# M212

## 1U Next Generation Modular Timing System


Brandywine's M212 Master Clock System represents the next generation of modular timing systems.

At the center of the M212 system is Brandywine's powerful Master Clock Module (MCM). The MCM may be synchronized by a variety of reference sources and uses the selected reference to steer an embedded oscillator to provide stable and accurate time and frequency for the M212. Multiple references can be prioritized with automatic failover.

Available input reference selections include GNSS (both commercial GNSS and SAASM GPS receivers are supported), IRIG-B, and Have Quick/1PPS.

The base oscillator in the M212 is a high quality Temperature Compensated Crystal oscillator, but the M212 optionally can be ordered with other reference oscillator choices, including Rubidium, and Ovenized Oscillator (OCXO); with future support for a Chip Scale Atomic Clock (CSAC) planned.

### FEATURES

- **Modular design with multiple reference paths built in for high-availability.**
- **6 expansion slots for customization and expansion.**
- **Industry-first GPS integrity checking with Timewall™**
- **LCD display and keypad for basic status and configuration – secure web browser for detailed setup.**
- **Future support for optical crosslink planned.**

The output signals for the M212 are generated by up to 6 Output Signal Modules (OSM), and are ideal for custom solutions or future expansion. Available modules include NTP, low-phase-noise frequency, time code modules such as IRIG A, B, G, H, and NASA 36, BCD, PPS, PPM, Have Quick, as well as serial data (RS232/422).

The M212 status and control is via front panel display for basic configuration and status, a secure web browser, and via SNMPv3. Network protocols also fully support privacy and authentication.

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# Available Modules

## Master Clock Module

All M212 configurations include a Master Clock Module (MCM), which provides the basic timekeeping and management functions of the M212.

**Management Functions**

The MCM is accessed either via the front display/keypad, which is typically used to configure only one of the Ethernet ports. Under a standard configuration, one port is dedicated to management and control, and the second port may be optionally enabled to support management and control through it, thus providing the option for a secured ethernet port that cannot be used as an attack surface for network security.

***MCM Reference Inputs***

**GNSS Receiver (standard)**

| | |
|---|---|
| Receiver Type | GNSS multi constellation (GPS, GLONASS, Galileo[1], Beidou) |
| Sensitivity | Tracking: -159 dBm<br>Acquisition: -147 dBm |
| Accuracy | 15ns (1σ) (@ -130 dBm) |
| Connector Type | BNC J8 |

**M-CODE/SAASM GPS Receiver (optional)**

| | |
|---|---|
| Receiver Type | GB-GRAM Type II |
| Keyfill cable | 5 pin Audio |
| Keyfill port | DS102 |
| COM Port | DB9–F connector |
| External 1PPS Input | |
| Signal Format | Per ICD-GPS-060B |
| Rate | 1 pulse per second |
| Impedance | 50 ohm |
| Connector Type | BNC J6B |

**External GPS Have Quick T/C Input**

| | |
|---|---|
| Signal Format | Per ICD-GPS-060A, STANAG 4246 HQ2A |
| Rate | 1 frame per second |
| Impedance | 10k Ω |
| Connector Type | DB9M J5A |

**External IRIG B Input**

| | |
|---|---|
| Signal Format | IRIG B Per IRIG 200-04 |
| Control Functions | Per IEEE1344 |
| Modulation ratio | 2.5:1 to 3.3:1 |
| Amplitude | 1 $V_{p-p}$ to 5$V_{p-p}$ |
| Impedance | >600 ohm |
| Connector Type | DB9M J5A |

**Signal Reference Selection Menu**

Up to 5 references may be selected and prioritized for the list below

- GPS[2] (Internal GPS, optional)
- IRIG B
- IRIG B + 1PPS
- Have Quick +1PPS
- 1PPS (requires manual time entry)
- RS232/422 NMEA (External GPS)

**MCM Outputs**

The MCM has a basic set of outputs available directly, without requiring additional modules

- Have Quick
- IRIG B DCLS + IEEE1344 CF
- 10 MHz

Propagation delay compensation

| | |
|---|---|
| Input | ±0 – 500ms in 5ms steps |
| Outputs | ±0 – 500ms in 5ms steps |

Status and Control

| | |
|---|---|
| No of ports | 2 |
| Port Type | 10/100 BaseT Ethernet |

Protocols Supported[3]

| | |
|---|---|
| SNMP v3 | RFC 3411, 3418 |
| NTP v4 | RFC 5905 |
| IP v4, IP v6 | |
| RFC2818 | |

Alarm Relay

| | |
|---|---|
| Dry Contact Closure | 100mA |

Audible Buzzer Alarm

***Oscillator Options***

The M212 may be configured with one of three types of oscillator, depending upon price/performance desired. This option must be specified at time of order

***Environmental***

**Power**

AC Supply

| | |
|---|---|
| Voltage | 90-265 VAC 50/60 Hz. 100W Maximum |

DC Supply

Future Support Planned, Specifications TBA

**Physical**

| | |
|---|---|
| Length (depth) | 20.00” |
| Width | 17.00” Chassis Width<br>19.00” Front Panel Width |
| Height | 1.72” 1U chassis |
| Weight | 10 lbs |

**Temperature**

| | |
|---|---|
| Air Temperature | -15 to 55°C |
| Altitude Conditions | -1500 ft to +11,000 ft |

**Shock and Vibration**

Designed to meet the following standards:

| | |
|---|---|
| Operating Shock | MIL-STD 810F 20g/11ms |
| Bench Handling Shock | MIL-STD 810F |
| Vibration | MIL-STD-167-1 |
| Structure-borne Noise | MIL-STD-740-2 |

**EMC**

Designed to meet the following standards:

FCC Part 15, Class A,
IEC CISPR 22,
CE

1 Requires firmware update

2 Future support for multi-format GNSS planned

3 Only available on port J7-B

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# Output Signal Modules

The flexibility of the M212 system is achieved by combining a number of available Output Signal Modules (OSM) to the basic Master Clock Module. Up to 6 OSMs may be installed at the time of order to extend the capacity and function of the M212.

## Universal Output Signal Module

The Universal OSM provides the ultimate in flexibility. The Universal OSM has 4 outputs, each of which is user-programmable to a wide variety of time code or pulse outputs. This flexibility ensures that an M212 can be reconfigured as requirements change, and fewer modules are needed in comparison to designs where modules are single function. Each output is individually adjustable for propagation delay, ensuring that for high accuracy synchronization different cable lengths can be accommodated.

Available output formats per connector

- 1 PPS and 1PPM
- HaveQuick
- IRIG A, B, E, G, H
- XR3, 2137
- STANAG 4372 SATURN
- STANAG 4372 HQ II A only

### *Specifications:*

**Pulse-per-second/minute**

| | |
|---|---|
| Signal Format | Per ICD-GPS-060B |
| 1PPS Rate | 1 pulse per second |
| 1PPM Rate | 1 pulse per minute |
| Rising Edge | On Time |
| Rise Time | <20ns |
| Fall time | <100ns |
| Pulse Width | 20 µs ±5% default. |
| Amplitude | 10V ±10% into 50Ω |
| Output condition | when TFOM<7 only |

**Have Quick Time of Day Output**

| | |
|---|---|
| Signal Format | Per ICD-GPS-060A |
| Rising Edge | On Time |
| Rise Time | <100ns |
| 1PPS coherence | < 100ns of rising edge |
| Amplitude | 5V ±5% |
| Output condition | when TFOM<7 only |

**BCD Time Code Output**

| | |
|---|---|
| Signal Format | Per ICD-GPS-060B |
| Rate | 50 bits/sec |
| 1PPS coherence | < 100ns of rising edge |
| Mark (logical 1) | +2.5V ±1V |
| Space | (logical 0) -2.5V ±1V |
| Output condition | when TFOM<7 only |
| Connector Type | 3 Pin (Consult factory) |

**IRIG Time Code Output**

| | |
|---|---|
| Signal Format | B002, B122, B004, B124 (Consult factory for other formats) |
| Control Functions | B124 per IEEE1344 |
| Rate | 1kHz modulated |
| Modulation ratio | 10:3 ±10% |
| Amplitude | $5V_{p-p}$ ±20% |
| Output condition | when TFOM<7 only |

**2137 Time code Output**

| | |
|---|---|
| Signal Format | 2137 |
| Carrier | 1kHz modulated |
| Modulation ratio | 10:3 ±10% |
| Amplitude | $5V_{p-p}$ ±20% |
| Output condition | when TFOM<7 only |

**XR3 Time code Output**

| | |
|---|---|
| Signal Format | XR3 |
| Rising Edge | On Time |
| Rise Time | <100ns |
| 1PPS coherence | < 100ns of rising edge |
| Amplitude | 5V ±5% |
| Output condition | when TFOM<7 only |

**Propagation delay compensation**

| | |
|---|---|
| Applicability | All 4 outputs individually |
| Range | ± 0 – 1ms in 5ns steps |

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# Output Signal Modules

## Low Phase Noise Analog OSM

The Analog Low Phase Noise Module provides 4 low phase noise reference frequency outputs at 5, or 10MHz. The OSM incorporates a clean-up OCXO that is phase-locked to the MCM oscillator which must be OCXO, CSAC, or a Rubidium oscillator

***Specifications:***

| | |
|---|---|
| Waveform | Sinusoid |
| Amplitude | 13 ±2 dBm/1$V_{rms}$ |
| Harmonics | -40dBc |
| Non Harmonic | <-80dBc 10k - 500MHz |
| Connector Type | Coaxial, BNC |
| Accuracy | Locked to MCM oscillator |

| Phase Noise dBc/√Hz | 10MHz[1] | 5MHz[1] |
|---|---|---|
| 1Hz | -90dBc | -95dBc |
| 10Hz | -120dBc | -125dBc |
| 100Hz | -145dBc | -148dBc |
| 1KHz | -155dBc | -155dBc |
| 10KHz | -158dBc | -158dBc |

## 5 MHz Output OSM

The 5MHz output OSM provides 4 reference frequency outputs at 5 MHz. The OSM buffers and distributes a 5MHz signal that is generated directly on the MCM. The stability and accuracy will reflect those of the selected MCM oscillator.

***Specifications:***

| | |
|---|---|
| Waveform | Sinusoid |
| Amplitude | 13 ±2 dBm/1$V_{rms}$ |
| Harmonic | -35dBc |
| Non Harmonic | <-65dBc 10k - 500MHz |
| Connector Type | Coaxial, BNC |
| Accuracy | Locked to MCM oscillator |
| Stability | Same as MCM oscillator |

## 10 MHz Output OSM

The 10MHz output OSM provides 4 reference frequency outputs at 10MHz. The OSM buffers and distributes a 10MHz signal that is generated directly on the MCM. The stability and accuracy will reflect those of the selected MCM oscillator.

***Specifications:***

| | |
|---|---|
| Waveform | Sinusoid |
| Amplitude | 13 ±2 dBm/1Vrms |
| Harmonic | -35dBc |
| Non Harmonic | <-65dBc 10k - 500MHz |
| Connector Type | Coaxial, BNC |
| Accuracy | Locked to MCM oscillator |
| Stability | Same as MCM oscillator |

## NTP Server OSM

The NTP Server module enables the Master Clock System to act as an NTP server over an Ethernet network. Designed with security in mind, the NTP server module uses a custom network stack that enables it to ONLY act as an NTP server, and prevent it from being used as a gateway to compromise the entire system.

***Specifications:***

| | | |
|---|---|---|
| Signal Format | Ethernet 10/100BaseT | |
| Protocols | NTPv3 | RFC1305 |
| | NTPv4 | RFC 5905 |
| Authentication | MD5, SHA-1 | |
| Connector Type | RJ45 | |
| No of Outputs | 2 | |

## PTP Grandmaster OSM

The PTP Server module enables the Master Clock System to act as a Precise Time Protocol (PTP) Grandmaster over an Ethernet network. The PTP OSM is fully compliant with the PTP protocol, and is capable of providing time synchronization for up to 256 clients. Designed with security in mind, the PTP server module uses a custom network stack that enables it to ONLY act as a PTP server, and prevent it from being used as a gateway to compromise the entire system.

***Specifications:***

| | | |
|---|---|---|
| Signal Format | 10/100/1000BaseT | |
| Protocols | PTPv2 | (IEEE1588-2008) |
| Resolution | 8ns packet timestamp resolution | |
| Accuracy | 20ns 3σ (crossover cable) | |
| PTP Profiles | Default, Telecom, Enterprise, Power | |
| Modes | Unicast, Multicast | |
| Connector Type | SFP | |
| Management | Web GUI | |
| No of Outputs | 2 | |
| Max no of cards | 3 | |

1 Typical Values, Contact Sales for better phase noise

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# Output Signal Modules

## BCD Time Code Output OSM

The BCD time code OSM provides 4 BCD time code outputs. The OSM buffers and distributes a BCD signal that is generated directly on the MCM. The stability and accuracy will be those of the selected MCM. The propagation delay compensation feature is not available on this OSM.

***Specifications:***

| | |
|---|---|
| Format | ICD-GPS-060B |
| Signal Format | Per ICD-GPS-060B 40 bits |
| Rising Edge | On Time |
| Rise Time | <100ns |
| 1PPS coherence | < 100ns of rising edge |
| Electrical | Per RS422/485 |

## Have Quick Distribution Module

The Have Quick Distribution Module provides 4 Have Quick time code outputs. The OSM buffers and distributes a Have Quick signal that is generated directly on the MCM. The stability and accuracy will be those of the selected MCM. The propagation delay compensation feature is not available on this OSM.

***Specifications:***

| | |
|---|---|
| Format | ICD-GPS-060A |
| Signal Format | Per ICD-GPS-060A<br>STANAG 4430 HQ2A (Consult factory) |
| Rising Edge | On Time |
| Rise Time | <100ns |
| 1PPS coherence | < 100ns of rising edge |
| Amplitude | Logic 1 2.4Vmin<br>Logic 0 0.25V max |

## Modulated Time Code Distribution Module

The Modulated Time Code Distribution Module provides 4 AC modulated time code outputs. The OSM buffers and distributes the same time code signal that is generated directly on the MCM. The stability and accuracy will be those of the selected MCM. The propagation delay compensation feature is not available on this OSM.

***Specifications:***

| | |
|---|---|
| Signal Format | B122, B124 2137 (Consult factory for other formats) |
| Control Functions | B124 per IEEE1344 |
| Rate | 1kHz modulated |
| Modulation ratio | 10:3 ±10% |
| Amplitude | $5V_{p-p}$ ±20% |
| Load impedance | >50ohm |

## 1PPS Distribution Module

The 1PPS Distribution Module provides 4 1PPS outputs. The OSM buffers and distributes a 1PPS signal that is generated directly on the MCM. The stability and accuracy will be those of the selected MCM. The propagation delay compensation feature is not available on this OSM.

***Specifications:***

| | |
|---|---|
| Rising Edge | On Time |
| Rise Time | <15ns |
| Fall time | <60ns |
| Pulse Width | 20 µs ±5% default. |
| Amplitude | 10V ±10% into 50Ω |
| Source impedance | link selectable 50Ω/lowZ |

## Serial Time Code Distribution Module

The Serial Time Code Distribution Module provides up to 8 RS232 or RS422 output ports that can be used to broadcast a time of day message. All output formats are identical, and selected at the MCM. One channel can be dedicated as an input channel to provide the MCM with a NMEA message as an input timing reference. Selection of RS232/422 is available on a per channel using user-installed push on links

***Specifications:***

| | |
|---|---|
| No of channels | 8 |
| Connector Type | 62pin D receptacle |
| Electrical | RS232<br>RS422/485 |
| Channel selection | push on link |
| Input channel format | NMEA |

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# Ordering Information

| Part Number | Description | Includes |
|---|---|---|
| 036600301 | Base Unit Commercial M212 Base Unit - AC | GPS receiver, Antenna, 100'cable, TCXO oscillator, 90-265 VAC power |
| 036600319 | M212 Base Unit – 24DC | GPS receiver, Antenna, 100'cable, TCXO oscillator, 18-36 VDC power |
| 036600320 | M212 Base Unit – 48DC | GPS receiver, Antenna, 100'cable, TCXO oscillator, 18-36 VDC power |
| 036600321 | Base Unit Military M212M Base Unit - AC | M-CODE/SAASM L1/L2 receiver, Antenna, 100'cable, TCXO oscillator, 90-265 VAC power |
| 036600322 | M212M Base Unit – 24DC | M-CODE/SAASM L1/L2 receiver, Antenna, 100'cable, TCXO oscillator, 18-36 VDC power |
| 036600323 | M212M Base Unit – 48DC | M-CODE/SAASM L1/L2 receiver, Antenna, 100'cable, TCXO oscillator, 18-36 VDC power |
| **Oscillator Options** | | |
| 036600313 | OCXO | Replaces standard TCXO with OCXO |
| 036600316 | Standard Rubidium | Replaces standard TCXO with Rubidium Oscillator |
| 036600324 | High Perf Rub | Replaces standard TCXO with High Performance Rubidium Oscillator |
| 036600317 | CSAC | Replaces standard TCXO with CSAC |
| **Output Signal Modules** | | |
| 036600303 | Universal Timing Module 2x Triad, 2x BNC Connectors | |
| 036600304 | Universal Timing Module 4x Triad Connectors | |
| 036600305 | Universal Timing Module 4x BNC Connectors | |
| 036600312 | Low Phase Noise 10MHz | |
| 036600311 | Low Phase Noise 5MHz | |
| 036600306 | NTP Server | |
| 036600308 | PTP Grandmaster | 2 ea 10/100/1000BaseT, 512 clients |
| 036600325 | EP- PTP Grandmaster | 2 ea 10GBEe, 1024 clients |
| 036600309 | T1/E1 Output | 16 outputs ( DB62F connector) |
| 002206495 | 36" breakout cable | Adapts DB62F connector to breakout panel |
| 002600302 | Breakout Panel | 1U Rack mount with 16 RJ45 connectors |
| 002600326 | Optical Crosslink OSM | 2 Port single mode optical cable |
| 036600307 | Octal Serial Output | 8 outputs ( DB62F connector) |
| 002206496 | 36" breakout cable | Adapts DB62F connector to breakout panel |
| 002600303 | Breakout Panel | 1U Rack mount with 8 RJ45 connectors |
| 003660310 | 1PPS Distribution Module | 4 outputs, BNC connectors |
| 036600318 | Have Quick Output Module | 4 outputs, BNC connectors |
| 036600314 | BCD Output Module | 4 outputs, Triad connectors |
| 036600315 | Modulated Time Code Module | 4 outputs, BNC connectors |
| | Service/Support Contract-12 | 12months priority tech support, firmware upgrades |
| | Service/Support Contract-24 | 24months priority tech support, firmware upgrades |
| | Service/Support Contract-36 | 36months priority tech support, firmware upgrades |

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