Tecstar

FGA-2030

30MS/s Arbitrary Waveform // 20MHz Programmable/
Function Generator

INSTRUCTION MANUAL
Introduction

The FGA-2030 is a microprocessor controlled programmable arbitrary function generator providing a full featured, accurate generator in compact low cost instrument. The design incorporates an LED back light 16x2 LCD giving clear easily read characters. The main output has wave-shapes of sine, square, triangle, DC and Arbitrary. The output frequency is continuously displayed along with the current edit parameters. As standard an RS-232 interface allowing remote control via a computer. Output has offset, amplitude and symmetry control.

An external input allows for external sweep and modulation (AM and FM). Internal sweep is also provided with a sweep rate of 20mS to 20Seconds with sweep modes logarithmic and linear.

Specification

Frequency
- Frequency: 0.2Hz to 20MHz, in 8 decade ranges
- Frequency range: 10:1 on each decade range
- Readout resolution: 5 digits
- Accuracy: Typically +/-5% plus 10, digits better than +/-10%
- Lock: Typically +/-0.05% plus 2 digits on KHz & MHz ranges

Sine
- Distortion: Typically 2% on KHz ranges
- Linearity: Typically 99% on KHz ranges
- Rise and Fall times: < 25nS
- DC: +/-10V from 50 Ohm

Arbitrary
- Waveforms are generated within the WaveGen software package supplied and downloaded to non-volatile memory within the FGA2030 via a RS232 interface.
- Memory: 256K Word definable in 32K word x 8 memories sections
- Vertical resolution: 12 bits
- Samples clock: 0.4S/s to 30MS/s
- Filter: 10MHz Bessel or None
- Sequence counter: Each waveform memory can be set to cycle 1 to 8K times or continuously.
- Threshold: Rising edge TTL level 1.4V.
- Response time: From +ve edge <= 1 sample clock period
- Input impedance: 1K Ohm/10pF

Offset
- Range: +/- 10V from 50 Ohm, offset plus signal limited to +/-10V(+/-5V into 50 Ohm)
- Resolution: 100mV steps
- Accuracy: +/-10% of setting +/-1 step
- Readout resolution: 100mV

Square
- Rise and Fall times: < 25nS
- DC: +/-10V from 50 Ohm

Distortion: Typically 2% on KHz ranges

Triangle
- Linearity: Typically 99% on KHz ranges
- Rise and Fall times: < 25nS
- DC: +/-10V from 50 Ohm

Symmetry
- Range: 15:85 to 85:15 up to 1MHz
- 40:60 to 60:40 up to 20MHz
- Resolution: 1% steps
- Accuracy: +/-1 step
- Readout resolution: 1%
- Frequency pulling: <2% to 1MHz, <5% to 20MHz

Trigger output
- Pulse width: 1 sample clock period
- Output impedance: 270ohm
- Output level: TTL compatible
- Polarity: +ve

Sweep (internal)
- Programmable: Start frequency, Stop frequency and Rate.

Start:
- Readout resolution: 3 digits
- Accuracy: +/- 10 digit

Stop:
- Readout resolution: 3 digits
- Accuracy: +/- 10 digit

Rate:
- Range: 20mS to 20 secs
- Readout resolution: 3 digits
- Accuracy: +/- 10 digit

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### Mode

**Step load:** Steps may be selected and loaded into the current setup via the keyboard or RS232

**Step store:** The current setup may be stored into a selected step via the keyboard or RS232

**Step store contents:** All user configurable setting.

### Mains requirement

**AC input:** 115V or 230V +/-15% 47 to 63Hz.

**Power consumption:** 25VA max. Installation Category II

### General

**Electrical safety:** Complies with EN61010-1

**EMC:** Complies with EN55011 and EN500082-1

**Environmental:** Indoor use at altitudes to 2000m, Pollution deg. 1

**Operating range:**
- +5°C to +35°C, 20% to 80% RH
- -10°C to 65°C

**Frequency:** DC to 50KHz

**Peak Deviation:**
- Up to range minimum and maximum

**Input sensitivity:** Approximately 0.4V peak-peak for +/-5% of range peak deviation

**AM modulation**

- **Range:** 0 to 100%
- **Frequency:** DC to 50KHz
- **Sensitivity:** Approximately 1V peak-peak for 50% modulation depth with output set to 20V peak-peak

**FM modulation**

- **Range:** Typically 20:1
- **Input sensitivity:** Approximately 0V to 4V for 10:1 sweep
- **Max skew rate:** 0.1V/μS

**External input**

- **Input impedance:** 15K Ohm
- **Max input voltage:** +/-10V

**Sweep function**

### FM modulation

- **Peak Deviation:** Up to range minimum and maximum
- **Frequency:** DC to 50KHz
- **Sensitivity:** Approximately 0.4V peak-peak for +/-5% of range peak deviation

### AM modulation

- **Range:** 0 to 100%
- **Frequency:** DC to 50KHz
- **Sensitivity:** Approximately 1V peak-peak for 50% modulation depth with output set to 20V peak-peak

### Outputs

- **50 Ohm:** 1V to 20V peak-peak in 100mV steps (500mV to 10V pk-pk into 500ohm)
- **-20 dB:** 100mV to 2V peak-peak in 10mV steps (50mV to 1V peak-peak into 500ohm)
- **-40 dB:** 10mV to 200mV peak-peak in 1mV steps (5mV to 100V peak-peak into 500ohm)

**TTL/CMOS:** 1 standard TTL load

### RS232 interface

All instrument functions are accessible via remote control and all measurements can be read via remote control.

- **Baud rate:** 19,200
- **Data bits:** 8
- **Parity:** No parity
- **Stop bits:** 1 Stop bit

### Programmability

- **Steps:** 14 non-volatile programmable steps
EMC

EC Declaration of conformity
We, Tecstar Electronics UK Ltd
1 Nuffield Road
St. Ives
Huntingdon
Cambs PE27 3LX England

declare that the FGA-2030 30MS/s arbitrary function generator meets the intent of the EMC Directive 89/336/EEC and the Low Voltage Directive 73/23/EEC. Compliance was demonstrated by conformance to the following specifications which have been listed in the Official Journal of the European Communities.

EMC

Emissions
EN50081-1 (1992) Generic (Light Industrial) referring to:
a) EN55022 Conducted, Class A
b) EN55022 Radiated, Class A

Immunity
EN50082-1 (1992) Generic (Light Industrial) referring to:
a) EN60801-2 (1993) Electrostatic Discharge
b) IEC801-3 (1984) RF Field
c) IEC801-4 (1988) Fast Transient

Safety

This function generator has been designed to meet the requirements of the EMC Directive 89/336/EEC. Compliance was demonstrated by meeting the test limits of the following standards:

Emissions
EN50081-1 (1992) Generic immunity standard for residential, commercial and light industry. Test methods and limits used were:
- EN55022 Conducted, Class B
- EN55022 Radiated, Class B

Immunity
EN50082-1 (1992) Generic immunity standard for residential, commercial and light industry. Test methods and limits used were:
- IEC801-3 (1984) RF Field, 3 V/m
- IEC801-4 (1988) Fast Transient, 1 kV peak (AC line), 0.5 kV peak (signal lines).

Cautions
To ensure continued compliance with the EMC directive the following precautions should be observed:

- Connect the generator to other equipment using only high quality, double-screened cables.
- After opening the case for any reason ensure that all signal and ground connections are remade correctly before replacing the covers. Always ensure all case screws are correctly refitted and tightened.
- In the event of part replacement becoming necessary, only use components of an identical type, see the Service Manual.
**Safety**

This instrument is Safety Class 1 according to IEC classification and has been designed to meet the requirements of EN61010-1 (Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use). It is an Installation Category II instrument intended for operation from a normal single-phase supply.

This instrument has been tested in accordance with EN61010-1 and has been supplied in a safe condition. This instruction manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the instrument in a safe condition.

This instrument has been designed for indoor use in a Pollution Degree 1 environment (no pollution, or only dry non-conductive pollution) in the temperature range 5°C to 40°C, 20%–80% RH (non-condensing). It may occasionally be subjected to temperatures between -50 and -10°C without degradation of its safety.

Use of this instrument in a manner not specified by these instructions may impair the safety protection provided. Do not operate the instrument outside its rated supply voltages or environmental range. In particular excessive moisture may impair safety.

**WARNING! THIS INSTRUMENT MUST BE EARTHED.**

Any interruption of the mains earth conductor inside or outside the instrument will make the instrument dangerous. Intentional interruption is prohibited. The protective action must not be negated by the use of an extension cord without a protective conductor.

When the instrument is connected to its supply, terminals may be live and opening the covers or removal of parts is likely to expose live parts. The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair.

Any adjustment, maintenance and repair of the opened instrument under voltage shall be avoided as far as possible and, if inevitable, shall be carried out only by a skilled person who is aware of the hazard involved.

If the instrument is clearly defective, has been subject to mechanical damage, excessive moisture or chemical corrosion the safety protection may be impaired and the apparatus should be withdrawn from use and returned for checking and repair.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders are prohibited.

Do not wet the instrument when cleaning it.

The following symbols are used on the instrument and in this manual:

Caution - refer to the accompanying documentation, incorrect operation may damage the instrument.

Terminal connected to chassis ground.

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**Installation**

**Mains operating voltage**

The operating voltage of the instrument is shown on the rear panel. Should it be necessary to change the operating range from 230V to 115V or vice-versa, the transformer links need changing, links L1 and L3 should be fitted for 115V operation and only L2 fitted for 230V operation. Note: safety links L1, L2 and L3 cannot be simultaneously fitted. Follow appropriate diagram below:

**230V operation - primaries in series**

**115V operation - primaries in parallel**

**Mains lead**

⚠️ When a three core mains lead with bare ends is provided it should be connected as follows:

- Brown - Mains live
- Blue - Mains neutral
- Green/yellow - Earth

**WARNING! THIS INSTRUMENT MUST BE EARTHED** Any interruption of the mains earth conductor inside or outside the instrument will make the instrument dangerous. Intentional interruption is prohibited.
Operation

When mains power is applied the unit will enter a standby state. Pressing the OPERATE button will cause the unit to enter normal operation, a second press of OPERATE button will re-enter the standby state.

General editing method

All parameters are changed by use of the rotary control: clockwise rotation to increment and anti-clockwise to decrement. The current changeable parameter is always indicated by an ‘active arrow’ in the display. The rotary control is velocity sensitive such that turning the control fast will increment or decrement in larger amounts whilst slow rotation will increment or decrement in smaller amounts allowing fine control.

Main function control

Frequency
At any time, pressing the FREQUENCY/RANGE button will select the frequency mode, the display will show an active arrow pointing to the frequency readout and the rotary control will enable frequency adjustment.

Range
A second press of the FREQUENCY/RANGE button will select Range edit mode, the display will show an active arrow pointing to the range readout and the rotary control will enable range adjustment.

Offset
When not in a edit level, pressing the OFFSET button will select the offset edit mode, the display will show an active arrow pointing to the offset readout and the rotary control will enable offset adjustment.

Symmetry
When not in a edit level, pressing the SYMMETRY button will select the symmetry edit mode, the display will show an active arrow pointing to the symmetry readout and the rotary control will enable symmetry adjustment.

Amplitude
When not in a edit level, pressing the AMPLITUDE button will select the amplitude edit mode, the display will show an active arrow pointing to the amplitude readout and the rotary control will enable amplitude adjustment.

Function
This allows the output waveform function to be changed between Sine wave, Square wave, Triangle wave, DC and Arbitrary waveform.

Sub function control

Edit
Pressing Edit changes the operation of the buttons: FUNCTION, AMPLITUDE, SYMMETRY and OFFSET. The edit rolls around the sub-functions: CONFIG, SWEEP and back to main mode. Two LED’s indicate the current edit mode. When the Arbitrary function is selected the edit key then rolls around the sub-functions: CONFIG, SWEEP, ARB and back to main mode. Three LED’s indicate the current edit mode

CONFIG level
Allows the input modulation mode to be selected, the attenuation to be set and the output programmable steps to be stored and recalled.

1. AM/FM
In the CONFIG edit level, pressing the FUNCTION button will select the function of the external input, the display will show an active arrow pointing to INPUT: OFF readout and the rotary control will enable the function to be changed between AM, OFF and FM. N.B. The external modulation voltage is summed with the internal control voltages, so boundary limits needs to be considered to ensure the output is within the working frequency and voltage range.

2. Attn
Range
In the CONFIG edit level, pressing the AMPLITUDE button will select the output attenuation, the display will show an active arrow pointing to ATTN: -0dB readout and the rotary control will enable the attenuation to be changed between 0dB, -20dB and -40dB.

A second press of the FREQUENCY/RANGE button will select Range edit mode, the display will show an active arrow pointing to the range readout and the rotary control will enable range adjustment.

3. Load program
In the CONFIG edit level, pressing the SYMMETRY button will select the program load function, the display will show an active arrow pointing to PROG: LOAD nn readout and the rotary control will enable the store number to be changed between 01 and 30. Pressing the LOAD button two times will execute the load function, pressing any other button will cancel the mode. When load is executing the display will fill with dots.

4. Save program
In the CONFIG edit level, pressing the OFFSET button will select the program save function, the display will show an active arrow pointing to PROG: SAVE nn readout and the rotary control will enable the store number to be change between 01 and 30. Pressing the SAVE button two times will execute the save function, pressing any other button will cancel the mode When save is executing the display will fill with dots.

SWEEP level

Allows the internal sweep function to be selected. Sweeping starts from the selected START frequency and stops (and restarts) at the selected STOP frequency. If the start frequency is less than the stop then the sweep will be increasing in frequency and if the start is greater than the stop the sweep will be decreasing in frequency.

N.B. The minimum sweep range is 4 digits.
1. **START**
In the SWEEP edit level, pressing the FUNCTION button will select the sweep start setup, the display will show an active arrow pointing to **START: 00.00MHz** readout and the rotary control will enable the sweep start frequency to be selected.

2. **STOP**
In the SWEEP edit level, pressing the AMPLITUDE button will select the sweep stop setup, the display will show an active arrow pointing to **STOP: 00.00MHz** readout and the rotary control will enable the sweep stop frequency to be selected.

3. **RATE**
In the SWEEP edit level, pressing the SYMMETRY button will select the sweep rate setup, the display will show an active arrow pointing to **RATE: 0.20S** readout and the rotary control will enable the sweep rate to be selected. N.B. The rate will increment in 10mS steps from 20mS to 1Sec and in 1Sec increments from 1Sec to 20Secs.

4. **MODE**
In the SWEEP edit level, pressing the OFFSET button will select the sweep mode setup, the display will show an active arrow pointing to **SWEEP: OFF** readout and the rotary control will enable the sweep mode to be selected.

   (For sweep rates above 1 second the current frequency is displayed. For rates below 1 second the frequency cannot be meaningfully displayed and will therefore show **FREQ: - - - . - - -**)

**ARBITRARY** level

Allows the control of the Arbitrary waveforms.

1. **W•MEM**
In the ARB edit level, pressing the FUNCTION button will select the arbitrary waveform store, the display will show an active arrow pointing to **WAVEFORM: MEM1** readout and the rotary control will enable the waveform memory to be changed selecting memories 1 to 8.

2. **FILTER**
In the ARB edit level, pressing the AMPLITUDE button will select the arbitrary output filter, the display will show an active arrow pointing to **FILTER: OFF** readout and the rotary control will enable the filter to be turned on and off.

3. **COUNT**
In the ARB edit level, pressing the SYMMETRY button will select the loop count function, the display will show an active arrow pointing to **COUNT: 1234** readout and the rotary control will enable the count number to be changed between 01 thru 8190 to continuous.

4. **TRIG**
In the ARB edit level, pressing the OFFSET button will select the program save function, the display will show an active arrow pointing to **TRIG: AUTO** readout and the rotary control will enable the trigger function to be change between AUTO, MANUAL, EXT ARM and EXTERNAL.

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**Trigger modes**

**AUTO**
The selected Waveform is continuously re-triggered automatically providing a continuos run mode.

**MANUAL**
The selected Waveform is triggered only when the TRIG key (OFFSET) is pressed. When triggered the waveform selected will cycle for the number of times set up in the COUNT field.

**EXTERNAL**
The selected Waveform is triggered only when a valid LOW pulse is input to the ‘Ext Trigger input’. When triggered the waveform selected will cycle for the number of times set up in the COUNT field. The input will automatically be re-armed within 100mS for further trigger inputs

**EXT ARM**
The selected Waveform is triggered only when a valid LOW pulse is input to the ‘Ext Trigger input’. When triggered the waveform selected will cycle for the number of times set up in the COUNT field. The input is re-armed when the TRIG button is pressed.

**RS232C Remote Control**

A fixed configuration serial interface is provided allowing for Direct front panel control emulation, Rotary emulation and advanced program store control. A 9-way ‘D’ socket to 9 way ‘D’ plug straight through cable will connect the unit to a PC serial port.

**Commands**

All commands are 7 bit ASCII characters as follows:

- @ ROTARY Decrement by 50 clicks
- A ROTARY Decrement by 1 click
- B Frequency entry
- C KEY (Amplitude)
- D ROTARY Increment by 50 clicks
- E ROTARY Increment by 1 click
- F KEY (Operate)
- G KEY (Symmetry)
- H Increment program step number
- I Decrement program step number
- J KEY (Edit)
- K KEY (Offset)
- L LOAD Program step
- M DEFAULT (see default configuration)
- N KEY (Function)
- O KEY (Frequency)

Following ‘B’ for frequency entry 5 ASCII characters (‘0’ to ‘9’) must be sent to set the required frequency.
Each command needs to be allowed execution time before a new command may be sent, following a default command allow 1 sec before the next command, following any other command allow 20mS. Serial commands may be missed while the unit is in frequency lock.
Default configuration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>10.000KHz</td>
</tr>
<tr>
<td>Range</td>
<td>20KHz</td>
</tr>
<tr>
<td>Function</td>
<td>SIN</td>
</tr>
<tr>
<td>Amplitude</td>
<td>5.0Vpp</td>
</tr>
<tr>
<td>Symmetry</td>
<td>50:50</td>
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<tr>
<td>Offset</td>
<td>0.00V</td>
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<tr>
<td>Input</td>
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</tr>
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<td>Attenuation</td>
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<td>Prog step</td>
<td>01</td>
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<tr>
<td>Sweep start</td>
<td>0.20KHz</td>
</tr>
<tr>
<td>Sweep rate</td>
<td>0.20S</td>
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<tr>
<td>Sweep mode</td>
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<tr>
<td>Waveform</td>
<td>mem 1</td>
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<tr>
<td>Filter</td>
<td>OFF</td>
</tr>
<tr>
<td>Count</td>
<td>0001</td>
</tr>
<tr>
<td>Trig</td>
<td>Auto</td>
</tr>
</tbody>
</table>

Maintenance

The Manufacturers or their agents overseas will provide a repair service for any unit developing a fault. Where owners wish to undertake their own maintenance work this should only be done by skilled personnel in conjunction with the service manual which may be purchased directly from the Manufacturers or their agents overseas.

To remove the unit case upper, use a flat blade screw driver to gently release the latches found in a recess on each side of the case along the top and bottom join.

Cleaning

If the instrument requires cleaning, use a cloth that is only lightly dampened with water or a mild detergent.

WARNING! TO AVOID ELECTRIC SHOCK, OR DAMAGE TO THE INSTRUMENT, NEVER ALLOW WATER TO GET INSIDE THE CASE. TO AVOID DAMAGE TO THE CASE, NEVER CLEAN WITH SOLVENTS.