1510A

Precision Signal Generator

with direct digital synthesis

Operation and Maintenance Manual

7001-0019 Revision 3.0
January 2, 2019

Thank you for purchasing your 1510A Precision Signal Source

The 1510A is a precision instrument developed to make calibration and testing easier and faster. It is a unique instrument that generates voltage and charge signals over a wide range of frequencies to make fast work of system calibrations. With two digitally synthesized channels capable of producing several types of waveshapes, the 1510A has the accuracy and flexibility to calibrate and test all types of measurement systems. Easy to use controls make the 1510A easy to operate, accurate enough for a calibration shop, and it is small and rugged enough for factory, test cell and flight line use.

Your new 1510A features:

High accuracy – The 1510A provides voltage and frequency signals with 0.05% accuracy.

Dual frequency synthesizers – The 1510A features two independent digital synthesizers for accurate and independent control of signals.

Twin mode signal outputs – The 1510A provides ***CHARGE*** signals for simulating the signals from accelerometers, and voltage signals for simulating signals from ***VELOCITY*** and other voltage generating sensors.

Multiple output wave shapes – The 1510A has the flexibility to generating SINE, SQUARE, TRIANGLE or SAWTOOTH waveforms for vibration signals. DC signals can be generated as an offset or as an independent output signal. Timing pulses with variable duty cycles can also be synthesized.

True engine speed signals – The 1510A produces tachometer generator speed signals as well as odd-tooth type signals for simulating all types of engine and machinery speed signals.

JOG function – The 1510A allows users to slowly vary output signal parameters to aid in detecting "sweet spots" or finding critical signal values.

Automatic sweep function – The sweep function of the 1510A allows simulation of machinery startups and shutdowns.

Rechargeable batteries – The 1510A operates for several hours on a single charge of its built-in NiMH batteries. This offers great flexibility in where and how you use your new calibrator.

Flexible programming – Up to 40 different "settings" can be SAVED and RECALLED instantly to make test set-up fast, easy, and repeatable.

Programming Port – The built-in USB port permits remote control of the 1510A as well as re-calibration and pre-programming of control memories and calibration with optional software.

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NOTICES and STATEMENTS

FCC Notices

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the manufacturer's instruction manual, may cause interference with radio and television reception. This equipment has been designed as a Class A digital device of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference, which can be determined by turning the equipment off and on, you are encouraged to try to correct the interference by one or more of the following measures:

Relocate the instrument with respect to the other device.

Plug the instrument into a different outlet so that the instrument and the other device are on different branch circuits.

If necessary, consult a representative of MTI Instruments Inc. You may find the following booklet helpful: *FCC Interference Handbook*, 1986, available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 004-000-00450-7.

WEEE Statement

The WEEE directive is intended to prevent waste consisting of electrical and electronic equipment from being introduced into the municipal/household waste stream, and places the responsibility for disposal, and or recycling, of WEEE on its producer. The WEEE directive also defines 10 product categories for differentiating electrical and electronic equipment covered by it and the RoHS directive. MTI Instruments (MTII) intends to comply with WEEE, and all our applicable products will be labeled with the WEEE-approved recycle bins marking by the directive's effective date of August 13, 2005.

The Label looks like this:

MTII will accept returns of MTII's products labeled with the recycle bin through our normal product return process. Products purchased from an Authorized MTII Dealer should be returned to that dealer. European Community Customers who purchased directly from MTII should contact MTII's Customer Service Department at sales@mtiinstruments.com for a Return Materials Authorization (RMA) number and then send the product(s) to MTII for proper disposal (MTII will not accept shipments without a valid RMA#).

Shipping costs are the responsibility of the customer. To save on shipping cost customers may collect units over time and send them back in bulk or along with working units that need service or repair, as long as they are separated and clearly marked for disposal. For United States Customs purposes, discarded products being returned for disposal have no value. Please consult your shipping carrier for details regarding shipping any batteries that have been removed from MTII's products.

EC Compliance Statement

This equipment is in compliance with applicable EC standards. See current Declaration of Conformity.

OVERVIEW OF THE 1510A

The 1510A with advanced Dual Channel Direct Digital Synthesis technology is the only precision instrument available that meets the calibration needs of machinery instrumentation and monitoring systems. The 1510A can be used to test:

Velocity probe vibration channels – As a precision signal generator, the 1510A is ideal for supplying accurate voltage signals. You can easily program the 1510A to output voltage signals ranging from 1 milliVolt to nearly 20 Volts peak-to-peak and from 1 Hz to 100KHz. Signals with different waveshapes such as sine, square, triangle, and sawtooth can be selected.

Accelerometer vibration channels – The 1510A is also ideal for supplying either single-ended or dual-ended charge signals ranging from 5 pC to nearly 10,000 pC, and from 1 Hz to 50,000Hz**.** Signals with different waveshapes such as sine, square, triangle, and sawtooth can be selected.

Speed Signals Channels – A second digital synthesizer is included in the 1510A to provide high accuracy speed signals. Signals up to nearly 20 VAC peak-to-peak can be generated to calibrate tachometer generator channels. Different ratios between the Channel A and Channel B frequency can be commanded, and single pulse and odd-tooth speed signals can also be programmed.

System Frequency response – The 1510A can be set-up to generate several different waveshapes for testing the bandwidth and sensitivity of systems. And the 1510A can also be programmed to sweep signals between two frequencies at programmable sweep rates for testing and monitoring system performance.

Phase measurements – The 1510A can control the phase relationship between its two output signals with 1 degree precision which is invaluable for calibration of dynamic balancing systems.

High-Accuracy Bridge Instrumentation – The 1510A can be used to simulate the low level voltages developed by high sensitivity bridge circuits. Voltages ranging from 1 µvolt to 100 µvolts can be programmed to test and calibrate bridge-type sensor instrumentation.

WARNING

The 1510A is to be used only for its intended purpose as described in this manual. Other uses may pose a safety hazard and cause injury to operator and instrument.

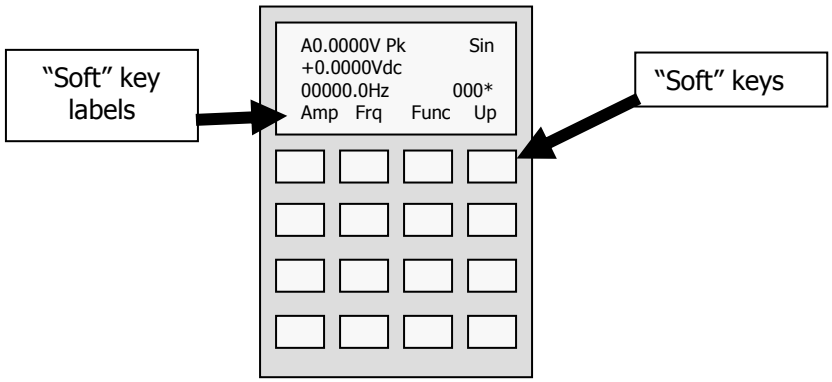
OVERVIEW OF THE 1510A

The 1510A has two output channels, and both can be easily programmed using the built-in keypad. The capabilities of each channel are summarized below:

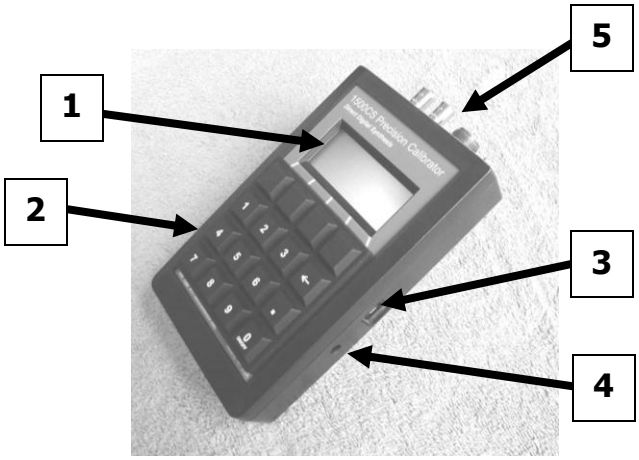
	CHANNEL A output	**CHANNEL B output**
AMPLITUDE	VOLTS AC VOLTS DC CHARGE (picoCoulombs)	VOLTS AC
AMPLITUDE RANGE	AC VOLTS: 0 – 10 VAC (RMS, PK or PK-to-PK) DC VOLTS: 0 – 10 VDC CHARGE: 0 – 10,000pC (RMS, PK or PK-to-PK)	VOLTS: 0 – 10 VAC (RMS, PK or PK-to-PK) Bridge Mode – 1 to 100 µvoltsDC
DC OFFSET	DC offset – 0-10 VDC Total of AC signal & DC offset not to exceed the 10 Voltpk signal limit.	NONE
FREQUENCY	0 – 100,000 Hz	0 – 100,000 Hz 0 - 100 times Channel A in ratio mode
WAVESHAPES	Sine, Square, Triangle, Sawtooth	Sine, Square, Triangle, Sawtooth, Odd-Tooth, or Pulse
PHASE		0-360 relative to Channel A signal

To program either channel, users follow a series of prompts on the 1510A display. The top row of keys on the 1510A keypad are "soft" keys which have changing functions depending upon the mode of operation.

The "soft" keys are always labeled by the bottom row of the display as illustrated below.



LOCATION OF CONTROLS



FRONT VIEW

REAR VIEW

1 - OPERATORS DISPLAY – A 4 line by 18 character display displays current calibrator settings and is used during programming.

2 - KEYPAD – A 16 button keypad is used for controlling the 1510A calibrator. Four "Soft" keys are defined by prompts from the display.

3 - COM PORT – A USB communications port is located on the side of the 1510A and is used to control and program the 1510A.

4 -CHARGER PORT – A battery charger port is provided to recharge the internal NiMH batteries. The 1510A can also be continuously operated using power provided via this connector.

5 –SIGNAL CONNECTORS – Four different connectors are provided to supply the various signals generated by the 1510A.

6 – BATTERY COMPARTMENT – The 1510A uses four (4) rechargeable AA size batteries contained in this compartment

WARNING

Only use the supplied AC adapter to charge the batteries in this unit. All other devices pose a safety hazard to the user and the unit.

NOTE

Only use the 1510A with the protective boot in place.

SIGNAL CONNECTIONS

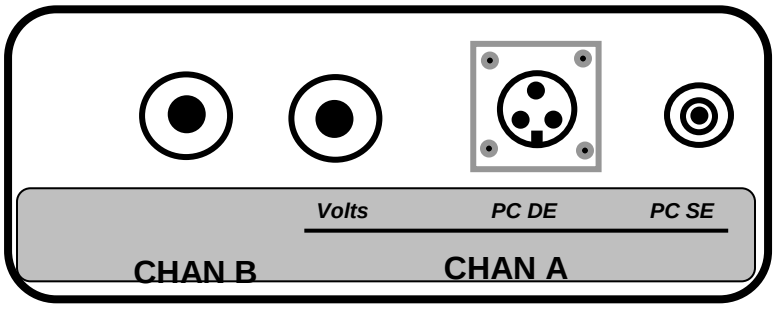
There are four connectors positioned on the top of the 1510A to provide the different output signals. The figure below illustrates these connectors.

OUTPUT B – This BNC style connector provides the Channel B output signal which can be used as a "speed" or synchronizing signal.

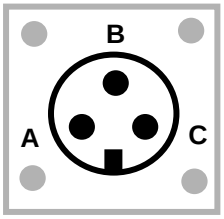
OUTPUT A VOLTS – This BNC style connector provides the VOLTAGE signal for CHANNEL A.

OUTPUT A pC DE –This MS style connector is used when CHANNEL A has been set-up to provide a true balanced DIFFERENTIAL CHARGE signal.
The mating connector is an MS3106A-10SL-3S. Pin A of the connector provides the positive charge signal, Pin B of the connector supplies the negative side of the charge signal, and Pin C of the connector is the shield connection point.

OUTPUT A pC SE –This Micro-Dot style connector is used when CHANNEL A has been programmed for a SINGLE-ENDED CHARGE signal.



SIGNAL CONNECTIONS

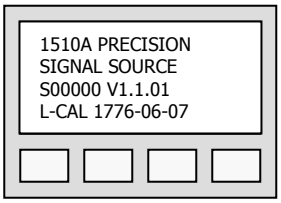


A = +
B = -
C = Gnd

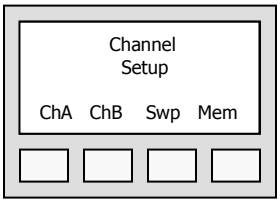
DE Charge CONNECTOR DETAILS

The 1510A is turned on by holding down the 0 ON/OF key for a minimum of 3 seconds. As soon as the "start-up" display is visible, you may release the button.

The Start-up display, illustrated below, will be displayed for about 10 seconds. It provides information including the 1510A serial number, the data of last calibration, and internal software revision number.

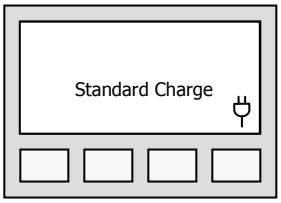


After about 10 seconds the display will change to the main Operator Entry Display.



The 1510A is turned off by holding down the 0 ON/OF key for approximately 3 seconds. As soon as the display becomes blank, the unit has shut down.

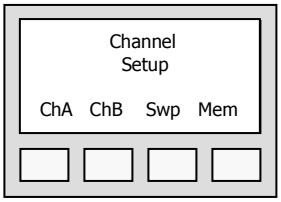
If the 1510A has been turned off, and the charging unit is connected, the charging message will appear, indicating that the 1510A batteries are being rejuvenated.



PROGRAMMING THE 1510A

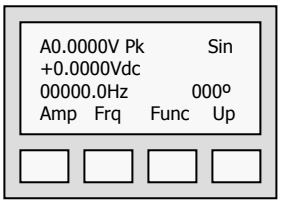
The 1510A can be easily programmed by pressing the "soft-keys" and following the on-screen prompts. There are four major steps to programming the 1510A as illustrated below:

SELECT the CHANNEL – Select either Channel A or Channel B



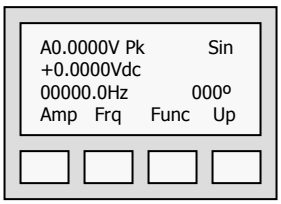
Pressing the button labeled ChA selects Channel A, and ChB selects Channel B
See Page 7 for Channel A programming details.

DEFINE the AMPLITUDE – Next, program the desired output level and type of output.



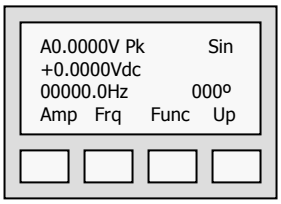
Pressing the button labeled Amp starts the process of selecting AC or DC output as well as VOLTS or Charge output. See Page 8 for Channel B Amplitude programming details.

DEFINE the FREQUENCY – Next, program the desired output frequency.



Pressing the button labeled FRQ starts the process of defining the desired output frequency in Hertz or RPM. See Page 10 for Frequency programming details.

DEFINE the FUNCTION – Finally, program the desired output waveshape.



Pressing the button labeled FUNC starts the process of defining the desired output Waveshape (i.e., Sine, square, triangle, or sawtooth). See Page 11 for Function programming details.

The 1510A can be used to generate a wide range of precision signals. The Channel A output can be programmed for voltage or charge signals. Voltage signals are useful for calibrating a wide range of instruments, and can also be used to simulate may types of signals. Charge signals are useful for calibrating charge amplifiers and simulating the outputs of accelerometers and other piezoelectric devices

Channel A parameters that users can control include:

AC VOLTAGE AMPLITUDE – Channel A amplitude may be programmed from 0.1 milliVolt peak to 9.999 Volts peak.

CHARGE AMPLITUDE – Channel A amplitude may be programmed from 1 picoCoulomb peak to more than 9,999 picoCoulombs (peak) of charge.

FREQUENCY – The Channel A frequency may be defined to be either a fixed frequency ranging from 1 Hz to 100KHz.

SIGNAL TYPE – The Channel A signal can be programmed to be a sine wave, a square wave, a triangle wave, or a sawtooth wave.

DC VOLTAGE AMPLITUDE – Channel A amplitude may be programmed from 0.1 milliVolt peak to more than 9.999 Volts peak.

NOTE

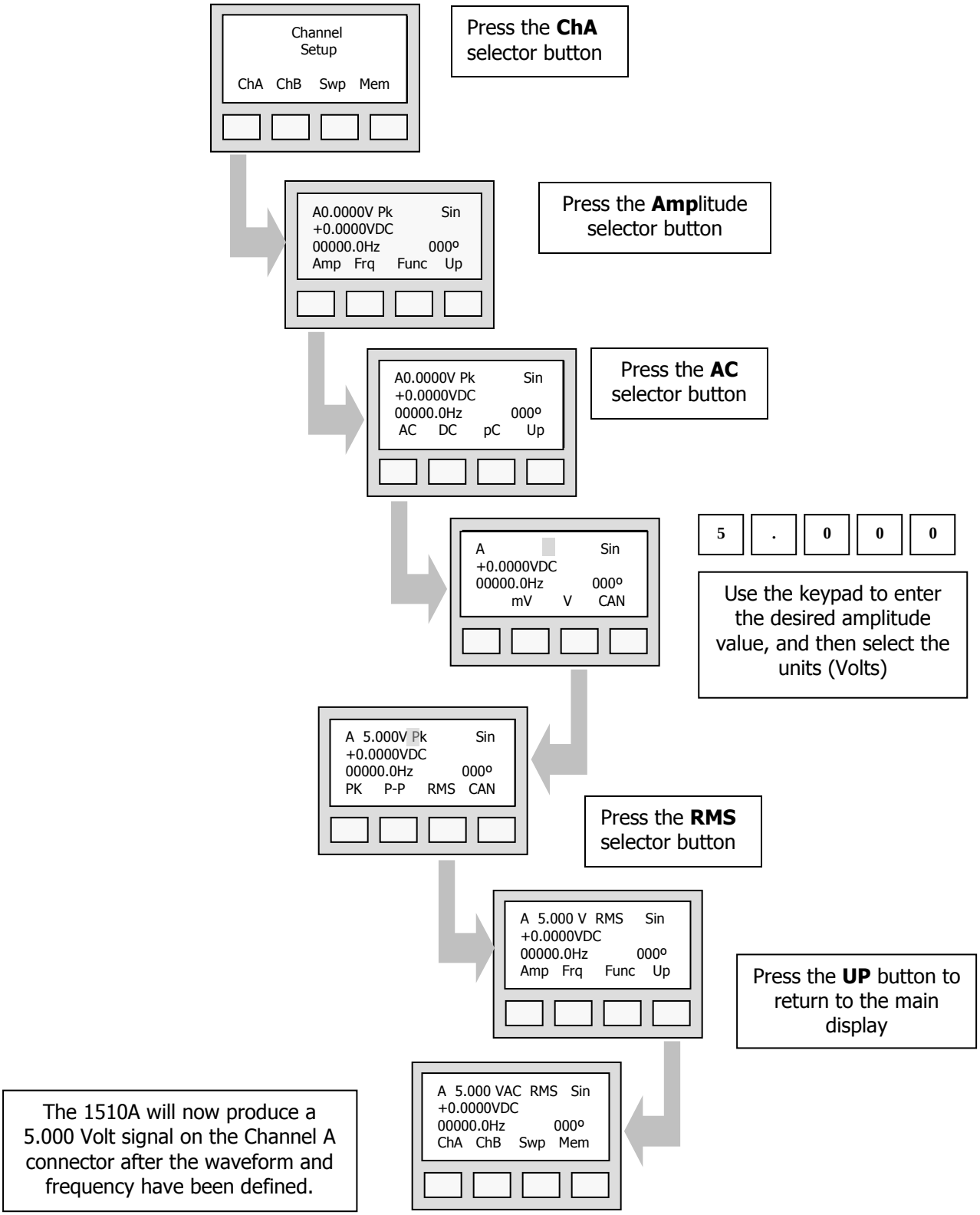
The combined AC and DC peak voltage value may not exceed 9.9999 Volts pk.

WARNING

Do not connect the 1510A directly to an ICP current source. Doing so may damage the instrument.

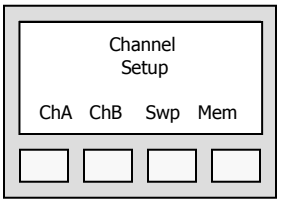
CHANNEL A – VOLTAGE AMPLITUDE SET UP

Channel A of the 1510A may be programmed for either voltage or charge outputs. The following is an example of how to program Channel A for a voltage output of 5.000 VAC RMS.

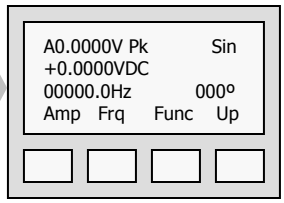


CHANNEL A – CHARGE AMPLITUDE SET UP

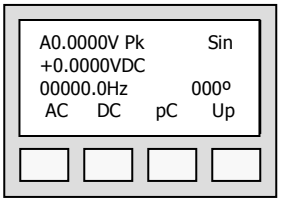
Channel A of the 1510A may be programmed for either voltage or charge outputs. The following is an example of how to program Channel A for a CHARGE output of 50.0 pC pk-pk.



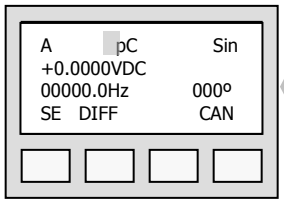
Press the **ChA** selector button



Press the **Amp**litude selector button



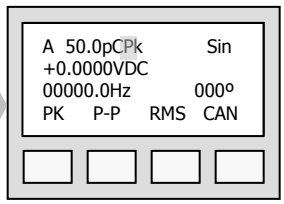
Press the **pC** selector button



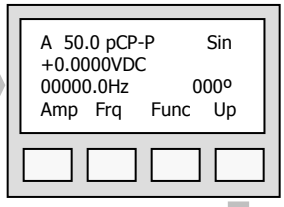
5 0 . 0

Use the keypad to enter the desired amplitude value, and then select the **DIFF**erential output option

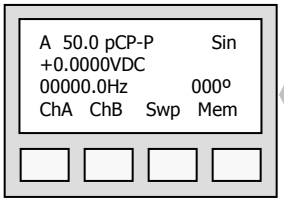
NOTE
Use the SE (Single Ended) option for the microdot connector. Use the DIFF (Differential) option for the MS connector.



Select **P-P** as the desired units



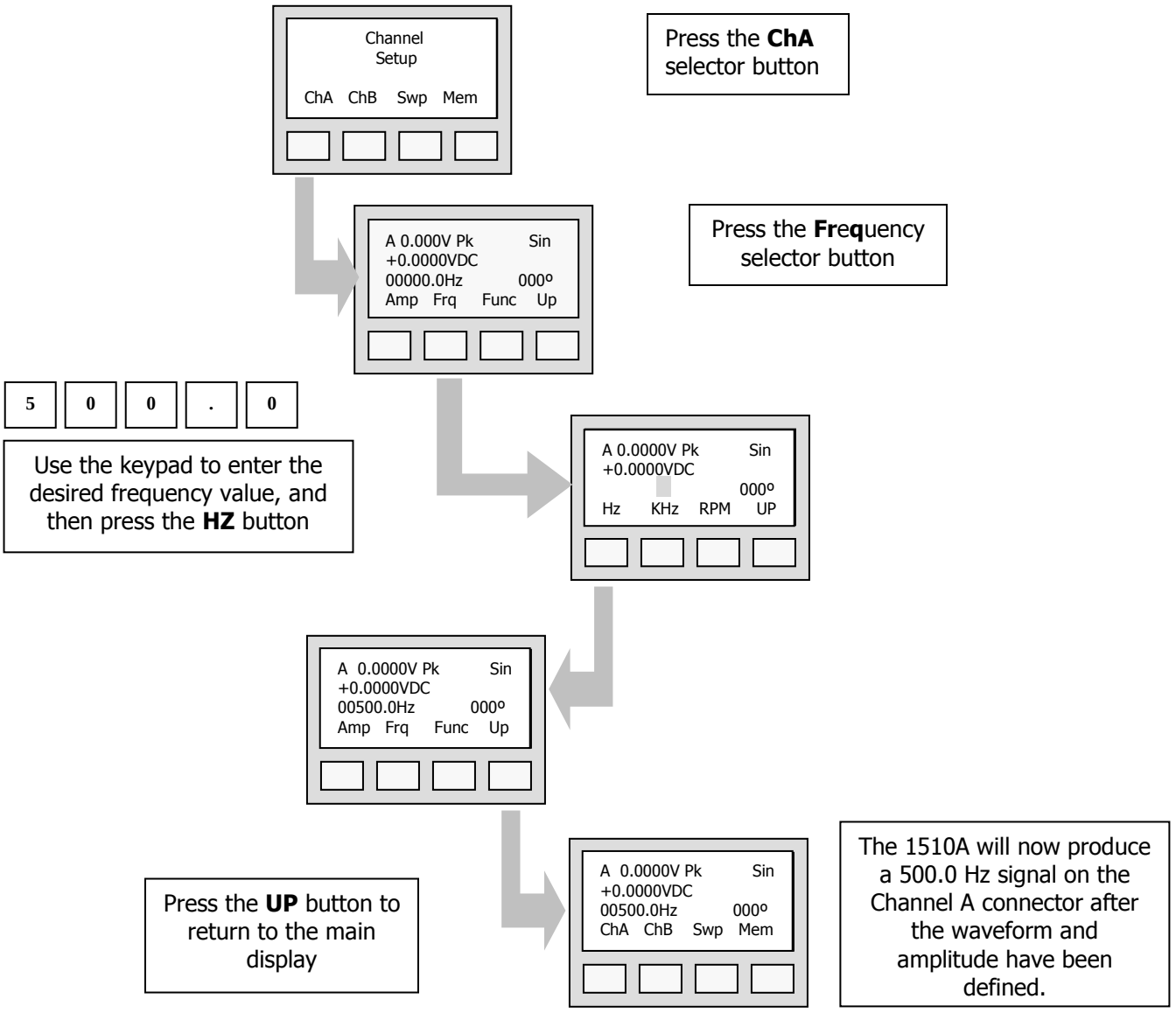
Press the **UP** button to return to the main display



The 1510A will now produce a 50 pC P-P charge signal on the Channel A connector after the waveform and frequency have been defined.

CHANNEL A – FREQUENCY SET UP

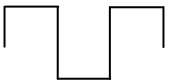
The 1510A can produce a signal ranging from 1 Hz to up to 100 KHz. The following is an example of how to program Channel A for a frequency of 500Hz:



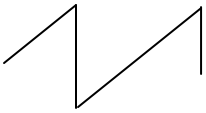
Channel A of the 1510A can be programmed for one of four different waveform. Sine waves are usually used as calibration signals because they consist of only one frequency component without any harmonics or other frequencies. Square, triangle, and sawtooth shaped waveforms are used to check the bandwidth and frequency response of systems.

SINE WAVE

TRIANGLE WAVE

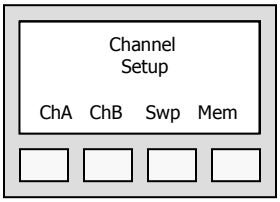


SQUARE WAVE

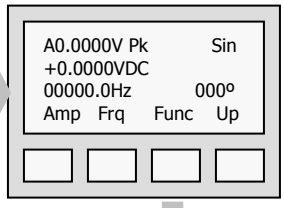


SAWTOOTH WAVE

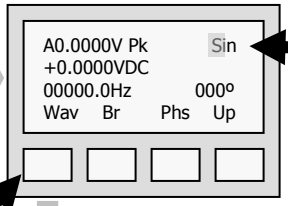
The following is an example of how to program Channel A for a SQUARE WAVE output.



Press the **ChA** selector button

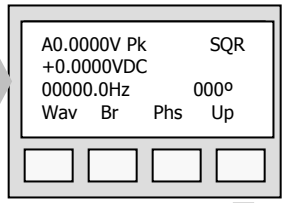


Press the **Func**tion selector button

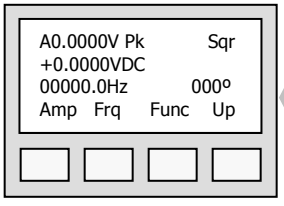


As the **Wav**eform button is pressed, this note will change

Use the **Wav**eform or button to cycle thru the list of available waveshapes.



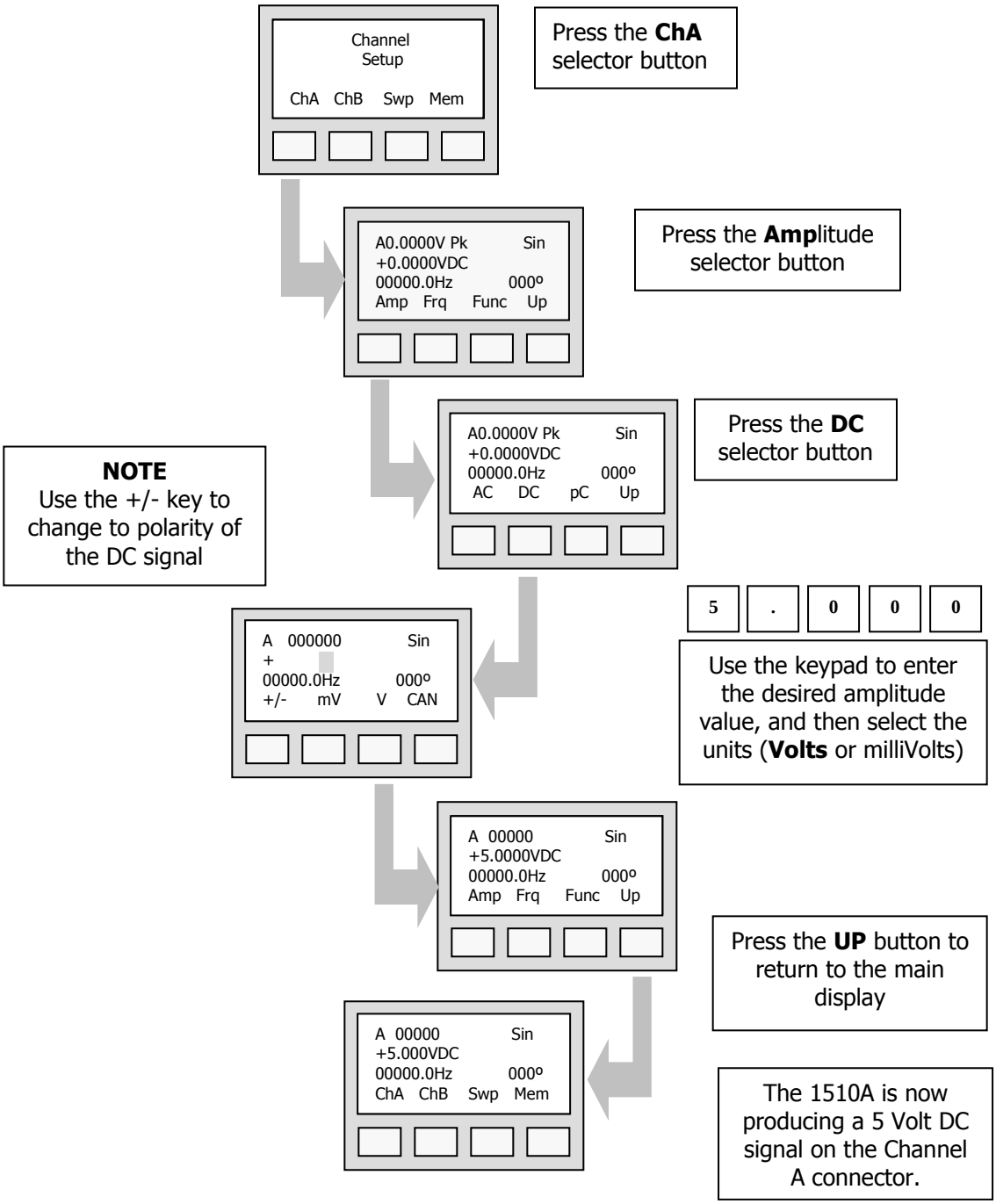
Press the **UP** button to return to the main display



The 1510A will now produce a square wave signal on the Channel A connector after the amplitude and frequency have been defined.

CHANNEL A – DC AMPLITUDE SET UP

Channel A of the 1510A may be programmed for either AC voltage or DC voltage outputs. Additionally, a DC offset or bias may be applied to the Channel A output voltage signal. The following is an example of how to program Channel A for a DC Voltage output of 5.00 Volts.



Channel B can be used to simulate a machinery vibration signal, a speed signal, or it can be used as a secondary timing signal or reference signal.

Channel B parameters that the users can control include:

AMPLITUDE – Channel B amplitude may be programmed from 0.1 milliVolt peak to more than 9.999 Volts peak.

FREQUENCY – Channel B frequency may be defined to be either a fixed frequency ranging from 1 Hz to 100KHz, or it may be defined to be a ratio of the Channel A frequency. The ratio can range from 0.1 to 100 times the Channel A frequency.

Note that the default Channel B frequency is the same as the Channel A frequency.

SIGNAL TYPE – Channel B can be programmed to be a sine wave, a square wave, a triangle wave, or a sawtooth wave.

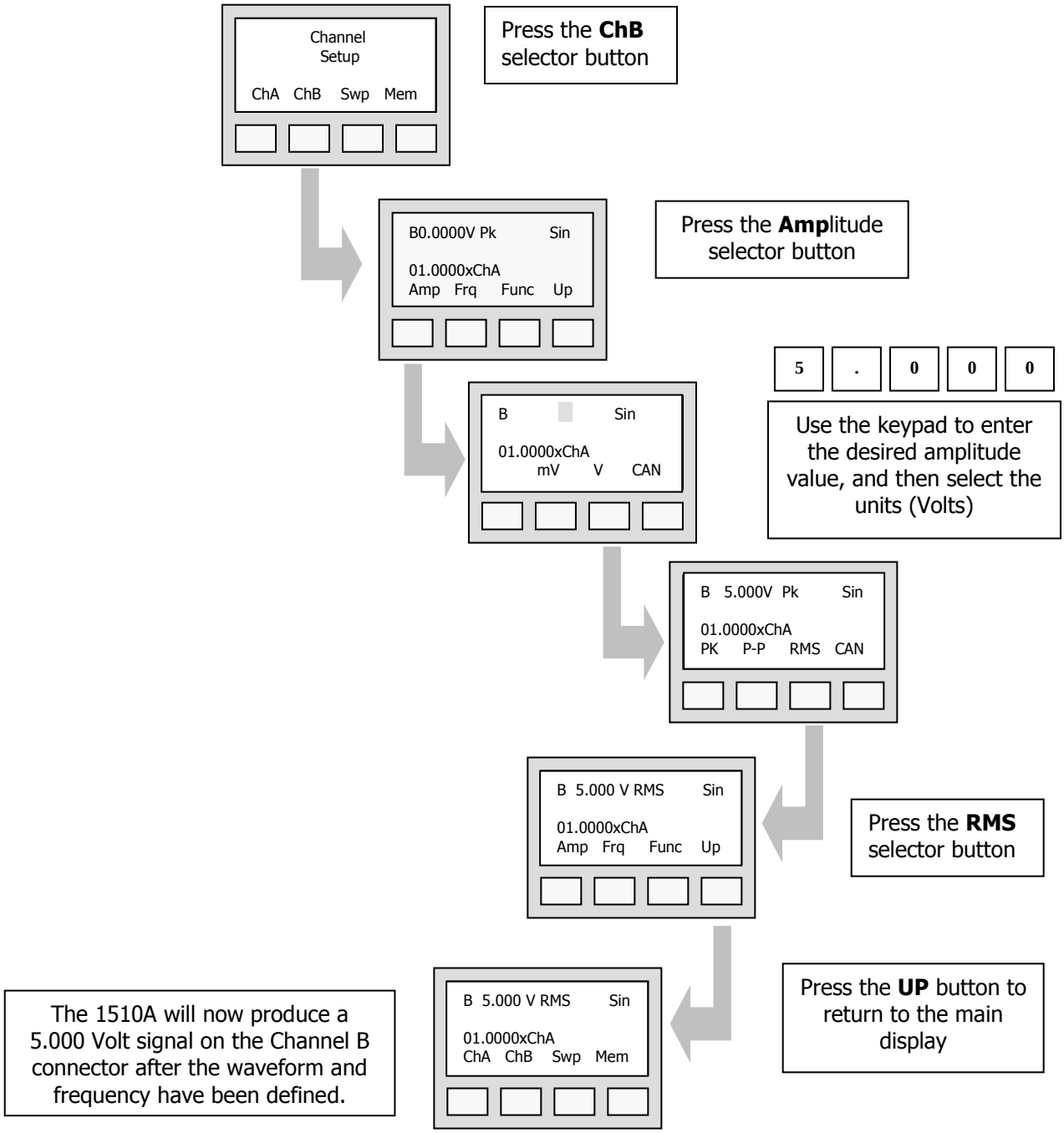
When Channel B is programmed to simulate a speed signal, there are many more options:

PULSE MODE – Channel B of the 1510A can be programmed to produce a single pulse occurring at the same frequency or at a ratio of the Channel A frequency. The pulse duty cycle can be programmed from 3% to 100% of the period. The shape of the pulse can be either a sine wave, or a square wave.

ODD TOOTH MODE - Channel B of the 1510A can be programmed to produce a multi-pulse tachometer signal with one of the pulses in every "revolution" being either smaller or larger than the other pulses. Both the number of pulses per revolution may be set as well as the relative size of the "odd" pulse.

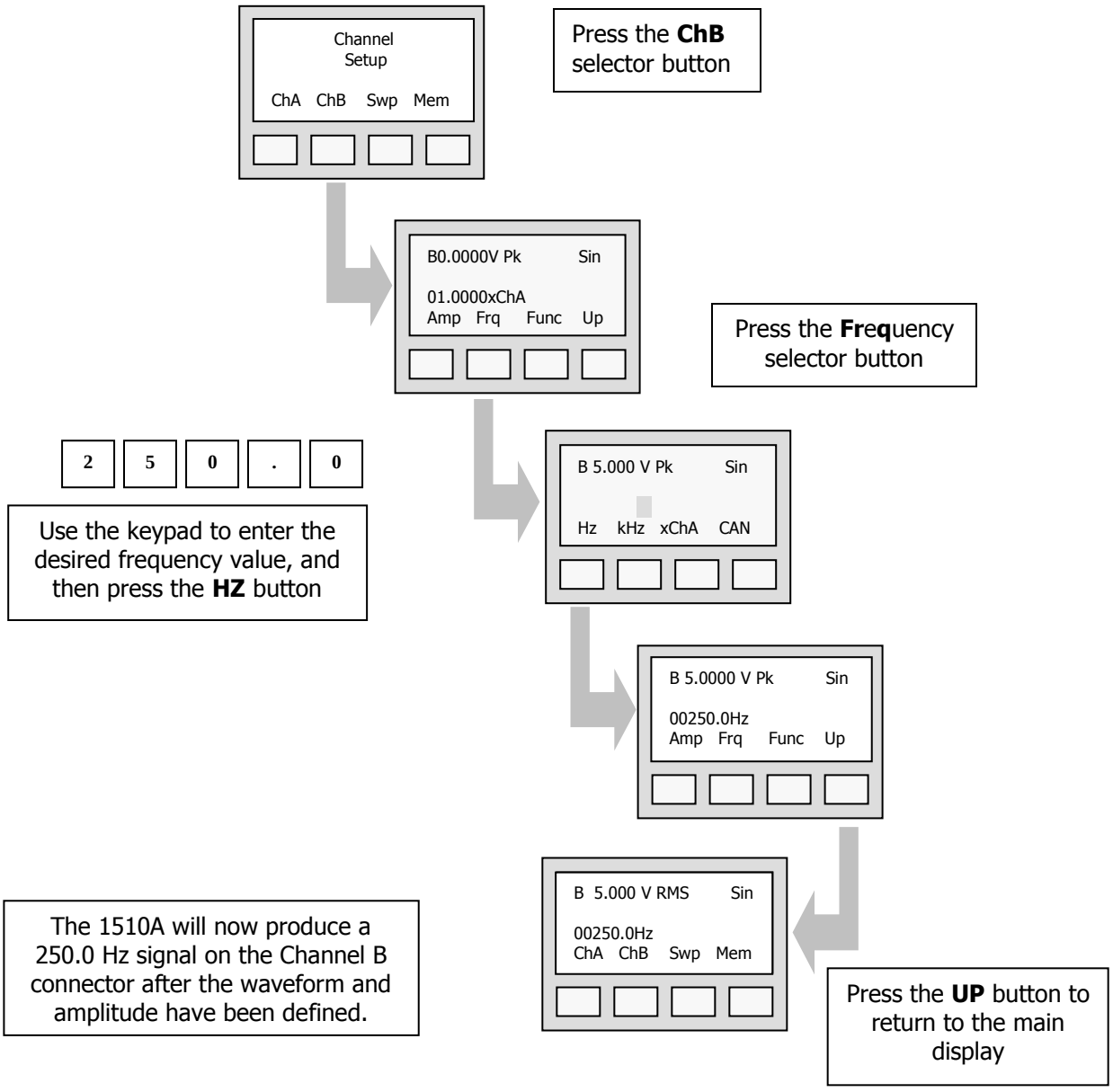
CHANNEL B – VOLTAGE AMPLITUDE SET UP

Channel B of the 1510A may be programmed for either voltage or special speed signals. The following is an example of how to program Channel B to create a 5.000 Volts RMS Sine wave output.



CHANNEL B – FREQUENCY SET UP

The 1510A can produce a signal ranging from 1 Hz to over 50 KHz. To program Channel B to produce a signal of 250Hz, perform the following steps:

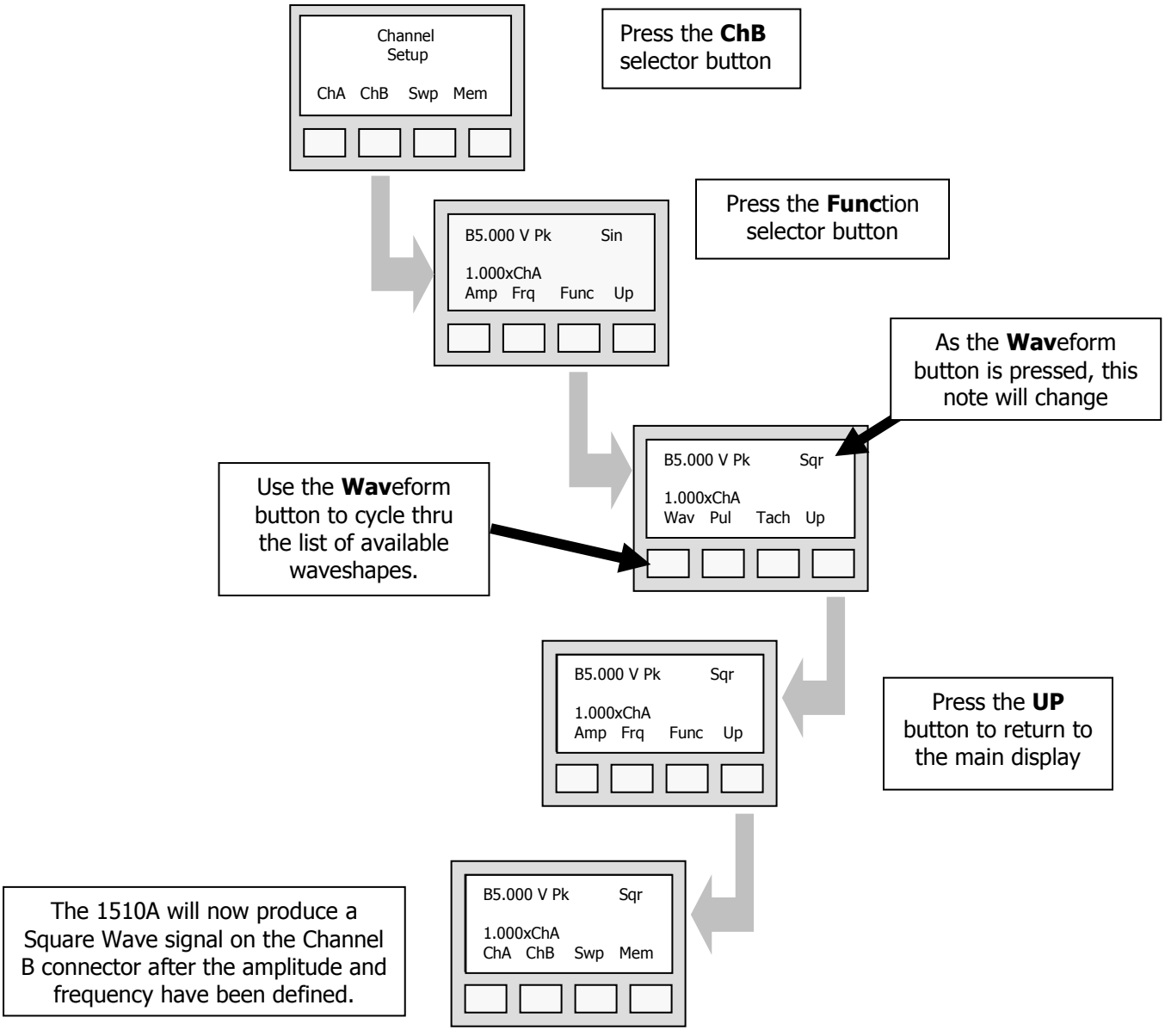


CHANNEL B WAVEFORM FUNCTION SET UP

Channel B of the 1510A can produce either a normal signal waveform, a single pulse at a specific frequency, or it can synthesize complex tachometer signals.

Channel B of the 1510A can be programmed for 1 of four different waveforms in the waveform mode. Sine waves are usually used as calibration signals because they consist of only one frequency component without any harmonics or other frequencies. Square, triangle, and sawtooth shaped waveforms are used to check the bandwidth and frequency response of systems.

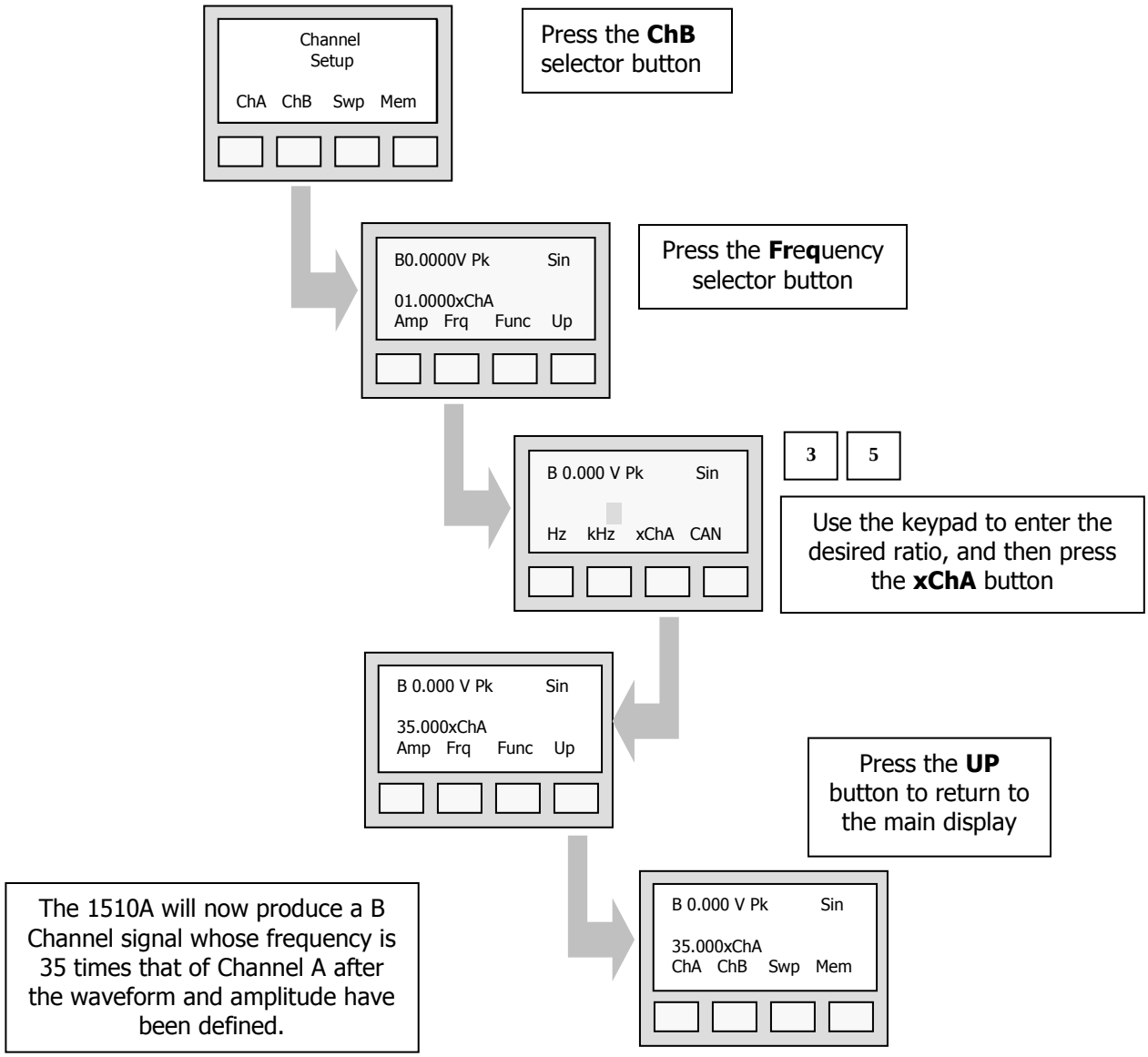
To set Channel B for a SQUARE wave perform the following:



CHANNEL B – RATIO FREQUENCY SET UP

The 1510A can produce a signal on Channel B whose frequency is a RATIO of the Channel A signal frequency. This is useful when trying to simulate one signal on channel B while maintaining a fixed relationship with the frequency of the signal being generated by Channel A. This feature can be very useful when trying to simulate signals from multi-spool machinery.

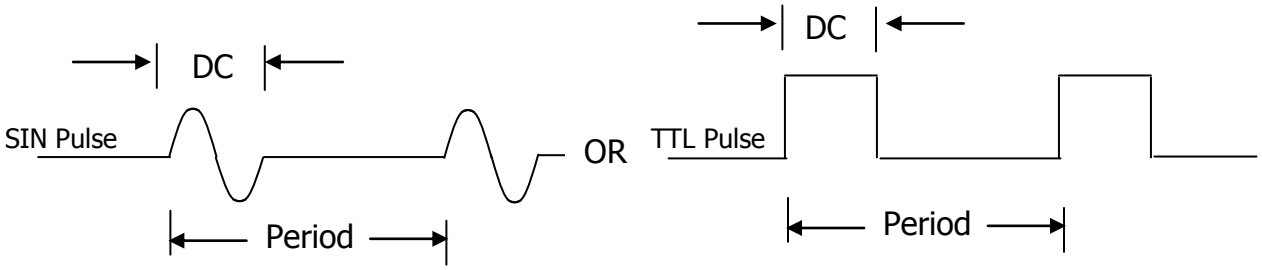
To program Channel B to produce a frequency 35 times that of the Channel A frequency, perform the following steps:



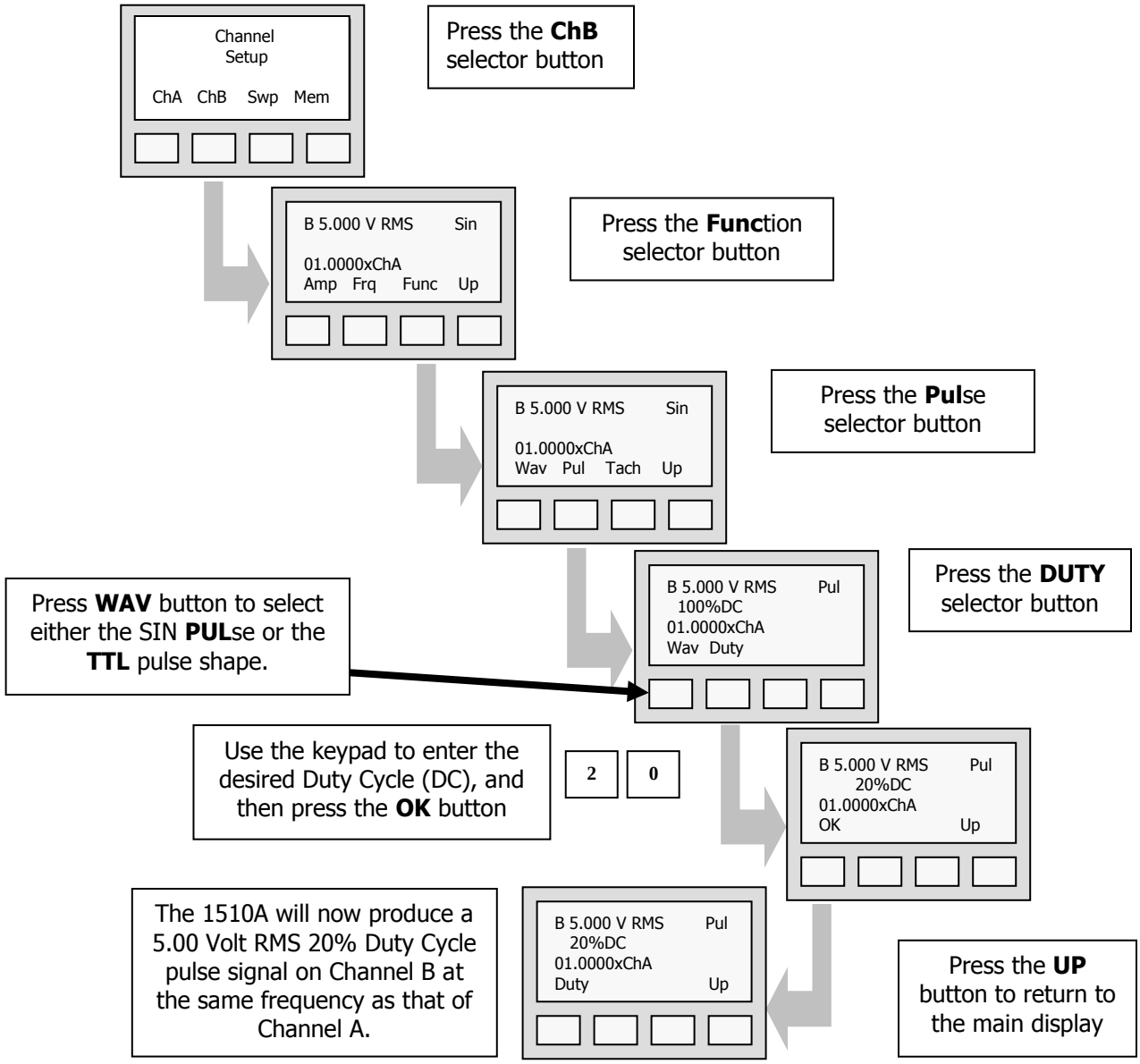
CHANNEL B PULSE SET UP

The 1510A can produce a bi-polar or "TTL" style PULSE function on Channel B which can be used to simulate a "key-phaser" signal, or similar type of machinery speed signal typically used as a once-per-revolution (1/rev) signal.

When programmed, the Channel B pulse signal will appear as illustrated below with a Duty Cycle (**DC**), which is specified as a PERCENTAGE of the period of the signal. The Duty Cycle can range from 5% to 100%.

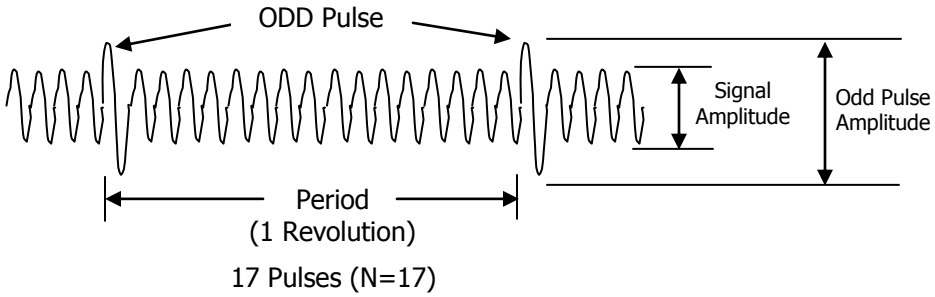


To program a PULSE signal, perform the following steps:

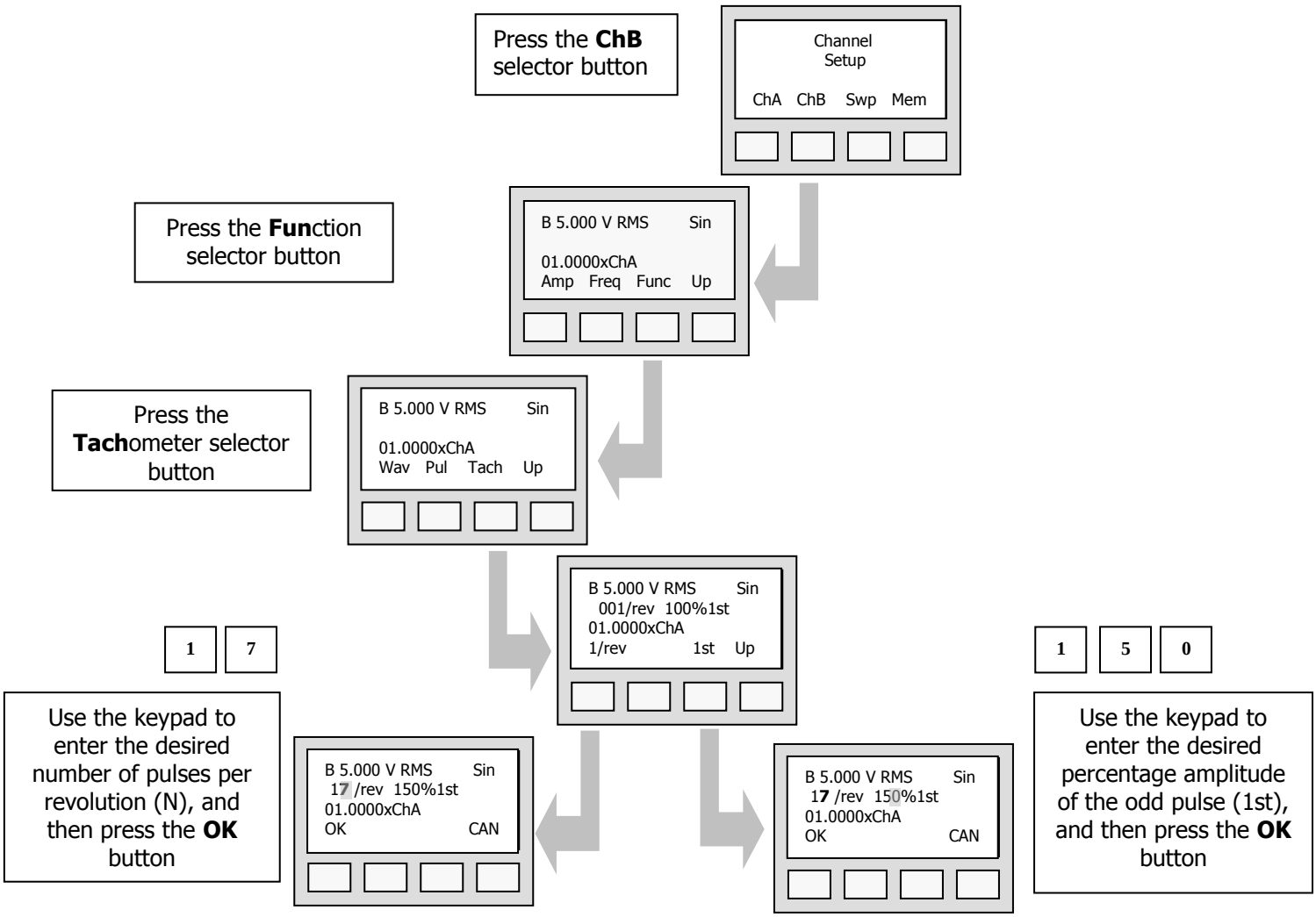


The 1510A can produce an odd-tooth tachometer signal to simulate speed signals with "embedded" 1/revolution pulses which are found on many modern gas turbine engines. The "embedded" of "odd-tooth" signal may be programmed with a larger or a smaller amplitude than the other pulses in the signal.

When programmed, the Channel B pulse signal will appear as illustrated below with a specified number of pulses (**N/REV**olution) and with the size of the first pulse being a percentage of the other pulses.



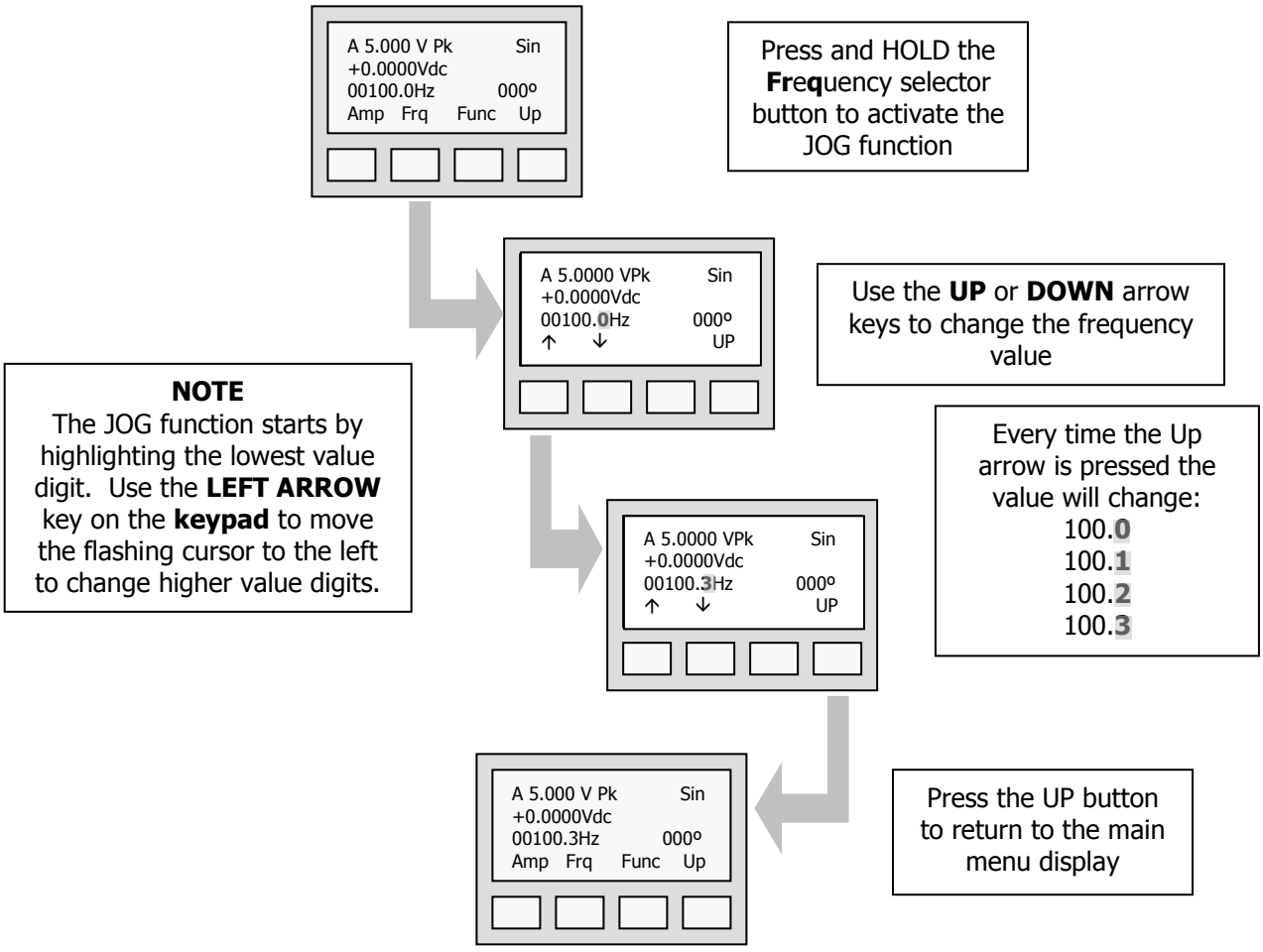
To program a **TACH**ometer signal, perform the following steps:



JOG FUNCTION

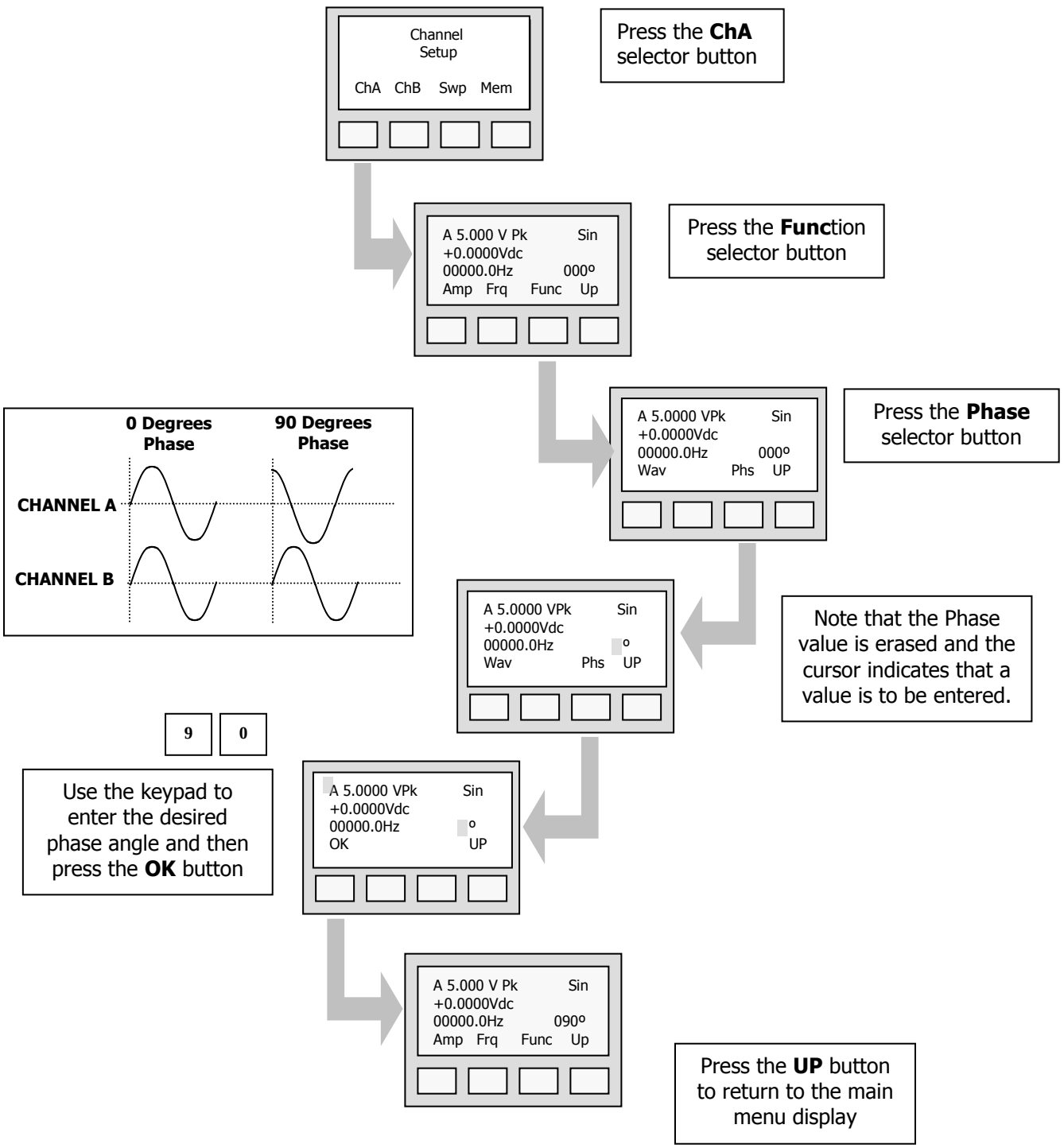
Often, it is desirable to repeatedly change one of the 1510A output values by just a small amount. To make this easy, the 1510A features a **JOG** function where users may repeatedly change a single parameter in small steps.

The following is an example of how to JOG the Channel A frequency setting. This same procedure can be applied to all other output parameters on Channel A of the 1510A.



Often, it is desirable to change the phase relationship between the Channel A and Channel B output signals. To make this easy, the 1510A features a PHASE function available from the Channel A setup page.

The following illustrates how to change the Phase Angle between the Channel A signal and the Channel B signal to 90 degrees. The entered phase value makes Channel A LEAD Channel B by the specified number of degrees.



FREQUENCY SWEEP OPERATION

The 1510A can be programmed to sweep the Channel A output signal between two pre-defined frequencies. This can be used to simulate machinery accelerations and decelerations or to check the frequency response of a device. When programmed, the 1510A will sweep from the Starting Frequency to the Ending Frequency, pause for approximately 2 seconds, and then sweep at the same rate back to the Starting Frequency. This sweeping continues until either the PAUSE or UP buttons are pressed.

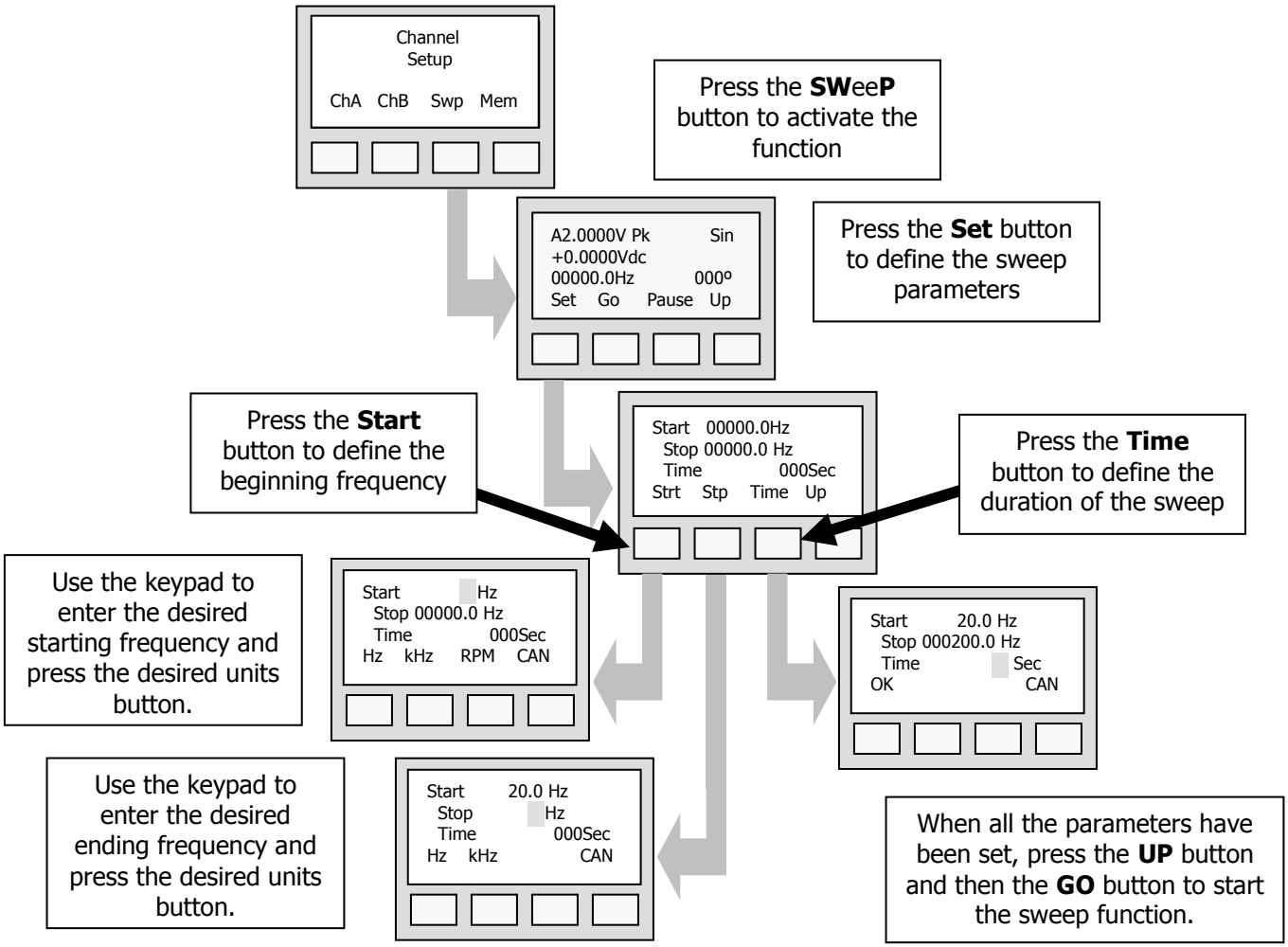
During a Channel A frequency sweep, the Channel B frequency will remain fixed, ***unless*** it has been programmed to be a ratio of Channel A.

Setting the Sweep Range –Three parameters define the sweep:

Starting Frequency - This is the frequency (or speed) at which the sweep will begin. You may enter either a frequency or a speed (rpm).

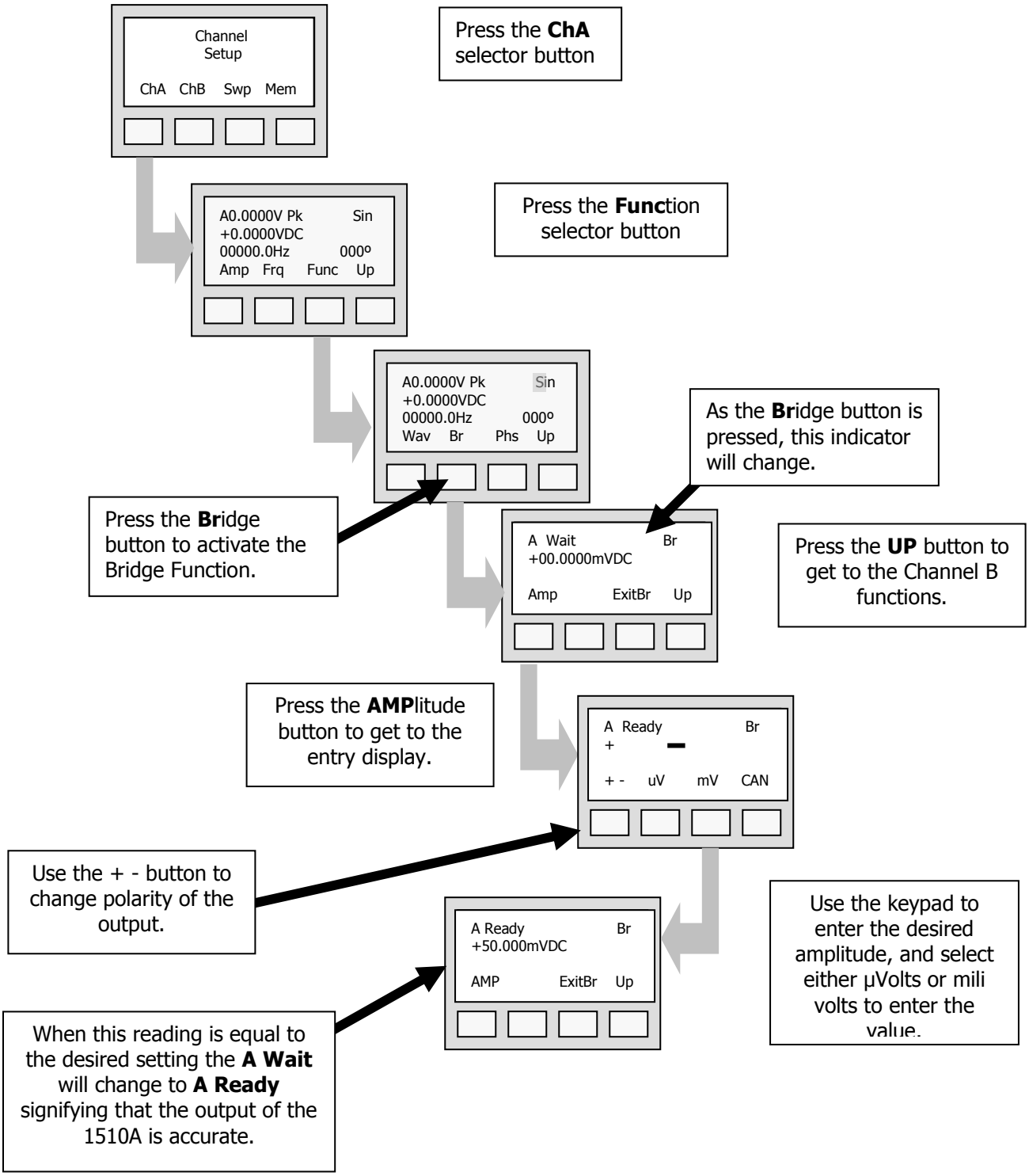
Ending Frequency – This is the frequency (or speed) at which the sweep will stop. To create a simulated deceleration, define the ending frequency to be lower than the starting frequency.

Sweep Duration – This is the length of time the 1510A will take to go from the starting frequency to the ending frequency. The time is entered as seconds. Sweep times of up to 199 seconds are permitted.



The 1510A can be programmed to produce low level DC voltages to simulate those produced by bridge type sensors such as load cells and strain gauges. This function allows users to calibrate measurement systems with high-accuracy low level signals.

The following illustrates how to program the **BRIDGE** function.



BRIDGE FUNCTION - Continued

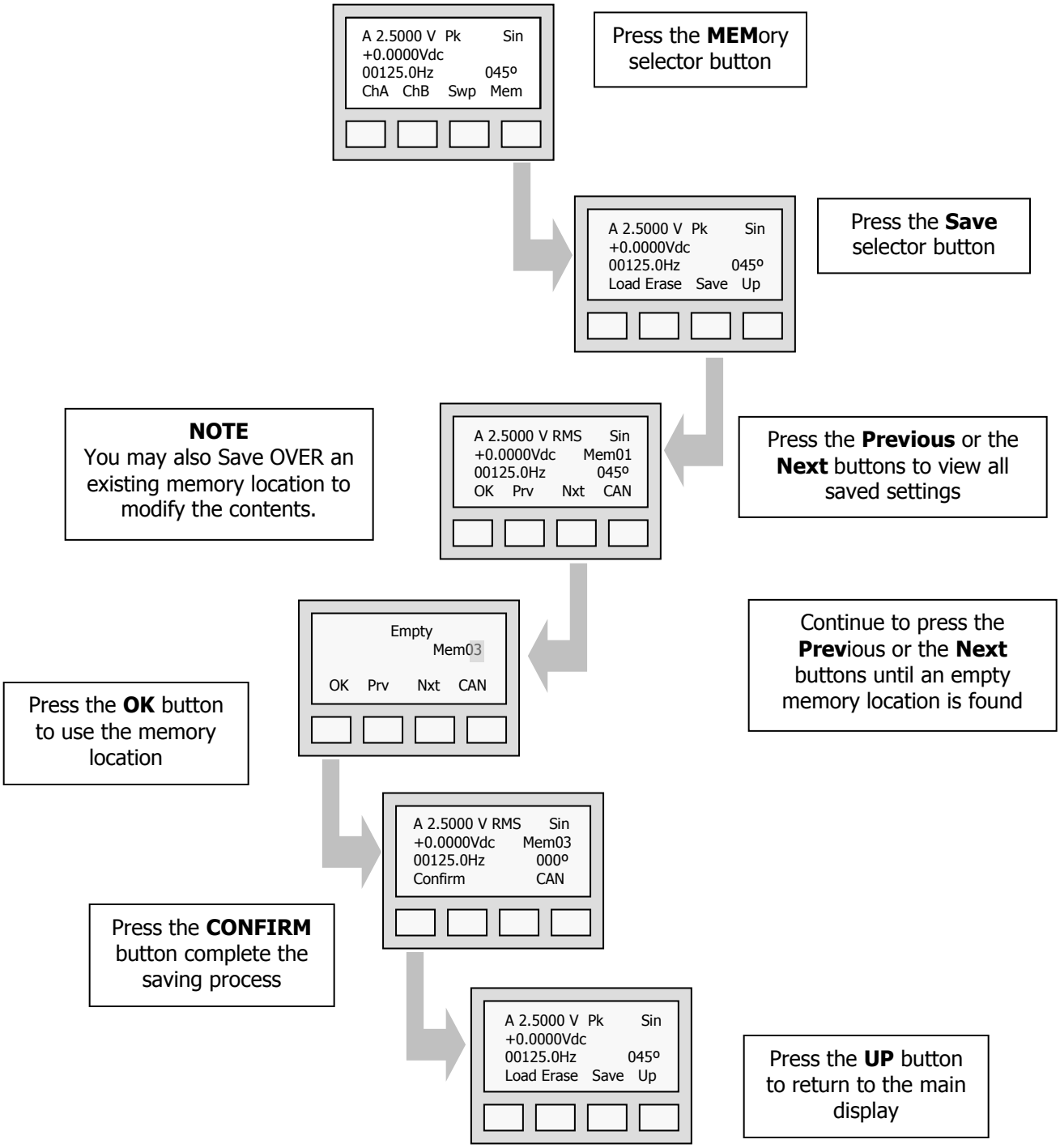
NOTE

For highest accuracy in Bridge Mode, ensure that cables are as short as possible and that no dissimilar metals are used in cables and connectors.

At very low signal amplitudes, dissimilar metals can cause false readings due to galvanic interaction.

The 1510A has 40 memory locations that can be used to save settings. Saving favorite settings can save set-up time and can help to ensure consistency between tests.

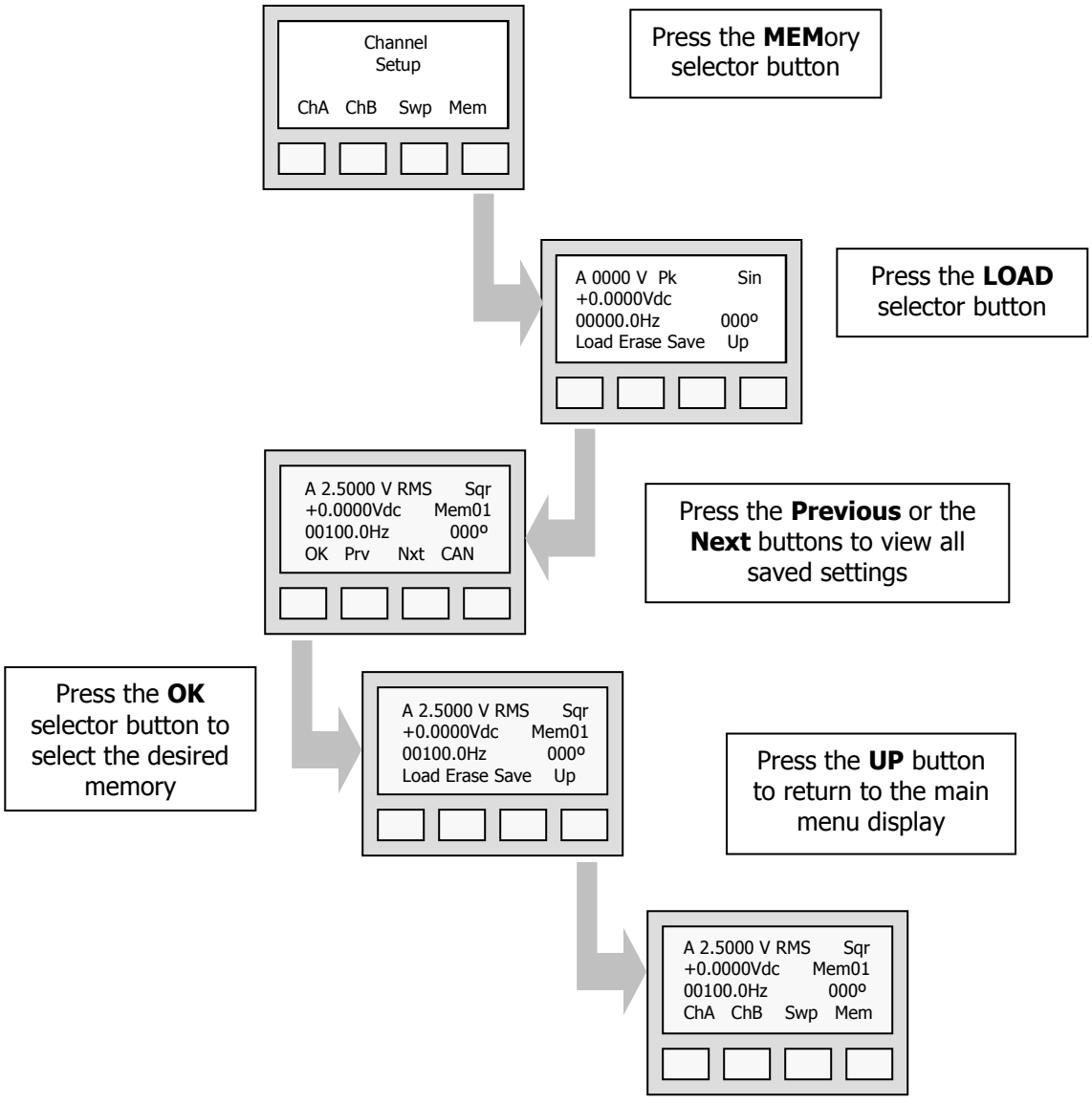
The following is an example of how to save 1510A settings after they have been defined. This same procedure can be use to save different settings in all 40 memories.



RECALLING SETUPS

Any setting that has been saved in one of the 1510A memory locations can be easily recalled. Recalling saved settings of frequently used configurations will save set-up time and will ensure consistency between tests.

The following is an example of how to recall one of the saved settings. This same procedure can be use to recall any settings saved in any of the 40 memories.



CHARGING THE RECHARGEABLE BATTERY

When you receive your 1510A, the batteries may be completely discharged, and may require a recharging to completely bring them up to full capacity. A full charge can be accomplished overnight using the built-in charger.

When fully charged, the 1510A will typically operate for several hours. However, battery life will vary depending upon the type of signals being generated and the loads that are being driven.

When long runs under battery power are anticipated, use the included "fast-charger" and extra set of batteries to keep a set of spares ready for duty.

When under battery power, the 1510A will display the relative condition of the battery state-of-charge in the lower right portion of the display. As illustrated, the symbols indicate:

Fully Charged – The battery has almost 100 % charge remaining 

Half Charged – The battery has almost 50 % charge remaining 

Low Charge – The battery has very little charge remaining 

When the battery conditon becomes very low (about 15 minutes of service remaining), the battery icon will begin to flash indicating that re-charging must begin soon.

To charge the batteries, plug the charging module into a suitable 120/240 VAC outlet. Next insert the charging connector into the charging port located on the side of the 1510A case. Note that there is a hole in the protective yellow case for the charging plug.

You may continue to use the 1510A while the batteries are charging without any compromise in signal quality.

When the charger is connected during use of the 1510A, the "plugged-in" symbol (illustrated below) will be displayed in the lower right hand corner of the display in place of the battery life symbol.

NOTE

The 1510A battery charging circuit constantly monitors and maintains the optimal charge to the battery. Users should however periodically completely drain the battery and recharge, to optimize the battery life.

REPLACING AND DISPOSAL OF THE RECHARGEABLE BATTERY

WARNING

To avoid the potential of electrical shock, remove the 1510A from the battery-charging module and disconnect all test leads prior to replacing the batteries.

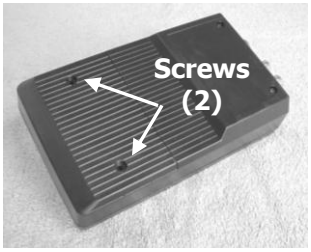
NOTE

The 1510A contains NiMH batteries. Do not dispose of these batteries with other solid waste. Used batteries should be disposed of by a qualified recycler or hazardous material handler.

To replace the batteries perform the following steps:

Disconnect the charger and all test leads from the 1510A.

Locate the battery access panel on the backside of the 1510A. Remove the battery compartment screws.



Lift the battery access cover from the 1510A.

Remove the individual batteries from the compartment.

Install new batteries into the compartment while carefully noting the orientation of the positive (+) terminal of each battery.

Re-install the battery compartment cover, and re-install the screws to secure the cover.

WARNING

Use only the battery type specified and supplied with this unit. Uses of other battery types pose a safety hazard to the operator and the unit.

The 1510A requires very little maintenance. Recalibration is recommended every 12 months.

To maintain the 1510A, periodic cleaning of the keys and all accessories is encouraged. A clean cloth dampened with water or a very mild cleaning solution is all that is required to clean the keyboard, case and accessories.

Do not use harsh abrasives or chemicals on the case or keyboard of the unit.

All accessory cables and the battery charger should be checked periodically for signs of insulation abrasion, bent pins, and damaged connectors. Replace or repair all damaged cables.

To maintain the highest level of performance, the 1510A should be calibrated once every 12 months. For highest accuracy, calibration can be accomplished by returning the 1510A to the MTI Instruments factory.

To return the unit to the factory service or for calibration, please call to obtain a Return Authorization Number and then ship the unit to:

MTI Instruments, Inc.
325 Washington Avenue Extension
Albany, NY 12205 USA

SAMPLE PROGRAMMING SETUPS

The 1510A can be used to quickly check the operation of your data acquisition and monitoring system for a number of different types of sensors, machinery and gas turbine engines. The following set-ups are provided as illustrations for setting up the 1510A for different testing and calibration needs.

ACCELEROMETERS – Accelerometers are manufactured in a variety of sensitivities. The following settings will simulate a 1 G or 2 G acceleration signal coming from an accelerometer with a sensitivity of 50pC/G.

	CHANNEL A settings for 1 G signal	**CHANNEL A settings for a 2 G signal**
AMPLITUDE	50 pC Peak	100 pC Peak
FREQUENCY	61.4 Hz	61.4 Hz
FUNCTION	Sine	Sine

If your accelerometer has a 100pC/G sensitivity, your settings would be:

	CHANNEL A settings for a 1 G signal	**CHANNEL A settings for a 2 G signal**
AMPLITUDE	100 pC Peak	200 pC Peak
FREQUENCY	61.4 Hz	61.4 Hz
FUNCTION	Sine	Sine

Note that the frequency of the signal has been set to 61.4 Hz. At this frequency acceleration is equal to velocity. Therefore, monitoring systems displaying vibration in IPS (inches per second) will display either 1 or 2 IPS.

Monitoring systems that display vibration in units of displacement will display approximately 5.18 mils.

VELOCITY SENSORS – Velocity sensors are manufactured in a variety of sensitivities. The following settings will simulate a 1 IPS or 2 IPS velocity signal coming from a sensor with a sensitivity of 135miliVolts/IPS.

	CHANNEL A settings for 1 IPS signal	**CHANNEL A settings for a 2 IPS signal**
AMPLITUDE	0.135 Volts AC Peak	0.270 Volts AC Peak
FREQUENCY	318 Hz	318 Hz
FUNCTION	Sine	Sine

Note that the frequency of the signal has been set to 318 Hz. At this frequency, vibration velocity is equal to displacement. Therefore, monitoring systems displaying vibration in mils will display either 1 or 2 mils peak-to-peak.

JT8D 1,5,7 – This program will simulate an acceleration run with a vibration level of 1.00 Inches per Second of constant vibration for engines that use velocity probes with 135 mV/IPS sensitivities.

Channel A is used as the vibration signal and Channel B is used as the N1 tach-generator speed signal.

	CHANNEL A output	**CHANNEL B output**
AMPLITUDE	0.135 VOLTS AC Peak	5.00 VOLTS: AC P-P
FREQUENCY		0.48928 X Chan A
FUNCTION	Sine	Sine
SWEEP	START – 60Hz (3600rpm) STOP – 143Hz (8600rpm) TIME – 90 SECONDS	

TF34 – This program will simulate a TEMS sensor acceleration run with a vibration level of approximately 1.00 Inches per Second of constant vibration.

Channel A is used as the vibration signal and Channel B is used as the N1 speed signal with an embedded 1/revolution short tooth signal.

	CHANNEL A output	**CHANNEL B output**
AMPLITUDE	0.060 VOLTS AC Peak	5.00 VOLTS: AC P-P
FREQUENCY		TACH 1/REV N=28 1st=75%
FUNCTION	Sine	Sine
SWEEP	START – 60Hz (3600rpm) STOP – 131Hz (7850rpm) TIME – 90 SECONDS	

CF6-50 – This program will simulate an acceleration run with a vibration level of approximately 1.00 G of constant vibration assuming flight rated 50pC/G accelerometers.

Channel A is used as the vibration signal and Channel B is used as the N1 speed signal with an embedded 1/revolution short tooth signal.

	CHANNEL A output	**CHANNEL B output**
AMPLITUDE	50.0 pC Peak	5.0 VOLTS: AC P-P
FREQUENCY		TACH 1/REV N=28 1st=75%
FUNCTION	Sine	Sine
SWEEP	START – 30Hz (3600rpm) STOP – 70Hz (8600rpm) TIME – 90 SECONDS	

SAMPLE PROGRAMMING SETUPS Continued

CFM56-7 – This program will simulate a constant speed of 6000 RPM with a vibration level of 1.00 G of constant vibration assuming 100pC/G sensitivity accelerometers.

Channel A is used as the vibration signal and Channel B is used as the N1 speed signal with an embedded 1/revolution long tooth signal.

	CHANNEL A output	**CHANNEL B output**
AMPLITUDE	100.0 pC Peak	5.0 VOLTS: AC P-P
FREQUENCY	100 Hz (6000 RPM)	TACH 1/REV N=30 1st=125%
FUNCTION	SINE	SINE

PW4000 – This program will simulate a constant speed of 3600 RPM with a constant vibration level of approximately 1.00 G of assuming flight rated 50pC/G sensitivity accelerometers.

Channel A is used as the vibration signal and Channel B is used as the N1 speed signal with an embedded 1/revolution short tooth signal.

	CHANNEL A output	**CHANNEL B output**
AMPLITUDE	50.0 pC Peak	5.0 VOLTS: AC P-P
FREQUENCY	60 Hz (3600 rpm)	TACH 1/REV N=60 1st=75%
FUNCTION	SINE	SINE

LM2500 – This program will simulate a steady state running speed of 3600 RPM with a constant vibration level of 2.00 G assuming recommended 50pC/G sensitivity accelerometers are normally used.

Channel A is used as the vibration signal and Channel B is used as the N1 speed signal with a 83 tooth speed sensor target.

	CHANNEL A output	**CHANNEL B output**
AMPLITUDE	50.0 pC Peak	5.0 VOLTS: AC P-P
FREQUENCY	60 Hz (3600 RPM)	83 x ChA
FUNCTION	SINE	Sine

OPTIONAL ACCESSORIES

There are a number of accessories available to compliment your 1510A, and to ease the challenges associated with connecting your calibrator to different cables and connectors. Contact your MTI Instruments representative for more information.

Carrying Case with accessory storage – 1400-4008

Replacement AC Power Adapter – 4000-0022A

Replacement NiMH batteries – 4000-0023-4

BNC to BNC adapter cable – 6000-4005

Differential Charge Output Adapter cable – 7500-7509

Single Ended Charge Output Adapter Cable Set – 6000-4007

Replacement Protective Boot – 7000-7002

USEFUL VIBRATION SIGNAL RELATIONSHIPS

Displacement = Inches peak-to-peak

Velocity = Inches per Second

Acceleration = Inches per Second^2

Frequency = RPM / 60.0

Acceleration (Gs) = Velocity (IPS) at 61.4 Hz

Acceleration (Gs) = Displacement (mils) at 139.9 Hz

Displacement (mils) = Velocity (IPS) at 318.3 Hz

Velocity = 3.14 x Frequency x Displacement

Velocity = 61.44 x Acceleration / Frequency

Displacement = 19.57 x G / Frequency^2

SPECIFICATIONS

Channel A

Waveform: Sine Wave

Voltage Range	
(0.1 Hz to 100 kHz)	0 to 9.9999 Volts pk
Voltage Accuracy (of setting)	
(10mV -10V, 10Hz-20Hz)	0.15%±0.1mV
(10mV -10V, 20Hz-30kHz)	0.05%±0.1mV
(30kHz – 50kHz)	0.07%±0.1mV
(50kHz – 80kHz)	0.08%±0.1mV
(80kHz – 100kHz)	0.10%±0.1mV
Charge Range	
(10 Hz to 100 kHz)	1 to 9,999.9 pC pk
Charge Accuracy (of setting)	
(10pC –10,000pC, 10Hz-30kHz)	0.20%±0.1pC
Resolution (voltage & charge)	0.1mV or 0.1 pC
Level Types	RMS, peak or pk-pk units
Frequency Range	0.1 Hz - 99,999.9 Hz
Distortion	
(10 Hz to 50 kHz)	<0.5%
(50 kHz to 100 kHz)	<3.0%
Frequency Accuracy (of setting)	
(3 Hz to 100 kHz)	±0.005%
Variable phase *(all waveform types)*	0 to 360°

Chan A phase on any waveform type can be synchronized and locked to Chan B phase, at any phase setting 0-360°, Step 1°.

In Sweep mode, Chan A & Chan B can be swept together, preserving phase relationship.

Waveform: Square Wave

Voltage Range	0 to 9.9999 Volts pk
Charge Range	0 to 9,999.9 pC pk
Resolution (voltage & charge)	0.1mV or 0.1 pC
Level Types	RMS, peak or pk-pk units
Frequency Range	0.1 Hz - 20 kHz
Frequency Accuracy (of setting)	
(3 Hz to 100 kHz)	±0.005%
Rise/Fall Time	
(10% - 90%)	≤3.0 µsec.
Asymmetry	Less than 3% at 10 kHz
Overshoot	Less than 2%
Voltage Accuracy (of setting)	0.1% typical, 0.25% max

Waveform: Triangle Wave

Voltage Range	0 to 9.9999 Volts pk
Charge Range	0 to 9,999.9 pC pk
Resolution (voltage & charge)	0.1mV or 0.1 pC
Level Types	RMS, peak or pk-pk units
Frequency Range	0.1 Hz - 20 kHz
Frequency Accuracy (of setting)	
(3 Hz to 100 kHz)	±0.005%
Voltage Accuracy (of setting)	0.1% typical, 0.25% max

Waveform: Saw-Tooth Wave

Voltage Range	0 to 9.9999 Volts pk
Charge Range	0 to 9,999.9 pC pk
Resolution (voltage & charge)	0.1mV or 0.1 pC
Level Types	RMS, peak or pk-pk units
Frequency Range	0.1 Hz - 20 kHz
Frequency Accuracy (of setting)	
(3 Hz to 100 kHz)	±0.005%
Voltage Accuracy (of setting)	0.1% typical, 0.25% max

DC Output (and DC offset)

Voltage Range	±9.9999 VDC
Voltage Accuracy (of setting)	0.05%±0.1mV
Resolution	0.1 mV

DC voltage can be generated alone or simultaneously with AC signal to simulate offsets

Microvolt DC Output – Bridge Mode

Voltage Range	±1 µvolt to ±99.999 mVDC
Voltage Accuracy (of setting)	0.05% ±5 µvolt
Resolution	0.1 µvolt

Bridge mode operates under 24-bit closed-loop control to ensure accuracy for testing of strain gage and other low-level bridge circuits.

Output Connectors

Connector Impedance	50 ohms
Voltage	BNC coaxial
Differential Charge (DE)	MS3102A-10SL-3P
Single-ended Charge (SE)	50 Ohm 10-32 MicroDot coaxial

Channel B

Standard signal types

(for speed synthesizer signals, see next page)

Waveform: Sine Wave

Voltage Range	
(0.1 Hz to 100 kHz)	0 to 9.9999 Volts pk
Voltage Accuracy (of setting)	
(10mV -10V, 10Hz-20Hz)	0.15%±0.1mV
(10mV -10V, 20Hz-30kHz)	0.05%±0.1mV
(30kHz – 50kHz)	0.07%±0.1mV
(50kHz – 80kHz)	0.08%±0.1mV
(80kHz – 100kHz)	0.10%±0.1mV
Resolution	0.1mV
Level Types	RMS, peak or pk-pk units
Frequency Range	0.1 Hz - 99,999.9 Hz

Chan. B frequency can also be set and locked to any ratio of Chan.A. Refer to Speed synthesizer specifications.

Distortion	
(10 Hz to 50 kHz)	<0.5%
(50 kHz to 100 kHz)	<3.0%
Frequency Accuracy (of setting)	
(3 Hz to 100 kHz)	±0.005%
Variable phase *(all waveform types)*	0 to 360°

Chan A phase on any waveform type can be synchronized and locked to Chan B phase, at any phase setting 0-360°, Step 1°.

In Sweep mode, Chan A & Chan B can be swept together, preserving phase relationship.

Waveform: Square Wave

Voltage Range	0 to 9.9999 Volts pk
Charge Range	0 to 9,999.9 pC pk
Resolution (voltage & charge)	0.1mV or 0.1 pC
Level Types	RMS, peak or pk-pk units
Frequency Range	0.1 Hz - 20 kHz
Frequency Accuracy (of setting)	
(3 Hz to 100 kHz)	±0.005%
Rise/Fall Time	
(10% - 90%)	≤3.0 µsec.
Asymmetry	Less than 3% at 10 kHz
Overshoot	Less than 2%
Voltage Accuracy (of setting)	0.1% typical, 0.25% max

Waveform: Triangle Wave

Voltage Range	0 to 9.9999 Volts pk
Charge Range	0 to 9,999.9 pC pk
Resolution (voltage & charge)	0.1mV or 0.1 pC
Level Types	RMS, peak or pk-pk units
Frequency Range	0.1 Hz - 20 kHz
Frequency Accuracy (of setting)	
(3 Hz to 100 kHz)	±0.005%
Voltage Accuracy (of setting)	0.1% typical, 0.25% max

Waveform: Saw-Tooth Wave

Voltage Range	0 to 9.9999 Volts pk
Charge Range	0 to 9,999.9 pC pk
Resolution (voltage & charge)	0.1mV or 0.1 pC
Level Types	RMS, peak or pk-pk units
Frequency Range	0.1 Hz - 20 kHz
Frequency Accuracy (of setting)	
(3 Hz to 100 kHz)	±0.005%
Voltage Accuracy (of setting)	0.1% typical, 0.25% max

Output Connectors

Impedance	50 ohms
Connector	BNC coaxial

Operating range is 0-50°C. Specifications are stated at 25°C under open load conditions, after minimum 30 minute warm-up

Bridge Mode Microvolt DC Signal: accuracy is based on use of RG58/U coaxial cable, 2 ft long, non-RoHS composition. NOTE: Connector metallic dissimilarity can cause false readings at low microvolt signal levels.

Specifications are subject to change without notice.

SPECIFICATIONS (cont'd)

Channel B
Speed Synthesizer Signals

Ratio Speed Signal Function

Signal Type	Sine, Square, Single pulse, Odd Pulse
Signal Range	0 to 9.9999 Volts Pk
Resolution	0.1 mV
Frequency Range (ratio)	0.1 to 100X Chan A frequency, Step 0.1
Units RMS, peak, or pk-pk	

Single Pulse Signal Function

Signal Type	1-cycle sine or ½ cycle square (TTL)
Signal Range	0 to 9.9999 Volts Pk
Resolution	0.1 mV
Pulse Duty Cycle	3% to 100%
Frequency Range (ratio)	0.1x to 100x Ch. A frequency, Step 0.1
Frequency Range (fixed)	1Hz to 100kHz
Units RMS, peak, or pk-pk	

Odd Pulse Signal Function

Odd Pulse Type	Long or Short
Odd Pulse Size	0 to 999% of Base Pulse
Number of Base Pulses between Odd Pulse	1 - 100
Frequency Range (ratio)	0.1x to 100x Ch. A frequency, Step 0.1
Frequency Range (fixed)	1 Hz to 99,999.9 Hz
Range0 to 9.9999 Volts Pk	
Resolution	0.1 mV
Voltage Units	RMS, peak, or pk-pk
Waveform	Sine wave

Sweep Function (Channels A & B)

Sweep time	1 to 999 sec (16.67 min)
Sweep time Step	1 Second
User Controls:	
Set START Frequency	
Set STOP Frequency	
Set SWEEP time (seconds)	
GO	
PAUSE	
CANCEL	
Channels	A alone or A & B together

Chan B can be swept synchronously with Chan A, if Chan B frequency is set to any Ratio of Chan A frequency.
Phase between Chan A and Chan B is preserved during sweep.

Other Features

Controls and features

User Display	Graphical, 128x64 pixel, B&W transflective
LCD white backlight	
Computer Port	USB 1.0 for remote control,
programming, and calibration	
USB-A Connector	
Battery Charger Port	For battery charging and
operation. 115/230VAC power	

Key Pad Functions

Numbers	0 through 9
Function Keys (soft keys)	4
(functions change depending upon operating mode)	
On/Off	Momentary Hold "soft" button
Set-Up Memory	40 locations to save settings for all outputs and functions
Memories (non-volatile)	
Save program setups (any combination of instrument settings)	

Physical Features

Unit Dimensions	7.5"H x 4.25W x 2.25"D (19cm x 11cm x 5.7cm)
Unit Weight	1.8 lb (816 g)
Charger Dimensions	3.5"H x 3.5"W x 3.5"D (11cm x 11cm x 11cm)
Charger Weight	0.4 lb (181 g)
Power	External charger operates from 100/240VAC, 50-60Hz
	Input Current: 400 mA
Charger Output	9 VDC at 1.5 A
	Battery Pack – NiMH, size AA (qty 4), 2500mAH

Operating range is 0-40°C. Specifications are stated at 25°C under open load conditions, after minimum 30 minute warm-up
Bridge Mode Microvolt DC Signal: accuracy is based on use of RG58/U coaxial cable, 60 cm (2 ft) long, non-RoHS composition. NOTE: Connector metallic dissimilarity can cause false readings at low microvolt signal levels.
Specifications are subject to change without notice.

WARRANTY STATEMENT

Seller warrants to the Purchaser that the equipment to be delivered hereunder which is of Seller's own manufacture will be free from defects in material or workmanship. Any parts of the equipment that have been purchased by Seller are warranted only to the extent of the original manufacturer's warranty.

This warranty shall apply only to defects appearing within 1 year from the date of shipment by Seller. If the equipment delivered hereunder does not meet the above warranty, and if the Purchaser promptly notifies Seller, Seller shall thereupon correct any defect, including nonconformance with the Seller's specifications, either at its option, by repairing any defective or damaged parts of the equipment, or by making available at Seller's plant necessary repaired or replacement parts. No allowance will be made for repairs or alterations made by others without Seller's written consent or approval. Seller assumes no responsibility for damage caused by improper installation or by operation in violation of its rated operating condition, intentional or otherwise, or by improper handling or maintenance. The liability of Seller under this warranty (except as to title), or for any loss or damage to the equipment whether the claim is based on contract or negligence, shall not in any case exceed the cost of correcting defects in the equipment during the warranty period. The foregoing shall constitute the exclusive remedy of the purchaser and the exclusive liability of the Seller.

The foregoing warranty is exclusive and in lieu of all warranties, whether written, oral, implied or statutory (except as to title). There are no warranties that extend beyond those expressly stated.

OTHER FINE AVIATION PRODUCTS FROM MTI INSTRUMENTS

Portable Vibration and Balancing System –
The PBS-4100^{+} is a powerful and full function vibration analysis system designed for flightline analysis of gas turbine engines. Trim balancing is fast and easy with the **Balancing Wizard**. Accessories are available for civilian and military engines and aircraft

Test Cell Vibration and Balancing Systems –
The PBS-4100R^{+} is a vibration analysis system designed for vibration analysis of gas turbine engines in a test cell environment. High-speed digital data interfaces allow computer control and data exchange. Accessories are available for all civilian and military engines.

Vibration Analysis for APUs –
The PBS-4100R^{+} LTE is a vibration analysis system designed specifically testing Auxiliary Power Units and gas turbine engines that cannot be balanced. Windows based software allows easy control and analysis of the data. Cable sets and accessories are available to service a wide selection of engine applications.

Tachometer Signal Conditioner –
The TSC-4800A is a complete speed signal conditioning unit capable of working with all types of engine speed signals. Whether testing engines with a long tooth or short tooth embedded N1 signal, engines with older high-voltage tachometer generators, or if testing involves the new offset tooth design, the TSC-4800A will condition all of these types of signals, up to 3 channels (N1, N2, N3).

Charge Amplifiers–
Available in rack mount or rugged NEMA configurations, these units are ideal for amplifying the signals from up to 8 accelerometers

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