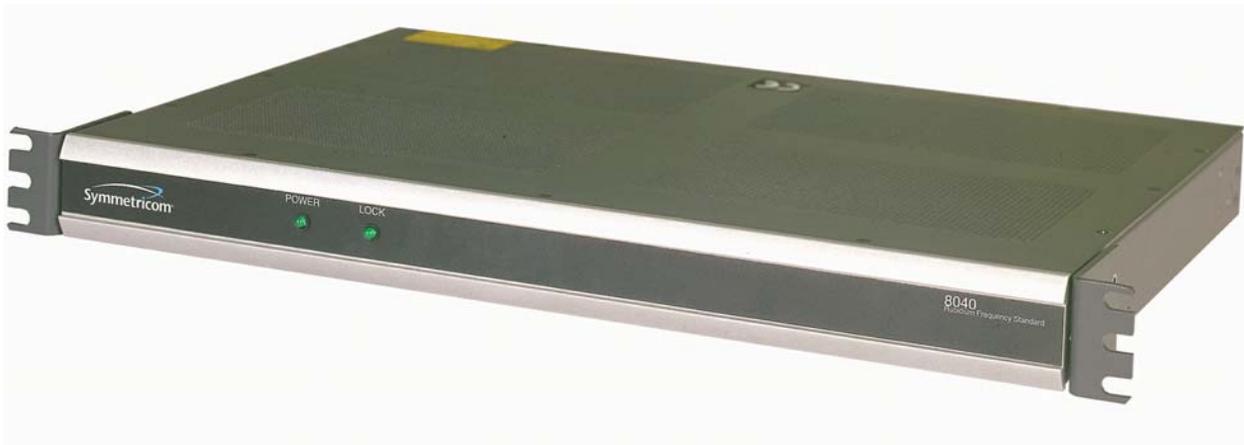




8040 Rubidium Frequency Standard

OPERATING MANUAL 8040 RUBIDIUM FREQUENCY STANDARD #12273-201 Rev D





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8040

Symmetrcom 8040 Rubidium Frequency Standard

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Chapter One

INTRODUCTION/PRODUCT OVERVIEW

The Symmetricom 8040 Rubidium Frequency Standard provides an accurate, stable and spectrally pure frequency reference for a variety of output signal configurations.

OPERATING MANUAL SUMMARY

This Operating Manual is divided into the following chapters:

A. CHAPTER ONE – INTRODUCTION/PRODUCT OVERVIEW

This chapter includes a general description of the Symmetricom 8040 and provides some basic product information.

B. CHAPTER TWO – INSTALLATION

Describes initial inspection and installation procedures for the Symmetricom 8040.

C. CHAPTER THREE – OPERATION

Describes the operation of the Symmetricom 8040

D. CHAPTER FOUR – SPECIFICATIONS

Describes the detailed performance specifications of the Symmetricom 8040

E. CHAPTER FOUR – OPTIONS

Describes the optional output configurations that may be provided with your Symmetricom 8040.

PURPOSE OF EQUIPMENT

The Symmetricom 8040 Rubidium Frequency Standard uses the Symmetricom 8000 Low Profile Rubidium Oscillator (LPRO) to produce a 10 MHz output signal, with the necessary power supply to operate from an AC line source. A LOCK indicator lights when the LPRO has warmed up and is locked to the rubidium resonance. In addition, the LOCK status line is set high (TTL) on a 9-pin D connector on the rear panel.

Additional output signal configurations are available when ordering from the factory. The basic enhancement upgrade provides one output at each of 1, 5, and 10 MHz. Other additional output signals are available by installing optional PCB assemblies. A complete list of performance characteristics for the rubidium standard is provided in Chapter Four.



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INSTRUMENT IDENTIFICATION

The model number 8040 may be followed by a slash (/) and a three-digit number to indicate an option that is supplied within the instrument.

OPTIONS

The Symmetricom 8040 is available with the following options

EU1	Buffered RF Sine Wave Outputs
R03	1 PPS Output (Qty 2, Synchronizable)
R41	Three 1 MHz Outputs*
R42	Three 5 MHz Outputs*
R43	Three 10 MHz Outputs*
	*Available in high isolation $\geq 100\text{dB}$ or standard isolation
R46	Disciplining to an External 1 PPS Input
R52	Two 3.58 MHz Output
R53	Three 10.23 MHz Output
R59	Synthesized RF Output from 0.1 MHz to 12 MHz
R63/T	T1 Telecom Output
R64/E	E1 Telecom Output

See Chapter Five for more information on the available options.



NOTE ...

Not all options can be combined. Symmetricom can provide other customized outputs for the 8040. Please consult the Sales department for specifications.



PREPARATION FOR SHIPMENT

To turn off the Symmetricom 8040 prior to shipment, remove the AC power cord from the rear panel. Package the instrument in its original packing if possible. If the original packing materials are not available, pack in a reinforced cardboard carton using foam to take up any space inside the carton. Do not use foam popcorn or crushed paper for packing.

If the instrument is being returned to Symmetricom, contact the Service Department at 1-888-367-7966 to advise of the product return.

TYPOGRAPHICAL AND OTHER CONVENTIONS

This Operating Manual uses the following conventions:

Acronyms and Abbreviations – Terms are spelled out the first time they appear in this Operating Manual. Thereafter, only the acronym or abbreviation is used. In addition, the glossary defines the acronyms and abbreviations.

TYPOGRAPHICAL CONVENTIONS

Table 1-1 describes the typographical conventions that this Operating Manual uses to distinguish between the different types of information according to how they are used.

WHEN TEXT APPEARS THIS WAY ...	IT MEANS ...
<i>Symmetricom 8040 Operating Manual</i>	The title of a document or the name of a product
CRITICAL PORT-1 J1	An operating mode, alarm state, status, or chassis label.
Press the Enter key.	A named keyboard key. The key name is shown as it appears on the keyboard. An explanation of the key's acronym or function immediately follows the first reference to the key, if required.
Press the Print Scrn key.	
A <i>re-timing</i> application ...	A term or a word being emphasized.
Symmetricom does not recommend ...	A word or term given special emphasis so that you do not miss the idea being presented.



WARNINGS, CAUTIONS, RECOMMENDATIONS, AND NOTES

Warnings, Cautions, Recommendations, and Notes attract attention to essential or critical information in this Operating Manual. The types of information included in each are explained as follows:



WARNING ...

All warnings have this symbol. Do not disregard warnings. They are installation, operation, or maintenance procedures, practices, or statements that if not strictly observed, may result in personal injury or loss of life.



ELECTRICAL SHOCK HAZARD ...

All electrical shock hazard warnings have this symbol. To avoid serious personal injury or death, do not disregard electrical shock hazard warnings. They are installation, operation, or maintenance procedures, practices, or statements that if not strictly observed, may result in personal injury or loss of life.



CAUTION ...

All cautions have this symbol. Do not disregard cautions. They are installation, operation, or maintenance procedures, practices, conditions, or statements that if not strictly observed, may result in damage to or destruction of equipment or may cause a long-term health hazard.



CAUTION ...

All Electrostatic Discharge (ESD) cautions have this symbol. They are installation, operation, or maintenance procedures, practices, conditions, or statements that if not strictly observed, may result in electrostatic discharge damage to, or destruction of, static sensitive components of the equipment.



RECOMMENDATION ...

All recommendations have this symbol. Recommendations indicate manufacturer-tested methods or known functionality. They contain installation, operation, or maintenance procedures, practices, conditions, or statements that provide you with important information for optimum performance results.



NOTE ...

All notes have this symbol. Notes contain installation, operation, or maintenance procedures, practices, conditions, or statements that alert you to important information which may make your task easier or increase your understanding.



WHERE TO FIND ANSWERS TO PRODUCT AND DOCUMENT QUESTIONS

If you believe that this product is not performing as expected, or if you have comments about this Operating Manual, please contact your Symmetricom representative or sales office

We appreciate your suggestions on ways to improve this Operating Manual. Please mark or write your suggestions on a copy of the page and mail or fax it to ...

Symmetricom – Timing, Test & Measurement
3750 Westwind Boulevard
Santa Rosa, CA 95403
US Toll Free: 1-888-367-7966
Phone: +1-707-528-1230
Fax: +1-707-527-6640
E-mail: ttm_info@symmetricom.com

Thank you for providing the information.



NOTE ...

Symmetricom offers a number of applicable training courses designed to enhance product usability. Contact your Symmetricom representative or sales office for a complete list of courses and outlines.



Chapter Two

INSTALLATION AND OPERATION

MOUNTING

The Symmetricom 8040 is designed to be mounted in a standard 19-inch equipment rack and take up 1 UI of vertical space (1.75"). The chassis depth is 12 inches. For best performance, the operating environment should have a stable temperature. In addition, the user should ensure that there are no strong magnetic fields (>2 gauss) in the vicinity of the shelf since the rubidium oscillator is sensitive to DC and AC magnetic fields.

POWER CONNECTION/FUSES/VOLTAGE SELECTION

The Symmetricom 8040 is powered from an AC source. Refer to Chapter Three - Specifications for power supply requirements. The AC fuse is located inside the AC connector/filter on the rear panel. To change the fuse, open the cover on the rear panel AC connector by applying a screwdriver to the connector's cover slot. Once the cover is open, the fuse holder may be removed for inspection or replacement. The fuses are specified in Chapter Three.

The Symmetricom 8040 may be powered from 85 to 264VAC. The 8040 automatically detects the input voltage therefore no manual configuration is required.



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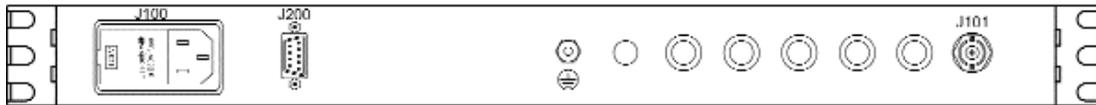
TURN-ON

To turn the Symmetricom 8040 on, plug the power cord into an AC source. The POWER indicator lights immediately, and the LOCK indicator lights within the specified warm-up time, indicating that the rubidium oscillator frequency accuracy is within $\pm 5E-8$ of absolute frequency. The 8040 will be within $4E-10$ of absolute frequency after fifteen minutes of operation. For best results, please allow the 8040 to warm up for at least thirty minutes.

SIGNAL CONNECTIONS

Output signals may be connected in any order to the rear panel BNC connectors. Only those BNC connectors that are required by a particular option are included. See Chapter Five for details.

FIGURE 2-2. SIGNAL CONNECTIONS



OUTPUT SIGNALS

The basic Symmetricom 8040 outputs 10 MHz through BNC connector J101. There is provision for up to five additional BNC connectors and one pushbutton switch to accommodate the requirements of options, which are described in Chapter Five.

STATUS CONNECTIONS

The Symmetricom 8040 provides for several monitors on the 9-pin connector on the rear panel, J200. Refer to Chapter Four for specifications.

Chapter Three

OPERATION

There are no external controls for the Symmetricom 8040. The two LED indicators on the front panel are described below.

POWER – When AC power is connected, and the unit is in operation. There is no power switch on the 8040. Power is turned off by removing the power cord from the IEC receptacle on the rear panel.

LOCK – When the internal rubidium oscillator has reached operating temperature and is producing a frequency output that is within specifications, the LOCK indicator is turned on.



CAUTION ...

Do not use the Symmetricom 8040 as a reference source until the LOCK indicator is turned on.

FIGURE 3-1. SYMMETRICOM 8040 FRONT PANEL

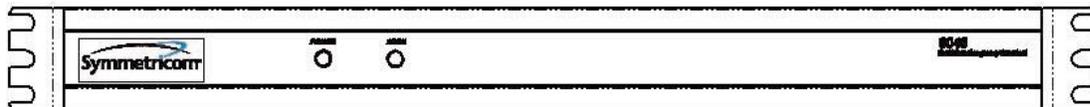


FIGURE 3-2. SYMMETRICOM 8040 REAR PANEL



FREQUENCY ADJUSTMENT PROCEDURES

There are two primary reasons to adjust the external frequency output of the Symmetricom 8040. The first is to compensate for aging over time, and the second is to syntonize (make the frequency the same) the rubidium oscillator to a more accurate primary frequency source. The Symmetricom 8040 is a secondary frequency standard (i.e., much more accurate than a quartz frequency standard, but not as accurate as a cesium standard, which is considered to be a primary frequency standard). Comparing the Symmetricom 8040 to an external cesium standard or a GPS receiver, it can be readjusted periodically to match the primary standard's greater accuracy.

There are two mechanisms to adjust the output frequency. Both methods result in a change in the current through a coil (the unit's C-field coil, which is wrapped around the resonance cell of the frequency standard, in turn adjusting the internal magnetic field of the resonator). The first method is electro-mechanical, by adjusting the external C-field potentiometer which is accessible through a small hole in the top cover of the rubidium oscillator. Rotation of the slotted adjustment screw of the potentiometer produces a frequency change. Use a small straight edge screwdriver to accomplish this task.



CAUTION ...

Do not force rotation, or damage to the potentiometer can result.

The second method of adjustment is electronic, using the external C-field control signal available at the monitor output, pin 4. The level is set to a nominal 2.5 volts at the factory and accepts an input between 0 and +5 V. Applying a voltage between 2.5 V and 5.0 V will pull the frequency in the positive direction. Applying a voltage between 0 V and 2.5 V will pull the frequency in the negative direction. Operating outside the range of 0 to +5 V dc is not recommended.



CAUTION ...

Do not exceed +36 VDC or -8 VDC or malfunctioning of the unit will result.

A typical external counter does not have a resolution or accuracy high enough to set this device, so do not reset the frequency unless established metrology methods are used for frequency measurement resolution of $<1E-11$.



CAUTION ...

The power supply voltage for this external C-field control must be very stable and pure or it will degrade the performance of the Symmetricom 8040.

The C-field control circuitry is designed to independently sum the contributions of the control potentiometer and the external control signal. Each signal contributes $>1.5E-9$ frequency offset correction capability.



Chapter Four

SPECIFICATIONS



NOTE ...

All performance is at an ambient temperature of 25°C unless otherwise specified.

RF OUTPUT

Output Frequency/Waveform	10 MHz, sine wave
Output Level	0.5V ms into 50 ohms
Output Impedance	50 @ 10 MHz
Harmonic Signals	</=-40dBc
Non-Harmonic Signals	</=-80dBc
Connector	BNC, rear panel

PHASE NOISE (SSB, 1 HZ BW)

Offset from carrier

1 Hz	-75 dBc//Hz
10 Hz	-89 dBc//Hz
100 Hz	-128 dBc//Hz
1,000 Hz	-140 dBc//Hz
10,000 Hz	-147 dBc//Hz

SHORT TERM STABILITY

$\tau = 1$ second	<2.5E-11
$\tau = 10$ second	<0.8E-11
$\tau = 100$ second	<0.25E-11

AGING

Monthly (after 1 month)	<5E-11/month
10 years	<1E-9

FREQUENCY ACCURACY

at shipment	$\pm 5E-11$ (25° C)
-------------	---------------------



FREQUENCY RETRACE

After 24 hours power on @ 25° C
and up to 48 hours off $\lt; \pm 2.5E-11$

WARM-UP

	At -20° C	At 25° C
Time to Lock	$\lt; 8.7 \text{ min}$	$\lt; 5.6 \text{ min}$
Time to $\lt; 1e-9$	$\lt; 10.2 \text{ min}$	$\lt; 7.3 \text{ min}$
Time to $\lt; 4e-10$	$\lt; 12.7 \text{ min}$	$\lt; 10.6 \text{ min}$

FREQUENCY CONTROL

Internal Trim Range (trimpot)	>math>\gt; \pm 1.5E-9 (0V \text{ } 1.5E-9)</math>
External Trim Range (electronic)	$\lt; \pm 1.5E-9 (0V \text{ to } +5V)$

STATUS MONITOR

Analog	VCXO volts, lamp volts (20 k impedance, filtered)
Digital	LOCK monitor: 5V CMOS load
Lock	>math>\gt; 2.5V (TTL \text{ high})</math>
Unlock	$\lt; 0.2V (TTL \text{ low})$

GENERAL

Power Requirements	
Operating Voltage	85 to 264 VAC
Power	$\lt; 60 \text{ W max, } \lt; 25 \text{ W quiescent}$
Mating Connectors	
RF Outputs	BNC
Status Monitors	9-pin "D" connector
Fuses	
AC Input	2 A, 250 V, slow acting, 5x20 mm or 0.25"x1.25"
Dimensions	
Height	1.75" (1 UI)
Width	19"
(including rack mounting ears)	
Depth	12"
Weight	$\lt; 6 \text{ lbs}$



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ENVIRONMENT

Temperature, Operating	0 to 50° C, <3E-10
Temperature, Storage	-55° C to +85° C
Relative Humidity	0 to 95%, non-condensing
Magnetic Field	±4E-11/Gauss, 2 Gauss max

OPTIONS

EU1	Buffered RF Sine Wave Outputs
R03	1 PPS Output (Qty 2, Synchronizable)
R41	Three 1 MHz Outputs*
R42	Three 5 MHz Outputs*
R43	Three 10 MHz Outputs*
	*Available in high isolation ≥100dB or standard isolation
R46	Disciplining to an External 1 PPS Input
R52	Two 3.58 MHz Output
R53	Three 10.23 MHz Output
R59	Synthesized RF Output from 0.1 MHz to 12 MHz
R63/T	T1 Telecom Output
R64/E	E1 Telecom Output

See Chapter Five for more information on the available options.



NOTE ...

Not all options can be combined. Symmetricom can provide other customized outputs for the 8040. Please consult the Sales department for specifications.



Chapter Five

OPTIONS

INTRODUCTION

There are several options available for the Symmetricom 8040 Rubidium Standard. Many different options may be installed in a given 8040 unit. All unused holes in the rear panel are plugged. The identification plate on the rear panel of the unit will indicate the option that is included. For example, if Option EU1 is included, the model number will be 8040/EU1.

OPTION EU1 – BUFFERED RF SINE WAVE OUTPUTS

The buffered sine wave output option provides for three RF outputs, one each of 1 MHz, 5 MHz and 10 MHz. The level of all outputs is 1 Vrms. A 10 MHz TTL signal is also output. All other performance parameters are as indicated in Chapter Four.

FIGURE 5-EU1-1. SIGNAL CONNECTIONS WITH OPTION EU1



OUTPUT CONNECTIONS

- J101 10 MHz
- J102 5 MHz
- J103 1 MHz
- J104 10 MHz TTL

OPTION R03 – 1 PPS OUTPUT

The 1 PPS output option provides two 1 PPS outputs, a 1 PPS synchronization input, a synchronization switch and the outputs listed in Option EU1. To synchronize the 1 PPS outputs to an input reference, connect the 1 PPS reference input to J106 and press the SYNC switch. This will cause the two 1 PPS output signals to be synchronized to the 1 PPS reference input. During normal operation, without a 1 PPS reference input, the internal rubidium oscillator of the 8040 synchronizes the two 1 PPS output signals.

FIGURE 5-R03-1. SIGNAL CONNECTIONS WITH OPTION R03



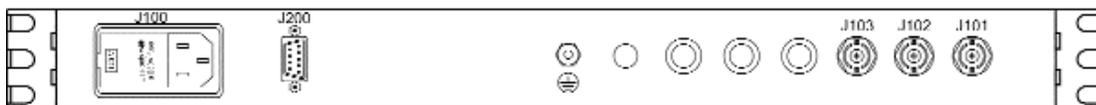
OUTPUT CONNECTIONS

- J101 10 MHz
- J102 5 MHz
- J103 1 MHz
- J104 1 PPS Out
- J105 1 PPS Out
- J106 1 PPS Reference Input
- SYNC Pushbutton Switch – Press to enable external synchronization.

OPTION R43 – THREE 10 MHZ OUTPUTS

Provides three high quality 10 MHz outputs that are derived from the internal rubidium oscillator. All performance parameters are as indicated in Chapter Four.

FIGURE 5-R43-1. SIGNAL CONNECTIONS WITH OPTION R43



OUTPUT CONNECTIONS

- J101 10 MHz
- J102 10 MHz
- J103 10 MHz



OPTION R42 – THREE 5 MHZ OUTPUTS

Provides three high quality 10 MHz outputs that are derived from the internal rubidium oscillator. All performance characteristics are as indicated in Chapter Four.

FIGURE 5-R42-1. SIGNAL CONNECTIONS WITH OPTION R42



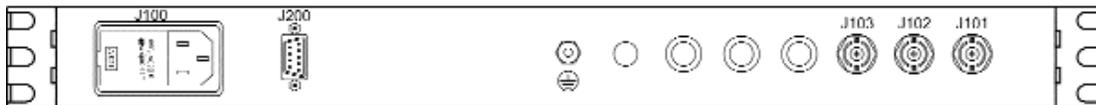
OUTPUT CONNECTIONS

- J101 5 MHz
- J102 5 MHz
- J103 5 MHz

OPTION R41– THREE 1 MHZ OUTPUTS

Provides three high quality 1 MHz outputs that are derived from the internal rubidium oscillator. All performance parameters are as indicated in Chapter Four.

FIGURE 5-R41-1. SIGNAL CONNECTIONS WITH OPTION R41



SIGNAL CONNECTIONS

- J101 1 MHz
- J102 1 MHz
- J103 1 MHz



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OPTION R46 – DISCIPLINING TO AN EXTERNAL INPUT

The Symmetricom 8040 Rubidium Frequency Standard houses a proven rubidium physics module in a 1.75-inch high rack mounted module. The 8040 offers a convenient, ready to use package accepting AC mains inputs and providing RF outputs on standard BNC output connectors.

As a stand alone unit, the Symmetricom 8040 is a highly accurate atomic frequency standard with a factory set accuracy of better than 5×10^{-11} and aging of less than 5×10^{-11} per month.

The Disciplining option (Option R46) provides a means by which to both enhance these parameters and give remote serial access, to monitor and control the Symmetricom 8040 against external references, by adding an additional (microprocessor controlled) interface circuit mounted within the unit.

DISCIPLINING

The disciplining function is designed to take an external reference which has superior long term stability to the Symmetricom 8040 (e.g., cesium standard, hydrogen maser, GPS receiver) and use the external reference to "steer" the internal rubidium module to give enhanced long term stability and accuracy.

Because the Symmetricom 8040 already possesses a high level of inherent accuracy and stability the changes made by reference to the external source are very small in nature. Typically the adjustments will be less than 1×10^{-11} fractional frequency change. In order to calculate the necessary corrections the error between the Symmetricom 8040 and the external reference is integrated over a long period of time (approximately 24 hours) before the adjustment is calculated and applied.

A separate input allows for a "valid" / "non valid" alarm input to the Symmetricom 8040 to confirm the external signal validity.

The external signal required for reference is a one pulse per second (1 PPS) input with the following characteristics.

- 2.4 V peak into 50
- Minimum pulse width 20 μ S
- Rise time <50 nS

The disciplining function will be inhibited if:

- a) The valid/non-valid input is pulled low, or
- b) The one pulse per second (1 PPS) signal is not present.



Remote Monitoring/Control

Option R46 also provides an RS232/RS422 interface to allow remote communications with the Symmetricom 8040 unit. The function available via this interface are:

Monitors

- i) Physics lamp voltage
- ii) Crystal oscillator (VCXO) control voltage
- iii) Rubidium module "lock" signal
- iv) Rubidium module input voltage
- v) Digital to analog converter value

Controls

- vi) Set and clear the digital to analog converter value
- vii) Adjust the control loop

In order to use these functions the user must write a dedicated software driver. A document detailing the necessary command set will be provided upon request.



FIGURE 5-R46-1. SIGNAL CONNECTIONS WITH OPTION R46



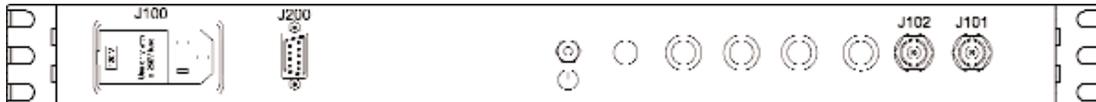
SIGNAL CONNECTIONS

- J101 10 MHz
- J102 5 MHz
- J103 1 MHz
- J104 1 PPS Input
- J105 1 PPS Health Output

OPTION R52 – TWO 3.58 MHZ OUTPUTS

The R52 option provides two 3.58 MHz outputs that are designed to support color-burst requirements in the television broadcasting industry.

FIGURE 5-R52-1. SIGNAL CONNECTIONS WITH OPTION R52



SIGNAL CONNECTIONS

- J101 3.58 MHz
- J102 3.58 MHz



OPTION R53 – THREE 10.23 MHZ OUTPUTS

Provides three 10.23 MHz outputs, 1 Vrms sine wave, that are derived from the internal rubidium oscillator. All performance parameters are as indicated in Chapter Four.

FIGURE 5-R53-1. SIGNAL CONNECTIONS WITH OPTION R53



SIGNAL CONNECTIONS

- J101 10.23 MHz
- J102 10.23 MHz
- J103 10.23 MHz

OPTION R59 – DDS SYNTHESIZER

Provides three synthesized RF outputs from 100 kHz to 12 MHz. Specifications are available upon request.



OPTION R63/T – T1 TELECOM OUTPUT

Option R63/T adds a DS1 Telecommunications Synthesizer PCB Assembly to the Symmetricom 8040. With Option R63/T, the Symmetricom 8040 can serve as a stand alone Stratum 2 Clock, or as a component of a Master Clock System.

Option R63/T adds the following outputs to the rear panel of the instrument:

- A balanced 1.544 MHz, framed all ones, DS1 signal
- An 8 kHz, TTL signal synchronous with the DS1 Frame Markers
- A 1.544 MHz TTL clock

All three outputs are phase-locked to a 10 MHz reference input provided by the Symmetricom 8040 Rubidium Frequency Standard.

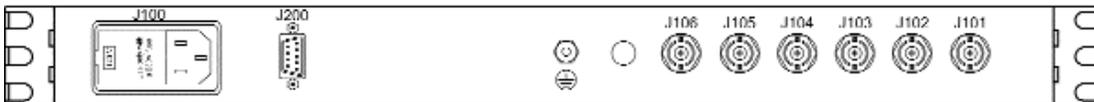
The DS1 output is switch selectable (via a 4-position terminal block on the PCB) to provide either a D4 or Extended Superframe (ESF) format. Figure 5-R63-1 provides an illustration of the D4 and ESF formats. As shipped from the factory, the switches are set to provide the D4 format.

The following input is added to the rear panel:

- Frame Synchronization, which allows the DS1 and Frame Alignment output signals to be synchronized to an external reference.
- A contact closure summary alarm is added to the rear panel monitor (J200) connector.

See Option R63/T Specifications.

FIGURE 5-R63-1. SIGNAL CONNECTIONS WITH OPTION R63/T

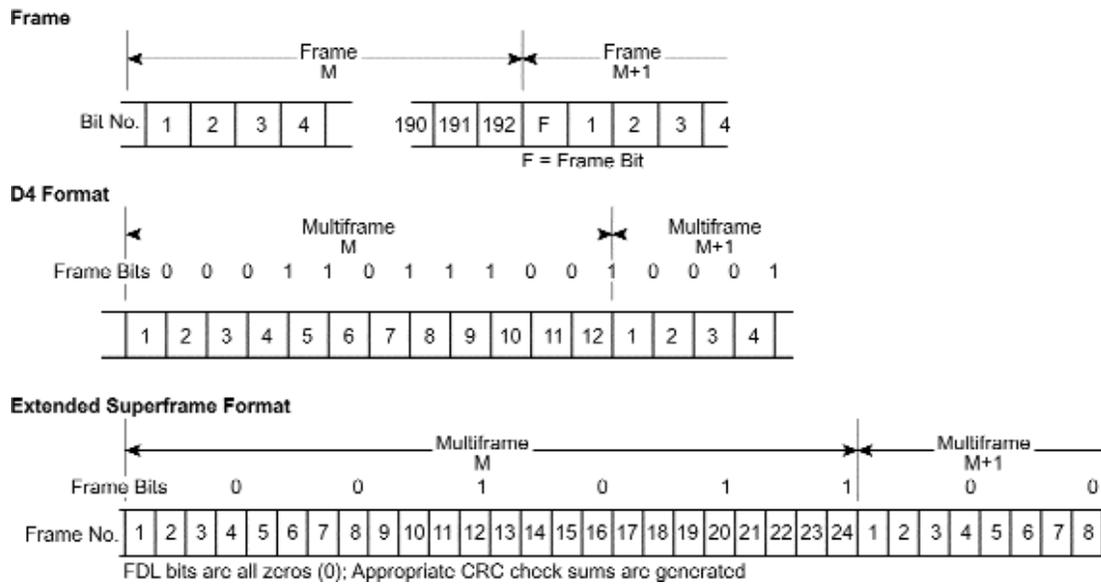


SIGNAL CONNECTIONS

- J101 10 MHz
- J102 5 MHz
- J103 1 MHz
- J104 1.544 MHz (balanced)
- J105 8 kHz TTL
- J106 1.544 MHz TTL Clock



FIGURE 5-R63-2. FRAME, D4 AND EXTENDED SUPERFRAME FORMATS



OPERATION

All Option R63/T external connections are made at the Symmetricom 8040 rear panel. The TTL CLOCK output uses BNC connectors. The DS1 signal is presented on three rear panel connectors.

Note that Alarm detection circuitry turns off the balanced DS1 output when a fault is detected or when proper rubidium oscillator lock has not been achieved. No balanced DS1 output is present during warm-up and lock acquisition of the Symmetricom 8040.

The Summary Alarm relay contacts are available at pins 6, 7, and 8 of the rear panel monitor connector (J200).



SYNCHRONIZING

The frame alignment of the DS1 output can be synchronized to an external reference. It is suggested that a TTL pulse with a repetition rate of 8 kHz (or a submultiple of 8 kHz) be used for synchronization because the frames repeat at a rate of 8,000 frames per second.

To synchronize, briefly apply the reference signal to the rear panel SYNC connector (BNC).

Any Symmetricom product equipped with a DS1 Synthesizer option may be used as a reference by connecting its Frame Marker output to the Frame Sync input of the unit being synchronized.

D4/Extended Superframe Selection

The DS1 format may be switched from D4 to ESF by setting a 4-position terminal block assembly located on the Synthesizer PCB (see Table 5-R63-1).

TABLE 5-R63-1. JUMPER CONFIGURATION

Condition	Block	D4	ESF
DS1 1.544MB/S Option R63/T Balanced	TB1	3-4	3-4
	TB2	B-C	B-C
	TB3	N/C	N/C
	TB4	2-5	N/C
	TB5	2-5	N/C

TB4			TB5		
4	5	6	4	5	6
<input type="radio"/>					
<input type="radio"/>					
1	2	3	1	2	3



MONITORING

System operating status is monitored in the same manner as described in the main body of the Symmetricom 8040 Operating Manual with the following changes:

- Operation status of the DS1 Synthesizer is available at the rear panel monitor connector (J200) at pins 6, 7, and 8.

When the DS1 Synthesizer is in normal operational condition, pins 6-8 are open and pins 7-8 are shorted to each other. In a DS1 Alarm condition, pins 6-8 are shorted and pins 7-8 are open.

A DS1 alarm condition exists when:

- a) Proper Rubidium lock has not been achieved (the front panel LOCK indicator is not on)
- b) A malfunction within the DS1 Synthesizer has occurred.

The balanced DS1 signal is turned off during a DS1 alarm condition.

Loss of Signal

A DS1 signal loss can be caused by:

- Loss of internal 10 MHz reference input signal to the synthesizer assembly,
- Loss of DS1 Synthesizer phase-lock, or
- Loss of Rubidium lock (or before the unit has achieved lock during warm-up).

If the Symmetricom 8040 is operational and the fault exists only with the DS1 Synthesizer Assembly, the front panel LOCK indicator is on.

FUNCTIONAL DESCRIPTION

The DS1 Synthesizer comprises:

- A Digital Phase-Locked Synthesizer
- DS1 Format Generator and Synchronization Circuit
- Frame Detector Circuit
- Alarm Circuitry
- Power Converter

Refer to Figure 5-063-2 for a block diagram of the DS1 Synthesizer Assembly.



DIGITAL SYNTHESIZER

The digital synthesizer section phase-locks a 6.176 MHz VCXO to a 10 MHz reference signal that is supplied by the Rubidium oscillator in the Symmetricom 8040. Both the 6.176 MHz and the 10 MHz signals are digitally divided, phase compared, and integrated to provide a control voltage to the VCXO.

- The first divide-by-four stage yields a 1.544 MHz signal. This signal is distributed to:
- The DS1 Format Generating Circuitry to provide the DS1 clock.

The rear panel as a buffered 1.544 MHz TTL output.

DS1 FORMATTING

The required DS1 formatted TTL output is provided by a Serial Receiver/Transmitter driven by the 1.544 MHz clock signal. The formatted data is applied to a T1 Line Interface Device.

The Line Interface device transforms the TTL signal (from the serial transmitter) into the appropriately shaped Alternating Mark Inverted (AMI) pulse.

DS1 SYNCHRONIZATION

The Receiver/Transmitter accepts an external SYNC signal and synchronizes the start of the frame to the sync reference. Synchronization occurs on the next clock pulse after the SYNC input has returned to a logic "1" (low-to-high transition).

DS1 FRAME DETECTOR

The Frame Detector accepts a five-bit BCD word from the Receiver/Transmitter that is the binary value of the channel being transmitted. At the start of the next frame, logic circuitry detects a binary (00000) and provides a Frame Marker output pulse.

DS1 ALARM CIRCUITRY

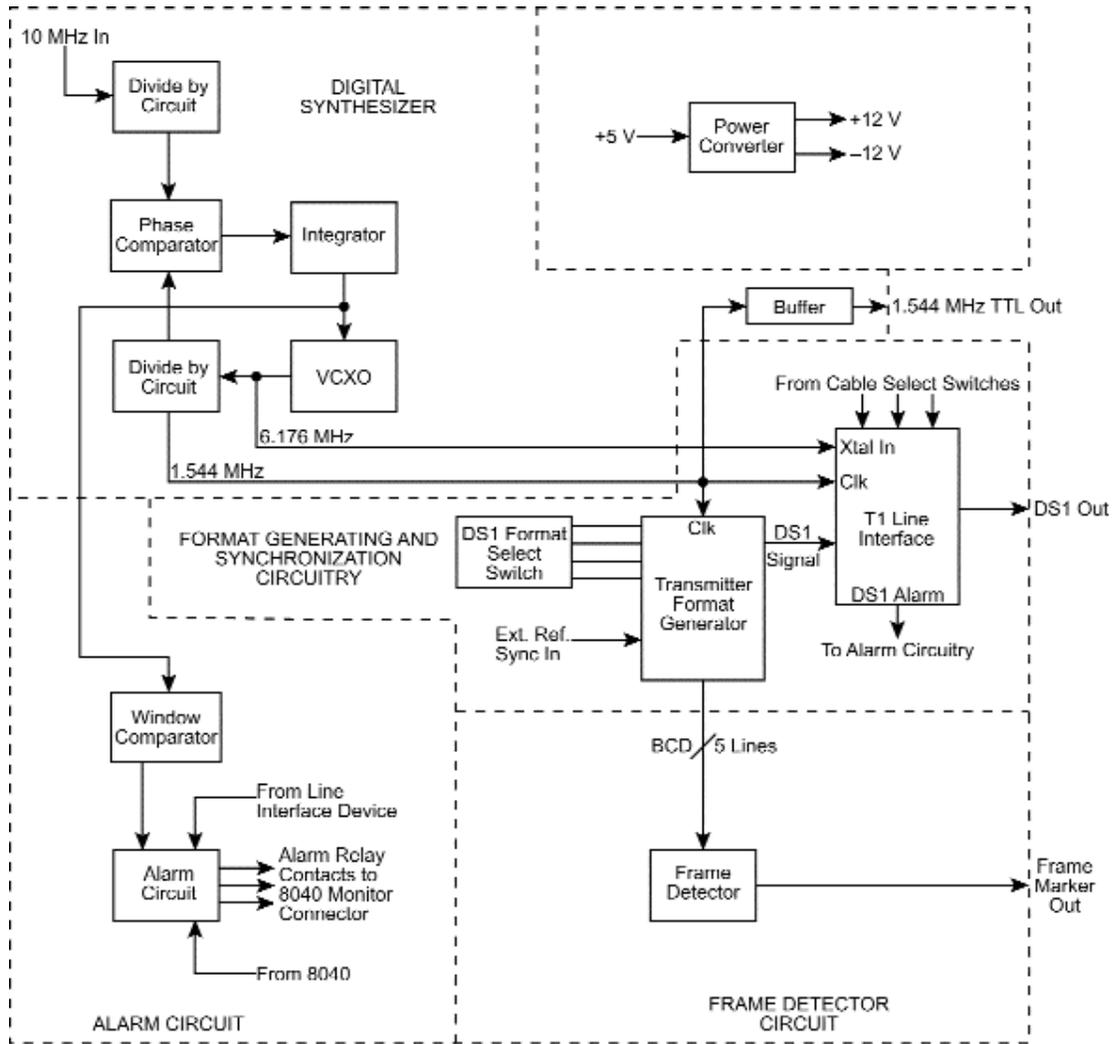
Alarm Circuitry is provided by relay contacts that are brought to the rear panel monitor connector (J200) of the Symmetricom 8040. The relay is activated by a loss of the 10 MHz reference input signal, a loss of the 6.176 MHz phase-lock, a loss of Rubidium lock, or a failure of the DS1 driver circuit.

DS1 POWER CONVERTER

The DS1 Synthesizer Assembly accepts +5Vdc and converts it to ± 12 Vdc. A DC-to-DC IC regulator is used.



FIGURE 5-R63-3. DS1 SYNTHESIZER ASSEMBLY BLOCK DIAGRAM





DS1 SPECIFICATIONS

Outputs

Signal Type	DS1, balanced
Frequency	1.544 MHz
Format	Framed all 1's (D4 or ESF)
Jitter	<0.05 U.I.
Connectors (connected in parallel)	Twin – BNC, receptacle (31-223, Amphenol) Mating connector (31-224, Amphenol)

Frame Marker:

Signal Type	TTL
Frequency	8 kHz
Connector	BNC

TTL Clock:

Signal Type	TTL
Frequency	1.544 MHz
Connector	BNC

Inputs

Frame Synchronization:

Signal Type	TTL compatible, active low
Frequency	8 kHz or submultiple of 8 kHz
Connector	BNC

Monitors

Summary Alarm:

Type of Alarm	Contact closure
Contact Rating	5 A (max) at 30 Vdc (max)
Connector	J200, pins 6, 7, & 8, rear panel

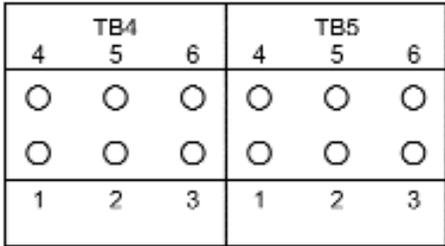
Controls

D4/ESF	4-Position terminal block on BCB (see Table 5-063-1)
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TABLE 5-R63-1. DS1 JUMPER CONFIGURATION

Condition	Block	D4
CEPT 2.048MB/S Option R64/E Balanced	TB1	1-6, 2-5, 3-4
	TB2	A-B
	TB3	N/C
	TB4	1-6, 2-5
	TB5	1-6, 2-5





OPTION R64/E – E1 TELECOM OUTPUT

Option R64/E adds a CEPT Telecommunications Synthesizer PCB assembly to the Symmetricom 8040. With Option R64/E, the Symmetricom 8040 can serve as a Stratum 2 Clock, or as a component of a Master Clock System.

Option R64/E adds the following outputs to the rear panel of the instrument:

- A balanced 2.048 MHz CEPT signal
- An 8 kHz, TTL signal synchronous with the CEPT Frame Markers
- A 2.048 MHz TTL clock

All three outputs are phase-locked to a 10 MHz reference input provided by the Symmetricom 8040. Figure 5-064-1 provides an illustration of the CEPT format.

The following are added to the rear panel:

- Frame SYNC input for synchronizing the framing of the balanced CEPT output and a FRAME MARKER output.
- A contact closure summary alarm.

FIGURE 5-R64-1. SIGNAL CONNECTIONS WITH OPTION R64/E

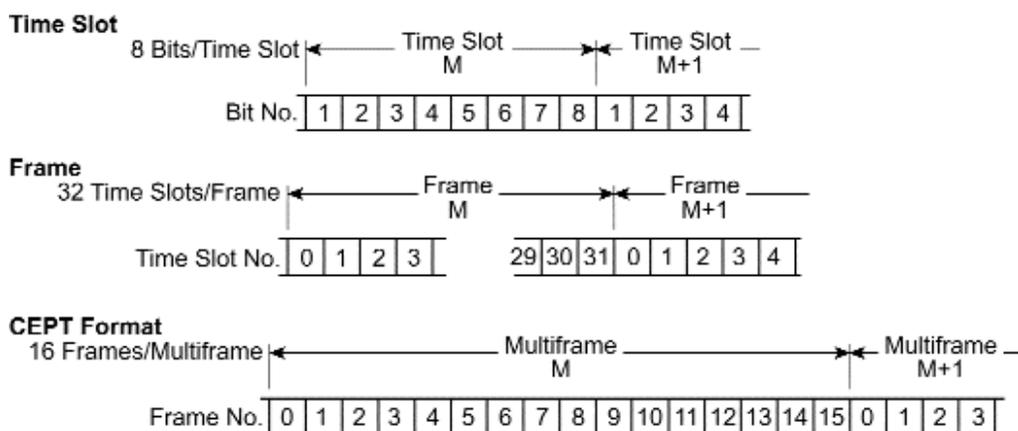


SIGNAL CONNECTIONS

- J101 10 MHz
- J102 5 MHz
- J103 1 MHz
- J104 2.048 MHz (balanced)
- J105 8 kHz TTL
- J106 2.048 MHz TTL Clock



FIGURE 5-R64-1. TIME SLOT, FRAME, AND CEPT FORMATS



FUNCTIONAL DESCRIPTION

Refer to Figure 5-R64-2 for a block diagram of the CEPT Synthesizer assembly.

The synthesizer phase-locks a VCXO to a 10 MHz reference signal supplied by the Symmetricom 8040 Rubidium oscillator. Both the VCXO and the 10 MHz signals are digitally divided, phase compared, and integrated to provide a control voltage to the VCXO.

The output of the VCXO is digitally divided to produce a 2.048 MHz signal. This signal is:

- Supplied to the rear panel as a buffered TTL output.
- Formatted and output as a balanced CEPT signal.

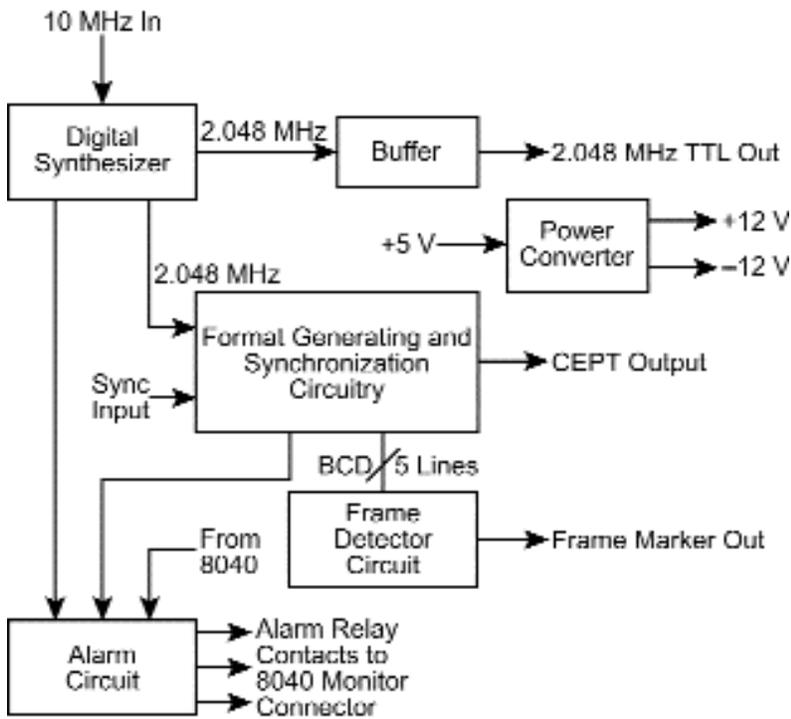
Alarm detection circuitry turns off the balanced CEPT output when a fault is detected in the CEPT synthesizer or when the proper Rubidium lock has not been achieved. Note that no balanced output is present during warm-up and lock acquisition of the Symmetricom 8040.

A Frame Detector circuit determines the start of each frame and provides a Frame Marker output pulse with each occurrence.

The CEPT Synthesizer Assembly accepts +5 Vdc and converts it to ±12 Vdc. A DC-to-DC IC regulator is used.



FIGURE 5-R64-2. CEPT SYNTHESIZER ASSEMBLY BLOCK DIAGRAM



CEPT SYNCHRONIZING

The frame alignment of the CEPT output can be synchronized to an external reference. To synchronize, briefly apply the reference to the rear panel Sync Input connector (BNC). Any Symmetricom product equipped with a DS1 Synthesizer option may be used as a reference by connecting its Frame Marker output to the Frame Sync input of the unit being synchronized. Synchronization occurs on the next clock pulse after the Sync Input has returned to a logic "1" (low-to-high transition).



CEPT MONITORING

Instrument status is monitored as described in the main body of the Symmetricom 8040 Operating Manual with the following changes:

- Operational status of the CDPT Synthesizer is available at the rear panel monitor connector (J200) at pins 6, 7, and 8.

When the CEPT Synthesizer is in normal operational condition, pins 6-8 are open and pins 7-8 are shorted to each other. In a CEPT Alarm condition, pins 6-8 are shorted and pins 7-8 are open.

A CEPT alarm condition exists when:

- a) Proper Rubidium lock has not been achieved (the front panel LOCK indicator is not on)
- b) A malfunction within the CEPT synthesizer has occurred

The balanced CEPT signal is turned off during a CEPT alarm.

CEPT LOSS OF SIGNAL

A DS1 signal loss can be caused by:

- Loss of internal 10 MHz reference input signal to the synthesizer assembly,
- Loss of DS1 Synthesizer phase-lock, or
- Loss of Rubidium lock (or before the unit has achieved lock during warm-up).

If the Symmetricom 8040 is operational and the fault exists only with the DS1 Synthesizer Assembly, the front panel LOCK indicator is on.



CEPT SPECIFICATIONS

Outputs

CEPT:

Signal Type CEPT, balanced
Frequency 2.048 MHz
Format Framed all 1's
Jitter <0.05 U.I.

Connector:

Balanced 120 , twin-BNC receptacle (31-223, Amphenol)
Mating connector (31-224)
Unbalanced 75 , BNC

Frame Marker:

Signal Type TTL
Frequency 8 kHz
Connector BNC

TTL Clock:

Signal Type TTL
Frequency 2.048 MHz
Connector BNC

Inputs

Frame Synchronization:

Signal Type TTL compatible, active low
Frequency 8 kHz or submultiple 8 kHz
Connector BNC

Monitors

Summary Alarm:

Type of Alarm Contact closure
Contact Rating 5 A (max) at 30 Vdc (max)
Connector J200 pins 6, 7, & 8, rear panel



TABLE 5-R64-1. CEPT JUMPER CONFIGURATION

Condition	Block	D4	ESF
DS1 1.544MB/S Option R63/T Balanced	TB1	3-4	3-4
	TB2	B-C	B-C
	TB3	N/C	N/C
	TB4	2-5	N/C
	TB5	2-5	N/C

TB4			TB5		
4	5	6	4	5	6
○	○	○	○	○	○
○	○	○	○	○	○
1	2	3	1	2	3