



PORTABLE 2.5 MEV X-BAND LINEAR ACCELERATOR STRUCTURE



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Abstract





- Two versions of 2.5 MeV X-Band linear accelerator have been designed and tested.
 - Traditional single input linac.
 - Dual input, two-section linac with power input through a 3-dB coupler.
- Applications: security screening, nondestructive testing, medical and industrial CT, other.



LINACS FOR SECURITY AND NDT





- Stringent Requirement: reduction of ABC (X-Ray Head) and Linac System size and weight;
- Source dimensions heavily influence mass of the radiation shielding housing, especially for mobile applications in security and NDT
- Radial dimensions of Accelerator Beam Centerline (ABC) are proportional to the RF source wavelength and define X-band ABC to be approximately three times smaller in radial dimensions than the similar Sband ABC.
- Common View: X-band linacs as of much lower power and dose rate units, and, sometimes, unreliable machines compared to the S-band linacs



X-BAND VERSUS S-BAND

IPAC21

Some Customers' and some OEMs' Common View:

X-band linacs are much lower power and dose rate units, unreliable machines compared to the S-band linacs



HOWEVER, Common Views are changing......

- Advances in the X-Band RF sources;
- Developed X-Band ABC design and production technique;
- X-band linacs are much smaller and lighter and permit easy service;
- Reduce shielding mass substantially;
- Maximum Power is reaching S-Band machines (Example 6 MeV X-Band linac delivers over 1000 R/min @1 m now;
- Most of lower energy mobile security screening units and portable NDT applications do not require high output, but in the range of 10 -100 R/min@ 1m;
- Cost of the magnetron source is being driven down by the market, multiple suppliers become available;
- Reliability of the linac system is improving.



SINGLE SECTION LINEAR ABC TEST RESULTS (1) (350 kW Maggy)



Energy and Dose Rate versus Peak Beam Current



ABC-1.8-X-X Design and Test Results (350 kW Maggy)

- Designed as a replacement of a Varian produced X-Band guide for linac system at energy of less than 2 MeV;
- Low cost, no export license required;
- Designed for a small, 350 kW peak RF magnetron;
- X-band linacs are much smaller and lighter and permit easy service;
- Low output, but very useful linac, multiple applications in both security and non-destructive testing (NDT);
- Maximum Power is reaching S-Band machines (Example 6 MeV X-Band linac delivers over 1000 R/min @1 m now;
- Tested to deliver loaded nominal energy of 1.8+0.1 MeV, nominal dose rate of 13+2 Rad/min, as expected.



SINGLE SECTION LINEAR ABC TEST RESULTS (2) (700 kW Maggy)



TWO SECTION, DUAL INPUT ABC TEST RESULTS



- Setup RF Power to ~0.7MW (Peak)
- Measured Dose and Energy at 100 PPS, 4.5 μS Mag I Pulse Width



- Setup RF Power to ~0.7MW (Peak)
- Measured Dose and Energy at 400 PPS, 2.2µS Mag I Pulse Width



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ABC-2.5-X-X-DI Design and Test Results (700 kW Maggy)

- Designed two-section ABC with a dual input through a 3dB coupler, a la Vaguine and Tanabe;
- Tested to deliver loaded nominal energy of 2.5+0.3 MeV, nominal dose rate of 30+5 Rad/min, as expected.
- Potential Advantages:
 - Elimination of the circulator in the most simple, nonregulated power and energy configuration;
 - Adding of the phase or phase-and-power regulator into the second arm permits a very effective broad energy regulation (circulator remains).







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