Huron Net Works, Inc.

DN-TC401
DN-TC401-0.5

Robot Tool Changer ID Module

Device Profile

Publication # 2200114
Date 8/12/04
Revision # 1.07

Firmware Revision 3.2

Rev	Date	TC-401-0.5 Revision	TC-401 Revision	Note(s)
1.00	10/9/02	N/A	N/A	Original – Derived from 2200083-A.0 for Atmel Processor and Half-Size Printed Circuit Board
1.01	10/10/02	1.1	N/A	New Product Code, Revision,Base Serial Number, and Product Name
1.02	10/11/02	1.1	N/A	Serial Number Range Change, and Add Vendor Specific Object References
1.03	12/20/02	1.1	N/A	Remove Debug Object, Increase explicit message produced and consumed size
1.04	3/21/03	2.1	2.1	Update catalog number, board revision, and firmware revision. Add attributes 9 & 10 to identity object and document vendor specific objects.
1.05	7/9/03	2.2	2.2	Add DN-TC401 Full Size with ATMEL processor and Firmware Revision Columns
1.06	4/16/04	3.1	3.1	Add Quick Connect
1.07	8/12/04	3.2	3.2	Add: Vendor Specific Parameter Object Add: Table of Contents Add: Minor improvements

Table of Contents

1 Object Model

DN-TC401 and DN-TC401-0.5 are DeviceNet capable robot tool changer ID modules. They are designed as a Device Type 0 (Generic) and both support an object model as defined below.

1.1 Objects Present in Device

Object Name	Class Id	Optional/ Required	# of Instances
Identity Object	0x01	Required	1
Message Router Object	0x02	Optional*	1
DeviceNet Object	0x03	Required	1
Assembly Object	0x04	Required	1 Instance #103 Tool Changer Input Assembly
Connection Object	0x05	Required	3 Instances 1--Explicit Messaging 1--Polled I/O 1--COS/Cyc I/O
Ack Handler	0x2B	Required	1
Tool Changer Object	0x69	VS/Required	1
Non-Volitile Test Object	**	VS/Required	1
Vendor Specific Parameter Object	**	VS/Required	1
Factory Test**		VS/Required	1

*Attributes and services are optional; behavior is required.
**See Vendor Specific Object Library

1.2 Objects That Effect Behavior

Object	Class Id	Effect on Behavior
Identity	0x01	Supports the reset service
Message Router	0x02	No effect
DeviceNet	0x03	Configures port attributes Enables Quick Connect
Assembly	0x04	Defines input data format
Connection	0x05	Establishes the number of connections
Ack Handler	0x2B	COS/Cyclic Acknowledge Handler
Tool Changer	0x69	Defines values to identify tool
Non-Volitile Test Object	**	Test Non-Volitile Memory
Vendor Specific Parameter Object	**	Vendor specific configuration
Factory Test	**	Vendor specific configuration

**See Vendor Specific Object Library

1.3 Object Interfaces

Object	Class Id	Interface
Identity	0x01	Message Router
Message Router	0x02	Explicit Message Connection Instance
DeviceNet	0x03	Message Router
Assembly	0x04	I/O Connection or Message Router
Connection	0x05	Message Router
Ack Handler	0x2B	I/O Connection or Message Router
Tool Changer	0x69	Message Router
Vendor Specific Parameter Object	**	Message Router
Factory Test	**	Message Router

**See Vendor Specific Object Library

2 Standard Objects

2.1 Identity Object (0x01)

There is a single instance of the identity object for the device.

2.1.1 Class Attributes

No class services or attributes are supported.

2.1.2 Instance Attributes

Attrib ID	Access Rule	Name	Data Type	DN-TC401 Value	DN-TC401-0.5 Value
1	Get	Vendor	UINT	0x0014	0x0014
2	Get	Device Type	UINT	0x0000	0x0000
3	Get	Product Code	UINT	0x0013	0x0017
4	Get	Revision	STRUCT	03.02	03.02
5	Get	Status	WORD	0x0001	0x0001
6	Get	Serial #	UDINT	0x00004400*	0x00005000*
7	Get	Product Name	STRUCT	15,Tool Changer ID	18,Tool Changer ID-SF
8	Get	State	USINT	[0..5]	[0..5]
9	Get	Configuration Consistency Value	UINT	Non-volatile memory checksum	Non-volatile memory checksum
10	Get/Set	Heartbeat	USINT	Heartbeat production trigger time in seconds	Heartbeat production trigger time in seconds

* Manufactured Default Base Serial Number.

2.1.3 Instance Services

Service Code	Service Name	Description of Service
05	Reset	Reset the device to power up configuration
0E	Get_Attribute_Single	Returns the contents of the specified attribute
10	Set_Attribute_Single	Changes the value of the specified Attribute

2.1.4 Reset Service

Data Type	Value	Description of Service
UINT	0	Reset the device to power up configuration
	1	Return the device to Out-of-Box configuration

2.2 Message Router Object (0x02)

There is a single instance of the Message Router Object. For this single instance of the Message Router Object there is no externally visible interface. There are no class attributes or services, and there are no instance attributes or services. This is consistent with the definition of the attributes and the services as optional. The behavior of this object is required.

2.3 DeviceNet Object (0x03)

There is a single instance of the DeviceNet Object for the device

2.3.1 Class Attributes

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	Revision	UINT	0x0002

2.3.2 Class Services

Service Code	Service Name	Description of Service
0E	Get_Attribute_Single	Returns the contents of the specified attribute

2.3.3 Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Value
1	Get/Set	MACID Value	USINT	Range 0-63
2	Get/Set	Baud Rate Value	USINT	Range 0-2
3	Get/Set	BOI	BOOL	0x00 Fault
4	Get/Set	Bus-Off Counter	USINT	0x00
5	Get	Allocation Information	STRUCT	Allocate Service
6	Get	MAC ID Switch Changed	BOOL	0=No Change 1=Changed
7	Get	Baudrate Switch Changed	BOOL	0=No change 1=Changed
8	Get	MAC ID Switch Setting	USINT	Range 0-63
9	Get	Baudrate Switch Setting	USINT	Range 0-3
10	Get/Set	Quick_Connect	BOOL	0=Disable 1=Enable

2.3.4 Instance Services

Service Code	Service Name	Description of Service
0E	Get_Attribute_Single	Returns the contents of the specified attribute
10	Set_Attribute_Single	Sets the contents of the specified attribute
4B	Allocate	Creates predefined M/S connections
4C	Release	Deletes predefined M/S connections

2.3.5 Object Specific Bahavior

Attribute 10 of the DeviceNet Object enables or disable the Quick Connect feature. This specification enhancement is described in DSE-001-088. It allows a device to go online after sending the first of two Duplicate MacId Check Request Messages. The device must still accept a Duplicate MacId Check Response and go offline if one is received. Once the device goes online it may accept any valid DeviceNet message. It will still send the second Duplicate MacId Check Request message after timing out the one second interval following the successful transmission of the first message. This will allow the Tool Changer ID Module minimize the response to a request for the Tool Identification after power is applied.

2.4 Assembly Object (0x04)

There is one instance of the assembly object for the device.

2.4.1 Class Attributes and Services

No class attributes or services are supported.

2.4.2 Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Value
3	Get/Set	Value	array of bytes	see definitions

2.4.3 Instance Services

Service Code	Service Name	Description of Service
0E	Get_Attribute_Single	Returns the contents of the specified attribute
10	Set_Attribute_Single	Sets the contents of the specified attribute

2.4.4 Identification of I/O Assembly Instances

Number	**Type**	**Name**
103	Input	Tool Changer Input Assembly

2.4.5 Format of I/O Assembly Data Attribute

2.4.5.1 Assembly #103 -- Device Inputs

Byte	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
0	Tool Number							
1	Line Number*				Robot Number*			

2.4.5.2 Mapping for Assembly instance #103

Data Name	Class		Instance	Attribute	
	Name	Number	Number	Name	Number
Tool Number	Tool Changer	69	1	Tool Number	1
Robot Number*	Tool Changer	69	1	Robot Number	2
Line Number*	Tool Changer	69	1	Line Number	3

* Least significant 4 bits of attribute of type USINT

2.5 Connection Object (0x05)

2.5.1 Class Attributes

No class Attributes are supported

2.5.2 Instance Attributes

There are three instances of the Connection Object in the device. Instance #1 is assigned to the explicit messaging connection. Instance #2 is assigned to the Polled I/O connection. Instance #4 handles COS I/O production and ack consumption. The tables below show the attributes and the predefined values where applicable.

2.5.3 Instance Services

Service Code	Service Name	Description of Service
05	Reset	Reset the connection - restart timer transition from timed out state.
0E	Get_Attribute_Single	Returns the contents of the specified attribute
10	Set_Attribute_Single	Sets the contents of the specified attribute

Explicit Message Connection (Instance #1)

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	state	USINT	0x03
2	Get	instance_type	USINT	0x00
3	Get	Xport Class trigger	USINT	0x83
4	Get	produced connection ID	UINT	0x5FB for MAC ID 63
5	Get	consumed connection ID	UINT	0x5FC for MAC ID 63
6	Get	initial comm characteristics	USINT	0x21
7	Get	produced connection size	UINT	0x0019
8	Get	consumed connection size	UINT	0x0019
9	Get/Set	expected packet rate	UINT	Application Dependent
12	Get/Set	watchdog timeout action	USINT	0x01 Auto Delete
13	Get	produced path length	UINT	0x0000
14	Get	produced path	Array of USINT	<NULL>
15	Get	consumed path length	UINT	0x0000
16	Get	consumed path	Array of USINT	<NULL>
17	Get	production inhibit timer	UINT	0x0000*

* Server devices do not use this timer

Poll Message Connection (Instance #2)

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	state	USINT	0x03
2	Get	instance_type	USINT	0x01
3	Get	Xport Class trigger	USINT	0x82
4	Get	produced connection ID	UINT	0x3FF 0xFFFF no Ack for MAC ID 63
5	Get	consumed connection ID	UINT	0x5FD for MAC ID 63
6	Get	initial comm characteristics	USINT	0x01
7	Get	produced connection size	UINT	0x0002
8	Get	consumed connection size	UINT	0x0000
9	Get/Set	expected packet rate	UINT	Application Dependent
12	Get/Set	watchdog timeout action	USINT	0x00 Time Out
13	Get	produced path length	UINT	0x0006
14	Get	produced path	Array of USINT	20.04.24.67.30.03
15	Get	consumed path length	UINT	0x0000
16	Get	consumed path	Array of USINT	<NULL>
17	Get	production inhibit timer	UINT	0x0000

COS/Cyc I/O Message Connection (Instance #4)

Attribute ID	Access Rule	Name	Data Type	Value
1	Get	state	USINT	0x03
2	Get	instance_type	USINT	0x01
3	Get	Xport Class trigger	USINT	0x12 COS 0x02 Cyc 0x10 COS, no Ack 0x00 Cyc, no Ack
4	Get	produced connection ID	UINT	0x37F for MAC ID 63
5	Get	consumed connection ID	UINT	0x5FA 0xFFFF no Ack for MAC ID 63
6	Get	initial comm characteristics	USINT	0x01 0x0F no Ack
7	Get	produced connection size	UINT	0x0002
8	Get	consumed connection size	UINT	0x0000
9	Get/Set	expected packet rate	UINT	Application Dependent
12	Get/Set	watchdog timeout action	USINT	0x00 Time Out
13	Get	produced path length	UINT	0x0006
14	Get	produced path	Array of USINT	20.04.24.67.30.03
15	Get	Consumed path length	UINT	0x0004 0x0000 no Ack
16	Get	consumed path	Array of USINT	20.2B.24.01 <null> no Ack
17	Get/Set	production inhibit timer	UINT	app dependent

3 Device and Vendor Specific Objects

3.1 Ack Handler (0x2B)

3.1.1 Class Attributes and Services

No class attributes or services are supported for this class.

3.1.2 Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description	Value
1	Get/Set	Acknowledge Timer	UINT	Wait time after production for retry	1-64k ms def=16
2	Get	Retry Limit	USINT	Number of retries if production not ack'd	1
3	Get	COS Producing Cnxn Instance	UINT	Source of production for which ack's are received	4

3.1.3 Instance Services

Service Code	Service Name	Description of Service
0x0E	Get_Attribute_Single	Returns the contents of the specified attribute
0x10	Set_Attribute_Single	Sets the contents of the specified attribute

3.2 Tool Changer (0x69)

3.2.1 Class Attributes

No class services or attributes are supported for this class

3.2.2 Instance Attributes

Attribute ID	Access Rule	Name	Data Type	Description	Value
1	Get	Tool Number	USINT		0..255
2	Get	Robot Number	USINT	Input Point Value	0..9
3	Get	Line Number	USINT	Input Point Value	0..9

3.2.3 Instance Services

Service Code	Service Name	Description of Service
0E	Get_Attribute_Single	Returns the contents of the specified attribute

3.3 Non-Volatile Test Object

This object is used for test, diagnostic, and factory configuration. This object allows control and manipulation of the non-volatile memory from DeviceNet and must be used with extraordinary care.

3.4 Vendor Specific Parameter Object

This object is used for test, diagnostic, and factory configuration; it affects the non-volatile memory and must be used with extraordinary care.

3.5 Factory Test Object

This object is used for test, diagnostic, and factory configuration; it affects the non-volatile memory and must be used with extraordinary care.