Software Design Description

GR-Unit Software System

ML STAR Vector OEM Interface Design

Review and Approvals		
Name	**Date**	**Signature**
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REVISION NOTES

2.3 2009-12-01 Claudio Jörg

- **Extended table StepList** (GSOEM.0046) with column **PD47** (extended from **6 to 7** double parameters).
- Extended Command 1000ul / 5ml Channel -> Aspirate (GSOEM.0006 / GSOEM.0069) with parameters 'touch off' (PI28), 'retract distance for transport air' (PD46) and 'aspiration position above touch' (PD47).
- Extended Command 1000ul / 5ml Channel -> Dispense (GSOEM.0007 / GSOEM.0070) with parameter 'retract distance for transport air' (PD46).
- Extended Command CO-RE 96 / 384 Head -> Aspirate (GSOEM.0034 / GSOEM.0043) with parameter 'retract distance for transport air' (PD46).
- Extended Command CO-RE 96 /384 Head -> Dispense (GSOEM.0035 / GSOEM.0044) with parameter 'retract distance for transport air' (PD46).
- Extended command CO-RE 384 Head -> Tip Pick Up (GSOEM.0055) with parameter 'reduced pattern mode' (PI25). Renamed parameter PI22 to 'tip mode'.
- Added dispense mode '4 = Drain tip in jet mode' as allowed value to all dispense commands.
- Added commands
  - 1000ul Channel Dispense on the Fly
  - 5ml Channel Dispense on the Fly

2.2 2008-02-26 Claudio Jörg

- Extended CO-RE 384 Head -> Tip Pick Up (GSOEM.0055) with parameters 'pick up from tip lifter' (PI23), 'head pattern as variable' (PI24) and 'head pattern' (PS01).
- Extended CO-RE Grip -> Get Plate (GSOEM.0038) with parameter 'check plate' (PI25).
- Extended CO-RE Grip -> Place Plate (GSOEM.0039) with parameters 'X acceleration' (PI24) and 'check plate' (PI25).
- Extended CO-RE Grip -> Move Plate (GSOEM.0040) with parameter 'X acceleration' (PI21).
- Extended Nano Pipettor -> Dispense (GSOEM.0063) with parameter 'volume check' (PI25).
- Extended Command Nano Pipettor -> Wash (GSOEM.0065) with parameter 'diagnostic mode' (PI26). Extended description of instrument results.
- Updated Command Initialize (GSOEM.0002). Only parameter 'initialize always' (PI21) remains for that step!
- Added 5ml Channel Steps:
  - 5ml Channel Tip Pick Up
  - 5ml Channel Aspirate
  - 5ml Channel Dispense
  - 5ml Channel Tip Eject
  - 5ml Channel Get Last Liquid Level
- Added 5ml CO-RE Grip Steps:
  - 5ml Channel CO-RE Grip Get Plate
  - 5ml Channel CO-RE Grip Place Plate
  - 5ml Channel CO-RE Grip Move Plate
  - 5ml Channel CO-RE Grip Read Barcode
- Added Tube Grip Steps:
  - Tube Grip Get
  - Tube Grip Place
  - Tube Grip Move
  - Tube Grip Read Barcode
- Added Tube Grip Steps:
  - Tube Grip Get
  - Tube Grip Place

- Added Miscellaneous Steps:
  - 5ml Channel Move To Position
  - Wait For TADM Upload
  - Get Channel Exclude State
- Added S-Tube Caper Steps:
  - S-Tube Cap
  - S-Tube Decap
- Marked Tip Tracking Speed (GSOEM.0054) as obsolete.
- Updated naming of steps to distinguish between 1000ul and 5ml channel steps.

2.1 2006-10-28 Claudio Jörg

- **Extended table StepList** (GSOEM.0046) with column **PI29 to PI32** (extended from 8 to 12 integer parameters).
- Extended **'Channel -> Aspirate'** (GSOEM.0006): For 'capacitive liquid level detection' and 'pressure liquid level detection' added '5 = From labware definition' to the allowed values.
- Extended **'Channel -> Dispense'** (GSOEM.0007) with parameters 'side touch' (PI29). For 'dispense mode' added '8 = From liquid class definition' to the allowed values. For 'capacitive liquid level detection' added '5 = From Labware definition' to the allowed values.
- Extended **'iSWAP -> Get Plate'** (GSOEM.0017) with parameters 'grip mode' (PI28).
- Extended **'iSWAP -> Move Plate'** (GSOEM.0019) with parameters 'grip mode' (PI22).
- Extended **'iSWAP -> Open Gripper'** (GSOEM.0020) with parameters 'grip mode' (PI23).
- Extended **'iSWAP -> Close Gripper'** (GSOEM.0021) with parameters 'grip mode' (PI24).
- Extended **'iSWAP -> Read Plate Barcode '** (GSOEM.0022) with parameters 'minimal Z-position during read' (PD41) and 'Y-position during read' (PD42).
- Extended **'iSWAP -> Get First Plate Position '** (GSOEM.0023) with parameters 'grip mode' (PI25).
- Extended **'CO-RE 96 Head -> Aspirate'** (GSOEM.0034): For 'capacitive liquid level detection' added '5 = From labware definition' to the allowed values.
- Extended **'CO-RE 96 Head -> Dispense'** (GSOEM.0035) with parameters 'side touch' (PI28). For 'capacitive liquid level detection' added '5 = From labware definition' to the allowed values.
- Updated **'Command CO-RE 96 Head -> Wash'** (GSOEM.0036) for wash on dual chamber wash station. Need much more parameters now.
- Updated **'Command CO-RE 96 Head -> Empty Washer'** (GSOEM.0037) for dual chamber wash station. Need much more parameters now.
- Extended **'Command CO-RE Grip -> Get Plate'** (GSOEM.0038) with parameters 'grip speed' (PD44) and 'Z-speed' (PD45).
- Extended **'Command CO-RE Grip -> Place Plate'** (GSOEM.0039) with parameters 'Z-speed' (PD41) and 'plate press on distance' (PD42).
- Extended **'Command CO-RE Grip -> Read Plate Barcode'** (GSOEM.0041) with parameter 'minimal Z-position during read' (PD41).
- Added commands for CO-RE 384 head:
  - **CO-RE 384 Head -> Tip Pick Up** (GSOEM.0055)
  - **CO-RE 384 Head -> Tip Eject** (GSOEM.0056)
  - **CO-RE 384 Head -> Aspirate** (GSOEM.0057)
  - **CO-RE 384 Head -> Dispense** (GSOEM.0058)
  - **CO-RE 384 Head -> Wash** (GSOEM.0059)
  - **CO-RE 384 Head -> Empty Washer** (GSOEM.0060)
- Added commands for Nano Pipettor:
  - **Command Nano Pipettor -> Prepare** (GSOEM.0061)
  - **Command Nano Pipettor -> Aspirate** (GSOEM.0062)
  - **Command Nano Pipettor -> Dispense** (GSOEM.0063)
  - **Command Nano Pipettor -> Dispense On The Fly** (GSOEM.0064)
  - **Command Nano Pipettor -> Wash** (GSOEM.0065)
- Added **command Re-Load Carrier** (GSOEM.0066)

2.0 2005-08-16 Claudio Jörg

- **Extended table StepList** (GSOEM.0046) with column **PI28** (extended from 7 to 8 integer parameters).
- Extended **'Channel -> Dispense' (**GSOEM.0007) with parameters 'touch off' (PI28) and 'dispense position above touch' (PD45). For the parameter 'dispense mode' (PI23) new allowed value added (**9, blow out tip**).
- Updated **'CO-RE 96 Head -> Wash' (**GSOEM.0036) for the changed parameters because of changed wash procedure.
- Extended the following command by the parameter 'collision control':
  - **'iSWAP -> Get First Plate Position'** (GSOEM.0023)
  - **'iSWAP -> Get Plate** (GSOEM.0017)
  - **'iSWAP -> Move Plate** (GSOEM.0019)
  - **'iSWAP -> Place Plate** (GSOEM.0018)
  - **'iSWAP -> Read Plate Barcode** (GSOEM.0022)
- Added GSOEM.0053 : Command Channel -> Get Last Liquid Level (39)
- Added GSOEM.0054 : Command Tip Tracking Speed (40)
- Extended instrument result count of Command Write Port (GSOEM.0026) from 3 to 4 values.
- **Removed** GSOEM.0051 (**ALIM_COMPATIBLE mode**). Is not longer supported.
  - Removed GSOEM.0050 (Command Wait (1002)).
  - Removed state diagram for ALIM_COMPATIBLE mode.

1.3 2004-11-08 Claudio Jörg

- Set document no to E2830162dd.

1.2 2004-10-14 Claudio Jörg

- Updated file segmentation described in 3.2.1. The low level steps used from the main-method are implemented in one file for each step, wrapped by a HSL-function.

1.1 2004-10-14 Claudio Jörg

- Added commands for the CO-RE 96 Head (command-Id's 27 – 32 / GSOEM.0032 - 0037).
- Added commands for the CO-RE Gripper (command-Id's 33 – 36 / GSOEM.0038 - 0041).
- Added command 'Calibrate' (command-Id 37 / GSOEM.42).
- Added command 'Lock Front Cover' (command-Id 38 / GSOEM.43).

1.0 2004-10-14 Claudio Jörg

- Document created: Merged from E2830100r ("Action List Interpreter Method" software requirements) and from E2830104dd ("Action List Interpreter Method" method design).
  Changed title to "ML_STAR Vector OEM Interface".
  Changed requirement abbreviation to GSOEM.
- Changed file names of OEM Interface method to 'ML_STAR_OemInterface*.*' (3.2.1).
- Changed file name of expected deck layout to 'ML_STAR_OemInterface.lay' (3.3)
- Changed file name of command list database to 'ML_STAR_OemInterface_CommandList.mdb' (3.4).
- Changed directory of command list database to configured <Phoenix LogFiles Path> (3.4).
- Changed naming of events to 'event_ML_STAR_OemInterface_IsWaiting' and 'event_ML_STAR_OemInterface_Continue' (5.1).
- Changed state diagram: OEM Interface method changes to state waiting after execution of each command independent of the command result (4.1).
- Added *ALIM_COMPATIBLE mode* (obsolete) (5.3).

CONTENTS

FIGURES

REQUIREMENTS

1 INTRODUCTION

1.1 Purpose

This document describes the design of the component **ML STAR Vector OEM Interface Design** (module HxStarOemInterface).

This document is intended to be read by authorized Hamilton Co. personnel only.

1.2 Scope

This document applies to the ML_STAR Vector Software System and all subsequent versions of the software developed internally by Hamilton Company or externally by an approved contractor.

1.3 Definition and Acronyms

OEM Application This is **a client** application created by a (OEM) customer that needs to control the ML_STAR by the *OEM Interface*. Has its own user interface to display the run progress. Creates the *Command List*, start and controls the *OEM Interface* and evaluates the results.

OEM Interface This is **the server** provided by Hamilton Co. build to provide full control over a ML_STAR for a (OEM) customer without using the ML_STAR Vector Method Editor and Run application.

Command List Database containing a list of *Commands*, their parameters and the result after execution. Provided by the *OEM Application* and used by the *OEM Interface method.*

OEM Interface method HSL-method executable by Hamilton's HSL Run Control that interprets the *Command List*, executes the *Commands* and writes the result of the command back into the *Command List.*

Command A Command provides the functionality as defined in it's description. It may use instrument low-level steps and/or HSL-functions to implement such functionality.

HSL Hamilton Standard Language

1.4 References

[1]	'Phoenix Software Requirements'	E2830019r
[2]	'Phoenix Architecture'	E2830022da
[3]	'Phoenix Design Guidelines'	E2830017dg
[4]	'HxHslRunControl2, Design'	E2830119dd
[5]	'GR-Unit Software Requirements'	E2830018r
[6]	'HxGRUCommand Design'	E2830021dd
[7]	'HxGRUCommand Help' (HxGRUCommandEnu.chm)	--
[8]	'HSLML_STAR Design'	E2830064dd

1.5 Overview

The component **HxStarOemInterface** provides an interface to control a ML_STAR without using the ML_STAR Vector Method Editor and Run application.

The OEM Interface method executes simple commands on a ML_STAR defined within a database. The method is written in HSL and may be executed by using Hamilton's run control [4].

After the OEM Interface has been started it reads the first command out of the database, execute it and write the result of the command back to the database. After writing of the result the method waits for an event to continue with next command.

2 OEM INTERFACE OVERVIEW

- A OEM Application generates an Command List (access database format) which contains a list of Commands to be executed.
- A OEM Application provides the deck layout used from the OEM Interface for command execution.
- The Command List includes specific Commands and their arguments.
- The Command List can be modified by a OEM Application.

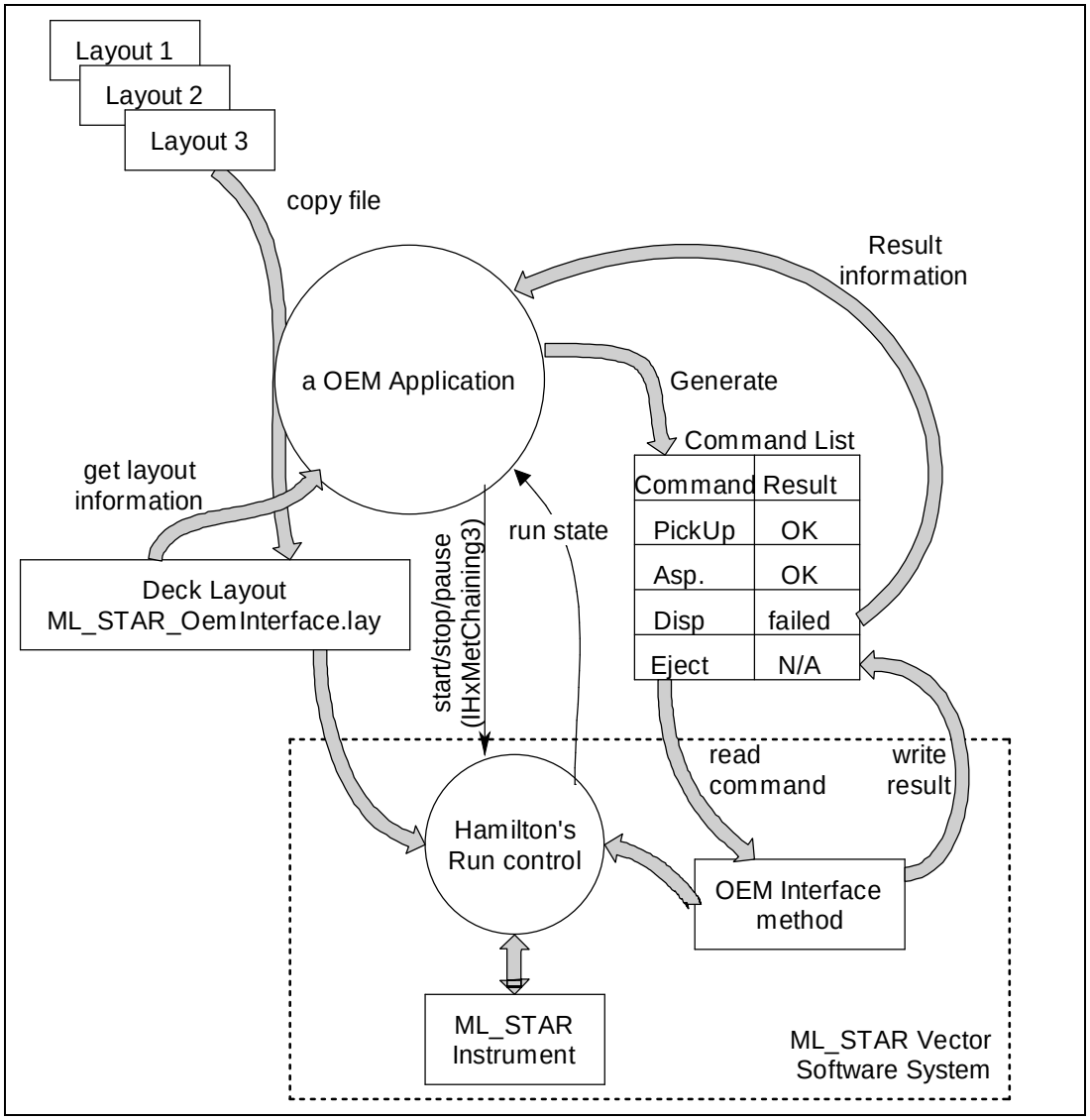


Figure 1: OEM Interface Overview

2.1 Available Commands

2.1.1 General Commands

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
Method Complete	**1001**																						
Abort	**1003**																						

2.1.2 ML_STAR Commands

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
Initialize	**1**				initialize always																		
1000ul Channel Tip Pick Up	**2**	channel pattern			sequence counting	channel use																	
1000ul Channel Needle Pick Up	**3**	channel pattern			sequence counting	channel use	use default waste																
1000ul Channel Tip/Needle Eject	**4**	channel pattern			sequence counting	channel use	use default waste																
1000ul Channel Aspirate	**5**	channel pattern	liquid class		sequence counting	channel use	aspirate mode	capacitive LLD	pressure LLD	liquid following	mix cycles	touch off					submerge depth	liquid height	maximum difference	mix position	mix volume	retract distance for air	asp. pos. above touch

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
1000ul Channel Dispense	**6**	channel pattern	liquid class		sequence counting	channel use	dispense mode	capacitive LLD	liquid following	mix cycles	z-move after step	touch off	side touch				submerge depth	liquid height	mix position	mix volume	disp pos. above touch	retract distance for air	
Load Carrier	**7**	carrier name	barcode file name	barcode read positions																			
Unload Carrier	**8**	carrier name																					
1000ul Channel Wait Needle Washed	**9**	wash station name																					
1000ul Channel Start Needle Wash	**10**	wash station name			liquid 1: flow rate	liquid 2: flow rate	start wash liquid										liquid 1: rinse time	liquid 1: soak time	liquid 2: rinse time	liquid 2: soak time	draining time		
1000ul Channel Get Container Volume	**11**	channel pattern			sequence counting	capacitive LLD	pressure LLD										maximum difference						
ISWAP Get Plate	**12**				sequence counting	movement type	transport mode	labware orientation	grip force	inverse grip	collision control	grip mode					retract distance	lift-up height	grip width	tolerance	grip height	width before	

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
iSWAP Place Plate	**13**				sequence counting	movement type	transport mode	labware orientation	collision control								retract distance	lift-up height					
iSWAP Move Plate	**14**				collision control	grip mode																	
iSWAP Open Gripper	**15**				sequence counting	transport mode	grip mode										opening width						
iSWAP Close Gripper	**16**				sequence counting	transport mode	grip force	grip mode									grip width	tolerance	grip height				
iSWAP Read Plate Barcode	**17**				barcode reader position	collision control											minimal Z-position	Y-position during read					
iSWAP Get First Plate Position	**18**				sequence counting	grip force	inverse grip	collision control	grip mode								grip width	tolerance	grip height	width before			
iSWAP Park	**19**				collision check dialog																		

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
Read Port	**20**				port number																		
Write Port	**21**				port number	port setting																	
1000ul Channel Move To Position	**22**				mode	direction											absolute position	relative position					
Move Auto Load	**23**				track number																		
Firmware Command	**24**	firmware command	firmware parameter																				
Set Carrier Temperature	**25**	carrier name			temperature control	time to temp. check	go to next step										temperature						
Get Carrier Temperature	**26**	carrier name																					
CO-RE 96 Head Tip Pick Up	**27**	channel pattern			start position	sequence counting	reduced pattern mode																

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
CO-RE 96 Head Tip Eject	**28**				start position	sequence counting	tip eject setting																
CO-RE 96 Head Aspirate	**29**	liquid class			start position	sequence counting	aspirate mode	capacitive LLD	liquid following	mix cycles							volume	submerge depth	height from bottom	mix position	mix volume	retract distance for air	
CO-RE 96 Head Dispense	**30**	liquid class			start position	sequence counting	dispense mode	capacitive LLD	liquid following	mix cycles	z-move after step	side touch					volume	submerge depth	height from bottom	mix position	mix volume	retract distance for air	
CO-RE 96 Head Wash	**31**				wash cycles (wash station)	start wash chamber	ONE: liquid following	ONE: wash cycles (head)	ONE: refill after wash	ONE: wash liquid	ONE: liquid change	TWO: liquid following	TWO: wash cycles (head)	TWO: refill after wash	TWO: wash liquid	TWO: liquid change	ONE: wash/mix volume	ONE: submerge depth	TWO: wash/mix volume	TWO: submerge depth			
CO-RE 96 Head Empty Washer	**32**				refill after empty	ONE: wash liquid	ONE: liquid change	ONE: wash liquid	ONE: liquid change															
1000ul Channel CO-RE Grip Get Plate	**33**				sequence counting	transport mode	grip force	gripper tool channel	check plate								grip width	grip height	width before	grip speed	Z-speed		
1000ul Channel CO-RE Grip Place Plate	**34**				sequence counting	transport mode	eject tool when finish	X acceleration	check plate								Z-speed	plate press on distance						

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
1000ul Channel CO-RE Grip Move Plate	**35**				X acceleration																		
1000ul Channel CO-RE Grip Read Plate Barcode	**36**				barcode reader position												minimal Z-position						
Calibrate Carrier	**37**	carrier name			calibrate channel																		
Lock Front Cover	**38**				lock setting																		
1000ul Channel Get Last Liquid Level	**39**																						
Tip tracking Speed (obsolete)	**40**				pipetting device												speed factor						
CO-RE 384 Head Tip Pick Up	**41**	head pattern			sequence counting	tip mode	pick up from tip lifter	head pattern as variable	reduced pattern mode														
CO-RE 384 Head Tip Eject	**42**				sequence counting	tip eject setting																	

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
CO-RE 384 Head Aspirate	**43**	liquid class			sequence counting	aspirate mode	capacitive LLD	liquid following	mix cycles								volume	submerge depth	height from bottom	mix position	mix volume	retract distance for air	
CO-RE 384 Head Dispense	**44**	liquid class			sequence counting	dispense mode	capacitive LLD	liquid following	mix cycles	z-move after step	side touch						volume	submerge depth	height from bottom	mix position	mix volume	retract distance for air	
CO-RE 384 Head Wash	**45**				wash cycles (wash station)	start wash chamber	ONE: liquid following	ONE: wash cycles (head)	ONE: refill after wash	ONE: wash liquid	ONE: liquid change	TWO: liquid following	TWO: wash cycles (head)	TWO: refill after wash	TWO: wash liquid	TWO: liquid change	ONE: wash/mix volume	ONE: submerge depth	TWO: wash/mix volume	TWO: submerge depth			
CO-RE 384 Head Empty Washer	**46**				refill after empty	ONE: wash liquid	ONE: liquid change	TWO: wash liquid	TWO: liquid change														
Nano Pipettor Prepare	**47**				prepare mode																		
Nano Pipettor Aspirate	**48**	channel pattern			sequence counting	aspirate oil gap	channel ID	pressure LLD	liquid following	aspiration pressure							submerge depth	liquid height	swap speed				
Nano Pipettor Dispense	**49**	channel pattern			sequence counting	channel ID	Z-move after step	dispensation	volume check								dispense height						

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
Nano Pipettor Dispense On The Fly	**50**	channel pattern			sequence counting	dispense on the fly mode	channel ID	dispensation pressure	dispense direction								dispense height	X-speed during dispense	X-acceleration distance				
Nano Pipettor Wash	**51**				channel ID	flush time	wash at ultrasonic bath	refill wash liquid	wash time	diagnostic mode							submerge depth						
Re-Load Carrier	**52**	barcode file name			sequence counting	load on tray position	reload empty carrier																
5ml Channel Tip Pick Up	**53**	channel pattern			sequence counting	channel use																	
5ml Channel Tip Eject	**54**	channel pattern			sequence counting	channel use	use default waste																
5ml Channel Aspirate	**55**	channel pattern	liquid class		sequence counting	channel use	aspirate mode	capacitive LLD	pressure LLD	liquid following	mix cycles	touch off					submerge depth	liquid height	maximum difference	mix position	mix volume	retract distance for air	asp. pos. above touch
5ml Channel Dispense	**56**	channel pattern	liquid class		sequence counting	channel use	dispense mode	capacitive LLD	liquid following	mix cycles	z-move after step	touch off	side touch				submerge depth	liquid height	mix position	mix volume	disp pos. above touch	retract distance for air	

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
5ml Channel Get Last Liquid Level	**57**																						
5ml Channel Move To Position	**58**				mode	direction											absolute position	relative position					
5ml Channel CO-RE Grip Get Plate	**59**				sequence counting	transport mode	grip force	gripper tool channel	check plate								grip width	grip height	width before	grip speed	Z-speed		
5ml Channel CO-RE Grip Place Plate	**60**				sequence counting	transport mode	eject tool when finish	X acceleration	check plate								Z-speed	plate press on distance					
5ml Channel CO-RE Grip Move Plate	**61**				X acceleration																		
5ml Channel CO-RE Grip Read Plate Barcode	**62**				barcode reader position												minimal Z-position						
Camera Channel Move	**63**	move to labware ID			sequence counting	identify labware by	Z-offset base	Z move during step									X-offset	Y-offset	Z-offset				
S-Tube Cap	**64**	channel pattern			sequence counting	channel use																	

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
S-Tube Decap	**65**	channel pattern			sequence counting	channel use																	
Tube Grip Get	**66**				sequence counting												grip height	opening with before					
Tube Grip Place	**67**				sequence counting												relative open with						
Tube Grip Move	**68**																						
Tube Grip Read Barcode	**69**				reader position																		
Wait For TADM Upload	**70**				head type																		
Get Channel Exclude State	**71**				head type																		
1000ul Channel Dispense on the Fly	**72**	channel pattern	liquid class	excluded LW positions	sequence counting	dispense on the fly mode	dispense direction										labware surface distance	X-speed during dispense	X-start offset	X-acceleration distance			

Command name	CommandID	PS01	PS02	PS03	PI21	PI22	PI23	PI24	PI25	PI26	PI27	PI28	PI29	PI30	PI31	PI32	PD41	PD42	PD43	PD44	PD45	PD46	PD47
5ml Channel Dispense on the Fly	**73**	channel pattern	liquid class	excluded LW positions	sequence counting	dispense on the fly mode	dispense direction										labware surface distance	X-speed during dispense	X-start offset	X-acceleration distance			

3 DEPENDENCY DESCRIPTION

3.1 ML_STAR Vector Software

The ML_STAR Vector Software must be installed before the ML_STAR OEM Interface may be installed/used.

3.2 ML_STAR OEM Interface method

3.2.1 File segmentation

The OEM Interface is implemented as a HSL-Method which is split into the following files:

ML_STAR_OemInterface.hsl/.stp	Main HSL-Method.
Files in subfolder \ML_STAR_Steps	Low Level steps (like Aspirate) used from the main HSL-Method. Each step is wrapped by a HSL-functions. Within this steps the error-handling may be optimized by the customer.
ML_STAR_OemInterfaceXxx.hs_ (and ML_STAR_OemInterfaceXxx.stp)	Language dependant part of the OEM Interface method. The language of the file is defined by the three characters 'Xxx'. Example: 'ML_STAR_OemInterfaceEnu.hs_' provides the texts for the language English United States.

3.2.2 Dependencies

The following HSL-libraries are part of the ML_STAR Vector Software System and are included / used by the OEM Interface method:

- HSLStringTableLib.hs_ Functions to load the language dependant string table information.
- HSLMlStarCfgKeys.hs_ Definition of the Microlab Star configuration keys.
- HSLMlStarStepReturnLib.hsl Interpretation of the block data returned by a Microlab Star Low Level step.
- HSLML_STARLib.hsl Implements additional functions to use together with a Microlab Star (e.g. measure container volume).

3.3 ML_STAR Deck Layout

For execute of any commands on the Microlab STAR a deck layout must be provided by a OEM Application. The Hamilton Deck Layout Editor may be used to create or edit any deck layout for the Microlab Star.

The OEM Interface method assumes that a Deck Layout for the connected Microlab Star with the name '**ML_STAR_OemInterface.lay**' exists in one of the following directories:

1) In the same directory as the OEM Interface method is stored.
2) In the directory that is configured as <Phoenix Methods Path>.
3) In the directory that is configured as <Phoenix Library Path>.
4) In the directories that are listed in the PATH environment variable.

3.4 Command List Database

As input for the OEM Interface method a database as defined in 4.2 [GSOEM.0001 : Command List Database]) with file name '**ML_STAR_OemInterface_CommandList.mdb**' must exist in the directory that is configured as <Phoenix LogFiles Path>.

The result of the executed commands is also written (from the OEM Interface method) into this data base (Table 'ResultList').

3.5 Start of the OEM Interface method

The OEM Interface method may be started by any application that uses the interface **IHxMetChaining3** of Hamilton's Run Control [4] (HxHslRunControl2, Design).

4 PROGRAMMER'S INTERFACE

4.1 State diagram

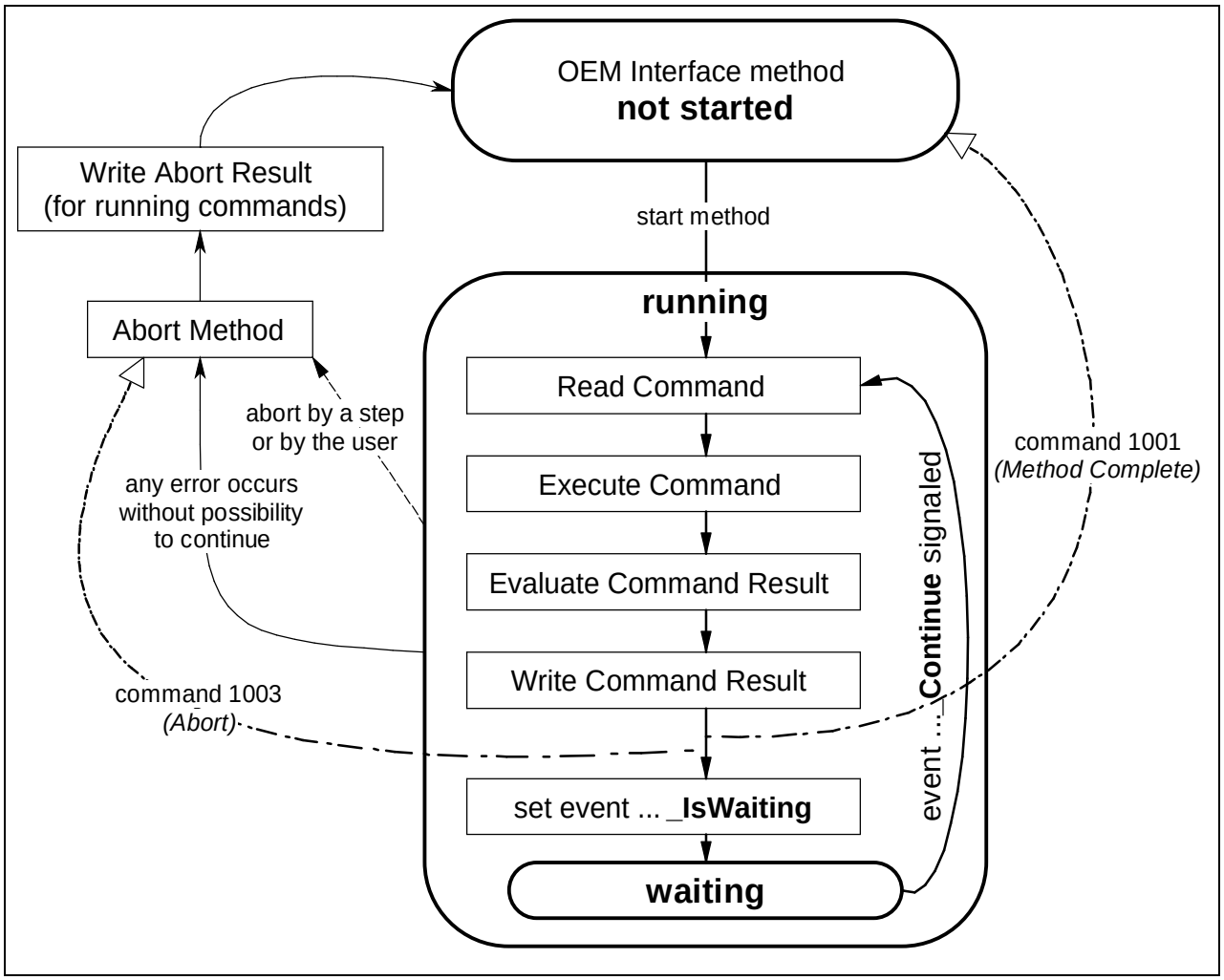


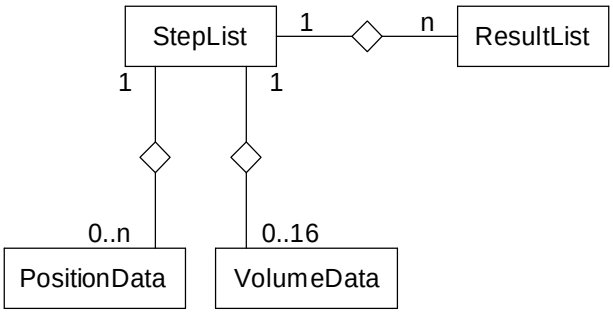
Figure 2: State Diagram

4.2 [GSOEM.0001 : Command List Database]

4.2.1 Overview

The Command List database contains the following tables:

- **StepList**
- **PositionData**
- **VolumeData**
- **ResultList** (written during execution from OEM Interface method)



4.2.2 Database format

The Command List database must be in a Microsoft Access format (as used from Microsoft Access 95, Access 97 (Jet 3.x)).

ADO Provider: "Provider=Microsoft.Jet.OLEDB.4.0"
Engine: "Jet OLEDB:Engine Type=4"

4.2.3 [GSOEM.0046 : Table - StepList]

The table must have the following columns:

Name	Key-Type	Type	Size	Comments
StepID	PK	Number (Long)	4	Unique ID of the step. The first step has number 0. The following numbers must incrementing by 1.
CommandID		Number (Long)	4	Command ID, defines the command which shall be executed (see list below)
PS01		Text	255	Command specific parameter 1
PS02		Text	255	Command specific parameter 2
PS03		Text	255	Command specific parameter 5
PI21		Number (Long)	4	Command specific parameter 21
PI22		Number (Long)	4	Command specific parameter 22
....		...	...	...
PI28		Number (Long)	4	Command specific parameter 28
PD41		Number (Double)	8	Command specific parameter 41
PD42		Number (Double)	8	Command specific parameter 42
....		...	...	...
PD47		Number (Double)	8	Command specific parameter 47

4.2.4 [GSOEM.0047 : Table - PositionData]

The table must have the following columns:

Name	Key-Type	Type	Size	Comments	
StepID	FK, PK	Number (Long)	4	Unique ID of the step.	
GroupID	PK	Number (Long)	4	Group the elements to define more than one element-group per StepID.	
SortKey	PK	Number (Long)	4	Defines the order of the elements (ascending numbering).	
LabwareID		Text	255	Labware ID	Defines a **element** (e.g. for the command Tip Pick Up)
PositionID		Text	255	Position ID	

4.2.5 [GSOEM.0048 : Table - VolumeData]

The table must have the following columns:

Name	Key-Type	Type	Size	Comments
StepID	FK, PK	Number (Long)	4	Unique ID of the step.
SortKey	PK	Number (Long)	4	Defines the order of the volumes (ascending numbering).
Volume		Number (Double)	8	Volume per channel (e.g. for the command Aspirate)

4.2.6 [GSOEM.0049 : Table - ResultList]

The table is created and updated from OEM Interface method after execute of a command.

The following columns are added:

Name	Key-Type	Type	Size	Comments
StepID	FK, PK	Number (Long)	4	Unique ID of the step.
CommandResult		Number (Long)	4	Main result of the executed command.
ResultNo	PK	Number (Long)	4	Defines the number of the result data.
ResultFragment	PK	Number (Long)	4	Defines the order of fragmented ResultData.
ResultData		Text	255	The ResultData will be fragmented into several parts if it's length is greater than 255 characters. The order of the parts is defined by the ResultFragment.

4.2.6.1 Definition of the CommandResult

For each executed command one of the following CommandResult value is written into the table ResultList.

CommandResult	Description	
0	Command completed successfully. The ResultData contains additional command specific information.	
1	Command not completed successfully. The ResultData contains additional command specific information.	
2	Command ends fatal. The ResultData contains the following result data:	
	ResultNo	**Description of ResultData**
	1	Error ID: Numeric value that specifies an error.
	2	Error description: Descriptive string associated with the error.
3	Method aborted. A command or the user has aborted. The ResultData contains the following result data:	
	ResultNo	**Description of ResultData**
	1	Error ID: Numeric value that specifies an error.
	2	Error description: Descriptive string associated with the error.

4.3 General Commands

4.3.1 General descriptions

4.3.1.1 Command result data

ResultNo	Description
1	These Commands has no result data. Always an empty string is written for the ResulData.

4.3.2 [GSOEM.0013 : Command Method Complete (1001)]

CommandID:	**1001**
Instrument step:	--
Command description:	Indicates that no more steps shall be executed and the method is completed.
PositionData:	--
VolumeData:	--

4.3.2.1 Parameter Details

Param	Description
--	This Command has no parameters.

4.3.3 [GSOEM.0015 : Command Abort (1003)]

CommandID:	**1003**
Instrument step:	--
Command description:	Terminates the program abnormally, by controlled aborting of the execution.
PositionData:	--
VolumeData:	--

4.3.3.1 Parameter Details

Param	Description
--	This Command has no parameters.

4.4 ML_STAR Commands

For a detailed description of all ML_STAR commands and their results please refer the HxGRUCommand Design [6] or the HxGRUCommand Help [7].

4.4.1 General descriptions

4.4.1.1 Command result data

ResultNo	Description
1	Number of elements used from the position list. Set to **–1** if the command uses no position list (like 'Load Carrier').
Instrument results:	
2	Result value 1: Contains always the instrument name e.g. 'Microlab STAR'.
3	Result value 2: Contains always the instrument step name e.g. 'Initialize'.
4...(**X+1**)	Result value 3: Contains one error flag and the block data. (see additional specification for each Command (like 'Initialize')). Result value 4...X: Step depended. (see additional specification for each Command). where **X** equals to the *result values count* specified for each Command.

The detailed description of the instrument results is specified in the HxGRUCommand Design [6] or the HxGRUCommand Help [7].

4.4.2 Preparation commands

4.4.2.1 [GSOEM.0002 : Command Initialize (1)]

CommandID:	**1**
Instrument step:	Initialize
Command description:	Initializes the instrument and brings it into a defined status.
PositionData:	--
VolumeData:	--

4.4.2.1.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	initialize always flag	integer	0 = Off 1 = On

4.4.2.1.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.2.2 [GSOEM.0008 : Command Load Carrier (7)]

CommandID:	**7**
Instrument step:	Load Carrier
Command description:	Loads a carrier from the loading tray on the defined instrument’s deck position.
PositionData:	--
VolumeData:	--

4.4.2.2.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	carrier name (Labware ID)	string	
PS02	barcode file name	string	
PS03	barcode read positions	string	

4.4.2.2.2 Instrument Results

Result values count:	6
Block data:	Result value 3 contains block data for the carrier. Result value 4 contains block data for each position (plate or tube) on the carrier. Result value 5 Contains the plate or tube position and the barcode mask. (e.g. [01, barcodeMaskA [02, barcodeMaskB...). Result value 6 Contains the plate or tube position and the labware position. ([e.g [01, labwarePosition [02, labwarePosition... or [01, deckSidePosition [02, deckSidePosition.labwarePosition...).

4.4.2.3 [GSOEM.0066 : Command Re-Load Carrier (52)]

CommandID:	**52**
Instrument step:	Re-Load Carrier
Command description:	This step may be used to either load, unload or reload a carrier.
PositionData:	GroupID=**1**: Defines the labware item of the **carrier** to be **loaded**. If zero positions are defined only an unload-procedure is executed. GroupID=**2**: Defines the labware item of the **carrier** to be **unloaded**. If zero positions are defined only a load-procedure is executed.
VolumeData:	--

4.4.2.3.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	barcode file name	string	
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	load on tray position	integer	0 = Off 1…count of loading trays = On
PI23	reload empty carrier	integer	0 = Off 1 = On

4.4.2.3.2 Instrument Results

Result values count:	6
Block data:	Result value 3 contains block data for the carrier. Result value 4 contains block data for each position (plate or tube) on the carrier. Result value 5 Contains the plate or tube position and the barcode mask. (e.g. [01, barcodeMaskA [02, barcodeMaskB...). Result value 6 Contains the plate or tube position and the labware position. ([e.g [01, labwarePosition [02, labwarePosition... or [01, deckSidePosition [02, deckSidePosition.labwarePosition...).

4.4.2.4 [GSOEM.0009 : Command Unload Carrier (8)]

CommandID:	**8**
Instrument step:	Unload Carrier
Command description:	Unloads a carrier from the instrument deck to the loading tray.
PositionData:	--
VolumeData:	--

4.4.2.4.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	carrier name (Labware ID)	string	

4.4.2.4.2 Instrument Results

Result values count:	3
Block data:	Block data: result value 3 contains block data for the carrier.

4.4.2.5 [GSOEM.0042 : Command Calibrate Carrier (37)]

CommandID:	**37**
Instrument step:	Calibrate Carrier
Command description:	This command executes a check of the actual position of the carrier and integrates the positioning correction for the x, y, z coordinates temporary into the deck layout. This step requires the special carrier with a calibration hole (e.g. special carrier used for 1536-well plates).
PositionData:	--
VolumeData:	--

4.4.2.5.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	carrier name (Labware ID)	string	
PI21	calibrate channel	integer	1 ... count of channels installed on the instrument.

4.4.2.5.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the carrier.

4.4.2.6 [GSOEM.0030 : Command Set Carrier Temperature (25)]

CommandID:	**25**
Instrument step:	Set Carrier Temperature
Command description:	This step sets the temperature of the defined temperature-controlled carrier (TCC).
PositionData:	--
VolumeData:	--

4.4.2.6.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	name of the TCC (Labware ID)	string	
PI21	temperature control	integer	0 = Off (heating / cooling is switched off) 1 = On (heating / cooling is switched on)
PI22	time to temperature check *(Only used if temperature control is set to 'On')*	integer	greater or equal than zero.
PI23	go to next step *(Only used if temperature control is set to 'On')*	integer	0 = Without waiting 1 = When temperature is reached
PD41	temperature *(Only used if temperature control is set to 'On')*	double	greater or equal than zero.

4.4.2.6.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the Temperature-controlled carrier.

4.4.2.7 [GSOEM.0031 : Command Get Carrier Temperature (26)]

CommandID:	**26**
Instrument step:	Get Carrier Temperature
Command description:	This step reads the temperature of the defined temperature-controlled carrier (TCC).
PositionData:	--
VolumeData:	--

4.4.2.7.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	name of the TCC (Labware ID)	string	

4.4.2.7.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the Temperature-controlled carrier.
	Result value 4 contains the temperature as float value in °C.

4.4.2.8 [GSOEM.0043 : Command Lock Front Cover (38)]

CommandID:	**38**
Instrument step:	Lock Front Cover
Command description:	This command locks or unlocks the front cover if the cover lock is installed to the Microlab Star.
PositionData:	--
VolumeData:	--

4.4.2.8.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	lock setting	integer	0 = unlocked 1 = locked

4.4.2.8.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the front cover.
	Result value 4 contains the cover state (0 = unlocked, 1 = locked).

4.4.2.9 [GSOEM.0077 : Command Camera Channel Move (63)]

CommandID:	**63**
Instrument step:	Camera Channel Move
Command description:	This step moves the camera channel to defined position.
PositionData:	GroupID=**1**: Defines the destination where the camera channel has to move. Only needed if '`identify labware by`' is set to **'sequence'**.
VolumeData:	--

4.4.2.9.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	move to labware ID (only used if '`identify labware by`' is set to '**Labware ID**')	string	Defines the labware where the camera channel has to move to.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	identify labware by	integer	0 = Sequence 1 = Labware ID
PI23	Z-offset base	integer	0 = Camera max. Z-height 1 = Container bottom
PI24	Z move during step	integer	0 = 0 normal 1 = 1 minimized
PD41	X-offset [mm]	double	signed double
PD42	Y-offset [mm]	double	signed double
PD43	Z-offset [mm]	double	greater or equal than zero.

4.4.2.9.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the camera channel.

4.4.2.10 [GSOEM.0078 : Command S-Tube Cap (64)]

CommandID:	**64**
Instrument step:	S-Tube Cap
Command description:	Capping of S-Tubes.
PositionData:	GroupID=**1**: This Command needs positions where the S-Tube Capper has to cap the S-Tube.
VolumeData:	--

4.4.2.10.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	channel use	integer	1 = All sequence positions 2 = Channel pattern

4.4.2.10.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.2.11 [GSOEM.0079 : Command S-Tube Decap (65)]

CommandID:	**65**
Instrument step:	S-Tube Decap
Command description:	Decapping of S-Tubes.
PositionData:	GroupID=**1**: This Command needs positions where the S-Tube Capper has to decap the S-Tube.
VolumeData:	--

4.4.2.11.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	channel use	integer	1 = All sequence positions 2 = Channel pattern

4.4.2.11.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.3 1000ul Channel commands

4.4.3.1 [GSOEM.0003 : Command 1000ul Channel-> Tip Pick Up (2)]

CommandID:	**2**
Instrument step:	1000ul Channel Tip Pick Up
Command description:	Picks up **tips** from a specified position.
PositionData:	GroupID=**1**: This Command needs positions from which the tips shall be picked up. Note: Giving of more positions than the count of activated channels allows to pick up the next tip if the pick up fails (error-recovery for error 'No tip error' -> Next).
VolumeData:	--

4.4.3.1.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	channel use	integer	1 = All sequence positions 2 = Channel pattern

4.4.3.1.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.3.2 [GSOEM.0004 : Command 1000ul Channel -> Needle Pick Up (3)]

CommandID:	**3**
Instrument step:	1000ul Channel Tip Pick Up
Command description:	Picks up **needles** from a specified position.
PositionData:	GroupID=**1**: This Command needs positions from which the needles shall be picked up.
VolumeData:	--

Note: As difference to the Command 'Tip Pick Up' the error-recovery option 'Next' is not available for the error 'No tip error' to prevent a needle pick up from a closed wash station block.

4.4.3.2.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	channel use	integer	1 = All sequence positions 2 = Channel pattern

4.4.3.2.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.3.3 [GSOEM.0005 : Command 1000ul Channel -> Tip/Needle Eject (4)]

CommandID:	**4**
Instrument step:	1000ul Channel Tip Eject
Command description:	Ejects a tip or needle into a specified position (waste, washer ...).
PositionData:	GroupID=**1**: This Command needs positions to which the tips/needles shall be ejected. If 'use default waste' is set to 'On', no such positions are needed.
VolumeData:	--

4.4.3.3.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	channel use	integer	1 = All sequence positions 2 = Channel pattern (value is ignored if 'use default waste' is set to 'On' -> always 'Channel Pattern' is used)
PI23	indicates whether to use the default waste	integer	0 = Off 1 = On

4.4.3.3.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.3.4 [GSOEM.0006 : Command 1000ul Channel -> Aspirate (5)]

CommandID:	**5**
Instrument step:	1000ul Channel Aspirate
Command description:	Aspirates a fluid from a defined position into a tip or needle.
PositionData:	GroupID=**1**: This Command needs positions from which the fluid shall be aspirated.
VolumeData:	The aspirate volumes shall be given only for the used channels (see channel pattern). For unused channels, no volume entry is interpreted from the list. The channel pattern is interpreted from left to right, the corresponding volumes are evaluated from the begin of the table to the end.

4.4.3.4.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PS02	liquid class	string	
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	channel use	integer	1 = All sequence positions 2 = Channel pattern
PI23	aspirate mode	integer	0 = Aspiration 1 = Consecutive aspiration 2 = Empty cup aspiration
PI24	capacitive liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Middle 4 = Low 5 = From labware definition
PI25	pressure liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Middle 4 = Low 5 = From liquid class definition
PI26	liquid following during aspirate and mix	integer	0 = Off 1 = On
PI27	prerinsing / mix cycles	integer	greater or equal than zero (0=Off).
PI28	touch off	integer	0 = Off 1 = On
PD41	submerge depth after the liquid level detection [mm]	double	no restriction
PD42	liquid height from bottom if liquid level detection is disabled [mm]	double	greater or equal than zero.

Param	Description	Interpreted as	Allowed values
PD43	the maximum difference between the two liquid level detection measurements [mm]	double	greater or equal than zero.
PD44	prerinsing / mix position [mm]	double	greater or equal than zero.
PD45	prerinsing / mix volume [µl]	double	greater or equal than zero.
PD46	retract distance for transport air [mm]	double	greater or equal than zero.
PD47	aspiration position above touch [mm]	double	greater or equal than zero.

4.4.3.4.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel (step data position contains the aspirated volume).

4.4.3.5 [GSOEM.0007 : Command 1000ul Channel -> Dispense (6)]

CommandID:	**6**
Instrument step:	1000ul Channel Dispense
Command description:	Dispenses the fluid in the tip or needle (partial or complete volume) into a defined position.
PositionData:	GroupID=**1**: This Command needs positions to which the fluid shall be dispensed.
VolumeData:	The dispense volumes shall be given only for the used channels (see channel pattern). For unused channels, no volume entry is interpreted from the list. The channel pattern is interpreted from left to right, the corresponding volumes are evaluated from the begin of the table to the end.

4.4.3.5.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PS02	liquid class	string	
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	channel use	integer	1 = All sequence positions 2 = Channel pattern
PI23	dispense mode	integer	0 = Jet mode part volume 1 = Jet mode empty tip 2 = Surface dispense part volume 3 = Surface dispense empty tip 4 = Drain tip in jet mode 8 = From liquid class definition 9 = Blow out tip

Param	Description	Interpreted as	Allowed values
PI24	capacitive liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Middle 4 = Low 5 = From Labware definition
PI25	liquid following during dispense and mix	integer	0 = Off 1 = On
PI26	prerinsing / mix cycles	integer	greater or equal than zero (0=OFF).
PI27	z-move after step	integer	0 = normal 1 = optimized
PI28	touch off	integer	0 = Off 1 = On
PI29	side touch	integer	0 = Off 1 = On
PD41	submerge depth after the liquid level detection [mm]	double	no restriction
PD42	liquid height from bottom if liquid level detection is disabled	double	greater or equal than zero.
PD43	prerinsing / mix position [mm]	double	greater or equal than zero.
PD44	prerinsing / mix volume [µl]	double	greater or equal than zero.
PD45	dispense position above touch [mm]	double	greater or equal than zero.
PD46	retract distance for transport air [mm]	double	greater or equal than zero.

4.4.3.5.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel (step data position contains the dispensed volume).

4.4.3.6 [GSOEM.0086 : Command 1000ul Channel -> Dispense on the Fly (72)]

CommandID:	**72**
Instrument step:	1000ul Channel Dispense on the Fly
Command description:	This step dispenses the fluid in the tip or needle (partial volume) into the defined positions. Before this step can be started, an Aspirate step with a volume greater or equal the sum of all shoots must be called.
PositionData:	GroupID=**1**: This Command needs positions to which the fluid shall be dispensed.
VolumeData:	The dispense volumes shall be given only for the used channels (see channel pattern). For unused channels, no volume entry is interpreted from the list. The channel pattern is interpreted from left to right, the corresponding volumes are evaluated from the begin of the table to the end.

4.4.3.6.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PS02	liquid class	string	
PS03	excluded labware positions	string	Defines wells (labware positions) which shall be excluded (not shoot). Define an empty string to include all wells.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	dispense on the fly mode	integer	0 = Complete plate 1 = Sequence order
PI23	dispense direction	integer	0 = Serpentine 1 = From left only
PD41	labware surface distance [mm]	double	greater or equal than zero
PD42	X-speed during dispense [mm/s]	double	greater or equal than zero
PD43	Start X-offset [mm]	double	greater or equal than zero
PD44	X-acceleration distance [mm]	double	greater or equal than zero

4.4.3.6.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.3.7 [GSOEM.0010 : Command 1000ul Channel -> Wait Needle Washed (9)]

CommandID:	9
Instrument step:	1000ul Channel Wait for Needle Wash
Command description:	Waits until the wash procedure is finished at the defined needle wash module.
PositionData:	--
VolumeData:	--

4.4.3.7.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	wash station name (Labware ID)	string	

4.4.3.7.2 Instrument Results

Result values count:	3
Block data:	Block data: result value 3 contains block data for the wash.

4.4.3.8 [GSOEM.0011 : Command 1000ul Channel -> Start Needle Wash (10)]

CommandID:	**10**
Instrument step:	1000ul Channel Start Needle Wash
Command description:	Starts the wash procedure on the defined needle wash module.
PositionData:	--
VolumeData:	--

4.4.3.8.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	wash station name (Labware ID)	string	
PI21	wash liquid 1: flow rate [ml/s]	integer	greater than or equal to 10 and less than or equal to 18.
PI22	wash liquid 2: flow rate [ml/s]	integer	greater than or equal to 10 and less than or equal to 18.
PI23	start wash liquid	integer	0 = One (red container, 2x3.5 l) 1 = Two (blue container, 3.5 l)
PD41	wash liquid 1: rinse time [s]	double	greater or equal than zero.
PD42	wash liquid 1: soak time [s]	double	greater or equal than zero.
PD43	wash liquid 2: rinse time [s]	double	greater or equal than zero.
PD44	wash liquid 2: soak time [s]	double	greater or equal than zero.
PD45	draining time [s]	double	greater or equal than zero.

4.4.3.8.2 Instrument Results

Result values count:	3
Block data:	Block data: result value 3 contains block data for the wash.

4.4.3.9 [GSOEM.0012 : Command 1000ul Channel -> Get Container Volume (11)]

CommandID:	**11**
Instrument step:	1000ul Channel Aspirate
Command description:	Measures the volume [ml] of the containers(s) specified by the position list. The functions MeasureContainerVolume() and GetContainerVolume() of the library 'HSLML_STARLib.hsl' are used (defined in [8], HSLML_STAR Design).
PositionData:	GroupID=**1**: This Command needs positions from which the container volume shall be calculated.
VolumeData:	--

4.4.3.9.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PI21	sequence counting	integer	0 = Manually 1 = Automatic

Param	Description	Interpreted as	Allowed values
PI22	capacitive liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Middle 4 = Low
PI23	pressure liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Middle 4 = Low
PD41	the maximum difference between the two liquid level detection measurements [mm]	double	greater or equal than zero.

4.4.3.9.2 Instrument Results

Result values count:	3
Block data:	Block data: Result value 3 contains block data for the measurement (step data position contains the measured volume [ml]), the other positions are not used. The value '-1' at the step data position indicates that the channel was not active, the value '0' indicates that the measurement at this position failed.

4.4.3.10 [GSOEM.0053 : Command 1000ul Channel -> Get Last Liquid Level (39)]

CommandID:	**39**
Instrument step:	1000ul Channel Get Last Liquid Level
Command description:	This step returns the height from the liquid level which was read at the last position from each channel. A precise liquid level can only then be returned, if an Aspirate step with liquid level detection switched on has been executed prior to this step.
PositionData:	--
VolumeData:	--

4.4.3.10.1 Parameter Details

Param	Description
--	This Command has no parameters.

4.4.3.10.2 Instrument Results

Result values count:	3
Block data:	Block data: result value 3 contains block data for each channel (step data position contains the actual liquid level).

4.4.4 5ml Channel commands

4.4.4.1 [GSOEM.0067 : Command 5ml Channel-> Tip Pick Up (53)]

CommandID:	**2**
Instrument step:	5ml Channel Tip Pick Up
Command description:	Picks up **tips** from a specified position.
PositionData:	GroupID=**1**: This Command needs positions from which the tips shall be picked up. Note: Giving of more positions than the count of activated channels allows to pick up the next tip if the pick up fails (error-recovery for error 'No tip error' -> Next).
VolumeData:	--

4.4.4.1.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	channel use	integer	1 = All sequence positions 2 = Channel pattern

4.4.4.1.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.4.2 [GSOEM.0068 : Command 5ml Channel -> Tip Eject (54)]

CommandID:	**54**
Instrument step:	5ml Channel Tip Eject
Command description:	Ejects a tip or needle into a specified position (waste, washer ...).
PositionData:	GroupID=**1**: This Command needs positions to which the tips/needles shall be ejected. If 'use default waste' is set to 'On', no such positions are needed.
VolumeData:	--

4.4.4.2.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PI21	sequence counting	integer	0 = Manually 1 = Automatic

Param	Description	Interpreted as	Allowed values
PI22	channel use	integer	1 = All sequence positions 2 = Channel pattern (value is ignored if 'use default waste' is set to 'On' -> always 'Channel Pattern' is used)
PI23	indicates whether to use the default waste	integer	0 = Off 1 = On

4.4.4.2.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.4.3 [GSOEM.0069 : Command 5ml Channel -> Aspirate (55)]

CommandID:	**55**
Instrument step:	5ml Channel Aspirate
Command description:	Aspirates a fluid from a defined position into a tip or needle.
PositionData:	GroupID=**1**: This Command needs positions from which the fluid shall be aspirated.
VolumeData:	The aspirate volumes shall be given only for the used channels (see channel pattern). For unused channels, no volume entry is interpreted from the list. The channel pattern is interpreted from left to right, the corresponding volumes are evaluated from the begin of the table to the end.

4.4.4.3.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PS02	liquid class	string	
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	channel use	integer	1 = All sequence positions 2 = Channel pattern
PI23	aspirate mode	integer	0 = Aspiration 1 = Consecutive aspiration 2 = Empty cup aspiration
PI24	capacitive liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Middle 4 = Low 5 = From labware definition

Param	Description	Interpreted as	Allowed values
PI25	pressure liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Middle 4 = Low 5 = From liquid class definition
PI26	liquid following during aspirate and mix	integer	0 = Off 1 = On
PI27	prerinsing / mix cycles	integer	greater or equal than zero (0=Off).
PI28	prerinsing / mix cycles	integer	greater or equal than zero (0=Off).
PD41	submerge depth after the liquid level detection [mm]	double	no restriction
PD42	liquid height from bottom if liquid level detection is disabled [mm]	double	greater or equal than zero.
PD43	the maximum difference between the two liquid level detection measurements [mm]	double	greater or equal than zero.
PD44	prerinsing / mix position [mm]	double	greater or equal than zero.
PD45	prerinsing / mix volume [µl]	double	greater or equal than zero.
PD46	retract distance for transport air [mm]	double	greater or equal than zero.
PD47	aspiration position above touch [mm]	double	greater or equal than zero.

4.4.4.3.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel (step data position contains the aspirated volume).

4.4.4.4 [GSOEM.0070 : Command 5ml Channel -> Dispense (56)]

CommandID:	**56**
Instrument step:	5ml Channel Dispense
Command description:	Dispenses the fluid in the tip or needle (partial or complete volume) into a defined position.
PositionData:	GroupID=**1**: This Command needs positions to which the fluid shall be dispensed.
VolumeData:	The dispense volumes shall be given only for the used channels (see channel pattern). For unused channels, no volume entry is interpreted from the list. The channel pattern is interpreted from left to right, the corresponding volumes are evaluated from the begin of the table to the end.

4.4.4.4.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PS02	liquid class	string	
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	channel use	integer	1 = All sequence positions 2 = Channel pattern
PI23	dispense mode	integer	0 = Jet mode part volume 1 = Jet mode empty tip 2 = Surface dispense part volume 3 = Surface dispense empty tip 4 = Drain tip in jet mode 8 = From liquid class definition 9 = Blow out tip
PI24	capacitive liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Middle 4 = Low 5 = From Labware definition
PI25	liquid following during dispense and mix	integer	0 = Off 1 = On
PI26	prerinsing / mix cycles	integer	greater or equal than zero (0=OFF).
PI27	z-move after step	integer	0 = normal 1 = optimized
PI28	touch off	integer	0 = Off 1 = On
PI29	side touch	integer	0 = Off 1 = On
PD41	submerge depth after the liquid level detection [mm]	double	no restriction
PD42	liquid height from bottom if liquid level detection is disabled	double	greater or equal than zero.
PD43	prerinsing / mix position [mm]	double	greater or equal than zero.
PD44	prerinsing / mix volume [µl]	double	greater or equal than zero.
PD45	dispense position above touch [mm]	double	greater or equal than zero.
PD46	retract distance for transport air [mm]	double	greater or equal than zero.

4.4.4.4.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel (step data position contains the dispensed volume).

4.4.4.5 [GSOEM.0087 : Command 5ml Channel -> Dispense on the Fly (73)]

CommandID:	**73**
Instrument step:	5ml Channel Dispense on the Fly
Command description:	This step dispenses the fluid in the tip or needle (partial volume) into the defined positions. Before this step can be started, an Aspirate step with a volume greater or equal the sum of all shoots must be called.
PositionData:	GroupID=**1**: This Command needs positions to which the fluid shall be dispensed.
VolumeData:	The dispense volumes shall be given only for the used channels (see channel pattern). For unused channels, no volume entry is interpreted from the list. The channel pattern is interpreted from left to right, the corresponding volumes are evaluated from the begin of the table to the end.

4.4.4.5.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	The channel pattern shall consist to the number of channels on the instrument. Use a '0' for an unused channel, a '1' for a used one. Example: '11110011'.
PS02	liquid class	string	
PS03	excluded labware positions	string	Defines wells (labware positions) which shall be excluded (not shoot). Define an empty string to include all wells.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	dispense on the fly mode	integer	0 = Complete plate 1 = Sequence order
PI23	dispense direction	integer	0 = Serpentine 1 = From left only
PD41	labware surface distance [mm]	double	greater or equal than zero
PD42	X-speed during dispense [mm/s]	double	greater or equal than zero
PD43	Start X-offset [mm]	double	greater or equal than zero
PD44	X-acceleration distance [mm]	double	greater or equal than zero

4.4.4.5.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.4.6 [GSOEM.0071 : Command 5ml Channel -> Get Last Liquid Level (57)]

CommandID:	**57**
Instrument step:	5ml Channel Get Last Liquid Level
Command description:	This step returns the height from the liquid level which was read at the last position from each channel. A precise liquid level can only then be returned, if an Aspirate step with liquid level detection switched on has been executed prior to this step.
PositionData:	--
VolumeData:	--

4.4.4.6.1 Parameter Details

Param	Description
--	This Command has no parameters.

4.4.4.6.2 Instrument Results

Result values count:	3
Block data:	Block data: result value 3 contains block data for each channel (step data position contains the actual liquid level).

4.4.5 iSWAP commands

4.4.5.1 [GSOEM.0017 : Command iSWAP -> Get Plate (12)]

CommandID:	**12**
Instrument step:	iSWAP, Get Plate
Command description:	This command gets the first labware item from the specified element(s) in the position list.
PositionData:	GroupID=**1**: Defines the labware item of the **plate** to transport. If '`transport mode`' is set to 'lid only', no such elements are needed. GroupID=**2**: Defines the labware item of the **lid** to transport. If '`transport mode`' is set to 'plate only', no such positions are needed.
VolumeData:	--

4.4.5.1.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	movement type	integer	0 = To carrier 1 = Complex movement
PI23	transport mode	integer	0 = Plate only 1 = Lid only 2 = Plate with lid
PI24	labware orientation (only used if '`movement type`' is set to 'complex movement')	integer	1 = Labware orientation 1 2 = Labware orientation 2 3 = Labware orientation 3 4 = Labware orientation 4
PI25	grip force	integer	2 (minimum) ... 9 (maximum)

Param	Description	Interpreted as	Allowed values
PI26	inverse grip	integer	0 = Off 1 = On
PI27	collision control	integer	0 = Off 1 = On
PI28	grip mode	integer	0 = Small side 1 = Large side
PD41	retract distance [mm] (only used if '`movement type`' is set to 'complex movement')	double	greater or equal than zero.
PD42	lift-up height [mm] (only used if '`movement type`' is set to 'complex movement')	double	greater or equal than zero.
PD43	grip width [mm]	double	greater or equal than zero.
PD44	tolerance [mm]	double	greater or equal than zero.
PD45	grip height [mm]	double	greater or equal than zero.
PD46	width before [mm]	double	greater or equal than zero.

4.4.5.1.2 Restriction for the command result data (used elements)

Restriction to the definition in 4.4.1.1, Command result data:

Even if the '`transport mode`' is set to 'Plate with lid' the ResultNo 1 contains the number of elements used from the plate elements (plate elements used priority).

4.4.5.1.3 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the iSWAP.

4.4.5.2 [GSOEM.0018 : Command iSWAP -> Place Plate (13)]

CommandID:	**13**
Instrument step:	iSWAP, Place Plate
Command description:	This command places a labware item to the first labware item specified by the element(s) in the position list.
PositionData:	GroupID=**1**: Defines the labware item of the **plate** to transport. If '`transport mode`' is set to 'lid only', no such positions are needed. GroupID=**2**: Defines the labware item of the **lid** to transport. If '`transport mode`' is set to 'plate only', no such positions are needed.
VolumeData:	--

4.4.5.2.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	movement type	integer	0 = To carrier 1 = Complex movement
PI23	transport mode	integer	0 = Plate only 1 = Lid only 2 = Plate with lid
PI24	labware orientation (only used if '`movement type`' is set to 'complex movement')	integer	1 = Labware orientation 1 2 = Labware orientation 2 3 = Labware orientation 3 4 = Labware orientation 4
PI25	collision control	integer	0 = Off 1 = On
PD41	retract distance [mm] (only used if '`movement type`' is set to 'complex movement')	double	greater or equal than zero.
PD42	lift-up height [mm] (only used if '`movement type`' is set to 'complex movement')	double	greater or equal than zero.

4.4.5.2.2 Restriction for the command result data (used elements)

Restriction to the definition in 4.4.1.1, Command result data:

Even if the '`transport mode`' is set to 'Plate with lid' the ResultNo 1 contains the number of elements used from the plate elements (plate elements used priority).

4.4.5.2.3 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the iSWAP.

4.4.5.3 [GSOEM.0019 : Command iSWAP -> Move Plate (14)]

CommandID:	**14**
Instrument step:	iSWAP, Move Plate
Command description:	This command moves the iSWAP to the position of the first labware item specified by the element(s) in the position list.
PositionData:	GroupID=**1**: Defines the labware item of the destination to move.
VolumeData:	--

4.4.5.3.1 Parameter Details

Param	Description		
PI21	collision control	integer	0 = Off 1 = On
PI22	grip mode	integer	0 = Small side 1 = Large side

4.4.5.3.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the iSWAP.

4.4.5.4 [GSOEM.0020 : Command iSWAP -> Open Gripper (15)]

CommandID:	**15**
Instrument step:	iSWAP, Open Gripper
Command description:	This command opens the clamps of iSWAP at the current gripper position.
PositionData:	GroupID=**1**: Defines the labware item of the **plate** which should be released (open its clamps) by the iSWAP. If '`transport mode`' is set to 'lid only', no such positions are needed. GroupID=**2**: Defines the labware item of the **lid** which should be released (open its clamps) by the iSWAP. If '`transport mode`' is set to 'plate only', no such positions are needed.
VolumeData:	--

4.4.5.4.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	transport mode	integer	0 = Plate only 1 = Lid only 2 = Plate with lid
PI23	grip mode	integer	0 = Small side 1 = Large side
PD41	opening width [mm]	double	greater or equal than zero.

4.4.5.4.2 Restriction for the command result data (used elements)

Restriction to the definition in 4.4.1.1, Command result data:

Even if the '`transport mode`' is set to 'Plate with lid' the ResultNo 1 contains the number of elements used from the plate elements (plate elements used priority).

4.4.5.4.3 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the iSWAP.

4.4.5.5 [GSOEM.0021 : Command iSWAP -> Close Gripper (16)]

CommandID:	**16**
Instrument step:	iSWAP, Close Gripper
Command description:	This command closes the clamps of iSWAP at the current gripper position
PositionData:	GroupID=**1**: Defines the labware item of the **plate** which should be gripped (close its clamps) by the iSWAP. If '`transport mode`' is set to 'lid only', no such positions are needed. GroupID=**2**: Defines the labware item of the **lid** which should be gripped (close its clamps) by the iSWAP. If '`transport mode`' is set to 'plate only', no such positions are needed.
VolumeData:	--

4.4.5.5.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	transport mode	integer	0 = Plate only 1 = Lid only 2 = Plate with lid
PI23	grip force	integer	2 (minimum) ... 9 (maximum)
PI24	grip mode	integer	0 = Small side 1 = Large side
PD41	grip width [mm]	double	greater or equal than zero.
PD42	tolerance [mm]	double	greater or equal than zero.
PD43	grip height [mm]	double	greater or equal than zero.

4.4.5.5.2 Restriction for the command result data (used elements)

Restriction to the definition in 4.4.1.1, Command result data:

Even if the '`transport mode`' is set to 'Plate with lid' the ResultNo 1 contains the number of elements used from the plate elements (plate elements used priority).

4.4.5.5.3 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the iSWAP.

4.4.5.6 [GSOEM.0022 : Command iSWAP -> Read Plate Barcode(17)]

CommandID:	**17**
Instrument step:	iSWAP, Read Plate Barcode
Command description:	This command reads a plate barcode with barcode reader of auto load.
PositionData:	--
VolumeData:	--

4.4.5.6.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	barcode reader position	integer	8 (left most position) ... 54
PI22	collision control	integer	0 = Off 1 = On
PD41	minimal Z-position during read [mm]	double	greater or equal than zero.
PD42	Y-position during read [mm]	double	greater or equal than zero.

4.4.5.6.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the iSWAP. Result value 4 contains the plate barcode as string.

4.4.5.7 [GSOEM.0023 : Command iSWAP -> Get First Plate Position (18)]

CommandID:	**18**
Instrument step:	iSWAP, Get First Plate Position
Command description:	This command search the first labware (plate) within the specified element(s) in the position list.
PositionData:	GroupID=**1**: Defines labware items on which the first **existing plate** is searched.
VolumeData:	--

4.4.5.7.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	grip force	integer	2 (minimum) ... 9 (maximum)
PI23	inverse grip	integer	0 = Off 1 = On
PI24	collision control	integer	0 = Off 1 = On
PI25	grip mode	integer	0 = Small side 1 = Large side
PD41	grip width [mm]	double	greater or equal than zero.
PD42	tolerance [mm]	double	greater or equal than zero.
PD43	grip height [mm]	double	greater or equal than zero.
PD44	width before [mm]	double	greater or equal than zero.

4.4.5.7.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the iSWAP. Result value 4 contains the name of the first labware found, if result value 4 is empty, no plate was found.

4.4.5.8 [GSOEM.0024 : Command iSWAP -> Park (19)]

CommandID:	**19**
Instrument step:	iSWAP, Park
Command description:	This command moves the iSWAP to the park position.
PositionData:	--
VolumeData:	--

4.4.5.8.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	show collision check dialog	integer	0 = No 1 = Yes

4.4.5.8.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the iSWAP.

4.4.6 CO-RE 96 Head commands

4.4.6.1 [GSOEM.0032 : Command CO-RE 96 Head -> Tip Pick Up (27)]

CommandID:	**27**
Instrument step:	*CO-RE 96 Head* -> Tip Pick Up
Command description:	This step picks tips or needles up from specified positions with the CO-RE 96 head.
PositionData:	GroupID=**1**: This Command needs 96 positions of same labware from which the tips/needles shall be picked up. The passed positions must be ordered as specified in the help for the HxGruCommand (*CO-RE 96 Head Pattern mode limitations)*. Additionally to the passed positions the 'start position' (**PI21**) must be defined.
VolumeData:	--

4.4.6.1.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	Variable for the channel selection. The content of this variable must be '1' or '0' for each used or unused head position. Example: '1110011011100111111...': the variable must contain 96 positions with '0' or '1'.
PI21	start position	integer	Greater than zero and less than or equal to the count of positions passed in PositionData. Defines the position at which this step pick up tips/needles. - If the 'reduced pattern mode' is set to 'All (0)' the start position is mostly set to 1. - If the 'reduced pattern mode' differs from 'All (0)' the start position defines at which position/row/column the tips/needles should be picked up.
PI22	sequence counting	integer	0 = Manually 1 = Automatic
PI23	reduced pattern mode	integer	0 = All (not reduced) 1 = One channel 2 = One row 3 = One column **Warning!** If a mode other than **0 (All)** is selected, please read *CO-RE 96 Head Pattern mode limitations* about the risks and limitations in the help for the HxGruCommand.

4.4.6.1.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the head.
	Result value 4 contains data for each head position.

4.4.6.2 [GSOEM.0033 : Command CO-RE 96 Head -> Tip Eject (28)]

CommandID:	**28**
Instrument step:	*CO-RE 96 Head* -> Tip Eject
Command description:	This step ejects the tips or needles into a specified position or back to the 'pick up position' with the CO-RE 96 head.
PositionData:	GroupID=**1**: This Command needs 96 positions of same labware to which the tips/needles shall be ejected. The passed positions must be ordered as specified in the help for the HxGruCommand (*CO-RE 96 Head Pattern mode limitations)*. Additionally to the passed positions the 'start position' (**PI21**) must be defined. Note: If 'tip eject setting' is set to '1' or '2', no such positions are needed.
VolumeData:	--

4.4.6.2.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	start position	integer	Greater than zero and less than or equal to the count of positions passed in PositionData. Defines the position at which this step eject tips/needles. - If the 'reduced pattern mode' in the tip pick up was set to 'All (0)' the start position is mostly set to 1. - If the 'reduced pattern mode' in the tip pick up was different from 'All (0)' the start position defines at which position/row/column the tips/needles should be ejected. Note: If 'tip eject setting' is set to '1' or '2', the 'start position' is ignored.
PI22	sequence counting	integer	0 = Manually 1 = Automatic
PI23	tip eject setting	integer	0 = Eject on passed positions 1 = Eject on tip pick up position 2 = Eject on default waste

4.4.6.2.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the head.
	Result value 4 contains data for each head position.

4.4.6.3 [GSOEM.0034 : Command CO-RE 96 Head -> Aspirate (29)]

CommandID:	**29**
Instrument step:	*CO-RE 96 Head* -> Aspirate
Command description:	This step aspirates fluid with the CO-RE 96 head from defined positions (plate) into the picked up tips or needles.
PositionData:	GroupID=**1**: This Command needs 96 positions of same labware from which the fluid shall be aspirated. The passed positions must be ordered as specified in the help for the HxGruCommand (*CO-RE 96 Head Pattern mode limitations)*. Additionally to the passed positions the 'start position' (**PI21**) must be defined.
VolumeData:	Only *one volume* for all 96 channels supported. Therefore the volume must be passed by the parameter **PD41** and *not* by the VolumeData

4.4.6.3.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	liquid class	string	
PI21	start position	integer	Greater than zero and less than or equal to the count of positions passed in PositionData. Defines the position at which this step aspirates. - If the 'reduced pattern mode' in the tip pick up was set to 'All (0)' the start position is mostly set to 1. - If the 'reduced pattern mode' in the tip pick up was different from 'All (0)' the start position defines at which position/row/column the aspirate should be done.
PI22	sequence counting	integer	0 = Manually 1 = Automatic
PI23	aspirate mode	integer	0 = Aspiration 1 = Consecutive aspiration 2 = Aspirate all
PI24	capacitive liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Medium 4 = Low 5 = From labware definition
PI25	liquid following during aspirate and mix	integer	0 = Off 1 = On
PI26	prerinsing / mix cycles	integer	greater or equal than zero (0=Off).
PD41	aspirate volume	double	greater or equal than zero.
PD42	submerge depth after the liquid level detection [mm]	double	no restriction
PD43	liquid height from bottom if liquid level detection is disabled [mm]	double	greater or equal than zero.

Param	Description	Interpreted as	Allowed values
PD44	prerinsing / mix position [mm]	double	greater or equal than zero.
PD45	prerinsing / mix volume [µl]	double	greater or equal than zero.
PD46	retract distance for transport air [mm]	double	greater or equal than zero.

4.4.6.3.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the head.
	Result value 4 contains data for each head position.

4.4.6.4 [GSOEM.0035 : Command CO-RE 96 Head -> Dispense (30)]

CommandID:	**30**
Instrument step:	*CO-RE 96 Head* -> Dispense
Command description:	This step dispenses the fluid with the CO-RE 96 head from the tips or needles (partial or complete volume) into the defined plate positions.
PositionData:	GroupID=**1**: This Command needs 96 positions of same labware where the fluid shall be dispensed. The passed positions must be ordered as specified in the help for the HxGruCommand (*CO-RE 96 Head Pattern mode limitations)*. Additionally to the passed positions the 'start position' (**PI21**) must be defined.
VolumeData:	Only *one volume* for all 96 channels supported. Therefore the volume must be passed by the parameter **PD41** and *not* by the VolumeData

4.4.6.4.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	liquid class	string	
PI21	start position	integer	Greater than zero and less than or equal to the count of positions passed in PositionData. Defines the position at which this step dispenses. - If the 'reduced pattern mode' in the tip pick up was set to 'All (0)' the start position is mostly set to 1. - If the 'reduced pattern mode' in the tip pick up was different from 'All (0)' the start position defines at which position/row/column the dispense should be done.
PI22	sequence counting	integer	0 = Manually 1 = Automatic

Param	Description	Interpreted as	Allowed values
PI23	dispense mode	integer	0 = Jet mode part volume 1 = Jet mode empty tip 2 = Surface dispense part volume 3 = Surface dispense empty tip 4 = Drain tip in jet mode 8 = From liquid class 9 = Blow out tip
PI24	capacitive liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Middle 4 = Low 5 = From labware definition
PI25	liquid following during dispense and mix	integer	0 = Off 1 = On
PI26	prerinsing / mix cycles	integer	greater or equal than zero (0=OFF).
PI27	z-move after step	integer	0 = normal 1 = optimized
PI28	side touch	integer	0 = Off 1 = On
PD41	dispense volume	double	greater or equal than zero.
PD42	submerge depth after the liquid level detection [mm]	double	no restriction
PD43	liquid height from bottom if liquid level detection is disabled	double	greater or equal than zero.
PD44	prerinsing / mix position [mm]	double	greater or equal than zero.
PD45	prerinsing / mix volume [µl]	double	greater or equal than zero.
PD46	retract distance for transport air [mm]	double	greater or equal than zero.

4.4.6.4.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the head.
	Result value 4 contains data for each head position.

4.4.6.5 [GSOEM.0036 : Command CO-RE 96 Head -> Wash (31)]

CommandID:	**31**
Instrument step:	*CO-RE 96 Head* -> Wash
Command description:	This step start the wash functionality of tip wash with CO-RE 96 Head and CO-RE 96 Head washer (single and dual chamber wash station).
PositionData:	--
VolumeData:	--

4.4.6.5.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	wash cycles (wash station)	integer	greater than zero.
PI22	start wash chamber	integer	1 = Chamber one 2 = Chamber two
	Chamber ONE:		
PI23	liquid following	integer	0 = Off 1 = On
PI24	wash cycles (head)	integer	greater than zero.
PI25	refill after wash	integer	0 = Drain chamber 1 = Refill chamber 2 = Use existing liquid for next wash
PI26	wash liquid	integer	1 = One (red container) 2 = Two (blue container)
PI27	liquid change	integer	0 = No 1 = Yes
	Chamber TWO:		
PI28	liquid following	integer	0 = Off 1 = On
PI29	wash cycles (head)	integer	greater than zero.
PI30	refill after wash	integer	0 = Drain chamber 1 = Refill chamber 2 = Use existing liquid for next wash
PI31	wash liquid	integer	1 = One (red container) 2 = Two (blue container)
PI32	liquid change	integer	0 = No 1 = Yes
	Chamber ONE:		
PD41	wash/mix volume [µl]	double	greater or equal than zero.
PD42	submerge depth [mm]	double	greater than zero.
	Chamber TWO:		
PD43	wash/mix volume [µl]	double	greater or equal than zero.
PD44	submerge depth [mm]	double	greater than zero.

4.4.6.5.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the head washer.

4.4.6.6 [GSOEM.0037 : Command CO-RE 96 Head -> Empty Washer (32)]

CommandID:	**32**
Instrument step:	*CO-RE 96 Head* -> Empty Washer
Command description:	This step empties the liquid in CO-RE 96 Head Washer (single and dual chamber wash station).
PositionData:	--
VolumeData:	--

4.4.6.6.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	refill after empty	integer	0 = Off 1 = On
	Chamber ONE:		
PI22	wash liquid	integer	1 = One (red container) 2 = Two (blue container)
PI23	liquid change	integer	0 = No 1 = Yes
	Chamber TWO:		
PI24	wash liquid	integer	1 = One (red container) 2 = Two (blue container)
PI25	liquid change	integer	0 = No 1 = Yes

4.4.6.6.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the head washer.

4.4.7 CO-RE 384 Head commands

4.4.7.1 [GSOEM.0055 : Command CO-RE 384 Head -> Tip Pick Up (41)]

CommandID:	**41**
Instrument step:	CO-RE 384 Head -> Tip Pick Up
Command description:	This step picks tips or needles up from specified positions with the CO-RE 384 head.
PositionData:	GroupID=**1**: This command needs positions from which the tips/needles shall be picked up. Required order/count depends of the pattern mode.
VolumeData:	--

4.4.7.1.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	head pattern	string	Head pattern variable must contain 0 or 1 for each channel/column.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	tip mode	integer	0 = All 1 = 96 Tips / Rocket Tips 3 = Tip lifter column(s)
PI23	pick up from tip lifter	integer	0 = Off 1 = One column 2 = Two columns 3 = All remaining tips

Param	Description	Interpreted as	Allowed values
PI24	head pattern as variable	integer	0 = Off 1 = Column pattern 2 = 384 manual pattern 3 = 96 manual pattern 4 = Row pattern
PI25	reduced pattern mode	integer	0 = All 1 = One channel 2 = Quarter 3 = Row(s) 4 = Column(s)

4.4.7.1.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the head.
	Result value 4 contains data for each head position.

4.4.7.2 [GSOEM.0056 : Command CO-RE 384 Head -> Tip Eject (42)]

CommandID:	**42**
Instrument step:	*CO-RE 384 Head* -> Tip Eject
Command description:	This step ejects the tips or needles into a specified position or back to the 'pick up position' with the CO-RE 384 head.
PositionData:	GroupID=**1**: This Command needs 384 positions of same labware to which the tips/needles shall be ejected. Note: If 'tip eject setting' is set to '1' or '2', no such positions are needed.
VolumeData:	--

4.4.7.2.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	Eject on known position	integer	0 = Off 1 = Eject on tip pick up position 2 = Eject on default waste

4.4.7.2.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the head.
	Result value 4 contains data for each head position.

4.4.7.3 [GSOEM.0057 : Command CO-RE 384 Head -> Aspirate (43)]

CommandID:	**43**
Instrument step:	*CO-RE 384 Head ->* Aspirate
Command description:	This step aspirates fluid with the CO-RE 384 head from defined positions (plate) into the picked up tips or needles.
PositionData:	GroupID=**1**: This command needs positions from which the fluid shall be aspirated. Required order/count depends of the pattern mode.
VolumeData:	Only *one volume* for all 384 channels supported. Therefore the volume must be passed by the parameter **PD41** and *not* by the VolumeData

4.4.7.3.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	liquid class	string	
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	aspirate mode	integer	0 = Aspiration 1 = Consecutive aspiration 2 = Aspirate all
PI23	capacitive liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Medium 4 = Low 5 = From labware definition
PI24	liquid following during aspirate and mix	integer	0 = Off 1 = On
PI25	prerinsing / mix cycles	integer	greater or equal than zero (0=Off).
PD41	aspirate volume	double	greater or equal than zero.
PD42	submerge depth after the liquid level detection [mm]	double	no restriction
PD43	liquid height from bottom if liquid level detection is disabled [mm]	double	greater or equal than zero.
PD44	prerinsing / mix position [mm]	double	greater or equal than zero.
PD45	prerinsing / mix volume [µl]	double	greater or equal than zero.
PD46	retract distance for transport air [mm]	double	greater or equal than zero.

4.4.7.3.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the head.
	Result value 4 contains data for each head position.

4.4.7.4 [GSOEM.0058 : Command CO-RE 384 Head -> Dispense (44)]

CommandID:	**44**
Instrument step:	*CO-RE 384 Head* -> Dispense
Command description:	This step dispenses the fluid from the tips or needles with the CO-RE 384 head (partial or complete volume) into the defined plate positions.
PositionData:	GroupID=**1**: This command needs positions to which the fluid shall be dispensed. Required order/count depends of the pattern mode.
VolumeData:	Only *one volume* for all 384 channels supported. Therefore the volume must be passed by the parameter **PD41** and *not* by the VolumeData

4.4.7.4.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	liquid class	string	
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	dispense mode	integer	0 = Jet mode part volume 1 = Jet mode empty tip 2 = Surface dispense part volume 3 = Surface dispense empty tip 4 = Drain tip in jet mode 8 = From liquid class 9 = Blow out tip
PI23	capacitive liquid level detection	integer	0 = Off 1 = Very high 2 = High 3 = Middle 4 = Low 5 = From labware definition
PI24	liquid following during dispense and mix	integer	0 = Off 1 = On
PI25	prerinsing / mix cycles	integer	greater or equal than zero (0=OFF).
PI26	z-move after step	integer	0 = normal 1 = optimized
PI27	side touch	integer	0 = Off 1 = On
PD41	dispense volume	double	greater or equal than zero.
PD42	submerge depth after the liquid level detection [mm]	double	no restriction
PD43	liquid height from bottom if liquid level detection is disabled	double	greater or equal than zero.
PD44	prerinsing / mix position [mm]	double	greater or equal than zero.
PD45	prerinsing / mix volume [µl]	double	greater or equal than zero.
PD46	retract distance for transport air [mm]	double	greater or equal than zero.

4.4.7.4.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the head.
	Result value 4 contains data for each head position.

4.4.7.5 [GSOEM.0059 : Command CO-RE 384 Head -> Wash (45)]

CommandID:	**45**
Instrument step:	*CO-RE 384 Head* -> Wash
Command description:	This step start the wash functionality of tip wash with CO-RE 384 Head and CO-RE 384 Head washer (dual chamber wash station).
PositionData:	--
VolumeData:	--

4.4.7.5.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	wash cycles (wash station)	integer	greater than zero.
PI22	start wash chamber	integer	1 = Chamber one 2 = Chamber two
	Chamber ONE:		
PI23	liquid following	integer	0 = Off 1 = On
PI24	wash cycles (head)	integer	greater than zero.
PI25	refill after wash	integer	0 = Drain chamber 1 = Refill chamber 2 = Use existing liquid for next wash
PI26	wash liquid	integer	1 = One (red container) 2 = Two (blue container)
PI27	liquid change	integer	0 = No 1 = Yes
	Chamber TWO:		
PI28	liquid following	integer	0 = Off 1 = On
PI29	wash cycles (head)	integer	greater than zero.
PI30	refill after wash	integer	0 = Drain chamber 1 = Refill chamber 2 = Use existing liquid for next wash
PI31	wash liquid	integer	1 = One (red container) 2 = Two (blue container)
PI32	liquid change	integer	0 = No 1 = Yes
	Chamber ONE:		
PD41	wash/mix volume [µl]	double	greater or equal than zero.
PD42	submerge depth [mm]	double	greater than zero.
	Chamber TWO:		
PD43	wash/mix volume [µl]	double	greater or equal than zero.
PD44	submerge depth [mm]	double	greater than zero.

4.4.7.5.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the head washer.

4.4.7.6 [GSOEM.0060 : Command CO-RE 384 Head -> Empty Washer (46)]

CommandID:	**46**
Instrument step:	*CO-RE 384 Head* -> Empty Washer
Command description:	This step empties the liquid in CO-RE 384 Head Washer (dual chamber wash station).
PositionData:	--
VolumeData:	--

4.4.7.6.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	refill after empty	integer	0 = Off 1 = On
	Chamber ONE:		
PI22	wash liquid	integer	1 = One (red container) 2 = Two (blue container)
PI23	liquid change	integer	0 = No 1 = Yes
	Chamber TWO:		
PI24	wash liquid	integer	1 = One (red container) 2 = Two (blue container)
PI25	liquid change	integer	0 = No 1 = Yes

4.4.7.6.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the head washer.

4.4.8 1000ul Channel CO-RE Grip commands

4.4.8.1 [GSOEM.0038 : Command 1000ul Channel CO-RE Grip -> Get Plate (33)]

CommandID:	**33**
Instrument step:	1000ul Channel CO-RE Grip, Get Plate
Command description:	This command gets the first labware item from the specified element(s) in the position list.
PositionData:	GroupID=**1**: Defines the labware item of the **plate** to transport. If '`transport mode`' is set to 'lid only', no such elements are needed. GroupID=**2**: Defines the labware item of the **lid** to transport. If '`transport mode`' is set to 'plate only', no such positions are needed. GroupID=**3**: Defines the position of the **gripper tool** to be used for transport the plate/lid. The tool is only picked up once by the instrument, but the position of the gripper tool must be defined each time this command is used.
VolumeData:	--

4.4.8.1.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	transport mode	integer	0 = Plate only 1 = Lid only 2 = Plate with lid
PI23	grip force	integer	2 (minimum) ... 9 (maximum)
PI24	gripper tool channel	integer	2 ... count of channels installed on the instrument.
PI25	check plate	integer	0 = Off 1 = On
PD41	grip width [mm]	double	greater or equal than zero.
PD42	grip height [mm]	double	greater or equal than zero.
PD43	width before [mm]	double	greater or equal than zero.
PD44	grip speed [mm/s]	double	greater or equal than zero.
PD45	Z-speed [mm/s]	double	greater or equal than zero.

4.4.8.1.2 Restriction for the command result data (used elements)

Restriction to the definition in 4.4.1.1, Command result data:

Even if the '`transport mode`' is set to 'Plate with lid' the ResultNo 1 contains the number of elements used from the plate elements (plate elements used priority).

4.4.8.1.3 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the CO-RE Grip.

4.4.8.2 [GSOEM.0039 : Command 1000ul Channel CO-RE Grip -> Place Plate (34)]

CommandID:	**34**
Instrument step:	1000ul Channel CO-RE Grip, Place Plate
Command description:	This command places a labware item to the first labware item specified by the element(s) in the position list.
PositionData:	GroupID=**1**: Defines the labware item of the **plate** to transport. If '`transport mode`' is set to 'lid only', no such positions are needed. GroupID=**2**: Defines the labware item of the **lid** to transport. If '`transport mode`' is set to 'plate only', no such positions are needed.
VolumeData:	--

4.4.8.2.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	transport mode	integer	0 = Plate only 1 = Lid only 2 = Plate with lid
PI23	eject tool when finished	integer	0 = No 1 = Yes
PI24	X acceleration	integer	1 (slow) … 5 (very fast)
PI25	check plate	integer	0 = Off 1 = On
PD41	Z-speed [mm/s]	double	greater or equal than zero.
PD42	plate press on distance [mm]	double	greater or equal than zero.

4.4.8.2.2 Restriction for the command result data (used elements)

Restriction to the definition in 4.4.1.1, Command result data:

Even if the '`transport mode`' is set to 'Plate with lid' the ResultNo 1 contains the number of elements used from the plate elements (plate elements used priority).

4.4.8.2.3 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the CO-RE Grip.

4.4.8.3 [GSOEM.0040 : Command 1000ul Channel CO-RE Grip -> Move Plate (35)]

CommandID:	**35**
Instrument step:	1000ul Channel CO-RE Grip, Move Plate
Command description:	This command moves the CO-RE Grip to the position of the first labware item specified by the element(s) in the position list.
PositionData:	GroupID=**1**: Defines the labware item of the destination to move.
VolumeData:	--

4.4.8.3.1 Parameter Details

Param	Description		
PI21	X acceleration	integer	1 (slow) … 5 (very fast)

4.4.8.3.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the CO-RE Grip.

4.4.8.4 [GSOEM.0041 : Command 1000ul Channel CO-RE Grip -> Read Plate Barcode (36)]

CommandID:	**36**
Instrument step:	1000ul Channel CO-RE Grip, Read Plate Barcode
Command description:	This command reads a plate barcode with barcode reader of auto load.
PositionData:	--
VolumeData:	--

4.4.8.4.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	barcode reader position	integer	8 (left most position) ... 54
PD42	minimal Z-position during read [mm]	double	greater or equal than zero.

4.4.8.4.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the CO-RE Grip. Result value 4 contains the plate barcode as string.

4.4.9 5ml Channel CO-RE Grip commands

4.4.9.1 [GSOEM.0073 : Command 5ml Channel CO-RE Grip -> Get Plate (59)]

CommandID:	**59**
Instrument step:	5ml Channel CO-RE Grip, Get Plate
Command description:	This command gets the first labware item from the specified element(s) in the position list.
PositionData:	GroupID=**1**: Defines the labware item of the **plate** to transport. If '`transport mode`' is set to 'lid only', no such elements are needed. GroupID=**2**: Defines the labware item of the **lid** to transport. If '`transport mode`' is set to 'plate only', no such positions are needed. GroupID=**3**: Defines the postion of the **gripper tool** to be used for transport the plate/lid. The tool is only picked up once by the instrument, but the position of the gripper tool must be defined each time this command is used.
VolumeData:	--

4.4.9.1.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	transport mode	integer	0 = Plate only 1 = Lid only 2 = Plate with lid
PI23	grip force	integer	2 (minimum) ... 9 (maximum)
PI24	gripper tool channel	integer	2 ... count of channels installed on the instrument.
PI25	check plate	integer	0 = Off 1 = On

Param	Description	Interpreted as	Allowed values
PD41	grip width [mm]	double	greater or equal than zero.
PD42	grip height [mm]	double	greater or equal than zero.
PD43	width before [mm]	double	greater or equal than zero.
PD44	gripSpeed [mm/s]	double	greater or equal than zero.
PD45	Zspeed [mm/s]	double	greater or equal than zero.

4.4.9.1.2 Restriction for the command result data (used elements)

Restriction to the definition in 4.4.1.1, Command result data:

Even if the '`transport mode`' is set to 'Plate with lid' the ResultNo 1 contains the number of elements used from the plate elements (plate elements used priority).

4.4.9.1.3 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the CO-RE Grip.

4.4.9.2 [GSOEM.0074 : Command 5ml Channel CO-RE Grip -> Place Plate (60)]

CommandID:	**60**
Instrument step:	5ml Channel CO-RE Grip, Place Plate
Command description:	This command places a labware item to the first labware item specified by the element(s) in the position list.
PositionData:	GroupID=**1**: Defines the labware item of the **plate** to transport. If '`transport mode`' is set to 'lid only', no such positions are needed. GroupID=**2**: Defines the labware item of the **lid** to transport. If '`transport mode`' is set to 'plate only', no such positions are needed.
VolumeData:	--

4.4.9.2.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	transport mode	integer	0 = Plate only 1 = Lid only 2 = Plate with lid
PI23	eject tool when finished	integer	0 = No 1 = Yes
PI24	X acceleration	integer	1 (slow) … 5 (very fast)
PI25	check plate	integer	0 = Off 1 = On
PD41	Z-speed [mm/s]	double	greater or equal than zero.
PD42	plate press on distance [mm]	double	greater or equal than zero.

4.4.9.2.2 Restriction for the command result data (used elements)

Restriction to the definition in 4.4.1.1, Command result data:

Even if the '`transport mode`' is set to 'Plate with lid' the ResultNo 1 contains the number of elements used from the plate elements (plate elements used priority).

4.4.9.2.3 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the CO-RE Grip.

4.4.9.3 [GSOEM.0075 : Command 5ml Channel CO-RE Grip -> Move Plate (61)]

CommandID:	**61**
Instrument step:	5ml Channel CO-RE Grip, Move Plate
Command description:	This command moves the CO-RE Grip to the position of the first labware item specified by the element(s) in the position list.
PositionData:	GroupID=**1**: Defines the labware item of the destination to move.
VolumeData:	--

4.4.9.3.1 Parameter Details

Param	Description		
PI21	X acceleration	integer	1 (slow) … 5 (very fast)

4.4.9.3.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the CO-RE Grip.

4.4.9.4 [GSOEM.0076 : Command 5ml Channel CO-RE Grip -> Read Plate Barcode (62)]

CommandID:	**62**
Instrument step:	5ml Channel CO-RE Grip, Read Plate Barcode
Command description:	This command reads a plate barcode with barcode reader of auto load.
PositionData:	--
VolumeData:	--

4.4.9.4.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	barcode reader position	integer	8 (left most position) ... 54
PD41	minimal Z-position during read [mm]	double	greater or equal than zero.

4.4.9.4.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the CO-RE Grip. Result value 4 contains the plate barcode as string.

4.4.10 Nano Pipettor commands

4.4.10.1 [GSOEM.0061 : Command Nano Pipettor -> Prepare (47)]

CommandID:	**47**
Instrument step:	Nano Pipettor -> Prepare
Command description:	This command prepares the Nano Pipettor
PositionData:	--
VolumeData:	--

4.4.10.1.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	prepare mode	integer	0 = Prime pipettor only 1 = Prime liquid system and flush pipettor

4.4.10.1.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the Nano Pipettor.

4.4.10.2 [GSOEM.0062 : Command Nano Pipettor -> Aspirate (48)]

CommandID:	**48**
Instrument step:	Nano Pipettor -> Aspirate
Command description:	Aspirates fluid from a defined position into tips of Nano Pipettor
PositionData:	GroupID=**1**: This Command needs positions from which the fluid shall be aspirated.
VolumeData:	The aspirate volumes shall be given only for the used channels (see channel pattern). For unused channels, no volume entry is interpreted from the list. The channel pattern is interpreted from left to right, the corresponding volumes are evaluated from the begin of the table to the end. **All volume values must be given as [µl]** (Them are converted to [nl] before passing to the Nano Pipettor step).

4.4.10.2.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	Use a '0' for a unused channel, a '1' for a used one. Example: '11110011'.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	aspirate oil gap	integer	0 = No 1 = Yes
PI23	channel ID	integer	0 = Multi channel 1 = Additional channel
PI24	pressure liquid level detection	integer	0 = Off 1 = On
PI25	liquid following	integer	0 = Off 1 = On
PI26	aspiration pressure [mbar]	integer	greater or equal than zero
PD41	submerge depth after the liquid level detection [mm]	double	no restriction
PD42	liquid height from bottom if liquid level detection is disabled [mm]	double	greater or equal than zero.
PD43	swap speed [mm/s]	double	greater or equal than zero.

4.4.10.2.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.10.3 [GSOEM.0063 : Command Nano Pipettor -> Dispense (49)]

CommandID:	**49**
Instrument step:	Nano Pipettor -> Dispense
Command description:	Dispense fluid out of the tip from Nano Pipettor (partial or complete volume) into a defined position.
PositionData:	GroupID=**1**: This Command needs positions to where the fluid shall be dispensed.
VolumeData:	The dispense volumes shall be given only for the used channels (see channel pattern). For unused channels, no volume entry is interpreted from the list. The channel pattern is interpreted from left to right, the corresponding volumes are evaluated from the begin of the table to the end. **All volume values must be given as [µl]** (Them are converted to [nl] before passing to the Nano Pipettor step).

4.4.10.3.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	Use a '0' for a unused channel, a '1' for a used one. Example: '11110011'.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	channel ID	integer	0 = Multi channel 1 = Additional channel
PI23	Z-move after step	integer	0 = Normal 1 = Minimized
PI24	dispensation pressure [mbar]	integer	greater or equal than zero
PI25	volume check	integer	0 = Off 1 = On
PD41	dispense height [mm]	double	greater or equal than zero

4.4.10.3.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.10.4 [GSOEM.0064 : Command Nano Pipettor -> Dispense On The Fly (50)]

CommandID:	**50**
Instrument step:	Nano Pipettor -> Dispense On The Fly
Command description:	Dispense fluid on the fly out of the tip from Nano Pipettor (partial or complete volume) into a defined position.
PositionData:	GroupID=**1**: This Command needs positions to where the fluid shall be dispensed.
VolumeData:	The dispense volumes shall be given only for the used channels (see channel pattern). For unused channels, no volume entry is interpreted from the list. The channel pattern is interpreted from left to right, the corresponding volumes are evaluated from the begin of the table to the end. **All volume values must be given as [µl]** (Them are converted to [nl] before passing to the Nano Pipettor step).

4.4.10.4.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	channel pattern	string	Use a '0' for a unused channel, a '1' for a used one. Example: '11110011'.
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PI22	dispense on the fly mode	integer	0 = Complete plate 1 = Sequence order
PI23	channel ID	integer	0 = Multi channel 1 = Additional channel
PI24	dispensation pressure [mbar]	integer	greater or equal than zero
PI25	dispense direction	integer	0 = Serpentine 1 = From left only
PD41	dispense height [mm]	double	greater or equal than zero
PD42	X-speed during dispense [mm/s]	double	greater or equal than zero
PD43	X-acceleration distance [mm]	double	greater or equal than zero

4.4.10.4.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.10.5 [GSOEM.0065 : Command Nano Pipettor -> Wash (51)]

CommandID:	**51**
Instrument step:	Nano Pipettor -> Wash
Command description:	Start the wash procedure of the Nano Pipettor.
PositionData:	--
VolumeData:	--

4.4.10.5.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	channel ID	integer	0 = Multi channel 1 = Additional channel
PI22	flush time [s]	integer	greater or equal than zero
PI23	wash at ultrasonic bath	integer	0 = Off 1 = On
PI24	refill wash liquid	integer	0 = Off 1 = On
PI25	wash time	integer	greater or equal than zero
PI26	diagnostic mode	integer	0 = Off 1 = On
PD41	submerge depth [mm]	double	greater or equal than zero

4.4.10.5.2 Instrument Results

Result values count:	10
Block data:	Result value 3 contains block data for the nano washer. Result value 4 to 10 contains the diagnostic data of the 'diagnostic mode' is set to On.

4.4.11 Tube Grip commands

4.4.11.1 [GSOEM.0080 : Command Tube Grip -> Get (66)]

CommandID:	**66**
Instrument step:	Tube Grip Get
Command description:	Gets a labware item (tube) from the selected sequence.
PositionData:	GroupID=**1**: This command needs positions where the tube has to be gripped.
VolumeData:	--

4.4.11.1.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PD41	grip height [mm]	double	greater or equal than zero
PD42	opening width before access [mm]	double	greater or equal than zero

4.4.11.1.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data.

4.4.11.2 [GSOEM.0081 : Command Tube Grip -> Place (67)]

CommandID:	**67**
Instrument step:	Tube Grip Place
Command description:	Places a labware item (tube) to the selected sequence.
PositionData:	GroupID=**1**: This command needs positions where the tube has to be placed.
VolumeData:	--

4.4.11.2.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	sequence counting	integer	0 = Manually 1 = Automatic
PD41	relative clamp open width [mm]	double	greater or equal than zero

4.4.11.2.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data.

4.4.11.3 [GSOEM.0082 : Command Tube Grip -> Move (68)]

CommandID:	**68**
Instrument step:	Tube Grip Move
Command description:	Moves a labware item (tube) to the selected sequence.
PositionData:	GroupID=**1**: This command needs positions where the tube has to move to.
VolumeData:	--

4.4.11.3.1 Parameter Details

Param	Description
--	This Command has no parameters.

4.4.11.3.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data.

4.4.11.4 [GSOEM.0083 : Command Tube Grip -> Read Barcode (69)]

CommandID:	**69**
Instrument step:	Tube Grip Read Barcode
Command description:	Reads a tube barcode with barcode reader of auto load.
PositionData:	--
VolumeData:	--

4.4.11.4.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	reader position [track number]	integer	1 … 54

4.4.11.4.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data.

4.4.12 Miscellaneous commands

4.4.12.1 [GSOEM.0025 : Command Read Port (20)]

CommandID:	**20**
Instrument step:	Read Port
Command description:	This command reads the status of the given port number.
PositionData:	--
VolumeData:	--

4.4.12.1.1 Parameter Details

none

Param	Description	Interpreted as	Allowed values
PI21	port number	integer	1 = Port 1 2 = Port 2

4.4.12.1.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for the requested port. Result value 4 contains the state of the requested port as long value (0 = off, 1 = on).

4.4.12.2 [GSOEM.0026 : Command Write Port (21)]

CommandID:	**21**
Instrument step:	Write Port
Command description:	This command changes the status for a given port number.
PositionData:	--
VolumeData:	--

4.4.12.2.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	port number	integer	1 = Port 1 2 = Port 2
PI22	port setting	integer	0 = Off 1 = On

4.4.12.2.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data of the given port. Result value 4 contains the state of the port as long value (0 = off, 1 = on).

4.4.12.3 [GSOEM.0027 : Command 1000ul Channel Move To Position (22)]

CommandID:	**22**
Instrument step:	1000ul Channel: Move To Postion
Command description:	This command can be used to move the channels to a defined position. **IMPORTANT:** This step can damage the Microlab STAR instrument! Make sure that the selected direction is collision-free; otherwise, a crash with the channels can occur.
PositionData:	--
VolumeData:	--

4.4.12.3.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	mode	integer	0 = Move to absolute deck position 1 = Move relative to current position
PI22	direction	integer	0 = X axis (all channels) 1 = Y axis (for the channel 1, the other channels moves in the raster given by the hardware) 2 = Z axis (all channels)
PD41	absolute position [mm] (only used if 'mode' is set to 'absolute position')	double	greater or equal than zero.
PD42	relative position [mm] (only used if 'mode' is set to 'relative position')	double	no restriction.

4.4.12.3.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.12.4 [GSOEM.0072 : Command 5ml Channel Move To Position (58)]

CommandID:	**58**
Instrument step:	5ml Channel: Move To Position
Command description:	This command can be used to move the channels to a defined position. **IMPORTANT:** This step can damage the Microlab STAR instrument! Make sure that the selected direction is collision-free; otherwise, a crash with the channels can occur.
PositionData:	--
VolumeData:	--

4.4.12.4.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	mode	integer	0 = Move to absolute deck position 1 = Move relative to current position
PI22	direction	integer	0 = X axis (all channels) 1 = Y axis (for the channel 1, the other channels moves in the raster given by the hardware) 2 = Z axis (all channels)
PD41	absolute position [mm] (only used if 'mode' is set to 'absolute position')	double	greater or equal than zero.
PD42	relative position [mm] (only used if 'mode' is set to 'relative position')	double	no restriction.

4.4.12.4.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for each channel.

4.4.12.5 [GSOEM.0028 : Command Move Auto Load (23)]

CommandID:	**23**
Instrument step:	Move Auto Load
Command description:	This command moves the auto load to a given loading position. If no auto load module is installed on the instrument, step returns with no error.
PositionData:	--
VolumeData:	--

4.4.12.5.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	track number	integer	1 (left most position) ... 54

4.4.12.5.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data for the autoload.

4.4.12.6 [GSOEM.0029 : Command Firmware-Command (24)]

CommandID:	**24**
Instrument step:	Firmware Command
Command description:	This command allows it to send any valid firmware command directly to the instrument. After completion of the command the original, not interpreted firmware response is returned. For the definition of valid firmware commands and their responses see the firmware documentation.
PositionData:	--
VolumeData:	--

4.4.12.6.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PS01	Firmware command **without** its identification number *id####*. Example (carrier identification): **C0CI**	string	All valid firmware commands of the master module and of all sub-modules. (see firmware documentation)
PS02	Firmware parameter. Example (carrier identification): **cp25**	string	Depends on the firmware command. (see firmware documentation)

4.4.12.6.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains the block data for the firmware command with the following format: ***ErrFlag[-1,-1,-1,-1,<firmware command>,,*** where: **ErrFlag**: Depends on the firmware response (see result value 4): - If the firmware response begins with error code **er**## and ## is equal **00**, the error flag is set to **0**. If ## is not equal **00**, the error flag is set to **1**. - If the response does not begin with an error code, the error flag is set to **0**. **Num**: Always set to **-1** (not used) **MainErr**: Always set to **-1** (not used) **SlaveErr**: Always set to **-1** (not used) **RecoveryBtnId**: Always set to **-1** (not used) **StepData**: Firmware command **without** module ID and identification number. **LabwareName**: Always an empty string (not used) **LabwarePos**: Always an empty string (not used) Example (carrier identification): **0[-1,-1,-1,-1,CI,,**
	Result value 4 contains the original unchanged firmware response described in the firmware documentation, **except** the firmware command and the identification number. Example (carrier identification): **er00/00bb/08ABCDEFGH**

4.4.12.7 [GSOEM.0054 : Command Tip Tracking Speed (40)]

CommandID:	**40**
Instrument step:	Tip tracking Speed (obsolete)
Command description:	This step sets a correction value to optimize the speed of liquid following during an aspiration or dispensation step. **This step is obsolete because the liquid following has been optimized on software and firmware side and should not longer be used.**
PositionData:	--
VolumeData:	--

4.4.12.7.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	Pipetting device	integer	1 = Channel 2 = CO-RE 96 Head
PD41	Speed factor	double	greater or equal than zero.

4.4.12.7.2 Instrument Results

Result values count:	5
Block data:	Result value 3 contains block data, Num is always set to 1 (step data position contains the correction value set for speed optimization. Result value 4 contains the correction value set for speed optimization as double value. Result value 5 contains the information for which device the correction value is set.

4.4.12.8 [GSOEM.0084 : Command Wait For TADM Upload (70)]

CommandID:	**70**
Instrument step:	Wait For TADM Upload
Command description:	Waits until all TADM data are uploaded.
PositionData:	--
VolumeData:	--

4.4.12.8.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	Upload data from head type	integer	0 = 1000µl Channel 1 = 5ml Channel 2 = CO-RE 96 Head

4.4.12.8.2 Instrument Results

Result values count:	3
Block data:	Result value 3 contains block data.

4.4.12.9 [GSOEM.0085 : Command Get Channel Exclude State (71)]

CommandID:	**71**
Instrument step:	Get Channel Exclude State
Command description:	Returns the state of the channels.
PositionData:	--
VolumeData:	--

4.4.12.9.1 Parameter Details

Param	Description	Interpreted as	Allowed values
PI21	Get state of head type	integer	0 = 1000µl Channel 1 = 5ml Channel

4.4.12.9.2 Instrument Results

Result values count:	4
Block data:	Result value 3 contains block data for each channel Result value 4 contains the channel pattern

5 DETAILED DESIGN

5.1 Events used for synchronization

For the synchronization between the OEM Interface method and a OEM Application named events (of theWin32api functionality) must be used.

The following **event names** must be used for the events as described in the state diagrams (4.1):

Event name	Signal direction		Description
	a OEM Appl.	OEM Interface method.	
event_ML_STAR_OemInterface_**IsWaiting**	X ← X		Signaled even if the OEM Interface method changes to the state **waiting**.
event_ML_STAR_OemInterface_**Continue**	X → X		Signaled even if the OEM Interface method shall continue and change to state **running**.

5.2 Errors

Even if a command ends fatal or the method has aborted, one of the following errors is set in the ResultList for the previous started command.

The error description may contain additional error information as listed in the following table.

5.2.1 [GSOEM.0044 : Errors that results in an abort of the method]

Error ID	Error Description
1	File open (table StepList) failed.
2	File read (table StepList) failed.
3	File open (table PositionData) failed.
4	File read (table PositionData) failed.
5	File open (table VolumeData) failed
6	File read (table VolumeData) failed.
7	File open (table ResultList) failed.
8	File write (table ResultList) failed.
9	Synchronization failed (during state waiting).
10	Method aborts without any error. User or Low Level step has aborted.

5.2.2 [GSOEM.0045 : Errors with possibility to continue]

Error ID	Error Description
11	Unknown error occurred.
12	Unknown CommandID readed.
13	Unexpected result data detected.
14	File close failed.
15	A Microlab Star command ends fatal.

5.3 [GSOEM.0052 : Read out of/Write to the Command List database]

For the communication between the OEM Interface method and a OEM Application the events (5.1) and Command List database (4.2) are used.

By this design its absolutely necessary that both of them works with the actual data out of the database. A OEM Application must be able to read the command result after it receives the event ..._IsWaiting, the OEM Interface methods must be able to read the latest command data after it receives the event ..._Continue.

The following definition applies to both, the OEM Interface method and the OEM Application:

- Write into a file:	Its in the responsibility of each component that writes into the database to perform a flush after writing the data if an other component expects that the data are written to the physical file.
- Read out of a file:	Its in the responsibility of each component to ensure that data are queried by a connection that is up to date if it likes to read the updated database.