Memorandum

To: John Delgado

cc: Gene Lauria
Marian Pospieszalski
Antonio Perfetto

From: John Effland

Date: 2004-10-15

Revisions: 2004-10-15 jee Initial

Subject: Protection of Cryo-3 HFETs Used in the in ALMA Band 6 Cartridge

The Atacama Large Millimeter Array[1] (ALMA) includes receivers called "Band 6 Cartridges[1]" that cover the 211 GHz to 275 GHz frequency range. These Band 6 receivers include cryogenically cooled mixers integrated with amplifiers[2,3]. The active elements in the amplifiers are Heterostructure Field Effect Transistors made from Indium Phosphide (InP HFETs), manufactured by TRW (now Northrup Grumman) under contract to JPL, and obtained by the NRAO under special agreement with JPL. These HFET devices are from a TRW manufacturing run called "Cryo-3," which exhibits superior performance compared to other runs of the same devices.

This memo shows that these devices are deeply integrated into the Band 6 receiver and hence their removal and use by other parties is considered highly unlikely.

Figure 1 shows one of the HFET devices mounted in the preamplifier body. Figure 2 is a photograph of a preamplifier block and highlights the location of the three HFET devices that are used for each preamplifier. Two preamplifiers are mounted on each mixer as shown in Figure 3 and there are two such mixer-preamplifiers used in each cartridge as illustrated in Figure 4. A Band 6 receiver consists of the vacuum section of the cartridge mated to the section exposed to atmosphere as shown Figure 5. Figure 6 depicts the present concept of a complete ALMA receiver that will be installed in each ALMA antenna shown in Figure 7. The receivers are located in the antenna cabin, which is located behind the hole in each reflector shown in Figure 7.

[1] The Atacama Large Millimeter Array (ALMA) is an international astronomy facility. ALMA is an equal partnership between Europe and North America, in cooperation with the Republic of Chile, and is funded in North America by the U.S. National Science Foundation (NSF) in cooperation with the National Research Council of Canada (NRC), and in Europe by the European Southern Observatory (ESO) and Spain. ALMA construction and operations are led on behalf of North America by the National Radio Astronomy Observatory (NRAO), which is managed by Associated Universities, Inc. (AUI), and on behalf of Europe by ESO.

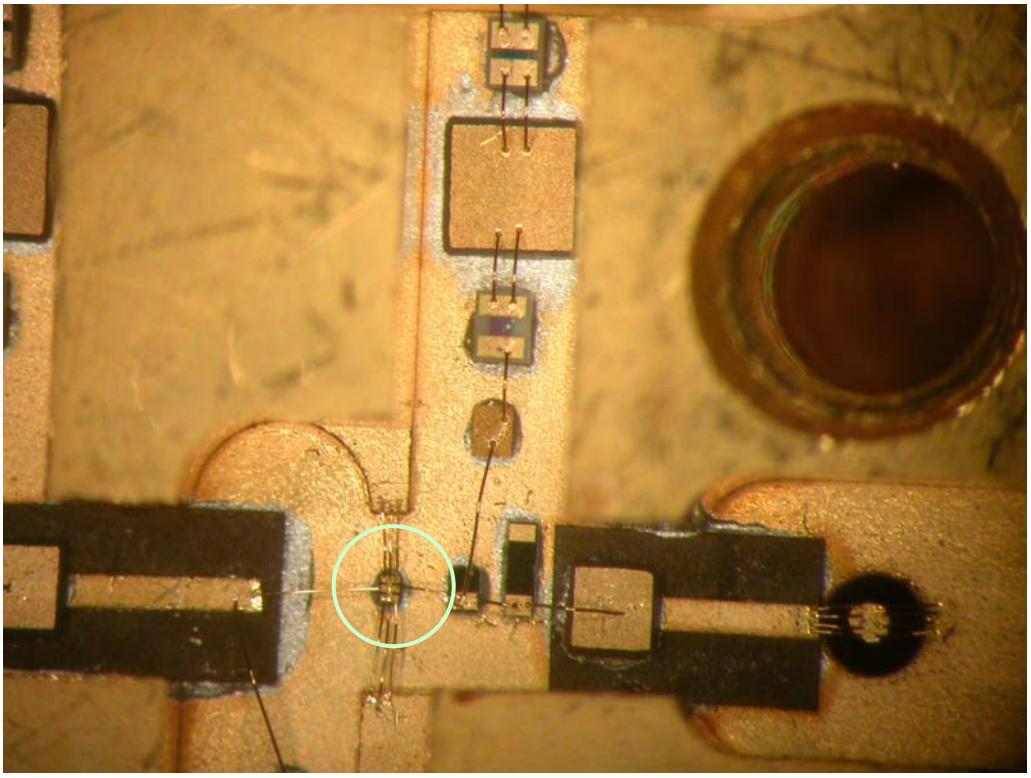

Figure 1: HFET (inside circle) installed in output section of Band 6 preamp

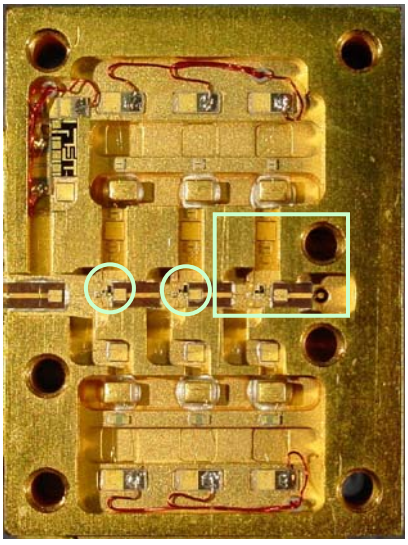

Figure 2: Open preamp showing installation of all 3 HFETs. Rectangle is region exploded in Figure 1.

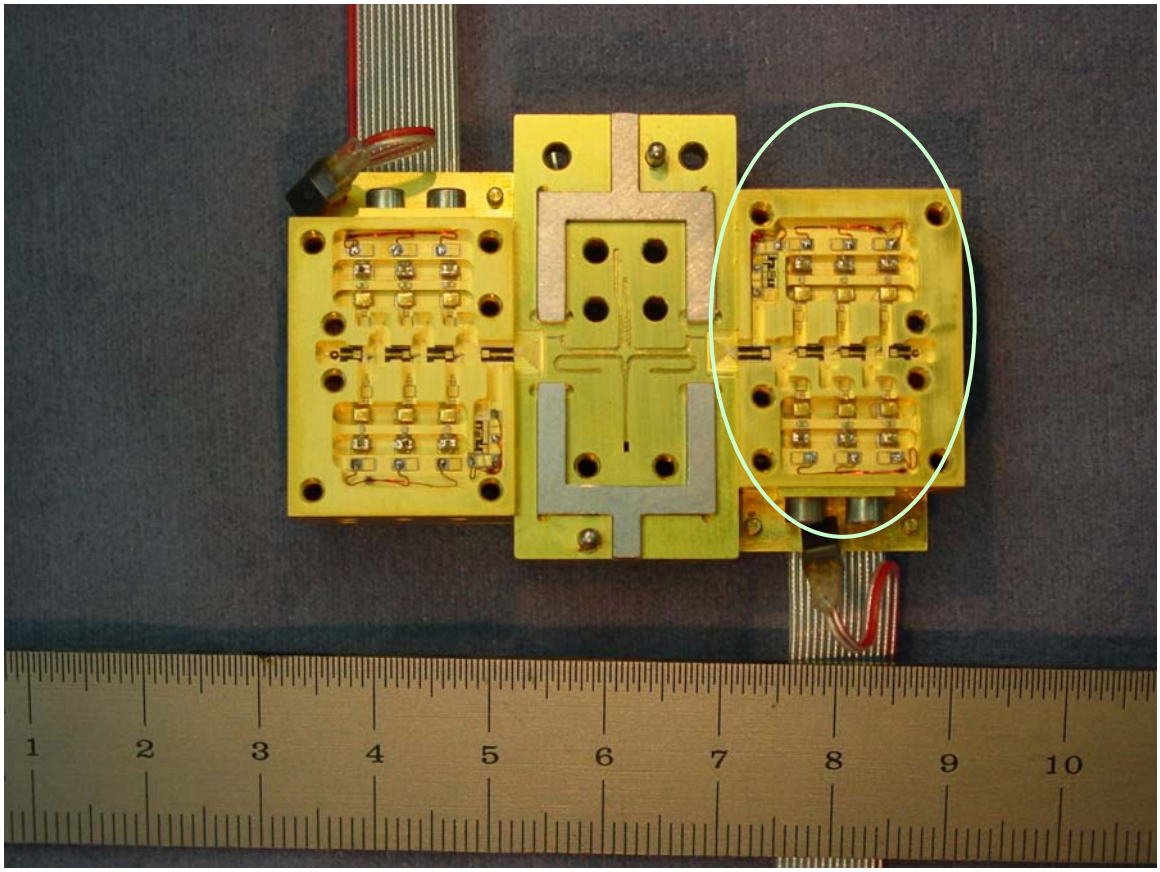

Figure 3: Open covers on Band 6 mixer-preamp with matched preamps

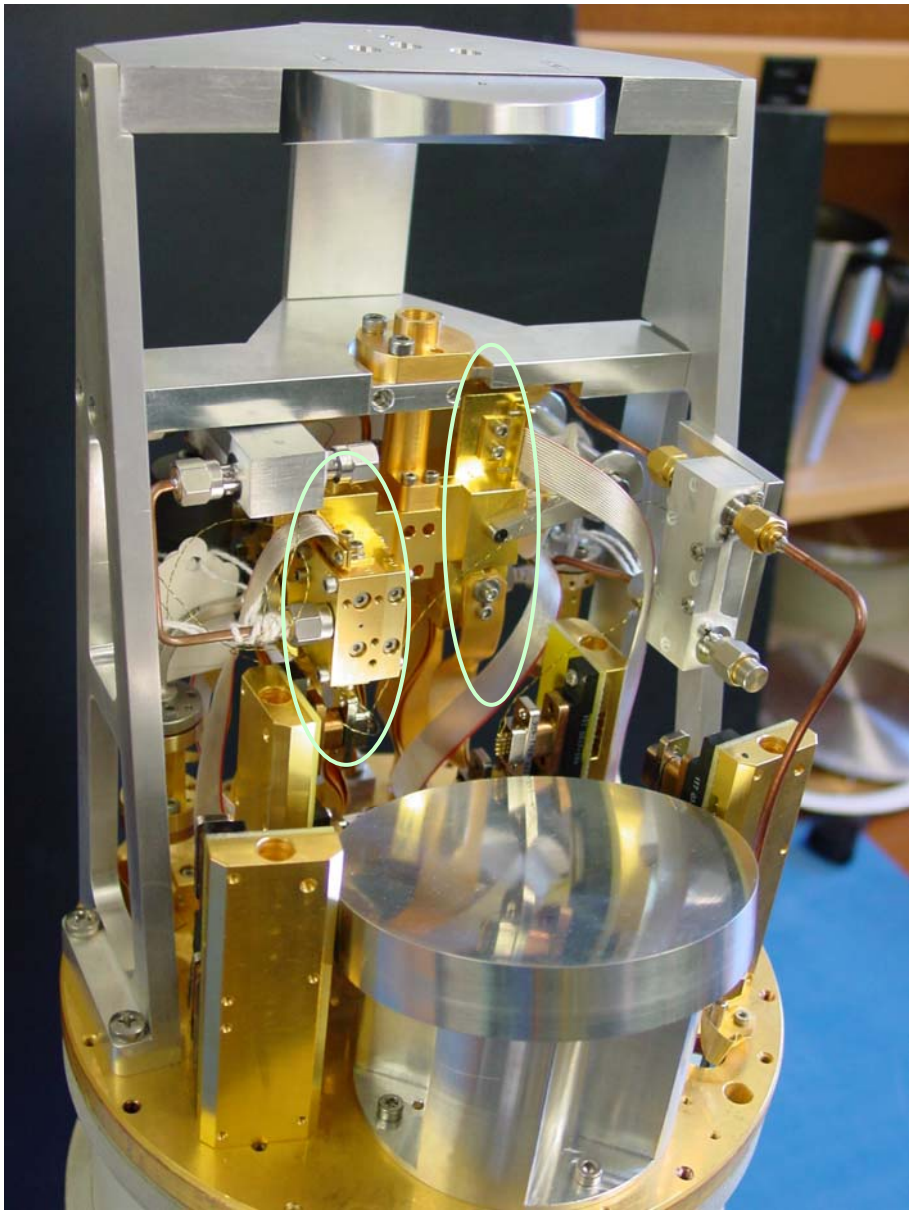

Figure 4: Two mixer-preamps mounted on cold stage of vacuum section of Band 6 cartridge

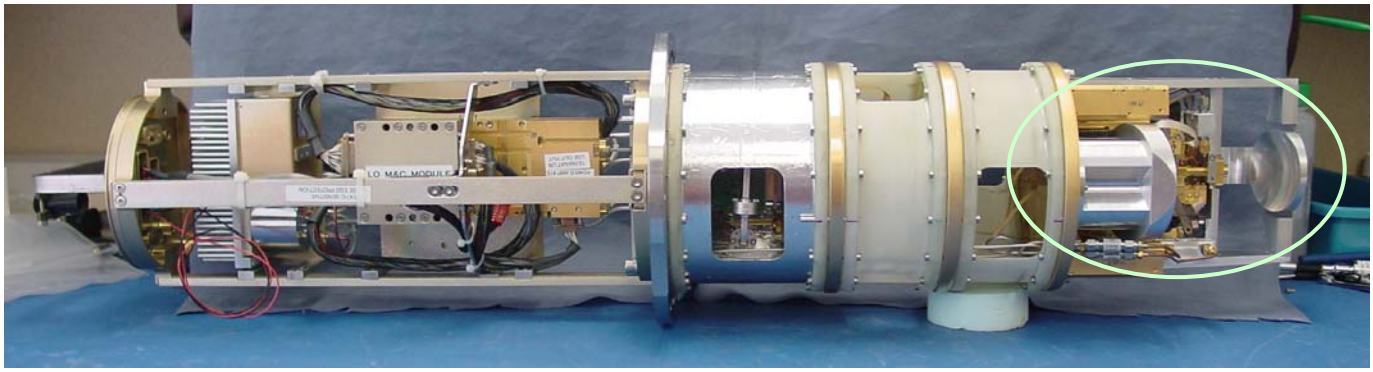

Figure 5: Complete Band 6 cartridge with cold stage of Figure 4 highlighted

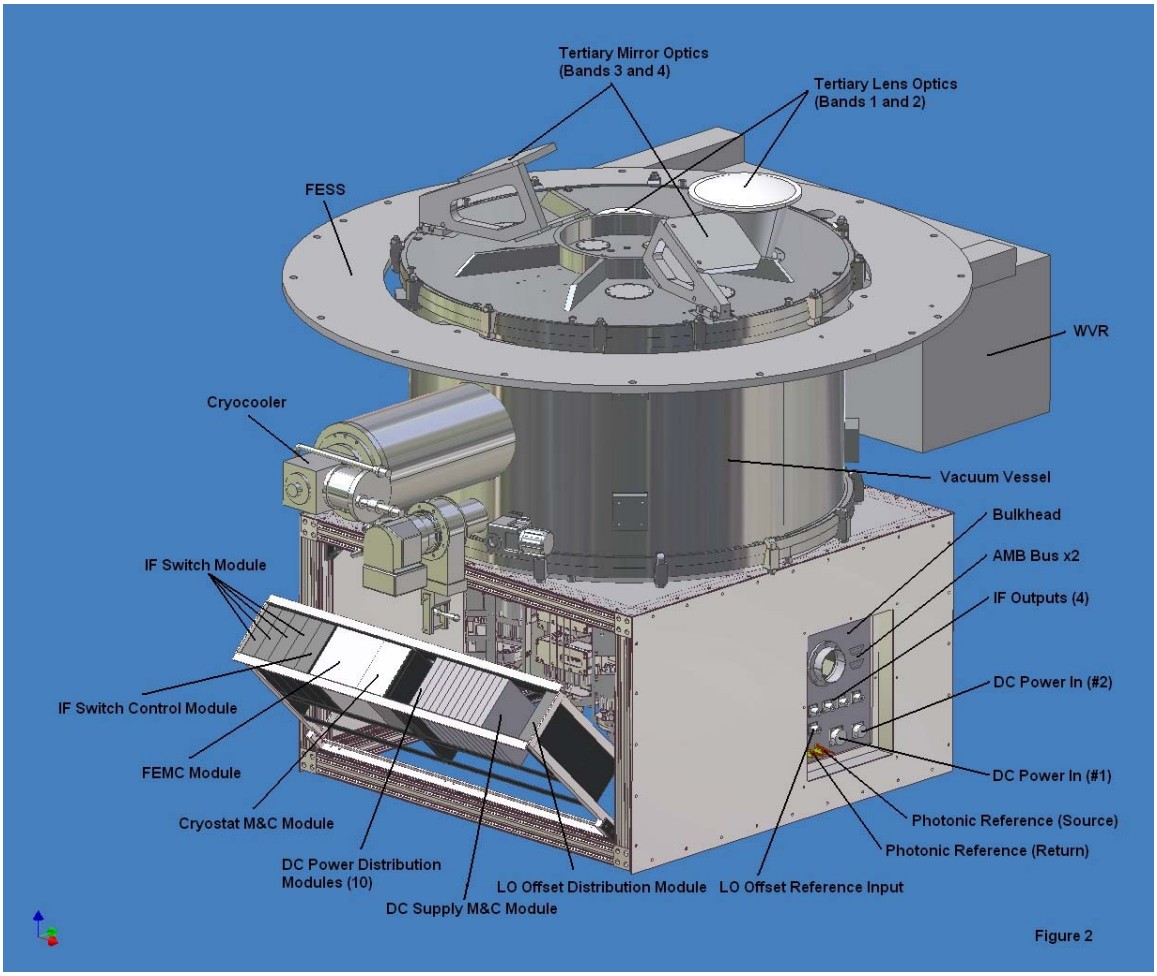

Figure 6: Complete ALMA receiver. Cartridges mounted in bottom of receiver

Figure 7: Artists Sketch of ALMA Array (Image courtesy of NRAO/AUI and ESO)

[1] G. A. Ediss, M. Carter*, J. Cheng, J. E. Effland, W. Grammer, N. Horner, Jr.A. R. Kerr, D. Koller, E. F. Lauria, G. Morris, S-K. Pan, G. Reiland and M. Sullivan, "ALMA Band 6 Prototype Cartridge: Design and Performance," ALMA Memo 502, 2004-06-21, available at
http://www.alma.nrao.edu/memos/html-memos/alma502/memo502.pdf

[2] A. R. Kerr, S.-K. Pan, E. F. Lauria, A. W. Lichtenberger, J. Zhang, M. W. Pospieszalski, N. Horner, G. A. Ediss, J. E. Effland, R. L. Groves, "The ALMA Band 6 (211-275 GHz) Sideband-Separating SIS Mixer-Preamplifier," ALMA Memo 498, 2004-05-14, available at
http://www.alma.nrao.edu/memos/html-memos/alma498/memo498.pdf

[3] E. F. Lauria, A. R. Kerr, M. W. Pospieszalski, S.-K. Pan, J. E. Effland, A. W. Lichtenberger, "A 200-300 GHz SIS Mixer-Preamplifier with 8 GHz IF Bandwidth," ALMA Memo 378, 2001-06-07, available at:
http://www.alma.nrao.edu/memos/html-memos/alma378/memo378.pdf