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INSTRUCTION MANUAL

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SW 5250
SW 3500
SW 1750

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ELGAR

ELGAR ONE-YEAR WARRANTY

Elgar Electronics Corporation (hereinafter referred to as Elgar) warrants its products to be free from defects in material and workmanship. This warranty is effective for one year from the date of shipment of the product to the original purchaser. Liability of Elgar under this warranty shall exist provided that:

- the Buyer exposes the product to normal use and service and provides normal maintenance on the product;
- Elgar is promptly notified of defects by the Buyer and that notification occurs within the warranty period;
- the Buyer receives a Return Material Authorization (RMA) number from Elgar's Repair Department prior to the return of the product to Elgar for repair, phone 800-73-ELGAR (800-733-5427), ext. 2295;
- the Buyer returns the defective product in the original, or equivalent, shipping container;
- if, upon examination of such product by Elgar it is disclosed that, in fact, a defect in materials and/or workmanship does exist, that the defect in the product was not caused by improper conditions, misuse, or negligence; and,
- that Elgar QA seal and nameplates have not been altered or removed and the equipment has not been repaired or modified by anyone other than Elgar authorized personnel.

This warranty is exclusive and in lieu of all other warranties, expressed or implied, including, but not limited to, implied warranties of merchantability and fitness of the product to a particular purpose. Elgar, its agents, or representatives shall in no circumstance be liable for any direct, indirect, special, penal, or consequential loss or damage of any nature resulting from the malfunction of the product. Remedies under this warranty are expressly limited to repair or replacement of the product.

CONDITIONS OF WARRANTY

- To return a defective product, contact an Elgar representative or the Elgar factory for an RMA number. Unauthorized returns will not be accepted and will be returned at the shipper's expense.
- For Elgar products found to be defective within thirty days of receipt by the original purchaser, Elgar will absorb all ground freight charges for the repair. Products found defective within the warranty period, but beyond the initial thirty-day period, should be returned prepaid to Elgar for repair. Elgar will repair the unit and return it by ground freight pre-paid.
- Normal warranty service is performed at Elgar during the weekday hours of 7:30 am to 4:30 pm Pacific time. Warranty repair work requested to be accomplished outside of normal working hours will be subject to Elgar non-warranty service rates.
- Warranty field service is available on an emergency basis. Travel expenses (travel time, per diem expense, and related air fare) are the responsibility of the Buyer. A Buyer purchase order is required by Elgar prior to scheduling.
- A returned product found, upon inspection by Elgar, to be in specification is subject to an inspection fee and applicable freight charges.
- Equipment purchased in the United States carries only a United States warranty for which repair must be accomplished at the Elgar factory.

ELGAR

Committed to Quality...Striving for Excellence

SAFETY NOTICE

BEFORE APPLYING POWER to the System, verify that the SW Series unit is properly configured for the user's particular application.

WARNING

HAZARDOUS VOLTAGES IN EXCESS OF 280 VRMS, 600V PEAK MAY BE PRESENT WHEN COVERS ARE REMOVED. QUALIFIED PERSONNEL MUST USE EXTREME CAUTION WHEN SERVICING THIS EQUIPMENT. CIRCUIT BOARDS, TEST POINTS AND OUTPUT VOLTAGES MAY ALSO BE FLOATING ABOVE (BELOW) CHASSIS GROUND.

Installation and servicing must be performed by QUALIFIED PERSONNEL who are aware of properly dealing with attendant hazards. This includes such simple tasks as fuse verification.

Ensure that the ac power line ground is properly connected to the Model SW Series unit input connector or chassis. Similarly, other power ground lines including those to application and maintenance equipment MUST be properly grounded for both personnel and equipment safety.

Always ensure that facility ac input power is de-energized prior to connecting or disconnecting the input/output power cables.

In normal operation, the operator does not have access to hazardous voltages within the chassis. However, depending on the user's application configuration, **HIGH VOLTAGES HAZARDOUS TO HUMAN SAFETY** may be normally generated on the output terminals. The Customer/User must ensure that the output power lines are properly labeled as to the SAFETY hazards and any that inadvertent contact with hazardous voltages is eliminated.

SAFETY NOTICE (Continued)

Guard against risks of electrical shock during open cover checks by NOT TOUCHING any portion of the electrical circuits. Even when power is OFF, capacitors may retain an electrical charge. Use SAFETY GLASSES during open cover checks to avoid personal injury by any sudden component failure.

Due to filtering, the unit has high leakage current to the chassis. For this reason it is essential to operate this unit with a safety ground.

Some circuits are live even with the front panel switch turned off. Servicing, and even fuse verification and connecting wiring to the chassis, must be accomplished with the power removed via external means; all circuits and/or terminals to be touched must be safety grounded to the chassis. This should be accomplished after waiting at least five minutes after the last power application to the unit.

After the unit has run for some time the metal near the rear of the unit may be hot enough to cause injury. Let the unit cool before handling.

Qualified service personnel need to be aware that some heatsinks are not at ground, but are at high potential.

European versions use 380V 3-phase power. These systems **must have neutral connections; the neutral must not be switched**. Neutral needs to be applied before phase voltage is applied or serious damage to the equipment may result.

SECTION III – OPERATION

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LIST OF FIGURES

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SECTION I

GENERAL DESCRIPTION

1.1 INTRODUCTION

The Elgar Model SW 5250 uses transformerless, direct coupled amplifiers and a true arbitrary waveform generator based controller. This technology allows the user to create, edit and generate complex SmartWave™ waveforms with high DC content for critical ATE and power line disturbance simulation testing.

The SW 5250 can create complex waveforms with high DC content for simulating real world power irregularities, including phase controlled sub-cycle or multi-cycle dropouts, spikes, sags, surges, frequency excursions, plus frequency and voltage ramps (sweeps). The unit can also generate clipped waveforms, harmonic distortion, high current inrush and other complex waveshapes.

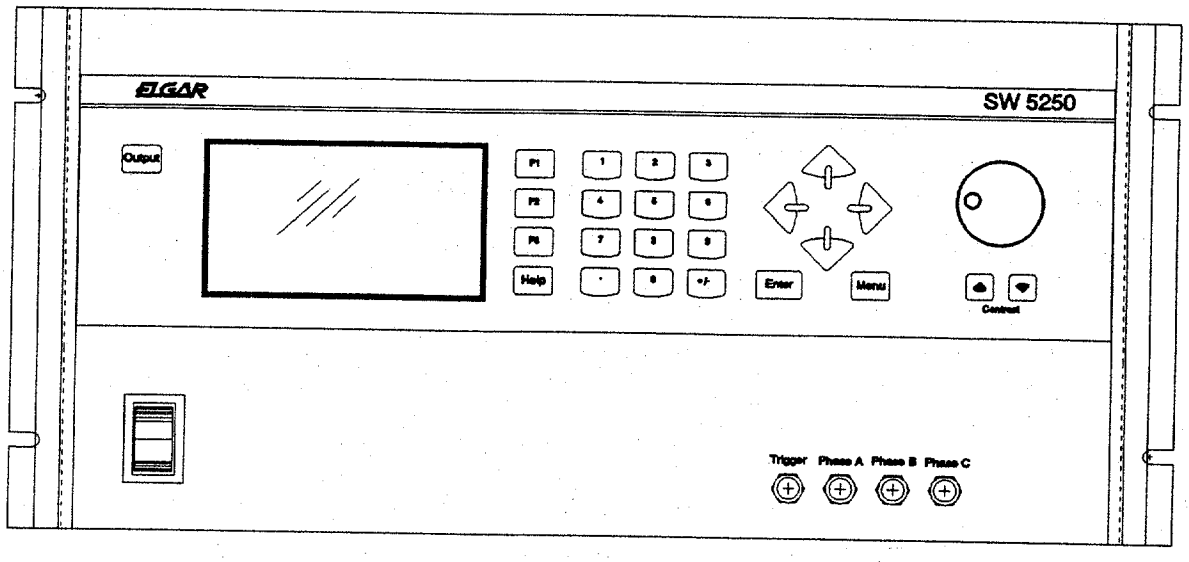


Figure 1-1. Elgar Model SW 5250 AC Power Source (Rack Mount Version)

Programming can be accomplished from the front panel or with a personal computer (PC) using optionally available software. A GPIB card in the computer is also required.

A library of 50 factory-supplied waveshapes is provided in Read Only Memory (ROM). Non-volatile memory storage is available for an additional 50 user-created waveshapes.

Waveshapes from the libraries can be assigned amplitude and frequency parameters and be stored as setups in non-volatile memory for immediate user recall. In addition, up to 1000 timed segments can be created by the user and linked together to form sequences (transient programs).

A back lit graphics LCD display allows quick confirmation of waveforms when created or edited from the front panel. Front panel BNCs provide waveform reference outputs for oscilloscope viewing. The front panel includes a keypad, knob and Help screens.

The SmartWave™ sources are true DC as well as AC power supplies. Up to 312 VRMS are available in AC or AC+DC modes. Multi–phase models can be switched to single or three–phased operation via the front panel or the GPIB.

A wide frequency range of DC or 40 Hz to 5 kHz is available for a broad array of applications. Utilizing the latest in AC switch mode technology, the SW 5250 achieves 55 dB of noise and ripple with total harmonic distortion (THD) of <0.5% to 500 Hz. A crest factor of 4.0 provides high peak–to–RMS current capability. An optional power factor correction (PFC) of .99 is also available.

1.2 INPUT SPECIFICATIONS

Input Power Ranges: Factory configured 187 to 264 VRMS, 3ϕ L–L (3 wire), or 342 to 457 VRMS, 3ϕ L–L (4 wire). A chassis ground is also required for safety.

Input Power Factor: .6 (.99 with input PFC option).

Input Frequency Range: 47 to 63 Hz.

Efficiency: 70%, minimum, at full load.

Ride Through: 3 msec, minimum; 10 msec, minimum, with PFC option.

1.3 OUTPUT SPECIFICATIONS

Power Factor of Load: 0 lagging to 0 leading.

AC or DC Output Voltage: 0 to 156 VRMS L–N range 1; 0 to 312 VRMS L–N range 2.

Output Current Per Phase: 13A to 135V in 156V range; 6.5A to 270V in 312V range (1750 VA maximum).

Crest Factor: 4.0 (peak output current to RMS output current).

Output Frequency: DC, or 40 Hz to 5 kHz. For output frequencies greater than 1 kHz, the maximum slew rate allowed is 1 kHz per second.

Output Power: 1750 VA, maximum, per phase.

Total Harmonic Distortion (Full Linear Load or No Load): 0.25% maximum, 40 to 100 Hz; 0.5% maximum to 500 Hz; and 1% maximum to 1 kHz plus 1%/kHz to 5 kHz.

AC Noise Level: 55 dB RMS below full output.

Amplitude Stability With Remote Sense: ±0.1% of full scale over 24 hours at constant line, load and temperature.

Load Regulation: ±0.025% of full scale voltage for a full resistive load to no load; above 1 kHz, add ±0.01%/kHz.

Line Regulation (DC, or 40 Hz to 5 kHz): ±0.025% of full scale for a ±10% input line change.

Voltage Accuracy: ±0.1% of range. Above 1 kHz, add 0.2%/kHz. Add ±0.1% of full scale for "AC PLUS DC" mode. Valid for 5 to 156 VRMS and 10 to 312 VRMS at 25°C (77°F), sense leads connected.

Voltage Resolution: 0.05% of full scale.

Frequency Resolution:

- 0.01 Hz: 40 to 99.99 Hz
- 0.05 Hz: 100 Hz to 999.9 Hz
- 0.5 Hz: 1000 Hz to 5000 Hz

Frequency Accuracy: ±0.01% at 25°C ±0.001%/°C.

Phase Accuracy, Phase-to-Phase Balanced Linear Resistive Load: ±1°, 40 Hz to 1 kHz, plus ±1°/kHz above 1 kHz.

Phase Angle Resolution: 0.1°.

Remote Output Voltage Sense: 5 VRMS total lead drop, maximum.

1.4 WAVEFORM SPECIFICATIONS

Waveshape Libraries: 50 factory supplied in ROM; storage available for up to 50 user created in non-volatile RAM.

User Created Setups: A total of 100 steady-state waveforms, consisting of parameters such as waveshapes from the libraries plus amplitude, frequency, phase angle and current limit.

Sequencing/Transient Programs: 1000 user-created segments stored in non-volatile RAM. Segments include wave-shape, amplitude, frequency, phase angle, **time** (from 1 msec to 7 days), and number of cycles.

MIL-STD-704 Transients

1.5 STANDARD MEASUREMENTS

1.5.1 Parameters Measured

- 1- to 3-Phase to Neutral RMS Output Voltages
- 1- to 3-Phase to Phase Voltages are Calculated
- 1- to 3-Phase RMS Output Currents
- 1- to 3-Phase Peak Current
- Output Frequency
- 1- to 3-Phase Power
- 1- to 3-Phase VA
- Power Factor of Load Calculated from 1 or 3 Phases
- Output Phase B and C Relative to Phase A

1.5.2 Measurement Capabilities and Accuracies

1.5.2.1 Measurement Capability

4.5 Digit Analog to Digital Measurement System

Calibration Interval: Calibrate at least yearly. 6 months recommended.

Temperature Range for Specified Accuracy: 25°C ±5°C.

Operating Temperature Range: 0°C to 45°C (32°F to 113°F).

1.5.2.2 Phase to Neutral RMS Voltage Measurement

Valid for phases A, B and C (use phase A for Parallel Mode).

Range: 0V to 350.0V plus sign bit for DC range.

Accuracy: ±0.3% of range, DC or 47 Hz to 1 kHz; ±0.5% of range, 40 to 47 Hz and for 1 kHz to 5 kHz.

Temperature Coefficient: ±200 ppm outside specified range.

1.5.2.3 Phase to Phase RMS Voltage Calculation

Calculated from Phase to Neutral voltages and phases.

Range: 0V to 700V.

Accuracy and **Temperature Coefficient** the same as for the Phase to Neutral voltage (see paragraph 1.5.2.2).

1.5.2.4 RMS Current Measurement

Valid for phases A, B, and C (use phase A for Parallel Mode).

Range 1: 0A to 7.5A plus sign bit for DC range; 3–phase mode, 312V range.

Range 2: 0A to 15A plus sign bit for DC range; 3–phase mode, 156V range.

Range 3: 0A to 22.5A plus sign bit for DC range; parallel mode, 312V range.

Range 4: 0A to 45A plus sign bit for DC range; parallel mode, 156V range.

Accuracy: ±1.0% of range, DC or 40 Hz to 500 Hz; add ±1.5%/kHz above 500 Hz. Accuracies are specified for a maximum crest factor of 4.0.

Temperature Coefficient: ±300 ppm outside specified range.

1.5.2.5 Peak Current Measurement

Valid for phases A, B, and C (use phase A for Parallel Mode).

Range 1: 0A to 28A; 3–phase mode, 312V range.

Range 2: 0A to 56A; 3–phase mode, 156V range.

Range 3: 0A to 84A; parallel mode, 312V range.

Range 4: 0A to 168A; parallel mode, 156V range.

Accuracy: ±5% of range, 40 to 500 Hz; add ±1%/kHz, 500 to 5 kHz.

Temperature Coefficient: ±300 ppm outside specified range.

1.5.2.6 Power Measurement

Valid for phases A, B, and C. Up to 3 phase total power and parallel mode (use phase A for parallel mode).

Range 1: 0 kW to 1.8 kW; 3–phase mode.

Range 2: 0 kW to 5.6 kW; parallel mode and total 3–phase power.

Accuracy: ±2.5% of range, DC or 40 to 500 Hz for crest factors <2.0. Add ±1% for crest factors up to 4.0. Add ±1%/kHz above 500 Hz.

Temperature Coefficient: ±500 ppm outside specified range.

1.5.2.7 VA Measurement

Valid for phases A, B, and C. Up to 3 phase total VA and parallel mode (use phase A for parallel mode).

Range 1: 0 kW to 1.8 kVA; 3–phase mode.

Range 2: 0 kW to 5.6 kVA; parallel mode and total 3–phase power.

Accuracy: ±2.5% of range, DC or 40 to 500 Hz for crest factors <2.0. Add ±1% for crest factors up to 4.0. Add ±1%/kHz above 500 Hz.

Temperature Coefficient: ±500 ppm outside specified range.

1.5.2.8 Power Factor Calculation

Valid for phases A, B, C, and TOTAL (use phase A for Parallel Mode).

The Power Factor is calculated from the Power and VA measurements. Phase powers are measured then the total power is calculated; phase VAs are measured then the total VA is calculated. Power is divided by VA; the result is the Power Factor.

Range: 0 to 1.00.

Accuracy: ±5% of range at full power, DC or 40 to 500 Hz for crest factors <2.0. Add ±2% for crest factors up to 4.0. Add ±1%/kHz above 500 Hz.

Temperature Coefficient: ±500 ppm outside specified range.

1.5.2.9 Frequency Measurement

Frequencies are calculated based on output zero crossing time measurements. To minimize errors due to switching noise, a 1 μs filter is used to filter the output signal before the zero comparator.

Resolution: Frequency is displayed to 5 figures maximum; the leading zeros are blanked. Displayed resolution is 0.01 Hz.

Accuracy: ±0.5% of reading, at 10% to full output voltage, 0°C to 45°C (32°F to 113°F).

1.5.2.10 Phase Measurement

Valid for phases A, B, and C relative to each other.

The phase of measured signals are calculated from timing measurements. The reference is the negative to positive zero crossing of the phase A reference signal. End of timing is the negative to positive crossing and the polarity signals are used for these measurements.

Results for phase A relative measurements are calculated from individual timings and displayed as: Phase 'X' is leading/lagging phase 'Y' by 'Z' degrees.

Resolution: ±1°.

Accuracy: ±2°, 40 to 500 Hz; add ±2°/kHz above 500 Hz. For sine wave, balanced resistive load, 10% to 100% of voltage measurement range. All accuracies are specified for 0°C to 45°C (32°F to 113°F).

1.6 PROTECTION AND SAFETY

Overvoltage Shutdown: Programmable for 60V to 255V peak, 156V range; 120V to 510V peak, 312V range.

Programmable Current Limit Shutdown: Settable to 1% of range (0.5A to 13A for 156V range; 0.5A to 6.5A for 312V range).

Programmable Current Limit with Timed Shutdown: Settable to 1% of range; the timeout is settable from 10 msec to 10 sec.

Programmable Constant Current: Settable to 1% of range (0.5A to 13A for 156V range; 0.5A to 6.5A for 312V range). For all current accuracies, add ±1.5%/kHz above 500 Hz. For paralleled amplifiers, add ±1%.

Overtemperature Shutdown (automatic, not programmable).

1.7 DESIGNED TO MEET THE FOLLOWING AGENCY REQUIREMENTS

- UL 1244
- IEC 1010–1
- IEC 555–2
- IEC 801–4 and 5
- FCC Part 15, Class A

1.8 PHYSICAL SPECIFICATIONS (Models SW 5250, SW 3500, SW 1750)

Height: 8.75" (222 mm)

Width: 19" (483 mm)

Depth: 23.5" (597 mm)

Weight:

- SW 5250 – 126.5 lbs. (57.2 kg)
- SW 3500 – 100 lbs. (45.4 kg)
- SW 1750 – 73 lbs. (33.1 kg)

Cooling: Air is drawn in from the top, bottom, and sides and exhausted through the rear of the chassis.

1.9 ENVIRONMENTAL DATA

Operating Temperature: 0°C to 45°C (32°F to 113°F).

Storage Temperature: –40°C to 70°C (–40°F to 158°F).

Humidity (Non–condensing): 0 to 85% at 25°C (77°F); derate to 50% at 40°C (104°F).

1.10 OTHER STANDARD FEATURES

- **1– to 3–Phase Programmable**
- **IEEE 488.2 Interface**
- **SCPI Protocol**
- **Waveform Trigger Output**
  (1 MegΩ Load Drive; positive edge is at 0° ±30μs)
- **BNC Outputs for Waveform Viewing** (1 MegΩ Load Drive)
- **SYNC OUT. User programmed for:**
  - Cycle Start, all cycles
  - Segment Start. all segments
  - Segment Start, selected segments

  For loads ≥2 kΩ: Vout ≤1V Low State; Vout ≥2.4V High State; Negative edge is at 0° ±30μs.
- **External Amplitude Modulation**
  - 0 to 5 VRMS provides 0 to ≥20% output amplitude modulation (±2% of full scale output).
- **CLOCK/LOCK**
  - **CLOCK** pulses at programmed frequency for loads ≥2 kΩ Vout ≤1V Low State; Vout ≥2.4V High State. Negative edge is at 0° ±30μs.
  - **LOCK** locks output to input 'TTL' frequency; signal needs to supply pull down current of 15 mA with voltage drop of ≤0.6V; no pull up needed. Negative edge is at 0° ±30μs.

- **PLL Specifications**
  - External PLL input frequency range is 45.00 Hz to 4500.00 Hz.
  - Tracking range is ±10% of programmed PLL center frequency.
  - External PLL input duty cycle is 50% ±10%.
  - External PLL input slew rate is .02% of input frequency/second, maximum, which produces a maximum phase shift of 5° from the external PLL input falling edge to the output rising edge.
  - The rising edge of the output will be locked to the falling edge of the external PLL input and will have less than a 30 μsec propagation delay.
  - Maximum output jitter when locked is <1% of external PLL input period.
  - PLL lock is achieved in <5 seconds.
- **External Drive**
  - Normal Amplifier, 0 to 5 VRMS (DC to 5 kHz) or ±5 VDC input for zero to full voltage output (±2% of full scale output).
- **External Gain Control**
  - 0 to ±7.07 VDC provides zero to full output (±2% of full scale output).
- **External Input Impedance**
  - ≥30 kΩ.

1.11 OPTIONS

- Parallelable For Additional Power above 5250 VA
- External Waveform Creation Software
- Elgar's VXP–1000 Controller For VXI
- Input Power Factor Correction to 0.99
- 5V or 26V, 0.25A Auxiliary AC Outputs for 115V on Phase A
- Test and Measurement can be removed.

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

NOTES

SECTION II

INSTALLATION

2.1 INTRODUCTION

The Elgar Model SW 5250 has been fully calibrated and tested prior to shipment. Therefore, the instrument is ready for immediate use upon receipt. The enclosure is designed to be installed in a standard 19" (483 mm) RETMA rack or a transit case; pem-nuts are provided for mounting optional slides.

The following checks should be made to ensure that the instrument was not damaged during shipment.

WARNING

The SW 5250 weighs 126 lbs. (57.2 kg)! A minimum two person lift is required!

WARNING

Hazardous voltages are present when operating this equipment. Read the "SAFETY" notices on page ii prior to performing installation, operation, or maintenance.

2.2 UNPACKING

Perform a visual inspection of the shipping container prior to accepting the package from the carrier. If extensive damage to the shipping container is evident, a description of the damage should be noted on the carrier's receipt and signed by the driver of the carrier agent.

If damage is not apparent until the instrument is unpacked, a claim for concealed damage should be placed with the carrier. In addition, the shipping container(s) and filler material should be saved for inspection. Forward a report of damage to the Elgar Repair Department. Elgar will provide instructions for repair or replacement of the instrument.

If the instrument needs to be returned to Elgar, suitable shipping containers and packing materials must be used. If proper packing material is not available, contact Elgar to provide containers and shipping instructions.

2.3 PRE-INSTALLATION INSPECTION

Perform a visual inspection of the instrument when it is removed from the shipping container. Check for shipping damage such as dents, scratches, distortion, and damaged connectors.

2.4 INSTALLATION

The Model SW 5250 is 8.75" (222 mm) high and is designed to be installed in a standard 19" (483 mm) wide cabinet enclosure or a transit case.

CAUTION

Avoid blocking the instrument air intakes or exhaust.

2.5 AIR INTAKE AND EXHAUST

The air intakes are located on the top, bottom, and side panels of the instrument and the exhaust is through the rear panel. Care must be taken not to block the side air intakes; the top and bottom air intakes allow for improved cooling if this air is available. No special vertical separation is required when stacking instruments. However, a 1.75" (45 mm) vertical spacer above and below the instrument may improve cooling. The temperature of the intake air should not exceed 113°F (45°C).

At full power the unit dissipates over 2250W with the PFC option. It is important that the heat produced is properly vented to the exterior of the chassis. Special baffling to control air flow may be required to prevent hot exhaust air being drawn into the intakes if the unit is to be run continuously at full power.

The preferred mounting method for full power operation is bottom mounting. Slide mounting may impair air flow from the side air intakes. If slides must be used, select narrow slides to minimize restrictions to air flow and select cabinets without wide rails which can block air flow. Refer to Table 2–1 for the recommended slides and Figure 2–2 for the mounting location.

2.6 INSTALLATION/DIMENSIONAL DRAWING

Refer to Figures 2–1 and 2–2 for information on outline and mounting dimensions of the SW 5250. Refer to Figure 2–3 and Tables 2–2 through 2–7 for rear panel connector information. Also refer to Figure 2–2 for customer wiring conduit details.

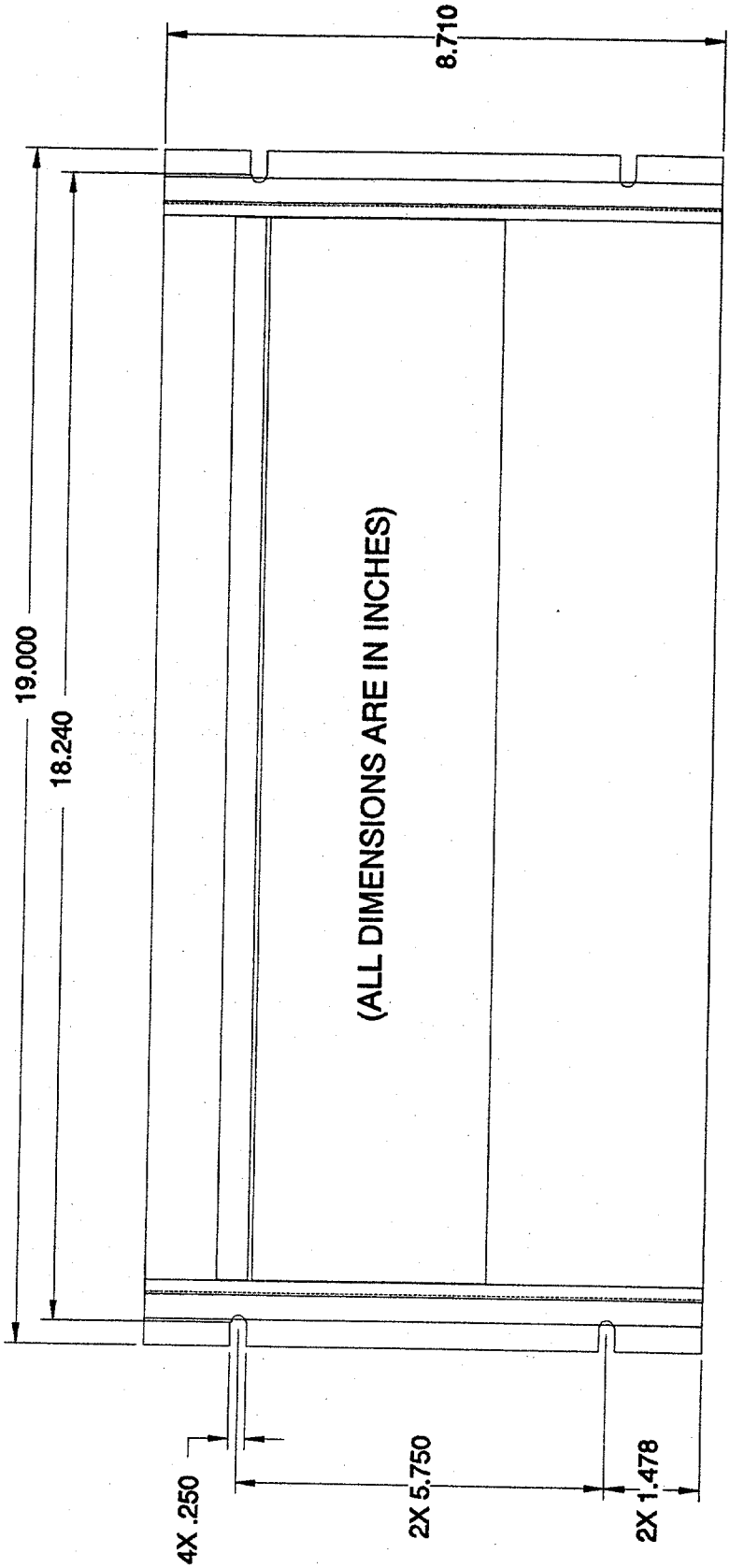


Figure 2-1. SW 5250 (Front View) Mounting Dimensions

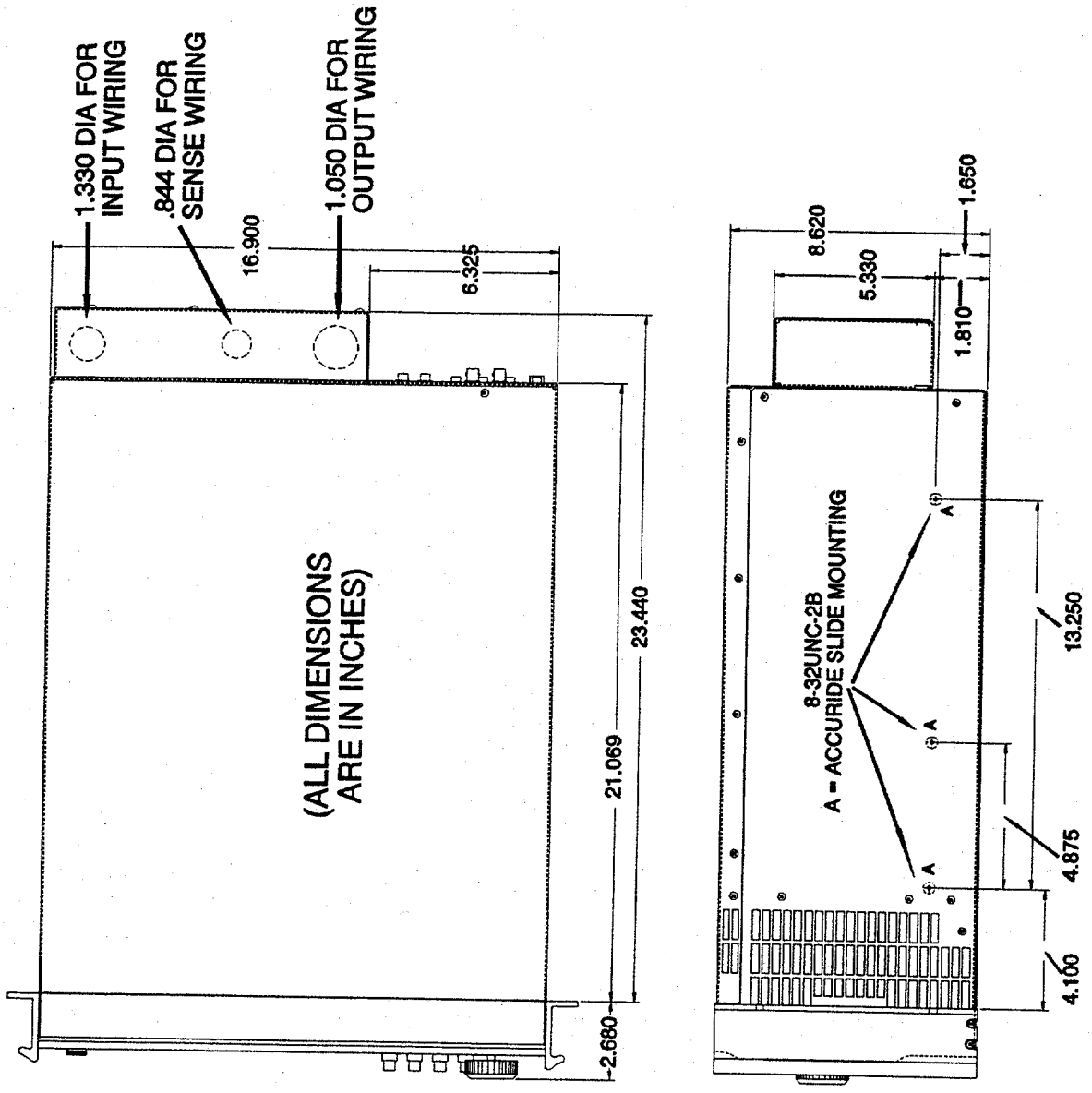


Figure 2-2. SW 5250 (Top and Side View) Mounting Dimensions

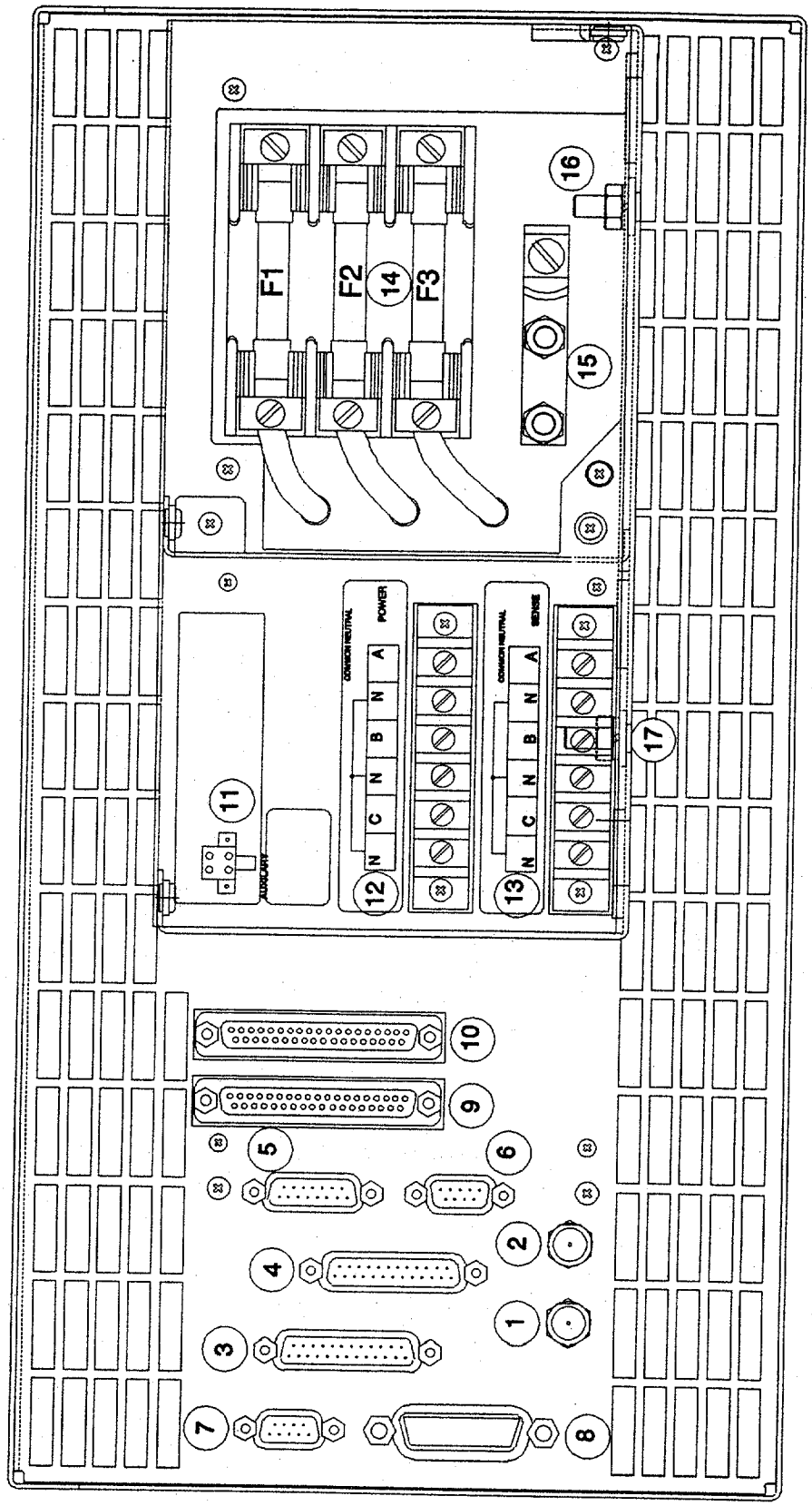


Figure 2-3. SW 5250 Rear Panel

Table 2-1. Recommended Mounting Slide

Type	Manufacturer	Part Number
Mounting Kit (for slides)	Jonathan	BK-3
Slides	Accuride	C-3307-16D

2.7 INPUT/OUTPUT CONNECTORS

Table 2-2 provides a listing of the SW 5250 input and output connectors and other data. Tables 2-3 through 2-7 provide specific pinout information.

NOTE

The RS232, SLAVE IN, SLAVE OUT AND AUX OUT connectors (Figure 2-3, Items 6, 9, 10, and 11, respectively) are Elgar proprietary. Thus, the pinouts will not be provided.

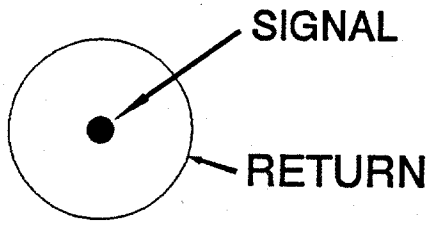
Table 2-2. SW 5250 Input/Output Connectors and Other Data (Refer to Figure 2-3)

Item #	Name	Type	Manufacturer and Part Number
1	SYNC OUT	BNC	KINGS, PN KC-79-179
2	CLOCK & LOCK	BNC	KINGS, PN KC-79-179
3	VXI A	25 POS SUB-D FEMALE (Gold Contacts)	AMP, PN 747052-2
4	VXI B	25 POS SUB-D FEMALE (Gold Contacts)	AMP, PN 747052-2
5	EXT IN ±7.5V MAX	15 POS SUB-D FEMALE (Gold Contacts)	AMP, PN 747052-3
6	RS232	9 POS SUB-D MALE (Gold Contacts)	AMP, PN 747043-4

Item #	Name	Type	Manufacturer and Part Number
7	DFI	9 POS SUB-D FEMALE (Gold Contacts)	AMP, PN 747052-4
8	IEEE 488.2	25 POS FEMALE (Gold Contacts)	AMP, PN 554434-1
9	SLAVE IN	37 POS SUB-D FEMALE	ITT CANNON, PN ADC37SOL2
10	SLAVE OUT	37 POS SUB-D FEMALE	ITT CANNON, PN ADC37SOL2
11	AUX OUT	4 POS MINIFIT JR	MOLEX, 39-29-9045
12	OUTPUT POWER TERMINAL BARRIER	6 POS (#6 HDW)	MAGNUM, PN A304106-07-CA-MP8
13	REMOTE SENSE TERMINAL BARRIER	6 POS (#6 HDW)	MAGNUM, PN A304106-07-CA-MP8
14	FUSE F1	300V 50A SLOW BLOW	BUSSMAN, G30060-3CR
	FUSE F2	300V 50A SLOW BLOW	BUSSMAN, G30060-3CR
	FUSE F3	300V 50A SLOW BLOW	BUSSMAN, G30060-3CR
15	INPUT, NEUTRAL LUG, SINGLE BARREL	90A, 8AWG-2AWG	PANDUIT, PN C070-14-Q
16	SAFETY GROUND	STUD	#1/4-20 X .75 LG
17	CHASSIS GROUND	STUD	#1/4-20 X .75 LG

2.7.1 BNC Connectors (Figure 2–3, Items 1 and 2)

The figure below illustrates the signal and return connections.



2.7.2 VXI A (Figure 2–3, Item 3)

Refer to Table 2–3.

Table 2–3. VXI A Connector Pinout

Pin #	Mnemonic	Level
1	TX IN +	RS–422
2	TX IN –	RS–422
3	RX IN +	RS–422
4	RX IN –	RS–422

2.7.3 VXI B (Figure 2–3, Item 4)

Refer to Table 2–4.

Table 2–4. VXI B Connector Pinout

Pin #	Mnemonic	Level
1	TX OUT +	RS–422
2	TX OUT –	RS–422
3	RX OUT +	RS–422
4	RX OUT –	RS–422

2.7.4 EXT IN (External Input) (Figure 2–3, Item 5)

Refer to Table 2–5.

Table 2–5. EXT IN Connector Pinout

Pin #	Mnemonic	Level
1	SHIELD	CHASSIS
2	SHIELD	CHASSIS
3	SHIELD	CHASSIS
4	SHIELD	CHASSIS
5	SHIELD	CHASSIS
6 through 9	Not Used	Not Used
10	EXT_IN_A	+7.25 Vpeak DC to 5000 Hz, ≥30 kΩ
11	EXT_IN_B	+7.25 Vpeak DC to 5000 Hz, ≥30 kΩ
12	EXT_IN_C	+7.25 Vpeak DC to 5000 Hz, ≥30 kΩ
13	EXT_RETURN	+20 Vpeak WRT CHASSIS GROUND
14 and 15	Not Used	Not Used

2.7.5 DFI (Direct Fault Indicator) (Figure 2–3, Item 7)

The DFI connector on the rear panel has both input and output functionality.

The DFI Output Relay indicates a shutdown fault has occurred on the SW. It is a SPST reed relay with rear panel connections to the normally closed output contacts. When the SW is operating the relay is energized so that the contacts are open. When a fault occurs, or if the unit should lose power, the relay closes to indicate a fault has occurred.

The DFI Input Signal is used to command the SW to open the Output relay, and close the DFI relay. It is a TTL–compatible input with a 1 kΩ input impedance, a 10 kΩ pullup to +5 VDC, and clamping diodes to _5 VDC and ground. A signal with a negative going edge from +5 VDC to ground will trigger the DFI response.

Refer to Table 2–6.

Table 2–6. DFI Connector Pinout

Pin #	Mnemonic	Level
1	DFI RLY COMM	------
2	Not Used	------
3	DFI IN +	TTL (10 kΩ input impedance)
4 and 5	Not Used	------
6	DFI RLY N.O.	------
7	Not Used	------
8	DFI IN RTN	TTL
9	IEEE 488.2	SIGNAL GND

2.7.6 IEEE 488.2 (Figure 2–3, Item 8)

Refer to Table 2–7.

Table 2–7. IEEE 488.2 Connector Pinout

Pin #	Mnemonic	Pin #	Mnemonic	Pin #	Mnemonic
1	DIO1	9	IFC	17	REN
2	DIO2	10	SRQ	18	GND (TW PAIR W/DAV)
3	DIO3	11	ATN	19	GND (TW PAIR W/NRFD)
4	DIO4	12	SHIELD	20	GND (TW PAIR W/NDAC)
5	EOI	13	DIO5	21	GND (TW PAIR W/IFC)
6	DAV	14	DIO6	22	GND (TW PAIR W/SRQ)
7	NRFD	15	DIO7	23	GND (TW PAIR W/ATN)
8	NDAC	16	DIO8	24	SIGNAL GROUND

2.7.7 Grounding

The three waveform outputs (TRIGGER OUT, CLOCK & LOCK, and SYNC OUT) share the same ground. **This ground should not exceed 30V from chassis ground.** It is recommended that this ground is connected to the chassis if possible.

DFI and IEEE 488.2 share the same signal ground.

2.8 INPUT POWER REQUIREMENTS

Input power is connected to the SW 5250 (also the SW 3500 and SW 1750) via the rear panel connectors. See Tables 2–8 and 2–9 for input current values.

WARNING

An overcurrent protection device (i.e., circuit breaker) is required in the building installation. The circuit breaker must disconnect the 3–phase voltages; the neutral must not be disconnected. The circuit breaker should be rated for continuous current as required by the specific SW system per Tables 2–8 and 2–9. Installation should comply with local safety standards.

A device for disconnecting the SW 5250 (SW 3500 or SW 1750) from the energy supply source is also required in the building installation. This device, either a switch or circuit breaker, must be in close proximity to the SW system, within easy reach of the operator, and marked as the disconnecting device for the SW system.

Table 2–8. Input Currents For 3–Phase Input Power

Model SW 5250			
		Maximum Line Current	Maximum Neutral Current
PFC	USA	25A	Not Required
PFC	EUR	13A	13A
RECT	USA	39A	Not Required
RECT	EUR	39A	68A
Model SW 3500			
		Maximum Line Current	Maximum Neutral Current
PFC	USA	25A	Not Required
PFC	EUR	13A	13A
RECT	USA	26A	Not Required
RECT	EUR	26A	45A

Model SW 1750			
		Maximum Line Current	Maximum Neutral Current
PFC	USA	14A	Not Required
PFC	EUR	13A	13A
RECT	USA	13A	Not Required
RECT	EUR	13A	23A

Table 2-9. Single-Phase Input Configurations

MODEL SW 5250					
		Required Input Terminal Jumper Connections	Connect Single-Phase Input Power To	Voltage	Maximum Input Current
PFC*	USA	F1 to F2	F1, F3	187-264 VRMS, L-L	28A RMS
PFC	EUR	F1 to F2, F2 to F3	F1, Neutral	187-264 VRMS, L-N	42A RMS
MODEL SW 3500					
		Required Input Terminal Jumper Connections	Connect Single-Phase Input Power To	Voltage	Maximum Input Current
PFC	USA	F1 & F2	F1, F3	187-264 VRMS L-L	28A RMS
PFC	EUR	F1 to F2, F2 to F3	F1, Neutral	187-264 VRMS L-N	28A RMS
MODEL SW 1750					
		Required Input Terminal Jumper Connections	Connect Single-Phase Input Power To	Voltage	Maximum Input Current
PFC	USA	None	F1, F3	187-264 VRMS L-L	14A RMS
PFC	EUR	None	F1, Neutral	187-264 VRMS L-N	14A RMS

* - Only Phase A and Phase B are present at the output.

2.8.1 187 to 264 VRMS 3–Phase Operation (3–Wire USA)

Connect the input wires to the phase A (F1), B (F2), and C (F3) input fuse terminals (no Neutral is required). **Ensure that the chassis safety ground is also connected.** Use cables with ratings equal to or greater than the current rating listed on the unit or in Table 2–8 (see Section 2.10). Any phase sequence of wiring can be used.

2.8.2 342 to 457 VRMS 3–Phase Operation (4–Wire EUR)

It is essential that the Neutral connection is present when using the unit. An external circuit breaker is required for the 3–phase voltages. Do not pass Neutral through the breaker. Only units factory set at this voltage will operate at this voltage.

CAUTION

Neutral must not be broken by an external switch. Severe damage to the unit may occur if Neutral is broken and phase voltage is present.

Connect the input wires to phases A (F1), B (F2), C (F3) and Neutral. **Ensure that the chassis safety ground is also connected.** Use cables with ratings equal to or greater than the current rating listed on the unit or in Table 2–8 (see Section 2.10).

2.8.3 Single–Phase Input Connections

The SW system is designed for three–phase input power operation, either 3–wire (USA) or 4–wire (EUR) plus a chassis safety ground. However, if only single–phase input power is available, the configurations listed in Table 2–9 are possible.

An overcurrent protection device and a device for disconnecting the single–phase energy supply source are required as indicated in Section 2.8 above.

2.9 OUTPUT CONNECTIONS TO THE LOAD

The Model SW 5250 can power 1–phase, 2–phase and 3–phase loads. Local or remote sensing can be used; if no sense lines are connected, the unit automatically reverts to local sense. Outputs may be directly paralleled for greater power. If the outputs are paralleled it is important to program the unit to the parallel mode before shorting the outputs together (refer to Figure 2–4). Outputs cannot be placed in series since the Neutral is common. However, by programming two phases 180° apart, double voltage, single phase is achieved.

Any phase sequence of wiring can be used.

The sense Neutral is also common. Thus, it is important not to mis–wire the sense wires (refer to Figure 2–5. If remote sense is used:

- Sense A is connected to Power A;
- Sense B is connected to Power B;
- Sense C is connected to Power C;
- Neutral Sense is connected to Neutral Power.

It is required for safe operation that output power neutral be connected to chassis ground. The SW system is shipped with a green/yellow wire connected from output power neutral to chassis ground. It is important that the Neutral not be >20V away from the chassis potential since the unit will shut down if this voltage is exceeded.

If a transformer or inductive load is present, the unit should be programmed to AC. This prevents small amounts of DC being generated which may saturate the magnetics.

For best performance, the sense leads should be connected and output neutral should be connected to chassis ground.

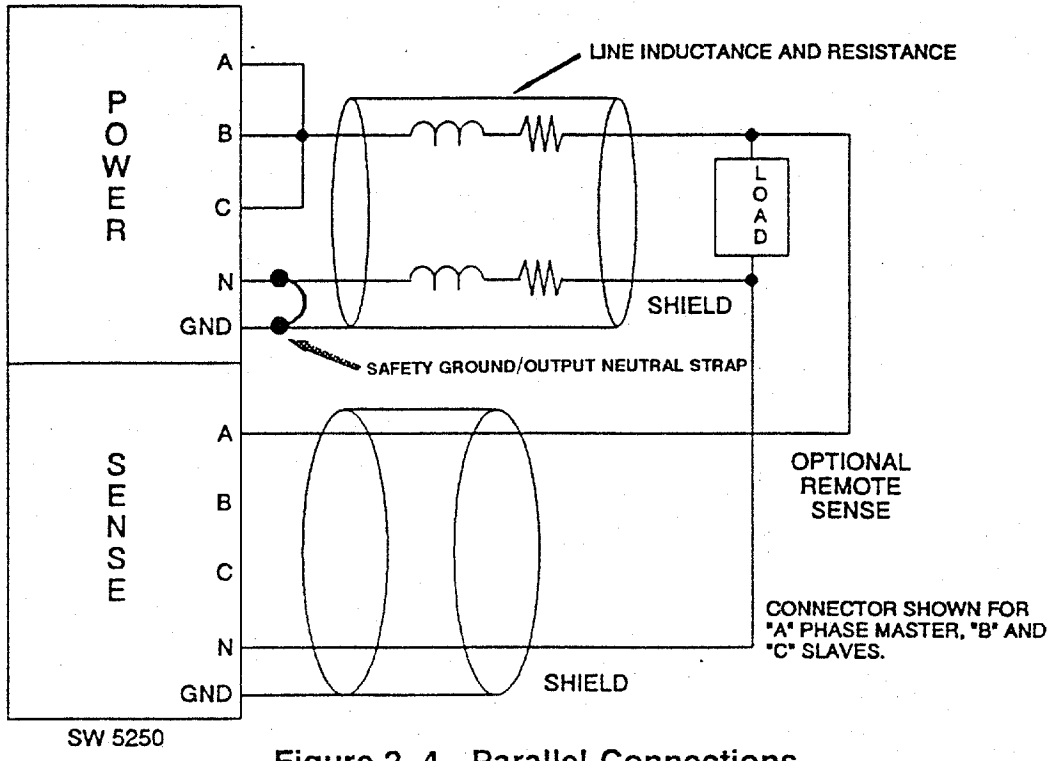


Figure 2–4. Parallel Connections

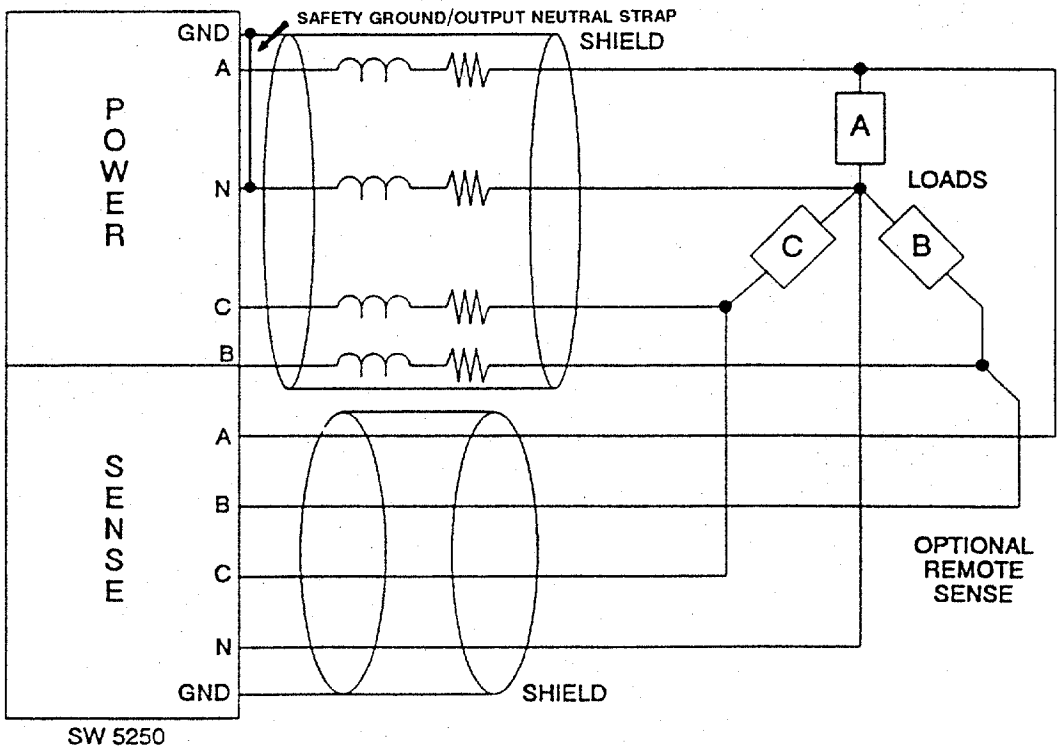


Figure 2–5. Sense Lead Connections for 3–Phase Output

The output power and sense leads should be shielded and the shield connected to the chassis to prevent noise pickup (or radiation to sensitive circuits in the vicinity). Again, the shield should be connected to chassis ground.

Due to the high voltages present, 312 VRMS line–to–neutral and 437 VRMS line–to–line cables rated to these voltages must be used for both the Power and Sense leads.

2.9.1 SW 3500 and SW 1750 Output Connections

The Model SW 3500 has phase A and phase B present; phase C is an open circuit. Make connections as for the SW 5250 but with phase C missing.

The Model SW 1750 has only phase A present; phases B and C are open circuits.

2.9.2 Wiring of Unit

Due to the high voltages and frequencies involved, it is recommended that all input and output wiring is protected with flexible conduit. Holes for this purpose are made in the terminal box (see Figure 2–2). All wiring must meet local standards for safety.

2.10 WIRE GAUGE SELECTION

The following guidelines assist in determining the optimum cable specification for the user's power applications. These guidelines are equally applicable to both DC and low frequency AC (up to 450 Hz) power cabling. The same engineering rules apply whether going into or out of an electrical device. Thus, this guide applies equally to the input cable and output cable for this ELGAR instrument and application loads.

Power cables must be able to safely carry maximum load current without overheating or causing insulation destruction. It is important to everyday performance to minimize IR (voltage drop) loss within the cable. These losses have a direct effect on the quality of power delivered to and from instruments and corresponding loads.

When specifying wire gauge, the operating temperature needs to be considered. Wire gauge current capability and insulation performance drops with the increased temperature developed within a cable bundle and with increased environmental temperature. Thus, short cables with generously derated gauge and insulation properties are recommended for power source applications.

Avoid using published commercial utility wiring codes. These codes are designed for the internal wiring of homes and buildings and accommodate the safety factors of wiring loss, heat, breakdown insulation, aging, etc. However, these codes consider that up to 5% voltage drop is acceptable.

Such a loss directly detracts from the quality performance specifications of this ELGAR instrument. Frequently, these codes do not consider bundles of wire within a cable arrangement.

In high performance applications, as in motor start–up and associated inrush/ transient currents, additional consideration is required. The cable wire gauge must consider peak voltages and currents which may be up to ten times the average values. An underrated wire gauge adds losses which alter the inrush characteristics of the application and thus the expected performance.

Table 2–10 identifies popular ratings for DC and AC power source cable wire gauges.

Table 2–10. Recommended Wire Gauge Selection Guide

Column 1	Column 2	Column 3	Column 4
Size (AWG)	Amperes (Maximum)	Ohms/100 Feet (One Way)	IR Drop/100 Feet (Col. 2 X Col. 3)
14	15	0.257	3.85
12	20	0.162	3.24
10	30	0.102	3.06
8	40	0.064	2.56
6	55	0.043	2.36
4	70	0.025	1.75
2	95	0.015	1.42
1/0	125	0.010	1.25
3/0	165	0.006	1.04

The following notes apply to Table 2–10 and to the power cable definition:

1. The above figures are based upon insulated copper conductors at 25°C (77°F), two current carrying conductors in the cable plus a safety (chassis) ground.

   Columns 3 and 4 refer to "one way" ohms and IR drop of current carrying conductors (e.g., a 50–foot cable contains 100 feet of current carrying conductor).

2. Determine which wire gauge for the application by knowing the expected peak load current (I_{peak}), the maximum tolerated voltage loss (V_{loss}) within the cable, and the one way cable length.

The formula below determines which ohms/100 feet entry is required from Column 3. Read the corresponding wire gauge from Column 1.

(Column 3 value) =

$V_{loss}/[I_{peak} \times 0.02 \times (\text{cable length})]$

Where:

Column 3 value =

Entry of the table above.

Cable length =

One way cable length in feet.

V_{loss} =

Maximum loss, in volts, permitted within cable.

Special case: Should the V_{loss} requirement be very loose, I_{peak} may exceed the maximum amperes (Column 2). In this case, the correct wire gauge is selected directly from the first two columns of the table.

Example:

A 20 ampere (I_{peak}) circuit which may have a maximum 0.5 volt drop (V_{loss}) along its 15–foot cable (one way cable length) requires (by formula) a Column 3 resistance value of 0.083. This corresponds to wire gauge size 8 AWG.

If the cable length was 10 feet, the Column 3 value would be 0.125 and the corresponding wire gauge would be 10 AWG.

3. Aluminum wire is not recommended due to soft metal migration at the terminals which may cause long term (on the order of years) poor connections and oxidation. If used, increase the wire gauge by two sizes (e.g., specify 10 gauge aluminum instead of 14 gauge aluminum).

4. Derate the above wire gauge (use a heavier gauge) for higher environmental temperatures since conductor resistance increases with temperature.

Temperature Degrees		Current Capability
C	F	
40	104	80%

5. Derate the above wire gauge (use a heavier gauge) for an increased number of current carrying conductors. This offsets the thermal rise of bundled conductors.

Number of Conductors	Current Capability
3 to 6	80%
Above 6	70%

6. The preferred insulation material is application dependent. Elgar's recommendation is any flame retardant, heat resistant, moisture resistant thermoplastic insulation rated to a nominal 75°C (167°F). Voltage breakdown must exceed the combined effects of:

   - The rated output voltage;
   - Transient voltages induced onto the conductors from any source;
   - The differential voltage to other nearby conductors; and,
   - Safety margins to accommodate degradations due to age, mechanical abrasion and insulation migration caused by bending and temperature.

7. As frequency increases, the magnetic field of the current carrying conductors becomes more significant in terms of adverse coupling to adjacent electrical circuits. Use twisted pairs to help cancel these effects. Shielded twisted pairs are even better. Avoid close coupling with nearby cables by using separate cable runs for high power and low power cables.

8. The above general values and recommendations should be reviewed, modified and amended, as necessary, for each application. Cables should be marked with appropriate safety WARNING decals as hazardous voltages may be present.

NOTES

SECTION III

OPERATION

3.1 INTRODUCTION

The controls and display for the Model SW 5250 are easily understood after a brief overview. Context–sensitive help is available from the front panel by pressing the **Help** key. Help screens may contain information that is not in this manual.

3.2 FRONT PANEL CONTROLS

Refer to Figure 3–1.

3.2.1 Power On/Off Switch

The power on/off switch is located in the lower left of the front panel. Pressing the top portion of the switch turns power on; pressing the bottom portion of the switch turns power off.

When power is turned on, the SW 5250 goes through the power up cycle. This cycle may last between 30 seconds and five minutes, depending on the amount of software that needs to be loaded and conditioned. The display will indicate the Elgar logo during the turn on cycle.

3.2.2 Contrast Keys

The **Contrast** keys, located below the knob, are used to adjust the contrast of the display. Pressing the left key decreases the contrast while pressing the right key increases the contrast. The appropriate key should be pressed and held until the display is at the desired contrast level.

3.2.3 Keypad

The 12–key keypad is used for entering various numeric values (0 through 9), a decimal point (when required), and to change the polarity of the selection via the +/– key. For example, to enter an amplitude value of "–139.2," the user enters 1, 3, 9, decimal point, 2; presses the +/– key to change the polarity; then presses the Enter key to accept the value.

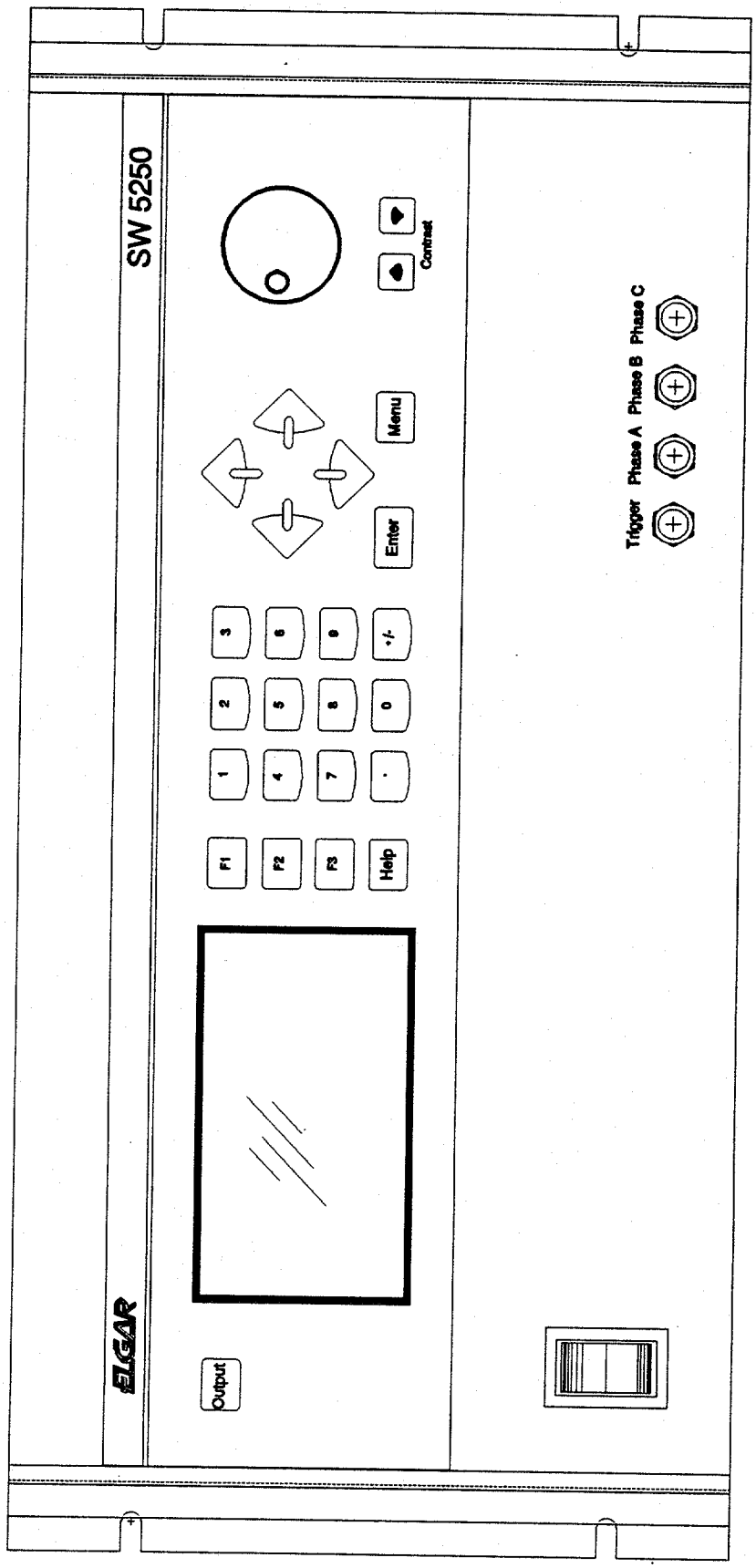


Figure 3-1. SW 5250 Front Panel Controls

3.2.4 Enter Key

Pressing the **Enter** key allows the user to:

- Go to the next menu level on the LCD display;
- Enter the incr./dec. mode using the knob or arrow keys;
- Accept a number after a numeric entry via the keypad and/or knob; and
- Accept a name in Text Mode entry.

3.2.5 Menu Key

Pressing the **Menu** key allows the user to go to the previous menu level on the LCD display, or to abort the modification of an edit field.

3.2.6 Arrow Cursor Keys

The **Up and Down Arrow Cursor Keys** are used to move between menu selections on the current page displayed on the LCD display and to increase or decrease values in the incr./dec. mode.

3.2.6.1 Left Arrow Cursor Key

The left Arrow Cursor Key moves the user to the previous menu level (a shortcut for the <Menu> key) and, in the Text Mode or numeric entry, acts as a backspace.

3.2.6.2 Right Arrow Cursor Key

The right Arrow Cursor Key moves the user to the next menu level (a shortcut for the <Enter> key) and, in the Text Mode, accepts the current character.

3.2.7 Knob

The **Knob** is used for data entry and for slewing of voltage and frequency. The knob serves the same function as the up and down arrow keys. There are three knob acceleration thresholds: incrementing by 0.1, 1.0 and 10.0.

3.2.8 Output Key

The **Output** key opens or closes the output relay. The condition of the output relay is indicated on the LCD display by "OUTPUT [ON]" or "OUTPUT [OFF]" being displayed on the top line.

3.2.9 Help Key

Pressing the **Help** key will display a help screen for the current menu item on the display.

3.2.10 Function Keys F1 Through F3

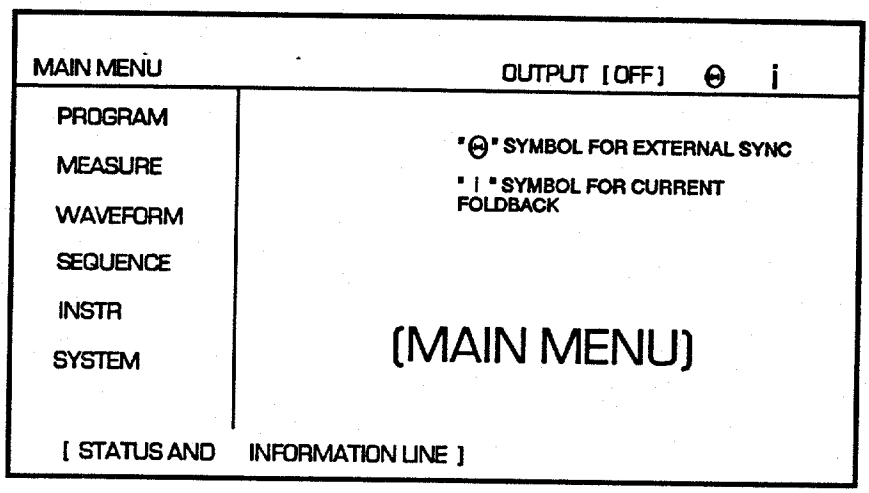
Function depends on the selected menu item and is defined in the Help screens.

3.3 MENUS

3.3.1 MAIN MENU

The **MAIN MENU** consists of the following sub–menus:

- PROGRAM
- MEASURE
- WAVEFORM
- SEQUENCE
- INSTR (INSTRUMENT)
- SYSTEM



MAIN MENU Status and Information Data

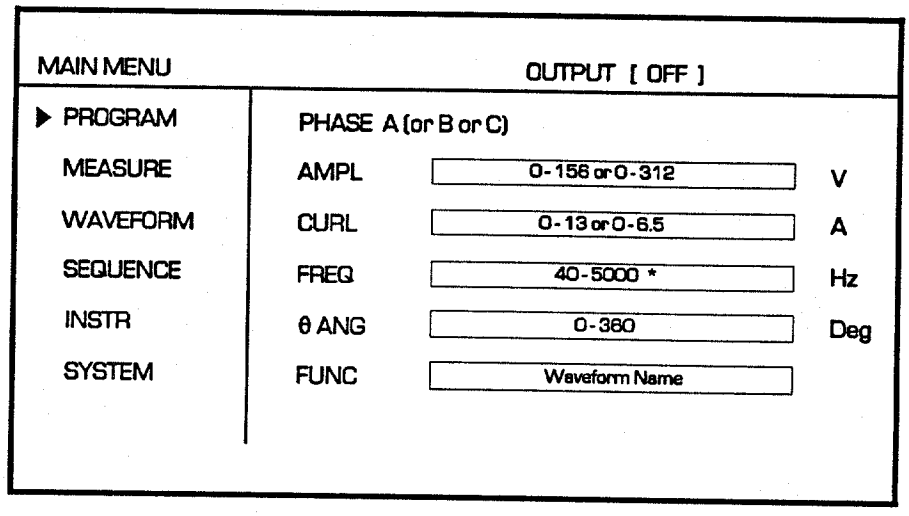
Item	Status and Information Line Readout
PROGRAM	[interactive programming]
MEASURE	[measurement system]
WAVEFORM	[create/edit waveform]
SEQUENCE	[create/edit sequences]
INSTR	[instrument configuration]
SYSTEM	[system configuration]

- Use the **Enter** and **Menu** keys or the **Right** and **Left** arrow keys to move between the menus.
- Use the **Up** and **Down** arrow keys to toggle within a menu.
- When an item is selected by an arrow pointing to it, either type in the data or press the **Enter** key to place a box around the value area. If the latter is done, use the **Up/Down** arrow keys or the knob to select the data to be entered.
- In either case, after the data is input, press the **Enter** key to enter the data.

3.3.2 PROGRAM Menu

The **PROGRAM** menu allows the user to:

- Select a phase.
- Program amplitude (in volts to 0.01V resolution).
- Program current limit, either a value or level (in amps).
- Program frequency (40 to 5000 Hz).
- Program phase offset (the default is 0°, 120°, 240°). Phase offset represents a phase lead.
- Select a function to be output on the selected phase.



* - Changing the Frequency of One Phase will Change the Frequency of the Other Two Phases

PROGRAM Menu Status and Information Line Data

Menu Item	Status and Information Line Readout
PHASE A	[<enter> for next phase]
AMPL	[program output RMS/DC voltage]
CURL	[program RMS/DC current limit]
FREQ	[program output frequency] *
θ ANG	[program phase angle offset]
FUNC	[program output waveform] **

* – There is only one frequency setting for all three phases. Changing the frequency of one phase changes the frequency for all phases.

** – To operate the SW 5250 as a DC supply, select the function as "DC+" or "DC–" for positive and negative DC. "AC+DC Coupling" must also be selected from the INSTRUMENT menu. The AMPL field is programmed to 0V as a precaution when changing to or from the "DC+" or "DC–" function.

3.3.2.1 *Locking Program Fields*

For two– or three–phase systems, individual programming fields of amplitude, current limit, frequency, phase angle, and function may be "locked" so that any change made to phase A will be made to phases B and C.

To lock a field:

1. Move the field select cursor to the field to be locked in the Phase A Program menu.

2. Press the **F1** function key. The "¥" symbol should appear to the right of the field indicating the lock mode is active.

To unlock a field:

1. Move the field select cursor to the field that is locked in the Phase A Program menu.

2. Press the **F1** function key. The "¥" symbol should disappear.

3.3.2.2 *Front Panel Store/Recall*

The current state of the Program menu (amplitude, current limit, frequency, phase angle, and function) may be saved as a front panel setup for later recall. The Store/Recall Menu can be accessed by pressing **F2** from any Program menu edit field. Setups are stored/recalled as a number from 0 to 49. The incr./dec. mode is not available for this menu. Store/Recall functions do not affect the Lock/Unlock status of the Program menu fields. If a field is locked, it will remain locked. However, the Recall parameters for phases B and C will be updated

To store a setup:

1. Press **F2** from any Program menu edit field.

2. Move the field cursor to "STORE SETUP."

3. Enter a setup number from 1 to 50.

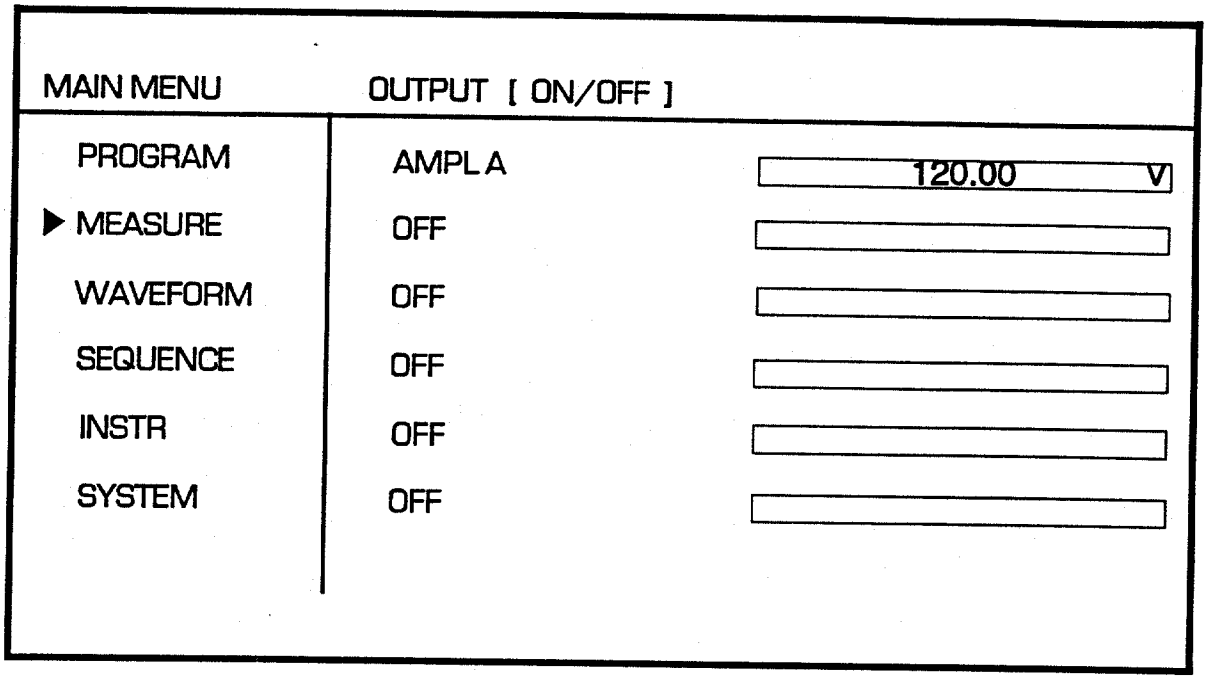
To recall a setup:

1. Press **F2** from any Program menu edit field.
2. Move the field cursor to "RECALL SETUP."
3. Enter the previously stored setup number from 1 to 50.

3.3.3 MEASURE Menu

The **MEASURE** menu allows the user to:

- Select a phase.
- Measure voltage (RMS).
- Measure current (RMS).
- Measure frequency.
- Measure phase angle (referenced to the master).
- Measure power (W).
- Measure apparent power (VA).
- Measure power factor (PF).
- Measure peak current.



The Measure menu contains six display fields that can be set to any of the available measurements.

To set a measurement field:

1. Move the field cursor to one of the six measurement fields.

2. Press <Enter>. A pop-up window will be displayed with the title **SELECT MEASUREMENT; OFF** will be selected.

3. Use the up/down arrow keys or the knob to scroll through the list of available measurements.

4. With the desired measurement in the selection window (or OFF to disable a measurement), press <Enter>.

5. The measured value will be displayed in the display field.

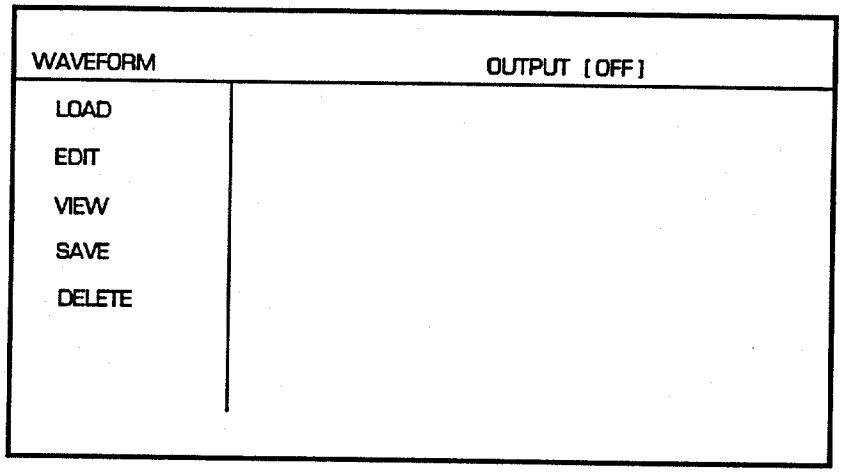
Active measurement fields are continually updated.

3.3.4 WAVEFORM Menu

The **WAVEFORM** menu allows the user to:

- Perform a variety of actions on waveshapes and waveforms, including the creation of a new waveform based on a waveshape in memory.

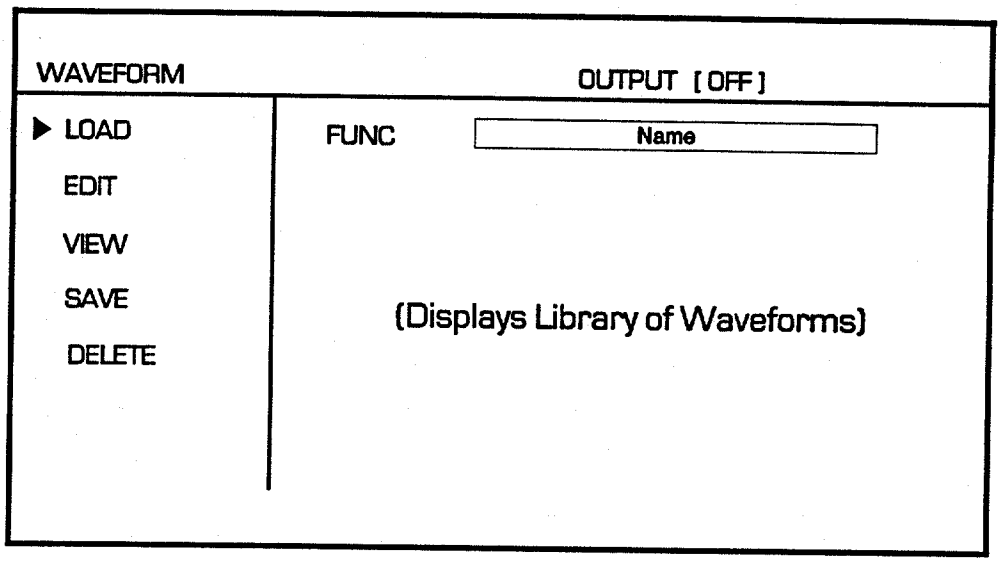
The waveshapes and waveforms are limited to spikes, dropouts, sags and surges of existing waveforms in the scratchpad area. This is accomplished by LOADing the existing waveshape into the waveform scratch pad then editing it. The edited waveform may then be viewed, output using the SCRATCH function name in the PROGRAM menu, or saved to the waveform library.



3.3.4.1 LOAD Sub–Menu

The WAVEFORM menu allows the user to **LOAD** an existing waveform from non–volatile memory or EPROM to the waveform scratchpad.

Any existing information in the scratchpad is erased when a new waveform is loaded.

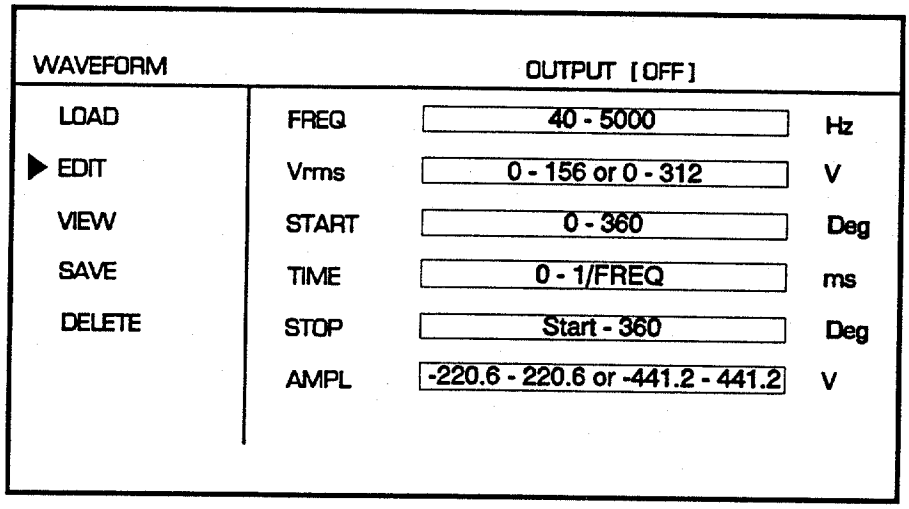


LOAD Sub–Menu Status and Information Line Data

Item	Status and Information Line Readout
LOAD	[load waveform to scratchpad]
FUNC	[<enter> to select waveform]

3.3.4.2 *EDIT Sub–Menu*

The WAVEFORM menu allows the user to **EDIT** a waveform in the scratchpad.



EDIT Sub–Menu Status and Information Line Data

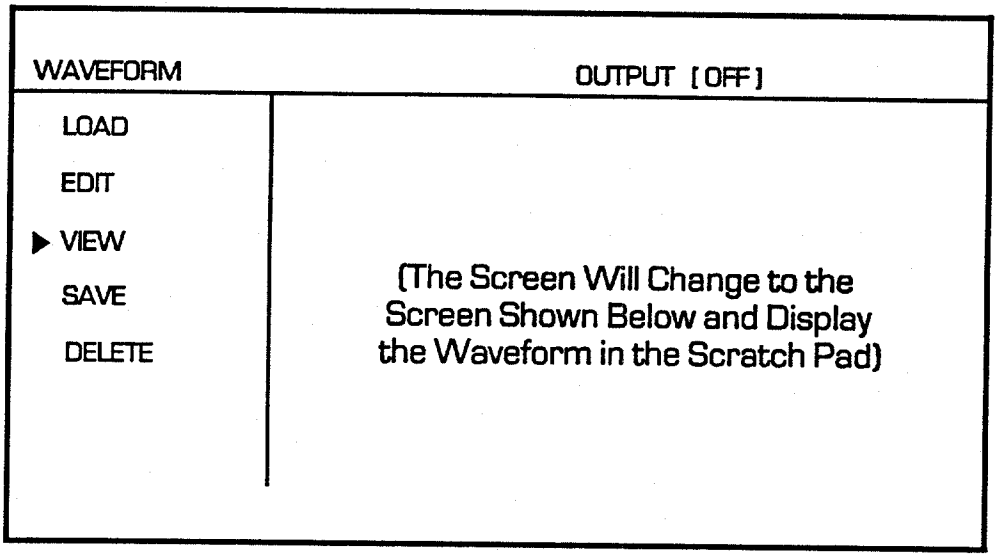
Item	Status and Information Line Readout
EDIT	[edit waveform in scratchpad]
FREQ	[waveform frequency]
Vrms	[output waveform voltage]
START	[starting phase angle]
TIME	[surge/sag duration]
STOP	[ending phase angle]
AMPL	[drop/spike voltage]

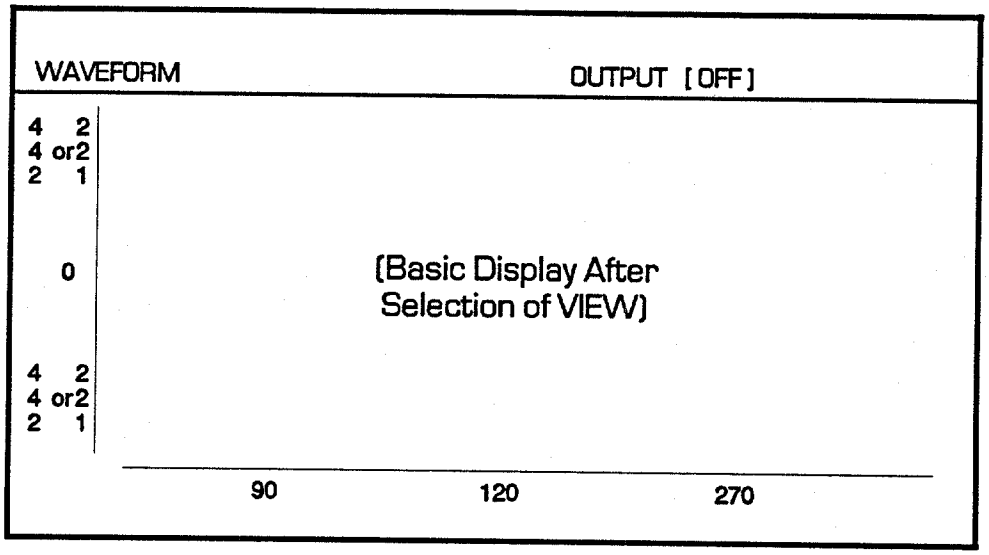
Note

Vrms is in terms of RMS voltage while AMPL is in terms of voltage. Both of these values depend on the current voltage range setting in the **Instrument** menu.

3.3.4.3 *VIEW Sub–Menu*

The WAVEFORM menu allows the user to **VIEW** a waveform:





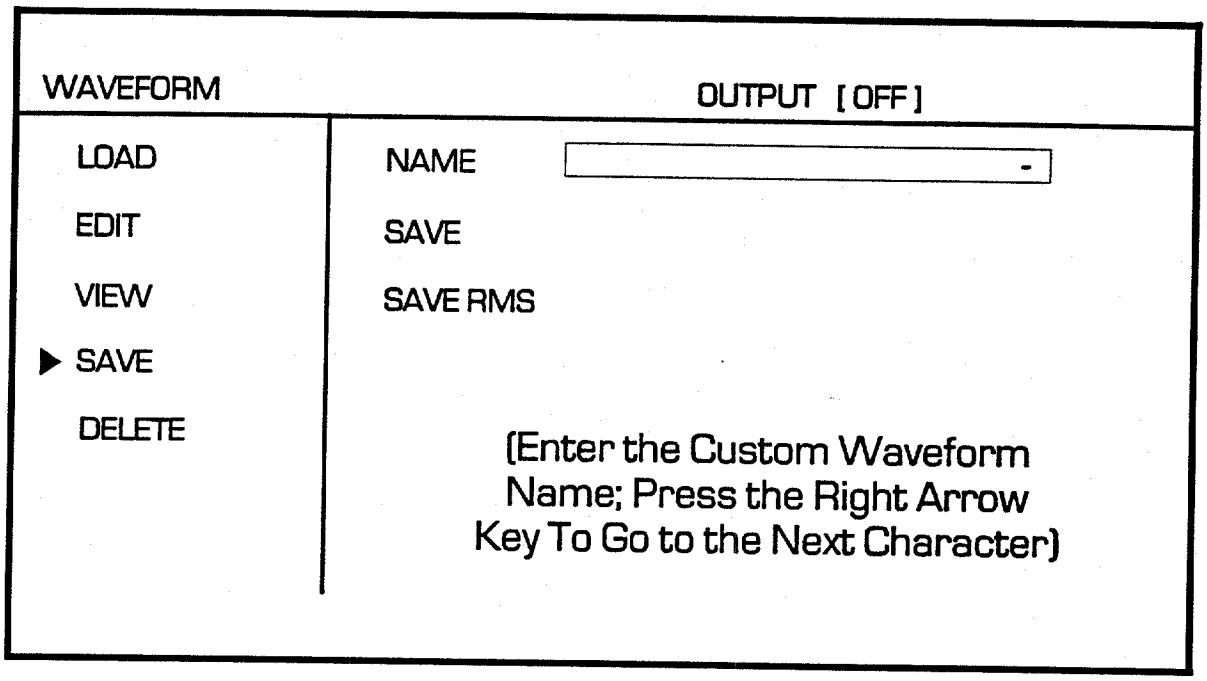
VIEW Sub–Menu Status and Information Line Data

Item	Status and Information Line Readout
VIEW	[display scratchpad]

3.3.4.4 *SAVE Sub-Menu*

The WAVEFORM menu allows the user to **SAVE** a new waveform from the scratchpad, with a user-defined name, to non-volatile memory.

- First, name the waveform.
- Second, go to SAVE or SAVE RMS and press <Enter> to save.



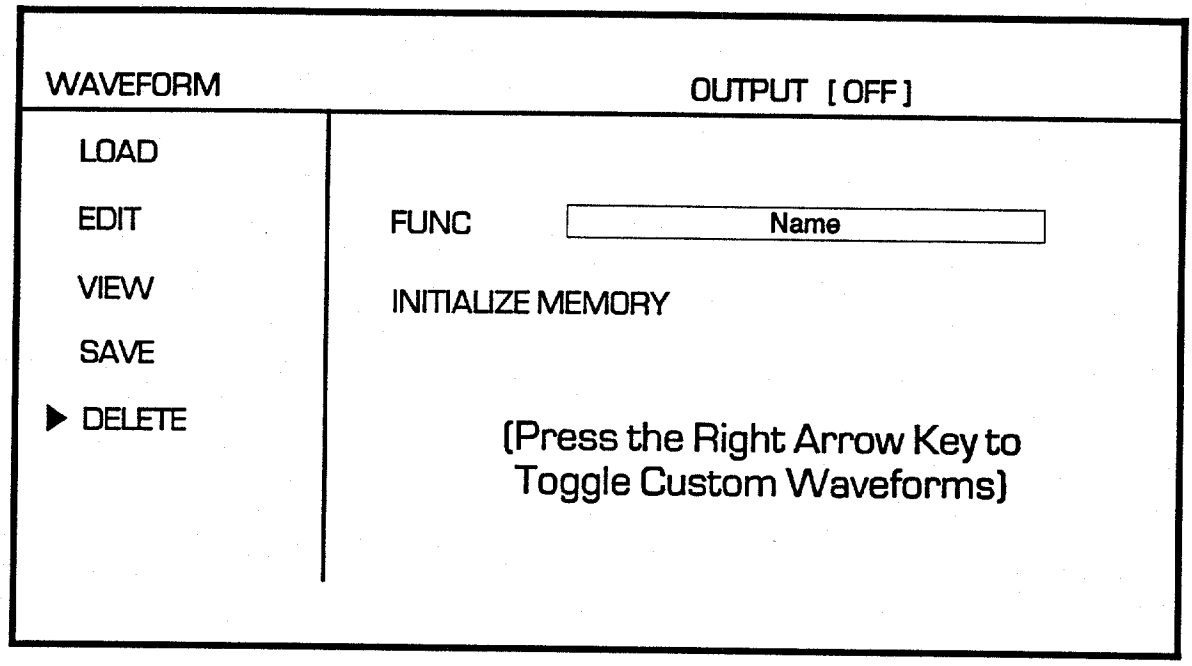
SAVE Menu Status and Information Line Data

Item	Status and Information Line Readout
SAVE	[save waveform in scratchpad]
NAME	[-> = next char, <- = backsp]
SAVE	[save waveform to library] The waveform is scaled to maintain the RMS value of the waveform fundamental.
SAVE RMS	[save waveform to library] The waveform is scaled so that the entire waveform conforms to the Vrms value of the Waveform **Edit** menu Vrms field.

3.3.4.5 *DELETE Sub–Menu*

The WAVEFORM menu allows the user to **DELETE** a waveform stored in non–volatile memory.

INITIALIZE MEMORY – This will reset the waveform library to the factory settings. All factory waveforms will be restored and all user waveforms stored in non–volatile RAM will be erased. The user must cycle power to the unit after this function for the changes to take effect.



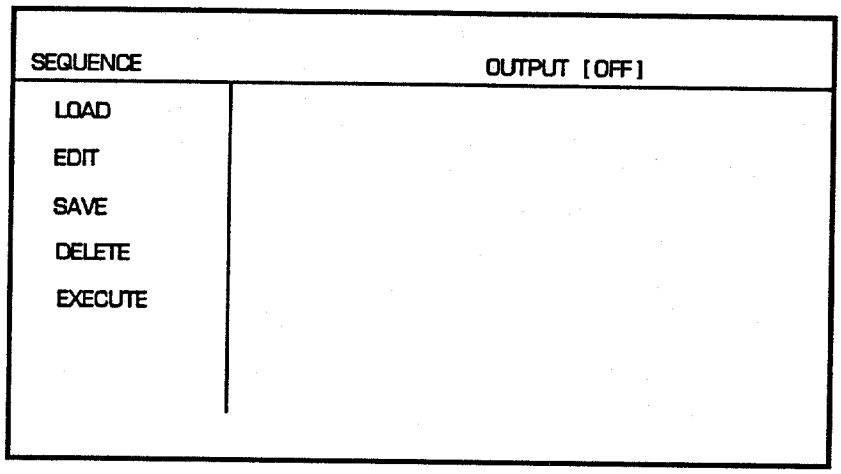
DELETE Sub–Menu Status and Information Line Data

Item	Status and Information Line Readout
DELETE	[delete stored waveform]
FUNC	[<enter> to select waveform]

NOTE: If the User attempts to delete a waveform in ROM, the message "ERROR – STANDARD WAVEFORM" will flash on momentarily.

3.3.5 SEQUENCE Menu

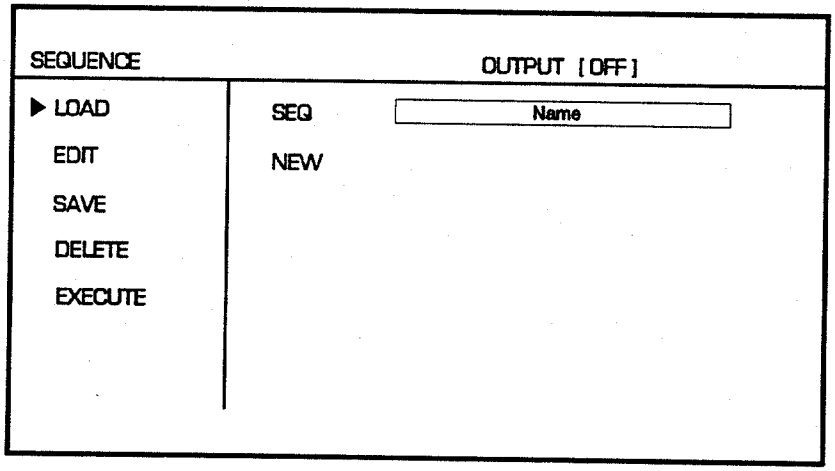
The **SEQUENCE** menu allows the user to create, edit, and execute a sequence.



3.3.5.1 LOAD Sub–Menu

The SEQUENCE menu allows the user to **LOAD** an existing sequence from non–volatile memory or EPROM to the sequence scratchpad.

NEW – Will erase all segments in the SEQUENCE scratchpad.

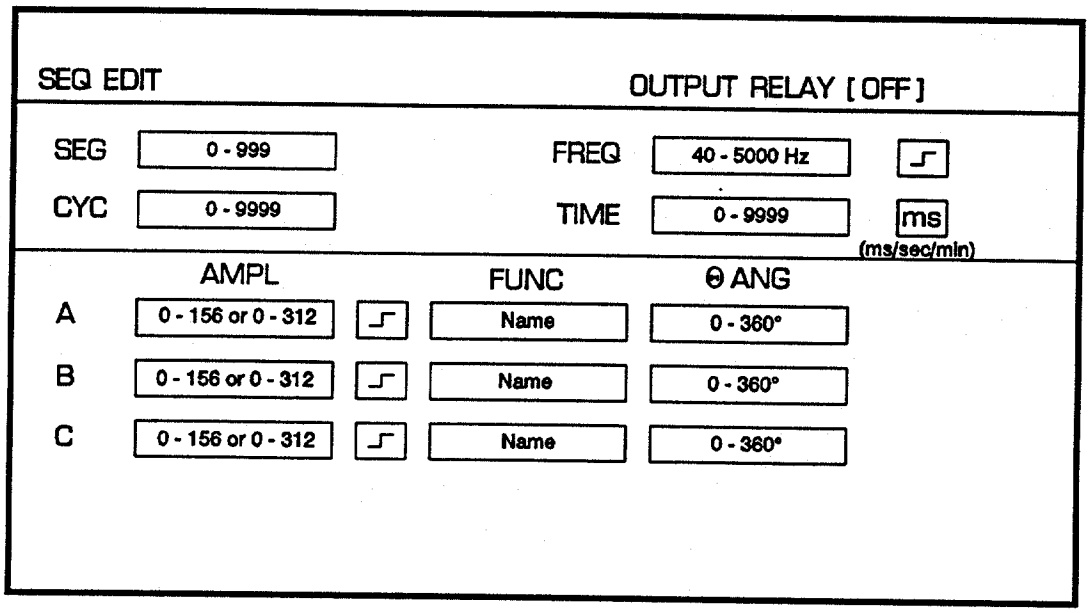


LOAD Sub–Menu Status and Information Line Data

Item	Status and Information Line Readout
LOAD	[load stored sequence]
SEQ	[load sequence to scratchpad]

3.3.5.2 EDIT Sub–Menu

The SEQUENCE menu allows the user to **EDIT** a sequence in the scratchpad. Frequency or amplitude can be ramped over the segment duration.



EDIT Sub–Menu Status and Information Line Data

Item	Status and Information Line Readout
EDIT	
SEG	[edit sequence in scratchpad]
CYC	[select cycles]
FREQ	[output frequency in Hz]
TIME	[segment execution time]
AMPL	[output voltage in volts]
FUNC	[output waveform]
Θ ANG	[phase angle in degrees]

The function keys **F1 – F3** are required to create and edit sequences. The function keys are dependent on the field selection cursor position and are defined as follows:

- **The "SEG" Edit Field**

The **SEG** edit field is used to move through the segment list and accept integer values from 0 to 999. Since Sequence is made up of a continuous list of segments, segments must be created in sequential order. When the Sequence scratchpad is initialized, only a single segment is available for editing. Trying to access segments other than segment 0 will result in an end of sequence error message. An existing segment number can be entered directly into the SEG field, or the SEG field can be selected (by pressing the <Enter> key) and the arrows or knob used to scroll through all existing segments. The function keys are used to insert, delete or copy segments:

F1 Inserts a new segment in the position immediately following the current segment. The new segment number will be one greater than the currently displayed segment. The Segment edit field will be automatically updated to display the newly created segment.

F2 Deletes the currently displayed segment.

F3 Copies the previous segment information to the currently displayed segment.

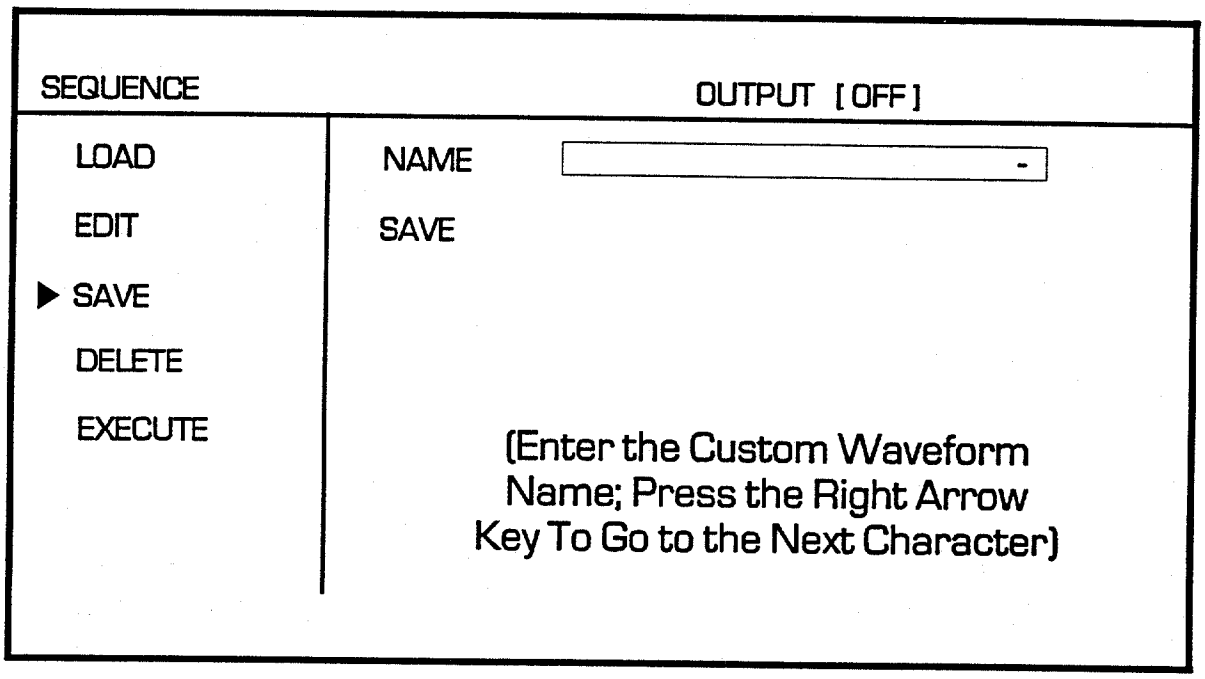
- **The "CYCLES" Edit Field**

When the field select pointer is at the CYCLES field, pressing **F1** will toggle the SYNC SELECT symbol "*". This is a flag used in conjunction with the SYNC field of the Sequence Execute menu; if SYNC is set to **SELECT SEG**, only those segments that are enabled will generate a sync signal at the front panel BNC connector. If SYNC is set to **EVERY SEG**, every segment will generate a sync signal.

The CYC field has a maximum input and display range of 9999. For FREQ and TIME combinations that exceed 9999 cycles, the CYC field will still indicate 9999. This limitation does not apply to GPIB control.

3.3.5.3 *SAVE Sub-Menu*

The SEQUENCE menu allows the user to **SAVE** a new sequence from the scratchpad, with a user-defined name, to non-volatile memory.



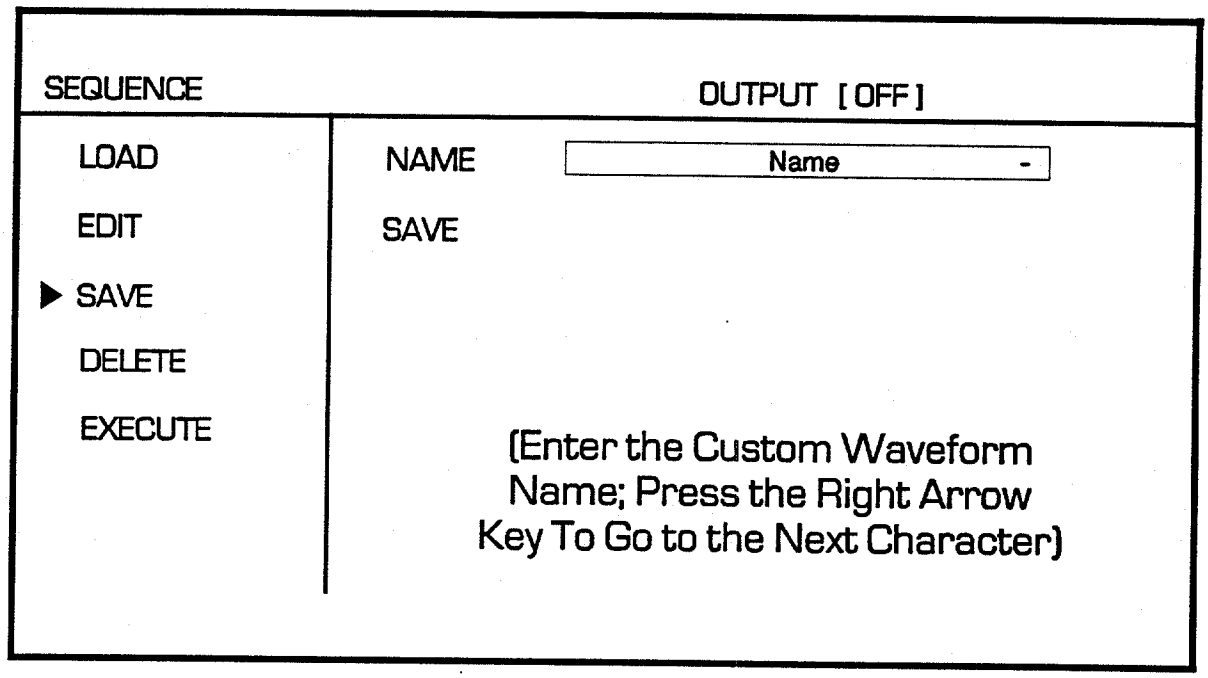
SAVE Sub-Menu Status and Information Line Data

Item	Status and Information Line Readout
SAVE	[save sequence to library]
NAME	[store sequence in library]
SAVE	(blank)

3.3.5.4 *DELETE Sub–Menu*

The SEQUENCE menu allows the user to **DELETE** a sequence stored in non–volatile memory.

INITIALIZE MEMORY – This will reset the sequence library to the factory settings. All factory sequences will be restored and all user sequences stored in non–volatile RAM will be erased. The user must cycle power to the unit after this function for the changes to take effect.



DELETE Sub–Menu Status and Information Line Data

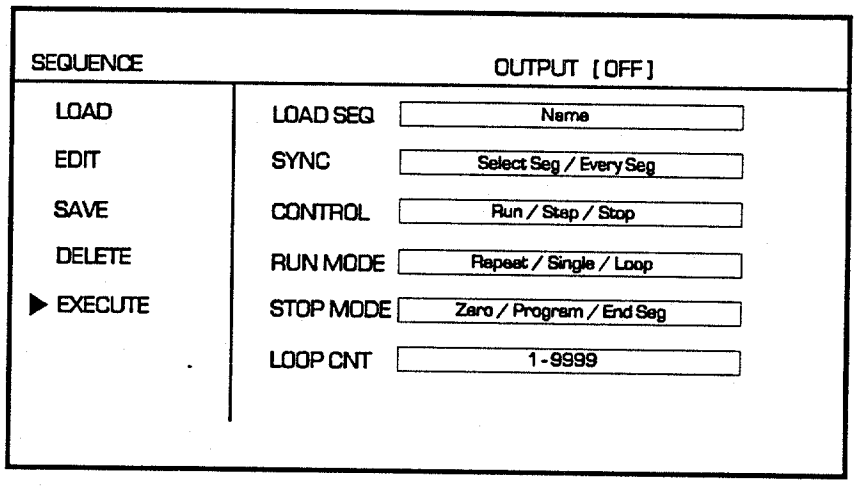
Item	Status and Information Line Readout
DELETE	[delete stored sequence]
SEQUENCE	[delete stored sequence]

3.3.5.5 *EXECUTE Sub-Menu*

The SEQUENCE **EXECUTE** menu allows the selection of the start, run, and stop modes of a sequence. The front panel operation is defined here, but all modes are also available via the GPIB. Sequence can be executed in any combination of the following modes:

- A sequence can be run in its entirety, or stepped through one segment at a time. When in this "step" mode, the most recent segment can be repeated.
- A sequence can be executed only once, or looped until the STOP command received.
- A sequence can be terminated with the outputs automatically programmed to 0 volts, restored to the waveforms and values before the sequence began, or remain at the waveforms and values of the last segment in the sequence. The last two options will occur with no interruption in output power.

The Sequence Execution Menu selections are explained in Table 3–1.



EXECUTE Sub–Menu Status and Information Line Data

Item	Status and Information Line Readout
EXECUTE	[select/start sequence]
LOAD SEQ	[<enter> to select output]
SYNC	[sync output configuration]
CONTROL	[start/stop sequence]
RUN MODE	[execute seg once or repeat]
STOP MODE	[restore output on seg stop]
LOOP COUNT	[loop execution count]

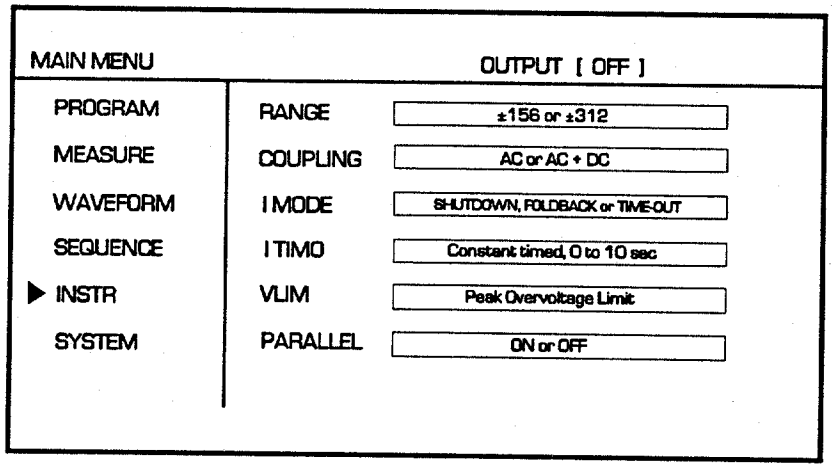
Table 3–1. Sequence Execution Menu

Selection	Purpose
LOAD SEQ	Loads a sequence from the sequence library or the sequence scratchpad. When running under GPIB control, the Event Status Register and serial polling can be used to indicate when the sequence loading is complete. The front panel display will indicate "Processing sequence..." while loading, and "Sequence loaded" when complete.
SYNC	Configures the SYNC Trigger output to generate a pulse for every segment or only selected segments.
CONTROL	Used to start a sequence, stop a sequence, or start a sequence in the STEP mode. A sequence must be loaded before RUN or STEP can be selected. All operations have an immediate effect. **RUN** – Run the previously loaded sequence. A sequence does not need to be reloaded when switching between RUN, STEP or STOP. The sequence will begin executing immediately after a RUN or STEP command. **STEP** – Step through the previously loaded sequence. Each segment will execute and remain at the value of the last cycle until instructed to execute the next segment, or repeat the current segment. When stepping through a sequence under front panel control, the **F1** function key is used to execute the next segment, and the **F2** key is used to repeat the current segment. **STOP** – Stops the active sequence.
RUN MODE	Specifies the running mode of the sequence. This parameter takes effect once a sequence has begun. **REPEAT** – Repeats sequence until a STOP command is received. **SINGLE** – Executes the sequence only once, then returns to the operation specified in the STOP MODE field.
STOP MODE	Specifies the mode of operation when a sequence is terminated. This can occur when running in the SINGLE execution mode, or when STOP is selected. **ZERO** – Programs the outputs to 0 volts when the sequence is terminated. **PROGRAM** – The outputs are restored to the waveforms and values in the Program Menu. This mode can be used for a continuous output between sequences. The Program Menu cannot be modified while a sequence is running. **ENG SEG** – The outputs will remain at the waveforms and values of the last segment in the sequence.

3.3.6 INSTR (Instrument) Menu

The **INSTR** menu allows the user to:

- Set the output range (156 or 312 volts).
- Select either AC or AC+DC coupling.
- Select the peak overvoltage limit.
- Select either shutdown, foldback or time–out mode (foldback for the time specified in the ITIMO field then shutdown mode).
- Select the time for the time–out mode.
- Select amplifier parallel operation.



INSTR Menu Status and Information Line Data

Item	Status and Information Line Readout
RANGE	[156V or 312V range]
COUPLING	[AC or AC + DC coupling]
VLIM	[peak voltage limit]
I MODE	[supervisory current mode]
I TIMO	[current limit time–out]
PARALLEL	[parallel output amplifiers]

CAUTION

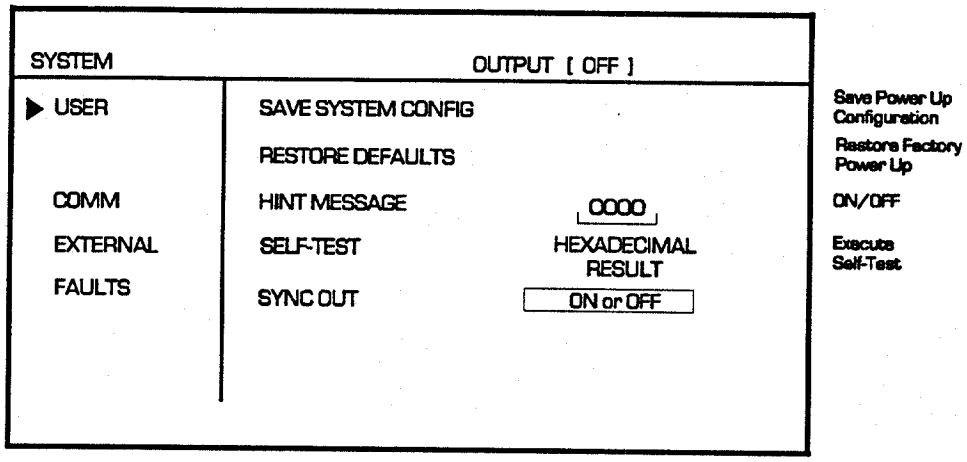
PARALLEL must match the rear panel output wiring.

3.3.7 SYSTEM Menu

3.3.7.1 USER Sub–Menu

The SYSTEM **USER** menu allows the user to:

- Configure power up values.
- Execute the unit's self–test.
- Enable/disable hint messages.
- Enable/disable the sync output in the Program mode (i.e., when a sequence is not running).



USER Sub–Menu Status and Information Line Data

Item	Status and Information Line
USER	[power–up config & self–test]
SAVE SYSTEM CONFIG	[store new power–up setting]
SELF–TEST	[execute self–test]
HINT MESSAGE	[hint messages on/off]
SYNC OUT	[sync output on/off]

SAVE SYSTEM CONFIG will save the current system configuration of the Program and Instrument menus and initialize the SW 5250 to these settings on power up.

RESTORE DEFAULTS will reset the power up configuration to factory defaults.

Table 3–2 provides self–test result definitions.

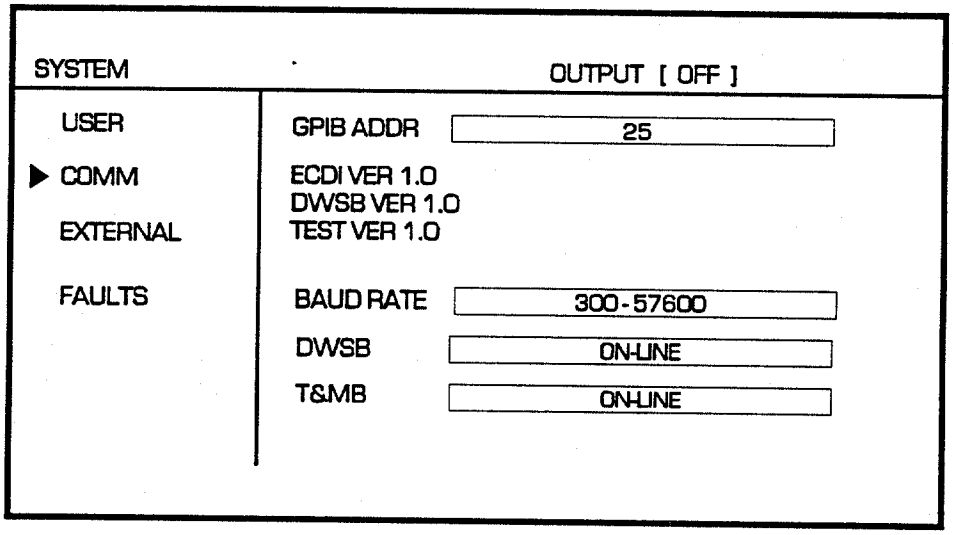
Table 3–2. SELF–TEST Results Definitions

Bit	Meaning	Bit	Meaning
0001	LCD Test	0100	Battery Test
0002	EPROM CKSUM	0200	QSPI Test
0004	NURAM BANK 0 CKSUM	0400	DFI Test
0008	NURAM BANK 1 CKSUM	0800	Speaker Test
0010	RAM Test	1000	DWSB Self–Test 0
0020	VXI Test	2000	DWSB Self–Test 1
0040	QSCI Test	4000	T&MB Self–Test 0
0800	GPIB Test	8000	T&MB Self–Test 1

3.3.7.2 COMM Sub–Menu

The SYSTEM **COMM** (Communications) menu allows the user to:

- Configure the GPIB address and display remote status.
- Display firmware version information.



The DWSB and TSMB fields indicate the internal communication status of the Digital Waveform Synthesis board and Test and Measurement board. These should always indicate **ON–LINE** unless a failure has occurred.

COMM Sub–Menu Status and Information Line Data

Item	Status and Information Line
COMM	[communication configuration]
GPIB ADDR	[select gpib address]
ECDI VER 1.0 DWSB VER 1.0 TEST VER 1.0	[installed firmware version]
BAUD RATE	[RS–232 Baud Rate]

3.3.7.3 EXTERNAL Sub–Menu

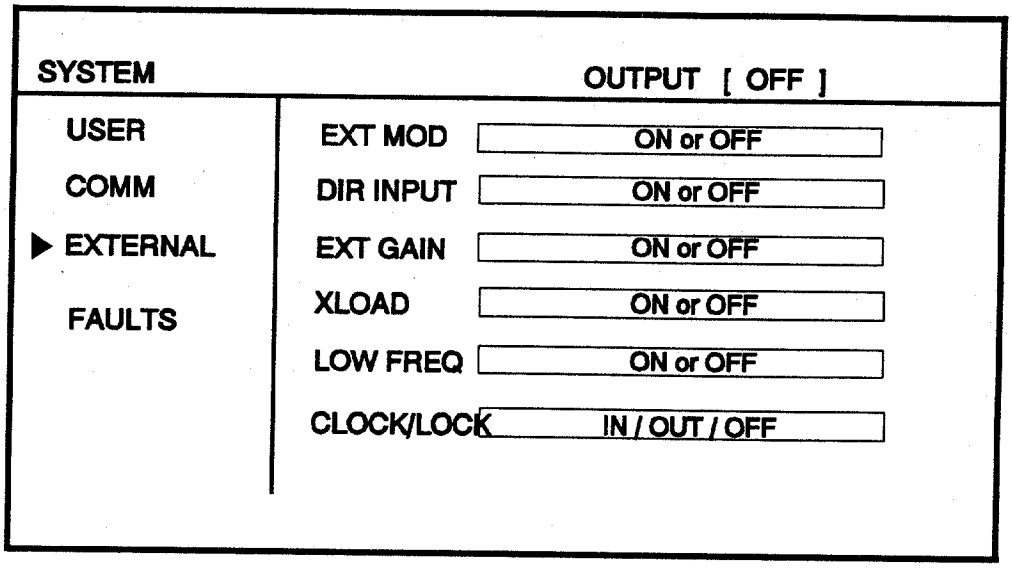
The SYSTEM **EXTERNAL** menu allows the user to:

- Select external modes of operation (Direct Input, External Modulation, External Gain, and Clock/Lock).
- Select alternate compensation (X–LOAD).
- Select Low Frequency for operation below 40 Hz when using an external input.
- Select compensation for reactive loads (X–LOAD).

CAUTION

Damage to the equipment may occur if input frequency requirements are violated (DC, 40 – 5000 Hz).

Refer to Table 2–5 for external analog inputs (EXTA, EXTB, EXTC). Table 3–3 provides additional data on the External sub–menu.



EXTERNAL Sub-Menu Status and Information Line Data

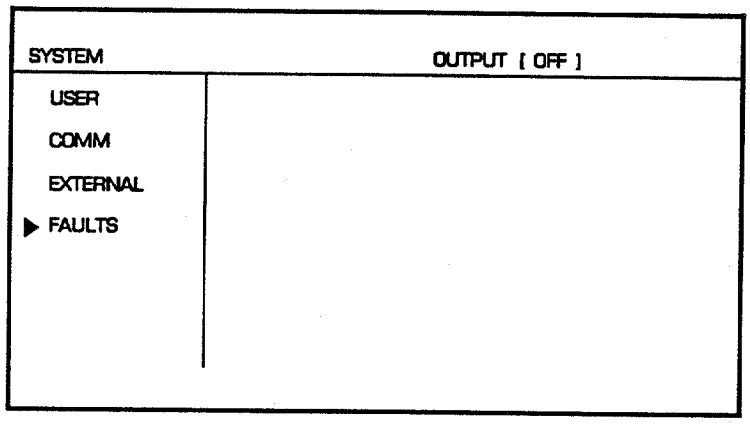
Item	Status and Information Line
EXTERNAL	[external input control]
EXT MOD	[external amplitude modulation]
DIR INPUT	[external direct input]
EXT GAIN	[external gain control]
XLOAD	[reactive load stability]
LOW FREQ	[for external freq. below 40 Hz]
CLOCK/LOCK	[clock/lock enable/disable]

Table 3–3. System External Menu

Selection	Purpose
EXT MOD (External Modulation)	Amplitude modulation of an output waveform is possible via an input signal from the rear panel. An input of 0–5 Vrms corresponds to a modulation of 0–20%. To allow for the modulation voltage, the maximum programmed voltage is 130 Vrms in low range, and 260 Vrms in high range.
DIR INPUT (Direct Input)	The input on the rear panel allows a reference signal to go directly to the amplifiers. A signal of 5 Vrms (±7.07 Vpeak) corresponds to 0 – full scale output. **CAUTION: Do not exceed the minimum or maximum frequency specifications.**
EXT GAIN (External Gain)	The input on the rear panel is used to scale the output waveform. A 0 – ±7.07 V input signal corresponds to 0 – ± full scale output.
X-LOAD (Reactive Load)	This option can be used to reduce overshoot, undershoot and ringing with unusual reactive loads. This option should not be used for normal loads.
LOW FREQ (Low Frequency)	This option should be used for external ac input signals between DC and 40 Hz (the maximum VA rating must be derated). It should **not** be used in normal operation, with an external DC input signal, or with frequencies above 40 Hz. The RMS servo is bypassed. As a consequence, load regulation drops off, and current limit (voltage foldback) is disabled.
CLOCK/LOCK	Use this option to configure the rear panel clock/lock signal as an input or output. When configured as an input, the power outputs will attempt to sync to the clock/lock input frequency. The target output frequency is determined by the frequency value entered in the Program Menu FREQ field. The target frequency should be entered before the clock/lock is configured as an output. The input configuration process is as follows: 1. Enter target frequency in the Program Menu FREQ field. 2. Go to the System External Menu and enable the CLOCK/LOCK option by selecting **IN**. 3. The unit will now attempt to lock to the input signal. This process can take up to 5 seconds. A phase lock is indicated on the LCD by the Θ symbol located to the right of the OUTPUT [ON/OFF] status. The output relay will not be allowed to close until a phase lock has been established. 4. Close the output relay. 5. The clock/lock input frequency is continually compared to the target frequency. If the input frequency changed more than ±10%, the output relay will open and an error message will be displayed. When configured as an output, the clock/lock signal will output a square wave of the same frequency as the power outputs. Select OFF to disable. OFF will configure clock/lock as an input with the PLL mode disabled.

3.3.7.4 *FAULTS Sub-Menu*

Pressing <Enter> to select FAULTS will display a list of logged fault conditions LOG1 – LOG7. These are three 8–bit registers used to troubleshoot errors that cause the system to shut down. Fault register definitions are available through the Help screens of the SW 5250.



Fault History

The FAULTS menu will display the last six shutdown faults in hexadecimal. All three fault registers are displayed with Log 1 being the most recent fault and Log 6 the oldest.

Register bit definitions are shown in Table 3–4 (X = unused bit).

Table 3–4. Fault Register Bit Definitions

BIT	FR1	FR2	FR3	BIT	FR1	FR2	FR3
7	X	X	RLY156	3	ROV	X	X
6	X	X	RLY312	2	OC	ROC	X
5	F3:OV	F4:OT	X	1	48VLOW	RMS_OV	X
4	DC_ERR	F2:OV	X	0	GND_FLT	FLT_IN	RLY_FLT

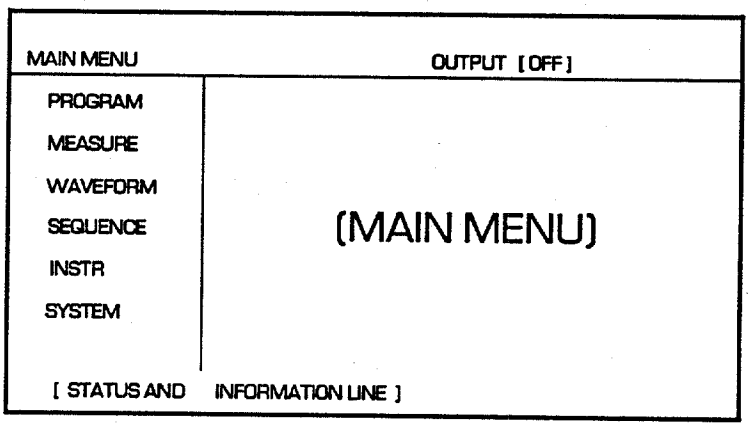
3.4 PROGRAMMING RULES

- Phases A, B, and C will be of the same frequency. A frequency change of any phase will affect the output frequency of all phases. The frequency field is available in all three programming screens as a convenience.
- A sequence can be run on one, two, or all three phases. Two different sequences cannot be run on two phases simultaneously.
- A sequence setting will take priority over continuous settings. When a sequence is terminated, all programming AMPL values are set to 0.

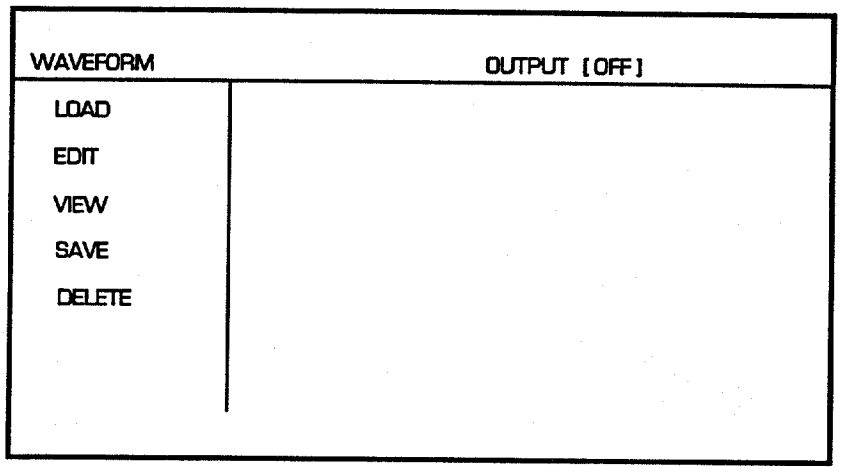
3.5 PROGRAMMING EXERCISES

3.5.1 Current Inrush Example

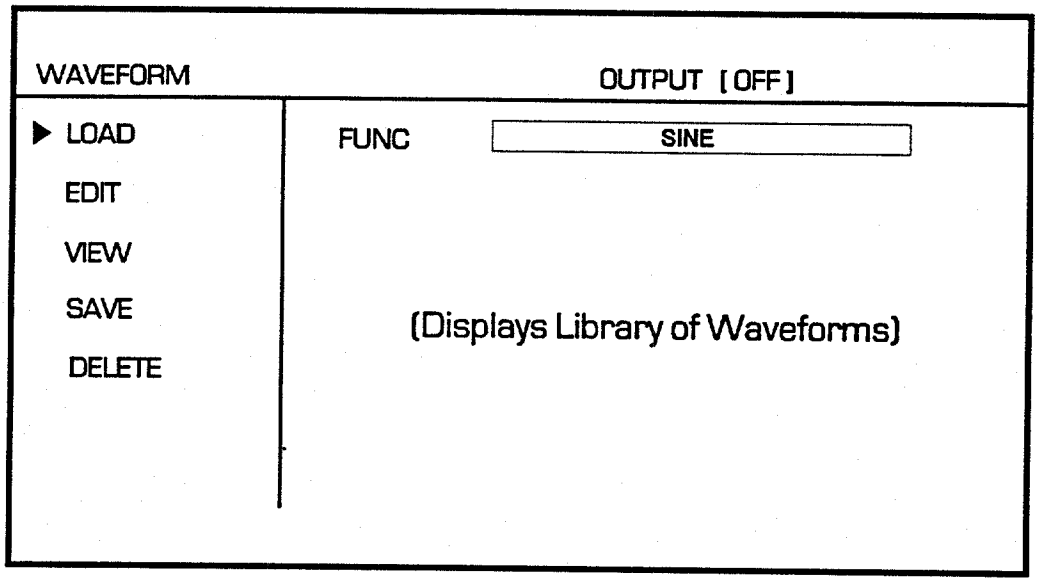
In this example the user programs the SW 5250 to simulate a current inrush waveform that is 0V between 0° and 90°, then instantaneously jumps from 0V to 120V at 90°.



1. At the **MAIN MENU**, using either the Knob or the up/down Arrow Cursor Keys, select the **WAVEFORM** menu then either press the <Enter> key or the right Arrow Cursor Key.



2. The **WAVEFORM** Menu will default to the **LOAD** sub–menu. If **LOAD** is not the default, use the **Knob** or Arrow Cursor Keys to select LOAD.



3. Press the <Enter> key to enter the **FUNC** (function) mode.

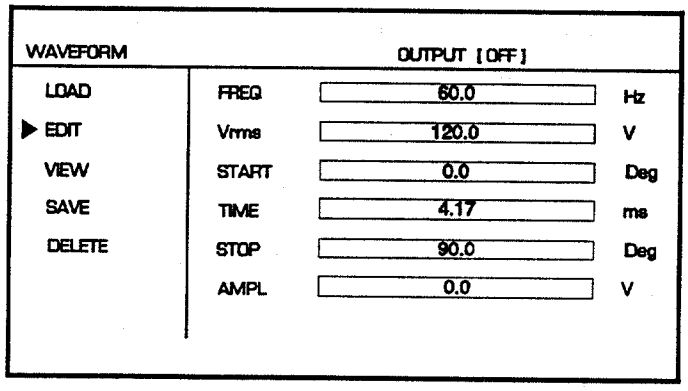
4. Press <Enter> again to place a box around the waveshape selection.

5. If required, using the Knob, rotate through the waveshape selections until **SINE** is observed in the FUNC box.

6. Press <Enter>; this loads the sine waveshape into scratchpad memory. A message, **[waveform successfully loaded]**, will indicate that the waveform is now in scratchpad memory.

7. Press <Menu> to return to the WAVEFORM Menu.

8. Using either the Knob or the up/down Arrow Cursor Keys, select the **EDIT** sub-menu then either press <Enter> or the right Arrow Cursor Key. The EDIT menu will be displayed.



9. Using either the Knob or the up/down Arrow Cursor Keys, select **FREQ.** The frequency is normally defaulted at 60 Hz with all other values set to 0. Using the **Keypad**, enter "6," "0," "decimal point", "0," "0" then press <Enter> to set the frequency to **60.00** Hz.

10. Using either the Knob or the up/down Arrow Cursor Keys, select **Vrms**. Using the Keypad, enter "1," "2," "0" then press <Enter> to set the RMS voltage to **120** volts.

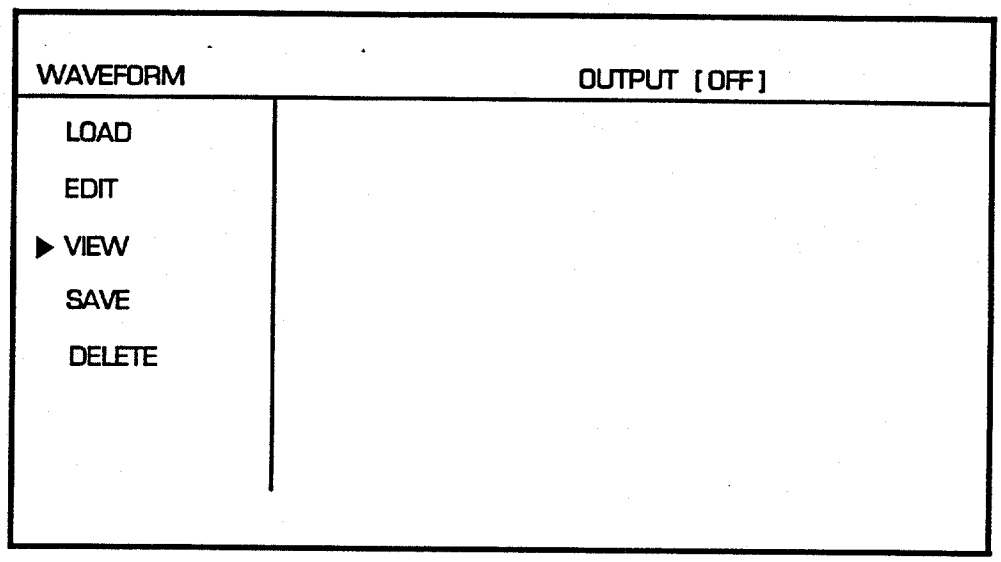
11. Using either the Knob or the up/down Arrow Cursor Keys, select **START**. Using the Keypad, enter "0" then press <Enter> to set the start phase angle to **0°**.

12. Although the TIME could be calculated then entered, in this example the **STOP** function will be used. Select **STOP** then enter "90" for a **90°** phase angle then press <Enter>. Note that the instrument automatically calculates the **TIME** (in this case, 4.17 ms).

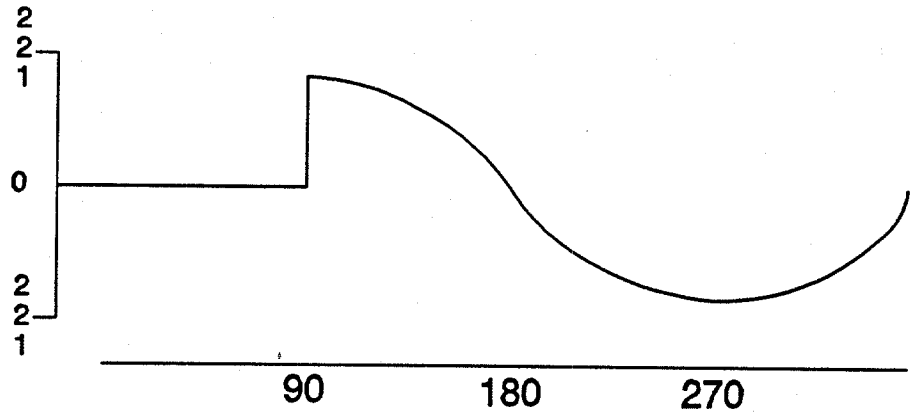
13. Since the operator is not programming a transient (drop/spike), leave the **AMPL** (amplitude) at **0V**.

14. Using either the <Menu> key or the left Arrow Cursor Key, press the key to return to the WAVEFORM Menu.

15. Select **VIEW** then press <Enter> to view the waveform on the LCD.



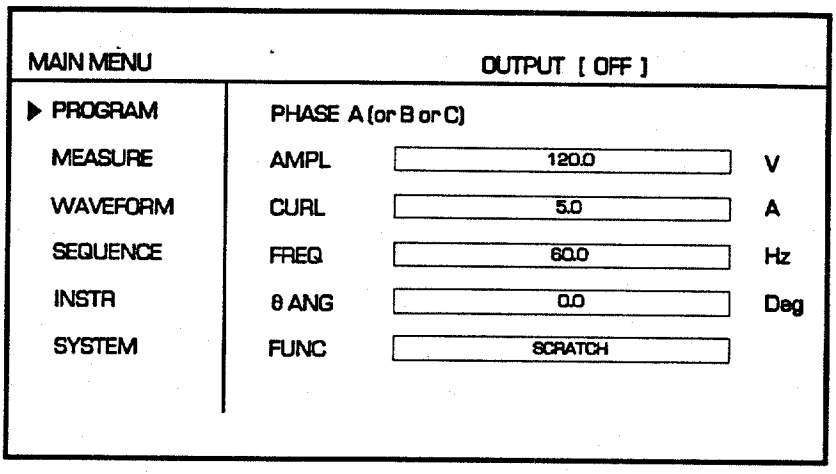
A waveform similar to the one below should be displayed on the LCD.



16. To display the waveform on the oscilloscope:

    a. Return to the **MAIN MENU** by pressing <Menu> twice.

    b. Select the **PROGRAM** Menu then press <Enter>.



17. In the **PHASE A** sub–menu:

    a. Select **FUNC** with the Knob then press <Enter> to place a box around the waveshape selection.

    b. If required, turn the Knob until "**SCRATCH**" is displayed, then press <Enter>.

18. While still in the **PHASE A** sub–menu:

    a. Select **AMPL** (amplitude) with the Knob or Arrow Cursor Keys.

    b. Enter "120" volts with the Keypad to set the amplitude at **120** volts then press <Enter>. The inrush waveform will now be displayed on Phase A of the oscilloscope.

19. While still in the **PROGRAM** mode:

    a. Select **PHASE B** by cursoring to Phase A, then press <Enter>.

    b. Select **FUNC** with the Knob, then press <Enter> to place a box around the waveshape selection.

    c. Rotate the Knob to select **TRIANGLE**, then press <Enter>.

    d. Select **AMPL** (amplitude) with the Knob, enter "120" volts with the Keypad, then press <Enter>. A triangular waveform will be displayed on Phase B of the oscilloscope.

    e. With the select cursor still at **AMPL**, press <Enter> to place a box around the waveshape selection then, using the Knob, vary the amplitude of the triangular waveform on Phase B.

f. Select **PHASE C** by cursoring to Phase B, then press <Enter>.

g. Select **FUNC** with the Knob, then press <Enter> to place a box around the waveshape selection.

h. Rotate the Knob to select **SQUARE**, then press <Enter>.

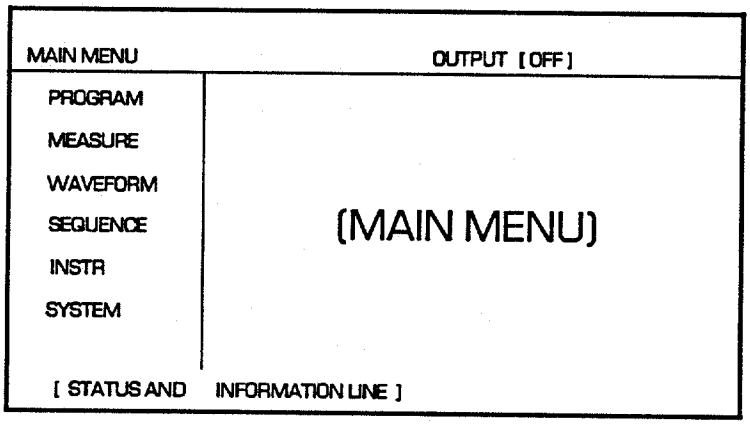
i. Select **AMPL** (amplitude) with the Knob, enter "120" volts with the Keypad, then press <Enter>. A square waveform will now be displayed on Phase C of the oscilloscope.

j. With the select cursor still at **AMPL**, press <Enter> to place a box around the waveshape selection then, using the Knob, vary the amplitude of the square waveform on Phase C.

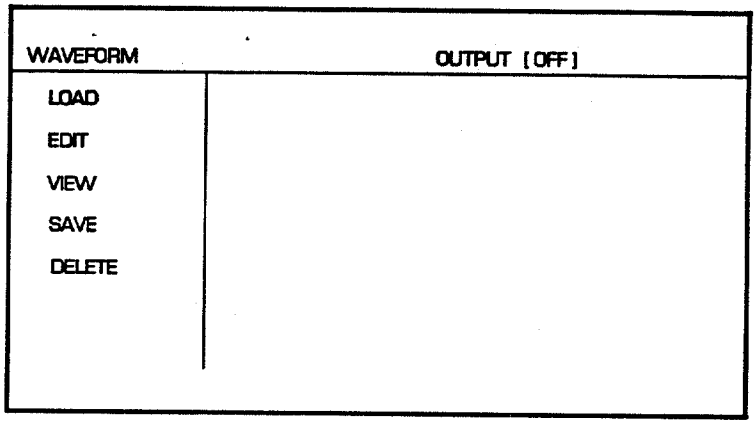
20. Using either the <Menu> key or the left Arrow Cursor Key, return to the MAIN MENU.

3.5.2 Voltage Spike Example

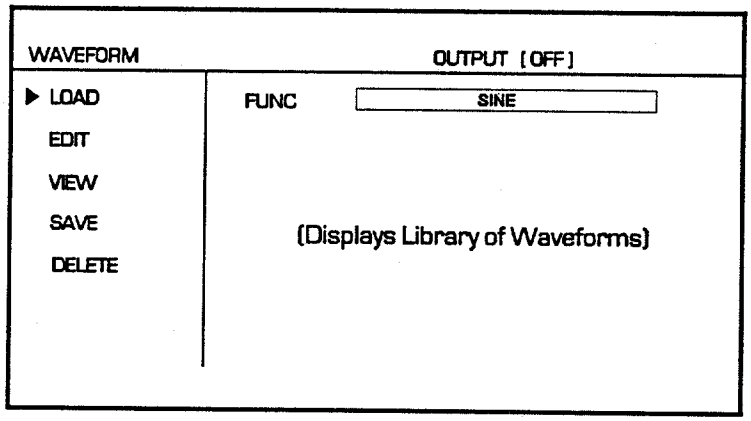
In this example the user programs the SW 5250 for a voltage spike on a 120V sine waveform that starts at 30°, ends at 32°, and is of maximum amplitude (in this case, 156V).



1. At the **MAIN MENU**, select the **WAVEFORM** menu, then press <Enter>.



2. The **WAVEFORM** Menu should default to the **LOAD** sub–menu. If **LOAD** is not the default, use the Knob or Arrow Cursor Keys to select LOAD.



3. Press <Enter> to enter the **FUNC** (function) mode.

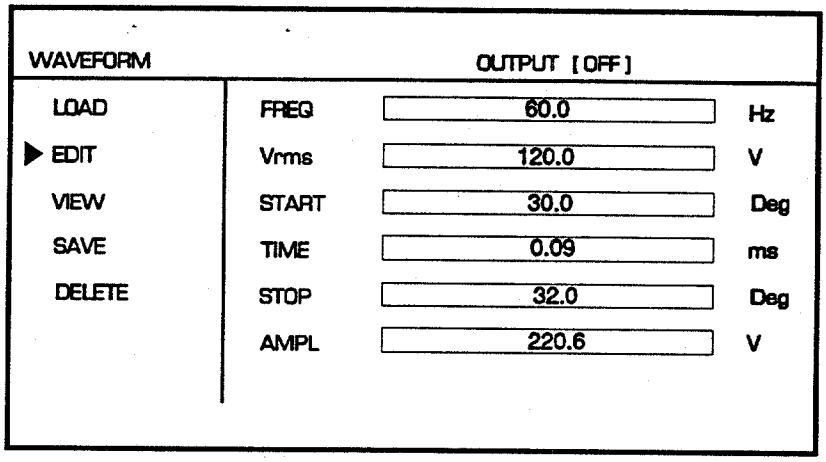
4. Press <Enter> again to place a box around the waveshape selection.

5. If required, using the Knob, rotate through the waveshape selections until **SINE** is observed in the FUNC box.

6. Press <Enter>; this loads the sine waveshape into scratchpad memory. A message, **[waveform successfully loaded]**, will indicate that the waveform is now in scratchpad memory.

7. Press <Menu> to return to the WAVEFORM Menu.

8. Using either the Knob or the up/down Arrow Cursor Keys, select the **EDIT** sub–menu then either press <Enter> or the right Arrow Cursor Key. The EDIT menu will be displayed.



9. Select **Vrms**. Enter "120" using the Keypad then press <Enter> to set the RMS voltage to **120** volts.

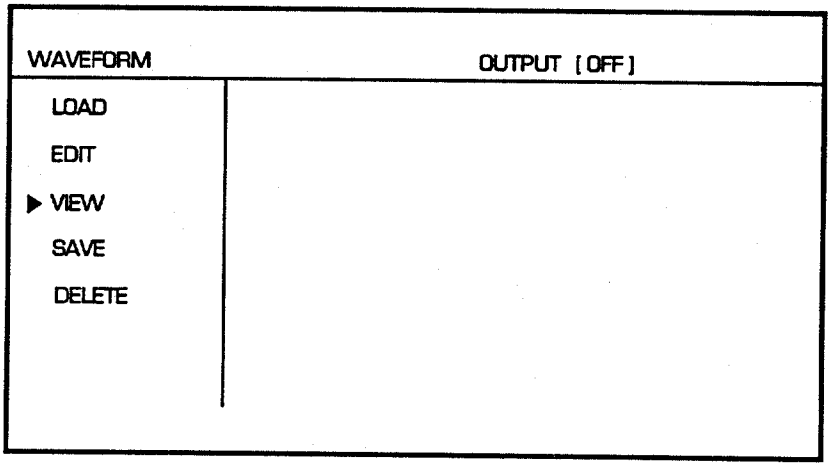
10. Select **START**. Enter "30" using the Keypad then press <Enter> to set the starting phase angle to **30°**.

11. Select **STOP**, enter "32" using the Keypad for an ending phase angle of **32°**, then press <Enter>. Note that the instrument automatically calculates the **TIME** (in this case, 0.09 ms).

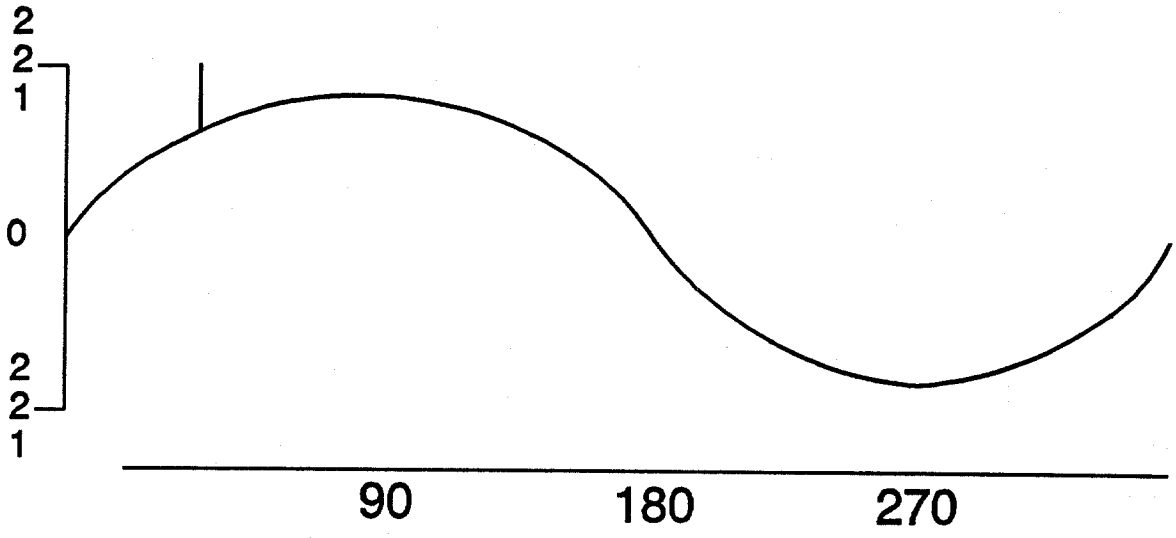
12. Select **AMPL** then press <Enter>. Enter "220.6" (the maximum output amplitude at the selected range), then press <Enter> again.

13. Return to the WAVEFORM Menu by pressing <Menu>.

14. Select **VIEW** to view the scratchpad.



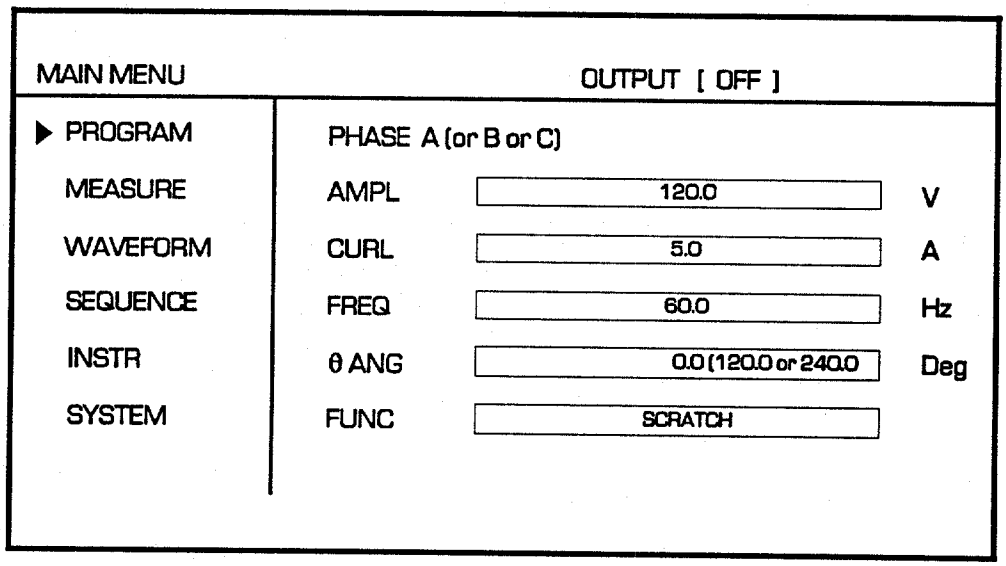
15. Press <Enter>. A waveshape similar to the one below should be displayed on the scratchpad.



16. To retain the waveshape and display it on Phase A of the oscilloscope:

a. Return to the **MAIN MENU** (press <Menu> twice).

b. Select the **PROGRAM** Menu then press <Enter>.



17. In the **PHASE A** sub–menu:

    a. Select **FUNC** with the Knob then press <Enter> to place a box around the waveshape selection.

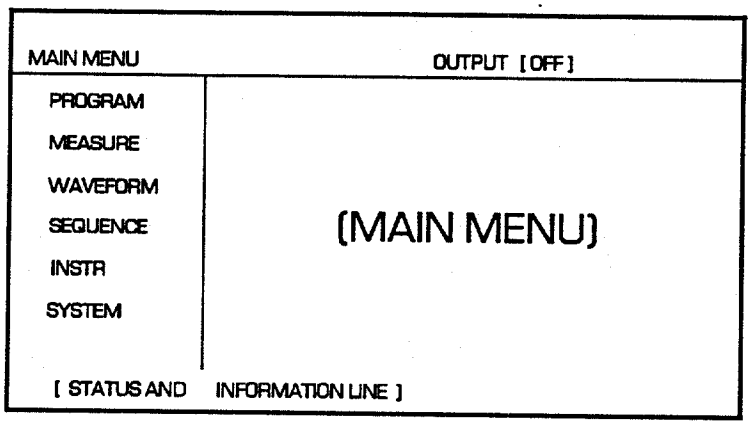
    b. If required, turn the Knob until **SCRATCH** is displayed, then press <Enter>.

    c. The scratchpad waveform will now be displayed on Phase A of the oscilloscope.

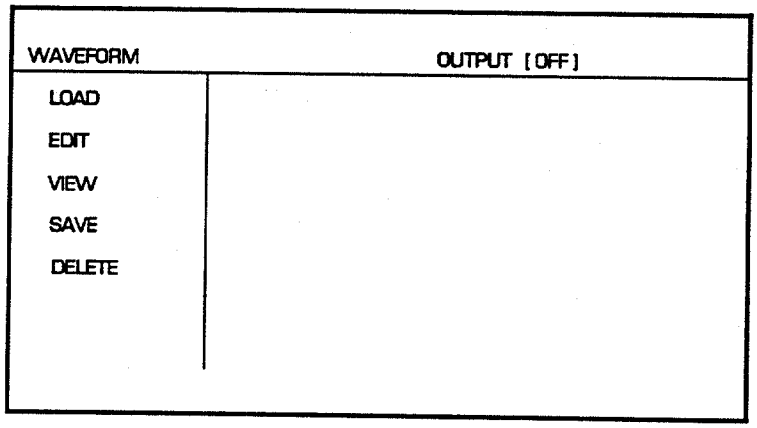
18. Using <Menu>, return to the MAIN MENU.

3.5.3 Voltage Dropout Example

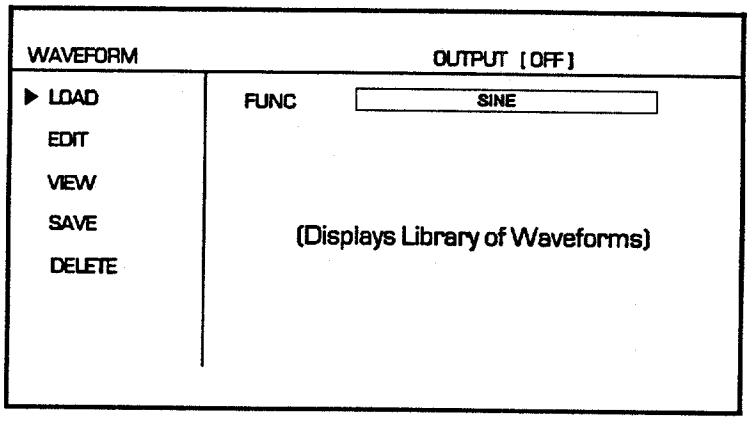
In this example the user programs the SW 5250 for a voltage dropout on a 120V sine waveform that starts at 45° with a duration of 1 millisecond and an amplitude of 10 volts.



1. At the **MAIN MENU**, select the **WAVEFORM** menu, then press <Enter>.



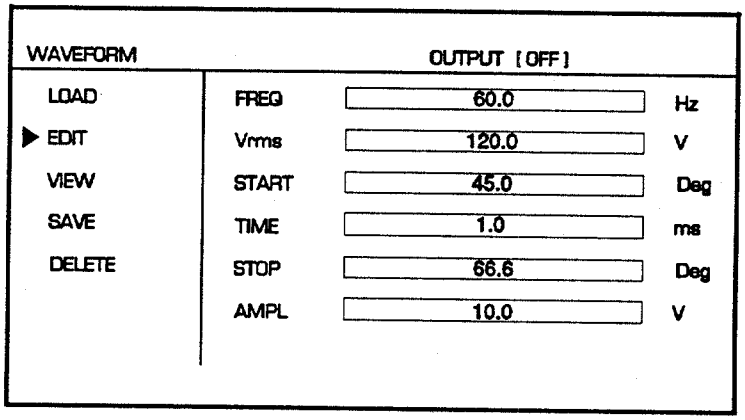
2. At the **WAVEFORM** Menu, select the **LOAD** sub–menu then press <Enter>. The LOAD menu will be displayed.



3. Press <Enter> to place a box around the waveform selection, select **SINE**, then press <Enter>. The sine waveshape is loaded into scratchpad memory.

4. Return to the **WAVEFORM** Menu by pressing <Menu>.

5. Select the **EDIT** sub–menu then press <Enter>. The EDIT menu will be displayed.



6. Select **Vrms**. Enter "120" then press <Enter> to set the RMS voltage to **120** volts.

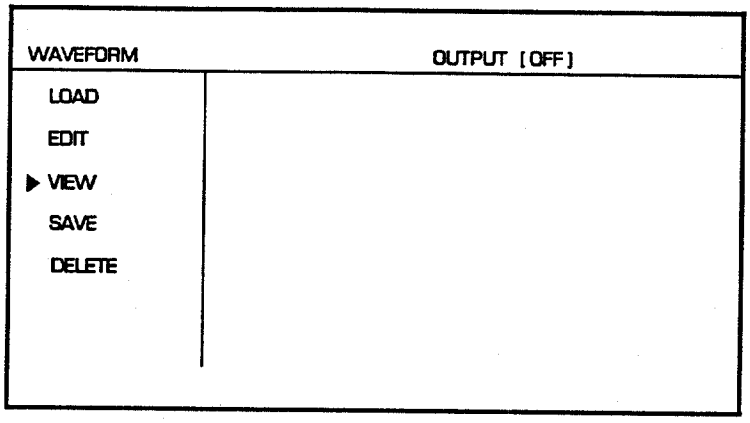
7. Select **START**. Using the Keypad, enter "45" then press <Enter> to set the starting phase angle to **45°**.

8. Select **TIME**, enter "1" for a duration of 1 millisecond, then press <Enter>. Note that the instrument automatically calculates the **STOP** phase angle value (in this case, 66.6°).

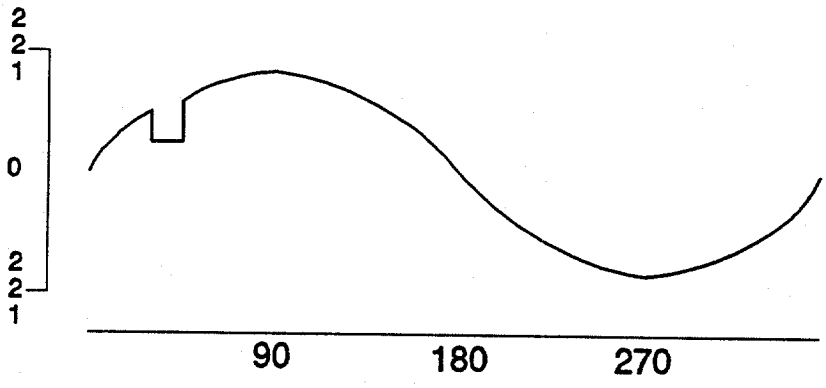
9. Select **AMPL**, enter "10" for 10 volts, then press <Enter>.

10. Return to the WAVEFORM Menu by pressing <Menu>.

11. Select **VIEW** to view the scratchpad.



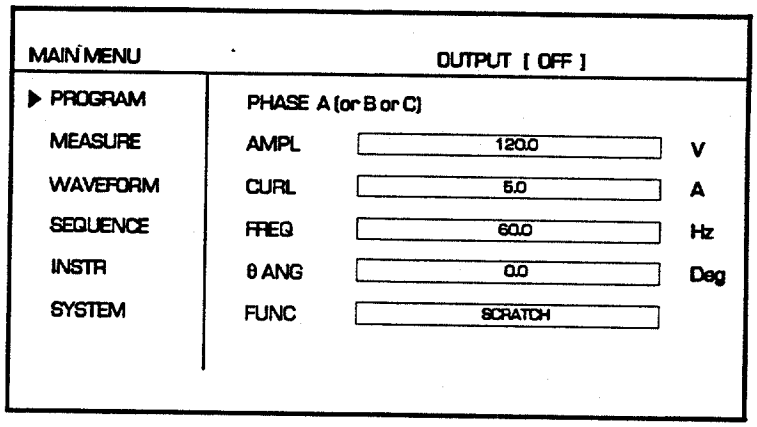
12. Press <Enter>. A waveshape similar to the one below should be displayed on the scratchpad.



13. To retain the waveshape and display it on Phase A of the oscilloscope:

    a. Return to the **MAIN MENU** (press <Menu> twice).

    b. Select the **PROGRAM** Menu, then press <Enter>.



14. In the **PHASE A** sub–menu, select **FUNC**, select **SCRATCH**, then press <Enter>. The scratchpad waveform will now be displayed on Phase A of the oscilloscope.

15. Using either the <Menu> key or the left Arrow Cursor key, return to the MAIN MENU.

3.6 SCPI SPECIFICATION

See the SmartWave™ SW Series SCPI Specification Manual (M162000–03).