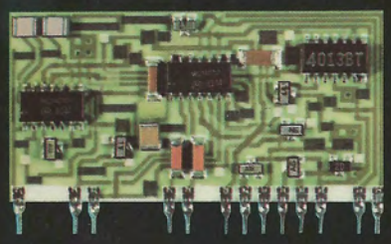
# HIGH QUALITY THICK FILM HYBRIDS & RESISTOR NETWORKS




MICRO-TECHNOLOGY INC.
-WISCONSIN

# WHAT MTI CAN OFFER YOU...

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## EXPERTISE.

**I. Thick Film.** The thick film industry is relatively young. Thick film processes were used during WWII and further developed during the 1950's. However, the potential of the technology was finally realized in the electronics boom that was triggered by the U.S. space program in the 1960's. MTI's key people were there at the blossoming of this industry. The key engineering and production people of MTI have developed expertise unmatched in this industry. For example, the resistor capabilities of MTI are second to none.

| | |
|---|---|
| **Resistor Range** | 1 ohm to 20 megohms standard<br>1 ohm to 1000 megohms available |
| **Resistor Tolerance** | ±1% standard<br>±.1% available |
| **Resistor Tracking** | ±.01% available in some ranges |
| **TCR** | ±100 ppm/° C standard<br>±50 ppm/° C available<br>±25 ppm/° C within certain resistance ranges |
| **TCR Tracking** | ±10 ppm/° C within certain resistance ranges |
| **Stability** | △R less than ±0.1% (after 1000 hours) |

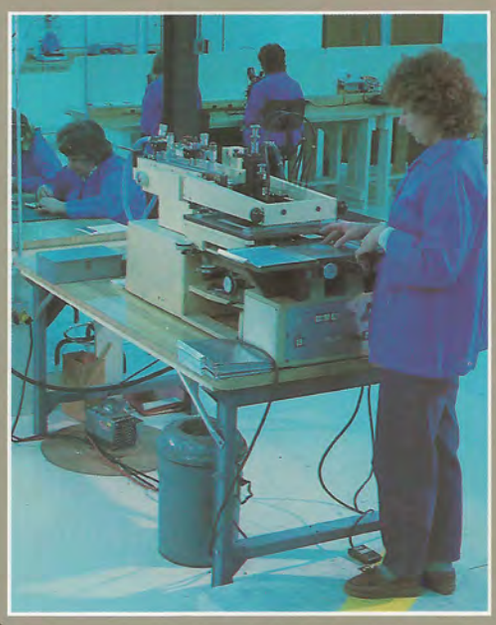
**II. SMD.** MTI has over five years of Surface Mount Device (SMD) experience as it was a pioneer of U.S. hybrid companies in using the technology back in 1980. This experience has grown to such a level of expertise that many of the major manufacturers of SMD components have come to MTI for recommendations on what components should be fabricated in SO (Small Outline) packages.

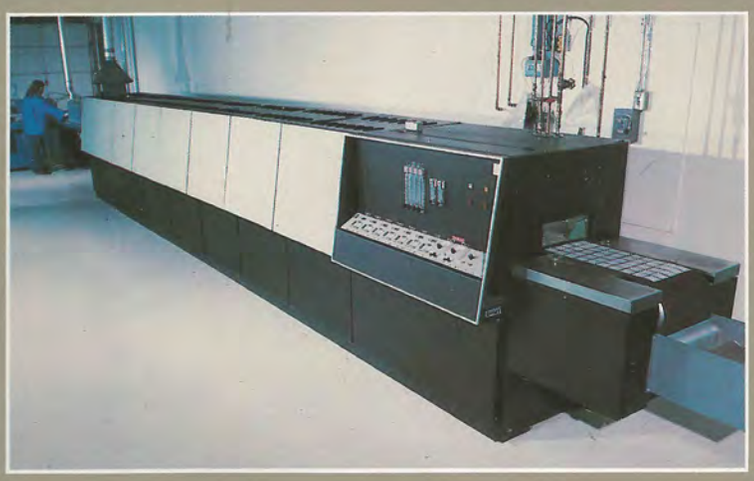
MTI uses the solder reflow and vapor phase methods of attachment of SMD components to the 96% alumina substrates it uses in the manufacture of its hybrids. With the greater availability of the SOT 23, SOT 89 and SOIC packages, MTI SMD hybrids have distinct cost advantages over wire bonded hybrids while still maintaining your strict physical space requirements.

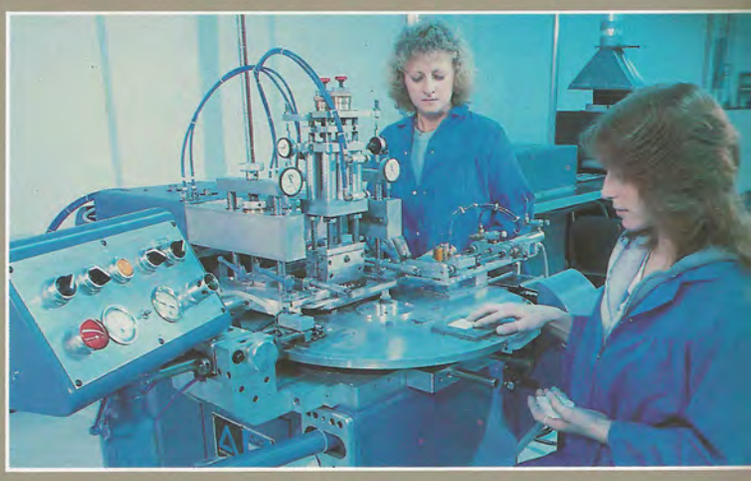
**III. Standard Products.** MTI offers you off-the-shelf Memory Module products in both DIP and SIP configurations. The company can also customize a Memory Module to your specifications.

MTI offers a standard hybrid product for Local Area Networks. This hybrid is designed to provide the link interface between the controller and the transmission cable in the interface module for the network. It is available off-the-shelf with either right angle pins or straight pins.

Expertise. One reason to make MTI your supplier for thick film hybrids and resistor networks.







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# MTI Hybrids Add Value To Its Customer's Products

**Micro-Technology, Inc.-Wisconsin hybrids add value to its customer's products by reducing their costs while increasing quality. We can do the same for your products.**

**COSTS are reduced because:**

- Development and tooling charges for MTI hybrids are low
- MTI processes are suited for mass-production techiques
- Prototypes, or evaluation units can be manufactured at a minimal cost in MTI's prototype line
- The expertise of MTI's design group can accomplish your circuit changes with minimal time, effort, and cost
- Your procurement costs for outside components are reduced as you will need to buy only one component rather than up to 40 different ones
- Your incoming inspection time is reduced
- Your inventory control and production line operation orders are reduced
- Your final product assembly time is significantly reduced

**QUALITY is improved through increased performance and reliability:**

- Every product is tested before leaving MTI
- Savings in size, weight, and volume can be achieved over a circuit constructed from discrete components on a PC board
- Close resistor tolerances and ratio matches are achievable
- MTI can functionally adjust resistors on our computer-controlled laser trim systems to compensate for parametric variations of other components to optimize circuit performance
- Your product is more reliable when using MTI hybrids; this increase in reliability is due to the reduction in the number of physical interconnections which is the most common failure mode of discrete components
- The replacement of a large percentage of the circuits solder connections reduces the susceptability to wiring errors, shock, and vibration.

**Micro-Technology, Inc.-Wisconsin hybrids add value to its customer's products. Let us do the same for your products.**

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# Hybrid Design Guidelines

MTI has the following suggestions to guide the engineer in producing hybrid circuit designs that can be produced at an optimal cost.

- Make sure to issue a complete specification. Disagreements on interpretation are costly to vendor and buyer.
- Never invoke MIL-Specifications or procedures for a commercial product. The result will be military product pricing. Specify what is needed, not ideals.
- Be reasonable about packing densities. It is indeed possible to produce hybrids which contain two dozen integrated circuits on a 1X2 inch substrate. But that is a laboratory exercise, not a practical production situation. Increased complexities lead to lower yields on a logarithmic scale. Often it is less expensive to partition circuitry into two or more hybrids, rather than trying to stuff everything into a single package.
- Wherever possible, utilize a standard package configuration. A conformally coated SIP style will be most economical in most instances.
- Hermetic packages for hybrids are expensive. They are seldom needed in a commercial application. Plastic packages are quite reliable when they are properly designed and adequate process controls are observed.
- Pay attention to capacitor values and utilize the smallest capacitance which can reasonably satisfy the requirements. Chip capacitors are relatively expensive, particularly in high values and close tolerances. The higher values are also physically large and wasteful of substrate area. In an RC combination, use a high value resistor (up to 10 megohms) and a small capacitor. Precision NPO capacitor chips are particularly costly. Use great care to minimize values. Standard capacitance ranges and tolerances are as follows:

| | | | |
|---|---|---|---|
| NPO | 10pF - 6800pF | 5% | 50 volts |
| X7R/BX | 1000pF - 0.1uF | 10% | 25 volts |
| Z5U | 0.01uF - 0.5uF | +80-20% | 25 volts |

- Thick film resistors are a bargain. When laser trimming is used, 1% resistor tolerances are routine. Specifying this level of resistor accuracy can improve your designs at little or no cost increase. Accuracies to 0.1% or even tighter in some cases are possible, but should not be specified unless required. Yield losses will increase prices.
- In specifying semiconductor characteristics, use only those parameters which are significant in the specific application. For example, packaged discrete transistors usually have 20 to 30 specified characteristics. Many of these parameters can only be tested after packaging. In most applications, it is sufficient to specify general device type (example: 2N2222A or equivalent) and to indicate those parameters which are important; beta, current, voltage, frequency response, etc.
- Minimize hybrid power dissipation if possible. Special heat sinking usually requires a special package and increases cost.
- Design for easy testing. Nearly all hybrids require construction of special test boxes which interface to external instrumentation and exercise the hybrid under various conditions of load, input stimuli, etc. The ideal test setup simply shows a 'go' or 'no go' indication to the operator. Give adequate thought to testing and test interface requirements. Minimize test time and complexity. The customer should plan to build a test interface box and furnish it to the hybrid vendor, along with detailed test instructions.
- Plan requirements to allow orderly, continuing production. If the product is to be utilized over a period of a year or more, program monthly deliveries which support your production. This procedure helps your company's cash flow and allows Micro-Technology, Inc.-Wisconsin to make long-term production plans.
- Be sure that your quantity requirements are large enough or the performance constraints are tight enough to warrant the conversion to hybrid form. Typical orders range from 5,000 to 50,000 units per year.

Following these guidelines will result in your receiving MTI hybrids at optimum cost and quality.

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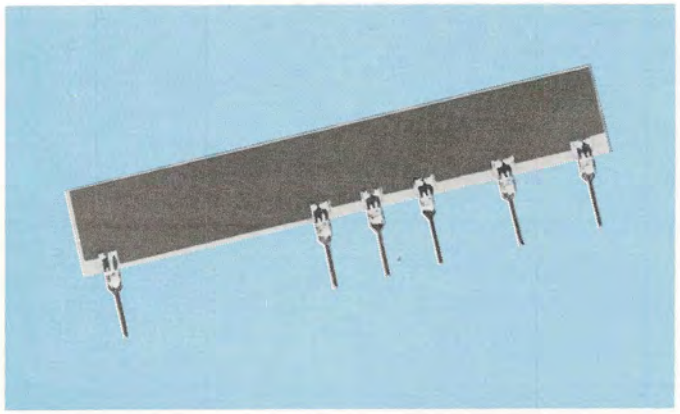
# Precision Decade Resistor Voltage Divider Network

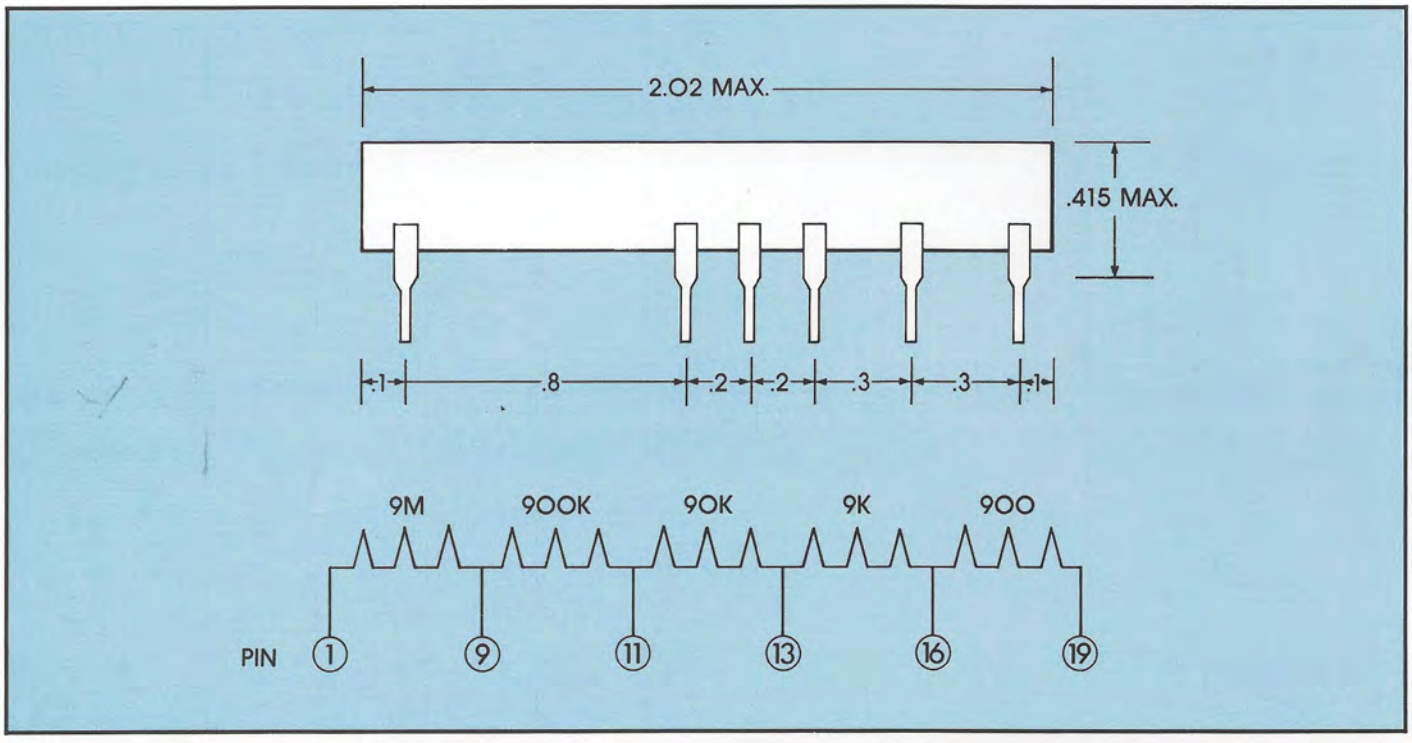
Micro-Technology's B30104-10-02 Precision Decade Resistor Voltage Divider Network is packaged in a 6 pin single-in-line configuration and is designed for use in Multimeters and other Range Switching Instruments. The network reduces board space, costs less, and increases performance over selected discrete resistor sets.

For Custom Resistor Networks that have requirements of special resistance values, special ratio, or special packaging requirements please call our representative in your area.



## FEATURES:

- Six pin SIP configuration
- Absolute Resistor Tolerance: ±0.1%
- Ratio Tolerance between all resistors: ±0.1%
- Absolute Temperature Coefficient: 50 PPM/°C
- Temperature Coefficient of Ratio: 50 PPM/°C from 0°C to 70°C
- Voltage Coefficient of Ratio: 0.2 PPM/Volt
- Storage temperature: –55°C to +105°C
- Ratio Stability: .1% after 1000 hours

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# Local Area Network Driver (LAND) Hybrid

**MTI P/N A60101-20-01 STRAIGHT EDGE PINS**
**MTI P/N A60101-20-02 RIGHT ANGLE PINS**

## FUNCTIONAL DESCRIPTION

The Modular Interface for Local Area Networks consists of two high current open collector drivers driving the primary of a pulse transformer through a low pass filter. The primary of the pulse transformer becomes the secondary when receiving externally generated signals. It is attached to a receive filter and amplifier whose filter characteristics are matched to the signal being received to improve signal to noise ratio. The output of the pulse transformer (input when receiving) is connected to 93 ohm coax cable through a BNC connector. A-12 volt to -5 volt voltage dropping circuit is also provided. Figure 2 provides detailed connection information for the integrated circuit drivers and line receiver. Performance of this microcircuit is dependent on a quality grounding technique and adequate supply voltage decoupling.

## ELECTRICAL CONNECTIONS

The hybrid provides 20 electrical pins. Six of the pins are optional test points only. No electrical connection should be made to the test point pins in the ARCNET application. Refer to Figure 1 and 2 for physical pin numbering. The pin out and signal description is as follows:

| PIN NO. | PIN NAME | DESCRIPTION | APPLICATION |
|---|---|---|---|
| 1 | −12V REG | −12V Return Line | (Note 1) |
| 2 | −12V | −12V Supply Line | (Note 2) |
| 3 | −5V | −5V Supply Line | (Note 3) |
| 4 | GROUND | Circuit Ground | Connect to Circuit Ground (Note 7) |
| 5 | (TPE) | No Connection | No Connection (Note 5) |
| 6 | +5V | +5V Supply Line | (Note 4) |
| 7 | RX | ARCNET Received Pulse Positive TTL Signal | Connect to RX Input on Transceiver Circuit DP710895 |
| 8 | (TPF) | No Connection | No Connection (Note 5) |
| 9 | (TPD) | No Connection | No Connection (Note 5) |
| 10 | (TPC) | No Connection | No Connection (Note 5) |
| 11 | OUT/S | Transformer Secondary Nondotted Side | Connect to Shield Contact on BNC Receptacle (Note 6) |
| 12 | OUT/C | Transformer Secondary Dotted Side | Connect to Center Contact on BNC Receptacle |
| 13 | GROUND | Optional: Ground or No Connection | Connect to Circuit Ground (Note 7) |
| 14 | GROUND | Optional: Test Point B or No Connection | Connect to Circuit Ground (Note 7) |
| 15 | (TPB) | No Connection | No Connection (Note 5) |
| 16 | (TPA) | No Connection | No Connection (Note 5) |
| 17 | GROUND | Circuit Ground | Connect to Circuit Ground (Note 7) |
| 18 | PULS2 | Transmit Pulse 2 Negative TTL Signal | Connect to PULS2 Output on Transceiver Circuit DP710895 |
| 19 | DISABLE | Transmitter Disable Function | (Note 8) |
| 20 | PULS1 | Transmit Pulse 1 Negative TTL Signal | Connect to PULS1 Output on Transceiver Circuit DP710895 |

## NOTES:

1. In applications supplied by +5 and −12 volt supplies, −12V RET shall be tied to circuit ground. In applications supplied by +5 and −5 volt supplies, this pin shall be left unconnected.
2. In applications supplied by b +5 and −12 volt supplies, − 12V shall be tied to the −12 volt supply. Additional decoupling may be required depending on the application. In applications supplied by +5 and −5 volt supplies, this pin shall be left unconnected.
3. In applications supplied by +5 and −12 volt supplies, the −5V pin shall be left unconnected. In applications supplied by +5 and −5 volt supplies, this pin shall be tied to the −5 volt supply. Additional decoupling may be required depending on the application.
4. The +5V pin shall be tied to the +5 volt supply in all applications. Additional decoupling at this pin (to circuit ground) is recommended because of the high current pulses being generated. The quantity of decoupling is application dependent, but 10 microfarads minimum is recommended.
5. The maximum number of pins have been provided on the hybrid microcircuit to provide mechanical security with polarization. Six of these pins have been reserved for optional circuit test points. No electrical connection shall be made to these six pins in standard ARCNET applications. No internal connection is required to meet this specification.
6. It is recommended that the shield contact on the BNC connector be decoupled to chassis ground with a resistor-capacitor circuit for improved ARCNET operation. A .005 microfarad 1KV disk ceramic capacitor is parallel with two 5.6K ohm ½ watt resistors in series has been adequate in most applications. The resistors provide a discharge path from the cable shield back to earth ground for any static build up or ground differential from one end of the cable to the other. The capacitor provides high frequency decoupling to aid in meeting FCC radiation requirements.
7. Ground pins on the hybrid microcircuit may be tied together on the component side of the substrate and will also make connection to the ground plane or grid on the noncomponent side of the substrate. It is recommended that pins 4, 13, 14, and 17 be tied to a high quality, low impedance circuit ground for optimum ARCNET operation.
8. The transmitter disable function is normally tied to GROUND (enabled) for most applications. When used in the Active Hub function, external circuitry uses this pin to disable the transmitter on the receiving channel.

## D.C. POWER

The hybrid operates from +5 volts and −12 volts or −5 volts as follows:

| | |
|---|---|
| +5 volts ± 5% | 0.5 amps peak<br>0.125 amps maximum average |
| −12 volts ± 10% | 0.025 amps max |
| or | |
| −5 volts ± 5% | 0.015 amps max |
| Maximum ripple and noise | 1% peak to peak |
| Heat Dissipation | 1 watt max |

## INPUT/OUTPUT ELECTRICAL CHARACTERISTICS

PULS1, PULS2: Each input represents two standard TTL loads.

DISABLE: Represents four standard TTL loads.

RX: Transistor driver output with 470 ohm pull up resistor capable of driving 4 standard TTL loads minimum.

OUT/S, OUT/C: Transformer coupled input/output. Connects to 93 ohm RG62/U coaxial cable through a BNC connector. Transmitted signal is approximately a 16 volt peak to peak bipolar pulse into 93 ohm cable. The received pulse amplitude depends on cable attenuation.

## ENVIRONMENTAL CHARACTERISTICS

Temperature, Ambient
Operating: 0°C to +70°C
Nonoperating: Storage −40°C to +150°C

Relative Humidity
Operating (no condensation): 5% to 95%
Nonoperating: 0% to 100%

The hybrid is capable of withstanding, without damage or degradation, normal printed circuit wavesoldering and cleaning operations.

## TEST CONDITIONS

a. The following terminals are tied to circuit ground: Pins 1, 4, 13, 14, and 17.
b. Pin 2 is tied to a −12 volt (±5%) supply voltage referenced to circuit ground.
c. Pin 6 is tied to a +5 volt supply that is set at +4.75 volts.
d. Pin 19, Disable, is connected to a signal source that can be switched between a TTL logic "zero" level and a logic "one" level.
e. Pins 18 and 20 are connected to a suitable signal source. PULS1 and PULS2 are 100 nanosecond pulses (+5, −0 ns) the trailing edge of PULS1 and the leading edge of PULS2 are coincident with no overlap and no more than 5 ns of delay (−0, +5 ns). If the Pulse Generation Circuit of Figure 4 is used, the "Test Input" is a positive TTL pulse, 150 ns ±25 ns with a maximum frequency of 2.5 MHz.

## SIGNAL MEASUREMENT

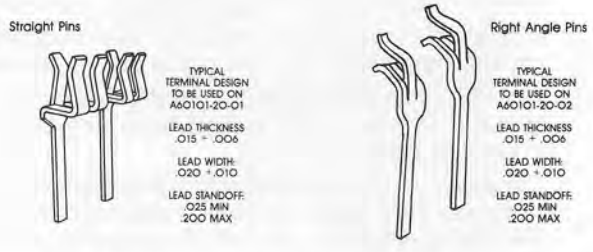
The measured test parameters are given in Table 2.

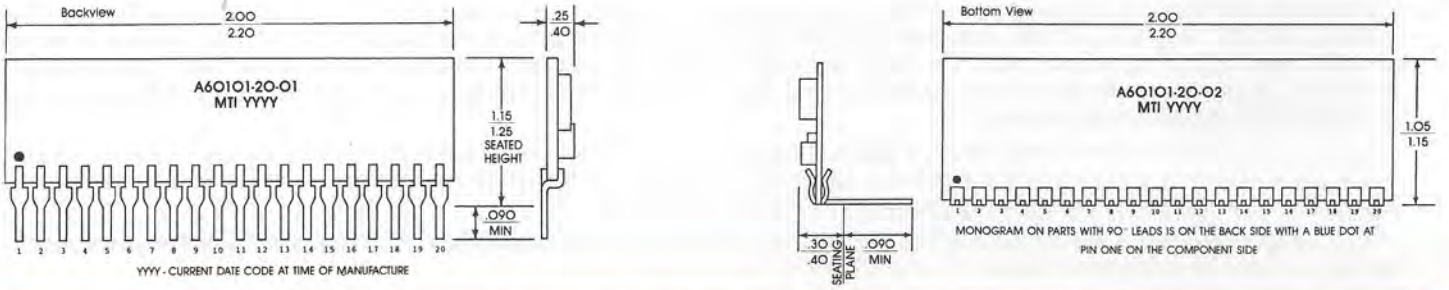
The XMIT signal is measured at pin 12 with respect to pin 11 on the transmitting hybrid.

The received pulse, TRX, is measured at pin 7 on the receiving hybrid with respect to signal ground.

**Table 2**
**TEST PARAMETERS**
Transmit Test

| PARAMETER | SYMBOL | UNITS | MIN | TYP | MAX |
|---|---|---|---|---|---|
| Output Transmitted Signal Positive Peak | VI | Volts | 7.4 | 7.8 | |
| Output Transmitted Signal Negative Peak | V2 | Volts | −8.0 | −8.4 | |
| Local Signal, Digitized Pulse Width | T1 | ns | | 105 | |
| | Receive Test | | | | |
| Received Signal, Attenuated and Digitized, Pulse Width (Measurement at 1.5 volts) | TRX | ns | 45 | 55 | |



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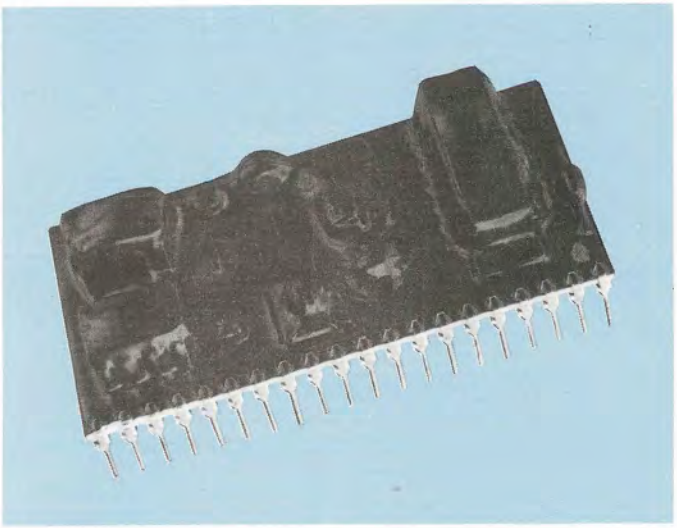
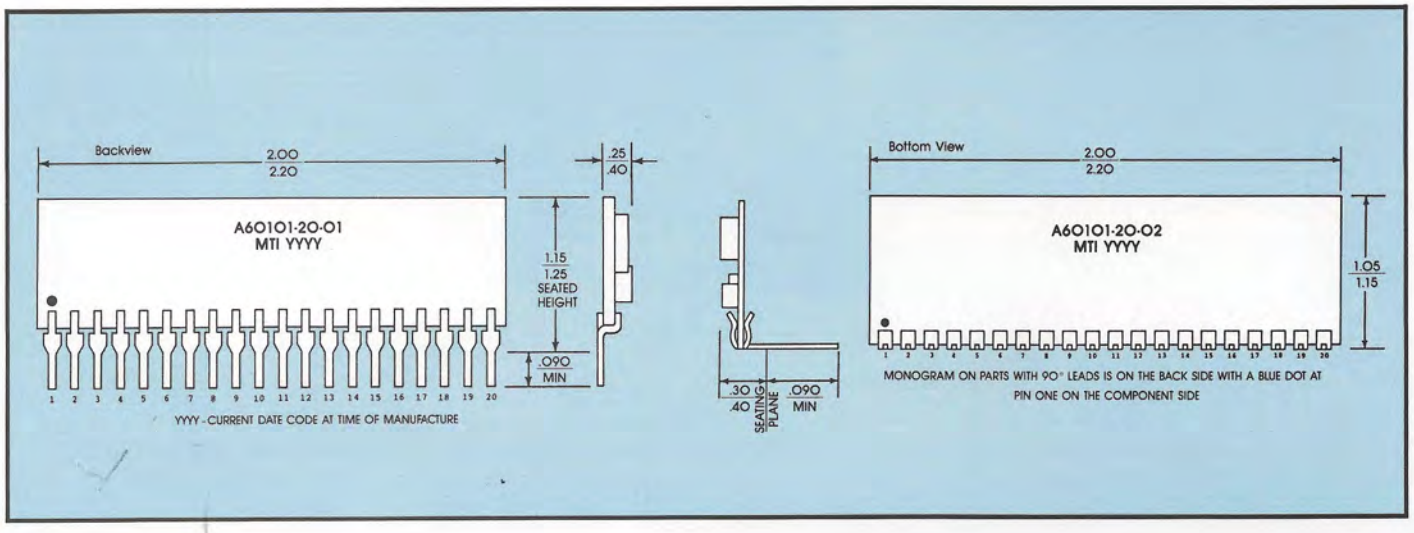
# Local Area Network Driver (LAND) Hybrid

Micro-Technology's Local Area Network Driver (LAND) Hybrid is a pulse transceiver that provides the link interface between the controller and transmission cable in the interface module for baseband LANs including Datapoint's ARCNET and other compatible systems.



## FEATURES:

- Is a compliment to the RIM and transceiver chips of Standard Microsystems Corp.
- Is functional with most network topologies including star, ring, bus, tree and unconstrained
- Provides the necessary noise immunity and filtering for interference free data transmission on coaxial cable
- Data Input and Output signals are TTL compatible
- Available with Right Angle or Straight leads
- Guaranteed for operation from 0°C to 70°C
- Available with or without Silicon Coating

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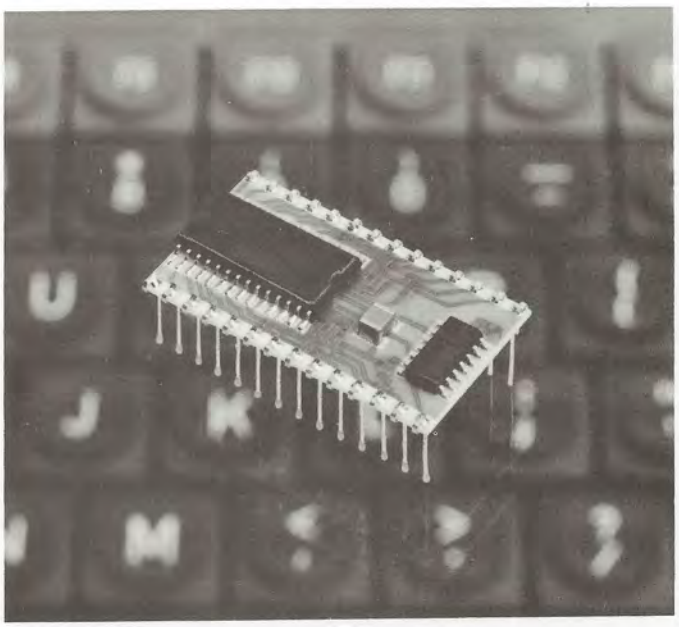
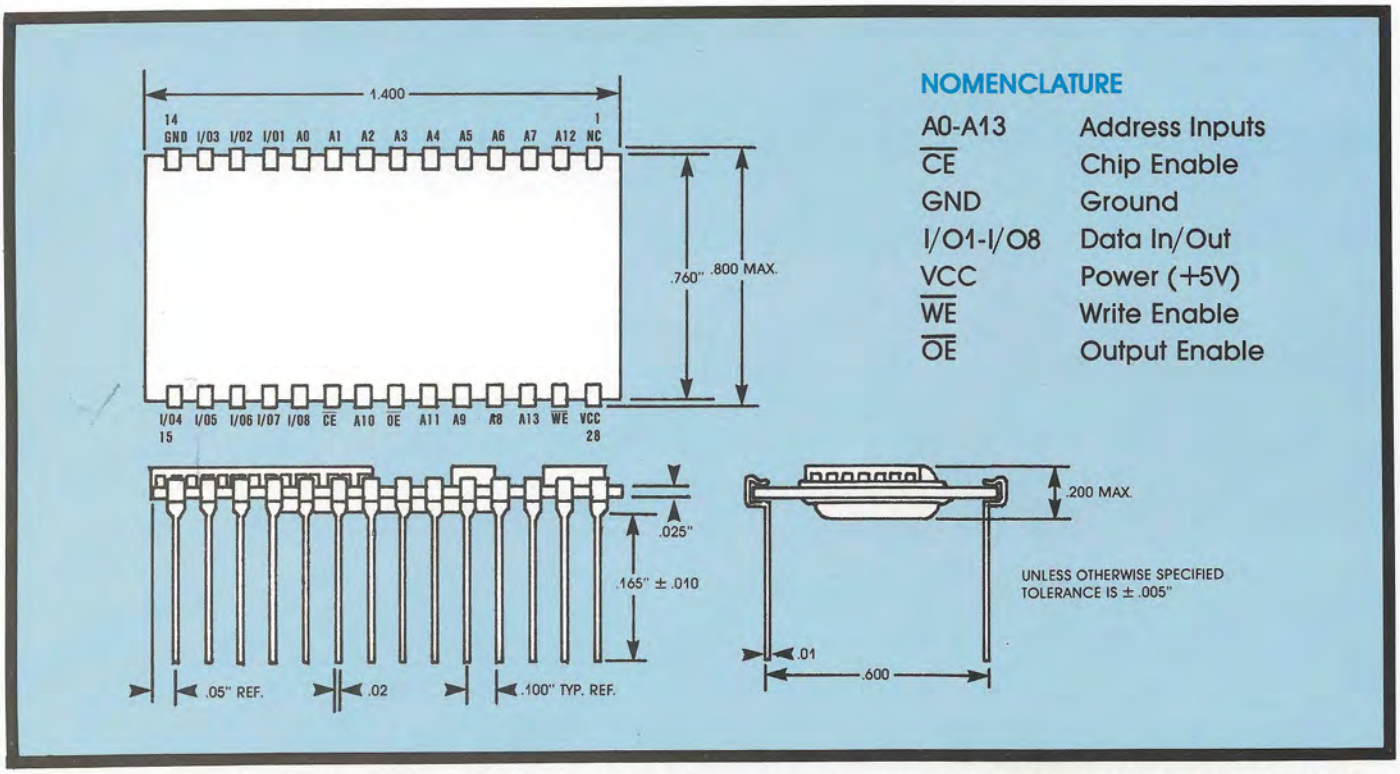
# 16K x 8 CMOS SRAM memory module

Micro-Technology's A60118 Memory Module is a 16K x 8, Static Random Access Module in a 28 pin dual-in-line package. It is comprised of two 8,192 word by 8 bit high speed static CMOS Random Access Memory units in 28 pin SOIC plastic packages and address decoding logic for the 14th address bit mounted on a ceramic substrate utilizing highly reliable thick film interconnections.



**FEATURES:**

- 16,384 x 8 organization
- Industry standard 28 pin DIP pin out
- Single +5V supply (10% tolerance)
- Completely static memory - no clock or timing strobe required
- All inputs, outputs, fully TTL compatible
- Equal access and cycle time
- Guaranteed for operation from 0°c to 70°c
- $\overline{CE}$ and $\overline{OE}$ functions for bus control
- 120/150/200 ns access times
- Decoupling capacitor provided on substrate




**NOMENCLATURE**

| | |
|---|---|
| A0-A13 | Address Inputs |
| $\overline{CE}$ | Chip Enable |
| GND | Ground |
| I/O1-I/O8 | Data In/Out |
| VCC | Power (+5V) |
| $\overline{WE}$ | Write Enable |
| $\overline{OE}$ | Output Enable |

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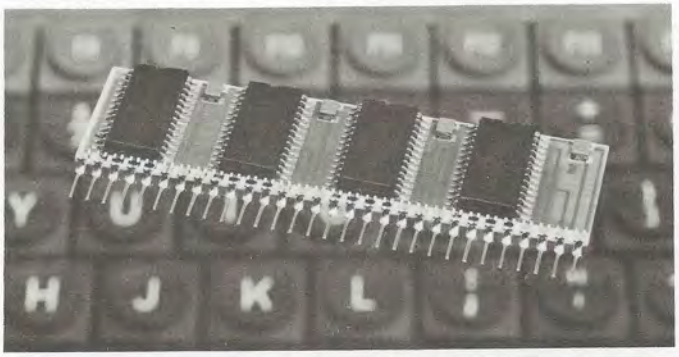
# 32K x 8 CMOS SRAM memory module

Micro-Technology's A60117 Memory Module is a 32K x 8, Static Random Access Module in a 30 pin single-in-line package. It is comprised of four 8,192 word by 8 bit high speed static CMOS Random Access Memory units in 28 pin SOIC plastic packages mounted on a ceramic substrate utilizing highly reliable thick film interconnections with four 0.1uf decoupling ceramic chip capacitors.

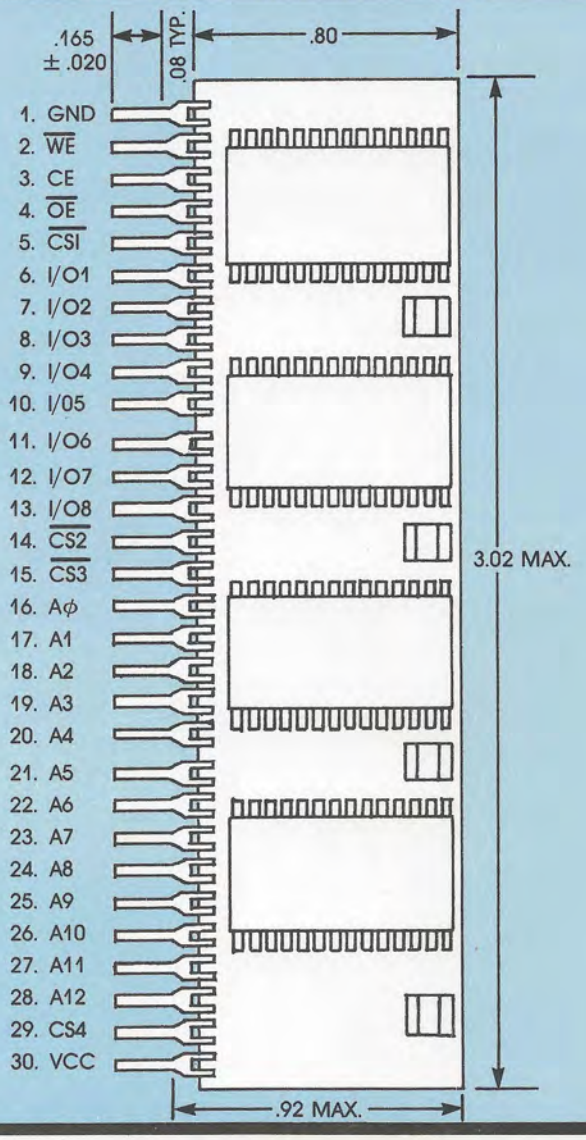


## FEATURES:

- 32,768 x 8 organization
- Single +5V supply (10% tolerance)
- 30-pin single-in-line package (SIP)
- Utilizes four 8K x 8 static CMOS RAM'S
- Completely static memory — no clock or timing strobe required
- All inputs, outputs, fully TTL compatible
- 3-state outputs
- Equal access and cycle time
- Common data input and output
- Very low power standby, O.1mW typical
- Low power operation, 200mW typical
- Operating free air temperature 0°C to 70°C
- 120/150/200 ns access time

## NOMENCLATURE

| | |
|---|---|
| A0-A12 | Address Inputs |
| CE | Chip Enable |
| GND | Ground |
| I/O1-I/O8 | Data In/Out |
| VCC | Power (+5V) |
| $\overline{WE}$ | Write Enable |
| $\overline{OE}$ | Output Enable |
| $\overline{CS1}$ | Chip Select 1 |
| $\overline{CS2}$ | Chip Select 2 |
| $\overline{CS3}$ | Chip Select 3 |
| $\overline{CS4}$ | Chip Select 4 |

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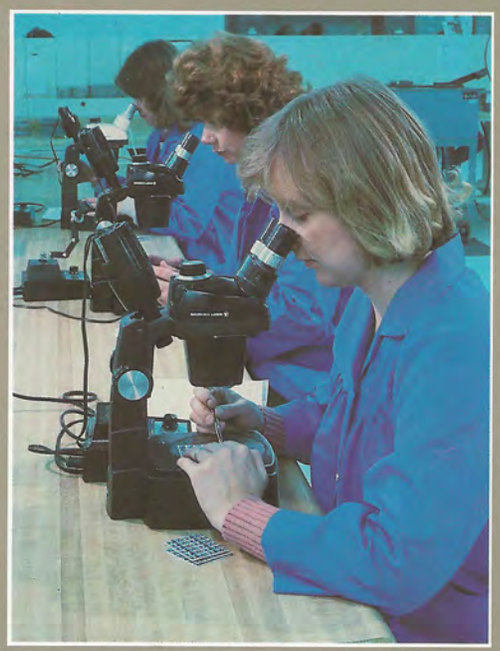
**PRECISION.** The equipment used in the manufacture of your hybrids and networks is the best available on the market today. For example, with MTI's computer controlled laser systems, resistor values can be trimmed to tolerances as low as ±.1% routinely.

Even the best equipment will not insure precision if not operated properly. At MTI, our people are trained as specialists in a particular area of hybrid/network manufacture. They know their equipment and their job.

Precision. Another reason to make MTI your supplier for thick film hybrids and resistor networks.


**RELIABILITY.** Micro-Technology, Inc.—Wisconsin is every bit as consistent as it is precise. In-process quality control checks, and 100% testing of all finished circuits assure you that every hybrid and network will meet your exacting specifications. This has made MTI a favorite supplier to its customers. Feel free to ask for customer references; they are one of our best sales tools.

Reliability. Another reason to make MTI your supplier for thick film hybrids and resistor networks.



**DELIVERY.** MTI understands the importance of meeting production schedules and is totally committed to meeting all customer need dates. MTI will react to short notice production orders or "move-ins" as well as anyone in our industry. Because MTI stocks a broad inventory of chip capacitors, diodes, transistors, IC's, and substrates, and has excellent relationships with most of the leading semiconductor companies, it can offer you unusually fast turnaround on prototypes. Standard delivery of prototypes is 6 to 8 weeks. Production quantities can begin shipping 8 to 10 weeks after prototype approval.

Delivery. Another reason to make MTI your supplier for thick film hybrids and resistor networks.

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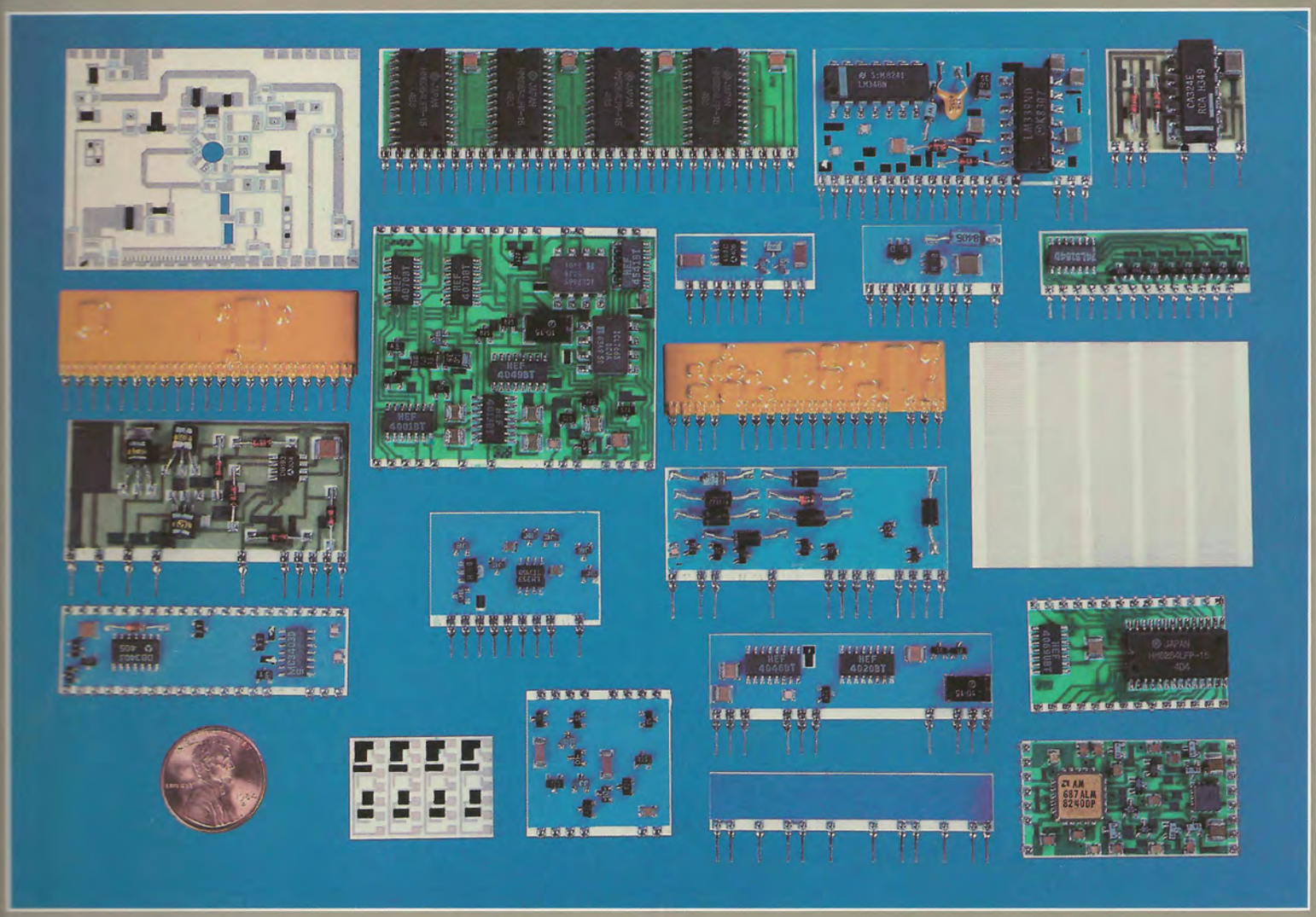

Micro-Technology, Inc.—Wisconsin, located in Menomonee Falls, a Milwaukee, Wisconsin suburb, was founded in 1976 to enhance the state of the art in thick film hybrid circuits.

After two years of extensive consulting assignments, MTI started its own design development and manufacturing facilities in 1978 to serve the hybrid circuit needs of industries around the Great Lakes.

With the creation of a nationwide sales representative network in 1982, MTI expanded its horizon to a national market.

MTI moved into a new, modern 20,500 square foot facility fully equipped for high volume production in mid-1984. This modernization has allowed the company to better serve its nationwide customer base by significantly increasing its production capacity.

MTI is recognized as a leading supplier of highly reliable commercial grade thick film circuits for telecommunications, instrumentation, computers, industrial controls, and automotive industries.

Micro-Technology, Inc.—Wisconsin is dedicated to providing industry with high quality thick film hybrids and resistor networks. Our hybrids offer your product improved quality, reduced size and lower costs.

Beginning with your schematic, MTI customizes a hybrid circuit to meet your electronic specifications and physical space limitations. From design layout to final packaging, each job is handled by professionals who have concentrated all their efforts into one thing — the manufacturing of thick film hybrids and resistor networks.

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