BECKHOFF New Automation Technology

Manual | EN

TwinCAT 3

ArtNet



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1 Foreword

1.1 Notes on the documentation

This description is intended exclusively for trained specialists in control and automation technology who are familiar with the applicable national standards.
The documentation and the following notes and explanations must be complied with when installing and commissioning the components.
The trained specialists must always use the current valid documentation.

The trained specialists must ensure that the application and use of the products described is in line with all safety requirements, including all relevant laws, regulations, guidelines, and standards.

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Safety regulations

Read the following explanations for your safety.
Always observe and follow product-specific safety instructions, which you may find at the appropriate places in this document.

Exclusion of liability

All the components are supplied in particular hardware and software configurations which are appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

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This description is only intended for trained specialists in control, automation, and drive technology who are familiar with the applicable national standards.

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Personal injury warnings

⚠ DANGER
Hazard with high risk of death or serious injury.

⚠ WARNING
Hazard with medium risk of death or serious injury.

⚠ CAUTION
There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE
The environment, equipment, or data may be damaged.

Information on handling the product



This information includes, for example:
recommendations for action, assistance or further information on the product.

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2 Disclaimer

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For the latest version of our data sheets and documentations visit our website www.beckhoff.de.

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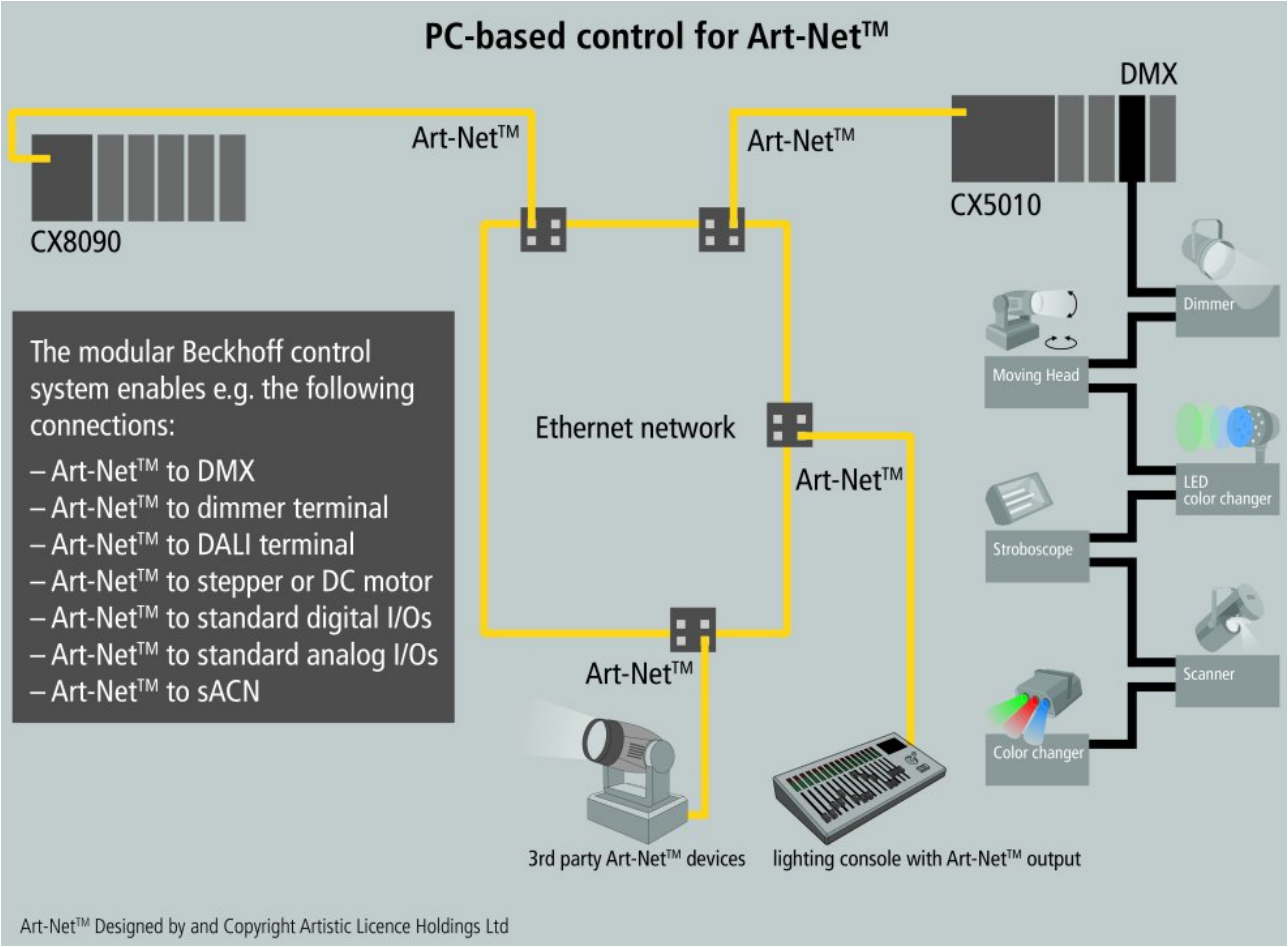
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3 Overview

Art-Net™ is a protocol specification, developed by Artistic Licence Holdings Ltd, to utilize the benefits of Ethernet for transferring DMX universes.
DMX is a standard that is widely used for controlling lighting elements in stage equipment and building services applications.
The corresponding Beckhoff range includes the EL6851 DMX master terminal and the EL6851-0010 DMX slave terminal.

Art-Net™ transfers DMX universes via UDP/IP, whereby DMX data are embedded in an Art-Net™ frame as a complete universe and thus tunneled through UDP/IP using another layer.

From Art-Net™ II, telegrams can also be sent in 'unicast' mode, as well as 'directed broadcast'.



Further information can be found on our website at: PC-based control for stage and show equipment

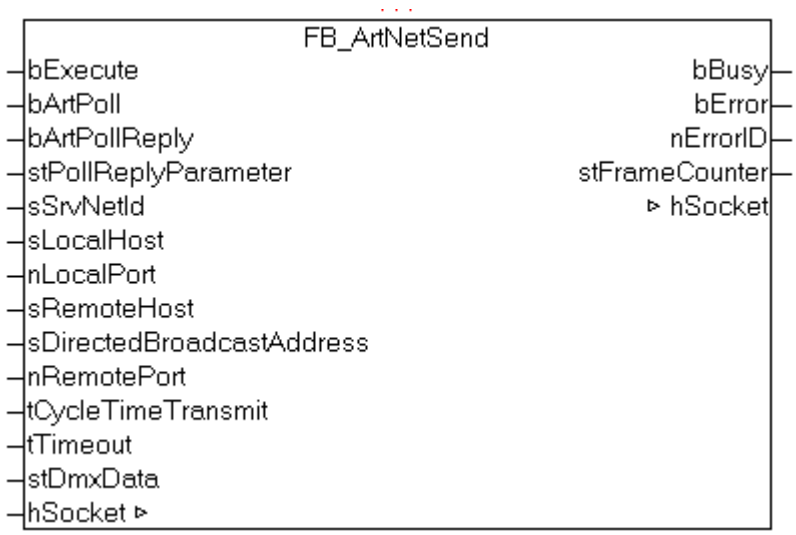
The Art-Net™ specification can be found at: www.Art-Net.org.uk

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4 Programming

4.1 Blocks

4.1.1 FB_ArtNetSend



This function block sends Art-Net telegrams via UDP.

VAR_INPUT

```
bExecute                : BOOL;
bArtPoll                : BOOL;
bArtPollReply           : BOOL;
stPollReplyParameter    : ST_PollReplyParameter;
sSrvNetId               : T_AmsNetId,
sLocalHost              : T_IPv4Addr;
nLocalPort              : UDINT;
sRemoteHost             : T_IPv4Addr;
sDirectedBroadcastAddress : T_IPv4Addr;
nRemotePort             : UDINT;
tCycleTimeTransmit      : TIME;
tTimeout                : TIME;
stDmxData               : ST_DmxArtNetData;
```

bExecute: The block starts processing if a positive edge is encountered at this input. A negative edge terminates processing.

bArtPoll: A one-off 'ArtPoll' telegram is sent via a positive edge at this input.
All Art-Net™ devices (including the sender) then respond with an 'ArtPollReply' telegram.

bArtPollReply: A one-off 'ArtPollReply' telegram is sent via a positive edge at this input.

stPollReplyParameter: This structure provides information for other Art-Net™ devices.

sSrvNetId: String containing the network address of the TwinCAT TCP/IP Connection Server. For the local computer (default) an empty string may be specified.

sLocalHost: The local IP address (IPv4) of the UDP client/server socket as a string (e.g. '2.168.0.5'). An empty string may be specified for the default network adapter.

nLocalPort: The local IP port number of the UDP client/server socket (e.g. 6454).

sRemoteHost: The remote IP address (IPv4) of the UDP client/server socket as a string (e.g. '2.17.54.239').

sDirectedBroadcastAddress: The IP address (IPv4) for 'directed broadcasts' as a string (e.g. '2.255.255.255').
This address is used in 'broadcast' mode, and also for sending 'ArtPoll' and 'ArtPollReply' telegrams.

nRemotePort: The remote IP port number of the UDP client/server socket (e.g. 6454).

tCycleTimeTransmit: Determines the cycle in which the telegrams are sent (e.g. t#20ms).

tTimeout: States the length of the timeout that may not be exceeded during execution of the command.

stDmxData: This structure contains the data to be sent.

VAR_OUTPUT

```
bBusy                   : BOOL;
bError                  : BOOL;
nErrorID                : UDINT;
stFrameCounterErrorID   : ST_FrameCounter;
```

bBusy: When the function block is activated this output is set. It remains set until a feedback is received.

bError: In the event of an error during the command transfer, this output is set once the *bBusy* output has been reset.

nErrorID: Returns the error code of the last executed step, if the bError output is set.
See Error codes.

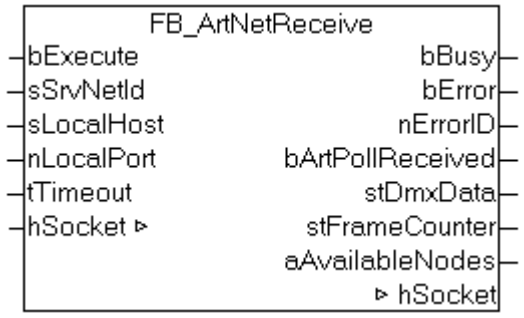
stFrameCounter: Structure with information about the number of sent 'ArtPoll', 'ArtPollReply' and 'ArtDmx' telegrams.

VAR_IN_OUT

```
hSocket         : T_HSOCKET;
```

hSocket: Input/output variable with the handle of an opened UDP socket. If the transfer takes place at input 0, the system tries to create a new socket.
If successful, a new socket is opened, and hSocket provides the associated socket handle.

4.1.2 FB_ArtNetReceive



This function block receives Art-Net telegrams via UDP.

VAR_INPUT

```
bExecute        : BOOL;
sSrvNetId       : T_AmsNetId,
sLocalHost      : T_IPv4Addr;
nLocalPort      : UDINT;
tTimeout        : TIME;
```

bExecute: The block starts processing if a positive edge is encountered at this input. A negative edge terminates processing.

sSrvNetId: String containing the network address of the TwinCAT TCP/IP Connection Server. For the local computer (default) an empty string may be specified.

sLocalHost: The local IP address (IPv4) of the UDP client/server socket as a string (e.g. '2.168.0.5'). An empty string may be specified for the default network adapter.

nLocalPort: The local IP port number of the UDP client/server socket (e.g. 6454).

tTimeout: States the length of the timeout that may not be exceeded during execution of the command.

VAR_OUTPUT

```
    bBusy                : BOOL;
    bError               : BOOL;
    nErrorID             : UDINT;
    bArtPollReceived     : BOOL;
    stDmxData            : ST_DmxArtNetData;
    stFrameCounter       : ST_FrameCounter;
    aAvailableNodes      : ARRAY[0..31] OF ST_PollReplyParameter;
```

bBusy: When the function block is activated this output is set. It remains set until a feedback is received.

bError: If an error should occur during the transfer of the command, then this output is set once the bBusy output was reset.

nErrorID: Returns the error code of the last executed step, if the bError output is set.
See Error codes.

stDmxData: This structure contains the most recently received data.

stFrameCounter: Structure with information about the number of received 'ArtPoll', 'ArtPollReply' and 'ArtDmx' telegrams.

aAvailableNodes: Provides an array of a structure with information on further Art-Net™ devices, from which an 'ArtPollReply' telegram was sent.

VAR_IN_OUT

```
    hSocket       : T_HSOCKET;
```

hSocket: Input/output variable with the handle of an opened UDP socket. If the transfer takes place at input 0, the system tries to create a new socket.
If successful, a new socket is opened, and hSocket provides the associated socket handle.

4.2 Error Codes

Table 1: Error Codes

Value (hex)	Value (dec)	Description
0x0000	0	No error.
0x8001	32769	The specified UDP port could not be opened.
0x8002	32770	Ports opened by the TwinCAT PLC runtime system could not be closed.
0x8003	32771	Invalid socket for receiving UDP telegrams.
0x8004	32772	Invalid socket for sending UDP telegrams.

4.3 Structures, enumerations

4.3.1 E_ArtNet_ErrorCodes

```
TYPE E_ArtNet_ErrorCodes
(
    eArtNetError_NoError          := 0,
    eArtNetError_UDPOpeningPort   := 32769,
    eArtNetError_UDPClosePorts    := 32770,
    eArtNetError_UDPReceive       := 32771,
    eArtNetError_UDPSend          := 32772
);
END_TYPE
```

4.3.2 E_ArtNet_OpCodes

```
TYPE E_ArtNet_OpCodes
(
    E_OpPoll             :=16#2000, (*This is an ArtPoll packet, no other data is contained in this
```

```
UDP packet.*)
    E_OpPollReply        :=16#2100, (*This is an ArtPollReply Packet. It contains device status info
rmation.*)
    E_OpDiagData         :=16#2300, (*Diagnostics and data logging packet.*)
    E_OpCommand          :=16#2400, (*Used to send text based parameter commands.*)
    E_OpDmx              :=16#5000, (*This is an ArtDmx data packet. It contains zero start code DMX
512 information for a single Universe.*)
    E_OpNzs              :=16#5100, (*This is an ArtNzs data packet. It contains non-
zero start code (except RDM) DMX512 information for a single Universe.*)
    E_OpAddress          :=16#6000, (*This is an ArtAddress packet. It contains remote programming i
nformation for a Node.*)
    E_OpInput            :=16#7000, (*This is an ArtInput packet. It contains enable -
 disable data for DMX inputs.*)
    E_OpTodRequest       :=16#8000, (*This is an ArtTodRequest packet. It is used to request a Table
 of Devices (ToD) for RDM discovery.*)
    E_OpTodData          :=16#8100, (*This is an ArtTodData packet. It is used to send a Table of De
vices (ToD) for RDM discovery.*)
    E_OpTodControl       :=16#8200, (*This is an ArtTodControl packet. It is used to send RDM discov
ery control messages.*)
    E_OpRdm              :=16#8300, (*This is an ArtRdm packet. It is used to send all non discovery
 RDM messages.*)
    E_OpRdmSub           :=16#8400, (*This is an ArtRdmSub packet. It is used to send compressed, RD
M Sub-Device data.*)
    E_OpVideoSetup       :=16#A010, (*This is an ArtVideoSetup packet. It contains video screen setu
p information for nodes that implement the extended video features.*)
    E_OpVideoPalette     :=16#A020, (* This is an ArtVideoPalette packet. It contains colour palette
 setup information FOR nodes that implement the extended video features.*)
    E_OpVideoData        :=16#A040, (*This is an ArtVideoData packet. It contains display data for n
odes that implement the extended video features.*)
    E_OpMacMaster        :=16#F000, (*This is an ArtMacMaster packet. It is used to program the Node
's MAC address, Oem device type and ESTA manufacturer code. This is for factory initialisation of a
Node. It is not to be used by applications.*)
    E_OpMacSlave         :=16#F100, (*This is an ArtMacSlave packet. It is returned by the node to a
cknowledge receipt of an ArtMacMaster packet.*)
    E_OpFirmwareMaster   :=16#F200, (*This is an ArtFirmwareMaster packet. It is used to upload new
firmware or firmware extensions to the Node.*)
    E_OpFirmwareReply    :=16#F300, (*This is an ArtFirmwareReply packet. It is returned BY the node
 TO acknowledge receipt OF an ArtFirmwareMaster packet OR ArtFileTnMaster packet.*)
    E_OpFileTnMaster     :=16#F400, (*Uploads user file to node. *)
    E_OpFileFnMaster     :=16#F500, (*Downloads user file from node.*)
    E_OpFileFnReply      :=16#F600, (*Node acknowledge for downloads.*)
    E_OpIpProg           :=16#F800, (*This is an ArtIpProg packet. It is used to reprogramme the IP,
 Mask and Port address of the Node. *)
    E_OpIpProgReply      :=16#F900, (*This is an ArtIpProgReply packet. It is returned by the node t
o acknowledge receipt of an ArtIpProg packet.*)
    E_OpMedia            :=16#9000, (*This is an ArtMedia packet. It is Unicast by a Media Server an
d acted upon by a Controller.*)
    E_OpMediaPatch       :=16#9100, (*This is an ArtMediaPatch packet. It is Unicast by a Controller
 and acted upon by a Media Server. *)
    E_OpMediaControl     :=16#9200, (*This is an ArtMediaControl packet. It is Unicast by a Controll
er and acted upon by a Media Server. *)
    E_OpMediaContrlReply :=16#9300, (*This is an ArtMediaControlReply packet. It is Unicast by a Med
ia Server and acted upon by a Controller.*)
    E_OpTimeCode         :=16#9700, (*This is an ArtTimeCode packet. It is used to transport time co
de over the network.*)
    E_OpTimeSync         :=16#9800, (*Used to synchronise real time date and clock*)
    E_OpTrigger          :=16#9900, (*Used to send trigger macros*)
    E_OpDirectory        :=16#9A00, (*Requests a node's file list*)
    E_OpDirectoryReply   :=16#9B00  (*Replies to OpDirectory with file list*)
);
END_TYPE
```

4.3.3 ST_ArtNetDmxData

```
TYPE ST_ArtNetDmxData:
STRUCT
    nNet             : BYTE; (*The top 7 bits of the 15 bit Port-Address to which this packet is
destined*)
    nSubUni          : BYTE; (*The low byte of the 15 bit Port-Address to which this packet is
destined*)
    aDmxChannels     : ARRAY[1..512] OF BYTE;
END_STRUCT
END_TYPE
```

nNet: contains the higher 7 bits of the 15-bit address.

nSubUni: contains the lower byte of the 15-bit address.

aDmxChannels: Array with DMX data of a universe.

Information on addressing can be found in the Art-Net™-specification under: www.Art-Net.org.uk

4.3.4 ST_ArtNetFrameCounter

```
TYPE ST_ArtNetFrameCounter:
STRUCT
    nDMX_Frames             : UDINT;
    nPOLL_Frames            : UDINT;
    nPOLL_REPLY_Frames      : UDINT;
    nUnknown_ArtNet_Frames  : UDINT;
END_STRUCT
END_TYPE
```

This structure is used for counting different Art-Net™ telegrams.

4.3.5 ST_ArtDMX_Frame

```
TYPE ST_ArtDMX_Frame:
STRUCT
    aPreamble        : ARRAY [0..7] OF BYTE; (*'Art-Net' 0x00*)
    aOpCode          : ARRAY [0..1] OF BYTE; (*OpDmx,transmitted low byte first - see
E_ArtNet_OpCodes*)
    aProtocolVersion : ARRAY [0..1] OF BYTE; (*The Art-Net protocol revision number*)
    nSequence        : BYTE;                 (*The sequence number is used to ensure that ArtDmx
packets are used in the correct order.*)
    nPhysical        : BYTE;                 (*The physical input port from which DMX512 data was
input.*)
    nSubUni          : BYTE;                 (*The low byte of the 15 bit Port-Address to which this
packet is destined.*)
    nNet             : BYTE;                 (*The top 7 bits of the 15 bit Port-Address to which
this packet is destined.*)
    aLenght          : ARRAY [0..1] OF BYTE; (*Length of the data array - should be an even number
in the range 2-512.*)
    aData            : ARRAY [0..1] OF BYTE; (*array of DMX data*)
END_STRUCT
END_TYPE
```

This structure is used for sending and receiving DMX data. It matches the telegram described in the Art-Net™ specification (www.Art-Net.org.uk) under 'ArtDMX'.

4.3.6 ST_ArtPOLL_Frame

```
TYPE ST_ArtPOLL_Frame:
STRUCT
    aPreamble        : ARRAY [0..7] OF BYTE; (*'Art-Net' 0x00*)
    aOpCode          : ARRAY [0..1] OF BYTE; (*OpDmx,transmitted low byte first - see
E_ArtNet_OpCodes*)
    aProtocolVersion : ARRAY [0..1] OF BYTE; (*the Art-Net protocol revision number*)
    nTalkToMe        : BYTE;                 (*Set behaviour of Node*)
    nPriority        : BYTE;                 (*Diagnostics Priority Code*)
END_STRUCT
END_TYPE
```

This structure is used for sending 'Poll' telegrams. It is based on the telegram described in the Art-Net™ specification (www.Art-Net.org.uk) under 'ArtPOLL'.

4.3.7 ST_ArtPOLLREPLY_Frame

```
TYPE ST_ArtPOLLREPLY_Frame:
STRUCT
    aPreamble        : ARRAY [0..7] OF BYTE; (*'Art-Net' 0x00*)
    aOpCode          : ARRAY [0..1] OF BYTE; (*OpDmx,transmitted low byte first - see
E_ArtNet_OpCodes*)
    aIP              : ARRAY [0..3] OF BYTE; (*Array containing the Node's IP address*)
    aPort            : ARRAY [0..1] OF BYTE; (*The value of the used UDP Port, should always be
0x1936, transmitted low byte first.*)
    aVersionInfo     : ARRAY [0..1] OF BYTE; (*Node's firmware revision number.*)
    nNetSwitch       : BYTE;                 (*Bits 14-8 of the 15 bit Port-Address are encoded into
the bottom 7 bits of this field.*)
    nSubSwitch       : BYTE;                 (*Bits 7-4 of the 15 bit Port-Address are encoded into
the bottom 4 bits of this field.*)
```

```
    aOem             : ARRAY [0..1] OF BYTE; (*The Oem describes the equipment vendor*)
    nUbeaVersion     : ARRAY [0..1] OF BYTE; (*This field contains the firmware version of the User
Bios Extension Area (UBEA).)
    nStatus1         : BYTE;                 (*General Status register*)
    nESTA            : ARRAY [0..1] OF BYTE; (*The ESTA manufacturer code*)
    aShortName       : ARRAY [0..17] OF BYTE; (*Node's short name*)
    aLongName        : ARRAY [0..63] OF BYTE; (*Node's long name*)
    aNumPorts        : ARRAY [0..1] OF BYTE; (*The low byte describing the number of input or output
ports. The maximum value is 4.*)
    aPortTypes       : ARRAY [0..3] OF BYTE; (*This array defines the operation and protocol of each
channel.*)
    aGoodInput       : ARRAY [0..3] OF BYTE; (*This array defines input status of the node.*)
    aGoodOutput      : ARRAY [0..3] OF BYTE; (*This array defines output status of the node.*)
    aSwIn            : ARRAY [0..3] OF BYTE; (*Bits 3-0 of the 15 bit Port-Address for each of the 4
possible input ports are encoded into the low nibble.*)
    aSwOut           : ARRAY [0..3] OF BYTE; (*Bits 3-0 of the 15 bit Port-Address for each of the 4
possible output ports are encoded into the low nibble.*)
    nSwVideo         : BYTE;                 (*Set to 00 when video display is showing local data.
Set to 01 when video is showing ethernet data.*)
    nSwMacro         : BYTE;                 (*If the Node supports macro key inputs, this byte
represents the trigger values.*)
    nSwRemote        : BYTE;                 (*If the Node supports remote trigger inputs, this byte
represents the trigger values.*)
    aSpare           : ARRAY [0..2] OF BYTE;
    nStyle           : BYTE;                 (*The Style code defines the equipment style of the
device.*)
    aMAC             : ARRAY [0..5] OF BYTE; (*Node's MAC-Address*)
    aBindIP          : ARRAY [0..3] OF BYTE; (*If this unit is part of a larger or modular product,
this is the IP of the root device.*)
    nBindIndex       : BYTE;                 (*Set to zero if no binding, otherwise this number
represents the order of bound devices*)
    nStatus2         : BYTE;                 (*Status register*)
END_STRUCT
END_TYPE
```

This structure is used for sending and receiving PollRepl-' telegrams. It matches the telegram described in the Art-Net™ specification (www.Art-Net.org.uk) under 'ArtPOLLREPLY'.

5 Examples

5.1 Art-Net Send / Receive in Broadcast mode

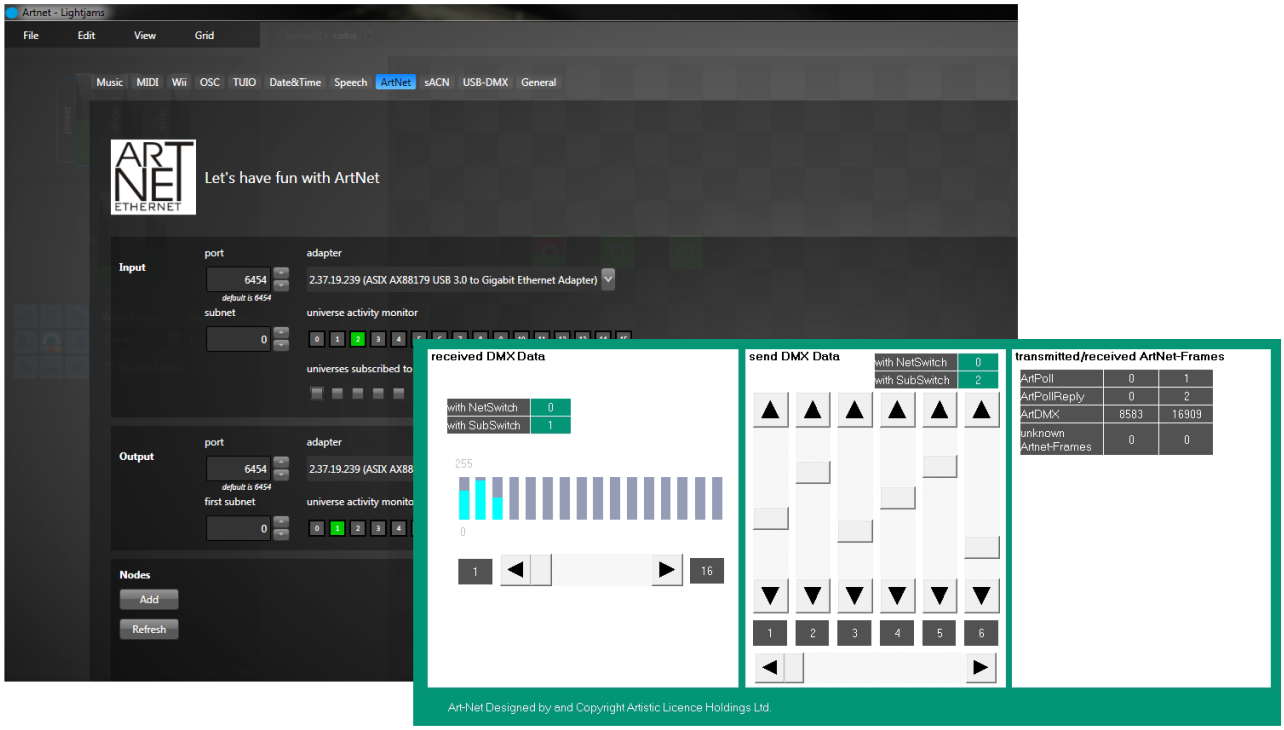
You can download the example here:

https://infosys.beckhoff.com/content/1033/artnet/Resources/1438397835.zip

The example consists of a PLC program and a Lightjams project file.
Data are sent and received in Broadcast mode to/from a computer, on which the Lightjams project is executed.

The individual function blocks of the example are explained in the "Programming" section.

The TwinCAT function TwinCAT TCP/IP Server is required for the example.



Based on this example, the user data of the Art-Net™ frame can be linked with any PLC variables. Links enabled by the modular Beckhoff control system include

- Art-Net™ to DMX (EL6851 and EL6851-0010)
- Art-Net™ to dimmer (KL2761 and KL2751)
- Art-Net™ to DALI (KL6811)
- Art-Net™ to stepper or DC motor
- Art-Net™ to digital IOs (e.g. 24V or 230V)
- Art-Net™ to analog IOs (e.g. 0-10V or 4-20mA).

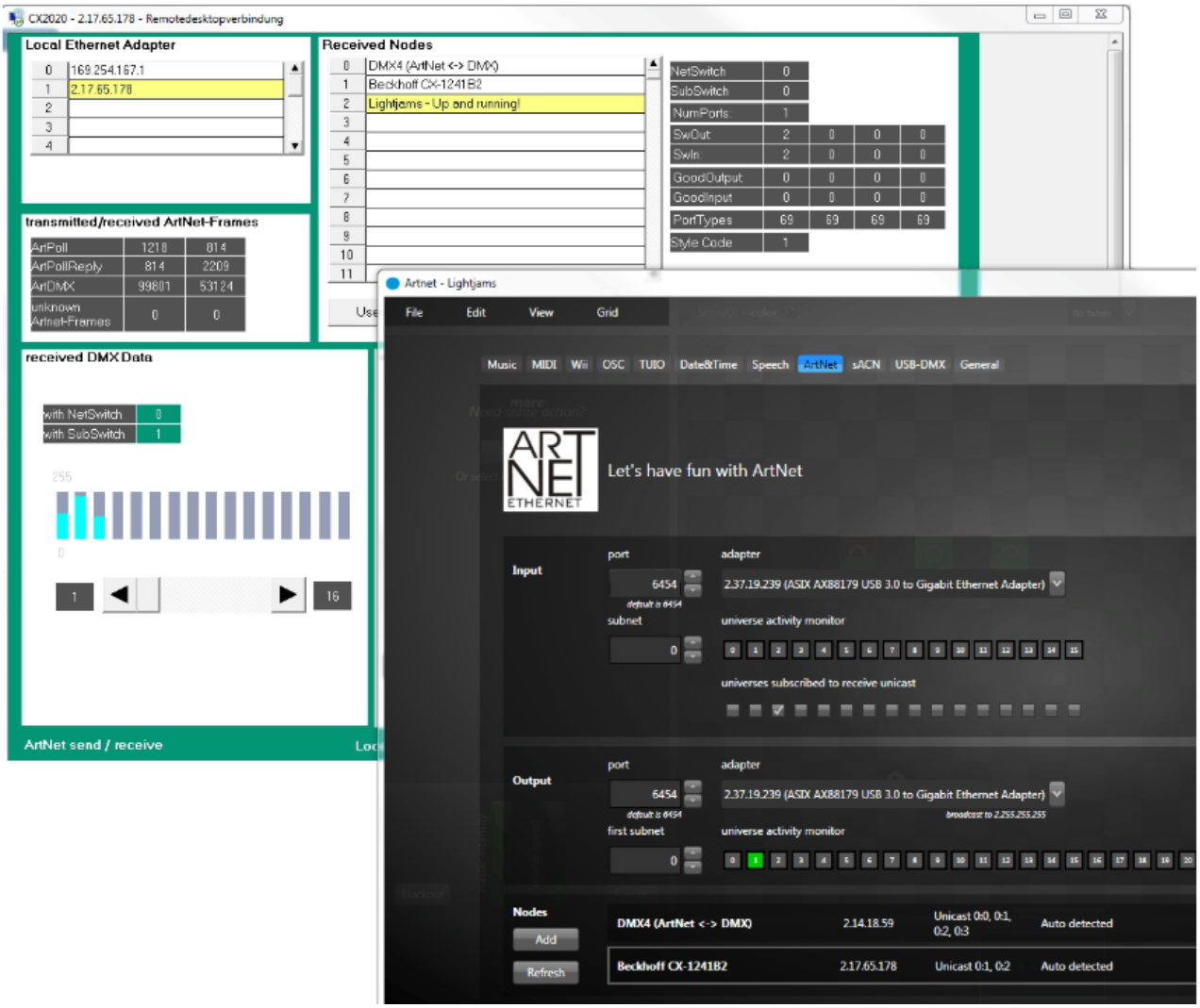
5.2 Art-Net Send / Receive in Unicast mode

You can download the example here:

https://infosys.beckhoff.com/content/1033/artnet/Resources/1438399499.zip

The example includes a PLC program and a Lightjams project file, plus a short video clip that describes the configuration.
Data are sent and received in Unicast mode to/from a computer, on which the Lightjams project is executed.
The individual function blocks of the example are explained in the "Programming" section.

The TwinCAT function TwinCAT TCP/IP Server is required for the example.



Based on this example, the user data of the Art-Net™ frame can be linked with any PLC variables. Links enabled by the modular Beckhoff control system include

- Art-Net™ to DMX (EL6851 and EL6851-0010)
- Art-Net™ to dimmer (KL2761 and KL2751)
- Art-Net™ to DALI (KL6811)
- Art-Net™ to stepper or DC motor
- Art-Net™ to digital IOs (e.g. 24V or 230V)
- Art-Net™ to analog IOs (e.g. 0-10V or 4-20mA).

Trademark statements

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More Information:
www.beckhoff.com/entertainment-industrie

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com