Waveform Template

This template is the instrument’s response to a command of the form “TMPL?”:

```
/00
000000              LECROY_2_2:  TEMPLATE
                    8 66 111
;
; Explanation of the formats of waveforms and their descriptors on the
; LeCroy Digital Oscilloscopes,
;     Software Release 44.1.1.1, 94/04/18.
;
; 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         8-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 :
;
< 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
```

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;
< 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 Dectect 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 Dectect 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>          RESERVED3: word
<294>          RESERVED4: word          ; 2 expansion entries
;
<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
;
;==========================================================================
;
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
;
;===========================================================================
;
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
;
;===========================================================================
;
```

```
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
;
;
000000               ENDTEMPLATE
```

A Template