810344-1.1 NeurOne Digital Out Technote

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Version 1.1

Introduction

This technote describes the UDP interface used in NeurOne system digital out feature for beta users.

NeurOne system can be configured to emit digital measurement data via an add-on Ethernet port. This is ideally suited for real-time solutions where minimally manipulated digital data is required with minimum latency.

This technote applies to NeurOne PC Software version 1.4.1.56 and NeurOne Main Unit firmware version 1.3_BETA8.

Specification

The following parameters can be configured by the user:

- Inputs that are directed to digital out port
- Destination IP address and UDP port for emitted digital out packets
- Digital out packet delivery frequency

The configuration itself is dependent on the user application driving NeurOne measurement hardware and is thus out of scope of this document.

Features

The emitted data is delivered at the sampling rate the measurement is running (i.e. there's no additional downsampling performed), at regular intervals. The chosen delivery rate (i.e. how often UDP datagrams are emitted) depends on measurement configuration and it cannot be higher that the measurement sampling rate. User can request delivery rates of 100 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 3 kHz, 4 kHz and 5 kHz.

Digital out sample packets

The digital out sample packets contain measured digital samples. The samples are delivered in bundles. A bundle contains a sample for every channel for the same time instant. In other words, the samples are delivered as channel-interleaved and the samples of every channel from a single moment in time are delivered within the same sample packet.

This packet also describes the sample index and time stamp for the first sample contained.

The sample packet structure is shown in Table 1.

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Table 1. Sample packet structure.

Type	Description
UInt8	Sample packet identifier
UInt8	Main unit indication
UInt8	Not in use
UInt8	Not in use
UInt32	Packet sequency number
UInt16	Number of channels
UInt16	Number of sample bundles in this packet
UInt64	Sample index of the first bundle from the start of measurement
UInt64	Time stamp of the first bundle in microseconds from start of measurement
Int24[][]	Data samples (channel-interleaved)

Examples

This chapter contains examples of how to parse sample packets. Examples can be repeated using the GNU Octave codes (Appendix A). GNU Octave is freely distributed software that is intended for numerical computations. The GNU Octave scripts need the GNU Octave sockets package. By default, the received values in the sample packets are in 8-bit unsigned format.

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Example 1. Only one channel is directed to the digital out and both the sampling rate and packet delivery frequency are set to be 500 Hz.

Table 2. The values of sample packet number 25. The values are in 8-bit unsigned format.

Byte	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Value uint8	2	0	0	0	0	0	0	24	0	1	0	1	0	0	0	0
Byte	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	
Value uint8	0	0	0	24	0	0	0	0	0	0	187	128	255	114	58	

Table 3. Illustration on parsing the sample packets.

Type	**Description**	**Value uint8**	**Value**
UInt8	Sample packet identifier	2	2
UInt8	Main unit indication	0	0
UInt8	Not in use	0	0
UInt8	Not in use	0	0
UInt32	Packet sequency number	0 0 0 24	24
UInt16	Number of channels	0 1	1
UInt16	Number of sample bundles	0 1	1
UInt64	Sample index of the first bundle	0 0 0 0 0 0 0 24	24
UInt64	Time stamp of the first bundle	0 0 0 0 0 0 187 128	48000
Int24[][]	Data samples	255 114 58	-36294

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Example 2. Two channels are directed to the digital out and both the sampling rate and packet delivery frequency are set to be 500 Hz.

Table 4. The values of sample packet number 31. The values are in 8-bit unsigned format.

Byte	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Value uint8	2	0	0	0	0	0	0	30	0	2	0	1	0	0	0	0	0
Byte	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**
Value uint8	0	0	0	30	0	0	0	0	0	234	96	248	231	55	248	232	51

Table 5. Parsing the sample packet 31.

Type	**Description**	**Value uint8**	**Value**
UInt8	Sample packet identifier	2	2
UInt8	Main unit indication	0	0
UInt8	Not in use	0	0
UInt8	Not in use	0	0
UInt32	Packet sequency number	0 0 0 30	30
UInt16	Number of channels	0 2	2
UInt16	Number of sample bundles	0 1	1
UInt64	Sample index of the first bundle	0 0 0 0 0 0 0 30	24
UInt64	Time stamp of the first bundle	0 0 0 0 0 0 234 96	60000
Int24	Data sample channel1	248 231 55	-465097
Int24	Data sample channel2	248 232 51	-464845

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Example 3. Only one channel is directed to the digital out and the sampling rate and packet delivery frequency are set to be 500 Hz and 100 Hz, respectively.

Table 6. The values of sample packet number 52. The values are in 8-bit unsigned format.

Byte	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Value uint8	2	0	0	0	0	0	0	51	0	1	0	5	0	0	0
Byte	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Value uint8	0	0	0	0	255	0	0	0	0	0	7	200	48	249	247
Byte	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**		
	34	249	233	27	249	218	135	249	210	6	249	205	203		

Table 5. Parsing the sample packet 52.

Type	**Description**	**Value uint8**	**Value**
UInt8	Sample packet identifier	2	2
UInt8	Main unit indication	0	0
UInt8	Not in use	0	0
UInt8	Not in use	0	0
UInt32	Packet sequency number	0 0 0 51	51
UInt16	Number of channels	0 1	1
UInt16	Number of sample bundles	0 5	5
UInt64	Sample index of the first bundle	0 0 0 0 0 0 0 0 255	255
UInt64	Time stamp of the first bundle	0 0 0 0 0 7 200 48	60000
Int24	Data sample sample index255	249 247 34	-395486
Int24	Data sample sample index256	249 233 27	-399077
Int24	Data sample sample index257	249 218 135	-402809
Int24	Data sample sample index258	249 210 6	-404986
Int24	Data sample sample index259	249 205 203	-406069

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Appendix A

GNU Octave script for receiving UDP sample packets:

```
pkg load sockets %loads the needed sockets packet
buff_size=50; %buffer size must be greater than the packet size
rcv_port=50000; %target port number
rcv_sck=socket(AF_INET, SOCK_DGRAM, 0);
bind(rcv_sck,rcv_port);
[str,len_s]=recv(rcv_sck,buff_size); %the first packet is empty packet

for n=1:10
  [pckt(n,:),len_s]=recv(rcv_sck,60); % buffer must be greater that the
packet size
end
```

Note: This script is intended only for test purposes. It is not suitable for real-time measurements.

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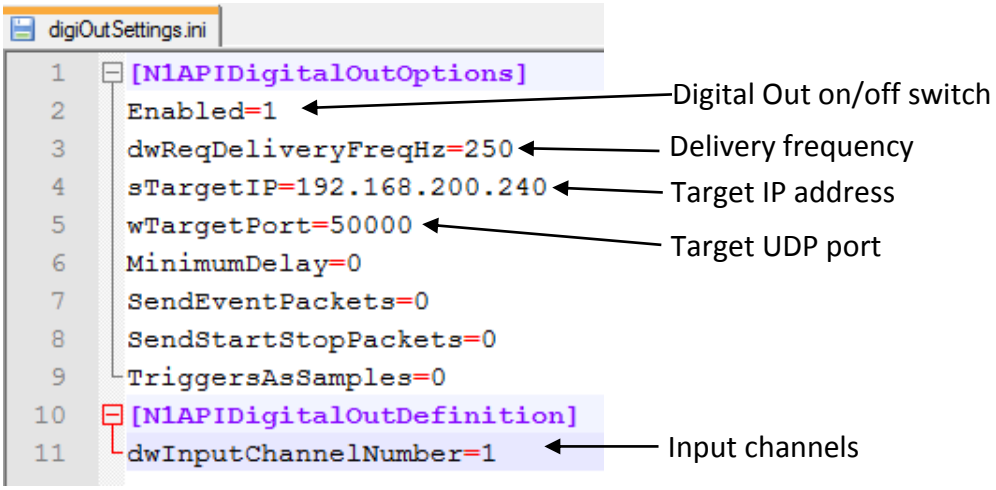
Appendix B

Digital Out settings in the beta version can be configured by modifying `digiOutSettings.ini` file that is located in the NeurOne MiscData folder, by default:

```
C:\ProgramData\Mega Electronic Ltd\NeurOne64
```

Note: Audio out and Analog out must be switched off when using Digital out in this version.

User can modify delivery frequency, target IP address, target port number, and input channels. The format for input channels is comma-separated. Make sure that the protocol you use has these inputs.



Example: Digital out for input channels 1-5 at 500 Hz to the default target address and port.

1. Open `digiOutSettings.ini` file
2. Modify the highlighted fields to be as follows:

```
[N1APIDigitalOutOptions]
Enabled=1
dwReqDeliveryFreqHz=500
sTargetIP=192.168.200.240
wTargetPort=50000
MinimumDelay=0
SendEventPackets=0
SendStartStopPackets=0
TriggersAsSamples=0
[N1APIDigitalOutDefinition]
dwInputChannelNumber=1,2,3,4,5
```

3. Save digiOutSettings.ini file