

# MKR 5 PROTOCOL SPECIFICATION

## DART PUMP INTERFACE

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# 1 GENERAL

This document describes the protocol between a Mekser pump, and a site controller at a petrol station. Only the protocol above the line protocol is described. From the line protocol, a device address and a buffer with data are received. All error handling e.g.

CRC and parity check is made in the line protocol.

Each pump has a device address (50H-6FH). A pump shall handle a block if the block is addressed to the pump. The test of device address is made in the line protocol.

The line protocol is described in the document "DART-LINE PROTOCOL SPECIFICATION".

The electronic interface is described in the document "DART-LINE PROTOCOL SPECIFICATION" and in the flow chart "DART CONFIGURATION".

## 1.1 Protocol levels

The protocol is divided into 3 levels. Level

3 Application level.

Level 2 Line protocol level. Level 1

Electronic level.

Level 2 is handling is polling of devices and transport of blocks that are created by level 3. Level 2 checks that a block is transmitted correctly. The check is made with CRC, parity and block sequence number. If an error occurs, retransmission is handled by level 2.

At level 3 blocks are transmitted between site controller and pumps. A block can contain one or more transactions that are specified in this document.

Example of a block sent on the communication line.

TRANS				DATA						
ADR	CTRL	NO	LNG	1	2	...	CRC-1	CRC-2	ETX	SF

Created and  
sent by level  
2.

Created by level 3. Sent by level 2.

Created and sent by level 2.

## 2 PRINCIPLES

### 2.1 Control of pumps

#### 2.1.1 Commands to a pump

The site controller can send the following commands to a pump.

- RETURN STATUS
- RETURN PUMP IDENTITY
- RETURN FILLING INFORMATION
- RESET
- AUTHORIZE
- *SUSPEND*
- *RESUME*
- STOP
- SWITCH OFF

##### RETURN STATUS:

The pump shall return status information. This is a global request that will cause the pump to return transaction "Pump status" and "Nozzle status and filling price".

The site controller use this command when a pump is connected the first time or after a communication fault. During normal operation the pump sends transaction "Pump status" and transaction "Nozzle status and filling price" at change of status.

##### RETURN PUMP IDENTITY:

The pump shall return pump identity in transaction "Pump identity". The site controller will only handle pumps that are tested together with the site controller. It is not necessary to use this command in normal operation.

##### RESET:

The pump clears the display and variables such as filled volume and filled amount.

##### AUTHORIZE:

Authorize of the pump. The pump shall now be ready for start of filling. The command can come before or after a nozzle is taken out.

##### *SUSPEND:*

This command is used to temporarily stop a filling e.g. when contact with a Vehicle Identification Device is lost. It is a command that will stop the filling, but the main pump status will still be AUTHORIZED or FILLING.

##### *RESUME:*

This command is used to reactivate the pump again e.g. when the contact is re-established with a Vehicle Identification Device.

##### STOP:

The pump goes to filling completed. If a filling was going on, it is stopped.

#### SWITCH OFF:

Switch off the pump. The command is used when the station is closing or if there is an error in the pump.

### 2.1.2 Pump status

Pump status is sent to the site controller with transaction "Pump status". The pump has the following status:

- PUMP NOT PROGRAMMED
- RESET
- AUTHORIZED (*SUSPENDED*)
- FILLING (*SUSPENDED*)
- FILLING COMPLETED
- MAX AMOUNT/VOLUME REACHED
- SWITCHED OFF

A status change is caused by a command from the site controller or by an action in the pump e.g. nozzle in.

### 2.1.3 Command and status flow

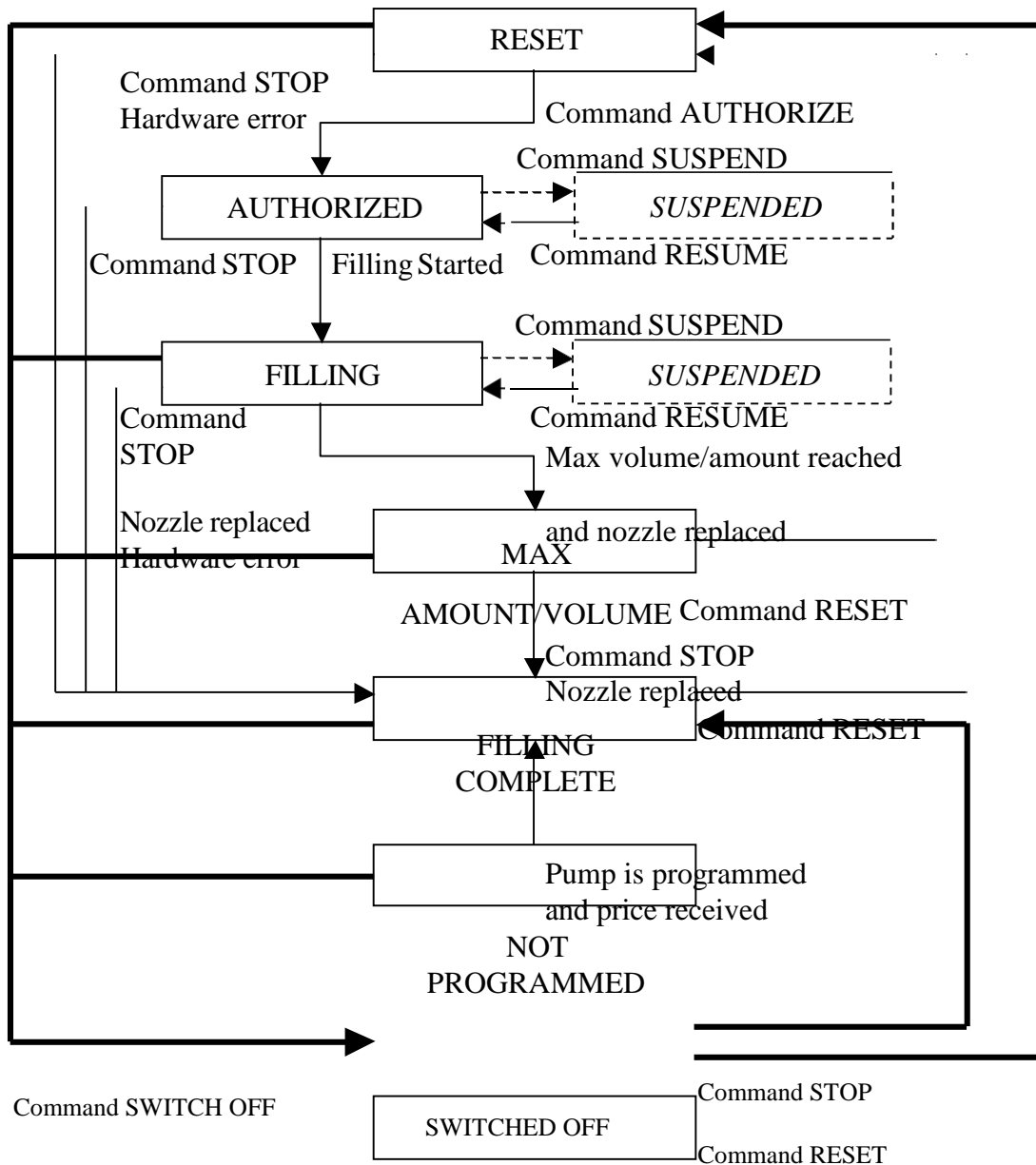
In the following table the possible commands in different pump status are listed. Command

	Normally received in status	Action RETURN
STATUS	All	Return status
RETURN FILLING INFORMATION	RESET AUTHORIZED ( <i>SUSPENDED</i> ) FILLING ( <i>SUSPENDED</i> ) FILLING COMPLETED MAX AMOUNT/VOLUME REACHED	Return filling information
RESET	FILLING COMPLETED MAX AMOUNT/VOLUME REACHED	Amount, volume and alarm are cleared. The light is switched on.
AUTHORIZE	RESET	If a grade is selected and allowed, then the pump motor is turned on.
<i>SUSPEND</i>	AUTHORIZED FILLING	The pump motor is turned off.
<i>RESUME</i>	<i>SUSPENDED</i>	The pump motor is turned on.
STOP	RESET AUTHORIZED ( <i>SUSPENDED</i> ) FILLING ( <i>SUSPENDED</i> ) MAX AMOUNT/VOLUME REACHED	The pump motor is turned off.
SWITCH OFF	All	The light and pump motor are turned off.

In the following table the possible status changes are listed.

From Status	To Status	Comment
PUMP NOT PROGRAMMED	FILLING COMPLETE	The pump is correctly programmed and price block received.
RESET	AUTHORIZED FILLING COMPLETE “ SWITCHED OFF	Command Authorize. Command Stop. Hardware reset or error. Command Switch off.
AUTHORIZED	FILLING  <i>SUSPENDED</i> FILLING COMPLETE “ SWITCHED OFF	Filled volume >= start limit.  Command Suspend. Command Stop. Hardware reset or error. Command Switch off.
FILLING	<i>SUSPENDED</i> FILLING COMPLETE “ “ MAX AMOUNT/VOLUME REACHED  SWITCHED OFF	Command Suspend. Nozzle hang-up. Command Stop. Hardware reset or error. Max amount/volume reached.  Command Switch off.
<i>SUSPENDED</i>	AUTHORIZED FILLING FILLING COMPLETE “ “ SWITCHED OFF	Command Resume. Command Resume. Nozzle hang-up. Command Stop. Hardware reset or error. Command Switch off.
FILLING COMPLETE	RESET SWITCHED OFF	Command Reset. Command Switch off.
MAX AMOUNT/VOLUME REACHED	RESET  FILLING COMPLETE  SWITCHED OFF	Command Reset.  Command Stop or nozzle replaced. Command Switch off.
SWITCHED OFF	RESET FILLING COMPLETE	Command Reset. Command Stop.

# STATUS CHANGE DIAGRAM





## 2.2 Data from the pump

Data is sent spontaneously at a change or at a request from the site controller. Spontaneous data:

- Status change
- Nozzle in/out
- Select logical nozzle number
- Change of filled volume or amount

### Pump status

Pump status is sent to the site controller with transaction "Pump status". The pump has the following status:

- PUMP NOT PROGRAMMED
- RESET
- AUTHORIZED (*SUSPENDED*)
- FILLING (*SUSPENDED*)
- FILLING COMPLETED
- MAX AMOUNT/VOLUME REACHED
- SWITCHED OFF

A status change is caused by a command from the site controller or by an action in the pump e.g. nozzle in.

## 2.3 Handling volume and amount

It is important that the display at the site controller has the same value as the display at the pump. The site controller does not make any calculations, it takes the volume and amount that is received from the pump and put it on the display. The pump sends the data only when a value is changed or if the site controller does request it. The data is sent in transaction "Filled volume and amount". The change normally occurs during a filling. Note that at reset of volume and amount counters, the transaction is sent with value=0.

For safety the site controller may request the pump to send transaction "Filled volume and amount" at end of filling.

## 2.4 Handling prices

The unit price that shall be used for a filling is sent from the site controller with transaction "Price update". In this document it is called filling price. The pump receives one filling price for each nozzle number. If the pump has more than one logical nozzle number, there must be prices for all nozzles, otherwise the hole trans is ignored. If there are more prices than nozzles, the prices are accepted but the prices without nozzle are ignored.

The filling price is sent only when the price is changed or if a pump is powered on or zeroized. A zeroized pump stays in status "pump not programmed" until a unit price has been received.

The pump does not accept a new unit price after a filling has started.

## 2.5 Grades and nozzle numbers

The pump shall work only with nozzle number. The site controller handles the connection grade-nozzle number.

In this document 'nozzle number' means logical nozzle number and not a physical nozzle. A blending pump e.g. with one nozzle and three grade select buttons has three logical nozzle numbers.

With transaction "Allowed nozzle numbers" the site controller can select nozzle numbers in a pump that is allowed to use for filling. An authorize command is only authorizing allowed nozzle numbers. Normally all existing nozzles are allowed. If the same nozzles are allowed at every filling from a pump, it is not necessary to send a new transaction for each authorization. The pump shall use the last received information about allowed nozzles.

## 2.6 Preset amount/volume

The site controller sends preset volume in transaction "Preset volume" or preset amount in transaction "Preset amount". The pump stops the filling when the preset value is reached.

A preset value is used only during one filling. The value is reset when the pump has done a reset caused by a reset command.

It is possible to send a new preset value during a filling. The pump always use the last received value. If the site controller sends preset volume 100 and during filling sends-preset amount 50, the pump stops the filling at amount 50. If the amount already is over 50, the filling is stopped immediately.

The preset value for amount and volume are set back to a default value when the pump receives the command RESET.

If a filling is stopped because of reached preset value, the status sent in transaction "Pump status" will be "max amount/volume reached" instead of "filling completed".

## 2.7 Pump identity

With a command the site controller can request an identity from the pump. The pump returns identity in transaction "Pump identity". The identity consists of 10 digits.

Digit 1-4: Manufacturer identity. The identity has to be received from Wayne/Dresser for use in the pump program.

Digit 5-6: Pump type within one manufacturer. Also this number has to be received from Wayne/Dresser.

Digit 7-10: Program version. Free to use by manufacturers. Digit 1 is

MSB.

### 3                      TRANSACTIONS

A block to or from a pump can have one or more transactions. A transaction can have fixed or variable length.

A transaction always starts with a byte containing transaction number and a byte containing the length of the data in the transaction. If a transaction has fixed length it does not seem necessary to have the length byte. But the length byte makes it possible for a program to skip transactions that the program does not recognize.

The length of the data block is received from the line protocol. All transactions are handled when the sum of handled transactions length is equal to the length of the data block.

Example:

TRANS	Transaction with fix length 1.
LNG	Number of data bytes in the transaction (1). DATA
1	
TRANS	Transaction with variable length n.
LNG	Number of data bytes in the transaction (n). DATA
1	
:	
DATA n	

In the following section also optional transactions are included for completeness. Transactions marked with an asterisk (\*) are not needed to interface a standard Dart pump and may not even be supported by the pump. They are however used in a full Dart implementation for Wayne pumps.

The following table contains existing transactions. From site controller to pump.

Transaction	Comment
CD1	Command to pump
CD2	Allowed nozzle numbers
CD3	Preset volume
CD4	Preset amount
CD5	Price updating
CD6	Reserved
CD7	- “ -
CD8	- “ -
CD9 *	Set pump parameters
CD10	Reserved
CD11	- “ -
CD12	- “ -
CD13 *	Filling type CD14
*	Suspend nozzle
CD15 *	Resume nozzle
CD16	For future standard transactions
:	
CD100	Application dependent transactions
CD101 *	Request Volume Total Counters
:	

From pump to site controller.

Transaction	Comment	DC1
	Pump status	
DC2	Filled volume, amount	
DC3	Selected nozzle number and nozzle in or out and filling price	DC4
	Reserved	
DC5 *	Alarm code	
DC6	Reserved	
DC7 *	Pump parameters	
DC8	Reserved	
DC9	Pump identity	
DC10	For future standard transactions	
:		
DC14 *	Suspended nozzles	
DC15 *	Resumed nozzles	
:		
DC100	Application dependent transactions	
DC101 *	Volume Total Counters	
:		

### 3.1 Transactions from site controller to pump

#### 3.1.1 Command to pump

Transaction: CD1

Format:

MNEMONIC NUMBER OF BYTES		
TRANS	1	01H
LNG	1	Number of data bytes in the transaction
DCC	1	Pump control command

DCC 0H-0AH

Following commands can be sent:

- 0H RETURN STATUS
- 2H RETURN PUMP PARAMETERS (\*)
- 3H RETURN PUMP IDENTITY
- 4H RETURN FILLING INFORMATION
- 5H RESET
- 6H AUTHORIZE
- 8H STOP
- AH SWITCH OFF

#### 3.1.2 Allowed nozzle numbers

Transaction: CD2

Format:

MNEMONIC NUMBER OF BYTES		
TRANS	1	02H
LNG	1	Number of data bytes in the transaction
NOZ1	1	Nozzle number
:		
NOZn	1	

LNG number of nozzle numbers in the transaction. NOZ

1-0FH

NOZ1-n specifies the logical nozzle numbers that is allowed for filling. The transaction is used when a pump is authorized. E.g. if nozzle 1-3 is allowed, the transaction contains 1, 2, 3.

---

### 3.1.3 Preset volume

Transaction: CD3

Format:

MNEMONIC	NUMBER OF BYTES	
TRANS	1	03H
LNG	1	Number of data bytes in the transaction
VOL	4	Volume

The volume is sent in packed BCD with MSB in first byte. The pump shall stop automatically when filled volume = VOL.

### 3.1.4 Preset amount

Transaction: CD4

Format:

MNEMONIC	NUMBER OF BYTES	
TRANS	1	04H
LNG	1	Number of data bytes in the transaction
AMO	4	Amount

The amount is sent in packed BCD with MSB in first byte. The pump shall stop automatically when filled amount = AMO.

---

### 3.1.5 Price update

Transaction: CD5

Format:

MNEMONIC	NUMBER OF BYTES	
TRANS	1	05H
LNG	1	Number of data bytes in the transaction
PRI1	3	Price
:		
PRIn	3	

LNG = 3\*number of prices.

PRI is the price in packet BCD with MSB in first byte. PRI1 is the price for logical nozzle number 1, PRI2 is the price for logical nozzle number 2 and so on.

### 3.1.6 Set pump parameters (\*)

Transaction: CD9

Format:

MNEMONIC	NUMBER OF BYTES	
TRANS	1	09H
LNG	1	Number of data bytes in the transaction
RES	22	Not used
DPVOL	1	Number of decimals in volume (0-8)
DPAMO	1	Number of decimals in amount (0-8)
DPUNP	1	Number of decimals in unit price (0-4)
RES	5	Not used
MAMO	4	Maximum amount
RES	17	Not used

MAMO is sent in packed BCD with MSB in first byte. The amount is used for delivery limit if CD 3 or CD 4 is not used.

Supported only by pumps with full implementation of Dart.

---



### 3.1.7 Set filling type(\*)

Transaction: CD13

Format:

MNEMONIC	NUMBER OF BYTES	
TRANS	1	0DH
LNG	1	Number of data bytes in the transaction
FTYPE	1	Filling type 0 = Cash filling 1 = Credit filling

Supported only by pumps with full implementation of Dart.

### 3.1.8 Suspend Request (\*)

Transaction: CD14

Format:

MNEMONIC	NUMBER OF BYTES	
TRANS	1	0EH
LNG	1	Number of data bytes in the transaction
NOZ	1	Nozzle number (0-0FH)

NOZ specifies the logical nozzle number that is suspended from filling. The number is only used for satellite pumps and should normally be 0.

Supported only by pumps with full implementation of Dart.

---

### 3.1.9 Resume Request (\*)

Transaction: CD15

Format:

MNEMONIC NUMBER OF BYTES		
TRANS	1	0FH
LNG	1	Number of data bytes in the transaction
NOZ	1	Nozzle number (0-0FH)

NOZ specifies the logical nozzle number that is resumed for filling. The number is only used for satellite pumps and should normally be 0.

Supported only by pumps with full implementation of Dart.

### 3.1.10 Request Volume Total Counters(\*)

Transaction: CD101

Format:

MNEMONIC NUMBER OF BYTES		
TRANS	1	65H
LNG	1	Number of data bytes in the transaction
COUN	1	Volume Total Counter number 1 = nozzle 1, 2 = nozzle 2, ...

Supported only by pumps with full implementation of Dart.

---

## 3.2 Transactions from pump to site controller

### 3.2.1 Pump status

Transaction: DC1

Format:

MNEMONIC	NUMBER OF BYTES	
TRANS	1	01H
LNG	1	Number of data bytes in the transaction
STATUS	1	Pump status

This transaction is sent by the pump if the status is changed or if the pump receives the command 'RETURN STATUS'.

The pump can have the following status:

- 0 PUMP NOT PROGRAMMED
- 1 RESET
- 2 AUTHORIZED
- 4 FILLING
- 5 FILLING COMPLETED
- 6 MAX AMOUNT/VOLUME REACHED
- 7 SWITCHED OFF

### 3.2.2 Filled volume and amount

Transaction: DC2

Format:

MNEMONIC	NUMBER OF BYTES	
TRANS	1	02H
LNG	1	Number of data bytes in the transaction
VOL	4	Filled volume
AMO	4	Filled amount

VOL and AMO are sent in packed BCD. MSB is sent in the first byte.

This transaction is sent by the pump at change of a value or if the pump receives the command RETURN FILLING INFORMATION.

---

### 3.2.3 Nozzlestatusandfillingprice

Transaction: DC3

Format:

MNEMONIC NUMBER OF BYTES		
TRANS	1	03H
LNG	1	Number of data bytes in the transaction
PRI	3	Filling price
NOZIO	1	

PRI is the price used by the pump for calculation of filled amount. It is sent in packed BCD, MSB first.

NOZIO bits 0-3 contain selected nozzle number. NOZIO

bit 4 contains nozzle in/out information.

0 = in

1 = out

This transaction is sent by the pump if the status is changed or if the pump receives the command 'RETURN STATUS' or 'RETURN FILLING INFORMATION'.

Example:

NOZIO Meaning

02H Nozzle 2 selected, nozzle in 12H

Nozzle 2 selected, nozzle out

10H No nozzle selected, nozzle out. (This is possible for a blending pump.)

There must never be more than one selected logical nozzle number. If two nozzles are taken out simultaneously, the pump determines which logical nozzle number is selected. The site controller will use the last received logical nozzle number.

---

3.2.4 Alarm Code (\*)

Transaction: DC5

Format:

MNEMONIC NUMBER OF BYTES		
TRANS	1	05H
LNG	1	Number of data bytes in the transaction
ALARM	1	Alarm code
3		1 CPU reset
		RAM error
		4 PROM checksum error
		6 Pulser error
		7 Pulser current error 9
		Emergency stop
		A Power failure B
		Pressure lost
		C Blend ratio error D
		Low leak error E High
		leak error

This transaction is sent by the pump if an alarm is generated or if the pump receives the command 'RETURN STATUS'.

Supported only by pumps with full implementation of Dart.

---

### 3.2.5 Pump Parameters(\*)

Transaction: DC7

Format:

MNEMONIC	NUMBER OF BYTES	
TRANS	1	07H
LNG	1	Number of data bytes in the transaction
RES	22	Not used
DPVOL	1	Number of decimals in volume (0-8)
DPAMO	1	Number of decimals in amount (0-8)
DPUNP	1	Number of decimals in unit price (0-4)
RES	5	Not used
MAMO	4	Maximum amount
RES	2	Not used
GRADE	15	Existing grade per nozzle number

MAMO is sent in packed BCD with MSB in first byte.

This transaction is sent by the pump if SET PUMP PARAMETERS is received or if the pump receives the command 'RETURN PUMP PARAMETERS'.

Supported only by pumps with full implementation of Dart.

### 3.2.6 Pumpidentity

Transaction: DC9

Format:

MNEMONIC	NUMBER OF BYTES	
TRANS	1	09H
LNG	1	Number of data bytes in the transaction
PID	5	Pump identity.

PID is sent in packed BCD, MSB first.

The pump sends this transaction if command 'RETURN PUMP IDENTITY' is received.

---

### 3.2.7 Suspend Reply (\*)

Transaction: DC14

Format:

MNEMONIC NUMBER OF BYTES		
TRANS	1	0EH
LNG	1	Number of data bytes in the transaction
NOZ	1	Nozzle number (from request).

The pump sends this transaction if SUSPEND REQUEST is received. Supported only by pumps with full implementation of Dart.

### 3.2.8 Resume Reply (\*)

Transaction: DC15

Format:

MNEMONIC NUMBER OF BYTES		
TRANS	1	0FH
LNG	1	Number of data bytes in the transaction
NOZ	1	Nozzle number (from request).

The pump sends this transaction if RESUME REQUEST is received. Supported only by pumps with full implementation of Dart.

---

### 3.2.9 Volume Total Counters (\*)

Transaction: DC101

Format:

MNEMONIC	NUMBER OF BYTES	
TRANS	1	65H
LNG	1	Number of data bytes in the transaction
COUN	1	Volume Total Counter number 1 = nozzle 1, 2 = nozzle 2, ...
TOTVOL	5	Total volume for nozzle
TOTV1	5	Total volume grade 1
TOTV2	5	Total volume grade 2 (zero if no blending)

Total volume counters are sent as packed BCD format with MSB first.

The pump sends this transaction if REQUEST VOLUME TOTAL COUNTERS is received. Supported only by pumps with full implementation of Dart.

---



## 4 EXAMPLES

### 4.1 Clear display when customer pays

Pump display is cleared when the customer pays the filling. Authorize is made when next customer takes out a nozzle or selects a grade.

Transaction		
To disp.	To	Comment
	centra l	
CD1		The pump is in status FILLING COMPLETE. Command RESET, the customer has paid.
	DC1	Status RESET.
		Next customer arrives.
	DC3	Grade selected.
CD2		Allowed nozzle numbers. Only needed if different from previous filling.
CD3		Preset volume. Note that preset values are set to default by the command RESET.
CD1		Command AUTHORIZE.
	DC1	Status AUTHORIZED.
	DC3	Nozzle out.
	DC1	Status FILLING.
	DC2	Filled volume and amount.
	:	
	DC2	
	DC3	Nozzle in.
	DC1	Status FILLING COMPLETE.

## 4.2 Clear display at start of filling

Pump display is cleared when a filling is started. Authorize is made when the customer pays the filling.

Transaction		
To disp.	To central	Comment
CD1	DC3	The pump is in status FILLING COMPLETE. Next customer arrives.
		Nozzle out.
		Command RESET.
CD1		The pump clears the display.
	DC1	Status RESET.
		Command AUTHORIZE. DC1
		Status AUTHORIZED. DC1
		Status FILLING.
	DC2	Filled volume and amount.
	:	
	DC2	
	DC3	Nozzle in.
	DC1	Status FILLING COMPLETE.

### 4.3 Price change

If a pump only is working with one filling type, it is not necessary to send out prices for each filling. In this example is the price known first then the nozzle is taken out.

Transaction		
To disp.	To	Comment
	centra 	
		The pump is in status FILLING COMPLETE. Next customer arrives.
	DC3	Nozzle out.
CD5		Price updating.
CD2		Allowed nozzle numbers.
CD1		Command RESET.
	DC1	Status RESET.
	DC3	Grade selected.
CD2		Allowed nozzle numbers. Only needed if different from previous filling.
CD3		Preset volume. Note that preset values must be sent after the command RESET.
CD1		Command AUTHORIZE.
	DC1	Status AUTHORIZED.
	DC1	Status FILLING.
	DC2	Filled volume and amount.
	:	
	DC2	
	DC3	Nozzle in.
	DC1	Status FILLING COMPLETE.

## 5 LIMITATIONS

Maximum 32 pumps

Volume	99999999
Amount	99999999
Filling price	999999

Nozzle number	1-0FH
---------------	-------

Blended products	6
------------------	---

Number of grades on one pump	15
---------------------------------	----

---

---

# **MKR5 Protocol**

## **Serial Communication Specifications**

---

## General description

---

This part describes the “MKR5” communications interface to dispensers for single or multiple hose applications. This interface, which employs a current loop as the data transmission medium, defines allowed states for pumps/dispensers, allowed state transitions, and the commands and data that may be transmitted and received by dispensers and the controller.

The standard data link is based on a master/slave relationship, where the master polls the slaves. If the master wants to send data to a slave, it sends a block with data instead of a poll. If the slave wants to send data it answers with data on a poll. Half duplex is used.

## Data format

---

Data transfer : Asynchronous  
Bit rate : 9600 / 19200 bits per second  
Data bits : 8  
Stop bits : 1  
Parity : Odd

Note :

A MARK corresponds to loop current “ON” (45mA), a SPACE corresponds to loop current “OFF” (0 mA).

MKR5 protocol shall not be baud-rate dependent. A baud rate of 19200 shall be possible, alternatively 9600, if distance and type of wiring are restrictive.

## Interface requirements

---

### Explosion proofing :

As fuel dispensers are located in a hazardous area, mechanical and electrical components of the interface, and its installation and service must satisfy relevant hazardous area equipment standards.

### Cable characteristics :

Current loop cabling should satisfy the following requirements :

Insulation            500 Vdc (min.)  
Loop length        400 meters (max.)  
Loop resistance    10 Ohms (max.)  
Input inductance   100 uH (max. at any terminals)  
Input capacitance   10 nF (max. at any terminals)

while a separate twisted pair should be regarded as the ideal cabling solution, acceptable performance is usually obtained from non-twisted pairs in the same conduit (or even the same sheath) as pump/dispenser power and control cables.

### Voltage and Current levels :

Loop current            45 mA +/- 5%  
Open circuit voltage    24 Vdc +/- 5%

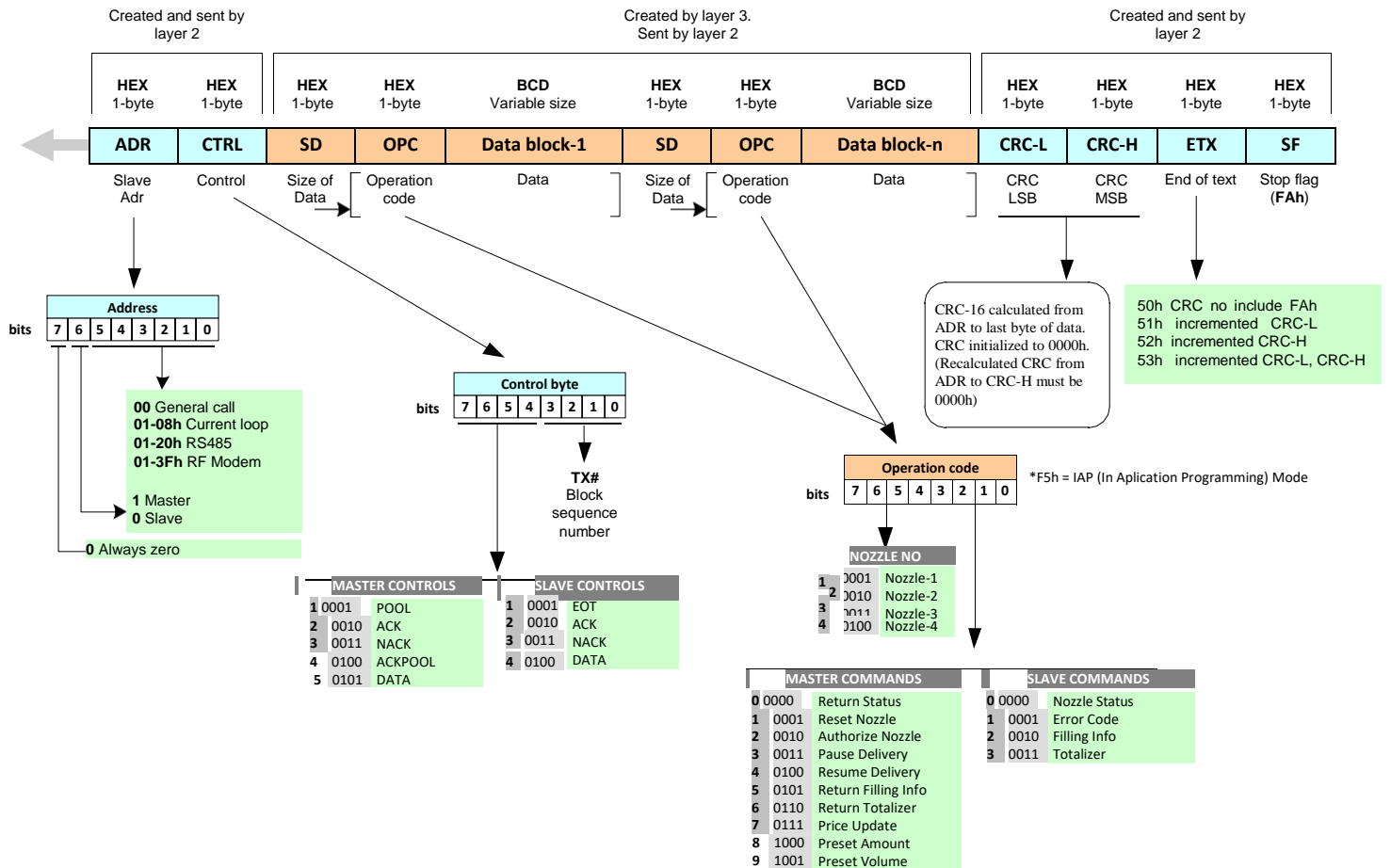
#### Note 1:

The maximum allowable voltage drop across any loop transceiver (either in a pump/dispenser or a controller) at a loop current of 45mA is 2.0 Volts.

#### Note 2:

While common mode voltages are likely to have little effect on data integrity, common mode voltage levels should be below 50Vdc to minimise personnel and property hazards.

## Message structure



### Note 1 :

The master has one independent TX# for each slave. Each slave has one TX#. When data is sent from the master or the slave a new TX# is generated for each new data block. The TX# is then returned from the master or the slave in ACK, NAK, EOT or ACKPOLL. Slave answering EOT at POLL contains 0 in TX#. TX# is initiated to 0 after restart of protocol and then incremented by one for each successfully transmitted data block. TX# wraps around to 1 after Fh.

### Note 2 :

Transaction buffer size is application dependent. However, maximum 128 bytes including control characters. Different slaves can have different buffer size.

### Note 3 :

MKR5 protocol must provide for reliable data transfer. Error checking to be implemented by CRC-16 (CCITT). Parity checking is required on each byte.

### Note 4 :

The protocol is divided into 3 layers.

Layer 3      Application layer.  
Layer 2      Line protocol layer.  
Layer 1      Electronic layer.

Layer 2 is handling is polling of devices and transport of blocks that are created by layer 3. Layer 2 checks that a block is transmitted correctly. The check is made with CRC, parity and block sequence number. If an error occurs, retransmission is handled by layer 2.

At layer 3 blocks are transmitted between Master and Slave. A block can contain one or more transactions that are specified in this part .

## Master Transactions

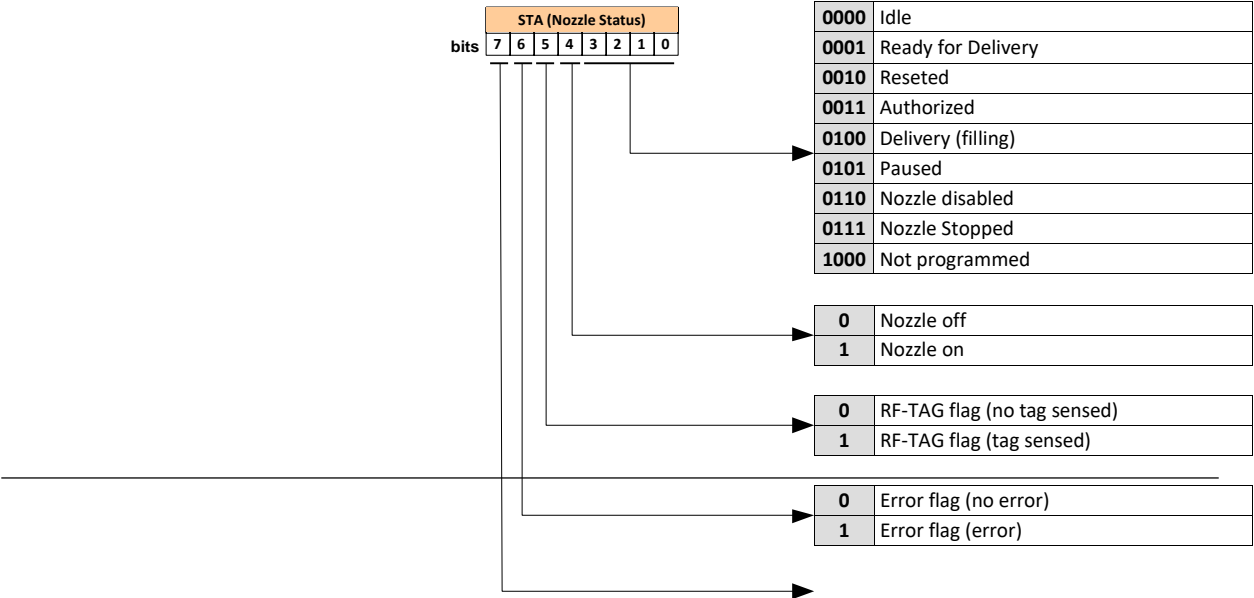
POOL	ADR	CTRL	SF				
ACK	ADR	CTRL	SF				
NACK	ADR	CTRL	SF				
ACKPOOL	ADR	CTRL	SF				
DATA	ADR	CTRL	Data Block	CRC-L	CRC-H	ETX	SF

Return Nozzle Status	SD	OPC	
Reset Nozzle	SD	OPC	
Authorize Nozzle	SD	OPC	
Pause Delivery	SD	OPC	
Resume Delivery	SD	OPC	
Return Filling Info	SD	OPC	
Return Totalizer	SD	OPC	
Price Update	SD	OPC	Price (4-Byte)
Preset Amount	SD	OPC	Amount (4-Byte)
Preset Volume	SD	OPC	Volume (4-Byte)
Disable Nozzle	SD	OPC	
Stop Nozzle	SD	OPC	

## Slave Transactions

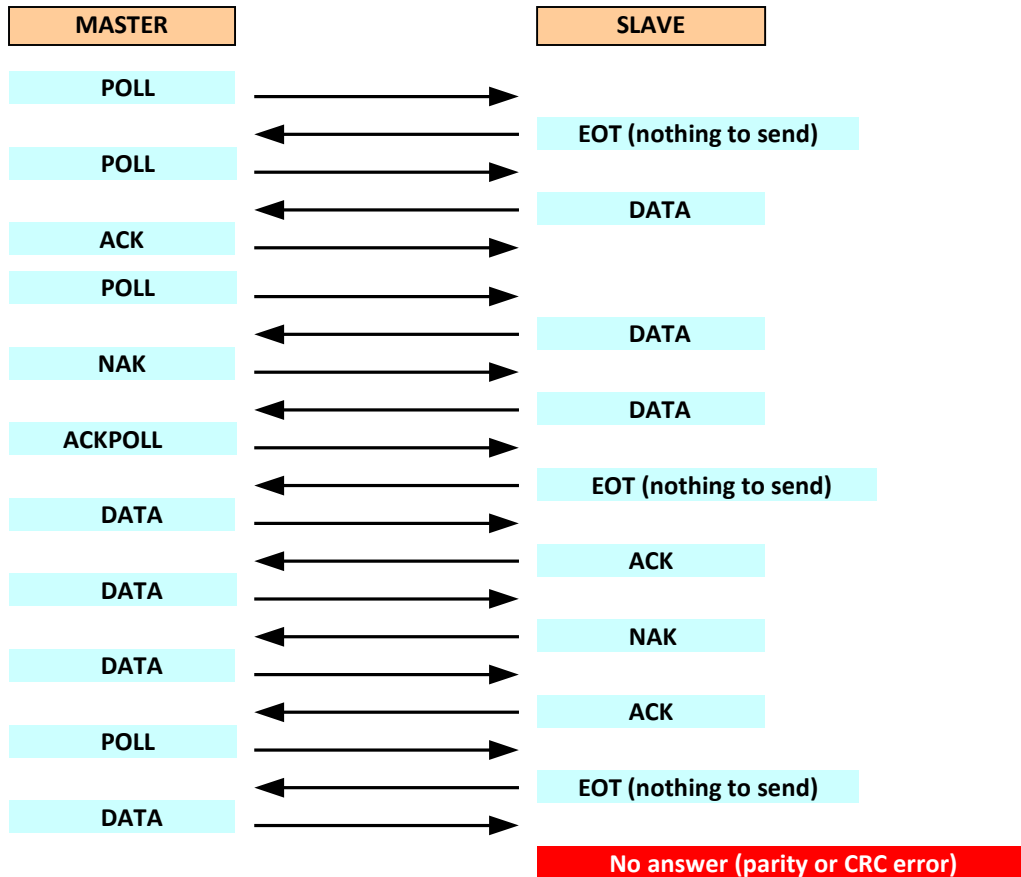
Eot	ADR	CTRL	SF				
Ack	ADR	CTRL	SF				
Nack	ADR	CTRL	SF				
DATA	ADR	CTRL	Data Block	CRC-L	CRC-H	ETX	SF

Nozzle Status	SD	OPC	STA		
Error Code	SD	OPC	ERR		
Filling Info	SD	OPC	STA	Amount (4-Byte)	Volume (4-Byte)
Totalizer	SD	OPC	STA	Amount (6-Byte)	Volume (6-Byte)









## Error Recovery

Error recovery is done when the expected block sequence number does not match the real one. It is done by both the master and the slave. This is a listing of all different situations when error recovery should be done. The TX#-check should be done in the following sequence.

1. **TX# = tx** Last received TX#. The transmitting unit did not get my last ACK. Skip data and answer ACK. Note that this must be done also when TX# = 0.
2. **TX# = 0** The transmitting unit has been restarted. Initiate the expected TX# to 0, accept data and send ACK.
3. **TX# <> tx** Expected. If expected TX# = 0 this means that actual unit has been restarted and the expected TX# should be sent to the one just received. If so accept data and send ACK. Otherwise another error has occurred and the block should be answered with NAK.

NAK is sent if TX#-error is found in received data. The slave shall not answer at parity error or CRC-error.

The unit transmitting data has the responsibility to restart the communication procedure when NAK has been received 3 times for identical message.

## Timing

Each unit must be capable to receive characters at 19200 / 9600 baud without delays between characters. The master controls the timing. The slave must respond to a poll or data within 25 ms, i.e. transmit the first character after a complete poll or data. The slave must be capable to receive an ACK and a poll transmitted from the master as one continuous byte stream (two lines 3 bytes). In this case ACK and poll are for two different device addresses. If ACK and poll are for the same device then ACKPOLL is sent as one message (3 bytes).