Reverse Engineering

System Upscreening, Characterization of components, Form, Fit, and Function

1 Introduction

From the '60s onwards, many systems mainly depend on the technology of the electronic components used. Is then necessary to extend the useful life well beyond the programmed one. Many military and civilian systems make use of electronics that pushes its roots in the '60s: these components were made by manufacturers who, in the vast majority of cases, do not exist anymore, so it becomes difficult, or impossible, to find datasheets, and all supporting documentation. On the other hand, Integrated circuits often seem to have been designed on obsolete, proprietary systems, which means that the only way to incorporate the functionality into new technology is to reverse engineer the existing chip and then re-design it.

2 What Reverse Engineering means?

Reverse engineering is the process of discovering the technological principles of a device or a system through analysis of its structure, function, and operation. It often involves disassembling the device and/or electronic components, in order to analyse its components and workings in detail, for either purposes of maintenance or to support creation of a new device that does the same thing, without using or simply duplicating (without understanding) the original.

3 Strategies

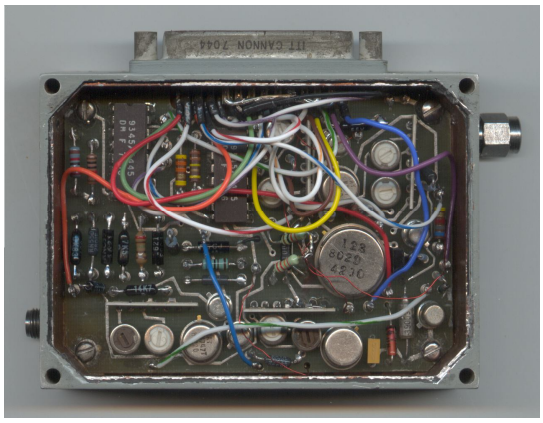
There are several strategies in reverse engineering that can be applied according to the technical and economic needs.

A first strategy is the reconstruction of the component or assembly. To such scope, LTG has a large experience in the field of reverse engineering. This choice allow to supply FFF (Form, Fit, and Function) components and subassemblies, equivalents to the originals. On the other hand, the logistical support to the system is guaranteed for several years, thanks to modernized, upgraded and high reliability components.

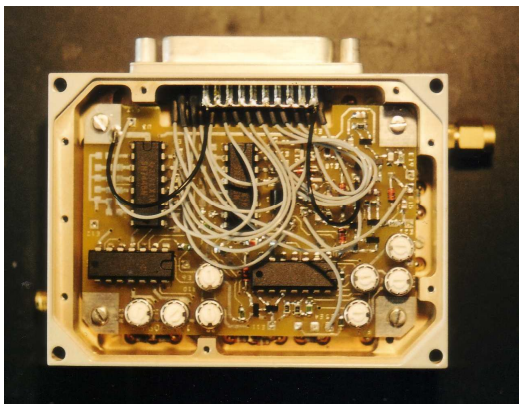
A second strategy, (when the precedent is not practicable for reasons of complexity or cost) is to acquire a commercial grade component (COTS - Commercial Off The Shelf) and to proceed to up screen it to MIL qualification. LTG, in this field, is in a position to offer all the necessary resources to the qualification process

4 Case Study: Radar Modulator

During the upgrading process of the radar test equipment system of Nike-Hercules missiles deployed by *Aeronautica Militare* (Italian Air Force), LTG, working in cooperation with a specialized firm in antennas and one in microelectronics assembly has been involved in reverse-engineering of an X-band modulator and an ALC circuit.



Original Modulator

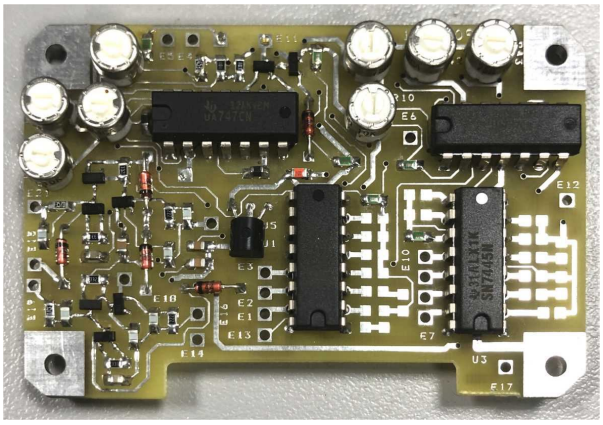


Remanufactured Modulator

The modulator consists of 3 main elements: the case, the control board, the RF section in microelectronics. LTG has redesigned both the electronic control board and the X-band RF section in microelectronics technology.

LTG, within the framework of reconstruction of a module in microelectronics FFF, decided to replicate the hybrid circuit chip-and-wire system, whose function was to provide dual fast drivers for the PIN diode modulators of the radar module.

Original PIN diodes driver hybrid

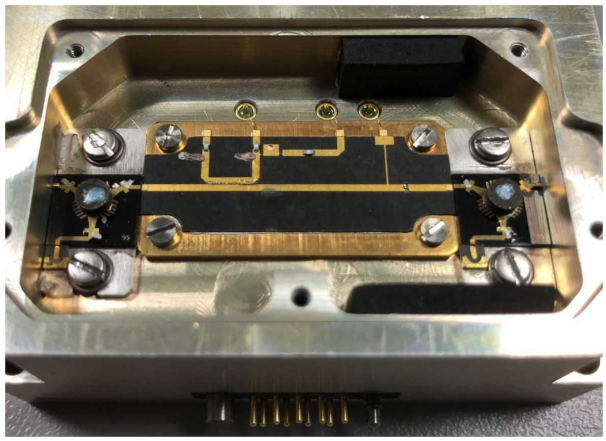


Remanufactured Modulator Electronic Circuit Board,
with PIN diode drivers in SMT technology.

LTG has been able to reconstruct the equivalent circuit, suitably simulate on a CAD platform, and check all the electrical critical parameters as, eg., the response time of the driver. He then proceeded to its realization with current components in SMD technology.

5 Final Delivery

The complete delivery consisted in ten (10) modulator circuits, ten (19) ALC circuits, and a test box to control all functions of the modulator and ALC.



ALC (Automatic Leveling Circuit) microelectronics detail

Modulator and ALC Engineering Prototype modules