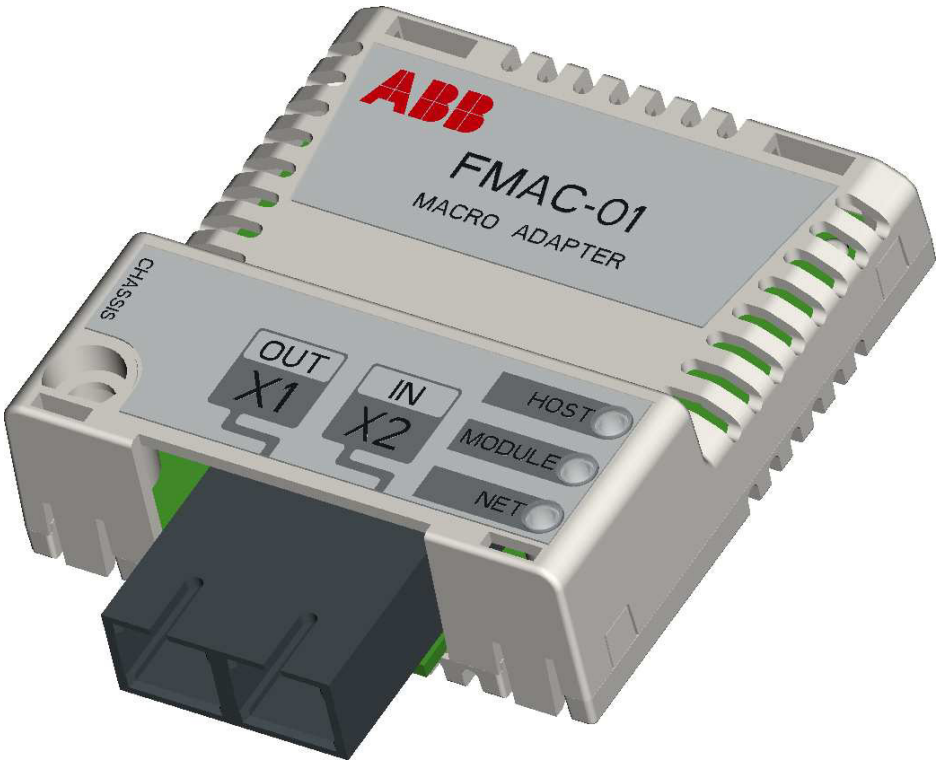
ABB drives

User's manual
MACRO adapter module
FMAC-01



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List of related manuals

Drive hardware manuals and guides	Code (English)
ACSM1-04 drive modules (0.75 to 45 kW) hardware manual	*3AFE68797543*
ACSM1-04 drive modules (55 to 110 kW) hardware manual	*3AFE68912130*
ACSM1-04Lx liquid-cooled drive modules (55 to 160 kW) hardware manual	*3AUA0000022083*

Drive firmware manuals and guides	
ACSM1 motion control program firmware manual	*3AFE68848270*

Option manuals and guides	
FMAC-01 MACRO adapter module user's manual	*3AUA0000089431*

All manuals are available in PDF format on the Internet. See section *Document library on the Internet* on the inside of the back cover.

User’s manual

MACRO adapter module FMAC-01

3AUA0000089431 Rev A
EN
EFFECTIVE: 2010-12-03

Table of contents

5. Electrical installation

6. Start-up

7. Communication profiles

8. Communication protocol

1

Safety

What this chapter contains

The chapter presents the warning symbols used in this manual and the safety instructions which you must follow when installing a fieldbus adapter module into a drive, solar inverter or wind converter. If ignored, physical injury or death may follow, or damage may occur to the equipment. Read this chapter before you start the installation.

Use of warnings

Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment and advise on how to avoid the danger. The following warning symbols are used in this manual:

Electricity warning warns of hazards from electricity which can cause physical injury and/or damage to the equipment.

General warning warns about conditions, other than those caused by electricity, which can result in physical injury and/or damage to the equipment.

Safety in installation

These warnings are intended for all who install a fieldbus adapter module into a drive, solar inverter or wind converter.

WARNING! Ignoring the following instructions can cause physical injury or death, or damage to the equipment.

- Only qualified electricians are allowed to install and maintain the drive, solar inverter or wind converter!
- Disconnect the drive, solar inverter or wind converter into which the module will be installed from all possible power sources. After disconnecting, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you proceed.
- Always ensure by measuring with a multimeter (impedance at least 1 Mohm) that:
  - there is no voltage between the input power terminals of the drive, solar inverter or wind converter and the ground
  - there is no voltage between the output power terminals of the drive, solar inverter or wind converter and the ground.
- Do not work on the control cables when power is applied to the external control circuits of the drive, solar inverter or wind converter. Externally supplied control circuits may carry dangerous voltage.

2

About the manual

What this chapter contains

This chapter introduces this manual.

Applicability

This manual applies to the FMAC-01 MACRO adapter module, SW version 0009 and later.

Compatibility

The FMAC-01 MACRO adapter module is compatible with the ABB ACSM1-04 and ACSM1-04Lx drives with the Motion control program. Note that FMAC-01 is not compatible with the Speed and torque control program.

FMAC-01 is a µMACRO station implementation and it is compatible with all MACRO masters that support µMACRO stations.

Target audience

The reader is expected to have a basic knowledge of the MACRO network, electrical fundamentals, electrical wiring practices and how to operate the drive.

Purpose of the manual

The manual provides information on installing, commissioning and using the FMAC-01 MACRO adapter module.

Related documents

Related manuals are listed on the inside front cover.

Before you start

It is assumed that the drive is installed and ready to operate before starting the installation of the adapter module.

In addition to conventional installation tools, have the drive manuals available during the installation as they contain important information not included in this manual. The drive manuals are referred to at various points of this document.

Contents

The manual consists of the following chapters:

- *Safety* presents the safety instructions which you must follow when installing a fieldbus adapter module.
- *About the manual* introduces this manual.
- *Overview of the MACRO network and the FMAC-01 module* contains a short description of the MACRO network and the adapter module.
- *Mechanical installation* contains a delivery checklist and instructions on mounting the adapter module.
- *Electrical installation* contains general cabling instructions and instructions on connecting the adapter module to the MACRO network.
- *Start-up* presents the steps to take during the start-up of the adapter module with the drive and the master system configuration.
- *Communication profiles* describes the communication profile used in the communication between the MACRO network, the adapter module and the drive.
- *Communication protocol* describes the communication on a MACRO network.
- *Diagnostics* explains how to trace faults with the status LEDs on the adapter module.
- *Technical data* contains the technical data of the adapter module and the MACRO link.

Terms and abbreviations used in this manual

General terms

Term	Explanation
Communication module	Communication module is a name for a device (eg, a fieldbus adapter) through which the drive is connected to an external communication network (eg, a fieldbus). The communication with the module is activated with a drive parameter.
Command word	See Control word.
Control word	A 16-bit word from a master to a slave containing commands for the addressed drive (usually called the Command word).
FMAC-01 MACRO adapter module	The FMAC-01 MACRO adapter module is one of the optional fieldbus adapter modules available for ABB drives. FMAC-01 is a device through which an ABB drive is connected to a MACRO network.
Parameter	An operating instruction for the drive. Parameters can be read and programmed with the drive control panel, drive PC tools or through the adapter module.
Profile	Adaptation of the protocol for certain application field, for example, drives.
Status word	A 16-bit word from a slave to a master containing status information.

MACRO terms

Term	Explanation
Amplifier	In this manual, ‘amplifier’ denotes ‘drive’.
Axis node	Slave node type used for sending axis control commands to and receiving feedback from the drive. Axis node communication consists of a 72-bit data frame that is transferred cyclically between a master node and a slave node.
Broadcast	The act of sending a data packet to multiple MACRO stations.
Control flag	A 24-bit control word containing MACRO-specific control commands for the addressed slave station.
Data packet	The set of data that is transmitted or received by a node during each ring communications cycle.
I/O node	Slave node type used for cyclic transfer of additional process data between the master and the drive. The 72-bit data frame can be used to transfer parameter-mapped data to and from the drive, such as control and status of the drive's digital and analog I/O.
Master	An entity on the ring that sends command data packets and receives feedback data packets.
Master node	A logical unit and set of registers on the ring that can send command data packets to a corresponding slave node and receive feedback data packets from the corresponding slave node.
Master number	A value from 0…15 that is assigned to each master node on a ring. The master number is used with the slave number to associate data packets with nodes.
Master station	A station on the ring containing one or more master nodes.

Term	Explanation
MI-variable	A pre-defined data object similar to, eg, drive parameters that are used by the master node to send and receive, eg, configuration data to and from a slave node.
Node	A logical unit on the ring. A node device sends and receives a data packet once each ring communications cycle. All nodes possess both a master number (0…15) and a slave number (0…15), whether the node is a master node or a slave node. For communications, there must be corresponding master and slave nodes.
Ring	MACRO ring network. A system of devices that are interconnected by a fiber optic or twisted pair copper cable that uses MACRO protocols.
Slave	An entity on the ring that receives command data packets and sends feedback data packets.
Slave node	A logical unit and set of registers on the ring that can receive command data packets from a corresponding master node and transmit feedback data packets back to the corresponding master node.
Slave number	A value from 0…15 associated with each node. There are 16 slave nodes which may be addressed per master in a ring. The slave number is used with the master number to associate data packets with nodes.
Slave station	A station on the ring containing one or more slave nodes.
Station	A physical unit on the ring with a ring receiving circuit, ring transmission circuit, and the circuitry for one or more nodes. There may be more than one station in a single hardware device.
Status flag	A 24-bit status word from a slave station to a master containing MACRO-specific status information.

Term	Explanation
Synchronizing master	The single master station on the ring that starts a ring communications cycle based on its own internal timing circuitry. Any other master stations on the ring must await receipt of the baton signal from the upstream master before starting its communications.

Abbreviations

Abbreviation	Explanation
EMC	Electromagnetic compatibility
FBA	Fieldbus adapter
LSB	Least significant bit
MSB	Most significant bit

3

Overview of the MACRO network and the FMAC-01 module

What this chapter contains

This chapter contains a short description of the MACRO network and the FMAC-01 MACRO adapter module.

MACRO network

MACRO stands for “Motion And Control Ring Optical”. MACRO is a non-proprietary, digital high-speed bus interface developed by Delta Tau Data systems for connecting multi-axis motion controllers, amplifiers and distributed I/O on a fiber optic or twisted pair copper ring.

One physical master or slave station in a MACRO network may contain multiple logical master or slave nodes. Altogether, MACRO supports up to 16 master stations. Each master station supports up to 16 slave nodes, so it is possible to build a network with 256 slave nodes. The maximum distance between nodes is 3000 m using fiber optic cables. Data rate is configurable, the maximum being 125 Mbit/s.

MACRO lends itself to large multi-axis applications where the amplifiers and I/O are spread out, as well as smaller applications where wiring simplicity and noise immunity are preferred.

The advantages of MACRO are multi-master capability, support for high transmission speed and noise immunity on optical fiber.

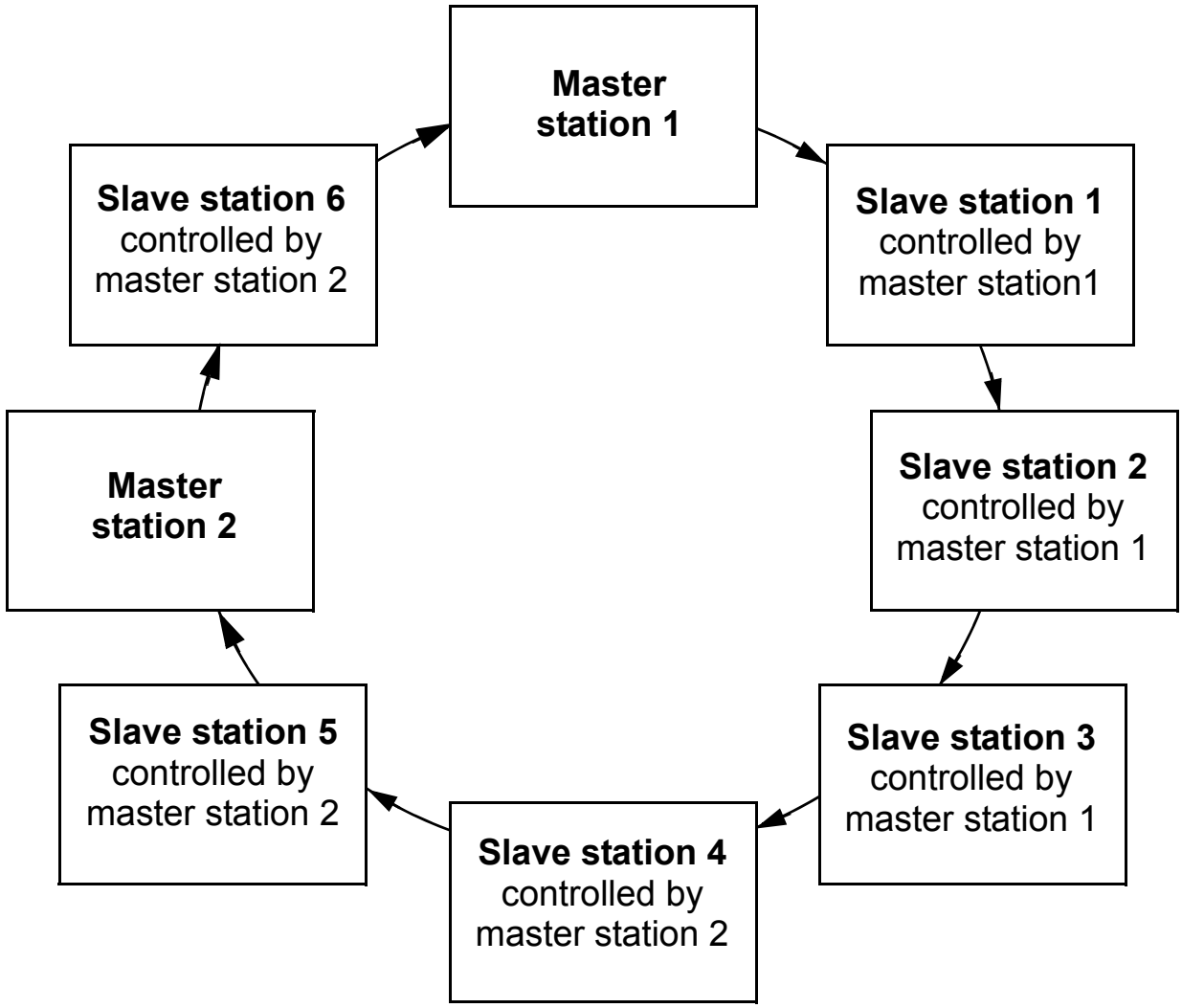
MACRO has two types of application layers called TYPE 0 and TYPE 1 protocols. The difference between these two protocols is that TYPE 0 strives to use more nodes, but less data, while TYPE 1 strives to use more data per node, but with less nodes.

- TYPE 0 supports 16 nodes of data per master, with 48 bits of data per node.
- TYPE 1 supports 14 nodes of data per master, with 72 bits of data per node.

Further information is available at www.macro.org and www.deltatau.com.

Topology of the MACRO ring

The figure below illustrates a MACRO ring with two master stations and six slave stations. The order of the stations on the ring is not significant.

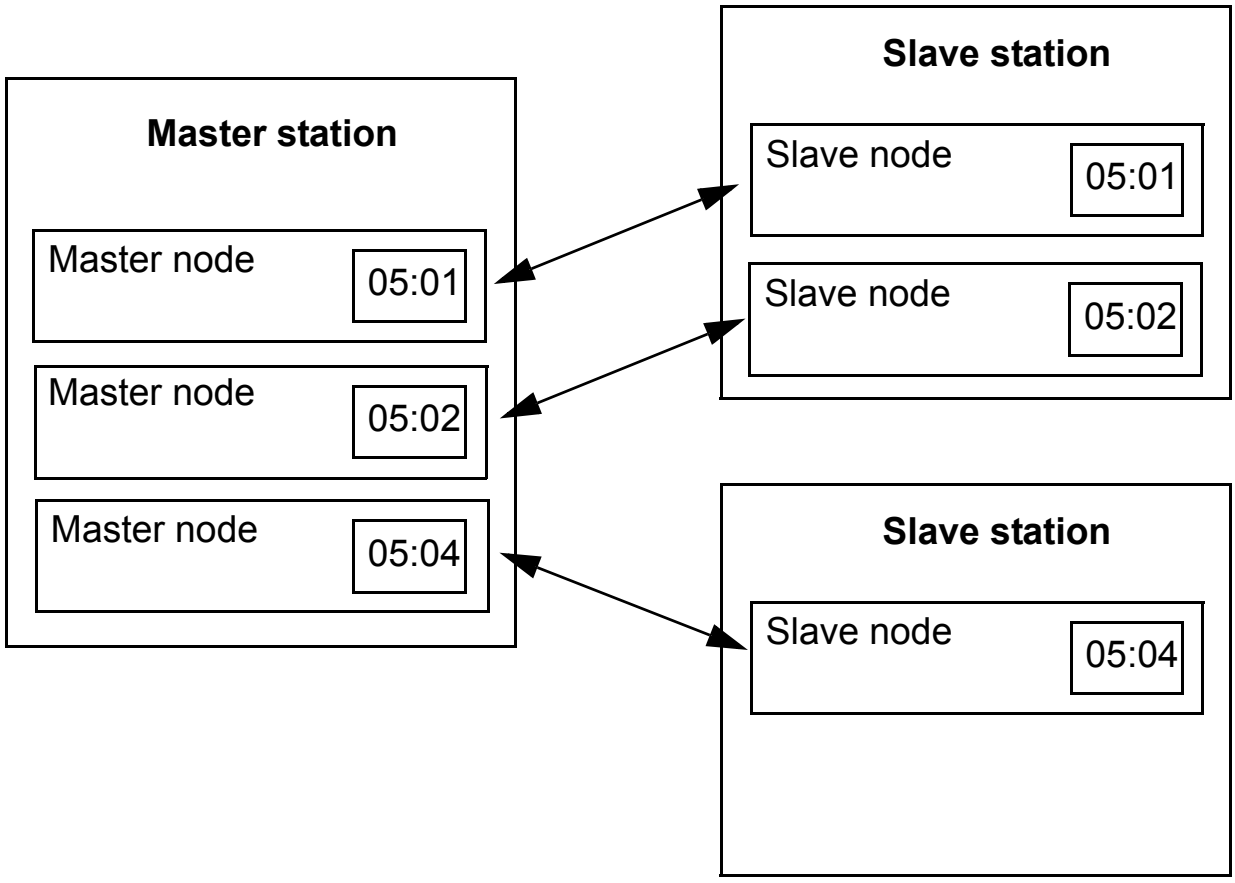


Logical arrangement of the MACRO network

Every node on a MACRO ring has an 8-bit node address. The node address consists of a 4-bit master number (0…15) and a 4-bit slave number (0…15). The corresponding master and slave nodes have the same node address. There may be only one active master node and one active slave node on the ring with any given node address. As there are 256 possible node addresses, there can be up to 256 active master nodes and 256 active slave nodes on the ring.

Although it is customary to configure the network so that all the nodes in one station use the same master number, it is not a requirement of the MACRO standard.

The figure below illustrates the logical principle of the MACRO network. In this example, there is one master station with three active master nodes and two slave stations with three active slave nodes in the network. One slave station has two active slave nodes, while the other slave station has one active slave node. The master and slave nodes having the corresponding node addresses communicate with each other through the MACRO network.



FMAC-01 MACRO adapter module

The FMAC-01 MACRO adapter module is an optional device for ABB drives which enables the connection of the drive to a MACRO network.

Through the adapter module it is possible to:

- give control commands to the drive (Start, Stop, Run enable, etc)
- feed a motor speed or torque reference to the drive
- give a process actual value or a process reference to the PID controller of the drive
- read status information and actual values from the drive
- reset a drive fault.

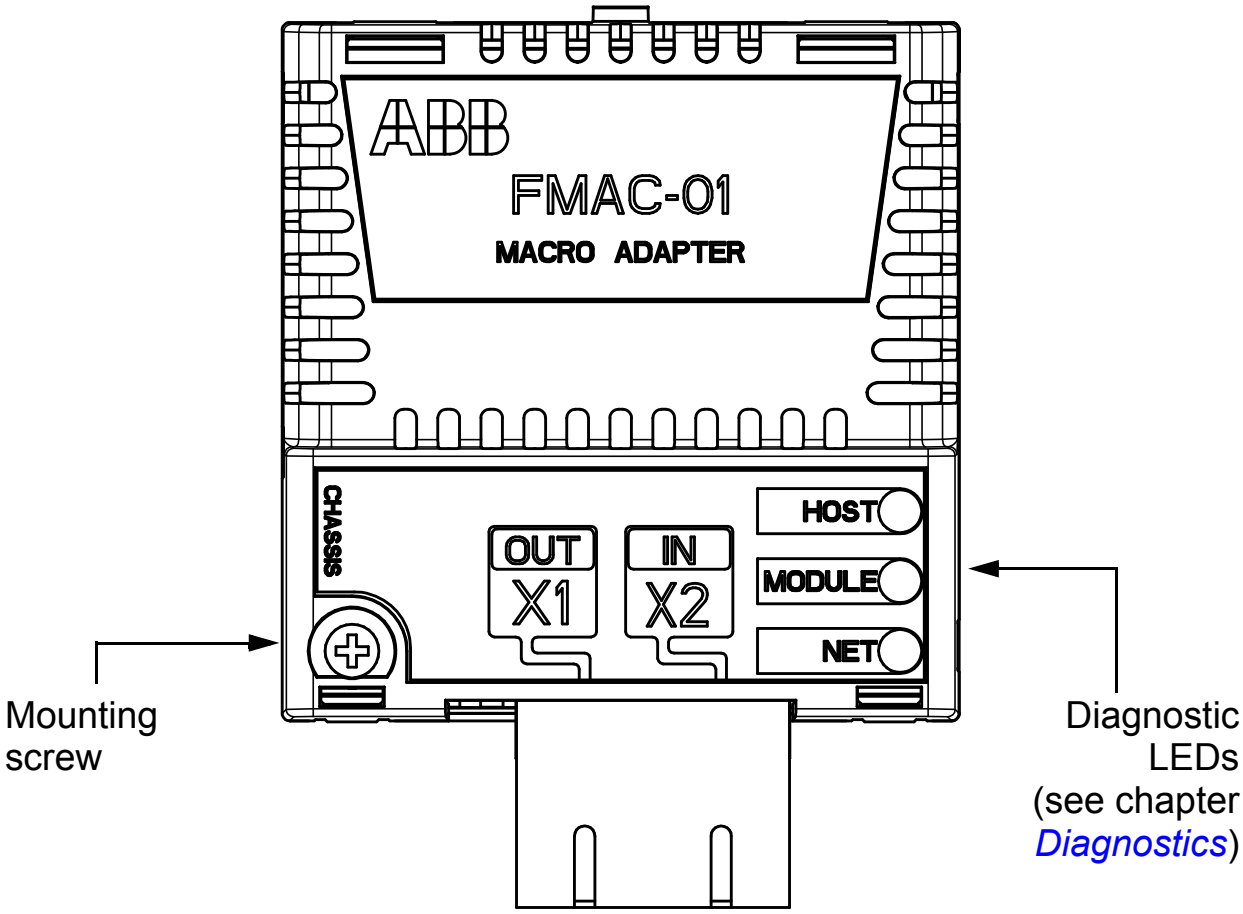
The FMAC-01 MACRO adapter module implements the TYPE 1 MACRO protocol as a µMACRO station. This means support for:

- Delta Tau-specific application layer protocols, such as MI-variables
- MACRO services, such as Home position, position capture and overtravel limits.

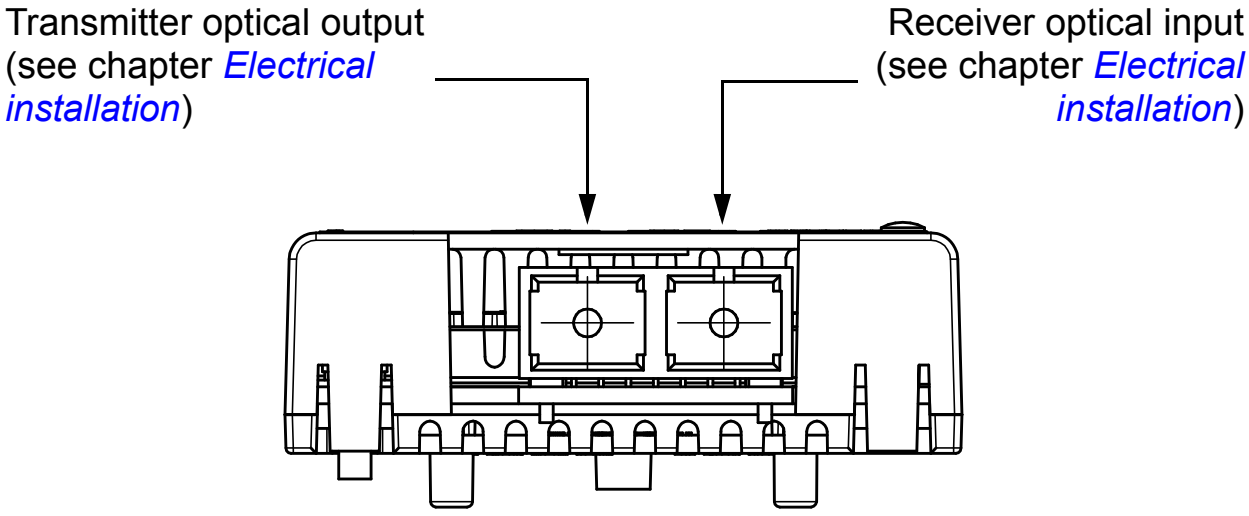
The MACRO commands and services supported by the adapter module are discussed in chapter *Communication protocol*. Refer to the user documentation of the drive as to which commands are supported by the drive.

The adapter module is mounted into an option slot on the motor control board of the drive. See the drive manuals for module placement options.

Layout of the adapter module



Top view



Side view

4

Mechanical installation

What this chapter contains

This chapter contains a delivery checklist and instructions on mounting the adapter module.

WARNING! Follow the safety instructions given in this manual and the drive documentation.

Delivery check

The option package for the adapter module contains:

- MACRO adapter module, type FMAC-01
- this manual.

Mounting the adapter module

The adapter module is to be inserted into its specific position in the drive. The module is held in place with plastic pins and one screw. The screw also provides the electrical connection between the module and drive frame for cable shield termination.

When the module is installed, the signal and power connection to the drive is made through a 20-pin connector. (All drives do not use all the available signals so the connector on the drive may have fewer pins.)

Mounting procedure:

1. Insert the module carefully into its position on the drive.
2. Fasten the screw.

Note: It is essential to install the screw properly to fulfill the EMC requirements and to ensure the proper operation of the module.

For more information on mounting, see the drive manuals.

5

Electrical installation

What this chapter contains

This chapter contains general cabling instructions and instructions on connecting the adapter module to the MACRO network.

WARNING! Before installation, switch off the drive power supply. Wait five minutes to ensure that the capacitor bank of the drive is discharged. Switch off all dangerous voltages connected from external control circuits to the inputs and outputs of the drive.

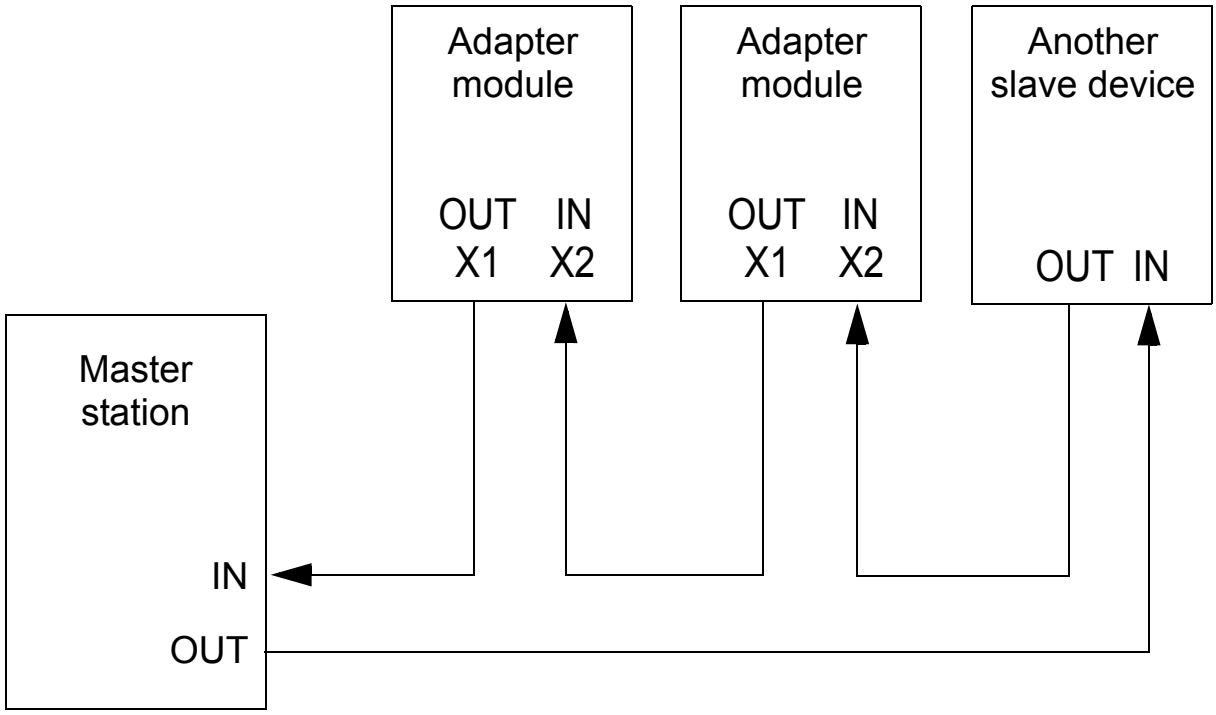
General cabling instructions

- Follow the general cabling rules for 100BaseFX fiber optic cables. When laying the cables, keep in mind the basic limitations of fiber optic cables, such as the minimum bending radius and abrasion resistance.
- Use bushings at cable entries.

Connecting the module to the MACRO network

1. Connect the network cables to the two SC connectors (X1 and X2) on the adapter module.
2. Connect the cable from the output of the previous device on the ring to the right port (IN X2) of the adapter module.
3. Connect the cable from the left port (OUT X1) of the adapter module to the input of the next device on the ring.

The figure below illustrates the cable connections:



6

Start-up

What this chapter contains

This chapter contains:

- information on configuring the drive for operation with the adapter module
- instructions on starting up the adapter module with the drive
- instructions on configuring the master system to communicate with the adapter module.

WARNING! Follow the safety instructions given in this manual and the drive documentation.

Drive configuration

After the adapter module has been mechanically and electrically installed according to the instructions in chapters *Mechanical installation* and *Electrical installation*, the drive must be prepared for communication with the module.

The detailed procedure of activating the module for MACRO communication with the drive depends on the drive type. Normally, a parameter must be adjusted to activate the communication. See section *Starting up the ACSM1 drive* on page *47*.

Once communication between the drive and the adapter module has been established, several configuration parameters are copied to the drive. These parameters are shown in the following tables and must be checked first and adjusted where necessary.

Some of the parameters represent MACRO MI-variables; the corresponding MI-variable(s) are given within parentheses after the parameter name. The alternative selections for these parameters are discussed in more detail below the tables.

Note: The new settings take effect only when the adapter module is powered up the next time or when the fieldbus adapter refresh parameter is activated (see page *47*).

FMAC-01 configuration parameters – group A (group 1)

Note: The actual parameter group number depends on the drive type. Group A (group 1) equals to parameter group 51 in ACSM1.

Par. no.	Parameter name	Parameter name in the drive	Alternative settings	Default setting
01	FBA TYPE	FBA TYPE	(Read-only)	MACRO
02	PROFILE	FBA PAR2	0 = MACRO Station	0
03	MASTER ADDRESS (SW2) (MI996 and MI3)	FBA PAR3	0…15	0
04	SW1 (MI3)	FBA PAR4	0…15	2

Par. no.	Parameter name	Parameter name in the drive	Alternative settings	Default setting
05	AXIS NODE ADDRESS (MI996)	FBA PAR5	0, 1, 4, 5, 8, 9,12, 13	0
06	AXIS NODE ENABLE (MI996)	FBA PAR6	0 = DISABLED 1 = ENABLED	0
07	I/O NODE ADDRESS (MI996)	FBA PAR7	2, 3, 6, 7, 10, 11	2
08	I/O NODE ENABLE (MI996)	FBA PAR8	0 = DISABLED 1 = ENABLED	0
09	STATION ORDER NUMBER (MI11)	FBA PAR9	0…254	0
10	STATION FIRMWARE VERSION (MI0)	FBA PAR10	0…9999 (BCD)	0
11	STATION ID / USER CONFIGURATION WORD HI (MI2)	FBA PAR11	0x00…0xFF	0
12	STATION ID / USER CONFIGURATION WORD LO (MI2)	FBA PAR12	0x0000…0xFFFF	0

Par. no.	Parameter name	Parameter name in the drive	Alternative settings	Default setting
13	STATION STATUS (MI4)	FBA PAR13	0…63 Decimal enumerated bit field: **Bit 5:** SYNC PACKET FAULT **Bit 4:** RING ACTIVE **Bit 3:** PERMANENT RING FAULT **Bit 2:** STATION FAULT SHUTDOWN **Bit 1:** RING BREAK FAULT **Bit 0:** CONFIGURATION FAULT	0
14	MACRO RING CHECK PERIOD (MI8)	FBA PAR14	0…255 (servo cycles)	200
15	MACRO RING ERROR SHUTDOWN COUNT (MI9)	FBA PAR15	0…65535	20
16	MACRO SYNC PACKET SHUTDOWN COUNT (MI10)	FBA PAR16	0…65535	180
17	RING ERROR COUNTER HI (MI5)	FBA PAR17	0x00…0xFF	0
18	RING ERROR COUNTER LO (MI5)	FBA PAR18	0x0000…0xFFFF	0

Par. no.	Parameter name	Parameter name in the drive	Alternative settings	Default setting
19	CLOCK CONTROL HI (MI990)	FBA PAR19	0x0000…0xFFFF	5000
20	CLOCK CONTROL LO (MI990)	FBA PAR20	0x0000…0xFFFF	1092
21	RAW REFERENCE SCALE	FBA PAR21	0…65535	8
22	POSITION FEEDBACK FORMAT (MI20)	FBA PAR22	0…7	0
23… 26*	-	FBA PAR23… FBA PAR26	-	0
27	PARAMETER REFRESH	FBA PAR REFRESH	0 = DONE 1 = REFRESH	0
28	PARAMETER TABLE REVISION	PAR TABLE VER	(Read-only)	0
29	DRIVE TYPE CODE	DRIVE TYPE CODE	(Read-only)	0
30	MAPPING FILE REVISION	MAPPING FILE VER	(Read-only)	0
31	FBA COMMUNI-CATION STATUS	D2FBA COMM STA	(Read-only)	0
32	FBA COMMON PROGRAM REVISION	FBA COMM SW VER	(Read-only)	0
33	FBA APPLICATION PROGRAM REVISION	FBA APPL SW VER	(Read-only)	0

*Not used by the adapter module

01 FBA TYPE

This parameter displays the fieldbus adapter type as detected by the drive. The value cannot be adjusted by the user.

If the value of this parameter is zero, communication between any module and the drive has never been established before.

02 PROFILE

This parameter selects the communication profile used by the adapter module. The following profile is available:

- 0 = MACRO Station

For more information on the profile, see chapter *Communication profiles*.

03 MASTER ADDRESS (SW2) (MI996 and MI3)

This parameter sets the master node address which the adapter module will listen to.

04 SW1 (MI3)

This parameter is an alternative way to set up the axis node and I/O node (parameters 05, 06, 07 and 08).

This parameter takes precedence over parameters 05, 06, 07 and 08 for all values, except when set to 14. When this parameter is set to 14, parameters 05, 06, 07 and 08 will be used.

The table below shows the settings available.

SW1 value	MI996 value*	Node # enabled
0	0x0F1FE20	0
1	0x0F1FE31	1
2	0x0F3FE20	0 and 2
3	0x0F3FE31	1 and 3
4	0x0F1FE64	4
5	0x0F1FE75	5
6	0x0F3FE64	4 and 6
7	0x0F3FE75	5 and 7

SW1 value	MI996 value*	Node # enabled
8	0x0F1FEA8	8
9	0x0F1FEB9	9
10	0x0F3FEA8	8 and 10
11	0x0F3FEB9	9 and 11
12	0x0F1FE2C	12
13	0x0F1FE3D	13
14	0x0F0FE10	None (Settings from par. 05, 06, 07 and 08)
15	0x0F1FE1B	11 (Set MI-variables to the factory default)

*The master node address in MI996 is not affected.

05 AXIS NODE ADDRESS (MI996)

There is one axis node in FMAC-01, whose address can be selected as 0, 1, 4, 5, 8, 9, 12 or 13.

Note: This parameter is only active when SW1 (parameter 04) is set to 14.

06 AXIS NODE ENABLE (MI996)

- 0 = Axis node communication is disabled.
- 1 = Axis node communication is enabled.

Note: This parameter is only active when SW1 (parameter 04) is set to 14.

07 I/O NODE ADDRESS (MI996)

There is one I/O node in FMAC-01, whose address can be selected as 2, 3, 6, 7, 10 or 11. I/O node communication is updated less frequently than axis node communication.

Note: This parameter is only active when SW1 (parameter 04) is set to 14.

08 I/O NODE ENABLE (MI996)

- 0 = I/O node communication is disabled.
- 1 = I/O node communication is enabled.

Note: This parameter is only active when SW1 (parameter 04) is set to 14.

09 STATION ORDER NUMBER (MI11)

This parameter allows a MACRO controller to set up the ring order using ASCII communication. When the station order number is set to 0, the MACRO controller will identify the station as “unordered” and assign a station order number for it as well as set up the axis and I/O node settings (parameters 05, 06, 07 and 08).

Note: This parameter is only active when SW1 (parameter 04) is set to 14.

10 STATION FIRMWARE VERSION (MI0)

This parameter shows the MACRO station firmware version used in the adapter module. Note that it is not the same as the FMAC-01 firmware version.

11 STATION ID / USER CONFIGURATION WORD HI (MI2)

Most significant 8 bits (bits 23…16) of MI2. The parameter can be used to store user configuration data, such as a station ID.

12 STATION ID / USER CONFIGURATION WORD LO (MI2)

Least significant 16 bits (bits 15…0) of MI2. See parameter 11.

13 STATION STATUS (MI4)

Each bit of this parameter reports the presence or absence of a particular fault/status.

- If the bit is 0, the condition is false.
- If the bit is 1, the condition is true.

Bit	Description
5	SYNC PACKET FAULT
4	RING ACTIVE
3	PERMANENT RING FAULT
2	STATION FAULT (station shutdown)
1	RING BREAK FAULT
0	CONFIGURATION FAULT

Example: If the value of this parameter is 5, it means that bits 0 and 2 are set, that is, a configuration fault and station fault have occurred.

14 MACRO RING CHECK PERIOD (MI8)

This parameter sets the number of servo cycles, within which a station must receive at least the sync packet count of sync packets (par. 16, MI10) and detect fewer ring communication errors than the ring error shutdown count (par. 15, MI9), to conclude that the ring is operating correctly.

15 MACRO RING ERROR SHUTDOWN COUNT (MI9)

This parameter sets the number of MACRO communication errors detected that will cause a station fault (station shutdown).

16 MACRO SYNC PACKET SHUTDOWN COUNT (MI10)

This parameter sets the number of MACRO ring sync packets that must be received during a MACRO ring check period (par. 14, MI8) to conclude that the ring is operating correctly.

17 RING ERROR COUNTER HI (MI5)

Most significant 8 bits (bits 23…16) of MI5. The counter shows the number of ring communications errors detected since the power-up or reset.

18 RING ERROR COUNTER LO (MI5)

Least significant 16 bits (bits 15…0) of MI5. See parameter 17.

19 CLOCK CONTROL HI (MI990)

Most significant 16 bits (bits 31…16) of MI990.

MI990 combines MI992, MI993 and MI994 and contains information about the phase clock, servo encoder clock and clock divisors.

20 CLOCK CONTROL LO (MI990)

Least significant 16 bits (bits 15…0) of MI990. See parameter 19.

21 RAW REFERENCE SCALE

This parameter determines the reference scaling when drive parameter 50.04 FBA REF1 MODESEL is set to ‘Raw data’.

The reference received is multiplied by the value of this parameter.

Example: If the parameter is set to 8 and the incoming reference is 1000, the reference passed to the drive will be 8000.

22 POSITION FEEDBACK FORMAT (MI20)

The three least significant bits of this parameter determine the position feedback format for the cyclic and non-cyclic position data.

Bit	Value	Description
2	0	Non-cyclic Absolute Position Data not shifted
	1	Non-cyclic Absolute Position Data shifted by 5 bits to the right
1	0	Non-cyclic Absolute Position Data not shifted
	1	Non-cyclic Position Capture Data shifted by 5 bits to the right
0	0	Cyclic Servo Position Data shifted by 5 bits to the left
	1	Cyclic Servo Position Data not shifted

23…26

These parameters are not used by the adapter module.

27 PARAMETER REFRESH

This parameter validates any changed adapter module configuration parameter settings. After refreshing, the value reverts automatically to **0** = DONE.

Note: This parameter cannot be changed while the drive is running.

28 PARAMETER TABLE REVISION

This parameter displays the parameter table revision of the fieldbus adapter module mapping file stored in the memory of the drive. In format xyz, where:

- x = major revision number
- y = minor revision number
- x = correction number.

29 DRIVE TYPE CODE

This parameter displays the drive type code of the fieldbus adapter module mapping file stored in the memory of the drive.

30 MAPPING FILE REVISION

This parameter displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. Example: 0x107 = revision 1.07.

31 FBA COMMUNICATION STATUS

This parameter displays the status of the fieldbus adapter module communication.

32 FBA COMMON PROGRAM REVISION

This parameter displays the common program revision of the adapter module in format axyz, where:

- a = major revision number
- xy = minor revision numbers
- z = correction letter.

Example: 190A = revision 1.90A

33 FBA APPLICATION PROGRAM REVISION

This parameter displays the application program revision of the adapter module in format axyz, where:

- a = major revision number
- xy = minor revision numbers
- z = correction letter.

Example: 190A = revision 1.90A

FMAC-01 configuration parameters – group B (group 2)

Note: The actual parameter group number depends on the drive type. Group B (group 2) equals to parameter group 53 in ACSM1.

Par. no.	Parameter name	Parameter name in drive	Alternative settings	Default setting
01	DATA OUT 1 (master to drive)	FBA DATA OUT1	0…9999 Format: **xxyy**, where **xx** = parameter group and **yy** = parameter index.	0
02	DATA OUT 2	FBA DATA OUT2	See DATA OUT 1 above.	0
03	DATA OUT 3	FBA DATA OUT3	See DATA OUT 1 above.	0
04	DATA OUT 4	FBA DATA OUT4	See DATA OUT 1 above.	0
05	DATA OUT 5*	FBA DATA OUT5	-	0
06	DATA OUT 6*	FBA DATA OUT6	-	0
07	DATA OUT 7*	FBA DATA OUT7	-	0
08	DATA OUT 8*	FBA DATA OUT8	-	0
09	DATA OUT 9*	FBA DATA OUT9	-	0
10	DATA OUT 10*	FBA DATA OUT10	-	0
11	DATA OUT 11*	FBA DATA OUT11	-	0
12	DATA OUT 12*	FBA DATA OUT12	-	0

*Not used by the adapter module

01 DATA OUT 1

This parameter represents data word 1 received by the drive over the MACRO network in I/O node communication. The content is defined by a decimal number in the range of 0 to 9999 as follows:

0	not used
101…9999	parameter area of the drive

The parameter area is allocated as follows:

Parameter number with format **xxyy**, where **xx** is the parameter group number (1 to 99) and **yy** is the parameter number index within that group (01 to 99).

Note: One DATA OUT parameter can assign only 16 bits of data to fieldbus communication. When a 32-bit drive parameter is assigned to fieldbus communication, the assigned parameter reserves two consecutive parameters from group B.

See also section *I/O node MACRO 72-bit cyclic I/O format* on page *68*.

02 DATA OUT 2 to 04 DATA OUT 4

See parameter 01 above.

05 DATA OUT 5 to 12 DATA OUT 12

These parameters are not used by the adapter module.

FMAC-01 configuration parameters – group C (group 3)

Note: The actual parameter group number depends on the drive type. Group C (group 3) equals to parameter group 52 in ACSM1.

Par. no.	Parameter name	Parameter name in drive	Alternative settings	Default setting
01	DATA IN 1 (drive to master)	FBA DATA IN1	0…9999 Format: **xxyy**, where **xx** = parameter group and **yy** = parameter index.	0
02	DATA IN 2	FBA DATA IN2	See DATA IN 1 above.	0
03	DATA IN 3	FBA DATA IN3	See DATA IN 1 above.	0
04	DATA IN 4	FBA DATA IN4	See DATA IN 1 above.	0
05	DATA IN 5*	FBA DATA IN5	-	0
06	DATA IN 6*	FBA DATA IN6	-	0
07	DATA IN 7*	FBA DATA IN7	-	0
08	DATA IN 8*	FBA DATA IN8	-	0
09	DATA IN 9*	FBA DATA IN9	-	0
10	DATA IN 10*	FBA DATA IN10	-	0
11	DATA IN 11*	FBA DATA IN11	-	0
12	DATA IN 12*	FBA DATA IN12	-	0

*Not used by the adapter module

01 DATA IN 1

This parameter represents data word 1 sent by the drive over the MACRO network in I/O node communication. The content is defined by a decimal number in the range of 0 to 9999 as follows:

0	not used
101…9999	parameter area of the drive

The parameter area is allocated as follows:

Parameter number with format **xxyy**, where **xx** is the parameter group number (1 to 99) and **yy** is the parameter number index within that group (01 to 99).

Note: One DATA IN parameter can assign only 16 bits of data to fieldbus communication. When a 32-bit drive parameter is assigned to fieldbus communication, the assigned parameter reserves two consecutive parameters from group C.

See also section *I/O node MACRO 72-bit cyclic I/O format* on page *68*.

02 DATA IN 2 to 04 DATA IN 4

See parameter 01 above.

05 DATA IN 5 to 12 DATA IN 12

These parameters are not used by the adapter module.

Control locations

ABB drives can receive control information from multiple sources including digital inputs, analog inputs, the drive control panel and a communication module (for example, the adapter module). ABB drives allow the user to separately determine the source for each type of control information (Start, Stop, Direction, Reference, Fault Reset, etc.).

In order to give the fieldbus master station the most complete control over the drive, the communication module must be selected as the source for this information. The parameter setting examples below contain the drive control parameters needed in the examples. For a complete parameter list, see the drive *Firmware manual*.

Starting up the ACSM1 drive

1. Power up the drive.
2. Enable the communication between the adapter module and the drive by setting parameter 50.01 FBA ENABLE to ‘ENABLE’.
3. Select how the drive reacts to a fieldbus communication break with parameter 50.02 COMM LOSS FUNC. In motion control applications, it is recommended to select setting ‘Fault’ for this parameter. Note that this function monitors both communication between the fieldbus master and adapter module and communication between the adapter module and drive.
4. Define the time between communication break detection and the selected action with parameter 50.03 COMM LOSS T OUT. Note that adapter module will stop the drive in case of a MACRO ring break, regardless of the action selected with parameter 50.02.

5. Select MACRO-specific values for parameters 50.04…50.11. These parameters define the data transferred in axis node communication. See the parameter setting examples below.
6. Set the FMAC-01 configuration parameters in parameter group 51. At the minimum, set the required node address for the master node with parameter 51.03 and the node addresses for the axis and I/O nodes with parameter 51.04.
7. Define the I/O node communication data transferred to and from the drive in parameter groups 52 and 53. Note that I/O node communication allows only 72 bits of data. Thus, it is possible to define variables only to parameters 1…4 in groups 52 and 53.
8. Validate the settings made in parameter groups 51, 52 and 53 by setting parameter 51.27 FBA PAR REFRESH to ‘REFRESH’.
9. Enable the fieldbus communication synchronization in the drive by setting parameter 57.09 KERNEL SYNC MODE to ‘FBSync’.
10. Set the relevant drive control parameters, encoder configuration parameters and MACRO-specific position control parameters. See the parameter setting examples below.

Parameter setting examples – Fieldbus communication

Drive parameter	Setting	Description
50.01 FBA ENABLE	1 = Enable	Enables the communication between the drive and the adapter module.
50.02 COMM LOSS FUNC	1 = FAULT	Enables fieldbus communication fault monitoring and selects fault as the action upon a fieldbus communication break.
50.03 COMM LOS T OUT	3.0 s	Defines that a communication fault is activated 3 seconds after the fieldbus communication break has been detected.
50.04 FBA REF1 MODESEL	0 = Raw data	Sets the fieldbus REF1/ACT1 mode to ‘Raw data’.
50.05 FBA REF2 MODESEL	3 = Position	Sets the fieldbus REF2/ACT2 mode to ‘Position’.
50.06 FBA ACT1 TR SRC	P.04.03 (PROBE1 POS MEAS)	Sets par. 04.03 as the source of the captured value. (To capture on probe 2, set par. 04.04 PROBE2 POS MEAS as the source.)
50.07 FBA ACT2 TR SRC	P.01.12 (POS ACT)	Sets par. 01.12 as the source of position feedback to the adapter module.
50.11 FBA SW B15 SRC	P.06.11.08 (POS CORR STATUS, bit 8 LATCH1 DONE)	Sets par. 06.11, bit 8 LATCH1 DONE as the source of FBA MAIN SW, bit 31. (This setting causes the capturing to use probe 1. If using probe 2, set par. 06.11, bit 9 LATCH2 DONE as the source.)
51.03 SW2	0	Selects the master node address.

Drive parameter	Setting	Description
51.04 SW1	2	Enables nodes 0 and 2.
51.21 RAW REFERENCE SCALE	8	Defines that the torque reference sent by the master is multiplied by 8 before passed to the drive.
51.22 CYCLIC POSITION FEEDBACK FORMAT	1	Defines that there will be no shifting of the position feedback value.
51.27 FBA PAR REFRESH	1 = REFRESH	Validates the FMAC-01 configuration parameters.

Parameter setting examples – Drive control

Drive parameter	Setting	Description
10.01 EXT1 START FUNC	3 = FBA	Allows the drive to be started by the adapter module.
22.01 SPEED FB SEL	Enc1 speed	Selects the actual speed measured by encoder 1 as the speed feedback.
32.01 TORQ REF1 SEL	3 = FBA REF1	Selects the fieldbus REF1 input as TORQUE REF1.
34.01 EXT1/EXT2 SEL	C.False	Selects EXT1 as the control location.
34.03 EXT1 CTRL MODE1	2 = Torque	Selects the Torque control mode for EXT1.
57.09 KERNEL SYNC MODE	2 = FBSync	Keeps the drive in sync with the servo clock.
60.01 POS ACT SEL	0 = ENC1	Selects ENC1 as the source for the position feedback.
60.09 POS RESOLUTION	18 bits	Sets the number of bits for the resolution of one revolution.

Parameter setting examples – Resolver configuration

The table below shows an example set of parameters that you need to set when using the resolver as encoder 1 for position control. When setting these parameters, check the correct resolver parameter values from the resolver used in the application.

Drive parameter	Setting	Description
90.01 ENCODER 1 SEL	5 = FEN-21 RES	Activates communication between the encoder module and the drive.
92.01 RESOLV POLEPAIRS	eg: 1	Sets the number of polepairs used in the resolver.
92.02 EXC SIGNAL AMPL	eg: 7.0 Vrms	Defines the amplitude of the excitation signal used in the resolver.
92.03 EXC SIGNAL FREQ	eg: 10 kHz	Defines the frequency of the excitation signal used in the resolver.
90.10 ENC PAR REFRESH	1 = Configure	Validates the encoder configuration parameters.

Parameter setting examples – Home position capture with homing switch

The table below shows an example set of parameters that you need to set when a home switch is used for homing. The parameters enable the cyclic correction mode in the drive, which captures a position value to parameter 04.03 PROBE1 POS MEAS every time the load passes the home switch. It is assumed that the capture triggers are connected to encoder DI1 and that the encoder in use is ENC1.

Note: Both trigger probe inputs must be taken from the same source for proper operation of the capture status flag.

Drive parameter	Setting	Description
50.11 FBA SW B15 SRC	P.06.11.08 (POS CORR STATUS, bit 8 LATCH1 DONE)	Sets par. 06.11, bit 8 LATCH1 DONE as the source of FBA MAIN SW, bit 31. (This setting causes the capturing to use probe 1. If using probe 2, set par. 06.11, bit 9 LATCH2 DONE as the source.)
62.01 HOMING METHOD*	0 = No Method	Disables the drive's internal homing methods, allowing the home control from the master.
62.14 CYCLIC CORR MODE	4 = 2 Probe Dist	Takes two capture triggers into use.
62.15 TRIG PROBE1	1 = ENC1 DI1_-	Sets the rising edge of DI1 in encoder 1 as the capture trigger for the home position.
62.17 TRIG PROBE2	1 = ENC1 DI1_-	
62.19 MAX CORRECTION	0	Disables the drive's internal cyclic position correction.
62.20 POS ACT OFFSET	0	Sets the absolute position measured by the encoder as the actual position of the drive.

Drive parameter	Setting	Description
62.30 PROBE TRIG FILT	3 = 1000 us	Determines how long the home switch signal detected by encoder DI1 must stay on before it is used to capture the position.

***Note:** Parameter 62.01 HOMING METHOD is reserved for the drive's internal homing methods. If this parameter is set to a selection other than 'No Method', it will override the selections made in the table above and perform the drive's internal homing method instead.

Parameter setting examples – Home position capture with emulated zero pulse

This example shows how to use an emulated zero pulse for home position capture. The encoder emulation mode can be configured to generate an emulated zero pulse from the resolver's actual position within one revolution. To enable the emulated zero pulse, you need:

- FEN-21 resolver interface modules with revision D or newer
- FEN-xx logic version VIExx500 or newer
- ACSM1 drive with a firmware version newer than UMFI1510.

The table below shows an example set of parameters that you need to set to enable encoder emulation and the emulated zero pulse.

Note: Both trigger probe inputs must be taken from the same source for proper operation of the capture status flag.

Drive parameter	Setting	Description
50.11 FBA SW B15 SRC	P.06.11.08 (POS CORR STATUS, bit 8 LATCH1 DONE)	Sets par. 06.11, bit 8 LATCH1 DONE as the source of FBA MAIN SW, bit 31. (This setting causes the capturing to use probe 1. If using probe 2, set par. 06.11, bit 9 LATCH2 DONE as the source.)
90.03 EMUL MODE SEL	8 = FEN-21 RES	Enables the TTL emulation from the resolver input.

Drive parameter	Setting	Description
93.21 EMUL PULSE NR	eg: 1024	Sets the pulse number for the TTL emulation.
93.23 EMUL POS OFFSET	eg: 0.5	Sets the offset of the zero pulse in relation to the absolute position 0…1.
90.10 ENC PAR REFRESH	1 = Configure	Validates the encoder configuration parameters.
62.01 HOMING METHOD*	0 = No Method	Disables the drive's internal homing methods, allowing the home control from the master.
62.14 CYCLIC CORR MODE	4 = 2 Probe Dist	Takes two capture triggers into use.
62.15 TRIG PROBE1	eg: 6 = ENC1 Zerop	Triggering input with zero pulse according to your need (for more information, see the drive *Firmware manual*.)
62.17 TRIG PROBE2	eg: 6 = ENC1 Zerop	
62.19 MAX CORRECTION	0	Disables the drive's internal cyclic position correction.
62.20 POS ACT OFFSET	0	Sets the absolute position measured by the encoder as the actual position of the drive.
62.25 Z-PULSE SOURCE 1	3 = Emulated Zp	Selects the source of the zero pulse.
62.26 Z-PULSE SOURCE 2	3 = Emulated Zp	
62.30 PROBE TRIG FILT	3 = 1000 us	Determines how long the home switch signal detected by encoder DI1 must stay on before it is used to capture the position.

***Note:** Parameter 62.01 HOMING METHOD is reserved for the drive's internal homing methods. If this parameter is set to a selection other than 'No Method', it will override the selections made in the table above and perform the drive's internal homing method instead.

Parameter setting examples – End limit inputs

This example shows how the drive's digital inputs can be used as end limit inputs in a MACRO status flag. It is assumed that:

- the positive end limit switch is connected to the drive's DI1
- the negative end limit switch is connected to the drive's DI2.

The drive's actual signal indicates the digital input status in packed boolean format. For example, parameter 02.01 DI STATUS = 000001 indicates that digital input DI1 is active and the other digital inputs are inactive. See the drive manuals for more details.

To use DI1 as the positive end limit input, the status of DI1 needs to be connected to parameter 02.13 FBA MAIN SW, bit 29. To use DI2 as the negative end limit input, the status of DI2 needs to be connected to parameter 02.13 FBA MAIN SW, bit 30. To assign the pre-selected bits correctly, set the parameters in the table below.

Drive parameter	Setting	Description
50.09 FBA SW B13 SRC	DI STATUS #	Routes the status of digital input # to 02.13 FBA MAIN SW, bit 29.
50.10 FBA SW B14 SRC	DI STATUS #	Routes the status of digital input # to 02.13 FBA MAIN SW, bit 30.

Configuring the master system

After the adapter module has been initialized by the drive, the master system must be prepared for communication with the module.

Configuring Delta Tau Turbo PMAC

This example shows how to configure a Delta Tau Turbo PMAC master for communication with two ACSM1 drives assigned as axis nodes 0 and 1 in the MACRO network. The example is carried out using the Terminal Window in the PeWinPro2 program. If you are using another master system, consult its manual for information on configuring the network.

To set up the master in PeWinPro2, type the following commands in the Terminal Window:

Command	Description
$$$***	Resets the MACRO master and restores it to the factory default values.
I6800 = 5895	10 kHz Max Phase Clock
I6802 = 4	2 kHz Servo Clock. **Note:** It is crucial for the ACSM1 to perform properly that the servo clock is set to 2 kHz.
I10 = 4193066	Servo interruption time (8388608/2kHz)
I78 = 32	Master/Slave communication timeout (in servo cycles)
I79 = 32	Master/Master communication timeout (in servo cycles)
I80 = 45	MACRO Ring check period (in servo cycles)
I81 = 2	MACRO Maximum ring error count
I82 = 13	MACRO Minimum sync packet count
I70 = 3*	MACRO IC 0 master 0 node auxiliary register enable for nodes 0 and 1
I71 = 3*	Node protocol type selection: Set MACRO protocol type as 1 for nodes 0 and 1 in MACRO IC master 0.
I100 = 1	Motor 1 Activation
I200 = 1	Motor 2 Activation

Command	Description
I124 = $840001	Motor 1 Flag mode control
I224 = $840001	Motor 2 Flag mode control
I6840 = $4030	MACRO IC 0 Ring configuration/status
I6841 = $0FC003*	MACRO IC 0 Node activation control. **Note:** This value activates only nodes 0, 1, 14 and 15.
SAVE	Saves the variables.
$$$	Resets the master while using the saved variables.

*These values have to be adjusted if more slave nodes are present on the ring.

For more information on the commands used in the Delta Tau Turbo PMAC master, refer to the software reference manual of Turbo PMAC/PMAC2.

7

Communication profiles

What this chapter contains

This chapter describes the communication profile used in the communication between the MACRO network, the adapter module, and the drive.

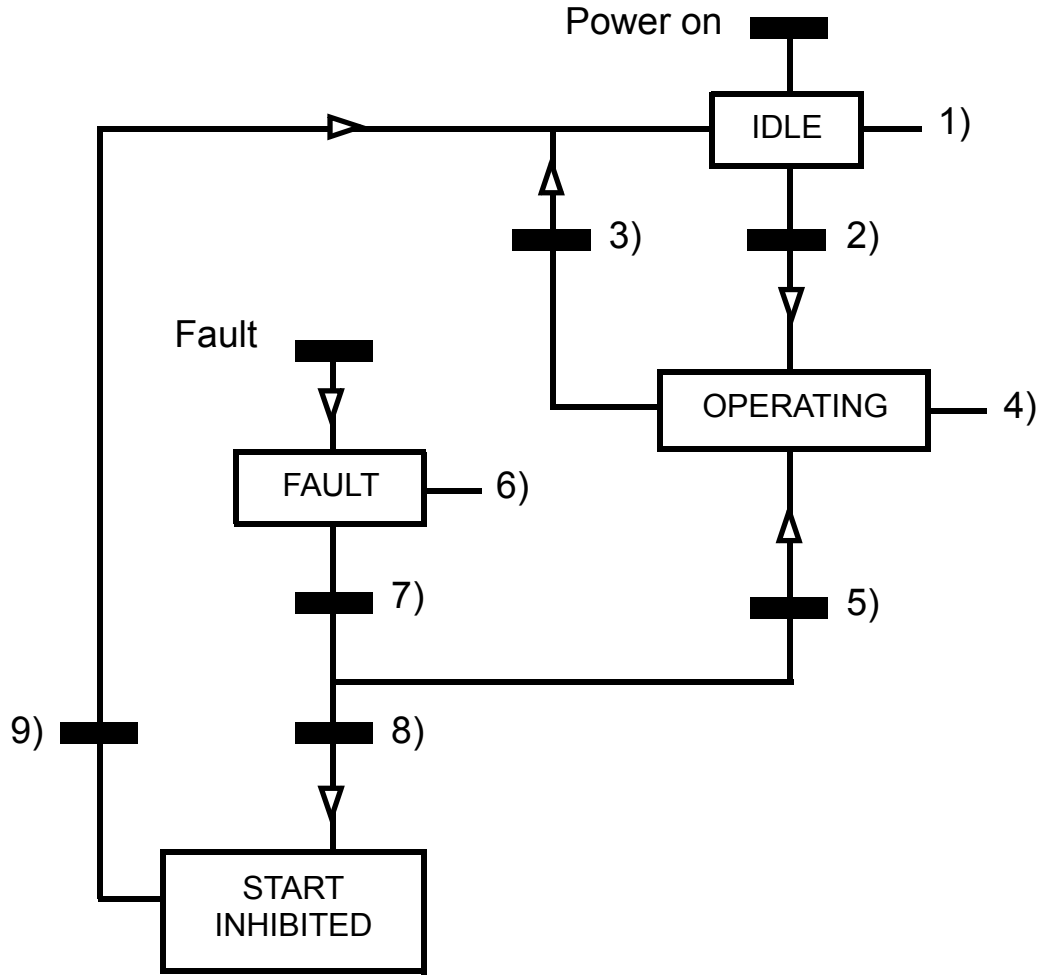
Communication profiles

Communication profiles are ways of conveying control commands (Control word, Status word, References and Actual values) between the master station and the drive.

With the FMAC-01 MACRO adapter module, the master employs the MACRO Station profile. The profile is converted to the FBA profile by the adapter module. The FBA profile is detailed in the drive manuals.

MACRO Station profile

The MACRO Station profile's control and status flags are handled by the adapter module. The figure below shows how the control and status flag correlate with the drive's internal Control/Status word.



1) FBA CW = xxxx xxxx xxxx xxx0 xxxx 1xx0 1xxx xx01
   Start inhibit = 0, Remote Cmd = 1, Reset = 0, Run Enable = 1, Start = 0, Stop = 1
2) Flag command Bit 14, Amp. enable = 1
3) Flag command Bit 14, Amp. enable = 0
4) FBA CW = xxxx xxxx xxxx xxx0 xxxx 1xx0 1xxx xx10
   Start inhibit = 0, Remote Cmd = 1, Reset = 0, Run Enable = 1, Start = 1, Stop = 0
5) FBA SW Bit 6, Ack Start Inhibit = 0
6) Flag status Bit 15, Station Fault = 1

7) Flag command Bit 12, Node Reset = 1 -> FBA CW Bit 8 = 1 (Reset = 1)
8) FBA SW Bit 6, Ack Start Inhibit = 1
9) Flag command Bit 14, Amp. enable = 0

MACRO Station control and status flags

The table below shows the contents the MACRO Station control flag:

Bit #	Description
23	UserCmdFlg5
22	UserCmdFlg4
21	UserCmdFlg3
20	UserCmdFlg2
19	UserCmdFlg1
18	Reserved
17	Reserved
16	Reserved
15	Station fault (when bit 13 is set to 1)
14	Amplifier Enable
13	This slave detected a MACRO ring break and became a Synchronizing master.
12	Node Reset command (Clear faults)
11	Position Capture (Triggered Event) Enable Flag
10	0 indicates a Command Message and not a Status Message.
9	Reserved
8	Reserved
7-0	Not available

The table below shows the contents of the MACRO Station status flag:

Bit #	Description
23	UserStatusFlg5
22	UserStatusFlg4
21	UserStatusFlg3
20	UserStatusFlg2
19	UserStatusFlg1
18	Negative End Limit Flag (NILMn) Input Value
17	Positive End Limit Flag (PILMn) Input Value
16	Home Flag (HMFLn) Input Value
15	Amplifier or Station Node shutdown Fault
14	Amplifier Enabled
13	This Node detected a MACRO Ring Break.
12	A Reset has occurred. This bit is cleared on the next Amplifier Enable.
11	Position Capture (Triggered Event) Occurred Flag
10	1 indicates a Status Message and not a Command Message.
9	Reserved
8	Reserved
7-0	Not available

8

Communication protocol

What this chapter contains

This chapter describes the communication on a MACRO network.

MACRO protocol

MACRO is an Ethernet-style protocol that uses multi-mode fiber optic (FDDI-PMD ISO/IEC 9314-3) or twisted pair copper (CAT5) called 100BASEFX and 100BASETX.

MACRO frame structure

Each data packet for a node contains four registers: 0, 1, 2 and 3.

- Register 0 is a 24-bit register for real time data.
- Registers 1, 2 and 3 are 16-bit registers for real-time data.

Each node has a command packet of four registers and a feedback packet of four registers. The command and feedback packets slip into the same data packet for the node (upon entering the addressed node, the data packet is a command packet; upon exiting, it is a feedback packet).

Services

The MACRO protocol has the ability to pass commands of different types from a controller to a drive. Thanks to the high rate of data transmission over the ring (125 Mbits/sec), MACRO facilitates the closure of high performance servo loops across the ring, allowing the controller and the drive to split the motion control tasks between themselves at any level.

MACRO specifies services for reading and writing data from the physical memory within the slaves. The FMAC-01 MACRO adapter module supports the following MACRO services:

- Writing and reading drive parameters
- Axis node MACRO 72-bit cyclic I/O format
- Fast digital output transfer in Control word
- Home position, position capture and over travel limits
- I/O node MACRO 72-bit cyclic I/O format
- Absolute power-on position
- Flag capture position
- ASCII transfer commands.

Writing and reading drive parameters

Writing parameter values to the drive is performed in two phases. In the first phase, the master writes the group and parameter number to MI30. In the second phase, the master writes the data to be written to MI31. If a writing error occurs, the slave returns an error by setting bit 18 of the node 15 status.

Likewise, reading parameter values from the drive is performed in two phases. In the first phase, the master writes the group and parameter number to MI30. In the second phase, the data is read by the master from MI31. If a reading error occurs, the slave returns an error by setting bit 18 of the node 15 status.

The table below shows the MI30 bit definitions:

Bit	Definition
47:16	Unused
15:8	Parameter group number (0…255)
7:0	Parameter index number (0…255)

The parameter group and index number have to be in hexadecimal format. For example, to read parameter 51.01:

- Group = 51 decimal = 33 hexadecimal
- Index = 1 decimal = 1 hexadecimal
- MI30 = $3301.

Axis node MACRO 72-bit cyclic I/O format

The 72-bit node cyclic transfer is used to control the drive. With the ACSM1 drive, the command data at the drive is updated at 500 microsecond intervals. The payload data comprises one 24-bit segment and three 16-bit segments:

Direction	Register			
	0 (24-bit)	1 (16-bit)	2 (16-bit)	3 (16-bit)
Master to FMAC-01	REF1 (Torque/velocity command)	Unused	Unused	Flag command
FMAC-01 to Master	ACT2 (Position feedback)	ACT1 (Flag captured position)		Flag status

The data transferred in axis node communication is selected in drive parameter group 50 by defining the reference control modes and actual values used in the application. For typical MACRO motion control applications, the parameter settings should be as follows:

- 50.04 FBA REF1 MODESEL = Raw data
- 50.05 FBA REF2 MODESEL = Position
- 50.06 FBA ACT1 TR SRC = P.04.03 (PROBE1 POS MEAS) or P.04.04 (PROBE2 POS MEAS)

With these settings, the 24-bit MACRO torque command is translated into the 32-bit drive-internal reference (REF1). The 24-bit MACRO position feedback (MI920) is translated from the 32-bit drive-internal actual value (ACT2). The MACRO flag captured position (MI921) is translated from the 32-bit drive-internal actual value (ACT1).

It is also possible to use alternative settings for the reference control modes. Since there is no control mode selection through the MACRO variables, parameter 50.04 FBA REF1 MODESEL determines how to scale the reference data, depending on what mode is in use. Valid modes are torque, speed and raw data mode. Note that the selected reference control mode also affects the feedback value transferred in ACT1.

- In the torque mode, the maximum MACRO torque command is scaled to a value of 1000.0% of the nominal torque. The feedback transferred in ACT1 is the motor torque in percent of the motor nominal torque.
- In the speed mode, the scaling is determined by parameter 25.02 SPEED SCALING. The feedback transferred in ACT1 is the filtered actual speed in rpm.
- In the raw data mode, the scaling is determined by the FMAC-01 configuration parameter 21 RAW REFERENCE SCALE. The feedback transferred in ACT1 is selected with parameter 50.06 FBA ACT1 TR SRC.

Even though reference 2 is not used in axis node communication, parameter 50.05 FBA REF2 MODESEL defines the feedback transferred in ACT2 from the drive to the master. With the MACRO interface, this parameter should always be set to ‘Position’. This setting transfers the drive's actual position as feedback in ACT2. The scaling of the position feedback is determined by the FMAC-01 configuration parameter 22 CYCLIC POSITION FEEDBACK FORMAT. However, the most significant 8 bits of the drive's ACT2 are always discarded.

The actual drive control mode is selected with drive parameters 34.01 EXT1/EXT2 SEL, 34.02 EXT1 MODE 1/2 SEL, 34.03 EXT1 CTRL MODE1 and 34.04 EXT1 CTRL MODE2. For further information, see the drive *Firmware manual* and the parameter setting examples in section *Starting up the ACSM1 drive* on page *47*.

Fast digital output transfer in Control word

Four freely programmable bits in the FBA MAIN CW can be used to transfer fast digital outputs as follows:

	Digital output 1	**Digital output 2**	**Digital output 3**	**Digital output 4**
FBA MAIN CW	CW B28	CW B29	CW B30	CW B31
MACRO Flag command	B19 - UserCmdFlg1	B20 - UserCmdFlg2	B21 - UserCmdFlg3	B22 - UserCmdFlg4

To use the freely programmable bits from the FBA MAIN CW in the drive, bits 28, 29, 30 or 31 of parameter 02.12 FBA MAIN CW have to be mapped to the bit in the parameter to be controlled.

Example: To map bit 28 of the FBA MAIN CW to the first digital output (DIO1), set parameter 12.04 DIO1 OUT PTR to P.02.12.28 (02.12 FBA MAIN CW, bit 28).

Home position, position capture and overtravel limits

The MACRO flag status bits are mapped to the drive FBA MAIN SW as shown in the table below.

	Home position	**Positive over travel**	**Negative over travel**	**Position capture**
FBA MAIN SW	SW B28	SW B29	SW B30	SW B31
MACRO Flag status	B16 - Home Flag (HMFLn) Input Value	B17 - Positive End Limit Flag (PILMn) Input Value	B18 - Negative End Limit Flag (NILMn) Input Value	B11 - Position Captured (Triggered Event Occurred) Flag

The captured position will be sent from the drive to the adapter module using ACT1. For this to work, an appropriate drive parameter has to be mapped to parameter 50.06 FBA ACT1 TR SRC. For the mapping, parameter 50.04 FBA REF1 MODESEL has to be set to ‘Raw data’. See the parameter setting examples in section *Starting up the ACSM1 drive* on page *47*.

I/O node MACRO 72-bit cyclic I/O format

The 72-bit node cyclic transfer is used to transfer parameter-mapped data to and from the drive (parameter groups 52 and 53). Low priority cyclic data is updated at 2 ms intervals. The payload data comprises one 24-bit segment and three 16-bit segments:

Direction	Register			
	0 (24-bit)	1 (16-bit)	2 (16-bit)	3 (16-bit)
Master to FMAC-01	53.01 FBA DATA OUT1	53.02 FBA DATA OUT2	53.03 FBA DATA OUT3	53.04 FBA DATA OUT4
FMAC-01 to Master	52.01 FBA DATA IN1	52.02 FBA DATA IN2	52.03 FBA DATA IN3	52.04 FBA DATA IN4

If the actual data is smaller than the payload segment, the data is placed in the least significant byte(s).

Absolute power-on position

MI-variable MI920 contains the drive's actual position read from drive parameter 01.12 POS ACT. The position value of the drive is shown in MACRO format in MI920.

Flag capture position

MI-variable MI921 contains the latest captured position value.

ASCII transfer commands

Node 14 is used to transfer 48-bit ASCII commands from the master. These commands are transmitted using the broadcast feature of the MACRO protocol.

The table below lists all ASCII commands supported by FMAC-01.

ASCII command	Explanation	Type
MACSTAx	Initiates ASCII communication between the master station and the selected slave station x.	
?	Reports the MACRO Station Global Status register (MI4).	Unsigned 32-bit integer
$$$	Resets the MACRO station and restores all station MI-variables to their last saved values.	
$$$***	Resets the MACRO station and restores all station MI-variables to their factory default values.	
BKUP	Reports all saved MI-variables.	ASCII string
CID	Reports the MACRO station's part number (CardID).	Unsigned 32-bit integer
CLRF	Clears all faults on the MACRO station and prepares it for further operation.	
DATE	Reports the date of the firmware.	Month/Day/Year
SAVE	Copies the MACRO station's MI-variable values from the volatile active memory to the non-volatile flash memory.	
SID	Reports the serial number of the MACRO station.	Unsigned 32-bit integer
TYPE	Reports the MACRO station type ("uMacro").	ASCII string
VERS	Reports the firmware version number.	0.001... 9.999 (BCD)

ASCII command	Explanation	Type
VID	Reports the MACRO station's vendor identification number (6 ABB).	ASCII string

Ring order set-up

Upon the initial binding of a MACRO station to a MACRO master, the ring order set-up is used if FMAC-01 configuration parameter 06 (STATION ORDER NUMBER) is set to 0. Otherwise parameter 03 (SW1) or parameters 04, 05 and 06 (MASTER ADDRESS, AXIS NODE ADDRESS and I/O NODE ADDRESS) are used to set up the axis and I/O nodes and the master.

In the ring order set-up, the ring controller sends out a command on the ring in the ASCII communication protocol, asking to talk to the first MACRO station that does not have a station number. Once the communication is established, the ring controller can define the MACRO binding of the slave station to a master and their binding node(s).

Timing and synchronization

The timing of the reference and actual position feedback is important in a MACRO network. The rate at which references should be fed and position feedback read is determined by the servo clock rate (which is determined by the phase clock and servo clock divider set by MI990). The servo clock has to be set to 2 kHz. This value corresponds to the hexadecimal value 0x13880444 of MI990.

In some applications, it may be beneficial that all drives in the ring are internally synchronized with each other. To start the synchronization, send an “msync” command from the MACRO master.

Acyclic and cyclic communication modes

The FMAC-01 MACRO adapter module supports the Type 1 MACRO protocol. One axis node and one I/O node are supported. The addresses available to the axis node are 0, 1, 4, 5, 8, 9, 12 or 13; to the I/O node, 2, 3, 6, 7, 10 or 11.

Nodes 14 and 15 are used for acyclic communication. Node 14 is used for 48-bit broadcast ASCII transfer. Node 15 is used by the master to read/write the MI-variables.

MI-variables supported by FMAC-01

MI-variable	**Name**	**RO/RW**	**FMAC-01 configuration parameter (group 51)**
MI0	Station Firmware Version	RO	10
MI1	Station Firmware Date	RO	
MI2	Station ID and User Configuration Word	RW	11, 12
MI3	SW1 and SW2	RW	03, 04
MI4	Station Status Word	RO	13
MI5	Ring Error Counter	RW	18, 19
MI8	MACRO Ring Check Period	RW	14
MI9	MACRO Ring Error Shutdown Count	RW	15
MI10	MACRO Sync Packet Shutdown Count	RW	16
MI11	Station Order Number	RW	09
MI12	Card Identification	RO	
MI20	Cyclic Position Feedback Format	RW	22
MI30	Drive parameter group/index	RW	
MI31	Drive parameter data	RW	

MI-variable	Name	RO/RW	FMAC-01 configuration parameter (group 51)
MI920	Absolute Power-On Position	RO	22
MI921	Flag Capture Position	RO	22
MI990	Clock Control Register	RW	19, 20
MI992	MaxPhase Frequency Control	RW	19, 20
MI993	Servo Encoder Clock Divisor	RW	19, 20
MI994	Flag Clock Divisor	RW	19, 20
MI995	MACRO Ring Configuration/Status	RW	17
MI996	MACRO Node Activate Control	RW	03, 04, 05, 06, 07, 08
MI998	Servo Clock Frequency Control	RW	

9

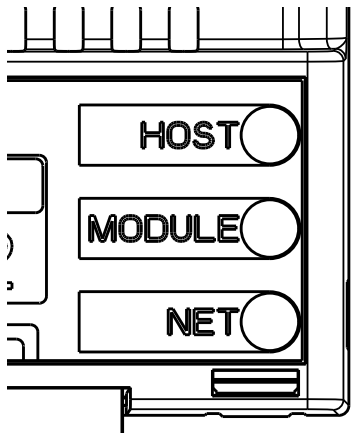
Diagnostics

What this chapter contains

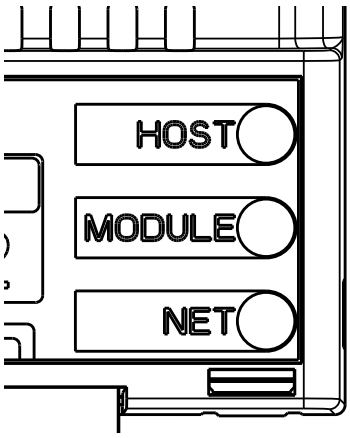
This chapter explains how to trace faults with the status LEDs on the adapter module.

LED indications

The adapter module is equipped with three bicolor diagnostic LEDs. The LEDs are described below.



Name	Color	Function
HOST	Blinking green	Establishing communication to host
	Green	Connection to host OK
	Blinking red	Communication to host lost temporarily



Name	Color	Function
MODULE	Off (dark)	Configuration not done. No nodes selected to be active.
	Green	Ring active, no faults
	Blinking green	Module in ASCII mode
	Red	Ring break detected
	Blinking red	Station fault* or drive fault
NET	Green	MACRO link OK
	Red	MACRO link down

*A station fault is triggered if:

- a ring break occurs
- the number of ring communication errors exceeds the MACRO ring error shutdown count defined by par. 15 (MI9)
- the number of sync packets falls short of the MACRO sync packet shutdown count defined by par. 16 (MI10) during the check period defined by par. 14 (MI8)
- another station is on the same node number.

For the descriptions of the FMAC-01 configuration parameters above, see page 39.

10

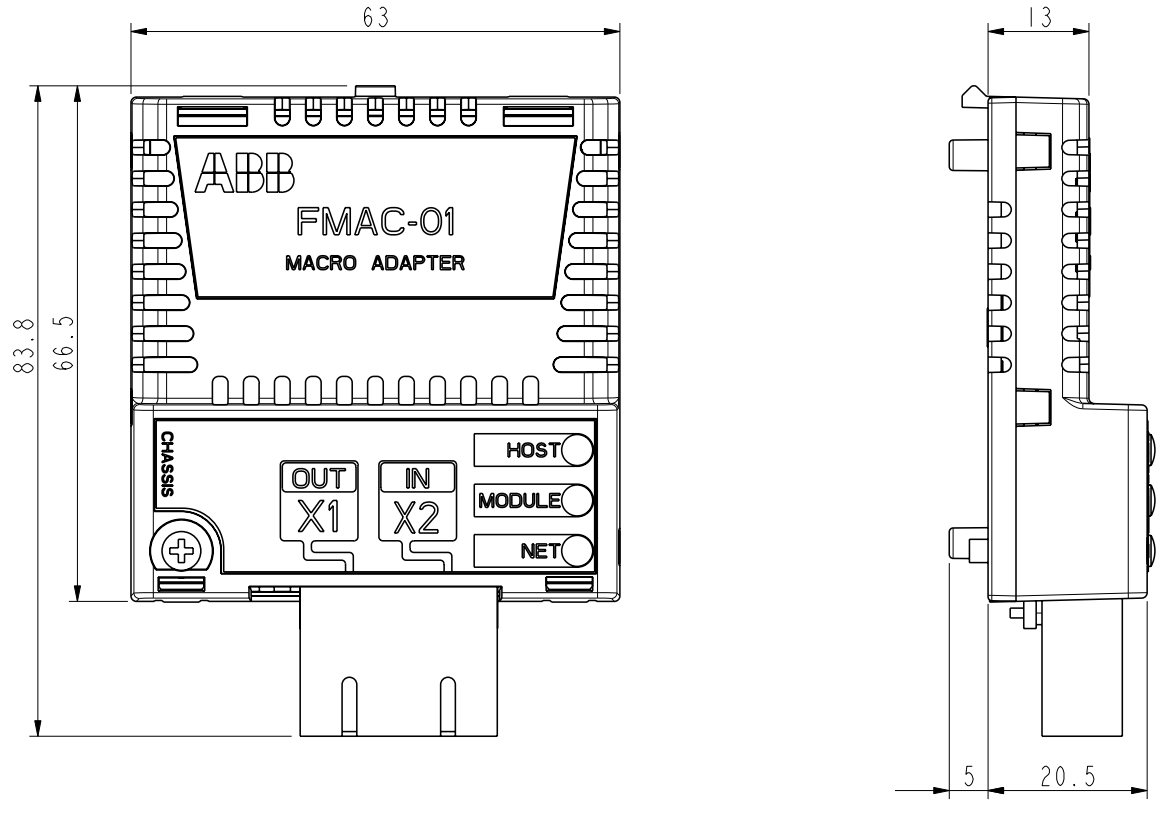
Technical data

What this chapter contains

This chapter contains the technical data of the adapter module and the MACRO link.

FMAC-01

The figure below shows the enclosure of the adapter module from the front and side.



Mounting	Into the option slot of the drive
Degree of protection	IP20
Ambient conditions	The applicable ambient conditions specified for the drive in its manuals are in effect.
Indicators	Three bicolor LEDs (HOST, MODULE, NET)
Connectors	20-pin connector to the drive (X3) Two SC fiber optic connectors (X1 and X2)
Power supply	+3.3 V ± 5% max. 450 mA (supplied by the drive)
General	Estimated min. lifetime 100 000 h All materials UL/CSA-approved Complies with EMC standard EN 61800-3:2004

MACRO link

Medium	Fiber optic • Wiring: FDDI-PMD ISO/IEC 9314-3 • Connector: SC • Maximum segment length: 3000 m
Topology	Ring
Transfer rate	Up to 125 Mbit/s
Serial communication type	Full duplex
Protocol	MACRO

Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/drives and selecting *Sales, Support and Service network*.

Product training

For information on ABB product training, navigate to www.abb.com/drives and select *Training courses*.

Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Go to www.abb.com/drives and select *Document Library – Manuals feedback form (LV AC drives)*.

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