Waveform Template

This appendix contains the Waveform Template that describes the contents of the Waveform Descriptor that is produced by the commands WF? DESC and WF? ALL. After the template are explanations of the construction of floating point numbers from bytes in the descriptor, followed by program fragments that show a method of performing the calculations.

Waveform Template

This template is the oscilloscope's response to a TMPL? query:

```
/00
000000              LECROY_2_3:  TEMPLATE
                    8 66 111
;
; Explanation of the formats of waveforms and their descriptors on the
; LeCroy Digital Oscilloscopes,
;     Software Release 8.1.0, 98/09/29.
;
; A descriptor and/or a waveform consists of one or several logical data blocks
; whose formats are explained below.
; Usually, complete waveforms are read: at the minimum they consist of
;       the basic descriptor block WAVEDESC
;       a data array block.
; Some more complex waveforms, e.g. Extrema data or the results of a Fourier
; transform, may contain several data array blocks.
; When there are more blocks, they are in the following sequence:
;       the basic descriptor block WAVEDESC
;       the history text descriptor block USERTEXT (may or may not be present)
;       the time array block (for RIS and sequence acquisitions only)
;       data array block
;       auxiliary or second data array block
;
```

; In the following explanation, every element of a block is described by a
; single line in the form

```
;
; <byte position>   <variable name>: <variable type> ; <comment>
;
;  where
;
;   <byte position> = position in bytes (decimal offset) of the variable,
;                     relative to the beginning of the block.
;
;   <variable name> = name of the variable.
;
;   <variable type> = string       up to 16-character name
;                                  terminated with a null byte
;                       byte       08-bit signed data value
;                       word       16-bit signed data value
;                       long       32-bit signed data value
;                      float       32-bit IEEE floating point value
;  with the format shown below
;                                  31  30 .. 23   22 ... 0   bit position
;                                  s   exponent   fraction
;                                  where
;                                  s = sign of the fraction
;                                  exponent = 8 bit exponent e
;                                  fraction = 23 bit fraction f
;                                  and the final value is
;                                  (-1)**s * 2**(e-127) * 1.f
;                     double       64-bit IEEE floating point value
;                                  with the format shown below
;                                  63  62 .. 52   51 ... 0   bit position
;                                  s   exponent   fraction
;                                  where
;                                  s = sign of the fraction
;                                  exponent = 11 bit exponent e
;                                  fraction = 52 bit fraction f
;                                  and the final value is
;                                  (-1)**s * 2**(e-1023) * 1.f
;                       enum       enumerated value in the range 0 to N
;                                  represented as a 16-bit data value.
;                                  The list of values follows immediately.
;                                  The integer is preceded by an _.
```

```
;                  time_stamp        double precision floating point number,
;                                    for the number of seconds and some bytes
;                                    for minutes, hours, days, months and year.
;
;                                    double  seconds     (0 to 59)
;                                    byte    minutes     (0 to 59)
;                                    byte    hours       (0 to 23)
;                                    byte    days        (1 to 31)
;                                    byte    months      (1 to 12)
;                                    word    year        (0 to 16000)
;                                    word    unused
;                                    There are 16 bytes in a time field.
;                        data        byte, word or float, depending on the
;                                    read-out mode reflected by the WAVEDESC
;                                    variable COMM_TYPE, modifiable via the
;                                    remote command COMM_FORMAT.
;                        text        arbitrary length text string
;                                    (maximum 160)
;             unit_definition        a unit definition consists of a 48 character
;                                    ASCII string terminated with a null byte
;                                    for the unit name.
;
;==========================================================================
;
```

WAVEDESC: BLOCK

;

; Explanation of the wave descriptor block WAVEDESC;

```
;
;
<  0>          DESCRIPTOR_NAME: string  ; the first 8 chars are always WAVEDESC
;
< 16>          TEMPLATE_NAME: string
;
< 32>          COMM_TYPE: enum          ; chosen by remote command COMM_FORMAT
               _0      byte
               _1      word
               endenum
;
< 34>          COMM_ORDER: enum
               _0      HIFIRST
               _1      LOFIRST
               endenum
;
;
```

```
; The following variables of this basic wave descriptor block specify
; the block lengths of all blocks of which the entire waveform (as it is
; currently being read) is composed. If a block length is zero, this
; block is (currently) not present.
;
; Blocks and arrays that are present will be found in the same order
; as their descriptions below.
;
;BLOCKS :
;
< 36>          WAVE_DESCRIPTOR: long    ; length in bytes of block WAVEDESC
< 40>          USER_TEXT: long          ; length in bytes of block USERTEXT
< 44>          RES_DESC1: long          ;
;
;ARRAYS :
;
< 48>          TRIGTIME_ARRAY: long     ; length in bytes of TRIGTIME array
;
< 52>          RIS_TIME_ARRAY: long     ; length in bytes of RIS_TIME array
;
< 56>          RES_ARRAY1: long         ; an expansion entry is reserved
;
< 60>          WAVE_ARRAY_1: long       ; length in bytes of 1st simple
                                        ; data array. In transmitted waveform,
                                        ; represent the number of transmitted
                                        ; bytes in accordance with the NP
                                        ; parameter of the WFSU remote command
                                        ; and the used format (see COMM_TYPE).
;
< 64>          WAVE_ARRAY_2: long       ; length in bytes of 2nd simple
                                        ; data array
;
< 68>          RES_ARRAY2: long
< 72>          RES_ARRAY3: long         ; 2 expansion entries are reserved
;
; The following variables identify the instrument
;
< 76>          INSTRUMENT_NAME: string
;
< 92>          INSTRUMENT_NUMBER: long
;
< 96>          TRACE_LABEL: string      ; identifies the waveform.
;
<112>          RESERVED1: word
<114>          RESERVED2: word          ; 2 expansion entries
;
```

```
; The following variables describe the waveform and the time at
; which the waveform was generated.
;
<116>         WAVE_ARRAY_COUNT: long   ; number of data points in the data
                                       ; array. If there are two data
                                       ; arrays (FFT or Extrema), this number
                                       ; applies to each array separately.
;
<120>         PNTS_PER_SCREEN: long    ; nominal number of data points
                                       ; on the screen
;
<124>         FIRST_VALID_PNT: long    ; count of number of points to skip
                                       ; before first good point
                                       ; FIRST_VALID_POINT = 0
                                       ; for normal waveforms.
;
<128>         LAST_VALID_PNT: long     ; index of last good data point
                                       ; in record before padding (blanking)
                                       ; was started.
                                       ; LAST_VALID_POINT = WAVE_ARRAY_COUNT-1
                                       ; except for aborted sequence
                                       ; and rollmode acquisitions
;
<132>         FIRST_POINT: long        ; for input and output, indicates
                                       ; the offset relative to the
                                       ; beginning of the trace buffer.
                                       ; Value is the same as the FP parameter
                                       ; of the WFSU remote command.
;
<136>         SPARSING_FACTOR: long    ; for input and output, indicates
                                       ; the sparsing into the transmitted
                                       ; data block.
                                       ; Value is the same as the SP parameter
                                       ; of the WFSU remote command.
;
<140>         SEGMENT_INDEX: long      ; for input and output, indicates the
                                       ; index of the transmitted segment.
                                       ; Value is the same as the SN parameter
                                       ; of the WFSU remote command.
;
<144>         SUBARRAY_COUNT: long     ; for Sequence, acquired segment count,
                                       ; between 0 and NOM_SUBARRAY_COUNT
;
<148>         SWEEPS_PER_ACQ: long     ; for Average or Extrema,
                                       ; number of sweeps accumulated
                                       ; else 1
;
```

```
<152>          POINTS_PER_PAIR: word    ; for Peak Detect waveforms (which
always
                                        ; include data points in DATA_ARRAY_1
and
                                        ; min/max pairs in DATA_ARRAY_2).
                                        ; Value is the number of data points for
                                        ; each min/max pair.
;
<154>          PAIR_OFFSET: word        ; for Peak Detect waveforms only
                                        ; Value is the number of data points by
                                        ; which the first min/max pair in
                                        ; DATA_ARRAY_2 is offset relative to the
                                        ; first data value in DATA_ARRAY_1.
;
<156>          VERTICAL_GAIN: float
;
<160>          VERTICAL_OFFSET: float   ; to get floating values from raw data :
                                        ; VERTICAL_GAIN * data - VERTICAL_OFFSET
;
<164>          MAX_VALUE: float         ; maximum allowed value. It corresponds
                                        ; to the upper edge of the grid.
;
<168>          MIN_VALUE: float         ; minimum allowed value. It corresponds
                                        ; to the lower edge of the grid.
;
<172>          NOMINAL_BITS: word       ; a measure of the intrinsic precision
                                        ; of the observation: ADC data is 8 bit
                                        ;    averaged data is 10-12 bit, etc.
;
<174>          NOM_SUBARRAY_COUNT: word ; for Sequence, nominal segment count
                                        ; else 1
;
<176>          HORIZ_INTERVAL: float    ; sampling interval for time domain
                                        ;  waveforms
;
<180>          HORIZ_OFFSET: double     ; trigger offset for the first sweep of
                                        ; the trigger, seconds between the
                                        ; trigger and the first data point
;
<188>          PIXEL_OFFSET: double     ; needed to know how to display the
                                        ; waveform
;
<196>          VERTUNIT: unit_definition  ; units of the vertical axis
;
<244>          HORUNIT: unit_definition   ; units of the horizontal axis
;
<292>          HORIZ_UNCERTAINTY: float ; uncertainty from one acquisition to the
                                        ; next, of the horizontal offset in seconds
;
<296>          TRIGGER_TIME: time_stamp ; time of the trigger
;
<312>          ACQ_DURATION: float      ; duration of the acquisition (in sec)
                                        ; in multi-trigger waveforms.
                                        ; (e.g. sequence, RIS,  or averaging)
;
<316>          RECORD_TYPE: enum
```

```
                _0      single_sweep
                _1      interleaved
                _2      histogram
                _3      graph
                _4      filter_coefficient
                _5      complex
                _6      extrema
                _7      sequence_obsolete
                _8      centered_RIS
                _9      peak_detect
                endenum
;
<318>           PROCESSING_DONE: enum
                _0       no_processing
                _1       fir_filter
                _2       interpolated
                _3       sparsed
                _4       autoscaled
                _5       no_result
                _6       rolling
                _7       cumulative
                endenum
;
<320>           RESERVED5: word          ; expansion entry
;
<322>           RIS_SWEEPS: word         ; for RIS, the number of sweeps
                                         ; else 1
;
; The following variables describe the basic acquisition
; conditions used when the waveform was acquired
;
```

```
<324>          TIMEBASE: enum
               _0    1_ps/div
               _1    2_ps/div
               _2    5_ps/div
               _3    10_ps/div
               _4    20_ps/div
               _5    50_ps/div
               _6    100_ps/div
               _7    200_ps/div
               _8    500_ps/div
               _9    1_ns/div
               _10   2_ns/div
               _11   5_ns/div
               _12   10_ns/div
               _13   20_ns/div
               _14   50_ns/div
               _15   100_ns/div
               _16   200_ns/div
               _17   500_ns/div
               _18   1_us/div
               _19   2_us/div
               _20   5_us/div
               _21   10_us/div
               _22   20_us/div
               _23   50_us/div
               _24   100_us/div
               _25   200_us/div
               _26   500_us/div
               _27   1_ms/div
               _28   2_ms/div
               _29   5_ms/div
               _30   10_ms/div
               _31   20_ms/div
               _32   50_ms/div
               _33   100_ms/div
               _34   200_ms/div
               _35   500_ms/div
               _36   1_s/div
               _37   2_s/div
               _38   5_s/div
               _39   10_s/div
               _40   20_s/div
               _41   50_s/div
               _42   100_s/div
               _43   200_s/div
               _44   500_s/div
               _45   1_ks/div
               _46   2_ks/div
               _47   5_ks/div
               _100  EXTERNAL
               endenum
;
<326>          VERT_COUPLING: enum
               _0      DC_50_Ohms
               _1      ground
               _2      DC_1MOhm
```

```
                _3      ground
                _4      AC,_1MOhm
                endenum
;
<328>           PROBE_ATT: float
;
<332>           FIXED_VERT_GAIN: enum
                _0   1_uV/div
                _1   2_uV/div
                _2   5_uV/div
                _3   10_uV/div
                _4   20_uV/div
                _5   50_uV/div
                _6   100_uV/div
                _7   200_uV/div
                _8   500_uV/div
                _9   1_mV/div
                _10  2_mV/div
                _11  5_mV/div
                _12  10_mV/div
                _13  20_mV/div
                _14  50_mV/div
                _15  100_mV/div
                _16  200_mV/div
                _17  500_mV/div
                _18  1_V/div
                _19  2_V/div
                _20  5_V/div
                _21  10_V/div
                _22  20_V/div
                _23  50_V/div
                _24  100_V/div
                _25  200_V/div
                _26  500_V/div
                _27  1_kV/div
                endenum
;
```

```
<334>          BANDWIDTH_LIMIT: enum
               _0      off
               _1      on
               endenum
;
<336>          VERTICAL_VERNIER: float
;
<340>          ACQ_VERT_OFFSET: float
;
<344>          WAVE_SOURCE: enum
               _0      CHANNEL_1
               _1      CHANNEL_2
               _2      CHANNEL_3
               _3      CHANNEL_4
               _9      UNKNOWN
               endenum
;
/00              ENDBLOCK
;
;============================================================================
;
USERTEXT: BLOCK
;
; Explanation of the descriptor block USERTEXT at most 160 bytes long.
;
;
<  0>          TEXT: text               ; a list of ASCII characters
;
/00              ENDBLOCK
;
;============================================================================
;
TRIGTIME: ARRAY
;
; Explanation of the trigger time array TRIGTIME.
; This optional time array is only present with SEQNCE waveforms.
; The following data block is repeated for each segment which makes up
; the acquired sequence record.
;
<  0>          TRIGGER_TIME: double     ; for sequence acquisitions,
                                        ; time in seconds from first
                                        ; trigger to this one
;
<  8>          TRIGGER_OFFSET: double   ; the trigger offset is in seconds
                                        ; from trigger to zeroth data point
;
/00              ENDARRAY
;
;============================================================================
;
RISTIME: ARRAY
;
; Explanation of the random-interleaved-sampling (RIS) time array RISTIME.
; This optional time array is only present with RIS waveforms.
; This data block is repeated for each sweep which makes up the RIS record
;
```

```
<  0>          RIS_OFFSET: double       ; seconds from trigger to zeroth
                                        ; point of segment
;
/00              ENDARRAY
;
;===========================================================================
;
DATA_ARRAY_1: ARRAY
;
; Explanation of the data array DATA_ARRAY_1.
; This main data array is always present. It is the only data array for
; most waveforms.
; The data item is repeated for each acquired or computed data point
; of the first data array of any waveform.
;
<  0>          MEASUREMENT: data        ; the actual format of a data is
                                        ; given in the WAVEDESC descriptor
                                        ; by the COMM_TYPE variable.
;
/00              ENDARRAY
;
;===========================================================================
;
DATA_ARRAY_2: ARRAY
;
; Explanation of the data array DATA_ARRAY_2.
; This is an optional secondary data array for special types of waveforms:
;       Complex FFT     imaginary part      (real part in DATA_ARRAY_1)
;       Extrema         floor trace         (roof trace in DATA_ARRAY_1)
;       Peak Detect     min/max pairs       (data values in DATA_ARRAY_1)
; In the first 2 cases, there is exactly one data item in DATA_ARRAY_2 for
; each data item in DATA_ARRAY_1.
; In Peak Detect waveforms, there may be fewer data values in DATA_ARRAY_2,
; as described by the variable POINTS_PER_PAIR.
;
<  0>          MEASUREMENT: data        ; the actual format of a data is
                                        ; given in the WAVEDESC descriptor
                                        ; by the COMM_TYPE variable.
;
/00              ENDARRAY
;
;===========================================================================
;
SIMPLE: ARRAY
;
; Explanation of the data array SIMPLE.
; This data array is identical to DATA_ARRAY_1. SIMPLE is an accepted
; alias name for DATA_ARRAY_1.
;
<  0>          MEASUREMENT: data        ; the actual format of a data is
                                        ; given in the WAVEDESC descriptor
                                        ; by the COMM_TYPE variable.
;
/00              ENDARRAY
;
;===========================================================================
```

```
;
DUAL: ARRAY
;
; Explanation of the DUAL array.
; This data array is identical to DATA_ARRAY_1, followed by DATA_ARRAY_2.
; DUAL is an accepted alias name for the combined arrays DATA_ARRAY_1 and
; DATA_ARRAY_2 (e.g. real and imaginary parts of an FFT).
;
<  0>          MEASUREMENT_1: data      ; data in DATA_ARRAY_1.
;
<  0>          MEASUREMENT_2: data      ; data in DATA_ARRAY_2.
;
/00              ENDARRAY
;
;
00                   ENDTEMPLATE
```

DECODING FLOATING POINT NUMBERS

Single precision values are held in four bytes. If these are arranged in decreasing order of value we get the following bits:

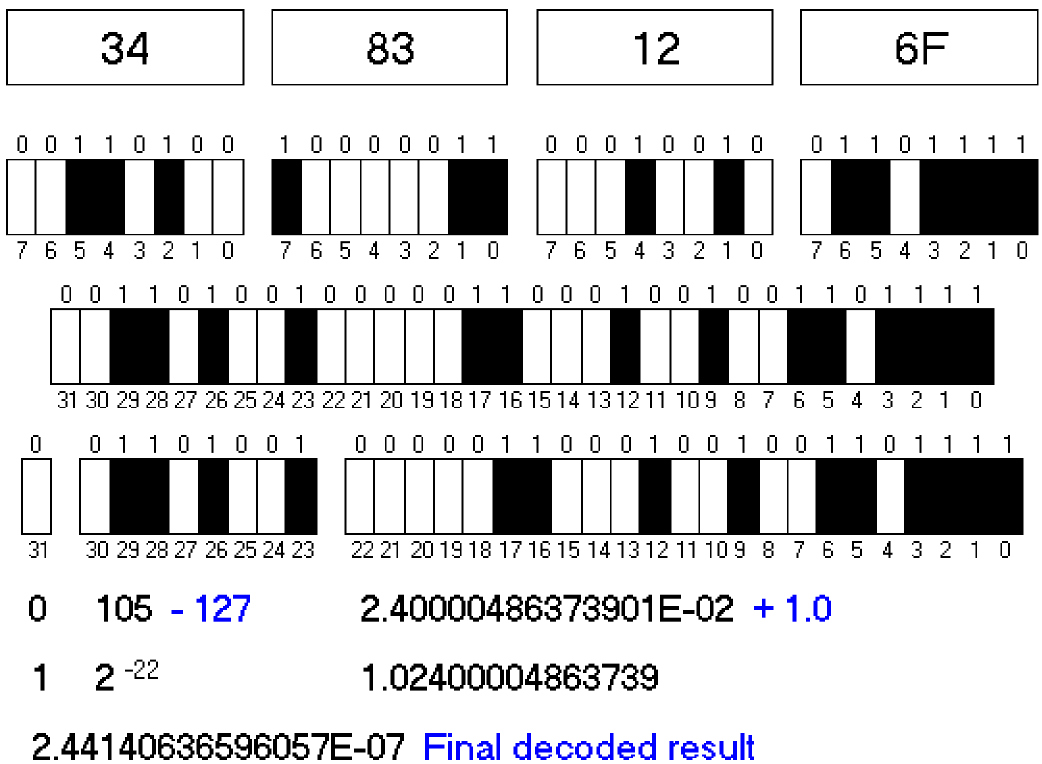
bit 31, bit 30, bit 29, bit 28 . . . . . bit 3, bit 2, bit 1, bit 0

We must remember that if the byte order command CORD has been set for low byte first, the bytes as received in a waveform descriptor will be received in the reverse order. But within a byte, the bits keep their order, highest at the left as expected.

From these bits we are to construct three numbers that are to be multiplied together: S x E x F. These in turn are constructed as follows:

$S = (-1)^s$ $E = 2^{(e - 127)}$ $F = 1 + f$

and it is **s**, **e**, and **f** that are calculated directly from the 32 bits. The diagram below illustrates the calculation of the vertical gain example of Chapter 4.



In a way that does not follow the byte boundaries, the bits are to be segregated as follows:

31	30, 29 . . . . 24, 23	22, 21 . . . . 2, 1, 0
sign	exponent bits	fractional bits
bit		0.5, 0.25, 0.125 . . .

The sign bit **s** is 1 for a negative number and 0 for a positive number, so it is easy to construct the sign from this:

S = (-1)^s

The 8 exponent bits have the following values:

bit 23 is worth 1, bit 24 is worth 2 . . . bit 29 → 64, bit 30 → 128, so the resulting number can range from 0 to 2^8 - 1, which is 255.

127 is then subtracted from this value **e** creating a range from -127 to +128. This is then used as an exponent to raise two to a power that is 2^e, to create a value E.

Then we have to create the multiplying number. The values of the 23 bits are as follows:

Bit 22 is worth 0.5, 21 is worth 0.25, 20 is worth 0.125, 19 is worth 0.0625 . . . .

When all the bits are added together, we obtain a positive number **f** that can be very close to one, differing from it only by the value of the smallest bit, if all the bits are ones. (Generally the value will be much less than one.) Then we add one to the result, obtaining 1 + f = F. The use of the added one extends the dynamic range of the data.

Another way of calculating **f** is to take the 23-bit number at face value, and divide it by 2^24.

Finally we multiply together the sign, the value **E**, and the value **F** to create the final result:

Result = (-1)^s x 2^(e-127) x (1 + f) = S x E x F

Example

In Chapter 4, one of the examples, Vertical Gain, states that the floating point number 34 83 12 6F leads to the decimal value 2.44141E-07. Let's see how this is done.

The bytes 34 83 12 and 6F can be written in binary as follows:

0011 0100   1000 0011   0001 0010   0110 1111.

This string of bits is to be split up as follows:

0 01101001 00000110001001001101111.

The first bit, 0, makes the sign of the number **S**, using the formula $S = (-1)^s = 1$.

The next eight bits make the exponent **e** as follows:

> 0 X 128 + 1 X 64 + 1 X 32 + 0 X 16 + 1 X 8 + 0 X 4 + 0 X 2 + 1 X 1 = 105, from which we subtract 127, giving -22.

So the factor **E** is $2^{(e-127)} = 2^{-22}$, which is 2.3842E-7.

Finally, we need to make the multiplier **F**. The remaining bits are given the values 0.5, 0.25, 0.125, 0.0625, 0.03125, etc. The first bits that are not zero are the 6th and 7th bits, whose values are 0.015625 and 0.078125, respectively. To get a rough value, we will take just these two bits, since the next three are zero, giving 0.0234375. We have to add 1 to this, giving 1.023 as a rough value for **F**.

The final result is therefore S x E x F = 1 X 2.3842E-7 X 1.023 = 2.439, which is a little smaller than the correct value because we did not use all the bits to calculate the value of **F**.

Double precision values are held in eight bytes. If these are arranged in decreasing order of value we get the following bits:

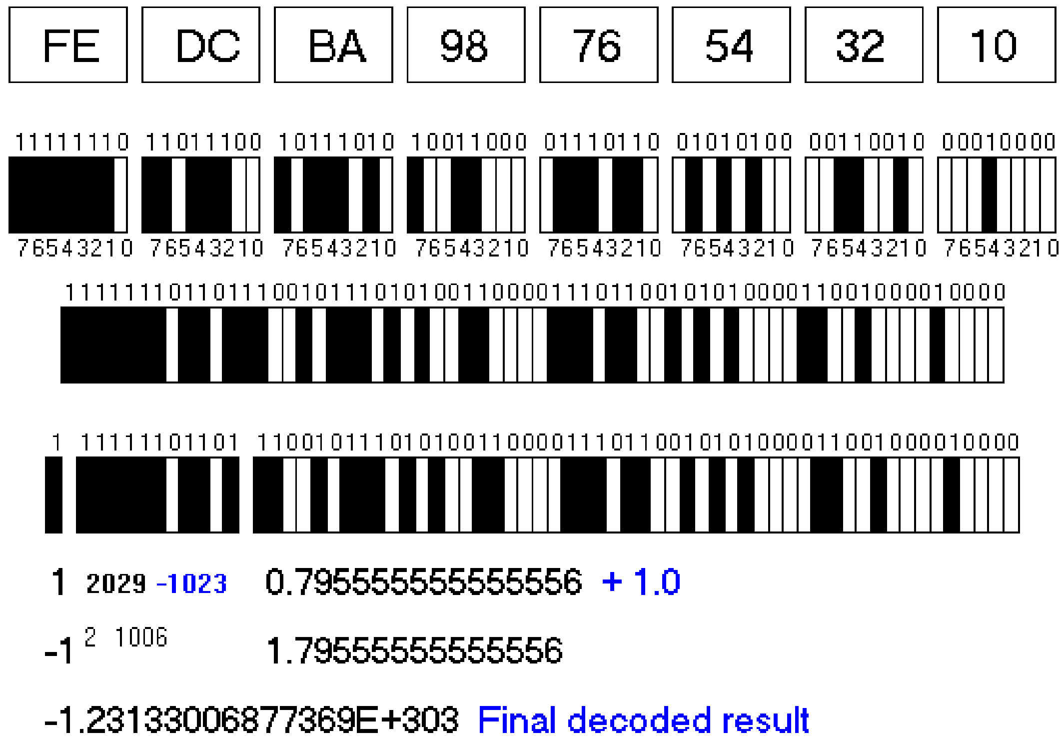
> 63, 62, 61, 62 . . . . . 3, 2, 1, 0.

We must remember that if the byte order command CORD has been set for low byte first, the bytes as received in a waveform descriptor will be received in the reverse order. But within a byte, the bits keep their order: highest at the left, as expected.

From these bits we are to construct three numbers that are to be multiplied together: S x E x F. These in turn are constructed as follows:

> $S = (-1)^s$ $E = 2^{(e - 1023)}$ $F = 1 + f$

and it is **s**, **e**, and **f** that are calculated directly from the 32 bits. The following diagram illustrates the calculation of an example.



In a way that does not follow the byte boundaries, the bits are to be segregated as follows:

63	62, 61 . . . . 53, 52	51, 50 . . . . 2, 1, 0
sign	11 exponent bits	52 fractional bits
bit		0.5, 0.25, 0.125 . . .

The sign bit is 1 for a negative number and 0 for a positive number, so it is easy to construct the sign from this: S = (-1)^s.

The 11 exponent bits have the following values:

52 → 1, 53 → 2 . . . 61 → 512, 62 → 1024

so the resulting number can range from 0 to 2^12 – 1, which is 2047. 1023 is then subtracted from this value, creating a range from -1023 to +1024. This is then used as a power of two to create a value **E**.

Then we have to create the multiplying number. The values of the 52 bits are as follows:

51 → 0.5, 50 → 0.25, 49 → 0.125, 48 → 0.0625 . . . .

When all the bits are added together, we obtain a positive number **f** that can be very close to one, differing from it only by the value of the smallest bit, if all the bits are ones. Generally the value will be much less than one. Then we add one to the result, obtaining 1 + f = F. The use of the added one extends the dynamic range of the data.

Alternatively, we can take the 52-bit number at face value, and divide it by 2^{53}

Finally we multiply together the sign, the value **E**, and the value **F**, to create the final result:

Result = S x E x F

HOW TO CONSTRUCT A FLOATING POINT NUMBER FROM FOUR BYTES

```
'   Routine to construct a floating point number from four bytes.

Function GetFloat(DescPoint as Integer)

'   DescPoint is the address of the byte in the waveform descriptor
'   where the data begin.
`   The data are assumed to be in an array called Desc (0 to 350).

'   For example, to calculate VERTICAL_GAIN, DescPoint = 156.

'   Constants needed by GetFloat
    Mult2 = 1 / 128
    Mult3 = Mult2 / 256
    Mult4 = Mult3 / 256

'   Comm_Order is the variable which provides information
'   about the order of the bytes in the descriptor and.
'   in the waveform data.  Comm_Order is the byte at position
'   34 in the descriptor.

'   Set ByteOrd = 1 when Comm_Order = 0 for high  byte first.
'   Set ByteOrd = -1 when Comm_Order = 1 for low byte  first.
'   Set ByteOrd3 = 3 * Comm_Order.
'   ______________________________________________________________

    ByteOrd = 1 - 2 * Comm_Order
    ByteOrd3 = 3 * Comm_Order
'   ______________________________________________________________

    FByte =  ByteOrd3                         ' Sign started

    FDigit =  Desc(DescPoint + FByte)
    FSign = (FDigit And 128) \  128
    FSign = 1 - 2 *  FSign                    ' Sign completed
'   ______________________________________________________________

    FExponent = FDigit  And  127               ' Exponent started
    FExponent = 2 * FExponent

    FByte = ByteOrd3 +  ByteOrd
    FDigit = Desc(DescPoint +  FByte)
    FExpBit = FDigit And  128

        If FExpBit = 128 Then FExpBit  = 1

    FExponent = FExponent + FExpBit - 127   '  Exponent completed
'   ______________________________________________________________
```

```
    FFraction =  CDbl(FDigit And 127)        ' Fraction  started
    FFraction = FFraction *  Mult2

    FByte = ByteOrd3 + 2 *  ByteOrd
    FDigit = Desc(DescPoint +  FByte)
    FFraction = FFraction + CDbl(FDigit) *  Mult3

    FByte = ByteOrd3 + 3 *  ByteOrd
    FDigit = Desc(DescPoint +  FByte)
    FFraction = FFraction + CDbl(FDigit) * Mult4   ' Fraction completed
'   ______________________________________________________________

    FVariable = 2  ^ FExponent
    GetFloat = FVariable * FSign * (1 +  FFraction)  ' Conversion
completed

    End

'   End of GetFloat ______________________________________________
```

HOW TO CONSTRUCT A FLOATING POINT NUMBER FROM FOUR BYTES

```
'   Routine to construct a double precision floating point number from
eight bytes.

Function GetDoubleFloat (DescPoint as Integer)

'   DescPoint is the address of the byte in the waveform descriptor
'   where the data begin.
`   The data are assumed to be in an array called Desc (0 to 350).

'   For example, to calculate HORIZontal_OFFSET, DescPoint = 180.

'   Constants needed by GetDoubleFloat
    DMult2 = 1 / 16
    DMult3 = DMult2 / 256

'   Comm_Order is the variable which provides information
'   about the order of the bytes in the descriptor and.
'   in the waveform data.  Comm_Order is the byte at position
'   34 in the descriptor.

'   Set ByteOrd = 1 when  Comm_Order = 0 for high byte first.
'   Set ByteOrd = -1 when Comm_Order  = 1 for low byte first.
'   Set ByteOrd7 = 7 * Comm_Order.
'   ______________________________________________________________

    ByteOrd = 1 - 2 * Comm_Order
    ByteOrd7 = 7 * Comm_Order

    DMult3 = DMult2 / 256
'   ______________________________________________________________

    FByte =  ByteOrd7                         ' Sign started
    FDigit = Desc(DescPoint +  FByte)
    FSign = (FDigit And 128) \  128
    FSign = 1 - 2 *  FSign                    ' Sign completed

    FExponent = FDigit  And  127               ' Exponent started
    FExponent = 16 * FExponent

    FByte = ByteOrd7 +  ByteOrd
    FDigit = Desc(DescPoint +  FByte)
    FExponent = (FExponent + CDbl((FDigit And 240) \  16)) -  1023
                                             ' Exponent  completed
'   ______________________________________________________________

    FFraction = CDbl((FDigit And 15)) *  DMult2    ' Fraction  started
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        For I = 2 To
        FByte = ByteOrd7 + I *  ByteOrd
        FDigit = Desc(DescPoint +  FByte)
        FFraction = FFraction +  CDbl(FDigit) * DMult3
        DMult3 =  DMult3 / 256
        Next  I                             ' Fraction completed
'   ______________________________________________________________

    FVariable = 2 ^  FExponent

    GetDoubleFloat = FVariable *  FSign * (1 + FFraction)

End

'   End of GetDoubleFloat ________________________________________
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