THE

COLLECTION

MERRIMAC

SPACE QUALIFIED PRODUCTS

Merrimac's Space Qualified Products

Merrimac has developed a program called Merrimac Space Qualified Products (MSQP) which reduces the complexity of the satellite component procurement process, reduces delivery time and improves product quality and reliability.

MSQP is based on Merrimac's 40+ years of innovative space heritage and input from our customers regarding standardizing the design, manufacturing, qualification and procurement process for space quality, hi-reliable components and sub systems. The company drew on established, proven design practices, compiled and standardized the documentation and levels of screening achieved for these products, and created a set of rules that customers can follow when tailoring a specification for certain components they want Merrimac to build. The result is Merrimac is able to reduce cycle times and cost through the economies of standardization and scale. By utilizing MSQP, Merrimac can draw on its library of documentation so each requirement is not started from scratch. Through continued utilization of the design, process and screening criteria in MSQP; variables are reduced improving product quality and reliability.

MSQP gives customers the choice of two methods: They can select a part from Merrimac's Standard MSQP product offering that meets their needs or they can create a specification for the component based on the MSQP design, process, qualification and screening guidelines. In the first case, once Merrimac receives the request, Merrimac produces the component based on existing documentation. Since Merrimac has pre-qualified each family of its Standard MSQP offering, the customer can save cost and cycle time by accepting qualification or qualification by similarity data. If the customer chooses to build a spec around the MSQP design, process, screening and qualification rules, Merrimac designs the desired component utilizing existing designs where possible. In either case, considerable time and cost are removed from the process. The customer also has the assurance that the requested component will be available over the long term reducing industry wide concern of part obsolescence.

The MSQP approach has cut many weeks from the procurement cycle for the growing number of customers who are using it. While the concept is simple, it requires and understanding of the hi-rel manufacturing and space-qualification process, and array of proven product families, and equally important, a desire to dynamically serve satcom and hi-rel customers.

MERRIMAC HIGH RELIABILITY ADVANTAGE

REV: 027, 10/29/02

HI REL CAPABILITIES STATEMENT

The custom products described in this brochure were designed and manufactured for specific customer's high reliability aerospace or satellite programs. The electrical, mechanical and environmental performance of these products demonstrate Merrimac's design, development and manufacturing capabilities for supplying similar products intended for use in critical applications where high performance and high reliability are mandatory.

Whether your application requires a custom or standard product, Merrimac's successful "track record" of 30 plus years attests to our ability to satisfy the marketplace and your specific needs!

A PIONEERING HERITAGE

From our initial involvement with the "first lunar landing" project to current "commercialization of space" efforts, we at Merrimac have been at the forefront of high-reliability signal processing component technology. In the early 1960's we developed miniaturized circuits, and in 1967 we introduced our "LUMPED ELEMENT" IF signal processing components that were used in the TIROS satellite. Subsequent developments lead to their use in 1969 in the Voyager space probe where they are today and are still operating flawlessly. In 1972 we produced a "STRIP-LINE" sub-assembly, which flew on the exterior of a classified satellite where it operated flawlessly at a temperature approaching absolute zero! In 1983 we designed and built a "redundant wired" Lumped Element Quadrapole Network which was fully functional from $-150^{o}C$ to $+125^{o}C$, had to withstand very high level pyro shock and continuously perform while being exposed to combinations of severe environments on the backside of a spacecraft antenna. This design yielded an extremely high MTBF considering the complexity.

These early pioneering programs, many of which were "scientific payloads", helped to "hone and position" Merrimac as a world-class leader in the design, development and manufacture of a wide variety of high reliability (Hi-Rel) signal processing components and sub-systems. Over the years, our products have been used in military and commercial satellite, space, missile and aircraft applications. Their reliability, which adheres to the most stringent environmental specifications, has led to a continuing demand for their use in critical present day applications where performance really counts, such as in global satellite constellations like "Iridium", "Global Star", "Inmarsat", and "ICO" to name a few. As we have entered the 21^{st} century, we go forward armed with the technology, motivation and "where with all" that it will take to supply the Hi-Rel needs through the next millennium.

PROVEN HI-REL SIGNAL PROCESSING COMPONENTS

Since 1967, Merrimac has furnished tens of thousands of products designed for over a thousand different aerospace programs. Merrimac products not only find applications in satellites and in the Shuttle and Space Station, but also into the heart of the aircraft industry, both military and commercial. For example, numerous Merrimac signal processing products have been designed and manufactured for fighter aircraft such as the A6-A, F-14, F-15, F-16, F-17, F-22, as well as military helicopters like the EH1010. In addition our products are used extensively in reconnaissance aircraft such as the EA-613 and E2C and commercially in passenger aircraft like the Boeing 737, 747, and 777. In all of these applications High Reliability is a common denominator. We have developed unique, exacting technologies for manufacturing products designed not to fail, even in the most rigorous environments.

IMPORTANT MILITARY & SCIENTIFIC PROJECTS USING MERRIMAC SIGNAL PROCESSING COMPONENTS

131-13
ACES
AEGIS
ALR 67
AMRAAM
ARTEMIS
ATS-6
AWACS
B1-B
B2
CD RADIO
CUTTY SARK
DOMSAT CHINASAT
DSCS-111
DSCS-II
DSP
F-117A
FLEETSATCOM
GALILEO
GEOS
GPS BLOCK IIR
HARM
ICO
INTELSAT
IUS
JRSC
J-TIDS
METEOSAT
MINUTEMAN
MK-21
NAVSTAR/GPS
PATRIOT
PHOENIX
PLSS
SEEK IGLOO
SKYNET
SMS
SPACE SHUTTLE
SPACE STATION
TELSAT
TERRIER
TIROS-M
THURAYA
TITAN
TDRSS
TPQ-36
TPQ-37
TPS-59
VIKING
VOYAGER
WSC-3

WE ARE PROUD OF OUR HI-REL SUCCESS

DIRECTIONAL COUPLERS

Couplers with literally any coupling value from as low as 1 dB to over 40 dB have been designed, using both lumped element and strip-line techniques, from the Kilo-Hertz region to greater than 45 GHz. Offered in a variety of packages, such as our Surface Mount model, couplers have been furnished for both narrow and wide-band systems. These products have been designed to perform under high shock and vibration conditions and are characterized by high directivity, low loss and excellent phase and amplitude stability over the prescribed environment.

90° QUADRATURE HYBRIDS

Hundreds of types have been produced, ranging from 0.01 MHz to over 45 GHz, in both lumped element and strip-line designs. Connectorized and PCB mounted devices are used throughout the industry, many models have been space qualified and are listed by the military as “approved parts” for satellite applications.

0/180° HYBRID JUNCTIONS

Numerous packages have been furnished for satellite systems. Among them are SMA, N and TNC connector models, a variety of SMD package products and flatpacks. From a miniaturization standpoint, a recent requirement resulted in the development of a broadband symmetrical hybrid covering 5 to 1000 MHz. This model was produced in a 0.50” x 0.375” x .125” flatpack, weighing less than 2 grams.

BALANCED MIXERS

Single, double and triple balanced mixers have been furnished in Hi-Rel designs. Connectorized models at frequencies up to 20 GHz have been used for many applications such as BPSK Modulators, phase detectors, pulse modulators, up converters and down converters. Low conversion loss, high isolation wide bandwidth, and good DC offset voltage characteristics are featured performance parameters. To insure Hi-Rel performance, Merrimac subjects the monolithic Schottky Barrier diode quad to a strict screening program. This custom Merrimac program is used to screen the diodes on a JAN-TX or JAN-S equivalent basis.

IN-PHASE POWER DIVIDERS/COMBINERS

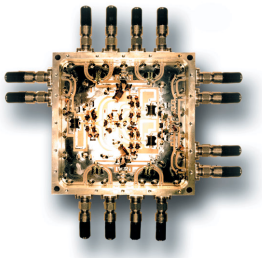
Power division ratios with both binary and “N” way combinations up to 512:1 have been furnished in a wide variety of packages. Low frequency lumped element models have been furnished from 10 kHz to over 3.0 GHz. Two broadband models worthy of note have been designed and developed for satellite applications. These are a two by four way, high-power, L-band helical antennae feed network and an “X” band, two by three way redundant circuit, L.O. feed network. An important trend is the use of “NxM” Divider arrays, where Merrimac is supplying 2x6, 5x6, 3x16 and many other combinations, in conventional and “Failsafe” configurations.

MULTILAYER BONDED ASSEMBLIES

In addition, where performance and mechanical constraints dictate, Merrimac can provide space qualified, bonded assemblies. These products, which are designed at Merrimac and fabricated by our wholly owned subsidiary Filtran Microcircuits Inc., have flight heritage in GPS applications. Filtran’s tight process controls allow Merrimac’s development engineers to design components and subsystems with critical performance characteristics and geometries that could not be realized without this capability.

INTEGRATED COMPONENTS

Merrimac continues to expand its range of Integrated Components. By definition an Integrated Component is a product that combines two or more basic networks into one unit. Many of these products are available as Hi-Rel Integrated Components, such as Beam Forming Networks, I&Q Modulator and Demodulator Networks, Vector Modulators, Single Side-Band Modulators and Demodulators.



BEAMFORMER

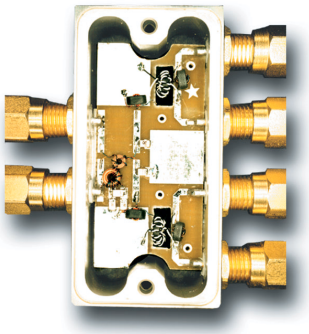
QUADRIPOLE NETWORKS

Quadripole networks are basically an integration of a 90°-quadrature network and two 0/180° hybrid tee junctions. Their function is to provide four output ports whose phase differences are 0, 90, 180 and 270 degrees. In many cases this network is used as a circularly polarized antenna feed where by feeding alternate input ports, clockwise or counter-clockwise, signal rotation (polarization) can be obtained.

In the VHF frequencies, Merrimac has provided networks that exhibited very close phase tolerances and low insertion loss. Equipped with SMA connectors, the units were designed to withstand rigorous vibration parameters and outgassing requirements.

A strip-line quadripole network covering 225-400 MHz was developed to fly on the outside of a spacecraft. The unique design of this product is a noteworthy example of Merrimac's strip-line expertise with respect to materials, bonding methods, thermal effects of connector expansion and of the temperature characteristics of resistive terminations. Significant specifications for this product were a combination of simultaneous operating conditions as defined below:

A. Operating temperature range of -250 to +265^{O}F
B. Input power level of 100 Watts into a load VSWR of 2:1
C. Requirement that unit operate in a vacuum.

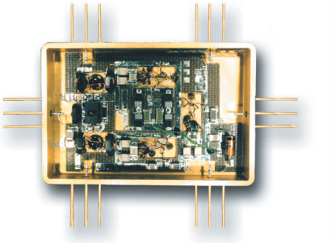


QUADRIPOLE NETWORK

These conditions subjected the internal resistive terminations to severe thermal stress. A rigorous screening and burn-in program was used to provide highly reliable resistors for this application. Merrimac performed Qualification Testing on this strip-line quadripole product and data is available from our archives.

OTHER HI-REL INTEGRATED COMPONENTS INCLUDE:

Beamformers
Up/Down Converters
Synchronous Detectors
Quadraphase Modulators (QPSK)/Demodulators
Single Side Band Modulators/Demodulators
Image Reject Mixers
I & Q Networks (Modulators & Demodulators)
Vector Modulators
N by M Power Dividers
200 Watt, X Band 5-Way Power Divider



I & Q NETWORK

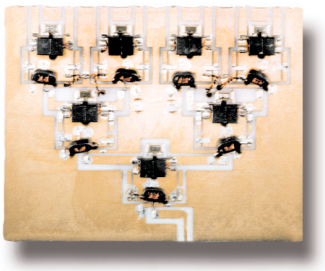
MERRIMAC SETS THE "STATE-OF-THE-ART"

HI-REL PROCESSING TO MEET SPECIFICATIONS

LUMPED ELEMENT TECHNOLOGY

Merrimac pioneered this process, and has continued to optimize it by extending the upper frequency range and its intrinsic reliability. Lumped Element Technology employs a variety of densely packaged basic components, i.e., chip capacitors, resistors, diodes, toroids, twisted wire, etc. Signal processing products can be made very small using this technology, which is very cost effective for use in space vehicles and satellites, airborne & ground applications where minimum weight and volume is a prime requirement.

RIVIT JOINT AIRCRAFT



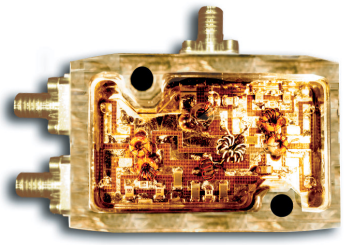
8-WAY
POWER DIVIDER

LUMPED ELEMENT COMPONENTS

In Hi-Rel systems several important considerations affect the design of Merrimac Hi-Rel components. They are:

1. Size and weight
2. Connector or printed circuit terminal requirements.
3. MTBF requirements.
4. Environmental exposure; particularly stress due to acceleration, vibration and temperature extremes. (These parameters should not be over specified!)

From an overall reliability standpoint, printed circuit designs (products with PC pins) are superior to connectorized designs. This is true from an MTBF standpoint, as well as for the smaller size and lighter weight afforded by this approach. The use of solder terminal, and or welded lead construction generally yields a higher product MTBF than a connectorized interface.



QUADRUPLE NETWORK

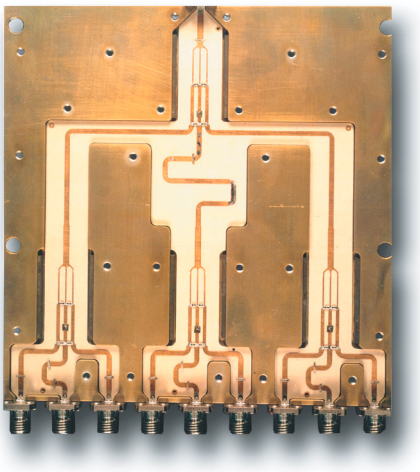
SURFACE MOUNT DESIGNS WITH WELDED CONSTRUCTION

In most lumped element products, Merrimac has standardized a number of low profile, lightweight, sub-miniature, surface mount packages ideal for high-density applications. Internal connections employ welded construction to yield high reliability connections, totally immune to processing temperatures on installation.

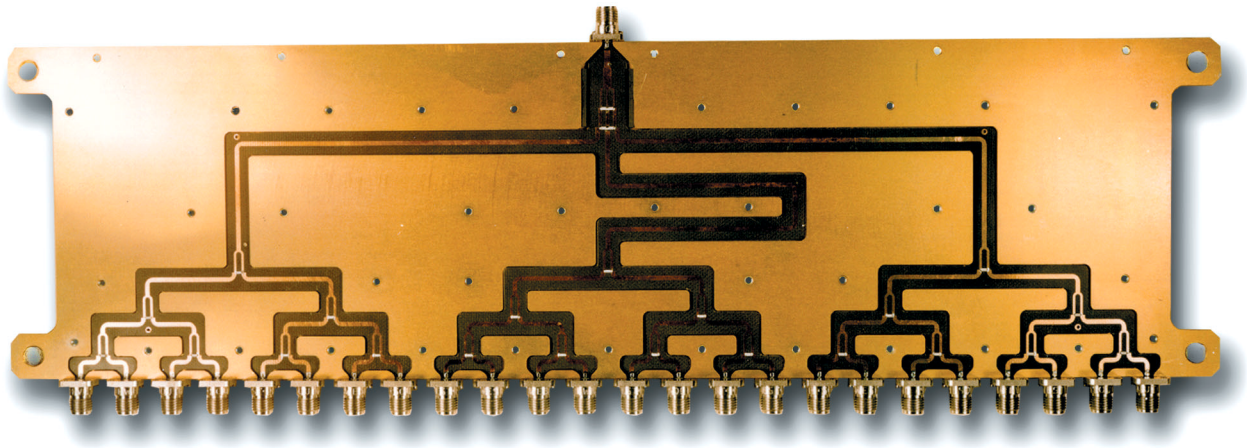
WIRE WELDING

DISTRIBUTED ELEMENT TECHNOLOGY

Distributed Element Technology employing strip-line and micro-strip techniques allows for the development of complex circuits, with minimal interconnections and size, and generally handles high power. Distributed Element Technology also allows operating to higher frequency limits, with high reliability. As with Lumped Element Technology, all Merrimac products are designed and manufactured to meet the requirements of military specifications MIL-E-5400 and MIL-E-16400. Merrimac has been designing and manufacturing Distributed Element Technology for Hi-Rel applications since the mid-1960's.



9-WAY POWER DIVIDER



24-WAY POWER DIVIDER

MERRIMAC OFFERS A DESIGN CHOICE OF "LUMPED ELEMENT", "MICRO-STRIP" OR "STRIP -LINE" TECHNOLOGY

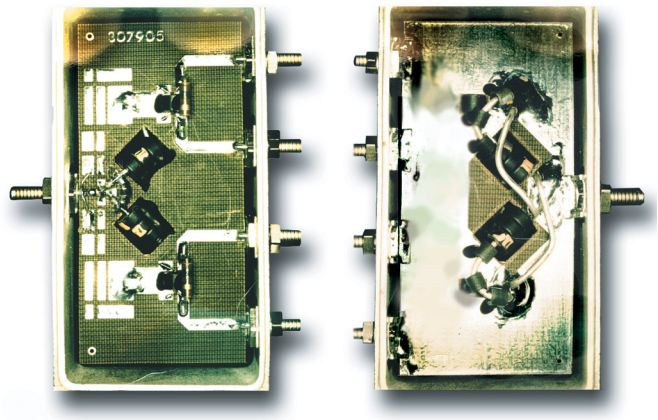
TAKE ADVANTAGE OF THE ONE THAT OFFERS YOU THE OPTIMUM SOLUTION TO YOUR PROBLEM

DESIGN CONSIDERATIONS AFFECTING RELIABILITY

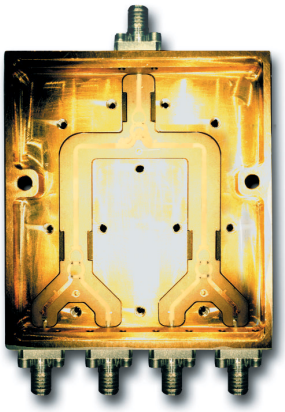
At Merrimac, three design techniques are used to produce the transmission characteristics of most of our signal processing components, integrated components and sub-assemblies. For low frequency applications up to approximately 4 GHz and power levels less than 5 watts, “Lumped Element” techniques employing toroidal ferrite transmission line transformers are employed.

For higher power (up to 1 kW) applications, from 30 MHz to 20 GHz, Merrimac employs balanced strip-line and microstrip techniques which entails the “printing of a circuit” onto a copper-clad sheet bonded to a low loss dielectric substrate material. In the microstrip case only one ground plane is employed while in the strip-line case two ground planes enclose the circuit symmetrically. Signals are brought in and taken out of the circuit via specially designed RF connectors. Thus, Merrimac offers a choice between lumped element and strip-line designs within the frequency range of 30 MHz to approximately 20 GHz, for most of its products.

The trade-off between lumped element and strip-line design is illustrated below using a four-way Power Divider constructed in both technologies.



LUMPED ELEMENT



STRIPLINE

Lumped element designs generally afford smaller size, lighter weight and lower cost. Strip-line designs generally exhibit lower insertion loss and offer potentially higher operating power at higher frequencies. Tradeoffs and combinations of these various technologies are possible using Merrimac capabilities. Special products can be designed to perform to highly unique parameters that are encountered in Hi-Rel space applications. The unusual and difficult are Merrimac’s specialty!

PARTS, MATERIALS AND PROCESSES

An important design consideration is the specification and use of previously “qualified” parts, materials and processes. Merrimac Industries selects from existing standards such as, MIL-PRF-55342, MIL-PRF-55681, levels R or S, NEMA 1000 wire type MW80-C-heavy poly, 155 class. Specialized diode assemblies are procured to JAN-TX or JAN-S equivalent. Epoxies are MIL-STD-883, method 5011 compliant when required and all other materials and processes are purchased and/or controlled by Merrimac’s document and configuration control systems.

REDUNDANT CIRCUITRY

Merrimac has been utilizing redundant wiring techniques since 1983. Redundant wiring can deploy 2x the required wiring to insure that any break of a single wire will have a negligible effect on electrical performance. In addition, resistor and capacitor circuitry can also exhibit a certain degree of redundancy. A pair of parallel resistors can realize a terminating resistance wherever they are necessary. Any failure of a resistor, although highly unlikely, will result in some performance degradation, but not nearly as significant as the degradation that would occur in a standard wiring scheme utilizing stand alone resistors. A pair of parallel capacitors can also be used to replace a single capacitor, with the same net effect. Built in redundancy greatly reduces the failure rate and greatly enhances the MTBF of the completed assembly.

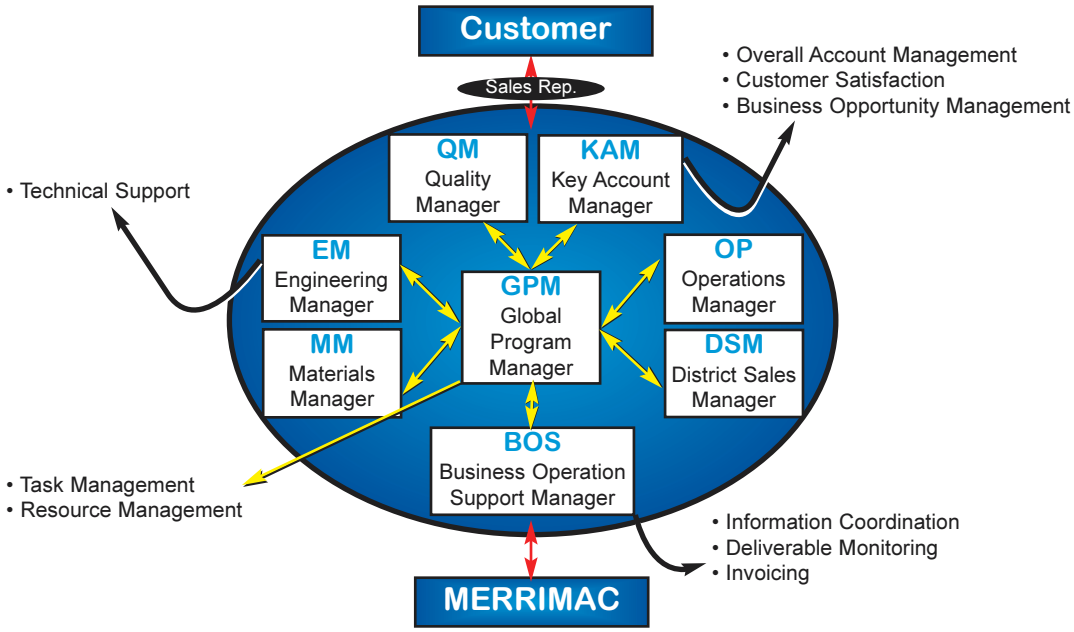
Redundant circuitry has been utilized on a wide variety of components for satellite programs such as ICO, Thuraya and GPS. Among these devices are complex beam formers, two way, three way, four way, nine way, and twelve way power dividers, as well as dividers that provide redundant inputs to go along with redundant wiring.

QUALITY SYSTEMS ASSURE HI-REL PERFORMANCE

Merrimac has a top management commitment to provide “World Class” capabilities to support our customers’ Hi-Rel requirements. Starting with a management organization dedicated to Hi-Rel technology, we maintain an on-going training and certification program for assemblers and wirers to ANSIJ-STD-001, with IPC registered instructors on staff. Merrimac’s Quality system is ISO-9001 compliant and also exceeds the requirements of MIL-I-45208A. Use of “state-of-the-art” test equipment assures consistent and reliable data. Merrimacs’ capital equipment budgets routinely provide the specialized environmental test equipment required to manufacture our customer’s latest requirements. With over thirty-five years of successful heritage, we are fully committed to meeting the challenges of the future!

PROGRAM MANAGEMENT ORGANIZATION

At the start of each project, a dedicated Program Manager is assigned to work on the specific customers' project. The Program Manager has full responsibility for the completion of the project, from start to finish. They are responsible for obtaining all the necessary commitments for manpower and all other resources to complete the job on schedule. The Sales Manager on the team is the primary point of contact between the Customer and Merrimac and assures a smooth continuity throughout the project.



DEDICATION & DOCUMENTATION

TRACKING PROGRESS TO ASSURE ACCURACY

The key to producing successful Hi-Rel hardware is the installation of the proper systems for documentation of the tasks necessary to plan, organize, direct and control the scope of work. Proper documentation also assures traceability and reproducibility. This is essential for possible re-orders of the same requirement as well as any future analysis if required.

At Merrimac the extent of documentation required is a function of the degree of complexity anticipated coupled with the customers requirements. Documentation is a cost element. Generally, when documentation is set up properly between the customer and Merrimac, it forms an efficient tool in providing the lowest cost, most reliable hardware delivered on time.

PROCESS IDENTIFICATION DOCUMENT (P.I.D.)

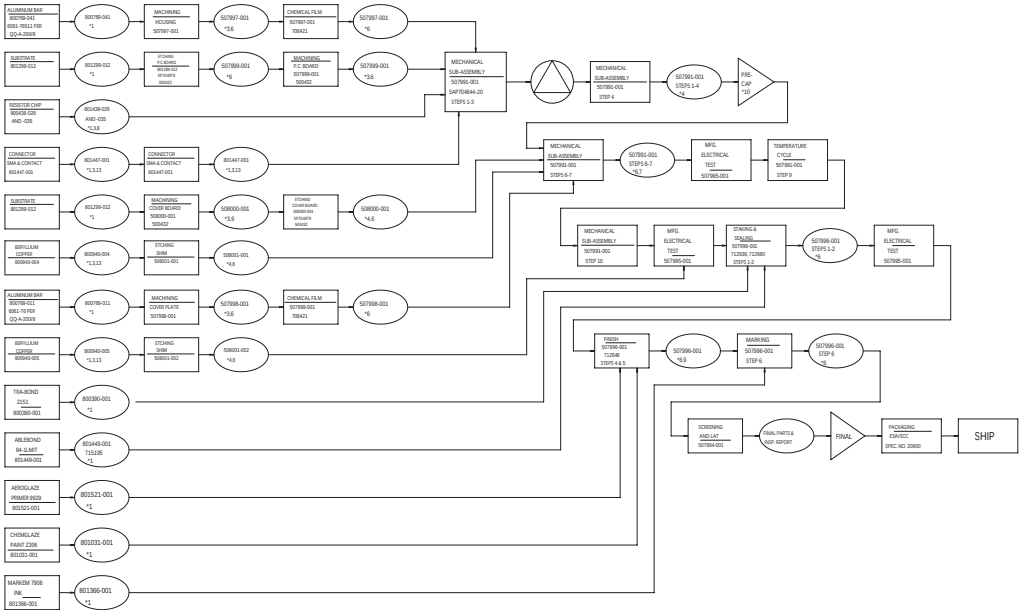
For contracts with extensive requirements for Quality Assurance and Reliability, Merrimac employs, or as the customer's subcontract may require, or by our own volition, a "Process Identification Document" (P.I.D.).

The P.I.D. is Merrimac's controlling document that translates the detailed customer source control specifications into Merrimac working drawings, process procedures and test methods. All Merrimac drawings used on Hi-Rel jobs are controlled by the use of a special drawing numbers. The P.I.D. assures that all of the electrical, mechanical and environmental test conditions are addressed and documented. The Manufacturing and Quality Assurance requirements of the P.I.D. are contained in the following pages.

HI-REL CONTROL PROCEDURES

The Hi-Rel product must be controlled at all stages from purchasing of materials to shipping the final product. The P.I.D. includes all Merrimac Source Control Drawings (SCDs) for all materials to be used on the project.

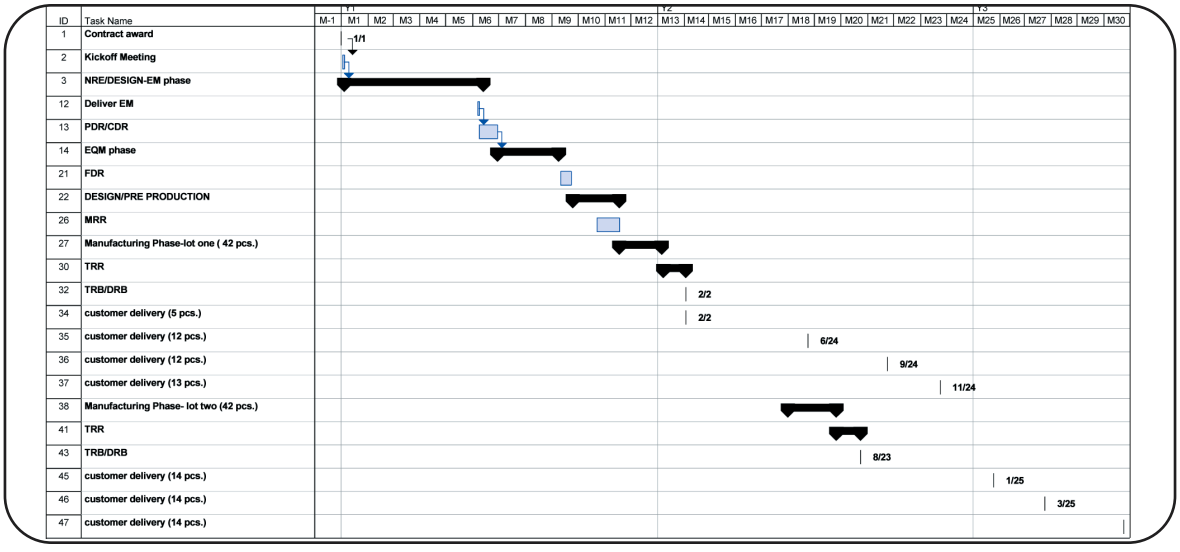
A manufacturing flow chart will be prepared which will detail all of the steps, procedures, inspection stations and tests that are required to complete the product, See Figure 1 below for a typical manufacturing flow chart.



MANUFACTURING FLOW CHART

MASTER PROGRAM PLAN

Illustrated below is a typical work schedule for the production and qualification flow performed on a Hi-Rel 180° Hybrid Junction. The work schedule also provides a milestone schedule of all planned events.



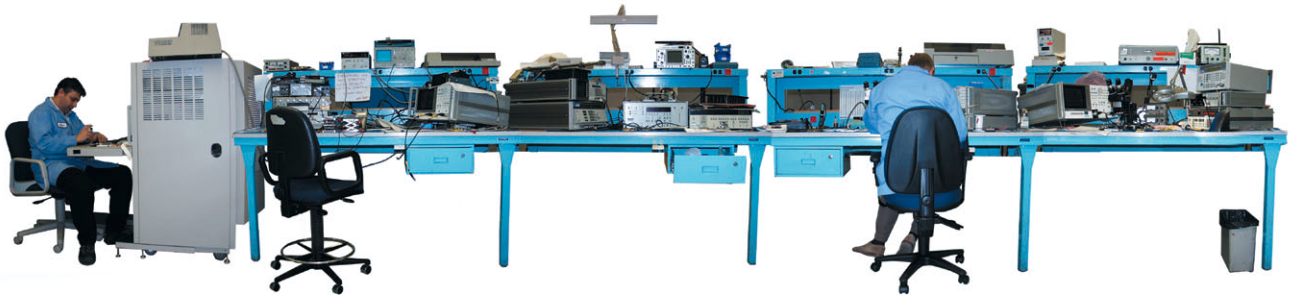
WORK SCHEDULE

TRACEABILITY

Merrimac has the systems in place to insure forward and backward traceability in support of our products in manufacturing and during field service. Merrimac maintains the traceability information for 7 years or as the contract dictates.

Through our traceability infrastructure, Merrimac can determine the origin of each individual piece from the finished unit back through to the Purchase Order that the part was procured. In addition, our internal processes are traceable forward from the individual co-workers who performed manufacturing, testing or inspecting operations through completion and shipment of the customer order. Complete assembly, test or inspection procedures and criteria support each operation so operational variables are minimized.

Test and environmental data are available from Merrimac in electronic format so that customer and system correlation is facilitated. These reports identify the serial number, data specifications and test limits including the test operator and inspector identification.



TESTING

ACCEPTANCE TEST PROCEDURES

An Acceptance Test Procedure (ATP) will be generated for each Hi-Rel project in conjunction with the Quality Assurance and the Design Engineering representatives on the project team. This procedure details the information on the Q.C. Flow Chart.

This procedure provides for a series of electrical, mechanical and environmental tests (including where necessary, life tests) to be performed on 100% of the items produced. All data is recorded on prepared test log sheets with operators and inspectors identified, as well as noting the date and the serial number of the unit under test. All of the environmental tests specified will be detailed by giving MIL Specification numbers with applicable paragraphs and acceptance limits. A detailed report with environmental test results and variables data will be compiled for shipment with the project, and a copy will be archived at Merrimac.

TEST DATA FORMAT

There are a number of test data formats available depending on customer requirements. Available formats are listed below:

Recording of three frequency test point data on a specially prepared data sheet.
"Swept" X-Y Test Plots.
Computerized Network Analyzer data
Computer Disk Data/EDI.

MANUFACTURING AND TEST EQUIPMENT

While Hi-Rel packages vary extensively, dependent on the product required, Merrimac has devoted much effort to the production of:


AUTOMATED MIXER TEST

Hermetically sealed packages with connectors
Packages with glass sealed printed circuit pins meeting low leak rate requirements
Various plating and package finishes
"Vibration proof" packages (foam filled)
Laser sealing for EMI/EMC.

A computer controlled Parallel Seam Gap Welder is used extensively to seal Ceramic SMD packages, Flatpacks, and other PC packages for Hi-Rel applications, with a high level of reliability. An important consideration in producing reasonably priced Hi-Rel hardware is using the latest computer controlled RF electrical test equipment which reduces tune and test time. Merrimac is committed to obtaining, wherever possible, the most modern automated test equipment available.

CLEAN ROOM

Should program requirements dictate, Merrimac has an on-site Class 10,000 "clean room" available which permits wiring, assembly and other production requirements, including electrical testing to be performed in a "controlled" environment, including ESD (Electrostatic Sensitive Device) protection. With the exception of environmental testing, the clean room permits all required Hi-Rel functions to be performed in one area, thereby reducing potential problems associated with the transit of the product from one area to another within the company.


CLEAN ROOM FACILITY

Materials routed to a Hi-Rel job from incoming inspection are generally handled by Q.C. specialists who segregate assigned materials to specific lockers or cabinets within the clean room. This procedure assures the traceability for all materials used on the project.

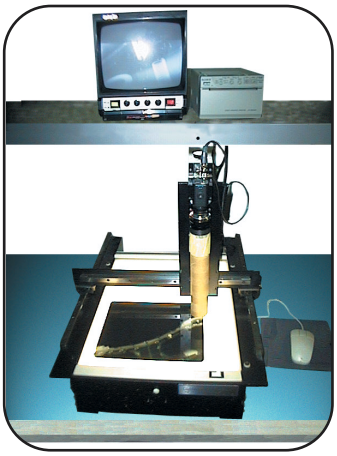
HI-REL TESTING

MERRIMAC EXCEEDS CUSTOMERS EXPECTATIONS

An important consideration in assuring the integrity of Hi-Rel hardware is testing the product within its anticipated operating and/or non-operating environmental conditions.

These environmental tests, when done to the extreme, are known as Qualification Tests, First Article Inspection Tests or Group B Tests. Some of the typical tests conducted by Merrimac are:

Thermal Shock
Thermal Cycle
Vibration, Random or Sine Wave



PIND
(particle impact noise detection)

Hermeticity
Thermal Vacuum
Life

Pyro Shock
Critical Pressure
Moisture Resistance
Contact Retention
EMI/EMC

Salt Spray
Sand and Dust
Acceleration
Radiation Hardness
X-Ray
Steam Aging

Merrimac designs its products to operate in accordance with the customers' environmental parameters. With the exception of some "hard" physical and radiation environments, Merrimac has all the necessary environmental test services and equipment "in house" that would be required to verify compliance to the customers' specifications. Strategic alliances have been pre-arranged with qualified vendors to provide outside testing beyond our present in house facilities. Merrimac has on a number of occasions worked with its customer to conduct specific tests at the customers' facility. In addition Merrimac can perform tests with or without monitoring of RF parameters during environmental testing, such as thermal vacuum for example.

MILITARY SPECIFICATIONS

MILITARY SPECIFICATIONS FOR STANDARD PRODUCT

Merrimac uses the environmental requirements of MIL-E-5400 and MIL-E-16400 as design considerations for its standard products whenever possible. There are also a variety of MIL specifications applicable to our products, such as:

PRODUCT	MIL SPEC
Power Divider/Combiners	MIL-P-23971, MIL-STD-883
90° Quadrature Hybrids	MIL-P-23971, MIL-STD-883
Directional Couplers	MIL-C-15370, MIL-STD-883
Variable Attenuators	MIL-A-24215
Balanced Mixers	MIL-M-28837*, MIL-STD-883

*** Merrimac is QPL for a number of these devices**

PACKAGING AND SHIPMENT

Special inspection and packaging instructions are written for each project to comply with the customer specifications. This assures the Hi-Rel products performance characteristics will not be compromised during shipment.

IN SUMMARY

This is a brief description of Merrimac's design and manufacturing controls for Military and Space Qualified Hi-Rel components. We encourage our customers to visit our 3 facilities located in West Caldwell, NJ, San Jose, Cost Rica and Ottawa, Canada so that we can provide a comprehensive presentation of Merrimac's Hi-Rel capabilities. Customized services for our customer's Hi-Rel requirements are Merrimac's core competency.

West Caldwell, NJ

Ottawa, Canada

San Jose, Costa Rica

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