Epic Instruments Wavesaver 10 Transient Waveform Recorder Instruction Manual

Contents

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Product Information

Specifications

- **Model**: Wavesaver 10
- **Maximum Real Time Sampling Speed**: 10MHz (100ns)
- **Selectable Sweep Speeds**: 100ns to 80ms
- **External Clock Input**: Yes

Introduction

- The Wavesaver 10 is a high-speed transient analog and digital waveform storage instrument. It is designed to store any analog or digital waveform at a maximum real-time sampling speed of 10MHz (100ns). The instrument offers flexible selection of recording rates with selectable sweep speeds ranging from 100ns to 80ms. Additionally, the Wavesaver 10 allows for the use of an externally supplied clock to determine the recording rate through its EXT.CLK input.
- Please note that throughout this manual, the name Wavesaver, Wavesaver 10, Wavesaver IOH, and 10 are used interchangeably. They refer to the same instrument in all respects.
- Software is available from Epic Instruments to transform your IBM PC/XT/AT and compatible microcomputers

into waveform analysis tools. Interfacing hardware for connecting the Wavesaver 10 to IBM PCs and IBM clone computers is also available. For more details, please consult Epic Instruments.

Product Usage Instructions

Initial Inspection & Service

Initial Inspection
After unpacking, carefully inspect your Wavesaver 10 for any signs of damage. If there are signs of shipping damage, please inform the carrier immediately. All factory direct shipments are insured for the full value of the instrument. To file a claim, contact Epic Instruments for details. It is recommended to save the shipping container and packing material in case reshipment is necessary in the future.

Factory Service
If you require service, a return authorization number, or technical assistance, please contact Epic Instruments Inc. at (415)5749081 or write to 551-G Foster City Blvd., Foster City, California 94404, U.S.A.

NOTE: Do not return any equipment to the factory for service or any other reason without prior authorization from Epic Instruments Inc. Equipment returned without proper authorization will be rejected upon delivery.

FAQ (Frequently Asked Questions)

- **Q: What is the maximum real-time sampling speed of the Wavesaver 10?**
  A: The Wavesaver 10 has a maximum real-time sampling speed of 10MHz (100ns).
- **Q: What are the selectable sweep speeds of the Wavesaver 10?**
  A: The Wavesaver 10 offers selectable sweep speeds ranging from 100ns to 80ms.
- **Q: Can I use an external clock with the Wavesaver 10 to determine the recording rate?**
  A: Yes, the Wavesaver 10 has an EXT.CLK input that allows you to use any desired externally supplied clock to determine the recording rate.

INITIAL INSPECTION & SERVICE

INITIAL INSPECTION
After unpacking please carefully inspect your Wavesaver 10 for any signs of damage, if there are signs of shipping damage, please inform the carrier immediately. All factory direct (to end-user) shipments are insured for the full value of the instrument: so please call Epic Instruments for details as to filing the claim11 • The shipping container and packing material should be saved in case reshipment is ever necessary.

FACTORY SERVICE
For service, return authorization number, or technical assistance: please call Epic Instruments Inc. at (415)574-9081. Or write us at 551-G Foster City Blvd., Foster City, California 94404: U.S.A.

NOTE
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INTRODUCTION

General Description

- The Wavesaver 10 is a high speed transient analog and digital waveform storage instrument capable of storing any analog or digital waveform at a maximum real time sampling speed of l0Mhz (l00ns).
- Selectable sweep speeds of l00ns to 80ms allows for flexible selection of the recording rate. In addition to the supplied sweep speeds; the EXT.CLK input allows the operator to use any desired externally supplied “clock” to determine the recording rate.
- In the pre-trigger mode of recording, occurrences that happened before the trigger signal can be captured; also, a mixing of post-trigger and pre-trigger information can be captured by using the pre-trigger “1/2” mode of operation. As an added feature, the Wavesaver 10 can be “Armed” and 11
- Triggered” by an externally supplied source. The standard parallel output port allows captured data to be easily accessed by most personal and lab type computers. If a direct hard copy is desired, the
- Wavesaver 10 is capable of driving most popular chart recorders.

NOTE ON OPERATION MANUAL
Note that throughout this manual the name Waves aver, Wavesaver 10, Wavesaver l0H and 10 is used in a random manner, please remember that they are the same instrument in all respects.

SOFTWARE NOTE
Software to transform your IBM PC/XT/AT and compatible microcomputers to perform waveform analysis is available from Epic Instruments. Interfacing hardware from the Wavesaver 10 to the IBM PC’s and IBM clone computers is also available, please consult Epic Instruments for more details.

SPECIFICATIONS

- **Input Impedance** : 1 megohm/18pf. (approx.)
- **Input Voltage Range** : +/- SOmv to +/- 10 volts full scale. (In 1,2,5 steps. 8 ranges).
- **Maximum Input sensitivity** +/- SOmv (lOOmv total).
- **Minimum Input sensitivity** : +/- 10 volts (20v total).
- **Maximum Input voltages** : +/- 50 volts continuous.
- +/- 70 volts transient.
- **Input Coupling** : AC, DC & Ground.
- **Offset Adjustment :** +/- lx Input voltage range setting.
- (“Switched” Zero centering provided).

ANALOG TO DIGITAL CONVERSION

- **Vertical Resolution :** 8 bits (256 steps).
- **A/D Accuracy** : Better than 0.4%.
- **Max. Digitizing rate** : 10 Mhz, lOOns per sample point.
- Converter Technology 8 bit parallel technique (Flash).
- Recording Rates Internal Clock = lOOns to 80ms, (24 ranges).
- Ex ternal Clock = SOns to DC (TTL).
- Clock symmetry = 60/40% or 40/60%.
- **Note**: External clock requires 2x actual sample frequency.

MEMORY

- Memory Size 4096 x 8 (Static Ram).
- **Jitter** : Plus or minus 2 data points at start of record cycle, worst case.

RECORDING MODES

- **Post-Trigger** : Starts recording after receiving a trigger and continues until the 4K x 8 memory is filled.
- Pre-Trigger (ALL) Upon receiving the “ARM” signal, the unit begins the recording cycle: and will continue to record until a trigger is received, and stops. Note that only the last 4096 samples is stored before the trigger occurred, since the depth of the memory is 4096 points.
- Pre-Trigger (1/2) Fills half the memory with information (data) before the trigger and half after the trigger. A mixing of both pre and post trigger data: (2K before the trigger occurred and 2K after).

TRIGGERING

- **Internal** : Preset desired level with 11 Trig-Level 11 potentiometer. Tracks +/- VOLTS attenuator. Selectable positive or negative slope. Range is l x +/VOLTS attenuator.
- **External** : Via rear panel 15 pin “D 11 connector, TTL levels only. Note that the +/- trigger slope selector is also active when this input is used.
- **Manual** : Front panel pushbutton switch.

ABMIBG

- **Manual** : Front panel pushbutton switch.
- **External** : Via rear panel 15 pin 11 D” connector, TTL levels only; active “LOW” pulse required.
- **Auto :** Unit will arm itself after the first display period (one memory dump period} has occurred.
- **Memory Dump Time to** ARM : Internal playback Clock = 10 ms. : External Clock at lOMhz = 410 us.

OSCILLOSCOPE & PLO’I”TER OUTPUTS

- Vertical Output : Min = 0 volts, Max = 8 volts.
    - Most negative = 0 volts (00000000) (O}.
    - Mid scale(Ov) = 4 volts (10000000)(127).
    - Most positive = 8 volts (11111111)(255).
- **Horizontal Output** : Oscilloscope trigger pulse.
- **Plotter** : Analog output rate is slowed to allow the use of mechanical pen plotters; or the data (in analog form) can also be clocked out (single stepped) using an external clock source.

DIGITAL DATA OUTPUTS

1. **8 BIT PARALLEL DATA:** Output is word serial.
2. **EXTERNAL RECORD GATING:** Start/stops recording cycle, TTL levels only; “LOW11 level halts recording.
3. **SYNC IN:** Used usually for synchronizing multiple units, TTL levels only. Active “LOW .. input.
4. **SYNC OUT**: Used usually for synchronizing multiple units, TTL levels only. “LOW” level output pulse.
5. **EXTERNAL ARM:** Duplicates “ARMu pushbutton, TTL levels only. Active LOW input pulse required.

6. **EXTERNAL TRIGGER:** Duplicates TRIGGER11 pushbutton, TTL levels only. Active LOW or HIGH, edge sensitive, determined by +/- Trigger Slope Pushbutton.
7. **EXTERNAL READ CLOCK:** User supplied clock to step data out of Wavesaver (data request), TTL levels only.

GENERAL
Operating Temperature : 35F. to 9SF.

- Power Requirements : (l} 108vac to 125vac
- Fuse Requirements
- Physical Size/Weight
- (2) 216vac to 250vac
    - For ll7vac range use
    - For 220vac range use
    - Length = 11.6 inches.
    - Width = 12.6 inches.
    - Height = 5.5 inches.
    - @ lOW, 50-60Hz.
    - @ lOW, 50-60Hz.
    - 0.25A. 3AG FB.
    - 0.125A. 3AG FB.
- Weight = 5.0 pounds (approx.).

MISCELLANEOUS & GENERAL SAFETY:

- Published specifications apply at 72F. After 30 minutes warmup.
- This Instrument is wired for earth ground via the third (round) prong of the power (AC) plug. Do not bypass or defeat earth grounding by any method.
- Before plugging in" the instrument, please read this manual carefully.
- Maintenance may require the power to be on and with the the plastic cover(s) removed. This should only be performed by qualified personnel aware of electrical hazards.
- The instrument's case is made of high grade ABS plastic, and no exterior maintenance is required except for an occasional cleaning. It is not a "waterproof" enclosure, 11
  so no bathing11 should ever be performed.

OPERATIONS

- The Wavesaver 10 is basically an oscilloscope "add-on" which will give digital storage capabilities to any oscilloscope. Effectively transforming a regular oscilloscope into a high speed digital storage scope: and with the added feature of being able to interface and transfer its captured data to most personal and lab type computers.
- Being a digital instrument, the Wavesaver 10 does have some differences when compared with regular analog storage oscilloscopes. The main difference is that an analog storage scope holds the captured waveform usually by "burning in" the trace onto the CRT itself and the Wavesaver holds the recorded data in its own

digital memory, thus adding the flexibility of being able to extract the information recorded and thereby allowing a more precise examination of the captured data.

- The Wavesaver 10 converts defined sample points of an analog waveform and converts these points into their digital equivalent codes, these codes are then stored in it's internal memory. After the memory is filled, these codes are then reconverted back into their analog equivalents and is then continuously played back on the oscilloscope: thus transforming a regular oscilloscope into a storage scope but with none of the "undesirable" features, such as the blooming11 and "fading" effect that is inherent and common in most analog type storage oscilloscopes.

DITERPRETI.NG THE DISPLAY

With the recommended setup for the oscilloscope (lms per division for the horizontal sweep rate and 2 volts per division vertical deflection): the Wavesaver 10 will display its full 4K x 8 memory on the oscilloscope. With this setup, the full horizontal width and exactly four divisions vertically will be utilized as the display area on the oscilloscope.

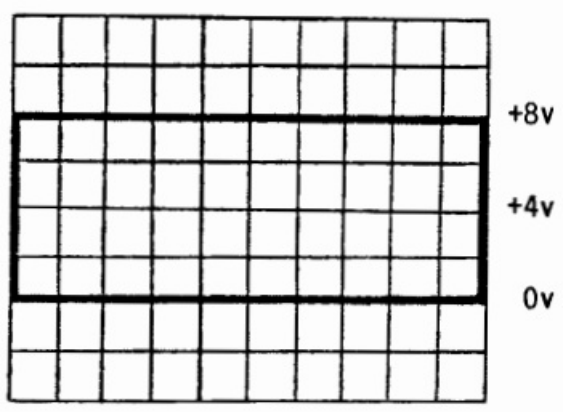


Fig. 3.10 – 1

NOTE

1. Standard Settings. (Display Area)
2. Vertically = 4 div.
3. Horizontally = 10 div.

With these standard settings, the recorded waveform will never exceed the area as shown in Fig 3.10-1. If the input signal exceeds the digitizing range (an overange condition), the waveform displayed will show up as "flat spots" wherever an overload occurs.

WAVEFORM FREQUENCY

- Interpreting the recorded waveform is simple and varies little from reading the display of an ordinary oscilloscope. Always remember that the Wavesaver 10 has a 4K x 8 memory and it samples at defined intervals determined by the Time Per-Point11 switch or a user supplied clock via the "EXT.CLK .. input.
- From this point on, the recommended scope settings of lms per/div horizontally and 2 volts per/div vertically will be used for all examples given; and will be referred to as the "standard settings".
- Remember that the full 4K bytes of memory will be displayed per sweep when the standard settings are used.
- The scope, when used with the Wavesaver 10, is really being used as a display and not used like one would

usually use a scope; as the interpretation of the recorded waveform is really a relationship between the setting of the “TimePerPoint” switch on the Wavesaver 10 when the recording was made, and the 4K bytes of memory. For example: If a recording was made at a TPP setting of lus per point, the duration of the entire memory sweep will be 4096 x lus = 4096us;
or 4.096ms, therefore each of the 10 horizontal divisions on the Scope is 4.096ms/10 = 409.6us or simply 400us wide.

- The chart on the following page shows the relationships between the TPP switch setting, the Horizontal divisions on the oscilloscope and the duration (or complete sweep length) of the 4K bytes of memory for the particular TPP setting. The user should be aware that since over 400 “data points” will be compressed into one scope division, and if the
captured data is closely packed; the user should use the 11 xlO” expansion or the so called “mixed-mode” function avai lable on most oscilloscopes to enable a more precise exami nation of the captured data.

	TIME PER POINT	TOTAL SWEEP TIME	PER SCOPE DIVISION
(1)	100 ns	409.6 us	40.96 us
(2)	200 ns	819.2 us	81.92 us
(3)	400 ns	1.6384 ms	163.84 us
(4)	800 ns	3.2768 ms	327.68 us
(5)	1 us	4.096 ms	409.6 us
(6)	2 us	8.192 ms	819.2 us
(7)	4 us	16.384 ms	1.6384 ms
(8)	8 us	32.786 ms	3.2768 ms
(9)	10 us	40.96 ms	4.96 ms
(10)	20 us	81.92 ms	8.192 ms
(11)	40 us	163.84 ms	16.38 ms
(12)	80 us	327.68 ms	32.768 ms
(13)	100 us	409.6 ms	40.96 ms
(14)	200 us	819.2 ms	81.92 ms
(15)	400 us	1.638 sec	163.84 ms
(16)	800 us	3.277 sec	327.68 ms
(17)	1 ms	4.96 sec	409.6 ms
(18)	2 ms	8.192 sec	819.2 ms
(19)	4 ms	16.384 sec	1.6384 sec
(20)	8 ms	32.768 sec	3.2768 sec
(21)	10 ms	40.96 sec	4.96 sec
(22)	20 ms	81.92 sec	8.192 sec
(23)	40 ms	163.84 sec	16.38 sec
(24)	80 ms	327.68 sec	32.768 sec

Fig. 3.20 – 1

The above chart shows the relationship between the setting of the Time-Per-Point switch and the horizontal divisions on a regular oscilloscope. Note that the normal ten divisions that is on most scope grids is assumed. Also the scope’s variable sweep control is used to compress the entire 4096 bytes into the 10 divisions. The user should always remember that the Wavesaver 10 has a 4Kx8 memory and it samples at defined intervals determined by the setting of the Time-Per-Point switch: therefore the length of each sweep is:

- Length of sweep= 4096 x (setting of TPP switch)
- Example: TPP at 20us.

- Length of sweep = 4096 x 20us = 81.92ms Each scope Div. = 81.92us / 10 = 8.192ms

From the previous explanation and examples one can see that from the timing chart (Fig. 3.20-1); the values of the “Per-Scope-Division” is somewhat difficult to use because of the odd values that is obtained when 4096 bytes of data is being displayed on an oscilloscope with 10 equal horizontal divisions. Therefore we have chosen a display rate of 400Khz or 2.Sus per display point; which, as we will show would enable a much easier interpretation of any time related measurements on an oscilloscope.
A display frequency rate of 2.Sus per sample point with 4096 bytes of data to display is equal to exactly 10.24ms per sweep, and since there are 10 horizontal divisions on the oscilloscope; and the horizontal sweep speed on the oscilloscope is set at lms per division; there will be a “spillover” or over-sweep11 of 0.24ms, which is equal to 96 bytes. Therefore exactly 4000 data points will occupy the 10 horizontal divisions, and 400 data points occupies each division. With exactly 400 points per division, one can visualize that it is much easier to interpret time related measurements. If the last 96 points is of interest, the operator can use the horizontal position control on the scope to move the trace slightly to the left and examine the 96 bytes under a gridded division.
The explanation and Fig.3.20-1 was included for clarity and can be realized if the horizontal sweep of the scope is set for lms per division and if the variable sweep control on the oscilloscope is used to compress the entire sweep of the Wavesaver into the ten grids. But for all practical purposes the scope should be set for lms (calibrated) and the horizontal position control is used to measure the last 96 data points if required.

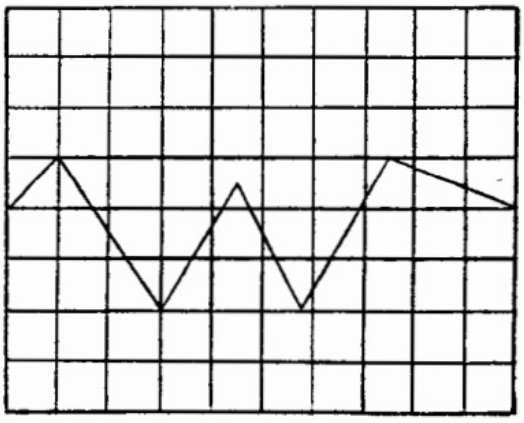
SUMMARY

1. The Wavesaver’s scope output frequency rate is constant at 400Khz, and therefore the total output sweep time is 10.24ms (4K Memory).
2. When the scope is set at lms per/div, an over-sweep of 96 data points exists and 400 data points will occupy each scope division.
3. No matter what TPP setting a waveform was recorded at, the Wavesaver’s scope output rate is always constant at 400Khz.

WAVEFORM VOLTAGE LEVEL:
To measure or read the recorded voltage level, always refer to the setting of the +/-VOLTS switch which it was recorded at. The setting on the oscilloscope has absolutely no relationship to the actual level being displayed. Because, after the data is stored into memory; the digital codes are reconverted back into analog form and tl:\e output of the D/A converter _is constant throughout all the range settings of the +/-VOLTS switch. In other words if a sine wave with a level of +/-2 volts was recorded at the +/-VOLTS setting of +/-2 volts, the sine wave would fill the entire vertical display area on the scope. If one was to measure the exact voltages coming out of the Wavesaver 10, the levels would be a voltage swing of Oto 8 volts. Now take a +/-50 mv sine wave and record it at a setting of +/-50 mv on the Wavesaver 10, the voltage level coming out of the Wavesaver 10 is also 0-8 volts.

In Other Words

1. The analog output of the D/A converter is always fixed at 0-8 volts.
2. The vertical display area on the scope is a ratio of the +/-VOLTS setting on the Wavesaver 10.
3. To read the recorded voltage level(s), the +/-VOLTS switch must be referenced.
4. The oscilloscope’s voltage attenuator has no relation as to the actual level being displayed.
5. The 0-8 volts is always a ratio of the +/-VOLTS switch setting the waveform was recorded at.
6. Switching the +/-VOLTS range on the Wavesaver 10 after the recording cycle has no effect on the output levels.



Wavesaver Setting:-
+/-VOLTS = +/-5 volts

Scope Setting:-
Standard settings.

Waveform:-
Maximum = +2.5 volts
Minimum = -5.0 volts

CON'CLUSIOII

- To measure/read the recorded level, always refer to the "level" it was recorded at, changing the setting on the +/VOLTS switch during the display period would not change the "size" of the displayed waveform. Remember that the level coming out of the Wavesaver 10 is always· Oto 8 volts. Application of voltages greater than the selected range would only result in a "flattening out" of the portion exceeding the level selected. This will not dam age the Wavesaver 10 if the maximum input level speci.fied (+/- 50v} is not exceeded, but should be an indication to the user to select a more appropriate range.
- Note again that the output range is Oto 8 volts, which means that actual "O" level is really an offset level of +4 volts. The settings on the +/-VOLTS attenuator is set for FULL SCALE and is not for each scope division; in other words, if the +/-VOLTS selector is set for +/-2 volts, it means +/-2 volts for all four vertical divisions (0.5 volts per division).

RELATIOII: DIGITALLY

MSB			LSB											
1	1	1	1	1	1	1	1	=	255	=	+8 volts.	(Most	Positive).	
1	0	0	0	0	0	0	0	=	127	=	+4 volts.	("0"	Point).	
0	0	0	0	0	0	0	0	=	0	=	0 volts.	(Most	Negative).	

CONTROL SWITCHES/ INPUTS & OUTPUTS:

FRONT PANEL DESCRIPTIOR

PUSHBUTTON SWITCHES

1. **ALL**/ **1**/2 : Selects between "ALL" Pre-Trigger data or half Pre-Trigger and half Post-Trigger data.
2. **POST**/ **PRE:** Selects either "Post " or "Pre" Trigger.
3. **+** / **–** : Selects either positive or negati ve trigger slope.
4. **INT**/ **EXT** : Selects between Internal or External trigger.
5. **ARM** : Momentary Push swit ch, push to ARM Wavesaver.

6. **TRIG :** Momentary Push swit ch, push to TRIGGER Wavesaver.
7. **AUTO/ MANUAL :** Selects between .. AUT0 11 arming or “MANUAL” arming.
8. **uSEC** / **mSEC :** Selects TIME-PER-POINT rotary swit ch for microsecond or millisecond ranges.
9. **INT.CLK** / **EXT.C LK** : Selects between INTERNAL clock or EXTERNAL clock.
10. **OFFSET/ CENTER :** Select “OFFSET” to enable offset potentiometer, “CENTER” to disable offset potentiometer and zero center scale.

ROTARY SWITCHES

- **TIME PER POINT :** Selects the A/ D’s sampling speed.
- **+/-VOLTS :** Input voltage attenuator, note that s cales are “Full Scale”. Please also note that the level is +/- of setting (eg. The +/-SOmv range is actually +50mv & -50m v which equals lOOm v total}.

TOGGLE SWITCHES

- **POWER :** Supplies AC power to Wavesaver 10.
- **DC /GND /AC** : Selects input signal to be either AC or DC coupled. GND position grounds input circuit for calibration purposes and disconnects the input signal to the Wavesaver 10.

MISCELLANEOUS

- **INPUT (BNC)** : Signal Input Jack.
- **TRIG-LEVEL POTENTIOMETER :** Sets Internal trigger level.
- **OFFSET POTENTIOMETER :** Sets offset level, disable with pushbutton switch “OFFSET/CENTER”.

REAR PANEL DESCRIPTION

Most of the “control” switches is located on the front panel except for the “SCOPE or PLOT” selector toggle switch which is located on the re ar panel. The re ar panel consist mainly of the data interfaces and the “BNC” connectors.

1. **SCOPE/PLOT (toggle switch)** : Selects between either the internal clock for displaying the captured waveform on an oscilloscope. Or if the “PLOT” position is selected; an external clock can be appli ed to drive a peripheral such as a plotter or chart recorder.
2. **EXT.CLK (BNC Connector)** : Input for external “record” or “write ” clock. The maximum input frequency is 20 Mhz and only a TTL signal should be used.
3. **OUTPUT (BNC Connector)** : Vertical (Y) output. Analog output to drive either an oscilloscope or a plotter.
4. **TRI GGER (BNC Connector)** : TTL level output pulse used for triggering the oscilloscope or can be used for sync purposes.
5. **FUSE** : Fuse used depends on AC voltag e. Use a l/2A.FB for 117vac operation or a l/4A.FB for 220vac.
6. **AC POWER :** AC power input, 108vac – 250vac, selectable.
7. DATA CONNECTOR (15 pin “D” connector)
    - Pin (1) = Data out Le ast significant Bit (1) : (LSB) .
    - Pin (2) = Data out – Second data bit. (2) .
    - Pin (3) = Data out Third data bit. (3) .
    - Pin (4) = Data out – Fourth data bit. (4) .

- Pin (5) = Data out Fifth data bit. (5) .
- Pin (6) = Data out Sixth data bit. (6) .
- Pin (7) = Data out Seventh data bit. (7) .
- Pin (8) = Data out – Most Significant Bit (8) : (MSB) .
- Pin (9) = SIGNAL G ROUND.
- Pin (10) = Pin (11) = External Gating:- Starts or stops recording, Starts = HIGH (open), Stops = LOW.
- Pin (12) = Pin (13) = Sync In:- Synchronizing signal. Application of a LOW level resets memory t9 beginning of record position (home). \b"-)·"""""""') … \ -c–"'-'""/J
- Pin (14) = External Trigger Input:-To "trigger" the Wavesaver with an external source. e•? ? —,___ External Read Clock:- External clock to step the stored data out. Usable for both analog and digital output formats. e..-l'.l<!., ? ,_r analog and digital output formats. e..-l'.l<!., ? ,_r Sync Out:- Synchronizing output signal,
  pulsed output signal.
- Pin (15)= External Arm:- A LOW level input arms the Wavesaver.

NOTE
Only TTL level signals should be used with the Wavesaver 10, otherwise damage might result. The minimum and maximum level of the analog "OUTPUT" is from 0-8 volts, if this is to be connected to monitors that only accepts low level inputs, please consult factory. All other outputs of the Wavesaver 10 are TTL level signals.

The 15 pin connector used is a standard 15 Pin type 1 D11 connector which is made by various manufacturers. It's in the same family as the 25 pin "D11 connector used for the RS- 232 interface.

* after trigger, first byte available
after trigger, first + edge strobe: second byte to output port

PREPARATION FOR USE
The wavesaver 10 may be connected to any suitable AC power source ranging from 108vac to 250vac. For display of the recorded waveform, an oscilloscope or CRT waveform monitor with an external trigger input is required.

NOTE:- Two BNC to BNC con necting cor ds (not supplied) is required for hookup to the oscilloscope. A signal probe is also required for input to the Wavesaver.

PLEASE READ TRIS SECTION CAREFULLY BEFORE

APPLYING AC POWER TO THE WAVESAVER 10

1. If this is a fir st time start up, make sure that the AC operating voltage is cor rec t for the location of operation.
2. Make all necessary connection s from the Wavesaver 10 to the oscilloscope. The rear panel BNC marked "OUTPUT" should be connected to the vertical input of the oscilloscope. The rear panel BNC marked " T RIGGER•• should be connected to the external trigger in put of the scope.
3. Set up the oscilloscope as follows:-
   - Horizontal S weep speed at lms per division.
   - Vertical attenuator at 2 volts per division. Note that when the sweep speed is at l ms per/div, the full 4K bytes of memory will be displayed in one sweep. With the vertical at 2 volts per/div, this will yield a full scale deflection of 4 division s on the oscilloscope. Therefore the display a rea will be 10 divisions

horizontally and 4 division s vertically. These are considered the .. stan dard" settings for the Wavesaver 10 an d will be used th roughout this manual.

4. On the Wavesaver 10 use the following positions for the control switches:-
   - ALL/ 1/2 = Don't care, either position.
   - POS T / PRE = POST trigger position.
   - + / – = "+" position.
   - INT / EXT = INT position.
   - AUTO / MAN = AUTO position.
   - uSEC / mSEC = uSEC position.
   - INT / EXT CLK = INT CLK position.
   - OFFSET/CENTER = CENTER position.
   - DC / GND I AC = GND position.
   - TIME PER POINT = 1 uSEC per point position.
   - OFFSET (potentiometer) =Don't care.
   - TRIG-LEVEL (potentiometer) = Mid-Scale.
   - +/- VOLTS = +/- SOmv position.
   - SCOPE / PLOT (Rear Panel) = SCOPE position.
5. Recheck all connections from the Wavesaver 10 to the oscilloscope, and apply AC power to both instruments.
6. When the oscilloscope trace appears. Slowly rotate the TRIG-LEVEL potentiometer left and right from center scale until the Trig-Level L.E.D. begins to blink briefly (this initiates a record cycle). Now center the the trace on the scope on "mid" or 11 0 11 scale.
   This in effect calibrates the scope's trace with the Wavesaver !O's output amplifier.
7. vSwitch "DC / GND / AC" toggle switch to "DC" position.

   NOTES

   Under certain conditions on initial power up, a "scram-bled" display might be visible on the scope's screen, this is a normal condition since the memory of the Wavesaver has not been properly reset after "power-on". To reset the Wavesaver, simply place the "DC / GND / AC" switch to "GND" and put it through a record cycle: this in effect clears the 4K x 8 memory to a 11011 state.

   If the display is "jittery" or unstable, adjust the trigger level on the oscilloscope for a stable display.

OPERATING THE WAVESAVER 10

- The operation of the Wavesaver 10 consists mainly of two different "modes" or functions. One is the "PRE-TRIGGER" mode and the other is the "POST-TRIGGER" mode. They differ mainly in "when" the unit triggers and how the data is stored and displayed. In the Pre-trigger mode, the Wavesaver has the ability to capture data before the trigger occurs. In the Post-trigger mode, the Wavesaver begins to record after detecting the trigger and stops after the 4K memory is filled.
- All the control switches and data/control lines can be utilized in the Pre-trigger mode of operation. In the Post-trigger mode, only the "1/2 / ALL" push switch is not used and is not active in the Post-trigger mode.

Before Continuing

If not done so already, please read the previous sections on the interpretation of the waveform frequency (3.20), voltages (3.30); and also the portion on the explanation of the control switches (4.10 & 4.20) before continuing.

POST-TRIGGER OPERATION

In the Post-trigger mode, the Wavesaver resembles a regular analog storage oscilloscope. The waveform or signal is stored after first detecting the trigger; and in the case of the Wavesaver, the recording terminates after the 4K x 8 memory is filled.

For the following operating example, the following additional equipment is required

1. OSCILLOSCOPE (With External Trigger Input).
2. FUNCTION GENERATOR (With Triangular Output).
3. (BNC to BNC) CORD SETS (Connecting Cords).

Connect one cord set from the vertical output of the Wavesaver to the scope's vertical input channel. Connec t another cord set from the "TRIG"(BNC) output of the Wavesaver to the scope's external trigger input.
The set up for the Wavesaver as desc ribed in section 4.30@(4) must be used for this demonstration. Recheck connections to both instruments and adjust the function generator to supply a triangular waveform at lKhz and an output level of +/-SOmv. If a triangular waveform is unavailable, a sine wave or any other "repetitive" type of waveform can be used, but do not use a squa re wave as it does not demonstrate well the full capabilities of the Wavesaver 10.

1. Set up the Wavesaver, Oscilloscope and function generator as described in the previous paragraphs. Turn all three instruments 0N11 and connect the function generator to the Wavesaver.
2. TIME-PER-POINT selector should be set to supply lus per point. The +/-VOLTS should be set at +/-SOmv full scale.
3. Select signal to be "AC" coupled (DC/GND/AC toggle switch). Trig-Level potentiometer should be set for 11 11 "mid-scale" or 0 position.
4. The "AUTO/MAN" push switch is set at manual (MAN).
5. The Wavesaver 10 is now ready to store waveforms.
6. Depress the ARM pushbutton. The applied signal should now be visible on the CRT of the oscilloscope. If the displayed waveform appears unstable, adjust the triglevel on the scope for a stable display.
7. Change the function generator to output another frequency, depress the ARM switch the new wave-shape should instantly replace the previously recorded waveform.
8. Now put the Wavesaver 10 in the "AUTO" arming mode (AUTO/MAN Pushbutton). The Wavesaver will now toggle between the record and display cycles. Try varying the input frequency, note that the the "AUTO" mode places the Wavesaver in a semi-real-time mode.

Experiment recording different waveforms, frequencies and voltages to get a "feel" in which the Wavesaver 10 functions in the Post-trigger mode. An interesting way is to use an ordinary audio microphone connected to the Wavesaver 10 adjust the T.P.P. for the most appropriate sampling rate that gives the best display on the oscilloscope. Also adjust the +/-VOLTS switch and the TRIG-LEVEL potenti ometer to match the output level of the microphone being used.

NOTE
The user have probably noticed that when the input signal exceeds the range setting of the +/-VOLTS swit ch, either the top or bottom points of the waveform exceeding the range setting will "flatten out11 , this is a normal condition since the Analog to Digital converter in the Wavesaver is at an overload condition.

PRE-TRIGGER OPERATION
The Pre -T rigger function allows the Wavesaver 10 to capture waveforms before the trigger occurs. Functionally

there are two basi c methods or modes the Wavesaver can operate in:

1. The ALL mode and
2. The 1/2 mode. The ALL mode is the utilization of 11 all11 the me mory in the Wavesaver to record data before the 11 trigger 11 o c cu r red.

The 1/2 mode dedicates half the memory for data before the trigger and the other h a lf of the memory for data after the trigger; this, in effect, will yield a recording that. contains data that happened before the trigger and after the trigger. Fo r the following op erating ex ample, the following additional equipment is required:-

1. OSCILL OSCOPE (With External Trigger Input).
2. FUNCTION GENERATOR (With Triangular Output).
3. 3 (BNC to BNC) CORD SETS (Connecting Cords).

Connect one cord set from the verti cal output of the Wavesaver to the scope's verti cal input channel. Connect another cord set from the TRIG11(BNC) output of the Wavesaver to the scope's external trigger input.
The set up for the Wavesaver as described in section 4.30@(4) must be used for this demonstration. Recheck con nections to both instruments and adjust the function generator to supply a triangular waveform at lKhz and an output level of +/-SOmv. If a triangular waveform is unavailable, a sine wave or any other repetitive11 type of waveform can be used, but do not use a square wave as it does not demonstrate well the full capabilities of the Wavesaver 10.

1. Set up the Wavesaver, Oscilloscope and Function Generator as described in the previous paragraphs. Turn all 11 three instruments 0N11 and connect the function generator to the Wavesaver.
2. Select the PRE/POST trigger switch for PRE-TRIGGER.
3. TIME-PER-POINT selector should be set to supply lus per point. The +/-VOLTS selector switch should be set at +/-SOmv full scale.
4. Select input signal to be 11AC11 coupled (DC/GND/AC toggle switch). Trig-level potentiometer should be set for 11mid-scale11 or 11 011 position.
5. The "AUTO/MAN" push switch is set at manual (MAN).
6. The "INT/EXT" push-button should be set for 11 EXT11
7. The "1/2 & ALL" push-button should be set for 11 ALL".
8. Depress the ARM switch, the display as viewed on the oscilloscope should appear to be out of sync, this is normal since the Wavesaver is actually digitizing the input waveform and will continue to do so until it detects a trigger.
9. Depress the manual TRIG push-switch, the recording will immediately stop and the Wavesaver will switch from the record mode to the display mode. Note that the data (waveform) displayed happened before the trigger and that the "trigger II is located on the right (end) of the display. This is the Pre-Trigger 11 ALL" mode. The Wavesaver will remain in the display mode until another ARM signal is received.
10. Try using the microphone and experiment recording dif ferent sounds. Use the INTERNAL TRIGGER and the AUTO ARM feature to make recordings. Try the Pre-Trigger 1/2 mode; it
operates in the same way as the ALL mode and only differs in the way that 2K of memory is used to record Pre-Trigger data and 2K is used to record Post-Trigger information; the 1/2 mode will place the trigger point in the middle of the display, enabling viewing "before" trigger and 1after11 trigger information.

NOTE ON PRE-TRIGGER RECORDDIG

- During Pre-Trigger recording, if the trigger occurs before the entire sweep of the memory; the resulting display might include a certain part of the previ ously recorded waveform. To alleviate this condition, the entire memory should first be “cleared” if the next recording cycle is kno wn to be shorter then the 4K memory length; or if the trigger will present itself before the 4K of me mory is cycled once (written over).
- To erase the memory, simply “ground” the input amplifier on the Wavesaver (DC/GND/AC switch): now place the External Tr igg er switch in the “EXT” position. ARM the Wavesaver, after the “time” (4096 x Setting of TPP switch) have elapsed, the memor y will be complete ly erased. The signal coupling and trigger select switches should be returned to their desired positions after erasing.

INTERFACING WITH A PLOTTER/CHART RECORDER:

The SCOPE/PLOT switch is used to switch the analog output frequency rate between the oscilloscope and the plotter. The difference between the two is that when the oscilloscope (SCOPE) rate is selected, the playback rate is preset at 400Khz. If the Plotter is selected, an external TTL clock must be supplied and used (15 pin D connector, Pin 13) to step the data out of the Wavesaver.
If the plotter being used requires an external initializing signal, the “TRIG-OUT” signal can be used.

USING A LOW CAPACITANCE SIGNAL INPUT PROBE

When the use of a low capacitance probe is necessary. The probe would have to be matched to the input of the Wavesaver.

Proceed as follows

1. A square wave@ lKhz is applied to the low capacitance (10:1) probe which is attached to the input of the Wavesaver.
2. Set the Time-Per-Point switch to display a number of cycles on the oscilloscope. Post-Trigger, Auto Arm, Internal Trigger and DC Coupling should be used.
3. Set the +/-VOLTS selector to match the input signal level being applied (Do not overload). Adjust the probe until the square wave “squares up”.

NOTE

Please note that due to the ”record to display time11 or 11lag-time11 , a probe adjustment made during the “record period11 will not show up until the display period.

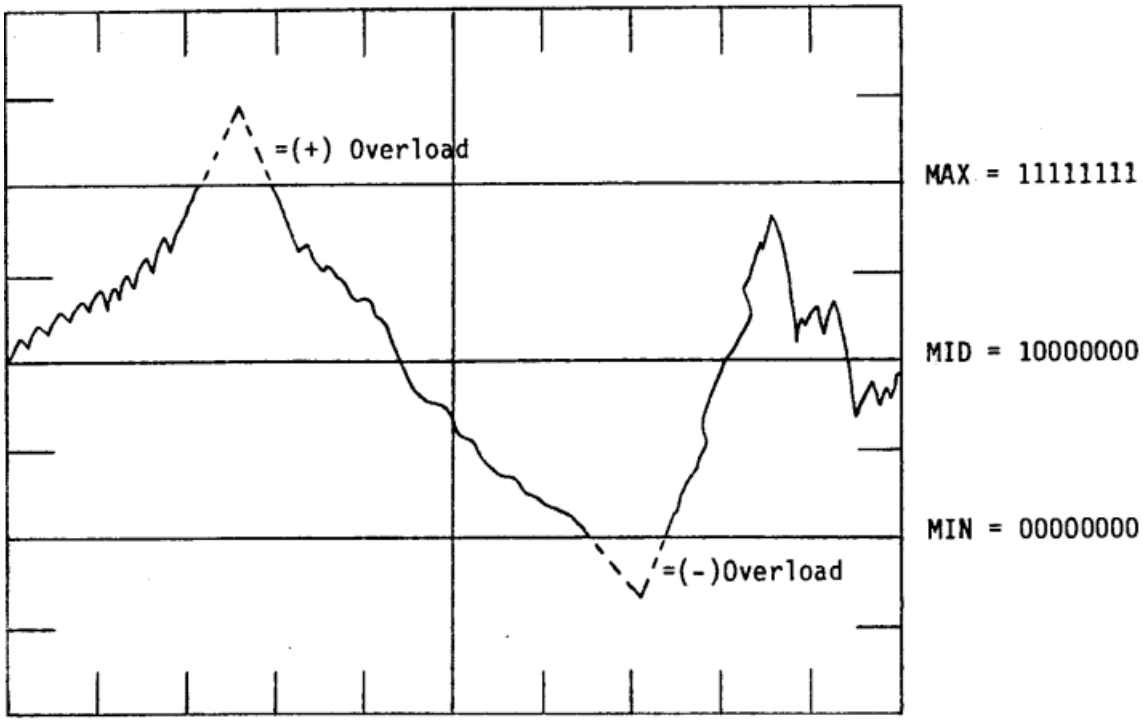
- The Digital Interface allows users of the Wavesaver 10 to extract the digitized waveform in• digital form. It also allows the user to externally ARM, TRIGGER and GATE the Wavesaver. Pins 1 thru 8 are the data output pins with pin 1 being the least significant bit (LSB): and pin 8 the most significant bit (MSB). Pin 9 is the signal ground and should always be connected, otherwise improper data transfer might occur. Pin 10 is the external “GATE” input, if a low level TTL signal is applied to this point, the recording will stop; and will remain in this standby condition until the “Low” is removed or brought “High”.
- Pin 11 is the Sync-In signal and is used for synchronizing multiple uni ts; it can also be used as an input to reset the display to it’s “Starting point” or “Home” position. Pin 12 is the External Trigger input.
- Pin 13 is the External Read Clock, it is used in conjunction with the “Scope/Plot” switch to clock the data out at a user selected rate. Pin 14 is the Sync-Out output pin, the signal is a compliment to the “Trig-Out” BNC connector. Pin 15 is the External Arm input.

Cation

1. All signals to the data connector MUST be TTL levels, otherwise damage will result. Pinslthru 8 & 14 can each drive 10 74Ls loads.
2. If the PLOT function is used, the data output rate will depend on the externally supplied clock.

15 pin "D" Connector Pinouts

- Pin l Thru 8 = Data output Pins.
- Pin 1 = LSB (Least Significant Bit).
- Pin 8 = MSB (Most Significant Bit).
- Pin 9 = Digital Ground .
- Pin 10 = External Gate (Input).
- Pin 11 = Sync-In (Input).
- Pin 12 = External Trigger Input (Input).
- Pin 13 = External Read Clock (Input).
- Pin 14 = Sync-Out (Output).
- Pin 15 = External Arm (Input}.



Note that the above diagram shows that midscale is 10000000, most positive is 11111111 and most negative is 00000000. Be aware that the Wavesaver cannot exceed these ranges. When a positive(+) overload condition occurs, the overload will show up as code 11111111 and a flattening-out of the waveform when viewed with an oscilloscope. A negative overload will have the same effect on the negative side.

IN SUMMARY

MSB LSB

- 1 1 1 1 1 1 1 1 = (255) . Represents most positive point. .
- 1 0 0 0 0 0 0 0 = (127) . Mid-scale . .
- 0 0 0 0 0 0 0 0 = (0) . Represents most negative point.

SUMMARY

1. Only TTL levels are to be used.
2. The External “GATE” allows the recording cycle to be gated (turned on and off during a recording cycle).
3. The SYNC-IN Input (If held in a LOW state) resets the memory counters to their original or “begin” position.
4. The EXTERNAL READ CLOCK is a user supplied signal, and enables the user to clock the data out at any rate up to 6 Mhz. ‘
5. The SYNC-OUT output signal is compliment signal to the TRIG-OUT (BNC) pulse.
6. The EXTERNAL TRIGGER INPUT can be activated by either a positive or negative going TTL pulse, depending on the selection of the “+/- Pushbutton”.
7. The EXTERNAL ARM INPUT triggers on the positive going edge of the pulse.
8. The Sync-In and Sync-Out is usually used for multiple unit operation.

WARRANTY

- Epic Instruments Inc. warrants that its Wavesaver products to be free of defects in materials and workmanship for six months after the date of customer purchase. Epic Instruments will replace, or repair, at its option, any equipment r acce ssories which is found to be defective under this warranty. This warranty does not cover any damage caused by negligence, abuse, tampering or modifications performed by the user or customer.
- To obtain service under this warranty, all products to be repaired must be returned to Epic Instruments or its authorized distributor from which the product was purchased. No product will be accepted for repair or service unless accompanied by a “Return of Merchandise Authorization” number;- which may be obtained by writing or calling Epic Instruments at:-
  551-G Foster City Blvd., Foster City, Ca. 94404. Tel: (415)574-9081

ROTE
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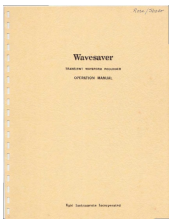
LIPE SUPPORT APPLICATION POLICY

Epic Instruments Inc. does not recommended the use of 11 its Wavesaver products in any Life Support Applications” wherein the failure of the Epic Instruments Inc. products would threaten life or make injury probable. Any user of Epic Instruments Inc. products in association with a life support system must obtain prior written consent based upon the assurance of Epic Instruments Inc. that a malfunction of Epic Instruments Inc. products does not pose direct or indirect threat or injury or death, and even if such consent is given shall indemnify Epic Instruments Inc. from any claim, loss, liability, and related expenses arising from any injury or death resulting f rem the use of Epic Instruments Inc. products in a life support application.

Documents / Resources

	Epic Instruments Wavesaver 10 Transient Waveform Recorder [pdf] Instruction Manual Wavesaver 10 Transient Waveform Recorder, Wavesaver 10, Transient Waveform Recorder, Waveform Recorder, Recorder

References

- User Manual