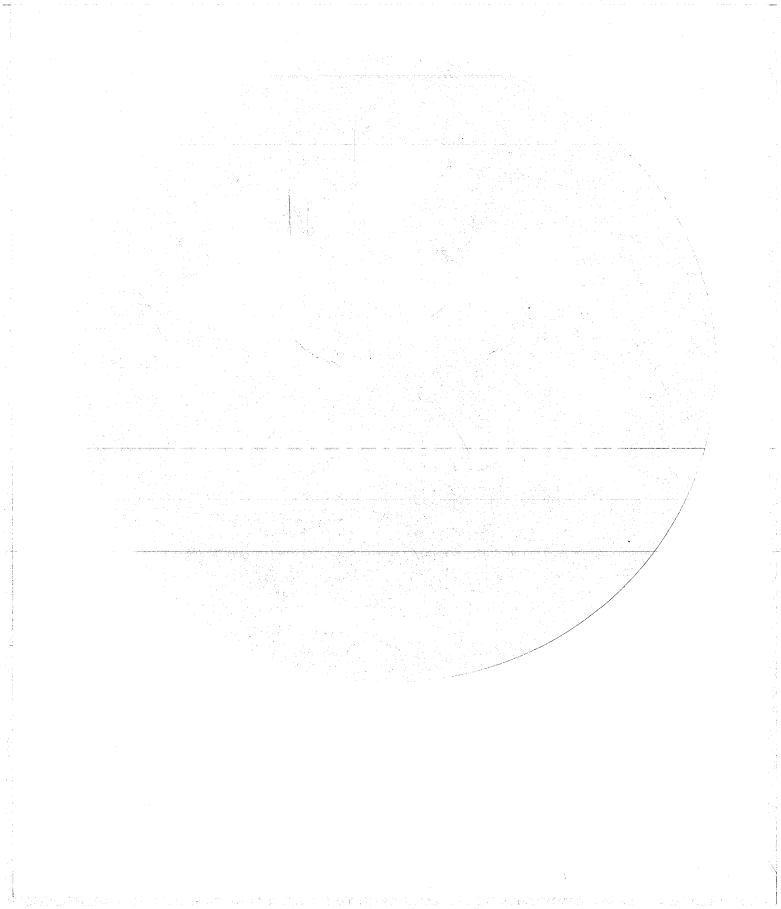

50 WAYS TO

TOUCH MEMORY

THIRD EDITION

From the company that took the memory out of the computer

DALLAS SEMICONDUCTOR

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Third Edition August 1994

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INTRODUCTION

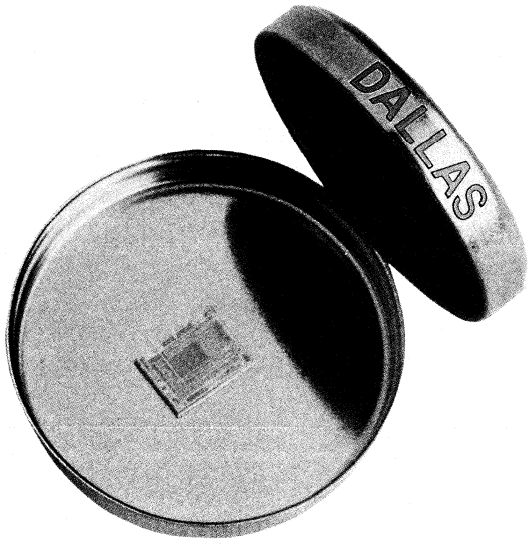
Semiconductor memory chips, to date confined to the printed circuit board inside of computers, can now be directly attached to almost anything. Dallas Semiconductor has designed Touch Memory™ chips so that they can be taken outside the computer and stuck in all kinds of novel places: on hospital bracelets, pallets, garbage cans—even cows. DS19xx Touch Memory chips are stainless steel, self-stick labels that read or write with a momentary contact.

When a memory chip becomes a label, information is available immediately on the spot — there's no need to reference a remote computer's memory.

Large amounts of up-to-date information accompany the tagged object. Data can be added with little or no worker involvement. As the object moves from point to point, information is transferred free from the restrictions of a wired network. Further, it is not limited by the radio interference, range, and degradation of an RF network. Even with many objects arriving from multiple originations, relevant information about a particular object is selected with the specificity of a touch.

Touch Memory chips are packaged in coin-shaped MicroCans™ to withstand harsh environments. The simple conductive surfaces of this package are the conduit for error-free data transfer to other chips in the system with the economy of a direct chip-to-chip digital link.

Getting a memory chip to operate with just one signal plus ground was critical to make practical a memory that reads or writes with a touch. Other semiconductor memories such as DRAMs have multiplexed address signals to reduce connections, but stop far short of the magic of a solo signal. Touch Memories are intensely multiplexed using Dallas Semiconductor's 1-Wire™ Touch Protocol. The touch signal transitions between 0-volt and +5-volt levels. The master chip stimulates the Touch Memory



Touch Memory is housed in a stainless steel container called a MicroCan™. Canning is a high-volume, low-cost packaging methodology known for its excellent ability to preserve contents.

by sourcing +5 volts; the Touch Memory responds by pulling the signal down with an input impedance that changes between 500,000 ohms and 50 ohms. This four order-of-magnitude impedance shift permits easy sensing of the digital signal, even with substantial contact impedances (> 500 ohms). The length of time (long or short) that the signal is pulled down represents 1's or 0's.

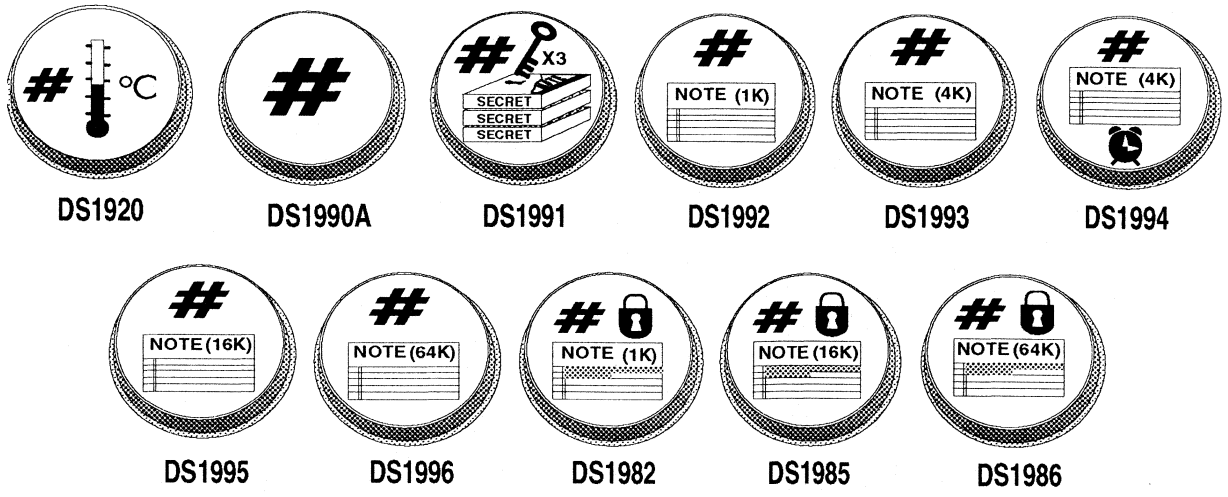
The coin surfaces of the Touch Memory can be extended to facilitate automation. The touch surface area can be enlarged, reshaped, folded, and designed for rubbing motion. A distance of 300 meters between the Touch Memory and the chip it is communicating with can be accommodated. As an example, the Touch Memory's surface can be extended to incorporate the bumper of a truck for contacting the loading dock, circumventing the need to align a probe to the smaller MicroCan itself.

Application software support is available from Dallas Semiconductor for Touch Memories, Touch Transporters, Touch Pen, Touch Editor, PC keyboard, PC COM port, VAX terminals (VT101 and VT220) and a teleserviced dumping cradle that allows information in the Touch Memory to be transferred to a remote computer over the phone lines.

No two Touch Memories are the same. Each contains a guaranteed unique serial number that is lasered into the chip at the time of manufacture in Dallas. This number is a permanent registration code engraved in silicon that provides absolute traceability.

This booklet illustrates some 50 application examples and is an invitation to Touch Memory *your* way.

DS19xx TOUCH MEMORIES



Information at the touch of a Button has often been promised but seldom delivered. Dallas Semiconductor Touch Memory makes good on that promise in the most literal way. Inside the Button's protective (and conductive) shell is a special read/write microchip that holds up to 8192 characters (64K bits) of information.

Touch Memory Characteristics

- Read or write with a momentary contact
- Unique, factory-lasered 48-bit serial number for traceability
- MicroCan can be affixed to almost any object
- Communicates to master via a single signal
- Announces connection to master with a presence detect
- Data retention > 10 years

MicroCan Package

- 16.3mm button shape is standard to entire Touch family
- Durable stainless steel case
- F5 package height is 5.8mm with an attachment flange around the base for mounting
- F3 package height is 3.2mm with an attachment flange around the base for mounting

Environmental Conditions

- Temperature Range (Operational/Storage)
  -40 to +70°C (DS1991-DS1996)
  -40 to +85°C (DS1990A/DS1982-DS1986)
  -55 to +100°C (DS1920)
- Mechanical Shock 500 g's (6 axis)
- Immersion in Saline 24 hrs.
- Drop Test 1.5m to concrete
- Crush Test 12kg for 30 sec.
- Contact Durability 10^6 insertion/withdrawals

Touch Protocol

- 16.3k bits/sec. bidirectional data transfer rate
- Multiple devices can share a common conductive surface
- Unknown devices in a field of many discovered at a rate of up to 75 per second
- Data integrity insured by use of CRC's, scratchpad, verification and page writes via an uninterruptible copy command
- Can transfer data with intermittent, resistive contact

Touch Family

Part	Description	Registration #	Memory	Organization	Scratchpad	MicroLAN	Family Code
DS1990AF3/F5	Touch Serial Number	8+48+8 bits ROM	—	—	—	YES	01H
DS1991LF5	Touch MultiKey, 3 Secure Partitions[1]	8+48+8 bits ROM	1,344 bits NV RAM	3x64 bits + 3x384 bits	512 bits	YES	02H
DS1992LF5	Touch Memory	8+48+8 bits ROM	1,024 bits NV RAM	4x256 bits	256 bits	YES	08H
DS1993LF5	Touch Memory	8+48+8 bits ROM	4,096 bits NV RAM	16x256 bits	256 bits	YES	06H
DS1994LF5	Touch Memory Plus Time[2,3]	8+48+8 bits ROM	4,096 bits NV RAM	16x256 bits	256 bits	YES	04H
DS1995LF5	Touch Memory	8+48+8 bits ROM	16,384 bits NV RAM	64x256 bits	256 bits	YES	0AH
DS1996LF5	Touch Memory	8+48+8 bits ROM	65,536 bits NV RAM	256x256 bits	256 bits	YES	0CH
DS1982F3/F5	Add-Only Touch Memory[3,4]	8+48+8 bits ROM	1,024 bits EPROM	4x256 bits	8 bits	YES	09H
DS1985F3/F5	Add-Only Touch Memory[3,4]	8+48+8 bits ROM	16,384 bits EPROM	64x256 bits	8 bits	YES	0BH
DS1986F3/F5	Add-Only Touch Memory[3,4]	8+48+8 bits ROM	65,536 bits EPROM	256x256 bits	8 bits	YES	0FH
DS1920F3/F5	Touch Thermometer[5]	8+48+8 bits ROM	16 bits EEPROM	1x64 bits	64 bits	YES	10H

1 Three secure memory partitions each protected by a 64-bit password; incorrect passwords return random data to confuse unauthorized listeners.

2 Calendar date and time, interval timer, and access counter included with alarm and interrupt signalling.

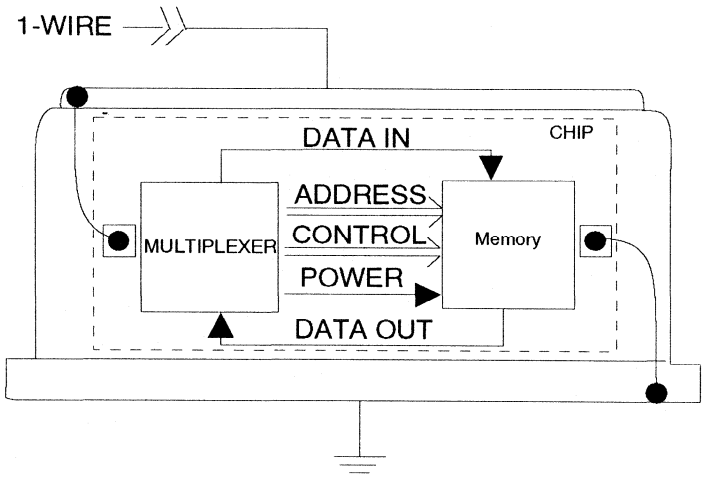
3 Lock bits prevent tampering.

4 Page Redirection provides authentic audit trail of data change history.

5 Double Trip Point Monitor with alarm signalling.

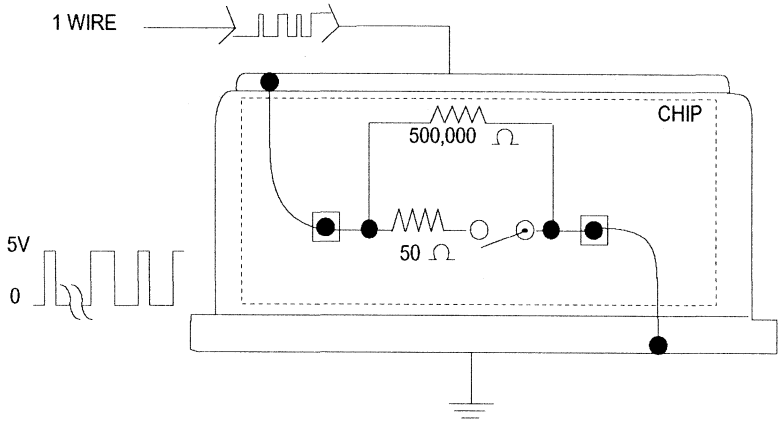
Touch Memory uses digital signals to activate electric locks, providing convenient entry to secure areas.

Multiplexing



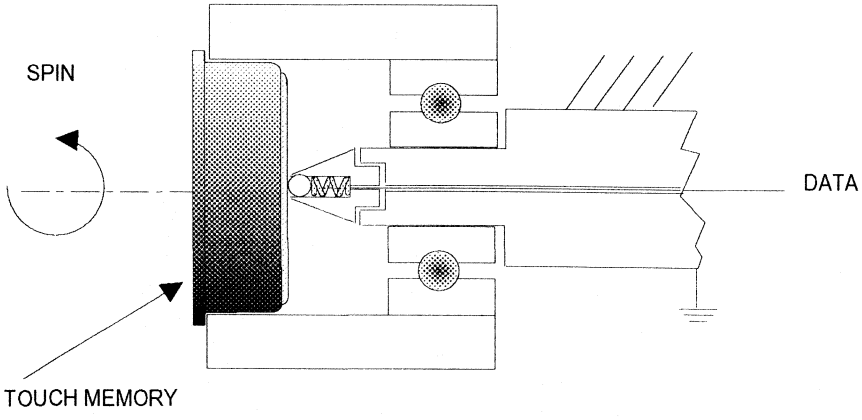
1-Wire technology reduces signalling associated with a nonvolatile memory to a single conductor plus ground.

Input/Output Circuit Model



A Touch Memory chip is stimulated by a 5-volt signal from a master and responds by switching the input impedance four orders of magnitude, from 500,000 to 50 ohms. Substantial contact impedance can be tolerated because this 10,000-to-1 off-to-on ratio swamps out the effects of poor contacts.

Contact Dwell



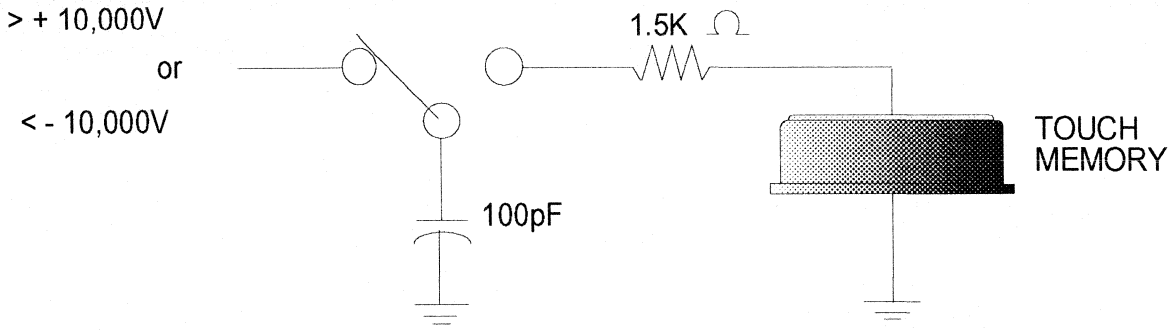
Intermittent contact such as encountered on a spinning wheel can be accommodated. Contact dwell for reading the registration number is only 5ms, and transferring a 256-bit memory page is just 20ms. Even though the ball bearing contacts are sliding and intermittent, communication is error-free because data packets are transferred in short intervals, the scratchpad is verified before writing memory, and all data is tagged with a powerful cyclic redundancy check (CRC16).

ASPECTS OF TOUCH

Tolerance to ESD beyond ± 10,000 volts results from reducing pin count to one and including a special protection device in the chip layout.

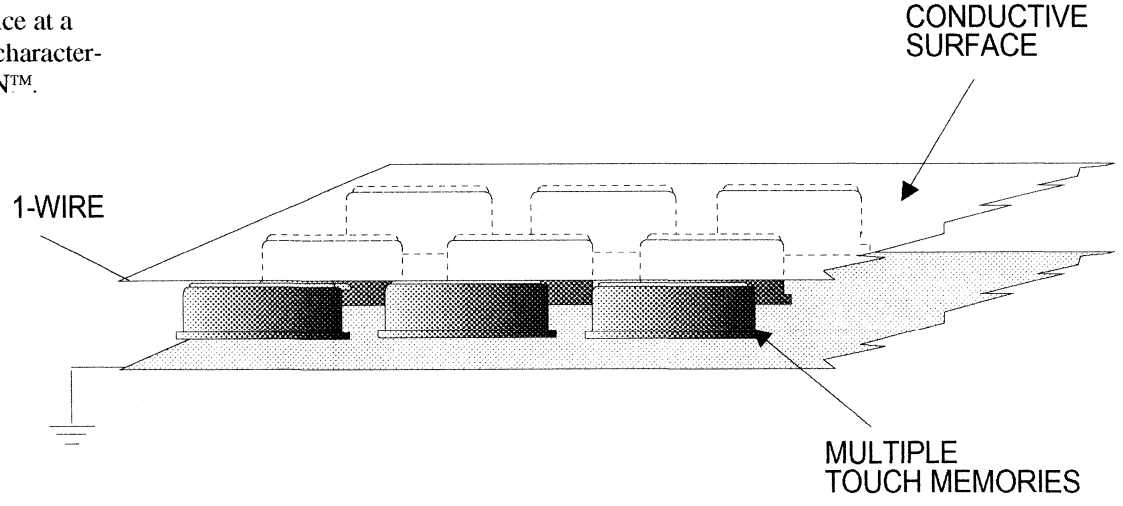
Static Electricity Testing

Human body circuit model

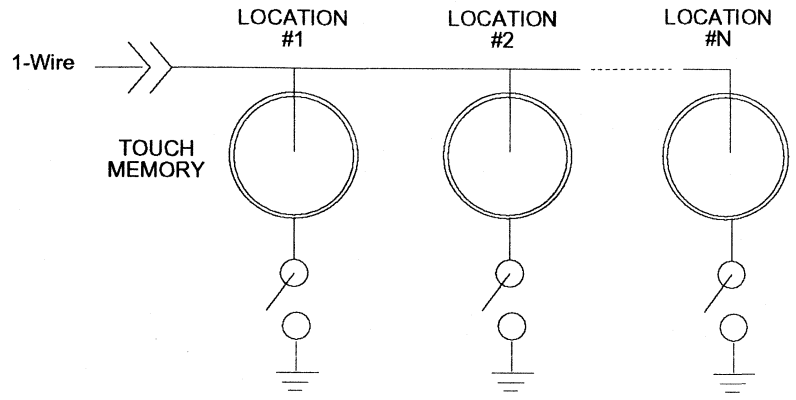


The unique registration number and sorting logic in each Touch Memory allows for discovery at a rate of 75 per second out of a population of 10^{19} devices. Once a specific Touch Memory is selected, communication occurs with one device at a time, taking on the characteristics of a MicroLAN™.

Sharing The Same Surface

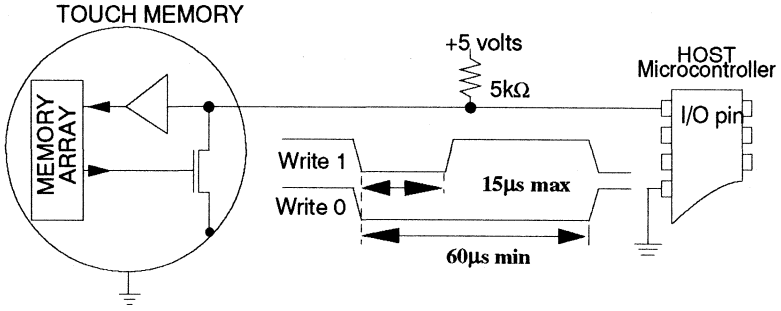


Multidrop Capability



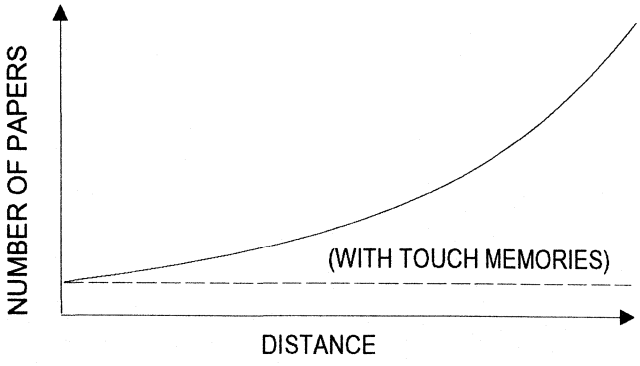
The 1-Wire Touch Protocol forms a MicroLAN at the lowest price point. This powerful protocol can identify the opening or closing of a specific switch by using the unique registration number in each Touch Memory. The master then knows the location by reading the notation stored in the Touch Memory. A closure or opening can be from a reed relay, pressure switch, or bi-metallic temperature switch.

Inexpensive Interface



The 1-Wire Touch Protocol uses long and short pulses to encode binary data, much like Morse Code. A single conductive link (plus ground) is the lowest cost way for two chips to communicate.

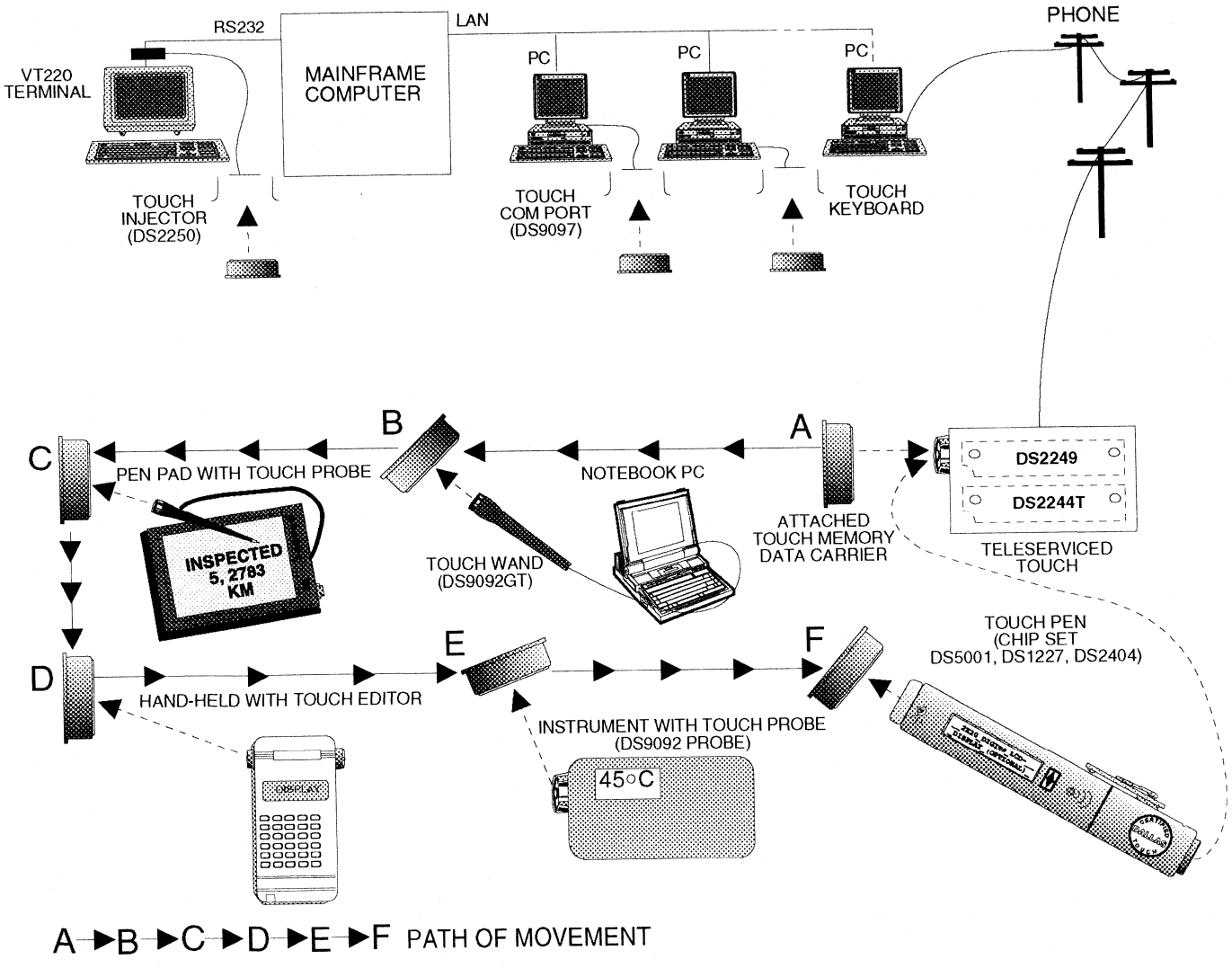
Paperwork vs. Distance From Computer



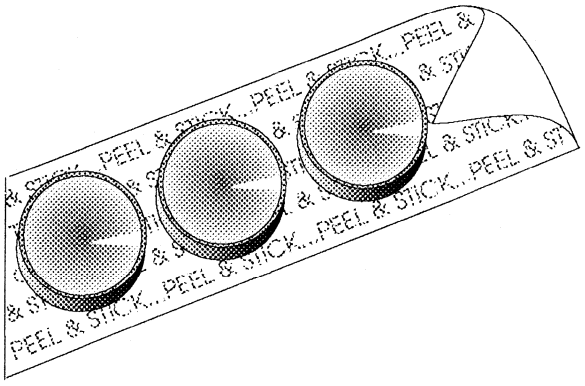
The amount of paper needed to document an activity increases as work is done away from the computer. However, with Touch Memories the paper-reducing benefits of computers continue even where the network stops.

Touch Memories keep information flowing to the hands-on, walking workers. The low interface cost of chip-to-chip communication serves hand-helds as well as networked computers. The movement of Touch Memories from point to point carries information as a network without wires.

Touch Memory Extends the Reach of Computing



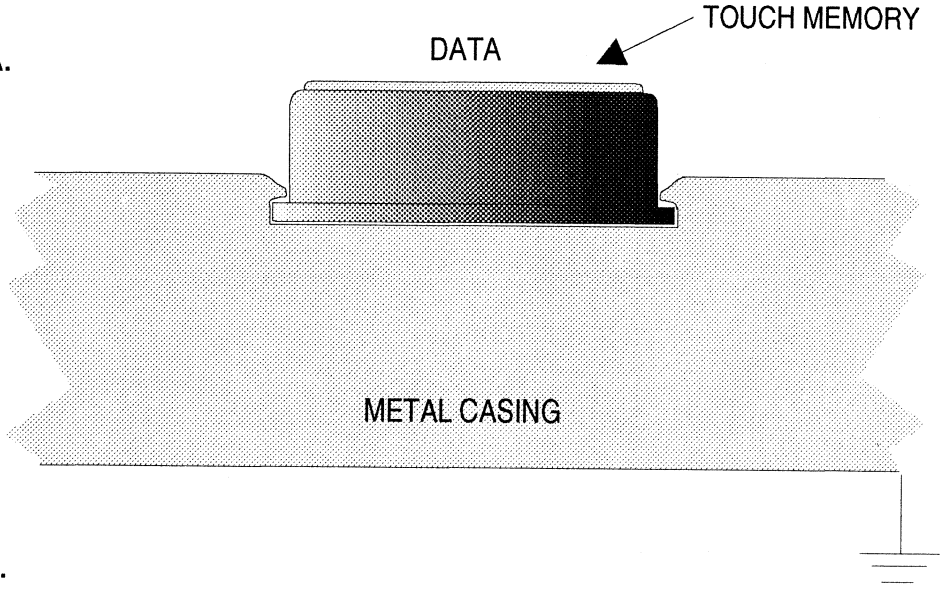
1. DS9096P Mounting Pads



1. The DS9096P double-sided foam mounting pads attach Touch Memories to almost any surface with the ease of adhesive tape.

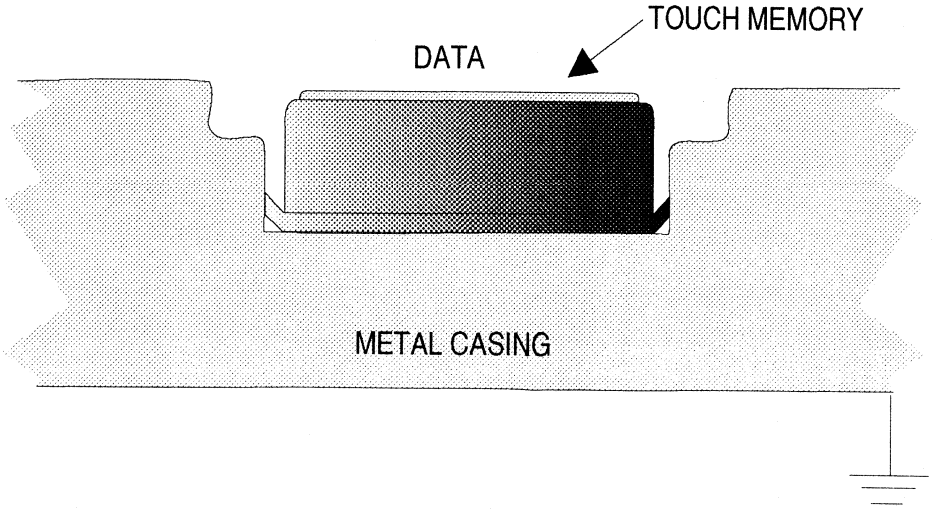
2. Press Fit

2A.



2A. By deforming the metal over the flange, a Touch Memory is locked into place.

2B.

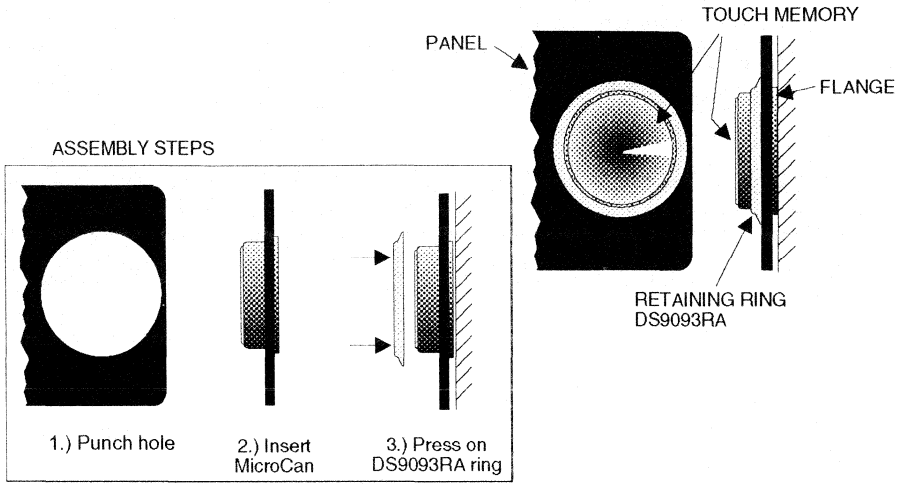


2B. An interference fit secures the Touch Memory in an undersize hole.

ATTACHMENTS

3. A circular retaining ring DS9093RA is pressed over the Touch Memory, biting into the side wall. The fastener locks the Touch Memory in the panel through-hole.

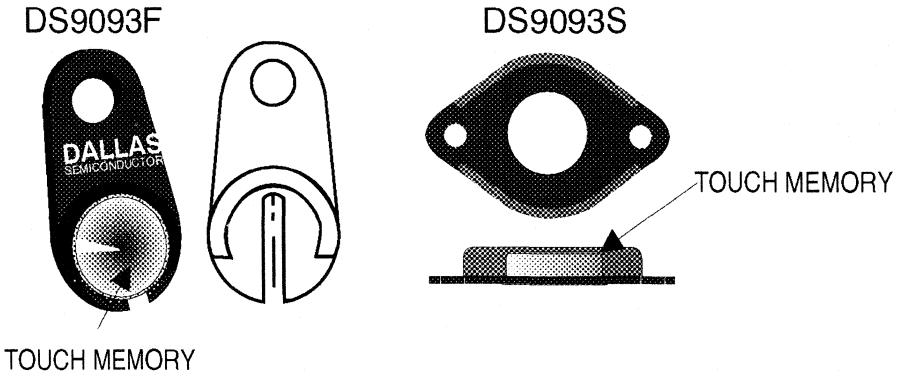
3. Panel Mount



4. A C-clip such as the one molded into the DS9093F mount binds the flange of the MicroCan.

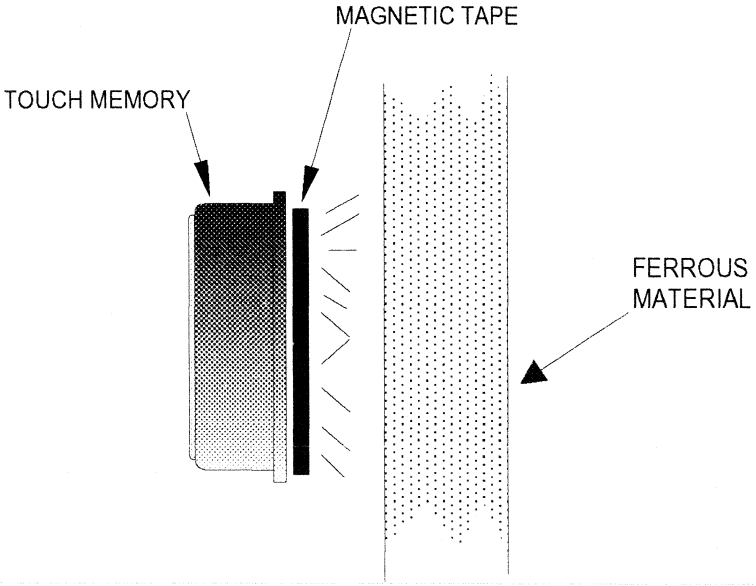
The DS9093S holds the MicroCan captive with screws or rivets.

4. Mechanical Flange Mount

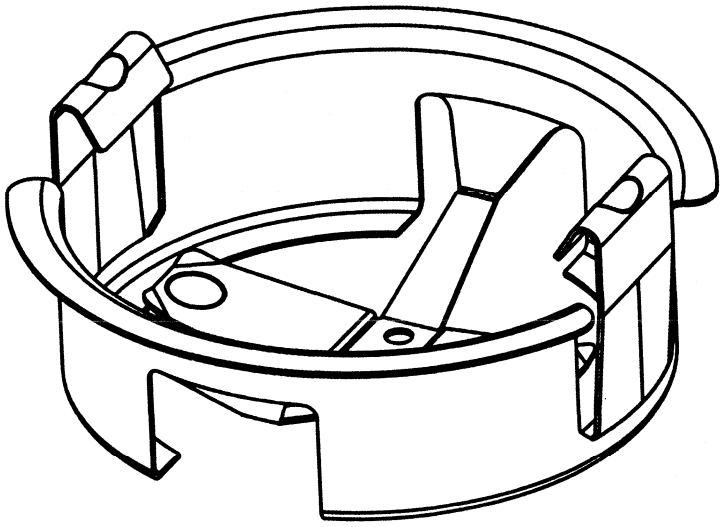


5. Readily available magnetic adhesive tape conveniently adheres to ferrous surfaces for reusable self-stick applications.

5. Adhesive-Backed Magnetic Tape

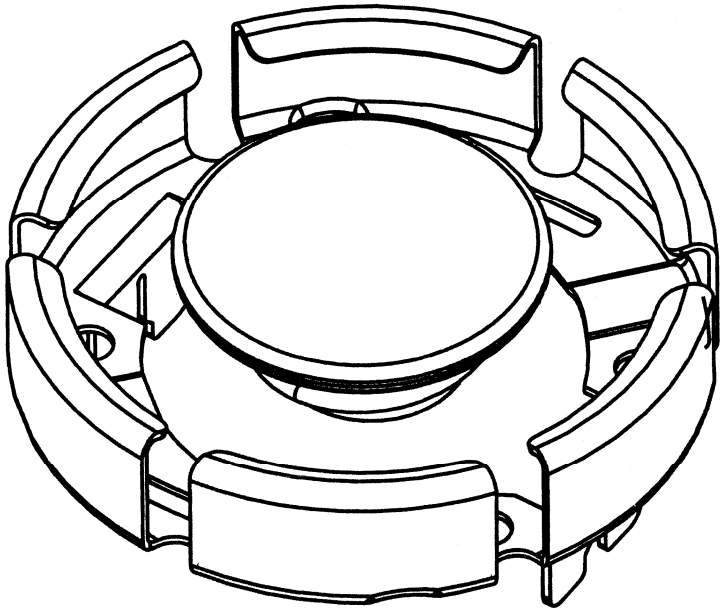


6. DS9098 MicroCan Retainer



6. The DS9098 Retainer is a single piece, all-metal receptacle for surface mounting a MicroCan to a printed circuit board. The center contact is permanently seperated at first insertion. The MicroCan pops up for removal when the side latch is released.

7. Touch and Hold Probe

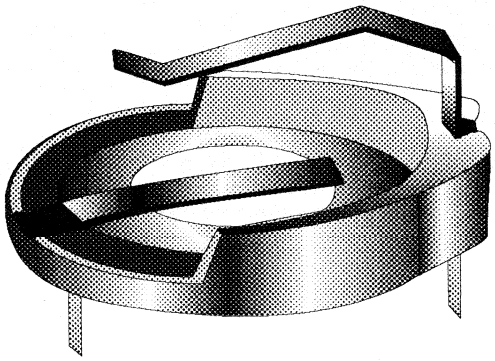


7. For applications requiring a continuous contact as well as easy disconnection, a Touch and Hold Probe can be manufactured from the DS9100 metal stampings. In contrast to the DS9098, the DS9100 holds the MicroCan by the stiff springs of its outer ring. The DS9100 also allows reading Touch Memories with a momentary contact.
For the center contact there are two options: a) coiled spring (DS9100C) as shown in this picture and b) cantilever (DS9100B) as shown on page 13. The outer ring (DS9100A) is the same for both options.

ATTACHMENTS

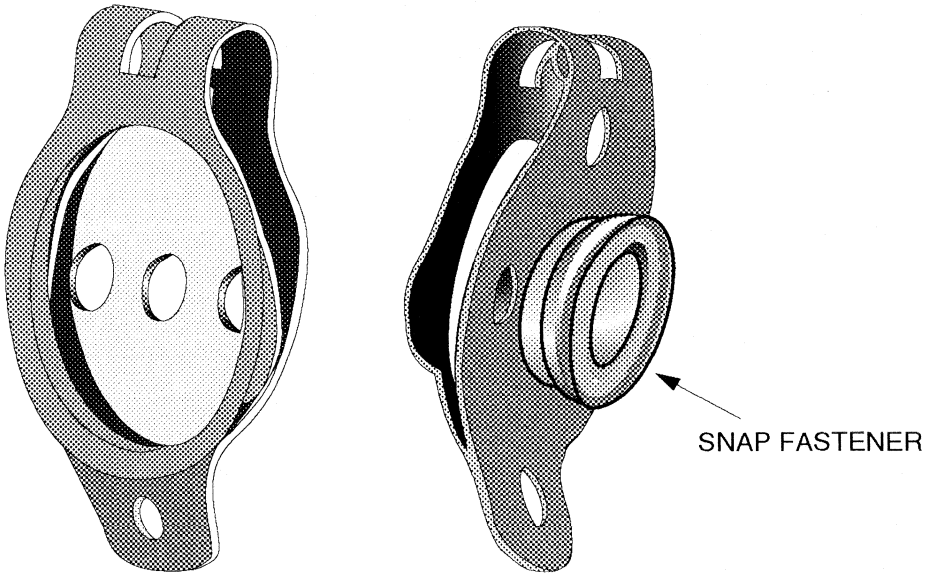
8. The DS9094F MicroCan Clip holds and connects a Touch Memory to a printed circuit board. This picture shows the DS9094F for conventional printed circuit boards. For surface mount use the DS9094FS with flat contacts instead of pins.

8. DS9094F and DS9094FS MicroCan Clip



9. The DS9101 Multi-Purpose Clip is a low-cost stainless steel fixture to mount a Touch Memory to a plastic badge, or, using an additional wire or tie wrap, to any soft surfaced object that provides a hole for strapmounting. The DS9101S is assembled with a standard 7mm snap fastener for quick attachment and dismount.

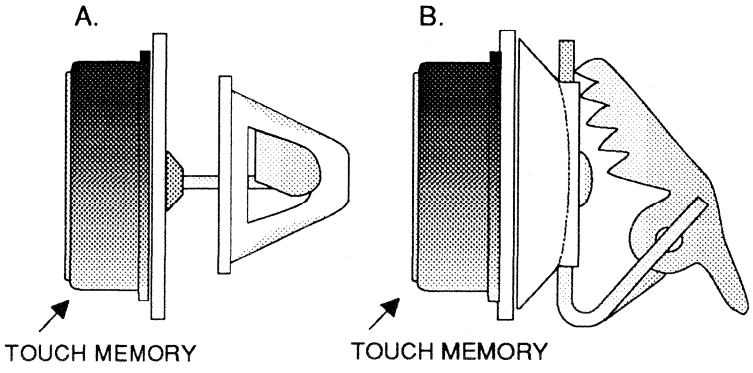
9. DS9101 Multi-Purpose Clip



10A. Touch Memories fasten to soft, flexible materials such as fabrics using a pin.

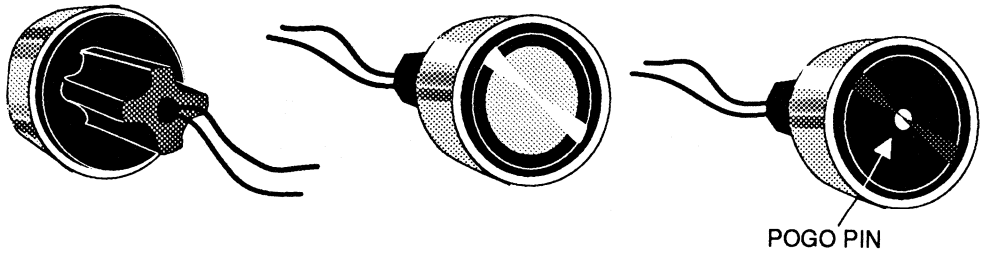
10B. Spring-loaded clip.

10. Fabric Mount



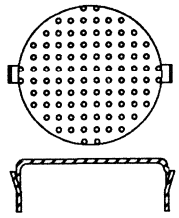
11A. DS9092 Touch Memory Probe

11B. DS9092T Touch Memory Probe (Tactile)

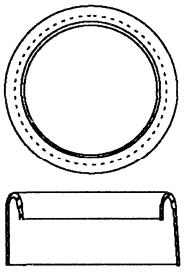


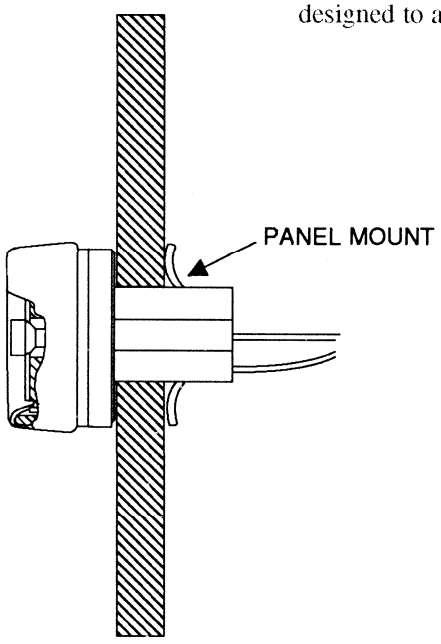
11. The DS9092 Probe self-aligns to the circular rim of the Touch Memory. The probe can be panel-mounted using a press-on locking retainer.

12A. Ground Contact Stamping (center)



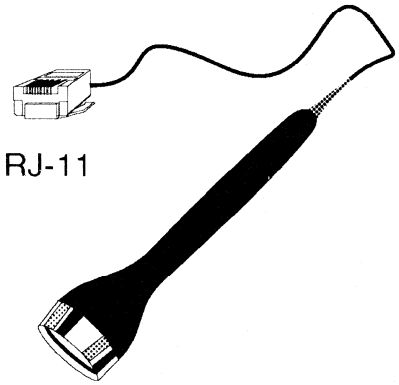
12B. Ground Contact Stamping (wall)





12. Simple, low-cost metal stampings form a read/write probe for the Touch Memory family. The stampings can be pressed into a plastic molding designed to accept them.

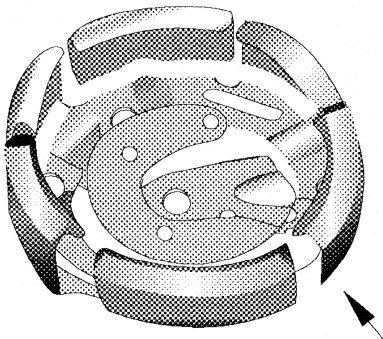
13. DS9092GT Probe with Grip



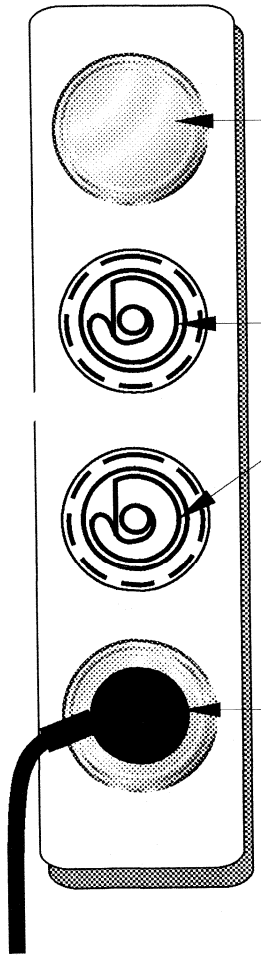
13. The DS9092GT hand grip-mounted probe comes attached to a 4-inch handle and a 1-meter cable terminated with an RJ11 jack.

14. Made from stiff stainless steel Touch and Hold Probe Stampings, this holder allows reading or writing Touch Memories on either momentary or permanent contact. Multiple memories share the same 1-Wire interface, yet can be communicated with individually. This holder arrangement is ideal for identifying multiple personnel, each with their own Touch Memory, to a computer.

14. Front Panel Button Holder



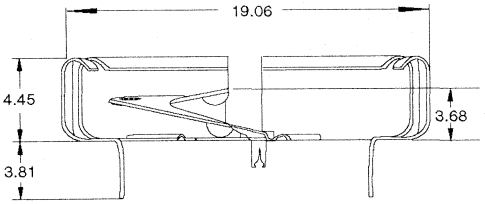
TOUCH AND HOLD
PROBE STAMPING
PERSPECTIVE VIEW



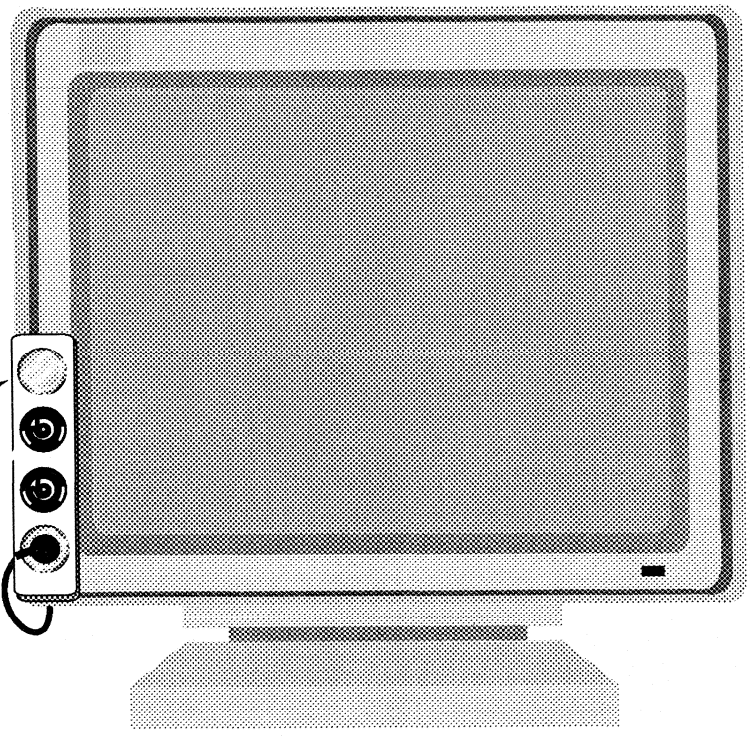
TOUCH MEMORY

FREE PLACES
FOR MORE
TOUCH
MEMORIES

DS 1402BR
BUTTON TO
RJ-11 CORD



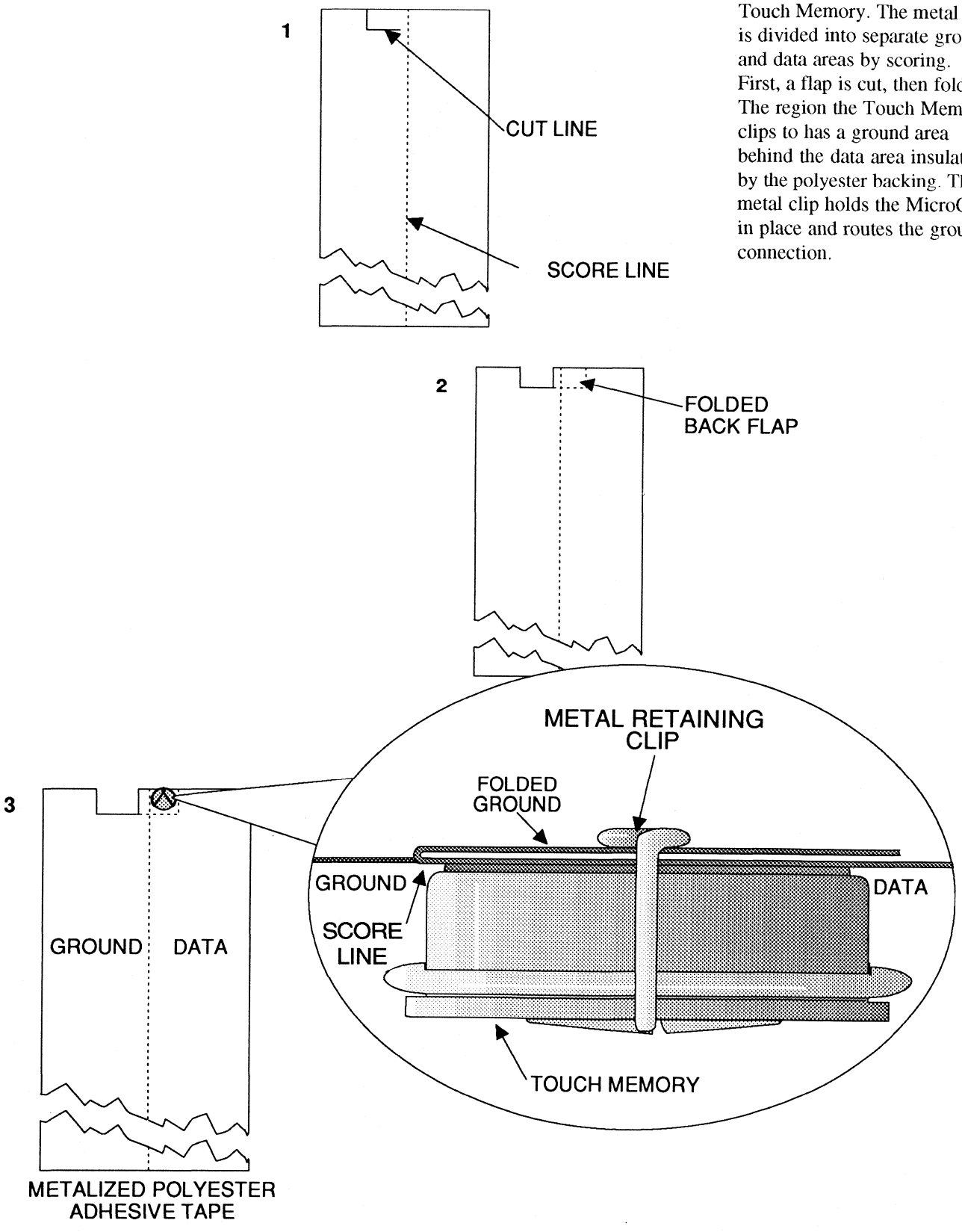
CUT-AWAY
SIDEVIEW



TOUCH MEMORY

15. Conductive Tape

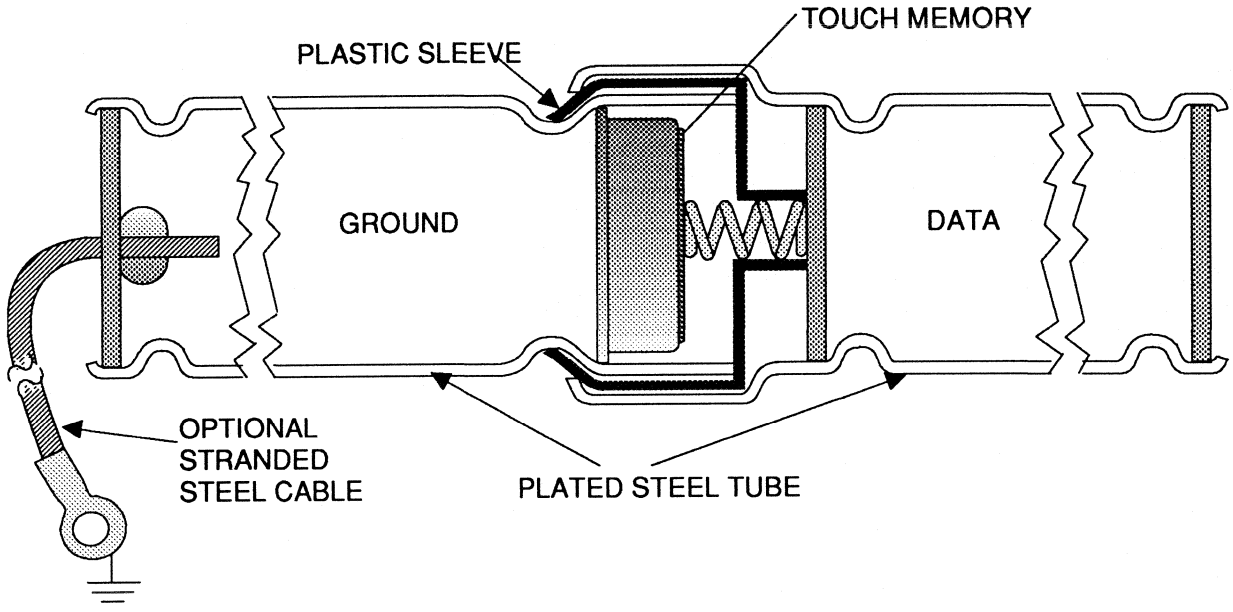
15. Metalized tape can enlarge the conductive surface of a Touch Memory. The metal film is divided into separate ground and data areas by scoring. First, a flap is cut, then folded. The region the Touch Memory clips to has a ground area behind the data area insulated by the polyester backing. The metal clip holds the MicroCan in place and routes the ground connection.

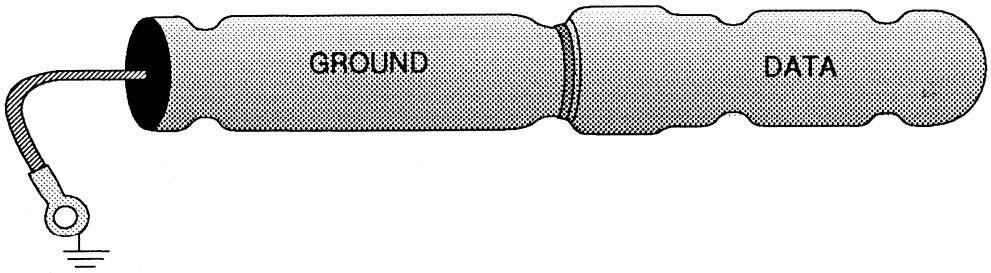


SURFACE EXTENSION

16. A Touch bar can be made by joining two tubes separated by an insulator. The bar length can be increased to make loose alignment tolerance for touching the data and ground surfaces.

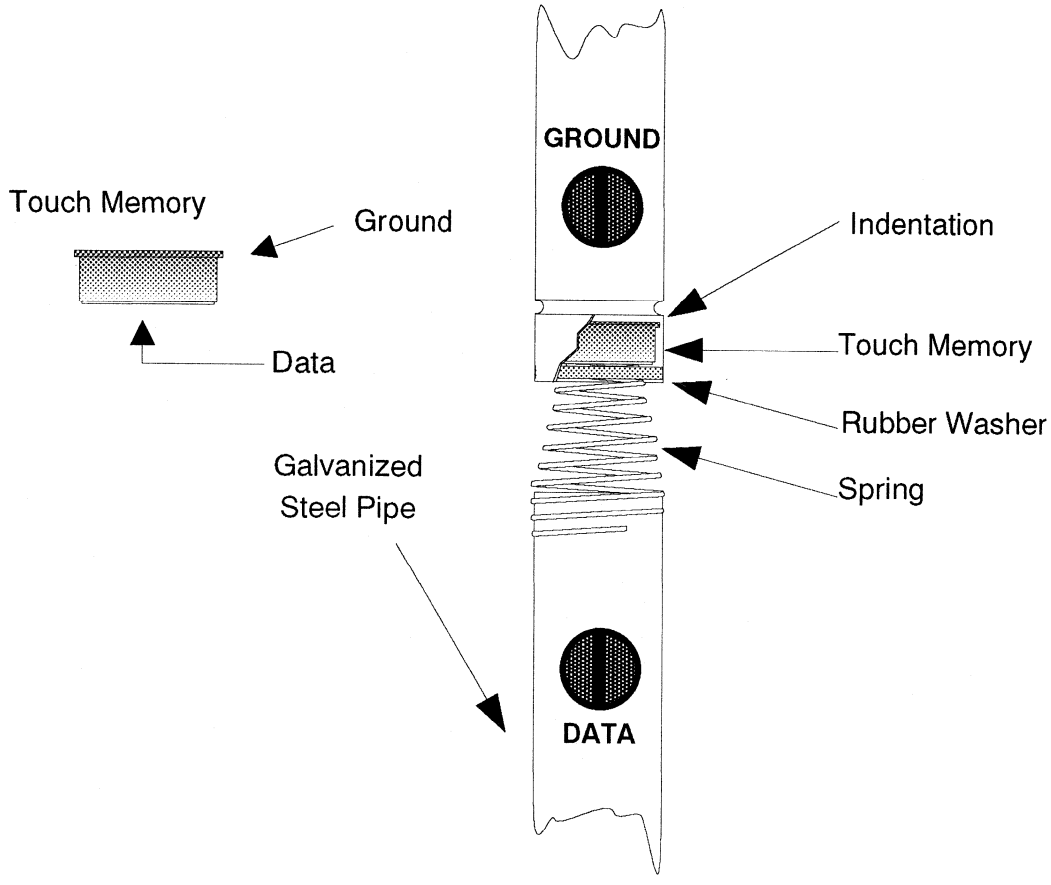
16. Bar





17. Split Conduit

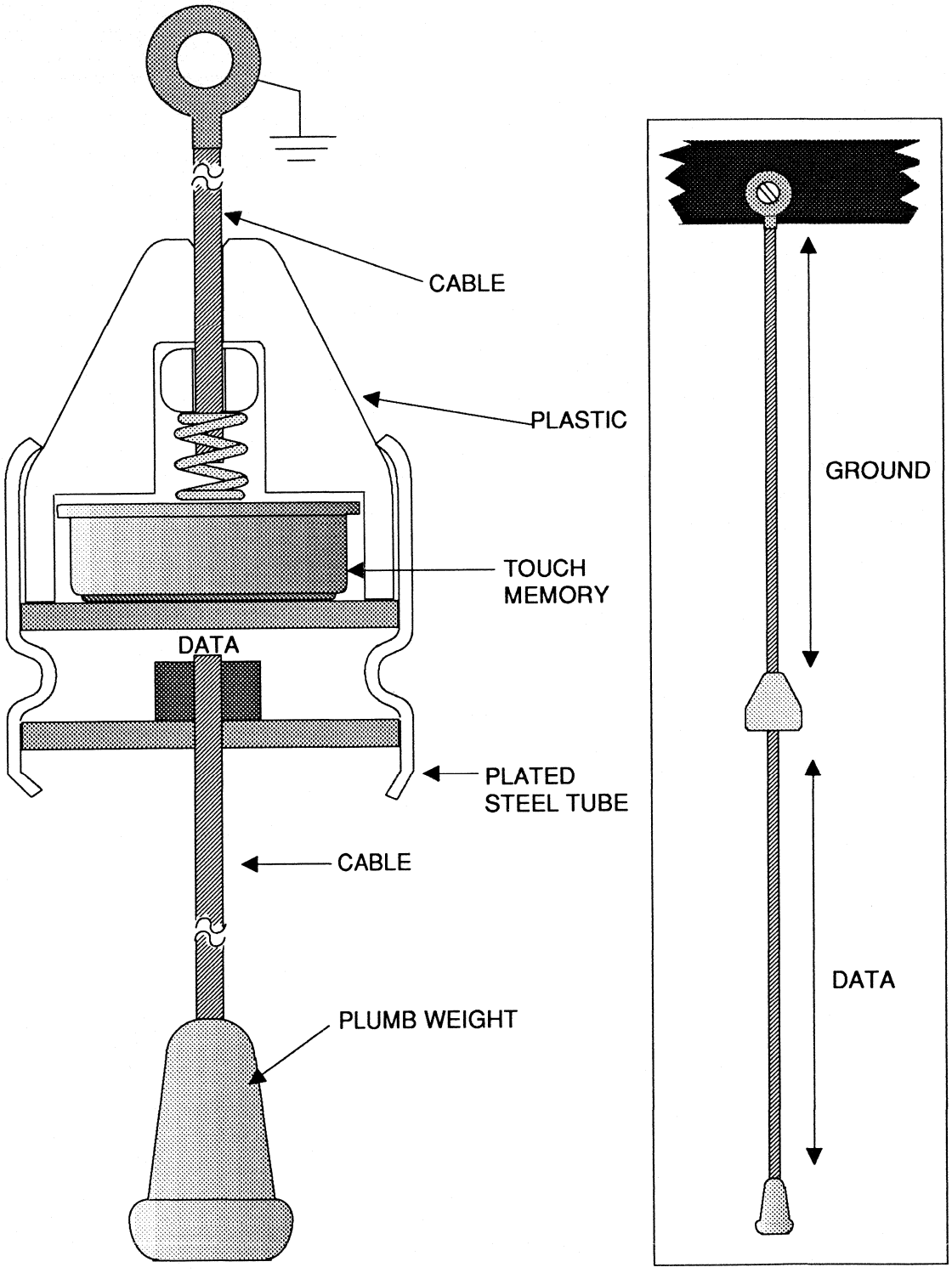
17. Steel pipe that is used as a bumper or lift for a container can become a rub rail for touching the expanded data and ground surfaces of the Touch Memory.



SURFACE EXTENSION

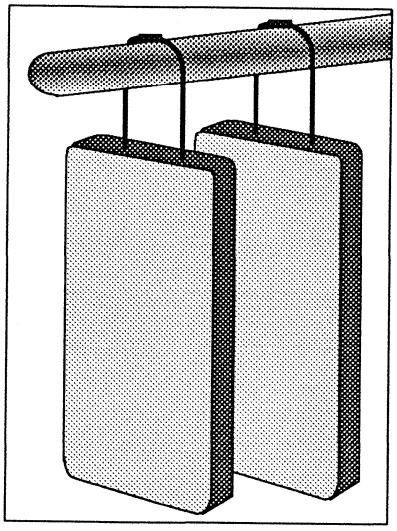
18. Instead of enlarging a rigid surface, metal cable is used so deflection occurs if force associated with touching is not controllable.

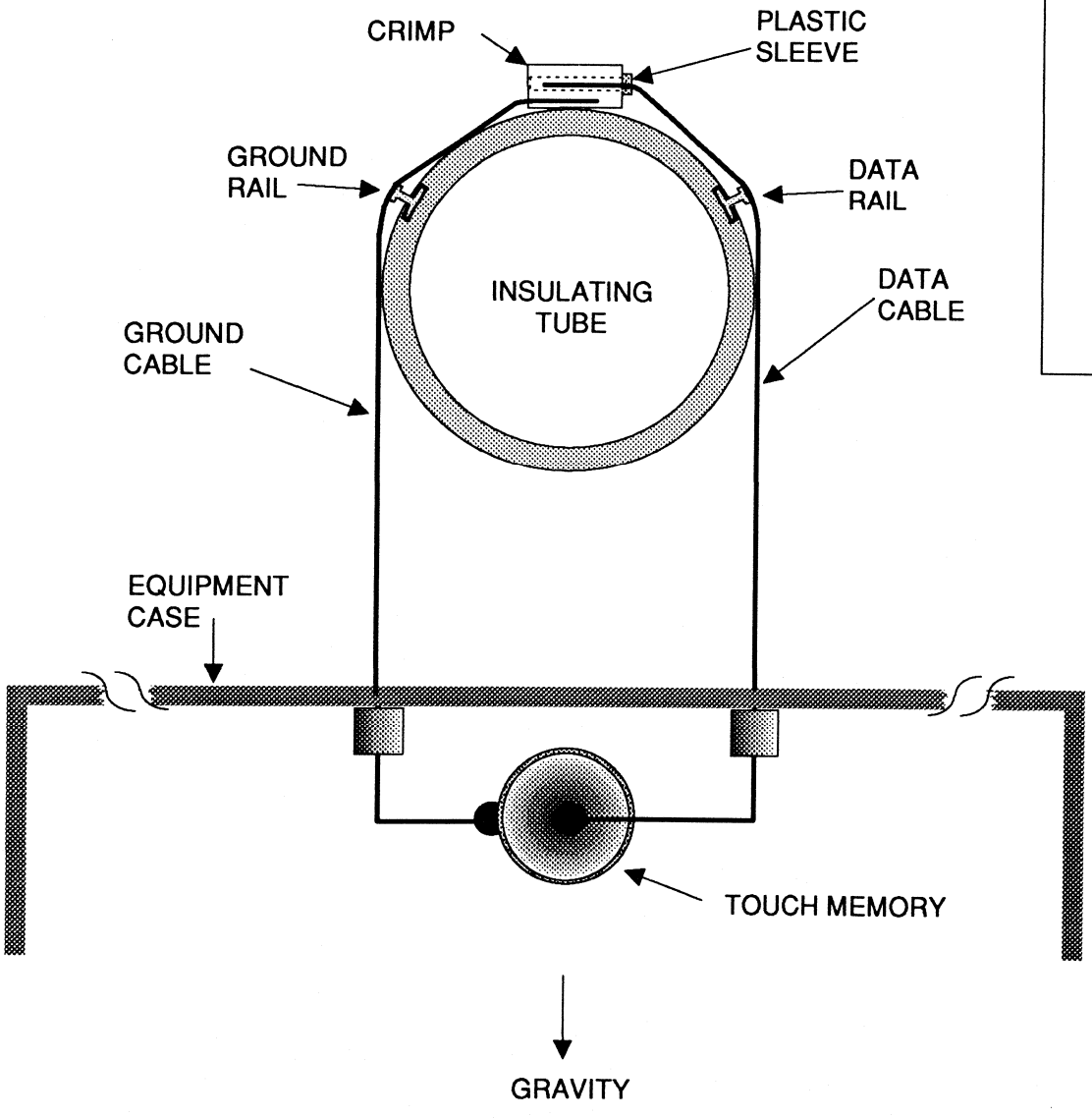
18. Hanging Cable



19. Cable Loop

19. In addition to serving as a hanger, the cable loop provides the conductive path to the Touch Memory. Multiple objects can be on the same hook because the 1-Wire Touch Protocol can single out each Touch Memory for individual communication.

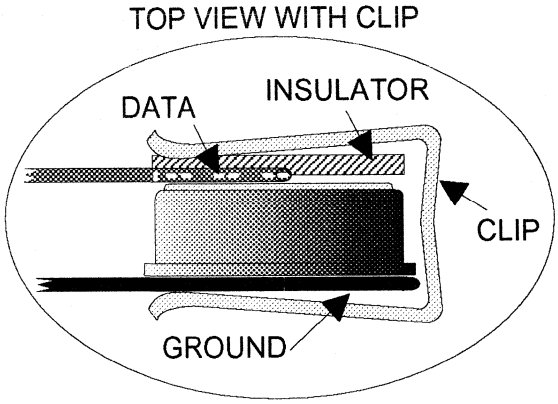


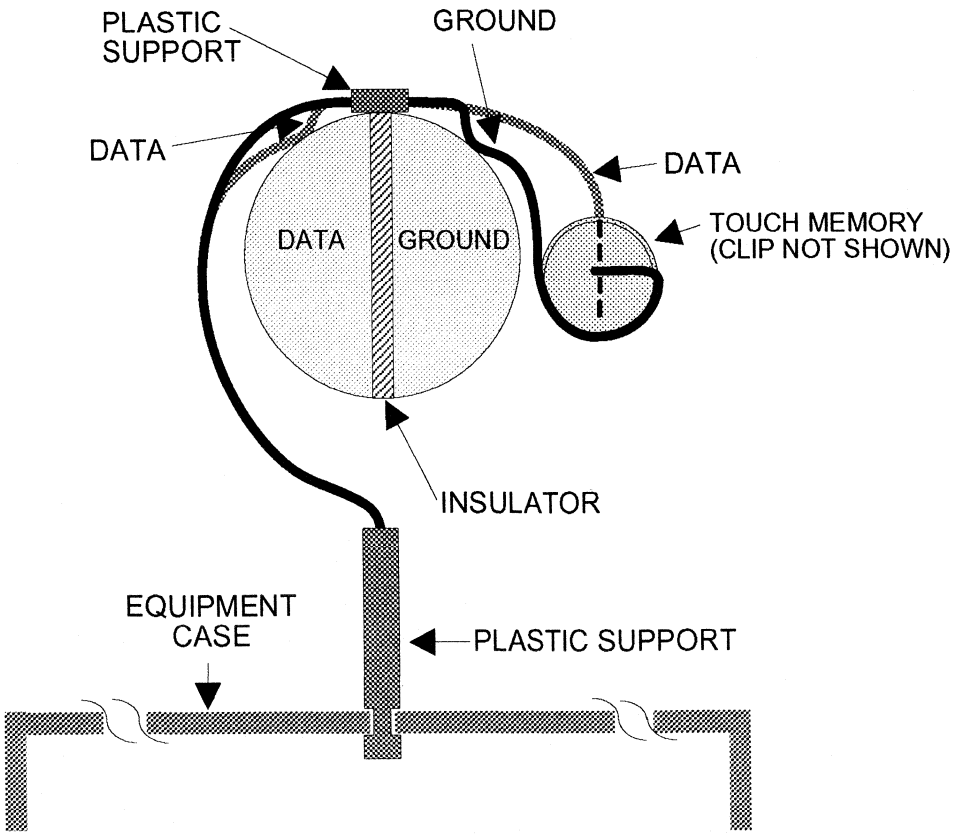


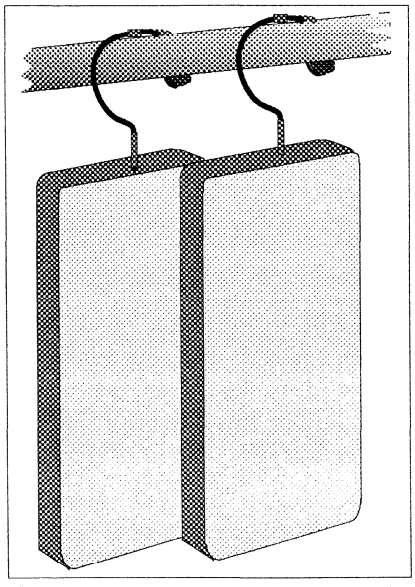
SURFACE EXTENSION

20. A wire hanger makes data and ground contacts while on a rod. The rod is split into two half circles to match the contacts on the hanger.

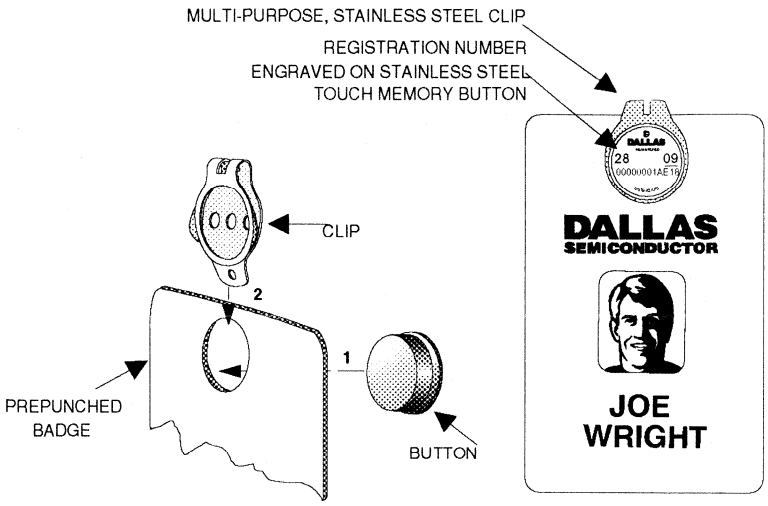
20. Hanger





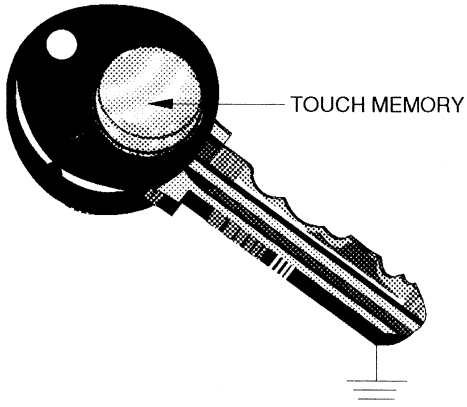


21. Badge



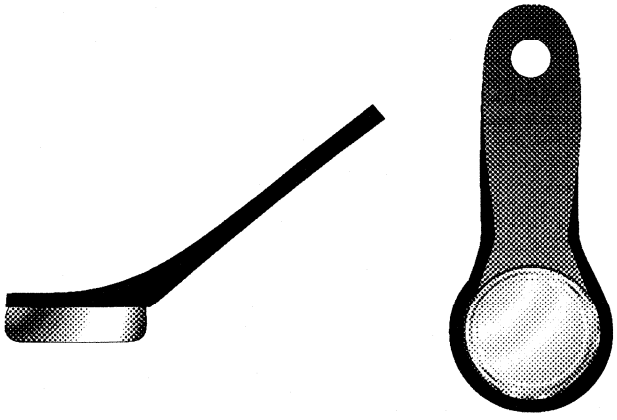
21. The Touch Memory is pressed into the hole of the badge and captured in a multi-purpose clip. The clip attaches the badge to the pocket of the shirt.

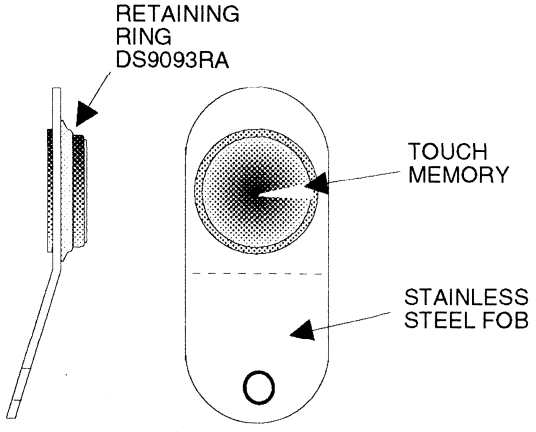
22. Key



22. A combination of a mechanical and electronic key boosts security.

23. Key Fob





23. The Touch Memory easily fits on a keyring and stays body-friendly.

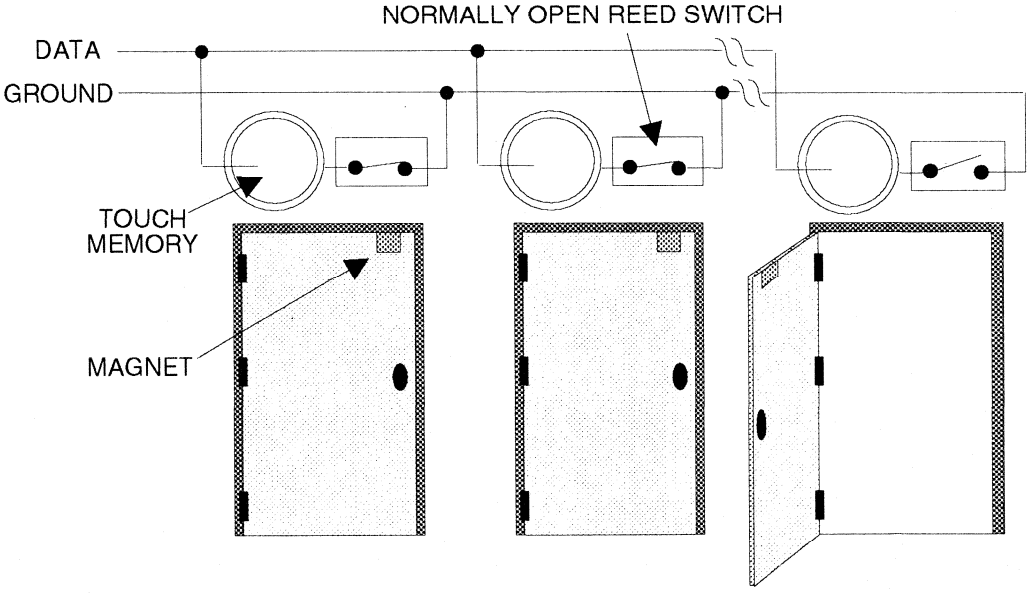
ACCESS CONTROL

24. This employee ID badge uses Touch technology to provide convenient yet secure access to restricted areas. The wall plate holds a DS9092 Touch Probe and an LED indicator. No electronics are needed at the probe point. The door controller electronics can be hundreds of meters away.

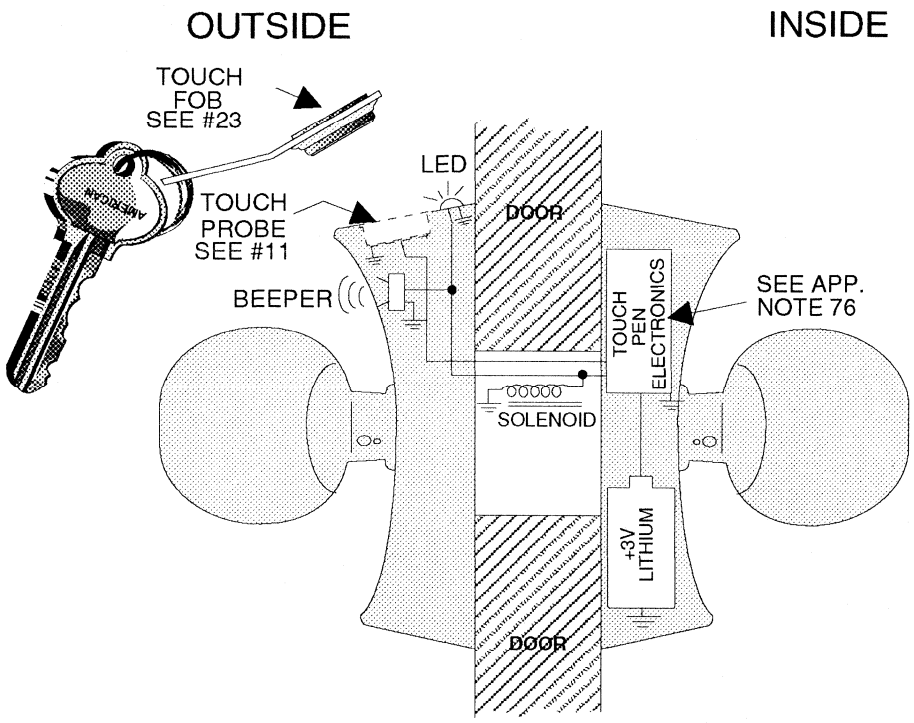
24. Door Entry Wall Plate

25. Each Touch Memory stores the location of the door frame to which it is attached. As long as the doors are closed, every Touch Memory is accessible on the 1-Wire MicroLAN. Opening a door removes the corresponding Touch Memory from the MicroLAN. Only one wire is required to detect and identify the location of a large quantity of doors.

25. Door Monitor

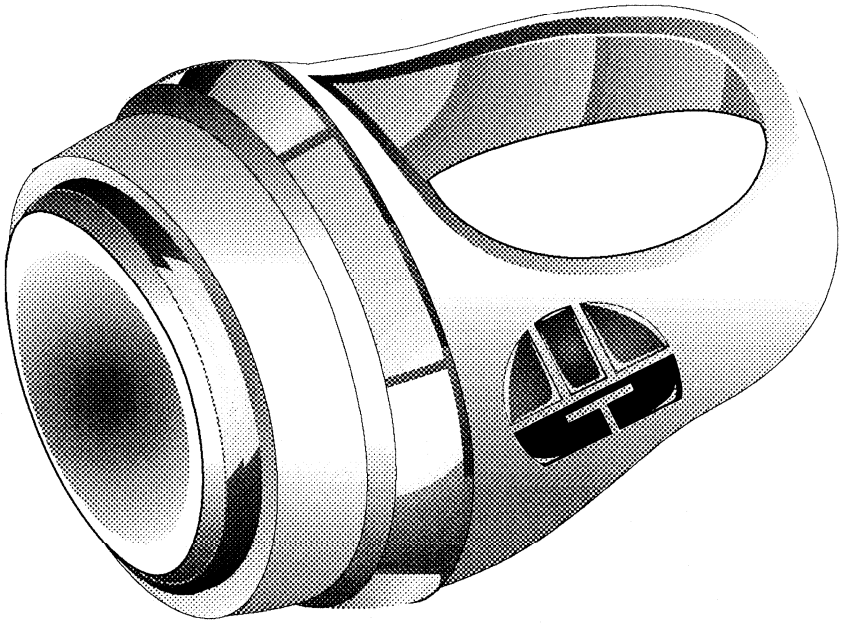


26. Standalone Access Control System



26. An electronic door lock can be fitted with Touch Pen electronics to conditionally grant door entry. The Touch Key identifies the person to the door. If the name in the Key matches a name on the access list and meets the time-of-day criteria, then the solenoid releases the latch for entry. A record of the entry can be logged in both the Key and the lock electronics. A Touch Pen can draw out the time and date of access, transporting the log to a PC for archiving. The access list can be updated (with addition or deletion of names and times) by copying a new access control file into the lock electronics.

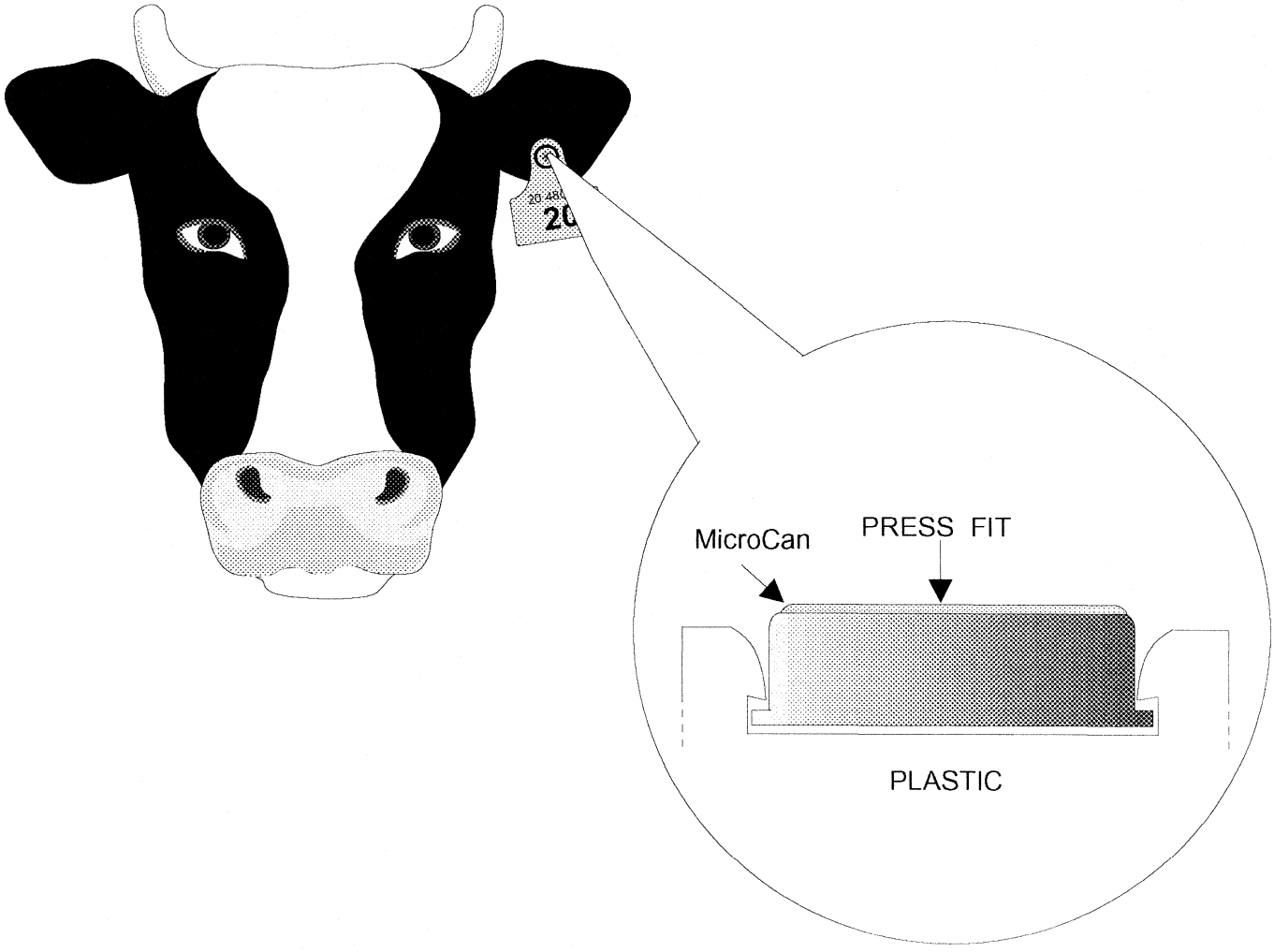
27. Touch Memory Ring



27. As an alternative to key rings that may be forgotten when leaving a place, the elegant Touch Memory Ring avoids such inconveniences. Loaded with several independent data files, it may contain, for example, personal identification, medical emergency data and access codes to cars, home, office or computers.

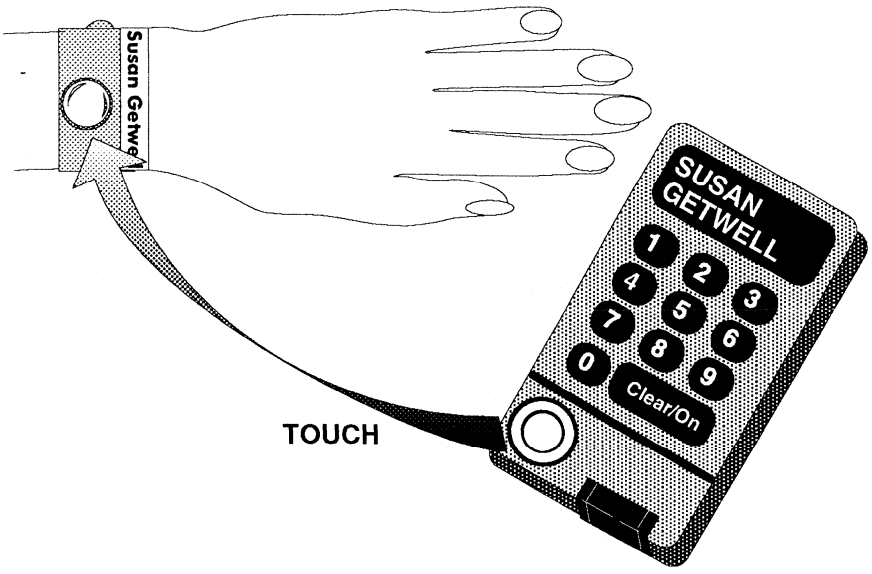
28. The ownership and medical records of livestock are kept on the ear tag.

28. Cowboy Tag



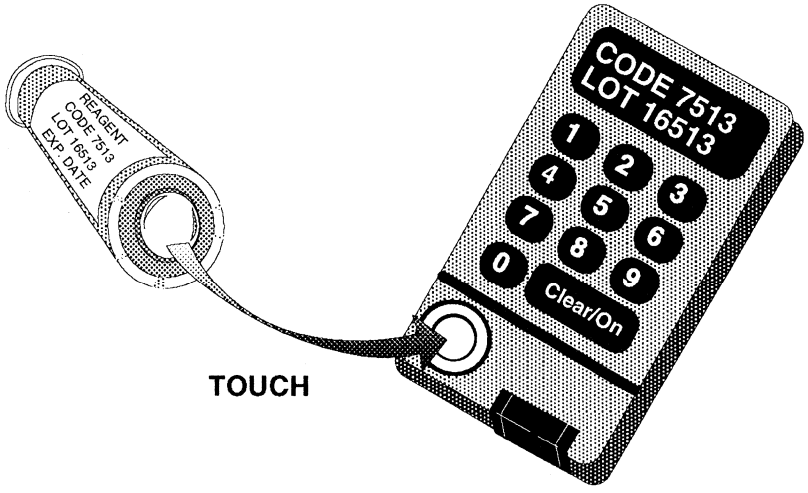
29. Bracelet

29. The hand held meter is touched to the patient's hospital bracelet to identify who is being tested.



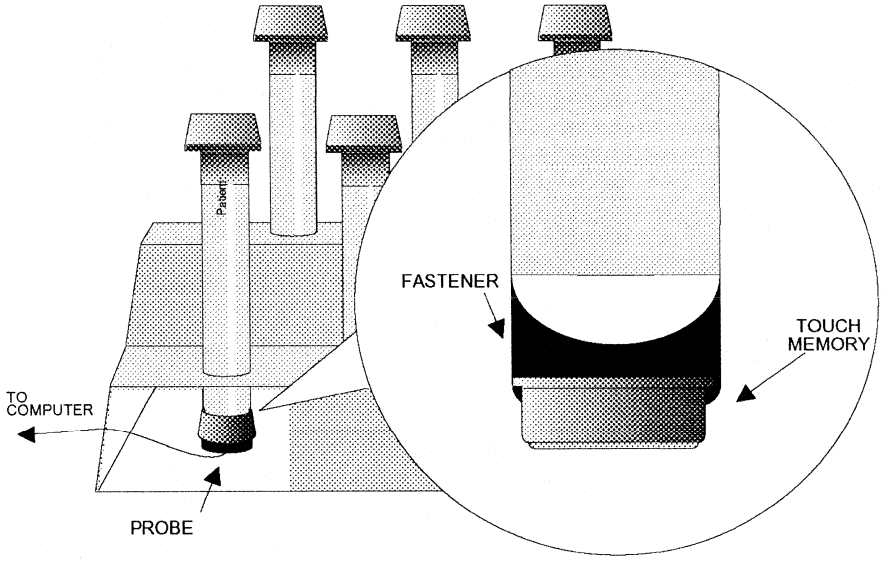
30. Diagnostic Reagent Label

30. The Touch Memory affixed to the reagent vial holds specific information about this reagent. In order to insure accurate test results, it is touched to the test meter to calibrate the instrument.



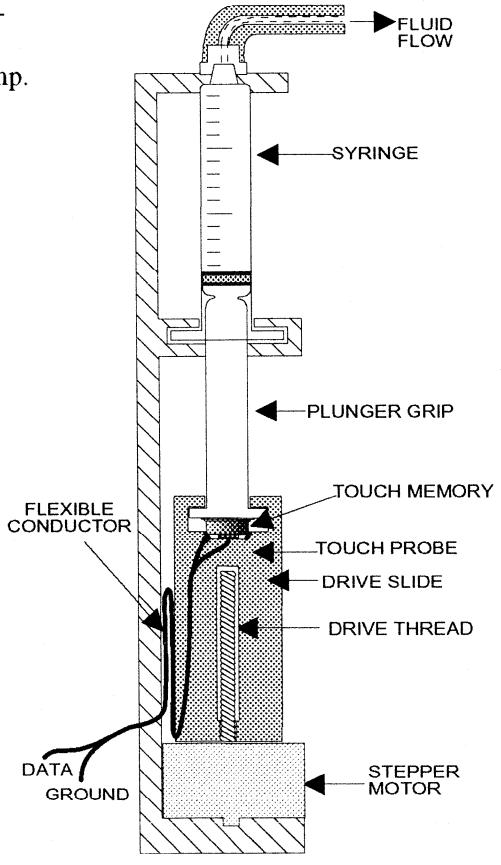
31. A Touch Memory fitted to the bottom of the sample tube stores the patient's name, hospital ID code, and the time and date the sample was collected. Gravity holds the Touch Memory in contact with the probe. Information is automatically added to the memory as the sample tube is processed in the laboratory.

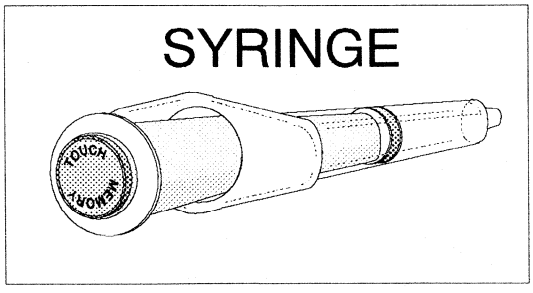
31. Sample Tube



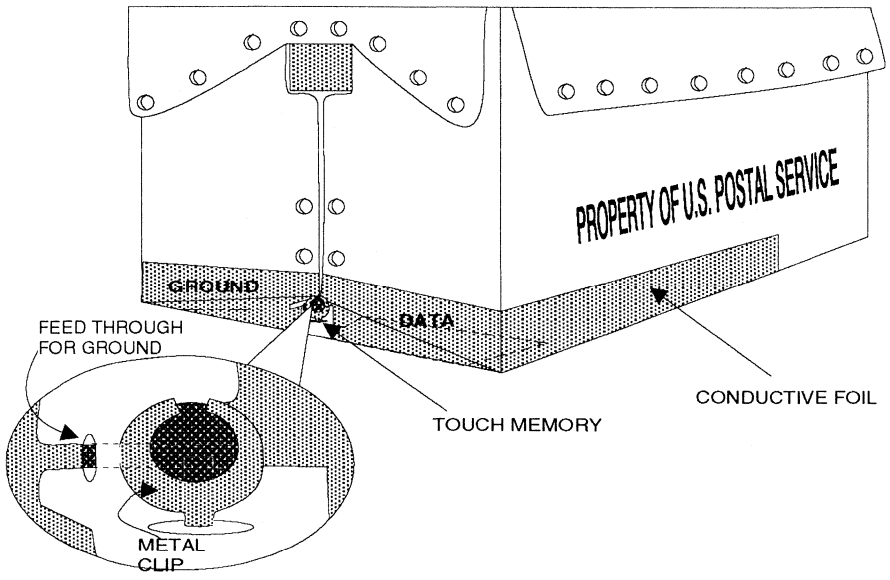
32. A Syringe with a Touch Memory mounted on the plunger grip supplies relevant information about the fluid to the microprocessor-controlled pump.

32. Syringe



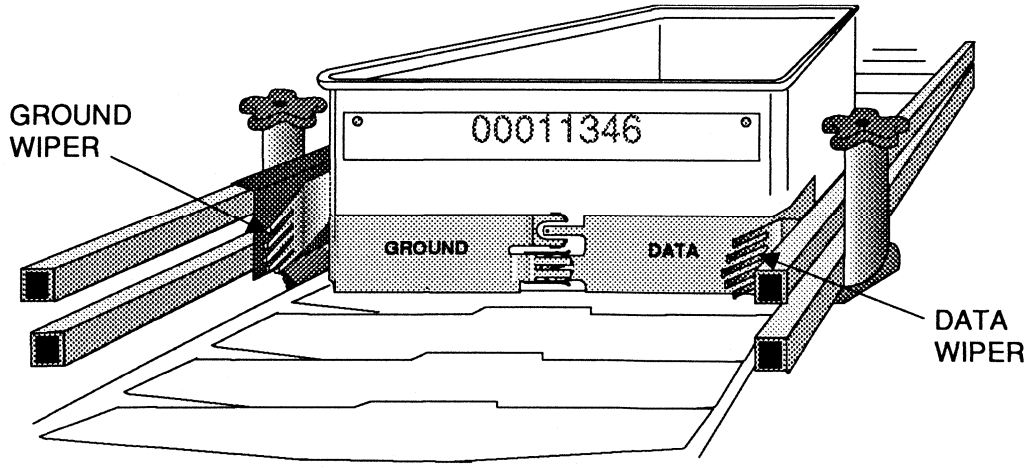


33. Mail Tray



33. The surface of the Touch Memory is extended to the bottom and sides of the mail tray with conductive tape. The tray can be identified and sorted according to its destination by a contact from the side or bottom.

34. Conveyer Side

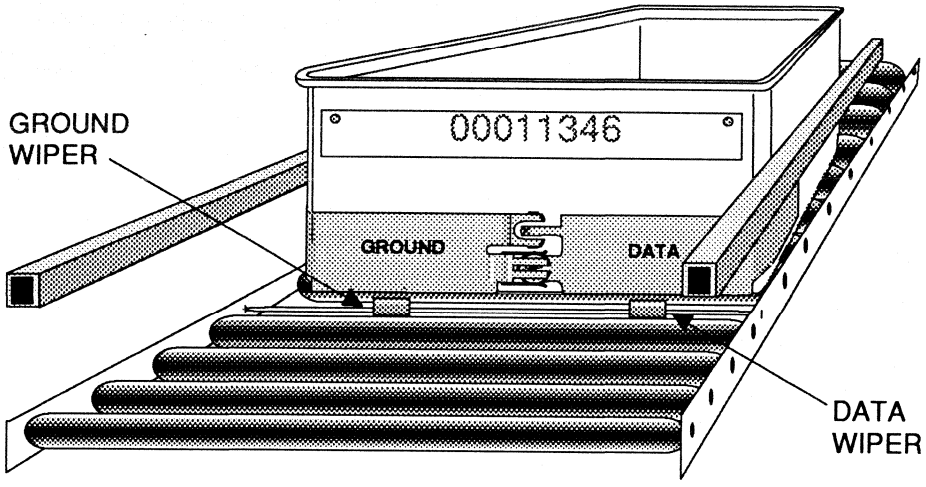


34. The container moves down this conveyer belt, passing by fingers that wipe the extended Touch Memory surfaces.

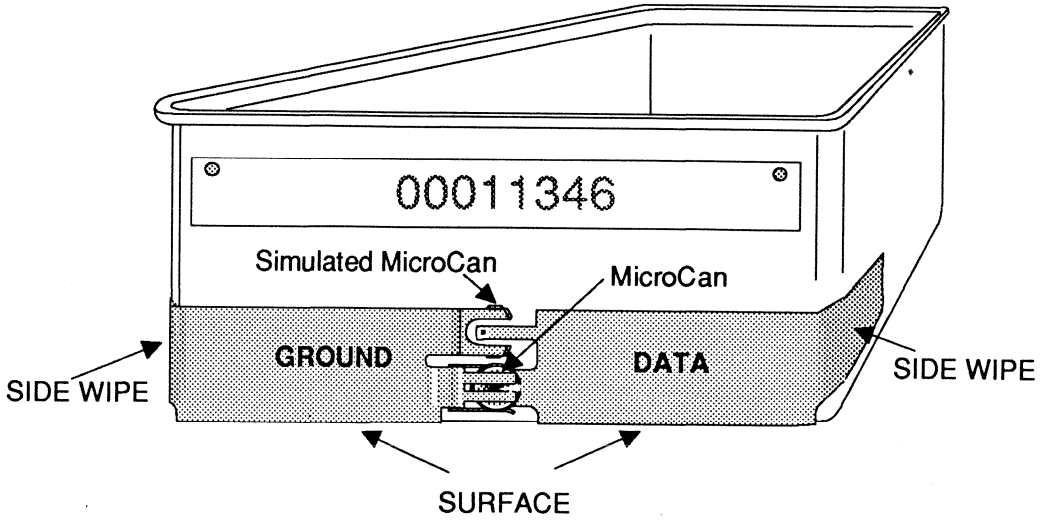
CONTAINER AND CONTAINER HANDLING EQUIPMENT

35. This container slides on rollers that wipe the conductive surface from the bottom.

35. Conveyer Bottom

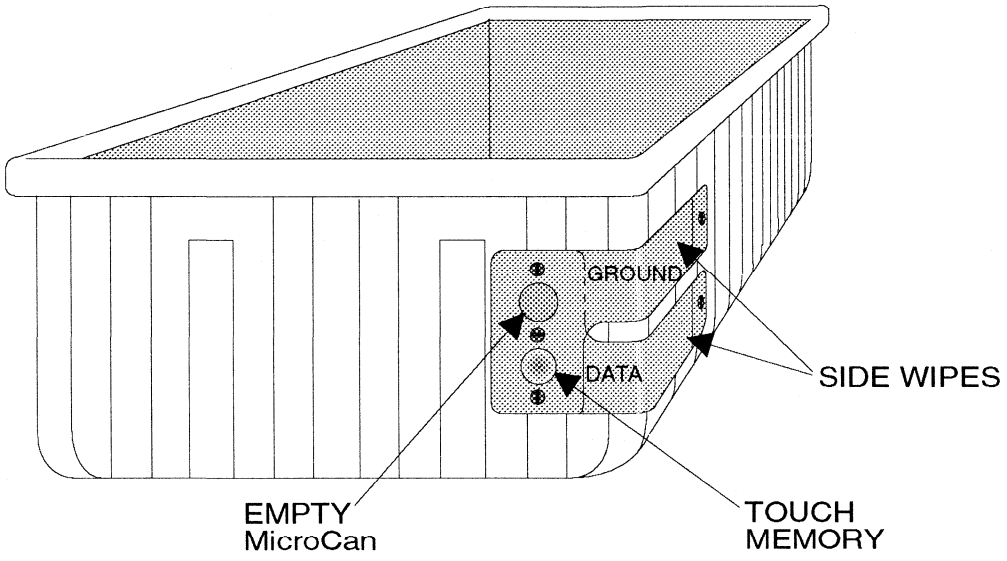


35A. Metal stampings are affixed to a plastic work tote. They are formed to hold the Touch Memory and simulate the MicroCan shape for contacting with a Touch Probe.



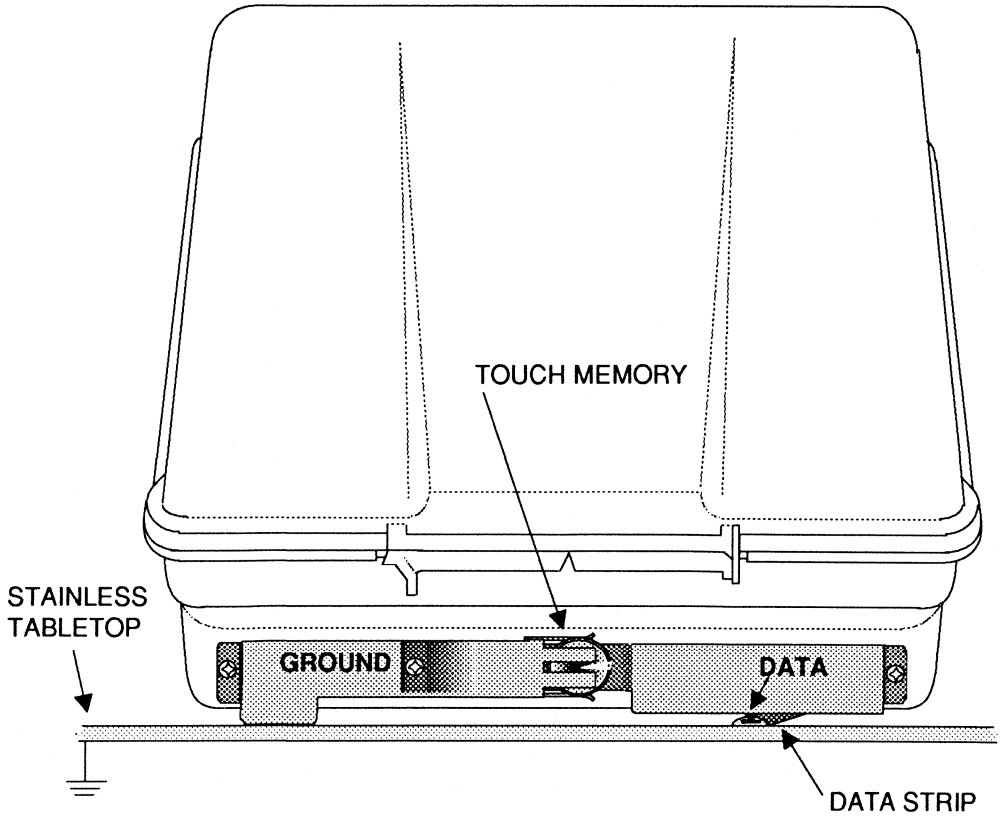
36. Work Tote

36. Metal stampings are affixed to a plastic work tote. They are formed to hold Touch Memory and an empty MicroCan for contacting with a Touch Probe.



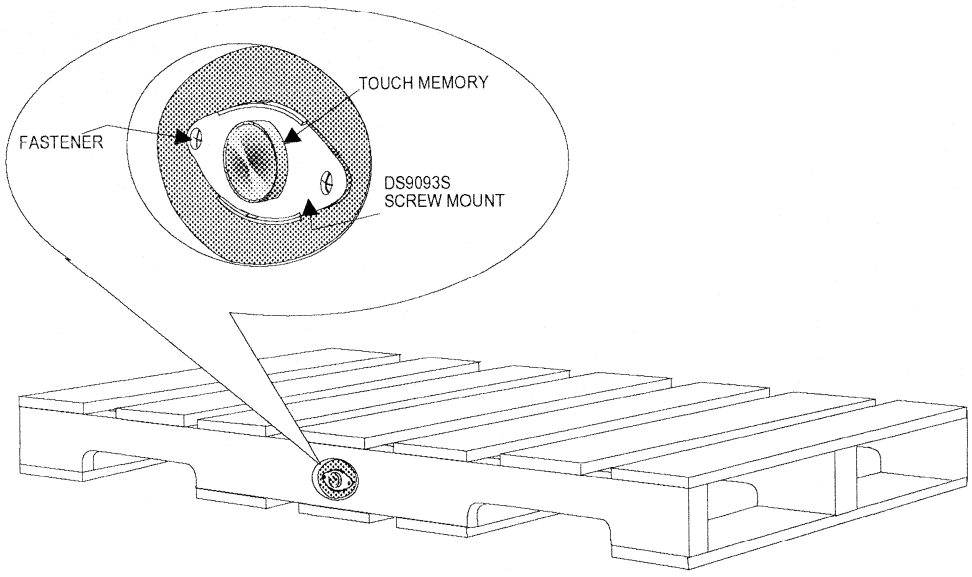
37. Wafer Carrier

37. This silicon wafer container identifies itself and specifies the process parameters for the workstation while resting on a table top. The grounded stainless steel table surface has an insulated data strip to communicate with the Touch Memory.



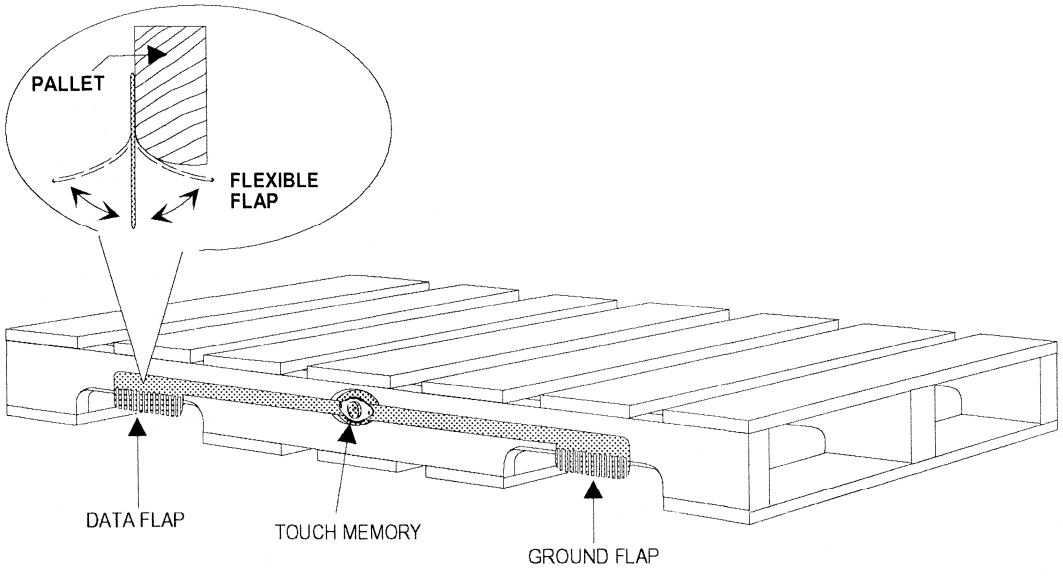
38. The Touch Memory is fastened with screws to the pallet using the DS9093S screw mount accessory.

38. Pallet with Screw Mount

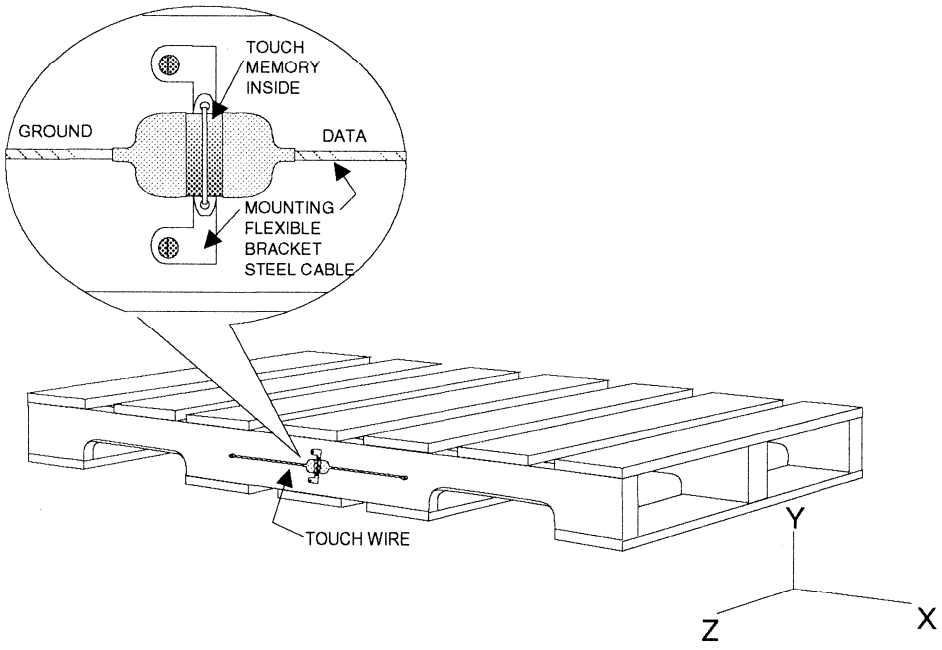


39. The conductive flaps contact the fork lift arms to transfer data to the Touch Memory. The left arm needs an insulated contact area for the data path.

39. Pallet with Fork Lift Flap

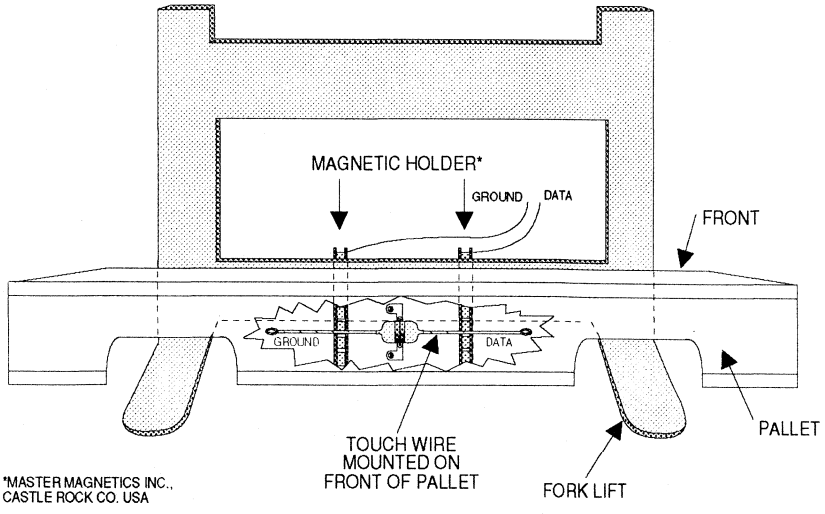


40. Pallet with Touch Wire



40. The magnets mounted on the fork lift arm attract the Touch wire to the data and ground surfaces. Tolerances for X,Y, and Z alignments are provided by the length of the wire(X), length of the magnet(Y), and the attraction of the magnet/deflection of the wire(Z).

40A. Fork Lift Reader/Writer

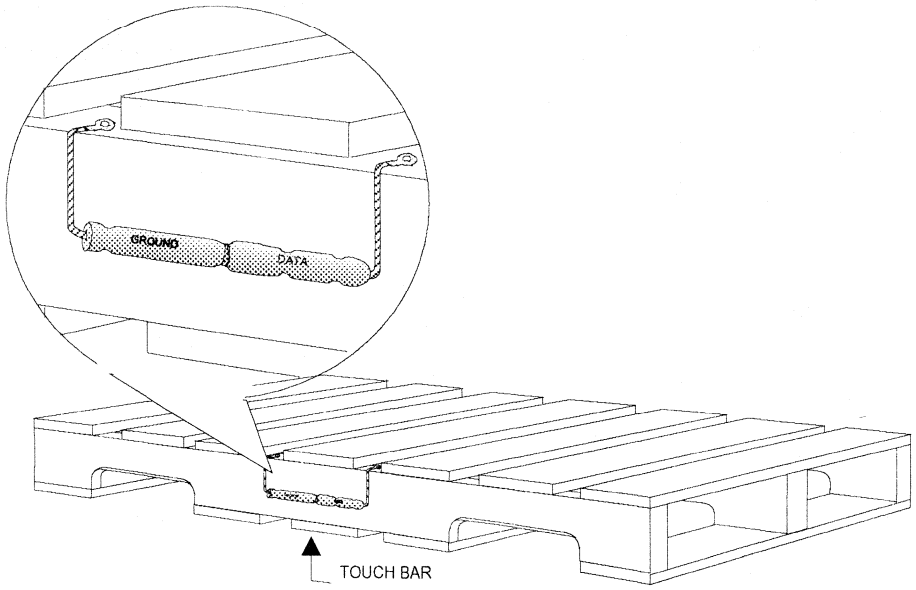


40A. Whenever the pallet is moved, its contents are identified. Further, a record of the activity can be stored in both the pallet and the fork lift truck with no worker involvement. The contents, date codes, date of last movement, and the location can be stored. Pallets can be located quickly and old stock can be avoided by using the data collected by the truck.

CONTAINER AND CONTAINER HANDLING EQUIPMENT

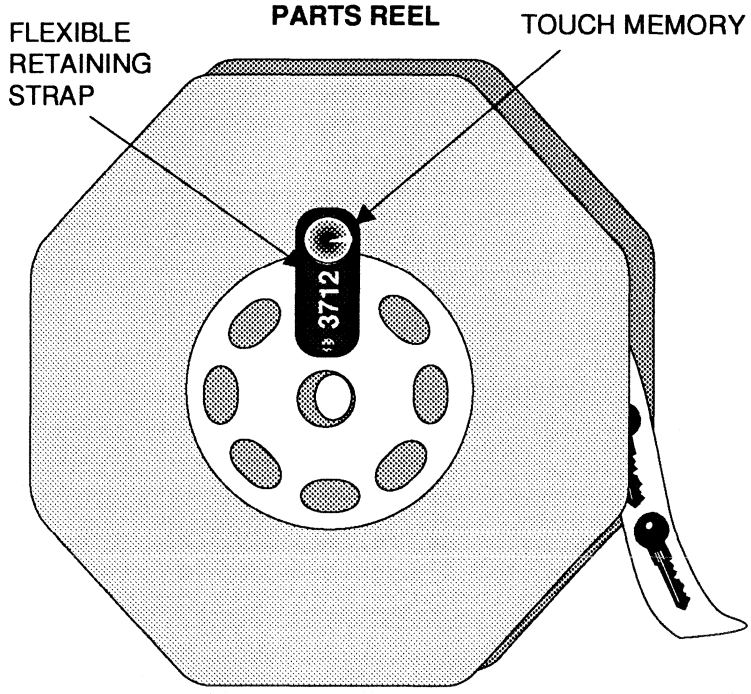
41. As an alternative to Touch Wire or Flap, the Touch Bar can be used if the mechanical tolerances are tighter.

41. Pallet with Touch Bar

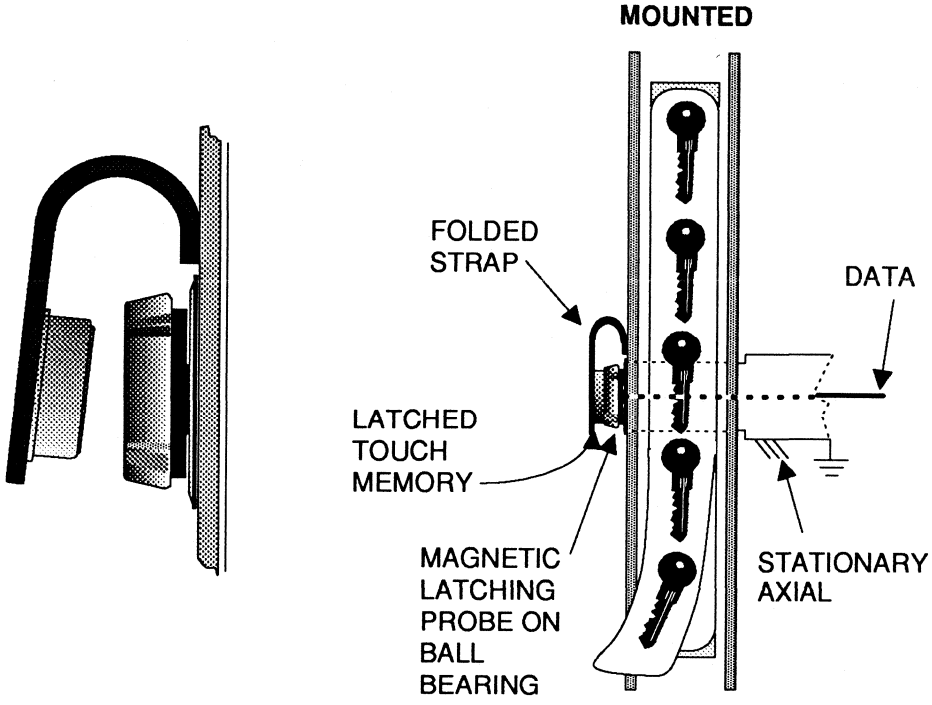


42. Information concerning the devices on this reel, such as part type and number of parts left, is stored in the Touch Memory. When free-standing, the reel can be probed with a hand-held computer. When mounted, the Touch Memory transfers information through the axial to the dispensing machine even while rotating. See #42B for a detail of the bearing.

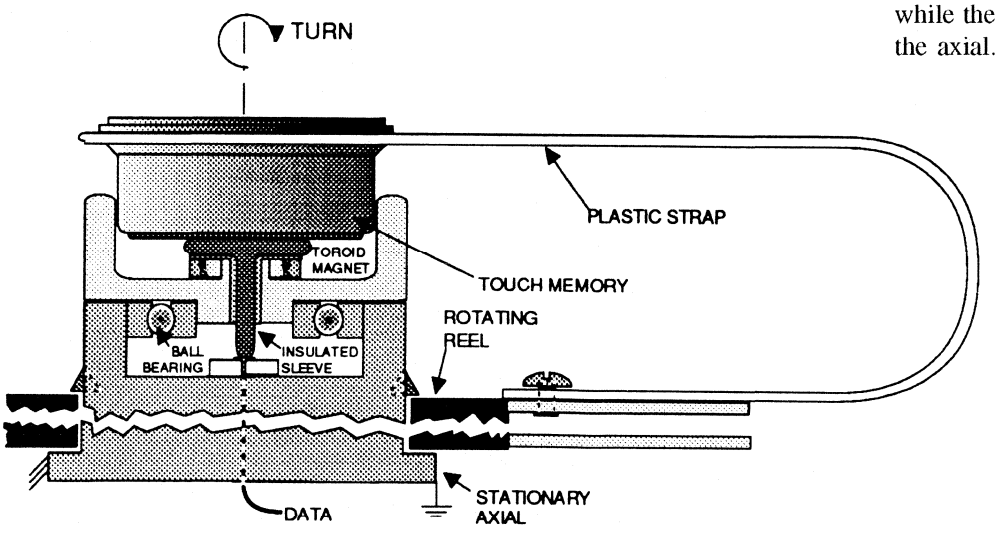
42. Reel



42A. Reel



42B. Detail of Bearing

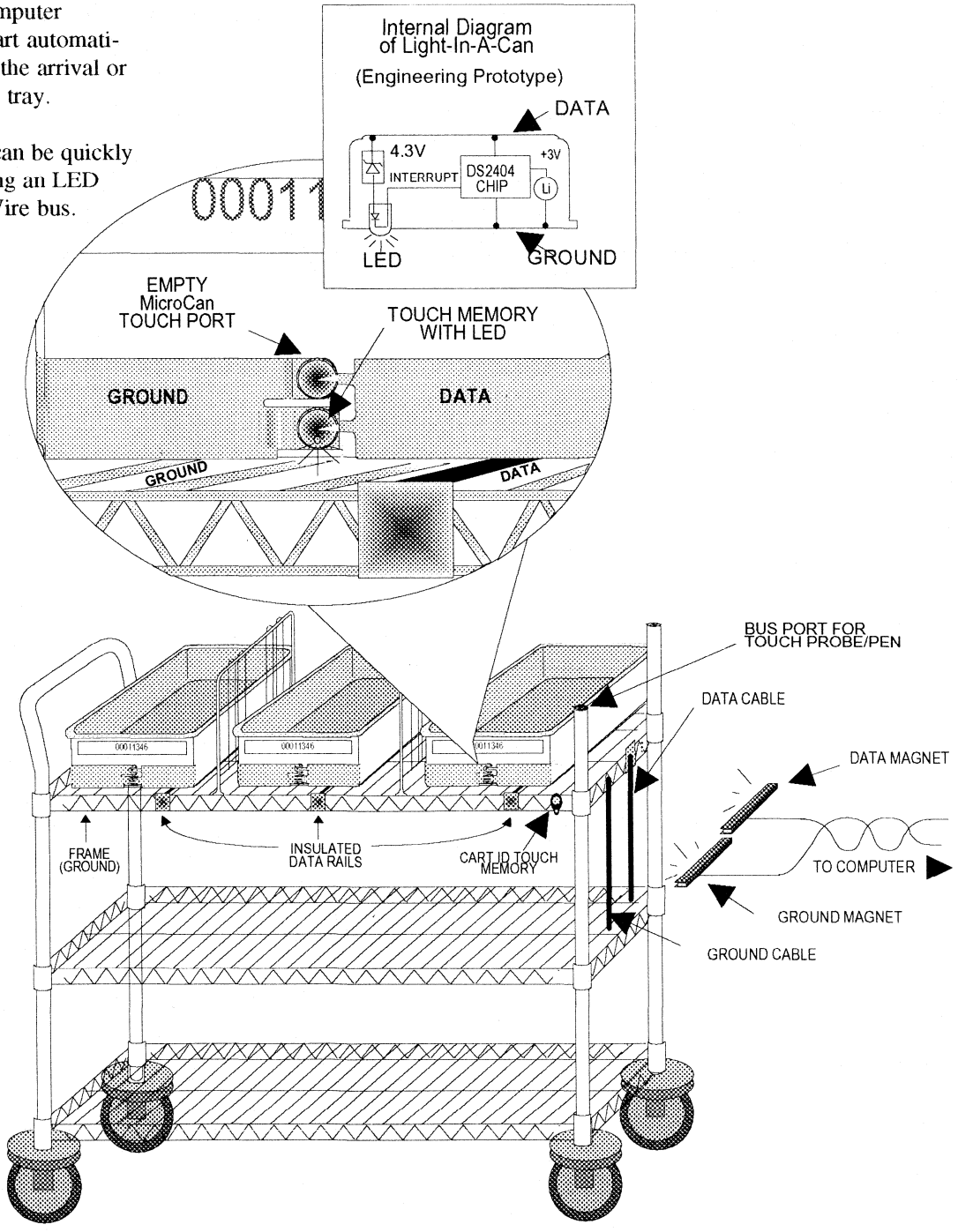


42B. The Touch Memory is latched into place like a hub cap. A magnet in the Touch Probe holds the connection while the reel turns relative to the axial.

43. The cart and its individual work trays are tagged with Touch Memories. The weight of a tray holds the connections to the data rail and grounded frame. As the cart docks at a workstation, magnets attract the flexible cables to form a conductive path to the Touch Memory. The computer inventories the cart automatically and detects the arrival or departure of each tray.

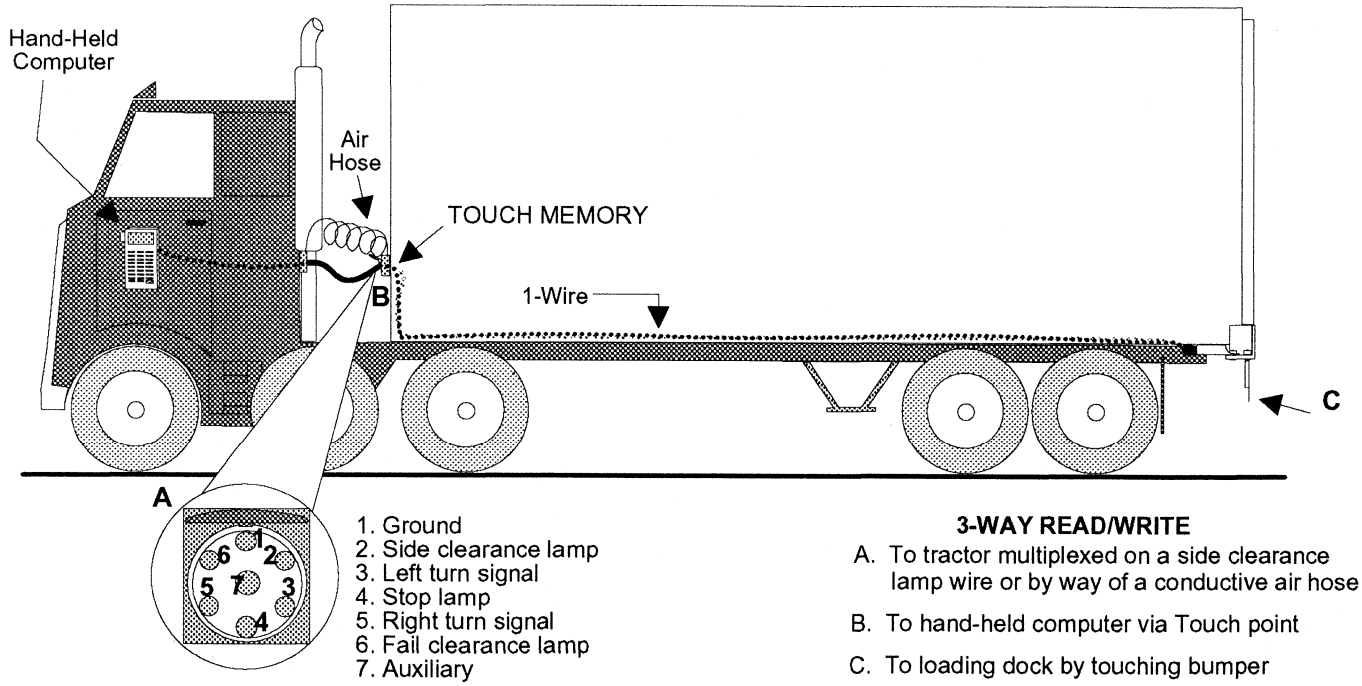
Individual trays can be quickly located by flashing an LED indicator via 1-Wire bus.

43. Cart with Automatic Check-In/Out



44. 1-Wire Trailer Identification

44. Identification and cargo information stored in the trailer's Touch Memory is brought forward to the tractor without driver involvement. Alternatively, if the trailer is standalone in a parking lot, a hand-held computer can probe a designated contact point.



1. Ground
2. Side clearance lamp
3. Left turn signal
4. Stop lamp
5. Right turn signal
6. Fail clearance lamp
7. Auxiliary

3-WAY READ/WRITE

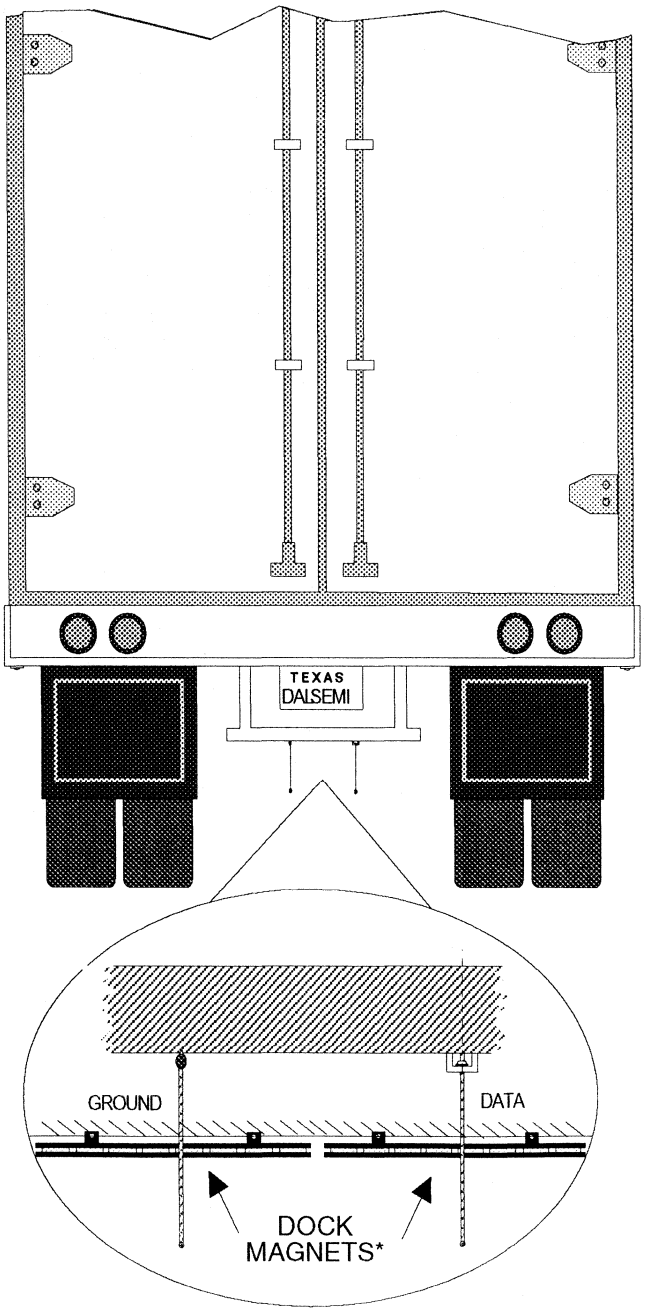
A. To tractor multiplexed on a side clearance lamp wire or by way of a conductive air hose

B. To hand-held computer via Touch point

C. To loading dock by touching bumper

45. In order to service rough use conditions, flexible cable readily yields if hit by an obstruction. The cable straddles the trailer center line and is kept straight by gravity. Each cable is drawn into its respective dock magnet as it becomes influenced by the magnetic field. Wide positioning tolerances in the X,Y, and Z axes can be achieved.

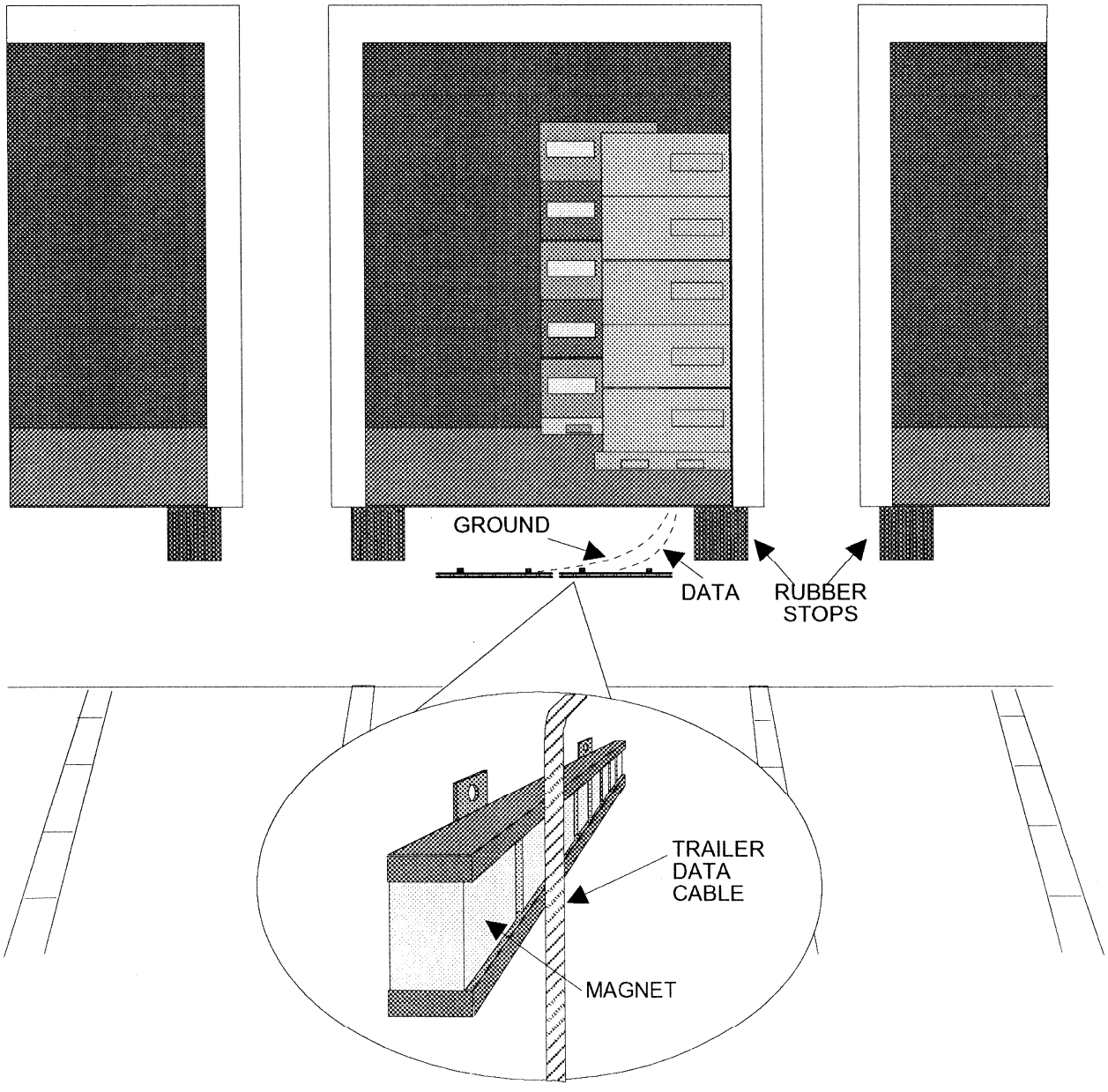
45. Trailer Bumper



*MANUFACTURED BY MASTER MAGNETICS CASTLE ROCK, CO USA

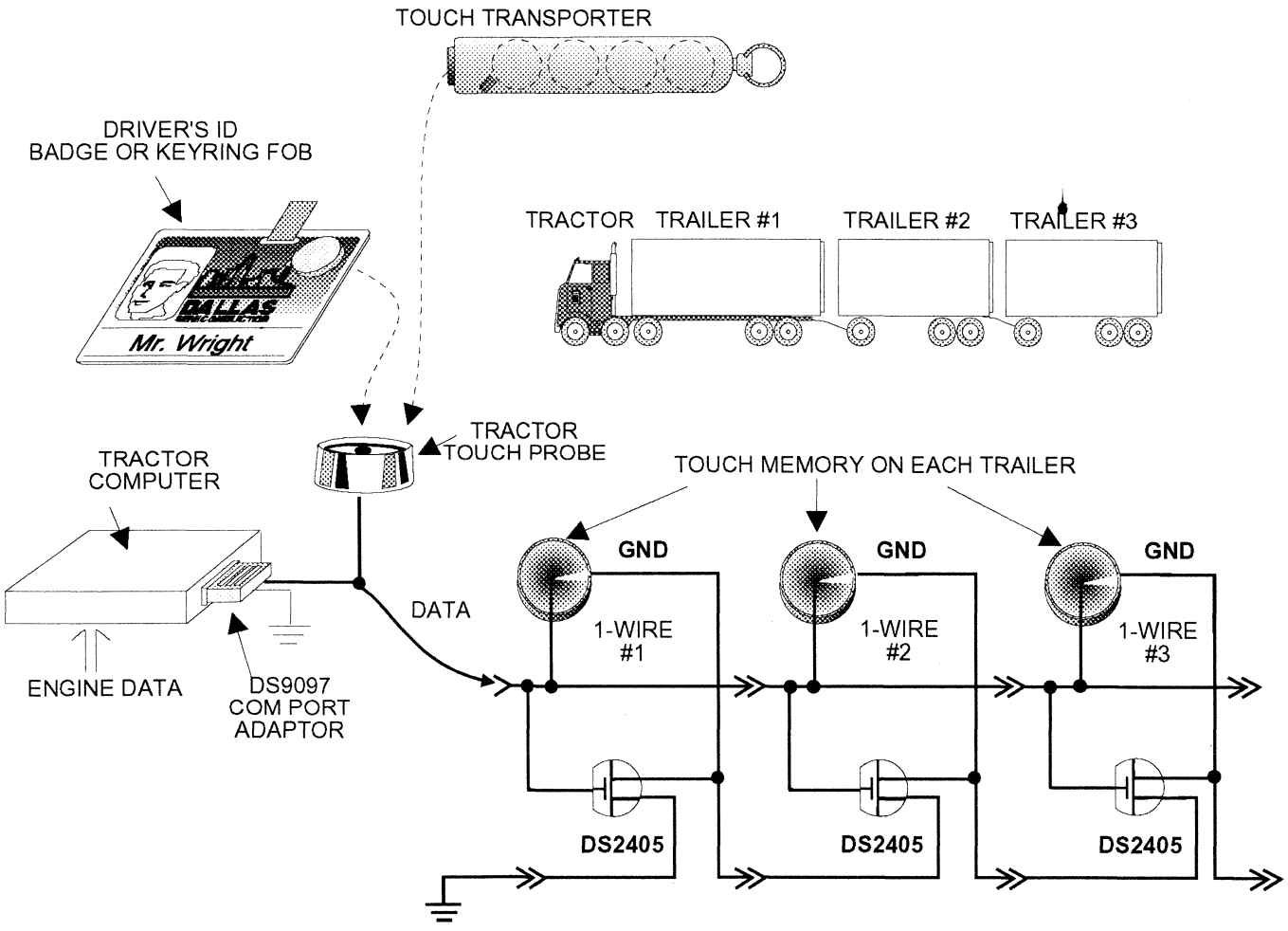
46. Loading Dock

46. The identification and location of each trailer is made automatically as its data and ground cables are captured by the magnets before the bumper hits the rubber stops.

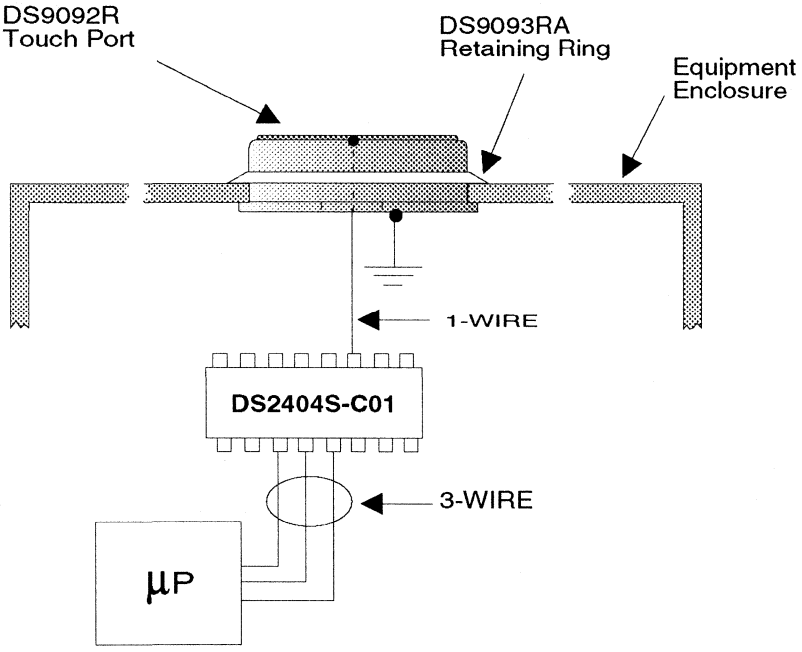


47. Multiple trailer IDs, along with cargo information, are forwarded to the tractor using the 1-Wire Touch protocol. Transportation records, including driver ID, download from the tractor to the base station by a Touch Transporter, which is basically a high capacity Touch Memory. Using the DS2405 Addressable Switch, even the sequence of trailers is identified automatically.

47. Multi-Trailer Truck

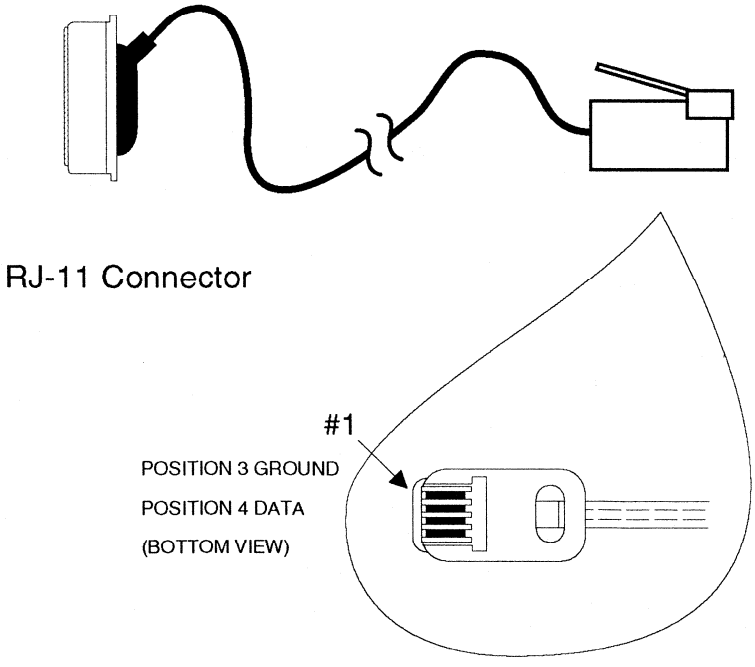


48. Dual Ported Touch Memory



48. The DS2404S-C01 chip has two serial ports: a 1-Wire that supports the Touch protocol and a 3-Wire for a higher speed microprocessor interface. Serial number, location of home base, calibration records, and percent of time during which equipment is utilized are available by touching the DS9092R Touch Port.

49A. Button to RJ-11 Cord
DS1402BR

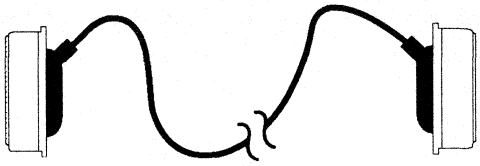


49. Button Cords
To conveniently build 1-Wire networks, one needs a well-defined assortment of cables with fitting connectors. For 1-Wire systems, these connectors are Button, Cup and RJ-11.

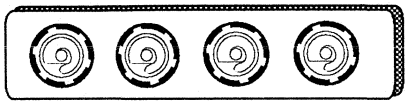
The Button-to- RJ-11 Cord has two applications: to make a dual-ported Touch Memory chip (DS2404S-C01) accessible as a MicroCan, or to connect a Button Holder to a computer using the DS9097(E) COM Port Adapter.

49B. The Button-to-Button Cord easily connects two Button Holders with each other or extends the capacity of a 1-Button Holder to many buttons.

49B. Button-to-Button Cord
DS1402BB

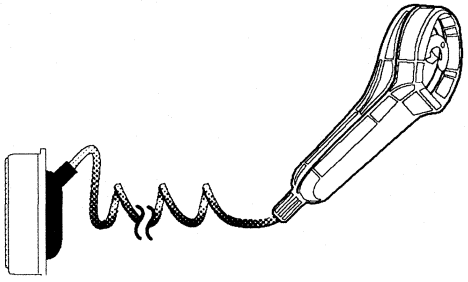


Button Holder
DS1401

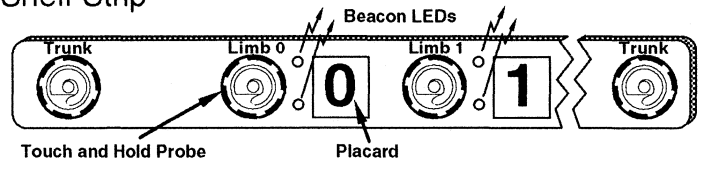


49C. The Button-to-Cup Coiled Cord provides a reliable surface extension of a Touch Memory mounted, for example, on a container to a Button Holder or a shelf strip.

49C. Button-to-Cup Coiled Cord
DS1402BP

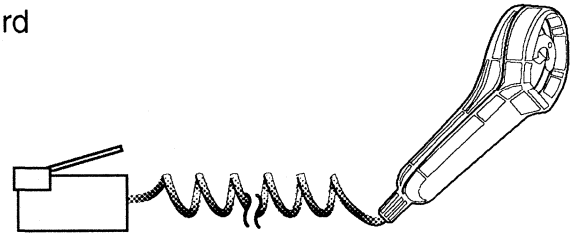


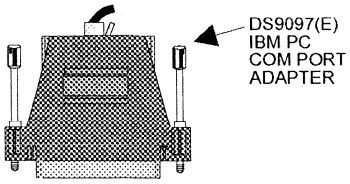
Shelf Strip



49D. The RJ-11-to-Cup Coiled Cord extends the surface of a remote Touch Memory and directly connects it to a DS9097(E) COM Port Adapter.

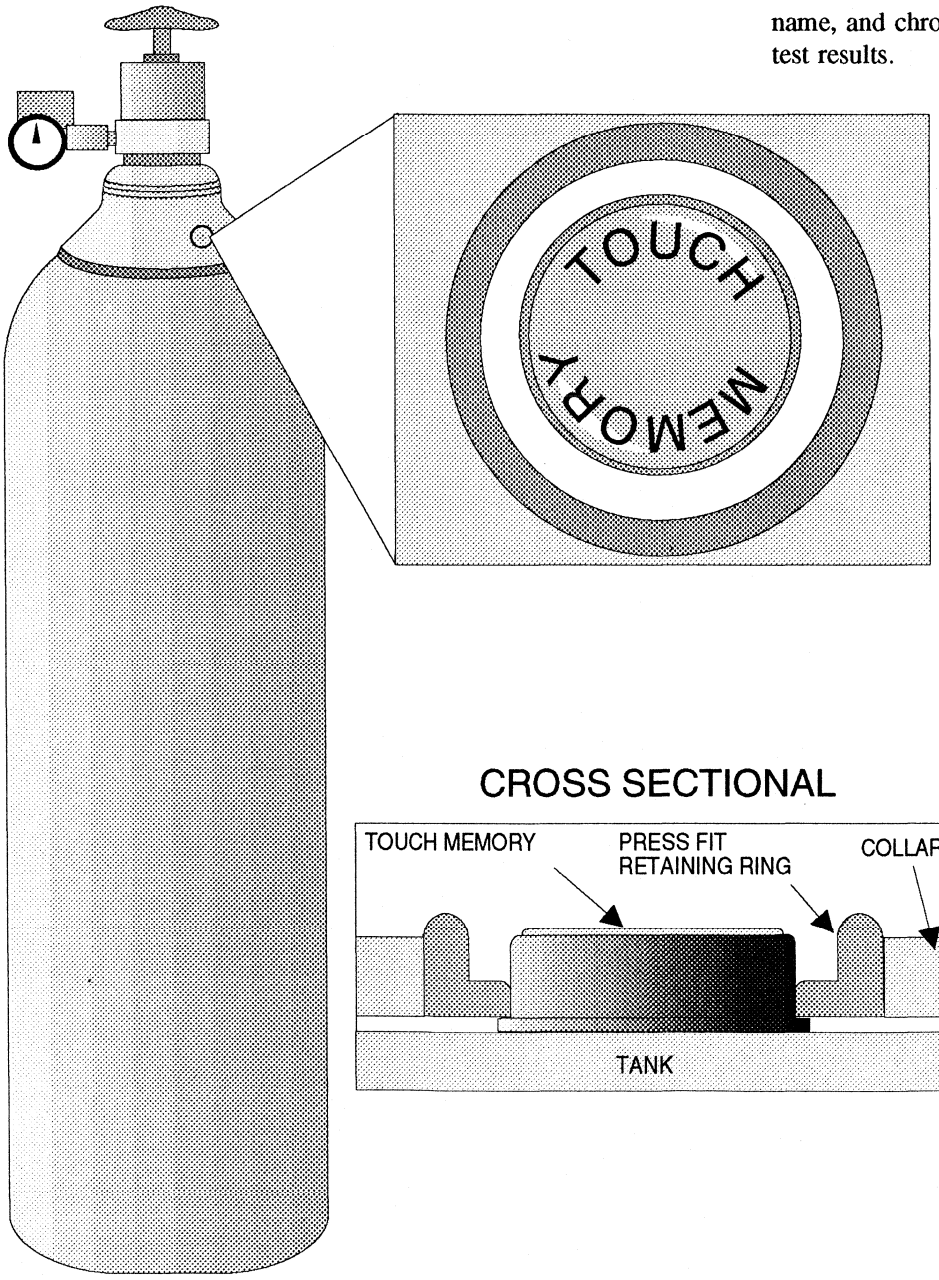
49D. RJ-11-to-Cup Coiled Cord
DS1402RP





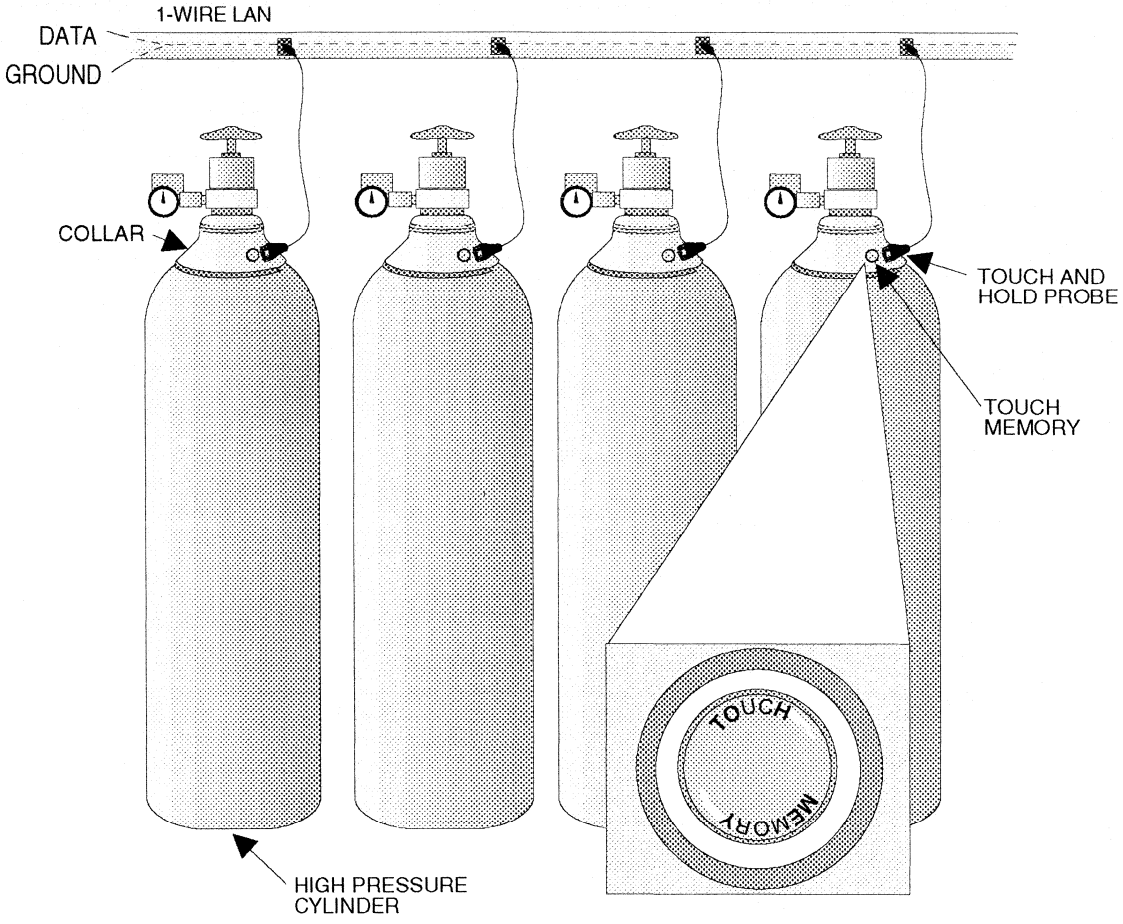
50. Compressed Cylinder

50. Touch Memory press-fits into the collar of a gas cylinder. The chip's registered serial number can be used to return lost or stolen cylinders to their rightful owner. Information stored in the Touch Memory can include date of manufacture, inspection dates, inspectors, type of gas, fill date, location of fill, gas weight, empty weight, destination address, customer name, and chromatography test results.

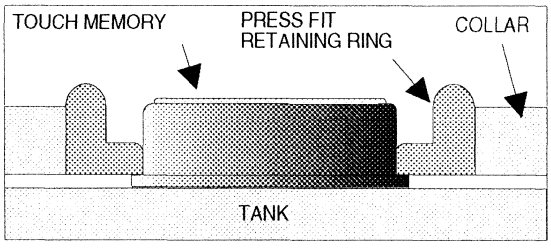


51. The Touch Memory is press-fit mounted into the collar of the high-pressure cylinder. Magnetic probes keep contact with the Touch Memories. All probes are connected to a common 1-Wire bus, forming a MicroLAN. Thus a constant inventory and location monitoring of all cylinders in the rack is achieved for asset management.

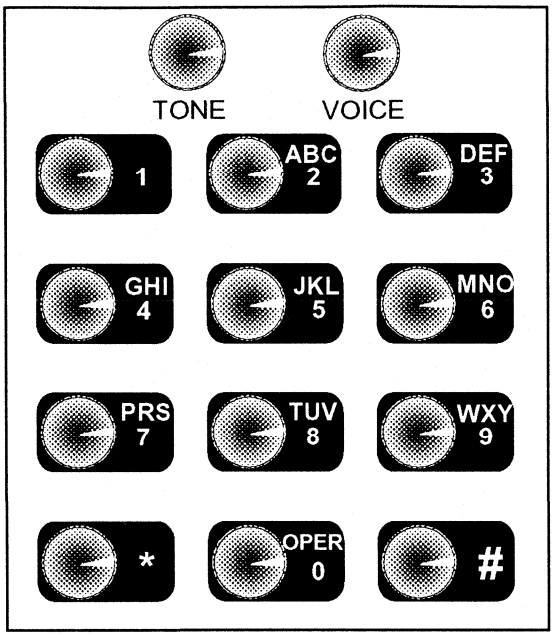
51. Monitoring of Cylinder Stock



CROSS SECTIONAL



52. Touch Command Pad



Touch Memories can store commands as well as data. Simple keyboards can be constructed by placing Touch Memories next to visuals. Unlike traditional keyboards, no wires interconnect the Buttons.

DESCRIPTION

Placing Touch Memory Buttons next to keywords or symbols and associating functions with them creates a Touch Command Pad. Instead of pressing a key or entering text/commands manually, just probe a Touch Memory. Storing notes rather than commands, the devices may function as Annotation Buttons, making entry of standard messages very efficient and free of typing errors.

OPERATION

A Touch Command Pad may be set up in different ways. Either the Buttons store the message or command as ASCII text in a standardized data structure or the computer reads the registration number of the device and gets the associated text from a lookup table. Mixed combinations are also possible, where some devices store application-specific texts and others are used to trigger functions. The Buttons can be programmed with text by an IBM-compatible PC or a Touch Editor.

The Touch Command Pad is ready to use with IBM-compatible PCs — no modification or installation of software is required. Simply exchange the standard keyboard with a Touch Keyboard (see page 64) and probe the Buttons with a passive wand. Firmware executed by the microcontroller inside the keyboard translates data from the Button to key strokes and transmits them to the computer as if keys had been pressed.

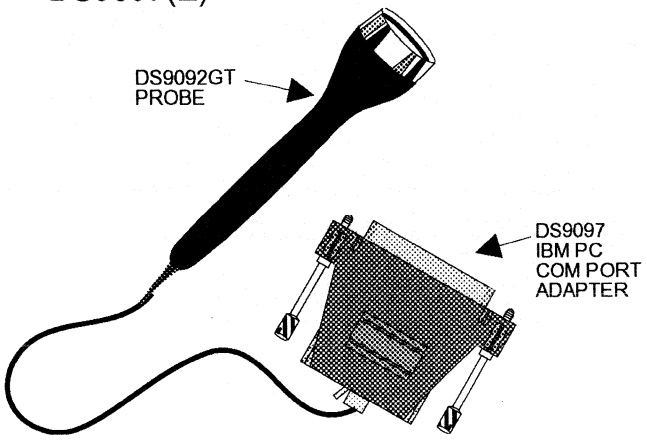
APPLICATION

Touch Command Pads can be used with IBM-compatible PCs, hand-held Touch Memory Readers/Writers such as Touch Pens or Touch Editors, or other microcontroller based systems. They simplify and speed up data intake at any place where texts or commands from a limited menu need to be entered frequently together with other machine-readable information or manually entered data. Examples include work-in-progress tracking, tracking at shipping/receiving docks, order registration, waiter accounting and billing at restaurants, lead registration, taking census, electronic ballot, machine operation by language- independent symbols, annotations on guard tours, keeping maintenance records, or missioning Touch Pens.

ADVANTAGES

Due to the Touch Memory's stainless steel casing, Touch Command Pads are well suited for harsh environments as well as for clean rooms, offices, restaurants or work places. They are easy to clean, easy to update and have no wear off. Customization is done by sticking the required quantity of Buttons on a base preprinted with keywords and symbols. Touch Command Pads can be extended for more commands by adding more Buttons — no wiring is necessary. They allow one-hand data entry without misspelling at a speed much greater than the fastest typist.

53. Touch COM Port Adapter DS9097(E)



Personal computers read and write Touch Memory with a probe connected directly to the COM Port.

DESCRIPTION

The DS9097 Touch COM Port Adapter is a simple, low-cost passive adapter circuit which performs RS232C level conversion, allowing a Touch Memory probe to be connected to a PC so that a Touch Memory can be read and written. The serial port must support a data transmission rate of 115,200 bits/second in order to form the 1-Wire time slots correctly. Nearly all PCs support the required bit rate and are fully compatible with the DS9097. For writing to the EPROM-based Add-Only Touch Memories as well as for communication with other Touch Memories there is the DS9097E, an enhanced version of the DS9097.

ELECTRICAL OPERATION

The DS9097 modifies the standard RS232C communication signals in three ways to enable communication with TM devices:

1. The separate RXD (receive) and TXD (transmit) signal lines are coupled together to produce a 1-Wire signal line.
2. Schottky and Zener diodes clamp the RS232C voltages to values between zero and six volts, making them compatible with Touch Memory.
3. A power supply for the 1-Wire bus is created with diodes and connected to Data; the 1-Wire ground is connected to RXD and modulated by TXD for communication.

TIMING

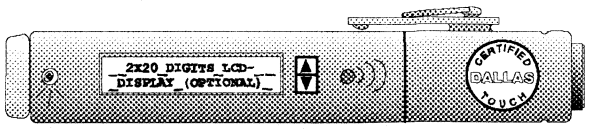
In order to generate the time slots required by the Touch Memory I/O protocol, the 8250 UART, which controls the serial port in a PC, is set for its maximum communication rate of 115,200 bits/second. At this rate, the period of a single bit is 8.68 microseconds. Seven RS232C bit periods produce an interval of 60.76 microseconds, which is very near the 60 microsecond minimum allowed time for transmitting or receiving a single bit on the 1-Wire bus. This interval can be achieved by setting the UART to transmit or receive six data bits, which together with the start bit produce the 60.76 microsecond time interval. Therefore, each character sent or received by the UART corresponds to a single bit of 1-Wire data. The PC serial port is thus capable of communicating 1-Wire data at 14,400 bits per second.

A **write-one** time slot is generated by transmitting a character consisting of all ones to the serial port. This causes an 8.68-microsecond start bit, followed by six 1 data bits lasting 52.08 microseconds. The **write-zero** time slot is generated by transmitting a null character to the serial port. This causes a start bit and six 0 data bits to be transmitted, producing a LOW pulse lasting 60.76 microseconds. The **read data** time slot is produced by transmitting a write-one time slot and then examining the least significant bit of the character that is received. The UART samples the least significant bit of the received character one and one-half bit periods after the falling edge of the start bit, or 13.02 microseconds. The 8.68 microsecond stop bit insures a minimum idle time between time slots. The 1-Wire **reset pulse** is produced by temporarily programming the UART for a bit rate of 10473 bits/second and transmitting four 0 data bits followed by four 1 data bits to generate the two 480-microsecond periods.

SOFTWARE

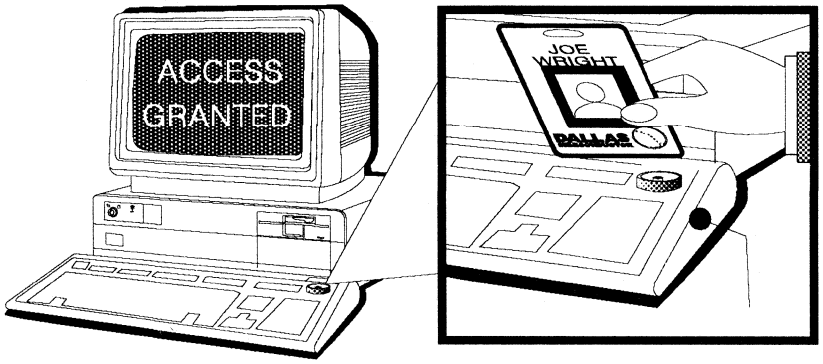
A selection of software examples illustrating how to communicate with Touch Memory using the DS9097(E) is provided in the DS9092K Touch Memory Starter Kit, available from Dallas Semiconductor. A very detailed description on how to communicate with Touch Memories via serial interfaces including the COM Port Adapter is available (see Application Note 74).

54. Touch Pen



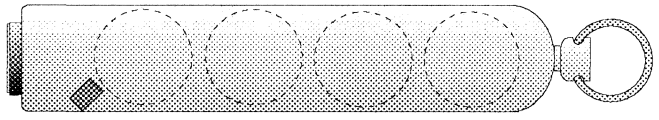
54. A cordless wand collects and distributes the data from Touch Memories. See page 48.

55. Touch Keyboard



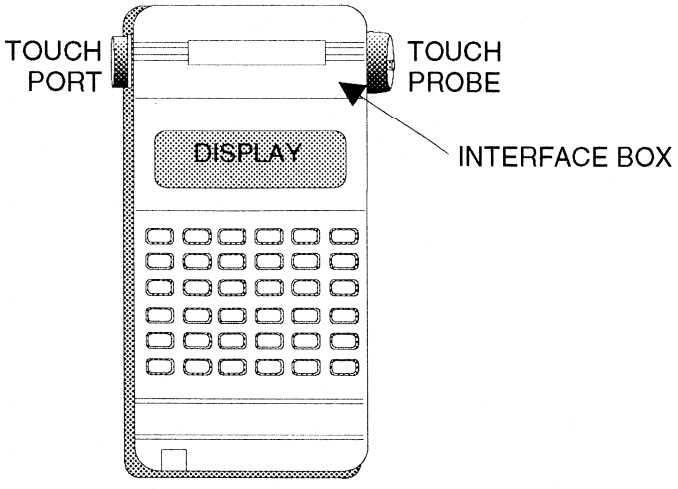
55. Touch Memory identifies a person to a computer and generates many keystrokes with a single touch. See page 64.

56. Touch Transporter



56. This is a high-capacity Touch Memory that can act as a data dump for Touch Pens and Touch Editors. It carries data back to a personal computer.

57. Touch Editor



57. An inexpenxive interface box added to a PSION hand-held displays and edits Touch Memories. See page 68.

A MOBILE ARCHITECTURE FOR MOVING DATA

Information When You Need It. And WHERE You Need It.

Touch Memories are chip -based data carriers that enhance the timely flow of information. Data notes stored in the Touch Memories move with the objects to which they are attached for instantaneous access to information and the opportunity to update at every point of activity. Touch Memories surpass the density, endurance and functionality of ink-on-paper technology.

At the bottom of the information food chain are the Touch Memory Buttons containing data files. In the highly mobile architecture of Touch componentry, the Button shape of the MicroCans™ implies that they accept orders and subordinate themselves to the Touch Probe shape. This master/slave relationship is not to be confused with the fact that the Buttons can be both read and written. A Touch Probe orders the transfer of data notes to any Button shape: a Touch Transporter, Touch Pen, or Touch Editor.

Probes do not talk to probes. There is not only a physical incompatibility, but also a problem of two equals (master) not knowing which one should subordinate to initiate the communication. Buttons do not talk directly to other Buttons since they both expect to receive orders from a master.

A particular application is best served by matching the component selection to needs. The cost/size/functionality of Touch componentry (Touch Memory, Touch Transporter, Touch Pen [display optional], Touch Editor, and Touch Probe interface to a PC) form a hierarchical continuum from the least cost, smallest size to the most capable.

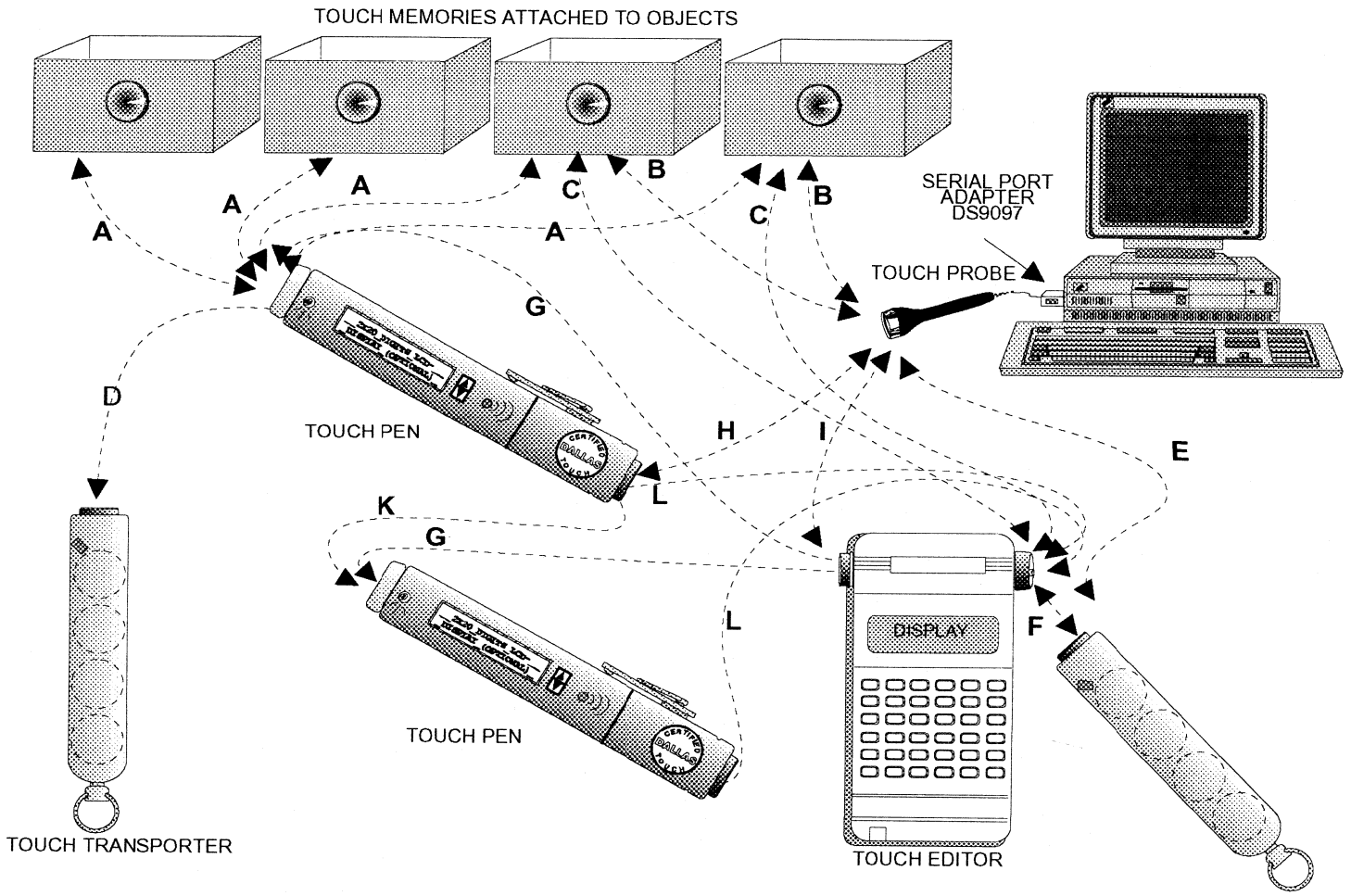
In general, the amount of brand new information is small compared to the information that is copied, filed, erased, filtered, merged, and edited. A significant benefit of Touch Memories is the ease with which information can be organized, communicated, and retrieved after it has been created.

It is often necessary to flow information between two or more computer islands. Touch Memories serve as a bridge between the gaps of computing while collecting and distributing data among their chip-based relatives. Individuals files within a particular Touch Memory can be randomly accessed by referencing an on-chip directory to get to the pertinent information quickly.

Up -to-date information travels *with the object* so that quality and efficiency imperatives can be met—

Doing Things Right at Lower Cost

TOUCH MEMORY DATA FLOW



Touch Memory System Example

A Touch Memory System can consist of the following components:

- Touch Memories mounted on many objects
- At least 1 Touch Pen as a mobile reader/rubber stamp
- At least 1 Touch Editor as a mobile writer and reader
- 1 Personal Computer (or a time-shared host computer)
- Several Touch Transporters (optional)

COMPONENT DESCRIPTION

Touch Memories

These are tiny stainless steel cans with registered ID numbers mounted on the objects to be tracked and/or identified. Touch Memories are the electronic equivalent of Post-It Notes. They outperform the identification function of bar codes. Data is transferred between a computer and the Touch Memory with a quick electrical contact.

Touch Transporter

This is a high-capacity Touch Memory that can act as data dump for Touch Pens (d) and Touch Editors (f). The dumped data can then be read by the System PC (e) or by a Touch Editor (f). The System PC can also write data to a Transporter (e) to be dumped later to a Touch Editor (f).

Touch Pen

This is a pen-shaped mobile reader for Touch Memories. It can display (optional), rubber stamp, prompt the operator, read (a,g), store and time-stamp data from readings and dump them either to a Touch Transporter (d), another Touch Pen (k), a Touch Editor (l) or to the System PC (h). The Touch Pen loads its own application software via the serial port adapter from the PC (h).

Touch Editor

This is a hand-held computer that can accept data and commands via its keyboard. It can read and write data from/to Touch Memories (c) and Touch Transporters (f), exchange data with the System PC (i), read Touch Pens (l), and supply data to be read by Touch Pens (g).

System PC

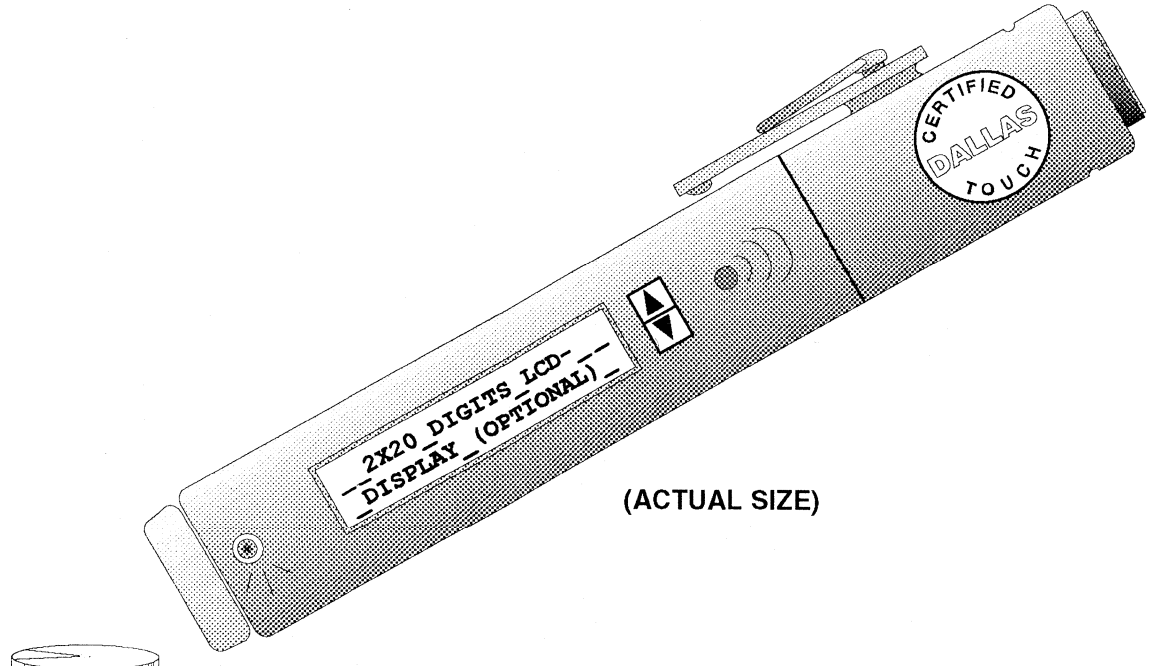
This is the central computer in laptop or desktop form that holds an inventory of all objects carrying Touch Memories. It gets new data about the objects, their contents and location via Touch Pens (h), Touch Transporters (e), Touch Editors (i) or directly (b). It can write to Touch Memories either via the Touch Pen (a), Touch Editor (i,c) or directly (b). It also can load new application software to Touch Pens (h).

Summary

The flexibility and the excellent price/performance ratio of this concept is based on standard mass-produced Touch Memories and customer-specific software. To realize a specific application, first a data flow chart including type and quantity of data must be detailed.

DALLAS SEMICONDUCTOR

Touch Pen Design Guide



(ACTUAL SIZE)

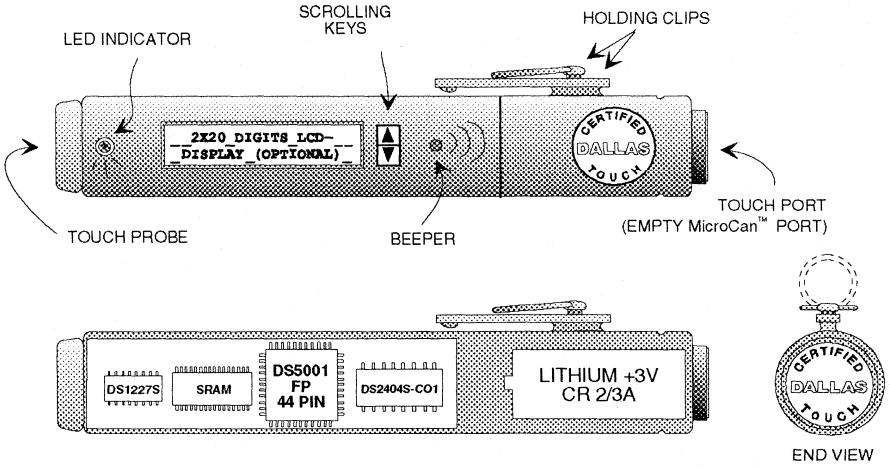
TOUCH PEN CONCEPT OVERVIEW

This design guide shows how to build a low-cost device to collect data from multiple, dispersed Touch Memories. Called the Touch Pen, this device is a battery-operated, hand-held reader/writer. One end of the Pen contains the Touch Probe, which collects data from multiple Touch Memories and stores it in up to 128K bytes of nonvolatile memory. The other end of the Pen contains the Touch Port, which uploads the data to a PC (see Figure 1). The Touch Pen accommodates 32K and 128K bytes of memory.

The user can write application specific firmware that will allow the Pen to deposit information in each Touch Memory that it contacts, thus leaving an audit trail in the Touch Memory as well as the Pen.

Operation of the Touch Pen is intuitive. The instruction manual reads: "Please Touch." The Touch Probe's cup shape mates with a Touch Memory. When the data is logged, an LED blinks and a beeper sounds to signal the user that the transaction is complete. The Touch Port looks like a Touch Memory but is actually a connector to the Pen's internal electronics. To upload data from the Pen, the Touch Port mates with a probe on the PC keyboard or a serial port adapter. Either the PC or the Touch Pen can signal the user that the transfer is complete.

Dallas Semiconductor supplies all the special parts necessary to build the Touch Pen in the DS9099 chip set. Not included is the commodity SRAM. Also available is the DS9099K Touch Pen Development Kit that includes a ready-made printed circuit board with all hardware components installed and firmware pre-loaded. The circuit board is laid-out for 32K as well as for 128K byte SRAM chips. Factory-installed is a 11.0592 clock crystal for the microcontroller. In addition to this, the DS9099K contains assembly language source code of the firmware to demonstrate the basic functionality of the Touch Pen with the most common types of Touch Memories.



DALLAS SEMICONDUCTOR MANUFACTURES ONLY THE TOUCH PEN CHIP SET, NOT THE COMPLETED PEN.

DS9099 TOUCH PEN CHIP SET:

DS5001FP-12-44N	Microcontroller Chip
DS1227S	Kickstarter Chip
DS2404S-C01	Dual-Port Memory Plus Time Chip
DS9092T	Touch Probe With Tactile Feedback
DS9092R	Touch Port
DS9093RA	Lock Ring
CR1632	Lithium Cell (3V)
DS9032	Crystal, 32KHz

As the Touch Pen is designed around the DS5001FP Soft Microcontroller, the user also needs the DS5000TK, which includes the DS5000 Soft Microcontroller User's Guide and RS232 interface for downloading firmware from an IBM-compatible PC. The DS5001FP supplement for the DS5000TK and the DS5001FP downloading firmware for the PC are included in the DS9099K. These books provide instructions for operating the DS5001FP to load the Pen with operating firmware. The user should obtain a version of an Intel 8051 compiler for developing custom firmware based on the communication routines shipped with the kit.

TOUCH PEN DESIGN

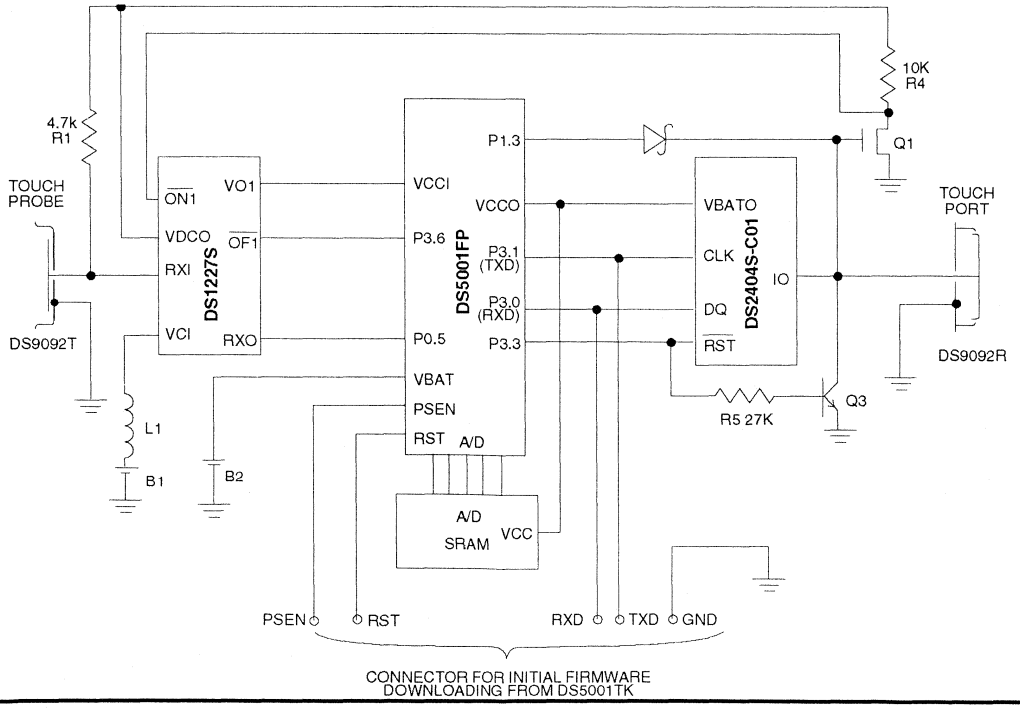
The Touch Pen consists of a microcontroller, nonvolatile SRAM, a Kickstarter that allows for a low-power standby mode, a Dual-Port Memory Plus Time Chip, a lithium energy source, and a few discrete components (see Figure 2). A Touch Probe (cup- shaped master) and Touch Port (button-shaped slave) on opposite ends of the Touch Pen provide the proper mating surfaces for data transfer to and from the Pen. The Touch Pen is serialized with the DS2404S-C01 Chip having the special family code 84H for identification. When no data transfer is taking place, the Pen is in a low-power resting state. In this state, only the DS1227 Kickstarter and the Dual-Port Memory Plus Time Chip are powered up. The Kickstarter will supply power to the rest of the Touch Pen circuitry when a falling edge is detected on either RXI or ON1\.

Both the Touch Probe and Port are pulled high via resistors. When contact is made between the Touch Pen and a Touch Memory, the Touch Memory sees the high voltage level on the data line of the Touch Probe (RXI pin of DS1227) for a period not longer than 60 µs before driving the RXI input low by exerting its presence detect signal. (See time t1 in Figure 3.) A falling edge on ON1\ is accomplished by driving the Touch Port data line (I/O pin of DS2404S-C01) high. This occurs when the host attempts to upload data from the Touch Pen when contact is made with the Touch Port. This high voltage level turns transistor Q1 on, pulling ON1\ to ground. The DS2404S-C01 also responds to the high level on the Touch Port by asserting a presence detect signal. (See time t1 in Figure 4.)

READING TOUCH MEMORY DATA

Once contact has been made with a Touch Memory and the Kickstarter has powered up the microcontroller, the Touch Pen firmware issues a reset pulse to the Touch Probe data line. If the Touch Memory is still in contact with the Touch Probe, it will respond by issuing its presence detect signal (time = t2, Figure 3). Once this is complete, the Touch Memory is ready to receive a command. In the next step the Touch Pen sends a ROM Search command to get the

TOUCH PEN FUNCTIONAL DIAGRAM Figure 2



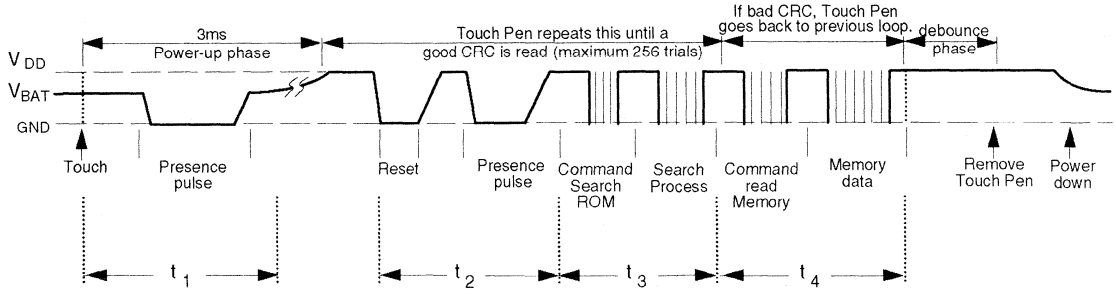
Touch Memory's registration number (time = t3, Figure 3). Using the Search ROM rather than the Read ROM enables the Touch Pen to distinguish if one or more devices are connected. If several devices are found, each of them will be identified and read one after another. After one device is addressed at the end of a search process, the Touch Pen issues the Read Memory command (DS1992/3/4) or the Read Scratchpad command (DS1991) and reads the Touch Memory data (time = t4, Figure 3). If a DS1990A is found, the registration number of the device is treated as if it were memory data and a Read Memory command will not be issued.

The firmware in the Touch Pen requires the Touch Memory data to be formatted either according to the Default Data Structure or the Extended File Structure. The outline of the Default Data Structure is shown in Figure 5. Fundamentals of the Extended File Structure are found in the Book of DS19xx Touch Memory Standards. PC-Software to format Touch Memories and to store files using the Extended File Structure are part of the Touch Memory Executive TMEX, available as DS0620. If the Touch Pen encounters Extended File Structure, then it looks by default for a file DEMO.0. If this file is not found, the Touch Memory is ignored. After data is read and checked for integrity via the CRC, it is stored in the nonvolatile memory of the Touch Pen. Data read in the Extended File Structure is converted to Default Data Structure before storing it in the Touch Pen's memory. The firmware in the Touch Pen next reads the time and date information from the real-time clock in the DS2404S-C01 Dual-Port Memory Plus Time Chip and stores it together with the Registration Number of the Touch Memory immediately after the data record. The format is also shown in Figure 5. It reflects a simple way of protecting data transfer in a 1-Wire environment.

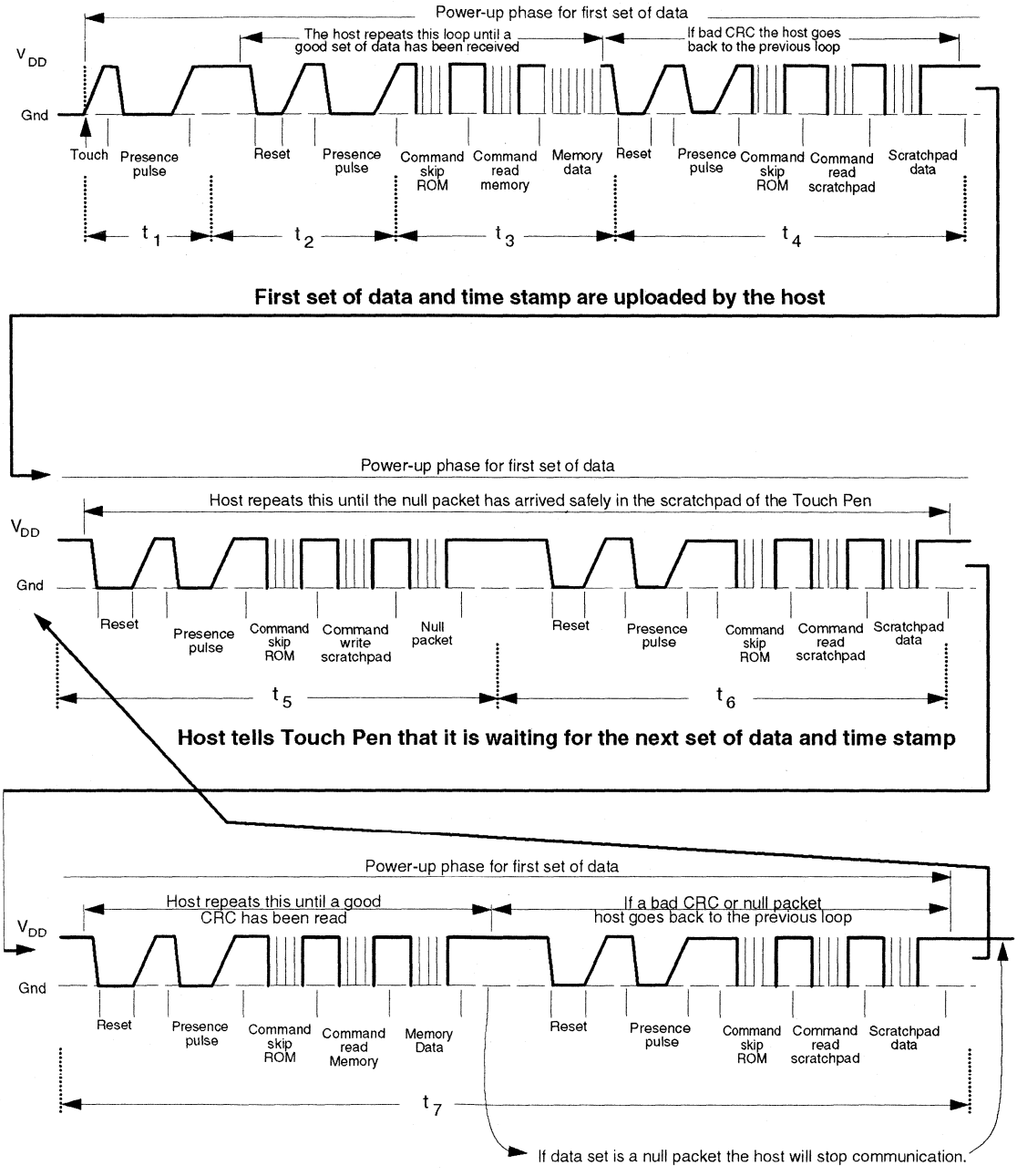
If Touch Memories are formatted according to the Extended File Structure, it is possible to teach the Touch Pen to look only for a certain file. This is called "missioning". To mission the Touch Pen, the Pen must touch a Touch Memory containing the following text formatted as Default Data Structure: PASSWORDfile<nn>

"PASSWORD" is an ASCII string that must be matched exactly to do the missioning. "file" is the new ASCII file name the Touch Pen shall look for. "<nn>" is the hexadecimal value of the new file's extension. There are no delimiters between PASSWORD and the new file name as well as between the file name and its binary extension. A short utility (MAKED) to do the required formatting is available on request.

TIMING SCHEDULE FOR TOUCH PROBE Figure 3



TIMING SCHEDULE FOR TOUCH PORT Figure 4



An attempted read may abort for one of the following reasons:

1. No presence pulse was issued by the Touch Memory.
2. The data format was not recognized
3. The CRC failed.

DATA STRUCTURE Figure 5

(O<N<PAGE SIZE -3)

N	NBYTES OF DATA	$\overline{\text{CRC 16}}$ (low byte)	$\overline{\text{CRC 16}}$ (highbyte)

13	DATE/TIME STAMP	8 BYTES REG.NR.	$\overline{\text{CRC 16}}$ (low byte)	$\overline{\text{CRC 16}}$ (highbyte)

These aborts are the result of either a momentary loss of contact with the reader or the use of an invalid data format when writing data into the Touch Memory. If a read attempt is not successful, the above process is repeated until the data is read successfully, or 256 failures occur. This allows the user sufficient time to make good contact with the device. If the data is not read successfully within 256 attempts, it is most likely due to invalid data written in the Touch Memory. After completion of the data read procedure, the first Touch Memory data record will be copied into the memory of the DS2404S-C01 and its corresponding date and time stamp will be copied into the DS2404S-C01 scratchpad. This initializes the DS2404S-C01 for the uploading protocol described later. The microcontroller then looks at the Touch Port data line to see if an upload operation is being attempted.

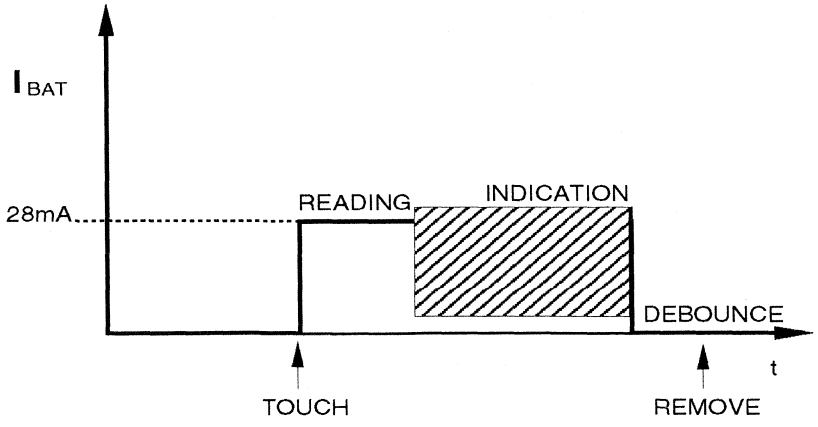
ENERGY CONSIDERATIONS

The Touch Pen uses lithium energy very economically (Figure 6). The Kickstarter powers the Pen up just as it touches the Touch Memory. While reading, the Pen requires about 28 mA at 1.8432 MHz clock frequency (58 mA at 11.059 MHz). In addition to the energy required for reading or writing, energy is consumed for indication; the amount consumed for indication depends on the duration, loudness and brightness of the indicator. If the microprocessor generates the beep, current during the indication period is higher because the microprocessor is left running.

At 1.8432 MHz a typical cycle reading all data, including the ROM of a DS1992 (1K bit RAM + 64 bit ROM), along with activating the LED and the beeper, takes approximately 0.25 seconds (150 ms reading, 100 ms beep). This is equivalent to an energy consumption of about 2 µAh. With the recommended lithium battery (CR2/3A, 1.3 Ah) this is equivalent to more than 600,000 readings. At 11.06 MHz reading will take only 75 ms, the beep will intentionally stay for 100 ms.

Further energy reduction is possible using a self-timed turn-off circuit for switching the LED and beeper. Thus, one battery can last for more than one million readings. The interval timer of the DS2404S-C01 can be used under software control to count the total operating time to indicate the battery status. An additional flip-flop controlled by a battery change detector (see Figure 7) can record a battery change; the microprocessor reading this flip-flop subsequently will reset the interval timer when a fresh battery is installed.

Current consumption at 1.8432MHz Figure 6



UPLOADING DATA FROM THE TOUCH PEN

When contact is made between the Touch Port and the host system, the data line of the Touch Port (I/O pin of DS2404S-C01) is driven high, which causes the DS2404S-C01 to issue a presence detect onto the data line. This same rising edge on the data line also drives ON1\ low through Q1, which begins a wake-up sequence for the microcontroller via the DS1227 Kickstarter. While the wake-up is occurring (approx. 3 ms to wake up), the host confirms that the Touch Pen is still present by asserting a Reset Pulse and observing a Presence Pulse response from the Touch Pen (see time = t2, Figure 4). The host then reads the current record stored in the DS2404S-C01. That record consists of the Touch Memory data record stored in the memory section of the DS2404S-C01 (time = t3, Figure 4), and its corresponding date and time stamp with Registration Number stored in the scratchpad (time = t4, Figure 4).

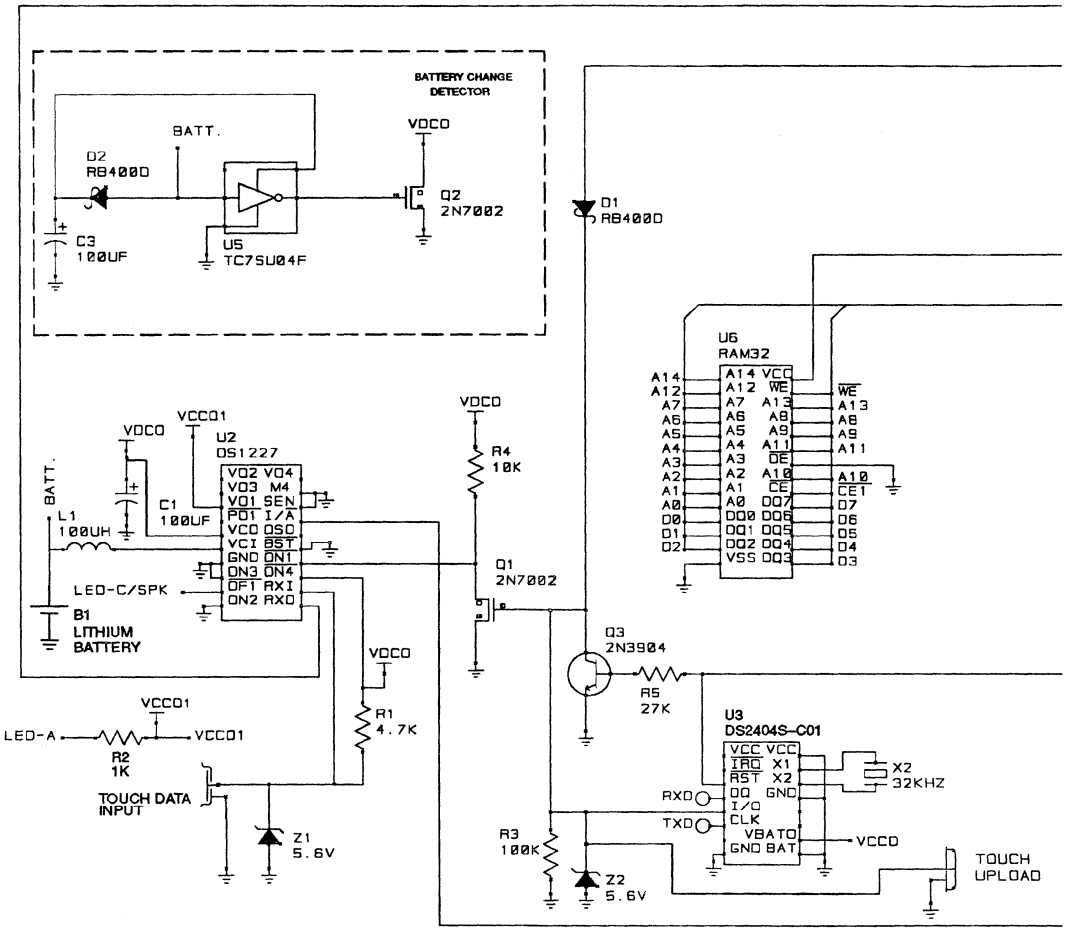
The host then writes a null packet (00h FFh FFh) into the scratchpad of the DS2404S-C01 to acknowledge receipt of a good record (time = t5, Figure 4) and then reads the scratchpad to confirm receipt of the null packet by the DS2404S-C01 (time = t6, Figure 4). The host continues to read the null packet in the scratchpad and the original data record in the memory as the microcontroller powers up (time = t7, Figure 4). When the microcontroller goes active, RST\ of the DS2404S-C01 is driven high and I/O is driven low. This will abort any current communication between the host and the DS2404S-C01. Since the source of the wake-up signal is unknown, the microcontroller first attempts to read a Touch Memory from the Touch Probe. Since none is found, the Touch Port is examined. The microcontroller drives the RST\ of the DS2404S-C01 low and monitors the data line of the Touch Port for activity from the host. The communication from the host will consist of periodic attempts to read the scratchpad of the DS2404S-C01 followed by several milliseconds of inactivity during which the data line of the Touch Port will be left high. When the microcontroller has observed the Touch Port data line in a high state for at least 1 millisecond, the RST\ of the DS2404S-C01 is again driven high, which causes I/O of the DS2404S-C01 to go low. This will allow the microcontroller to examine the contents of the DS2404S-C01 scratchpad using the 3-wire port (RST\, DQ and CLK) of the DS2404S-C01 without contention from the host through the Touch Port via the I/O line. If the scratchpad does not contain a null packet, the RST\ line is driven low and the microcontroller returns to monitoring the data line of the Touch Port as before. If the scratchpad does contain a null packet, the next Touch Memory record in the Touch Pen's nonvolatile memory is written to the memory of the DS2404S-C01; the date and time stamp corresponding to this record is written into the scratchpad. Upon completion, the RST\ line is driven low to allow the host to access the DS2404S-C01 through the Touch Port and receive the next record (time = t7, figure 4). This process is repeated until either the Touch Port data line remains high for more than 40 milliseconds or the host has successfully read all of the Touch Memory records and corresponding date and time stamps from the Touch Pen nonvolatile memory. If the data line remains high for more than 40 milliseconds, the Touch Pen assumes that the upload attempt has been aborted and instructs the Kickstarter to remove power. If all data records were successfully uploaded, the microcontroller copies the null packet that resides in the scratchpad of the DS2404S-C01 to page 0 of the memory area in the DS2404S-C01. This condition indicates to the host that it has received all of the data records that had been stored in the Touch Pen. The data line is then monitored until activity ceases and the Kickstarter is instructed to remove power. Note that if the upload attempt is aborted for any reason or contact is lost for a long period of time, no records will be lost or corrupted. Once the host resumes an interrupted upload attempt, the microcontroller will wake up again and the remaining data can be read from the Touch Pen. Successful uploading frees memory space for the collection of more Touch Memory data.

TOUCH PEN PART LIST Table 1

Qty.	Reference	Description	Value	Manufacturer	Part #	Package	Note
1	U1	IC		Dallas Semi	DS5001FP-12-44N	44-PIN QFP	1, 5
1	U2	IC		Dallas Semi	DS1227S	20-PIN SOIC	1, 5
1	U3	IC		Dallas Semi	DS2404S-C01	16-PIN SOIC	1, 5
1	P1	Touch Probe		Dallas Semi	DS9092T		1, 5
1	P2	Touch Port		Dallas Semi	DS9092R		1, 5
1		Retaining Ring		Dallas Semi	DS9093RA		1, 5
1	B2	Battery	3.0 Volt	Panasonic	Tabbed CR1632		1, 5
1	X2	Crystal	32 KHz	Dallas Semi	DS9032		1, 5
1	X1	Crystal	11.059 MHz		HC49/S-11.0592		5
1	X1	Crystal	1.8432 MHz		HC49/S-1.8432		2
1	U4	IC		Hitachi	HM62256LFP-12	28-PIN SOIC	3, 5
1	U5	IC		Toshiba	TC7SU04F	SOT225	5
1	U6	IC		Hitachi	HM628128LFP-10	32-PIN SOIC	3
2	C1,C3	Capacitor	100 µF Tant.	AVX	TAJD107K006R	7343	5
1	C2	Capacitor	1 µF Tant.	KEMET	C3216C104K5RAC	3216	5
2	C4,C5	Capacitor	33 pF	KEMET	C1206C330J5RAC	1206	5
1	R1	Resistor	4.7 k	KOA	RM73B2BTE372J	1206	5
1	R2	Resistor	1 k	KOA	RM73B2BTE102J	1206	5
1	R3	Resistor	100 k	KOA	RM73B2BTE104J	1206	5
1	R4	Resistor	10 k	KOA	RM73B2BTE103J	1206	5
1	R5	Resistor	27 k	KOA	RM73B2BTE273J	1206	5
1	R6 or R7	Resistor	0 Ohms	KOA	RM73B2BTE10J	1206	4, 5
1	LD1	Red LED	2 mA	LIT-ON	LTL-422INLC	Radial	
2	Q1,Q2	TMOS FET		Motorola	2N7002LT1	SMD	5
1	Q3	Transistor		Motorola	MMBT3904	SOT23	5
2	Z1,Z2	Zener Diode	5.6 Volt	Motorola	MMBZ5232B	SOT23	5
1	B1	Battery	3.0 Volt	Panasonic	CR2/3A		
1	SK1	Beeper	3-16 VDC	Project Unltd.	Al-175		
2	D1,D2	Schottky Diode		Philips	BAT54	SOT23	5
1	L1	Inductor	100 µH	TOKO	D73C636CY101M	1812	5
1	PCB	Circuit Board					5

NOTE:
1. These components are provided in the Touch Pen Chip Set DS9099.
2. Optional slower clock speed for lower power consumption and longer battery life.
3. Select the size of memory desired.
4. R6 only for 128K memory. R7 only for 32K memory.
5. These components are provided with the Touch Pen Prototype Development Kit DS9099K.

TOUCH PEN SCHEMATIC Figure 7



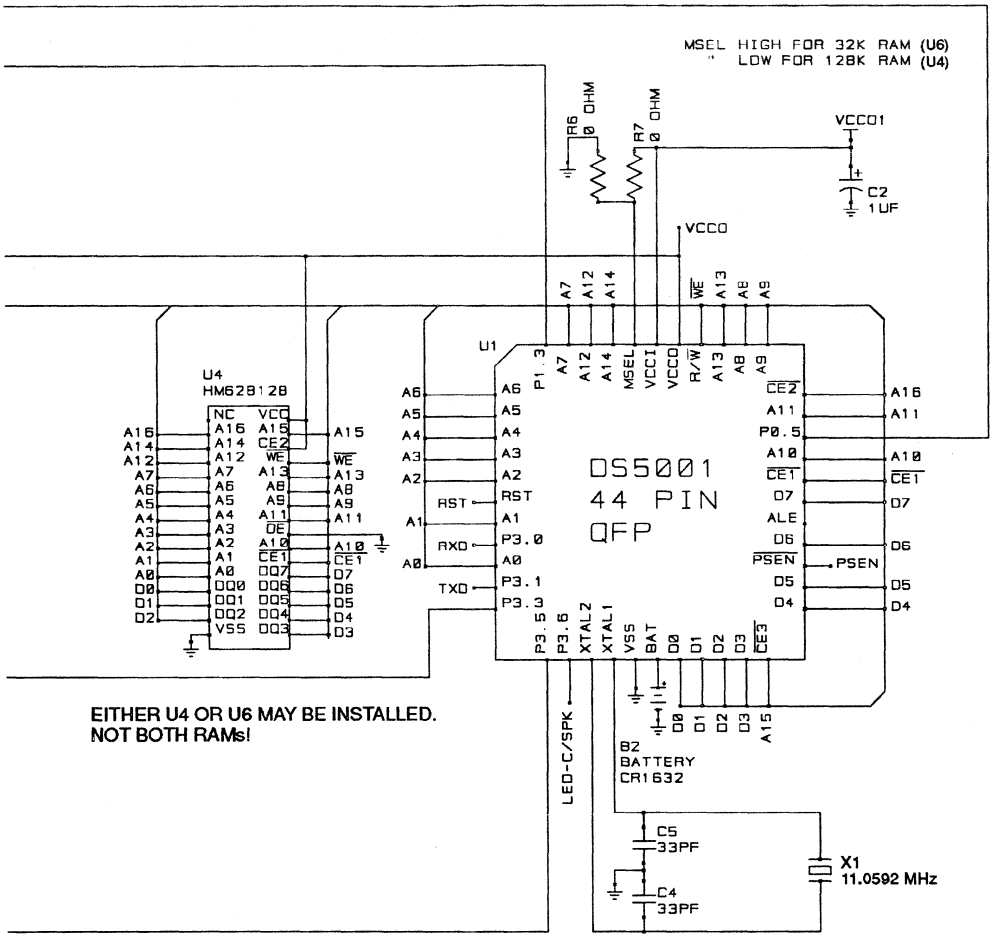
P1 1	VCC01			PSEN	P3 1
P1 2	LED-C/SPK	GND	P2 1	RST	P3 2
P1 3	LED-ANODE	BATT.	P2 2	RXD	P3 3
P1 4	DATA	I/O	P2 3	TXD	P3 4
P1 5	GND	GND	P2 4	GND	P3 5

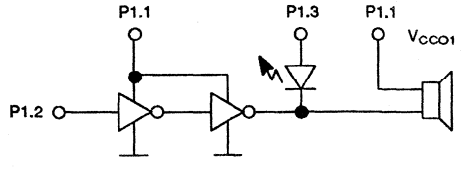
TOUCH PROBE AND SIGNALLING CONNECTOR

TOUCH PORT (UPLOAD) AND BATTERY CONNECTOR

SOFTWARE UPLOAD CONNECTOR (SEE FIGURE 9)

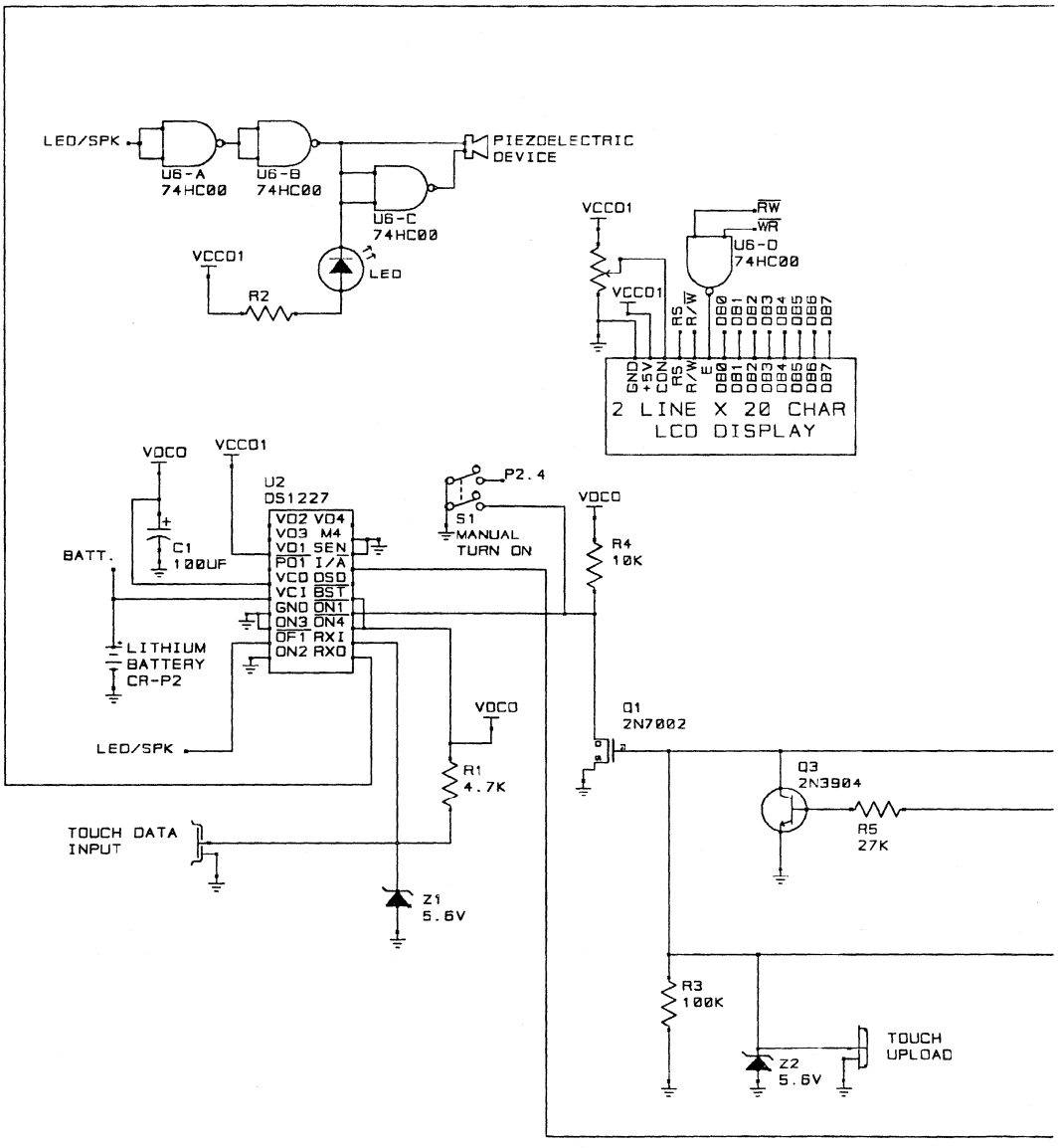
TOUCH PEN SCHEMATIC Figure 7



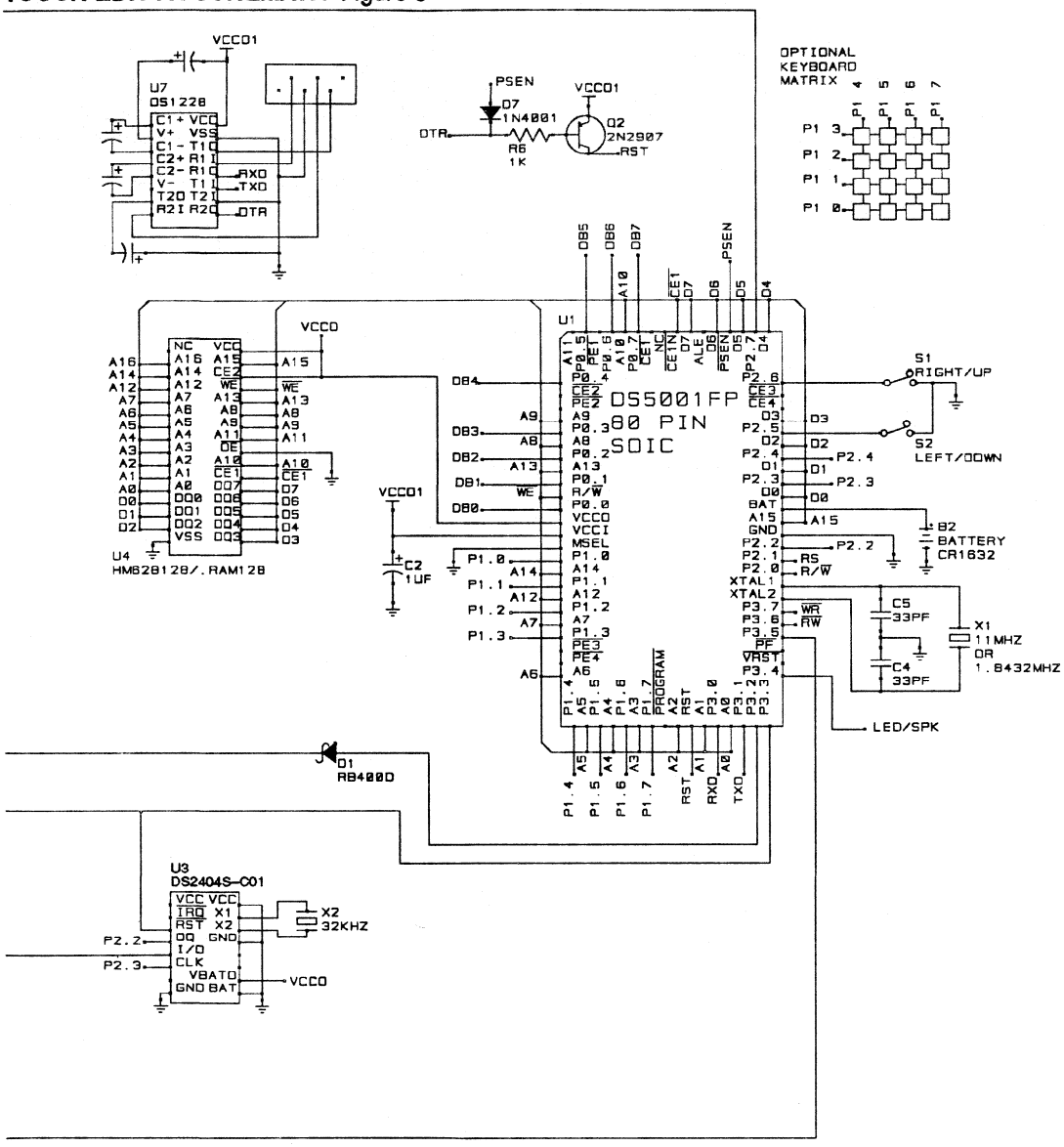


Recommended interface circuit for LED indicator and beeper.

TOUCH EDITOR SCHEMATIC Figure 8



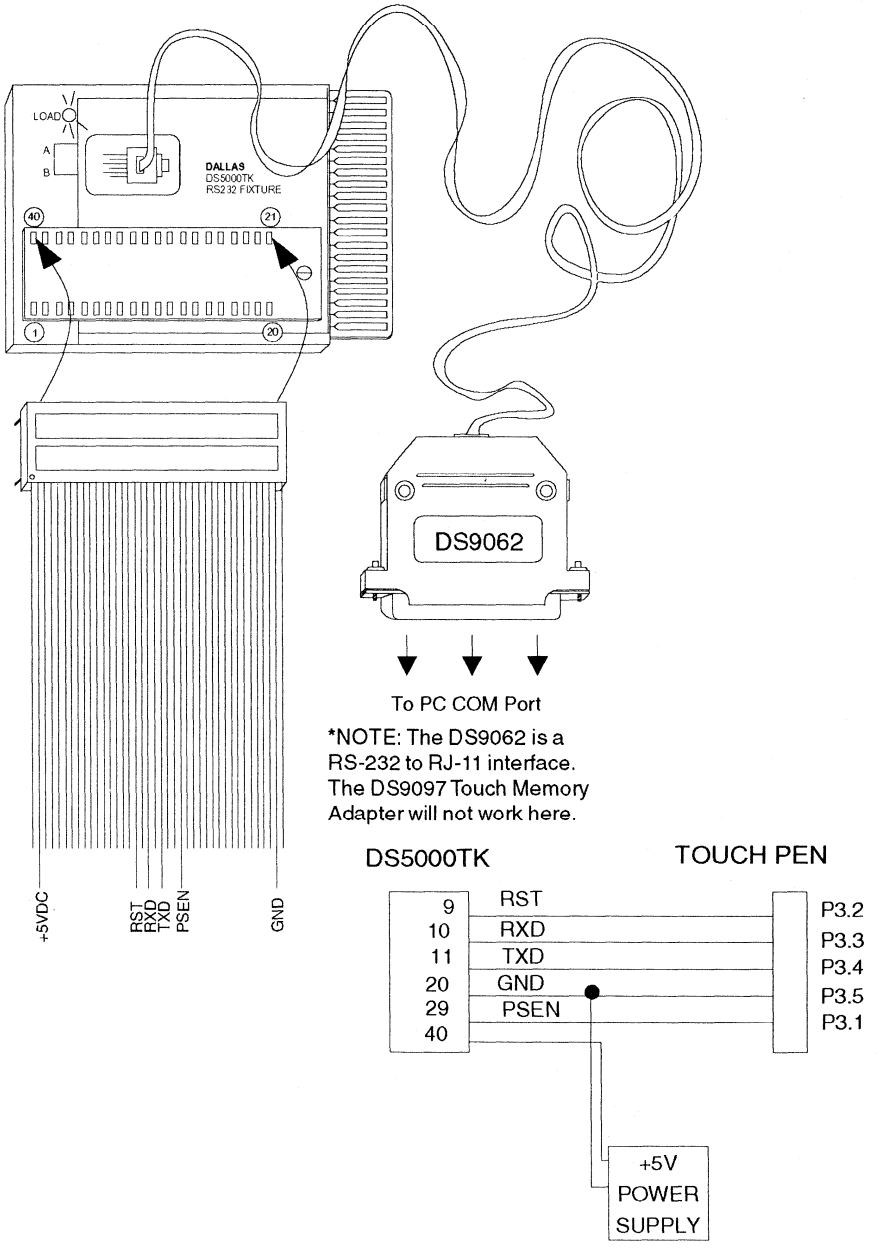
TOUCH EDITOR SCHEMATIC Figure 8



DEVELOPMENT TOOL/ LOADING THE PEN

The DS5000TK/DS5001TK contains a special COM port adapter. The Soft Microcontroller User's Guide explains how the kit works. Figure 9 shows how to make an adapter cable to load the Touch Pen.

DS5000TK Figure 9



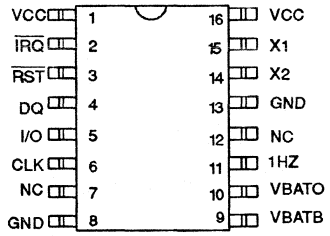
DALLAS SEMICONDUCTOR

DS2404S–C01
Dual Port Memory Plus Time

FEATURES

- Bridge for electronic equipment to the 1–Wire MicroLAN
- 4096 bits of nonvolatile dual–port memory including real time clock/calendar in binary format, programmable interval timer, and programmable power–on cycle counter
- 1–Wire interface for MicroLAN communication at 16.3k bits per second
- 3–Wire host interface for high–speed data communications at 2M bits per second
- Unique, factory–lasered and tested 64–bit registration number (8–bit family code + 48–bit serial number + 8–bit CRC tester) assures absolute traceability because no two parts are alike
- Memory partitioned into 16 pages of 256–bits for packetizing data
- 256–bit scratchpad with strict read/write protocols ensures integrity of data transfer
- Programmable alarms can be set to generate interrupts for interval timer, real time clock, and/or cycle counter
- Space saving 16–pin SOIC package
- Operating temperature range from –40°C to +85°C
- Operating voltage range from 2.8 to 5.5 Volts

PIN ASSIGNMENT



16–PIN SOIC (300 Mil)

PIN DESCRIPTION

Pin #	Pin Name	Description
Pin 1&16	- V_{CC}	2.8 to 5.5 Volts
Pin 2	- $\overline{IRQ}$	Interrupt Output
Pin 3	- $\overline{RST}$	3-Wire Reset Input
Pin 4	- DQ	3-Wire Input/Output
Pin 5	- I/O	1-wire Input/Output
Pin 6	- CLK	3-Wire Clock Input
Pin 7 & 12	- NC	No Connection
Pin 8 & 13	- GND	Ground
Pin 9	- V_{BATB}	Battery Backup Input
Pin 10	- V_{BATO}	Battery Operate Input
Pin 11	- 1 Hz	1 Hz Output
Pin 14 & 15	- X_1,X_2	Crystal Connections

DESCRIPTION

In order to provide universal access to the MicroLAN, the DS2404S–C01 Dual Port Memory Plus Time has been developed. This device has both 1–Wire and a 3–Wire serial microcontroller interface. The DS2404S–C01 can be used to make complex functions involving microcontrollers behave as if they were Touch Memories.

Being a custom–ROM version of the DS2404, the DS2404S–C01 has the family code 84H. In addition to this, the 12 most significant bit of the serialization field are coded 001H, leaving 28 bits for serialization. The communication with the DS2404S–C01 through the 1–Wire port is identical to the DS1994; all functions of the DS1994 are available.

DALLAS SEMICONDUCTOR

DS9092R
Touch Port

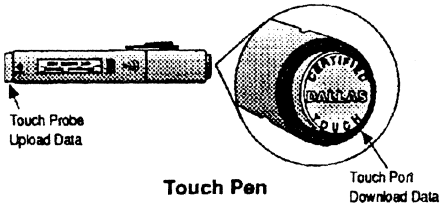
FEATURES

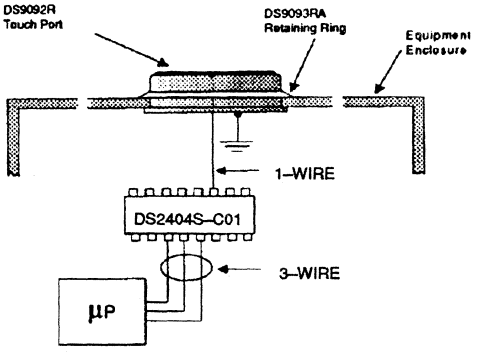
- Empty stainless steel MicroCan with opening in rear and solder tabs.
- Acts as a touch contact for remotely located 1–Wire devices
- Together with DS2404S–C01 makes complex functions involving microcontrollers behave as if they were Touch Memories.
- Available with "CERTIFIED DALLAS TOUCH" logo

DESCRIPTION

The DS9092R Touch Port provides the electrical contact necessary for mating remotely located Touch Memories or other 1–Wire MicroLAN devices with reader/writers. The DS9092R is also available with logo.

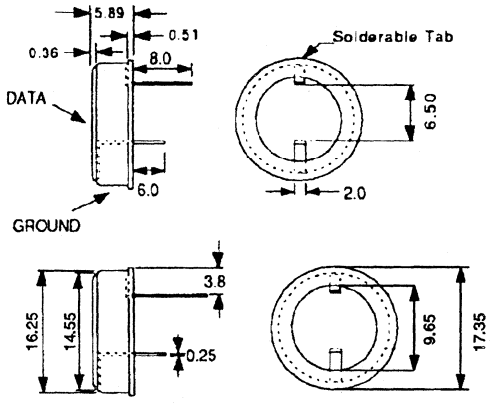
APPLICATIONS





Equipment fitted with 1–Wire button contact.

PACKAGE OUTLINE



All dimensions are shown in millimeters.

CONTACTS

Rim	Ground
Inner Face	Data

ORDERING INFORMATION

DS9092R–000	Tabbed MicroCan
DS9092R–L00	Tabbed MicroCan with logo

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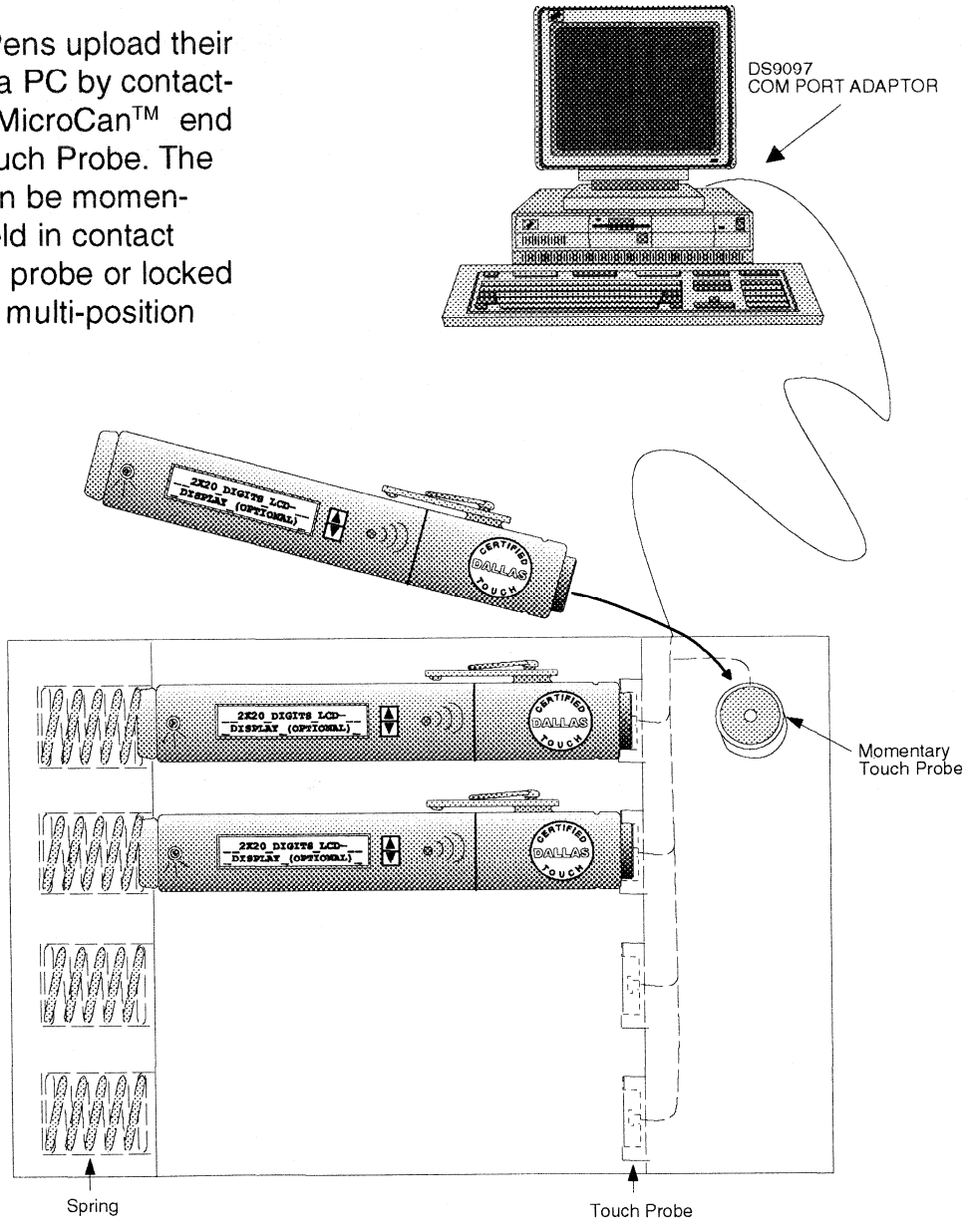
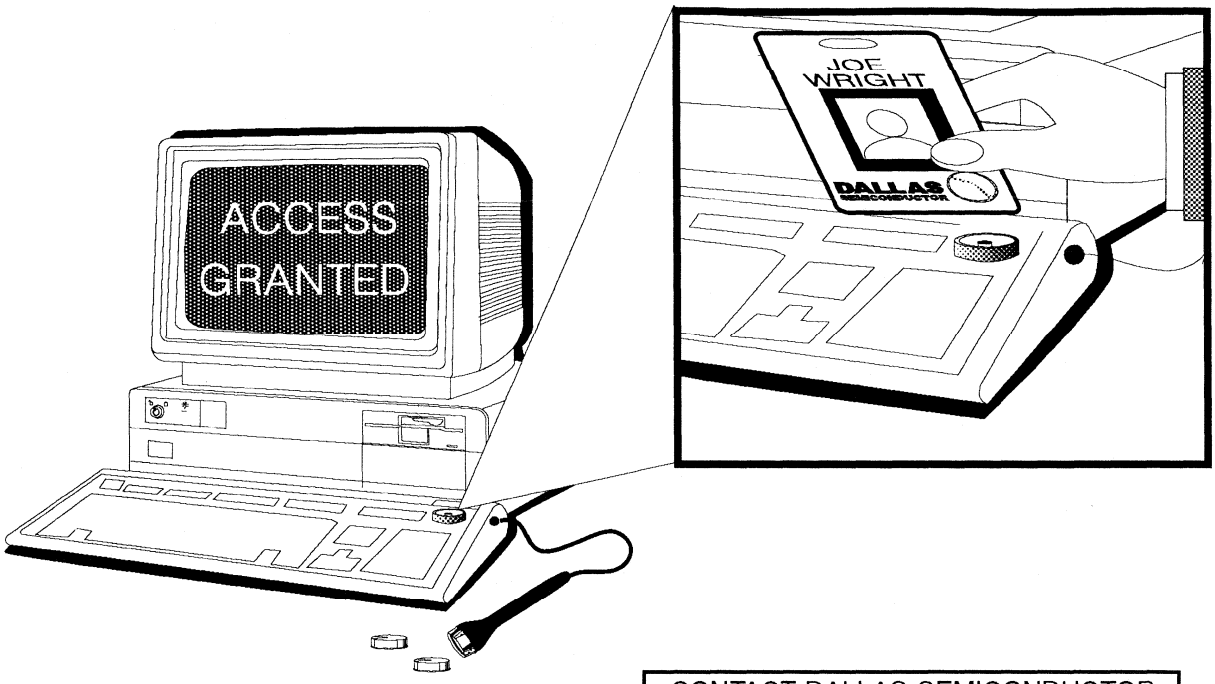
UPLOAD CRADLE

Touch Pens upload their data to a PC by contacting the MicroCan™ end to a Touch Probe. The Pen can be momentarily held in contact with the probe or locked into the multi-position fixture.



TOUCH KEYBOARD



CONTACT DALLAS SEMICONDUCTOR FOR REFERENCE TO SUPPLIERS.

PURPOSE

To allow Touch Memory to substitute for keystroke data entry with existing PC programs.

DESCRIPTION

The Touch Keyboard was developed by Dallas Semiconductor with the cooperation of Keytronics Corporation, a leading manufacturer of PC keyboards. A standard, high volume PC keyboard is converted for use with Touch Memory by replacing the standard keyboard control microprocessor with a specially programmed DS5000 (8051) microprocessor, and by connecting a Touch Memory probe to the port pin that controls the Scroll Lock LED. The modified keyboard control firmware polls the probe for the presence of Touch Memory while scanning the keyboard for keystrokes. When a Touch Memory is detected, the control firmware reads and checks the CRC of the unique lasered serial number and identifies the device type by the family code. If the Touch Memory is a DS1990A Silicon Serial Number, the firmware converts the serial number to a hexadecimal character string, which it then converts to scan codes and transmits to the PC. If the Touch Memory contains nonvolatile RAM, the firmware attempts to read a CRC 16 validated string from the Touch Memory. If the string is found to be valid, the characters of the string are converted to scan codes and transmitted to the PC, just as if the character string had been typed at the keyboard. The activity on the 1-wire data line can be monitored visually on the Scroll Lock LED, and the Num Lock LED is programmed to blink whenever a successful read has been completed.

Both upper lower case characters and control characters can be read from the Touch Memory and transmitted correctly to the PC. In addition, a set of character codes has been defined in the range of 183-208 to allow for the transmission of keyboard codes having no corresponding ASCII equivalents. The assigned correspondence is listed as follows:

Character Dec	Hex	Key Symbol	Scan Code	Character Dec	Hex	Key Symbol	Scan Code
183	B7	Scroll Lock	84	196	C4	Tab	0D
184	B8	F1	05	197	C5	PrtScr	7C
185	B9	F2	D6	198	C6	Home	6C
186	BA	F3	04	199	C7	UpArrow	75
187	BB	F4	DC	200	C8	PgUp	7D
188	BC	F5	D3	201	C9	LeftArrow	6B
189	BD	F6	0B	202	CA	RightArrow	74
190	BE	F7	83	203	CB	End	69
191	BF	F8	0A	204	CC	DownArrow	72
192	C0	F9	01	205	CD	PgDn	7A
193	C1	F10	09	206	CE	Ins	70
194	C2	F11	78	207	CF	Del	71
195	C3	F12	07	208	D0	NumLock	77

The Touch Keyboard allows Touch Memory to substitute directly for keystrokes, so that data entry can be automated without modifying existing data collection programs. All that is needed is to program the Touch Memory with the same keystrokes that would be used to enter the data manually. The Touch Keyboard offers the additional advantage of not consuming an existing hardware resource of the PC, such as a serial port.

The Touch Keyboard reads devices containing data according to the default data structure as well as devices formatted under TMEX (Extended File Structure, see the "Book of DS19xx Touch Memory Standards" for details). Since TMEX supports multiple files residing in the same device, the Touch Keyboard must learn which file to look for. This training or missioning is done using a Touch Memory formatted as follows:

PASSWORDfile<nn>

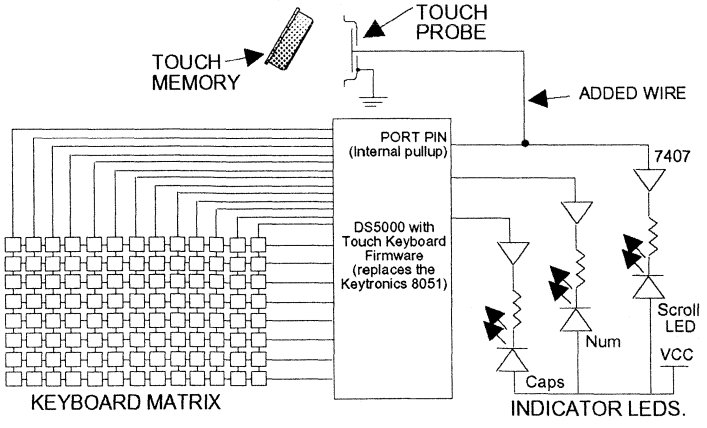
"PASSWORD is an ASCII string that must be matched exactly to do the missioning. "file" is the new ASCII file name the Touch Keyboard shall look for. "<nn>" is the hexidecimal value of the new file's extension. There are no delimiters between PASSWORD and the new file name as well as between the file name and its binary extension.

The control firmware in the keyboard could also be designed to allow writing of Touch Memory data as well as reading. In this mode of operation, the PC would transmit to the keyboard the data to be written, and the keyboard would store the data and write it into the next Touch Memory placed in contact with the probe.

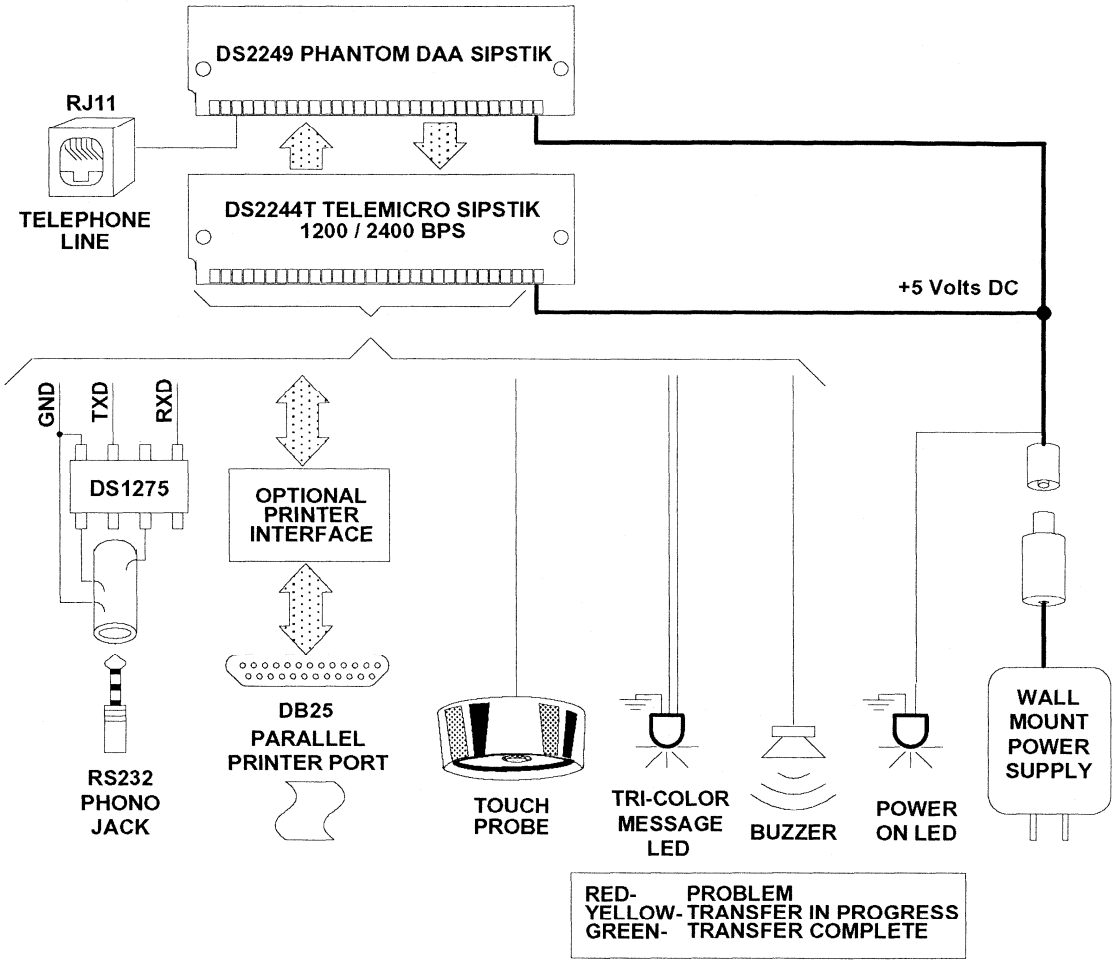
KEYTRONICS 101 RETROFIT (Model E03600QEMI)

1. Replace 8051 with DS5000
   a. Pin-for-pin compatible
   b. Includes 2Kx8 or 26Kx8 buffer SRAM

2. Mount and connect DS9092T Touch Probe to LED port pin (Touch shared with Scroll Lock LED).



TELESERVICED TOUCH



PURPOSE
To demonstrate software and hardware for reading a Touch Pen or Touch Memory and forwarding the data over a telephone modem communication link to a remote computer (host).

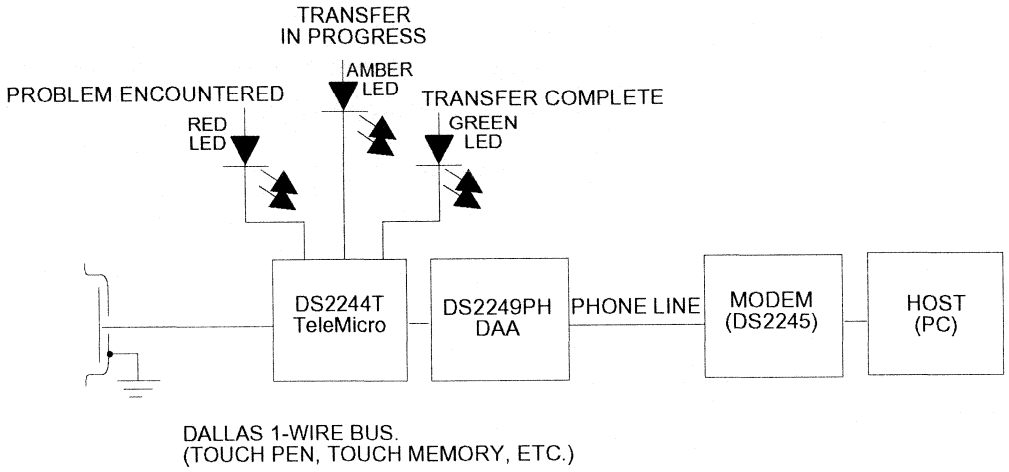
DESCRIPTION
A system for reading the Touch Pen and transmitting the contents over the phone line (TeleServicer) can be constructed using the following hardware:

DS2244T TeleMicro Stik
DS2249PH Phantom DAA Stik

Software for the TeleServicer benefits from the use of the DS0065 TeleMicro Interface System.

The DS0065 Tele Micro Interface system greatly simplifies software design for the DS2244T. The modem connect handshake logic is managed automatically, allowing the user to concentrate on issues that are unique to the application. A multi-tasking core allows the modem connection to proceed while consuming a minimum of system resources.

Together the above provide a powerful set of tools for construction of a reliable and cost-effective system for collec-

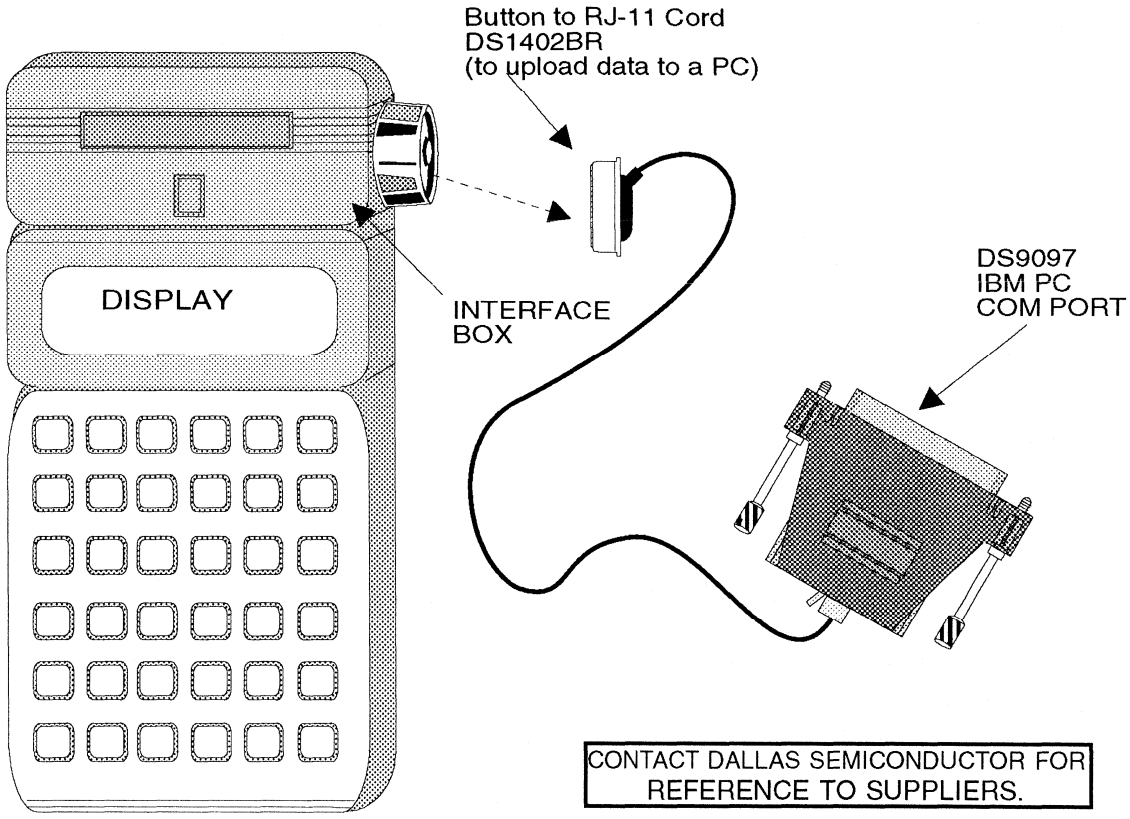


tion of the required data. Any host computer with a modem and suitable communication software can be used to collect and store the data received from the remote sites. After a connection is established the host system and the TeleServicer handshake to detect and correct errors on the phone line. A CRC 16 calculation routine is provided in the DS0065 package.

OPERATION

A Touch Memory, or a Touch Pen containing data from multiple Touch Memories, is contacted to the TeleServicer's Probe. The contents of the Pen are copied automatically to the TeleServicer and then transmitted over the phone line to a host system with a modem. If the Pen contains more than the DS2244T memory can hold, the Pen should remain in the reader for a brief period until enough data is sent to the host system to permit removal of the Pen. The status of the transfer is indicated by LEDs. If the connection is lost before the transfer is complete then the TeleServicer will call the host again. This process is repeated until an error-free transfer is acknowledged by the host.

TOUCH EDITOR



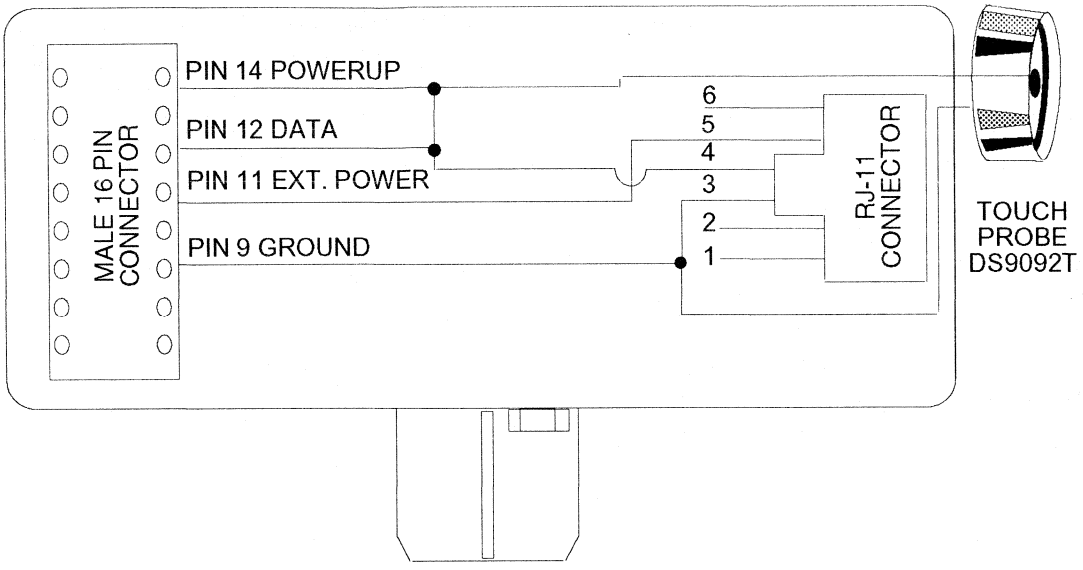
PURPOSE

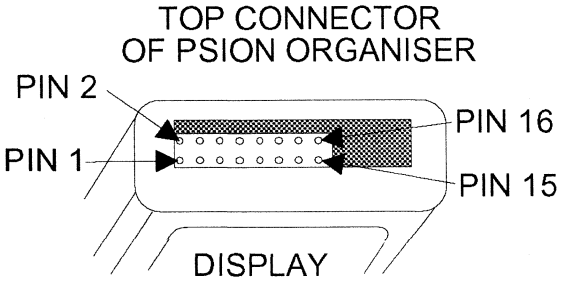
To permit the collection, display, editing, and redistribution of Touch Memory data with a compact hand-held instrument having both a keypad and a display.

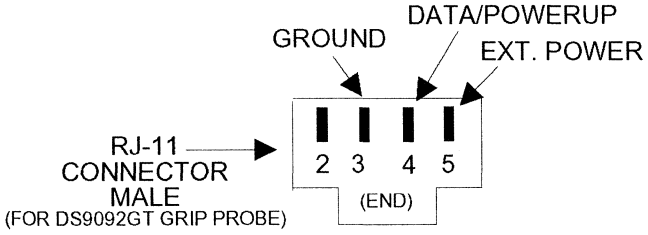
DESCRIPTION

The Psion Organiser II is a battery-powered hand-held computer with a keyboard and LCD display, capable of storing and retrieving many different kinds of information. The Organiser operating system provides data file management resources and a convenient high-level programming language (OPL) which is similar to Basic. Touch Memory data can be read or written by an Organiser using the Easy Touch interface shown in Figure 1 and a set of subroutines written in machine language which can be called from OPL. The subroutine package allows an OPL programmer to perform the basic Reset/Presence and Byte I/O functions that are required to communicate with individual Touch Memorys. A more comprehensive subroutine package has also been designed to allow communication with multiple memories connected together in parallel (multidrop).

Dallas Semiconductor has prepared a set of programming examples for Psion Organiser Model LZ or LZ64 which demonstrate how to communicate efficiently and without errors on the 1-wire bus. The programs demonstrate Touch Memory reading, writing, logging, date/time stamping, and uploading of accumulated data to a PC. The examples are provided on a diskette along with program documentation and data format standards developed by Dallas Semiconductor to insure Touch Memory data integrity and format compatibility between different application programs. The programming examples can be loaded into the Organiser from a PC with the COMMS Link serial communication accessory available from Psion.


MALE 16 PIN CONNECTOR
PIN 14 POWERUP
PIN 12 DATA
PIN 11 EXT. POWER
PIN 9 GROUND
6
5
4
3
2
1
RJ-11 CONNECTOR
TOUCH PROBE DS9092T


TOP CONNECTOR OF PSION ORGANISER
PIN 2
PIN 1
PIN 16
PIN 15
DISPLAY


GROUND
DATA/POWERUP
EXT. POWER
RJ-11 CONNECTOR MALE
(FOR DS9092GT GRIP PROBE)
2 3 4 5
(END)

TOUCH INJECTOR FOR RS232C

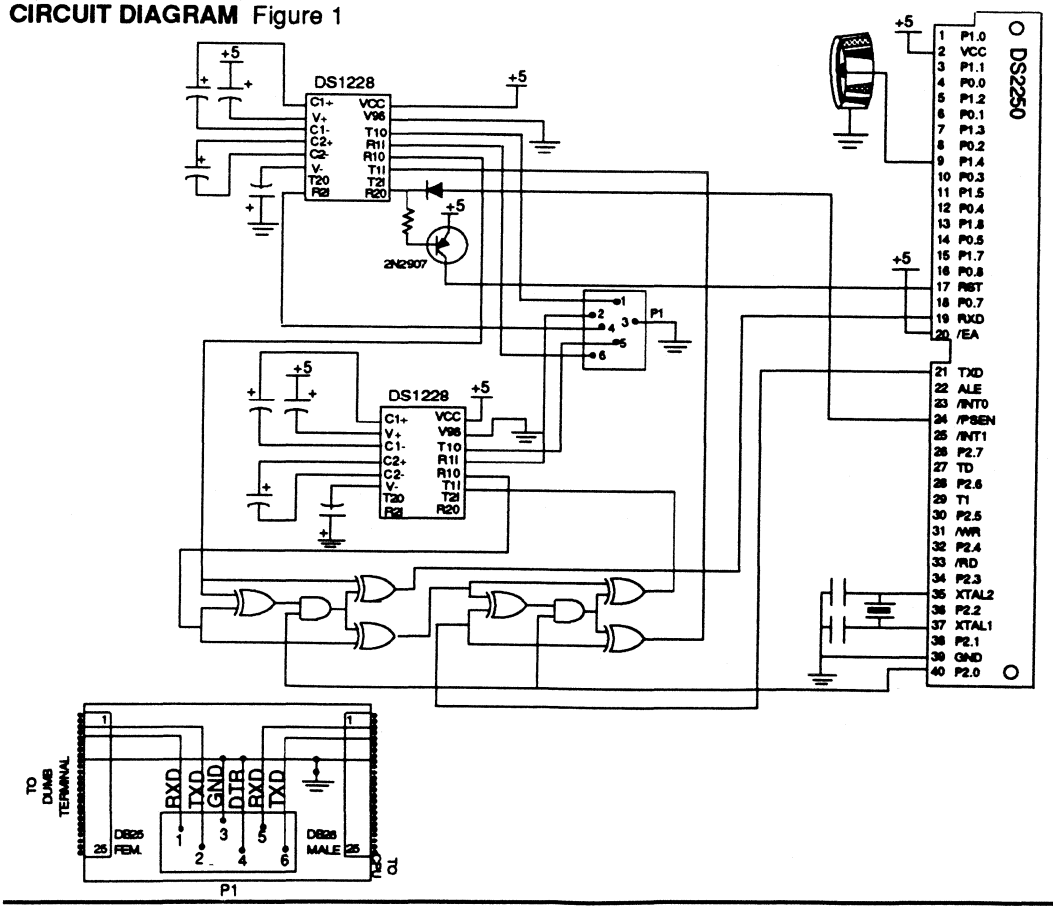
PURPOSE

To allow use of Touch Memory with a remote terminal connected to a central computer by means of an RS232C communication link.

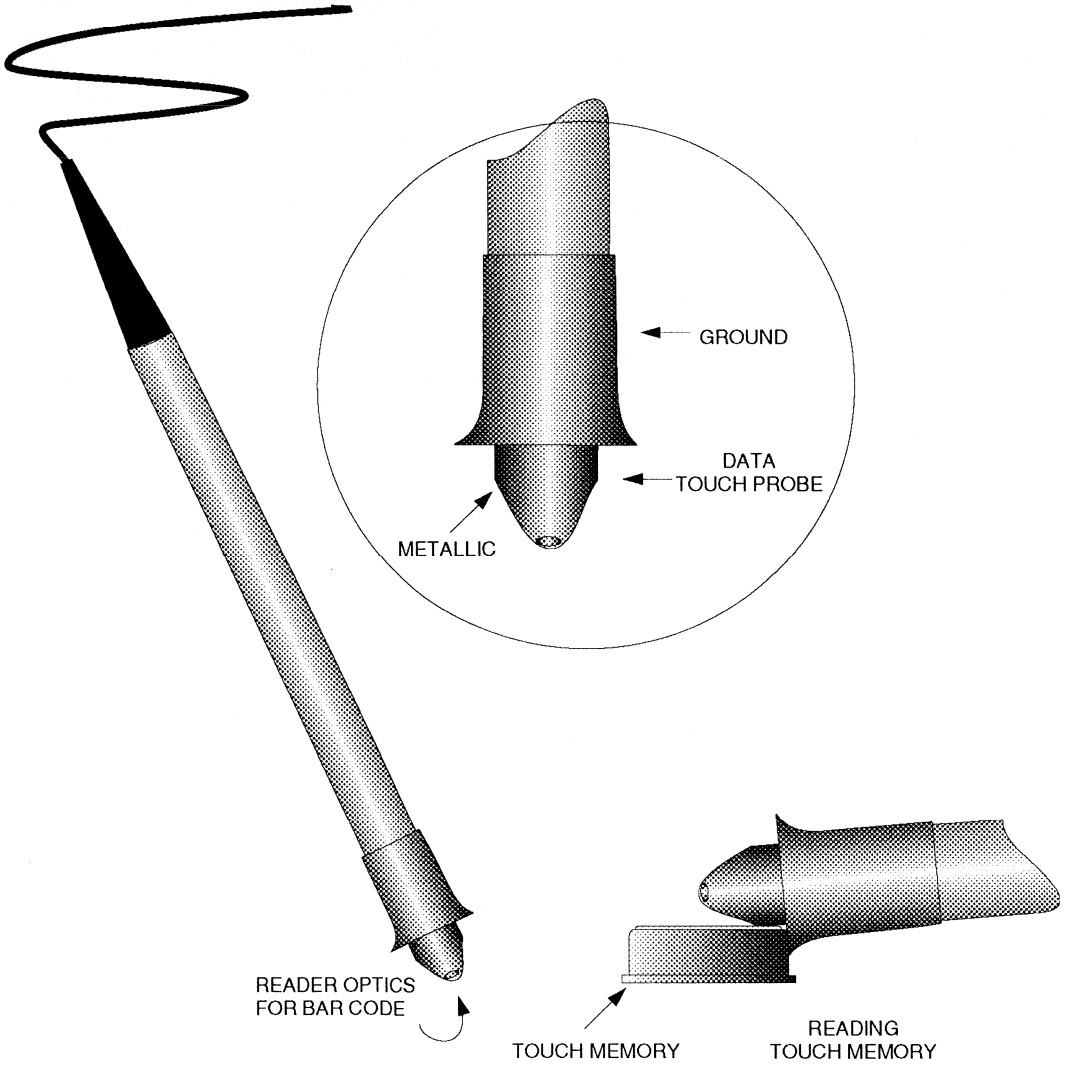
DESCRIPTION

The Touch RS232C Data Injector is a microprocessor-controlled interface which allows the data read from a Touch Memory to be injected into an RS232C data link between a central computer and a remotely located "dumb terminal" such as a VT220. Conversely, data can be transmitted from the remote computer, captured by the Data Injector, and written into a Touch Memory. In prototype form, the Data Injector is housed in a DS9005 enclosure and powered by a wall mount power supply connected to an AC outlet. The Data Injector contains a DS2250 Microcontroller Stik and logic for RS232C voltage level conversion and communication path switching. The DS2250 is programmed to send and receive serial data on the RS232 data link, and it normally receives serial data from the remote terminal and retransmits it serially to the central computer. It also continuously polls for and reads CRC16 validated data from a Touch Memory. If the data is valid, it is injected into the RS232C serial data stream as if it had been typed on the remote terminal. The microprocessor provides a large memory buffer to permit the injection of a large amount of Touch Memory data. The communication path in the Data Injector can be switched so that data is received by the injector from the central computer and retransmitted serially to the remote terminal. In this mode, specially coded data received from the central computer is buffered and stored in the DS2250. This stored data will then be written into the next Touch Memory that comes into contact with the probe. Contact Dallas Semiconductor for software which can be used in the Data Injector.

CIRCUIT DIAGRAM Figure 1

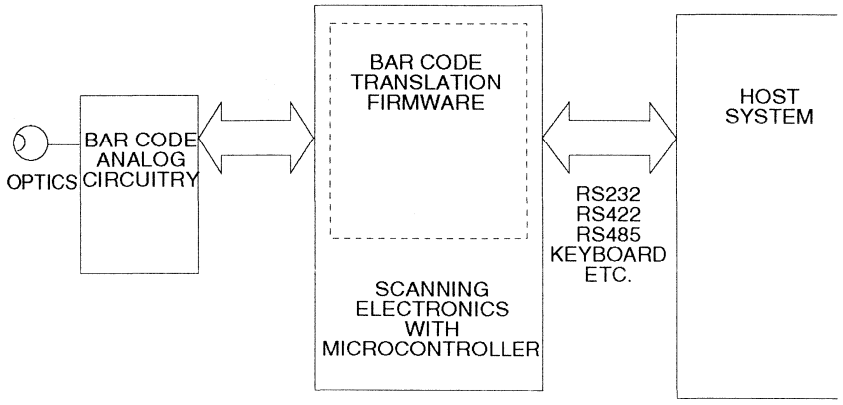


BAR CODE TO TOUCH CONVERSION

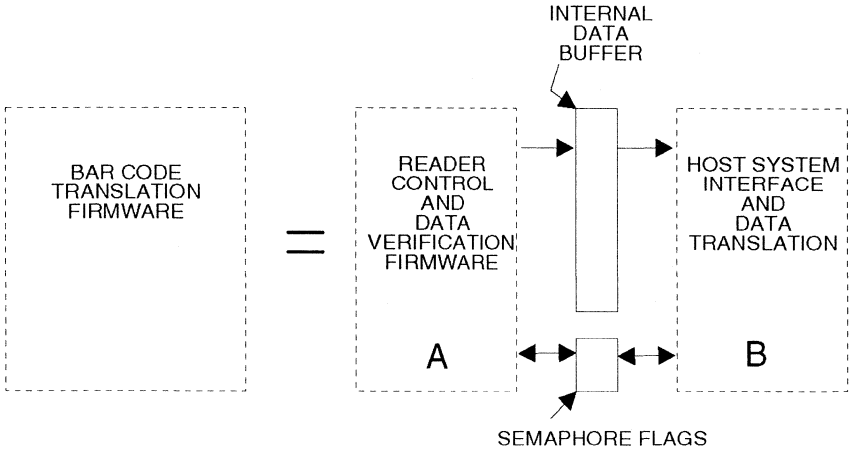


A combination reader can serve both bar codes and Touch Memories. Bar codes can be read and deposited into Touch Memories.

ADDING TOUCH MEMORY TO EXISTING BAR CODE READERS

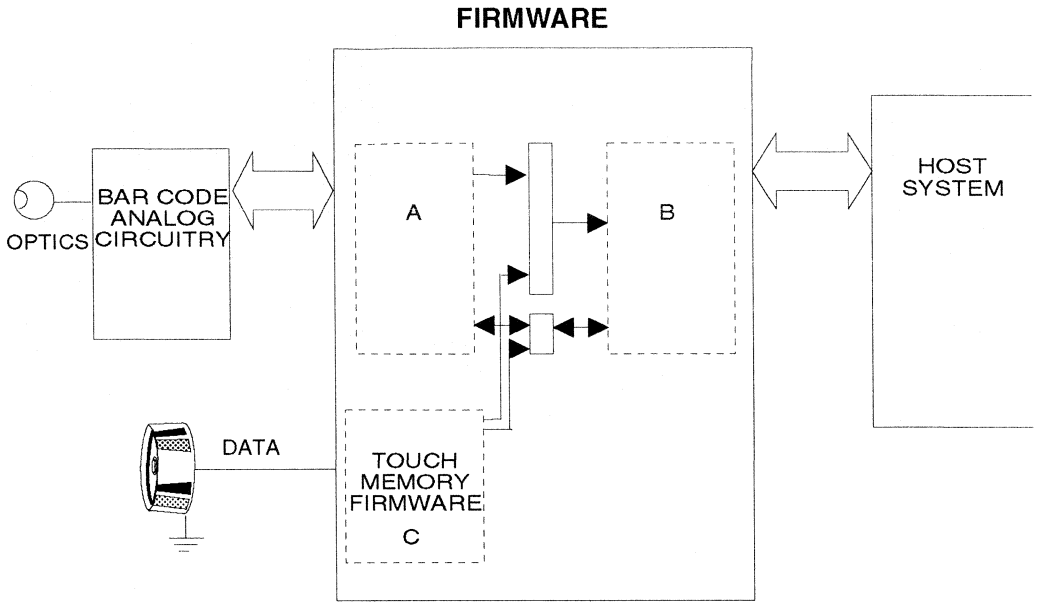


This is a typical block diagram of a Bar Code reader



The software of such a reader is usually organized as shown above.

- Module A controls reader, places data read in internal buffer, verifies data validity and signals success.
- Module B controls host interface, translates buffered data to host-preferred format, sends data to host and signals completion.



Adding a Touch Memory option requires a simple 1-Wire interface. This is often a free resource as most systems have an under-utilized port pin.

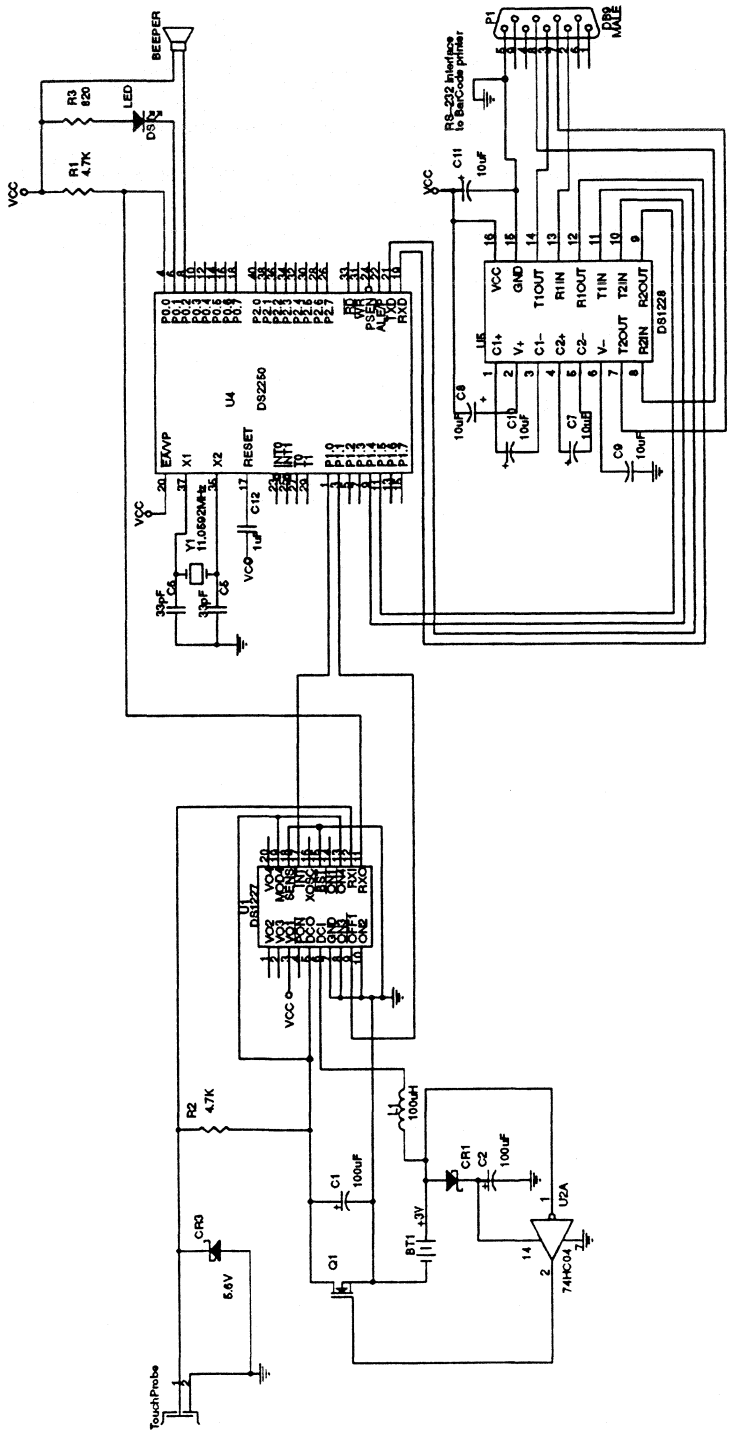
- Touch Memory firmware reads data from a Touch Memory into an internal buffer, verifies data validity and signals success.
- Execution of module A alternates with module C to poll both Touch Memory and a conventional reader.

Transparent introduction of Touch technology to bar code identification systems is achievable because the microcontroller which controls the optics and decodes the symbology can easily generate the 1-Wire protocol.

TOUCH MEMORY TO BAR CODE CONVERSION

To copy data from a Touch Memory to a bar code, an instrument with both a Touch Memory reader and a bar code printer is required. Figure 1 illustrates a hardware design for such an instrument. The circuit is activated when a Touch Memory makes contact with the Touch Probe and produces a presence signal, causing the DS1227 Kickstarter to boost voltage from the 3–volt battery and apply Vcc to the DS2250 Micro Stik. When the DS2250 powers up, it begins attempting to read data from the Touch Memory and to check the CRC for validation. If no valid read is achieved within a predetermined number of attempts, the DS2250 directs the DS1227 to remove power to conserve the battery. If a successful read is obtained, the DS2250 activates the beeper to acknowledge the read, reformats the data into the bar code format required by the attached printer, and transmits the data to the printer through the DS1228 level shifter to the RS232C interface connector. (If the printer contains built–in bar code printing firmware, the DS2250 must send the appropriate commands to select the bar code format and the ASCII characters representing the data to be coded.) Once the data has been transmitted to the printer, the DS2250 directs the DS1227 to remove power. Because of its low duty cycle, the instrument described here can operate for long periods of time on a single 3–volt battery.

TOUCH MEMORY TO BAR CODE PRINTER INTERFACE



TAMPER DETECTOR

It is possible to connect a DS1994 Touch Memory Plus Time to a fixed object in such a way that it cannot easily be removed without altering the data maintained in the date/time registers. The ROM and NV RAM data in the Touch Memory can still be read at any time. This type of connection is useful for "sealing" cargo containers, instruments, vehicles, etc. so that any attempt to remove the Touch Memory, tamper with the contents of the container, and then replace the Touch Memory can be recognized at a later time. Interruption of the current flowing in the tamper loop leaves a record in the Touch Memory. Depending on the circumstances, the information read from the date/time registers can reveal the date and time when the Touch Memory was disconnected, the number of times that the Touch Memory was disconnected and reconnected, or the total length of time that the Touch Memory was disconnected from the object.

Figure 1 illustrates one of many possible forms for the tamper detection circuit. The essential elements of the circuit are the following:

1. An additional lithium power cell such as CR1632 (16mm x 3.2 mm) that supplies a bias voltage to keep the interval timer running for years or as long as it is connected to the DS1994.

2. A resistor between the bias supply and the DS1994, so that a portable computer can read or write data in the DS1994 without interference from the bias supply.

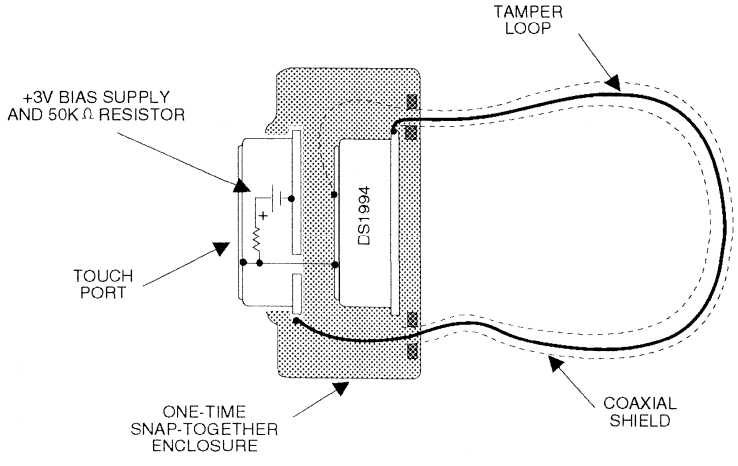
3. A loop of wire that completes the circuit between the bias supply and the DS1994. This loop of wire is threaded through the lock hasp or other mechanical part of the protected container so that the wire must be cut to gain entry into the container. (This loop should be the center conductor of a coaxial cable in which the outer conductor is connected to data. Coaxial cable prevents keeping the loop intact with a simple shunt cable while cutting the coaxial cable.)

4. A Touch Editor which can be used to synchronize the real time register with the interval time register and then can optionally lock the real time, interval time, and cycle counting registers.

To attach the tamper detection circuit, the user threads the wire tamper loop through the mechanical element which seals the container and attaches the wire so that it completes the circuit which contains the bias supply, the resistor, and the DS1994 Touch Memory.

To activate the tamper detection mechanism, the user contacts the Touch Editor to the DS1994. The Touch Editor writes a zero to the cycle counter register and then writes both the real time register and the interval time register to the current date and time (number of 256ths of a second since the beginning of January 1,1970). The Touch Editor also sets the alarm registers (if needed) and then sets the device control register to BF hex to set the mode of operation of the interval timer and to lock all the operation modes and counters.

TAMPER DETECTION CIRCUIT Figure 1
Breaking or shortening the loop leaves a record of time in the Touch Memory



To read the condition of the tamper detection circuit, the user applies a Touch Editor to the DS1994 to read the contents of the date/time registers. The following conditions may be encountered:

A. The Serial Number is equal to its original value: if contents of Real Time Clock equal contents of Interval Timer, and Real Time Clock shows actual date and time and contents of Cycle Counter equal 0, then there was no tampering.

B. The Serial Number differs from its original value: then there was tampering. The thief has replaced the tamper detector with a counterfeit one.

C. The Serial Number is equal to its original value: if contents of Real Time Clock differ from contents of Interval Timer, and contents of Cycle Counter are greater than 0, then there was tampering. The difference between the Real Time Clock and Interval Timer is the total duration of all tampering instances. The Cycle Counter contains the number of tampering instances that have occurred.

D. The loop wire is broken and the Serial Number is equal to its original value: if the contents of Cycle Counter equal 1, then there was tampering. The contents of Interval Timer give the date and time that the tampering occurred.

Case D requires that the loop is reconnected to be able to read the device. Reading should occur immediately after fixing the loop to get the most accurate date and time of tampering.

Note that in cases C and D above, the time does not include the delay time that it takes the DS1994 to respond to the disconnection of the bias supply. The tamper detection circuit does not detect interruptions of the bias supply lasting less then the delay time of 123 ms.

The NV RAM and ROM data in the DS1994 can be read and the RAM data can be rewritten at any time with a Touch Editor without disturbing the tamper detection function. In addition, a simple non-Touch Editor alarm detector can be used to detect any alarm condition that may have been generated by the device, again without disturbing the tamper detection function.

ALARM INDICATOR FOR TOUCH MEMORY

The DS1994 Touch Memory Plus Time allows one or more alarm interrupt conditions to be set internally. The conditions which can result in setting the alarm interrupt are: the value of the real time reaches that of the real time alarm, the value of the interval time reaches that of the interval time alarm, or the value of the cycle count reaches that of the cycle count alarm. Whenever any of these conditions is enabled and satisfied, the DS1994 enters the alarm interrupting state. This state can be detected easily with a simple circuit that uses only discrete timing and logic elements and requires no microprocessor or firmware.

The advantage of a simple circuit for detecting alarm interrupts is that the circuit can be made cheaply and used as a simple tester to determine whether the DS1994 affixed to a vehicle, perishable product, etc. has expired. The simple test is based on the fact that the alarm interrupt condition significantly alters the response of the DS1994 to the Reset signal. When a DS1994 is not in the alarm interrupt state, it responds to a 480 µs low pulse on the 1–wire line by allowing the line to go high for at least 15 µs and then pulling it low for no longer than 240 µs (presence pulse). However, if the DS1994 is in the alarm interrupt state, it responds to the 480 µs low pulse by holding the line low for at least another 480 µs before releasing it. To distinguish these two responses, the circuit produces low pulses of at least 480 µs duration periodically and then monitors the 1–wire bus in the period between pulses to detect the prolonged low level produced by the alarm interrupting state. If the prolonged low level is detected, the circuit activates an LED indicator with a one–shot pulse extender which allows the indicator light to be seen clearly. The result is a blinking LED indicator which flashes only when the tester is applied to an alarm interrupting the DS1994.

The detector circuit is shown schematically in Figure 1; its operation is as follows: The ICM7555 timer (U1) provides a 3.3–volt reference voltage and also generates 480 µs (+40/–0 µs) low pulses periodically (every 90 ms in this example). These pulses are applied to the 1–wire line as reset pulses. While the 1–wire line is low, C3 charges through R6. When the 1–wire line goes high, C3 is rapidly discharged by U2A. When there is no Touch Memory in contact with the probe, the voltage across C3 never reaches the 3.3–volt reference before the 1–wire line returns high and discharges C3 (Figure 2). When a Touch Memory without alarm is in contact with the probe, the presence pulse adds a small peak following the ramp generated by the reset pulse (Figure 3), resulting in a voltage across C3 that still remains less than the reference voltage. When an alarm interrupting Touch Memory is in contact with the probe, the 1–wire line remains low for a time greater than the 700 µs period established by R6 and C3, causing the voltage across C3 to exceed the 3.3–volt reference voltage on the U2B pin 5. This in turn causes the LED to be switched on as U2B rapidly discharges C4 (Figure 4). Once on, the LED remains on for about 50 ms as C4 is recharged above the reference voltage through R7. Therefore, when a Touch Memory with an active alarm interrupt is probed, the LED will blink for 50 ms out of each 90 ms period. This flashing indicates the alarm condition. Circuitry can be added to turn on power for a period of time when the probe contacts a Touch Memory.

TOUCH MEMORY ALARM DETECTOR Figure 1

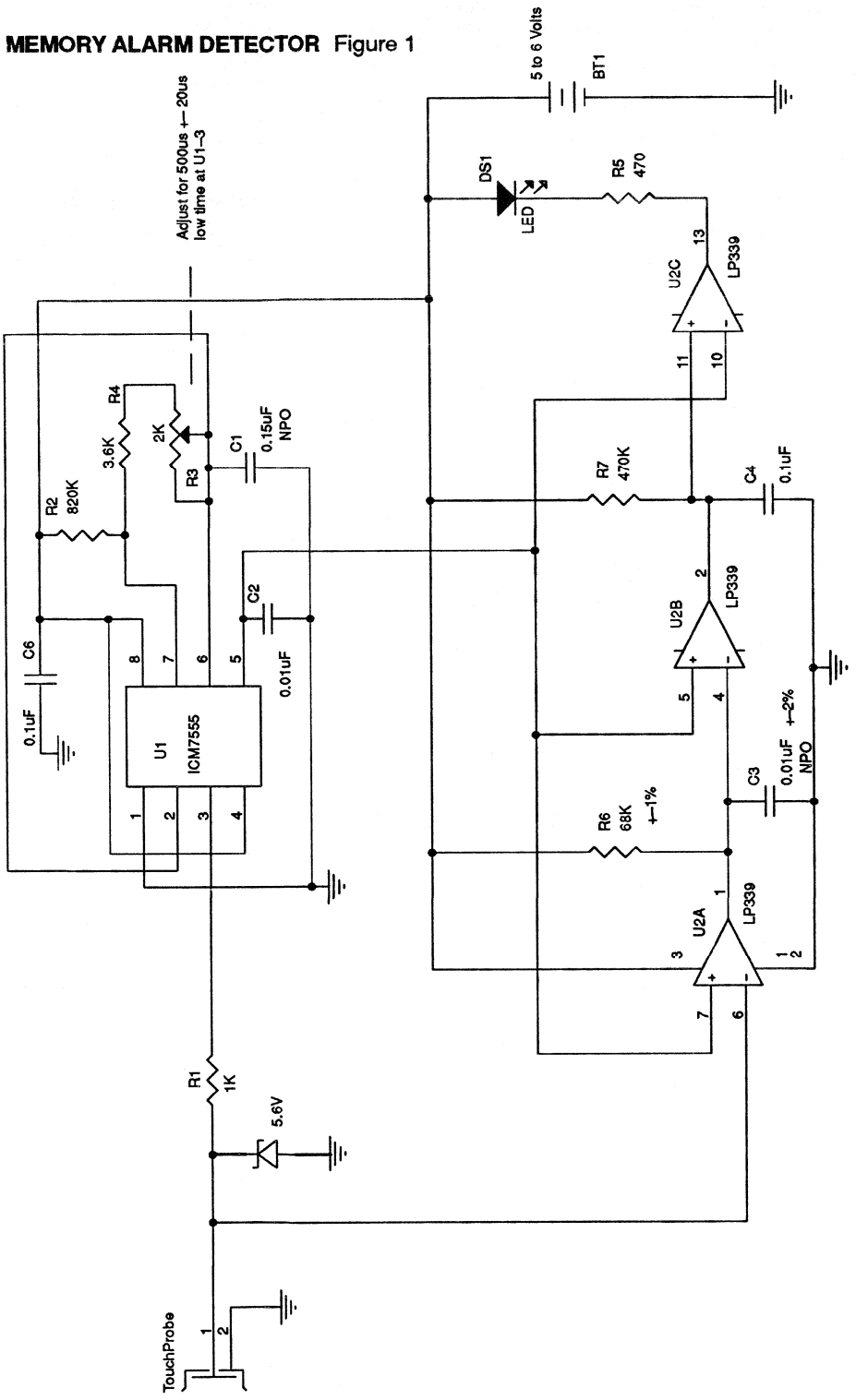


Figure 2

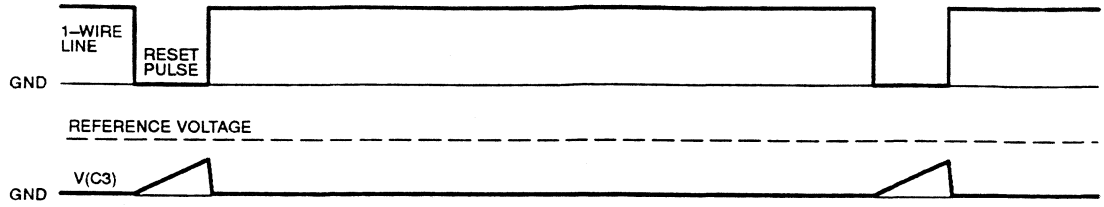


Figure 3

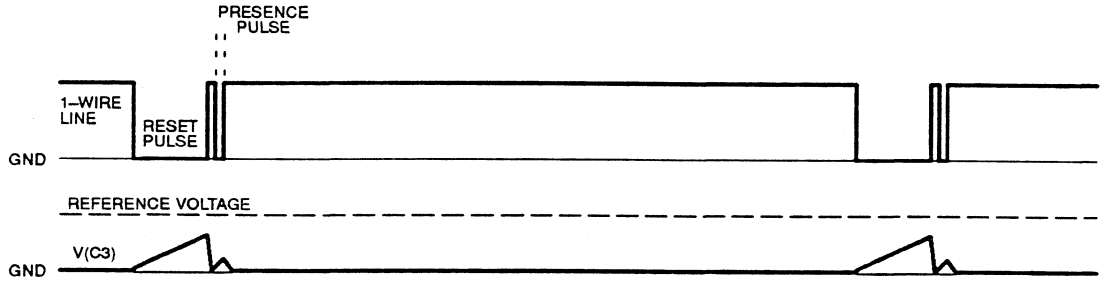
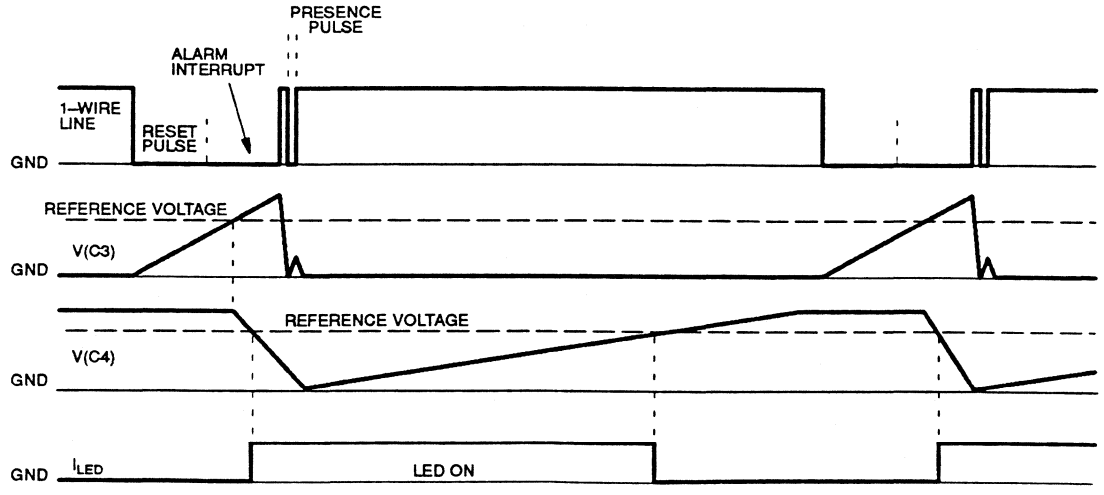
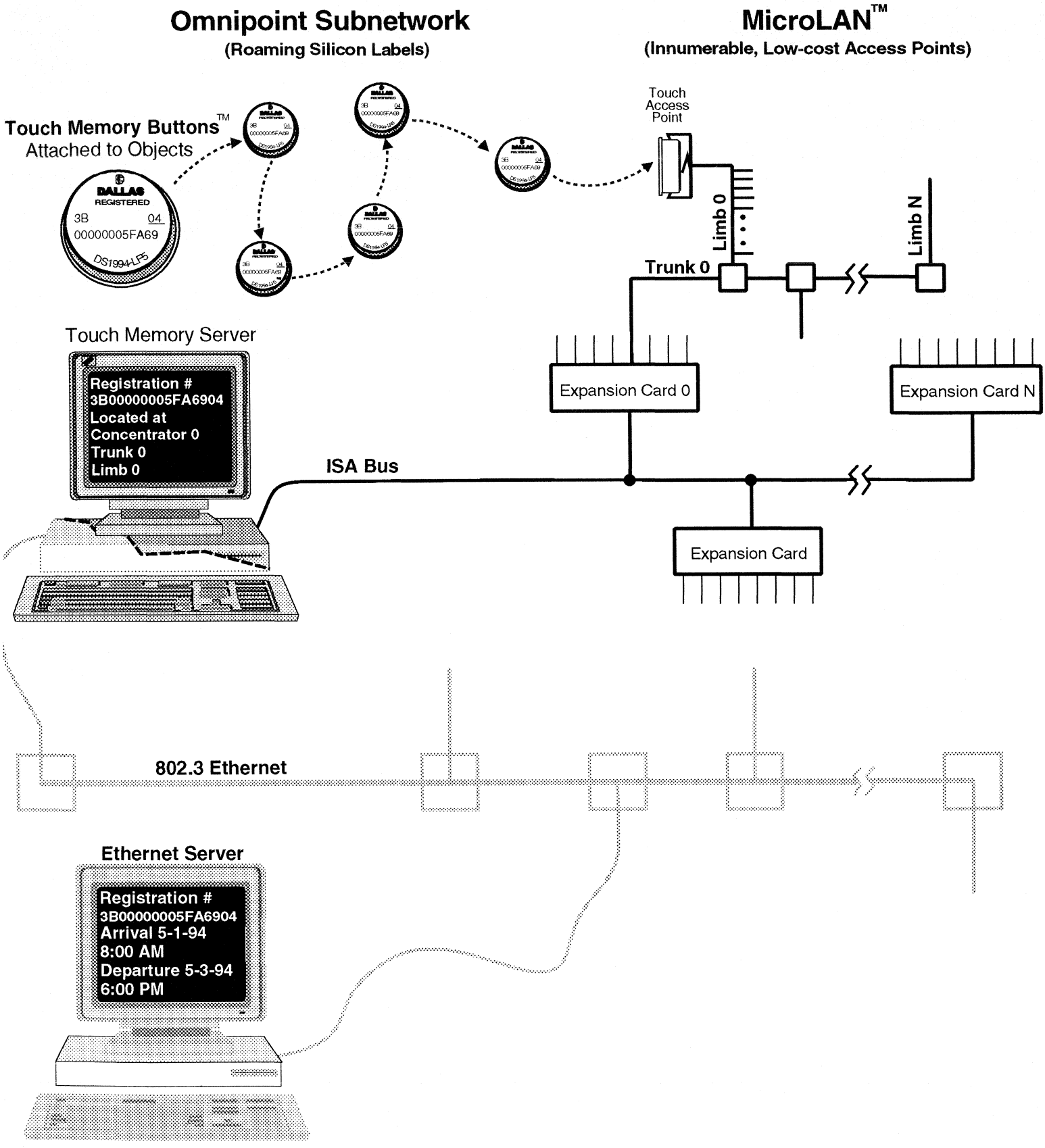


Figure 4

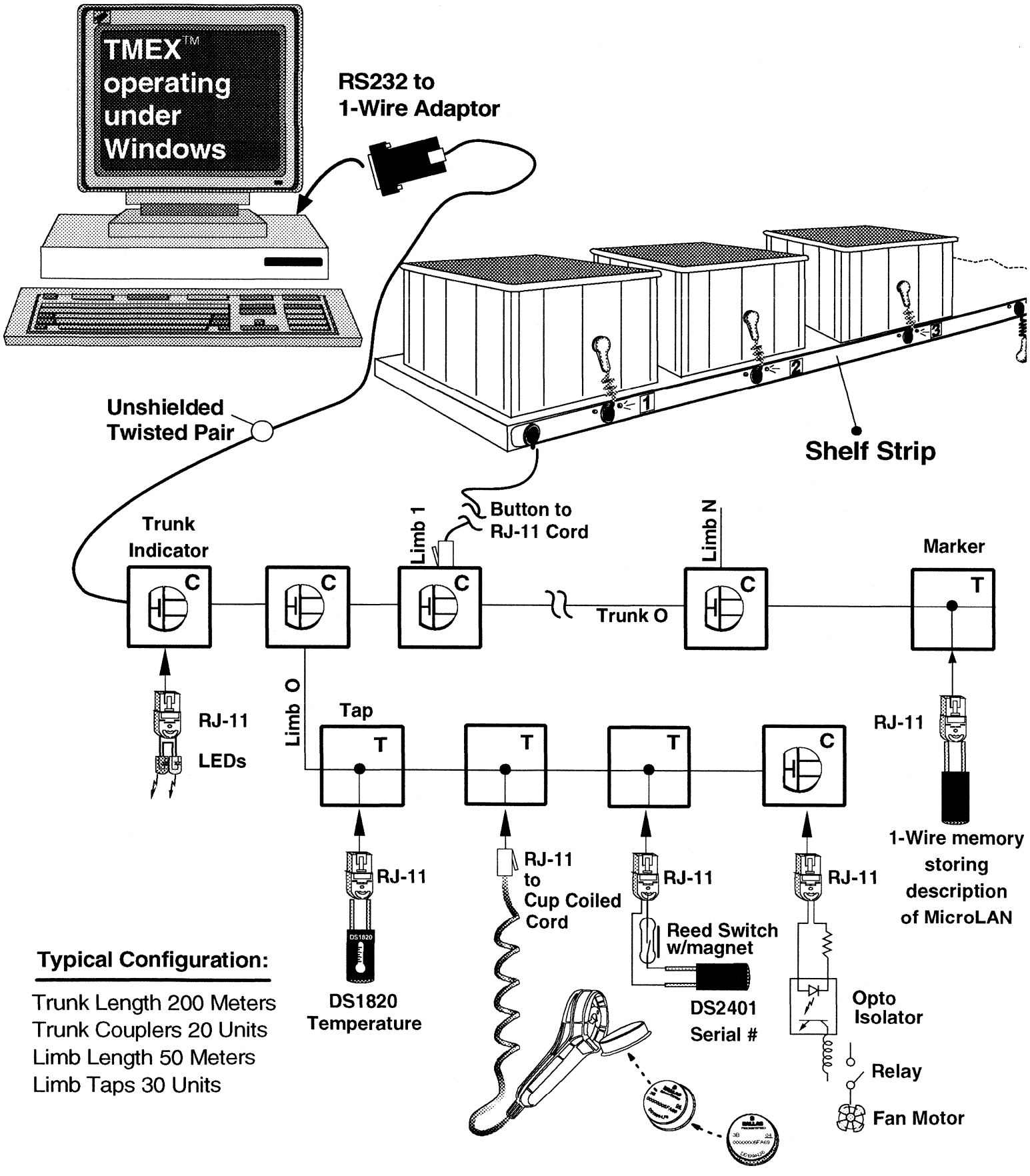


ALL-SILICON NETWORKING

chip to chip to chip. . .



PC Driven MicroLAN

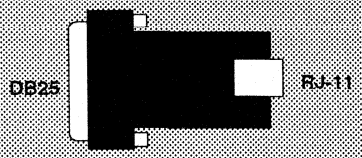


Typical Configuration:

Trunk Length 200 Meters
Trunk Couplers 20 Units
Limb Length 50 Meters
Limb Taps 30 Units

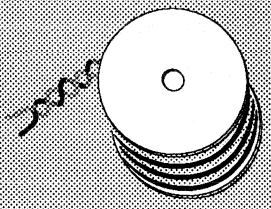
Do-it-Yourself Parts List

PC Connector:



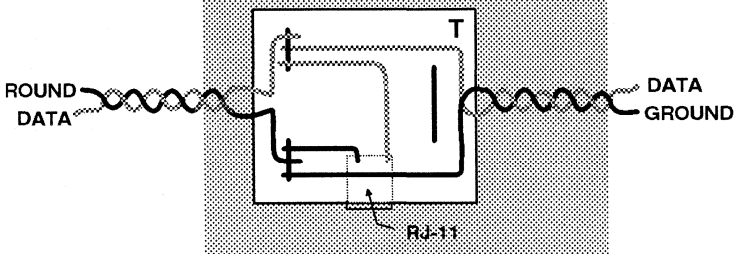
RS232 to 1-Wire Adaptor
(DS9097)

Generic Telephone Wiring:



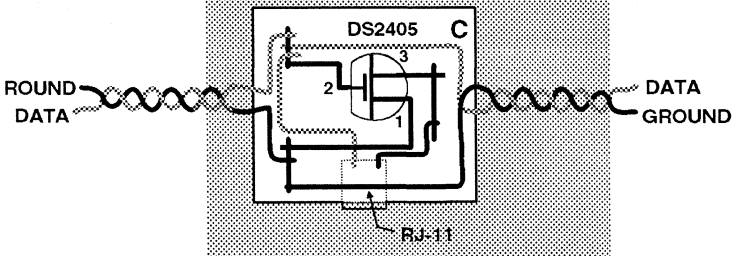
Unshielded twisted pair 24 gauge wire < 30 pf per meter, 150 ohm, Level 5
(Belden 1590A 4pair)
(Belden 1588A 2pair)

RJ-11 Piercing Modular Plug
(Woods #972 or equivalent)

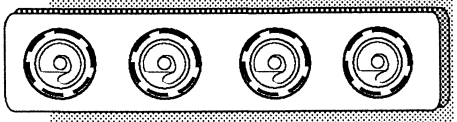


Line Tap (T)
(Woods #900 or equivalent)

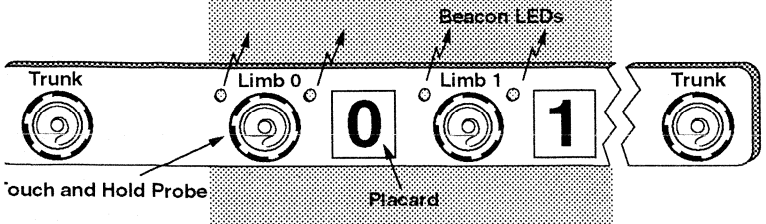
MicroLAN Accessories:



MicroLAN Coupler (C)
(Woods #900 with DS2405 Addressable Switch)

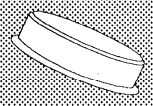


Button Holder
(DS1401)



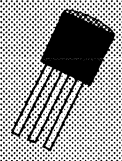
Shelf Strip
(DS2405 Addressable Switches at each LIMB)

1-Wire Components:



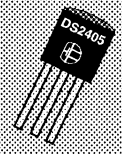
DS19xx
Touch Memory Button™

1-Wire components usually have the shape of a Touch Memory Button. Devices include the DS1990A Serial Number, DS199x re-writeable devices, DS198x Add-Only Memories, and the DS1920 Thermometer. For more details on these devices, see page 3.



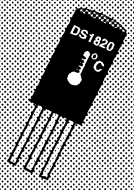
DS2xxx
1-Wire Memory

Some of the Button-shaped, 1-Wire components are also packaged for solder-mount applications. These include the DS2401 Silicon Serial Number (DS1990A equivalent), and the DS2502, DS2505 and DS2506 Silicon Label parts (DS1982, DS1985, DS1986 equivalents).



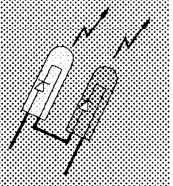
DS2405
Addressable Switch

The Addressable Switch combines 1-Wire network interface, Silicon Serial Number and remotely controlled and sensed I/O pin in a single device. The DS2405 is the heart of the MicroLAN Coupler, where it activates the limbs of the network or switches/senses other peripheral parts.



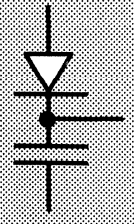
DS1820
1-Wire Thermometer

The 1-Wire Thermometer is ideally suited for building large networks of temperature sensors, e.g., to monitor rooms for a sprinkler system. The third lead of the DS1820 may be used as an optional power supply to speed up temperature sensing.



LEDs
(Light Emitting Diodes)

Due to their high energy efficiency, LEDs controlled by addressable switches (or couplers) are a cheap and reliable indicator in 1-Wire networks. An external power supply allows the brightness to be adapted to the individual requirements.



Energy Reservoir

Whenever there is no possibility of providing a separate wire for power supply, this energy reservoir can steal power from the 1-Wire bus to bias additional circuitry or even to power an LED.

For cables and connectors see pages 38 and 39.

1–WIRE CONCENTRATOR

The 1–Wire Concentrator is an interface that collects data from multiple Touch Memories forming a distributed database and transports it to where it is needed. By allowing data to stay with the objects and processes being identified and monitored, this method of flexible connectivity results in new levels of efficiency.

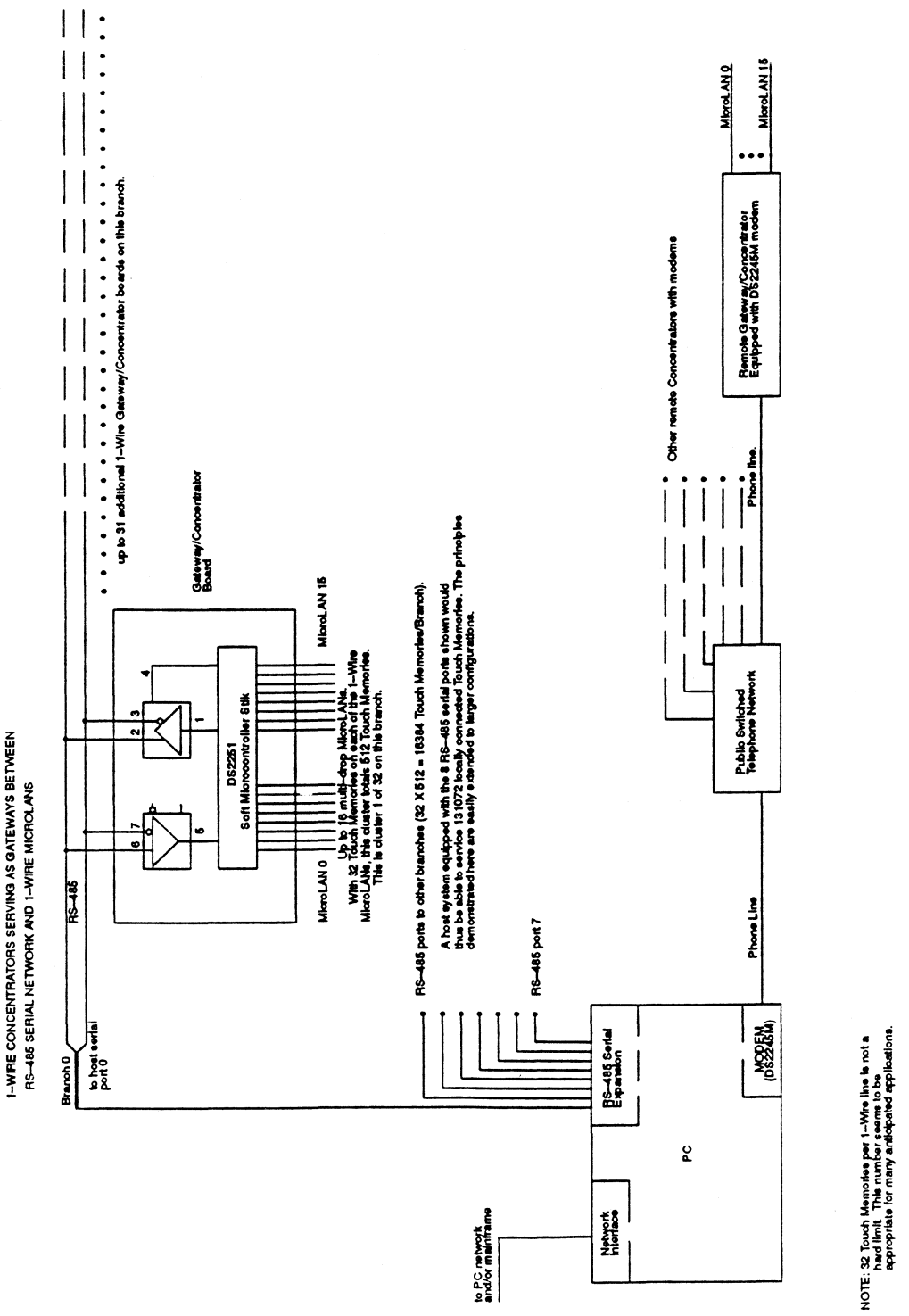
The 1–Wire Concentrator has 8 or 16 1–Wire lines and an asynchronous serial port for connection to higher layers of the network. The Concentrator accommodates RS232 and RS485 serial ports. The RS232 option is suitable when there is a point–to–point connection to a mainframe. With the RS485 option, Concentrators can be multi–dropped on a twisted pair connection to the next network layer. In larger network configurations, there can be an intermediate layer of processors, each of which can be connected to multiple Concentrators configured for RS485 operation.

Each of the 1–Wire lines connected to the Concentrator board is, in fact, a network; for that reason it is called "MicroLAN." Concentrator boards serve as gateways between RS485 serial networks and the MicroLANs.

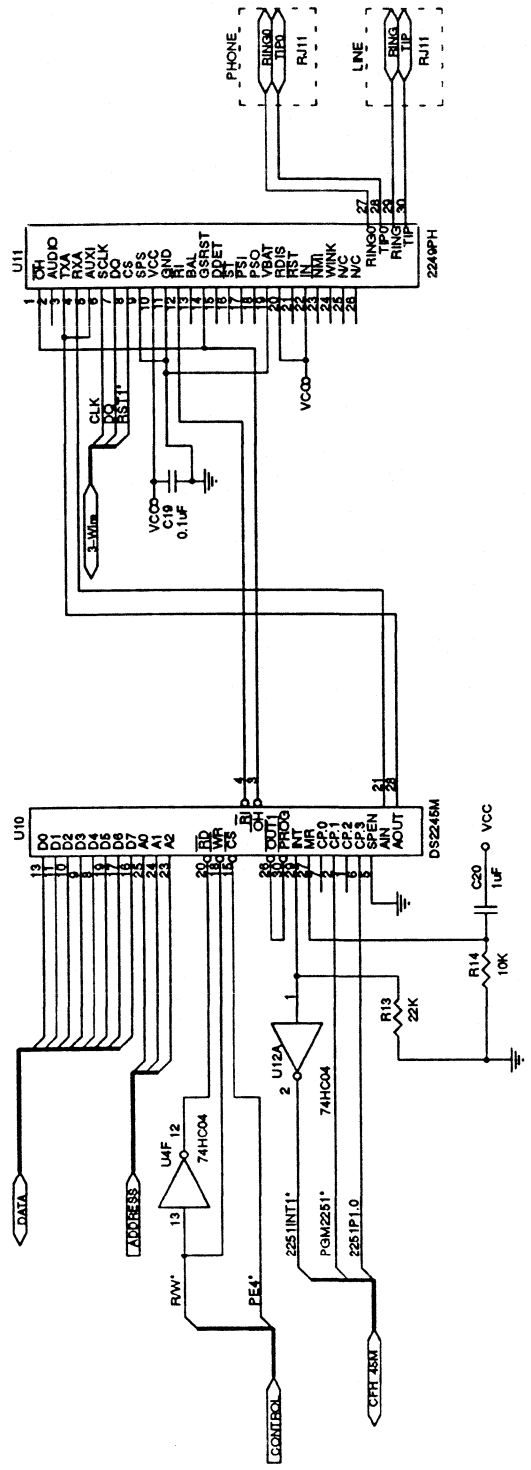
Communication over the Public Switched Telephone Network is also possible with the optional DS2245M Soft Modem and DS2249PH Phantom DAA SIP Stik subassemblies available from Dallas Semiconductor. These components have received FCC Part 68 approval for connection to the US telephone system.

The following figures show an overview of a 1–Wire Concentrator Network, giving details about the phone line interface, the CPU–section of the gateway board and the 1–Wire interface.

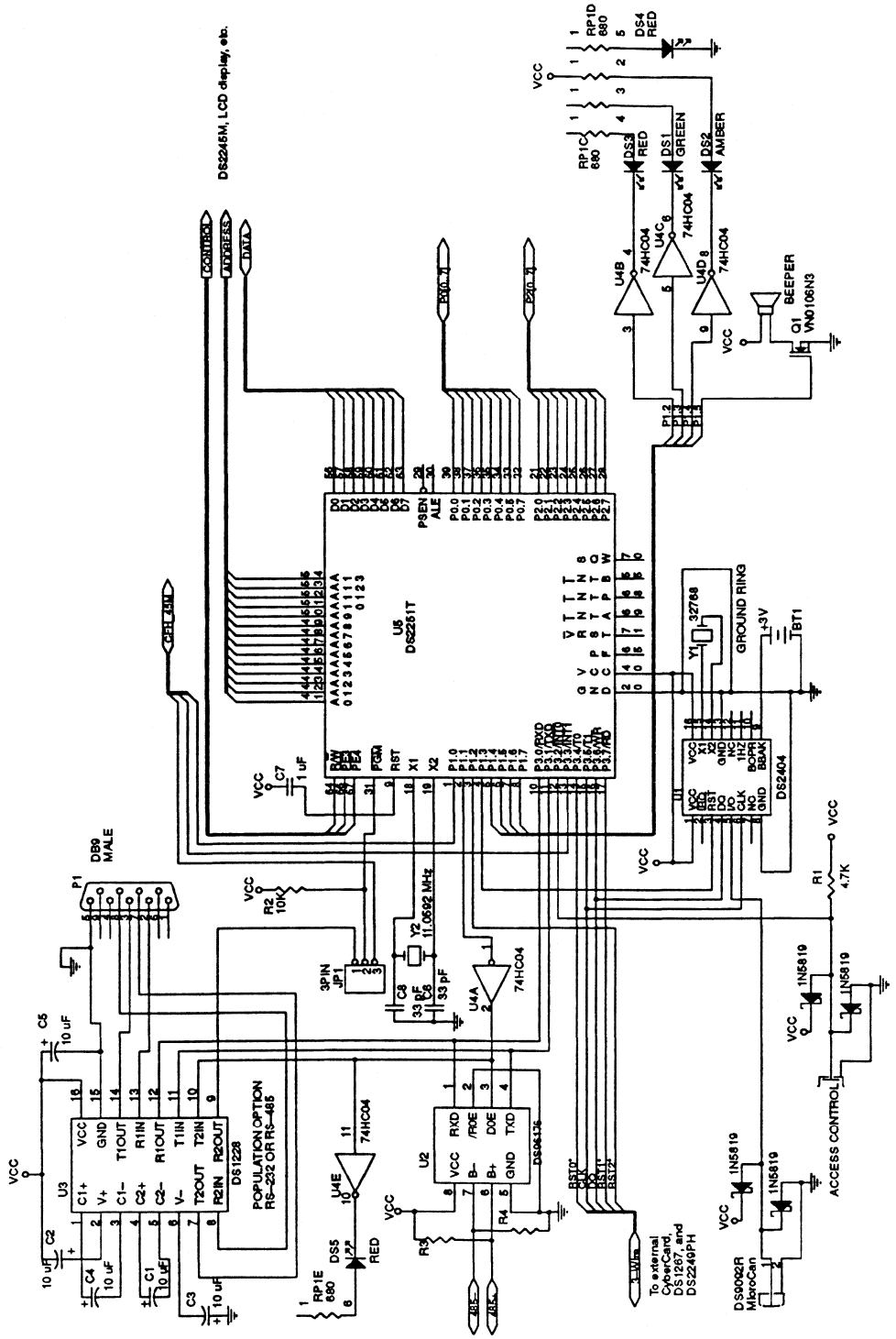
1–WIRE CONCENTRATOR, SYSTEM OVERVIEW



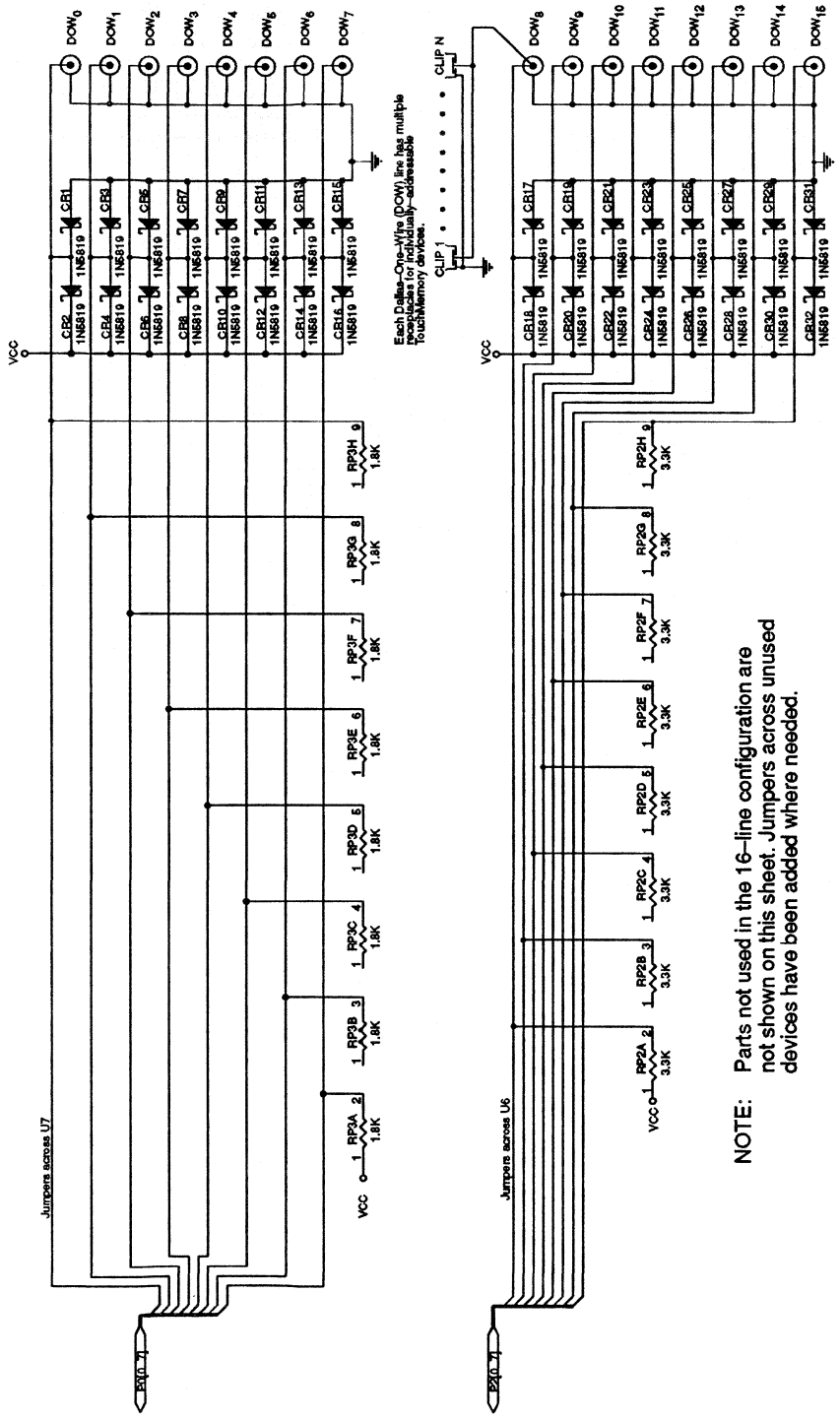
1–WIRE CONCENTRATOR, PHONE LINE INTERFACE



1–WIRE CONCENTRATOR, GATEWAY BOARD, CPU SECTION



1–WIRE CONCENTRATOR, GATEWAY BOARD, 1–WIRE INTERFACE, 16–LINE OPTION SELECTED



NOTE: Parts not used in the 16–line configuration are not shown on this sheet. Jumpers across unused devices have been added where needed.

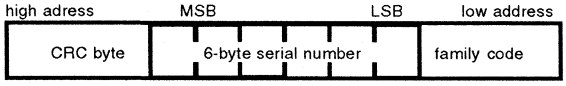
TOUCH MEMORY FILE AND DATA STRUCTURES

ROM SECTION

A uniquely programmed ROM section of 64 bits **(Figure 1)** is common to all Touch Memories. The ROM contents start with a family code, which identifies the type of device. The following 6 bytes are the unique serial number of the individual Touch Memory. The last byte, called CRC, is similar to a checksum. It is required to guarantee error-free reading even if the electrical contact is poor. The CRC is superior to a checksum because it allows detection of the following types of errors:

1) Any odd number of bit errors.
2) All double-bit errors.
3) Any cluster of errors that can be contained within an 8-bit "window" (1-8 bits incorrect).
4) Most larger clusters of errors.

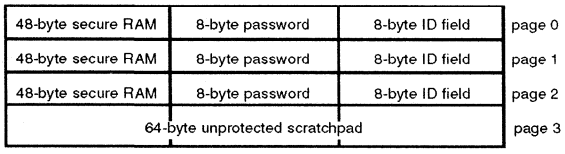
DATA ORGANIZATION ROM Figure 1



NV RAM DEVICES DS199x

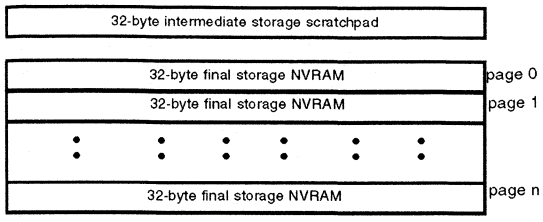
The DS1990A contains only a ROM Section. The DS1991 has a special NV RAM structure because of security features. Its file system is hard-wired, featuring three files with an 8-byte identification field, an 8-byte password and 48 bytes of protected memory. Additionally, there is a publicly accessible NV RAM area called a scratchpad that can be used independently of the protected files **(Figure 2)**.

NV RAM ORGANIZATION DS1991 Figure 2



The DS1992 to DS1996 have no hard-wired file system. The memory of these devices is organized as pages of 32 bytes each **(Figure 3)**. One extra page acts as a scratchpad to store data before it is copied to the final destination. This allows data to be organized in different ways within the device.

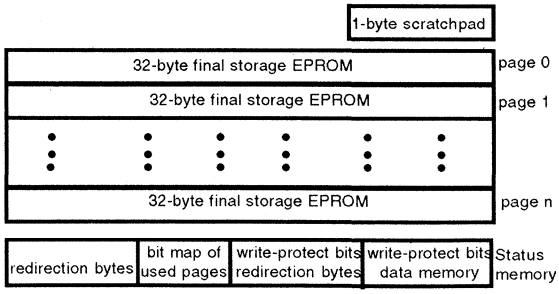
NV RAM ORGANIZATION DS1992-6 Figure 3



EPROM DEVICES DS198X

Although based on a different semiconductor technology, these devices have a memory structure very similar to DS199x Touch Memories. The major differences are a 1-byte scratchpad and a status memory providing means to write protect, mark and redirect pages **(Figure 4)**. Writing EPROM-based Touch Memories requires special hardware (DS9097E); reading is compatible to NV RAM based devices. To safeguard data transfer in situations where data cannot be organized as files, EPROM devices contain a CRC-generator that inserts an 8-bit CRC (DS1982) or an inverted CRC16 (DS1985/6) at the end of each page if a special read command is issued.

MEMORY ORGANIZATION DS198x Figure 4



DATA ORGANIZATION STANDARDS

Standards to organize data in the user-writeable sections are required to allow fast and efficient checking of data integrity. Additionally, standards provide a means to store data from different applications or for different purposes in the same device. The data structures used with Touch Memories have many similarities to floppy disk systems; a page of a Touch Memory resembles a sector of a disk.

CRC16 DATA INTEGRITY CHECK

There are two standards to organize data within the user-writeable memory sections, called "Default Data Structure" and "Extended File Structure." Common to both standards is the length indicator that precedes each set of data and the inverted CRC16 double-byte that follows each set of data. The CRC has the same purpose as with the ROM. Since the quantity of data is much larger, a more sophisticated CRC algorithm is required. The CRC16 allows the detection of the following types of errors:

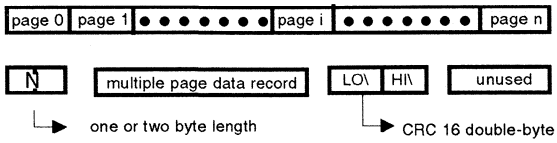
1) Any odd number of bit errors.
2) All double-bit errors.
3) Any cluster of errors that can be contained within a 16-bit "window" (1-16 bits incorrect).
4) Most larger clusters of errors.

The inverted CRC allows the safe transfer of NULL-Packets, which is a data set of length 0 (no data) followed by two bytes FF (CRC-check). (Null-Packets are used as flags to synchronize equipment that communicates with Touch Memories, e.g., the Touch Pen.) Software modules to calculate the CRC16 and the CRC for the ROM section are included in the Book of DS19xx Touch Memory Standards.

DEFAULT DATA STRUCTURE

The Default Data Structure (Figure 5) is the simplest way to store data in a Touch Memory. The first one or two bytes tell the length of the data bytes to follow. If the number of bytes to follow is 255 or greater (up to 508), then the first byte of the length indicator will contain 255 and the next byte will contain the number of remaining bytes (up to 253). The only overhead with this structure is the length-information and the CRC16 double-byte. This structure also simplifies the design of the software to read and write data, which may be important for applications with single-chip microcontrollers.

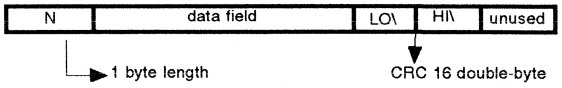
DEFAULT DATA STRUCTURE Figure 5



However, there are limitations to this simple structure. If the device has no hard-wired file system (which is generally the case), then only one unnamed file can be stored. Of course, the remaining data pages may be used, but the user has to be careful no to lose knowledge about the location and meaning of this data. Since the Default Data Structure uses only one CRC16 double-byte at the end of the multi-page application data, it is not possible to perform a CRC-checked reading of a single memory page (unless the device is a DS198x type); the complete file has to be read instead. Furthermore, the definition of the length indicator makes the Default Data Structure not applicable to devices with more than 512 bytes of user-writeable memory.

The Default Data Structure is, however, recommended for use with the DS1991, for data within the secured RAM areas and the scratchpad, if it is used as independent storage. Since the DS1991 does not allow multi-page data records, the data structure is simplified as shown in **Figure 6**.

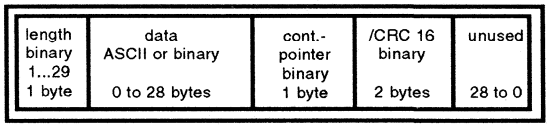
DEFAULT DATA STRUCTURE FOR DS1991 Figure 6



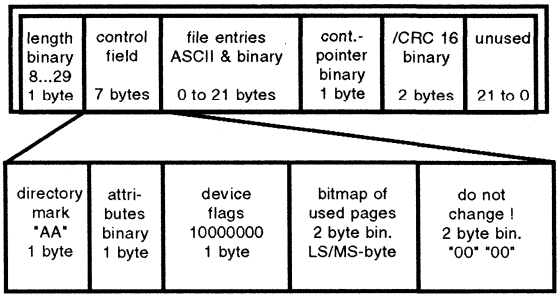
EXTENDED FILE STRUCTURE

To overcome the limitations of the Default Data Structure and to provide the foundation for an operating system, the Extended File Structure has been specified. Special care has been taken to keep compatibility (length byte, inverted CRC16 double-byte) and to be able to recognize either standard when reading a device with an unknown structure. The Extended File Structure is applicable to devices with paged memory. Suitable devices are DS1992 to DS1996 as well as DS1982 to DS1986.

STRUCTURE OF A PAGE OF A DATA FILE Figure 7



STRUCTURE OF THE FIRST PAGE OF THE DEVICE DIRECTORY Figure 8



The Extended File Structure supports a DOS-like file system with unlimited levels of nested directories using Touch Memory devices with a capacity of up to 256 pages of 256 bytes (65,536 bytes). Each individual memory page can be read, CRC-checked or written without affecting other pages. The pages of a file need not be contiguous; if a page of a file cannot store additional data after a modification, another page can be deployed simply by redefining pointers (DS199x-type devices) or by redirecting and patching with data from another page (DS198x-type devices). Since each page contains its own CRC, the Ex-

tended File Structure will allow higher speeds in a difficult operating environment.

The Extended File Structure requires two different types of files: data files, storing application data **(Figure 7)**, and directory files, storing file entries and system management data **(Figure 8)**. The continuation pointer is included for easy extension of files. The end of a file is reached if the value of the continuation pointer is 0.

To support the operating system in allocating free space, the Extended File Structure defines a bitmap to indicate the allocation of memory pages. With NV RAM devices this bitmap is either stored inside the device directory (DS1992/3/4) or in a separate bitmap file (DS1995/6). EPROM devices (DS1985/6) have a section of the status memory reserved to store bitmap information. With NV RAM devices, a used page is marked with a 1, free pages are marked with a 0. Due to their different technology, with EPROM devices the polarity is reversed (free pages are marked with a 1).

STRUCTURE OF A FILE ENTRY Figure 9

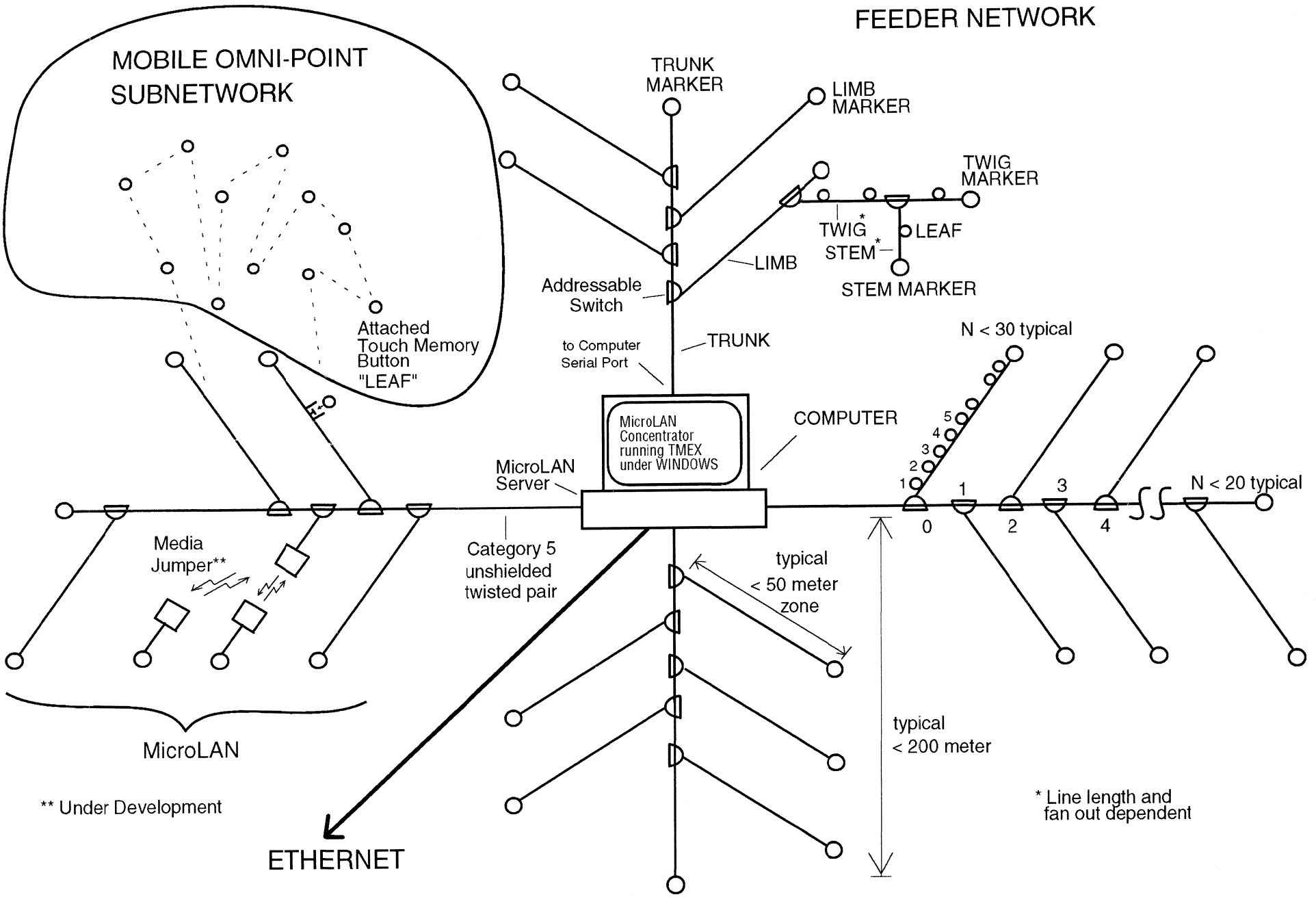
file name ASCII, blank filled, left justified 4 bytes	extension binary 1 byte	start page binary 1 byte	# pages binary 1 byte

The directory entry for each file consists of file name, file extension, start page, and number of pages used to store the data of the file **(Figure 9)**. The Extended File System also allows options like attributes, date/time information, passwords, access control list, owner identification, etc.

SOFTWARE SUPPORT

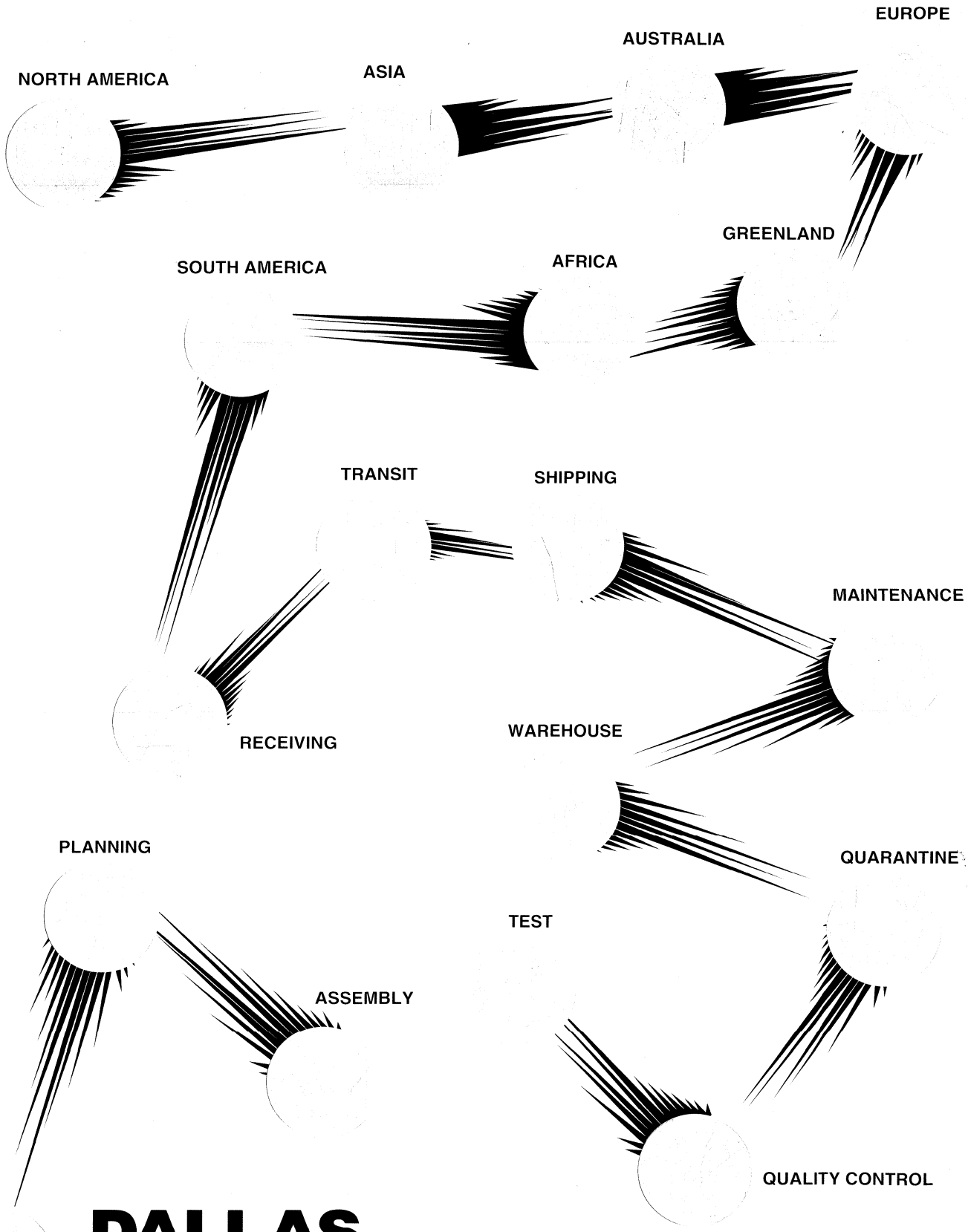
The full description of the Extended File Structure is provided with the Touch Memory Executive TMEX, available as part number DS0620. The TMEX functions are implemented for the MS-DOS environment as interrupt calls. For MS-Windows, the TMEX functions are provided in a Dynamic Link Library (DLL). A detailed description of the TMEX functions is found in Chapter 9 of the Book of DS19xx Touch Memory Standards. In addition to the interrupts and DLLs, a set of utility programs based on TMEX has been developed that can be executed to perform standard file-oriented data transfers to and from Touch Memories. The utility programs TFormat, TType, TCopy, TDir, TAttrib, and TDel perform for Touch Memory the same operations as the corresponding DOS utilities for disk files. All these utilities are shipped as source code and executables together with TMEX.

UNLIMITED NETWORKING



The combination of a Mobile Omni-Point Subnetwork (Roaming Silicon Labels) and a conductivity-based feeder network delivers information to any computer and its associated network. All that is needed to transmit and receive data is an electrically conductive path that can extend up to 300 meters.

A MOBILE OMNI-POINT SUBNETWORK



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