During Input Reference Switching

- Phase response according to §9 EN 300 462-4-1.

2.12.7 Phase Transient due to CLOCK Module Switching

- < 10 ns.

2.12.8 Noise Generation in GPS Locked Mode

- According to §5.1 & 5.2 EN 300 462-6-1 fig. 1 & 2 (PRC performance).
- Loop filter type: Kalman predictive algorithm.
- Time constant: 100-300-1000-3000-10000 s (nominal: 1000 s).

2.12.9 1 pps/UTC Accuracy in GPS Mode

- ± 50 ns (1σ).

2.13 Timing Characteristics of SSU-SLN

- Optional OCXO configuration
- Type of local oscillator: low cost crystal oscillator OCXO.
- According to ETSI EN 300 462-1,2,3,7 or ITU-T G.811, G.812.

2.13.1 Pull-in Range

- Minimum pull-in range: ± $1x10^{-6}$.

2.13.2 Noise Generation in Locked Mode from Ideal Reference

- Wander according to §6.1 EN 300 462-7-1 fig. 1 & 2.
- Jitter according to §6.3 EN 300 462-7-1.

2.13.3 Holdover Mode

- According to §9.2 EN 300 462-7-1.
- Stability < ± $1x10^{-9}$/jour.
- Short-term stability < ± $1x10^{-10}$/10 s

2.13.4 Phase Noise Tolerance

- According to §7 EN 300 462-7-1.

2.13.5 Transfer Characteristic

- According to §8 EN 300 462-7-1.
- Loop filter type: Kalman predictive algorithm.
- Time constant: 100-300-1000-3000-10000 s (nominal: 1000 s).

2.13.6 Phase Response During Input Reference Switching

- Phase response according to §9 EN 300 462-7-1.

2.13.7 Phase Transient due to CLOCK Module Switching

- < 10 ns.

2.13.8 Noise Generation in GPS Locked Mode

- According to §5.1 & 5.2 EN 300 462-6-1 fig. 1 & 2 (PRC performance).
- Loop filter type: Kalman predictive algorithm.
- Time constant: 100-300-1000-3000-10000 s (nominal: 1000 s).

2.13.9 1 pps/UTC Accuracy in GPS Mode

- ± 100 ns (1 σ).

2.14 Phase lock-in at power-up

2.14.1 Warming-up

- Warm-up time for the local oscillator before tracking search: 1000 s for OCXO version and 3600 s for Rubidium version.
- Then a fast tracking search bring the oscillator frequency close to the reference input signal frequency.

2.14.2 Lock-in Time with 2048 kHz or 2048 kbit/s Signal

- Output wander compatible with §6.1 EN 300 462-4-1 fig. 1 in: 1000 s max after warming-up.

2.14.3 Lock-in Time with GPS Signal

- Output wander compatible with §4.1 EN 300 462-4-1 fig. 1 in: 600 s max after warming-up.

2.15 Input Reference Signal Quality Monitoring

Parameters for MTIE/TDEV measurement:

- Sampling period: 0.3 Hz.
- Observation interval: 10 s, 100s, 1000 s.
- Measurement period: 3 times the observation interval.
- Measurement resolution: 1 ns.

2.16 2.048 kHz Output

- Number of DIST modules: 4 max.
- Number of outputs: 8 per module.
- One 9-pin SubD connector per output.
- Port type: 120 Ω symmetrical pair or 75 Ω coaxial pair
  (configuration achieved by strap presence in mating plug).

- Interface specifications according to G.703 ITU-T - fig 20.
- Level: 0.75 to 1.5 Volts (75 Ω) or 1.0 to 1.9 Volts (120 Ω).

2.17 2.048 kbit/s Output

- Number of DIST modules: 4 max.
- Number of outputs: 8 per module.
- One 9-pin SubD connector per output.
- Port type: 120 Ω symmetrical pair or 75 Ω coaxial pair
  (configuration achieved by strap presence in mating plug).

- Line coding: HDB3.
- Pulse mask according to G.703 ITU-T – fig 15 specifications.
- Level 2.37 Volts (75 Ω) or 3 Volts (120 Ω) ± 10%.
- Frame structure complying with G.704 and G.706 ITU-T.
- Permanent CRC-4 operation.
- Transmission of AIS alarm.
- Coding of SSM messages according to definitions from ETSI EN 300 417-6-1 (§4.4 and 4.5).

2.18 1pps, 10 MHz, ToD Outputs

2.18.1 10 MHz

- Number of outputs: 2.
- One 9 pin SubD connector per output.
- Waveform: sine.
- Level: > 10 dBm over 50 Ω.

2.18.2 1PPS

GPS Receiver required:

- Number of outputs: 2.
- One 9-pin SubD connector per output.
- Level: TTL over 50 Ω.
- Pulse width: 100 µs ± 10 %.
- Active rising edge: < 20 ns.

2.18.3 ToD

GPS Receiver required:

- Number of outputs: 2.
- One 9-pin SubD connector per output.
- Asynchronous RS232C, ASCII, 9600 bauds, 8 bits, 1 stop bit, odd parity.
- Period: 1 s.
- Content: Day/Month/Year/Hour/Minute/Second/Source.
- User-programmable format.
- Timing: 200 ms ± 100 ms after the 1 pps signal.

2.19 Auxiliary Connector Signals

2.19.1 Alarm Connectors

- Relay contact.
- Maximum switching power: 30 W, 62.5 VA (resistive load).
- Maximum switching voltage: 110 VDC, 125 VAC.
- Maximum switching current: 1 A.
- Urgent Alarm Connector: 9-pin SubD.
- Non Urgent Alarm Connector: 9-pin SubD.

2.19.2 Remote-control RJ45

For SSU management:

- Ethernet 802.3 10 Base T. Protocols: TCP/IP, SNMP, and FTP.
- RJ45 connector.

2.19.3 Remote-control RS232

For network parameters initialization only.

- Asynchronous RS232C, 19200 bauds, 8 bits, 1 stop bit, no parity.
- 9-pin SubD connector.

2.19.4 Extension Connector

- TTL level.
- 25-pin SubD connector.

2.20 Control PC for SSUWIN Software

OS required:
- Windows NT, 2000, XP.
- Network management protocol: TCP/IP.

Hardware configuration:
- RAM mini: 256 MB.
- Hard disk: 10 GB.
- Ethernet interface: 10 Base T RJ45.
- Display resolution: 1024x768 (SSUWIN) or 1280x1024 (EPSYNC Manager)

3 Putting the SSU into Service

3.1 Installation

The apparatus can be used as such, or built installed in a rack. In the latter case, locking brackets shall be secured to the SSU casing. Choose the arrangement: brackets on SSU front or brackets set back rearwards, depending on the type of rack. The space between brackets can follow either the Standard 19" Adaptation or the ETSI Adaptation.

Leave free space of a few centimetres under the apparatus, in order to facilitate natural air flow from bottom to top of the SSU.

Connecting cables for signals and power supply should be secured to locks provided for this purpose.

3.2 Modules and Composition of an SSU

3.2.1 Composition of an SSU

A SSU is composed of a Base Unit (Ref.: EPSSU) including the proper rack delivered equipped only with the MANAGEMENT module. Various modules are installed according to the ordered configuration.

The SSU composition varies according to applications.

3.2.2 INPUT Modules

- EPSSU-INP: four 2048 kHz inputs, two 2048 kbit/s inputs.

3.2.3 CLOCK Modules

-EPSSU-Rb:	Rubidium Oscillator (PRC performance), two 2048 kHz inputs.
-EPSSU-Rb-10 MHz:	Rubidium Oscillator (PRC performance), one 2048 kHz input, one 10 MHz input.
-EPSSU-Rb-GPS:	Rubidium Oscillator (PRC performance), two 2048 kHz inputs, GPS equipped.
-EPSSU-Rb-GPS-10 MHz:	Rubidium Oscillator (PRC performance), one 2048 kHz input, one 10 MHz input, GPS equipped.
-EPSSU-DO:	Double-oven OCXO Oscillator (STNe performance), two 2048 kHz inputs.
-EPSSU-DO-10 MHz:	Double-oven OCXO Oscillator (STNe performance), one 2048 kHz input, one 10 MHz input.
-EPSSU-DO-GPS:	Double-oven OCXO Oscillator (STNe performance), two 2048 kHz inputs, GPS equipped.
-EPSSU-DO-GPS-10 MHz:	Double-oven OCXO Oscillator (STNe performance), one 2048 kHz input, one 10 MHz input, GPS equipped.
-EPSSU-XO:	OCXO Oscillator (STN performance), two 2048 kHz inputs.
-EPSSU-XO-10 MHz:	OCXO Oscillator (STN performance), one 2048 kHz input, one 10 MHz input.
-EPSSU-XO-GPS:	OCXO Oscillator (STN performance), two 2048 kHz inputs, GPS equipped.
-EPSSU-XO-GPS-10 MHz:	OCXO Oscillator (STN performance), one 2048 kHz input, one 10 MHz input, GPS equipped.

3.2.4 DIST Modules

- EPSSU-DIST-2MH:	Eight 2048 kHz outputs.
- EPSSU-DIST-2MB:	Eight 2048 kbit/s outputs
- EPSSU-DIST-10 MHz:	Two 10 MHz outputs, two 1PPS outputs, two ToD outputs.

3.3 Installation of Modules into an SSU

Installation of modules from left to right:

- INPUT A: slot 1
- INPUT B: slot 2
- CLOCK A: slot 3
- CLOCK B: slot 4
- MANAGEMENT: slot 5
- DIST A: slot 6
- DIST B: slot 7
- DIST C: slot 8
- DIST D: slot 9

A polarization system consisting of a dowel and a notch in the board prevents the user from inserting boards into non-authorized slots.

As regards input signals, INPUT boards support four 2048 kHz inputs and two 2048 kbit/s inputs. While CLOCK boards support one 2048 kHz or 10 MHz Ref input (factory choice) and another 2048 kHz input. For a limited number of inputs, INPUT boards are no longer essential. Moreover, if backup is not necessary, a single INPUT board is sufficient. In this case, prefer INPUT A board slot.

The actual composition of the SSU is set at the start of the MANAGEMENT board. If the INPUT board is present, then the signal inputs are processed by the INPUT board. In this case the 10 MHz Ref input is unavailable. If the INPUT board is not present, the signal inputs go directly to the CLOCK board. In this case and if the CLOCK board is a 10 MHz type board, one 2 MHz input and one 10 MHz Ref input are available. **When modifying the composition, a reset of the MANAGEMENT board must be performed, so that the new configuration is initialized**.

As regards CLOCK boards, the minimum is one board. It will be backed up, if its redundancy is required. Every CLOCK board can accommodate its GPS receiver in the mezzanine form. The GPS module replaces or complements a Caesium-type PRS in PRC applications. In the case of a single CLOCK board, prefer CLOCK A slot.

GPS receivers of CLOCK modules are connected to antenna feed through coaxial cable. In the case where the GPS is absent, the cable is secured to a dummy connector located on the backplane board.

If CLOCK module oscillator is of Rubidium type, a plate improving the thermal scattering is screwed on the chassis frame, on the right of the board.

For DISTRIBUTION boards, take care to use board guides aligned on backplane DIN41612 connectors. Intermediate slots are intended for an extension (option) of the number of distributed signals.

From one to four DIST boards can be installed in the main chassis. These boards are of 2048 kHz (clock signal G.703) or 2048 kbit/s (framed signal G.703/G.704) type. A version of distribution of 10 MHz, 1PPS, ToD sync also is available. The place is free in slots reserved for DIST boards.

During a normal operation, automatic selections of backed-up boards give precedence to INPUT A board and CLOCK A board.

3.4 Powering Up

Connect one or two power cables to the -48 V connector. Check the polarity of the power signal before connecting it (refer to the Appendix or to the front panel for the pin-out).

After power-up, the MANAGEMENT module downloads and initializes the software of the INPUT and CLOCK modules. This may take a few minutes. A LED sequence starts flashing and then a default configuration is set: all inputs are enabled, highest priority is on H1 input, the INPUT module provides the reference signal to the CLOCK module.

Check the LED status after the initialization sequence, and with no input connection. If the led is not ON, it is OFF. If a configuration has already been asked by the client before shipment, then the led status has been checked already. If you want to check it again, go on with the installation and reload with SSUWIN a standard configuration (all inputs declared enabled, priority 1..6, all automatic modes). Then check the led status according to the table.

INPUT		CLOCK		MANAGEMENT		DIST	
IN H1	ON	IN H1	ON	RS232		O1	ON
IN H2	ON	IN H2	ON	ETHERNET		O2	ON
IN H3	ON	IN Ref				O3	ON
IN H4	ON	IN GPS	ON			O4	ON
IN B1	ON					O5	ON
IN B2	ON					O6	ON
SEL H1	ON	SEL H1	ON	URG	ON	O7	ON (*)
SEL H2		SEL H2		NURG	ON	O8	ON (*)
SEL H3		SEL Ref					
SEL H4		SEL GPS					
SEL B1						2048 kHz	ON (on corresponding type)
SEL B2		HOLDOVER	ON			2048 kbit/s	
SEL	ON (1/2)	SEL	ON (1/2)			Freq/pps/ToD	
DEF	ON	DEF	ON	DEF		DEF	

Table 3 - 1. LED Status.

(*) The led is ON for 2048 kHz and 2048 kbit/s type only. On Freq/pps/ToD type, the led is OFF.

On INPUT modules, the six red LEDs (H1 to B2) are ON, as no input is available. The SEL. LED for H1 link is ON. The red DEF. LED is also ON. Only one INPUT module is selected (led SEL ON).

On CLOCK modules, three red INP. LEDs are ON and the green SEL H1 SYNC. SOURCE LED is ON. The yellow HOLDOVER LED is ON. CLOCK A module SEL. LED alone is ON (CLOCK A is the master module). The red DEF. LED is ON.

On OUTPUTS modules, green STATUS LEDs are ON, and the green module type LED is ON.

If the SSU comes with no INPUT module, on 2048 kHz type CLOCK module, follow the above table. On 10 MHz type CLOCK module, the IN H1 led is OFF and the IN Ref is ON.

3.5 Configure the SSU

The next step to get the SSU working according to the actual set-up is to connect a PC running the SSUWIN software, and program the setup parameters.

As the connection is of Ethernet type, the network parameters (IP adress) of the SSU must be compatible with network parameters of the PC running SSUWIN. See §6.2 describing the installation of the SSUWIN software.

Once the PC can communicate (diagnostic "SNMP : OK" in the screen bottom status bar), the minimum configuration parameter to set relates to the source of the reference signal on INPUT and CLOCK module. Leaving all the selection modes on "Automatic", all the "Link Declaration" on "On", enables all the input accesses. The SSU is able to track a reference signal and distribute output signals.

While making connection set-up at the input of the SSU, keep in mind that the selection algorithm of input channel applies a confirmation delay of 10s before selecting a lower priority input and 1000s before going back to a higher priority input.

3.6 Synchronizing with 2048 kHz or 10 MHz signal with no INPUT Module

CLOCK modules come in two versions (factory configured):

- Channel A Input working at 10 MHz, and Channel B Input at 2048 kHz.
- Channel A Input working at 2048 kHz, and Channel B Input at 2048 kHz.

3.6.1 Synchronizing with a 10 MHz signal and a 2048 kHz signal

The 10 MHz reference signal is labelled REF on the Front Panel Alarm Leds and Sync Source Leds. But the processing chanel in the CLOCK board is the A chanel which works also in the 2048 kHz signal version.So the configuration and status fields in the SSUWin menus are the same for the 10 MHz input or 2048 kHz input on the A chanel.

Connect a 10 MHz reference (REF label) signal to R1 connector for CLOCK A module, and another one to R2 connector for CLOCK B module. Connect a 2048 kHz to H2 connector for both CLOCK A and CLOCK B modules.

Make sure that the reference frequency is within the pull-in range (paragraphs 2.12.1 or 2.13.1 or 2.10.3).

The corresponding INP. REF and INPUT B/H2 LEDs are cleared.

After a synchronizing period (a few tens of minutes), DEF. LEDs are cleared.

SEL. LEDs show the selected reference input.

3.6.2 Synchronizing with Two 2048 kHz signals

Connect two 2048 kHz reference signals to H1 and H2 connectors.

Make sure that the reference frequency is within the pull-in range.

The corresponding INPUT A/H1 or INPUT B/H2 LEDs are cleared.

After a synchronizing period (a few tens of minutes), DEF. LEDs are cleared.

SEL. LEDs show the selected reference input.

3.7 Synchronizing with 2048 kHz or 2048 kbit/s Signal through INPUT Module

Connect at least one 2048 kHz reference signal to a H1 to H4 connector and/or a 2048 kbit/s signal to B1 to B2 connector.

Be sure that the reference frequency is within the pull-in range (paragraphs 2.12.1 or 2.13.1 or 2.10.3).

The corresponding INP. 2048 LEDs are cleared.

After a synchronizing period, DEF. LEDs are cleared.

SEL. LEDs show the selected reference input.

3.8 Synchronizing with GPS

The GPS antenna should be connected to G1 for GPS of CLOCK A or G2 connector for GPS of CLOCK B.

The corresponding INP. GPS LED is cleared after initialization of the module (about 10 minutes).

After a synchronizing period, DEF. LEDs are cleared.

SEL. LEDs show the selected reference input.

4 Operation

4.1 General Information on Operating Functions

4.1.1 Management of Operating Functions

The MANAGEMENT module manages the operation run on INPUT, CLOCK and DIST modules, that is initialization, software loading, configuration parameters, status and alarms feedback, and also performance measurements.

Nevertheless, once they have been initialized, these modules are able to perform their synchronization hold task in respect for the recommendations.

Moreover, through the MANAGEMENT board, operators gain access to operating functions via REMOTE CONTROL Ethernet connection, locally with SSUWIN software or via the supervision network with EPSYNC software.

4.1.2 Remote Control Ethernet

4.1.2.1 Local Control

Thanks to this access, the SSU is controlled in local mode by an operator, from a PC fitted with SSUWIN software under Windows NT/2000/XP. Configurations are modifiable, and states and alarms can be viewed locally.

Configuration modification operations can be carried out during the normal run of the SSU OPERATION.

This is SSUWIN software, which we will refer to in all accesses from control PC during start-up, setup, and status display operations.

4.1.2.2 Control by Supervision Network

When a certain number of SSUs make up a complete network of synchronization distribution, these units can be connected as a network of IP type through RJ45 Ethernet connector. EPSYNC software under Windows 2000 is then used to monitor the distribution consistency and quality.

Remotely, the configuration of SSUs is programmed, SSU states are displayed, and the quality of links is continuously observed. A centralized database gathers all the information relating to the network and equipment and also that concerning operators. Consult EPSYNC software documentation.

4.1.3 Configuration of the SSU

On SSU power-up, a configuration stored on MANAGEMENT board is implemented in each of the modules. Likewise, if a module alone has just been hot plugged, MANAGEMENT module initializes it with its configuration.

It is also possible to program entirely an SSU from a configuration file sent by SSUWIN software.

4.1.4 Nominal Operation of the SSU

In nominal operation, the SSU reacts autonomously according to default criteria or criteria operator-programmable through MANAGEMENT board.

Operations managed by the very modules concern:

- Automatic selection of input links by INPUT board (or CLOCK board, if the SSU configuration SSU is without INPUT board);
- Automatic selection of the operational INPUT board ("Running/Spare") (decision by Master CLOCK module);
- Automatic selection of the operational CLOCK board ("Master/Slave" choice) (mutual decision by CLOCK modules);
- Slaving algorithm for the local oscillator, which works with programmable slaving constants;
- Quality measurement for the six 2048 kHz and 2048 kbit/s input links that are continuously characterized by a measurement of MTIE and TDEV made on 3 points of the template. The measurement result is compared to a threshold and comes into selection criteria for synchronization links. Thresholds are fixed.

4.1.5 Maintenance Functions of the SSU

Certain functions normally performed automatically by SSU modules can be forced through SSUWIN software run on a PC.

Operator-controllable operations are:

- Selection of input links on INPUT board (choice from six),
- Selection of the operational INPUT board ("Running/Spare" choice),
- Selection of the operational CLOCK board ("Master/Slave" choice),
- Selection of the input link on CLOCK board (INPUT A/ INPUT B/ GPS choice).

The operator has thus the possibility of replacing a faulty module or analyzing a special problem without hindering the normal SSU operation.

4.1.6 Status of the Elements

The status of the various elements in SSU and also the measurements made are accessible by SSUWIN software.

They relate to the selection of the reference synchronization link at the input, selection of "Running" INPUT board, selection of "Master" CLOCK board. Fault detection's on each board is used to monitor the right operation SSU operation.

4.1.7 Alarms

Two alarms (Urgent and Non-Urgent) are generated depending on the states of modules making up the SSU and configurations performed. Relevant LEDs are visible on MANAGEMENT module.

Non-Urgent alarms are generated when a parameter goes out of operating limits but have no effect on SSU performance.

Urgent alarms are generated when the SSU detects a defective module, or when the generated signal has lost its synchronizing reference.

Refer to section 6.3 for the Urgent and Non Urgent alarm origins.

Concurrently with the display, both alarms are available in the form of two contact relays; the one being open and the other closed in the absence of an alarm and reversely in the presence of an alarm.

Refer to the Appendix for the pin assignment of the front panel alarm connectors.

4.2 Configuration Parameters

4.2.1 Network Parameters

- Initialization by a text terminal connected to RS232 Remote Control connector.

4.2.2 INPUT Module

4.2.2.1 Links Synchronizing INP Module

For each of the 6 input links (1 to 4 : 2048 kHz links, 5 to 6 : 2048 kbit/s links):

- Taking into account or not the input link (1 to 6),
  (Default: All the links are taken into account)
- Input selection mode (Automatic or Forced),
  (Default: automatic selection)

- Module selection mode (Automatic or Forced),
  (Default: automatic selection)
- Priority of the link (1 to 6), (Default: 1, 2, 3, 4, 5, 6)

4.2.2.2 MTIE / TDEV measurements

- Define or not the utilization of MTIE measurements for selecting the synchronizing link, (Default: non-utilization)
- Define or not the utilization of TDEV measurements for selecting the synchronizing link, (Default: non-utilization)
- MTIE template parameterization in µs:
  (Fixed: 10 s = 1000 ns, 100 s = 2000 ns, 1000 s = 5000 ns),
- TDEV template parameterization in ns:
  (Fixed: 10 s = 34 ns, 100 s = 170 ns, 1000 s = 170 ns),

4.2.2.3 SSM thresholds

- For links 5 and 6, define the taking into account or not of SSM content for selecting the link and the taking-into-account threshold.
- Taking the SSM into account: used or not used for each of the 2 links, (Default: not used)
- Minimum quality threshold per link: (0010, 0100, 1000, 1011, 1111), (Default: 1111) with, in descending order of quality:

  0010: PRC quality,
  0100: Transit Node quality,
  1000: Local Node quality,
  1011: SEC quality,
  1111: "Do not use" quality.

The link is considered useable if its detected SSM message is of greater or equal quality than the threshold.

4.2.3 CLOCK Module

4.2.3.1 CLOCK Module Inputs

The parameters depend on presence or not of INPUT boards.

- Input from INPUT boards or from Direct Accesses on Front Panel.

In the case of Direct Accesses on Front Panel, channel A is factory configured in 2048 kHz (H1 input) or in 10 MHz (Ref input). Channel B is always in 2048 kHz (H2 input).

In the case of INPUT board Accesses, channel A and B come respectively from INPUT A an B boards in 2048 kHz (H2 input).

4.2.3.2 CLOCK Module Selection

For maintenance purpose, the Master/Slave CLOCK mode can be automatic or manually forced on CLOCK A or CLOCK B module (Default: Automatic).

4.2.3.3 Links Synchronizing CLOCK Module

For the 3 incoming links: (link 1: 2048 kHz or 10 MHz, link 2: 2048 kHz, link 3: GPS).

- Taking into account or not of links (1 to 3), (Default: all the links are active).
- Section mode: automatic or In A forced or In B forced or GPS forced, (Default: Automatic).
- Priority of each of the links (1 to 3), (Default: 1, 2, 3).

4.2.3.4 Issued 2048 kbit/s Frame Content

- Activation of the issued SSM: always enabled.

4.2.3.5 MTIE / TDEV Measurement

- Define or not the utilization of MTIE measurements for selecting the synchronizing link, (Default: non-utilization).
- Define or not the utilization of TDEV measurements for selecting the synchronizing link, (Default: non-utilization).
- MTIE template parameterization in µs:
  (fixed: 10 s = 1000 ns, 100 s = 2000 ns, 1000 s = 5000 ns).
- TDEV template parameterization in ns:
  (fixed: 10 s = 34 ns, 100 s = 170 ns, 1000 s = 170 ns).

4.2.3.6 Oscillator

Oscillator parameters are stored in non-volatile memory, in factory. They describe the characteristics essential to slave and follow up the setpoint (ageing). Only the type of oscillator (Rubidium/OCXO) is recalled on SSUWIN software screen.

4.2.3.7 Slaving Time Constant

- Choice of the slaving time constant: 100/300/1000/3000/10000s (Default: 1000s).

4.2.3.8 GPS

- The GPS antenna position must be fixed.
- Receiver operating mode: automatic position calculation but for fixed set. Once the position has been calculated, data are extracted from a single satellite.
- Correction of the antenna delay (Default: 0 ns).

4.2.4 DIST Modules

The SSU distribution function is provided with 4 slots reserved for inserting DIST modules. Modules can be of different types: 2048 kHz, 2048 kbit/s, T/F. Configuring is performed in factory and is non-programmable.

For a special maintenance mode:

- Selection mode for the synchronization source (Automatic, CLOCK A, CLOCK B), (Default: Automatic).

4.3 Operating States

Two kinds of states are available at a module: static states related to operator-performed configurations, and dynamic states related to behaviour of SSU modules.

SSUWIN software is able to retrieve the status of SSU configuration parameters according to the description in the above paragraph.

Dynamic states are described per module. They are displayed by the LEDs on SSU front panel, against each of the modules concerned.

4.3.1 INP modules

- Faulty module (yes/no). The module is faulty if none of the declared synchronization signals is present, or if the synchronization signal is not delivered to CLOCK modules;
- Operation ("Running" or "Spare"). The choice is made by Master CLOCK board, and displayed on "sel" LED;
- Detection of presence of declared links (OK/Alarm). On 2048 kHz inputs, it is presence detection for clocks leading edges at nominal frequency. In 2048 kbit/s, the detection of frame locking is added;
- Number of the selected synchronizing link (one from 6) according to the algorithm described on page 4-10.

4.3.2 CLOCK Modules

- Module faulty (yes/no). The module is faulty if none of the declared synchronization signals is present, if the slaving to this signal is not yet achieved, or if the signal is not delivered to DIST board. In the case of a "Slave" CLOCK board, a misalignment of the signal distributed on "Master" board signal also contributes to setting to fault;
- Operating mode (Master, Slave), displayed on "Sel" LED;
- Detection of presence of declared links (OK or alarm). LEDs concern A and B inputs, 10 MHz Reference inputs, GPS module (locked or fault);
- Selected synchronizing link (Input A, Input B, GPS) ;

- Oscillator status (In progress of slaving, Slaved, Holdover).

4.3.3 DIST Modules

- Faulty module (yes/no),
- Type of DIST module (2 MHz, 2 Mbit/s, T/F),
- Selected signal source (CLOCK A or CLOCK B),
- Output signal states for the 8 channels (1: OK/NOK … 8 : OK/NOK).

4.3.4 Management Module

Available states at the Management module are as follows:

- General status of the board (OK/Fault),
- Urgent Alarm status (OK/Fault),
- Non-Urgent Alarm status (OK/Fault),

4.4 Description of the SSU Functions

4.4.1 Automatic Selection of Input Links

The algorithm follows the same principles on INPUT board and on CLOCK board.

Selecting the synchronizing input link is either automatic according to parameterizable criteria, or forced. The selection algorithm is operational in automatic mode.

The management system for INP module makes the following works on synchronizing links:

1 - Scanning of links that are declared "enable", "disable" links cannot be selected.

2 - For each of the available links, check of the signal presence. If the link is "not present", it is declared unusable, an alarm is generated, but the scanning remains active.

3 - For each of the available and present links, a quality test (MTIE and TDEV) is conducted, if authorized. If the test result remains within its boundaries, the link is declared useable.

4 - For both 2048 kbit/s links only, a test on SSM message is conducted if authorized. The link is declared useable if the SSM quality code read is higher than or equal to the programmed threshold.

5 - Each of the links has a configurable priority level that is used to decide between useable links.

Sanction:

The synchronizing link accepted at a given instant is that for which points 1, 2, 3, 4 are correct and that has the highest declared priority.

The decision law reacts according to the processing order for parameters used in the following order: Forcing, Declaration, Presence, Performance, SSM, Priority.

A few special cases shall be noted.

If a 2 Mbit/s link includes a SSM message of higher quality level and is put into competition with another 2 Mbit/s link of lower quality level but higher than the minimum required threshold, the latter can be selected if its priority is higher.

If certain links are declared but do not include SSM (2 MHz, 1st-generation GPS or network), and are put into competition with links including a SSM, a first selection is performed on 2 Mbit/s links with SSM, and then useable links are put again into competition with links without SSM according to their priority.

Criteria of selection according to MTIE/TDEV quality measures are only valid if a current slaving assures a stable enough reference signal. The decision to change of link because of measurement results is only after stabilization and confirmation of 1000 s (typical values).

4.4.1.1 Switching Management for Synchronizing Downlinks

Switching from the nominal synchronizing link to another link with lower priority is only performed if the nominal link is declared out of tolerance for a minimum (10s by default).

Switching is then performed to the immediately lower priority link, if this link is correct. The link momentarily defective remains qualified.

If the nominal link is out of tolerance for less than 10 seconds, the selection stays on it.

4.4.1.2 Switching Management for Synchronizing Uplinks

All the incoming synchronizing links are continuously qualified. If the defective link becomes correct again, its qualification continues. If after a minimum time (1000s by default), the link is still correct, it takes again its place in the table of links available for synchronization, moreover, if this link has priority higher than that of the current link, changeover to this link is performed.

4.4.1.3 Selection of the Synchronizing Link in Forced Mode

This mode is used by the operator in charge of synchronizing the communication network, when he/she detects choices of synchronizing-link switching that are not judicious and that may result in uncontrolled drifts. This is the typical case of an SSU synchronizing with another SSU that itself is in "Holdover" mode.

In this mode, this is the operator, who manages, through the PC/SSUWIN, the switching between synchronizing links from the information he/she is provided with. The automatism existing at input links is disabled and replaced with operator controls designating the link used as the synchronization link.

4.4.2 Selection of the Operational INPUT Board

This choice is made by CLOCK module, from the configuration, INPUT board states, and measurement made on CLOCK board input links.

The choice in automatic mode depends on operator-performed parameterizations, priorities: INP or GPS.

For 2 INP boards, choices of INPUT board used depend on:

- The clock validation signal transmitted by INPUT boards,
- The status of each of CLOCK board inputs (presence detection, MTIE/TDEV),
- The priority assigned to INPUT board signals and to GPS channel.

When all the states are correct, the selection is performed on the module with the highest priority.

If the INP board selected as the synchronizing link has a defective status, switching to the second INP board is only performed if the defective status appears for a minimum time (10s fault). The return to priority board is only performed if the status of this board is continuously correct for a minimum time (1000s by default).

4.4.3 Selection of the Master CLOCK Board

4.4.3.1 Master/Slave Switching of CLOCK Modules

On SSU start-up, choosing "Master" module is performed by default automatically and results, on completion of the putting into operational condition phase, in the choice of CLOCK A module.

During operation, the choice can remain automatic or can be forced (either A Master and B Slave, or A Slave and B Master) the operator through the maintenance PC or the supervision station.

4.4.3.2 Selection of Master CLOCK Module in Automatic Mode

In automatic mode, the signal used by distribution (DIST) boards is chosen by a switching implemented on these boards. The selection control is performed on both CLOCK boards simultaneously by a logic module (H/W) for rapidity reasons. This module uses the signals from the other CLOCK module.

As a general rule, if both CLOCK modules are slaved and faultless, CLOCK A module is set as "Master". If the "Master" module is faulty, the selection switches to the other CLOCK module instantaneously, provided that this one is not itself faulty. The return to normal slaving conditions on module A results in switching immediately again to module A in "Master" mode.

4.4.3.3 Selection of Master CLOCK Module in Forced Mode

For maintenance reasons, the user can use CLOCK B module in the place of module A. The operator forces then the selection, using PC/SSUWIN. When the maintenance operation is completed on module A, the operator restores the automatic selection mode.

4.4.4 Slaving of the Local Oscillator

4.4.4.1 Slaving Algorithm

The slaving is of this type: slaving in phase with local oscillator on reference signal whose phase is taken at arbitrary value at slaving beginning. The filtering used in the loop is of self-adaptive type: this is Kalman filtering.

At the algorithm start, a first rapid step enables the oscillator to come close to the reference frequency ("fast mode"). Then, the slaving time constant is set to its nominal value for a precise slaving step ("accurate mode").

It is possible to modify the slaving constants during operation. The nominal constant meeting ETSI standards for SSUs is the 1000 s constant. For reasons of compatibility with the quality of signal transmission lines, it is possible to change this slaving constant, knowing that too long constants will not enable certain oscillator drifts to be taken up, which are due to exterior conditions, of temperature for example.

4.4.4.2 Management of Special Events

If the signal at the input is lost for a short time (less than 10s), the slaving is stopped in "Holdover" mode, and then resumed in its accurate phase after phase calculation restabilization.

In a case of a longer or multiple interrupt, the slaving resumes in fast mode.

On switching of the synchronizing input link, the slaving is stopped momentarily in "Holdover" mode and resumes in accurate mode.

4.4.4.3 Holdover Mode

This SSU operating mode is a degraded mode that occurs when the SSU is in Auto Select mode and is no longer provided with any valid synchronizing link.

In this mode, CLOCK module oscillators are standalone and operate on the last frequency slaving step applied before the changeover to Holdover. In this mode, incoming synchronizing links keep being qualified so as to be able to resume slavings when one of them becomes valid again.

Through an operator's configuration command, Holdover mode can be forced for maintenance reasons.

4.4.5 MTIE/TDEV Measurements

4.4.5.1 Measurement Conditions

Measurements are made on the six input links simultaneously on INPUT board and both INP inputs on CLOCK board. The measurement reference is the slaved local oscillator.

Three points of each of the MTIE and TDEV templates are examined: 10, 100, 1000 s. A result is provided on demand with SSUWin software.

The measurement is effective and the results available only when local "Master" oscillator has changed over to a locked status.

It shall be noted that depending on the tracking time constant, the measurement at 1000 s loses its value since the oscillator is likely to "follow" the reference signal. The phase difference measured between the two signals will thus be decreased with respect to its actual value.

4.4.5.2 Measurement Parameters

The measurement is used to compare the quality of links with a given template. By default, these values represent the template of the figure in ETSI recommendation concerning the tolerance for inputs of synchronization with the wander.

4.5 Management of the SSM Message

4.5.1 Utilization of the SSM message

The SSM message is designed to help right synchronization distribution, considering the quality level of references (PRC, Transit node, Local node, unknown). It is only available on 2048 kbit/s synchronization frames.

The message is composed of 4 bits located in Sa bits (1 from 5: Sa4 to Sa8) of 2 Mbit/s frame G.704. Currently, only channel Sa4 is used.

SSM code	Quality Level
0010	PRC (highest)
0100	SSUT Transit clock
1000	SSUL Local clock
1011	SEC SDH Equipment clock
1111	DNU do not use clock (timing loop situation) or SSM usage disabled
0000	Unknown

Table 4 - 1. Utilization of the SSM message.

The frame of the reference input signal is analyzed and its SSM retrieved on the Sa4 bit. According to the SSU status and to this message, a decision of input selection is made. On the

distribution side, an output SSM message constituted according to the slaving operating status is integrated into the distributed 2048 kbit/s output frame.

4.5.2 Review of Received SSM Messages

The received SSM indicates the quality of the synchronization source. It is used to select the input link used as the reference.

If an input link is enabled and present, and if its SSM messages shows a quality level higher or equal to the programmed minimum threshold, it can be selected as a reference link. The priority level decides in case there are two links available.

If an input link is enabled and present, but if its SSM message shows a quality level below the programmed minimum threshold, an alarm is activated on that link and it cannot be selected as a reference link.

The operator has the choice to include or not the SSM into the link alarm and selection criteria.

The SSM corresponding to the selected link is transmitted to CLOCK board for constitution of the issued SSM. The SSM transmitted to CLOCK board is that of the selected incoming 2 Mbit/s link or SSM=0000 (quality unknown) if this is a link of clock at 2048 kHz.

N.B. The Unknown code should not be used in the new synchronisation networks. If the threshold is set to "Unknown", only the "Unknown" SSM link will be accepted as a selectable link.

4.5.3 Constitution of the Distributed SSM Message

This are the rules applied for constituting the SSM contained in distributed 2 Mbit/s signal (into the Sa4 frame bit).

- If the distributed signal is coming from a 2048 kbit/s reference signal to which the output is slaved, the signal SSM is copied as such;
- If the distributed signal is coming from a 2048 kHz reference signal to which the output is slaved, quality code SSM "Transit Node" is issued;
- When the signal comes from a GPS reference or a 10 MHz signal, the SSM assumes the value of PRC quality;
- During transient "Warm-Up" phases, the SSM assumes the value of "Do Not Use" quality;
- During Holdover phase or "Tracking Search" phase, the SSM assumes "Transit Node" quality level if the oscillator is Rubidium, and "Unknown" after 24 hours. If other types of oscillator are used (OCXO), the SSM assumes "Local Node" quality level, and "Unknown" after an hour.

4.6 MANAGEMENT OF 2048 kbit/s FRAMES G.704

4.6.1 Received Frames

If the Frame Alignment detection is in a locked state, the clock extracted from the data stream is used as a possible synchronizing source.

The SSM message is decoded at this level and is used, if necessary, for selecting the reference link.

4.6.2 Transmitted Frames

The received data stream is looped back to the same B1 or B2 connector. As a physical loop-back, the frame content is unchanged. If no signal is present at the input, nothing is transmitted back.

4.6.3 Output Distributed Frames

The Output distributed frames are built with the Frame Alignment pattern with CRC4 and an idle content (0B in hexadecimal) on the other slots. The SSM message is inserted into the odd framing pattern slots, in the Sa4 bit.

4.7 Hot-Plugging/Extraction

During maintenance operations, boards can be hot extracted with minimum disturbance to output signal.

If the INPUT module processing the input signal is extracted, CLOCK board changes over to "Holdover" mode for a few seconds, the time to switch to the other INPUT board. However, it is preferable, with SSUWIN software (on control PC) to force the selection mode for INPUT module to "Forced B Input" before performing extraction. Restore automatic mode after extraction.

CAUTION: *As the Master CLOCK board provides the synchronization signal to the distribution, it must NOT be extracted abruptly. A command from SSUWIN software (on PC) shall previously force it to "Slave" mode, and the other module to "Master", and thus discharges it from its function. Else, the distributed signal is likely to be subjected to cuts of several periods.*

5 SSUWIN Maintenance Software

5.1 Operating Environment

The SSUWIN software is designed to dialogue with the SSU, locally from a PC connected via an Ethernet 10 Base T link, with **crossed** RJ45 cable.

It is then possible to reread an SSU configuration, modify it, and follow up the operating status of modules with respect to input links.

The software is executable on PC fitted with Windows OS (NT, 2000, XP) and Ethernet 10 Base T-RJ45 interface.

The PC will communicate with the SSU if IP addresses declared on each side are compatible, i.e. they belong to the same sub-network. So, check that the combination of the IP address of the PC and SSU and the corresponding mask gives the same sub-network address.

5.2 Installation AND START-UP

5.2.1 PC Connection with the SSU

The PC shall have an Ethernet 10 Base T interface.

To connect the PC directly with the SSU, use a crossed RJ45 cable of good quality (shielded cable is preferable).

It is also possible to connect the SSU to a local area network through a straight RJ45 cable, provided that IP addresses are programmed adequately on the SSU and on the PC.

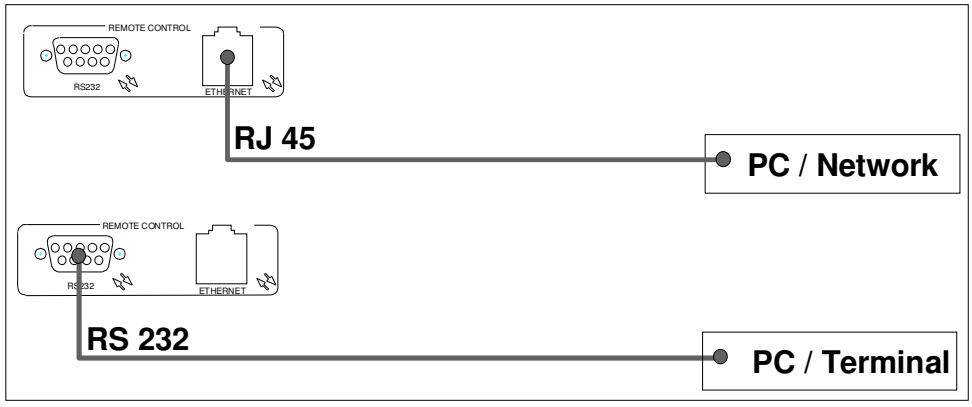


Figure 5 - 1. EPSILON SSU / PC or Terminal Connections

The SSU/PC serial RS232 cable is a straight 9-point cable.

The RS232 serial link is necessary to program the IP parameters of the SSU (see paragraph 5.2.3 and 5.2.4).

The RJ 45 link is necessary to control the SSU from a PC running the SSUWIN software.

5.2.2 Installation of SSUWIN Software in PC

Before upgrading SSUWIN, it is advised to uninstall the previous version under Windows OS.

The software is available on SSUWIN CD-ROM.

Insert the CD (autorun mode) or run SETUP.EXE program and follow instructions for a standard installation.

By default, EPSYNC Manager is installed in c:\Programfiles\Tekelec Systemes\SSUWin.

Start then SSUWIN program through the shortcut.

5.2.3 Default SSU IP Addresses

When outgoing factory, the SSU is configured with an IP address x.y.z.w that was used for testing and mask 255.255.255.0. It recognizes an address at sub-network address x.y.z.0.

For PC / SSU dialogue to be possible, two methods can be used:

- either the PC IP address is changed to match the SSU IP address with Windows tools (configuration Panel -> Network -> TCP/IP -> Properties), giving it an address of the same sub-network (same first 3 numbers and different fourth number).
- or the SSU IP address is changed with its utility through the RS232 serial link in order to dialogue directly with the PC. This address should form part of the same sub-network as the PC. The procedure is detailed in the paragraph below.

In both cases, the SSU IP address must be typed in the PC (SSUWIN) with <Setup>Network> menu of SSUWIN.

5.2.4 Changing IP Network and Configuration Paramaters in the SSU

5.2.4.1 Implementation of the SSU Configuration

When you want to change IP addresses in the SSU and its correspondents, a special utility contained in the SSU provides the means.

In order to activate this utility, connect a VT100 compatible terminal (U.S. characters) or a PC emulating a terminal (with Hyperterminal program for example), to RS232 serial link located on SSU front panel on the left of the RJ45.

On the SSU side, a connection program continuously active will recognize the TTY serial connection and a login prompt will be displayed on the terminal screen.

Answer:

```
>login : ssu

>password : manager
```

The programming utility for IP addresses starts automatically.

The matter is then to answer the questions use to change SSU IP addresses and allowed destination addresses.

Several text menus are to be browsed to establish the various network addressees the SSU must know.

Keys to be used are as follows:

- Up and down arrows to select the operation to be performed.
- Tabulation to change over from a field to be validated to another.
- Return to <OK> or entry field to validate the operation.
- Return to <Cancel> to exit the current menu.
- Space to tick lines during multiple selections.
- Uppercase and lower alphanumeric characters (case sensitive) and "_" allowed, for entry of network and machine names.

5.2.4.2 Menu: "Configuring the SSU"

Select the operation with up and down arrows. Return to <OK> to start the operation. Return to <Cancel> to exit the program.

NOTE: Changes will only be taken into account when "Applying modifications" operation is executed.

5.2.4.2.1 Menu: "Setting the SSU Parameters"

Enter the name of the machine seen by the network (see allowed characters, above).

Enter the date and local time.

5.2.4.2.2 Menu: "Configuring the Network Access"

IP addresses and names in the network will be entered in these menus.

5.2.4.2.3 Menu: "IP Parameters Setting"

This menu edits the SSU IP address, corresponding mask, subnetwork address, broadcast address and default gateway address.

In the case of a direct SSU connection with a PC, mandatory fields are the IP address, mask and subnetwork address.

In the case of a connection via network and if the PC is not on the same sub-network, the default gateway address is essential to access the PC (unless the path is shown in the routing table below).

5.2.4.2.4 Menu: "DNS Configuration"

Optional utilization of the function, if the network is equipped consequently.

In such a case, enter the address of the name server provided by the network administrator.

Parameters not used in direct connection with PC.

5.2.4.2.5 Menu: "Host Table Definition"

Optional.

This table is used to establish the correspondence between mnemonics and addresses of machines in the network. It facilitates the establishment of the routing table by handling the mnemonics of routers / gateways in the place of their digital addresses.

5.2.4.2.6 Menu : "Defining the Network Name Table"

Optional.

This table is used to establish the correspondence between mnemonics and network addresses. It facilitates the establishment of the routing table by handling the mnemonics of networks in the place of their digital addresses.

5.2.4.2.7 Menu: "Defining the Routing Table"

Optional.

This table is used to establish the first transit address of packets according to their final destination.

The network to be reached is entered first, and then the address of the router located on the same network as the SSU enabling it to be accessed. The "metric" parameter evaluates the route in number of hops (0 means undetermined). The type of router should be set to "passive" in the case of a simple router without routing daemon, to "active" if routing protocol daemons are activated, to "external" if the router is connected to Internet. In case of doubt, it is preferable to program the mode to "passive".

5.2.4.2.8 Menu: "Doing a Ping"

After applying changes, it is possible to test a connection with a ping at an address to be entered.

5.2.4.2.9 Menu : "Determining the Network Path"

Display transit nodes to reach the entered destination address.

5.2.4.2.10 Menu: Active Routing Table

Summarize the addresses of intermediate gateways enabling final-destination addresses to be reached.

5.2.4.2.11 Menu: "List the Modifications"

Before applying changes, it is possible to make sure of them by rereading the items.

5.2.4.2.12 Menu: "Applying the Modifications"

Must be done before performing a ping and before exiting the program.

5.2.4.2.13 Menu: "Cancel the Modifications"

Run this function in case of error in the modifications.

5.2.4.2.14 Menu: "Retrieving Previous Config"

After applying the modifications, in case of error, it is possible to go back to the original parameters.

5.3 <File> Menu

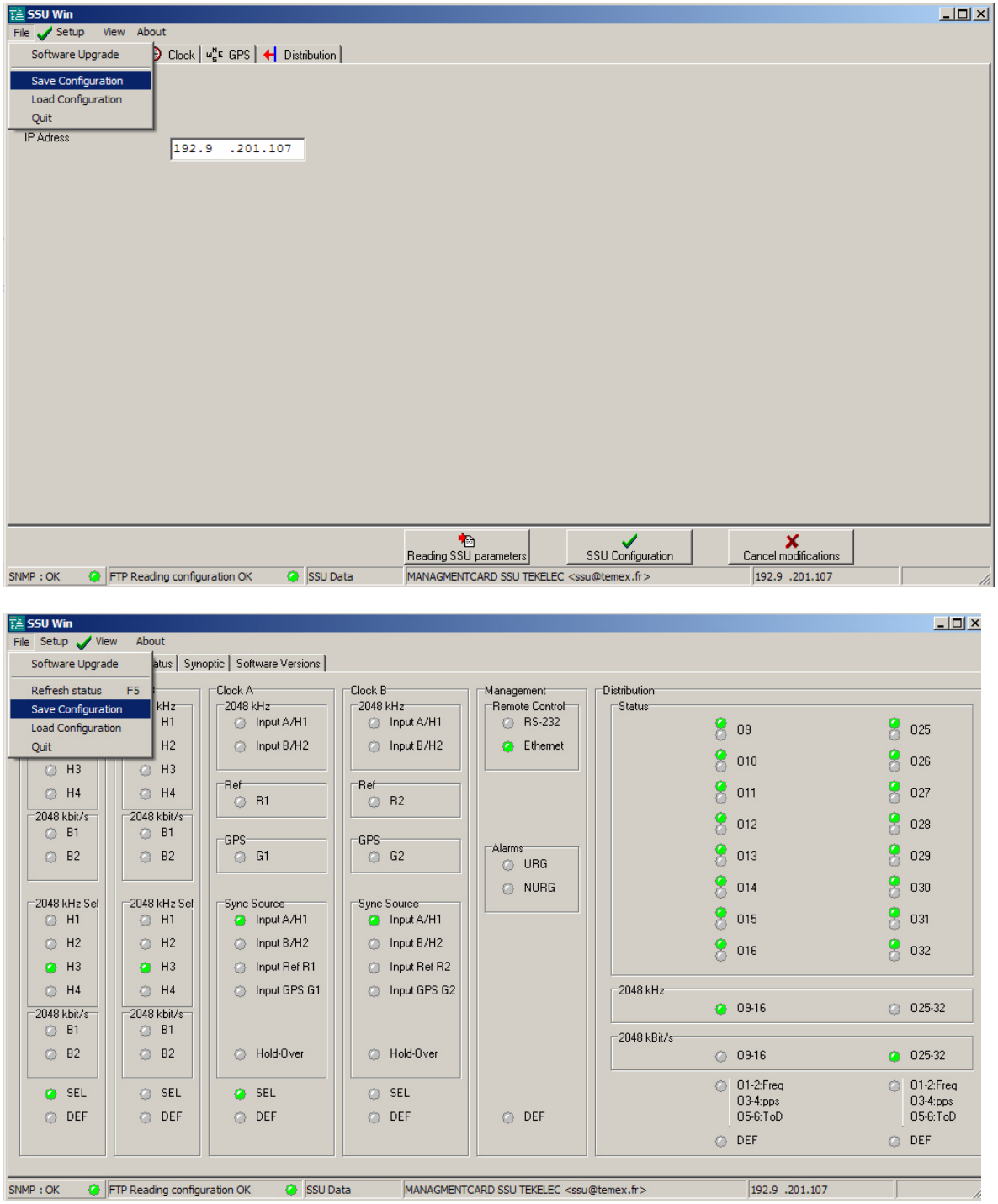


Figure 5 - 2. File Menu.

File menu allows accesses to following functions:

- Software upgrading.
- Status refreshing F5.
- Configuration saving.
- Configuration loading.

5.3.1 Saving or Loading the Configuration

SSU configurations are stored in the PC under ".cfg" extension files.

When you want to save an SSU configuration you are editing in <Configuration> menu, execute "Save Configuration" command. Choose the file name.

When you want to retrieve a saved configuration, execute "Load Configuration" command. You can then edit it and program the SSU with this configuration in <Configuration> menu.

When you quit SSUWIN program, and in order to prevent the current configuration from being lost, the program proposes the operator to save the configuration in a file.

5.3.2 Status Refreshing "F5"

Available only in "View" menu, typing "F5" key produces a refresh of the detailed SSU status displayed in this menu. It only accelerates the regular scanning of the status (about every minute).

In the "Setup" menu, "F5" key has no effect. Instead, upload the parameters of the SSU by clickink on the "Reading SSU parameters" button.

5.3.3 Software Upgrade

A new software version of any ssu module (Input, Clock, Management) is upgraded with the "Software Upgrade" function of the "File" menu.

Upgrading a software is done in several steps.

When available for upgrade, the new release is copied in any chosen directory of the PC running SSUWin. Its extension is always ".tgz".

Then, the SSU operator can decide to download the files into the SSU. Downloading does not interrupt the ongoing synchronization of the SSU. The release file is just stored in the Management Module waiting to be activated. The activation will take place at the next reset of the board to be upgraded.

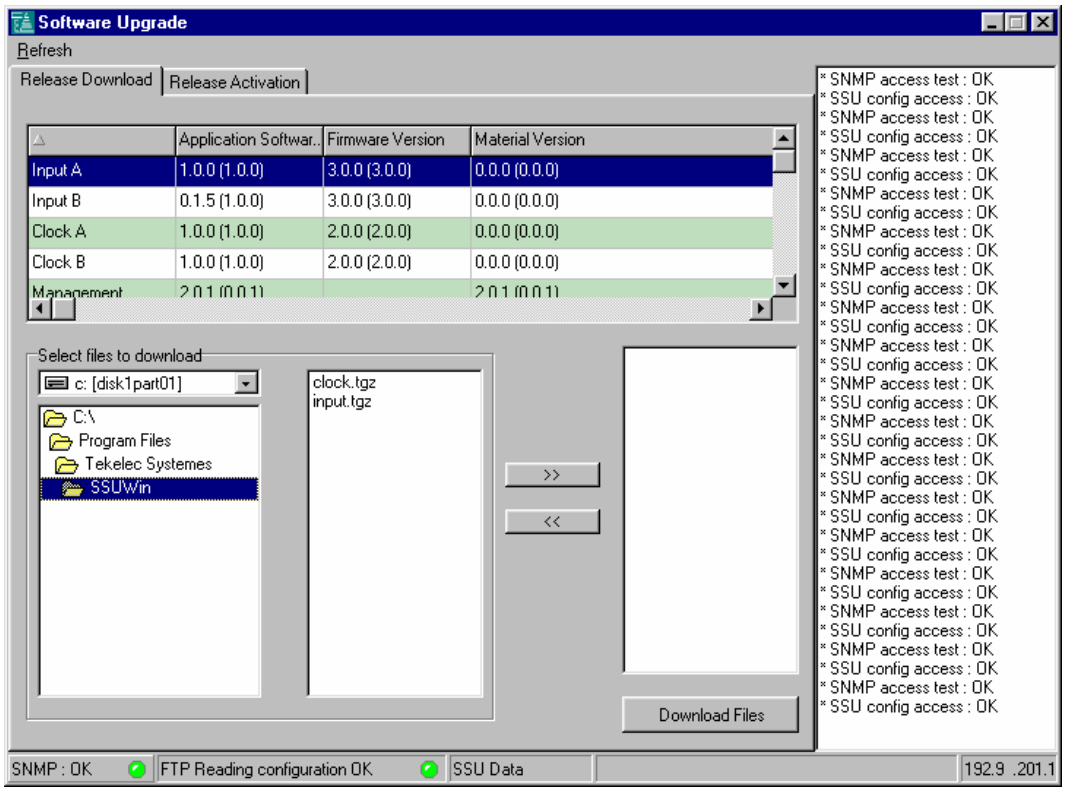


Figure 5 - 3. Release Download Menu.

Choose the "Release Download" menu. The files directory will be selected in the "Select files to download" window. Then click on the files to be downloaded and pass them into the right windown with the ">>" button. To delete a file from the list, click on the "<<" button.

To start downloading, click on the "Download Files" button. Follow the status in the rightmost window.

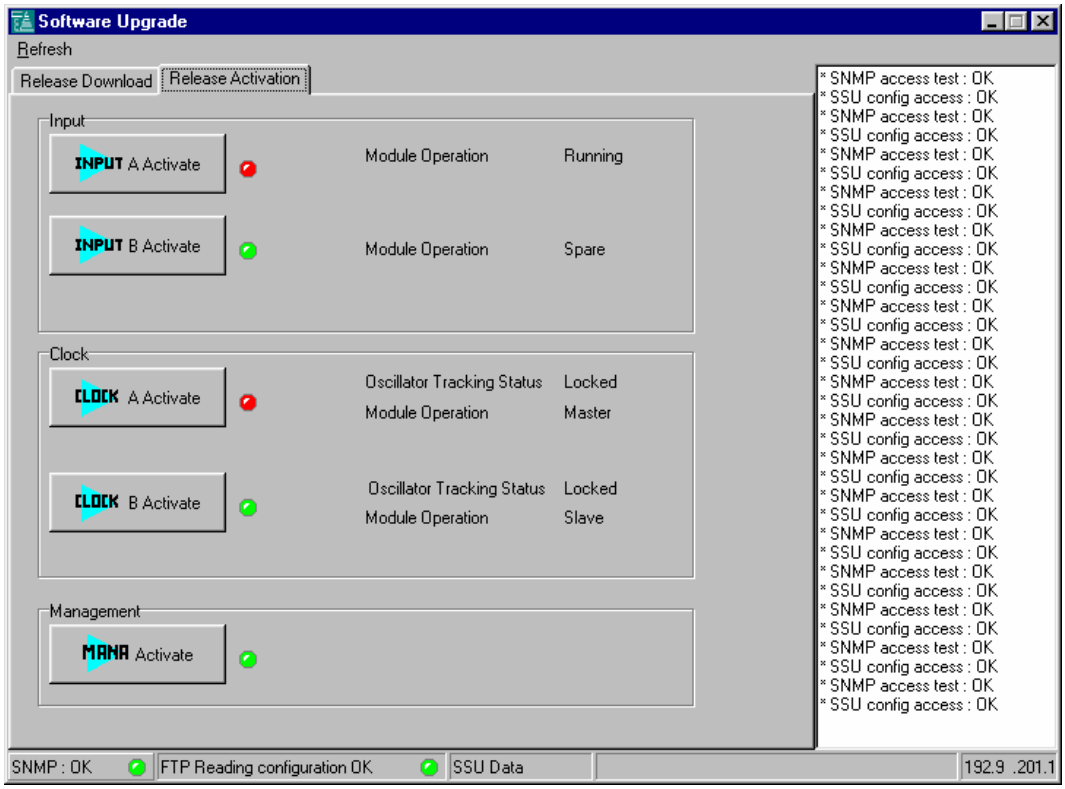


Figure 5 - 4. Release Activation Menu.

Choose the "Release Activation" menu to activate the downloaded version. Actually a new version replaces a running version when the card is reset. The Management Module reload the new version and start the software.

You must be carefull not to reset the Master Clock Module for a release. Instead, force the Master Clock to Slave in the "Set Up" menu, make the "Release Activation" operation and program back the Master/Slave Mode to "Automatic" for a normal state.

In this "Release Activation" screen, the "Activate" button starts the reset of the corresponding module. The led on the right give an indication about the safety of the procedure. A green light means "go". A red light means "not safe". On the right of the led, the current module operation give the reason why it may or may not be safe to activate the reset.

In a fully equipped SSU, the Input B Module (Spare) and the Clock B Module (Slave) and the Management Module should show a green light and can be reset (one after the other). Once this release is done, use the "Set Up>Clock" menu to program the Master/Slave mode to Master for the Clock B module and Slave for the Clock A module. And use the "Set Up>Input" menu to program the Module Selection Mode to "Input B running, Input A Spare". Click on the "SSU Configuration" button to program the SSU.

Then going back to the "Release Activation", wait for the green light to be on and click the "Activate" button for Input A and Clock A modules (one after the other).

5.4 <Setup> MENU

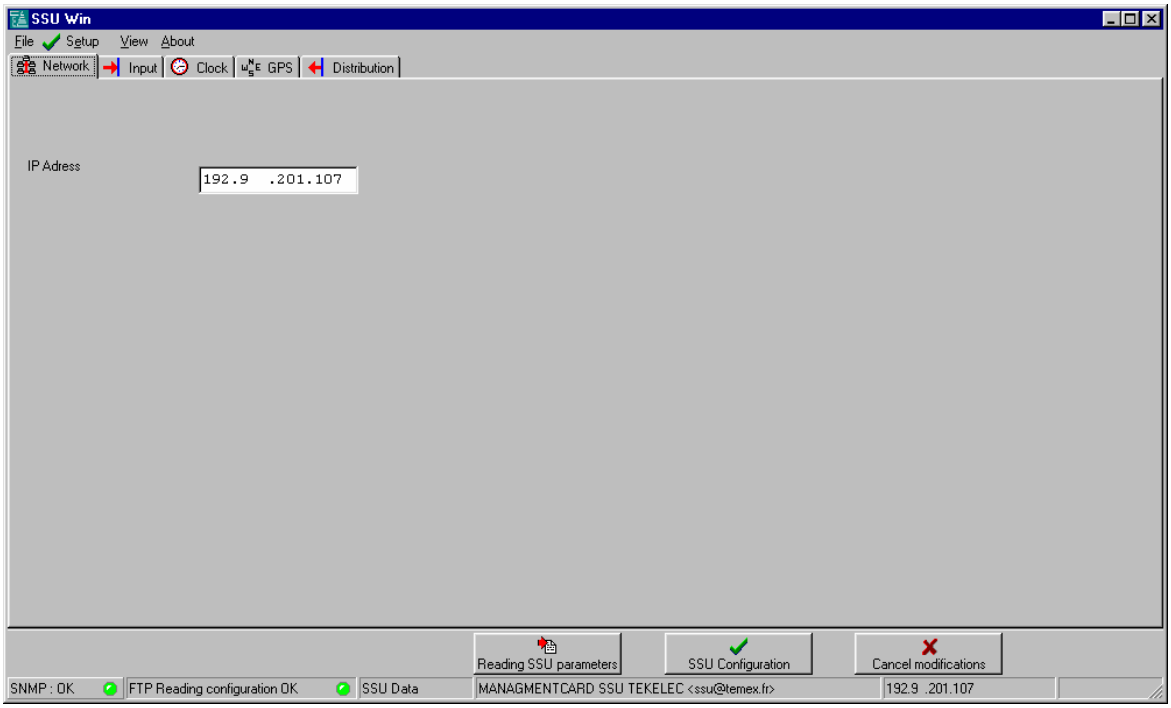


Figure 5 - 5. Setup Menu.

Setup menu provide accesses to the following submenus:

- Setup Network.
- Setup Input.
- Setup Clock.
- Setup GPS.
- Setup Distribution.

5.4.1 Functions of the Menu

All the SSU operating parameters can be changed from this menu. They concern the internal operating modes of the modules and the SSU behaviour with respect to synchronization links.

Dialogues with SSU are performed in the form of SNMP exchanges or FTP files. A status bar located at screen bottom provides diagnostics on current exchanges.

NOTE: The configuration of modules displayed on the screen is a configuration currently being edited, which is not sent to the SSU from modification.

The displayed configuration is actually sent to the SSU by clicking "Configure SSU" button at screen bottom.

It is possible to retrieve a configuration to be edited either through <File> menu, from a saved configuration, or by clicking on "Reading SSU States" button from the connected SSU. In the latter case, configuration parameters and states are fed back simultaneously. Key F5 is not active.

At program start, a default configuration is loaded, but not that of the connected SSU.

5.4.2 <Setup >Network> Submenu

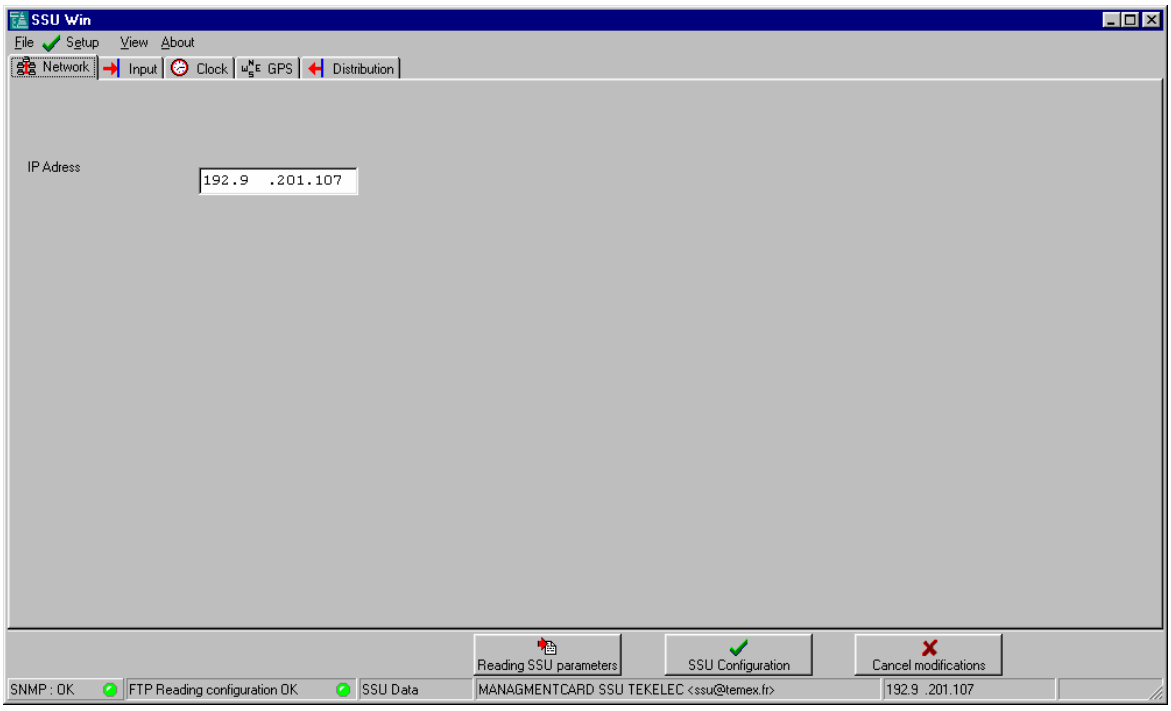


Figure 5 - 6. Network Menu.

Network menu provides accesses to the following parameter:

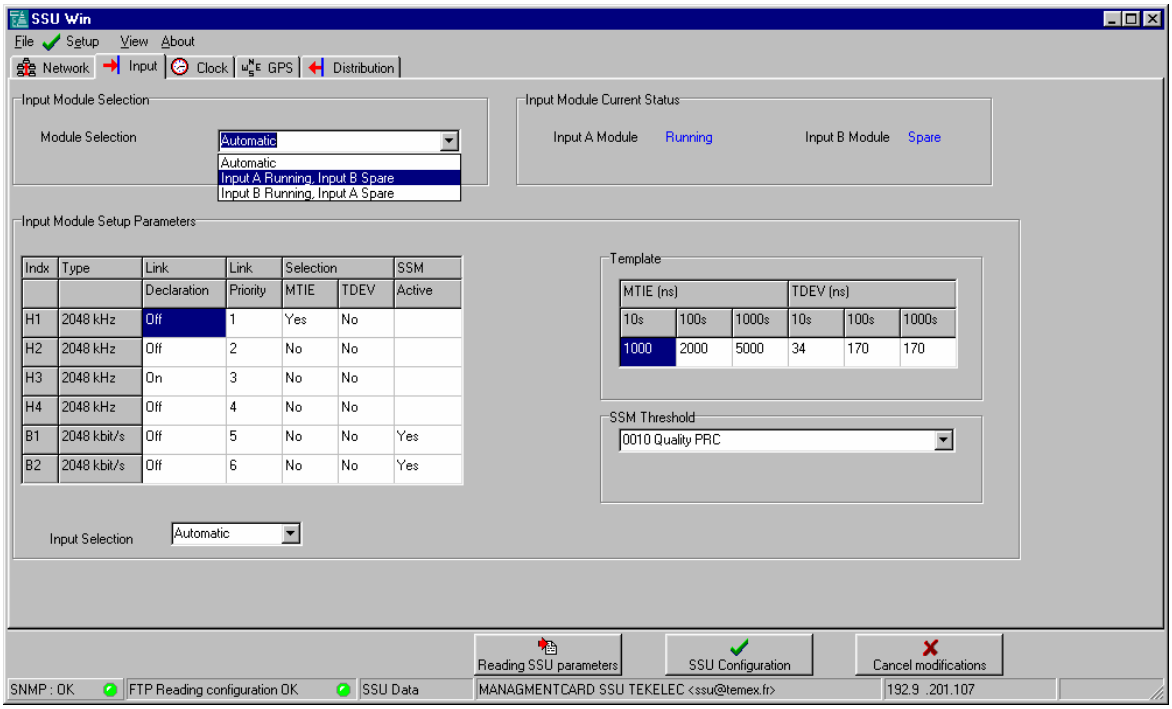
- IP Address.
- SSU Parameters.
- SSU Configuration.

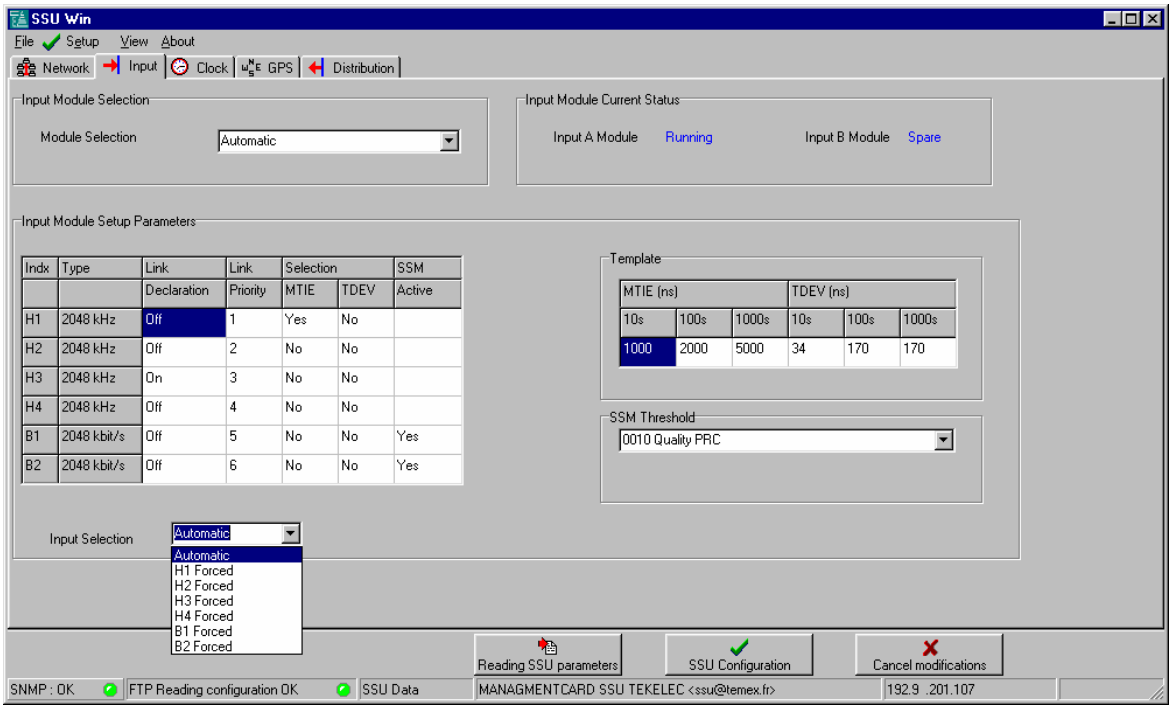
In order to access SSU, it is first indispensable to enter its IP address. Once the IP address has been entered (press <Enter>), a connection is attempted with SNMP protocol. The connection is displayed in the lower left corner of the screen (SNMP OK or ERR or NOT SSU in case the equipment responding at this address is not an SSU).

Pressing "Reading SSU parameters" button upload the configuration parameters of the SSU to be edited.

Pressing "SSU Configuration" button transmits the module configuration information to the SSU.

5.4.3 <Setup >Input> Submenu





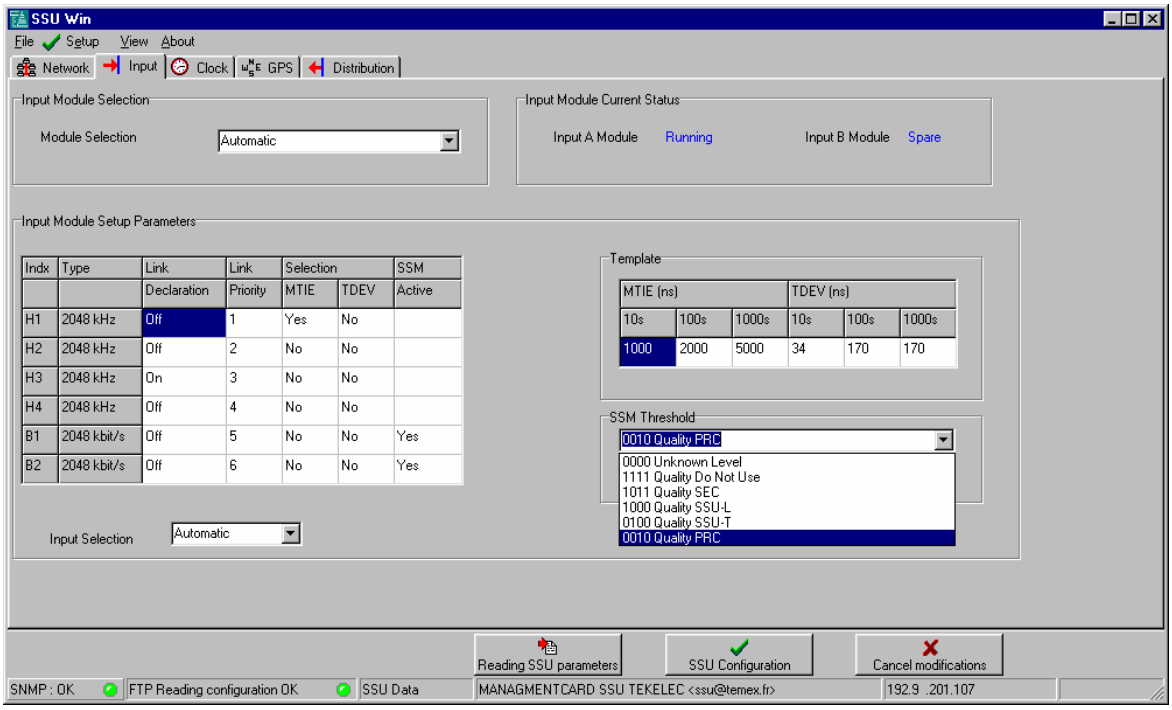


Figure 5 - 7. Input Setup Menu.

Input menu provides accesses to the following parameters:

- Module Selection.
- Input Link Selection.
- Link Declaration.
- Link Priority.
- MTIE/TDEV selection criteria.
- MTIE/TDEV Template.
- SSM Threshold Selection criteria.

INPUT board detects the available reference synchronization links, selects one to provide it to CLOCK boards.

Programmed choices concern the input module receiving the synchronization links and characterizing them.

Click on the drop down box with the left button to modify the parameters.

"Module Selection" frame defines the selection mode for the active INPUT board (A or B):

- automatically (A has priority if everything operates correctly),
- INPUT A board forcing or INPUT B board forcing (on the occasion of maintenance operation for example).

The function is to used in particular to replace or to software upgrade INPUT A board.

"Input Module Current Status " recalls which INPUT provides the synchronization reference to CLOCK boards. "Running" board provides the signal and "Spare" board is available in case the first is failing. By default, the A board is in "Running".

"Input Selection " frame defines the selection mode for synchronization links:

- Automatically according to presence, priority, and MTIE/TDEV and SSM criteria declared in "INPUT board configuration parameters" table;
- Forcing for each of the links (4 links at 2048 kHz, and 2 at 2048 kbit/s).

Among configuration parameters, it is necessary to edit:

- "Link Declaration " column indicating that the input link is part of the choices possible in the selection of the synchronizing link in "On" case; if the box is at "Off", the link is not envisaged as the synchronization source;
- "Link Priority" indicates the priority level of each of the links, 1 being the highest priority. Priorities are exclusive, as each of the links has a priority different from the others;
- "Selection MTIE/TDEV" columns indicate whether MTIE/TDEV measurements made on input links are taken into account to select the synchronizing link;
- "SSM Active" column indicates whether the SSM code carried by the frame of 2048 kbit/s input links is a selection criterion for links;
- "Template MTIE/TDEV" frame gives the values of comparison threshold for taking into account input links from declared links if the relevant boxes in "MTIE/TDEV measurements" columns are at "YES". Values are not programmable for the moment;
- "SSM Threshold" frame gives the minimum SSM code to be observed for the 2048 kbit/s link to be selectable;

NOTE: The frame G.704 uses the bit Sa4 of odd IT0 Time Slot to convey the SSM message. It is frozen at Sa4 for the moment and is not programmable.

5.4.4 <Setup >Clock> Submenu

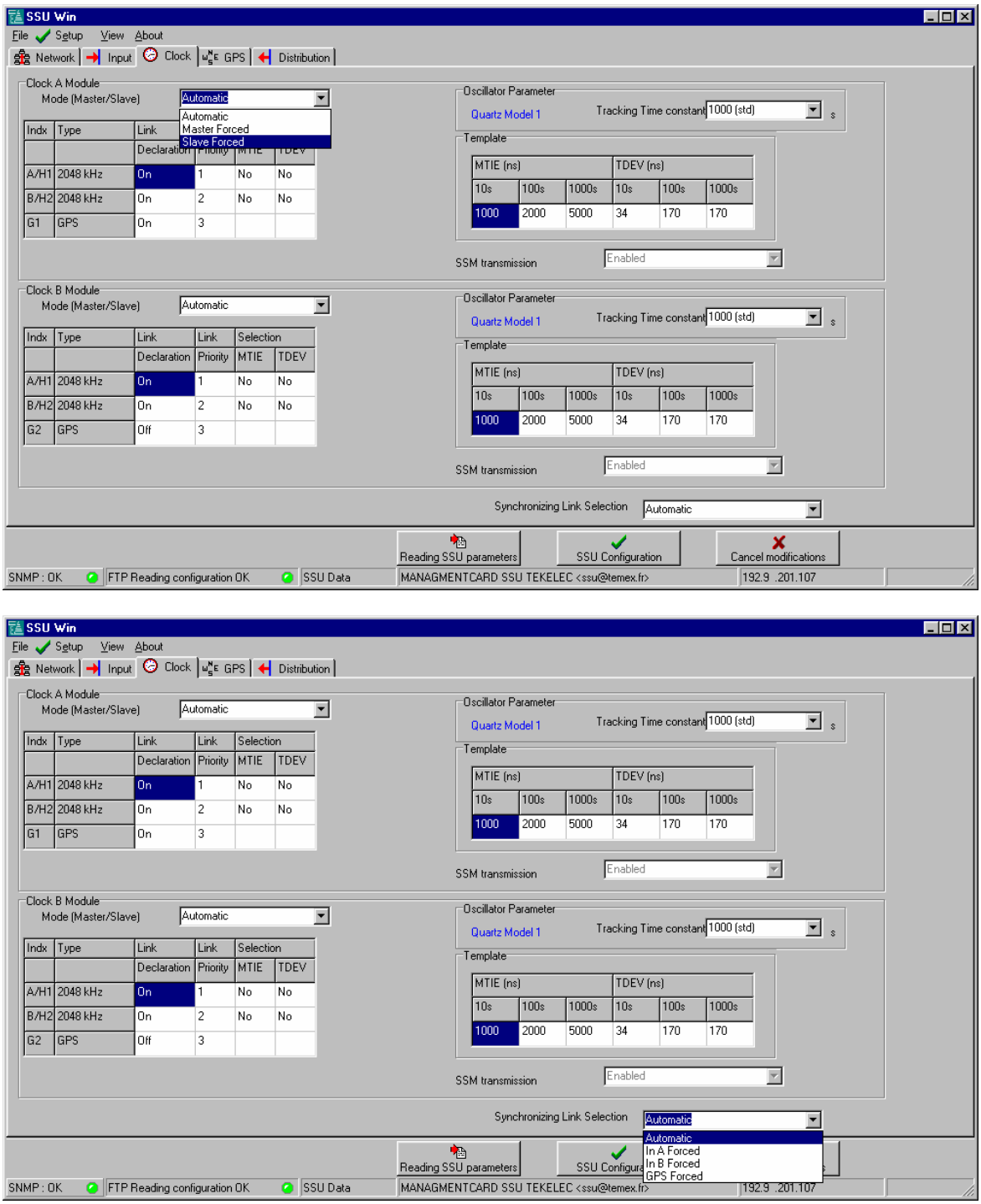


Figure 5 - 8. Clock Setup Menu.

The Clock menu provides accesses to the following parameters:

- Master/Slave Selection Mode.
- Synchronization Link Selection Mode.
- Link Declaration.
- MTIE/TDEV Measurements.
- MTIE/TDEV Template.
- Tracking Time Constant.

CLOCK board receives the reference synchronization link used to synchronize its internal oscillator.

"Mode (Master/Slave)" field is used to program the CLOCK board selection mode providing the clock to be distributed:

- Automatic (with priority on CLOCK A board),
- "Master Forced" (so, B Slave) or "Slave Forced " (so, B Master).

The function is to used in particular to replace or to software upgrade CLOCK A board.

"Synchronizing Link Selection" frame programs the selection between INPUT A, INPUT B, GPS:

- Automatic (depending on alarms, priorities and MTIE/TDEV measures),
- "Forced INPUT A" or INPUT B or GPS.

In normal operation, leave in "automatic".

Among configuration parameters, it is necessary to edit:

- "Link Declaration " column indicating that the input link is part of the choices possible in selecting the synchronizing link;
- "Link Priority" indicates the priority level of each of the links. Priorities are exclusive, as each of the links has a priority different from the others, 1 being the highest priority;
- Selection MTIE/TDEV" columns indicate whether MTIE/TDEV measurements made on input links are taken into account to select the synchronizing link;
- "Template MTIE/TDEV" frame gives the values of comparison threshold for taking into account input links from the selected ones;
- "Oscillator Parameter" frame is used to program the slaving time constant for the local oscillator. And recalls the type of oscillator available on CLOCK boards.

5.4.5 <Setup >GPS> Submenu

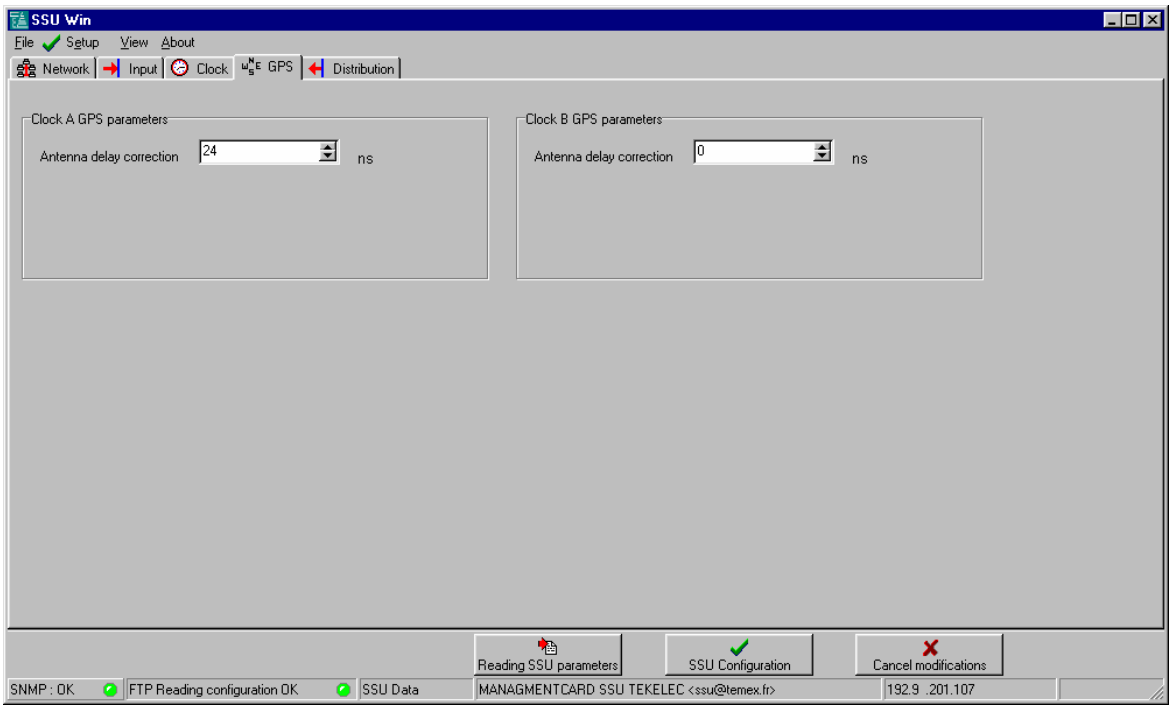


Figure 5 - 9. GPS Setup Menu.

GPS menu provides accesses to the following parameters:

- Value of the correction of antenna propagation delay in ns.

A single parameter is to be programmed: this is a deviation expressed in ns to be applied a priori to slaving calculations in order to compensate for the signal delay between antenna and SSU input.

Used when the absolute phase of output signal is important (1PPS signal).

5.4.6 <Setup >Distribution> Submenu

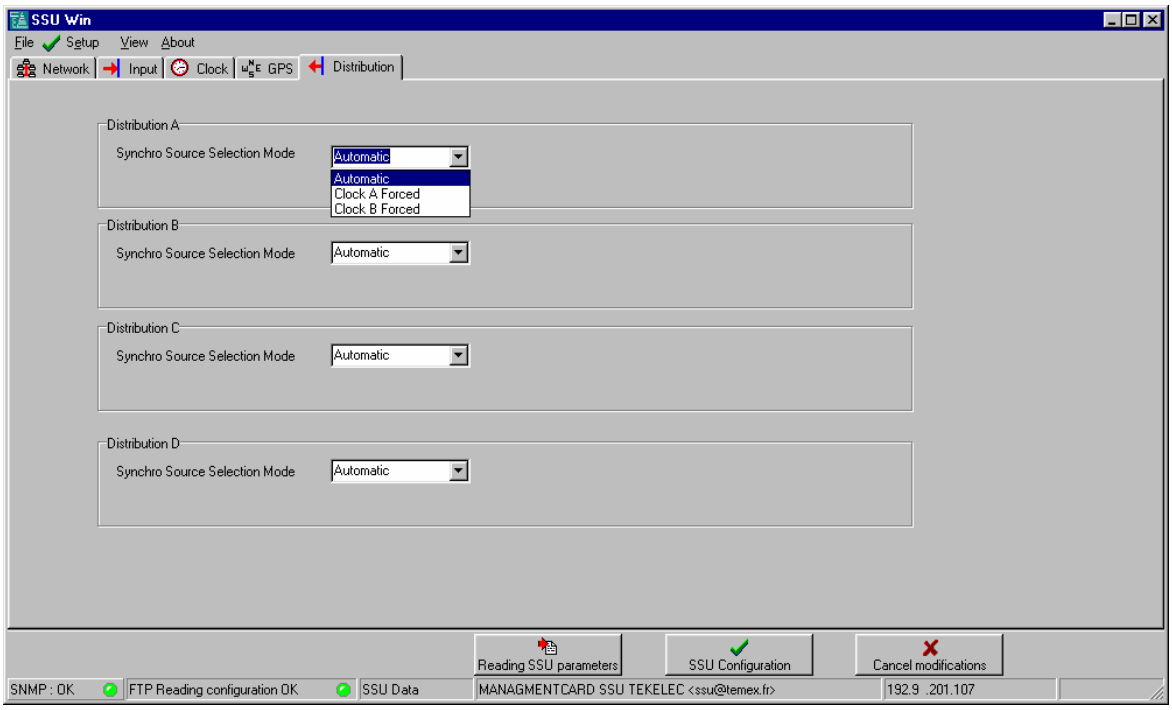


Figure 5 - 10. Distribution Setup Menu.

Distribution menu provides accesses to the following parameters:

- Sync Source Selection Mode.

DISTRIBUTION board makes 8 copies of the 2048 kHz or 2048 kbit/s output signals provided by a CLOCK board. Then, output signals are distributed to SubD connectors on front panel.

A parameter is used, in special maintenance case, to force the synchronization source selection for the DISTRIBUTION board.

In normal case of operation, leave the operation in "Automatic". "CLOCK A Forced " or "CLOCK B Forced " states are to be used for special tests but they do not assure that the Master CLOCK board provides the synchronization signal.

5.5 <View> MENU

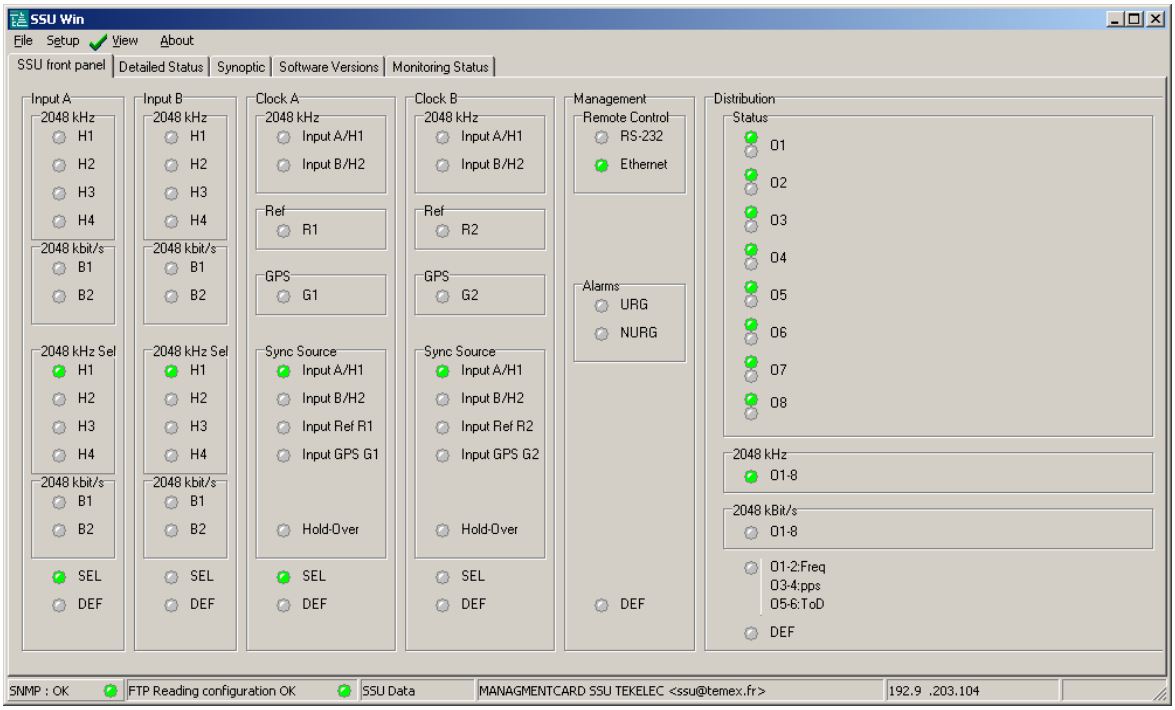


Figure 5 - 11. View SSU Front Panel Menu.

The View menu provides access to the following information:

- SSU Front Panel.
- Status Input.
- Status Clock.
- Status GPS.
- Status Distribution.
- Synoptical.
- Software versions.

5.5.1 Functions of the <View> Menu

In this menu, the SSU remote image and current status are displayed with refresh time of one minute.

Immediate refresh may be required by pressing key F5 (rereading SSU states).

5.5.2 <View >SSU Front Panel> Submenu

The actual status of LEDs is displayed on this image of the SSU.

5.5.3 <View >Detailed Status> Submenu

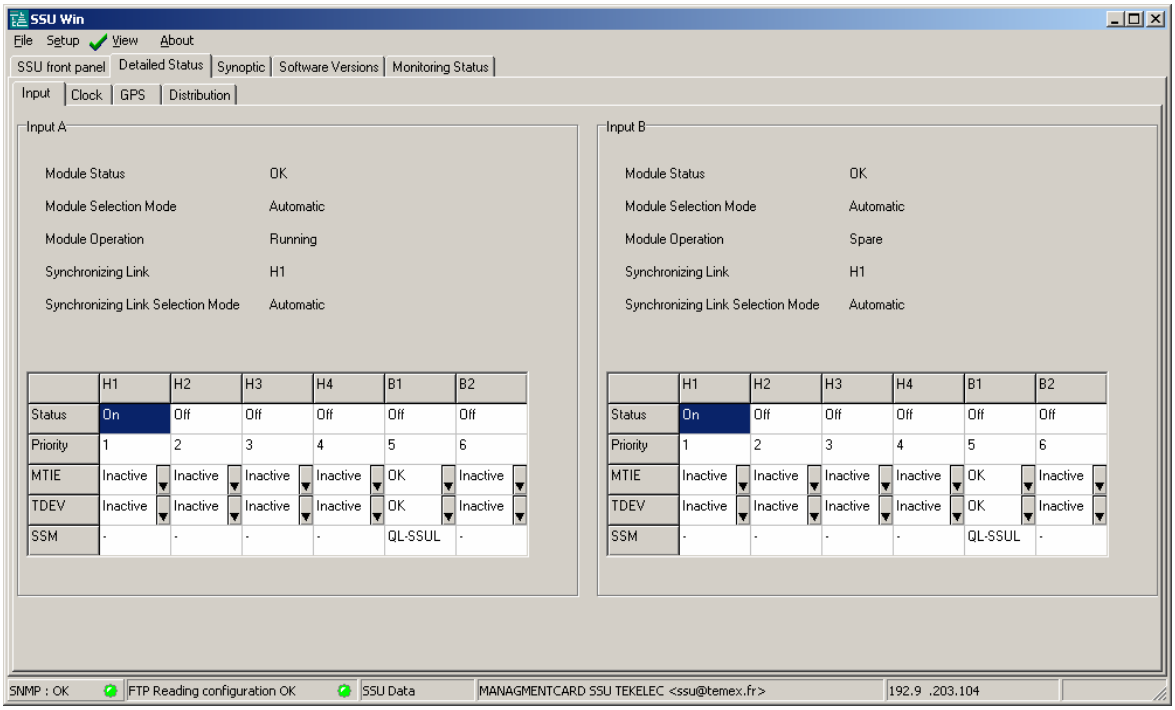


Figure 5 - 12. View Detailed Status Menu.

View status menu provides accesses to the following informations:

- View Status INPUT.
- View Status CLOCK.
- View Status DISTRIBUTION.
- View Status GPS.

For each module, the reread SSU configuration is displayed, and also the states, selections and measurement results in the form of tables.

For each module, the "Module Status" indicator takes up the indication on front panel "Default" LED. When it reads OK on every module, the synchronization on a reference signal and the distribution are performed.

5.5.3.1 <View >Detailed Status>INPUT> Submenu

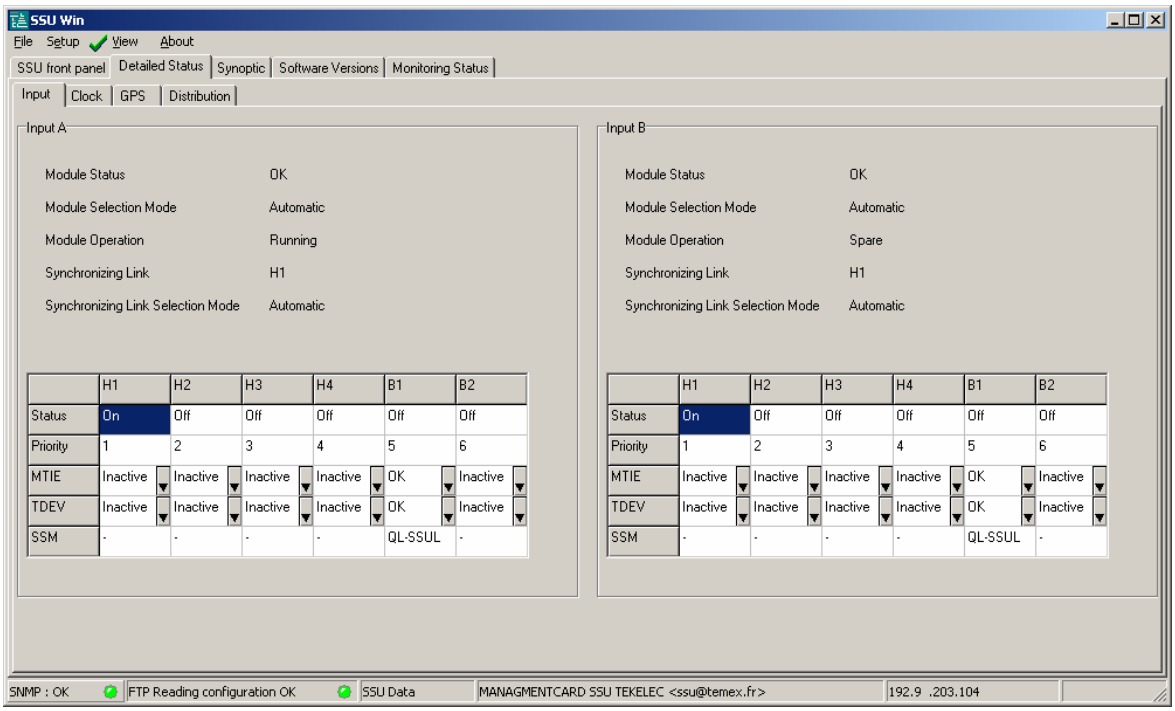


Figure 5 - 13. View Input Status Submenu.

The indicators below recall the board configuration parameters.

- "Module Selection Mode" indicates whether "Running/Spare" selection between INPUT A or B module is automatic or forced;
- "Module Operation" indicates that INPUT module is effectively in "Running" or "Spare" status;
- "Synchronizing Link" indicates the synchronizing link source: H1/H2/H3/H4/B1/B2;
- "Synchronizing Link Selection Mode" indicates automatic or forced selection mode for INPUT module input links.

The table groups together the states and parameters concerning each link: input alarm, priority, taking into account or not the MTIE and TDEV and SSM for the automatic link selection.

Moreover, by clicking on down arrow in MTIE/TDEV boxes, a table of current measurement results is displayed.

The SSM value displayed in the B1 and B2 columns are the minimum SSM threshold qualifying a link for selection when the function is activated.

Status take up the alarm and link selection information available on front-panel LEDs.

5.5.3.2 <View >Status>CLOCK> Submenu

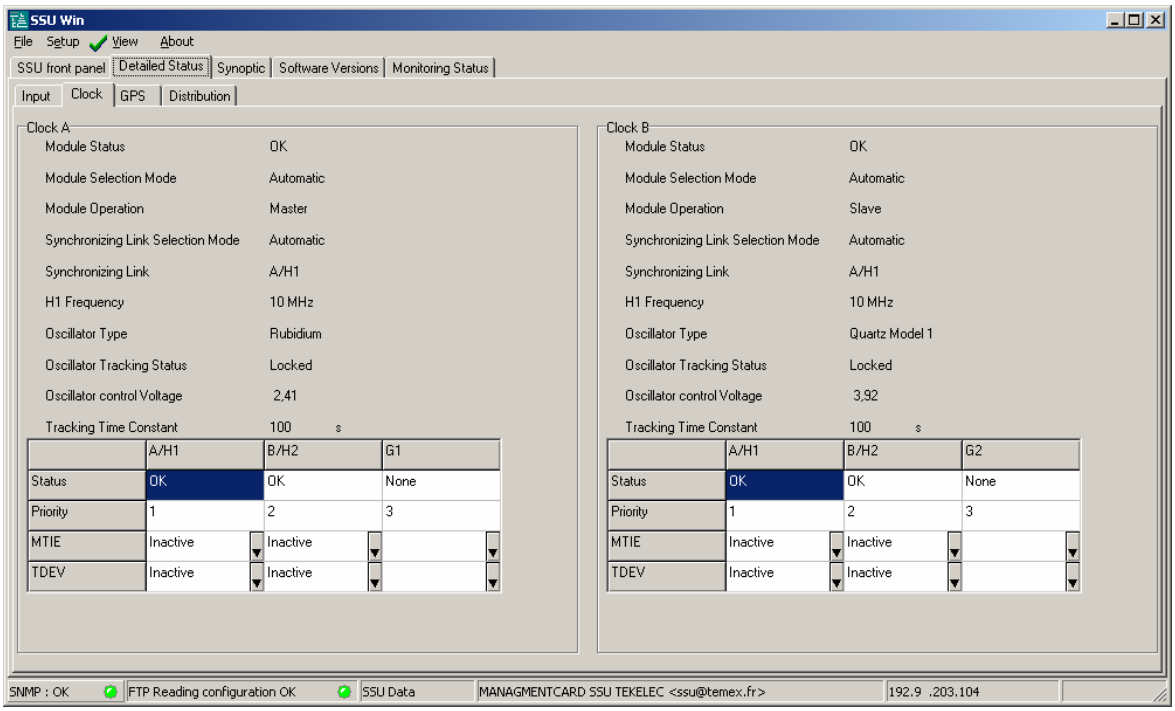


Figure 5 - 14. View Clock Status Submenu.

The indicators below recall the board configuration parameters.

- "Module Selection Mode" indicates whether "Master/Slave" selection between CLOCK A or B module is automatic or forced;
- "Module Operation" indicates that CLOCK module is effectively in "Master" or "Slave" status;
- "Synchronizing Link" indicates the synchronizing link source: INPUT A/H1 or INPUT B/H2 or GPS;
- "Synchronizing Link Selection Mode" indicates automatic or forced selection mode for CLOCK module input links;
- "H1 Frequency": in the case of an SSU configuration without INPUT board, indicates the type of direct input used by channel A 2048 kHz by H1 or 10 MHz by R1 (or R2) on the CLOCK module;
- "Oscillator Type": indicates whether the local oscillator is a Standard Quartz oscillator (OCXO model 1) or Double-oven quartz oscillator (OCXO model 2) or Rubidium type;
- "Oscillator Tracking Status" indicates the slaving status: "Holdover" or "Tracking Search" or "Locked".
- "Oscillator Control Voltage" gives the current control voltage of the local oscillator. The value lies between 0 and 10 Volts. At the beginning of the life of oscillators, we should read around 2.5 Volts for the Rubidium model and 3.6 Volts for the Quartz model. The value varies according to the input link reference frequency and the aging of the oscillator.

- "Tracking Time Constant" gives the programmed time constant in the Tracking phase loop.

The table groups together the states and parameters concerning each link: input alarm, priority, taking into account or not the MTIE or TDEV for the automatic link selection.

Moreover, by clicking on down arrow in MTIE/TDEV boxes, a table of current measurement results is displayed.

States take up the alarm and link selection information available on front-panel LEDs.

5.5.3.3 <View >Status>DISTRIBUTION> Submenu

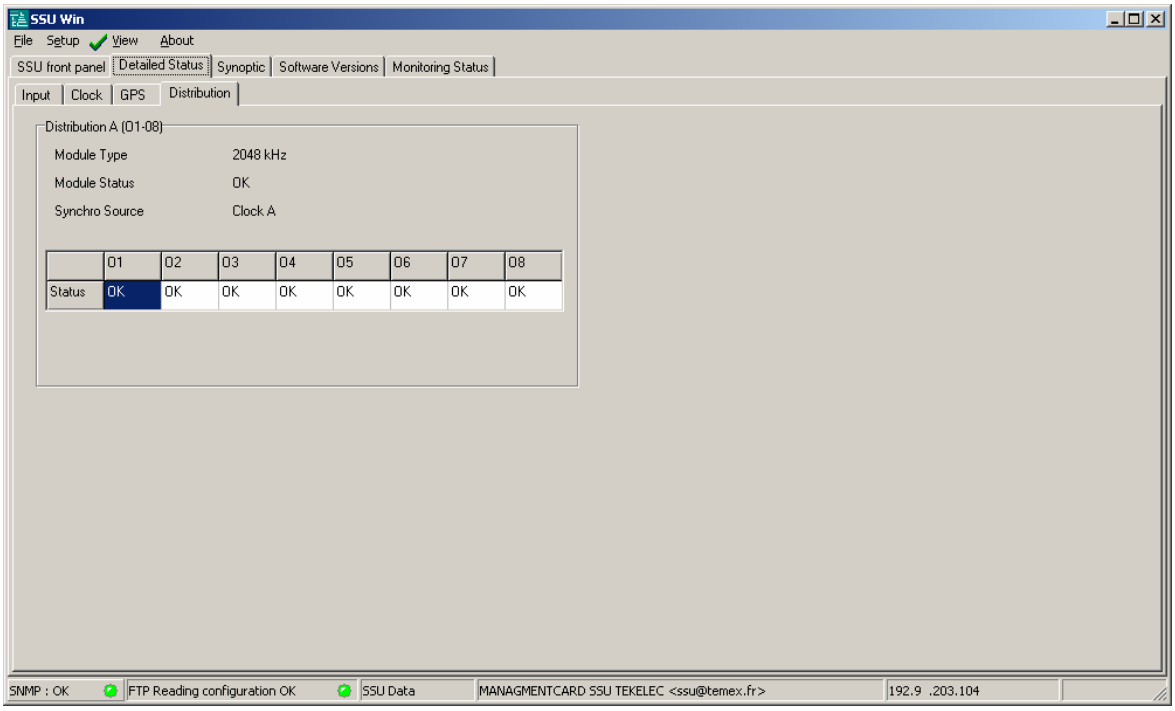


Figure 5 - 15. View Distribution Status Submenu.

The indicators below recall the board configuration parameters.

- "Module Type" indicates the type of Distribution board: 2048 kHz or 2048 kbit/s or T/F;
- "Synchro Source" indicates which of CLOCK A or B modules provides the signal to be distributed, normally, the synchro source is the "Master" module, unless forcing is requested.

The table shows the status concerning each output signal.

5.5.3.4 <View >Status>GPS> Submenu

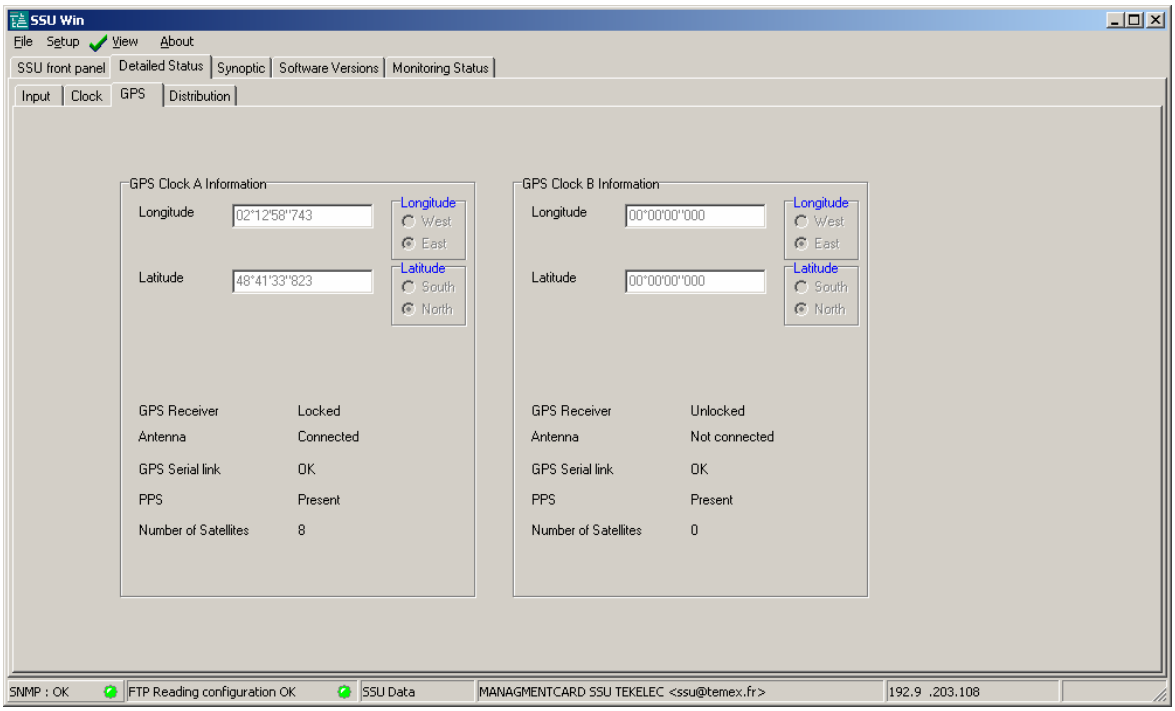


Figure 5 - 16. View GPS Status Submenu.

The "GPS Clock Information" provide the decoded information of SSU position co-ordinates and information about GPS receiver status :

- "GPS Receiver " gives the global status of the GPS reception. "Locked" means that reception is good on at least 4 satellites. "Unlocked" means that a problem of reception exists, either with the antenna connection or the number of decoded satellites;
- "Antenna" indicates the status of the connection with the GPS module;
- "GPS serial link" relates to the link between the CLOCK module and the GPS module. When no GPS module is present, no GPS information is displayed. So, "GPS serial link" is always read at OK.
- "PPS" is the reference for clock synchronization. It should stay at "Present". Otherwise an alarm on the CLOCK module may be triggered.
- "Number of Satellites " gives the number of satellites decoded by the receiver providing the Signal/noise ratio is high enough for decoding the channel. Four satellites is a minimum to lock the receiver;

5.5.4<View >Synoptical> Submenu

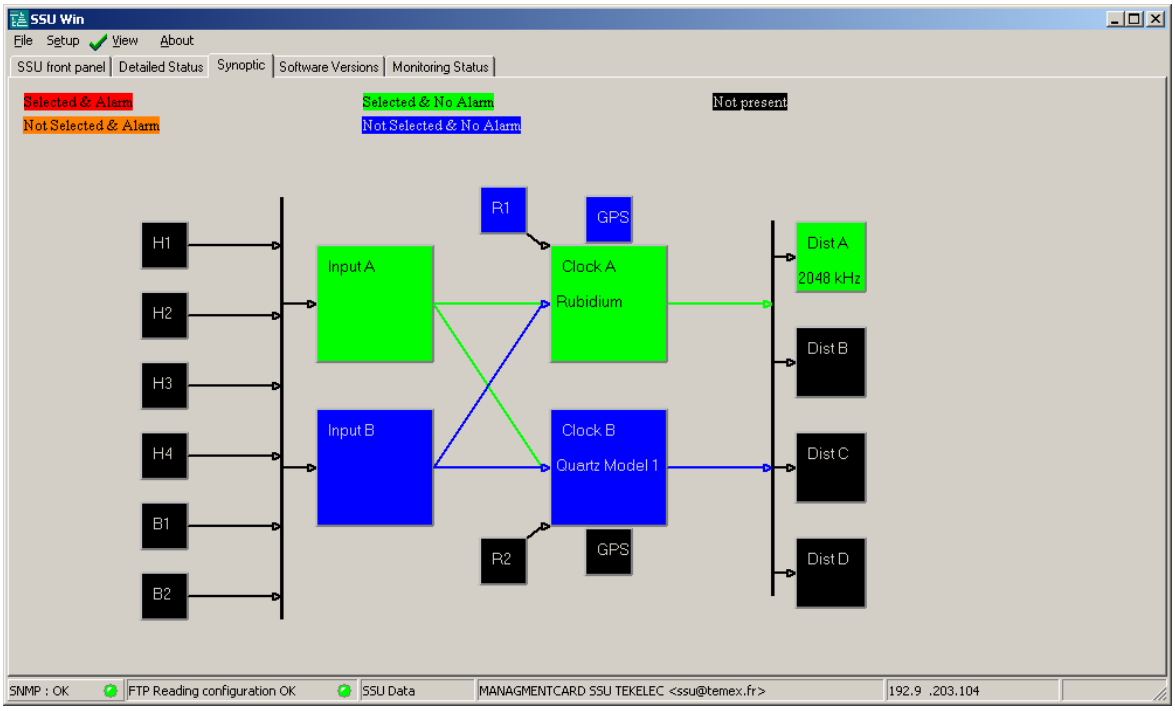


Figure 5 - 17. View Synoptic Submenu.

The block diagram shows the path of signals inside the SSU, from synchronization reference inputs to distributed signals. The boards selected or not, in alarm or not, are marked according to the colour code displayed on the same screen.

5.5.5 <View >Software versions> Submenu

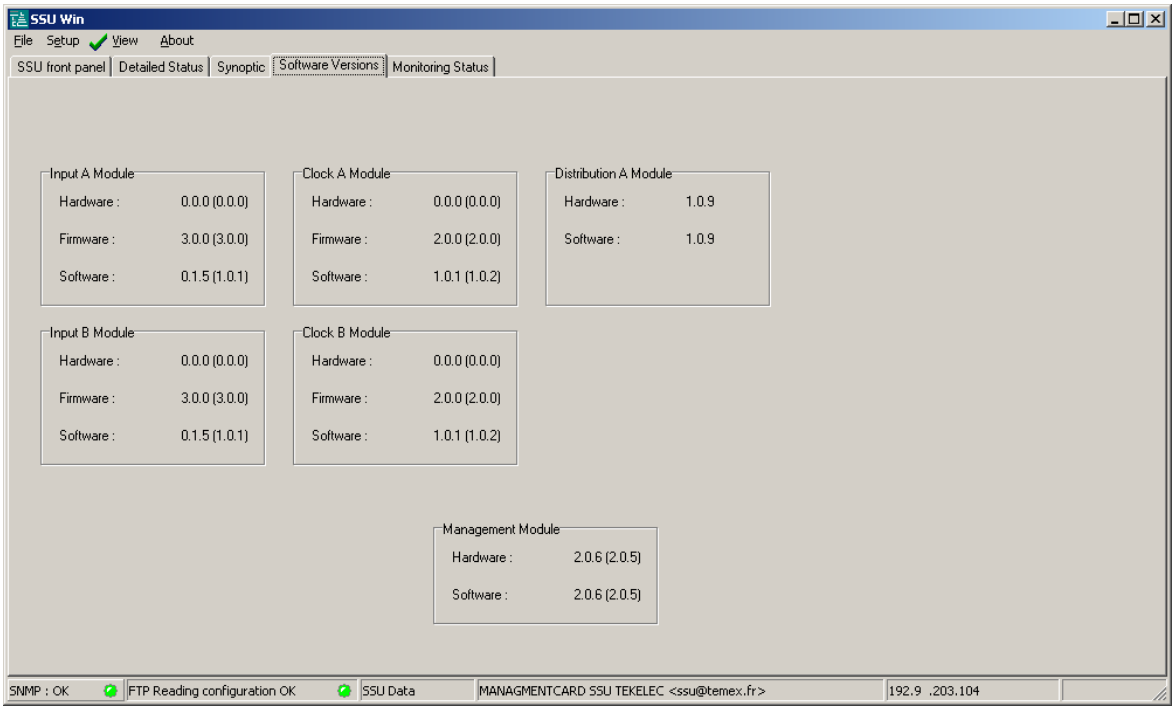


Figure 5 - 18. View Software Versions Submenu.

All the hardware and software versions are listed in these frames, per module of the connected SSU.

The first number is the version currently running. The second number (in parenthesis) is the waiting version which will be activated at the next reset of the module. When the versions are up-to-date, the two numbers are identical.

When upgrading a module (Hardware, Firmare and Software alltogether), the new version is first downloaded into the MANAGEMENT module and its number will appear in the second number.

Only the recognized module in an SSU are displayed.

The Upgrade menu is accessible with "File>Software Upgrade"

5.5.6 <View >Monitoring Status> Submenu

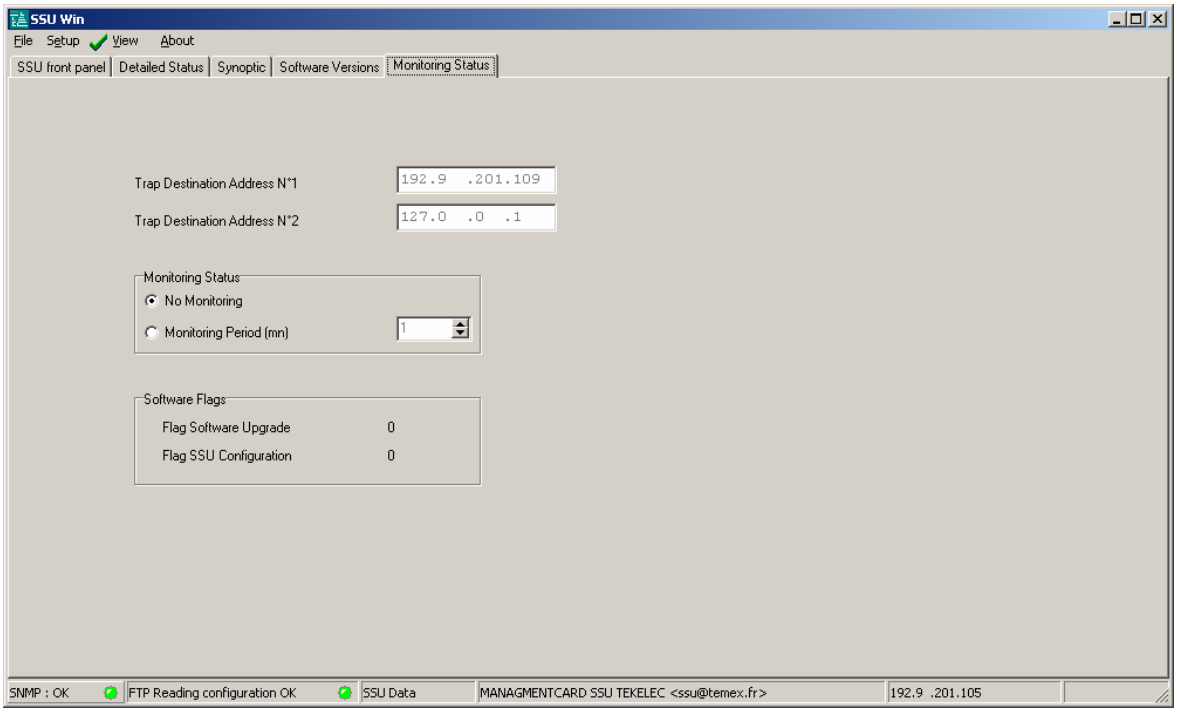


Figure 5 - 19. View Monitoring Status Submenu.

With SSUWin, it is still possible to check the parameters set by the management software EPSYNC Manager. No programming is achieved on these parameters with SSUWin.

The first display shows the destination addresses of the alarms messages (SNMP traps) and performance monitoring. With the "EPSYNC Manager" network management system, only the Destination Address N°1 is used. The second address can be modified by any MIB Browser (specialized for SNMP protocol dialog), and where a parallel network management system would be able to process the traps.

Then the "Monitoring Status" frame shows if the monitoring is enabled or disabled and the period of monitoring in minutes.

The "Software Flags" is an indicator of FTP transfer status of files between the PC and the SSU. The normal state is 0. The "Software release download" flag goes to 1 during the "Release Download" operation (Input or Clock or Management module). When the file has been acknowledged by the SSU, the flag reset. The "SSU Configuration" flag goes to 1 when the Configuration Parameters are sent down to an SSU. The meaning of a permanent "1" flag would be a failure of the Management module to process the sent files.

6 Maintenance

6.1 Updating the Software Version

6.1.1 Definition of the Software Versions

The type software architecture of a CLOCK or INPUT module in the SSU is represented in the following form:

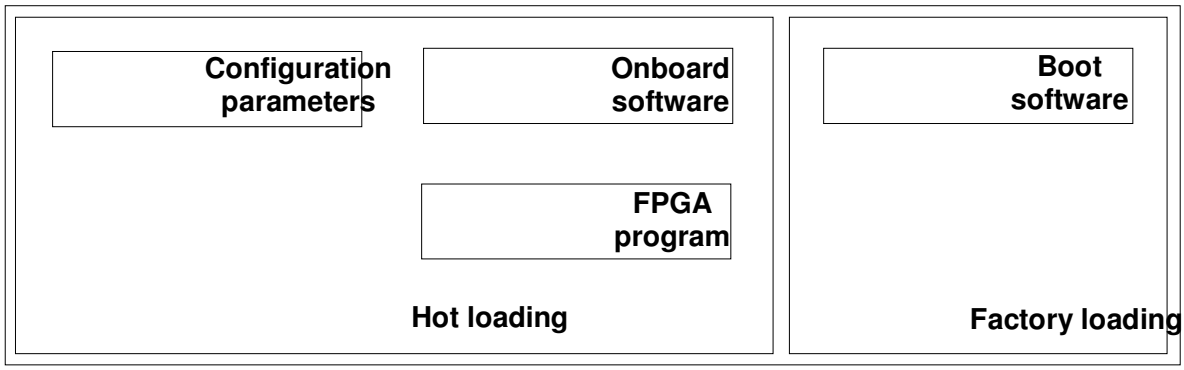


Figure 6 - 1. Software versions.

Hot-loaded software is stored in Management board in Compact Flash. This board also contains the operating system OS (Linux) and the onboard application.

The software is modifiable remotely through network access.

DIST board software is contained in its own microcontroller and is started in an autonomous way. It is not modifiable by downloading.

A software version follows the representation below:

Software version	Major	Minor	Micro
V	X	Y	Z

Table 6 - 1. Software versions.

In which, the change in indices follows this logic:

X: When new functionalities are implemented, which are not compatible with the previous versions.

Y: New functionalities are introduced and are compatible with the previous versions and/or correction of bugs.

Z: Correction of bugs only.

The downloading update function is available for Management, Input and Clock modules. The update includes "On board software" and "FPGA program". A downloadable software is a file with a .tgz extension.

In the menus, the running version is displayed in a straight manner, and the waiting version is diplayed in parenthesis on the right of the running version. When up-to-date, the running version is the same as the waiting version.

6.1.2 Updating software in nominal operation

Updating software is performed from SSUWin or EPSYNC Manager software. Refer to section 5.3.3 for the procedure description.

The updating concerns one board after the other. The procedure performs a restart of the board concerned by the updating. It is therefore essential, first, to force the synchronization path on boards not affected by the updating. To do so, use "CLOCK A Slave" forcing or reversely, and then "Input A Running/ Input B Spare" forcing, or reversely. On completion of updating command, a board restart is performed, and then forced modes are set back to automatic for the operation.

6.2 Oscillator Control

One good indicator of the oscillator behavior and of the tracking status is the value of the control voltage of the oscillator which is available in the View>Detailed Status>Clock screen. When the input reference link is traced to a PRC, or a GPS signal, the control voltage is the image of the ageing of the oscillator.

Abnormal values are stable 0 volts or stable high voltage (>9 Volts). In that case, the tracking algorithm cannot bring the oscillator to the reference frequency. The reason can be either a bad oscillator or a bad reference. A locked GPS receiver is a good reference. If while tracking a GPS reference, the oscillator voltage is still in a shifted position, it should be changed.

6.3 Urgent AND NON-Urgent alarms

Alarms are grouped together at the level of the MANAGEMENT board, in two forms. **N**on **Ur**gent **AL**arms and **Ur**gent **AL**arms. The meaning of these alarms is as follows:

- **AL NUR**: means that one of the backed-up items is unavailable, but that the general operating condition of the signal generation chain is correct,
- **AL UR**: means that the service quality is no longer assured and that the operation is degraded. An action is imperative.

These alarms are visible on the SSU front panel (red LEDs) and available in the form of dry loops ALARMS front panel connectors.

Types of Alarm	Items concerned	AL NUR	AL UR
Disappearance of a backed-up module or Def led activated on a backed-up working module	INPUT, CLOCK	X	
Disappearance of a module DIST	DIST modules		X
Disappearance of the last module or Def led activated on the last working module	INPUT, CLOCK modules		X
Fault of a declared link	Link declared on INPUT (from 6) and CLOCK(GPS)	X	
Fault of all declared links	Link declared on INPUT (from 6) and CLOCK(GPS)		X
Changeover of a CLOCK module to "Holdover" mode	CLOCK A or B module		X

Table 6 - 2. Urgent/non-urgent alarms.

Consult the pin assignment of ALARMS connectors in order to control the initiation of audible alarm for example.

6.4 Analysis of Internal Warning Lights

When the Def front panel led is activated on the CLOCK module, internal warning lights give additional indications on noticed malfunctions.

Power Supply/Management Alarm (DS4)	Red	Absence of 5/12 Volts converted voltage or problem with PC or terminal operation
Slaved Oscillator Alarm (DS6)	Red	Oscillator not slaved to input link (algorithm in "Tracking search" state)
Slaved Phase Shifter Alarm (DS7)	Red	Slave CLOCK module phase shifter not slaved to Master CLOCK module signal. Activated sometimes during transitional operations.
Output Signal Alarm (DS8)	Red	Absence of CLOCK module output signal

Table 6 - 3. Internal warning lights.

Any of these internal alarms activates the general "Def" led.

6.5 Troubleshooting

Use a PC provided with SSUWIN software to perform diagnostics.

Symptoms can be analysed with front panel leds. Every DEF leds at the lower part of the front panel should be OFF when the configuration is correct and the oscillator tracking achieved. If not, go through the following examination.

6.5.1 INPUT Board

When fault warning light (DEF) is ON while input signals are connected:

- Check that connected links are declared "active" in INPUT configuration menu;
- If yes, then check that alarm LEDs corresponding to input links declared active are OFF;
- If an input LED is ON, then the signal is absent or at a wrong frequency, or does not meet the required MTIE/TDEV quality conditions, (cancellable function with SSUWin>Setup>Input);
- If input LEDs are OFF and the fault LED is ON, then the board is defective;
- If input links in alarm are of 2048 kbit/s type, then either the signal is absent, or the frame locking detection failed (G.703 not framed or frame without CRC for example), or the required SSM is of quality level lower than the programmed threshold (cancellable function with SSUWin>Setup>Input).

6.5.2 CLOCK Board

When the fault warning light is ON while input signals are available:

- Check that the inputs used are declared as "active" in CLOCK configuration menu;
- Check that INPUT boards are faultless;
- Check that alarm LEDs for INPUT, REF inputs are OFF;
- If a fault is present, then check that the inputs used are in accordance with the wiring performed, of Input by INPUT Board or CLOCK Board Direct Input type. The configuration with/without INPUT board is performed at the start of the MANAGEMENT module. It may be necessary to reset the MANAGEMENT module (hot-removing the board and plugging it back into the unit) if an INPUT module is added to an equipement.
- Make sure that the slaving time has normally elapsed after connection (15 min approx.) of the input link plus warm-up time (1000 s for OCXO clock, 3600 s for Rubidium clock) if the power supply has just been applyed to the module, and that the control stop of the local oscillator is not reached (CLOCK board Status menu);
- Check that the GPS alarm LED is OFF;
- If the LED is ON, see on the SSUWin>Detailed Status>GPS the status. If no Status is displayed, the connection (serial link) between the CLOCK board and the GPS board is not operational due to a badly plugged or faulty GPS board on the CLOCK Board. If

detailed status is displayed, check status of antenna connections and number of received satellites;
- If alarm LEDs for inputs signals are OFF, then the board has an internal problem of operation.

6.5.3 DIST Board

When the fault warning light is ON, while CLOCK and INPUT boards operate without fault:

- If all the green and yellow LEDs of signal presence are OFF, the signal is no longer distributed. The origin may be CLOCK boards, the backplane or the DIST board itself. Examine whether other DIST boards have the same problem. If they have, then CLOCK boards no longer provide the clock (problem in Master CLOCK boards or backplane connections);
- If all the green and yellow LEDs of signal presence are ON, then there is a DIST board internal problem.
- If one or several green leds are OFF and the corresponding yellow led ON, then a redundant buffer may be broken or the load of the distributed channel is too low.

6.5.4 Management Board

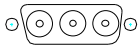
When the fault warning light is ON, there is a module failure. The board must be replaced.

If no alarm shows on the INPUT, CLOCK and DIST modules, the signal is still processed normally even if the MANAGEMENT module fails. After replacing the MANAGEMENT module, the configuration of the SSU has to be rebuilt.

7 Appendix

7.1 Pin Assignment of Front Panel Connectors

7.1.1 DC power supply connectors POWER –48V

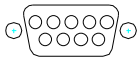


Pin	Signal	Description
A1	-48V	DC power supply, –36 Volts to –72 Volts
A2	0V	Power supply return, -48 Volts
A3	CASEGND	Case grounding

Table 7 - 1. DC power supply connectors POWER –48V.

The above view is the front panel view as seen by the operator. Pin A1 is on the left of the drawing, and at the lower position on the panel.

7.1.2 Connectors INPUTS 2048 kHz H1, H2



Pin	Signal	Description
1	2048kHz+IN	Input + 2048 kHz, INP board
2	STRAP75+IN	Strap + installed in 75 Ω utilization, INP board
3	GND	Electrical ground
4	STRAP75+INPRC	Strap + installed in 75 Ω utilization, CLOCK board
5	2048kHz+INPRC	Input + 2048 kHz, CLOCK board
6	2048kHz-IN	Input - 2048 kHz, INP board
7	STRAP75-IN	Strap - installed in 75 Ω utilization, INP board
8	STRAP75-PRC	Strap - installed in 75 Ω utilization, CLOCK board
9	2048kHz-INPRC	Input - 2048 kHz, CLOCK board

Table 7 - 2. Connectors INPUTS 2048 kHz H1, H2.

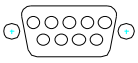
For an input in 120 Ω symmetrical on INPUT board, connect + and – signals to 1 and 6, the electrical ground to 3.

For input in 75 Ω dissymmetrical on INPUT board, connect the signal to 1, the electrical ground and cable braid to 3. Establish a direct link between 2 and 7. Establish a direct link between 3 and 6.

For an input in 120 Ω symmetrical on CLOCK board, connect + and – signals to 5 and 9, the electrical ground to 3.

For input in 75 Ω dissymmetrical on CLOCK board, connect the signal to 5, the electrical ground and cable braid to 3. Establish a direct link between 4 and 8. Establish a direct link between 3 and 9.

7.1.3 Connectors INPUTS 2048 kHz H3, H4



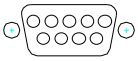
Pin	Signal	Description
1	2048kHz+IN	Input + 2048 kHz, INP board
2	STRAP75+IN	Strap + installed in 75 Ω utilization, INP board
3	GND	Electrical ground
4		
5		
6	2048kHz-IN	Input + 2048 kHz, INP board
7	STRAP75-IN	Strap - installed in 75 Ω utilization, INP board
8		
9		

Table 7 - 3. Connectors INPUTS 2048 kHz H3, H4.

For an input in 120 Ω symmetrical on INPUT board, connect + and – signals to 1 and 6, the electrical ground to 3.

For input in 75 Ω dissymmetrical on INPUT board, connect the signal to 1, the electrical ground and cable braid to 3. Establish a direct link between 2 and 7. Establish a direct link between 3 and 6.

7.1.4 Connectors INPUTS 2048 kbit/s B1, B2



Pin	Signal	Description
1	2048kb+IN	Input + 2048 kHz, INP board
2	STRAP75+IN	Strap + installed in 75 Ω utilization, INP board
3	GND	Electrical ground
4		
5	2048kb+OUT	Output + 2048 kHz, INP board
6	2048kb-IN	Input - 2048 kHz, INP board
7	STRAP75-IN	Strap + installed in 75 Ω utilization, INP board
8		
9	2048kb-OUT	Output - 2048 kHz, INP board

Table 7 - 4. Connectors INPUTS 2048 kbit/s B1, B2.

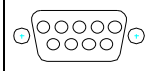
For an input in 120 Ω symmetrical on INPUT board, connect + and – signals to 1 and 6, the electrical ground to 3.

For input in 75 Ω dissymmetrical on INPUT board, connect the signal to 1, the electrical ground and cable braid to 3. Establish a direct link between 2 and 7. Establish a direct link between 3 and 6.

For an output in 120 Ω symmetrical from INPUT board, connect + and – signals to 5 and 9, the electrical ground to 3.

For an output in 75 Ω dissymmetrical from INPUT board, connect the signal to 5, the electrical ground and cable braid to 3. Establish a direct link between 3 and 9.

7.1.5 Connectors OUTPUTS O1 to O32 at outputs 2048 kHz or 2048 kbit/s



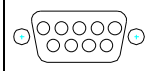
Pin	Signal	Description
1	S+OUT	Output + 2048 kHz or kbit/s, DIST board
2	GND	Electrical ground
3		
4		
5	S+OUT+32	Output + 2048 kHz or kbit/s, DIST board offset (n.u.) Not Used
6	S-OUT	Output - 2048 kHz or kbit/s, DIST board
7		
8		
9	S-OUT+32	Output -2048 kHz or kbit/s, DIST board offset (n.u.) Not Used

Table 7 - 5. Connectors OUTPUTS O1 to O32 at 2048 kHz or 2048 kbit/s outputs.

For a 75 Ω output of the distributed signal, connect the signal to 1. Establish a direct link between 2 and 6. Connect the electrical ground and cable braid to 2 and 6.

For a 120 Ω output of the distributed signal, connect the signal to 1 and 6. Connect the electrical ground and cable braid to 2.

7.1.6 Connectors OUTPUTS O1 and O2, O9 and O10, O17 and O18, O26 and O27 at T/F outputs (10 MHz)

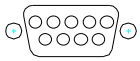


Pin	Signal	Description
1	S+OUT	Output + 10 MHz, DIST board
2	GND	Electrical ground
3		
4		
5	S+OUT+32	Output + 10 MHz, DIST board offset (n.u.) Not Used
6	S-OUT	Output - 10 MHz, DIST board
7		
8		
9	S-OUT+32	Output –10 MHz, DIST board offset (n.u.) Not Use

Table 7 - 6. Connectors OUTPUTS O1 and O2, O9 and O10, O17 and O18, O26 and O27 at T/F outputs (10 MHz).

For a 50 Ω output of the distributed signal, connect the signal to 1. Establish a direct link between 2 and 6. Connect the electrical ground and cable braid to 2 and 6.

7.1.7 Connectors OUTPUTS O3 and O4, O11 and O12, O19 and O20, O28 and O29 at T/F outputs (1PPS)

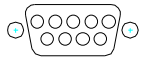


Pin	Signal	Description
1	S+OUT	Output + 1PPS, DIST board
2	GND	Electrical ground
3		
4		
5	S+OUT+32	Output + 1PPS, DIST board offset (n.u.) Not Used
6	S-OUT	Output - 1PPS, DIST board
7		
8		
9	S-OUT+32	Output - 1PPS, DIST board offset (n.u.) Not Used

Table 7 - 7. Connectors OUTPUTS O3 and O4, O11 and O12, O19 and O20, O28 and O29 at T/F outputs (1PPS).

For a 50 Ω output of the distributed signal, connect the signal to 1. Establish a direct link between 2 and 6. Connect the electrical ground and cable braid to 2 and 6.

7.1.8 Connectors OUTPUTS O3 and O4, O11 and O12, O19 and O20, O28 and O29 at T/F outputs (ToD)



Pin	Signal	Description
1	S+OUT	Output + ToD, DIST board
2	GND	Electrical ground
3		
4		
5	S+OUT+32	Output + ToD, DIST board offset (n.u.) Not Used
6	S-OUT	Output – ToD, DIST board
7		
8		
9	S-OUT+32	Output – ToD, DIST board offset (n.u.) Not Used

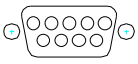
Table 7 - 8. Connectors OUTPUTS O3 and O4, O11 and O12, O19 and O20, O28 and O29 at T/F outputs (ToD).

For a 50 Ω output of the distributed signal, connect the signal to 1. Establish a direct link between 2 and 6. Connect the electrical ground and cable braid to 2 and 6.

Outputs are distributed between all four DIST modules:

O1 to O8 is piloted by DIST A module,
O9 to O16 by DIST B,
O17 to O24 by DIST C,
O25 to O32 by DIST D.

7.1.9 Connector REMOTE CONTROL RS232



Pin	Signal	Description
1		
2	RX	Receive data (output)
3	TX	Transmit data (input)
4	DTR	Data Terminal Ready (input)
5	GND	Electric Ground
6	DSR	Data Set Ready (output)
7	RTS	Request To Send (input)
8	CTS	Clear To Send (output)
9	TEST	Auxiliary output RS232 – diagnostic of MANAGEMENT module start

Table 7 - 9. Connector REMOTE CONTROL RS232.

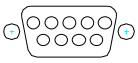
Control signals CTS, DSR, RTS, DTR are not managed at inputs and are active at outputs. The wiring corresponds to a DCE type interface (female). It should be connected to a PC with a straight DB9 cable.

7.1.10 Connector REMOTE CONTROL ETHERNET

	Pin	Signal	Description
RJ45	1	TX+	Transmit Data +
	2	TX-	Transmit Data -
	3		
	4	RX+	Receive Data +
	5	RX-	Receive Data -
	6		
	7		
	8		

Table 7 - 10. Connector REMOTE CONTROL ETHERNET.

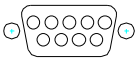
7.1.11 Connector ALARMS-NURG A1



Pin	Signal	Description
1	ALNURGF+	Non Urgent Alarm, contact closed
2	ALNURGF-	Non Urgent Alarm, contact closed
3		
4		
5	GND	Electrical ground
6		
7		
8	ALNURGO+	Non Urgent Alarm, contact open
9	ALNURGO-	Non Urgent Alarm, contact open

Table 7 - 11. Connector ALARMS-NURG A1.

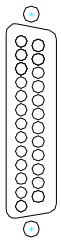
7.1.12 Connector ALARMS-URG A2



Pin	Signal	Description
1	ALURGF+	Urgent Alarm, contact closed
2	ALURGF-	Urgent Alarm, contact closed
3		
4		
5	GND	Electrical ground
6		
7		
8	ALURGO+	Urgent Alarm, contact open
9	ALURGO-	Urgent Alarm, contact open

Table 7 - 12. Connector ALARMS-NURG A2.

7.1.13 Connector EXTENS

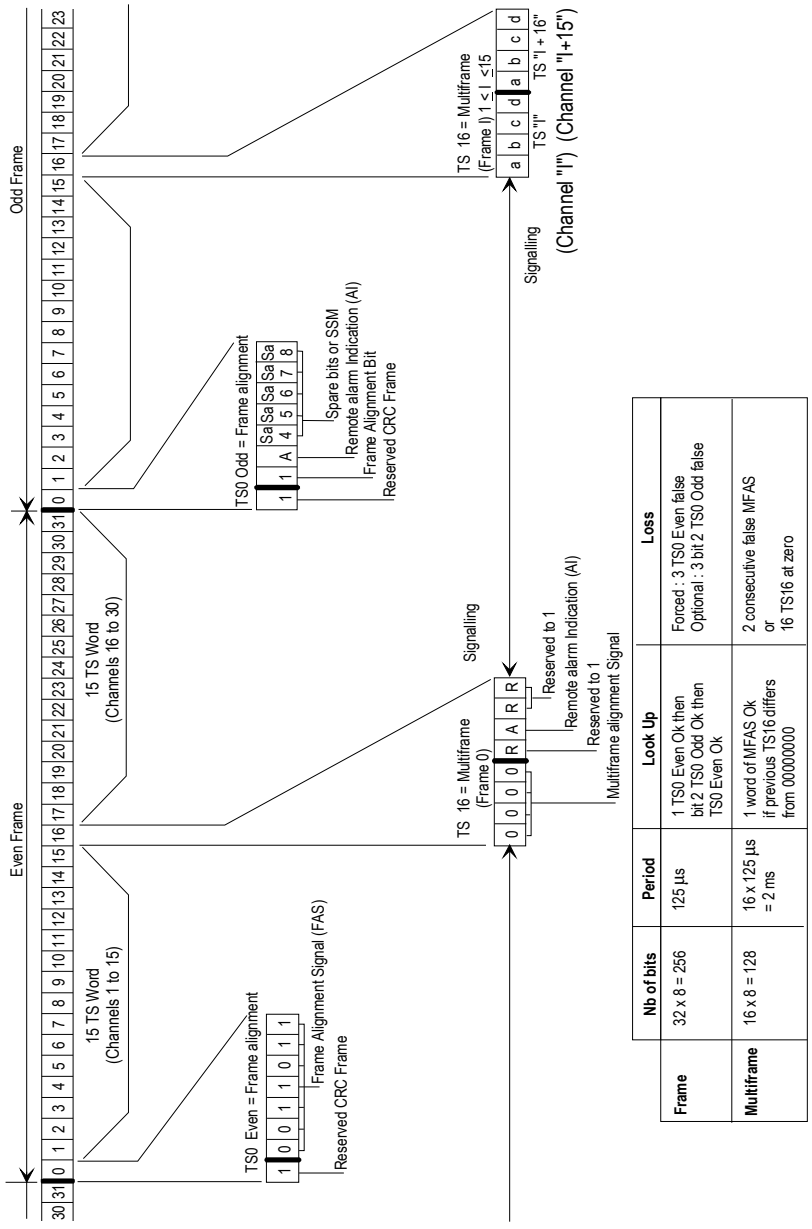


Pin	Signal	Description
1	CLKA_2048kHzOUT	Clock CLOCK A board output
2	CLKA_8192kHz	8192 kHz reference CLOCK A
3	CLKA_OK	Clock OK CLOCK A board output
4	CLKA_TOD	ToD CLOCK A board output
5	CLKA_2048kbOUT-	2048 kbit/s OUT-CLOCK A board output
6	CLKB_2048kHzOUT	Clock CLOCK B board output
7	CLKB_8192kHz	8192 kHz reference CLOCK B board output
8	CLKB_OK	Clock OK CLOCK A board output
9	CLKB_TOD	ToD CLOCK A board output
10	CLKB_2048kbOUT-	2048 kbit/s OUT- CLOCK B board output
11	TX+422	Transmit + RS422
12	TX-422	Transmit – RS422
13	GND	Electrical ground
14	GND	Electrical ground
15	CLKA_MS	Master/Slave CLOCK A board output
16	CLKA_PPS	PPS CLOCK A board output
17	CLKA_2048kbOUT+	2048 kbit/s OUT+ CLOCK A board output
18	GND	Electrical ground
19	GND	Electrical ground
20	CLKB_MS	Master/Slave CLOCK B board output
21	CLKB_PPS	PPS CLOCK B board output
22	CLKB_2048kbOUT+	2048 kb/s OUT+ CLOCK B board output
23	GND	
24	RX+422	Receive + RS422
25	RX-422	Receive - RS422

Table 7 - 13. Connector EXTENS.

7.2 2048 kbit/s FRAME AND SSM Messages

7.2.1 2048 kbit/s frame



	Nb of bits	Period	Look Up	Loss
Frame	32 x 8 = 256	125 µs	1 TS0 Even Ok then bit 2 TS0 Odd Ok then TS0 Even Ok	Forced : 3 TS0 Even false Optional : 3 bit 2 TS0 Odd false
Multiframe	16 x 8 = 128	16 x 125 µs = 2 ms	1 word of MFAS Ok if previous TS16 differs from 00000000	2 consecutive false MFAS or 16 TS16 at zero

Figure 7 - 1. 2048 kbit/s frame.

The 2048 kbit/s frame is built according to recommendations G.704. It consists of 32 repetitive bytes called time intervals (TS 0 to 31), the TS0 of which is used to convey data of frame locking and transfer quality (CRC4 calculated all over the issued frame). TS1 to TS31 convey the usable data, here not utilized, and filled with an idle byte.

SSM messages are conveyed over one of bits Sax1 to Sax4 (x=4, 5, 6, 7 or 8) of the odd TS0, aligned on multiframe CRC4. Bits are ranked so that Sax1 (MSB) is contained in TS0 of frame 1 and Sax4 (LSB) contained in TS0 of frame 7.

7.2.2 SSM Messages

QL	SSM Code (MSB ... LSB)	Source
Unknown	0000	Quality Unknown
QL-PRC	0010	PRC clock
QL-SSUT	0100	Transit SSU clock
QL-SSUL	1000	Local SSU clock
QL-SEC	1011	SEC clock
QL-DNU	1111	Do not use clock (loop risk)

Table 7 - 14. SSM message code.

7.3 Format ToD

Month/Day/Year Hour:Minute:Second Source
03/20/2002 21:02:05 *UTC*

Table 7 - 15. Format ToD.

UTC appears at the end of the message if the GPS is the reference selected and the SSU is not in Holdover mode.

The message is 19 or 23 (if UTC) characters long plus CR and LF characters.

7.4 GPS Antenna Installation

Before choosing the GPS Antenna and the connecting cable between the GPS Antenna and the EPSILON SSU, you have to perform the following steps:

- Choose the antenna location,
- Evaluate the overall gain,
- Choose the antenna and cable type.

7.4.1 GPS Antenna Location

A place, far away from any hindrance of a direct view of the sky is necessary.

Actually, the EPSILON SSU has to know the exact location of its antenna for the GPS synchronization. The EPSILON SSU determines automatically this location.

The minimum number of tracked GPS satellites is four. And a vertical observation cone in sky open view, of a semi-angle higher than or equal to 65° (optimum at 85°), is recommended (see example below).

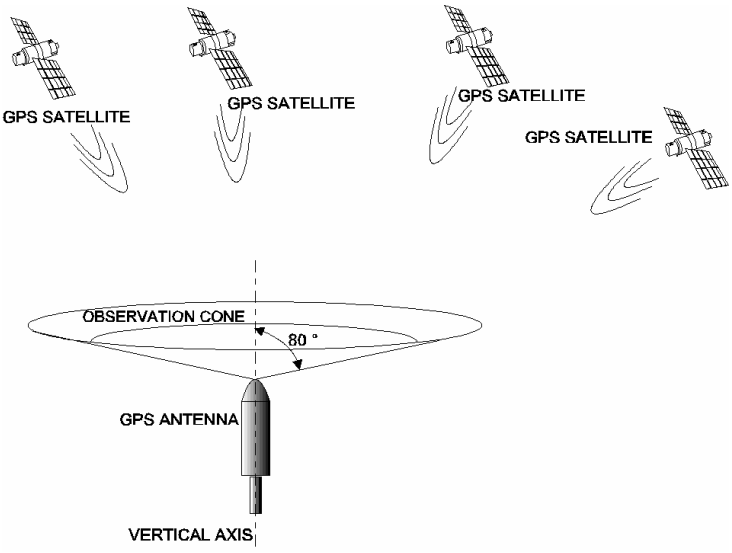


Figure 7 - 2. GPS Antenna Locations.

NOTE: The open view angles are given according to the criterion of a complete GPS constellation of 24 satellites, evenly distributed in solid angle around the earth.

7.4.2 Gain Calculation

To ensure the correct reception of the GPS signal, the overall system of antenna / cable / protection (and line amplifier / splitter if used) requires a relative gain of 3 to 33 dB.

Example:

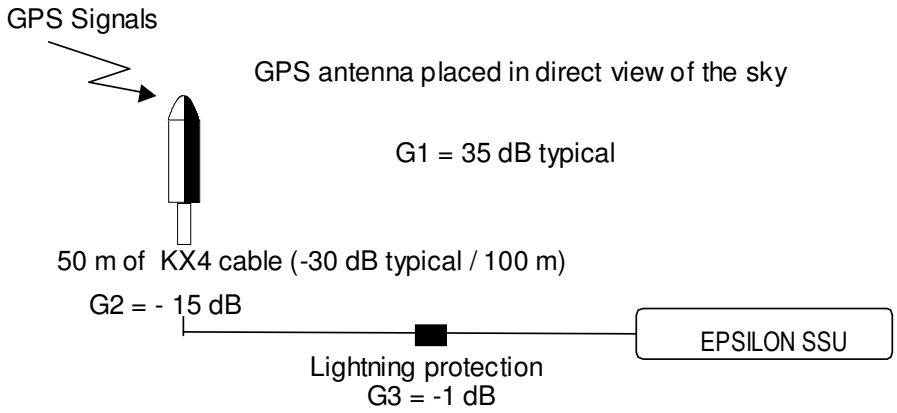


Figure 7 - 3. Gain calculation.

G1 + G2 + G3 = 35 dB - 15 dB - 1 dB = 19 dB
Thus:3 dB < G1 + G2 + G3 = 24 dB < 33 dB

7.4.3 Antenna and Cable Choice

Determine the cable route path, from the GPS Antenna to the EPSILON SSU, and calculate the cable length.

The following information indicates the best antenna/cable arrangement recommended, depending on the different cable lengths.

		27 dB Antenna			**35 dB Antenna**		
Cables length (meters)		Min	Standard	Max	Min	Standard	Max
Type of cable	KX 15 / RG 58	1	10	20	6	25	30
	KX 4 / RG 214	1	50	70	15	50	85

Table 7 - 16. Antenna and Cable Choice.

If greater cable lengths are required, the use of a line amplifier is necessary (only one line amplifier per antenna link is recommended in order to limit the noise factor degradation)

8 Abbreviations and Acronyms

AI	Remote Alarm Indication
AIS	Alarm Indication Signal
ALURGO	Urgent Alarm Open contact
CRC4	Cyclic Redundancy Check (4 bits)
DEF	Default
DIST	DISTribution
ETSI	European Telecommunication Standards Institute
GPS	Global Positioning System
FAS	Frame Alignment Signal
HDB3	High Density bipolar Coding (order 3)
INP	INPut
ITU-T	International Telecommunications Union-Telecommunications sector
LOF	Loss Of Frame alignment
LOS	Loss Of Signal
LSB	Lowest Significant Bit
MFAS	Multiframe Alignment Signal
MSB	Most Significant Bit
MTIE	Maximum Time Interval Error
NURG	Non Urgent
OCXO	Oven-Controlled Crystal Oscillator
PRC	Primary Reference Clock
PRS	Primary Reference Source
Rb	Rubidium
SDH	Synchronous Digital Hierarchy
SEC	SDH Equipment Clock
SEL	Selection
SLN	Synchronization Local Node
SSM	Synchronization Status Message
SSU	Synchronization Supply Unit
STN	Synchronization Transit Node
TDEV	Time DEViation
TIE	Time Interval Error
ToD	Time of Day
TS	Time Slot
TTY	Tele TYpe
IU	Interval Unit
URG	URgent
XO	Crystal Oscillator

REVISION HISTORY

Revision Level	***ECN Number***	***Description***
A-C	----	*Previous documentation*
D0	30/07/08	First iteration of this Spectracom documentation, converted from previous documentation. Applies to SSUWin software 1.3.0 or greater and SSU Synchronization Supply Unit 2.0.10 or greater.

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