

## Introduction

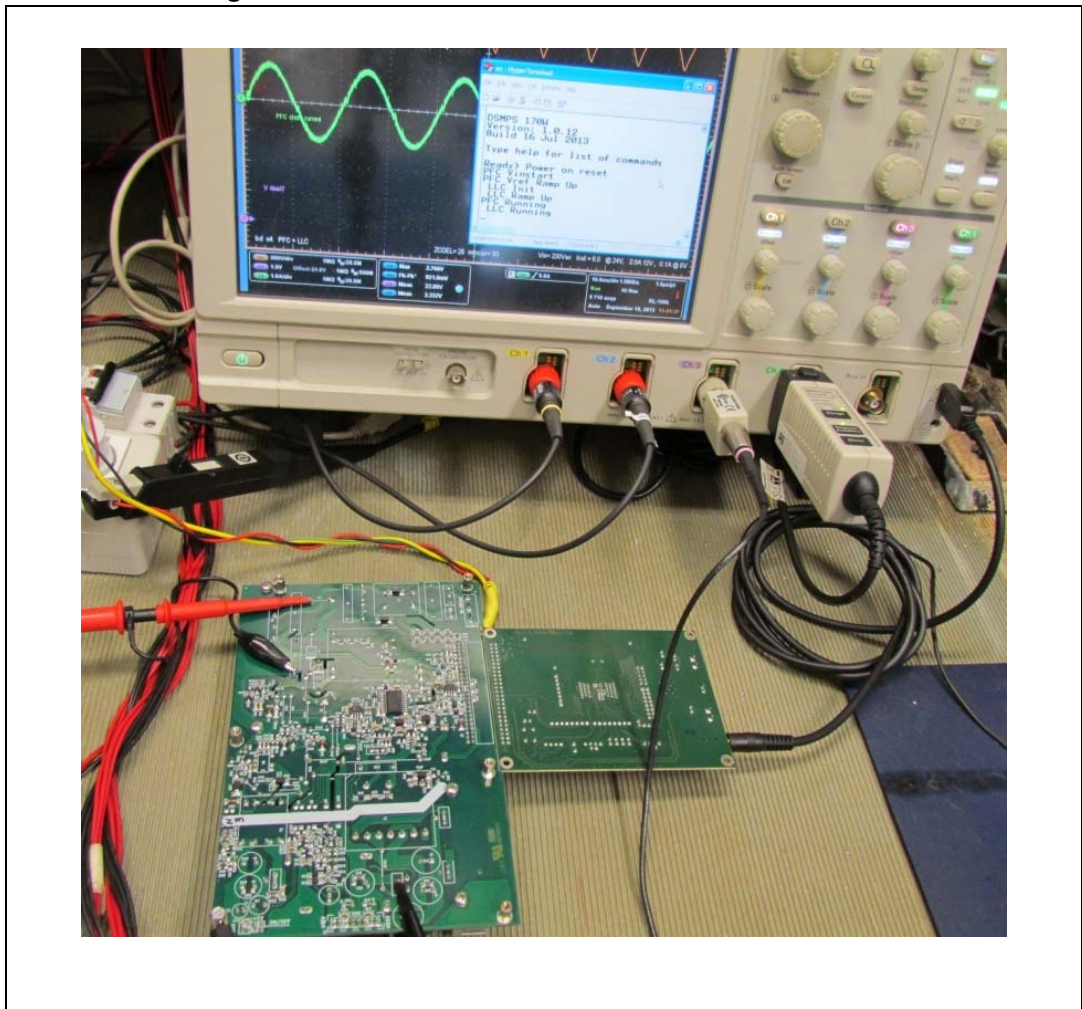
The EVLSTNRG-170W demonstration board implements a simple user interface that allows the operator modifying temporarily or permanently several parameters that determine the application functionalities.

It is also possible to monitor, in real time, the value of the most important variables.

This user manual describes the commands available and how to use the interface. From the hardware point of view just a USB to UART (3.5 mm jack) cable is required.

A picture of a working board with the serial interface in use is shown in [Figure 1](#).

**Figure 1. EVLSTNRG-170W with serial interface in use**



# Contents

- 1      Getting started ..... 5**
  - 1.1    System requirements ..... 5
  - 1.2    General input rules ..... 5
  - 1.3    Online help ..... 6
  
- 2      General rules for commands ..... 7**
  
- 3      Available commands ..... 8**
  - 3.1    acpdelay ..... 8
  - 3.2    acpdelta ..... 8
  - 3.3    acpexit ..... 9
  - 3.4    adt ..... 9
  - 3.5    display ..... 9
  - 3.6    dllc ..... 10
  - 3.7    dlramp ..... 10
  - 3.8    dpfc ..... 11
  - 3.9    dserv ..... 11
  - 3.10    dvin ..... 12
  - 3.11    dvout ..... 12
  - 3.12    factory ..... 12
  - 3.13    help ..... 13
  - 3.14    hwconf ..... 13
  - 3.15    kil ..... 13
  - 3.16    kih ..... 14
  - 3.17    kpl ..... 14
  - 3.18    kph ..... 14
  - 3.19    llcac ..... 15
  - 3.20    llcdead ..... 15
  - 3.21    llcs ..... 16
  - 3.22    llcstart ..... 16
  - 3.23    llcstop ..... 16

3.24	mincurr	17
3.25	nompwr	17
3.26	nshift	17
3.27	ocpdelay	18
3.28	ocppwr	18
3.29	ocpdelta	18
3.30	ocptime	19
3.31	ovp	19
3.32	pfcdelay	19
3.33	pfccop	20
3.34	pfcs	20
3.35	ratio	20
3.36	reset	21
3.37	rudelta	21
3.38	rutfast	21
3.39	rutmax	21
3.40	rutslow	22
3.41	seteedata	22
3.42	synch	22
3.43	tdelmax	23
3.44	tdelmin	23
3.45	tonblank	23
3.46	trace	24
3.47	trrate	24
3.48	uvp	25
3.49	vctrl	25
3.50	vctrlloff	25
3.51	vers	25
3.52	vin	25
3.53	vinstart	26
3.54	vinbout	26
3.55	vout	26
3.56	vrec	26

---

3.57	vref	27
3.58	vrramp	27
3.59	vshyst	27
3.60	vstep	28
3.61	zcddac	28
3.62	zcdel	28
3.63	zcdsbeg	28
3.64	zcdsend	29
3.65	zcdthrhi	29
3.66	zcdthrlo	29
3.67	zcdwait	30
<b>4</b>	<b>Revision history</b>	<b>31</b>

# 1 Getting started

## 1.1 System requirements

In order to use the EVLSTNRG-170W user interface the following HW/SW tools are required:

- USB to UART cable (with 3.5 mm stereo jack)  
- example: FTDI Chip p/n TTL-232R-3V3-AJ
- PC driver for the USB to UART cable (provided by cable manufacturer)
- Terminal emulator client on the PC (like HyperTerminal or Tera Term)

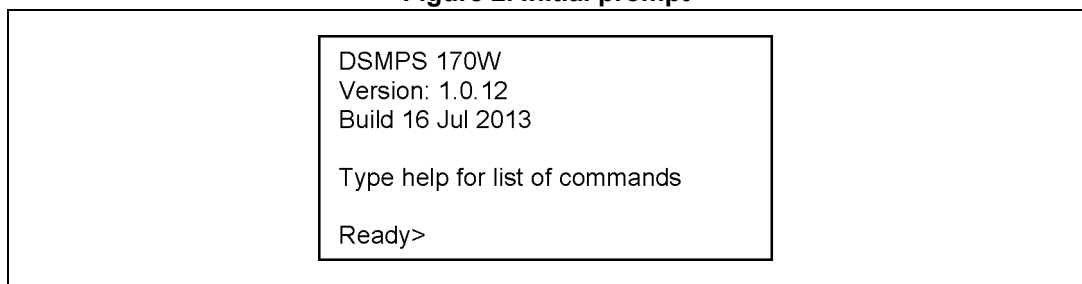
The serial interface has the following fixed configuration:

- 115200 bps
- 8 bit data
- No parity
- No flow control
- No echo

After the power-on or hardware reset the application displays a version message followed by the input prompt.

The initial prompt may vary on different revisions of the code; [Figure 2](#) displays the initial prompt of the revision available at the time of writing this document.

**Figure 2. Initial prompt**



```
DSMPS 170W
Version: 1.0.12
Build 16 Jul 2013

Type help for list of commands

Ready>
```

## 1.2 General input rules

The following general rules apply to all command input sequence:

- All commands are typed in lowercase letters
- The backspace character (ASCII code 0x08) may be used to cancel typed characters
- The Ctrl C character (ASCII code 0x03) may be used to cancel typed input and to restart a new input prompt
- All numbers unless explicitly indicated, are entered in the decimal format
- The arrow keys have no edit capability
- Input lines are terminated by a carriage return (ASCII code 0x0D)

## 1.3 Online help

The application has a simple online help feature that may be used to remind the syntax of the available commands.

The help command has the two following formats:

- help
- help command\_name

The first version displays the list of all the available commands with their syntax in a short form.

The second version displays a more complete syntax of the specified command in a long format; an example is displayed in [Figure 3](#) for the help command itself.

**Figure 3. Help command example**

```
Ready> help help

Syntax: help [cmd_name]
Without arguments prints the list of available commands
If cmd_name is present, prints help on specific command

Ready>
```

## 2 General rules for commands

Several available commands may have one or more parameters; as a general rule if the command is entered without parameter(s), it displays the current setting of the parameter, while if entered with parameter(s), modifies the current settings.

All parameters have default values that are automatically initialized at the absolute first system power-on and are stored permanently in the EEPROM data. Permanently means that their values are maintained across hardware resets and power-on resets.

At the power-on or hardware reset, the values of all parameters stored in EEPROM data are automatically copied into their corresponding RAM locations for run-time usage.

The EEPROM data are protected by a checksum to avoid data corruption. Before copying parameters from the EEPROM to RAM, the checksum is verified. Only if the checksum is correct the parameters are copied into the RAM, otherwise the EEPROM contents are replaced with the default parameter values and then copied into the RAM.

Whenever the user modifies a parameter using the appropriate command, the parameter value is changed only in the RAM location for immediate run-time usage, while the EEPROM copy remains unaltered. At the next hardware reset or power-on reset, the value in the RAM location is restored from the EEPROM data losing the temporary modification.

Parameters stored in the EEPROM may also be restored in the RAM after temporary modifications using the reset command (see [Section 3.36 on page 21](#)).

To modify permanently a parameter the user must use the `seteedata` (see [Section 3.41 on page 22](#)) command that copies the RAM location values into the corresponding EEPROM data.

The system is delivered with a default set of parameters already stored in the EEPROM.

The default parameters may be restored into the EEPROM at any time using the factory command (see [Section 3.12 on page 12](#)).

## 3 Available commands

This section describes the format and the function of all the available commands.

The commands are sorted in alphabetical order to simplify the search.

The full list of available commands may be displayed with the help command without any parameter.

### 3.1 **acpdelay**

Anti-capacitive protection delay

Syntax: `acpdelay [ms]`

Default value: 20 ms

Range: 1-1000

The LLC may enter the capacitive conditions if the ZCD signal event is too near to the switch on event (on anyone of the high- or low-side MOS; see [Section 3.19 on page 15](#)).

This parameter indicates the maximum time in ms during which this condition may be accepted. If the capacitive condition persists for a longer period, a restart condition is generated by the LLC.

When the capacitive condition is firstly recognized an internal timer is started and incremented until the capacitive condition persists.

The `acpdelay` parameter indicates the maximum acceptable period for capacitive condition. If the capacitive condition persists for a time longer than this value, the LLC generates a restart condition.

During the capacitive condition the LLC control loop is opened and the `TimeShift` parameter decremented every 250  $\mu$ s until the condition persists (resonant frequency increment; see [Section 3.2](#)).

### 3.2 **acpdelta**

Anti-capacitive protection delta

Syntax: `acpdelta [value]`

Default value: 4

Range: 1-255

This parameter indicates the decrement amount of the `TimeShift` parameter during the capacitive condition (see [Section 3.1](#)).

The parameter is expressed in SMED clock cycles at 96 MHz.



### 3.3 acpexit

Anti-capacitive protection exit

Syntax: acpexit [value]

Default value: 30

Range: 1-1000

To exit from the LLC capacitive condition the distance between the switch on event and the ZCD event must be greater than this parameter. The parameter must be greater than the limit used to enter the capacitive condition in order to have an hysteresis between the enter and exit condition (see [Section 3.19 on page 15](#)).

The parameter is expressed in SMED clock cycles at 96 MHz.

### 3.4 adt

Automatic dead time

Syntax: adt [on|off]

Default value: on

The dead time between the switching of the high-side and low-side MOS may be automatically detected by the system hardware.

This parameter enables/disables this feature. If the feature is disabled, the dead time is determined by the `llc_dead` parameter (see [Section 3.20 on page 15](#)).

### 3.5 display

Display all settable parameters

Syntax: display

The command displays the current value of all settable parameters.

The value displayed is the one currently stored in the run-time RAM copy.

The command automatically recalls all the partial display commands available to display only specific parameters (see following `dxxxx` commands).

### 3.6 **dllc**

Display LLC parameters

Syntax: `dllc`

The command displays all the parameters related to the LLC configuration; the displayed parameters are:

- LLC start
- LLC stop
- LLC dead
- LLC ac
- ACP delay
- ACP exit
- OCP delay
- OCP pwr
- NOM pwr
- Tdel max
- Tdel min

See the corresponding commands for the meaning of each parameter.

### 3.7 **dlramp**

Display LLC startup ramp parameters

Syntax: `dlramp`

The command displays all the parameters related to the LLC startup ramp; the displayed parameters are:

- Ramp-up maximum time
- Ramp-up time fast increment
- Ramp-up time increment period
- Ramp-up time slow increment
- OCP time increment
- OCP time increment period
- ACP time increment

See the corresponding commands for the meaning of each parameter.

### 3.8 dpfc

Display PFC parameters

Syntax: dpfc

The command displays all the parameters related to the PFC configuration; the displayed parameters are:

- Ton blank (LEB time)
- ZCD delay
- ZCD dac
- ZCD wait
- Valley skipping hysteresis
- PFC restart delay
- ZCD suppression high threshold
- ZCD suppression low threshold
- ZCD suppression begin
- ZCD suppression end
- PFC overcurrent protection
- Minimum current
- Steady-state and transition state integral parameter
- Steady-state and transition state proportional parameter
- Normalization compensation output shift

See the corresponding commands for the meaning of each parameter.

### 3.9 dserv

Display global service parameters

Syntax: dserv

The command displays global parameters related to the system configuration; the displayed parameters are:

- Automatic dead time
- Hardware configuration
- Current LLC state
- Current PFC state
- Current half bridge feedback control voltage

See the corresponding commands for the meaning of each parameter.

### 3.10 dvin

Display mains control parameters

Syntax: dvin

The command displays all the parameters related to the control of the mains voltage levels; the displayed parameters are:

- Current mains input voltage
- Minimum mains input voltage level for PFC startup
- Minimum mains input voltage level to maintain PFC active
- Synchronization count for ADC interrupt function
- Coefficient for computation of feed-forward compensation

See the corresponding commands for the meaning of each parameter.

### 3.11 dvout

Display PFC output voltage control parameters

Syntax: dvout

The command displays all the parameters related to the control of the PFC output voltage; the displayed parameters are:

- Current PFC output voltage
- PFC output reference voltage
- PFC reference voltage ramp step
- PFC overvoltage protection level
- PFC recovery voltage level after burst
- PFC undervoltage protection level

See the corresponding commands for the meaning of each parameter.

### 3.12 factory

Restore default factory parameter values into the EEPROM and RAM.

Syntax: factory

The command restores the default factory parameter values both into the EEPROM and RAM memory locations (see also [Section 2 on page 7](#), [Section 3.36 on page 21](#) and [Section 3.41 on page 22](#)).

### 3.13 help

Help command

Syntax: help [cmd\_name]

The command, when called without parameters, displays the list of all available commands with their syntax in a short form.

If a valid command name is passed as a parameter, the command displays the syntax of the selected command and a short description of the command function.

### 3.14 hwconf

Hardware configuration settings

Syntax: hwconf [pfcon|pfclock|pfcoff||lcon||lclock||lcoff]

Default value: PFC active LLC active

The PFC and LLC subsystem may be enabled independently for test purposes. The command displays the current activation state of the PFC and LLC sections.

Both PFC and LLC may be in the following state:

- Off: the subsystem is not activated
- On: the subsystem is active
- Locked: the subsystem is activated but the corresponding SMED(s) are not activated (test functionality).

### 3.15 kil

Integral coefficient value for steady-state

Syntax: kil [value]

Default value: 43

Range: 1-1023

Without any parameter, the command displays the value of the integral coefficient used when the system is in steady-state.

If a parameter is entered, the value is assigned to the integral coefficient used for steady-state.

### 3.16 **kih**

Integral coefficient value for transition state

Syntax:       kih [value]

Default value: 462

Range:         1-1023

Without any parameter, the command displays the value of the integral coefficient used when the system is in transition state.

If a parameter is entered, the value is assigned to the integral coefficient used for transition state.

### 3.17 **kpl**

Proportional coefficient value for steady-state

Syntax:       kpl [value]

Default value: 230

Range:         1-1024

Without any parameter, the command displays the value of the proportional coefficient used when the system is in steady-state.

If a parameter is entered, the value is assigned to the proportional coefficient for steady-state.

### 3.18 **kph**

Proportional coefficient value for transition state

Syntax:       kph [value]

Default value: 920

Range:         1-1024

Without any parameter, the command displays the value of the proportional coefficient used when the system is in transition state.

If a parameter is entered, the value is assigned to the proportional coefficient for transition state.

### 3.19 Ilcac

LLC anti-capacitive detection limit

Syntax: Ilcac [value]

Default value: 24

Range: 1-960

The command sets the value of the delay between the LLC switch on event and the ZCD event to enter the capacitive condition.

If the delay is less than the parameter value, the capacitive condition is entered and the following actions are executed:

- The capacitive condition timer is started (see [Section 3.1 on page 8](#))
- The detection limit is decreased to the minimum while the exit condition is determined by the acpexit parameter (need hysteresis between Ilcac and acpexit parameters, see [Section 3.3 on page 9](#))
- The LLC control loop is opened
- The TimeShift value is decremented at every ADC interrupt cycle (see [Section 3.2 on page 8](#)).

The parameter is expressed in SMED clock cycles at 96 MHz.

### 3.20 Ilcdead

LLC dead time

Syntax: Ilcdead [value]

Default value: 80

Range: 1-255

The command sets the maximum dead time between the high-side switch off and low-side switch on (and vice versa).

This timeout may be interrupted if the automatic dead time function is activated (see [Section 3.4 on page 9](#)).

The parameter is expressed in SMED clock cycles at 96 MHz.

### 3.21 llcs

LLC status display control

Syntax: llcs [on|off]

Default value: on

The command enables/disables the automatic display of every change in the LLC state machine.

If the command is enabled, at every change of the LLC state machine a monitoring message is displayed indicating the new state. The possible LLC states are the following:

- RESET initial state
- IDLE idle state before restarting
- BURST burst mode (minimum load)
- INIT initialization, tank discharge, boot charge
- RAMPUP decrease frequency until stable output
- RUNNING nominal working mode
- SWITCHOFF increase frequency before to switch off LLC
- OCP lavg overcurrent protection
- ACP anti-capacitive protection

### 3.22 llcstart

Syntax: llcstart [volt]

Default value: 380

Range: 3-500

The command sets the minimum PFC output voltage required to start the LLC resonant half bridge. This level is verified to start the LLC after a power up sequence or after a restart of the system (see also [Section 3.23](#)).

The parameter is expressed in volt.

### 3.23 llcstop

Syntax: llcstop [volt]

Default value: 300

Range: 3-500

The command sets the minimum PFC output voltage required to maintain active the LLC resonant half bridge. This level is verified to stop the LLC due to an insufficient supply from PFC (see also [Section 3.22](#)).

The parameter is expressed in volt.



### 3.24 mincurr

Minimum PFC current level

Syntax: mincurr [value]

Default value: 40

Range: 1-255

The command sets the minimum level of the current in the boost inductor before starting the Ton period. This minimum current level is used both to compensate the negative current during the switch on phase and to compensate crossover conduction during the mains zero crossing.

The parameter controls a PWM signal that generates the reference level for the PFC current comparator.

The parameter is expressed in SMED clock cycles at 48 MHz.

### 3.25 nompwr

Nominal power reference for LLC

Syntax: nompwr [value]

Default value: 26000

Range: 1-32000

The command sets the reference value for the LLC output power under which the system reenters the normal operations after an overcurrent protection event.

The parameter is used as a base value to compute at run-time the reference current for the half bridge average current level; the computed value is dynamically updated depending on the value of the PFC output voltage (see also [Section 3.28](#)).

The parameter at this moment does not have a unit measure; future versions of the firmware may support a reference unit (e.g.: output power in Watt).

### 3.26 nshift

Normalization shift count for PFC compensation

Syntax: nsfhift [value]

Default value: 4

Range: 1-15

The compensation algorithm used to control the PFC system generates a control parameter that has a signed 16-bit value to maintain the maximum precision during the computation. This value must be normalized before to apply it to the SMED0 as the Ton parameter, and limited to a maximum value, that determines the maximum PFC switching on time.

The parameter determines the number of right shifts applied to the algorithm result to obtain the Ton value (divisions by powers of 2).

### 3.27 ocpdelay

Maximum duration of overcurrent protection condition

Syntax: ocpdelay [value]

Default value: 100

Range: 10-1000

The command sets the maximum duration of the LLC overcurrent protection condition. When the LLC average current exceeds the overcurrent protection level (see [Section 3.28](#)), the system enters the OCP condition and executes the following actions:

- Set the LLC OCP condition
- Start the timeout control
- Open the LLC control loop
- Decrement the time shift (see parameters [Section 3.29](#) and [Section 3.30](#))

The parameter is expressed in milliseconds.

### 3.28 ocppwr

Overcurrent protection power reference for LLC

Syntax: ocppwr [value]

Default value: 28000

Range: 1-32000

The command sets the reference value for the LLC output power over which the system enters the overcurrent protection state starting the corresponding timeout (see [Section 3.27](#)).

The parameter is used as a base value to compute at run-time the reference current for the half bridge average current level; the computed value is dynamically updated depending on the value of the PFC output voltage (see also [Section 3.25](#)).

The parameter at this moment does not have a unit measure; future versions of the firmware may support a reference unit (e.g.: output power in Watt).

### 3.29 ocpdelta

LLC time shift decrement during OCP

Syntax: ocpdelta

Default value: 1

Range: 1-255

The command sets the decrement value for the time shift parameter during the OCP condition (see also [Section 3.30](#)).

The parameter is expressed in SMED clock cycles at 96 MHz.

### 3.30 **ocptime**

LLC time shift decrement period during OCP

Syntax: `ocptime`

Default value: 2

Range: 1-255

The command sets the decrement period value for the time shift parameter during the OCP condition (see also [Section 3.29](#)).

The parameter is expressed in ADC interrupt cycles.

### 3.31 **ovp**

PFC overvoltage protection

Syntax: `ovp [volt]`

Default value: 430

Range: 3-450

At every ADC interrupt cycle, the system checks that the PFC output voltage is under this reference value. If the limit is exceeded the PFC enters the burst mode switching off the MOS (see also [Section 3.56 on page 26](#)).

The parameter is expressed in volt.

### 3.32 **pfcdelay**

PFC restart time after reset

Syntax: `pfcdelay [value]`

Default value: 1000

Range: 10-15000

Depending on the mains input value and on the output load, the PFC+LLC system may be turned off to avoid critical conditions. In this case, the system tries to restart automatically.

The command sets the timeout period before to retry an automatic restart of the system.

The parameter is expressed in milliseconds.

### 3.33 pfcocp

PFC absolute current limit

Syntax: pfcocp [value]

Default value: 11

Range: 1-15

The command sets the maximum absolute current limit for the PFC boost inductor. If this limit is exceeded the MOS is immediately switched off. This control is always active at every switching cycle.

The parameter is expressed in steps of the DAC used by the current sensing comparator; each step corresponds to about 83 mV on the current sensing resistor.

### 3.34 pfcs

PFC status display control

Syntax: pfcs [on|off]

Default value: on

The command enables/disables the automatic display of every change in the PFC state machine.

If the command is enabled, at every change of the PFC state machine a monitoring message is displayed indicating the new state. The possible PFC states are the following:

- RESET initial state
- VINSTART waiting for  $V_{in} > V_{instart}$
- RAMPUP moving  $V_{ref}$  up to nominal
- RUNNING nominal working mode
- BURST PFC active pulse during burst conditions
- RESTART restart condition after an LLC HB\_ocp2

### 3.35 ratio

Feed-forward reference

Syntax: ratio [value]

Default value: 3300

Range: 100-65535

The command sets the reference value for the computation of the feed-forward compensation to be applied to the proportional and integral coefficients due to variations of the mains level.

The value is strictly connected to internal computation rules used by the PFC compensation algorithm and has no measure unit.

### 3.36 **reset**

Restore parameter values.

Syntax: reset

The command restores the values of all the system parameters copying their values from the EEPROM data to their corresponding RAM locations (see also [Section 2 on page 7](#) and [Section 3.41](#)).

### 3.37 **rudelta**

LLC ramp-up fast mode increment value

Syntax: rudelta [value]

Default value: 4

Range: 1-255

The command sets the increment value of the time shift parameter during the LLC fast ramp-up phase (see also [Section 3.38](#), [Section 3.39](#), and [Section 3.40](#)).

The parameter is expressed in SMED clock cycles at 96 MHz.

### 3.38 **rutfast**

LLC ramp-up fast mode increment period

Syntax: rutfast [value]

Default value: 6

Range: 1-255

The command sets the increment period of the time shift parameter during the LLC fast ramp-up phase (see also [Section 3.37](#), [Section 3.39](#), and [Section 3.40](#)).

The parameter is expressed in ADC interrupt cycles.

### 3.39 **rutmax**

LLC ramp-up maximum time

Syntax: rutmax [value]

Default value: 400

Range: 1-1023

The command sets the maximum value of the time shift parameter during the LLC fast ramp-up phase. When this value is exceeded, the ramp-up automatically switches to the slow phase (see also [Section 3.37](#), [Section 3.38](#), and [Section 3.40](#)).

The parameter is expressed in SMED clock cycles at 96 MHz.

### 3.40 **rutslow**

LLC ramp-up slow mode increment period

Syntax: `rutslow [value]`

Default value: 2

Range: 1-255

The command sets the increment period of the time shift parameter during the LLC slow ramp-up phase (see also [Section 3.37](#), [Section 3.38](#), and [Section 3.39](#)).

The parameter is expressed in ADC interrupt cycles.

### 3.41 **seteedata**

Write parameters in EEPROM data

Syntax: `seteedata`

The command updates the contents of the EEPROM data copying all the parameters from their RAM locations to the corresponding EEPROM data.

The values stored by this command are maintained through hardware resets and power-on resets (see also [Section 2 on page 7](#) and [Section 3.36](#)).

### 3.42 **synch**

Synchronization count for PFC

Syntax: `synch [value]`

Default value: 128

Range: 0-255

The command sets the synchronization point for the ADC interrupt routine. The value indicates the distance (in ADC interrupt cycles) between the mains peak value detected by the synchronization SMED and the real mains zero cross. This is necessary because the detected zero crossing may be misaligned due to distortion of the measured rectified mains voltage.

The parameter is expressed in ADC interrupt cycles.

### 3.43 **tdelmax**

LLC absolute maximum time shift

Syntax: `tdelmax [value]`

Default value: 960

Range: 1-1023

The command sets the absolute maximum value that may be assigned to the time shift parameter of the LLC (see also [Section 3.44](#)). This determines the minimum working frequency of the LLC half bridge.

The parameter is expressed in SMED clock cycles at 96 MHz.

### 3.44 **tdelmin**

LLC absolute minimum time shift

Syntax: `tdelmin [value]`

Default value: 48

Range: 1-1023

The command sets the absolute minimum value that may be assigned to the time shift parameter of the LLC (see also [Section 3.43](#)). This determines the maximum working frequency of the LLC half bridge.

The parameter is expressed in SMED clock cycles at 96 MHz.

### 3.45 **tonblank**

PFC blanking time (LEB)

Syntax: `tonblank [value]`

Default value: 25

Range: 1-10000

The command sets the duration of the LEB time (“Leading Edge Blanking”) after the switch on of the PFC MOS. During this period, the current sensing comparator is disabled.

The parameter is expressed in SMED clock cycles at 96 MHz.

### 3.46 trace

Tracing monitor function

Syntax: trace [name1 [name2 [...]]]

The command is used to configure the monitoring capability of the PFC LLC system. The command selects which parameters to display at every tracing cycle (see [Section 3.47](#)); each parameter is identified by a two-letter name. The command may be repeated with difference parameters adding new elements to the current display list.

The list of selectable parameters and their meaning is the following:

- en enable tracing
- di disable tracing and maintains selected parameters list
- cl disable tracing and clear selected parameters list
- vo PFC output voltage
- vi mains RMS voltage
- co PFC compensation output (Ton value)
- pr proportional compensation
- in integral compensation
- ia integral accumulator
- or PFC output raw voltage
- vc LLC feedback raw voltage (time shift)
- ve PFC compensation error
- vs number of valley skipping inserted
- ac LLC average current

### 3.47 trrate

Tracing rate

Syntax: trrate [value]

Default value: 50

Range: 1-255

The command sets the rate of the tracing function, which is the display frequency of the parameters selected (see [Section 3.46](#)).

The parameter is expressed in multiples of the 10 ms cycles.



### 3.48 **uvp**

PFC undervoltage protection

Syntax: `uvp [volt]`

Default value: 300

Range: 2-380

The command sets the minimum level of the PFC output voltage under which the entire system is turned off to avoid critical conditions (typically temporary overload). The system is automatically restarted after a configurable delay (see [Section 3.32 on page 19](#)).

The parameter is expressed in volt.

### 3.49 **vctrl**

LLC feedback control voltage

Syntax: `vctrl`

The command displays the actual value of the feedback control voltage of the LLC half bridge.

The parameter is expressed in ADC counts.

### 3.50 **vctrloff**

LLC feedback optocoupler offset voltage

Syntax: `vctrloff`

The command sets the actual value of the offset subtracted from the feedback voltage of the LLC read from the optocoupler.

The parameter is expressed in ADC counts.

### 3.51 **vers**

System firmware version identification

Syntax: `vers`

The command displays the version of the system firmware.

### 3.52 **vin**

Mains input voltage

Syntax: `vin`

The command displays the value of the last measured mains peak voltage. The value is updated every half cycle of the mains.

The parameter is expressed in volt RMS.

### 3.53 **vinstart**

Mains brown-in voltage

Syntax: vinstart [volt]

Default value: 90

Range: 3-265

The command sets the value of the minimum mains RMS voltage required to start the PFC LLC system after power-on or restart condition (see also [Section 3.54](#)).

The parameter is expressed in volt RMS.

### 3.54 **vinbout**

Mains brown-out voltage

Syntax: vinbout [volt]

Default value: 80

Range: 3-265

The command sets the value of the minimum mains RMS voltage required to maintain the PFC LLC system active (see also [Section 3.53](#)).

The parameter is expressed in volt RMS.

### 3.55 **vout**

PFC output voltage

Syntax: vout

The command displays the value of the last measured PFC output voltage. The value is updated in a mobile window of 16 samples one out of 16 of the ADC interrupt cycle.

The parameter is expressed in volt.

### 3.56 **vrec**

PFC voltage recovery

Syntax: vrec [volt]

Default value: 390

Range: 2-390

The command sets the level of the PFC output voltage under which the PFC is restarted after burst condition (see also [Section 3.31 on page 19](#)).

The parameter is expressed in volt.

### 3.57 **vref**

PFC output reference voltage

Syntax: vref [volt]

Default value: 400

Range: 3-500

The command sets the nominal reference voltage of the PFC output (see also [Section 3.58](#)).

The parameter is expressed in volt.

### 3.58 **vrramp**

PFC reference voltage increment during startup

Syntax: vramp [value]

Default value: 35

Range: 1-255

The command sets the increment of the reference voltage of the PFC output during the startup phase (soft start).

At PFC startup, the reference voltage is forced at the instantaneous value of the output (rectified mains peak value) and is incremented at every compensation cycle (depending on mains frequency) until it reaches the defined nominal value (see also [Section 3.57](#)).

The parameter is expressed in ADC counts.

### 3.59 **vshyst**

Valley skipping hysteresis

Syntax: vshyst [value]

Default value: 50

Range: 1-255

When the Ton parameter of the PFC decreases under a minimum level (currently 2), due to decreased load conditions, the system inserts a valley skipping after the first ZCD detected.

The command sets the minimum value that the Ton parameter must reach before to exit from the valley skipping insertion, creating an hysteresis between the enter and exit value. The insertion of the valley skipping may be nested up to three levels before to enter the burst condition.

The parameter is expressed in SMED clock cycles at 96 MHz.

### 3.60 **vstep**

Vin steps check enable flag

Syntax: vstep [on/off]

Default value: off

The command enables/disables the checks performed inside the ADC ISR to verify the instantaneous changes of the Vin signal.

### 3.61 **zcddac**

Level of the comparator for PFC ZCD

Syntax: zcddac [value]

Default value: 0

Range: 1-15

The command sets the level of the DAC used as reference value for the PFC ZCD.

The parameter is expressed in steps of the DAC used by the zero cross detection comparator; each step corresponds to about 83 mV on the input voltage.

### 3.62 **zcdel**

PFC zero crossing delay

Syntax: zcdel [value]

Default value: 5

Range: 1-1000

The command sets the delay inserted after the PFC has detected the zero crossing event, before to switch on the MOS for the next cycle.

The parameter is expressed in SMED clock cycles at 96 MHz.

### 3.63 **zcdbeg**

PFC zero crossing detection suppression begin

Syntax: zcdbeg [value]

Default value: 64

Range: 1-255

The command sets the value of the mains phase after which the zero crossing detection may be suppressed if necessary (see [Section 3.64](#) and [Section 3.65](#)).

The mains phase is determined by the number of ADC interrupts inside a single mains cycle; this value is fixed to 256 by the system synchronization independently from the mains frequency. Each ADC interrupt corresponds to 180/256 degrees.

The parameter is expressed in ADC counts.

### 3.64 zcdsend

PFC zero crossing detection suppression end

Syntax: zcdsend [value]

Default value: 160

Range: 1-255

The command sets the value of the mains phase after which the zero crossing detection must be restored after eventual suppression (see [Section 3.63](#) and [Section 3.65](#)).

The mains phase is determined by the number of ADC interrupts inside a single mains cycle; this value is fixed to 256 by the system synchronization independently from the mains frequency. Each ADC interrupt corresponds to 180/256 degrees.

The parameter is expressed in ADC counts.

### 3.65 zcdthrhi

PFC zero crossing detection suppression level high threshold

Syntax: zcdthrhi [value]

Default value: 140

Range: 1-1000

The command sets the minimum value of the difference between the instantaneous levels of PFC output voltage and mains input voltage to enable the ZCD suppression to avoid continuous conduction mode in the PFC boost inductor. The suppression is enabled only if the actual mains phase is inside a configured range (see [Section 3.63](#) and [Section 3.64](#)).

The parameter is expressed in ADC counts.

### 3.66 zcdthrlo

PFC zero crossing detection suppression level low threshold

Syntax: zcdthrlo [value]

Default value: 60

Range: 1-1000

The command sets the minimum value of the difference between the instantaneous levels of PFC output voltage and mains input voltage to double the off time to avoid continuous conduction mode in the PFC boost inductor. The suppression is enabled only if the PFC is already in the ZCD suppression mode (see [Section 3.65](#)).

The parameter is expressed in ADC counts.

### 3.67 **zcdwait**

PFC zero crossing detection timeout

Syntax: `zcdwait [value]`

Default value: 7200

Range: 1-65535

The command sets the maximum waiting time for the PFC zero crossing detection event. If this time is exceeded, a new PFC MOS cycle is started independently from the ZDC.

The parameter is expressed in SMED clock cycles at 96 MHz.

## 4 Revision history

Table 1. Document revision history

Date	Revision	Changes
23-Jun-2015	1	Initial release.

**IMPORTANT NOTICE – PLEASE READ CAREFULLY**

STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2015 STMicroelectronics – All rights reserved