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TELECOMMANDS OF THE RETE EXPERIMENT

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1. RETE MODES OF OPERATIONS

An accurate description of the RETE modes of operation,the data which are acquired in each mode and the time resolution is contained in Ref. 1.Here we will give just a summary description of the main modes to be used in the baseline of RETE operations.All of these, except NM (Normal Mode), are accessible only by TLC.

1a SUMMARY OF RETE MODES OF OPERATION

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NM(Normal Mode) :

When RETE is powered on it goes into a default mode of operation called Normal Mode (NM)>.In this mode simultaneous ac and dc measurements are taken.The ac measurements refer to the three different frequency ranges (LF,MF,HF) with a cyclical rotation between sensors on the different axes.
With no other telecommand,RETE would remain in this mode of operation. If this mode is not interrupted by TLC,in the last 6 of every 64 formats,a change takes place automatically to Mode PP3 (200 Hz waveform mode) which is more DC dedicated (see below).

MODE 1 :

This is the Normal Mode NM except that the experiment does not switch automatically to PP3 in the last 6 of every 64 formats.

NM1:

By this we denote several possible variations on the mode NM.
a) a given sensor can be chosen in the LF range.
b) a given sensor pair can be fixed in the MF frequency range.
c) a given sensor can be fixed in the HF range.
d) we can fix a frequency in the HF range and have high resolution measurements around that frequency.
e) we can select the gain in the attenuators.

These possibilities will be denoted below by NM1a-e.

PP2:

Mode dedicated to mostly to plasma package data and , in particular, to a survey of the effect of varying the penthode equivalent resistance. Ac data are acquired only in LF range, in the same way as in NM.

PP3:

Mode dedicated mostly to waveform samplying of E at 340 Hz rate. AC data are acquired only in LF range, in the same way as in NM.

WFC:

Waveform capture mode dedicated to fast data acquisition (either tether current or IF signals) using the DPU memory buffer.This mode is in turn divided into different submodes :
a) immediate acquisition
b) MF chain acquisition
c) tether current acquisition.

CAL:

Calibration mode: it can be actuated by telecommand. Otherwise, it is actuated, for 2 formats every 514 formats,when the experiment is in NM.

2.BASIC RETE TELECOMMANDS

We give in the following the bit structure of the basic telecommands relevant to the modes introduced in the previous section.

NM : RETURN TO NORMAL MODE*[1]

BIT		
B15-B11	:	1 0 0 0 0
B10-B0	:	not significant

In Hexadecimal the NM TLC is : 8000.

MODE 1

BIT		
B15-B11	:	1 0 1 0 1
B10-B0	:	not significant

In Hexadecimal the MODE 1 TLC is : A800.

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*NOTE : We need this TLC only if we want to go to NM from another mode.When the experiment is turned on,it goes automatically in NM.

1.

NM1a-c : Normal Mode Fixed Sensor

BIT		
B15-B11	:	1 0 0 0 1
B10-B8	:	not significant
B7 -B6	:	selection of frequency chain
		0 1 LF CHAIN
		1 0 MF CHAIN
		1 1 HF CHAIN
B5-B3	:	selection of sensors in LF or MF1 or HF
		0 0 0 Ex
		0 0 1 Ey
		0 1 0 Ez
		0 1 1 Bx or Bzh
		1 0 0 Bz
B2-B0	:	selection of sensor in MF2
		0 0 0 Ex
		0 0 1 Ey
		0 1 0 Ez
		0 1 1 Bx
		1 0 0 Bz

NOTE : the bits B2-B0 are significant only if B7-B6 = 1 0.

All the commands of NM1a-c are listed in Hexadecimals in Table 1.

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NM1d : High Frequency Selection

BIT		
B15-B11	:	1 0 0 1 0
B10-B8	:	not significant
B7-B0	:	frequency selection in HF
		00000000 channel 0
		00000001 channel 1
		. .
		. .
		. .
		11111111 channel 255

In Hexadecimal we have the following variable field for NM1d :

9 0 0 0 - 9 0 F F

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NM1e : Select Attenuation

B15-B11	:	1 0 1 0 0
B10-B8	:	not significant
B7- B4	:	selection of frequency band

0 0 0 0	band A
0 0 0 1	band B
0 0 1 0	band C1
0 0 1 1	band D1
0 1 0 0	band E1
0 1 0 1	band F1
0 1 1 0	band C2
0 1 1 1	band D2
1 0 0 0	band E2
1 0 0 1	band F2
1 0 1 0	HF

B3 -B1 : selection of sensor

0 0 0	Ex
0 0 1	Ey
0 1 0	Ez
0 1 1	Bx or Bh in HF
1 0 0	Bz

B0 : select attenuation value

0	ON
1	OFF

MODES PP2 and PP3 (DC Modes)

BIT		
B15-B11	:	1 0 1 1 0
B10-B1	:	not significant
B0	:	mode identification

0	PP2 (Penthode Mode)
1	PP3 (200 Hz Mode)

In Hexadecimal the commands are :

PP2	:	B000
PP3	:	B001

3.WFC COMMANDS

WFC-a : Waveform capture-Immediate acquisition

BIT		
B15-B11	:	0 0 0 0 0
B10-B5	:	not significant
B4 -B3	:	MF band selection
		0 0 C
		0 1 D
		1 0 E
		1 1 F
B2 -B0	:	Sensor selection
		0 0 0 Ex
		0 0 1 Ey
		0 1 0 Ez
		0 1 1 Bx
		1 0 0 Bz

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WFC-b : Waveform Capture-MF chain acquisition

This Mode requires two telecommands.The first one (TLC1) individuates the Mode properly.As this particular mode requires also a current threshold to be established,a second telecommand (TLC2) is used to do that.

TLC1 : MF chain acquisition

BIT		
B15-B11	:	0 0 0 0 1
B10-B5	:	Selection of sampling time*
		0 T 3F
B4 -B3	:	MF band selection
		see WFC-a
B2 -B0	:	Sensor selection
		see WFC-a

* When the tether current reaches the threshold value indicated by TLC2 (see the following),the MF chain acquisition goes up for a certain time,indicated by bits B10-B5 of TLC1,and then stops.If this time is greater than the storing time of the converted data,MF data are overwritten on the buffer.Therefore,the choice of this time implies the possibility of delaying the collection of those data which are then transmitted.This delay or sampling time is indicated,in the layout of TLC1,in unit of 256 proceeding samples (6 bits).The time for each sample is the storing time of the converted data and therefore depends in turn on the frequency band of the input signal.

TLC2 : Tether Current Threshold

BIT

B15-B11 : 0 0 0 1 1
B10-B0 : Value of Threshold

0 0 0 V 7 F F ?

WFC-c : Tether Current Acquisition

BIT		
B15-B11	:	0 0 0 1 0
B10-B1	:	not significant
B0	:	data accuracy*
		0 least significative byte
		1 most significative byte

* The tether current is converted into a 12 bits word,although only 8 bits are stored in the RAM buffer and sent to the telemetry.The bit B0 of the TLC specifies if the most significant bits or the least significant ones must be stores.

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WFC STOP

BIT		
B15-B13	:	0 0 1
B12-B0	:	not significant

4.DC DEDICATED COMMANDS

In all of the modes recalled to in Sect. 1,several DC measurements are taken .These are : LP sweeps , LP fixed bias ,DC E field , ion measurements and are described in Ref. 1.

Many variations in the above mentioned measurements are possible through several DC dedicated commands.

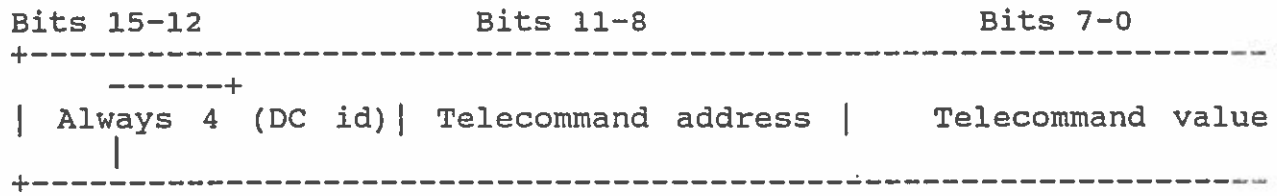
If no such dedicated commands are used,but only the TLC'S already given (leading to NM,NM1.PP2,PP3) a default configuration is chosen for the DC measurements in the various modes.The default values,which correspond to the 0's of the bit specification given below, are as follows :

LP FINE SWEEP	:	OFF
SWEEP START VALUE	:	32
SWEEP DECREMENT VALUE	:	32
LP SAMPLES PER SWEEP	:	32
LP FIX SWEEP VALUE	:	32
E FIELD BIAS VALUE	:	OFF
LP GAIN	:	HIGH
SETTING OF PENTHODE MODE	:	CURRENT MODE
PENTODE RESISTOR SETTING	:	0
SHUNT CAPACITOR SETTING	:	OFF
CALIBRATION RELAY	:	OFF
E FIELD GAIN	:	LOW
AC PROBES GAIN	:	LOW

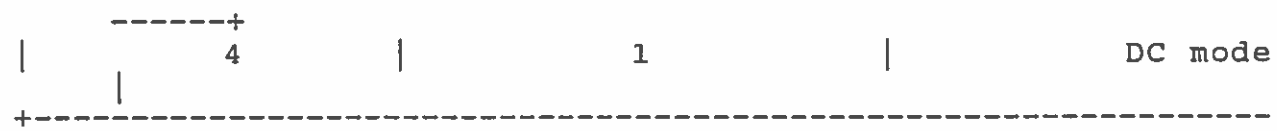
The list and structure of the dedicated DC commands which,in any possible RETE mode produce variations of the above default values for the DC measurements is given below.

List of RETE DC Telecommands.

The DC Telecommands are a 16 bit commands with the following layout:



Telecommand address = 1 : Dc Mode command *



DC Mode = 0 => DC experiment in Normal mode.
= 1 => DC experiment in RETE 200 Hz mode (DC submode survey mode)
= 2 => DC experiment in RETE 200 Hz mode (DC submode 200 hz)

* Note that the DC mode command is not a TLC that can be sent to the DCE directly but it is rather transmitted as a command to the DCE from the RETE DPU when the overall mode of RETE is changing.

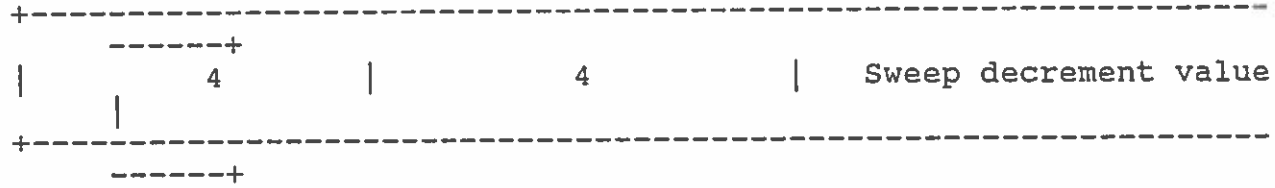
Telecommand address = 2 : Langmuir probe Fine sweep command

Fine sweep = 0 => Fine sweep off.
= 1 => Fine sweep on.

Telecommand address = 3 : Langmuir probe Sweep start value.

Sweep start value : 0-31.

Telecommand address = 4 : Langmuir probe Sweep decrement value



Sweep decrement value : 0-31.

Telecommand address = 5 : Langmuir probe sweep samples.

Sweep samples = 0 => Take 32 samples per sweep.
= 1 => Take 64 samples per sweep.
= 2 => Take 128 samples per sweep.

Telecommand address = 6 : Langmuir probe fix sweep.

Fix sweep : 0-31.

Telecommand address = 7 : E-field bias values

E-field bias = 0 => Bias off.
= 1 => Bias = 40 nAmp.
= 2 => Bias = 70 nAmp.
= 3 => Bias = 140 nAmp.

Telecommand address = 8 : Langmuir probe gain.

Langmuir probe gain = 0 => Set probe in high gain.
= 1 => Set probe in Low gain.
= 2 => Set probe in auto gain.

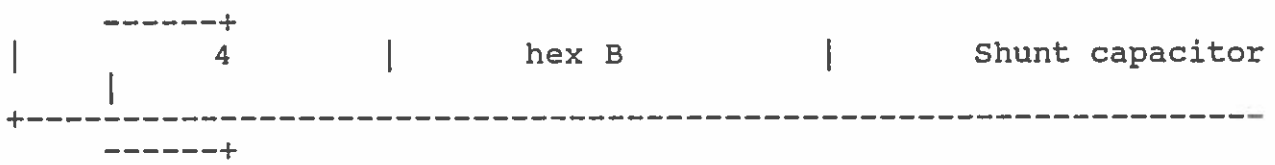
Telecommand address = 9 : Pentode Resistor/Current Setting.

Resistor/Current Setting : 0-255.

Telecommand address = 10 : Set Pentode mode

Pentode mode = 0 => Pentode in Current mode.
= 1 => Pentode in Resistor mode.

Telecommand address = 11 : Shunt capacitor setting.



Shunt capacitor = 0 => Shunt capacitor off.
= 1 => Shunt capacitor on.

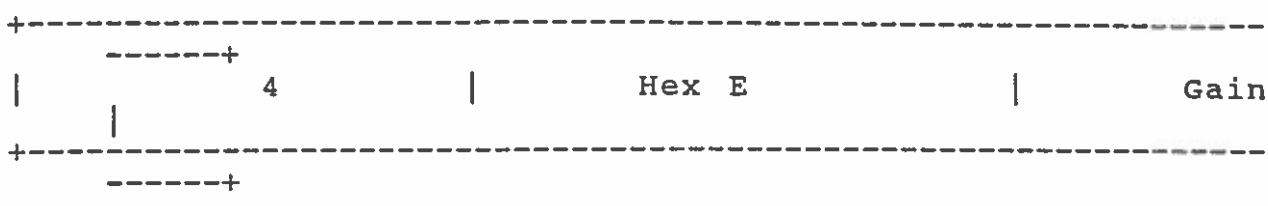
Telecommand address = 12 : Calibration relay.

Calibration = 0 => Calibration relay off.
= 1 => Calibration relay on.

Telecommand address = 13 : E-field gain factor

Gain factor = 0 => E-field probes in low gain.
= 1 => E-field probes in high gain.

Telecommand address = 14 : AC gain setting



Gain = 0 => AC probes in low gain
= 1 => AC probes in high gain.

TABLE 1

Unit Code	Exp.	Description	Value [Hex]	Source
1036	01	FIX Ex on LF	[8840]	RTUP
1036	01	FIX Ey on LF	[8848]	RTUP
1036	01	FIX Ez on LF	[8850]	RTUP
1036	01	FIX Bx on LF	[8858]	RTUP
1036	01	FIX Bz on LF	[8860]	RTUP

Unit Code	Exp.	Description	Value [Hex]	Source
1036	01	FIX Ex on HF	[88C0]	RTUP
1036	01	FIX Ey on HF	[88C8]	RTUP
1036	01	FIX Ez on HF	[88D0]	RTUP
1036	01	FIX Bh on HF	[88D8]	RTUP

Unit Code	Exp.	Description	Value [Hex]	Source
1036	01	FIX Ex,Ex[MF1-2]	[8880]	RTUP
1036	01	FIX Ex,Ey[MF1-2]	[8881]	RTUP
1036	01	FIX Ex,Ez[MF1-2]	[8882]	RTUP
1036	01	FIX Ex,Bx[MF1-2]	[8883]	RTUP
1036	01	FIX Ex,Bz[MF1-2]	[8884]	RTUP
1036	01	FIX Ey,Ex[MF1-2]	[8888]	RTUP
1036	01	FIX Ey,Ey[MF1-2]	[8889]	RTUP
1036	01	FIX Ey,Ez[MF1-2]	[888A]	RTUP
1036	01	FIX Ey,Bx[MF1-2]	[888B]	RTUP
1036	01	FIX Ey,Bz[MF1-2]	[888C]	RTUP
1036	01	FIX Ez,Ex[MF1-2]	[8890]	RTUP
1036	01	FIX Ez,Ey[MF1-2]	[8891]	RTUP
1036	01	FIX Ez,Ez[MF1-2]	[8892]	RTUP
1036	01	FIX Ez,Bx[MF1-2]	[8893]	RTUP
1036	01	FIX Ez,Bz[MF1-2]	[8894]	RTUP
1036	01	FIX Bx,Ex[MF1-2]	[8898]	RTUP
1036	01	FIX Bx,Ey[MF1-2]	[8899]	RTUP
1036	01	FIX Bx,Ez[MF1-2]	[889A]	RTUP
1036	01	FIX Bx,Bx[MF1-2]	[889B]	RTUP
1036	01	FIX Bx,Bz[MF1-2]	[889C]	RTUP
1036	01	FIX Bz,Ex[MF1-2]	[88A0]	RTUP
1036	01	FIX Bz,Ey[MF1-2]	[88A1]	RTUP
1036	01	FIX Bz,Ez[MF1-2]	[88A2]	RTUP
1036	01	FIX Bz,Bx[MF1-2]	[88A3]	RTUP
1036	01	FIX Bz,Bz[MF1-2]	[88A4]	RTUP

TABLE 2

DEDICATED DC COMMANDS

DESCRIPTION		COMMAND (Hex)
DC mode setting	MODE 1	4100 *
	Penthode Survey (PP2)	4101 *
	200 Hz mode (PP3)	4102 *
LP Fine Sweep Off		4200
LP Fine Sweep On		4201
LP Sweep Start Value		4300-431F
LP Sweep Decrement Value		4400-441F
LP Sweep Samples	32/sec	4500
	64/sec	4501
	128/sec	4502
LP Fixed Sweep		4600-461F
E Field Bias	Off	4700
	40 nA	4701
	70 nA	4702
	140 nA	4703
LP Gain	High	4800
	Low	4801
	Auto	4802
Penthode Resistor/Current Setting		4900-49FF
Set Penthode in Current Mode		4A00
Set Penthode in Resistor Mode		4A01
Shunt Capacitor Setting	Off	4B00
	On	4B01

Calibration Relay	Off	4C00
	On	4C01
E Field Gain	Low	4D00
	High	4D01
AC Gain	Low	4E00
	High	4E01

* Note that these commands are sent internally to the RETE experiment,e.g.from the DPU to the DCE.