

IMU (Inertial Measurement Unit): M-G552PC80

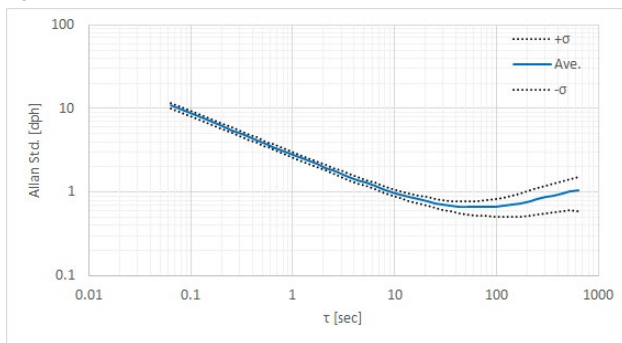
Features

- Small Size, Lightweight : 65 x 60 x 30 mm, 115 g
- Low-Noise, High-Stability
 - Gyro Bias Instability : 0.8 °/h
 - Angular Random Walk : 0.06 °/√h
- Initial Bias Error : 360 °/h (1σ) / 3 mG (1σ)
- 6-Axis Sensor Dynamic Range
 - Triple Gyroscopes : ±450 °/s
 - Tri-Axis Accelerometer : ±8 G/±16 G
- 16/24-bit Data Resolution
- Digital Serial Interface : CAN Interface
ISO 11898
(High speed)
- Calibrated Stability
(Bias, Scale Factor, Axial Alignment)
- Data Output Rate : 1k sps (Max.)
- Operating Temperature Range : -30 °C to +80 °C
- Power Supply Voltage Range : 9 V to 32 V
- Power Consumption : < 0.6 W at 12 V
- Waterproof and Dustproof : IP67
- Regulatory compliance : CE marking / FCC compliant

Application

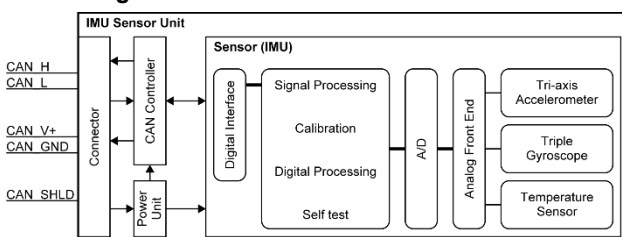
- Antenna Platform Stabilization
- Camera Gimbals
- Navigation Systems
- Vibration Control and Stabilization
- Pointing and Tracking Systems
- Autonomous Vehicle

Typical Performance Characteristic



Gyro Allan Variance Characteristic

Block Diagram



Product Name and Number
M-G552PC80 : X2G000241000200



Description

The M-G552PC80 is a small form factor inertial measurement unit (IMU) with 6 degrees of freedom: tri-axial angular rates and linear accelerations, and provides high-stability and high-precision measurement capabilities with the use of high-precision compensation technology. A variety of calibration parameters are stored in memory of the IMU, and are automatically reflected in the measurement data being sent to the application after the power of the IMU is turned on.

Communication with the host is supported via a CAN interface, enabling easy implementation of inertial measurement and control in system configurations where various units are integrated. The unit is packaged in a waterproof and dustproof metallic case, making it suitable for applications requiring environmental resistance.

The IMU's features — high stability, high accuracy, and compact size — facilitate new applications and differentiation in a wide range of industrial and commercial systems.

This product is compliant with RoHS 3 (EU Directive 2015/863)

Note: Lead is contained as per RoHS directive exemptions.

Outline Dimensions

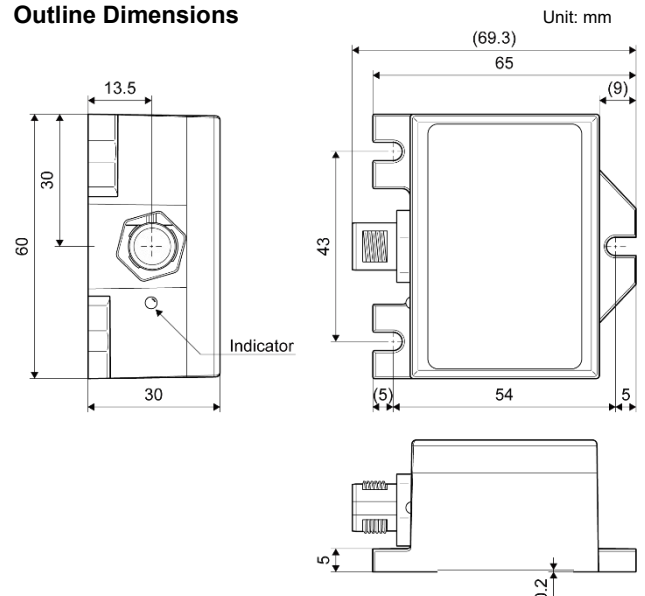


Table of Contents

Revision History	7
Ordering Information	8
Symbols	9
Notice of the Document.....	10
1. Product Specifications	11
1.1 Absolute Maximum Ratings	11
1.2 Recommended Operating Conditions	11
1.3 Characteristics and Electrical Specifications.....	12
1.4 Non-volatile Memory Specifications	14
2. Mechanical Dimensions	15
2.1 Outline Dimensions	15
2.2 Connector Specifications	16
3. Typical Performance Characteristics.....	17
4. Connection	18
4.1 Connection to Host	18
4.2 Precautions for Wiring and Cabling.....	18
4.3 Precautions for Power Line Wiring.....	18
4.4 Functional Block Diagram	19
5. Basic Operation (Control Sequence).....	20
5.1 CANopen	20
5.2 Terminology.....	21
5.3 Messages.....	22
5.4 Object Dictionary.....	23
5.4.1 Read/Write Sequence	23
5.4.2 Object Dictionary Access Interval.....	24
5.4.3 Object Dictionary List	25
5.5 Changing NMT Mode.....	28
5.5.1 Reset Node (81h).....	29
5.5.2 Reset Communication (82h)	29
5.6 Measurement	29
5.6.1 Synchronous Mode	30
5.6.2 Sampling Mode	31
5.7 Measurement Values	32
5.8 Trigger Counter	32
5.9 Basic Output (6-dof Output)	32
5.10 Filter	33
5.11 Time Setting	35
5.12 Heartbeat	36
5.13 SYNC Producer	36
5.14 Application of Synchronous Mode.....	37
5.15 Auto Output Setting.....	39
5.16 CAN Node Configuration.....	40
5.17 Sensor Configuration	40
5.18 Bus Status.....	41
5.19 LED Display	42

6. Handling Notes	43
6.1 Cautions for Use	43
6.2 Cautions for Storage	43
6.3 Other Cautions	44
6.4 Limited Warranty	44
7. Standards and Approvals	45
7.1 NOTICE	45
7.2 CE Statement.....	45
7.3 RoHS & WEEE	45
7.4 UKCA Statement.....	45
7.5 FCC Compliance Statement for American users.....	46
7.6 Industry ICES Compliance Statement for Canadian users.....	46
8. Third Party Licenses	47
Appendix 1. Messages	49
A.1.1 NMT Message.....	49
A.1.2 SYNC Message	49
A.1.3 TIME Message	49
A.1.4 TPDO1 Message	50
A.1.5 TPDO2 Message	50
A.1.6 TPDO3 Message	51
A.1.7 TPDO4 Message	51
A.1.8 TSDO Message	52
A.1.9 RSDO Message.....	52
A.1.10 HB Message	53
Appendix 2. Object Dictionary	54
A.2.1 Communication Profile (DS-301)	54
A.2.1.1 Device type	54
A.2.1.2 Error register	54
A.2.1.3 Manufacturer status register.....	55
A.2.1.4 SYNC COB-ID.....	55
A.2.1.5 Communication cycle period	56
A.2.1.6 Manufacturer device name.....	56
A.2.1.7 Manufacturer hardware version.....	56
A.2.1.8 Manufacturer software version	56
A.2.1.9 Save all parameters	57
A.2.1.10 Restore all default parameters	57
A.2.1.11 TIME COB-ID.....	57
A.2.1.12 Producer heartbeat time.....	57
A.2.1.13 Vendor ID	58
A.2.1.14 Product code	58
A.2.1.15 Product revision	58
A.2.1.16 Product serial number	58
A.2.1.17 Synchronous counter overflow value	58
A.2.1.18 RSDO COB-ID	59
A.2.1.19 TSDO COB-ID.....	59
A.2.1.20 TPDOn COB-ID.....	59
A.2.1.21 TPDOn transmission type	59
A.2.1.22 TPDO1 mapping	60
A.2.1.23 TPDO2 mapping	61
A.2.1.24 TPDO3 mapping	62
A.2.1.25 TPDO4 mapping	63

A.2.1.26 NMT startup mode	63
A.2.2 Manufacture Profile	64
A.2.2.1 CAN node-ID	64
A.2.2.2 CAN bitrate	64
A.2.2.3 Sensor sample rate	64
A.2.2.4 Acc dynamic range	65
A.2.2.5 Gyroscope resolution	65
A.2.2.6 Sensor range over status information	65
A.2.2.7 Trigger counter	66
A.2.2.8 Time of day	66
A.2.2.9 Time difference	66
A.2.3 Measuring Device Profile (DS-404)	66
A.2.3.1 AI sensor type 1–3	66
A.2.3.2 AI sensor type 4–6	66
A.2.3.3 AI sensor type 7	67
A.2.3.4 AI physical unit PV 1–3	67
A.2.3.5 AI physical unit PV 4–6	67
A.2.3.6 AI physical unit PV 7	67
A.2.3.7 AI filter type 1–7	67
A.2.3.8 AI filter tap constant 1	68
A.2.3.9 AI filter tap constant 2–7	68
A.2.3.10 AI input PV 1–3 (Gx / Gy / Gz)	68
A.2.3.11 AI input PV 4–6 (Ax / Ay / Az)	68
A.2.3.12 AI input PV 7	69
A.2.3.13 AI input PV 1–3 (24-bit Gx / Gy / Gz data)	69
A.2.3.14 AI input PV 4–6 (24-bit Ax/Ay/Az data)	69
Contact	70

List of Figures

Figure 1.1	Measurement Timing Specifications	13
Figure 1.2	Boot-up Timing Specifications	14
Figure 1.3	Reset Timing Specifications	14
Figure 2.1	Outline Dimensions	15
Figure 2.2	Recommended Mounting Dimension	15
Figure 2.3	Axial Direction	16
Figure 2.4	Connector Pin Layout	16
Figure 3.1	Gyro Allan Variance Characteristic	17
Figure 3.2	Gyro Bias vs. Temperature Characteristic	17
Figure 3.3	Gyro Noise Frequency Characteristic	17
Figure 3.4	Accelerometer Allan Variance Characteristic	17
Figure 3.5	Accelerometer Bias vs. Temperature Characteristic	17
Figure 3.6	Accelerometer Noise Frequency Characteristic	17
Figure 4.1	Connection Example	18
Figure 4.2	Surge Protection Circuit	19
Figure 4.3	Functional Block Diagram	19
Figure 5.1	Read OD Sequence	23
Figure 5.2	Write OD Sequence	24
Figure 5.3	OD Abort Sequence	24
Figure 5.4	NMT Mode Transition Diagram	28
Figure 5.5	NMT Sequence	29
Figure 5.6	Synchronous Mode Sequence	30
Figure 5.7	Sampling Mode Sequence	31
Figure 5.8	Axis Orientation	32
Figure 5.9	Moving Average Filter Characteristics	33
Figure 5.10	FIR Kaiser Filter Typical Characteristic 1	33
Figure 5.11	FIR Kaiser Filter Typical Characteristic 2	34
Figure 5.12	TIME Sequence	35
Figure 5.13	HB Sequence	36
Figure 5.14	HB Operation Example	36
Figure 5.15	Example of SYNC Without Counter Value Field	36
Figure 5.16	Example of SYNC Counter Overflow Operation	37
Figure 5.17	Example: TPDO Transmission Every 3 SYNC Messages	37
Figure 5.18	Example: TPDO Transmission When SYNC Counter Is a Multiple of 3	38
Figure 5.19	Bus State Transition Diagram	41

List of Tables

Table 1.1	Absolute Maximum Ratings	11
Table 1.2	Recommended Operating Conditions	11
Table 1.3	Sensor Specifications	12
Table 1.4	Interface Specifications	13
Table 1.5	Current Consumption	13
Table 1.6	Measurement Timing Specifications	13
Table 1.7	State Transition Timing Specifications	14
Table 1.8	Non-volatile Memory Specifications	14
Table 2.1	Pin Function Description	16
Table 2.2	Connector Part Number	16
Table 4.1	Recommended Maximum Total Cable Length (Reference)	18
Table 5.1	CANopen Feature Compliance	20
Table 5.2	Message List	22
Table 5.3	Message List (when Gyro 24-bit setting is enabled ^{*3})	23
Table 5.4	List of Abort Codes	24
Table 5.5	OD Execution Time	25
Table 5.6	OD List	25
Table 5.7	Valid Function of Each NMT State	29
Table 5.8	Transmit Modes	29
Table 5.9	List of Measurement Values	32
Table 5.10	Transient Response in Number of Samples Based on Output Data Rate vs Filter Tap	34
Table 5.11	Valid Combinations of Output Rate and Filter Settings	35
Table 5.12	Time Information Format	35
Table 5.13	Bus / Error Status	41
Table 5.14	Run LED (Green) Status	42
Table 5.15	Error LED (Red) Status	42

Revision History

Rev. No.	Date	Page	Description
Rev1.0	2025/08/01	ALL	Newly established
Rev1.1	2026/01/14	P1	Corrected the unit to mm
		P44	Changed the wording of the Limited Warranty

Ordering Information

The product can be ordered with the following numbers. Please inquire separately about details.

Product Model Number	Product Name	Comments
X2G000241000200	M-G552PC80	This product.

Symbols**• Compliant with the EU RoHS directive**

* About products without the Pb-Free label

Product terminals are lead-free but the internal components of the product contain lead (high melting point solder lead as well as the lead contained in the glass of an electronic component are both not applicable under the EU RoHS directive).

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1. Product Specifications

1.1 Absolute Maximum Ratings

Table 1.1 Absolute Maximum Ratings

Parameter	Min.	Typ.	Max.	Unit
V _{IN} to GND	-0.3	–	+32	V
Voltage on Any Pin to GND	-32	–	+32	V
Storage Temperature Range	-40	–	+85	°C
Operating Temperature Range	-30	–	+80	°C
Acceleration / Shock (Half-sine 0.5 ms)	–	–	1000	G

Operating the unit beyond the absolute maximum ratings may result in malfunction or permanent damage. Even if the unit appears to operate normally under such conditions, its long-term reliability may be significantly compromised.

1.2 Recommended Operating Conditions

Table 1.2 Recommended Operating Conditions

Parameter	Term	Condition	Min.	Typ.	Max.	Unit
Power Supply Voltage	V _{IN}	V _{IN} to GND *2	9 *1	12 (24)	32	V
Port Input Voltage	V _{PORT}	CANH / CANL to GND	-2	–	7	V
Operating Temperature	T _{OPE}		-30	–	+80	°C

*1. When power supply voltage is 9 V or less, the host may not be able to communicate with this node normally even if the LED turns on.

*2. The power supply voltage must reach the recommended operating condition within 2 seconds after power is applied to this node.

1.3 Characteristics and Electrical Specifications

Table 1.3 Sensor Specifications

Unless otherwise specified: $V_{IN} = 12\text{ V}$, $T_a = 25\text{ }^\circ\text{C}$, angular rate = $0\text{ }^\circ/\text{s}$, $\pm 1\text{ G}$

Parameter	Test Conditions / Comments	Min.	Typ.	Max.	Unit
GYRO SENSOR					
Sensitivity					
Output Range		—	± 450	—	$^\circ/\text{s}$
Scale Factor	16 bits	-0.2%	66	+0.2%	LSB/($^\circ/\text{s}$)
	24 bits *5	-0.2%	$66 \times (2^{16})$	+0.2%	
Nonlinearity (Best fit straight line)	1σ	—	0.05	—	% of FS
Misalignment	1σ , Axis-to-axis, $\Delta = 90^\circ$ ideal	—	0.01	—	$^\circ$
Bias					
Initial Error	1σ , $-30\text{ }^\circ\text{C} \leq T_A \leq +80\text{ }^\circ\text{C}$	—	360	—	$^\circ/\text{h}$
Repeatability	1σ , Turn-on to turn-on *3	—	36	—	$^\circ/\text{h}$
Bias Instability	Average	—	0.8^{*5}	—	$^\circ/\text{h}$
Angular Random Walk	Average	—	0.06^{*5}	—	$^\circ/\sqrt{\text{h}}$
Linear Acceleration Effect	Average	—	18	—	($^\circ/\text{h}$)/G
Noise Density	$f = 10\text{ Hz to } 20\text{ Hz}$	—	4.7	—	($^\circ/\text{h}$)/ $\sqrt{\text{Hz}}$, rms
Frequency Property					
3 dB Bandwidth		—	189	—	Hz
ACCELEROMETERS					
Sensitivity					
Output Range		—	$\pm 8/\pm 16^{*4}$	—	G
Scale Factor	16 bits, Output Range ± 8	-0.1%	4	+0.1%	LSB/mG
	16 bits, Output Range ± 16	-0.1%	2	+0.1%	
Nonlinearity (Best fit straight line)	1σ , $< 1\text{ G}$	—	0.1	—	% of FS
Misalignment	1σ , Axis-to-axis, $\Delta = 90^\circ$ ideal	—	0.01	—	$^\circ$
Bias					
Initial Error	1σ , $-30\text{ }^\circ\text{C} \leq T_A \leq +80\text{ }^\circ\text{C}$	—	3	—	mG
Repeatability	1σ , Turn-on to turn-on *3	—	2	—	mG
Bias Instability	Average	—	24	—	μG
Velocity Random Walk	Average	—	0.02	—	(m/s)/ $\sqrt{\text{h}}$
Noise Density	$f = 10\text{ Hz to } 20\text{ Hz}$	—	50	—	$\mu\text{G}/\sqrt{\text{Hz}}$, rms
Frequency Property					
3 dB Bandwidth		—	333	—	Hz
TEMPERATURE SENSOR					
Scale Factor *1*2	Output = 0 @ $+25\text{ }^\circ\text{C}$	—	0.00390625	—	$^\circ\text{C}/\text{LSB}$

*1. This is a reference value used for internal temperature compensation. There is no guarantee that the value gives an absolute value of the internal temperature.

*2. This is the scale factor for the temperature sensor at 16 bits.

*3. Turn-on to turn-on / Day by day, estimated variation during 5 consecutive days.

*4. Selectable via the object dictionary Acc dynamic range (OD[2021h, 03h]) setting.

*5. Use of the gyro sensor with 24-bit resolution is recommended.

Note) • The values in the specifications are based on the data calibrated at the factory. The values may change according to the way the product is used.

• The Typ. values in the specifications are average values or 1σ values.

• Unless otherwise noted, the Max./Min. specification values represent the standard values obtained during calibration testing of the assembled product.

• Acceleration characteristics do not depend on the output range.

Table 1.4 Interface Specifications

Unless otherwise specified: $T_a = 25\text{ }^\circ\text{C}$, $V_{IN} = 12\text{ V}$, $R_L = 60\ \Omega$, all voltages are defined with respect to ground; positive currents flow into the sensor unit.

Parameter	Term	Condition	Min.	Typ.	Max.	Unit
Output voltage (dominant)	$V_{O(\text{dom})}$	CANH	2.75	3.5	4.5	V
		CANL	0.5	1.5	2.25	V
Output voltage (recessive)	$V_{O(\text{rec})}$	CANH / CANL	2	2.5	3	V
Differential output voltage (dominant)	$V_{O(\text{dif})\text{ dom}}$	CANL to CANH	1.5	–	3	V
Differential output voltage (recessive)	$V_{O(\text{dif})\text{ rec}}$	CANL to CANH	-120	–	12	mV
Output current (dominant)	$I_{OS(\text{dom})}$	CANL = open; $V_{\text{CANH}} = +0.3\text{ V}$	-100	–	–	mA
		CANH = open; $V_{\text{CANL}} = +32\text{ V}$	–	–	100	mA
Output current (recessive)	$I_{OS(\text{rec})}$	$V_{\text{CANH}} = V_{\text{CANL}}$	-5	–	5	mA

*1. Do not access the unit during startup or reinitialization.

*2. Data rate and optimum filter characteristics can be changed by a command.

Table 1.5 Current Consumption

Unless otherwise specified: $T_a = 25\text{ }^\circ\text{C}$, $R_L = 60\ \Omega$, Sampling mode, CAN bitrate = 250 kbps, sensor sample rate = 100 sps, all voltages are defined with respect to ground; positive currents flow into the sensor unit.

Parameter	Term	Condition	Min.	Typ.	Max.	Unit
Mean current in Measurement state	$I_{IN(\text{OP})}$	$V_{IN} = 12\text{ V}$, 250 kbps, 100 sps	–	33	–	mA
		$V_{IN} = 24\text{ V}$, 250 kbps, 100 sps	–	19	–	mA
Mean current in Idle state	$I_{IN(\text{ready})}$	$V_{IN} = 12\text{ V}$, 250 kbps	–	30	–	mA
		$V_{IN} = 24\text{ V}$, 250 kbps	–	17	–	mA
Maximum input current	$I_{IN(\text{max})}$	With No-Host, CANbus Busy $V_{IN} = 9\text{ V}$	–	–	60.0	mA

Table 1.6 Measurement Timing Specifications

Parameter	Term	Condition	Min.	Typ.	Max.	Unit
Response time	t_{RS}	Time from SYNC reception to TPDO transmission	–	0.1	0.4	ms
Sampling cycle	t_{SC}	Accuracy	-0.1	–	+0.1	%

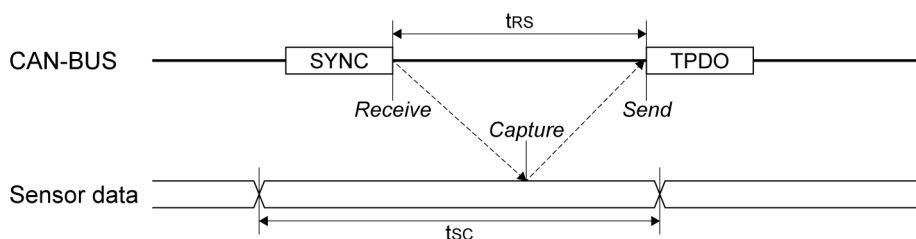
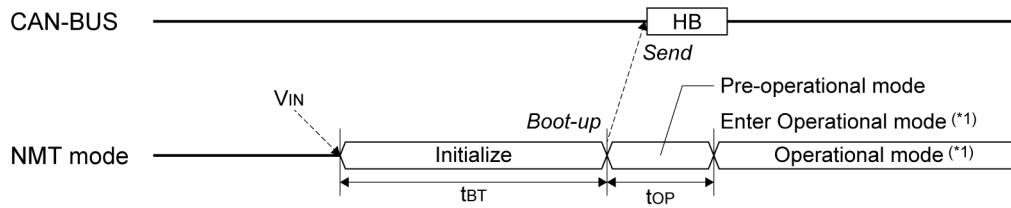
**Figure 1.1 Measurement Timing Specifications**

Table 1.7 State Transition Timing Specifications

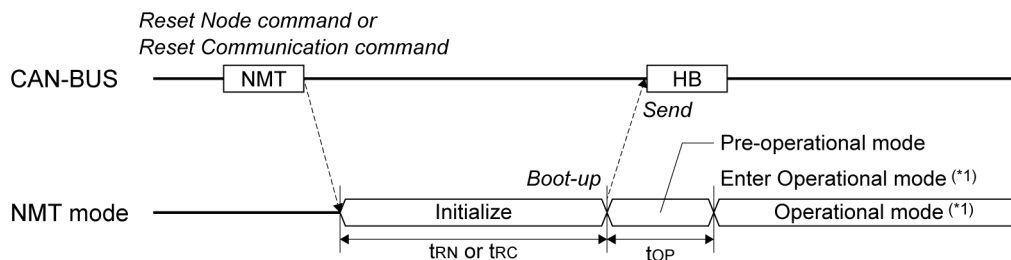
Parameter	Term	Condition	Min.	Typ.	Max.	Unit
Power-on boot-up time	t_{BT}	Time from V_{IN} application (power-on) to boot-up completion	–	–	4000	ms
Reset node boot-up time	t_{RN}	Time from reception of a Reset Node command to boot-up completion	–	–	1600	ms
Reset node complete time	$t_{RN} + t_{OP}$	Time from reception of Reset Node command to exit from Pre-operational mode	–	–	2900	ms
Reset communication boot-up time	t_{RC}	Time from reception of a Reset Communication command to boot-up completion	–	–	500	ms
Start mode transition time	–	Time to transition from Pre-operational or Stop mode to Start mode	–	–	500	ms
Stop mode transition time	–	Time to transition from Operational or Pre-operational mode to Stop mode	–	–	100	ms
Pre-operational mode transition time	–	Time to transition from Operational or Stop mode to Pre-operational mode	–	–	1300	ms
Operational mode transition time	t_{OP}	Time from boot-up to automatic transition to Operational mode (only when the Startup mode is set to Operational)	–	–	1800	ms

To reliably confirm that the system has entered Operational mode after boot-up, either decode the NMT status from the Heartbeat (HB) message or set the MNT startup mode (OD[1F80h, 00h]) to Pre-operational and manually switch to Operational mode using the NMT Start command. Note that the LED indicator may change to green slightly after the actual mode transition.



(*1) When the startup mode is Operational

Figure 1.2 Boot-up Timing Specifications



(*1) When the startup mode is Operational

Figure 1.3 Reset Timing Specifications

1.4 Non-volatile Memory Specifications

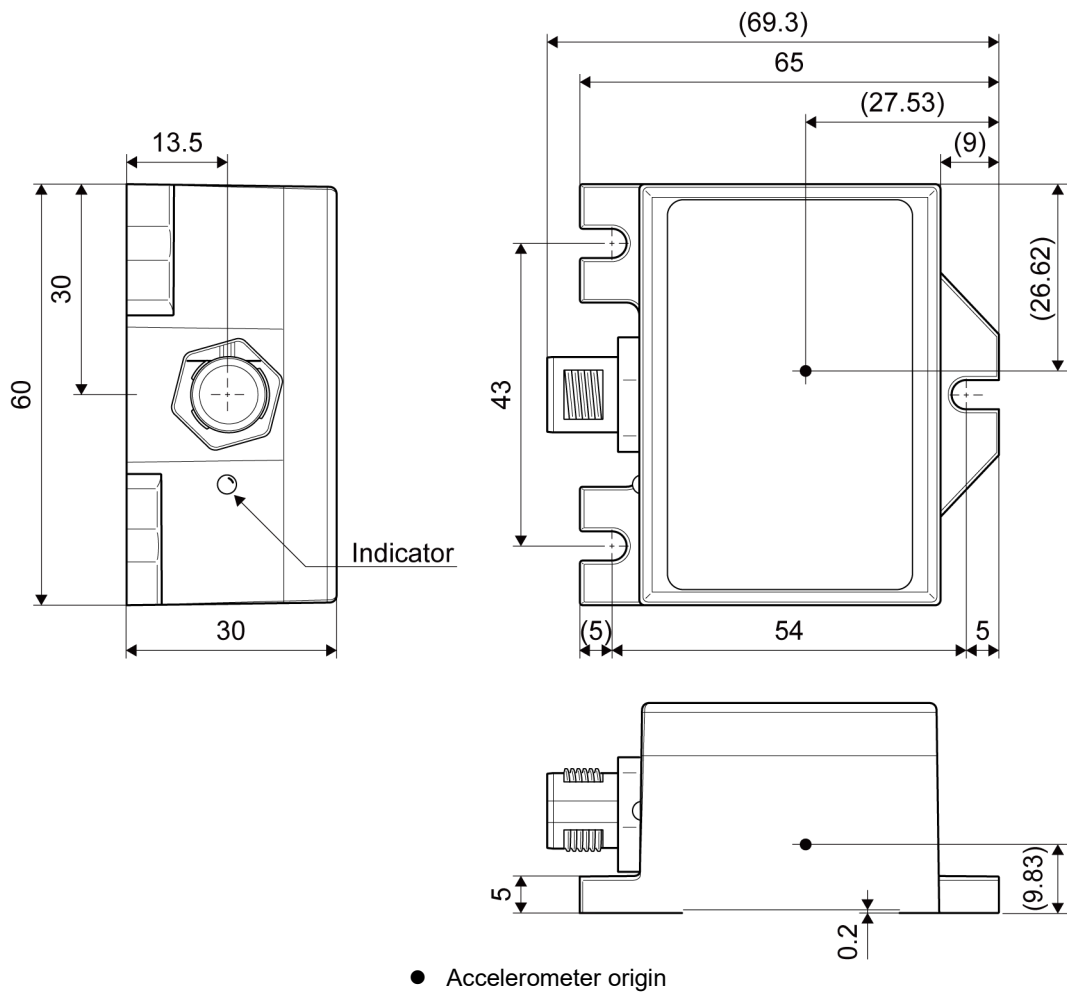
Table 1.8 Non-volatile Memory Specifications

Ta = -30 °C to +80 °C

Parameter	Term	Condition	Min.	Typ.	Max.	Unit
Write cycles	T_{WC}		100000	–	–	cycle
Data retention time	t_{RET2}	Powered	10	–	–	year

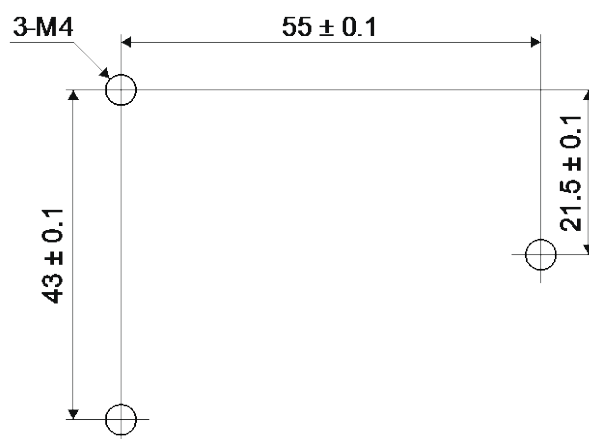
2. Mechanical Dimensions

2.1 Outline Dimensions



(Unit: mm)

Figure 2.1 Outline Dimensions



(Unit: mm)

Figure 2.2 Recommended Mounting Dimension

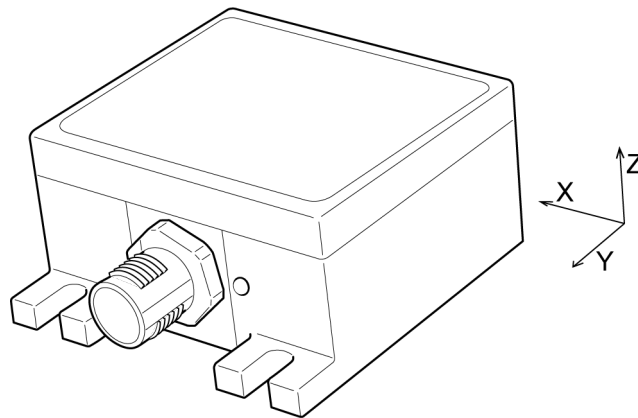


Figure 2.3 Axial Direction

2.2 Connector Specifications

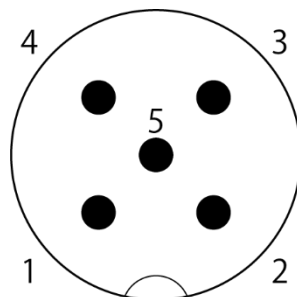


Figure 2.4 Connector Pin Layout

Table 2.1 Pin Function Description

Pin No.	Mnemonic	Type ^{*1}	Description ^{*2}
1	CAN_SHLD	–	CAN shield ^{*2}
2	CAN_V+	I	External power supply (9 to 32 V)
3	CAN_GND	–	Ground
4	CAN_H	I/O	CAN H bus line
5	CAN_L	I/O	CAN L bus line

*1. Pin Type I: Input, I/O: Input/Output

*2. The CAN_SHLD pin is coupled to CAN GND through a 0.01 μ F / 100 V capacitor.

The connection between the case and the CAN_SHLD pin depends on the housing specification.

- Nickel-plated housing: Connected to the case via the connector shell.
- Painted housing: The connector shell is not connected to the case due to the paint layer. (Insulation resistance is not guaranteed.)

NOTE: Please use an M12-5 pin mating female connector that corresponds to IP67 specifications.

Table 2.2 describes the connector manufacturer and the model number which is used in this product.

Table 2.2 Connector Part Number

Manufacturer	Part Number	RoHS Compliant
PHOENIX CONTACT	SACC-DSI-MS-5CON-M12-SCO SH(X)	Yes

3. Typical Performance Characteristics

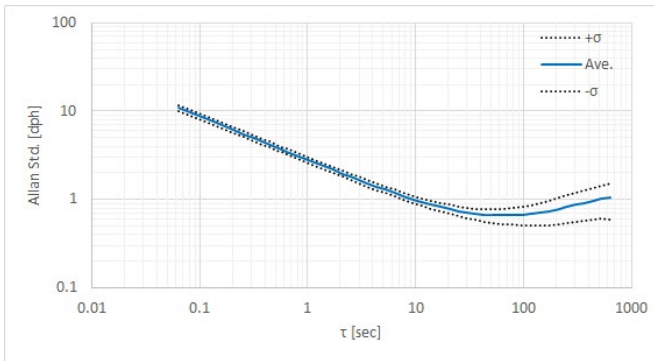


Figure 3.1 Gyro Allan Variance Characteristic

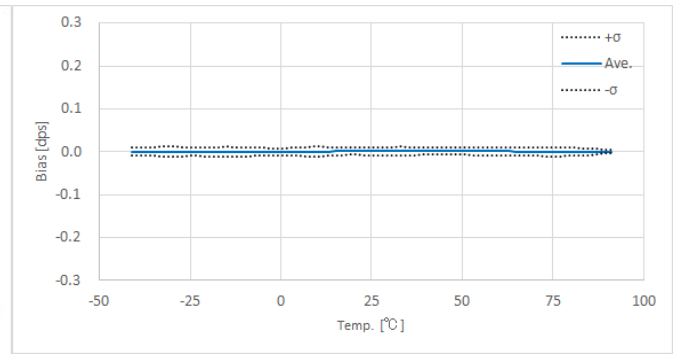


Figure 3.2 Gyro Bias vs. Temperature Characteristic

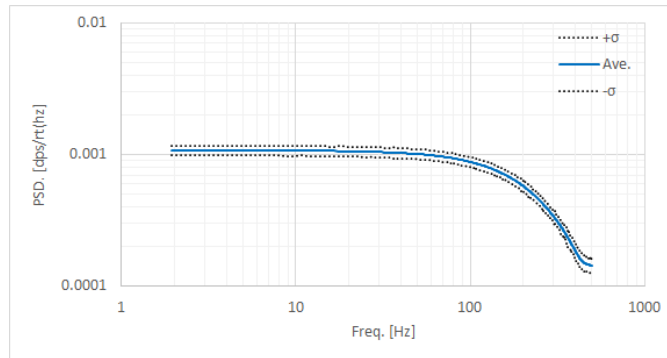


Figure 3.3 Gyro Noise Frequency Characteristic

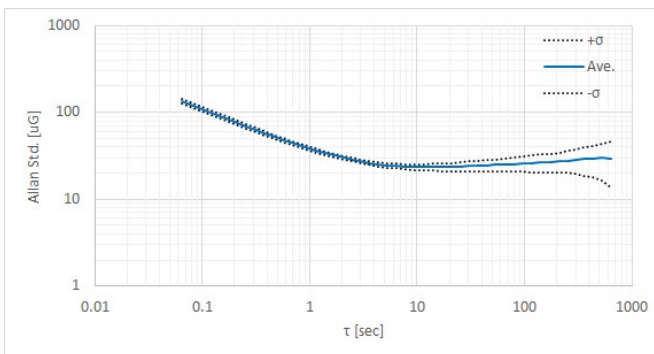


Figure 3.4 Accelerometer Allan Variance Characteristic

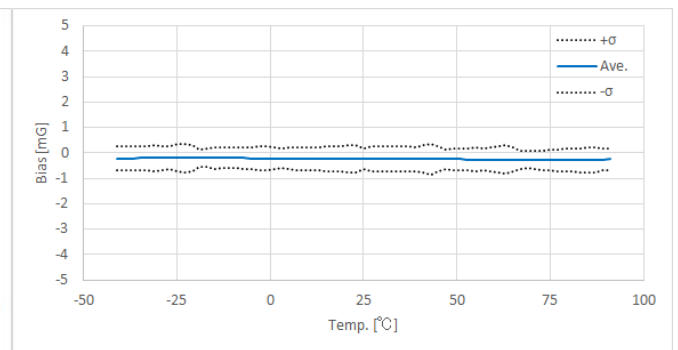


Figure 3.5 Accelerometer Bias vs. Temperature Characteristic

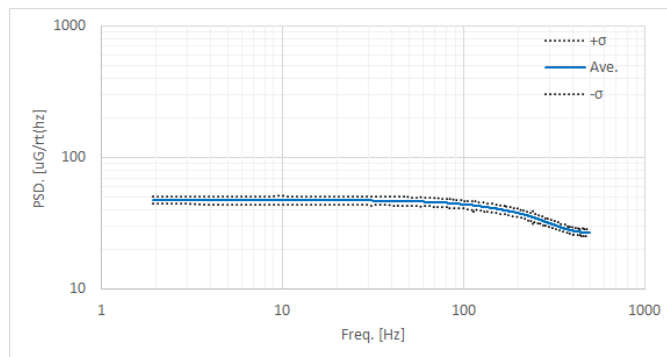


Figure 3.6 Accelerometer Noise Frequency Characteristic

The product characteristics shown above are typical examples and are not guaranteed as specifications.

4. Connection

4.1 Connection to Host

Figure 4.1 shows an example of connection between this unit and the CAN bus.

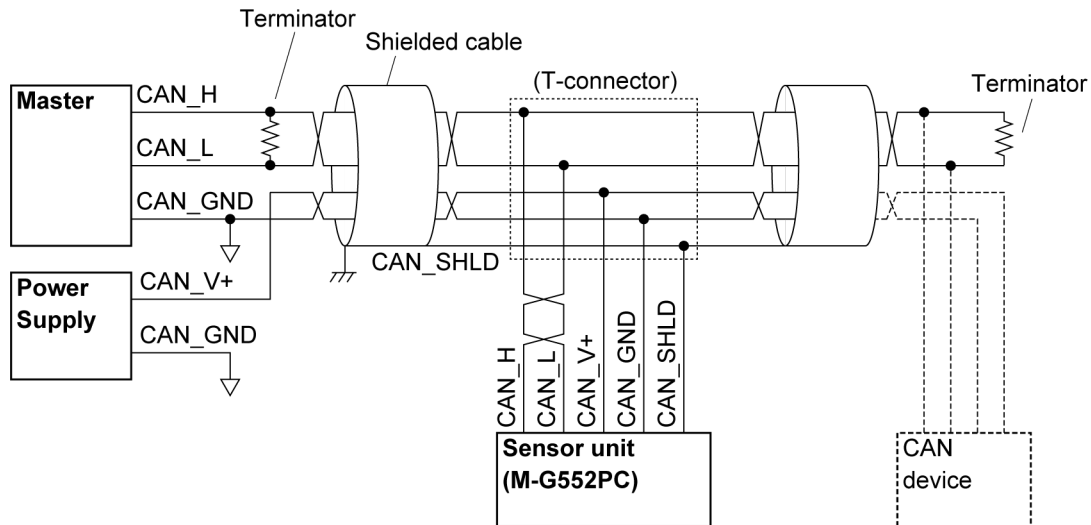


Figure 4.1 Connection Example

4.2 Precautions for Wiring and Cabling

- This product does not include internal termination resistors. Please ensure that terminators are connected at both ends of the CAN network.
- It is recommended to connect the cable shield to ground.
- Use cables that comply with CAN standards.
- Refer to Table 4.1 for the recommended maximum total cable length. However, even within the specified range, communication may be unstable or fail depending on the system environment. Be sure to evaluate the performance under actual operating conditions.

Table 4.1 Recommended Maximum Total Cable Length (Reference)

CAN bitrate	Total length
1000 kbps	40 m
500 kbps	100 m
250 kbps	250 m
125 kbps	500 m

4.3 Precautions for Power Line Wiring

When extending power lines, protection is required against voltage drop (IR drop) caused by increased wiring length and surge-induced overvoltage due to increased inductance. For outdoor wiring, protection is also necessary against surges from other equipment and lightning surges. Figure 4.2 shows an example of specific countermeasures required for outdoor installation. This example shows a protection circuit designed under the assumption that a lightning surge of ± 1 kV (line-to-line) / ± 2 kV (line-to-ground), as specified in IEC61000-4-5, is directly applied to the DC power line.

- Note)
- VP: CAN V+ (Sensor power supply)
 - PGND: CAN GND (Sensor power ground)
 - FGND: EARTH (System ground potential)
 - U3039: Line-to-line surge absorber (manufactured by Okaya Electric Industries Co., Ltd.)
 - ERZ-V14D390: Line-to-ground surge absorber (manufactured by Panasonic Corporation)

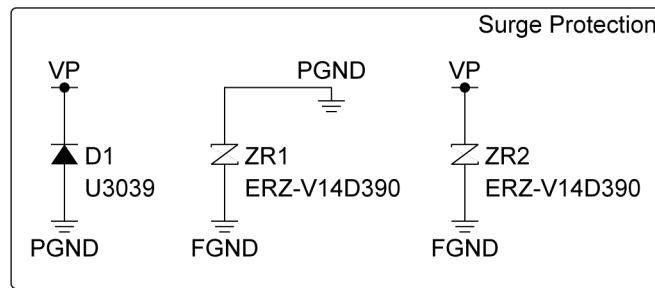


Figure 4.2 Surge Protection Circuit

4.4 Functional Block Diagram

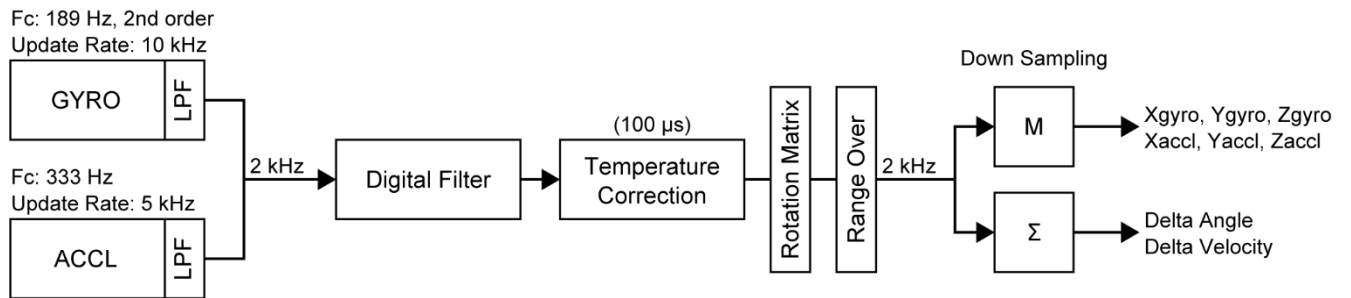


Figure 4.3 Functional Block Diagram

5. Basic Operation (Control Sequence)

5.1 CANopen

Table 5.1 CANopen Feature Compliance

Function	Supported	Comment
High-speed bitrate (1 Mbps–125 kbps)	✓	Compliant with ISO 11898-2
Low-speed bitrate (125 kbps–10 kbps)	✓	Optional (physical layer based on ISO 11898-2)
Data Frame	✓	Compliant with CAN 2.0A
Remote Frame	✓	Compliant with CAN 2.0A
Error Frame	✓	Compliant with CAN 2.0A
Overload Frame	✓	Compliant with CAN 2.0A
Interframe Space	✓	Compliant with CAN 2.0A
Expedited Transfer (1/2/3/4-byte data)	✓	–
Segmented Transfer (over 4-byte data)	–	–
NMT Master	–	–
NMT Slave	✓	Always enabled
SDO Server	✓	Always enabled
SDO Client	–	COB-ID is uniquely assigned based on node ID
PDO Producer	✓	TPDO1–4 can be enabled/disabled individually. COB-IDs are assigned based on the node ID. PDO mapping is fixed.
PDO Consumer	–	–
SYNC Producer	✓	Can be enabled/disabled
SYNC Consumer	✓	Enabled in synchronous transmission mode
EMCY Producer	–	–
EMCY Consumer	–	–
HB Producer	✓	Can be enabled/disabled
HB Consumer	–	–
Timestamp Producer	–	–
Timestamp Consumer	✓	Always enabled
Synchronous Sequence	✓	Triggered by SYNC message
Group Sequence	–	–
Event-driven Sequence by Value Change	–	Change Of State (COS) event
Event-driven Sequence by Sampling	✓	–
Event-driven Sequence by Timer	–	Timer-based event
Standard Data Types	–	OD[0001h]–[001Fh]
Standard Composite Data Types	–	OD[0020h]–[0023h]
Manufacturer-specific Composite Data Types	–	OD[0040h]–[005Fh]
Device Profile Standard Data Types	–	OD[0060h]–[007Fh]
Device Profile Composite Data Types	–	OD[0080h]–[009Fh]
Multiplexed Device Module Data Types	–	OD[00A0h]–[025Fh]

5.2 Terminology

The following terms are defined as used in this document:

CAN-ID:

Message identifier. This unit uses an 11-bit CAN-ID.

Client:

A device that sends a request to a Server. In this document, it typically refers to a host device such as a PC.

COB-ID:

Communication **Object ID**. It is a CAN-ID with additional control bits that indicate the message type. COB-IDs are defined in the Object Dictionary (OD) to enable or disable specific messages.

Consumer:

A device that receives messages sent by a Producer.

DLC:

Data Length Code, indicating the number of bytes in the data field of a message.

FC:

Function Code. Refers to the upper 4 bits of the CAN-ID.

HB:

Heartbeat. Heartbeat message indicating node status periodically.

NMT:

Network Management. A protocol for managing node states, such as Operational and Pre-operational.

Node-ID (NID):

A 7-bit node identifier used in the lower 7 bits of the CAN-ID or as a message parameter. Typically, a unique value from 1 to 127 is assigned. The value 0 may be reserved for special use.

OD:

Object Dictionary. A list of parameters including communication settings and device data.

Producer:

A device that sends messages to a Consumer.

RSDO:

Receive Service Data Object. Configuration data received from a Client.

Server:

A device that holds a data set and responds to requests from a Client. In this document, "Server" usually refers to this unit functioning as an SDO server.

SYNC:

Synchronization object. Trigger message for synchronizing communication between nodes.

TPDO:

Transmit Process Data Object. Real-time process data sent from the device.

TSDO:

Transmit Service Data Object. Response data sent from the device to the Client.

5.3 Messages

In the default configuration, this unit communicates using the messages listed in Table 5.2. When the Gyro 24-bit setting is enabled (Gyro resolution (OD[2021h, 04h]) = 01h), the TPDO message assignment is defined in Table 5.3. TPDO messages can be freely reassigned by the user by modifying the CANopen standard TPDO mapping parameters (OD[1A00h]–[1A03h]).

For details of each message, refer to “Appendix 1. Messages.”

Table 5.2 Message List

COB	CAN-ID		DLC	Data field (byte) *1								Description	
	FC	Node-ID		1	2	3	4	5	6	7	8		
NMT	0000b	0000000b	2	Cs	Id						Cs = Command specifier Id = Node-ID		
SYNC	0001b	0000000b	1	Cn						Cn = SYNC counter			
			0	or									
TIME	0010b	0000000b	6	Ms			Dy				Dy = Days Ms = Milliseconds		
TPDO1	0011b	0000001b to 1111111b	8	Tc	Gx	Gy	Gz					Tc = Trigger counter Gx/Gy/Gz = Gyroscope data	
TPDO2	0101b	0000001b to 1111111b	8	Tc	Ax	Ay	Az					Tc = Trigger counter Ax/Ay/Az = Accelerometer data	
TPDO3	0111b	0000001b to 1111111b	8	Tc	Te	Reserved	STS					Tc = Trigger counter Te = Temperature STS = Range over status	
TPDO4	1001b	0000001b to 1111111b	8	Tc	Ms			Dy					Tc = Trigger counter Ms = Time difference Dy = Time of day
TSDO	1011b	0000001b to 1111111b	8	Cs	Pi	Ps	Pd				Cs = Command specifier Pi = Index Ps = Sub-index Pd = Data		
RSDO	1100b	0000001b to 1111111b	8	Cs	Pi	Ps	Pd				Cs = Command specifier Pi = Index Ps = Sub-index Pd = Data		
HB	1110b	0000001b to 1111111b	1	St						St = State			

*1. Byte order is little endian.

Table 5.3 Message List (when Gyro 24-bit setting is enabled *3)

COB	CAN-ID		DLC	Data field (byte) *1								Description
	FC	Node-ID		1	2	3	4	5	6	7	8	
TPDO1	0011b	0000001b to 1111111b	8	Tc	Gx		Gy			Tc = Trigger counter Gx/Gy = Gyroscope data (24 bits)		
TPDO2	0101b	0000001b to 1111111b	8	Tc	Ax	Ay	Az		Tc = Trigger counter Ax/Ay/Az = Accelerometer data			
TPDO3	0111b	0000001b to 1111111b	8	Tc	Te	Gz			Tc = Trigger counter Te = Temperature Gz = Gyroscope data (24 bits)			
TPDO4	1001b	0000001b to 1111111b	8	Tc	Ms			Dy		Tc = Trigger counter Ms = Time difference Dy = Time of day		

*1. Byte order is little endian.

5.4 Object Dictionary

5.4.1 Read/Write Sequence

Object Dictionary (OD) access is performed through a request-response exchange, where the client (e.g., a PC) sends a request and the server (this unit) responds. OD read/write operations are available only when the unit is in Pre-operational or Operational mode.

This unit supports only expedited SDO communication. The OD data length must be 1, 2, or 4 bytes. A 3-byte length is also supported for read access only.

Read OD Sequence

1. The SDO client sends a request using an RSDO message with command (Cs) 40h, specifying the index (Pi) and sub-index (Ps).
2. The SDO server responds with a TSDO message containing the requested OD data in the Pd field. The command (Cs) in the response is set to 43h, 47h, 4Bh, or 4Fh depending on the data size.

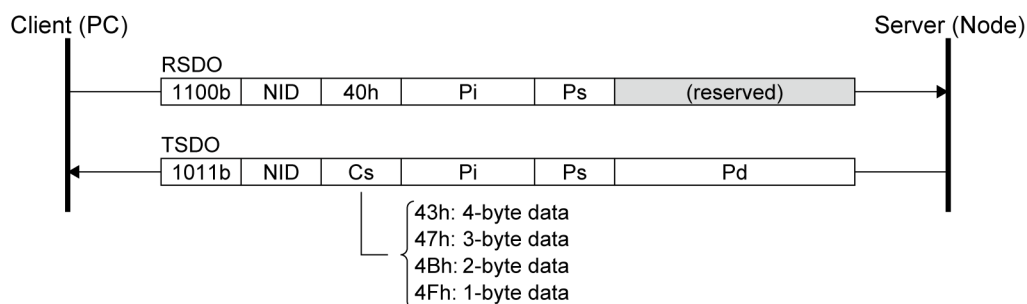


Figure 5.1 Read OD Sequence

Write OD Sequence

1. The SDO client sends a request via an RSDO message, specifying the index (Pi), sub-index (Ps), and the data (Pd) to be written. The command (Cs) is set to 23h, 2Bh, or 2Fh depending on the size of the data.
2. If the data is written successfully, the SDO server responds with a TSDO message using command (Cs) 60h.

* For write operations, only OD entries with data lengths of 1, 2, or 4 bytes are supported.

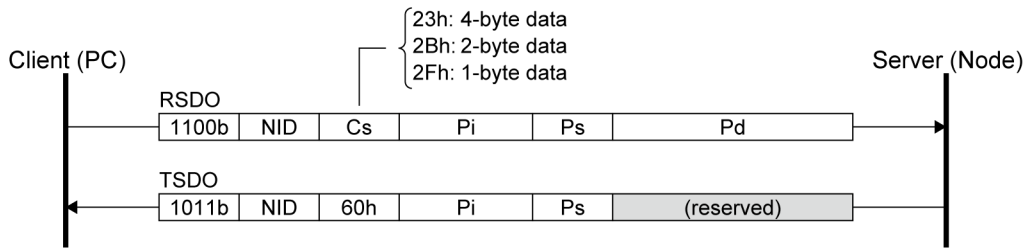


Figure 5.2 Write OD Sequence

In the OD read/write sequence, if an error occurs, the SDO server responds with an abort sequence. In the abort sequence, the SDO server returns a TSDO message with command (Cs) 80h, placing the abort code (listed in Table 5.4 List of Abort Codes) in the data field (Pd).

The CAN message data length (DLC) must always be set to 8 bytes. If the transmitted message does not contain at least 3 bytes—enough to identify the OD index—the server cannot return an appropriate abort code. In such cases, the following abort code will be returned: 0x05040001 — Client/server command specifier not valid or unknown.

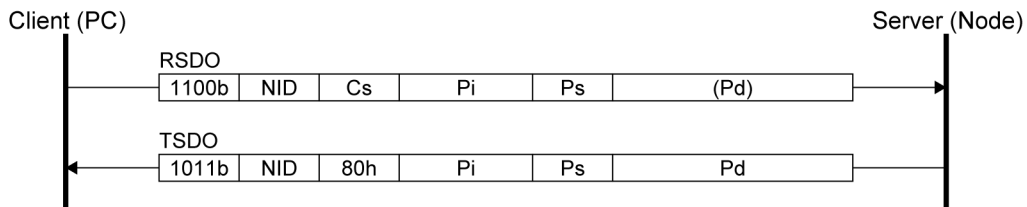


Figure 5.3 OD Abort Sequence

Table 5.4 List of Abort Codes

Abort code	Description
05030000h	Toggle bit not alternated
05040000h	SDO protocol time out
05040001h	Client/server command specifier not valid or unknown.
05040005h	Out of memory.
06010000h	Unsupported access to an object.
06010001h	Attempt to read a write only object.
06010002h	Attempt to write a read only object.
06040041h	Object cannot be mapped to the PDO.
06020000h	Object does not exist in the object dictionary.
06060000h	Access failed due to a hardware error.
06070010h	Length of service parameter does not match.
06090011h	Sub-index does not exist.
06090030h	Invalid value for parameter.
08000000h	General error
08000021h	Data cannot be transferred or stored to the application because of local control.
08000022h	Data cannot be transferred or stored to the application because of the present device state.

5.4.2 Object Dictionary Access Interval

Table 5.5 shows the execution time required for accessing the Object Dictionary. Make sure to allow the specified Execution Time (max.) between command executions. Most OD entries can be accessed within approximately 1 ms, except for a few exceptions. For details on access procedures, refer to “Appendix 2. Object Dictionary.”

Table 5.5 OD Execution Time

Index	Sub	Function	Execution Time (typ.)	Execution Time (max.) @10 kbps	Comment
1010h	01h	Save all parameters	105 ms	200 ms	
1011h	01h	Restore all default parameters	15 ms	100 ms	
–	–	OD other than the above	1 ms	25 ms	

5.4.3 Object Dictionary List

Table 5.6 lists the Object Dictionary (OD) entries supported by this unit. For detailed information on each OD entry, refer to “Appendix 2. Object Dictionary.”

Notation Example:

Index	Sub	Function	Type	Access	Default Value	Save
(1)	(2)	(3)	(4)	(5)	(6)	(7)

(1) Index number

(2) Sub-index number

(3) Functional overview

(4) Data type

U8: 8-bit unsigned integer (0 to 255)

U16: 16-bit unsigned integer (0 to 65535)

U32: 32-bit unsigned integer (0 to 4294967295)

I16: 16-bit signed integer (-32768 to 32767)

I24: 24-bit signed integer (-8388608 to 8388607)

VS4: Array[4] of character (eg., 65766173h = "save")

(5) Access type

const: Constant (never changes)

ro: Read only

rw: Read/Write

(6) Default value

(7) An OD entry marked with ‘✓’ in the “Save” column can be stored in non-volatile memory.

Table 5.6 OD List

Index	Sub	Function	Type	Access	Default Value	Save
1000h	00h	Device type	U32	const	0002 0194h	
1001h	00h	Error register	U8	ro	00h	
1002h	00h	Manufacturer status register	U32	ro	0000 0000h	
1005h	00h	SYNC COB-ID	U32	rw	0000 0080h	✓
1006h	00h	Communication cycle period	U32	rw	0000 2710h	✓
1008h	00h	Manufacturer device name	VS	const	3235 3547h	
1009h	00h	Manufacturer hardware version	VS	const	3038 4350h	
100Ah	00h	Manufacturer software version	VS	const	(latest Rev)	
1010h	00h	Highest sub-index supported	U8	const	01h	
	01h	Save all parameters	VS	rw	0000 0001h	
1011h	00h	Highest sub-index supported	U8	const	01h	
	01h	Restore all default parameters	VS	rw	0000 0001h	
1012h	00h	TIME COB-ID	U32	const	8000 0100h	
1017h	00h	Producer heartbeat time	U16	rw	0000h	✓
1018h	00h	Highest sub-index supported	U8	const	04h	
	01h	Vender ID	U32	const	0000 0000h	
	02h	Product code	U32	const	0000 0018h	
	03h	Product revision	U32	const	0000 0002h	
	04h	Product serial number	U32	const	undefined	
1019h	00h	Synchronous counter overflow value	U8	rw	00h	✓

Index	Sub	Function	Type	Access	Default Value	Save
1200h	00h	Highest sub-index supported	U8	const	02h	
	01h	RSDO COB-ID	U32	ro	0000 0600h + NID	
	02h	TSDO COB-ID	U32	ro	0000 0580h + NID	
1800h	00h	Highest sub-index supported	U8	const	02h	
	01h	TPDO1 COB-ID	U32	rw	4000 0180h + NID	✓
	02h	TPDO1 transmission type	U8	rw	FEh	✓
1801h	00h	Highest sub-index supported	U8	const	02h	
	01h	TPDO2 COB-ID	U32	rw	4000 0280h + NID	✓
	02h	TPDO2 transmission type	U8	ro	(FEh)	
1802h	00h	Highest sub-index supported	U8	const	02h	
	01h	TPDO3 COB-ID	U32	rw	C000 0380h + NID	✓
	02h	TPDO3 transmission type	U8	ro	(FEh)	
1803h	00h	Highest sub-index supported	U8	const	02h	
	01h	TPDO4 COB-ID	U32	rw	C000 0480h + NID	✓
	02h	TPDO4 transmission type	U8	ro	(FEh)	
1A00h	00h	Highest sub-index supported	U8	rw	04h/03h (max. 08h)	✓
	01h	TPDO1 mapping 1 (Tc)	U32	rw	2100 0010h	✓
	02h	TPDO1 mapping 2 (Gx/Gx24)	U32	rw	7130 0110h/8130 0118h	✓
	03h	TPDO1 mapping 3 (Gy/Gy24)	U32	rw	7130 0210h/8130 0218h	✓
	04h	TPDO1 mapping 4 (Gz)	U32	rw	7130 0310h	✓
1A01h	00h	Highest sub-index supported	U8	rw	04h(max08h)	✓
	01h	TPDO2 mapping 1 (Tc)	U32	rw	2100 0010h	✓
	02h	TPDO2 mapping 2 (Ax)	U32	rw	7130 0410h	✓
	03h	TPDO2 mapping 3 (Ay)	U32	rw	7130 0510h	✓
	04h	TMAP2 mapping 4 (Az)	U32	rw	7130 0610h	✓
1A02h	00h	Highest sub-index supported	U8	rw	04h (max. 08h)	✓
	01h	TPDO3 mapping 1 (Tc)	U32	rw	2100 0010h	✓
	02h	TPDO3 mapping 2 (Te/ Gz24)	U32	rw	7130 0710h/8130 0318h	✓
	03h	TPDO3 mapping 3 (Rsv)	U32	rw	2022 0410h	✓
	04h	TPDO3 mapping 4 (STS)	U32	rw	2022 0110h	✓
1A03h	00h	Highest sub-index supported	U8	rw	03h (max. 08h)	✓
	01h	TPDO4 mapping 1 (Tc)	U32	rw	2100 0010h	✓
	02h	TPDO4 mapping 2 (Ms)	U32	rw	2101 0220h	✓
	03h	TPDO4 mapping 3 (Dy)	U32	rw	2101 0110h	✓
	04h	TPDO4 mapping 4 (Reserve)	U32	rw	0000 0000h	✓
1F80h	00h	NMT startup mode	U32	rw	0000 0008h	✓
2000h	00h	Highest sub-index supported	U8	const	02h	
	01h	CAN node-ID	U8	rw	01h	✓
	02h	CAN bitrate	U8	rw	03h	✓
2001h	00h	Sensor sample rate	U8	rw	0Ah	✓
2015h	00h	Measurement mode (reserved)	U8	rw	01h ^(*)	✓
2021h	00h	Highest sub-index supported	U8	const	04h	
	01h	<i>reserved</i>	U8	rw	0Ch	✓
	02h	<i>reserved</i>	U8	rw	0Ch	✓
	03h	Acc dynamic range	U8	rw	00h	✓
	04h	Gyro resolution	U8	rw	00h	✓
2022h	00h	Highest sub-index supported	U8	const	04h	
	01h	Sensor range over status	U16	ro	0000h	
	02h	<i>reserved</i>	U16	ro	0000h	
	03h	<i>reserved</i>	U16	ro	0000h	
	04h	<i>reserved</i>	U16	ro	0000h	
2100h	00h	Trigger counter	U16	rw	0000h	
2101h	00h	Highest sub-index supported	U8	const	02h	
	01h	Time of day	U16	ro	undefined	
	02h	Time difference	U32	ro	undefined	
6110h	00h	Highest sub-index supported	U8	const	0Ah	
	01h	AI sensor Type 1	U16	ro	28A1h	

Index	Sub	Function	Type	Access	Default Value	Save
	02h	AI sensor Type 2	U16	ro	28A1h	
	03h	AI sensor Type 3	U16	ro	28A1h	
	04h	AI sensor Type 4	U16	ro	2905h	
	05h	AI sensor Type 5	U16	ro	2905h	
	06h	AI sensor Type 6	U16	ro	2905h	
	07h	AI sensor Type 7	U16	ro	0064h	
	08h	AI sensor Type 8 (reserved)	U16	ro	28A1h	
	09h	AI sensor Type 9 (reserved)	U16	ro	28A1h	
	0Ah	AI sensor Type 10 (reserved)	U16	ro	28A1h	
	6131h	00h	Highest sub-index supported	U8	const	0Ah
01h		AI physical unit PV 1	U32	ro	0041 0300h	
02h		AI physical unit PV 2	U32	ro	0041 0300h	
03h		AI physical unit PV 3	U32	ro	0041 0300h	
04h		AI physical unit PV 4	U32	ro	FDf1 0000h	
05h		AI physical unit PV 5	U32	ro	FDf1 0000h	
06h		AI physical unit PV 6	U32	ro	FDf1 0000h	
07h		AI physical unit PV 7	U32	ro	002D 0000h	
08h		AI physical unit PV 8 (reserved)	U32	ro	0041 0000h	
09h		AI physical unit PV 9 (reserved)	U32	ro	0041 0000h	
0Ah	AI physical unit PV 10 (reserved)	U32	ro	0041 0000h		
61A0h	00h	Highest sub-index supported	U8	const	0Ah	
	01h	AI filter type 1	U8	const	02h	
	02h	AI filter type 2	U8	const	02h	
	03h	AI filter type 3	U8	const	02h	
	04h	AI filter type 4	U8	const	02h	
	05h	AI filter type 5	U8	const	02h	
	06h	AI filter type 6	U8	const	02h	
	07h	AI filter type 7	U8	const	02h	
	08h	AI filter type 8 (reserved)	U8	const	02h	
	09h	AI filter type 9 (reserved)	U8	const	02h	
0Ah	AI filter type 10 (reserved)	U8	const	02h		
61A1h	00h	Highest sub-index supported	U8	const	0Ah	
	01h	AI filter tap constant 1	U8	rw ^(*)	08h	✓
	02h	AI filter tap constant 2	U8	ro	08h	
	03h	AI filter tap constant 3	U8	ro	08h	
	04h	AI filter tap constant 4	U8	ro	08h	
	05h	AI filter tap constant 5	U8	ro	08h	
	06h	AI filter tap constant 6	U8	ro	08h	
	07h	AI filter tap constant 7	U8	ro	08h	
	08h	AI filter tap constant 8 (reserved)	U8	ro	08h	
	09h	AI filter tap constant 9 (reserved)	U8	ro	08h	
0Ah	AI filter tap constant 10 (reserved)	U8	ro	08h		
7130h	00h	Highest sub-index supported	U8	const	0Ah	
	01h	AI input PV 1	I16	ro	undefined	
	02h	AI input PV 2	I16	ro	undefined	
	03h	AI input PV 3	I16	ro	undefined	
	04h	AI input PV 4	I16	ro	undefined	
	05h	AI input PV 5	I16	ro	undefined	
	06h	AI input PV 6	I16	ro	undefined	
	07h	AI input PV 7	I16	ro	undefined	
	08h	AI input PV 8 (reserved)	I16	ro	undefined	
	09h	AI input PV 9 (reserved)	I16	ro	undefined	
0Ah	AI input PV 10 (reserved)	I16	ro	undefined		
8130h	00h	Highest sub-index supported	U8	const	0Ah	
	01h	AI input PV 1 (Gyro x)	I24	ro	undefined	
	02h	AI input PV 2 (Gyro y)	I24	ro	undefined	
	03h	AI input PV 3 (Gyro z)	I24	ro	undefined	

Index	Sub	Function	Type	Access	Default Value	Save
	04h	AI input PV 4 (Acc x)	I24	ro	undefined	
	05h	AI input PV 5 (Acc y)	I24	ro	undefined	
	06h	AI input PV 6 (Acc z)	I24	ro	undefined	
	07h	AI input PV 7 (reserved)	I24	ro	undefined	
	08h	AI input PV 8 (reserved)	I24	ro	undefined	
	09h	AI input PV 9 (reserved)	I24	ro	undefined	
	0Ah	AI input PV 10 (reserved)	I24	ro	undefined	

- *1. Please leave the Measurement mode (OD[2015h, 00h]) at its default setting (01h) without modification.
- *2. When AI filter tap constant 1 (OD[61A1h, 01h]) is set, AI filter tap constant 2 to 10 (OD[61A1h, 02h] through OD[61A1h, 0Ah]) are automatically set to the same value.

5.5 Changing NMT Mode

The sensor unit transitions between NMT modes, as shown in Figure 5.4, based on requests received from an NMT Producer (e.g., a PC). These requests are issued as commands via NMT messages. The current NMT mode is also indicated by the green LED (refer to “5.19 LED Display”).

In general, measurement is performed in Operational mode, while configuration is performed in Pre-operational mode. The primary difference between these two modes is that TPDO output is enabled only in Operational mode. Additionally, certain OD entries can only be modified in Pre-operational mode. For details, refer to Table 5.7, “Valid Function of Each NMT State,” and “Appendix 2. Object Dictionary.”

In Stop mode, measurement is suspended, and all functions except Heartbeat output and time synchronization are disabled. Access to the Object Dictionary is also not possible in Stop mode.

Sensor measurement is active only in Operational mode.

The current NMT mode can be identified by the status parameter (St) included in the Heartbeat message.

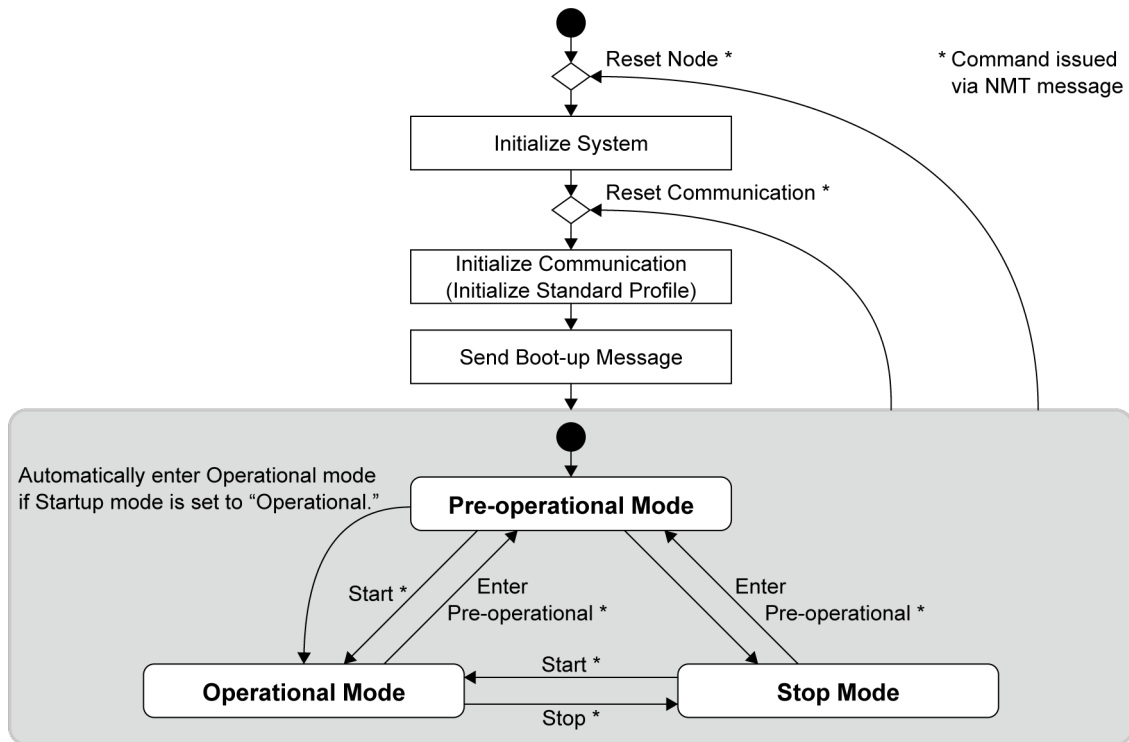


Figure 5.4 NMT Mode Transition Diagram

At startup, this unit always transitions to Pre-operational mode after completing initialization and outputs a Boot-up message, which is a Heartbeat message with a status parameter (St) of 00h. By setting NMT startup mode (OD[1F80h, 00h] bit 2), the unit can be configured to automatically transition to Operational mode after startup. In this case, the transition occurs after the Boot-up message is sent. Please refer to Table 1.7 to determine duration for mode change to complete from power-on.

This unit can also be reset by issuing a Reset Node or Reset Communication command. The Reset Node command initializes the entire system, while the Reset Communication command initializes only the communication profile.

Figure 5.5 shows the sequence for transitioning between NMT modes. By specifying 00h for the Node-ID parameter (Id), it is possible to broadcast an NMT mode change to multiple NMT Consumers, including this unit.

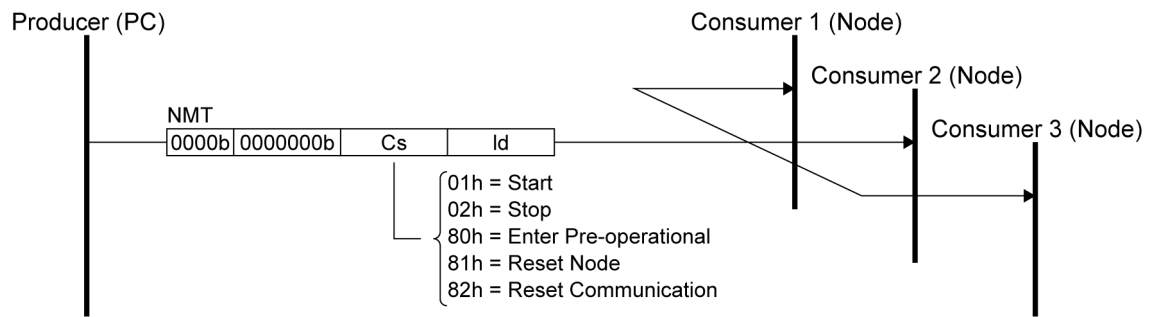


Figure 5.5 NMT Sequence

Table 5.7 Valid Function of Each NMT State

Function	Initialization	Pre-operational	Operational	Stop
Boot-up message	Valid	–	–	–
TPDO producer	–	–	Valid	–
SDO server	–	Valid	Valid	–
SYNC producer	–	Valid	Valid	–
TIME consumer	–	Valid	Valid	Valid
HB producer	–	Valid	Valid	Valid
Sensor	–	–	Active	–

5.5.1 Reset Node (81h)

The sensor unit performs an initialization equivalent to a power-on reset, except that it retains certain error information.

5.5.2 Reset Communication (82h)

The sensor unit initializes the following Object Dictionary (OD) entries.

- SYNC COB-ID (OD[1005h, 00h])
- Communication cycle period (OD[1006h, 00h])
- Producer heartbeat time (OD[1017h, 00h])
- Synchronous counter overflow value (OD[1019h, 00h])
- TPDOx COB-ID / TPDOx transmission type (OD[180xh, 01h] / OD[180xh, 02h])
- TPDOx mapping 1–4 (OD[1A0xh, 01h–04h])
- NMT startup mode (OD[1F80h, 00h])

5.6 Measurement

During measurement in Operational mode, the sensor unit transmits TPDO messages triggered either by SYNC messages or by sensor sampling events (timer events). TPDO messages are not transmitted in any mode other than Operational mode.

This unit supports two transmit modes, depending on the type of trigger, as shown in Table 5.8. The following sections describe the measurement sequences for each transmit mode.

Table 5.8 Transmit Modes

Transmit modes	Trigger	Operation
Synchronous mode	SYNC message	TPDO messages are transmitted each time the specified number of SYNC messages is received.
Sampling mode	Timer event	TPDO messages are transmitted periodically based on the unit's internal timer.

5.6.1 Synchronous Mode

Synchronous mode transmits TPDO messages triggered by the reception of a specified number of SYNC messages. The SYNC period can be set to a value from 1 to 240.

A sample procedure for configuring this mode is given below:

1. Enter Pre-operational mode.
 2. Disable TPDO1, TPDO2, TPDO3, and TPDO4.
 - TPDO1 COB-ID (OD[1800h, 01h]) = C000 0180h + NID
 - TPDO2 COB-ID (OD[1801h, 01h]) = C000 0280h + NID
 - TPDO3 COB-ID (OD[1802h, 01h]) = C000 0380h + NID
 - TPDO4 COB-ID (OD[1803h, 01h]) = C000 0480h + NID
 3. Set the SYNC counter overflow value.
 - Synchronous Counter overflow value (OD[1019h, 00h]) = 00h
- * Steps 4 to 6 apply only to the TPDOs to be enabled.
4. If necessary, configure the sensor sample rate (OD[2001h, 00h]) and filter settings (OD[61A1h, 01h]).
 5. Set the Synchronous mode.
 - TPDO1 transmission type (OD[1800h, 02h]) = SYNC period (1 to 240)
(The same value as TPDO1 is applied to TPDO2 and TPDO4.)
 6. Enable the TPDOs to be output.
 - TPDO1 COB-ID (OD[1800h,01h]) = 4000 0180h + NID
 - TPDO2 COB-ID (OD[1801h,01h]) = 4000 0280h + NID
 - TPDO3 COB-ID (OD[1802h,01h]) = 4000 0380h + NID
 - TPDO4 COB-ID (OD[1803h,01h]) = 4000 0480h + NID
 7. Enter Operational mode to enable TPDO message transmission.

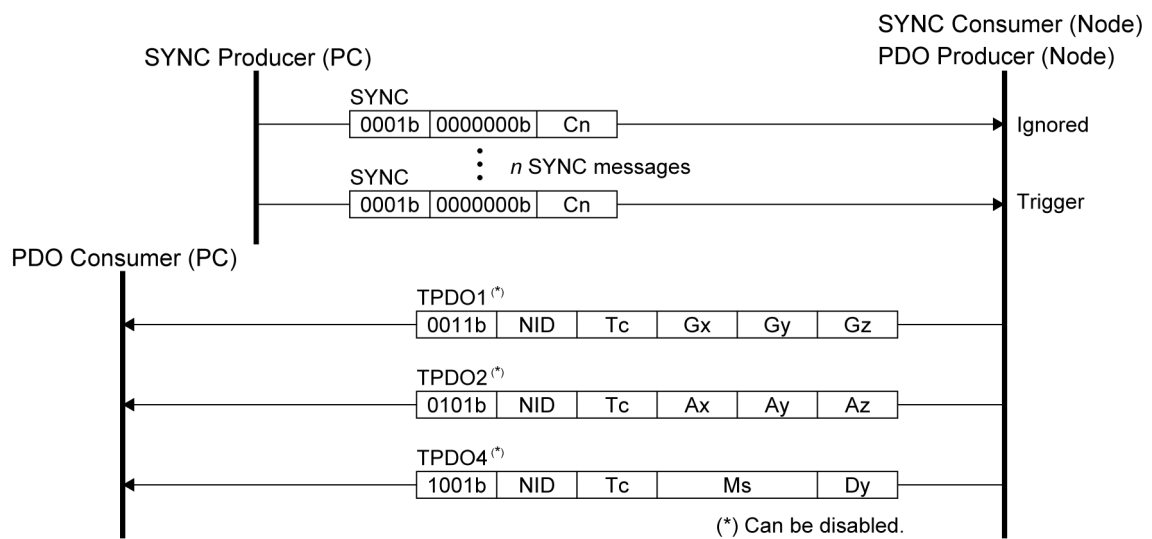


Figure 5.6 Synchronous Mode Sequence

If the Synchronous counter overflow value (OD [1019h, 00h]) is set to 00h, the SYNC counter value (Cn) included in the SYNC message is ignored. In this case, TPDO messages are transmitted based on the number of SYNC messages received.

If a value other than 00h is set, TPDO messages are transmitted only when the Cn value in the SYNC message is a multiple of the configured SYNC period.

5.6.2 Sampling Mode

Sampling mode is a mode in which the unit autonomously transmits TPDO messages at fixed sampling intervals.

A sample procedure for configuring this mode is given below:

1. Enter Pre-operational mode.
2. Disable TPDO1, TPDO2, TPDO3, and TPDO4.
 - TPDO1 COB-ID (OD[1800h, 01h]) = C000 0180h + NID
 - TPDO2 COB-ID (OD[1801h, 01h]) = C000 0280h + NID
 - TPDO3 COB-ID (OD[1802h, 01h]) = C000 0380h + NID
 - TPDO4 COB-ID (OD[1803h, 01h]) = C000 0480h + NID
- * Steps 3 to 5 apply only to the TPDOs to be enabled.
3. Set the Sampling mode.
 - TPDO1 transmission type (OD[1800h, 02h]) = FEh
(The same transmission type setting as TPDO1 is applied to TPDO2, TPDO3, and TPDO4.)
4. If necessary, configure the sensor sample rate (OD[2001h, 00h]) and filter settings (OD[61A1h, 01h]).
5. Enable the TPDOs to be output.
 - TPDO1 COB-ID (OD[1800h, 01h]) = 4000 0180h + NID
 - TPDO2 COB-ID (OD[1801h, 01h]) = 4000 0280h + NID
 - TPDO3 COB-ID (OD[1802h, 01h]) = 4000 0380h + NID
 - TPDO4 COB-ID (OD[1803h, 01h]) = 4000 0480h + NID
6. Enter Operational mode to start TPDO message transmission.

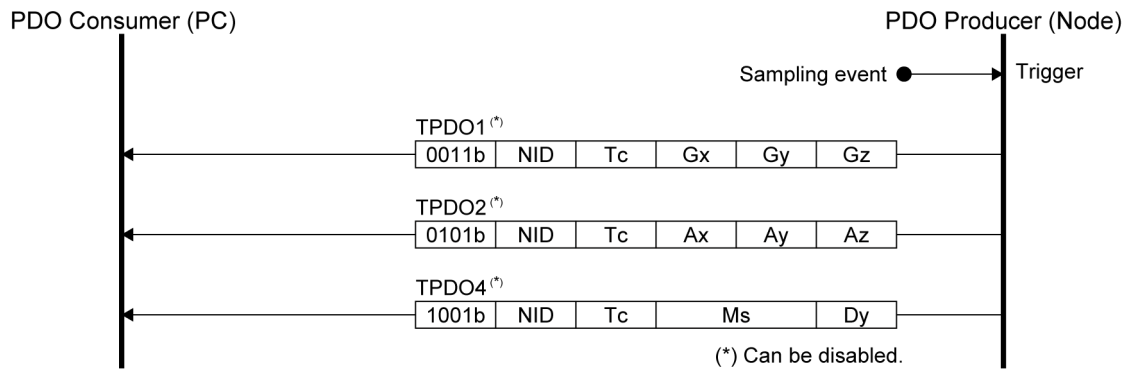


Figure 5.7 Sampling Mode Sequence

5.7 Measurement Values

Table 5.9 shows the measurement values and their attributes used by this unit.

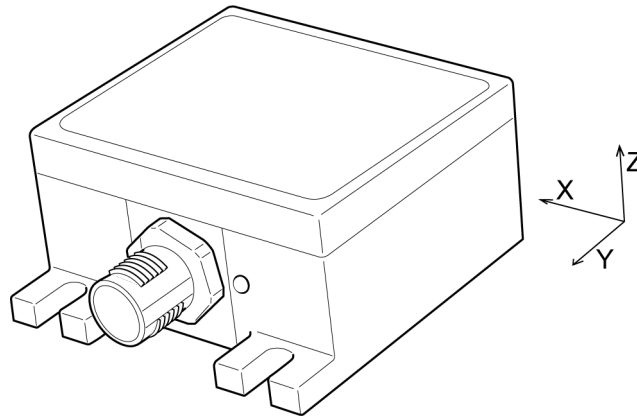


Figure 5.8 Axis Orientation

Table 5.9 List of Measurement Values

Name	Code	OD mapping	Sensor type	Data type	Resolution
Angular velocity (x)	Gx	OD[7130h,01h]	Gyroscope	INTEGER16	0.01515 [dps/LSB]
Angular velocity (y)	Gy	OD[7130h,02h]			
Angular velocity (z)	Gz	OD[7130h,03h]			
Angular velocity (x)	Gx	OD[8130h,01h]	Gyroscope	INTEGER24	0.01515/2 ⁸ [dps/LSB]
Angular velocity (y)	Gy	OD[8130h,02h]			
Angular velocity (z)	Gz	OD[8130h,03h]			
Acceleration (x)	Ax	OD[7130h,04h]	Accelerometer	INTEGER16	0.5 [mG/LSB] for ±16G 0.25 [mG/LSB] for ±8G
Acceleration (y)	Ay	OD[7130h,05h]			
Acceleration (z)	Az	OD[7130h,06h]			
Angular velocity (x)	Ax	OD[8130h,04h]	Accelerometer	INTEGER24	0.5/2 ⁸ [mG/LSB] for ±16G 0.25/2 ⁸ [mG/LSB] for ±8G
Angular velocity (y)	Ay	OD[8130h,05h]			
Angular velocity (z)	Az	OD[8130h,06h]			
Temperature	Te	OD[7130h,07h]	Temperature	INTEGER16	T[°C] = 0.00390625 × Te + 25
Time of day	Dy	OD[2101h,01h]	Time stamp	UNSIGNED16	days (Gregorian calendar)
Time difference	Ms	OD[2101h,02h]		UNSIGNED32	ms (from 0:00 a.m.)
Trigger counter	Tc	OD[2100h,00h]	Counter	UNSIGNED16	Count

5.8 Trigger Counter

The trigger counter is incremented with each sampling event, and its value is appended to the TPDO messages that transmit measurement data. Measurement values acquired at the same sampling timing are assigned the same counter value, ensuring synchronization among TPDO1 to TPDO4.

The trigger counter is initialized to 0 upon reset (including Reset Node) or power-on. It can also be set to an arbitrary value via the Object Dictionary. For details, refer to “A.2.2.7 Trigger counter.”

5.9 Basic Output (6-dof Output)

This unit provides 3-axis gyroscope output and 3-axis accelerometer output as basic IMU functions.

The gyroscope output resolution can be switched between 16-bit and 24-bit by changing Gyro resolution (OD[2021h, 04h]). For details, refer to “A.2.2.5 Gyroscope resolution.” In the default configuration, 16-bit gyroscope data (Gx, Gy, and Gz) is transmitted via TPDO1. For 24-bit resolution, Gx and Gy are transmitted via TPDO1, and Gz is transmitted via TPDO3.

The accelerometer resolution can be set to 0.5 [mG/LSB] or 0.25 [mG/LSB] by changing Acc dynamic range (OD[2021h, 03h]). For details, refer to “A.2.2.4 Acc dynamic range.” In the default configuration, accelerometer data (Ax, Ay, and Az) is transmitted via TPDO2.

5.10 Filter

This unit incorporates the following filters:

- Moving average filter
- FIR Kaiser filter

(1) Moving Average Filter

The number of filter taps can be set to 2, 4, 8, 16, 32, 64, or 128.

Figure 5.9 shows the characteristics of this filter.

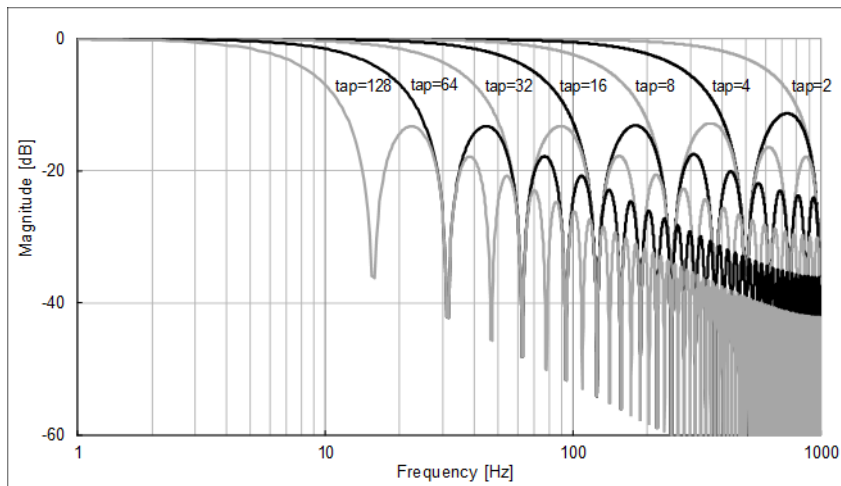


Figure 5.9 Moving Average Filter Characteristics

Since the number of filter taps is based on the internal sensor sample rate of 2000 sps, it is recommended to determine the setting using the following formula, in accordance with the sampling theorem:

$$\text{Recommended number of taps} \geq \text{Internal sample rate} \div \text{Output sample rate}$$

(2) FIR Kaiser Filter

The filter uses Kaiser Window (parameter = 8).

The number of filter taps can be set to 32, 64, or 128.

The cutoff frequency f_c can be configured to 50, 100, 200, or 400 Hz.

Figure 5.10 And Figure 5.11 show the typical characteristic of this filter.

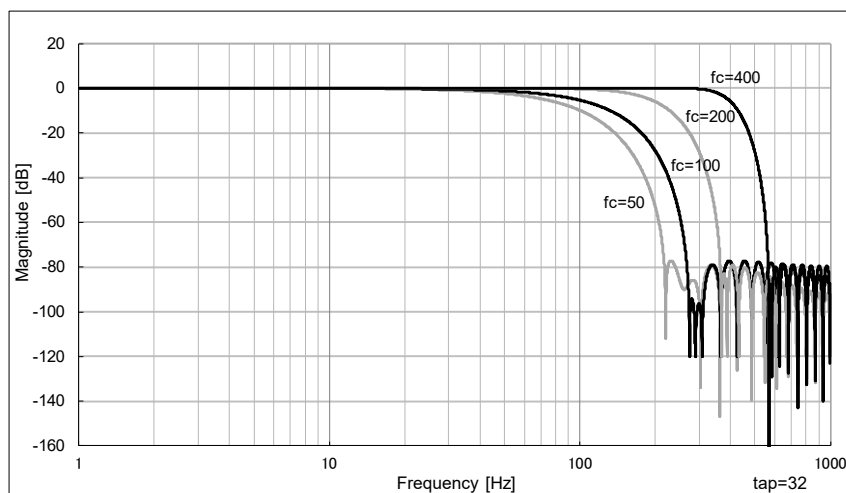


Figure 5.10 FIR Kaiser Filter Typical Characteristic 1

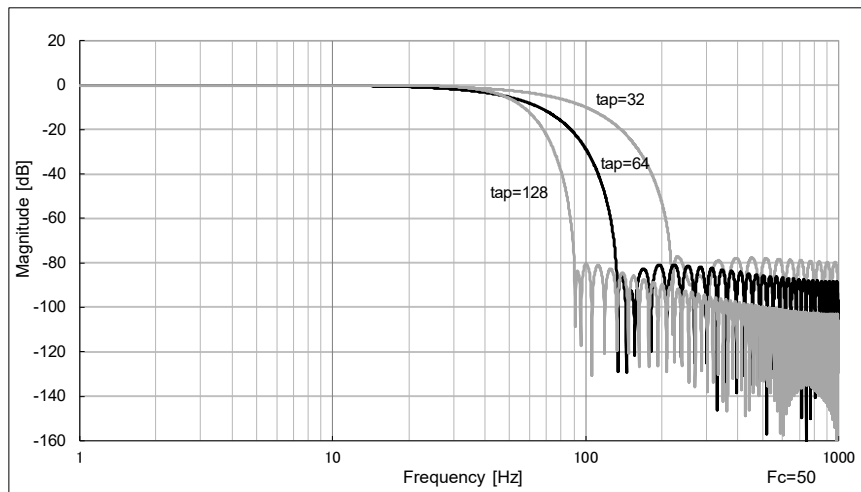


Figure 5.11 FIR Kaiser Filter Typical Characteristic 2

Depending on the combination of the filter tap setting and the data output rate, up to 63 samples of transient response data may be output immediately after sampling starts. The number of transient response samples for all combinations of tap count and output rate is shown below.

Table 5.10 Transient Response in Number of Samples Based on Output Data Rate vs Filter Tap

Output rate	TAP2	TAP4	TAP8	TAP16	TAP32	TAP64	TAP128
1000 sps	0	1	3	7	15	31	63
500 sps		0	1	3	7	15	31
400 sps			1	3	6	12	25
250 sps			0	1	3	7	15
200 sps				1	3	6	12
125 sps				0	1	3	7
100 sps					1	3	6
80 sps					1	2	5
62.5 sps					0	1	3
50 sps						1	3
40 sps						1	2
31.25 sps						0	1
25 sps							1
20 sps							1
15.625 sps							0

Table 5.11 Valid Combinations of Output Rate and Filter Settings

		Output rate [sps]															
		1000	500	400	250	200	125	100	80	62.5	50	40	31.25	25	20	15.625	
Filter setting	Moving average	tap = 2	OK	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		tap = 4	OK	OK	-	-	-	-	-	-	-	-	-	-	-	-	-
		tap = 8	OK	OK	OK	OK	-	-	-	-	-	-	-	-	-	-	-
		tap = 16	OK	OK	OK	OK	OK	OK	-	-	-	-	-	-	-	-	-
		tap = 32	OK	OK	OK	OK	OK	OK	OK	OK	OK	-	-	-	-	-	-
		tap = 64	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	-	-	-
		tap = 128	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
	FIR Kaiser filter	tap = 32, fc = 50 Hz	OK	OK	OK	OK	OK	OK	OK	-	-	-	-	-	-	-	-
		tap = 32, fc = 100 Hz	OK	OK	OK	OK	OK	-	-	-	-	-	-	-	-	-	-
		tap = 32, fc = 200 Hz	OK	OK	OK	-	-	-	-	-	-	-	-	-	-	-	-
		tap = 32, fc = 400 Hz	OK	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		tap = 64, fc = 50 Hz	OK	OK	OK	OK	OK	OK	OK	-	-	-	-	-	-	-	-
		tap = 64, fc = 100 Hz	OK	OK	OK	OK	OK	-	-	-	-	-	-	-	-	-	-
		tap = 64, fc = 200 Hz	OK	OK	OK	-	-	-	-	-	-	-	-	-	-	-	-
		tap = 64, fc = 400 Hz	OK	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		tap = 128, fc = 50 Hz	OK	OK	OK	OK	OK	OK	OK	-	-	-	-	-	-	-	-
		tap = 128, fc = 100 Hz	OK	OK	OK	OK	OK	-	-	-	-	-	-	-	-	-	-
		tap = 128, fc = 200 Hz	OK	OK	OK	-	-	-	-	-	-	-	-	-	-	-	-
tap = 128, fc = 400 Hz	OK	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

*1. If the filter setting is out of the allowable range (indicated as “-”) when setting the sample rate, the filter will be automatically set to the value shown in bold as “OK”.
 *2. The reference sample rate for determining the number of filter taps is 2000 sps.

5.11 Time Setting

This unit is equipped with an internal clock and can acquire a timestamp at the time of measurement, transmitting it simultaneously with the measurement data. The internal clock can be set using a TIME message. When there are multiple timestamp consumers on the CAN bus, the TIME message will synchronize all nodes, including this unit, to the same time. Note that the internal clock does not have a backup function, so the time must be set every time the unit is powered on. The current time can be verified via Time of day (OD [2101h, 01h]) and Time difference (OD [2101h, 02h]). Be sure to wait at least 3 milliseconds after sending the TIME message before reading these OD entries.

The unit can receive TIME messages at any time, but to minimize latency in setting the internal clock, it is recommended to perform the time setting while in Pre-operational mode. Do not set a value equal to or greater than 86400000 ms (the number of milliseconds in one day) to the Ms field (bit[28:0]) in the TIME message. The Dy (days) field wraps around to 0 after reaching 65535.

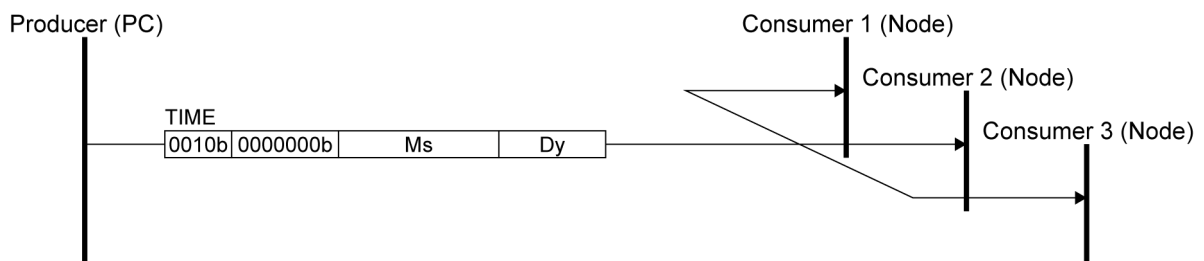


Figure 5.12 TIME Sequence

Table 5.12 Time Information Format

Item	Bit field	Content	Value	Comment
Ms	Bit 31–28	reserved	(fixed at 0)	
	Bit 27–0	Milliseconds from 0:00 a.m.	0 to 86399999	Local time
Dy	Bit 15–0	Days from January 1, 1984	0 to 65535	Gregorian calendar

5.12 Heartbeat

This unit periodically transmits a heartbeat (HB) message that indicates its current NMT mode. An HB consumer (such as a PC) uses this message to monitor whether the unit is operating normally. If the HB producer function is enabled, the unit will transition to Bus Heavy or Bus Off state when a bus disconnection is detected. To enable fault detection, make sure the HB function is active.

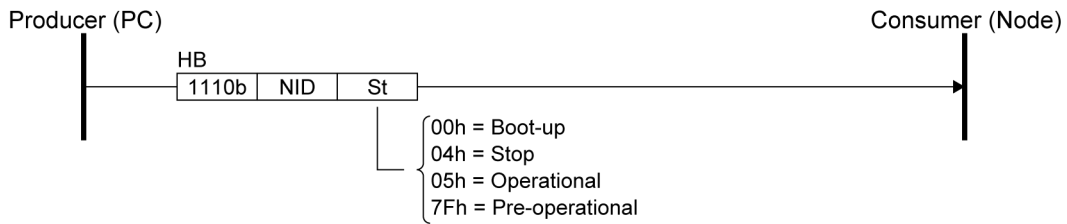


Figure 5.13 HB Sequence

The transmission interval of the heartbeat message is configured using Producer heartbeat time (OD [1017h, 00h]). Setting this OD to 00h disables the heartbeat message (default setting is disabled).

Regardless of this setting, the unit always transmits a single heartbeat message (St = 00h) as a boot-up message after initialization is complete. This boot-up message cannot be disabled. If an error such as failure to communicate with the host is detected at boot-up, the unit transitions to Bus Heavy (but not to Bus Off).

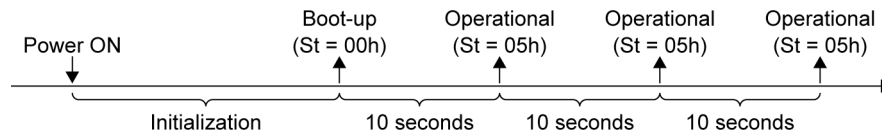


Figure 5.14 HB Operation Example

5.13 SYNC Producer

When the SYNC producer function is enabled, this unit can transmit SYNC messages at regular intervals. This allows multiple SYNC consumers to synchronize their TPDO transmissions based on the timing of this unit. The SYNC message transmitted by this unit is also valid for the unit itself.

Note that the timing accuracy for this SYNC producer function depends on the operating conditions of this unit. For applications that require high-precision synchronization, use a CANopen device equipped with a more accurate SYNC producer function.

This SYNC producer function can be enabled with or without an optional counter value field attached to each SYNC message. The inclusion of the optional counter value field in the SYNC producer function is determined by the programmed value in Synchronous counter overflow value (OD[1019h, 00h]).

If the Synchronous counter overflow value is set to 00h, the SYNC message will not include a counter value.

Example) When Synchronous counter overflow value (OD[1019h, 00h]) is set to 00h.

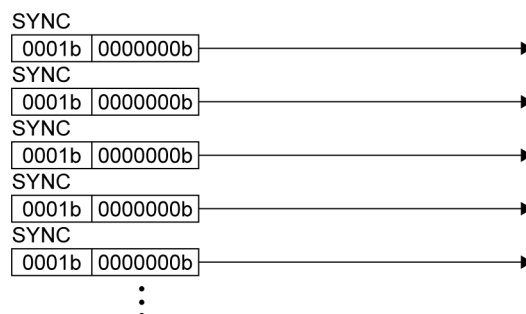


Figure 5.15 Example of SYNC Without Counter Value Field

If the Synchronous counter overflow value is set to 02h to F0h, the SYNC message will include a counter value. This count value is incremented by 1 for every SYNC transmission until it reaches the programmed synchronous counter overflow value, then rolls over and starts counting from 1.

Example) When Synchronous counter overflow value (OD[1019h, 00h]) is set to 03h.

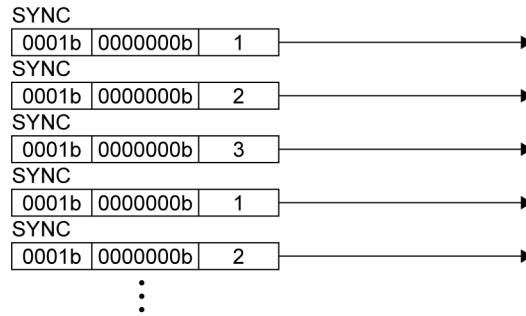


Figure 5.16 Example of SYNC Counter Overflow Operation

The procedure for configuring the SYNC producer is as follows:

Configuration Procedure

1. Disable the SYNC producer.
 - SYNC COB-ID (OD[1005h, 00h]) = 0000 0080h
 - Communication cycle period (OD[1006h, 00h]) = 0000 0000h
2. Set the Synchronous counter overflow value as needed.
 - To enable the SYNC producer without a counter value, set the Synchronous counter overflow value to 00h. Refer to Figure 5.15 for an example of an operation.
 - Synchronous counter overflow value (OD[1019h, 00h]) = 00h

To enable the SYNC producer with a counter, set the Synchronous counter overflow value to the desired upper limit counter value. Refer to Figure 5.16 for an example of an operation.

- Synchronous counter overflow value (OD[1019h, 00h]) = 02h to F0h

* If setting 02h to F0h, refer to “5.14 Application of Synchronous Mode.”

3. Set the SYNC interval.
 - Communication cycle period (OD[1006h, 00h]) = Interval (in microseconds)

Note: Only the millisecond portion of the value is valid. Any value below 1 ms will be truncated.

If 0000 0000h is set, SYNC messages will not be sent (SYNC producer is disabled).

4. Enable the SYNC producer.
 - SYNC COB-ID (OD[1005h, 00h]) = 4000 0080h

Note: The SYNC producer can only be enabled while in operational mode.

5.14 Application of Synchronous Mode

This section introduces application examples of Synchronous mode, both when using and not using the SYNC counter (Cn). When the SYNC producer is enabled in this unit, the upper limit value of the SYNC counter can be configured using Synchronous counter overflow (OD [1019h, 00h]). This setting can also affect the behavior of measurement in synchronous mode.

Example 1: Transmitting TPDO Every n SYNC Messages

In this example, TPDO messages are transmitted based on the number of SYNC messages received. This behavior is not affected by the SYNC producer counter configuration (enabled/disabled or counter value). This example assumes that a SYNC producer is already properly operating on the CAN network.

The following example shows the procedure for configuring the unit to transmit TPDO every 3 SYNC messages.

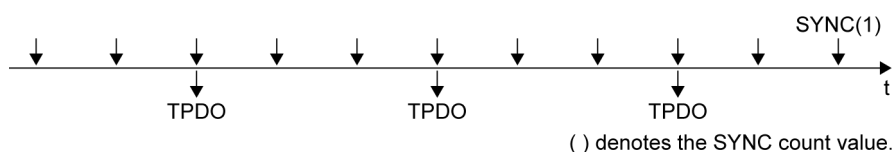


Figure 5.17 Example: TPDO Transmission Every 3 SYNC Messages

Configuration Procedure

1. Enter Pre-operational mode.
2. Disable TPDO1, TPDO2, TPDO3, and TPDO4.
 - TPDO1 COB-ID (OD[1800h, 01h]) = C000 0180h + NID
 - TPDO2 COB-ID (OD[1801h, 01h]) = C000 0280h + NID
 - TPDO3 COB-ID (OD[1802h, 01h]) = C000 0380h + NID
 - TPDO4 COB-ID (OD[1803h, 01h]) = C000 0480h + NID
- * Steps 3 to 5 apply only to the TPDOs to be enabled.
3. Configure the Synchronous mode (set the SYNC interval to 3).
 - TPDO1 transmission type (OD[1800h, 02h]) = 3
(The same value as TPDO1 is applied to TPDO2 and TPDO4.)
4. Enable the TPDOs to be output.
 - TPDO1 COB-ID (OD[1800h, 01h]) = 4000 0180h + NID
 - TPDO2 COB-ID (OD[1801h, 01h]) = 4000 0280h + NID
 - TPDO3 COB-ID (OD[1802h, 01h]) = 4000 0380h + NID
 - TPDO4 COB-ID (OD[1803h, 01h]) = 4000 0480h + NID
5. Enter Operational mode to enable TPDO message transmission.

As a result, measurement data will be transmitted once every 3 SYNC messages.

Example2: Transmitting TPDO When the SYNC Counter Is a Multiple of n

In this configuration, the unit transmits a TPDO message only when the SYNC counter value (Cn) included in the SYNC message is a multiple of n. To perform this control, the SYNC message must include a SYNC counter value (Cn). The following example shows the configuration where the SYNC counter overflow is set to 5, and TPDOs are transmitted when the SYNC counter value is a multiple of 3.

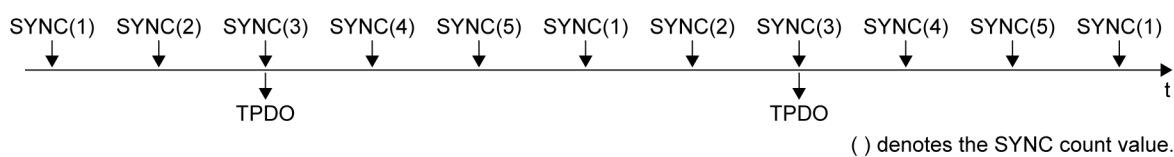


Figure 5.18 Example: TPDO Transmission When SYNC Counter Is a Multiple of 3

The configuration procedure below includes the steps to enable the SYNC producer in this unit with the counter overflow value set to 5. If another SYNC producer with a counter overflow value of 5 is already configured on the CAN network, then steps 3, 5, and 9 may be omitted.

Configuration Procedure

1. Enter Pre-operational mode.
2. Disable TPDO1, TPDO2, TPDO3, and TPDO4.
 - TPDO1 COB-ID (OD[1800h, 01h]) = C000 0180h + NID
 - TPDO2 COB-ID (OD[1801h, 01h]) = C000 0280h + NID
 - TPDO3 COB-ID (OD[1802h, 01h]) = C000 0380h + NID
 - TPDO4 COB-ID (OD[1803h, 01h]) = C000 0480h + NID
3. Disable the SYNC producer.
 - SYNC COB-ID (OD[1005h, 00h]) = 0000 0080h
 - Communication cycle period (OD[1006h, 00h]) = 0000 0000h
4. Set the SYNC counter overflow value to 5.
 - Synchronous counter overflow value (OD[1019h, 00h]) = 05h
5. Set the SYNC interval.
 - Communication cycle period (OD[1006h, 00h]) = Interval (in microseconds)

Note: Only the millisecond portion of the value is valid. Any value below 1 ms will be truncated.

* Steps 6 to 7 apply only to the TPDOs to be enabled.

6. Configure the Synchronous mode (set the SYNC interval to 3).
 - TPDO1 transmission type (OD[1800h, 02h]) = 3
(The same value as TPDO1 is applied to TPDO2 and TPDO4.)
7. Enable the TPDOs to be output.
 - TPDO1 COB-ID (OD[1800h, 01h]) = 4000 0180h + NID
 - TPDO2 COB-ID (OD[1801h, 01h]) = 4000 0280h + NID
 - TPDO3 COB-ID (OD[1802h, 01h]) = 4000 0380h + NID
 - TPDO4 COB-ID (OD[1803h, 01h]) = 4000 0480h + NID
8. Enter Operational mode to enable TPDO message transmission.
9. Enable the SYNC producer.
 - SYNC COB-ID (OD[1005h, 00h]) = 4000 0080h

As a result, measurement data will be transmitted whenever the SYNC counter reaches a multiple of 3.

5.15 Auto Output Setting

This section describes the configuration procedure for enabling the sensor unit to automatically output measurement data with a specified sensor sample rate and filter setting after power-on. The example below uses Sampling mode to periodically transmit measurement data.

Configuration Procedure

1. Enter Pre-operational mode.
 2. Disable TPDO1, TPDO2, TPDO3, and TPDO4.
 - TPDO1 COB-ID (OD[1800h, 01h]) = C000 0180h + NID
 - TPDO2 COB-ID (OD[1801h, 01h]) = C000 0280h + NID
 - TPDO3 COB-ID (OD[1802h, 01h]) = C000 0380h + NID
 - TPDO4 COB-ID (OD[1803h, 01h]) = C000 0480h + NID
- * Steps 3 to 5 apply only to the TPDOs to be enabled.
3. Set the Sampling mode.
 - TPDO1 transmission type (OD[1800h, 02h]) = FEh
(The same transmission type setting as TPDO1 is applied to TPDO2 and TPDO4.)
 4. Configure the sensor sample rate and filter tap constant.
 - Sensor sample rate (OD[2001h, 00h]) = Sample rate value

01h = 1000 sps	02h = 500 sps	03h = 250 sps	04h = 125 sps
05h = 62.5 sps	06h = 31.25 sps	07h = 15.625 sps	08h = 400 sps
09h = 200 sps	0Ah = 100 sps	0Bh = 80 sps	0Ch = 50 sps
0Dh = 40 sps	0Eh = 25 sps	0Fh = 20 sps	
 - AI filter tap constant 1 (OD[61A1h, 01h]) = Tap constant

01h = tap 2	02h = tap 4	03h = tap 8	04h = tap 16
05h = tap 32	06h = tap 64	07h = tap 128	
08h = FIR tap 32 fc 50	09h = FIR tap 32 fc 100	0Ah = FIR tap 32 fc 200	
0Bh = FIR tap 32 fc 400	0Ch = FIR tap 64 fc 50	0Dh = FIR tap 64 fc 100	
0Eh = FIR tap 64 fc 200	0Fh = FIR tap 64 fc 400	10h = FIR tap 128 fc 50	
11h = FIR tap 128 fc 100	12h = FIR tap 128 fc 200	13h = FIR tap 128 fc 400	
- Note: Valid combinations of sample rate and tap count are limited (refer to Table 5.11).
5. Enable the TPDOs to be output.
 - TPDO1 COB-ID (OD[1800h, 01h]) = 4000 0180h + NID
 - TPDO2 COB-ID (OD[1801h, 01h]) = 4000 0280h + NID
 - TPDO3 COB-ID (OD[1802h, 01h]) = 4000 0380h + NID
 - TPDO4 COB-ID (OD[1803h, 01h]) = 4000 0480h + NID
 6. Set the NMT startup mode to Operational.
 - NMT startup mode (OD[1F80h, 00h]) = 0000 0008h

7. Save the settings to non-volatile memory.
 - Save all parameters (OD[1010h, 01h]) = 6576 6173h
8. Wait for the Save all parameters command to complete (see OD Execution Time in Table 5.5), then turn off the unit's power.

After this configuration, the unit will automatically start outputting measurement data at the next power-on.

5.16 CAN Node Configuration

This section describes the procedure for changing the Node ID and CAN bitrate.

Note: All units connected to the same CAN bus must have unique Node IDs and use the same CAN bitrate.

Configuration Procedure

1. Enter Pre-operational mode.
2. Set the Node ID and CAN bitrate.
 - CAN node-ID (OD[2000h, 01h]) = Node ID (1–127)
 - CAN bitrate (OD[2000h, 02h]) = CAN bitrate

00h = 1 Mbps	01h = 800 kbps	02h = 500 kbps	03h = 250 kbps	04h = 125 kbps
05h = 50 kbps	06h = 20 kbps	07h = 10 kbps	08h = 100 kbps	
3. Save the settings to non-volatile memory.
 - Save all parameters (OD[1010h, 01h]) = 6576 6173h
4. Wait for the Save all parameters command to complete (see OD Execution Time in Table 5.5), then restart the unit.

5.17 Sensor Configuration

This section describes the procedure for changing the sensor sample rate and filter tap constant.

Configuration Procedure

1. Enter Pre-operational mode.
2. Configure the sensor sample rate, filter tap constant, and FIR filter.
 - Sensor sample rate (OD[2001h, 00h]) = Sample rate

01h = 1000 sps	02h = 500 sps	03h = 250 sps	04h = 125 sps
05h = 62.5 sps	06h = 31.25 sps	07h = 15.625 sps	08h = 400 sps
09h = 200 sps	0Ah = 100 sps	0Bh = 80 sps	0Ch = 50 sps
0Dh = 40 sps	0Eh = 25 sps	0Fh = 20 sps	
 - AI filter tap constant 1 (OD[61A1h, 01h]) = Tap constant

01h = tap 2	02h = tap 4	03h = tap 8	04h = tap 16
05h = tap 32	06h = tap 64	07h = tap 128	
08h = FIR tap 32 fc 50	09h = FIR tap 32 fc 100	0Ah = FIR tap 32 fc 200	
0Bh = FIR tap 32 fc 400	0Ch = FIR tap 64 fc 50	0Dh = FIR tap 64 fc 100	
0Eh = FIR tap 64 fc 200	0Fh = FIR tap 64 fc 400	10h = FIR tap 128 fc 50	
11h = FIR tap 128 fc 100	12h = FIR tap 128 fc 200	13h = FIR tap 128 fc 400	

Note: Valid combinations of sample rate and tap count are limited (refer to Table 5.11).

This configuration will take effect at the start of the next measurement session. The configuration may be saved to non-volatile memory, if necessary.

5.18 Bus Status

The bus status of this unit is defined as shown in Table 5.13. The transition between bus states depends on the frequency of bus errors, including bit errors, stuff errors, CRC errors, form errors, and acknowledgment (ACK) errors (see Figure 5.19). In addition, the red Error LED (red) changes its blinking pattern based on the current bus status.

Table 5.13 Bus / Error Status

Bus status	Description	Error LED (red)	Comment
Normal	Normal operation or low frequency of bus errors	Off	Transitions to Bus Heavy if error frequency increases.
Bus Heavy	High frequency of bus errors	Single flash (ON 200 ms, OFF 1000 ms)	Transitions to Normal if error frequency decreases. Transitions to Bus Off if transmit errors continue to accumulate. Receive errors alone do not cause a transition to Bus Off. Boot-up message transmission errors also do not cause Bus Off.
Bus Off	Critical fault state	On	Enters a special Pre-operational mode. Recovery requires a system reboot.
Parameter Memory Checksum Error	User-defined parameter data is corrupted due to some fault	Blinking (ON 200 ms OFF 200 ms)	The user configuration area (measurement conditions, etc.) has been corrupted (e.g., power interruption during save). The unit starts up in factory default mode. Re-save the settings. If saving fails, please contact your distributor, as the flash memory may be damaged.

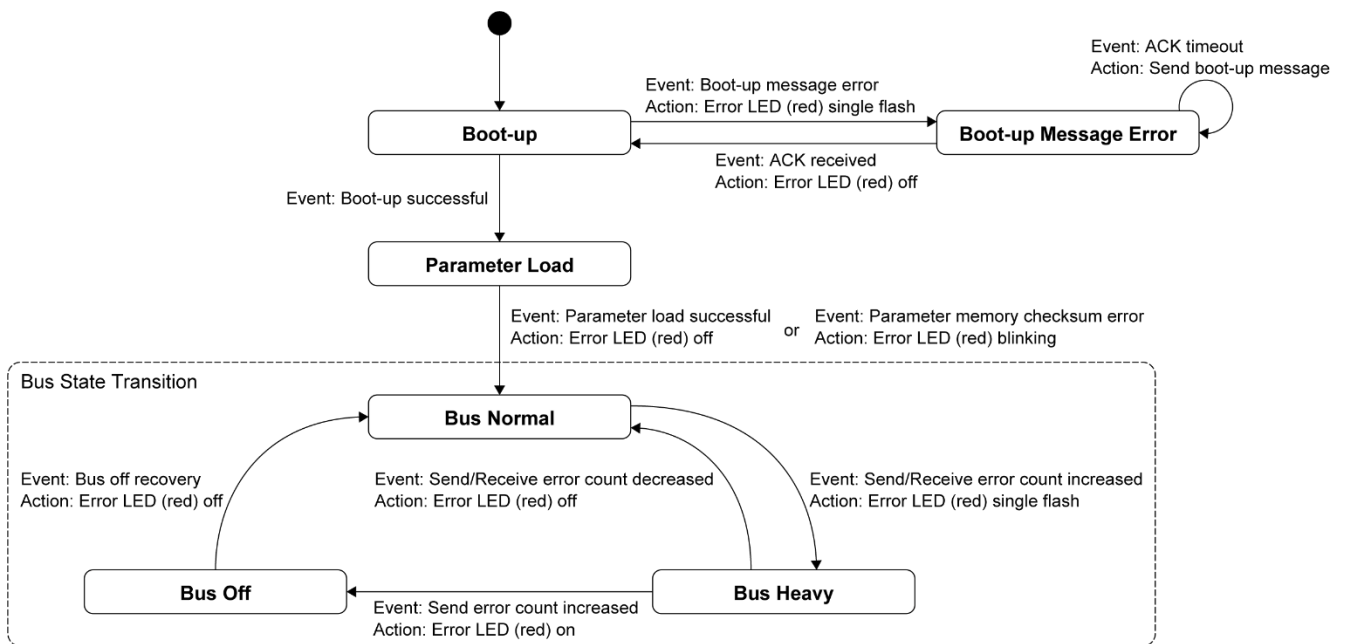


Figure 5.19 Bus State Transition Diagram

As an exception, the unit transitions to the Bus Off state only when transmit errors accumulate while in the Bus Heavy state. Accumulation of receive errors alone will not cause the unit to enter the Bus Off state. Likewise, transmission errors that occur during the boot-up message will not trigger a transition to Bus Off.

In the Bus Off state, the unit enters a special Pre-operational mode where message transmission is disabled. To recover from the Bus Off state, a system reboot or a Bus Off recovery procedure is required. The Bus Off recovery procedure involves the reception of 128 consecutive recessive 11 bits, typically occurring after a period of no bus traffic. After that, the unit must receive either a Reset Node or Reset Communication command to resume normal operation.

The Run LED (green) changes its blinking pattern according to the NMT mode, indicating the operational state of the unit.

5.19 LED Display

The LED indicators change according to the NMT mode and bus status, as specified in Table 5.14 and Table 5.15. This unit uses a bicolor LED (red and green). When both the Run LED (green) and Error LED (red) are ON at the same time, the LED will appear orange.

Table 5.14 Run LED (Green) Status

Status	Run LED (green)	Comment
Initialization	Off	
Pre-operational	Blinking	ON 200 ms / OFF 200 ms
Operational	On	
Stopped	Single flash	ON 200 ms / OFF 1000 ms
Erase Non-volatile Memory	Double flash	ON 200 ms / OFF 200 ms, ON 200 ms / OFF 1000 ms

Table 5.15 Error LED (Red) Status

Status	Error LED (red)	Comment
Normal status	Off	
Bus Heavy	Single flash	ON 200 ms / OFF 1000 ms
Bus Off	On	

6. Handling Notes

6.1 Cautions for Use

- When you attach the product to a housing, equipment, jig, or tool, make sure you attach it properly so that no mechanical stress is added to create a distortion such as a warp or twist. In addition, tighten the screws firmly but not too firmly because the mount of the product may break. Use screw locking techniques as necessary.
- When you set up the product, make sure the equipment, jigs, tools, and workers maintain a good ground in order not to generate high voltage leakage. If you add overcurrent or static electricity to the product, the product may be damaged permanently.
- When you install the product, make sure metallic or other conductors do not enter the product. Otherwise, malfunction or damage of the product may result.
- If excessive shock is added to the product when, for example, the product falls, the quality of the product may be degraded. Make sure the product does not fall when you handle it.
- Before you start using the product, test it in the actual equipment under the actual operating environment.
- Since the product has capacitors inside, inrush current will occur during power-on. Evaluate in the actual environment in order to check the effect of the supply voltage drop by inrush current in the system.
- If water enters the product, malfunction or damage of the product may result. If the product can be exposed to water, the system must have a waterproof structure. We do not guarantee the operation of the product when the product is exposed to condensation, dust, oil, corrosive gas (salt, acid, alkaline, or the like), or direct sunlight.
- This product is not designed to be radiation resistant.
- Never use this product if the operating condition is over the absolute maximum rating. If you do, the characteristics of the product may never recover.
- If the product is exposed to excessive exogenous noise or the like, degradation of the precision, malfunction, or damage of the product may result. The system needs to be designed so that the noise itself is suppressed or the system is immune to the noise.
- Mechanical vibration or shock, continuous mechanical stress, rapid temperature change, or the like may cause cracks or disconnections at the various connecting parts.
- Take sufficient safety measure for the equipment this product is built into.
- This product is not intended for general use by the consumer but instead for engineering design. For the customer, please consider it safely with the proper use.
- This product is not designed to be used in the equipment that demands extremely high reliability and where its failure may threaten human life or property (for example, aerospace equipment, submarine repeater, nuclear power control equipment, life support equipment, medical equipment, transportation control equipment, etc.). Therefore, Seiko Epson Corporation will not be liable for any damages caused by the use of the product for those applications.
- Do not alter or disassemble the product.
- The casing of this product is electrically conductive. When the product is connected or mounted to the circuit board, ensure the board substrate or board wiring pattern does not short-circuit or contact to the case.

6.2 Cautions for Storage

- Do not add shock or vibration to the packing box. Do not spill water over the packing box. Do not store or use the product in the environment where dew condensation occurs due to rapid temperature change.
- To suppress the characteristic change by prolonged storage, it is recommended to maintain the environment at normal temperature and normal humidity. Normal temperature: +5 °C to +35 °C Normal humidity: 45% RH to 85% RH (JIS Z 8703).
- Do not store the product in a location subject to High Temperature, high humidity, under direct sunlight, corrosive gas or dust.
- Do not put mechanical stress on the product while it is stored.

6.3 Other Cautions

- When you connect the socket to the header of this product, make sure you do not insert the header in the reverse orientation. If you do, the IMU may be damaged permanently. In addition, if you attach the product to the equipment, etc. using connection harness, connect the connection harness to the product first, and then attach it to the equipment, etc.
- The gloss marks derived from the adhesive material may have appeared on the casing surface of the product, but it does not affect the function and quality of the product.
- The Parting line as a result of die cast manufacturing process may have appeared on the casing surface of the product, but it is not an abnormality.
- Please take care not to tamper with or accidentally disturb the assembly screw on the surface where the serial number is printed when attaching and detaching the product to the system. We do not guarantee the performance and the quality of the product in case the assembly screw is manipulated.
- Never turn off power while the host communicates the product. Otherwise, malfunction of the product may result.
- Small performance deterioration due to long-term use and aging effects, etc. cannot be detected through the self-test in this product. Discontinue use immediately even when the self-test results in a "pass" when experiencing abnormality in the sensor performance.
- If noise is induced on the external trigger terminal, there is a possibility an invalid measurement process is unintentionally sent to the host. To prevent this, when using an external trigger, take precaution to minimize noise on the external trigger terminal.
- Exercise care and precaution with the packaging and during transport of the equipment that this product is installed on to avoid excessive vibration and or damage from impact.

6.4 Limited Warranty

- The product warranty period is one year from the date of shipment.
- If a defect due to a quality failure of the product is found during the warranty period and is clearly attributable to us, we will provide a replacement.

7. Standards and Approvals

The following standards apply only to units that are so labeled. (EMC testing was performed using EPSON power supplies.)

7.1 NOTICE

This is a Class A product. In a domestic environment, this product may cause radio interference, in which case the user may be required to take appropriate measures.

Connecting a non-shielded interface cable to this product may invalidate the device's EMC compliance.

You are cautioned that changes or modifications not expressly approved by Seiko Epson Corporation could void your authority to operate the equipment.

7.2 CE Statement

This product conforms to the following Directives and Norms,

Directive 2014/30/EU:
EN61326-1 Class A

Directive 2011/65/EU:
EN IEC 63000:2018

Representative information:
Epson Europe Electronics GmbH
Riesstrasse 15
80992 Munich
Germany

7.3 RoHS & WEEE

The crossed-out wheeled bin label on your product indicates that it should not be disposed of with regular household waste. To prevent potential harm to the environment or human health, please separate this product from other waste streams so that it can be recycled in an environmentally sound manner. For more details on available collection facilities please contact your local government office or the retailer where you purchased this product.

AEEE Yönetmeliğine Uygundur.

Обладнання відповідає вимогам Технічного регламенту обмеження використання деяких небезпечних речовин в електричному та електронному обладнанні

7.4 UKCA Statement

This product conforms to the following Directives and Norms,

Directive 2014/30/EU:
BS EN 61326-1 Class A

Directive 2011/65/EU:
EN IEC 63000:2018

Representative information:
Epson (UK) Ltd., Westside
Floor 3&4, The Clarendon Works,
37-39 Clarendon Road, Watford WD17 1JA,
United Kingdom

7.5 FCC Compliance Statement for American users

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

7.6 Industry ICES Compliance Statement for Canadian users

CAN ICES-3(A)/NMB-3(A)

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Appendix 1. Messages

A.1.1 NMT Message

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
0000b	0000000b	2	Cs	Id						

Cs Command specifier

01h = Start
 02h = Stop
 80h = Enter Pre-operational
 81h = Reset Node
 82h = Reset Communication
 Other values are reserved.

Id Consumer node-ID

00h = All nodes
 01h–7Fh = Specific Node-ID
 Other values are reserved.

This message changes the NMT state of the node specified by Id, according to the command specified by Cs. If Cs is set to Reset Node or Reset Communication, the corresponding reset operation is executed on the target node. When Id = 00h, the message is broadcast to all NMT consumers on the CAN network. This sensor unit functions only as an NMT consumer.

A.1.2 SYNC Message

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
0001b	0000000b	1	Cn							
		0								

Cn SYNC counter

01h–F0h = Count value
 Other values are reserved.

The SYNC message is used in synchronous PDO transmission mode. It provides a measurement trigger to all SYNC consumers on the CAN bus. Each SYNC consumer that receives the message returns measurement data in a TPDO message.

The SYNC message can optionally include a counter Cn, which increments from 1 up to a maximum of 240 with each transmission and wraps back to 1 after reaching the maximum count.

When using this unit as the SYNC producer, the inclusion or omission of the counter is determined by the setting of the Synchronous counter overflow value (OD[1019h, 00h]), which also sets the maximum count for the counter Cn.

The CAN network allows only one SYNC producer to transmit SYNC messages at a time. This unit supports operation as both a SYNC producer and a SYNC consumer.

A.1.3 TIME Message

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
0010b	0000000b	6	Ms (28 bits)			0	Dy			

Ms Time difference

Bits 27–0: Elapsed milliseconds since 0:00 a.m. (midnight)
 bits 31–28: Fixed value (0)

Dy Time of day

0000h–FFFFh = Number of days since January 1, 1984

The TIME message is used to synchronize the time across all timestamp consumers on the CAN bus. Upon receiving this message, all timestamp consumers are set to the same time.

This sensor unit functions only as a timestamp consumer.

After sending the TIME message, wait at least 3 ms before accessing the relevant OD entries.

To avoid delays in applying the time setting, it is recommended to perform this operation in Pre-operational mode.

Do not set a value greater than or equal to 86400000 ms (the maximum value representing one full day) to bits 27–0 of the Ms field.

For detailed configuration procedures, refer to “5.11 Time Setting.”

A.1.4 TPDO1 Message

Gyro 16-bit mode: Gyro resolution (OD[2021h, 04h]) = 00h

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
0011b	Node-ID	8	Tc		Gx		Gy		Gz	

Tc Trigger counter

Gx Raw gyro data along X-axis (16 bits)

Gy Raw gyro data along Y-axis (16 bits)

Gz Raw gyro data along Z-axis (16 bits)

Gyro 24-bit mode: Gyro resolution (OD[2021h, 04h]) = 01h

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
0011b	Node-ID	8	Tc		Gx		Gy			

Tc Trigger counter

Gx Raw gyro data along X-axis (24 bits)

Gy Raw gyro data along Y-axis (24 bits)

This sensor unit outputs gyroscope measurement data using the TPDO1 message.

Transmission of TPDO1 is triggered by either a SYNC message or a sensor sampling event. The output of TPDO1 can be enabled or disabled using TPDO1 COB-ID (OD[1800h, 01h]).

The data fields included in this message can also be reconfigured using the PDO mapping function. For details, refer to “A.2.1.22 TPDO1 mapping.”

A.1.5 TPDO2 Message

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
0101b	Node-ID	8	Tc		Ax		Ay		Az	

Tc Trigger counter

Ax Raw acceleration data along X-axis

Ay Raw acceleration data along Y-axis

Az Raw acceleration data along Z-axis

This sensor unit outputs accelerometer measurement data using the TPDO2 message.

Transmission of TPDO2 is triggered by either a SYNC message or a sensor sampling event. The output of TPDO2 can be enabled or disabled using TPDO2 COB-ID (OD[1801h, 01h]).

The data fields included in this message can also be reconfigured using the PDO mapping function. For details, refer to “A.2.1.23 TPDO2 mapping.”

A.1.6 TPDO3 Message

Gyro 16-bit mode: Gyro resolution (OD[2021h, 04h]) = 00h

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
0111b	Node-ID	8	Tc		Temp		Reserved		STS	

Tc **Trigger counter**

Temp **Temperature sensor output data**

Reserved Reserved

STS **Range over status information**

Bits 7–0: Reserved

Bit 8: Z ACCL Range Over flag*1

Bit 9: Y ACCL Range Over flag*1

Bit 10: X ACCL Range Over flag*1

Bit 11: Z Gyro Range Over flag*1

Bit 12: Y Gyro Range Over flag*1

Bit 13: X Gyro Range Over flag*1

Bit 14: Reserved

Bit 15: Reserved

*1: Each flag is set to 1 when the corresponding sensor exceeds its measurement range.

Gyro 24-bit mode: Gyro resolution (OD[2021h, 04h]) = 01h

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
0111b	Node-ID	7	Tc		Temp		Gz			

Tc **Trigger counter**

Temp **Temperature sensor output data**

Gz **Raw gyro data along Z-axis (24 bits)**

In Gyro 16-bit mode, the unit outputs temperature sensor data and sensor status information.

In Gyro 24-bit mode, it outputs temperature data and Z-axis gyro data.

Transmission of TPDO3 is triggered by either a SYNC message or a sensor sampling event. The output of TPDO3 can be enabled or disabled using TPDO3 COB-ID (OD[1802h, 01h]).

The data fields included in this message can also be reconfigured using the PDO mapping function. For details, refer to "A.2.1.24 TPDO3 mapping."

A.1.7 TPDO4 Message

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
1001b	Node-ID	8	Tc		Ms			Dy		

Tc **Trigger counter**

Ms **Time difference**

Bits 27–0: Elapsed milliseconds since 0:00 a.m. (midnight)

bits 31–28: Fixed value (0)

Dy **Time of day**

0000h–FFFFh = Number of days since January 1, 1984

This sensor unit outputs measurement timestamp data using the TPDO4 message.

Transmission of TPDO4 is triggered by either a SYNC message or a sensor sampling event. The output of TPDO4 can be enabled or disabled using TPDO4 COB-ID (OD[1803h, 01h]).

The data fields included in this message can also be reconfigured using the PDO mapping function. For details, refer to "A.2.1.25 TPDO4 mapping."

A.1.8 TSDO Message

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
1011b	Node-ID	8	Cs	Pi		Ps	Pd			

Cs Command specifier

43h = 4-byte data (read sequence)
 47h = 3-byte data (read sequence)
 4Bh = 2-byte data (read sequence)
 4Fh = 1-byte data (read sequence)
 60h = Success (write sequence)
 80h = Failure (write sequence)

Pi Index

Ps Sub-index

Pd Data field

-For read sequence: Actual data
 -For write sequence: Fixed to 0000h on success
 - On error: Abort code

This sensor unit outputs a TSDO message in response to an SDO client request for OD read/write access.

- In a read sequence, the requested data is returned in Pd.
- In a write sequence, a success (60h) or failure (80h) code is returned in Cs.
- If an error occurs, an abort code is returned in the Pd field.

For more information, refer to "5.4.1 Read/Write Sequence."

A.1.9 RSDO Message

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
1100b	Node-ID	8	Cs	Pi		Ps	Pd			

Cs Command specifier

40h = Read request (read sequence)
 23h = 4-byte data (write sequence)
 2Bh = 2-byte data (write sequence)
 2Fh = 1-byte data (write sequence)

Pi Index

Ps Sub-index

Pd Data field

For write sequence: Data to be written
 For read sequence: Don't care

This message is sent by the SDO client to this sensor unit to request OD read or write access.

- In a read sequence, it specifies the index and sub-index of the OD entry to be read.
- In a write sequence, it specifies the index, sub-index, and the data to be written.

For more information, refer to "5.4.1 Read/Write Sequence."

A.1.10 HB Message

COB-ID		DLC	CAN data field							
FC	NID		1	2	3	4	5	6	7	8
1110b	Node-ID	1	St							

St State of unit (NMT mode)

00h = Boot-up

04h = Stop

05h = Operational

7Fh = Pre-operational

This sensor unit periodically transmits a heartbeat message (this message) indicating its current NMT state, which is included in the single-byte parameter St.

By default, heartbeat output is disabled. The heartbeat interval and enable/disable status are configured using Producer heartbeat time (OD[1017h, 00h]).

Upon completion of system initialization, the unit automatically transmits a boot-up message (St = 00h). This boot-up message is mandatory and cannot be disabled.

Appendix 2. Object Dictionary

Notation Example:

Index	Sub	Data Type	Access	Default Value	Save
(1)	(2)	(3)	(4)	(5)	(6)
Function	(Overview of the object's function)				
Data field *1	(Bit field definitions)				
Description	(Detailed explanation)				
Restriction	(Usage limitations)				

*1. The data field must be set using little-endian byte order.

(1) Index number

(2) Sub-index number

(3) Data type

UNSIGNED8:	8-bit unsigned integer (0 to 255)
UNSIGNED 16:	16-bit unsigned integer (0 to 65535)
UNSIGNED 32:	32-bit unsigned integer (0 to 4294967295)
INTEGER16:	16-bit signed integer (-32768 to 32767)
INTEGER 24:	24-bit signed integer (-8388608 to 8388607)
VISIBLE_STRING4:	Array[4] of character (eg., 65766173h = "save")

(4) Access type

CONST:	Constant (never changes)
RO:	Read only
RW:	Read/Write

(5) Default value

(6) An OD entry marked with '✓' in the "Save" column can be stored in non-volatile memory.

A.2.1 Communication Profile (DS-301)

A.2.1.1 Device type

Index	Sub	Data Type	Access	Default Value	Save
1000h	00h	UNSIGNED32	CONST	0002 0194h	–
Function	Device type				
Data field	Bit 15–0: Device profile 0194h (404) = DS-404 (Measuring device profile) Bit 31–16: Measurement type 0002h = Analog input block				

A.2.1.2 Error register

Index	Sub	Data Type	Access	Default Value	Save
1001h	00h	UNSIGNED8	RO	00h	–
Function	Error register				
Data field	bit 0: Generic error 0 = no error, 1 = error bit 1: (reserved) bit 2: (reserved) bit 3: (reserved) bit 4: (reserved) bit 5: (reserved) bit 6: (reserved) bit 7: Sensor error (An error has occurred in one or more internal sensors) 0 = no error, 1 = error				

Description	<p>Indicates general error status of the unit.</p> <ul style="list-style-type: none"> • bit 0 is set when the unit enters the Bus Off state. • bit 7 is set if an internal sensor error occurs. <p>For more details on internal sensor errors, refer to Manufacturer status register (OD[1002h, 00h]). The register value is retained until the unit is restarted.</p>
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A.2.1.3 Manufacturer status register

Index	Sub	Data Type	Access	Default Value	Save																																																																																				
1002h	00h	UNSIGNED32	RO	0000 0000h	–																																																																																				
Function	Manufacturer-specific status register																																																																																								
Data field	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 10%;">bit 0:</td><td style="width: 40%;">n/a</td><td style="width: 50%;"></td></tr> <tr><td>bit 1:</td><td>Program memory error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 2:</td><td>OD memory read error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 3:</td><td>OD memory read error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 4:</td><td>RAM read/write error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 5:</td><td>Parameter memory error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 6:</td><td>(reserved)</td><td></td></tr> <tr><td>bit 7:</td><td>Sensor check error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 8:</td><td>n/a</td><td></td></tr> <tr><td>bit 9:</td><td>Sensor communication error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 10:</td><td>Sensor timeout error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 15–11:</td><td>(reserved)</td><td></td></tr> <tr><td>bit 16:</td><td>Internal memory backup error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 17:</td><td>Sensor internal error 1</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 18:</td><td>Sensor memory communication error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 19:</td><td>n/a</td><td></td></tr> <tr><td>bit 20:</td><td>Sensor communication error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 21:</td><td>Sensor hardware error 0</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 22:</td><td>Sensor hardware error 1</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 23:</td><td>n/a</td><td></td></tr> <tr><td>bit 24:</td><td>n/a</td><td></td></tr> <tr><td>bit 25:</td><td>n/a</td><td></td></tr> <tr><td>bit 26:</td><td>n/a</td><td></td></tr> <tr><td>bit 27:</td><td>Acceleration error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 28:</td><td>Z-axis gyro error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 29:</td><td>Y-axis gyro error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 30:</td><td>X-axis gyro error</td><td>(0 = no error, 1 = error)</td></tr> <tr><td>bit 31:</td><td>n/a</td><td></td></tr> </table>					bit 0:	n/a		bit 1:	Program memory error	(0 = no error, 1 = error)	bit 2:	OD memory read error	(0 = no error, 1 = error)	bit 3:	OD memory read error	(0 = no error, 1 = error)	bit 4:	RAM read/write error	(0 = no error, 1 = error)	bit 5:	Parameter memory error	(0 = no error, 1 = error)	bit 6:	(reserved)		bit 7:	Sensor check error	(0 = no error, 1 = error)	bit 8:	n/a		bit 9:	Sensor communication error	(0 = no error, 1 = error)	bit 10:	Sensor timeout error	(0 = no error, 1 = error)	bit 15–11:	(reserved)		bit 16:	Internal memory backup error	(0 = no error, 1 = error)	bit 17:	Sensor internal error 1	(0 = no error, 1 = error)	bit 18:	Sensor memory communication error	(0 = no error, 1 = error)	bit 19:	n/a		bit 20:	Sensor communication error	(0 = no error, 1 = error)	bit 21:	Sensor hardware error 0	(0 = no error, 1 = error)	bit 22:	Sensor hardware error 1	(0 = no error, 1 = error)	bit 23:	n/a		bit 24:	n/a		bit 25:	n/a		bit 26:	n/a		bit 27:	Acceleration error	(0 = no error, 1 = error)	bit 28:	Z-axis gyro error	(0 = no error, 1 = error)	bit 29:	Y-axis gyro error	(0 = no error, 1 = error)	bit 30:	X-axis gyro error	(0 = no error, 1 = error)	bit 31:	n/a	
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bit 30:	X-axis gyro error	(0 = no error, 1 = error)																																																																																							
bit 31:	n/a																																																																																								
Description	<p>Indicates device-specific error status detected at boot-up.</p> <ul style="list-style-type: none"> • bit 7 is set when a sensor fault is detected during startup. • bit 5 is set when erasure of the parameter memory area fails. 																																																																																								

A.2.1.4 SYNC COB-ID

Index	Sub	Data Type	Access	Default Value	Save												
1005h	00h	UNSIGNED32	RW	0000 0080h	✓												
Function	SYNC message output control and SYNC COB-ID																
Data field	<table border="0" style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 10%;">bit 10–0:</td><td style="width: 40%;">SYNC COB-ID (fixed value: 0001 0000000b)</td><td style="width: 50%;"></td></tr> <tr><td>bit 29–11:</td><td>(reserved, fixed to 0)</td><td></td></tr> <tr><td>bit 30:</td><td>Generate SYNC message</td><td>0 = disabled, 1 = enabled</td></tr> <tr><td>bit 31:</td><td>(reserved, fixed to 0)</td><td></td></tr> </table>					bit 10–0:	SYNC COB-ID (fixed value: 0001 0000000b)		bit 29–11:	(reserved, fixed to 0)		bit 30:	Generate SYNC message	0 = disabled, 1 = enabled	bit 31:	(reserved, fixed to 0)	
bit 10–0:	SYNC COB-ID (fixed value: 0001 0000000b)																
bit 29–11:	(reserved, fixed to 0)																
bit 30:	Generate SYNC message	0 = disabled, 1 = enabled															
bit 31:	(reserved, fixed to 0)																

Description	Configures the SYNC producer function, enabling or disabling the transmission of SYNC messages from the unit. There must be only one SYNC producer on the CAN network. Before enabling SYNC message output (bit 30 = 1), make sure to configure the following parameters: <ul style="list-style-type: none"> • Communication cycle period (OD [1006h, 00h]) • Synchronous counter overflow value (OD [1019h, 00h]) Writing 1 to bit 30 will reset the SYNC counter to 1. Note that the SYNC COB-ID (bits 10–0) is fixed and cannot be changed.
Restriction	Attempting to write 1 to bit 30 while not in Operational mode will reject the command and return abort code 0x08000021.

A.2.1.5 Communication cycle period

Index	Sub	Data Type	Access	Default Value	Save
1006h	00h	UNSIGNED32	RW	0000 2710h	✓
Function	SYNC output cycle setting				
Data field	bit 31–0: SYNC cycle period [μs] (If set to 0000 0000h, no SYNC message will be transmitted.)				
Description	Specifies the transmission cycle of SYNC messages in microseconds. However, values below 1 ms are truncated and not applied. This OD is writable in Operational mode, However, if the SYNC producer function is already enabled (SYNC COB-ID (OD[1005h, 00h]) bit 30 = 1), the new value will not take effect until the function is disabled and then re-enabled, as recommended in the following procedure. <ol style="list-style-type: none"> 1. Switch to Pre-operational mode 2. Disable SYNC producer (OD[1005h, 00h] bit 30 = 0) 3. Write the new cycle period 4. Switch to Operational mode 5. Re-enable SYNC producer (OD[1005h, 00h] bit 30 = 1) 				
Restriction	When the SYNC producer is enabled, writing a new value to this OD has no effect. To apply the setting, the SYNC output must first be disabled and then re-enabled.				

A.2.1.6 Manufacturer device name

Index	Sub	Data Type	Access	Default Value	Save
1008h	00h	VISIBLE_STRING4	CONST	See “Data field”	–
Function	Device name				
Data field	bit 31–0: Device name G550PCxx: 3235 3547h (“G552”)				
Description	Holds the first four characters of the product model number as the device name string. This value is fixed and cannot be modified by the user.				

A.2.1.7 Manufacturer hardware version

Index	Sub	Data Type	Access	Default Value	Save
1009h	00h	VISIBLE_STRING4	CONST	See “Data field”	–
Function	Hardware version				
Data field	bit 31–0: Hardware version G552PC8x: 3038 4350h (“PC80”)				
Description	Holds the last four characters of the product model number as the hardware version string. This value is fixed and cannot be modified by the user.				

A.2.1.8 Manufacturer software version

Index	Sub	Data Type	Access	Default Value	Save
100Ah	00h	VISIBLE_STRING4	CONST	See “Data field”	–
Function	Software version				
Data field	bit 31–0: Software version 3x3y2E32h (“2.xy”)				
Description	Stores the software version embedded in the product. This value is fixed and cannot be modified by the user.				

A.2.1.9 Save all parameters

Index	Sub	Data Type	Access	Default Value	Save
1010h	01h	VISIBLE_STRING4	RW	0000 0001h	–
Function	Save parameters to non-volatile memory				
Data field	Write bit 31–0: Keyword 6576 6173h (“save”) = Save parameters Other values = Ignored				
	Read bit 31–0: (fixed at 0000 0001h)				
Description	Writing 6576 6173h (“save”) to this OD saves all current parameters stored in volatile memory to non-volatile memory, limited to those OD entries marked with a ✓ in the Save column. After the write operation, successful completion can be confirmed by the SDO response. Refer to the OD execution time for Save all parameters shown in Table 5.5. If a power interruption or other anomaly occurs during the save process, memory data may become corrupted. Therefore, ensure a stable power supply while accessing non-volatile memory. If minor data corruption is detected, the system will attempt to automatically restore factory default settings using checksum verification. If any parameter abnormalities are observed, please review and reconfigure the settings manually.				

A.2.1.10 Restore all default parameters

Index	Sub	Data Type	Access	Default Value	Save
1011h	01h	VISIBLE_STRING4	RW	0000 0001h	–
Function	Restore parameters to default values				
Data field	Write bit 31–0: Keyword 6461 6F6Ch (“load”) = Restore parameters Other values = Ignored				
	Read bit 31–0: (fixed at 0000 0001h)				
Description	Writing 6461 6F6Ch (“load”) to this OD restores all OD entries marked with ✓ in the Save column to their factory default values. Refer to the OD execution time for Restore all default parameters shown in Table 5.5. Note that this operation does not affect the current operating status, nor does it write the restored values to the non-volatile memory. To apply the restored settings, perform the following steps: 1. Save parameters to non-volatile memory (write “save” to OD[1010h, 01h]). 2. Restart the system (either power cycle the unit or issue a Reset Node command).				

A.2.1.11 TIME COB-ID

Index	Sub	Data Type	Access	Default Value	Save
1012h	00h	UNSIGNED32	CONST	8000 0100h	–
Function	COB-ID for TIME message				
Data field	bit 10–0: TIME COB-ID (fixed at 0010 0000000b) bit 30–11: (fixed at 0) bit 31: (fixed at 1)				
Description	Stores the COB-ID for TIME messages. The sensor unit always functions as a TIME consumer. This value is fixed and cannot be modified by the user.				

A.2.1.12 Producer heartbeat time

Index	Sub	Data Type	Access	Default Value	Save
1017h	00h	UNSIGNED16	RW	0000h	✓
Function	Heartbeat transmission interval setting				
Data field	bit15-0: Heartbeat cycle period [ms]				
Description	Specifies the cycle period for sending Heartbeat (HB) messages in milliseconds. Once this value is set, the unit will start outputting HB messages periodically. If set to 0000h, the Heartbeat producer function is disabled.				

A.2.1.13 Vendor ID

Index	Sub	Data Type	Access	Default Value	Save
1018h	01h	UNSIGNED32	RO	0000 0000h	–
Function	Vendor ID				
Data field	bit 31–0: Vendor ID				
Description	Indicates the vendor ID. Fixed at 0000 0000h for this unit.				

A.2.1.14 Product code

Index	Sub	Data Type	Access	Default Value	Save
1018h	02h	UNSIGNED32	RO	0018h	–
Function	Product code				
Data field	bit 31–0: Product code				
Description	Stores the product code of the unit.				

A.2.1.15 Product revision

Index	Sub	Data Type	Access	Default Value	Save
1018h	03h	UNSIGNED32	RO	0002h	–
Function	Product Revision				
Data field	Bit 31–0: Revision				
Description	Stores the revision number of the unit.				

A.2.1.16 Product serial number

Index	Sub	Data Type	Access	Default Value	Save
1018h	04h	UNSIGNED32	RO	–	–
Function	Serial number				
Data field	bit 31–0: Serial number				
Description	Stores the serial number of the unit.				

A.2.1.17 Synchronous counter overflow value

Index	Sub	Data Type	Access	Default Value	Save
1019h	00h	UNSIGNED8	RW	00h	✓
Function	Synchronous counter overflow value setting				
Data field	bit 7–0: Synchronous counter overflow value 00h = SYNC message without counter 02h–F0h = Overflow value Other values = Reserved				
Description	<p>When SYNC producer function is enabled (SYNC COB-ID (OD[1005h, 00h]) bit 30 = 1):</p> <p>If set to 00h, no counter is included in sending the SYNC message.</p> <p>If set to 02h to F0h, a counter is added when sending the SYNC message. The counter increments from 1 to the specified overflow value and then returns to 1. (Example: When set to 04h, the sequence is 1 → 2 → 3 → 4 → 1 → 2…)</p> <p>Setting bit 30 of SYNC COB-ID (OD[1005h, 00h]) to 1 resets the counter to 1.</p> <p>When synchronous TPDO mode is enabled with transmission type in OD[1800h, 02h] set to n, where n = 01 to F0h:</p> <p>If set to 00h, any counter field is ignored in the SYNC message and the TPDO is sent every n SYNCs.</p> <p>If set to 02h to F0h, the counter field in the SYNC message is used, and the TPDO is sent when the counter field is a multiple of n.</p>				
Restriction	<p>This setting can only be changed when SYNC output is disabled, i.e., the following two conditions are met:</p> <ul style="list-style-type: none"> • SYNC COB-ID (OD[1005h, 00h]) bit 30 = 0 • Communication cycle period (OD[1006h, 00h]) = 0000 0000h 				

A.2.1.18 RSDO COB-ID

Index	Sub	Data Type	Access	Default Value	Save
1200h	01h	UNSIGNED32	RO	0000 0600h + NID	–
Function	RSDO message COB-ID				
Data field	bit 10–0: RSDO COB-ID (1100 0000000b + NID) bit 31–11: (fixed at 0)				
Description	The RSDO COB-ID is uniquely determined by the node ID.				

A.2.1.19 TSDO COB-ID

Index	Sub	Data Type	Access	Default Value	Save
1200h	02h	UNSIGNED32	RO	0000 0580h + NID	–
Function	TSDO message COB-ID				
Data field	bit 10–0: TSDO COB-ID (1011 0000000b + NID) bit 31–11: (fixed at 0)				
Description	The TSDO COB-ID is uniquely determined by the node ID.				

A.2.1.20 TPDO_n COB-ID

Index	Sub	Data Type	Access	Default Value	Save
1800h 1801h 1802h 1803h	01h	UNSIGNED32	RW	4000 0180h + NID 4000 0280h + NID C000 0380h + NID C000 0480h + NID	✓
Function	TPDO _n message output control and COB-ID				
Index	1800h = TPDO1, 1801h = TPDO2, 1802h = TPDO3, 1803h = TPDO4				
Data field	bit 10–0: TPDO _n COB-ID (read only) bit 29–11: (fixed to 0) bit 30: (fixed to 1) bit 31: Validity of TPDO _n message output 0 = TPDO _n output is enabled, 1 = TPDO _n output is disabled				
Description	Enables or disables the TPDO _n message output. The TPDO _n COB-ID is uniquely determined by the node ID.				

A.2.1.21 TPDO_n transmission type

Index	Sub	Data Type	Access	Default Value	Save
1800h 1801h 1802h 1803h	02h	UNSIGNED8	RW	FEh	✓
Function	TPDO _n transmission mode				
Index	1800h = TPDO1, 1801h = TPDO2, 1802h = TPDO3, 1803h = TPDO4				
Data field	bit 7–0: TPDO _n transmission type 00h = Synchronous mode (on every SYNC message) 01h–F0h = Synchronous mode (on every n SYNC messages) FEh = Sampling mode (timer event mode) Other values = Reserved				
Description	Specifies the PDO transmission mode. <ul style="list-style-type: none"> • If set to 00h, the unit enters Synchronous mode and transmits the TPDO on every SYNC message. • If set to 01h–F0h while the Synchronous counter overflow value (OD[1019h, 00h]) is 00h, the TPDO is transmitted every n SYNC messages. • If set to 01h–F0h while the Synchronous counter overflow value (OD[1019h, 00h]) is set to a non-zero value, the TPDO is transmitted only when the SYNC counter (Cn) is a multiple of this setting. For examples, refer to section “5.14 Application of Synchronous Mode.” Ensure that the following condition is met when using this unit in Synchronous mode with SYNC counter (Cn): OD[1019h ,00h] > OD[1800h, 02h]				

	<p>If this condition is not met, TPDO messages will not be transmitted.</p> <ul style="list-style-type: none"> If set to FEh, when the unit enters Sampling mode, TPDO is triggered by internal timer events. In this case, set the sample rate using Sensor sample rate (OD[2001h, 00h]).
Restriction	<p>Only OD[1800h, 02h] can be used to set the transmission mode. OD[1801h, 02h], OD[1802h, 02h], and OD[1803h, 02h] automatically follow the setting of OD[1800h, 02h].</p> <p>FEh (Sampling mode) can only be set while in Pre-operational mode. Attempts to change this setting in other modes will return abort code 0x08000022.</p> <p>Although switching from Sampling mode to Synchronous mode is allowed, the sampling conditions will remain active unless explicitly updated. To apply synchronous conditions, transition to Pre-operational mode, configure the desired settings, and then switch to Operational mode.</p>

A.2.1.22 TPDO1 mapping

Index	Sub	Data Type	Access	Default Value	Save
1A00h	00h 01h 02h 03h 04h	UNSIGNED32	RW	04h 2100 0010h 7130 0110h 7130 0210h 7130 0310h	✓
Function	TPDO1 mapping				
Data field	<p>bit 7–0: Data size [bit]</p> <p>08h = 8 bits</p> <p>10h = 16 bits</p> <p>18h = 24 bits</p> <p>20h = 32 bits</p> <p>Other values = Ignored</p> <p>bit 15–8: Sub-index</p> <p>bit 31–16: Index</p>				
Description	<p>Shows the current mapping configuration of the TPDO1 message, which can be modified. For details of PDO mapping rules, refer to CANopen standard DS-301.</p> <p>Default TPDO1 message structure is defined as follows:</p> <p>When Gyro 16-bit mode is selected (OD[2021h, 04h] = 00h):</p> <p>Element 1 = Tc: Trigger counter OD[2100h, 00h] 16-bit data (10h)</p> <p>Element 2 = Gx: AI input PV 1 OD[7130h, 01h] 16-bit data (10h)</p> <p>Element 3 = Gy: AI input PV 2 OD[7130h, 02h] 16-bit data (10h)</p> <p>Element 4 = Gz: AI input PV 3 OD[7130h, 03h] 16-bit data (10h)</p> <p>When Gyro 24-bit mode is selected (OD[2021h, 04h] = 01h):</p> <p>Element 1 = Tc: Trigger counter OD[2100h, 00h] 16-bit data (10h)</p> <p>Element 2 = Gx: AI input PV 1 OD[8130h, 01h] 24-bit data (18h)</p> <p>Element 3 = Gy: AI input PV 2 OD[8130h, 02h] 24-bit data (18h)</p> <p>When modifying the mapping, enter the proper values according to the format described in the above “Data field” section.</p> <p>Write the number of mapped elements to Sub-index 00h. Up to 8 mapping entries are allowed. Sub-indexes up to 08h are supported and can be read even if not configured.</p> <p>Ensure the total data size does not exceed the CAN message payload limit of 64 bytes.</p> <p>To apply changes, execute Save all parameters (OD[1010h, 01h]), then perform a node reset or power cycle. Settings take effect upon restart.</p> <p>If the data field fails the following checks, the write will be treated as invalid:</p> <ul style="list-style-type: none"> Index must point to a valid OD entry. Sub-index must exist for the specified OD. <p>If the mapped OD exists and is valid, but the data size [bit] field is incorrect, the correct value will be automatically adjusted.</p>				

Restriction	<p>Sub-index 00h may only be written in Pre-operational mode. Attempts to change this setting in other modes will return abort code 0x08000022.</p> <p>If mapping content is out of range, abort code 0x06090030 is returned.</p> <p>This mapping may be automatically overwritten by the setting in Gyro resolution (OD[2021h, 04h]).</p> <p>After changing these settings, reapply custom mapping if necessary.</p>
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A.2.1.23 TPDO2 mapping

Index	Sub	Data Type	Access	Default Value	Save
1A01h	00h 01h 02h 03h 04h	UNSIGNED32	RW	04h 2100 0010h 7130 0410h 7130 0510h 7130 0610h	✓
Function	TPDO2 mapping				
Data field	bit 7–0: Data size [bit] 08h = 8 bits 10h = 16 bits 18h = 24 bits 20h = 32 bits Other values = Ignored bit 15–8: Sub-index bit 31–16: Index				
Description	<p>Shows the current mapping configuration of the TPDO2 message, which can be modified. For details of PDO mapping rules, refer to CANopen standard DS-301.</p> <p>Default TPDO2 message structure is defined as follows:</p> <ul style="list-style-type: none"> Element 1 = Tc: Trigger counter OD[2100h, 00h] 16-bit data (10h) Element 2 = Ax: AI input PV 4 OD[7130h, 04h] 16-bit data (10h) Element 3 = Ay: AI input PV 5 OD[7130h, 05h] 16-bit data (10h) Element 4 = Az: AI input PV 6 OD[7130h, 06h] 16-bit data (10h) <p>When modifying the mapping, enter the proper values according to the format described in the above “Data field” section.</p> <p>Write the number of mapped elements to Sub-index 00h. Up to 8 mapping entries are allowed.</p> <p>Sub-indexes up to 08h are supported and can be read even if not configured.</p> <p>Ensure the total data size does not exceed the CAN message payload limit of 64 bytes.</p> <p>To apply changes, execute Save all parameters (OD[1010h, 01h]), then perform a node reset or power cycle. Settings take effect upon restart.</p> <p>If the data field fails the following checks, the write will be treated as invalid:</p> <ul style="list-style-type: none"> • Index must point to a valid OD entry. • Sub-index must exist for the specified OD. <p>If the mapped OD exists and is valid, but the data size [bit] field is incorrect, the correct value will be automatically adjusted.</p>				
Restriction	<p>Sub-index 00h may only be written in Pre-operational mode. Attempts to change this setting in other modes will return abort code 0x08000022.</p> <p>If mapping content is out of range, abort code 0x06090030 is returned.</p>				

A.2.1.24 TPDO3 mapping

Index	Sub	Data Type	Access	Default Value	Save																					
1A02h	00h 01h 02h 03h 04h	UNSIGNED32	RW	04h 2100 0010h 7130 0710h 2022 0410h 2022 0110h	✓																					
Function	TPDO3 mapping																									
Data field	bit 7–0: Data size [bit] 08h = 8 bits 10h = 16 bits 18h = 24 bits 20h = 32 bits Other values = Ignored bit 15–8: Sub-index bit 31–16: Index																									
Description	<p>Shows the current mapping configuration of the TPDO3 message, which can be modified. For details of PDO mapping rules, refer to CANopen standard DS-301.</p> <p>Default TPDO3 message structure is defined as follows:</p> <p>In Gyro 16-bit mode (OD[2021h, 04h] = 00h):</p> <table> <tr> <td>Element 1 = Tc:</td> <td>Trigger counter OD[2100h, 00h]</td> <td>16-bit data (10h)</td> </tr> <tr> <td>Element 2 = Temp:</td> <td>AI input PV 7 OD[7130, 07h]</td> <td>16-bit data (10h)</td> </tr> <tr> <td>Element 3 = Reserved:</td> <td>OD[2022h, 04h]</td> <td>16-bit data (10h)</td> </tr> <tr> <td>Element 4 = STS:</td> <td>Sensor range over status information OD[2022h, 01h]</td> <td>16-bit data (10h)</td> </tr> </table> <p>In Gyro 24-bit mode (OD[2021h, 04h] = 01h):</p> <table> <tr> <td>Element 1 = Tc:</td> <td>Trigger counter OD[2100h, 00h]</td> <td>16-bit data (10h)</td> </tr> <tr> <td>Element 2 = Temp:</td> <td>AI input PV 7 OD[7130h, 07h]</td> <td>16-bit data (10h)</td> </tr> <tr> <td>Element 3 = Gz:</td> <td>AI input PV 3 OD[8130h, 03h]</td> <td>24-bit data (18h)</td> </tr> </table> <p>When modifying the mapping, enter the proper values according to the format described in the above “Data field” section.</p> <p>Write the number of mapped elements to Sub-index 00h. Up to 8 mapping entries are allowed. Sub-indexes up to 08h are supported and can be read even if not configured.</p> <p>Ensure the total data size does not exceed the CAN message payload limit of 64 bytes.</p> <p>To apply changes, execute Save all parameters (OD[1010h, 01h]), then perform a node reset or power cycle. Settings take effect upon restart.</p> <p>If the data field fails the following checks, the write will be treated as invalid:</p> <ul style="list-style-type: none"> • Index must point to a valid OD entry. • Sub-index must exist for the specified OD. <p>If the mapped OD exists and is valid, but the data size [bit] field is incorrect, the correct value will be automatically adjusted.</p>					Element 1 = Tc:	Trigger counter OD[2100h, 00h]	16-bit data (10h)	Element 2 = Temp:	AI input PV 7 OD[7130, 07h]	16-bit data (10h)	Element 3 = Reserved:	OD[2022h, 04h]	16-bit data (10h)	Element 4 = STS:	Sensor range over status information OD[2022h, 01h]	16-bit data (10h)	Element 1 = Tc:	Trigger counter OD[2100h, 00h]	16-bit data (10h)	Element 2 = Temp:	AI input PV 7 OD[7130h, 07h]	16-bit data (10h)	Element 3 = Gz:	AI input PV 3 OD[8130h, 03h]	24-bit data (18h)
Element 1 = Tc:	Trigger counter OD[2100h, 00h]	16-bit data (10h)																								
Element 2 = Temp:	AI input PV 7 OD[7130, 07h]	16-bit data (10h)																								
Element 3 = Reserved:	OD[2022h, 04h]	16-bit data (10h)																								
Element 4 = STS:	Sensor range over status information OD[2022h, 01h]	16-bit data (10h)																								
Element 1 = Tc:	Trigger counter OD[2100h, 00h]	16-bit data (10h)																								
Element 2 = Temp:	AI input PV 7 OD[7130h, 07h]	16-bit data (10h)																								
Element 3 = Gz:	AI input PV 3 OD[8130h, 03h]	24-bit data (18h)																								
Restriction	<p>Sub-index 00h may only be written in Pre-operational mode. Attempts to change this setting in other modes will return abort code 0x08000022.</p> <p>If mapping content is out of range, abort code 0x06090030 is returned.</p> <p>This mapping may be automatically overwritten by the setting in Gyro resolution (OD[2021h, 04h]).</p> <p>After changing these settings, reapply custom mapping if necessary.</p>																									

A.2.1.25 TPDO4 mapping

Index	Sub	Data Type	Access	Default Value	Save
1A03h	00h 01h 02h 03h	UNSIGNED32	RW	03h 2100 0010h 2101 0220h 2101 0110h	✓
Function	TPDO4 mapping				
Data field	bit 7–0: Data size [bit] 08h = 8 bits 10h = 16 bits 18h = 24 bits 20h = 32 bits Other values = Ignored bit 15–8: Sub-index bit 31–16: Index				
Description	<p>Shows the current mapping configuration of the TPDO4 message, which can be modified. For details of PDO mapping rules, refer to CANopen standard DS-301.</p> <p>Default TPDO4 message structure is defined as follows: Element 1 = Tc: Trigger counter OD[2100h, 00h] 16-bit data (10h) Element 2 = Ms: Time difference OD[2101h, 02h] 32-bit data (20h) Element 3 = Dy: Time of day OD[2101h, 01h] 16-bit data (10h)</p> <p>When modifying the mapping, enter the proper values according to the format described in the above “Data field” section.</p> <p>Write the number of mapped elements to Sub-index 00h. Up to 8 mapping entries are allowed. Sub-indexes up to 08h are supported and can be read even if not configured.</p> <p>Ensure the total data size does not exceed the CAN message payload limit of 64 bytes. To apply changes, execute Save all parameters (OD[1010h, 01h]), then perform a node reset or power cycle. Settings take effect upon restart.</p> <p>If the data field fails the following checks, the write will be treated as invalid:</p> <ul style="list-style-type: none"> • Index must point to a valid OD entry. • Sub-index must exist for the specified OD. <p>If the mapped OD exists and is valid, but the data size [bit] field is incorrect, the correct value will be automatically adjusted.</p>				
Restriction	Sub-index 00h may only be written in Pre-operational mode. Attempts to change this setting in other modes will return abort code 0x08000022. If mapping content is out of range, abort code 0x06090030 is returned.				

A.2.1.26 NMT startup mode

Index	Sub	Data Type	Access	Default Value	Save
1F80h	00h	UNSIGNED32	RW	0000 0008h	✓
Function	NMT startup mode				
Data field	bit 1–0: (fixed to 0) bit 2: Startup mode 0 = Automatically enter Operational mode 1 = Stay in Pre-operational mode bit 3: (fixed to 1) bit 31–4: (fixed to 0)				
Description	Selects the initial NMT mode at startup. If bit 2 is set to 0, the unit first enters Pre-operational mode, sends a boot-up message, and then automatically transitions to Operational mode. Refer to Table 1.7 for the transition time from Pre-operational to Operational mode.				

A.2.2 Manufacture Profile

A.2.2.1 CAN node-ID

Index	Sub	Data Type	Access	Default Value	Save
2000h	01h	UNSIGNED8	RW	01h	✓
Function	CAN node-ID				
Data field	bit 7–0: CAN node-ID 01h–7Fh = Node-ID Other values = Ignored (returns abort code: 0x06090030)				
Description	The CAN node ID can be read or modified. To change the node ID, save the parameters using Save all parameters (OD [1010h, 01h]) after writing to this OD, then execute the Reset Node command or power-cycle the unit. The new CAN node ID will take effect after the restart.				
Restriction	The CAN node ID can only be changed in Pre-operational mode. Attempts to change this setting in other modes will return abort code 0x08000022.				

A.2.2.2 CAN bitrate

Index	Sub	Data Type	Access	Default Value	Save
2000h	02h	UNSIGNED8	RW	03h	✓
Function	CAN bitrate				
Data field	bit 7–0: CAN bitrate 00h = 1 Mbps 01h = 800 kbps 02h = 500 kbps 03h = 250 kbps 04h = 125 kbps 05h = 50 kbps 06h = 20 kbps 07h = 10 kbps 08h = 100 kbps Other values = Ignored (returns abort code: 0x06090030)				
Description	The CAN bitrate can be read or modified. To change the CAN bitrate, save the parameters using Save all parameters (OD [1010h, 01h]) after writing to this OD, then execute the Reset Node command or power-cycle the unit. The new CAN bitrate will take effect after the restart.				
Restriction	The CAN bitrate can only be changed in Pre-operational mode. Attempts to change this setting in other modes will return abort code 0x08000022.				

A.2.2.3 Sensor sample rate

Index	Sub	Data Type	Access	Default Value	Save
2001h	00h	UNSIGNED8(32)	RW	0Ah	✓
Function	Sensor sample rate				
Data field	bit 7–0: Sensor sample rate 01h = 1000 sps 02h = 500 sps 03h = 250 sps 04h = 125 sps 05h = 62.5 sps 06h = 31.25 sps 07h = 15.625 sps 08h = 400 sps 09h = 200 sps 0Ah = 100 sps 0Bh = 80 sps 0Ch = 50 sps 0Dh = 40 sps 0Eh = 25 sps 0Fh = 20 sps Other values = Ignored (returns abort code: 0x06090030)				
Description	The sensor sample rate can be read or modified. When the sample rate is set to a value, the filter setting will automatically be adjusted to the default filter setting if the sample rate is set to a value that is inconsistent with the filter setting. After changing the sample rate, please reconfigure the filter settings accordingly. For details on filters, refer to "5.10 Filter," and for filter configuration, see "A.2.3.8 AI filter tap constant 1."				
Restriction	The sensor sample rate can only be changed in Pre-operational mode. Attempts to change this setting in other modes will return abort code 0x08000022. The changed setting will take effect after switching to Operational mode. If the sample rate is set to a value inconsistent with the filter cutoff frequency, abort code 0x08000021 will be returned. For details on compatibility between the sample rate and filter settings, refer to Table 5.11.				

A.2.2.4 Acc dynamic range

Index	Sub	Data Type	Access	Default Value	Save
2021h	03h	UNSIGNED8	RW	00h	✓
Function	Accelerometer dynamic range				
Data field	bit 7–0: Accelerometer dynamic range 00h = ±8G 01h = ±16G Other values = Ignored (returns abort code: 0x06090030)				
Description	Specifies the dynamic range of the accelerometer.				
Restriction	This setting can only be changed in Pre-operational mode. Attempts to change this setting in other modes will return abort code 0x08000022.				

A.2.2.5 Gyroscope resolution

Index	Sub	Data Type	Access	Default Value	Save
2021h	04h	UNSIGNED8	RW	00h	✓
Function	Gyroscope output resolution				
Data field	bit 7–0: Gyroscope output resolution 00h = 16 bits (Gyro 16-bit mode) 01h = 24 bits (Gyro 24-bit mode) Other values = Ignored (returns abort code: 0x06090030)				
Description	Specifies the output resolution of the gyroscope.				
Restriction	This setting can only be changed in Pre-operational mode. Attempts to change this setting in other modes will return abort code 0x08000022. Changing the gyroscope resolution will forcibly overwrite the TPDO1 mapping (OD[1A00h, 02h–04h]) and TPDO3 mapping (OD[1A02h, 00h–04h]). If a non-default TPDO mapping is desired, re-mapping is required after the change.				

A.2.2.6 Sensor range over status information

Index	Sub	Data Type	Access	Default Value	Save
2022h	01h	UNSIGNED16	RO	0000h	–
Function	Built-in sensor range over status information				
Data field	bit 0–7: (reserved) bit 8: ZACCL Range Over flag (0 = no error, 1 = error) bit 9: YACCL Range Over flag (0 = no error, 1 = error) bit 10: XACCL Range Over flag (0 = no error, 1 = error) bit 11: ZGyro Range Over flag (0 = no error, 1 = error) bit 12: YGyro Range Over flag (0 = no error, 1 = error) bit 13: XGyro Range Over flag (0 = no error, 1 = error) bit 14: (reserved) bit 15: (reserved)				
Description	This unit supports notifications when a range-over condition is detected in the sensor data. The host can check for range over occurrences by reading this OD. The threshold values for range over detection are as follows: Gyroscope: ±450 [deg/s] Accelerometer: ±7.5 [G] (for output range ±8 G, OD[2021h, 03h] = 00h) ±15 [G] (for output range ±16 G, OD[2021h, 03h] = 01h) Detection is performed by the "Range Over" block in the processing order as shown in Figure 4.3. Error flags are automatically cleared at each sampling timing.				

A.2.2.7 Trigger counter

Index	Sub	Data Type	Access	Default Value	Save
2100h	00h	UNSIGNED16	RW	0000h	–
Function	Trigger counter value				
Data field	bit 15–0: Count value (0 to 65535)				
Description	The trigger counter increments each time a trigger is received (either a SYNC message or a timer event). The trigger counter can be started from a specific value by writing that value to this OD entry.				

A.2.2.8 Time of day

Index	Sub	Data Type	Access	Default Value	Save
2101h	01h	UNSIGNED16	RO	Undefined	–
Function	Current date				
Data field	bit 15–0: Number of days since January 1, 1984				
Description	Indicates the number of days elapsed since January 1, 1984.				

A.2.2.9 Time difference

Index	Sub	Data Type	Access	Default Value	Save
2101h	02h	UNSIGNED32	RO	Undefined	–
Function	Current time (milliseconds)				
Data field	bit 27–0: Elapsed milliseconds since 0:00 a.m. (midnight) bit 31–28: (fixed at 0)				
Description	Indicates the number of milliseconds that have elapsed since 0:00 a.m. (midnight) in local time.				

A.2.3 Measuring Device Profile (DS-404)**A.2.3.1 AI sensor type 1–3**

Index	Sub	Data Type	Access	Default Value	Save
6110h	01h 02h 03h	UNSIGNED16	CONST	28A1h	–
Function	Sensor type for analog inputs 1–3				
Data field	bit 15–0: Sensor type 28A1h (10401) = Gyroscope (manufacture-specific)				
Description	Indicates the type of sensor connected to each analog input (AI1 to AI3). This value is fixed and cannot be changed.				

A.2.3.2 AI sensor type 4–6

Index	Sub	Data Type	Access	Default Value	Save
6110h	04h 05h 06h	UNSIGNED16	CONST	2905h	–
Function	Sensor type for analog inputs 4–6				
Data field	bit 15–0: Sensor type 2905h (10501) = Accelerometer (manufacture-specific)				
Description	Indicates the type of sensor connected to each analog input (AI4 to AI6). This value is fixed and cannot be changed.				

A.2.3.3 AI sensor type 7

Index	Sub	Data Type	Access	Default Value	Save
6110h	07h	UNSIGNED16	CONST	0064h	–
Function	Sensor type for analog input 7				
Data field	bit 15–0: Sensor type 0064h (100) = Temperature				
Description	Indicates the type of sensor connected to the analog input (AI7). This value is fixed and cannot be changed.				

A.2.3.4 AI physical unit PV 1–3

Index	Sub	Data Type	Access	Default Value	Save
6131h	01h 02h 03h	UNSIGNED32	CONST	0041 0300h	–
Function	Physical unit identifier for analog inputs 1–3				
Data field	bit 31–0: Physical unit 0041 0300h = deg/s				
Description	Indicates the physical unit associated with the process value (PV) for analog inputs 1 to 3 (AI1–AI3). This value is fixed and cannot be changed. The unit represents angular velocity in degrees per second.				

A.2.3.5 AI physical unit PV 4–6

Index	Sub	Data Type	Access	Default Value	Save
6131h	04h 05h 06h	UNSIGNED32	CONST	FDF1 0000h	–
Function	Physical unit identifier for analog inputs 4–6				
Data field	bit 31–0: Physical unit FDF1 0000h = mG				
Description	Indicates the physical unit associated with the process value (PV) for analog inputs 4 to 6 (AI4–AI6). This value is fixed and cannot be changed. The unit represents acceleration in milliG.				

A.2.3.6 AI physical unit PV 7

Index	Sub	Data Type	Access	Default Value	Save
6131h	07h	UNSIGNED32	CONST	002D 0000h	–
Function	Physical unit identifier for analog input 7				
Data field	bit 31–0: Physical unit 002D 0000h = °C				
Description	Indicates the physical unit associated with the process value (PV) for analog input 7 (AI7). This value is fixed and cannot be changed. The unit represents temperature in degrees Celsius.				

A.2.3.7 AI filter type 1–7

Index	Sub	Data Type	Access	Default Value	Save
61A0h	01h 02h 03h 04h 05h 06h 07h	UNSIGNED8	CONST	02h	–
Function	Filter type for analog inputs 1 to 7				
Data field	bit 7–0: filter type 02h = Manufacturer-specific filter				
Description	Indicates the filter type applied to analog inputs 1 to 7 (AI1 to AI7). This value is fixed to 02h, corresponding to a manufacturer-specific filter, and cannot be changed.				

A.2.3.8 AI filter tap constant 1

Index	Sub	Data Type	Access	Default Value	Save
61A1h	01h	UNSIGNED8	RW	08h	✓
Function	Filter setting for analog inputs				
Data field	bit 7-0: Filter tap constant 00h = Setting not allowed 01h = tap 2 02h = tap 4 03h = tap 8 04h = tap 16 05h = tap 32 06h = tap 64 07h = tap 128 08h = FIR tap 32 fc 50 09h = FIR tap 32 fc 100 0Ah = FIR tap 32 fc 200 0Bh = FIR tap 32 fc 400 0Ch = FIR tap 64 fc 50 0Dh = FIR tap 64 fc 100 0Eh = FIR tap 64 fc 200 0Fh = FIR tap 64 fc 400 10h = FIR tap 128 fc 50 11h = FIR tap 128 fc 100 12h = FIR tap 128 fc 200 13h = FIR tap 128 fc 400 Other values = Ignored (returns abort code: 0x06090030)				
Description	This OD defines the filter setting applied to the sensor signal. It is uniformly applied to all analog input channels. The supported filter settings for each sensor sample rate are described in detail in "5.10 Filter."				
Restriction	This setting can only be changed in Pre-operational mode. Attempts to change this setting in other modes will return abort code 0x08000022. Additionally, valid settings depend on the sample rate (OD[2001h, 00h]), so be sure to match the filter tap value accordingly. If the specified value is incompatible with the sample rate, abort code 0x08000021 will be returned and the filter is automatically changed to the default filter setting for the selected sensor sample rate. Refer to Table 5.11 for compatible conditions.				

A.2.3.9 AI filter tap constant 2–7

Index	Sub	Data Type	Access	Default Value	Save
61A1h	02h 03h 04h 05h 06h 07h	UNSIGNED8	RO	08h	–
Function	Filter tap count for analog inputs				
Data field	Same as OD[61A1h, 01h]				
Description	The values for AI filter tap constants 2–7 reflect the setting of AI filter tap constant 1 (OD[61A1h, 01h]).				

A.2.3.10 AI input PV 1–3 (Gx / Gy / Gz)

Index	Sub	Data Type	Access	Default Value	Save
7130h	01h 02h 03h	INTEGER16	RO	Undefined	–
Function	Measurement values of analog inputs 1–3 (Gx / Gy / Gz)				
Data field	bit 15–0: Process value (-32768 to 32767)				
Description	Indicates the measured data for each axis (Gx, Gy, Gz) of the 3-axis gyroscope.				

A.2.3.11 AI input PV 4–6 (Ax / Ay / Az)

Index	Sub	Data Type	Access	Default Value	Save
7130h	04h 05h 06h	INTEGER16	RO	Undefined	–
Function	Measurement values of analog inputs 4–6 (Ax / Ay / Az)				
Data field	bit 15–0: Process value (-32768 to 32767)				
Description	Indicates the measured data for each axis (Ax, Ay, Az) of the 3-axis accelerometer.				

A.2.3.12 AI input PV 7

Index	Sub	Data Type	Access	Default Value	Save
7130h	07h	INTEGER16	RO	Undefined	–
Function	Measurement value of analog input 7 (Te)				
Data field	bit 15–0: Process value (-32768 to 32767)				
Description	Indicates the measured data (Te) from the temperature sensor. The actual temperature [°C] is calculated using the following formula: $T [^{\circ}\text{C}] = 0.00390625 \times \text{Te} + 25$				

A.2.3.13 AI input PV 1–3 (24-bit Gx / Gy / Gz data)

Index	Sub	Data Type	Access	Default Value	Save
8130h	01h 02h 03h	INTEGER24	RO	Undefined	–
Function	Measurement values of analog inputs 1–3 (Gx / Gy / Gz)				
Data field	bit 23–0: Process value (-8388608 to 8388607)				
Description	Indicates the 24-bit measured data for each axis (Gx, Gy, Gz) of the 3-axis gyroscope.				

A.2.3.14 AI input PV 4–6 (24-bit Ax/Ay/Az data)

Index	Sub	Data Type	Access	Default Value	Save
8130h	04h 05h 06h	INTEGER24	RO	Undefined	–
Function	Measurement values of analog inputs 4–6 (Ax / Ay / Az)				
Data field	bit 23–0: Process value (-8388608 to 8388607)				
Description	Indicates the 24-bit measured data for each axis (Ax, Ay, Az) of the 3-axis accelerometer.				

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