AksIM-4™ HIPERFACE DSL®
application and integration guide

Abstract: This application note provides detailed guidance on the configuration, operation, and diagnostics of the AksIM-4™ HIPERFACE DSL® off-axis absolute magnetic encoder. It supplements the product datasheet by describing system architecture, resource database access, and custom resource implementation. Practical information is included to support integration, including calibration procedures, signal monitoring, and error handling. This document is intended for developers, system integrators, and advanced users who are integrating AksIM- 4™ HIPERFACE DSL® encoder systems into industrial automation and robotics applications.

This document applies to part numbers MC053HLA***VJH00 and MC080HLA***TJH00.

Related products



AksIM-4™ HIPERFACE DSL®
off-axis rotary absolute
magnetic encoder

Introduction

Objective

The purpose of this document is to provide additional technical information on the AksIM-4™ HIPERFACE DSL® (AksIM HDSL) encoder system, including installation, configuration, calibration, operation, and diagnostics.
For additional product information, refer to the data sheet MCD06 available at **RLS Media center** or **contact RLS**.

Scope

This document applies only to the AksIM-4™ HIPERFACE DSL® encoder variant. For information on other AksIM-4™ variants or RLS products, refer to the data sheet MCD06 available at **RLS Media center** or **contact RLS**.

Glossary

D/R	Direct / read
D/W	Direct / write
HDSL®	High-performance Digital Servo Link
I/R	Indirect / read
I/W	Indirect / write
MCU	Microcontroller unit (also referred to as microprocessor)
MFB	Motor feedback; SICK-specific terminology to denote an HDSL slave device as a whole; MFB MCU refers to the specific MCU of AksIM HDSL responsible for resource database management and error reporting.
RA	Register access
RDB	Resource database
SFE	Sensor front-end; part of the AksIM HDSL responsible for capturing and decoding position information, running on a dedicated MCU.

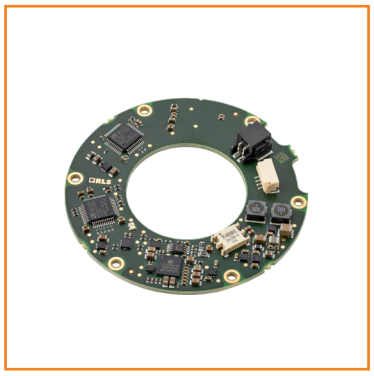
System overview

The AksIM HDSL is an absolute, quasi-true multiturn rotary magnetic encoder that provides position information to control devices using SICK HIPERFACE DSL® technology [1]. It is primarily intended for use in industrial automation and robotics applications, although it may also be used in any suitable environment supporting HIPERFACE DSL®.

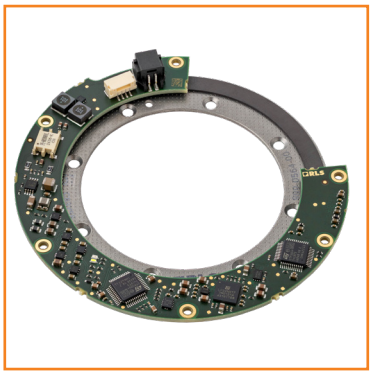
The encoder system consists of an information carrier ring and a sensing PCB.

The AksIM HDSL is currently available in two sizes, with diameters of 53 mm or 80 mm.

For mounting dimensions, environmental conditions and electrical specifications, refer to the data sheet MCD06 available at **RLS Media center**.



Size 53 mm



Size 80 mm

Architecture

The system architecture follows the prescribed SICK structure, as detailed in [1]. The MFB MCU manages the resource database and error reporting, while the SFE is responsible for position acquisition and decoding.

Resource database

The HIPERFACE DSL® resource database (RDB) enables users to access information about the motor feedback system (MFB) using the long message protocol.

Resource index

Supported AksIM HDSL RDB entries

RID	Name	Time overrun [ms]	Description
0x000	ROOT	25	Top/root node of resource tree.
0x001	IDENT	25	Node for accessing all identification resources.
0x002	MONITOR	25	Node for accessing all monitoring resources.
0x003	ADMIN	25	Node for accessing all administration resources.
0x005	DATA	25	Node for accessing file system.
0x006	SENSHUB	25	Node for accessing MFB I/O.
0x007	PRODUCTN	25	Node for accessing production dependent resources.
0x080	ENCTYPE	25	Basic properties of encoder.
0x081	RESOLUTN	25	Encoder's singleturn resolution.
0x082	RANGE	25	Encoder multiturn range.
0x083	TYPECODE	25	Type code name of the MFB.
0x084	SERIALNO	25	Serial number of HDSL slave product.
0x085	FWREVNO	25	firmware and hardware revision number of HDSL slave product.
0x086	FWDATE	25	Firmware date of HDSL slave product.
0x087	EESIZE	25	Size of non-volatile memory for storing user files.
0x0C0	TEMPRNG	25	Min and max temperature value for HDSL slave product.
0x0C1	TEMPRTUR	25	Current temeprature at the sensor.
0x0C4	SUPRANGE	25	Minimum and maximum permitted values of supply voltage.
0x0C5	SUPVOLT	25	Measured supply voltage of DSL MFB.
0x0C6	SPEEDRNG	25	Maximum permitted rotation speed of encoder.
0x0C7	SPEED	25	Measured velocity in RPM.
0x0CB	LIFETIME	50	Counts lifetime of encoder in minutes.
0x0CC	ERRORLOG	50	System errors logging.
0x0D5	ERRORLOGFI	50	Selective disabling of error logging.
0x0D6	SIGLVL	25	Signal level
0x0D7	DETSTAT	25	Detailed status
0x0D8	MINDIST	25	Minimal distance of decoding point from decoding warning threshold.
0x100	RESET	25	MFB processor is in the process of reset or shut down.
0x101	SETPOS	75	Setting position offset.
0x104	SETACCES	25	RDB access levels that governs which resources are available.
0x105	CHNGEKEY	150	Used to change access keys (password) required to set appropriate access level.
0x108	FACTRST	2000	Resets MFB mcu, file system or encoder configuration to factory settings.
0x109	ENCIDENT	60	User defined MFB index.
0x113	MT_INFO	25	Multiturn specific data and functionality.
0x114	SELFCAL	2000	Self calibration specific data and functionality.

RID	Name	Time overrun [ms]	Description
0x115	CFGBLOCK	25	Encoder's configuration block.
0x130	LOADFILE	2000	Resource allows loading existing file before accessing it.
0x131	RWFILE	2000	Resource allows reading/writing to an existing file.
0x132	FILESTAT	2000	Resource shall indicate status of the loaded file.
0x133	MAKEFILE	2000	Resource shall create new file, change status of a file or delete existing file.
0x134	DIR	2000	Resource indicates number of files, free and user memory and user file names.
0x180	EOLT	25	Reserved for internal use during production
0x200	ACCESSIO	25	Resource containing external temperature sensor measurement in ohms).

Detailed descriptions of AksIM HDSL optional and custom resources

This section provides detailed descriptions of optional and custom resources implemented in the AksIM HDSL. Resources not described here are mandatory resources defined by SICK. Their descriptions can be found in the **SICK HIPERFACE DSL® documentation**.

Lifetime counter

This resource provides the encoder lifetime value in minutes.

Lifetime counter resource properties

RDB entry qualifier	Value
Resource type	SYS_EEPROM (4)
RID	0x0CB
Address	Data storage address
Start	N/A
Size	8
W	15
R	0
Timeout	MFB-specific
Name	"LIFETIME"
Resource data type	unsigned 32 (5)
Profile requirement	Optional

Lifetime counter resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"LIFETIME"	Resource name
0001h	2	D/R	-	8	Data size
0002h	2	D/R	-	0	Read access level
0003h	2	D/R	-	15	Write access level
0004h	2	D/R	-	xx	Timeout
0005h	2	D/R	-	5	Data type - u32
0000h	4	I/R	-	"xxxxxxxx"	Lifetime of encoder in minutes
0000h	0, 2, 8	I/R	-	"xxxxxxxx"	Lifetime of encoder in minutes , 4 MSB bytes are 0 (Shaft rotations currently not supported)
0004h	4	I/R	-	"00000000"	Shaft rotations (Currently not supported, zero returned)
0004h	0, 2, 8	I/R	-	Error: 11 40	Incorrect length
0000h	0 - 8	I/W	"xx"	Error: 10 41	Write access not possible
0001h - 7FFFh	0 - 8	I/R	-	Error: 13 40	Offset value to high
0001h - 7FFFh	0 - 8	I/W	"xx"	Error: 13 40	Offset value to high

Error log

This resource provides error logging functionality for errors detected by the MFB.

Error log resource properties

RDB entry qualifier	Value
Resource type	Function pointer (7)
RID	0x0CC
Address	Data storage address
Start	N/A
Size	8
W	15
R	0
Timeout	MFB-specific
Name	"ERRORLOG"
Resource data type	struct 16 bytes (32)
Profile requirement	Optional

Error log resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"ERRORLOG"	Resource name
0001h	2	D/R	-	8	Data size
0002h	2	D/R	-	0	Read access level
0003h	2	D/R	-	15	Write access level
0004h	2	D/R	-	50	Timeout
0005h	2	D/R	-	32	Data type: struct 16 bytes
0000h	0, 2, 4, 8	I/R	-	"xxxxxxxx"	Number of valid entries (max. 8)
0001h	8	I/R	-	"xxxxxxxx"	First 8 bytes of newest entry
0101h	8	I/R	-	"xxxxxxxx"	Second 8 bytes of newest entry
0002h	8	I/R	-	"xxxxxxxx"	First 8 bytes of second entry
0102h	8	I/R	-	"xxxxxxxx"	Second 8 bytes of second entry
0003h	8	I/R	-	"xxxxxxxx"	First 8 bytes of third entry
0103h	8	I/R	-	"xxxxxxxx"	Second 8 bytes of third entry
0004h	8	I/R	-	"xxxxxxxx"	First 8 bytes of fourth entry
0104h	8	I/R	-	"xxxxxxxx"	Second 8 bytes of fourth entry
0005h	8	I/R	-	"xxxxxxxx"	First 8 bytes of fifth entry
0105h	8	I/R	-	"xxxxxxxx"	Second 8 bytes of fifth entry
0006h	8	I/R	-	"xxxxxxxx"	First 8 bytes of sixth entry
0106h	8	I/R	-	"xxxxxxxx"	Second 8 bytes of sixth entry
0007h	8	I/R	-	"xxxxxxxx"	First 8 bytes of seventh entry
0107h	8	I/R	-	"xxxxxxxx"	Second 8 bytes of seventh entry
0008h	8	I/R	-	"xxxxxxxx"	First 8 bytes of oldest entry
0108h	8	I/R	-	"xxxxxxxx"	Second 8 bytes of oldest entry
0001h - 7FFFh	0 - 8	I/R		Error: 14 40	Invalid offset
0000h - 7FFFh	0 - 8	I/W	"xx"	Error: 10 41	Write access not permitted

For more information refer to the chapter **Error log**.

Error log filter

This resource controls which encoder status (ENC_ST) errors are captured in the error log.

ERRLOGFI resource properties

RDB entry qualifier	Value
Resource type	Function pointer (7)
RID	0x0D5
Address	Data storage address
Start	N/A
Size	2
W	4
R	0
Timeout	MFB-specific
Name	"ERRLOGFI"
Resource data type	Unsigned 16 (4)
Profile requirement	Optional

ERRLOGFI resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"ERRLOGFI"	Resource name
0001h	2	D/R	-	2	Data size
0002h	2	D/R	-	0	Read access level
0003h	2	D/R	-	4	Write access level
0004h	2	D/R	-	50	Timeout
0005h	2	D/R	-	4	Data type - unsigned 16
0000h	2	I/R	-	"xxxx"	Error log filter value
0000h	0, 4, 8	I/R	-	Error: 11 40	Incorrect length
0000h	2	I/W	"xxxx"	-	Set new error log filter value
0000h	0, 4, 8	I/W	"xxxx"	Error: 11 40	Incorrect length
0000h	2	I/W	data != 0x0000 or data != 0x0050	Error: 15 40	Invalid data
0000h	2	I/W	"xxxx" (acc.lvl < 4)	Error: 12 41	Write access denied
0001h - 7FFFh	0 - 8	I/R	-	Error: 14 40	Invalid offset
0001h - 7FFFh	0 - 8	I/W	"xxxx"	Error: 14 40	Invalid offset

For more information refer to the chapter **Error log filter**.

Signal level

This resource provides the encoder signal level and ride height values.

Signal level resource properties

RDB entry qualifier	Value
Resource type	Function pointer (7)
RID	0x0D6
Address	Data storage address
Start	N/A
Size	4
W	15
R	0
Timeout	MFB-specific
Name	"SIGLVL"
Resource data type	struct 12 bytes (28)
Profile requirement	Optional

Signal level resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"SIGLVL"	Resource name
0001h	2	D/R	-	4	Data size
0002h	2	D/R	-	0	Read access level
0003h	2	D/R	-	15	Write access level
0004h	2	D/R	-	xx	Timeout
0005h	2	D/R	-	28	Data type - struct 12 bytes
0000h	4	I/R	-	"xxxxxxxx"	Signal level value
0001h	2	I/R	-	"xxxx"	Ride height K value
0002h	2	I/R	-	"xxxx"	Ride height N value
0003h	4	I/R	-	"xxxxxxxx"	Ride height in µm
0000h, 0003h	0, 2, 8	I/R	-	Error: 11 40	Incorrect length
0001h, 0002h	0, 4, 8	I/R	-	Error: 11 40	Incorrect length
0000h	0 - 8	I/W	"xx"	Error: 10 41	Write access not possible
0004h - 7FFFh	0 - 8	I/R	-	Error: 13 40	Offset value to high
0001h - 7FFFh	0 - 8	I/W	"xx"	Error: 13 40	Offset value to high

For more information refer to the chapter **Signal level**.

Speed

This resource provides the encoder's velocity value.

Speed resource properties

RDB entry qualifier	Value
Resource type	Function pointer (7)
RID	0x0C7
Address	Data storage address
Start	N/A
Size	2
W	15
R	0
Timeout	MFB-specific
Name	"SPEED"
Resource data type	Unsigned 16-bit (4)
Profile requirement	Optional

Speed resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"SPEED"	Resource name
0001h	2	D/R	-	2	Data size
0002h	2	D/R	-	0	Read access level
0003h	2	D/R	-	15	Write access level
0004h	2	D/R	-	xx	Timeout
0005h	2	D/R	-	4	Data type: u16
0000h	2	I/R	-	"xxxx"	Speed value in rpm
0000h	0, 4, 8	I/R	-	Error: 11 40	Incorrect length
0000h	0 - 8	I/W	"xx"	Error: 10 41	Write access not permitted
0001h - 7FFFh	0 - 8	I/R	-	Error: 13 40	Offset value too high
0001h - 7FFFh	0 - 8	I/W	"xx"	Error: 13 40	Offset value too high

Detailed status

This resource provides the encoder's persistent detailed status.

Detailed status resource properties

RDB entry qualifier	Value
Resource type	Function pointer (7)
RID	0x0D7
Address	Data storage address
Start	N/A
Size	8
W	0
R	0
Timeout	MFB-specific
Name	"DETSTAT"
Resource data type	Unsigned 32-bit (5)
Profile requirement	Optional

Detailed status resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"DETSTAT"	Resource name
0001h	2	D/R	-	4	Data size
0002h	2	D/R	-	0	Read access level
0003h	2	D/R	-	0	Write access level
0004h	2	D/R	-	xx	Timeout
0005h	2	D/R	-	5	Data type: u32
0000h	4	I/R	-	"xxxxxxxx"	Persistent detailed status
0000h	0, 2, 8	I/R	-	Error: 11 40	Incorrect length
0000h	0	I/W	-	-	Reset persistent detailed status
0000h	2, 4, 8	I/W	"xxxxxxx"	Error: 11 40	Incorrect length
0001h	4	I/R	-	"xxxxxxxx"	Detailed status
0001h	0, 2, 8	I/R	-	Error: 11 40	Incorrect length
0001h	0 - 8	I/W	"xx"	Error: 10 41	Write access not permitted
0002h - 7FFFh	0 - 8	I/R	-	Error: 13 40	Offset value too high
0002h - 7FFFh	0 - 8	I/W	"xx"	Error: 13 40	Offset value too high

For more information refer to the chapter **Detailed status**.

Minimal distance from decoding warning threshold

This resource provides the encoder's minimum distance between the decoding point and the decoding warning threshold. Both persistent and non-persistent values can be read. The persistent value represents the largest recorded value since the last power cycle, while the non-persistent value represents the most recent measurement.

Minimal distance from decoding warning threshold resource properties

RDB entry qualifier	Value
Resource type	Function pointer (7)
RID	0x0D8
Address	Data storage address
Start	N/A
Size	4
W	0
R	0
Timeout	MFB-specific
Name	"MINDIST"
Resource data type	struct 4 bytes (20)
Profile requirement	Optional

Minimal distance from decoding warning threshold resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"MINDIST"	Resource name
0001h	2	D/R	-	4	Data size
0002h	2	D/R	-	0	Read access level
0003h	2	D/R	-	0	Write access level
0004h	2	D/R	-	xx	Timeout
0005h	2	D/R	-	20	Data type: struct 4 bytes
0000h	2	I/R	-	"xxxx"	Current minimum decoding distance
0000h	0, 4, 8	I/R	-	Error: 11 40	Incorrect length
0000h	0 - 8	I/W	"xx"	Error: 10 41	Write access not permitted
0001h	2	I/R	-	"xxxx"	Persistent minimum decoding distance
0001h	0, 4, 8	I/R	-	Error: 11 40	Incorrect length
0001h	2	I/W	"xxxx"	-	Write persistent minimum decoding distance
0001h	0, 4, 8	I/W	"xx"	Error: 11 40	Incorrect length
0002h - 7FFFh	0 - 8	I/R	-	Error: 13 40	Offset value too high
0002h - 7FFFh	0 - 8	I/W	"xx"	Error: 13 40	Offset value too high

Multiturn information

This resource provides the encoder's multiturn-specific data and functionality.
After writing to the multiturn counter preset (offset 0), execute the command "Apply MT counter" at offset 2.
After writing to the multiturn error arc length, the encoder configuration must be saved using the command in the "CFGBLOCK" resource (offset 3). For more information refer to the chapter **Configuration data block**.

Multiturn information resource properties

RDB entry qualifier	Value
Resource type	Function pointer (7)
RID	0x113
Address	Data storage address
Start	N/A
Size	6
W	0
R	0
Timeout	MFB-specific
Name	"MT_INFO"
Resource data type	struct 6 bytes (22)
Profile requirement	Optional

Multiturn information resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"MT_INFO"	Resource name
0001h	2	D/R	-	6	Data size
0002h	2	D/R	-	0	Read access level
0003h	2	D/R	-	0	Write access level
0004h	2	D/R	-	xx	Timeout
0005h	2	D/R	-	22	Data type: struct 6 bytes
0000h	4	I/R	-	"xxxxxxxx"	Multiturn counter preset
0000h	0, 2, 8	I/R	-	Error: 11 40	Incorrect length
0000h	4	I/W	"xxxxxxxx"	-	Write multiturn counter preset
0000h	0, 2, 8	I/W	"xxxxxxxx"	Error: 11 40	Incorrect length
0001h	2	I/R	-	"xxxx"	Multiturn error arc length
0001h	0, 4, 8	I/R	-	Error: 11 40	Incorrect length
0001h	2	I/W	"xxxx"(<=90)	-	Write multiturn error arc length
0001h	2	I/W	"xxxx"(>90)	Error: 15 40	Invalid data (maximum value is 90)
0001h	0, 4, 8	I/W	"xxxx"	Error: 11 40	Incorrect length
0002h	8	I/W	""	-	Apply MT counter (command)
0002h	2, 4, 8	I/W	"xxxx"	Error: 11 40	Incorrect length
0002h	0 - 8	I/R	-	Error: 11 41	Read access not permitted
0003h - 7FFFh	0 - 8	I/R	-	Error: 13 40	Offset value too high
0003h - 7FFFh	0 - 8	I/W	"xxxx"	Error: 13 40	Offset value too high

Self-calibration

This resource provides the encoder's self-calibration-specific data and functionality.

Self-calibration resource properties

RDB entry qualifier	Value
Resource type	Function pointer (7)
RID	0x114
Address	Data storage address
Start	N/A
Size	16
W	0
R	0
Timeout	MFB-specific
Name	"SELFCAL"
Resource data type	struct 16 bytes (32)
Profile requirement	Optional

Self-calibration resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"SELFCAL"	Resource name
0001h	2	D/R	-	0	Data size
0002h	2	D/R	-	0	Read access level
0003h	2	D/R	-	0	Write access level
0004h	2	D/R	-	xx	Timeout
0005h	2	D/R	-	1	Data type: Void
0000h	4	I/R	-	"xxxxxxxx"	Self-calibration status
0000h	0, 2, 8	I/R	-	Error: 11 40	Incorrect length
0000h	0 - 8	I/W	"xx"	Error: 10 41	Write access not permitted
0001h	2	I/R	-	"xxxx"	Partial arc length
0001h	0, 4, 8	I/R	-	Error: 11 40	Incorrect length
0001h	2	I/W	"xxxx"	-	Write partial arc length (HEX LSB first) - must be 360°.
0001h	0, 4, 8	I/W	"xxxx"	Error: 11 40	Incorrect length
0002h	2	I/R	-	"xxxx"	Calibration timeout
0002h	0, 4, 8	I/R	-	Error: 11 41	Incorrect length
0002h	2	I/W	"xxxx" (<=40 (28h))	-	Write to calibration timeout (HEX LSB first).
0002h	2	I/W	"xxxx" (>40)	Error: 15 40	Invalid data (maximum value is 40)
0002h	0, 4, 8	I/W	"xxxx"	Error: 11 40	Incorrect length
0003h	2	I/R	-	"xxxx"	Ring eccentricity shift - [µm]
0003h	0, 4, 8	I/R	-	Error: 11 40	Incorrect length
0003h	0 - 8	I/W	"xx"	Error: 10 41	Write access not permitted
0004h	2	I/R	-	"xxxx"	Ring eccentricity angle - [°]
0004h	0, 4, 8	I/R	-	Error: 11 40	Incorrect length
0004h	0 - 8	I/W	"xx"	Error: 10 41	Write access not permitted
0005h	2	I/R	-	"xxxx"	Readhead radial shift - [µm]
0005h	0, 4, 8	I/R	-	Error: 11 40	Incorrect length
0005h	0 - 8	I/W	"xx"	Error: 10 41	Write access not permitted
0006h	0	I/W	""	-	Start self-calibration (command)
0006h	2, 4, 8	I/W	"xxxx"	Error: 11 40	Incorrect length
0006h	0 - 8	I/R	-	Error: 11 41	Read access not permitted
0007h	2	I/R	""	"000x"	Self-calibration finished
0007h	0, 4, 8	I/R	""	"xx"	Incorrect length
0007h	0 - 8	I/W	"xxx"	""	Write access not permitted
0008h - 7FFFh	0 - 8	I/R	-	Error: 13 40	Offset value too high
0008h - 7FFFh	0 - 8	I/W	"xxxx"	Error: 13 40	Offset value too high

For more information refer to the chapter **Self-calibration,**

Configuration data block

This resource provides the encoder's configuration-specific data and functionality.

Configuration data block resource properties

RDB entry qualifier	Value
Resource type	Function pointer (7)
RID	0x115
Address	Data storage address
Start	N/A
Size	12
W	0
R	0
Timeout	MFB-specific
Name	"CFGBLOCK"
Resource data type	struct 12 bytes (28)
Profile requirement	Optional

Configuration data block resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"CFGBLOCK"	Resource name
0001h	2	D/R	-	12	Data size
0002h	2	D/R	-	0	Read access level
0003h	2	D/R	-	0	Write access level
0004h	2	D/R	-	xx	Timeout
0005h	2	D/R	-	28	Data type: struct 12 bytes
0000h	4	I/R	-	"xxxxxxxx"	Position filter value
0000h	0, 2, 8	I/R	-	Error: 11 40	Incorrect length
0000h	4	I/W	"xxxxxxxx"	-	Write position filter value
0000h	0, 2, 8	I/W	"xxxx"	Error: 11 40	Incorrect length
0001h	4	I/R	-	"xxxxxxxx"	Position filter speed
0001h	0, 2, 8	I/R	-	Error: 11 40	Incorrect length
0001h	4	I/W	"xxxxxxxx"	-	Write position filter speed
0001h	0, 2, 8	I/W	"xxxx"	Error: 11 40	Incorrect length
0002h	4	I/R	-	"xxxxxxxx"	Velocity filter value
0002h	0, 2, 8	I/R	-	Error: 11 40	Incorrect length
0002h	4	I/W	"xxxxxxxx"	-	Write velocity filter value
0002h	0, 2, 8	I/W	"xxxx"	Error: 11 40	Incorrect length
0003h	0	I/W	-	-	Save encoder configuration
0003h	2, 4, 8	I/W	"xxxx"	Error: 11 40	Incorrect length
0003h	0 - 8	I/R	-	Error: 11 41	Read access not permitted
0003h - 7FFFh	0 - 8	I/R	-	Error: 13 40	Offset value too high
0003h - 7FFFh	0 - 8	I/W	"xxxx"	Error: 13 40	Offset value too high

Factory reset

This resource provides functionality to reset the file system, reset the encoder to factory settings, or perform both operations.

Factory reset resource properties

RDB entry qualifier	Value
Resource type	Function pointer (7)
RID	0x108
Address	Data storage address
Start	N/A
Size	0
W	2
R	15
Timeout	MFB-specific
Name	"FACTRST"
Resource data type	Void (1)
Profile requirement	Optional

Factory reset resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"FACTRST"	Resource name
0001h	2	D/R	-	0	Data size
0002h	2	D/R	-	15	Read access level
0003h	2	D/R	-	2	Write access level
0004h	2	D/R	-	xx	Timeout
0005h	2	D/R	-	1	Data type: Void
0000h	8	I/W	"xxxxxxxx" (acc.lvl < 2)	Error: 12 41	Write access denied
0000h	8	I/W	"RESETUFS" (acc.lvl >= 2)	-	Reset file system to factory settings
0000h	8	I/W	"RESETALL" (acc.lvl >= 2)	-	Reset all to factory settings
0000h	8	I/W	"RESETENC" (acc.lvl >= 2)	-	Reset SFE to factory settings
0000h	8	I/W	"xxxxxxxx" (acc.lvl >= 2)	Error: 15 40	Invalid data
0000h	0 - 4	I/W	"xxxxxxxx"	Error: 40 11	Incorrect length
0000h - 7FFFh	0 - 8	I/R	-	Error: 11 41	Read access not permitted
0000h - 7FFFh	0 - 8	I/W	-	Error: 13 40	Offset value too high

EOLT

This resource is intended for internal production testing and is protected by access level 5.

External temperature sensor resistance value

This resource provides the external temperature sensor value in ohms.

External temperature sensor value resource properties

RDB entry qualifier	Value
Resource type	Function pointer (7)
RID	0x200
Address	Data storage address
Start	N/A
Size	4
W	15
R	0
Timeout	MFB-specific
Name	"ACCESSIO"
Resource data type	Unsigned 32-bit (5)
Profile requirement	Optional

External temperature sensor value resource structure

Offset	Length	Mode	Data bytes	Response	Description
0000h	8	D/R	-	"ACCESSIO"	Resource name
0001h	2	D/R	-	4	Data size
0002h	2	D/R	-	0	Read access level
0003h	2	D/R	-	15	Write access level
0004h	2	D/R	-	xx	Timeout
0005h	2	D/R	-	5	Data type: u32
0000h	4	I/R	-	"xxxx"	Sensor reading [Ω]
0000h	0, 2, 8	I/R	-	Error: 11 40	Incorrect length
0000h	0 - 8	I/W	"xx"	Error: 10 41	Write access not permitted
0001h - 7FFFh	0 - 8	I/R	-	Error: 13 40	Offset value too high
0001h - 7FFFh	0 - 8	I/W	"xx"	Error: 13 40	Offset value too high

For more information refer to the chapter **External temperature sensor.**

Installation and calibration

Signal level

Using the signal level information available in the resource database (refer to the table **SIGLVL resource structure**) and the following equation, users can estimate the ride height (air gap), defined as the distance between the magnetic surface of the ring and the sensor.

Ride height = K × Ln (SignalLevel) + N

The calculated ride height value in µm is also available directly on the offset 0003h of the SIGLVL resource.

Distance from decoding warning

AksIM-4 HDSL detects when the ride height approaches the decoding limits. If these limits are exceeded, position decoding fails and an error is raised. A warning is issued slightly before these limits are reached. Resource 0x0D8 provides data describing the distance to the decoding warning threshold in µm. For more information refer to the chapter **Minimal distance from decoding warning threshold resource structure**.

This value can be used to determine the available margin before decoding issues occur.

The resource contains both the current distance to the decoding warning threshold (offset 0000h I/R) and a persistent value representing the smallest recorded distance since the last power cycle (offset 0001h I/W). The persistent value can be reset by writing to offset 0001h I/W or by power-cycling the encoder.

Self-calibration

Self-calibration is a routine that compensates for the effects of eccentricity in the encoder's position measurement. It is recommended to run this routine after the encoder is mounted to maximise performance.

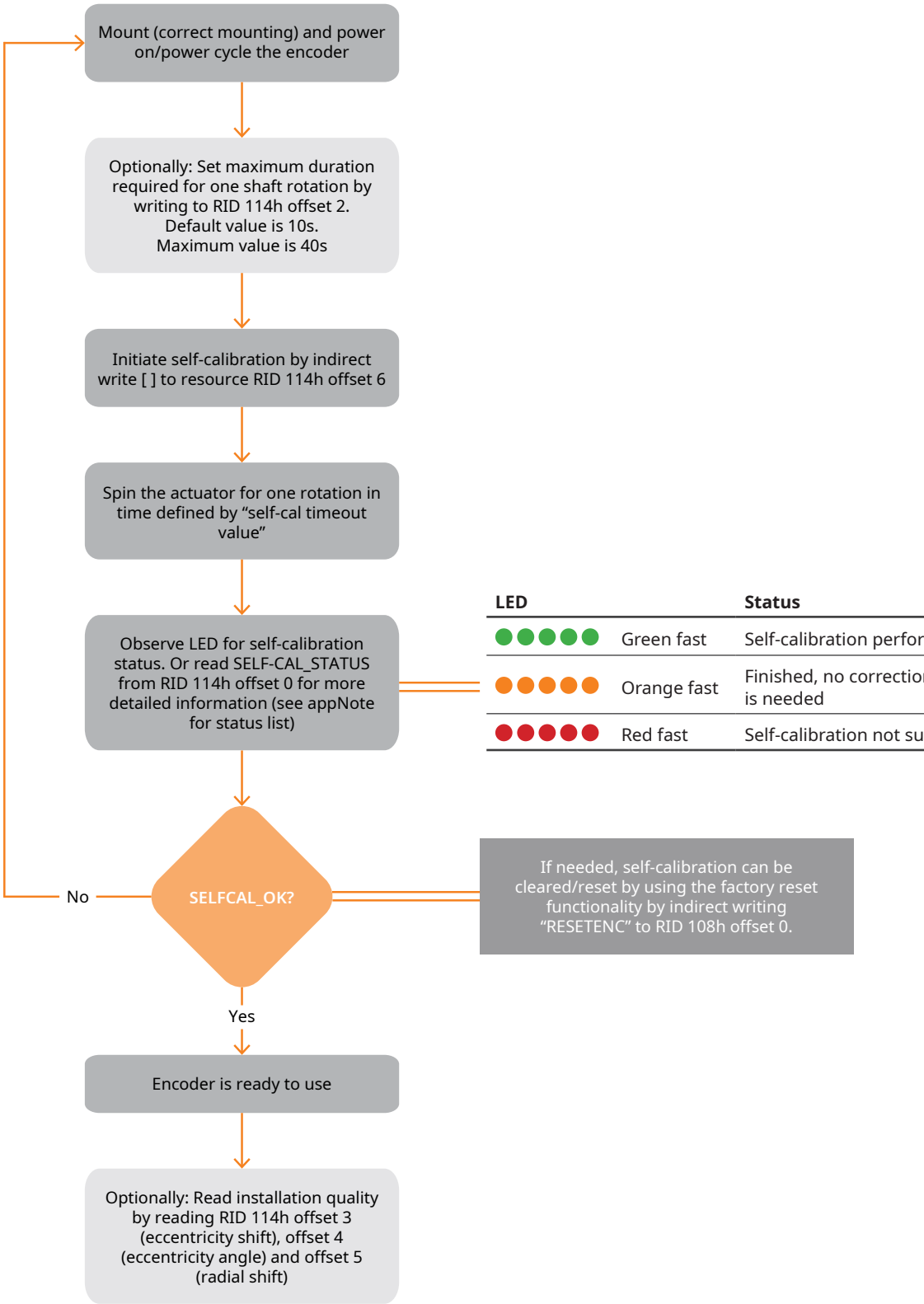
Self-calibration must be performed over whole 360° range

Position data is unavailable while the encoder is in self-calibration mode. Consequently, the electric motor cannot be used in closed loop to rotate the shaft. If the motor driver supports open-loop control, this mode may be used; otherwise, rotating the shaft by hand or with an external drive is recommended.

For more information regarding data structure refer to table **Self-calibration resource structure**.

Self-calibration routine procedure

The following flowchart illustrates the self-calibration procedure:



LED	Status
Green fast	Self-calibration performed successfully
Orange fast	Finished, no correction of error map table is needed
Red fast	Self-calibration not successful

Self-calibration status list

This section lists all possible self-calibration statuses with brief descriptions. The status can be read from the self-calibration RDB resource offset 0. For more information refer to the chapter **Self-calibration**.

Status type	Category	Bit mask	Description
Counter	Info	0x00000001	Self-calibration counter is incremented at the end of the self-calibration procedure
Counter	Info	0x00000002	
General	Ok	0x00000010	Self-calibration successfully completed
General	Error	0x00000040	Self-calibration failed
Detailed	Error	0x00000100	Self-calibration duration exceeded the timeout threshold
Detailed	Error	0x00000200	Encoder was in an error state when calibration started; procedure aborted
Detailed	Error	0x00001000	Numerical error during data processing
Detailed	Error	0x00002000	Eccentricity is very high
Detailed	Error	0x00008000	Radial displacement is very high
Detailed	Info	0x00100000	Calibration was already performed and position correction is active.
Detailed	Error	0x00200000	Parameters could not be saved to non-volatile memory (system fault)

Error reporting and diagnostics

HDSL error registers (ENC_ST)

The AksIM-4™ HDSL maps its error states to the HDSL error registers.

Address - Name register	Bit	Fault description	SFE status bit	Persistence	Controller reaction
ENC_ST0	0	Protocol reset indication	-	-	-
	1	Acceleration overflow error	-	-	-
	2	Reserved	-	-	-
	3	Not used (always 0)	-	-	-
	4	Not used (always 0)	-	-	-
	5	Not used (always 0)	-	-	-
	6	Not used (always 0)	-	-	-
	7	Not used (always 0)	-	-	-
ENC_ST1	0	Not used (always 0)	-	-	-
	1	Not used (always 0)	-	-	-
	2	Not used (always 0)	-	-	-
	3	Multiturn counter mismatch. Encoder rotated more than ±90° during power-down. Cycle power to clear this error.	9	p	SW reset of encoder
	4	Not used (always 0)	-	-	-
	5	Not used (always 0)	-	-	-
	6	Not used (always 0)	-	-	-
	7	Not used (always 0)	-	-	-
ENC_ST2	0	Not used (always 0)	-	-	-
	1	Not used (always 0)	-	-	-
	2	Not used (always 0)	-	-	-
	3	Not used (always 0)	-	-	-
	4	Internal SPI communication error	-	np	Clear error by writing 0 into ENC_ST
	5	Not used (always 0)	-	-	-
	6	Internal system error (Host MCU diagnostics or SFE identification error)	-	np	SW reset of encoder
	7	Not used (always 0)	-	-	-

table continued

Address - Name register	Bit	Fault description	SFE status bit	Persistence	Controller reaction
ENC_ST3	0	Temperature out of range. The readhead temperature is out of the specified range (Tmin, Tmax).	14	np	Clear warning by writing 0 into ENC_ST
	1	Not used (always 0)	-	-	-
	2	Power supply is out of range	-	np	Clear warning by writing 0 into ENC_ST
	3	High speed warning. Speed is above the threshold	10	np	Clear warning by writing 0 into ENC_ST
	4	Not used (always 0)	-	np	Clear warning by writing 0 into ENC_ST
	5	Position decoding error	8, 7, 6, 5	np	Clear warning by writing 0 into ENC_ST
	6	SFE internal error / incosistent calibration table	4, 3, 2	np	Clear warning by writing 0 into ENC_ST
	7	Not used (always 0)	-	-	-
ENC_ST4	0	Invalid access	-	-	-
	1	Access denied	-	-	-
	2	Resource access error	-	-	-
	3	File access error	-	-	-
	4	Not used (always 0)	-	-	-
	5	Not used (always 0)	-	-	-
	6	Not used (always 0)	-	-	-
	7	Not used (always 0)	-	-	-
ENC_ST5	0 - 7	Not used (always 0)	-	-	-
ENC_ST6	0 - 7	Not used (always 0)	-	-	-
ENC_ST7	0 - 7	Not used (always 0)	-	-	-

Detailed status

The detailed status resource contains information on the diagnostics of the encoder's SFE. It is saved as a 16-bit word where each bit corresponds to a specific SFE error state. For more information refer to the chapter **Detailed status**.

Bit number	Description of error/warning	Error/Warning	Clearing
15	Reserved		
14	Temperature out of range. The readhead temperature is outside the specified range (Tmin, Tmax)	Warning	When absent
13	Signal amplitude low. The distance between the readhead and the ring is too large	Warning	When absent
12	Signal amplitude high. The readhead is too close to the ring	Warning	When absent
11	Signal decoding below threshold; position decoding may fail	Warning	When absent
10	High-speed warning. Speed is above the threshold	Warning	When absent
9	Multiturn counter mismatch. Encoder rotated more than ±90° during power-down. Cycle the power to clear this error	Error	Upon reset
8	Acceleration error. Position data changed unexpectedly due to stray magnetic fields or metal particles between the readhead and the ring	Error	At communication
7	Magnetic pattern error. Caused by stray magnetic fields, contamination, or incorrect radial positioning	Error	When absent
6	Signal lost. The readhead is misaligned or the ring is damaged	Error	When absent
5	Signal amplitude too high. External magnetic field present	Error	When absent
4	System error. Internal circuitry malfunction; may require power cycling with rise time < 20 ms	Error	When absent
3	Internal power supply error	Error	When absent
2	System error. Inconsistent calibration data detected; may require power cycling with rise time < 20 ms	Error	Upon reset
1	Reserved		
0	Reserved		

Detailed status is available in both current or persistent variants. The persistent variant holds all errors that have occured since the last power cycle, while the current variant includes only active, uncleared errors.

Error log

The error log stores the last eight errors detected by the MFB. If more than eight errors are recorded, the oldest entry is overwritten (first-in-first-out).

> Error log can be cleared by using "RESETALL" command via the factory reset (FACTRST) resource.

Byte	Value	Description
15	00h to FFh	Error code
14	00h to FFh	Additional error code
13	0 - 255	Error counter
12	0	Reserved
11/10	0 to 65535	Rotation speed in RPM at the time of the error
9/8	0 to 65535	Internal supply voltage in mV at the time of the error
7/6	0	Reserved
5/4	-2730 to 10000	Temperature in 0.1 °C at the time of the error
3/2/1/0	0 to 4294967295	Error time information in min

Error code interpretation

Error codes are mapped to correspond to ENC_STx registers (refer to **the HDSL registers table**):

- First (high) nibble: the ENC_ST register.
- Second (low) nibble: the bit number within that ENC_ST register.

For example, if ENC_ST3 bit 4 is set, the error code is 0x34.

Additional error code interpretation

Additional error code represents the detailed status of the sensor front-end. For description of detailed status bits refer to the chapter **Detailed status**. Additional error code bits map to the detailed status bits as follows:

Additional error code bit number	Detailed status bit number
0	2
1	3
2	4
3	5
4	6
5	7
6	8
7	9

Error counter

The error counter records occurrences of the same error up to a maximum of 255; any further occurrences are not counted. The counter is reset when the error log is manually cleared or when an error is pushed out of the log by other types of error.

Error log spam protection

If an error (error code) already exists in the error log, any new occurrence of this error will only increment the existing error's counter.

Temperature, speed and voltage information

Temperature, speed and voltage information for an entry with multiple occurrences (error counter > 1) correspond to the values at the first occurrence.

Error time information

The time of the first occurrence is captured from the LIFETIME resource. It is not updated if the same error type occurs again. The timestamp is updated only when the error log is manually cleared or the error entry is replaced with another error type.

Error log filter

Using the error log filter reduces logged entries to only include errors from ENC_ST1 and ENC_ST2 (refer to **the HDSL registers table**).

The filter can be used in two modes:

- Engineering Mode: the Error Log Filter is OFF, so any error that might trigger a new error log entry will be logged.
- Operational Mode: the Error Log Filter is ON and only ENC_ST1 and ENC_ST2 relevant errors are saved into the error log.

Usage:

Filter state	Indirrect write to RID 0D5h offset 0
Turn ON	0050
Turn OFF	0000

Default setting is 0x00 00 (= OFF)
For full resource structure, refer to **the ERRLOGFI resource structure table**.

Additional features

External temperature sensor

The AksIM-4 HDSL includes a 2-pin connector for an external temperature sensor. One example of usage is to sense winding temperature in electric motors. Supported sensors include Pt1000, LPTC600, KY84-130, or any sensor with a resistance in the range 0-5 kΩ. The AksIM-4 HDSL measures resistance only and does not convert this value into temperature. The measured value can be read from the RDB. For more information refer to the chapter **External temperature sensor resistance value**.
The sensing circuitry is tuned to this resistance range but is not calibrated.

References

[1] "SICK Hiperface DSL," [Online]. Available: **https://www.sick.com/ae/en/s/hiperface-dsl**

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Issue	Date	Page	Description
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