Specifications for Input Log to the Mitaka FX-Correlator

KAMENO Seiji[1]
National Astronomical Observatory of JAPAN

1995 8.10 V2.0

1 Overview

The Mitaka FX-correlator can correlate VLBI data which is recorded with the DIR-1000 recorder. It accepts K4, New-K4, and VSOP format. S2 and VLBA tapes are also acceptable after copied to DIR-1000 tapes for correlation.

This document describes the specification of the input log file to the Mitaka FX-correlator. The correlation software refers to log files from each station and a schedule file. The format of the schedule file is similar to that of MK3 drudge files, with some modifications for the VSOP terminal.

The translation software (S2→VSOP, VLBA→VSOP) will accept log files generated by FS 9.1 and outputs the log files for Mitaka FX-correlator. Therefore, it is not necessary for S2 and VLBA recording system personnel to refer this document.

The general format for the log file consists of a time tag, item, and parameters as follows:

```
dddhhmmss/ITEM/ param1, param2, ...
```

where `ddd` is day of year (`001` for 1 Jan.), `hh` hour in UT, `mm` minute, and `ss` second. `ITEM`s are specified in the next chapter, like C language format. Any other `ITEM`s will be neglected. `param`s are separated by a comma (,). If the 10th column is not a slash (/), it is recognized as a comment.

2 ITEMs Necessary for the Correlation

`/EXPER/`

Observation Code (with observation data and year)

```
''%03d%02d%02d%02d/EXPER/ %01s%02d%03d'', doy, hh, mm, ss, code, year, doy
```

`code:` Observation code.

`year:` The last two digit of the year at the start of the observation.

`doy:` Day of Year at the start of the observation.

CAUTION : The format of `EXPER` must be kept. This is only the information source for the observation year.

`/STATION/`

Station name, station code, station position, and mounting.

```
''%03d%02d%02d%02d/STATION/ %01s, %02s, %s, %04s %13.4f, %13.4f, %13.4f, %8f'', doy, hh,
mm, ss, code1, code2, name, mount, x, y, z, ofs
```

`code1:` One-character code for the station.

`code2:` Two-character code for the station.

`name:` The station name.

`mount:` AZEL, HADC, or XY

`x, y, z:` Station position in VLBI coordinates (in meters).

`ofs :` The offset of the secondary axis from the primary (fixed to the ground) axis, in meters.

[1]E-mail: kameno@hotaka.mtk.nao.ac.jp

/TSID/

Tracking-station name, Tracking-station code, and station position.

Format is the same with /STATION/. This item is written if the data is recorded in a tracking station which receives down-linked data from the MUSES-B satellite. In this case, the station name in /STATION/ item will be MUSES-XX, where XX is the two-character station code in TSID.

/SOURCE/

Information for the object to be observed.

''%03d%02d%02d%02d/SOURCE/ %8s, %8s, %02d, %02d, %8.5f, %03d, %02d, %7.4f, %6.1f, %f, %f'', doy, hh, mm, ss, iau, common, rh, rm, rs, dd, dm, ds, ep, pa, pd

IAU: IAU-format name of the radio source. It consists of 4-digit right ascension, 1-character sign of the declination, and 3-digit declination in B1950. IAU name of the source at 19 21 26.20000 +14 24 44.0000 will be, for example, 1921+144.

common: Common name of the radio source in less than 8 ASCII characters. If no common name is defined, IAU-format name will be written again.

rh, rm, rs: Right ascension at the epoch.

dd, dm, ds: Declination at the epoch.

ep: Epoch. B1950 or J2000 is acceptable.

pa, pd: Proper motion in unit of mas/yr. Put zero for extragalactic sources and do not leave them blank.

/LO/

Index number of the local oscillator and frequency.

''%03d%02d%02d%02d/LO/ %02d, %8.2f'', doy, hh, mm, ss, nn, freq

nn: Index number of the local oscillator.

freq: frequency in unit of MegaHertz.

/BBC/

Index number of the baseband converter and its local frequency.

''%03d%02d%02d%02d/BBC/ %02d, %02d, %8.2f'', doy, hh, mm, ss, nl, nn, freq

nl: Index number of the related LO.

nn: Index number of the baseband converter.

freq: frequency in MegaHertz.

/FORM/

Index number, sideband, sampling speed, and quantization of the formatter.

''%03d%02d%02d%02d/FORM/ %02d, %02d, %s, %07d, %02d'', doy, hh, mm, ss, nb, nn, side, rate, bit

nb: Index number of the related baseband converter.

nn: Index number of the formatter.

side: Sideband. USB, LSB, or DSB

rate: Sampling rate in kilosamples per second.

bit: Quantization bit number.

/LABEL/

Barcode tape label stamped on the tape. This item will be written when a new tape is inserted to the recorder.

‘‘%03d%02d%02d%02d/LABEL/ %08s’’, doy, hh, mm, ss, label

label: Tape label with 8 or less ASCII characters

/WX/

Temperature, pressure, and humidity.

‘‘%03d%02d%02d%02d/WX/ %f, %f, %f’’, doy, hh, mm, ss, temp, pres, humd

temp: Temperature at the station in degrees Celsius.

pres: Atmospheric pressure in unit of hectoPascal (hPa).

humd: Relative humidity, expressed as a percentage.

/ST/

Track Set Sync ID (TSSID) number at the start of the recording. This TSSID is a 23-bit counter of the revolution of the rotary head in the DIR-1000 recorder, and used as the time tag.

‘‘%03d%02d%02d%02d/ST/ %7d’’, tss

tss: TSSID at the start of the recording.

/ET/

TSSID number at the end of the recording.

‘‘%03d%02d%02d%02d/ST/ %7d’’, tss

tss: TSSID at the end of the recording.

3 ITEMs Applied for the Correlation

/CLOCK/

The offset of the frequency standard at each station relative to the GPS satellite in unit of microsec. Only one CLOCK and CLKRATE in a log file will be used. If there are two or more CLOCK and CLKRATE in a log file, the final one will be referred. The clock offset $Delta\tau(t)$ at time t will given by

$$\Delta\tau(t) = \Delta\tau_0 + \dot{\tau} \cdot (t - t_0)$$

where t_0 is the epoch, τ_0 the clock offset at the epoch, and $\dot{\tau}$ the clock rate.

‘‘%03d%02d%02d%02d/CLOCK/ %f’’, doy, hh, mm, ss, offset

offset: Clock offset in microseconds.

/CLKRATE/

The drift rate of the frequency standard at each station relative to the GPS satellite, i.e. the time derivative of the clock offset. Each station will calculate the clock rate based on the clock offset data for long time span. In the Mitaka FX-correlator, a priori parameter will be calculated by the constant clock rate.

‘‘%03d%02d%02d%02d/CLKRATE/ %f’’, doy, hh, mm, ss, rate

rate: Clock rate, in picoseconds per second.

/ONSOURCE/

Time when the antenna starts to track the radio source.

‘‘%03d%02d%02d%02d/ONSOURCE/’’, doy, hh, mm, ss

doy, hh, mm, ss: Epoch when the antenna starts to track the radio source.

/FLAG/

Time range when the observed data is invalid. Correlation will be done even if the data is invalid, and *invalid* flags will be stamped on the correlated data.

`''%03d%02d%02d%02d/FLAG/ %03d,%02d,%02d,%02d,%03d,%02d,%02d,%02d,%22s'',`

`doy, hh, mm, ss, sd, sh, sm, ss, ed, eh, em, es, reason`

`sd, sh, sm, ss:` Start time when the data become invalid.

`ed, eh, em, es:` End time, from when the data become valid again.

`reason:` Reason, in 22 or less ASCII characters.

/POLAR/

Receiving circular polarization in *IEEE* definition.

`''%03d%02d%02d%02d/POLAR/ %02d,%1s'', doy, hh, mm, ss, nn, polar`

`nn:` Index number of `LO`

`polar:` Receiving polarization, `L` or `R`

/TEC/

Column density of electrons in the ionosphere.

`''%03d%02d%02d%02d/TEC/ %f'', doy, hh, mm, ss, tec`

`tec:` Total electron contents in unit of 10^{15} m^{-2}.

/CABLE/

Cable delay in the station. This value will be added to `CLOCK`.

`''%03d%02d%02d%02d/CABLE/ %e'', doy, hh, mm, ss, cable`

`cable:` Cable delay, in microseconds.

4 Items Necessary for Calibration after Correlation

/TSYS/

Receiver and system noise temperature at each elevation.

`''%03d%02d%02d%02d/TSYS/ %02d, %f, %f, %f'', doy, hh, mm, ss, nn, el, trx, tsys`

`nn:` Index number of the formatter.

`el:` Elevation angle in unit of degree.

`trx:` Receiver noise temperature, in Kelvins.

`tsys:` System noise temperature including atmospheric radiation, in Kelvins.

/PCAL/

Amplitude and phase of the phase calibration tones.

`''%03d%02d%02d%02d/PCAL/ %02d, %f, %f, %f'', doy, hh, mm, ss, nn, fre, amp, phs`

`nn:` Index number of the formatter.

`fre:` Frequency in unit of kiloHertz.

`amp:` Amplitude relative to the system noise, as a percentage.

`phs:` Phase in unit of degree.

Example for the Relation among LO, BBC, and FORM

```
150102100/LO/ 01, 21798.00
150102100/LO/ 02, 42750.00
150102200/BBC/ 01, 01, 430.99
150102200/BBC/ 01, 02, 434.99
150102200/BBC/ 01, 03, 438.99
150102200/BBC/ 01, 04, 442.99
150102200/BBC/ 02, 05, 370.99
150102200/BBC/ 02, 06, 374.99
150102200/BBC/ 02, 07, 378.99
150102200/BBC/ 02, 08, 382.99
150102200/FORM/ 01, 01, LSB, 4000, 1
150102200/FORM/ 01, 02, USB, 4000, 1
150102200/FORM/ 02, 03, LSB, 4000, 1
150102200/FORM/ 02, 04, USB, 4000, 1
150102200/FORM/ 03, 05, LSB, 4000, 1
150102200/FORM/ 03, 06, USB, 4000, 1
150102200/FORM/ 04, 07, LSB, 4000, 1
150102200/FORM/ 04, 08, USB, 4000, 1
150102200/FORM/ 05, 09, LSB, 4000, 1
150102200/FORM/ 05, 10, USB, 4000, 1
150102200/FORM/ 06, 11, LSB, 4000, 1
150102200/FORM/ 06, 12, USB, 4000, 1
150102200/FORM/ 07, 13, LSB, 4000, 1
150102200/FORM/ 07, 14, USB, 4000, 1
150102200/FORM/ 08, 15, LSB, 4000, 1
150102200/FORM/ 08, 16, USB, 4000, 1
```

The above log describes the frequency settings like below.

LO	BBC	tape stream	sideband	bandpass
01	01	01	LSB	22228.99 → 22226.99
		02	USB	22228.99 → 22230.99
	02	03	LSB	22232.99 → 22230.99
		04	USB	22232.99 → 22234.99
	03	05	LSB	22236.99 → 22234.99
		06	USB	22236.99 → 22238.99
	04	07	LSB	22240.99 → 22238.99
		08	USB	22240.99 → 22242.99
02	05	09	LSB	43120.99 → 43118.99
		10	USB	43120.99 → 43122.99
	06	11	LSB	43124.99 → 43122.99
		12	USB	43124.99 → 43126.99
	07	13	LSB	43128.99 → 43126.99
		14	USB	43128.99 → 43130.99
	08	15	LSB	43132.99 → 43130.99
		16	USB	43132.99 → 43134.99