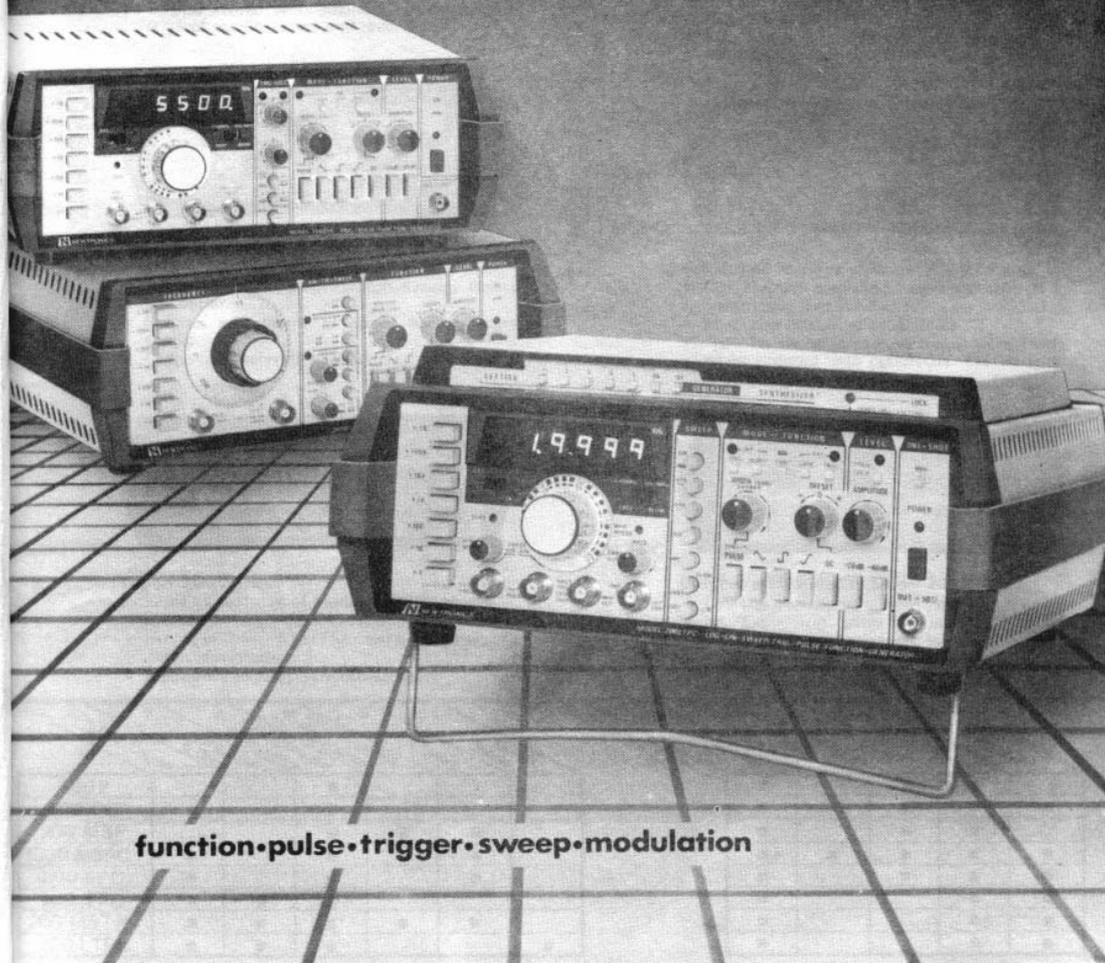


NEWTRONICS

series 200 CDF generators



function • pulse • trigger • sweep • modulation

SPECIFICATIONS

VERSATILITY

Waveforms: Sine \sim , square \square , triangle \wedge , DC, pulse $\text{—}|$, sawtooth \nearrow and distorted sine achieved by symmetry variations.

Operational Modes ("T" Designed Models):
CONTINUOUS: Generator runs continuously at selected frequency.

TRIGGERED (EXTERNAL): Generator is quiescent until triggered by external signal or manual trigger, then generates one complete waveform cycle at selected frequency.

GATED (EXTERNAL): As triggered mode, except output continues for duration of gate signal. Last waveform started is completed.

INTERNAL-TRIGGERED/ GATED (BURST): (Not in model 200TPC) Same as external except triggering/gating is done by the sweep sawtooth signal, which is internally applied to perform bursts (in the gate mode) and single cycles at selected frequencies. Sweep "rate" control determines the burst repetition rate, "width" determines the number of cycles in each burst. ("rate" may slightly influence as well).

MANUAL ("MAN"): Pressing "MAN" will perform one cycle in the external "TRIG" mode. In the external "GATE" mode the output will continuously oscillate as long as "MAN" is pressed.

FREQUENCY LOCKING/SYNCHRONIZING: Generators' output frequency can be stabilized by locking it to external references applied to "lock" input connector.

SYNTHESIZER (OPTION): The synthesizer's pushbuttons are used to electronically set the output frequency. Setting is displayed on 5 CDF-display digits. The frequency is determined by: $FREQ. = SETTING \times MULT.$ (where "MULT" is the generator's frequency range multiplier chosen).

Pulse Generator Performance: TTL pulse, dual pulse (positive + negative), high level (20V) pulse, one-shot pulses, self-defined logic (amplitude + DC), all repetition rate and duty cycle controlled.

AM-Internal/External ("M" Designed Models): Auxiliary 400Hz (approx.) internal sine wave will modulate generator's sine wave at the main output. Modulation depth is adjustable from 0 to 100%. External waveforms will perform tone bursts.

FM-Internal/External ("M" Designed Models): Auxiliary 400Hz (approx.) internal sine wave will modulate any frequency selected at the generator's output. Deviation is adjustable by "MOD LEVEL" control. 8Vpp (400Hz approx.) modulating source is then available at the "AF OUT" connector. Impedance 600 Ω . FSK and lin/log sweep are available at the external FM mode.

"HF" Mode (Model 200MSPC Only): Generator's sine wave output is increased to: 7MHz — when ordered with option 01. 11MHz — when ordered with option 02.

Sweep ("S" & "L" Designed Models): Sweep start and stop frequencies are held for precise sweep limit adjustment.

Sweep modes: Linear or logarithmic (Model 200 LTPC).

Sweep width: Max. width 1000:1 achieved by positive (internal) 0V-4V sawtooth.

Sweep rate: Continuously variable 30msec to 10sec (\sim 2sec) in "S" models. Continuously variable 100sec to 1msec (1KHz) via "fast/slow" and "rate" controls in Model 200 LTPC.

Sweep output: Impedance 1K Ω in "S" marked models. Impedance 1.5K Ω in Model LTPC. Linear ramp is available in both lin or log modes. 3V peak into open circuit.

Marker output: Step function at "MKR - OUT" Level variable 0-4V via front panel "MKR-INTENS" Control (screwdriver adjustment). Fan out — 10 TTL loads minimum.

Frequency Range: 0.002Hz-2MHz in 7 overlapping ranges. 2MHz-5.5MHz Option 01. For higher sine wave frequency see "HF" mode.

Main Output: \sim , \square , \wedge variable to 20Vpp. Impedance 50 Ω (600 Ω special request). ATTENUATOR (-90 dB) 0-60 dB in 20 dB steps, plus 30 dB vernier (amplitude).

TTL PULSE OUTPUT functions as SYNC. out also. TTL pulse at generator's frequency, rise and fall time typical 40nsec (counters: "INT/EXT" slide switch in "EXT"), duty cycle variable by "WIDTH" control.

DC Offset and DC Output: DC output appears at main (50 Ω) output by depressing "DC" pushbutton and releasing all other function pushbuttons. DC offset is achieved by adding "DC" function to any of the main output waveforms (sine, square, triangle, sawtooth and pulse). Waveform offset and DC output continuously variable to $\pm 10V$, signal peak plus DC offset limited to $\pm 10V$ and are proportionally attenuated by the attenuator.

Sweep Input (VCG): Up to 1000:1 frequency change with external (AC or DC) 0 to +5V signal. To achieve maximum width, dial setting should be at the minimum and a 0 (or 50mV negative) to +5V sawtooth must be applied. Same can be done with 0 to +5V sawtooth when the dial is set to maximum.

INPUT IMPEDANCE: 5k Ω .

LINEARITY: 0.5%.

SLEW RATE: 2% of range per μ sec.

Width (Symmetry) Control: Width of square wave and symmetry of all waveform outputs is continuously adjustable from 10% to 90% (approx.). Varying width provides variable duty cycle pulses, sawtooth ramps and non-symmetrical sine waves.

Trigger Gate and Phase ("T" Designed Models):

Impedance: 10K Ω .

Pulse Width: 200 nsec minimum.

Repetition Rate: 1MHz maximum.

MODEL 200TPC: Includes also adjustable triggered signal start/stop phase: -90° to $+90^\circ$ on sine wave with calibrated 0 position ($\pm 85^\circ$ for triangle) "SLOPE" pushbutton increases phase range to -180° to $+180^\circ$.

"SLOPE" Enables triggering on positive (+) or negative (-) slopes.

"MAN": Allows manual gating or triggering or creating fully adjustable "one-shot" pulses when in the pulse generator mode.

FREQUENCY AND AMPLITUDE PRECISION

Dial Accuracy:

Synthesized models: 0.005% of setting
Models with counter ± 1 least significant digit (virtually 100% accuracy)
Models without counter $\pm 3\%$ of full scale up to 200KHz, $\pm 5\%$ of full scale from 200KHz to 5.5MHz.

Time Symmetry: 1% to 200KHz

Sine Flatness: 0.2dB to 2MHz, 3.0dB up to 5.5MHz

WAVEFORM CHARACTERISTICS

Sine Distortion: $< 1.0\%$ for 20Hz to 100KHz.

Triangle Linearity: Better than 99% up to 200KHz.

Square Wave Rise and Fall Time: Typical 75nsec terminated with a 50 Ω load.

Stability: Amplitude, frequency and DC offset $\pm 0.25\%$ for short term, 0.5% for 24 hours. Synthesized models: locking is done to a 10MHz/30PPM crystal providing an overall frequency stability of 5×10^{-5} for long term.

SYNTHESIZER OPTION:

Range: 20Hz to 2MHz, setting is accepted from 0.1000 to 1.9999 (20:1 freq. ratio).

Resolution: 0.001Hz on "X10" frequency multiplier, decreasing by a factor of 10 for each multiplier increase.

Locking time: within 0.01% of final frequency in < 2 sec; on X100, X1K, X10K, X100K and X1M ranges (after first lock).

Frequency Stability: 5×10^{-5} for long term.

FREQUENCY COUNTER

Measures generator's frequency in the "INT" mode or external signals in the "EXT" mode.

Range: 5Hz to 90MHz (100MHz with decreased sensitivity).

Accuracy: ± 1 digit + time base accuracy.

Resolution: 1Hz (100Hz on 1-100MHz range).

Sensitivity: 70mVRMS 50Hz to 50MHz, trimmer controlled at front panel.

Impedance: 1M Ω /25pF.

Time Base: 10MHz — 30PPM crystal.

Overload: Maximum 250Vrms to 1kHz.

Display: 6-digit led shows frequency in kHz.

GENERAL

Environmental: Specifications apply at $(25 \pm 5)^\circ\text{C}$. Instrument will operate from 0°C to 50°C .

Dimensions: 310mm W X 100mm H X 354mm D.

Weight: 4 Kg.

Power: 230VAC (115V option) $\pm 10\%$, 50-60Hz consumption, 20 watts max.

Note: Specifications apply for dial at 0.2-2.0 with DC offset removed, with 50 Ω resistive load and after 20min. warm-up. All specifications are subject to change without notice.

SECTION 2: OPERATION

Simple selection of the desired waveform will bring sine, square or triangle to the main output.

Proper use of the built in - 4 step attenuator plus 30dB vernier (Amplitude) will bring the output to the desired level.

It is important to understand that in order to achieve clean, noise free waveforms one should avoid using the amplitude control in its very low end but to reach low level amplitude by proper attenuation keeping amplitude control far for its very low end.

NOTE: Sine distortion is affected by the ambient temperature who strongly affects waveform symmetry. Waveform symmetry determines distortion. A 1.0% distortion is curranseed in the normal operating conditions. However a far better distortion (0.4-0.5%) may be reached adjusting P4 on PC 200P board.

DC OUTPUT AND DC OFFSET

DC output appears at the main output by depressing "DC" pushbutton and releasing all other pushbuttons. Turning the "OFFSET" knob clockwise will bring positive dc level to the main output.

This level is also controlled by the attenuator. (Same can be done with negative dc level).

DC offset is achieved by adding the above DC output to any of the main output waveforms. (Clipping distortion may appear if DC OFFSET plus signal peak reaches the output amplifiers level limitations - +/- 10V into open circuit).

CDF - COUNTER DISPLAYED FREQUENCY

A built-in 100 MHz/70mV frequency counter, based on new LSI technology, is a unique Newtronics feature.

These Function Generators, give a frequency setting accuracy of ± 1 least significant digit and overcoming the 2, 3 or 5% errors found on normal function generators by a few decades.

CDF also overcomes the influence of changing environmental conditions, and hence stability, as any change in the output frequency is automatically indicated on the digital readout and can be reset by the high resolution coarse-fine tuning control. This 1 : 10 reduction drive enables the frequency to be adjusted in small accurate steps, similar to that achieved by a synthesiser.

Another benefit of the internal counter is the ability to feed an external signal of up to 100 MHz into the function generator to double as a 100 MHz, 6 digit Frequency Meter.

FREQUENCY SETTING

* A suggested way to adjust CDF generators' frequency combines a use of the main dial to bring the generator near the required frequency and the fine adjustment to the exact required value observed on the counter's display.

* To achieve high setting accuracy on low frequency signals (the built in counter will read down to 5 Hz only), use either of the following methods:

- a. Adjust a frequency 10000 times higher than the required frequency and then divide by 10000 - accuracy is 2%, e.g., 0.2 Hz is required - adjust the generator to 2000 Hz using the "x10K" multiplier, then divide by 10000 depressing the "x1" multiplier. The frequency achieved is 0.2 Hz with 2% accuracy of the multiplier capacitors.
- b. Ignore the counter's display and relate your reading to the dial marks only - accuracy is then of course the dial accuracy only.

5.5 MHZ 7 MHZ AND 11 MHZ FREQUENCY SETTING

Frequency adjustments up to 2 MHz are simply achieved by the multiplier pushbutton and the continuous coarse/fine dial.

To achieve 2-5.5 MHz signals all multiplier pushbuttons must be released, then the dial's upper part (half of the whole arc) will bring the generator to the required frequency.

For sinewaves higher in frequency - up to 7 or 11 MHz (Model 200 MSPC) frequency setting is achieved using "HF" mode with the built in frequency counter and ignoring the marks on the dial. specifications will considerably be degraded in this range.

Note: Normal operation of the generator should use the dial between 0.2 to 2.0 only. Specifications like distortion, stability, linearity etc. apply only to this range, and may seriously be affected when the 0.002 to 0.2 dial range is used. The main aim for this dial range is to enable wide frequency span for sweep purpose in order to enable wide band sweeping when upper sweep limit is set to 2.0 the lower limit should be set to 0.002 (1 : 10000 range) or lower. However for sweep purposes output level flatness is of major importance and other specifications like distortion and stability are of secondary importance only.

SAWTOOTH AND DISTORTED SINE

A symmetrical triangle is chosen; depress the "SYM". Pushbutton! Turning the "Width (SYM)" push button in both directions will continuously vary the triangle waveform from a quick rise time, slow fall time sawtooth to a slow rise time and quick fall time sawtooth. The above modification is smooth and continuous and can be done also with the sinewave output.

PULSE GENERATOR PERFORMANCE

Simple operation of the 200 series as a pulse generator is achieved by depressing two function pushbuttons.

SQUARE WAVE PUSHBUTTON

"PULSE" PUSHBUTTON.

TTL Logic: +3V squarewave is available at the "PULSE OUTPUT"

This signal is repetition rate controlled by the "Width" knob.

Negative logic: Set any required negative square wave using

"LEVEL" + "OFFSET" controls. The repetition rate and duty cycle can then be controlled.

Dual pulse generator: is available when using the "PULSE OUTPUT" at its negative logic mode.

C mos logic: is available due to the high output levels at the main output.

Self defined logic: The "0" and "1" logic levels can be set as required e.g.

For "0" = -2V and "1" = +4V use 6 volt output level shifted + 1V positively by the "DC OFFSET" control. For "0" = - 5V and "1" = +3V use 8V output level shifted -1V negatively by the "DC OFFSET" control.

After setting the above - duty cycle and repetition rate can be modified by "WIDTH" control and by the frequency dial respectively.

NOTES

1. The actual rise/fall time of the TTL output depends on counters "INT/EXT" switch position (as TTL output is slightly loaded when used for frequency monitoring).
 - 40 nsec when in the "EXT" mode
 - 70 nsec when in the "INT" mode
 - 25 nsec when loaded with a 50 ohm load (level will not longer be TTL level).
2. As the repetition rate is increased, a conflict develops between the minimum pulse width dictated by rise and fall time considerations and the command to adjust down to 10 percent duty cycle. The rise time limitations prevail and the minimum pulse width on the X1M range is approximately 100 nanoseconds.
3. It is important to remember that modifying duty cycle ("WIDTH" control) will slightly affect frequency which can of course be readjusted using the CDF arrangement). The reason for that is simple - the two current sources that produce the main triangle/square waveforms are controlled by two potentiometer wafers rotated by the same shaft = these two wafers are not 100% matched and therefore cause the frequency change.

S W E E P

SWEEP - "L" and "S" designed models.

Frequency sweeps of up to 1:1000 may be obtained on any frequency range. Choosing the proper frequency multiplier should be done by stop frequency consideration, both start and stop frequencies should be within the chosen range.

The low starting frequency is set by the main dial in the normal continuous mode (pressing "STR" pushbutton is necessary on model 200LTPC), the high sweep limit may be set by pressing "STP" pushbutton and adjusting the "WIDTH" control.

Both Start & Stop frequencies can statically be read on the CDF/Counter for precise setting. Depressing "RUN" will sweep the output frequency linearly or logarithmically ("Lin/Log" pushbutton), the sweeping speed is set by "FAST/SLOW" pushbutton and continuously variable "RATE" control.

The sawtooth output waveform may be used for driving the X axis of an XY recorder and the marker output (Model 200LTPC only) can be used as a recorder pen lift signal.

NOTE:

1. Markers' intensity (Model 200LTPC) is screwdriver adjustable via front panel ("MKR INTENS." control).
2. Start/Stop setting accuracy is +/- 5%, stop frequency setting accuracy is +/- 10% on the log - sweep mode.
3. Markers' positioning capabilities depend on stop to start ratio, slight jitter may appear when the marker is at its extreme starting point.

APPLICATIONS

1. Response analyzer system.

The sweep section in "S" designed models is so arranged as to create a:

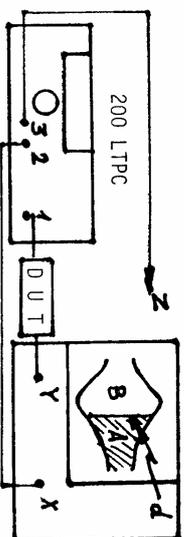
FULL RESPONSE CURVE ANALYZER

If a certain device has to be analyzed, the Sweep Generator must be preset on the desired frequency band. An oscilloscope, used as a display, should be preadjusted to the generator and then:

- * A response picture with a complete marker system is present.
- * Accurate frequency and level measurements can be made.
- * A detailed view of desired segments is possible.

2. Response analysis using intensity modulation marker - Model 200 LTPC:

The marker output 3 is connected to the oscilloscope-Intensity modulation input Z, the response picture is then divided into two areas:



- 2-"-out"-connected to the oscilloscope X input
 - 3-"MKR-out" connected to the oscilloscope Z input (intensity modulation input.)
- The separating line d can be shifted left and right using the generators' marker control ("Width-Sym" control is used as a marker control in the Sweep Mode).

Adjusted to a point of interest and depressing "MKR" pushbutton provides the following:

1. Frequency. (of the point of interest) is immediately displayed on the CDF Counter - high or low resolution can be chosen
2. Amplitude can be measured using the oscilloscope's calibration or by connecting a DMM to the oscilloscope Y input.
3. Segments of interest can be enlarged using higher sensitivity on the X input and X position control.

TRIGGER GATE AND PHASE ("T" DESIGNED MODELS)

Provides selection of the modes in which the main generator may be operated:

- A. CONTINUOUS: An uninterrupted train of selected wave form at the output.
- B. TRIGGERED: Generator starts at d-c baseline and produces one complete waveform cycle when enabled by an external trigger signal or the Manual trigger. Waveform ends at the original d-c baseline.
- C. GATE: Same as triggered except that waveform cycles continue for as long as the external or MANUAL trigger is applied. The last cycle is always completed and ends at the original d-c baseline.
- D. INTERNAL - TRIGGER - GATE - BURST

In this mode the sweep sawtooth is internally applied to the Trig/Gate circuitry and produces bursts or triggers single-cycles when "INT" "TRIG" pushbutton is depressed.

Sweep "RATE" control in the "FAST" or "SLOW" modes determines the Burst (or Trigger) repetition rate, sweep "WIDTH" control presets the number or cycles in each burst.

E. MANUAL ("MAN")

Depressing "MAN" will perform one cycle in the "EXT" "TRIG" mode. In the "EXT" "GATE" mode the output will continuously oscillate as long as "MAN" pushbutton is depressed.

F. "FREQ. LOCK"

The generator's output frequency can be stabilized by locking it to any external reference. The reference should be applied to the "LOCK" input BNC connector, the generator's frequency "FREQ. LOCK" pushbutton should be depressed - LED lamp lights, then fine frequency tune will bring the generator to a complete lock.

NOTE: it is recommended to confirm that by observing both signals on a dual trace oscilloscope.

TRIGGER LEVEL (MODEL 200TPC)

Adjust the level (-10 to +10 volts) at which an external d-c voltage will trigger or gate the generator.

PHASE (MODEL 200TPC)

Active only in the TRIG, GATE, models, the PHASE control permits continuous adjustment of the start and stop d-c baseline for sine and triangle waveforms. Approximately +/- 90 degrees of adjustment is provided so that haversine (sine squared) and havers-triangle functions can be generated as well as baseline initiated ramps (variable symmetry triangles).

"SLOPE" (MODEL 200TPC)

Enables triggering on positive (+) or negative (-) slopes therefore the phase range increases to +/- 180°.

NOTE

1. On multiplier frequency range of x100KHz or higher the stop phase angle of the output waveform may vary from the theoretical zero degrees, in some discrete frequencies it may reach 30-40°.
2. It is recommended to use "LIN" and not "LOG" mode (on model 200LTPC) for internal triggering and gating, in this mode it is more convenient to adjust the number of cycles accurately.
3. It is recommended to disconnect the sweep circuitry in Trigger/Gate modes - "ON" pushbutton on model 200LTPC released - this will avoid noise on the DC-ground line.
4. To avoid bouncing on the 200TPC "ONE-SHOT" mode make sure that "DIS" led lamp lights.

OPERATING HINTS

UNIPOLAR RAMP. - Unipolar positive or negative ramps starting at and returning to zero volts may be triggered from the main generator with the proper settings of the following controls: Waveform at triangle PHASE at +/-90 degrees; MODE at Trig and adjust the SYM vernier for desired duty cycle. OFFSET may be added if desired.

CREATING NARROW PULSES WITH LONG VARIABLE DELAYS.

By cabling the SWEEP RAMP output to the TRIG/input, operating in the TRIG mode and adjusting the TRIGGER LEVEL control to pick off the desired delay along the ramp, the main generator will trigger out one pulse each ramp period.

AM - FM MODULATION ("W" designed models)

The "W" designed models are equipped with a built in auxiliary audio oscillator.

The "AM-FM" pushbutton will select the desired type of modulation "Mod Level" knob will vary the AM depth in the AM mode (to 100 %) and will also change FM deviation in the FM modulation mode. The auxiliary audio source (which is the modulating source) appears simultaneously at the "AF OUT" BNC connector.

In the external "EXT." mode any waveform applied to the "AM-FM INPUT" connector will modulate the generator. Modulation level will be controlled by the same "MOD. LEVEL" knob.

In the "EXT." mode of operation complex waveforms like, triangle/sawtooth AM modulation, PWM (Pulse Width Modulation) can be achieved by applying a variable duty cycle pulse, adjustable "RFBURST" - using 100% AM modulated pulse, FSK (Frequency Shift Keying) using pulse in the ext. FM mode, and also adjustable sweep by applying a sawtooth waveform.

NOTES (AM-FM)

1. AM modulation is limited to sinewave output and will reach full specification on frequencies of 20KHz to 5.5MHz.
2. AM/FM modulation may occasionally start at 10% ("MOD-LEVEL" control at zero-full anti-clock wise) instead of a complete "zero" to reach a complete zero simply set modulation to "OFF".
3. Slight distortion of the output waveform may appear on AM modulation reaching beyond 70% depth.
4. In the "HF" mode AM depth is limited to 30% and FM deviation to a few KHz deviation from center frequency.