

# Lattice Manual v1.0

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## 1 Setup

Device is pretty easy to make operational since no configuration is needed generally. Only necessary electrical connections should be made. These are;

- 120-240VAC Power connection.
- Trigger connection.
- Ultrasonic transducer connection.

However user can also interact with the device. All the interaction is composed of command-response transactions. Commands should be sent by the user over the serial communication protocol. Simply a hyper-terminal program can be used for this purpose. Serial communication settings should be 9600 8N1. Available commands, their format and functions are given in the following pages. It's also beneficial to express that every command can not be executed in every state. Device state should be convenient to execute a command.

## 2 Device states

Device is one of the following states on it's operation. On start-up; device is put to the Searching mode. After searching is completed, it switches to the Tracking mode automatically. This is also the operational state. If any error occur during the operation; device switches itself to the Error mode. At this point, output power is disabled and error can be determined by sending "gerror" command. After the error has been fixed; device should be reset in order to restart it's operation.

If one require to change the configuration of the device; he should put the device into the config mode. " config " command with password " 111995 " is used for this purpose. After the configuration process is completed; device should be restarted by send "reset" command in order to run it again.

Device modes are as in the following list;

- Config  
Brief: In config modes, device is open for configurations. After the configuration; in order to return to normal operation; reset command should be sent.
- Calibrating  
Brief: In calibrating mode, device is busy measuring the calibration element's impedance for the operation frequency range. Then it calculates it's measurement frequency response and returns to the config mode.
- Searching  
Brief: Device searches for a resonance frequency in this mode. This is the frequency which device gives the lowest resonance measure.
- Tracking  
Brief: Device is operating normally in this mode. And it's tracking both for power and frequency.
- Error  
Brief: Error has occurred and the device had stopped working. Error code should be checked in order to understand error cause. After fixing, device should be reset.

### 3 Commands

Following are the list of available commands.

1. devinf  
Brief: Gets device information.  
Response:  $\langle F|MinOperationFrequency \rangle \langle R|MaxOperationFrequency \rangle \langle P|OutputPowerCapacity \rangle \langle N|VersionMinor \rangle \langle J|VersionMajor \rangle$   
Modes: All.
2. config  $\langle P|Password \rangle$   
Brief: Puts the device into the config mode.  
Response:  $\langle R|OperationResult \rangle$   
Modes: Searching, Tracking
3. defaults  
Brief: Loads default configuration values.  
Response:  $\langle R|OperationResult \rangle$   
Modes: Config
4. reset  
Brief: Resets the device.  
Response: None.  
Modes: All

5. gstatus  
Brief Gets the device status.  
Response:  $\langle S|Status \rangle$   
Modes: All
6. gerror  
Brief: Gets the error code.  
Response:  $\langle E|ErrorCode \rangle$   
Modes: All
7. calibrate  $\langle R|CalibrationResistance \rangle$   
Brief: Starts the calibration procedure.  
Response:  $\langle R|OperationResult \rangle$   
Modes: Config
8. report  
Brief: Reports the monitoring parameters.  
Response:  $\langle S|Status \rangle \langle T|TriggerStatus \rangle \langle F|Frequency \rangle \langle D|Duty \rangle \langle W|PowerReal \rangle$   
 $\langle Q|PowerImaginary \rangle \langle R|ImpedanceReal \rangle \langle I|ImpedanceImaginary \rangle$   
Modes: Tracking
9. calpoly-s  $\langle R|a_0 \rangle \langle E|a_1 \rangle \langle A|a_2 \rangle \langle I|b_0 \rangle \langle M|b_1 \rangle \langle G|b_2 \rangle$   
Brief: Sets calibration polynomial.  
Response:  $\langle R|OperationResult \rangle$   
Modes: Config
10. constr-s  $\langle P|MaximumPower \rangle \langle F|MinFrequency \rangle \langle R|MaxFrequency \rangle$   
Brief: Sets constraints.  
Response:  $\langle R|OperationResult \rangle$   
Modes: Config
11. srcpms-s  $\langle P|NormalizedPower \rangle \langle S|Steps \rangle$   
Brief: Sets search parameters.  
Response:  $\langle R|OperationResult \rangle$   
Modes: Config.
12. errdet-s  $\langle N|MinHornImpedance \rangle \langle X|MaxHornImpedance \rangle \langle P|PowerTrackTolerance \rangle$   
 $\langle F|FreqTrackTolerance \rangle \langle O|MonitoringPeriod \rangle \langle T|Timeout \rangle$   
Brief: Sets error detection parameters.  
Response:  $\langle R|OperationResult \rangle$   
Modes: Config.
13. pwpid-s  $\langle P|Kp \rangle \langle I|Ki \rangle \langle D|Kd \rangle \langle T|PidInputFilterTc \rangle$   
Brief: Sets power tracking PID parameters.  
Response:  $\langle R|OperationResult \rangle$   
Modes: Config.
14. frpid-s  $\langle P|Kp \rangle \langle I|Ki \rangle \langle D|Kd \rangle \langle T|PidInputFilterTc \rangle$   
Brief: Sets frequency tracking PID parameters.

- Response:  $\langle R|OperationResult\rangle$   
Modes: Config.
15. destpow-s  $\langle P|DestinationPower\rangle$   
Brief: Sets destination power.  
Response:  $\langle R|OperationResult\rangle$   
Modes: Config.
16. calpoly-g  
Brief: Gets calibration polynomials.  
Response:  $\langle R|a_0\rangle \langle E|a_1\rangle \langle A|a_2\rangle \langle I|b_0\rangle \langle M|b_1\rangle \langle G|b_2\rangle$   
Modes: All.
17. constr-g  
Brief: Gets device operation constraints.  
Response:  $\langle P|MaximumPower\rangle \langle F|MinFrequency\rangle \langle R|MaxFrequency\rangle$   
Modes: All.
18. srcpms-g  
Brief: Gets searching parameters.  
Response:  $\langle P|NormalizedPower\rangle \langle S|Steps\rangle$   
Modes: All.
19. errdet-g  
Brief: Gets error detection parameters.  
Response:  $\langle N|MinHornImpedance\rangle \langle X|MaxHornImpedance\rangle$   
 $\langle P|PowerTrackTolerance\rangle \langle F|FreqTrackTolerance\rangle \langle O|MonitoringPeriod\rangle$   
 $\langle T|Timeout\rangle$   
Modes: All.
20. pwpid-g  
Brief: Gets power tracking PID parameters.  
Response:  $\langle P|Kp\rangle \langle I|Ki\rangle \langle D|Kd\rangle \langle T|PidInputFilterTc\rangle$   
Modes: All.
21. frpid-g  
Brief: Gets frequency tracking PID parameters.  
Response:  $\langle P|Kp\rangle \langle I|Ki\rangle \langle D|Kd\rangle \langle T|PidInputFilterTc\rangle$   
Modes: All.
22. destpow-g  
Brief: Gets destination power.  
Response:  $\langle P|DestinationPower\rangle$   
Modes: All.

## 4 Parameters

1. VersionMinor  
Brief: Firmware version minor value.  
Values: Integers in  $[0, 4294967296]$ .
2. VersionMajor  
Brief: Firmware version major value.  
Values: Integers in  $[0, 4294967296]$ .
3. Password  
Brief: 32-bit password to enter factory mode.  
Values: Integers in  $[0, 4294967296]$ .
4. OperationResult  
Brief: Operation result.  
Values: Integers in  $[0, 1]$ .
  - 0: Failure
  - 1: Success
5. Status  
Brief: Device status.  
Values: Integers in  $[0, 4]$ .
  - 0: Config
  - 1: Calibrating
  - 2: Searching
  - 3: Tracking
  - 4: Error
6. ErrorCode  
Brief: Error code.  
Values: Integers in  $[0, 3]$ .
  - 0: None.
  - 1: Power tracking failure.
  - 2: Frequency tracking failure.
  - 3: Horn impedance out of window.
7. CalibrationResistance  
Brief: Resistance element which is connected to the output while calibrating.  
Values: Positive real numbers.
8. NormalizedPower  
Brief: Power given in units of maximum power device can deliver.  
Values: Real in  $[0, 1]$ .

9. Steps  
Brief: Controls searching resolution. Increasing the steps will increase resonance maxima finding time.  
Values: Integers in  $[0, 8192]$ .
10. TriggerStatus  
Brief: Output power trigger status.  
Values: Integers in  $[0, 1]$ .
  - 0: Not triggered
  - 1: Triggered
11. MinHornImpedance  
Brief: Minimum acceptable horn impedance.  
Values: Real in  $[0, \text{MaxHornImpedance}]$ .
12. MaxHornImpedance  
Brief: Maximum acceptable horn impedance.  
Values: Real in  $[\text{MinHornImpedance}, \text{inf}]$ .
13. PowerTrackTolerance  
Brief: Maximum acceptable output power error.  
Values: Positive real numbers.
14. FrequencyTrackTolerance  
Brief: Maximum acceptable tracking measure error.  
Values: Positive real numbers.
15. MonitoringPeriod  
Brief: Error detection check interval.  
Values: Real numbers in  $[0.1, \text{inf}]$ .
16. Timeout  
Brief: Error detection time window. In order to error to be detectable; it should be persistent for at least timeout value.  
Values: Real numbers in  $[0.1, \text{inf}]$ .
17. Frequency  
Brief: Output drive frequency.  
Values: Real numbers in  $[\text{MinFrequency}, \text{MaxFrequency}]$ .
18. Duty  
Brief: Output drive duty.  
Values: Real numbers in  $[0, 1]$ .
19. PowerReal  
Brief: Output power real component.  
Values: Real numbers.

20. PowerImaginary  
Brief: Output power imaginary component.  
Values: Real numbers.
21. ImpedanceReal  
Brief: Horn impedance real component.  
Values: Real numbers.
22. ImpedanceImaginary  
Brief: Horn impedance imaginary component.  
Values: Real numbers.
23. Kp  
Brief: PID controller proportionality coefficient.  
Values: Positive Real numbers.
24. Ki  
Brief: PID controller integral coefficient.  
Values: Positive real numbers.
25. Kd  
Brief: PID controller derivative coefficient.  
Values: Positive real numbers.
26. PidInputFilterTc  
Brief: PID controller first order input filter time constant in seconds.  
Values: Positive real numbers.
27.  $a_0, a_1, a_2$   
Brief: Calibration polynomial real part coefficients. Polynomial is in the form  $P_r(f) = a_2(f/1e4)^2 + a_1(f/1e4)^1 + a_0$   
Values: Real numbers.
28.  $b_0, b_1, b_2$   
Brief: Calibration polynomial imaginary part coefficients. Polynomial is in the form  $P_i(f) = b_2(f/1e4)^2 + b_1(f/1e4)^1 + b_0$   
Values: Real numbers.
29. MaximumPower  
Brief: Maximum power that can be delivered to horn.  
Values: Positive real numbers.
30. DestinationPower  
Brief: Power tracking reference value.  
Values: Real numbers in  $[0, MaximumPower]$ .
31. MinFrequency  
Brief: Minimum operation frequency.  
Values: Real numbers in  $[0, MaxFrequency]$ .

32. MaxFrequency

Brief: Maximum operation frequency.

Values: Real numbers in  $(MinFrequency, \inf]$ .