FREQUENTLY ASKED QUESTIONS (FAQS) ABOUT QUICKSYN® SYNTHESIZERS

----

1. Product features

Q What are unique features of the QuickSyn® synthesizer?
A This product represents a new generation of microwave frequency synthesizers based on a patented, phase-refining technology that provides a unique combination of fast-switching speed, very low phase noise, low spurious, and low-cost characteristics.

Q What synthesizer characteristics are the most important?
A Although the answer strictly depends on a particular application, frequency coverage, resolution, spectral purity (i.e., phase noise and spurs), and switching speed are the characteristics that customers pay attention to first.

Q How do phase noise and spurs affect system performance?
A A signal of small amplitude can be masked by system phase noise or confused with a system spur. Thus, in many cases these two parameters limit the system's sensitivity, or in other words, the ability to resolve a signal of small amplitude.

Q Why is switching speed important?
A The time spent by the synthesizer transitioning between frequencies becomes increasingly valuable since it cannot be used for data processing. Let's assume you are making a 401-point sweep measurement on an RF IC test using a source with 25 ms

switching speed (that is a very typical number for a YIG-based synthesizer). In this case, your dead-time per measurement exceeds 10 sec—just for one measurement! If you can use a synthesizer with 100 us switching, your dead-time is reduced to 40 ms. It is quite a significant throughput improvement if you run continuous measurements. Thus, while many systems still work adequately with millisecond switching speeds, newer requirements demand microsecond operation together with comparable spectral purity of the low-speed designs.

Q What technologies can be used to achieve such speed?
A Direct analog, direct digital, and indirect (or phase-locked) approaches are used for modern synthesizers. Each has tradeoffs. For example, direct-analog synthesizers can provide the best performance in terms of speed, but they are extremely complex and expensive. Direct-digital synthesis (DDS) is fast and reasonably priced, although it is limited in terms of frequency coverage and spurious performance. Thus, the most comprehensive current solutions are associated with VCO-based PLL synthesizers.

Q Why don't you use YIG-tuned oscillators?
A Historically, synthesizer developers have relied on YIG oscillators featuring broadband operation and excellent phase noise performance. The disadvantages include high power consumption, large size, high sensitivity to microphonics, and very high cost. However, the main problem inherent in YIG technology is slow tuning because of high inductance of the tuning coil. Typical achievable switching time is in the milliseconds range. Clearly, YIG technology cannot support today's requirements for switching speed.

Q What are advantages of the VCO-based designs?
A Unlike YIGs, VCOs are very fast, capable of switching speeds in the microsecond range. With VCOs available as ICs, size, power consumption, and cost are negligible in comparison with YIGs. Besides, VCOs are much less sensitive to microphonic effects because of their extremely low weight and profile.

Q How do you achieve good phase noise characteristics with VCOs?
A VCO phase noise is controlled by utilizing an ultra low-noise reference OCXO as well as very wide (a few MHz) loop bandwidth. In contrast to traditional approaches (which tend to minimize the PLL loop division ratio), our new technology makes a radical step by completely removing the divider from the PLL feedback path. Moreover, it inverts the PLL division ratio by applying a multiplication within the PLL that drastically improves both phase noise and spurious characteristics.

Q Is QuickSyn® technology patented?
A Yes. The technology is protected by US patent number US7,701,299.

Q Where can I find technical details regarding the QuickSyn® synthesizer?
A The QuickSyn® product page contains a datasheet of technical characteristics and a communications specifications document for information about programming and control.

Q Where can I find more information about QuickSyn® technology and other frequency synthesizers?
A Many facts related to frequency synthesis can be found in technical articles available on Phase Matrix's technical articles page.

2. Technical Characteristics

2.1 Frequency Coverage and Resolution

Q What are frequency coverage and resolution?
A Frequency coverage (or range) denotes the range of frequencies that can be generated by the synthesizer. It is specified in the units of Hz (MHz, GHz) by indicating the minimum and maximum frequencies generated by the synthesizer. Frequency resolution (or step size) is the minimum frequency difference between two successive output frequencies

Q What is the frequency accuracy of the QuickSyn® synthesizer?
A Frequency accuracy indicates the maximum deviation between the synthesizer's set output frequency and its actual output. Frequency accuracy is normally determined by the reference signal, which can be internal or external to the synthesizer as further explained in the reference section.

Q What is the frequency coverage and step size of the QuickSyn® synthesizers?
A The product line includes FSW-0010 and FSW-0020 models covering the 0.5-10 and 0.5-20 GHz bands respectively (extendable down to 0.1 GHz and 0.2 GHz with Option 01). The resolution is 0.001 Hz for both models.

Q How were you able to accomplish this wide tuning range? Do you use frequency multiplication within your synthesizer?
A Both models utilize a broadband fundamental VCO. No multiplication is used and this eliminates spectrum contamination from subharmonic products.

Q How do you achieve frequency extension? Do you use downconversion?
A No, we use frequency division, which further improves both spurious and phase-noise characteristics.

2.2 Switching speed

Q What is switching speed?
A Switching (or tuning) speed determines how fast the synthesizer transitions from one desired frequency to another with specified accuracy and is defined as time spent by the synthesizer between these two states (thus, the switching time is a more proper term).

Q What switching speed is achieved by the QuickSyn®?
A The switching speed for a standard unit is specified at 1 millisecond for ±50 kHz accuracy.

Q Can the QuickSyn's switching speed be improved?
A Yes, switching speed is improved to 200 microseconds (regular programming mode) and 100 microseconds (list mode) with Option 03.

Q Are these numbers set for a specific frequency step or subband?
A No. The specification is valid for any frequency to any frequency step within the entire operating range.

Q Is the output power set within these numbers?
A Yes. The output power is set to its specified accuracy within these numbers.

2.3 Output Power

Q What output power is available? Can I change the output power level?
A Yes. With Option 02 the output power is leveled between -25 and +15 dBm for the FSW-0010 model. The FSW-0020 specified range is -10 to +13 dBm.

Q Is the output power calibrated?
A Yes. The output power is calibrated at the factory.

Q How is the output power controlled?
A The output power is controlled using an open-loop method (i.e., a look-up table) that ensures extremely fast output power settling.

Q How is the performance across the entire band and over temperature?
A The synthesizer includes sophisticated temperature compensation that ensures repeatable output power characteristics within specified frequency and temperature limits.

Q I noticed that the maximum output power below 0.5 GHz is significantly lower. Is this correct?
A Yes, this is correct. The maximum leveled power for the standard frequency coverage (0.5-10 GHz or 0.5-20 GHz) is specified at +15 dBm. For extended frequency range (down to 0.1 or 0.2 GHz) the output power below 0.5 GHz is specified at +10 dBm level (as indicated in the note 1 on the page 7 of the datasheet) due to architecture limitations.

Q The QuickSyn® datasheet says that the output power resolution is 0.1 dB and the power accuracy is +/- 2.0 dB. Is this correct?
A Yes. The power resolution specification shows that the QuickSyn® output power can be changed (programmed) in increments. In other words, it is a relative change. Let's say, you program the QuickSyn® to +15 dBm and try to measure the output power with a power meter. Naturally, your reading will be slightly different, let's say +15.3 dBm. That's why we specify absolute power accuracy of +/- 2 dBm. The number is very conservative and, in most cases, you will see a much better accuracy. Note, that you can still change the output power with the same increment of 0.1 dBm.

Q Is the Option 02 (power control) related to the external output ALC?
A No. In both cases (with or without Option 02) we use an open-loop calibration and control. If you need a better accuracy, you can implement a closed-loop ALC by adding an external directional coupler and detector. The QuickSyn® provides a DC-coupled analog amplitude control input (which is the AM input) that allows you to close the ALC loop. Theoretically, this method provides better accuracy and, therefore, can be used in some specific applications. In practice, the open loop ALC is sufficient in majority of applications.

Q Can the synthesizer output be muted?
A The output power can be turned off (i.e., muted) by switching off the output power amplifier. This is accomplished by sending a proper command as indicated in the Communications Specifications document. Note that the VCO and PLL core remain turned on, which minimizes recovery time when the synthesizer is back to normal operation.

Q I need to turn-off the output very fast – within a few tens of nanoseconds. Is it possible?
A Yes. The output signal can also be turned on and off with better than 80 dB on/off ratio by applying pulse modulation.

Q What is blanking?
A Blanking is special function that turns off the RF output while the synthesizer transitions to a newly-programmed frequency. This prevents any stray transient signals that may result in unexpected behavior of a system where the synthesizer is utilized.

Q Is blanking available with QuickSyn?
A Yes. The synthesizer provides a software-selectable blanking function

2.4 Phase noise

Q What is phase noise and how can it affect system performance?
A Phase noise is a measure of the synthesizer's short-term frequency instability, which manifests itself as random frequency fluctuations around the desired tone. Phase noise generated by the frequency synthesizer is a critical parameter that imposes the ultimate limit on the system's ability to resolve signals of small amplitude.

Q What phase noise performance does the QuickSyn® exhibit?
A Phase noise is a function of the output frequency and frequency offset and is usually represented as a graph or a table. Such a representation can be found on the page 2 of the QuickSyn® datasheet. At a 20 GHz output and 10 kHz offset, the phase noise is typically measured at -116 dBc/Hz. At a 10 GHz output, the noise drops down on 6 dB to about -122 dBc/Hz, same offset.

Q How does QuickSyn® noise compare to other synthesizers?

A It is difficult (if possible at all) to compare phase noise at all output frequency and offset scenarios. In general, the QuickSyn® exhibits comparable or better phase noise performance as compared to the best signal generators currently available on the market.

Q Are these phase noise characteristics still available with the fast switching option (Option 03)?

A Yes! Note, it is not difficult to obtain good phase noise only. Similarly, it is not difficult to achieve good switching speed either. However, it is very difficult to get both parameters simultaneously. The uniqueness of the QuickSyn® synthesizer is in that it allows both excellent phase noise and fast switching.

2.5 Spurs

Q What are spurs?

A Spurious signals (or spurs) are undesired artifacts created by the synthesizer at some discrete frequencies that are not harmonically related to the output signal. Spurs can come from different sources such as PLL reference spurs, mixer intermodulation products and LO leakage, some internal auxiliary signals, or even external signals coming through the bias or control interface.

Q What problems can spurious signals present and what levels are acceptable?

A Spurs can sit very close to the main tone and in many cases cannot be filtered. Thus, the spurious level has to be minimized, typically to -60 dBc relative to the main signal, although many applications require bringing this level even lower.

Q What levels do you achieve for spurious?

A Typically -80 dBc or better at 10 GHz. It is hard to measure the spurs at these levels since they become comparable to the spurs generated by the test instruments themselves. Keep in mind that every spectrum analyzer has it is own LO source that is not ideal either. Many detected spurs can belong to test equipment and, thus, need careful processing. Thus, we specify this parameter at a -65 dBc maximum level to simplify our testing in mass production. Overall, the QuickSyn® spurious levels are comparable or even better to what is provided by instrument-grade signal generators.

Q Can the QuickSyn® synthesizer be used as an LO source in a modern spectrum analyzer from the spurious and phase noise characteristics point of view?

A This can certainly be the case. Furthermore, it can also help to reduce sweep time. Similarly, the QuickSyn® can be used as an engine in many other test-and-measurement applications, for example, phase noise testers.

Q What are microphonics?

A This term refers to mechanically induced spurs. These spurs appear due to the sensitivity of certain, massive components (such as YIG oscillators) to external mechanical perturbations.

Q How are microphonics treated in QuickSyn?
A Microphonic effects are greatly reduced in the QuickSyn® synthesizer due to the use of a low-mass VCO and very wide PLL filter bandwidth.

2.6 Harmonics and subharmonics

Q What are harmonics?
A Harmonics appear in the synthesizer spectrum as integer multiples of the output frequency because of signal distortion in non-linear components such as amplifiers. For example, if the fundamental frequency is represented by *f*, the frequencies of the harmonics would be represented by 2*f*, 3*f*, etc.

Q What harmonic levels are acceptable?
A Harmonics usually do not cause serious problems since they are well separated from the main tone and can be easily filtered out. Moreover, they are often recreated in a non-linear device (such as a mixer) connected to the synthesizer. The range of -20 to -30 dBc is acceptable in many cases.

Q How do you control harmonics in the QuickSyn?
A A switched filter bank at the synthesizer output reduces generated harmonics, which typically do not exceed -40 dBc level.

Q What are subharmonics?
A Sub-harmonics are created at frequencies that are "sub-harmonically" related to the main signal such as *f*/2, *f*/3, etc. A typical example that can demonstrate the creation of sub-harmonics is a frequency doubler, which is often used to extend the synthesizer output frequency range. As a non-linear device, the doubler generates a number of harmonics of the incoming signal. Since the second harmonic now becomes the main signal, all the odd products do not meet the harmonic relationship with respect to the desired output and are, therefore, considered as sub-harmonics.

Q How are subharmonics treated in QuickSyn?
A The QuickSyn® synthesizer utilizes a broadband fundamental VCO that eliminates spectrum contamination from subharmonic products inherent to the frequency multiplication process.

2.7 Reference

Q What is the frequency accuracy of a synthesizer?
A Frequency accuracy indicates the maximum deviation between the synthesizer's set output frequency and its actual output. Frequency accuracy is normally determined by the reference signal, which can be internal or external to the synthesizer.

Q Does the QuickSyn® synthesizer includes an internal reference?
A Yes. It includes a highly-stable oven-controlled crystal oscillator (OCXO) that serves as its internal time base.

Q How accurately is the internal time base set?

A The internal reference is factory calibrated to exactly 10 MHz referred to a GPS-based factory frequency standard. Note, that the internal reference may exhibit slight discrepancy due to thermal stability and aging effects.

Q What is temperature frequency stability?

A Temperature stability denotes the maximum frequency drift over the operating temperature range and is usually expressed in ppm. The term ppm is an acronym for parts-per-million - a dimensionless coefficient equal to 10^{-6}. For example, the temperature stability of 0.5 ppm for a 100-MHz crystal oscillator means that the oscillator frequency can drift up to 50 Hz ($0.5 \times 10^{-6} \times 100 \times 10^{6}$ Hz) over the specified operating temperature range.

Q What is aging?

A Aging is a change in frequency over time that occurs because of changes in the resonator material or a buildup of foreign material on the crystal. It is also specified in ppm over a certain period of time. Aging leads to a permanent frequency error; thus, it is good practice to use mechanical or electronic frequency adjustment means to compensate for internal reference aging.

Q I noticed that after several months of operation the output frequency has slightly changed. Is this normal?

A Yes. Any crystal oscillator exhibits aging. The aging is usually higher during first few months of operation and exponentially reduces with time.

Q Can I adjust the QuickSyn® internal time base frequency?

A The QuickSyn® internal reference frequency can be electronically adjusted by sending a proper command as indicated in the Communications Specifications document.

Q Is the internal reference output available?

A Yes. The internal 10 MHz reference output is available at the QuickSyn® front panel.

Q What type of control signal is required to mute the reference output and which pin is it applied to?

A There is no dedicated pin. The internal reference output can be muted by sending a proper command via either SPI or USB interface. Programming details can be found in the Communications Specifications document.

Q How can I synchronize the synthesizer with other equipment?

A You can utilize the internal 10 MHz output for synchronization of the external equipment. Alternatively, the internal oscillator can be automatically locked to an external reference too.

Q How can I choose between the internal and external references?

A If the reference mode is programmed to "Internal," the QuickSyn® is driven by its internal reference and ignores any external one. If the reference mode is programmed to "External," the synthesizer is still driven by its internal reference and also starts monitoring the external reference port. If an external reference is detected, the synthesizer automatically locks its internal reference to the external reference.

Q Does an external reference affect synthesizer's phase noise?

A The locking bandwidth for external reference is about 20 Hz. This means that the phase noise below this frequency is mainly determined by the external reference phase noise. Phase noise around 20 Hz depends on both references. Phase noise above 100 Hz is mainly driven by the internal QuickSyn® references and, therefore, is preserved.

Q I understand that the QuickSyn® internal time base ages with time. Will I be able to lock the QuickSyn® unit to an external 10 MHz reference after a few years of operation?

A The QuickSyn® internal time base aging is specified at +/-1.25 ppm over 10 years while its locking range is specified at +/-2 ppm min. Therefore, you will be able to lock the QuickSyn® in 10 years assuming you will use a precise (such as GPS) 10 MHz source.

2.8 Modulation

Q What modulation functions are available with QuickSyn?

A The QuickSyn® synthesizer provides multiple modulation options including AM, FM, phase and pulse modulation.

Q How do you implement pulse modulation?

A Pulse modulation is achieved by switching the output signal on and off in accordance with the applied modulating pulses. The result is a sequence of RF pulses that replicate the input modulating signal. We utilize multiple solid-state RF switches to ensure high on/off ratio (greater than 80 dB) and extremely fast settling. A high-pass filter at the synthesizer output prevents modulating signal leakage to the RF output. The pulse modulation is available with Option 05.

Q What is the input pulse modulating signal?

A The modulating signal is an external CMOS or TTL signal (+5 V = RF on, 0 V = RF off). The modulating signal frequency (also called repetition frequency) can be between DC and 10 MHz.

Q Is an internal pulse generator available?

A No. An external modulating signal is required.

Q How do you implement amplitude modulation?

A Amplitude modulation (AM) is realized by varying the output signal amplitude in accordance with an applied modulating signal. Similarly to the pulse modulation, an external modulating between DC and 100 kHz is required.

Q Is AM available with a standard unit?
A No. The AM is available with Option 06. Additionally, the Option 2 (power control) has to be installed.

Q What output power should I set in the AM mode?
A The AM function is available with any power level. However, the output power should be preferably set at the mid range to maximize the AM depth. Note that the RF output is clipped when available power (min. or max.) is reached.

Q How can I control the AM depth?
A The AM depth can be controlled by changing the amplitude of the external modulating signal. Alternatively, it can be controlled by changing the AM input sensitivity via software (see Communications Specifications for a proper command). Note that the AM depth is dependent on synthesizer output frequency; thus, the sensitivity control command can be also utilized to linearize the AM response versus output frequency.

Q I noted that the AM input is specified to work at DC. Does this mean that I can use a DC voltage to change the synthesizer output power?
A Yes, absolutely! This is just another way to control the output power (in addition to the digital control via software).

Q How do you implement frequency and phase modulation?
A The process of producing a frequency-modulated signal involves the variation of the synthesizer output frequency in accordance with the modulating signal. There are several FM modes depending on the modulating frequency rate as indicated in the QuickSyn® datasheet. Note that the phase modulation is treated as one of the FM modes. All these modes are available with the Option 07.

Q Why is phase modulation specified in the FM section?
A Both processes (frequency and phase modulation) are quite similar since in both cases we vary the argument (the angle) of the same sine function.

Q Is an internal FM generator available?
A No. Similar to AM, and pulse modulation, an external modulating signal is required.

Q I noted that phase noise degrades when the FM mode is selected. Is this normal?
A Yes, this is normal. The QuickSyn® utilizes a proprietary phase refining technology that makes it insensitive to any external frequency or phase perturbations. In the FM mode, phase refining has to be switched-off to allow FM modulation. Thus, some phase noise degradation may occur.

Q How can I control the FM deviation?
A Similar to AM, the FM deviation can be controlled by changing the amplitude of the external modulating signal. Alternatively, it can be controlled by changing the FM input sensitivity via software (see Communications Specifications for a proper command).

Note that the FM depth is dependent on synthesizer output frequency; thus, the sensitivity control command can be also utilized to linearize the FM response.

Q I noted that the FM input is specified to work at DC in the phase modulation mode. Does it mean I can use a DC voltage to change the synthesizer's output phase.

A Yes, it does. You can control the phase of the output signal by changing the DC voltage on the FM input connector.

2.9 Sweep and list modes

Q What is frequency sweep?

A It is often desirable to linearly change the output frequency within certain limits. This function is called frequency sweep and is widely used in test-and-measurement applications for characterizing various devices across their operating frequency range.

Q How is the frequency sweep function implemented in the QuickSyn?

A QuickSyn® employs an extremely accurate digital frequency sweep method is by changing the synthesizer output frequency in precise discrete frequency increments (steps). Note that the VCO is locked at every discrete point across the sweep range. Hence, the digital sweep provides significantly better frequency accuracy compared to analog sweep methodes used in older instruments.

Q How can I define frequency sweep?

A The frequency sweep is defined by setting the start frequency, stop frequency, number of points, and sweep time. Alternatively, it can be defined by setting the start frequency, stop frequency, number of points, and dwell time.

Q What is power sweep?

A Synthesizer output power can also be swept between desired power levels. This function is called power sweep and is used in characterization of output power and linearity characteristics (P_{-1dB} compression point, IP_3, etc.) of various devices.

Q How is the power sweep function implemented in the QuickSyn?

A Similar to the frequency sweep, the QuickSyn® utilizes digital power sweep by changing the synthesizer output power in discrete increments.

Q What is list mode?

A The list mode offers even better flexibility by storing a list of frequencies and power levels in the synthesizer's memory. In this case, any desired frequency-power profile can be created, stored, and executed. The list is executed by sending a proper command or by applying a trigger signal. Once the synthesizer detects a trigger pulse, it starts moving from one frequency point to another according to the programmed list. Alternatively, the synthesizer can go to the next state, stop there, and wait for the next trigger pulse; then, the process repeats.

Q Are there any other parameters that can be stored and then controlled via the list mode?
A In list mode you can control not only frequency but also output power level. Furthermore, you can turn off synthesizer output power or enable pulse modulation.

Q What are other advantages of the list mode?
A The list mode offers much faster frequency switching compared to the regular programming mode when new frequency setting commands are sent one-by-one.

Q How does the list mode increase switching speed?
A The utilized PLL hardware is very fast capable of locking within less than 100 microseconds. However, extra delays are required to receive a tuning command, perform all necessary calculations in accordance with the employed frequency plan, and program individual devices inside the synthesizer. Hence, the total switching time is specified at 200 uSec in the regular operation mode when new frequency commands are sent one-by-one. Most of these delays, however, can be reduced or completely eliminated in list mode. Let's assume you have a preset list of frequencies you want to jump between. Knowing these frequencies, you can pre-calculate and memorize all necessary parameters required to control individual components of the synthesizer. Thus, all calculations can be avoided by the time you execute the list mode. This reduces the switching speed to 100 uSec regardless of the current and destination frequency.

Q Where can I store the list points?
A The list points can be stored in the synthesizer's internal non-volatile memory.

Q How many list points can be stored?
A You can store as many as 32,000 points.

Q How can I set the list mode?
A Please consult the QuickSyn® Communications Specifications and User's Manual for detailed instructions on how to use the list mode. Both documents can be downloaded from our website at http://www.phasematrix.com/pages/Synthesizers.html

Q What is the difference between normal and fast sweep modes?
A The fast sweep mode is essentially a list mode where all the frequency or power settings change linearly. Similar to the list mode, the synthesizer can calculate and memorize all parameters required to program individual devices according to the synthesizer's frequency plan. When you start sweep, these calculations can be avoided and that results in faster sweep (as fast as 100 microseconds per point). However, the number of points is limited to 32,000 due to the internal memory limitations. More points are available in the normal sweep mode. In this mode you memorize only start, stop frequencies, step size, and dwell time. Thus, there are virtually no limitations on the number of points since the minimal step size is 0.001 Hz. The disadvantage is slightly slower tuning. Since all calculations have to be made on the fly, the switching speed is limited to 200 uSec per point.

3. Mounting, connectors, DC Supply

Q How can I mount the QuickSyn® synthesizer?
A The synthesizer can be mounted using its either bottom or backplane with 4-40-size mounting screws as shown on the page 4 of the QuickSyn® datasheet.

Q What is the size of this synthesizer?
A The QuickSyn® measures only 5 by 7 by 1 inches. All critical dimensions are indicated on the page 4 of the QuickSyn® datasheet.

Q Is a heatsink required?
A Yes, a heatsink is necessary since the unit dissipates about 20 Watts in a relatively small volume. QuickSyn® can be (and normally is) a part of a complex system. It should mounted on a metal chassis that serves as a heat sink. In general, a thorough thermal analysis is required that takes into account many factors (i.e., chassis size, other heat generating devices in a close proximity, available airflow, etc.). In practice, a 10" x 12" x 0.3" metal plate can work nicely as a simple heatsink example.

Q What DC supply should be used to bias the QuickSyn?
A The synthesizer requires a single +12V DC, 2A bias line only; neither negative nor high-voltage bias is needed. Moreover, the design includes custom-built active filters to prevent possible signal contamination. Nevertheless, a clean, stable bias is essential for obtaining low spurs. Note that for proper operation it is important to keep the bias voltage on the QuickSyn® SPI connector bias pin not less than +12V. Therefore, the voltage of the DC power supply may need to be adjusted to compensate for the drop across the bias cable. We recommend adding a little margin; 12.6V (+/-5%) seems to be a good number.

Q Can I use a higher voltage?
A Yes. A higher voltage up to +15V can be used. Just keep in mind that this excessive voltage will result in higher DC power (i.e., heat) dissipated by the unit, so more aggressive heat sinking may be required.

Q I noticed that the current consumption sometimes is higher when I just turn on the unit. Is it normal?
A Yes, it is normal. The synthesizer initially consumes more current to warm up its internal OCXO.

Q How do I hook up the QuickSyn® module and get started?
A Separate cables may be purchased as accessories from Phase Matrix but a very convenient QuickStart kit is also available that contains AM/FM, USB, DC bias, and SPI cables as well as a DC power supply. Please see the QuickSyn® User's Manual and QuickStart Guide on the Phase Matrix website for more details.

Q What is the part number for the SPI mating connector on the QuickSyn?
A We recommend Hirose's socket DF1B-20DS-2.5RC and contacts DF1B-2022SC.

4. Control interfaces and programming

4.1 SPI

Q What kinds of interfaces are available for controlling the QuickSyn® module?

A Currently, SPI and USB interfaces are supported. The SPI is available through the main SPI connector and the USB is available through the USB Mini-B receptacle.

Q Does the QuickSyn® include a CPU to support these interfaces?

A A built-in 32-bit RISC 200 MHz CPU brings the required horsepower to support all communications as well as internal signal processing.

Q What is SPI?

A Serial peripheral interface (SPI) is a synchronous serial data link that offers full duplex communication, relatively high throughput, and flexibility. The idea behind the SPI is to send controlling bits one-by-one rather than altogether via a single data line. Another line is added to receive some information from the device under control. In order to synchronize the data streams, an auxiliary synchronization signal (such as clock pulses) is needed. And finally, one may want to control not one but several devices via the same wires. This is accomplished using an additional, auxiliary line that allows the selection of a particular device. Thus, a multi-device, full-duplex interface is constructed with four signal lines, specifically SPI_CLK, SPI_SS, SPI_MISO, and SPI_MOSI.

Q What is the maximum communication speed trough the SPI bus?

A The communication speed is limited by the SPI clock rate and the length of a particular command. For example, if a command is 10 bits long and clock speed is 10 MHz, then the time required to send this command will be about 1 usec. The maximum SPI clock rate of the QuickSyn® is limited at 12 MHz.

A What commands can be sent trough the SPI interface?

Q All available commands are documented in the Communications Specifications available at http://www.phasematrix.com/pages/Synthesizers.html

Q When using SPI for communication to the QuickSyn, why do I have to issue query commands twice?

A When doing any query through the SPI you must issue the query twice and disregard the value returned from the first query. The second time that the query is issued, the correct value will be returned. SPI is a serial bus that uses shift registers to input and return data. The first time that a query is issued, the data requested is acquired by the internal CPU but cannot be clocked out of the return shift registers until another query is issued.

Q What other types of I/O are available on the main SPI connector?

A Besides the SPI control lines themselves, the main SPI connector also includes DC supply bias line, hardware trigger, hardware reset, frequency lock and external reference lock indicators.

Q What are the logic levels for the SPI, hardware trigger and hardware reset inputs?
A These inputs use a +3.3V logic level.

Q Are the SPI inputs protected? May I use a higher voltage to drive the SPI inputs?
A There is a 68 Ohms input resistor limiting the current draw from the SPI source driving it. The SPI lines are protected with 68 Ohms serious resistors and Schottky connected to the internal +3.3V DC supply. Thus, a higher voltage will be simply clipped and has no effect on functioning of SPI.

Q May I use TTL to drive the SPI lines?
A Yes, TTL may be used.

Q Is there a hardware reset?
A Yes, the QuickSyn® module may be reset by utilizing the hardware reset input on the main connector. This input has an internal pull-up resistor and requires an active low signal to reset the module.

4.2 USB

Q What is advantage of the USB interface?
A The USB interface and the soft panel control GUI software offer instant deployment and evaluation of the QuickSyn® synthesizer. They also allow using the QuickSyn® synthesizer as a stand-alone laboratory signal generator. Furthermore, the GUI visualizes all SPI commands that simplifies writing your own code if required.

Q How can I get the USB interface?
A The USB interface is available as Option 04. You will also need to install USB drivers on your PC. The drivers are available on the Phase Matrix website at http://www.phasematrix.com/pages/Synthesizers.html

Q What drivers are needed for the USB interface?
A QuickSyn® uses a CDC USB interface and we have drivers available for Windows XP, Windows Vista, and Windows 7 for both the 32 and 64 bit versions of each operating system. For Linux, the generic USB serial driver that comes with most distributions of Linux can be used. The Windows drivers and Linux instructions can be downloaded from our website on the QuickSyn® main page.

Q Do I need to develop my own code if I use USB?
A You can develop your own code and control the QuickSyn® by sending individual commands through either SPI or USB interface. This usually happens when one needs to embed the QuickSyn® in a more complex instrument or subsystem. All the commands are documented and thoroughly described in the Communication Specifications. If you want to utilize the QuickSyn® as a stand-alone instrument (i.e., a signal generator) you can also use the control GUI as thoroughly described in the User's Manual document.

Q What is the difference between the SPI and USB commands?
A There is not much difference. The command structure remains the same as indicated in the Communications Specifications document. The USB interface is just another physical link to send commands into the synthesizer.

Q Can the USB communication slow down the synthesizer switching speed?
A In some instances it can since performance of the USB interface is subject to the performance of the computer that it is connected to. If the switching speed is the main concern, we recommend using the list mode. Once a desired list is uploaded into the synthesizer memory, it is executed by an external trigger signal and runs independently of the outside communication. Thus, the performance will not be affected by any interface.

Q Can I use the USB and SPI interfaces at the same time?
A Both the USB and SPI ports are active and will accept commands but the internal microprocessor will service them in the order that the commands are received; you cannot send simultaneous commands.

A Could the SPI connector be ignored if I control the unit via USB only?
Q The SPI interface itself (clock, data in, data out, slave select lines) can be ignored, no connection is required. However, you still need to connect +12V bias to the same SPI connector. You may also need to connect a physical trigger line (if you use a triggered list mode) and lock detector lines (if you monitor the lock state using a physical line but not a command).

Q Are there any USB programming examples available?
A Currently we have LabView, VB and C/C++ programming examples for common commands. Please contact tech support to have the files emailed to you.

Q What is the buffer length for the USB interface?
A The USB buffer for the QuickSyn® module is 64 bytes. Each string sent via USB to the QuickSyn® may be up to 64 bytes long including the termination character. Commands may be combined but each command must be complete and cannot be split.

Q What termination character is used for sending commands via USB?
A An ASCII Carriage Return (13, 0x0D) is used when terminating a string and sending it via USB.

Q How do I write my own software to work with the USB interface?
A With the USB driver installed, the USB interface can be accessed just as a regular COM port on your PC. The parameters are 115200 baud, 8 bits, no parity, 1 stop bit and flow control must be disabled. If you have any communication problems, make sure that the following members of the COM port DCB structure are set correctly:

```
dcb.fRtsControl = RTS_CONTROL_DISABLE;
dcb.fDtrControl = DTR_CONTROL_DISABLE;
```

Q How do I format commands sent via the USB interface?

A The command string sent to the QuickSyn® must be single byte characters which are an ASCII representation of the Hex codes i.e. "0C09184E72A000" and must be terminated with the termination character.

4.3 Ethernet

Q What hardware is needed to allow a QuickSyn® module to communicate via Ethernet?

A The QuickSyn® Ethernet adapter kit is required to connect a QuickSyn® module to the Ethernet.

Q What are the power requirements for the Ethernet adapter?

A The Ethernet adapter is powered from the same +12V that is used to power the QuickSyn® module. A special cable is included in the adapter kit that provides the appropriate connections; the adapter requires an additional 150mA of current from the +12V supply.

Q What Ethernet communication protocols are used by the Ethernet adapter?

A The Ethernet adapter uses UDP for IP address location, and a TCP/IP socket to communicate to the host application.

Q Does the Ethernet adapter support DHCP?

A Yes DHCP is turned on by default so the Ethernet adapter IP address will be assigned by a DHCP server automatically.

Q How do I find out what IP address has been assigned to my Ethernet adapter?

A You can use the GUI to find all of the Ethernet adapters connected to your network; just click the Network button on the Locate QuickSyn® Device dialog box when you launch the GUI and then choose the one with the correct MAC address.

Q What is a MAC address?

A MAC stands for Media Access Control and it is a hardware specific unique ID that corresponds only to your Ethernet adapter.

Q Where can I find the MAC address for my Ethernet adapter?

A The MAC address is printed on the case of your Ethernet adapter.

Q What ports are used to communicate with the Ethernet adapter?

A When locating the Ethernet adapters on the network, the GUI will broadcast a UDP packet on port 30718, and will listen for responses on port 28674; normal communication uses TCP/IP on port 10001. If these ports are blocked on your machine, firewall, or network then you will not be able to communicate with the Ethernet adapter and should contact technical support for instructions on changing the port.

Q How do I format commands sent via the Ethernet interface?
A Commands can be formatted either as SCPI or ASCII representations of the Hex command codes (see the Communications Specifications document for formatting specifics) and must be terminated with the termination character.

4.4 GPIB

Q What hardware is needed to allow a QuickSyn® module to communicate via GPIB?
A The QuickSyn® GPIB adapter kit is required to connect a QuickSyn® module to GPIB.

Q What are the power requirements of the GPIB adapter?
A The GPIB adapter kit includes a universal AC to DC plug in adapter and uses regular AC line voltages.

Q How do I format commands sent via the GPIB interface?
A Commands can be formatted either as SCPI or ASCII representations of the Hex command codes (see the Communications Specifications document for formatting specifics) and must be terminated with the termination character.

4.5 RS232

Q What hardware is needed to allow a QuickSyn® module to communicate via RS232?
A The QuickSyn® RS232 adapter kit is required to connect a QuickSyn® module to an RS232 port.

Q How do I format commands sent via the RS232 interface?
A Commands can be formatted either as SCPI or ASCII representations of the Hex command codes (see the Communications Specifications document for formatting specifics) and must be terminated with the termination character.

Q How do I write my own software to work with the RS232 interface?
A The COM Port parameters are 115200 baud, 8 bits, no parity, 1 stop bit and flow control must be disabled. If you have any communication problems, make sure that the following members of the COM port DCB structure are set correctly:
dcb.fRtsControl = RTS_CONTROL_DISABLE;
dcb.fDtrControl = DTR_CONTROL_DISABLE;

4.6 Control GUI

Q Is there any control software available for the QuickSyn® module?
A We provide a QuickSyn® control GUI application that runs on a Windows PC and allows easy control of the QuickSyn® module. The program may be downloaded from our website on the QuickSyn® main page. The GUI emulates virtually all functions available in traditional bench-top signal generator instruments.

Q Can I control more than one QuickSyn® with a single computer?
A Beginning with version 1.0.17 of the QuickSyn® control GUI application, multiple copies of the application can be run. This allows control of multiple QuickSyn® modules as each control GUI will be using a different COM/USB port.

Q Whom should I contact to if I need more details about the QuickSyn® synthesizer?
A Please send your inquiry to sales@phasematrix.com or just call 408-428-1000.

4.7 Memory

Q What kind of memory is contained in the QuickSyn® module and how do I clear the it?
A The QuickSyn® module memory description and clearing procedure are described in the Clearing QuickSyn® Memory document available on the Phase Matrix website.