

To our customers,

---

## Old Company Name in Catalogs and Other Documents

---

On April 1<sup>st</sup>, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: <http://www.renesas.com>

April 1<sup>st</sup>, 2010  
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

Send any inquiries to <http://www.renesas.com/inquiry>.

## Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

"Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

"High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

"Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.

8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

To all our customers

---

## **Regarding the change of names mentioned in the document, such as Hitachi Electric and Hitachi XX, to Renesas Technology Corp.**

---

The semiconductor operations of Mitsubishi Electric and Hitachi were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Hitachi, Hitachi, Ltd., Hitachi Semiconductors, and other Hitachi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Renesas Technology Home Page: <http://www.renesas.com>

Renesas Technology Corp.  
Customer Support Dept.  
April 1, 2003

## Cautions

Keep safety first in your circuit designs!

1. Renesas Technology Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage.  
Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

Notes regarding these materials

1. These materials are intended as a reference to assist our customers in the selection of the Renesas Technology Corporation product best suited to the customer's application; they do not convey any license under any intellectual property rights, or any other rights, belonging to Renesas Technology Corporation or a third party.
2. Renesas Technology Corporation assumes no responsibility for any damage, or infringement of any third-party's rights, originating in the use of any product data, diagrams, charts, programs, algorithms, or circuit application examples contained in these materials.
3. All information contained in these materials, including product data, diagrams, charts, programs and algorithms represents information on products at the time of publication of these materials, and are subject to change by Renesas Technology Corporation without notice due to product improvements or other reasons. It is therefore recommended that customers contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor for the latest product information before purchasing a product listed herein.  
The information described here may contain technical inaccuracies or typographical errors. Renesas Technology Corporation assumes no responsibility for any damage, liability, or other loss rising from these inaccuracies or errors.  
Please also pay attention to information published by Renesas Technology Corporation by various means, including the Renesas Technology Corporation Semiconductor home page (<http://www.renesas.com>).
4. When using any or all of the information contained in these materials, including product data, diagrams, charts, programs, and algorithms, please be sure to evaluate all information as a total system before making a final decision on the applicability of the information and products. Renesas Technology Corporation assumes no responsibility for any damage, liability or other loss resulting from the information contained herein.
5. Renesas Technology Corporation semiconductors are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact Renesas Technology Corporation or an authorized Renesas Technology Corporation product distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.
6. The prior written approval of Renesas Technology Corporation is necessary to reprint or reproduce in whole or in part these materials.
7. If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.  
Any diversion or reexport contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.
8. Please contact Renesas Technology Corporation for further details on these materials or the products contained therein.

# Ho7000 Series

## Communication Manual

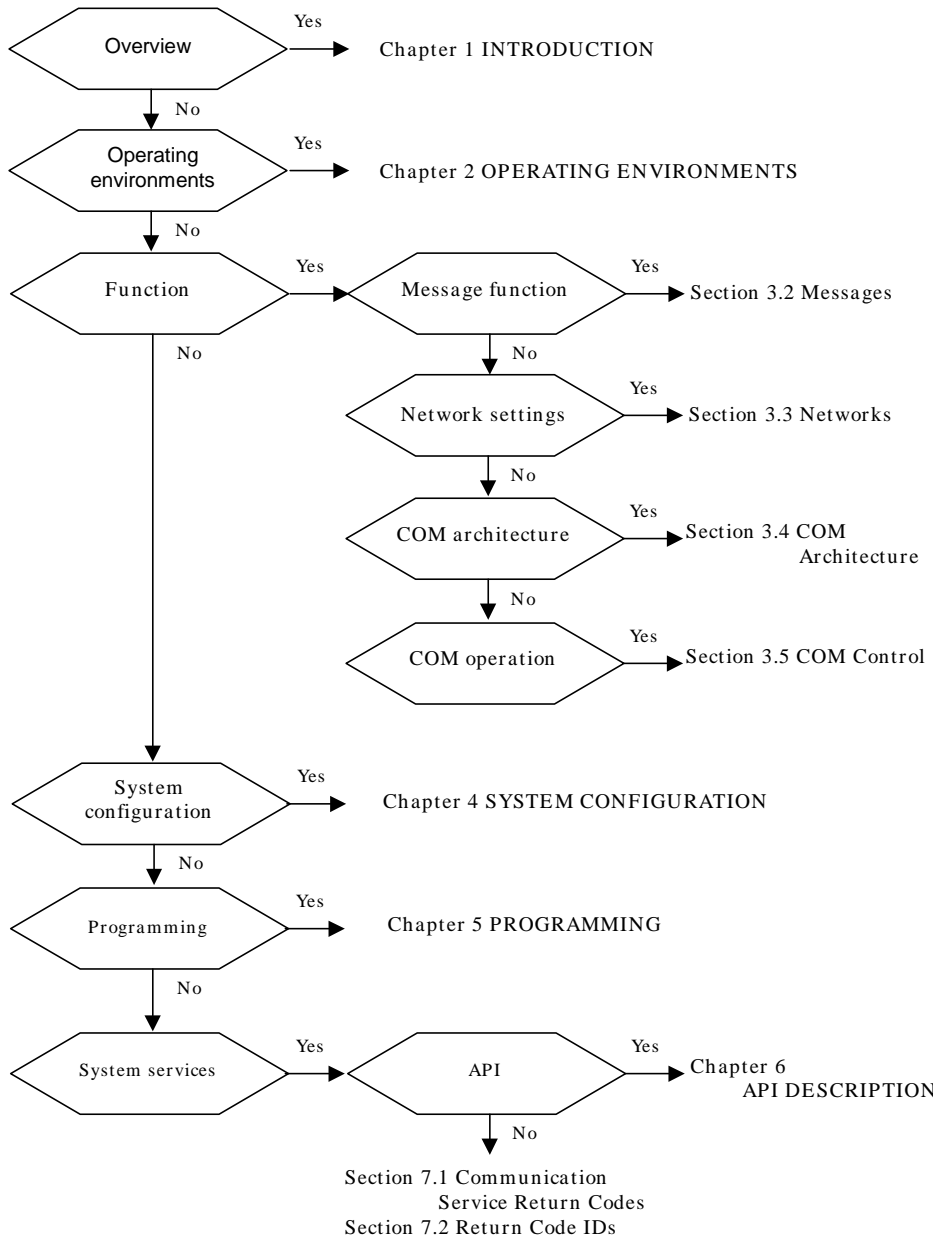
## Cautions

### **PLEASE READ THE FOLLOWING CAREFULLY BEFORE YOU USE THIS PRODUCT.**

1. If you use the enclosed software product and any related software products (hereafter referred to as “PRODUCT”), before exporting or taking such PRODUCT to other countries or states, you must comply with applicable export control laws and regulations of Japan and other countries with jurisdiction and the applicable states and provinces within Japan and such other countries.
2. Please be advised that Hitachi neither warrants nor grants licenses of any rights to the patents, copyrights, trademarks, or other intellectual property rights owned by Hitachi or any third party for the use of the PRODUCT, unless otherwise expressly granted to you by Hitachi in a contract or other document including without limitation any warranty or license included in the user’s manual for the PRODUCT (hereinafter referred to as “CONTRACTS”). Please be further advised that Hitachi bears no responsibility for problems that may arise with third party’s rights, including intellectual property rights, in connection with the use of the PRODUCT.
3. The PRODUCT, its specifications and/or its description in the user’s manual are subject to change in the future without any prior notice. Confirm that you have received the latest standards and/or specification for the PRODUCT (including the user’s manual) before you make your final design, purchase or use.
4. Please be advised that Hitachi will not have any liability whatsoever for damages, including indirect or consequential damages, arising out of your use of the PRODUCT (including the use based on the descriptions of the user’s manual). Hitachi shall not be liable for any damages caused by any equipment or media used for delivery of the PRODUCT.
5. The PRODUCT is not designed for, and you may not use the PRODUCT for, applications that demand especially high quality and reliability, or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as equipment used for aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support. If you have any questions regarding whether or not your intended use of the PRODUCT is permitted by Hitachi, please contact your local Hitachi’s sales office.
6. At the time of designing or planning your system using the PRODUCT, please consider normally foreseeable failure rates or failure modes and employ sufficient systematic measures such as fail-safe systems so that the equipment incorporating the PRODUCT does not cause any accident or other consequential damage due to operation of the PRODUCT.
7. This manual and the PRODUCT are copyrighted by Hitachi. Under any circumstances, you may not copy, analyze, reverse engineer, and/or modify, in whole or in part, the PRODUCT, except to the extent expressly provided in the CONTRACTS.
8. You may not use or copy, in whole or in part, the user’s manual for the PRODUCT without the prior written consent of Hitachi, except to the extent expressly provided in the CONTRACTS.

9. You may use the PRODUCT on just one (1) computer. You may not transfer, lease or otherwise assign the PRODUCT to any third party or parties, except to the extent expressly provided in the CONTRACTS.
10. Please contact your local Hitachi's sales office for any questions regarding the PRODUCT, any Hitachi semiconductor products or any related products.

Select the items you want to know from the following flowchart before reading this manual.





# Table of Contents

<b>1</b>	<b>INTRODUCTION.....</b>	<b>7</b>
1.1	Document Overview .....	7
1.2	Definitions and Acronyms .....	7
1.3	COM Overview .....	7
1.4	Features of This Product .....	9
<b>2</b>	<b>OPERATING ENVIRONMENTS .....</b>	<b>11</b>
2.1	Conformity Version.....	11
2.2	Conformance Class.....	11
2.3	Communication Bus.....	11
2.4	Operating System .....	12
2.5	Notes.....	12
<b>3</b>	<b>FUNCTIONS .....</b>	<b>13</b>
3.1	Function Overview .....	13
3.2	Messages .....	13
3.2.1	Message Types.....	13
3.2.2	Message Operations.....	14
3.2.3	Notification to Application.....	15
3.2.4	Transmission Modes.....	16
3.2.5	Deadline Monitoring.....	20
3.2.6	Message Attributes .....	21
3.3	Networks.....	22
3.3.1	HCAN Related Parameters .....	22
3.3.2	Channel .....	22
3.4	COM Architecture .....	24
3.5	COM Control.....	25
3.5.1	Start Up.....	26
3.5.2	Normal Operation .....	26
3.5.3	Shut Down .....	26
3.5.4	Error Handling .....	27
<b>4</b>	<b>SYSTEM CONFIGURATION .....</b>	<b>29</b>
4.1	COM Application Building .....	29
4.2	COM Configuration Files.....	30
4.2.1	Evb .....	31
4.2.2	Hcan .....	31
4.2.3	Mcs.....	32
4.2.4	Msg.....	32
<b>5</b>	<b>PROGRAMMING .....</b>	<b>33</b>

<b>5.1</b>	<b>COM Initialisation .....</b>	<b>33</b>
<b>5.2</b>	<b>Include Files .....</b>	<b>33</b>
<b>5.3</b>	<b>Interrupts.....</b>	<b>34</b>
5.3.1	HCAN Interrupts.....	34
5.3.2	Interrupt Priority Levels .....	34
<b>5.4</b>	<b>User Code .....</b>	<b>35</b>
5.4.1	Initialisation processing .....	35
5.4.2	Call-Back Functions .....	35
5.4.3	HCAN ISR .....	36
<b>5.5</b>	<b>Interface to OS.....</b>	<b>37</b>
5.5.1	Interrupt.....	37
5.5.2	Alarm and Task.....	37
<b>5.6</b>	<b>Registers.....</b>	<b>37</b>
<b>5.7</b>	<b>Stack.....</b>	<b>37</b>
<b>5.8</b>	<b>Calling a Communication Service From an Assembler Routine .....</b>	<b>38</b>
<b>5.9</b>	<b>Notes on Assembler Use .....</b>	<b>38</b>
<b>6</b>	<b>API DESCRIPTION.....</b>	<b>39</b>
<b>6.1</b>	<b>Standard Interface .....</b>	<b>39</b>
6.1.1	StartCOM.....	39
6.1.2	MessageInit .....	40
6.1.3	SendMessage .....	41
6.1.4	ReceiveMessage.....	42
6.1.5	GetMessageStatus .....	42
<b>6.2</b>	<b>Original Interface Functions.....</b>	<b>43</b>
6.2.1	OC_SendMsgToNetPer .....	43
6.2.2	OC_MixedTxEval.....	44
<b>7</b>	<b>APPENDIX.....</b>	<b>45</b>
<b>7.1</b>	<b>Communication Service Return Codes.....</b>	<b>45</b>
<b>7.2</b>	<b>Return Code IDs.....</b>	<b>46</b>
<b>7.3</b>	<b>Communication Service Calls.....</b>	<b>47</b>
<b>7.4</b>	<b>Data Types.....</b>	<b>47</b>
<b>7.5</b>	<b>Maximum Parameters .....</b>	<b>47</b>

# 1 INTRODUCTION

## 1.1 Document Overview

This document defines the operation of the Ho7000 series Communication V1 (hereafter referred to as COM) which conforms to the OSEK/VDX (hereafter referred to as OSEK) open standard for communication, Specification Version 2.0a. **This document is described on the assumption that OSEK specification is understood.**

Read this document carefully and understand the contents of the following documents before using this product.

- “OSEK/VDX Operating System”, Version 2.0 revision 1 (OSEK/VDX steering committee)
- “OSEK/VDX Communication”, Version 2.0a (OSEK/VDX steering committee)
- “OSEK/VDX Communication”, Version 2.1 revision 1 (OSEK/VDX steering committee)
- Release Notes of this product
- SuperH RISC engine C/C++ Compiler Package Manual
- Programming Manual and Hardware Manual of the target SH microprocessor

## 1.2 Definitions and Acronyms

API	Application Program Interface
CAN	Controller Area Network
CCC	Communication Conformance Class
COM	Communication for Hitachi Vehicle Operating System
DLL	Data Link Layer
ECU	Electronic Control Unit
HCAN	Hitachi Controller Area Network or Hitachi Controller Area Network 2
HW	Hardware
NM	Network Management
OS	Operating System
OSEK	Open systems and the corresponding interfaces for automotive electronics
SW	Software
VDX	Vehicle Distributed eXecutive

## 1.3 COM Overview

The OSEK COM is one of SW components specified by the OSEK Standard. The other components are the operating system (OS) and the network management module (NM). All three components provide functionality common to automotive applications.

Figure 1.1 shows a system concept for automotive applications. In a car, there are a number of ECUs exchanging information over a CAN network. Each ECU is dedicated to the control of a certain mechanical component or subsystem in the car. For instance, ECU #1 may be the Engine Management Controller, ECU #2 the Gearbox Controller, etc. Higher level functionality in the car may be distributed over several ECUs.

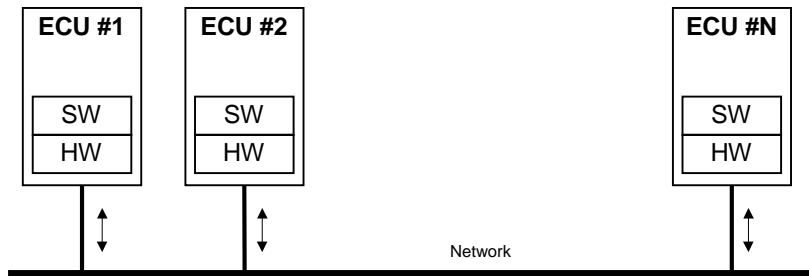


Figure 1.1 System Concept for Automotive Applications

The internal structure of an ECU is shown in Figure 1.2.

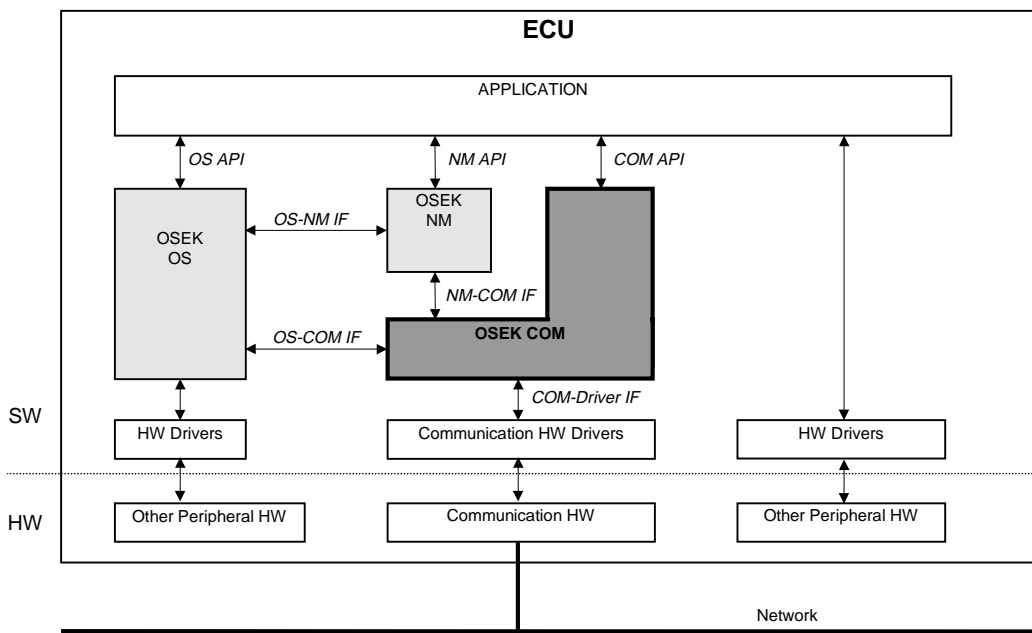


Figure 1.2 Internal SW Structure of an ECU

The COM controls the communication, both within the ECU, and between ECUs. It provides the application with services for sending and receiving messages. The API is uniform for services exchanging messages within a node and between nodes.

The COM component can be implemented with compatibility, which is reflected by its Communication Conformance Class (CCC). With this product, the CCC0 and CCC1 conformance classes are supported. CCC0 is the least resource demanding class and may be implemented without any OS support. CCC1 requires the OS. The CCCs are provided in order to allow the communication component capabilities to be adapted to the communication need of the application.

In order to gain access to the communication HW, the COM makes use of the device drivers provided by the COM-driver interface. This interface is not specified by the OSEK standard. The CAN device is used in this product.

## 1.4 Features of This Product

The features of this product are shown below:

- The COM supports portability of application by providing a standardised application program interface that is defined according to the ANSI C standard.
- An OSEK COM implementation provides the following features for message exchange in applications.
  - **Task – Task communication**

- **ECU – ECU communication**
- **Different transmission concepts: Direct/Periodical/Mixed**
- **Communication deadline monitoring**
- **Notification by event setting and task activation**

Note: Periodical transmission and mixed transmission is provided by an original interface. Please refer to section 3.2.4 for details.

## 2 OPERATING ENVIRONMENTS

### 2.1 Conformity Version

The COM conforms to version 2.0a of the OSEK/VDX Communication specification and version 2.1 revision 1 of the OSEK/VDX Message transmission modes and deadline monitoring.

### 2.2 Conformance Class

The function corresponding to the conformance class of OSEK Communication specification is shown by ✓.

Table 2.1 Conformance Classes

Functions and Services		Conformance Classes	
		CCC0	CCC1
Transmission concept	Direct	✓	✓
	Periodical		✓
	Mixed		✓
Communication deadline monitoring			✓
Messages	Unqueued	✓	✓
Protocols	UUDT (undivided message)	✓	✓
Services	SendMessage	✓	✓
	ReceiveMessage	✓	✓
	GetMessageStatus	✓	✓
Notification	Task activation		✓
	Event setting		✓

#### CCC0

Provides the minimum services and functions to ECU-internal and inter-ECU communication.

**The OS is not indispensable.**

#### CCC1

Provides periodical transmission, mixed transmission, deadline monitoring, and notification mechanism. **The OS is indispensable.**

### 2.3 Communication Bus

The COM is implemented for a communication bus of CAN (hereafter referred to as a bus). The COM uses HCAN as communication HW. **The COM does not operate on other communication HW and buses.**

## 2.4 Operating System

The COM can be used with the OS of corresponding 'Ho7000 series'. **The COM cannot be used by combining with other OSs.**

## 2.5 Notes

- (1) The COM includes drivers for the HCAN devices that are built in the CPU. The drivers are not parts of the OSEK COM standard, but do not remove them because they are required for the COM operation.
- (2) Refer to the help file of the COM configurator for details on COM configuration.
- (3) Cannot be used in little endian. The COM must be used in big endian.



## 3 FUNCTIONS

### 3.1 Function Overview

The overview of the COM function is shown in Figure 3.1.

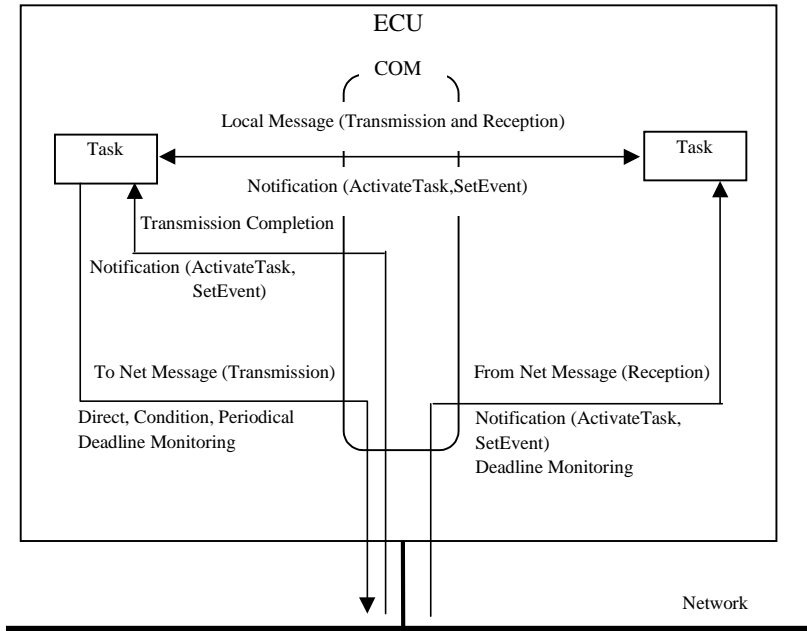


Figure 3.1 COM Function Overview

### 3.2 Messages

#### 3.2.1 Message Types

There are three types of messages as follows:

- Local messages
- To Net messages
- From Net messages

### 3.2.1.1 Local

The Local messages are sent and received within a single ECU, without being transmitted over the network. They are used to exchange information between different parts of a single application.

### 3.2.1.2 To Net

The To Net messages are transmitted from the ECU to the network. They are received from the network by other ECUs. These messages may be received locally by the sending the ECU.

### 3.2.1.3 From Net

The From Net messages are received in the ECU from the network. They are transmitted from another ECU.

## 3.2.2 Message Operations

The following message operations are possible:

- Sending a message
- Receiving a message
- Reading the status of a message

### 3.2.2.1 Send

A message is transmitted via the SendMessage communication service. The transmission operation differs depending on the message types.

#### Local

For Local messages, transmission means copying message data from the application to a data area within the COM.

#### To Net

For To Net messages, message data is copied from the application, as for Local messages. In addition, the message data is sent to the network.

The above description is relevant for a message that is transmitted in *Direct* mode. Please see section 3.2.4 for details on other transmission modes.

### 3.2.2.2 Receive

#### Local

This service copies the message data from a data stored within COM message data area to the application.

#### From Net

When receiving a message from a bus, the message data domain in COM is immediately updated at the time. Message data is copied to application from the message data in COM at the time of ReceiveMessage communication service call. **Reception from a bus is asynchronously processed with ReceiveMessage communication service call.**

### 3.2.2.3 Get Status

The status of a message is obtained via the communication service GetMessageStatus. The operation is applicable to messages of all types. The status expresses the following conditions of the message:

- In use status: Locked (in use) or unlocked (not used)
- Data value status: Updated at least once or never updated

#### In Use

The status is locked if COM is using the message. The application cannot access the message when the status is locked. If the application calls a communication service, no action that alters the message will be performed and an error code indicating Locked will be returned. When the message can be used, the status is unlocked.

#### Data Value

At COM start-up, the status of all messages is Never Updated. When a message has been sent from the application or received from the network at least once, the status is changed into Update. Henceforth, it does not become Never Updated.

### 3.2.3 Notification to Application

This function can use only CCC1. Operations on messages are performed asynchronous to the application. A transmission to the network is requested by the application, but the transmission operation is not finished before the communication service returns to the application. In CCC1, the notification mechanism makes it possible for the COM to inform the application when the transmission has been completed. A reception from the network is performed entirely without intervention of the application. The COM receives a new message from the communication bus and stores it internally. These operations are:

Table 3.1 Notification Timing

Operation	Timing	Applies to Message of Type
Transmission of message	When issuing SendMessage	Local
	When transmission of the message to a bus is completed	To Net
Reception of message	When the reception of a message from bus is completed	From Net

There are two kinds of notification methods.

- COM sets an **event** when the operation is finished
- COM activates a **task** when the operation is finished

### 3.2.4 Transmission Modes

The COM offers the following transmission modes:

- **Direct**
- **Periodical (only CCC1)**
- **Mixed (only CCC1)**

Table 3.2 Message Transmission Modes

<i>Direct</i>	Message transmission is requested by each call by issuing <code>SendMessage</code> .
<i>Periodical (only CCC1)</i>	Message transmission is requested by a dedicated task activated by a cyclic alarm.
<i>Mixed (only CCC1)</i>	Message transmission is requested by a dedicated task activated by a cyclic alarm. In addition, message transmission is conditionally. The condition is user-defined.

#### 3.2.4.1 Direct

A transmitted message is unconditionally transmitted by issuing `SendMessage`. Direct transmission is available for messages of types *Local* and *To Net*.

#### 3.2.4.2 Periodical

When CCC1 is used, periodic transmission using alarm can be performed by combining with OS. A transmission message is transmitted periodically. In this mode, the communication service `SendMessage` does not initiate the transmission to the net. It only updates the message data.

The transmission to net is initiated by a periodically activated task. The task and the alarm must be defined by the user.

The periodic task initiates transmission through a special Send service that is not a formal part of the COM API. This service is named `OC_SendMsgToNetPer`. The user must add a call to this service in the periodic task. See chapter 6 for details.

Do not start periodical transmission until COM initialisation is complete. This means that the earliest point in time to start the alarm is from the `MessageInit()` function.

Periodical transmission is available for messages of type *To Net*.

## Application

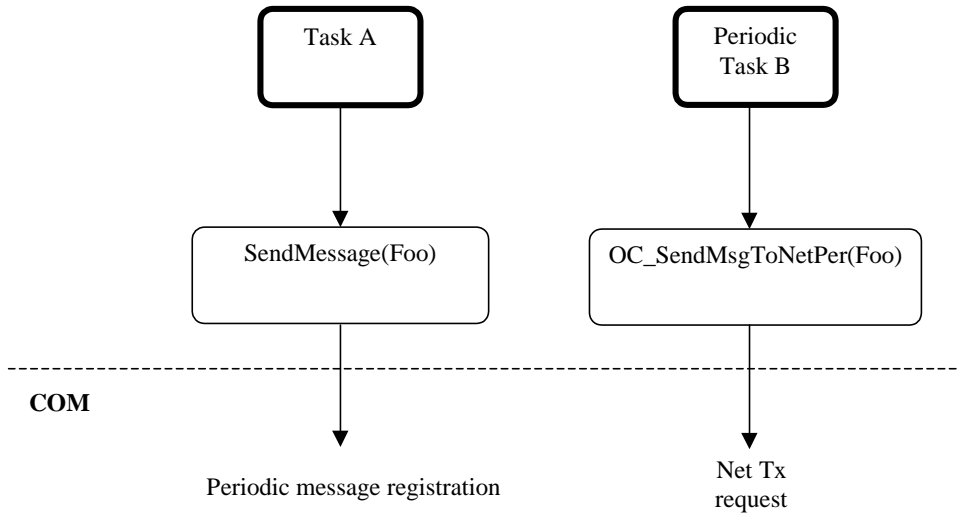


Figure 3.2 Periodical Transmission

The Task A runs independently from the periodic task B. The latter requests a transmission to the network, each time it is activated. The message named *Foo* is configured for periodical transmission mode.

### 3.2.4.3 Mixed

When CCC1 is used, mixed transmission using alarm can be performed by combining with OS. A transmission message is transmitted periodically. In addition, SendMessage conditionally initiates a transmission to the network. A condition is evaluated each time SendMessage is called. If the condition evaluates to “Send”, a transmission is initiated; otherwise not.

In this mode, the communication service SendMessage

1. Updates the message data
2. Calls the evaluation original function OC\_MixedTxEval()
3. Requests a transmission to network if the evaluation function returned “Send”.

The evaluation performed in OC\_MixedTxEval() is defined by application. The function must return a value that tells COM whether to send the message or not. See section 6 for details.

Transmissions to net are initiated by a periodically activated task. The task and the alarm must be defined by the user.

The periodic task initiates transmission through a special Send service that is not a formal part of the COM API. This service is named OC\_SendMsgToNetPer. The user must add a call to this service in the periodic task.

Do not start periodical transmission until COM initialisation is complete. This means that the earliest point in time to start the alarm is from the MessageInit() function.

Mixed transmission is available for messages of type *To Net*.

# Application

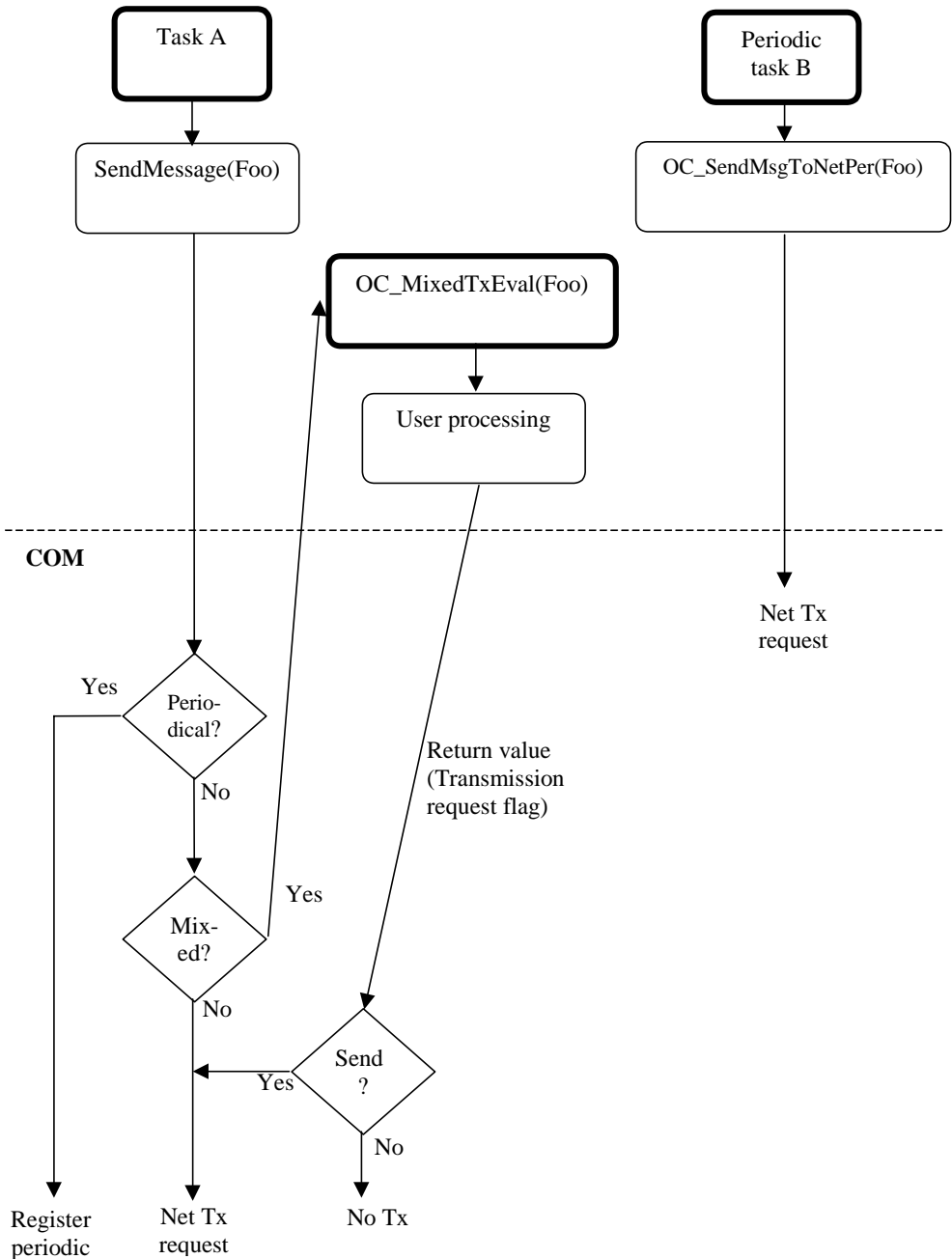


Figure 3.3 Mixed Transmission

Task A runs independently from the periodic task B. Task A calls `SendMessage` that conditionally requests a transmission to the network. Task B requests a transmission to the network, each time it is activated. The message named *Foo* is configured for mixed transmission mode.

### 3.2.5 Deadline Monitoring

When CCC1 is used, the deadline monitoring using alarm can be performed by combining with OS. Deadline monitoring means that a deadline is monitored. It can be applied regardless of whether the message is configured for transmission or reception. For transmission, this means that an initiated transmission to the net must be completed within a certain time frame. If not, an alarm expires and as a consequence, a task is activated or an event is set. For reception, a message must be received within a certain time frame. The start of this time frame is the point in time when the previous message was received. If the deadline is broken, an alarm expires and as a consequence, a task is activated or an event is set.

User must define the alarm, the task, and the event.

Deadline monitoring is applicable to messages of type *To Net* or *From Net*.

#### (1) Transmission

An alarm is started just before COM issues a transmission request to the network. Depending on the transmission mode, this is done in either of

- `SendMessage`
- `OC_SendMsgToNetPer`

The alarm is cancelled automatically when COM receives a transmission confirmation from the network.

If a confirmation does not occur within the alarm time, the alarm will expire.

Deadline monitoring may be used in both direct, periodical and mixed transmission modes.

#### (2) Reception

Start of the deadline monitoring of reception is possible by starting the alarm from a task or by receiving the message that had once specified deadline monitoring.

In reception monitoring, the alarm is never cancelled; only restarted automatically.

Do not start reception monitoring until COM initialisation is complete. This means that the earliest point in time to start the alarm is from the `MessageInit()` function.

The alarm is restarted each time COM receives a reception indication from the network.

If an indication does not occur within the alarm time, the alarm will expire.



### 3.2.6 Message Attributes

The following attributes must be configured for each message. All configurations are done with the COM Configurator. Please see the COM Configurator Help File for details.

- Message Name (The character string which starts with an alphabetic character or an underline, followed by zero or more alphabetic characters, underlines, or numbers. A maximum of 32 characters.)
- Data Length (A maximum of 8 bytes)
- Message Type
  - Local
  - To Net
  - From Net
- Notification Function
  - None
  - Event Mask (Event setting)
  - Task ID (Task ID for task activation or event setting)
- Transmission Mode
  - Direct
  - Periodic (only CCC1)
  - Mixed (only CCC1)
- Deadline Monitoring
  - Alarm ID
  - Expiration Time
- HCAN
  - Mailbox Number (0 to 15)
  - Bit Length of CAN ID (11 or 29 bits)
  - CAN ID

Please note the following.

- (1) Do not set up multiple messages of the same name.**
- (2) Do not set up multiple same CAN IDs.**
- (3) Mail box number 16 or above cannot be used.**

## 3.3 Networks

### 3.3.1 HCAN Related Parameters

Each net message has the following settings related to the HCAN:

- Mailbox
- CAN ID

#### (1) Mailbox

Data exchange between a message and the CAN net is done through a mailbox. This is a data area within the HCAN device that holds message data and control information. Each net message must use a mailbox.

The following mailboxes exist in an HCAN device

- Mailbox for either transmission or reception (mailboxes 1-15)
- Mailbox only for reception (mailbox 0)

#### Mailboxes 1-15

These mailboxes can be used for *To Net*, or *From Net*. Multiple messages must not be assigned to the same mailbox.

#### Mailbox 0

Only messages of type *From Net* may use this mailbox. It is intended to receive a group of messages. During reception processing, reception of two or more messages in the mailbox 0 causes an error, and is not processed.

Mail box number 16 or above cannot be used.

#### (2) CAN ID

Each message has a unique identifier (CAN ID) that is used to identify the message on the CAN bus. The CAN ID may consist of either 11 or 29 bits. 11 bits mean that 11 standard ID bits are used in the CAN bus frame. 29 bits mean that 18 extended and 11 standard ID bits are used.

### 3.3.2 Channel

COM can treat two separate HCAN buses by one ECU. HCAN has the following parameters. All configurations are done with the COM Configurator. Please see the Hardware Manual and the COM Configurator Help File for details.

- Mailbox 0
  - Bit length of CAN ID (11 or 29 bits)
  - CAN ID
  - LAFM (local acceptance filter mask for mailbox 0)
- Operation
  - Transmission priority (mailbox order or ID order)
  - Bit sample point (1 point or 3 points)
- Bit configuration
  - Baud-rate prescaler (BRP)
  - Time segment 1 (TSEG1)
  - Time segment 2 (TSEG2)

- Maximum bit synchronisation width (SJW)
- Interrupts
  - For each HCAN interrupt source: Enabled/disabled

Restriction of a setting of a bit configuration is shown below.

$TSEG1 > TSEG2 \geq SJW$  (SJW = 1 to 4)

$3 + TSEG1 + TSEG2 = 8$  to 25 Time Quanta

$TSEG2 > B'001$  (BRP = B'000000)

$TSEG2 > B'000$  (BRP > B'000000)

Refer to the Hardware Manual for details.

### 3.4 COM Architecture

The COM is divided into two main parts that are termed packages.

- Message Package
- Net Package

The Message Package provides the COM API. The Net Package transmits and receives the HCAN network. *To Net* and *From Net* Messages require both packages.

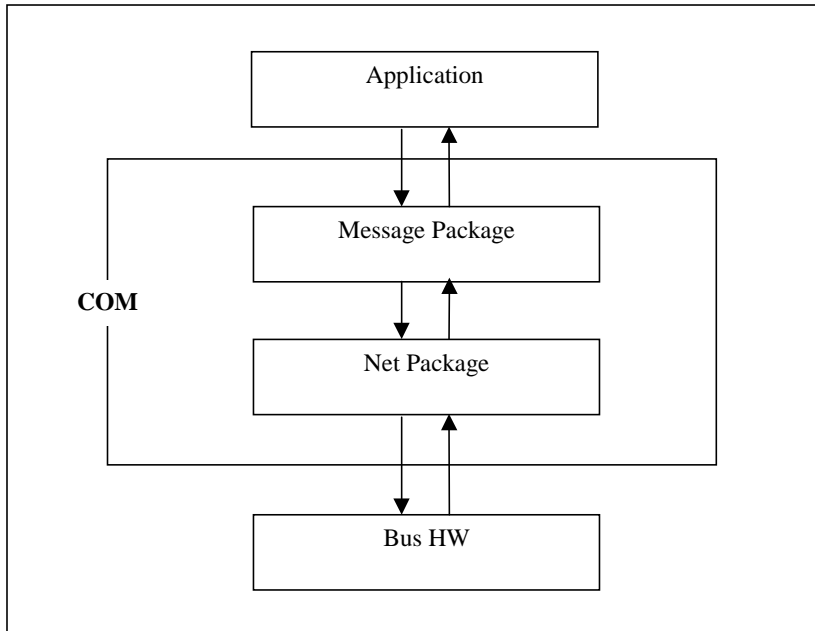


Figure 3.4 COM Architecture

### 3.5 COM Control

The processing procedure of COM is shown below.

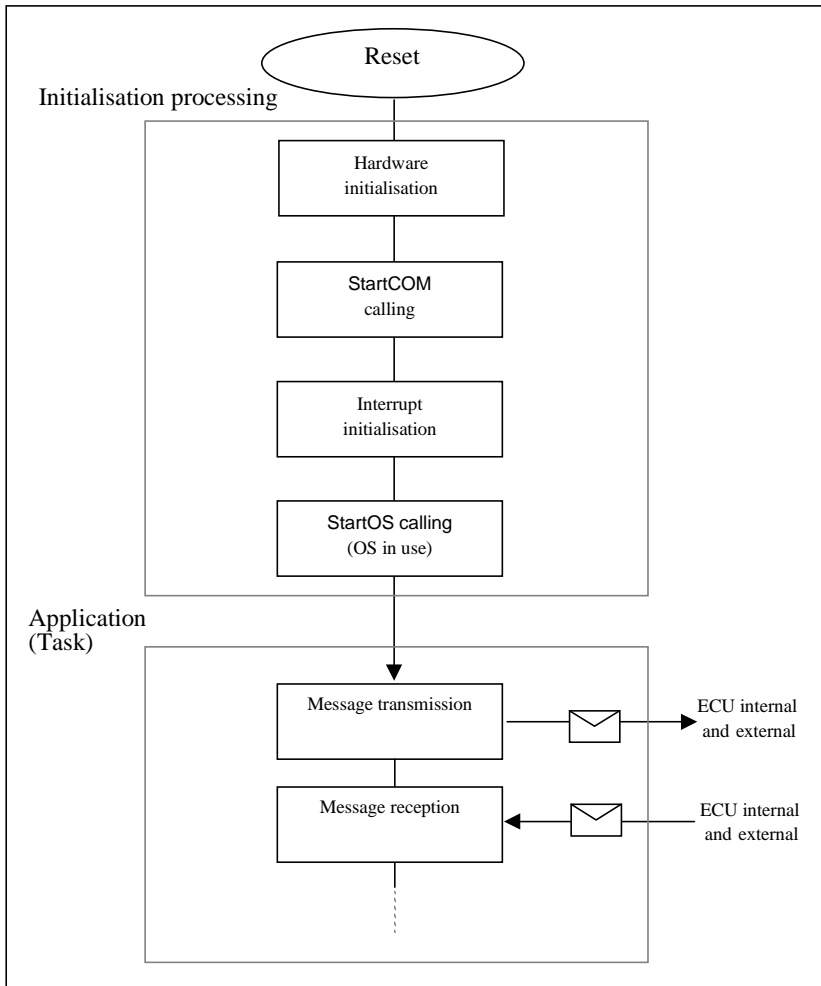


Figure 3.5 COM Processing Procedure

### 3.5.1 Start Up

The start-up method of COM is

1. HW Reset
2. HW initialisation with interrupts disabled
3. Call StartCOM communication service
4. Interrupt initialisation
5. Call StartOS system service, if OS is used

The application must provide the code for steps 2 and 4. This product provides those codes as sample (see section 4.2).

During start up, no messages may be transmitted or received.

### 3.5.2 Normal Operation

COM runs in normal mode after start-up is finished. Message transmission and reception can be performed in this state. The flow of transmission and reception is shown below.

#### 3.5.2.1 Message Transmission

1. Application calls SendMessage.
2. SendMessage copies message data from application to data area in COM.
3. For a net message, SendMessage starts net transmission.
4. SendMessage returns.
5. The message is sent from the HCAN to the CAN bus.
6. When transmission is finished, a Slot Empty interrupt occurs.
7. The ISR performs a call to the message package and net package of COM. This transmission confirmation makes COM aware that the transmission operation is finished.
8. The ISR returns.

#### 3.5.2.2 Message Reception in Application

1. Application calls ReceiveMessage.
2. ReceiveMessage copies message data from data area in COM to application.
3. ReceiveMessage returns.

#### 3.5.2.3 Message Reception from Network

1. When message is received from the bus, a received-message interrupt occurs.
2. The ISR performs a call to the message package and net package of COM.
3. The COM copies message data from the HCAN to the data area in COM.
4. The ISR returns.

### 3.5.3 Shut Down

The COM cannot be shut down. When initialising COM, issue the StartCOM communication service again.

### 3.5.4 Error Handling

The following error mechanisms are provided:

- Error codes returned from communication service
- Error interrupts related to the HCAN device
- Exceptions

#### 3.5.4.1 Error Codes

The COM can operate in one of the following two error modes.

- Standard Status Mode
- Extended Status Mode

The COM with extended status is used in the development and debugging of applications; the COM with standard status is used in fully debugged systems. Section 7.1 gives a summary of the error codes returned by COMMUNICATION services.

### 3.5.4.2 Error Interrupt

The HCAN module may generate interrupts as described below:

Table 3.3 Interrupts from the HCAN Module

<b>Interrupt Cause</b>	<b>Default Setting</b>	<b>Configurator Setting</b>
Received message	Available (reserved for COM)	Impossible
Unread mail	Available (reserved for COM, user code can be added)	Impossible
Transmission mailbox empty	Available (reserved for COM)	Impossible
Reset	Available (can be changed by the user)	Impossible
Overload frame	Unavailable	Possible
Bus-off	Unavailable	Possible
Error passive	Unavailable	Possible
Bus receive overload warning	Unavailable	Possible
Bus transmit overload warning	Unavailable	Possible
Remote frame request	Unavailable	Possible
Bus operation request	Unavailable	Possible

All interrupts that are not reserved by COM may be used by the application. The COM provides default handlers for all these interrupts. If required, it is possible to add codes. Refer to section 5.3 for details.

#### 3.5.4.3 Exception

COM does not include any exception handling features.

If OS is not used, exceptions must be handled by the application.

If OS is used, exceptions will be handled by the OS. Please refer to the Operating System Manual for details.



## 4 SYSTEM CONFIGURATION

### 4.1 COM Application Building

Figure 4.1 shows the building process of a COM application.

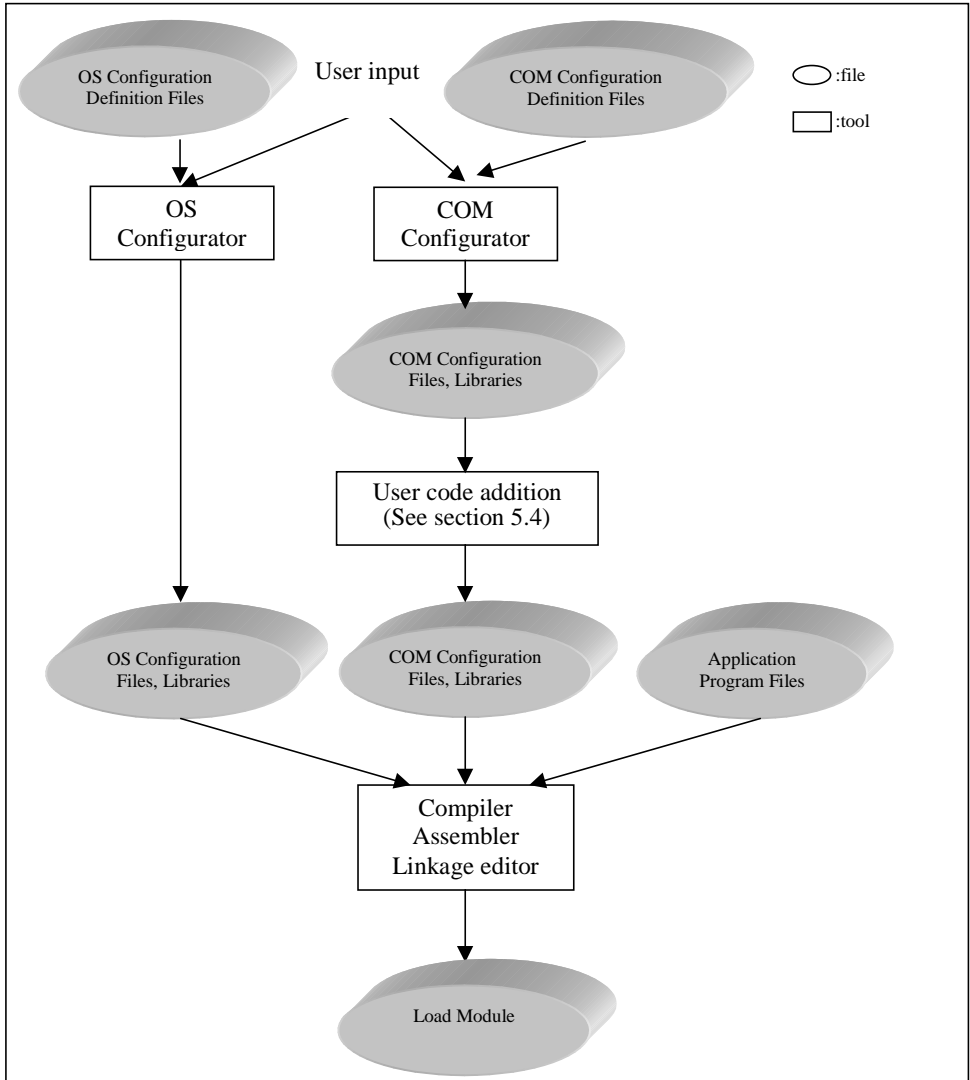


Figure 4.1 Building Process of a COM Application.

The configurator generates the configuration files and the library files determined by the user input or configuration definition file. Along with the application program files, these files are compiled, assembled and linked to generate the load module.

Refer to help files of OS and COM Configurator for information on how to generate configuration files. Please refer to the Operating System Manual on the details of OS configuration file.

## 4.2 COM Configuration Files

Configuration files are divided into the following file groups:

- **App**  
Sample application files.
- **Com**  
COM libraries, COM objects, COM configuration files and sample files generated by the COM Configurator.
- **Os**  
Sample OS configuration files generated by the OS Configurator.

The **Com** group may be further subdivided into:

- **Evb**  
Sample files related to the target HW set-up.
- **Hcan**  
HCAN driver files.
- **Mcs**  
Sample CPU initialisation and section initialisation files.
- **Msg**  
Message package files.
- **Net**  
Net package files.

If required, rewrite the following files. Note that they are overwritten whenever these files generate a COM configuration file by COM Configurator.

### 4.2.1 Evb

Table 4.1 Evb Group

<b>File</b>	<b>Description</b>
int_hndl.c	Interrupt handler
ma_cpu.c	Hardware initialisation processing
ma_cpu.h	Hardware initialisation header
ma_int.c	Interrupt initialisation
ma_int.h	Interrupt initialisation header
ma_io.c	Port setting
ma_io.h	Port setting header
ma_pfc.c	Pin function controller (PFC) setting
ma_pfc.h	Pin function controller (PFC) setting header
makeapp.h	Macro

### 4.2.2 Hcan

Table 4.2 Hcan Group

<b>File</b>	<b>Description</b>
ma_hcan1.c	HCAN channel 0 processing
ma_hcan1.h	HCAN channel 0 header
ma_hcan2.c	HCAN channel 1 processing
ma_hcan2.h	HCAN channel 1 header
mac.h	HCAN macro
macan1.h	HCAN channel 0 macro
macan2.h	HCAN channel 1 macro

### 4.2.3 Mcs

Table 4.3 Mcs Group

<b>File</b>	<b>Description</b>
dbset.src	Section initialisation definition
hwsetup.src	Hardware initialisation
initsct.c	Section initialisation
intprg.src	Common interrupt program
resetprg.src	Reset processing
stackset.src	Reset stack definition
vect.inc	Vector table include file
vecttbl.src	Vector table definition

### 4.2.4 Msg

Table 4.4 Msg Group

<b>File</b>	<b>Description</b>
ocallb.c	Call function for message initialisation and mixed transmission
ocos.h	COM interrupt level setting

## 5 PROGRAMMING

The programming method of COM application is shown below.

### 5.1 COM Initialisation

For COM initialisation, call services and functions according to the procedure shown below. COM interrupt level must be maintained until COM initialisation is completed. If not using OS, StartOS system service call is not required.

```
/*--- HW Init ---*/
MA_Init_PFC();           /* Pin function controller (PFC) initialisation */
MA_Init_CPU();          /* Hardware initialisation */
MA_Init_IO();           /* Port initialisation */

/*--- COM Init ---*/
StartCOM();             /* COM initialisation */
MA_Init_INT();         /* Interrupt initialisation */

/*--- OS Init ---*/
StartOS(application mode); /* OS initialisation */
```

### 5.2 Include Files

The program which uses a message must include the ocmsh.h file.

## 5.3 Interrupts

### 5.3.1 HCAN Interrupts

There are four vectors in each HCAN as follows, and each interrupt is divided into groups. Each ISR must be defined in a vector table. In CCC0 with OS, register as category 1 interrupt. In CCC1, register as category 2 interrupt. In CCC1, add “\_ISR” at the end of ISR name because HCAN interrupt handler is called via interrupt preamble of OS. HCAN ISR name is shown in Table 5.1.

- **ERS vector**
  - Error passive interrupt
  - Bus off interrupt
- **OVR vector**
  - Reset interrupt
  - Remote frame request interrupt
  - Bus transmit overload warning interrupt
  - Bus receive overload warning interrupt
  - Overload frame interrupt
  - Unread mail interrupt
  - Bus operation request interrupt
- **RM vector**
  - Received message interrupt
- **SLE vector**
  - Transmission mailbox empty interrupt

Table 5.1 HCAN ISR Name

vector	CCC0	CCC1
ERS	MA_IntHandler_ERS_HCAN $x$	MA_IntHandler_ERS_HCAN $x$ _ISR
OVR	MA_IntHandler_OVR_HCAN $x$	MA_IntHandler_OVR_HCAN $x$ _ISR
RM	MA_IntHandler_RM_HCAN $x$	MA_IntHandler_RM_HCAN $x$ _ISR
SLE	MA_IntHandler_SLE_HCAN $x$	MA_IntHandler_SLE_HCAN $x$ _ISR

Note:  $x$  is 1 (for HCAN channel 0) or 2 (for HCAN channel 1).

### 5.3.2 Interrupt Priority Levels

- COM Interrupt Level

The highest interrupt priority level in the program which uses communication service must be set as a COM interrupt level. When the OS is used by CCC0, the COM interrupt level must be set higher than the OS interrupt level. In CCC1, the OS interrupt level is set to the COM interrupt

level. Communication service must not be issued from a program higher than the COM interrupt level. Refer to `ocos.h` for the setting method of COM interrupt level.

- HCAN Interrupt Level

Both channels 0 and 1 of the HCAN module should be set to the same interrupt priority level. The HCAN interrupt level should be set to the same COM interrupt level. Refer to `ma_int.c` provided as a sample for the setting method.

## 5.4 User Code

The COM configuration file is generated by the COM Configurator. However, the user can add some user codes to the following processing:

- Initialisation processing
- Call-back functions
- HCAN interrupts that are not reserved by COM

### 5.4.1 Initialisation processing

#### **MA\_Init\_PFC()**

This function exists in `ma_pfc.c`. This function is called from `main.c` provided as a sample.

#### **MA\_Init\_CPU()**

This function exists in `ma_cpu.c`. This function is called from `main.c` provided as a sample.

#### **MA\_Init\_IO()**

This function exists in `ma_io.c`. This function is called from `main.c` provided as a sample.

#### **MA\_Init\_INT()**

This function exists in `ma_int.c`. This function is called from `main.c` provided as a sample.

### 5.4.2 Call-Back Functions

#### **MessageInit()**

This function exists in `occallb.c`. This function is called from the StartCOM service. Refer to section 6.1.2 for details.

#### **OC\_MixedTxEval()**

This function exists in `occallb.c`. This function is called from within COM when a message is transmitted in the mixed transmission mode. Refer to section 6.2.2 for details.

### 5.4.3 HCAN ISR

The user can add codes that handle interrupts from the HCAN. For details on interrupt causes, refer to the Hardware Manual.

Table 5.2 User Code Placement for HCAN Interrupts.

<b>Interrupt Cause</b>	<b>Add User Code In</b>
Unread mail	int_hndl.c: MY_UnReadMailHandler1() (for HCAN channel 0) MY_UnReadMailHandler2() (for HCAN channel 1)
Reset	int_hndl.c: MY_PowerUpHandler1() (for HCAN channel 0) MY_PowerUpHandler2() (for HCAN channel 1)
Overload frame	macan1.h: MA_OVERLOAD_FRAME_USERCODE1 macro (for HCAN channel 0) macan2.h: MA_OVERLOAD_FRAME_USERCODE2 macro (for HCAN channel 1)
Bus-off	macan1.h: MA_BUS_OFF_USERCODE1 macro (for HCAN channel 0) macan2.h: MA_BUS_OFF_USERCODE2 macro (for HCAN channel 1)
Error passive	macan1.h: MA_ERROR_PASSIVE_USERCODE1 macro (for HCAN channel 0) macan2.h: MA_ERROR_PASSIVE_USERCODE2 macro (for HCAN channel 1)
Bus receive overload warning	macan1.h: MA_REC_WARNING_USERCODE1 macro (for HCAN channel 0) macan2.h: MA_REC_WARNING_USERCODE2 macro (for HCAN channel 1)
Bus transmit overload warning	macan1.h: MA_TEC_WARNING_USERCODE1 macro (for HCAN channel 0) macan2.h: MA_TEC_WARNING_USERCODE2 macro (for HCAN channel 1)
Bus operation request	macan1.h: MA_WU_BUS_ACTIF_USERCODE1 macro (for HCAN channel 0) macan2.h: MA_WU_BUS_ACTIF_USERCODE2 macro (for HCAN channel 1)



## 5.5 Interface to OS

### 5.5.1 Interrupt

According to the following category rule, interrupt which uses COM (communication service) must be registered into OS Configurator.

Table 5.3 Category Rule

Interrupt	CCC0	CCC1
HCAN interrupt	Category 1	Category 2
Other interrupts	Category 1 or 2	Category 1 or 2

### 5.5.2 Alarm and Task

Cyclic alarm and task for a periodic and the mixed transmission modes must be prepared by user application. The task needs to be registered into OS Configurator.

## 5.6 Registers

The values of general registers R0-R7, FR0-FR11, FPUL, and FPSCR<sup>1</sup> cannot be guaranteed in the communication service. If you use these registers after a communication service call, they must be saved beforehand.

## 5.7 Stack

The COM never changes the stack. Therefore, add stack size of each service to the stack of the program which calls communication service. Moreover, add the interrupt stack size of each interrupt to the interrupt stack. Refer to the Ho7000 Series Release Notes for details on stack size.

---

<sup>1</sup> The FR0-FR11, FPUL, and FPSCR registers are only valid for the processor with Floating Point Unit (FPU).

## 5.8 Calling a Communication Service From an Assembler Routine

Communication services may be called from assembler routines. In this case, the application programmer must branch to the start address of each communication service by the JSR command. Follow the rules governing parameter area allocation. For the type of a parameter, refer to Table 7.4 Data Types, and C-language header file of Msg group of configuration files.

Table 5.4 Argument Convention

Register	Argument number
R4	First argument
R5	Second argument
R6	Third argument
R7	Fourth argument

General register R0 is used for the return value.

The values of general registers R0-R7, PR, FR0-FR11, FPUL, and FPSCR cannot be guaranteed before and after calling the communication service. If you use these registers, they must be saved before the call, and restored after the call.

## 5.9 Notes on Assembler Use

When the COM is initialised from an assembler routine, call each initialisation processing of a MA\_Init\_PFC() function, etc. by JSR. Although assembly language can describe Evb and Mcs groups of a configuration file, be sure to describe Hcan, Msg, and Net groups in the C language.

## 6 API DESCRIPTION

The interface of the communication service is described below. Refer to section 5.8 on an assembler interface.

### 6.1 Standard Interface

#### 6.1.1 StartCOM

Syntax:            StatusType StartCOM(void)

Parameter (In):

None

Parameter (Out):

None

Description:

COM is initialised. In the end, this service calls call-back function MessageInit().

Error Status:

Standard

No error:            E\_OK

Extended (Code added as extended status)

None

## 6.1.2 MessageInit

Syntax:        StatusType MessageInit(void)

Parameter (In):

None

Parameter (Out):

None

Description:

COM calls this function automatically by StartCOM service. This function is provided by the occallb.c file. Rewrite if needed.

Error Status:

### Standard

No error:                       E\_OK

Initialise failed:               E\_COM\_SYS\_MSG\_INIT\_FAILED

### Extended (Code added as extended status)

None





## 6.2 Original Interface Functions

In addition to the communication services defined by the OSEK COM specification, the **original interface** is provided.

### 6.2.1 OC\_SendMsgToNetPer

Syntax:

```
enum OC_ILOpResultE OC_SendMsgToNetPer(OC_SymbolicNameT <Msg>)
```

Parameter (In):

Msg            Message name

Parameter (Out):

None

Description:

Transmission to the network of a periodic message is started. Only the message for periodical or mixed transmission can be used. This service must be called from task activated periodically. The SendMessage service must be issued before transmitting to a network periodically by this service. Message data transmitted by SendMessage communication service is transmitted periodically. When not issuing SendMessage service, this service does not return an error but transmits undefined data to a network.

Error Status:

#### Standard

No error:

OC\_ILOpResOK

Message is locked:

OC\_ILOpResMsgDsInUse

Alarm for deadline monitoring could not be started:

OC\_ILOpResError

Transmission was denied by the net package:

OC\_ILOpResNetTxDenied

#### Extended (Code added as extended status)

Invalid message:

OC\_ILOpResError

## 6.2.2 OC\_MixedTxEval

Syntax:

```
OC_CallbStatusT OC_MixedTxEval(OC_SymbolicNameT <pMsgH> )
```

Parameter (In):

pMsgH                      Message name

Parameter (Out):

None

Description:

The purpose is to evaluate a condition that tells COM whether to initiate or not a transmission to network. Only the message for mixed transmission can be used. This function is automatically called within COM at the time of the message transmission by SendMessage service. Since this function is provided by the occallb.c file, the application programmer is responsible for adding the code that evaluates the transmission condition. Since pMsgH is not an integer, a judgement by the "switch" statement cannot be performed. It can judge by the "if" statement. The evaluation must result in either of the following return values.

Error Status:

### Standard

Initiate a transmission to net:

OC\_TxCondIsSendD

Do NOT initiate a transmission to net:

OC\_TxCondIsNoSendD

### Extended (Code added as extended status)

None



## 7 APPENDIX

### 7.1 Communication Service Return Codes

Table 7.1 Communication Service Return Codes

Communication Service	Standard Error Status	Code Added in Extended Error Status
StartCOM	E_OK	---
MessageInit	E_OK E_COM_SYS_MSG_INIT_FAILED*	---
SendMessage	E_OK E_COM_LOCKED E_COM_SYS_EVENT_SETTING_DENIED* E_COM_SYS_TASK_ACTIVATION_DENIED* E_COM_SYS_ALARM_START_DENIED* E_COM_SYS_NET_TX_DENIED*	E_COM_ID
ReceiveMessage	E_OK E_COM_NOMSG	E_COM_ID
GetMessageStatus	E_OK E_COM_NOMSG E_COM_LOCKED	E_COM_ID
OC_SendMsgToNetPer*	OC_ILOpResOK * OC_ILOpResMsgDsInUse * OC_ILOpResError * OC_ILOpResNetTxDenied *	OC_ILOpResError *
OC_MixedTxEval*	OC_TxCondIsSendD * OC_TxCondIsNoSendD *	---

Note: \*: Original function

Table 7.2 Return Code IDs

<b>Return Code</b>	<b>Description</b>	<b>ID</b>
E_OK	No error	0 (H'0)
E_COM_ID	Invalid message	1 (H'1)
E_COM_LIMIT	Reserved (not used)	2 (H'2)
E_COM_NOMSG	After initialising message data, it has not updated	3 (H'3)
E_COM_LOCKED	Message is locked	4 (H'4)
E_COM_SYS_NET_TX_DENIED*	Transmission was denied by the net package	64 (H'40)
E_COM_SYS_EVENT_SETTING_DENIED*	An event could not be set as notification	65 (H'41)
E_COM_SYS_TASK_ACTIVATION_DENIED*	A task could not be started as notification	66 (H'42)
E_COM_SYS_ALARM_START_DENIED*	An alarm for deadline monitoring could not be started	67 (H'43)
E_COM_SYS_UNEXPECTED_STATE*	Reserved (not used)	68 (H'44)
E_COM_SYS_MSG_INIT_FAILED*	Initialise failed	69 (H'45)
OC_ILOpResOK*	No error	256(H'100)
OC_ILOpResError*	Invalid message Alarm for deadline monitoring could not be started	257 (H'101)
OC_ILOpResMsgDsInUse*	Message is locked	258 (H'102)
OC_ILOpResNetTxDenied*	Transmission was denied by the net package	259 (H'103)
OC_ILOpResMsgUnexpectedState*	Reserved (not used)	260 (H'104)
OC_ILOpResToNetMessageNotSupported*	Reserved (not used)	261 (H'105)
OC_ILOpResFrNetMessageNotSupported*	Reserved (not used)	262 (H'106)
OC_TxCondIsSendD*	Initiate a transmission to net	1 (H'1)
OC_TxCondIsNoSendD*	Do NOT initiate a transmission to net	2 (H'2)

Note: \*: Original function

## 7.3 Communication Service Calls

In calling a program, “Yes” shows communication service which can be issued. "---" means that operation is not guaranteed.

Table 7.3 Communication Service Calls

Communication service	Before COM initialisation (Indispensable) CCC0/ CCC1	CCC0	CCC1						
			Task	ISR	Error hook	PreTask hook	PostTask hook	Startup hook	Shutdown hook
StartCOM	Yes	---	---	---	---	---	---	---	---
SendMessage	---	Yes	Yes	Yes	---	---	---	---	---
ReceiveMessage	---	Yes	Yes	Yes	Yes	---	---	---	---
GetMessageStatus	---	Yes	Yes	Yes	Yes	---	---	---	---
OC_SendMsgToNetPer*	---	---	Yes	---	---	---	---	---	---

Note: \*: Original function

## 7.4 Data Types

Table 7.4 Data Types

Name	Type(size)	Description
StatusType	unsigned long (4 bytes)	Return value
OC_SymbolicNameT	struct OC_MsgHandleS * (4 bytes)	Message name
OC_DataRefT	void * (4 bytes)	Address or pointer for message data
OC_ILOpResultE	enum (4 bytes)	Return value
OC_CallbStatusT	unsigned char (1 byte)	Return value

## 7.5 Maximum Parameters

Table 7.5 Maximum Parameters

Item	Limit
Max number of Nets per COM	2
Max number of Local messages	1000
Max number of To Net messages per Net	15
Max number of From Net messages per Net	31
Max number of messages for mailbox 0	16
Max number of messages for mailboxes 1-15	1
Max number of messages per Net	31

Ho7000 Series  
Communication Manual  
Publication date: 1<sup>st</sup> Edition, June 2002  
Copyright (c) Hitachi, Ltd., 2002. All rights reserved. Printed in Japan.