1   KOMB (band width synthesis) output data format (Ver.2020-10-13)

KOMB (band-width synthesis software package) processes a correlator output data file of which name starts from either "K" or "C" or "E" or "V" [1] and creates an output file having the name as same as that of correlator output file but the 1st character is substituted by "B" (means KOMB output file). If KOMB output file has been already existed, processing results are appended to the file. The place where KOMB outputs a file follows a rule below. If letter string "kross" is included in the pass of correlator output file, the pass (directory) of which letter string "kross" substituted by "komb" will become the pass for KOMB output file. For an example, KOMB processes correlator output file "/vlbidata1/kross1/KS97123/K01234" and creates KOMB output file "/vlbidata1/komb1/KS97123/B01234". Therefore, the corresponding directory for KOMB output files should be created in advance. If there is no letter string "kross" in the pass of correlator output file, KOMB outputs results to the same directory as that of correlator output file.

   KOMB output file consists of 256-byte fixed-length records, and each record is classified into 5 kinds as follows; header record (HDxx: xx is serial number), observation and correlation information record (OBxx), band-width synthesis result record (BDxx), correlation amplitude and phase by PP record (5R), and line printer image reord (#1 and #2). BD, 5R, #1, and #2 records are appended when KOMB processes the same correlation data file.

HD	OB	BD	5R	#1	#2	6R	BD	5R	#1	#2	6R	BD	⋯

Figure 1: Contents of KOMB output file. HD: header record, OB: observation and correlation information record, BD: band-width synthesis result record, 5R: correlation amplitude and phase by PP record, #1 and #2: line printer image record. 6R: cross spectrum record when WBWS processing with '-SPE' option.

HD00	HD01	⋯		

OB01	OB02	OB03		

BD01	BD02	BD03	BD04	BD05

5R	5$	5$	⋯	

#1	ASCII data	ASCII data	⋯	

#2	ASCII data	ASCII data	⋯	

6R	6$	6$	⋯	

Figure 2: Contens of each record (normal processing), i.e., HD, OB, BD, 5R, #1, #2 from top to bottom. Each record is a 256-byte fixed-length record.

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[1] "K": KSP correlator output format, "C": software correlator output format (converted from 'cout' format to KSP format), "E": extended KSP format which is free from the limit of lags. "V": extended KSP format supporting upto 128 channel (VGOS mode).

HD00	HD01			
OB01	OB02#0	OB02#1	[OB02#2]	$\cdots$
OB03#0	OB03#1	[OB03#2]	$\cdots$	
BD01	BD02	BD03	BD04	BD05
5R	5$	5$	$\cdots$	
#1	ASCII data	ASCII data	$\cdots$	
#2	ASCII data	ASCII data	$\cdots$	
6R	6$	6$	$\cdots$	

Figure 3: Contens of each record (normal processing for VGOS mode data), i.e., HD, OB, BD, 5R, #1, #2 from top to bottom. OB02 and OB03 records are increased by every 16ch information. Each record is a 256-byte fixed-length record.

HD00	HD01	$\cdots$			
OB01	OB02#0	OB02#1	[OB02#2]	$\cdots$	
OB03#0	OB03#1	[OB03#2]	$\cdots$		
BD00	BD01	BD02	BD03	BD04	BD05
5R	5$	5$	$\cdots$		
#1	ASCII data	ASCII data	$\cdots$		
#2	ASCII data	ASCII data	$\cdots$		
6R	6$	6$	$\cdots$		

Figure 4: Contens of each record (WBWS processing for VGOS mode data), i.e., HD, OB, BD, 5R, #1, #2 from top to bottom. BD00 record is newly added. OB02 and OB03 records are increased by every 16ch information. Each record is a 256-byte fixed-length record.

1.1 Header record (HD)

mnemonic	# of bytes	byte position	type	comment
LID	4	1	A4	record ID (4 letters) "HDxx" xx denotes continuation, 00, 01, ···.
KSPID	3	5	A3	KSP format ID (3 letters) "KSP"
—	1	8	—	unused
EXCODE	10	9	A10	experiment code (10 letters)
NOBS	2	19	I*2	observation number
LBASE	2	21	A2	baseline ID (2 letters)
LREC	2	23	I*2	total number of records in this file
LHDCN	2	25	I*2	total number of HD records
LFILB	6	27	A6	KOMB output file nme (6 letters)
—	24	33	—	unused
$\cdots$ directory of record ID $\cdots$				
[Record #1]				
	2	57	I*2	record #
	4	59	A4	record ID (4 letters) ("T500" for Type 500 record that has no record ID)
	2	63	A2	frequency sub-group ID of the record (2 letters) ("␣X" or "␣S" or "␣W" etc. "␣␣"(two spaces) for header record block)
.				
.				
repeat directory of record ID up to 25 times.				
If total number of records exceed 25, header record is repeated				
so as to include all record information.				
.				
.				
[Record #25]				
	2	57	I*2	record #
	4	59	A4	record ID (4 letters) ("T500" for Type 500 record that has no record ID)
	2	63	A2	frequency sub-group ID of the record (2 letters) ("␣X" or "␣S" or "␣W" etc. "␣␣"(two spaces) for header record block)

1.2 Observation and correlation information record (OB)

mnemonic	# of bytes	byte position	type	comment
LID	4	1	A4	record ID (4 letters) "OB01"
—	4	5	—	unused
EXCODE	10	9	A10	experiment code (10 letters)
NOBS	2	19	I*2	observation number
LBASE	2	21	A2	baseline ID (2 letters)
IOBSST	10	23	I*2	DIM(5) Observation (scan) start time (year, total day, hour, minute, second)
IOBSET	10	33	I*2	DIM(5) Observation(scan) stop time (year, total day, hour, minute, second)
IPRT	10	43	I*2	DIM(5) PRT (Processing Reference Time) (year, total day, hour, minute, second)
LCROSS	6	53	A6	correlator output file name (6 letters)
—	2	59	—	unused
LFILB5	6	61	A6	KOMB output file name
—	2	67	—	unused
KRDATE	8	69	I*2	DIM(4) correlation procesing time (year, total day, hour, minute)
—	4	77	—	unused
NPPSEC	2	81	I*2	PP period (sec)
NPP	2	83	I*2	# of PP
SAMPL	4	85	R*4	sampling period (sec)
VBW	4	89	R*4	video band width (Hz)
LMODE	2	93	A2	correlator mode "NO": normal mode, "SE": fringe search mode
or APORDER	2	93	I*2	a-priori order (3|4) (added on 2020/10/13) Note: APORDER is valid when LMODE is not "NO" and "SE"
LSORNA	8	95	A8	radio source name (8 letters)
SDEC	4	103	R*4	declination of radio source (deg) J2000
SGHA	4	107	R*4	Greenwhich hour angle of the source at PRT (deg)
LSTATX	8	111	A8	X station name (8 letters)
LSTATY	8	119	A8	Y station name (8 letters)
DXXYZ	24	127	R*8	DIM(3) X station position (x, y, z) (m)
DYXYZ	24	151	R*8	DIM(3) Y station position (x, y, z) (m)
DTAUAP	32	175	R*8	DIM(4) a-priori values at PRT at correlation processing τ(sec), $\dot{\tau}$(s/s), $\ddot{\tau}$(s/s^2), and $\dddot{\tau}$(s/s^3)
DACLKE	8	207	R*8	a-priori clock error (sec) time synchronization error between X and Y stations at PRT (positive sign denotes that Y clock is ahead)
DACLKR	8	215	R*8	clock rate difference between X and Y stations at PRT (s/s)
DLYINS	8	223	R*8	instrumental delay difference between X and Y stations (sec)
DXCLKE	8	231	R*8	difference between X station clock and UTC at PRT (sec)
SRA	4	239	R*4	right ascension of the radio source (deg) J2000
FMTFLAG	4	243	A4	unused or flag to identify format as follows. "KSP␣"|"K4␣␣"|"KSP1"|"KSP2" | "VGOS" | "VGO2" The unit of PP is sec for "KSP␣" and "K4␣␣", 10 msec for "KSP1", and 1 msec for "KSP2".
—	2	247	—	unused
TAU4DOT	8	249	R*8	a-priori value of $\ddddot{\tau}$(s/s^4) (added on 2020/10/13) Note: TAU4DOT is valid when APORDER is valid

mnemonic	# of bytes	byte position	type	comment
LID	4	1	A4	record ID (4 letters) "OB02"
LIDSUB	2	5	A2	continuation number for OB02 record for FMTFLAG="VGOx". "#0", "#1", "#2". ··· from the first OB03 record. unused for FMTFLG≠"VGOx"
—	2	7	—	unused
DPI	8	9	R*8	π
DCV	8	17	R*8	light speed (m/s)
EOPFLAG	2	25	A2	EOP flag (always "ON")
UT1_C	4	27	R*4	UT1-UTC (sec)
XWOBB	4	31	R*4	Wob-X (arcsec)
YWOBB	4	35	R*4	Wob-Y (arcsec)
—	18	39	—	unused
NFREQA	2	57	I*2	total number of channels processed
INDEXT	64	59	I*2	DIM(2,16) index number table (by side band (USB, LSB), by channel) increase every 16CHs for FMTFLG="VGOx"
—	134	123	—	unused

mnemonic	# of bytes	byte position	type	comment
LID	4	1	A4	record ID (4 letters) "OB03"
LIDSUB	2	5	A2	continuation number for OB03 record for FMTFLAG="VGOx". "#0", "#1", "#2". ··· from the first OB03 record. unused for FMTFLG≠"VGOx"
—	2	7	—	unused
DFREQT	128	9	R*8	DIM(16) RF frequency table (Hz) by channel increase every 16CHs for FMTFLG="VGOx"
PCALFX	64	137	R*4	DIM(16) X station PCAL frequency table (Hz) increase every 16CHs for FMTFLG="VGOx" (by channel)
POLXYT	32	201	A*2	DIM(16) Polarization information, e.g., "RR","LL","RL","XX","YY","XY","−−", etc. "−−" means no information. increase every 16CHs for FMTFLG="VGOx" unused before Ver.2019-07-16
—	24	233	—	unused

1.3 Band-width synthesis result record (BD)

mnemonic	# of bytes	byte position	type	comment
LID	4	1	A4	record ID (4 letters) "BD00" Remarks: this record exists only the case of BWSMOD="WBWV" (WBWS processing for multi-channel per band data, such as VGOS mode data)
BWSMOD	4	5	A4	wide band bandwidth synthesis (WBWS) mode usually "WBWV": WBWS for VGOS mode data (multi-channel per band)
IDSUB	2	9	A2	frequency sub-group ID (2 letters) usually "⎵W" etc.
NBAND	2	11	I*2	valid of bands in BDCHTB table
BDCHTB	200	13	I*2	DIM(100) band-ch table (delimiter between bands is '0', end of table is '-1' contents of array: bd#1-ch1, bd#1-ch2, ..., 0, bd#2-ch1, bd#2-ch2, ..., -1
—	44	213	—	unused

mnemonic	# of bytes	byte position	type	comment
LID	4	1	A4	record ID (4 letters) "BD01"
BWSMOD	4	5	A4	unused or wide band bandwidth synthesis (WBWS) mode "EBWS": extended WBWS (single-channel per band) "WBWS": normal WBWS (single-channel per band) "WBW2": WBWS using a new method "WBWV": WBWS for VGOS mode data (multi-channel per band)
IDSUB	2	9	A2	frequency sub-group ID (2 letters) "␣X" or "␣S" or "␣W" etc.
KMDATE	8	11	I*2	KOMB processing date and time (year, total day, hour, minute)
KOMVAL	2	19	I*2	KOMB processing number =(KROSS processing number)×1000+(KOMB processing number)
ISTART	12	21	I*2	DIM(6) correlation data start time (year, total day, hour, minute, second, milli-second)
ISOP	12	33	I*2	DIM(6) correlation data stop time (year, total day, hour, minute, second, milli-second)
NFREQ	2	45	I*2	total number of channels (or bands) processed
INDEX	64	47	I*2	DIM(2,16) index number table (by sideband (USB, LSB), by channel)
NTAPEQ	6	111	A6	tape quality code (6 letters) (no meaning in KSP system)
DRREF	8	117	R*8	processing reference RF frequency (Hz)
DRFREQ	128	125	R*8	DIM(16) RF frequency table (Hz)
IONFLG	4	253	A4	unused or flag to TEC estimation (4 characters)"OFF␣":no estimation, "ONmw": estimation ("GTEC" for given TEC) where 'm' is 1|2|3|4|5 showing an estimation method, and 'w' is 0|1|2 showing a weighting mode or '-' for m=5.

Note "WBWV" mode means a WBWS processing for multi-channel per band data, such as VGOS mode data.

mnemonic	# of bytes	byte position	type	comment
LID	4	1	A4	record ID (4 letters) "BD02"
BWSMOD	4	5	A4	unused or wide band bandwidth synthesis (WBWS) mode "EBWS": extended WBWS (single-channel per band) "WBWS": normal WBWS (single-channel per band) "WBW2": WBWS using a new method "WBWV": WBWS for VGOS mode data (multi-channel per band)
IDSUB	2	9	A2	frequency sub-group ID (2 letters) "␣X" or "␣S" or "␣W" etc.
KOMBQ	2	11	A2	KOMB quality code
JERRS	80	13	A4	DIM(20) error status mask code (4 letters) × 20
NPPR	64	93	I*2	DIM(2,16) processing PP number table (by sideband, by channel)
QB	4	157	R*4	rms PP number by channel
TEF	4	161	R*4	effective integration period (sec)
FISC	4	165	R*4	rejection rate of correlation data
IEPOCM	12	169	I*2	DIM(6) central epoch (center time of processing data) (year, total day, hour, minute, second, milli-second)
DGPDM	8	181	R*8	observed group delay at the central epoch (sec)
DRATM	8	189	R*8	observed delay rate at the central epoch (s/s)
TOTPM	4	197	R*4	observed total phase at the central epoch (deg)
SSDES	8	201	R*4	DIM(2) coarse delay search parameters (start, stop) (really used values: sec)
SMDEM	8	209	R*4	DIM(2) fine delay search parameters (start, stop) (really used values: sec)
SRTM	8	217	R*4	DIM(2) fine delay rate search parameters (start, stop) (really used values: s/s)
DEPE	8	225	R*8	PRT − earth centered epoch (sec)
TOTP	4	233	R*4	observed total phase at PRT (deg)
EARP	4	237	R*4	observed total phase at the earth centered epoch (deg)
REARP	4	241	R*4	observed residual fringe phase at the earth centered epoch (deg)
TEC	8	245	R*8	unused or ionospheric correction ΔTEC (electrons/m^2) for WBWS mode. When TEC is given from the outside, i.e., IONFLG="GTEC" in the BD01 record, its value.
TECERR	4	253	R*4	unused or estimation error of TEC

mnemonic	# of bytes	byte position	type	comment
LID	4	1	A4	record ID (4 letters) "BD03"
BWSMOD	4	5	A4	unused or wide band bandwidth synthesis (WBWS) mode
				"EBWS": extended WBWS (single-channel per band)
				"WBWS": normal WBWS (single-channel per band)
				"WBW2": WBWS using a new method
				"WBWV": WBWS for VGOS mode data (multi-channel per band)
IDSUB	2	9	A2	frequency sub-group ID (2 letters) "␣X" or "␣S" or "␣W" etc.
DRPCAL	16	11	R*8	DIM(2) PCAL rate (s/s) by station (X, Y)
				no meaning for WBWS processing mode
XAPCAL	128	27	R*4	DIM(2,16) X station PCAL amplitude and phase (deg) table
				no meaning for WBWS processing mode
PCFILE	102	155	A80	unused or phase correction file name for EBWS or WBWS mode.
				"NONE" means that no phase correction at EBWS or WBWS mode
PCFPRT	10	235	I*2	unused or PRT (yyyy, ddd, hh, mm, ss) of the scan that used for making the PCFILE file
—	11	245	—	unused

mnemonic	# of bytes	byte position	type	comment
LID	4	1	A4	record ID (4 letters) "BD04"
BWSMOD	4	5	A4	unused or wide band bandwidth synthesis (WBWS) mode
				"EBWS": extended WBWS (single-channel per band)
				"WBWS": normal WBWS (single-channel per band)
				"WBW2": WBWS using a new method
				"WBWV": WBWS for VGOS mode data (multi-channel per band)
IDSUB	2	9	A2	frequency sub-group ID (2 letters) "␣X" or "␣S" or "␣W" etc.
—	16	11	—	unused
YAPCAL	128	27	R*4	DIM(2,16) X station PCAL amplitude and phase (deg) table
				no meaning for WBWS processing mode
DCFILE	102	155	A80	unused or inter-band delay correction file name for WBWS mode.
				"NONE" means that no inter-band delay correction at WBWS
DCFPRT	10	235	I*2	unused or PRT (yyyy, ddd, hh, mm, ss) of the scan that used for making the DCFILE file
—	11	245	—	unused

mnemonic	# of bytes	byte position	type	comment
LID	4	1	A4	record ID (4 letters) "BD05"
BWSMOD	4	5	A4	unused or wide band bandwidth synthesis (WBWS) mode
				"EBWS": extended WBWS (single-channel per band)
				"WBWS": normal WBWS (single-channel per band)
				"WBW2": WBWS using a new method
				"WBWV": WBWS for VGOS mode data (multi-channel per band)
IDSUB	2	9	A2	frequency sub-group ID (2 letters) "␣X" or "␣S" or "␣W" etc.
COHE	4	11	R*4	fine search fringe amplitude
AAMP	4	15	R*4	coarse search fringe amplitude
SNR	4	19	R*4	SNR
AICOH	4	23	R*4	incoherently integrated fringe amplitude
PROB	4	27	R*4	false detection probability for fringe peak
DGPD	8	31	R*8	observed fine search group delay at PRT (sec)
DTAU	8	39	R*8	observed fine search group delay residual (sec) = (delay residual obtained by fine search only)
EGPD	4	47	R*4	one sigma error of observed fine search group delay (sec)
GPDA	4	51	R*4	ambiguity of fine search group delay (sec)
DRATO	8	55	R*8	observed delay rate at PRT (s/s) (after PCAL rate correction)
DRATR	8	63	R*8	observed delay rate residual (s/s) = (coarse search delay rate residual) + (fine search delay rate residual) (without PCAL rate correction)
ERAT	4	71	R*4	one sigma error of observed delay rate (s/s)
DGPDN	8	75	R*8	observed coarse delay at PRT (sec)
DTAUS	8	83	R*8	coase search delay residual (sec)
EGPDN	4	91	R*4	one sigma error of coarse search delay (sec)
DRATS	8	95	R*8	coarse search delay rate residual (s/s)
DPHD	8	103	R*8	phase delay (sec) at PRT
DPHD1	8	111	R*8	phase delay (sec) at PRT+1 sec
DPHD2	8	119	R*8	phase delay (sec) at PRT−1 sec
AMPB	128	127	R*4	DIM(2,16) fringe amplitude and phase (deg) by channel
POLXY	2	255	A2	polarization infomation e.g., "XX", "YY", "XY". "−−" for no information.

1.4 Type500 record (5R)

mnemonic	# of bytes	byte position	type	comment
LID2	2	1	A2	record ID (2 letters) "5R" or "5$" for continuation
IDUR	2	3	I*2	continuation number
INDEXN	4	5	I*2	DIM(2) index # for this PP data by sideband
OBSPTM	4	9	R*4	time at the first data of each block (10 second value past from on the hour)
PPTIM	4	13	R*4	PP period (sec)
EPCOTM	4	17	R*4	time at the first data of each block (10 second value past from PRT)
—	36	21	—	unused
	2	57	I*2	amplitude at the 1st PP (normalized as 30000=100%) −1 = deleted or no data −2 = just to fill out (initialized data)
	2	59	I*2	phase at the 1st PP $0 \sim 9999 = 0 \sim 360°$ USB+LSB $10000 \sim 19999 = 0 \sim 360°$ USB $20000 \sim 29999 = 0 \sim 360°$ LSB phase means residual phase after KROSS+KOMB processing PCAL rate is not corrected −1 = deleted or no data −2 = jsut to fill out (initialized data)
	2	61	I*2	X PCAL signal phase at the 1st PP
	2	63	I*2	Y PCAL signal phase at the 1st PP $0 \sim 9999 = 0 \sim 360°$ −1 = deleted or no data −2 = jsut to fill out (initialized data)
$\cdots$ repeat items from byte position 57 to 63 up to 25 times $\cdots$				
	2	255	I*2	Y PCAL signal phase at the 25th PP

mnemonic	# of bytes	byte position	type	comment
LID2	2	1	A2	record ID (2 leters) "#1". header record of PLOT#1
NREC	2	3	I*2	# of records (NREC records of line-printer image data follows this record)
—	252	5	—	unused

mnemonic	# of bytes	byte position	type	comment
LID2	2	1	A2	record ID (2 leters) "#2". header record of PLOT#2
NREC	2	3	I*2	# of records (NREC records of line-printer image data follows this record)
—	252	5	—	unused

1.5 Type600 record(6R) (cross spectrum and phase and delay correction information for WBWS mode)

mnemonic	# of bytes	byte position	type	comment
LID2	2	1	A2	record ID (letters) "6R" or "6$" for continuation.
IDUR	2	3	I*2	continuation number
NUMDAT	4	5	I*4	# of spectrum elements
PHSOFST	4	9	R*4	phase offset (deg) (applied for all data)
	6	13	–	unused
	8	19	R*8	RF frequency (Hz) 0.0 jsut to fill out
	2	27	I*2	band INDEX # 0 jsut to fill out
	4	29	R*4	cross spectrum (real part)
	4	33	R*4	cross spectrum (imaginary part)
	4	37	R*4	phase correction data in a band (deg)
	4	41	R*4	phase correction data inter band (deg)
	8	45	R*8	delay correction data inter band (sec)
⋯ repeat items 19∼52 upto 7 times ⋯				
	8	249	R*8	7th delay correction data inter band (sec)

Update history

2019.08.07 add "OB02#1"[, "OB02#2", ⋯] in case of FMTFLG=VGOx.

2019.07.16 add "OB03#1"[, "OB03#2", ⋯] in case of FMTFLG=VGOx. add "BD00" in case of BWSMOD="WBWV" (WBWS processing for VGOS mode data).

2019.07.12 add "VGOS" and "VGO2" at FMTFLG in "OB01" record. add "WBWV" [1] at BWSMOD in "BD01"∼"BD05" records. add POLXY (polarization information) to "BD05" record.

2018.06.14 add EOP parameters to "OB02" record

2016.04.20 modify IONFLAG in "BD01" record

2016.02.16 modify BWASMOD in BD records. modify IONFLG in "BD01" record and TEC in "BD02" record.

2015.10.13 add correction data file names and epoch information to "BD03" and "BD04" records.

2015.10.07 add TEC estimation flag to "BD01" record.

2015.08.05 add TEC estimation error to "BD02" record.

2015.03.02 add Type600 records to output cross spectrum in case of WBWS mode with '-SPE' option.

2015.02.25 add new mode "WBWS" [2] in BWSMOD field in BDxx records to support a wide-band band width synthesis. Frequency group (SUBID) of "␣W" was newly defined for the WBWS mode, and some items were added to reflect a WBWS mode processing.

2014.08.26 add new field "FMTFLAG" in the OB01 record according to the addition of "KSP2" mode in FMTFLAG field in the correlator output data.

2012.01.12 aupport extended band-width synthesis (EBWS) [3] processing. Information showing EBWS processing was added to BDxx records.

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[1]WBWV was developed to process a wide-band band width synthesis for data consisting of multi-channel per band including conventional geodetic mode.

[2]WBWS was developed to process a wide-band band width synthesis of which band width is wider than the case of EBWS and consisting of one channel per band.

[3]EBWS was developed to process RF-direct sampling data and do band-width synthesis for a number of band data without band gap.