

**Withdrawn; however may be applied on  
special agreement !**

**EUROMAP  
15**

**PROTOCOL FOR COMMUNICATION BETWEEN INJECTION  
MOULDING MACHINES AND A CENTRAL COMPUTER**

**Part 1**

**BASIC COMMUNICATION PROTOCOL**

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This recommendation was prepared by the Working Group "Electronic Control of Injection Moulding Machines" of EUROMAP.

It is part of the complete EUROMAP 15 recommendation.

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## 1. Introduction

Part 1 of the EUROMAP 15 recommendation, basic communication protocol, defines the telegrams and data structures necessary to establish a communication between a central computer and one or several injection moulding machines by means of the master/slave principle. The central computer is the master, whereas the injection moulding machines are slaves.

A telegram is one single message going from the central computer to an injection moulding machine or vice versa.

As the physical network the BITBUS (according to IEC 435) is used.

## 2. Communication Principle

Definition: The telegrams transferred from the central computer to a machine controller are called commands, whereas the telegrams transferred from a machine controller to the central computer are called responses.

A machine may not send any telegram onto the BITBUS unless it is asked to do so by the central computer.

The central computer polls every machine in regular intervals by means of a special command, the standard question. A machine which has been polled sends a special command, the standard answer, to the central computer, indicating that it has either a service request (i.e. it wants to send a message to the central computer) or it has no request (no information for the central computer).

The central computer can send commands to the machine without a preceding service request from the machine. The machine has to answer such a command by sending the corresponding response telegram or by sending a negative acknowledgement (unable to accept or execute the command) to the central computer.

Due to BITBUS restrictions a slave cannot accept a new command before it has answered the previous one (i.e. there may be no more than one outstanding response to a command from the central computer). The central computer is responsible that for each machine there is only one outstanding response to a command.

### 3. ISO-OSI Layers 1 and 2

#### 3.1 Hardware

The BITBUS is to be applied for the ISO-OSI-layers 1 to 2. The central computer is the master node and the single machines are the slave nodes. Every node must provide an electrical isolation to the BITBUS. Substations are forbidden, repeaters are allowed. The self clocked mode is to be used. Only the baudrate of 375 kbit/s is allowed. Every BITBUS node must provide its isolation without using the power supply of the BITBUS cable.

For simplification of wiring every injection moulding machine must have two 9 pin D-sub connectors in parallel:

- 9 pin D-sub, female (BITBUS output)
- 9 pin D-sub, male (BITBUS input)

The master must have a 9 pin D-sub connector, female.

The cable must contain 3 twisted pairs and a shield and should be 24 AWG or corresponding metric cross section of 0.25 mm<sup>2</sup>. (details see RS 485 specification)

Signal	Pin Number	
Data	8	] twisted pair 1
Data*	3	
RTS	9	] twisted pair 2
RTS*	4	
GND	2	] twisted pair 3
GND	7	
Shield	5	

The ground GND is not connected to machine ground because of the optical isolation of the BITBUS connection of every injection moulding machine. The shield is connected to chassis ground at the central computer but not to machine ground at any injection moulding machine.

If a repeater function is not included in a slave, the signals RTS and RTS\* must be directly passed through from the input connector to the output connector.

The terminating resistors of 120 Ohms between Data and Data\* and between RTS and RTS\* must be located at the central computer and the last machine on the BITBUS cable. For the last machine these resistors must be mounted on a blind male connector which is plugged into the unused female BITBUS output connector.

### 3.2 Software

EUROMAP 15 requires a telegram length of 52 bytes. These 52 bytes include the two link bytes. The two link bytes are automatically inserted by the BITBUS protocol. The slave node initializes itself to the telegram length of 52 bytes after power on. During this initialization the slave must not cause any bus contention by sending anything onto the bus. The tristate bus drivers must be switched off until initialization is complete.

The first 5 bytes of the BITBUS message format (BITBUS header) are defined as follows:

- Byte 0, 1, 2 as defined by BITBUS specification
- Byte 3 (source task / destination task):  
Source and destination task is 1 for master and slave.  
Master : 11 hex  
Slave : 11 hex
- Byte 4 (command / response):  
Master : 00 hex  
Slave : 00 hex or error number specified by BITBUS

### 4. General Statements

The following general statements must be paid attention to:

- The central computer may repeat any command several times without causing problems to the machine controller.
- The machine address must be identical to the BITBUS node address of this machine.
- A timeout time of 30 seconds is defined. If there is no response to a central computer command from the machine controller within this time, the central computer can reset the communication controller of the machine by means of the BITBUS RAC command "Reset Slave". After this reset the command can be repeated.
- The machine controller can reset its communication controller after expiration of the timeout time of 30 seconds after an outstanding question from the central computer.
- All data in the predefined fields of the telegrams are right justified. Unused bytes are filled with ASCII Blank (20 hex, blank)

Examples for telegrams with predefined fields:

002, 004, 013, 021, 103, 105, 106, 110, 111, 120

Exceptions to this rule are described at the respective places in the Parts 2 to 6.

## **5. Telegram Structure**

The structure of the EUROMAP 15 telegrams is as follows (excluding the BITBUS header):

- The first two bytes (bytes 00 and 01) of the 45 byte data field (EUROMAP telegram length of 45 bytes with bytes 00 to 44) are used for the machine address numbered from 01 to 99.
- The next three bytes (bytes 02 to 04) contain the telegram number. The telegram numbers 000 to 499 are reserved for the actual EUROMAP protocol and for future extensions. The telegram numbers from 500 to 999 are free for the machine manufacturer's specific extensions.
- The next bytes (bytes 05 to max. 44) are for the contents of the telegram, if needed. The EUROMAP telegram length is not always 45 bytes, but only as long as defined for the specific telegrams. So the shortest telegrams are only 5 bytes long (2 bytes machine address, 3 bytes telegram number).
- Within a EUROMAP 15 telegram fulfilling this recommendation only printable ASCII characters from 20 hex to 7E hex as listed in ISO 646 - 1983 are allowed. Only for the machine manufacturer specific telegrams (500 to 999) and for some telegrams, where it is especially mentioned, the whole range from 00 hex to FF hex can be used.

**6. Data Formats**

The following data format description is used in all parts of EUROMAP 15 to specify which kind of data is allowed in the data fields of the telegrams.

- Axx A character string of length xx, where the characters are in the range of 20 hex to 7E hex ("printable" characters)  
Example for A06: \*47B+\$
- Bxx A character string of length xx, where the characters are in the range of 00 hex to FF hex (full range of binary data)
- Nxx A character string of length xx, where the characters are in the range of 30 hex to 39 hex (numeric characters, the numerals 0 to 9)  
Example for N12: 423741078659

**7. Types of Telegrams**

**7.1 Definition of Telegrams from the Central Computer**

**Telegram 000: CYCLIC STANDARD QUESTION**  
contains no data bytes

**Telegram 001: REQUEST FOR MACHINE IDENTIFICATION**  
contains no data bytes

**Telegram 096: COMMUNICATION FLOW OUT OF SEQUENCE**  
contains no data bytes

**Telegram 097: INCORRECT TELEGRAM CONTENTS**

Byte	cont.	Description
05	-N01-	error reason
	"0"	- no reason specified
	"1"	- incorrect format, e.g. not printable ASCII characters
	"2"	- incorrect parameter

**Telegram 098: TELEGRAM TYPE NOT IMPLEMENTED**

Byte	cont.	Description
05..07	-N03-	rejected telegram-no.

**Telegram 099: CANCEL ACTUAL DATA TRANSFER**  
contains no data bytes (used for data streams only)

**7.2 Standard Answers**

<b>Telegram 100:</b>		<b>STANDARD ANSWER</b>
Byte	cont.	Description
05..07	-N03-	Request number
	"000"	- no service requested
	"001"	- request for machine identification
	"002"	- to be defined by EUROMAP
	"..."	(valid responses are specified in
	"499"	the descriptions of other modules)
	"500"	
	"..."	- user defined commands
	"999"	

**7.3 Definition of Telegrams from the Machine Controller**

<b>Telegram 101:</b>		<b>MACHINE IDENTIFICATION</b>
Byte	cont.	Description
05..06	-N02-	EUROMAP - communication protocol version
	"13"	- current version is 1.3
07..09	-N03-	manufacturer code (defined by EUROMAP)
	"000"	- undefined, not in the list
	"001"	- Battenfeld
	"002"	- Billion
	"003"	- Biraghi
	"004"	- Cincinnati Milacron
	"005"	- Engel
	"006"	- Kloeckner Ferromatik Desma
	"007"	- Krauss Maffei
	"008"	- Mannesmann Demag
	"009"	- Metalmeccanica Plast
	"010"	- Negri Bossi
	"011"	- Netstal
	"012"	- Sandretto
	"013"	- Stork
	"014"	- Krupp Formaplast
	"015"	- Novapax
	"016"	- Rico Rego
	"017"	- Codim DK
	"018"	- Presses Kap
	"019"	- B. M. B.
	"020"	- Italtech
	"021"	- MIR
	"022"	- Nuova Plastic Metal
	"023"	- Oima
	"024"	- Plastimac
	"025"	- Realpress
	"026"	- Remu
	"027"	- Triulzi
	"028"	- Bucher-Guyer
	"029"	- Construcciones Margarit

	"030"	- Hidrometal
	"031"	- Industrial Somar
	"032"	- Industrias Fiser
	"033"	- Marrodan y Rezola
	"034"	- Mateu y Sole
	"035"	- Banbury Plastics
	"036"	- C K Consultants (Plastics)
	"037"	- John Brown Plastics
	"038"	- Clayton Plastics
10..44	-A35-	machine code (manufacturer dependent, NOT specified by EUROMAP)

**Telegram 124: TRANSFER ACKNOWLEDGEMENT**

Byte	cont.	Description
05	-N01-	acknowledgement
	"1"	- positive

**Telegram 195: SLAVE IS NOT ABLE TO ANSWER**  
contains no data bytes

**Telegram 196: COMMUNICATION FLOW OUT OF SEQUENCE**  
contains no data bytes

**Telegram 197: INCORRECT TELEGRAM CONTENTS**

Byte	cont.	Description
05	-N01-	error reason
	"0"	- no reason specified
	"1"	- incorrect format, e.g. not printable ASCII characters
	"2"	- incorrect parameters

**Telegram 198: TELEGRAM TYPE NOT IMPLEMENTED**

Byte	cont.	Description
05..07	-N03-	rejected telegram-no.

**Telegram 199: CANCEL ACTUAL DATA TRANSFER**  
contains no data bytes (used for data streams only)



## 8. Communication Flow

### 8.1 Standard Question / Answer

The communication flow is based on the master/slave principle. The central computer, which is the master of the system, polls the machine-controllers, which are the slaves, using standard questions (telegram "000"). If the central computer has to send data to a specific slave, it will send the data immediately, using the applicable telegram. If a machine-controller has to send data to the central computer, it will answer to a standard question with "100"+"abc" instead of "100"+"000", in which "abc" is the number of the request belonging to the data to be send.

Example:

"000"		- standard question
"100"+"abc"		- receive standard answer with "abc"
"abc"		- transmit request telegram
"xyz"		- receive answer with data

### 8.2 Prevention of Time-out

The timing at the lowest level is handled by the Bitbus, but at the application level there are timing requirements as well. The reason for this is the following: because there is only one outstanding response allowed for each slave, there would be no possibility to recover if a slave would not answer. This is prevented with a time-out of 30 seconds. If a slave does not answer within this time, any communication between the central computer and this slave is stopped and the slave has to be reset first (manually or automatic). The slave can use telegram "195" to prevent the 30 s time out, so that pending message problems are avoided. This telegram is especially usefull in systems, where a gateway is used for connection of machine-controllers (for instance with an RS232 interface) to the Bitbus. If such a gateway loses connection with the machine-controller or if it does not get a correct answer, it can answer independently of the machine-controller with "195" within the time-out.

**8.3 Cancellation of a Transfer**

If a sequence of telegrams is started (for instance transfer of machine settings), this sequence can be interrupted by the central computer or the machine controller at any time.

**8.3.1 Cancellation by Central Computer**

"099"	- transmit cancellation
"124"+"1"	- receive acknowledgement

**8.3.2 Cancellation by Machine Controller**

"199"	- transmit cancellation instead of   any other answer, but not the   standard answer
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**8.4 Communication out of Sequence**

If a telegram is sent by the central computer or the machine-controller, which belongs to a sequence, but the sequence is not started before, a sequence error is detected.

**8.4.1 Sequence Error Detected by the Central Computer**

"096"	- transmit error report
"124"+"1"	- receive acknowledgement

**8.4.2 Sequence Error Detected by Machine Controller**

"196"	- transmit error report instead of   normal answer
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**8.5 Request for a not Implemented Call**

Because Euromap 15 has a modular structure and allows for user-defined telegrams to be implemented, it is possible that the machine controller has a more extended vocabulary than the central computer or the other way around.

**8.5.1 Not Implemented Call Detected by Central computer**

"000"		- standard question
"100"+"xyz"		- receive standard answer, but "xyz" is not implemented
"098"+"xyz"		- transmit error report
"124"+"1"		- receive acknowledgement

**8.5.2 Not Implemented Call Detected by Machine Controller**

"xyz"		- transmit "xyz" (not implemented)
"198"+"xyz"		- transmit error report instead of normal answer

**8.6 Incorrect Telegram Contents**

If a telegram contains characters, which are not allowed in a specific telegram, like non-ASCII characters in a numeric field or a selection, which is not possible, an error is reported to the sender.

**8.6.1 Incorrect Contents Detected by Central Computer**

"abc"		- transmit telegram
"xyz"+"*"		- receive answer, but "*" is no valid data
"097"+"2"		- transmit error report
"124"+"1"		- receive acknowledgement

**8.6.2 Incorrect Contents Detected by Machine Controller**

"xyz"+"*"		- transmit telegram, but "*" is no valid data
"197"+"2"		- transmit error report instead of normal answer

### 8.7 Procedure after Switching on the Machine

Every time when a machine is switched on, it will start the following sequence of telegrams to make itself known to the central computer:

"000"		- standard question
"100"+"001"		- standard answer with request for machine identification
"001"		- request for machine identification
"101"+data		- machine identification

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