

| Description: Phase Shifter w. Permanent magnets | | | | Product description Phase Shifter - Main Assembly | | | |
|---|--|--------------------------|--------|---|--------------------|-------------------------------|--------------------|
| Order No.: 504313 | | Customer: SLAC | | Part/Drawing No.: 7103050653 | | Serial No.: 2410083 | |
| To be carried out after assembly | | | | | | | |
| No. | Description | Test equipment | Result | Criteria / Tolerance | Comments | Accepted | Sign/Date |
| 1 | Document information Template: Test_504313_PhaseShifter.A | | | | | | |
| | Author: | N/A | OK | | | OK | 27/02/2024 DANA |
| | Reviewer: | N/A | OK | | | OK | 04/03-2024 EBCH |
| 2 | Visual Inspection according to main drawing | | | | | | |
| 3 | Magnet Arrays: | | | | | | |
| 4 | Torque wrench check for magnet assembly According to drawing: 7103050655 & 7103050656 | | | | | | |
| | Verify torque wrench setting at torque transducer | 2361-D | 4.8 | 5Nm ±0,3Nm | Torque Transducer. | OK | 23/08/2024 bgr |
| | Tightening torque for 10 x M5 bolts | 2361-D | OK | 10 x M5 bolts fastened | Torque Transducer. | OK | 23/08/2024 bgr |

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| 5 | Magnet array (Upper) Numbers Only note (xxx) See dwg. 7103050656 | | | | | | |
| | SXRHE-VS(xxx) N | N/A | 074 | | | OK | 23/08/2024 bgr |
| | SXRHE-HS(xxx) ↑ | N/A | 023 | | | OK | 23/08/2024 bgr |
| | SXRHE-VL(xxx) S | N/A | 057 | | | OK | 23/08/2024 bgr |
| | SXRHE-HL(xxx) ↓ | N/A | 027 | | | OK | 23/08/2024 bgr |
| | SXRHE-VL(xxx) N | N/A | 098 | | | OK | 23/08/2024 bgr |
| | SXRHE-HS(xxx) ↑ | N/A | 040 | | | OK | 23/08/2024 bgr |
| | SXRHE-VS(xxx) S | N/A | 125 | | | OK | 23/08/2024 bgr |
| 6 | Magnet array (Lower) Numbers Only note (xxx) See dwg. 7103050655 | | | | | | |

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| | SXRHE-VS(xxx) N | N/A | 054 | | | OK | 23/08/2024 bgr |
| | SXRHE-HS(xxx) ↑ | N/A | 082 | | | OK | 23/08/2024 bgr |
| | SXRHE-VL(xxx) S | N/A | 119 | | | OK | 23/08/2024 bgr |
| | SXRHE-HL(xxx) ↓ | N/A | 046 | | | OK | 23/08/2024 bgr |
| | SXRHE-VL(xxx) N | N/A | 030 | | | OK | 23/08/2024 bgr |
| | SXRHE-HS(xxx) ↑ | N/A | 054 | | | OK | 23/08/2024 bgr |
| | SXRHE-VS(xxx) S | N/A | 019 | | | OK | 23/08/2024 bgr |
| 7 | Mechanical test: Without magnets | | | | | | |

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| 8 | <p>Measure the parallelism of each girder by measuring the distance in 6 points (10mm from transverse edges (Z=±35mm), 10mm (X=-59mm), 69mm (X=0) and 100mm (X=31) from longitudinal edge). Enter the measured values.</p> <p>Measure at 3 gaps, 10mm (121mm without magnets), 50mm (161mm without magnets) and 100mm (211mm without magnets).</p> <p>Illustration can be found in "504313_ReferenceDoc"</p> | | | | | | |
| | Z=-35, X=-59 at 121mm gap | 2138-D | 121.05 | 121mm ±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=-35, X=0 at 121mm gap | 2138-D | 121.04 | 121mm ±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=-35, X=31 at 121mm gap | 2138-D | 121.02 | 121mm ±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=35, X=-59 at 121mm gap | 2138-D | 121.08 | 121mm ±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=35, X=0 at 121mm gap | 2138-D | 121.06 | 121mm ±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |

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| 504313 | | SLAC | | 7103050653 | | 2410083 | |
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| | Z=35, X=31 at 121mm gap | 2138-D | 121.06 | 121mm ±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Deviation max-min at 121mm: | Calculated | 0.06 | <0,1 mm | | OK | 19/06/2024 MMOL |
| | Z=-35, X=-59 at 161mm gap | 2138-D | 161.02 | 161mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=-35, X=0 at 161mm gap | 2138-D | 161.02 | 161mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=-35, X=31 at 161mm gap | 2138-D | 161.01 | 161mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=35, X=-59 at 161mm gap | 2138-D | 161.07 | 161mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=35, X=0 at 161mm gap | 2138-D | 161.06 | 161mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=35, X=31 at 161mm gap | 2138-D | 161.05 | 161mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Deviation max-min at 161mm: | Calculated | 0.06 | <0,1 mm | | OK | 19/06/2024 MMOL |
| | Z=-35, X=-59 at 211mm gap | 2138-D | 211.01 | 211mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=-35, X=0 at 211mm gap | 2138-D | 211.01 | 211mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |

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|---|--|----------------|--------|--------------------------------------|--------------|----------------|--------------------|
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| No. | Description | Test equipment | Result | Criteria / Tolerance | Comments | Accepted | Sign/Date |
| | Z=-35, X=31 at 211mm gap | 2138-D | 211.00 | 211mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=35, X=-59 at 211mm gap | 2138-D | 211.06 | 211mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=35, X=0 at 211mm gap | 2138-D | 211.05 | 211mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Z=35, X=31 at 211mm gap | 2138-D | 211.04 | 211mm±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Deviation max-min at 211mm: | Calculated | 0.06 | <0,1 mm | | OK | 19/06/2024 MMOL |
| 9 | Measure the distance between the lower girder and top of base plate. Illustration can be found in "504313_ReferenceDoc" | | | | | | |
| | Gap set to 121mm | 2138-D | 121.00 | 121mm ±0,1mm | Gauge Blocks | OK | 19/06/2024 MMOL |
| | Position of lower girder | 2138-D | 162.5 | 162,5±1 | Gauge Blocks | OK | 19/06/2024 MMOL |
| 10 | Mechanical test: With magnets | | | | | | |

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| 11 | Adjust the gap to 10mm. Draw a 10mm ceramic block through the magnet gap and check that it can be pulled through the entire gap. | | | | | | |
| | 10mm ceramic block pulled through gap | 2138-D | OK | | Gauge Blocks | OK | 19/07/2024 csoj |
| | Set offset parameters in motor and encoder software. | N/A | 20.28470 | Encoder raw Value | | OK | 19/07/2024 csoj |
| 12 | Set the gap to 100mm as indicated by the motor. Draw a 100.00 mm ceramic block through the magnet gap and check that it can be pulled through the entire gap. | | | | | | |
| | 100,00mm ceramic block pulled through gap | 2138-D | OK | | Gauge Blocks | OK | 19/07/2024 csoj |

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| No. | Description | Test equipment | Result | Criteria / Tolerance | Comments | Accepted | Sign/Date |
| 13 | Set the gap to 10mm. Open the gap to 15mm. Reset a dial gauge installed between the girders to zero. Close the gap to 10mm. Open the gap to 15mm and read the dial gauge. Repeat the measurements 3 times. | | | | | | |
| | Initial dial setting | 2138-D | 15 | 15mm ±0,005mm | Gauge Blocks | OK | 19/07/2024 csoj |
| | Measurement 1 | 2291-D | 14.999 | 15mm ±0,007mm | Dial Indicator | OK | 19/07/2024 csoj |
| | Measurement 2 | 2291-D | 14.998 | 15mm ±0,007mm | Dial Indicator | OK | 19/07/2024 csoj |
| | Measurement 3 | 2291-D | 15 | 15mm ±0,007mm | Dial Indicator | OK | 19/07/2024 csoj |
| | Max deviation | Calculated | 0.002 | <0,002mm | | OK | 19/07/2024 csoj |

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| 14 | Set the gap to 15mm. Close the gap to 10mm. Reset a dial gauge installed between the girders to zero. Open the gap to 15mm. Close the gap to 10mm and read the dial gauge. Repeat the measurements 3 times. | | | | | | |
| | Initial dial setting | 2138-D | 10 | 10mm ±0,005mm | Gauge Blocks | OK | 19/07/2024 csoj |
| | Measurement 1 | 2291-D | 9.999 | 10mm ±0,007mm | Dial Indicator | OK | 19/07/2024 csoj |
| | Measurement 2 | 2291-D | 10 | 10mm ±0,007mm | Dial Indicator | OK | 19/07/2024 csoj |
| | Measurement 3 | 2291-D | 9.998 | 10mm ±0,007mm | Dial Indicator | OK | 19/07/2024 csoj |
| | Max deviation | Calculated | 0.002 | <0,002mm | | OK | 19/07/2024 csoj |
| 15 | Mechanical test: Stop and switch settings | | | | | | |

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| 16 | Attempt to bring to Hard stop settings as close to 9.8/102,2mm as possible to increase adjustment range for limit and power switches. | | | | | | |
| | Hard stop setting closed gap Set the gap to 9.84 ± 0.04 mm and adjust the Hard stop to reach the upper girder | 2138-D | OK | | Gauge Blocks | OK | 19/07/2024 csoj |
| | Hard stop setting open gap Set the gap to $102.25 +0/-0.1$ mm and adjust the Hard stop to reach the lower girder | 2138-D | OK | | Gauge Blocks | OK | 19/07/2024 csoj |
| 17 | Limit switch setting (encoder read gap where the switch activates) Motor speed 5mm/s Approach closed gap from gap position = 20mm | | | | | | |
| | The gap "in" limit switch | 2138-D | 9.955 | 9,97mm $\pm 0,025$ mm | Gauge Blocks | OK | 19/07/2024 csoj |
| | Encoder | N/A | 20.2313 | Encoder raw value | | OK | 19/07/2024 csoj |

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| No. | Description | Test equipment | Result | Criteria / Tolerance | Comments | Accepted | Sign/Date |
| | The gap "in" power switch | 2138-D | 9.91 | 9,915mm ±0,03mm | Gauge Blocks | OK | 19/07/2024 csoj |
| | Encoder | N/A | 20.19295 | Encoder raw value | | OK | 19/07/2024 csoj |
| 18 | Limit switch setting (encoder read gap where the switch activates) Motor speed 5mm/s Approach open gap from gap position = 90mm | | | | | | |
| | The "out" limit switch | 2138-D | 100.5 | 100,5mm ±0,5mm | Gauge Blocks | OK | 19/07/2024 csoj |
| | Encoder | N/A | 110.60435 | Encoder raw value | | OK | 19/07/2024 csoj |
| | The "out" power switch | 2138-D | 102 | 101,6mm ±0,5mm | Gauge Blocks | OK | 19/07/2024 csoj |
| | Encoder | N/A | 111.827 | Encoder raw value | | OK | 19/07/2024 csoj |

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| 19 | Brake test Set the gap to 10.5mm. Note the exact encoder reading. Turn off the power supply for the brake and the motor controller. Read the gap. | | | | | | |
| | Gap initial setting | 2138-D | 10.5 | 10,5mm ±0,05mm | Gauge Blocks | OK | 19/07/2024 csoj |
| | Encoder | N/A | 20.78220 | Encoder raw value | | OK | 19/07/2024 csoj |
| | Gap after power off | 2138-D | 10.41 | 10,5mm ±0,1mm | Gauge Blocks | OK | 19/07/2024 csoj |
| | Encoder | N/A | 20.67125 | Encoder raw value | | OK | 19/07/2024 csoj |
| | Deviation of initial setting and after power off | Calculated | 0.09 | 0mm ±0,05mm | See NCR 4009 CSOJ: 23-08-2024 | OK | 19/07/2024 csoj |
| 20 | Open/close speed test. Measured in seconds First article only! | | | | | | |

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| | Open to closed (40mm gap to 10mm gap) | N/A | 6.5 | <10s | | OK | 19/07/2024 csoj |
| | Closed to open (10mm gap to 40mm gap) | N/A | 6.5 | <10s | | OK | 19/07/2024 csoj |
| 21 | Magnetic test See drawing 7103050653 for magnetic center | | | | | | |
| 22 | Stretch wire measurement: | | | | | | |
| | Stretch wire measurements at all gaps in x=-10 through x=10 in 2 mm steps. At all gaps shall both 1st and 2nd integral scans be performed Use seperate document for data logging, see "504313_ReferenceDoc" • 10 mm gap • 15 mm gap • 20 mm gap • 30 mm gap • 100,0 mm gap | N/A | OK | Stretchwire measurement completed | | OK | 26/07/2024 PMHA |

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| 23 | Hall probe measurements: | | | | | | |
| | <p>Hall probe measurements at intermediate gaps. Before and after each measurement series, reference magnetic field and magnet array temperature must be logged in order to perform temperature correction.</p> <p>600 mm scans.</p> <p>Use separate document for data logging, see "504313_ReferenceDoc"</p> <ul style="list-style-type: none"> • 10 mm gap • 15 mm gap • 20 mm gap • 30 mm gap • 100,0 mm gap | N/A | OK | Hall probe gap measurement completed | | OK | 23/08/2024 CSOJ |

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| | <p>Hall probe Horizontal measurements. Before and after each measurement series, reference magnetic field and magnet array temperature must be logged in order to perform temperature correction. 600 mm scans. Use seperate document for data logging, see "504313_ReferenceDoc"</p> <ul style="list-style-type: none"> • 10 mm gap (x=-2) • 10 mm gap (x=-1) • 10 mm gap (x=1) • 10 mm gap (x=2) • 30,0 mm gap (x=-2) • 30,0 mm gap (x=-1) • 30,0 mm gap (x=1) • 30,0 mm gap (x=2) | N/A | OK | Hall probe Horizontal measurement completed | | OK | 26/07/2024 PMHA |

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|---|--|--------------------------|--------|---|----------|-------------------------------|--------------------|
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| | Hall probe Vertical measurements. Before and after each measurement series, reference magnetic field and magnet array temperature must be logged in order to perform temperature correction. 600 mm scans. Use seperate document for data logging, see "504313_ReferenceDoc" <ul style="list-style-type: none"> • 10 mm gap (y=-0,2) • 10 mm gap (y=-0,1) • 10 mm gap (y=0) • 10 mm gap (y=0,1) • 10 mm gap (y=0,2) | N/A | OK | Hall probe Vertical measurement completed | | OK | 26/07/2024 PMHA |
| 24 | Fiducial holes measurements, magnetic gap 10 mm | | | | | | |

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| | Report uploaded | N/A | OK | | Y:\DFYProjects\DFY5 04313_SLAC Phase Shifters\30 Technical\40 QA and Test results\FAT documentation\241 0083 | OK | 26/08/2024 CSOJ |
| 25 | Visual inspection See drawing 7103050653 | | | | | | |
| | Visual appearance | N/A | OK | | | OK | 23/08/2024 bgr |
| | Labels attached as indicated by drawing | N/A | OK | | | OK | 23/08/2024 bgr |
| | Varnistop applied to bolts. | N/A | OK | | | OK | 23/08/2024 bgr |
| 26 | Corrosion protection, all surfaces | | | | | | |
| | Protection product used: | N/A | OK | All bare metal protected | Product used: | OK | 23/08/2024 bgr |

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| | Data label | N/A | OK | Label present | | OK | 23/08/2024 bgr |
| 27 | Production control | | | | | | |
| | Approved by | N/A | OK | | | OK | 23/08/2024 bgr |
| 28 | Lead Engineer | | | | | | |
| | Approved by | N/A | OK | | | OK | 23/08/2024 JPKR |