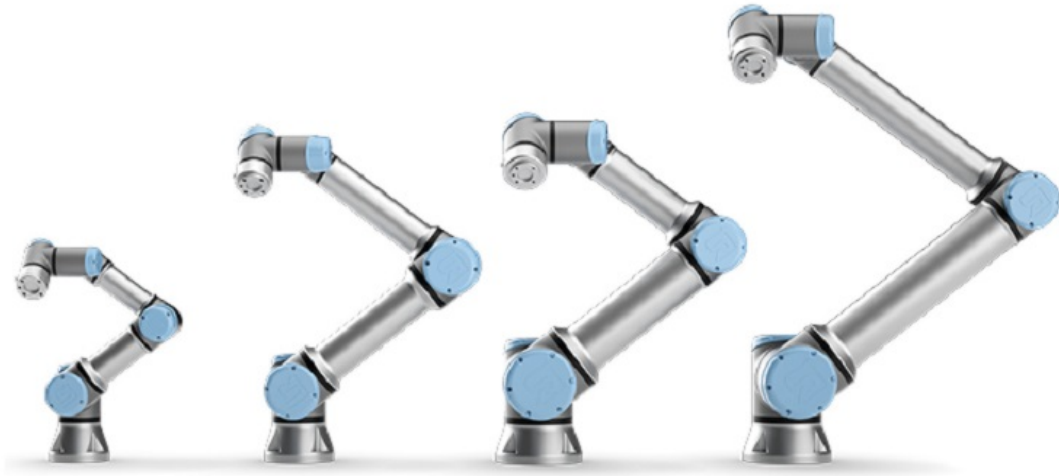




# UNIVERSAL ROBOTS



Realtime Client Interface

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# 1. Introduction

## The Realtime communications Interface

(The RealTime interface has been deprecated since version 3.5. It is recommended to use the RTDE Interface, instead)

The information on this section applies to UR software versions shown, below:

RealTime client=port 30003

RealTime client **read only**=port 30013

The realtime communications interface is also known as the Matlab interface

e-Series (500 Hz):

## 2. RealTime 5.9

(The RealTime interface has been deprecated since version 3.5. It is recommended to use the RTDE Interface, instead)

Meaning	Type	Number of values	Size in bytes	Gnuplot col.	Notes
Message Size	integer	1	4		Total message length in bytes
Time	double	1	8	1	Time elapsed since the controller was started
q target	double	6	48	2 - 7	Target joint positions
qd target	double	6	48	8 - 13	Target joint velocities
qdd target	double	6	48	14 - 19	Target joint accelerations
I target	double	6	48	20 - 25	Target joint currents
M target	double	6	48	26 - 31	Target joint moments (torques)
q actual	double	6	48	32 - 37	Actual joint positions
qd actual	double	6	48	38 - 43	Actual joint velocities
I actual	double	6	48	44 - 49	Actual joint currents
I control	double	6	48	50 - 55	Joint control currents
Tool vector actual	double	6	48	56 - 61	Actual Cartesian coordinates of the tool: (x,y,z,rx,ry,rz), where rx, ry and rz is a rotation vector representation of the tool orientation
TCP speed actual	double	6	48	62 - 67	Actual speed of the tool given in Cartesian coordinates
TCP force	double	6	48	68 - 73	Generalised forces in the TCP
Tool vector target	double	6	48	74 - 79	Target Cartesian coordinates of the tool: (x,y,z,rx,ry,rz), where rx, ry and rz is a rotation vector representation of the tool orientation

TCP speed target	double	6	48	80 - 85	Target speed of the tool given in Cartesian coordinates		
Digital input bits	double	1	8	86	Current state of the digital inputs. NOTE: these are bits encoded as int64_t, e.g. a value of 5 corresponds to bit 0 and bit 2 set high		
Motor temperatures	double	6	48	87 - 92	Temperature of each joint in degrees celsius		
Controller Timer	double	1	8	93	Controller realtime thread execution time		
Test value	double	1	8	94	A value used by Universal Robots software only		
Robot Mode	double	1	8	95	Robot mode	<a href="#">Robot Modes</a>	
Joint Modes	double	6	48	96-101	Joint control modes	<a href="#">Control Modes</a>	
Safety Mode	double	1	8	102	Safety mode	<a href="#">Safety Mode Types</a>	
	double	6	48	103 - 108	Used by Universal Robots software only		
Tool Accelerometer values	double	3	24	109 - 111	Tool x,y and z accelerometer values (software version 1.7)		
	double	6	48	112 - 117	Used by Universal Robots software only		
Speed scaling	double	1	8	118	Speed scaling of the trajectory limiter		
Linear momentum norm	double	1	8	119	Norm of Cartesian linear momentum		
	double	1	8	120	Used by Universal Robots software only		

	double	1	8	121	Used by Universal Robots software only			
V main	double	1	8	122	Masterboard: Main voltage			
V robot	double	1	8	123	Masterboard: Robot voltage (48V)			
I robot	double	1	8	124	Masterboard: Robot current			
V actual	double	6	48	125 - 130	Actual joint voltages			
Digital outputs	double	1	8	131	Digital outputs			
Program state	double	1	8	132	Program state			
Elbow position	double	3	24	133 - 135	Elbow position			
Elbow velocity	double	3	24	136 -138	Elbow velocity			
Safety Status	double	1	8	139	Safety status		<a href="#">Safety Status Types</a>	
	double	1	8	140	Used by Universal Robots software only			
	double	1	8	141	Used by Universal Robots software only			
	double	1	8	142	Used by Universal Robots software only			
TOTAL		143	1140					

If it is experienced that less than 1140 bytes are received, the protocol for the actual received bytes also follows the structure listed above, only not containing the entries at leading up the 1140th byte.



## 3. RealTime 5.10

(The RealTime interface has been deprecated since version 3.5. It is recommended to use the RTDE Interface, instead)

Meaning	Type	Number of values	Size in bytes	Gnuplot col.	Notes
Message Size	integer	1	4		Total message length in bytes
Time	double	1	8	1	Time elapsed since the controller was started
q target	double	6	48	2 - 7	Target joint positions
qd target	double	6	48	8 - 13	Target joint velocities
qdd target	double	6	48	14 - 19	Target joint accelerations
I target	double	6	48	20 - 25	Target joint currents
M target	double	6	48	26 - 31	Target joint moments (torques)
q actual	double	6	48	32 - 37	Actual joint positions
qd actual	double	6	48	38 - 43	Actual joint velocities
I actual	double	6	48	44 - 49	Actual joint currents
I control	double	6	48	50 - 55	Joint control currents
Tool vector actual	double	6	48	56 - 61	Actual Cartesian coordinates of the tool: (x,y,z,rx,ry,rz), where rx, ry and rz is a rotation vector representation of the tool orientation
TCP speed actual	double	6	48	62 - 67	Actual speed of the tool given in Cartesian coordinates
TCP force	double	6	48	68 - 73	Generalised forces in the TCP
Tool vector target	double	6	48	74 - 79	Target Cartesian coordinates of the tool: (x,y,z,rx,ry,rz), where rx, ry and rz is a rotation vector representation of the tool orientation

TCP speed target	double	6	48	80 - 85	Target speed of the tool given in Cartesian coordinates		
Digital input bits	double	1	8	86	Current state of the digital inputs. NOTE: these are bits encoded as int64_t, e.g. a value of 5 corresponds to bit 0 and bit 2 set high		
Motor temperatures	double	6	48	87 - 92	Temperature of each joint in degrees celsius		
Controller Timer	double	1	8	93	Controller realtime thread execution time		
Test value	double	1	8	94	A value used by Universal Robots software only		
Robot Mode	double	1	8	95	Robot mode	<a href="#">Robot Modes</a>	
Joint Modes	double	6	48	96-101	Joint control modes	<a href="#">Control Modes</a>	
Safety Mode	double	1	8	102	Safety mode	<a href="#">Safety Mode Types</a>	
	double	6	48	103 - 108	Used by Universal Robots software only		
Tool Accelerometer values	double	3	24	109 - 111	Tool x,y and z accelerometer values (software version 1.7)		
	double	6	48	112 - 117	Used by Universal Robots software only		
Speed scaling	double	1	8	118	Speed scaling of the trajectory limiter		
Linear momentum norm	double	1	8	119	Norm of Cartesian linear momentum		
	double	1	8	120	Used by Universal Robots software only		

	double	1	8	121	Used by Universal Robots software only		
V main	double	1	8	122	Masterboard: Main voltage		
V robot	double	1	8	123	Masterboard: Robot voltage (48V)		
I robot	double	1	8	124	Masterboard: Robot current		
V actual	double	6	48	125 - 130	Actual joint voltages		
Digital outputs	double	1	8	131	Digital outputs		
Program state	double	1	8	132	Program state		
Elbow position	double	3	24	133 - 135	Elbow position		
Elbow velocity	double	3	24	136 -138	Elbow velocity		
Safety Status	double	1	8	139	Safety status		<a href="#">Safety Status Types</a>
	double	1	8	140	Used by Universal Robots software only		
	double	1	8	141	Used by Universal Robots software only		
	double	1	8	142	Used by Universal Robots software only		
Payload Mass	double	1	8	143	Payload Mass [kg]		
Payload CoG	double	3	24	144-146	Payload Center of Gravity (x, y, z) [m]		
Payload Inertia	double	6	48	147-152	Payload Inertia (Ixx, Iyy, Izz, Ixy, Ixz, Iyz) [kg*m^2]		
TOTAL		153	1220				

If it is experienced that less than 1220 bytes are received, the protocol for the actual received bytes also follows the structure listed above, only not containing the entries at leading up the 1220th byte.

## 4. Message Sources

Each message sent has a "source" code for the sender of the message.

	Value
MESSAGE_SOURCE_JOINT_0_FPGA	100
MESSAGE_SOURCE_JOINT_0_A	110
MESSAGE_SOURCE_JOINT_0_B	120
MESSAGE_SOURCE_JOINT_1_FPGA	101
MESSAGE_SOURCE_JOINT_1_A	111
MESSAGE_SOURCE_JOINT_1_B	121
MESSAGE_SOURCE_JOINT_2_FPGA	102
MESSAGE_SOURCE_JOINT_2_A	112
MESSAGE_SOURCE_JOINT_2_B	122
MESSAGE_SOURCE_JOINT_3_FPGA	103
MESSAGE_SOURCE_JOINT_3_A	113
MESSAGE_SOURCE_JOINT_3_B	123
MESSAGE_SOURCE_JOINT_4_FPGA	104
MESSAGE_SOURCE_JOINT_4_A	114
MESSAGE_SOURCE_JOINT_4_B	124
MESSAGE_SOURCE_JOINT_5_FPGA	105
MESSAGE_SOURCE_JOINT_5_A	115
MESSAGE_SOURCE_JOINT_5_B	125
MESSAGE_SOURCE_TOOL_FPGA	106
MESSAGE_SOURCE_TOOL_A	116
MESSAGE_SOURCE_TOOL_B	126
MESSAGE_SOURCE_EUROMAP_FPGA	107
MESSAGE_SOURCE_EUROMAP_A	117
MESSAGE_SOURCE_EUROMAP_B	127
MESSAGE_SOURCE_TEACH_PENDANT_A	108
MESSAGE_SOURCE_TEACH_PENDANT_B	118
MESSAGE_SOURCE_SCB_FPGA	40
MESSAGE_SAFETY_PROCESSOR_UA	20
MESSAGE_SAFETY_PROCESSOR_UB	30
MESSAGE_SOURCE_ROBOTINTERFACE	-2
MESSAGE_SOURCE_RTMACHINE	-3



MESSAGE_SOURCE_SIMULATED_ROBOT	-4
MESSAGE_SOURCE_GUI	-5
MESSAGE_SOURCE_CONTROLLER	7
MESSAGE_SOURCE_RTDE	8
The message types are:	
MESSAGE_TYPE_DISCONNECT	-1
MESSAGE_TYPE_ROBOT_STATE	16
MESSAGE_TYPE_ROBOT_MESSAGE	20
MESSAGE_TYPE_HMC_MESSAGE	22
MESSAGE_TYPE_MODBUS_INFO_MESSAGE	5
MESSAGE_TYPE_SAFETY_SETUP_BROADCAST_MESSAGE	23
MESSAGE_TYPE_SAFETY_COMPLIANCE_TOLERANCES_MESSAGE	24
MESSAGE_TYPE_PROGRAM_STATE_MESSAGE	25

## 5. Safety Mode Types

	Value	Comment
SAFETY_MODE_UNDEFINED_ SAFETY_MODE	11	
SAFETY_MODE_VALIDATE_ JOINT_ID	10	
SAFETY_MODE_FAULT	9	
SAFETY_MODE_VIOLATION	8	
SAFETY_MODE_ROBOT_ EMERGENCY_STOP	7	(EA + EB + SBUS->Euromap67) Physical e-stop interface input activated
SAFETY_MODE_SYSTEM_ EMERGENCY_STOP	6	(EA + EB + SBUS->Screen) Physical e-stop interface input activated
SAFETY_MODE_SAFEGUARD_ STOP	5	(SI0 + SI1 + SBUS) Physical s-stop interface input
SAFETY_MODE_RECOVERY	4	
SAFETY_MODE_PROTECTIVE_ STOP	3	
SAFETY_MODE_REDUCED	2	
SAFETY_MODE_NORMAL	1	

## 6. Safety Status Types

	Value	Comment
SAFETY_STATUS_SYSTEM_THREE_POSITION_ENABLING_STOP	13	
SAFETY_STATUS_AUTOMATIC_MODE_SAFEGUARD_STOP	12	
SAFETY_STATUS_UNDEFINED_SAFETY_MODE	11	
SAFETY_STATUS_VALIDATE_JOINT_ID	10	
SAFETY_STATUS_FAULT	9	
SAFETY_STATUS_VIOLATION	8	
SAFETY_STATUS_ROBOT_EMERGENCY_STOP	7	(EA + EB + SBUS->Euromap67) Physical e-stop interface input activated
SAFETY_STATUS_SYSTEM_EMERGENCY_STOP	6	(EA + EB + SBUS->Screen) Physical e-stop interface input activated
SAFETY_STATUS_SAFEGUARD_STOP	5	(SI0 + SI1 + SBUS) Physical s-stop interface input
SAFETY_STATUS_RECOVERY	4	
SAFETY_STATUS_PROTECTIVE_STOP	3	
SAFETY_STATUS_REDUCED	2	
SAFETY_STATUS_NORMAL	1	

## 7. Control Modes

Control Modes	
Mode	Description
0	CONTROL_MODE_POSITION
1	CONTROL_MODE_TEACH
2	CONTROL_MODE_FORCE
3	CONTROL_MODE_TORQUE





## 8. Robot Modes

Robot Modes	
Mode	Description
-1	ROBOT_MODE_NO_CONTROLLER
0	ROBOT_MODE_DISCONNECTED
1	ROBOT_MODE_CONFIRM_SAFETY
2	ROBOT_MODE_BOOTING
3	ROBOT_MODE_POWER_OFF
4	ROBOT_MODE_POWER_ON
5	ROBOT_MODE_IDLE
6	ROBOT_MODE_BACKDRIVE
7	ROBOT_MODE_RUNNING
8	ROBOT_MODE_UPDATING_FIRMWARE

## 9. Joint Modes

	Value
JOINT_MODE_RESET	235
JOINT_MODE_SHUTTING_DOWN	236
JOINT_MODE_BACKDRIVE	238
JOINT_MODE_POWER_OFF	239
JOINT_MODE_READY_FOR_POWER_OFF (FROM VERSION 5.1)	240
JOINT_MODE_NOT_RESPONDING	245
JOINT_MODE_MOTOR_INITIALISATION	246
JOINT_MODE_BOOTING	247
JOINT_MODE_VIOLATION	251
JOINT_MODE_FAULT	252
JOINT_MODE_RUNNING	253
JOINT_MODE_IDLE	255



## 10. Tool Modes

	Value
JOINT_MODE_RESET	235
JOINT_MODE_SHUTTING_DOWN	236
JOINT_MODE_POWER_OFF	239
JOINT_MODE_NOT_RESPONDING	245
JOINT_MODE_BOOTING	247
JOINT_MODE_BOOTLOADER	249
JOINT_MODE_FAULT	252
JOINT_MODE_RUNNING	253
JOINT_MODE_IDLE	255