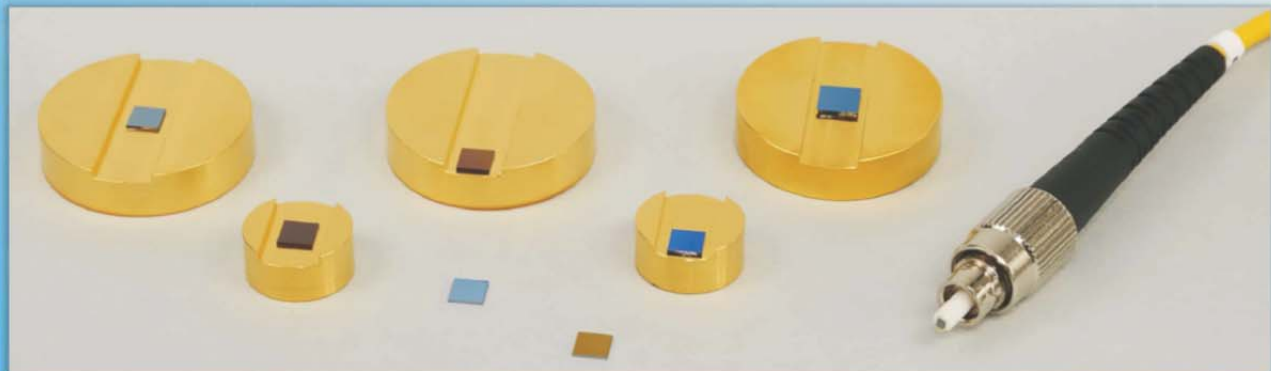
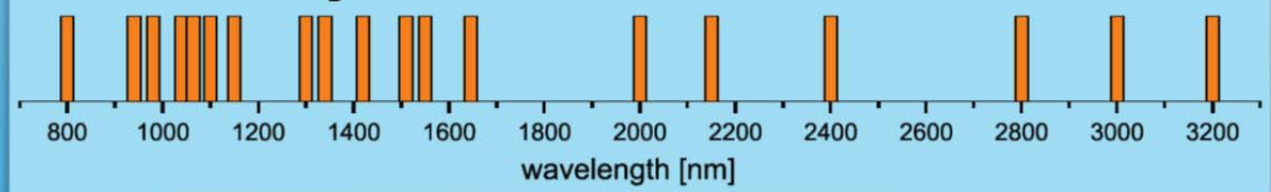


Introduction to Saturable Absorbers

Saturable Absorber Mirrors SAM™



Available Wavelengths of Saturable Absorber Mirrors




wavelength [nm]

Application:

- **Mode-Locking of Solid State Bulk Laser**



Absorption: 0.5 ... 10 %
 Relaxation time: 500 fs ... 10 ps
 Chip area: 1.3 mm x 1.3 mm to 4 mm x 4 mm

Mounting: glued or soldered on a gold plated copper Mount with 1/2" (12.7 mm) or 1" (25.4 mm) diameter



SA - Saturable Absorber




- for mode-locking of solid state, ring or fiber ring laser
- use in transmission applications
- available as unmounted chips, mounted on copper heat sink or mounted inside a single mode fiber with FC/PC or FC/APC connectors

- **Mode-Locking of Fiber Laser**

Absorption: 10 ... 60 %
 Relaxation time: 500 fs ... 30 ps
 Chip area: 1.3 mm x 1.3 mm to 4 mm x 4 mm

Mounting: batch of 1.3 mm x 1.3 mm with fiber mount FM-1.3 mounted on a single mode fiber with FC/PC or FC/APC connector and passive heat sink








Super Flat Saturable Absorber Mirrors for Large Beam Diameters

- For high power short pulse lasers, e.g. thin disc laser

More than 100 W demonstrated!

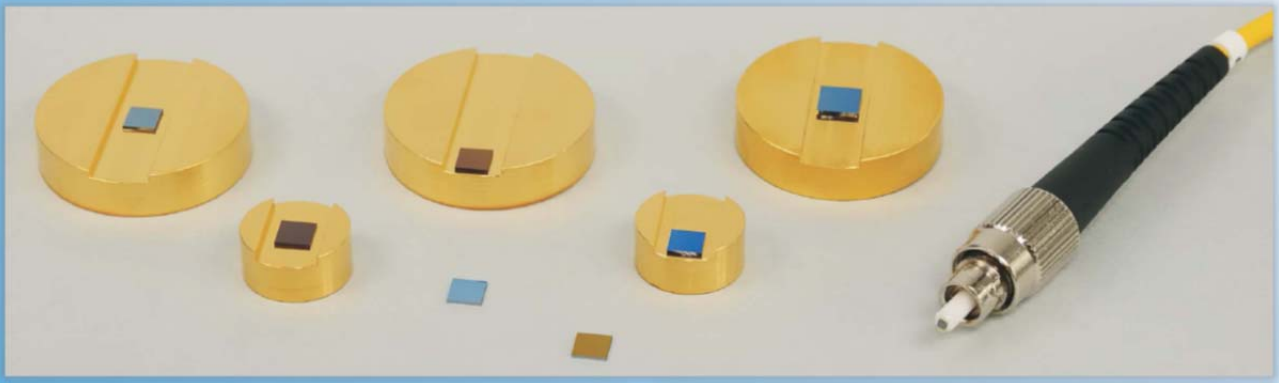
- Radius of curvature > 50 m (typically 80 - 100 m)
- Chip size: 8 mm x 8mm
- Thickness: 1.5 mm
- Mounting: soldered on a water cooled gold plated copper mount



This work has been supported by the "Federal Ministry of Economics and Technology" program ZIM grant No. KF2376304AB4.

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

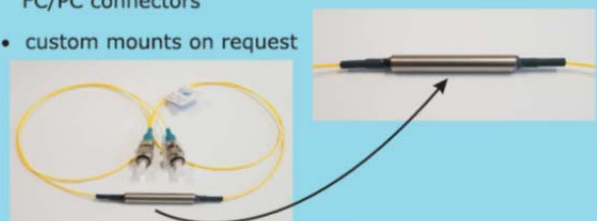
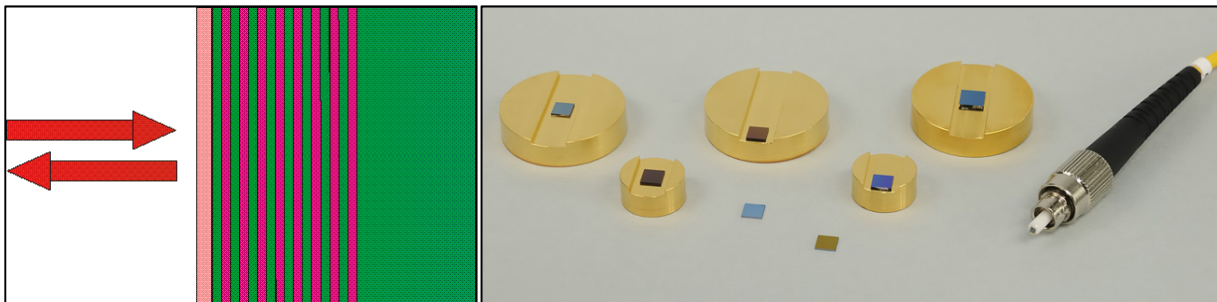


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STB Series Saturable Absorber Mirrors (SAM)

Saturable absorber mirrors are Bragg-mirrors with AIAs/GaAs quarter-wave stacks, grown on GaAs wafers with one or more low temperature GaAs (LT-GaAs) or LT-InGaAs films as saturable absorbers.



Our saturable absorber mirrors with carrier relaxation times in the picosecond range can be used for passive mode-locking and Q-switching of diode-pumped lasers. The design of the thin film stack can be adjusted to meet the requirements of different passively mode-locked lasers in the picosecond and femtosecond region.

STB-SAM order information:

Part-No description: STB-SAM- λ -A- τ -x

- λ - laser wavelength
- A - low intensity absorption
- τ - absorber relaxation time
- x - mounting condition (please see mounting conditions)

Step 1	Step 2	Step 3
Part-No description: SAM- λ -A- τ -x Please select the main parameters from the tables below. <ul style="list-style-type: none"> ● λ - Laser wavelength for example: 1550 nm ● A - Low intensity absorption for example: 33 % ● τ - Absorber relaxation time for example: 2 ps 	Please select the mounting option. For Example, if you have chosen x=4.0-25.4s-c, mounting is as follows: <ul style="list-style-type: none"> ● Chip size: 4 mm ● Heat sink diameter: 25.4 mm ● Mounting type: soldered ● Position: center 	Example: SAM-1550-33-2ps-4.0-25.4s-c <ul style="list-style-type: none"> ● Laser wavelength: 1550 nm ● Absorption: 33 % ● Relaxation time: 2 ps ● Chip size: 4 mm x 4 mm ● Soldered in the center of a gold plated Copper heat sink with 25.4 mm diameter

Product Ranges:

- Wavelength region 790 nm ... 830 nm: 800 nm
- Wavelength region 910 nm ... 990 nm: 920 nm | 940 nm | 980 nm
- Wavelength region 1020 nm ... 1150 nm: 1040 nm | 1064 nm | 1100 nm
- Wavelength region 1110 nm ... 1320 nm: 1150 nm | 1300 nm
- Wavelength region 1320 nm ... 1460 nm: 1340 nm | 1420 nm
- Wavelength region 1470 nm ... 1660 nm: 1510 nm | 1550 nm | 1645 nm
- Wavelength region 1900 nm ... 2600 nm: 2000 nm | 2400 nm
- Wavelength region 2700 nm ... 3200 nm: 2800 nm | 3000 nm

Part no.	Wavelength range [nm]	Absorptance [%]	Relaxation time [ps]	Modulation depth ΔR [%]	Saturation fluency $\mu J/cm^2$
STB-SAM-800-1-5ps-x	780-820	1	5	0.6	
STB-SAM-800-4-5ps-x	780-820	2	5	1.52	
STB-SAM-810-5-1ps-x	785-830	5	1	3	
STB-SAM-810-6-1ps-x	785-835	6	1	3.5	
STB-SAM-800-6-1ps-x	780-820	6	1	3.5	
STB-SAM-800-7-1ps-x	780-820	7	1	4	
STB-SAM-810-7-1ps-x	790-840	7	1	4	
STB-SAM-800-10-1ps-x	785-820	10	1	6	
STB-SAM-810-10-1ps-x	790-830	10	1	6	
STB-SAM-830-10-1ps-x	810-845	10	1	4	
STB-SAM-800-32-1ps-x	780-840	32	1	20	

STB-SAM-920-30-0.5ps-30-x	920	30	0.5	15	30
STB-SAM-920-45-0.5ps-30-x	920	30	0.5	22	30
STB-SAM-920-30-1ps-15-x	920	45	1	18	15
STB-SAM-920-20-3ps-15-x	920	20	3		15
STB-SAM-920-30-3ps-15-x	920	30	3		15
STB-SAM-940-4-1ps-x	940	4	1	2.6	70
STB-SAM-940-5-1ps-x	940	5	1	3	60
STB-SAM-940-6-1ps-x	940	6	1	3.5	50
STB-SAM-940-22-1ps-x	940	22	1	14	60
STB-SAM-940-47-2ps-x	940	47	2		
STB-SAM-940-68-2ps-x	940	68	2		
STB-SAM-980-3-1ps-x	980	3	1		
STB-SAM-980-4-1ps-x	980	4	1		
STB-SAM-980-12-500fs-x	980	12	0.5		
STB-SAM-980-15-500fs-x	980	15	0.5		
STB-SAM-980-50-500fs-x	980	50	0.5		
STB-SAM-980-70-500fs-x	980	70	0.5		
STB-SAM-1040-1-1ps-x	1040	1	1		
STB-SAM-1040-1.5-1ps-x	1040	1.5	1		
STB-SAM-1040-2-1ps-x	1040	2	1		
STB-SAM-1040-2.5-800fs-x	1040	2.5	0.8		
STB-SAM-1040-3-1ps-x	1040	3	1		
STB-SAM-1040-4-800fs-x	1040	4	0.8		
STB-SAM-1040-5-800fs-x	1040	5	0.8		
STB-SAM-1040-5-1ps-x	1040	5	1		
STB-SAM-1040-7-1ps-x	1040	7	1		
STB-SAM-1040-8-1ps-x	1040	8	1		
STB-SAM-1040-10-1ps-x	1040	10	1		
STB-SAM-1040-15-500fs-x	1040	15	0.5		
STB-SAM-1040-27-1ps-x	1040	27	1		
STB-SAM-1030-30-1ps-x	1030	30	1		
STB-SAM-1030-32-1ps-x	1030	32	1		
STB-SAM-1040-43-1ps-x	1040	43	1		
STB-SAM-1030-44-1ps-x	1030	44	1		
STB-SAM-1040-48-1ps-x	1040	48	1		
STB-SAM-1030-54-1ps-x	1030	54	1		
STB-SAM-1040-54-1ps-x	1040	54	1		
STB-SAM-1030-55-500fs-x	1030	55	0.5		
STB-SAM-1040-56-700fs-x	1040	56	0.7		
STB-SAM-1040-60-1ps-x	1040	60	1		
STB-SAM-1040-2.5-2ps-x	1040	2.5	2		
STB-SAM-1030-2.5-5ps-x	1030	2.5	5		
STB-SAM-1030-3-2ps-x	1030	3	2		
STB-SAM-1030-3.5-5ps-x	1030	3.5	5		
STB-SAM-1040-4-5ps-x	1040	4	5		
STB-SAM-1040-10-3ps-x	1040	10	3		
STB-SAM-1040-10-5ps-x	1040	10	5		
STB-SAM-1040-20-2ps-x	1040	20	2		
STB-SAM-1040-28-3ps-x	1040	28	3		
STB-SAM-1030-30-2ps-x	1030	30	2		
STB-SAM-1040-30-3ps	1040	30	3		
STB-SAM-1030-32-2ps	1030	32	2		
STB-SAM-1030-32-3ps	1030	32	3		
STB-SAM-1040-32-5ps	1040	32	5		
STB-SAM-1040-33-5ps	1040	33	5		
STB-SAM-1040-35-3ps	1040	35	3		
STB-SAM-1030-38-2ps	1030	38	2		
STB-SAM-1030-50-3ps	1030	50	3		
STB-SAM-1040-52-2ps	1040	52	2		
STB-SAM-1040-53-5ps	1040	53	5		
STB-SAM-1040-54-4ps	1040	54	4		

STB-SAM-1030-57-3ps	1030	57	3		
STB-SAM-1040-65-2ps	1040	65	2		
STB-SAM-1040-1-10ps-x	1040	1	10		
STB-SAM-1040-1.5-10ps-x	1040	1.5	10		
STB-SAM-1040-2-10ps-x	1040	2	10		
STB-SAM-1040-2.5-10ps-x	1040	2.5	10		
STB-SAM-1040-3.5-6ps-x	1040	3.5	6		
STB-SAM-1040-5-6ps-x	1040	5	6		
STB-SAM-1040-6-14ps-x	1040	6	14		
STB-SAM-1040-18-10ps-x	1040	18	10		
STB-SAM-1040-30-8ps-x	1040	30	8		
STB-SAM-1040-32-9ps-x	1040	32	9		
STB-SAM-1040-35-9ps-x	1040	35	9		
STB-SAM-1040-40-9ps-x	1040	40	9		
STB-SAM-1040-43-8ps-x	1040	43	8		
STB-SAM-1040-50-12ps-x	1040	50	12		
STB-SAM-1030-18-18ps-x	1030	18	18		
STB-SAM-1040-21-35ps-x	1040	21	35		
STB-SAM-1040-30-25ps-x	1040	30	25		
STB-SAM-1040-40-25ps-x	1040	40	25		
STB-SAM-1064-0.7-1ps-x	1064	0.7	1		
STB-SAM-1064-1.5-1ps-x	1064	1.5	1		
STB-SAM-1064-2-1ps-x	1064	2	1		
STB-SAM-1064-3-1ps-x	1064	3	1		
STB-SAM-1064-3.5-1ps-x	1064	3.5	1		
STB-SAM-1064-4-1ps-x	1064	4	1		
STB-SAM-1064-5-1ps-x	1064	5	1		
STB-SAM-1064-6-1ps-x	1064	6	1		
STB-SAM-1064-10-1ps-x	1064	10	1		
STB-SAM-1064-13-500fs-x	1064	13	0.5		
STB-SAM-1064-18-500fs-x	1064	18	0.5		
STB-SAM-1064-26-1ps-x	1064	26	1		
STB-SAM-1064-38-1ps-x	1064	38	1		
STB-SAM-1064-70-500fs-x	1064	70	0.5		
STB-SAM-1064-1-5ps-x	1064	1	5		
STB-SAM-1064-3-5ps-x	1064	3	5		
STB-SAM-1064-5-3ps-x	1064	5	3		
STB-SAM-1064-10-5ps-x	1064	10	5		
STB-SAM-1064-12-5ps-x	1064	12	5		
STB-SAM-1064-14-2ps-x	1064	14	2		
STB-SAM-1064-18-5ps-x	1064	18	5		
STB-SAM-1064-19-4ps-x	1064	19	4		
STB-SAM-1064-21-3ps-x	1064	21	3		
STB-SAM-1064-28-4ps-x	1064	28	4		
STB-SAM-1064-30-2ps-x	1064	30	2		
STB-SAM-1064-32-3ps-x	1064	32	3		
STB-SAM-1064-40-3ps-x	1064	40	3		
STB-SAM-1064-48-4ps-x	1064	48	4		
STB-SAM-1064-50-5ps-x	1064	50	5		
STB-SAM-1064-57-4ps-x	1064	57	4		
STB-SAM-1064-60-4ps-x	1064	60	4		
STB-SAM-1064-70-3ps-x	1064	70	3		
STB-SAM-1064-0.6-10ps-x	1064	0.6	10		
STB-SAM-1064-1-10ps-x	1064	1	10		
STB-SAM-1064-2-10ps-x	1064	2	10		
STB-SAM-1064-3-10ps-x	1064	3	10		
STB-SAM-1064-4-10ps-x	1064	4	10		
STB-SAM-1064-4-15ps-x	1064	4	15		
STB-SAM-1064-5-9ps-x	1064	5	9		
STB-SAM-1064-6-10ps-x	1064	6	10		
STB-SAM-1064-8-14ps-x	1064	8	14		

STB-SAM-1064-12-16ps-x	1064	12	16		
STB-SAM-1064-19-10ps-x	1064	19	10		
STB-SAM-1064-22-6ps-x	1064	22	6		
STB-SAM-1064-28-15ps-x	1064	28	15		
STB-SAM-1064-30-8ps-x	1064	30	8		
STB-SAM-1064-39-6ps-x	1064	39	6		
STB-SAM-1064-40-9ps-x	1064	40	9		
STB-SAM-1064-50-10ps-x	1064	50	10		
STB-SAM-1064-50-12ps-x	1064	50	12		
STB-SAM-1064-55-10ps-x	1064	55	10		
STB-SAM-1064-65-10ps-x	1064	65	10		
STB-SAM-1064-3-25ps-x	1064	3	25		
STB-SAM-1064-5-25ps-x	1064	5	25		
STB-SAM-1064-8-25ps-x	1064	8	25		
STB-SAM-1064-15-30ps-x	1064	15	30		
STB-SAM-1064-17-25ps-x	1064	17	25		
STB-SAM-1064-20-30ps-x	1064	20	30		
STB-SAM-1064-25-25ps-x	1064	25	25		
STB-SAM-1064-26-35ps-x	1064	26	35		
STB-SAM-1064-28-25ps-x	1064	28	25		
STB-SAM-1064-30-25ps-x	1064	30	25		
STB-SAM-1064-33-30ps-x	1064	33	30		
STB-SAM-1064-36-45ps-x	1064	36	45		
STB-SAM-1064-9-47ps-x	1064	9	47		
STB-SAM-1064-10-47ps-x	1064	10	47		
STB-SAM-1064-14-240ps-x	1064	14	240		
STB-SAM-1064-22-47ps-x	1064	22	47		
STB-SAM-1100-30-500fs-x	1100	30	0.5		
STB-SAM-1100-50-500fs-x	1100	50	0.5		
STB-SAM-1100-70-500fs-x	1100	70	0.5		
STB-SAM-1100-90-500fs-x	1100	90	0.5		
STB-SAM-1150-3-500fs-x	1150	3	0.5		
STB-SAM-1150-4-500fs-x	1150	4	0.5		
STB-SAM-1150-6-500fs-x	1150	6	0.5		
STB-SAM-1150-28-1ps-x	1150	28	1		
STB-SAM-1150-32-1ps-x	1150	32	1		
STB-SAM-1300-4-10ps-x	1300	4	10		
STB-SAM-1300-7-10ps-x	1300	7	10		
STB-SAM-1300-8-10ps-x	1300	8	10		
STB-SAM-1300-10-10ps-x	1300	10	10		
STB-SAM-1300-12-10ps-x	1300	12	10		
STB-SAM-1340-1-1ps-x	1340	1	1		
STB-SAM-1340-2-1ps-x	1340	2	1		
STB-SAM-1340-3-1ps-x	1340	3	1		
STB-SAM-1340-7-1ps-x	1340	7	1		
STB-SAM-1340-15-1ps-x	1340	15	1		
STB-SAM-1420-1-10ps-x	1420	1	10		
STB-SAM-1420-4-10ps-x	1420	4	10		
STB-SAM-1510-4-10ps-x	1510	4	10		
STB-SAM-1510-6-10ps-x	1510	6	10		
STB-SAM-1510-15-2ps-x	1510	15	2		
STB-SAM-1510-18-2ps-x	1510	18	2		
STB-SAM-1510-23-2ps-x	1510	23	2		
STB-SAM-1550-3-4ps-x	1550	3	4		
STB-SAM-1550-4-4ps-x	1550	4	4		
STB-SAM-1550-10-5ps-x	1550	10	5		
STB-SAM-1550-12-2ps-x	1550	12	2		
STB-SAM-1550-12-5ps-x	1550	12	5		
STB-SAM-1550-14-5ps-x	1550	14	5		
STB-SAM-1550-16-2ps-x	1550	16	2		
STB-SAM-1550-17-1.5ps-x	1550	17	1.5		

STB-SAM-1550-17-2ps-x	1550	17	2		
STB-SAM-1550-17-4ps-x	1550	17	4		
STB-SAM-1550-18-2ps-x	1550	18	2		
STB-SAM-1550-20-3ps-x	1550	20	3		
STB-SAM-1550-20-4ps-x	1550	20	4		
STB-SAM-1550-21-2ps-x	1550	21	2		
STB-SAM-1550-22-2ps-x	1550	22	2		
STB-SAM-1550-23-2ps-x	1550	23	2		
STB-SAM-1550-25-5ps-x	1550	25	5		
STB-SAM-1550-26-2ps-x	1550	26	2		
STB-SAM-1550-26-5ps-x	1550	26	5		
STB-SAM-1550-27-2ps-x	1550	27	2		
STB-SAM-1550-32-4ps-x	1550	32	4		
STB-SAM-1550-33-2ps-x	1550	33	2		
STB-SAM-1550-40-2ps-x	1550	40	2		
STB-SAM-1550-41-1.5ps-x	1550	41	1.5		
STB-SAM-1550-55-2ps-x	1550	55	2		
STB-SAM-1550-7-10ps-x	1550	7	10		
STB-SAM-1550-11-18ps-x	1550	11	18		
STB-SAM-1550-15-7ps-x	1550	15	7		
STB-SAM-1550-15-12ps-x	1550	15	12		
STB-SAM-1550-17-10ps-x	1550	17	10		
STB-SAM-1550-20-10ps-x	1550	20	10		
STB-SAM-1550-20-12ps-x	1550	20	12		
STB-SAM-1550-22-5ps-x	1550	22	5		
STB-SAM-1550-22-12ps-x	1550	22	12		
STB-SAM-1550-25-18ps-x	1550	25	18		
STB-SAM-1550-28-12ps-x	1550	28	12		
STB-SAM-1550-30-5ps-x	1550	30	5		
STB-SAM-1550-32-18ps-x	1550	32	18		
STB-SAM-1550-40-10ps-x	1550	40	10		
STB-SAM-1550-42-12ps-x	1550	42	12		
STB-SAM-1550-50-10ps-x	1550	50	10		
STB-SAM-1645-2-2ps-x	1645	2	2		
STB-SAM-1645-4-2ps-x	1645	4	2		
STB-SAM-1645-5-2ps-x	1645	5	2		
STB-SAM-1645-8-2ps-x	1645	8	2		
STB-SAM-1645-32-2ps-x	1645	32	2		
STB-SAM-1645-50-2ps-x	1645	50	2		
STB-SAM-1920-2-30ps-x	1920	2	30		
STB-SAM-1920-4-40ps-x	1920	4	40		
STB-SAM-1920-7-10ps-x	1920	7	10		
STB-SAM-1920-8-10ps-x	1920	8	10		
STB-SAM-1920-18-15ps-x	1920	18	15		
STB-SAM-1920-36-10ps-x	1920	36	10		
STB-SAM-1960-3-10ps-x	1960	3	10		
STB-SAM-1960-4-10ps-x	1960	4	10		
STB-SAM-1960-5-10ps-x	1960	5	10		
STB-SAM-1960-8-10ps-x	1960	8	10		
STB-SAM-1960-13-10ps-x	1960	13	10		
STB-SAM-1960-15-10ps-x	1960	15	10		
STB-SAM-1960-18-10ps-x	1960	18	10		
STB-SAM-1960-30-10ps-x	1960	30	10		
STB-SAM-1960-54-10ps-x	1960	54	10		
STB-SAM-2000-2-10ps-x	1960	2	10		
STB-SAM-2000-13-10ps-x	2000	13	10		
STB-SAM-2000-20-10ps-x	2000	20	10		
STB-SAM-2000-22-10ps-x	2000	22	10		
STB-SAM-2000-30-10ps-x	2000	30	10		
STB-SAM-2000-36-10ps-x	2000	36	10		
STB-SAM-2000-43-10ps-x	2000	43	10		

STB-SAM-2400-1-10ps-x	2400	1	10		
STB-SAM-2400-1.5-10ps-x	2400	1.5	10		
STB-SAM-2800-14-10ps-x	2800	14	10		
STB-SAM-2800-20-10ps-x	2800	20	10		
STB-SAM-2800-34-10ps-x	2800	34	10		
STB-SAM-2900-9-10ps-x	2900	9	10		
STB-SAM-3000-33-10ps-x	2900	33	10		

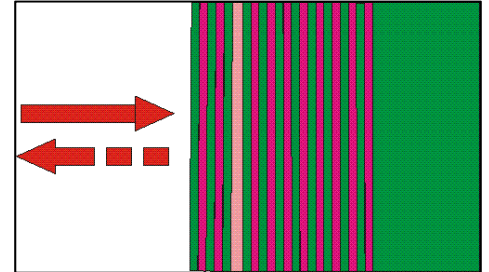
STB Series Resonant Saturable Absorber Mirrors

The resonant saturable absorber mirror (RSAM) is designed to reshape an optical signal. An optical signal which propagates in optical fibers, communication nodes and other optical devices is subject to optical losses and is modified. After every amplification stage, which uses the stimulated optical emission process, the signal to noise ratio decreases as a result of the inevitable spontaneous emission.

The RSAM, included after an optical amplifier, decreases the noise floor and allows to pass the optical pulses unaffected due to the nonlinear-optical behavior.

Part-No description: RSAM- λ - τ -x

- λ - laser wavelength
- τ - absorber relaxation time
- x - mounting condition



Part no.	Wavelength range [nm]	Low intensity reflectivity R_0 [%]	Absorptance A_0 [%]	Relaxation time [ps]	Non-saturable loss A_{ns} [%]
STB-RSAM-980-x	975-984	1	99	1	40
STB-RSAM-1030-1ps-x	1030	1	99	1	45
STB-RSAM-1060-32ps-x	1056-1064	2	98	32	40
STB-RSAM-1064-9ps-x	1050-1064	1	99	9	40
STB-RSAM-1550-10ps-x	1550	2	98	10	40
STB-RSAM-1560-100ps-x	1560	5	95	100	25

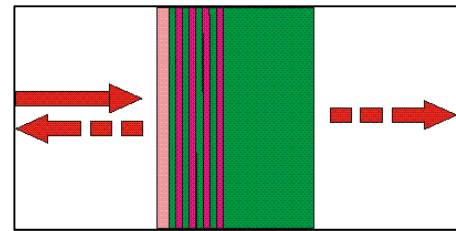
STB Series Saturable Output Couplers (SOC)

Using a saturable output coupler (SOC), a self-starting, passively mode-locked or Q-switched diode-pumped solid-state or fiber laser with a very simple layout can be arranged. The SOC is a combination of a saturable absorber mirror (SAM) with an output coupler.

SOC order information:

Part-No description: SOC- λ -A-T- τ -x

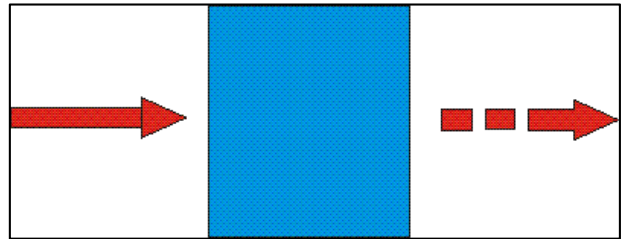
- λ - laser wavelength
- A - low intensity absorption
- T - low intensity transmittance
- τ - absorber relaxation time
- x - mounting condition



Part number	Wavelength nm	Absorptance %	Transmittance %	Reflectance %	Modulation depth %	Non-saturable loss %
STB-SOC-1040-2-3-1ps-x	1040	2	3	95	1.2	0.8
STB-SOC-1040-3-0.4-1ps-x	1040	3	0.4	96	1.8	1.2
STB-SOC-1040-3-4-1ps-x	1040	3	4	93	1.8	1.2
STB-SOC-1040-5-5-1ps-x	1040	5	5	90	3	2
STB-SOC-1040-6-0.5-1ps-x	1040	6	0.5	93	3.5	1.5
STB-SOC-1040-6-2-1ps-x	1040	6	2	92	3.5	2.5
STB-SOC-1040-7-2-1ps-x	1040	7	2	91	4	3
STB-SOC-1040-8-0.6-1ps-x	1040	8	0.6	91	5	3
STB-SOC-1040-8-6-15ps-x	1040	8	6	84	4.5	3.2
STB-SOC-1040-9-9-1ps-x	1040	9	9	82	5	4
STB-SOC-1040-11-3-1ps-x	1040	11	3	86	6	5
STB-SOC-1040-14-10-15ps-x	1040	14	10	76	7.5	5.5
STB-SOC-1040-17-5-1ps-x	1040	17	5	78	10	7
STB-SOC-1040-24-19-15ps-x	1040	22	19	58	9.5	9
STB-SOC-1064-1-1-5ps-x	1064	1	1	98	0.6	
STB-SOC-1064-1.8-2.2-1ps-x	1064	1.8	2.2	96	1.1	0.7
STB-SOC-1064-2-0.3-1ps-x	1064	2	0.3	97	1.2	0.8
STB-SOC-1064-2.7-3.2-1ps-x	1064	2.7	3.2	93	1.7	1.0
STB-SOC-1064-4-0.5-1ps-x	1064	4	0.5	95	2.8	1.2
STB-SOC-1064-7-0.7-1ps-x	1064	7	0.7	92	4	3
STB-SOC-1064-8-6-1ps-x	1064	8	6	86	4	4
STB-SOC-1064-8-8-15ps-x	1064	8	8	84	4.5	3
STB-SOC-1064-9-13-17ps-x	1064	9	13	78	6	5
STB-SOC-1064-13-12-15ps-x	1064	13	12	76	6.5	5
STB-SOC-1064-15-23-17ps-x	1064	15	23	62	8	7
STB-SOC-1064-21-13-20ps-x	1064	21	13	66	13	
STB-SOC-1064-22-19-15ps-x	1064	22	19	58	9.5	9
STB-SOC-2000-26-19-10ps-x	2000	26	19	55	15	11
STB-SOC-2000-26-24-10ps-x-thin	2000	26	24	50	15	11
STB-SOC-2000-40-28-10ps-x	2000	40	28	32	23	17

Saturable Noise Suppressor (SANOS)

The resonant saturable absorber mirror (RSAM) is designated to reshape an optical signal. An optical signal which propagates in optical fibers, communication nodes and other optical devices is subject to optical losses and is modified. After every amplification stage, which uses the stimulated optical emission process, the signal to noise ratio decreases as a result of the inevitable spontaneous emission.



The RSAM, included after an optical amplifier, decreases the noise floor and allows to pass the optical pulses unaffected due to the nonlinear-optical behavior.

1. Free-space Saturable Noise Suppressor

For 1064 nm wavelength we offer a free-space saturable noise suppressor: FS-SANOS. It consists of a RSAM and a 100% mirror and allows the insertion into a laser beam without change of the beam direction.

Free space SANOS order information:

Part-No description: FS-SANOS- λ - τ -x

- λ - laser wavelength
- τ - absorber relaxation time
- x - number of absorber stages (1 or 2)

SANOS applications

- Suppression of noise (ASE – amplified spontaneous emission) after an optical amplifier
- Suppression of remaining pulses after a pulse picker

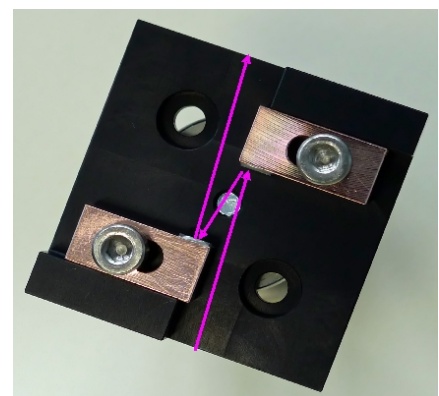
1.1 Free-space SANOS @ 1064 nm with One RSAM

One stage FS-SANOS-1064-15ps-1

A FS-SANOS consists of a resonant saturable absorber mirror (RSAM) and a conventional 100% mirror. The beam goes true the FS-SANOS without changing of the direction, but with a parallel offset of 2 mm. The RSAM has a strong non-linear reflectance. For a low input signal level the transmittance of the FS-SANOS is only 2 % (98 % loss), whereas high intensity pulses are transmitted with a lower loss of 50 %. The input is isolated better than 50 dB. To meet exactly the low-intensity reflectance minimum the input beam inclination can be changed by some degrees.

Main FS-SANOS data:

- Resonance wavelength: 1064 nm (1050 nm – 1064 nm on request)
- Full width at half maximum FWHM: 20 nm
- Noise suppression ratio: 14 dB
- Insertion loss: 3 dB
- Saturation fluence: 4 $\mu\text{J}/\text{cm}^2$ @ noise suppression of 10 dB
- Relaxation time constant: 15 ps
- Parallel beam offset: 2 mm
- Mirrors: one RSAM and one dielectric mirror with $R > 99\%$, size: 4 mm x 4 mm
- Angle of incidence on mirrors: 8°



1.2 Two stage FS-SANOS-1064-9ps-2

A FS-SANOS-2 consists of two resonant saturable absorber mirrors (RSAM). The beam goes true the free-space SANOS without changing of the direction, but with a parallel offset of 2 mm. The RSAM has a strong non-linear reflectance. For a low input signal level the transmittance of the FS-SANOS-2 is lower than 0,1% (99,9 % loss), whereas high intensity pulses are transmitted with a lower loss of 75 %. The input is isolated better than 50 dB. To meet exactly the low-intensity reflectance minimum the input beam inclination can be changed by some degrees.

Main FS-SANOS data

- Resonance wavelength: 1064 nm
- Full width at half maximum FWHM: 17 nm
- Noise suppression ratio: > 20 dB
- Insertion loss: 6 dB
- Saturation fluence : 10 $\mu\text{J}/\text{cm}^2$ @ noise suppression of 20 dB
- Relaxation time constant: 15 ps
- Parallel beam offset: 2 mm
- Mirrors: two RSAM, size: 4 mm x 4 mm
- Angle of incidence on mirrors: 8°

2. Fiber-coupled Saturable Noise Suppressor

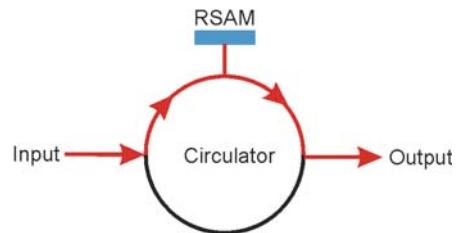
For 1550 nm wavelength we offer a fiber coupled saturable noise suppressor: FC-SANOS. It consists of a RSAM on the second port of a three port circulator and allows simple insertion into a fiber.

Fiber coupled SANOS order information:

Part-No description: FC-SANOS- λ -x

- λ - laser wavelength
- x - fiber and connector type

A SANOS is a resonant saturable absorber mirror (RSAM), mounted on a circulator. The RSAM has a strong non-linear reflectance. For a low input signal level the transmittance of the FC-SANOS is only 3% (97% loss), whereas high intensity pulses are transmitted with a lower loss of 50%. The needed peak pulse power for saturation is about 500 mW. Because the RSAM is a resonant device, the noise is only suppressed at the resonance wavelength. The common fiber connector type is FC/PC, but it can be customized. The input isolation is better than 50 dB.



- Part number: FC-SANOS-15XX
- Resonance wavelength: 1530 nm, 1535 nm, ... ,1555 nm, 1560 nm in steps of 5 nm
- Full width at half maximum FWHM: 16 nm
- Low intensity transmittance: 3 %
- High intensity transmittance: 45 %
- Noise suppression factor: 6 ... 18 (dependent on the input signal/noise ratio)
- Insertion loss: 3 dB
- Pulse fluence: $F = 100 \mu\text{J}/\text{cm}^2$
- Relaxation time constant : ~ 5 ps
- Maximum mean input power: 0.5 W
- Directivity: 50 dB
- Fiber connector type: FC/PC, other on request

Saturable Absorber in Transmission (SA)

The saturable absorber without a Bragg-mirror can be used for self-starting, passively mode-locking of a laser in a similar way as a SAM, but it is working in transmission mode. It can be inserted for instance into a fiber ring laser. The saturation fluence of a SA is substantial higher than that of a SAM.

SA order information:

Part-No description: SA- λ -A- τ -x

- λ - laser wavelength
- A - low intensity absorption
- τ - absorber relaxation time
- x - mounting condition

1. Part number: SA-1020-40-x at wavelength 1020 nm

Laser wavelength: 980 nm ... 1040 nm

Absorptance: 40 %

Modulation depth: 25 %

Non-saturable loss: 15 %

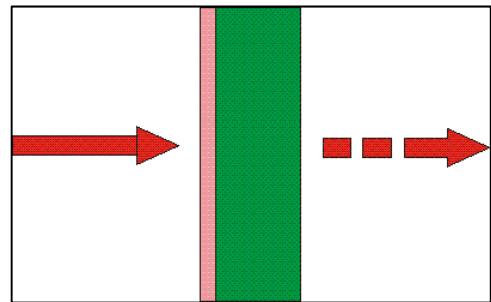
Saturation fluence: 300 $\mu\text{J}/\text{cm}^2$

Pulse damage threshold: 1.2 mJ/cm^2

Relaxation time constant: ~ 500 fs

Chip area: 5mm x 5mm; other dimensions on request

Chip thickness: 625 μm ; semi-insulating GaAs



2. Part number: SA-1030-34-3ps-x at wavelength 1030nm

Laser wavelength: 1000 nm ... 1040 nm

Absorptance: 34 %

Modulation depth: 20 %

Non-saturable loss: 14 %

Saturation fluence: 300 $\mu\text{J}/\text{cm}^2$

Pulse damage threshold: 1.2 mJ/cm^2

Relaxation time constant: ~ 3 ps

Chip area: 5mm x 5mm; other dimensions on request

Chip thickness: 450 μm ; semi-insulating GaAs

3. Part number: SA-1064-14-28ps-x at wavelength 1064 nm

Laser wavelength: 1000 nm ... 1100 nm

Absorptance: 14 %

Transmittance: 85 %

Modulation depth: 3.4 %

Saturation fluence: 300 $\mu\text{J}/\text{cm}^2$

Damage threshold : 200 MW/cm^2

Relaxation time constant: ~ 28 ps

Chip area: 5.0 mm x 5.0 mm; other dimensions on request

Chip thickness: 625 μm ; semi-insulating GaAs

4. Part number SA-1064-25-500fs-x at wavelength 1064 nm

Laser wavelength: 1050 nm ... 1090 nm

Absorptance : 25 %

Modulation dept: 13 %

Non-saturable loss: 12 %

Saturation fluence: 300 $\mu\text{J}/\text{cm}^2$

Damage threshold: 1.2 mJ/cm^2

Relaxation time constant: ~ 500 fs

Chip area: 5.0 mm x 5.0 mm; other dimensions on request

Chip thickness: 625 μm ; semi-insulating GaAs

5. Part number SA-1064-26-37ps-x at wavelength 1064 nm

Laser wavelength: 1000 nm ... 1100 nm

Absorptance: 26 %

Transmittance: 73 %

Modulation depth: 4.9 %

Saturation fluence: 300 $\mu\text{J}/\text{cm}^2$

Damage threshold: 1 mJ/cm²
Relaxation time constant: ~ 37 ps
Chip area: 5.0 mm x 5.0 mm; other dimensions on request
Chip thickness: 625 µm; semi-insulating GaAs

6. Part number SA-1064-40-500fs-x at wavelength 1064 nm

Laser wavelength: 1030 nm ... 1090 nm
Absorptance: 40 %
Modulation depth: 25 %
Non-saturable loss: 15 %
Saturation fluence: 300 µJ/cm²
Damage threshold: 1 mJ/cm²
Relaxation time constant: ~ 500 fs
Chip area: 5.0 mm x 5.0 mm; other dimensions on request
Chip thickness: 625 µm; semi-insulating GaAs

7. Part number SA-1340-22-20ps-x at wavelength 1340 nm

Laser wavelength: 1340 nm
Absorptance: 22 %
Modulation depth: 14 %
Non-saturable loss: 8 %
Saturation fluence: 300 µJ/cm²
Damage threshold: 1.2 mJ/cm²
Relaxation time constant: ~ 20 ps
Chip area: 5.0 mm x 5.0 mm; other dimensions on request
Chip thickness: 625 µm; semi-insulating GaAs

8. Product list SA, λ = 1550 nm, 625 µm substrate thickness for free space application

(1) Part number SA-1550-6-20ps-x at wavelength 1550nm

Laser wavelength: 1550 nm
Absorptance : 6 %
Modulation depth: 4 %
Non-saturable loss: 2 %
Saturation fluence: 300 µJ/cm²
Damage threshold : 1.5 mJ/cm²
Relaxation time constant: ~ 20 ps
Chip area: 5.0 mm x 5.0 mm; other dimensions on request
Chip thickness: 625 µm; semi-insulating GaAs

(2) Part number SA-1550-35-2ps-x at wavelength 1550 nm

Laser wavelength: 1400 nm ... 1600 nm
Absorptance: 35 %
Modulation depth: 21 %
Non-saturable loss: 14 %
Saturation fluence: 300 µJ/cm²
Damage threshold: 1.5 mJ/cm²
Relaxation time constant: ~ 2 ps
Chip area: 5.0 mm x 5.0 mm; other dimensions on request
Chip thickness: 625 µm; semi-insulating GaAs

(3) Part number SA-1550-46-2ps-x at wavelength 1550 nm

Laser wavelength: 1400 nm ... 1600 nm
Absorptance: 46 %
Modulation depth: 28 %
Non-saturable loss: 18 %
Saturation fluence: 300 µJ/cm²
Damage threshold: 1.5 mJ/cm²
Relaxation time constant: ~ 2 ps
Chip area: 5.0 mm x 5.0 mm; other dimensions on request
Chip thickness: 625 µm; semi-insulating GaAs

9. Product list SA, λ = 1550 nm, 150 µm substrate thickness for fiber butt coupling

(1) Part number SA-1550-25-2ps-x at wavelength 1550 nm

Laser wavelength: 1500 nm ... 1600 nm

Absorptance: 25 %
Modulation depth: 15 %
Non-saturable loss: 10 %
Saturation fluence: 300 $\mu\text{J}/\text{cm}^2$
Damage threshold: 2 mJ/cm^2
Relaxation time constant: ~ 2 ps
Chip area: 5.0 mm x 5.0 mm; other dimensions on request
Chip thickness: 100 μm ; semi-insulating GaAs

(2) Part number SA-1550-41-2ps-thin-x at wavelength 1550 nm, thin saturable absorber for fiber coupling

Laser wavelength: 1400 nm ... 1600 nm
Absorptance: 41 %
Modulation depth: 25 %
Non-saturable loss: 16 %
Fiber coupling insertion loss: ≤ 1.6 dB
Saturation fluence: 300 $\mu\text{J}/\text{cm}^2$
Damage threshold: 1.5 mJ/cm^2
Relaxation time constant: ~ 2 ps
Chip area: 1.3 mm x 1.3 mm; other dimensions on request
Chip thickness: 150 μm ; semi-insulating GaAs

(3) Part number SA-1550-58-2ps-thin-x at wavelength 1550 nm, thin saturable absorber for fiber coupling

Laser wavelength: 1400 nm ... 1600 nm
Absorptance: 58 %
Modulation depth: 35%
Non-saturable loss: 23 %
Fiber coupling insertion loss: ≤ 1.6 dB
Saturation fluence: 300 $\mu\text{J}/\text{cm}^2$
Damage threshold: 1.5 mJ/cm^2
Relaxation time constant: ~ 2 ps
Chip area: 1.3 mm x 1.3 mm; other dimensions on request
Chip thickness: 150 μm ; semi-insulating GaAs

10. Product list SA, $\lambda = 2000$ nm

(1) Part number SA-2000-1-x at wavelength 2000 nm

Laser wavelength: 1900 nm ... 2100 nm
Absorptance: 1 %
Modulation depth: 0.6 %
Non-saturable loss: 0.4 %
Saturation fluence: 300 $\mu\text{J}/\text{cm}^2$
Damage threshold: 3 mJ/cm^2
Relaxation time constant: ~ 10 ps
Chip area: 5.0 mm x 5.0 mm; other dimensions on request
Chip thickness: 625 μm ; semi-insulating GaAs

(2) Part number SA-2000-25-10ps-x at wavelength 2000 nm

Laser wavelength: 1800 nm ... 2200 nm
Absorptance: 25 % @ 2000 nm
Transmittance: 74 % @ 2000 nm
Reflectance: 1 % @ 2000 nm
Modulation depth: 15 % @ 2000 nm
Non-saturable loss: 11 % @ 2000 nm
Saturation fluence: 2 mJ/cm^2
Damage threshold: 4 mJ/cm^2
Relaxation time constant: ~ 10 ps
Chip area: 5.0 mm x 5.0 mm; other dimensions on request
Chip thickness: 180 μm ; semi-insulating GaAs

(3) Part number SA-2000-43-x at wavelength 2000 nm

Laser wavelength: 1800 nm ... 2200 nm
Absorptance: 43 % @ 2000 nm
Transmittance: 56 % @ 2000 nm

Reflectance: 0.2 % @ 2000 nm
Modulation depth: 23 % @ 2000 nm
Non-saturable loss: 20 % @ 2000 nm
Saturation fluence: 300 $\mu\text{J}/\text{cm}^2$
Damage threshold: 2 mJ/cm^2
Relaxation time constant: ~ 10 ps
Chip area: 5.0 mm x 5.0 mm; other dimensions on request
Chip thickness: 625 μm or 150 μm for fiber butt coupling ; semi-insulating GaAs

11. Part number SA-2800-10-10ps-x at wavelength 2800 nm

Laser wavelength: 2500 nm ... 3000 nm
Absorptance: 10 % @ 2.8 μm
Transmittance: 90 % @ 2.8 μm
Reflectance: 0 % @ 2.8 μm
Modulation depth: 6 % @ 2.8 μm
Non-saturable loss: 4 % @ 2.8 μm
Saturation fluence: 300 $\mu\text{J}/\text{cm}^2$
Damage threshold: 2 mJ/cm^2
Relaxation time constant: ~ 10 ps
Chip area: 5 mm x 5 mm; other dimensions on request
Chip thickness: 625 μm semi-insulating GaAs

RSA - Resonant Saturable Absorber in transmission

The resonant saturable absorber can be used for passively mode-locking of a ring laser in a similar way as a SA. But it is a resonant device with the following special characteristics:

- Zero reflectance at the resonance wavelength for low intensity.
- Zero transmittance for all wavelengths outside the resonance.
- At the resonance wavelength increasing transmittance with increasing pulse fluence.
- The saturation fluence is substantial lower than that of a SA and even lower than that of a typical SAM.



The above mentioned characteristics allow the construction of a passively mode locked fiber ring laser with

- a laser wavelength fixed at the resonance wavelength of the RSA,
- and low power threshold for start of cw mode-locking.

RSA order information:

Part-No description: RSA- λ -A-T- τ -x

- λ - laser wavelength
- A - low intensity absorption
- T - low intensity transmission
- τ - absorber relaxation time
- x - mounting condition

Part number RSA-1057-53-45-6ps-x at wavelength 1057 nm

- Resonance wavelength: 1056..1060 nm
- Absorbance: 53 %
- Transmittance: 45 %
- Reflectance: 2 %
- Modulation depth: $\Delta T = 27 \%$, $\Delta R = 15 \%$, $\Delta A = 43 \%$
- Saturation fluence: 25 $\mu\text{J}/\text{cm}^2$
- Damage threshold: 2 mJ/cm^2
- Relaxation time constant: 6 ps
- Chip area: 5 mm x 5 mm; other dimensions on request
- Chip thickness: 450 μm ; semi-insulating GaAs
- Front side protection: dielectric coating
- Back side coating: the SA back side is polished and antireflection coated for 1060 nm

Mounting option x denotes the type of mounting as follows:

x = 5.0-0 unmounted chip 5.0 mm x 5.0 mm

x = 5.0-12.7 g glued on a copper heat sink with 12.7 mm diameter with 4 mm hole

x = 5.0-25.0 g glued on a copper heat sink with 25.4 mm diameter with 4 mm hole

x = 5.0-25.4 g glued on a copper heat sink with 25.4 mm diameter with 4 mm hole

Mounting conditions

x = 4.0-0

- Single chip, unmounted
- Chip area 4.0 mm x 4.0 mm
- Chip thickness 450 μ m

x = 1.0b-0

- Batch of 4 unmounted chips
- Chip area 1.0 mm x 1.0 mm
- Chip thickness 450 μ m

x = 1.3b-0

- Batch of 4 unmounted chips
- Chip area 1.3 mm x 1.3 mm
- Chip thickness 450 μ m

x = 4.0-12.7g-c / 4.0-12.7g-e

- Chip area 4.0 mm x 4.0 mm
- Glued on a copper heat sink with 12.7 mm diameter
- Center mounted : x = 4.0-12.7g-c
- Edge mounted : x = 4.0-12.7g-e

x = 4.0-12.7s-c / 4.0-12.7s-e

- Chip area 4.0 mm x 4.0 mm
- Soldered on a copper heat sink with 12.7 mm diameter
- Center mounted : x = 4.0-12.7s-c
- Edge mounted : x = 4.0-12.7s-e

x = 4.0-25.0g-c / 4.0-25.0g-e

- Chip area 4.0 mm x 4.0 mm
- Glued on a copper heat sink with 25.0 mm diameter
- Center mounted : x = 4.0-25.0g-c
- Edge mounted : x = 4.0-25.0g-e

x = 4.0-25.0s-c / 4.0-25.0s-e

- Chip area 4.0 mm x 4.0 mm
- Soldered on a copper heat sink with 25.0 mm diameter
- Center mounted : x = 4.0-25.0s-c
- Edge mounted : x = 4.0-25.0s-e

x = 4.0-25.4g-c / 4.0-25.4g-e

- Chip area 4.0 mm x 4.0 mm
- Glued on a copper heat sink with 25.4 mm diameter
- Center mounted : x = 4.0-25.4g-c
- Edge mounted : x = 4.0-25.4g-e

x = 4.0-25.4s-c / 4.0-25.4s-e

- Chip area 4.0 mm x 4.0 mm
- Soldered on a copper heat sink with 25.4 mm diameter
- Center mounted : x = 4.0-25.4s-c
- Edge mounted : x = 4.0-25.4s-e

x = 4.0-25.0w-c / 4.0-25.0w-e

- Chip area 4.0 mm x 4.0 mm
- Soldered on a water cooled copper heat sink with 25.0 mm diameter
- Center mounted : x = 4.0-25.0w-c
- Edge mounted : x = 4.0-25.0w-e

x = 4.0-25.0h-c / 4.0-25.0h-e

- Chip area 4.0 mm x 4.0 mm
- Thin film soldered on a water cooled copper heat sink with 25.0 mm diameter for high power application.
- Center mounted : x = 4.0-25.0h-c
- Edge mounted : x = 4.0-25.0h-e

x = FC/(A)PC-SMF

- Mounted on a 1 m long single mode fiber.
- Available fibers: 780HP
- FC/PC connector: x = FC/PC-SMF
- FC/APC connector: x = FC/APC-SMF

x = FC/(A)PC-PMF

- Mounted on a 1 m long polarization maintaining fiber.
- Available fibers: Panda PM780-HP
- FC/PC connector: x = FC/PC-PMF
- FC/APC connector: x = FC/APC-PMF