Intel HEX File Format

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The **Intel HEX** file format is a widely used format for conveying binary information in ASCII text form. This format is commonly used for programming microcontrollers, EPROMs, and other types of programmable logic devices and hardware emulators. The format was originally designed for Intel's Intellec Microcomputer Development Systems in 1973 to load and execute programs from paper tape.

Structure of Intel HEX File

An Intel HEX file consists of lines of ASCII text, each representing a record. Each record contains six fields:

1. **Start Code**: A single character, an ASCII colon `:`.
2. **Byte Count**: Two hex digits indicating the number of bytes in the data field.
3. **Address**: Four hex digits representing the 16-bit beginning memory address offset of the data.
4. **Record Type**: Two hex digits defining the meaning of the data field.
5. **Data**: A sequence of bytes represented by 2n hex digits.
6. **Checksum**: Two hex digits, a computed value used to verify the record has no errors.

Example of a Record

Here is an example of a record in an Intel HEX file:

```
:10010000214601360121470136007EFE09D2190140
```

This record can be broken down as follows:

- **Start Code**: `:`
- **Byte Count**: `10` (16 bytes)
- **Address**: `0100`
- **Record Type**: `00` (Data record)
- **Data**: `21460136012147013600 7EFE09D21901`
- **Checksum**: `40`

Record Types

Intel HEX has several standard record types, each identified by a specific code:

- **00**: Data Record
- **01**: End of File Record
- **02**: Extended Segment Address Record

- **03**: Start Segment Address Record
- **04**: Extended Linear Address Record
- **05**: Start Linear Address Record[1].

Example of a File

A typical Intel HEX file might look like this:

```
:10010000214601360121470136007EFE09D2190140
:100110002146017E17C20001FF5F16002148011928
:10012000194E79234623965778239EDA3F01B2CAA7
:100130003F0156702B5E712B722B732146013421C7
:00000001FF
```

This file contains four data records followed by an end-of-file record[1].

Checksum Calculation

The checksum is calculated by summing all the byte values in the record, taking the least significant byte (LSB) of the sum, and then calculating the two's complement of the LSB. For example, in the record `:0300300002337A1E`, the sum of the byte values is `03 + 00 + 30 + 00 + 02 + 33 + 7A = E2`. The two's complement of `E2` is `1E`, which is the checksum[1].

Variants and Extensions

Several third parties have defined variants and extensions of the Intel HEX format, including Digital Research, Zilog, Mostek, and others. These variants may include additional information such as program entry points, register contents, and different byte orders[1].

The Intel HEX format is a versatile and widely adopted format for binary-to-text encoding, making it suitable for various applications in embedded systems and computer file formats[1].

Learn more:

1 -

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