SYSTEM 2000

Enhanced GPS-System for Telecom and Calibration

- **8 x 10^{-13} Frequency Stability under Selective Availability (24 h)**
- **Telecom Primary Reference Source PRS for Level I / G.811**
- **Rb-Oscillator with perfect Holdover Stability (Aging ca. 1,3 x 10^{-12} per day)**

The System 2000 is Efratom´s second generation of enhanced GPS Systems. The system provides extremely reliable reference frequencies, which are used in telecommunication, in calibration laboratories and in electric supply companies.

The application of Efratom´s high performance Rubidium Oscillators allows the use of special GPS algorithms (enhanced GPS) in order to guarantee the high accuracy of the System 2000. Not only the effects of Selective Availability are filtered out, but also the unintentional troubles of the GPS-System.

GPS technology has enabled improved performance to be achieved in many timing and frequency applications. Efratom has more than 10 years experience in the technology of disciplining GPS/Qz and GPS/Rubidium Oscillators, which assures the gain of the optimum cost effective performance. This fact coupled as well as over 20 years experience as the leading producer of about 90% of the world´s commercial Rubidium Oscillators offers us the opportunity to take advantage of both technologies. Efratom assures a lifetime guarantee for the critical components (rubidium lamp and cell) of the equipment. The MTBF of the Rubidium Oscillators is 150.000 hours at the minimum.

The outstanding characteristics of the System 2000 takes effect especially in the operation as a Primary Reference Source. During GPS regulation the system is at the minimum tenfold better (< $1x10^{-12}$) than the G.811 (< $1x10^{-11}$) demands. In case of GPS failure the Rubidium Oscillator changes into the holdover mode with an extremely low inherent error and meets all the requirements of the G.811 up to one week!

Theory of Operation

The System 2000 receives the satellite signals of the GPS-System at any place on earth and uses special algorithms to control a Rubidium Oscillator or OCXO (oven controlled crystal oscillator).

Especially the use of a Rubidium Oscillator takes effect of the enhanced GPS algorithms, which enables the characterization of the GPS data. This effect combines the short-term stability of the Rubidium Atomic Reference with the long-term stability of the GPS-System in an excellent way.

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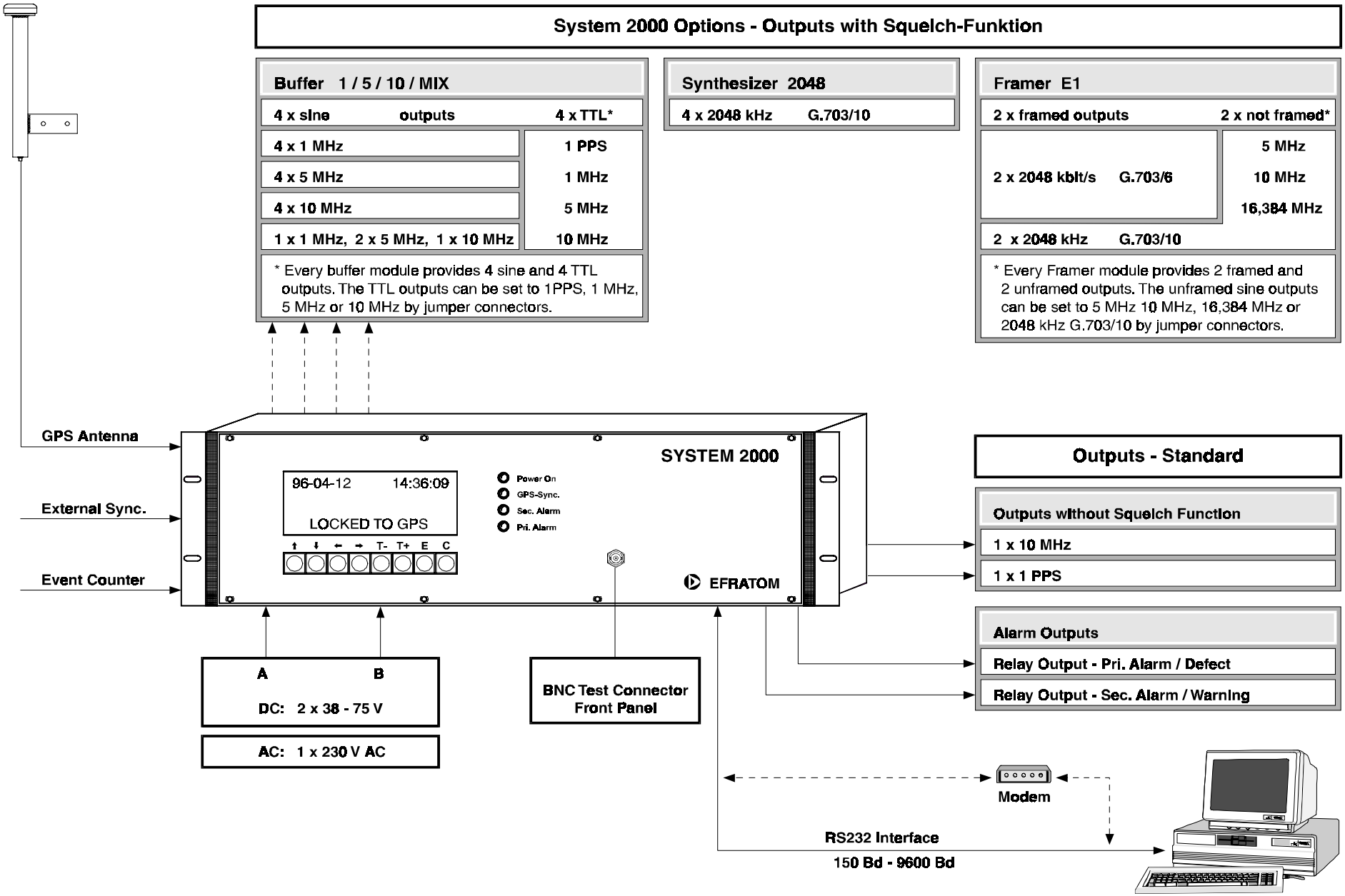
System 2000 Options - Outputs with Squelch-Funktion
Buffer 1 / 5 / 10 / MIX
4 x sine outputs
4 x TTL*
4 x 1 MHz
4 x 5 MHz
4 x 10 MHz
1 x 1 MHz, 2 x 5 MHz, 1 x 10 MHz
1 PPS
1 MHz
5 MHz
10 MHz
* Every buffer module provides 4 sine and 4 TTL outputs. The TTL outputs can be set to 1PPS, 1 MHz, 5 MHz or 10 MHz by jumper connectors.
Synthesizer 2048
4 x 2048 kHz G.703/10
Framer E1
2 x framed outputs
2 x not framed*
2 x 2048 kbit/s G.703/6
5 MHz
10 MHz
16,384 MHz
2 x 2048 kHz G.703/10
* Every Framer module provides 2 framed and 2 unframed outputs. The unframed sine outputs can be set to 5 MHz 10 MHz, 16,384 MHz or 2048 kHz G.703/10 by jumper connectors.
GPS Antenna
External Sync.
Event Counter
SYSTEM 2000
96-04-12 14:36:09
LOCKED TO GPS
Power On
GPS-Sync.
Sec. Alarm
Pri. Alarm
T- T+ E C
EFRATOM
A B
DC: 2 x 38 - 75 V
AC: 1 x 230 V AC
BNC Test Connector Front Panel
Outputs - Standard
Outputs without Squelch Function
1 x 10 MHz
1 x 1 PPS
Alarm Outputs
Relay Output - Pri. Alarm / Defect
Relay Output - Sec. Alarm / Warning
Modem
RS232 Interface
150 Bd - 9600 Bd

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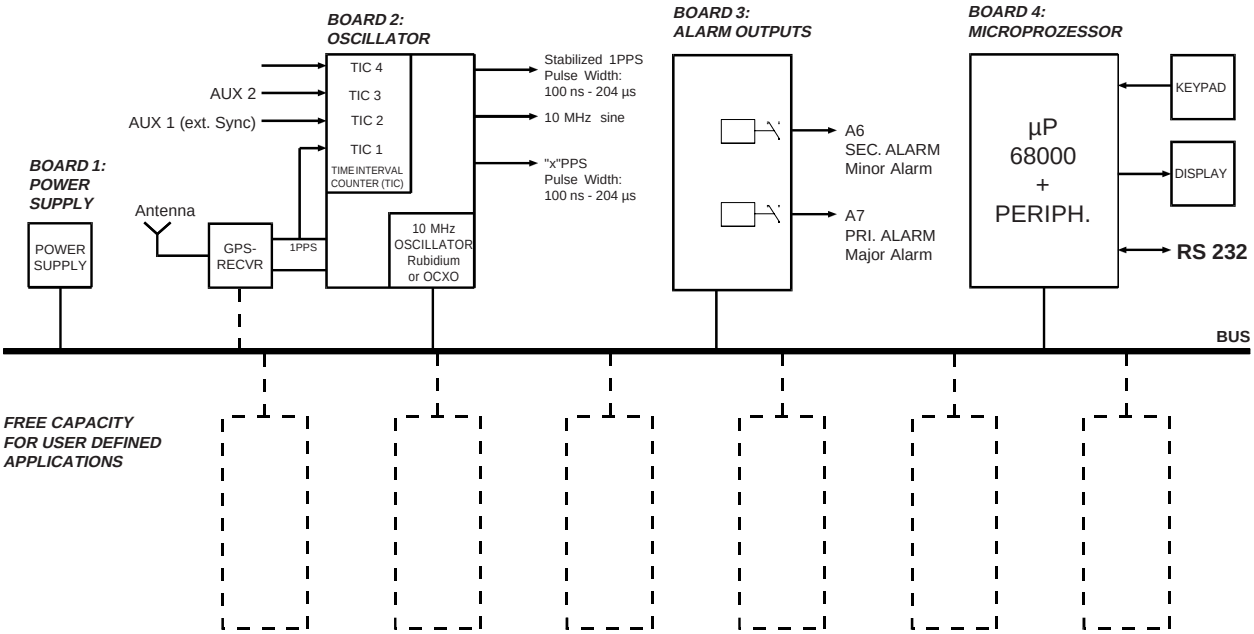
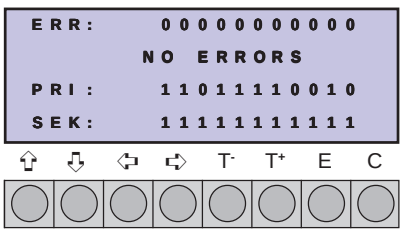
Block Diagram



System 2000 - Assembly

The System 2000 is of modular design. The basic system provides add-on capabilities to satisfy customer needs for specific frequencies and varying numbers of outputs. Up to 24 BNC and four SubD9 outputs can be installed.

The System 2000 is controlled by a well-contrived multistage alarm system which can be set by the user individually for different applications. Two alarm relays are used as an error detection. One output is the composite error Secondary Alarm (warning), the other is the composite error Primary Alarm (defect). In case of any defect (Primary Alarm) the optional frequency outputs will be disabled (squelch function). If a GPS failure occurs the system would indicate the Secondary Alarm / Warning (timeout 2 reached) after 2 hours and the Primary Alarm / Defect (timeout 2 reached) after 72 hours (factory setting). The settings of the freerunning time (timeout 1, timeout 2) can be defined - in dependence of the application - by the user.



Possible Error Message (Bits):

Bit	*Error Message*	
	NO ERRORS	
1	GPS-MODULE FAULT	->
2	RAM IS DEFECT	
3	OFFSET FAULT	
4	TIMEOUT 1 REACHED	->
5	OSCILLATOR DEFECT	
6	TIMEOUT 2 REACHED	->
7	ROM IS DEFECT	
8	GPS INIT FAILED	
9	IO-CARD FAULT	
10	CLOCK ERROR	
11	NOT SYNC UNTIL NOW	->

The alarm display shows the conditions for the output of Primary or Secondary Alarm messages. Each error bit stands for a specific system fault.

Line **PRI** (Primary Alarm) and **SEC** (Secondary Alarm) shows the conditions which are leading to a Major- or a Minor Alarm. These conditions can be changed by the user for different applications.

Line **ERR** (Error) shows the actual operation conditions.
(0 = no error, 1 = error)

No GPS signal available. The system is freerunning.
(Antenna defect or GPS-Failure).

The system is freerunning for longer than Timeout 1.

MINOR ALARM

The system is freerunning for longer than Timeout 2.

MAJOR ALARM

Statusinformation during warm up.

All remaining Alarm Messages were displayed in case of hardware failures and are leading to Primary Alarms.

SYSTEM 2000 / Error Messages	
Secondary Alarm	**Primary Alarm**
-> MINOR ALARM (warning)	-> MAJOR ALARM (defect)
-> LED yellow / SEC. ALARM	-> LED red / PRIM. ALARM
-> alarm relay A6	-> alarm relay A7
-> frequency outputs are available	-> frequency outputs are disabled

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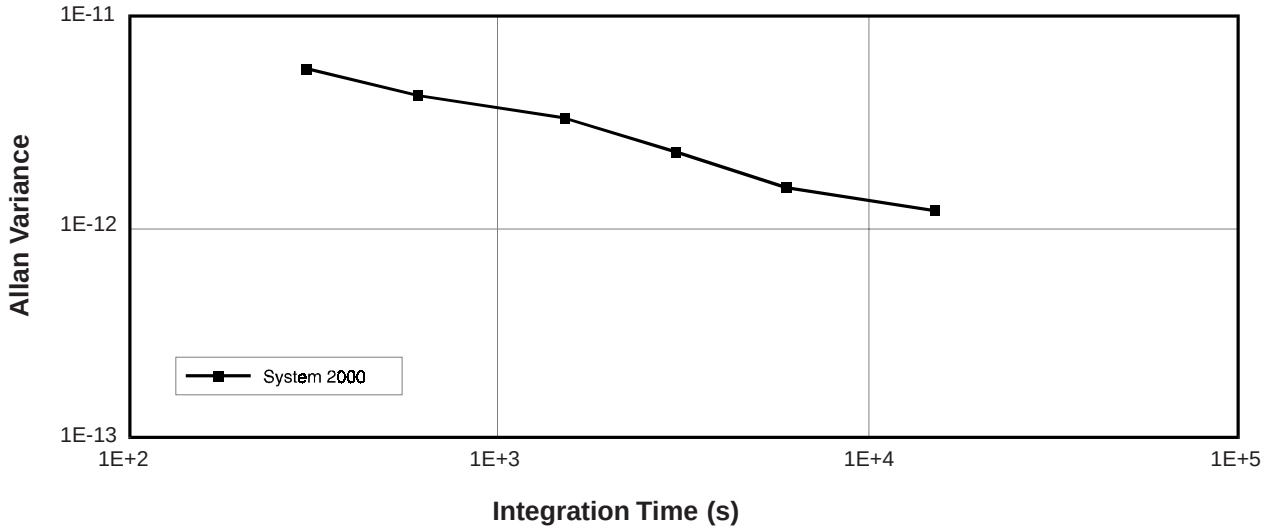
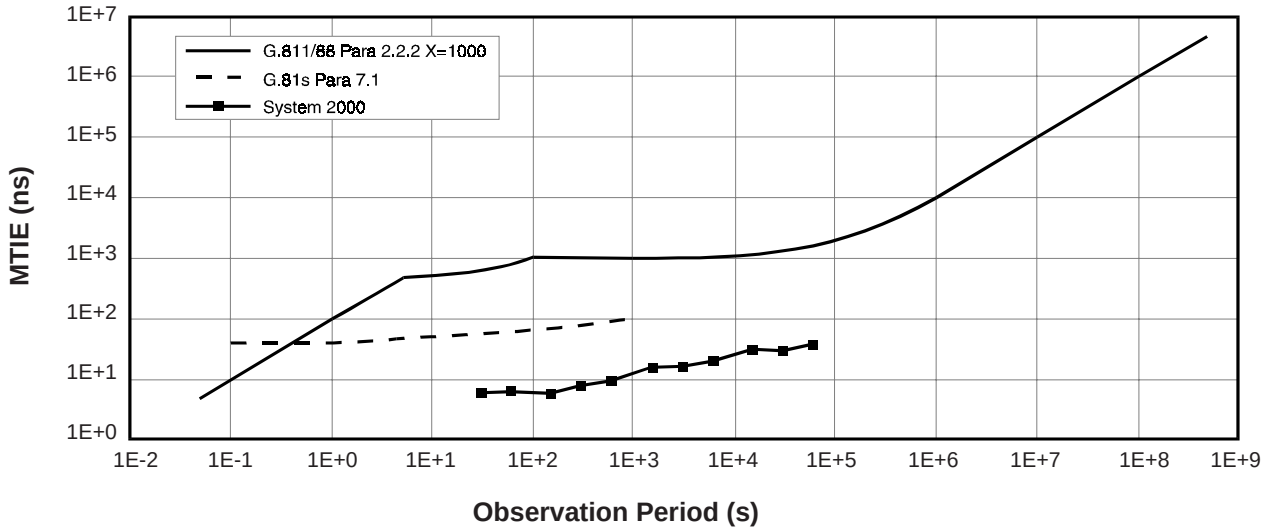
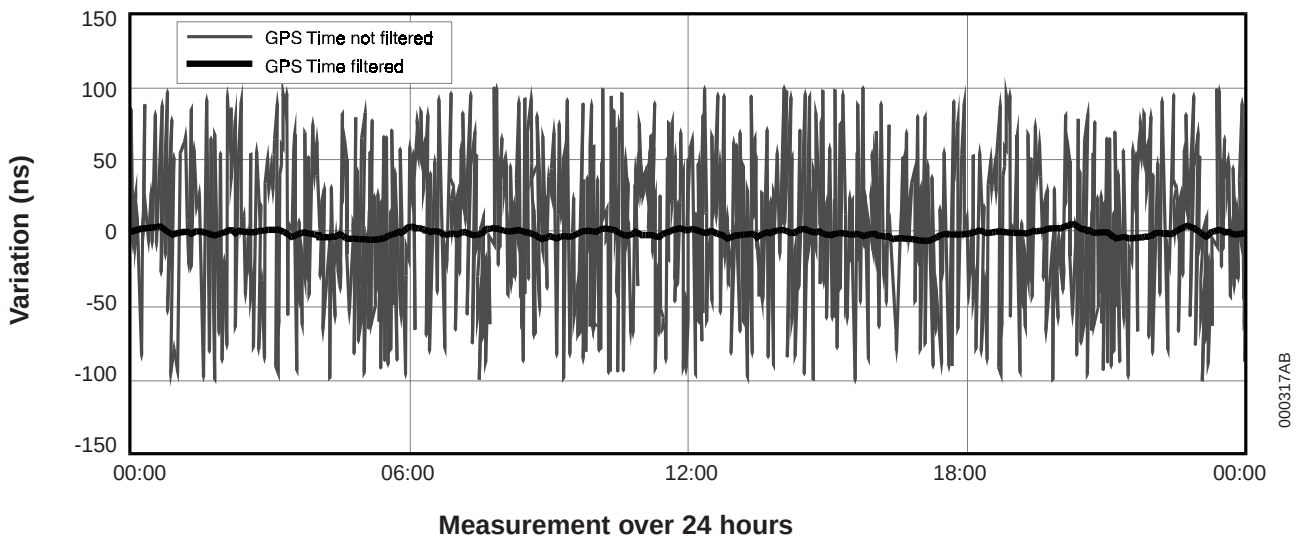
System 2000 AVAR Performance



System 2000 MTIE Performance



Effect of the Enhanced GPS-Algorithms referred to the Time-Output (1PPS)



SYSTEM 2000 STANDARD CONFIGURATION

Relay Outputs

Number:	2 x change-over contacts potential free SubD25
Current Capability:	1 A
Voltage Capability:	75 V- / 50 V~
Power Capability:	30 W / 60 VA
Relay 1 = Minor Alarm / SEC. ALARM	
Relay 2 = Major Alarm / PRI. ALARM	

Frequency - Inputs / - Output BNC

1PPS Input:	TTL level into 50 Ω - external synchronization - time interval counter with 50 ns resolution
1PPS Output:	TTL level into 50 Ω
10 MHz Output:	sine level / 0,5 Vrms into 50 Ω

GPS-Receiver

Type:	6-channel C/A-Code-Receiver, tracks up to 8 satellites continuously
Accessories:	Antenna with mounting hardware and 25 m RG213 cable, N-Connector
Options:	- antenna cable 50 m up to 275 m - high-voltage protector

CE EG-Regulations 89/336/EWG:

Immunity	EN 50082-1 / EN 50082-2
Emissions	EN 50081-1 / EN 50081-2

Flywheel Oscillator (normal performance)

Type:	OCXO
Frequency:	10 MHz

Flywheel Oscillator (high performance)

Type:	Rubidium Atomic Oscillator
Frequency:	10 MHz
Long Term Stability:	$3{,}9 \times 10^{-11}$ per month
Temp. Coefficient:	6×10^{-12} per kelvin

Power Supply

DC: 2 x 38 - 74 V or AC: 1 x 230 VAC

Power

30 W typical, max. 120 W (warm up)

Operation Temperature

Unit:	0° C to +45° C
Antenna:	-55° C to +85° C

Dimensions

Unit: 483 x 132 x 320 / w x h x d (mm)

RS232-Interface

config. from 150 Bd to 9600 Bd SubD9
(hardware handshake, controlling by modem)

SYSTEM 2000 OPTIONS

Buffer Options

Every buffer module provides 4 sine and 4 TTL outputs. The TTL outputs can be set to 1 MHz, 5 MHz, 10 MHz or 1PPS (all outputs BNC).

Buffer 10 **ETN 83200011**

Outputs:

4 x 10 MHz sine level	1,0 - 1,4 Vrms / 50 Ω
4 x 10 / 5 / 1 MHz or 1PPS	TTL into 50 Ω

Buffer 5 **ETN 83200010**

Outputs:

4 x 5 MHz sine level	1,0 - 1,4 Vrms / 50 Ω
4 x 10 / 5 / 1 MHz or 1PPS	TTL into 50 Ω

Buffer 1 **ETN 83200012**

Outputs:

4 x 1 MHz sine level	1,0 - 1,4 Vrms / 50 Ω
4 x 10 / 5 / 1 MHz or 1PPS	TTL into 50 Ω

Buffer MIX **ETN 83200013**

Outputs:

1 x 1 MHz sine level	1,0 - 1,4 Vrms / 50 Ω
2 x 5 MHz sine level	1,0 - 1,4 Vrms / 50 Ω
1 x 10 MHz sine level	1,0 - 1,4 Vrms / 50 Ω
4 x 10 / 5 / 1 MHz or 1PPS	TTL into 50 Ω

Telecom Options

Synthesizer 2048 **ETN 83200014**

Outputs:

4 x 2048 kHz / G.703/10 75 Ω asym. BNC / SubD9

Framer E1 **ETN 83200020**

Outputs:

2 x 2048 kbit/s / G.703/6 75 Ω / 120 Ω SubD9
- SSM-Level (1-15) and bit S_{a4} - S_{a8} are adjustable
- CRC4 Generation can be switched ON or OFF

2 outputs are available alternatively:

2048 kHz G.703/10	75 Ω / 120 Ω	BNC / SubD9
16,384 MHz	1 Vrms 75 Ω	BNC
10 MHz	1 Vrms 75 Ω	BNC
5 MHz	1 Vrms 75 Ω	BNC

The System 2000 provides up to 24 outputs in dependance of the configuration. The plug in modules can be combined individually. These outputs will be disabled in case of any Primary Alarm.

Squelch Function:

In case of any Primary Alarm the optional frequency outputs will be disabled. This facility prevents the output frequency from unserviceable signals. In this way the system guarantees the specified frequency during operation. The conditions which are leading to a Primary Alarm can be set by the user and depends on the specific application.

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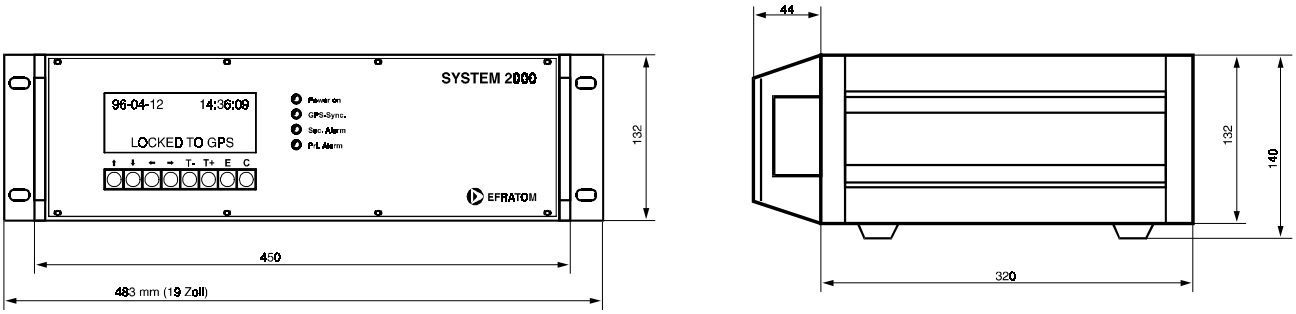
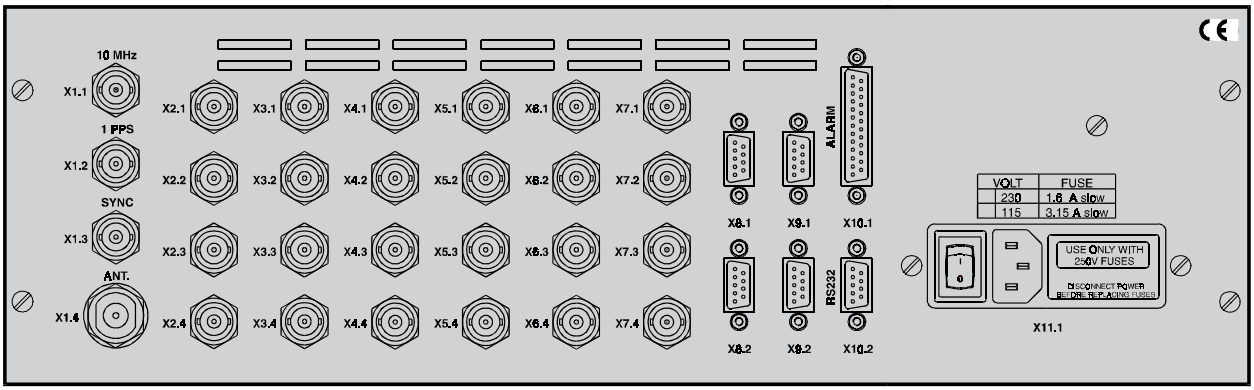
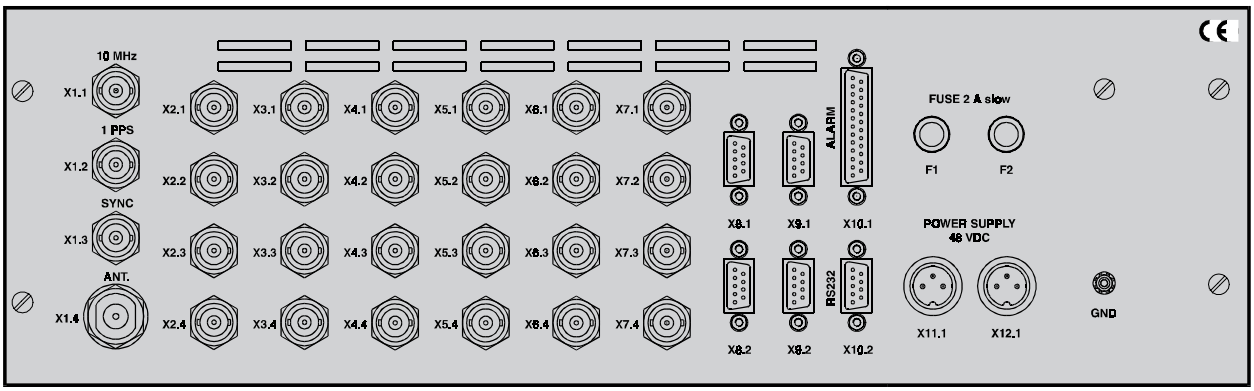


Dimensions System 2000



Rear Panel System 2000 / AC-Power Supply



Rear Panel System 2000 / DC-Power Supply

Standard-Systems		Order-Number
System 2000	AC / Rubidium	ETN 83200000
System 2000	AC / OCXO	ETN 83210000
System 2000	DC / Rubidium	ETN 83201000
System 2000	DC / OCXO	ETN 83211000

Options	Order Number
Synthesizer 2048	ETN 83200014
Framer E1	ETN 83200020
Buffer 10	ETN 83200011
Buffer 5	ETN 83200010
Buffer 1	ETN 83200012
Buffer MIX	ETN 83200013
High-Voltage Protector (N)	ETN 83209001
Antenna Cable 50 m up to 275 m on request.	

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System 2000
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