# COMTRADE recorder

write1

**COMTRADE**

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## 1 Introduction

This device records the EMTP control signal waveforms included into its bundle into COMTRADE files following the standards IEEE C37.111-1999 and IEEE C37.111-2013. The signals must also be described in the input signal tables. The EMTP control signals may be:

- analog, for example when CTs, VTs and CVTs outputs are recorded. The precision will depend on the files format and the resolution selected (12-bit, 16-bit or 32-bit)
- digital, for example, when relays tripping signals are recorded. The status is 1 when the input signal value is greater than 0 and is zero else.
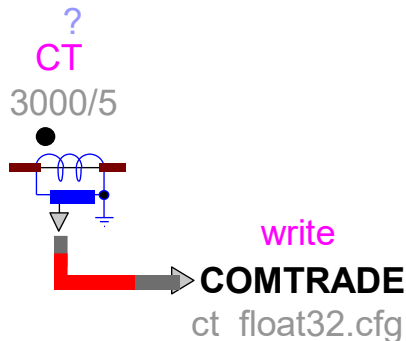


**Figure 1: COMTRADE recorded connected to a CT**

If a COMTRADE recorder device is connected to a Bundle with signals from CTs, VTs, CVTs or Relays and before the input signal tables are filled, they will be filled automatically with the signals included inside this Bundle.

As defined by the COMTRADE standards, the signals recorded are described in the Configuration file (extension .cfg) and the samples are recorded in the Data file (extension .dat).

The formats available for the Data file are BINARY, BINARY32, FLOAT32 or ASCII.

According to section 7.4.2 of IEEE C37.111-2013, the first line of the Configuration file is:
station_name,rec_dev_id,rev_year
where

station_name is the name of the substation or the location of the substation.
rec_dev_id is the identification number or name of the recording device.
rev_year is the year of the standard revision.

When the COMTRADE files are generated with EMTP:
- station_name is the name of the circuit where the COMTRADE recorder device is located or the name of the direct parent device if the COMTRADE recorded device is in a subcircuit.
- rec_dev_id: is EMTP

## 2 Parameters

- ❑ **Standard**: it is the standard used to write the files. The year selected appears in the Configuration file.
- ❑ **Format file:** If the 1999 standard is selected, the format BINARY32 and FLOAT32 are not available.
- ❑ **Precision**: available only if the selected format is ASCII. Define the precision to save the samples in the Data file. For example, if 16-bit (+/-32767) is selected, the stored values saved in the Data file (x value of the transformation ax+b defined in the COMTRADE standard) are between -32767 and 32767.
  For 32-bit, the limit is +/-3.4028235E38.
  If BINARY is selected, the precision of analog signals is 2 bytes (same as 16-bit (+/-32767)).
  If BINARY32 and FLOAT32, the precision is 4 bytes.
- ❑ **Start time**: Simulation time when the recording starts.
- ❑ **Stop time**: Simulation time when the recording stops.
- ❑ **Power frequency:** Power frequency. It is not used in the recording but is critical for the Configuration file.
- ❑ **Sampling frequency:** Number of samples saved in the Data file per seconds simulated. The sampling period should always be bigger than the time-step of the simulation. If the sampling period is not a multiple of the simulation time step, an linear interpolation is used.

- ❑ **Analog signals:** contains the analog signal information required by the COMTRADE standard. These information are written in the Configuration file.
- ❑ **Chanel identifier**: Signal name. A signal with the same name is added to the COMTRADE recorder device in the graphical user interface in order to feed this signal.
- ❑ **Minimum value (in .DAT file)**: if 'Overwrite Factor A and Factor B' is not checked, it is the range minimum value received from the channel (i.e. for a CT, -100sqrt(2/3)).
  If the box is checked, it is the range minimum of the stored values in the .DAT file (x value after ax+b conversion).
- ❑ **Maximum value (in .DAT file)**: Same as Minimum value for the maximum
- ❑ **Value measured**: Primary or secondary data scaling identifier (p or s). Specifies whether the value received from the channel conversion factor equation ax+b will represent a primary (p) or secondary (s) value.
- ❑ **Factor A, Factor B**: Channel conversion factor (ax+b). if **Overwrite Factor A and Factor B** is checked, the factors are calculated as recommended in Annex E of IEEE Std C37.111-2013.
- ❑ **Primary value**: Channel voltage or current transformer ratio primary factor. The default value is 1.
- ❑ **Secondary value**: Channel voltage or current transformer ratio secondary factor. The default value is 1.
- ❑ **Phase**: Channel phase identification.
- ❑ **Signal unit**: Channel units (e.g., kV, V, kA, A, A RMS, A Peak).
- ❑ **Component monitored**: Circuit component being monitored.

- ❑ **Digital signals:** contains the digital signal information required by the COMTRADE standard. These information are written in the Configuration file.
- ❑ **Chanel identifier**: Signal name. A signal with the same name is added to the COMTRADE recorder device in the graphical user interface in order to feed this signal.
- ❑ **Normal status:** Normal state of status channel. State of the input when the primary apparatus is in the steady state condition. The default value is zero.

- ❏ **Phase**: Channel phase identification.
- ❏ **Component monitored**: Circuit component being monitored.

- ❏ **Run** # : Run number. Number added at the end of the Configuration file and Data file name. It is intended to be used during parametric studies so the COMTRADE files are automatically saved under different names without erasing previously recorded files.
  Leave it blank when base cases are ran.
  If **Auto increment** is checked: any time a simulation is ran and if the .cfg file already exists and is not empty, the **Run#** is incremented by 1 or to the next non-existing file name.

- ❏ **Select a CFG file name**: this button allows to specify the folder and the name of the generated Configuration file.
- ❏ **Select a DAT file name**: this button allows to specify the folder and the name of the generated Data file.

# 3 Pins

The COMTRADE recorder has one bundle which contains the input pins of the control signals recorded. The bundle pins' names are the same as the ones entered in the column **Chanel identifier** of the analog and digital tables. The total number of pins corresponds to the number of rows in the two tables.

# 4 Example of Data file

## *4.1 ASCII format:*

Each line of the Data file represents a sample. Here is an example recorded in the ASCII format:
5, 667, –760, 1274, 72, 61, –140, –502,0,0,0,0,1,1
- - The first element is the sample number
- - The second element is the sample time (in micro seconds)
- - The following comma-separated values are the analog values followed by the digital (or logical) values. In this example, we have 6 analog signals and 6 digital signals. All values are separated by commas.
  For stored analog values, the recorded value is found by applied the conversion factor equation $ax+b$ where $a$ is the Factor A, $b$ is the Factor B et $x$ is the value stored in the Data file.

## *4.2 BINARY format:*

Each line of the Data file represents a sample. Here is the same example as above but recorded in the BINARY format:
05 00 00 00 9B 02 00 00 08 FD FA 04 48 00 3D 00 74 FF 0A FE 30 00
The elements are the same as in the ASCII format but stored in BINARY. In BINARY format, there is no comma. The sample number and the sample time are written into 4 bytes integers, the analog signals into 2 bytes integers (or 4 bytes if the format is BINARY32 or FLOAT32) and the digital signals are written by group of sixteen (padded with zeros) into 2 bytes integers.