LS3300 Driver User's Manual

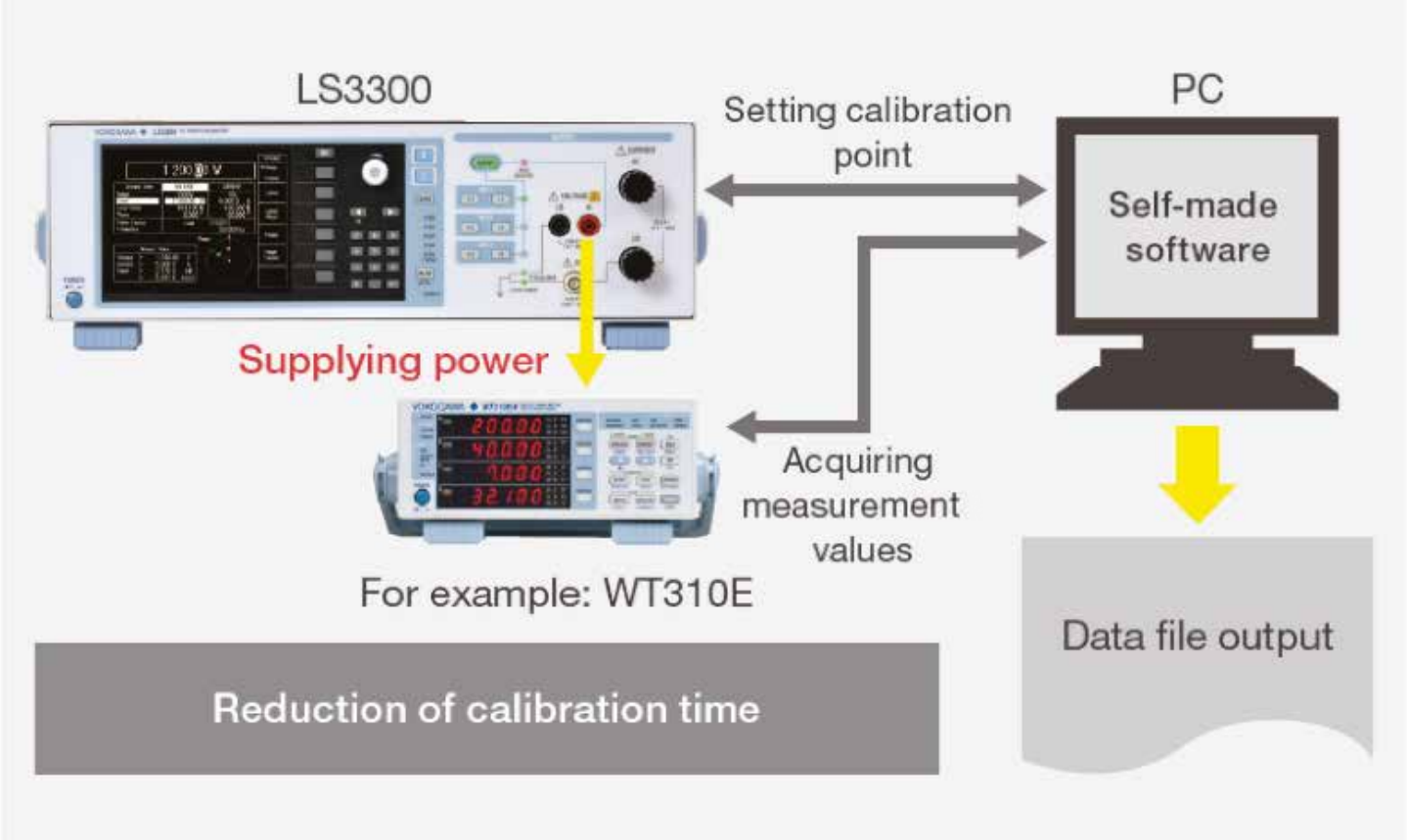

Figure 1: Example of an automated calibration procedure setup using the LS3300. The LS3300 driver will be used in the user self-made software to simplify and decrease procedure writing and debugging time.

The LS3300 driver is meant for usage with a METCAL Editor or Run Time Fluke calibration procedure software. Its main purpose is to further simplify the communication with the LS3300 when writing a calibration procedure in METCAL Editor. Rather than having to write, for each test point, four to eight lines of code to execute a series of commands, the user is now able to combine a series of commands in one command string and have the driver execute them. This driver does a similar job to the Fluke calibrators' FSCs[1] such as the 55220 or 5700 FSCs.

The user, who acquires this driver, should save a version of the driver in every procedure directory where the LS3300 standard is being used. One USB version and two GPIB versions of the driver are available. The standard version works with a GPIB interface and requires the LS3300 to be added into the METCAL list of user configured instruments and aliased as LS3300. The other two versions do not require the LS3300 to be added as used configured instrument, but will require the user to enter the GPIB address of the instrument or choose the appropriate USB port when prompted in METCAL each time the driver is used.

Driver Functionality

The LS3300 driver can be used to output power, voltage, current or auxiliary voltage. By passing a command string to specify the output parameters (frequency, level ratio, level, range, power factor, phase etc..) and calling the driver, the instrument adjusts the parameters and outputs a voltage, current or auxiliary voltage depending on the settings. The following are two examples illustrating potential usage modes of the driver.

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Example 1:

```
MEM2      =V:RAN 10V:LEV 5V:FREQ 70 HZ
CALL      Yokogawa LS3300 Driver V1.0
```

In this example, the LS3300 voltage range is set to 10V. Its voltage output level is set at 5V and the internal frequency at 70Hz. Thus, in this case, when the driver is called, the LS3300 will output 5V at 70Hz.

Example 2:

```
MEM2 =P:RAN1V:LEV.5V:RAN1A:LEV1A:FREQ70Hz
MATH      @PHASE  ="VPHASE90:CPHASE60"
MATH      @LRATIO ="VRATIO50:CRATIO120"
CALL      Yokogawa LS3300 Driver V1.0
```

In this example, the LS3300 current and voltage ranges are set to respectively 1V and 1A. The output level of the current and voltage are set to respectively 1A and 0.5V. After the second CALL command is executed, the LS3300 will output 0.25V at a phase of 90 degrees relative to the voltage reference signal and output 1.2A at a phase of 60 degrees relative to the current reference signal. The LS3300 real power output will be 0.51962 W.

A few variables are also predefined and left to the user for data assignment. These variables are used to change the setting of some parameters such as wiring mode, sweep time, or simply phase output reference.

Also, the driver uses the memory registers MEM2, MEM1, and MEM. At the end of every successful call to the driver, the nominal output value is stored in MEM1. For power mode (P), the value stored in MEM1 is the output real or active power in Watts. For current (C) and voltage (V) modes the nominal output value in Amps or Volts is stored in MEM1. This feature is useful when using the MEMCX FSC after a call to the driver. Since MEM1, holds the nominal value, the latter does not need to be specified again in the nominal field of the MEMCX FSC. When in PX[2] mode, MEM1 holds its value before the call to the driver. MEM always holds its value before the driver call after each successful call.[3]

After a call to the driver, MEM2 also retains its value before the driver call. This allows for the user to change the phase or other variables' setting and call the driver again without having to rewrite the MEM2 command string. MET/CAL EDITOR registers S[32], S[31] AND M[252] and M[255][4] are also used in the driver for algorithmic purposes.

Voltage & Current Output Command String

MEM2 = FIELD1:FIELD2:FIELD3:FIELD4:FIELD5

Delimiter

Function — specifies the end of a field and the beginning of a new one .

Syntax — :

FIELD 1

Function — specifies the output mode.

Syntax — <mode>
<mode> = V, C, or CX.

Description — V stands for voltage mode, C stands for current mode and CX auxiliary voltage output mode

Example — V
C

FIELD 2

Function — specifies the output range for current , voltage, or auxiliary voltage.

Syntax — RAN <value> <units>
<units>can be mA, A, mV, or V

Description — For voltage mode <value>= 1, 10, 30, 100, 300, 1000 (V), for current mode <value>=30m, 100m, 1, 10, 50 (A), for auxiliary voltage output mode <value> = 500m, 5 (V).

Example — RAN 5V
RAN 50A

FIELD 3

Function — specifies the current or voltage output level.

Syntax — LEV <value><units>
<units>= mA, A, mV, or V

Description — Note that <value> should be within the resolution of the range specified in FIELD2. For example, in the 100V range, the minimum level is 1mV.

Example — LEV 1V
LEV 30A

FIELD 4

Function — specifies the frequency mode and frequency level.

Syntax: — FREQ <value> Hz or FREQ <mode>

Description — <value> : 40Hz to 1200Hz (resolution: 0.001 Hz). <mode> : EXT or LINE. Note that for internal frequency ONLY the value and units (Hz) need to be specified.

Example — FREQ 50Hz
FREQ LINE

FIELD 5 (optional)

Function — specifies the output level ratio. The default value when not specified is 100.

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Syntax: LEVR <value>
<value> ranges from 0.000 to 120.000 (resolution 0.001%)

Example LEVR 105

Complete Command String

Description The complete command string should be stored in MEM2. Check the following examples for reference. Note that all the fields from 1 to 4 must be defined for the driver to function properly. Only field 5 can be omitted.

Examples

MEM2 = V:RAN 10V:LEV 5V:FREQ 50 Hz
MEM2 = C:RAN 10A:LEV 5A:FREQ EXT:LEVR 100
MEM2 = CX:RAN 5V:LEV 3V:FREQ LINE:LEVR 50

Power Output Command String

MEM2= FIELD1:FIELD2:FIELD3:FIELD4:FIELD5:FIELD6:FIELD7

Delimiter

Function specifies the end of a field and the beginning of a new one

Syntax :

FIELD1

Function specifies the output mode.

Syntax: <mode>
<mode> can be P or PX.

Description P stands for power mode , and PX stands for simultaneous voltage and auxiliary voltage output.

Example P
PX

FIELD 2

Function specifies the voltage output range.

Syntax: RAN <value> <units>
<units> must be V

Description <value>= 1, 10, 30, 100, 300, 1000 (V),

Example RAN 100V

FIELD 3

Function specifies the voltage output level.

Syntax: LEV <value> <units>
<units> : V or mV

Description For <value>, note that the output level should be within the range specified in FIELD2.

Example LEV 90V

FIELD 4

Function specifies the current output range in P mode or the auxiliary voltage range in PX mode.

Syntax: RAN <value> <units>
<units> can be mA ,A, mV, or V

Description For current mode
<value>=30m, 100m, 1, 10, 50 (A),
for auxiliary voltage output
mode <value> = 500m, 5 (V).

Example RAN 500mV
RAN 50A

FIELD 5

Function specifies the current output level in P mode or the auxiliary output level in PX mode.

Syntax: LEV <value> <units>
<units> can be mV, V, mA, or A.

Description For <value>, note that the output level should be within the range specified in FIELD4.

Example LEV 30A

FIELD 6

Function specifies the frequency mode and frequency level.

Syntax: FREQ <value> Hz or
FREQ <mode>

Description <value> : 40Hz to 1200Hz (resolution: 0.001 Hz). <mode> : EXT or LINE. Note that for internal frequency ONLY the value and units (Hz) need to be specified.

Example FREQ 50Hz
FREQ LINE

FIELD 7 (optional)

Function specifies the output power factor. The default value when not specified is 1 and the power factor polarity is lag.

Syntax: PF <value> <polarity>
<value> ranges from -1.0000 to 1.0000 (resolution 0.0001) <polarity> can be D or G.

Description "D" stands for Lead and "G" stands for Lag.

Complete Command String

Description The complete command string should be stored in MEM2. Check the following examples for reference. Note that all the fields from 1 to 6 must be defined for the driver to function properly. Only field 7 can be omitted.

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Examples

MEM2 = P:RAN 10V:LEV 5V:RAN 50A:LEV 30A:FREQ 60Hz
MEM2 = P:RAN 10V:LEV 5V:RAN 50A:LEV 30A:FREQ EXT:PF 0.500 D
MEM2 = PX:RAN 10V:LEV 5V:RAN 50A:LEV 30A:FREQ 60Hz:PF 0.7500 G

Note: The number of characters per string before any FSC is limited to 55 characters in MET/CAL Editor. The user should try to minimize the command string, by deleting trailing or leading zeroes and spaces when a MET/CAL Editor error E14218 (FSC line too long) occurs. They can also split the command string into two parts and concatenate them. The following is an example illustrating the concatenation.

Example

MEM2 = P:RAN 10V:LEV 5V:RAN 50A:LEV 30A
MATH = MEM2 & ":FREQ 60Hz:PF 0.5 D"

*This is only needed when the error E14128 occurs.

Optional Variables

@PHASE

Function — This variable can be set to specify the phase relative to the voltage output's reference signal and the phase relative to the current output's reference signal.

Syntax: — @PHASE = "VPHASE <value>:CPHASE <value>"

Description — <value> can be -180.000 to +359.999 (resolution: 0.001°) This variable is reset to default (0.000°) after each call to the driver. The user will have to specify the value for each driver call, if the output phase desired is not 0.000°

Example

@PHASE = "VPHASE 90:CPHASE 60"

@LRATIO

Function — This variable can be set to specify the output level ratios for current, voltage or auxiliary voltage mode.

Syntax: — @LRATIO = "VRATIO <value>:CRATIO <value>"

Description — <value> ranges from 0.000 to 120.000 (resolution 0.001%). This variable is reset to default (100%) after each call to the driver. The user will have to specify the value for reach driver call, if the output level ratio is to differ from 100%.

Example

@LRATIO = "VRATIO 120:CRATIO 50"

@WIRING

Function — This variable can be used to specify the wiring mode and wiring priority settings. It is optional; the user does not have to set it unless otherwise needed. The default setting is 1P2W for the wiring mode, and UNIT3 for the priority.

Syntax — @WIRING = "<value1>:<value2>"

Description — <value1> can be 1P2W , 1P2WHC, 1P3W, 3P3W, 3P4W, or 3V3A. <value2> can be UNIT2 or UNIT3. This variable is NOT reset to default (1P2W) after each call to the driver. The user will have to change the setting of the wiring mode and priority whenever needed.

Example

@WIRING = "1P3W:UNIT2"

@SWEEP

Function — This variable can be set to specify the sweep time and range. It is optional; the user does not have to set it unless otherwise needed. The default setting is 16s for sweep time

Syntax — @SWEEP = "<value1> S:<value2> %"

Description — <value1> ranges from 0.0001 to 99999.9999 (resolution mV/A) . This variable is NOT reset to default (1000.0000mV/A) after each call to the driver. The user will have to set a new sensor ratio value each time when needed. Note that the sweep range does not have to be specified if the only change being made is the sweep time.

Example

@SWEEP = "8S:110%"
@SWEEP = "64S"

@SRATIO

Function — This variable can be used to specify the current sensor ratio value. It is optional; the user does not have to set it unless otherwise needed. The default setting is 1000mV/A.

Syntax — @SWEEP = "<value1> mV/A"

Description — <value1> ranges from 0.0001 to 99999.9999 (resolution mV/A). This variable is NOT reset to default (1000.0000mV/A) after each call to the driver. The user will have to set a new sensor ratio value each time when needed.

Example

@SRATIO = "100.00mV/A"

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Note

- The optional variables must be defined in upper case. Any lower case character will result in errors.
- For the optional variables, no spaces are allowed between the fields and the delimiter. Leaving a blank space character may cause a syntax error in some instances.

Appendix

I. A few calibration procedure test points written in METCAL Editor using the LS3300 driver

- AC Voltage test: 30V at 60Hz, Range 100V

```
1.000  MEM2       =AC:RAN 100V:OUT 30.000V:FREQ 60 Hz
1.001  CALL       Yokogawa LS3300 Driver V1.0
1.002  VISA       [D999]:NUM:NORM:VAL? [I]
1.003  MEMCX  30          V          0.1% 0.05/    60H
```

- AC Current test: 100mA at 60Hz, Range 100mA

```
2.000  MEM2       =AC: RAN 100mA:OUT 100.000mA:FREQ 60 Hz
2.001  CALL       Yokogawa LS3300 Driver V1.0
2.002  VISA       [D999]:NUM:NORM:VAL? [I]
2.003  MEMCX  100         mA         0.1% 0.05/    60H
```

- AC Power test: 150W at 60Hz, 15V and 1A outputs

```
3.000  MEM2       =P:RAN 30V:LEV 15V:RAN 1A:LEV 1A:FREQ 60Hz
3.001  CALL       Yokogawa LS3300 Driver V1.0
3.002  VISA       [D999]:NUM:NORM:VAL? [I]
3.003  ACC        15.000W      0.05%
3.004  MEMCX  15          W          0.1% 0.05/    15V/1A/60Hz
```

II. Various driver calls to set parameters or to output voltage, current or power

```
# Voltage Test with a different Sweep time setting

1.001  MATH       @SWEEP =”64S:105%”
1.002  MEM2       =V:RAN 10V:LEV 5V:FREQ 70 HZ
1.003  CALL       Yokogawa LS3300 Driver V1.0

# Voltage Test with a different Sweep time setting

1.004  MATH       @SWEEP =”64S”
1.005  MEM2       =V:RAN 10V:LEV 5V:FREQ 70 HZ
1.006  CALL       Yokogawa LS3300 Driver V1.0

# Voltage Test with wiring setting

1.007  MATH       @WIRING =” 1P2W”
1.008  MATH       @SRATIO =”100mV/A”
1.009  MEM2       =V:RAN 10V:LEV 5V:FREQ 60 HZ
1.010  CALL       Yokogawa LS3300 Driver V1.0

# Voltage Test with Sensor Ratio

1.011  MATH       @SRATIO =”100mV/A”
1.012  MEM2       =V:RAN 10V:LEV 5V:FREQ 60 HZ
1.013  CALL       Yokogawa LS3300 Driver   V1.0

# Voltage Test with LINE frequency

1.014  MEM2       =V:RAN 10V:LEV 5V:FREQ LINE
1.015  CALL       Yokogawa LS3300 Driver V1.0

# Voltage Test with External frequency

1.016  MEM2       =V:RAN 10V:LEV 5V:FREQ EXT
1.017  CALL       Yokogawa LS3300 Driver V1.0

# Power test with External frequency

1.018  MEM2
=P:RAN1000mV:LEV10mV:RAN100mA:LEV50mA:FREQ
EXT:PF0.5 D
1.019  CALL       Yokogawa LS3300 Driver V1.0

# Power test with LINE frequency

1.020  MEM2       =P:RAN 100V:LEV 10V:RAN 10A:LEV 5A:FREQ
LINE:PF 0.5 D
1.021  CALL       Yokogawa LS3300 Driver V1.0

# Wiring Setting feature

1.022  MATH       @WIRING =” 1P2W”
1.024  MEM2       =V:RAN 10V:LEV 5V:FREQ 60 HZ
1.025  CALL       Yokogawa LS3300 Driver V1.0

# Voltage Test Default (no level ratio)

1.026  MEM2       =V:RAN 10V:LEV 5V:FREQ 70 HZ
1.027  CALL       Yokogawa LS3300 Driver V1.0

# Voltage Test with level ratio

1.028  MEM2       =V:RAN 100V:LEV 80V:FREQ 60 HZ:LEVR 50
1.029  CALL       Yokogawa LS3300 Driver V1.0

# Current Test Default (no level ratio)

1.030  MEM2       =C:RAN 100mA:LEV 10mA:FREQ 70 HZ
1.031  CALL       Yokogawa LS3300 Driver V1.0

# Current Test with level ratio

1.032  MEM2       =C:RAN 10A:LEV 5A:FREQ 40 HZ:LEVR 120
1.033  CALL       Yokogawa LS3300 Driver V1.0

# Power Test default (no power factor)

1.034  MEM2       =P:RAN 100V:LEV 10V:RAN 10A:LEV 1A:
FREQ 60Hz
1.035  CALL       Yokogawa LS3300 Driver V1.0

# Power Test with power factor LEAD

1.036  MEM2       =P:RAN 100V:LEV 10V:RAN 10A:LEV 5A:FREQ
60Hz:PF 0.5 D
1.037  CALL       Yokogawa LS3300 Driver V1.0

# Power Test with power factor LAG

1.038  MEM2       =P:RAN 100V:LEV 10V:RAN 10A:LEV 5A:FREQ
60Hz:PF 0.5 G
1.039  CALL       Yokogawa LS3300 Driver V1.0
```


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Power test with Level Ratio & Power Factor

1.040 MEM2 =P:RAN 100V:LEV 50V:RAN 10A:LEV 5A:FREQ 70Hz:PF 0.5 G
1.041 MATH @LRATIO = "VRATIO50:CRATIO120"
1.042 CALL Yokogawa LS3300 Driver V1.0

Power test with Phase

1.043 MEM2 =P:RAN 100V:LEV 50V:RAN 50A:LEV 15A:FREQ 70Hz:PF 0.5 G
1.044 MATH @PHASE = "VPHASE90:CPHASE80"
1.045 CALL Yokogawa LS3300 Driver V1.0

Power test with Phase & Level Ratio & Power Factor

1.046 MEM2 =P:RAN 100V:LEV 50V:RAN 50A:LEV 15A:FREQ 70Hz:PF 0.5 G
1.047 MATH @PHASE = "VPHASE90:CPHASE60"
1.048 MATH @LRATIO = "VRATIO50:CRATIO120"
1.049 CALL Yokogawa LS3300 Driver V1.0

AUX Voltage Output Default

1.050 MEM2 =CX:RAN 5V:LEV 5V:FREQ 100 HZ
1.051 CALL Yokogawa LS3300 Driver V1.0

AUX Voltage Output with Level ratio

1.052 MEM2 =CX:RAN 500mV:LEV 150mV:FREQ 1000 HZ:LEVR 120
1.053 CALL Yokogawa LS3300 Driver V1.0

AUX Mode Power

1.054 MEM2 =PX:RAN 100V:LEV 50V:RAN 500mV:LEV 300mV:FREQ 70Hz
1.055 CALL Yokogawa LS3300 Driver V1.0

AUX Mode Power with Power Factor

1.056 MEM2 =PX:RAN 100V:LEV 50V:RAN 5V:LEV 3V:FREQ 70Hz:PF 0.5 D
1.057 CALL Yokogawa LS3300 Driver V1.0

---

[1]FSC stands for function selection code. It used to direct the system to perform a specific task during a procedure execution. For example, the 5520 FSC can instruct the system to output voltage or current from the Fluke 5520 Multi-Product Calibrator.

[2]Voltage being outputted simultaneously from both the AUX and the regular voltage output terminal.

[3]Note that these registers may not get their expected values reassigned when the driver encounters a failure.

[4]M[255] holds the value of 1 or -1 when the driver encounters a failure.

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