US4G

Synchronisation Supply Unit
Network Clock Distributor

for PDH & SDH networks

PRODUCT SPECIFICATIONS

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1. *INTRODUCTION*

With the ever increasing stringent requirements of new broadband technologies and new multimedia high demanding applications, synchronisation matter has become the warranty to Quality of Service provided to the customer.

The GILLAM Group, as a consequence of its long experience in this field, proposes global turnkey solutions to all type of network synchronisation needs, ranging from :

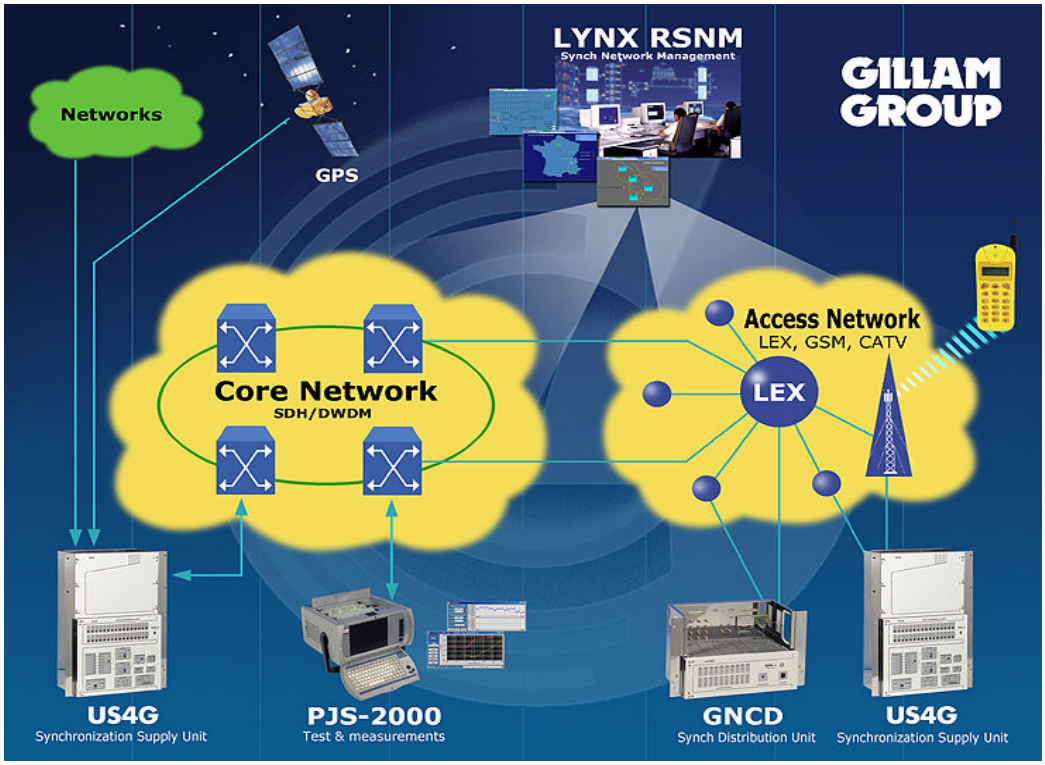


Figure 1 : Synchronisation : the turnkey solution

- Primary Reference Clock (G.811 PRC, based on Cesium or GPS)
- Synchronisation Supply Unit (US4G G.812 T and L)
- Network Clock Distributor Unit (US4G release NCD, GNCD, UADRS)
- Network Management System (LYNX Remote Synchronisation Network Manager)
- Synch Test instrument (Portable PJS-2000).

Regarding Synchronisation Supply Unit, GILLAM has developed a new generation of equipment: the US4G.

The US4G is a modular synchronisation supply unit (SSU or SASE), full redundant and convenient for PDH and SDH networks synchronisation.

2. US4G MAIN FEATURES

❑	***Synchronisation inputs*** 6 synchronisation inputs, GPS PRR support, Caesium PRS support, management of synchronisation reference priorities, alarms, configurations and performance.
❑	***Full redundant architecture***
❑	***Hot swapping*** Modules and cards are dynamically exchangeable**.**
❑	***Quality parameters monitoring*** MTIE, TDEV, false frequency on synchronisation inputs.
❑	***Oscillators*** High-performance Quartz , Quartz OCXO or Rubidium Oscillator.
❑	***Performances*** Exceed major ITU-T recommendations and ETSI standards : ITU- G.812 / G.813, ETSI 300 462-3/4/5
❑	***Number of outputs easily increasable :*** Direct interface with the GNCD allowing to increase easily the maximal number of available outputs with the US4G.
❑	***Phase jumps*** No perturbation on outputs (phase jump < 1/64 U.I.) during oscillators, reference inputs and outputs reconfiguration.
❑	***SSM Management*** Full SSM and quality level management. Field configuration supported.
❑	***Frequency monitoring of the synchronization equipments*** Capability to check the effectiveness of the synchronization through frequency measurement (« feed back » interface).
❑	***Software download*** Firmware software in FLASH memory. Software remote download through local and remote control interfaces.
❑	***Remote control standardised protocols*** Use of wide spread standard protocols (IP-UDP, V25 bis, X25 or 10 Base-T, SNMP) to manage the NE US4G in the synchronization network.
❑	***LYNX RSNM integrated equipment*** Integrated into the remote synchronisation network management system of GILLAM, the LYNX-RSNM allows a dynamic and graphic management of the network : detection of timing loops, interaction with the US4Gs, management of the quality, ... Support of FCAPS functionalities.

Figure 2 : US4G main unit front panel

3. PRODUCT SPECIFICATIONS

3.1. US4G Product Portions

The US4G unit provides two different configurations :

1. US4G / SSU : the US4G will be used as a standard SSU unit
2. US4G / NCD : the US4G will be used as a clock distributor (without embedded oscillators, those ones being bypassed)

The US4G can be upgraded during life time on field from the NCD release up to the SSU release, by simply adding two oscillator cards.

The modular structure of the US4G unit allows to integrate different cards and modules :

Product Portion	Ref.	Min. Qty	Max. Qty	Basic/ Option
SUBRACKS				
US4G Main subrack ETSI compliant or US4G Main subrack 19" compliant	Z8-99247G00-10 Z8-99247G00-11	1	1	X
US4G Main subrack panel connection type xx	Z6-99247G30-xx	1	1	X
US4G Extension 1 subrack ETSI compliant or US4G Extension 1 subrack 19" compliant	Z8-99247G00-20 Z8-99247G00-21	0	1	OPT
US4G Extension 1 subrack panel connection type xx	Z6-99247G31-xx	0	1	OPT
US4G Extension 2 subrack ETSI compliant or US4G Extension 2 subrack 19" compliant	Z8-99247G00-30 Z8-99247G00-31	0	1	OPT
US4G Extension 2 subrack panel connection type xx	Z6-99247G32-xx	0	1	OPT
OSCILLATORS				
Quartz OCXO oscillator & synthesis card	Z8-99247G25-00	1	2	X
High precision Quartz OCXO oscillator & synthesis card	Z8-99247G25-10	0	2	OPT
Rubidium atomic oscillator & Synthesis card	Z8-99247G26-00	0	2	OPT
POWER SUPPLY				
Power Supply –48/-72 VDC-DC converter	Z8-99247G08-00	1	2	X
Power Supply 220 Vac	Z8-99247G34-00	0	2	OPT
LOCAL MANAGEMENT				
CPU management card 2Mbytes	Z3-99247G10-10	1	1	X
Frequency feedback card	Z3-99247G17-00	1	2 (1)	X
Visual synoptic interface card	Z3-99247G07-00	1	1	X

INPUTS				
Input multiplexer card	Z3-99247G13-00	0	2	OPT
2048 kHz-kbit/s Input card (2 input ports)	Z8-99247G14-00	1	3	X
1-5-10 MHz input card	Z8-99247G16-00	0	3	OPT
OUTPUTS				
2048 kHz Output card (4 output ports, 1+1 redundancy)	Z3-99247G21-00	2	32 (1)	X
2048 kHz Output card (2 output ports, 2 frequency feedback)	Z3-99247G18-00	1	32 (1)	OPT
2048 kbit/s Output card (2 output ports, 1+1 redundancy, + SSM)	Z3-99247G33-00	2	32 (1)	OPT
2048 kbit/s Output card (2 output ports, 2 frequency feedback + extended SSM)	Z3-99247G20-00	1	32 (1)	OPT
2048 kHz or kbit/s Output card V0 (8 outputs per card, 1+1 redundancy)	Z3-99247G29-00	2	10 (2)	OPT
2048 kHz or kbit/s Output card V1 (Basic) standard frequency feedback support (8 outputs per card, 8 frequency feedback)	Z3-99247G29-10	1	10 (2)	OPT
2048 kHz or kbit/s Output card V2 (Enhanced) frequency feedback with support of MTIE, TDEV, f/f. (8 outputs per card, 8 frequency feedback)	Z3-99247G29-20	1	10(2)	OPT
1-5-10 MHz Output card (2 outputs)	Z3-99247G22-00	1	16 (4)	OPT
2048 kbit/s Output retiming card (2 retimed output ports, 2 inputs ports)	Z3-99247G19-00	1	32 (1)	OPT
REMOTE MANAGEMENT				
X25/PSTN Remote control card	Z3-99247G11-00	0	1 (3)	OPT
10B-T Remote control card	Z3-99247G12-00	0	1 (3)	OPT
PRS				
GPS FE-5019A	Z8-99247G38-00	0	2	OPT

Notes : (1) : with *US4G Extension 1 subrack ETSI compliant* or *US4G Extension 1 subrack 19" compliant*

(2) : with *US4G Extension 2 subrack ETSI compliant* or *US4G Extension 2 subrack 19" compliant*

(3) : option *X25/PSTN Remote control card* and *10B-T Remote control card* cannot be installed simultaneously.

(4) : with *US4G Main subrack ETSI compliant* or *US4G Main subrack 19" compliant.*

3.2. Typical US4G equipment configuration

The US4G Main unit can be equipped with :

- 2 x input multiplex cards (option)
- 3 x input cards with two input references per card
- 2 x oscillator & synthesis cards (Rubidium, Quartz or mixed)
- 2 x power supply cards – 48 Vdc / 72 Vdc
- 1 x CPU management card
- 2 x power supply cards 220 Vac (option)
- 1 x remote control communication card (X25/PSTN or 10 Base T)
- 1 x visual interface card
- AND for the 16 output slots the following optional max. configurations :
  * 16 x 1+1 redundant 2048 kHz output cards with 4 outputs per card (64 1+1 redundant outputs)
  * 16 x 2048 kHz output cards with 2 outputs per card and 2 frequency feedback (32 outputs + 32 frequency feedback)
  * 16 x 2048 kbit/s output cards with 2 outputs per card and 2 frequency feedback (32 outputs + 32 frequency feedback)
  * 16 x 2048 kbit/s retiming cards with 2 retimed outputs per card and 2 input ports (32 retiming outputs + 32 input ports)

The US4G Extension unit 1 (16 output slots) can be equipped with either :

* 16 x 1+1 redundant 2048 kHz output cards with 4 outputs per card (64 1+1 redundant outputs)
* 16 x 2048 kHz output cards with 2 outputs per card and 2 frequency feedback (32 outputs + 32 frequency feedback)
* 16 x 2048 kbit/s output cards with 2 outputs per card and 2 frequency feedback (32 outputs + 32 frequency feedback)
* 16 x 2048 kbit/s retiming cards with 2 retimed outputs per card and 2 input ports (32 retiming outputs + 32 input ports)

The US4G Extension unit 2 (10 output slots) can be equipped with either :

- 10 x 2048 kHz or kbit/s 1+1 redundant 8 output ports cards (max. of 80 1+1 redundant outputs), V0 release.
- 10 x 2048 kHz or kbit/s 8 output ports cards and 8 frequency feedback (max. of 80 outputs, and 80 frequency feedback), V1 or V2 release.

3.3. US4G Block diagram

US4G Block diagram is given in Appendix 1.

3.4. Input card (Main)

Maximum number of inputs :	6, 2 allowing to connect to a GPS receiver
Impedance :	75 Ohms, 120 Ohms or high Z
Compatible signals :	– 2048 kHz ITU-T G.703 § 13
	– 2048 kbit/s ITU-T G.703 § 9
	– 1-5-10 MHz : 50 Ohms 0dBm (special card)
Jitter and wander tolerance :	ITU-T G.823
G.703 § 13 signal monitoring :	MRTIE, TDEV, LOS
G.703 § 9 signal monitoring :	MRTIE, TDEV, LOS, AIS
G.704 signal monitoring :	MRTIE, TDEV, LOS, AIS, OOF, CRC-4 (with or without) CAS-16, SSM.

This card ensures the interface and monitoring functions of the synchronisation inputs. The US4G can integrate three cards of this type; each card manages two inputs.
The card can be configured for operation in following modes :

- G703 § 9
- G703 § 13
- G704 multiframe CRC-4

Each input can be configured separately.

It is also possible to configure the inputs to interface with an external GPS receiver.

The input card function can be proposed with a redundant Input multiplexer function in order to reach full 1+1 redundancy (option).

The 1-5-10 MHz special input card is designed in order to accept two different input types :

- 1 x 1-5-10 MHz input signal
- 1 x 2048 kHz or 2048 kbit/s input signal.

3.5. Oscillator and synthesis card (Main)

Quartz oscillator :	
Stability in Holdover mode:	< ±- 2 10^{-10} / day
Preheating period:	30 min
Acquisition range:	± 0.4 10^{-6}
Frequency drift (temperature variation between 5 and 40 °C, gradient of 0.5 °C / min):	< ± 1 10^{-9}
Quartz oscillator high quality OCXO	
Stability in Holdover mode	< ± 1 10^{-10}/day
Preheating period:	30 min
Acquisition range:	± 0.4 10^{-6}
Frequency drift (temperature variation between 5 and 40 °C, gradient of 0.5 °C / min):	< ± 1 10^{-9}
FE-5650A Rubidium oscillator :	
Stability in Holdover mode:	< 2 10^{-11} / day
Preheating period:	< 4 min to lock at 25° C
Acquisition range:	± 1.6 10^{-8}
Frequency resolution:	2 10^{-13}
Jitter and wander filter:	0.01 - 0.0001 Hz (programmable)
	Typically : 0.0007 Hz
Fifo for frequency measurement:	10 – 1000 s (programmable)
	Typically : 75 s

This is an autonomous synchronisation module ensuring functions like :

- jitter and wander filtering
- locking of the oscillator (DPLL)
- distribution towards output cards

Two different technology-based configurations are available :

- Quartz technology
- Rubidium technology

3.6. Output card

3.6.1. 2048 kHz output cards (Main, Extension 1)

Maximal number of signal outputs:	64 (128 with extension unit 1)
Impedance:	75 Ohms, 120 Ohms
Compatible signals:	- 2048 kHz ITU-T G.703 §13

Two types of cards are available :

- **4 output ports** : this card provides a 1+1 redundancy but does not allow for the use of the frequency feedback function. To provide a 1 + 1 output card redundancy, it is always necessary to equip the SSU with an even number of cards.
- **2 output ports** : this card can be combined with the useful frequency feedback card, and provides a 2+1 amplifier redundancy on card.

Those cards amplify and distribute the synchronisation signal.
In the main subrack, up to 16 cards can be placed.
In the extension 1 subrack, up to 16 cards can also be placed.

3.6.2. 2048 kbit/s output cards (Main, Extension 1)

Maximal number of signal outputs :	32 + 32 with extension unit 1
Impedance:	75 Ohms, 120 Ohms
Compatible signals:	- 2048 kbit/s ITU-T G.703 § 9
Configuration signal :	ITU-T G-704 ; AIS, CRC-4, CAS-16, SSM.

Two types of cards are available :

- **2 output ports with redundancy and SSM** : this card is designed to be mounted in the US4G Main/Extension unit 1. A 1 + 1 hardware redundancy is then provided. To provide a 1 + 1 output card redundancy, it is always necessary to equip the SSU with an even number of cards.
- **2 independent output ports with SSM** : this card is designed to be mounted in the US4G Main/Extension unit 1. No redundancy is available but the card provides SSM delivery on two independent channels. It also allows extended SSM features such as "DO NOT USE" management, AIS signalling in extension of the "DO NOT USE" message, and frequency feedback monitoring.

3.6.3. 2048 kHz or 2048 kbit/s output cards (Extension 2)

Maximal number of signal outputs :	32 + 80 with extension unit 2
Impedance:	75 Ohms, 120 Ohms
Compatible signals:	- 2048 kbit/s ITU-T G.703 § 9 - 2048 kHz ITU-T G.703 § 13
Configuration signal :	ITU-T G-704 (2048 kbit/s) : AIS, CRC-4, CAS-16, SSM.

Three types of cards are available :

- **8 1 + 1 redundant output ports** : this card is designed to be mounted in the US4G Extension 2. A 1 + 1 hardware redundancy is provided, with a maximum of 80 outputs in Extension 2.
- **8 output ports V1 (basic)** : this card is designed to be mounted in the US4G Extension 2. The 8 outputs ports are combined with 8 standard frequency feedback ports, which supports the same performance monitoring parameters as "3.7 frequency feedback monitoring".
- **8 output ports V2 (enhanced)**: this card is designed to be mounted in the US4G Extension 2. The 8 outputs ports are combined with 8 enhanced frequency feedback ports, which supports: LOS, AIS, f/f, MTIE and TDEV monitoring.

3.6.4. 1-5-10 MHz output card (Main, Extension 1)

Maximal number of signal outputs:	32 (64 with extension unit 1)
Impedance:	75 Ohms
Signals:	1 MHz, sine wave – 10dBm 50 Ohms 5 MHz, sine wave – 10dBm 50 Ohms 10 MHz, sine wave– 10dBm 50 Ohms

- **2 output ports** : this card is designed to be mounted in the US4G Main/Extension unit.

3.6.5. Retiming card (Main, Extension 1)

Maximal number of signal outputs:	32 (64 with extension unit 1)
Impedance:	75 Ohms, 120 Ohms
Compatible signals:	2048 kbit/s ITU-T G703 § 9
Configuration signals:	ITU-T G704, AIS, CRC-4, CAS-16
FIFO maximum depth:	± 512 bits

- The Data stream on the output port comes from the FIFO at the 2048 kbit/s synchronized speed. This FIFO is filled with the data stream coming from the input port at the 2048 kbit/s external speed.
- Two output ports per card.
- Two input ports per card.

3.6.6. 10 MHz Card

Number of outputs:	8
Impedance:	50 Ohms unbalanced
Amplitude	2,8Vpp
Distortion	< -30dBC

3.7. Frequency feedback monitoring card (Main, Extension 1)

Supervision of 32 frequency feedback signals	
Phase comparator resolution : 0,48 10^{-9} s	
Alarms : * Frequency programmed threshold :	df/f > 10^{-8}
	df/f > 10^{-9}
	df/f > 10^{-10}
	df/f > 10^{-11}
* LOS	

This card allows to check that the synchronisation provided to NE by the US4G is correctly used by the NE.
One card supervises 32 frequency feedback signals.
One card is necessary in the main unit and in the extension subrack.
This card is always necessary for the operation of the US4G, even when there is no wired frequency feedback. It also controls the output card status multiplexing.

3.8. Power supply module (Main)

Input voltage :	48 VDC nominal, 35 VDC → 72 VDC	
Output voltage :	5 VDC	10 A
	12 VDC	7 A
	-12 VDC	2,5 A
Load distribution system of each voltage when putting in parallel both power supplies.		
Protection :	– polarity inversion – current limitation	
Test points : Signal power fail	3 x	

In the US4G, two identical power supply cards are available.
Each card allows to supply power for the whole equipment by its own (redundant configuration).
An additional optional 220 Vac power module is available.

3.9. CPU management card (Main)

• Serial interface for self-powered local terminal (TPE, ...) or 9600 bit/s VT100 terminal, compatible or PC. Automatic recognition of the physical interface.
• Craft terminal : V24/V28 (RS-232C)
• User interface accessible through tree-sorted menus : list of alarms, configuration, dynamic supervision, events logbook, ...
• User interface accessible through menus protected by password : configuration of temporising, management of oscillators, supervision of reference inputs frequency, ...
• Management automatons : - Frequency feedback monitoring - Oscillators - Synchronization references - …
• Files buffering for : - Logbook - Monitoring of oscillators - MRTIE + TDEV
• SNMP agent interface
• Extended alarms management

This card is connected to the different modules of the equipment and concentrates every status, alarms and configuration information.

The card enables the remote control function (in communication with the remote control interface card) and the local management function :

- data base
- visual synoptic interface management
- configuration
- alarms management (relays interface, ...)

3.10. Remote control communication cards (Main)

• Interface towards the LYNX-RSNM remote synchronisation network management.
• Remote control and configuration of each US4G equipment functions.
• Local user interface directly accessible on the LYNX Manager.
• SNMP agent (partial MIB-II + proprietary MIB)
• Option 1 : 10 Base-T LAN Local interface
• Option 2 : X25 / V25bis interface : V24 DTE / DCE, Clock DTE / DCE
• Internet protocols : IP / UDP / TFTP

Those cards ensure the management of the communication protocols necessary to the connection to the remote control network (through Data Communication Network : DCN). This card is in communication with the CPU management card.

The X25/PSTN and the 10 Base-T remote control cards cannot be installed simultaneously in the equipment.

3.11. Visual interface card (Main)

Test points :	– 120 Ohms symmetrical / galvanic isolation – accessible for : • Selected reference • Selected oscillator • Oscillator 1 • Oscillator 2 • Output signal (64 x)
Led status :	6 inputs, 2 oscillators, power supplies, CPU, ...
Led selection :	inputs / oscillators
Alarm LED :	Major/Minor
Serial interface for local remote control terminal	
Acknowledgement button	

Visual interface : synoptic panel with LEDs. Representation of the functional modules and their status with colour coded Led (off / red /green / yellow, blinking).
In addition, test points allowing non intrusive measurements on the reference signal and oscillators are to be found.

3.12. Mechanics

The mechanical Main subrack is ETSI 300 119-2 compliant :

Height	:	750 mm
Width	:	449 mm
Depth	:	285 mm
Matter	:	stainless steel
Option	:	fixation for Rack 19"

The Extension 1 mechanical subrack is ETSI 300 119-2 compliant:

Height	:	425 mm
Width	:	449 mm
Depth	:	285 mm
Matter	:	stainless steel
Option	:	fixation for Rack 19"

The Extension 2 mechanical subrack is ETSI 300 119-2 compliant:

Height	:	650 mm
Width	:	449 mm
Depth	:	285 mm
Matter	:	stainless steel
Option	:	fixation for Rack 19"

3.13. Environment and typical power consumption

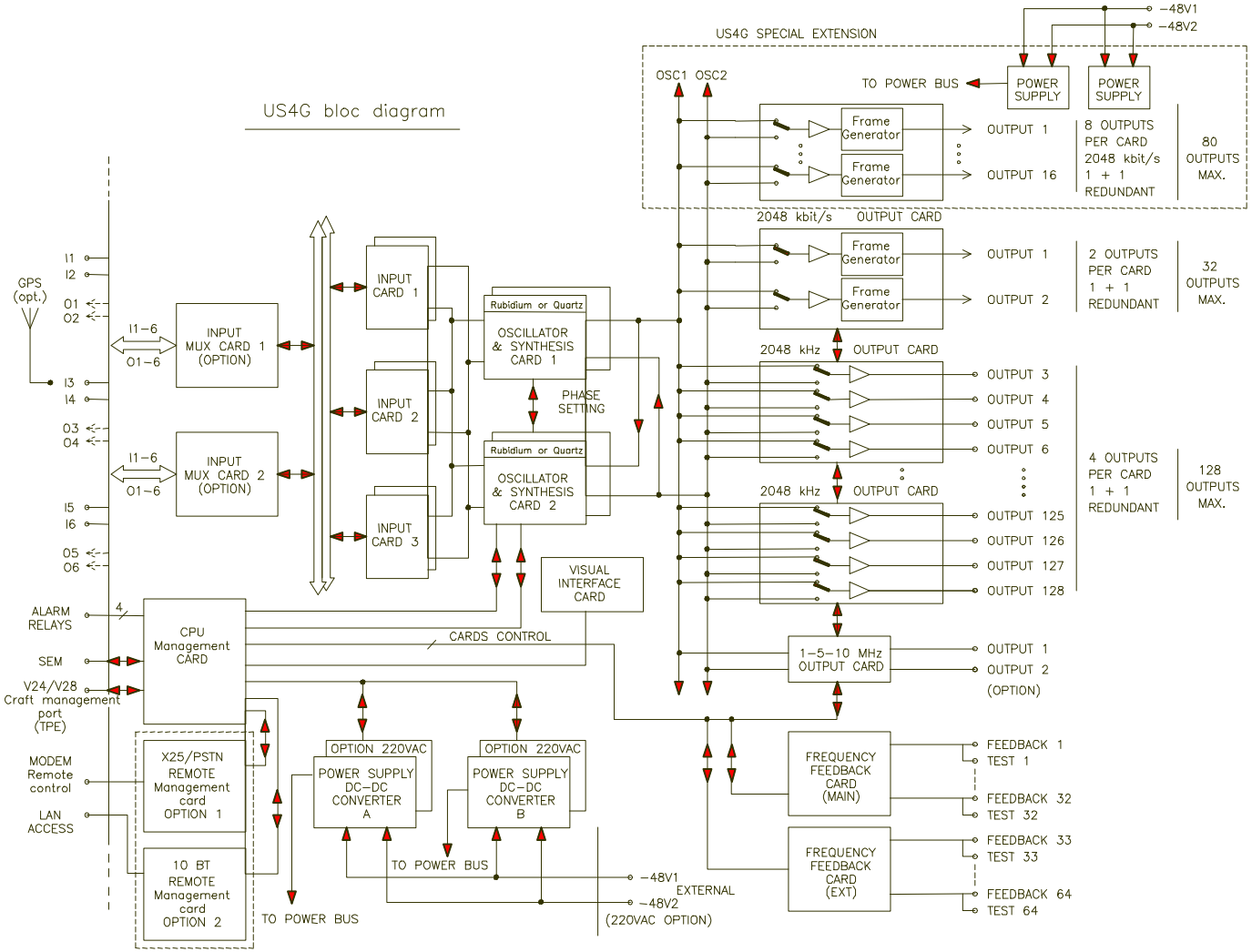
The US4G is compliant with the ETSI 300 019 recommendations, part 1-3, class 3.1 (5° < Temp < 40°).

Typical power consumptions:

100 W ≤ US4G Main unit (double Quartz)	≤ 120 W
120 W ≤ US4G Main unit (double Rubidium)	≤ 140 W
US4G Extension 1	≤ 50 W
US4G Extension 2	≤ 80 W

A more precise indication of power consumption can be calculated on request.
This one will be based on the precise definition of the US4G configuration.

3.14. Weigth

US4G Main unit	≤ 50 kg
US4G Extension 1	≤ 25 kg
US4G Extension 2	≤ 40 kg

4. APPENDIX 1 : BLOCK DIAGRAM