YIG-Oscillators

YIG-tuned oscillators

A complete range of YIG-tuned oscillators covering 1 to 18 GHz is available. Below 8 GHz uncapsulated bipolar transistors are used as active element and for higher frequencies, up to 18 GHz, GaAs FET's are used. As tuning resonator a YIG-sphere is used. The YIG-tuning gives excellent linearity and the high Q-value results in low noise and good frequency stability.

All oscillators have integral buffer amplifiers to achieve high flat output power and low pulling. For phase locking or modulation applications, a FM coil is standard in the oscillator.

The circuits are made in thin film hybrid technology with gold microstrip line on ceramic substrate.

The oscillators are housed in a cylindrical case serving as tuning magnet for the YIG-circuit as well as self shielding cover. The case is hermetically sealed and filled with an inert gas.

The combination of these technologies results in a microwave oscillator linearly tunable over octave and multioctave bands and able to withstand and operate under severe environmental conditions (wide temperature range, vibration, humidity etc).

Principle of operation

The YIG resonator serves as a tunable reactive element in the YIG-tuned oscillator. It is ideal for this purpose because of the great tunable range and high Q-value. The YIG-resonance determines the oscillation frequency, which is directly proportional to the applied magnetic field, as in YIG-filters. Hence, hysteresis, tuning speed and delay, tuning sensitivity and frequency drift appear similar to YIG-filters and are determined by the magnetic circuit.

Main types

The YIG-tuned oscillators are available in two basic types:

1. Bipolar transistor oscillators with low DC power consumption and covering 1–8 GHz.
2. FET-transistor oscillators for the range 8–18 GHz.

Power output

The output power from the oscillator as measured into a 50 ohm load.

The output power variation is measured over the frequency range. Variations due to changes in base plate temperature are also included.

Tuning linearity

Defined as the maximum frequency deviation from the best fit frequency – current line at 25°C.

The YIG-tuned oscillators exhibit the same excellent linearity as the filters. The effects from the variable reactance of the active element, either transistor or diode, is carefully reduced in the oscillator design.

Tuning current

For estimation of tuning current, use the following formula:

$$\text{Tuning current} \simeq \frac{\text{Frequency in MHz}}{\text{Tuning sensitivity}} \text{mA}.$$

Tuning sensitivity

This is the frequency change per mA tuning current. For most SIVERS IMA YIG-oscillators the tuning current sensitivity is 17.5 to 20 MHz/mA.

FM-modulation

For fast narrow-range FM or phase-lock operation, all oscillators are provided with an integral FM-coil. The FM-coil 3 dB bandwidth is the modulation frequency at which the tuning sensitivity of the coil is reduced to 0.7 of its DC-value. At rates above the –3 dB frequency, the modulation coil behaves as a low-pass filter with a rolloff of 6 dB/octave. The coil resistance is 0.5 ohm and the inductance approx 1 μH.

For high-rate modulation, most oscillators can be provided (option) with a fast FM-coil, which enables modulation frequencies exceeding 3 MHz with an associated frequency deviation greater than $\pm$ 200 MHz

Standard FM-coil characteristics

Coil used in	Tuning current sensitivity kHz/mA	Frequency deviation max MHz	Modulation rate (–3 dB) min kHz	Tuning current max mA
PM 7020L	310	±100	100	400
PM 7025S	310	±100	400	400
PM 7027C	310	±100	400	400
PM 7027SC	310	±100	400	400
PM 7027X	450	±300	400	800
PM 7027P	450	±300	400	800
PM 7027XP	450	±300	400	800

Frequency pushing/pulling

Pushing is the frequency shift caused by change in oscillator supply voltage and is expressed in MHz/V. It is measured at a maximal voltage change of ±0.5 V.

Frequency pulling is the peak-to-peak frequency shift for all phases of a specified load VSWR of 1.5:1.

FM-noise

The FM-noise characteristics are mainly determined by noise contents in the coil current. If a low-noise current source is used, the YIG-tuned oscillators will have a typical FM-noice of 85–100 dBc (SSB, 10 kHz from carrier, 1 Hz bandwidth).

Post tuning drift

This effect is most noticeable on the oscillators at the higher frequency ranges (8–18 GHz). After tuning from one end to the other of the frequency range, the oscillator frequency continues to shift a few megahertz during a time of up to 30 minutes. This is caused by temperature gradients in the magnetic shell.

Environmental

All standard oscillators have a rugged mechanical design and will withstand severe shocks and vibration. Additionally, the case also serves a magnetic shield.

Standard temperature range is 0–50°C but units with extended temperature interval are available on request. Temperature is referred to base plate.

SIVERS IMA can offer special solutions for low noise performance in vibrational environments. Contact factory.

SIVERS IMA standard YIG-oscillator screening proceedure include:

Temperature cycling	6 cycles –50°–+100°C (total 24h).
Burn-in	48 hours at +85°C (RF active)
Hermeticity	Fine and gross leak (He max 2x10–7 atm cc/sec.)

Final electrical tests on computer-testsystem (including ATP)

Extended screening can be provided on request (in accordance with MIL STD 883, 202 and 810) 100 % or batch-sample including:

High temperature storage
Mechanical shock
Vibration
Extended temperature-cycling
Temperature shock
Extended burn-in
Electrical endurance

YIG-tuned oscillators

(Temperature range 0°–50°C, other temperature ranges available on request)

Model	Frequency range GHz	Power output 25°C mW	Power variation dB	Harmonics dBc	Non-harmonics dBc	Frequency drift 0–50°C MHz	Linearity 25°C MHz	Pushing (max 0.5 V) MHz/V	Pulling (VSWR 1.5:1) MHz	Hysteresis MHz	Tuning sensitivity MHz/mA	Tuning coil impedance Ω	Tuning coil impedance mH	Bias supply V	Bias supply mA	Outline	Weight g
PM 7020L	1– 2	30	4	–13	–50	10	± 3	1	1	3	17	20	100	+15 V/–5 V	±100	I	350
PM 7025S	2– 4	30	4	–16	–60	10	± 4	2	1.5	4	20	20	100			K	200
PM 7027C	4– 8	30	4	–12	–60	20	± 7	1	2	7	18	12	110	+15 V/–5 V	±150	M	350
PM 7027SC	2– 8	25	6	–10	–60	20	±10	1	2	10	18	12	110			M	350
PM 7027X	8–12.4	10	4	–20	–60	20	± 5	1	3	10	17	7	90	+15 V	100	O	500
PM 7027P	12–18	10	6	–15	–60	40	±15	1	1	12	17	7	90	+15 V	150	O	500
PM 7027XP	8–18	10	6	–12	–60	40	±20	1	1	14	17	7	90	+15 V	150	O	500

Heater supply: nominal voltage 20–30 V. Current: 40 mA (steady state) to 150 mA (surge).
Broader frequency range available on request.
Please contact factory.

YIG-tuned oscillators/drivers

Model	Basic oscillator	Frequency range[1] GHz	Power output min at 25°C mW	Frequency accuracy MHz[2]	Supply voltage[3] and current surge value	Tuning coil current max mA	Weight g	Outline
PM 7030L	PM 7020L	1– 2	30	±10	+15 V/200 (250) mA	150	550	P
PM 7035S	PM 7025S	2– 4	30	±10	–15 V/200 (250) mA	250	400	U
PM 7037C	PM 7027C	4– 8	30	±15	+15 V/250 (350) mA –15 V/250 (350) mA	450	550	R
PM 7037SC	PM 7027SC	2– 8	25	±20	+15 V/250 (350) mA –15 V/250 (350) mA	450	550	R
PM 7037X	PM 7027X	8–12.4	10	±20	+15 V/200 (300) mA –15 V/100 (200) mA	750	700	T
PM 7037P	PM 7027P	12–18	10	±20	+15 V/250 (350) mA –15 V/100 (200) mA	1100	700	T
PM 7037XP	PM 7027XP	8–18	10	±40	+15 V/250 (350) mA –15 V/100 (200) mA	1100	700	T

[1] Tuning command: 0–10 V for full frequency range.

[2] Frequency accuracy–the maximum deviation from nominal frequency straight line across specified
frequency and temperature range. This value includes effects of nonlineary and temperature drift, but excludes pulling, and hysteresis.

[3] Supply voltages: + and −15 V (±0.2 V) DC. These voltages, supply the driver electronic circuits, the oscillator circuit, the heater for the YIG-sphere and the tuning coil current. The tuning coil is supplied from the −15 V only, but to increase the tuning speed a higher value (max −28 V) may be used. Add tuning coil current to the negative voltage current consumption.

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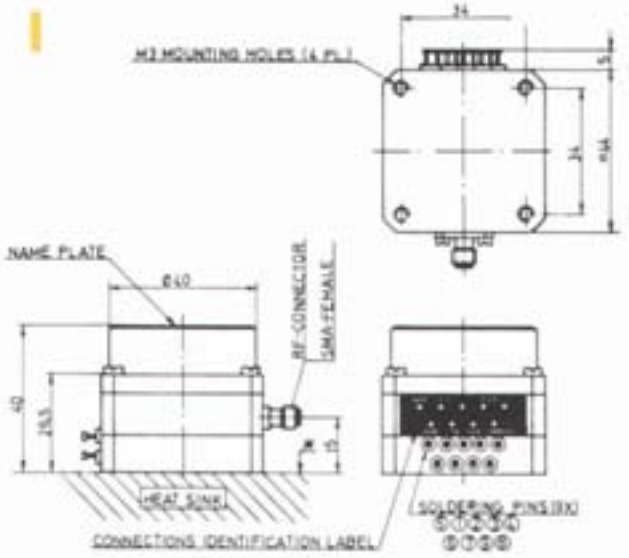
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HEAT SINK
CONNECTIONS IDENTIFICATION LABEL
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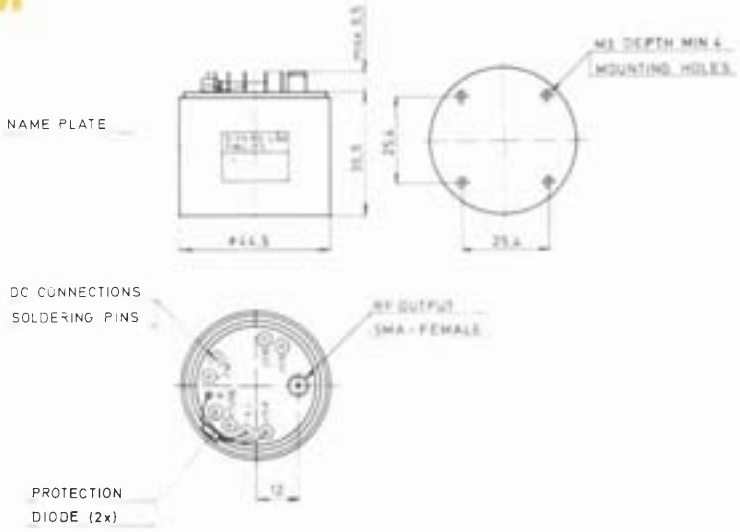
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PROTECTION
DIODE (2x)

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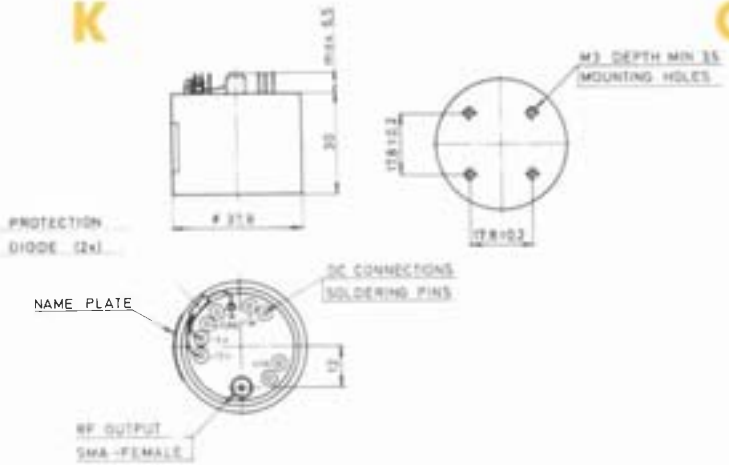
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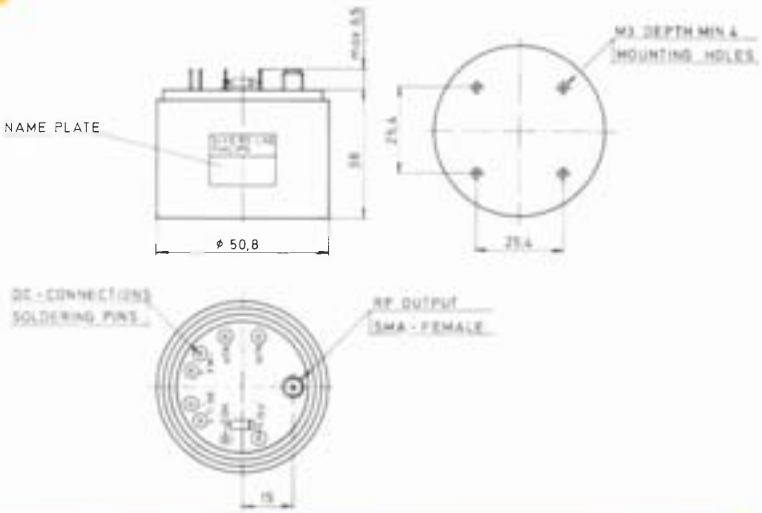
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DC - CONNECTIONS
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