

Product Overview

- Application:**
- Passive mode-locking
 - Q-switching

BATOP GmbH

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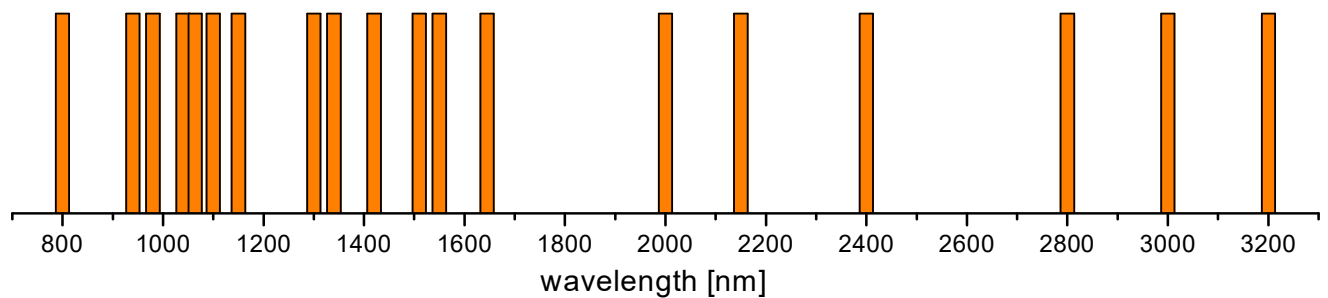
Phone: +49 3641 634009 - 0

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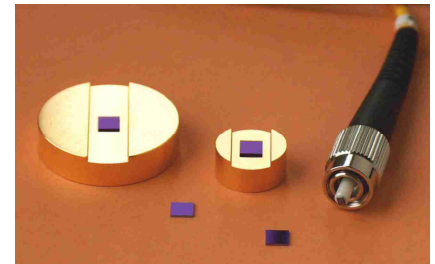
URL: <http://www.batop.de>

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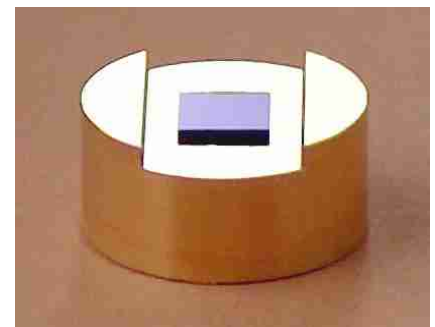
Available Wavelengths



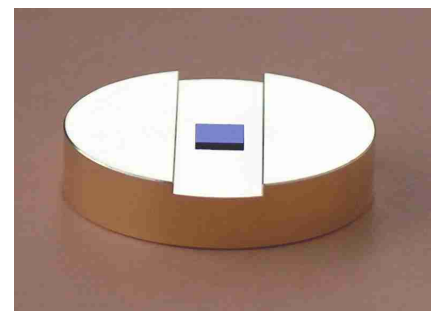
SAM 800	Laser wavelength Saturable absorption Relaxation time	$\lambda = 780 - 830 \text{ nm}$ $A_0 = 5 - 10 \%$ $\tau = 1 \text{ ps}$
SAM 940	Laser wavelength Saturable absorption Relaxation time	$\lambda = 910 - 990 \text{ nm}$ $A_0 = 4 - 30 \%$ $\tau = 1 \text{ ps}$
SAM 980	Laser wavelength Saturable absorption Relaxation time	$\lambda = 940 - 1000 \text{ nm}$ $A_0 = 2 - 70 \%$ $\tau = 500 \text{ fs}$
SAM 1040	Laser wavelength Saturable absorption Relaxation time	$\lambda = 1020 .. 1050 \text{ nm}$ $A_0 = 1 - 64 \%$ $\tau = 500 \text{ fs} - 10 \text{ ps}$
SAM 1064	Laser wavelength Saturable absorption Relaxation time	$\lambda = 1050 .. 1100 \text{ nm}$ $A_0 = 0.7 - 70 \%$ $\tau = 500 \text{ fs} - 124 \text{ ps}$
SAM 1100	Laser wavelength Saturable absorption Relaxation time	$\lambda = 1070 .. 1120 \text{ nm}$ $A_0 = 30 - 90 \%$ $\tau = 500 \text{ fs}$
SAM 1150	Laser wavelength Saturable absorption Relaxation time	$\lambda = 1100 .. 1200 \text{ nm}$ $A_0 = 3 - 32 \%$ $\tau = 500 \text{ fs} / 1 \text{ ps}$
SAM 1300	Laser wavelength Saturable absorption Relaxation time	$\lambda = 1230 .. 1330 \text{ nm}$ $A_0 = 4 - 12 \%$ $\tau = 10 \text{ ps} / 12 \text{ ps}$



Mounting Options



12.7 mm Ø - (1/2" Ø) - Cu-Mount



25.4 mm Ø - (1" Ø) - Cu-Mount

SAM 1340	Laser wavelength Saturable absorption Relaxation time	$\lambda = 1310 \dots 1370 \text{ nm}$ $A_0 = 1 - 15 \%$ $\tau = 1 \text{ ps}$
SAM 1420	Laser wavelength Saturable absorption Relaxation time	$\lambda = 1360 \dots 1460 \text{ nm}$ $A_0 = 1 - 4 \%$ $\tau = 10 \text{ ps}$
SAM 1510	Laser wavelength Saturable absorption Relaxation time	$\lambda = 1470 \dots 1570 \text{ nm}$ $A_0 = 4 - 23 \%$ $\tau = 10 \text{ ps}$
SAM 1550	Laser wavelength Saturable absorption Relaxation time	$\lambda = 1500 \dots 1600 \text{ nm}$ $A_0 = 2 - 55 \%$ $\tau = 2 - 12 \text{ ps}$
SAM 1645	Laser wavelength Saturable absorption Relaxation time	$\lambda = 1560 \dots 1720 \text{ nm}$ $A_0 = 2 - 50 \%$ $\tau = 2 \text{ ps}$
SAM 2000	Laser wavelength Saturable absorption Relaxation time	$\lambda = 1900 \dots 2050 \text{ nm}$ $A_0 = 2 - 36 \%$ $\tau = 10 \text{ ps} / 30 \text{ ps}$
SAM 2150	Laser wavelength Saturable absorption Relaxation time	$\lambda = 2050 \dots 2200 \text{ nm}$ $A_0 = 2.5 - 8 \%$ $\tau = 10 \text{ ps}$
SAM 2400	Laser wavelength Saturable absorption Relaxation time	$\lambda = 2300 \dots 2600 \text{ nm}$ $A_0 = 1 \% / 1.5 \%$ $\tau = 10 \text{ ps}$
SAM 2800	Laser wavelength Saturable absorption Relaxation time	$\lambda = 2700 \dots 2900 \text{ nm}$ $A_0 = 4 \% - 23 \%$ $\tau = 10 \text{ ps}$
SAM 3000	Laser wavelength Saturable absorption Relaxation time	$\lambda = 2500 \dots 3200 \text{ nm}$ $A_0 = 9 - 33 \%$ $\tau = 10 \text{ ps}$

Chip area: 1.3 mm x 1.3 mm, 4 mm x 4 mm, 8 mm x 8 mm
(other dimensions on request)

Chip thickness: 450 μm (other on request)

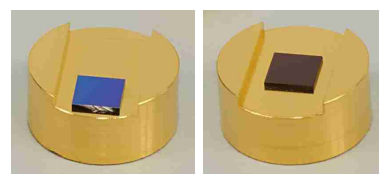
- Mounting:
- Unmounted
 - Glued or soldered on:
 - 12.7 mm $\varnothing$ (1/2" $\varnothing$) Cu-mount
 - 25.0 mm $\varnothing$ Cu-mount
 - 25.4 mm $\varnothing$ (1" $\varnothing$) Cu-mount
 - Soldered on a water-cooled 25.0 mm $\varnothing$ Cu-mount
 - Thin film soldered on a water-cooled Cu-mount
 - Fiber coupled (SMF, PM fiber) / Fiber mount FM1.3
 - Mounting on custom mounts on request



Fiber coupled SAM



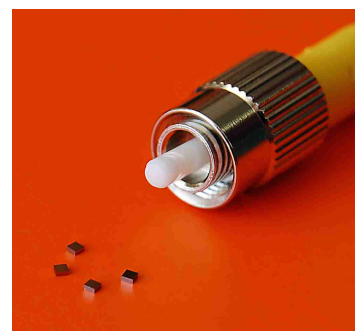
Fiber mount FM1.3



Edge
mounting Center
mounting



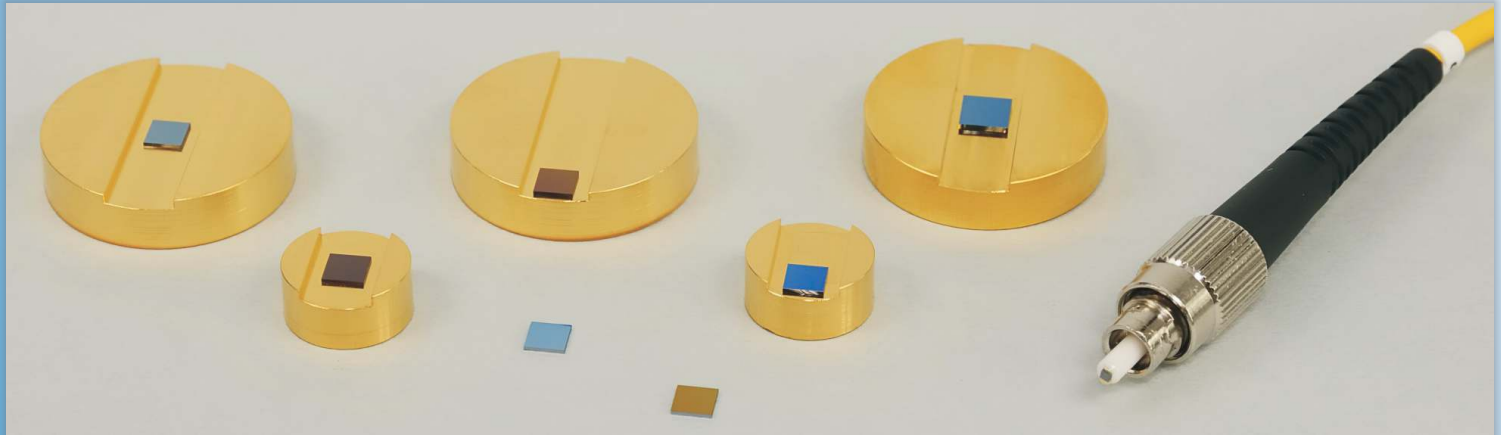
Water-cooled 25.0 mm $\varnothing$ Cu-mount



Batch of 4 chips, 1.3 mm x 1.3 mm

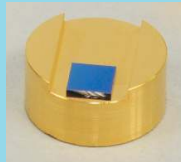
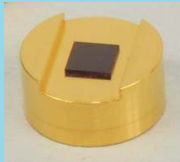
Other wavelengths and parameters on request.

Saturable Absorbers - Mounting Options



SAM™ - saturable absorber mirror

- unmounted chip 4.0mm x 4.0mm / 1.3mm x 1.3mm
- batch of 4 small unmounted chips (1.3mm x 1.3mm)
- glued or soldered on a gold plated copper mount
- mounts of 12.7mm (1/2"), 25.0mm or 25.4mm (1") diameter
- edge or center mounting



- mounted on a single mode fiber with FC/PC or FC/APC connector



- **for high power applications:**
soldered on a water cooled gold plated copper mount with 25.0mm diameter



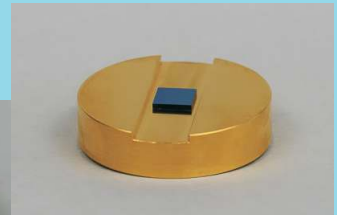
soldered chip on water cooled mount with 25.0mm diameter

or thin film soldered on a water cooled gold plated copper mount with 25.0mm diameter

- custom mounts on request

SOC - saturable output coupler

- unmounted chip 5.0mm x 5.0mm
- glued or soldered on a gold plated copper mount with 4mm diameter clearance hole
- mounts of 12.7mm (1/2") or 25.4mm (1") diameter
- edge or center mounting
- mounted on a single mode fiber with FC/PC or FC/APC connector
- custom mounts on request



SA - saturable absorber

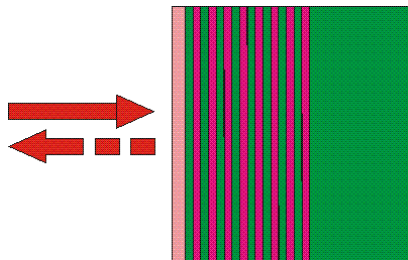
- unmounted chip 5.0mm x 5.0mm
- batch of 4 small unmounted chips (1.3mm x 1.3mm)
- glued on a gold plated copper mount
- mounts of 12.7mm (1/2"), 25.0mm or 25.4mm (1") diameter and thickness of 3mm or 6mm
- edge or center mounting
- mounted inside a single mode fiber with FC/PC connectors
- custom mounts on request



RSAM™ – Resonant Saturable Absorber Mirror

Product Overview

- For optical noise suppression or optical pulse cleaning after a pulse picker or amplifier
- Low intensity reflectance at resonance wavelength $\leq 1 \%$



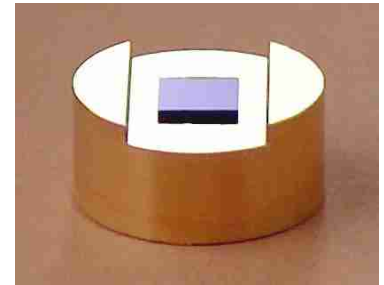
RSAM 980	Laser wavelength	$\lambda = 968 - 984 \text{ nm}$
	Absorptance	$A_0 \geq 99 \%$
	Modulation depth	$\Delta R \sim 60 \%$
	Relaxation time	$\tau \sim 1 \text{ ps}$
	Saturation fluence	$\Phi_{\text{sat}} = 15 \text{ } \mu\text{J}/\text{cm}^2$

RSAM 1030	Laser wavelength	$\lambda = 1030 \text{ nm}$
	Absorptance	$A_0 \geq 99 \%$
	Modulation depth	$\Delta R \sim 55 \%$
	Relaxation time	$\tau \sim 1 \text{ ps}$
	Saturation fluence	$\Phi_{\text{sat}} = 50 \text{ } \mu\text{J}/\text{cm}^2$

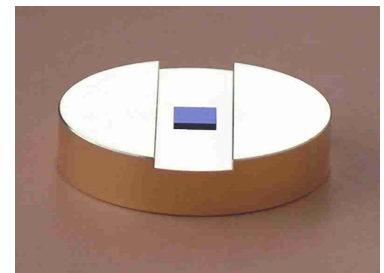
RSAM 1064	Laser wavelength	$\lambda = 1050 - 1064 \text{ nm}$
	Absorptance	$A_0 \geq 98 \%$
	Modulation depth	$\Delta R \sim 60 \%$
	Relaxation time	$\tau \sim 9 - 32 \text{ ps}$
	Saturation fluence	$\Phi_{\text{sat}} = 15 - 30 \text{ } \mu\text{J}/\text{cm}^2$

RSAM 1550	Laser wavelength	$\lambda = 1530 - 1560 \text{ nm}$
	Absorptance	$A_0 \geq 98 \%$
	Modulation depth	$\Delta R \sim 60 \%$
	Relaxation time	$\tau \sim 10 \text{ ps}$
	Saturation fluence	$\Phi_{\text{sat}} = 15 \text{ } \mu\text{J}/\text{cm}^2$

Mounting Options



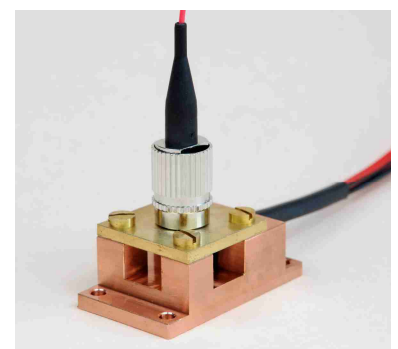
12.7 mm $\varnothing$ - Cu-Mount with
 $\varnothing$ 4 mm hole



25.0 mm / 25.4 mm $\varnothing$ - Cu-Mount



Fiber coupled RSAM



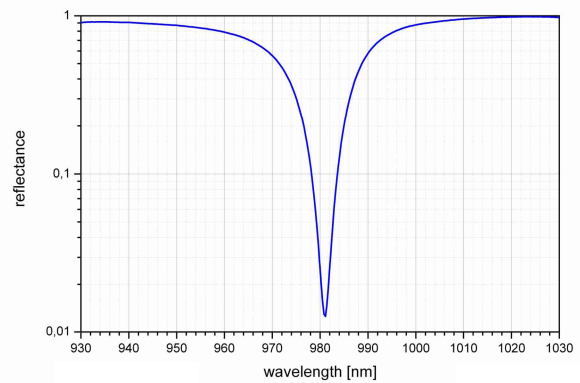
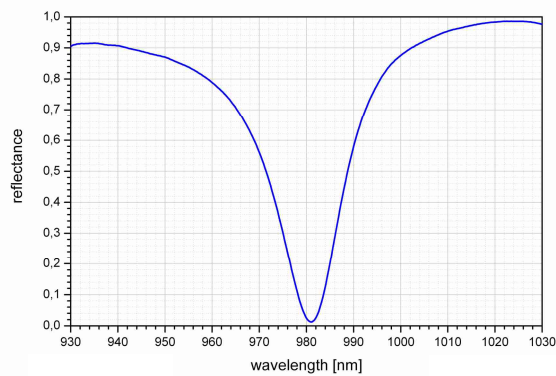
Fiber coupled RSAM™ with TEC
cooler

Other wavelengths and parameters on request.

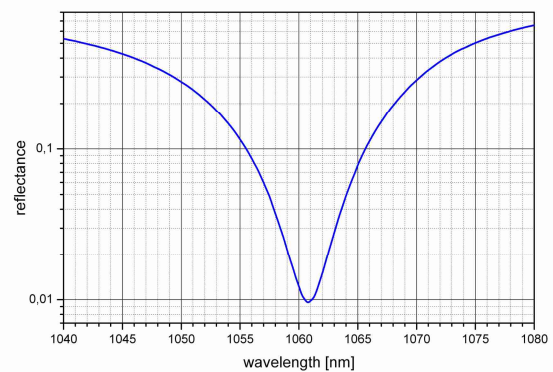
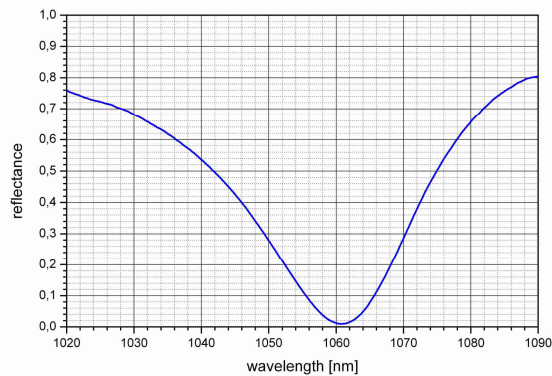
- | | |
|-----------------|--|
| Chip area: | 4 mm x 4 mm |
| Chip thickness: | 450 μm , semi – insulating GaAs |
| Mounting: | <ul style="list-style-type: none"> ▪ Unmounted ▪ Glued or soldered on: <ul style="list-style-type: none"> ▪ 12.7 mm $\varnothing$ (1/2" $\varnothing$) Cu-mount ▪ 25.0 mm $\varnothing$ Cu-mount ▪ 25.4 mm $\varnothing$ (1" $\varnothing$) Cu-mount ▪ Soldered on a water-cooled 25.0 mm $\varnothing$ Cu-mount ▪ Thin film soldered on a water-cooled Cu-mount ▪ Fiber coupled (SMF, PM fiber) ▪ Fiber coupled (SMF, PM fiber) with TEC cooler ▪ mounting on custom mounts on request |

Spectral reflection / transmission:

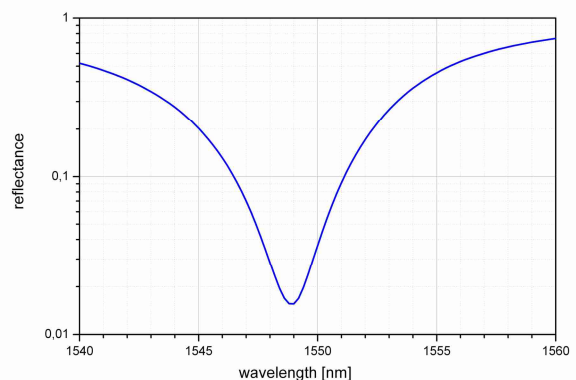
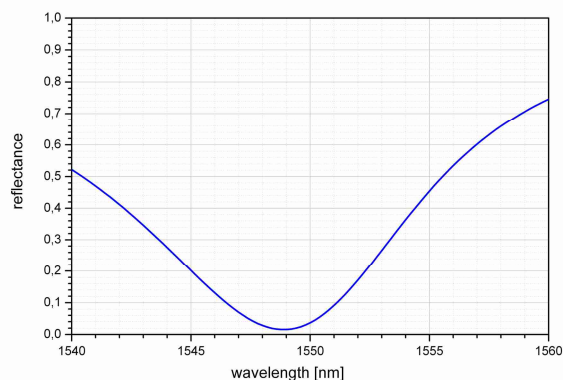
RSAM 980-X



RSAM 1064-X



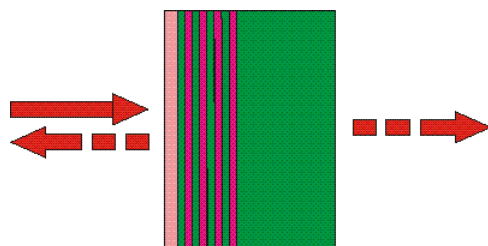
RSAM 1550-X



SOC – Saturable Output Coupler

Product Overview

- For passive mode-locking of solid state lasers and use as laser output element



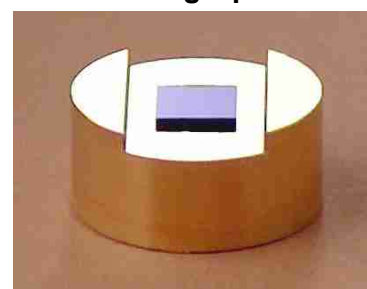
SOC 1040	Laser wavelength	$\lambda = 1020 - 1080 \text{ nm}$
	Absorptance	$A_0 = 2 - 24 \%$
	Modulation depth	$\Delta R = 1.2 - 9.5 \%$
	Transmittance	$T = 0.4 - 19 \%$
	Relaxation time	$\tau = 1 - 15 \text{ ps}$
	Saturation fluence	$\Phi_{\text{sat}} = 40 - 90 \mu\text{J}/\text{cm}^2$

SOC 1064	Laser wavelength	$\lambda = 1040 - 1100 \text{ nm}$
	Absorptance	$A_0 = 1 - 22 \%$
	Modulation depth	$\Delta R = 0.6 - 9.5 \%$
	Transmittance	$T = 0.3 - 23 \%$
	Relaxation time	$\tau = 1 - 20 \text{ ps}$
	Saturation fluence	$\Phi_{\text{sat}} = 40 - 500 \mu\text{J}/\text{cm}^2$

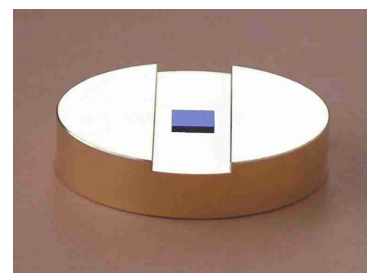
SOC 2000	Laser wavelength	$\lambda = 1950 - 2050 \text{ nm}$
	Absorptance	$A_0 = 26 - 40 \%$
	Modulation depth	$\Delta R = 15 - 23 \%$
	Transmittance	$T = 19 - 28 \%$
	Relaxation time	$\tau \sim 10 \text{ ps}$
	Saturation fluence	$\Phi_{\text{sat}} = 70 - 80 \mu\text{J}/\text{cm}^2$

Other wavelengths and parameters on request.

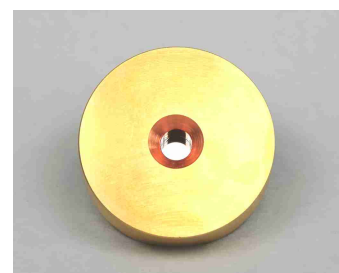
Mounting Options



12.7 mm $\varnothing$ - Cu-Mount with
 $\varnothing$ 4 mm hole



25.0 mm / 25.4 mm $\varnothing$ - Cu-Mount
with $\varnothing$ 4 mm hole



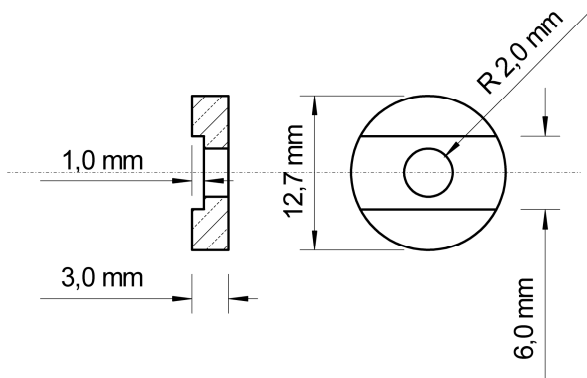
Backside of 25.0 mm / 25.4 mm
 $\varnothing$ - Cu-Mount with $\varnothing$ 4 mm hole



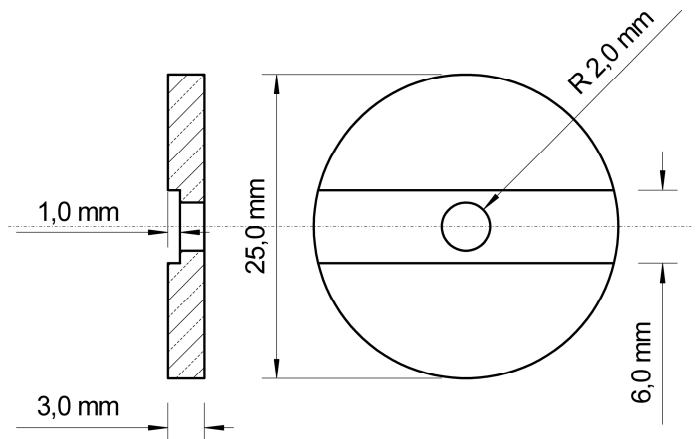
Fiber coupled SOC

Chip area:	5 mm x 5 mm
Chip thickness:	625 μm , semi – insulating GaAs
Front side coating:	Dielectric protection layer
Back side:	Polished and AR coated
Mounting:	▪ Unmounted ▪ Glued on: ▪ 12.7 mm $\varnothing$ Cu-mount with $\varnothing$ 4 mm hole ▪ 25.0 mm $\varnothing$ Cu-mount with $\varnothing$ 4 mm hole ▪ 25.4 mm $\varnothing$ Cu-mount with $\varnothing$ 4 mm hole ▪ Fiber coupled (SMF, PM) ▪ Mounting on custom mounts on request

Cu-Mount $\varnothing$ 12.7 mm with $\varnothing$ 4 mm hole:

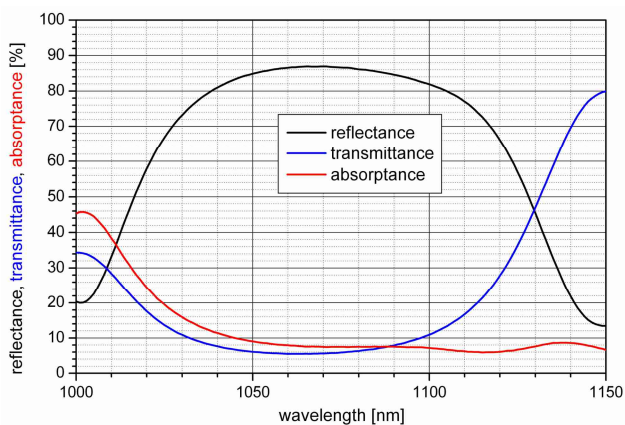


Cu-Mount $\varnothing$ 25.4 mm with $\varnothing$ 4 mm hole:

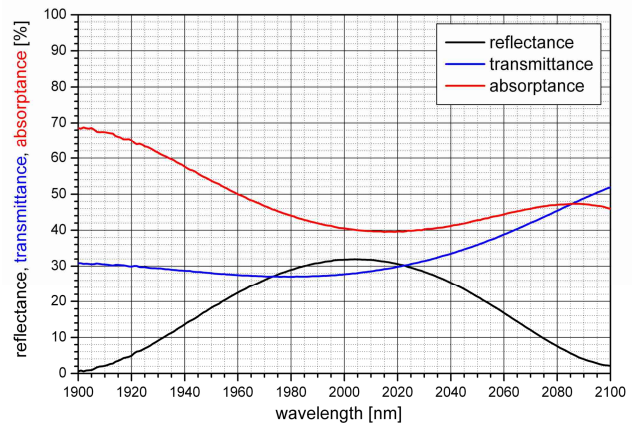


Spectral reflection / transmission:

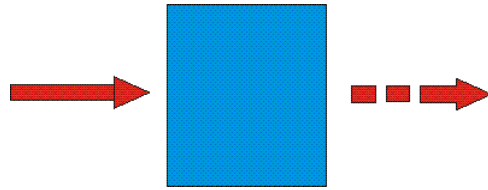
SOC-1064-8-6-1ps-X



SOC-2000-40-28-1ps-X



SANOS™ – Saturable Noise Suppressor



Product Overview

- Cleaning of optical noise between consecutive pulses after a pulse picker or optical amplifier
- All optical wavelength conversion of pulsed optical signals

SANOS 1064	Laser wavelength	$\lambda = 1050 - 1064 \text{ nm}$
	FWHM	17 nm / 15 nm *
	Noise suppression ratio	12 dB / 20 dB *
	Insertion loss	3 dB / 6 dB *
	Relaxation time	$\tau \sim 9 \text{ ps}$
	pulse fluence for saturation	$F = 4 \mu\text{J}/\text{cm}^2 / 10 \mu\text{J}/\text{cm}^2 *$

* Two-stage FS-SANOS

SANOS 1550	Laser wavelength	$\lambda = 1530 \text{ nm} \dots 1560 \text{ nm}$
	FWHM	15 nm
	Noise suppression ratio	up to 18 dB **
	Insertion loss	3 dB
	Relaxation time	$\tau \sim 5 \text{ ps}$
	pulse fluence for saturation	$F = 30 \mu\text{J}/\text{cm}^2$

** dependent on the input SNR

Other wavelengths and parameters on request.



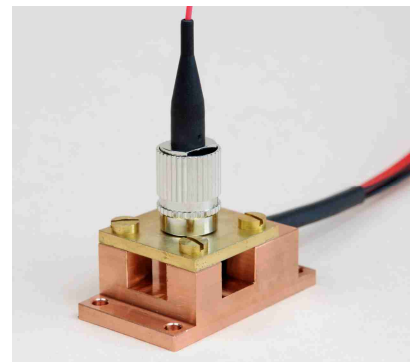
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Mounting Options



Free space (FS) SANOS™

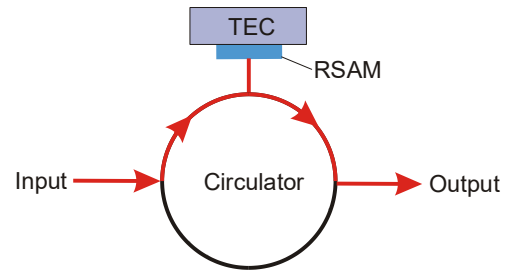
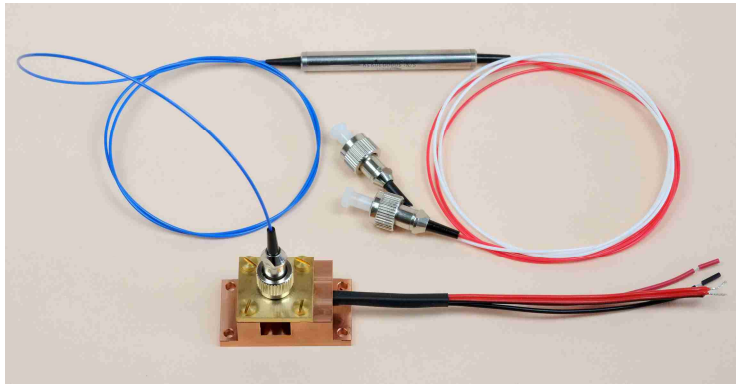


Fiber coupled (FC) SANOS™ with
TEC cooler



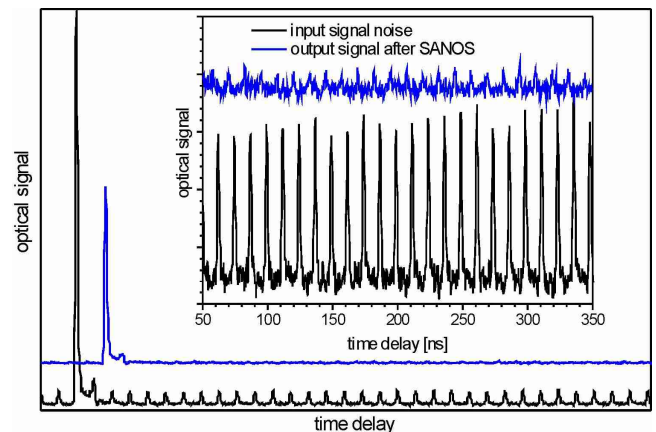
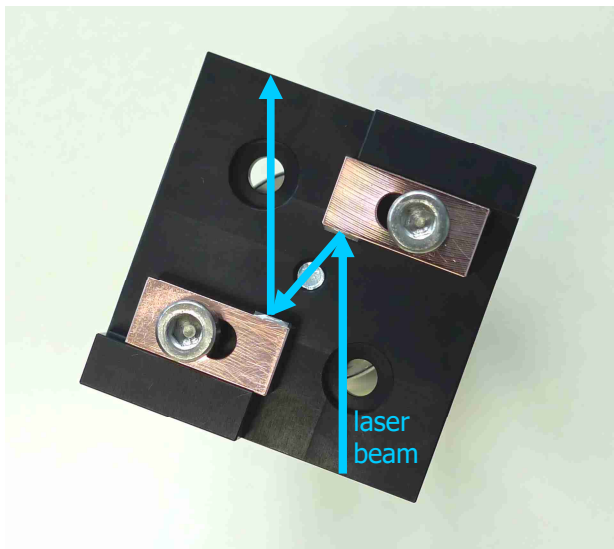
Fiber coupled SANOS™

FC-SANOS™ with thermoelectric cooler (TEC)



A FC-SANOS is a resonant saturable absorber mirror (RSAM), mounted on a circulator. The RSAM has a strong non-linear reflectance, therefore the low level input signal transmittance of the FC-SANOS is only 3% (97% loss), whereas high intensity pulses are transmitted with a lower loss of 50%. Because the RSAM is a resonant device, the noise is only suppressed at the resonance wavelength. The RSAM is temperature controlled using a thermoelectric cooler/heater (TEC) for fine tuning of the resonance wavelength with a maximum shift of 6 nm.

FS-SANOS™

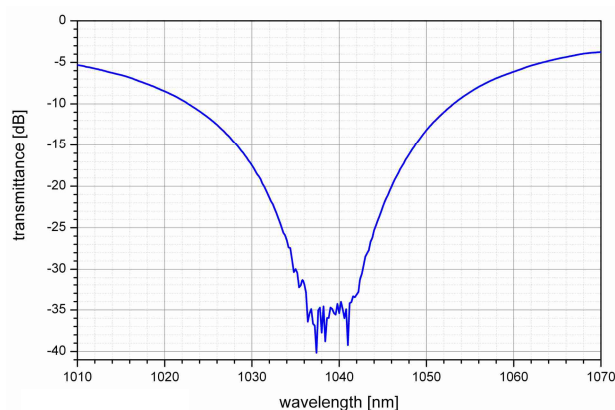


Measured suppression of small pulses (after a pulse picker) using a SANOS. The black curve is the time dependent optical signal, which hits the SANOS and the blue curve is the SANOS output signal.

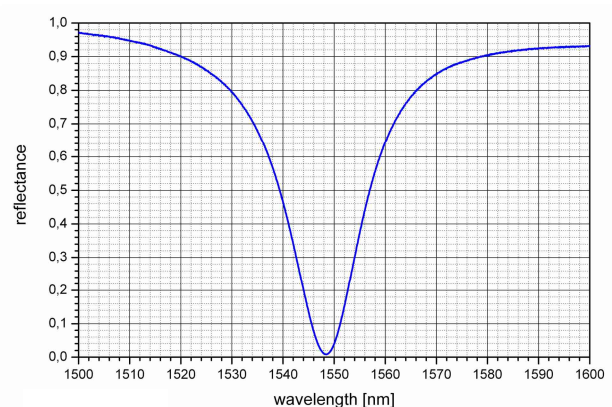
A FS-SANOS consists of a resonant saturable absorber mirror (RSAM) and a conventional 100% mirror (optional with second RSAM). The beam propagates through the FS-SANOS without changing of the direction, but with a parallel offset of about 2 mm. The RSAM has a strong non-linear reflectance, therefore the low level input signal transmittance is only 2 % (98 % loss), whereas high intensity pulses are transmitted with a lower loss of 50 %.

Spectral transmission:

FS-SANOS-1040-2



FC-SANOS-1550



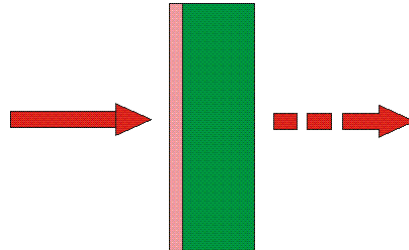
SA – Saturable Absorber

Product Overview

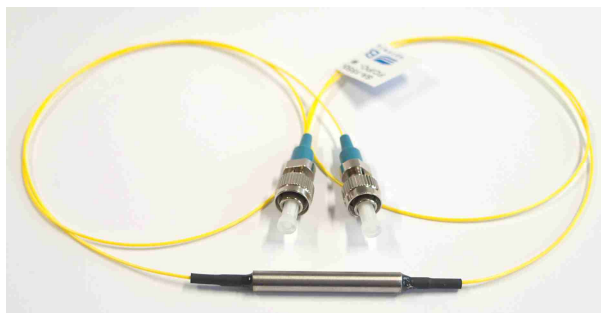
- Saturable absorber for use in transmission applications
- For passive mode-locking of solid state, ring or fiber ring lasers

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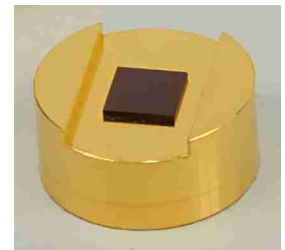


SA 1020	Laser wavelength Absorptance Relaxation time Saturation fluence	$\lambda = 980 \text{ nm} - 1040 \text{ nm}$ $A_0 = 40 \%$ $\tau \sim 500 \text{ fs}$ $\Phi_{\text{sat}} = 300 \mu\text{J}/\text{cm}^2$
SA 1064	Laser wavelength Absorptance Relaxation time Saturation fluence	$\lambda = 1030 \text{ nm} - 1090 \text{ nm}$ $A_0 = 14 - 40 \%$ $\tau \sim 500 \text{ fs} - 37 \text{ ps}$ $\Phi_{\text{sat}} = 300 \mu\text{J}/\text{cm}^2$
SA 1550	Laser wavelength Absorptance Relaxation time Saturation fluence	$\lambda = 1400 \text{ nm} - 1600 \text{ nm}$ $A_0 = 6 - 58 \%$ $\tau \sim 2 - 20 \text{ ps}$ $\Phi_{\text{sat}} = 300 \mu\text{J}/\text{cm}^2$
SA 2000	Laser wavelength Absorptance Relaxation time Saturation fluence	$\lambda = 1900 \text{ nm} - 2100 \text{ nm}$ $A_0 = 1 - 43 \%$ $\tau \sim 10 \text{ ps}$ $\Phi_{\text{sat}} = 300 \mu\text{J}/\text{cm}^2$
SA 2800	Laser wavelength Absorptance Relaxation time Saturation fluence	$\lambda = 2500 \text{ nm} - 3000 \text{ nm}$ $A_0 = 10 \%$ $\tau \sim 10 \text{ ps}$ $\Phi_{\text{sat}} = 300 \mu\text{J}/\text{cm}^2$

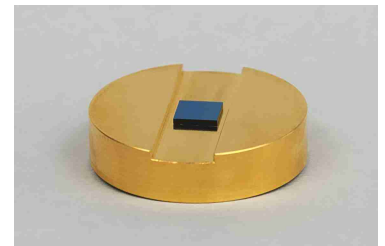


Other wavelengths and parameters on request.

Mounting Options



12.7 mm $\varnothing$ - Cu-Mount with
 $\varnothing$ 4 mm hole



25.0 mm $\varnothing$ - Cu-Mount with
 $\varnothing$ 4 mm hole



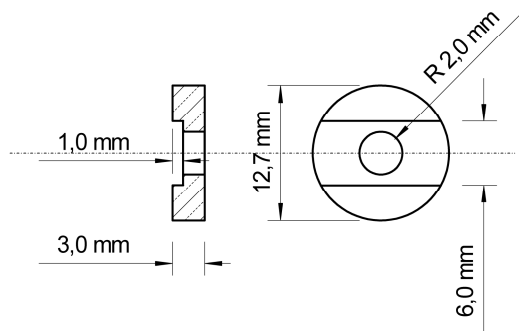
Backside of 25.0 mm $\varnothing$ - Cu-Mount
with $\varnothing$ 4 mm hole



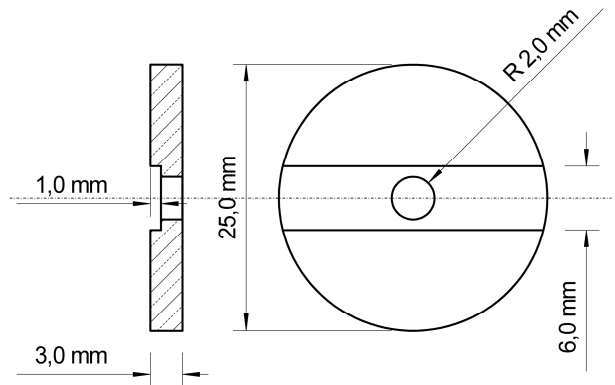
Fiber coupled SA

Chip area:	5 mm x 5 mm
Chip thickness:	625 μ m semi – insulating GaAs, other thickness on request
Front side protection:	AR coating
Back side:	Polished and AR coated
Mounting:	▪ Unmounted ▪ Glued on: ▪ 12.7 mm $\varnothing$ Cu-mount with $\varnothing$ 4 mm hole ▪ 25.0 mm $\varnothing$ Cu-mount with $\varnothing$ 4 mm hole ▪ Fiber coupled (SMF, PM) ▪ Mounting on custom mounts on request

Cu-Mount $\varnothing$ 12.7 mm with $\varnothing$ 4 mm hole:

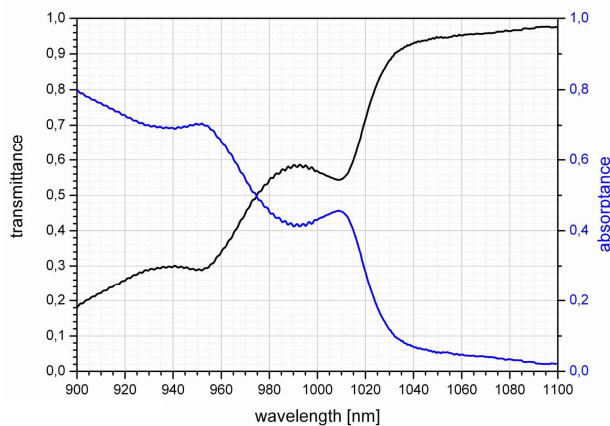


Cu-Mount $\varnothing$ 25.0 mm with $\varnothing$ 4 mm hole:

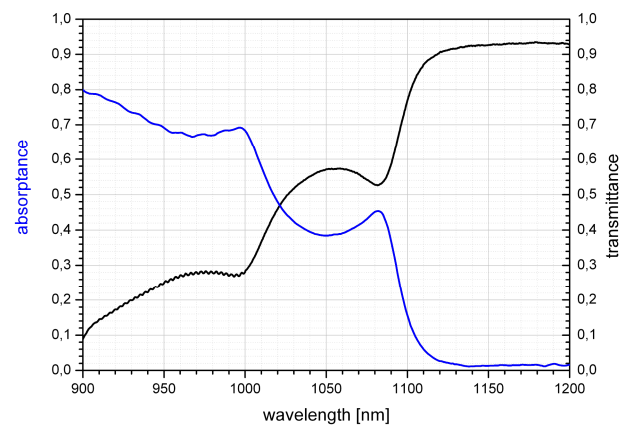


Spectral transmission / absorption:

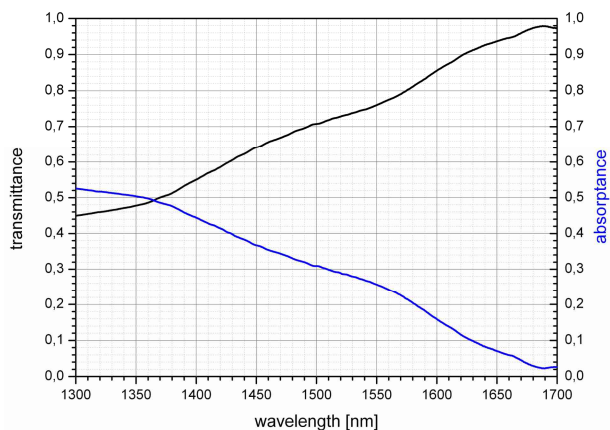
SA 1020-40-X



SA 1064-40-X



SA 1550-25-X



SA 2000-25-X

