Micro Weather Station (MWS®)

User Guide – Military Series

intellisense SYSTEMS

MICRO WEATHER STATION (MWS®) OVERVIEW

This guide serves as a comprehensive overview of the installation and operation of the Military Series of Micro Weather Stations (MWS®) from Intellisense Systems. Features that are not included on certain models will be noted in the charts, graphics, and installation instructions to follow.

The MWS Military Series At-A-Glance

	Series Name	Military	
	Model No.	M525	M625
FEATURES	Colors Available:		
	White	o	o
	Coyote Brown	●	●
	Integrated Solar Panels	●	●
	Integrated NiCd Battery Pack	●	●
	Supports Cloud-based Data Processing	●	●
MEASUREMENTS & CAPABILITIES	Temperature	●	●
	Pressure (Barometric)	●	●
	Humidity	●	●
	Altimeter	●	●
	Wind Speed	●	●
	Wind Direction	●	●
	Angular Tilt	●	●
	Dust Accumulation	●	●
	Lightning Count	●	●
	Lightning Distance	●	●
	GPS	●	●
	Compass	●	●
	Precipitation Amount	●	●
	Present Weather	●	●
	Visibility	●	●
	360° Panoramic Camera	●	●
	Ceilometer	—	●
COMM.	Cabled (RS-232 to USB)	●	●
	Cellular LTE-M	—	—
	Iridium SBD	●	●

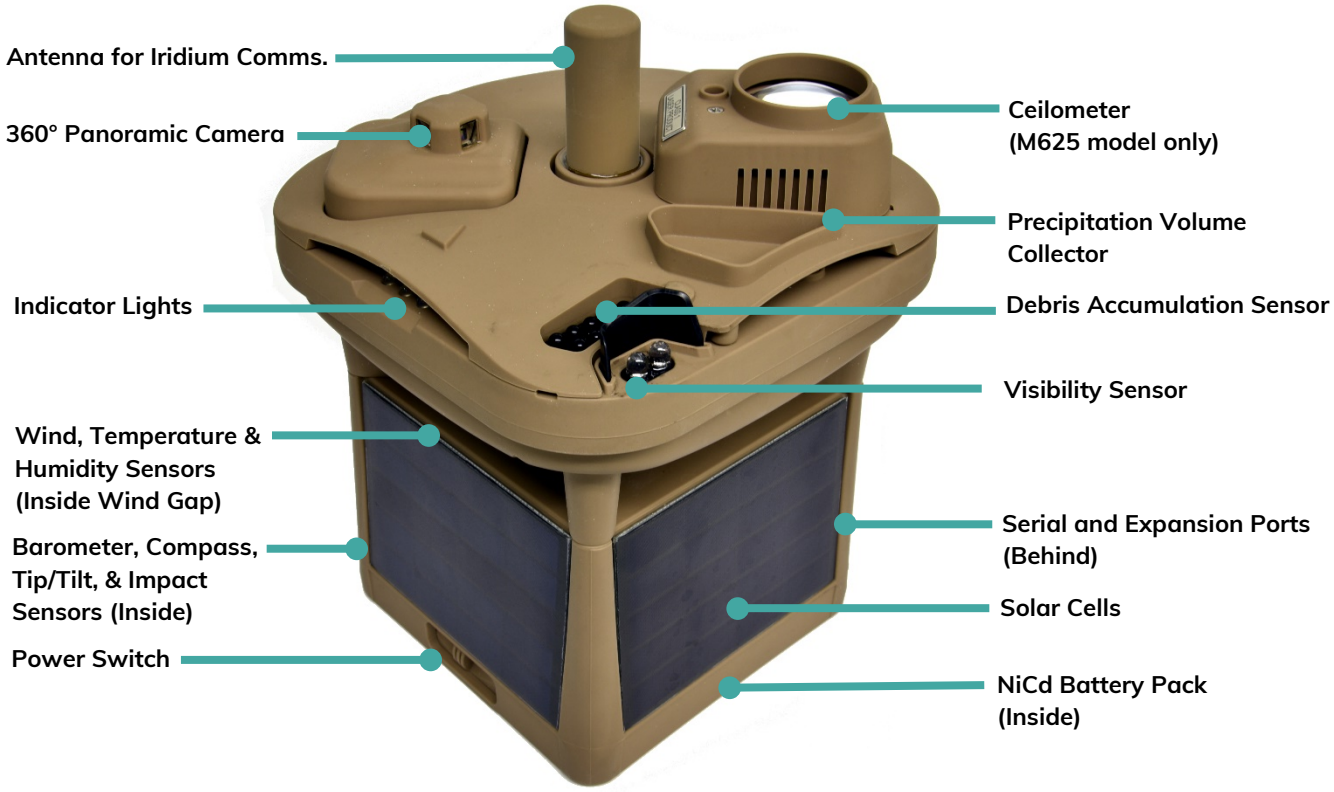
Table Key:

● = Standard

o = Optional

— = Not available

MWS Features



Environmental Parameters Measured and Calculated

The MWS measures the following environmental parameters using on-board sensors:

1. Air Temperature
2. Relative Humidity
3. Barometric Pressure
4. Wind Speed
5. Peak Wind Speed
6. Wind Direction
7. Peak Wind Direction
8. GPS Latitude
9. GPS Longitude
10. GPS Elevation
11. Precipitation Type
12. Precipitation Amount
13. Lightning Frequency
14. Lightning Distance
15. Compass Orientation
16. Angular Tilt
17. Visibility
18. Debris Accumulation
19. Cloud Height (M625 model only)

These environmental parameters are determined using inputs from a combination of sensors and internal data processing on the MWS:

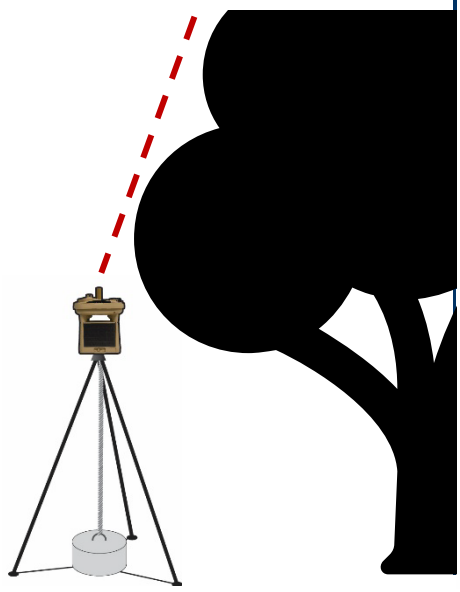
1. Wind Chill
2. Heat Index
3. Dew Point
4. Altimeter Setting
5. Pressure Altitude
6. Density Altitude

SITE SELECTION

Before installing your MWS, first determine the ideal location for your station. Consider these conditions to ensure the most accurate collection of environmental data before installing your MWS.

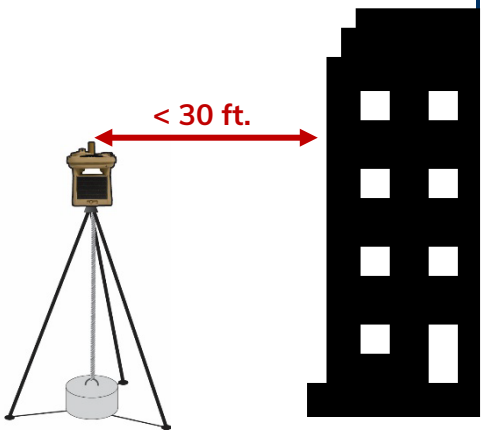
DO NOT:

- Install near any large objects that obstruct the unit from above



DO NOT:

- Place the unit within 30 ft of any structures, trees, or boulders taller than the MWS

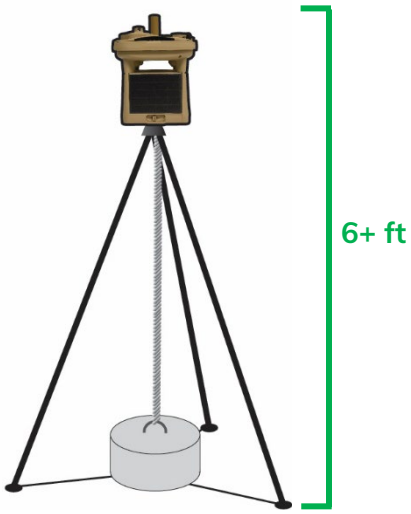


DO NOT:

- Use a mounting solution that may cause the unit to tilt more than 10° off center

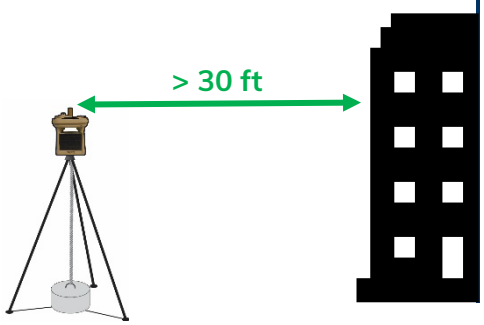
DO:

- Mount the unit at least 3 ft or higher off the ground or surface (6 ft or higher is ideal)



DO:

- Install the unit at least 30 ft away from any structures, trees, or boulders that are taller than the MWS



DO:

- Use a strongly anchored mounting point that will not cause the unit to tilt

INSTALLATION INSTRUCTIONS

The MWS comes equipped with a standard ¼-20 threaded “camera” mount feature on its baseplate. Intellisense recommends and offers two proven mounting solutions for the MWS to meet the needs of lightweight and rugged portable deployment:

1. MWS Tripod – a low profile and fixed-height collapsible tripod with gimbal for leveling
2. MWS Pole Mount – a short, lightweight pole to temporarily affix to existing poles and structures

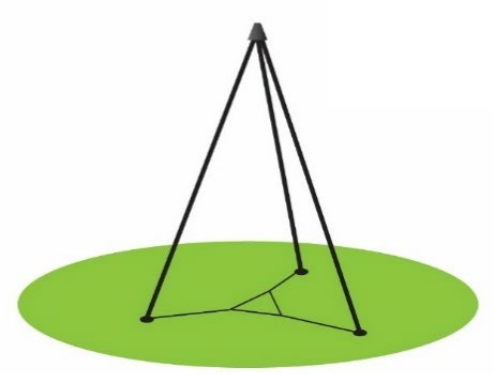
For all mounting solutions, the mount must be weighted down or rigidly affixed to a substrate to prevent the dislodgement or accidental tipping of the system during high winds or other unintended incidents. Please note: the mounting solution should be rigidly emplaced *before* the MWS is installed and turned on.

MWS Installation – Tripod

1. Place the tripod on level ground with a clear view of the sky.
2. Secure the tripod to the ground by attaching an anchor or weight (minimum 50 lb) to the center hook.
3. If possible, secure the tripod legs to the ground with stakes.

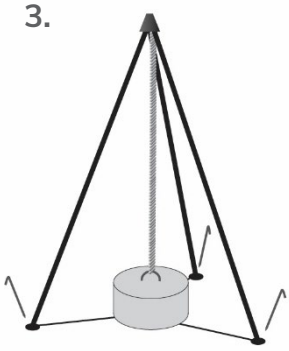
CAUTION: The MWS Tripod must be secured to the ground with the center eyebolt before attaching the MWS.

1.



2.

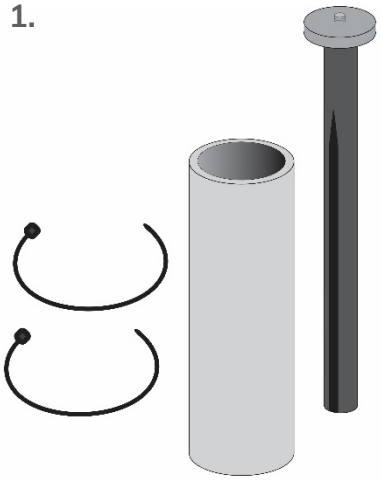
3.



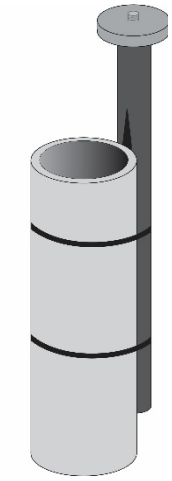
MWS Installation – Pole Mount

1. Place the grooved side of the pole mount against a rigid, secure, and vertically oriented pole.
2. Secure the pole mount using the included zip ties.

1.



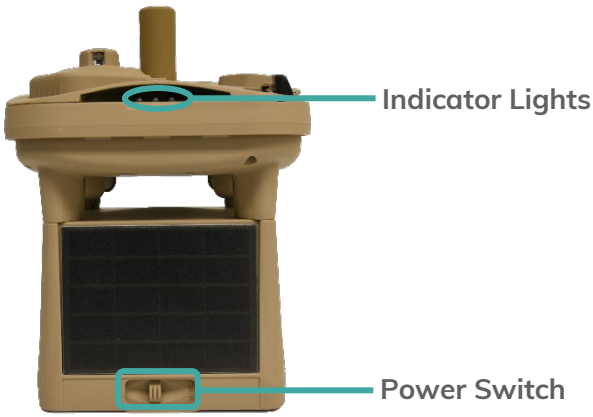
2.



OPERATION

Powering on the MWS

Once the system is powered on, check the lights beneath the cap (on the same side as the power switch, pictured right) for these status indications:



- **3 lights:** MWS is fully charged and will begin reporting automatically

- **2 lights:** MWS is not fully charged but will begin reporting automatically

- **0–1 lights:** Power is too low – the MWS requires solar or cabled charging

- **Flashing lights:** Self-check failure

If the lights blink multiple times when the unit is first powered on, then there has been a self-check failure and the unit will require maintenance by the manufacturer. If the lights do not illuminate, then the power is too low and the unit will need to be charged. There are two options to charge the MWS:

1. Place the MWS in sunlight.
2. Connect the MWS to a power source using the MWS Data and Power Cable.

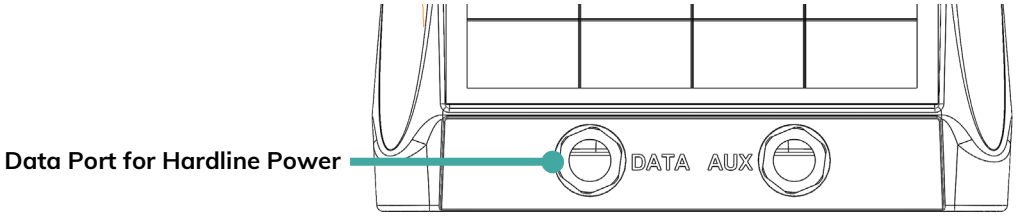
The unit will charge with the power switch in either the “ON” or “OFF” position. When charging outdoors, the switch can remain in the “ON” position and the MWS will start reporting in the default mode once it has enough power to operate.

NOTE: If the unit has been in service previously, visually inspect for dust or other debris build-up. This can be removed from surfaces by gently wiping it with a soft cloth or towel soaked in water. For users of the M625, ensure the lens and window of the ceilometer are clear by gently wiping them with a soft microfiber lens cloth. To prevent moisture accumulation on the lens, gently wipe the provided Rain-X® wipe around the lens in a circular motion to apply an even coat of the hydrophobic solution.

Special Battery Warning

In fast reporting mode or areas with little sun exposure and extreme cold temperatures, the MWS will need to be charged to at least 5 V for extended full operations under these conditions. ***Please note that the charging process could take up to 24 hours***, so operation checks before installation are highly recommended.

When your MWS is plugged in to hardline power with the “DATA” port (on the front of the unit, pictured below), the system charges via a power and data cable over USB. As a result, the raw data voltage reading is slightly higher than when it is unplugged. If the first report back from your MWS when not connected to hardline power provides a low battery voltage (below 5 V), change the reporting mode to every 3 hours until the battery is charged to over 5 V. If operating in limited sun exposure or there is a need to use the 5-minute reporting mode, keep in 3-hour mode until the battery is charged to at least 5.5 V. Overall, monitoring the MWS battery pack voltage over time and environmental changes will ensure system availability and limit downtime due to low battery levels.



Initial Operation

After the MWS is properly installed and powered on, the system acquires and syncs its GPS location and system time, which can take 15-30 minutes depending on satellite signal strength. This step occurs before it begins transmitting weather data. If the unit is indoors or unable to acquire a GPS signal, it will keep trying to acquire satellites before reporting weather data. Make sure the unit is placed in an ideal location for operation (see the “Site Selection” section above). Each time the unit is turned off and on, it will repeat the 15-30 min GPS sync before reporting weather data. For security reasons the reporting of latitude and longitude is turned off by default.

Default Settings

When the MWS is powered on, the default settings of operation are as follows:

- 1-hour reporting mode
- Camera sends no images
- GPS latitude/longitude/elevation not reported
- Ceilometer set on auto (M625 model only)

System settings must be reconfigured each time the unit is turned off and back on. No settings or weather data is stored in local memory for security reasons. The settings of your MWS can be changed using the Quantimet website or other remote communication software.

REPORTING MODES

A summary of reporting modes based on model and measured parameters is outlined below:

	POWER		COMMUNICATIONS				MEASUREMENT ABILITY		
	Line Power	Battery	Cellular	Iridium	USB to PC (Cable req.)	Quantimet Compatible	Core Weather & Precipitation	Lightning	Ceilometer (M625 Model)
10-second	X	—	—	—	X	—	X	—	—
20-second	X	—	—	—	X	—	X	X*	
1-minute	X	—	—	—	X	—	X	X	X
5-minute	X	—	X	X	X	X	X	X	X
20-minute	—	X*	X	X	X	X	X	X	X
1-hour	—	X	X	X	X	X	X	X	X
3-hour	—	X	X	X	X	X	X	X	X

The MWS's weather reports are centered around discrete 10-second samples. These 10-second samples occur at different intervals and are averaged differently depending on the set reporting mode. Details are as follows for the different modes:

- **10-Second:** Single 10-second sample reported continuously.
- **20-Second:** Single 10-second sample reported every 20 seconds. (*This mode has a reduced sensitivity to lightning when compared to the slower reporting modes.)
- **1-Minute:** Single 10-second sample reported every minute.
- **5-Minute:** Single 10-second sample reported every 5 minutes.
- **20-Minute:** 10x 10-second samples performed each minute in the last 10 minutes and averaged before reporting every 20 minutes. Line power required if images requested, otherwise battery may deplete too rapidly (C500/600 models only). Reports at 15, 35, and 55 minutes after the hour.
- **1-Hour (Default):** 10x 10-second samples performed each minute in the last 10 minutesand averaged before reporting every hour. Reports at 55 minutes after the hour.
- **3-Hour:** 10x 10-second samples performed each minute in the last 10 minutes and averaged before reporting every 3 hours. Reports every three hours at 55 minutes after the hour.

MAINTENANCE

Replacing Batteries

Occasionally, the battery pack inside the MWS may require replacement. To determine if the batteries need to be replaced, check these guidelines below:

- Charging the unit via USB cable and/or setting the unit in the sun for at least 24 hours will not charge battery to > 5 V
- MWS unable to maintain standard reporting mode due to low power
- Operational situation does not permit time for in-system self-charging
- Flashing LED indicator lights identify a Self-Check failure.

If the above four criteria are met, the battery likely requires replacement. To replace the battery pack, please follow the steps below:

1. Flip the MWS over so that bottom side is facing upward (make sure the antenna and top-mounted sensors are not damaged during this process)
2. Loosen the 4 thumb screws at each corner to remove bottom plate (screws should remain in the bottom plate)
3. Pull on the tab to remove the battery from its enclosure
4. Gently disconnect the battery harness from battery pack
5. Connect the new battery pack to the harness
6. Reinstall the battery pack and screw the bottom plate back onto the unit

Sensor and System Notes

Power System: The power system of the MWS consists of nickel-cadmium (NiCd) batteries and crystalline solar cells that provide state-of-the-art, reliable power storage and generation in extreme environments. The solar power generation system on the MWS was designed to support hourly observations at a location between -50° and +50° latitude, with 50% cloud cover, in winter conditions. By default, the MWS operates in hourly mode, but at more extreme latitudes the MWS can be placed in 3-hour mode to reduce power consumption. Power is considered marginal if the battery voltage ever falls below 5 V and should be conserved unless operations are essential or critical.

Visibility Sensor: The visibility sensor works by sensing miniscule back-reflection from the atmosphere, so it is required for the MWS to be in an open area outdoors. It is also important for the area above the height of the MWS to be completely clear of obstructions. Using the sensor indoors will not yield accurate environmental data, and the area surrounding the MWS must be cleared within a radius of 30 ft. For the most accurate readings, it is also essential that debris (leaves, dust, spider webs, etc.) not cover any areas of the sensor.

OPTIONAL SETTINGS AND ADVANCED FEATURES

Optional Settings

The optional settings control certain aspects of measurement timing and sampled parameters. They are reset at each power cycle for security reasons.

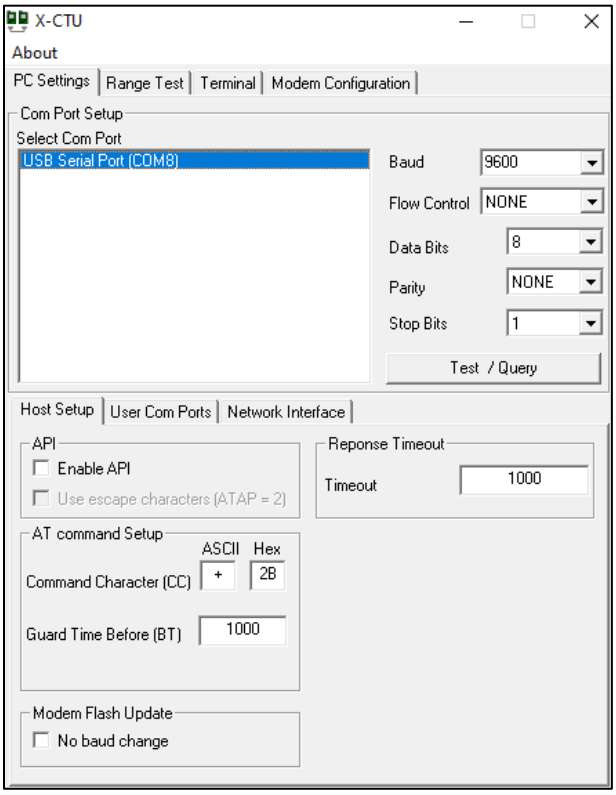
- **GPS:** GPS latitude and longitude can be enabled or disabled by the user. GPS is disabled from the factory by default. However, a GPS lock is still required upon powerup to obtain elevation and to obtain the proper system time for reported weather readings. GPS coordinates are reset upon each power cycle (via the physical power switch) and a re-lock is required upon each new power-up. GPS will also attempt a re-sync approximately once every 10 days of continuous operation to accomodate for station movement and to update the system clock.

- **Image Requests:** A single image set can be requested or scheduled based on system time (with hourly images being the fastest). When hourly images are requested, they will always send at 56 minutes after the hour. The default setting is no images.

- **Ceilometer (M625 model only):** There are 3 ceilometer settings: “Disabled.” “Enabled,” and “Enabled Always.” The “Enabled Always” command enables users to take 4 ceilometer readings (in 15-minute intervals) regardless of what reporting mode the station is in, which may consume more power. The “Enabled” setting changes the number of ceilometer readings depending on reporting mode. The default setting is “Enabled.”

Raw Output Over Serial Connection

For advanced users or those using custom data processing software, the station output can also be viewed over serial USB connection in its raw format by plugging a MWS Power and Data Cable into the “DATA” port on the unit and plugging the receiving end into a standard USB Type-A port on your PC. The station will output over serial automatically at each sample time as defined in the reporting descriptions above. Output can be viewed on X-CTU or a similar serial terminal software with the settings shown below and COM port that coincides with the cable input. An example is pictured right:



A sample output packet viewed over RS-232 serial connection is shown below:

@I:356726109932152
@0AX
N:104:2/10
B:5.55:2:000000:78:5:VM
T:20/04/29,23:27:13
LA:34.99414
LO:-108.33632
EL:68:D
OR:88:3:257
TA:22.4
BA:1006.50:2995
RH:73
WI:4:357
GU:5:357
LD:?:0:--
CL:1KZ0F:0:?:?:?
PW:0.00:299:?:--:83:207:200
VI:6.2
XA:22.1:22.4:22.2:02
XD:9:9:18:17:26.6

The meaning of each output parameter is defined in the table below:

Tag	Name	Description	Example
@I	IMEI	Station Modem IMEI Number	@I:356726109932152
@0	Type	Message type and version	@0ab
N	Message number	1) Rotating message number 0-255; rotates back to 16 so a number below 16 means new start 2) Sample cycle number / max number of cycles	N:255:10/10
B	Battery level	1) Battery level (Volts to 2 decimals) 2) Operating mode 3) Auto-imaging hour setting (6-character hexadecimal representing 24 bits, which represent each hour in the 24 hour system; bit 0 = hour 0, bit 1 = hour 1…and bit 23 = hour 23. A bit is set if the hour it represents is set for auto image capture) 4) MWS configuration 5) Days of operation count (2-3 digits typical) 6) Command key (2 upper/lower case alphabet characters)	B:5.43:1:000000:6F:123:qr
T	Time	GPS UTC time YY/MM/DD,HH:MM:SS or with a leading '-' if no GPS sync	T:16/02/26,20:10:45
LA	Latitude	GPS latitude (decimal degrees to 5 decimals) or ? if no reading or disabled	LA:30.00900
LO	Longitude	GPS longitude (decimal degrees to 5 decimals) or ? if no reading or disabled	LO:-85.95787

Tag	Name	Description	Example
EL	Elevation	1) GPS elevation (meters) or ? if no GPS reading 2) GPS VDOP (measure of vertical estimation quality) divided into 0.2 increments over 1.0 converted to a-z, '-' if the elevation was set by the user, or ? if no GPS reading	EL:1840:c
OR	Orientation	1) Compass orientation from magnetic north (degress) 2) Tip from vertical (degrees) 3) Direction of tilt (degrees)	C:339:2:119
TA	Temperatur e ambient	Ambient air temperature (degrees C to 1 decimal)	TA:29.1
BA	Barometric pressure	1) Pressure (millibars to 2 decimals) 2) Altimeter setting (inHg x 100) if GPS active	BA:1008.19:2985
RH	Relative humidity	Relative Humidity 0-99 (percent), or ? if not present	RH:25
WI	Wind speed & direction	1) Average wind speed (knots) 2) Direction (degrees)	WI:2:225
GU	Peak wind & direction	1) Peak wind speed (knots) 2) Direction (degrees)	GU:3:240
LD	Lightning distance	1) Lightning distance (nautical miles to 1 decimal) or ? if no detections 2) Number of 5-minute detection periods with strikes detected 3) Lightning event timestamps Character 1: First event detected during 5-minute intervals of GPS time converted to a-l. Character 2: Last event detected during 5-minute intervals of GPS time converted to a-l.	LD:1.0:4:cf
CL	Cloud height	1) Character 1: Ceilometer status 'a' if operating and no detections, 1-4 if detection by method 1-4, '-' if disabled, ? if not present or operating properly. Character 2: Highest high clipping sample converted to a-z from all sets of raw data. Character 3: Highest low clipping sample converted to a-z from all sets of raw data. Characters 4-5: Hex value of calculated threshold. 2) Cloud height of ranging attempt 1 (meters) 3) Cloud height of ranging attempt 2 (meters) 4) Cloud height of ranging attempt 3 (meters) 5) Cloud height of ranging attempt 4 (meters) Height ranging attempts report 0 if no cloud, or ? if no or unsuccessful attempt	CL:1cp14:1000:1001:1002:1003

Tag	Name	Description	Example
PW	Present weather	1) Precipitation amount (in/hour to 2 decimals) calculated from drops counted 2) Disdrometer peak 0-999 3) Spare field always displays '?' 4) Precipitation event timestamps (triggered by drop, disdrometer, and moisture detection) Character 1: First event detected during 5-minute intervals of GPS time converted to a-l. Character 2: Last event detected during 5-minute intervals of GPS time converted to a-l. 5) Accumulation 0-99 6) Visibility millivolts 7) Visibility calibration value	PW:1.25:30:346:ek:99:115:100
VI	Visibility	Estimated visibility in miles (calculated from visibility millivolts) to 1 decimal place at and above 2.0 miles, 2 decimal places below 2.0 miles.	VI:10.0
XA	Raw sensor data	Raw sensor data 1) Temperature internal sensor (degrees C to 1 decimal) 2) Temperature external sensor (degrees C to 1 decimal) or ? if not present 3) Temperature from barometer (degrees C) 4) I2C errors	XA:35.0:29.9:35:02
XD	System diagnostics		

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