



EMITTANCE SCANNER – MODEL ES-4

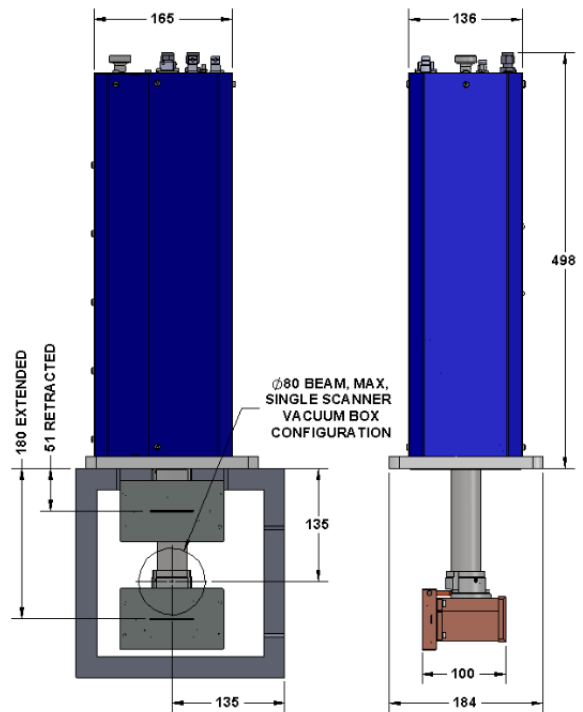
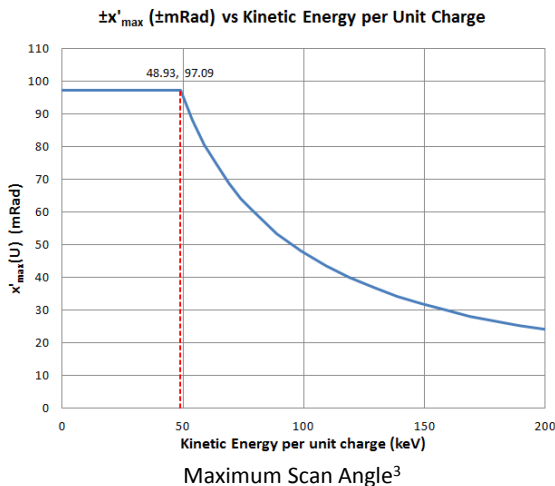
TRIUMF-Licensed Emittance & Phase Space Scanner Probe
With Turnkey Controller and Analysis Software



- Measure magnitude of emittance for low-energy charged particles (<1MeV)
- Water-cooled head for beam power up to 1500W and 500W/cm²
- Determine phase space ellipses by percentage of total beam or by RMS emittance
- Use data for modelling beam transport in ion-optical analysis software
- TRIUMF-licensed technology¹

The D-Pace Emittance and Phase Space Scanner System is an Allison-type emittance scanner, combining an electric trajectory sweep technique with a mechanical position beam sweep, enabling the simultaneous measurement of position (y) and angle (y'). Two probes can be used to scan horizontal and vertical plane phase spaces, or a single head can be used by re-mounting the head on a port 90° to the first. The system includes probe, computer, software, power supplies, and instrumentation.

D-Pace acquisition and analysis software enables the operator to optimize scans for resolution and scan time, and plot beam profiles, 2D and 3D contours with and without emittance ellipses. Data can be exported.



D-Pace can customize the Emittance Probe to customers' requirements. D-Pace provides custom vacuum boxes for single or dual scanners.²

| SPECIFICATIONS - EMITTANCE PROBE | |
|---------------------------------------|---|
| Maximum Travel | 130 mm |
| Distance, Slit to Flange | 50 mm to 180 mm |
| Flange | Custom Rectangular, O-Ring |
| Y Resolution | 100 μm (for $s = 100 \mu\text{m}$) |
| Y Step, Minimum | 1 μm |
| Y' Max | $\pm 97 \text{ mRad}$ (for K.E. < 50keV, see plot) |
| Y' Resolution | 1.3 mRad (for $s = 100\mu\text{m}$) |
| Y' Step, Minimum | 16 bit resolution over +/- Y' Max |
| Sweep Voltage (V_{max}) | +/-1000V |
| Slit width (s) | 100 μm nominal Factory configurable 25 μm to 250 μm |
| Slit length (l) | 50 mm |
| Beam ϕ_{max} (nominal) | 40 mm |
| Bias Voltage | -100 Volts |
| Electrode gap (g) | 4.0 mm |
| Electrode length (L_{eff}) | 76 mm |
| Mass | 19 kg |
| Cooling Water | 1.5 LPM Minimum MIN: 210 kPa (30 PSI) MAX: 620 kPa (90 PSI) |
| Max Beam Power ³ | 1500 W |
| Max Beam Intensity ³ | 500 W/cm ² |
| Cooling Plate | Molybdenum/Copper |
| Slits | Molybdenum (Front), Copper (Rear) |

| SPECIFICATIONS – TURNKEY CONTROL SYSTEM | |
|---|---|
| Instrument Rack | 16U 19" rack, w/ keyboard, power bar |
| Platform | Industrial PC / Windows™ / LabView™ |
| Typical Scan Time | < 1 minute for 30 step Y by 30 step Y' scan |
| Current Meter | 2nA to 20mA (full scale) 5 pA (typical noise floor) |
| Power | 115 or 220 VAC, 600 W, 1 ϕ |
| Data Plots & Analysis | 2D & 3D phase-space intensity distributions, computed emittance, RMS ellipses, Twiss Parameters |
| File Export | CSV, PDF |
| Dim (W x D x H) | 545mm x 660mm x 785mm |
| Mass (approx.) | 70 kg excluding probe |

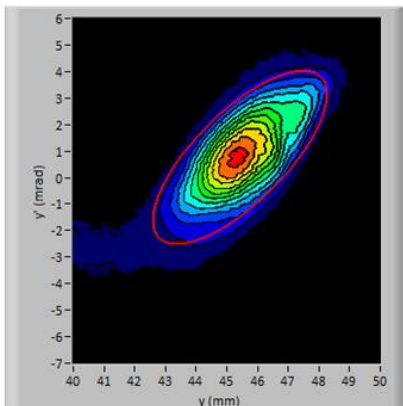
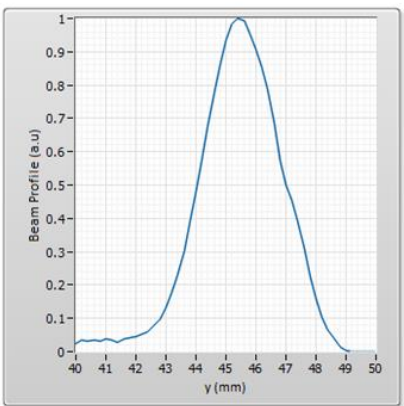
- Licensed from TRIUMF for exclusive world-wide distribution.
- Vacuum boxes available. Contact D-Pace.
- Contact D-Pace with beam requirements.
- D-Pace reserves the right to update specifications as part of its ongoing product improvement program.



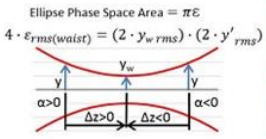
ES-4 Control Rack

Phase Space Analysis System 2.0

| File Name | |
|---------------------|------------------|
| 300keV 1mA H- V20 | |
| Scan | |
| Date: | 3/30/2014 |
| Time: | 4:55:03 PM |
| Beam Energy: | 294 keV |
| # y | 51 points |
| delta y | 0.2 mm |
| # y' | 101 points |
| delta y' | 0.113451 mrad |
| Axis: | Vertical Top |
| Rejection Threshold | |
| 4% Emittance Mode | |
| Beam Centroid | |
| y | 45.422627 mm |
| y' | 0.750859 mrad |
| TWISS Parameters | |
| β | 1.264003 mm/mrad |
| γ | 1.684777 mrad/mm |
| α | -1.062809 |
| Beam Waist Location | |
| Δz | -0.630831 m |



| % Beam In Ellipse | | % Beam Dimensions | | | Emittance | | Transport Sigma Matrix | | |
|-------------------|----|-------------------|---------------------------|-----------|---|--|----------------------------------|-------------------------------------|------------------------------------|
| % | n | y (mm) | y _w Waist (mm) | y' (mrad) | ϵ_N Normalized (mm ² ·mrad) | ϵ Geometric (mm ² ·mrad) | σ_{11} (mm ²) | $\sigma_{12}=\sigma_{21}$ (mm·mrad) | σ_{22} (mrad ²) |
| 38.7123 | 1 | 1.4002 | 0.9595 | 1.6166 | 0.0388 | 1.5511 | 1.9606 | 1.6485 | 2.6132 |
| 62.8932 | 2 | 1.9802 | 1.3569 | 2.2861 | 0.0777 | 3.1022 | 3.9212 | 3.2970 | 5.2265 |
| 78.4950 | 3 | 2.4252 | 1.6619 | 2.8000 | 0.1165 | 4.6533 | 5.8817 | 4.9455 | 7.8397 |
| 87.3408 | 4 | 2.8004 | 1.9190 | 3.2331 | 0.1553 | 6.2044 | 7.8423 | 6.5940 | 10.4530 |
| 92.7853 | 5 | 3.1310 | 2.1455 | 3.6147 | 0.1942 | 7.7555 | 9.8029 | 8.2426 | 13.0662 |
| 95.8613 | 6 | 3.4298 | 2.3503 | 3.9597 | 0.2330 | 9.3065 | 11.7635 | 9.8911 | 15.6794 |
| 98.2886 | 8 | 3.9604 | 2.7139 | 4.5723 | 0.3107 | 12.4087 | 15.6847 | 13.1881 | 20.9059 |
| 98.8053 | 10 | 4.4278 | 3.0342 | 5.1120 | 0.3883 | 15.5109 | 19.6058 | 16.4851 | 26.1324 |



Screen shot of ES-4 analysis software