**HEX File Format:**

1. Intel HEX file is an ASCII text file with lines of text that follows the intel hex file format.
2. Each line in an intel hex file contains one HEX record. These records are made up of hexadecimal numbers.

**Record format:**

An intel HEX file is composed of any number of HEX records. Each record is made up of five fields that are arranged in following format.

:llaaaatt[dd...]cc

Each group of letters corresponds to a different field. And each letter represents a single hexadecimal digit. Each field is composed of at least two hexadecimal digit which make up a byte.

**:** starts every intel HEX records

**ll** record length field that represents number data bytes in the record.

**aaaa** address field that represents the starting address of sub sequent data bytes in the record.

**tt** is the field that represents the HEX record type, which may be one of the following.

* 00 – Data record
* 01 – end of file record
* 02 – extended segment address record.
* 04 – extended linear address record.
* 05 – start linear address record(MDK arm only).

**dd** is a data field that represents one byte of data. A record may have multiple data bytes. The number of data bytes in the record must match the number specified in the ll field.

cc is the checksum field that represents the checksum of the record.

The checksum is calculated by summing the values of all hexadecimal digits pair in the record and modulo 256 and taking the two’s complement.

**Data Records**

The intel HEX file is made up of any number of data records that are terminated with the carriage return and a line feed. Data records appears as follows.

:10246200464C5549442050524F46494C4500464C33

**This record is decoded as follows:**

:10246200464C5549442050524F46494C4500464C33

||||||||||| CC->Checksum

|||||||||DD->Data

|||||||TT->Record Type

|||AAAA->Address

|LL->Record Length

:->Colon

**Extended Linear Address record:**

Extended linear address records are also known as 32 bit address record or HEX386 records. These record contains the upper 16 bits of the data record.

The extended linear address record always contains two data bytes and appears as follows.

:02000004FFFFFC

* 02 – Number of data bytes in the record.
* 0000 – Address field. For the extended linear address record this field is always 0000
* 04 – Is the record type.
* FFFF – Is the upper 16 bit of the address.
* FC is the checksum of the record.

When an extended linear address is read. The extended linear address stored in the data field is saved. And is applied to subsequent records read from the intel HEX file. The linear address remains effective until changed by another address record.

The absolute memory address of a data record is obtained by adding the address in the record to the shifted address to the data from the extended linear address record. The following example illustrates this process.

Address from the data record's address field 2462

Extended linear address record data field FFFF

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Absolute-memory address FFFF2462

**Extended Segment Address Record:**

Extended segment address record also known as HEX86 records. Contains bits 4-19 of the data address segment. The extended segment address always has two data bytes and appears as follows.

:020000021200EA

Where:

02 – Is the number of data bytes in the record.

0000 – Address field. For extended segment address record, this field is always 0000

02 – Record type. Extended segment address record.

12 00 – Is the segment of the address.

EA – Checksum of the record.

When an extended segment address record is read, the extended segment address stored in the data field is saved and is applied to subsequent records read from the HEX file. The segment address remains effective until changed by another extended address record.

The absolute memory address of a data record is obtained by adding the address field in the record to the shifted address data from the extended segment address record. The following example illustrates this process.

Address from the data record's address field 2462

Extended segment address record data field 1200

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Absolute memory address 00014462

**Start Linear Address Record:**

Start linear address record specify the start address of the application. These records contains full linear 32 bit address.

The start linear address records always has four data bytes and appears as follows.

:04000005000000CD2A

Where,

04 – Is the number of data bytes in the record.

0000 – is the address field. For the start linear address record, This field is always 0000.

05 – Is the record type. (start linear address record.)

000000CD – is the byte linear start address of the application

2A – Is the checksum of the record.

The start linear address specifies the address of the main function but not the address of the start up code. Which usually calls \_\_main after calling systemInit().

An odd linear start address specifies that \_\_main is compiled for thump instruction set.

The start linear address record can appear anywhere in hex file. In most cases this record can be ignored because it does not contain information which is needed to program flash memory.

**End of file record:**

An intel hex file must end with an (EOF) end file record. This value must have 01 in the record type field. An EOF record always appears as follows.

:00000001FF

Where

00 – is the number of data bytes in the record.

0000 – Is the address where the data are to be located in memory. The address in end of file record is meaningless and is ignored. An address of 0000h is typical.

01 – Is record type.

FF – Is the checksum of the record.

**Example Intel HEX file:**

:10001300AC12AD13AE10AF1112002F8E0E8F0F2244

:10000300E50B250DF509E50A350CF5081200132259

:03000000020023D8

:0C002300787FE4F6D8FD7581130200031D

:10002F00EFF88DF0A4FFEDC5F0CEA42EFEEC88F016

:04003F00A42EFE22CB

:00000001FF