

Versatile automated weather observation for Demanding Tactical Military

Military forces have a universal need for automated weather stations that can be rapidly deployed and used in diverse field operations. They have also tended increasingly to use commercial-off-the-shelf (COTS) products. Vaisala's new generation MAWS201M Tactical Meteorological Observation System meets the versatile requirements of military forces, and is a genuine COTS product.



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Military forces have a universal need for rapid-deployment, automated weather stations that can be used in diverse field operations. Furthermore, they are increasingly using commercial-off-the-shelf (COTS) equipment. The challenge is to provide COTS systems that can be easily shipped, installed and field-upgraded with a variety of sensors to give full aviation support capabilities in the METAR format, for example.

Vaisala's new generation MAWS201M Tactical Meteorological (TACMET) Observation System offers all these capabilities, and is a genuine COTS product.

Field-deployable weather station for tactical situations

The MAWS201M TACMET System is a field-deployable, compact weather station, capable of monitoring two general types of environmental parameters – meteorological parameters (wind, air temperature, humidity, pressure, precipitation) and aviation support parameters (cloud height and cover, visibility/precipitation type, thunderstorms/lightning). The system is designed

to be portable, capable of quick deployment worldwide, and operational in tactical situations in a variety of environments.

Two systems can be connected to a Windows NT-based workstation via hardware or radio modems. The workstation displays the data numerically and graphically, codes aviation weather reports in METAR/SPECI, and archives and transmits the data for further processing. A handheld display is also available for viewing all measured and calculated data while still in the field.

High-performance Basic System

The MAWS201M Basic System is a high-performance system fitted into a very compact equipment package built around a stable tripod design. The system can be powered by mains power (AC) or by an integrated solar panel when mains power is not available. Back-up batteries, which can be used for a minimum seven days without charging, are also included.

The MAWS201M interfaces with a basic set of sensors for wind speed and direction, barometric pressure, air tem-

perature and relative humidity and precipitation. In addition to the basic functions of powering and taking measurements from the sensors, the MAWS201M also processes the statistical calculations, performs data quality control, logs data into a secure Flash memory, and formats the data for output in application-specific formats.

The MAWS201M uses a 32-bit Motorola CPU, a 16-bit A/D conversion, and advanced software to ensure the continuous accuracy of the measured data. The built-in quality control software validates the sensor data against the climatological limits set by the user, and the step changes between successive measurements. The modular design and efficient Built-In-Test (BIT) diagnostics allow quick identification, removal and replacement of defective LRUs (Lowest Replaceable Units) in the field.

The MAWS201M has 5 serial I/O ports for interfacing with intelligent sensors such as those used in enhancement configuration, and for transmitting data to users via land-line cable and/or VHF or UHF radio modem.

The data can be presented on either a handheld display unit or a Windows NT-based

Needs

- Real-time data display
- METAR/SPECI coding and editing
- Data and message storage
- System diagnostics

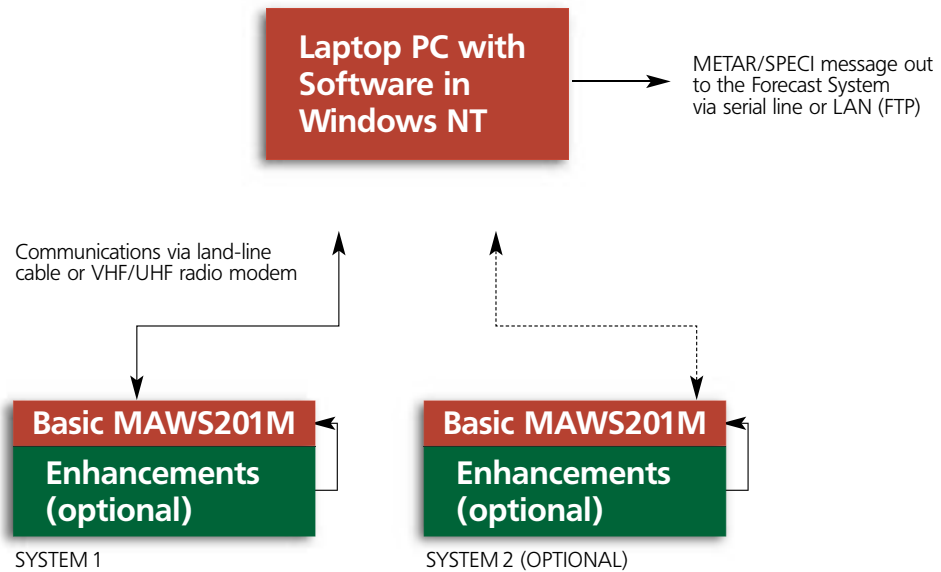


Figure 1. The complete MAWS201M System with enhancements and options.

workstation, both of which are described in more detail below.

Versatile enhancements

The Basic System can be enhanced with sensors for cloud height and cover, visibility, present weather and lightning detection, all of which are needed for aviation support. The enhancement sensors are all powered by mains power, but have a back-up battery supply with an in-built charger to support operation in the limited mode for 24 hours.

Cloud height and cover

Cloud height and cover is detected by the CT25KAM, which is a portable model of Vaisala's FAA-approved (approved by the US Federal Aviation Administration) ceilometer known as the CT25K. The CT25KAM has a unique single lens design, making it lighter, more reliable and easier to maintain. The heater/blower window conditioner ensures performance in all specified environmental conditions, and under all precipitation types. It also significantly reduces the need for operator maintenance in the field.

A special tilt sensor is provided to automatically com-

pensate for uneven terrain. Its installation is easier and faster, if no exact leveling is required.

The cloud cover algorithm used in the CT25KAM is a further development of the algorithm specified by FAA. The cloud cover (amount) is reported in 0 to 8 octals, according to the WMO (World Meteorological Organization) regulations. The cloud height/vertical visibility accuracy is within 50 feet in a range of up to 25,000 feet. In addition to reporting the standard four layers of cloud, the system reports fifth layers in the remark fields of the METAR report.

Visibility and present weather

The PWD11A visibility and present weather sensor evaluates the Meteorological Optical Range (MOR) by measuring the intensity of infrared light scattered at an angle of 45°. The scatter measurement is converted to visibility after a careful analysis of the signal properties. Special processing is used in the case of precipitation. The MOR range (visibility) of the PWD11A is from 10m...20,000 m.

The PWD11A is a lightweight instrument designed to operate continuously with minimum



Figure 2. The MAWS201M Basic System.

maintenance. Condensation is avoided by lens heating, resulting in better performance in all conditions and reduced operator maintenance. The PWD11A is quickly installed on the tripod of the Basic System. No tools are required.

The present weather is also measured with the same instrument. The PWD11A present weather detector uses the same sensing technology as the FD12P present weather sensor, which is FAA-approved and has been found to be one of the best sensors in an extended comparison organized by the WMO.

The PWD11A software detects precipitation droplets from rapid changes in the scatter signal. The droplet data is used to estimate precipitation intensity and precipitation amount. In addition to the optical signal, a capacitive rain detector is used to estimate precipitation intensity and the precipitation type. The output of the capacitive rain detector is proportional to the water amount on the capacitive sensing surfaces, while the

optical intensity is proportional to the volume of the reflecting particles.

Lightning detection

The SA20 StrikeAlert Thunderstorm sensor is designed to detect and locate lightning activity within a 50 nautical mile range of the sensor. The SA20 is also an FAA-approved sensor.

The SA20M detects lightning occurring within clouds, between clouds and between the clouds and the ground. The ability to detect inter-cloud activity allows the SA20M to detect lightning during the buildup stages of a thunderstorm, before sufficient charge buildup has occurred to generate a ground strike. Consequently, the SA20M provides early warning of potentially fatal, single-event, ground strikes.

The primary functional components of the SA20M are the antenna, strike processor board and main processor board. The antenna is mounted on top of a ground plane with the proces-

Figure 3. The complete MAWS201M TACMET system with enhancements.



Figure 4. The complete system can become operational in less than 30 minutes.

sor boards mounted below, resulting in a compact, single sensor lightning detection system.

The antenna is a set of crossed loop antennas and a vertical electrical field antenna. Circuitry to simulate a lightning strike at a predetermined range and bearing is integrated into the antenna for continuous BIT purposes.

To ensure proper functioning of all components, BIT is performed every four seconds. The main processor initiates a 'test strike' through the strike processor board and the antenna. This provides a complete analog test of the antenna and the strike processor. If the correct test result is not returned, an error condition is set and is not cleared until a valid test result is obtained.

The display/output messages generated by the SA20M in the current TACMET configuration use the standard METAR reporting format. Output consists of a 15-minute 'moving window' of all reported lightning activity. Output messages are generated at five-second in-

tervals for display on the operator terminal or the handheld test set. The data includes the distance and direction of the closest lightning and the total count of the lightning activity during the last 15 minutes.

Portable system

The TACMET system is designed for maximum portability and ease of use. The mechanical parts are made of lightweight, but robust, anodized aluminum and durable plastic. All cables, made of polyurethane, are fitted with quick release connectors making installation and unpacking quick and easy, even under the most difficult conditions.

System configuration and site-specific parameters can be set with the handheld terminal, or remotely with the PC workstation.

The carrying cases are made of cellular polypropylene (EPP), which is lightweight but very rugged material. It provides excellent cushioning and, after a shock or push, will return to its initial form by itself.

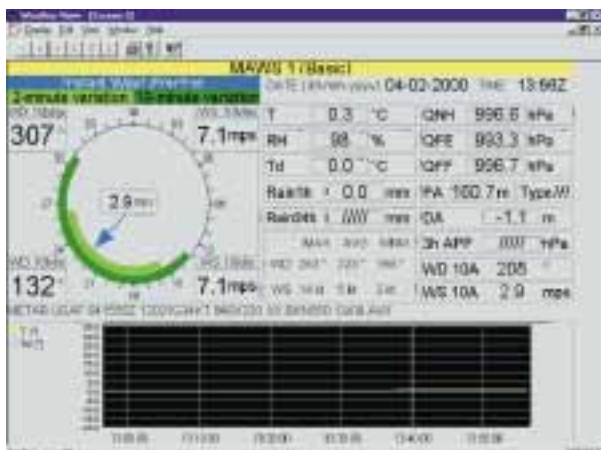


Figure 5. Real-time data display of basic parameters.

The cases are equipped with handles, hinges and latches where padlocks can be used. The two carrying cases of the Basic System weigh only 46 kg.

Data displays

There are two different types of display unit available. Both provide timely, real-time, in-theater weather information for users at the installation site or remotely at a command center.

Handheld display

The QMD101M is a lightweight, rugged, easy-to-read, handheld display device. It has a 160 x 160 graphic LCD with backlight for night-time operation. The backlight setup allows the user to adjust the number of seconds before the backlight automatically turns off.

It provides paged screens for measurement and calculation results, an alarm screen that shows active alarms and a setup screen for setting environmental variables such as time, date, station name, altitude, etc.

The display is a low-power device. It is powered directly from the MAWS201M in the field, or from mains power in indoor use. The handheld terminal can be connected to the Basic System directly via cable or by VHF/UHF radio modems.

PC workstation software

The Windows NT software collects the measured and calcu-

lated data from the MAWS201M systems, automatically generates METAR/SPECI reports (aviation routine weather reports) and interfaces with an operator. The data is archived for 30 days on hard disk and also distributed further to other systems via the serial port or as an FTP transfer.

The workstation software allows the user to edit the METAR reports with easy-to-use templates. The aviation special weather reports (SPECI) are automatically generated whenever the relevant criteria is observed, or if initiated by the operator.

In addition, this software provides real-time graphical data displays in multiple windows. The stored data can be viewed in the ASCII format. The Event Monitor allows the operator to monitor system performance and sensor alarms.

In any configuration, up to two MAWS201M systems can be connected to the Laptop PC workstation using landline cables, VHF/UHF radio modems or any combination of these. ■

Vaisala Technology for the U.S. Air Force

Vaisala has received a major production order from the American company Raytheon Inc., to supply the U.S. Air Force (USAF) with Tactical Meteorological (TACMET) Observation Systems. The order was obtained as a result of international competitive bidding and successful completion of USAF qualification tests. Deliveries started in August 2000.

"The importance of weather conditions and their monitoring is rapidly growing worldwide. This order serves as an excellent international reference for Vaisala. We won the international bidding because of our technological expertise," says Pekka Ketonen, President and CEO of Vaisala.

The system to be delivered is designed to measure and collect meteorological data and to observe aviation weather. The weather stations monitor air temperature, wind direction and speed, relative humidity, air pressure, precipitation amount and type, soil moisture and temperature, lighting conditions, cloud height and cover, visibility and lightning. The system is designed to be capable of quick deployment and to operate in the most demanding conditions.

The TACMET systems are part of Vaisala's range of surface weather observation products. The technology of the weather stations is based on the company's standard products, which have been delivered to meteorological institutes and aviation authorities in various countries. ■



Vaisala's Tactical Meteorological (TACMET) Observation System is a field-deployable, compact weather station for various operations. Pictured the production facilities.