WEC INSTRUMENT USER MANUAL

CHAPTER 3

CONTROL

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Document Control

Document	Document number	Version /Date	Author	Comments
DWP Kernel Operation	**CL-DWP-KO-0003**	**v1.1 26-9-91**	**CMD**	**First complete document describing HK and commands for EM**
WEC Operator manual	**CL-DWP-WO-001**	**v1.0 21-5-92**	**CMD**	**Based on DWP kernel operation, reformatted and more material added, including references to AIT. Supplied with EM ADP.**
WEC Operator manual Part 1 - Commands	**CL-WEC-WO-002**	**4-11-92**	**CMD**	**Updated with new command for FM and corrections**
Writing WEC macros	**CL-WEC-WO-004**	**10-2-93**	**CMD**	**Definitive description of macros stored in DWP ROMs and how to write and upload new macros to DWP.**
WEC Instrument User Manual - Chapter 3	**CL-WEC-WO-006**	**28-4-93**	**CMD**	**Combines CLUSTER WEC housekeeping parameter defn. document and latest AIT database parameters with latest WEC operator manual. DRAFT for circulation within WEC only.**
WEC Instrument User Manual - Chapter 3	**CL-WEC-WO-008**	**v 1.0, 4-6-93**	**CMD**	**As above, updated with input from WEC teams, corrections, first issue for general distribution**

Acronyms

See chapter 1.

Introduction

This chapter describes the control of the WEC. Section 3.1 shows how DWP acts as the controller for the WEC and acts as the interface to the spacecraft commanding system. Section 3.2 gives an overview of the decoding and execution of telecommands by the WEC. This provides the context for the telecommand reference guide. Section 3.3 is the telecommand reference guide which orders the commands alphabetically gives a detailed description of each command, including an index of AIT database names. Section 3.4 covers modification of on-board calibration tables. Section 3.4 covers modification of onboard software in the WEC instruments that support this feature. Section 3.5 covers autonomous behaviour of the WEC which is supported mainly by DWP macros.

References

Reference number	Document title	Latest known version and date	Originator
1	WEC Internal EID Part 1 - Interface Hardware	v3.2 CL-DWP-EID-006 27 Sept. 1991	DWP, Sheffield
2	WEC Internal EID Part 4 - Interface software protocols	v1.1 CL-DWP-EID-005 26 Sept. 1991	DWP, Sheffield
3	EFW Command and Telemetry Description	Rev F, May 1992	EFW, Berkeley
4	WHISPER Internal EID	Issue 7, Rev 4 Jan. 17, 1992	WHISPER, Orleans
5	WIDEBAND Command and Telemetry Description	?	WIDEBAND, Iowa
6	WEC Internal EID Part 5 - Application software definition	v1.0 CL-DWP-EID-009 Nov 19, 1992	DWP, Sheffield
7	Implementation and analysis of the ESA/NASA Cluster Digital Wave Processor software.	Under production.	DWP, Sheffield.

3.1 Control Philosophy

The Digital Wave Processor instrument, DWP, is connected to all the WEC instruments, and is at the centre of a star configuration as shown in Figure 0.1. DWP and WBD are the only WEC instruments connected to the spacecraft OBDH. The WBD to OBDH interface does not support commanding.

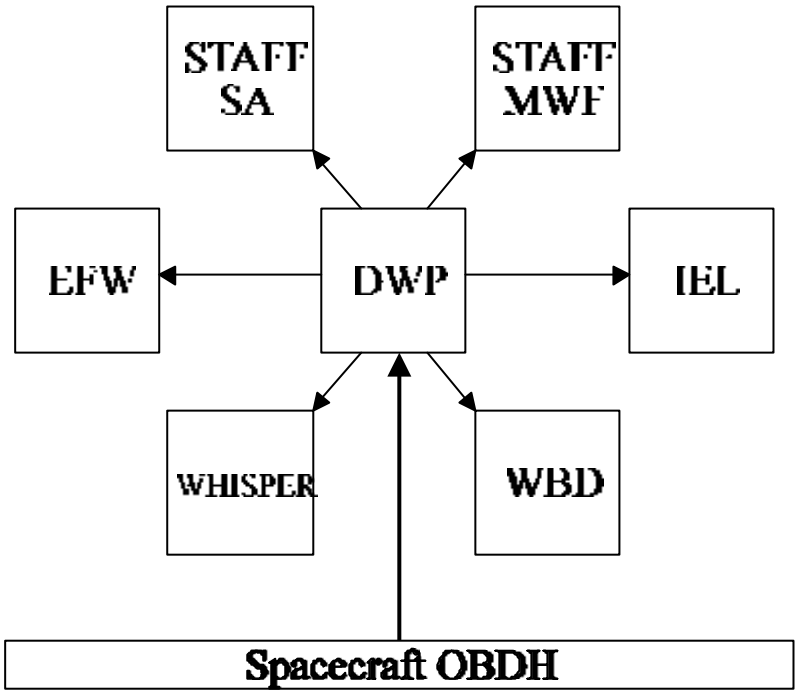


Figure 0.1 - WEC instrument command connections

The link between each WEC instrument and DWP consists in most cases of a serial command interface from DWP, and a parallel or serial data link to DWP. The description of the DWP electrical interfaces to the WEC is given in [1], and the description of the telecommand interfaces between DWP and the WEC is given in [2].

DWP is responsible for handling all WEC telecommands. Some telecommands only modify DWP operations, other telecommands are forwarded by DWP to the selected WEC instrument.

3.2 TELECOMMANDING OVERVIEW

3.2.1 Introduction

This section gives an overview of the decoding and execution of telecommands by the WEC.

The only type of command used by the WEC is the *memory load* command.

Nominal and redundant interfaces to the spacecraft OBDH are provided. DWP will automatically accept commands on either interface. The Sun Pulse and Spin Segment Clock are taken from the interface branch most recently used for commanding (if no commands have been received since power on the redundant branch is used by default). Most DWP commands can also be executed from the DWP internal macro system. DWP regards commands from all three sources as equivalent unless otherwise stated.

The function of commands received by DWP may depend on the DWP state at the time the command is received. The descriptions in this manual assume the *normal* commanding state unless otherwise stated. The alternative commanding states are:

Double word command: DWP is expecting the second part of a double word command, and will reject any command that is not valid in this context.

Macro loading: All commands will be copied into the DWP macro memory, and not executed directly, until a SetMacroOps (END) command is received.

Code patch loading: All commands are regarded as 16 bit data to be copied into memory until the specified number of words has been received.

One exception to the above is the DWPConfig command which is decoded by hardware, and therefore always executes as described no matter what the DWP state at the time.

DWP views the least significant bit as being bit 0, and the most significant bit as bit 15.

The spacecraft RTU Serial Digital Telemetry (SDT) interface to DWP is configured to be 16 bits.

3.2.2 Buffering and echoing of received commands in WEC HK.

All memory load commands (except **DWPConfig**) received by DWP are buffered in a FIFO telecommand buffer. This buffer can hold 16 memory load commands.

Every 30 ms DWP polls the buffer, and if it is not empty, fetches the memory load command at the front of the queue. The command read is also stored in the next HK block (ref. **Telecommand echo**, AIT entries **EW5MLECC** and **EW5MLEC1** to **EW5MLE15**).

The poll interval of 30 ms allows DWP to execute up to 170 memory load commands between any two OBDH resets. This meets the project specification of two spacecraft macro sequences (each up to 80 words) being downloaded into an instrument in one reset period.

Only up to 15 memory load commands per HK frame can be echoed. The memory load commands are only echoed in the first HK frame output after the command was received. The **DWPConfig** command, and the transputer data commands following a **LoadKernelMemory** command are not echoed like all other WEC commands.

3.2.3 Commanding rate limitations

The spacecraft OBDH specification requests that DWP be able to accept short bursts of commands separated by only 240 microseconds.

DWP may be commanded at a rate of one command every 240 us as long as the following conditions are met:

i/ At any time no more than 16 commands can be transmitted as a high rate burst. This is because of the limited size of the commanding FIFO buffer described in the previous section. If more than 16 commands are transmitted then some will be lost.

ii/ If the DWP kernel processor is running at half speed (the default), then high rate commanding is only possible before starting a typical WEC mode.

iii/ If the DWP kernel processor is running at full speed then high rate commanding is possible when a typical normal bit rate WEC mode is in use. However, some commands will be lost if a WEC high bit rate mode is in use.

As a general rule, it is recommended that if high rate command bursts are planned these should be transmitted to DWP before other WEC mode execution starts and preferably before powering on the other WEC instruments.

3.2.4 Decoding of memory load commands

All memory load commands are 16 bits wide. Every memory load command received by DWP is decoded as shown in the Table 3.2.4.1

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0	Description
x x x	Main Function
x	Extension flag, 1 = double word command
x x x x	Sub function
x x x x x x x x	Function data

Table 3.2.4.1 - Decoding of memory load command

The decoding of bits of a *memory load* command are split into four fields; *main function* (3 bits), *extension* (1 bit), *sub function* (4 bits) and *function data* (8 bits).

The main function field selects the destination for the memory load, as shown in Table 3.2.4.2 Memory load commands can only affect the instrument(s) selected by the main function bits. However, when the main function selects either *DWP Configuration* or *DWP System*, the operation of DWP and some or all of the WEC instruments will be affected.

15	14	13	Instrument selected
0	0	0	EFW
0	0	1	STAFF SA
0	1	0	STAFF calibration
0	1	1	WHISPER
1	0	0	WBD
1	0	1	DWP configuration
1	1	0	DWP system
1	1	1	Extension for double word command assembly

Table 3.2.4.2 - Decoding of main function

All the information DWP requires to execute a telecommand is usually contained in a single memory load command. A *single word* command provides 4 bits of sub function and 8 bits of function data, and has the extension bit set to zero. However, a few commands recognised by DWP require more data than will fit into a single memory load. The concept of a *double word* command is introduced. A memory load command that is the first word of a double word command has its extension field set to 1. The memory load command that is transmitted next must have the main function and extension fields set to 1. If it does not, DWP will ignore both memory load commands, and set the **Telecommand extension invalid** (AIT entry **EW5EITEW**) field of the HK..

3.2.5 Double word commands

Double word commands double the number of bits used to represent sub function and function data to 8 bits and 16 bits respectively. The first memory load command should contain the most significant bits of sub function and data, and the second memory load the least significant bits of sub function and data. The process of decoding is described in more detail below.

After validating the main function and extension fields of the second memory load word, the sub function and function data fields set by the first memory load are extended. The 4 bits of the first sub function are shifted up by 4 bits, and the sub function bits of the second memory load word written to the 4 least significant bits. The 8 bits of the first function data are shifted up by 8 bits, and the function data bits of the second memory load word written to the 8 least significant bits.Table 3.2.5.1 and Table 3.2.5.2 demonstrate this. *H* represents a bit set by the first memory load, *L* a bit set by the second memory load.

Assembled sub function 7 4 3 0	Assembled function data 15 8 7 0
0 0 0 0 H H H H	0 0 0 0 0 0 0 0 L L L L L L L L

Table 3.2.5.1 - After the first memory load

Assembled sub function 7 4 3 0	Assembled function data 15 8 7 0
H H H H L L L L	H H H H H H H H L L L L L L L L

Table 3.2.5.2 - After the second memory load

3.2.6 Introduction to WEC commands

The following sections briefly introduce the commands defined for the WEC, grouped by instrument. The definitive description of each of the commands listed is given in the telecommand reference section later in this document.

Full details of the command set for each of the WEC instruments taken from the WEC instruments internal EIDs are given.

3.2.7 DWP Configuration

Fixed Pattern	AIT name	Name	Purpose
0xA000	ZEWNSCFS	DWPConfig	Reset DWP and WEC operations

Table 3.2.7.1 - DWP configuration

This memory load command is handled as a special case by DWP. The most significant 6 bits of the memory load are decoded by a hardware comparator, and when the bit pattern is 101011 the least significant 8 bits are strobed onto the DWP hardware command bus.

DWPConfig examines the least significant bits of the memory load to determine which transputers it will power off, or switch to high clock speed. Two bits indicate which DWP processor should run the kernel software.

This command resets all DWP software and WEC operations to their default states, and powers off all other WEC instruments.

3.2.8 DWP System Commands

Fix Value	AIT name	Name	Purpose
0xC000	ZEWMS0FS	SetWECClock	Set WECSS frequency and source
0xC100	ZEWMS1FS	FlagOBDHAcqMode	Set OBDH Acquisition Mode
0xC200	ZEWMS2FS	SetInstrPower	Set instrument on/off or reset
0xC300	ZEWMS3FS	FlagIntfFail	Flag failure of WEC interface
0xC400	ZEWMS4FS	FlagInstrFail	Flag failure of WEC instrument
0xC500	ZEWMS5FS	NOP	No Operation
0XC600	ZEWMS6FS	MacroSetCounter	Set macro loop counter
0XC700	ZEWMS7FS	MacroTestCounter	Test macro counter and loop
0XCA00	ZEWMSAFS	SetMWFDataProc	Set MWF data processing
0XCB00	ZEWMSBFS	SetWHDataProc	Set WH data processing
0XCC00	ZEWMSCFS	SetWBDDataProc	Set WBD data processing
0XCD00	ZEWMSDFS	SetCorrDataProc	Set Correlator data processing
0XCE00	ZEWMSEFS	MacroWaitOrLoop	Macro execution delay or jump
0XCF00	ZEWMSFFS	SetMacroOps	Begin/Stop macro execution or load one macro slot
0XD100	ZEWMD1FS	MacroLoad	Load any number of macro commands
0XF000	ZEWED0FS		
0XD100	ZEWMD1FS	SetDWPMemRead	Set DWP Kernel Memory Read Address
0XF100	ZEWED1FS		
0XD100	ZEWMD1FS	SetDWPMemWrite	Set DWP Kernel Memory Write Address
0XF200	ZEWED2FS		
0XD100	ZEWMD1FS	LoadKernelMemory	Load Kernel Memory
0XF300	ZEWED3FS		
0XD100	ZEWMD1FS	FlagExtExpStatus	Flag spin mode of PEACE instrument
0XF400	ZEWED4FS		
0xD100	ZEWMD1FS	SetWECPwrLimit	Set limit for total WEC current
0xF500	ZEWED5FS		

Table 3.2.8.1 - DWP commands

Most *DWP System* commands are single word commands. A small number of double word commands implement facilities that are either used less frequently or require 16 bits of function data.

The primary use of **SetWECClock** is to change the WEC sample clock to a frequency of either 25 Hz or 450 Hz. Additional commands will be required by some instruments for them to make best use of the increase in sampling frequency. The secondary function of **SetWECClock** is to control the redundant backup of the internal programme clock used by DWP.

FlagOBDHAcqMode must be transmitted to DWP if the OBDH acquisition rate is to be changed, or if the OBDH acquisition rate at WEC power on is not the normal mode. The switch to

the new OBDH acquisition rate will occur on the next OBDH reset. It is vital that DWP is correctly informed of the OBDH acquisition rate, if it is not the science data output is likely to be garbage.

The primary use of **SetInstrPower** is to allow the power to individual WEC instruments to be turned on or off. A secondary functions of **SetInstrPower** is to allow some instruments to be reset only without power off, or for STAFF SC to disable the telemetry data.

FlagIntfFail allows automatic DWP monitoring of some WEC interface signals to be disabled in the event of hardware failures in the interface. The interface signals are either ADC or alarm signals that indicate latchup in the interfaced instrument. The normal action that DWP takes in the event of latchup detection is to power off the instrument and then to turn it back on a short time later.

FlagInstrFail is to be used if a WEC instrument has a catastrophic failure such that operating it could endanger other WEC operations. It disables the power commands for the selected instrument in the event of catastrophic failure of that instrument.

NOP does not affect WEC operations. It is provided to allow testing of the command and HK interfaces without affecting other WEC operations.

MacroSetCounter may only be executed from a macro sequence running within DWP. It allows one of four internal counters to be set. Processing Control

MacroTestCounter may only be executed from a macro sequence running within DWP. It allows one of four internal counters to tested, and if non-zero, a jump to an earlier point in the macro sequence to be executed.

SetMWFDataProc controls the compression of STAFF MWF data.

SetWHDataProc controls the processing and compression of WHISPER data.

SetWBDDataProc specifies what DWP processing of WIDEBAND data is required.

SetCorrDataProc specifies the particle correlation parameters and DWP data processing.

All of the **Set**X**DataProc** commands require that the application processors within DWP be powered and ready to perform the processing, otherwise the **DWP no processor for application task** (AIT entry **EW5ATSNP**) HK is set.

MacroWaitOrLoop may only be executed from a macro sequence running within DWP. It allows timed delays to be inserted between execution of DWP macro commands, or unconditional jumps to earlier points in the macro sequence to be executed.

SetMacroOps provides the means to load a new sequence of commands into a DWP macro buffer, and then to execute it. An executing macro may also be terminated by this command. If used to indicate a macro sequence is to be uploaded, the next 8 memory load commands are not executed, but copied into the selected macro command slot.

All the commands listed to this point have been single word commands. The following are double word commands.

MacroLoad provides an alternative more flexible arrangement for loading any number of new macro sequences into DWP memory. It can also be used to edit a few words of an existing macro sequence. The next n memory load commands are not executed, but copied into the selected macro command slot at the selected offset.

SetDWPMemRead sets the **DWP memory read address pointer** (AIT entry **EW5MEMRD**). DWP routinely dumps a few words from its memory in most HK frames in the **Telecommand echo** (AIT entry **EW5MLECC**). **SetDWPMemRead** allows the address of this dump to be selected by command.

SetDWPMemWrite sets the **DWP memory write address pointer** (AIT entry **EW5MEMWR**).

LoadKernelMemory specifies that the next n memory load commands will be copied directly into DWP memory starting from the address specified by **DWP memory write address pointer**.(AIT entry **EW5MEMWR**). Those memory load commands do not match the standard format given earlier as they are transputer instruction words.

FlagExtExpStatus command must be sent to DWP to inform it of the mode of the PEACE instrument. This is required to run the particle correlation software correctly, and to synchronise WHISPER sounding with the particle experiments in some WHISPER modes.

3.2.9 DWP Macro Command Overview

WEC macro definitions, and guidelines for writing WEC macro sequences may be found in section 3.5. This section gives a brief overview of how macros are stored within DWP.

The concept of DWP macros are that are they are primarily used to store the basic sequence of WEC telecommands required to set up the WEC configuration for a particular WEC science mode. A number of predefined DWP macros are stored in the EPROM of each processor. These implement the standard WEC science modes. This means that the WEC can be commanded to any of its defined modes by means of a single command, **SetMacroOps**.

DWP provides 32 *macro command slots.* Each DWP macro command slot stores a sequence of 8 memory load commands. During DWP reset initialisation after either initial power on, or after reception of a **DWPConfig** command, the contents of all macro command slots are copied from EPROM to RAM.

There may be a request from the WEC to redefine some of the WEC modes to allow for change of scientific priorities or instrument failure. By use of the **SetMacroOps** or **MacroLoad** command, new DWP macros may be uploaded. DWP uses volatile RAM to store these user defined macros, so they will need to be uploaded after every DWP power on. User defined macro sequences are preserved after **DWPConfig** commands.

User defined macro command sequences may occupy multiple macro command slots at the expense of reducing the number of available DWP macros. However, care must be taken to ensure that the **SetMacroOps** command specifies a macro command slot which has the first memory load command of the required sequence.

3.2.10 EFW Commands

Fixed Pattern	AIT name	Name	Purpose
0x0000	ZEWWS0FS	SetEFWComLSB	Set LSB of EFW command holding register in DWP
0x0100	ZEWWS1FS	SetEFWComMSB	Set MSB of EFW command holding register in DWP
0x0200	ZEWWS2FS	SetEFWTapeMode	Set EFW tape mode
0x0500	ZEWWS5FS	SetEFWTestSeq	Set EFW test sequence number
0x0600	ZEWWS6FS	SetEFWWinPos	Set position of sliding window in EFW science telemetry
0x0800	ZEWWS8FS	SetEFWComLSBTx	Set LSB of EFW command holding register in DWP and transmit holding register to EFW
0x0900	ZEWWS9FS	SetEFWComMSBTx	Set MSB of EFW command holding register in DWP and transmit holding register to EFW

Table 3.2.10.1 - EFW commands

SetEFWTapeMode selects which EFW tape mode will be commanded by DWP when the WECSS frequency is changed to 450 Hz.

SetEFWTestSeq sets a value which is echoed in the WEC HK to show the current test sequence number (for ground based experiment checkout only).

SetEFWWinPos sets the position of a window in the EFW science telemetry, the contents of which are echoed in the telemetry stream.

EFW requires a 16 bit command to be transmitted as two bytes across the interface from DWP. **SetEFWComLSB** and **SetEFWComMSB** modify a DWP holding register without transmitting the register to EFW. **SetEFWComLSBTx** and **SetEFWComMSBTx** modify the DWP holding register and transmit the holding register to EFW. The commands accepted by the EFW instrument and their effect are listed below.

00000,bbb,dddddddd BIAS
Sets the bias value on boom bbb (1 - 4) to dddddddd (-127 - 127).
If bbb is set to 5, boom 1 & 2 are changed.
If bbb is set to 6, boom 3 & 4 are changed.
If bbb is set to 7 all four booms are changed.

Verification in housekeeping: not possible.
00001,bbb,dddddddd STUB
Sets the stub value on boom bbb (1 - 4) to dddddddd (-127 - 127).
If bbb is set to 5, boom 1 & 2 are changed.
If bbb is set to 6, boom 3 & 4 are changed.
If bbb is set to 7 all four booms are changed.

Verification in housekeeping: not possible.
00010,bbb,dddddddd GUARD
Sets the guard value on boom bbb (1 - 4) to dddddddd (-127 - 127).
If bbb is set to 5, boom 1 & 2 are changed.
If bbb is set to 6, boom 3 & 4 are changed.
If bbb is set to 7 all four booms are changed.

Verification in housekeeping: not possible.
00011,bbb,00000000 EFIELD
Sets boom bbb (1 - 4) to electric field mode.
If bbb is set to 5, boom 1 & 2 are changed.
If bbb is set to 6, boom 3 & 4 are changed.
If bbb is set to 7 all four booms are changed.

Verification in housekeeping:

bbb	parameter	value
1	EW0EDMD1	0
2	EW0EDMD2	0
3	EW0EDMD3	0
4	EW0EDMD4	0
5	EW0EDMD1	0
	EW0EDMD2	0
6	EW0EDMD3	0
	EW0EDMD4	0
7	EW0EDMD1	0
	EW0EDMD2	0
	EW0EDMD3	0
	EW0EDMD4	0

00011,bbb,00000001 DENSITY
Sets boom bbb (1 - 4) to density mode.
If bbb is set to 5, boom 1 & 2 are changed.
If bbb is set to 6, boom 3 & 4 are changed.
If bbb is set to 7 all four booms are changed.

```
     Verification in housekeeping:
     bbb  parameter  value
     1    EW0EDMD1   1
     2    EW0EDMD2   1
     3    EW0EDMD3   1
     4    EW0EDMD4   1
     5    EW0EDMD1   1
          EW0EDMD2   1
     6    EW0EDMD3   1
          EW0EDMD4   1
     7    EW0EDMD1   1
          EW0EDMD2   1
          EW0EDMD3   1
          EW0EDMD4   1
00100,000,0000000x   INFERO
     Turns interferometric mode on (x = 1) or off (x = 0).

     Verification in housekeeping:
     EW0IFMOD is set to the value of x.
00101,000,000000xx   SAMPLECTL
     Sets EFW sample mode.

     xx   sampling mode
     00   normal
     01   split
     10   HX only
     11   null

     Verification in housekeeping:
     EW0SAMOD is set to the value of xx.
00110,bbb,0000000x   MOTOR
     Turns deployment motor bbb (1 - 4) on (x = 1) or off (x =
0).
     If bbb is set to 5, motor 1 & 2 are controlled.
     If bbb is set to 6, motor 3 & 4 are controlled.
     If bbb is set to 7 all four motors are controlled.

     Verification in housekeeping:
     bbb  x    parameter  value
     1    0    EW0MOT1S   0
     2    0    EW0MOT2S   0
     3    0    EW0MOT3S   0
     4    0    EW0MOT4S   0
     5    0    EW0MOT1S   0
               EW0MOT2S   0
     6    0    EW0MOT3S   0
               EW0MOT4S   0
     7    0    EW0MOT1S   0
               EW0MOT2S   0
               EW0MOT3S   0
```

```
                EW0MOT4S   0
     1     1    EW0MOT1S   1
     2     1    EW0MOT2S   1
     3     1    EW0MOT3S   1
     4     1    EW0MOT4S   1
     5     1    EW0MOT1S   1
                EW0MOT2S   1
     6     1    EW0MOT3S   1
                EW0MOT4S   1
     7     1    EW0MOT1S   1
                EW0MOT2S   1
                EW0MOT3S   1
                EW0MOT4S   1
01000,000,00xxxxxx   HXFMT0
     Sets the HX format index used in mode 0 to xxxxxx (0 - 63).

     Verification in housekeeping: not possible
01000,001,00xxxxxx   HXFMT1
     Sets the HX format index used in mode 1 to xxxxxx (0 - 63).

     Verification in housekeeping: not possible
01000,010,00xxxxxx   HXFMT2
     Sets the HX format index used in mode 2 to xxxxxx (0 - 63).

     Verification in housekeeping: not possible
01000,011,00xxxxxx   HXFMT3
     Sets the HX format index used in mode 3 to xxxxxx (0 - 63).

     Verification in housekeeping: not possible
01000,100,00xxxxxx   LXFMT
     Sets the LX format index used in all modes to xxxxxx (0 -
63).

     Verification in housekeeping: not possible
01000,101,00xxxxxx   BFMT
     Sets the burst format index to xxxxxx (0 - 63).

     Verification in housekeeping: not possible
01000,110,00xxxxxx   INDEX
     Sets the current index to xxxxxx (0 - 63).

     Verification in housekeeping: not possible
01000,111,xxxxxxxx   QTY
     Sets the current quantity to xxxxxxxx (0 - 0xff).

     Verification in housekeeping: not possible
01001,xxx,xxxxxxxx   RAMBASE
     Sets the RAM base address to xxxxxxxxxxx (0 - 0x7ff).

     Verification in housekeeping: not possible
```

01010,000,000000yz FITMODE
Enables spin fits on V12 (z = 0) and V34 (y = 0).
Disables spin fits on V12 (z = 1) and V34 (y = 1).

Verification in housekeeping: not possible
01011,000,xxxxxxxx SAWOFF
Sets sawtoth starting bias to xxxxxxxx (-127 - 127).

Verification in housekeeping: not possible
01011,001,xxxxxxxx SAWDEL
Sets sawtoth bias step size to xxxxxxxx (-128 - 127).

Verification in housekeeping: not possible
01011,010,xxxxxxxx SAWPER
Sets sawtoth steps to xxxxxxxx (0 - 255).

Verification in housekeeping: not possible
01011,011,xxxxxxxx SAWDIV
Sets sawtoth step rate divider to xxxxxxxx (0 - 255).

Verification in housekeeping: not possible
01011,100,0000dcba SAWOPT
Selects which sensors to control.

bit	sensor
a	1
b	2
c	3
d	4

Verification in housekeeping: not possible
01011,101,0000dcba SAWENA
Enables which sensors to control.

bit	sensor
a	1
b	2
c	3
d	4

Verification in housekeeping: not possible
01100,000,00xxxxxx SWPADR
Sets the relative address (0 - 41) to load a sweep quantity.

Verification in housekeeping: not possible
01100,001,xxxxxxxx SWPQTY
Sets addressed sweep quantity to xxxxxxxx.

Verification in housekeeping: not possible
01100,010,00000ppp SWPREBIAS

Assigns the auto-calculated bias value to probe pair ppp (1 = V12, 3 = V34).

Verification in housekeeping: not possible

01110,000,00000111 MRESET

Reset EFW instrument.

Verification in housekeeping: All FDM values are reset to default.

parameter	default
EW0BINTS	0
EW0EDMD1	0
EW0EDMD2	0
EW0EDMD3	0
EW0EDMD4	0
EW0IFMOD	0
EW0MABPB	0
EW0INSDS	0
EW0SAMOD	0
EW0MOT1S	0
EW0MOT2S	0
EW0MOT3S	0
EW0MOT4S	0
EW0SWEEP	0

01110,000,00001000 ADRESET

Reset and recalibrate the A/D converters.

Verification in housekeeping: not possible

01111,000,n00f0000 ADPOWER

A/D converter power control.

nf	function
00	forces A/D power on
01	-"-
10	forces A/D power on
11	enable single event latch circuit

Verification in housekeeping: not possible

```
10100,000,rpaaaatt   BTRIG
     Set burst trigger parameters.

     r    repeat after playback
     0    no
     1    yes

     p    auto playback after burst collection
     0    no
     1    yes

     aaaa trigger adjustment level

     tt   trigger function
     00   off
     01   immediate
     10   analog
     11   ram

     Verification in housekeeping: not possible
10100,001,mmmmmmmm   BCHIRP
     Sets duty cycle of burst sampling.

     Verification in housekeeping: not possible
10100,010,sssscccc   BPAGES
     Sets number of burst search pages to ssss and collect pages
to cccc.

     Verification in housekeeping: not possible
10100,011,tttttttt   BTHRESHO
     Sets the burst trigger threshold register to tttttttt.

     Verification in housekeeping: not possible
10100,1rr,xxxxxxxx   BPARAM
     Sets the burst parameter rr (0 - 3) to xxxxxxxx (0 - 0xff).

     Verification in housekeeping: not possible
10101,000,x0ss0fff   BFREQ
     Sets the burst sampling frequency.

     x    function
     0    normal
     1    HX override

     ss   sampling mode
     00   normal
     01   split
     10   HX only
     11   null
```

```
     fff   sampling frequency
     000   450 Hz
     001   900 Hz
     010   2250 Hz
     011   4500 Hz
     100   9000 Hz
     101   18000 Hz
     110   36000 Hz

     Verification in housekeeping: not possible
10110,000,0000psss   BSTATE
     Forces the burst state machine into the specified state.

     p     playback
     0     off
     1     on

     sss   burst state
     000   off
     001   startup
     010   restart
     011   search
     100   collect
     101   close
     110   wait
     111   play

     Verification in housekeeping: not possible
10111,000,000000xx   BPLAY
     Starts a burst playback.

     xx    sampling mode
     00    normal
     01    split
     10    HX only
     11    null

     Verification in housekeeping:
     EW0INSDS is set to one.
10110,000,00000000   BSTOP
     Stops a burst playback and burst triggering.

     Verification in housekeeping:
     EW0INSDS is set to zero.
11000,000,xxxxxxxx   CMDWT
     Pause the execution of the internal command list
     for xxxxxxxx * 20 milliseconds.

     Verification in housekeeping: not possible
```

11001,000,xxxxxxxx CMDS
Tells EFW instrument to expect xxxxxxxx commands.

Verification in housekeeping:
EW0CNTMM will be set to zero when exactly xxxxxxxx successful
commands have been received (including the CMDS command).
11010,000,00000000 DEP_STOP
Turn off both motors.

Verification in housekeeping:
EW0MOT1S set to zero
EW0MOT2S set to zero
EW0MOT3S set to zero
EW0MOT4S set to zero
11010,001,uuuuuuuu DEP_A
Deploy A side (1 or 3) uuuuuuuu * 10 centimeters.

Verification in housekeeping:
EW0MOT1S set to one during the deployment if pair 12 is selected
EW0MOT2S set to zero
EW0MOT3S set to one during the deployment if pair 34 is selected
EW0MOT4S set to zero
11010,010,uuuuuuuu DEP_B
Deploy B side (2 or 4) uuuuuuuu * 10 centimeters.

Verification in housekeeping:
EW0MOT1S set to zero
EW0MOT2S set to one during the deployment if pair 12 is selected
EW0MOT3S set to zero
EW0MOT4S set to one during the deployment if pair 34 is selected
11010,011,uuuuuuuu DEP_BOTH
Deploy both sides uuuuuuuu * 10 centimeters.

Verification in housekeeping: not possible
EW0MOT1S set to one during the deployment if pair 12 is selected
EW0MOT2S set to one during the deployment if pair 12 is selected
EW0MOT3S set to one during the deployment if pair 34 is selected
EW0MOT4S set to one during the deployment if pair 34 is selected
11010,100,mmmmmmmm DEP_OVER
Used to override a deployment microswitch failure,
where mmmmmmmm is a mask to apply to the microswitch byte.

```
     Verification in housekeeping: not possible
11010,101,000000pp   DEP_PAIR
     Sets which boom pair to deploy.

     pp   boom pair
     01   12
     11   34

     Verification in housekeeping: not possible
11101,011,llllllll   ADDRL
     Sets low byte of current memory address to llllllll.

     Verification in housekeeping: not possible
11101,100,hhhhhhhh   ADDRH
     Sets high byte of current memory address to hhhhhhhh.

     Verification in housekeeping: not possible
11101,101,xxxxxxxx   LOAD
     Loads byte xxxxxxxx into the location addressed by the
     current memory address.

     Verification in housekeeping: not possible
11101,110,00000000   EXEC
     Execute an uploaded program.

     Verification in housekeeping: not possible
11110,000,0000000x   SCVMODE
     Sets polarity of the spacecraft potential.

     x    measurement
     0    + (V1 + V2)/2
     1    - (V1 + V2)/2

     Verification in housekeeping: not possible
11111,000,xxxxxxxx   TEST
     Used to set test labels in the telemetry stream.

     Verification in housekeeping:
     xxxxxxxx   content of EW0SUNAN
     0          the calculated sun angle
     1 - 255          xxxxxxxx
```

3.2.11 STAFF SA Commands

Fixed Pattern	AIT name	Name	Purpose
0x2000	ZEWAS0FS	SetSACom	Transmit command to STAFF SA

Table 3.2.11.1. - STAFF SA command

There is a direct mapping from the bottom 12 bits of the **SetSACom** command to the command format required by the STAFF SA interface. The 12 bits read are immediately copied to SA. The commands accepted by the STAFF SA instrument and their effect are listed below.

Telecommand word bits are assigned as shown in Table 3.2.11.2.

Telecommand bits	Description
11 to 8	Command function
7 to 0	Command data

Table 3.2.11.2- Decoding of SA telecommand

The allocation of commands to the function codes is shown in Table 3.2.11.3.

After receiving any command from DWP, SA will transmit a response tag. Four of the commands in table Table 3.2.11.3(those marked with a '*') will cause SA to transmit to DWP a sized block of data following the tag.

bit 11	bit 10	bit 9	bit 8	Description		bits 7 to 0
0	0	0	1	Do Analysis (timed start pulse required)	(*)	mode
1	0	0	0	Despin on/off		0=default on
1	0	0	1	Address Low		lower 6 bits (bits 2-7)†
1	0	1	0	Address High		upper 8 bits
1	0	1	1	Load Low byte		least sig. byte
1	1	0	0	Load Mid byte		middle byte
1	1	0	1	Load High byte		most sig. byte
1	1	1	0	Load Enable		Don't care
1	1	1	1	Load Disable		Don't care
0	1	0	1	Load Program Counter with Address(High,Low)		Don't care
0	0	1	0	Dump Data	(*)	length (bytes)
0	0	1	1	Dump Co-efficients	(*)	length (bytes)
0	1	0	0	Dump Program	(*)	length (bytes)

Table 3.2.11.3- SA telecommand functions

† The address low bits are read as follows: 1001SSSSSSXX where the 1001 is the command address low, SSSSSS are the lower six bits of the address and XX are ignored.

(e.g. to load the address DCI:

		D				C				I					
0	0	1	1	0	1	1	1	0	0	0	0	0	1	X	X
		8	bits						6	bits					
0	0	1	1	0	1	1	1	0	0	0	0	0	1	0	0
		3				7				0				4	

The commands are: 0x2904, 0x2A37)

The decoding of the mode field for the 'Do Analysis' command is hown in Table 3.2.4.1. Only the bottom 4 bits of the mode are decoded.

bit 3	bit 2	bit 1	bit 0	Mode	Analysis time (seconds)
0	0	0	0	Normal mode 1	4
0	0	0	1	Normal mode 2e	1
0	0	1	0	Normal mode 2b	1
0	0	1	1	Illegal	-
0	1	0	0	Emergency mode	4
0	1	0	1	Special mode	2
0	1	1	0	Normal mode 1'e	4
0	1	1	1	Normal mode 1'b	4
1	0	0	0	Fast mode 1	1
1	0	0	1	Fast mode 3e	1
1	0	1	0	Fast mode 3b	1
1	0	1	1	Illegal	-
1	1	0	0	Fast mode 2	1
1	1	0	1	Illegal	-
1	1	1	0	Illegal	-
1	1	1	1	Illegal	-

Table 3.2.11.4 - Decoding of 'Do Analysis' mode

The telecommands specified in Table 3.2.11.3 will allow three basic operations. These will be for DWP to load SA programme memory, to initiate a spectrum analysis, and to allow a SA memory dump (for diagnostic purposes). The command protocol for each of these operations is described below.

Normally the commanding procedure will be for DWP to send a command, and then to read the response tag and data (if any) before sending the next command. However, in continuous analysis mode 'do analysis' commands may be sent whilst data from the previous analysis is still being read.

DWP will transmit 'do analysis' commands in synchronisation with a one second timing boundary (OSTB).

The End-of-Command strobe (ref. [1]) following the transmission of the 'do analysis' command will be synchronised by DWP with the WEC OSTB. The End-of-Command strobe will be asserted no later than 1 ms after the OSTB. The time that will be taken by SA to do a spectrum analysis is shown in Table 3.2.11.4, timed from the receipt of the 'do analysis' telecommand. SA will then respond with a tag and data block in the formats shown in Table 3.2.11.1 and Table 3.2.11.2

There will be two methods of commanding SA do analysis, these are single shot and continuous.

Single shot method

This method will be used if commanding SA by telecommand.

DWP receives a SA 'do analysis' telecommand and transmits it (DA1) to SA at the next OSTB (time 0). A response tag (RT1) must be transmitted by SA, followed by the science telemetry (S1). Usually the response tag and the first byte of the science telemetry should be sent before time d (d is the expected duration of the analysis in seconds), but in single shot mode DWP will not flag any errors or timeout if they are not, unless another command is received for transmission to SA.

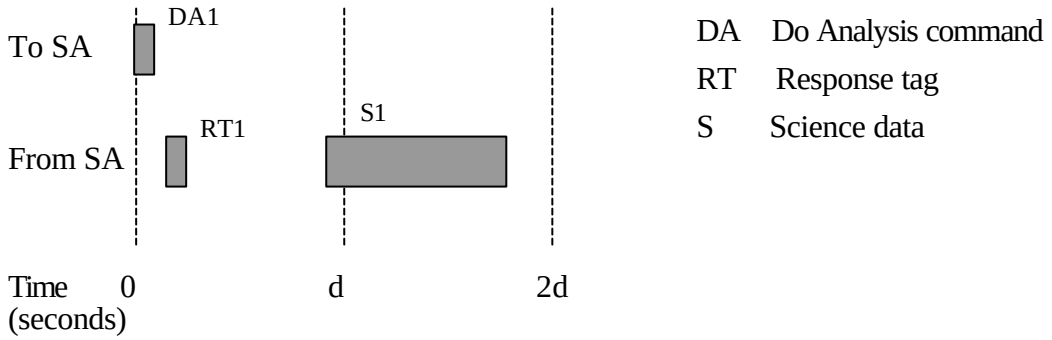


Figure 0.1 - DWP/STAFF SA protocol, single shot analysis

Continuous method

This method will be used when DWP executes macro loops that repeat SA 'do analysis' commands at intervals of time d where d is the duration of the SA analysis. Double buffering will be used within the SA instrument so that it can be transmitting the results of the last analysis to DWP whilst working on the current analysis.

The following describes the operation of the double buffering software protocol of the DWP/SA interface.

DWP transmits a 'do analysis' command at an OSTB (time 0). The response tag (RT1) and the first byte of science data S1 must be received by DWP before it is time for DWP to transmit DA2 which will occur at time d. If not, DWP will flag an error, but will not reset the spectrum analyser. The rest of the packet S1 must be transmitted to DWP by time 2d.

DA2 will be transmitted at time d. This raises possible confusion over whether the next byte DWP receives will be RT2 or part of S1. Therefore, the implementation definition is that the response tag will not be expected until the current science packet transfer is complete. The byte after the last byte of the science packet S1 must be the response tag RT2. The response tag RT2 must be transmitted to DWP before DWP sends command DA3 at time 2d.

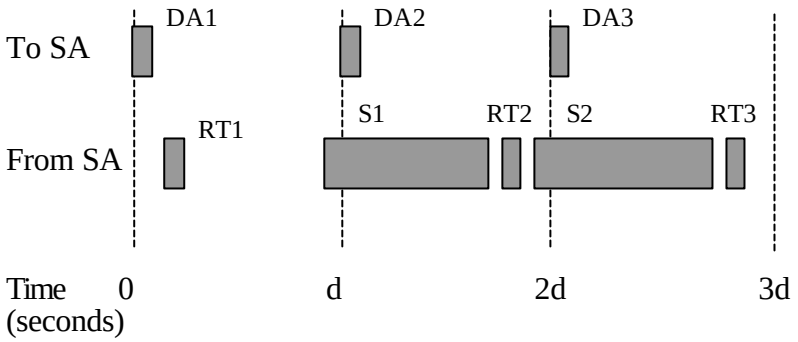


Figure 0.2- DWP/STAFF SA protocol, continuous analysis

If the protocol is violated (E.g. no response tag received) then DWP will typically flag an error in the STAFF housekeeping (ref. section 3.3), but will not reset SA. Ref.[2] for details of DWP handling of interface protocol errors.

The following command protocol is required by SA but will not be checked by DWP which will just relay the telecommands to SA.

The first telecommand of the memory load procedure will always be 'Load Enable'. The address for the load will be set by sending the 'Address Low' and 'Address High' telecommands. SA will set an address pointer from these transmitted commands, and will use the address pointer to store bytes transmitted from DWP with the 'Load Low byte', 'Load Mid Byte' and 'Load High Byte' instructions. SA will only change the address pointer in response to further 'Address Low' and 'Address High' instructions. Any telecommand received by SA after a 'Load Enable' other than those listed above will cause an 'invalid Load command' error to be returned in the response tag to the telecommand. A SA programme memory load will be terminated by sending the 'Load Disable' command. The code can be executed immediately if required, by loading the start of code address with 'Address Low' and 'Address High' commands, followed by the 'Load Program Counter' command.

The following command protocol is required by SA but not checked by DWP which will just relay the telecommands to SA.

First the address of the memory to be dumped will be set by sending the 'Address Low' and 'Address High' telecommands. SA will set an address pointer from these transmitted commands, and will use the address pointer to read from its memory. Then one of the 'Dump' telecommands will be transmitted, specifying in the data field of the command a count of the amount of memory to dump. If this count would cause the dump to go beyond the top of SA memory, an 'Invalid non-load command' response tag will be transmitted to DWP. Otherwise SA will send a non-error response tag, followed by the required number of words/bytes starting from the specified address, ref. [2].

The procedure is as desribed by the example:

To DUMP at the address 1800:

Enable upload:	0x2E00
Upload lower 6 bits of the address 1800:	0x2900
Upload upper 8 bits of address 1800:	0x2A60
Disable uploads:	0x2F00
Wait 10 (seconds)	
Dump 64 instructions:	0x2C40

DWP provides a telecommand, StartSTAFFCal described in sectio 3.2.12 to start the STAFF calibration sequence. Whilst the calibration is running, the SetSACom command should not be used to avoid conflict with the DWP control of STAFF SA during the calibration.

The default value of this command is ON (function data = 0 or :tlc 0x2800). Other values can be telecommanded, :tlc 0x2801 which means despin OFF (can be used for calibration, or e.g. in case one boom has not been ejected completely). :tlc 0x2802 makes despin in the inverse sense.

Those two values have to be sent after each experiment turn ON in case they are wanted.

The commands for despin ON and despin OFF change the value of the HK parameter EW1DSPIN (this parameter is set by DWP, and does not absolutely confirm that STAFF SA has processed the command correctly). The inverse despin command is not verified in the HK, but errors in command execution can be seen in STAFF SA error word status (see p.2.4.110)

Bits 4-7 are set to 0.

bit 3	bit 2	bit 1	bit 0	Description
0	0	0	0	Despin ON (default value)
0	0	0	1	Despin OFF
0	0	1	0	Despin ON in inverse sense

Table 3.2.11.5- Decoding of the Despin command

3.2.12 STAFF calibration

Fixed Pattern	AIT name	Name	Purpose
0x4000	ZEWCS0FS	StartSTAFFCal	Start STAFF MWF and SA calibration

Table 3.2.12.1- STAFF calibration command

StartSTAFFCal commands DWP to start a STAFF calibration sequence at the next OSTB. The STAFF Calibration sequence will control both MWF and SA operations if they are active, ref. [1] and [2].

The calibration will be performed only if STAFF MWF is ON, otherwise the telecommand will be ignored. If SA is on and the telemetry interface is in the IDLE state (i.e. no telemetry transfers are outstanding) then STAFF SA and MWF will be controlled by DWP for the duration of the calibration.. A STAFF calibration should not be commanded when STAFF SA is in continuous analysis mode, i.e. being commanded from a DWP macro.

The STAFF calibration applies to both STAFF MWF and STAFF SA. The calibration signal is produced in the STAFF MWF box, and the signals sent to both parts of STAFF. The level of calibration is a level of attenuation with respect to the most intense signal. The cal ON status is copied to Housekeeping (STAFF MWF Calibration Mode p.2.4.87, as well as cal steps (STAFF MWF Calibration step p.2.4.88. and p.2.4.89). In those pages the tables give the level of calibration (or attenuation) and the telecommands corresponding to the different steps.

DWP will select the calibration sequence to be performed by determining the current WECSS frequency. If the WECSS frequency is 25 Hz, DWP will perform the low bit rate calibration (16 second step). If the WECSS frequency is 450 Hz, DWP will perform the high bit rate calibration (4 second step).

Cal Step	Staff MWF CalMode	Staff MWF CalLevel	Staff SA mode Low bit rate	Staff SA mode High bit rate
1	Cal4	1	NM 2e	FM 3e
2	Cal4	1	NM 1	FM 2
3	Cal4	1	NM 2b	FM 3b
4	Cal4	1	NM 1	FM 1
5	Cal4	2	NM 1	FM 1
6	Cal4	3	NM 1	FM 1
7	Cal4	4	NM 1	FM 1
8	Cal4	5	NM 1	FM 1
9	Cal4	6	NM 1	FM 1
10	Cal4	7	NM 1	FM 1
11	Cal4	8	NM 1	FM 1
12	Cal3	1	NM 1	FM 1
13	Cal3	3	NM 1	FM 1
14	Cal1	1	NM 1	FM 1
15	Cal2	1	NM 1	FM 1
16	Cal1	3	EM	FM 1
17	Cal2	3	SM	FM 1
18	Cal1	5	NM 1'e	FM 1
19	Cal2	5	NM 1'b	FM 1
20	Cal4	8	NM 1	FM 1
21	BKG	1	NM 1	FM 1
22	Cal2	3	NM 1	FM 1
23	BKG	1	NM 1	FM 1

Table 3.2.12.2 - Calibration for STAFF

As requested by STAFF, in the calibration mode only one 'do analysis' will be commanded per calibration step (under DWP software control). This will allow the SA autogain circuitry to settle. In normal bit rate calibration, the 'do analysis' will be commanded 12 seconds after the start of the 16 second step. In high bit rate calibration, the 'do analysis' will be commanded 3 seconds after the start of the 4 second step.

3.2.13 WHISPER Commands

Fixed Pattern	AIT name	Name	Purpose
0x6000	ZEWRS0FS	SetWHCom0	Set byte 0 of WHISPER command holding register in DWP
0x6100	ZEWRS1FS	SetWHCom1	Set byte 1 of WHISPER command holding register in DWP
0x6200	ZEWRS2FS	SetWHCom2	Set byte 2 of WHISPER command holding register in DWP
0x6300	ZEWRS3FS	SetWHCom3	Set byte 3 of WHISPER command holding register in DWP
0x6800	ZEWRS8FS	SetWHCom0Tx	Set byte 0 of WHISPER command holding register in DWP and transmit register to WHISPER
0x6900	ZEWRS9FS	SetWHCom1Tx	Set byte 1 of WHISPER command holding register in DWP and transmit register to WHISPER
0x6A00	ZEWRSAFS	SetWHCom2Tx	Set byte 2 of WHISPER command holding register in DWP and transmit register to WHISPER
0x6B00	ZEWRSBFS	SetWHCom3Tx	Set byte 3 of WHISPER command holding register in DWP and transmit register to WHISPER

Table 3.2.13.1. - WHISPER commands

WHISPER requires a 32 bit command (WCMW) to be transmitted as four bytes across the interface from DWP. **SetWHCom0, SetWHCom1, SetWHCom2** and **SetWHCom3** modify bytes of a DWP holding register without transmitting the register to WHISPER. **SetWHCom0AndTx, SetWHCom1AndTx, SetWHCom2AndTx** and **SetWHCom3AndTx** modify the DWP holding register and transmit the holding register to WHISPER. The commands accepted by the WHISPER instrument and their effect are listed below.

The **SetWHCom0(1,2,3)Tx** will only be used to set the last byte in the command which needs to be modified before all of the holding register is transmitted.

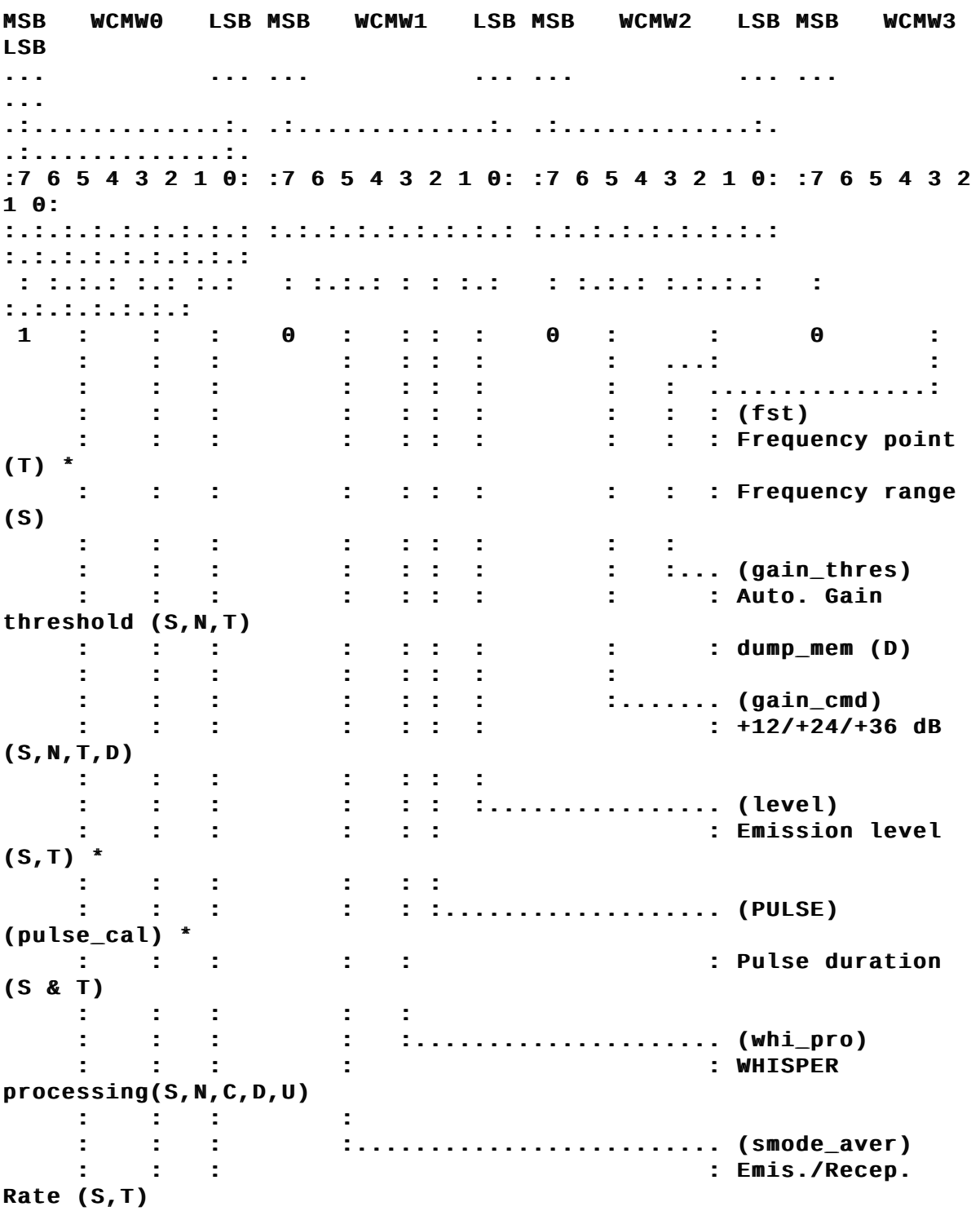
`WHISPER default command (internal DWP)`

The WPW 4F is to be used for this mode

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
...           ... ...           ... ...           ... ...
...
.:............:. .:............:. .:............:.
.:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2
1 0:
:.:.:.:.:.:.:.:.: :.:.:.:.:.:.:.:.: :.:.:.:.:.:.:.:.:
:.:.:.:.:.:.:.:.:
 1 1 0 0 1 0 1 1   0 0 0 1 0 0 1 1   0 1 1 0 0 0 0 0   0 1 1 1 0 0
0 0
   CB h   203d       13 h   19d        60 h   96d       70 h
112d

mode = 4           smode_aver = 1    gain_cmd = 6      fst = 112
 (natural waves)    (16 spectra)      (+36/+24 dB)     (default
for active)
fft_size = 2        whi_pro = 0       gain_thres = 0
 (256 bins)         (DWP processing)  (2 overflows)
rep_fac = 3        PULSE = 0 (1.024) E_signal=0 (Ez)
 (116 cycles)      level = 3
                      (200 Vpp default for active)
```

WHISPER Command Mode Word (WCMW)



```
     :    :   :                                    : Nb. of averaged
spectra (N)
     :    :   :
     :    :   :................................... (rep_fac)
     :    :                                        : Repetition
factor (S,N,T,C,D)
     :    :
     :    :...................................... (fft_size)
     :                                            : FFT size
(S,N,T,C,)
     :                                            : data block size
(D)
     :
     :........................................... (mode)
                                                  : Modes
definition(S,N,T,C,D,U)
```

* In tracking mode these parameters are set with the values corresponding to the first tracking step and then can be overwritten by DWP commanding for the following steps. In this mode the WHISPER unit is fully controlled and commanded by the DWP. A WCMW command including an FST = 0, while in tracking mode, will stop receiving new update and the unit will perform the two output steps and stop.

Modes definition

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
...           ... ...           ... ...           ... ...
...
.:............:. .:............:. .:............:.
.:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2
1 0:
:.:.:.:.:.:.:.: :.:.:.:.:.:.:.: :.:.:.:.:.:.:.:
:.:.:.:.:.:.:.:
 : : : : :.: :.:   : :.:.: : : :.:   : :.:.: :.:.:.:   :
:.:.:.:.:.:.:
 1 : : :  :   :    0   :   : :  :    0   :      :      0       :
   : : :
   : : :      (mode)                  Modes description
   0 0 0        0         - Contingency 1 (Natural Waves)   (N)
   0 0 1        1         - Tracking     (T) also Uploading (U)
   0 1 0        2         - Sounding                        (S)
   0 1 1        3         - Calibration 2 (Sounding)        (C)
   1 0 0        4         - Natural waves                   (N)
   1 0 1        5         - Calibration 1 (Quiet)           (C)
   1 1 0        6         - Dump_Troubleshooting            (D)
   1 1 1        7         - Contingency 2 (Sounding)        (S)
```

FFT size - Data block size (fft_size)

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
...           ... ...           ... ...           ... ...
...
.:............:. .:............:. .:............:.
.:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2
1 0:
:.:.:.:.:.:.:.: :.:.:.:.:.:.:.: :.:.:.:.:.:.:.:
:.:.:.:.:.:.:.:
 : :.:.: : : :.:   : :.:.: : : :.:   : :.:.: :.:.:.:   :
:.:.:.:.:.:.:
 1   :   : :  :    0   :   : :  :    0   :      :      0       :
         : :
fft_size : :      FFT size (0 to 83.170 kHz)      Data block size
         : :      (0 to 3) for S, N and T modes   (0 only) for D
mode
         : :      (0 only) for C modes            (0 only) for C
(WHI_pro)
   0     0 0 ----------  64 bins   ------------------  64 words
(16)
   1     0 1 ---------- 128 bins
```

```
2     1 0 ---------- 256 bins
3     1 1 ---------- 512 bins
```

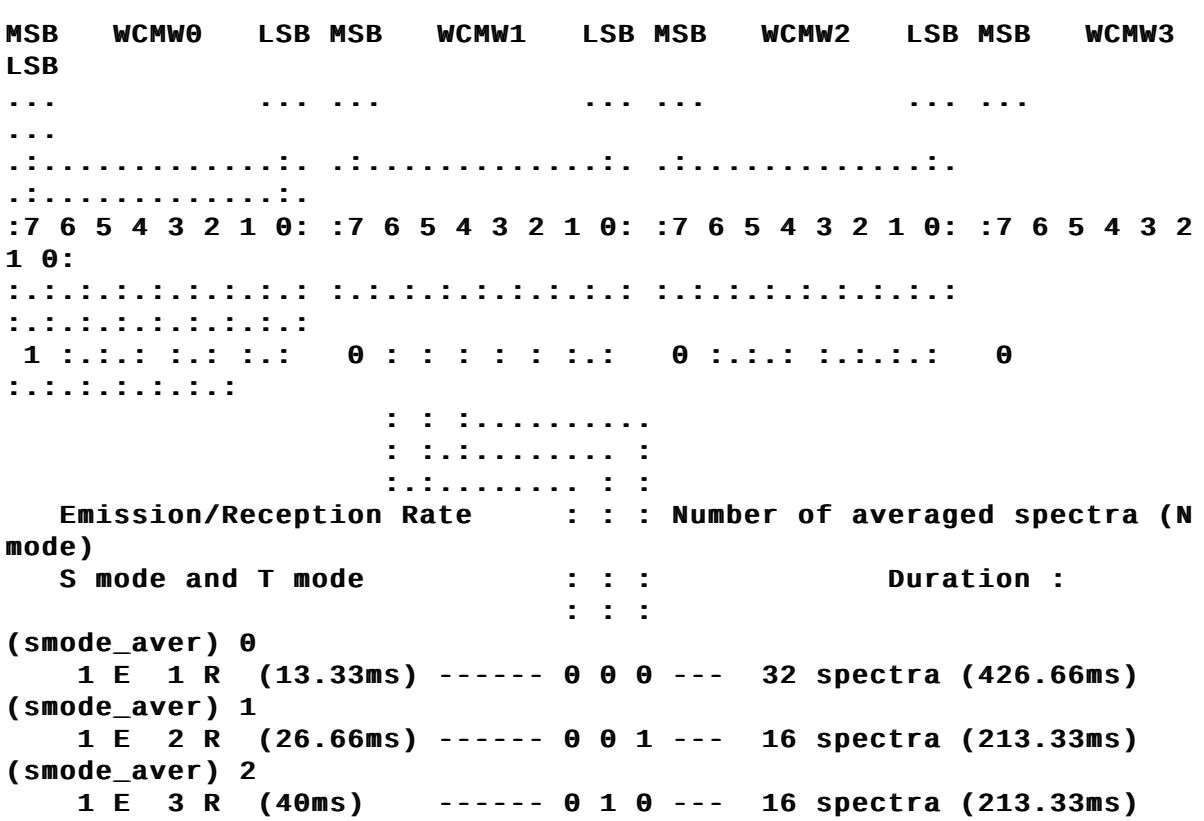
The FFT is applied to the range 0 to 83.170 kHz (fixed sampling frequency, 166.66kHz). Its size, M, defines the frequency resolution lower limit, 83.170/M in kHz. The final resolution may be larger, after processing inside DWP. In a S mode, M will generally be set to 512.

Repetition factor (rep_fac)

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
...           ... ...           ... ...           ... ...
...
.:............:. .:............:. .:............:.
.:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2
1 0:
:.:.:.:.:.:.:.: :.:.:.:.:.:.:.: :.:.:.:.:.:.:.:
:.:.:.:.:.:.:.:
 : :.:.: :.: : :   : :.:.: : : :.:   : :.:.: :.:.:.:   :
:.:.:.:.:.:.:
 1           : :   0                 0                 0
  (rep_fac)  : :            Repetition factor (number of cycle)
             : :
             : :        S,T modes            N mode       C,D
modes
     0       0 0 ------    1   ---------   1  ---------  1
     1       0 1 ------    2   ---------   8  ---------  1
     2       1 0 ------   32   --------- 232  ---------  1
     3       1 1 ------  128   --------- 116  ---------  1
```

The repetition factor corresponds to the number of time the instrument works in the same configuration. It is one way to limit the sounder operations in case of a mistake or failure in the TC stream. It will also be of use in the definition of duty cycles.

Emis./Rec Rate, Nb of averaged spectra (smode_aver)



```
    (1E 13) (186.66ms)
+ B (Waiting) (63.34ms adj.)
14 WHSS requested
13 frames issued
```

WHISPER processing modes (whi_process)

If bit 3 of WCMW1 is set, a internal WHISPER processing is requested for tracking mode (mode 1), sounding mode (mode 2), natural waves mode (mode 4) and calibration modes (modes 3 & 5), always used for troubleshotting mode (mode 6). In these modes DWP is requested to transmit the output data in a transparent mode, the WHISPER data flow is below 650 bit/sec exception is made for three dedicated modes internally processed, documented later in this paragraph.

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
...           ... ...           ... ...           ... ...
...
.:............:. .:............:. .:............:.
.:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2
1 0:
:.:.:.:.:.:.:.: :.:.:.:.:.:.:.: :.:.:.:.:.:.:.:
:.:.:.:.:.:.:.:
 1 : : : :.: :.:   0 :.:.: : : :.:   0 :.:.: :.:.:.:   0
:.:.:.:.:.:.:
   : : :                  :
   : : :   (mode)         :       modes processing
   0 0 1      1     (T)    0   - Tracking DWP processing
   0 0 1      1     (T)    1   - Tracking WHISPER processing
                                    (also used for uploading
EEPROM)
   0 1 0      2     (S)    0   - Sounding DWP processing
   0 1 0      2     (S)    1   - Sounding WHISPER processing
   0 1 1      3     (C)    0   - Cal 2 (sounding) DWP processing
   0 1 1      3     (C)    1   - Cal 2 (sounding) WHISPER
processing
   1 0 0      4     (N)    0   - Natural waves DWP Processing
   1 0 0      4     (N)    1   - Natural waves WHISPER Processing
   1 0 1      5     (C)    0   - Cal 1 (quiet) DWP processing
   1 0 1      5     (C)    1   - Cal 1 (quiet) WHISPER Processing
   1 1 0      6     (D)    1   - Dump_Troublesooting
```

WHISPER internal processing dedicated modes

Three modes with WHISPER internal processing are implemented. These modes do not need any DWP application task and no WPW are set.

Two modes are dedicated to natural waves mode they are :

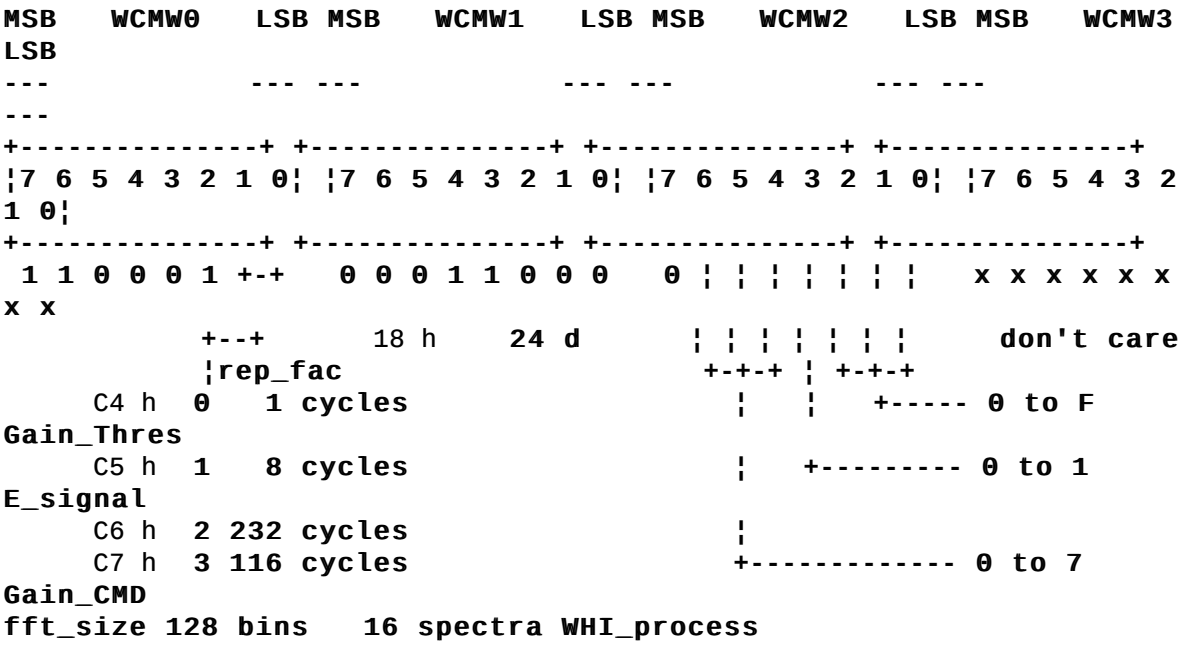
a) 16 averages of fft 128 bins

b) 8 averages of fft 256 bins

One mode is dedicated to a sounding mode. For this mode DWP is requested to run WHISPER in continuous mode.

The parameters : repetition factor, gain, overflow threshold and level (sounding) are addressable. All the other parameters are exclusive for these modes.

WHISPER Processed Natural (duration 74 ms + 1240 ms per cycle)



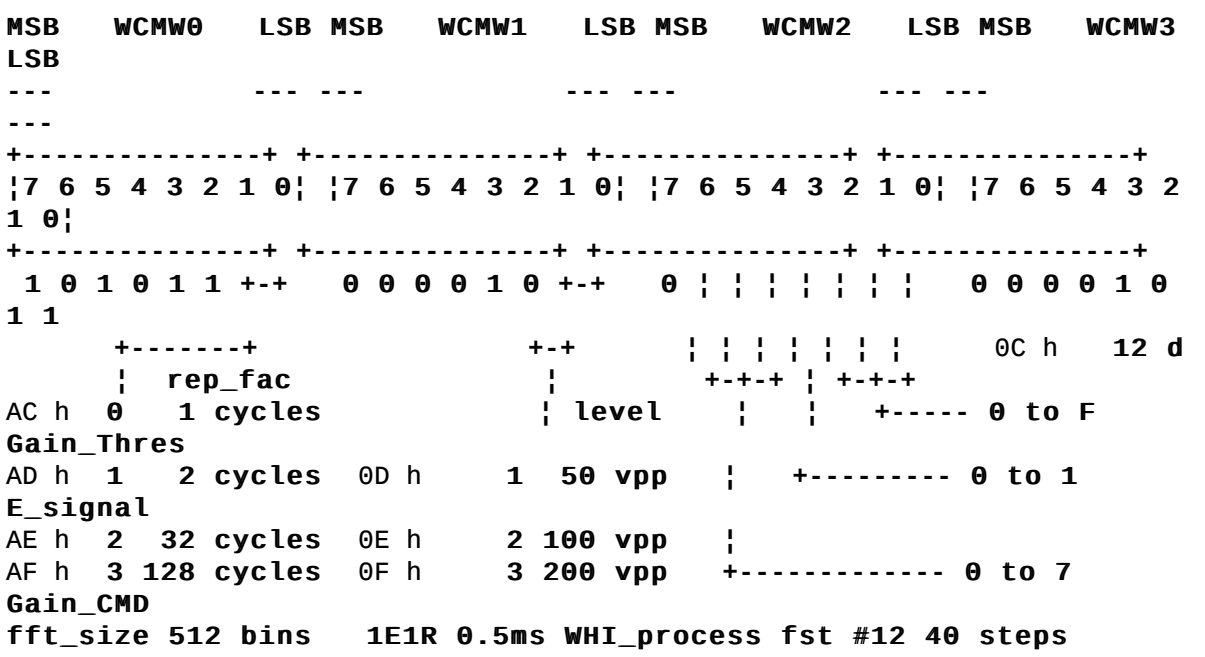
WHISPER Processed Natural Waves B (duration 74 ms + 1133.33 ms per cycle)

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
---           --- ---           --- ---           --- ---
---
+--------------+ +--------------+ +--------------+ +--------------+
¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2
1 0¦
+--------------+ +--------------+ +--------------+ +--------------+
 1 1 0 0 1 0 +-+   0 0 1 1 1 0 0 0   0 ¦ ¦ ¦ ¦ ¦ ¦   x x x x x x
x x
           +--+      38 h    56 d      ¦ ¦ ¦ ¦ ¦ ¦ ¦     don't care
           ¦rep_fac                    +-+-+ ¦ +-+-+
     C8 h  0   1 cycles                  ¦   ¦   +----- 0 to F
Gain_Thres
     C9 h  1   8 cycles                  ¦   +--------- 0 to 1
E_signal
     CA h  2 232 cycles                  ¦
     CB h  3 116 cycles                  +------------- 0 to 7
Gain_CMD
fft_size 256 bins   8 spectra WHI_process
```

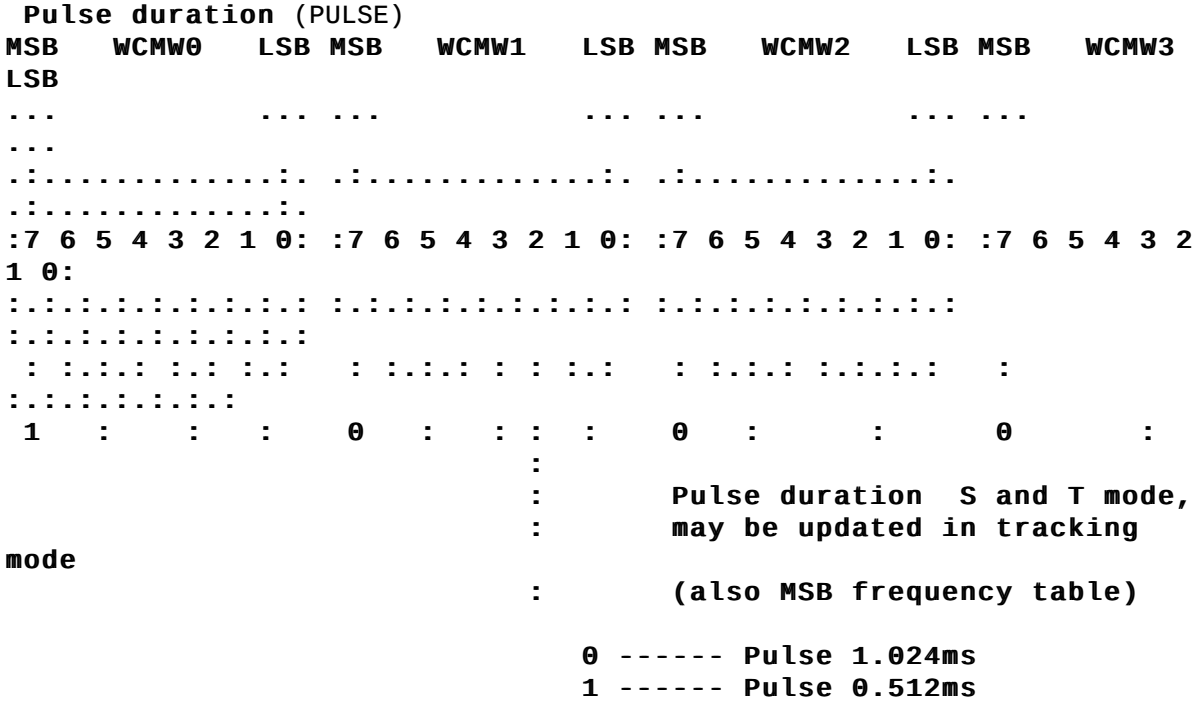
WHISPER Processed Sounding A (duration 74 ms + 4053 ms per cycle)

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
---           --- ---           --- ---           --- ---
---
+--------------+ +--------------+ +--------------+ +--------------+
¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2
1 0¦
+--------------+ +--------------+ +--------------+ +--------------+
 1 0 1 0 1 1 +-+   0 0 0 0 1 0 +-+   0 ¦ ¦ ¦ ¦ ¦ ¦   0 0 0 0 1 0
1 1
      +-------+               +-+      ¦ ¦ ¦ ¦ ¦ ¦     0B h   11 d
      ¦ rep_fac               ¦        +-+-+ ¦ +-+-+
AC h  0   1 cycles            ¦ level    ¦   ¦   +----- 0 to F
Gain_Thres
AD h  1   2 cycles  09 h     1  50 vpp   ¦   +--------- 0 to 1
E_signal
AE h  2  32 cycles  0A h     2 100 vpp   ¦
AF h  3 128 cycles  0B h     3 200 vpp   +------------- 0 to 7
Gain_CMD
fft_size 512 bins   1E1R 1ms WHI_process fst #11 80 steps
```

WHISPER Processed Sounding B listen delayed (duration 74 ms + 4053 ms per cycle)

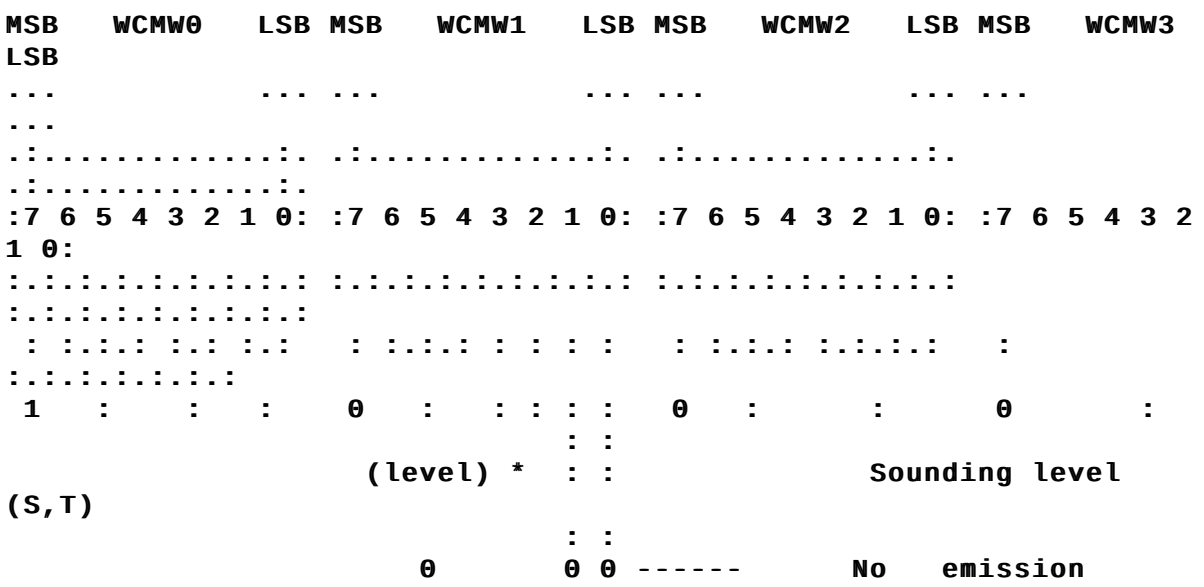

MSB WCMW0 LSB MSB WCMW1 LSB MSB WCMW2 LSB MSB WCMW3 LSB
7 6 5 4 3 2 1 0
7 6 5 4 3 2 1 0
7 6 5 4 3 2 1 0
7 6 5 4 3 2 1 0
1 0 1 0 1 1
0 0 0 0 1 0
0 0 0 0 1 0
1 1
rep_fac
level
0C h 12 d
AC h 0 1 cycles
0 to F
Gain_Thres
AD h 1 2 cycles
0D h 1 50 vpp
0 to 1
E_signal
AE h 2 32 cycles
0E h 2 100 vpp
AF h 3 128 cycles
0F h 3 200 vpp
0 to 7
Gain_CMD
fft_size 512 bins 1E1R 0.5ms WHI_process fst #12 40 steps

Pulse duration (PULSE)



In S modes, the frequency difference between two adjacent steps will be adjusted to the pulse duration : respectively 1 or 2 kHz for 1 or 0.5 ms. The related status bit (word 4 byte 1 bit 6) can be taken into account when interpreting the frequency scan mode bit.

Emission (level)



```
                        1       0 1 ------  Sounding at  50 Vpp
                        2       1 0 ------  Sounding at 100 Vpp
                        3       1 1 ------  Sounding at 200 Vpp
```

- **may be updated in tracking mode**

-
- **Gain command** (gain_cmd)

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
...           ... ...           ... ...           ... ...
...
.:............:. .:............:. .:............:.
.:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2
1 0:
:.:.:.:.:.:.:.:. :.:.:.:.:.:.:.:. :.:.:.:.:.:.:.:.
:.:.:.:.:.:.:.:.
 1 :.:.: :.: :.:   0 :.:.: : : :.:   0 : : : :.:.:.:   0
:.:.:.:.:.:.:.
                          (Gain_cmd)   : : : Gain Command
(S,N,T,Dacq)
                              0        0 0 0 --- Fixed Gain  + 12
dB
                              1        0 0 1 --- Fixed Gain  + 24
dB
                              2        0 1 0 --- Fixed Gain  + 36
dB
                              3        0 1 1 --- Fixed Gain  + 36
dB
                              4        1 0 0 --- Auto Gain   +
24/12 dB
                              5        1 0 1 --- Auto Gain   +
24/12 dB
                              6        1 1 0 --- Auto Gain   +
36/24 dB
                              7        1 1 1 --- Auto Gain   +
36/24 dB
In acq_dump mode, bit 6 is ignored, thus only fixed gain is set.
```

Automatic Gain Threshold/Dump acq-memory (gain_thres/dump_mem)

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
---           --- ---           --- ---           --- ---
---
+--------------+ +--------------+ +--------------+ +--------------+
¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2
1 0¦
+--------------+ +--------------+ +--------------+ +--------------+
 1 +-+-+ +-+ +-+   0 +-+-+ ¦ ¦ +-+   0 +-+-+ ¦ ¦ ¦ ¦   0 +-----+-----+
                                                ¦ ¦ ¦  Gain
Threshold (S,N,T)
 for modes N,S,T               (gain_thres)   ¦ ¦ ¦  (Number of
overflows
```

during Gain control)

0 0 0 0 ----- 0 (use of internal default value)

(2 overflows for FM's)

1 0 0 1 ----- from 3

7 1 1 1 ----- to 15 (step 2)

for mode D (dump) (mode 6)

0 0 0 0 -- acquisition dump 1k (16) 18 frames of 64 words (16)

1 0 0 1 -- dump PROM mC 2k (8) 18 frames of 64 words (16)

2 0 1 0 -- dump EEPROM mC 32k (8) 283 frames of 64 words (16)

3 0 1 1 -- dump VSP PROM 8k (16) 142 frames of 64 words (16)

4 1 0 0 -- dump WINDOW RAM 1k (16) 18 frames of 64 words (16)

7 1 1 1 -- dump all prog. memories 461 frames of 64 words (16)

Contingency modes

Rules :

After receiving a command from the DWP the integrity of the WCWM is checked according to the rules defined below for the normal operations:

if a WCMW anomaly is detected or the mode decoded in WCMW0 is contingency 1 (natural)

a contingency mode 1 (Natural Waves) is issued.

if the mode decoded in WCMW0 is contingency 2
a contingency mode 2 (Sounding) is issued.

criteria :

the MSB (bit) of the WCMW words must be respectively 1, 0, 0, 0

Contingency mode 1 (Natural Waves)

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
---           --- ---           --- ---           --- ---
---
+--------------+ +--------------+ +--------------+ +--------------+
¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2
1 0¦
+--------------+ +--------------+ +--------------+ +--------------+
 1 0 0 0 x x x x   0 x x x x x x x   0 x x x x x x x   0 x x x x x
x x
   8x h              xx h              xx h              xx h   0 d
                        external command

 1 0 0 0 0 0 0 0   1 1 1 1 0 0 0 0   0 1 1 0 0 0 0 0   0 0 0 0 0 0
0 0
   80h  128 d        78 h    120d       60 h  96 d        00 h   0 d
 WHISPER internal default values set by an abnormal commanding or
the above command

mode = 0           smode_aver = 7    gain_cmd = 6      fst = 0
 (contingency 1)    (1 spectrum)      (+36/+24 dB)

fft_size =0        whi_pro = 1       gain_thres = 0
 (64 bins)         (WHI processing)  (2 overflows)

rep_fac = 0        PULSE = 0         E_signal =0
 (1 cycles)                           (Ez)
                   level = 0
```

Contingency mode 2 (Sounding)

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
---           --- ---           --- ---           --- ---
---
+--------------+ +--------------+ +--------------+ +--------------+
¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2
1 0¦
+--------------+ +--------------+ +--------------+ +--------------+
 1 1 1 1 x x x x   0 x x x x x x x   0 x x x x x x x   0 x x x x x
x x
   Fx h              xx h              xx h              xx h
                        external command

 1 1 1 1 1 1 0 0   0 0 0 0 1 0 1 0   0 1 1 0 0 0 0 0   0 1 1 1 0 0
0 0
   FC h    252 d     0A h    10 d       60 h   96 d      70 h    112
d
      internal default values set by an abnormal commanding

mode = 7           smode_aver = 0    gain_cmd = 6      fst = 112
 (contingency 2)    (1E 1R)           (+36/+24 dB)     (83 to 4,
80 steps)

fft_size =3        whi_pro = 1       gain_thres = 0
 (512 bins)         (WHI processing)  (2 overflows)

rep_fac = 0        PULSE = 0         E_signal = 0
 (1 cycles)         (1.024 ms)           (Ez)

                   level = 2
                    (100 Vpp)
```

Calibration modes

These WCMW commands will be used to allow the verification of the receiver transfer function and the transmitter transfer function.

The calibration 1 (quiet) is a passive calibration ; the synthesiser is connected internally and as the transmitter is not operating, the 27 V is off.

The calibration 2 (sounding) is an active calibration ; the transmitter output is connected to the receiver input, via an attenuator, and the 27 V power is needed for this calibration (27 V on).

As the transmitter is still connected to the antennae braids, this calibration is "active" and a blanking pulse will be issued according to the transmitted pulse (1.024 ms). During both calibrations, the

levels are checked for several frequency points in all receiver gain levels. The parameters for both calibrations (steps, frequencies, levels, gains) are internally programmed and thus, they cannot be modified in flight by commanding.

The calibration 2 is selected internally, only if the 27 V is on and the calibration 1 is selected if the 27 V is off.

The two different commands are issued only to advise the DWP to switch on or off the 27 V according to the requested mode.

Calibration 1 mode (Quiet) 99 steps 160 seconds.

```
frequency steps : 124, 100, 76, 72, 64, 52, 36, 20, 16, 8, 0
         hexa       :  7C,  64, 4C, 48, 40, 34, 24, 14, 10, 8, 0

MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
...           ... ...           ... ...           ... ...
...
.:............:. .:............:. .:............:.
.:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2
1 0:
:.:.:.:.:.:.:.: :.:.:.:.:.:.:.: :.:.:.:.:.:.:.:
:.:.:.:.:.:.:.:
 1 1 0 1 0 0 0 0   0 0 0 0 0 0 0 0   0 0 0 0 0 0 0 0   0 0 0 0 0 0
0 0
   D0 h   208 d      00 h     0 d      00 h     0 d      00 h    0
d
```

Calibration 2 mode (Sounding) 99 steps 160 seconds.

132 blanking pules are issued by DWP at a rate of one every 120 x 13.33 ms
frequency steps : 76, 72, 64, 52, 44, 36, 24, 16, 12, 8, 0
hexa : 4C, 48, 40, 34, 2A, 24, 18, 10, 0C, 08, 00

MSB WCMW0 LSB MSB WCMW1 LSB MSB WCMW2 LSB MSB WCMW3 LSB
... ...
.:.....:. .:.....:. .:.....:. .:.....:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0:
:.:.:.:.:.:.:.:.: :.:.:.:.:.:.:.:.: :.:.:.:.:.:.:.:.:
1 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
B0 h 176 d 00 h 0 d 00 h 0 d 00 h 0 d

NOTE :
- These two calibration modes will issue 132 frames of 64 bins (moduli)
at a rate of one frame every 1.6 second (120 x 13.3 ms).
Total duration : 212 seconds.

Calibration 1 whi_pro (Quiet) 45 steps (690ms).

```
frequency steps : 124, 100, 76, 72, 64, 52, 36, 24, 16, 8, 0
         hexa       :  7C,  64, 4C, 48, 40, 34, 24, 18, 16, 8, 0

MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
...           ... ...           ... ...           ... ...
...
.:.............:. .:.............:. .:.............:.
.:.............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2
1 0:
:.:.:.:.:.:.:.:.: :.:.:.:.:.:.:.:.: :.:.:.:.:.:.:.:.:
:.:.:.:.:.:.:.:.:
 1 1 0 1 0 0 0 0   0 0 0 0 1 0 0 0   0 0 0 0 0 0 0 0   0 0 0 0 0 0
0 0
   D0 h   208 d      08 h     8 d      00 h     0 d      00 h    0
d
```

Calibration 2 whi_pro (Sounding) 45 steps (690ms).

```
51 blanking pules are issued by DWP at a rate of one every 13.33
ms
frequency steps :  76, 72, 64, 52, 44, 36, 24, 16, 12,  8,  0
         hexa       :  4C, 48, 40, 34, 2A, 24, 18, 10, 0C, 08, 00

MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
...           ... ...           ... ...           ... ...
...
.:.............:. .:.............:. .:.............:.
.:.............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2
1 0:
:.:.:.:.:.:.:.:.: :.:.:.:.:.:.:.:.: :.:.:.:.:.:.:.:.:
:.:.:.:.:.:.:.:.:
 1 0 1 1 0 0 0 0   0 0 0 0 1 0 0 0   0 0 0 0 0 0 0 0   0 0 0 0 0 0
0 0
   B0 h   176 d      08 h     8 d      00 h     0 d      00 h    0
d
```

NOTE :
- These two calibration modes will issue one frame of 64 words at the end of the WHISPER internal processing. Total duration : 0.7 seconds.
- These two calibration modes are part of the WHISPER automatic test.

Troubleshooting modes

In all the troubleshooting modes the sequence produces a number of frames of 64 words at a rate of (120 X 13.33 ms) 1.6 second.

Acquisition Dump mode

An Acquisition dump mode can also be invoked by commanding the troubleshooting mode command with (dump_mem) set to 0.

With this command a 1 k Word (16 bit) of the EFW signal is sampled and dumped.

The output are 16 frames starting with a block of 6 bytes setup followed by 64 data.

The gain can be commanded by using the WCMW2 (bit 4, 5, 6 ,7). Fix gain only.

Programme Memory Dump modes

Several programme memory dump modes can be invoked by commanding the troubleshooting mode command including a four bit word (dump_mem) in WCMW2 bit 0 to 3.

With this command a programme memory dump is performed separately or together according to the four bit word.

The output data frame contains block of 6 bytes status followed by 64 data words.

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
---           --- ---           --- ---           --- ---
---
+--------------+ +--------------+ +--------------+ +--------------+
¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2 1 0¦ ¦7 6 5 4 3 2
1 0¦
+--------------+ +--------------+ +--------------+ +--------------+
 1 1 1 0 0 0 0 0   0 0 0 0 1 0 0 0   x x x x x x x x   0 0 0 0 0 0
0 0
   E0 h   224 d      08 h     8 d                         00 h    0
d
                                    ¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦
Receiver on Ez    gain 12 dB 00 h   0 0 0 0 0 0 0 0 --
acquisition dump 1k (16)
                  24 dB 10 h    0 0 0 1 0 0 0 0  18 frames of
64 words (16)
                  36 dB 20 h    0 0 1 0 0 0 0 0
                  36 dB 30 h    0 0 1 1 0 0 0 0
                                    ¦ ¦ ¦ ¦ ¦ ¦ ¦ ¦
Reciever on Ey    gain 12 dB 08 h   0 0 0 0 1 0 0 0 --
acquisition dump 1k (16)
                  24 dB 18 h    0 0 0 1 1 0 0 0  18 frames of
64 words (16)
                  36 dB 28 h    0 0 1 0 1 0 0 0
                  36 dB 38 h    0 0 1 1 1 0 0 0
                                          ¦ ¦ ¦
                        01 h    0 0 0 0 0 0 0 1 -- dump PROM
mC 2k (8)
                                           18 frames of
64 words (16)
                                          ¦ ¦ ¦
                        02 h    0 0 0 0 0 0 1 0 -- dump
EEPROM mC 32k (8)
                                          283 frames of
64 words (16)
                                          ¦ ¦ ¦
                        03 h    0 0 0 0 0 0 1 1 -- dump VSP
PROM 8k (16)
                                          142 frames of
64 words (16)
                                          ¦ ¦ ¦
                        04 h    0 0 0 0 0 1 0 0 -- dump
WINDOW RAM 1k (16)
                                           18 frames of
64 words (16)
                                          ¦ ¦ ¦
                        07 h    0 0 0 0 0 1 1 1 --dump all
program memories
```

461 frames of 64 words (16)

Frequency point, Frequency Range (fst)

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3
LSB
...           ... ...           ... ...           ... ...
...
.:............:. .:............:. .:............:.
.:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2
1 0:
:.:.:.:.:.:.:.: :.:.:.:.:.:.:.: :.:.:.:.:.:.:.:
:.:.:.:.:.:.:.:
 : :.:.: :.: :.:   : :.:.: : : :.:   : :.:.: :.:.:.:   : : : : : :
: :
 1   :    :   :    0   :   : :  :    0   :      :      0 : : : : :
: :
                                                         : : : : :
: :
                                                         : : : : :
: :
      Frequency point in tracking mode (T) *             : : : : :
: :
      (N = syn_step)
          not used        : from N = 0  * * ------------ 0 0 0 0 0
0 0
                          :
                          : to   N = 3  ---------------- 0 0 0 0 0
1 1
                                                         : : : : :
: :
     F = N x 976.5625 Hz  : from N =  4  (3906.3 Hz) --- 0 0 0 0 1
0 0
                          :
                          : to   N = 83 (81054.7 Hz) --- 1 0 1 0 0
1 1
          not used        : from N = 84  --------------- 1 0 1 0 1
0 0
                          :
                          : to   N = 127 --------------- 1 1 1 1 1
1 1
                                                         : : : : :
: :
      Frequency Range (Frequency Scan Table)   (S)       : : : : :
: :
      (fst)
                            from FST = 0  -------------- 0 0 0 0 0
0 0
                            to   FST = 127 ------------- 1 1 1 1 1
1 1
```

* may be updated in tracking mode.

3.2.14 WIDEBAND Commands

Fixed Pattern	AIT name	Name	Purpose
0x8000	ZEWDS0FS	SetWBDComLSB	Set LSB of WBD command holding register in DWP
0x8100	ZEWDS1FS	SetWBDComMSB	Set MSB of WBD command holding register in DWP
0x8200	ZEWDS2FS	SetWBDGUP	Set gain update clock frequency
0x8400	ZEWDS4FS	SetWBDDataPath	Set WBD data path
0x8800	ZEWDS8FS	SetWBDComLSBTx	Set LSB of WBD command holding register in DWP and transmit holding register to DWP
0x8900	ZEWDS9FS	SetWBDComMSBTx	Set MSB of WBD command holding register in DWP and transmit holding register to DWP

Table 3.2.14.1 - WIDBAND commands

SetWBDGUP specifies the period of the gain update clock signal routed to WBD.

SetWBDDataPath determines whether WBD telemetry is routed through DWP or directly from WBD to the spacecraft.

WBD requires a 16 bit command to be transmitted as two bytes across the interface from DWP. **SetWBDComLSB** and **SetWBDComMSB** modify a DWP holding register without transmitting the register to WBD. **SetWBDComLSBTx** and **SetWBDComMSBTx** modify the DWP holding register and transmit the holding register to WBD. The commands accepted by the WBD instrument and their effect are listed below.

The format of a telecommand word sent by DWP to WIDEBAND is shown in Table 3.2.14.2

Bit	Description
15 (MSB)	gain mode, manual(=1) / auto(=0)
14,13,12,11	gain select
10,9	antenna select
8,7	frequency select
6,5	upper AGC threshold
4,3,2	output mode
1,0	lower AGC threshold

Table 3.2.14.2 - WIDEBAND telecommand word format

Mnemonic	MSB	LSB	Action
WB_GN_SEL 0	0000xxxx	xxxxxxxx	set gain = 0 dB
WB_GN_SEL 5	0001xxxx	xxxxxxxx	set gain = 5 dB
WB_GN_SEL 10	0010xxxx	xxxxxxxx	set gain = 10 dB
WB_GN_SEL 15	0011xxxx	xxxxxxxx	set gain = 15 dB
WB_GN_SEL 20	0100xxxx	xxxxxxxx	set gain = 20 dB
WB_GN_SEL 25	0101xxxx	xxxxxxxx	set gain = 25 dB
WB_GN_SEL 30	0110xxxx	xxxxxxxx	set gain = 30 dB
WB_GN_SEL 35	0111xxxx	xxxxxxxx	set gain = 35 dB
WB_GN_SEL 40	1000xxxx	xxxxxxxx	set gain = 40 dB
WB_GN_SEL 45	1001xxxx	xxxxxxxx	set gain = 45 dB
WB_GN_SEL 50	1010xxxx	xxxxxxxx	set gain = 50 dB
WB_GN_SEL 55	1011xxxx	xxxxxxxx	set gain = 55 dB
WB_GN_SEL 60	1100xxxx	xxxxxxxx	set gain = 60 dB
WB_GN_SEL 65	1101xxxx	xxxxxxxx	set gain = 65 dB
WB_GN_SEL 70	1110xxxx	xxxxxxxx	set gain = 70 dB
WB_GN_SEL 75	1111xxxx	xxxxxxxx	set gain = 75 dB
WB_AGC_UP 0	xxxx00xx	xxxxxxxx	upper agc = UV0
WB_AGC_UP 1	xxxx01xx	xxxxxxxx	upper agc = UV1
WB_AGC_UP 2	xxxx10xx	xxxxxxxx	upper agc = UV"
WB_AGC_UP 3	xxxx11xx	xxxxxxxx	upper agc = UV3
WB_AGC_LO 0	xxxx00xx	xxxxxxxx	lower agc = LV0
WB_AGC_LO 1	xxxx01xx	xxxxxxxx	lower agc = LV1
WB_AGC_LO 2	xxxx10xx	xxxxxxxx	lower agc = LV2
WB_AGC_LO 3	xxxx11xx	xxxxxxxx	lower agc = LV3
WB_GN_AUT	xxxxxxxx	0xxxxxxx	auto gain select
WB_GN_MAN	xxxxxxxx	1xxxxxxx	manual gain select
WB_FREQ 0	xxxxxxxx	x00xxxxx	conv. freq. = 0Hz
WB_FREQ 125	xxxxxxxx	x01xxxxx	conv. freq. = 125 kHz
WB_FREQ 250	xxxxxxxx	x10xxxxx	conv. freq. = 250 kHz
WB_FREQ 500	xxxxxxxx	x11xxxxx	conv. freq. = 500 kHz
WB_OUT 0	xxxxxxxx	xxx000xx	BW = 9.5 kHz; 8-bits
WB_OUT 1	xxxxxxxx	xxx001xx	BW = 9.5 kHz; 8-bits
WB_OUT 2	xxxxxxxx	xxx010xx	BW = 19 kHz; 4-bits
WB_OUT 3	xxxxxxxx	xxx011xx	BW = 19 kHz; 8-bits
WB_OUT 4	xxxxxxxx	xxx100xx	BW = 77 kHz; 8-bits
WB_OUT 5	xxxxxxxx	xxx101	BW = 77 kHz; 1-bit
WB_OUT 6	xxxxxxxx	xxx110xx	BW = 77 kHz; 4-bits
WB_OUT 7	xxxxxxxx	xxx111xx	BW = 77 kHz; 8-bits
WB_SEN Ez	xxxxxxxx	xxxxxx00	select Ez antenna
WB_SEN Bx	xxxxxxxx	xxxxxx01	select Bx search coil
WB_SEN By	xxxxxxxx	xxxxxx10	select By search coil
WB_SEN Ey	xxxxxxxx	xxxxxx11	select Ey antenna

Table 3.2.14.3

3.3 Telecommand Reference Guide

This section provides the definitive description of the purpose and effects of each of the defined WEC commands. One or more pages per command is used, with a standard layout.

The *AIT database* section provides the information stored for this command in the AIT database.

The *Purpose* section gives a thumbnail sketch of the command

The *Constraints* section highlights any limitations or dangers of the command.

The *Description* section provides the bulk of the detailed information for the command.

The *Housekeeping* section identifies the principal changes that should be observed in the HK if the command was successful. References are made to the chapter 2 of the WEC instrument user manual which describes the housekeeping telemetry. Where possible a table has been provided that shows what new values some HK parameters will take if the command is successful. But in many cases these tables are only valid if no other commands are transmitted to DWP until the HK block is received, i.e. up to 5.2 seconds later.

Finally, *Related Commands* lists other WEC commands that may be useful for the planned operations.

Listing of commands.

3.3.1 DummyCommand

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Authorised?
ZEWDUMMY YEWDUMMY	0x0B (Nominal) 0x1B (Redundant)	DummyCommand DummyCommand	0x0000 0x0000	0x0000 0x0000	

Purpose:

Used to load raw binary values into DWP following a **LoadKernelMemory** command. May also be used to send command patterns not conforming to any of the other defined AIT entries.

Constraints:

None.

Description:

Used to load raw binary values into DWP following a **LoadKernelMemory** command. May also be used to send command patterns not conforming to any of the other defined AIT entries.

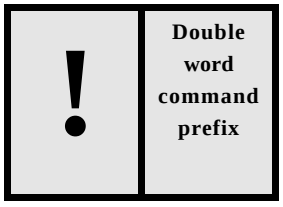
Housekeeping:

When used following a **LoadKernelMemory** command the **DummyCommand** is NOT echoed in the memory load telecommand echo words.

Related commands:

LoadKernelMemory.

3.3.2 DWPCommonCmd



AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMD1FS YEWMD1FS	0x0B (Nominal) 0x1B (Redundant)	DWPCommonCmd DWPCommonCmd	0xFF00 0xFF00	0xD100 0xD100	

Purpose:

Used as the first word of a double word command.

Constraints:

The **DWPCommonCmd** telecommand must be transmitted as the first memory load of any the five defined double word commands. It may be necessary to set the function data bits of **DWPCommonCmd** in some cases depending on the double word command.

Description:

Used as the first word of a double word command. The next command must be a valid second word of a double word command, ref. section 3.2.

The function data of **DWPCommonCmd** will become bits 8 to 15 of the assembled double word command data.

If the next telecommand received after **DWPCommonCmd** is not a valid word then the **Telecommand extension invalid** HK parameter will be set and both the DWPCommand and the second command will be discarded.

The **Telecommand assembly status** HK parameter will be set to the value of DWPCommonCmd to indicate a second telecommand is expected to complete the double word command assembly.

Housekeeping:

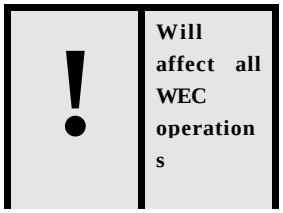
Telecommand assembly status will be set to the value of **DWPCommonCmd**.

HK parameter	New value
EW5TCASS	Memory load received

Related commands:

None.

3.3.3 DWPConfig



AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWNSCFS YEWNSCFS	0x0B (Nominal) 0x1B (Redundant)	DWPConfig DWPConfig	0xFC00 0xFC00	0xAC00 0xAC00	

Purpose:

To determine how many DWP processors should be powered and at what clock speed. To determine how the selection of which DWP processor will run the kernel software will be made.

Constraints:

All WEC operations are halted by this command and most of the DWP software is reset. Therefore, this command should be used with caution. Some instances of this command will cause code patches and uploaded DWP macros to be lost, ref. section 2.3. This command cannot be executed from a DWP macro.

Description:

The **DWPConfig** command is handled as a special case by DWP. The most significant 6 bits of the memory load are decoded by a hardware comparator, and when the bit pattern is 101011 the least significant 8 bits are strobed onto the hardware command bus. The decoding of the operand to **DWPConfig** is shown in the table. Bits set to zero in bit positions 0 to 7 have no effect.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Description
1	0	1	0	1	1											DWPConfig command select
						x	x									Allocation of kernel to transputer
								1								1 = assert DWP reset
									x							1 = Default configuration
										x						1 = Full clock speed for processor 2
											x					1 = full clock speed for processor 1
												x				1 = full clock speed for processor 0
													x			1 = power down processor module 2
														x		1 = power down processor module 1
															x	1 = power down processor module 0

Decoding of DWPConfig memory load command

9	8	Description
0	0	kernel on processor 0
0	1	kernel on processor 1
1	0	kernel on processor 2
1	1	automatic allocation of kernel to processor

Decoding of kernel allocation bits

It is recommended that the Assert DWP Reset bit should always be set to 1 when sending **DWPConfig**. This is because DWP can only sense which processors modules are powered, and at what clock speed after a DWP reset. Powering off a processor module is likely to crash DWP without a DWP Reset.

If **DWPConfig** is sent without setting the assert DWP reset bit, then the following notes should be taken into account. Changing the clock speed of a transputer running an application process will halve the processing power available, and may mean the application process will not be able to process all the instrument data routed to it. Changing the clock speed of the transputer running the kernel process will affect the frequency of the kernel software generated DWP master clock and the timing characteristics of some of the instrument interfaces may be affected.

Approximately one second after **DWPConfig** is sent, DWP will execute the macro in slot 31, which by default will power off all WEC instruments except DWP itself. In some cases it is possible to modify this behaviour using the FlagInstrumentFail command, or by redefining the macro, but this should not be done without an in depth knowledge of DWP because there can be undesirable side effects.

Housekeeping:

Because this command resets DWP operations, there will be a number of changes in the HK. The principle changes to note are that the **OBDH reset count** (AIT entry **EW5RSCNT**) will initialised

to 1, and the **DWP last configuration telecommand** (AIT entry **EW5LCTCM**) will change to echo the **DWPConfig** command sent. The correct execution of **DWPConfig** can also be verified by inspecting the **DWP kernel processor module** (AIT entry **EW5KPNUM**), the **DWP processor configuration** (AIT entries **EW5P0CFG**, **EW5P1CFG**, **EW5P2CFG**) and the **DWP processor status** (AIT entries **EW5PMST0**, **EW5PMST1**, **EW5PMST2**).

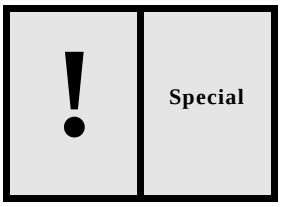
Note that unlike most other WEC commands, the DWPConfig command is not echoed in the memory load telecommand echo words.

HK parameter	New value
EW5RSCNT	**1**
EW5LCTCM	**DWPConfig command bit pattern**
EW5KPNUM	**MLCom masked with 0x30**
EW5P0CFG	**-**
EW5P1CFG	**-**
EW5P2CFG	**-**
EW5PMST0	**-**
EW5PMST1	**-**
EW5PMST2	**-**

Related commands:

None.

3.3.4 ESCAPE



AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMESCA	**0x0B (Nominal)**	**ESCAPE**	**0xA000**	**0xFC00**	
YEWMESCA	**0x1B (Redundant)**	**ESCAPE**	**0xA000**	**0xFC00**	

Purpose:

May be used in addition to **DummyCommand** when uploading binary code patches after a **LoadKernelMemory** command.

Constraints:

ESCAPE commands must be used in pairs.

Description:

When uploading a memory patch following a LoadKernelMemory command, to prevent a transputer instruction memory load from tripping the **DWPConfig** command decoder when the top 6 bits of the transputer instruction match **DWPConfig**, the **ESCAPE** command is introduced. The **ESCAPE** command is one whose 6 most significant bits are 101000.

If the most significant six bits of a transputer instruction match either the **ESCAPE** command or **DWPConfig** the instruction would be sent in the least significant byte of two consecutive **ESCAPE** Memory load commands. The first **ESCAPE** command should contain the most significant byte of the binary code word.

Housekeeping:

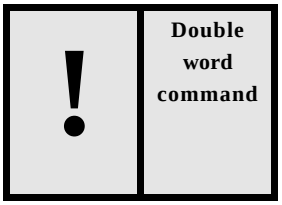
After reception of the first **ESCAPE** command of a pair**, Telecommand assembly status** will be set to the value of the memory load. After reception of the second ESCAPE command of a pair, **Telecommand assembly status** will be set to zero.

HK parameter	New value
EW5TCASS	Memory load command bit pattern or zero

Related commands:

LoadKernelMemory, **DummyCommand**.

3.3.5 FlagExtExpStatus



AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWED4FS YEWED4FS	0x0B (Nominal) 0x1B (Redundant)	FlagExtExpStatus FlagExrExpStatus	0xFF00 0xFF00	0xF400 0xF400	

Purpose:

To flag to DWP the current operational mode of the PEACE instrument. This is required by DWP to correctly control the particle correlator software and to synchronise WHISPER sounding with the PEACE spin.

Constraints:

The **DWPCommonCmd** telecommand must be transmitted immediately before **FlagExtExpStatus** as this is a double word telecommand. It may be necessary to set the function data bits of **DWPCommonCmd** in some cases, see the command description below.

This command must be sent whenever a telecommand to the PEACE instrument will cause a change in PEACE operations that would affect DWP operations (either a change in PEACE spin offset of number or flybacks / spin).

Description:

The operational mode of the PEACE particle experiment is required in order for the DWP kernel software to correctly program spin synchronisation of WHISPER sounding, and for DWP to determine the PEACE energy level during a sweep for the purpose of particle correlations.

A bit in this command can also be set to inhibit the decoding of vectors from the FGM IEL interface. This bit can be used to indicate that FGM is off or that the interface has failed.

The least significant bits of the function data give the offset in time of the PEACE reference pulse from that of the spacecraft sun reference pulse. This time interval must be specified in units of 1.1 milliseconds (the period of DWPs master clock).

The default time offset for the sun reference pulse is zero.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Description
x	x															Number of PEACE flybacks / spin
		x														Ignored
			x													1 = FGM vector forwarding to EFW disabled
				x	x	x	x	x	x	x	x	x	x	x	x	Sun reference pulse offset

Decoding of telecommand function data

15	14	Description
0	0	PEACE off / fixed energy mode
0	1	16 flybacks / spin
1	0	32 flybacks / spin
1	1	64 flybacks / spin

Decoding of number of PEACE flybacks / spin field

Housekeeping:

The **Peace flybacks per spin** (AIT entry **EW3PCFBS**) and **Peace SRP offset** (AIT entry **EW3SRPOF**) HK fields are updated from the command data.

Telecommand assembly status will be set to zero to flag successful completion of assembly of the double word command.

HK parameter	New value
EW5TCASS	**0**
EW3PCFBS	**Data masked with 0xC000**
EW3SRPOF	**Data masked with 0x0FFF**
EW5FGMDS	**Data masked with 0x1000**

Related commands:

None.

3.3.6 FlagInstrFail

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMS4FS	**0x0B (Nominal)**	**FlagInstrFail**	**0xFF00**	**0xC400**	
YEWMS4FS	**0x1B (Redundant)**	**FlagInstrFail**	**0xFF00**	**0xC400**	

Purpose:

To disable all commanding and telemetry acquisition for the selected instrument in the event of catastrophic failure of that instrument.

Constraints:

FlagInstrFail should be sent after either a DWP reset or power on, before the instruments have been powered on.

Description:

The **FlagInstrFail** disables all commands to DWP to either power or operate the selected WEC instrument. This would only be used in the event of a terminal failure of an instrument such that turning on the instrument would endanger WEC operations, e.g. instrument consuming too much power.

Once sent, all subsequent commands received by DWP to either power or command that instrument are ignored until either DWP is reset followed by a cold or warm start, or a **FlagInstrFail** command re-enabling the instrument is received.

7	6	5	4	3	2	1	0	Description	HK AIT entries affected
x	x							Ignored	
		x						WHISPER TRANSMITTER	EW3TXDIS
			x					WIDEBAND	EW4INSDS
				x				WHISPER	EW3INSDS
					x			STAFF mwf	EW2INSDS
						x		STAFF SA	EW1INSDS
							x	EFW	EW0INSDS

Decoding of FlagInstrFail command

Setting a bit disables the **SetInstrPower** (ZEWMS2FS) command for the corresponding instrument and prevents it being commanded ON or OFF.

In the case of WHISPER, setting bit 3 will also delay any commands for WHISPER (ZEWRS8FS to ZEWRSBFS) until bit 3 is cleared by another **FlagInstrFail** command.

Forwarding of commands to other WEC instruments, or taking telemetry from any instrument, does not appear to be affected by **FlagInstrFail**, but it is NOT recommended that instruments be operated while flagged as failed.

The **FlagInstrFail** command should normally be used directly ***after*** DWP configuration and ***before*** any WEC instruments are powered ON. If it is used to disable an instrument that is already ON, the instrument will probably continue to operate normally (except for forwarding commands to WHISPER), but it will not be possible to power OFF that instrument.

Staff latch up protection will also be disabled.

Housekeeping:

EFW instrument disabled, STAFF SA instrument disabled, STAFF MWF instrument disabled, WHISPER instrument disabled, WBD instrument disabled, WHISPER Tx instrument disabled.

HK parameter	Loc	New value
EW0INSDS	53	MLCom masked with 0x01
EW1INSDS	53	MLCom masked with 0x02
EW2INSDS	53	MLCom masked with 0x04
EW3INSDS	53	MLCom masked with 0x08
EW4INSDSS	53	MLCom masked with 0x10
EW3TXDIS	53	MLCom masked with 0x20

Related commands:

FlagIntfFail

3.3.7 FlagIntfFail

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMS3FS	0x0B (Nominal)	FlagIntfFail	0xFF00	0xC300	
YEWMS3FS	0x1B (Redundant)	FlagIntfFail	0xFF00	0xC300	

Purpose:

To suppress DWP monitoring of latchup in the selected WEC instruments.

Constraints:

FlagIntfFail must be transmitted before using the affected interface (i.e. before the instrument connected to the interface is turned on).

Description:

7	6	5	4	3	2	1	0	Description	HK AIT entries affected
x								WHISPER alarm monitor	EW3MONDS
	x							Ignored	
		x						Ignored	
			x					STAFF SA ADC monitor	EW1MONDS
				x				STAFF MWF ADC monitor	EW2MONDS
					x			Ignored	
						x		Ignored	
							x	Ignored	

Decoding of FlagIntfFail command

The **FlagIntfFail** command provides a manual override for the automatic monitoring by DWP of analogue signals from WEC instruments. Normally when DWP detects analogue voltages out of the expected range for a WEC instrument DWP will reset the instrument, ref. WEC[2]. However, if an interface fault has developed resulting in erroneous levels on the analogue signals this command can be sent to disable DWP monitoring of those signals.

DWP always outputs the digitised values for each analogue channel in the WEC HK. The **FlagIntfFail** command only disables DWP comparisons of the digitised voltages with threshold values.

DWP does not perform latchup checks by using ADC values for the EFW, WHISPER and WBD instruments. Therefore setting the bits in the **FlagIntfFail** command for these instruments will cause the appropriate HK parameter to be set but will not actually change DWPs operation of that instruments interface.

The WH Alarm monitoring disable bit allows DWP monitoring of the logic signal WH Alarm to be disabled. This could be used in the event that WH Alarm became permanently active due to some interface fault.

Housekeeping:

STAFF SA latchup monitor control, STAFF MWF latchup monitor control, WHISPER latchup monitor control.

HK parameter	New value
EW1INSDS	MLCom masked with 0x10
EW2INSDS	MLCom masked with 0x08
EW3INSDS	MLCom masked with 0x04

Related commands:

FlagInstrFail

3.3.8 FlagOBDHAcqMode

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMS1FS	0x0B (Nominal)	FlagOBDHAcqMode	0xFF00	0xC100	
YEWMS1FS	0x1B (Redundant)	FlagOBDHAcqMode	0xFF00	0xC100	

Purpose:

To inform DWP of the spacecraft OBDH acquisition mode in use from the next OBDH reset.

Constraints:

As part of the WEC/DWP switchon procedure, this command should be sent to DWP to establish the acquisition mode in use. If the OBDH acquisition mode known to DWP does not match the actual OBDH acquisition mode in use then the WEC science telemetry output will be garbage.

Description:

FlagOBDHAcqMode defines the number of interrogations in each OBDH frame. The switch to the new OBDH acquisition rate will occur on the next OBDH reset pulse.

DWP decodes the data to determine the OBDH acquisition mode according to the table given below**Error! Bookmark not defined.**.

Data value	OBDH Mode	Number of frames between OBDH resets	Frame size (words)
0x96	**NM1**	**10**	**168**
0x97	**NM2**	**10**	**168**
0x98	**NM3**	**10**	**168**
0x99	**BM1**	**62**	**228**
0x9A	**BM2**	**62**	**474**
0x9B	**BM3**	**62**	**153**

Decoding of FlagOBDHAcqMode function data

Upon receiving **FlagOBDHAcqMode**, DWP will immediately flush the DWP telemetry buffer and disable it. On the next OBDH reset pulse, the DWP telemetry buffer will be re-enabled. This prevents problems when switching from a high bit rate OBDH acquisition mode to a low bit rate mode but does cause the loss of a small amount of science telemetry if WEC instruments are operating at the time.

Housekeeping:

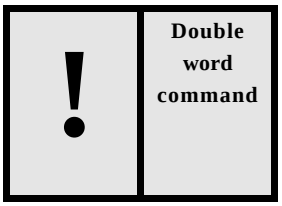
OBDH acquisition mode (AIT entry **EW5ACQMD**) will be set to the data bits of the command.

HK parameter	New value
EW5ACQMD	**Memory load masked with 0xFF**

Related commands:

None

3.3.9 LoadKernelMemory



AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWED3FS	**0x0B (Nominal)**	**LoadKernelMemory**	**0xFF00**	**0xF300**	
YEWED3FS	**0x1B (Redundant)**	**LoadKernelMemory**	**0xFF00**	**0xF300**	

Purpose:

Interprets following memory load commands as processor instructions and data to be written into kernel memory at contiguous locations starting at the address given in the **DWP memory write address pointer** (AIT entry **EW5MEMWR**).

Constraints:

The **DWPCommonCmd** telecommand must be transmitted immediately before **LoadKernelMemory** as this is a double word telecommand. It may be necessary to set the function data bits of **DWPCommonCmd** in some cases, see the command description below.

Great care must be taken not to overwrite segments of memory that are currently in use. This requires a detailed knowledge of DWP software, ref. [7].

Description:

DWP supports memory patching through the use of this instruction. The procedures for devising and implementing code patches are more fully described in ref. [7].

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Description
x																Ignored
	x															Ignored
		x	x													Ignored
				x	x	x	x	x	x	x	x	x	x	x	x	Size of code patch

Decoding of LoadKernelMemory function data

The least significant 12 bits of data specify the number of memory words (*n*) to be written to the RAM of the Processor Module running the kernel software. The next n memory load commands received by DWP after the **LoadKernelMemory** command will be written directly into the kernel processor RAM starting at the address specified by the **DWP memory write address pointer** (AIT entry **EW5MEMWR**).

IT IS IMPORTANT TO NOTE THAT THE N MEMORY LOAD COMMANDS TO BE WRITTEN INTO DWP RAM ARE NOT IN THE FORMAT THAT ALL OTHER MEMORY LOAD COMMANDS CONFORM TO IN THIS DOCUMENT.

To minimise the number of commands required, patches are normally loaded into DWP using just one memory load command for each 16 bit word to be loaded into memory. This approach was taken to halve the telemetry bandwidth requirements for uploading code patches that would have been required if double word commands were used. Therefore these words should be sent as a **DummyCommand**.

The command interface to DWP cannot be made transparent to all possible 16 bit command words, so in some cases the 16 bit words must be split into two bytes which are sent as parameters to two consecutive **ESCAPE** commands .

It is possible to upload an unlimited number of relocating patches for both kernel and application processors. DWP maintains a linked list of patches and relocation addresses, one list for the kernel processor and another for application processors.

Ideally a patch that is to be relocated should be uploaded into an area of DWP memory that will not be reused for another purpose during the planned operations. Otherwise, if a watchdog reset were to occur due to an SEU, DWP would attempt to relocate the patch again from the area of memory where the patch was originally uploaded, and this would no longer contain the original patch.

The normal DWP commanding rate constraints apply when loading software patches. In particular, not more than 16 commands may be sent in a burst at the maximum rate of one per 244 µs, and the average rate must not be greater than one per 30 ms. These constraints also apply to the other WEC instruments which can be patched (i.e. EFW and Staff SA).

Housekeeping:

As each memory load command is received the **DWP memory write address pointer** (AIT entry **EW5MEMWR**) is incremented to the next RAM location after the last word written.

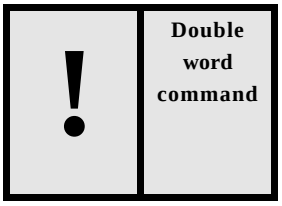
Telecommand assembly status will be set to zero to flag successful completion of assembly of the double word command.

HK parameter	New value
EW5TCASS	0

Related commands:

SetDWPMemWrite, ESCAPE, DummyCommand.

3.3.10 MacroLoad



AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWED0FS **YEWED0FS**	**0x0B (Nominal)** **0x1B (Redundant)**	**MacroLoad** **MacroLoad**	**0xFF00** **0xFF00**	**0xF000** **0xF000**	

Purpose:

To allow a new sequence of any number of macro commands to be loaded into the macro buffer at any position, overwriting the previous contents of that part of the buffer.

Constraints:

The **DWPCommonCmd** telecommand must be transmitted immediately before **MacroLoad** as this is a double word telecommand. It may be necessary to set the function data bits of **DWPCommonCmd** in some cases, see the command description below.

A new macro definition can only be loaded if no other macro is currently being executed.

Valid slot numbers are in the range 0 to 31. Each slot holds eight macro commands.

The DWP EM model handles this command slightly differently from the FM as described below.

Description:

MacroLoad(<slot offset>, <slot>) specifies a position in the macro buffer whose contents will be overwritten by a new macro sequence. All commands received up to but not including the next **SetMacroOps (END)** instruction (FM only, the EM stores the terminating **SetMacroOps(END)**) will be stored in the macro buffer starting from the slot offset of the slot specified.

MacroLoad allows the editing of a few commands at any point in a macro slot.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	Description
x	x	x	x	x	x											**Ignored**
						x	x	x	x							**Offset from base of macroslot**
										x	x	x	x	x	x	**Macro slot number**

Decoding of MacroLoad

Housekeeping:

MacroLoad(<slot offset>, <slot>) will set the **WEC mode macro loading** (AIT entry **EW5WECML**) field. **WEC mode macro offset** (AIT entry **EW5WECMO**) will be set to the <slot offset> parameter value. **WEC mode macro slot** (AIT entry **EW5WECMS**) will be set to

the <slot> parameter value. As the sequence of commands that are to be loaded are read by DWP, **WEC mode macro offset** will be incremented. When the offset reaches the size of the macro slot it is zeroed and **WEC mode macro slot** is incremented. If **WEC mode macro slot** becomes 32 (the number of slots) it is zeroed.

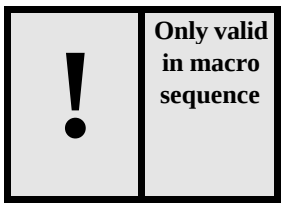
Telecommand assembly status will be set to zero to flag successful completion of assembly of the double word command.

HK parameter	New value
EW5TCASS	0
EW5WECML	1
EW5WECMO	Data masked with 0x03C0
EW5WECMS	Data masked with 0x003F

Related commands:

SetMacroOps

3.3.11 MacroSetCounter



AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMS6FS	0x0B (Nominal)	MacroSetCounter	0xFF00	0xC600	
YEWMS6FS	0x1B (Redundant)	MacroSetCounter	0xFF00	0xC600	

Purpose:

Allows the initialisation of one of the four macro counters in the range 1 to 64.

Constraints:

Must only be executed from within a DWP macro sequence.

Description:

7	6	5	4	3	2	1	0	Description
0	0							Select counter 0
0	1							Select counter 1
1	0							Select counter 2
1	1							Select counter 3
		0	0	0	0	0	0	Initialise selected counter to 1
		0	0	0	0	0	1	Initialise selected counter to 2
		0	0	0	0	1	0	Initialise selected counter to 3
		.	.	.	.	.	.	
		1	1	1	1	1	1	Initialise selected counter to 64

Decoding of MacroSetCounter data

Four counters are available. Each counter may be set in the range 1 to 64. The only other command that can read or modify the values of these counters is **MacroTestCounter**.

The use of the counters is described under **MacroTestCounter**.

Housekeeping:

If counter 0 is initialised, then **WEC Macro Counter 0** (AIT entry **EW5WECC0**) will be set to the value given.

Related commands:

MacroTestCounter

3.3.12 MacroTestCounter

!	**Only valid in macro sequence**

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMS7FS	0x0B (Nominal)	MacroTestCounter	0xFF00	0xC700	
YEWMS7FS	0x1B (Redundant)	MacroTestCounter	0xFF00	0xC700	

Purpose:

Allows conditional looping within macro sequences to implement limited repetition of commands in the DWP macro buffer.

Constraints:

Must only be executed from within a DWP macro sequence.

Description:

MacroTestCounter decrements the selected counter and then tests the new value. If the value is greater than zero then macro execution is transferred to an earlier point in the macro command buffer, determined by the jump offset parameter. An offset of up to 64 commands is allowed.

The **MacroTestCounter** command is not included when calculating the jump offset. Thus, a jump taken when the offset is specified as zero will transfer control to the command immediately before the **MacroTestCounter** command in the buffer. Jumps outside of the macro command buffer wrap around to an offset from the top of the macro buffer. For example, if a **MacroTestCounter** instruction with a jump offset of 20 is executed at word 10 in the 256 word macro, then the next executed instruction will be at macro buffer word 245.

7	6	5	4	3	2	1	0	Description
0	0							Select counter 0
0	1							Select counter 1
1	0							Select counter 2
1	1							Select counter 3
		0	0	0	0	0	0	Jump back 1 macro buffer command if selected counter is not zero
		0	0	0	0	0	1	Jump back 2 macro buffer commands if selected counter is not zero
		0	0	0	0	1	0	Jump back 3 macro buffer commands if selected counter is not zero
		.	.	.	.	.	.	.
		1	1	1	1	1	1	Jump back 64 macro buffer commands if selected counter is not zero

Decoding of MacroTestCounter

Housekeeping:

Execution of **MacroTestCounter** with counter 0 selected will update **WEC Macro Counter 0** (AIT entry **EW5WECC0**).

If a jump is taken, the new macro slot and offset from base of that slot will be reported in **WEC mode macro offset** (AIT entry **EW5WECMO**) and **WEC mode macro slot** (AIT entry **EW5WECMS**) fields.

Related commands:

MacroSetCounter, MacroWaitOrLoop

3.3.13 NOP

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMS5FS	0x0B (Nominal)	NOP	0xFF00	0xC500	
YEWMS5FS	0x1B (Redundant)	NOP	0xFF00	0xC500	

Purpose:

To enable testing of DWP commanding without changing the state of either the WEC instruments or DWP.

Constraints:

None

Description:

It allows the spacecraft to test the DWP reception of commands without changing the state of either DWP or the WEC.

Housekeeping:

None.

Related commands:

None

3.3.14 SetCorrDataProc

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMSDFS	0x0B (Nominal)	SetCorrDataProc	0xFF00	0xCD00	
YEWMSDFS	0x1B (Redundant)	SetCorrDataProc	0xFF00	0xCD00	

Purpose:

To control DWP auto-correlation of PEACE electron count activity.

Constraints:

A number of constraints must be met before correlator operations are permitted. These are:

i/ WBD data cannot be collected through DWP (parameter **Wideband data via DWP** must be zero),

ii/ The kernel processor must be running at full speed (the appropriate **DWP processor n configuration** parameter must be non-zero) and

iii/ An application processor must be available (appropriate **DWP processor n configuration** must be non-zero).

Description:

The DWP particle correlator takes raw electron detection pulses from the PEACE instrument and performs software auto-correlation functions (ACF) that are sorted and summed according to instantaneous PEACE selected energy.

SetCorrDataProc controls the selection of these energies and starts or stops correlator operations, as shown in the table below.

7	6	5	4	3	2	1	0	Description
0								High Load off
1								High Load on (R suffix)
	0	0	0					Normal Mode (COR0)
	0	0	1					High bit rate (COR4)
	0	1	0					Intermediate 1 (COR1)
	0	1	1					Intermediate 2 (COR2)
	1	0	0					Intermediate 3 (COR3)
	1	0	1					High bit rate
	1	1	0					High bit rate
	1	1	1					High bit rate
				x	x	x	x	Fixed Energy Level

Decoding of SetCorrDataProc

If all bits are given as zero then the correlator operations are stopped.

The **FlagExtExpStatus** command with correct data on spin and PEACE modes must be sent to DWP before beginning correlator operations.

Resolution	Normal bit rate	High bit rate
Bitrate	**136 bits/sec**	**2176 bits/sec**
Pre-selected energy time resolution	**4s**	**0.25s**
All other energies (14) time resolution	**56s**	**3.50s**
Angular resolution pre-selected energy	**none**	**22.5 degrees**
Frequency range	**0 – 41.6 kHz**	**0 – 41.6 kHz**
Frequency resolution	**1.3 kHz**	**1.3 kHz**

Correlator specifications

Housekeeping:

The data bits of the command will be used to update the **correlator control** (AIT entry **EW5PRCTL**) parameter.

HK parameter	New value
EW5PRCTL	**Data masked with 0xFFFF**

Related commands:

FlagExtExpStatus, SetMWFDataProc, SetWHDataProc, SetWBDDataProc.

3.3.15 MacroWait

!	**Only valid in macro sequence**

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMSEFS	**0x0B (Nominal)**	**MacroWait**	**0xFF00**	**0xCE00**	
YEWMSEFS	**0x1B (Redundant)**	**MacroWait**	**0xFF00**	**0xCE00**	

Purpose:

To provide a facility in macro command sequences for either timed delays and synchronisation to One Second Timing Boundaries (OSTBs) or unconditional branching to an earlier point in a macro sequence.

Constraints:

Must only be executed from within a DWP macro sequence.

Description:

The function required is selected by the most significant two bits of the operand. The least significant bits of the operand supply the parameter for that function.

7	6	5	4	3	2	1	0	Description
0	0							SHORT WAIT (seconds)
0	1							LONG WAIT (minutes)
1	0							undefined
1	1							JUMP
		x	x	x	x	x	x	Function parameter

Decoding of MacroWait command

MacroWait (SHORT_WAIT, <seconds>) prevents execution of commands after it in the macro sequence until the specified number of One Second Timing Boundaries (OSTBs) have occurred. The concept of OSTBs is discussed in WEC[2]. The number of OSTBs can be specified in the range 1 to 64. An operand with all bits clear specifies the value 1, and an operand with all bits set specifies the value 64.

MacroWait (LONG_WAIT, <minutes>) prevents execution of commands after it in the macro sequence until the specified number of OSTBs have occurred. The delay is set by adding one to the function parameter and multiplying by 60. This gives a delay ranging from 60 OSTBs (approximately one minute) to 3840 OSTBs (approximately 64 minutes). An operand with all bits clear specifies the value 60, and an operand with all bits set specifies the value 3840.

MacroWait (JUMP, <offset>) transfers macro execution to an earlier point in the macro command buffer. The number of commands to jump back ranges from 1 to 64. An operand with all bits clear specifies the value 1, and an operand with all bits set specifies the value 64. The **MacroWait** command is not included when calculating the jump offset. Thus, a jump taken when the offset is specified as zero will transfer control to the command immediately before the **MacroWait** command in the buffer. Jumps outside of the macro command buffer wrap around to an offset from the top of the macro buffer. For example, if a **MacroWait** instruction with a jump offset of 20 is executed at word 10 in the 256 word macro, then the next executed instruction will be at macro buffer word 245.

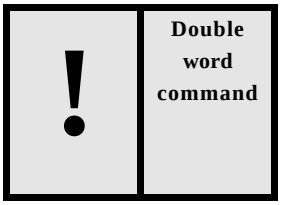
Housekeeping:

MacroWait (SHORT_WAIT) and **MacroWait (LONG_WAIT)** will not cause a change in the HK. **MacroWait (JUMP)** will set the **WEC mode macro offset** (AIT entry **EW5WECMO**) and the **WEC mode macro slot** (AIT entry **EW5WECMS**) fields to the new macro slot and offset within slot of the next macro command to be executed.

Related commands:

MacroTestCounter

3.3.16 SetDWPMemRead



AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWED1FS	**0x0B (Nominal)**	**SetDWPMemRead**	**0xFF00**	**0xF100**	
YEWED1FS	**0x1B (Redundant)**	**SetDWPMemRead**	**0xFF00**	**0xF100**	

Purpose:

Set the start address in kernel processor RAM for dumping of kernel memory contents in the WEC housekeeping.

Constraints:

The **DWPCommonCmd** telecommand must be transmitted immediately before **SetDWPMemRead** as this is a double word telecommand. It may be necessary to set the function data bits of **DWPCommonCmd** in some cases, see the command description below.

Only addresses in the kernel memory map are valid. Addresses must be specified as word addresses. Some words at the bottom of the memory map are reserved for transputer use (addresses less than 0x0012) and any address specified in this range will be automatically altered to 0x0012, ref. [7] for details of the DWP memory map.

Description:

The WEC housekeeping shows a dump of a portion of kernel memory. At DWP power on the MemRead pointer is set to 0x0012. After every WEC HK frame it is automatically incremented. **SetDWPMemReadAddr** allows the position of the kernel memory dump in the HK to be positioned in memory.

This command is only likely to be used for diagnostic purposes.

Housekeeping:

The **DWP memory read address pointer** (AIT entry **EW5MEMRD**) will be set to the address specified by the command in the next HK block following the command. In subsequent HK blocks, it will be incremented.

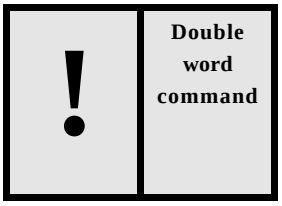
Telecommand assembly status will be set to zero to flag successful completion of assembly of the double word command.

HK parameter	New value
EW5MEMRD	Data masked with 0xFFFF
EW5TCASS	0

Related commands:

None.

3.3.17 SetDWPMemWrite



AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWED2FS	0x0B (Nominal)	SetDWPMemWrite	0xFF00	0xF200	
YEWED2FS	0x1B (Redundant)	SetDWPMemWrite	0xFF00	0xF200	

Purpose:

Set the start address in kernel processor RAM for overwriting of kernel memory contents. New code and/or coefficients can then be uploaded into the DWP kernel using **LoadKernelMemory**.

Constraints:

The **DWPCommondCmd** telecommand must be transmitted immediately before **SetDWPMemWrite** as this is a double word telecommand. It may be necessary to set the function data bits of **DWPCommonCmd** in some cases, see the command description below.

Only addresses in the kernel memory map are valid. Addresses must be specified as word addresses. Some words at the bottom of the memory map are reserved for transputer use (addresses less than 0x0012) and any address specified in this range will be automatically altered to 0x0012. Ref. [7] for details of the DWP memory map.

Description:

At DWP power on the **DWPMemWrite** pointer is set to 0x0012. **SetDWPMemWrite** allows this address to be changed.

This command should only be used in preparation for uploading either code or data patches, ref. [7] and section 3.5 for full details of procedures.

Housekeeping:

The **DWP memory write address pointer** (AIT entry **EW5MEMWR**) will be set to the address specified by the command.

Telecommand assembly status will be set to zero to flag successful completion of assembly of the double word command.

HK parameter	New value
EW5MEMWR	Data masked with 0xFFFF
EW5TCASS	0

Related commands:

LoadKernelMemory.

3.3.18 SetEFWComLSB

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWWS0FS	0x0B (Nominal)	SetEFWComLSB	0xFF00	0x0000	
YEWWS0FS	0x1B (Redundant)	SetEFWComLSB	0xFF00	0x0000	

Purpose:

Set LSB of EFW command holding register in DWP.

Constraints:

None.

Description:

EFW cmd reg LSB will be updated to the value of the function data of **SetEFWComLSB**.

The contents of the EFW command holding register in DWP will not be transmitted to EFW until either **SetEFWComLSBTx** or **SetEFWComMSBTx** is received by DWP.

When EFW power off is commanded, DWP sets **EFW cmd reg LSB** to zero.

Reference section 3.2 for details of EFW commands and protocols.

Housekeeping:

EFW cmd reg LSB, **EFW cmd reg MSB.**

HK parameter	New value
EW0CREGL	Memory load bit pattern masked with 0xFF

Related commands:

SetEFWComMSB, **SetEFWComLSBTx**, **SetEFWComMSBTx**.

3.3.19 SetEFWComLSBTx

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWWS8FS	0x0B (Nominal)	SetEFWComLSBTx	0xFF00	0x0800	
YEWWS8FS	0x1B (Redundant)	SetEFWComLSBTx	0xFF00	0x0800	

Purpose:

Sets LSB of EFW command holding register in DWP. If EFW is active, the command holding register is transmitted to EFW, otherwise the **WECErrorInstNotReady** error condition is flagged.

Constraints:

If EFW is not active when this command is received, the **WECErrorInstNotReady** error condition is flagged in the next WEC HK block.

Description:

Sets LSB of EFW command holding register in DWP, given by the **EFW cmd reg LSB** parameter. If EFW is active, the command holding register is transmitted to EFW, otherwise the **WECErrorInstNotReady** error condition is flagged.

EFW cmd reg LSB will be updated to the value of the function data of **SetEFWComLSBTx**.

When EFW power off is commanded, DWP sets the default value of **EFW cmd reg LSB** to zero.

Reference section 3.2 for details of EFW commands and protocols.

Housekeeping:

EFW cmd reg LSB, **EFW cmd reg MSB.**

EFW fast digital monitor (AIT entry **EW0FDMF**) will be updated depending on the EFW command sent, ref. section 3.2.

HK parameter	New value
EW0CREGL	Memory load bit pattern masked with 0xFF

Related commands:

SetEFWComLSB, **SetEFWComMSB**, **SetEFWComMSBTx**.

3.3.20 SetEFWComMSB

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWWS1FS YEWWS1FS	0x0B (Nominal) 0x1B (Redundant)	SetEFWComMSB SetEFWComMSB	0xFF00 0xFF00	0x0100 0x0100	

Purpose:

Set MSB of EFW command holding register in DWP.

Constraints:

None.

Description:

EFW cmd reg LSB will be updated to the value of the function data of **SetEFWComMSB**.

The contents of the EFW command holding register in DWP will not be transmitted to EFW until either **SetEFWComLSBTx** or **SetEFWComMSBTx** is received by DWP.

When EFW power off is commanded, DWP sets **EFW cmd reg MSB** to zero.

Reference section 3.2 for details of EFW commands and protocols.

Housekeeping:

EFW cmd reg LSB, **EFW cmd reg MSB.**

HK parameter	New value
EW0CREGM	Memory load bit pattern masked with 0xFF

Related commands:

SetEFWComLSB, **SetEFWComLSBTx**, **SetEFWComMSBTx**.

3.3.21 SetEFWComMSBTx

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWWS9FS YEWWS9FS	0x0B (Nominal) 0x1B (Redundant)	SetEFWComMSBTx SetEFWComMSBTx	0xFF00 0xFF00	0x0900 0x0900	

Purpose:

Sets MSB of EFW command holding register in DWP. If EFW is active, the command holding register is transmitted to EFW, otherwise the **WECErrorInstNotReady** error condition is flagged.

Constraints:

If EFW is not active when this command is received, the **WECErrorInstNotReady** error condition is flagged in the next WEC HK block.

Description:

Sets MSB of EFW command holding register in DWP, given by the **EFW cmd reg MSB** parameter. If EFW is active, the command holding register is transmitted to EFW, otherwise the **WECErrorInstNotReady** error condition is flagged.

EFW cmd reg MSB will be updated to the value of the function data of **SetEFWComMSBTx**.

When EFW power off is commanded, DWP sets the default value of **EFW cmd reg MSB** to zero.

Reference section 3.2 for details of EFW commands and protocols.

Housekeeping

EFW cmd reg LSB, **EFW cmd reg MSB.**

EFW fast digital monitor (AIT entry **EW0FDMF**)will be updated depending on the EFW command sent (Reference EFW[3]).

HK parameter	New value
EW0CREGM	Memory load bit pattern masked with 0xFF

Related commands:

SetEFWComLSB, **SetEFWComMSB**, **SetEFWComLSBTx**.

3.3.22 SetEFWTapeMode

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWWS2FS YEWWS2FS	0x0B (Nominal) 0x1B (Redundant)	SetEFWTapeMode SetEFWTapeMode	0xFF00 0xFF00	0x0200 0x0200	

Purpose:

Selects which of the three EFW tape modes will be commanded by DWP when the WECSS frequency is changed to 450 Hz with the **SetWECClock** command.

Constraints:

SetEFWTapeMode should not be commanded when an EFW tape mode is already running.

Description:

Only the patterns in the table below are permissible, ref. [2]. Any other pattern will generate a **EFW bad tape mode command** error in the WEC HK.

Parameter	Tape Mode Selected
0xF1	Tape mode 1
0xF2	Tape mode 2
0xF3	Tape mode 3

Valid EFW tape modes

When EFW power off is commanded, DWP sets the default tape mode to 0xF1.

Housekeeping:

No change.

Related commands:

SetWECClock.

3.3.23 SetEFWTestSeq

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWWS5FS YEWWS5FS	0x0B (Nominal) 0x1B (Redundant)	SetEFWTestSeq SetEFWTestSeq	0xFF00 0xFF00	0x0500 0x0500	

Purpose:

Sets the EFW test sequence register in DWP.

Constraints:

The test sequence number selected is masked with 0x0007 by DWP. Thus only test sequence numbers in the range 0 to 7 are valid.

Description:

The value of the test sequence register is reported as **EFW test sequence number** in the WEC HK.

When EFW power off is commanded, DWP resets the test sequence register to zero.

The **EFW Tape modes** enables the EFW instrument to capture short bursts of higher resolution data. ref.[2,3].

Housekeeping:

EFW test sequence number (AIT entry **EW0TSEQN**) will be set to the test sequence number.

HK parameter	New value
EW0TSEQN	Memory load bit pattern masked with 0x07

Related commands:

None.

3.3.24 SetEFWWinPos

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWWS6FS	**0x0B (Nominal)**	**SetEFWWinPos**	**0xFF00**	**0x0600**	
YEWWS6FS	**0x1B (Redundant)**	**SetEFWWinPos**	**0xFF00**	**0x0600**	

Purpose:

Sets the position of an eight byte window in EFW telemetry or digital sub-com table. The position of the window is specified as an offset in bytes from the start of an EFW telemetry packet. The contents of the window are reported as **EFW sliding window bytes** in the WEC HK.

Constraints:

In the EFW tape modes, when ten packets of data are received by DWP after each OSTB, the window can only be positioned in the first of the telemetry packets.

The window position must be selected so that no part of the window is outside an EFW telemetry packet.

Description:

When EFW power off is commanded, DWP sets the window position to byte 84.

If the least significant bit of the parameter is zero, the window is positioned within the EFW telemetry packet at a word (two byte) offset specified by the remaining parameter bits.

If the least significant bit of the parameter is one, the window is positioned within the EFW digital sub-com table on a 8 byte boundary specified by parameter bits 3 to 7.

Housekeeping:

EFW sliding window position (AIT entry **EW0SLWP**) will be set to the position selected.

HK parameter	New value
EW0SLWP	**Memory load bit pattern masked with 0xFF**

Related commands:

None.

3.3.25 SetInstrPower

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMS2FS	0x0B (Nominal)	SetInstrPower	0xFF00	0xC200	
YEWMS2FS	0x1B (Redundant)	SetInstrPower	0xFF00	0xC200	

Purpose:

To drive the WEC PWR unit relays to turn WEC instruments either on or off. Alternatively, an instrument may be reset without being powered off, or for STAFF SC only the telemetry data may be disabled whilst the power remains on.

Constraints:

When more than one WEC instrument is to be turned on, a delay of 30 ms must be allowed after turning on an instrument, before turning on the next. This is to minimise instantaneous current demands on WEC PWR.

Description:

The function data of the **SetInstrPower** command is decoded as shown in the table below.

7	6	5	4	3	2	1	0	Description
x	x							Power control function selected
		x	x	x				Ignored
					x	x	x	Instrument selected

Decoding of SetInstrPower command

The action that DWP takes after receiving **SetInstrPower** depends upon the current powered state of the instrument, and the requested control action**.** It also depends on if the instrument has been flagged as failed, see **SetInstrFailed** command. If failed attempts to power on the instrument will be ignored.

7	6	Current power status	Action taken with selected instrument
0	0	OFF	OFF relay driven
		ON	Instrument and interface are reset and OFF relay driven
0	1	OFF	ON relay driven, instrument and interface are reset
		ON	ON relay driven, instrument and interface are reset.
1	0	OFF	Illegal – do not use
		ON	Instrument and interface are reset
1	1	OFF	Illegal – do not use
		ON	STAFF SC only – data disabled

Decoding of power control function bits

2	1	0	Instrument selection
0	0	0	EFW
0	0	1	STAFF SA
0	1	0	STAFF MWF
0	1	1	WHISPER
1	0	0	WIDEBAND
1	0	1	WHISPER Tx
1	1	x	Ignored

Decoding of instrument selection

When an instrument is either powered on or reset, DWP initialises the kernel software controlling the instrument interface. When an instrument is powered off DWP sets all interface control parameters to their default values.

Housekeeping:

The fields of the HK affected by the change will be determined by the instrument selected. The table below shows which AIT entries may be affected for each of the possible instrument selections.

Description	Power status	Relay cycles	Voltage monitors
EFW	EW0PWRST	EW0RLCYC	n/a
STAFF SA	EW1PWRST	EW1RLCYC	EW1VMON0
			EW1VMON1
			EW1VMON2
STAFF MWF	EW2PWRST	EW2RLCYC	EW2VMON0
			EW2VMON1
			EW2VMON2
			EW2VMON3
WHISPER	EW3PWRST	EW3RLCYC	n/a
WIDEBAND	EW4PWRST	EW4RLCYC	EW4VMON0
WHISPER Tx	EW3TXPST	EW3RLCYC	n/a

Mapping of instrument selection to housekeeping parameters

When the selected instrument is powered on, the count of relay cycles for that instrument will be incremented. The voltage monitors (if any) for that instrument should rise to nominal levels after a delay.

Related commands:

SetInstrFail.

3.3.26 SetMacroOps

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMSFFS	**0x0B (Nominal)**	**SetMacroOps**	**0xFF00**	**0xCF00**	
YEWMSFFS	**0x1B (Redundant)**	**SetMacroOps**	**0xFF00**	**0xCF00**	

Purpose:

To provide overall control for macro operations. Macro sequences may be loaded, executed or terminated.

Constraints:

A new macro definition can only be loaded if no macro is currently being executed (i.e. the **WEC macro loading** field (AIT entry **EW5WECML**) must be zero).

Description:

The function required is selected by the most significant two bits of the operand. The least significant bits of the operand supply the parameter for that function.

7	6	5	4	3	2	1	0	Description
0	**0**							**CALL macro**
0	**1**							**LOAD macro**
1	**0**							**END macro**
1	**1**							**RETURN from macro subroutine (FM only)**
		x	**x**	**x**	**x**	**x**	**x**	**Function parameter**

Decoding of SetMacroOps command

SetMacroOps(CALL, <slot>) allows a telecommand to execute the macro sequence in the specified macro slot. Valid slot numbers are in the range 0 to 31. Each slot holds eight macro commands. The execution of the first instruction is delayed until the next One Second Timing Boundary (OSTB). If a macro is already executing, a subroutine call is made to the specified macro without waiting for an OSTB (FM only, the EM will set the **Telecommand illegal whilst macro exec** HK field (AIT entry **EW5TIWME**)). The return address stack has only 4 elements so subroutine calls are restricted to a maximum depth of 4 from the top level of an executing macro.

SetMacroOps(LOAD, <slot>) specifies a macro slot in the function parameter whose contents will be overwritten by a new macro sequence. All commands received up to but not including the next **SetMacroOps(END)** instruction (FM only, the EM stores the terminating **SetMacroOps(END)**) will be stored in the macro buffer starting from the first command of the slot specified.

SetMacroOps(END) may be sent at any time a macro is executing, and will terminate execution of that macro immediately, even if a subroutine call is in progress. If macro loading is in progress

(the **WEC macro loading** field (AIT entry **EW5WECML**) is set) then the load sequence will be terminated and the **WEC macro loading** field cleared to zero.

SetMacroOps(RETURN) is only available in the DWP FM. It must not be used in the DWP EM. **SetMacroOps(RETURN)** must be stored in the macro buffer at the end of every macro sequence that does not loop indefinitely. Its action is to pop the return address of the address stack and to move macro execution to that point. If the return address stack is empty, macro execution terminates.

Housekeeping:

SetMacroOps(CALL, <slot>) will set the **WEC mode macro executing** (AIT entry **EW5WECMX**) field. **WEC mode macro offset** (AIT entry **EW5WECMO**) will be set to zero. **WEC mode macro slot** (AIT entry **EW5WECMS**) will be set to the <slot> parameter value.

HK parameter	New value
EW5WECML	0
EW5WECMX	1
EW5WECMO	0
EW5WECMS	MLCom masked with 0x3F

SetMacroOps(LOAD, <slot>) will set the **WEC mode macro loading** (AIT entry **EW5WECML**) field. **WEC mode macro offset** (AIT entry **EW5WECMO**) will be set to zero. **WEC mode macro slot** (AIT entry **EW5WECMS**) will be set to the <slot> parameter value. As the sequence of commands that are to be loaded are read by DWP, **WEC mode macro offset** will be incremented. When the offset reaches the size of the macro slot it is zeroed and **WEC mode macro slot** is incremented. If **WEC mode macro slot** becomes 32 (the number of slots) it is zeroed.

HK parameter	New value
EW5WECML	1
EW5WECMX	0
EW5WECMO	0
EW5WECMS	MLCom masked with 0x3F

SetMacroOps(END) will clear the **WEC mode macro executing** (AIT entry **EW5WECML**) field and the **WEC mode macro loading** (AIT entry **EW5WECML**) field.

HK parameter	New value
EW5WECML	**0**
EW5WECMX	**0**

SetMacroOps(RETURN) will clear the **WEC mode macro executing** (AIT entry **EW5WECML**) field if the return address stack is empty. Otherwise the **WEC mode macro offset** (AIT entry **EW5WECMO**) and the **WEC mode macro slot** (AIT entry **EW5WECMS**) will be set to value on the return address stack.

Related commands:

MacroLoad

3.3.27 SetMWFDataProc

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMSAFS	**0x0B (Nominal)**	**SetMWFDataProc**	**0xFF00**	**0xCA00**	
YEWMSAFS	**0x1B (Redundant)**	**SetMWFDataProc**	**0xFF00**	**0xCA00**	

Purpose:

To define DWP processing required on STAFF MWF data.

Constraints:

This command requires at least one DWP application processor to powered to perform the processing. If no application processor is available DWP will set the **DWP no processor for application task** parameter in the WEC housekeeping and not perform any processing of MWF data.

Description:

A non-zero value in the function data of **SetMWFDataProc** means that compression of STAFF data is required. This compression must execute on a DWP application transputer.

7	6	5	4	3	2	1	0	Description
x	**x**	**x**	**x**	**x**	**x**			**Ignored**
						0	**0**	**No application processing**
						x	**1**	**Backup algorithm**
						1	**0**	**Nominal algorithm**

Decoding of SetMacroOps command

Two algorithms are available, nominal and backup. Both algorithms are based on taking the differences between consecutive samples and compressing these rather than the field measurements themselves. Each algorithm outputs the same quantity of data but the backup algorithm uses a different encoding method that allows greater dynamic range in the data but slightly larger encoding errors, ref. [6].

Housekeeping:

The data bits of the command will be used to update the **STAFF MWF processing control** (AIT entry **EW2PRCTL**) field.

HK parameter	New value
EW2PRCTL	Memory load bit pattern masked with 0xFF

Related commands:

SetWHDataProc, SetWBDDataProc, SetCorrDataProc.

3.3.28 SetSACom

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWAS0FS	0x0B (Nominal)	SetSACom	0xF000	0x2000	
YEWAS0FS	0x1B (Redundant)	SetSACom	0xF000	0x2000	

Purpose:

Allows commands to be relayed through DWP to SA.

Constraints:

DWP provides no mechanism for setting the top 4 bits of the 16 bit SA command word, ref. [2]. These bits are always assumed to be zero by the SA instrument in any case.

If SA is active, the command holding register is transmitted to SA, otherwise the **WECErrorInstNotReady** error condition is flagged in the WEC HK.

Description:

See section 3.2 and ref. [2] for a description of SA commands and protocols.

Housekeeping:

If the Staff SA 'do analysis' function is selected with this command, the **Staff SA analysis mode** (AIT entry **EW1AMODE**) will change to the selected mode.

Other STAFF SA functions do not change the HK.

Related commands:

None.

3.3.29 SetWBDDataPath

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWDS4FS YEWDS4FS	0x0B (Nominal) 0x1B (Redundant)	SetWBDDataPath SetWBDDataPath	0xFF00 0xFF00	0x8400 0x8400	

Purpose:

The command data to this command selects whether WBD data will either be output to DWP or directly to the spacecraft.

Constraints:

WBD data can only be read by DWP when the WHISPER instrument is powered off.

Description:

The **WBD processing control** parameter should be initialised with **SetWBDDataProc** before routing WBD data through DWP.

The WBD instrument has a direct connection to the spacecraft OBDH interface for the output of telemetry data, see section 2.1. This is its default data path. If **SetWBDDataPath** is transmitted to DWP with non-zero function data, DWP will start to acquire WBD telemetry data. The processing done on this data depends on the **WBD processing control** parameter.

Function data	WBD data path
0	Direct WBD to OBDH
not 0	WBD to DWP

Decoding of SetWBDDataPath function data

When WBD power off is commanded, DWP sets the default data path to zero (WBD direct to spacecraft).

Housekeeping:

Wideband data via DWP will be set if the function data is non-zero and cleared if the function data is zero.

Related commands:

SetWBDDataProc.

3.3.30 SetWBDDataProc

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMSCFS	0x0B (Nominal)	SetWBDDataProc	0xFF00	0xCC00	
YEWMSCFS	0x1B (Redundant)	SetWBDDataProc	0xFF00	0xCC00	

Purpose:

To define DWP processing required on WBD data.

Constraints:

Two application processors running at full power are required for DWP to perform WBD filtering. If a **SetWBDDataProc** command is received with an operand to select digital filtering of WIDEBAND data when sufficient application power is not available, the **DWP no processor for application task** parameter will be set in the WEC housekeeping and the operand will be ignored.

Description:

Normally the WIDEBAND data is routed via the WIDEBAND OBDH interface directly to the spacecraft and not to DWP. However, when WIDEBAND data is to be transmitted to the tape recorder, it is output to DWP, this is controlled by the **SetWBDDataPath** command. The operand of **SetWBDDataProc** defines the processing that DWP will perform on the data before outputting to the DWP OBDH.

The raw bit rate from WIDEBAND is much greater than that available on the OBDH interface. The **SetWBDDataProc** operand allows the selection of one of two options to reduce this bit rate according to the table below.

Function data	DWP processing of WBD data
0 **not 0**	**Emergency mode, 1 in 3 packets selected by kernel software for output** **Digital filtering and output of all WBD data using two full speed application processors**

Decoding of SetWBDDataPath function data

The option that should be used whenever two full speed application processors are available is the digital filter to reduce the data rate by a factor of three. Otherwise, the DWP kernel processor will simply throw away two out of the three packets it receives from WIDEBAND, and output one in three of the raw packets to the OBDH.

Housekeeping:

The data bits of the command will be used to update the **WBD processing control** (AIT entry **EW4PRCTL**) field.

HK parameter	New value
EW4PRCTL	Memory load bit pattern masked with 0xFF

Related commands:

SetMWFDataProc, SetWHDataProc, SetCorrDataProc, SetWBDDataPath.

3.3.31 SetWBDGUP

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWDS2FS YEWDS2FS	0x0B (Nominal) 0x1B (Redundant)	SetWBDGUP SetWBDGUP	0xFF00 0xFF00	0x8200 0x8200	

Purpose:

The data to this command specifies the period of the gain update clock in steps of 100 ms from a minimum of 100 ms.

Constraints:

The gain update clock period is constrained between 100 ms and 25.6 seconds.

Description:

The period of the GUP clock is derived by the expression:

Period (ms) = (Data + 1) * 100

When WBD power off is commanded, DWP sets the default period of the gain update clock to 100 ms (10 Hz).

Housekeeping:

No change.

Related commands:

None.

3.3.32 SetWBDComLSB

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWDS0FS	**0x0B (Nominal)**	**SetWBDComLSB**	**0xFF00**	**0x8000**	
YEWDS0FS	**0x1B (Redundant)**	**SetWBDComLSB**	**0xFF00**	**0x8000**	

Purpose:

Set LSB of WBD command holding register in DWP.

Constraints:

None.

Description:

WBD cmd reg LSB will be updated to the value of the function data of **SetWBDComLSB**.

The contents of the WBD command holding register in DWP will not be transmitted to WBD until either **SetWBDComLSBTx** or **SetWBDComMSBTx** is received by DWP.

When WBD power off is commanded, DWP sets **WBD cmd reg LSB** to zero.

Reference section 3.2 for details of WBD commands and protocols.

Housekeeping:

WBD cmd reg LSB, **WBD cmd reg MSB.**

HK parameter	New value
EW4CREGL	Memory load bit pattern masked with 0xFF

Related commands:

SetWBDComMSB, **SetWBDComLSBTx**, **SetWBDComMSBTx**.

3.3.33 SetWBDComLSBTx

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWDS8FS	0x0B (Nominal)	SetWBDComLSBTx	0xFF00	0x8800	
YEWDS8FS	0x1B (Redundant)	SetWBDComLSBTx	0xFF00	0x8800	

Purpose:

Sets LSB of WBD command holding register in DWP. If WBD is active, the command holding register is transmitted to WBD, otherwise the **WECErrorInstNotReady** error condition is flagged.

Constraints:

If WBD is not active when this command is received, the **WECErrorInstNotReady** error condition is flagged in the next WEC HK block.

Description:

Sets LSB of WBD command holding register in DWP, given by the **WBD cmd reg LSB** parameter. If WBD is active, the command holding register is transmitted to WBD, otherwise the **WECErrorInstNotReady** error condition is flagged.

WBD cmd reg LSB will be updated to the value of the function data of **SetWBDComLSBTx**.

When WBD power off is commanded, DWP sets the default value of **WBD cmd reg LSB** to zero.

Reference section 3.2 for details of WBD commands and protocols.

Housekeeping:

WBD cmd reg LSB, WBD cmd reg MSB.

HK parameter	New value
EW4CREGL	Memory load bit pattern masked with 0xFF

Related commands:

SetWBDComLSB, **SetWBDComMSB**, **SetWBDComMSBTx**.

3.3.34 SetWBDComMSB

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWDS1FS YEWDS1FS	0x0B (Nominal) 0x1B (Redundant)	SetWBDComMSB SetWBDComMSB	0xFF00 0xFF00	0x8100 0x8100	

Purpose:

Set MSB of WBD command holding register in DWP.

Constraints:

None.

Description:

WBD cmd reg MSB will be updated to the value of the function data of **SetWBDComMSB**.

The contents of the WBD command holding register in DWP will not be transmitted to WBD until either **SetWBDComLSBTx** or **SetWBDComMSBTx** is received by DWP.

When WBD power off is commanded, DWP sets **WBD cmd reg MSB** to zero.

Reference section 3.2 for details of WBD commands and protocols.

Housekeeping:

WBD cmd reg LSB, **WBD cmd reg MSB.**

HK parameter	New value
EW4CREGM	Memory load bit pattern masked with 0xFF

Related commands:

SetWBDComLSB, **SetWBDComLSBTx**, **SetWBDComMSBTx**.

3.3.35 SetWBDComMSBTx

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWDS9FS	0x0B (Nominal)	SetWBDComMSBTx	0xFF00	0x8900	
YEWDS9FS	0x1B (Redundant)	SetWBDComMSBTx	0xFF00	0x8900	

Purpose:

Sets MSB of WBD command holding register in DWP. If WBD is active, the command holding register is transmitted to WBD, otherwise the **WECErrorInstNotReady** error condition is flagged.

Constraints:

If WBD is not active when this command is received, the **WECErrorInstNotReady** error condition is flagged in the next WEC HK block.

Description:

Sets MSB of WBD command holding register in DWP, given by the **WBD cmd reg MSB** parameter. If WBD is active, the command holding register is transmitted to WBD, otherwise the **WECErrorInstNotReady** error condition is flagged.

WBD cmd reg MSB will be updated to the value of the function data of **SetWBDComMSBTx**.

When WBD power off is commanded, DWP sets the default value of **WBD cmd reg MSB** to zero.

Reference section 3.2 for details of WBD commands and protocols.

Housekeeping:

WBD cmd reg LSB, **WBD cmd reg MSB.**

HK parameter	New value
EW4CREGM	Memory load bit pattern masked with 0xFF

Related commands:

SetWBDComLSB, **SetWBDComMSB**, **SetWBDComLSBTx**.

3.3.36 SetWECClock

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMS0FS	**0x0B (Nominal)**	**SetWECClock**	**0xFF00**	**0xC000**	
YEWMS0FS	**0x1B (Redundant)**	**SetWECClock**	**0xFF00**	**0xC000**	

Purpose:

To select WECSS frequency of either 25 Hz or 450 Hz, and to over-ride the automatic selection of either crystal or software generation of the internal DWP clock that produces the WECSS.

Constraints:

The WECSS frequency will not be changed until the start of the next OSTB. The required EFW tape mode should be selected using **SetEFWTapeMode** before sending **SetWECClock** to change the WECSS clock from 25 Hz to 450 Hz.

To avoid disturbing the selected master clock source when changing the WECSS frequency, the DWP master clock origin bits should be set to the 'No change' pattern.

To avoid disturbing the current WEC sample sync frequency when changing the master clock origin, the WECSS frequency bits should be set to the 'No change' pattern.

Description:

The decoding of the function data for **SetWECClock** is shown in the table.

7	6	5	4	3	2	1	0	Description
x	**x**	**x**	**x**					**Ignored**
				x	**x**			**WEC sample sync frequency**
						x	**x**	**DWP master clock origin**

Decoding of SetMacroOps command

The DWP master clock is driven by a crystal oscillator on DWP and is divided down by the DWP kernel software to generate the WEC sample clock and WHISPER SampleSync signals required to synchronise sampling by the WEC instruments. The WEC sample clock is supplied to EFW as the signal SamClock and to STAFF MWF as the signal SaH, ref. WEC[1].

These sampling signals can be driven at either 25 Hz or 450 Hz, the selection is made with the function data of the **SetWECClock** command as shown in the table below. The change will take affect at the next OSTB.

3	2	WEC sample clock frequency
0	0	No change
0	1	25 Hz
1	0	450 Hz
1	1	No change

Selection of WEC sample clock frequency from function data of SetWECClock.

In the event that DWP detects the failure of this crystal during reset initialisation (ref. description of **DWP master clock generation parameter**), DWP will generate the WEC sample clock and WHISPER SampleSync signals from a transputer timer. The high frequency signal ADClock to EFW can no longer be driven.

The DWP master clock origin bits of **SetWECClock** provide a manual over-ride for the selection of generation of the DWP master clock made during DWP reset initialisation as shown in the table below.

1	0	DWP master clock origin
0	0	No change
0	1	Crystal
1	0	Software
1	1	No change

Selection of DWP master clock origin from function data of SetWECClock.

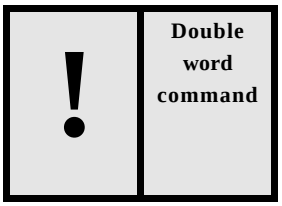
Housekeeping:

WEC sample clock frequency (AIT entry **EW5SCFRQ**) and **DWP master clock generation** (AIT entry **EW5MCSRC**) may change depending on the data bits of the command.

Related commands:

SetEFWTapeMode

3.3.37 SetWECPwrLimit



AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWED5FS	**0x0B (Nominal)**	**SetWECPwrLimit**	**0xFF00**	**0xF500**	
YEWED5FS	**0x1B (Redundant)**	**SetWECPwrLimit**	**0xFF00**	**0xF500**	

Purpose:

To set the threshold value for the total WEC power above which limit DWP would command off all instruments.

Constraints:

The **DWPCommonCmd** telecommand must be transmitted immediately before **SetWECPwrLimit** as this is a double word telecommand. It may be necessary to set the function data bits of **DWPCommonCmd** in some cases, see the command description below.

Description:

As this is a double word telecommand, bits 0 to 7 of the data come from the function data field of **SetWECPwrLimit** and bits 8 to 15 come from the function data field of **DWPCommonCmd**.

Bits 0 to 7 specify the power threshold (see calibration curve for the **WEC current sense** parameter, but 0.7A is approximately 0xF0, the default value).

Bit 15 if set to 1 specifies that the check should be disabled. The default value is bit 15 is 0, the check is enabled

Housekeeping:

WEC current limit will be set to the function data bits of this command.

Telecommand assembly status will be set to zero to flag successful completion of assembly of the double word command.

HK parameter	New value
EW5TCASS	**0**
EW5PWRLT	**Memory load bit pattern masked with 0xFF**

Related commands:

None.

3.3.38 SetWHCom0

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWRS0FS	0x0B (Nominal)	SetWHCom0	0xFF00	0x6000	
YEWRS0FS	0x1B (Redundant)	SetWHCom0	0xFF00	0x6000	

Purpose:

Set byte 0 of WHISPER command holding register in DWP.

Constraints:

None.

Description:

Whisper cmd reg 0 will be updated to the value of the function data of **SetWHCom0**.

The contents of the WHISPER command holding register in DWP will not be transmitted to WHISPER until either **SetWHCom0Tx, SetWHCom1Tx, SetWHCom2Tx** or **SetWHCom3Tx** is received by DWP.

Reference section 3.2 for details of WHISPER commands and modes.

When WHISPER power off is commanded, DWP sets **Whisper cmd reg 0** to the value specified by WHISPER, ref. section 3.2.

Housekeeping:

Whisper cmd reg 0, **Whisper cmd reg 1, Whisper cmd reg 2, Whisper cmd reg 3.**

HK parameter	New value
EW3CREG0	Memory load bit pattern masked with 0xFF

Related commands:

SetWHCom1, SetWHCom2 SetWHCom3, SetWHCom0Tx, SetWHCom1Tx, SetWHCom2Tx, SetWHCom3Tx.

3.3.39 SetWHCom0Tx

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWRS8FS **YEWRS8FS**	**0x0B (Nominal)** **0x1B (Redundant)**	**SetWHCom0Tx** **SetWHCom0Tx**	**0xFF00** **0xFF00**	**0x6800** **0x6800**	

Purpose:

Set byte 0 of WHISPER command holding register in DWP. If WHISPER is active, the command holding register is transmitted to WHISPER, otherwise the **WECErrorInstNotReady** error condition is flagged.

Constraints:

If WHISPER is not active when this command is received, the **WECErrorInstNotReady** error condition is flagged in the next WEC HK block.

Description:

Sets byte 0 of the WHISPER command holding register in DWP, given by the **Whisper cmd reg 0** parameter. If WHISPER is active, the command holding register is transmitted to WHISPER, otherwise the **WECErrorInstNotReady** error condition is flagged.

WHISPER cmd reg 0 will be updated to the value of the function data of **SetWHCom0Tx**.

When WHISPER power off is commanded, DWP sets the default value of **WHISPER cmd reg 0** to the value specified by WHISPER, ref. section 3.2.

Reference section 3.2 for details of WHISPER commands and protocols.

Housekeeping

Whisper cmd reg 0, **Whisper cmd reg 1, Whisper cmd reg 2, Whisper cmd reg 3.**

Whisper command word echo (AIT entry **EW3WCWE**) should change to the command sent from the WHISPER command holding register when the first frame of telemetry has been read from WHISPER. Reference [4] for the exact format of this data.

HK parameter	New value
EW3CREG0	**Memory load bit pattern masked with 0xFF**

Related commands:

SetWHCom0, SetWHCom1 SetWHCom2, SetWHCom3, SetWHCom1Tx, SetWHCom2Tx, SetWHCom3Tx.

3.3.40 SetWHCom1

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWRS1FS	0x0B (Nominal)	SetWHCom1	0xFF00	0x6100	
YEWRS1FS	0x1B (Redundant)	SetWHCom1	0xFF00	0x6100	

Purpose:

Set byte 1 of WHISPER command holding register in DWP.

Constraints:

None.

Description:

Whisper cmd reg 1 will be updated to the value of the function data of **SetWHCom1**.

The contents of the WHISPER command holding register in DWP will not be transmitted to WHISPER until either **SetWHCom0Tx, SetWHCom1Tx, SetWHCom2Tx** or **SetWHCom3Tx** is received by DWP.

Reference section 3.2 for details of WHISPER commands and modes.

When WHISPER power off is commanded, DWP sets **Whisper cmd reg 1** to the value specified by WHISPER, ref. section 3.2.

Housekeeping:

Whisper cmd reg 0, **Whisper cmd reg 1, Whisper cmd reg 2, Whisper cmd reg 3.**

HK parameter	New value
EW3CREG1	Memory load bit pattern masked with 0xFF

Related commands:

SetWHCom0, SetWHCom2 SetWHCom3, SetWHCom0Tx, SetWHCom1Tx, SetWHCom2Tx, SetWHCom3Tx.

3.3.41 SetWHCom1Tx

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWRS9FS YEWRS9FS	0x0B (Nominal) 0x1B (Redundant)	SetWHCom1Tx SetWHCom1Tx	0xFF00 0xFF00	0x6900 0x6900	

Purpose:

Set byte 1 of WHISPER command holding register in DWP. If WHISPER is active, the command holding register is transmitted to WHISPER, otherwise the **WECErrorInstNotReady** error condition is flagged.

Constraints:

If WHISPER is not active when this command is received, the **WECErrorInstNotReady** error condition is flagged in the next WEC HK block.

Description:

Sets byte 1 of the WHISPER command holding register in DWP, given by the **Whisper cmd reg 1** parameter. If WHISPER is active, the command holding register is transmitted to WHISPER, otherwise the **WECErrorInstNotReady** error condition is flagged.

WHISPER cmd reg 1 will be updated to the value of the function data of **SetWHCom1Tx**.

When WHISPER power off is commanded, DWP sets the default value of **WHISPER cmd reg 1** to the value specified by WHISPER, ref. section 3.2.

Reference section 3.2 for details of WHISPER commands and protocols.

Housekeeping

Whisper cmd reg 0, **Whisper cmd reg 1, Whisper cmd reg 2, Whisper cmd reg 3.**

Whisper command word echo (AIT entry **EW3WCWE**) should change to the command sent from the WHISPER command holding register when the first frame of telemetry has been read from WHISPER. Reference [4] for the exact format of this data.

HK parameter	New value
EW3CREG1	Memory load bit pattern masked with 0xFF

Related commands:

SetWHCom0, SetWHCom1 SetWHCom2, SetWHCom3, SetWHCom0Tx, SetWHCom2Tx, SetWHCom3Tx.

3.3.42 SetWHCom2

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWRS2FS	0x0B (Nominal)	SetWHCom2	0xFF00	0x6200	
YEWRS2FS	0x1B (Redundant)	SetWHCom2	0xFF00	0x6200	

Purpose:

Set byte 2 of WHISPER command holding register in DWP.

Constraints:

None.

Description:

Whisper cmd reg 2 will be updated to the value of the function data of **SetWHCom2**.

The contents of the WHISPER command holding register in DWP will not be transmitted to WHISPER until either **SetWHCom0Tx, SetWHCom1Tx, SetWHCom2Tx** or **SetWHCom3Tx** is received by DWP.

Reference section 3.2 for details of WHISPER commands and modes.

When WHISPER power off is commanded, DWP sets **Whisper cmd reg 2** to the value specified by WHISPER, ref. section 3.2.

Housekeeping:

Whisper cmd reg 0, **Whisper cmd reg 1, Whisper cmd reg 2, Whisper cmd reg 3.**

HK parameter	New value
EW3CREG2	Memory load bit pattern masked with 0xFF

Related commands:

SetWHCom0, SetWHCom1 SetWHCom3, SetWHCom0Tx, SetWHCom1Tx, SetWHCom2Tx, SetWHCom3Tx.

3.3.43 SetWHCom2Tx

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWRSAFS YEWRSAFS	0x0B (Nominal) 0x1B (Redundant)	SetWHCom2Tx SetWHCom2Tx	0xFF00 0xFF00	0x6A00 0x6A00	

Purpose:

Set byte 0 of WHISPER command holding register in DWP. If WHISPER is active, the command holding register is transmitted to WHISPER, otherwise the **WECErrorInstNotReady** error condition is flagged.

Constraints:

If WHISPER is not active when this command is received, the **WECErrorInstNotReady** error condition is flagged in the next WEC HK block.

Description:

Sets byte 2 of the WHISPER command holding register in DWP, given by the **Whisper cmd reg 2** parameter. If WHISPER is active, the command holding register is transmitted to WHISPER, otherwise the **WECErrorInstNotReady** error condition is flagged.

WHISPER cmd reg 2 will be updated to the value of the function data of **SetWHCom2Tx**.

When WHISPER power off is commanded, DWP sets the default value of **WHISPER cmd reg 2** to the value specified by WHISPER, ref. section 3.2.

Reference section 3.2 for details of WHISPER commands and protocols.

Housekeeping

Whisper cmd reg 0, **Whisper cmd reg 1, Whisper cmd reg 2, Whisper cmd reg 3.**

Whisper command word echo (AIT entry **EW3WCWE**) should change to the command sent from the WHISPER command holding register when the first frame of telemetry has been read from WHISPER. Reference [4] for the exact format of this data.

HK parameter	New value
EW3CREG2	Memory load bit pattern masked with 0xFF

Related commands:

SetWHCom0, SetWHCom1 SetWHCom2, SetWHCom3, SetWHCom0Tx, SetWHCom1Tx, SetWHCom3Tx.

3.3.44 SetWHCom3

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWRS3FS	0x0B (Nominal)	SetWHCom3	0xFF00	0x6300	
YEWRS3FS	0x1B (Redundant)	SetWHCom3	0xFF00	0x6300	

Purpose:

Set byte 3 of WHISPER command holding register in DWP.

Constraints:

None.

Description:

Whisper cmd reg 3 will be updated to the value of the function data of **SetWHCom3**.

The contents of the WHISPER command holding register in DWP will not be transmitted to WHISPER until either **SetWHCom0Tx, SetWHCom1Tx, SetWHCom2Tx** or **SetWHCom3Tx** is received by DWP.

Reference section 3.2 for details of WHISPER commands and modes.

When WHISPER power off is commanded, DWP sets **Whisper cmd reg 3** to the value specified by WHISPER, ref. section 3.2.

Housekeeping:

Whisper cmd reg 0, **Whisper cmd reg 1, Whisper cmd reg 2, Whisper cmd reg 3.**

HK parameter	New value
EW3CREG3	Memory load bit pattern masked with 0xFF

Related commands:

SetWHCom0, SetWHCom1 SetWHCom2, SetWHCom0Tx, SetWHCom1Tx, SetWHCom2Tx, SetWHCom3Tx.

3.3.45 SetWHCom3Tx

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWRSBFS	**0x0B (Nominal)**	**SetWHCom3Tx**	**0xFF00**	**0x6B00**	
YEWRSBFS	**0x1B (Redundant)**	**SetWHCom3Tx**	**0xFF00**	**0x6B00**	

Purpose:

Set byte 3 of WHISPER command holding register in DWP. If WHISPER is active, the command holding register is transmitted to WHISPER, otherwise the **WECErrorInstNotReady** error condition is flagged.

Constraints:

If WHISPER is not active when this command is received, the **WECErrorInstNotReady** error condition is flagged in the next WEC HK block.

Description:

Sets byte 3 of the WHISPER command holding register in DWP, given by the **Whisper cmd reg 3** parameter. If WHISPER is active, the command holding register is transmitted to WHISPER, otherwise the **WECErrorInstNotReady** error condition is flagged.

WHISPER cmd reg 3 will be updated to the value of the function data of **SetWHCom3Tx**.

When WHISPER power off is commanded, DWP sets the default value of **WHISPER cmd reg 3** to the value specified by WHISPER, ref. section 3.2.

Reference section 3.2 for details of WHISPER commands and protocols.

Housekeeping

Whisper cmd reg 0, **Whisper cmd reg 1, Whisper cmd reg 2, Whisper cmd reg 3.**

Whisper command word echo (AIT entry **EW3WCWE**) should change to the command sent from the WHISPER command holding register when the first frame of telemetry has been read from WHISPER. Reference [4] for the exact format of this data.

HK parameter	New value
EW3CREG3	**Memory load bit pattern masked with 0xFF**

Related commands:

SetWHCom0, SetWHCom1 SetWHCom2, SetWHCom3, SetWHCom0Tx, SetWHCom1Tx, SetWHCom2Tx.

3.3.46 SetWHDataProc

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWMSBFS	**0x0B (Nominal)**	**SetWHDataProc**	**0xFF00**	**0xCB00**	
YEWMSBFS	**0x1B (Redundant)**	**SetWHDataProc**	**0xFF00**	**0xCB00**	

Purpose:

To define DWP processing required on WH data.

Constraints:

The operand of **SetWHDataProc** is recorded by DWP, but only referenced when the current WHISPER mode command word requests DWP processing (see below).

Either one or two application processors must be available to perform WH processing.

Description:

The raw WHISPER data bit rate is far greater than the entire WEC allocation. Usually it is expected that DWP will apply a variety of scientific processing on this data to reduce the bit rate to a reasonable level. A bit in the WHISPER mode command word defines whether either DWP should perform the processing, or WHISPER itself should limit its data bit rate. The WHISPER mode command word is controlled by the **SetWHComm*n*** and **SetWHComm*n*Tx** commands.

When WHISPER limits the data bit rate itself, DWP does not reference the selected WHISPER processing but outputs all WHISPER data as read, to the OBDH. When DWP processing is selected, a copy of the latest **SetWHDataProc** command operand is transmitted with every data packet from WH to the application processor. The processing performed by the application processor is controlled according to the table below.

If it is required to set any of the 8 most significant bits of the Whisper processing word then the command **SetWHDataProc** must be sent as a double word command. As the required commands are not specifically defined in the AIT database the ZEWDUMMY command must be used, i.e.:

send ZEWDUMMY, 0xD0mm

send ZEWDUMMY, 0xFBll

where mmll is the required 16 bit word in hexadecimal.

Full details of the DWP processing strategies for WHISPER are given in [6].

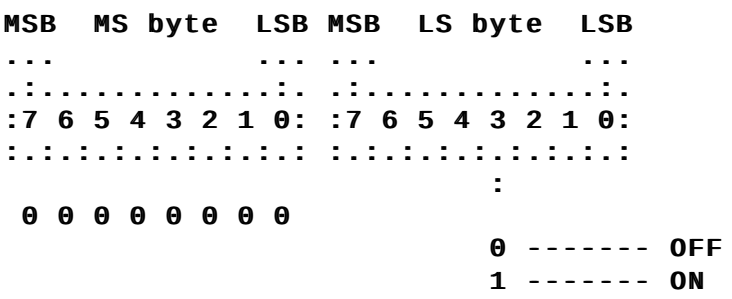
WHISPER Processing Word (WPW) - "Natural Waves" modes (N)

```
MSB  MS byte  LSB MSB  LS byte  LSB
...           ... ...          ...
.:............:. .:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0:
:.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:.:
                  : :.: : : :.:.:
 0 0 0 0 0 0 0 0  :  :  : :   :...  Averaged spectrum output rate
                  :  :  : :.......  Energy and overflow averaging
                  :  :  :.........  Spare bit (set to 0)
                  :  :............  FFT data compression
                  :...............  reserved (set to 0)
```

Averaged spectrum output rate

```
MSB  MS byte  LSB MSB  LS byte  LSB
...           ... ...          ...
.:............:. .:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0:
:.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:.:
                                : : :
 0 0 0 0 0 0 0 0
                                0 0 0 --- output all averaged
spectra
                                0 0 1 --- output 2 out of 3 averaged
spectra
                                0 1 0 --- output 1 out of 2 averaged
spectra
                                0 1 1 --- output 1 out of 3 averaged
spectra
                                1 0 0 --- output 1 out of 4 averaged
spectra
                                1 0 1 --- output 1 out of 6 averaged
spectra
                                1 1 0 --- output 1 out of 8 averaged
spectra
                                1 1 1 --- output 1 out of 10
averaged spectra
```

Energy and overflow averaging

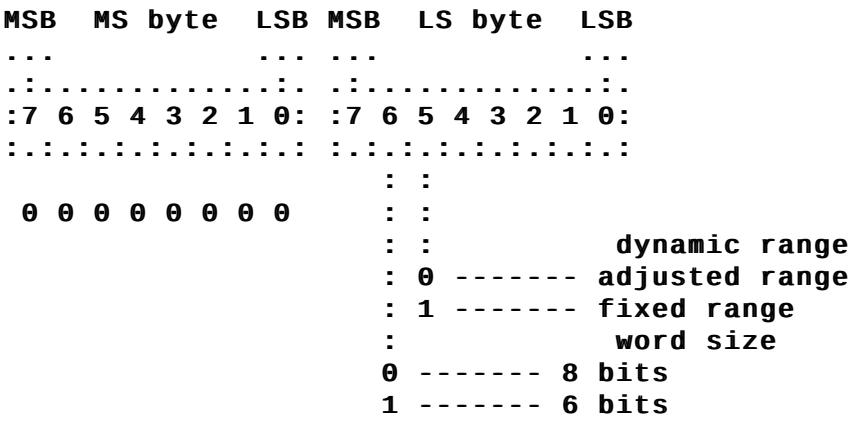


There is no option on Energy and overflow averaging in "sounding" modes.

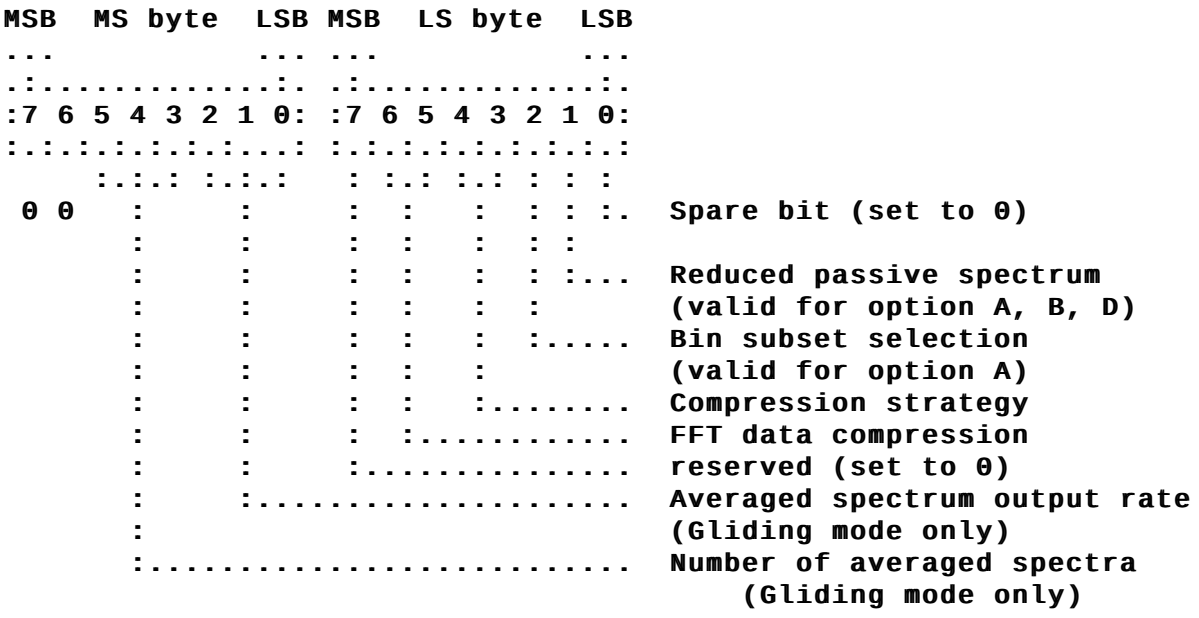
When this information is transmitted (gliding mode),

the fixed option is : averaging ON.

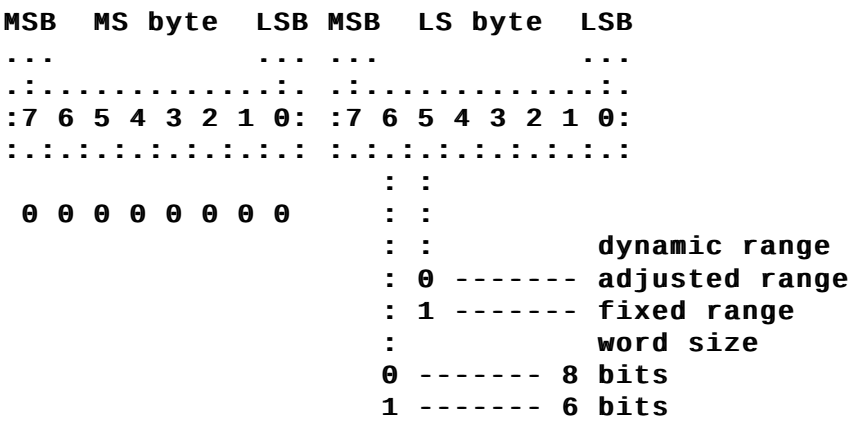
FFT data compression



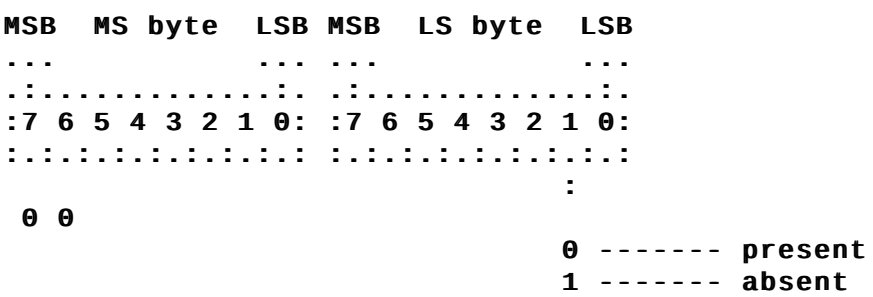
WHISPER Processing Word (WPW) - "Sounding" modes (S)



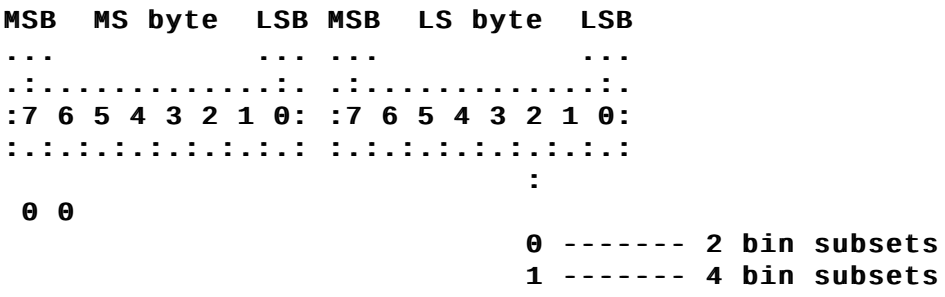
FFT data compression



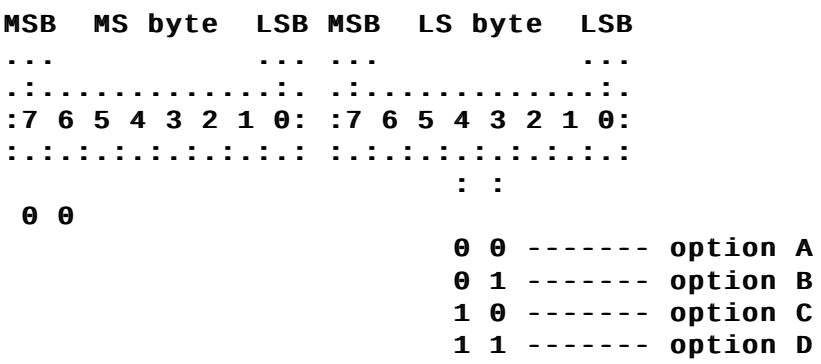
Reduced passive spectrum (valid for option A,B,D of the compression strategy)



Bin subset selection (valid for option A of the compression strategy)



Compression strategy


MSB MS byte LSB MSB LS byte LSB
7 6 5 4 3 2 1 0 7 6 5 4 3 2 1 0
0 0
0 0 ------- option A
0 1 ------- option B
1 0 ------- option C
1 1 ------- option D

Averaged spectrum output rate

```
MSB  MS byte  LSB MSB  LS byte  LSB
...           ... ...           ...
.:............:. .:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0:
:.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:.:
          : : :
 0 0
          0 0 0 ------- output all averaged spectra
          0 0 1 ------- output 2 out of 3 averaged spectra
          0 1 0 ------- output 1 out of 2 averaged spectra
          0 1 1 ------- output 1 out of 3 averaged spectra
          1 0 0 ------- output 1 out of 4 averaged spectra
          1 0 1 ------- output 1 out of 6 averaged spectra
          1 1 0 ------- output 1 out of 8 averaged spectra
          1 1 1 ------- output 1 out of 10 averaged spectra
```

Number of averaged passive spectra

```
MSB  MS byte  LSB MSB  LS byte  LSB
...           ... ...           ...
.:............:. .:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0:
:.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:.:
     : : :
 0 0
     0 0 0 --- 32 spectra (426.66 ms)
     0 0 1 --- 16 spectra (213.33 ms)
     0 1 0 --- 16 spectra (213.33 ms)
     0 1 1 ---  8 spectra (106.66 ms)
     1 0 0 ---  4 spectra  (53.33 ms)
     1 0 1 ---  2 spectra  (26.66 ms)
     1 1 0 --- 64 spectra (853.33 ms)
     1 1 1 ---  1 spectrum (13.33 ms)
```

Housekeeping:

The data bits of the command will be used to update the **WHISPER processing control** field.

HK parameter	New value
EW3WPW	Data masked with 0xFFFF

Related commands:

SetMWFDataProc, SetWBDDataProc, SetCorrDataProc.

3.3.47 StartSTAFFCal

AIT database:

Memory load name	OBDH interface ID	Short Description	Fix mask	Fix value	Author-ised?
ZEWCS0FS	**0x0B (Nominal)**	**StartSTAFFCal**	**0xF000**	**0x4000**	
YEWCS0FS	**0x1B (Redundant)**	**StartSTAFFCal**	**0xF000**	**0x4000**	

Purpose:

StartSTAFFCal commands DWP to start a STAFF calibration sequence at the next OSTB, or to set the STAFFCalibrationStep HK parameter to any value without starting a calibration. The STAFF Calibration sequence will also control SA operations if SA is active.

Constraints:

If STAFF MWF is not active when the command is received the **WECErrorInstNotReady** error condition is flagged in the WEC HK.

Description:

If the parameter is in the range 0x000 to 0xEFF the calibration is started, whilst if the parameter is in the range 0xF00 to 0xF3F (ie. 0xF00 + N) the step number is set (to N) but the calibration is not started. This latter function is intended for marking steps during ground tests.

There are two possible calibration sequences. DWP automatically selects the sequence to be used by testing the frequency of WECSS at the next OSTB. If the WECSS frequency is 25 Hz, DWP will perform the low bit rate calibration (16 second step). If the WECSS frequency is 450 Hz, DWP will perform the high bit rate calibration (4 second step).

Once the calibration is started it will run until completion. An exception is when the command **SetWECClock** is used to changed the WEC sample frequency in the middle of a calibration sequence. This will abort the calibration.

It is not essential that SA be active when the calibration starts.

Reference [2] for details of the STAFF calibration sequences.

Housekeeping:

Staff MWF Calibration mode (AIT entry **EW2CALMD**) will be set, and **Staff MWF calibration ste**p (AIT entry **EW2CALST**) will be set to 1 if the calibration mode could be successfully started.

HK parameter	New value
EW2CALMD	**1**
EW2CALST	**1**

Related commands:

SetWECClock

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3.4 ON BOARD SOFTWARE MODIFICATION

Not all WEC instruments support code patching. DWP, EFW and STAFF SA are the only instruments whose code can be patched in flight operations. The following sections outline the procedures to follow when uploading code patches.

3.4.1 DWP

DWP supports a facility for modifying the contents of memory of at least one of the DWP transputers and possibly all of them. This facility may be used to upload new data tables or code patches as required.

Any memory patches must be prepared by a DWP team representative with reference to an internal document, [7]. ANY ERRORS IN FORMULATING THE PATCH MAY CAUSE DWP TO CRASH OR MALFUNCTION. THEREFORE GREAT CARE MUST BE EXERCISED.

It is suggested that as a matter of procedure any code patches should be tested in a spare DWP unit on the ground.

Patches uploaded to DWP are stored in volatile memory and therefore will be lost when DWP is powered off. Certain types of DWP reset will also cause loss of code patches see Table 3.4.1.1and section 2.3.2. DWP reset action classification

DWP reset type	Code patches
Cold	Lost
Warm	Lost
Hot	Still valid
Watchdog	Still valid

Table 3.4.1.1- Status of code patches after DWP reset.

DWP memory patches are uploaded to DWP following the **DWPSetMemoryWrite** and **LoadKernelMemory** telecommands. The detailed descriptions of these commands is given in the command reference section 3.3.

IT IS IMPORTANT TO NOTE THAT THE MEMORY LOAD COMMANDS TO BE WRITTEN INTO DWP RAM ARE NOT IN THE FORMAT THAT ALL OTHER MEMORY LOAD COMMANDS CONFORM TO. They represent 16 bit transputer instructions. This approach was taken to halve the telemetry bandwidth requirements for uploading code patches that would have been required if *Double Word* commands were used.

The descriptions of the detailed mechanics of writing patches, the constraints on which transputers memory may be modified, and the option of relocatable patches are beyond the scope of this document and therefore do not appear here.

3.4.2 EFW

One of the most important, yet simplest, pieces of the flight code is the programme loader. Together with various vectors tucked away in various places much of the CPU operations can be changed or increased, and any location in either memory or input/output can be modified.

The reset of EFW after the loading of a memory patch will cause the patch to be lost.

.CMDS n	Set expected command count
.ADRL l	Set low byte of memory address in MAIN
.ADDH h	Set high byte of memory address in MAIN
.LOAD x	Load byte x into memory(h,l) in MAIN
.EXEC	Execute program (at a fixed location) in MAIN

Table 3.4.2.1 - Available commands for code patching

To load a programme one must set the high and low addresses and then enter the series of bytes. The memory pointer increments with each load.

Occasionally commands will be rejected by the spacecraft receiving electronics which will ruin the uplink entirely. To prevent the EXEC command starting a partially loaded programme and crashing the processor the CMDS command will tell how many commands to expect. The EXEC checks this counter before beginning execution. Also the first byte of the load must be a "AA" code to prevent an EXEC from operating without any load at all. For example, to load/execute a "C9" at 4DAAH :

```
.CMDS 5
.ADRL 0XAA
.ADRH 0X4D
.LOAD 0XAA
.LOAD 0XC9
.EXEC
```

Example of uploading memory patch

Note that the final command (EXEC) must see that the command count status is zero (i.e. 4 commands expected, 4 executed) before it will execute the programme.

Some important flight programme functions can be replaced by uploaded functions by changing RAM vectors:

Address	Name	Description
0x41bb	BKGVECT	background processing, called 50 times per second
0x41be	EOP_VECTOR	DMA EOP interrupt, called 450 times per second if the interrupt is enabled (default is disabled)
0x41f5	EXEVECT	foreground processing
0x4272	USERVECT0	user quantity function 0
0x4275	USERVECT1	user quantity function 1
0x463e	BALGVECT	burst trigger alghorithm
0x4703	SWPANAVECT	sweep analyze function
0x4706	SWPBIASVECT	sweep bias function

RAM vectors for EFW instrument

3.4.3 STAFF SA

STAFF SA supports a facility for modifying the content of memory of a ADSP computer. The facility may be used to upload new data tables (e.g. Despin table) or code patches as required.

Any error in formulating the patch may cause STAFF SA malfunction. Therefore, great care must be exercised.

It is suggested that as a matter of procedure any code patch should be tested in a spare or EM unit on the ground.

VERY IMPORTANT:

Patches uploaded to STAFF SA are stored in volatile RAM memory and therefore, will be lost when STAFF SA is powered OFF or resetted.

STAFF SA memory patches are uploaded following the STAFF SA/DWP procedure described in section .

It is important to note that the memory load commands written into STAFF SA Ram can be dumped to verify the code patches.

No DWP macro should be executed whilst a STAFF SA memory patch is being uploaded.

3.4.4 WHISPER (ground patches only)

Uploading and protect / unprotect S/W (ground operation)

These WCMW commands will be used, only during ground operation, to allow the updating of the micro-controller programme stored in EEPROM. The presence of the 27v is of no importance for this mode.

These special modes issue an output data frame of 64 words at the end of the loading programme, including the checksum of the EEPROM for verification. Only the status words are significant, other are meaningless.

NOTE : For the three following commands, the WHISPER EEPROM LOADER must be connected to the J05 (HV Ctrl/Test) connector in order to enable the hardware WR (write) of the EEPROM. The WHISPER EEPROM LOADER includes HV disabling.

[load] uploads a new software into EEPROM

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3   LSB
...           ... ...           ... ...           ... ...           ...
.:............:. .:............:. .:............:. .:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0:
:.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:.
 1 0 0 1 0 0 0 0   0 0 0 0 1 0 0 0   0 0 0 0 0 0 0 0   0 1 1 1 1 1 1 1
   90 h   144 d      08 h     8 d      00 h     0 d      7F h  127 d
```

[protect] activates the SWP (Software Write Protect) of the EEPROM

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3   LSB
...           ... ...           ... ...           ... ...           ...
.:............:. .:............:. .:............:. .:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0:
:.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:.
 1 0 0 1 0 0 0 0   0 0 0 0 1 0 0 0   0 1 0 0 1 1 1 1   0 1 0 1 0 1 0 1
   90 h   144 d      08 h     8 d      4F h    79 d      55 h   85 d
```

[unprotect] desactivates the SWP of the EEPROM

```
MSB   WCMW0   LSB MSB   WCMW1   LSB MSB   WCMW2   LSB MSB   WCMW3   LSB
...           ... ...           ... ...           ... ...           ...
.:............:. .:............:. .:............:. .:............:.
:7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0: :7 6 5 4 3 2 1 0:
:.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:: :.:.:.:.:.:.:.:.
 1 0 0 1 0 0 0 0   0 0 0 0 1 0 0 0   0 1 0 0 1 1 1 1   0 1 1 0 1 1 1 1
   90 h   144 d      08 h     8 d      4F h    79 d      6F h  111 d
```

Commands and data collection can be performed via CCS, WEC EGSE or WHISPER GSE (MINI-DPU) according to the present setup.

- connect the EEPROM LOADER and the associated NOTEBOOK

- POWER ON WHISPER (and DWP or MINI-DPU)

- issue the unprotect command, record the present checksum

- issue the load command

- run the uploading programme on the NOTEBOOK

- when completed, record the new checksum

- issue the protect command, record the modification of the new

  checksum and verify the protect status

- POWER OFF WHISPER (and DWP or MINI-DPU)

- disconnect the EEPROM LOADER and the associated NOTEBOOK

- uploading operation completed

NOTE : A protect status (value 0x55) will overwrite the last byte of the EEPROM (at address 0xFFFF) when the protect command is issued. The EEPROM checksum is affected with the value of this status. The protect status is cleared when the unprotect command is issued and the initial checksum is restored.

3.5 AUTONOMOUS BEHAVIOUR - DWP MACROS

This section describes the facilities provided by DWP for the loading, storage and execution of telecommand sequences, referred to as DWP macros. These are distinct from the macro command facilities provided by the spacecraft. DWP macro execution allows time structured WEC instrument commanding and mode changes without requiring regular telecommanding from the spacecraft, i.e. autonomous behaviour. Most of the material in this section describes the DWP macro facilities and the DWP macro sequences that have been defined to implement this autonomy.

Two instances of autonomous behaviour can be identified for the WEC.

i/ After a DWP reset, DWP will execute an internal macro sequence, **NBR emergency and default** if no telecommands have been received on either OBDH interface after counting 24 OBDH reset pulses (ref. section 2.3.2 of this manual), a period of approximately minutes.

ii/ The **SetMacroOps(EXECUTE)** telecommand when transmitted to DWP begins execution of an internally stored sequence of telecommands. These commands are executed at a rate of one every 30 milliseconds until the end of the sequence is reached. Most DWP macro sequences that have been defined loop indefinitely.

In the two instances above, the transmission of a single WEC telecommand may cause the execution of a large sequence of internally stored telecommands with consequent changes in housekeeping parameter values.

3.5.1 Provision of resources for DWP macros

256 words of DWP ROM are used for non-volatile macro storage. The contents of ROM are copied into RAM at DWP reset, and can then be modified by further commands before execution of a macro is started.

The DWP macro buffer is segmented into 32 slots, each slot of size exactly 8 words. Most WEC telecommands are only 1 word, although some are 2 words. The distinction is made clear in section 3.2.

A single macro sequence can occupy more than one contiguous slot in the macro buffer.

The command **SetMacroOps** is used to control macro usage. **SetMacroOps (CALL, <slot>)** allows a macro to be executed, or a macro subroutine to be called from the currently executing macro. Macro execution can only be begun at the start of a slot. **SetMacroOps (LOAD, <slot>)** allows the macro buffer contents to be overwritten starting from the beginning of the specified slot.

SetMacroOps (END, <slot>) completes a load sequence or terminates the executing macro. **SetMacroOps (RETURN, <slot>)** returns from the executing macro subroutine, or terminates the executing macro if at the top level.

The **MacroLoad (<slot offset>, <slot>)** command provides a more versatile method of loading new macro sequences. The flexibility of **MacroLoad** makes it feasible to edit existing macro sequences stored in DWP memory, rather than uploading a new macro sequence.

There are three other commands used exclusively by macros, these can only be executed from within a macro sequence. **MacroSetCounter (<counter>, <value>)** sets one of four counters to a value in the range 1 to 64. **MacroTestCounter (<counter>, <jump offset>)** decrements the specified counter, and tests its value. If the value is not zero, a jump back of the offset specified is taken. **MacroWaitOrLoop (SHORT_WAIT,<seconds>)** and **MacroWaitOrLoop (LONG_WAIT,<minutes>)** provide delay facilities and synchronisation to One Second Timing Boundaries (OSTBs). **MacroWaitOrLoop (JUMP, <offset>)** executes a backwards jump of the specified offset.

3.5.2 Macro Buffer Allocation

This should be read in conjunction with the chapters of the WEC Instrument User manual describing the WEC mode planning.

Each WEC mode requires a DWP macro to control the timing and sequencing of the active WEC instruments. Any macro sequence can be uploaded into any part of the macro buffer. However, the following initial allocation is used for the predefined macros stored in the DWP ROMs. These may be replaced in RAM by the uploaded sequences. During the course of an orbit it is likely that different macro sequences may be uploaded several times. It is proposed that it would be useful to stick to the defined allocations wherever possible to avoid any accidental conflicts between macros.

Some WEC modes are very similar, for example there are several classed as HBR low-recurrence, they have the same structure and only differ by a few command values. To switch to a mode whose macro is not specified in the current macro buffer it may only be necessary to edit one or two locations of a macro slot with the **MacroLoad** command. In other cases it will be better to upload the complete macro sequence for that mode. These decisions must be made depending on the constraints on commanding etc. imposed by the mission circumstances.

Macro slots 0 and 1 are reserved for the NBR default and emergency macro that will be run by DWP in the event that no commands are received within 30 seconds of a DWP reset. This is essentially an emergency mode in the event of commanding difficulties and is not expected to be used in routine operations. It only requires one reduced power DWP processor to be available.

Slot	General use	ROM definition
31	All off subroutine	All off subroutine
30	Leave Standby	Leave Standby
29	EFW,SA,SC on subroutine	EFW,SA,SC on subroutine
28	Enter Standby	Enter Standby
27 26	Spare / scratch space	Spare / scratch space
25 24 23	General NBR macros	General NBR macros
22 21 20	General HBR macros	General HBR macros
19 18 17	Langmuir NBR	NBR Langmuir (a)
16 15 14	Continuous NBR	NBR Continuous (a)
13 12 11	HBR basic	HBR basic
10 9 8	HBR low recurrence	HBR low recurrence (a)
7 6 5	NBR basic	NBR basic
4 3 2	NBR low recurrence	NBR low recurrence (a)
1 0	NBR emergency and default	NBR emergency and default

3.5.3 Guidelines for DWP macros

Most DWP macros defined for implementation of WEC modes will loop indefinitely or until **SetMacroOps(END)** is received. Exceptions that exist in the DWP ROMs are the three subroutines in slots 28, 29, 30 and 31 which perform their functions and then return.

Each macro sequence has certain preconditions that must be met before beginning its execution. Failure to meet these conditions may result in errors reported in the HK and / or garbage science telemetry.

Primary constraints are electrical power, telemetry bandwidth, DWP processing power, instrument design constraints, DWP software constraints.

Electrical power and telemetry bandwidth are outside the scope of this section and are discussed elsewhere in the WEC instrument user manual. The other constraints are explored.

The spacecraft OBDH acquisition rate must be programmed correctly. The DWP power on default mode is NM3. The NBR modes require OBDH modes NM1,2 or 3 (each approximately 5.1 kbps). The HBR modes defined here require BM1 (approx. 45 kbps). They will also work with BM2 (approx. 95 kbps) although not all of the telemetry bandwidth will be used.

STAFF SC data must be disabled during a BM3 dump of EFW.

The DWP design imposes some constraints on combinations of some instruments operations. These have been documented previously in several places, but are repeated here for ease of reference.

WBD data cannot be read through DWP unless WHISPER is OFF. The correlator cannot operate when WBD data is being read through DWP. WHISPER can operate when WBD is on only in the nominal configuration where WBD output directly via their own OBDH interface and not through DWP.

The STAFF SC and EFW instruments share a common WEC sample clock which can be driven at either 25 Hz or 450 Hz. The sample clock frequency is independent of the OBDH acquisition mode selection.

If application processing is required (i.e. if correlator, WHISPER or STAFF SC operations are planned) then at least two DWP transputers must be available. The transputer designated as the application processor must usually be running at full power. Testing of some of the WEC macros has shown that if WHISPER application handling of 512 bin packets is required, then two full speed applications will be required, rather than one.

The transputer running the kernel software must be switched to full power if the correlator is to be used.

It is advisable to switch the kernel to full speed whenever possible. Although DWP will function with the kernel running at half power, some tests with SA and DWP processing of WHISPER simultaneously show intermittent errors on the interfaces which will result in the loss of a small amount of data.

3.5.4 DWP macros stored in the DWP ROMs

In the example macros given, the WBD instrument is only powered and commanded in the HBR WBD modes. In all other modes commanding for WBD must be given. This gives some operational flexibility. Similarly, the correlator is not included in any predefined macro. If correlator operation is

required then the general constraints on its use must be met and the commands **SetCorrDataProc** and **SetExtExpStatus** sent. Failure to send the **FlagExtExpStatus** command or to set its function data correctly will not disrupt WEC operations but means that WHISPER sounding will not be synchronised to the flyback periods of the particle experiments. The correlator may not output useful data unless the **FlagExtExpStatus** command has been used to inform the correlator of the current PEACE mode.

NBR Emergency and Default	**SWECM000.ZEW**
NBR Basic Low Recurrence (a)	**SWECM002.ZEW**
NBR Basic	**SWECM005.ZEW**
HBR Basic Low Recurrence (a)	**SWECM008.ZEW**
HBR Basic	**SWECM011.ZEW**
NBR Continuous (a)	**SWECM014.ZEW**
NBR Langmuir (a)	**SWECM017.ZEW**
Enter Standby mode	**SWECM028.ZEW**
Power on EFW, Staff SC and Staff SA	**SWECM029.ZEW**
Leave Standby mode	**SWECM030.ZEW**
Power off all WEC and stop Correlator	**SWECM031.ZEW**

The internal Macros are listed below. Their use depends on the number of transputers available and whether they are running at full or half speed. This is discussed further in Chapter 6 Nominal Operations.

SWECM000.ZEW NBR Emergency and Default

```
Name:           WEC mode macro 0

Description:    NBR Emergency and default

00:00:00  ZEWMSFFS,0x40   -- Load macro slot 0
          ZEWMS0FS,0x04   -- WEC 25 Hz sampling
          ZEWMSFFS,0x1d   -- Power on EFW, SC, SA
          ZEWMS2FS,0x43   -- Power on WH
          ZEWRS0FS,0xc8
          ZEWRS1FS,0x38
                          -- 'repeat mode cycle'
          ZEWRSAFS,0x60   -- Command WH processed, 6.5 sec mode
          ZEWAS0FS,0x100  -- Command SA NM1
          ZEWMSEFS,0x03   -- Wait 4 OSTB's
          ZEWAS0FS,0x100  -- Command SA NM1
          ZEWMSEFS,0x03   -- Wait 4 OSTB's
          ZEWMSEFS,0xc4   -- Jump to 'repeat mode cycle'
          ZEWMSFFS,0x80   -- End macro load
```

SWECM002.ZEW NBR Low Recurrence (a)

```
Name:           WEC mode macro 2

Description:    NBR Low recurrence (a)


00:00:00  ZEWMSFFS,0x42   -- Load macro slot 2
          ZEWMS0FS,0x04   -- WEC 25 Hz sampling
          ZEWMSAFS,0x02   -- Nominal SC compression
          ZEWMSFFS,0x1e   -- Leave standby mode
                          -- 'repeat mode cycle'
                          -- Active part
          ZEWMSBFS,0x00   -- Set WPW (WEL5a = 00)
          ZEWRS0FS,0xad
          ZEWRS1FS,0x12
          ZEWRS2FS,0x60
          ZEWRSBFS,0x61   -- Command WH WEL5a
          ZEWAS0FS,0x107  -- Command SA NM1'b
          ZEWMSEFS,0x03   -- Wait 4 OSTB's
                          -- Passive part
          ZEWMSBFS,0x0b   -- Set WPW (WEL2d = 0b)
          ZEWRS0FS,0xcb
          ZEWRS1FS,0x60
          ZEWRSAFS,0x60   -- Command WH WEL2d
          ZEWMS6FS,0x18   -- Set counter 0 to 25
                          -- 'repeat passive'
          ZEWAS0FS,0x100  -- Command SA NM1
          ZEWMSEFS,0x03   -- Wait 4 OSTB's
          ZEWMS7FS,0x01   -- Decrement counter 0, jump 'repeat passive'
          ZEWMSEFS,0xce   -- Jump to 'repeat mode cycle'
          ZEWMSFFS,0x80   -- End macro load
```

SWECM005.ZEW NBR Basic

```
Name:           WEC mode macro 5

Description:    NBR Basic


00:00:00  ZEWMSFFS,0x45   -- Load macro slot 5

          ZEWMS0FS,0x04   -- WEC 25 Hz sampling

          ZEWMSAFS,0x02   -- Nominal SC compression
          ZEWMSFFS,0x1e   -- Leave standby mode
                          -- 'repeat mode cycle'
                          -- Active part
          ZEWMSBFS,0x00   -- Set WPW (WEL4a = 00)
          ZEWRS0FS,0xad
          ZEWRS1FS,0x12
          ZEWRS2FS,0x60
          ZEWRSBFS,0x0e   -- Command WH WEL4a
          ZEWAS0FS,0x107  -- Command SA NM1'b
          ZEWMSEFS,0x02   -- Wait 3 OSTB's
                          -- Passive part
          ZEWMSBFS,0x4f   -- Set WPW (WEL1a = 4f)
          ZEWRS0FS,0xcb
          ZEWRS1FS,0x10
          ZEWRSAFS,0x60   -- Command WH WEL1a
          ZEWMSEFS,0x00   -- Wait 1 OSTB
          ZEWMS6FS,0x05   -- Set counter 0 to 6
                          -- 'repeat SA 2'
          ZEWAS0FS,0x100  -- Command SA NM1
          ZEWMSEFS,0x03   -- Wait 4 OSTB's
          ZEWMS7FS,0x01   -- Decrement counter 0, jump 'repeat SA 2'
          ZEWMSEFS,0xcf   -- Jump to 'repeat mode cycle'
          ZEWMSFFS,0x80   -- End macro load
```

SWECM008.ZEW HBR Low Recurrence (a)

```
Name:           WEC mode macro 8

Description:    HBR Low recurrence (a)


00:00:00  ZEWMSFFS,0x48   -- Load macro slot 8

          ZEWWS2FS,0xf1   -- Select EFW tape mode 1

          ZEWMS0FS,0x08   -- WEC 450 Hz sampling
          ZEWMSAFS,0x02   -- Nominal SC compression
          ZEWMSFFS,0x1e   -- Leave standby mode
                          -- 'repeat mode cycle'
                          -- Active part
          ZEWMSBFS,0x12   -- Set WPW (WEL5d = 12)
          ZEWRS0FS,0xad
          ZEWRS1FS,0x12
          ZEWRS2FS,0x60
          ZEWRSBFS,0x61   -- Command WH WEL5d
          ZEWMS6FS,0x03   -- Set counter 0 to 4
                          -- 'repeat SA 1'
          ZEWAS0FS,0x10a  -- Command SA FM3'b
          ZEWMSEFS,0x00   -- Wait 1 OSTB's
          ZEWMS7FS,0x01   -- Decrement counter 0, jump 'repeat SA 1'
                          -- Passive part
          ZEWMS6FS,0x43   -- Set counter 1 to 4
          ZEWMSBFS,0x43   -- Set WPW (WEL1c = 43)
          ZEWRS0FS,0xcb
          ZEWRS1FS,0x10
                          -- 'repeat passive'
          ZEWMS6FS,0x18   -- Set counter 0 to 25
          ZEWRSAFS,0x60   -- Command WH WEL1b
                          -- 'repeat 25'
          ZEWAS0FS,0x108  -- Command SA FM1
          ZEWMSEFS,0x00   -- Wait 1 OSTB's
          ZEWMS7FS,0x01   -- Decrement counter 0, jump 'repeat 25'
          ZEWMS7FS,0x44   -- Decrement counter 1, jump 'repeat passive'
          ZEWMSEFS,0xd2   -- Jump to 'repeat mode cycle'
          ZEWMSFFS,0x80   -- End macro load
```

SWECM011.ZEW HBR Basic

```
Name:           WEC mode macro 11
Description:    HBR Basic

00:00:00  ZEWMSFFS,0x4b   -- Load macro slot 11
          ZEWWS2FS,0xf1   -- Select EFW tape mode 1
          ZEWMS0FS,0x08   -- WEC 450 Hz sampling
          ZEWMSAFS,0x02   -- Nominal SC compression
          ZEWMSFFS,0x1e   -- Leave standby mode
                          -- 'repeat mode cycle'
                          -- Active part
          ZEWMSBFS,0x12   -- Set WPW (WEL4b = 12)
          ZEWRS0FS,0xad
          ZEWRS1FS,0x12
          ZEWRS2FS,0x60
          ZEWRSBFS,0x0e   -- Command WH WEL4b
          ZEWMS6FS,0x02   -- Set counter 0 to 3
                          -- 'repeat SA 1'
          ZEWAS0FS,0x10a  -- Command SA FM3'b
          ZEWMSEFS,0x00   -- Wait 1 OSTB
          ZEWMS7FS,0x01   -- Decrement counter 0, jump 'repeat SA 1'
                          -- Passive part
          ZEWAS0FS,0x10a  -- Command SA FM3'b
          ZEWMSBFS,0x41   -- Set WPW (WEL1b = 41)
          ZEWRS0FS,0xcb
          ZEWRS1FS,0x10
          ZEWRSAFS,0x60   -- Command WH WEL1b
          ZEWMSEFS,0x00   -- Wait 1 OSTB
          ZEWMS6FS,0x17   -- Set counter 0 to 24
                          -- 'repeat SA 2'
          ZEWAS0FS,0x10c  -- Command SA FM2
          ZEWMSEFS,0x00   -- Wait 4 OSTB's
          ZEWMS7FS,0x01   -- Decrement counter 0, jump 'repeat SA 2'
          ZEWMSEFS,0xd2   -- Jump to 'repeat mode cycle'
          ZEWMSFFS,0x80   -- End macro load
```

SWECM014.ZEW NBR Continuous (a)

```
Name:           WEC mode macro 14
Description:    NBR Continuous (a)

00:00:00  ZEWMSFFS,0x4e   -- Load macro slot 14
          ZEWMS0FS,0x04   -- WEC 25 Hz sampling
          ZEWMSAFS,0x02   -- Nominal SC compression
          ZEWMSFFS,0x1e   -- Leave standby mode
                          -- 'repeat mode cycle'
                          -- Active part
          ZEWMSBFS,0x18   -- Set WPW (WEL7a = 18)
          ZEWRS0FS,0xae
          ZEWRS1FS,0x22
          ZEWRS2FS,0x60
                          -- 'repeat mode cycle'
          ZEWRSBFS,0x71   -- Command WH WEL7a
          ZEWMS6FS,0x19   -- Set counter 0 to 26
                          -- 'repeat outer'
          ZEWAS0FS,0x107  -- Command SA NM1'b
          ZEWMSEFS,0x03   -- Wait 4 OSTB's
          ZEWMS7FS,0x01   -- Decrement counter 0, jump 'repeat outer'
          ZEWMSEFS,0xc4   -- Jump to 'repeat mode cycle'
          ZEWMSFFS,0x80   -- End macro load
```

SWEC017.ZEW NBR Langmuir (a)

```
Name:           WEC mode macro 17
Description:    NBR Langmuir (a)

00:00:00  ZEWMSFFS,0x51   -- Load macro slot 17
          ZEWMS0FS,0x04   -- WEC 25 Hz sampling
          ZEWMSAFS,0x02   -- Nominal SC compression
          ZEWMSFFS,0x1e   -- Leave standby mode
                          -- 'repeat mode cycle'
                          -- Active part
          ZEWMSBFS,0x18   -- Set WPW (WEL5b = 18)
          ZEWRS0FS,0xad
          ZEWRS1FS,0x12
          ZEWRS2FS,0x60
          ZEWRSBFS,0x61   -- Command WH WEL5a
          ZEWAS0FS,0x107  -- Command SA NM1'b
          ZEWMSEFS,0x03   -- Wait 4 OSTB's
                          -- Passive part
          ZEWMSBFS,0x0b   -- Set WPW (WEL2b = 0b)
          ZEWRS0FS,0xcf
          ZEWRS1FS,0x60
          ZEWRSAFS,0x60   -- Command WH WEL2b
          ZEWMS6FS,0x18   -- Set counter 0 to 25
                          -- 'repeat passive'
          ZEWAS0FS,0x107  -- Command SA NM1'b
          ZEWMSEFS,0x03   -- Wait 4 OSTB's
          ZEWMS7FS,0x01   -- Decrement counter 0, jump 'repeat passive'
          ZEWMSEFS,0xce   -- Jump to 'repeat mode cycle'
          ZEWMSFFS,0x80   -- End macro load
```

SWEC028.ZEW Enter Standby Mode

```
Name:           WEC macro 28

Description:    Load "enter STANDBY" macro into slot 28

00:00:00    ZEWMSFFS,0x5c   -- Load slot 28
            ZEWMS2FS,0xc2   -- Disable SC data
            ZEWCS0FS,0xf3f  -- Flag data disabled in HK cal/test step
            ZEWMS0FS,0x04   -- Set WEC clock to 25 Hz
            ZEWMS2FS,0x83   -- Stop Whisper operations
            ZEWMSDFS,0x00   -- Turn off correlator
            ZEWMSFFS,0xc0   -- Return from macro
            ZEWMSFFS,0x80   -- Stop macro load
```

SWECM029.ZEW Power on EFW, SC and SA

```
Name:           WEC macro 29
Description:    Power on EFW, SC and SA

00:00:00  ZEWMSFFS,0x5d  -- Load slot 29
          ZEWMS2FS,0x40  -- EFW on
          ZEWMSEFS,0x0a  -- Wait 11 OSTB's
          ZEWMS2FS,0x42  -- SC on
          ZEWMSEFS,0x0a  -- Wait 11 OSTB's
          ZEWMS2FS,0x41  -- SA on
          ZEWMSEFS,0x0a  -- Wait 11 OSTB's
          ZEWMSFFS,0xc0  -- Return from macro
          ZEWMSFFS,0x80  -- End macro load
```

SWECM030.ZEW Leave Standby Mode

```
Name:           WEC macro 30
Description:    Load slot 30 with "leave STANDBY" macro.

00:00:00    ZEWMSFFS,0x5e   -- Load slot 30
            ZEWMS2FS,0x82   -- Reset STAFF MWF
            -- May need to modify following address
            ZEWMD1FS,0x3d
            ZEWED1FS,0x80   -- Set mem read to 3d80 (nominal macro)
            ZEWMSFFS,0xc0   -- Return from macro
            ZEWMSFFS,0x80   -- Stop macro load
```

SWECM031.ZEW Power Off All WEC and Stop Correlator

```
Name:           WEC macro 31
Description:    Power off all WEC, stop correlator

00:00:00  ZEWMSFFS,0x5f  -- Load slot 31
          ZEWMS2FS,0x05  -- WH TX off
          ZEWMS2FS,0x04  -- WBD off
          ZEWMS2FS,0x03  -- WH off
          ZEWMS2FS,0x01  -- SA off
          ZEWMS2FS,0x02  -- SC off
          ZEWMS2FS,0x00  -- EFW off
          ZEWMSDFS,0x00  -- Correlator off
          ZEWMSFFS,0xc0  -- Return from macro
          ZEWMSFFS,0x80  -- End macro load
```

3.5.5 DWP macros defined for uploading

The WEC mode is changed by uploading command sequences. This is discussed further in Chapter 6 Nominal Operations.