# Test Data Sheet

PM-Li6_0.2M3

(old: EO-Li6-M3)

S/N:

Resonant electro-optic phase modulator

with
- tunable resonance frequency
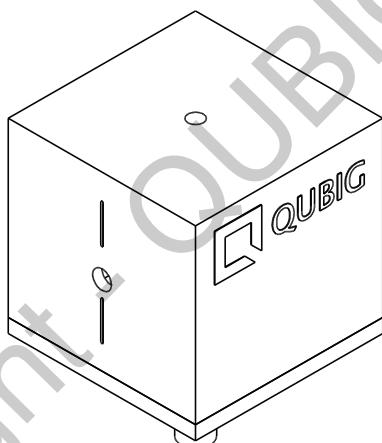
RF properties	Value	Unit
Resonance frequency: f_0 [1]	196 - 265	MHz
Preset frequency: f_{set} [1]	229	MHz
Bandwidth: $\Delta\nu$	897	kHz
Quality factor: Q	255	
Required RF power for 1rad @ 671nm [2]	21.3	dBm
max. RF power: RF_{max} [3]	1	W

Optical properties		
EO crystal	MLN	
Aperture	3x3	mm^2
Wavefront distortion (633nm)	λ/4	nm
recommended optical intensity (671nm)	<5	W/mm^2
AR coating (R<0.5%)	360 - 720	nm

[1] at 22.3°C   [2] with 50Ω termination   [3] no damage with RF_{in} < 5W

Fig. 1: Oscilloscope trace

$f_0 = 229.$ MHz
$\beta = 0.99$ rad
$\lambda_{test} = 671$ nm
$RF_{in} = 21.2$ dBm

Intensity [arb. units] vs Modulation frequency [MHz]
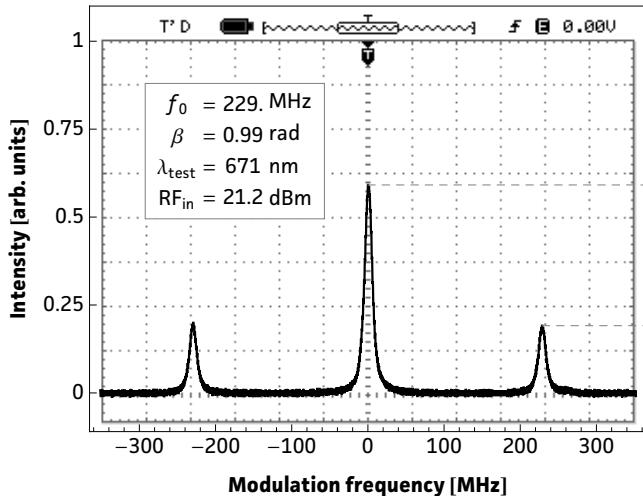
Fig. 2: Carrier/sideband ratio

Bessel Fct.
— $|J_0|^2$
— $|J_1|^2$
— $|J_2|^2$

rel. Intensity vs Modulation depth β [rad]
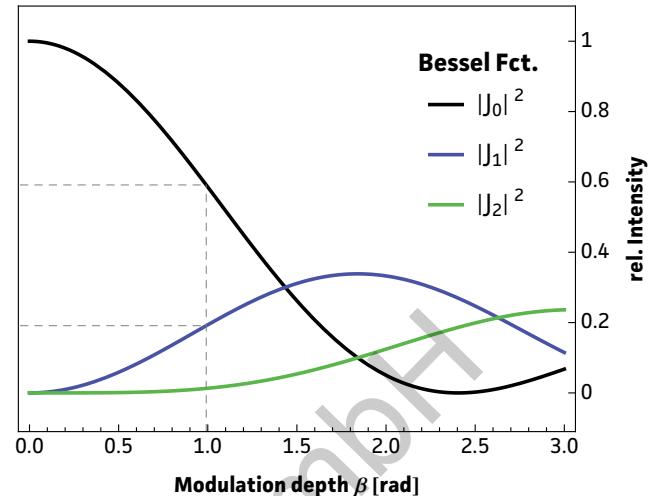
Table 1: Expected modulation

$\beta = 1$ rad	unit	λ_1
λ	nm	**671**
P	dBm	21.3
P	mW	134
U	V_p	3.7
U_π	V_p	11.5
β / U	rad / V	0.27

Fig. 3: RF−signal amplitude vs. modulation depth
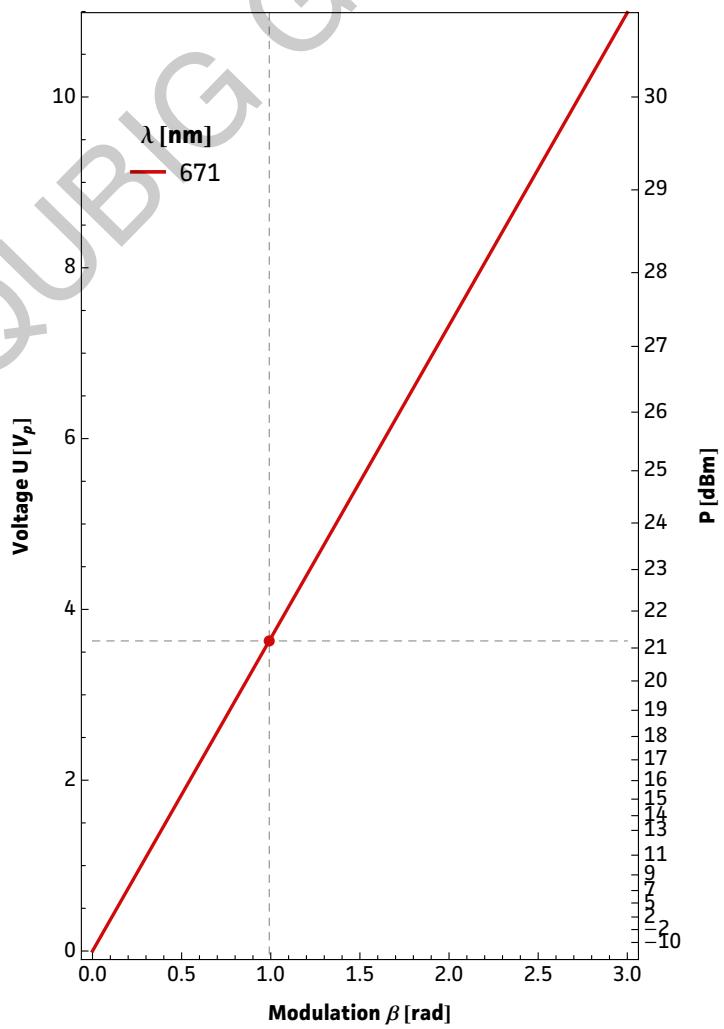
Fig.1: Recorded oscilloscope trace retrieved from a test setup as illustrated below.

Fig.2: Squared absolute values of first-kind Bessel functions vs. modulation depth. Vertical lines reveal the ratio between the carrier $|J_0|^2$ and the ith sideband $|J_i|^2$ at a specific ß.

Fig.3: Dependency between RF amplitude and modulation depth for different wavelengths. Points on the curve allow to retrieve either the required RF amplitude for a specific/desired ß or the max. achievable modulation depth for a given/available RF power.

Table 1: Expected RF-amplitude/-power values and conversion factors for the required wavelength at the reference modulation depth of 1 rad. **Note:** Experimentally recorded modulation depth displayed in Fig.1 might vary from the respective values (ß=1rad) provided in the table.

laser
EOM
RF
spectrum analyzer
PD
Oscilloscope
Test setup
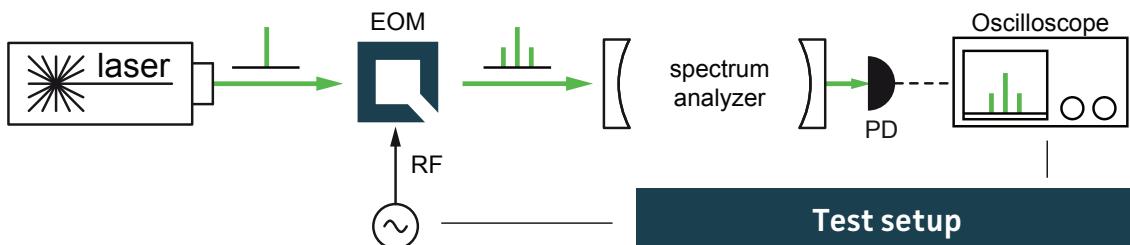
Resonance characteristics

Test setup

laser — +45° Glan-Thompson Polarizer — EOM — - 45° Glan-Thompson Polarizer — PD → Transmission / Vector Network Analyzer / Return ← RF sweep
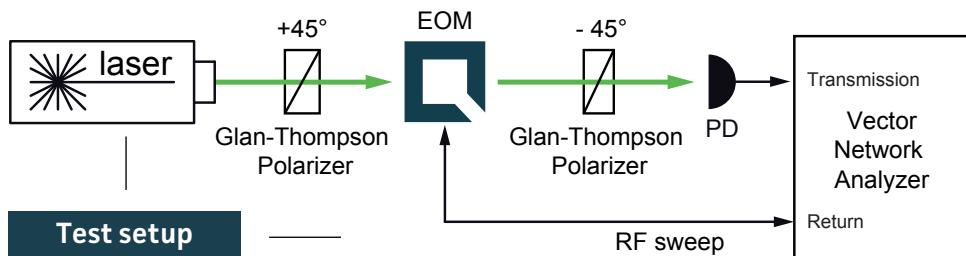
4/4/2017 6:36:00 PM
1328.5170K92-100899-yZ

Trc1 —— S11 dB Mag 5.3 dB/ Ref -23.5 dB Cal int 1

M1 228.992000 MHz -46.3622 dB
M2 228.547432 MHz -3.2413 dB
M3 229.447284 MHz -3.1854 dB
M4 228.996916 MHz -38.6987 dB

Ch1 Center 228.994 MHz Pwr 3 dBm Bw 10 kHz Span 10 MHz

Trc2 —— S21 dB Mag 5 dB/ Ref -30 dB Cal int 2

Bandpass Ref to Max Track
Bandwidth 897.189654 kHz
Center 228.997410 MHz
Lower Edge 228.549255 MHz
Upper Edge 229.446445 MHz
Quality Factor (3dB) 255.239 U
Loss 19.1133 dB

M1 228.986000 MHz -19.1133 dB
M2 228.549255 MHz -22.1133 dB
M3 229.446445 MHz -22.1133 dB
*M4 228.997410 MHz -19.1227 dB

Ch1 Center 228.994 MHz Pwr 3 dBm Bw 10 kHz Span 10 MHz

Trc3 —— S11 Smith 200 mU/ Ref 1 U Cal int 3

M1 228.998000 MHz 48.861 Ω
-j766.491 mΩ
906.737 pF
M2 228.547432 MHz 32.976 Ω
j75.206 Ω
52.371 nH
M3 229.447284 MHz 9.654 Ω
j12.496 Ω
8.668 nH
M4 228.996916 MHz 49.089 Ω
-j728.873 mΩ
953.540 pF

Ch1 Center 228.994 MHz Pwr 3 dBm Bw 10 kHz Span 10 MHz

Trc4 —— S21 Phase 20°/ Ref -60° Cal int 4

M1 228.998000 MHz -59.16 °
M2 228.547432 MHz -13.66 °
M3 229.447284 MHz -103.33 °
M4 228.996916 MHz -59.03 °

Ch1 Center 228.994 MHz Pwr 3 dBm Bw 10 kHz Span 10 MHz

Tuning performance

| MAX resonance frequency	f_0 max	265	MHz
MIN resonance frequency	f_0 min	196	MHz
number of turns	N_{max}	10	
counter clock-wise turns ↗	higher f_0 ↑		
clock-wise turns ↘	lower f_0 ↓		

- use only supplied tuning tool
- actuate tuner carefully
- do not apply too much pressure or torque
- keep tuning tool coaxial
- tuner might not be perfectly orthogonal to box

$f0_{max}$

Attention: no upper stop!

$f0_{min}$

0 ------------ (tuning: ccw) ------------> N_{max}
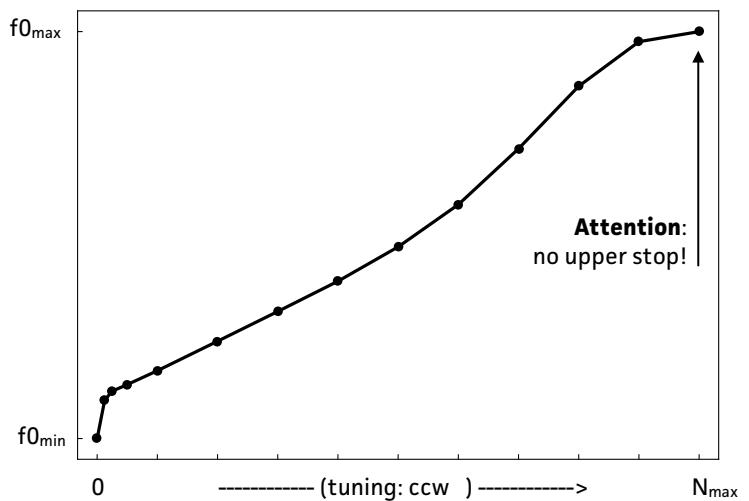
- Input laser polarization must be aligned with respect to the white markers on the housing
- Please handle device carefully. Avoid shock. Don't drop.
- After turn on the resonance frequency might drift slightly with applied RF power. Please compensate by tuning the RF drive frequency until steady-state (~min).
- Slight angle adjustment can reduce unwanted residual amplitude modulation (RAM)

Package drawing

8,5

40

31,5

M4x0.7 (max. 4mm)
mounting option

20
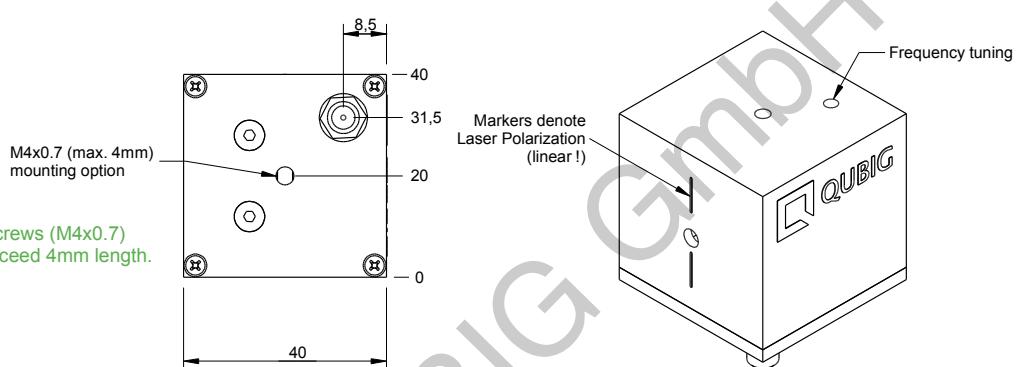
Note 1: mounting screws (M4x0.7) must not exceed 4mm length.

0

40

Frequency tuning

Markers denote
Laser Polarization
(linear !)

QUBIG

QUBIG

40

20

20

Ø 4
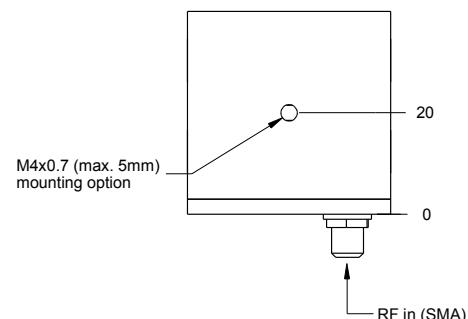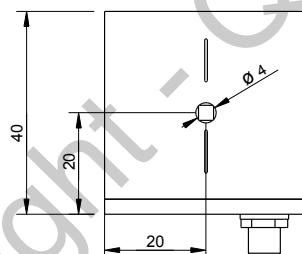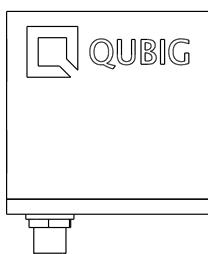
Note 2: crystal aperture is 3x3mm.

M4x0.7 (max. 5mm)
mounting option

20

0

RF in (SMA)
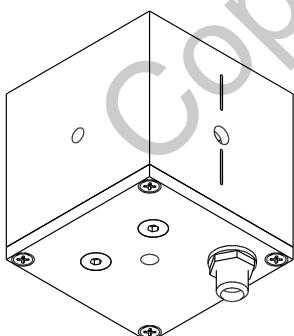
M4x0.7 (max. 4mm)
mounting option

Frequency tuning

Attention!!

- use only supplied tuning tool
- actuate tuner carefully
- do not apply too much pressure or torque
- keep tuning tool coaxial
- tuner might not be perfectly orthogonal to box

Tested by:

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