RTOF Instrument Modes and Measurement Sequences

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1. Change Record

Date	Version No.	Responsible	Description of Change
	3.0	K. Altwegg	First distributed issue
15/12/2000	3.1	K. Altwegg	Appendix C, Windowing mode WCS, Parameters WCS, power consumption, transitions
09/01/01	3.2	K. Altwegg	Add Instrument modes (1,1L,1I, 1G)
13/03/2001	3.3	K. Altwegg	Add low and high sensitivity modes, 1,5,10 kHz modes
03/07/2001	4	K. Altwegg	Add ETS parameter settings
24/01/2002	5	K. Altwegg	Replace WCS by ETS-L

2. RTOF Instrument Modes and Measurement Sequences

2.1 RTOF Instrument Parameter Settings

Channel	STOrage	
	ORThogonal	
	BOTh	
	OFF{cov}	
Function	GAS	
	ION	
	GAs and Ion	
Task	COMetary	
	BACkground	
	SHUt off{pos1,pos2}	
	OPTimization{AMU}	
	CALibration	
Ambient	AMBient{U1,U2}	
Emission	NONe	
	SUBemission{fil}	
	EMIssion{fil,I}	
	HEAt{fil,sec}	
Electron Energy	HIGh	
	LOW	
	VAR{U1,U2}	
Reflections	SINgle	
	TRIple	
	BLAnk{t1,t2}	
Data acquisition	ETS{d,freq,NOE,CAL, thr,MLM, SM, thr_L,MLM_L,SM_L}	_L refers to ETS Light
Data Compression	DAC{num}	

3. Explanations to the RTOF Parameters

Channel:
This parameter determines which channel to be used. Normally the orthosource is used for ions, the storage source for gas. However, if for example the filaments in the storage source fail the orthosource can also be used to measure neutrals. The channel OFF means that both channels are inactive, the {cov} determines if the cover shall be closed (=1) or stay open (=0).
Associated table: cover position; Voltages for ion sources

Function:
This parameter determines if the instrument measures gas, ions, ions and gas simultaneously
Associated tables: Voltages for ion sources

Task:
COMetary means that the instrument measures the cometary (asteroidal) gas and/or ions.
BACkground is measured by deflecting the ions away from the detector (adjust for example reflectron backplane?). This then gives the detector/data acquisition background.
SHUt off closes partly the cover to shut off cometary particles. Mass spectra are measured in a fixed position of the cover if pos1=pos2, or in a series of positions between pos1 and pos2. E.g. cover position is 90 degrees, 80, 70, 60, etc up to 20 degrees. In this way the background from reflections on the spacecraft and/or RTOF can best be distinguished from cometary neutrals,
OPTimization means that the voltages in RTOF are being optimized (S/W to be developed at a later stage, possibly not before the end of 2002). The parameter GCU determines if the GCU is used for this purpose (AMU=0) or if a cometary mass is being used (AMU=mass number)
CALibration will be used to recalibrate RTOF (without optimization) with the GCU.
Associated tables: Voltages for reflectron; cover position;optimization;calibration

Ambient:
This parameter is only active for the function ION. It determines the absolute potential of the external attraction grid. U1 and U2 determine the potential of the grid. If U1=U2 the voltage is fixed. If U1 is not U2 then the voltage is scanned at a fixed number of steps (limits included). Internal voltages are adjusted automatically to the different potentials according to a table.
Associated tables: ion source voltages dependency on attraction potential

Emission:
This parameter sets the emission current and the active filament.
Filament no. 1 and 2 are in the storage source,
filament no. 3 and 4 in the orthosource.
The number of filament settings should be kept as low as possible. RTOF like DFMS 2, 20, 200 μA.
In the setting SUB the filament is kept just below the emission threshold.
In the setting HEA, the ion source heater of the ion source with the filament f would

be used for sec seconds. Parallel to this the filament f would be kept in subemission mode.
Associated tables: FEC settings

Electron Energy:
The electron energy in the source can be adjusted continuously. However, to simplify calibration it is advisable to use only two values regularly:
HIGh (ca. 70 eV), LOW (ca. 17 eV). In the VARiable setting the electron energy will be stepped (0.2 eV steps, tbc) from U1 to U2. It must be guaranteed that no dangerous combinations of emission and electron energies are executed (tbd).
FEC settings

Reflections:
SINgle reflection is the mode with lower resolution but higher sensitivity.
TRIple reflection uses the hardmirror and twice the reflectron to enhance the time of flight and with it the mass resolution.
BLAnk mode uses a triple reflection with a blanking pulse in the hardmirror, t1 indicates the delay of the blank pulse with respect to the extraction pulse, t2 gives the duration of the pulse.
Associated table : Voltages for ion sources, hard mirror and reflectron

Data acquisition:
ETS is connected to the storage source, ETS_Light to the ortho source. If both are active they have to work together, that is, ETS is triggered by ETS_L. The blank pulser can only be triggered by the ETS. A detailed description of the ETS modes is in appendix B to D. *Associated table : calibration table for ETS;*

Data Compression:
This gives the method for the DAta Compression.
0=no compression, which may lead to too much data being produced. The DPU would then stop the data taking. >0=data compression by integration. Num is the minimum number of spectra being integrated. The DPU would increase this value if the data flow is not compatible with the allowed data rate, it would lower it again if permissible, but never below num. <0= wavelet compression.

4. RTOF Sub Parameter Definitions

Channel:	OFF{cov}	cov=0	cover open
		cov=1	cover closed
Task:	SHUt off{pos1,pos2}		
		pos1: start position of cover	
		pos2: end position of cover steps of 10 degrees (TBC)	
	OPTimization(AMU)		
		AMU: mass number to be used for optimization; if AMU=0, GCU is used	
Ambient:	AMBient{U1,U2}		

U1:start voltage of attraction grid potential
U2:stop voltage of attraction grid potential
Steps 2V, TBC

Emission SUBemission{fil}
fil: filament no., 1 and 2 in storage , 3 and 4 ortho
EMIssion{fil,I}
fil: as above
I: Emission current in microamps
HEAt{fil,sec}
fil as above
sec: time in seconds for heating

Electron energy: VAR{U1,U2}
U1: start energy
U2: stop energy
steps 0.2V, TBC

Reflections BLAnk{t1,t2}
t1: delay of blank pulse in microsecs
t2:duration of pulse in microsecs

Data acquisition: ETS{d,freq,thr,MLM, SM, NOE,CAL,thr_L,MLM_L,SM_L }.
The appendix _L refers to ETS_L
d: Ex. Del.: Extraction Delay, this values delays the start of the data acquisition
Freq: Rep. Rate: Extraction frequency **, 2,5,or 10kHz**
NOE: Number of Extractions, a fixed number between 1... 65535 if "on" is selected , if NOE<0 it gives the integration time in seconds. The parameter has to be set to „off" in the ETS and the integration is started and stopped by the DPU.
Cal. Func.: Functions of the internal electrical calibrator 0=off, >0 =on (a few combinations of pulse width, pulse heigth TBD)
Thr (THR_L).: Threshold level of the analog signal discriminator
MLM (MLM_L): Mass Lines Mode: 31, 63, 255 (related to Freq)
SM (SM_L): Sampl. Mode: Sampling Mode, STD, TDC_STD, DTS, TDC_DTS or HIRM, for SM_L only TDC modes

Data compression: DAC{num}
num=0: no compression
num>0: compression by integration over num spectra
num<0: wavelet compression

5. Examples of RTOF Modes

To facilitate the definition of measurement sequences it is necessary to use short hand designation for specific modes. The simplest solution is to just consecutively number the modes. This requires that an updated table of modes is available to designate sequences. The numbering should however follow a few simple rules:

Thus the following last digits should be used for the following combination of channel, function:

- 0: Other combinations of source,task,freq
- 1: STO,GAS,ETS,10kHz
- 2: STO,ION,ETS, 10 kHz
- 3: ORT,GAS,ETS_L, 10 kHz
- 4: ORT,ION,ETS_L, 10 kHz
- 5: BOT,GAI, both ETS, 10 kHz
- 6: STO,GAS,ETS,5 kHz
- 7: ORT,ION,ETS_L, 5 kHz
- 8: STO,GAS,ETS,2 kHz
- 9: ORT,ION,ETS_L, 2 kHz

The numbering should be arranged as follows:

- 0 to 49 Basic modes for switch on/off
- 50 to 99 Bake out and other technical modes
- 100 to 499 Basic optimization and calibration modes
- 500 to 999 Standard survey modes
- 1000 to 1999 Modes specialized for scientific questions
- 2000 to 9999 Custom modes

A wide mass range, storage source only mode would be defined by the following parameter set:

A normal gas and ion mode for RTOF could be commanded by:

M205:
mode(BOT,GAI,COM,AMB{5,5},EMI{1,med},HIG,TRI,ETS{10,10,0, 31,STD,0,-100,1,31,STD}, DAC{-1}) In this mode the instrument would measure cometary gas and ions, using both channels and both data acquisition systems. The filament 1 has a medium emission (20 microA) and an electron energy of 70 eV. The hard mirror is active, triple reflection. Delay time for both ETS and ETS_L is 10 μs, the measurement mode for both ETS is standard, which is with ADC for the ETS. The threshold level is 0 for ETS and 1 for ETS_L. Data compression is by wavelet compression. Integration time is 100 s/spectra. The extraction frequency is 10 kHz.

A lower power mode is given by:

M201:
mode(STO,GAS,COM,AMB{0,0},EMI{1,med},HIG,SIN,ETS{10,10, 0,31,TDC,0,-100,0,0,0}, DAC{-1})

The background is then measured by the two following sequences:

M101:
mode(STO,GAS,BAC,AMB{0,0},EMI{1,med},HIG,SIN,ETS{10,10, 0,31,TDC,0,-100,0,0,0}, DAC{10})
M111:
mode(STO,GAS,SHU{10,80},AMB{0,0},EMI{1,med},HIG,SIN,ETS{10,10, 0,31,TDC,0,-100,0,0,0}, DAC{10})

ETS is put in the TDC mode (ADC inactive). M101 measures the electronic background (the pulser voltage is misadjusted)). The integration is 10 spectra, that is 2000 sec. M111 then measures the gas density while the cover is being closed in steps of 10 degrees (TBC) from 10 degrees to 80 degrees. This gives a measure for the background molecules coming from inside the ion source or being reflected from the spacecraft or from RTOF itself. Maximum number of mass lines per extraction is 31 (should be sufficient if we need the low power mode); the extraction frequency is 10 kHz.

6. Possible Standard RTOF Modes

The RTOF Instrument Modes are detailed in a separated document named RTOF_MODE_DESC.ASC.

7. Power Consumption in the different modes

The power consumption of RTOF is composed of six main components, namely of the standby power (low voltage converters and main controller), of the analyzer part, of the filament, of the data acquisition system(s) used, of the ion source heater and of the cover motor. It does vary neither with triple or single reflection nor with using one or two channels. The following table shows the four contributions:

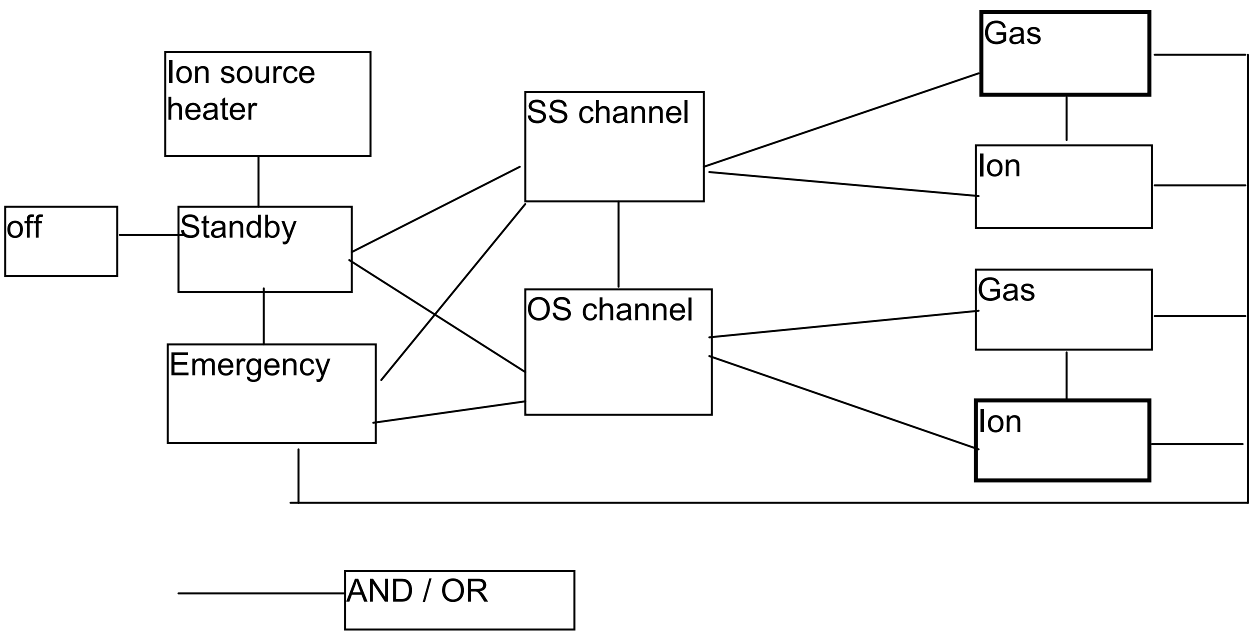
	Power (W)
Standby mode (LVPS, MC)	11.2
Analyzer Part	1.5
Filament	2.8
ETS low power or ETS_L / ETS normal/ Both	4 / 7 / 11
Ion source heater*	12
Cover motor	2

- *Not run in parallel to analyzer part, filament or cover motor

The power used by RTOF in each mode can therefore be calculated. A normal measurement mode (one channel only) in power savings mode needs 19.5 W; with ETS in normal operation 22.5 W, with ETS and ETS_L 26.5 W, the ion source heater needs 23.2 W.

8. Mode Transitions

All mode transitions are controlled by the DPU.



8.1 From Standby to SS OR / AND OS mode and vice versa

To go from standby mode to either the SS (Storage Source) or OS (Ortho Source) mode needs the activation of the high voltage power supply. This is done in a predefined sequence by the DPU (set voltages to zero, activate high voltage enable, set voltages in a predefined sequence to their respective values). The SS and the OS mode can be run in parallel. To go back to standby mode is done in the same way (set voltages to zero, disable high voltages).

8.2 From Ion mode to Gas mode and vice versa

For all the gas modes (including Gas calibration, optimization and background measurement with the cover) the filament is needed. For this mode normally the Storage Source is used. The ion modes can either be done with the filament in subemission mode or with the filament off. For this mode the Ortho source is optimised. If both channels are active, normal operation in the OS is without filament, in the SS with filament in emission mode. However, if for scientific reasons or because one of the channels is degraded, gas and ions are measured with the same channel the following restrictions apply: To switch between gas and ion mode and vice versa is done by adjusting the filament current from emission to subemission and vice versa in order not to stress the filament. This is also controlled by the DPU.

8.3 From Standby to Ion source heater mode and vice versa

The ion source heater mode is activated by the DPU from the standby mode only. No transitions are foreseen from any active mode into this mode.

8.4 Transition into emergency mode

From all modes, a transition into the emergency mode is possible. From the emergency mode the only transition allowed is into standby mode (TBC).

8.5 All other mode changes

All mode transitions not shown in the diagram (e.g. triple reflection to single reflection, electronic noise to cometary gas measurement, optimization to calibration, etc.) can be done without involving any intermediate modes. There are no mode transitions, which are forbidden, except the ones shown above.

9. Examples of RTOF measurement sequences

Standard Survey sequence, low power mode:

Step no.	Mode	Description	Time
10	M50	10 minutes bake of storage source	600 s
20	M1	Storage source switch on, A waiting time to stabilize ion source may be required	50 s
30	M161	Storage source, Gas, Electr. Background,ETS low power	100 s
40	M221	Storage source, Gas, Background, ETS , low power	1000 s
50	n*M261	Storage source, Gas, Survey, ETS,low power	n*100 s
60	M161	Storage source, Gas, Electr. Background,ETS, low power	100 s
70	go to 50		

Standard Survey Sequence, full power mode

Step no.	Mode	Description	Time
10	M50	10 minutes bake of storage source	600 s
20	M5	Storage source and ortho source switch on A waiting time to stabilize ion source may be required	50 s
30	M155	Both sources,Gas and ions, Electr. Background,ETS and ETS_L	50 s
40	M245	Both sources, Gas and ions, S/C charging, ETS and ETS_L	1000 s
50	M2156	Both sources, Gas and ions, Background,ETS and ETS_L	1000 s
60	n*M205	Both sources, Gas and Ions, Survey, ETS and ETS_L	n*100 s
70	M155	Both sources, Gas and ions, Electr. Background,ETS and ETS_L	50 s
80	go to 60		

10. Tabels necessary to run RTOF autonomously (stored in the DPU)

Table 1: Standard voltage values for mass spectrum at 20 °C

Storage source parameters	**Ortho source parameters**	**Reflectron, single reflection**	**Reflectron, triple reflection**	**Hard Mirror**
Lens 1: $L1_0$	Lens 1	Lens	Lens	Lens
Lens 2	Lens 2	U1	U1	U1
Backplane	Backplane	U2	U2	Backplane
etc.	etc.	Backplane	Backplane	etc.
		etc	etc	

Table 2: Functions of temperatures for all voltages :

Storage source parameters	**Ortho source parameters**	**Reflectron, single reflection**	**Reflectron, triple reflection**	**Hard Mirror**
Lens 1:$L1(T)=L1_0*f(T)$				
etc.				

Table 3: Relationship between mass no. and delay time for single and triple reflections:

m=f(t)

Table 4: Relationship between attraction grid potential and source voltages for ortho source and storage source

See Appendix C

Table 6.: Cover position table

Table 7a….: Tables for Optimisation

Table 8: Settings for FEC: High, med, low emission, subemission

Table 9: Calibration mode tables for ETS_L and ETS (internal pulser)

11. Appendix A: Time of Flight

Below some typical TOF's (μs) for inexperienced people like myself:

Mass	TOF single	delta to next mass	TOF triple	delta to next mass
1	3.3	1.3	6	2.5
4	6.5	0.9	12	1.3
28	17	0.3	31	0.56
40	21	0.26	37	0.47
130	37	0.14	68	0.26
300	56	0.09	103	0.17

12. Appendix B: ETS and ETS_L Operations

The ETS has the following parameters

ETS{d,thr,fifo,freq,int,ADC,dts,cal}

Thereby the parameters have the following meaning:

d	delay (units TBD)
thr	threshold (0…7)
fifo	number of mass lines allowed (16 ADC samples per mass line)
freq	Extraction pulser frequency
Int	Integration time
ADC	=1: ADC is on; =0 ADC is off (2.5W power savings); not for ETS_L
Dts:	delayed time sampling, 0=off, 1=on; <0 =high resolution mode
cal	Calibration (0=off, 1….n different combinations of settings of pulse height,etc., TBD)

The time to take one ETS spectrum is divided into the following sections:

d is the delay time before ETS starts looking for peaks. Electronic noise can also trigger the ETS signal acquisition, which looks the same to the ETS electronics. At the moment the extraction pulser disturbance extends to approx. 10 µs after pulser firing, which then gives the minimal useful time for d. However, protons will arrive at approx. 3 µs in single reflection mode and arrive at approx. 6 µs in triple reflection mode. s is the time while ETS looks for mass peaks. d+s therefore gives the flight time of the heaviest mass in the mass range. Acc is the time needed to calculate the spectrum. This is given by number of detected mass lines x 1.3 µs. T is the time period for 1 spectrum and is 1/f with f being the frequency of the extraction pulser. While d and s are fixed, acc depends on the number of detected mass lines. The ETS is able to record up to 256 signals (e.g. mass lines) per spectrum.

In order to keep f constant which is essential to be able to analyze the data at least for the storage source it was decided to add one more parameter for ETS which is fifo. This is the maximum number of mass lines allowed for a given frequency. This then fixes the time acc. Fifo can have the following values:

31 which corresponds to acc = 40.3 µs
63 which corresponds to acc = 80.6 µs
255 which corresponds to acc = 322.4 µs

The max. value of s is 217 μs; this time is given by the size of the data memory in ETS. This corresponds to 128 kWords (48 bits/word; 30 for the ADC, 18 for the counter) of data.

From this the following table can be deduced:

1/Freq (μs)	**d_{min} (μs)**	**s (μs)**	**$Fifo_{max}$**	**acc (μs)**
100	10	50	31	40
200	10	110	63	80
500	10	170	255	320
1000	10	217	255	320
200	10	70 (high resolution)	63	80

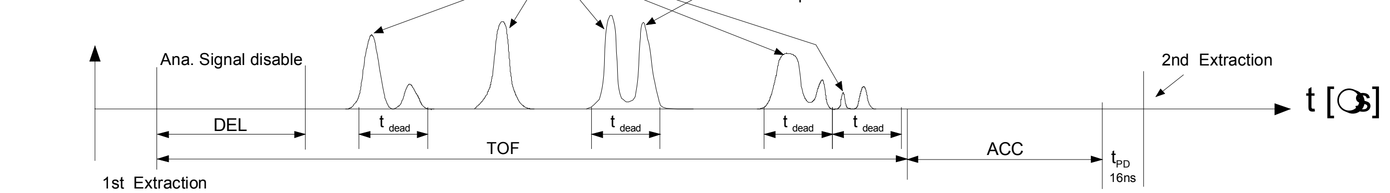
I suggest the following combinations of fifo and freq to be used:

Purpose	**d (μs)**	**freq (kHz)**	**fifo**	**Max. mass (amu)**
Normal survey, triple reflection	10	2	255	>300
Low intensity mode, single refl.	10	5	63	>300
Light masses only, high sensitivity	10	10	31	>300 (single refl.) 100 (triple refl.)
Very large mass range	Variable (<217 μs), i.e. first spectrum 10, second spectrum 100	2	255	>1000
High resolution, triple reflection	Variable, i.e. first spectrum 10, second spectrum 60	5	63	>300

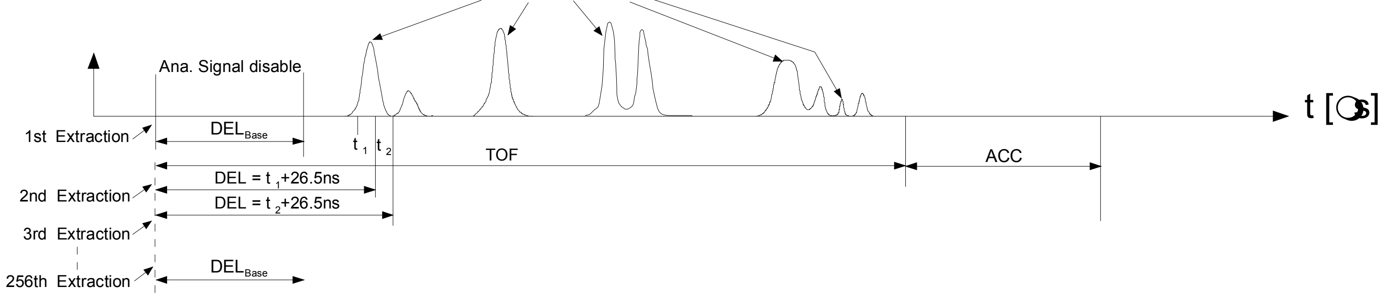
13. Appendix C: ETS Sampling Modes

Mode		Commands *		Extraction Period	Prog. Parameters				Resolution		DPU Readout	Event dead time [ns]
No	Name	DTS	HIRM		Delay [μs]	TOF [μs]	Spectrum [μs]	# of mass lines	TDC	ADC		
0	STANDARD	off	off	TOF + ACC	0...217.0615	0...217.0615	–	→ 255 → 63 → 31	1.65	1.65	Delay: HK as info	133
1	DTS	on	off	TOF + ACC	0...217.0615	0...217.0615	–	→ 255 → 63 → 31	1.65	1.65	Delay: HK as info	0
2	HIRM	off	on	DEL + S + ACC	0...217.0615	–	0...54.272	→ 255 → 63 → 31	0.55	0.55	Delay: required	133
3	HI_DTS	on	on	TOF + ACC	0...217.0615	0...217.0615	–	→ 255 → 63 → 31	0.55	0.55	Delay: HK as info	0

0 = Standard Mode (STD)

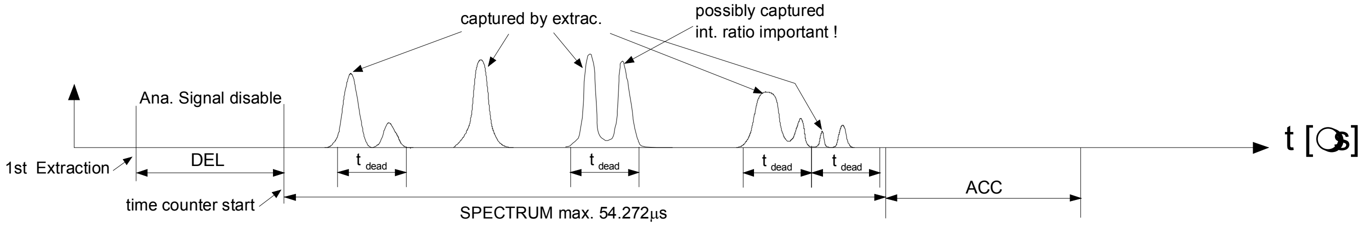


1 = Scanning Mode (DTS)



The time of flight of the first event after the delay time (base delay) is elapsed is the new delay time for the next extraction.
After 255 delay increments the next extraction starts with the base delay again. The delay is always increased by an event, but the restart condition can be selected between counting the extraction or the event up to 255. When DEL has reached TOF the system starts from DEL_{BASE} again.

2 = High Resolution Mode (HIRM)



In this mode the max. spectrum time is 54.272µs. But to have the possibility to measure in high resolution thru the entire spectrum time, given by the mass range, the delay time is set as an offset not only for the analog disable, but also for the start od the time measurement. Therefore it is required that the DPU transfers the delay time setting for each individual spectrum. There are fourtimes more extraction needed than in the standard mode!

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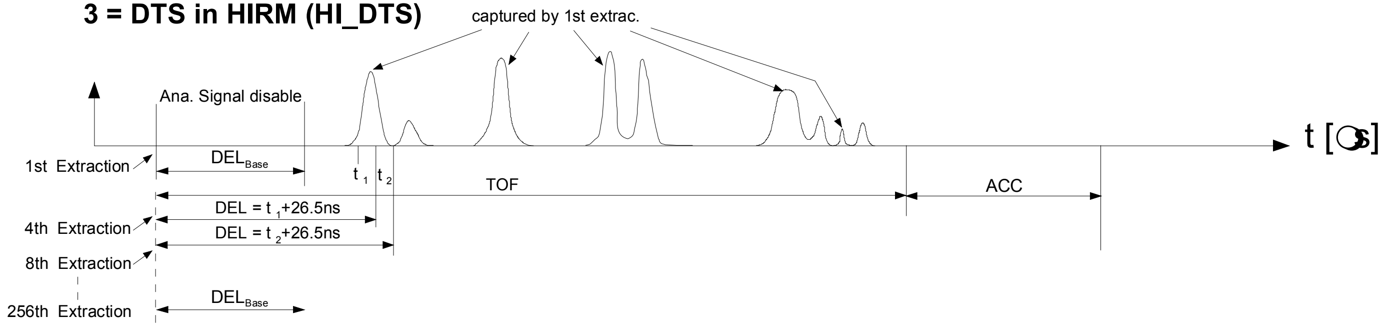
Title : DTS Sampling Modes	
Size : A4	Number : Last Revision :
Date : 00-11-02	Sheet : 1 of 2
File : int_con.ds4	Drawn by: A. Loose

3 = DTS in HIRM (HI_DTS)



The diference to the DTS without HIRM is that the event depended delay is active with every 4th extraction. That means integration time must be fourtimes higher to get the same statistics as in the DTS mode. The delay is always increased by an event, but the restart condition can be selected between counting the extraction or the event up to 255. When DEL has reached TOF the system starts from DELBASE again.

Mass Line Mode	ACC [µs]
31	39.432
63	80.136
255	324.360

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Title : DTS Sampling Modes		
Size : A4	Number :	Last Revision :
Date : 00-11-02	Sheet : 2 of 2	
File : int_con.ds4	Drawn by: A. Loose	

14. Appendix D: ETS Parameter Settings

NEW Parameter Definitions:
ETS{d,freq,thr,MLM, SM, NOE,CAL }

The modified parameters are listed in red!
lowest frequency 1.84kHz.

File ETS_PAR_M#.txt

Explanation of Parameters:

d: Ex. Del.: Extraction Delay, this values delays the start of the data acquisition
Freq: Rep. Rate: Extraction frequency
Thr.: Threshold level of the analog signal discriminator
MLM: Mass Lines Mode: 31, 63, 255 or adaptive 1 to 512
SM: Sampl. Mode: Sampling Mode, STD, TDC_STD, DTS, TDC_DTS or HIRM
NOE: Number of Extractions, a fix number between 1... 65535 if "on" is selected
Cal. Func.: Functions of the internal electrical calibrator 0=off, >0 =on (a few combinations of pulse width, pulse heigth TBD)

Other parameters for the ETS which will be deduced from the instrument mode parameters

Sync.: Synchronization: internal(=0) or external (=1) trigger
See also ETS Documentation for detailed information!

Other parameters for the ETS, to be set by the DPU independent of instrument mode?

RAM: Memory function: NONE, CLR or TEST before data acquisition
Mem. Range: Memory readout address range
TOF: Time Of Flight of extracted ions, after this time accumulation is initiated (derived from freq, d and MLM)

Table : List of ETS Parameter settings for RTOF Operation

Mode	File #	Parameter ETS{ d,freq,thr,MLM, SM, NOE,CAL }	Rep. Rate [kHz]	MLM	TOF [µs]	Ex. Del [µs]	Sampl. Mode	Trig. to Source N/A	Sig. Input N/A	Thr. [mV]	Sync.	Cal. Func.	Cal. Width [ns]	Cal Height [mV]	NOE	RAM	Mem. Range [µs]
OPTIMIZATION AND CALIBRATION MODES																	
101 111 121 131 141 151 161 171 181 191 201 211	1	10,10,0,31,STD,off,0	10	31	60.0225	9.9915	STD			18	Int	off	0	0	off	CLR	0 ... 64.9968
STANDARD MODES																	
506 516 526	0	10,5,0,63,STD,off,0	5	63	118.694	9.9915	STD	GAS	GAS	18	Int	off	0	0	off	CLR	0 ... 120.001
501 511 521 531 541 551	2	10,10,0,31,STD,off,0	10	31	118.694	9.9915	STD	ION	ION	18	Int	off	0	0	off	CLR	0 ... 120.001
504 505 514 524 534 535 544 554 815	2	10,10,0,31,STD,off,0	10	31	118.694	9.9915	STD	ION	ION	18	Int	off	0	0	off	CLR	0 ... 120.001
509		10,2,0, 255,STD,off,0															0

Mode	File #	Parameter ETS{ d,freq,thr,MLM, SM, NOE,CAL }	Rep. Rate [kHz]	MLM	TOF [µs]	Ex. Del [µs]	Sampl. Mode	Trig. to Source N/A	Sig. Input N/A	Thr. [mV]	Sync.	Cal. Func.	Cal. Width [ns]	Cal Height [mV]	NOE	RAM	Mem. Range [µs]
519 529 819	3		2	255	172.754	9.9915	STD	GAS	GAS	18	Int	off	0	0	off	CLR	... 174.999
591 601 611	4	10,5,0, 63,DTS,off,0	5	63	118.694	9.9915	ADC + DTS	GAS	GAS	18	Int	off	0	0	off	CLR	0 ... 120.001
861	5	10,5,0, 63,TDC_STD,off,0	5	63	118.694	9.9915	TDC_ STD	GAS	GAS	18	Int	off	0	0	off	CLR	0 ... 120.001
864 865	6	10,5,0, 63,TDC_STD,off,0	5	63	118.694	9.9915	TDC_ STD	ION	ION	18	Int	off	0	0	off	CLR	0 ... 120.001
871	7	10,2,0, 255,TDC_STD,off,0	2	255	172.754	9.9915	STD	GAS	GAS	18	Int	off	0	0	off	CLR	0 ... 174.999
874	8	10,2,0, 255,TDC_STD,off,0	2	255	172.754	9.9915	STD	ION	ION	18	Int	off	0	0			
196 506 516 526 536 546 556 596 606 616	9	10,5,0, 63,STD,off,0	5				STD	ION	ION		Ext						
802	10	100,5,0, 63,STD,off,0	5	63			STD	GAS	GAS		Ext						
801	11	10 ,5,0, 63,HIRM,off,0	5	63			HIRM	GAS	GAS		Ext						
804	12	10,5,0, 63,HIRM,off,0	5	63			HIRM	ION	ION		Ext						
211	13	10,10,0, 31,STD,1,N	10				STD	GAS	GAS		Int	On	TBD	TBD	1		
214	14	10,10,0, 31,STD,1,N	10				STD	ION	ION		Int	On	TBD	TBD	1	CLR	0

Mode	File #	Parameter ETS{ d,freq,thr,MLM, SM, NOE,CAL }	Rep. Rate [kHz]	MLM	TOF [µs]	Ex. Del [µs]	Sampl. Mode	Trig. to Source N/A	Sig. Input N/A	Thr. [mV]	Sync.	Cal. Func.	Cal. Width [ns]	Cal Height [mV]	NOE	RA M	Mem. Range [µs]
																	… 174.999