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ad notam Display Frame Unit (DFU)

IR Protocol Description

VERSION 4.xx

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Document Revisions

Ver.	Date	Authors	Remarks
3.0	May 23, 2013	Dovi Engler	First Ver. 3.0 Release (For previous versions please see ver. 1.6 dated 15.03.2013)
3.1	June 19, 2013	Dovi Engler	"Left / Volume-" is now 0x6C (108) "Right / Volume+" is now 0x6D (109)
4.0	June 18, 2014	Dovi Engler	New commands following new controller Board "Input VGA": 0x0C (12)

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1 Introduction

In 2013 it was decided that future ad notam products shall use the Extended NEC protocol for its IR commands. This document describes the details for DFU IR control.

2 IR Control Protocol

2.1 General Description of the NEC Protocol

The NEC protocol uses pulse distance encoding of the bits. Each pulse is a 560µs long 38kHz carrier burst (26.3µs). Logical bits are transmitted as follows:

Logical '0' – a 562.5µs pulse burst followed by a 562.5µs space, with a total transmit time of 1.125ms

Logical '1' – a 562.5µs pulse burst followed by a 1.6875ms space, with a total transmit time of 2.25ms

When a key is pressed on the remote controller, the message transmitted consists of the following, in order:

- A 9ms leading pulse burst
- A 4.5ms space
- The 8-bit address for the receiving device
- The 8-bit logical inverse of the address
- The 8-bit command
- The 8-bit logical inverse of the command
- A final 562.5µs pulse burst to signify the end of message transmission.

The four bytes of data bits are each sent least significant bit first. Figure 8 illustrates the format of an NEC IR transmission frame, for an address of 59h and a command of 16h.

Fig. 1   Example message frame using the NEC IR transmission protocol
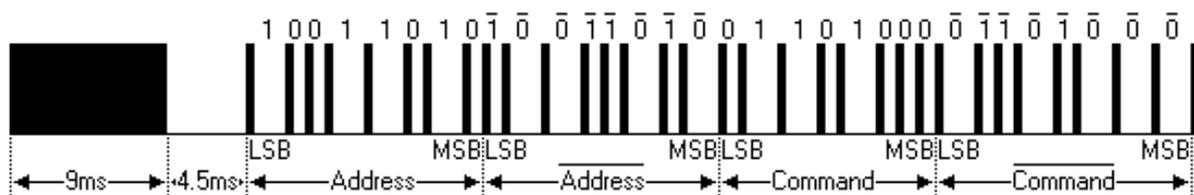
A command is transmitted only once, even when the key on the remote control remains pressed. Every 110ms a repeat code is transmitted for as long as the key remains down.

Fig. 2   Example message when the key on the remote control remains pressed
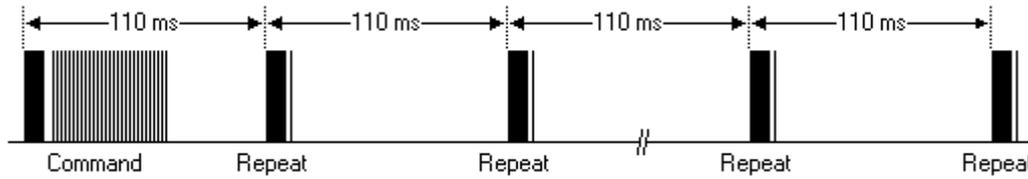
Fig. 3   One burst of code
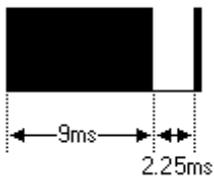
This repeat code is simply a 9ms AGC pulse followed by a 2.25ms space and a 560μs burst.

2.1.1   Extended NEC Protocol

By sacrificing the address redundancy the address range was extended from 256 possible values to approximately 65000 different values. This way the address range was extended from 8 bits to 16 bits without changing any other property of the protocol. The command redundancy is still preserved. Therefore each address can still handle 256 different commands.

Fig. 4   Example message frame using the Extended NEC IR transmission protocol.
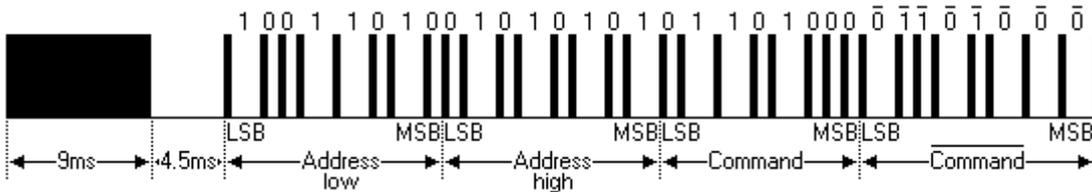
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2.2 ad notam IR-Protocol

This section describes the ad notam specific implementation of the Extended NEC IR-protocol.

2.2.1 Remote Control Address

A DFU shall always listen to two device addresses:

> The first one shall be configurable in the OSD in the range between 4E.00 – 4E.FE (device address = 0 to 254) whereas the setting at time of shipment or after reset shall be 4E.00.

> The second address 4E.FF (device address = 255) is the master address, which is fixed programmed in the DFU.

A remote control is always programmed with only 1 (one) address 4E.00 – 4E.FE (0 to 254) or 4E.FF (255). The standard remote control shall be preprogrammed with address 4E.FF (master address).

Example for Device Address Behavior

A remote control that is programmed with device address 4E.24 can only control the DFU that is also programmed with device address 4E.24. DFUs with different addresses will not listen to this remote control and ignore its commands.

A remote control that is programmed with the master code 4E.FF can control all DFUs, because all DFUs always "listen" to this master address. E.g. a service engineer uses this "master remote control" to operate any DFU.

2.2.2   IR Commands

Fig. 5   IR Command List (Master Device Address 0x4E.FF)

Command	Code (HEX)	Code (DEC)
Power Toggle	0x07	7
Power On	0x1F	31
Power Off	0x1E	30
Sleep Timer (Toggle)	0x15	21
Sleep Timer Off	0x66	102
Digit 1	0x21	33
Digit 2	0x22	34
Digit 3	0x23	35
Digit 4	0x25	37
Digit 5	0x26	38
Digit 6	0x27	39
Digit 7	0x29	41
Digit 8	0x2A	42
Digit 9	0x2B	43
Digit 0	0x28	40
Up / Channel + [1]	0x6A	106
Down / Channel - [1]	0x6B	107
Left / Volume - [1]	0x6C	108
Right / Volume + [1]	0x6D	109
Ok	0xC0	192
Up	0xC1	193
Down	0xC2	194
Left	0xC3	195
Right	0xC4	196
Volume +	0x04	4
Volume -	0x00	0
Mute	0x06	6
Mute On	0x71	113
Mute Off	0x72	114
Play	0x2D	45
Pause	0x2F	47
Stop	0x30	48
Skip forward / Chapter +	0x31	49
Skip backwards / Chapter -	0x32	50
Fast Forward	0x33	51
Fast Backward	0x34	52
Setup	0x05	5
Exit	0xCB	203
Input Select (Toggle)	0x0B	11
Input HDMI 1	0x0E	14
Input HDMI 2	0x0F	15
Input HDMI 3	0x37	55
Input Component	0x1D	29
Input USB / DMP	0x35	53
Input VGA	0x0C	12
Aspect Select (Toggle)	0x3C	60

[1]   Up / Down / Left / Right should work only if OSD is on-screen. If the OSD is not on-screen the Left / Right commands will function as Volume - / Volume + respectively.

2.2.3 Waterproof Remote Control

The following map and code table shows all IR commands of the DFU as used on the waterproof remote control.

Fig. 6   Waterproof Remote Control: Key Map

	A	B	C	D
1	POWER			SOURCE
2	1	2	3	CH+
3	4	5	6	CH-
4	7	8	9	V+
5	TXT	0	EPG	V-
6	MENU	UP	GOTO	MUTE
7	LEFT	OK	RIGHT	INFO
8	EXIT	DOWN	BACK	LEARN
9	RED	GREEN	YELLOW	BLUE
10	SETUP	TV/R	FAV	DIM PWR
11	SLEEP	ASPECT	AUDIO	DIM PRESET

RC "LEARN" MODE

DFU IR CODES

STB IR CODES

DIMMER IR CODES

DFU/STB SHARED IR CODES

Fig. 7   Waterproof Remote Control: Code Table

Btn	Code (Hex)	Code (Dec)	Device	Function
1A	0x07	7	DFU	POWER TOGGLE
1B				
1C				
1D	0x0B	11	DFU	SOURCE
2A	0xB1	177	STB	NUMERIC 1
2B	0xB2	178	STB	NUMERIC 2
2C	0xB3	179	STB	NUMERIC 3
2D	0xA1	161	STB	CHANNEL UP
3A	0xB4	180	STB	NUMERIC 4
3B	0xB5	181	STB	NUMERIC 5
3C	0xB6	182	STB	NUMERIC 6
3D	0xA2	162	STB	CHANNEL DOWN
4A	0xB7	183	STB	NUMERIC 7
4B	0xB8	184	STB	NUMERIC 8
4C	0xB9	185	STB	NUMERIC 9
4D	0x04	4	DFU	VOLUME UP
5A	0xA5	165	STB	TELETEXT
5B	0xB0	176	STB	NUMERIC 0
5C	0xA6	166	STB	EPG
5D	0x00	0	DFU	VOLUME DOWN
6A	0xCA	202	STB	MENU
6B	0xC1	193	DFU/STB	CURSOR UP
6C	0xD2	210	STB	GOTO
6D	0x06	6	DFU	MUTE
7A	0xC3	195	DFU/STB	CURSOR LEFT
7B	0xC0	192	DFU/STB	OK
7C	0xC4	196	DFU/STB	CURSOR RIGHT
7D	0xD5	213	STB	INFO

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8A	0xCB	203	DFU/STB	EXIT
8B	0xC2	194	DFU/STB	CURSOR DOWN
8C	0xD4	212	STB	BACK
8D	None	None	RC	Programming
9A	0xAC	172	STB	RED
9B	0xAD	173	STB	GREEN
9C	0xAE	174	STB	YELLOW
9D	0xAF	175	STB	BLUE
10A	0x05	5	DFU	SETUP (OSD)
10B	0xC7	199	STB	TV/RADIO
10C	0xD7	215	STB	FAV
10D	0x82	130	DIMMER	POWER TOGGLE
11A	0x15	21	DFU	SLEEP
11B	0x3C	60	DFU	ASPECT
11C	0xD3	211	STB	AUDIO
11D	0x8A	138	DIMMER	PRESET 1

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2.2.4   SlimLine Remote Control

The following map and code table shows all IR commands of the DFU as used on the SlimLine remote control.

Fig. 8   SlimLine Remote Control: Key Map

	A	B	C	D
1	Pwr		Src	
2	1	2	3	
3	4	5	6	
4	7	8	9	
5	TXT	0	EPG	
6	Menu	TV/R	GOTO	
7		Up		
8	Left	OK	Right	
9		Dwn		
10	Exit	FAV	Back	
11	Red	Green	Yellow	Blue
12	V+	Info	CH+	
13	V-	Mute	CH-	
14	Stop	Rec	Play	Pause
15	Setup	I<<	>>I	Dim1
16	Sleep	Aspect	Audio	Dim2

	DFU IR CODES
	STB IR CODES
	DIMMER IR CODES
	DFU/STB SHARED IR CODES

Fig. 9   SlimLine Remote Control: Code Table

Btn	Code (Hex)	Code (Dec)	Device	Function
1A	0x07	7	DFU	POWER TOGGLE
1C	0x0B	11	DFU	SOURCE
2A	0xB1	177	STB	NUMERIC 1
2B	0xB2	178	STB	NUMERIC 2
2C	0xB3	179	STB	NUMERIC 3
3A	0xB4	180	STB	NUMERIC 4
3B	0xB5	181	STB	NUMERIC 5
3C	0xB6	182	STB	NUMERIC 6
4A	0xB7	183	STB	NUMERIC 7
4B	0xB8	184	STB	NUMERIC 8
4C	0xB9	185	STB	NUMERIC 9
5A	0xA5	165	STB	TELETEXT
5B	0xB0	176	STB	NUMERIC 0
5C	0xA6	166	STB	EPG
6A	0xCA	202	STB	MENU
6B	0xC7	199	STB	TV/RADIO
6C	0xD2	210	STB	GOTO
7B	0xC1	193	DFU/STB	CURSOR UP
8A	0xC3	195	DFU/STB	CURSOR LEFT
8B	0xC0	192	DFU/STB	OK
8C	0xC4	196	DFU/STB	CURSOR RIGHT
9B	0xC2	194	DFU/STB	CURSOR DOWN
10A	0xCB	203	DFU/STB	EXIT
10B	0xD7	215	STB	FAV
10C	0xD4	212	STB	BACK
11A	0xAC	172	STB	RED
11B	0xAD	173	STB	GREEN
11C	0xAE	174	STB	YELLOW

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11D	0xAF	175	STB	BLUE
12A	0x04	4	DFU	VOLUME UP
12B	0xD5	213	STB	INFO
12C	0xA1	161	STB	CHANNEL UP
13A	0x00	0	DFU	VOLUME DOWN
13B	0x06	6	DFU	MUTE
13C	0xA2	162	STB	CHANNEL DOWN
14A	0x30	48	DFU	STOP
14B	0x2E	46	DFU	RECORD
14C	0x2D	45	DFU	PLAY
14D	0x2F	47	DFU	PAUSE
15A	0x05	5	DFU	SETUP
15B	0x32	50	DFU	PREV
15C	0x31	49	DFU	NEXT
15D	0x82	130	DIMMER	POWER TOGGLE
16A	0x15	21	DFU	SLEEP
16B	0x3C	60	DFU	ASPECT
16C	0xD3	211	STB	AUDIO
16D	0x8A	138	DIMMER	PRESET