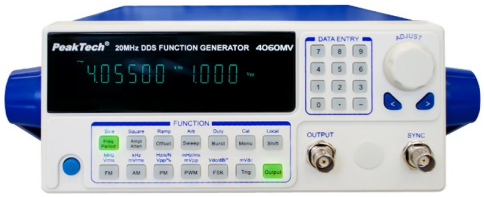
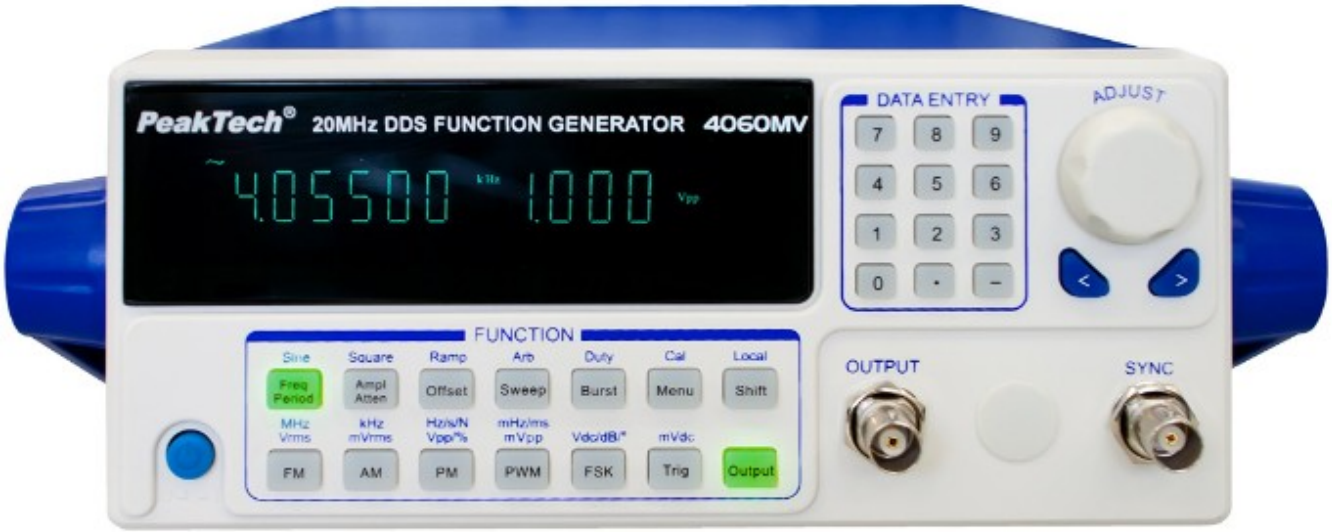


PeakTech 4060 MV DDS Function Generators User Manual

PeakTech®

Unser Wear ist meassbar…..
4060 MV DDS Function Generators
User Manual



PeakTech 4055 MV / 4060 MV MVMV
Operation Manual
DDS Function Generators

Contents

4060 MV DDS Function Generators

Safety Precautions

This product complies with the requirements of the following directives of the European Union for CE conformity: 2014/30/EU (electromagnetic compatibility), 2014/35/EU (low voltage), 2011/65/EU (RoHS).
To ensure safe operation of the equipment and eliminate the danger of serious injury due to short-circuits (arcing), the following safety precautions must be observed.
Damages resulting from failure to observe the safety precautions are exempt from any legal claims whatever.

- Prior to connection of the equipment to the main outlet, check that the available mains voltage corresponds to the voltage setting of the equipment.
- Connect the main plugs of the equipment only to a mains outlet with earth connection.
- Do not exceed the maximum permissible input rating
- Replace a defective fuse only with a fuse of the original rating. Never short-circuit fuse or fuse holding

- Disconnect test leads or probe from the measuring circuit before switching models or functions.
- Check the test leads and probes for faulty insulation or bare wires before connection to the equipment
- Do not cover the ventilation slots of the cabinet to ensure that the air is able to circulate freely inside
- Do not insert metal objects into the equipment by way of the ventilation slots
- Do not place water-filled containers on the equipment (danger of short-circuit in case of know-over the container)
- To avoid electrical shock, do not operate this product in wet or damp conditions. Conduct measuring works only in dry clothing and rubber shoes, i. e. on isolating mats
- Never touch the tips of the test leads or probe
- Comply with warning labels and other info on the equipment
- Do not subject the equipment to direct sunlight or extreme temperatures, humidity or dampness
- Do not subject the equipment to shocks or strong vibrations
- Do not operate the equipment near strong magnetic fields (motors, transformers etc.)
- Keep hot soldering irons or guns away from the equipment
- Allow the equipment to stabilise at room temperature before taking up measurement important for exact measurements)
- Periodically wipe the cabinet with a damp cloth and mid detergent. Do not use abrasives or solvents * The meter is for indoor use only.
- Do not operate the meter before the cabinet has been closed and screwed safely as terminal can carry voltage.
- Do not store the meter in a place of explosive, inflammable substances
- Do not modify the equipment in any way
- Opening the equipment and service- and repair work must only be performed by qualified service personnel
- The instrument must be set up so that the power plug can removed from the socket easily.
- Measuring instruments don’t belong to children hands-

Cleaning the cabinet:
Prior to cleaning the cabinet, withdraw the mains plug from the power outlet. Clean only with a damp, soft cloth and a commercially available mild household cleaner. Ensure that no water gets inside the equipment to prevent possible short and damage to the equipment.

Introduction of PeakTech® DDS Function Generators

With Direct Digital Synthesis Technique (DDS), PeakTech® DDS function generators are of the high performance indexes and numerous function characteristics which are necessary for the fast completion of measuring. The simple and clear front panel design and the display interface of number and indicator light are convenient for the users to operate and observe. Moreover, the extended optional functions enhance the system characteristics.

2.1. Prepare to use

2.1.1. To check the instrument and the accessories

Check whether the instrument and the accessories are complete and unbroken. If the package is badly damaged, please keep it until the instrument passes the performance testing.

2.1.2. Plug in and turn on the function generator

To guarantee the safe operation of the instrument, the following conditions should be achieved.

Voltage:	AC 100-240V
Frequency:	45 – 65 Hz
Power:	< 20VA
Temperature:	0 ~ 40°C
Humidity:	< 80%

WARNING!
In order to ensure the security of the operator, triple- core socket outlet with safe earth-wire must be used.

2.2. Description of Front Panel and Rear Panel

2.2.1. Front Panel:

1. Power switch 2. Function keys 3. Waveform output 4. Sync output	5. Adjusting knob 6. Numeric keys 7. Display screen

2.2.2. Rear Panel:

8. USB device 9. Power Amplifier output 10. Power Amplifier input	11. Trigger input 12. AC power socket

2.3. Screen description

The display screen display two groups of digits, the group on the left with 6 digits shows frequency, period, attenuation, duty cycle and so on of the signals. The four digits on the right show amplitude offset and so on of the signals. There are also letter indicator lights on the display screen, to indicate present waveform signal, parameter options and also units of parameters.

2.4. Keyboard introduction

There are totally 28 keys on the front panel (see front panel picture), the functions of which respectively are:

- 0 1 2 3 4 5 6 7 8 9 keys: Digits inputting key.
- . key: Point inputting key.
- - key: Minus inputting key, press this key to input minus under “offset” option. Press this key to enable or disable the key-tone circularly under other options.
- key: Move the cursor left; delete the input when inputting digits.
- key: Move the cursor right.
- Freq Period key: select frequency and period circularly, disable calibration process when calibrating.
- Ampl Atten key: select amplitude and attenuation circularly.
- Offset key: select offset.
- FM AM PM PWM FSK Sweep Burst key: respectively select and exit FM, AM, PM, PWM, FSK, frequency sweeping and burst function.
- Trigg key: select external trigger under frequency sweeping, FSK modulation and burst function.
- Output key: open and close output signal circularly.
- Shift key: select shift key, return back to keyboard function under remote control state.
- Sine Square Ramp key: shift key, select respectively sinewave, square and ramp three common waveforms.
- Arb key: shift key, select 16 kinds of waveforms with the waveforms sequence number.
- Duty key: shift key, select duty cycle of square and symmetry of ramp.
- Cal key: shift key, select parameter calibration function.

- Unit key: The six keys with unit characters above them on the bottom of the instrument are not shift keys, but double-function keys, press these keys directly to execute the functions marked on themselves; when inputting digits with numeric keys, press these six keys to select the unit of the inputting and end the digits Inputting at the same time.
- Menu key: key for menu, select different options circularly under different functions, see below list:

Options list of menu

Menu	Option
Tone	Phase and version of waveform
Frequency sweeping	Start frequency, end frequency, sweep time, sweep mode
Burst	Period, pulse count, start phase
FM	Modulation frequency, modulation frequency deviation, modulation waveform
AM	Modulation frequency, modulation amplitude depth, modulation waveform
PM	Modulation frequency, phase deviation, modulation waveform
PWM	Modulation frequency, modulation width depth, modulation waveform
FSK	Hop rate, hop frequency
Calibration	Calibration value: zero, offset, amplitude, frequency, amplitude flatness

2.5. Basic operation

The following description will explain the basic operation to meet the usual need of the users. Every user whoever has questions should read the corresponding contents in the chapter 3 of this instruction.

2.5.1 Single frequency function:

Which is default after booting and outputs single frequency signal.

Frequency setting:

Set the frequency value at 3.5 kHz Freq 3 . 5 kHz .

Frequency adjusting:

Press or key to move the cursor, switch the adjusting knob left or right to decrease or increase the digit at the cursor, borrowing from or carry to the former digit continuously. Move the cursor left for coarse adjusting, and right for fine adjusting. The adjusting knob is applicable for adjusting digits of other options too, which will not be described any more.

Period setting:

Set the period as 2.5ms Period 2 . 5 ms .

Amplitude setting:

Set the amplitude as 1.5Vpp Ampl 1 . 5 Vpp .

Attenuation setting:

Set the attenuation as 0dB Auto attenuation is default after booting Atten 0 dB .

Offset setting:

Set DC offset as -1Vdc Offset - 1 Vdc .

Common waveform selection:

Select square (sine is default after booting) Shift Square .

Duty cycle setting:

Set the duty cycle of square as 20% Shift Duty 2 0 % .

Other waveforms selection:

Select exponent waveform (sequence number 16, see sequence number list of 16 kinds of waveforms) Shift Arb 1 2 N

Below content shows the frequency sweeping function. In order to observe and measure, users may set the single frequency signal as sine, with amplitude of 1Vpp and offset of 0V DC.

2.5.2 Frequency sweeping function:
Press Sweep key to output frequency sweeping signal.
Start frequency setting:
Set the start frequency at 5 kHz
Press Menu key to light the “Start” letter, press 5 kHz .
End frequency setting:
Set the end frequency at 2 kHz
Press Menu key to light the “Stop” letter, press 2 kHz .
Sweeping time setting:
Set the sweeping time at 5 s
Press Menu key to light the “Time” letter, press 5 s .
Sweeping mode setting
Set logarithm sweeping mode
Press Menu key, press 1 N .
Trigger sweep setting:
Press Trig key, the sweeping will end when reaching to the end point, each time you press Trig key, the generator trigger sweep once. Press Sweep key again to resume to continuous sweep.
2.5.3. Burst function:
Set continuous frequency as 1kHz.
Burst key, output burst signal.
Repeated period setting:
Set repeated period as 5ms
Menu key, light “Period” character, press 5 ms .
Pulse count setting:
Set pulse count as 1
Menu key, light “Ncyc” character, press 1 N .
Start phase setting:
Set start phase as 180°.
Menu key, light “Phase” character, press 1 8 0 ° .
Trigger burst setting:
Press Trig key to stop the output of burst, then each time you press Trig key, the generator triggers a burst once.
Press Burst key to resume continuous burst.
2.5.4. Frequency modulation function:
Set continuous frequency as 20kHz
FM key, output frequency modulation signal.
Modulation frequency setting: set modulation frequency as 10Hz
Press Menu key to light “Mod_f” character, press 1 0 Hz .
Frequency deviation setting: set frequency deviation as 2kHz.
Press Menu key to light “Devia” character, press 1 kHz .
Modulation waveform setting: set modulation waveform as tri-angle
Press Menu key to light “Shape” character, press 2 N .
2.5.5. Amplitude modulation function:
AM key, output amplitude modulation signal.
Modulation frequency setting:
Set modulation frequency as 1kHz.
Press Menu key to light “Mod_f” character, press 1 kHz .
Modulation amplitude depth setting:
Set modulation amplitude depth as 50 .
Press Menu key to light “Depth” character, then press 5 0 % .
Modulation waveform setting:
Set modulation waveform as sine.
Press Menu key to light “Shape” character, then press 0 N .
2.5.6. Phase modulation function:
PM key, output phase modulation signal.
Modulation frequency setting: set modulation frequency as 10kHz.
Press Menu key to light “Mod_f” character, then press 1 0 kHz .
Phase deviation setting: set phase deviation as 180°.
Press Menu key to light “Phase” character, then press 1 8 0 ° .
Modulation waveform setting: set modulation waveform as square.

Press Menu key to light “Shape” character, then press 1 N .

2.5.7. Pulse width modulation function (PWM):

PWM key, output pulse width modulation signal.

Modulation frequency setting: set modulation frequency as 1Hz

Press Menu key to light “Mod_f” character, then press 1 Hz .

Pulse Width Deviation Setting set pulse width deviation as 80 .

Press Menu key to light “Devia” character, then press 8 0 % .

Modulation waveform setting: set modulation waveform as sine.

Press Menu key to light “Shape” character, and then press 0 N .

2.5.8. Frequency shift keying function (FSK):

Set the waveform as sine.

FSK key, output FSK signal.

Hop rate setting: set hop rate as 1kHz.

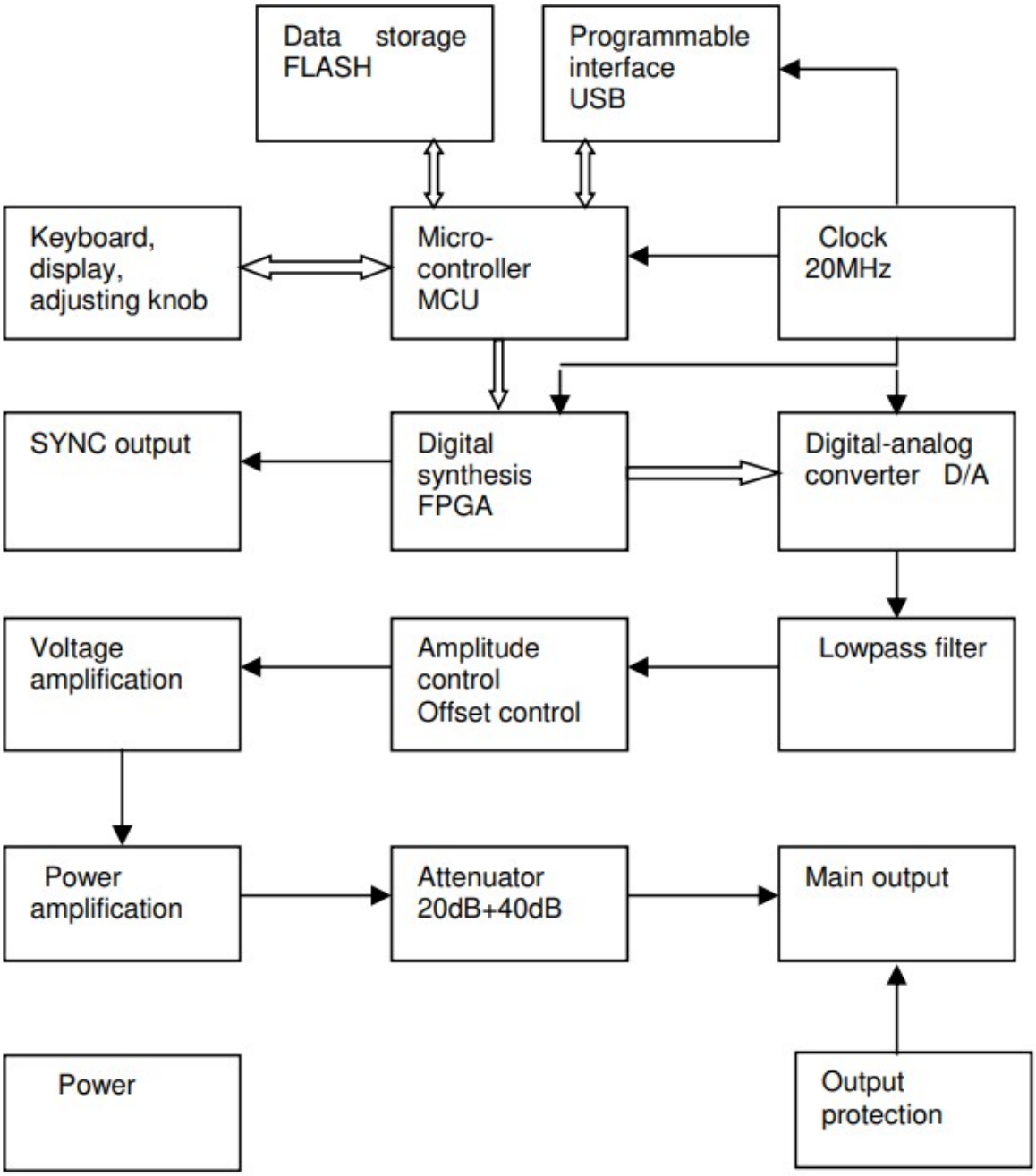
Press Menu key to light “Rate” character, then press 1 kHz .

Hop frequency setting: set hop frequency as 2kHz.

Press Menu key to light “Hop” character, then press 2 kHz .

Principle summarize

3.1. Principle frame



3.2. Working principle of DDS

- To generate a voltage signal, the traditional analogue signal source adopts electronic components as oscillator in different ways. So both frequency accuracy and stability are not high enough. Besides, it is of the disadvantages of complicated technique, low resolution and inconvenient frequency setting and realization of computer control. Direct Digital Synthesize (DDS) technique is a new developing method of generating signals without any oscillator components, by which a series of data stream are generated using digital synthesizing method and then a pre-established analogue signal is generated from digital-analogue converter.
- To generate a sine signal, for example, the function of y=sinx should be digitally quantized first, and then taking x as the address and y as the quantized data to store them into waveform memorizer. DDS uses phase adding technique to control the address of waveform memorizer. Add a phase increment on the present result of phase accumulator in each sampling clock period so as to change the output frequency value by change phase increment. According to the address from the phase accumulator, take the quantized data out from the wave memorizer and then convert it into analog voltage via digit-analog converter and operation amplifier. Since the waveform data are discontinuous sampling, stair sine waveform is output from DDS generator. The included high-level harmonic wave should be filtered by lowpass filter so to output a continuous sine wave. With high accurate reference voltage source in digitanalog converter, the output waveform is if high amplitude accuracy and stability.
- Amplitude controller is a digital-analogue converter. Based on the amplitude value preset by user, it generates a corresponding analogue voltage and then multiplied by the output signal so to guarantee the amplitude of output signal to be the preset value. Offset controller is a digit-analog converter. Based on the offset value preset by user, it generates a corresponding analog voltage and then added with the output signal so to guarantee the offset of output signal to be the preset value.

3.3. Working principle of operation control

- Micro-controller controls the keyboard and display parts with interface circuit, when a key is pressed, the micro-controller recognizes the code of pressed key and executes corresponding command program of thiskey. The display circuit will work to display the instrument’s working state and each parameter.
- Switch the adjusting knob on the panel to change the digit on the cursor position, generating a trigger pulse every 15°rotation. The microprocessor could judge the rotation is left or right, if it is left, the number in the position of cursor will be subtracted by 1; if it is right, the number in the position of cursor will be added by 1 with continuous carry or borrow.

Handling instruction

4.1. General operation rule
4.1.1. Data input:

- Select an option and input with the numeric keys the parameters of this option. The ten digit keys are of the function of inputting data from left to right one by one.
  Point is allowed in this data, but only the first one is valid when more than one points inputted. Under “offset” function, minus may be input. The digit keys input digit to the display area which do not work yet and could be deleted by pressing , or select this option again, to input right one if it is a wrong input, but these must

happen before pressing an unit key. End the digits input and make them valid by pressing an unit key.
- For any input by pressing the point key and the units, the generator will display this input in its own certain form. Such as, the generator displays 1.50000 kHz for both of input of 1.5 kHz and 1500 Hz.

4.1.2. Adjust with the adjusting Knob:

- In actual operations, users may use the adjusting knob to continuously adjust the signal. Press or to move the cursor left or right. Rotate the adjusting knob on the front panel right to add the digit on the cursor position by 1, it can do a carry to the former; rotate the adjusting knob left to subtract the digit on the cursor position by 1, it can borrow digit from the former. The digit adjusted by the adjusting knob works immediately and no need to press unit key. Move the cursor to the left to do rough adjusting by the knob, and to the right to do fine adjusting.

4.1.3. Selecting of inputting means:

- For known data, it is the most convenient to use numeric keys as it can be gotten easily without the generating of transient data no matter how big the change of the data is, which is so important. For the modifying of the entered data or for entering sequence data, it will be more convenient to use the knob. But for a series of equidistant data, using step key will be much more convenient. So user should select neatly according to the different applications.

4.2. Single frequency function

- After booting, the generator enters continuity function automatically, continuity function means the output signal is stable and continuous, of which the waveform, frequency, amplitude and phase will not change along with the time change.

4.2.1. Frequency setting:

- Press Freq key, the light of which will be on, to display present frequency value. Input frequency value with numeric keys or adjusting knob and the signals of this frequency will be output from the output port.

4.2.2. Period setting:

- Press Freq key, the light of “Period” will be on, to display present period value, input period value with numeric keys or adjusting knob. Frequency is synthesized in the internal of the generator, and converted to period when inputting and displaying. Limited by the frequency low resolution, for a comparatively long period, the generator could only output some frequency points with long period interval. Although the setting and displaying period value are accurate, the period of actual output signal may be comparatively different from them, which should be under consideration during operations.

4.2.3. Amplitude setting:

- Press Ampl key, the light of which will be on, to display present amplitude value, input amplitude value with

numeric keys or adjusting knob and the signals of this amplitude will be output from the output port.

- The relation between maximum amplitude and offset value should be below formula, if the setting of amplitude exceeds specification, the generator will modify it until it is within the range of allowed maximum amplitude value.

Vpp≤2× (10-|offset|)

4.2.4. Format of amplitude value:

There are two forms for amplitude input and display: peak-peak form and RMS form.

- Press Vpp or mVpp to input amplitude peak-peak value after inputting the digits.
- Press Vrms or mVrms to input amplitude RMS value. RMS value is applicable only to sinewave, square wave and ramp wave, and other waveforms could only be shown by amplitude peak-peak value.

4.2.5. Amplitude attenuation setting

- Press Ampl key to light “Atten” and show the present attenuation value. Amplitude attenuation is auto as default of booting and there display “Auto” the generator will select automatically proper attenuation proportion according to the amplitude setting value, higher amplitude resolution, higher signal-noise ratio and less waveform distortion could be realized at the same time regardless of the amplitude magnitude of the signal. The output signal makes a momentary hop when the attenuation changes, which is not welcome in some operations, but the generator has fixed attenuation function to avoid this circumstance. Input attenuation values of 0dB, 20dB, 40dB and 60dB with the numeric keys, input 80dB to select auto attenuation. Users may use the adjusting knob as well, the attenuation changes to next one for every step of the rotation. When select fixed attenuation mode, the attenuation is fixed while the signal amplitude changes, and the output signal could changes continuously within the whole amplitude range. But higher distortion of the waveform and poor signal-noise ratio maybe appear when the attenuation is 0dB and the amplitude of the signal is small.

4.2.6. Output load:

- The setting value of amplitude is calibrated when the output end is open. The real voltage of output load is the setting value of amplitude multiplied by the assignment ratio of load impedance (including inductance and capacitance) and output impedance. The output resistance is about 50. When the load impedance is high enough, the assignment ratio approaches to 1. The voltage loss of output impedance can be neglected. The real voltage approaches to the setting value of amplitude. But when the load impedance is lower, the voltage loss of output impedance cannot be neglected. It should be paid more attention that the real voltage does not accord with the setting value of amplitude.
- With 50Ω output resistance, a momentary short-circuit of the output port makes no damage to the generator, but the users should try to avoid long time short-circuit under high voltage output as a danger of making damage to the generator. The generator has function of opposite voltage protection, with which the generator close output automatically, make an alarm with the output indicating light off when carelessly connect a high voltage (less than 30 V) to the output port. Open the output by pressing Output key only after the fault cleared.

4.2.7. Offset-setting:

In some cases, certain DC components should be contained in the AC signal to be output so as to produce DC

offset.

Press Offset key, the light of which will be on and the present offset value will be displayed. Input offset value with the numeric keys or adjusting knob for the output signal to generate this DC offset to the output. The relationship between the maximum DC offset and amplitude value should be below formula, if the setting of offset exceeds, the generator will modify it until it is within the limit of the maximum offset value.

offset ≤10-Vpp÷2

It must be paid attention that the summation of the half of the output amplitude of signal and the absolute offset value should be less than 10V to guarantee the peak value of signal less than ±10V. Otherwise, the amplitude-limited distortion will be induced. Besides, when the attenuation of channel A is selected auto, the output offset will attenuate with the attenuation of amplitude. For the Vpp of amplitude greater than 2V, the real output offset is the set offset value. For the Vpp of amplitude greater than 0.2V but less than 2V,the real output offset is tenth of the set offset value. For the Vpp of amplitude less than 0.2V, the real output offset is one percent of the set offset value.

It will be more convenient using the numeric keys than the knob when adjusting DC offset for output signal. In general case, whether DC offset is positive or negative, DC level will rise if turning right and fall if turning left. Sign of positive and negative will change automatically when passing through zero point.

4.2.8. DC Output voltage:

- If the amplitude attenuation is set to 0 dB, the output offset value is equal to the preset offset value and is independent of the amplitude.Set amplitude at 0V, the offset value could be set arbitrarily within ±10V range, the generator is now a DC voltage power supply and outputs specified DC voltage signal.

4.2.9. Selection of waveform of channel A:

- The generator could output 16 kinds of waveforms, press Shift Sine , Shift Square , Shift Ramp keys directly to select these three kinds of common waveforms, the corresponding waveform character will be displayed. Users may select all 16 kinds of waveforms with waveforms sequence numbers, Shift Arb key to show current waveforms sequence number, users may also input waveforms sequence numbers with the numeric keys or adjusting knob to select the corresponding waveforms defined by the sequence numbers. Except three common waveforms, the waveform character of the other waveforms are “Arb”. The waveform sequence numbers of 16 kinds of waveforms are listed as below:

List of names and sequence numbers of 16 waveforms:

sequence number	waveform
0	sine
1	square
2	ramp
3	pos-pulse
4	neg-pulse
5	stair
6	noise
7	half sine
8	limit sine
9	exponent
10	logarithm
11	tangent
12	sin (x)/x
13	half round
14	cardiac
15	quake

4.2.10. Setting of duty cycle:

When the present selection of waveform is square or ramp(including pos-square and pos-ramp), users may press Duty key to display present duty cycle value, input duty cycle value with numeric keys or adjusting knob, then the output will be square or ramp with a fixed duty cycle value. The definition of square duty cycle is the ratio of high level time of one square to the period of this square. The usual thought of square duty cycle is 50 , waveforms with other duty cycle are usually named pulse. The definition of ramp duty cycle is the ratio of rising time of one ramp to the period of this ramp. The ramp duty cycle is usually named ramp symmetry, ramps with symmetry of 0% or 100% are usually named sawtooth wave, and ramp with symmetry of 50% is named triangle wave.

When the frequency of square is comparatively high, the setting of duty cycle is limited by the edge time, in a relationship as below formula:

Duty cycle× Period≥2× Edge time

or

Duty cycle × Period ≤ Period 2× Edge time

4.3. Output phase setting

- Under continuity function, press Menu to display output phase value, input phase value with numeric keys or adjusting knob, there are only two output phase values, 0 and 1.
- When setting the phase as 0, the phase of signal from OUTPUT port and is the same with the one of signal from SYNC port while when setting the phase as 1, the two are opposite.

4.4. Frequency sweeping function

In frequency sweep, the output frequency changes from the start frequency point to the end frequency point according to the setting sweep time. Users may sweep within the whole frequency range. During this process, the phase of output signals is continuous. All the 16 kinds of waveform could be swept, of course it makes no sense to

sweep DC or noise. Linearity frequency sweeping is similar with ramp frequency modulation, with the difference of, frequency sweeping does not use modulation waveform, but continuously output a series of discrete frequency points according to certain time interval. Press Sweep key and the generator enters frequency sweeping function.

4.4.1 Start and end frequency:

- Press Menu key to light “Start” letter and then set start frequency point.
- Press Menu key to light “Stop” letter and then set end frequency point.
- If the end frequency value is more than the start frequency value, the sweep is positive from lower frequency to higher frequency, increasing step by step from the start frequency to the end frequency and then return to the start frequency.
- If end frequency value is less than the start frequency value, the sweep is opposite from higher frequency to lower frequency, decreasing step by step from the start frequency to the end frequency and then return to the start frequency.

4.4.2 Sweeping time:

- Press Menu -key to light “Time” letter and then set sweep time value.
- Sweep time means the time of sweeping from the start frequency point to the end frequency point.
- The sweep time of every frequency point is the same, so the longer the sweep time is, the more frequency points are swept, the less the step of the frequency point is, and the finer the sweep is.
- The shorter of the sweep time is, the less frequency points are swept, the more the step of the frequency point is, and the rougher the sweep is.

4.4.3. Sweeping mode:

- Press Menu -key to set sweeping mode. Set the value as 0, the character “linear” will be lighted, and the sweeping mode now is linearity. Set the value as 1, the character “log” will be lighted, to select logarithm mode.
- Under linearity sweeping mode, the frequency step is fixed, but a fixed frequency step always does a bad effect when sweeping comparatively wide-range frequency.
- In that case, the resolution is high when sweeping high end of frequency, the frequency changes slowly, and the sweeping is fine.
- But the resolution is low when sweeping the low end of frequency, the frequency changes very quickly, the nsweeping is rough.
- So linearity sweeping is applicable only for sweeping with narrow frequency range.
- Under logarithm sweeping mode, the frequency step value is not fixed but changes according to logarithm relation.
- When sweeping the high end of frequency, the frequency step value is comparatively large; when sweeping the low end of frequency, the frequency step value is comparatively small.
- The frequency change is comparatively average for sweeping with wide frequency range.
- So logarithm sweeping is applicable for sweeping with wide frequency range.

4.4.4 Trigger sweeping:
When continuous sweep, the generator uses internal continuous trigger source, and the sweep runs continuously

and repeatedly. Press trig key to light “trig” keyboard indicator, and the sweep will end when reaching to the end point, then each time you press trig key, the sweep runs once and then stops at the start frequency waiting for the next trigger.
External trigger is also available.
Input TTL trigger signal into the Trig In port on the rear panel.
The sweep runs once at the rising edge of each trigger signal. Of course, the period of trigger signal should be larger than the sweep time set.
In trigger sweep, press Sweep key, the “trig” keyboard indicator will be off and the generator resumes to continuous sweep mode.

4.4.5. Sync output:

- During frequency sweeping, the “Sync” port on the front panel output a sync signal.
- A sync signal is a pulse wave signal with TTL level, of which the rising edge of the pulse is match along with the start point of the sweeping, and the falling edge is match along with the middle point of the sweeping area, the period of the pulse wave is the same with sweeping time.

4.5. Burst function

It is explained that in burst mode, the word “burst” means the cycle of any waveform, not only the pulse. In burst output, instrument outputs a waveform with a specified number of cycles and at a specified period at a starting phase, or it outputs a waveform with a specified number of cycles only single once. All the 16 waveforms could be used as burst waveform, Of course, using DC or noise signal as burst signal is invalid. Before entering burst function, users should set the waveform, frequency and amplitude of the burst under the continuity function.
Press Burst key to light “Burst” keyboard indicator, the generator will enter into burst function.

4.5.1. Repeated Period:

Press Menu key to light “Period” character, and then set repeated period. Period represents time from the start of one pulse string to the start of the next one which must be long enough to contain the pulse numbers of setting, as the following formula shows:
Repeated period Pulse count ÷ Pulse frequency
If the repeated period setting is too short, the instrument will modify it to the allowable minimum value.

4.5.2. Burst count:

Press Menu key to light “Ncyc” indicator, and then set the burst count. Burst count represents the number of cycles of pulse string in a repeated period, which must be small enough to be contained in one repeated period, as following formula shows:
Pulse count (repeated period × pulse frequency)
If the pulse count setting is too big, the instrument will modify it to the allowable maximum value.

4.5.3. Start phase:

Press Menu key to light “Phase” character, and then set start and end phase value. The start and end of the pulse string are always on the same phase of the waveform, this phase is named as the start phase. The start phase setting range is 0° to 360°, it is not available to square wave.

4.5.4. Trigger burst:

In continuous burst mode, the generator uses internal continuous trigger source to output continuous burst based on the repeated period and burst count set in advance. Press trig key to light “trig” keyboard indicator, the burst output stop and the generator outputs a burst each time pressing trig key, then keep on the start phase point and wait for the next trigger. You can also use external trigger source, input TTL trigger signal from the instrument rear panel “Trig In” connector. The generator outputs a burst at each rising edge of the trigger signal, then keeps on the start phase point and waits for the next trigger. Of course, the trigger signal cycle should conform to the restricted conditions of burst period. When trigger burst, the setting of period is ignored. When trigger burst, press Burst key, the “trig” keyboard light will be off and the generator will resume to continuous burst mode.

4.5.5. Sync output:

Regardless of in the continuous burst, single burst mode or gated output mode, a sync signal can be outputted from the front panel “Sync” connector. It is a TTL level’s pulse wave, its rising edge is corresponding to the burst starting point, while the falling edge is corresponding to the end of the burst. That is to say, during the continuation of burst, sync output keeps high level; during the stop period of burst, sync output keeps at low level.
In continuous burst, press Burst key again, the keyboard indicator will be off, the generator exit burst function and return back to continuity function.

4.6. Frequency modulation (FM)

In Frequency modulation, the frequency of the carrier is varied by the instantaneous voltage of modulating

waveform, all 16 waveforms could be used as carrier waveform, Of course, using DC or noise as carrier wave is invalid. Before entering into frequency modulation, users should firstly set the waveform, frequency and amplitude of carrier wave under continuity function.

Press FM key, the keyboard indicator of “FM” will be on, and the generator will enter into frequency modulation function.

4.6.1 Modulation frequency:

Press Menu key to light “Mod_f” character, and then set modulation frequency value. In FM, modulation frequency is usually far lower than carrier frequency.

4.6.2 Frequency deviation:

Press Menu key to light “Devia” character, and then set frequency deviation value. Frequency deviation represents the frequency variation of carrier wave when the modulating waveform is with full amplitude during FM process. When the amplitude of the modulating waveform is at positive peak value, the output frequency is equal to the frequency of the carrier plus the frequency deviation, and when it is at the negative peak value, the output frequency is equal to the carrier frequency minus the frequency deviation. Therefore, the frequency deviation setting must conform to the following two conditions:

(Carrier frequency – frequency deviation) > 0

(Carrier frequency + frequency deviation) < The upper limit of the generator

4.6.3 Modulation waveform:

Press Menu key to light “Shape” character, the current modulation waveform sequence No. is shown, input modulation waveform No. with the numeric keys or adjusting knob to select modulation waveform, the modulation waveform may be any one of the 16 kinds of waveforms listed in the waveforms table in section 4.2.9.

4.6.4. Sync output:

In FM, the generator outputs a sync signal from the front panel “Sync” connector, which is a square wave with TTL level and 50% duty cycle, its frequency is equal to modulating wave frequency and its phase is referenced to the phase of the modulating wave.

In FM, press FM key, the keyboard light of “FM” will be off, the generator will exit frequency modulation function and return back to continuity function.

4.7. Amplitude modulation (AM)

In AM, the amplitude of the carrier is varied by the instantaneous voltage of the modulating waveform, all the 16 waveforms could be used as carrier waveform, of course, it is invalid to use DC or noise. Before entering into amplitude modulation, users should firstly set the waveform, frequency and amplitude of carrier wave under continuity function.

Press AM key, the keyboard light of “AM” will be on and the generator enters into amplitude modulation function.

4.7.1. Modulation frequency:

Press Menu key to light “Mod_f” character, and then set modulation frequency value. In AM, modulation frequency is usually far lower than carrier frequency.

4.7.2. Modulation depth:

Press Menu key to light “Depth” character, and then set modulation depth value. Modulation depth represents the percentage of variation of the carrier amplitude to the amplitude setting value while the modulating wave is with full amplitude during AM process. If the maximum amplitude of the modulated waveform is called as Amax, the minimum amplitude as Amin, the amplitude setting value as A, the modulation depth as M, then the relationship between the four values is:

Amax (1 + M) x A ÷ 2.2 Amin (1 – M) x A ÷ 2.2

Then the modulation depth is M (Amax – Amin) x 1.1÷A

If modulation depth is 120%, Amax=A, Amin=-0.09A.

If modulation depth is 100%, Amax=0.909A, Amin=0.

If modulation depth is 50%, Amax=0.682A, Amin=0.227A.

If modulation depth is 0%, Amax=0.455A, Amin=0.455A.

That is to say, when modulation depth is 0, carrier amplitude is half of the amplitude setting.

4.7.3. Modulation waveform:

Press Menu key to light “Shape” character, the current modulation waveform sequence No. is shown, input modulation waveform No. with the numeric keys or adjusting knob to select modulation waveform, the modulation waveform may be any one of the 16 kinds of waveforms listed in the waveforms table in section 4.2.9.

4.7.4. Sync output:

In AM, the generator outputs a sync signal from the front panel “Sync” connector, which is square wave with TTL level and 50% duty cycle, its frequency is equal to modulating frequency and its phase is referenced to the phase of the modulating signal.

In AM, press AM key again, the “AM” light will be off, and the generator exits AM function and returns back to continuity function.

4.8 Phase modulation (PM)

In PM, the phase of the carrier is varied by the instantaneous voltage of the modulating waveform.

All the 16 waveforms could be used as carrier waveform.

Of course, it is invalid to use DC or noise.

Before entering into phase modulation, users should firstly set the waveform, frequency and amplitude of carrier wave under continuity function.

Press PM key to light “PM”, the generator enters into PM function.

4.8.1. Modulation frequency:

Press Menu key to light “Mod_f” character and then set modulation frequency value.

In PM, modulation frequency is usually far lower than carrier frequency.

4.8.2. Phase deviation:

Press Menu key to light “Devia” character, and then set phase deviation value.

Phase deviation represents the variation of carrier phase while the modulating waveform is with full amplitude in phase modulation. When the amplitude of the modulating waveform is at positive peak value, the phase of the outputted signal increase one phase shift, and when it is at the negative peak value, the phase of the outputted signal decrease one phase shift.

4.8.3. Modulation waveform:

Press Menu key to light “Shape” character, the current modulation waveform sequence No. is shown, input modulation waveform No. with the numeric keys or adjusting knob to select modulation waveform, the modulation waveform may be any one of the 16 kinds of waveforms listed in the waveforms table in section 4.2.9.

4.8.4. Sync output:

In PM, the generator outputs a sync signal from the front panel “Sync” connector, which is a square wave with TTL level and 50% duty cycle, its frequency is equal to modulating frequency and its phase is referenced to the phase of the modulating signal.

In PM, press PM key, the “PM” keyboard light will be off, the generator exits PM function and returns back to continuity function.

4.9. Pulse width modulation (PWM)

In PWM, the pulse width of the carrier varies with the instantaneous voltage of the modulating signal, and the waveform shape of the carrier must be pulse.

Before entering into PWM, users should firstly set the frequency and amplitude of carrier wave under continuity function.

Press PWM key, the keyboard indicator of “PWM” will be on and the generator enters into pulse width modulation function, the carrier wave is automatically set as pulse wave.

4.9.1. Modulation frequency:

Press Menu key to light “Mod_f” character and set modulation frequency value. In pulse width modulation, modulation frequency is far lower than carrier frequency.

4.9.2. Pulse width deviation:

Press Menu key to light “Depth” indicator and set pulse width deviation value. It represents the variation of carrier pulse width to the period of the pulse when the modulating waveform is with full amplitude during PWM process, also the variation of the duty cycle. Name the maximum duty cycle of modulated carrier as Dmax, and the minimum as Dmin, the pulse width deviation’s formula should be:

Pulse width deviation = Dmax – Dmin

If Dmax = 80%, Dmin = 20%, the pulse width deviation is 60%.

If Dmax = 50%, Dmin = 50%, the pulse width deviation should be 0%.

That is to say, when pulse width deviation is 0, the duty cycle of pulse wave is 50%.

4.9.3. Modulation waveform:

Press Menu key to light “Shape” character, the current modulation waveform sequence No. is shown, input modulation waveform No. with the numeric keys or adjusting knob to select modulation waveform, the modulation waveform may be any one of the 16 kinds of waveforms listed in the waveforms table in section 4.2.9.

4.9.4. Sync output:

In PWM, the generator outputs a sync signal from the front panel “Sync” connector, which is a square wave with TTL level and 50% duty cycle, its frequency is equal to modulating frequency and its phase is referenced to the phase of the modulating signal.

In PWM, press PWM key, the “PWM” keyboard light will be off, and the generator exits PWM function and returns back to continuity function.

4.10. Frequency shift keying (FSK)

In FSK, the frequency of the carrier shifts between “carrier frequency” and “hop frequency” alternately, the rate at which the output shifts is determined by hop rate.

All 16 waveforms could be used as carrier wave.

Of course, using DC or noise signal as carrier wave is invalid.
Before entering into FSK, users should firstly set the waveform, frequency and amplitude of carrier wave under continuity function.
Press FSK key to light “FSK” keyboard indicator, the generator enter into FSK function.

4.10.1. Hop rate:

Press Menu key to light “Rate” character, then set hop rate value.
In FSK, the modulation waveform is fixed as a square wave with 50% duty cycle, the frequency of the square wave is the hop rate.

4.10.2. Hop frequency:

Frequency shift keying is similar with FM whose modulating waveform is square.
“Hop frequency” is similar with “Frequency offset”, with the difference of, frequency offset is an offset value that the frequency of carrier wave positive or negative, whose setting range is relational with the frequency of carrier wave, hop frequency could be set arbitrarily within whole frequency range, it has no relationship with carrier frequency.

4.10.3. External trigger:

After entering into FSK function, the generator uses internal trigger source as default, outputs FSK signal based on hop rate set.
Press trig key, the “trig” keyboard indicator will be on and the generator enters into FSK mode with external trigger.
The trigger signal with TTL level is inputted from the rear panel “Trig In” connector.
If the level of the trigger signal is low, the frequency of the output signal is that of the carrier, if the level of the trigger signal is high, the frequency of the output signal is the hop frequency.
When using external trigger, the setting of hop rate is ignored. When using external trigger, press FSK key, the “trig” keyboard indicator will be off and the generator resume to internal trigger mode.

4.10.4 Sync output:

In FSK, the generator outputs a sync signal from the front panel “Sync” connector, which is a square wave with TTL level and 50% duty cycle, its frequency is equal to the hop rate. If the output signal is the carrier, a low level sync signal is outputted. If the output is hop frequency, a high level sync signal is outputted.
In internal trigger FSK, press FSK key again, the “FSK” keyboard indicator will be off, the generator exits FSK function and returns back to continuity function.

4.11. Output port:

There are two output ports on the front panel of the instrument, users must not input signal to the output port as a possibility of damaging the instrument.

4.11.1. Signal output port:

* Output the signals that the instrument generates are all output from the signal output port, press Output key to open or close the signal from the output port circularly.

* The output port is open when the “Output” light is on, and close when the “Output” is off. If wrongly connect external high voltage to signal output port, instrument will suffer “inverse filling” danger, and then instrument will turn on the protection function, close immediately signal output port and make an alarm with the “Output”light off. In this case, you must check external load, only after eliminating the failure can press output key to open signal output port.

4.11.2. Sync output port Sync :

Output pulse wave compatible with TTL and CMOS, high level >4 V, low level <0,3 V.

1. Under single frequency function, sync signal is a square signal with TTL level, the frequency of sync signal is the same as the frequency of the signal from Output port, when the phase is set to be 0 the phase of sync signal is the same as the phase of the signal from the Output port. When the phase is set to be 1 the phase of sync signal is the opposite of the phase of the signal from the Output port.
2. Under frequency sweep function, the sync signal is a pulse signal with TTL level, the rising edge of the pulse wave match along with the start point of the sweep, and the falling edge of the pulse wave match along with the middle point of sweep range, the period of pulse wave is the same as sweep time.
3. In FM, AM, PM, PWM modulation, sync signal is a square wave with 50% duty cycle, whose frequency equals to frequency of modulating waveform and phase refers to the phase of modulating waveform.

4. In FSK, sync signal is a square wave with 50% duty cycle, whose frequency equals to hop rate, when outputting carrier frequency, sync signal is low level; when outputting hop frequency, sync signal is high level.
5. When pulse string output, sync signal is a pulse wave whose rising edge corresponds to start point, falling edge corresponds to stop point, and cycle equals to pulse string repeated cycle.
6. In frequency sweep, pulse string and FSK, if select manual trigger or external trigger, frequency of sync signal will be determined by trigger signal.

4.12. Input port

There is a trigger input port Trig In on the rear panel of the generator, which could be used only as the input channel of external signal, but not output channel. This port could be also used as the input channel of pulse signal which is compatible with TTL and CMOS, the high level of which is higher than 4V, and low level is lower than 0.3V.

4.13. Programmable interface

There is an USB device interface socket USB Device on the rear panel of the instrument, through which the instrument could be program-controlled by connecting to computer with an USB cable. The use method of this interface is described in detail in the CD that attached with the instrument.

4.14. Parameter calibration

- The instrument is calibrated before shipment, but some specifications may change a bit lot during long time of use. To ensure the accuracy, the instrument should be calibrated termly.
- Users may regain the accuracy of the instrument by operating the keyboard to calibrate the main specifications without removing the cover of the instrument.

4.14.1. Enable calibration:

- After booting, the calibration is in off state, and the generator could not be calibrated without inputting calibration password, this is a way to protect calibrated parameters which may be changed carelessly.
- To enable calibration, select sine wave and then press Shift Cal -key, the calibration password displayed as 0, input calibration password 1900, press N -key to enable calibration.

4.14.2. Parameters calibration:

- Press Menu -key to display calibration value on the left, and calibration sequence number on the right when setting calibration conditions automatically.
- Adjust calibration value to calibrate present selected calibration option and make the output expected.
- Continue to press Menu -key and the calibration sequence number will increase step by step, users could calibrate all those options respectively, which is shown in the following list.
- During calibration process, press Cal -key at any time then press Menu -key to return the calibration sequence number to 00.

Parameter calibration table

Sequence No.	Default calibration valu e	Output nominal val ue	Adjust the calibration value till the output is wit hin the error range
0	2047	0 VDC	Zero calibration: output DC voltage as: -20 – 2 0 mVDC
1	870	10 VDC	Offset calibration: output DC voltage as: 9.88 – 10.12 VDC
2	873	7 Vrms	Amplitude calibration: output AC voltage as: 6. 928 – 7.072 Vrms
3	300	0.71 Vrms	Amplitude calibration: output AC voltage as: 0. 701 – 0.719 Vrms
4	500	1 MHz	Frequency calibration: output frequency as: 1 MHz ± 20 Hz
05 – —	100	5 Vpp	Flatness calibration: output amplitude as. 4,5 Vpp – 5,5 Vpp

** P 4055: Sequence-no.: 05~07
P 4060: Sequence-no.: 05~24

4.14.3. Disable calibration:

- After finishing the calibration, press Shift & Cal key and the display shows 1900, press any numeric keys and then N key to store the calibration parameters, disable calibration and exit the process.
- During the calibration process, if wrong calibration occurred, press Freq key at any time to disable calibration and exit without storing calibration parameters.
- After rebooting, the generator automatically recalls and uses the calibration parameters stored during last calibration.

4.15. Default setting

4.15.1. Continuity function:

Continuity function is default after booting.

Waveform	sinewave
Frequency	1 kHz
Amplitude	1 Vpp
Attenuation	auto
Offset	0Vdc
Duty cycle	50%
Output phase	0°
Output port	open

4.15.2. Frequency sweeping function:

Start frequency	100 Hz
End frequency	1 kHz
Sweep time	3 s
Sweep mode	linearity
Trigger mode	internally, continuous

4.15.3. Burst:

Repeated period	10ms
Burst count	3
Start phase	0°
Trigger mode	internally, continuous

4.15.4. Modulation (FM, AM, PM, PWM):

Modulation frequency	1 kHz
Modulation frequency deviation	1 kHz
Modulation amplitude depth	100%
Phase offset	180°
Modulation width depth	50%
Modulation waveform	Sine

4.15.5. FSK

Hop rate	1 kHz
Hop frequency	4 kHz
Modulation waveform	square
Trigger mode	internally, continuous

4.16. Power amplifier

The unit has an integrated power amplifier. It is an independent component of the generator, ‘Amplifer In’ in rear panel is input connector of power amplifier and ‘Amlifer Out’ is output connector of power amplifier. Connect the input signal to ‘Amplifer In’ connector, then amplified signal can be obtained at the connector of ‘Amlifer Out’. The input signal can be the output signal of this instrument or other device’s.

4.16.1 Input Waveform

Sine.

For other waveforms, the distortion will be too big. It is not recommend to input other waveforms than sine.

4.16.2. Input voltage:

The multiple of the power amplifier is double and the maximum output amplitude is 9 VRMS. So the maximum input amplitude should be limited within 4,5 VRMS. The output signal will be distorted beyond the limitation.

4.16.3. Frequency range:

The frequency range of the power amplifier is 100Hz ~ 10kHz.

4.16.4. Output power:

- The expression of power for the power amplifier isP = V2 / R
- Where, P is the output power (the unit is W), V is the output virtual amplitude value (the unit is Vrms), R is the load resistance (the unit is Ω).
- The maximum output amplitude can reach 9 VRMS and the minimum load resistance can be 2Ω.

Besides, the higher the temperature of the working environment, the larger is the frequency of the output signal and the greater distortion of the output signal. Usually, the maximum output power can reach 10 W (8Ω).

4.16.5. Output protection:

The power amplifier is of short circuit protection function and over heat protection. Usually it is unable to be destroyed but long time output short circuit should be avoided. The frequency, amplitude and loading should be best within the limitation, two of which, especially, cannot get the limitation at the same time in case that the power amplifier is damaged.

Specifications

5.1. Output characteristics of channel A

5.1.1. Waveform characteristics:

Waveform types	16 types including sine, square. ramp. exponent, noise a nd so on.
Waveform length	1024 points
Sampling rate	100 MSa/s
Amplitude resolution	8 bits
Harmonic distortion (1Vpp)	s-40 dBc (<5 MHz) s-35 dBc (>5 MHz)
Total distortion of sine	s0.5 % (20 Hz – 20 kHz/20 Vpp)
Rising/Falling Edge time	s35 ns. over shoot: s 10 %
Duty cycle of Square	0,1 % – 99.9 %
Ramp symmetry	0.0 % – 100.0 %

5.1.2. Frequency characteristics:

Frequency range	Sine	P 4055	10 pHz – 3 MHz
		P 4060	10 pHz – 20 MHz
	Square	P 4055	10 pHz – 3 MHz
		P 4060	10 pHz – 5 MHz
	Others		10 pHz – 1 MHz
Resolution	10 pHz		
Frequency accuracy	±50 ppm		

5.1.3. Amplitude characteristics:

Amplitude range	open circuit load	<8 MHz	0 mVpp – 20 Vpp
		>8 MHz	0 mVpp – 18 Vpp
	50 0 load	<8 MHz	0 mVpp – 10 Vpp
		>8 MHz	0 mVpp – 9 Vpp
Resolution	5 mVpp	for amplitude >2 Vpp	
	0.5 mVpp	for amplitude <2 Vpp	
Amplitude accuracy	±(1% + 2 mVrms)	frequency is 1 kHz / > 5 mVrms	
Amplitude flatness	±10%	Sine. compared to 1 MHz. 5 Vpp	
Output impedance	500 typical		

5.1.4. Offset characteristics:

Offset range	±10 V DC (open circuit load)
	±5V DC (50 EL load)
Resolution	5 mV DC
Offset accuracy	±(1% + 20 mV DC)

5.1.5. Sweeping characteristics:

Waveform	16 kinds of waveforms including sine, square, ramp. etc.
Sweeping range	the start/end point can be set arbitrarily
Sweeping rate	50 ms – 500 s
Sweeping mode:	linearity, logarithm
Trigger source	internal continuous, external signal, manual trigger

5.1.6. FM, AM, PM, PWM:

Carrier waveform		16 kinds of waveforms including sine, square, ramp. etc. (PWM only for pulse)
Modulation waveform		16 kinds of waveforms including sine. square. ramp. etc.
Modulation frequency		40 mHz – 20 kHz
Frequency offset	P 4055	10 pHz – 3 MHz
	P 4060	10 pHz – 20 MHz
Modulation amplitude depth		0%-120%
Phase offset		0°-360°
Pulse width deviation		0%-99%

5.1.7. FSK:

Carrier waveform		16 kinds of waveforms including sine, square. ramp. etc.
Modulation waveform		Square
FSK rate		40 mHz -100 kHz
Hop frequency	P 4055	10 pHz – 3 MHz
	P4060	10 pHz – 20 MHz
Trigger source		Internal continuous, external signal

5.1.8. Burst:

Waveform	16 kinds of waveforms including sine, square, ramp
Repeated period	1 ps – 20 s
Pulse count	1 -1000000
Start phase	0°- 360°
Trigger source	Internal continuous, external signal, manual trigger

5.2. Sync-Output characteristics

Waveform characteristics:	Square. edge time	< 20 ns
Amplitude characteristics:	Compatibility of TTL. CMOS	low level < 0.3 V high level > 4 V

5.2.1 Programmable interface:
USB device interface, of which the operation guide is on the CD attached with the generator.
5.3. Power amplifier

Input Signal	0 Vrms to 4.5 Vrms
Maximum output voltage	9 Vrms
Frequency bandwidth:	100 Hz – 10 kHz
Voltage Amplifier	Double
Maximum output power	10 W (load 8Q)

5.4. General characteristics

Power conditions	Voltage	100 – 240 V AC
	Frequency	45 – 65 Hz
	Power	< 20 VA
Environment conditions	Temperature 0 40 °C	–
	Humidity	<80% RH
Operation characteristics	Fully keyboard operation, continuously adjust with adjusting knob.	
Dimensions (WxHxD)	256 x 102 x 322 mm	
Weight	1,5 kg	

This manual considers the latest technical knowing. Technical alterations reserved.
We herewith confirm, that the units are calibrated by the factory according to the specifications as per the technical specifications.
We recommend to calibrate the unit again, after one year.

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Documents / Resources

	**PeakTech 4060 MV DDS Function Generators** [pdf] User Manual 4060 MV DDS Function Generators, 4060 MV, DDS Function Generators, Function Generators, Generators

References

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