ATP Industrial Grade NANODURA Specification

Revision 1.2

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Revision History

Date	Version	Changes compared to previous issue
July. 25th, 2012	1.0	- 1st version
Aug. 23rd, 2012	1.1	- Revised 512MB P/N and Performance
May 28th, 2013	1.2	- Updated the P/N, reliability, performance

1 ATP Industrial Grade NANODURA UFD Overview

1.1 Images

**Laser engraving logo and letters.*

1.2 Capacities

ATP UFD P/N	CAPACITY	COLOR
AF512UFNDNC(I)-AABXX	512MB	Blank
AF1GUFNDNC(I)-AABXX	1GB	Blank
AF2GUFNDNC(I)-AACXX	2GB	Blank
AF4GUFNDNC(I)-AACXX	4GB	Blank
AF8GUFNDNC(I)-9AAXX	8GB	Blank

1.3 Features

USB Interface	UFD Feature
• High Speed USB 2.0 (480Mbps) compliant and backward compatible with USB1.1 (12Mbps) • True "Plug and play" connection support hot swap.	• SIP technology with SLC NAND Flash • Color - Black

System Support
• No driver needed for Windows 7 / Vista / 2000 / ME / XP, Mac. OS 9.x or above. Linux Kernel 2.4.0 or above • Device driver is needed for Windows 98SE

2 Product Specification

2.1 Electrical Specifications

Symbol	Parameter	Min.	Typ.	Max.	Unit
Vcc	Recommend Supply Voltage	4.5	5.0	5.5	V
Vpeak	Peak Voltage on any pin	-0.3	-	5.5	V
Icc	Operating Current (read & write)	-	100	-	mA
I_{SB}	Standby Current	-	50	-	mA

2.2 Environment Specifications:

Parameter		Value
Temperature	Operating	-40°C to 85°C
	Non-Operating	-40°C to 85°C
Humidity	Operating	25 °C, 95% RH
	Non-Operating	40 °C, 93% RH
ESD *(IEC61000-4-2)*	Non contact pads	+/- 15KV (Air discharge)
	Contact pads	+/- 8KV (Coupling plane discharge)
	Contact pads	+/- 4KV
Salt Water Spray	Non-Operating	3%NaCI/35, Over 85%RH, 24hours
Drop Test	Non-Operating	150cm/free fall, total 6 drops
Random Vibration	Non-Operating	10~2000Hz, 6 Grms, 30 mins per axis
UV Light Exposure Test	Non-Operating	254nm, 15Ws/cm2

2.3 Reliability:

Type	Measurement	
Endurance	Global Wear Leveling algorithm SLC block endurance: >60,000 P/E cycles	
Endurance TBW (Total Bytes Written)	512MB	up to 6 terabyte random write up to 12 terabyte random write
	1G	up to 12 terabyte random write up to 24 terabyte sequential write
	2G	up to 24 terabyte random write up to 48 terabyte sequential write
	4GB	up to 48 terabyte random write up to 96 terabyte sequential write
	8GB	up to 96 terabyte random write up to 192 terabyte sequential write
MTBF (25℃)	>5,000,000 hours	

2.4 Performance:

Type	Parameter	Value
512MB	Sequential read	up to 18MByte/s
	Sequential write	up to 10MByte/s
1GB	Sequential read	up to 18MByte/s
	Sequential write	up to 14MByte/s
2GB	Sequential read	up to 20MByte/s
	Sequential write	up to 16MByte/s
4GB	Sequential read	up to 19MByte/s
	Sequential write	up to 17MByte/s
8GB	Sequential read	up to 18MByte/s
	Sequential write	up to 16MByte/s

Note: Tested by HDBENCH 3.4 with 40MB file size. The performance may vary based on configuration, firmware/setting and testing environment.

2.5 Extra Features:

Type	Value
Water Proof	Yes
Dust Proof	Yes
ESD Proof	Yes
Shock Resistant	Yes

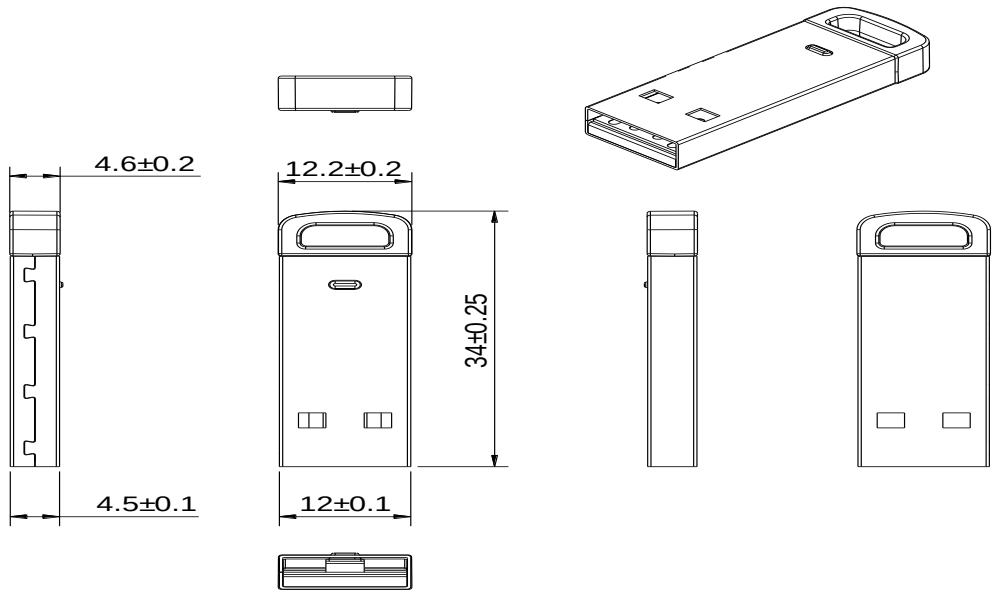
2.6 Certifications

Mark/Approval	Documentation	Certification
CE	The CE marking (also known as CE mark) is a mandatory conformance mark on many products placed on the single market in the European Economic Area (EEA). The CE marking certifies that a product has met EU consumer safety, health or environmental requirements. CE stands for Conformité Européenne, "European conformity" in French.	Yes
FC	FCC Part 15 Class B was used for Evolution of United States (US) Emission Standards for Commercial Electronic Products, The United States (US) covers all types of unintentional radiators under Subparts A and B (Sections 15.1 through 15.199) of FCC 47 CFR Part 15, usually called just FCC Part 15	Yes
RoHS	RoHS is the acronym for Restriction of Hazardous Substances. RoHS, also known as Directive 2002/95/EC, originated in the European Union and restricts the use of specific hazardous materials found in electrical and electronic products. All applicable products in the EU market after July 1, 2006 must pass RoHS compliance. For the complete directive, see Directive 2002/95/EC of the European Parliament.	Yes

2.7 Physical Dimension Specifications (Units in MM):

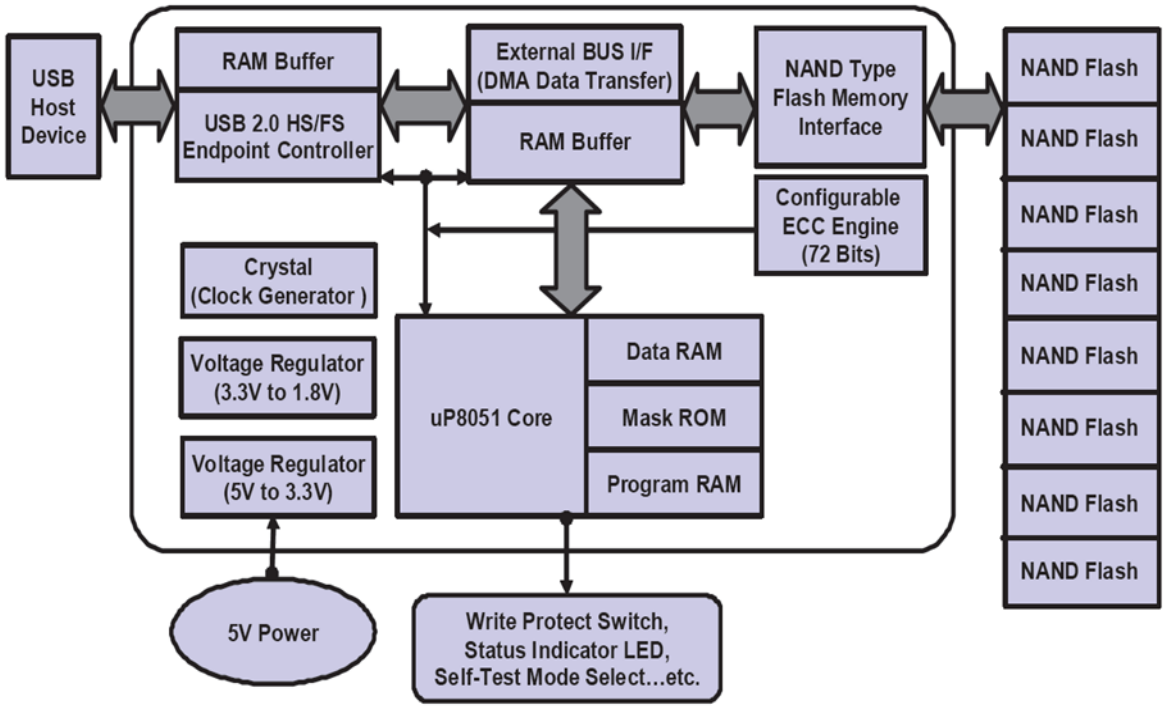
Type	Value
Length*	34mm +/- 0.25mm
Width	12.2mm +/- 0.2mm
Thickness	4.5mm +/- 0.1mm
Weight*	8g Max.

2.8 Mechanical Form Factor (Units in MM)

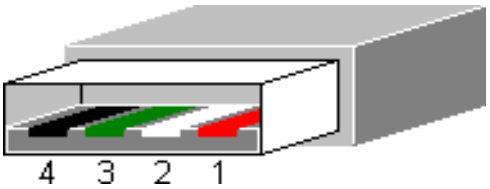


3 Electrical Interface

3.1 Block Diagram



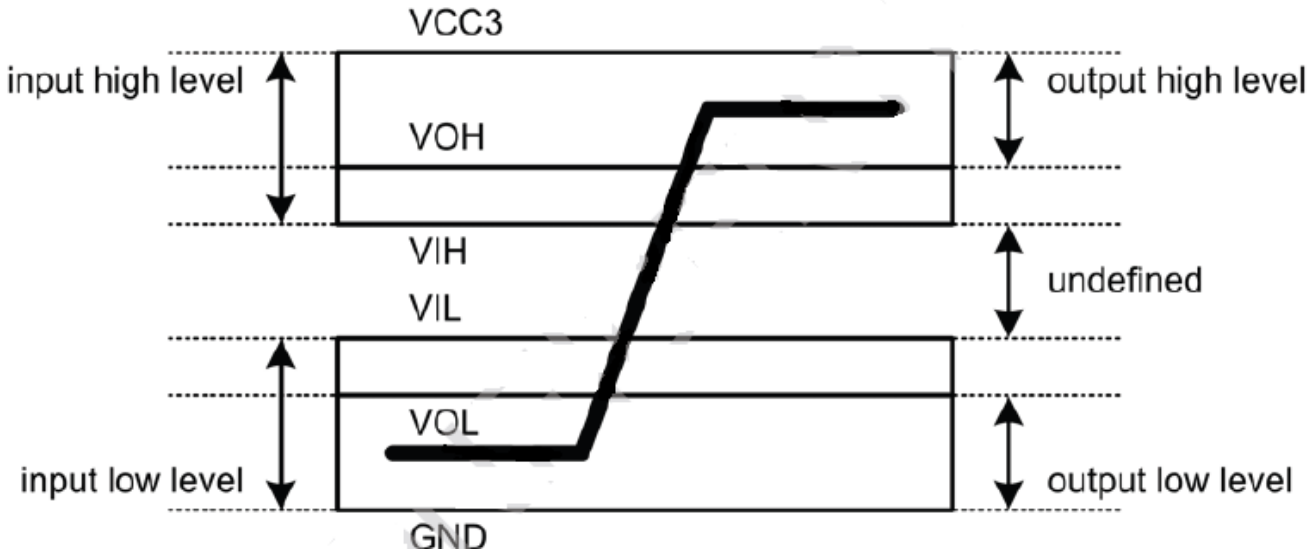
3.2 Pin Assignment



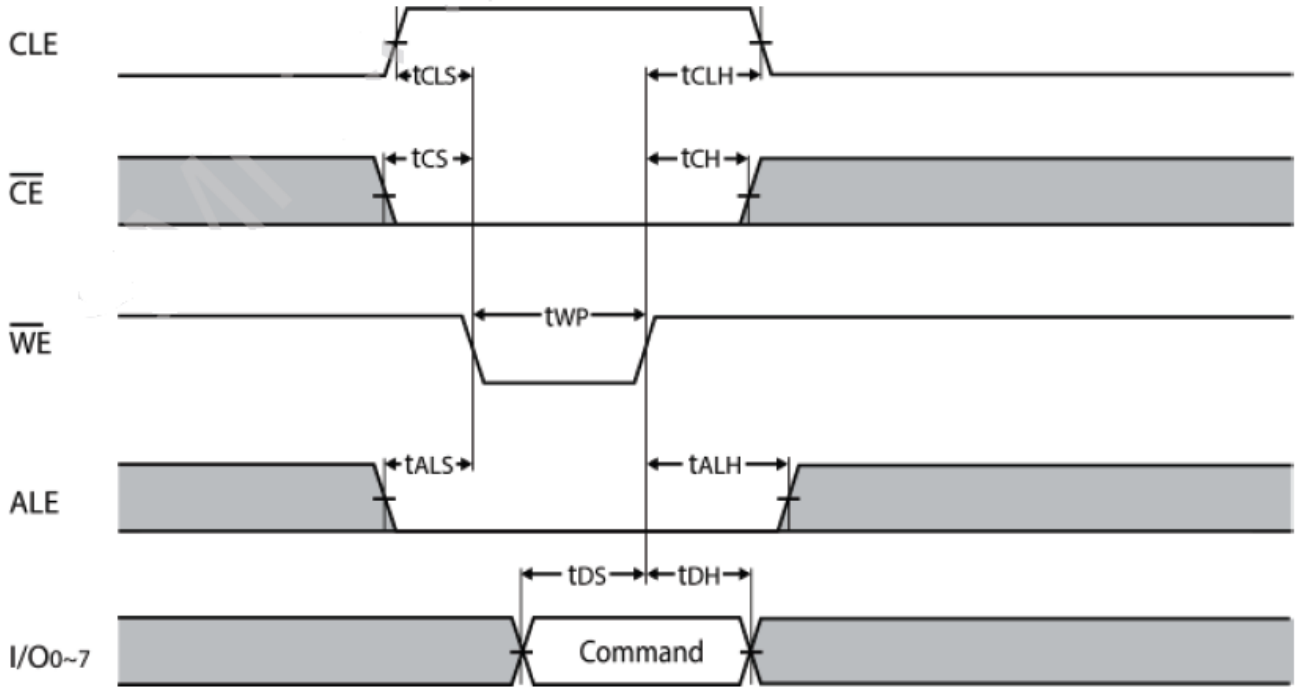
Pin	Name	Color	Function
1	**Vcc**	Red	+5V supply voltage
2	**D-**	White	Data- signal line
3	**D+**	Green	Data+ signal line
4	**GND**	Black	Supply ground

*ATP UFD uses SIP process without additional GND connection to shield and has better ESD protection than others.

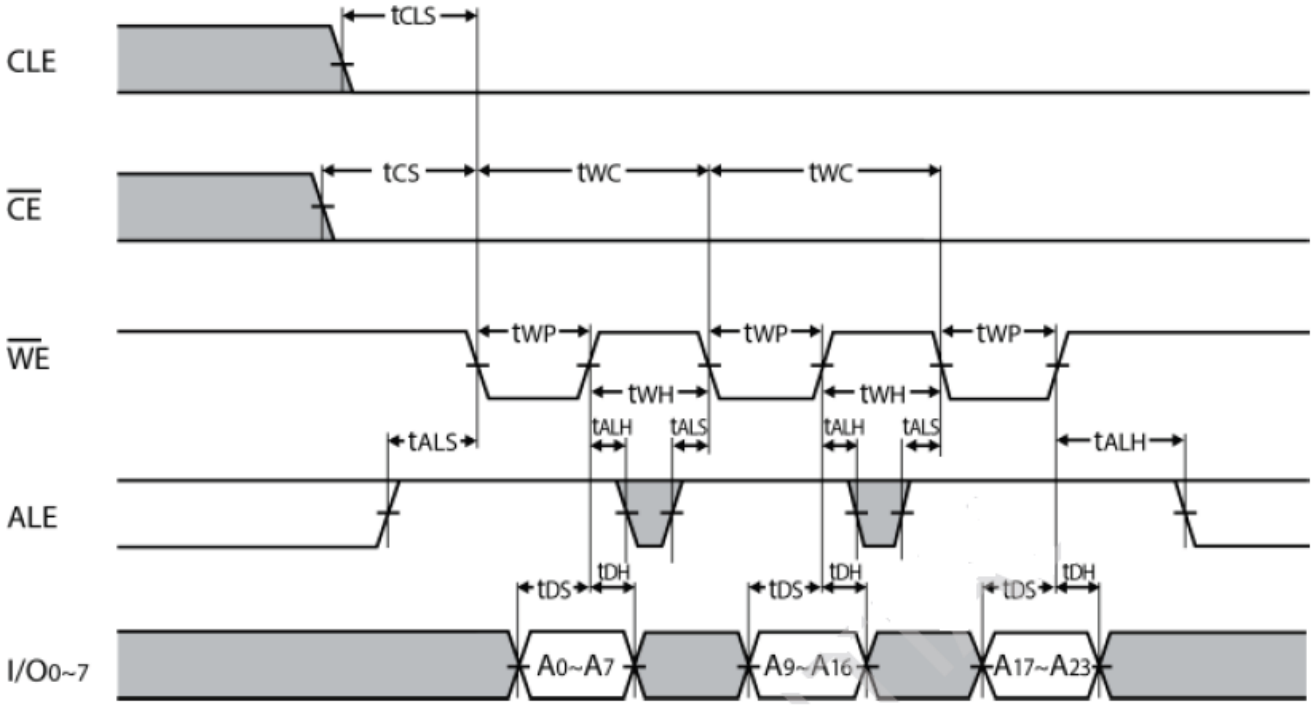
3.3 Bus Signal Level



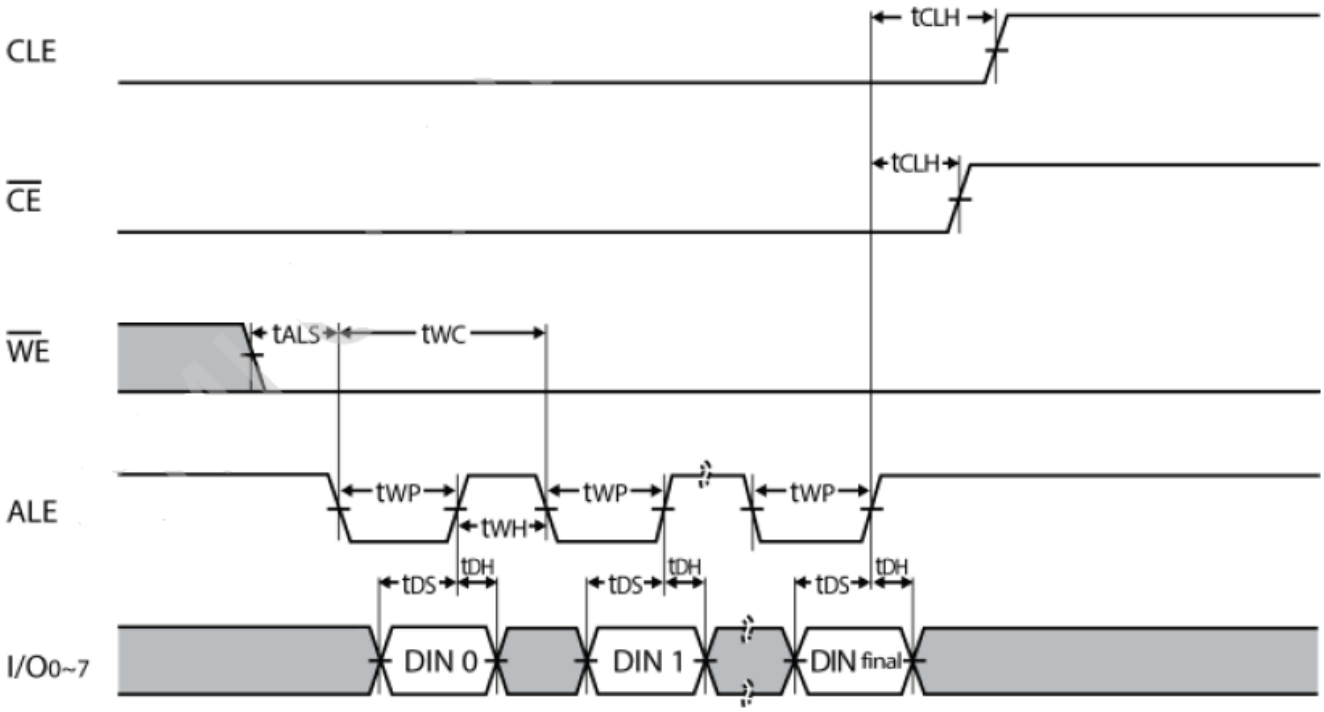
3.4 Flash Command Latch Cycle



3.5 Flash Address Latch Cycle



3.6 Flash Input Data Latch Cycle



4 UFD Protocols

Each UFD transaction consists of a

- Token Packet (Header defining what it expects to follow)
- Optional Data Packet, (Containing the payload)
- Status Packet (Used to acknowledge transactions and to provide a means of error correction)

USB is a host centric bus. The host initiates all transactions. The first packet, also called a token is generated by the host to describe what is to follow and whether the data transaction will be a read or write and what the device's address and designated endpoint is. The next packet is generally a data packet carrying the payload and is followed by a handshaking packet, reporting if the data or token was received successfully, or if the endpoint is stalled or not available to accept data.

4.1 Common UFD Packet Fields

Data on the UFD BUS is transmitted LSB first. UFD packets consist of the following fields,

- Sync
  All packets must start with a sync field. The sync field is 8 bits long at low and full speed or 32 bits long for high speed and is used to synchronize the clock of the receiver with that of the transmitter. The last two bits indicate where the PID fields starts.
- PID
  PID stands for Packet ID. This field is used to identify the type of packet that is being sent. The following table shows the possible values.

Group	PID Value	Packet Identifier
Token	0001	OUT Token
	1001	IN Token
	0101	SOF Token
	1101	SETUP Token
Data	0011	DATA0
	1011	DATA1
	0111	DATA2
	1111	MDATA
Handshake	0010	ACK Handshake
	1010	NAK Handshake
	1110	STALL Handshake
	0110	NYET (No Response Yet)
Special	1100	PREAMBLE
	1100	ERR
	1000	SPLIT

	0100	Ping

There are 4 bits to the PID, however to insure it is received correctly, the 4 bits are complemented and repeated, making an 8 bit PID in total. The resulting format is shown below.

PID0	PID1	PID2	PID3	nPID0	nPID1	nPID2	nPID3

- ADDR

  The address field specifies which device the packet is designated for. Being 7 bits in length allows for 127 devices to be supported. Address 0 is not valid, as any device which is not yet assigned an address must respond to packets sent to address zero.

- ENDP

  The endpoint field is made up of 4 bits, allowing 16 possible endpoints. Low speed devices, however can only have 2 additional endpoints on top of the default pipe. (4 endpoints max)

- CRC

  Cyclic Redundancy Checks are performed on the data within the packet payload. All token packets have a 5 bit CRC while data packets have a 16 bit CRC.

- EOP

  End of packet. Signalled by a Single Ended Zero (SE0) for approximately 2 bit times followed by a J for 1 bit time.

4.2 UFD Packet Types

UFD has four different packet types. Token packets indicate the type of transaction to follow, data packets contain the payload, handshake packets are used for acknowledging data or reporting errors and start of frame packets indicate the start of a new frame.

- Token Packets

  There are three types of token packets,

  1. In - Informs the USB device that the host wishes to read information.
  2. Out - Informs the USB device that the host wishes to send information.
  3. Setup - Used to begin control transfers.

  Token Packets must conform to the following format,

Sync	PID	ADDR	ENDP	CRC5	EOP

- Data Packets

There are two types of data packets each capable of transmitting up to 1024 bytes of data.

1. Data0
2. Data1

Data packets have the following format,

Sync	PID	Data	CRC16	EOP

- Handshake Packets

There are three types of handshake packets which consist simply of the PID

1. ACK - Acknowledgment that the packet has been successfully received.
2. NAK - Reports that the device temporary cannot send or received data. Also used
3. During interrupt transactions to inform the host there is no data to send.
4. STALL - The device finds it's in a state that it requires intervention from the host.

Handshake Packets have the following format,

Sync	PID	EOP

- Start of Frame Packets

The SOF packet consisting of an 11-bit frame number is sent by the host every 1ms ±500ns on a full speed bus or every 125 µs ±0.0625 µs on a high speed bus.

Sync	PID	Frame Number	CRC5	EOP