TABOR ELECTRONICS

LUCID SERIES

Lucid Series RF Analog Signal Generator

Desktop Model

User Manual

Rev. 1.3

Distribution in the UK & Ireland

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Table Document Revision History

Revision	Date	Description	Author
1.3	04-May-2021	• Release supporting Lucid SW Ver. 1.8.15, FPGA Ver. 18111215 for HW Ver. D, 221220 for HW Ver. E and Ver. 221220 for HW Ver. F, and SPI & SCPI Commands List Summary Rev. 1.17. • 1.2 Software Support, page 14 – New. • Removed sections "Lucid Software Requirements", "Installation, "PC Control Software", 'Troubleshooting", and "FPGA Firmware Update" that are included in the new "Lucid Control Panel User Manual". • Removed section SCPI Programming that is included in the new "Lucid Programming Manual". • Table 3.3 Set Frequency, page 20 – Changed Min Value from 100 kHz to 9 kHz. • Table 3.64 Set Sweep Start Frequency, page 40 – Changed Min Value from 100 kHz to 9 kHz. • Table 3.66 Set Sweep Stop Frequency, page 41 – Changed Min Value from 100 kHz to 9 kHz. • Table 3.5 Set Output Power, page 21 – Changed Min Value and Max Value from "-90 to +15" to "-100 dBm to +20dBm". • Table 3.76 Set Sweep Start Power, page 44 – Changed Min Value and Max Value from "-90 to +15" to "-100 dBm to +20dBm". • Table 3.9 Set Run Mode, page 23 – Changed values, and added Gate (set and query). • Table 3.11 Set Trigger Source, page 23 – New value SPI (set and query). • Table 3.21 Set Trigger Timer, page 26 – Changed Min Value from 100 µs to 1 µs. • Table 3.99 Query Firmware, page 54 – Changed Query Code from CB to EC. • Table 5.4 Modulation Specification, page 66 – Changed Sweep Dwell Time from "10 µs to 1,000 s" to "100 µs to 1,000 s".	Jakob Apelblat
1.2	6-Aug-2020	• Minor typos. • 5 Lucid Desktop Specifications, page 65 – Updated.	Jakob Apelblat

Revision	Date	Description	Author
1.1	23-Jun-2020	• Supporting Lucid. 1.2.x SW version. • Updated formatting, corrected typos, etc. • Figure 2.3 Rear Panel, page 18 – New photo. • Figure 2.2 Front Panel, page 18 – New photo. • 2.3 Rear Panel Connectors, page 18 – EXT IO removed, SYNC OUT changed to SYNC IN. • Figure 3.4 CW & Modulation Tab, page 28– The status bar has a thermometer. • 3 SPI Programming, page 19 – Updated according to SPI & SCPI Commands List Summary Rev. 1.14 • 4 SPI Programming, page 46 – Updated according to SPI & SCPI Commands List Summary Rev. 1.14 • 4.1.2 USB Device Driver Manual Installation (Windows 7), page 61 – Updated step 10.	Jakob Apelblat
1.0	26-Feb-2020	• First edition supporting Lucid 1.1.0 SW version.	Jonathan Netzer

Acronyms & Abbreviations

Table Acronyms & Abbreviations

Acronym	Description
µs or us	Microseconds
ADC	Analog to Digital Converter
AM	Amplitude Modulation
ASIC	Application-Specific Integrated Circuit
ATE	Automatic Test Equipment
AWG	Arbitrary Waveform Generators
AWT	Arbitrary Waveform Transceiver
BNC	Bayonet Neill–Concelm (coax connector)
BW	Bandwidth
CW	Carrier Wave
DAC	Digital to Analog Converter
dBc	dB/carrier. The power ratio of a signal to a carrier signal, expressed in decibels
dBm	Decibel-Milliwatts. E.g., 0 dBm equals 1.0 mW.
DDC	Digital Down-Converter
DHCP	Dynamic Host Configuration Protocol
DSO	Digital Storage Oscilloscope
DUC	Digital Up-Converter

Acronym	Description
ENoB	Effective Number of Bits
ESD	Electrostatic Discharge
EVM	Error Vector Magnitude
FPGA	Field-Programmable Gate Arrays
GHz	Gigahertz
GPIB	General Purpose Interface Bus
GS/s	Giga Samples per Second
GUI	Graphical User Interface
HP	Horizontal Pitch (PXIe module horizontal width, 1 HP = 5.08mm)
Hz	Hertz
IF	Intermediate Frequency
I/O	Input / Output
IP	Internet Protocol
IQ	In-phase Quadrature
IVI	Interchangeable Virtual Instrument
JSON	JavaScript Object Notation
kHz	Kilohertz
LCD	Liquid Crystal Display
LO	Local Oscillator
MAC	Media Access Control (address)
MDR	Mini D Ribbon (connector)
MHz	Megahertz
ms	Milliseconds
NCO	Numerically Controlled Oscillator
ns	Nanoseconds
PC	Personal Computer
PCAP	Projected Capacitive Touch Panel
PCB	Printed Circuit Board
PCI	Peripheral Component Interconnect
PXI	PCI eXtension for Instrumentation
PXIe	PCI Express eXtension for Instrumentation
QC	Quantum Computing
Qubits	Quantum bits

Acronym	Description
R&D	Research & Development
RF	Radio Frequency
RT-DSO	Real-Time Digital Oscilloscope
s	Seconds
SA	Spectrum Analyzer
SCPI	Standard Commands for Programmable Instruments
SFDR	Spurious Free Dynamic Range
SFP	Software Front Panel
SMA	Subminiature version A connector
SMP	Subminiature Push-on connector
SPI	Serial Peripheral Interface
SRAM	Static Random-Access Memory
TFT	Thin Film Transistor
T&M	Test and Measurement
TPS	Test Program Sets
UART	Universal Asynchronous Receiver-Transmitter
USB	Universal Serial Bus
VCP	Virtual COM Port
Vdc	Volts, Direct Current
V p-p	Volts, Peak-to-Peak
VSA	Vector Signal Analyzer
VSG	Vector Signal Generator
WDS	Wave Design Studio

1 General

1.1 Scope

The scope of this manual is to describe the setup and operating procedures of the Lucid Series RF Analog Signal Generator. This covers the following models listed in the ordering information.

Table 1.1 Ordering Information

Model	Description
LS3081D	3 GHz RF Analog Signal Generator Desktop Module
LS6081D	6 GHz RF Analog Signal Generator Desktop Module
LS1291D	12 GHz RF Analog Signal Generator Desktop Module
Options	
PLS	Pulse Modulation
PAT	Pattern Modulation
LP	Low Power to -90 dBm
FS	Fast Switching 100 µs
EMU	Emulator for Keysight, R&S, Anapico & Holzworth

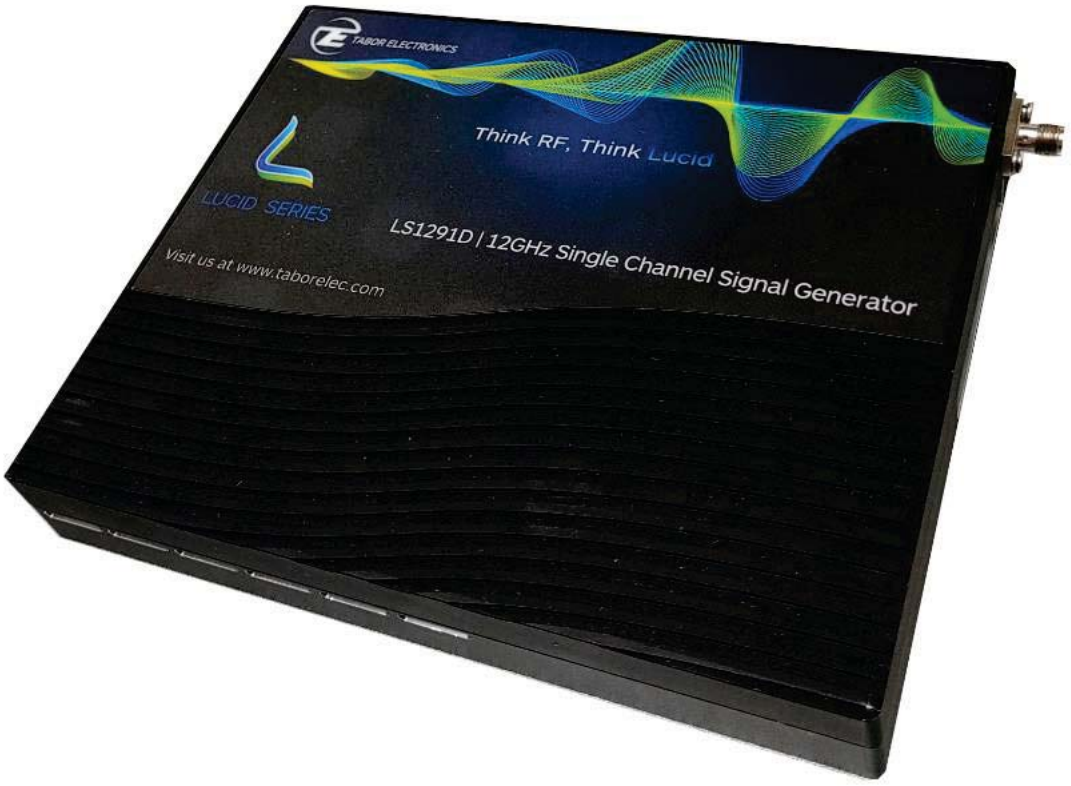


Figure 1.1 LS1291D – 12GHz RF Analog Signal Generator Desktop Module

1.2 Software Support

The **Lucid Control Panel** is a software package that comes on a CD supplied with the device. It enables full control and programming of your Tabor Electronics Lucid series RF analog signal generators via a user-friendly graphical user interface. The **TE Update Tool** is a utility for updating the Lucid device FPGA. The **Lucid Programming Manual** lists and describes the set of SCPI-compatible (Standard Commands for Programmable Instruments) remote commands used to operate the Lucid devices.

The programs and the user manuals can be downloaded from the Tabor Electronics website at http://www.taborelec.com/downloads.

1.3 Document Conventions

Convention	Description	Example
Bold Writing	Indicates an item/message in the User Interface.	Click the **On** button.
<Angled and Bolded Brackets>	Indicates a physical key on the keyboard.	Press <Ctrl>+<B>.

Caution!

- A Caution indicates instructions, which, if not followed, may result in damage to the equipment or to the loss of data.

Note

- A Note provides additional information to help obtain optimal equipment performance.

Idea

- An Idea provides an alternate procedure to obtain the same results.

1.4 Safety

To avoid Electrical Shock, fire or personal injury:

- Use only the proper power cord specified for this manual and certified for the country of use.
- This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, the grounding conductor must be connected to the ground. Before connecting to the power input or output, ensure that the product is properly grounded.
- Do not operate this product with removed covers or panels.

- Observe all the ratings and markings on the product. Search this manual for further rating information, before connecting to it. Do not apply potential that is higher than the maximum rating.
- Do not operate in dark or wet conditions.
- Do not operate in an explosive environment. Keep product clean and dry.

1.5 Maintenance

1.5.1 Preventive Maintenance

There are no hardware adjustments within Lucid Generators. Tabor Electronics Ltd., recommends that the Lucid Generator is calibrated every 12 months or whenever a problem is suspected. The specific calibration interval depends upon the accuracy required. No periodic preventive maintenance is required.

1.5.2 Long Term Storage or Repackaging For Shipment

If the instrument is to be stored for a long period of time or shipped immediately, proceed as directed below. If you have any questions, contact your local Tabor Electronics representative or the Tabor Electronics Customer Service Department.

1. Repack the instrument using the wrappings, packing material and accessories originally shipped with the unit. If the original container is not available, purchase replacement materials.
2. Be sure the carton is well sealed with strong tape or metal straps.
3. Mark the carton with the model and serial number. If it is to be shipped, show sending and return address on two sides of the box.

   If the instrument is to be shipped for service or repair, the following information must be included with the shipment:

   - Name and address of the owner.
   - Record the model and serial number of the instrument, options, and firmware version.
   - Note the problem and symptoms – detailed information will help in verifying the problem
     - What was the instrument setup?
     - Did the unit work; then fail?
     - What other equipment was connected to the generator when the problem occurred?

- The name and telephone number of someone familiar with the problem who can be contacted by Tabor Electronics if any further information is required.
- Show the returned authorization order number (RMA) as well as the date and method of shipment.

> **Note**
>
> Always obtain a return authorization number from the factory before shipping the instrument to Tabor Electronics.

2 Introduction

The Lucid series desktop models feature 3, 6 and 12 GHz single channel generator versions, all sharing the very same industry leading highlighted features, in a compact, small footprint module. Featuring extremely fast switching speed, superior signal integrity and purity, all the necessary modulated signals for analog communication systems, with built in SPI and micro-USB interface. The Lucid Series is designed to meet today's most demanding requirements that is needed from the R&D benches to the production lines.

2.1 Unpacking

Check that the packaging is undamaged. If packaging is damaged, notify the carrier immediately.

The Lucid desktop model instrument is supplied with:

- 12V power supply
- Power cord with a plug according to customer country standard
- USB to Micro USB cable for connecting a control PC to the instrument
- CD with Lucid software, user manual and instrument drivers

Caution!

The Lucid Series RF Signal Generator ships in an antistatic package to prevent damage from electrostatic discharge (ESD). When storing the unit, use the antistatic case.

Figure 2.1 Package and Contents of Lucid Desktop Model

2.2 Front Panel Connector

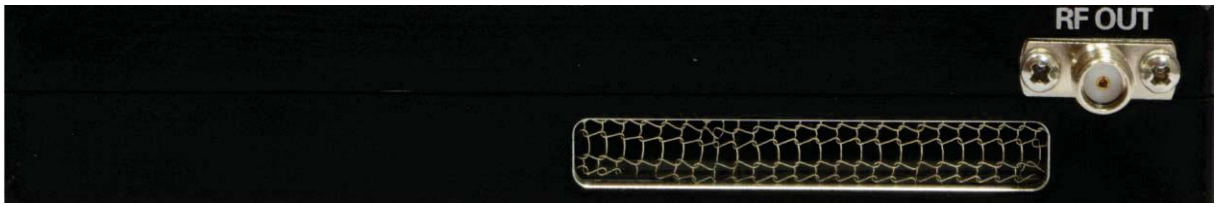


Figure 2.2 Front Panel

- RF OUT - SMA type connector for RF signal output

2.3 Rear Panel Connectors

Figure 2.3 Rear Panel

- PULSE/TRIG IN - an MMCX type connector for external pulse modulation or for external trigger
- AM IN – MMCX type connector for external amplitude modulation
- FM IN – MMCX type connector for external frequency modulation
- SYNC IN – MMCX type connector for Tabor Electronics factory use only
- Micro-USB – USB Interface for remote connection to PC
- SPI connector – SPI interface for remote connection to PC
- 10/100MHz IN – SMA type connector for external 10 MHz or 100 MHz signal.
- 10 MHz OUT – SMA type connector for 10MHz signal output
- 100 MHz OUT – SMA type connector for 100MHz signal output
- Power – 12V Power supply connector

Note

For a detailed description of the SPI connector please refer to 6 Appendix A. SPI Interface, page 70.

Note

The Lucid generator will automatically revert to external reference when a signal is detected at its input.

3 SPI Programming

Use the following instructions to control the device from your own PC application using the device's SPI interface.

Notes

- The set and query code values are in hexadecimal notation.
- Refer to the Lucid Programming Manual for a description of the SCPI software interface.

3.1 SPI Programming Example

The following example explains how to set the basic frequency of the generator to 1000.123456789 MHz, see Table 3.3 Set Frequency, page 20 for a description of the command.

1. The command is 7 bytes long, so start with 0x00 00 00 00 00 00 00 using hexadecimal notation.
2. The set code is 0x01, so the command value becomes 0x01 00 00 00 00 00 00.
3. Set the frequency to 1000.123456789 MHz, which is E8DC00DD15, so the command value becomes 0x01 00 E8 DC 00 DD 15.
4. Write the value 0x01 00 E8 DC 00 DD 15 to the SPI bus.

Idea

- Use the MS Windows' Calculator in Programmer view to convert from decimal to hexadecimal values.

3.2 CW Mode Commands

3.2.1 RF Output

Sets the RF output On or Off.

Table 3.1 Set RF Output

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set RF Output	2	1	15:8	04	1	7:0	0 – Off, default 1 – On

Default: .....Off

Table 3.2 Query RF Output

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query RF Output	2	1	15:8	84	1	7:0	1	1	7:1	Don't Care
									0	0 – Off, default 1 – On

3.2.2 Frequency

Sets the basic frequency of the generator.

Table 3.3 Set Frequency

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Frequency	7	1	55:48	01	6	47:0	Units of 1 mHz

Resolution: .....1 mHz
Min Value: .....9 kHz
Max Value: .....12 GHz
Default: .....1 GHz

Table 3.4 Query Frequency

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Frequency	7	1	55:48	81	6	47:0	7	1	55:48	Don't Care
								6	47:0	Units of 1 mHz

3.2.3 Power

Sets the power (intensity) of the generator's output signal (in dBm).

Table 3.5 Set Output Power

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set output power	3	1	23:16	03	2	15:0	Power in units of 0.01 dBm

Resolution: .....Units of 0.01 dBm

Min Value:..... -100 dBm

Max Value: ..... +20 dBm

Default: ..... 5 dBm

Table 3.6 Query Output Power

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query output power	3	1	23:16	83	2	15:0	2	1	23:16	Don't Care
								2	15:0	Power in units of 0.01 dBm

3.2.4 Phase

Sets the phase offset of the signal. Phase Offset range is between **0 degrees** to **360 degrees**.

Table 3.7 Set Phase

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Phase in Degrees	3	1	23:16	02	2	15:0	Phase in units of 0.01 Degrees

Resolution: .....0.01 Degrees
Min Value:.....0 Degrees
Max Value: .....360 Degrees
Default: .....0 Degrees

Table 3.8 Query Phase

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Phase in Degrees	3	1	23:16	82	2	15:0	2	1	23:16	Don't Care
								2	15:0	Phase in units of 0.01 Degrees

3.3 Run Mode Commands

For software interface, see Lucid Control Panel User Manual.

3.3.1 Run Mode

Sets the Run Mode to Continuous or Trigger.

Table 3.9 Set Run Mode

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Run Mode	2	1	15:8	22	1	7:0	0 – Trigger 1 – Continuous 2 – Gate

Default: .....Continuous

Table 3.10 Query Run Mode

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Run Mode	2	1	15:8	A2	1	7:2	1	1	7:1	Don't Care
0										0 – Trigger 1 – Continuous 2 – Gate

3.3.2 Trigger Source

Sets the Trigger Source to External, Bus, or Timer.

Table 3.11 Set Trigger Source

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Trigger Source	2	1	15:8	23	1	7:0	0 – External 1 – Bus 2 – Timer 3 – SPI

Default: .....External

Table 3.12 Query Trigger Source

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Trigger Source	2	1	15:8	A3	1	7:0	1	1	7:2	Don't Care
									1:0	0 – External 1 – Bus 2 – Timer 3 – SPI

3.3.3 Trigger Edge

Sets whether a trigger is valid on the rising edge or falling edge

Table 3.13 Set Trigger Edge

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Trigger Edge	2	1	15:8	20	1	7:0	0 – Positive 1 – Negative

Default: .....Positive

Table 3.14 Query Trigger Edge

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Trigger Edge	2	1	15:8	A0	1	7:0	1	1	7:2	Don't Care
									1:0	0 – Positive 1 – Negative

3.3.4 Trigger Advance

Sets trigger advance mode to Once or Step

Table 3.15 Set Trigger Advance

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Trigger Advance	2	1	15:8	21	1	7:0	0 – Once 1 – Step

Default: .....Once

Table 3.16 Query Trigger Advance

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Trigger Advance	2	1	15:8	A1	1	7:0	1	1	7:1	Don't Care
									0	0 – Once 1 – Step

3.3.5 Trigger Count

Sets the number of triggers to generate.

Table 3.17 Set Number of Triggers

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Number of Triggers	4	1	31:24	24	3	23:0	Number of repeats.

Resolution: 1

Min Value:.....1

Max Value: .....2^24-1

Default: 1

Table 3.18 Query Number of Triggers

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Number of Triggers	4	1	31:24	A4	3	23:0	3	3	23:0	Number of repeats.

3.3.6 Trigger Delay

Sets a delay in units of time between the receiving of the trigger signal and the generation of the output signal.

Table 3.19 Set Trigger Delay

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Trigger Delay	6	1	47:40	31	5	39:0	Time in units of 6.4 ns

Resolution: .....1 (unit of 6.4 ns)

Min Value:.....0

Max Value: .....2^40-1 (7036 s)

Default: 0

Table 3.20 Query Trigger Delay

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Trigger Delay	6	1	47:40	B1	5	39:0	3	5	39:0	Time in units of 6.4 ns

3.3.7 Trigger Timer

Sets the timer to generate the triggers.

Table 3.21 Set Trigger Timer

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Trigger Timer	6	1	47:40	25	5	39:0	Time in units of 6.4 ns

Resolution: .....1 (unit of 6.4 ns)

Min Value:.....156 (1 µs)

Max Value: .....2^40-1 (7036 s)

Default: .....156,250 (1 ms)

Table 3.22 Query Trigger Timer

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Trigger Timer	6	1	47:40	A5	5	39:0	5	5	39:0	Time in units of 6.4 ns

3.3.8 Trigger

Sets off a Trigger.

For use when the Trigger source is the computer (Bus).

Table 3.23 Set Trigger Function

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Trigger Function	2	1	15:8	26	1	7:0	Don't Care

3.4 Modulations Mode Commands

For software interface, see Lucid Control Panel User Manual.

3.4.1 Amplitude Modulation

Sets AM modulation On/Off.

Table 3.24 Set AM Modulation

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set AM Mod. On/Off	2	1	15:8	0D	1	7:0	0 – Off 1 – On

Default: .....Off

Table 3.25 Query AM Modulation State

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query AM Mod. State	2	1	15:8	8D	1	7:0	1	1	7:1	Don't Care
									0	0 – Off 1 – On

3.4.2 Amplitude Modulation Source

Sets the source of the AM signal.

Table 3.26 Set Amplitude Modulation Source

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set AM. Mod. Source	2	1	15:8	0E	1	7:0	0 – Internal 1 – External

Default: .....Internal

Table 3.27 Query Amplitude Modulation Source

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query AM. Mod. Source	2	1	15:8	8E	1	7:0	1	1	7:1	Don't Care
									0	0 – Internal 1 – External

3.4.3 Amplitude Modulation Frequency

Sets the AM modulation frequency.

Table 3.28 Set Modulation Frequency

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Mod. Frequency	4	1	31:24	0F	3	23:0	Units of 1 Hz

Resolution: .....1 Hz

Min Value:.....0 Hz

Max Value: .....100 kHz

Default: .....10 kHz

Table 3.29 Query Modulation Frequency

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Mod. Frequency	4	1	31:24	8F	3	23:0	3	3	23:0	Units of 1 Hz

3.4.4 Amplitude Modulation Depth

Sets the AM Modulation depth in percent.

Table 3.30 Set AM Depth

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set AM Depth	3	1	23:16	10	2	15:0	Units of 0.1%

Resolution: 0.1%
Min Value:.....0 (0%)
Max Value: 1000 (100%)
Default: 500 (50%)

Table 3.31 Query AM Depth

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query AM Depth	3	1	23:16	90	2	31:0	2	2	15:0	Units of 0.1%

3.4.5 Frequency Modulation

Sets the FM modulation On/Off.

Table 3.32 Set FM Modulation

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set FM Mod. On/Off	2	1	15:8	09	1	7:1	Don't care
						0	0 – Off 1 – On

Default: .....Off

Table 3.33 Query FM Modulation State

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query FM Mod. State	2	1	15:8	89	1	7:0	1	1	7:1	Don't Care
									0	0 – Off 1 – On

3.4.6 Frequency Modulation Source

Sets the FM source Internal or External.

Table 3.34 Set FM Modulation Source

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set FM Mod. Source	2	1	15:8	0A	1	7:1	Don't Care
						0	0 – Internal 1 – External

Default: .....Internal

Table 3.35 Query FM Modulation Source

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query FM Mod. Source	2	1	15:8	8A	1	7:0	1	1	7:1	Don't Care
									0	0 – Internal 1 – External

3.4.7 Frequency Modulation Frequency

Sets the FM frequency.

Table 3.36 Set Modulation Frequency

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Mod. Frequency	4	1	31:24	0B	3	23:0	Units of 1 Hz

Resolution: .....1 Hz
Min Value:.....1 Hz
Max Value: .....1 MHz
Default: .....100 kHz

Table 3.37 Query Modulation Frequency

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Mod. Frequency	4	1	31:24	8B	3	23:0	3	3	23:0	Units of 1 Hz

3.4.8 Frequency Modulation Deviation

Sets the FM deviation.

Table 3.38 Set FM Deviation

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set FM Deviation	5	1	39:32	0C	4	31:24	Don't care
						23:0	Units of 1 Hz

Resolution: .....1 Hz

Min Value: .....1 Hz

Default: .....1 MHz

Max Value: .....5 MHz

Table 3.39 Query FM Deviation

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query FM Deviation	5	1	39:32	8C	1	31:24	4	1	31:24	Don't care
								3	23:0	Units of 1 Hz

3.4.9 Phase Modulation

Sets the Phase modulation On/Off.

Table 3.40 Set Phase Modulation

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Phase Mod.	2	1	15:8	5F	1	7:1	Don't care
						0	0 – Off 1 – On

Default: .....Off

Table 3.41 Query Phase Modulation

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Phase Mod.	2	1	15:8	DF	1	7:0	1	1	7:1	Don't Care
									0	0 – Off 1 – On

3.4.10 Phase Modulation Frequency

Sets the Phase Modulation frequency.

Table 3.42 Set Phase Modulation Frequency

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Phase Mod. Freq.	4	1	31:24	5E	3	23:0	Units of 1 Hz

Resolution: .....1 Hz

Min Value:.....1 Hz

Max Value: .....1 MHz

Default: .....100 kHz

Table 3.43 Query Phase Modulation Frequency

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Phase Mod. Freq.	4	1	31:24	DE	3	23:0	3	3	23:0	Units of 1 Hz

3.4.11 Phase modulation Deviation

Sets the Phase modulation deviation.

Table 3.44 Set Phase Modulation Deviation

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Phase Mod. Dev.	3	1	23:16	5D	2	15:0	Units of 0.01 degrees

Resolution: .....0.01 Degrees
Min Value:.....0 Degrees
Default: .....0 Degrees
Max Value: .....360 Degrees

Table 3.45 Query Phase Modulation Deviation

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Phase Mod. Dev.	3	1	23:16	DD	2	31:0	2	2	15:0	Units of 0.01 degrees

3.4.12 Pulse Modulation

Sets the Pulse Modulation On or Off.

Table 3.46 Set Pulse Modulation

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Pulse Modulation On/Off	2	1	15:8	05	1	7:0	0 – Off 1 – On

Default: .....Off

Table 3.47 Query Pulse Modulation Status

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Pulse Modulation Status	2	1	15:8	85	1	7:0	1	1	7:1	Don't Care
									0	0 – Off 1 – On

3.4.13 Pulse Modulation Source

Sets the Pulse Modulation source to Internal or External.

Table 3.48 Set Pulse Modulation Source

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Pulse Modulation Source	2	1	15:8	06	1	7:0	0 – Internal 1 – External

Default: .....Internal

Table 3.49 Query Pulse Modulation Source

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Pulse Modulation Source	2	1	15:8	86	1	7:0	1	1	7:1	Don't Care
									0	0 – Internal 1 – External

3.4.14 Pulse Modulation Frequency

Sets the Pulse repetition frequency.

Table 3.50 Set Pulse Modulation Frequency

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Pulse Mod. Freq.	4	1	31:24	07	3	23:0	Units of 1 Hz

Resolution: .....Units of 1 Hz

Min Value:.....1 Hz

Max Value: .....10 MHz

Default: .....1 MHz

Table 3.51 Query Pulse Modulation Frequency

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Pulse Mod. Freq.	4	1	31:24	87	3	23:0	3	3	23:0	Units of 1 Hz

3.4.15 Pulse Modulation Width

Sets the width of the pulse.

Table 3.52 Set Pulse Modulation Width

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Pulse Mod. Width	5	1	39:32	08	4	31:0	Units of 6.4 ns

Resolution: .....Units of 6.4 ns
Min Value:.....5 (32 ns)
Max Value: .....2^24-1 (0.107 s)
Default: .....50 (320 ns)

Table 3.53 Query Pulse Modulation Width

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Pulse Mod. Width	5	1	39:32	88	4	31:0	4	4	31:0	Units of 6.4 ns

3.4.16 Pulse Pattern

Sets the pulse pattern state On or Off.

Table 3.54 Set Pattern Modulation

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Pattern Modulation	2	1	15:8	59	1	7:0	0 – Off 1 – On

Default: .....Off

Table 3.55 Query Pattern Modulation Status

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Pattern modulation status	2	1	15:8	D9	1	7:0	1	1	7:1	Don't Care
									0	0 – Off 1 – On

3.4.17 Pulse Pattern Repetitions

Sets the number of repetitions of current step. When set to 0 enables editing of a previously defined step.

Table 3.56 Set Number of Repetitions for Pattern Step

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Number of Repetitions for Pattern Step	3	1	23:16	5A	2	15:0	Repetitions count

Resolution: 1

Min Value (edit step):0

Min Value:.....1 repetition

Max Value: .....65535 repetitions

Default: 1

Table 3.57 Query Number of Repetitions for Pattern Step

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Number of Repetitions for Pattern Step	3	1	23:16	DA	2	15:0	2	2	15:0	Repetitions count

3.4.18 Pulse Pattern On Time

Sets the On Time of the current pulse step. To edit a previously defined step, set pulse repetitions and pulse off time to 0, then with the pulse On Time command send the value of the step to edit. The maximum number of steps is 2048.

Table 3.58 Set Pulse On Time/ Set Pattern Step to Edit

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Pulse On Time/ Set Pattern Step to Edit	7	1	55:48	5B	6	47:0	Units of 6.4 ns

Resolution: .....Units of 6.4 ns

Min Value (step#):.....1

Max Value (step#): ... 2048

Min Value (On Time): 5 (32 ns)

Max Value(On Time): 2^48-1 (20 days)

Default: .....78,125 (320 ns)

Table 3.59 Query Pulse On Time

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Pulse On Time	7	1	55:48	D7	3	47:0	6	6	47:0	Units of 6.4 ns

3.4.19 Pulse Pattern Off Time

Sets the Off Time of the current pulse step. When set to 0 enables edition of previously defined step

Table 3.60 Set Pulse Off Time

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Pulse Off Time	7	1	55:48	5C	6	47:0	Units of 6.4 ns

Resolution: .....Units of 6.4 ns

Min Value (edit step):0

Min Value:.....5 (32 ns)

Max Value: .....2^48-1 (20 days)

Default: .....78,125 (320 ns)

Table 3.61 Query Pulse Off Time

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Pulse Off Time	7	1	55:48	D8	6	47:0	6	6	47:0	Units of 6.4 ns

3.5 Sweep Mode Commands

For software interface, see Lucid Control Panel User Manual.

3.5.1 Frequency Sweep

Table 3.62 Set Frequency Sweep

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Frequency Sweep	2	1	15:8	11	1	7:0	Don't Care.
						0	0 – Off 1 – On

Default: .....Off

Table 3.63 Query Frequency Sweep

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Frequency Sweep	2	1	15:8	91	1	7:0	1	1	7:1	Don't Care
									0	0 – Off 1 – On

3.5.2 Frequency Sweep Start

Sets the start frequency of the sweep.

Table 3.64 Set Sweep Start Frequency

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Sweep Start Freq.	7	1	55:48	12	6	47:0	Units of 1 mHz

Resolution: .....1 mHz
Min Value: .....9 kHz
Max Value: .....12 GHz
Default: .....1 GHz

Table 3.65 Query Sweep Start Frequency

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Sweep Start Freq.	7	1	55:48	92	6	47:0	6	6	47:0	Units of 1 mHz

3.5.3 Frequency Sweep Stop

Sets the stop frequency of the sweep.

Table 3.66 Set Sweep Stop Frequency

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Sweep Stop Freq.	7	1	55:48	13	6	47:0	Units of 1 mHz

Resolution: .....1 mHz

Min Value:.....9 kHz

Max Value: .....12 GHz

Default: .....2 GHz

Table 3.67 Query Sweep Stop Frequency

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Sweep Stop Freq.	7	1	55:48	93	6	47:0	7	6	47:0	Units of 1 mHz

3.5.4 Frequency Sweep Steps

Sets the number of steps in the sweep.

Table 3.68 Set Number of Steps

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set number of steps	3	1	23:16	14	2	15:0	Number of Steps

Resolution: .....1 Step

Min Value:.....2 Steps

Max Value: .....65535 Steps

Default: .....1000 Steps

Table 3.69 Query Number of Steps

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query number of steps	3	1	23:16	94	2	15:0	7	2	15:0	Units of 1 steps

3.5.5 Frequency Sweep Step Time

Sets the duration (dwell) of the step in 6.4 ns units.

Table 3.70 Set Frequency Sweep Step Time

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Freq. Sweep Step Time.	6	1	47:40	15	5	39:0	Time in units of 6.4 ns

Resolution: .....6.4 ns

Min Value:.....15,625 (100 µs)

Max Value: .....2^40-1 (7036 s)

Default: .....156,250 (1 ms)

Table 3.71 Query Frequency Sweep Step Time

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Freq. Sweep Step Time.	6	1	47:40	95	6	39:0	5	5	39:0	Time in units of 6.4 ns

3.5.6 Frequency Sweep Direction

Table 3.72 Set Sweep Direction

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Sweep Direction	2	1	15:8	16	1	7:1	Don't Care
						0	0 – Normal (goes from start to stop) 1 – UpDown (goes from start to stop and back to start)

Default: .....Normal

Table 3.73 Query Sweep Direction

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Sweep Direction	2	1	15:8	96	1	7:0	1	1	7:1	Don't Care
									0	0 – Normal 1 – UpDown

3.5.7 Power Sweep

Turns Power Sweep On or Off.

Table 3.74 Set Power Sweep

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Power Sweep	2	1	15:8	17	1	7:1	Don't Care
						0	0 – Off 1 – On

Default: .....Off

Table 3.75 Query Power Sweep

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Set Code	Bytes	Bits				
Query Power Sweep	2	1	15:8	97	1	7:0	1	1	7:1	Don't Care
									0	0 – Off 1 – On

3.5.8 Power Sweep Start

Sets the start power of the sweep.

Table 3.76 Set Sweep Start Power

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Sweep Start Power	3	1	23:16	18	3	15:0	Sweep Start power in units of 0.01 dBm

Resolution: .....Units of 0.01 dBm

Min Value:..... -100 dBm

Max Value: ..... +20 dBm

Default: ..... -5 dBm

Table 3.77 Query Sweep Start Power

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Sweep Start power	3	1	23:16	98	2	15:0	2	2	15:0	Sweep Start power in units of 0.01 dBm

3.5.9 Power Sweep Stop

Sets the stop power of the sweep.

Table 3.78 Set Sweep Stop Power

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Sweep Stop Power	3	1	23:16	19	2	15:0	Sweep stop power in units of 0.01 dBm

Resolution: .....Units of 0.01 dBm
Min Value:..... -100 dBm
Max Value: ..... +20 dBm
Default: ..... 5 dBm

Table 3.79 Query Sweep Stop Power

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Sweep Stop Power	3	1	23:16	99	2	15:0	2	2	15:0	Sweep stop power in units of 0.01 dBm

3.5.10 Power Sweep Steps

Sets the number of steps in the sweep.

Table 3.80 Set Power Sweep Steps

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Power Sweep Steps	4	1	31:24	1A	3	23:0	Number of steps

Resolution: .....1 Step
Min Value:.....2 Steps
Max Value: .....16,777,215 Steps
Default: .....10 Steps

Table 3.81 Query Power Sweep Steps

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Power Sweep Steps	4	1	31:24	9A	3	23:0	3	3	23:0	Number of steps

3.5.11 Power Sweep Step Time

Sets the duration of the step in 6.4 ns units.

Table 3.82 Set Power Sweep Step Time

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Power Sweep Step Time	6	1	47:40	1B	5	39:0	Time in units of 6.4 ns

Resolution: .....1 (6.4 ns)
Min Value:.....15,625 (100 µs)
Max Value: .....2^40-1 (7036 s)
Default: .....156,250 (1 ms)

Table 3.83 Query Power Sweep Time

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Power Sweep Time	6	1	47:40	9B	5	39:0	5	5	39:0	Time in units of 6.4 ns

3.5.12 Power Sweep Direction

Sets the sweep direction.

Table 3.84 Set Power Sweep Direction

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Power Sweep Direction	2	1	15:8	1C	1	7:1	Don't Care
						0	0 – Normal 1 – UpDown

Default: ..... Normal

Table 3.85 Query Power Sweep Direction

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Set Code	Bytes	Bits				
Query Power Sweep Direction	2	1	15:8	9C	1	7:0	1	1	7:2	Don't Care
									1:0	0 = Normal 1 = UpDown

3.6 List Mode Commands

For software interface, see Lucid Control Panel User Manual.

3.6.1 List

Sets the list of frequencies and power to generate.

Table 3.86 Set List of Frequencies and Power to Generate

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set List of Freq. and Power to Generate	16	1	127: 120	1F	15	119:88	Dwell time in units of 1 µs
						87:82	Don't Care
						81	0 – Advance False, default 1 – Advance True
						80	0 – Last Entry False, default 1 – Last Entry True
						79:64	Power in units of 0.01 dBm
						63:16	Frequency in units of 1 mHz
						15:0	Step Number

Step Number

Resolution:.....1

Min Value:.....2

Max Value: 4096

Frequency

See 3.2.2 Frequency, page 20.

Power

See 3.2.3 Power, page 20.

Dwell time

Resolution:.....1 µs

Min Value:.....100

Max Value: .....2^32-1

Table 3.87 Query List of Frequencies and Power to Generate

Description	Command Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query List of Freq. and Power to Generate	16	1	127:120	9F	15	119:0	15	4	119:88	Dwell time in units of 1 µs
								1	87:82	Don 't Care
									81	0 – Advance False 1 – Advance True
									80	0 –Last Entry False 1 – Last Entry True
								2	79:64	Power in units of 0.01 dBm
								6	63:16	Frequency in units of 1 mHz
								2	15:0	Step Number

3.6.2 List Enable

Sets the List function On or Off.

Table 3.88 Set List Function

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set List Function	2	1	15:8	1D	1	7:1	Don't Care
						0	0 – Off 1 – On

Default: .....Off

Table 3.89 Query List Function

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query List Function	2	1	15:8	9D	1	7:0	1	1	7:1	Don't Care
									0	0 – Off 1 – On

3.6.3 Delete List

Deletes the list of frequencies.

Table 3.90 Delete List Function

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Delete List Function	2	1	15:8	1E	1	7:1	Don't Care
						0	0 – Off 1 – On

3.7 System Commands

For software interface, see Lucid Control Panel User Manual.

3.7.1 Save Setup

Saves a numbered setup file to the Signal Generator. Refer to the Lucid Control Panel User Manual section “System Tab”.

Table 3.91 Set Save Setup

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Save Setup	2	1	15:8	28	1	7:0	Save the numbered setup file 1 to 5

3.7.2 Erase Setup

Deletes a numbered setup file in the Signal Generator.

Table 3.92 Set Erase Setup

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Erase Setup	2	1	15:8	27	1	7:0	Erases the numbered setup file 1 to 5

3.7.3 Recall Setup

Recalls a numbered setup file from the Signal Generator.

Table 3.93 Set Recall Setup

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Recall Setup	2	1	15:8	29	1	7:0	Recall the numbered setup file 1 to 5

3.7.4 Powerup

Sets the numbered setup file that the Signal Generator loads when powering up.

Table 3.94 Set Power-Up Setup File

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set Power-Up Setup File	2	1	15:8	2A	1	7:0	Set the numbered setup file loaded on power-up. 0 – Factory setup file. 1..5 – User setup files.

Default:.....0 (factory default)

Table 3.95 Query Power-Up Setup File

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Power-Up Setup File	2	1	15:8	AA	1	7:0	1	1	7:0	Query numbered setup file loaded on power-up; 0 to 5

3.7.5 Reset

Resets all the parameters to factory default.

Table 3.96 Reset

Description	Command Length (Bytes)	Header			Parameters		
		Bytes	Bits	Set Code	Bytes	Bits	Value
Set reset	2	1	15:8	2B	1	7:0	Don't Care

3.7.6 System Information

Can only be used as a query. Its response is the full system information of the instrument including model ID, options, model name, serial number, calibration date and HW revision.

Table 3.97 Query System Information

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query System Information	2	1	15:8	D2	1	7:0	24	1	3:0	Model ID and Options. Frequency options are 3 | 6 | 12
									4	1 – Modulation Package (AM, FM, PM)
									5	1 – Pulse Generator
									6	1 – Fast Switching
									7	1 – Low Power (-90 dBc)
								2	8	1 – Emulator Pack
									9	1 – Pattern Generator
									15:10	N/A
								3:9	71:16	Model Name (ASCII value)
								10:17	135:72	Serial Number. Byte for each digit.
								18:23	183:136	Calibration Date: Day('DD') Month('MM') Year('YY') Hour('HH') Minutes('mm') Second('SS')
								24	191:184	HW version (ASCII Value)

3.7.7 Temperature

Can only be used as a query. Its response is the temperature (°C) of the Lucid signal generator.

Table 3.98 Query Temperature

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Temperature	2	1	15:8	B4	1	7:0	1	1	7:0	Temperature

3.7.8 Firmware

Can only be used as a query. Its response is the number of the currently installed firmware version.

Table 3.99 Query Firmware

Description	Query Length (Bytes)	Command					Response			
		Header			Don't Care		Response Length (Bytes)	Bytes	Bits	Value
		Bytes	Bits	Query Code	Bytes	Bits				
Query Firmware	2	1	15:8	EC	1	7:0	1	1	7:0	FW version number

4 Troubleshooting

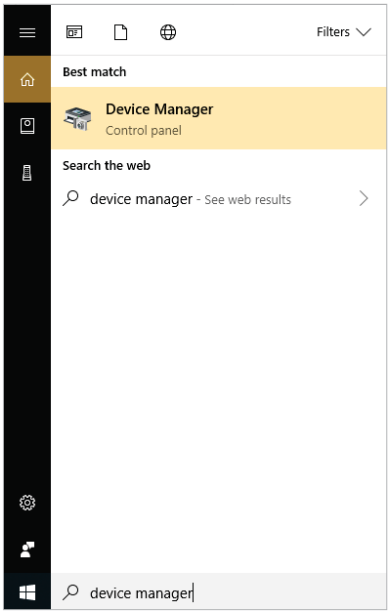
4.1 Manually Installing Instrument Drivers

4.1.1 USB Device Driver Manual Installation (Windows 10)

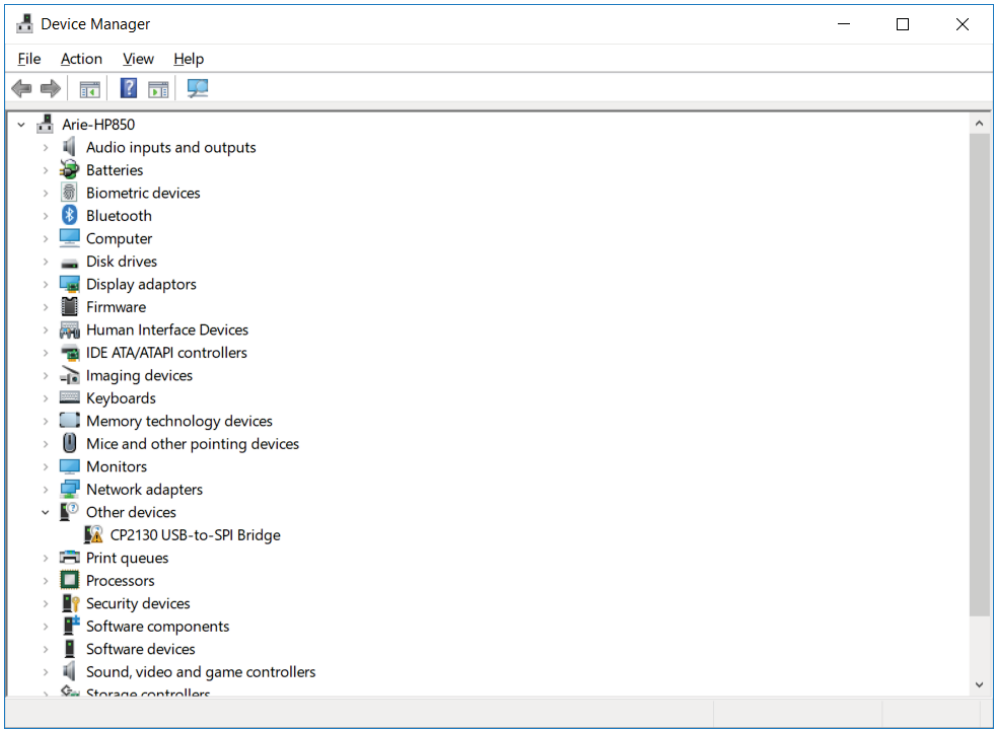
1. Download the latest Lucid series USB device driver from www.taborelec.com/downloads.

1. Using the supplied USB cable, connect the Lucid desktop model to the PC.

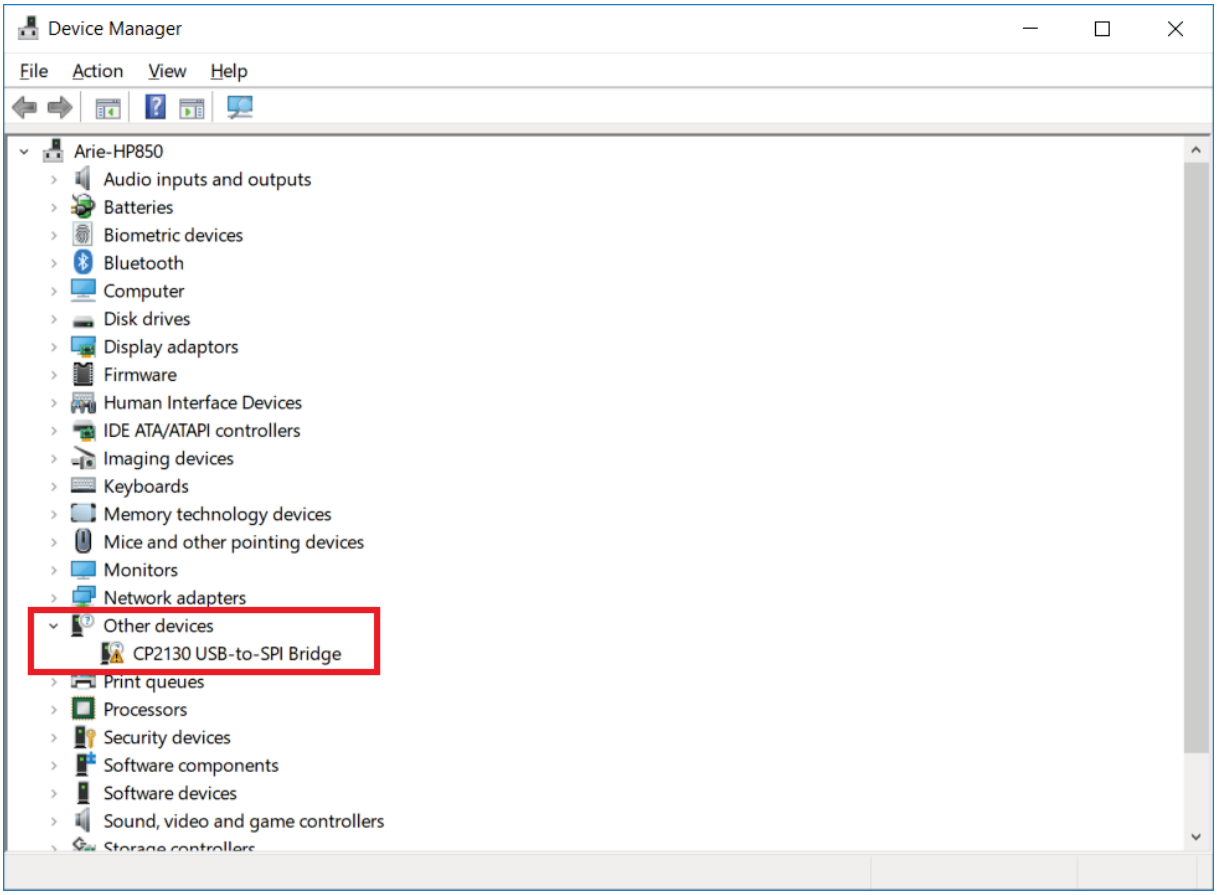
2. Open the **Start** menu, and in the search field, type Device Manager.



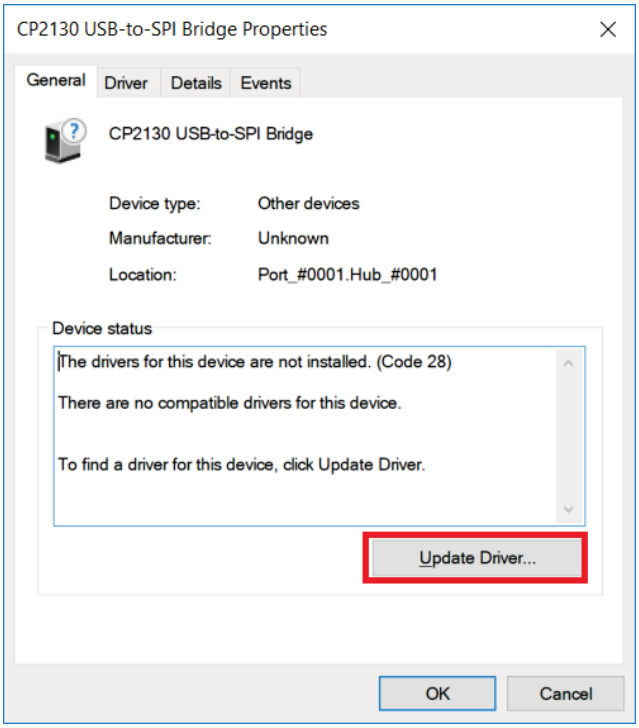
3. In the search results list, select Device Manager.
   The Device Manager window opens.



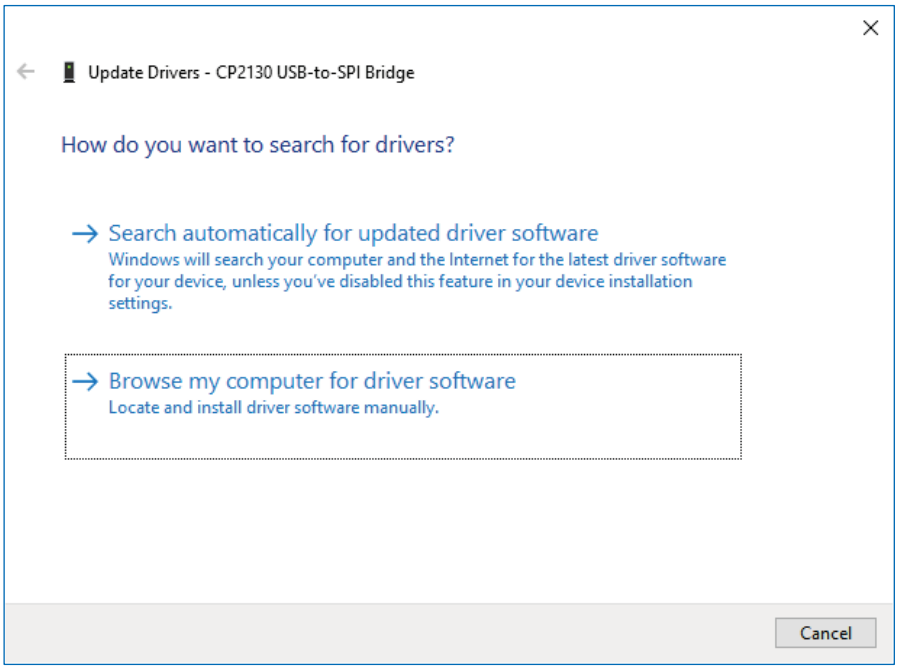
4. In the navigation tree, expand Other devices and double click on CP2130 USB-to-SPI Bridge.



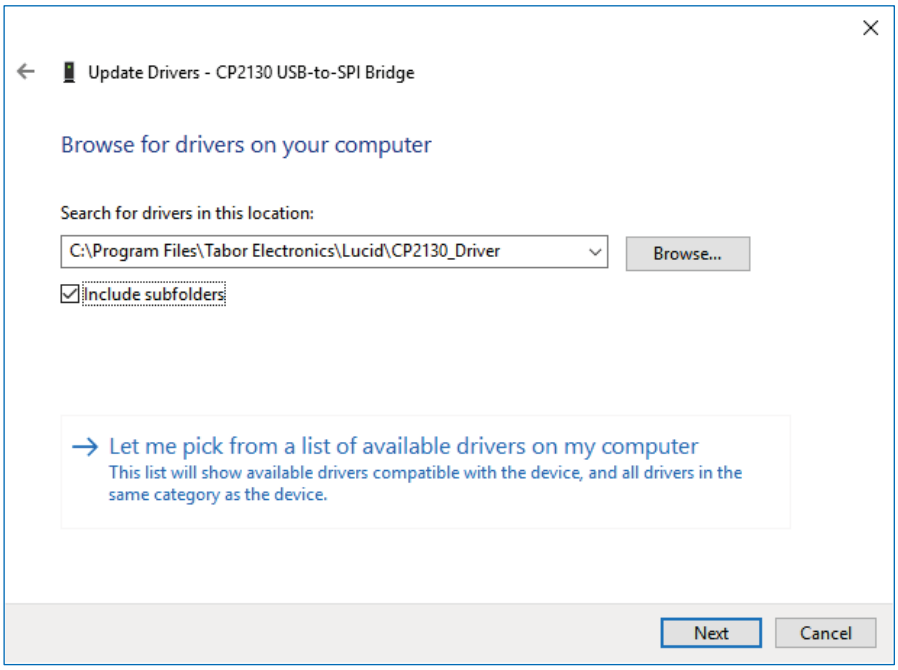
5. The CP2130 USB-to-SPI Bridge Properties window opens.
   Click Update Driver.



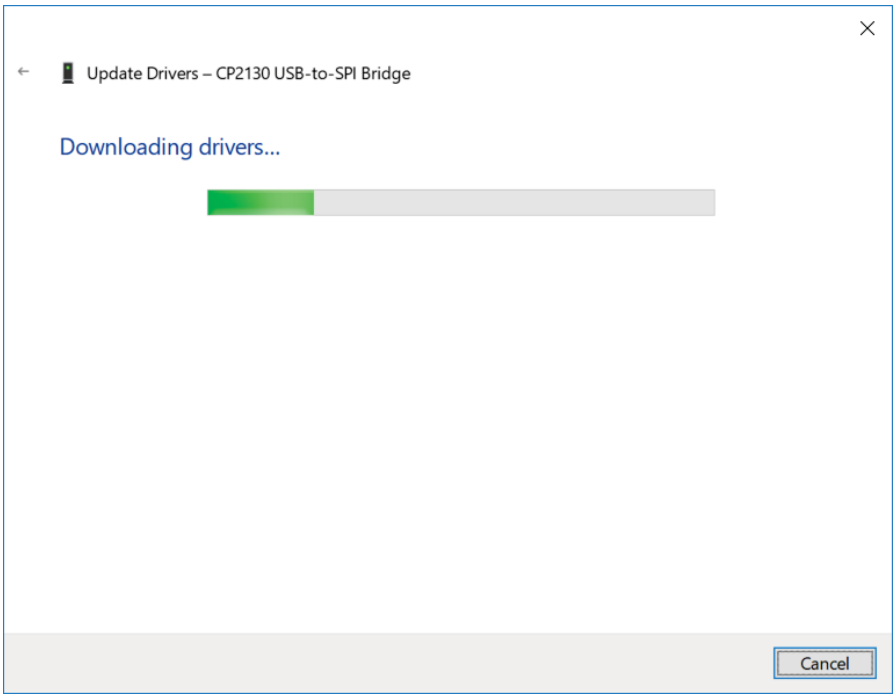
6. In the Update Drivers - CP2130 USB-to-SPI Bridge window, select Browse my computer for driver software.



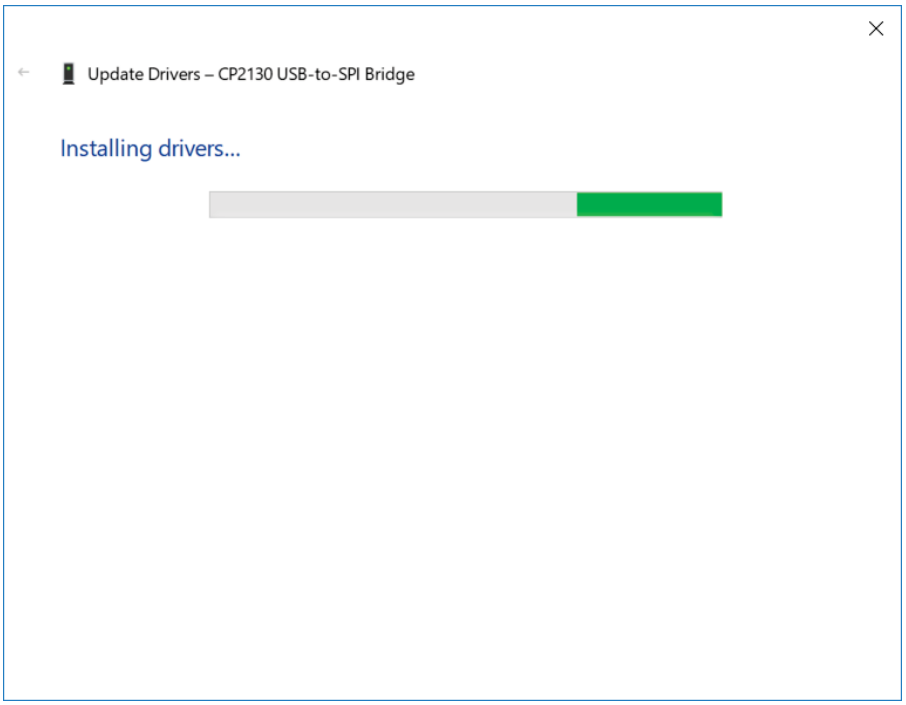
7. Browse to the driver software location on PC, select the file and click OK.



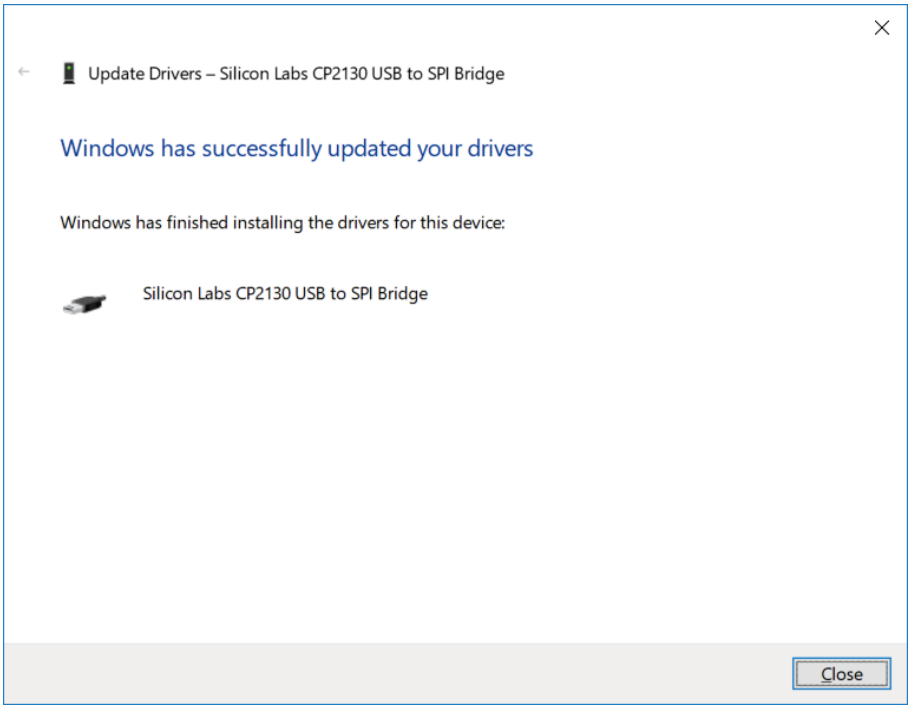
8. Driver download begins.



9. After the download is complete, the driver installation begins.

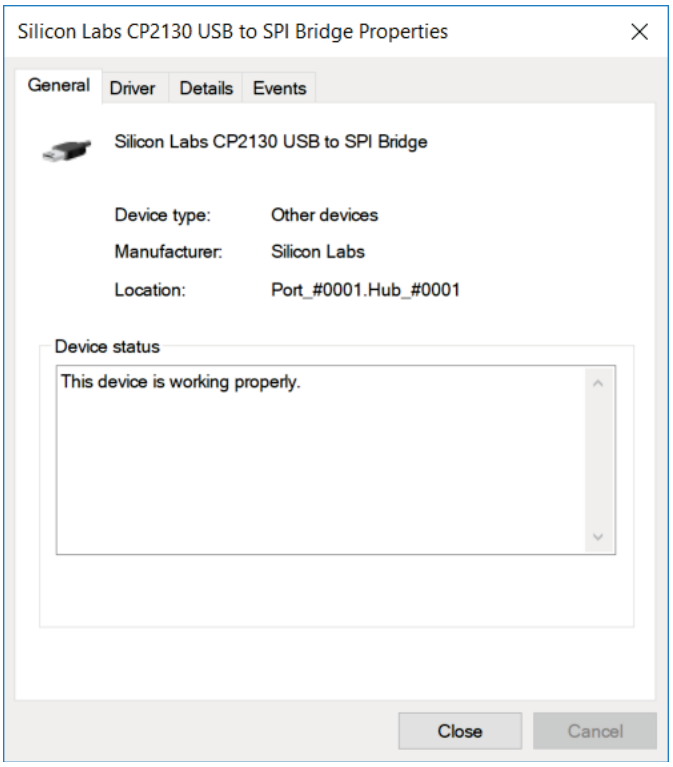


10. After the installation is complete, the following success message is displayed:



11. Click Close to close the Update Drivers window and to proceed.

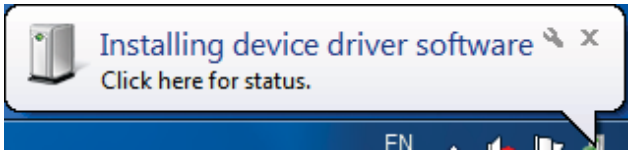
12. In the CP2130 USB-to-SPI Bridge Properties window the displayed device status should be: **The device is working properly**.



4.1.2 USB Device Driver Manual Installation (Windows 7)

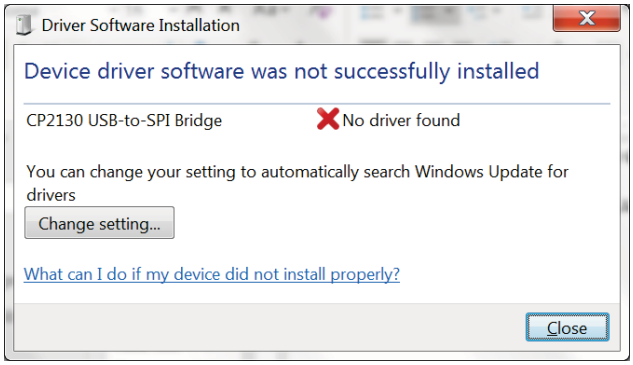
1. Download the latest Lucid series USB device driver from the Tabor Electronics Ltd., website. Device drivers are available at **www.taborelec.com/downloads**

2. Connect the Lucid Generator to the PC using the supplied USB Cable.



The Installing Device Driver Software message is displayed at the lower-right part of the screen.

3. Wait for the following messages to appear:

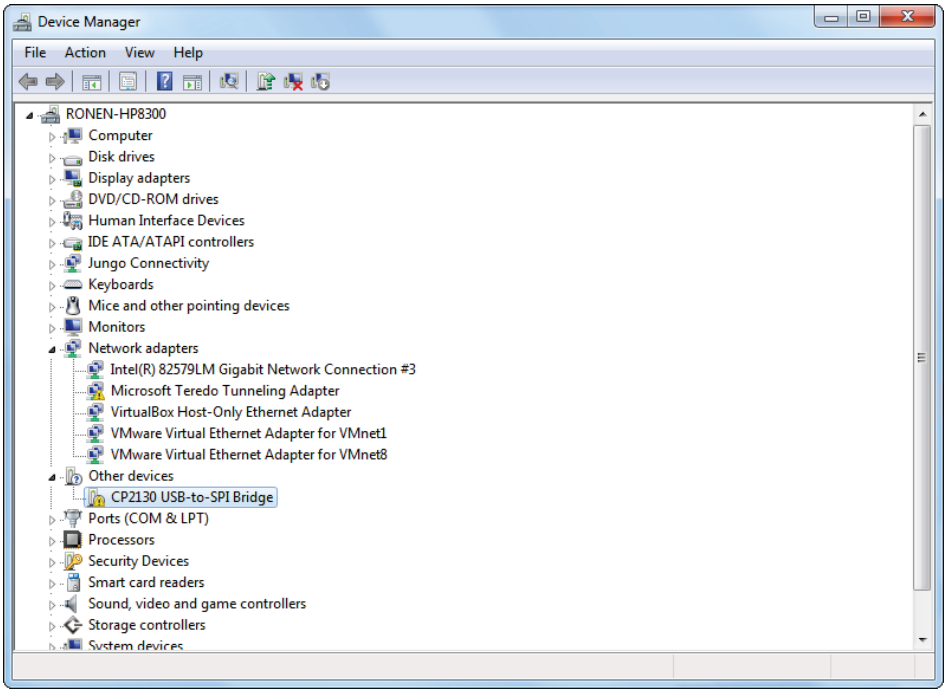


4. Click **Close**.

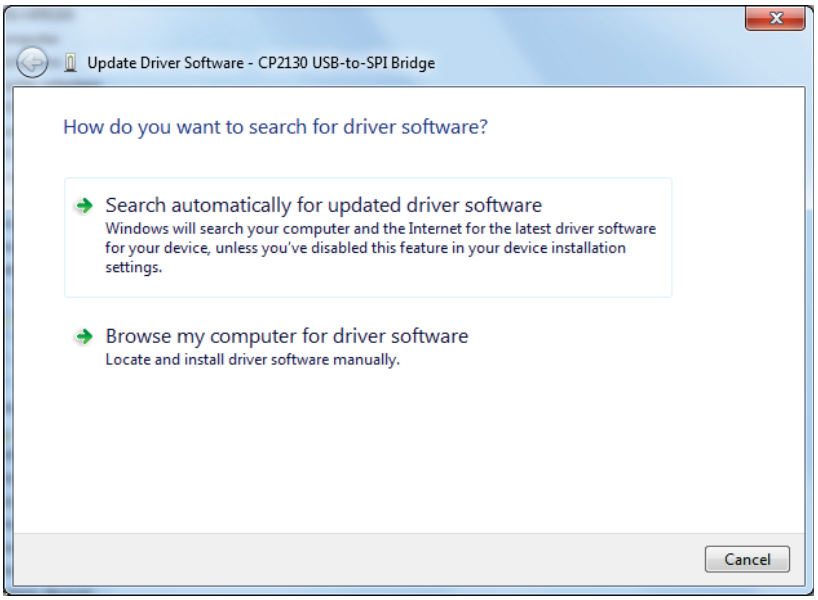
5. Open the **Start** menu, and in the search field, type Device Manager.

6. In the search results list, select Device Manager. The Device Manager window opens.

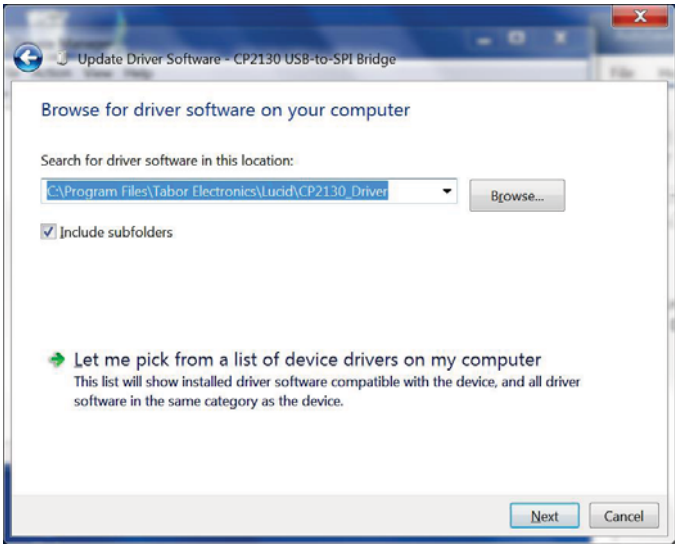
7. In the navigation tree, expand Other devices and select CP2130 USB-to-SPI Bridge.



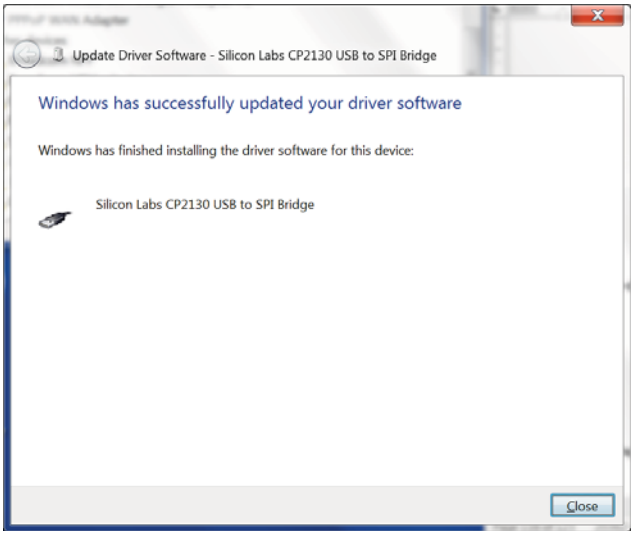
8. Right-click on CP2130 USB-to-SPI Bridge and select **Update Driver Software**…from the drop-list menu.
9. In the Update Drivers - CP2130 USB-to-SPI Bridge window, select Browse my computer for driver software.



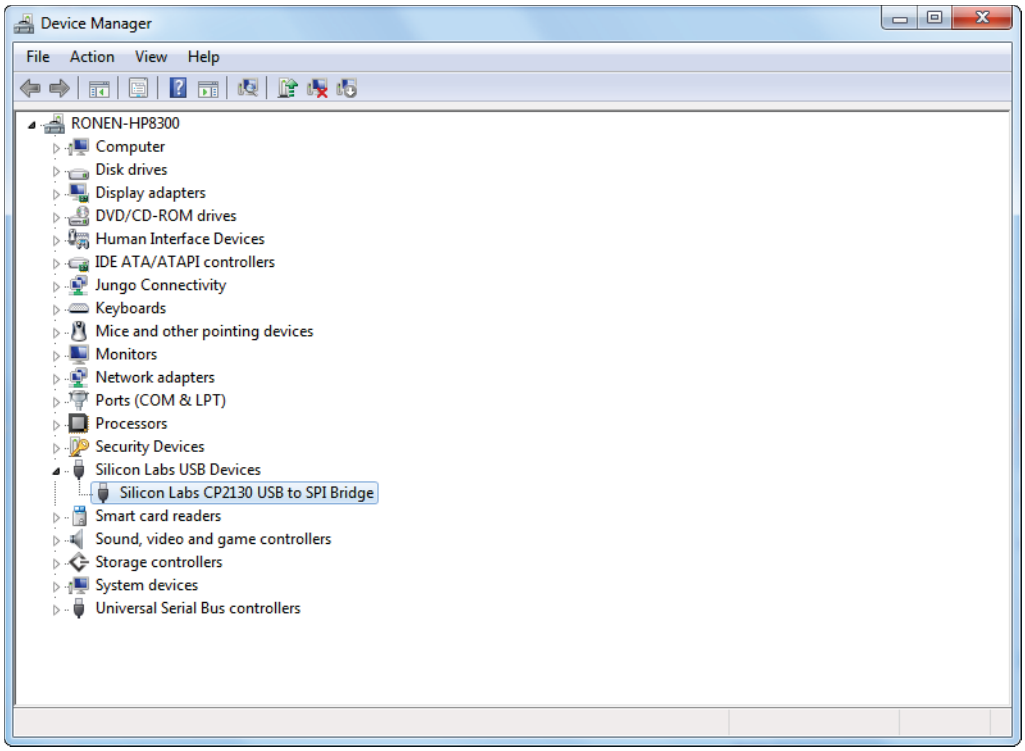
10. Browse to the driver software location on PC, select the folder and click Next. Driver installation begins.



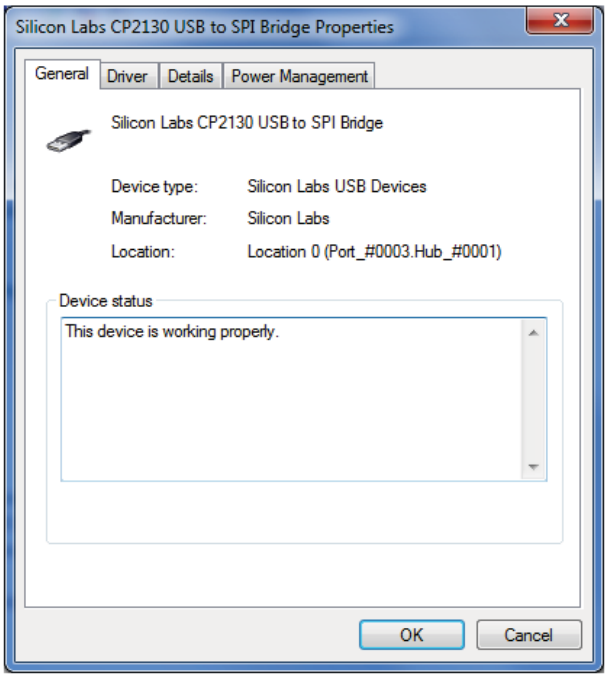
11. After the driver software installation is complete, click Close.



12. In the Device Manager, under Silicon Labs USB Devices, click **Silicon Labs CP2130 USB to SPI Bridge**.



13. In the CP2130 USB-to-SPI Bridge Properties window the device status should indicate the device is working properly.



5 Lucid Desktop Specifications

5.1 Frequency

Table 5.1 Frequency Specification

Frequency	
Range	
LS3081D	9 kHz to 3 GHz
LS6081D	9 kHz to 6 GHz
LS1291D	9 kHz to 12 GHz
Resolution	0.001 Hz
Phase Offset	0.01 deg
Switching Speed	
Standard	500 µs
FS Option	100 µs

Frequency Reference	
Temperature Stability	±25 ppb max
Aging	±3 ppm max for 20 years
Warm Up time	30 min

5.2 Amplitude

Table 5.2 Amplitude Specification

Amplitude		
Max Output Power		
Settable	+20 dBm	
Calibrated	+15 dBm[1]	
Min Output Power	Base	LP Option
Settable	-30 dBm	-100 dBm
Calibrated	-20 dBm	-80 dBm
Resolution	0.01 dB	
Power Mute	-95 dBm	
Output Return Loss	-10 dBm	
Accuracy (dB)	-50 dBm to +15 dBm	-90 dBm to -50 dBm

Up to 100 MHz	±0.3 (typ.)	±0.5 (typ.)
100 MHz to 3 GHz	±0.4 (typ.)	±0.6 (typ.)
3 GHz to 9 GHz	±0.7 (typ.)	±0.9 (typ.)
Above 9 GHz	±1 (typ.)	±1.5 (typ.)

[1] Above 25 kHz.

5.3 Phase Noise and Harmonics

Table 5.3 Phase Noise and Harmonics Specification

Phase Noise (dBc/Hz	
Measured @ 10 kHz Offset)	
1 GHz	-138 (typ.)
2 GHz	-133 (typ.)
3 GHz	-130 (typ.)
6 GHz	-124 (typ.)
12 GHz	-118 (typ.)
Harmonics (dBc)	
Up to 100 MHz	-30 dBc
100 MHz to 12 GHz	-50 dBc[2]
Sub-harmonics (dBc)	
6 to 12 GHz:	-55 dBm
Non-harmonics (dBc)	
Up to 12 GHz	-90 dBc (typ.)[3,4], -60 dBc (max.)[5]

[2] 750 MHz to 900 MHz -35dBc (typ.).

[3] -60 dBm max. @ 1 GHz, 1.5 GHz, 2.5 GHz and 3 GHz.

[4] -75 dBm max. @ -15 dBm to +15 dBm and f> 6 GHz.

[5] Boundary spurs which may appear @ -100 MHz to +100 MHz offset from CW.

5.4 Modulation

Table 5.4 Modulation Specification

Modulation	
Frequency Modulation	
Maximum Deviation	10 MHz
Resolution	0.1 % or 1 Hz (the greater)
Modulation Rate	1 MHz
Resolution	1 Hz

Amplitude Modulation	
AM Depth	
Type	Linear
Maximum Settable	90 %
Resolution	0.1 % of depth
Accuracy (1 kHz)	< ± 4% of setting
Modulation Rate	DC to 100 kHz
Phase Modulation	
Peak Deviation	360 deg
Modulation Rate	DC to 100 kHz
Pulse Modulation (PLS Option)	
On/off Ratio	80 dB
Rise/fall Time (10%-90%)	15 ns (typ.)
Resolution	6.4 ns
Minimum Width	32 ns
Repetition Frequency	DC to 10 MHz
Pattern Modulation (PAT Option)	
Number of Steps	1 to 2,048
Step Repetitions	1 to 65,535
ON/Off Time	32 ns to 20 days
Sweep	
Range	Same as frequency range
Modes	Frequency and amplitude step, list
Dwell Time	100 µs to 1,000 s
Resolution	1 µs
Number of Points	
List	2 to 4, 096
Step	2 to 65,535
Step Change	Linear
Trigger	Free run, External, Bus, Timer

5.5 Inputs

Table 5.5 Inputs Specification

Inputs	
Pulse/Trigger	
Connector Type	1 x MMCX
Input Impedance	50 Ω
Input Voltage	TTL, CMOS compatible
Threshold	1.5 V
Damage Level	-0.42 V
	+5.42 V
Modulation	AM, FM
Connector Type	2 x MMCX
Input Impedance	50 Ω
Maximum Input Voltage	±1 V
Input Damage Level	±3.5 V
Sync (Tabor Electronics Factory Use Only)	1 x MMCX
External Reference	
Connector Type	1 x SMA
Input Impedance	50 Ω
Waveform	Sine or Square
Frequency	10 MHz/100 MHz
Power	-3 dBm to +10 dBm
Absolute Maximum Level	+15 dBm
Locking Range	±2 ppm

5.6 Outputs

Table 5.6 Outputs Specification

Outputs	
RF Out	
Impedance	50 Ω
Connector Type	SMA
Number of Outputs	1
Reference Out	

Impedance	50 Ω
Connector Type	2 x SMA
Frequency	10 MHz, 100 MHz
Shape	Sine
Power	3 to 7 dBm

5.7 General

Table 5.7 General Specification

General	
Voltage Range	+12.0 to +12.6 VDC
Power Consumption	
Normal Operation	18 W nom.
Max	24 W max.
Interface	
Device (remote connection to PC)	1 x micro-USB, 1 x SPI
Dimensions (WxHxD)	12 x 16 x 2.5 cm
Weight	
Without Package	1 kg
Shipping Weight	1.5 kg
Temperature	
Operating	0°C to +40°C
Storage	-40°C to +70°C
Warm up time	15 minutes
Humidity:	85% RH, non-condensing
Safety	CE Marked, IEC61010-1:2010
EMC	IEC 61326-1:2013
Calibration	2 years
Warranty	1-year or 3-year warranty plans

6 Appendix A. SPI Interface

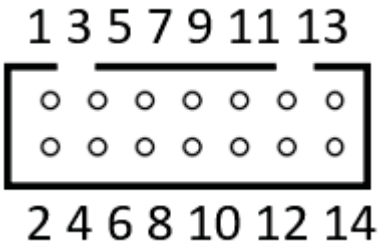


Figure 6.1 SPI Connector Pin Numbering

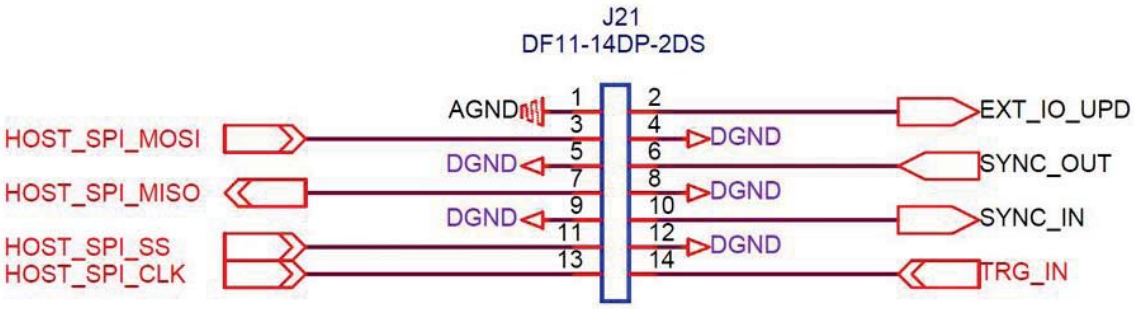


Figure 6.2 SPI Connector Pad Description

The SPI hardware interface consists of a standard SPI interface plus additionally assigned lines as defined in the table below.

Table 6.1 SPI Connector Pin Description

Signal	Description	Pin
SPI_MOSI	Master Out, Slave In. Command and query data sent from remote PC (Master) to Instrument (Slave).	3
SPI_MISO	Master In, Slave Out. Data sent from the instrument to the remote PC.	7
SPI_CLK	SPI clock, supplied by remote PC	13
SPI_SS	Slave Select. This line uses an active low logic. Before data is sent to the instrument the line goes low and when done the line is made high again.	11
EXT_IO_UPD	For factory use only. Do not connect	2
SYNC_OUT	For factory use only. Do not connect	6
SYNC_IN	For factory use only. Do not connect	10
TRG_IN	When enabled the trigger signal to the instrument can initiate a signal, a frequency change or step through a sweep or list.	14

Signal	Description	Pin
GND		1,4,5,8,9,12