

GOVERNMENT OF INDIA  
DEPARTMENT OF SPACE  
ISRO SATELLITE CENTRE (ISAC)  
AIRPORT ROAD, VIMANAPURA POST  
BANGALORE 560 017

**TENDER NOTICE NO. 11 DATED 18.01.2010**

On behalf of President of India, Head, Purchase & Stores, ISRO Satellite Centre (ISAC), Bangalore 560 017 invites sealed tenders for the supply of the following items:

SL. NO	TENDER REFERENCE	BRIEF DESCRIPTION	QTY	TENDER FEE INCL OF S.TAX Rs. Ps.
01	ISIR 2009015021	BARE DICE TRANSISTORS & DIODES	(as per Document)	Rs.225/-
02	ISHS 2009015110	DUAL CHANNEL RF POWER METERS WITH POWER SENSORS	(as per Document)	Rs. 225/-
03	ISIP 2009015487	RF MEASUREMENT SYSTEM	(as per Document)	Rs. 225/-
04	ISIR 2009015492	MOLEDENUM SULPHIDE COATED TITANIUM FASTENERS	(as per Document)	Rs. 225/-
05	ISGE 2009015609 <b>(THIS IS A TWO PART TENDER)</b>	SOLAR ARRAY SIMULATOR	60 Nos	Rs. 225/-
06	ISDO 2008013184 <b>(THIS IS A TWO PART TENDER)</b>	THERMAL SHOCK CHAMBER	01 No	Rs. 225/-
07	ISIR 2009014980 <b>(THIS IS A TWO PART TENDER)</b>	DEVELOPMENT & TESTING OF PAYLOAD BIT SYNCHRONIZERS.	08 Nos	Rs. 225/-

FOR SUBMISSION OF TENDER : 01<sup>ST</sup> MARCH 2010 AT 1600HRS (IST)

OPENING OF TENDER : 02<sup>ND</sup> MARCH 2010 AT 1000HRS (IST)

**NOTE: TWO PART TENDER SYSTEM IS APPLICABLE FOR SL. NOS. 05, 06, & 07 ONLY . INSTRUCTIONS ARE PART OF THE TENDER DOCUMENTS.**

**NOTE:**

1. Tender documents are also available on ISRO Web site of [www.isro.gov.in](http://www.isro.gov.in) Tender Notice No.11 dtd. 18-01-2010. Interested tenderers may, at their option, download the tender documents from website and submit offers along with prescribed tender cost (in form of Bank Draft) as per details in the tender notification. The Demand Draft should be sent in a separate cover with a covering letter along with the cover containing the quotation.
2. Tender fee shall be payable only in the form of bank draft drawn in favour of Accounts Officer, ISRO Satellite Centre, payable at Bangalore. No other mode of payment for tender fee is acceptable.
3. Vendors/firms name and tender no. shall be indicated on the reverse side of the Demand Draft.
4. While requesting for tender documents, please do not superscribe tender number and due date on the envelop. Instead indicate "Request for Tender Documents".
5. Detailed specification, terms and conditions are furnished in the tender documents.
6. DD should not be dated prior to the date of advertisement / intimation / website. Separate requests and demand drafts shall be sent for each tender document.
7. ISAC will not be responsible for non-receipt of tender documents/offers due to postal delay / loss in transit.
8. Quotations received without payment of tender fee will be treated as unsolicited.
9. Indian agents while quoting on behalf of their principals are requested to provide necessary authorisation letter from their Principals.
10. The offer should be valid for the period of Ninety days from the date of opening.
11. Quotations received after the due date and time will not be considered.
12. While submitting your offer please superscribe tender no and due date on the envelope. Addressed to Head Purchase & Stores, ISRO Satellite Centre, Airport Road, Vimanapura Post, Bangalore-560 017.
13. If tender opening date happens to be public holiday tender will be opened on the next working day & interested Vendors may depute their Representatives to attend the Public Tender Opening.
14. Request for the extension of the due date will not be considered.
15. Head, Purchase and Stores, ISAC reserves the right to accept or reject any tenders in part or full without assigning any reasons thereof.
16. Those who do not utilise the website shown at clause 01 above can also buy the Tender documents from Purchase Officer, Purchase & Stores Division, ISRO Satellite Centre, Airport Road, Vimanapura Post, Bangalore-560 017, INDIA on payment of Non-refundable tender fee as indicated above, on all working days between **1400Hrs to 1600Hrs**.

For preparing an offers in response to the two part tender called for:  
We propose to receive offers in response to this tender in Two parts as follows:

**PART ONE**

This should consist of two sections viz., (a) Technical and  
(b) Commercial

(a) Technical : This section should consist of:

- All technical specifications of the items options and accessories offered by you.
- Relevant leaflets and literature and any other technical matter pertaining to the items offered.

(b) Commercial: All the commercial points to be indicated (other than prices) should come in this section for example:  
Delivery terms and delivery period , Payment terms (our standard Terms i.e. 100% Payment within 30 days after receipt and Acceptance)

- Validity period of the offer (120 days required)
- Warranty / Guarantee applicable
- Installation details such as installation is done Free of cost or not
- If not indicate “installation charges indicated in Price part”.
- Whether training is required; if so, free of cost, if not indicate “training charges indicated in price part”/  
“Approximate weight of the consignment”.

Note: (1) Part 1 prepared as above should be Enveloped and  
Superscribed Technical & Commercial part 1

Reference No.....  
Due date .....

Note (2) Part 1 should not contain any price details

: 2 :

**PART II (PRICE PART)**

This part should consist of :

- Prices of the unit and total amount for the items offered (with break-up Wherever required):  
Price of option and accessories Installation charges & Training (if not free)

Where the quotation is on Ex-works basis Packing forwarding and inland freight charges if any Price part (Part II) thus prepared should be Enveloped separately and superscripted as.

- Price part II
- Reference No:.....
- Due Date.....

Note (3): Both the envelopes (Part 1 and Part II)

Prepared as above should be placed in another envelope and superscribed as follows:

Reference No:.....  
Due Date :.....

Part 1 & Part II individually enveloped inside:

TO

THE HEAD, PURCHASE AND STORES  
ISRO SATELLITE CENTRE  
GOVERNMENT OF INDIA  
DEPARTMENT OF SPACE  
AIRPORT ROAD  
VIMANAPURA POST  
BANGALORE-560 017.

Note(4):The above should reach us on or before the due date and time.

Note(5): HEAD, PURCHASE AND STORES, ISRO SATELLITE CENTRE,  
GOVERNMENT OF INDIA, DEPARTMENT OF SPACE.  
AIRPORT ROAD, VIMANAPURA POST,, BANGALORE-560 N017.  
RESERVES THE RIGHT OF ACCEPT OR REJECT ANY OF THE  
QUOTATION IN FULL / PART THEREOF WITHOUT ASSIGNING  
ANY REASONS

## **ISIR 2009015021**

### **PROCUREMENT SPECIFICATIONS FOR DIODE & TRANSISTOR DICE**

Transistors:

Sl.no.	Type	Preferred Die dimensions in mils	Minimum bond pad dimensions in mils
1	2N2222	20 x 20	4 x 4
2	2N2907A	20 x 20	4 x 4
3	2N5154	60 x 60	4 x 4
4	2N918	16 x 16	3 x 3
5	2N2857	20 x 20	4 x 4
6	2N2906A	20 x 20	4 x 4
7	2N2369	20 x 20	4 x 4
8	2N3019	24 x 26	4 x 4

Diodes:

Sl.no.	Type	Preferred Die dimensions in mils	Minimum bond pad dimensions in mils
1	1N4623	23 x 23	4 x 4
2	1N4625	23 x 23	4 x 4
3	1N4627	23 x 23	4 x 4
4	1N4148	20 x 20	4 x 4
5	1N758A	23 x 23	4 x 4
6	1N759A	23 x 23	4 x 4
7	1N3070	20 x 20	4 x 4

- NOTE :
1. Quote for quantities in slabs of 200+, 500+, 1000+, 10000+, 20000+
  2. Back metallization shall be gold.
  3. Die diagrams shall be provided.
  4. Devices other than the specified dimensions can also be quoted.

#### **A. QUALITY REQUIREMENTS**

1. The dice shall be **Qualified to** JANKC or **equivalent** to JANKC of MIL- PRF-19500.
2. Each wafer lot shall undergo Wafer Lot Acceptance Test in accordance with MIL-PRF-19500.
3. All deliverable dice shall be from single wafer lot & wafer lot traceability information shall be provided.
4. Dice from each wafer lot shall be evaluated as per the evaluation matrix enclosed.
5. Test samples shall be assembled in suitable packages using standard assembly procedures.
6. All Electrical, Mechanical & Environmental Specifications shall be as per applicable Detail Specifications.

**B. DATAPACK REQUIREMENTS**

The following data will accompany the dice:

1. Read & Record data (for evaluation samples) of:
  - a. Delta parameters - Pre & Post HTRB (if applicable), Pre & Post Burn in, Pre & post Life test with deltas calculated
  - b. Report of 100% final electrical parameters measurements, as per Group A, subgroups 2 and 3.
2. Wafer Lot Acceptance Test report.

**3. SEM report along with photographs.**

4. Die shear & bond pull test reports.
5. Certificate of Conformance issued by the manufacturer & supplier.

**C. OTHER REQUIREMENTS**

1. Dice shall be from the latest batch only. The datecode of the batch shall be mentioned in the quotation.
2. Die Topography shall be supplied along with the offer.
3. The required Bond Pad Dimensions is 4mils X 4mils. In case not available to required dimensions, quote for other possible options.
4. All waffles containing dice to be purged with dry nitrogen and sealed.
5. Report to ISAC all NCR/DCR during procurement.
6. Only vendors/Suppliers authorized to source Space Grade Dice from the manufacturer will be considered. Necessary Certificate from the Manufacturer shall be enclosed along with the offer.

Please provide the point-by-point compliance to specification in your quote.

Encl: Semiconductor Dice Evaluation Matrix

**Semiconductor Dice Evaluation Matrix**

Step	Test	MIL-STD-750		Quantity
		Method	Condition	(accept no.)

1	Electrical Test	Associated Detail Spec		100%
2	Visual Inspection	2069,2070, 2072,2073		100%
3a	Internal/die Visual inspection	2069,2070, 2072,2073		10(0)
3b	Sample assembly			10 pieces min
4	Stabilisation Bake	1032	C, t=24 Hr min	10(0)
5	Temperature Cycling	1051	C	
6	Constant Acceleration	2006	Y <sub>1</sub> direction	
7	Electrical test (Read/record)		Group A, subgroups 2,3,4	
8	HTRB a. Transistors b. PowerFETS c. Diodes	1039 1042 1038	t=48Hrs, T <sub>A</sub> =150°C Condition A Condition B Condition A	
9	Electrical test (Read/record)		Group A, subgroup 2	
10	Burn-in a. Transistors b. PowerFETS c. Diodes	1039 1042 1038	t=240Hrs, T <sub>A</sub> =25°C Condition B Condition A Condition B	
11	Electrical test (Read/record) a. Interim electrical & Delta Calculations b. Other Electrical Parameters		Group A, subgroup 2  Subgroups 3 & 4	
12	Steady State Life Test a. Transistors b. PowerFETS c. Diodes	1039 1042 1038	t=1000Hrs, T <sub>A</sub> =25°C Condition B Condition A Condition B	
13	Electrical test (Read/record) a. Interim electrical & Delta Calculations b. Other Electrical Parameters		Group A, subgroup 2  Subgroups 3 & 4	
14	Wire bond Evaluation	2037	Condition A	10(0)wires
15	Die shear Evaluation	2017		5(0)
16	SEM	2077		See Test Method 2077

1. Sample size shall be 3 die from each wafer and a total of at least 10 die from each wafer lot.
2. During Burn-in and Life test no heat sink or forced air cooling on the devices shall be permitted.

All applicable slash sheet and associated detailed specification shall be as per MIL-PRF-19500

## **ISHS 2009015110**

### **Specifications**

#### **Power Meter with Sensors**

##### **1. Power Meter :**

1. Frequency Range : 10KHz to 110GHz
2. Power Range : -70 to +44 dBm , Sensor dependant
3. No.of Channels : 2(two)
4. Inputs : Front & Rear panel sensor connector(Both),  
Rear panel GPIB (LAN Optional, IPV 6 compliance shall be specified)connector
5. Remote Control Interface: GPIB (LAN Optional, IPV 6 compliance shall be specified)  
on Rear panel
6. Display : Menu driven
7. Display Units : Linear/logarithmic
8. Display Resolution : better than or equal to 0.01(dB,dBm,dBr)
9. In built Zeroing & Internal calibration facility to be provided
- 10.Reference level : better than or equal to -99.99 dB to+99.99 dB in 0.01 steps for dBr  
measurements
11. Power Supply : AC 220 V, 50 Hz
- 12.Power Reference  
Frequency : 50MHz  
Output level : 0dBm  
Source Impedance: 50 ohm  
VSWR : better than1.05  
Connector : N Type (Female)
13. All functions of the power meter to be programmable
14. Rack mountable Handle & Flange kit. (Optional: Rack sliding provision)
15. Measurement accuracy/Uncertainty values to be provided
16. Provision of calibration data storage of the power sensors
17. Calibration cycle values to be provided
18. Warranty with calibration: 1 Year minimum
19. Extended Warranty support including calibration up to 5 yrs may be quoted  
separately.
20. The vendor shall have an explicit calibration & repair facility in Bangalore/India.  
The vendor shall confirm that they will be able to perform calibration of both Power  
meter and sensors at their facility in India. The total turn around time for this shall also  
be mentioned.

##### **21. Quote in slabs of 1 to5, 6 to 10, 11 to 15 and 16 to 20.**

##### **2. CW RF Power Sensors:**

1. Frequency Range :10MHz to 18GHz
2. Dynamic Range : -70 to +20 dBm
3. Impedance : 50 ohms
4. Connector : N type (Male)
5. Max SWR : upto 18GHz better than 1.25

6. Sensor cable length : 5 feet min
7. Sensor Calibration Uncertainty values to be provided
8. Quote in slabs of 1 to 10, 11 to 20 and 21 to 30 of each type
9. Additional Power sensor inter connection cables :  
Cable lengths Required: 10ft, 20ft, 50 ft & 100ft

**Quote in slabs of 1-5,6-10,11-15 for each length**

**NOTE :-** All detailed Technical note/Catalogue to be provided along with the quotation.

**ISIP 2009015487**

**RF MEASUREMENT SYSTEMS:**

1. SIGNAL GENERATOR - QUANTITY : 01 NO.
2. POWER METER WITHN SENSORS - QUANTITY : 01 NO.
3. FREQUENCY COUNTER - QUANTITY : 01 NO.
4. TRUE RMS VOLTMETER - QUANTITY : 01 NO.

**The equipments must be quoted separately**

Specifications for Signal Generator		
SI No	Parameters	
1	Frequency Range	250KHz to 40GHz and single unit covering the entire range
2	Frequency Resolution	0.001 Hz (CW mode), 0.01Hz (sweep mode)
3	Output level	-130 dBm to +12 dBm
4	Harmonics level @ +10 dBm	100 kHz ≤ f < 300 kHz : <-25 dBc 300 kHz ≤ f < 10 MHz : <-28 dBc 10 MHz ≤ f < 200 MHz : <-40 dBc 200 MHz ≤ f < 1 GHz : <-50 dBc 1 GHz ≤ f ≤ 21 GHz : <-30 dBc 21 GHz ≤ f ≤ 43.5 GHz: <-40 dBc
5	Non harmonics level @ +10 dBm	Better than -50 dBc

		21 GHz ≤ f ≤ 43.5 GHz: <-40 dBc
5	Non harmonics level @ +10 dBm	Better than -50 dBc
6	Sweep	Equipment must have facility for both digital and Analog (Ramp)
7	RF Digital Sweep	Automatic, Single or external triggered
	Sweep range	Freely selectable
	Step time	2 ms to 10 s with resolution of 0.1ms
8	RAMP Sweep	
	RF sweep	Automatic, manual
	Sweep time	Selectable - 2 ms to 10 s
9	External Modulation Requirements	
	AM – Modulation Depth	0 to 100 %
	FM – Frequency Deviation	10 MHz
	Phase Modulation - Deviation	80 Radians

---

10	Pulse Modulation	External, Internal
	ON/OFF Ratio	>80dB
	Rise / Fall time	20ns
	Pulse repetition frequency	DC to 5 MHz
General Requirements		
11	EMC	Compliance with European Norms
12	Interface	GPIB, LAN / Ethernet
13	Power Requirement	220V ± 5% AC, 50 Hz
14	Other Accessories to be Included	<ul style="list-style-type: none"> <li>• 2m GPIB Cable</li> <li>• USB-GPIB Converter with drivers</li> <li>• Hard and Soft Copy of Operating, Programming &amp; Service Manuals</li> <li>• 19" Rack mount Kit and slide Kit</li> </ul>

---

<b>Technical Specifications for Power Meter &amp; Sensor</b>		
<b>Power Meter</b>		
SI No	Parameter	Specifications
1	Measurement function	Average Power
2	Frequency range	9 kHz - 40GHz
3	Resolution of display	0.001dB
4	No of channels	Dual channel
5	External Interface	GPIO
6	Display units : Absolute Relative	in W, dBm and dBμV in dB, as change in percent (Δ%) or as quotient
7	Power supply	220 V ± 5% AC, 50 Hz
8	Other Accessories to be Included	<ul style="list-style-type: none"> <li>• 2m GPIO Cable</li> <li>• Hard and Soft Copy of User (Operating, Programming &amp; Service) Manuals</li> <li>• 19 inch rack mounting kit &amp; slide kit</li> </ul>

**Power Sensors with cable – Quantity : Two (One for Each Channel)**

SI No	Parameters	Specs
1	Frequency	DC to 40 GHz
2	Power Range	-70 dBm to +20 dBm
3	Matching (SWR)	Below 26.5GHz : < 1.20 Above 26.5GHz : <1.30
4	Max. power (Average) Pulse energy	0.3 W (+25 dBm) continuous 10 Wμs
5	Linearity uncertainty	< 0.02 dB
6	RF connector	2.9 mm (male) (with SMA adapter)

Specification for Frequency Counter		
Sl.No.	Parameters	
1	Frequency Range	10 Hz - 40GHz
2	Frequency Resolution	1 Hz to 1MHz
3	Impedance	Channel 1: 1 M $\Omega$ Channel 2: 50 $\Omega$
4	Connector	Channel 1: BNC female Channel 2: 2.9mm with SMA adapter
5	Input/Output coupling	AC
6	Operating level	10 Hz – 100 MHz : 2 V <sub>rms</sub> (at Channel 1) 50 MHz – 2 GHz : + 5 dBm (at Channel 2) Above 2 GHz : +10dBm (at Channel 2)
7	Acquisition time	<200 ms
8	Amplitude Discrimination	Applicable to Channel 2 : Above 200MHz : 20dB for 75MHz separation 10dB for less than 75MHz separation
9	Display	LED / LCD
10	Power Supply	220 V $\pm$ 5%, 50 Hz
11	<b>GPIO Programmability to be provided</b>	
12	Other Accessories to be Included	<ul style="list-style-type: none"> <li>• 2m GPIO Cable</li> <li>• Hard and Soft Copy of User (Operating, Programming &amp; Service) Manuals</li> <li>• 19 inch rack mounting kit &amp; slide kit</li> </ul>

Specifications for True RMS Voltmeter		
SI No	Parameters	
1	Measurement functions	RMS Voltage, DC Voltage, Frequency
2	Frequency range	3Hz to 300KHz
3	Voltage range (AC and DC)	100mV to 300V
4	Input impedance	1M Ohm, shunted by 40pF
5	IEC/IEEE Bus	GPIO Programmability
6	Maximum Crest factor (AC Voltage measurement)	Maximum of 5:1 at full scale
7	Input Connector	BNC
8	Power Supply	220 V $\pm$ 5%, 50 Hz
9	Other Accessories to be Included	<ul style="list-style-type: none"> <li>• 2m GPIO Cable</li> <li>• Hard and Soft Copy of Operating, Programming &amp; Service Manuals</li> <li>• 19 inch rack mounting kit &amp; slide kit</li> </ul>

**HEXAGONAL SOCKET HEAD CAP SCREWS**

Thread	: ISO Metric Thread as per ISO 68
Tolerance	: 4h as per ISO 965
Fastener	: Grade A as per ISO4762
	Designation, Length, (l), shank length (ls) and the quantity required are as per the Table-1 attached.
Surface finish	: Before protection Ra max. 3.2 µm.
Finish	: Anodised & coated with Molybdenum-di-sulphide dry lubricant
End of fastener	: Chamfered as per ISO4753
Material	: Ti – 6Al – 4V as per AMS 4967 G
Ultimate Tensile strength	: 1100 MPa (Minimum)
Yield strength	: 900 MPa
Acceptance inspection:	ISO3269, Test method as per ISO898
Tolerance for fastener:	As per ISO4759/1
Acceptable surface discontinuities:	As per ISO6157-3
Magnetic cleanliness	: Non-magnetic
Sampling procedure	: As per ISO3269-1984 (E)

Note:

- 1. Supplier can use equivalent national / international standards, but shall include in their data package for the standard used.**
- 2. Drawing to be sent to us for approval before manufacturing**
- 3. Original Test reports conforming chemical composition, mechanical strengths, finish, tolerance for threads, etc from the manufacturer to be sent along with the supply.**

**4. Bolts manufactured by ALCOA (MECAERO), FRANCE or LISI (BLANCAERO), FRANCE only to be quoted. The fasteners manufactured by these companies only will be accepted.**

**5. Test report must indicate the source of manufacturing.**

**TABLE-1**

Sl. No.	Description / Designation	Length, l (mm)	Shank length, ls (mm)	Qty (nos.)
1	M4 x 0.7 mm Pitch	8	2.5	1000
2	M4 x 0.7 mm Pitch	10	2.5	2000
3	M4 x 0.7 mm Pitch	12	5	2000
4	M4 x 0.7 mm Pitch	25	15	2000
5	M4 x 0.7 mm Pitch	30	15	2000
6	M4 x 0.7 mm Pitch	35	15	2000
7	M6 x 1.0 mm Pitch	12	2.5	5000
8	M6 x 1.0 mm Pitch	14	2.5	5000
9	M6 x 1.0 mm Pitch	16	2.5	5000
10	M6 x 1.0 mm Pitch	18	2.5	2000
11	M6 x 1.0 mm Pitch	20	2.5	2000
12	M6 x 1.0 mm Pitch	22	2.5	2000
13	M6 x 1.0 mm Pitch	25	5	2000
14	M6 x 1.0 mm Pitch	30	15	2000
15	M6 x 1.0 mm Pitch	35	15	2000
16	M6 x 1.0 mm Pitch	40	15	1000
17	M6 x 1.0 mm Pitch	50	15	1000
18	M6 x 1.0 mm Pitch	60	15	1000
19	M8 x 1.25 mm Pitch	20	4	500

## ISGE 2009015609

### SPECIFICATIONS OF 100 VDC / 5A (1U) STRING SOLAR ARRAY SIMULATOR

Sl No	PARAMETER	SPECIFICATIONS
A)	<b>MECHANICAL : SINGLE STRING</b>	
	<b>Diamensions: Unit:</b>	19"(W) X 1U(H) X 500(D-excluding projection) The unit should be fitted with slides and extender brackets This will enable the user to slide the string from the main 19" rack easily
B)	<b>ELECTRICAL : SINGLE STRING</b>	
1.	INPUT VOLTAGE	230V AC. +/- 10% 50Hz 1 phase
2.	OPEN CIRCUIT VOLTAGE	100V DC +/- 5V 95 ~ 105 V DC (Adjustable range)
3.	SHORT CIRCUIT CURRENT (ISC)	5 Amps (maximum) 100mA to 5 Amps (Settable)
4.	VOLTAGE RIPPLE	<300mV peak to peak when operted in voltage mode
5.	CURRENT RIPPLE	<40mA peak to peak (equivalent voltage depends or load resistance)
6.	TRANSIENT (DYNAMIC) RESPONSE	Peak current : <8A Rise & Fall time : <5u Sec Varying frequency : 1KHz ~ 15KHz Varying duty cycle: 10% ~ 100% The overshoot current should stabilize within initial 10% of total time period.
7.	CONSTANT CURRENT RANGE	Current should be constant from 0 to 70V ( <u>+2V</u> ) with variable load.
8.	PROTECTIONS	The SMPS output is protected against: i) Output will be protected with a series diode to suit the switching requirement to avoid external supply feeding current into the module. ii) Output overvoltage: By crowbar MOSFET across the output which will operate around >105V. Mains has to be recycled to restore normalcy. iii) Fast Current Limit: This will be set at 6A and will act within 5 milli secs. iv) Over temperature OT trip provision is made for temperature in excess of 90 +/- 3 Deg C. v) Input UV. Trip type protection operating below 207V is provided. vi) Input OV Trip type protection operating above 253V is provided.
9.	INDICATIONS	SMPS : 1) Output DC OK - Green LED 2) O/V - Amber LED 3) C/C - Red LED 4) I/P U/V - Red LED 5) I/P O/V - Red LED 6) O/T - Blue LED String Card: 1) 100V - Green LED 2) O/P - Green LED

		<p>3) OVP - Amber LED  4) Shunt - yellow LED  5) OTP- Blue LED  6) Load ON - Amber LED</p>
10.	METERING	2 Nos of backlit LCD displays one each for indicating Voltage & Current respectively
11.	CONTROLS	<p>&gt; Input ON/OFF : By a toggle Switch/Breaker on front Panel  &gt; Output Voltage/Current adj: By recessed pot on the front Panel  &gt; Load ON: By a toggle switch on front panel  &gt; Reset: By a push button switch on front panel</p>
12.	OUTPUT SWITCH	Through a relay with double break in the O/P path and an isolated monitoring contact
13.	EMI/EMC	FCC part 15 class B subpart J on output lines
14.	TEMPERATURE	<p>&lt;80°C.  The power devices temperature should not exceed 80° C at Room temperature at continuously loaded condition for 8 hours.</p>
15.	SAFETY REQUIREMENT Isolation (Passive)	<p>(a) Between input &amp; chassis}  (b) Between input &amp; output} 10mΩ  (c) Between output &amp; chassis}  (d) Between AC in &amp; DC out}</p>
16.	DC OUTPUT	On a 2 pin MS shell connector on rear side of Unit
17.	AC INPUT	On a 3 Pin MS shell connector on the rear side of Unit. 2nos of 3 pin MS shell connector will be required on individual units to Daisy Chain with other units.
<b>D)</b>	<b>TESTING</b>	<p>The unit shall be subjected to 168 hours of continuous test with the string outputs shorted (i. e., Isc mode)  Temperature of critical components shall not increase more than 70°C on the case for an ambient of 40°C Voc. Isc plots. Temperature profile, switching (0 to 25KHz) performance results to be given for each module separately.</p>

E)	GENERAL	<ol style="list-style-type: none"> <li>1. Operation &amp; Service manual: The manual will contain front and back panel component description and their functionality. Back panel connector wiring list should be provided Complete circuit diagrams with explanation component list in accordance with circuit should be put in this document.</li> <li>2. All components will be derated to 50% of Voltage current and power.</li> <li>3. Components used in the module will be of industrial grade and from reputed companies.</li> <li>4. Colour of the front panel will be Siemens grey</li> </ol>
----	---------	--

**ALL UNITS SHOULD BE HOUSED IN 2 RACKS, 30 UNITS IN EACH RACK**

**ISDO 2008013184**

**THERMAL SHOCK CHAMBER**

**QTY : 1 No**

**Specifications**

- 1.Type of Chamber : Three chamber version air to air thermal shock chamber
- 2.Type of thermal shock : Time based thermal shock ( the test specimen dwells at each test space for a definite period of time defined by the respective dwell timer irrespective of the test specimen temperature)
- 3.External dimensions of the chamber :  $W \leq 1400$ ,  $D \leq 2600$ ,  $H \leq 2500$ mm.
- 4.Basket size :  $W \geq 500$ ,  $D \geq 500$ ,  $H \geq 400$ mm
- 5.Temperature range:
  - (i)Hot Chamber :  $+25^{\circ} \text{C}$  to  $+250^{\circ} \text{C}$
  - (ii)Ambient Chamber :  $+50^{\circ} \text{C}$  to  $-10^{\circ} \text{C}$
  - (iii)Cold Chamber :  $-180^{\circ} \text{C}$  to  $+40^{\circ} \text{C}$

6. Temperature uniformity of chambers :  $\pm 1^{\circ}\text{C}$
7. Hot chamber Heating : Armored finned type electric heaters
8. Cold chamber Cooling : (i) Refrigeration system to reach  $-80^{\circ}\text{C}$   
: (ii) LN2 circulation through Copper Fin&tube heat exchanger to reach  $-180^{\circ}\text{C}$
9. Ambient chamber cooling : Using refrigeration system
10. Refrigeration system cooled : Comprising compressor with water/air condenser, Fin&tube evaporator and thermostatic expansion valve
11. Refrigerants second : R404A for first stage and R23 for second stage refrigeration system
12. Basket transfer type : Electro mechanical elevator
13. Heat transfer medium inside the chamber : Air
14. Basket transfer time from cold to hot or hot to cold :  $\leq 15$  seconds (without jerks & mechanical shock)
15. Test specimen thermal load : Equivalent to 2 kg of aluminum
16. Recovery time : 3 minutes or better in the range of  $250^{\circ}\text{C}$  to  $-180^{\circ}\text{C}$
17. Number of settable test cycles : 0 TO 9999 cycles (operator re-settable)
18. Dwell timers : 0 TO 99 minutes with least count of seconds
19. Chamber construction:
- (i) External walls: The chamber shall be of monobloc construction. The external walls should be made of zincor steel sheet of suitable thickness. The external surface of the external wall shall be painted with two coats of polyurethane paint with matte finishing.
- (ii) Internal walls: The internal walls must be made of AISI SS 304 sheets of suitable thickness with

reinforcements at regular intervals, argon arc welded for strength durability and impermeability for moisture. The chamber shall be able to structurally withstand thermal stresses. Internal structure must be connected to external structure by means of phenolic joints

(iii)Chamber insulation

Both hot and cold chambers must be provided with suitable insulation material to withstand extreme temperatures. The thickness of the insulation should allow least heat transfer between the chamber interior and the surroundings. The exterior of the chamber shall be within 5°C of the ambient temperature when the inside chamber temperature is at the extreme values. Suitable cryogenic insulation materials and techniques must be used.

An appropriate insulated baffles ensuring minimum heat transfer between the test spaces must thermally isolate the ambient to hot and ambient to cold.

(iv)Door

Each test space must be provided with a door hinged to the right by a heavy duty hinge set, providing access to the full working space. The door should be provided with silicone gasket in double rings to have a leak proof joint while chamber is in operation.

The doors shall be provided with a lockable latch set. A door switch (safety micro switch) is to be provided and electrical interlock should ensure the door closure when program is enabled. It should also provide a positive indication of the door closure in the operator panel. The chamber operation shall be stopped when the doors are opened.

All the three doors shall have glass windows. The window of the cold and ambient chambers should equipped with low tension heating system to prevent freezing on the window glass.

(v)Chamber conditioning

The test spaces are conditioned by suitable air blowers, one per cabinet, ensure uniform temperatures, and allow the specimen to quickly reach the temperature levels. The motors of these blowers shall be placed

outside the working space with suitable protection from outside air or temperature which effects the chamber conditions. The motor shaft shall be made of SS and motor blade shall be made of SS/Al material

Armored finned heaters shall be used to heat the chambers. The heaters shall be located such that there is no direct radiation from the heaters onto the test specimen and the location of heaters should be easily accessible for maintenance.

To cool the hot chamber to +25°C from +250°C, ambient chamber to -10°C from +50°C and cold chamber to -180°C from +25°C a suitable heat exchanger must be provided. The cryogenic temperature compatible long stem solenoid valve shall be used in the LN2 line to control the cold temperature in cold chamber.

For more precise adjustment at cold and ambient chambers heaters shall be used. This shall allow the cold and ambient chambers to be used either as a thermostatic chamber or as a fast automatic(PLC Programmable) defrosting system. For more precise adjustment at hot chamber GN2 circulation through Fin&tube heat exchanger shall be used.

The cold chamber and ambient chamber shall be provided with suitably placed condensate drainage pipeline which automatically drain the condensate collected on the floor of the chamber after defrosting.

(vi)GN2 purging system

All the three test spaces shall be provided with GN2 purging provision. The test spaces shall be provided with one ½" NPT pipe connection (preferably) for GN2 purging purpose

(vii)Portholes

Each of the chamber shall be provided with two portholes of minimum16-mm size with suitable sealing plugs.

(viii)Test specimen carrier

The chamber shall be provided with electrical driven actuator with specimen holding

carriage (Basket) to transfer the test specimen after the lapse of the set time in each cabinet. The basket must be made of expanded stainless steel mesh to facilitate good air circulation.

(ix) Standards

The chamber construction shall be confined to the international standards( MIL-STD, IEC, DIN, etc.) for the thermal shock tests. Also, all the chambers internal materials should not generate any corrosive elements like sulphur, chlorine, etc., during operation of the chamber.

20.Safety features:

(i)Over temperature protection

The hot chamber and ambient should be provided with an over temperature protector capable of accepting settings over the entire test space temperature range. The entire chamber operation shall be interrupted on activation of this device with alarm.

(ii)Under temperature protection

The cold chamber and ambient chamber shall be provided with an under temperature protector capable of accepting settings over the entire test space temperature range. The entire chamber operation should be interrupted on activation of this device with alarm.

21.Electrical specifications:

Mains Supply

415v, 50Hz, 3-phase AC supply provided with a suitable cable. The control switch gear and electrical equipment must conform to various safety and IP standards.

22. Control system & Instrumentation system

- (i) The control panel should include a PLC programmer/controller device.
- (ii) Programming activity shall be performed by means of a front panel Membrane keyboard and it shall provide digital / graphic displays of system parameters such as
  - (a) Set / actual / pre-heat / pre-cool test space temperatures
  - (b) Number of set and elapsed test cycles.

- (c) Set & elapsed time at each test space
- (d) Test specimen location.
- (e) Status of the safety features
- (iii) The regulation shall be a PID type
- (iv) The PID controller accuracy shall be  $\pm 1$  °C.
- (v) The system shall be capable of measuring & logging temperature data of test specimen & test spaces, at specified time intervals.
- (vi) A microprocessor graphic recorder shall be installed to provide a continuous recording of all events performed by the chamber.
- (vii) It should be possible to print the time scale and the values of all the events performed by the chamber
- (viii) Thermal probes shall be available in the movable basket to measure and record the specimen temperature

23. The electrical control system should be designed conforming to industry standard and must facilitate the following:

- (i) Electric connections according to IEC specification
- (ii) Smooth starting of electrical systems.
- (iii) Electrical protection against load faults such as short circuit, overload etc.,
- (iv) Electrical protection against supply faults such as single phasing, low voltage and negative phase sequence.
- (v) Safety push button in case of emergency.

24. Vendor's qualification Requirement:

- (i) The bidder should have good experience (at least 5 years) in supplying similar large size thermal shock chambers. The chambers should have good product heritage. MTTF should be at least equivalent to 1,00,000 cycles.
- (ii) The bidder should provide details of the customers along with type and number of similar thermal shock chambers supplied in the last three years.
- (iii) References including name of company, chamber supplied, year of supply contact person and phone numbers, performance certificate, if any should be given along with quote.

Failing to provide all the above details or the details with inaccurate/incomplete information, The quote may not be considered and the offer will be rejected

#### 25. Scope of supply:

The following items are under the scope of supply from the supplier:

- (i)The chamber shell consisting inner test space, insulation, outer shell and door as per specification.
- (ii)The complete electrical/instrumentation hardware, pipelines, pressure switches, pressure gauges, safety gadgets, line insulation etc.,
- (iii)Chamber installation / operation manual containing circuit diagrams, drawings & trouble shooting techniques, GN2 pressure for purging system, LN2 pressure requirement for cooling the cold chamber.
- (iv)Operation manuals of all subsystems.
- (v)Chamber drawings with all mechanical and electrical systems.

#### 26. Note:

- (i) The quote should be complete with a compliance statement against our specification from 1 to 25
- (ii) All deviations must be clearly stated with merits.
- (iii) A recommended spares list with prices should be given along with quote.
- (iv) The quote should also indicate the space requirement, auxiliary requirements (like pneumatic, power connections, LN2 requirement etc.)
- (v) Any options should be indicated with technical details & price.

**ISIR 2009014980**

**BIT SYNCHRONIZER**

**FABRICATION AND TESTING DOCUMENT**

# TABLE OF CONTENT

<b>LIST OF ABBRIVIATIONS .....</b>	<b>27</b>
<b>1. SCOPE OF WORK.....</b>	<b>29</b>
1.1. INTRODUCTION .....	29
1.2. STATEMENT OF WORK.....	29
1.3. NATURE OF WORK.....	30
1.4. RESPONSIBILITIES OF VENDOR .....	32
1.5. LIST OF DELIVERABLES .....	33
1.6. SAFETY PRECAUTIONS TO BE FOLLOWED BY VENDOR .....	35
1.7. SECRECY & SECURITY .....	35
1.8. DURATION OF WORK.....	36
<b>2. BIT SYNCHRONIZER .....</b>	<b>37</b>
2.1. FUNCTIONAL DESCRIPTION.....	37
2.2. SPECIFICATION .....	38
<b>3. PCB GUIDELINES .....</b>	<b>41</b>
<b>4. FRONT AND BACK PANEL .....</b>	<b>43</b>
4.1. FRONT AND BACK PANEL INTERCONNECTION DETAILS .....	43
4.2. FRONT PANEL DIAGRAM.....	44
4.3. BACK PANEL DIAGRAM .....	45
4.4. FRONT PANEL DESCRIPTION .....	46
4.5. BACK PANEL DESCRIPTION .....	46
<b>5. POWER SUPPLY SPECIFICATIONS.....</b>	<b>48</b>
<b>6. TEST METHODOLOGY .....</b>	<b>49</b>
6.1. TEST / TUNING METHODOLOGY FOR.....	49
6.2. Test Procedure for Testing Bit synchronizer : .....	51
6.3. BER performance verification .....	52

<b>6.4.</b>	<b>HMC VCO .....</b>	<b>52</b>
	<b>ANNEXURE -1.....</b>	<b>54</b>
<b>A.</b>	<b>BIT SYNCHRONIZER COMPONENT DETAILS.....</b>	<b>54</b>
<b>A.1.</b>	<b>BIT SYNCHRONIZER COMPONENT LIST .....</b>	<b>56</b>

## LIST OF ABBRIVIATIONS

BER	Bit Error Rate
BP	Back Panel
BPF	Bandpass Filter
BS	Bit Synchronizer
BW	Bandwidth
ECL	Emitter Coupled Logic
ESD	Electrostatic Discharge
FP	Front Panel
FPGA	Field Programmable Gated Array
GEOSAT	Geostationary Satellite
HMC	Hybrid Micro Circuit
IC	Integrated Circuits
I/P	Input
IRS	Indian Remote Sensing Satellite
ISAC	ISRO Satellite Centre
ISRO	Indian Space Research Organization
LED	Light Emitting Diode
LVDS	Low Voltage Differential Signaling
MBPS	Mega Bits Per Second
O/P	Output
PCB	Printed Circuit Board

PLL	Phase Lock Loop
QPSK	Quadrature Phase Shift keying
TTL	Transistor-Transistor Logic
VCO	Voltage Controlled Oscillator

## 1. SCOPE OF WORK

### 1.1. INTRODUCTION

The Bit synchronizer will be used as a part of the Payload data reception system during ground checkout activities of various IRS and GEOSAT spacecrafts. All the hardware required for this unit (except HMC VCO) will be procured and fabricated by the Vendor himself. The Vendor will deliver the full unit as per specifications and design (including essential spares). Vendor may adopt advanced concepts (if required) for better Engineering purposes.

### 1.2. STATEMENT OF WORK

#### 1.2.1. General

This statement of work comprises nature of work and the responsibilities of the Vendor in connection with the fabrication, testing and preparation of documentation in respect of Bit synchronizer.

#### 1.2.2. Scope of work

The Vendor is totally responsible for the fabrication/procurement of all the components (except HMC VCO) of Bit synchronizer, testing for their electrical functions in consultation with ISAC

focal point, preparation of test and fabrication documents for each module and the integrated equipment.

## **1.3.NATURE OF WORK**

### **1.3.1. FABRICATION**

The work prescribed will be carried out at Vendor facility by the Vendor. During the fabrication process, the following are to be followed without exception.

- 1.3.1.1. The system layout shall be approved by focal point at ISAC before implementation.
- 1.3.1.2. To strictly adhere to the guidelines provided for the PCB.
- 1.3.1.3. To maintain a folder for each module being fabricated and to log all relevant information.
- 1.3.1.4. Any deviations, anomalies observed must be logged and reported to the concerned authorities and to proceed only after clearance by ISAC
- 1.3.1.5. To test the module and assist in the incorporation of test selectable components to realize the design goals and to complete module level testing wherever necessary.
- 1.3.1.6. To mechanically fix the modules on the chassis and interconnect them as per the respective module interconnection details provided
- 1.3.1.7. All the modules should be suitably labeled for easy identification.
- 1.3.1.8. All interconnection cables and wires should be properly labeled
- 1.3.1.9.Maintain a folder for each card being fabricated.**

### **1.3.2. TESTING**

The testing work involves broadly the following:

#### ***1.3.2.1. Component Testing***

All the components that are procured must be tested individually and ascertained for its compliance with its specification as supplied by the manufacturer. Approval of the test results have to be obtained from the ISAC focal point before proceeding with module level or system level integration.

### **1.3.2.2. *Card Testing***

1.3.2.2.1. For the first set of PCBs, testing should be carried out in the presence of ISAC focal point or his representative.

1.3.2.2.2. Subsequently every PCB to be checked as per the predetermined procedure and tabulate the results.

1.3.2.2.3. Vendor shall log the test conditions, test results and report deviations to the ISAC focal point and proceed only after necessary clearance.

1.3.2.2.4. After completion of the test on each module, the results are to be reviewed and their compliance to be indicated as per the instructions.

1.3.2.2.5. All the details of the test equipment used such as model number, serial number, make etc. and the input voltages are to be recorded.

In nut shell the test setup and the environment is to be recorded in detail for an in-depth analysis in case of any requirement to simulate an identical situation in future.

### **1.3.2.3. *Unit level Check***

1.3.2.3.1. To check all input signals for their levels and format.

1.3.2.3.2. To log the test conditions, test results and reporting any deviations to the focal point and proceed only after necessary clearance. All actions carried out are to be recorded and to be produced for verification/analysis.

1.3.2.3.3. All the test results are to be recorded in the specified records as per the guide- lines.

1.3.2.3.4. All the details of the test equipment used such as model number, serial number make etc. and the input voltages are to be recorded. In nut shell the test setup and the environment is to be recorded in detail for an in-depth analysis in case of any requirement to simulate an identical situation in future.

1.3.2.3.5. Burn in test 168 hrs (min) for the unit should be conducted & the test results to be provided.

1.3.2.3.6. All the test results shall be reviewed by concerned Division Head/ Group Director of ISAC.

### **1.3.3. DOCUMENTATION**

Vendor has the responsibility of maintaining the folders for fabrication procedure and log-books for test procedure and recording results.

#### ***1.3.3.1. Fabrication Documentation:***

Necessary folders are to be maintained for the card and unit. The fabrication procedure to be adopted for both card and unit is as per the respective fabrication procedures provided with the contract.

#### ***1.3.3.2. Test Procedure Documentation***

Card and unit has to be tested and all the results have to be logged as per the respective test procedure provided to the Vendor along with contract. Any deviations should be reported promptly. Remedial measures to be taken only after due authorization. Separate documents/log books to be maintained for the card and unit.

## **1.4. RESPONSIBILITIES OF VENDOR**

### ***1.4.1. Interaction with focal point***

**1.4.1.1.** Vendor engineers have to interact with the focal point to accomplish the tasks in scheduled periods.

### **1.4.2. *Compilation of Test Results***

- 1.4.2.1. Vendor has to compile all the test results both at card level and unit level and assist in analyzing the compliance. All the results are to be recorded and to be systematically documented.
- 1.4.2.2. All the results compiled should be discussed with ISAC focal point before concluding the analysis and documentation.

### **1.4.3. *Status Reporting***

Status report on fabrication, testing and documentation should be submitted for review once in 15 days to the focal point.

### **1.4.4. *Log Books, Folders & File Maintenance***

All log books, test procedures, test results, individual card and package folders and files to be maintained and to be submitted to ISAC along with hardware.

### **1.4.5. *Review, Approval & Acceptance***

After execution of the jobs assigned, the Vendor shall present all the documents for review by ISAC for approval and acceptance. ISAC reserve the right to witness testing of any card or unit at the Vendors premises as and when required.

### **1.4.6. *Focal Point***

Vendor will identify focal point for all communications/instructions to have better management. Similarly ISAC will identify a focal point to communicate with Vendor.

## **1.5. LIST OF DELIVERABLES**

### **1.5.1. BY ISAC**

- 1.5.1.1. *Detailed block diagram, circuit details, interconnection details and module / component model number and make.*
- 1.5.1.2. *HMC VCO module, specifications, package details and the relevant test and handling procedures*
- 1.5.1.3. *Executable files which gives the values of data rate/frequency dependent components when the data rate/frequency is fed as input*
- 1.5.1.4. *A .POF file for programming the FPGA*
- 1.5.1.5. *Any other details as required & Mutually Agreeable like safety guidelines and soldering guidelines.*
- 1.5.1.6. *Acceptance and rejection criteria*

## **1.5.2. BY VENDOR**

- 1.5.2.1. The unit in fully fabricated form along with necessary spares.
- 1.5.2.2. PCB films, layout diagrams and the schematic for all the PCBs used in the unit (all the required PCBs will be designed by the Vendor).
- 1.5.2.3. Front and Back panel screen printing films and mechanical drawings (with dimensions).
- 1.5.2.4. Individual module test results should be given before assembly of the unit is taken up.
- 1.5.2.5. Burn-in test result for DC power supply under full load condition for 24Hrs should be given before fabrication of unit is taken up.
- 1.5.2.6. Counterpart of the sub-rack slides to be supplied.
- 1.5.2.7. A set of important spare components to be supplied.

- 1.5.2.8. Burn in test 168 hrs (min) for the unit should be conducted & the test results to be provided.
- 1.5.2.9. Specification Compliance Certificate for the unit to be provided.
- 1.5.2.10. Warranty certificate to be provided.
- 1.5.2.11. Fabrication history folders for each card and package.
- 1.5.2.12. Test results, log-book and analysis reports.
- 1.5.2.13. Full set of fabrication, test & acceptance documents.

## **1.6. SAFETY PRECAUTIONS TO BE FOLLOWED BY VENDOR**

- 1.6.1. The personnel of Vendor must adhere to all the safety guidelines while handling components, cards, modules while testing and transportation.
- 1.6.2. Vendor should have ESD facility.
- 1.6.3. As most of the devices are ESD sensitive the relevant precautions has to be taken while handling
- 1.6.4. The personnel of Vendor must adhere to soldering temperature control guidelines while soldering the components.

## **1.7. SECRECY & SECURITY**

All documents prepared for fabrication, test procedures, log books, drawings, schematics and any other communications, codes revealed during the process of testing will be exclusive property of ISAC and Vendor shall have no right what so ever on them. These documents are to be strictly confidential and should not be reproduced, copied/transmitted to any media without explicit permission of ISAC. Further, the Vendor must not quote any of these works in any publications or to any of their customers

without explicit permission from ISAC and adhere to strict confidentiality.

## **1.8. QUANTUM OF WORK AND SCHEDULE**

Units required : 4Nos at 2 X 52.5MBPS (TYPE I)  
2Nos at 2 X 16MBPS (TYPE II)  
2Nos at 2 X 5.2MBPS (TYPE III)

Delivery schedule : One equipment of TYPE I should be delivered first followed by one equipment of TYPE II & TYPE III, and then the remaining five equipments

Eight months from date of P.O released for all the 8 equipments

With the detailed testing and acceptance of the first unit, clearance for development of further units will be given.

## **1.9. PREREQUISITES FROM VENDOR**

1.9.1.The vendor should provide necessary documentation indicating the availability of necessary equipment/infrastructure for the accomplishment of the said task and a team of ISAC engineers will visit the premises of the vendor to assess the capabilities of the vendor if required.

1.9.2.Vendor shall provide information regarding the similar works carried out by them earlier

1.9.3.Vendor should provide a detailed schedule plan.

1.9.4.Party should deliver the first unit of the type specified by ISAC for validation. With the detailed testing and acceptance of the unit, clearance for development of further units will be given.

1.9.5.Party should provide a detailed cost break-up for all the activities involved in realizing the equipment and one time costs.

## **2. BIT SYNCHRONIZER**

### **2.1. FUNCTIONAL DESCRIPTION**

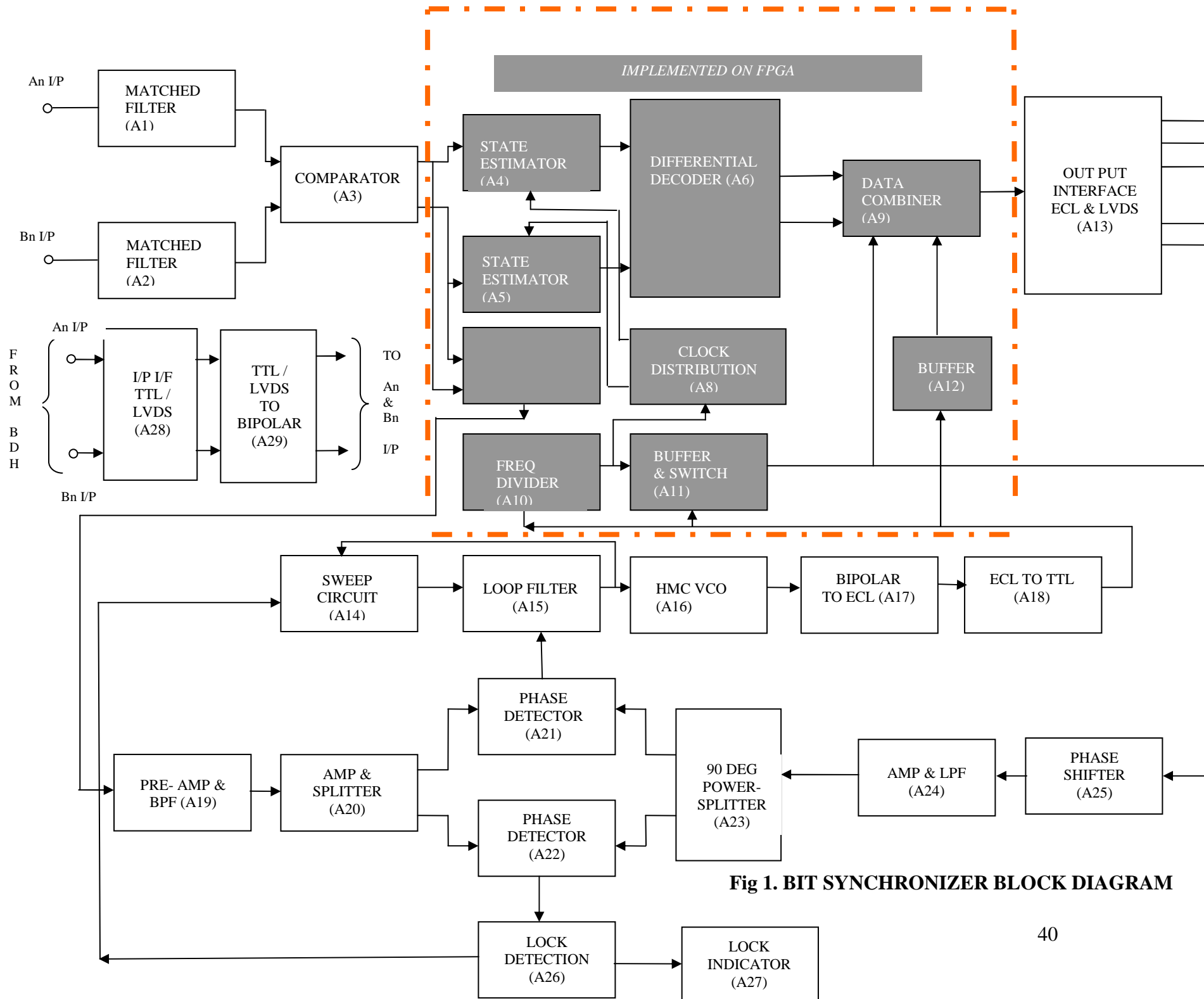
This Bit Synchronizer Module is a part of Payload Data Acquisition System which will support data reception of Remote

Sensing Payloads, during ground checkout activities. The design caters to a data rate from 1MBps to 320 MBPS, and has to be tuned for a spot frequency as required. This Bit synchronizer receives An & Bn data from Demodulator and recovers clock from the received data and provides I and Q data synchronous with clock to the Data Acquisition system for further processing. Detailed block diagram of this unit is furnished in Fig.1. Individual blocks are explained in detail in the sections to follow.

## 2.2. SPECIFICATION

1. Input Data Modulation : QPSK
2. Data rate : 1MBPS to 320MBPS  
(Spot data rates )
3. Input data level : 100mv to 2Vpp
4. Input impedance : 50 Ohms
5. Clock-acquisition range : 0.5% of symbol rate
6. Clock-acquisition time : <100 ms
7. Tracking loop (double sided) : 0.02% of symbol rate
8. Decoding : 4-state differential
9. Outputs
  - a. Data : LVDS combined data, I & Q
  - b. Clock : LVDS 0 deg/180 degree bit rate  
Clock selectable





**Fig 1. BIT SYNCHRONIZER BLOCK DIAGRAM**

### 3. PCB GUIDELINES

- 1) Substrate : Glass Epoxy
- 2) All signal tracks widths adhere to 50 ohm control impedance except for LVDS tracks and the LVDS tracks should have a differential impedance of 100 ohms . And all supply tracks should be 40mil wide. Stacking holes should be of 3.0 mm diameter.
- 3) PCB dimension should be optimized.
- 4) PCB thickness should not exceed 2.0 mm and embedded layer spacing to be adjusted based on the required track impedance.
- 5) PCB should have solder mask.
- 6) Component numbering (copper) should be available for atleast transistors, diodes, inductors, connectors & Pin 1 for all IC 's .
- 7) All area other than tracks & pads should be covered by ground area. And the ground area should be stitched adequately.
- 8) Main supply outputs should be coppered. The coppering should be such that it should be visible even after mating the connector.
- 9) All the different supply grounds should be brought out separately and should be shorted at the power supply end.
- 10) Adequate ground vias should be provided in the ground
- 11) All the decoupling capacitors should be very close to the supply from the ICs . If required, capacitors can be mounted on the solder side.
- 12) Six stacking holes (M3) to be provided which are connected to ground only on the component and solder side. It should be a PTH.
- 13) Grounding area with mounting hole(M3) has to be provided for regulators and they should be placed close to the supply connector.
- 14) Few GND turret holes (T1 to T8 1.6mm) to be provided in consultation with the ISAC focal point.

- 15) Care should be taken such that input data signals I & Q travel equal distance before reaching FPGA after matched filtering.
- 16) No. of layers (for Bit Synchronizer) : 10
- |               |                |
|---------------|----------------|
| i) Layer 1    | component side |
| ii) Layer 2   | Gnd            |
| iii) Layer 3  | -5.2V          |
| iv) Layer 4   | Gnd            |
| v) Layer 5    | +5V            |
| vi) Layer 6   | +3.3           |
| vii) Layer 7  | Gnd            |
| viii) Layer 8 | +2.5V          |
| ix) Layer 9   | Gnd            |
| x) Layer 10   | solder side    |

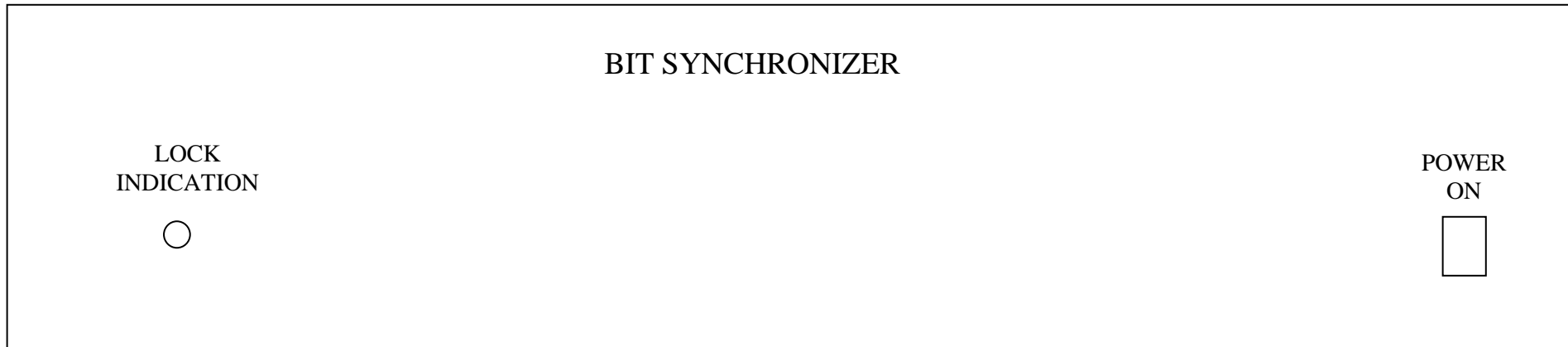
## 4. FRONT AND BACK PANEL

A representative diagram of front and back panel is given in the next page. The party can modify the front and back panel connector placements for better design without modifying the I/O requirements supplied by ISAC. In case of 'FROM BDH' indicated in the back panel diagram, it can be either 'D-type LVDS I/P' or TTL – I I/P and TTL-Q I/P which will be supplied by ISAC at the time of ordering. In case of 'BIT SYNC O/P' indicated in the back panel diagram, it will be LVDS O/P.

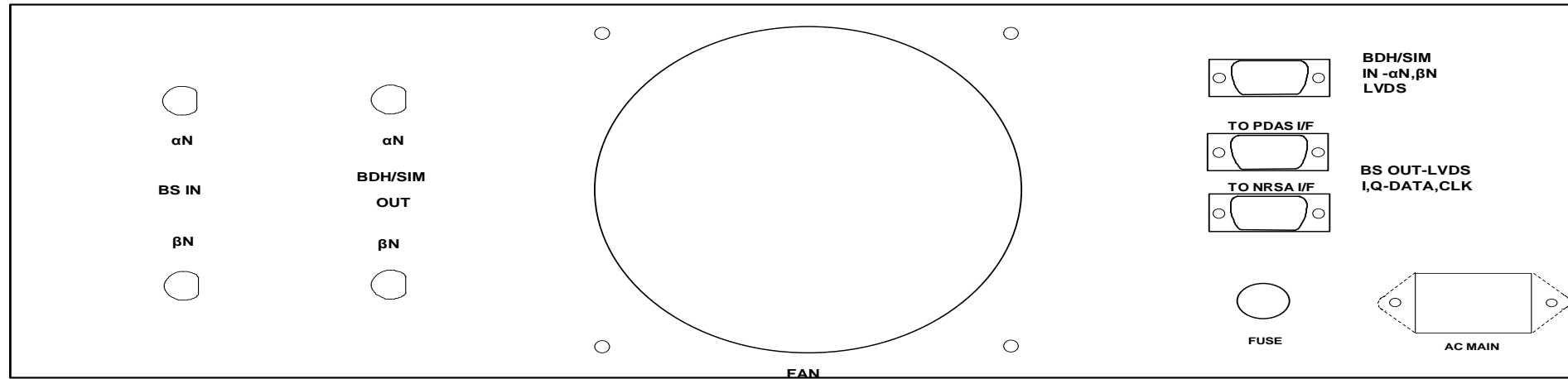
### 4.1. FRONT AND BACK PANEL INTERCONNECTION DETAILS

FROM	TO	CABLE TYPE	CONNECTOR TYPE
$\alpha_n$ (BP)	A1 I/P(BS)	RG 188	SMA(F) , SMA (F)
Bn(BP)	A2 I/P(BS)	RG 188	SMA(F) , SMA (F)
A29 O/P(BS)	$\alpha_n$ BDH(BP)	RG188	SMA(F) , SMA (F)
A29 O/P(BS)	Bn BDH(BP)	RG 188	SMA(F) , SMA (F)
LVDS I/P (BP)	A28 I/P (BS)	Twist & Flat Ribbon	D-TYPE (F), D-TYPE (F)
A13 O/P (BS)	LVDS O/P-1 (BP)	Twist & Flat Ribbon	D-TYPE (F), D-TYPE (F)
A13 O/P (BS)	LVDS O/P-2 (BP)	Twist & Flat Ribbon	D-TYPE (F), D-TYPE (F)
3-PIN AC SOCKET(BP)	AC SWITCH (FP)	DC WIRE	SOLDER, SOLDER
A27 O/P (BS)	LOCK-BS(FP)	DC WIRE	2-PIN-POWERMATE, SOLDER
AC SWITCH (FP)	DC POWER SUPPLY	DC WIRE	SOLDER, SOLDER

## 4.2. FRONT PANEL DIAGRAM



### 4.3. BACK PANEL DIAGRAM



#### 4.4. FRONT PANEL DESCRIPTION

<b>DESIGNATION</b>	<b>CONNECTOR TYPE</b>
LOCK-BIT-SYNC	5mm LED (GREEN)
POWER ON/OFF	AC SWITCH WITH INDICATION

#### 4.5. BACK PANEL DESCRIPTION

<b>DESIGNATION</b>	<b>CONNECTOR TYPE</b>
--------------------	-----------------------

$\alpha_n$	BNC(F) TO SMA(F) ADAPTOR (PANEL MOUNT)
Bn	BNC(F) TO SMA(F) ADAPTOR (PANEL MOUNT)
$\alpha_n$ BDH	BNC(F) TO SMA(F) ADAPTOR (PANEL MOUNT)
Bn BDH	BNC(F) TO SMA(F) ADAPTOR (PANEL MOUNT)
LVDS I/P	15 PIN HIGH DENSITY D-TYPE (F)
LVDS O/P-1	15 PIN HIGH DENSITY D-TYPE (F)
LVDS O/P-2	15 PIN HIGH DENSITY D-TYPE (F)

## 5. POWER SUPPLY SPECIFICATIONS

1. Input Voltage : 180 VAC to 260 VAC
  
2. Output Voltage : + 15 V, 1.7 A (min)  
- 15 V, 1.0 A (min)  
+ 5 V, 4 A (min)  
- 5 V, 2A (min)
  
3. Output set Point Accuracy :  $\pm 1.5 \%$
  
4. Line/Load Regulation :  $\pm 0.5 \%$
  
5. Ripple : 50 mV on 5V output(max)
  
6. Spikes : 100 mV on all outputs (max)
  
7. Protection Provided : Short circuit & Overvoltage at output
  
8. Operating Temperature :  $-10^{\circ} \text{C}$  to  $55^{\circ} \text{C}$
  
9. Storage Temperature :  $-20^{\circ} \text{C}$  to  $85^{\circ} \text{C}$
  
10. Isolation
  - a) Input to Output : 1.5 KVAC
  - b) Input to Earth/Chassis : 1.5 KVAC
  - c) Output to Earth/Chassis : 0.5 KVDC
  - d) Output to Output : 0.5 KVDC
  
11. Input Operating Frequency : 50 Hz
  
12. Convertor Operating : Greater than 20 KHz Frequency
  
13. Remote Sense : To be provided for Main output
  
14. Termination
  - a) Input : 3 way terminal strip
  - b) Output : Solderable lugs

## 6. TEST METHODOLOGY

### 6.1. TEST / TUNING METHODOLOGY FOR BIT SYNCHRONIZER

The testing of Bit synchronizer has to be initiated as early as individual stages are being wired as some of the modules can be characterized / tuned by feeding external stimuli. Essentially the modules like matched filters, VCO and clock recovery circuits have to be tested/ tuned as and when these stages are wired. These stages have to be isolated while being characterized. Characterization procedure for these stages will be dealt in this section. Characterization of VCO is also dealt in this section.

#### 6.1.1. Test / tuning Procedure for Matched Filter:

*List of equipment required:*

Signal generator covering frequency range upto 200 MHz

Oscilloscope with BW upto 1 GHz

- 6.1.1.1. Feed signal to the input of matched filter at K16; Set voltage level to 1Vpp
- 6.1.1.2. Monitor the voltage on oscilloscope at node connecting L9 and C126
- 6.1.1.3. At frequency equal to (symbol rate / 4) adjust the capacitor C126 such that 3dB point is achieved.
- 6.1.1.4. Set the input frequency to symbol rate, monitor at the node connecting L10 and C89 and adjust C89 such that null is achieved at this frequency.

6.1.1.5. Vary the input frequency from 1 kHz to symbol rate and verify the frequency response.

6.1.1.6. Repeat the above procedure for Q chain matched filter also.

### **6.1.2. Test / tuning Procedure for Clock recovery circuit:**

*List of equipment required:*

- Signal generator covering frequency range upto 200 MHz.
- Oscilloscope with BW upto 1GHz & sampling rate > 2GSPS and 2 – Channels (minimum)
- Wide BW probes ( > 500MHz) with probe capacitance < 2pf
- Data generator covering data rates upto 200 MBPS with bipolar output.

6.1.2.1. Feed signal to the input of BPF at K16; Set voltage level to 1Vpp

6.1.2.2. Vary the input frequency from  $F_s - \Delta f$  to  $F_s + \Delta f$  such that  $F_s$  is symbol rate and  $\Delta f$  is 20% of  $F_s$ .

6.1.2.3. Monitor voltage at pin -6 of U37. Vary  $R^*$  if required to achieve peak frequency response at  $F_s$ . Compute Q of the filter.

6.1.2.4. Feed 10101...pattern to the input of the matched filters and observe recovered clock peaking at  $F_s$ .

6.1.2.5. Once the above stages are tested along with VCO and all components are assembled, before proceeding for comprehensive testing of the Bit synchronizer, the sweep frequency and amplitude at the output of the loop filter section i.e at the control input of VCO has to be recorded.

## **6.2. Test Procedure for Testing Bit synchronizer :**

*List of equipment required:*

- Data generator covering data rates upto 200 MBPS with bipolar output.
- Oscilloscope with BW upto 1GHz & sampling rate > 2GSPS and 2 - Channels minimum
- Wide BW probes ( > 500MHz) with probe capacitance < 2pf
- Voltmeter

### **6.2.1. Lock verification :**

Apply any PN sequence at symbol rate (voltage level= 1Vpp) at An and Bn input and verify authentic PLL lock thru lock indication and monitor at VCO control pin for disappearance of sweep signal.

### **6.2.2. Differential Decoder verification:**

Apply 11001100.....pattern at An-I/P and 00110011 pattern at Bn-I/P and verify all 1's or 0's data at the output of I & Q.

### **6.2.3. Acquisition range verification:**

Apply any PN sequence at  $F_s - \Delta f_a$  and  $F_s + \Delta f_a$  at An and Bn input and verify authentic PLL lock, where  $f_a$  is the specified acquisition range.

### **6.2.4. Tracking range verification:**

Vary the input symbol rate in steps of 200Hz or lesser over the specified tracking range and ensure continuous lock.

### **6.2.5. Input dynamic range verification:**

Vary the input level from 100mVpp to 2Vpp in steps of 0.1V (frequency: symbol rate) and verify lock and proper data output. Repeat the above procedure for symbol rates  $F_s - \Delta f_a$  and  $F_s + \Delta f_a$ .

### **6.2.6. Clock - data relationship verification:**

Set the input signal at symbol rate and 1Vpp level. Measure the clock and data relationship at I & Q output and record.

### **6.3. BER performance verification should be carried out at ISAC.**

This test maybe carried out using ISAC BER setup. Any tuning required for optimizing BER performance maybe done in consultation with ISAC engineers.

### **6.4. HMC VCO**

The HMC VCO will be supplied by ISAC and its frequency will be set based on the bit rate required. It is a 38 pin DIP package and the package details are given

#### **PIN DETAILS**

PIN NO	DESCRIPTION
2,29,18	+15V
5	GND
12	-15
14	GND
4	CONTROL I/P
6	GND

21	VCO O/P
24	GND
16 & 23	TWO 680 OHM RESISTORS SHOULD BE CONNECTED IN PARALLEL ACROSS 16 AND 23

### **TEST PROCEDURE:**

1. Mount the HMC VCO on the test PCB. Mount the device on the base pins.
2. Ensure correctness of the DC supply wires based on pin details
3. Ground the control pin of the VCO.
4. Record the output power and frequency on Spectrum Analyzer/frequency Counter.
5. Record all the spectral components on the spectrum analyzer. If Spurious and Harmonic values are within specifications, supplied along with VCO, proceed further.
6. Carryout frequency stability test on the VCO for 8Hrs. Frequency counter has to be used for this test. If frequency variation is within the specified value, then proceed further.
7. Now connect the control pin of the VCO to a variable supply whose output voltage can vary over the range specified. Vary the voltage in steps of 0.5V and record the frequency on frequency counter. Plot and tabulate control voltage versus frequency deviation. If the frequency deviation is as expected, the test is complete.

## **ANNEXURE -1**

### **A.BIT SYNCHRONIZER COMPONENT DETAILS**



## A.1. BIT SYNCHRONIZER COMPONENT LIST

### A.1.1. LIST OF COMPONENTS ( REF FIG : 3)

#### A.1.1.1. MATCHED FILTER(A1,A2, A3)

##### A.1.1.1.1. RESISTORS

NAME	VALUE	DESCRIPTION
R160	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R151	390	1/4 W 5% THICK FILM SMD 1206 TYPE
R161	390	1/4 W 5% THICK FILM SMD 1206 TYPE
R147	390	1/4 W 5% THICK FILM SMD 1206 TYPE
R164	100	1/4 W 5% THICK FILM SMD 1206 TYPE
R165	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R150	39	1/4 W 5% THICK FILM SMD 1206 TYPE
R148	390	1/4 W 5% THICK FILM SMD 1206 TYPE
R166	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R168	120	1/4 W 5% THICK FILM SMD 1206 TYPE
R172	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R169	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R171	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R152	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R149	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R170	4.7K	1/4 W 5% THICK FILM SMD 1206 TYPE
R153	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R143	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R144	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R100	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R101	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R10	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R7	390	1/4 W 5% THICK FILM SMD 1206 TYPE
R11	390	1/4 W 5% THICK FILM SMD 1206 TYPE
R3	390	1/4 W 5% THICK FILM SMD 1206 TYPE
R14	100	1/4 W 5% THICK FILM SMD 1206 TYPE
R189	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R6	39	1/4 W 5% THICK FILM SMD 1206 TYPE
R4	390	1/4 W 5% THICK FILM SMD 1206 TYPE
R16	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R18	120	1/4 W 5% THICK FILM SMD 1206 TYPE
R22	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R19	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R21	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R8	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R5	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R20	4.7K	1/4 W 5% THICK FILM SMD 1206 TYPE
R184	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R1	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R2	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R93	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R88	330	1/4 W 5% THICK FILM SMD 1206 TYPE

##### A.1.1.1.2. CAPACITORS

NAME	VALUE	DESCRIPTION
C97	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C102	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C107	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C105	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C92	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C93	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C126	*	ULTRA MINIATURE TRIMMER CAP. 35V
C98	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C108	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C103	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C106	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C94	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C89	*	ULTRA MINIATURE TRIMMER CAP. 35V
C101	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C99	OPEN	
C90	10PF	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C84	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C85	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C104	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C100	OPEN	
C56	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C85	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C84	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C118	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C113	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C115	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C111	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C10	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C11	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C7	*	ULTRA MINIATURE TRIMMER CAP. 35V
C112	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C120	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C110	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C215	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C12	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C8	*	ULTRA MINIATURE TRIMMER CAP. 35V
C117	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C114	OPEN	
C9	10PF	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C127	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C4	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C119	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C116	OPEN	
C45	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C175	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C172	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

### A.1.1.1.3. INDUCTORS

NAME	VALUE	DESCRIPTION
L8	*	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE
L9	*	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE
L10	*	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE
L1	*	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE
L2	*	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE
L3	*	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE

### A.1.1.1.4. ICS

NAME	VALUE	DESCRIPTION
U30	AD8009	OP AMP 8-PIN SOIC
U4	AD8009	OP AMP 8-PIN SOIC
U32	MAX9693	COMPARATOR 16-PIN SOIC
U38	100H125	ECL TO TTL TRANSLATOR 24-PIN PQFP
U1	AD8009	OP AMP 8-PIN SOIC
U2	AD8009	OP AMP 8-PIN SOIC
U3	MAX9693	COMPARATOR 16-PIN SOIC
U41	100H125	ECL TO TTL TRANSLATOR 24-PIN PQFP

### A.1.1.1.5. CONNECTORS

NAME	VALUE	DESCRIPTION
K16	-	SMA-FEMALE
K3	-	SMA-FEMALE

### A.1.1.2. VCO(A16,A17,A18)

#### A.1.1.2.1. RESISTORS

NAME	VALUE	DESCRIPTION
R99	680	1/4 W 5% THICK FILM SMD 1206 TYPE
R98	680	1/4 W 5% THICK FILM SMD 1206 TYPE
R94	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R129	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R128	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R126	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R127	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R119	4.7K	1/4 W 5% THICK FILM SMD 1206 TYPE
R118	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R117	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R114	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R110	10	1/4 W 5% THICK FILM SMD 1206 TYPE
R115	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R116	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R104	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R105	39	1/4 W 5% THICK FILM SMD 1206 TYPE
R112	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R109	39	1/4 W 5% THICK FILM SMD 1206 TYPE
R120	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R121	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R131	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R132	330	1/4 W 5% THICK FILM SMD 1206 TYPE

### A.1.1.2.2. CAPACITORS

NAME	VALUE	DESCRIPTION
C165	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C164	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C79	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C71	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C124	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C122	OPEN	
C80	10PF	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C123	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C121	OPEN	
C161	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C158	OPEN	
C187	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C81	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C186	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

### A.1.1.2.3. ICS

NAME	VALUE	DESCRIPTION
U19	-	HMC VCO
U24	MAX9693	COMPARATOR 16-PIN SOIC
U23	SYE100E195	DELAY LINE 28PIN PLCC SOCKET
U18	100H125	ECL TO TTL TRANSLATOR 24-PIN PQFP

#### **A.1.1.2.4. CONNECTORS**

NAME	VALUE	DESCRIPTION
K10	-	SMA-FEMALE
K14	-	BERG STICK 7X2

### **A.1.1.3. LVDS & ECL OUTPUT INTERFACE (A13)**

#### **A.1.1.3.1. RESISTORS**

NAME	VALUE	DESCRIPTION
R89	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R90	330	1/4 W 5% THICK FILM SMD 1206 TYPE

R72	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R73	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R133	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R134	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R136	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R135	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R70	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R71	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R41	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R40	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R212	10	1/4 W 5% THICK FILM SMD 1206 TYPE
R156	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R157	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R158	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R159	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R217	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R218	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R215	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R216	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R137	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R145	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R139	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R146	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R162	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R154	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R141	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R138	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R219	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R220	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R221	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R222	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R163	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R155	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R142	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R140	82	1/4 W 5% THICK FILM SMD 1206 TYPE

### A.1.1.3.2. CAPACITORS

NAME	VALUE	DESCRIPTION
C135	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C178	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C125	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C183	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

C41	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C19	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C95	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C96	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C189	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C191	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C185	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C188	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C184	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

### A.1.1.3.3. ICS

NAME	VALUE	DESCRIPTION
U16	DS90C31	TTL TO LVDS CONVERTER 16 PIN SOIC
U25	DS90C31	TTL TO LVDS CONVERTER 16 PIN SOIC
U10	DS90C31	TTL TO LVDS CONVERTER 16 PIN SOIC
U29	DS90C31	TTL TO LVDS CONVERTER 16 PIN SOIC
U27	100H124	TTL TO ECL TRANSLATOR 24-PIN PQFP
U28	100H124	TTL TO ECL TRANSLATOR 24-PIN PQFP

### A.1.1.3.4. CONNECTORS

NAME	VALUE	DESCRIPTION
K9	-	25- PIN DTYPE
K15	-	25- PIN DTYPE
K4	-	BERG STICK 4X2
K5	-	BERG STICK 4X2
K17	-	SMA-FEMALE
K18	-	SMA-FEMALE
K19	-	SMA-FEMALE
K20	-	SMA-FEMALE

### A.1.1.4. BDH INTERFACE(A28,A29)

#### A.1.1.4.1. RESISTORS

NAME	VALUE	DESCRIPTION
R28	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R29	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R30	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R24	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R13	51	1/4 W 5% THICK FILM SMD 1206 TYPE

R25	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R26	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R27	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R23	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R12	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R113	100	1/4 W 5% THICK FILM SMD 1206 TYPE
R103	100	1/4 W 5% THICK FILM SMD 1206 TYPE
R108	10	1/4 W 5% THICK FILM SMD 1206 TYPE
R102	10	1/4 W 5% THICK FILM SMD 1206 TYPE

#### A.1.1.4.2. CAPACITOR

NAME	VALUE	DESCRIPTION
C153	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C150	OPEN	

#### A.1.1.4.3. ICS

NAME	VALUE	DESCRIPTION
U31	74F244	TTL BUFFER 20 PIN DIP
U21	DS90C32	LVDSTO TTL CONVERTER 16 PIN SOIC
U5	AD8009	OP-AMP 16 PIN SOIC
U33	AD8009	OP-AMP 16 PIN SOIC

#### A.1.1.4.4. CONNECTORS

NAME	VALUE	DESCRIPTION
K13	-	25- PIN DTYPE
J1	-	BERG STICK 3PIN
J2	-	BERG STICK 3PIN
J6	-	SMA-FEMALE
J5	-	SMA-FEMALE
K1	-	SMA-FEMALE
K2	-	SMA-FEMALE

A.1.1.5. F

#### PGA AND ASSOCIATED INTERFACE(A4,A6,A9,A5,A8,A12,A10,A11)

#### A.1.1.5.1. RESISTORS

NAME	VALUE	DESCRIPTION
R173	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R174	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R175	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R123	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R124	100	1/4 W 5% THICK FILM SMD 1206 TYPE
R125	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R107	10	1/4 W 5% THICK FILM SMD 1206 TYPE

R106	10	1/4 W 5% THICK FILM SMD 1206 TYPE
R213	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R214	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R97	1K	1/4 W 5% THICK FILM SMD 1206 TYPE

### A.1.1.5.2. CAPACITORS

NAME	VALUE	DESCRIPTION
C133	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C23	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C214	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C130	0.22UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C221	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C222	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C171	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C174	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C179	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C170	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C167	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C159	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C156	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C143	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C147	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C146	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C149	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C155	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C163	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C168	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C74	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C75	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C77	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C67	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C59	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

NAME	VALUE	DESCRIPTION
C54	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C141	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C142	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C52	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C64	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C68	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C177	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C180	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C173	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C176	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

C166	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C160	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C157	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C145	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C151	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C148	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C152	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C154	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C162	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C169	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C73	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C76	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C78	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C69	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C60	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C55	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C140	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C144	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C53	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C66	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C70	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

### A.1.1.5.3. ICS

NAME	VALUE	DESCRIPTION
U9	EPCS4S18N	FPGA CONFIGURATON DEVICE 8 PIN SOIC PACKAGE
U22	EP3C40Q240C8N	ALTERA FPGA CYCLONE III SERIES

### A.1.1.5.4. CONNECTORS

NAME	VALUE	DESCRIPTION
K11	-	BERG STICK 6X2
K6	-	BERG STICK 5X2
K8	-	BERG STICK 2PIN

### A.1.1.6. POWER DISTRIBUTION

#### A.1.1.6.1. CAPACITORS

NAME	VALUE	DESCRIPTION
C63	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C61	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE

C58	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C57	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C49	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C48	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C47	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C46	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C65	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C51	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C62	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C50	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

### A.1.1.6.2. INDUCTORS

NAME	VALUE	DESCRIPTION
L7	2.2UH	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE
L6	2.2UH	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE
L5	2.2UH	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE
L4	2.2UH	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE

### A.1.1.6.3. ICS

NAME	VALUE	DESCRIPTION
U20	TPS75933	3.3V DROP IN REGULATOR
U17	TPS75925	2.5V DROP IN REGULATOR

### A.1.1.6.4. CONNECTORS

NAME	VALUE	DESCRIPTION
K12	-	8 PIN POWER MATE CONNECTOR

## A.1.1.7. CLOCK RECOVERY(A19,A20,A24,A25)

### A.1.1.7.1. RESISTORS

NAME	VALUE	DESCRIPTION
R176	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R177	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R167	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R17	330	1/4 W 5% THICK FILM SMD 1206 TYPE
R178	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R223	33	1/4 W 5% THICK FILM SMD 1206 TYPE
R185	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R9	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R186	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R224	470	1/4 W 5% THICK FILM SMD 1206 TYPE
R210	*	1/4 W 5% THICK FILM SMD 1206 TYPE

R180	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R187	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R181	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R182	120	1/4 W 5% THICK FILM SMD 1206 TYPE
R15	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R190	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R192	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R191	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R193	4.7K	1/4 W 5% THICK FILM SMD 1206 TYPE
R194	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R195	120	1/4 W 5% THICK FILM SMD 1206 TYPE
R196	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R211	470	1/4 W 5% THICK FILM SMD 1206 TYPE
R188	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R197	220	1/4 W 5% THICK FILM SMD 1206 TYPE
R198	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R200	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R202	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R199	SHORT	1/4 W 5% THICK FILM SMD 1206 TYPE
R201	SHORT	1/4 W 5% THICK FILM SMD 1206 TYPE
R203	OPEN	1/4 W 5% THICK FILM SMD 1206 TYPE
R31	OPEN	1/4 W 5% THICK FILM SMD 1206 TYPE
R33	OPEN	1/4 W 5% THICK FILM SMD 1206 TYPE
R32	OPEN	1/4 W 5% THICK FILM SMD 1206 TYPE
R34	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R35	130	1/4 W 5% THICK FILM SMD 1206 TYPE
R42	51	1/4 W 5% THICK FILM SMD 1206 TYPE
R36	82	1/4 W 5% THICK FILM SMD 1206 TYPE

NAME	VALUE	DESCRIPTION
R43	39	1/4 W 5% THICK FILM SMD 1206 TYPE
R37	82	1/4 W 5% THICK FILM SMD 1206 TYPE
R38	100	1/4 W 5% THICK FILM SMD 1206 TYPE
R44	68	1/4 W 5% THICK FILM SMD 1206 TYPE
R39	100	1/4 W 5% THICK FILM SMD 1206 TYPE
R204	680	1/4 W 5% THICK FILM SMD 1206 TYPE
R205	680	1/4 W 5% THICK FILM SMD 1206 TYPE

### A.1.1.7.2. CAPACITORS

NAME	VALUE	DESCRIPTION
C191	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C190	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C134	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C109	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C196	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

C197	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C198	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C132	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C13	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C14	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C15	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C16	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C17	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C18	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C1218	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C20	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C137	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C193	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C202	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C219	3.3UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C129	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C199	OPEN	
C217	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C194	OPEN	
C3	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C192	OPEN	
C200	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C131	OPEN	
C128	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C201	OPEN	
C5	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C195	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE

NAME	VALUE	DESCRIPTION
C22	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C21	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C24	0.01UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C29	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C25	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C27	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C220	*	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C30	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C28	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C31	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

### A.1.1.7.3. INDUCTORS

NAME	VALUE	DESCRIPTION
L11	*	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE
L12	2.2UH	SHIELDED MOULDED %10 Q-30 SMD 1210 TYPE

### A.1.1.7.4. ICS

NAME	VALUE	DESCRIPTION
U12	AD8009	OP-AMP 8 PIN SOIC
U13	AD8009	OP-AMP 8 PIN SOIC
U6	AD8009	OP-AMP 8 PIN SOIC
U37	AD8009	OP-AMP 8 PIN SOIC
U15	AD8009	OP-AMP 8 PIN SOIC
U26	MAX9693	COMPARATOR 16 PIN SOIC
U34	MAR-8A	MINI CIRCUITS MONOLITHIC AMPLIFIER

### **A.1.1.8. PHASE DETECTOR AND LOCK INDICATION(A21,A22,A23,A26,A27)**

#### **A.1.1.8.1. RESISTORS**

NAME	VALUE	DESCRIPTION
R45	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R48	SHORT	
R47	OPEN	
R46	OPEN	
R49	560	1/4 W 5% THICK FILM SMD 1206 TYPE
R50	SHORT	
R55	OPEN	
R54	OPEN	
R51	560	1/4 W 5% THICK FILM SMD 1206 TYPE
R206	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R59	47K	1/4 W 5% THICK FILM SMD 1206 TYPE
R52	1K	1/4 W 5% THICK FILM SMD 1206 TYPE
R57	1.2K	1/4 W 5% THICK FILM SMD 1206 TYPE
R58	10k	1/4 W 5% THICK FILM SMD 1206 TYPE
R56	4.7k	1/4 W 5% THICK FILM SMD 1206 TYPE
R60	10k	1/4 W 5% THICK FILM SMD 1206 TYPE

#### **A.1.1.8.2. CAPACITORS**

NAME	VALUE	DESCRIPTION
C33	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C32	10UF	TANTALUM CAP. 35V 10% SMD 7533 TYPE
C34	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C35	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C36	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C37	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

### A.1.1.8.3. ICS AND TRANSISTORS

NAME	VALUE	DESCRIPTION
U7	PSCQ SERIES	MINI CIRCUITS 90 <sup>0</sup> SPLITTER
U35	SYPD SERIES	MINI CIRCUITS PHASE DETECTOR
U36	SYPD SERIES	MINI CIRCUITS PHASE DETECTOR
U14	LM311	OP-AMP 8 PIN SOIC
Q2A	SMBT 3906	SMD TRANSISTOR TO-23 PACKAGE
D3		SMD LED

### A.1.1.8.4. CONNECTORS

NAME	VALUE	DESCRIPTION
J3	-	BERG STICK 3PIN
J4	-	BERG STICK 3 PIN
J7	-	BERG STICK 2 PIN

### A.1.1.9. SWEEP CIRCUIT(A14,A15)

#### A.1.1.9.1. RESISTORS

NAME	VALUE	DESCRIPTION
R62	10K	1/4 W 5% THICK FILM SMD 1206 TYPE
R61	10K	1/4 W 5% THICK FILM SMD 1206 TYPE
R67	10K	1/4 W 5% THICK FILM SMD 1206 TYPE
R63	20K	1/4 W 5% THICK FILM SMD 1206 TYPE
R64	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R66	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R208	20K	1/4 W 5% THICK FILM SMD 1206 TYPE
R69	20K	1/4 W 5% THICK FILM SMD 1206 TYPE
R68	20K	1/4 W 5% THICK FILM SMD 1206 TYPE
R82	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R80	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R65	6.8K	1/4 W 5% THICK FILM SMD 1206 TYPE
R207	10K	1/4 W 5% THICK FILM SMD 1206 TYPE
R87	20K	1/4 W 5% THICK FILM SMD 1206 TYPE

R76	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R209	*	1/4 W 5% THICK FILM SMD 1206 TYPE
R83	2.2K	1/4 W 5% THICK FILM SMD 1206 TYPE
R77	4.7K	1/4 W 5% THICK FILM SMD 1206 TYPE
R85	4.7K	1/4 W 5% THICK FILM SMD 1206 TYPE
R84	2.2K	1/4 W 5% THICK FILM SMD 1206 TYPE

### A.1.1.9.2. CAPACITORS

NAME	VALUE	DESCRIPTION
C38	220PF	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C39	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C40	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C209	18PF	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C208	33PF	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C212	18PF	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C205	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C206	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C207	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

NAME	VALUE	DESCRIPTION
C44	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C210	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C211	100PF	CERAMIC CAP. 50V 5% SMD 1206 TYPE
C203	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C204	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C216	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE
C213	0.1UF	CERAMIC CAP. 50V 20% SMD 1206 TYPE

### A.1.1.9.3. ICS

NAME	VALUE	DESCRIPTION
U39	AD797	OP AMP 8-PIN SOIC
U8	AD797	OP AMP 8-PIN SOIC
U40	AD797	OP AMP 8-PIN SOIC
U11	HA9P2 2406-5	PROGRAMMABLE OP AMP HA9P2-2406-5 HARRIS MAKE

The components whose values are indicated by \* are data rate dependent components whose values can be obtained from program supplied by ISAC



## **COMMENTS / NOTES**