1. Verification Methods

Visual Inspection
- Visual inspection of mechanical components
- Interfaces meet the specification

Factory Test
- Subassembly test
- Verification of performance of all parameters (Test protocols)

Acceptance Test
Verification of specific parameters to demonstrate functional reliability

Lifetime-Test and Environmental Test
not foreseen in the test program

2. Test Specification

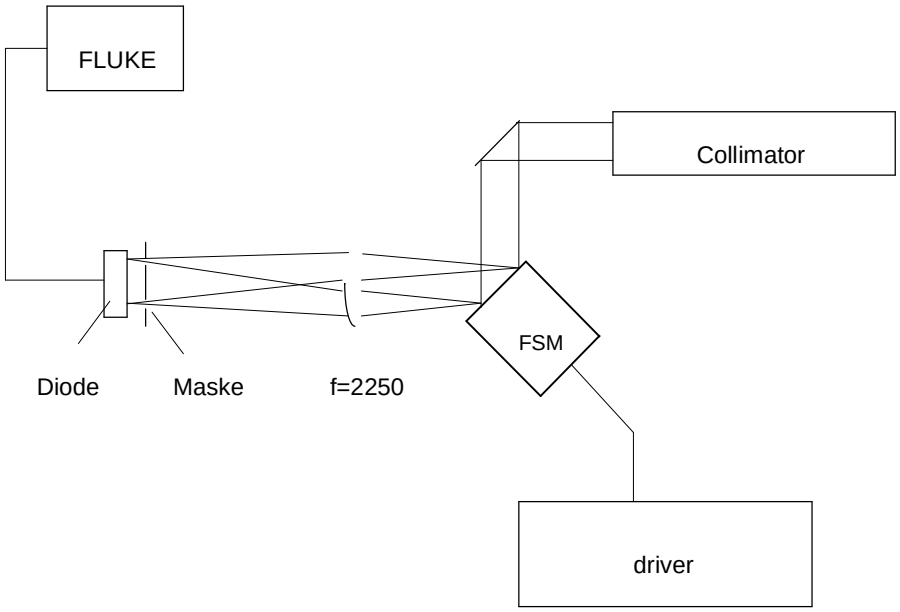
Parameter	**Requirement**	**Acceptance Test**
Full stroke	?500µrad (?102.6 arcsec) beam deflection 0 bis 20 Hz	Test 1
Tilt stroke bei 250 Hz	49.8 µrad (10.2arcsec) beam deflection	Test 2
Position of axes	degrees	Test 3
Tilt range	R_i = ?0.41 log(f_i) + 1.033 f_i - frequency [Hz]	
Resolution	1.5µrad (0.3arcsec)	Test 4
Repeatability	4µrad (0.8arcsec)	
Static jitter	1µrad RMS (0.2arcsec)	
Resonance	>250Hz	
Reactionless	<2% bei 250Hz	Test 5
Linearity error	<1%	
Pivot stability	?0.05mm	Test 6
Response time	1 ms	

Test 1.

1. Scope of the test

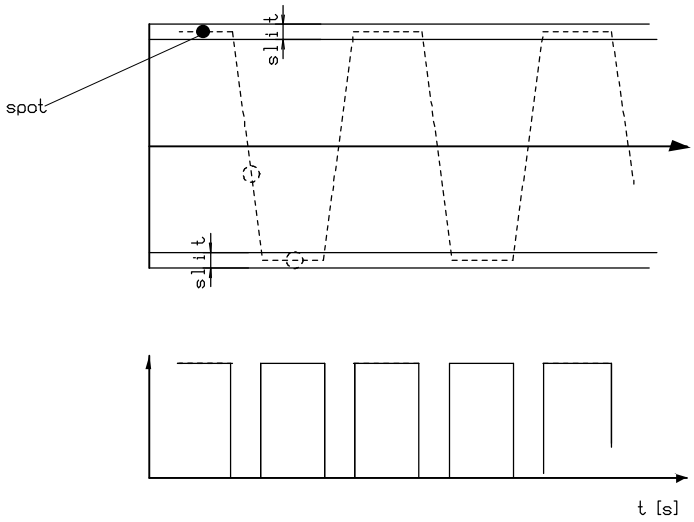
Verificaton of the full stroke 0 to 20 Hz

2. Test Procedure



In front of the large-size diode a mask with a double slit will be placed. The distance of the slits is s = 2*2250*tan(103.1arcsec)=2250 µm. Light incidence on the diode only takes place, if the FSM generates a beam deviation of 103.1 arcsec (= 500 µrad). The signal will be recorded on an oscilloscope (FLUKE).
With the driver the frequency of of the square signal will be variied.from von 0 Hz to 20 Hz .
The amplitude of the driver will be adjusted in that way, that the spot at full-scale deflection (.?) rests exactly on the slit.
The test will be carried out in $?_x$ and in $?_y$.

Signal proceeding on FLUKE :



3. Test Results

f_i [Hz]	U [V] $?_x$ $?_y$	remark
0		
5		
10		
15		
20		
25		
30		

4. Test Equipment

- Collimator f=3000mm with illumination unit
- Objective f=2250mm
- Oszilloscope FLUKE
- PC mit driver card
- receiver with mask

Test 2

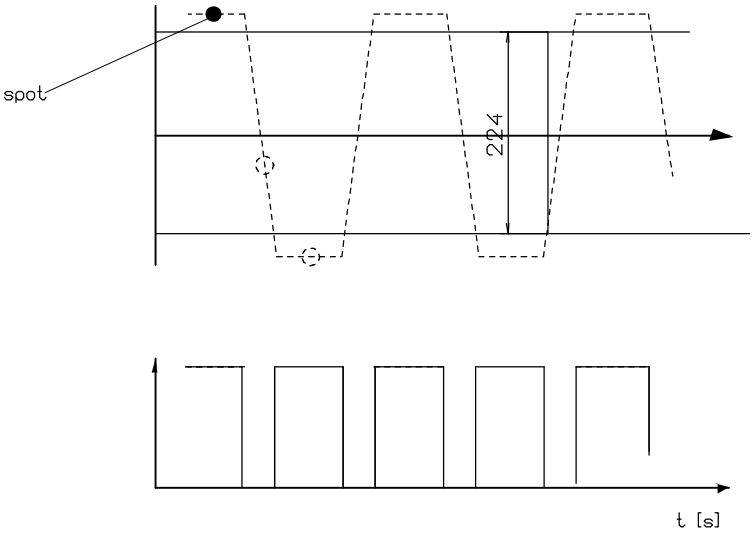
1. Scope of the test

Verificaton of the tilt stroke by 250 Hz

2. Test Procedure

Die Test procedure is analogue to test 1.
The double slit will be replaced by a translucent bar.
Width s= 2* 2250*tan(10.28arcsec)=224 µm

Signal proceeding on FLUKE :



3. Test Results

f_i [Hz]	U [V] $?_x$ $?_y$	remark
250		

4. Test Equipment

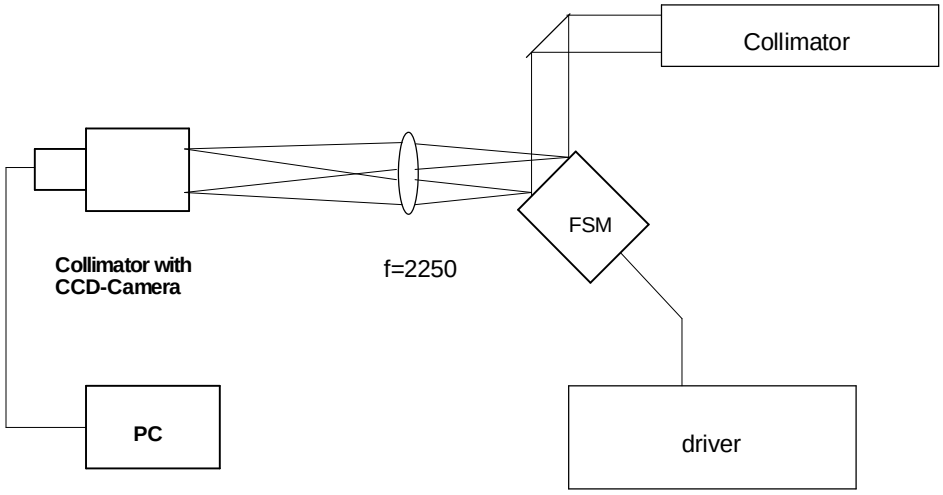
- Collimator f=3000mm with illumination unit
- Objective f=2250mm
- Oszilloscope FLUKE
- PC with driver card
- receiver with mask

Test 3

1. Scope of the test

Verification of the Rectangularity of axes

2. Test Procedure



The axes x and y of the FSM will adjusted successively in 10 positions each.
The spot positions will be measured and recorded with a collimator with CCD-camerasystem
The rectangularity will be calculated from the positional field by means of an adjustment method.

3. Test Results

x - axes

U [V]	Spot position x [µm]	y [µm]
0		
1		
2		
3		
4		
5		
6		
7		

8		
9		
10		

y - axes

U [V]	**Spot position**	
	x [µm]	**y [µm]**
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Deviation from the rectangularity : .....

4. Test Equipment

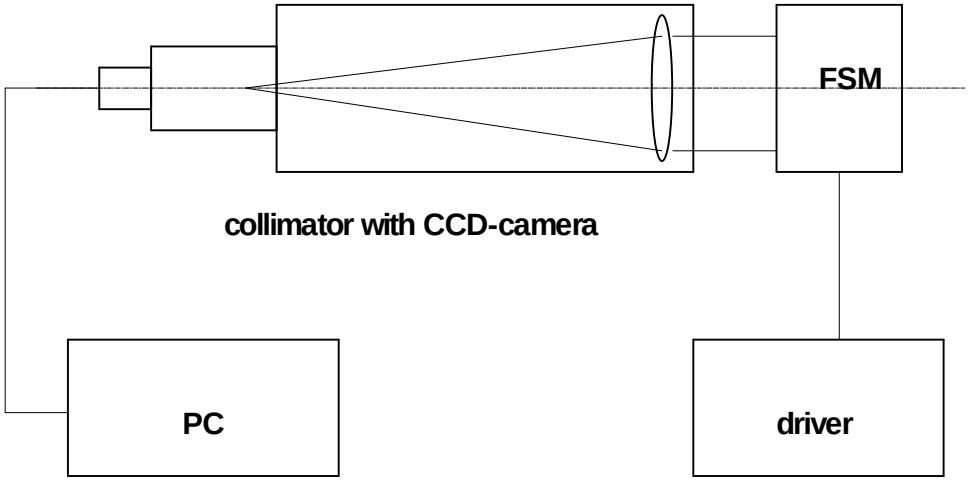
- Collimator f=3000mm with illumination unit
- Objective f=2250mm
- PC mit driver card
- collimator with CCD-camera systems

Test 4

1. Scope of the test

Verificaton of the resolution in the static mode

2. Test Procedure



The FSM will be placed in front of a collimator. The collimator has an illumination unit and a CCD-camera system. The FSM will be controlled with voltages, which become smaller.
The smallest voltage skip is 0.24mV (10V, 12 bit).
This test will be carried out at different offset voltages.
The collimator has a focal length of 2250mm. Therefore 1µm within the focal plane corresponds to a beam deviation of 0.09 arcsec.

3. Test Results

offset	? **U=i*0.244 [V]** **i**	**Spotposition** **x [µm]**	**y [µm]**
$U_x = U_y = 0$ V	3		

	2		
	1		
U_x = +10V, U_y = 0 V	3		
	2		
	1		
U_x = -10 , U_y = 0 V	3		
	2		
	1		
U_x = U_y = +6 V	3		
	2		
	1		

Resolution : .....

4. Test Equipment

- Autocollimator f=2250mm with illumination unit and CCD-camera

Test 5

1. Scope of the test

Verificaton of the Reactionless by 250 Hz

2. Test Procedure

In order to avoid significant increase of the housing mass, the FSM will be supported on foam rubber.
Successively a piezoelectric vibration receiver will be mounted on the mirror surface and on the interface surface 1.
The vibration parameters will be recorded in dynamic mode and the attenuation will be calculated.

3. Test Results

f_i [Hz]	Mirror	Interface	Damping ratio
250			
300			

4. Test Equipment

- piezoelectric vibration receiver system

Test 6

1. Scope of the test

Verificaton of the Pivot stability ? 50 µm

2. Test Procedure

The mirror dummy will be provided with a thin centre cross. (authorization from ROE is necessary).
The centre cross will be observed with a microscope.
The position of the centre cross will be measured in static mode in in x,y and z.

3. Test Results

U_x [V]	U_y [V]	Centre cross position x [µm]	y [µm]
0	0		
0	+10		
0	-10		
+10	0		
-10	0		
+7	+7		
-7	+7		
-7	-7		
+7	-7		

Max deflection of the centre cross : .....

4. Test Equipment

- Microscope