

**Item Name: Integration of X-Band High Resolution SAR System on FTB (KD-707) Dornier Aircraft**

**SPECIFICATIONS**

**1. INTRODUCTION:**

LRDE is developing X-band Radar and the Radar will be qualified for Dornier platform. It will be fitted on DRDO-FTB (KD-707) DO-228 aircraft for the demonstration of radar functionality and electrical evaluation on an airborne platform. M/s HAL (TAD) Kanpur is the OEM of the Dornier-228 Aircraft and LRDE intended to enter into an agreement with M/s HAL (TAD) Kanpur for integration of X-Band Radar of HiSAR on Dornier Aircraft. The proposal has been worked out incorporating scope of work, roles and responsibility of HAL & LRDE. The following section contains functional details of LRUs, system block diagram, product tree, responsibility of LRDE and HAL scope of work.

**2. SYSTEM DESCRIPTION**

**2.1 Brief Description of System**

The need of the hour is to provide Near-Real Time intelligence inputs to decision makers. This calls for self-reliance through developing indigenous technologies in the field of Intelligence, Surveillance and Reconnaissance (ISR). High resolution SAR is one of the major sensors in such technologies. The X-Band SAR will be integrated and tested on Dornier-228 aircraft which is serving as DRDO Flying Test Bed (FTB).

**2.2 System Configuration**

Synthetic Aperture Radar (SAR) is an all-weather, day-night microwave imaging system. The Radar comprises of an Active Array Antenna Unit (AAAU), Airborne Liquid Cooling System (ALCS) with static inverter & Airborne Heat Exchanger (AHE), Exciter Receiver Unit, Radar Processor Unit, HMI, and INS-GPS. System also includes Ethernet switch, Data Recorder for interface and recording purpose.



**Item Name: Integration of X-Band High Resolution SAR System on FTB (KD-707) Dornier Aircraft**

**3. SCOPE OF WORK:**

The scope of work is realization of interface hardware and installation of X-band Radar of HiSAR system on DRDO FTB Aircraft as detailed below:

**3.1 SWAP Details:**

SI No	LRU Nomenclature	Dimensions in (mm) (L×D×H)	Maximum Mass (kg)	Power Consumption (Watts)	Heat dissipation (Watts)	Mounting location on Aircraft
1.	Active Array Antenna Unit(AAAU)	700X400X400	80	3000	2300	Under the belly of the Aircraft
2.	Airborne Liquid cooling system (ALCS) with Inverter and Heat exchanger	400x250x250	25	750	350	On the Seat rail with interface plate
3.	Radar Subsystems on Radar Rack		40	-	-	On the Seat rail of Aircraft.
	ER Unit	350X260X250	25	250	200	
	RP Unit	350X260X230	20	400	320	
	Data Recorder	135x255x185	10	45	40	
	Ethernet switch	110x280x400	09	75	55	
4	INS/GPS	438x223x206	18	55	35	On the Seat rail of Aircraft.
	Total		227	4575	3300	

**Note:** All the required peg and retainers are to be provided by HAL for installation of the LRU's on the seat rails of the aircraft.

**3.2 HAL's Responsibility**

- To carry out the study/analysis (Structural, Electrical, thermal, EMI/EMC & safety, etc.) for the installation and operation of X-Band Radar of HiSAR system on DRDO FTB (Dornier-228, KD-707)
- Design and realisation of suitable **interface plates/mounting frames** required for mounting of Airborne Liquid Cooling System, Inverter, and Heat exchanger inside the cabin.
- Design and realisation of **Radar Rack** for housing X-Band SAR LRUs as per mounting configuration inside the cabin.

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**Item Name: Integration of X-Band High Resolution SAR System on FTB (KD-707) Dornier Aircraft**

- iv. Carry out the study and make scoops on the side wall of the aircraft for tapping ambient air for circulation to the heat exchanger of LCS. Design of suitable cold air ducts for connecting the scoops to heat exchanger has to be done by HAL. Overall dimensions of AHE will be provided LRDE. The design of scoops and ducting to ensure the flow of tapped air to heat exchanger in the order of 10 kg/m. The projection of tapping duct outside the skin of aircraft body shall be designed accordingly.
- v. Design and realisation of **Interface frame** for mounting of Active Array Antenna Unit (AAAU) weighing 80 Kg under the belly of aircraft.
- vi. Preparation of Modification Leaflets for installation of HiSAR on DRDO-FTB and obtain the necessary approval.
- vii. Carrying out structural analysis (static and dynamic analysis) for mounting frames/interface frames and Radar Rack to verify structural integrity.
- viii. Provide power cable, suitable circuit breakers, switches and relay for tapping of DC power (+28v DC) required for radar from aircraft.
- ix. Prepare required mechanical and electrical Installation drawings required for installation of HiSAR on DRDO-FTB.
- x. Carry out the study on effect of C.G and stress data due to Aircraft modification.
- xi. Carry out modification of DRDO-FTB for installation HiSAR X-Band radar subsystems.
- xii. Fabrication of modification kit, modification of platform, installation, integration and testing of payload.
- xiii. Realisation of airborne qualified interconnecting cables (power and signal) between aircraft to radar and between radar LRUs.
- xiv. Installation of SoFT qualified Radar LRUs on DRDO-FTB as per approved drawings.
- xv. Installation of support equipments (INS, GPS, Data Recorder, Ethernet Switch, 1553B, Cables) on DRDO-FTB.
- xvi. Carry out the study and provide the detailed electrical load analysis based on the electrical load details of the platform and the payloads.
- xvii. Routing of all interconnecting cables between the LRUs and securing of looms.
- xviii. Carry out installation checks as well as qualitative EMI-EMC checks after installation on DRDO-FTB.

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**Item Name: Integration of X-Band High Resolution SAR System on FTB (KD-707) Dornier Aircraft**

- xix. Installation of AAAU under the belly to the accuracy of  $\pm 0.5^\circ$
- xx. Harmonization of INS-GPS and AAAU with aircraft reference axis.
- xxi. Incorporate appropriate power mechanism to provide sufficient power to the system and proper grounding connections for all the LRU's
- xxii. Preparation of ground test schedules and flight test schedules and daily inspection (DI) based on input from LRDE.
- xxiii. Ground testing to check the electrical continuity checks, insulation resistance and mechanical integrity of Radar payload and support LRU's as per RCMA approved documents.
- xxiv. Plan and conduct the shakedown sorties (app. 10 sorties, 2hour/sorties) for initial performance trials of radar payload at HAL (K). Structural, electrical integrity and safety of flight to be ensured.
- xxv. Obtain FCC for ferrying the aircraft from HAL, Kanpur to Bangalore or any other location in India for system evaluation.
- xxvi. Prepare the AMM supplement and IPC supplements detailing the following:
  - a) Electrical load analysis report, Stress analysis report and weight & CG report aerodynamics analysis report, structural analysis report, vibration and vibration analysis report.
  - b) RCMA approved draft Modification Leaflet
  - c) Flight clearances note or F.C.C
  - d) Harmonization Report
  - e) Mod leaflet and work done report
  - f) Ground checks and flight check reports at HAL, Kanpur
  - g) EMI EMC Report

**3.3 LRDE's Responsibility**

- i. LRDE is responsible for supply of airworthy LRUs. These LRUs should be duly co-ordinated and approved by CEMILA / RCMA.
- ii. Positioning of serviceable aircraft at HAL, Kanpur as per contractually agreed timelines
- iii. Mechanical and electrical ICDs for payload integration on aircraft to be provided to HAL.
- iv. LRDE will provide requisite data for preparation of ground and flight test schedules.

  
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**Item Name: Integration of X-Band High Resolution SAR System on FTB (KD-707) Dornier Aircraft**

- v. LRDE will participate in Radar Integration, Ground test, Flight test.
- vi. LRDE will provide necessary hardware (Duly Co-ordinated by DGAQA)
- vii. **Radar Hardware Supply:**  
Following SoFT Qualified Radar LRUs along with applicable documents:
  - a. Active Array Antenna Unit (AAAU) -1No
  - b. Exciter Receiver Unit (ERU) -01 No
  - c. Radar Processing Unit – 1 No
  - d. Airborne Liquid Cooling System (ALCS) with inverter and Airborne Heat Exchanger -1 No
- viii. **Support Systems:**
  - a. Data Recorder
  - b. Ethernet Switch
  - c. MIL STD 1553B STUB
  - d. Accessories, adapters, connectors, instrument kit
- ix. **List of Documents:**
  - a. Mechanical and electrical ICDs.
  - b. Necessary inputs for preparation of ground test schedule and flight test schedules
  - c. DI, STP for conducting ground testing after installation of LRUs.
  - d. Inputs for payload harmonization post installation

**4. LIST OF DELIVERABLES**

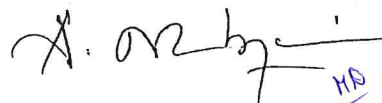
S. No	Nomenclature	Qty
A.	<b>Integration of X-Band High Resolution SAR System on LRDE FTB(KD-707) Dornier Aircraft</b> <b>(Each lot consists of the following</b>	01 Lot
1.	Installation of X-Band HiSAR Radar pay load on DRDO FTB (KD-707)	01 Job
2.	Design and Realisation of the following mod kits <ul style="list-style-type: none"><li>i. Interface frame/plate for mounting Airborne Liquid Cooling System(ALCS) with Inverter and AHE</li><li>ii. Cold air ducts( for inlet and outlet)</li><li>iii. Radar Rack</li><li>iv. AAAU Interface plate/frame</li></ul>	01 Set
3.	Realization of power cable connecting from the aircraft bus bar to Radar Power Distribution Unit. Supply of suitable circuit breakers, switches and relays for tapping of DC power from Aircraft.	02 Sets

**Item Name: Integration of X-Band High Resolution SAR System on FTB (KD-707) Dornier Aircraft**

4.	<b>Documents</b> <ol style="list-style-type: none"> <li>Electrical load analysis, Stress analysis and weight &amp; CG reports</li> <li>Modification Leaflet</li> <li>Flight clearances</li> <li>EMI/ EMC report</li> <li>Harmonization report</li> <li>Structural analysis report for Rack and aircraft interface frames</li> <li>Engineering drawings of console structures, interface brackets and supporting structures for mounting of LRUS</li> <li>Mechanical and electric ICDs for LRUS integration on AC</li> <li>System test plan (STP) for conducting ground testing</li> <li>Design documents for provisioning of circuit breakers, switches relays for tapping DC power supply (+28 V DC) from aircraft.</li> <li>Installation drawings of all support equipment's (INS, GPS, Data Recorder, Ethernet Switch, MIL-STD-1553B STUB, qualified cables)</li> </ol>	01 Set
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**5. DELIVERY SCHEDULE:**

S. No.	Activity	Delivery Schedule	Responsibility
1.	Signing of contract/placement of order and supply of technical details & drawings to HAL by LRDE for preparation of modification.	T0 <b>(Milestone-1)</b>	LRDE
2.	Providing technical information for designing interfaces, hardware and Provision of X- Band LRUs details with foot print and relevant drawings	T0+ 1 months	LRDE
3.	Design and development of modifications like AAAU mounting structure, Scoop design, other interface hardware for integration of X-Band HiSAR system. Generation of relevant documents, analysis reports, drawings, etc. <b>PDR on scoop design, mounting interfaces and aircraft modifications</b>	T0+3 months	HAL
4.	RCMA approval for MOD kit	T0+3 months	HAL
5.	Kit fabrication including racks, Scoops, ducts interface plates, cables, etc. for installation of X-Band HiSAR system	T0+4 months	HAL
6.	Positioning of serviceable aircraft and Induction of serviceable aircraft at HAL, TAD, Kanpur for De-modification.	T0+6 months	LRDE&HAL
7.	Positioning of airworthy certified radar LRUs at HAL TAD Kanpur.	T0+7 months	LRDE
8.	Integration of X-Band Radar on aircraft.	T0+7 months	HAL & LRDE
9.	X-band Radar ground testing, flight testing and acceptance at HAL TAD Kanpur	T0+8 months <b>(Milestone-2)</b>	HAL & LRDE



**Item Name: Integration of X-Band High Resolution SAR System on FTB (KD-707) Dornier Aircraft**

**6. OTHER TERMS AND CONDITIONS**

**6.1 PAYMENT TERMS**

Sl. No	Phase	Stage Payment	Remarks
1.	Milestone1	35%	Advance payment of 35% of total order value (inclusive of taxes) shall be paid on placement of supply order
2.	Milestone2	65 %	65% of the cost of the item (inclusive of taxes) shall be paid on completion of work and signal out of aircraft, inspection and acceptance as per para 6.2&6.3.

**6.2 INSPECTION**


The modified aircraft would be inspected after the modification/installation and de-modification by DGAQA / CRI at TAD, Kanpur or by a representative of LRDE duly nominated by the Director, LRDE.

**6.3 Acceptance Criteria**

- 6.3.1 Established standard test procedures exist for acceptance of modified aircraft through HAL quality/DGAQA/HAL/CRI-Test pilots. The same shall be followed for acceptance of aircraft modifications.
- 6.3.2 Acceptance test procedure (both ground and flight) for LRDE supplied equipments will be evolved jointly by LRDE, HAL-TAD and RCMA (Kanpur). Conformance to above procedure will be ensured by HAL Quality /DGAQA/CRI/HAL Test pilots.
- 6.3.3 Aircraft test flight and acceptance will be carried out by Chief Test Pilot (CTP), HAL (TAD). Signal out by RDAQA, Kanpur along with HAL (Quality Control)

**6.4 WARRANTY**

12 months from the date of acceptance. Warranty is applicable for work carried out by HAL TAD and items supplied/replaced by HAL during modification. If within the period of warranty, the goods are reported by LRDE to have failed to perform as per the specification, and or are unserviceable and not available for flying, then HAL-TAD shall either replace or rectify the defect free of charge.



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**7. CONCEPTUAL DRAWINGS OF X-BAND SAR SYSTEM:**

**7.1 Active Array Antenna Unit:**

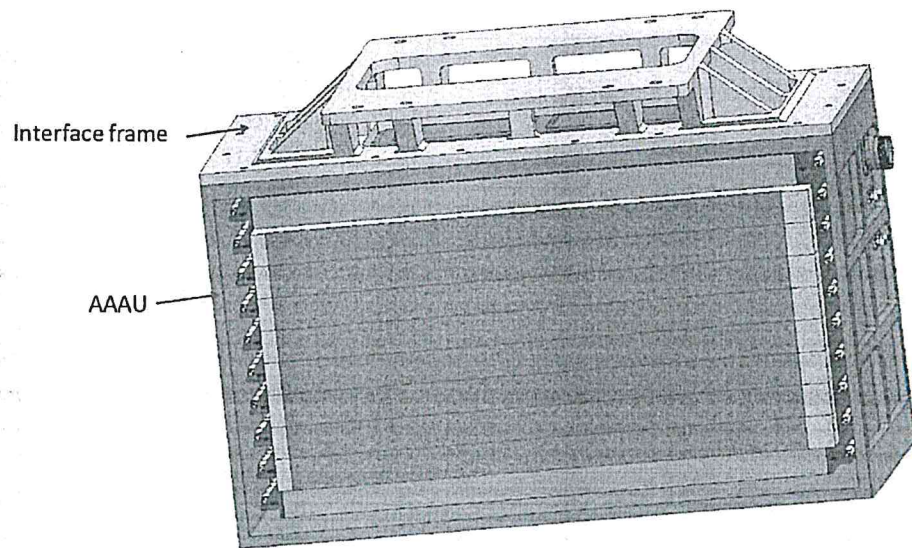


Figure 1: Concept of AAAU with interface frame

**Maximum AAAU size:**

AAAU: 680 mm (L) x 380 mm (D) x 380 mm (H) (height excluding Interface frame)

Height of aircraft Interface frame: 70 mm

**7.2 Assembly of Liquid Cooling System with Inverter and Airborne Heat Exchanger**

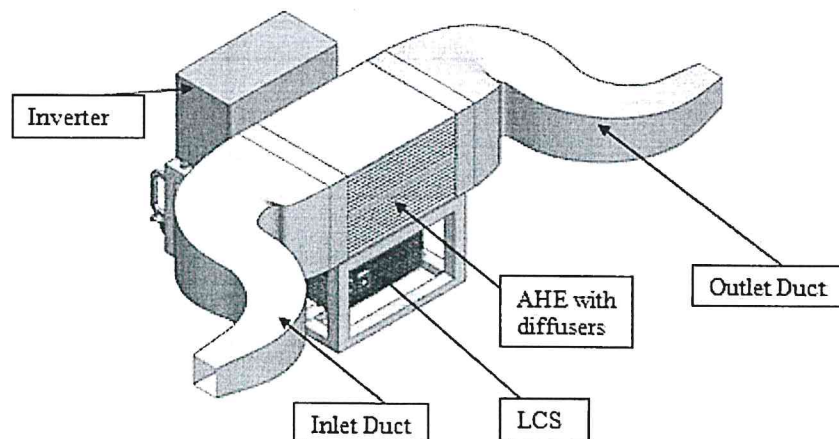


Figure 2: Assembly of LCS

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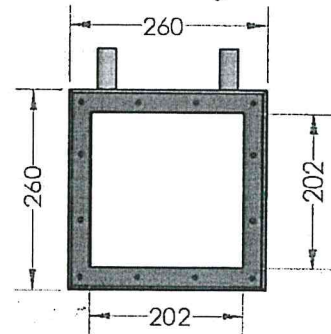
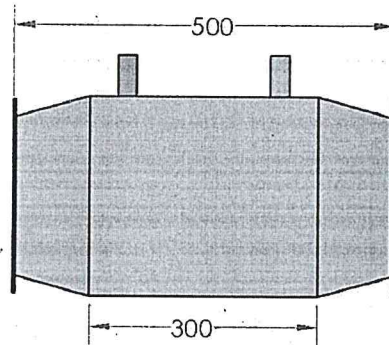
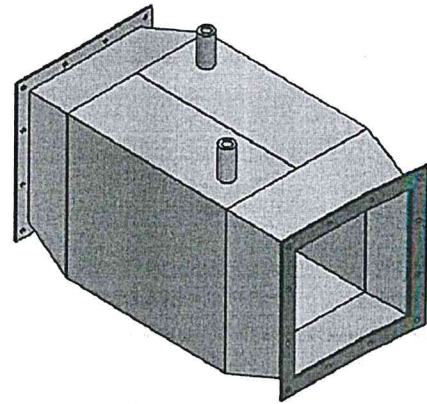
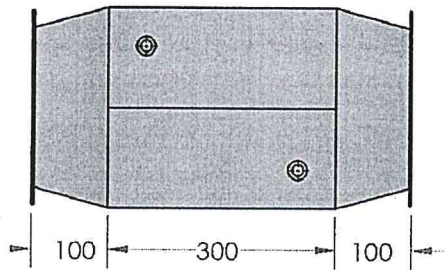
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7.3 Tentative Overall Dimensions of the Airborne Heat Exchanger with Inlet and Outlet Diffuser:



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LIST OF DELIVERABLES AND ACCEPTANCE

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3.	Realization of power cable connecting from the aircraft bus bar to Radar Power Distribution Unit. Supply of suitable circuit breakers, switches and relays for tapping of DC power from Aircraft.	02 Sets
4.	Documents i. Electrical load analysis, Stress analysis and weight & CG reports ii. Modification Leaflet iii. Flight clearances iv. EMI/ EMC report v. Harmonization report vi. Structural analysis report for Rack and aircraft interface frames vii. Engineering drawings of console structures, interface brackets and supporting structures for mounting of LRUS viii. Mechanical and electric ICDs for LRUS integration on AC ix. System test plan (STP) for conducting ground testing x. Design documents for provisioning of circuit breakers, switches relays for tapping DC power supply (+28 V DC) from aircraft. xi. Installation drawings of all support equipment's (INS, GPS, Data Recorder, Ethernet Switch, MIL-STD-1553B STUB, qualified cables)	01 Set

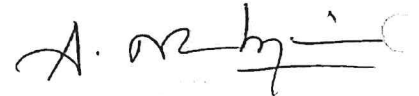
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