SIGNAL⚡FORGE

Signal Forge 800™
Digitally Synthesized Signal Generator

User Manual

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Introduction

The Signal Forge 800 Digitally Synthesized Signal Generator is a low-cost, high performance signal source, which combines several key functions into a single unit: frequency generation, frequency sweep, frequency modulation, amplitude modulation and arbitrary modulation. A convenient, dedicated output port tailored for testing digital systems with support for 3.3V TTL, 2.5V TTL and 1.8V STTL voltage levels is also provided. An integral TCXO oscillator ensures a high level of precision and accuracy.

A wide, stable frequency range with AC coupled single-ended, differential and digital outputs with selectable TTL voltage levels in a small, easy to use package combine to make the Signal Forge 800 (SF800) the ideal tool for a full range of RF and digital electronics test and development applications.

General Features

The Signal Forge 800 supports the following features:

- 1000 Hz to 800 MHz output, usable to 1GHz
- Programmable synthesized frequency source
- FSK, AM, OOK, ASK and arbitrary modulation modes
- External and internal control of Start, FSK, OOK and ASK
- TCXO oscillator provides high level of precision and accuracy
- Low parts count makes it highly reliable (as required for ATE systems)
- Easy to learn and operate
- Microprocessor controlled
- Output jitter performance +/-20 ps Pk- to-Pk
- Minimal frequency overshoot when changing frequency
- Small, portable package (8.5" x 5.5" x 1.5")

Applications

The list below shows some of the possible applications where the Signal Forge 800 may be used:

- IF and RF sections of receivers as well as the mobile bands up to 1 GHz and some telemetry bands
- Test amplifiers for gains and for the 1 dB compression point
- Portable, bench top and ATE system applications
- Local Oscillator (L.O.) source
- Programmable clock generator

- Sweep mode of the digital output can be used to test setup and hold of digital systems
- FSK and frequency sweep may be used to test FM receivers
- Can be used as an amateur or commercial RF exciter

Chapter

2

Specifications

Frequency Range…………………………………1000 Hz - 800 MHz, usable to 1 GHz

Frequency Resolution... 1 Hz

Amplitude Resolution.. 1 dB

Power Range (AC Output).. −11 to 7 dBm

Power Output Accuracy (AC Output)......................…+/-2 dB over full frequency and power range

Frequency Drift per hour (After warm-up)................. 0.0002 %

Frequency Stability... …. 0.001 % - Over temperature of range of
15-35 ºC ambient

Frequency precision …………………………….....4ppm (based on 2.5ppm TCXO)

Frequency accuracy ………………………………… 5ppm (calibrated with a 1ppm frequency
counter)

Frequency stability…………………………………….May drift 3ppm in the first year then
1ppm/year thereafter

Phase Noise: -64 dBc/Hz @ 1 KHz Offset

-90 dBc/Hz @ 10 KHz

-110 dBc/Hz @ 100 KHz

Harmonics:

    2 MHz to 50 MHz.....................................< -50 dBc

   50 MHz to 100 MHz...................................< -50 dBc

  100 MHz to 500 MHz...................................< -20 dBc

  500 MHz to 1GHz...................................... < -20 dBc

Non-Harmonics:

  100 KHz to 100 MHz...........................…………< -65 dBc

  100 MHz to 500 MHz..................................< -60 dBc

  500 MHz to 800 MHz..................................< -60 dBc

Clock feed-through......….. < -85 dBm

Output Match (VSWR)

  1 MHz to 7 MHz………...............................< 2:1 @ +7 dBm output

  7 MHz to 800 MHz..< 1.3:1 @ +7dBm output

External Control Header

      Input Voltage…………………………………… 3.3V (5V Tolerant)

      Output voltage (TX_MOD pin)……………….5V

Note

Output ratings at 100 MHz, 0 dBm output power and 25 ºC, unless otherwise specified.

Getting Started

Power Adapter

110V AC power adapter with a 5VDC output is provided. The power connector is on the rear panel. Use only the power adapter that came with your SF800.

Connecting the SF800 to Your Computer

Attach a standard serial port cable with a DB-9 connector to the RS-232 port on the rear panel of the SF800 and the other end to the serial port on your computer. Alternatively, the SF800 may be connected to a USB connection on your computer by attaching an inline Keyspan 19HS serial port-to-USB adapter to the serial port cable.

Front Panel Connections
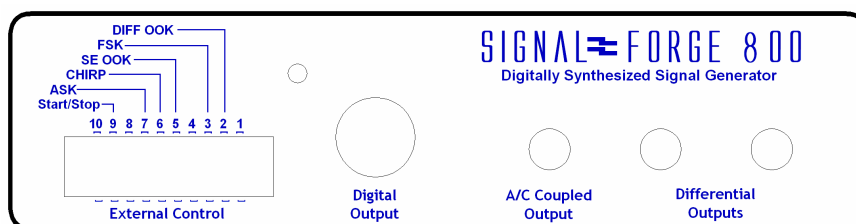
Figure 1. Front Panel

Differential Outputs. Two SMA connectors for driving the differential clock output. LVPECL compatible, 50 MHz to 800 MHz range (usable to 1 GHz).

A/C Coupled Output. One SMA connector for driving the AC coupled, sine wave output with a frequency range of 100 KHz to 800 MHz (usable to 1 GHz).

Digital Output. BNC connector. Digital voltage levels supported are: TTL, LVTTL, STTL over a frequency range of 1000 Hz to 100 MHz.

External Control. Dual-row 10-position header provides 10 two-pin connectors for:

▪ Differential Clock On/Off Keying (OOK) control
▪ Frequency Shift Keying (FSK) control
▪ OOK control (for AC Coupled output)
▪ ASK control (AC Coupled output)
▪ Remote START control

LED. The front panel LED will be turned on solid if the SF800 has powered up correctly. If the LED does not turn on, then a power error has occurred and the SF800 may not be operational. The LED is also turned off during some operations to signify a change of state.

> **Note**
>
> *At power-up, all outputs are disabled, unless a waveform has been previously saved and programmed to automatically start at power up.*

Rear Panel Connections
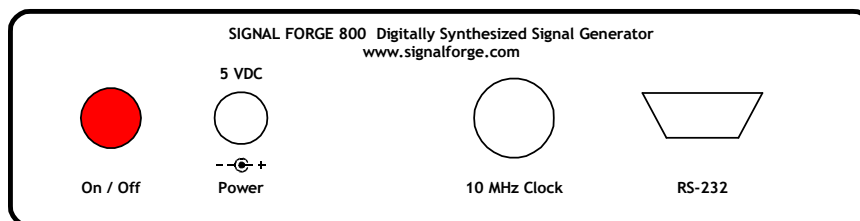
Figure 2. Rear Panel

RS-232. The RS-232 port uses a standard DB-9 serial connector, which connects the SF800 to the serial port on your PC. The required RS-232 port settings are: 8 data bits, 1 stop bit and no-parity; flow control: XON/XOFF only, no hardware handshake pins are implemented. The baud rate must be set to 57,600.

10 MHz Clock. BNC connector that provides a 10 MHz TTL reference signal derived from the internal TCXO timebase. Output impedance is approximately 50 Ω.

> **Note**
>
> *The rear BNC connector for the 10 MHz clock is a reference clock **input** on the **SF800E** enabling it to be driven by an external standard. It is a clock <u>output</u> on the <u>SF800</u>.*

Power. Input for the AC power adapter (provided). 5 VDC only.

On/Off. Power on/off button. The LED on the front panel will be on solid if the SF800 has powered up correctly. If the LED does not turn on, then a power error has occurred and the SF800 may not be operational. In this case contact technical support for assistance.

Wave Manager Software

Setup, configuration and programming is accomplished using Wave Manager, the embedded, menu-driven software included with the SF800. The software uses an external serial console (typically a computer monitor) as the display device. Standard terminal console software, such as Windows HyperTerminal may be used as the console.

At power up, the main menu is displayed, presenting the current configuration, operational status and programming options. The menu screens are organized such that *only* the options allowable for the selected waveform and output type are displayed making the software easy to learn and navigate.

```
               ----  SF800 Main Menu  ----

Waveform: Single Tone (running)
Output A/C                       External START     DISABLED
Frequency 1 (hz)        1,000    External OOK/FSK    DISABLED
                                 OOK (internal)      DISABLED
                                 dBm Base            -11
                                 dBm Offset          0



A) Modify active waveform        B) Copy active waveform to creation menu
C) Waveform creation menu        D) Turn off outputs
E) Version information           F) Download firmware
G) Calibrate frequency




            Select from above...   <ESC> to previous screen
```

Figure 3. Main Menu of the Wave Manager software.

Creating a Waveform

To configure a new waveform, select the *Waveform Creation Menu*.

```
            ----   SF800 Waveform Creation Menu   ----

Waveform: Single Tone
Output A/C                       External START     DISABLED
Frequency 1 (hz)        1,000    External OOK/FSK    DISABLED
                                 OOK (internal)      DISABLED
                                 dBm Base            -11
                                 dBm Offset          0



A) Edit parameters      B) Validate parameters    C) New waveform type
D) Run                  E) Save                    F) Save & load at powerup
G) Load




            Select from above...   <ESC> to previous screen
```

Figure 4. Waveform Creation Menu.

First select *New Waveform Type* and choose the desired waveform from the list.

```
                    ----   SF800 Waveform Creation Menu   ----

 Waveform: Single Tone
 Output A/C                          External START     DISABLED
 Frequency 1 (hz)         1,000      External OOK/FSK   DISABLED
                                     OOK (internal)     DISABLED
                                     dBm Base           -11
                                     dBm Offset         0



 A) Single Tone          B) FSK Unramped         C) FSK Ramped
 D) FSK Triangle         E) FSK Arbitrary        F) Sweep
 G) Square AM            H) Sine AM




                  Select from above...   <ESC> to previous screen
```

Figure 5. Select New Waveform menu.

Hit ESC to return to the main *Waveform Creation Menu*, then select *Edit Parameters*.

```
                    ----   SF800 Waveform Edit ----

 Waveform: Single Tone
 Output A/C                          External START     DISABLED
 Frequency 1 (hz)         1,000      External OOK/FSK   DISABLED
                                     OOK (internal)     DISABLED
                                     dBm Base           -11
                                     dBm Offset         0



 A) Output                          M) External START
 B) Frequency 1 (hz)                N) External OOK/FSK
                                    O) OOK (internal)
                                    P) dBm Base
                                    Q) dBm Offset



                  Select from above...   <ESC> to previous screen
```
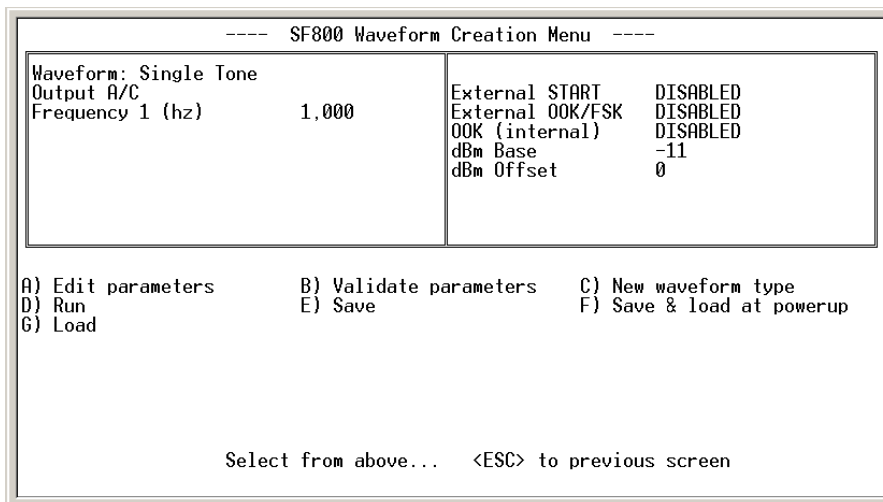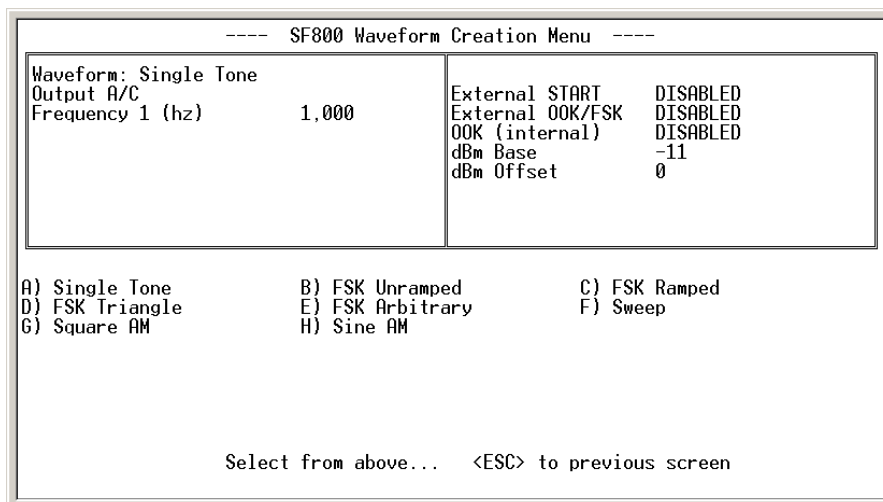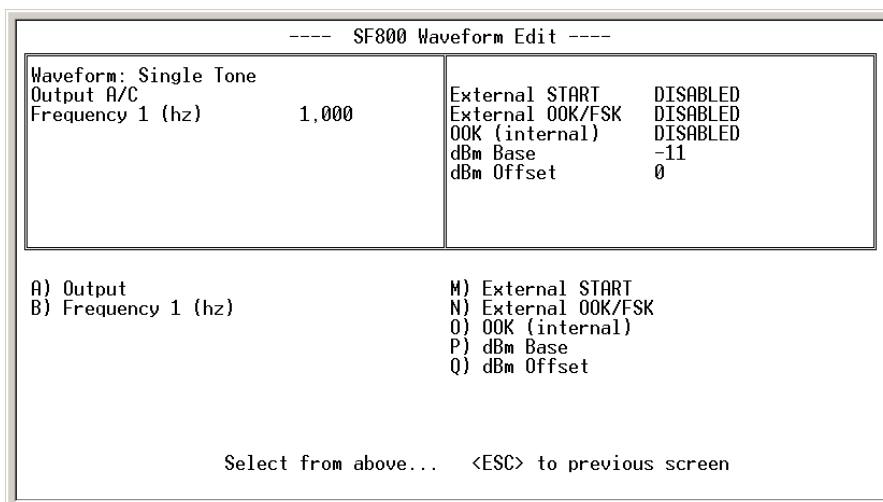
Figure 6. Edit Parameters menu.

Then select Output from the menu to configure the output type from the list displayed.

```
                    ----  SF800 Waveform Edit ----

 Waveform: Single Tone
 Output A/C                          External START     DISABLED
 Frequency 1 (hz)        1,000       External OOK/FSK   DISABLED
                                     OOK (internal)     DISABLED
                                     dBm Base           -11
                                     dBm Offset         0




 A) A/C
 B) DIFF
 C) TTL 1.8v
 D) TTL 2.5v
 E) TTL 3.3v




              Select from above...   <ESC> to previous screen
```

Figure 7. Output selection menu.

```
                    ----  SF800 Waveform Edit ----

 Waveform: FSK Ramped
 Output A/C                          External START     DISABLED
 Frequency 1 (hz)        5,000,000   External OOK/FSK   DISABLED
 Frequency 2 (hz)        110,000,000 Arbitrary modulation  DISABLED
 Delta Freq  (hz)        1,000       dBm Base           -11
 Ramp Rate (hz)          300         dBm Offset         0
 FSK modulating freq (hz) 1
 %Time freq1 selected    50


 A) Output                    M) External START
 B) Frequency 1 (hz)          N) External OOK/FSK
 C) Frequency 2 (hz)          O) Arbitrary modulation
 D) Delta Freq  (hz)          P) dBm Base
 E) Ramp Rate (hz)            Q) dBm Offset
 F) FSK modulating freq (hz)
 G) %Time freq1 selected

              Select from above...   <ESC> to previous screen
```
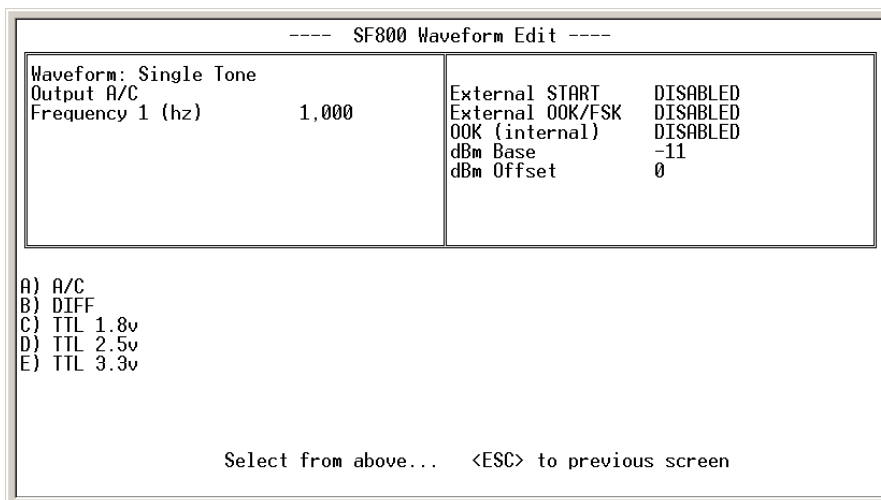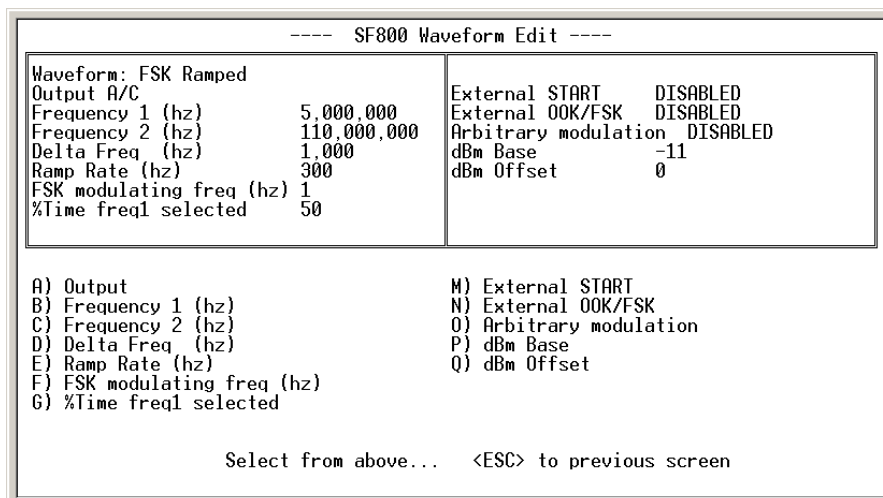
Figure 8. Edit Parameters menu.

Hit ESC to return to the main *Edit Parameters* menu and configure all other applicable parameters such as frequency, output power, etc.

External Controls. The *Edit Parameters* menu also allows you to enable the external controls, where applicable. See the External Controls section for a description of the external control connector.

Note

The Arbitrary Modulation selection enables you to upload a file containing a user defined modulation pattern. See the Arbitrary Modulations and Arbitrary Waveforms chapter below for information on creating an Arbitrary Modulation file.

Note

Entering a frequency value greater than the maximum supported will be flagged as an error or automatically reset to the highest valid value.
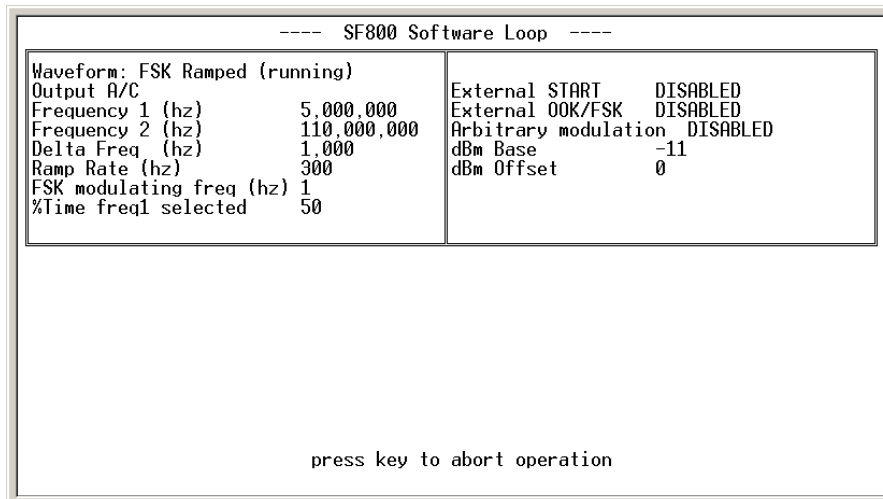
```
            ----  SF800 Software Loop  ----

Waveform: FSK Ramped (running)
Output A/C
Frequency 1 (hz)      5,000,000    External START     DISABLED
Frequency 2 (hz)      110,000,000  External OOK/FSK   DISABLED
Delta Freq  (hz)      1,000        Arbitrary modulation  DISABLED
Ramp Rate (hz)        300          dBm Base           -11
FSK modulating freq (hz) 1         dBm Offset         0
%Time freq1 selected  50




                 press key to abort operation
```

Figure 9. Running the new waveform.

Running the Waveform

Return to the main *Waveform Creation* menu and select Run to start the new waveform. You may run the waveform with or without saving it.

Saving Waveforms

From the *Waveform Creation* menu, you may chose to save the new waveform to one of the four non-volatile memory locations.

You also have the option to save your waveform with the Load at Power-up option. The Load at Power Up feature causes the selected waveform to be loaded and started when the SF800 is first turned on. This feature enables the SF800 to operate in a repeatable stand-alone mode.

Note

Saving a new configuration overwrites any previously saved configuration at that location.

In addition to the four memory locations, one set of user-developed arbitrary waveform data may be saved (see the Arbitrary Waveform Modulation section below).

Modifying Waveforms "On-The-Fly"

Some of the parameters of the **Single Tone** and **FSK** type waveforms may be modified during runtime providing you with increased flexibility to exercise specific areas of the device under test.
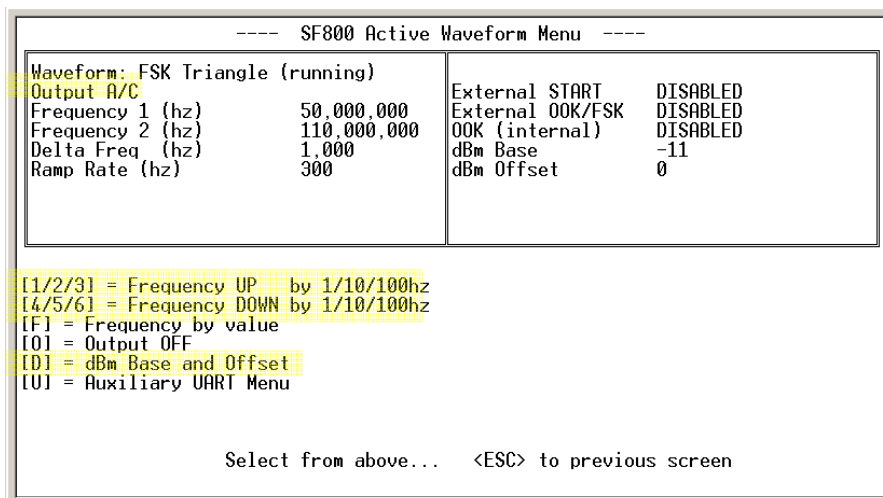
```
              ----  SF800 Active Waveform Menu  ----

 Waveform: FSK Triangle (running)
 Output A/C                          External START     DISABLED
 Frequency 1 (hz)      50,000,000    External OOK/FSK   DISABLED
 Frequency 2 (hz)     110,000,000    OOK (internal)     DISABLED
 Delta Freq  (hz)       1,000        dBm Base           -11
 Ramp Rate (hz)         300          dBm Offset         0




 [1/2/3] = Frequency UP   by 1/10/100hz
 [4/5/6] = Frequency DOWN by 1/10/100hz
 [F] = Frequency by value
 [O] = Output OFF
 [D] = dBm Base and Offset
 [U] = Auxiliary UART Menu


                 Select from above...   <ESC> to previous screen
```

Figure 10. Modify Active Waveform Menu.

Frequency Step Up, Step Down

While either the Single Tone or FSK type waveform is running, the frequency may be changed by stepping it up or down in discrete steps using the selections on the *Modify Active Waveform* menu (in the case of FSK, Frequency 1 is changed only). The frequency may be repeatedly stepped up or down in increments of 1 Hz, 10 Hz or 100Hz. You may also enter a new frequency value by using menu selection [F].

Power Level / Attenuation Control (dBm Base and Offset)

The Wave Manager software allows you to change the Base power level and the Offset during operation when the AC Coupled output is enabled. The power values are entered in dBm.

▪ **Base Power (dBm Base).** Base power may be increased or decreased within the supported range, which is -11 dBm to +7 dBm.

▪ **Offset**. Allows you to adjust the Base Power to offset the losses of external connections (i.e. interconnect cables). For example: You enter a frequency of 500 MHz and require an output of 5 dBm; you then enter an offset of 2 dB causing the SF800 to drive the output at 7dBm. After a cable loss of 2 dBm, the output power measured at the Device Under Test should be 5 dBm (7-2 = 5 dBm) In all cases; the total power must not exceed the maximum dBm provided by the SF800.
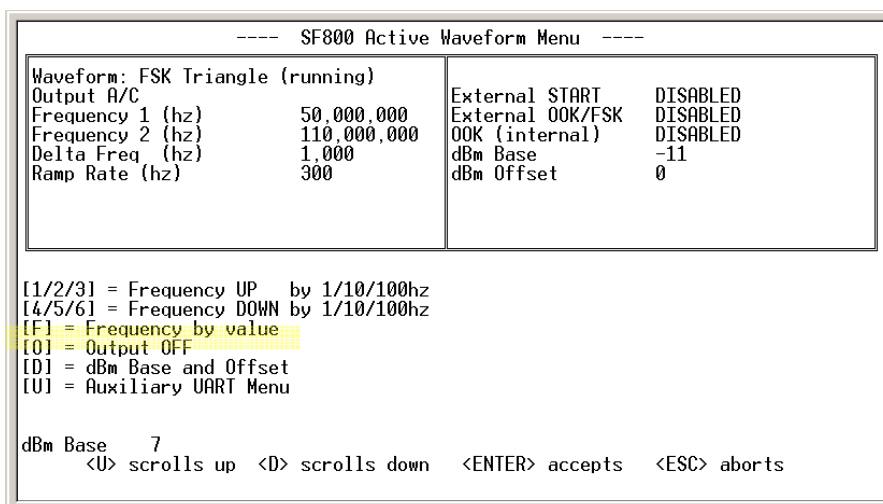
```
              ----  SF800 Active Waveform Menu  ----

 Waveform: FSK Triangle (running)
 Output A/C                          External START     DISABLED
 Frequency 1 (hz)      50,000,000    External OOK/FSK   DISABLED
 Frequency 2 (hz)     110,000,000    OOK (internal)     DISABLED
 Delta Freq  (hz)       1,000        dBm Base           -11
 Ramp Rate (hz)         300          dBm Offset         0




 [1/2/3] = Frequency UP   by 1/10/100hz
 [4/5/6] = Frequency DOWN by 1/10/100hz
 [F] = Frequency by value
 [O] = Output OFF
 [D] = dBm Base and Offset
 [U] = Auxiliary UART Menu


 dBm Base    7
        <U> scrolls up  <D> scrolls down   <ENTER> accepts   <ESC> aborts
```

Figure 11. Modify Power Setting.

Output Types

The SF800 provides three different output types:

- **AC Coupled, Single-ended**
- **Differential**
- **Digital**

All outputs have a resolution of 1Hz.

When an output type is selected, all other output types are disabled (e.g. when AC Coupled is selected, the TTL output is tri-stated and the differential output is at 0 MHz).

AC Coupled Output

The output driver of the AC Coupled signal source provides a nominal 50-Ohm output impedance–the output driver implementation is described in the drawing below.
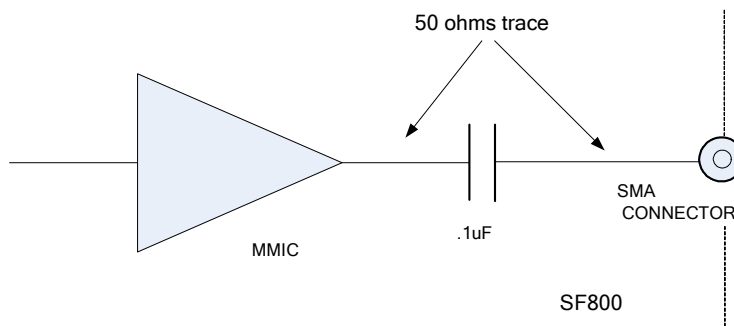
Figure 12. AC Coupled Output Driver

Differential Output

The outputs of the differential driver conform to the LVPECL standard. The driver and the recommended method of interfacing to it are described in the drawing below. This differential driver is designed to work in 50-Ohm systems.
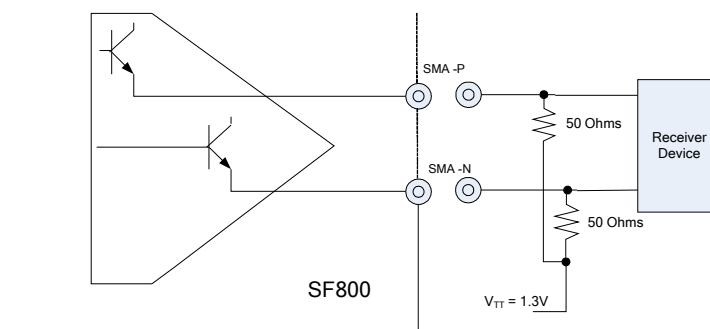
Figure 13. Differential Output Driver

Digital Output

The following block diagram shows the implementation of the programmable TTL output buffer:
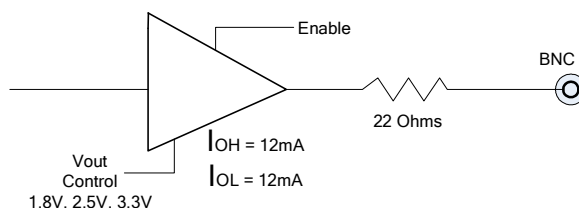
Figure 14. Digital Output Driver

Operating Limits

- AC Coupled output   100 KHz - 800 MHz (usable to 1 GHz)
- Differential output   50 MHz - 800 MHz (usable to 1 GHz)
- Digital (TTL) output   1000 Hz - 100 MHz
- Internal Max FSK deviation range is as follows:
    - Digital (TTL)   Any deviation allowed
    - AC Coupled from 1 Hz to 100 MHz   Any deviation allowed
    - AC Coupled above 100 MHz   Deviation ±1% max
    - Differential   Deviation ±1% max
    - The duty cycle (Frequency1 direction) 10% to 90%
- External OOK/FSK (User-driven signal)   4.5 KHz maximum
- Internal OOK   500 KHz maximum
- OOK is supported for:
    - AC Coupled output   Up to 100 MHz
    - Differential output   Full range
    - The duty cycle (ON percentage)   10 to 90% except near the highest modulating frequency

Operating Ranges

Waveform / Operation	Range
OOK	Modulating frequency 0.1 Hz to 500 KHz
FSK ramped / unramped	Modulating frequency 0.1 Hz to 500 KHz
FSK Arbitrary	Modulating frequency 0.1 Hz to 26 KHz
Sweep	Frequency changes using step time of 10ms to 60s in 1ms increments
Square AM wave	Modulating frequency 0.1 Hz to 45 KHz
Sine AM wave	Modulating frequency 0.1 Hz to 65 K Hz

Table 1 Operating Ranges

Chapter

5

Waveforms

The SF800 provides a wide range of waveform modulation features from which you can create a variety of waveforms. Numerous waveform modifiers may be applied to customize the output to meet your specific testing needs. The waveforms, modifiers and options are configured using the Wave Manager software.

In addition, you may develop arbitrary modulation files to create your own unique type of FSK or AM modulated output. An *Arbitrary Modulation* option will be displayed on the *Edit Parameters* screen of any waveform that supports user-developed waveform modulation files.

Single Tone

The Single Tone waveform outputs a continuous tone at the user-selected output frequency.

Output types

- AC Coupled

- Differential

- Digital (TTL: 3.3V, LVTTL: 2.5V, SVTTL: 1.8V)

Options

- Externally or internally controlled OOK

- Externally controlled Start

> **Note**
>
> *External control requires an external user-provided modulating source (TTL level).*

FSK Unramped

The Frequency Shift Keying (FSK) Unramped waveform allows you to select two output frequencies which are alternately driven at a preprogrammed rate. For internal FSK operation, the modulating frequency that determines the rate at which the frequencies change is selected from the *Edit Parameters* menu. The duty cycle menu entry determines the duration that frequency1 is asserted versus frequency2. The alternate frequency selection is determined either by internal timers, or by the front panel FSK signal (when external control is enabled).
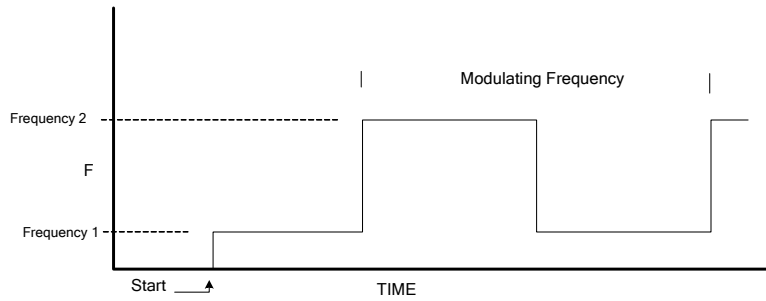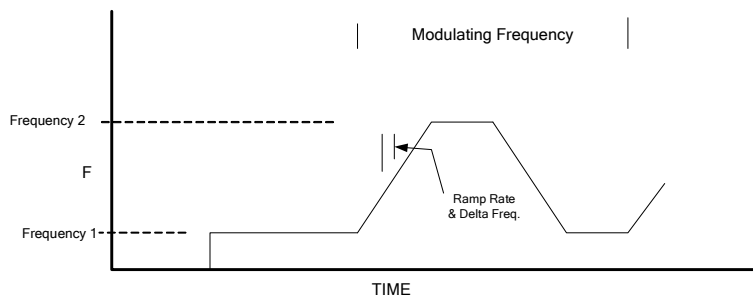
Figure 15. FSK Unramped Modulation

Output types

- AC Coupled

- Differential

- Digital (TTL: 3.3V, LVTTL: 2.5V, SVTTL: 1.8V)

Options

- Externally controlled OOK

- Externally controlled Start

- Arbitrary modulation (from a user created file)

FSK Ramped

The FSK Ramped waveform varies the output frequency within a specified range. The rate of frequency change is determined by the delta frequency (the amount that the frequency is changed at each step) and the ramp rate (at what interval the frequency is changed).

The direction of frequency change is determined by internal timers or by the front panel FSK signal (when external control is enabled). For internal FSK operation, the modulating frequency and duty cycle determine how long frequency1 and frequency2 are selected. When frequency2 is selected, the direction of change is towards frequency2. Once frequency2 is reached, the frequency will remain there until the internal timer signal selects frequency1 (which causes the frequency to ramp towards frequency1).

The user would normally select a modulating frequency and duty cycle such that the ramp has time to complete (i.e. If the FSK signal changes before the ramp is complete, then you will not have reached full range). See drawing below:

Figure 16. FSK Ramped Modulation

Output types

- AC Coupled

- Differential

- Digital (TTL: 3.3V, LVTTL: 2.5V, SVTTL: 1.8V)

Options

- Externally controlled OOK

- Externally controlled Start

- Arbitrary modulation (from a user created file)

FSK Triangle

FSK Triangle is similar to FSK ramped, except that ramping from one frequency to the next occurs automatically. When an end frequency is reached, the direction changes and ramping continues towards the other frequency. See drawing below:
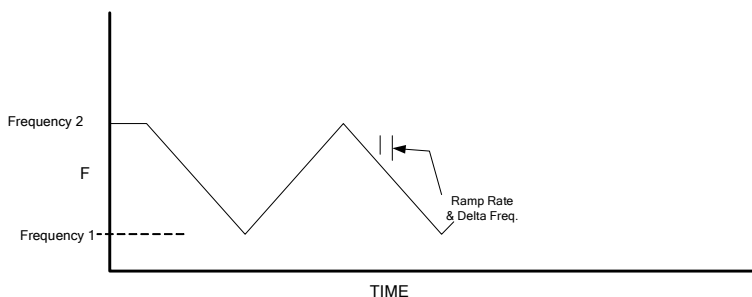
Figure 17. FSK Triangle Modulation

Output types

- AC Coupled

- Differential

- Digital (TTL: 3.3V, LVTTL: 2.5V, SVTTL: 1.8V)

Options

- Externally controlled OOK

- Externally controlled Start

- Arbitrary modulation (from a user created file)

FSK Arbitrary Waveform

For FSK Arbitrary Waveforms, a user developed file describing a set of frequency variations is uploaded to the SF800 and optionally saved in internal non-volatile memory. One arbitrary data set may be saved at a time.

FSK Arbitrary descriptor files may be created using a text editor or waveform generator software.

Arbitrary FSK allows the user to specify a set of frequency variations, the user-entered data includes:

- Center frequency

- Maximum deviation

- Sample rate

- A set of descriptors that define the deviation for each sample point

The output frequency changes at a time defined by the sample rate. The actual output frequency is determined using the formula

$$Fout = <center\ frequency> + (deviation * descriptor)$$

Where each descriptor is a floating point value in the range –1.0 to 1.0. For example, a center frequency of 50 MHz with deviation 10 MHz and descriptor -0.5 will create a frequency of 45 MHz.

The file format and number of descriptors supported is described in the Creating Arbitrary Waveforms chapter below.

The drawing below illustrates how FSK Arbitrary Waveforms operate.
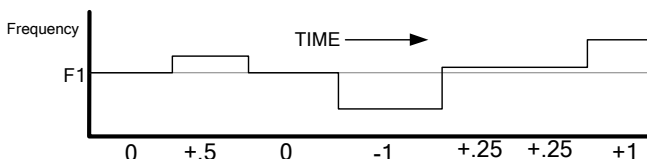
Figure 18. Example of FSK Arbitrary waveform

The FSK waveform shown above was created from the following text file:

```
number_of_points 7
// start with highest output frequency for 1 sample times
1.0
//go down to center frequency and then back to highest using 25% freq  X 2
.50  0 -.10  .25 .25  1.0
```

Figure 19. Sample FSK Arbitrary Text File

Sweep

Sweep is similar to the FSK ramped mode of operation except that it allows frequencies to span the full operational range. It also allows any delta frequency. Sweep allows the user to pause, change direction, or single-step. When a sweep range completes, it starts over at the first frequency.

Output types

- AC Coupled (single-ended)

- Differential

- Digital (TTL: 3.3V, LVTTL: 2.5V, SVTTL: 1.8V)

Options

- Externally controlled or OOK

- Externally controlled Start

Square AM

For Square AM, the user specifies a single frequency (the carrier frequency) and two power values. The duty cycle may be programmed to a value other than 50%, which will result in the creation of an asymmetrical wave instead of a square wave (50% at the first power value and 50% at the lower power value). The drawing below depicts AM Square Wave operation (in this example, the modulation is set to 50%)
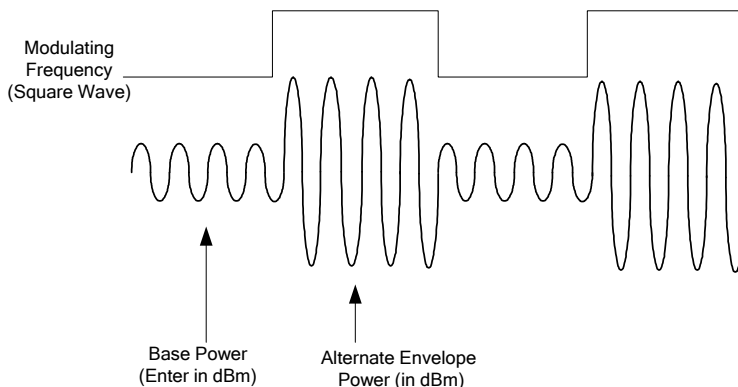

Figure 20. Sample Square AM Waveform

Arbitrary waveform modulation may be used to completely customize an AM type waveform by downloading arbitrary amplitude descriptors from a user-generated file.

Output types

▪ AC Coupled

Options

▪ Externally controlled OOK

▪ Externally controlled Start

▪ Arbitrary modulation (from a user created file)

Sine AM

A Sine Wave AM waveform modulates power using a sinusoidal pattern. The SF800 outputs a discrete number of power levels as shown in the drawing below. The existence of these discrete power steps is normally not an issue since an AM demodulator includes a low pass filter at its output that will remove any high frequency components (higher than the maximum modulating frequency).
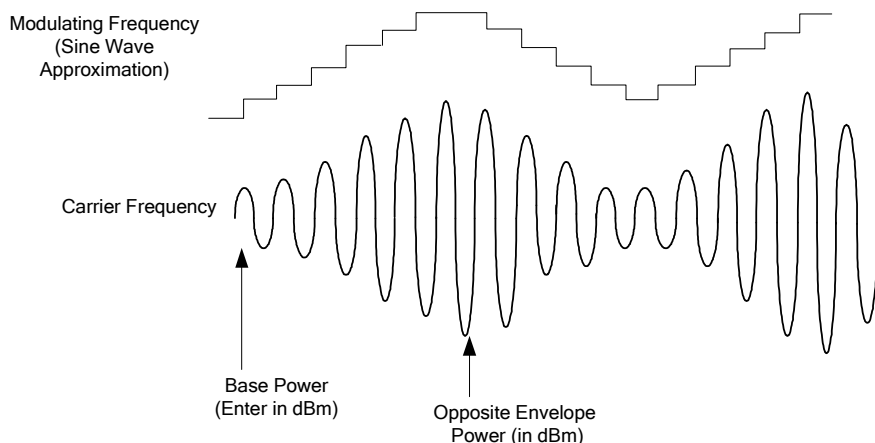
Figure 21. Example of Sine AM Waveform

Output types

- AC Coupled

Options

- Externally controlled OOK

- Externally controlled Start

- Arbitrary modulation (from a user created file)

The modulating frequency affects the number of sample points that are used to create the waveform as shown in the following table:

Modulating frequency	Samples per cycle
7500 Hz	12
2500 Hz	36
1500 Hz	60
750 Hz	120
500 Hz	180
250 Hz	360

Table 2. Sine AM Samples per Cycle Table

The Arbitrary Modulation mode may be used to completely customize an AM waveform by downloading a user-generated arbitrary descriptor file. In this case, each descriptor defines the output power using values of –1.0 to 1.0, where –1.0 is the lowest power and +1.0 is the highest power.

Note

Maximum Square AM modulating frequency is 40 KHz. Maximum Sine AM modulating Frequency is 66 KHz.

Chapter

6

Arbitrary Waveforms

Arbitrary Waveforms allow the user to define specific frequency or power values at a specified sample rate. CHIRP testing can be executed easily with the SF800 by creating the appropriate arbitrary waveforms. The following sections describe how to create, upload and save Arbitrary Modulation files to the SF800.

An Arbitrary Modulation selection will be displayed on the *Edit Parameters* menu of all waveforms that support arbitrary modulation.

Arbitrary Modulation Operation

The Arbitrary Modulation mode of operation enables you to specify data points that describe a waveform and the rate of execution. The maximum rates are shown in the following table.

Operation	Sample Rate
OOK	90 KHz
FSK	90 KHz
Square AM	80 KHz
Sine AM	80 KHz

Table 3. Arbitrary Waveform: Maximum Sample Rate.

Waveform Descriptors

Two types of descriptors are supported: digital and floating point.

Digital Descriptors

Digital descriptors are used in cases where the output is only in one of two states, such as on/off or frequency high/low. Up to 2048 digital descriptors are supported. For example, digital descriptors would be used for OOK operation or Square Wave AM.

Digital descriptors may be in floating point or integer format where values greater than 0 are considered TRUE and other values are considered FALSE.

Floating Point Descriptors

Floating-point descriptors are used in cases, such as FSK Arbitrary or Sine AM, where the output is in more than two states. Up to 512 floating point descriptors are supported.

Floating point descriptors must be in the range –1.0 to 1.0, and are used to define the amount of deviation to apply at each sample point. The output is determined by multiplying the descriptor and deviation, then adding the result to the center value.

Creating a Modulation File

An Arbitrary Modulation file must comply with the following criteria. The file may be created using a text editor, or any program that creates an ASCII file:

- One line should contain the keyword "number_of_points " followed by the number of sample points described (e.g. "number_of_points 22"). This may be on any line.
- Sample points separated by spaces, commas, or tabs

Comments may be inserted anywhere in the file starting with any character other than characters used for numbers ("0123456789.+-"), or matching the keyword "number_of_points". When a comment character is recognized, the rest of the line is ignored.

The file must contain, at a minimum, the number of sample points indicated on the "number_of_points" line. If you include more samples than specified, they will be ignored.

Digital Descriptors

Operation	Description
OOK	FALSE means output is OFF, else ON
FSK	FALSE means output frequency one, else frequency two
AM square wave	FALSE means output low power, else high power

Table 4. Digital Descriptor Definitions

The following sample file describes how to create a floating point set of data points to control an FSK type or AM sine wave type of output:

Sample File

```
// file sine.txt
// Half Sine wave data points for FSK arbitrary or Sine AM
number_of_points 15
-1.0 -.8 -.6 -.4 -.3 -.2 -.1 0
.1  .2  .3  .4  .6  .8  1.0
```

Figure 22. Example of an Arbitrary Modulation file.

Uploading A Modulation File

Once created, the Arbitrary Modulation file may be uploaded to the SF800 and optionally saved in its non-volatile memory.

Before uploading the file, you must first setup the waveform that will be modulated by your set of arbitrary data points. There are two ways to setup the waveform:

- ❑ Select either the FSK Arbitrary waveform from the *New Waveform Type* menu
- ❑ ENABLE Arbitrary Waveform from the *Edit Parameters* menu (where applicable).

Once enabled, an Upload Arbitrary Modulation File selection will appear on the *Edit Parameters* menu.
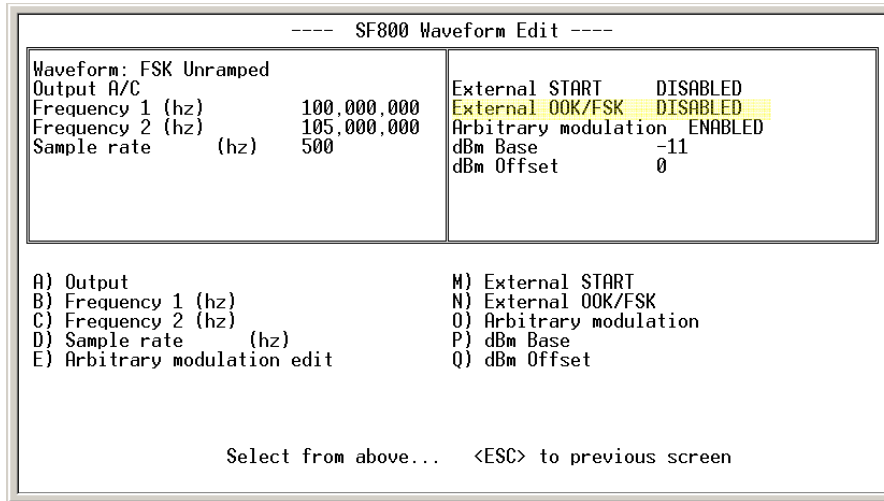
Figure 23. Enable Arbitrary Waveform option.

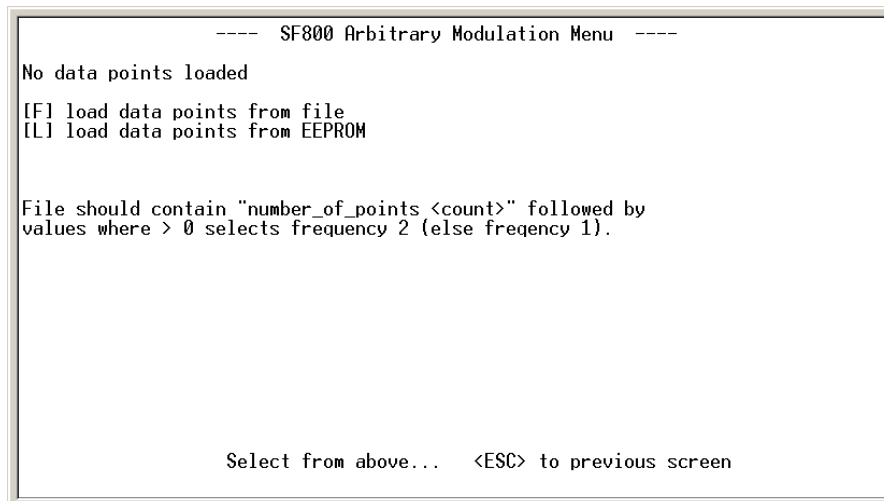Next select Upload Arbitrary Waveform File and follow the onscreen instructions.

Figure 24. Upload Arbitrary Waveform File.

Note

If you wish to save the arbitrary data to non-volatile memory, use the save option before exiting the arbitrary modulation menu.

Chapter

7

Auxiliary UART

The SF800 provides a transmit only UART port (TX_MOD – pin 8) that may be used to send ASCII data characters to an internal or external modulation device. This port is completely separate from the UART port used for the console.

The data that is sent by the auxiliary UART port can be ASCII data generated by a keyboard or from a file. The baud rate is programmable at these rates: 2400, 4800, 9600, 19200, 38400, and 57600 baud.

The Wave Manager software provides support for this UART port on the *Auxiliary UART Menu* (under the *Modify Active Menu* entry).

You may connect the Auxiliary UART output using the appropriate filtering/interface (i.e. polarity control) to an external modulating device or to the OOK/FSK control pins of the same SF800. In this way, you can create modulated waveform outputs, which are actually encoding UART driven data. The diagram below depicts how to configure the UART TX_MOD pin to create an ASCII data keyed OOK Waveform:
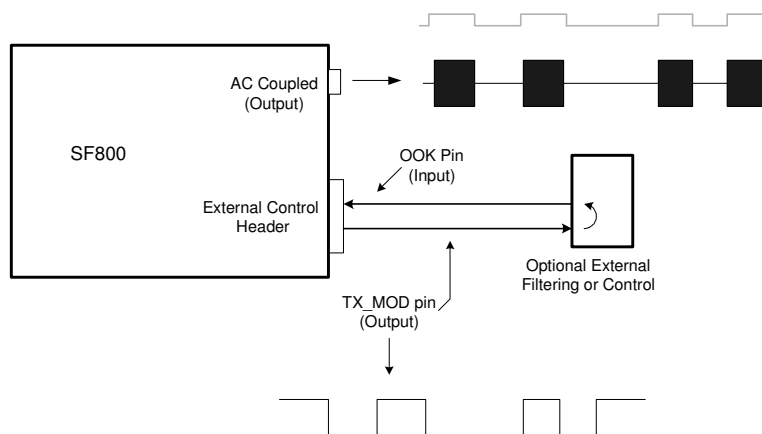
Figure 25: Auxiliary UART Usage

Chapter

8

Calibration

The user has the option to calibrate the SF800 against a known accuracy time base standard at any time. The accuracy of the device used to get the frequency determines the accuracy of the SF800.

The Calibration entry can be found in the *Main Menu* and may be performed as follows:

1. Connect the SF800 to a frequency counter.

2. Enable a TTL or AC Coupled output with a frequency in the range of 1 MHz to 100 MHz (10 MHz is a common standard but the SF800 does not limit the user to this frequency value).

3. Select "Calibration" from the *Main Menu*.

4. Enter the frequency as indicated by the external frequency counter. The difference between these frequencies is used to determine the required calibration. Calibration information is stored by the SF800 in non-volatile memory, loaded at power up, and used until the device is calibrated again.

Chapter

9

External Control Header

The SF800 provides ten 2-pin connectors in a header labeled External Control on the front panel. These connectors enable you to control several modulation functions, such as frequency shift keying (FSK) or On/Off Keying (OOK). The function assignments are listed below.

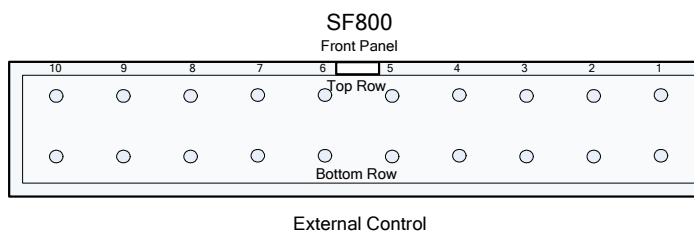| POSITION	NAME (bottom row)		POSITION	NAME (top row)
1	Reserved		1	Reserved
2	DIFF OOK		2	GND
3	FSK		3	GND
4	TX_MOD		4	GND
5	SE OOK		5	GND
6	CHIRP/Reserved		6	GND
7	5V		7	ASK
8	5V		8	GND
9	START		9	GND
10	Reserved		10	GND

Table 5. External Control Header

Figure 26: External Control Header on SF800 Front Panel.

Connector Descriptions

DIFF OOK. The differential clock output supports OOK for the frequency range of 50 MHz to 800 MHz (usable to 1 GHz). This input pin controls the differential output: driving this pin low will stop the differential output. By default this pin is set to a high state.

FSK. This pin allows the user to shift the frequency output as defined previously using the menu entry. This pin is normally high. Driving it low enables you to slow the output frequency as required.

TX_MOD. This is the TX output from the internal Auxiliary UART port. The Wave Manager software provides support for this UART port on the *Auxiliary UART Menu* (under the *Modify Active Menu* entry). The user can connect this output, using the appropriate filtering/interface to the OOK or FSK external control pins of the SF800 and create UART data modulated waveforms if so desired.

SE OOK. The SF800 supports OOK (On/Off Keying) for the AC Coupled output in frequency range of 1 Hz to 100 MHz only. This input pin provides for external control of the output: placing this pin low stops the output of the SF800. This pin is normally set to a high state.

ASK. This control pin allows you to modulate the AC Coupled output in order to implement an externally controlled Asynchronous Shift Keying. When this pin is driven low the AC coupled output will be attenuated by 16 dB over the full output power (when the signal is high).

START. External START is an output control option. A high to low transition causes the SF800 to start outputting its preprogrammed frequency. This feature is available for the AC Coupled, Differential and TTL outputs. When waiting for START the front panel LED is OFF until a valid START polarity is received. FSK unramped or triangle waveforms with external FSK control do not support the wait for START (output is as selected by the FSK external control pin).

The time from assertion of the START signal to output valid will vary depending on the type of output/frequency chosen and modifiers used. The user must first measure this time delay and account for it - if it will affect the type of operation being performed.

As described above, the SF800 gives you the ability to control the output frequency using external control pins. Each one of the control pins has a low pass filter placed at its input, except the Start pin. The low pass filter has a 3 dB cutoff point of 4800 Hz. The input signals must be driven by 3.3V compatible signals. Input impedance is 2K ohms.

The External Control inputs are 5V tolerant and include a certain level of protection as described in the following block diagram:
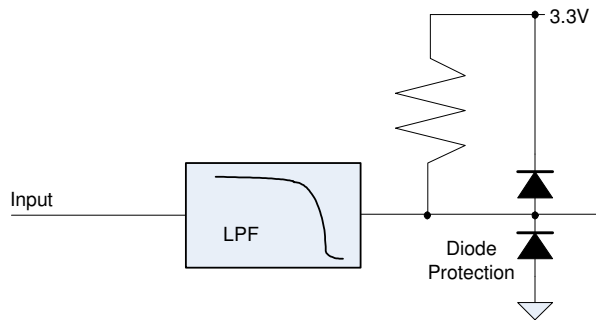

Figure 27: External Control Pin Filter

The Figure below gives an example of external control of a waveform. In the example chosen, an external signal controls the FSK signal pin of the SF800.
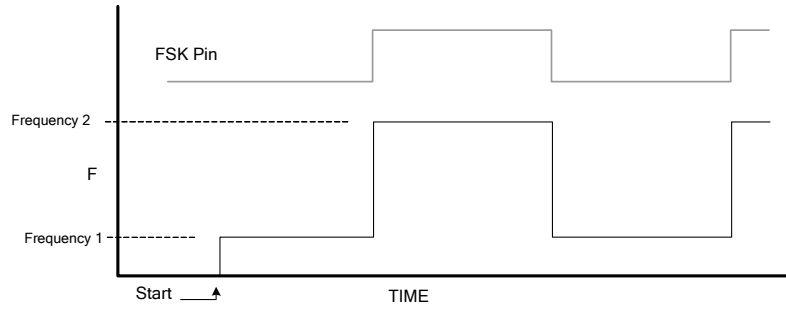

Figure 28: FSK Control Pin Operation

General Safety and Warranty Information

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified service personnel should perform service procedures.

To Avoid Fire or Personal Injury

Use Proper Power Cord. Use only the power module provided with this product.

Connect and Disconnect Properly. Do not connect or disconnect external header pin leads while they are connected to a voltage source (turn the SF800 and external control logic simultaneously).

Observe All Terminal Ratings. Consult the product manual for ratings information before making connections to the product.

Do Not Operate Without Cover. Do not operate this product with the cover removed.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Operate Within Operating Range. No not operate this product outside the operating ranges specified on the manual.

Do not operate in Wet/Damp Conditions.

Do Not Operate in Explosive Atmosphere.

Keep Product Surfaces Clean and Dry.

Warranty

Signal Forge warrants that the products that it manufactures and sells will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If a product proves defective within the respective period, Signal Forge will repair or replacement the product without charge.

EXCEPT AS PROVIDED HEREIN, SIGNAL FORGE MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL SIGNAL FORGE BE LIABLE FOR INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES.

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