TABOR ELECTRONICS

LUCID SERIES

Lucid Series Performance Verification Manual

Rev. 1.3

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Document Revision History

Revision	Date	Description	Author
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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
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

Acronym	Description
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
MIMO	Multiple-Input Multiple-Output
ms	Milliseconds
NCO	Numerically Controlled Oscillator
ns	Nanoseconds
PC	Personal Computer
PCAP	Projected Capacitive Touch Panel
PCB	Printed Circuit Board
PCI	Peripheral Component Interconnect
PRBS	Pseudorandom Binary Sequence
PRI	Pulse Repetition Interval
PXI	PCI eXtension for Instrumentation
PXIe	PCI Express eXtension for Instrumentation
QC	Quantum Computing
Qubits	Quantum bits
RADAR	Radio Detection And Ranging
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

Acronym	Description
WDS	Wave Design Studio

Contents

Figures

Tables

1 Introduction

This document describes the specifications and performance verification tests necessary for validating the Lucid Series Signal Generator.

Figure 1.1 LS1294B – 12GHz Four Channel RF Analog Signal Generator Benchtop

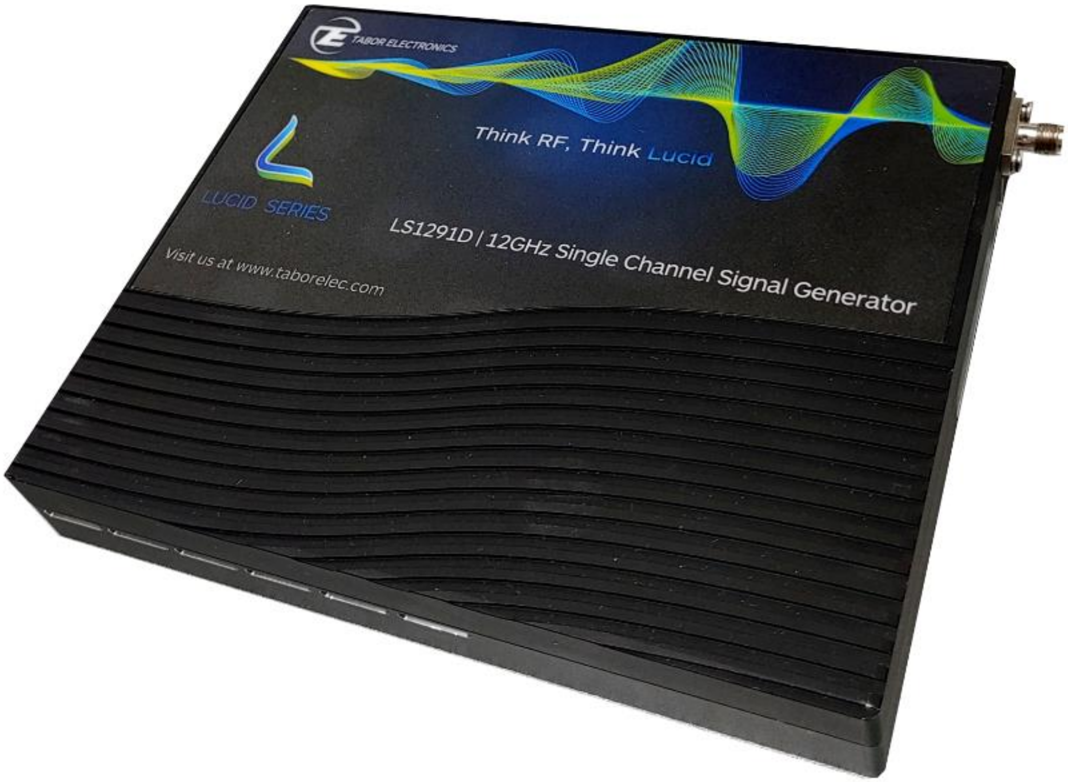

Figure 1.2 LS1291D – 12GHz RF Analog Signal Generator Desktop

Figure 1.3 LS1291P – 12GHz One Channel RF Analog Signal Generator Portable

Figure 1.4 LS1294R – 12GHz Four Channel RF Analog Signal Generator Rackmount

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Caution!

The procedures described in this section are for use only by qualified service personnel. Do not remove instrument covers as it may affect product characteristics and temperature.

Caution!

Always perform performance tests in a static safe workstation.

1.1 Lucid Series Devices

The tables below list the validated Lucid devices. The validation also includes all the applicable device options.

Table 1.1 Validated Lucid Benchtop Devices

Model	Description
LS3081B	3 GHz, 1 channel, benchtop RF analog signal generator
LS3082B	3 GHz, 2 channels, benchtop RF analog signal generator
LS3084B	3 GHz, 4 channels, benchtop RF analog signal generator

LS6081B	6 GHz, 1 channel, benchtop RF analog signal generator
LS6082B	6 GHz, 2 channels, benchtop RF analog signal generator
LS6084B	6 GHz, 4 channels, benchtop RF analog signal generator
LS1291B	12 GHz, 1 channel, benchtop RF analog signal generator
LS1292B	12 GHz, 2 channels, benchtop RF analog signal generator
LS1294B	12 GHz, 4 channels, benchtop RF analog signal generator

Table 1.2 Validated Lucid Desktop Devices

Model	Description
LS3081D	3 GHz, 1 channel, desktop RF analog signal generator
LS6081D	6 GHz, 1 channel, desktop RF analog signal generator
LS1291D	12 GHz, 1 channel, desktop RF analog signal generator

Table 1.3 Validated Lucid Portable Devices

Model	Description
LS3081P	3 GHz, 1 channel, portable RF analog signal generator
LS6081P	6 GHz, 1 channel, portable RF analog signal generator
LS1291P	12 GHz, 1 channel, portable RF analog signal generator

Table 1.4 Validated Lucid Rackmount Devices

Model	Description
LS3081R	3 GHz, 1 channel, rack-mounted RF analog signal generator
LS3082R	3 GHz, 2 channels, rack-mounted RF analog signal generator
LS3084R	3 GHz, 4 channels, rack-mounted RF analog signal generator
LS30816R	3 GHz, 16 channels, rack-mounted RF analog signal generator
LS6081R	6 GHz, 1 channels, rack-mounted RF analog signal generator
LS6082R	6 GHz, 2 channels, rack-mounted RF analog signal generator
LS6084R	6 GHz, 4 channels, rack-mounted RF analog signal generator
LS60816R	6 GHz, 16 channels, rack-mounted RF analog signal generator
LS1291R	12 GHz, 1 channel, rack-mounted RF analog signal generator
LS1292R	12 GHz, 2 channels, rack-mounted RF analog signal generator
LS1294R	12 GHz, 4 channels, rack-mounted RF analog signal generator
LS12916R	12 GHz, 16 channels, rack-mounted RF analog signal generator

Table 1.5 Validated Lucid Module Devices

Model	Description
LS3081M	3 GHz, 1 channel, module RF analog signal generator
LS6081M	6 GHz, 1 channel, module RF analog signal generator
LS1291M	12 GHz, 1 channel, module RF analog signal generator

1.2 Qualification Procedure

The following the specifications and performance verification tests verifies that the Lucid Series device is working according to specifications.

1.3 Environmental Conditions

Tests should be performed under laboratory conditions having an ambient temperature of 25°C, ±5°C and at relative humidity of less than 80%. If the instrument has been subjected to conditions outside these ranges, allow at least one additional hour for the instrument to stabilize before beginning the tests.

1.4 Warm-up Period

Most equipment is subject to a small amount of drift when it is first turned on. To ensure accuracy, turn on the power to the Model LS1291 and allow it to warm-up for at least 30 minutes before beginning the tests.

1.5 Initial Instrument Setting

To avoid confusion as to which initial setting is to be used for each test, it is required that the instrument be reset to factory default values prior to each test. To reset the LS1291 to factory defaults, use the Factory Rest command.

1.6 Recommended Test Equipment

Recommended test equipment for troubleshooting, calibration and performance checking is listed in the table below. Test instruments other than those listed may be used only if their specifications equal or exceed the required characteristics.

Table 1.6 Recommended Test Equipment

Equipment	Model No.	Manufacturer
Oscilloscope	MSOS404A	Keysight
Frequency Counter	53132A	Keysight
Spectrum Analyzer	N9000A	Keysight
Arbitrary Pulse Generator	PM8571A	Tabor
Power Meter	E4418B	Keysight
Signal Source Analyzer	E5052B	Keysight

1.7 Test Procedures

Use the following procedures to check the LS1291 against the specifications. A complete set of specifications is listed in the LS1291 user manual. The following paragraphs show how to set up the instrument for the test, what the specifications for the tested function are, and what acceptable limits for the test are. If the instrument fails to perform within the specified limits, the instrument must be calibrated or tested to find the source of the problem.

1.8 Default Setup

- Frequency: 1 GHz
- Phase: 0

- Power: 5 dBm
- RF Output: OFF
- Pulse Modulation: OFF
- Pulse Modulation Source: Int
- Pulse Modulation Frequency:1 MHz
- Pulse Modulation Width: 500 µs
- FM Modulation: OFF
- FM Modulation Source: Int
- FM Modulation Frequency: 100 kHz
- FM Deviation: 1 MHz
- AM Modulation: OFF
- AM Modulation Source: Int
- AM Modulation Frequency: 10 kHz
- AM Depth: 50%
- Frequency Sweep: OFF
- Frequency Sweep Start: 1 GHz
- Frequency Sweep Stop: 2 GHz
- Frequency Sweep Steps: 1000
- Frequency Sweep Step Time: 1 ms
- Frequency Sweep Direction: Up
- Power Sweep: OFF
- Power Sweep Start: -5 dBm
- Power Sweep Stop: 5 dBm
- Power Sweep Steps: 10
- Power Sweep Step Time : 1 ms
- Power Sweep Direction: Up
- List Enable: OFF
- Run Mode: Continuous
- Trigger Source: External
- Trigger Count: 1

- Trigger Timer: 1 ms

1.9 Related Documentation

- Lucid Programming Manual
- Lucid Control Panel User Manual
- Lucid Benchtop/Desktop/Portable/Rackmount User Manual

2 Test Plan

Notes

The test plan is written for the 12GHz module, but is also applicable for the 3/6GHz modules.
The test plan is written for the 1 channel module, but it should be applied for all channels when relevant.
The text refers to LS1291, but it is interchangeable for your specific instrument module.

2.1 Frequency Accuracy

Test Equipment Counter

Preparation:

1. Configure the counter as follows:
    a. Termination: 50Ω, DC coupled
    b. Connect the LS1291 output to the counter input channel 1
    c. Connect the LS1291 10MHz output Ref to the counter 10MHz Ref input
2. Configure the LS1291 as follows:
    a. Frequency: 100 kHz
    b. Output: On

Test Procedure:

1. Perform frequency Accuracy tests according to the table below.
2. Increase output frequency up to 1 MHz within 100 kHz resolution and repeat Test Procedure 1 for each frequency
3. Repeat Test Procedure 1 for 10MHz, 50MHz, 100MHz, 1GHz and 3GHz output frequency

Table 2.1 Frequency Accuracy

Test Number	Output Frequency	Error Limits	Counter Reading	Pass	Fail
1	100 kHz	±10 mHz			
10	1 MHz	±100 mHz			
11	10 MHz	±100 mHz			
15	3 GHz	±0.3 kHz			

2.2 Frequency Resolution

Test Equipment: Counter

Preparation:

1. Configure the counter as follows:
   a. Gate: DIGITS
   b. DIGITS: as specified in the test
   c. Measurement: Frequency 1
2. Connect the LS1291 10MHz output Ref to the counter 10MHz Ref input
3. Connect the LS1291 output to the counter input channel 1
4. Configure the LS1291 as follows:
   a. Frequency as specified in the test
   b. Output: On

Test Procedure:

1. Perform frequency resolution tests by reading the requested frequency listed in the table below, increase the frequency by 1mHz and then read and verify that the frequency changed by 1mHz

Table 2.2 Frequency Accuracy

Test Number	Output Frequency	Counter Digits Number	Reference Frequency	Delta Frequency Counter Reading	Pass	Fail
1	100 MHz	11				

2.3 Output Power vs. Frequency

Test Equipment: Power Meter

Preparation:

1. Connect the LS1291 output to the power meter input
2. Configure the LS1291 as follows:
   a. Frequency as specified in the test
   b. Output: On
   c. Power: 15dBm

Test Procedure:

1. Perform output power test according to the table below
2. Decrease the power by 1dB and perform the test again
3. Repeat step 2 down to power of -20 dBm
4. Select the next frequency and repeat steps 1 to 3
   a. 0.1 MHz ≤ frequency ≤ 1 MHz; increment size of 0.1 MHz (10 frequencies)
   b. 2 MHz ≤ frequency ≤ 10 MHz; increment size of 1 MHz (9 frequencies)
   c. 20 MHz ≤ frequency ≤ 12000 MHz; increment size of 10 MHz (128 frequencies)

Table 2.3 Power vs. Frequency

Test Number	Output Frequency	Output Power	Error Limits	Power Reading	Pass	Fail
1	100 kHz	15 dBm	±0.5 dB			
36	100 kHz	-20 dBm	±0.5 dB			
5256	12 GHz	15 dBm	±1.0 dB			
5292	12 GHz	-20 dBm	±1.0 dB			

2.4 Ref In

Test Equipment: Scope, Signal Generator

Preparation:

1. Connect the LS1291 output to the scope channel 1 input
2. Connect the signal generator 10MHz Ref output to the scope channel 2 input
3. Connect the signal generator output to the LS1291 Ref In input
4. Set the signal generator output ON and configure it as specified in the test table.
5. Configure the LS1291 as follows:
   a. Frequency: 10 MHz
   b. Output: On
   c. Power: 5 dBm

Test Procedure:

1. Perform Ref In tests using Table 5 by verified that the phase between the LS1291 output and the signal generator 10MHz Ref out is locked:
   Measure delta between min and max tolerance: ±1.5ns
2. Increase the signal generator power as requested in the test and perform Ref In tests again

Table 2.4 Ref In

Test Number	Signal Generator Frequency	Signal Generator Power	Pass	Fail
1	100 MHz	-5 dBm		
2	100 MHz	0 dBm		
3	100 MHz	10 dBm		
4	10 MHz	-5 dBm		
5	10 MHz	0 dBm		
6	10 MHz	10 dBm		

2.5 Ref Out

Test Equipment: Scope

Preparation:

1. Connect the LS1291 10 MHz Ref out to the scope channel 1 input
2. Connect the LS1291 output the scope channel 2 input
3. Configure the LS1291 P as follows:
    a. Output: ON
    b. Frequency: 10 MHz

Test Procedure:

1. Perform Ref Output tests using Table 6 by verified that the phase between the LS1291 output and Ref Output is locked.
2. Measure delta between min and max tolerance: ±1ns
3. Connect the LS1291 100 MHz Ref output to the scope channel 1 input.
4. Change the LS1291 output frequency to 100MHz and verified that the phase between the LS1291 output and Ref Output is looked.

Table 2.5 RefClkOut

Ref Out Frequency	Output Frequency	Pass	Fail
10 MHz	10 MHz		
100 MHz	100 MHz		

2.6 Harmonic Distortion

Test Equipment: Spectrum Analyzer

Preparation:

1. Configure the Spectrum as follows:
   a. Measurement: Harmonic Distortion
2. Connect the LS1291 output to the spectrum input
3. Configure the LS1291 as follows:
   a. Output: On
   b. Frequency: As specified in the test
   c. Power: As specified in the test

Test Procedure:

1. Perform Harmonic Distortion tests according to the table below.
2. Select the next frequency and repeat step 1
3. 10MHz, 15 MHz, 25 MHz, 35 MHz, 60MHz, 85MHz, 93.75MHz, 93.751MHz, 130MHz, 190MHz, 240MHz, 315MHz, 365MHz, 400MHz, 401MHz, 500MHz, 700MHz, 800MHz, 900MHz, 1500MHz, 1501MHz, 1800MHz, 2100MHz, 2400MHz, 2401MHz, 2700MHz, 3000MHz, 4500MHz, 6000MHz, 6001MHz, 6800MHz, 7400MHz, 8000MHz, 8001MHz, 8800MHz, 9600MHz, 11300MHz, 12000MHz

Table 2.6 Harmonic Distortion

Test Step	Output Frequency	Power	Error Limits	Max HD Spectrum Reading	Pass	Fail
1	10 MHz	15 dBm	-40 dBc			
2	10 MHz	0 dBm	-40 dBc			
3	10 MHz	-15 dBm	-40 dBc			
112	12 GHz	15 dBm	-40 dBc			
113	12 GHz	0 dBm	-40 dBc			
114	12 GHz	-15 dBm	-40 dBc			

2.7 Spurious In-Band Test

Test Equipment: Spectrum Analyzer

Preparation:

1. Configure the Spectrum as follows:
   a. Start frequency: As specified in the test
   b. Stop frequency: As specified in the test
   c. Res BW: 30 kHz
2. Connect the LS1291 output to the spectrum input
3. Configure the LS1291 as follows:
   a. Frequency: As specified in the test
   b. Output: On
   c. Power: 5 dBm.

Test Procedure:

1. Perform Spurious tests according to the table below.

Table 2.7 Spurious

Test Step	Output Frequency (MHz)	Start Frequency	Stop Frequency	Error Limits	Max Spurious Reading	Pass	Fail
1	1000.1	500	1500	-60 dBc			
2	2000	1500	2400	-60 dBc			
3	3500	2400	3400	-60 dBc			
4	4000	2400	3400	-60 dBc			
5	550	3400	3900	-60 dBc			
6	2300	3900	4900	-60 dBc			
7	1500	4900	5900	-60 dBc			
8	3500	5900	6900	-60 dBc			
9	4000	5900	6900	-60 dBc			
10	3500	6900	7900	-60 dBc			
11	4000	6900	7900	-60 dBc			
12	550	7900	8900	-60 dBc			
13	2300	8900	9900	-60 dBc			
14	1500	9900	10900	-60 dBc			
15	3500	10900	11900	-60 dBc			
16	4000	10900	11900	-60 dBc			

2.8 Spurious Next to Carrier

Test Equipment: Spectrum Analyzer

Preparation:

1. Configure the Spectrum as follows:
   a. Center Frequency: as specified in the test
   b. Res BW: 200 kHz
   c. Video BW: 400 Hz
2. Connect the LS1291 output to the spectrum input
3. Configure the LS1291 as follows:
   a. Frequency: As specified in the test
   b. Output: On
   c. Power: 5 dBm.

Test Procedure:

1. Perform Spurious tests using Table 9
2. Select the next frequency and repeat steps 1
   20 MHz ≤ frequency ≤ 100 MHz; increment size of 10 MHz
   Spectrum Frequency Span: 20 MHz
   150 MHz ≤ frequency ≤ 1000 MHz; increment size of 50 MHz
   Spectrum Frequency Span: 30 MHz
   1250 MHz ≤ frequency ≤ 12000 MHz; increment size of 250 MHz
   Spectrum Frequency Span: 40 MHz

Table 2.8 Spurious

Test Step	Output Frequency (MHz)	Error Limits	Max Spurious Reading	Pass	Fail
1	20	-60 dBc			
2	30	-60 dBc			
70	11750	-60 dBc			
71	12000	-60 dBc			

2.9 Phase Noise

Test Equipment: Signal Source Analyzer (SSA)

Preparation:

1. Configure the SSA as follows:
    a. Carrier frequency: as specified by the test
    b. Res BW: 1E5
    c. Start Frequency: 100
    d. Stop Frequency: 100 MHz
    e. Correlation Count: 5
    f. Measurement: Phase Noise at 10kHz offset
2. Connect the LS1291 output to the SSA input
3. Configure the LS1291 as follows:
    a. Frequency: As specified by the test
    b. Output: On
    c. Power: 5 dBm

Test Procedure:

1. Perform Phase Noise tests according to the table below.
2. Select the next frequency and repeat steps 1

Table 2.9 Phase Noise

Test Step	Output Frequency	Error Limits	Phase Noise Reading	Pass	Fail
1	500 MHz	-132 dBc/Hz			
2	1000 MHz	-132 dBc/Hz			
3	3 GHz	-123 dBc/Hz			
4	6 GHz	-119 dBc/Hz			

2.10 External Trigger Input

Test Equipment: Scope, Function Generator

Preparation:

1. Connect the LS1291 output to the scope channel 1 input
2. Split the Function Generator output and connect it to the LS1291 Trigger input and scope channel 2 input
3. Configure the Function Generator as follows:
    a. Function shape: Square
    b. Frequency: 10 kHz
    c. Duty Cycle: 20 %
    d. Amplitude: 4Vpp
    e. Offset: 2V
    f. Output: ON
4. Configure the LS1291 as follows:
    a. Output: ON
    b. AM Modulation: ON
    c. Modulation Frequency: 100kHz
    d. Modulation Depth: 50%
    e. Run Mode: Trigger
    f. Trigger Source: External
    g. Trigger Edge: As specified by the test

Test Procedure:

1. Perform External Trigger tests according to the table below.

Table 2.10 External Trigger

Trigger Edge	Pass	Fail
Positive		
Negative		

2.11 Internal Trigger

Test Equipment: Scope

Preparation:

1. Connect the LS1291 output to the scope channel 1 input
2. Configure the scope as follows:
    a. Amplitude: 500 mV per division
    b. Time base: 50% of the LS1291 Trigger Timer
    c. Trigger mode: Triggered
    d. Trigger Level: 0.5
3. Configure the LS1291 as follows:
    a. Output: ON
    b. Frequency: 100 MHz
    c. Run Mode: Trigger
    d. Trigger Source: Internal
    e. Trigger Timer: As specified by the test
    f. AM Modulation: ON
    g. Modulation Frequency: 100 kHz
    h. Modulation Depth: 50%

Test Procedure:

1. Perform the Internal Trigger tests according to the table below.
2. Measure the delay between two nearby output signals.

Table 2.11 Internal Trigger

Timer	Trigger Period Limit	Delay Reading	Pass	Fail
1 ms	1msec ± 7nsec			
100 µs	100µsec ± 7nsec			

2.12 List Mode

Test Equipment: Scope

Preparation:

1. Connect the LS1291 output to the scope channel 1 input
2. Configure the scope as follows:
    a. Amplitude: 200 mV per division
    b. Time base: 100 µs per division
    c. Trigger: Normal
    d. Trigger edge: Rise
3. Configure the LS1291 as follows:
    a. Output: ON
    b. Run mode: List
    c. List step 1: Frequency 1 GHz, Power 0dBm, Dwell 500 µs
    d. List step 2:Frequency 2 GHz, Power 0dBm, Dwell 500 µs
    e. List step 3: Frequency 3 GHz, Power 0dBm, Dwell 500 µs

Test Procedure:

1. Perform List Mode tests according to the table below.
2. Measure the frequency of each step.

Table 2.12 List Mode - Frequency Switching Speed

Switching time Limit	Switching time Reading	Pass	Fail
500 µs ± 7nsec			

3. Configure the LS1291 as follows:
    a. List step 1: Frequency 1 GHz, Power 5dBm, Dwell 500 us
    b. List step 2: Frequency 2 GHz, Power 0dBm, Dwell 1000 us
    c. List step 3: Frequency 3 GHz, Power -5dBm, Dwell 1500 us
4. Perform List Mode Frequency, Power and Dwell tests according to the table below.

Table 2.13 List Mode - Frequency

Frequency	Power	Dwell time	Frequency Reading	Power Reading	Dwell time Reading	Pass	Fail
1 GHz	5dBm	500 µs					
2 GHz	0dBm	1000 µs					
3 GHz	-5dBm	1500 µs					

2.13 Frequency Modulation

Test Equipment: Scope with Jitter analysis, Function Generator

Preparation:

1. Connect the LS1291 output to the scope channel 1 input
2. Connect the function generator output to the LS1291M FM input
3. Configure the scope as follows:
   a. Amplitude: 200 mV per division
   b. Time base: 100 us per division
   c. Jitter analysis: ON
4. Configure the function generator as follows:
   a. Amplitude: 1 Vpp
   b. Frequency: 1 MHz
   c. Output: ON
5. Configure the LS1291 as follows:
   a. Output: ON
   b. FM modulation: ON
   c. Frequency deviation: 5 MHz
   d. Modulation source: External

Test Procedure:

1. Perform Frequency Modulation tests according to the table below.

Table 2.14 Frequency Modulation – External Source

Frequency Deviation Reading	Modulation Frequency Reading	Pass	Fail

2. Configure the function generator as follows:
   a. Output: OFF
3. Configure the LS1291 as follows:
   a. Output: ON
   b. FM modulation: ON
   c. Modulation Frequency: 1 MHz
   d. Frequency deviation: 5 MHz
   e. Modulation source: Internal

Test Procedure:

1. Perform Frequency Modulation tests according to the table below.

Table 2.15 Frequency Modulation –Internal Source

Frequency Deviation Reading	Modulation Frequency Reading	Pass	Fail

2.14 Amplitude Modulation

Test Equipment: Scope, Function Generator

Preparation:

1. Connect the LS1291 output to the scope channel 1 input
2. Connect the function generator output to the LS1291M AM input
3. Configure the scope as follows:
    a. Amplitude: 500 mV per division
    b. Time base: 5 us per division
4. Configure the function generator as follows:
    a. Amplitude: 1 Vpp
    b. Frequency: 100 kHz
    c. Output: ON
5. Configure the LS1291 as follows:
    a. Output: ON
    b. AM modulation: ON
    c. Modulation source: External

Test Procedure:

1. Perform Frequency Modulation tests according to the table below.

Table 2.16 Amplitude Modulation – External Source

Modulation Depth Reading	Modulation Frequency Reading	Pass	Fail

2. Configure the function generator as follows:
    a. Output: OFF
3. Configure the LS1291 as follows:
    a. Output: ON
    b. AM modulation: ON
    c. Modulation source: Internal
    d. Modulation Frequency: 100 kHz
    e. Modulation Depth: 75%

Test Procedure:

1. Perform Frequency Modulation tests according to the table below.

Table 2.17 Amplitude Modulation – Internal Source

Modulation Depth Reading	Modulation Frequency Reading	Pass	Fail

2.15 Pulse Modulation

Test Equipment: Scope, Function Generator

Preparation:

1. Connect the LS1291 output to the scope channel 1 input
2. Connect the function generator output to the LS1291M Pulse input
3. Configure the scope as follows:
   a. Amplitude: 200 mV per division
   b. Time base: 100 µs per division
4. Configure the function generator as follows:
   a. Function shape: Square
   b. Amplitude: 1 Vpp
   c. Offset: 1V
   d. Output: ON
   e. Duty Cycle: As specified in the test
   f. Frequency: As specified in the test
5. Configure the LS1291 as follows:
   a. Output: ON
   b. Pulse modulation: ON
   c. Modulation source: External

Test Procedure:

1. Perform Frequency Modulation tests according to the table below.

Table 2.18 Pulse Modulation – External Source

Function Generator Duty Cycle	Function Generator Frequency	Pulse Duration Reading	Pulse Repetition Reading	Pass	Fail
50%	1 MHz				
30 %	10 MHz				

2. Configure the function generator as follows:
   a. Output: OFF
3. Configure the LS1291 as follows:
   a. Output: ON
   b. Pulse modulation: ON
   c. Modulation source: Internal
   d. Pulse Width: As specified in the test
   e. Pulse Repetition Rate: As specified in the test

Test Procedure:

1. Perform Frequency Modulation tests according to the table below.

Table 2.19 Pulse Modulation – Internal Source

Pulse Width	Pulse Repetition	Frequency Deviation Reading	Modulation Frequency Reading	Pass	Fail
500 ns	1 MHz				
30 ns	10 MHz				

2.16 EPR Option - Output Power vs Frequency

Test Equipment: Spectrum

Preparation:

1. Connect the LS1291 output to the power meter input
2. Configure the LS1291 as follows:
   a. Spectrum: Minimum span
   b. Frequency: As specified in the test
   c. Output: On
   d. Power: As specified in the test

Test Procedure:

1. Perform output power test according to the table below.

Table 2.20 Power vs Frequency

Test Number	Output Frequency	Output Power	Error Limits	Power Reading	Pass	Fail
1	1 MHz	25 dBm	±0.5 dB			
2	1 MHz	0 dBm	±0.5 dB			
3	1 MHz	-70 dBm	±0.5 dB			
4	1 MHz	-120 dBm	±0.5 dB			
5	100 MHz	25 dBm	±0.5 dB			
6	100 MHz	0 dBm	±0.5 dB			
7	100 MHz	-70 dBm	±0.5 dB			
8	100 MHz	-120 dBm	±0.5 dB			
9	1 GHz	25 dBm	±0.5 dB			
10	1 GHz	0 dBm	±0.5 dB			
11	1 GHz	-70 dBm	±0.6 dB			
12	1 GHz	-120 dBm	±0.6 dB			
13	3 GHz	25 dBm	±0.5 dB			
14	3 GHz	0 dBm	±0.5 dB			
15	3 GHz	-70 dBm	±0.6 dB			
16	3 GHz	-120 dBm	±0.6 dB			
17	6 GHz	25 dBm	±0.7 dB			
18	6 GHz	0 dBm	±0.7 dB			
19	6 GHz	-70 dBm	±1.0 dB			
20	6 GHz	-120 dBm	±1.0 dB			
21	12 GHz	25 dBm	±1.0 dB			
22	12 GHz	0 dBm	±1.0 dB			
23	12 GHz	-70 dBm	±1.5 dB			
24	12 GHz	-120 dBm	±1.5 dB			