

**3 MHz Function Generator/
Counter
SM5070/ SM5071**

User Manual

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3 MHz Function Generator/Counter SM5070/ SM5071

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3 MHz Function Generator/ Counter SM5070/ SM5071

- Frequency Range 0.3 Hz to 3 MHz
- Operating Modes : Sine, Square, Triangle, DC
- Digital Frequency Readout
- DC-Offset Adjustment
- Internal Sweep Facilities
- Square Wave Rise time Typ. 40 ns
- Back lit LCD display for modes & frequency
- Counter Sensitivity 50 mVrms (SM5071)
- Counter Range 10 Hz - 15 MHz (SM5071)

The various signals available from the **SM5070/SM5071** Function Generator makes it a versatile signal source useful for most measurement and test applications. Its low frequency ranges are particularly well suited for simulating mechanical and servo techniques.

Frequencies are read out on a **16*2 dot matrix LCD display** with a maximum resolution of 1 mHz. Additional quality features include the relatively **low distortion factor** of the generated signals and **constant amplitude flatness** throughout the entire frequency range of the instrument. All outputs are short-circuit-proof in **SM5070/SM5071**.

The **SM5070/SM5071** can also be used in the **sweep mode** with an internal or external signal source.

Technical Specifications

Operating Modes	: Sine, Square, Triangle, DC, Free running, internal sweep or external frequency modulation, with or without DC offset
Frequency Range	: 0.3 Hz to 3 MHz in 7 decade steps, variable control : x 0.1 to x1 (10:1)
Frequency Stability	: < 0.5%/ h or 0.8% /24 h at constant ambient temperature (Medium position of frequency Control)
Waveform Characteristics	
Sine Wave Distortion	: 0.3 Hz to 100 kHz : max. 0.5% 0.1 MHz to 0.5 MHz : max. 1.5% 0.5 MHz to 3 MHz : max. 3%
Square Wave Rise Time	: Typ. \leq 40 ns (10 to 90%)
Overshoot	: \leq 5% (when output is terminated with 50 Ω)
Triangular Non-Linearity	: < 1% (up to 100 kHz)
Frequency Display Accuracy	: up to 3 Hz : \pm (1%+ 3 digit) 3 Hz to 3 MHz : \pm (5×10^{-5} + 1 Digit)
Output (short circuit proof)	
Output voltage	: 10 Vpp into 50 Ω , max 20 Vpp open circuit
Attenuation	: Max. 60 dB, 2 steps : 20 dB \pm 0.2 dB each Variable : 0 to 20 dB
Amplitude Flatness	: (sine / triangle into 50 Ω) 0.3 Hz to 0.3 MHz : max. \pm 0.2 dB 0.3 MHz to 3 MHz : max. \pm 0.5 dB
Output Impedance	: Switchable 50 Ω / 600 Ω
DC Offset	: Variable Offset range : max. \pm 2.5 V into 50 Ω , max. \pm 5 V open circuit
Trigger Output	: Square wave synchronous to signal output, Approx. + 5 V (TTL)

Frequency Modulation :

FM input (VCF)	:	Connector on rear panel
Frequency change	:	Approx. 1:100
Input Impedance	:	50 k Ω 25pF
Input Voltage	:	\pm 30 V max.
Internal Sweep	:	Sweep speed : 20 ms to 4 s Sweep Range : approx. 1:100.

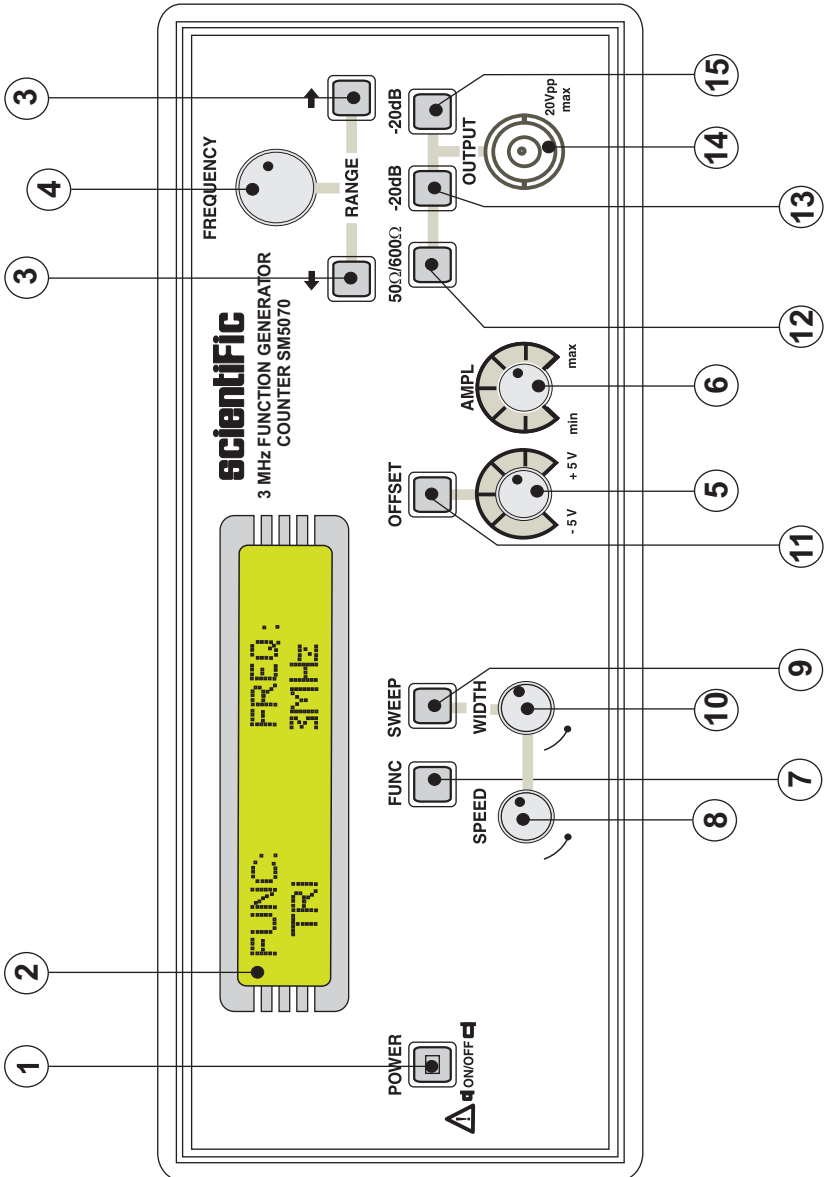
Frequency Counter (SM5071) :

Frequency Range	:	10 Hz to 15 MHz
Accuracy	:	\pm (5x10 ⁻⁵ +1D)
Input Sensitivity	:	50 mVrms
Max. Input Voltage	:	150 Vrms
Input Impedance	:	1 M Ω 50pF
General information		
Display	:	16*2 dot matrix LCD display
Supply	:	230 V, \pm 10%, 50 Hz
Power consumption	:	22 VA approx
Operating Conditions	:	0°C to +50°C., RH 95% (max.)
Dimensions (mm)	:	W: 205, H: 95, D: 292 (mm)
Weight	:	Approx 2.0 kg.
Accessories	:	BNC – BNC

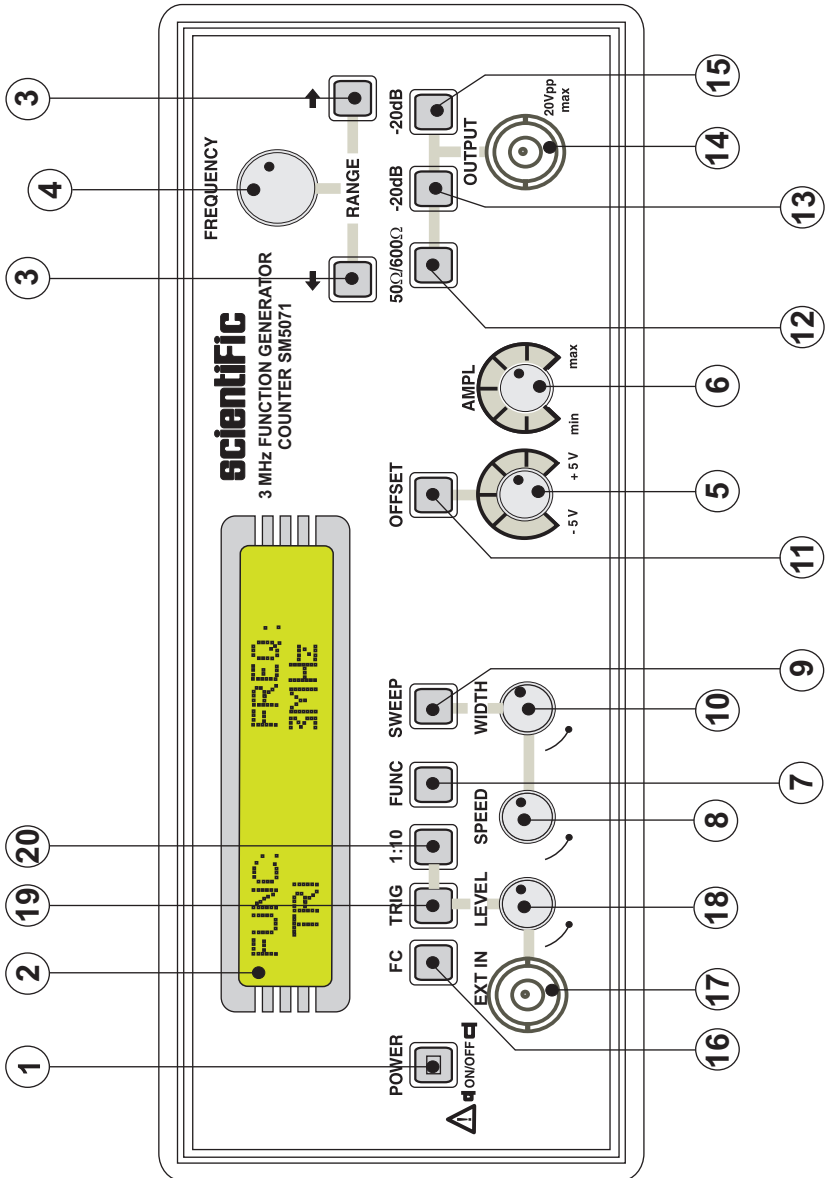
Values without tolerances are intended as guidelines and represent characteristics of the average instrument.

(Subject to Change)

Front Panel Controls SM5070



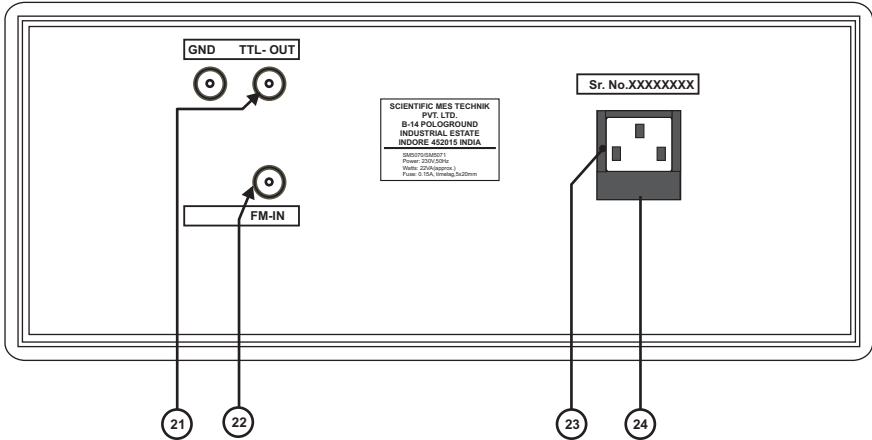
Front Panel Controls SM5071



- ① **POWER** : Push button switch for supplying power to instrument.
- ② **DIGITAL DISPLAY** : 16*2 dot matrix LCD display
- ③ **Range** : Frequency range selection from 0.3 Hz to 3 MHz in 7 decade steps
- ④ **FREQUENCY** : (adjusting knob) Continuous and linear frequency fine adjustment, overlapping the ranges selected with③. Setting range from x0.09 to x 1.1 of the selected range.
- ⑤ **OFFSET** : Adjustment of the positive or negative offset voltage. DC voltage can be superimposed on the output signal. The max. offset voltage is ± 5 V (o.c.) or ± 2.5 V when terminated with 50 Ω .
- ⑥ **AMPLITUDE** : Continuous adjustment of the output amplitude from 0 to – 20 dB .
- ⑦ **FUNCTION** : Mode selection switch (Triangle- Sine – Square – DC)
- ⑧ **SPEED** : Setting of wobulation speed in Sweep mode
- ⑨ **SWEEP** : Activates the internal Sweep mode
- ⑩ **WIDTH** : Setting of wobulation width
- ⑪ **OFFSET** : Activates the DC offset function
- ⑫ **50 Ω /600 Ω** : Selects the output impedance at the output BNC
- ⑬ **-20 dB** : When pressed the output signal gets attenuated by 20 dB fixed attenuator.
- ⑭ **OUTPUT (BNC connector)** : Short-circuit-proof signal output of the generator. The output impedance is 50 Ω /600 Ω , and the max. output amplitude is 20 V_{pp} (o.c.) or 10 V_{pp} respectively when terminated with 50 Ω
- ⑮ **-20 dB** : When pressed the output signal gets attenuated by 20 dB fixed attenuator. When both attenuator push buttons are activated, a total attenuation of 40dB results. Including the amplitude control the max. attenuation amounts to 60 dB (factor 1000).
- ⑯ **FC (Push button)** : When pressed instrument reads frequency of the input connected on “EXT-IN” BNC connector.
- ⑰ **EXT IN (BNC CONNECTOR)** : Input to frequency counter. (max 15 MHz)

- ⑱ **LEVEL (adjusting knob):** Trigger level setting of counter.
- ⑲ **TRIG (Push button) :** When pressed the trigger level of counter can be adjusted with help of LEVEL potentiometer.
- ⑳ **1:10 (push button):** When pressed the input signal to frequency counter is attenuated 10 times.

Rear Panel Controls



- ②1 **TTL- OUT (Banana socket)** : Trigger output BNC.
- ②2 **FM - IN (Banana socket)** : External input for FM.
- ②3 **Mains** : Mains input 230 V AC 50 Hz \pm 10%.
- ②4 **Spare Fuse** : Spare fuse for mains is kept inside.

Operating Instruction

General Information

The logical front panel layout of **SM5070/ SM5071** ensures rapid familiarization with the various functions. However, even experienced operators should not neglect to carefully read the following instructions, to avoid any operational errors and to be fully acquainted with the instrument when later in use.

After unpacking the instrument, check for any mechanical damage or loose parts inside. Should there be any transportation damage, inform the supplier immediately and do not put the instrument into operation.

Safety

The case, chassis and all measuring parts are connected to the protective earth contact of the inlet. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord without a protective conductor.

WARNING!

ANY INTERRUPTION OF THE PROTECTIVE CONDUCTOR INSIDE OR OUTSIDE THE INSTRUMENT OR DISCONNECTION OF THE PROTECTIVE EARTH TERMINAL IS LIKELY TO MAKE THE INSTRUMENT DANGEROUS. INTENTIONAL INTERRUPTION IS PROHIBITED. THE MAINS/ LINE PLUG SHOULD BE INSERTED BEFORE CONNECTIONS ARE MADE TO MEASURING CIRCUITS.

When removing the metal case or replacing, the instrument must be completely disconnected from the mains supply. If any measurement or calibration procedures are unavoidable on the opened-up instrument, these must only be carried out by qualified personnel acquainted with the danger involved.

Operating Conditions

The ambient temperature range during operation should be between + 0° to + 50°C RH 95% should not exceed -40°C or +70°C during transport or storage. The operational position is optional, however, the ventilation holes on the **SM5070/ SM5071** must not be obstructed.

First Time Operation

After unpacking the instrument check for any mechanical damages. The instrument should be plugged in mains-plug of proper mains supply $230V \pm 10\%$. On switch ON no undue observation should be noticed. Once the instrument is switched ON, the power ON is indicated by lighting of displays.

Function Selection

The type of output signal is selected with the function selection switch . A total number of 4 different waveforms - sine, square, triangle are available apart from the DC level. The functions are marked with the corresponding symbols. If the "OFFSET" pushbutton is activated a DC voltage level is supplied by the **SM5070/SM5071** is superimposed on the output signal.

Frequency Adjustment

Coarse adjustment is performed with the range keys. The desired frequency is selected by turning the FREQUENCY control ④.

The selected frequency appears on the LCD display. Compared to knob scales, this display has a much higher resolution and accuracy.

Output Amplitude and Signal Connections

Adaptation in decade steps to the desired amplitude range is performed by the use of two attenuators with -20 dB each, which are activated by push buttons & Including the continuously adjustable AMPLITUDE control the maximum attenuation amounts to -60 dB. With the maximum amplitude of $10V_{pp}$, the minimum signal voltage to be supplied is about 10 mV. These values are obtained when the generator output is terminated with 50Ω . In the open-circuit condition, the available signal amplitude is twice as high. Therefore the maximum output voltage of the output socket is specified with $20V_{pp}$.

If exact square-shaped signals are required, care should be taken that only 50Ω coaxial cables are used. Furthermore, this cable must be terminated with a 50Ω through termination. If these precautions are not observed, overshoot may occur, especially when high frequencies are selected. If test circuits having a 50Ω input impedance are connected, this termination is not required.

In high signal voltage ranges it should be noted that the used terminating resistor must dissipate the corresponding effective power.

The output terminal of the **SM5070/ SM5071** is short circuit proof. If the output of the **SM5070/SM5071** unit comes into contact with components of the circuit under test, which are carrying DC voltage, an isolating capacitor of appropriate dielectric strength should be connected in series with the output of the generator. The capacitance of this isolating capacitor should be selected in such way that the frequency response of the output signal is not affected over the whole frequency range of the **SM5070/SM5071** unit.

Trigger Output

In the sine, square and triangle modes, the trigger output (at back panel) supplies a square signal in synchronism with the output signal. Set up time is considerably reduced because the fixed logic levels and polarity are ready for direct injection into any TTL circuits. An offset voltage adjusted at the 50 Ω output has no influence upon the trigger signal. The trigger output is short-circuit proof and can drive several TTL inputs.

Sweep Facilities

Internal Sweep

The internal sweep facility of the **SM5070/ SM5071** allows checking of filters and equipment in the frequency range from 0.3 Hz to 3 MHz. Operation is very easy and is confined to the setting of sweep-speed and sweep-width. Activation is by simply pressing the **SWEEP** push button and can be combined with all available functions on the **SM5070/ SM5071**. The Stop- frequency is automatically given by the settings of the range selector and the frequency dial and is shown on the LCD display. Start frequency is related to the stop-frequency by the sweep-width factor. Latter is set by means of the (Sweep) Width potentiometer and is up to approx. X 100. The sweep speed is set by means of the (Sweep) Speed potentiometer and ranges from 20 ms to 4 s. For external wobulation please refer to "FM input".

FM input

If a positive DC voltage is applied to the FM input on the rear BNC of **SM5070/ SM5071**, the generator frequency increases and is accordingly displayed. A negative DC voltage reduces the frequency. The frequency displacement depends

on the value and polarity of the DC voltage U and on the FREQUENCY setting. The set frequency N_o (DC voltage not included) can be selected at will.

Computation : $N = N_o + A.U$ or $U = (N - N_o)/A$

N_o = digit display without voltage U ,

N = digit display including voltage U ,

$U = \pm$ voltage at the FM input ,

$A = 740$ (digits per volt)

It should be noted that only the displayed digits are valid; the decimal point is not taken into consideration (e.g. 100.0 1000 digit). The max. frequency (3 MHz) cannot and "000" should not be exceeded. Any zeros preceding the decimal point are dropped.

Limits : If the highest displayed number is $N = 3000$ and the smallest $N_o = 300$, then U will be +3.6 V max. The frequency increases by a factor of 10. If the smallest displayed number is $N = 30$ (lower number are possible, but inaccurate) and the highest $N_o = 3000$, then U will be -4 V max.

The frequency changes by a factor of 100. The frequency change is linear as a function of the voltage U and has the same value in all ranges.

This mode can be used in applications where the periodically required frequencies are to be set , This will eliminate the repetitive setting of frequency from front panel via FREQUENCY set knob. Such applications exist in production departments, where signals at several specific frequencies are required for various tests. FSK (Frequency Shift Keying) signals also may be generated in this manner.

DC Offset

When the switch ⑪ OFFSET is depressed, a DC voltage can be superimposed on the output signal. The maximum offset voltage with open output is ± 5 V. If large DC offset is added or a large signal is added with DC offset, make sure that the desired combination is obtained without clipping. An oscilloscope may be used for proper setting of DC offset addition.

Frequency Counter: (SM5071)

1. INPUT SIGNAL : Input signal to the counter is given to EXT IN ⑰ BNC terminal.

The minimum applied signal is 50 mVrms and maximum applicable signal is 150 Vrms.

2. **TRIGGER** : In normal mode counter is auto triggered. When TRIG^⑨ switch is pressed, instrument can be triggered externally by adjusting LEVEL^⑱ Knob .When instrument is triggered trigger LED is ON.
3. **ATTENUATOR**: The input signal to frequency counter can be attenuated 10 times by pressing 1:10^⑳ Switch.
4. **FUNCTION GENERATOR / COUNTER MODE**: When switched ON the instrument works as a function generator. By pressing FC^⑩ Switch the instrument function as a Frequency Counter.

Maintenance

There are no user serviceable part inside **SM5070/ SM5071**.Your **SM5070/ SM5071** 3 MHz Function Generator is thoughtfully engineered for ease of use, accuracy and reliability. The instrument is carefully tested and calibrated using standards traceable to National Laboratories.

Take care of your instrument by cleaning the exterior of the instrument regularly with a dusting brush. Dirt which is difficult to remove on the casing & plastic parts, can be removed with a moist cloth (99% water, 1% mild detergent) spirit or washing benzene(petroleum ether) can be used to remove greasy dirt. The display may be cleaned with water or washing benzene (but not with spirit-alcohol solvents), it must then be wiped with a dry clean lint-free cloth. Under no circumstances the cleaning fluid should get into the instrument. The use of cleaning agents can attack the plastic & paint surfaces.

Power Line Fuse Replacement

The power line fuse is located on rear panel on lower right side. In case, the instrument does not show any sign of working, no LED is lit or there is no display immediately switch OFF the mains power switch of the instrument and unplug the mains cord from the mains socket. With the help of small flat blade screwdriver remove the fuse cap of the fuse holder, located just below the socket. There is one spare fuse kept in the fuse cap, replace it for the defective one. Press the cap so that it locks in place . The rating of the fuse is 150 mA , 250 V , slow blow , 5x20 mm glass fuse. Do not use a fuse with a higher value other wise it may damage the instrument in case, the mains voltage goes much higher than the rating of the mains fluctuation of $\pm 10\%$.

Dispatch Procedure For Service

No user serviceable parts are inside the instrument, should it become necessary to send back the instrument to factory for service, please observe the following procedure.

Before dispatching the instrument please write to us giving full details of the fault noticed.

1. After receipt of your communication, our service department. will advise you whether it is necessary to send the instrument back to us for repairs or the adjustment is possible in your premises.
2. Dispatch the instrument (only on the receipt of our advise) securely packed in original packing duly insured and freight paid along with accessories and a copy of the faults details noticed at our Service Center listed on last page of this manual, nearest to you.

Warranty Conditions

1. Scientific warrants all its Instruments to be free from defects in material and workmanship when used under normal operating conditions in accordance with the instructions given in the manual for a period of 12 (Twelve) months from date of purchase from Scientific or its authorised dealers. The service during the warranty period will be rendered on return to factory /service center basis.
2. Its obligation under this warranty is limited to repairing or replacing at its own discretion. This warranty shall not apply to any defect, failure or damage caused by accident, negligence, mis-application, alteration or attempt to repair, service or modify in any way.
3. This warranty does not include LCD, fuses, batteries or accessories. This warranty is only valid with the original purchaser who must have properly registered the product within 15 days from date of purchase. No other warranty is expressed or implied.
4. When it becomes necessary to return the instrument to our Factory facility, kindly pack it carefully in the original carton or equivalent and ship it duly insured, transportation charges prepaid.
5. Your Scientific instrument is a complex electronic device and deserves the best service available by technicians thoroughly familiar with its service and calibration procedures.