



Synthesiser Module SYM44XX/60XX

User Manual

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V 1_06

SYM44XX/60XX, User manual

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1. INTRODUCTION

Congratulations for the acquisition of the **SYM44XX** module synthesizer, a device that will prove of great help in any laboratory studying RF and microwave electronics.

This module exists in several versions (SYM4400-USB, SYM4435-USB, SYM2250H-USB, etc...), this manual describes the common and specific characteristics of each module, and the programming guide of the modules, most of the commands being common to all of them.

2. CHARACTERISTICS

◆ Characteristics common to all modules :

- Phase noise: <-95 dBc at 100kHz offset from carrier, at 1GHz (except SYM60XX series)
- Frequency stability: +/- 0,5 ppm by internal reference (+/-2,5ppm over the temperature range)
- Harmonics : < -30 dBc, Non-harmonics : < -70 dBc
- External reference input, programmable frequency.
- Switching time : < 1 ms
- Temperature range : -40 to +85°C

◆ Main characteristics of each module:

SYM4400-USB :

- 150 MHz to 4400 MHz, min. step 1 kHz
- Mini-USB interface
- Output level adjustable from +10 to -20 dBm
- Single supply voltage : 5 V dc, 200 mA

SYM4400-DB25 :

- 140 MHz to 4400 MHz, min. step 1 kHz
- Serial interface, I2C or SPI in standard with DB25 connector.
- Output level adjustable from +10 to -20 dBm
- Single supply voltage : 6 to 25 V dc, 200 mA

SYM4435-DBH :

- 35 MHz to 4400 MHz, min. step 1 kHz
- Serial interface, I2C or SPI in standard with DB25 connector.
- Output level adjustable from -60 to -10 dBm
- Single supply voltage : 6 to 25 V dc, 200 mA

SYM4435-USB :

- 35 MHz to 4400 MHz, min. step 1 kHz
- Mini-USB interface
- Output level adjustable from +10 to -20 dBm
- Single supply voltage: 5 V dc, 200 mA

SYM2250H-USB :

- 50 MHz to 2200 MHz, min. step 1 kHz
- Mini-USB interface
- Output level adjustable from +20 to -10 dBm
- Single supply voltage: 5 V dc, 200 mA

SYM6025-USB :

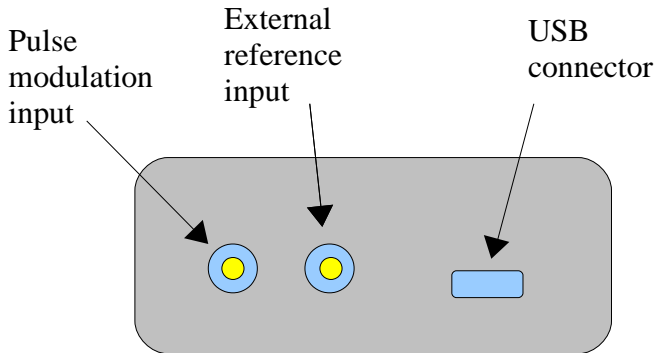
- 25 MHz to 6000 MHz, min. step 1 kHz
- Mini-USB interface
- Output level adjustable from +10 to -40 dBm
- Single supply voltage: 5 V dc, 250 mA
- External reference input , SMB type
- External pulse modulation input, SMB type
- 2 Power meter inputs, 10 MHz to 6 GHz, 60 dB range

3. MINI USB CONNECTOR PINOUT

SYMXXYY-USB modules have one SMA female connector to deliver the output signal, 2 SMB coaxial connectors for external reference and modulation input, and a USB mini-B connector for control and supply of the module.

The following table gives the pinout:

Pin N°	Name	Description
1	Vbus	Supply voltage (5 V dc +/- 0.25V)
2	D-	Data -
3	D+	Data +
4	NC	No connection
5	Gnd	Signal ground



4. DB25 CONNECTOR PINOUT

SYMXXYY-DB25 modules have 2 connectors, one SMA female connector to deliver the output signal, and a SUB-D 25 points female connector for control and supply of the module.

The following table gives the pinout:

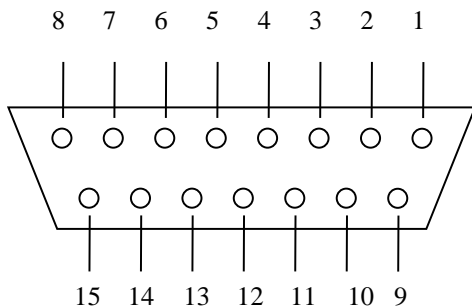
Pin N°	Name	Description
1	Vin	Supply voltage (6 to 25 V dc)
2	TXD	serial asynchronous link, TTL 3V3 level
3	RXD	serial asynchronous input, TTL 3V3 level, 5V accepted.
4	SDA	Serial data, I2C bus (1)
5	SCL	Clock I2C bus (1)
6	SSEL	Validation input for serial synchronous link (SPI)
7	MOSI	MOSI Signal (master out slave in) for SPI synchronous bus
8	MISO	MISO Signal (master in slave out) for SPI synchronous bus
9	GND	Supply gnd
10	EXT Ref	External reference input for the module. Max level 5Vpp.
11	GND	Supply gnd
12	Pulse	Pulse modulation input, TTL 3 or 5V compatible.
13	GND	Supply gnd
14	NC	Do not connect
15	SCK	SPI synchronous clock

(1): The I2C bus if used must be connected to a 3 to 5V voltage source through external pull-up resistors (3 to 10 k Ω).

The selection of the communication protocol should be done at power-up of the module by the levels present on SDA and SCL lines, according to the following table:

SDA	SCL	Etat
0	0	Serial asynchronous bus (default)
0	1	SPI Bus
1	0	SPI Bus
1	1	I2C Bus

Female module connector, seen from outside:



5. COMMUNICATION PROTOCOLS

5.1. Asynchronous serial link

The asynchronous serial interface uses the following parameters:

- 8 bits data
- 1 bit stop
- No parity
- Data rate: 38400 bauds.

The format of commands is as follows:

<command> + <SPC> + <parameter 1> + <SPC> + <parameter 2> + ... + <CR> [+ <LF>]

Where: <SPC> represents a space (hexadecimal ASCII code 20)
<CR> represents carriage return (hexadecimal ASCII code 0D)
<LF> represents line feed (hexadecimal ASCII code 0A)
[..] Denotes an optional parameter

The parameters are either character strings, or numerical values coded as ASCII with integer format.

Ex : 225000 (for 225 MHz)
2450015 (for 2,450015 GHz)

Decimal values are accepted starting from firmware version 1.07 or beyond for frequency input. (6 decimals figures max)

Command example: `FREQ 433920 + <CR> + <LF>`

`FREQ 1.57542G + <CR> + <LF>`

Numerical values can be followed by a unit character according to parameter type (firmware version greater or equal to 1.07):

K: kHz (default)
M: MHz
G: GHz

Without unit character, frequencies are in kHz, and levels in dBm.

Commands terminated by an interrogation mark will be followed by an answer from module, with the following format :

<value> + <CR> + <LF>

where <value> can be either numerical, or a string.

List of commands

The following table shows the list of commands available in the asynchronous serial communication mode

Command	Parameters	Description
FREQ	Carrier frequency (kHz)	Carrier frequency, between 25 MHz and 6 GHz.
FREQ?		Asks current carrier frequency.
FMIN?		Asks minimal carrier frequency of module.
FMAX?		Asks maximal carrier frequency of module.
POW	Amplitude	Output level in dBm; between -50 and +10 dBm ⁽¹⁾
POW?		Asks current output power level
REF	1: INT, EXT 2: external ref. frequency	Selects the frequency reference internal or external, and in the latter case specifies the frequency. (see limitations section 5)
REF?		Asks current reference mode and frequency (if external)
*IDN?		Asks module to send its identification string. Response has the following format : Ormelabs, SYM4435USB, V1.00, 0915030112
OUTP	ON, OFF	Activates or deactivates RF output.
OUTP?		Asks status of output
PMOD	ON, OFF	Activates or deactivates pulse modulation.
SAVE	memory	Saves the current configuration (frequency, amplitude, modulation) in the specified memory location (1 to 100) for quick recall. The memory 1 contains the configuration of the module at startup.
RECALL	memory	Restores the stored configuration (frequency, amplitude, modulation) in the specified memory location (1 to 100)
SEQU	1: ON , OFF 2: start memory	Start / stop the sequencer to allow to chain recorded configurations.

	3: end memory	
DELAY	delay	Specifies the waiting time for each memory in the sequencer mode (in ms).
SER?		Asks module to provide the serial number. Response type: 1219080053
*RST	Reinitialisation of module	Equivalent to power-up.
CALD?	Calibration date	Responds with the calibration date in the format: DD/MM/YYYY
FABD?	Manufacturing date	Responds with the production date in the format: DD/MM/YYYY
PMET	OFF, 1, 2	Activates or deactivates one of the power meter inputs ⁽²⁾
PM_READ ?		Asks the value of the incident power on the active measurement channel (1 or 2) ⁽²⁾ Réponse du type : -xx.x dBm
GETID ?		Demande le N° d'identification de la PLL
Secure commands: Need the preliminary send of the adequate password.		
PWD :	Password	Enters the password for secure commands.
SER :	Serial number	Enters the serial number of the instrument
CDATA	Coef, value	Enters the calibration coefficient by its number and value
CDATA ?	coef	Asks the value of the specified coefficient
FABD :	date	Enters the manufacturing date (8 characters)
CALD :	date	Enters the calibration date (8 characters)

(1): The minimum time depends on calibration values, and may be higher by a few dB depending on the frequency range.

(2): SYM6025-USB only

5.2. I2C link

➤ This interface is only available for some modules, see chapter 1.

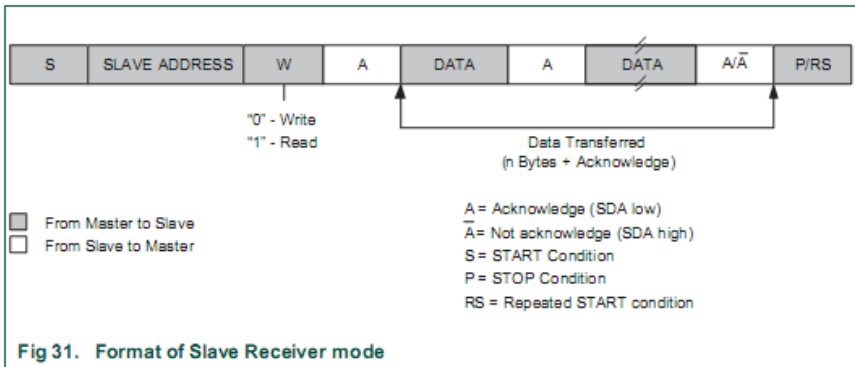
The module SYM44XX-DB only works in slave mode.

The communication through I2C bus uses the following chronology:

Write mode (W):

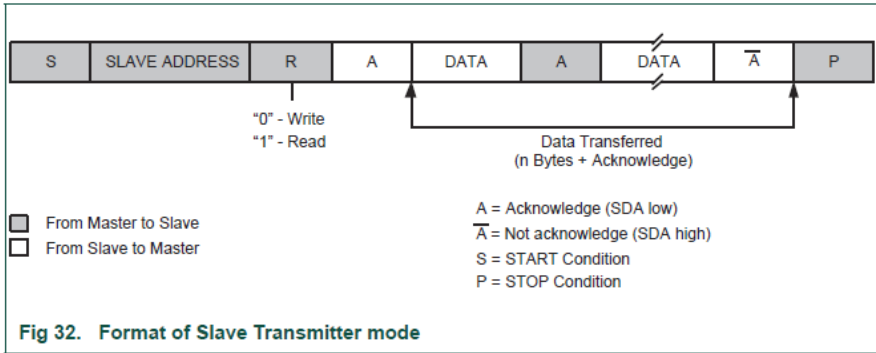
- Start condition
- One address byte (2F hexadecimal) and the direction bit (0 for write)
- One command byte
- Eventually from 1 to 4 data bytes, according to the length of the parameter in bits. (8 to 32)
- STOP condition

The maximum frequency of the I2C bus is 400 kHz.



Read mode (R):

- Start condition
- One address byte (2F hexadecimal) and the direction bit (1 for read)
- One command byte, indicating the awaited value
- Reception of 1 to 4 data bytes, according to the length of the parameter in bits. (8 to 32)
- STOP condition



The following table gives the list of the command codes in I2C and SPI protocols:

Command (hexa.)	Type	Parameters received/sent	Description
01	W	Carrier frequency (4 bytes)	Frequency of the carrier in kHz, between 35 MHz and 4400 MHz. (according to version)
02	R	Carrier frequency (4 bytes)	Asks used carrier frequency
03	W	Amplitude (1 byte)	Output level in dBm; between -60 and +10 dBm with a resolution of 1 dB. . (according to version)
04	R		Asks output level in use
05	W	00:INT, 01: EXT (1 byte)	selects reference frequency as internal or external
06	W	Frequency in MHz (1 octet)	Specifies the external reference frequency. (See limitations chapter 5)
07			Not used
08	W	00: ON, 01: OFF (1 byte)	Activates or deactivates RF output.
09	W	00: ON, 01: OFF (1 byte)	Activates or deactivates pulse modulation.
0A	W	Memory (1 byte)	Save the configuration in use (frequency, amplitude, modulation) in the specified memory setting for a fast recall.

			Memory N° 1 contains startup module configuration.
0B	W	Memory (1 byte)	Restores the memorized configuration (frequency, amplitude, modulation) in the specified memory setting (from 1 to 100)
0C	W	1st byte: 00 for on, 01 for off. 2nd byte: start memory 3rd byte : end memory	Starts / stops the sequencer to allow chaining of memorized configurations.
0D			Not used
0E	R	Code (1 byte)	Asks to send the last error code generated.

- It has to be noted that the instrument does not respond to general call (address 0x00 in I2C protocol).
- It is recommended to add a small 1 millisecond temporization after sending a read command, before initiating the reading of the corresponding data, in order to allow the microcontroller to prepare the data string.

5.3. SPI Link

The SPI link uses the following parameters:

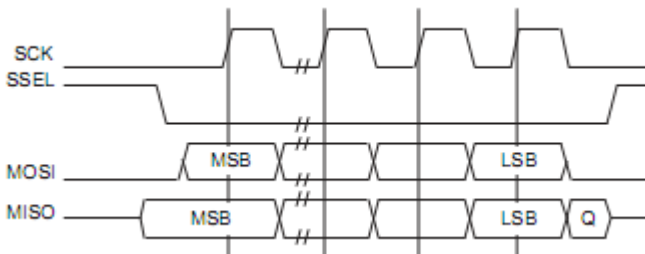
- Send most significant byte first (MSB first)

The timing diagram decomposes as follows :

- One 8 bits command byte, followed by a rising edge on signal SSEL.
- Eventually, one or more bytes defining the eventual parameters, each one followed by a rising edge on signal SSEL.

The command codes and parameters are the same as for I2C bus. Please refer to table 5.2 for the list.

The maximum speed of the SPI bus is 10 MHz.



6. EXTERNAL REFERENCE

The external reference input accepts a signal amplitude between 0.7 and 5Vpp and frequency between 20 and 100 MHz, but with a limited number of possible frequencies.

The frequencies available are 20, 40, 60, 80 and 100 Mhz.

The phase noise and precision of the output signal will be strongly dependent on that of the external reference signal used, it is advisable to use a source with high spectral purity and stability greater or equal to SYM44XX specifications.

7. PULSE MODULATION INPUT

The pulse modulation input accepts TTL level signals ranging from 3.3V to 5V. A low level inhibits the RF output while a high one activates it.

The attenuation in the low state is greater than 30 dB above 1 GHz, and greater than 50 dB below 1 GHz.

The rise / fall time are very fast (typ. <10 ns) and the delay is <50 ns, which allows a frequency modulation of up to about 25 MHz.

8. FACTORY CONFIGURATION

The configuration of the output of manufacture is as follows:

Frequency: 1 Ghz

Output amplitude: 0 dBm (-10 dBm for SYM4435-DBH)

RF output: Off

Modulation: Off

Sequencer delay: 100 ms

Reference: Internal 20 MHz

This is also the contents of memory 1 if no other configuration has been saved there.

ANNEX 1 : TECHNICAL SPECIFICATIONS

Reference temperature : 25°C except where specified

Internal reference

Module SYM4400-DB25 :

Parameter	Min.	Typ.	Max.	Unit
Supply voltage	6		25	V
Supply current		120	200	mA
Reference precision at 25°C		+/- 0,5		ppm
Reference precision over temperature range		+/- 2		ppm
Amplitude precision f < 4GHz f >= 4GHz		+/- 1 +/- 2	+/-2,5 +/-3	dB
Rise time, pulse mod.		10		ns
Fall time, pulse mod.		10		ns
Delay, pulse mod.		30	50	ns
External reference level	0,7		5	V _{pp}
Phase noise at 1GHz, offset = 100kHz		-100	-95	dBc/VHz
Frequency switching time		1	5 ⁽¹⁾	ms
Harmonics level : f > 300 MHz f <= 300 MHz			-30 -20	dBc
Non-harmonics frequencies			-70	dBc
I2C bus frequency			400	kHz
SPI bus frequency			10	MHz
Operating temperature range	-40		+85	°C

⁽¹⁾: Excluding communication time delay

Module SYM4435-USB :

Parameter	Min.	Typ.	Max.	Unit
Supply voltage	4,75	5	5,25	V
Supply current		200	250	mA
Reference precision at 25°C		+/- 0,5		ppm
Reference precision over temperature range		+/- 2		ppm
Amplitude precision f < 4GHz f >= 4GHz		+/- 1 +/- 1	+/-1,5 +/-2	dB
Rise time, pulse mod.		10		ns
Fall time, pulse mod.		10		ns
Delay, pulse mod.		30	50	ns
External reference level	0,7		5	Vpp
Phase noise at 1GHz, offset = 100kHz		-100	-95	dBc/VHz
Frequency switching time		1	5 ⁽¹⁾	ms
Harmonics level : f > 300 MHz f <= 300 MHz			-30 -20	dBc
Non-harmonics frequencies			-60	dBc
Operating temperature range	-40		+85	°C

ANNEX 2: ERROR CODES

The following table lists the error codes returned by the module if necessary.

In the case of asynchronous serial link, the syntax is:

ERR: <code> + <CR> + <LF>

In the case of SPI and in I2C connections, reading of the error code is done using the read error code command (OE)

Code	Description
01	Syntax error
02	Value beyond acceptable range
03	Missing parameter(s)
04	Parity error
05	PLL unlocked
06	Power meter not in use

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