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# ad notam<sup>®</sup>

## ad notam Display Frame Unit (DFU)

# IR Protocol Description

VERSION 3.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)<br>"Right / Volume+" is now 0x6D (109)           |
|      |               |             |   |
|      |               |             |   |

## 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

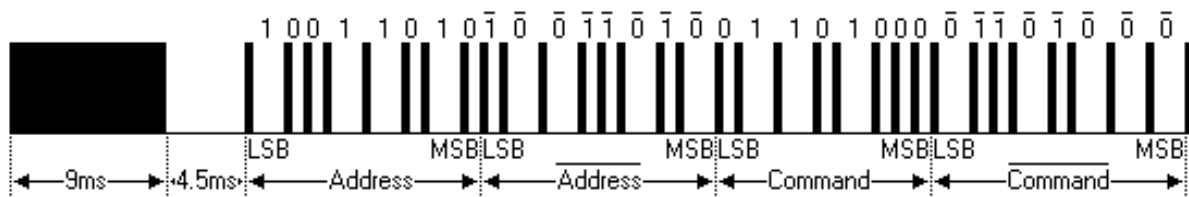
Logical '1' – a 562.5µs pulse burst followed by a 1.6875ms space, with a total transmit time of 2.25ms

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

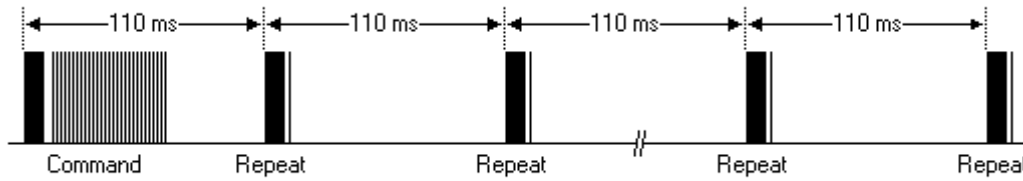
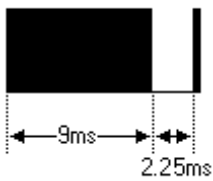


Fig. 3 One burst of code

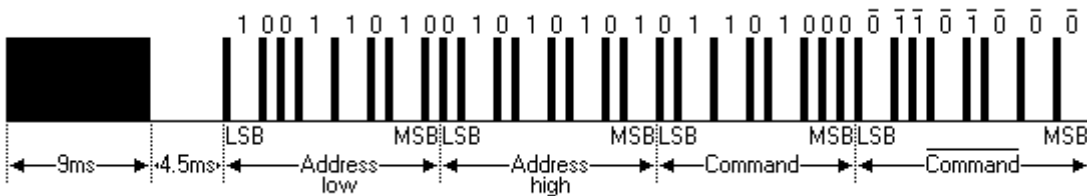


This repeat code is simply a 9ms AGC pulse followed by a 2.25ms space and a 560µs burst.

**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.



## 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         |
| 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         |
|  | <b>DFU IR CODES</b>     |
|  | 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/ST B | CURSOR UP    |
| 6C  | 0xD2       | 210        | STB      | GOTO         |
| 6D  | 0x06       | 6          | DFU      | MUTE         |
| 7A  | 0xC3       | 195        | DFU/ST B | CURSOR LEFT  |
| 7B  | 0xC0       | 192        | DFU/ST B | OK           |
| 7C  | 0xC4       | 196        | DFU/ST B | CURSOR RIGHT |
| 7D  | 0xD5       | 213        | STB      | INFO         |



|     |      |      |         |                 |
|-----|------|------|---------|-----------------|
| 8A  | 0xCB | 203  | DFU/STB | EXIT            |
| 8B  | 0xC2 | 194  | DFU/STB | CURSOR<br>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<br>TOGGLE |
| 11A | 0x15 | 21   | DFU     | SLEEP           |
| 11B | 0x3C | 60   | DFU     | ASPECT          |
| 11C | 0xD3 | 211  | STB     | AUDIO           |
| 11D | 0x8A | 138  | DIMMER  | PRESET 1        |

## 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   | GOT<br>O |       |
| 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  |

|  |                         |
|--|-------------------------|
|  | <b>DFU IR CODES</b>     |
|  | 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       |

|         |      |     |        |                 |
|---------|------|-----|--------|-----------------|
| 11<br>D | 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<br>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            |
| 14<br>D | 0x2F | 47  | DFU    | PAUSE           |
| 15A     | 0x05 | 5   | DFU    | SETUP           |
| 15B     | 0x32 | 50  | DFU    | PREV            |
| 15C     | 0x31 | 49  | DFU    | NEXT            |
| 15<br>D | 0x82 | 130 | DIMMER | POWER<br>TOGGLE |
| 16A     | 0x15 | 21  | DFU    | SLEEP           |
| 16B     | 0x3C | 60  | DFU    | ASPECT          |
| 16C     | 0xD3 | 211 | STB    | AUDIO           |
| 16<br>D | 0x8A | 138 | DIMMER | PRESET          |