Model 560- 5287
N.1 Synthesizer

Serial Number _____

June 6, 2003

Model 560-5287
N.1
FREQUENCY SYNTHESIZER MANUAL

SECTION ONE

1. FUNCTIONAL DESCRIPTION

1.1. PURPOSE OF EQUIPMENT

The Symmetricom 560-5287 N.1 Frequency Synthesizer is a plug-in option card for the Model 56000 DRC. The N.1 option is a direct digital synthesizer (DDS) programmable by the controller onboard the 56K DRC. It is a plug-in card module that fits into the 56K DRC (slots 1-17), and has its own dedicated output card. Each N.1 Frequency Synthesizer application located in the Model 56000 (56K) platform contains six independent DDS's.The DDS outputs single frequencies over the range of 1 Hz to 25 MHz, with a standard tuning resolution of 1 Hz. The DDS output is compatible to 56K system reference frequencies.

The frequency synthesizer for frequency syntonization requires a reference frequency input. The N.1 card set-up and output frequency control is via the system CPU through the Fault Monitor CPU card/Network Port Adapter using RS-232, RS-422, HTTP, or Telnet functions.

1.2. PHYSICAL SPECIFICATIONS

Dimensions:	0.8" W X 3.94" H X 8.66" D (2 cm X 10 cm X 22 cm)
Weight:	½ lb (1/4 kg)

1.3. ENVIRONMENTAL SPECIFICATIONS

Operating Temp:	0° to +50°C
Storage Temp:	-40°C to +85°C
Humidity:	Up to 95% relative, non-condensing
Cooling Mode:	Convective to 30°C; >30°C 50 CFM required
Altitude:	Sea level to 10,000 ft.

1.4. POWER REQUIREMENTS

Voltage:	36 to 72 VDC
Power	1.5 W per output channel or 9 W per card

1.5. FUNCTIONAL SPECIFICATIONS

1.5.1. REF A, B, C INPUTS

Signal Type:	Squarewave or Sinewave
Amplitude:	2 to 5 Vp-p
Frequency:	1,5, or 10 MHz individually selectable

1.5.2. OUTPUT ACCURACY

Frequency Range:	1 Hz to 25 MHz
Frequency Steps:	1 Hz
Jitter:	Less than 1 ns edge to edge

1.5.3. OUTPUT SPECIFICATIONS

Quantity:	6
Signal Type:	Digital
Type:	TTL Single-ended outputs on BNC con-nectors to 10MHz or RS-422 levels on Triax type to 25MHz

1.5.4. DRC CARD COMPATIBILITY

Location:	Slots 1-17 with compatible I/O card in rear slot.
Compatibility:	See Card Compatibility Matrix.

SECTION TWO

2. INSTALLATION AND OPERATION

2.1. HOT SWAPPING

All cards, input cables and output cables are hot swappable. It is not necessary to remove chassis power during insertion or removal. Hot swapping and reference-source changes are abrupt, the effects are difficult to characterize; however, the system is designed to protect against permanent effects and minimize temporary effects of these events.

Typically, adjacent-card hot swapping has a negligible effect on the N.1 Frequency Synthesizer. Although the hot swapping event directly affects the control voltage of each on-board oscillator, it typically lasts less than one clock-period and has an average of 0 Volts. The effect of redundant power supply switch-over is also negligible.

The effect of a reference-source change is less predictable. The reference frequency is delivered via REF A, B, and C on the backplane. The 1, 5, or 10 MHz Frequency Synthesizer receives the reference via the Fast ABC Switch Circuit. If the currently-highest priority reference is changed, the synthesizer locks to the next highest priority reference (A + /A * B + /A * /B * C). The fault is sensed and switched in one cycle + 10%. The resultant output is counted down to 1MHz which drives a 1MHz tuned circuit that absorbs any extra edge as a phase shift. When the new reference is in phase with the old reference, the output frequency is affected by less than 1 part in 10^8 over a 1 second period. When the new reference is of opposite phase, the effect can approach 1 part in $10^{6.}$
Note: Hot swapping a local frequency source, such as an oscillator or fiber optic receiver, qualifies as a hot swap and reference-source change.

2.2. REMOVAL AND INSTALLATION

CAUTION: Individual components on this card are sensitive to static discharge. Use proper static discharge procedures during removal and installation.

Refer to CARD COMPATIBILITY section prior to installing new card.

To remove card, loosen the captive retaining hardware at the top and bottom of the assembly, then firmly push downward on the extractor cam handle (or pull on any connector on rear panel adapter cards) at the bottom of the card. Slide the card free of the frame. Reinstall the card in the frame by fitting it into the card guides at the top and bottom of the frame and sliding it in slowly, avoiding contact between bottom side of card and adjacent card front panel, until it mates with the connector. Seat card firmly to avoid contact bounce. Secure the retaining screws at the top and bottom of the card assembly.

2.3. SETUP

The N.1 Synthesizer Assembly does not require switches being set. It will self-load all outputs to a default value of 10MHz upon first power-up. The N.1 will phase lock to any valid 1, 5, or 10MHz input frequency received on its FREQA, FREQB, and/or FREQC inputs. If another output frequency between 1Hz and 25MHZ is required or if a specific input frequency source is required, the user must use the systems Fault Monitor Frequency Register and the Input Reference A, B, and C adjustment procedures.

2.4. FAULT INDICATIONS

All indicators activate briefly following hot-insertion or power-up. The following paragraphs describe operation during steady-state conditions.

2.4.1. SYNTH FAULT INDICATOR

The card indicates its status to the users through the communication port and colored LEDs. It also indicates the status of the individual outputs, so users can know at a glance the status of the card.

FAULT LEDs:	**If GREEN:**	**If RED:**
SYNTH	LOCKED	UNLOCKED
OUT A – OUT F	OK	OUTPUT FAULT

2.4.2. INIT. FAULT INDICATOR

This is an on-card fault indicator that is not externally visible unless the card is installed next to an empty slot. It indicates a failure of the card to initialize properly during power-up. Activation of this LED is accompanied by activation of all of the front panel indicators. Occasionally, this fault is caused by a temporary condition related to the cycling of power and can be cleared by a power or hot swap cycle. If this is unsuccessful, the card is defective.

2.4.3. DETAILED FAULT STATUS VIA CPU

This status information is supplied as monitor screen data in response to power-up default conditions, user adjustment of the Fault Monitor Frequency Register, or the Input Reference A, B, and C adjustment procedure (see 3.3.1).

SECTION THREE

3. THEORY OF OPERATION

3.1 GENERAL INFORMATION

Every attempt has been made to automate the procedure for frequency and syntonization source selection. User adjustments, other than re-cabling and an occasional re-seating of the card in a powered up chassis as a test reset of that assembly, are accomplished by keyboard data entry on the User Port of the Fault Monitor Assembly.

3.2 HARDWARE PHYSICAL DESCRIPTION

The 560-5287 N.1 Synthesizer Assembly is a standard Model 56K Distribution Chassis sub-assembly (0.8" w X 3.94" h X 8.66" d) with six independent output channels which feed through the 56K Mid-plane to a mating Output PCA connector assembly at the rear of the chassis (560-5292-3 TWINAX or 560-52XX-X BNC).

3.3 HARDWARE FUNCTIONAL DESCRIPTION

The N.1 Synthesizer uses a local oscillator operating at 33.554432 MHz (2^{27}) as a base division frequency for the DDS's. The 33.554432 MHz is then multiplied times four internally and the resulting 134.217728 MHz runs a 2^{48} output counter which drives a cosine DAC input in each DDS. Each DDS Frequency Register is loaded independently by a common byte-wide FPGA bus under this Fault Monitor control.

The Cosine DAC output is then squared, scaled by FPGA counters, and then fed into RS-422/TTL drivers for distribution.

The base 33.554432 MHz is externally phase locked by dividing it down to 1 MHz with a seventh DDS used especially for this purpose. This 1 MHz frequency is then counted down to 100 KHz and mixed in quadrature with the 1, 5, or 10 MHz external synchronizing frequency counted down to 100 KHz.

3.4 DETAILED CONTROL DESCRIPTION

3.4.1 USER COMMANDS

The N1 card utilizes the Fault Monitor serial port to set frequency and other parameters for the six outputs and the card as a whole.

All commands to the N1 card follow the same format based on the slot that the card is occupying. Each command begins with Cxx where "xx" is the slot number (1-based, no leading 0) in which the card resides. All letters that are part of an actual command string can be lower case or upper case.

There are setup and status commands.

3.4.1.1 Standard Command

The standard command is used with all cards and has the format

Cxx?<CR>

where: ? is the question mark character
<CR> is a carriage return

The response to this command is the format:

xx, 5287 Six Channel N.1 Back Card Type
N1 Output Mode = y
C13 A F: zzzzzzzz Hz
C13 B F: zzzzzzzz Hz
C13 C F: zzzzzzzz Hz
C13 D F: zzzzzzzz Hz
C13 E F: zzzzzzzz Hz
C13 F F: zzzzzzzz Hz

where:

xx = is the slot number

y = is the output type (D, S, or O)

zzzzzzzz = is the frequency setting for the specified channel (1 to 25,000,000)

3.4.1.2 Setup Command

The setup command sets the frequency for a specific channel. Typically, the frequency is set between 1 Hz and 25,000,000 Hz.

The output frequency is set with the command:

Cxx y z<CR>

Error! No index entries found.

where:

y = is the selected channel and must be a letter A-F.

z = is the selected frequency, entered in units of Hz.

(e.g. to set a 10 Hz output, z=10 to set a 1.85 MHz output, z = 1850000)

<CR> is a carriage return

3.4.1.3 Reference Frequency Command

Three different frequencies are allowed for the reference 1 MHz, 5 MHz, and 10 MHz.

The command is:

REFx

where x is 1,5, or 10.

Use above command to set the input frequency to 1 MHz, 5 MHz, or 10 MHz.