

Annexure-I**Specifications and Scope of Work for (Transceiver) Onboard DL Test-Jig
and
Ground DL Test-Jig****1. Scope of Work:**

1. The Vendor has to develop, fabricate the following modules to meet all the functional specifications as per the specs given below

➤ Onboard DL Test-Jig:

- The Onboard DL Transceiver Test-Jig Module -1 No
- DL RF Test-Jig Module -1 No
- OBC DL Simulator -1 No
- Onboard DL Test-Jig Simulator -1 No

➤ Ground DL Test-Jig:

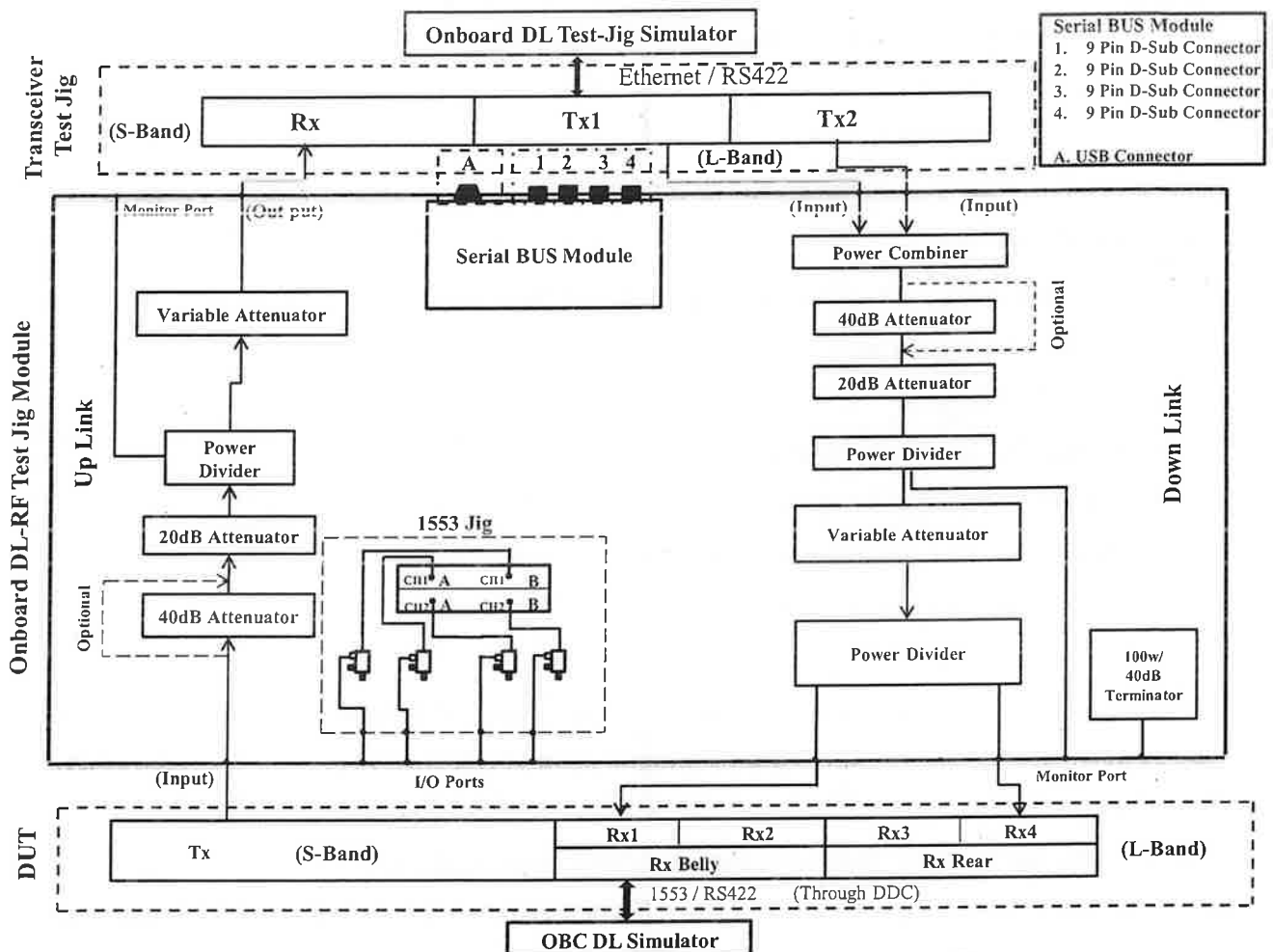
- The Ground DL Transceiver Test-Jig Module -1 No
- DL RF Test-Jig Module -1 No
- FCC DL Simulator -1 No
- Ground DL Test-Jig Simulator -1 No
- 1*12 RF Power Divider -2 No
- Data Acquisition and Multiplexer System
- 2 Series Mixed Signal Oscilloscope

2. The Onboard DL Test-Jig will test the functional specifications of Onboard DL transceiver. The Ground DL Test-Jig will test the functional specifications of Ground DL transceiver.
3. The vendor has to carry out the functional tests, and necessary documents should be submitted.
4. Ability to program the code length and data rate through user interface.
5. GUI based user control (Capable of hosting on laptop or tablet) for controlling the test Jig parameters.
6. Architecture should support programmability and variation in multi user definition
7. Waveform measurements should be logged and available – such as RSSI, CFO and SNR



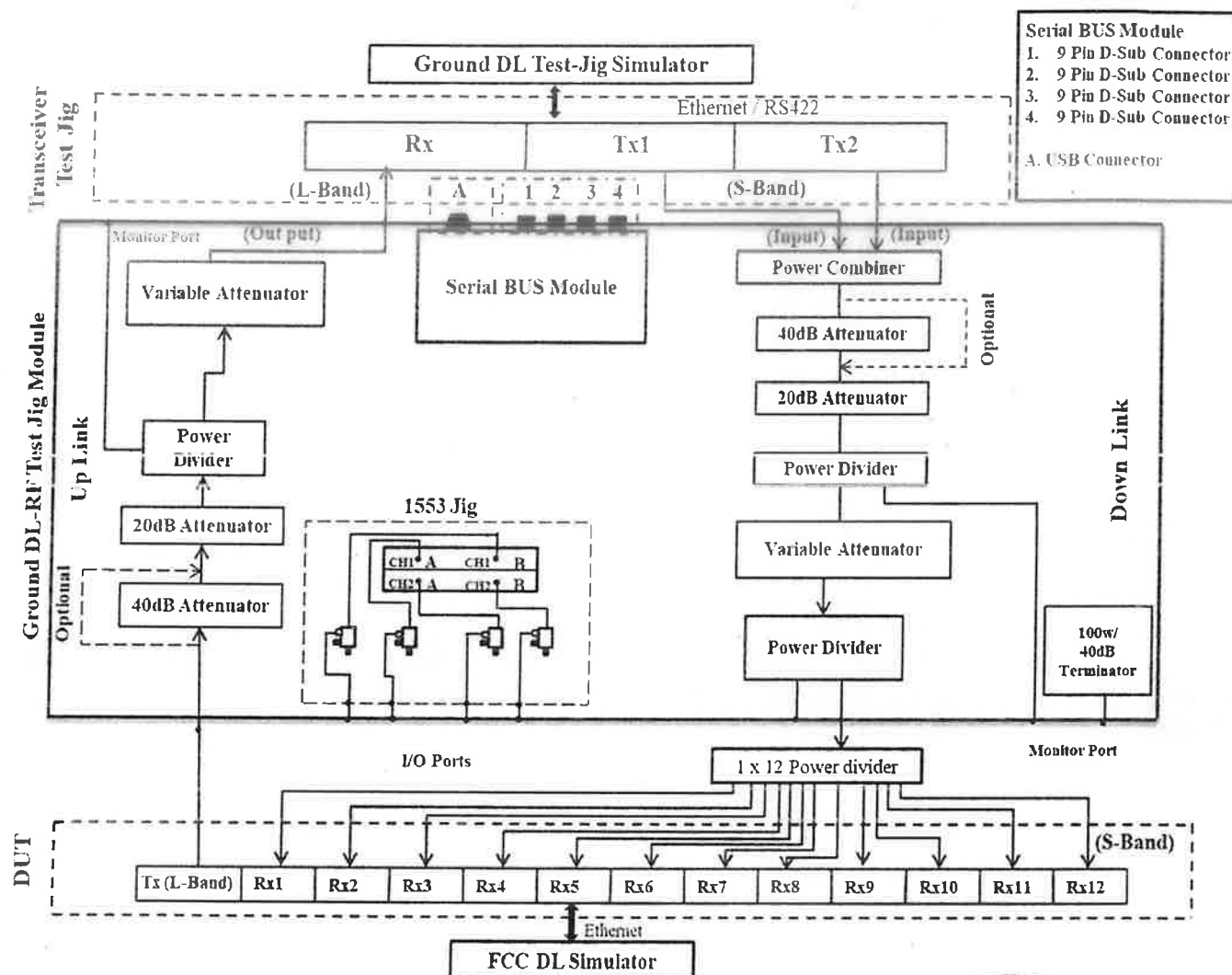
2. BLOCK DESIGN:

i. The Onboard DL Transceiver Test-Jig Module:



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ii. The Ground DL Transceiver Test-Jig Module:

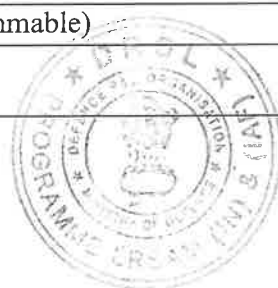


3. Technical Specifications:

3 (a). Table 1. Onboard Transceiver Test Jig Module Specifications:

To test Onboard data link Transmitter and Receivers Operating at different Frequencies

1. Transmitter Module	No of Transmitters: 2(SMA)
	Frequency: L-band (programmable in steps of 0.1MHz)
	No of CDMA users : 6
	Code length 1023 or 512 programmable
	Provision to be kept for other higher code lengths
	Signal Bandwidth: less than 15 ± 0.5 MHz for 1023 code
	Less than 7.5 ± 0.5 MHz for 511 code
	Adjacent Channel Rejection:
	With 4 MHz Guard Band : 50dB min
	Transmission rate :9600 bps
	Data rate: 9600 bps without FEC, 4800 with FEC
	Error Correction Coding: 1/2 convolution with Viterbi soft
	With FEC ON/OFF feature
	CDMA code: 1023/511 chip length PN code (programmable)
	Provision to be kept for other higher code lengths
	Encoder: DSSS to ensure minimum detectable signal of 6 user combined CDMA to be -104+/- 1 dBm (without FEC) at the Receiver
	Modulation: BPSK
	Available RF Bandwidth: 100 MHz(for multiple Transmitter Operation)
	RF Output Power: 0 dBm
	Doppler to be generated in the Transmitter : ± 30 KHz Max Doppler rate : 4 KHz Max
2. Receiver Module	It is an S-Band Receiver (Programmable in Steps of 0.1 MHz)
	WAVEFORM 1
	Transmission rate: 4800 bps
	Spreading code: 127 or 31 bit programmable
	Modulation: BPSK
	Data rate: 4800 bps
	Error Correction Coding: 1/2 Convolutional with Viterbi soft
	With FEC ON/OFF feature
	System RF Bandwidth: 100MHz(for multiple spot frequencies of users)
	No. of Antenna Inputs : 1(SMA)
	Sensitivity: better than -113 dBm @PER of 1 in 100 packets without FEC for each receiver
	Note: Minimum Signal level at the input of combined 12 Receiver module will be -113dBm
	Each receiver chain to be independent with common 100 base T
	Dynamic Range:70 dB
	Acquisition/Reacquisition Time:< 10 ms
	BER:1 in 10^{-6}
	WAVEFORM 2
	Input / Output Interface: Ethernet/ RS422
	Data rate : 3.125 Mbps (Programmable)
	Modulation : PCM-FM/SOQPSK – TG (Programmable)
	Input / Output Interface: Ethernet/ RS422



3. Power Supply	Power supply : 28V \pm 4V operation
4.Connectors	RF Input (Rx) :SMA(F)1 No
	RF Output (Tx1,Tx2) : SMA (F)2 Nos
	Power Supply : 3 Series Circular Connector (6-Pin)
5. Enclosure	Mechanical : 19" Rack 2U (Approx.) Size with mounting slides and handles
	Cooling fans: Forced air using fans adequate heat sink
	Gaskets, mesh at openings, back shelf of connectors
6.Interface	Ethernet & RS422

7. Data Link Controller Module for Onboard Test jig	Spartan 6 LX 100 FPGA with ARM 32 processor or equivalent
	4Port RS422 UART Parts, 8-pin 3.3V output, 8-pin 3.3V LV TTL input, 19.6416 MHz TCXO \pm 1PPM control for <u>signal processing, reset operation</u>
	Power Supply: 28V DC operation with Gaia DC-DC & filter
	Mechanical: 4" X 7" HE-15/13 Box (Approx)
	51 pin Micro D, Ethernet RJ45 connector
	Spartan 6 LX 100 FPGA with ARM 32 processor

Note: Vendor has to provide 1 set of mating cables

3 (b). Table 1. Ground Transceiver Test Jig Module specifications:

To test Ground Transmitter and Receiver systems

Ground Trans-receiver Test jig	Consists of Two Onboard S-Band transmitters operating at different frequency and One L-Band Receiver
1. Transmitter Module	Consists Two S-Band Transmitting Modules
	Frequency: S-band (programmable in steps of 0.1 MHz)
	Data rate: 4800 bps without FEC/ Transmission rate 9600 with FEC(optional)
	Spreading code length:127 or 31 programmable
	Signal Bandwidth: less than 1MHz @127 code length 4800 data rate Signal Bandwidth @31-bit code 4800 data rate less than 0.25 MHz OR Signal Bandwidth @31-bit code 4800 data rate (9600bps Transmission rate) less than 0.5 MHz RRC or other Bandwidth reduction technique to be used without compromising the Processing Gain
	No of transmitters: 2(SMA)
	Input/output data Interface: Ethernet & RS422
	Modulation: BPSK
	Output: 0 dBm
	RF Connector: SMA connector for RF output
	Doppler to be generated in the Transmitter : \pm 30KHz Max Doppler rate : 4 KHz Max
2. Receiver Module	Frequency: L-band (programmable in steps of 0.1 MHz)
	No of Rx antenna ports: 1(SMA)
	RF Bandwidth: 100 MHz



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	CDMA decoder: Direct Sequence Spread Spectrum
	Data Rate : 9600 without FEC, 4800 bps with FEC (1/2 rate convolutional coding)
	Error Correction de Coding: Viterbi soft
	Decoder: Decode single user data from 6 user CDMA data
	Minimum signal of 6 user combined CDMA Signal: -105 dBm \pm 1 dB @ PER of 1 in 100 Packets without FEC, -108dBm with FEC or better.
	Anti - Jam margin: 15 \pm 1 dB @1023 code with respect to single user 12 \pm 1 dB @ 511 code with respect to single user
	Dynamic Range: 70 dB or Higher
	PN Code :511/1023 or programmable to higher code lengths
	Modulation : BPSK
	PER: 1 in 100 Packets at Sensitivity level
	Acquisition/Reacquisition Time:< 10 ms
	Input / Output Interface: Ethernet/ RS422
3. Power Supply	Power supply : 28V \pm 4V operation
4.Connectors	RF Input (Rx) :SMA(F)1 No
	RF Output (Tx1,Tx2) : SMA (F)2 Nos
	Power Supply : 3 Series Circular Connector (6-Pin)
5. Enclosure	Mechanical : 19" Rack 2U (Approx.) Size with mounting slides and handles
	Cooling fans: Forced air using fans adequate heat sink
	Gaskets, mesh at openings, back shelf of connectors
6.Interface	Ethernet/ RS422

7. Data Link Controller Module for Ground Test jig	Spartan 6 LX 100 FPGA with ARM 32 processor or equivalent
	4Port RS422 UART Parts, 8-pin 3.3V output, 8-pin 3.3V LV TTL input, 19.6416 MHz TCXO \pm 1PPM control for signal processing, reset operation
	Power Supply: 28V DC operation with Gaia DC-DC & filter
	Mechanical: 4" X 7" HE-15/13 Box (Approx.)
	51 pin Micro D, Ethernet RJ45 connector
	Spartan 6 LX 100 FPGA with ARM 32 processor



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3 (c). DL RF test Jig Module Specifications

S.No.	Type	Description
1	Termination	a) Power Rating: 100W Part No: 1492LIM Make: API Technologies Frequency Range: DC to 6 GHz SWR: 1.15 Impedance: 50 Ohms, nominal Connector: N Type Connector
2	Attenuator	a) Frequency Range: 0 Hz - 6 GHz Part No: 5940 N-50-1/133-N Make: Huber + Suhner VSWR: 1.45 Connector: N-Type Impedance: 50 Ohms, nominal Power Rating: 100W Attenuation: 40 dB Fixed b) Frequency Range: 0 to 6 GHz Make: API Technologies Part No: 6B20W-20F VSWR: 1.20:1 Connector: SMA male and female connectors Impedance: 50 Ohms, nominal Power Rating: 20W Attenuation: 20 dB Fixed
3	Power Divider	a) 2 Ways DC Pass Power Splitter Part No: ZN2PD2-63-S+ Make: Mini Circuits Frequency Range: 350 - 6200 MHz Impedance: 50 Ohms, nominal Power Rating: 25W Insertion loss: 0.9dB Connector: SMA
4	variable attenuator	a) 0 to 99 dB Rotary Step Attenuator Part No: PE7443-99 Make: Pasternak Frequency Range: DC - 8000 MHz Impedance: 50 Ohms, nominal Power Rating: 2W Insertion loss: 1 dB VSWR: 1:5:1 Connector: SMA Female to SMA Female
5	USB to 1553	a) Portable USB 2.0 Device MIL-STD-1553 & ARINC 429 MIL-STD-1553 – 2 channels ARINC 429 Physical Dimension: 1.50 x 5.20 x 5.00 in b) DATA BUS COUPLER, 2 STUBS c) TERMINATION ASSY 78.7 OHM d) PL75/PL75 with MIL-C-17/176-00002- 1 ft Make: DDC Model: BU-67102U200L-CA0



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6	SERIAL BUS MODULE	
	USB 2.0 Interface	<ul style="list-style-type: none"> • 4 Port Serial Port : RS422 • Suitable for DIN rail Mounting • 1x Lockable USB Cable included for connection security
	Configuration	<ul style="list-style-type: none"> • Each port is individually software configurable for RS 232, RS 422, and two-wire or four-wire RS 485
	FIFO Depth	<ul style="list-style-type: none"> • High Speed UART with 128-byte Tx FIFO and 384-byte Rx FIFO
	RS-485 Selection	<ul style="list-style-type: none"> • Automatic Hardware RS 485 enable/disable
	BAUD	<ul style="list-style-type: none"> • Each serial port supports data rates to 921.6k bps
	Connectors	<ul style="list-style-type: none"> • Four DB9M connectors with full modem control signals implemented in RS 232 mode
	Status	<ul style="list-style-type: none"> • Status LEDs indicates power, electrical interface and serial data activity for each port
	Dimensions	<ul style="list-style-type: none"> • (L x W x H) 23.4 cm x 13.5 cm x 4.3 cm
	Power	<ul style="list-style-type: none"> • Should operate with USB power • External +5V power input provided (power consumption typical : 5V @ 400 mA)
	Environmental	<ul style="list-style-type: none"> • Operating temperature Range : -40°C to 85°C • Storage temperature Range -65°C to 150°C • Relative Humidity Range : 5-95% RH (NC)
	Make	<ul style="list-style-type: none"> • CONNECTIVE PERIPHERALS
	Model	<ul style="list-style-type: none"> • USB-H-6004-M
7	Portable Data Acquisition Module	<p>48 Channel TTL D10 USB Module USB 2.0 Cable Mounting bracket</p> <p>Make: Advantec Part Number: USB 4751</p>
8	Cables and Connectors	<p>a) Adapter: Part No: SF2991-6007-ND Make: Amphenol Type: SMA to SMA Impedance: 50 Ohms Max Freq: 11 GHz Orientation: Straight</p> <p>b) Cables: 1mtr – SMA to SMA MAX Freq: 18 GHz 2mtr- SMA to SMA MAX Freq: 18 GHz</p> <p>Ethernet Cable. Cat-IV Cable Part No: MCSSP60030 – 3mts Part No: MCSSP60050 – 5mts</p> <p>Termination: 132360- 2W up to USB 2.0 Cable-3ft</p>
9	Combiner	<p>a) Power Combiner: Frequency: 700-6000MHZ Part No: IPP-1272 Make: Innovative Power Products Insertion Loss: 0.9db</p>



		VSWR: 1.35:1 Power: 125W Isolation > 8dB Connector: SMA Connector
10	Enclosure with Handlers	a) Connectorized Mechanical enclosure. The 2U/3U rack mount equipment should be used For integrating above S.No. 1 to 7 b) Dc fans 24VDC Square - 40mm L x 40mm H Sintec 5.3 CFM (0.148m ³ /min) 2 Wire Leads c) EMI/EMC shielding/gaskets should be provided d) Integration of Modules will be done by using 3mm 5mm rigid low loss Coaxial cables. e) Handles to be provided for 2U/3U equipment. f) All mating connectors/cables to be provided
11	Power Supply	28V Power supply
12	Connectors	Series 3 circular connectors for data SMA(f) for RF
13	Cooling fans	Forced air using fans adequate heat sink

Note: Vendor has to provide 1 set of mating cables

3(d). Simulators with Software IPA:

It consists of four simulators

1. OBC DL Simulator
2. Onboard DL Test-Jig Simulator
3. FCC DL Simulator
4. Ground DL Test-Jig Simulator

Each simulator has Graphical user interface to configure and evaluate the functional specifications of DL components.

- i) Dell Latitude 5430, Make: DEL
1. 512GB SSD
 2. 11th Generation Intel® Core™ i7-1185G7 vPro®
 3. (12 MB cache, 4 cores, 8 Threads, 3.0 GHz to 4.30 GHz, 28 W)
 4. Windows 11 Pro, 64-bit
 5. Intel® Iris Xe Graphics
 6. 14-inch, FHD, 1920 x 1080, 60 Hz, anti-glare,
 7. Non-touch, 100% Srgb, 400 nits,
 8. Wide-viewing angle
 9. 16 GB, 2 x 8 GB, DDR4, 3200 MHz, non-ECC,
 10. Dual-channel
- Rom: 512GB

II) Software IPs:

- a) BPSK/QPSK
- b) PCM-FM to be provided
- c) Data rate; 3 to 5Mbps programmable
- d) Demo to be done on Zynq+AD 9361 Module



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3(e). 12-way Power Divider

a) 12 Ways DC Pass Power Splitter

Part No	:	ZN12PD-63-S+
Make	:	Mini Circuits
Frequency Range	:	600 - 6000 MHz
Impedance	:	50 Ohms, nominal
Power Rating	:	20W
Isolation	:	19dB
Insertion loss	:	1.4-3.0 dB
Connector	:	SMA

3(f). Data Acquisition and Multiplexer System

Data Acquisition System with 32 Channel Multiplexer Digital I/O Module CONSIST OF

Data Acquisition and Multiplexer System

MULTIPLEXER DIGITAL I/O MODULE

Software for Data Acquisition System in a CD/DVD

01	Functions and Features: Volts, Ohms, Amps, True RMS, Frequency, Period, Temperature, Capacitance Measurements and Data Recorder Mode
02	Sample Rate: System should have V/I digitizer with 1 MS/ sec and should capture voltage or current transients with 1 MS/sec digitizer
03	Resolution: 6 1/2 bit or better
04	Display: Large 12.7 cm (5 in.) capacitive touch, color TFT WVGA (800 × 480) with LED backlight multi-touch and graphical display
05	DC Voltage range: 100 nV to 1010V or better
06	AC Voltage range: 100 nV to 750Vrms or better
07	DC Current range: 10 pA to 3 A or better
08	AC Current range: 100 pA to 3 A or better
09	Resistance Measuring range(2-wire): 10 $\mu\Omega$ to 120M Ω or better
10	Resistance Measuring range(4-wire): 1 $\mu\Omega$ to 120M Ω or better
11	Capacitance Measuring range: 0.1 pF to 120 μ F or better
12	Period Measuring range: 3.3 μ s to 333 ms or better
13	Frequency Measuring range: 3Hz to 300KHz or better
14	Diode Measuring range: 10 μ V to 12 V or better (Selectable: 10 μ A / 100 μ A / 1 mA / 10 mA source)
15	Digitize Voltage range: 10 μ V to 1010 V or better
16	Digitize Current range: 10 nA to 3 A or better
17	Thermocouple Measuring range: -200°C to 1820°C or better
18	Thermistor Measuring range: -80°C to 150°C or better
19	2-, 3-, 4-Wire RTD Measuring range: -200°C to 850°C or better
20	Maximum Reading Memory (volatile): Up to 7 million readings with standard buffer (includes channel and formatting information).
21	Internal (non-volatile) Memory for Saved Scripts and Scan Configurations: 6 MB or better
22	Communication interface: USB, LAN LXI
23	Net Weight: \leq 5 kg



24	Warranty: 3 years
25	Processor : Intel i7 RAM:16 GB DDR\$ Hard disc Drive: SSD-500 GB or Higher Peripheral Ports:2 or more speed USB(3.0) Ports 4 or more High speed USB(2.0) ports 1 or more Gigabit Ethernet ports(10/100/1000 base) base to be available in system controller 1 X HDMI/VGA port Operating System : Windows 10 (64bit)
26	Input Signal Connections: Front plug-in modules
27	Plug-in Module Slot: Two slots on the rear panel
28	32 Channel Multiplexer Digital I/O Module: (a) Description: 32 Ch. Digital I/O Module (b) No. Analog: Inputs 10 (c) Configuration: Digital I/O/ Multiplexer (1×10 or two 1×5) (d) Connector Type: 50 pin male D-sub and 25 pin female D-sub (e) Max. Voltage: 300 V or better (f) Max. Switched Current: 1 A or better (g) Bandwidth: 2 MHz or better (h) Switch Speed 3 ms or better
29	Dimensions(WxHxD): 224 mm x 107.2 mm x 387.4 mm Approx.
30	Math Functions: (a) REL, Minimum, Maximum, Average, Standard Deviation, peak-peak, dB, Limit Test, Percent, 1/x, and mX+b with user-defined units
31	Miscellaneous: (a) Password Protection: 30 characters (b) Alarms: Up to six
32	Accessories to be supplied: (a) Pair, General Purpose Test Lead Set, 1000 V Cat II (b) USB Cable, Type A to Type B, 1 m (3.3 ft.) (c) Traceable Calibration Certificate
33	Operating Temperature: 0 °C to +50 °C
34	Additional Specification: (a) Vendor should submit Authorization certificate from the OEM without which bid will not be considered (b) Make in India content certificate from OEM should be submitted (c) OEM should have their own service and Calibration Centre in India; proof must be submitted
37	Power Supply: 230V, 50 Hz Power supply
35	Make : Keithley Model: DAQ6510 (For DAQ Unit), 7707 (for Digi I/O Module)
36	Software: Linux/Windows drivers , GUI software for Data Acquisition system in a CD/DVD



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3(g). 2- series Mixed Signal Oscilloscope

1	No. of analog Channels : 4 or More (Separate AUX input Channel required)
2	Record Length : >10M points
3	Sample rate per channel : ≥ 1.25 GS/s
4	Analog Channel bandwidth : 500 MHz or better
5	Input coupling : AC, DC
6	Vertical Setting : Independent windows for simultaneous measurement of all channels
7	Input sensitivity range : 1mV/div to 10V/div
8	Maximum input voltage : 300 Vrms
9	Vertical Resolution : 8 bits ADC and Up to 16 bits in high-resolution mode
10	Display type : Color TFT or Better
11	Minimum Display size : ≥ 10 Inches
12	Display type : 1280 X 800 resolution capacitive touch screen or better
13	Time Base Accuracy : ± 25 ppm or better
14	Standard Trigger type: Edge, pulse width, runt, timeout, logic, setup & hold, rise/fall time, and parallel bus
15	Probe Compensation signal :
	(a) Amplitude : 0 to 2.5 V
	(b) Frequency : 1 KHz
	(c) Source Impedance : 1 K Ω
16	Standard analysis :
	Cursors : waveform, V bars, H bars, and V&H bars
	Measurement : 36
	Plots: XY, limit mask
	Math : basic waveform arithmetic, FFT, and advanced equation editor
	Search: Search on any Trigger Criteria
17	Time Base Range :
	2 ns/div to 1000 s/div (all Channels)
	1 ns/div to 1000 s/div (half Channel)
18	Time base delay range : -10 divisions to 5000s
19	Channel to Channel deskew range :-95 ns to +95 ns
20	Trigger Modes : Auto, Normal and Single
21	Trigger Coupling : DC, HF reject, LF reject, Noise reject
22	Trigger Hold off Range : 0 s to 10 s
23	Acquisition modes : Sample, peak detect, Averaging, Envelope, Hi Resolution
24	Measurement Statistics : Mean, Standard deviation, Maximum, Minimum and population
25	I/O interface: USB, LAN
26	Power source : 240 V, 50 Hz
27	Net weight : ≤ 1.8 kg
28	Regulatory : CE and RoHS Compliant
29	Dimensions : 210 mm Height x 344 mm width x 40.4 mm Depth or better
30	Make: Tektronix/Key sight/R & S



List of Deliverables

1. The Onboard DL Transceiver Test-Jig Module -1 No
2. DL RF Test-Jig Module -2 No's
3. OBC DL Simulator -1 No
4. Onboard DL Test-Jig Simulator -1 No
5. The Ground DL Transceiver Test-Jig Module -1 No
6. FCC DL Simulator -1 No
7. Ground DL Test-Jig Simulator -1 No
8. 1*12 RF Power Divider -2 No
9. Data Acquisition and Multiplexer System- 1 No
10. 2- Series Mixed Signal Oscilloscope- 1 No

Terms and Conditions

1. Software if applicable to be written as per RCI ICD
2. RCI ICD will be given to L1 Vendor
3. The items will be accepted by conducting FTP by User Rep(RCI)
4. Cable Loom to be provided by vendor for external connectivity.
5. Internal cabling to be done by low loss semi-rigid RF cables.
6. All the Connectors to be closed with dust caps.
7. All the RF Connectors to be terminated with RF terminators.
8. Proper title & label to be printed. RCI logo to be printed.
9. Model number to be given as per RCI standard plan and it must be there on all deliverables.
10. Delivery: Delivery to be completed within 8 months of S.O under any circumstances.
11. Warranty: 1 Year minimum Warranty should be provided for all the deliverables



12

