

**Applications of Innovative Technology – Making the  
KVH TracVision® M3 Small, Simple, and Powerful**

January 2007

KVH Europe A/S

Kokkedal Industripark 2B  
2980 Kokkedal, Denmark

Phone: 45 45 160 180

Web: [www.KVH.com](http://www.KVH.com)

Email: [info@kvh.dk](mailto:info@kvh.dk)

---



---

TracVision, KVH, and the unique light-colored dome with dark contracting base are registered trademarks of KVH Industries, Inc.

All other trademarks are the property of their respective companies.

---

## The KVH TracVision M3 – Applying Innovative Technology to Serve an Untapped International Market

KVH's TracVision M3 is the first and only fully stabilised mobile marine satellite television system designed specifically for boats in the 25-40 foot range. Compact, quiet, and simple to use, the TracVision M3 is the world's smallest system of its kind with a 37 cm diameter antenna design. Despite its size, it offers precision tracking, and a coverage range comparable to larger 45 cm antennas, which used to be the smallest antennas capable of delivering acceptably strong satellite TV reception to boats. KVH's TracVision M3 is fully automatic, connecting boaters to popular local satellite TV programming broadcast by such satellites as Astra 1H and 1G, Astra 2A South, Hotbird and Hotbird Widebeam, and Hispasat.

Up until now, marine satellite TV antennas had either been too large to look good on smaller vessels or made significant compromises in the tracking ability and signal strength they delivered in an effort to reduce antenna size. Manufacturers of these inferior, smaller products tried to hide their reception issues by suggesting that they were intended only for at-anchor or "coastal" use. In reality, the dynamic tracking requirements on smaller boats are more stringent than on larger vessels. The TracVision M3 achieves its high standard for performance with innovations in design and technology, extensive testing, and by applying a wealth of experience and expertise in mobile satellite systems within a dynamic marine environment. Just as important as its great look on smaller boats is its superior signal strength and tracking.

This paper describes the innovations in design and technology that allow the TracVision M3 to offer 45 cm antenna performance in the smallest marine satellite TV system available – all without compromising the reception, precision tracking capability, or coverage. Beyond the powerful performance, KVH addresses the question of reliability with its own rigorous and extensive design verification testing – at a level far above the industry standard, and an important prerequisite for the TracVision M3 to join the award-winning TracVision family.

### 1 Innovations in Efficiency

Rather than shrink the components of larger antennas and compromise performance, KVH focused on redesigning key components to operate more efficiently. KVH considered every

Figure 1

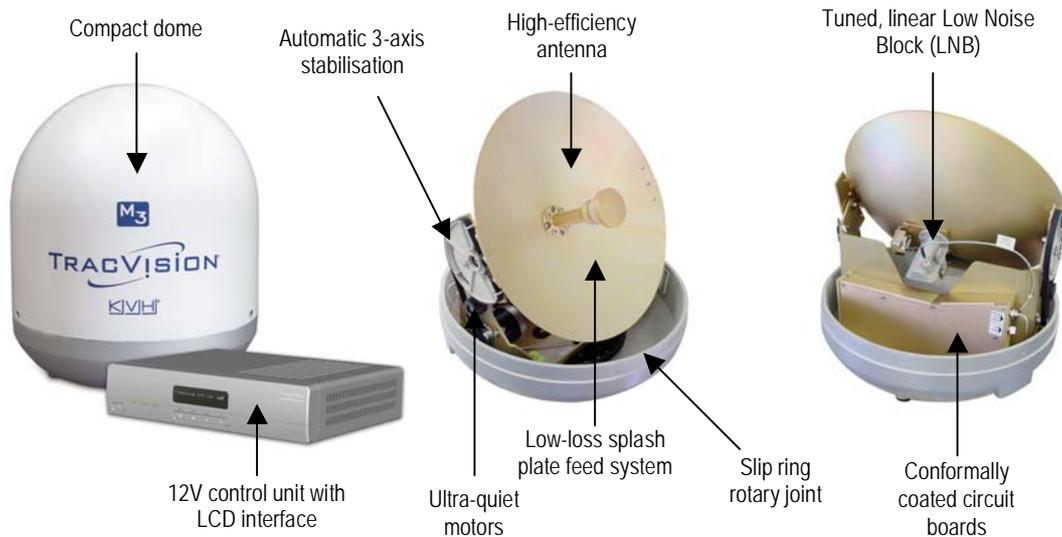
*The TracVision M3, a 37 cm diameter satellite TV antenna with reception and gain comparable to 45 cm systems*



aspect of the product – the way it looks, the way it works, and the way boaters will use it – every detail was considered. The TracVision M3 changes the course of things to come with a list of innovations that enabled KVH to achieve its breakthrough combination of size, power, and simplicity. From its compact dome to its small, high-efficiency antenna design, the TracVision M3 is the mobile satellite TV solution that fits the 25-40' market perfectly.

**Figure 2**

*TracVision M3 includes a wide range of improvements and enhancements to antenna efficiency and performance*

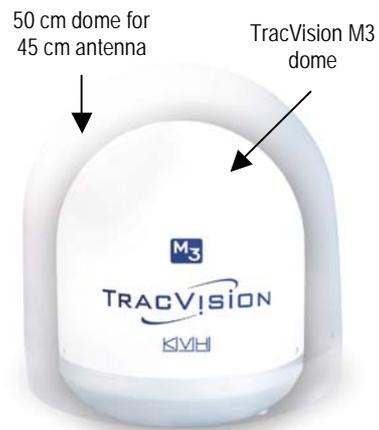


## 1.1 Compact dome

Up until now, larger antenna domes looked too big on smaller vessels. However, the TracVision M3 offers a package designed specifically for smaller vessels. Compact and 40% smaller than the domes housing 45 cm antennas, the TracVision M3 demonstrates the latest innovations beginning from the top, down. Made of high-efficiency, minimal-loss material, the dome is rugged enough for the harsh marine environment yet allows satellite TV signals to pass to the antenna virtually unimpeded.

**Figure 3**

*The TracVision M3 dome is 40% smaller than those used with 45 cm antennas*

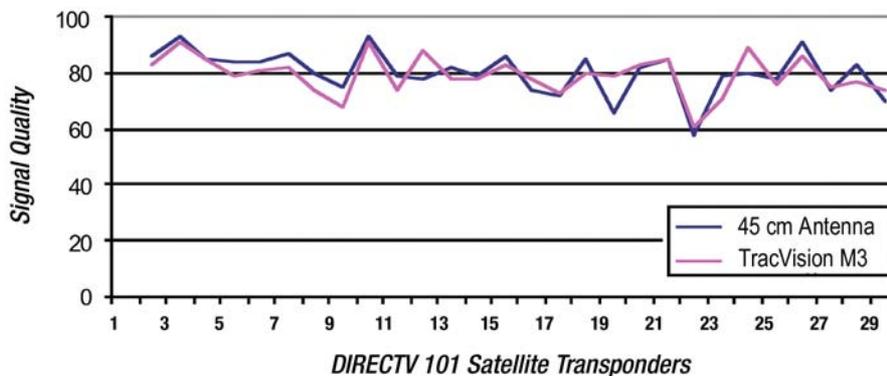


## 1.2 Small, high-efficiency antenna design

Modeled after the cassegrain (backfire) design, the TracVision M3 antenna reflects more than 65% of the incoming signal compared to the 50% typical of 45 cm antennas, making it possible to be both small and powerful. With a rear-feed reflector and linear Low Noise Block (LNB), the TracVision M3 boasts a shaped reflector panel that is smaller and flatter than any other cassegrain-style antenna, ensuring greater performance with higher gain and efficiency.

Figure 4

*A comparison of signal quality between the 32 cm diameter TracVision M3 and a standard 45 cm diameter satellite TV system shows that the smaller antenna offers comparable reception*



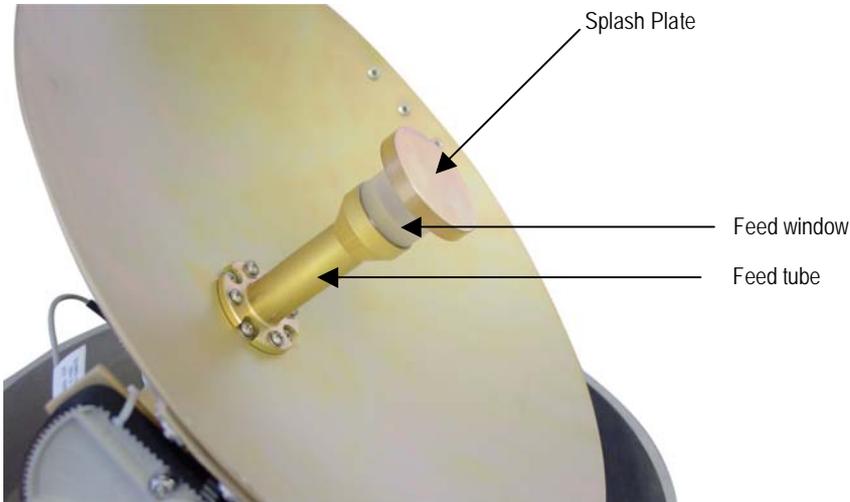
The rear-feed antenna design is suited best for the size modifications needed to fit the 37 cm antenna dish under its compact dome. Feed blockage on the reflector panel is minimized as well, which further improves efficiency by increasing the percentage of panel surface used to reflect the signal. It also lowers the center of weight in the antenna, making it more stable and agile for tracking in the highly dynamic environment of smaller boats.

## 1.3 Splash plate feed system

The TracVision M3's high efficiency and low signal loss continues with its innovative splash plate feed system. Typical of the cassegrain design, the system stems from the center of the reflector panel, and consists of a splash plate, feed window, and feed tube. It is designed to direct the satellite TV signal from the reflector panel to the custom LNB with as little signal loss as possible. To start, the signal bounces off the reflector panel; the splash plate captures it through the low-loss permeable material of the feed window, directing it down the feed tube to the LNB.

Figure 5

*A close-up of the TracVision M3 splash plate feed system*



#### 1.4 Compact Low Noise Block (LNB)

Half the size of standard LNBs found on 45 cm antennas, KVH's TracVision M3's LNB is compact compared to industry standards, and offers superior low noise performance, low weight, and low signal loss. European satellite TV is broadcast as vertical and horizontal linearly polarised signals, which requires the LNB to be turned, or "skewed," to align with the linear signals for crystal-clear reception. Positioned on a rear-fed mount on the back of the main reflector, the TracVision M3's LNB provides easy access and a simple means of adjusting the skew to adapt to new locations.

Figure 6

*To reduce the overall size and weight of the TracVision M3 along with the required number of cables, KVH is using a smaller linear LNB design (right), a significant change from the large, multi-cable LNBs used in antennas 45 cm and larger (left)*



The TracVision M3 LNB's superior low noise performance weeds out the signals you don't want (noise from the surrounding area, other satellites, etc.) and amplifies the signal you do want with very low noise amplifiers. It also converts the satellite signal from 12 GHz Ku-band (broadcast from the satellite) to 1.5 GHz L-band (compatible with receivers) to efficiently pass the signal through a single cable.

## 1.5 Single data/power cable

Most satellite TV systems require at least three cables to transfer data up to the antenna, send TV satellite signals to the receiver, and power the antenna's motors. KVH's cable design and ability to shift signal bands and polarisation allow the TracVision M3 to use a single cable to connect the antenna above to the receiver below, making it easy to use and a snap to install.

## 2 Innovations for Performance

Drawing on years of design experience with award-winning TracVision systems, KVH broke free from traditional thinking and employed proven technologies in a whole new way. Proven, field-tested technology that ensures reliability is one thing. Coming up with innovative ways to optimise those technologies is what distinguishes the TracVision M3 from all the rest.

### 2.1 Slip ring rotary joint

The big challenge for mobile satellite antenna systems is passing the satellite TV signal from a continuously rotating antenna above to the receiver secured below. Traditionally, a cable wrap is used to connect the antenna's base to the rotating antenna, but given the limited length of the cable, the antenna could rotate only 720° before the cable would reach its limit. The antenna would then have to rotate 360° in the opposite direction to reset the cable but doing so would cause a brief interruption in TV reception.

The KVH-designed slip ring rotary joint solves this problem with a two-piece component (the top moves while the bottom remains stationary) that passes electricity across several points of contact. A core component in several land mobile TracVision systems, it allows the antenna to rotate freely and continuously to provide a constant, uninterrupted signal whether the boat is underway or safely docked. KVH improved upon this new technology with stronger points of contact than ordinary, high-loss slip rings. With low path loss and a steady signal, the KVH slip ring rotary joint allows for greater cable length between the antenna and receiver, which translates into a steady signal for a variety of boats of differing lengths.

### 2.2 Conformally coated circuit boards

The TracVision M3's circuit board illustrates the antenna's power and simplicity. By combining both the main circuit board and the RF (radio frequency) board, troubleshooting and

diagnostics take minutes rather than hours. The use of the latest Intel RF chips contribute to the new RF circuit design and make it possible for the TracVision M3 to decode information faster than ever before. In addition, tracking performance on weaker satellite TV signals is improved by the use of this RF chipset, which can tune and decode weaker signals than was previously possible using older chipsets. The circuit board is uniformly sealed with the industry's leading conformal coating, HumiSeal®, recognized as the best protection for electronic components subject to the hostile environments and rugged conditions found in marine applications.

### 2.3 Ultra-quiet motors

The proximity of a small boat's equipment to its passengers can be very close, which is why KVH engineers designed TracVision M3 to be so quiet. The TracVision M3 employs ultra-quiet stepper motors with all the strength for continuous tracking and constant stabilisation hundreds of miles offshore. Virtually silent, these motors deliver the same uncompromising performance and reliability as larger 45 cm antennas, but you will never know it by listening.

### 2.4 Fully stabilised in-motion operation

The TracVision M3's powerful offshore performance and full stabilisation relies upon two extremely small gyros that measure the vessel's pitch, roll, and yaw, which are then translated into elevation and azimuth for the purposes of antenna pointing. In addition, the system constantly measures the strength of the satellite signal. This combination of data enables the TracVision M3 to compensate for the dynamic motion typical of small boats, maintaining a lock on the satellite at all times. As with 45 cm diameter antennas, the TracVision M3 can maintain an uninterrupted satellite signal even during offshore navigation in lively waters.

Figure 7

*The stabilised TracVision M3 is capable of maintaining a lock on the satellite even when the vessel is cruising at high speed or in rough seas*



## 2.5 12V Control Unit with LCD Interface

To make the installation as easy as possible as well as support a range of satellite TV services, the TracVision M3 comes standard with KVH's 12V control unit. This compact unit connects via a single cable to the antenna, as well as directly to the vessel's 12V power supply. In addition, it serves as the junction point for virtually any make or model of home receiver necessary to support the TV installation onboard.

Once the antenna, 12V control unit, and satellite TV receiver are installed, using the system is extremely easy. When the antenna is powered up, it automatically searches for the requested satellite. In-motion tracking is fully automated. And for boaters who wish to switch among satellite TV services, the TracVision M3 makes switching satellites as easy as 1-2-3 by using the DiSEqC communications from the attached Digital Video Broadcast (DVB<sup>®</sup>) satellite TV receiver and its remote control. As an added feature, the TracVision M3 also permits manual satellite switching via the 12V control unit's LCD control panel.

For ongoing operation, there are times when satellite TV providers change the parameters necessary to track the satellite successfully, including satellite frequency, network ID code, etc. Updating this information on the TracVision M3 is now a snap using the 12V control unit's two-line LCD interface.

## 3 Extensive Design Verification Testing

KVH Industries is a financially secure company that has been serving the marine marketplace with award-winning products for almost 25 years. Certified to the rigorous ISO 9001:2000 standard for quality, the company strives to bring its customers the best products available. A key to KVH's success in attaining this goal is the fact that KVH carries out the most stringent performance evaluations in the industry. The TracVision M3 must survive a demanding series of tests before production as well as during the manufacturing process.

### 3.1 Military Specification Environmental Tests

KVH is an approved contractor for the U.S. and allied militaries and as such, employs a range of tests and specialised equipment to ensure that the company's products meet military specifications (aka "mil-spec"). These same tests and equipment are applied to KVH's marine products, including the TracVision M3, to ensure the highest quality possible.

Figure 8

*The TracVision M3 with its 12V control unit*



The mil-spec environmental tests that KVH uses for its military and marine products include:

- Salt Fog Accelerated Life Testing (MIL-STD-810 Method 509.4)
- Humidity Testing (MIL-STD-810 Method 507.4)
- Dust Testing (MIL-STD-810 Method 510.4)
- Rain Testing (MIL-STD-810 Method 521.2)
- Temperature Change Testing (MIL-STD-810 Method 503.4)
- Temperature Testing (MIL-STD-810 Method 501.4/502.4)

### **3.2 KVH-specific Design Verification Tests**

Well beyond the industry standard, the TracVision M3 must survive a complete battery of tests before it is released for production that includes:

- CE EN55033 approval for Electromagnetic Interference (EMI) – Confirms that the product will not interfere with the performance of other electronic devices.
- CE EN55024 approval for powerline transient immunity – Confirms that the product will survive exposure to power line surges and spikes.
- Inmarsat operational and survival testing – Confirms the product's ability to function during the following stress-testing standards: Operational: 20-150 Hz @ 1.1G; Survival: 20-150 Hz @ 1.7G.
- HALT (Highly Accelerated Life Cycle) – Prior to production, the product design cycle tests determine the product's extreme physical limits of shock, vibration, and thermal cycling (-30° to 90° C).
- HASS (Highly Accelerated Stress Screening) – As part of the manufacturing process, further tests include a combination of shock, vibration, and thermal cycling (-25° to 60° C) to confirm product quality before shipment.
- Power tests of circuit board and receiver – Confirms stable operation at a variety of power and temperature extremes.
- Simulated consumer installations – Ensures that no special technical expertise is required.
- ISTA (International Safe Transit Authority) Packaging Testing – Consists of ten controlled drops on specific edges, corners, and faces of outer box. For greater confidence in shipping survivability, KVH increases the height 30 cm beyond the specified ISTA height.
- FCC Part 15 Class B approval for Electromagnetic Interference (EMI) – Determines the product will not interfere with the performance of other electronics.

### **3.3 Ongoing System Support & Upgrades**

For KVH, the success of its products is based on the satisfaction of its customers. For that reason, the performance and operational tuning of the TracVision M3 does not end when the product leaves the factory. Ongoing support is critical to ensure optimal performance, especially in the world of satellite TV as the service providers are constantly adjusting and altering the programming and satellite data.

For this reason, the TracVision M3, like all of KVH's TracVision products, is designed for easy software updates to make certain that the antenna always has the most up-to-date satellite and transponder data. Together with KVH's two-year warranty and backed up by our international Certified Support Network (CSN), the TracVision M3 comes with the most comprehensive support in the industry.

## **4 Conclusion**

In the world of mobile marine satellite TV, no other system can claim to be more compact, quiet, or simple to use than the TracVision M3. The groundbreaking design and outstanding performance was recently celebrated when the TracVision M3 won the Marine Electronics category for the prestigious DAME Award, garnering it international recognition only weeks after the TracVision M3 also won the "Best Marine Electronics Award" from North America's National Marine Electronics Association. Remarkably efficient with uncompromising performance and reception comparable to 45 cm diameter systems, the TracVision M3 delivers everything it promises in a size that is designed to bring the best mobile satellite TV to the largest untapped segment of the boating market.