Model 4610M

Precision Multi Product Calibrator

Programming Manual

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1. INTRODUCTION

The 4610M calibrator offers the most advanced and up to date means of calibration of a wide variety of electrical measuring instruments. The 4610M advanced multi product calibrator provides a fully functional, precision programmable calibration source.

1.1. MAIN FEATURES

- AC/DC Volts to 1025 V
- AC/DC Current to 30 Amps
- AC/DC Current to 1500 Amps with EA002 50 turn clamp coil adapter (option)
- 2 and 4 wire passive resistance to 1 *G*Ω
- 2 wire, 2 wire compensated, and 4 wire simulated resistance
- Capacitance to 100 mF (passive and simulated modes)
- Frequency to 1 MHz
- Pulse width modulation / duty cycle
- RTD (PRT) simulation
- Thermocouple source simulation and measurement (°C & °F)
- USB Interface
- GPIB (IEEE488) Interface

1.2. ACCURACY AND FUNCTIONALITY

The 4610M integrates powerful calibration capabilities using built-in software.

1.3. TRUE MULTIPRODUCT CALIBRATION

From one instrument

Designed to provide an accurate cost-effective instrument for the calibration of multimeters, clamp meters, frequency meters, temperature meters, and capacitance meters.
Designed for use in the laboratory or portable on siteon site calibration, the 4610M calibrator is suitable for use in a standards laboratory. The 4610M boasts a fast-warm up time combined with connection to a PC/laptop (via a USB / GPIB interface) allowing for a fast return on investment and premium accuracy.

1.4. RETRO FIT OPTIONS

Allows additional functions to be added.

Several internal retrofit options including oscilloscope and power allow the user to select the most cost-effective solution for the calibration work with the ability to add extra functions at a later date. External options include current coil adapter for the calibration of clamp meters.

1.5. USB INTERFACE

All functions and outputs of the 4610M calibrator are fully programmable over the USB interface.

1.6. GPIB (IEEE488) INTERFACE

All functions and outputs of the 4610M calibrator are fully programmable over the GPIB (IEEE488) interface.

1.7. OUTPUT CONNECTIONS

The output terminal configuration is designed to match the majority of multimeter input connections, e.g. volts/ohms, low current and high current eliminating the need for lead changing during calibration. All outputs are isolated when not in use and an L.E.D. indicator shows the active output(s).

2. COMMAND MODES

The 4610M comes with two command modes which can be selected via the front panel or via the remote interface.

2.1. TRANSMILLE

The Transmille command mode provides access to all functions remotely in a structured programming language

2.2. 55XX

The 55xx command mode provides an emulation/compatibility mode allowing the 4610M to be used with existing software when replacing legacy products.

Note - some functions of the 4610M have no equivalent 55xx command and vice versa. The 55xx

command mode should only be used for interoperability with existing software packages

2.3. CHANGING COMMAND MODE - FRONT PANEL

To change the command mode from the front panel, press the ‘Menu’ key from the home screen

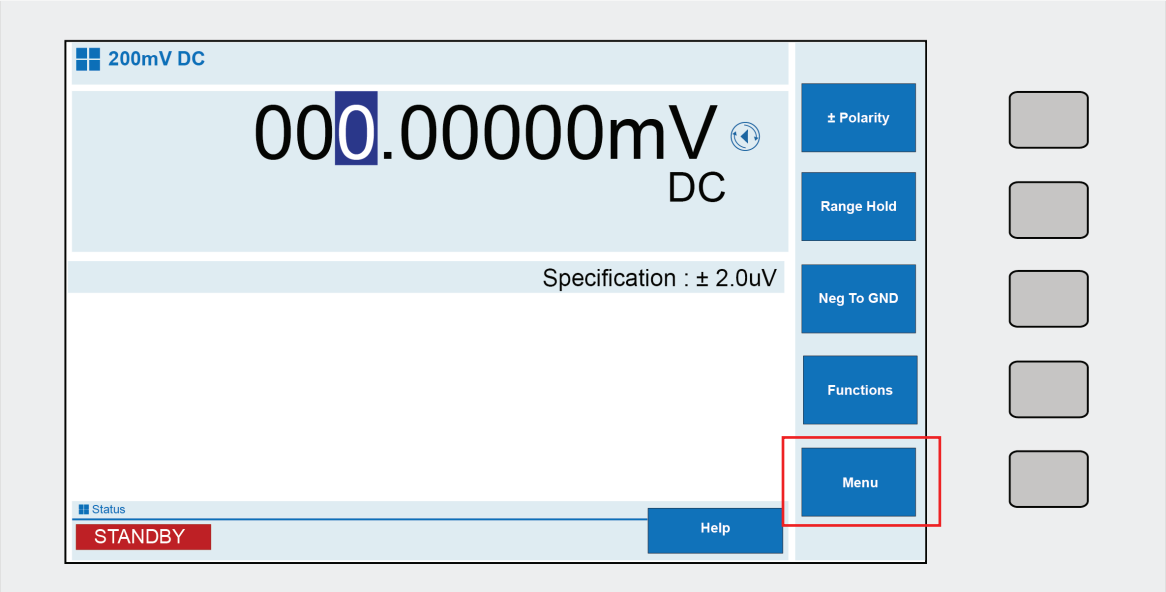


Figure 1 – Calibrator Home Screen

From the Main Menu, select ‘General Settings’, and then scroll to ‘Configure Command Mode’

The current command mode is listed after the menu item.

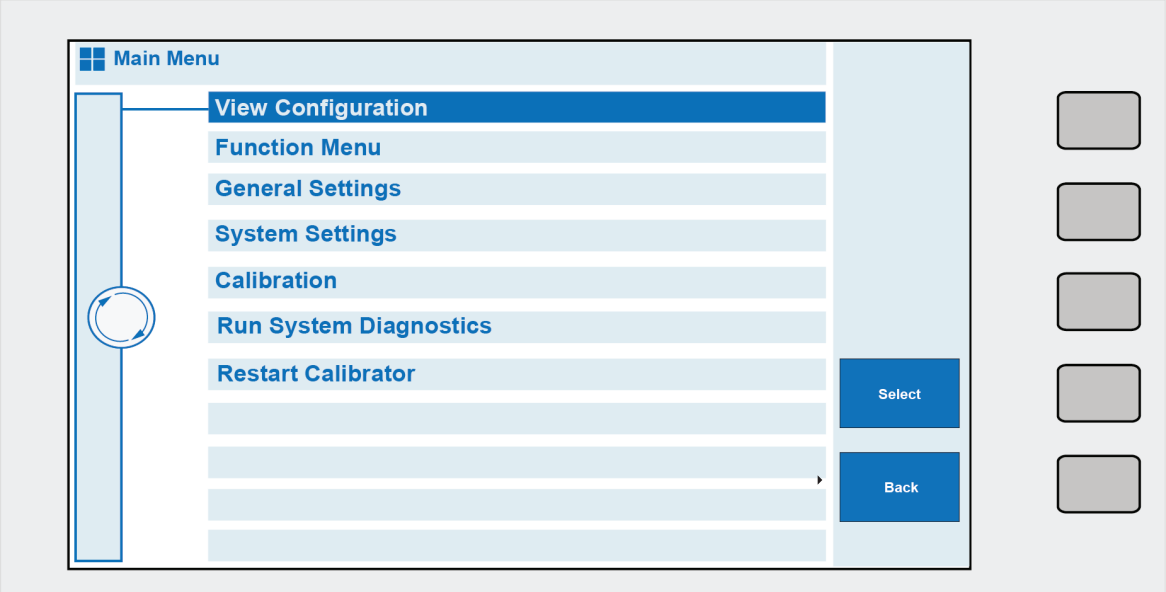


Figure 2 – Calibrator Main Menu

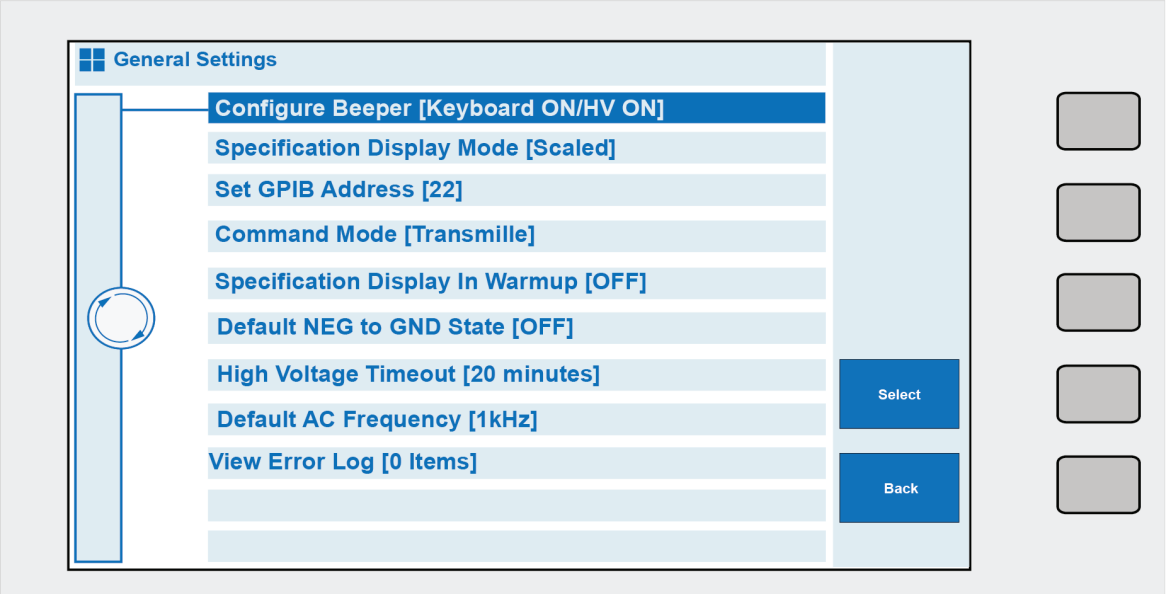


Figure 3 – Calibrator Home Screen

Pressing the Select Key, the Enter key or selecting from the touch screen will show a menu allowing the user to change the command mode.

Select the desired command mode, and press the Enter Key. The command mode has now been updated and the menu will reflect this.

2.4. CHANGING COMMAND MODE - REMOTE INTERFACE

To change the command mode, send the following command

2.4.1. 'TRANSMILLE' COMMAND MODE

```
SYSTEM:COMMANDS:MODE TRANSMILLE
```

2.4.2. '55XX' COMMAND MODE

```
SYSTEM:COMMANDS:MODE 55XX
```

2.5. QUERYING COMMAND MODE - REMOTE INTERFACE

To query the current command mode, send the following command

SYSTEM:COMMANDS:MODE?

A response of ‘TRANSMILLE’ indicates that the calibrator is in the ‘Transmille’ command mode

A response of ‘55XX’ indicates that the calibrator is in the ‘55xx’ command mode

3. TRANSMILLE COMMANDS

	*Warning: Risk of shock.* *High voltages may be present on the output binding posts.* *Ensure calibrator is in the STANDBY condition* *before changing leads or connections.*

For voltages greater than 30V AC RMS, 42V AC Peak or 60V DC, the binding posts must be in the closed position.
ONLY 4mm banana connections should be used for outputs above these voltages.

	*Do not touch exposed metal on banana plugs, spade connections or bare wires. These outputs may have lethal voltages present*

	*Warning: Under no circumstances should any voltage be connected to the calibrator outputs.* *Although the output terminals are protected against voltage/current being applied, repeated application of voltage/current may affect the performance and reliability of the protection circuitry.*

3.1. RESPONSE / ERROR CODES

Response Code	Description
*0	Command Successful
*1	Unrecognized Command
*2	Invalid Range
*3	Invalid Frequency
*4	Invalid Output Value
*5	Invalid Calibration Factor
*6	Unauthorized Command
*7	Correct Command, incorrect data
*8	High Voltage Timeout
*9	Output error

*10	I-Guard Voltage Detected
*11	High Current Over Temperature
*12	High Current Timeout
*13	Current Over Compliance
*14	Output Overload

Table 1 – Transmille Error Code / Response Codes

All status/error responses are followed by <CR><LF>

3.2. PROGRAMMING COMMANDS OVERVIEW

The 4610M calibrators are controlled by a set of simple high level commands which can be used either individually or as part of a command sequence.

The required terminator for the commands to be detected by the calibrator is a carriage return (ASCII character 13) and should be the last character sent on a command line.

For Example:

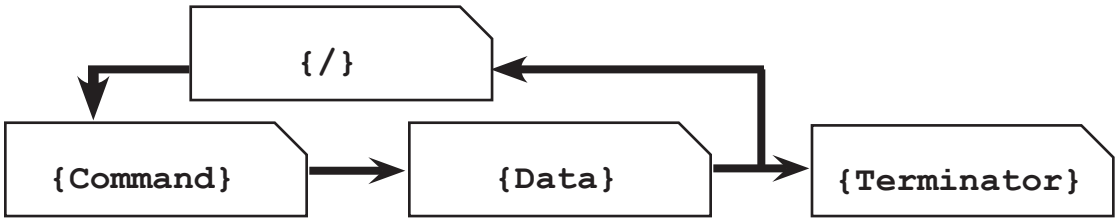
{Command}{Data}<CR>

Where the command is represented as {Command}, the required value as {Data} and the carriage return (ASCII character 13) is represented by <CR>

3.3. COMPOUND / CHAINED COMMANDS

To simplify remote commands, multiple commands can be sent in a single line of instructions. This can reduce the number of lines required in a program to configure the output of the calibrator.

The separator '/' (backslash) should be used between each command/data pair, as shown below.



An example of the use of this would be setting Range 1 (r1) for 200mV DC Voltage, with an output of 100mV (O100), followed by turning the output on (S0)

r1/O200/S0

These commands do not need extra delays, and can assist with writing complicated commands while

minimizing extra lines of code.

3.4. SETTING OUTPUT STATUS

The output status of the 4610M can be controlled with the following commands

Output Mode	
Output OFF (i.e. Standby ON)	**S1**
Output ON (i.e. Standby OFF)	**S0**

The above commands have been included for software that communicates to legacy Transmille products. Alternative commands are

Output Mode	
Output OFF	**STBY**
Output ON	**OPER**

3.5. QUERYING OUTPUT STATUS

The output status of the 4610M can be queried with the following command

OPER?

Responses to this command are as follows

Output State	Response
ON	**1**
OFF	**0**

3.6. FUNCTIONS

3.6.1. DC VOLTAGE

Function	Range	Command
DC Voltage	200mV	**r1**
	2V	**r2**
	20V	**r3**
	200V	**r4**
	1000V	**r5**

Output	
Set Output	**Oxxxx (NOT zero)**

The DC voltage section consists of a set of range commands which are used in conjunction with the standby and output command. To enable a DC Voltage to be set and an output assigned, the following command sequence should be used:

<RANGE>/<OUTPUT>/<STANDBY CONDITION><CR>

For example, to assign 2V D.C. with the output switched on, the command is:

r2/O2/S0<CR>

r2 = 2V Range (as detailed in the table above)
O2 = 2V Output
S0 = Standby OFF (i.e. output switched ON)
<CR> = Carriage Return (ASCII character 13)

Additional examples:

150mV DC	r1/O150/S0<CR>	(sets 150mV output on the 200mV range)
22V DC	r4/O22/S1<CR>	(sets 22V output on the 200V range, with the output turned off)

3.6.2. AC VOLTAGE

Function	Range	Command
AC Voltage	20mV	**r20**
	200mV	**r21**
	2V	**r22**
	20V	**r23**
	200V	**r24**
	1000V	**r25**

Output	
Set Output	**Oxxxx(NOT zero)**

Frequency	
Set Frequency	**Fxxxx**

The AC voltage section consists of a set of range commands which are used in conjunction with the Standby, Frequency and Output commands. To enable a AC Voltage to be set and an output assigned, the following command sequence should be used:

<RANGE>/<OUTPUT>/<FREQUENCY>/<STANDBY CONDITION><CR>

For example, to assign 20V AC, at 1kHz with the output switched on, the command is:

r22/O2/F1000/S0<CR>

r22 = 2V Range (as detailed in the table above)
O2 = 2V Output
F1000 = 1kHz Frequency Output
S0 = Standby OFF (i.e. output switched ON)
<CR> = Carriage Return (ASCII character 13)

Additional examples:

150mV AC @ 500kHz r21/O150/F500000/S0<CR> (sets 150mV output on the 200mV range)

22V AC @ 10Hz r23/O22/F10/S1<CR> (sets 22V output on the 200V range, with the output turned off)

3.6.3. DC CURRENT

Function	Range	Command
DC Current	200uA	**r11**
	2mA	**r12**
	20mA	**r13**
	200mA	**r14**
	2A	**r15**
	30A	**r16**

Output	
Set Output	**Oxxxx (NOT zero)**

The DC Current section consists of a set of range commands which are used in conjunction with the standby and output command. To enable a DC Current to be set and an output assigned, the following command sequence should be used:

<RANGE>/<OUTPUT>/<STANDBY CONDITION><CR>

For example, to assign 200mA DC with the output switched on, the command is:

r14/O200/S0<CR>

r14 = 200mA Range (as detailed in the table above)
O200 = 200mA Output
S0 = Standby OFF (i.e. output switched ON)
<CR> = Carriage Return (ASCII character 13)

Additional examples:

10mA DC	r33/O10/S0<CR>	(sets 10mA output on the 20mA range)
15A DC	r16/O15/S1<CR>	(sets 15A output on the 30A range, with the output turned off)

3.6.4. AC CURRENT

Function	Range	Command
AC Current	200uA	**r31**
	2mA	**r32**
	20mA	**r33**
	200mA	**r34**
	2A	**r35**
	30A	**r36**

Output	
Set Output	**Oxxxx(NOT zero)**

Frequency	
Set Frequency	**Fxxxx**

The AC current section consists of a set of range commands which are used in conjunction with the Standby, Frequency and Output commands. To enable a AC Current to be set and an output assigned, the following command sequence should be used:

<RANGE>/<OUTPUT>/<FREQUENCY>/<STANDBY CONDITION><CR>

For example, to assign 2A AC, at 1kHz with the output switched on, the command is:

r35/O2/F1000/S0<CR>

r35 = 2A Range (as detailed in the table above)
O2 = 2A Output
F1000 = 1kHz Frequency Output
S0 = Standby OFF (i.e. output switched ON)
<CR> = Carriage Return (ASCII character 13)

Additional examples:

10mA @ 10kHz AC r33/O10/F10000/S0<CR> (sets 10mA output @ 10kHz on the 20mA range)
15A @ 60Hz AC r36/O15/F60/S1<CR> (sets 15A output @ 60Hz on the 30A range, with the output turned off)

3.6.5. PASSIVE RESISTANCE OUTPUT

Function	Range	Command	2-Wire	4-Wire
Passive Resistance	0 Ω	**r41**	✓	✓
	0.1 Ω	**r42**	✓	✓
	1 Ω	**r43**	✓	✓
	10 Ω	**r44**	✓	✓
	100 Ω	**r45**	✓	✓
	1 kΩ	**r46**	✓	✓
	10 kΩ	**r47**	✓	✓
	100 kΩ	**r48**	✓	✓
	1 MΩ	**r49**	✓	✓
	10 MΩ	**r50**	✓	✓
	100 MΩ	**r51**	✓	✓
	1 GΩ	**r52**	✓	

2 / 4 Wire Resistance	
2 Wire	**I0**
4 Wire	**I1**

The resistance section consists of a set of range commands which are used in conjunction with the 2 wire, 4 Wire modes and standby commands. To enable a DC resistance to be set, the following command sequence should be used:

<RANGE>/<2 WIRE or 4 WIRE MODE>/<STANDBY CONDITION><CR>

The use of the output (O) command is not necessary as the resistance ranges are fixed values at decade points. For example, to set the 1 kΩ range 2-Wire output with the output switched on, the command is:

r46/I0/S0<CR>

r46 = 1 kΩ Range (as detailed in the table above)
I0 = 2 Wire mode
S0 = Standby OFF (i.e. output switched ON)
<CR> = Carriage Return (ASCII character 13)

Additional examples:

1 kΩ 4-Wire r46/I1/S0<CR>

10 MΩ 2-Wire r49/I0/S0<CR>

3.6.6. PASSIVE CAPACITANCE OUTPUT

Function	Range	Command
Capacitance	1 nF	**r61**
	2 nF	**r62**
	5 nF	**r63**
	10 nF	**r64**
	100 nF	**r65**
	1 uF	**r66**
	10 uF	**r67**

The capacitance section consists of a set of range commands which are used in conjunction with the standby command. To enable a capacitance to be set, the following command sequence should be used:

<RANGE>/<STANDBY CONDITION><CR>

The use of the output (O) command is not necessary as the capacitance ranges are fixed ranges at decade points.

For example, to set the 10nF output with the output switched on, the command is:

r64/S0<CR>

r64 = 10nF Range (as detailed in the table above)
S0 = Standby OFF (i.e. output switched ON)
<CR> = Carriage Return (ASCII character 13)

3.6.7. SIMULATED RESISTANCE

Function	Range	Command	2-Wire	4-Wire	2 Wire Compensated
Simulated Resistance	10 Ω	**r162**	✓	✓	✓
	33 Ω	**r163**	✓	✓	✓
	100 Ω	**r164**	✓	✓	✓
	330 Ω	**r165**	✓	✓	✓
	1 kΩ	**r166**	✓	✓	✓
	3.3 kΩ	**r167**	✓	✓	✓
	10 kΩ	**r168**	✓	✓	✓
	33 kΩ	**r169**	✓	✓	✓
	100 kΩ	**r170**	✓	✓	✓
	330 kΩ	**r171**	✓	×	×
	1 MΩ	**r172**	✓	×	×
	3.3 MΩ	**r173**	✓	×	×
	10 MΩ	**r174**	✓	×	×
	33 MΩ	**r175**	✓	×	×
	100 MΩ	**r176**	✓	×	×
	330 MΩ	**r177**	✓	×	×
	1 GΩ	**r178**	✓	×	×

Resistance Mode	
2 Wire Simulated	**I0**
4 Wire Simulated	**I1**
2 Wire Compensated	**I2**

The resistance section consists of a set of range commands which are used in conjunction with the standby command. To enable a resistance to be set, the following command sequence should be used:

<RANGE>/<2W, 4W OR 2W COMPENSATED MODE>/<OUTPUT>/<STANDBY CONDITION><CR>

Examples:

2 Wire Mode, 500M Ohms	4 Wire Mode, 10 Ohms	2 Wire Compensated, 10k Ohms

r178/I0/O0.5/S0<CR>	r162/I1/O10/S0<CR>	r168/I2/O10/S0<CR>
r178 = 1 GΩ Range (as detailed in the table above) I0 = 2 Wire mode S0 = Standby OFF (i.e. output switched ON) <CR> = Carriage Return (ASCII character 13)	r162 = 10 Ω Range (as detailed in the table above) I1 = 4 Wire mode S0 = Standby OFF (i.e. output switched ON) <CR> = Carriage Return (ASCII character 13)	r168 = 10 kΩ Range (as detailed in the table above) I2 = 2 Wire Compensated mode S0 = Standby OFF (i.e. output switched ON) <CR> = Carriage Return (ASCII character 13)

3.6.8. SIMULATED CAPACITANCE OUTPUT

Function	Range	Command
Simulated Capacitance	10 nF	**r187**
	100 nF	**r189**
	1 uF	**r191**
	10 uF	**r193**
	100 uF	**r195**
	1 mF	**r197**
	10 mF	**r199**
	100mF	**r201**

The capacitance section consists of a set of range commands which are used in conjunction with the standby command. To enable a capacitance to be set, the following command sequence should be used:

<RANGE>/<OUTPUT>/<STANDBY CONDITION><CR>

The use of the output (O) command is not necessary as the capacitance ranges are fixed ranges at decade points.

For example, to set an output of 7nF with the output switched on, the command is:

r187/O7/S0<CR>

r187 = 10nF Simulated Range (as detailed in the table above)
O7 = 7nF Output
S0 = Standby OFF (i.e. output switched ON)
<CR> = Carriage Return (ASCII character 13)

3.6.9. PWM

The PWM Function consists of setting the PWM Range (r97), the desired duty cycle, level, frequency and optional DC Offset. These commands are used in conjunction with the standby command. The following command sequence should be used:

<r97>/<OUTPUT>/PWM_LEVEL<xxx>/F<FREQUENCY>/DC_OFFSET<xxx>/<STANDBY CONDITION><CR>

For example, to set an output of 50% duty cycle, 5V, 1kHz and 0V DC Offset, with the output switched on, the command is:

r97/O50/PWM_LEVEL5/F1000/DC_OFFSET0/S0<CR>

3.6.10. SIMULATED PRT

The PRT Function consists of setting the PRT Range (r95), the desired output, r0 value and the standby command.

r0 Value	
Set r0 Value	**PRTZERO<Value in Ohms>**

Resistance Mode	
2 Wire Simulated	**I0**
4 Wire Simulated	**I1**
2 Wire Compensated	**I2**

<r95>/<OUTPUT>/<OPTIONAL r0>/<OPTIONAL RESISTANCE MODE>/<STANDBY CONDITION><CR>

For example, to set a temperature output of 100°C, with an R0 of 100 in 4 Wire simulated mode, the command is :

r95/O100/PRTZERO100/I1<CR>

3.6.11. THERMOCOUPLE OUTPUT

The Thermocouple Output Function consists of setting the Thermocouple Source Range (r98), the desired output, the thermocouple type and the standby command.

Thermocouple Type Command	
K	**TC_TYPE K**
J	**TC_TYPE J**
T	**TC_TYPE T**
R	**TC_TYPE R**
S	**TC_TYPE S**
B	**TC_TYPE B**
N	**TC_TYPE N**
E	**TC_TYPE E**
L	**TC_TYPE L**
U	**TC_TYPE U**
C	**TC_TYPE C**
1mV/°C	**TC_TYPE m**

Cold Junction Source	
Auto Cold Junction	**TEMP:TC:CJ:SOURCE INT**
Manual Cold Junction	**TEMP:TC:CJ:SOURCE EXT**

Cold Junction Value	
Set Cold Junction Value (In Manual Mode)	**TEMP:TC:CJ:VALUE <Value>**
Query Cold Junction Value	**TEMP:TC:CJ:VALUE?**

Temperature Units	
Set Temperature Units	**TEMP:TC:CJ:UNIT <"C" or "F">**
Query Temperature Units	**TEMP:TC:CJ:UNIT?**

To enable thermocouple simulation output, the following command sequence should be used:

<RANGE>/<THERMO TYPE>/<TEMP VALUE>/<CJC SOURCE>/<STANDBY CONDITION><CR>

For example, to set 100°C, Type K, Auto Cold Junction, send the following command

r98/TC_TYPE K/O100/TEMP:TC:SJ:SOURCE INT/S0<CR>

3.6.12. THERMOCOUPLE MEASUREMENT

The Thermocouple Measurement function consists of setting the Thermocouple Measurement Range (r134), the thermocouple type, cold junction configuration and then querying the calibrator for the reading

Thermocouple Type Command	
K	**TC_TYPE K**
J	**TC_TYPE J**
T	**TC_TYPE T**
R	**TC_TYPE R**
S	**TC_TYPE S**
B	**TC_TYPE B**
N	**TC_TYPE N**
E	**TC_TYPE E**
L	**TC_TYPE L**
U	**TC_TYPE U**
C	**TC_TYPE C**
1mV/°C	**TC_TYPE m**

Cold Junction Source	
Auto Cold Junction	**TEMP:TC:CJ:SOURCE INT**
Manual Cold Junction	**TEMP:TC:CJ:SOURCE EXT**

Cold Junction Value	
Set Cold Junction Value (In Manual Mode)	**TEMP:TC:CJ:VALUE <Value>**
Query Cold Junction Value	**TEMP:TC:CJ:VALUE?**

Temperature Units	
Set Temperature Units	**TEMP:TC:CJ:UNIT <"C" or "F">**
Query Temperature Units	**TEMP:TC:CJ:UNIT?**

To perform thermocouple measurement, the following command sequence should be used:

<RANGE>/<THERMO TYPE>/<CJC SOURCE><CR>

For example, to measure Type J thermocouple, with a manual cold junction of 22°C

r138/TC_TYPE J/TEMP:TC:CJ:SOURCE EXT/TEMP:TC:CJ:VALUE 22<CR>

To read the measured value displayed by the calibrator, send the following command

READ?

The response is returned in exponent format, for an input of 100°C, this will be returned as

+1.0E3

3.7. CALIBRATION COMMANDS

3.7.1. ENABLE / DISABLE CALIBRATION MODE

Calibration Mode	
Enabled / Unlock	**CAL:UNLOCK <Passcode>**
Disabled / Lock	**CAL:LOCK**

Locking the calibration will also save any changes that have been made to the calibration since unlocking.

To unlock the calibration to enable adjustments, the passcode must be provided. For example

CAL:UNLOCK 1234

Will unlock the calibration, assuming the default passcode is still in use

3.7.2. QUERYING CALIBRATION STATE (LOCKED / UNLOCKED)

To query the current calibration state, send

CAL:STATE?

A response of 1 indicates that the calibration is unlocked (i.e. adjustments can be performed), a response of 0 indicates that the calibration is locked (i.e. adjustments cannot be performed)

3.7.3. STORING CALIBRATION CHANGES

To save any changes made to calibration, without disabling calibration mode, send

CAL:STORE

3.7.4. ABORT CALIBRATION CHANGES

To abort any adjustments to calibration and recover to the last set of calibration factors, send

CAL:ABORT

The calibration state will also be locked automatically

3.7.5. PERFORM A BACKUP OF CALIBRATION FACTORS

To perform a backup of calibration factors to internal storage, send

CAL:BACKUP

Note - this command can be run with the calibration both locked or unlocked

A response of 1 indicates that the backup was successful

3.7.6. RESTORE TO FACTORY CALIBRATION

To restore the calibration to factory constants, send

CAL:FACTORYRESTORE {EXTSD}

Where the optional EXTSD parameter will restore the factory defaults stored on the internal SD card (if fitted)

For example, to restore from local memory send

CAL:FACTORYRESTORE

To restore from the SD Card, send

CAL:FACTORYRESTORE EXTSD

The calibration state must be UNLOCKED to perform this command

3.7.7. RESTORE RANGE TO DEFAULT FACTORS

If a hardware repair has taken place (for example replacing a board) it may be desirable to reset factors to defaults (not Factory)

To perform this, send the following command along with required parameters as listed

Reset Function	
Reset Full Scale / Zero calibration for Range	**CAL:RESET:RANGE {Range Number}**
Reset Frequency Response for Range	**CAL:RESET:FREQ:RANGE {Range Number}**
Reset DA Linearity Factors	**CAL:RESET:LINEARITY**
Reset Simulated Resistance Offset	**CAL:RESET:RCOFFSET**
Reset Simulated Resistance Trimmers	**CAL:RESET:RCTRIM**
Reset Thermocouple Cold Junction	**CAL:RESET:CJUNCTION**

For example, to reset the frequency response (but not the 1kHz calibration), send

CAL:RESET:FREQ:RANGE 22

Where 22 is the 2V AC Range

To reset the 200V DC Factors

CAL:RESET:RANGE 5

Where 5 is the 200V DC Range

Note - The calibration must be unlocked for these commands to function, and the calibration must be STORED for changes to be saved

3.7.8. PERFORMING AN ADJUSTMENT

Calibration of the 4610 is performed by setting a calibration point (as defined in the Calibration Manual) and sending the TOVAL command along with the measured value

For Example, the 2V DC Range requires adjustment at the positive full scale point

r2/O1.9/S0

Sets the 2V DC Range, sets the output to +1.9V DC and turns the output on

CAL:UNLOCK 1234

Enables Calibration

CAL:TOVAL 1.895V

Tells the calibrator to perform an adjustment, as well as the measured output value. Note that the output value does NOT need units and can be an exponent. The value will be converted to base units, i.e. 100m = 0.1

The calibrator automatically makes adjustments for all ranges with this command, including frequency response, however the correct Frequency / output must be set for an adjustment to be performed.

If the measured value is too far away from the expected value, or the calibration factor is too large and indicates a hardware failure, and adjustment will not be performed.

To save the calibration, the store command must be sent before resetting or restarting the calibrator

3.7.9. EXPORTING CALIBRATION TO USB (SERVICE MODE)

For backup purposes the calibration can be exported to a connected USB stick. With the USB stick connected to the internal USB port, send

CAL:EXPORT

Backup files will be copied and stored to the USB stick for archive purposes.

3.7.10. QUERYING CALIBRATION FACTOR VALUE

To retrieve the calibration factor for a range, send the command

CAL:FACTOR? {Calibrator Range}

The response format varies depending upon the range

For a DC Range or a Simulated Resistance/Capacitance Range the response is

{zero factor},{positive factor},{negative factor}

For an AC Range, the response is

{10%, 1kHz Factor},{1kHz Full Scale Factor},{Frequency 0},{Frequency 1},{Frequency 2},{Frequency 3},{Frequency 4},{Frequency 5}

For a Passive Resistance/Capacitance Range, the response is

{2 Wire Value},{4 Wire Value},0

3.8. MISCELLANEOUS COMMANDS

3.8.1. EARTH RELAY / NEGATIVE TO GROUND

Earth Relay	
Closed (Negative tied to Earth)	**EARTH ON<CR>**
Open (Negative Floating)	**EARTH OFF<CR>**

To query the state, send

EARTH?<CR>

EARTH? Response	
Closed (Negative tied to Earth)	**TIED**
Open (Negative Floating)	**OPEN**

3.8.2. RESET CALIBRATOR TO STARTUP

To reset the calibrator to startup / default settings, the following command can be sent

***RST<CR>**

This will perform the same as the Shift + C button from the front panel

3.8.3. SYSTEM ID

To query the instrument for Serial Number and Firmware versions, send the following command

***IDN?<CR>**

The response format is

<MANUFACTURER>,<MODEL>,<SERIAL NUMBER>,<INGUARD PROCESSOR VERSION>+<UI VERSION>+<MIDBOARD VERSION>+<SIMRC VERSION>+<KEYBOARD VERSION>

For Example, a 4610M will return

TRANSMILLE,4610M,1234,18.0.3+1.5.01+4+4+2

3.8.4. QUERY OUTPUT

To query the output, send the following command

OUT?

The response format is

<MAIN OUTPUT NUMBER>,<MAIN OUTPUT UNITS>,0,0,<FREQUENCY>

3.8.5. ONTIME?

The ONTIME? Command allows software to query how long the calibrator has been left turned on for. The response is in minutes.

For example, if the calibrator has been turned on for 3 hours, the response will be 180

3.8.6. QUERY SPECIFICATION

To query the calibrator specification, send the following command

SPEC?

The response is sent in scientific/exponent format

3.8.7. SET LOCAL OPERATION

To return the calibrator to local mode after finishing remote commands, the following command can be sent

LOCAL

3.8.8. INCREMENT OUTPUT

To increment the output, the following command can be used

Increment Output	
Increment Main Digits	**INCR <VALUE>**
Increment Frequency	**INCR:FREQ <VALUE>**

These commands accept values with units. For example, to increment the frequency by + 1.5kHz

INCR:FREQ +1.5kHz

To increment the main digits by -5mV

INCR -5mV

3.8.9. QUERY ERRORS

To query stored errors in the unit, send the following command

ERR?

The last recorded error will be read out and returned. The error code can then be compared against the operators manual for the description/meaning

4. 55XX COMMAND MODE

4.1. DESCRIPTION

The 4610M provides a high level command set that is compatible with existing commands from other manufacturers. To enable this compatibility mode, either refer to the operators manual for instructions or enable compatibility mode via the remote commands

Compatible commands do not respond with a status code, they require the software program to query the state after setting to retain compatibility

Note : Compatible commands do not offer access to low level functions such as enabling/disabling calibration mode

4.2. COMMANDS

4.2.1. EARTH

This command allows both querying the state of Negative To Ground, as well as configuring the output

To Query the state of the setting, send the command

EARTH?

The response will be “TIED” for Negative to Ground ON, and “OPEN” for Negative to Ground OFF

To set Negative to Ground ON, send the command

EARTH TIED

To disable Negative to Ground, send the command

EARTH OPEN

4.2.2. FUNC?

The FUNC? command allows software to query the current state of the calibrator, a list of responses

and the respective function is listed below

Response	Function
DCV	DC Voltage
ACV	AC Voltage
DCI	DC Current
ACI	AC Current
CAP	Capacitance
RES	Resistance
RTD	PRT / RTD Output
TC_OUT	Thermocouple Simulation
TC_MEAS	Thermocouple Measurement

4.2.3. ONTIME?

The ONTIME? Command allows software to query how long the calibrator has been left turned on for. The response is in minutes.

For example, if the calibrator has been turned on for 3 hours, the response will be 180

4.2.4. *RST

The *RST command sets the calibrator to default start up conditions. This is the same as turning the calibrator off and then back on again from the front panel switch.

4.2.5. OPER

The OPER command allows software to both query the output state of the calibrator, as well as turn the output of the calibrator ON

To query the output state, send the command OPER?

The calibrator will respond with 1 if the output is presently on, and a 0 if the calibrator is in standby

To turn the output on, send the command OPER

4.2.6. RANGELCK

The RANGELCK command allows software to both query the Range Hold status as well as perform a

range hold operation

To query the Range Hold state, send the command RANGELCK?

The calibrator will respond with ON if Range Hold is active, and OFF if Range Hold is disabled

To enable Range Hold, send the command RANGELCK ON

To disable Range Hold, send the command RANGELCK OFF

4.2.7. STBY

The STBY command sets the calibrator to standby. This is the same as pressing the STANDBY key on the front of the unit.

4.2.8. OUT

The OUT command allows software to both query the currently set output as well as set a new output

To query the output, send the command OUT?
The calibrator will respond with the currently set output in the following format

<MAIN PARAMETER>,<UNIT OF MAIN OUTPUT>, 0,0, <FREQUENCY>

For example, an output of 150mV AC, with a frequency of 1kHz will respond to the command with

1.000E-3, V, 0,0, 1.000E3

To set an output using the OUT command, the command needs multiple parameters

The desired output VALUE and units must be supplied, and then with a modifier as required.

A table of valid units is located below

Unit	Function
V	Voltage
A	Current
F	Capacitance
OHM	Resistance
CEL	Thermocouple – Degrees Centigrade
FAR	Thermocouple – Degrees Fahrenheit

To specify a frequency for Voltage or Current, the frequency must accompany the desired output after a the , separator

For example, to set 3.5V DC

```
OUT 3.5V, 0HZ
```

To set 1A AC, 100Hz

```
OUT 1A, 100HZ
```

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Transmille Ltd. guarantees this instrument to be free from defects under normal use and service for a period of 1 year from purchase. This guarantee applies only to the original purchaser and does not cover fuses, or any instrument which, in Transmille's opinion, has been modified, misused or subjected to abnormal handling or operating conditions.

Transmille's obligation under this guarantee is limited to replacement or repair of an instrument which is returned to Transmille within the warranty period. If Transmille determines that the fault has been caused by the purchaser, Transmille will contact the purchaser before proceeding with any repair.

To obtain repair under this guarantee the purchaser must return the instrument in its original packaging (carriage prepaid) and a description of the fault to Transmille in either the UK or the USA. The instrument will be repaired at the factory and returned to the purchaser; carriage prepaid.

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