TDC Technical Memorandum
TDC-TM20160805Re
2016-08-05 Revised
T.KONDO

KSP Coorelation Data File Format (extended definition)

1 Introduction

On the bandwidth processing using "KOMB" software package, COUT type correlation data file whichi is the ouput of K5 software correlator are converted to KSP correlation data at first, then processed by KOMB. The number of lags of the original KSP format is fixed to 32, however it is required to increase the number of lags more than 32 these days. Therefore KSP format is extended to support the large number of lags.

2 Extention of KSP correlation data format

Header portion (HD: 512 bytes) of extended format is almost same as that of the original format, but "F" (meaning FULL) is added as the "CRSMODE". The size of correlation counter is changed from 24 bits to 32 bits for "F" mode. Furthermore add "LAG" for lag size and "ADBIT" for AD resolution.

Correlation data (CD) of each integration period PP (parameter period) consists of correlation data of each channel unit (UD) like the original format, but UD can be extended by 256 bytes according to the lag size. Therefore items in UD were changed largely.

HD 512 bytes	CD	CD	$\cdots$

Figure 1: Record structure of KSP correlation data format. HD: header, CD:correlation data by PP.

CD(correlation data by PP)				
UD (1unit)	UD (2unit)	UD (3unit)	$\cdots$	UD (K unit)

Figure 2: Record structure in CD by PP. UD:unit (channel) data.

Correlation data by UD (channel)				
UD#0 256 bytes	UD#1 256 bytes	UD#2 256 bytes	$\cdots$	UD#N 256 bytes

Figure 3: Record structure in UD (unit data). UD#0 includes time information, and 32-lag correlation data are contained in UD#1 and after. In case of 64-lag data, it finish in UD#2. In case of 1024-lag data, UD# continues upto 32.

2.1 Correlation data format: header record (HD)

Table 1. KSP correlation data format: header record (HD: 512bytes)

symbol	# of bytes	byte position	type	note
EXCODE	10	1	A10	experiment code (A10)
NOBS	2	11	I*2	scan #
LFILE	6	13	A6	correlation file name (A6)
LBASE	2	19	A2	baseline ID (A2)
NPP	2	21	I*2	# of PPs
NPPSEC	2	23	I*2	period of PP unit is sec for FMTFLAG "KSP " and "K4" unit is 10 msec for FMTFLAG "KSP1" unit is 1 msec for FMTFLAG "KSP2"
NKOMB	2	25	I*2	# of KOMB processings
KRDATE	8	27	I*2	correlation processing date and time DIM(4) (year, total day, hour, minute)
KBFILE	6	35	A6	KOMB out file name (set by KOMB)
SRCNAM	8	41	A8	radio source name (A8)
SRCRA	4	49	I*2	DIM(2) right ascension of radio source (α) (hour, minute) J2000
	8	53	R*8	right ascension of radio source (α) (second) J2000
SRCDEC	4	61	I*2	DIM(2) declination of radio source (δ) (degree, minute) J2000
	8	65	R*8	declination of radio source (δ) (second) J2000
IPRT	10	73	I*2	DIM(5) PRT (processing reference time) (almost center of scan length) (year, total day, hour, minute, second)
STATX	8	83	A8	X station name (A8)
STATY	8	91	A8	Y station name (A8)
X_XYZ	24	99	R*8	DIM(3) X station position (X, Y, Z)(m)
Y_XYZ	24	123	R*8	DIM(3) Y station position (X, Y, Z)(m)
OSTART	10	147	I*2	DIM(5) scan start time (year, total day, hour, minute, second)
OSTOP	10	157	I*2	DIM(5) scan stop time (year, total day, hour, minute, second)
SRCGHA	4	167	I*2	DIM(2) Greenwich hour angle of source at PRT (hour, minute)
	8	171	R*8	Greenwich hour angle of source at PRT (second)
TSAMPL	4	179	R*4	sampling period (sec)
VBW	4	183	R*4	video bandwidth (Hz)
NCH	2	187	I*2	# of channel at correlation processing
ACLKO	4	189	R*4	clock offset (sec) at PRT positive value menas Y clock tic earlier than X clock tic
ACLKR	4	193	R*4	clock rate difference at PRT (s/s)
DLYINX	4	197	R*4	instrumental delay difference at X band (sec)
DLYINS	4	201	R*4	instrumental delay difference at S band (sec)
AXCLKE	4	205	R*4	clock error of X station (sec) at PRT. positive value menas X clock tic earlier than UTC clock tic
PI	8	209	R*8	π
C	8	217	R*8	light speed (m/s)
FRQTAB	128	225	R*8	DIM(16) RF frequency table(Hz) +VE: USB, -VE: LSB
PCALF	64	353	R*4	DIM(16) PCAL (phase calibration) frequency table (Hz)

APTAU	32	417	R*8	DIM(4) a-priori values of delay etc. τ(sec),$\dot{\tau}$(s/s),$\ddot{\tau}$(s/s^2), $\dddot{\tau}$(s/s^3)
SRCH	2	449	I*2	common channel # for fringe search mode (1∼16)
CMODE	2	451	A2	KSP hardware correlator mode “NO”: normal mode,“SE”: fringe search mode
UINT	2	453	I*2	# of lags between units in case of fringe search mode (default is 30)
CUNIT	2	455	I*2	unit # that includes 0 lag in case of fringe search mode
CRLDBL	8	457	R*8	8-byte real value set from KSP control work station (unused)
CRLLNG	4	465	I*4	4-byte integer value set from KSP control work station (unused)
CRLSHT	2	469	I*2	2-byte integer value set from KSP control work station (unused)
FRGMOD	2	471	A2	fringe stopping mode “CO”: continuous, “EV”: initialize each PP
CRSMODE	1	473	A1	flag of integration counter resolution for correlation and PCAL detection “U”: take upper 24 bits from 28-bit counter, “L”: take lower 24 bits “H”: take upper 24 bits from 32-bit counter “F”: take full 32 bits from 32-bit counter
VER	8	474	A8	version of correlator ROM for hardware correlator. in case of CRSMODE=“F”, set “K5-WIDE ”
—	1	482	—	unused
JXOFST	4	483	I*4	delay offsets of X station data in case hardware correlator (in unit of sample)
JYOFST	4	487	I*4	delay offsets of Y station data in case hardware correlator (in unit of sample)
LAG	4	491	I*4	# of lags in case of CRSMODE=“F” unused or 32 in case of CRSMODE is not equal to“F”
ADBIT	4	495	I*4	AD resolution (bits)
ADBITY	4	499	I*4	AD resolution of Y station when CORTYPE is set
CORTYPE	2	503	A2	correlator type “Xf” for XF or“Fx” for FX
—	4	505	—	unused
FMTFLAG	4	509	A4	format ID. “KSP ”,“K4 ”,“KSP1”, “KSP2”

2.2 Correlation data file format (in case of CRSMODE="F"): correlation data by unit (UD)

Format is the same as the original one in case that CRSMODE is not "F".

Table 2. KSP correlation data format (UD#0)(1st 256 bytes)

symbol	# of bytes	byte position	type	note
RMKS	2	1	2BYTE	remarks set by correlator byte #1: KSEL (K value at fringe rotation) byte #2: BIT#(LSB=0) 7-3: channel # (1-16) 2: delete flag set by KOMB 1:delete 1-0: unused
COFLG	1	3	BYTE	correlation flag BIT#(LSB=0) 7-6: sign of fringe rotation 10 ··· negative rotation 00 ··· sign reversal occurred during PP 01 ··· positive rotation 5: mode of fringe rotator 1 ··· carried out by hardware 0 ··· carried out by software 4: fringe stopping reference frequency 1 ··· at center of baseband bandwidth 0 ··· at baseband frequency 3: flag for fractiona bit correction 1 ··· carried out by hardware 0 ··· carried out by software 2: PP parameter update flag 1 ··· updated 0 ··· not updated 1-0: unused
TWESTS	1	4	BYTE	integration status BIT#(LSB=0) 7: AVL integration validity flag 1 ··· valid 0 ··· invalid 6-0: unused
**** items below are changed largely ****				
TIMX	7	5	14×4bits	X station time label: YYDDDHHMMSSmmm (by hexadecimal)
TIMY	7	12	14×4bits	X station time label:YYDDDHHMMSSmmm (by hexadecimal)
TMDIFF	4	19	I*4	offset of X and Y time siries (unit of sample) positive for Y station time is ahead
FRADD	4	23	32bits	fringe rotator address (32 bits) at the end of PP when fringe stopping is carried out, a-priori fringe rotator address at PP.
IFBIT	2	27	I*2	fractional part of delay in the unit of sample at PP. $-32768 \sim 32767$ corresponds to $-0.5 \sim +0.5$.
MODE	1	29	BYTE	versatile mode (unused) BIT#(LSB=0) 7-2: unused 1: 2/1 bit mode 1 ··· 2-bit correlation (K4 hardware correlator only)

				0 · · · 1-bit correlation 2: weight mode at 2-bit correlation 1 · · · Weight mode 0 · · · Binary binary mode
IPP	2	30	I*2	PP#
PCALD	16	32	I*4	DIM(4) counter value for PCAL detection real part for X station (4 bytes) imaginary part for X station (4 bytes) real part for Y station (4 bytes) imaginary part for Y station (4 bytes)
COUNTP	8	48	I*4	DIM(2) total # of samples for PCAL detection (real part 4 bytes, imaginary part 4 bytes)
—	—	56	—	unused

Table 3. KSP correlation data format (UD#1)(256 bytes)

symbol	# of bytes	byte position	type	note
CROSP	4	1	I*4	lag #1 real part of correlation data
	4	5	I*4	lag #2 real part of correlation data
				· · ·
	4	125	I*4	lag #32 real part of correlation data
	4	129	I*4	lag #1 imaginary part of correlation data
	4	133	I*4	lag #2 imaginary part of correlation data
				· · ·
	4	253	I*4	lag #32 imaginary part of correlation data

When the number of lags is larger than 32, UD records are added by 256 bytes (32 lags) as follows.

Table 4. KSP correlation data format (UD#2)(256 bytes)

symbol	# of bytes	byte position	type	note
CROSP	4	1	I*4	lag #33 real part of correlation data
	4	5	I*4	lag #34 real part of correlation data
				· · ·
	4	125	I*4	lag #64 real part of correlation data
	4	129	I*4	lag #33 imaginary part of correlation data
	4	133	I*4	lag #34 imaginary part of correlation data
				· · ·
	4	253	I*4	lag #64 imaginary part of correlation data

Table 5. KSP correlation data format (UD#N)(256 bytes)

symbol	# of bytes	byte position	type	note
CROSP	4	1	I*4	lag #$32 \times (N-1)+1$ real part of correlation data
	4	5	I*4	imaginary part
	4	9	I*4	lag # $32 \times (N-1)+2$ real part of correlation data
	4	13	I*4	imaginary part
				...
	4	249	I*4	lag # $32 \times N64$ real part of correlation data
	4	253	I*4	imaginary part

2.3 Correlation data file format (in case that CRSMODE is not "F"): correlation data by unit (UD)

Table 6. KSP correlation data format (UD)(256 bytes

symbol	# of bytes	byte position	type	note
RMKS	2	1	2BYTE	remarks set by correlator byte #1: KSEL (K value at fringe rotation) byte #2: BIT#(LSB=0) 7-3: channel # (1-16) 2: delete flag set by KOMB 1:delete 1-0: unused
COFLG	1	3	BYTE	correlation flag BIT#(LSB=0) 7-6: sign of fringe rotation 10 ··· negative rotation 00 ··· sign reversal occurred during PP 01 ··· positive rotation 5: mode of fringe rotator 1 ··· carried out by hardware 0 ··· carried out by software 4: fringe stopping reference frequency 1 ··· at center of baseband bandwidth 0 ··· at baseband frequency 3: flag for fractiona bit correction 1 ··· carried out by hardware 0 ··· carried out by software 2: PP parameter update flag 1 ··· updated 0 ··· not updated 1-0: unused
TWESTS	1	4	BYTE	integration status BIT#(LSB=0) 7: AVL integration validity flag 1 ··· valid 0 ··· invalid 6-0: unused
CROSP	192	5	I*3	DIM(64) correlation data (reset every PP) (real part 3 bytes × 32 lags, imaginary part 3 bytes × 32 lags) according to CRSMODE in HD "L": take lower 24 bits from 28-bit counter, "U": take upper 24 bits "H": take 24 bits from 32-bit counter
COUNTP	8	197	I*4	DIM(2) # of samples for correlation (real part 4 bytes, imaginary part 4 bytes)
PCALD	12	205	I*3	DIM(4) PCAL detection counter (reset every PP) real part (3 bytes) for X station imaginary part (3 bytes) for X station real part (3 bytes) for Y station imaginary part (3 bytes) for Y station according to CRSMODE in HD "L": take lower 24 bits from 28-bit counter, "U": take upper 24 bits "H": take 24 bits from 32-bit counter
TIMX	7	217	14×4bits	X station time label: YYDDDHHMMSSmmm

				(by hexadecimal)
TIMY	7	224	14×4bits	X station time label: YYDDDHHMMSSmmm (by hexadecimal)
TMDIFF	4	231	I*4	offset of X and Y time siries (unit of sample) positive for Y station time is ahead
FRADD	4	235	32bits	fringe rotator address (32 bits) at the end of PP when fringe stopping is carried out, a-priori fringe rotator address at PP.
IFBIT	2	239	I*2	fractional part of delay in the unit of sample at PP. $-32768 \sim 32767$ corresponds to $-0.5 \sim +0.5$.
MODE	1	241	BYTE	versatile mode (unused) BIT#(LSB=0) 7-2: unused 1: 2/1 bit mode 1 ⋯ 2-bit correlation (K4 hardware correlator only) 0 ⋯ 1-bit correlation 2: weight mode at 2-bit correlation 1 ⋯ Weight mode 0 ⋯ Binary binary mode
IPP	2	242	I*2	PP#
—	13	244	—	unused