

# 8040C Rubidium Frequency Standard User Guide

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# About this User Guide

## Purpose

The 8040C User Guide describes the procedures for unpacking, installing, using, maintaining the 8040C.

## Conventions

This guide used the following conventions:

**Acronyms and Abbreviations** – Terms are spelled out the first time they appear in text. Thereafter, only the acronym or abbreviation is used.

**Revision Control** – The title page lists the printing date and versions of the product this guide describes.

**Typographical Conventions**- This guide uses the typographical conventions described in the Table 1 below.

*Table 1. Text Formats and Their Meanings*

<b>Text that appears this way...</b>	<b>... is</b>
<b>Product User Guide</b>	A document title
SSU CRITICAL	An operating mode, alarm state, status, or chassis label
Select <b>File</b> , <b>Open</b> ...	A menu item to be selected by the user
Press <b>Enter</b>	A named keyboard key
Username :	Command line input or output
A <i>re-timing</i> application	Emphasis on a word or term
Symmetricom <b>does not</b> recommend	Special emphasis on a word or term

## Special Notices

Warnings, Cautions, Recommendations, and Notes attract attention to essential or critical information in this guide. The types of information included in each are explained in the following examples.



**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 that may make your task easier or increase your understanding.

## Limited Product Warranty

1. Hardware and embedded software - For a period of one (1) year from date of shipment by Symmetricom, Symmetricom warrants that all Products shall be free from defects in design, material, and workmanship; shall conform to and perform in accordance with Symmetricom's published specifications, if any; shall be free and clear of any liens and encumbrances; and shall have good and valid title. This warranty will survive inspection, acceptance, and payment by Buyer. Symmetricom does not warrant that the operation of such Product will be uninterrupted or error free. This warranty does not cover failures caused by acts of God, electrical or environmental conditions; abuse, negligence, accident, loss or damage in transit; or improper site preparation.

This warranty shall be null and void in the event (i) Buyer or any third party attempts repair of the goods without Symmetricom's advance written authorization, or (ii) defects are the result of improper or inadequate maintenance by Buyer or third party; (iii) of damage to said goods by Buyer or third party-supplied software, interfacing or supplies; (iv) of improper use (including termination of non-certified third party equipment on Symmetricom's proprietary interfaces and operation outside of the product's specifications) by Buyer or third party; or (v) the goods are shipped to any country other than that originally specified in the Buyer's purchase order.

Goods not meeting the foregoing warranty will be repaired or replaced, at Symmetricom's option, upon return to Symmetricom's factory freight prepaid; provided, however that Buyer has first obtained a return materials authorization number ("RMA Number") from Symmetricom authorizing such return. The RMA Number shall be placed on the exterior packaging of all returns. Symmetricom will pay shipping costs to return repaired or replacement goods to Buyer. Symmetricom reserves the right to disallow a warranty claim following an inspection of returned product. When a warranty claim is questioned or disallowed, Symmetricom will contact Buyer by telephone or in writing to resolve the problem.

2. Software - Symmetricom warrants that for a period of ninety (90) days from date of shipment by Symmetricom the accompanying media will be free from defects in materials and workmanship under normal use. The physical media warranty does not apply to defects arising from misuse, theft, vandalism, fire, water, acts of God or other similar perils. Symmetricom will not be liable for any damages caused by the Buyer's failure to fulfill its responsibilities as stated above.

3. THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF TITLE, MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE HOWSOEVER ARISING.

4. Limitation of Liability - The remedies provided herein are the Buyer's sole and exclusive remedies. In no event or circumstances will Symmetricom be liable to Buyer for indirect, special, incidental or consequential damages, including without limitation, loss of revenues or profits, business interruption costs, loss of data or software restoration, or damages relating to Buyer's procurement of substitute products or services. Except for liability for personal injury or property damage arising from Symmetricom's negligence or willful misconduct, in no event will Symmetricom's total cumulative liability in connection with any order hereunder or Symmetricom's Goods, from all causes of action of any kind, including tort, contract, negligence, strict liability and breach of warranty, exceed the total amount paid by Buyer hereunder. SOME JURISDICTIONS DO NOT ALLOW CERTAIN LIMITATIONS OR EXCLUSIONS OF LIABILITY, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO ALL BUYERS.

# Introduction

## Overview

This manual contains procedures and information for proper installation and operation of the Symmetricom 8040C Rubidium Frequency Standard.

## Purpose of Equipment

The 8040C is a highly accurate and stable Rubidium frequency reference standard that provides atomic clock performance in a user-configurable 1U rack-mount chassis. Each of the connectors can be individually programmed to generate any of the following frequency outputs:

- 1, 5 or 10 MHz sine wave
- 1, 5 or 10 MHz square wave
- 1 PPS

The 8040C uses Symmetricom's model X72 Rubidium as its internal oscillator, and provides direct user control via an RS-232 to perform the following tasks:

- Adjust the X72 Rubidium oscillator frequency.
- Syntonize (tune) the X72 to an external 1 PPS input.
- View system alarms and monitor status.

# Installation

## Mounting

The Symmetricom 8040C mounts in standard 19-inch equipment racks, and takes up 1U of vertical space (1.75"). The chassis depth is 12 inches. For best performance, the operating environment should have a stable temperature. In addition, ensure that there are no strong magnetic fields (>2 gauss) in the vicinity of the shelf since the unit's Rubidium oscillator is sensitive to DC and AC magnetic fields.

## Power Connection/Fuse/Voltage

The Symmetricom 8040C is powered from an AC source (See AC Power Requirements, page 22). 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 Symmetricom 8040C may be powered from 120 or 240 VAC. The 8040C automatically detects the input voltage therefore no manual configuration is required.



**ELECTRICAL SHOCK HAZARD** - Use a locally approved power cord or power cord adapter for connection to the power source.

## Signal Connections

Output signal cables may be connected in any order to the rear panel BNC connectors.



**Figure 1: 8040C Standard Configuration – Rear Panel**

## Output Signals

The standard Symmetricom 8040C has six BNC output connectors. The outputs are factory-programmed as described in Table 2.



*Table 2: Factory Settings for Standard Outputs*

<b>BNC #</b>	<b>Signal</b>
1	10 MHz Sine wave
2	10 MHz Sine wave
3	10 MHz Sine wave
4	5 MHz Sine wave
5	1 MHz Sine wave
6	1 PPS
7 –12	Optional. Not included in the base configuration

## Input Signals

The 1 PPS IN connector takes a 1 PPS input from an external source, such as a GPS receiver or Cesium frequency standard, which is then used to discipline the 8040C's Rubidium oscillator. See *Disciplining to External 1 PPS* on page 8.

## Console

The RS-232 connector on the 8040C's back panel provides a command line interface to perform the following tasks:

- Adjust the Rubidium oscillator's frequency
- Synchronize to an external 1 PPS input
- View alarms and monitor status

*Table 3. RS-232 Connector Pin-Out*

<b>DB9-F</b>	<b>Function</b>
3	TX (Transmit Data)
2	RX (Receive Data)
5	GND (Signal Ground)

# Operation

## Powering Up

Connecting the power cord from the 8040C to AC source provides power to the unit. The POWER LED illuminates immediately thereafter. The LOCK LED illuminates within five minutes, indicating that the 8040C's frequency accuracy is within  $\pm 5 \times 10^{-8}$  of absolute frequency. Frequency accuracy is within  $\pm 5 \times 10^{-11}$  after 30 minutes of operation. Removing the power cord from the IEC receptacle on the rear panel turns the power off.

## Indicator LEDs



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

The three LED indicators on the front panel provide a cursory view of the 8040C operating status.

**POWER** is lit when AC power is applied to the unit.

**LOCK** is lit when the unit's Rubidium oscillator reaches operating temperature and its frequency output is within specifications.

**1 PPS SYNC** is lit when a valid external 1 PPS signal is available on 1 PPS IN.

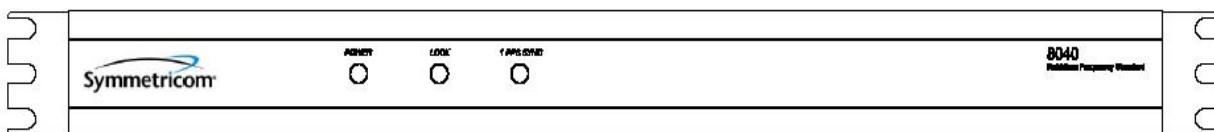


Figure 2: Symmetricom 8040C Front Panel



Figure 3: Symmetricom 8040C Rear Panel

## Adjusting Oscillator Frequency

There are two reasons to adjust the unit's frequency output:

- To adjust for the effects of aging on the Rubidium oscillator's frequency
- To syntonize (or tune) the Rubidium oscillator's frequency to that of a more accurate primary frequency source.

The Symmetricom 8040C is a secondary frequency standard (i.e., much more accurate than a quartz frequency standard, but not as accurate as a Cesium primary frequency standard). By comparing the Symmetricom 8040C to an external Cesium standard or GPS receiver, it can be readjusted periodically to match the primary standard's greater accuracy.



**NOTE:** 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  $<1E-11$ .

The 8040C output frequency is adjusted by using the RS-232 interface. The "F" command described in the Console section (page 12) of this manual allows the user to adjust the output frequency in parts  $<1E-11$ .

## Disciplining to External 1 PPS

### 1 PPS Disciplining

The advent of low cost GPS technology has brought about its widespread use throughout the telecommunications industry. The GPS system provides 1 PPS with extremely good long-term stability (e.g.,  $<1E-12$  averaged over 24 hours). However the short-term stability of this signal is not suitable due to inherent noise perturbations in GPS related to background noise, atmospheric conditions, cross talk, multipath, and instabilities in the oscillators of GPS satellites and GPS receivers.

In order to provide the required stability for telecommunications, system designers must combine the benefits of short-term stability (such as from a Rubidium or low noise OCXO) with long-term stability (such as from GPS, Loran-C, GLONASS, or Cesium). In the past, external disciplining circuitry was required to combine short-term and long-term stability. The traditional approach involved adding an external circuit to the oscillator that had a phase lock loop detector to handle disciplining algorithms.

Symmetricom is a leader in time and frequency design and has pioneered the use of Rubidium oscillators in telecommunications. The model X72 Rubidium oscillator in the Symmetricom 8040C provides an important new feature – built-in disciplining to a 1 PPS input from an external reference. This new feature eliminates the need for additional external disciplining circuitry. The 8040C is inherently capable of disciplining to an external primary reference to remove frequency offsets due to long-term aging.

## Operation

Connect the 1 PPS source to the 1 PPS IN on the rear panel of the 8040C. The 8040C's Symmetricom Synchronization Adaptive Algorithm (SSAA) qualifies the 1 PPS input reference by detecting 256 valid 1 PPS input pulses and determining the number of outliers based on the time constant. An outlier is detected when the absolute time difference between the input 1 PPS and its expected time is greater than 1 microsecond. Once the SSAA detects two outliers (two bad 1 PPS pulses) or no input 1 PPS, the algorithm places the 8040C into flywheel (holdover) mode. The flywheel mode provides for Rubidium short-term and long-term stability without the benefit of an external reference. The 8040C remains in flywheel mode until 256 "good" 1 PPS input pulses are detected. Once the number of outliers is less than 2, the unit disciplines to the external reference. This implementation was designed to support applications where the reference input is a GPS receiver without serial communications between the receiver and the 8040C. There are two modes of operation for the 1 PPS input: manual and automatic.

## Manual Control

The manual mode is beneficial to applications where the quality of 1 PPS is worse than 50 nanoseconds, or applications where the noise profile is well known and a deterministic solution yielding more control to the system designer is desired. The manual mode requires the user to input two parameters, which are tau (or time constant) and dampening factor. Tau is expressed in seconds and determines the PLL time constant for following a step in phase for the reference. The range of tau is 5 to 100,000 seconds. Tau values outside of this range put the unit in automatic disciplining mode. The dampening factor determines the relative response time and ringing in response to each step. There are no limitations for the dampening factor value; however, values between 0.5 and 2 are strongly recommended.

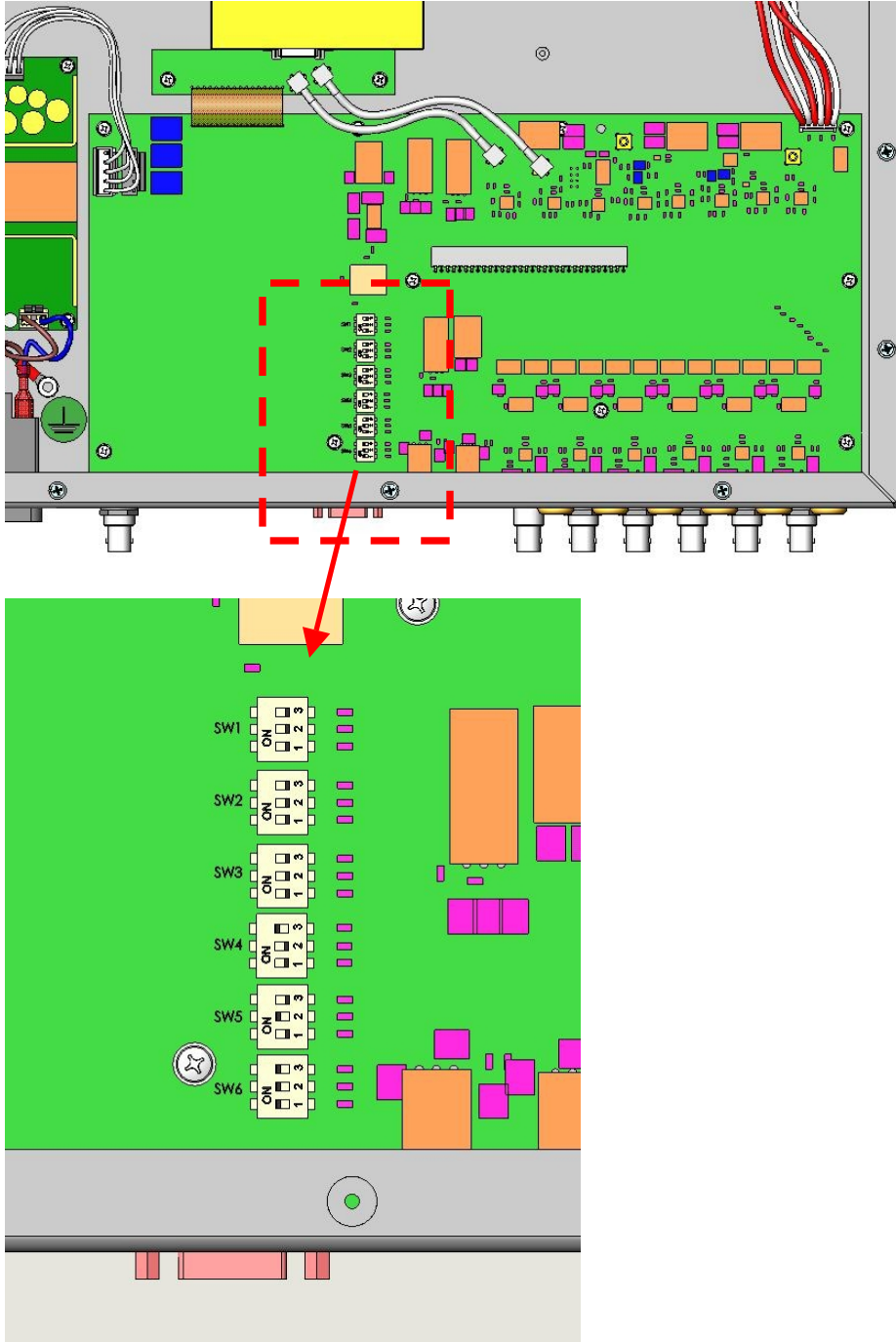
## Automatic Control

The automatic mode requires no user inputs to the X72 Rubidium oscillator. Automatic mode is adaptive and changes the SSAA time constant as changes in the 1 PPS reference are detected. The automatic mode is optimized for a 1 PPS input with up to 50 nanoseconds RMS of noise such as from a GPS timing receiver. Since short-term jitter of 50 nanoseconds is typically present on 1 PPS from a GPS reference, the automatic mode is generally suitable for most applications.

## Configuring Outputs

The 8040C has the unique capability of providing flexible output configurations. To change the output configuration of your 8040C:

1. Unplug the 8040C from the AC power source and remove the top cover by removing the Phillips head screws around the perimeter of the unit.
2. Locate the main PCB inside the 8040C as indicated in Figure 4 and identify the dipswitches shown in Figure 5. *Each dipswitch configures the output format on its corresponding BNC* (e.g., SW1 configures the output format on BNC1).



**Figures 4 & 5: Dipswitch Locations for Configuring Outputs**

- Use the dipswitch positions shown in Table 4 to generate a specific output format on a specific BNC. For example, to generate 10 MHz TTL on BNC3, set SW3 position 1 to ON, position 2 to OFF, and position 3 to OFF.

*Table 4: Output Configuration Table*

<b>Output Format</b>	<b>Position 1</b>	<b>Position 2</b>	<b>Position 3</b>
10 MHz Sine	OFF	OFF	OFF
10 MHz TTL	ON	OFF	OFF
5 MHz Sine	OFF	OFF	ON
5 MHz TTL	ON	OFF	ON
1 MHz Sine	OFF	ON	OFF
1 MHz TTL	ON	ON	Off
1 PPS	ON	ON	ON

- After setting the outputs, replace the top cover and apply power.

## Console

The Symmetricom Serial Interface Protocol (SSIP) provides user communication with the 8040C through the serial port when the unit is connected to a host PC or terminal. All “developer-mode” commands are single-letter format. Of the eight RUN MODE commands, three require the host to supply data.

### Host Terminal Emulator Setup

Set up the comm port of the PC with the following configuration:

- Data rate (Baud/BPS - see note below)
- No parity
- 8 data bits
- 1 stop bit
- No local echo (unit echoes)
- No hardware or software flow control

All SSIP commands are a single ASCII letter. The baud rate of the 8040C is 57.6K.

### Run Mode Data Format (Customer Mode)

8040C outputs are all decimal DATA as “ASCII Coded Hex” except for echoed characters. Do not convert data to decimal when transmitting to the 8040C. All data are sent to the 8040C and received back as “ASCII Coded Hex”. The following example shows how data are encoded.



NOTE: Flow control is not permitted in “Run Mode”. Data sent to the X72 Rubidium oscillator in run mode should not be encoded.

Example of actual output from X72 Rubidium oscillator after power applied to the unit:

```
X72 by Symmetricom, Inc., Copyright 2001
SDCP Version 3.75 of 3/2001; Loader Version 2
Mode CNN1 Flag 0004 [822F]ok
Unit serial code is 0009AB001B-h, current tuning state is 6
Crystal: 60000000hz, AC MOS: 10000000.0hz, Sine: 10000000.0hz
Ctl Reg: 029C, Res temp off: -1.5410, Lamp Temp off: -2.1142 FC: Enabled
Srcv: high
Enter Run Mode
FC Mode is enabled
f>
```

The following print out is an example of the response one gets by entering the letter “i” to get serial number and other facts of “*information*” on the 8040C:

```
r>i
X 7 2 by Symmetricom, Inc., Copyright 2001
```

```
SDCP Version 3.75 of 3/2001; Loader Version 2
Mode CNN1 Flag 0004
Unit serial code is 0009AB0018-h, current tuning state is 6
Crystal: 3938700hz, AC MOS: 989680.00000000hz, Sine: 989680.00000000hz
Ctl Reg: 029C, Res temp off: BFC53F7D, lamp temp. off: c0074FOE,
FC: enabled, Srvc: low
```

The following print out is an example of entering the letter “h” to get the “*help menu*” from the 8040C:

```
r>h
a: Set FC Mode
f: Adjust DDS Frequency (delta e-11)
i: Info (show program info)
j: Display 1 PPS Delta Reg
k: Set 1 PPS TIC
l: Set Service Pin Sense
o: Set AC MOS Output Frequency 'N'
p: Display Control Reg
q: Set Control Reg
t: Save Tuning Data
w: Display Health Data
x: Exit Run Mode
r>
```

The following printout shows the response to the command for “w” for 8040C “*Health Data*” (wellness):

```
r>w
AData:
SCont: 6012
SerNum: 18C
PwrHrs: 18A
PwrTicks: 11A6848
LHHrs: 17E
LHTicks: 83DBD0
RHHrs: 17E
RHTicks: 83D2E3
dMP17: 41883621
dMP5: 40A158E9
dHtrVolt: 41381AF5
PLmp: 3FAA43C6
PRes: 3FA10F45
dLVthermC: 39500000
dRVthermC: B9DD8000
dLVolt: 3F327288
dMVoutC: 494005E0
dTempLo: 00000000
dTempHi: 42928000
dVoltLo: 4134DC6A
dVoltHi: 41C1CA16
iFpgaCtl: 029E
dCurTemp: 42690000
dLVoutC: 3E25B538
dRVoutC: 3E19A67E
dmv2 demAvg: 3F337D72
```



The following print out shows how entering the letter “a” followed by an integer sets the “enable/disable” feature of FC mode (Frequency Control Mode). Integer zero followed by <cr> disables FC mode and any nonzero integer followed by <cr> enables the FC mode.

```
r>a
<nonzero integer-><cr>
FC mode enabled
r>a
0<cr>
FC mode disabled
```

The following print out shows the “control register” contents by entering the letter “p”:

```
r>p
Control Reg: 029E
```

### Factory Mode

Data output from the X72 Rubidium oscillator in factory mode is not intended for user outside the factory and is not described in this document beyond Table 5.



**CAUTION:** use of factory mode could result in the erasure of firmware on the X72, rendering it inoperable, making it necessary to return it to the factory for re-programming.

### Floating Point Number Representation

The host PC must convert Floating Point numbers output by the 8040C to the host’s own floating point using the definition shown in Table 5. Likewise, the host’s floating-point numbers must be converted to 8040C coding before being sent to the 8040C.

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
S	E7	E6	E5	E4	E3	E2	E1	E0	M22	M21	M20	M19	M18	M17	M16
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
M15	M14	M13	M12	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0

Table 5: Floating Point Number Representation for SSIP

### Floating Point Format - Single Precision

Single precision floating point format is a 32-bit format, consisting of a 1-bit sign field, an 8 bit exponent field, and a 23-bit mantissa field. The fields are defined as follows:

- Sign <S>: 0 = positive values; 1 = negative value
- Exponent <E7-E0>: offset binary format

- 00 = special cases (i.e., zero)
- 01 = exponent value + 127 = -126
- FE = exponent value + 127 = +127
- FF = special cases (not implemented)

Mantissa <M22-M0>: fractional magnitude format with implied 1

1.M22M21. . . M1M0

Range: -1.9999998 e+127 to -1.0000000 e-126

+1.0000000 e-126 to +1.9999998 e+127

(where e represents 2 to the power of)

The serial interface is initialized as follows:

- Table 6 defines the X72 Rubidium oscillator's Run Mode Commands.
- Table 7 defines the bit functions of the factory mode commands of the X72 Rubidium oscillator.
- Table 8 defines the administrative mode commands.
- Table 9 defines the bit functions and controlling agent of the output control register of the X72 Rubidium oscillator.

Table 6: X72 Rubidium Oscillator Run Mode Commands

USER OUTPUT TO X72		RESPONSE TO HOST	NAME & DESCRIPTION OF COMMAND
Command	DATA		
a	Set FC mode Example: a "<zero><cr>" to disable FC a "<nonzero integer><cr>" to enable FC	<i>To be Specified</i>	Set Analog Frequency Control Mode This command toggles the analog input pin to the unit 'Freq Cntl' between enable and disable. In Factory mode the default is enabled. During factory test the default is set to disable for shipping unless the customer ordered the default to be set enabled.
f	Desired frequency change from free running center frequency in parts to E-11 Example: for a +100E-11 change: "100<cr>" Example: for a -100E-11 change: "-100<cr>"	<i>To be Specified</i>	Adjust Frequency Adjust Unit output frequency. Used to discipline the unit. The smallest incremental frequency change is 2E-12 (or "f.2"). Any value less than this will still be used. No illegal values. Unit always powers up at free running factoryset frequency. This command is always relative to the free running frequency.
h	None	<i>To be Specified</i>	HELP command Displays menu.
i	None	<i>To be Specified</i>	Outputs Unit information. While dumping data, Clock outputs are not guaranteed to meet specifications during the use of this command.
o	Loads the value of N to set the ACMOS output frequency. Example: to change ACMOS output to 10MHz for a VCXO of 60MHz is: "3<cr>."	<i>To be Specified</i>	Loads the value of N to set the ACMOS output frequency. N is 1 to 65536. Output FACMOS is equal to crystal frequency divided by 2N. For values outside range, unit sends an illegal notice. E uses the previous valid setting.
p	None	<i>To be Specified</i>	Displays Control Register (See Table B-5). As Hex number.
q	Set Control Register. Hex data to set or reset bits in the Control Register immediately follows the command Example "hex number"<cr>	<i>To be Specified</i>	Set Control Register. Allows enabling or disabling of outputs. See Table B-5.
t	SAVE command Example :to SAVE changes: "5987717<cr>"	<i>To be Specified</i>	Saves all changes made. NOTE: if the 't' command is not used, unit defaults to factory settings at next power up.
w	None	<i>To be Specified</i>	Displays Health Monitor data

Table 7: X72 Rubidium Oscillator Factory Mode Commands

USER OUTPUT TO X72		RESPONSE TO HOST	NAME & DESCRIPTION OF COMMAND
Command	DATA		
a	None	Outputs 6 lines of banner - same as power-up	Unit Information Same as the "i" command in FACTORY mode and RUN mode.
b	"File" from Datum (self-burning)	<i>To be Specified</i>	Operating this command without valid 'file' will not overwrite the existing data stored in FLASH memory.
x	None	x f>	EXIT Administrative mode to FACTORY mode
y	None	Y asks "are you sure?"	Soft reset. Restarts processor.
z	None	Z asks "are you sure?"	Puts unit into a mode where it will wake only when the power is recycled.

**NOTE:** ADMIN mode allows the loading of new code or updates, or reconfiguring defaults in the field. It is not a normal operating mode.

*Table 8: X72 Rubidium Oscillator Administrative Mode Commands*

USER OUTPUT TO X72		RESPONSE TO HOST	NAME & DESCRIPTION OF COMMAND
Command	DATA		
a	None	a>	Goes to Administration mode
i	None	Outputs 6 lines of Banner (same as power-up information)	Displays Unit Information
r	Run Mode	Enter RUN mode. FC mode is disabled (enabled)	Goes to RUN mode

**NOTE:** This mode and ADMIN mode allow the loading of new code or updates, or reconfiguring defaults in the field. It is not a normal operating mode.

Table 9: X72 Rubidium Oscillator Output Control Status Register Structure

Bit #	Control	Description	Controller
0. *	Lamp Switch Power Boost – internal unit function	0 = Lamp Switch off 1 = Lamp Switch is on	Controlled by firmware – Automated Function
1. *	BIST Output	0 = Unit is locked 1 = Unit is not locked	Controlled by firmware – Automated Function
2.	FXO Enable	0 = Enable FXO output 1 = Disable FXO output	Default is set at Factory per Configuration file that matches customer's selection – Host can alter during operation, however, host cannot alter the default power up condition.
3.	1PPS Output Enable	0 = Enables 1PPS Output 1 = Disables 1PPS Output	Default is set at Factory per Configuration file that matches customer's selection – Host can alter during operation, however, host cannot alter the default power up condition.
4.	ACMOS Output Enable	0 = Enable Output 1 = Disables Output	Default is set at Factory per Configuration file that matches customer's selection – Host can alter during operation, however, host cannot alter the default power up condition.
5. *	C-field Boost	0 = Low C-field 1 = High C-field	Controlled by firmware - an automated function.
6.	SINE Output Enable	0 = Enables Output to 40% of max output 1 = Disables Output	Default is set at Factory per Configuration file that matches customer's selection – Host can disable SINE output, however, host cannot alter the default power up condition. Note – if a SINE filter is not installed then SINE enable will not provide an output.
7. *	SINE Output Level Adjust 1	0 = Zero Level 1 = Adds 30% of max Output	Controlled by firmware - set at factory.
8. *	SINE Output Level Adjust 2	0 = Zero Level 1 = Adds 20% of max Output	Controlled by firmware - set at factory.
9. *	SINE Output Level Adjust 3	0 = Zero Level 1 = Adds 10% of max Output	Controlled by firmware - set at factory.
10.*	SERVICE	0 = Unit is OK 1 = Unit requires Service	Controlled by firmware - Automated Function.
11 - 15.	Reserved - Not Used.		

\* When altering the Control Register these bits are masked out by firmware, the Host will consider these bits as "DON'T CARE".

# Specifications

All performance is at an ambient temperature of 25°C (77°F) unless otherwise specified.

## Outputs

### Sine Wave

Frequency	1MHz, 5MHz, & 10 MHz
Amplitude	1V RMS
Harmonic	< -40 dBc
Non Harmonic	< -60 dBc
Connector	BNC
Load Impedance	50 Ohms
Location	Rear Panel

### Square Wave

Frequency	1MHz, 5MHz, & 10 MHz
Amplitude	>3V Peak
Format	TTL
Pulse Width	50% Duty Cycle
Connector	BNC
Load Impedance	50 Ohms
Location	Rear Panel

Outputs can be configured to sine or square wave. These are square wave specifications.

### Timing Outputs

Quantity	(1) 1 PPS
Amplitude	>3V
Pulse Width	400 nS
Rise Time	<20 nS
Jitter	< 10ps RMS
Connector	BNC
Load Impedance	50 Ohms
Location	Rear Panel

### Timing Inputs

Quantity	(1) 1 PPS Sync Input
Amplitude	TTL Compatible
Connector	BNC
Load Impedance	50 Ohms
Location	Rear Panel

## Stability

Averaging Time (s)	Allan Deviation
1	<3.0E-11
10	<1.0E-11
100	<3.0E-12

## GPS Disciplining

Time to lock	</= 1000 sec.
Freq Accuracy	+/- 1E-12
1 PPS Accuracy	+/-30 nS

## Aging

Monthly	<5E-11
Yearly	<5E-10
Accuracy at Shipment	<+/-5.0E-11
Retrace	<+/- 2E-11
Control Range	+/- 1E-6 with 1E-12 resolution

## Warm-up Time

Time to Lock	5 minutes
Time to <1E-9	<8 minutes

## SSB Phase Noise

Phase Noise Offset (Hz)	Standard	Low Noise
	10 MHz Output	10 MHz Output
1	-72 dBc	-94 dBc
10	-90 dBc	-126 dBc
100	-128 dBc	-144 dBc
1,000	-140 dBc	-150dBc
10,000	-148 dBc	-150dBc

## Environmental & Physical

### General

Operating Temperature	0°C to 50°C (32°F - 122°F)
Temperature Coefficient	<3E-10
Storage Temperature	-40°C to 71°C (-40°F to 160°F)
Humidity	95% RH, Non-condensing from 0°C to 50°C (32°F - 122°F)
Magnetic Field Sensitivity	DC (+/-2 Gauss) <4E-11/Gauss
Altitude (operating)	0 – 15240 meters (0 to 50,000 feet)



## Remote System Interface and Control

Protocol	RS-232-C (DTE Configuration)
Connector	9-pin male rectangular D subminiature type
Location	Rear panel
Protocol	8 Data Bits
Stop	1 Stop bit
Baud Rate	57600

## AC Power Requirements

Voltage	90 to 240VAC
Frequency	47 to 63 Hz
Power (Operating)	25W (Operating)
Power (Warm Up)	45W (Warm Up)

## Fuses

AC Input	TO 2.0A, 250 V, slow blo
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## Dimensions

Height	1.75" (1 UI) (44mm)
Width	19" (48 cm)
Depth	12" (30.5 cm)
Weight	<6 lbs (<2.7 kg)

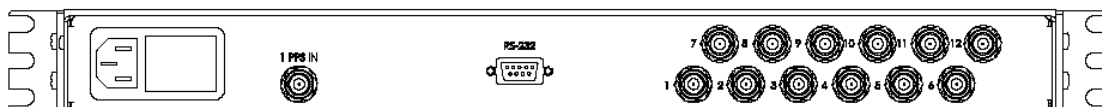
# Options

## Introduction

There are two optional configurations for the 8040C, six additional outputs and a low phase noise oscillator. The additional outputs require an additional circuit card that provides six configurable outputs that are set up the same as in the standard unit. The low phase noise oscillator option can be purchased with either the standard six outputs or with the optional twelve outputs.

## Option 102 – Six Additional Outputs

The six additional outputs on channels 7 through 12 come pre-configured the same as channels 1 through 6 in the standard configuration. They can be reprogrammed as described in Configuring Outputs (page 9).



**Figure 6: Back Panel of 8040C with Option 102 – Six Additional Outputs**

*Table 10: Output Connections*

BNC	Signal
7	10 MHz Sine wave
8	10 MHz Sine wave
9	10 MHz Sine wave
10	5 MHz Sine wave
11	1 MHz Sine wave
12	1 PPS
1-6	Standard Configuration

## Option 103 – Low Phase Noise Oscillator

The low phase noise oscillator option does not require different operator instructions. This option provides improved phase noise specifications as described in specifications section of this manual

# Technical Support

## Maintenance

This unit is designed to be maintenance-free. However, the following guidelines should be observed:

- Keep the unit clean, using a slightly water-moistened cloth.
- Keep it free from excessive dirt and moisture.
- Avoid cycling the power off and on more than is necessary.

If the unit requires servicing or repair, please contact Symmetricom Customer Assistance to obtain a Return Materials Authorization (RMA) using one of the numbers provided below.

## Customer Assistance

[http://www.symmetricom.com/Contact/Customer Assistance Centers/](http://www.symmetricom.com/Contact/Customer_Assistance_Centers/)

Customer Assistance Center Telephone Numbers:

- Worldwide (Main Number): 1-408-428-7907
- USA, Canada, Latin America including Caribbean, Pacific Rim including Asia, Australia and New Zealand: 1-408-428-7907
- USA toll-free: 1-888-367-7966 (1-888-FOR-SYMM)
- Europe, Middle East & Africa: 49 700 32886435

## Preparation for Shipment

Turn off the Symmetricom 8040C prior to shipment by removing 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 the unit 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.

Contact the Customer Assistance department before returning the unit to Symmetricom. Additional information is available from the following sources:

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