Manual Code Number 983-298

RE 201 Dual Channel Audio Analyzer

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IEEE488 Commands

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SECTION 1 INTRODUCTION

INTRODUCTION TO THIS SECTION

This section describes how to control the RE201 by means of a GPIB controller and the RE201 IEEE488 bus interface. Apart from this introduction it is composed of the following eight subjects:

2 General description of the IEEE488 interface describing the bus concept and the organization of the bus.

3 General operational aspects concerning the RE201 under bus control, including a typical measuring sequence, and typical use of set-ups.

4 IEEE488 bus implementation in the RE201 covering the interface functions available with the RE201 IEEE488 interface.

5 The commands. A full description of the entire RE201 command set and how to use it writing controller programs.

6 The results. This subject covers the output from the RE201 and gives details about the output formats used.

7 The IEEE488 to CRT-display link. This describes in detail how to transfer data from the controller to the RE201 CRT-display and includes a description of the cursor control features.

8 The IEEE488 to RS232C link. This covers the ability to transfer data from the controller to the serial output port of the RE201 in order to control RS232C interfaced equipment, e.g. a printer or a plotter.

9 Tutorial covering hands-on examples of communicating with the RE201 using various controllers.

GENERAL DESCRIPTION OF THE IEEE488 INTERFACE

In recent years, the rapid development of digital technology and the growing popularity of microprocessors have brought about a change in instrumentation philosophy. The test equipment tends to become more and more "intelligent" and the tasks it performs more and more complex. The amount of measured data and information is approaching a level where the human operator is the throughput limiting factor. This is often unacceptable when all tests have to be carried out fast and efficiently.

A straight forward solution to this problem would be to connect all instruments in a specific test system to a computer acting not only as a task manager and supervisor but also as an additional data handling computer.

At first glance, this seems to be a nice solution, but in practice the system designer would very easily find himself in a situation where he had to interface 5 to 10 instruments with different adaptors, different interface requirements and different data exchange philosophies to his computer. This would be expensive, time consuming and, consequently, not very attractive.

In an attempt to avoid this chaotic situation, HP introduced the HP-GPIB in the beginning of the seventies. In 1975, the Institute for Electrical and Electronics Engineers approved the "IEEE STANDARD DIGITAL INTERFACE FOR PROGRAMMABLE INSTRUMENTATION" (IEEE488) and hereby made the HP-GPIB an American National Standard. Furthermore, in 1978 the International Electronical Commission approved a standard (IEC 625-1) based on a concept nearly identical with the IEEE488. The only difference is the type of connector recommended, where IEC recommends a 25 terminal Sub-D type and IEEE recommends a 24 terminal CHAMP type.

The following sections discuss the fundamental principles of the GPIB. This description should be considered an introduction and not a complete description of the programming capabilities. Also, it is intended to be a description of the benefits obtained by IEEE control of the RE201.

WHAT IS THE GPIB BUS?

The GPIB bus is a multicore cable (24/25 lines) with a length not exceeding 20 meters.

Different instruments may be connected in parallel to the bus by means of specified stackable connectors. As many as 15 instruments may be connected at the same time, and information may be interchanged between the instruments at rates not exceeding 1,000,000 bytes per second.

The circuitry in a connected instrument is considered separated in two (but, of course, interconnected) parts:

* Circuitry necessary for the functions of the instrument

* Bus interface circuitry

The standard only defines the bus interface circuitry and specifies in detail how this circuitry must react upon control information (interface messages) received from the bus lines.

TALKER, LISTENER AND CONTROLLER CONCEPT

* Talker:

  A Talker is an instrument which is allowed to transmit data via the bus. Only one instrument may have Talker status at a given time.

* Listener:

  Instruments in the Listener state accept data from the bus. In principle, all instruments on the bus may be Listeners, thus one of the instruments is listening to itself.

* Controller:

  The controller supervises the data flow on the bus and it is the only instrument which is able to manage all control lines on the bus. By manipulation of these control lines and the data bus the controller is able to control the other connected instruments. Generally speaking, a computer is used as controller.

  Two of the most important controller functions are listed here:

A. Change the State of an Instrument:

* To be a Talker or to leave Talker state
* To be a Listener or to leave Listener state
* To be passive (neither Talker nor Listener)
* To be either remotely or locally (manually) controlled

B. Service Instruments Having Requested Service

Typically, a request for service indicates that "Data is ready/wanted" in one of the instruments. But the service request facility may also be used to indicate error conditions.

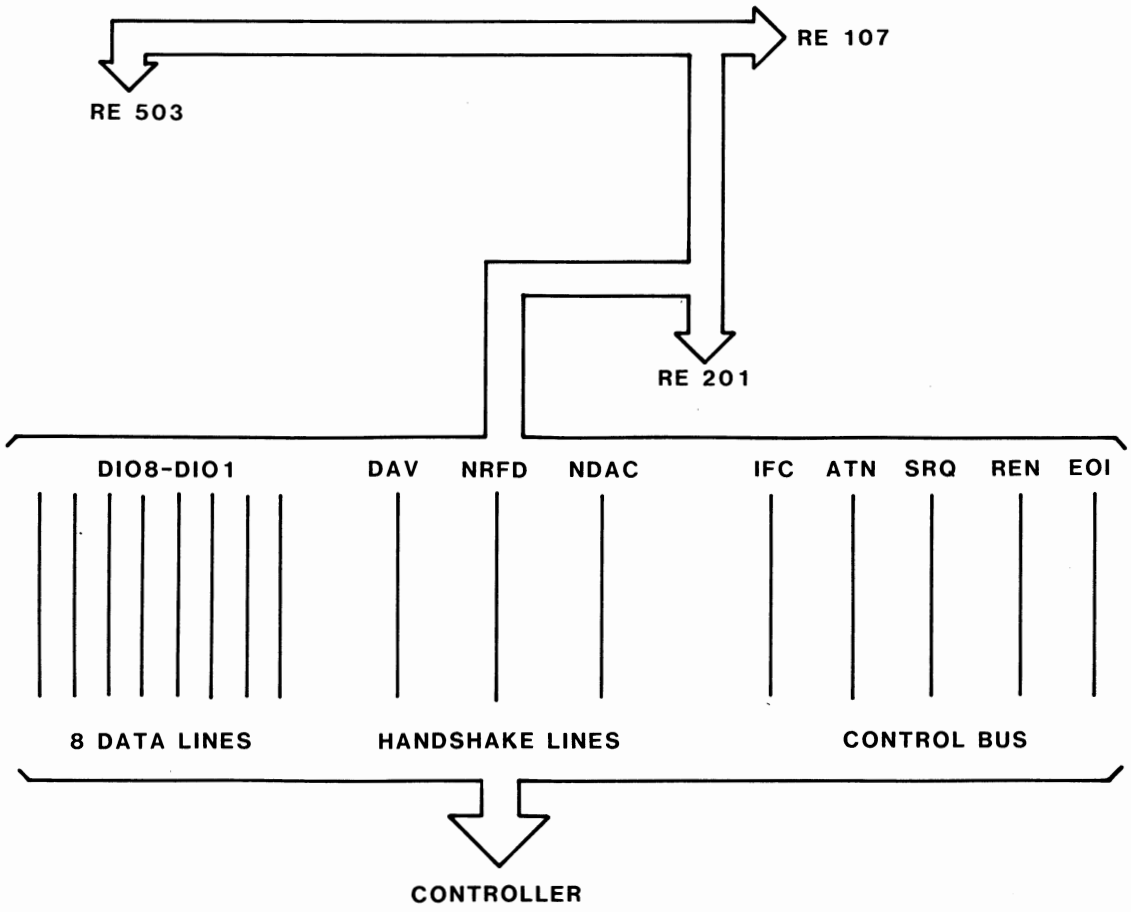
ADDRESS CONCEPT

To make it possible for the controller to point out a specific instrument, a unique 5-bit-address is assigned to every instrument. When an instrument observes its address on the bus data lines together with appropriate control bits, it changes its present state (e.g. to become a Listener or a Talker) depending on the information in the control bits.

The user should be able to select the actual 5-bit-address by means of straps or switches. Therefore, it has been common to supply the instrument with a facility for operator selection of the address. In the RE201 the bus address is considered one of the system parameters.

ORGANIZATION OF THE BUS

The figure below illustrates a possible bus configuration with three instruments and a controller. The bus lines are shown and the function of the individual bus lines will be discussed in the following.



Example of a GPIB system

As mentioned before, the GPIB has 24 (25) individual lines. 16 are used as signal lines and the rest for grounding purposes.

Information is transferred as digital information using standard TTL levels. An important feature is that all lines are false (at 5V) when the bus is passive. In the standard it is specified that all instruments able to transmit data to the bus must have open collector outputs or three-state outputs with pull-up resistors. In this way, each instrument can keep the bus lines low, independent of all other instruments.

This is a central point in the GPIB philosophy, because it ensures that the data flow on the bus never exceeds the capability of the individual instruments. In other words, the slowest reacting instrument sets the maximum speed.

The 16 signal lines may again be divided into three sub-sets:

* Data bus (8 lines)
* Control bus (5 lines)
* Handshake bus (3 lines)

DATA BUS

The data bus is used to carry the bulk of the information. As mentioned before, this may typically be:

* Instructions from the controller (interface messages)

* Programming information (device dependent messages)

* Data transmitted from one instrument to another.

CONTROL BUS

The control bus is used when it is necessary to indicate special conditions on the GPIB. Below is a list of names and functions of the individual lines in the control bus:

IFC: InterFace Clear

Is used by the controller to place the instruments in a well defined state.

(The expression "a well defined state" does not refer to the actual functional settings of the instruments but to the state or condition of the bus interface circuitry).

ATN: ATtentioN

Used by the controller to indicate whether the bits on the data bus should be regarded as device dependent (ATN= false) or interface messages (ATN= true).

SRQ: Service ReQuest

Used by the individual instruments to inform the controller that service is necessary. The RE201 will pull this line true if the programming information is inadequate, incorrect or if a result is ready.

REN: Remote ENable

Used by the controller (in conjunction with other messages) to instruct the individual instrument to operate under remote (bus) or local (manual) control.

EOI: End Or Identify

Used to indicate the end of a multiple byte transfer sequence. After service has been requested, it is also used to instruct the instrument that has required the service to identify itself to the controller during a parallel poll sequence.

HANDSHAKE BUS

These three lines are used whenever a data byte is transmitted via the bus:

DAV: DAta Valid

Indicates that data on the data bus is valid.

NRFD: Not Ready For Data

Indicates that at least one Listener is not ready to receive data.

NDAC: Not Data ACcepted

Indicates that at least one Listener has not accepted (received) data yet.

A typical handshake sequence proceeds in the following way:

* The instrument waiting for transmission of a data byte monitors the NRFD line.

* When all Listeners are ready for data (indicated by NRFD entering the false state), the Talker loads data on the data lines and pulls the DAV line true.

* Now all Listeners pull the NRFD true and start accepting data. When the last Listener has accepted the data (indicated by NDAC going false), the Talker lets the DAV line go false.

* When the Listeners observe that data is no longer valid, they set their NDAC line true.

Now a new byte transfer may commence.

GENERAL OPERATIONAL ASPECTS

As the RE201 is designed with special attention paid to remote control applications, it is possible to initiate all types of measurements from an external controller and to instruct the RE201 to transfer the result of a measurement to the controller.

Consequently, the RE201 may be instructed to measure:

* Level (DC, RMS, PEAK, SELECTIVE, QUASI-PEAK, AVERAGE)
* Frequency
* Phase
* THD, IM, Difference Frequency Distortion, TIM
* Crosstalk
* Wow and Flutter
* Weighted Noise (e.g. CCIR468)
* SINAD

Any measurement may be performed in either the left or right channel.

Note that the RE201 can perform the same measurements under remote control as when operated manually. If the RE201 is instructed to perform a measurement which requires an option that is not installed, an error message will be issued to the controller.

In addition, the following features are provided:

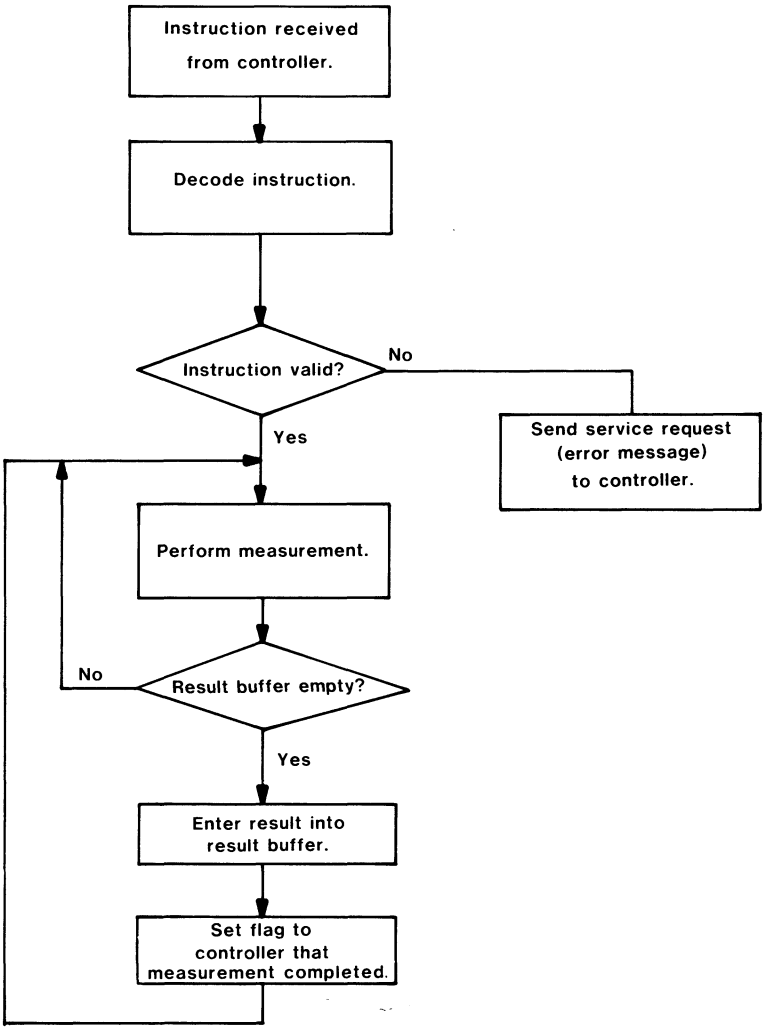
* Full control of the Audio Generator
* Full CRT control (text, graphics and analog meters on the screen).
* Facilities for data collection (sampling a time function) and basic FFT spectral analysis.
* Routing of text and data from the controller to the RS232C interface of the RE201.

HOW CAN IT BE CONTROLLED?

In the typical situation where the RE201 (and maybe other programmable instruments) is bus controlled, the setting of the instrument and the sequence of measurements will be performed according to the programmed instructions executed by the controlling device (e.g. HP85). At a

given stage in the program the controller can instruct the RE201 to perform a measurement and it can also obtain the measurement results.

A typical sequence is sketched in the figure below. When an instruction is received by the RE201 it is decoded and checked for errors. If the instruction is not valid, an error flag is sent to the controller (service request). If the instruction is valid the measurement will be performed and, when finished, a service request will be issued to the bus informing the controller that data is now available. When the data has been transferred from the RE201 to the controller the measurement will commence again and this sequence will be repeated until the RE201 receives a new instruction.



Typical (simplified) measurement sequence

The instructions are basically text strings where each character (letters, numbers and delimiters) on the bus is represented as an ASCII code, i.e. each letter or number is assigned a specific 8-bit-binary code in accordance with the ASCII recommendations (American Standard Code for Information Interchange). In order to help the user to remember the individual instructions they have been written in clear text as the following example will show.

In case an RMS measurement is to be executed, the following text string must be transferred to the RE201:

RMS, PARM1, PARM2.

The first three letters inform the RE201 that an RMS measurement is to be performed. The "," (delimiter) indicates that a section of the instruction is finished and that a new one will follow.

PARM1 and PARM2 are parameters used to give the RE201 complete information about the desired RMS measurement.

PARM1: Specifies channel. For the right channel it must have the value: 1 and for the left channel the value: 2.

PARM2: Specifies the duration of the RMS measurement (integration time). May be 8, 16, 32, 64, 128, 256, or 512 (milliseconds).

This is just one example showing a commonly used instruction. However, it demonstrates the general principle which is used for all instructions. In addition to the simple instructions, the RE201 GPIB interface provides many advanced facilities such as an instruction debugging and a set-up mode where individual instruction or sequences of instruction may be stored in the RE201 and executed at a later time by means of the EX command.

SET-UPS AND THE IEEE488 INTERFACE

In order to minimize bus transfer time during runtime a facility to store a sequence of commands as a set-up is provided.

The user may store up to 100 different set-ups, each of which may contain up to 18 measurement commands and an unlimited number of utility commands.

The measurement commands in a set-up will be executed as a sequence in the RE201 local mode, i.e. all LEFT channel measurements are done before RIGHT channel measurements.

During the writing of controller programs the user may inspect previously defined set-ups by means of the INSPECT command.

Definition of set-ups is done with the SDEF command while execution is done with the EX command.

SUMMARY

The GPIB provides a means for interconnection and remote control of an array of instruments. This allows the user to perform complicated measurements in much less time than a manual mode of operation and with no possibilities of introducing errors due to incorrect handling of the individual instruments. Typical measurements to be performed in this way are:

* Frequency Response (amplitude and phase)

* Distortion as a function of frequency and output level

* Crosstalk between two channels.

All of which may optionally be combined in a set-up, thereby decreasing bus transfer time.

However, in more complex measurement tasks, the test may incorporate thorough adjustment or final testing of any kind of audio equipment where the GPIB connected instruments provide RF, AF, and stereo signals, and the RE201 performs the required analysis of the reproduced audio signal.

IEEE488 BUS IMPLEMENTATION IN THE RE201

When this option is installed it is possible to perform any measurement under remote control. This makes the RE201 an ideal instrument for systems applications where it will substitute a number of dedicated instruments, such as counters, DVM's, phase meters, and distortion analyzers.

The following IEEE488 sub-set is implemented in the interface:

SH 1:	Source Handshake	(complete capability)
AH 1:	Acceptor Handshake	(complete capability)
T 6:	Talker	(talk only omitted)
L 4:	Listener	(listen only omitted)
SR 1:	Service Request	(complete capability)
RL 1:	Remote Local	(complete capability)
PP 1:	Parallel Poll	(remote configuration)
DC 0:	Device Clear	(no capability)
DT 1:	Device Trigger	(complete capability)
C 0:	Controller	(no capability)
E 2:	Driver Type	(tri-state, except during Parallel Poll)

Setting the Bus Address

Setting the bus address is done in LEARN mode by changing the system parameters.

System parameters are used to set up the RE201 to communicate with the external world (printers, controllers, and monitors).

Go to LEARN mode by using the LEARN key and activate the F1 (<SYSTEM>) key to inspect/modify system parameters:

```
**********************************

      *** SYSTEM PARM'S ***

CRT REFRESH RATE            50 HZ

BAUD RATE                 9600
PARITY                    EVEN
STOP BIT(S)                  1

IEEE ADDRESS        >        10

IEEE ADDRESS                 [ ]
                            STORE

**********************************
```

Now, use the cursor to point to the parameter(s) to be modified. Use numeric entries or softkeys to modify, and press <STORE> to set up the instrument. If you are only inspecting the SYSTEM PARAMETERS, leave the display by using the EXIT key.

***** NOTE *****

When entering the LEARN mode please observe that the green LED in the LOCAL/LEARN key is lit indicating that the RE201 is forced to LOCAL, i.e. the controller will not be able to gain control of the RE201.

The REMOTE/LOCAL Function

The RE201 has full REMOTE/LOCAL capability implementation in its IEEE488 interface. This means that the RE201 will be in one of the following four states:

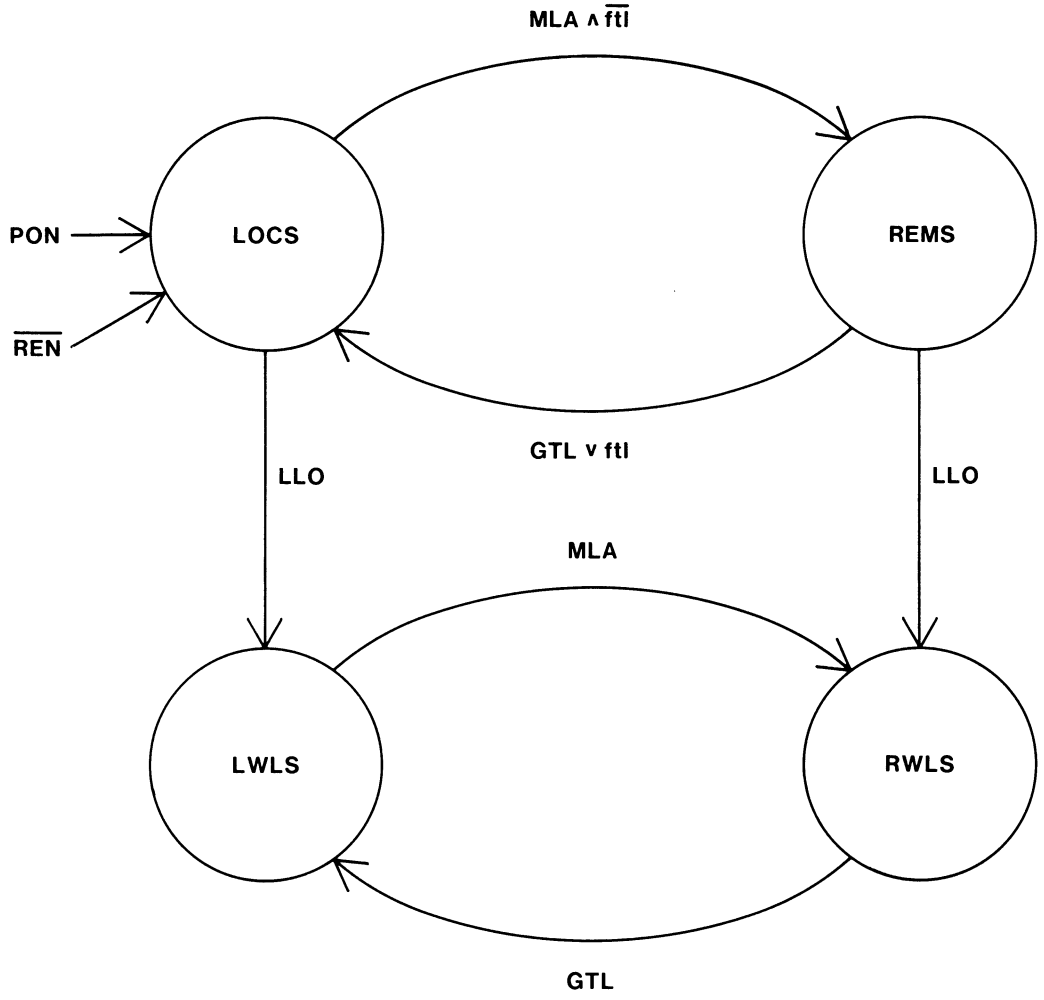
1. LOCal State (LOCS)
   The local state is entered from power-up. It can be entered from remote state by means of either a GTL interface message, a false level on the REN line or activation of the LOCAL key on the front panel.

2. Local With Local Lock-out State (LWLS)
   The local with local lock-out state is entered either from LOCS by means of an LLO interface message, or from remote with local lock-out state by means of a GTL interface message. Note that this state cannot be entered by using the front panel LOCAL key.

3. REMote State (REMS)
   The remote state is entered only from LOCS and by means of the interface being listen addressed. The latter can only occur if the green local LED is off, i.e. the RE201 is not in forced local mode.

4. Remote With Local Lock-out State (RWLS)
   The remote with local lock-out state is entered either from REMS by means of an LLO interface message, or from LWLS by means of the interface being listen addressed.

The REMOTE/LOCAL state diagram on the next page describes the four states.



Notation used in state diagram.

$\overline{\quad}$	:	Inversion bar indicating false state
$\wedge$	:	Logical AND function
$\vee$	:	Logical OR function
PON	:	Initial Power-ON of the RE201
REN	:	IEEE bus Remote ENable line
MLA	:	Being addressed as a Listener
ftl	:	State of green LED in LOCAL/LEARN key (forced to local=Lit)
GTL	:	Go To Local interface message received
LLO	:	Local Lock-Out interface message received
LOCS	:	LOCal State
REMS	:	REMote State
LWLS	:	Local With local Lock-out State
RWLS	:	Remote With local Lock-out State

***** Note *****

When the green LED in the LEARN/LOCAL Key on the front panel is lit, it indicates that the RE201 is "Forced-to-Local", meaning that the controller will not be able to gain control of the RE201. This condition may be detected by the controller, as the RE201 issues an SRQ (code=64 decimal) when it is "Forced-to-Local" and another SRQ (code=65 decimal) when the "forced" condition is released.

The "forced" condition is established upon one of the following actions:

* The LOCAL key on the front panel is activated
* LEARN mode is entered
* The GENCTRL softkey (only present when the Audio Generator is active) is activated

The following actions may release the "forced" condition:

* The LOCAL key is re-activated, and the RE201 is neither in LEARN mode, nor is GENCTRL active
* LEARN mode is completed
* GENCTRL is completed.

In the latter two cases, the "Forced-to-Local" is only released, if the RE201 was not "forced" prior to activation of either LEARN mode or GENCTRL.

It should be noted that if the RE201 is addressed as a listener, the remote state will be entered immediately upon a "Forced-to-Local" release.

The Device Trigger Function

In the RE201 the device trigger function is used only by the DATACO command for initiation of data collection.

Upon receiving a DATACO command with parameter 3 set to 1, the RE201 will wait to receive the GET interface message. When this is received the data collection will take place.

The Interface Clear Function

The interface clear function resets the RE201 IEEE488 interface to a known quiescent state, i.e. any ongoing bus transfer is stopped.

In order to make the RE201 ready to receive a new command, the RE201 command interpreter is initialized.

In order to avoid measurement results changing the interface state, all measurements in progress are stopped and the RE201 is placed in its idle state.

Furthermore, the CRT display is cleared and the REMOTE message is written indicating that the RE201 is ready.

The Service Request Function

The interface capability of issuing service requests is utilized to flag errors, warnings, and ready codes. Upon a service request the controller may obtain the status byte by means of a serial poll sequence. The status byte indicates the cause of the service request, e.g. whether it was caused by an error or a result being ready.

By means of the SRQDIS command the controller may disable service requests initiated by errors/warnings or ready codes, or both, but still be able to obtain the same status bytes by using the serial poll sequence.

The following is a list of all service request codes obtainable with a serial poll sequence.

The service request codes are put in order of priority as follows:

* Status Information
* Result Ready
* Errors and Warnings
* Audio Generator Not Ready
* Forced-to-Local/Forced-to-Local Released

meaning that status information is overruled by result ready codes, which are overruled by errors and warnings etc.

Please note that the Audio Generator Not Ready - although given a high priority, overruling errors and warnings - should be regarded as a status, as no Service Request is generated, and the code is overwritten when the Audio Generator is ready.

The Service Request Codes

The following is a list of the possible service request codes followed by a detailed description in alphabetical order. The type column indicates whether the code is an error (E), a warning (W), a ready code (R), or a status code (S).

For a description of the Forced-to-Local and Forced-to-Local released

codes, please refer to the description of the Remote/Local function above (p. 2).

HEXADECIMAL	DECIMAL	MEANING	TYPE
40	64	RE201 Forced to Local	S
41	65	Forced-to-Local Released	S
50	80	Syntax Error	E
51	81	Illegal Parameter Count	E
52	82	Parameter Limits Exceeded	E
53	83	Missing Option	E
54	84	Set-up Not Defined	E
55	85	No Room For Set-up	E
56	86	No Acceptor on Bus	E
60	96	No Filter Found	W
61	97	Input Too Low	W
62	98	Input Overload	W
63	99	Selftest Error	W
64	100	W & F Out Of Range	W
65	101	Parameter Truncated	W
67	103	Frequency Out of Range	W
69	105	Memory Bus Uncalibrated	W
6A	106	RS232C Time-out	W
6B	107	Command Ignored	W
C0	192	Test Successful	R
C1	193	DATACO & SPECTRUM	R
C2	194	PEAK	R
C3	195	RMS	R
C4	196	RMSBPF	R
C5	197	RMSFIL	R
C6	198	THD	R
C7	199	IM	R
C8	200	TIM	R
C9	201	TRIMFQ	R
CA	202	FREQ	R
CB	203	TWOLEV	R
CC	204	WOWFLU	R
CD	205	RMSLBW	R
CE	206	SEP	R
CF	207	PHASE	R
D0	208	PHASEF	R

HEXADECIMAL	DECIMAL	MEANING	TYPE
D1	209	DC	R
D2	210	SINAD	R
D3	211	DFIM	R
D4	212	INSPECT	R
D5	213	AVERAGE	R
D6	214	QUASIPK	R
D7	215	INTERG	R
D8	216	HD	R
0	0	Measurement In Progress	S
80	128	RE201 In IDLE State	S
81	129	DATACO Waiting For Trigger	S
82	130	Audio Generator Not Ready	S

Audio Generator Not Ready **Hexadecimal 82; Decimal 130**

The Audio Generator Not Ready code is output during set-up of the Audio Generator. The code is overwritten upon completion of the set-up. As measurements internally in the RE201 are detained until the Audio Generator is set up, this code is only for use if external measurement equipment is used.

Command Ignored **Hexadecimal 6B; Decimal 107**

The command ignored warning is issued when an attempt is made to define a set-up containing one of the commands: SDEF, INSPECT, EX, DATACO or SPECTRUM.

Illegal Parameter Count **Hexadecimal 51; Decimal 81**

An "illegal parameter count" error occurs whenever needed parameter values are not specified or when too many parameters are specified.

Input Overload **Hexadecimal 62; Decimal 98**

"Input overload" indicates an input voltage above the limit or, if fixed gain is used, that the gain should be decreased, if possible.

Input Too Low **Hexadecimal 61; Decimal 97**

"Input too low" indicates that the input is actually too low or, if fixed gain is used, that the gain should be increased, if possible.

Please note that "Input Too Low" is only issued by the following measurements:

DFIM, FREQ, HD, IM, RMSBPF, RMSFIL, SEP, SINAD, SPECTRUM, THD, TIM, TRIMFQ and TWOLEV.

Memory Bus Uncalibrated **Hexadecimal 69; Decimal 105**

"Memory bus uncalibrated" is issued if, when executing a MEMBUS command, the UNCAL line of the memory bus connector is pulled true by any of the instruments on the memory bus.

Missing Option **Hexadecimal 53; Decimal 83**

"Missing option" occurs if a particular option needed for a command is absent, such as trying to set the Audio Generator with none installed.

No Acceptors On Bus **Hexadecimal 56; Decimal 86**

"No Acceptors On Bus" is given if for any reason the RE201 is talk addressed and the NRFD and NDAC bus lines are "false" simultaneously.

No Filter Found **Hexadecimal 60; Decimal 96**

"No filter found" is issued if the RMSFIL command is sent when no filter has been defined by the FILTER or the FILDEF commands.

No Room For Set-up **Hexadecimal 55; Decimal 85**

"No room for set-up" occurs either if an attempt is made to define more than 18 measurement commands for one set-up, if the physical memory space available for set-ups is already occupied, or if more than one measurement command is accompanying the WEIGHT command.

Parameter Limits Exceeded **Hexadecimal 52; Decimal 82**

"Parameter limits exceeded" is issued if a parameter value is out of range (e.g. if channel =3 is specified).

Parameter Truncated **Hexadecimal 65; Decimal 101**

"Parameter truncated" occurs, for example, if one of the frequency parameters of RMSBPF is not an exact multiple of 125 Hz. The nearest lower exact multiple of 125 Hz is chosen. "Parameter truncated" is also used for the gain parameter for the ATTENU command.

Result Ready Codes **Hexadecimal C0-D7; Decimal 192-215**

The result ready codes tell the controller when a measurement is ready to deliver a result. As the different measurements have specific ready

codes the controller may use this information to, for example, apply the proper unit (%, V, or Hz) to the result.

RS232C Time-out **Hexadecimal 6A; Decimal 106**

The RS232C time-out service request code occurs if the handshake on the serial output of the RE201 is not completed within the time set by the SETTIME command. At power-up the time-out is set to 3 seconds.

Selftest Error **Hexadecimal 63; Decimal 99**

"Selftest error" is issued if an error is discovered during a selftest sequence.

Set-up Not Defined **Hexadecimal 54; Decimal 84**

If INSPECT or EX is attempted on a set-up not previously defined by an SDEF command, the "set-up not defined" error is issued.

Status Codes **Hexadecimal 0,40,41,80,81,82; Decimal 0,64,65,128,129,130**

The status codes inform the controller of the state of the RE201, i.e. idling, measuring, waiting for a trigger for a data collection, if the RE201 is forced to local, if forced to local is released or if the Audio Generator is not ready.

Syntax Error **Hexadecimal 50, Decimal 80**

A "syntax" error is flagged whenever a command mnemonic is not recognized or if an illegal character is encountered in the input character stream.

W & F Out Of Range **Hexadecimal 64; Decimal 100**

"W & F out of range" is issued only during wow and flutter measurements and indicates improper range selection on the Wow & Flutter option.

THE COMMANDS

This subject describes the RE201 command set. It gives an alphabetical list of all commands and where to find a detailed description of a particular command. It also explains how to use the command descriptions. The commands are divided into two types: measurement commands initiating measurements, and utility commands not initiating measurements. The descriptions are divided likewise.

The Commands in Alphabetical Order (max. number of parameters in ( ))

The Command Descriptions

The descriptions of all the commands are made in such a way that users not familiar with the RE201 functions and commands may find all the information necessary to make controller programs utilizing all the capabilities of the RE201.

The command descriptions are composed of a functional description, a reference part, and an example of how the particular command is used.

Users familiar with the RE201 may skip the functional descriptions and examples, and use the chapters as a reference section only.

The functional descriptions describe the action caused by the commands, and how to use them in conjunction with the variety of options available for the RE201. There are references to any related commands.

The reference part contains details of the abbreviation allowed for the command, the required syntax, and the meaning of the command parameters. It also includes parameter limits, and if the ZOOM facility is applicable to the command, the modified limits are given. Finally, specific service request codes related to the command are listed. If the command is a measurement or one of the other output generating commands, the output format is stated.

The examples show a command string containing the allowed abbreviation for the particular command and the parameters for it. If the command

has default values for some of its parameters, some of the examples make use of the default values. Therefore, in some of the examples not all of the parameters are specified.

The function of the example command is explained, and an output string example is given.

General Syntax Description

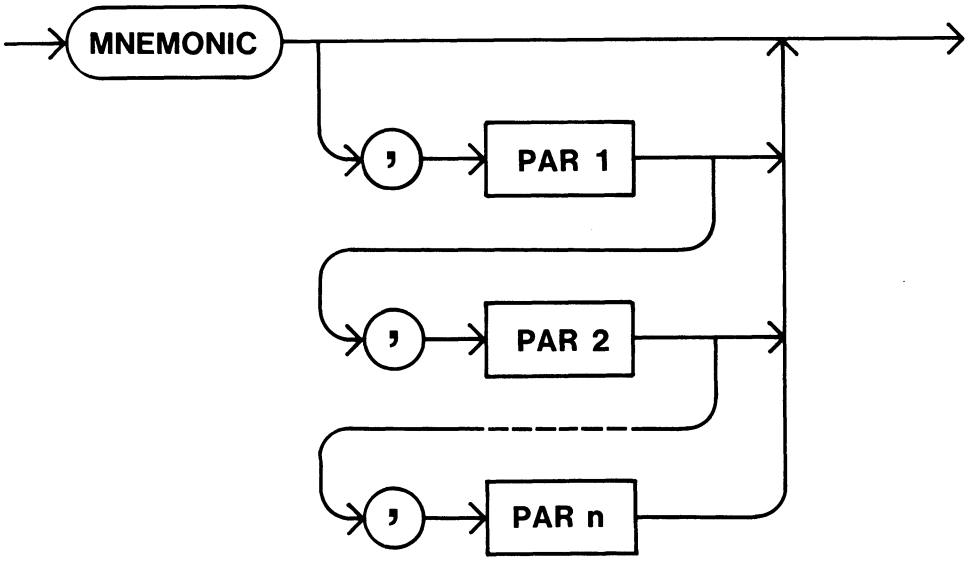
This part gives a detailed description of the syntax required for input to the RE201 from the bus. It is assumed that the IEEE488 protocol is fulfilled.

Communication to the RE201 is divided into two types: commands and information - either for the CRT-display or for the RS232C output. The syntax is described by means of syntax diagrams.

Commands

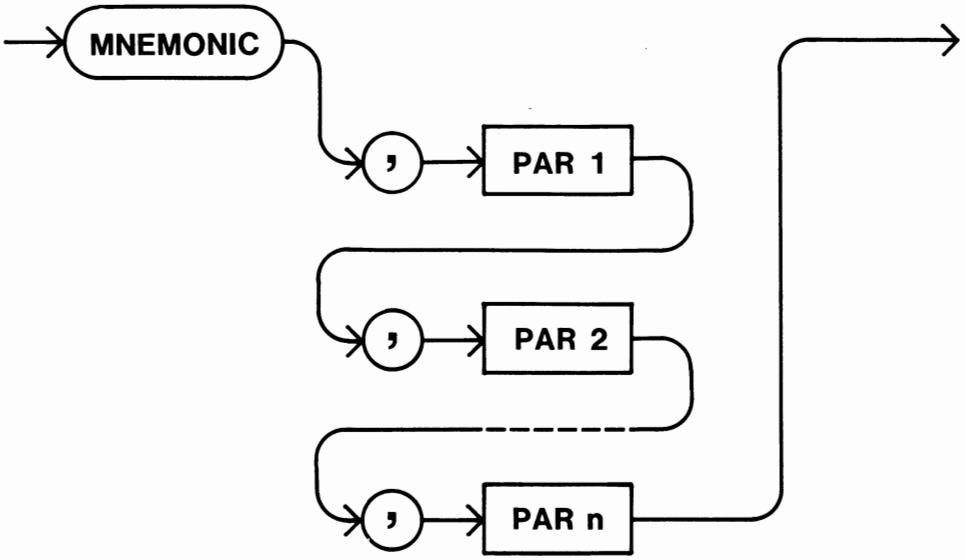
Commands are mnemonics followed by parameters. Most of the commands have default values for the parameters. These are employed if no parameters or only some of the parameters are specified. This syntax is referred to as FORMAT 1.

FORMAT 1: All parameters are optional.



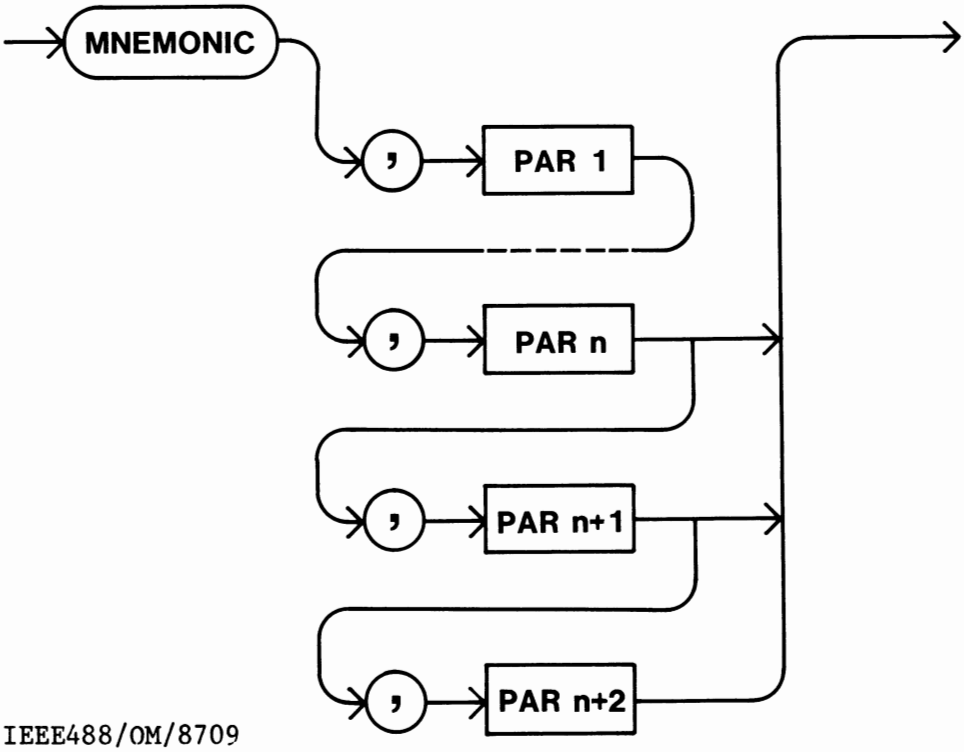
Some commands need specification of all parameters. This syntax is referred to as FORMAT 2.

FORMAT 2: All parameters needed.



Finally, a few of the commands have default values for some but not all of their parameters. This syntax is referred to as FORMAT 3.

FORMAT 3: Some parameters are optional.

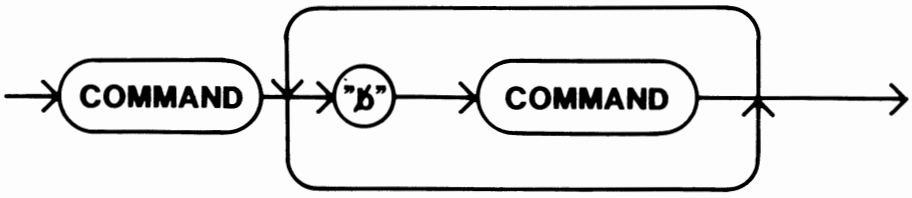


From the figure it can be seen that a command is defined as a mnemonic plus parameters, all separated by commas.

Commands are sent as a set of commands. A set consists of all the commands to be sent in any one transaction.

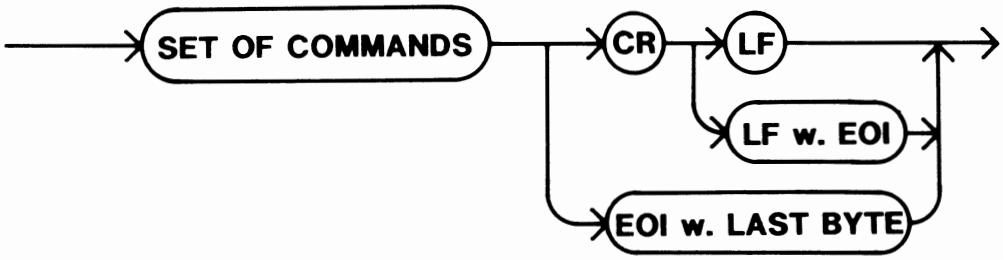
In a set of commands, the commands are separated by one or more blanks (␣)

Set of commands:



A set of commands plus an end-of-line sequence constitute a command string.

Command string:



It can be seen that three end-of-line sequences are possible, namely:

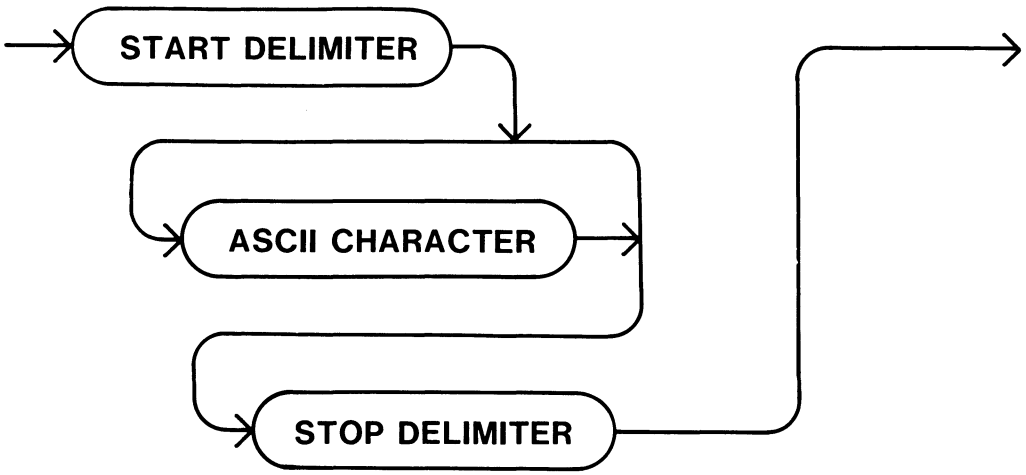
Carriage Return and Line Feed or
Carriage Return and Line Feed with the END message or
just the END message accompanying the last byte.

Please note that using just EOI with the last byte as end-of-line sequence, in conjunction with a very fast IEEE488 bus controller, may result in reception of old results e.g. when restarting measurements or altering Audio Generator settings. Therefore, in such cases, it is recommended to use the CR LF or CR LF with an EOI end-of-line sequence.

Information for the CRT/RS232C

Transfer of information to the RE201 CRT-display or RS232C serial output is done by sending a start delimiter, the information, and finally, a stop delimiter. The following syntax diagram describes the format.

Transfer to the CRT-display or the serial output.



The delimiters act as input guides for the RE201, i.e. the start delimiter tells the destination, CRT or serial out, and the stop delimiter sets the input back to the command accept mode.

Start and stop delimiters can be any ASCII character and are set by the CRTDEL and SERDEL commands. When concluding a selftest (e.g. at power-up), the delimiters are set as shown in the following table.

DESTINATION	START DELIMITER	STOP DELIMITER
CRT-display	STX (ctrl B or Ø2H)	ETX (ctrl C or Ø3H)
Serial out	SO (ctrl N or ØEH)	SI (ctrl O or ØFH)

If the start delimiters for the CRT and for the serial out are programmed to the same value, the CRT-display will be chosen as the output destination.

THE SET-UP FACILITY

SDEF, INSPECT, EX, The RE201 IEEE488 Set-up Commands

Description

The RE201 IEEE488 set-up commands, SDEF, INSPECT and EX, provide the facility to store complete set of commands, to inspect such sets , and to execute them (by means of the simple command, EX). This reduces bus transfer time considerably.

Definitions of set-ups are made by using the SDEF command. For example "SDEF,(set-up number) (set of commands)" describes the particular set-up (set-up number) with the aid of the set of commands. The set of commands may contain any number of commands, with the exceptions, however, that no more than 18 measurement commands may be included and the set must not include any of the set-up commands. **When using the WEIGHT command in a set-up, only one measurement command is allowed.**

The number of set-ups possible is limited to 100, or to the random access memory space available (whichever is the smallest). The size of a set-up depends on its set of commands. A command will need the parameter count + 2 words of memory, and a set-up will need the total of all the commands + 1 word of memory. The random access memory space available for set-ups is 2600 words giving, for example, 78 set-ups, each containing two 7 parameter commands and two 5 parameter commands.

Inspection of set-ups during debugging is made by using the INSPECT command. The INSPECT command without a parameter will transmit the set of commands of all set-ups defined. Using the INSPECT command with a set-up number as its parameter transmits the set of commands of that particular set-up.

Execution of set-ups is done by using the EX command with a set-up number as its parameter. When executing set-ups containing more than one measurement, the measurements are executed in the same way as they would be in RE201 local mode, i.e. the measurements in the LEFT channel will be executed before the RIGHT channel measurements. In order to keep track of the results transmitted by the RE201 a position number precedes every result. Position number and result(s) are separated by means of a comma (,).

If linear averaging is specified for one of the measurements in a set-up please note that the number of results from the other measurements, contained in that particular set-up, is multiplied by the average count.

For example, if a set-up, containing an RMS and a THD with averaging using 4 loops, is executed, the RE201 will transmit 4 RMS results per THD result. Here the position numbers are useable to detect the result type as well as the position in the set-up.

If CHANNEL = 0 (both channels) is used, the measurement in the RIGHT channel is counted before that of the LEFT channel.

For example the set-up:

"SDEF,0 AU,1 AU,2 RS,1,8 RS,2,8 FQ,0"

will, when executed by an

"EX,0"

transmit the following results:

2,1.0765E+0	as the result of the RS,2,8 (being measurement No. 2)
4,1000	as the result of the FQ in the LEFT channel (being measurement No. 4)
1,2.5031E-1	as the result of the RS,1,8 (being measurement No. 1)
3,2000	as the result of the FQ in the RIGHT channel (being measurement No. 3).

It must be noted that only measurement commands in a set-up are counted. The two AU utility commands are not.

Abbreviations

The abbreviations allowed for the set-up commands are:

SF for the SDEF command
IT for the INSPECT command and
E for the EX command.

Syntax

The SDEF and EX commands follow the syntax description FORMAT 2, (i.e. all parameters are needed).

The INSPECT command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Set-up number.

Parameter Values

For SDEF and EX:

PARAMETER	RANGE
1	0 - 99

For INSPECT:

PARAMETER	RANGE	DEFAULT VALUE	
1	-1 - 99	-1	(Note 1.)

Notes

1. INSPECT with no parameters or parameter 1 = -1 will transmit the set of commands of all defined set-ups; each set-up will be preceded by a service request code 212.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
54	84	Set-up Not Defined (INSPECT and EX)
55	85	No Room For Set-up (SDEF)
6B	107	Command Ignored (SDEF)
D4	212	Output Available (INSPECT)

Example

The command "SDEF,89 RS RS,2 TD TD,2,2" defines set-up number 89 to measure RMS and THD in both channels, using linear averaging of 2 loops in the left channel THD measurement.

The command "INSPECT,89" will then transmit the set of commands of set-up number 89 showing all the parameters like this:

"SF,89 RS,1,64,0 RS,2,64,0 TD,1,1,1000,2,9,1 TD,2,2,1000,2,9,1".

The command "EX,89" will, when executed, transmit its results in the following way:

```
2,3.1622E+0
1,1.6180E-1
3,9.8074E-1
2,3.1622E+0
4,7.6210E-2
1,1.6180E-1
3,9.8074E-1
```

Note that the LEFT channel measurements are executed first, that the results are preceded by position numbers, and that linear averagering is being used.

The Utility Commands

The utility commands are commands that do not generate any output. They are used for set-up purposes such as the setting of input amplifier gain, meter deflection, changing link delimiters and the time-out value.

The following table shows the dependence of the various options, e.g. whether or not a particular option is necessary to execute the command.

An "N" in the option column indicates that the particular option is necessary. An "I" indicates that a particular option may improve the performance of the specific command, and a "." indicates that the command is not affected by the option.

	AUDIO GENERATOR	FIL-TER	WOW & FLUTTER	WEIGHTING FILTER
ATTENU	.	.	.	.
ATTENUW	.	.	.	N
AUDIOA	N	.	.	.
AUDIOG	N	.	.	.
AUDIOM	N	.	.	.
AUDIOS	N	.	.	.
CRTDEL	.	.	.	.
ERRDISP	.	.	.	.
EX	.	.	.	.
FILDEF	.	.	.	.
FILTER	.	.	.	.
FSKDEL	.	.	.	.
GPIO	.	.	.	.
IDLE	.	.	.	.
INSPECT	.	.	.	.
MEMBUS	.	.	.	.
METER	.	.	.	.
PP	.	.	.	.
SDEF	.	.	.	.
SERDEL	.	.	.	.
SETTIME	.	.	.	.
SRQDIS	.	.	.	.
TEST	.	.	.	.
WEIGHT	.	.	.	N

Now follow the utility command descriptions.

ATTENU, The Input Amplifier Gain Control Command

Description

The input amplifier gain control command, ATTENU, enables user control of the input amplifier, i.e. a fixed gain may be chosen instead of the autorange algorithm normally used by the RE201.

The gain may be set from -20 dB to +58 dB in steps of 2 dB, giving an input voltage range from 3.15 mVpeak to 25.0 Vpeak for full utilization of the dynamic range of the A/D-converter (0 dB equivalent to 2.50 Vpeak). Please note that the input overload service request is issued when the A/D-converter input voltage reaches 2.35 Vpeak. In case the gain parameter is not an exact multiple of 2, the service request code, (hex 65, dec. 101 - parameter is truncated) is sent, and the nearest multiple of 2 below the specified value is used.

The gain may be set for each channel separately, thereby enabling e.g. autorange in LEFT channel and fixed range in RIGHT channel simultaneously. It is possible, however, to set the gain in both channels with only one ATTENU command by selecting Par 1=0.

Autorange is chosen at power-up and after a selftest, and may be obtained during run-time by sending the ATTENU command omitting parameter 2.

Abbreviation

The abbreviation allowed for the ATTENU command is AU.

Syntax

The ATTENU command follows the syntax description FORMAT 3, (i.e. some parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH; 1= RIGHT; 2= LEFT.
Parameter 2: Gain specification. (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	n.a.
2	-20 - 58	Autorange

Notes

1. If the ATTENU command is used without parameter 2, autoranging is applied in the selected channel(s).

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
65	101	Parameter Truncated

Examples

The command "AU,2" selects autorange in the LEFT channel and the command "AU,1,2" sets a fixed gain of 2 dB in the RIGHT channel. A signal of value 2.35/1.26 = 1.87Vp will reach the overload of the RE201 at this setting (1.26 being antilog 2/20).

ATTENUW, The Weighting Filters Input Gain Control Command

Description

The Weighting Filters input gain control command, ATTENUW, is used to enable control of the gain whenever one of the Weighting Filters included on the Weighting Filters board is in use, e.g. fixed gain may be chosen instead of the autoranging algorithm normally used by the RE201. Additionally, this gain command must be used if fixed gain is wanted for quasi-peak measurements.

The gain may be set from -20 dB to +106 dB in steps of 2 dB, giving an input voltage range from 110 uVpeak to 22 Vpeak for full utilization of the dynamic range of the A/D-converter (0 dB equivalent to 2.50 Vpeak). Please note that the input overload service request is issued when the A/D-converter input voltage reaches 2.35 Vpeak. In case the gain parameter is not an exact multiple of 2, the service request code, (hex 65, dec. 101 - parameter is truncated) is sent, and the nearest multiple of 2 below the specified value is used. Due to the different filter transfer characteristics, specification of gain in front of the filter and following the filter must be provided.

Gain should be set as follows:

* In front of the filter, the peak voltage should not exceed 2.5 V. In the case of white noise, the peak voltage is approx. 6 dB above the RMS voltage.

* Following the filter, sufficient gain must be selected to obtain a peak voltage of approx. 1.2 V. This voltage is a good compromise between utilizing the entire dynamic range of the A/D-converter and ensuring that spurious noise spikes do not activate the overload detector.

The gain selected for the Weighting Filters operates independently of the gain selected by means of the ATTENU command, e.g. it is possible to utilize fixed range for the Weighting Filters measurements and autoranging for other measurements, or vice versa.

The gain may be set for each channel separately, thereby enabling autorange in LEFT channel and fixed range in RIGHT channel simultaneously. It is possible, however, to set the gain in both channels with only one ATTENUW command by selecting Par 1=0.

Autorange is chosen at power-up and after a selftest, and may be obtained during run-time by sending the ATTENUW command omitting parameters 2 and 3.

Abbreviation

The abbreviation allowed for the ATTENUW command is AW.

Syntax

The ATTENUW command follows the syntax description FORMAT 3, (i.e. some parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH; 1= RIGHT; 2= LEFT.
Parameter 2: Pre-filter gain specification. (Note 1.)
Parameter 3: Post-filter gain specification.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE	
1	0 - 2	n.a.	
2	-20 - 40	Autorange	(Notes 1, 2)
3	0 - 78	n.a.	(Note 3)

Notes

1. If the ATTENUW command is used without parameters 2 and 3, auto-ranging is applied in the selected channel(s).
2. Pre-filter gain is only selectable in steps of 10 dB, i.e. legal values are -20, -10, 0, 10, 20, 30, 40.
3. The sum of the pre-filter gain and the post-filter gain may not exceed 106 dB.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
65	101	Parameter Truncated

Examples

The command "AW,2" selects autorange in the LEFT channel and the command "AW,1,-10,32" sets a fixed gain of 22 dB in the RIGHT channel.

AUDIOA, The Audio Generator Level Command

Description

The Audio Generator level command, AUDIOA, is used to control the output level of the Audio Generator option. The level is controllable in steps of 0.1 dB in the range from -69.9 dB to +11.0 dB related to 2.5 Vpeak, EMF. It should be noted that the level specification is done in tenths of a dB, meaning that if -69.9 dB is to be programmed, the correct specification is -699.

As the Audio Generator provides two separate outputs, the AUDIOA command also needs information about which channel to program. Selecting Par 1=0 will program both channels simultaneously.

During execution of this command - like the other Audio Generator related commands, AUDIOG, AUDIOM and AUDIOS, - a not-ready status code is obtainable by a serial poll.

Abbreviation

The abbreviation allowed for the AUDIOA command is AA.

Syntax

The AUDIOA command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: Output channel 0= BOTH; 1= RIGHT; 2= LEFT
Parameter 2: Output level in tenths of a dB. (Note 1.)

Parameter Values

PARAMETER	Audio Generator +18 dBu	Audio Generator +24 dBu	
1	0 - 2	0 - 2	
2	-699 - 110	-639 - 170	(Note 1.)

Notes

1. As only integers are accepted as command parameters the desired output level in dB, related to 2.5 Vpeak EMF, must be multiplied by 10 before transfer to the RE201, i.e. a level of + 7.2 dB must be specified as PARM 2 = 72.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
82	130	Audio Generator Not Ready

Example

The command "AA,2,-49" sets the output level in the LEFT channel to 2.5Vp - 4.9 dB = 1.4221Vp, corresponding to 1.0056V RMS, in case of a single tone.

AUDIOG, The Audio Generator Command

Description

The Audio Generator command, AUDIOG, is used to specify single tone frequencies and multitone frequencies and their relative levels.

Single tone frequencies are selectable in the range from 1 Hz to 25 kHz in steps of 1 Hz. For a single tone the relative level is arbitrary and may be omitted.

Multitones may contain up to eight tones which have frequencies in the range from 10 Hz to 25 kHz in steps of 10 Hz. The relative levels of each frequency are selectable as proportionals in the range from 1 to 1000.

As multitones in the worst case might take up to approx. 3 seconds to build up, a service request code flagging not-ready condition is provided.

Abbreviation

The abbreviation allowed for the AUDIOG command is AG.

Syntax

The AUDIOG command follows the syntax description FORMAT 1, (i.e. all parameters are optional with the exception that multitone frequencies must be specified as a pair consisting of a frequency and a proportional).

Parameters

Parameter 1: Frequency 1 or single tone frequency.
Parameter 2: Proportional for frequency 1.
Parameter 3: Frequency 2.
Parameter 4: Proportional for frequency 2.
Parameter 5: Frequency 3.
Parameter 6: Proportional for frequency 3.
Parameter 7: Frequency 4.
Parameter 8: Proportional for frequency 4.
Parameter 9: Frequency 5.
Parameter 10: Proportional for frequency 5.
Parameter 11: Frequency 6.
Parameter 12: Proportional for frequency 6.
Parameter 13: Frequency 7.
Parameter 14: Proportional for frequency 7.
Parameter 15: Frequency 8.
Parameter 16: Proportional for frequency 8.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE	
1	1-25000	1000	(Note 1.)
2	1- 1000	n.a.	
3	10-25000	n.a.	
4	1- 1000	n.a.	
5	10-25000	n.a.	
6	1- 1000	n.a.	
7	10-25000	n.a.	
8	1- 1000	n.a.	
9	10-25000	n.a.	
10	1- 1000	n.a.	
11	10-25000	n.a.	
12	1- 1000	n.a.	
13	10-25000	n.a.	
14	1- 1000	n.a.	
15	10-25000	n.a.	
16	1- 1000	n.a.	

Notes

In case of a multitone specification the range of parameter 1 is from 10 to 25000. If the frequency parameter values are not multiples of 10, a "parameter limits exceeded" error occurs, and the command is ignored.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
82	130	Audio Generator Not Ready

Example

The command "AG,70,4,7000,1" sets the Audio Generator to make a standard intermodulation test signal of 70 Hz and 7 kHz with the amplitude relation 4:1.

AUDIOM, The Audio Generator Mode Command

Description

The Audio Generator TIM mode command, AUDIOM, provides control of the low frequency of the Transient Inter-Modulation test signal: Selection of square or triangle waves is possible. The command also determines the 3 dB frequency of the low pass filter, i.e. 30 or 100 kHz.

The abbreviation allowed for the AUDIOM command is AM.

Syntax

The AUDIOM command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Mode 0= square 1= triangle
Parameter 2: 3 dB cut-off frequency in kHz.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 1	0
2	30 or 100	100

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
82	130	Audio Generator Not Ready

Example

The command "AM,1,30" sets the 3.2 kHz of the TIM test signal to a triangle wave filtered by a 30 kHz low pass filter.

AUDIOS, The Audio Generator Source Select Command

Description

The Audio Generator source select command, AUDIOS, is used to control the signal type guided to the outputs of the Audio Generator. The AUDIOS command enables selection of 4 different sources: Ground, 1 kHz reference, single/multitone or TIM test signal. By means of the channel specifier the two output channels may be set to different signal types. However, in case one channel has a single, multitone or TIM signal the second channel can have the same signal, ground or 1 kHz reference. Specifying channel=BOTH will select source for both channels simultaneously.

Abbreviation

The abbreviation allowed for the AUDIOS command is AS.

Syntax

The AUDIOS command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: Channel 0= BOTH; 1= RIGHT; 2= LEFT
Parameter 2: Source selector 0= ground
1= 1 kHz reference
2= single or multitone
3= TIM test signal

Parameter Values

PARAMETER	RANGE	
1	0 - 2	
2	0 - 3	(Note 1.)

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
82	130	Audio Generator Not Ready

Notes

1. In case the TIM signal is sent in one channel and the other channel selects a single/multitone signal the 15 kHz signal from the TIM signal will be sent in the latter channel.

Example

The command "AS,2,3" will set the source for the LEFT channel to the TIM test signal.

CRTDEL, The CRT Link Delimiter Command

Description

The CRT link delimiter command, CRTDEL, is used to specify start and stop characters (delimiters), for the IEEE-to-CRT-display link. Please refer to section 10.4.7 for more information on the IEEE-to-CRT-display link.

The delimiters are initially set to ctrl B (STX) as start character and ctrl C (ETX) as stop character. By means of the CTRDEL command they may be altered to any character or value represented by 8-bit, i.e. in the range from 0 to 255. Start and stop delimiters may be of the same value if applicable.

Abbreviation

The abbreviation allowed for the CTRDEL command is CL.

Syntax

The CTRDEL command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: Start (or open) delimiter.
Parameter 2: Stop (or close) delimiter.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 255	2
2	0 - 255	3

Example

The command "CL,60,66" will set the IEEE-to-CRT-display link delimiters to the ASCII characters "<" and ">", please refer to the ASCII table in section 10.4.7.

ERRDISP, The Debug Command

Description

The debug command, ERRDISP, is used during controller program development. The command enables erroneous command strings to be written on the CRT-display, using inverse video to point out the error.

The display will be erased after a user specified time - setting this time to Ø disables the error display feature. Following power up or a selftest this facility will be enabled with time = 3 sec.

Abbreviation

The abbreviation allowed for the ERRDISP command is EP.

Syntax

The ERRDISP command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Display time in 1/100 seconds.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 32767	300

Examples

If an erroneous command occurs after receiving "EP,500", the RE201 command will display the error for a time period of 5 seconds.

The following error types are displayed:

1. Syntax Errors (SRQ code hex. 50) The display will be an abbreviation made of the first and last letters of the erroneous command and the text "INVALID COMMAND". If an illegal character is encountered the text "ILLEGAL CHARACTER IN COMMAND" is displayed.

2. Illegal Parameter Count (SRQ code hex. 51)
   The display will be:
   "MAX. PAR. COUNT FOR" command abbreviation in inverse video "IS" count.

3. Parameter Limits Exceeded (SRQ code hex. 52)
   The display will be the command string just including the faulty parameter, which is shown in inverse video, and the text "PARAMETER LIMITS EXCEEDED".

4. Missing Option (SRQ code hex. 53)
   The text "MISSING OPTION" is displayed.

5. Set-up Not Found (SRQ code hex. 54)
   The text "SET-UP NOT FOUND" is displayed.

6. No Room For Set-up (SRQ code hex. 55)
   The text "NO ROOM FOR SET-UP" is displayed.

7. No Acceptors on Bus (SRQ code hex. 56)
   The text "NO ACCEPTORS ON BUS" is displayed.

EX, The Set-up Execute Command

Description

The set-up execute command, EX, will execute a previously defined set-up. The number of the particular set-up is specified as a parameter. In case more than one measurement command is included in the defined set-up, the measurements are performed in the same way as they would be in the RE201 local mode, (i.e. the measurements in the left channel are performed before the measurements in the right channel). To keep track of the results, the RE201 will transmit an identification number preceding every result. Please refer to the description of the set-up facility in this section.

Abbreviation

The abbreviation allowed for the EX command is E.

Syntax

The EX command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: Set-up number.

Parameter Values

PARAMETER	RANGE
1	0 - 99

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
54	84	Set-up Not Defined

Example

The command "E,17" will execute all the commands included in the set of commands of set-up number 17.

FILDEF, The Software Filter Define Command

Description

The software filter define command, FILDEF, is used to create filters for the RMSFIL measurement. It is used to set a number of succeeding filter bins to equal values.

The user specifies the start and stop bins and the filter weight multiplier to be loaded.

As the RE201 provides 2 software filters, the filter number may be specified as well.

Please refer to the RMSFIL command for use of the filters and to the FILTER command for another way of defining filters.

Abbreviation

The abbreviation allowed for the FILDEF command is FF.

Syntax

The FILDEF command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Start bin number. (Note 1.)
Parameter 2: Stop bin number. (Note 1.)
Parameter 3: Filter weight multiplier. (Note 2.)
Parameter 4: Filter number.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 200	0
2	0 - 200	200
3	0 - 32767	0
4	0 - 1	0

Notes

1. The frequency distance between the bin centers is dependent on parameter 5 of the RMSFIL command (the option mode). When using the ZOOM facility not all of the bins are used. The table below shows frequency bin distance versus option mode.

OPTION MODE	NAME	DISTANCE IN HZ	NO. OF BINS	BANDWIDTH IN HZ
0	NORMAL	125	201	25000
4	ZOOM 1	125/2	155	9625
5	ZOOM 2	125/8	155	2406
6	ZOOM 3	125/32	155	601
7	ZOOM 4	125/128	155	150

2. Weighting factor = 32767 means weighting with 1, i.e. weighting factor N means weighting with N/32767.

Example

The commands "FF,0,6,0,1", "FF,7,9,32767,1" and "FF,10,200,0,1" create a bandpass filter 3 bins wide around bin number 8 corresponding to 1 kHz center frequency and a bandwidth of approx. 475 Hz.

In case RMSFIL is specified using option mode 7 and a mixer frequency of 1000 Hz, i.e. par 6= 32, the center frequency of this bandpass filter is:

fc= fmix - ((77-bin number) x bin distance)
fc= 1000 - ((77 - 8) x 125/128)= 932.62 Hz
and the 3 dB bandwidth is approx. 2.9 Hz.

FILTER, The Software Filter Define Command

Description

The software filter define command, FILTER, is used to create filters for the RMSFIL measurement. It is used to assign a filter weight multiplier to a particular filter bin.

The user specifies the particular bin number and the filter weight to be loaded.

As the RE201 provides 2 software filters the filter number may be specified as well.

Please refer to the RMSFIL command for use of the filters and to the FILDEF command for another way of defining filters.

Care must be taken to define all 201 (155) filter bins before using the filter.

Abbreviation

The abbreviation allowed for the FILTER command is FR.

Syntax

The FILTER command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Bin number. (Note 1.)
Parameter 2: Filter weight multiplier. (Note 2.)
Parameter 3: Filter number.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 200	200
2	0- 32767	0
3	0 - 1	0

Notes

1. The frequency distance between the bin centers is dependent on parameter 5 of the RMSFIL command (the option mode). When using the ZOOM facility not all the frequency bins are used. The table below shows frequency bin distance versus option mode.

OPTION MODE	NAME	DISTANCE IN HZ	NO. OF BINS	BANDWIDTH IN HZ
0	NORMAL	125	201	25000
4	ZOOM 1	125/2	155	9625
5	ZOOM 2	125/8	155	2406
6	ZOOM 3	125/32	155	601
7	ZOOM 4	125/128	155	150

2. Weighting factor = 32767 means weighting with 1, (i.e. weighting factor N means weighting with N/32767).

Example

The command "FR,8,32767" will set the weight multiplier of bin number 8 in filter 0 to 32767, which is the maximum value.

Please refer to the FILDEF command for another example.

FSKDEL, The FSK Output Link Delimiter Command

Description

The FSK Output link delimiter command, FSKDEL, is used to specify open and close characters, so-called delimiters, for the IEEE-to-FSK output link.

The delimiters are initially set to SOH (ctrl A) as the start character and ETX as the stop character. By means of the FSKDEL command they may be altered to any character or value represented by 8 bits, i.e. in the range from 0 to 255. Start and stop delimiters may be of the same value if applicable. Please refer to section 9 for more information on the IEEE488-to-FSK Output link.

Abbreviation

The abbreviation allowed for the FSKDEL command is FL.

Syntax

The FSKDEL command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: Start (or open) delimiter.
Parameter 2: Stop (or close) delimiter.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 255	1
2	0 - 255	3

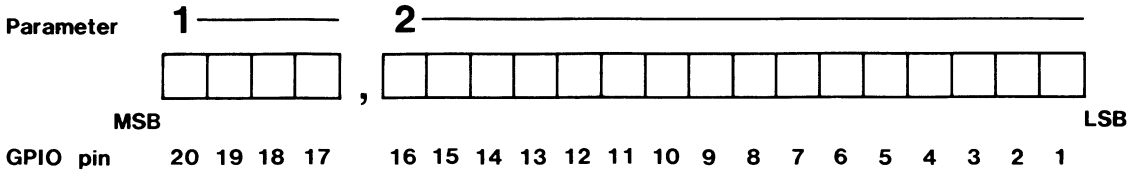
Example

The command "FL,91,93" will set the IEEE-to-FSK Output link delimiters to the ASCII characters "[" and "]". Please refer to the ASCII table in section 7.

GPIO, The General Purpose Interface Output Command

Description

The general purpose interface output command, GPIO, enables control of the RE201 GPIO connector, which provides 20 individually programmable TTL outputs. These 20 bits are regarded as a 4-bit word, parameter 1, and a 16-bit word, parameter 2. The figure below shows the relationship between the physical connector pin and the two parameters. As the input parameters cannot exceed 16 bits, parameter 2 is a 2's complement figure.



Pin-out of the RE201 GPIO connector.

Pins 1-20 Standard LS-TTL outputs.
Pin 21 Positive going LS-TTL output valid strobe pulse.
Pin 22 Negative going LS-TTL output valid strobe pulse.
Pin 23 Input for DC 1 measurement.
Pin 24 Input for DC 2 measurement.
Pin 25 0V reference.

Following each GPIO command two output valid strobe pulses, a positive and a negative going, are available on pins 21 and 22. These are provided for latching of the outputs.

Abbreviation

The abbreviation allowed for the GPIO command is GO.

Syntax

The GPIO command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: Setting of pins 17 to 20.
Parameter 2: Setting of pins 1 to 16. (Note 1.)

Parameter Values

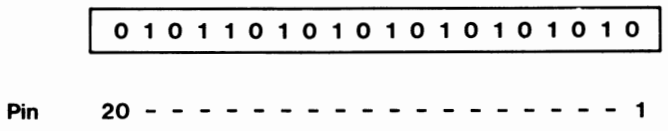
PARAMETER	RANGE
1	0 - 15
2	-32768 - 32767

Notes

1. The decimal value is obtained by regarding the bit pattern as a 2's complement number, (i.e. the pattern 1000 0000 0000 0000 = -32768 while 1111 0000 0000 0000 = -4096 ("1" = +5V, "0" = 0V)).

Example

The command "GO,5,-21846" gives the following output on the GPIO connector.



IDLE, The Measurement Halt Command

Description

The measurement halt command, IDLE, is used to stop the measurement process in the RE201, placing the instrument in a waiting state. Following an IDLE command the next measurement initiated will be preceded by an autorange if this facility is enabled (please refer to the ATTENU command).

Abbreviation

The abbreviation allowed for the IDLE command is IE.

Syntax

The IDLE command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

The IDLE command has no parameters.

Parameter Values

None.

Example

The command "IE" halts the present measurement, if any, and places the RE201 in its waiting state.

INSPECT, The Set-up Inspection Command

Description

The set-up inspection command, INSPECT, enables the user to examine the contents of the defined set-ups. This feature is especially valuable during the writing and debugging of controller programs.

The output is obtained in the same way as measurement results. The INSPECT command generates an output available service request code, and when talk addressed the RE201 will output the contents of the specified set-up. If no set-up specifications are used, all defined set-ups will be presented to the controller. Please refer to the description of the set-up facility in this section.

Abbreviation

The abbreviation allowed for the INSPECT command is IT.

Syntax

The INSPECT command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Set-up number. (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	-1 - 99	-1

Notes

1. If no parameter is specified or if Par 1 = -1 the output returned will be the contents of all the defined set-ups. Each set-up will be announced by means of SRQ code 212 (Output available).

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
D4	212	Output Available
54	84	Set-up Not Defined

Output Format

The set-up contents are returned as shown below.

SF,n Command Command etc.
Corresponding to the "INSPECT" output format (n being the number of the set-up being inspected).

Example

The command "IT,73" will return the contents of set-up number 73. Say the set-up consists of a fixed gain setting of + 8 dB, an RMS level measurement and a THD measurement of 3rd harmonic distortion tracking the input frequency, the output appears as follows:

"SF,73 AU,1,8 RS,1,256,0 TD,1,1,-1,3,3".

MEMBUS, The Memory Bus Interface Control Command

Description

The memory bus interface control command, MEMBUS, enables control of instruments equipped with a memory bus interface connected to the RE201.

The MEMBUS command simply specifies the memory bus set-up number wanted for the next test step. The number of memory bus set-ups supported is 100 (from 0 to 99).

Abbreviation

The abbreviation allowed for the MEMBUS command is MS.

Syntax

The MEMBUS command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: Memory bus set-up number.

Parameter Values

PARAMETER	RANGE
1	0 - 99

Example

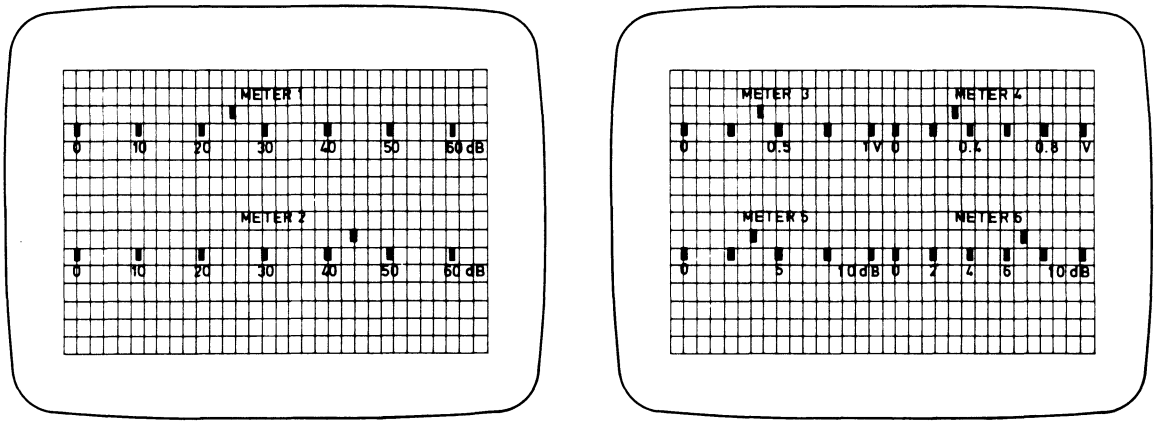
The command "MS,57" will recall memory bus set-up number 57 in the connected instruments.

METER, The "Analog Meter" Command

Description

The "analog meter" command, METER, provides the possibility of controlling six different graphic meter pointers on the CRT-display of the RE201, thereby making it into an analog instrument very useful for adjustment tasks.

Two large and four small meters are available. The large meters provide a resolution of 256 discrete steps and are numbered 1 and 2. The small meters providing a resolution of 128 steps are numbered from 3 to 6.



One large and two small meters can be combined, i.e. meters 1, 5 and 6 or meters 2, 4 and 3.

The meter scales and annotation shown are all made by using the IEEE-to-CRT-display-link, also described in this manual. In other words, the user is given full flexibility concerning the form of the meters, i.e. compressed, linear, logarithmic etc. Likewise the denominations are written on the CRT-display using the IEEE-to-CRT-display-link.

As the METER command is a utility it does not affect any activity going on in the RE201. Utilities are like the IEEE-to-CRT and serial output links executed in parallel to measurements.

Deletion of meters is performed by overwriting, using the IEEE-to-CRT-display-link.

Meter Specifications

To understand where the meter needles are placed on the CRT-display, the display should be considered as a character matrix consisting of 16 rows, from row 0 to row 15, each consisting of 32 characters, 9 dots wide (ref. section 7).

The following table shows the position of the needle centers at zero and full deflection of the six meters. The width of a needle is 3 dots (ref. section 7).

METER NO.	ROW	ZERO DEFLECTION	FULL DEFLECTION
1	2	1st dot of 2nd character	5th dot of 30th character
2	9	1st dot of 2nd character	5th dot of 30th character
3	2	1st dot of 2nd character	3rd dot of 15th character
4	2	1st dot of 17th character	5th dot of 30th character
5	9	1st dot of 2nd character	3rd dot of 15th character
6	9	1st dot of 17th character	5th dot of 30th character

The resulting resolution then becomes 256 steps for the two large meters (1 and 2), and 128 steps for the four small meters, 3 to 6.

Abbreviation

The abbreviation allowed for the METER command is MR.

Syntax

The METER command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: Meter number.
Parameter 2: Deflection. (Note 1.)

Parameter Values

PARAMETER	RANGE	
1	1 - 6	
2	0 - 255	(Note 1.)

Notes

1. When specifying meters 3 through 6 allowed range for parameter 2 is 0 to 127.

Example

The command "MR,5,19" will place a needle in the 2nd dot of the 4th character in row 9. If meter number 5 is in use the needle is moved from the old to the new position.

PP, The Parallel Poll Configure Command

Description

The parallel poll configure command, PP, is included to oblige users who have a controller which is not able to PP-configure instruments according to the IEEE488 interface standard.

The PP command specifies the parallel poll response line on the data bus or it is used to unconfigure the interface.

Abbreviation

No abbreviation is allowed for the PP command.

Syntax

The PP command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: PP-response line number. (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 8	0

Notes

1. Parameter 1 = 0 means unconfigure (i.e. no response).

Example

The command "PP,4" will configure the RE201 to a PP-response on DIO line number 4.

SDEF, The Set-up Defining Command

Description

The set-up defining command, SDEF, is used during creation of set-ups. A command string beginning with the SDEF command and the number of the set-up means that the subsequent set of commands is to be stored as that particular set-up.

A set-up may contain any number of utility commands and up to 18 measurement commands.

When defining set-ups the programmer must assure that the command string describing the set-up is terminated with the end-of-line sequence (please refer to the syntax diagram for a command string), just after the last command or parameter. Please refer to the description of the set-up facility in this section.

Abbreviation

The abbreviation allowed for the SDEF command is SF.

Syntax

The SDEF command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: Set-up number.

Parameter Values

PARAMETER	RANGE
1	0 - 99

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
55	85	No Room for Set-up
6B	107	Command Ignored

Please note that the "No room for set-up" error also is issued in the following cases:

* More than 18 measurement commands are included in the command list

* An attempt is made to define a set-up with more than one measurement command accompanying the WEIGHT command

* DATACO or SPECTRUM is included in the set-up.

Example

The command "SF,19 AU,1 RS FQ" defines the set-up number 19 to set, when executed, right channel amplifier to autorange and to start an RMS level and a frequency measurement sequence in the right channel as well.

SERDEL, The RS232C Link Delimiter Command

Description

The RS232C link delimiter command, SERDEL, is used to specify open and close characters, so-called delimiters, for the IEEE-to-RS232C serial output link.

The delimiters are initially set to ctrl N (SO) as the start character and ctrl O (SI) as the stop character. By means of the SERDEL command they may be altered to any character or value represented by 8 bits, i.e. in the range from 0 to 255. Start and stop delimiters may be of the same value if applicable. Please refer to section 8 for more information on the IEEE488-to-RS232C link.

Abbreviation

The abbreviation allowed for the SERDEL command is SL.

Syntax

The SERDEL command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: Start (or open) delimiter.
Parameter 2: Stop (or close) delimiter.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 255	14
2	0 - 255	15

Example

The command "SL,91,93" will set the IEEE-to-RS232C link delimiters to the ASCII characters "[" and "]". Please refer to the ASCII table in section 7.

SETTIME, The Time-out Time Set Command

Description

The time-out time set command, SETTIME, is used to specify time-out interval for the IEEE-to-RS232C link, i.e. the time that the RE201 will wait in case no handshake is done on the RS232C bus. The time interval is specified in 1/100 seconds from 10 ms to 5.46 minutes.

The IEEE-to-RS232C link time-out value is initially set to 3 seconds. The SETTIME command provides a means to alter this figure if applicable.

Abbreviation

The abbreviation allowed for the SETTIME command is SE.

Syntax

The SETTIME command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: Time-out value in 1/100 seconds.

Parameter Values

PARAMETER	RANGE
1	1 - 32767

Example

The command "SE,1000" will set the IEEE-to-RS232C link time-out value to 10 seconds.

SRQDIS, The Service Request Disable Command

Description

The service request disable command, SRQDIS, provides the possibility of disabling service requests initiated by a result ready, an error or a warning.

It should be noted that disabling service requests has no influence on the status byte obtainable from a serial poll.

The following options are available:

0. Enable all SRQ's.
1. Disable error and warning SRQ's.
2. Disable result SRQ's.
3. Disable all SRQ's.

Hereby it is possible to make polling controller programs, which are only interrupted by service requests issued as a function of an error/ warning.

Abbreviation

The abbreviation allowed for the SRQDIS command is SS.

Syntax

The SRQDIS command follows the syntax description FORMAT 2, (i.e. all parameters are needed).

Parameters

Parameter 1: SRQ disable code. (Note 1.)

Parameter Values

PARAMETER	RANGE
1	0 - 3

Notes

1. Parameter 1 = 0 enable all SRQ's.
   Parameter 1 = 1 disable error and warning SRQ's.
   Parameter 1 = 2 disable result SRQ's.
   Parameter 1 = 3 disable all SRQ's.

Example

The command "SS,2" disables service requests from results ready conditions, meaning that service requests (SRQ's) will only be issued in case of an error or a warning.

TEST, The Selftest Command

Description

The selftest command, TEST, initiates a selftest sequence similar to the test performed during power-up of the RE201.

The TEST command may be used for "on the fly" tests during the day in order to ensure that all instruments are okay. Please note that filters and set-ups previously defined are lost after a selftest.

Abbreviation

The abbreviation allowed for the TEST command is TT.

Syntax

The TEST command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

The TEST command has no parameters.

Parameter Value

None.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
C0	192	Selftest Successful
63	99	Error Found in Digital Section

Example

The command "TT" initiates an RE201 selftest sequence. After the selftest the RE201 will be idling, waiting for a command.

WEIGHT, The Weighting Filters Command

Description

The Weighting Filters command, WEIGHT, enables the user to select a filter type to be applied to the input signal during a succeeding level measurement. This means that in order to perform a weighted level measurement the WEIGHT command and the desired level command (detector) must be sent as a pair with no other measurement commands in between. The utility commands, however, will have no influence at all.

Please note that when the WEIGHT command is used in a set-up, the set-up must only contain one measurement command, and this command must be one of the level commands.

The level commands available are:

a. RMS
b. RMSBPF
c. RMSFIL
d. RMSLBW
e. PEAK
f. QUASIPK
g. AVERAGE
h. INTERG

All other measurement commands, such as FREQ or THD, will de-select the Weighting Filters specification.

The Weighting Filters available are:

a. CCITT P53 and C-message filter for measurement of noise in telephone systems (CCITT P53 and US standards)

b. CCIR 468 and 22.4 Hz to 22.4 kHz (3 dB) bandpass filter for measurement of noise in broadcasting (CCIR 468 standard)

c. 300 Hz to 15 kHz (3 dB) bandpass filter for measurement of noise in FM radios (DIN 45300 standard)

d. Sound level filters A, B and C weighting for measurement of noise (DIN 45633 and IEC 651 standards)

e. Rumble filters for measurement of weighted and unweighted rumble in disk record playing equipment (DIN 45539 standard)

f. User recommended filters: the IBA filter for measurement of weighted crosstalk, and Dolby Lab's filter (CCIR/ARM) for measurement of noise in professional as well as consumer audio equipment.

After measuring weighted level, the next level command automatically de-selects the Weighting Filters Option. The WEIGHT command, however, gives a means to specify no Weighting Filters, or not to use the Weighting Filters Option at all (straight or normal), which is useful during program development or if the test sequence is programmed as a loop. Selecting straight will utilize the RE201 noise autorange algorithm.

***** Note *****

The Weighting Filters Option (901-526) has to be installed in order to use the WEIGHT command.

Abbreviation

The abbreviation allowed for the WEIGHT command is WT.

Syntax

The WEIGHT command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Filter type selector. (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	-1 - 12	0

Notes

1. The meaning of the different parameter values is stated below:

PAR. 1	MEANING
-1	Normal, Weighting Filters Option Not Used
0	25 kHz Low-pass
1	CCITT P53 Psophometric Filter
2	C-message Psophometric Filter
3	CCIR 468 Noise Weighting Filter
4	CCIR Bandpass 22.4 Hz to 22.4 kHz
5	DIN 45300 Bandpass 300 Hz to 15 kHz
6	Crosstalk Weighting Filter
7	DIN 45633/IEC 651 A Weighting
8	DIN 45633/IEC 651 B Weighting
9	DIN 45633/IEC 651 C Weighting
10	CCIR/ARM Noise Weighting (Dolby)
11	DIN 45539 Rumble Unweighted
12	DIN 45539 Rumble Weighted

Example

The command "WT,3" sets up the RE201 to apply the CCIR 468 Noise Weighting Filter to the input signal during the succeeding level measurement.

THE MEASUREMENT COMMANDS

The measurement commands are the commands initiating measurements and they therefore generate results as their output. Please note that once initiated all measurements (except DATACO and SPECTRUM) deliver new results continuously.

There is a measurement command for every measurement type available in the RE201 LOCAL or manual mode, and besides this, the following measurements are added.

1. Fast frequency measurement, TRIMFQ.
2. Two-channel level measurement, TWOLEV.
3. Data collection, DATACO, and the ability to obtain a frequency spectrum, SPECTRUM.

The following table shows the dependence of the various options, e.g. whether or not a particular option is necessary to execute the command. An "N" in the option column indicates that the particular option is necessary. An "I" indicates that a particular option may improve the performance of the specific command and a "." indicates that the command is not affected by the option.

	AUDIO GENERATOR	FIL-TER	WOW & FLUTTER	WEIGHTING FILTER
AVERAGE	.	.	.	N
DATACO	.	.	.	.
DC	.	.	.	.
DFIM	.	.	.	.
FREQ	.	.	.	.
HD	.	I	.	.
IM	.	I	.	.
INTERG	.	.	.	I
PEAK	.	.	.	I
PHASE	.	.	.	.
PHASEF	.	.	.	.
QUASIPK	.	.	.	N
RMS	.	.	.	I
RMSBPF	.	.	.	I
RMSFIL	.	.	.	I
RMSLBW	.	N	.	I
SEP	.	.	.	.
SINAD	.	N	.	.
SPECTRUM	.	.	.	.
THD	.	I	.	.
TIM	.	.	.	.
TRIMFQ	.	.	.	.
TWOLEV	.	.	.	.
WOWFLU	.	.	N	.

In the following each measurement command will be described separately. The commands are listed in alphabetical order.

AVERAGE, The Average Level Command

Description

The average level command, AVERAGE, starts a level measurement giving a result corresponding to an average detecting meter calibrated to show the RMS value (in dBm).

The input channel and the integration time are programmable.

The integration time used by the measurement will be the nearest multiple of 128 ms above the specified value.

*** Note ***

In order to use the AVERAGE command the Weighting Filters Option (901-526) must be installed in the RE201.

Abbreviation

The abbreviation allowed for the AVERAGE command is AE.

Syntax

The AVERAGE command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0 = BOTH; 1 = RIGHT; 2 = LEFT.
Parameter 2: Integration time in ms. (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	100 - 9999	512

Notes

1. The integration time used is the nearest multiple of 128 ms.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
D5	213	Result Ready

Output Format

The result is returned as a signed real in dBu (0 dBu = 0.775V).

Example

The command "AE,2" will measure RMS calibrated average level in the LEFT channel using the default integration time of 512 ms. The result appears like this:

+6.0000E+0 (meaning a level 6 dB above 0.775V).

DATACO, The Data Collection Command

Description

The data collection command, DATACO, gives access to the raw data samples generated by the Analog to Digital converter.

The number of data samples may be specified from 1 to 1024, the data collection may be initiated by the command itself or it may be armed for start upon a GET (Group Execute Trigger) bus command. In both operation modes a delay from 0 to 99 ms may be specified.

The output is available in both ASCII and Binary formats. When specifying ASCII the samples are separated by semicolons (;) and the transmission is terminated by the normal end-of-line sequence (CR, LF with EOI). The Binary format transmits the 16-bit values as two bytes with the most significant byte first. There are no delimiters and the last byte is marked with the EOI message.

The output samples will be in the range from -2048 to +2047 corresponding to a 12 bit resolution. The actual value is obtained by dividing the sample by 2048 and multiplying this value with 2.5V and dividing it again by the gain in the analog front end. Thus, if the actual value is of importance, fixed gain must be used by employing the ATTENU command.

For example consider a front end setting of -20 dB and a sample value of -517 - the calculation will be as follows:

$$Vin = \frac{-517}{2048} \times 2.5 \times \frac{1}{10^{\frac{-20}{20}}} = -6.31V$$

in general terms the formula is:

$$Vin = \frac{sample}{2048} \times 2.5 \times \frac{1}{10^{\frac{gain}{20}}} \quad V$$

The DATACO will execute only once, and the RE201 will be idling when a data collection has been concluded.

*** Note ***

The DATACO must not be incorporated in a set-up.

Abbreviation

The abbreviation allowed for the DATACO command is DO.

Syntax

The DATACO command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT.
Parameter 2: Format 0= ASCII, 1= Binary.
Parameter 3: Trigger arm 0= Off, 1= On.
Parameter 4: Delay in milliseconds.
Parameter 5: Number of samples.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	0 - 1	1
3	0 - 1	1
4	0 - 99	0
5	1 - 1024	512

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
81	129	Waiting For Trigger
C1	193	Result Ready

Please note that DATACO and SPECTRUM have the same result ready code.

Output Format

The result is transmitted in either ASCII or two's complement Binary format according to the value of parameter 2.

Example

The command "DO,1,0,0,0,3" initiates a data collection directly with no delay and consisting of 3 samples in the RIGHT channel. The result will be transmitted in ASCII appearing like this:

2173;157;-1859 CR LF with EOI.

DC, The DC Command

Description

The DC command is used to measure DC voltages. The RE201 has a special connector (BNO-type) at the rear of the instrument for this type of input allowing 2 inputs called DC1 and DC2 (male part of BNO being DC1, female part being DC2) - pins 23 and 24 in the GPIO connector also connect to the BNO connector.

The DC inputs of the instrument have a fixed range of +/- 16V and a resolution of 125mV.

Abbreviation

No abbreviation allowed for the DC command.

Syntax

The DC command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 1= DC 1, 2= DC 2

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	1 - 2	1

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
D1	209	Result Ready

Output Format

The result is returned as a real in V.

Example

The command "DC,2" measures level at DC input 2. The result appears like this:

-1.2500E+1 (meaning a voltage of -12.5V).

DFIM, The Difference Frequency Intermodulation Distortion Command

Description

The DFIM measurement is used to measure Two-tone Distortion (Difference-frequency Distortion). The RE201 measures any combination tone(s) selectively from order 2 to order 9.

The difference frequency distortion of n'th order for n even is calculated as

$$d_n = \frac{V_{F2-F1}}{\sqrt{2} \cdot V}$$

where V_{F2-F1} is the RMS value of the component frequency and V is the RMS value of the total signal.

For n odd the results are calculated as

$$d_n = \frac{V_{(2F2-F1)} + V_{(2F1-F2)}}{\sqrt{2} \cdot V}$$

i.e. the arithmetic sum of sideband RMS levels divided by 2 times RMS level of total signal.

As there is no definition of "Total Difference-frequency Distortion" the RE201 only displays resulting distortion created by one (set of) combination tone(s).

Abbreviation

The abbreviation allowed for the DFIM command is DM.

Syntax

The DFIM command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1:	Channel 0= BOTH, 1= RIGHT, 2= LEFT	
Parameter 2:	Lower frequency fL.	(Notes 1,2,3,4.)
Parameter 3:	Higher frequency fH.	(Notes 1,2,3,4.)
Parameter 4:	DFIM product number N.	(Notes 1,2,3,4.)
Parameter 5:	Averaging.	(Note 5.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	24 - 24996	7000
3	28 - 25000	8000
4	2 - 9	2
5	0 - 64	1

Notes

1. The following 80 dB isolation frequency is in force:
   RANGE: fisol= 4 Hz.
2. fH-fL $\geq$ fisol.
3a. For N even: 4 x fL -2 x fH > N x (fH-fL).
3b. For N odd: 4 x fL -2 x fH > (N-1) x (fH-fL).
4. Odd and even products tend to overlap if the following conditions have not been fulfilled:
   For N even: N x (fH-fL) < fL-fisol.
   For N odd: (N-1) x (fH-fL) < fL-fisol.
5. If 0 is chosen exponential averaging is used.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
D3	211	Result Ready

Output Format

The result is returned as a real in %.

Example

The command "DM,2,850,900,3,5" will measure 3rd order DFIM in the LEFT channel using linear averaging over 5 loops, use 850 and 900 Hz as test signals, and will produce a result like:

3.1012E-1 (which means a distortion of 0.31 %).

FREQ, The Frequency Command

Description

The FREQ measurement is used to measure

a) Frequency, absolute

b) Drift (DIN, NAB, JIS)

The RE201 measures the frequency of the largest component in the audio band - based on this information several types of results (see above) are possible. Due to the fact that frequency measurements are based on spectral analysis the RE201 is relatively unaffected by low S/N ratios.

Abbreviation

The abbreviation allowed for the FREQ command is FQ.

Syntax

The command FREQ follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT
Parameter 2: Mode. (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	-1 - 1	0

Notes

1. Mode = 0, Normal frequency measurement using a full spectrum.
   Mode = -1, Drift measurement, i.e the RE201 will find the frequency of the largest component in the range 2.500 kHz to 4.500 kHz, i.e. in a band around the standard wow and flutter measuring frequencies 3 and 3.15 kHz.

Mode = 1, Option lock, to speed up continuous measurements in the same frequency band. The RE201 will use the option found necessary during the first loop continuously, contra issuing a baseband FFT, and possibly some ZOOM FFTs, in the beginning of each measurement.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
CA	202	Result Ready
67	103	Frequency Out of Range

Output Format

The result is returned as an integer in Hz.

Example

The command "FQ,0" will measure frequency in both channels using normal mode. The results will appear as follows:

2,15555 (meaning 15.555 kHz in the LEFT channel)
1,14237 (meaning 14.237 kHz in the RIGHT channel)

HD, The Harmonic Distortion Command

Description

The HD command is used to measure harmonic distortion. The RE201 measures up to 9 user-specified harmonics selectively. Thereby it is possible to measure a single harmonic or a group of succeeding harmonics. The result consists of the THD value succeeded by the value of the harmonics specified. In case one harmonic is specified only ONE value is returned. In case the HD command is included in a set-up only the THD value is returned.

Normally, the fundamental frequency must be specified, but the RE201, however, is able to track the fundamental frequency itself by specifying PAR3= -1.

Abbreviation

The abbreviation allowed for the HD command is HD.

Syntax

The HD command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1:	Channel 0= BOTH, 1= RIGHT, 2= LEFT.	
Parameter 2:	Averaging.	(Note 1.)
Parameter 3:	Fundamental frequency or tracking.	(Note 2.)
Parameter 4:	First harmonic to be included.	(Note 3.)
Parameter 5:	Last harmonic to be included.	
Parameter 6:	Filter option enable.	(Note 4.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	0 - 64	1
3	-1,20 - 12500	1000
4	2 - 9	2
5	2 - 9	9
6	0 - 1	1

Notes

1. If 0 is chosen exponential averaging is used.
2. Fundamental frequency of input signal: -1 selects tracking mode.
3. Harmonic number * fundamental frequency $\leq$ 25000 Hz.
4. When the Filter option (901-525) is installed, parameter 6 enables the programmer to decide whether the RE201 should automatically use it or not. If par 6=0 the RE201 will not use the Filter option.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
D8	216	Result Ready

Output Format

The result is returned as reals in %, separated by semicolon(;).

Example

The command "HD,1,0,-1,3,5" will measure harmonic distortion in the RIGHT channel, using exponential averaging. It will determine the fundamental frequency automatically, and it will include 3rd, 4th and 5th harmonics in the calculations. The result will appear like this:

2.6001E-2;1.6645E-2;8.6015E-3;1.8137E-2
(meaning a THD of 0.026% including the following harmonics:

3rd 0.0166%
4th 0.0086%
5th 0.0181%)

IM, The Intermodulation Distortion Command

Description

The IM measurement is used to measure Intermodulation Distortion (SMPTE and DIN). The RE201 selectively measures specified sidebands generated by the Device Under Test (DUT).

Abbreviation

No abbreviation allowed for the IM command.

Syntax

The IM command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT
Parameter 2: Lower input frequency fL. (Notes 1,3.)
Parameter 3: Higher input frequency fH. (Notes 1,3.)
Parameter 4: First IM product to include (N.) (Note 2.)
Parameter 5: Last IM product to include (M.) (Notes 1,2,3.)
Parameter 6: Averaging. (Note 4.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	16 - 8000	700
3	48 - 25000	7000
4	2 - 9	2
5	2 - 9	2
6	0 - 64	1

Notes

1. $2 \times fL < fH - fL \times (M-1)$
2. $M > N$
3. Harmonics of fL tend to overlap desired IM product if

   $5 \times fL > fH - fL\ (M-1)$

4. If 0 is chosen exponential averaging is used.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
C7	199	Result Ready

Output Format

The result is returned as a real in %.

Example

The command "IM,1,625,6250" measures 2nd order intermodulation in the RIGHT channel using 625 and 6250 Hz as measuring frequencies. The result appears like this:

2.5013E-1 (meaning a distortion of 0.25 %).

INTERG, The Interchannel Gain Measurement Command

Description

The Interchannel Gain Measurement Command, INTERG, measures the RMS level relationship between the two channels in dB. The measurements are RMS measurements in a 25 kHz bandwidth.

The measurement channel and integration time are user selectable. The measurement channel is the channel to be measured in relation to the other, e.g. the output of the device under test.

The user can select an integration time from 8 to 512 ms depending on the frequency contents of the signal under measurement, i.e. according to the formulas shown in the RMS-command section, low frequencies/ components being close to each other call for high integration times to give a result which has a low uncertainty.

Abbreviation

The abbreviation allowed for the INTERG command is IG.

Syntax

The INTERG command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Measurement channel 0= BOTH, 1= RIGHT, 2= LEFT.
Parameter 2: Integration time in ms. (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	8 - 512	64

Notes

1. Integration time is not a continuously variable parameter but must have one of the following values:

   8, 16, 32, 64, 128, 256 or 512.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
D7	215	Result Ready

Output Format

The result is returned as a real in dB.

Example

The command "IG,2,8" performs the fastest INTERG measurement available with the LEFT channel as measurement channel, namely with an integration time of only 8 ms per channel. The result appears like this:

1.2576E+1 (meaning a difference from LEFT to RIGHT channel of 12.58 dB).

PEAK, The Peak Level Command

Description

By means of the PEAK command, the instrument will measure positive and negative peak values PEAK+ and PEAK-. The input channel and the integration time are programmable.

Abbreviation

The abbreviation allowed for the PEAK command is PK.

Syntax

The PEAK command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT.
Parameter 2: Duration in ms.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	1 - 999	20

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
C2	194	Result Ready

Output Format

The result is returned as 2 signed reals in V, separated by a semicolon (;).

Example

The command "PK,1,100" measures positive and negative peak voltage of the input wave form in the RIGHT channel, using 100 ms integration time. The result appears like this:

+2.2043E-1;-3.3327E-1 (meaning a positive peak of 220mV and a negative peak of 333mV).

PHASE, The Phase Command

Description

The phase measurement command, PHASE, initiates a measurement of absolute phase relation between right and left input signals, in degrees. The RIGHT channel is used as reference.

Integration time is user-definable between 100 and 32767 milliseconds.

Further inversion of the left channel signal is possible thus enabling measurements in the difficult range around 0 degrees to be performed around 180 degrees.

Abbreviation

The abbreviation allowed for the PHASE command is PE.

Syntax

The PHASE command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Measurement time in ms.
Parameter 2: Invert left channel (1: invert). (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	100 - 32767	500
2	0 - 1	0

Notes

1. Inversion of left channel enables measurement in the difficult range around 0 degrees to be done around 180 degrees.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
CF	207	Result Ready

Output Format

The result is returned as an integer in degrees.

Example

The command "PE,1000,1" measures the phase relationship between the two input wave forms, using a measuring time of 1 second, - with left channel inverted meaning that a phase difference of 2 degrees will give the following result:

182 (meaning 182 - 180 = 2 degrees).

PHASEF, The Phase Fluctuation Command

Description

The phase fluctuation command, PHASEF, initiates a measurement of peak to peak phase fluctuation, in between the right and the left input signals, in degrees. The RIGHT channel is used as reference.

Integration time is user-definable between 500 and 32767 milliseconds.

Further inversion of the left channel signal is possible thus enabling measurements in the difficult range around 0 degrees to be performed around 180 degrees.

Abbreviation

The abbreviation allowed for the PHASEF command is PF.

Syntax

The PHASEF command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Measurement time in ms.
Parameter 2: Invert left channel (1: invert). (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	500 - 32767	1000
2	0 - 1	0

Notes

1. Inversion of left channel enables measurement in the difficult range around 0 degrees to be done around 180 degrees.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
D0	208	Result Ready

Output Format

The result is returned as an integer in degrees.

Example

The command "PF,3000" measures peak to peak phase fluctuation in between the two input wave forms, using a measuring time of 3 seconds. The result appears like this:

17 (meaning a fluctuation, peak to peak, of 17 degrees).

QUASIPK, The Quasi-Peak Level Command

Description

The Quasi-Peak level command, QUASIPK, initiates an RMS calibrated peak level measurement with a dynamic response in accordance with the CCIR 468 recommendations.

The input channel and the measurement time are programmable. If fixed gain is to be used, the command ATTENUW should be used instead of ATTENU.

***** Note *****

In order to use the QUASIPK command the Weighting Filters Option (901-526) must be installed in the RE201.

Abbreviation

The abbreviation allowed for the QUASIPK command is QK.

Syntax

The QUASIPK command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT; 2= LEFT.
Parameter 2: Measurement time in ms.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	100 - 32767	2000

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
D6	214	Result Ready

Output Format

The result is returned as two signed reals in dBu, separated by a semicolon (;) (Ø dBu = 0.775V).

Example

The command "QK,1,5000" measures the peak level of the RIGHT channel input signal using the Quasi-Peak detector. The measurement time is 5 seconds and the results will look like this:

+2.0107E+0;-3.3242E-1 (meaning a maximum reading of +2.01 dBu and a mean value of -0.332 dBu).

RMS, The RMS Level Command

Description

The user can select an integration time from 8 to 512 ms depending on the frequency contents of the signal under measurement, i.e according to the formulas below, low frequencies/components being close to each other call for high integration times to give a result which has a low uncertainty.

Formulas:

Uncertainty of one component: $+/- 8/(f \times T)$ %

Uncertainty of two components: $+/- 16/((f_2 - f_1) \times T)$ %

where f_1, f_2 and f_2 are frequencies in kHz, T is the integration time in ms and $(f_2 - f_1) << f_1$.

Abbreviation

The abbreviation allowed for the RMS command is RS.

Syntax

The RMS command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT.
Parameter 2: Integration time in ms. (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	8 - 512	64

Notes

1. Integration time is not a continuously variable parameter but must have one of the following values:

   8, 16, 32, 64, 128, 256 or 512.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
C3	195	Result Ready

Output Format

The result is returned as a real in V.

Example

The command "RS,2,8" performs the fastest RMS measurement available in the LEFT channel, namely with an integration time of only 8 ms. The result appears like this:

1.2537E+1 (meaning an RMS voltage of 12.5V).

RMSBPF, The Selective RMS Level Command

Description

When using the RMSBPF command the instrument will measure level selectively - the user is free to determine center frequency and bandwidth for the measurement, by specifying lower and higher filter corner frequencies.

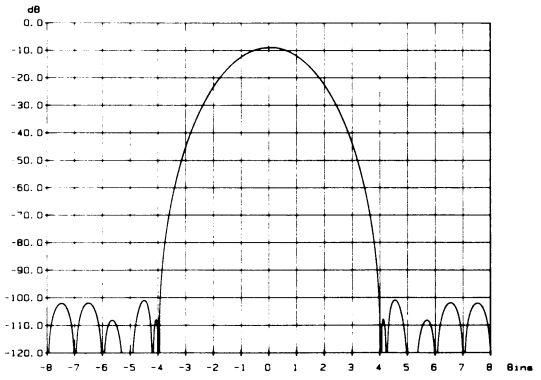
As the measurement is performed by means of the Fast Fourier Analysis on the incoming signal, the selectivity depends on a window function - the RE201 normally offers two such functions:

1. Four Terms Blackmann-Harris (FTBH)
2. SINE

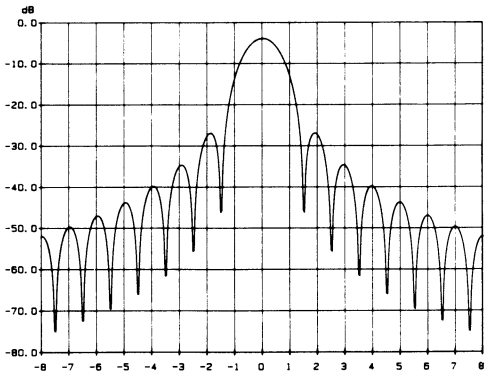
As a filter the FTBH has a relatively broad main lobe whereas side lobes are more than 90 dB below the main lobe. This window will be used most of the time in order to ensure high isolation from other signals in the input spectrum.

On the other hand, the SINE window has a narrow (selective) main lobe and a relatively high side lobe level. This window should be used to detect closely spaced signals in the input spectrum.

The figure below shows the relative performance of these filters when using a basic RE201. The ZOOM facility may increase the selectivity from 475 Hz (80 dB) down to 4 Hz (80 dB).



FTBH WINDOW



SINE WINDOW

Abbreviation

The abbreviation allowed for the RMSBPF command is RF.

Syntax

The RMSBPF command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT.
Parameter 2: Window select 0= FTBH, 1= SINE.
Parameter 3: Low corner frequency fL. (Note 1.)
Parameter 4: High corner frequency fH. (Note 1.)
Parameter 5: Averaging. (Note 2.)

Parameter Values

PARAMETER	RANGE	DEFAULT
1	0 - 2	1
2	0 - 1	1
3	0 - 25000	0
4	0 - 25000	25000
5	0 - 64	1

Notes

1. Care must be taken so that fL is kept above 20 Hz, as no warning is issued by the RE201.
2. If 0 is chosen exponential averaging will be used.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
C4	196	Result Ready

Output Format

The result is returned as a real in V.

Example

The command "RF,1,1,250,1000,5" measures the RMS level in the RIGHT channel in the band from 250 Hz to 1 kHz using the SINE window function on 5 measurements, the result appears like this:

3.4521E-3 (meaning 3.45mV RMS).

RMSFIL, The Filtered RMS Level Command

Description

The filtered RMS level command, RMSFIL, initiates a level measurement based on a modified frequency spectrum. The spectrum is modified by one of two software filter functions, which are user-definable by means of the FILTER and the FILDEF utility commands.

The filter definition commands, FILTER and FILDEF, are used to set a scale factor for each frequency bin created by the FFT. The output from a frequency bin can be regarded as the output from one filter in a 201 filter wide filterbank (155 filters wide when using the ZOOM facility).

The distance between the frequency bins depends on the option mode selectable by the user.

The option mode determines filter frequency resolution and the overall bandwidth of the measurement.

When using the ZOOM facility, a resolution increase from 125 Hz to 0.977 Hz (125/128) is possible decreasing the bandwidth down to 137 Hz. When specifying a mixer frequency this may be done everywhere in the 25 kHz input frequency range.

Please refer to the commands FILTER and FILDEF for detailed information about the creation of the software filter functions.

Abbreviation

The abbreviation allowed for the RMSFIL command is RL.

Syntax

The RMSFIL command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1:	Channel 0= BOTH, 1= RIGHT, 2= LEFT.	
Parameter 2:	Window select 0= FTBH, 1= SINE.	
Parameter 3:	Averaging, i.e. number of loops.	(Note 1.)
Parameter 4:	Filter select.	
Parameter 5:	Option mode.	(Note 2.)
Parameter 6:	Mixer frequency for ZOOM/62.5.	(Note 3.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUES
1	0 - 2	1
2	0 - 1	1
3	0 - 64	1
4	0 - 1	0
5	4 - 7	0
6	0 - 400	32

Notes

1. If parameter 3 = 0 is chosen exponential averaging will be used.
2. The function of parameter 5, the option mode, is shown below:

MODE	OPTION	BANDWIDTH	RESOLUTION IN HZ
0	Normal	25000 Hz	125
4	ZOOM 1	9625 Hz	125/ 2 = 62.50
5	ZOOM 2	2406 Hz	125/ 8 = 15.63
6	ZOOM 3	601 Hz	125/ 32 = 3.906
7	ZOOM 4	150 Hz	125/128 = 0.9766

3. Mixer frequency is specified in steps of 62.5 Hz, e.g. 1 kHz (1000/62.5 Hz) = 16.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
C5	197	Result Ready
53	83	Missing Option
60	96	No Filter Found

Output Format

The result is returned as a real in V.

Example

The command "RL,2,0,10,1,6,40" measures RMS level of the LEFT channel using the FTBH window, averaging over 10 measurements before a result is returned. Software filter function number 1 is applied and the ZOOM facility is used mixing at 2500 Hz and giving an overall bandwidth of 613 Hz around 2500 Hz. The result is returned like this:

1.0547E+1 (meaning an RMS voltage of 10.5V).

RMSLBW, The Large Bandwidth RMS Level Command

Description

The large bandwidth RMS level command, RMSLBW, initiates an RMS measurement in a 75 kHz bandwidth.

Integration time is user-definable from 1 to 999 milliseconds.

The accuracy of the measurement is 2% for a crest factor up to 7.

***** Note *****

Filter option (901-525) must be installed to utilize this command.

Abbreviation

The abbreviation allowed for the RMSLBW command is RW.

Syntax

The RMSLBW command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT.
Parameter 2: Integration time in ms.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	1 - 999	100

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
CD	205	Result Ready

Output Format

The result is returned as a real in V.

Example

The command "RW,2,50" measures RMS level in the LEFT channel in a 75 kHz bandwidth using an integration time of 50 ms. The result appears like this:

1.5833E-2 (meaning an RMS voltage of 15.8mV).

SEP, The Channel Separation Command

Description

The SEP measurement is used to measure the separation between the two channels. As the measurement is based on the utilization of the Fast Fourier Transform, it is possible to measure the separation from the RIGHT to the LEFT channel and from the LEFT to the RIGHT channel simultaneously. In order to perform this type of measurement only two conditions should be fulfilled, i.e. the two main signals must be sufficiently spaced in frequency and the two test signals should be of equal amplitude . Both results are displayed in dB relative to the level of the test signal in the opposite channel.

Abbreviation

The abbreviation allowed for the SEP command is SP.

Syntax

The SEP command follows the syntax description Format 1, (i.e. all parameters are optional).

Parameters

Parameter 1: RIGHT channel frequency in Hz fR. (Note 1.)
Parameter 2: LEFT channel frequency in Hz fL. (Note 1.)
Parameter 3: Averaging. (Note 2.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	20 - 25000	400
2	20 - 25000	1000
3	0 - 64	1

Notes

1. The following rule regarding the frequencies must be obeyed:

   Spacing in between the two input frequencies must be:

   RANGE: $fR - fL \geq 4$ Hz
2. If parameter 3 = 0 is chosen exponential averaging will be used.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
CE	206	Result Ready

Output Format

The results are returned as a string consisting of 2 signed reals in dB separated by a semicolon (;).

Example

The command "SP,400,1000" measures channel separation at 400 Hz from the RIGHT channel to the LEFT channel and at 1000 Hz from the LEFT channel to the RIGHT channel. The results are returned like this, RIGHT to LEFT first:

-4.1013E+1;-6.2332E+1 (meaning a right to left separation of -41 dB and a left to right separation of -62.3 dB).

SINAD, The Signal to Noise and Distortion Ratio Command

Description

The signal to noise and distortion ratio command, SINAD, initiates a measurement of inverse SINAD, i.e. the noise and distortion in relation to the signal. The fundamental frequency and the integration time are user-definable. In case the fundamental frequency is not known within +/- 2%, the RE201 is able to track the input signal itself.

The bandwidth in which the noise and distortion are measured is 125 kHz.

***** Note *****

Filter option (901-525) must be installed to utilize this command.

Abbreviation

The abbreviation allowed for the SINAD command is SD.

Syntax

The SINAD command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT.
Parameter 2: Fundamental frequency or tracking. (Note 1.)
Parameter 3: Integration time in ms.

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	20 - 25000	1000
3	1 - 999	100

Notes

1. Fundamental frequency of input signal. -1 selects tracking mode.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
D2	210	Result Ready

Output Format

The result is returned as a real in %.

Example

The command "SD,2" measures SINAD in the LEFT channel with a fundamental frequency of 1 kHz and an integration time of 100 ms. The result appears like this:

6.9442E-2 (meaning a SINAD of 0.0694%).

SPECTRUM, The Spectrum Command

Description

The spectrum command, SPECTRUM, is used to obtain a spectral analysis of the input signal(s) of the RE201.

The output from the RE201 following the SPECTRUM command consists of complex numbers, each representing the sampled output of a filter, the shape of which is controlled by means of PAR 2 - the WINDOW parameter.

If specified, by means of PAR 8, the last complex number is followed by a common exponent.

Windows

As a spectrum analyzer, the RE201 operates with 3 different filter characteristics:

* Four Term Blackmann-Harris (FTBH)
* SINE
* Rectangular.

refer to the figures on the following page.

Contrary to "normal" analog filters, these filters have a fixed absolute bandwidth, i.e. if a filter placed at 500 Hz obtains 80 dB isolation at 1 kHz, then an equivalent filter placed at 10000 Hz will also obtain 80 dB isolation 500 Hz away, i.e. at 10500 Hz.

Resolution

If PAR 6 - option mode - is equal to Ø, i.e. no option being used, the filters are spaced 125 Hz from DC to 25000 Hz; thus a maximum of 25000/125 + 1 = 201 complex samples. In case the selectivity offered by the various filters in this mode is not sufficient, the ZOOM facility must be utilized.

As soon as the ZOOM facility is used to obtain a spectrum, the maximum bandwidth that may be covered is reduced as described below:

MODE	OPTION	BANDWIDTH	RESOLUTION IN HZ	MAX. NO. OF SAMPLES
0	NORMAL	25000 HZ	125	201
4	ZOOM 1	9625 HZ	125/ 2 = 62.50	155
5	ZOOM 2	2406 HZ	125/ 8 = 15.63	155
6	ZOOM 3	601 HZ	125/ 32 = 3.906	155
7	ZOOM 4	150 HZ	125/128 = 0.9766	155

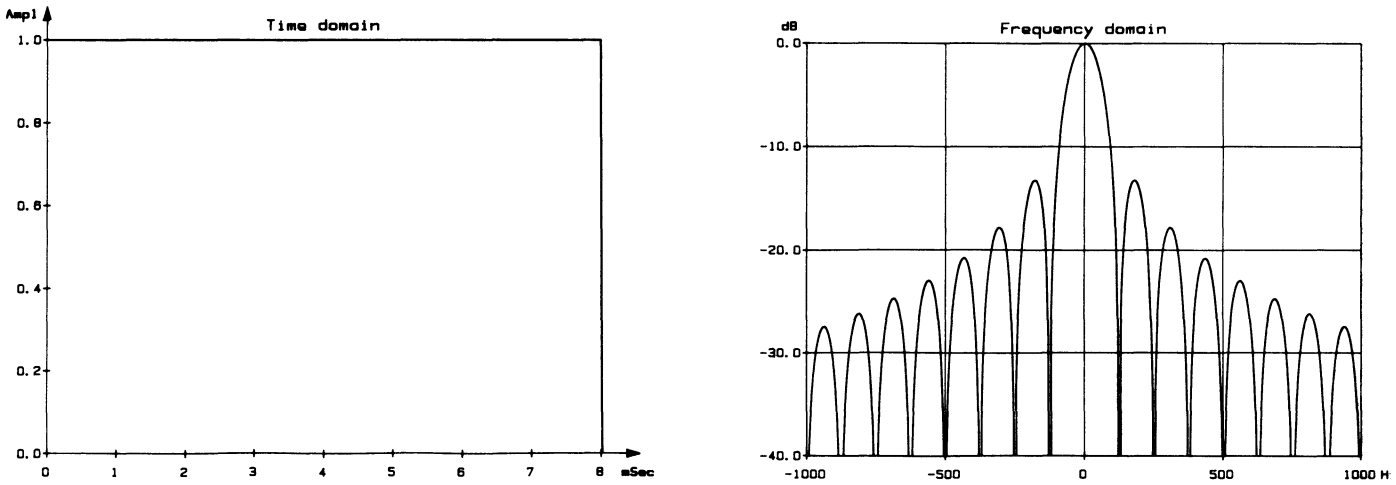


Fig. - Rectangular Window

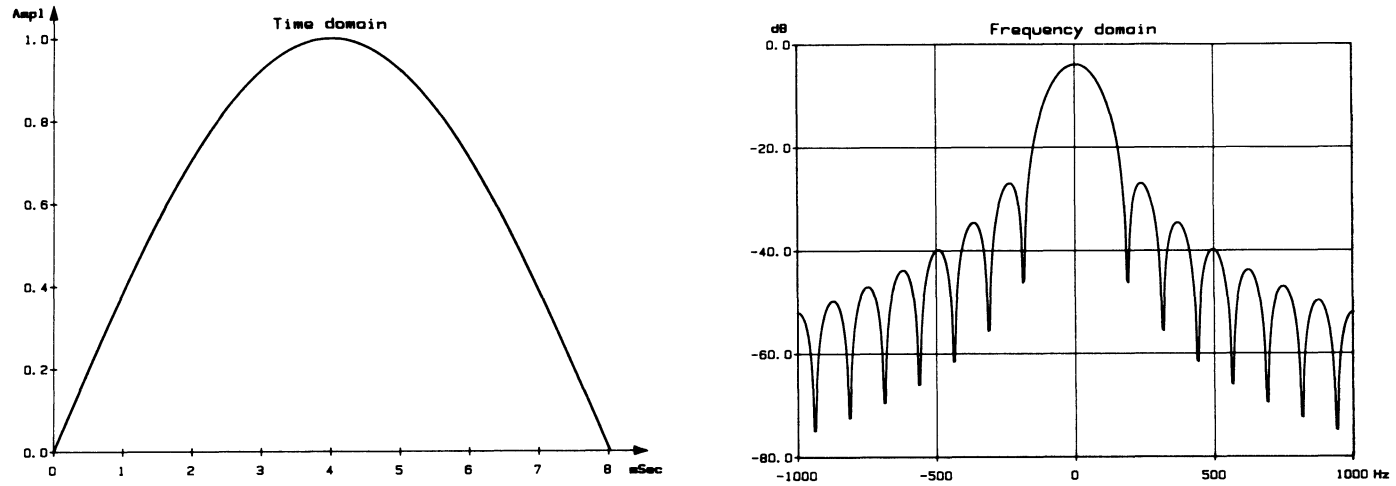


Fig. - Sine Window

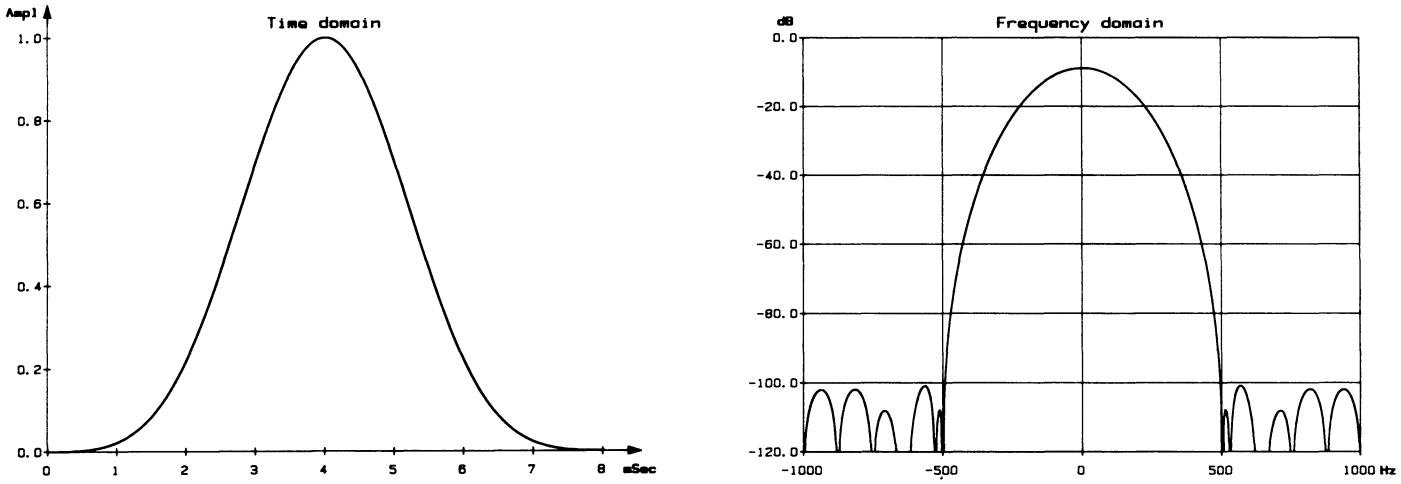


Fig. - FTBH Window

When PAR 6 is used in the range 4 to 7, the ZOOM facility is used to obtain spectra with increased selectivity.

Naturally, the increased selectivity is not available from DC to 25000 Hz at the same time; instead, a part of this band is selected for analysis using a digital mixer, so a new parameter (PAR 7) - the MIXER FREQUENCY - is introduced.

The ZOOM facility offers a maximum of 155 spectral components around a given mixer frequency, i.e. 77 components on each side of the selected frequency.

The ZOOM facility offers increases in selectivity from a factor 2 to a factor 128 in 4 steps (2, 8, 32 and 128 selectable by means of PAR 6) - at the same time the selectivity is increased, the spacing between the filters decreases by the same amount. Thus, if the ZOOM facility increases selectivity by a factor of 8, the filters will be spaced 125/8 = 15.625 Hz.

As previously mentioned, when using the ZOOM facility a maximum of 155 spectral components may be obtained. The spectrum in this example thus covers a band +/- 77 * 15.625 Hz (= +/- 1203 Hz) around a given mixer frequency.

Mixer Frequency

The mixer frequency is controlled by means of PAR 7 in steps of 62.5 Hz, i.e. PAR 7 = 100 sets the mixer frequency to 6250 Hz. If PAR 6 (the option Mode) indicates an increase in selectivity of 8, the band covered with PAR 7 = 100 will be:

100 * 62.5 - 77 x 125/8 to 100 * 62.5 + 77 x 125/8

or

5047 Hz to 7453 Hz.

If the filter having a selectivity of 80 dB at 500 Hz without any options involved is used in this example, the 80 dB selectivity would now be reached at 500/8 = 62.5 Hz.

Results

Using no option, a maximum of 201 complex frequency samples may be obtained, whereas the ZOOM facility limits the maximum to 155.

To keep the transfer of results from the RE201 to a minimum, PAR 2 and PAR 3 are used to indicate the Lower and Upper Frequencies of interest during a spectrum analysis.

Using the example from above, the Lower Frequency in this setting must be above 5047 Hz, whereas the Upper Frequency must be below 7453 Hz.

The first complex pair that is output originates from the filter at:

Frequency Resolution * TRUNCATE(Lower Frequency/Frequency Resolution)

whereas the last complex pair originates from a filter placed at:

Frequency Resolution * TRUNCATE(Upper Frequency/Frequency Resolution)

Abbreviation

The abbreviation allowed for the SPECTRUM command is SM.

Syntax

The SPECTRUM command follows the syntax description FORMAT 1 (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT.
Parameter 2: Window 0= FTBH, 1= SINE, 2= RECTANGULAR (no window)
Parameter 3: Lower frequency of spectrum. (Note 1).
Parameter 4: Higher frequency of spectrum. (Note 1).
Parameter 5: Format 0= ASCII, 1= Binary.
Parameter 6: Option mode. (Note 2.)
Parameter 7: Mixer frequency. (Note 3.)
Parameter 8: Exponent 0 = off, 1 = on

Parameter Values

PARAMETER	RANGE	DEFAULT VALUES
1	0 - 2	1
2	0 - 2	0
3	0 - 24875	0
4	6 - 25000	25000
5	0 - 1	0
6	0&4 - 7	0
7	0 - 400	32
8	0 - 1	0

Notes

1. The frequencies specified depend on PAR 6 and PAR 7 as follows:

PAR 6	PAR 3	PAR 4
0	$\geq$ 0	$\leq$ 25,000
4	$\geq$ PAR 7 x 62.5 - 77 * 125/2	$\leq$ PAR 7 x 62.5 + 77 * 125/2
5	$\geq$ PAR 7 x 62.5 - 77 * 125/8	$\leq$ PAR 7 x 62.5 + 77 * 125/8
6	$\geq$ PAR 7 x 62.5 - 77 * 125/32	$\leq$ PAR 7 x 62.5 + 77 * 125/32
7	$\geq$ PAR 7 x 62.5 - 77 * 125/128	$\leq$ PAR 7 x 62.5 + 77 * 125/128

2. PAR 6 influences the bandwidth, resolution and number of samples as follows:

PAR 6	OPTION	BANDWIDTH	RESOLUTION IN Hz	MAX. NO. OF SAMPLES
0	None	25000 HZ	125	201
4	ZOOM 1	9625 HZ	125/ 2	155
5	ZOOM 2	2406 HZ	125/ 8	155
6	ZOOM 3	601 HZ	125/ 32	155
7	ZOOM 4	150 HZ	125/128	155

3. As the mixer frequency is specified in steps of 62.5 Hz, the range allowed for this parameter is 0 to 400 (400 * 62.5 = 25000 Hz).

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
C1	193	Result Ready
65	101	Parameter Truncated

Note: C1 is also used by DATACO.

Output Format

The results will be output as a string of ASCII numbers (INTEGERS) separated by ";" (semicolons) in case PAR 5 = 0, whereas PAR 5 = 1 outputs two's complement binary results (most significant byte first) without separators with the last byte marked using the EOI message.

The results always appear in pairs with the real part output first.

If PAR 8 = 1 the resultpairs are concluded by a single common exponent.

To obtain relative magnitude of the samples, the following calculation should be carried out on the samples of interest:

$$Mag = \sqrt{imag^2 + real^2}$$

Example

The command "SM,1,0,0,25000,0" creates a full spectrum from DC to 25 kHz in the RIGHT channel using the FTBH window. The spectrum will be transferred in ASCII format as 201 complex pairs (402 numbers).

The value of e.g. the 1000 Hz component is found as the squaresum of output Nos. 18 and 19 - the real part being sample 18 and the imaginary part equal to sample 19.

THD, The Total Harmonic Distortion Command

Description

The THD measurement is used to measure harmonic distortion. The RE201 measures up to 9 user-specified harmonics selectively. Thereby it is possible to measure a single harmonic or a group of succeeding harmonics.

Normally, the fundamental frequency must be specified, but the RE201, however, is able to track the fundamental frequency itself by specifying PAR 3 = -1.

Abbreviation

The abbreviation allowed for the THD command is TD.

Syntax

The THD command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1:	Channel 0= BOTH, 1= RIGHT, 2= LEFT.	
Parameter 2:	Averaging.	(Note 1.)
Parameter 3:	Fundamental frequency or tracking	(Note 2.)
Parameter 4:	First harmonic to be included.	(Note 3.)
Parameter 5:	Last harmonic to be included.	
Parameter 6:	Filter option enable.	(Note 4.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	0 - 64	1
3	1,20 - 12500	1000
4	2 - 9	2
5	2 - 9	9
6	0 - 1	1

Notes

1. If 0 is chosen exponential averaging is used.
2. Fundamental frequency of input signal. -1 selects tracking mode.
3. Harmonic number * fundamental frequency $\leq$ 25000 Hz.
4. When the Filter option (901-525) is installed, parameter 6 enables the programmer to decide whether the RE201 should automatically use it or not. If Par 6=0 the RE201 will not use the Filter option.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
C6	198	Result Ready

Output Format

The result is returned as a real in %.

Example

The command "TD,1,0,-1,3,5" will measure harmonic distortion in the RIGHT channel, using exponential averaging. It will determine the fundamental frequency automatically, and it will include 3rd, 4th and 5th harmonics in the calculations. The result will appear like this:

5.3017E-4 (meaning a distortion of 0.00053 %).

TIM, The Transient Intermodulation Command

Description

The TIM measurement is used to measure Transient Intermodulation distortion according to the proposed IEC standard to be incorporated in the IEC Publication 268-3.

A test signal consists of a square (triangle) wave (3.15 kHz/3.18 kHz) and a SINE wave (15 kHz). TIM is expressed as:

Fig.

where Un is the amplitude of intermodulation products at the frequencies fs - n x fq, n = 1 .. 9 (fs = 15 kHz, fq = 3.15/3.18/3.20 kHz) while Us is the amplitude of the sinusoid.

Abbreviation

The abbreviation allowed for the TIM command is TM.

Syntax

The TIM command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT.
Parameter 2: Averaging. (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	0 - 64	1

Notes

1. If 0 is chosen exponential averaging will be used.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
C8	200	Result Ready

Output Format

The result is returned as a real in %.

Example

The command "TM" measures Transient Intermodulation distortion in the RIGHT channel without averaging. The result appears like this:

2.3445E-1 (meaning a distortion of 0.23 %).

TRIMFQ, The Frequency Measurement Command

Description

The frequency measurement command, TRIMFQ, allows frequency measurements which are 15 % faster than the FREQ command.

In order to gain this speed the user must specify an 8 kHz band in which the frequency is to be found. The total bandwidth is divided into 3 bands, one from 500 Hz to 8 kHz, one from 8 kHz to 16 kHz, and finally one from 16 kHz to 24 kHz.

Abbreviation

The abbreviation allowed for the TRIMFQ command is TQ.

Syntax

The TRIMFQ command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT.
Parameter 2: Band selector. (Note 1.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	0 - 2	1
2	1 - 3	3

Notes

1. Parameter 2 = 1 => band from 500 Hz to 8000 Hz.
   Parameter 2 = 2 => band from 8000 Hz to 16000 Hz.
   Parameter 2 = 3 => band from 16000 Hz to 24000 Hz.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
C9	201	Result Ready

Output Format

The result is returned as an integer in Hz.

Example

The command "TQ,2,2" measures the frequency of the largest frequency component in the band from 8 kHz to 16 kHz in the LEFT input channel. The result appears like this:

14917 (meaning a frequency of 14,917 kHz).

TWOLEV, The Two Channel Level Command

Description

The TWOLEV measurement is used to measure separation in between the two channels or to measure selective level in the two channels simultaneously. The TWOLEV measurement is therefore related to the SEP measurement and its task is the same except for calculation of the separation. TWOLEV simply delivers the result as the level of both frequency components in both channels in dB related to 2.5Vpeak. By means of simple addition the user may calculate the separation, if applicable. In order to perform this type of measurement only one condition must be fulfilled, namely the frequency distance between the two frequency components must be sufficient.

Abbreviation

The abbreviation allowed for the TWOLEV command is TV.

Syntax

The TWOLEV command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Right channel frequency (fR). (Note 1.)
Parameter 2: Left channel frequency (fL). (Note 1.)
Parameter 3: Averaging, i.e. number of loops. (Note 2.)

Parameter Values

PARAMETER	RANGE	DEFAULT VALUE
1	20 - 25000	400
2	20 - 25000	1000
3	0 - 64	1

Notes

1. The following rules regarding the frequencies must be obeyed. The distance between the RIGHT and LEFT frequency must be:

   RANGE: $S = fR - fL \geq 4$ Hz.

2. When using the PMZ option the highest frequency allowed is limited. The limit depends on the frequency spacing; here called S (S = fR - fL)

$S \geq 475$ Hz : an upper frequency of 25000 Hz
$80 < S \leq 475$ Hz : an upper frequency of 4125 Hz
$40 < S \leq 80$ Hz : an upper frequency of 2062 Hz
$24 < S \leq 40$ Hz : an upper frequency of 1237 Hz

3. If parameter 3 = 0 is chosen, exponential averaging will be used.

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
CB	203	Result Ready
65	101	Parameters Truncated
53	83	Missing Option

Output Format

The result is returned as four signed reals separated by semicolons, (;).

Example

The command "TV,4000,8000" measures a level of 4000 Hz and 8000 Hz using no averaging. The result appears in the following order:

RIGHT channel level at PAR1;
RIGHT channel level at PAR2;
LEFT channel level at PAR1;
LEFT channel level at PAR2

like this:

+1.8018E+1;-3.2023E+1;+7.2047E-1;+1.9538E+1 (meaning levels of:)

+18.0 dB of 4 kHz and -32.0 dB of 8 kHz in the RIGHT channel and
+0.72 dB of 4 kHz and +19.5 dB of 8 kHz in the LEFT channel (all readings related to 2.50Vpeak).

WOWFLU, The Wow and Flutter Command

Description

The W&F measurement is used to measure Wow and Flutter according to DIN, JIS and NAB standards. The results may be weighted according to DIN 45507 or by using a 500 Hz or 200 Hz LP filter.

The results obtained are returned by using a 2 sigma detector which delivers unambiguous results from the fluctuating readings of the W&F option board.

***** Note *****

In order to use the WOWFLU command the Wow & Flutter option board (901-456) must be installed.

Abbreviation

The abbreviation allowed for the WOWFLU command is WU.

Syntax

The WOWFLU command follows the syntax description FORMAT 1, (i.e. all parameters are optional).

Parameters

Parameter 1: Channel 0= BOTH, 1= RIGHT, 2= LEFT.
Parameter 2: Standard. (Note 1.)
Parameter 3: Bandwidth. (Note 2.)
Parameter 4: Range. (Note 3.)
Parameter 5: Integration time in seconds.

Parameter Values

PARAMETER	WOW & FLUTTER	DEFAULT VALUE
1	0 - 2	1
2	1 - 3	1
3	1 - 3	1
4	1 - 3	2
5	1 - 5	5

Notes

1. The frequency modulation is detected according to these standards:

   Parameter 2 = 1 : DIN 45507
   Parameter 2 = 2 : NAB 1965
   Parameter 2 = 3 : JIS C 5551

2. The following filters are available for bandwidth selection:

   Parameter 3 = 1 : 0.2 - 500 Hz
   Parameter 3 = 2 : 0.5 - 200 Hz
   Parameter 3 = 3 : weighting according to DIN 45507.

3. Range selector gives full scale deflections of

   Parameter 4 = 1 : 10 % W&F
   Parameter 4 = 2 : 1 % W&F
   Parameter 4 = 3 : 0.1% W&F

Service Request Codes

HEXADECIMAL	DECIMAL	MEANING
CC	204	Result Ready
64	100	W&F Out of Range

Output Format

The result is returned as a real in %.

Example

The command "WU,1,1,3,2,4" measures Wow and Flutter in the RIGHT channel according to DIN 45507, and when using an integration time of 4 seconds and the 1 % range, the result appears like this:

4.3111E-1 (meaning a W&F of 0.431 %).

THE RESULTS

Description of the Output Formats

As the measurement results produced by the RE201 are not transferred in one format this section gives information on the various output formats.

The following notation is used:

D	The symbol of an ASCII digit
.	ASCII decimal point
E	ASCII upper case "E" as exponent symbol
±	Sign of result and exponent
;	ASCII semicolon used as a separator
LSB	Least significant byte in binary transfers
MSB	Most significant byte in binary transfers
CR	ASCII carriage return
LF	ASCII line feed
EOI	The IEEE488 end message accompanying the last byte
MN	Mnemonic symbolizing command in INSPECT format
Par	Symbol for command parameter in INSPECT format
,	ASCII comma
SF,n	ASCII string used in INSPECT format
␣	ASCII blank

Note that blanks in the examples shown are only to clarify reading. Blanks are not sent except when shown as a "␣".

The REAL Format

␣D.DDDD CR LF with EOI

5 digit mantissa and 1 digit signed exponent and an end-of-line sequence.

The Signed REAL Format

␣±D.DDDD CR LF with EOI

Signed 5 digit mantissa and 1 digit signed exponent and an end-of-line sequence.

The INTEGER Format

ÞDDDDD CR LF with EOI

Up to 5 digit integer and an end-of-line sequence. Please note that leading zeroes are suppressed.

The ASCII Format

DDDDD;DDDDD;.....;DDDDD CR LF with EOI

Used by the DATACO and SPECTRUM commands. Up to 5 digit integers separated by semicolons and concluded by the end-of-line sequence. Please note that leading zeroes are suppressed.

The BINARY Format

MSB LSB MSB LSB.....MSB LSB with EOI

Used by the DATACO and SPECTRUM commands. MSB LSB pairs concluded only with the END message, i.e. EOI accompanying the last byte.

The INSPECT Format

SF,nÞMN,Par,ParÞMN,Par,...ÞMN,Par,Par CR LF with EOI

SF, set-up number and the command string included in the particular set-up concluded by the end-of-line sequence.

The SETUP and Dual Channel Format

As set-ups may contain up to 18 measurements, the results from measurements in a set-up containing more than one measurement, are preceded by a one or two digit integer measurement number and a comma.

If the channel parameter for a measurement command is specified as zero, i.e. channel = BOTH, the two measurements started are regarded as a set-up meaning that the results are preceded by measurement numbers, which in this case equal the channel number as well.

Succeeding the comma, the normal output format without leading blanks is transmitted.

Note that output from set-ups with only one measurement is equal to the output of the particular measurement.

REAL

ØDD,D.DDDDE±D CR LF with EOI

Signed REAL

ØDD,±D.DDDDE±D CR LF with EOI

INTEGER

ØDD,DDDDD CR LF with EOI

THE IEEE488 TO CRT-DISPLAY LINK

Description

The IEEE488 TO CRT-display link provided with the RE201 IEEE interface gives access to the entire RE201 CRT-display usable in semi-automatic test systems for operator prompts and for annotation of the "analog meter" scales (see the METER command). Text is always written from the current cursor position, and to add flexibility the link gives full cursor control including absolute cursor addressing and possibility of using the video attributes, i.e. inverse video and up to 12 blinking characters. Furthermore, the link gives access to the graphic mode normally used to make meters.

The link accepts all ASCII characters in such a way that control characters not used are skipped and all lower case characters are converted to upper case characters being the only ones displayable.

In order to use the link the output string must be started with the start delimiter and ended with the stop delimiter.

The default delimiters, start = STX (ctrl B or decimal 2) and stop = ETX (ctrl C or decimal 3) may be altered for user convenience by using the CRTDEL command (see section 10.4.5 Utility Commands).

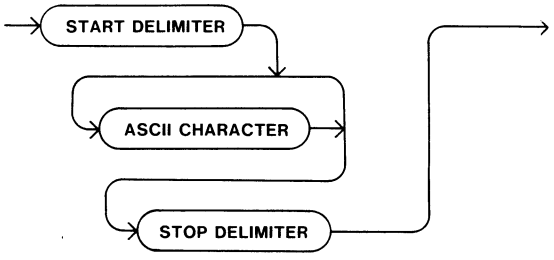
The start and stop delimiters may even be of equal value.

It should be noted that operation of this link is transparent for the other RE201 jobs, meaning that use of the link will not disturb any particular on-going measurement.

The RE201 CRT-display is organized as 16 lines by 32 characters.

Syntax

The IEEE488 to CRT-display link follows the syntax shown in this figure.



Simple Cursor Control

Cursor off	ctrl 0 (SI)	makes the cursor invisible
Cursor on	ctrl V (SO)	makes the cursor visible
Cursor home	ctrl A (SOH)	moves the cursor to the upper left corner
Cursor forward	ctrl F (ACK)	moves cursor to next character field
Cursor back	ctrl H (BS)	moves cursor to preceding character field
Cursor down	ctrl J (LF)	moves cursor one line down
Cursor up	ctrl Z (SUB)	moves cursor one line up
Return	ctrl M (CR)	Moves cursor to start of line
Clear screen	ctrl L (FF)	clears screen and cursor off and home

Video Attributes

The RE201 CRT-display video attributes are obtained by sending a three-character ESC sequence. (ESC = ctrl [or decimal 27).

Normal:	ESC Ø T	go to normal display mode
Inverse:	ESC Ø P	make succeeding characters inverse video
Blinking:	ESC Ø B	make succeeding characters blink. Max. number of blinking characters is 12, i.e. last 12 characters following the ESC Ø B will blink.

The "Ø" in the escape sequences is the digit "0".

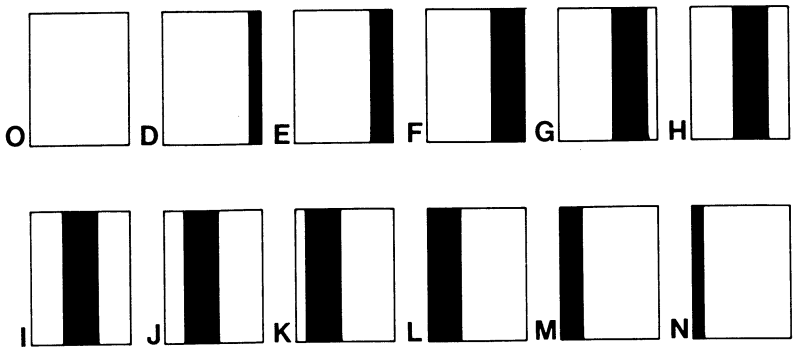
The inverse and blinking attributes may be mixed. E.g. ESC Ø P ESC Ø B make inverse blinking characters.

Graphic Mode

Graphic mode is entered and left using two-character ESC sequences (ESC = ctrl [or decimal 27).

Enter graphic:	ESC d or ESC G	go to graphic mode
Leave graphic:	ESC D	go to normal mode

In the graphic mode the following graphic is available sending the ASCII characters shown:



The graphic symbols shown are made in a 9 x 12 dot character fond.

Note that the video attributes also apply to the graphics.

Absolute Cursor Positioning

Apart from the simple cursor controls the RE201 provides the ability to position the cursor absolutely everywhere on the 16 x 32 character display.

This is done horizontally by using DLE (ctrl P) followed by a character representing the desired column and vertically by using VT (ctrl K) followed by a character representing the desired row.

E.g. in order to place the cursor in line (row) 7, one must send: "STX VT G ETX" and then place the cursor in character field No. 19 on that line, then send "STX DLE Y ETX".

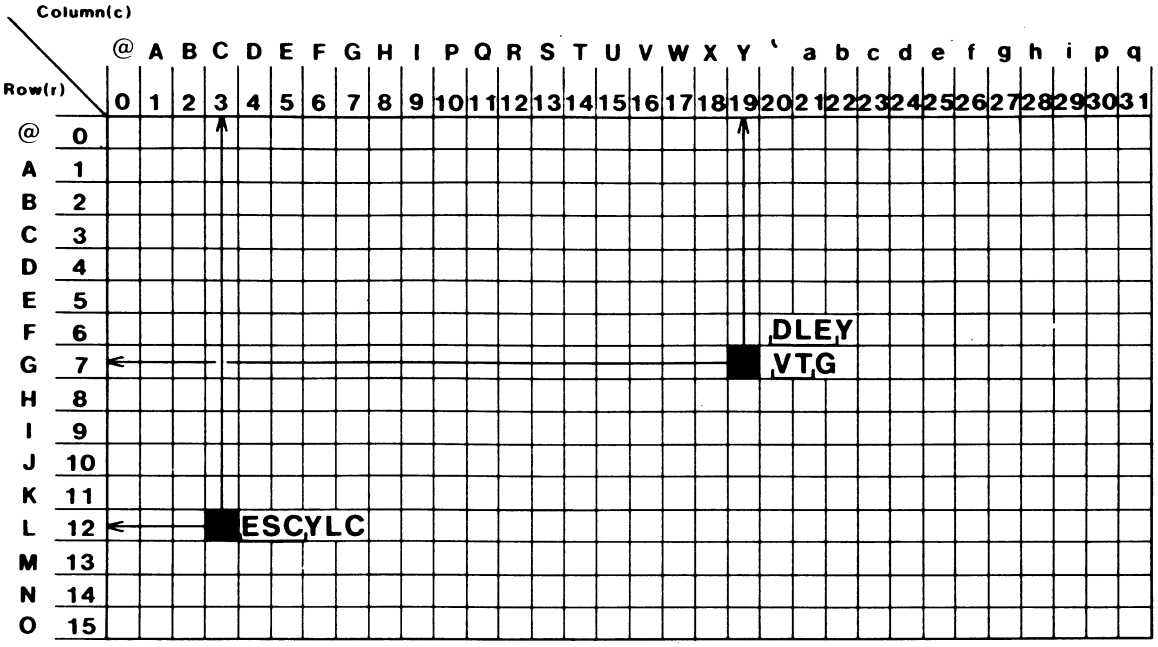
When using a four-character ESC sequence row and column may be specified at one time.

The sequence:

ESC Y r c

where r and c are characters representing the desired row and column.

The figure below shows which characters to use for a particular row and column.



Ctrl K r for the row and
Ctrl P c for the column or
ESC Y r c for row and column.

Examples

Note that the blanks shown in these examples are only included to clarify reading. They must not appear in the actual strings.

In order to place the cursor in row 12 character 3 the string: "STX ESC Y L C ETX" may be sent, alternatively the string "STX DLE C VT L ETX" will do.

In order to make the character in this particular position blink send the string: "STX ESC 0 B" and then the character and ETX. Now the character is blinking and the cursor points to the next position. In order to make this character appear in inverse video, send the string "STX ESC 0 T ESC 0 P" and the character and ETX.

If the third character is going to be a blinking inverse graphic character, the string "STX ESC 0 B ESC G" and the character representing the graphic symbol and ETX. Note that the RE201 was in inverse mode following the second character.

Of course all these commands may be sent in one string looking like this:

"STX ESC Y L C ESC 0 B char.1 ESC 0 T ESC 0 P char.2 ESC 0 B ESC G char.3 ETX".

The next page shows an ASCII table with the RE201 displayable characters and control codes. The lower case characters are omitted as they are converted to upper case for the CRT-display.

ASCII TABLE WITH RE201 CRT DISPLAYABLE CHARACTERS AND CONTROL CODES.

B7 / B6 / Bits / B5 / B4 B3 B2 B1	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1
	CONTROL		SYMBOLS & NUMBERS		UPPER CASE	
0000	00 NUL 0 000	10 DLE 16 column pos. 020 ctrl P	20 32 SPACE 040	30 48 Ø 060	40 64 @ 100	50 80 P 120
0001	01 SOH 1 Cursor home 001 ctrl A	11 DC1 17 021	21 33 ! 041	31 49 1 061	41 65 A 101	51 81 Q 121
0010	02 STX 2 002	12 DC2 18 022	22 34 " 042	32 50 2 062	42 66 B 102	52 82 R 122
0011	03 ETX 3 003	13 DC3 19 023	23 35 # 043	33 51 3 063	43 67 C 103	53 83 S 123
0100	04 EOT 4 004	14 DC4 20 024	24 36 $ 044	34 52 4 064	44 68 D 104	54 84 T 124
0101	05 ENQ 5 005	15 NAK 21 025	25 37 % 045	35 53 5 065	45 69 E 105	55 85 U 125
0110	06 ACK 6 Cursor forward 006 ctrl F	16 SYN 22 026	26 38 & 046	36 54 6 066	46 70 F 106	56 86 V 126
0111	07 BEL 7 007	17 ETB 23 027	27 39 ' 047	37 55 7 067	47 71 G 107	57 87 W 127
1000	08 BS 8 Cursor back 010 ctrl H	18 CAN 24 030	28 40 (050	38 56 8 070	48 72 H 110	58 88 X 130
1001	09 HT 9 011	19 EM 25 031	29 41) 051	39 57 9 071	49 73 I 111	59 89 Y 131
1010	0A LF 10 Cursor down 012 ctrl J	1A SUB 26 Cursor up 032 ctrl Z	2A 42 * 052	3A 58 : 072	4A 74 J 112	5A 90 Z 132
1011	0B VT 11 row pos. 013 ctrl K	1B ESC 27 ESC 033 ctrl [	2B 43 + 053	3B 59 ; 073	4B 75 K 113	5B 91 [133
1100	0C FF 12 Clear screen 014 ctrl L	1C FS 28 034	2C 44 , 054	3C 60 < 074	4C 76 L 114	5C 92 \ 134
1101	0D CR 13 Return 015 ctrl M	1D GS 29 035	2D 45 - 055	3D 61 = 075	4D 77 M 115	5D 93] 135
1110	0E SO 14 Cursor on 016 ctrl N	1E RS 30 036	2E 46 . 056	3E 62 > 076	4E 78 N 116	5E 94 ↑ 136
1111	0F SI 15 Cursor off 017 ctrl O	1F US 31 037	2F 47 / 057	3F 63 ? 077	4F 79 O 117	5F 95 ← 137

KEY:

"ASCII" name for controls

hex — 06 ACK 6 — decimal

Cursor forward — function or character

octal — 006 ctrl F — control code

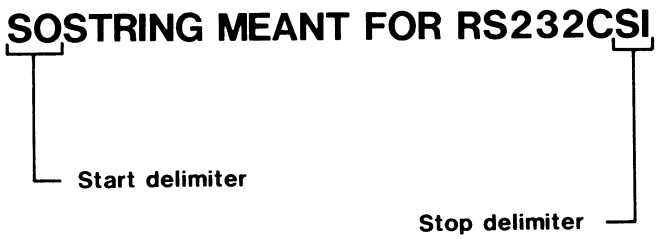
THE IEEE488 TO RS232C LINK

Description

The IEEE488 to RS232C link provides access to the RE201 RS232C interface connector. The link is configured using the RE201 system parameters editor and is an output only link.

The purpose of the link is to enable the RE201 to dump test documentation on an RS232C hard copy unit, i.e. a printer or a plotter. The default time-out count of 3 seconds may be altered using the SETTIME command.

In order to use the link, the output string must be started with the start delimiter and ended with the stop delimiter.

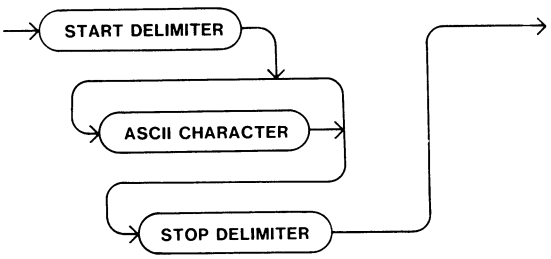


The default delimiters, start = SO (ctrl N or decimal 14) and stop = SI (ctrl O or decimal 15) may be altered using the SERDEL command. This is convenient when the default delimiters are used to control a printer/plotter. The start and stop delimiters may even be of equal value.

It should be noted that operation of this link is transparent for the other RE201 jobs, meaning that use of the link will not disturb any particular on-going measurement.

Syntax

The IEEE488 to RS232C link follows the syntax shown in this figure.



Example

The output string "AU,1Ø SO THIS IS A SERIAL OUT TEST SI RS", where

"SO" and "SI" are control characters, will make the RE201 set the RIGHT channel amplifier to autorange, send the string "THIS IS A SERIAL OUT TEST" to the RS232C interface connector and finally start an RMS level measurement in the RIGHT channel.

Configuring the RS232C Port

Configuration of baud rate, parity and stop bits is done in LEARN mode by changing the system parameters. Number of bits is 7.

Baud Rate Setting

```
*******************************************

          *** SYSTEM PARM'S ***

CRT REFRESH RATE                    50 HZ

BAUD RATE                 >        9600
PARITY                             EVEN
STOP BIT(S)                           1

IEEE ADDRESS                         10

BAUD RATE                          9600
-------------------------------------------

  300        600        1200       STORE
 2400       4800        9600

*******************************************
```

Parity Selection

```
*******************************************

          *** SYSTEM PARM'S ***

CRT REFRESH RATE                    50 HZ

BAUD RATE                          9600
PARITY                      >      EVEN
STOP BIT(S)                          1

IEEE ADDRESS                        10

PARITY                             EVEN
-------------------------------------------
                                   STORE
  EVEN     ODD     NONE

*******************************************
```

Stop Bit Selection

```
*******************************************

          *** SYSTEM PARM'S ***

CRT REFRESH RATE                    50 HZ

BAUD RATE                          9600
PARITY                             EVEN
STOP BIT(S)                 >        1

IEEE ADDRESS                        10

STOP BIT(S)                          1
-------------------------------------------
                                   STORE
     1     1.5     2

*******************************************
```

The RS232C INTERFACE Connector

Pin 2	RX, data in
Pin 3	TX, data out
Pin 4	RTS, request to send output
Pin 5	CTS, clear to send input
Pin 7	GND, signal ground
Pin 20	DTR, data terminal ready output. High whenever power is applied to the RE201.

***** NOTE *****

When entering the LEARN mode please observe that the green LED in the LOCAL/LEARN key is lit, indicating that the RE201 is forced to LOCAL.

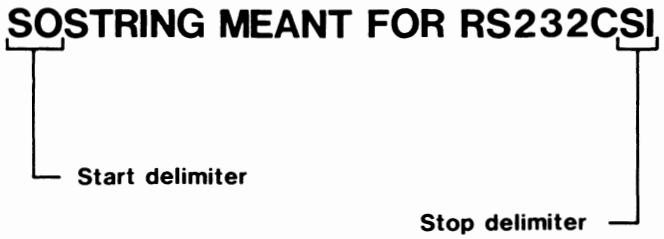
THE IEEE488 TO FSK OUTPUT LINK

Description

The IEEE488 to FSK output link provides access to the RE201 Audio Generator (901-500) left channel output. The link is configured according to the CCITT recommendation 0.33 (110 baud).

The purpose of the link is to enable the RE201 to output tone coded ASCII strings.

In order to use the link, the output string must be started with the start delimiter and ended with the stop delimiter.

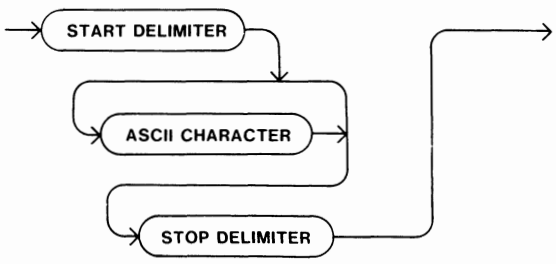


The default delimiters, start = SOH (ctrl A or decimal 01) and stop = EXT (ctrl C or decimal 03) may be altered using the FSKDEL command. The start and stop delimiters may even be of equal value.

It should be noted that operation of this link is not transparent for the other RE201 jobs, meaning that use of the link will stop any on-going measurement by forcing the RE201 into IDLE state.

Syntax

The IEEE488 to FSK output link follows the syntax shown in this figure.



Example

According to the CCITT recommendation 0.33 an output string could be

"<SOH>RE201<STX>08<EXT>".

The <SOH> is the character SOH (decimal 01), and similarly STX (decimal 02) and ETX (decimal 03). The characters RE201 are the source identification, the character 1 is the special signalling, and the 2 characters 08 are the measurement program identification.

TUTORIAL

This section is a tutorial on controlling the RE201 using various controllers. The examples are simple I/O routines starting an RMS measurement, obtaining the result and displaying it on the controller display.

The HP85 sample programs, (one measures frequency response, one uses the analog meters, and one displays the measurement results on the RE201 CRT-display using the IEEE488 To CRT-display Link), show some of the more complex facilities of the RE201 IEEE488 facility.

Simple I/O Routines

This HP BASIC example applies to the following computers:

HP83/85, HP9826 and HP9835/9845:

```
10 OUTPUT 710;"RS,1,128"
20 ENTER 710;A$
30 DISP A$
40 END
```

HPL example using the computers HP9825 or HP9826:

```
0: wrt 710;"RS,1,128"
1: red 710;A$
2: dsp A$
3: end
```

In these examples with HP computers it is assumed that the GPIB interface has select code 7 and that the RE201 is set to bus address 10.

Example using the BASIC of a TEKTRONIX 4041:

```
100 OPEN   201:"GPIB(PRI=10):"
110 PRINT   201:"RS,1,128"
120 INPUT   201:result$
130 PRINT result$
140 END
```

Example using the BASIC of Fluke 1720A and Fluke 1722A:

```
10 REMOTE
20 PRINT   10,"RS,1,128"
30 INPUT   10,R
40 PRINT R
50 END
```

Example using BASICA on an IBM PC equipped with the PC<>488 IEEE interface card from Capital Equipment Corp.

```
 10   DEFINT I-S              'define variables beginning with
                               I-S as INTEGERS
 20   INIT=0                  'offset for initialization routine
 30   OUTPUT=9                'offset for output routine
 40   SPOLL=12                'offset for serial poll routine
 50   ENTER=21                'offset for ENTER routine
 60   DEF SEG=&H C 000        'define segment start for CALL's
 70   MY.ADDRESS=0            'define IBM PC address
 80   SYSTEM.CONTROLLER=0     'INIT as system controller
 90   TRUE=1: FALSE=0
100   CR$=CHR$(13)
110   MAX.LENGTH=25
120   RE201=10                'address of RE201=10
130   CALL INIT (MY.ADDRESS,SYSTEM.CONTROLLER)
                              'INIT PC and bus
140   COMMAND$="RS,1,128" + CR$
150   CALL OUTPUT (RE201,COMMAND$,STATUS)
                              'send command
160   CALL SPOLL (RE201,POLL,STATUS)
                              'perform SPOLL
170   IF POLL <> 195 THEN GO TO 160
180   RESULT$= SPACE$ (MAX.LENGTH)
                              'INIT buffer
190   CALL ENTER (RESULT $,LENGTH,RE201,STATUS)
                              'enter result
200   PRINT "Result of measurement was:" + RESULT$
                              'print result
210   END
```

This example in HP85 BASIC measures frequency response in the band from 100 Hz to 10 kHz in steps of 1/10 decade. In the example it is assumed that the RE201 has the Audio Generator option installed.

```
 10 IMAGE"AG,"5Z
 20 DIM R(21)
 30 S=10  (1/10)
 40 F=100/S
 50 OUTPUT 710 USING "K";"RS,1,8 AA,1,-49 AS,1,2"
 60 IF SPOLL (710) < > 195 THEN GOTO 60
 70 FOR I=0 TO 20
 80 F=F*S
 90 OUTPUT 710 USING 10;F
100 IF SPOLL (710) = 130 THEN GOTO 100
110 ENTER 710;P,R(I)
120 NEXT I
130 DISP"ARRAY READY FOR PLOT"
140 END
```

Line 10 creates the output format for the AG command output in line 90.

Line 20 dimensions the result array.

Line 30 sets step factor for logarithmic sweep.

Line 40 initializes frequency variable

Line 50 starts RMS level measurements and sets output level and source selector in the Audio Generator option.

Line 60 waits for the first RMS result to be ready and thus waits for the Audio Generator to be set as the Audio Generator ready codes overwrite the result ready codes.

Line 70 sets up the loop.

Line 80 - calculation of the next output frequency.

Line 90 - setting of the Audio Generator frequency using the image of line 10.

Line 100 waits for Audio Generator (may be omitted).

Line 110 reads 2 results from the RE201 and stores the second in the result array. The first result is not used. Reading it clears the RE201 output buffer, and makes room for the new result.

Line 120 steps to the next frequency.

Line 130 displays a ready message.

The data may now be plotted or used in some other way.

Example using "Analog Meters" written in HP85 BASIC. The meter used has a full scale deflection of 3 V RMS.

```
10 OUTPUT 710;"RS,1,8 AU,1,-6"
20 ENTER 710 USING "Z.DDE";R
30 R=R*85
40 OUTPUT 710 USING "K,3Z";"MR,1,",R
50 GOTO 20
60 END
```

Line 10 starts an 8 ms RMS level measurement and sets the input amplifier gain to -6 dB applicable for 3V RMS.

Line 20 gets the result from the RE201.

Line 30 multiplies with the scale factor (255/3)=85; giving a full scale deflection of 3V.

Line 40 outputs the meter command controlling the meter pointer.

Line 50 makes the process repeat indefinitely.

HP BASIC example, displaying the measurement results on the RE201 CRT-display:

```
10 IMAGE"X̄",K,CHR$(13),"N̄"
20 OUTPUT 710;"RS,1,8"
30 ENTER 710;R$
40 OUTPUT 710 USING 10;R$
50 GO TO 30
60 END
```

Line 10 makes the string image (format) to be used in the CRT output in line 40: the $\bar{X}$ is ctrl B, the $\bar{N}$ is ctrl C and CHR$(13) is a carriage return.

Line 20 starts an 8 ms RMS measurement.

Line 30 fetches the result.

Line 40 uses line 10 for display of the result on the CRT-display.

Line 50 makes the process repeat indefinitely.