

## RANGE ONLY RADAR



Range Only Radar on Optical Tracking Platform

components as well as test equipment and the ready availability of proven X-band modules in the commercial marine and aviation field, X-band was the more attractive alternative.

The basic low-cost Range Only Radar consists of a small lightweight electronics package with a parabolic antenna and a simple, yet versatile interface to the system operator. The electronics package contains a proven off-the-shelf Receiver/Transmitter unit and PC-based range data processing and interface hardware and software. The electronics package is designed to mount on a single sensor station such as a Photo-Sonics, Kintec, Contraves or other small optical mount. The antenna attaches to the front of the electronics package.

The radar Receiver/Transmitter unit is an integrated unit proven in commercial service worldwide. The R/T unit operates at 9.4 GHz with an output peak power of 10 kW. Two pulse widths are selectable: 0.25 and 0.5 ms. Pulse repetition frequencies are programmable within duty cycle limitations up to 1280 pps. The radar receiver uses MIC low noise technology, matched IF filters, and a 60 MHz IF output. With a 0.8 meter (31 inch) parabolic antenna and operating at 0.5 ms pulse width, the radar will track a 0.1 meter RCS target to at least 10 km.

The antenna typically provided is a 0.8 meter Cassegrain design with a beamwidth of 2.8° and a gain of 35 dB. A larger or smaller antenna can be provided as needed with applicable differences in performance. The antenna may be mechanically interfaced to the electronics package to allow for constraints in the configurations of the mount, other sensors, or the mount cover.

A ruggedized PC-ATbus off-the-shelf controller is included with the radar. Input, output, and interrupt is passed between the range processor board and the host controller over the PC-ATbus. The controller has a software range tracker already proven in our VMEbus design and ported to the PCbus.

The software range track loop is a Type II computed in floating point in an 80486 processor for maximum granularity of data. A software alpha-beta filter is used which provides velocity memory. The Type II tracking loop provides good track response and zero-lag on non-accelerating targets. A programmable track bandwidth is available to match the range track servo loop performance to the target dynamics.

The hardware tracker card includes a precision 21 MHz on-board oscillator for range clocking. The assembly also contains the PRF generator, the radar video digitizer and the means to accept external time tag interrupts. For graphical video display purposes, a peak detector and FIFO memory are used to capture each PRF video.

With the need for a compact, lightweight, low-cost RF ranging sensor for optical tracking systems at test ranges in the U.S. and overseas, BAE SYSTEMS combined our expertise in computer-based radar and optical tracking systems to develop a Low-Cost X-band Range Only Radar. This radar blends proven tracking techniques with the reliability, flexibility and cost-effectiveness of off-the-shelf components and PC-based hardware and software.

The availability of a low-cost radar sensor enables the addition of real-time autonomous range data to optical tracking mounts for the price of an optical sensor. Autonomous range data allows an intelligent optical tracking mount (or host system) to produce:

- Single-station X, Y, Z position
- Auto-focus of optical sensors
- On-Axis Cartesian tracking
- Real-time AER slaving

The addition of range data to an otherwise highly accurate but two-dimensional optical mount is valuable in nearly all testing situations but is particularly crucial for the testing of smart munitions: a scenario in which events happen too quickly and unpredictably to permit more traditional tracking methods to provide the necessary data consistently and efficiently.

A major consideration in a radar which needs to be light and small is its operating frequency. In this case tradeoffs between X and Ka-bands were evaluated:

Ka-band radars have a narrower beam width than X-band units for a given antenna size. For a range only radar this results in higher loop gain and less clutter in the beam. However, Ka-band also has higher atmospheric losses and greater susceptibility to weather interference. A very narrow beam may also not be desired, especially during acquisition. Higher transmitting powers are readily available at X-band which helps offset the lower loop gain.

Cost was a major consideration in our design. Ka-band components are significantly more expensive than X-band both to purchase and to repair. Considering the expense of the

THE RANGE ONLY RADAR (ROR)  
IS A COMPACT, LIGHT WEIGHT, LOW  
COST RF RANGING SENSOR FOR  
OPTICAL TRACKING PLATFORMS.

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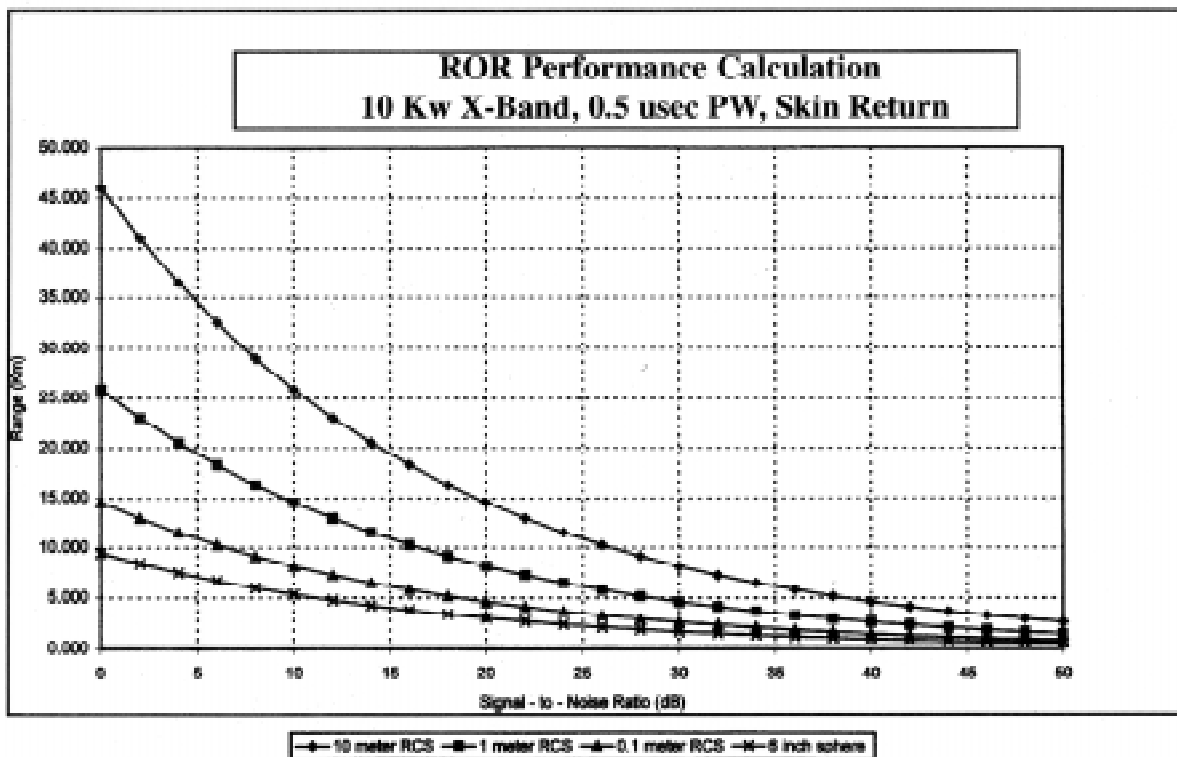
The ROR design minimizes requirements for real-time operator interface. Once the optical mount is aligned on the proper target, the operator only needs to push one button to place the range tracker into an automatic acquisition mode. In the auto-acquisition mode, the radar automatically searches a preset range window for a valid target return. After target acquisition, the range tracker provides a continuous real-time parallel range data output. If track is lost, the operator activates the same single button to re-start the auto-acquisition process.

A keyboard input and VGA output is provided on the radar host controller for access to internal parameters of the radar such as search window, PRF, pulse width, range bias and other pre-mission setup values. The operator can configure the radar to fit various mission profiles through a menu-driven sequence.

The open architecture of the radar hardware and software, enables various options and customized features to be incorporated without lengthy and costly re-engineering.

Options include:

- Expanded host processor functions such as coordinate conversion, special sequential search commands, parallel data outputs, and real-time data recording.
- Expanded and customized control panels including touch screen controls and target selection.
- Output video either for display on a Color A-Scope or superimposed on standard video signals.
- Integration of the ROR with other PC-ATbus-based hardware such as annotators, encoders, clocks, recorders, serial and parallel data communications devices and fiber optic interfaces.
- Extended range performance using either a larger antenna or higher power transmitter.



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