## Research & Vehicle Technology
## "Infotainment Systems Product Development"

# Global Clock Strategy Specification

Version 1.8
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**FORD CONFIDENTAL**

# Revision History

| Date | Version | Notes |
|---|---|---|
| September 10, 2008 | Draft 0.1 | |
| October 01, 2008 | Draft 0.2 | Updated Portioning table changed U38X to CGEA1.2 and Global Programs to CGEA1.3. Updated the Acronym table to include GPSM and BCM. Updated the Automatic GPS Setting Section. Updated the Physical Components section removed the Philips I^2C PCA8565 or equivalent from the spec. |
| October 13, 2008 | 1.0 | First release of the Global Clock Strategy Specification. |
| August 10, 2009 | 1.1 | Updated section 2.1 Introduction – changed latest RTC-value to latest HH:MM:SS value in 24 hour mode. Added 'The Clock Master shall send this out with a periodic rate of once per minute. **Note: Only Change for CGEA 1.2. Exception for CGEA 1.2 has been updated to include 'The Clock Master shall send the latest HH:MM:SS in either 24 or 12 hour mode based on the user selection.** Updated section 2.1.2 Portioning per Program – deleted AHU from table 3 in the CGEA 1.3 row. Updated section 2.2 Clock Modes – Changed XXX to BCM. Added statements 'The Slaves shall be responsible for determining the Day, Date, and Month including Leap years for display purposes based on Julian Date received from the Master Clock' and 'The message and signal names are place holders until reviewed with Netcom at which point the actual message and signal names will be updated in this spec. Changed table 4. Added table 5 which used to be table 4. Updated section 2.3 Clock Settings – changed Real Time clock to Master Clock. Added statement 'If GPSM is in system no date set is allowed. Deleted text ' i.e. also the internal ms timer if implemented' . Updated section 2.3.2 Manual setting of Clock via Slave – Added Set Year and Set Julian Date. Changed Real Time Clock to Master Clock shall. Added Note that Gateway shall wake up vehicle bus. Added Tables for CGEA 1.3 MFD and IPC TimeAdjustReq messages. Updated section 2.3.5 Automatic GPS setting – Changed CGEA 1.3 requirement that the MFD send request when GPS Time differs by +/- 30 seconds. Added ' For Automatic GPS setting the slave shall also set the seconds based on the GPS time received. Updated section 2.3.6 12/24 Hour Setting – **Note: Only Change for CGEA 1.2. Added exception for CGEA 1.2 that states the Clock Master shall report time out as 12 or 24 hour mode as selected by the user.** Updated section 2.4.1 Master doesn't receive 'TimeAdjustReq' (=1) – Removed Date Adjust Request signal only using Time Adjust Request signal for CGEA 1.3. Updated section 2.4.2 Master doesn't receive 'TimeAdjustReq' (=0) – Removed Date Adjust Request signal only using Time Adjust Request signal for CGEA 1.3. Updated section 3.1 Physical Components – Changed section to 'The Clock shall be generated in such a way that meets the requirements listed in this chapter. Updated section 3.5 Clock Storage – Changed section to state 'The Clock Master shall continue keeping accurate time as long as Vbatt >= 4v. The Clock Master shall not reset to a previous or default value given Vbatt = 0v for 50 msec. When the master does reset (if outside the specification limits) due to power interruption, the Clock Master will default back to Initial Clock Setting'. Deleted figure 10 Clock Storage in Master. |
| October 23, 2009 | 1.2 | Updated Section 2.2.2 CAN Bus in Sleep to state that if bus asleep or Ignition Off or PowerMode less than or equal to Accessory the slave shall be able to show the time if requested by HMI. Updated Section 2.4.3 'DateTime' Not received by Slave to state that if Bus is awake and Ignition equals Run or PowerMode is greater than Accessory then slave shall show dashes if Master time is not received within 10 seconds. These changes were made so that the Slave clock can be shown when the user is in 10 minute or 1 hour or Extended Play mode and the BMS-CAN or PT-CAN bus is asleep. Updated section 2.1 to state that Clock Master for CGEA 1.3 will have a periodic rate of 250ms. Updated section 2.1.2 Table 3 to show that C34X is a C1MCA program. Updated CGEA 1.3 BCM_DateTime message table to show message as Event Periodic at 250ms and that the event is the seconds change. Updated section 2.2 Clock Modes to add C1MCA table for Master Clock message for clarification. Updated sections 2.4.1 and 2.4.2 to add exception for C1MCA to state that DateAdjustRequest is used and follows the same strategy as TimeAdjustRequest. Updated section 2.3.5 change differs mare than +/- 30 seconds to +/- 2 seconds. Updated section 3.2 Accuracy of the Master Clock (Global Clock Accuracy) to new SDS requirement. |
| December 15, 2009 | 1.3 | Changed Section 2.1 Introduction to state that CGEA 1.3 Master Clock message is Fixed periodic at 1 second. Changed Section 2.2 Clock Modes Table for CGEA 1.3 Master Clock message to show fixed periodic at 1 second. In section 2.2.3 CAN Bus Transition Sleep to Awake: Changed time to 50ms for CGEA 1.3. In section 2.3.1 Initial Clock Setting: Changed Initial date to Manufacturing date of ECU for CGEA 1.3. In section 2.3.3 HMI-Handling during 'Set Process' for time: Spit scenario for user pressing set and HMI timeout. This change will effect C-Car and should be rolled back into U-Car. In section 2.3.5 Automatic GPS Setting: Changed time to differ by +/-3 seconds for CGEA 1.3. |
| April 6, 2010 | 1.4 | Add requirement stating that Clock Slaves must have default configuration for 12 or 24 hour mode based on Market to section 2.3.6. Updated note in Section 2.3.2 that a TimeAdjustRequest = 1 will wake up the bus for clarification. |

| | | |
|---|---|---|
| October 25, 2010 | 1.5 | Updated section 2.3.6 12/24 Hour Setting: to replace Clock Slaves text with Vehicle Settings Server text in regards to supporting a default configuration based on market. Updated section 2.2 Clock Modes to show new signal names based on database for master clock signals effects CGEA 1.3 only. Updated section 2.3.2 Manual setting of Clock via Slave to show new signal names based on database for request signals effects CGEA 1.3 only. |
| May 10, 2011 | 1.6 | Updated section 2.0 Clock Modes changed end date to 12.31.2254. Updated section 2.3.1 initial Clock Setting to show intial date as anufacturing date if possible or 1.1.XX where XX is the first production part date(year). Updated section 3.5 Clock Storage added table and removed line about VBAtt being >= 4v. Added statement in Master Clock signal table section 2.2 for CGEA 1.3 'Julian day goes from 1 – 366 with 0x0 being the initial startup value'. Updated the message names for the CGEA 1.3 messages. |
| October 19, 2011 | 1.7 | Updated the Start and End Bits in the CGEA 1.3 signals to match the database |
| June 20, 2018 | 1.8 | Updated section 2.3.3 HMI-handling during “Set-Process’ for Time by adding GPS assisted time keeping vs non GPS assisted time keeping rules for seconds setting. |

# Table of Contents

# 1 General

## 1.1 Purpose of Document

This document specifies the clock strategy for the Global Clock. The specification includes descriptions of CAN communication, that is needed for clock synchronization between the different nodes, clock setting, and the different clock modes. It also includes fault handling descriptions.

This document does not specify the HMI for clock functionality in the concerned nodes.

## 1.2 Application of Document

This document is applicable for CGEA 1.3 with exceptions for CGEA 1.2.

## 1.3 Abbreviations

| Acronym name | Acronym Description |
|---|---|
| HEC | Hybrid Electronic Cluster (Instrument Cluster) |
| ACU | Audio Control Unit |
| PJB | Power Junction Box |
| IMS-CAN | Infotainment Medium Speed – Controller Area Network (-Bus) |
| BMS-CAN | Body Medium Speed – Controller Area Network (-Bus) |
| CEM | Central Electric Module (EuCD-name for PJB) |
| DIM | Driver Information Module |
| FRC | Free Running Clock |
| MFD | Multifunction Display |
| IPC | Instrument Panel Cluster |
| Info CAN | Infotainment System HS-Controller Area Network (-Bus) |
| PT-CAN | Powertrain HS-Controller Area Network (-Bus) |
| BCM | Body Control Module |
| GPSM | Global Positioning Satellite Module |

Table 1 – Abbreviations

# 2 Clock Strategy

## 2.1 Introduction

The system consists of various ECU's where one ECU contains the Clock – Master and the other involved ECUs that need to be able to adjust or show the clock / date DATA are the Slave ECU(s).

The Clock Master includes a real-time clock, which is the master. The Clock-Master provides a signal via CAN.

All Slave ECUs have to synchronize their own clock with the Clock-Master every time the Master is available for the Slaves (CAN awake), regardless if the clock is displayed in the Slave or not. If the CAN bus is sleeping the Slaves have to run their own clock to provide info if required (HMI). Whenever a Slave receives the clock signal via CAN, the Slave-clock will be set to this time within 100 ms. All Slaves shall be able to show the time (as future clock strategy may change). The Clock-Master shall be adjustable via all Slave ECUs connected. The Clock–Master ECU can be a SLAVE as well, i.e. the Clock Master can show clock DATA as well and the adjustment is done in the same way but without using the Network.

It is important that, after start-up, the Clock-Master always sends the latest HH:MM:SS value in 24 hour mode out to the bus. This is to avoid the displaying of old time-values in the Slave-ECUs. The Clock-Master shall send this out with a fixed periodic rate of 1second.

**Exception for CGEA 1.2:** When the MFD is the Clock Master the other involved ECUs only need to be able to show the clock/date Data. The Clock-Master shall send the latest HH:MM:SS in either 24 or 12 hour mode based on the user selection.

### 2.1.1 Functional Overview

The following overview shows the basic system approach, but it does not describe the portioning of the system as that can vary between each carline.

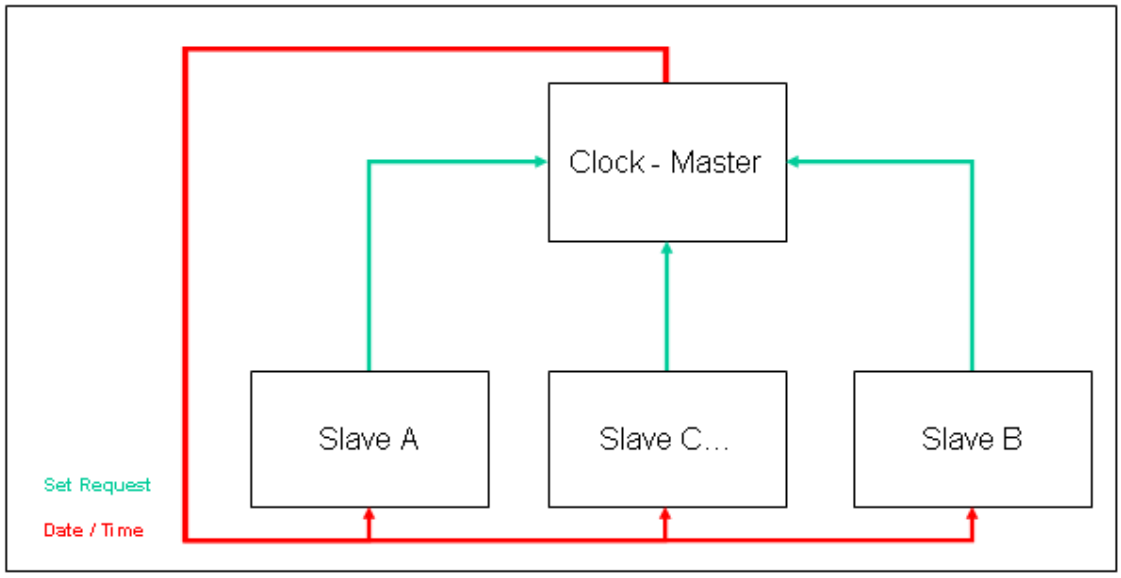


Figure 2 – Basic Functional Overview

### 2.1.2 Portioning per Program

The following table shows some examples of the portioning: As you can see here one ECU can be the Clock Master as well as a Slave.

| Carline | Clock- Master | Slave A | Slave B | Slave C |
|---|---|---|---|---|
| C214 / C307 | HEC | HEC | ACU | NAV |
| CD340 / CD345 | CEM | HEC | ACU | NAV |
| B2yy | HEC | MFD | | |
| C34X(C1MCA) | CEM | IPC | MFD | |
| CGEA 1.2 | MFD | IPC | | |
| CGEA 1.3 | BCM | MFD | IPC | |

Table 3 – Example Portioning per Program

## 2.2 Clock Modes

The following message is used by the Clock Master to distribute the actual Master Clock data to the Slave's. In this case the message will be BCM_DateTime and the signals will be BCM_signal name as listed in the table below. The Master-Clock shall be capable of providing date and time data between 01.01.2000 and 12.31.2254.

The Slaves shall be responsible for determining the Day, Date, and Month including Leap years for display purposes based on Julian Date received from the Master Clock.

The message and signal names are place holders until reviewed with Netcom at which point actual message and signal names will be updated in this spec.

| Message: GlobalClock_Data_HS3 Size[bits] 64 Event Periodic Message (Periodicity 1 second) | | | | | | |
|---|---|---|---|---|---|---|
| Meaning | Size | Start bit | End bit | Offset | Min Hex | Max Hex |
| GlblClkYr_No_Actl | 8 | 0 | 7 | 2000 | 0x00 | 0xFE |
| GlblClkDay_No_Actl | 16 | 16 | 31 | - | 0x01 | 0x16E |
| GlblClkHr_No_Actl | 8 | 48 | 55 | - | 0x00 | 0x17 |
| GlblClkMnte_No_Actl | 8 | 32 | 39 | - | 0x00 | 0x3B |
| GlblClkScnd_No_Actl | 8 | 40 | 47 | - | 0x00 | 0x3B |
| Values for Month, Day… shall be interpreted as Julian date (e.g. ´Year is 2009 so BCM_Year =0x9, Day is April 30th so BCM_Julian_Day = 0x78). Julian day goes from 1 – 366 with 0x0 being the initial startup value. | | | | | | |
| The max. time jitter shall not exceed 100ms on the event distribution of the signal. | | | | | | |

Table 4 – Frame Gateway'ed CAN-Message for CGEA 1.3 'BCM_DateTime'

**Exception for CGEA 1.2**: The MFD shall not send the MFD_DateTime message when configured as a Clock Slave.

For CGEA 1.2 the MFD shall use the MFD_DateTime format listed in the table below when configured as the Clock Master.

| Message: MFD_DateTime Size[bits] 64 Event Message | | | | | | | |
|---|---|---|---|---|---|---|---|
| Meaning | Size | Start bit | End bit | Offset | Min Hex | Max Hex | Invalid Hex |
| MFD_Year | 8 | 0 | 7 | 2000 | 0x00 | 0xFE | 0xFF |
| MFD_Month | 8 | 8 | 15 | - | 0x00 | 0xC | 0xFF |
| MFD_Day | 8 | 16 | 23 | - | 0x00 | 0x1F | 0xFF |
| MFD_Hour | 8 | 24 | 31 | - | 0x00 | 0x17 | 0xFF |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| MFD_Minute | 8 | 40 | 47 | - | 0x00 | 0x3B | 0xFF |
| MFD_Second | 8 | 32 | 39 | - | 0x00 | 0x3B | 0xFF |
| Values for Year, Month, Day… shall be interpreted as the decimal equivalents (e.g. ´January´=0x01) | | | | | | | |

Table 5 – CAN-Message for CGEA 1.2 'MFD_DateTime'

**Exception for C1MCA:**

For C1MCA the Clock Master shall use the XXX_DateTime format listed in the table below to distribute the actual Master Clock data to the slaves.

| Message: BCM_m_FrP12 Size[bits] 64 Periodic Message (150ms) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Meaning | Size | Start bit | End bit | Offset | Min Hex | Max Hex | Invalid Hex |
| HEC_Year | 8 | 0 | 7 | 2000 | 0x00 | 0xFE | 0xFF |
| HEC_Month | 8 | 8 | 15 | - | 0x00 | 0xC | 0xFF |
| HEC_Day | 8 | 16 | 23 | - | 0x00 | 0x1F | 0xFF |
| HEC_Hour | 8 | 24 | 31 | - | 0x00 | 0x17 | 0xFF |
| HEC_Minute | 8 | 32 | 39 | - | 0x00 | 0x3B | 0xFF |
| HEC_Second | 8 | 40 | 47 | - | 0x00 | 0x3B | 0xFF |
| Values for Year, Month, Day… shall be interpreted as the decimal equivalents (e.g. ´January´=0x01) | | | | | | | |

Table 6 – CAN-Message for C1MCA 'XXX_DateTime'

### 2.2.1 CAN Bus Awake

As long as the CAN BUS is awake the Slave ECU's have to synchronize their internal Clocks with the Clock Data received via CAN from the Master Clock ECU.

### 2.2.2 CAN Bus in Sleep

Whenever the bus is in sleep mode or if Ignition or Power Mode is less than or equal to Accessory, i.e. the Master–Clock signal cannot be received by the Slave ECU's (except for cases where the Clock Master is located in the MFD or in a ECU located on the Info CAN bus), the internal Clock of the Slave ECU has to run on its own whenever the clock is requested by the HMI. In case of an event which wakes the bus the Clock in the Slave ECU shall be synchronized immediately (e.g. door ajar).

### 2.2.3 CAN Bus transition Sleep to Awake

When the CAN Bus wakes up, the Clock Master shall begin sending the clock data within 50ms via CAN to the Clock Slaves.

**Exception for CGEA 1.2:** When the CAN Bus wakes up, the Clock Master shall begin sending the clock data within 750ms via CAN to the Clock Slaves.

### 2.2.4 CAN Bus transition Awake to Sleep

When the CAN Bus transitions to sleep mode the Clock shall be maintained by the Slave internal Clock as long as is required by the HMI.

**Exception for CGEA 1.2:** When the CAN Bus transitions to sleep mode the MFD shall maintain the clock.

## 2.3 Clock Settings

The customer shall be able to set the Date (Year, Month, and Day) and the Time (Hours, Minutes) via HMI. When the customer is adjusting the time, the Slaves shall not accept any updates from the Master-clock. This is to ensure that the clock transition is smooth and the display is flicker-free. Upon the final set command, the Slave will update the Master-Clock. Master-time is then broadcasted across the CAN network, updating the Slave's clock.
The Slaves shall not allow the customer to enter invalid times and dates and shall be capable of handling leap years. As soon as the Slaves receive the new time from the Master they shall set their internal time to this value.

If GPSM is in the system then the date shall be supplied by the GPS, therefore no date adjustments are allowed.

**Exception for CGEA 1.2:** The customer shall be able to set the Date (Year, Month, and Day) and the Time (Hours, Minutes) via HMI. Upon the final customer selection, the Master-time is broadcasted across the CAN network in message 'XXX_DateTime', updating the Slave's clock. As soon as the Slaves receive the new time from the Master they shall set their internal time to this value.

### 2.3.1 Initial Clock Setting

Upon battery being applied the initial state of the clock shall be set to Hour = 12, Minutes = 00, and Seconds = 00. The Date shall be set to the manufacturing date of the Master ECU or 1.1.XX where XX equals the year of the first production of the Master ECU (on CD4 2011) if manufacturing date is unavailable. Follow Trustmark (IS-0295) - The clock assembly shall be self-starting when subjected to voltage for functionality. "Voltage for functionality" is defined as the range of voltages where a module must operate without permanent damage.

**Exception for CGEA 1.2:** Upon battery being applied the initial state of the clock shall be set to Hour = 12, Minutes = 00, and Seconds = 00. The Date shall be set to Month = 1, Day = 1, and Year = 2009. Follow Trustmark (IS-0295) - The clock assembly shall be self-starting when subjected to voltage for functionality. "Voltage for functionality" is defined as the range of voltages where a module must operate without permanent damage.

### 2.3.2 Manual setting of Clock via Slave

Whenever the set menu in the Slave is active, the setting shall be performed as follows:
After the customer has entered the new time and/or date info and exits the menu, the Slave shall display the new Time/Date and shall send out the message ‘TimeAdjustReq’. Depending on whether the Date or Time is changed the Slave has to set the ‘TimeAdjustRequest’ signal (=1) and/or the ‘DateAdjustRequest’ (=1) and the entered Time/Date (Set Year, Set Julian Date, SetHour, SetMinute, SetSecond).

This message will be sent to the Master-Clock (xxx_TimeAdjustReq). As soon as the Master receives a ´TimeAdjustRequest/DateAdjustRequest´ (=1), the Master Clock shall be updated and the new Time/Date shall be sent out in message ‘xxx_DateTime’, updating the Slave's clock. If the received Data is equal to the requested Date/Time, the Slave shall reset ‘TimeAdjustRequest’ signal to ´0´. [Equal means within 5 seconds tolerance]. Default for these signals during normal operation is ´No Time/Date adjust request´.

In case one Slave (or all) is in local mode the customer should be able to alter Time or Date via the HMI. The Slave shall wake up the CAN (Only if the Clock Master is located outside the Infotainment Bus) to transmit the user-selected time for the time needed to set the clock.

Note: The Gateway shall wake up the vehicle bus if the TimeAdjustReq = 1 message is received and transmit this message to the BCM. The vehicle bus shall remain awake long enough for the BCM to transmit the new Time to the Gateway for transmission of the new time back to the slaves.

For CGEA 1.3 programs the messages listed below are used to adjust the Time/Date. The message and signal names are place holders until reviewed with Netcom at which point the actual message and signal names will be updated in this spec.

**Exception for CGEA 1.2:** MFD does not follow the Manual Setting section see exception in the Clock Setting section.

| Message: GlobalClock_Dsply Size[bits] 64 Event Message | | | | | | |
|---|---|---|---|---|---|---|
| Meaning | Size | Start bit | End bit | Offset | Min Hex | Max Hex |
| DispGlblClkYr_No_Rq | 8 | 0 | 7 | 2000 | 0x00 | 0xFE |
| DispGlblClkDay_No_Rq | 16 | 16 | 31 | - | 0x01 | 0x16E |
| DispGlblClkHr_No_Rq | 8 | 48 | 55 | - | 0x00 | 0x17 |
| DispGlblClkMnte_No_Rq | 8 | 32 | 39 | - | 0x00 | 0x3B |
| DispGlblClkScnd_No_Rq | 8 | 40 | 47 | - | 0x00 | 0x3B |
| DispGlblClkAdj_B_Rq | 1 | 57 | 57 | Binary 0:No time adjust request 1:Time adjust request | | |
| Values for Month, Day… shall be interpreted as Julian Date(e.g. 'Year is 2009 so MFD Year = 0x09, Day is April30th so MFD_JulianDay =0x78) | | | | | | |

Table 7 – Frame Gateway'ed CAN-Message for CGEA 1.3 'MFD_TimeAdjustReq'

| Message: GlobalClock_MsgCtr Size[bits] 64 Event Message | | | | | | |
|---|---|---|---|---|---|---|
| Meaning | Size | Start bit | End bit | Offset | Min Hex | Max Hex |
| McGlblClkYr_No_Rq | 8 | 0 | 7 | 2000 | 0x00 | 0xFE |
| McGlblClkDay_No_Rq | 16 | 16 | 31 | - | 0x01 | 0x16E |
| McGlblClkHr_No_Rq | 8 | 48 | 55 | - | 0x00 | 0x17 |
| McGlblClkMnte_No_Rq | 8 | 32 | 39 | - | 0x00 | 0x3B |
| McGlblClkScnd_No_Rq | 8 | 40 | 47 | - | 0x00 | 0x3B |
| McGlblClkAdj_B_Rq | 1 | 57 | 57 | Binary 0:No time adjust request 1:Time adjust request | | |
| Values for Month, Day… shall be interpreted as Julian Date(e.g. 'Year is 2009 so IPC Year = 0x09, Day is April30th so IPC JulianDay =0x78) | | | | | | |

Table 8 – CAN-Message for CGEA 1.3 'IPC_TimeAdjustReq'

For Non CGEA (FoE programs) the message listed below is used to adjust the Time/Date.

| Message: TimeAdjustReq Size[bits] 64 Event Message | | | | | | | |
|---|---|---|---|---|---|---|---|
| Meaning | Size | Start bit | End bit | Offset | Min Hex | Max Hex | Invalid Hex |
| SetYear | 8 | 0 | 7 | 2000 | 0x00 | 0xFE | 0xFF |
| SetMonth | 8 | 8 | 15 | - | 0x00 | 0xC | 0xFF |
| SetDay | 8 | 16 | 23 | - | 0x00 | 0x1F | 0xFF |
| SetHour | 8 | 24 | 31 | - | 0x00 | 0x17 | 0xFF |
| SetMinute | 8 | 32 | 39 | - | 0x00 | 0x3B | 0xFF |
| SetSecond | 8 | 40 | 47 | - | 0x00 | 0x3B | 0xFF |
| TimeAdjustRequest | 1 | 48 | 48 | Binary 0:No time adjust request 1:Time adjust request | | | |
| DateAdjustRequest | 1 | 49 | 49 | Binary 0:No date adjust request 1:Date adjust request | | | |
| Values for Year, Month, Day… shall be interpreted as the decimal equivalents (e.g. ´January´=0x01) | | | | | | | |

Table 9 – CAN-Message for Non CGEA 'MFD_TimeAdjustReq'

### 2.3.3 HMI-handling during 'Set-Process' for time

Valid only for GPS assisted time keeping: The ´SetSecond´-value shall not be set to ´0x00´ if the value ´SetMinute´ is changed in the HMI.

Valid only for non-GPS assisted time keeping systems: The ´SetSecond´-value shall be set to ´0x00´ if the value ´SetMinute´ is changed in the HMI.

Valid for GPS and non-GPS assisted time keeping: If only ´SetHour´ is changed (e.g. due to change from winter- to summer-time or vice versa), ´SetSeconds´ shall contain the latest value (remain unchanged). While the customer uses the set-menu, the time shall be ongoing internally in the ECU, i.e. the time shall not be stopped.

Example: Changing Hour only

| | |
|---|---|
| Actual time: | **18:11:19** |
| User sets time: | **17:11** |
| Time transmitted by ECU if user waits for 30 seconds until pressing SetButton or timeout of HMI: | **17:11:49** |

Example: Changing Hour and Minutes

| | |
|---|---|
| Actual time: | **18:11:19** |
| User sets time: | **17:30** |
| Time transmitted by ECU if user waits for 30 seconds until timeout of HMI occurs: | **17:30:30** |

Example: Changing Hour and Minutes

| | |
|---|---|
| Actual time: | **18:11:19** |
| User sets time: | **17:30** |
| Time transmitted by ECU if user waits for 30 seconds until pressing Set Button: | **17:30:00** |

### 2.3.4 Automatic RDS setting

RDS Clock should not be used at all.

### 2.3.5 Automatic GPS setting

When a GPS module is present on the bus and Automatic GPS setting is enabled the MFD shall compare the time received from the GPS module to the clock time received from the Master and send out a ´TimeAdjustReq´-Frame to the Master Clock with the current GPS-time when the MFD-Slave time differs more than +/- 3 seconds from GPS-time.

For Automatic GPS setting the slave shall also set the seconds based on the GPS time received.

If the message for GPS time is missing then the Master Clock shall maintain the currently displayed time as the standard time until the GPS time is reacquired. At this time the MFD will send a 'TimeAdjustReq' to the Master Clock to sync with the GPS time if the time differs based on the value stated above.

**Exception for CGEA 1.2:** When a GPS module is present on the bus and Automatic GPS setting is enabled the MFD shall compare the time received from the GPS module to the clock time stored in the MFD and update the MFD Clock when the time differs more than +/- 2 seconds from the GPS time. If the message for GPS time is missing then the MFD shall maintain the currently displayed time as the standard time until the GPS time is reacquired.

### 2.3.6 12/24 Hour Setting

The Clock HMI display shall support the twelve and twenty four-hour format. The format shall be configurable via HMI. The Vehicle Settings Server must support a default configuration for 12 or 24 hour mode based on the Vehicle Market they are supporting.

Exception for CGEA 1.2: The Clock Master shall report the time to the slaves in twelve or twenty four-hour format based on the user setting.

### 2.3.7 EOL Configurable

**Exception for CGEA 1.2:**
The MFD clock operation needs to be configurable between Stand Alone Clock for CGEA 1.2 programs and a Clock Slave for programs where the Clock Master resides in a different ECU i.e. CEM or SPDJB.

## 2.4 Missing Signals

### 2.4.1 Master doesn't receive 'TimeAdjustRequest' (=1)

The Slave shall reset ‘TimeAdjustRequest’ if the received Time/Date from the Master is equal to the entered Time/Date. If this is not the case during 2 seconds after the Slave have sent the time/date change request, the Slave has to reset ‘TimeAdjustRequest’ (set it to ´0´) and send out again a change request (‘TimeAdjustRequest’ (=´1´)) including the entered Time/Date. Between the reset and the next request a delay of min 150ms is defined. If the Slave doesn’t receive the correct time/date from the Master after the third sequence the clock setting has failed and the Slave clock display shall be set back to the time/date that is sent out by the Clock Master. However, if the user wants to set a new time during these 2 seconds the sequence will have to be restarted. The Slave has to reset ‘TimeAdjustRequest’ (=´0´) and send out the new change request (‘TimeAdjustRequest’ (=´1´)) including the entered Time/Date.

**Exception for CGEA 1.2:** TimeAdjustRequest message is not used so MFD will not follow the information above.

**Exception for C1MCA:** 'DateAdjustRequest' is used when the user adjusts the date so follow strategy above in the case that the Master doesn't receive 'DateAdjustRequest' (=1).

### 2.4.2 Master doesn't receive 'TimeAdjustRequest' (=0)

If the Master doesn’t receive ‘TimeAdjustRequest’ (=0), the Master shall not reset the clock to the previous Time/date. It shall keep the previously sent value although it was not confirmed by the Slave's because they will get the new value in next cycle.

**Exception for CGEA 1.2:** TimeAdjustRequest message is not used so MFD will not follow the information above.

**Exception for C1MCA:** 'DateAdjustRequest' is used when the user adjusts the date so follow strategy above in the case that the Master doesn't receive 'DateAdjustRequest' (=0).

### 2.4.3 'DateTime' not received by Slave only applicable while Ignition greater than Accessory

If the CAN bus is awake and if Ignition or Power Mode is greater than Accessory and the Slave doesn’t receive the clock information from the Master for 10 seconds, the Slave shall show dashes in the clock display. During the first 10 seconds it shall show its internal clock.

**Exception for CGEA 1.2:** If the Slave does not receive the DateTime message for more than 5 seconds then the Slave clock shall display dashes.

## 2.5 Set Time/Date via two or more Slaves at the same time

Due to the fact that the clock is adjustable via more than one Slave, a scenario is possible where the driver sets the clock via one Slave HMI and the passenger sets the Clock via another Slave HMI nearly at the same time. In most cases, the last set Time/Date will be shown in both Displays at the end.

Only if the request is very close in time (within milliseconds) the first one will be shown in both displays at the end.
This behaviour is not optimal but if the customer sets the time within ms in two or more Slaves, it will be difficult for the user to determine who was first.

**Exception for CGEA 1.2:** Only the MFD can set the clock so this scenario is not valid for CGEA 1.2.

# 3 Physical Requirements

## 3.1 Physical Components

The Clock shall be generated in such a way that it meets the requirements listed in this chapter.

## 3.2 Accuracy of the Master Clock

The Clock-IC used in the Master shall have a minimum accuracy as mentioned in the following table: Global Clock Accuracy

**Exception for CGEA 1.2:**
The Clock used in the MFD (Clock Master) shall have a minimum accuracy as mentioned in the following table: CGEA 1.2 Clock Accuracy

| Degrees Celsius min | Degrees Celsius max | Drift |
|---|---|---|
| - 40 degrees C | + 5 degrees C | +/- 15.0 s/week |
| + 5 degrees C | + 35 degrees C | +/- 6.0 s/week |
| + 35 degrees C | + 85 degrees C | +/- 15.0 s/week |

Table 10 – Global Clock Accuracy

| Degrees Celsius min | Degrees Celsius max | Drift |
|---|---|---|
| -5 degrees C | + 35 degrees C | +/- 10.5 s/week |
| -40 degrees C | -5 degrees C | +/- 15.25 s/week |
| +35 degrees C | +85 degrees C | +/- 15.25 s/week |

Table 11 – CGEA 1.2 Clock Accuracy

## 3.3 Accuracy of the Slave Clock

The clock used in the Slave's shall have a minimum accuracy as mentioned in the following table:

| Degrees Celsius min | Degrees Celsius max | Drift |
|---|---|---|
| -5 degrees C | + 85 degrees C | +/- 84 s/week |

Table 12 – Global Slave Clock Accuracy

## 3.4 Voltage Requirements

The requirements mentioned in this chapter have to be fulfilled to prevent unwanted resets of the clock which may result in a loss of the clock (reset to default value). They have to be fulfilled in the whole temperature range at the System, ECU, and IC level (see below).

**Exception for CGEA 1.2:**
There is no IC level requirement.

| External supply on module for data-retention in: | Static Power Supply | | | Dynamic Power Supply | |
|---|---|---|---|---|---|
| | Low | Hi | Nominal | Low | High |
| Function | 6.2 V | 16 V | 13.5 V | 3V for 100ms<br>0V for 50ms | 18V for 60 min<br>24V for 1 min |
| ECU | 6.2 V | 16 V | 13.5 V | | |
| I2C | 2.5 V | 16 V | 13.5 V | | |

Table 13 – Voltage Requirements

## 3.5 Clock Storage

The Clock Master shall not reset to a previous or default value given Vbatt = 0v for 50msec. When the master does reset (if outside the specification limits) due to power interruption, the Clock Master will default back to 'Initial Clock Setting'.

**Exception for CGEA 1.2:** This section is not used by the MFD.

See Hardware FS for PDropout definition and value. The value of 4.5v is being reviewed and is subject to change.

| Voltage | Global Clock Result |
|---|---|
| Above PDropout | Clock continues operating and keeping track of time |
| PDropout to 4.5v | Clock stops incrementing until voltage recovers to PDropoutRecover (lost time is never corrected) |
| 0v to 4.5v (assuming drop from 12v) for 50msec | Clock stops incrementing until voltage recovers to PDropoutRecover (lost time is never corrected) |
| 0v to 4.5v for longer than 50msec | Global Clock resets to initial clock setting |

Table 14 – Clock Storage

# 4 Table of Figures

# Table of Figures