# Modular Flat Panel Mounting and Environments Guide

**CARROLL TOUCH**

TOUCH PRODUCTS

an **AMP** company

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# Welcome

As computers become a part of daily life, a technology that makes them easier to use has become a necessity. Carroll Touch provides the solution through the power of touch.

Because pointing or touching is a natural means of indicating choice, touch systems are ideal for selection-based applications where easy-to-follow menus guide a user through a series of steps or choices. Touch is well accepted by the casual user because its simple, natural interface hides the complexity of computer systems.

The modular flat panel touch system is especially well-suited to rugged environments, such as industrial settings where exposure to chemicals is likely, medical settings where the system must be scrubbed after every use, and public settings (such as kiosks) that subject the system to repeated, possibly abusive use.

Thank you for your interest in Carroll Touch products!

## Purpose

This guide explains the operation of a scanning infrared (IR) touch system and reviews the types of mounting, sealing and coating techniques to adapt an IR touch system to various environmental and chemical factors.

# Audience

This guide is intended for analysts who need to determine how to use and/or adapt an infrared scanning touch system to the needs of their particular application.

# Organization

Chapter 1, “Introduction,” contains a brief technological overview of the ways in which scanning infrared touch systems function. The chapter goes on to list environmental factors affecting touch, such as temperature, ambient light, chemicals, particulate contaminants, moisture, shock and vibration.

Chapter 2, “Flat Panel Mounting Techniques,” illustrates four separate mounting schemes, each of which is designed to increase the functionality of the touch system in reaction to a different environment. The mounting methods include simple, typical NEMA/4, anti-shock/vibration, and industrial/medical.

Chapter 3, “Bezel/Filter Assembly,” shows the modular flat panel bezel and filter and its standard manufacturing material, along with its chemical properties.

Chapter 4, “Sealing and Coating,” discusses the concept of sealing, along with an explanation of how to seal the modular flat panel touch system. The concept of coating and reasons for it are explained, along with Carroll Touch conformal coating.

The Glossary defines terms that are unique or whose usage is unique to touch.

# Conventions

For clarity, this guide uses certain conventions to visually distinguish different types of information. The conventions are:

- **Bold** is used to emphasize a word or phrase, including definitions of important concepts.
- Information of particular importance or actions that may have undesirable results if performed improperly are included under the headings ***Note*** and ***Caution***.

# 1 Introduction

This chapter contains a brief technological overview of scanning infrared touch systems and describes the environmental factors that affect touch, such as temperature, shock and vibration, chemicals, moisture, ambient light, and particulates. A brief analysis of the environmental factors present in various locations is also included.

The topics covered include:

- Technological Overview.
- Environmental Factors.
- Application Environments.

# Technological Overview

The operation of all scanning infrared (IR) touch systems is based on the creation of a grid of IR light beams above the viewing surface of a CRT monitor or flat panel display and the recognition of the location at which individual beams within the grid are interrupted. To create such a grid, IR light emitting diodes (LEDs) are paired with phototransistors, each set constituting an opto-pair or physical beam, to create a horizontal (x-axis) and a vertical (y-axis) array of beams. The two arrays of beams and their circuitry make up an opto-matrix frame, as shown in Figure 1-1.

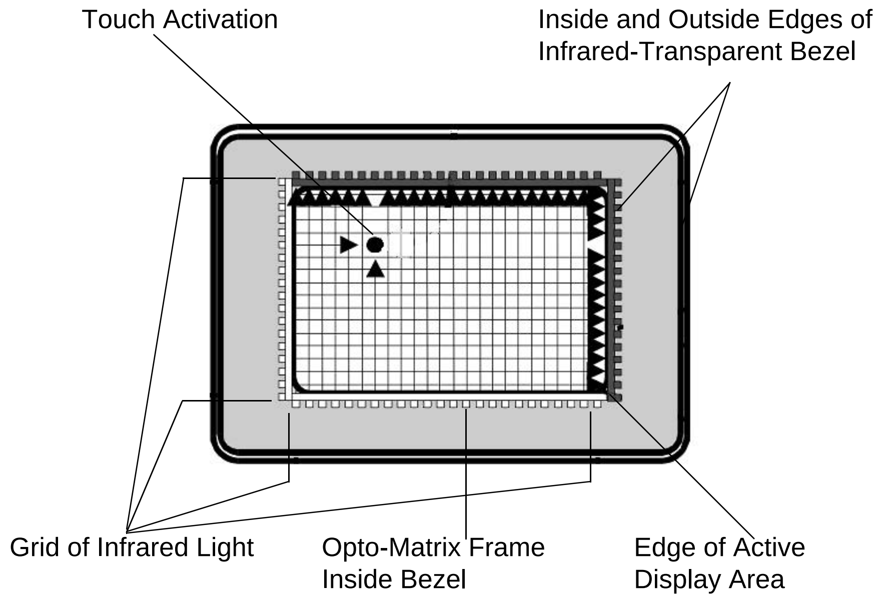


Figure 1-1. Scanning Infrared Technology

As shown in Figure 1-2, a Carroll Touch modular touch frame designed to function with a flat panel is composed of an opto-matrix frame, an IR-transparent protective bezel, and a transparent filter. To complete the touch system, the modular touch frame is linked to a modular touch controller via the modular digital interface (MDI), which is a standard 8-pin telephone-type plug attached to the touch frame by an 8-pin cable.

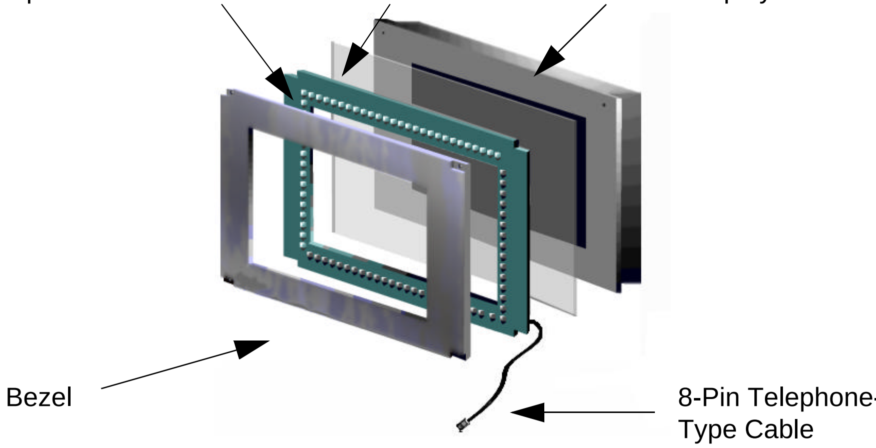


Figure 1-2. Modular Flat Panel Touch System Components

# Environmental Factors

Traditionally, the successful implementation of a scanning IR touch system has required that certain factors in the operational environment be addressed. Historically, the environmental factors that could influence the operation of a touch system were temperature, shock and vibration, chemicals, moisture, ambient light, and particulate contaminants (dust, dirt, etc.). Today's Carroll Touch modular touch systems with their improved hardware, software and firmware, compensate for these environmental conditions, along with such factors as misalignment or degradation of the opto-electronic devices, reducing their ability to affect touch system operations.

## *Temperature*

Carroll Touch's use of solid state electronics and its ASIC-based modular circuitry enables the touch system to withstand and adapt to temperature extremes as well or better than the host display and system.

The standard Carroll Touch modular flat panel system is designed to function in the temperature range from 0° C to 50° C (32° F to 122° F) and can be stored in the range from -20° C to 75° C (-4° F to 167° F). Customer systems have been designed to function at temperatures from -55° C to 125° C (-67° F to 257° F). For heat dissipation, Carroll Touch modular touch systems are designed to operate at altitudes up to 10,000 feet (3,048 meters) and at 0% to 95% non-condensing humidity, over the full temperature range.

## Shock and Vibration

Carroll Touch modular flat panel touch systems can more than withstand shock and vibration conditions that will disable a typical flat panel display. The lightweight solid state circuit card assemblies, because of their low mass, are relatively immune to shock and vibration, as are the other components of the system.

In the unlikely event that a beam is lost to severe local shock, fault tolerance begins and the touch system continues to function by virtue of its failed beam algorithms while reporting the beam loss.

## Chemicals

The modular touch system relies on the basic properties of the materials from which it is manufactured for environmental protection. The polycarbonate resins from which the touch system components are manufactured and their resistance to harsh chemicals and environmental extremes are discussed in Chapter 3.

If chemical factors make your operating environment unsuitable for some components of the touch system, other materials and coatings for touch systems and their components are available. These materials and coatings, along with tips on sealing the touch system, are discussed in Chapter 4.

## Moisture

Carroll Touch modular flat panel touch system are designed to function at up to 95% non-condensing humidity. In addition, modular flat panel systems can be sealed, making the touch system impervious to precipitated moisture, such as rain, dousing, or sprinkling, as long as it is mounted in a vertical position. As shown in Figure 1-3, an improperly mounted system can permit water to pool in the face of the modular system, absorbing a portion of the IR beam strength. The programmable gain features built into the ASIC and firmware will compensate for losses of beam strength in the range of 50-90% with no system failure.

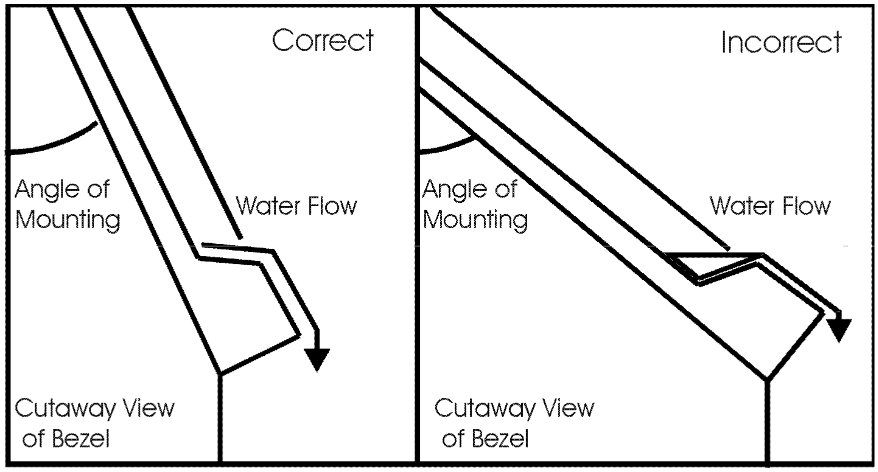


Figure 1-3. Mounting to Prevent Moisture Accumulation

## Ambient Light

Since IR touch systems operate using the IR portion of light, **ambient light**, the light in the touch environment, has long been a source of concern. Ambient light has varying levels of IR radiation, depending on whether the source of visible light is IR rich, as is sunlight, or IR poor, as is fluorescent light commonly used in offices. A high ambient light level in the well lit office would have little effect on the functionality of a scanning IR touch system.

Carroll Touch has developed advanced design techniques that allow the modular flat panel touch system to adjust to high levels of ambient light. These methods involve hardware design and the use of patented signal processing circuitry and algorithms, which can handle very high ambient light levels. Carroll Touch modular flat panel touch systems can tolerate well over 7,500 footcandles, and operate in full sunlight with only minor modification. Typical ambient light measurements are given in Table 1-1.

Table 1-1. Environmental Light Strengths

| Ambient Light | Footcandles | Ambient Light | Footcandles |
|---|---|---|---|
| Direct sunlight | 10,000 | Twilight | 1 |
| Indirect sunlight | 4,000 | Well lit office | 80 |
| Overcast day | 100 | Well lit factory | 70 |
| Dark overcast day | 10 | | |

### *Particulates*

Particulate contaminants such as dust, powder, smoke, and other particles found in the atmosphere of offices, manufacturing facilities, industrial and outdoor sites, have been considered the most common environmental hazard to IR touch systems. The two traditional places for such buildup were on the outer surface of the protective bezel, and on the IR LEDs and phototransistors themselves. The buildup of particulates around the LEDs and receivers is easily prevented by basic sealing. Today's modular systems are so easily sealed that such buildup is preventable at little cost. Guidelines for sealing a modular flat panel touch system can be found in Chapter 4 of this guide.

While particulate buildup on the protective bezel can lower signal strength in the opto-matrix grid, the integrity of the touch system is safeguarded by programmable gain and servo-loop circuitry. This circuitry and the attendant firmware dynamically compensates for degradation of the opto-electronic devices and for the effects of such environmental factors as ambient light variation and the accumulation of particulate contaminants.

Despite this built-in protection against weakened signal strength caused by buildup of particulates, the outer surface of the protective bezel should be dusted and/or cleaned with a mild soapy solution as needed.

## Application Environments

Table 1-2 identifies four types of application environments, gives examples of each, and lists the environmental factors common to each.

Table 1-2. Application Environments

| Application Environment | Typical Locations | Environmental Factors |
|---|---|---|
| Indoor | Offices, lobbies, schools, retail | Particulate contaminants |
| Outdoor | Outdoor information kiosks, automated teller machines (ATMs) | Particulate contaminants, moisture, chemicals, ambient light, temperature, shock |
| Industrial | Manufacturing facilities, laboratories, normal shop floor environments | Particulate contaminants, moisture, chemicals |
| Harsh | Ruggedized industrial equipment, aircraft, vehicles, severe shop floor environments | Particulate contaminants, moisture, chemicals, ambient light, temperature, shock and vibration |

# 2 *Mounting Techniques*

This chapter describes and illustrates four separate mounting schemes, each of which is designed to increase the functionality of the touch system in a different environment. The mounting methods include:

- Simplest Mounting Method.
- Typical NEMA 4 Mounting Method.
- Anti-Shock/Vibration Mounting Method.
- Industrial or Medical Mounting Method.

# Simplest Mounting Method

The simplest mounting technique provides effective sealing by merely using industrial strength double-sided tape to adhere both the touch system and the host display to the inside of a kiosk or enclosure opening. Front and side views are shown in Figures 2-1 and 2-2.

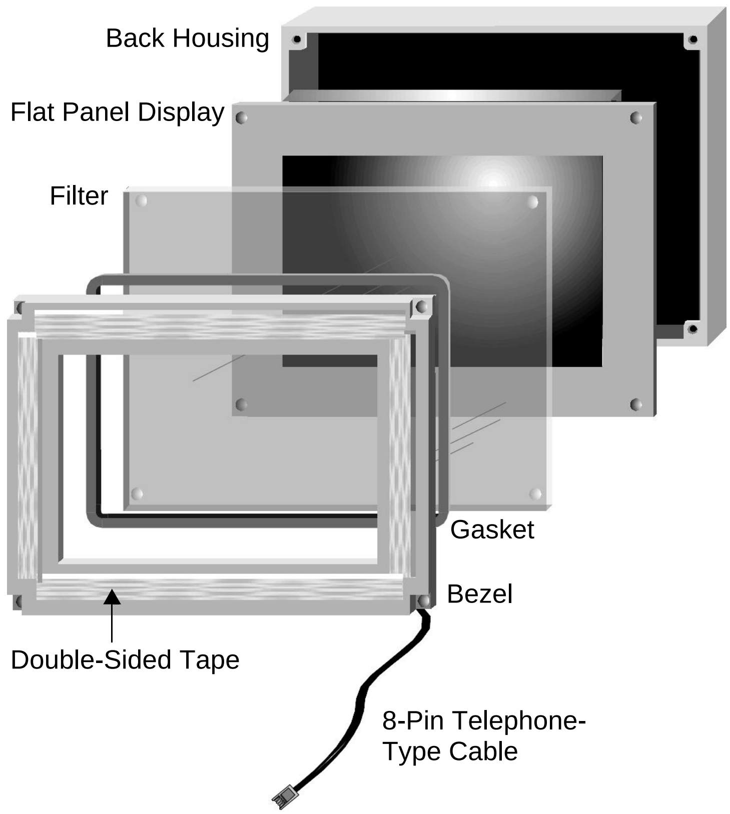


Figure 2-1. Simplest Mounting Method (Front View)

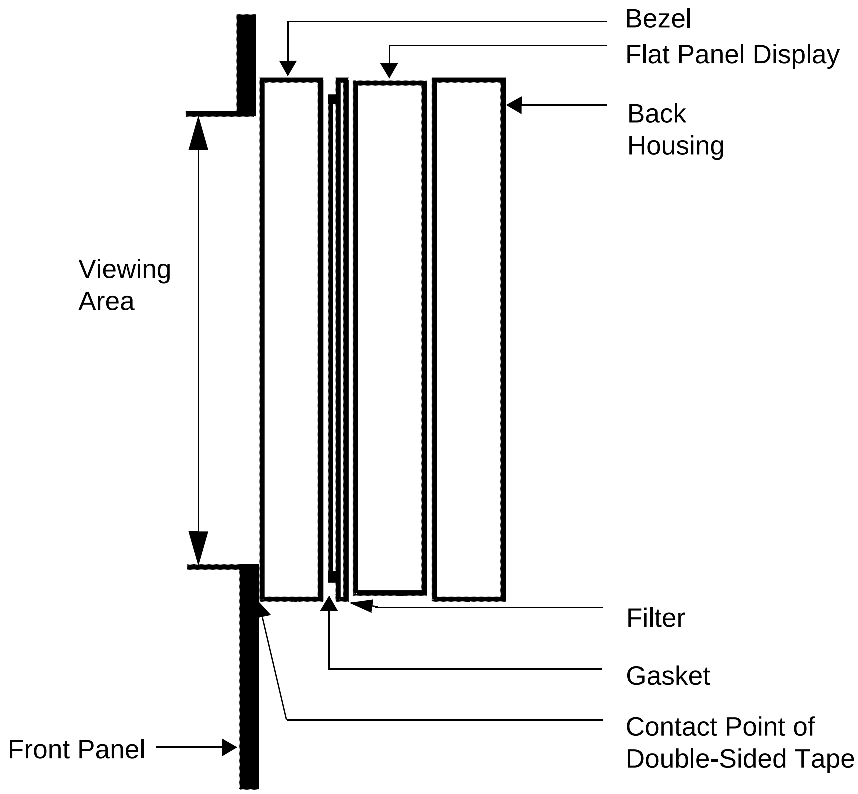


Figure 2-2. Simplest Mounting Method (Side View)

# Typical NEMA 4 Mounting Method

Figures 2-3 and 2-4 show the front and side views of a typical NEMA 4 sealable mounting. For more information on gasketing materials, see Chapter 4 of this guide.

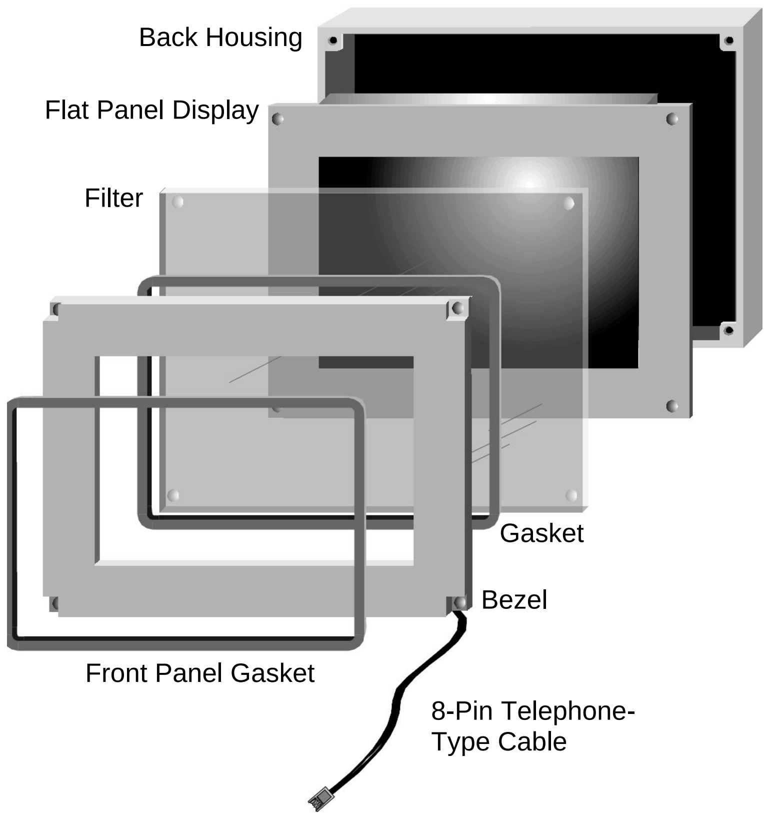


Figure 2-3. Typical NEMA 4 Mounting Method (Front View)

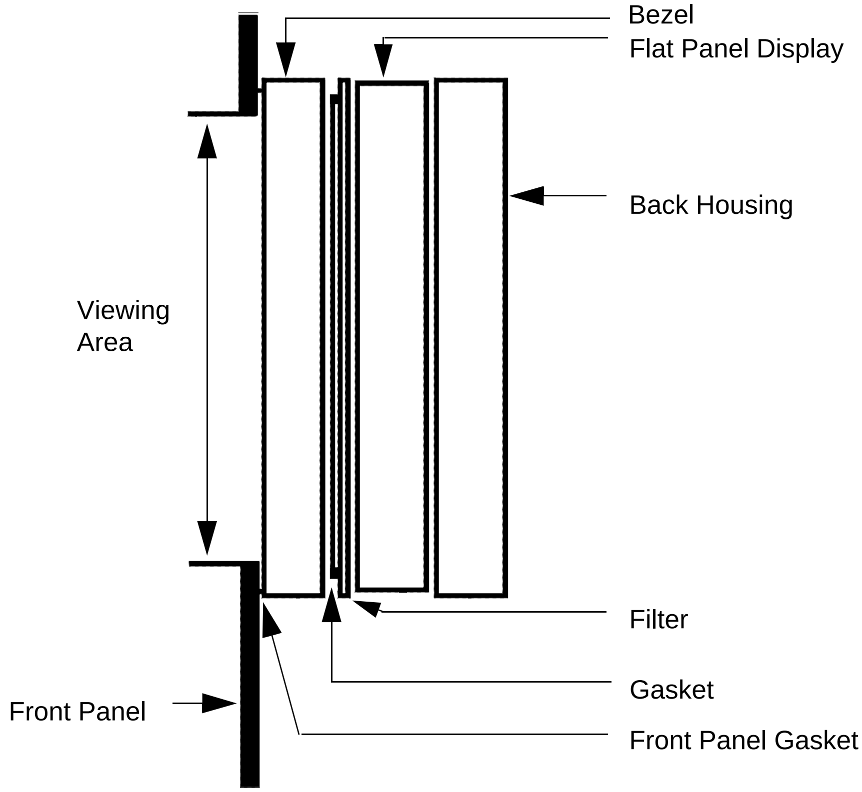


Figure 2-4. Typical NEMA 4 Mounting Method (Side View)

# Anti-Shock/Vibration Mounting Method

The shock and vibration resistance of a Carroll Touch modular touch system can be further enhanced by mounting techniques such as the one shown in Figure 2-5. This mounting is used in commercial aircraft and must withstand the vibration of the aircraft engines and the shock of air turbulence and landings, which can often be measured in impacts of multiple Gs of force.

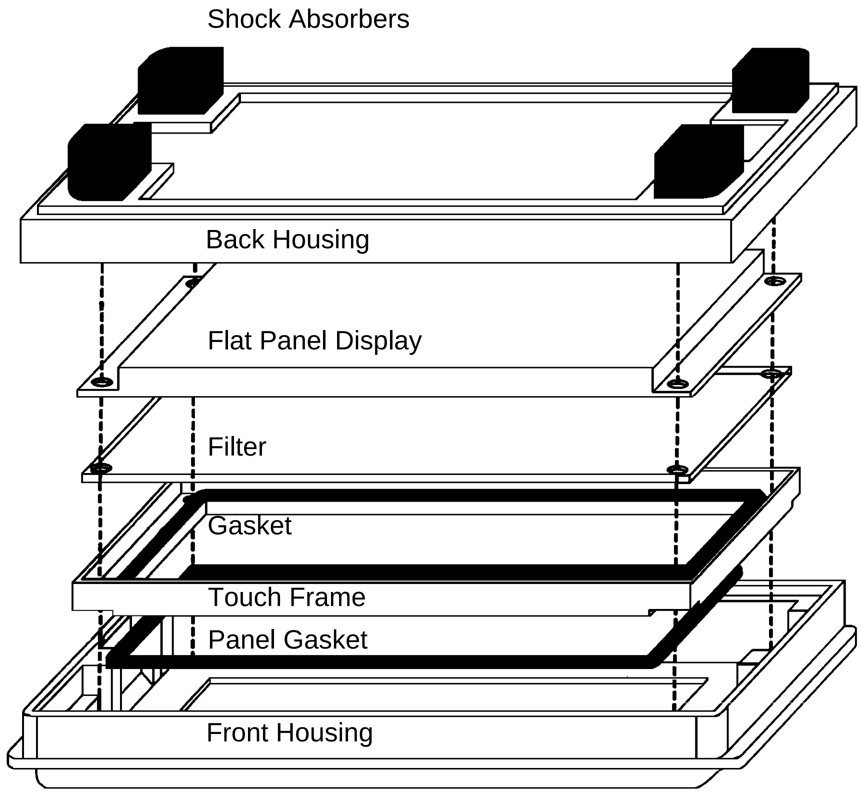


Figure 2-5.  Anti-Shock/Vibration Mounting Method

# Industrial or Medical Mounting Method

The sealing of a touch system is nowhere more important than in the surgical operating room (O.R.), where the entire system must be scrubbed between uses. The capacity to seal a system can be enhanced by the mounting techniques shown in Figure 2-6. The use of a Carroll Touch modular touch system and compact flat panel display in cramped conditions such as those found in the surgical O.R. is further supported by the touch frame's capacity for being located up to six feet from its host computer, connected only by a standard 8-pin telephone-type jack and cable.

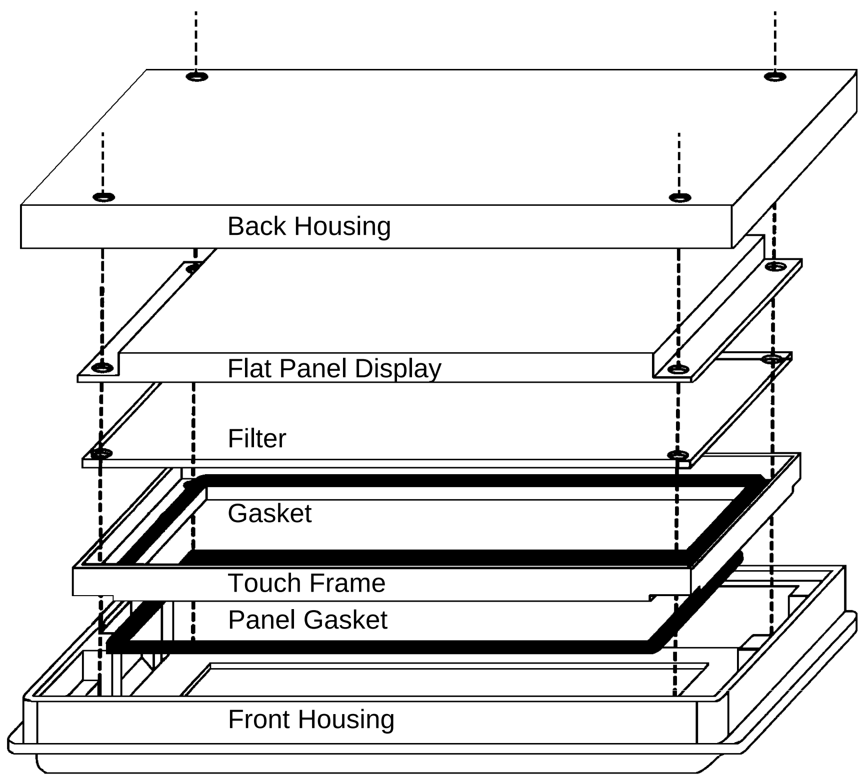


Figure 2-6. Industrial or Medical Mounting Method

# 3 *Bezel/Filter Assembly*

This chapter describes the component materials and chemical properties of the bezel/filter assembly. Topics discussed include:

- Component Materials.
- Polycarbonate Chemical Resistance.

# Component Materials

The IR-transparent protective bezel used by Carroll Touch's standard modular flat panel touch systems, shown in Figure 1-2, is vacuum formed from polycarbonate resin. This same resin in transparent grades is used to form the standard touch system filter.

From a wide spectrum of possible manufacturing materials, polycarbonate was chosen because it is rugged, IR-transparent and thermoformable. Indeed, this material is so impact resistant that it is used for bulletproof glass. Polycarbonates maintain their physical strength far past 100° C, even under impact testing.

Modular touch system filters with special optical properties such as polarization, anti-glare and anti-reflection are available from Carroll Touch. Polarizing filters are more sensitive to temperature extremes than polycarbonate filters. Contact Carroll Touch for options and details.

# Polycarbonate Chemical Resistance

Certain combinations of chemical environments, temperature, and stress can adversely affect thermoplastic parts made from polycarbonate resin. For this reason, lubricants, gaskets, O-rings, cleaning solvents, or any other material that may come in contact with the finished part should be carefully evaluated under end-use conditions for compatibility.

Polycarbonate resin is generally stable to water, mineral acids and organic acids.

Testing of the polycarbonate resins used in the manufacture of Carroll Touch touch system components has yielded the results shown in Table 3-1. However, interpretation of the test results is somewhat subjective. If a material is found to be incompatible in a short term test, it will usually be incompatible in the field. The converse, however, is not always true. Favorable performance is no guarantee that actual end-use conditions have been duplicated.

### *Caution*

The results of these tests should be used as a guide only. We recommend that you test production parts under true end-use conditions.

Table 3-1. Effects of Chemical Classes on Polycarbonates

| Chemical Class | Effects |
|---|---|
| Acids | No effect under most common conditions of concentration and temperature. |
| Alcohols | Generally compatible at low concentration and room temperature. Higher concentrations and elevated temperatures results in etching and attack, evidenced by decomposition. |
| Alkalis | Generally compatible at low concentration and room temperature. Higher concentrations and elevated temperatures results in etching and attack, evidenced by decomposition |
| Aliphatic Hydrocarbons | Generally compatible. |
| Amines | Surface crystallization and chemical attack. Avoid. |
| Aromatic Hydrocarbons | Partial solvents and severe stress cracking agents (i.e., xylene, toluene). Avoid. |
| Detergents and Cleaners | Mild soap solutions are compatible. Avoid strong alkaline materials. |
| Esters | Cause severe crystallization. Partial solvents. Avoid. |
| Halogenated Hydrocarbons | Solvents. Avoid. |
| Ketones | Cause severe crystallization and stress cracking. Partial solvents. Avoid. |
| Silicone Oils and Greases | Generally compatible up to 185° F. Avoid those that contain aromatic hydrocarbons. |

## Polycarbonate is dissolved by the following substances:

| | | | |
|---|---|---|---|
| Chloroform | Dioxane | Methylene chloride | Pyridine |
| Cresol | Ethylene dichloride | | |

## Polycarbonate may not be resistant to the following substances:

| | | | |
|---|---|---|---|
| Acetaldehyde | Butyric acid | Ethane tetrachloride | Phosphorous trichloride |
| Acetic acid (concentrated) | Carbolic acid | Ethylamine | Propionic acid |
| Acetone | Carbon disulphide | Ethyl ether | Sodium sulfide |
| Acrylonitrile | Carbon tetrachloride | Ethylene chlorohydrin | Stryrene |
| Ammonium fluoride | Caustic potash sol (5%) | Formic acid (concentrated) | Sulfuryle chloride |
| Ammonium sulfide | Caustic soda sol. (5%) | Freon (refrigerant and propellant) | Tetrahydronapthalene |
| Benzene | Chlorobenzene | Nitrobenzene | Thiophene |
| Benzoic acid | Cyclohexanone | Nitrocellulose lacquer | Toluene |
| Benzyl alcohol | Cyclohexane | Phenol | Xylene |
| Bromobenzene | Dimethyl formamide | Phosphorous hydroxy chloride | |

## Polycarbonate has limited resistance to the following substances:

| | | | |
|---|---|---|---|
| Cyclohexanol | Hydrochloric acid (concentrated) | Nitric acid (concentrated) | Sulphuric acid (concentrated) |
| Gasoline | Milk of lime (CaOH) | | |

At room temperature, polycarbonate is resistant to the following substances:

Acetic acid (20%)
Aluminum chloride
Aluminum sulphate
Ammonium chloride
Ammonium nitrate
Ammonium sulphate
Antimony trichloride
Arsenic acid (20%)
Axle oil
Beer
Borax
Brake fluid
Butyl alcohol
Calcium chloride
Calcium nitrate
Castor oil
Cement
Chlorinated lime paste
Chlorinated lime sol. (2%)
Chrome alum
Chromic acid (20%)
Citric acid (40%)
Cocoa
Coffee
Cognac
Compressor oil
Copper chloride
Copper sulphate
Cuprous chloride
Cyclohexane
Decahydronapthalene
Diesel oil
Ethyl alcohol (96%)
Fish oil
Floor polish
Formic acid (10%)
Formalin (30%)
Gasoline (low aromatic)
Glazier’s putty
Glycerine
Glycol
Grapefruit peel, juice
Gypsum
Hydrochloric acid (10% & 20%)
Hydrogen peroxide (30%)
Hydrofluoric acid (20%)
Ink
Iron chloride
Iron sulphate
Insulating tape
Isoamyl alcohol
Lactic acid
Linseed oil & varnish
Liqueur
Magnesium chloride
Magnesium sulphate
Manganese sulphate
Mercuric chloride
Milk
Mineral heating oil
Mineral water
Mustard
Nickel sulphate
Nitric acid (10% & 20%)
Oleic acid
Orange juice, peel
Oxalic acid
Paraffin oil
Pentane
Petrol
Petroleum ether
Phosphoric acid, concentrated
Potassium aluminum alum
Potassium bichromate
Potassium bromate
Potassium bromide
Potassium chloride
Potassium nitrate
Potassium perchlorade
Potassium permanganate
Potassium persulphate
Potassium sulphate
Propyl alcohol
Rapeseed oil
Refined oil
Rum
Salad oil
Salt solution (10%)
Silicone oil
Silver nitrate
Soap (soft & hard)
Sodium bicarbonate
Sodium bisulphate
Sodium bisulphite
Sodium carbonate
Sodium chlorate
Sodium chloride
Sodium hypochlorite
Sodium sulphate
Spindle oil
Stannous chloride
Sulphur
Sulphuric acid (10% & 20%)
Tartaric acid (30%)
Tincture of iodine
Tomato juice, concentrate
Transformer oil
Trichloroacetic acid
Turpentine
Vacuum pump oil
Vinegar
Vodka
Water
Wine
Zinc chloride
Zinc sulphate

# 4 *Sealing and Coating*

Once an application environment is analyzed, most customers find that they will be able to use Carroll Touch modular flat panel touch systems without any adaptation. However, in some instances, it may be necessary to enhance the standard touch system with additional sealing or conformal coating.

This chapter discusses the following topics:

- Sealing.
- Coating.

# Sealing

As shown in Figure 4-1, the modular flat panel touch system is sealed by the application of gasketing material or sealant between the two contact edges of the IR-transparent protective bezel and the filter. This seal provides adequate protection against accidental exposure to liquids, such as that involved in cleaning or spillage.

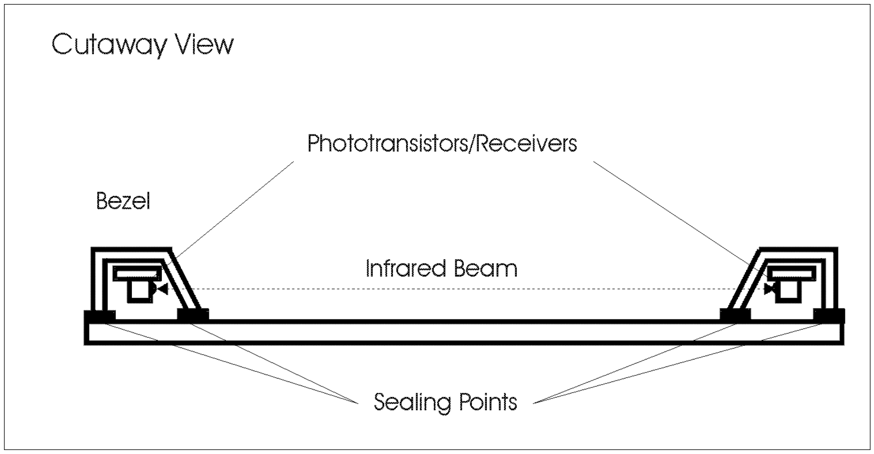


Figure 4-1. Modular Flat Panel Touch System Sealing

Modular bezels are fitted with gasket material at the factory. Carroll Touch offers enhanced sealing with assorted sealants and gasket materials as a custom service.

With CRT touch systems, gasketing is the preferred method, since it allows easy disassembly and efficient access for cleaning and maintenance of the touch system. The amount of cleaning required is dependent on the amount of dust or moisture in the environment and the quality of the seal. Unlike CRT monitors, flat panels do not attract dust. Therefore, the buildup of dust in the interior of a modular flat panel touch system does not occur.

Gasket material characteristics that must be considered are compression resilience (how the material bounces back after compression), and moisture and chemical resistance. Recommended gasket materials are polyester, urethane, and silicone.

Polyester and urethane are available as open cell or closed cell materials. Open cell polyester and urethane cost less than silicone. Closed cell sealing material is preferred in environments containing moisture or chemicals. Polyester and urethane are resistant to ozone, oxidation and hydrocarbons and can withstand wide temperature variations.

Silicone is an environmentally inert material available in sponge or solid form. It is recommended for application environments that involve electrostatic discharge, severely caustic or actively corrosive chemicals, high moisture, broad temperature ranges, oxidation, or acids.

# Coating

In the case of certain high density or high current circuits, or in harsh or explosive environments where the intent is to prevent corrosion, erosion, arcing or sparking, or in the face of critical service issues where the failure of a circuit could cause loss of human life, conformal coating is used as a second method to seal a circuit. Carroll Touch has used conformal coating only rarely in the past for extremely ruggedized or military applications.

**Conformal coating** is a polyurethane resin insulating compound that is sprayed on or washed over the printed circuit board assembly during the manufacturing process. It may be required in outdoor information systems, shipboard applications, industrial environments, or wherever moisture or corrosives must be prevented from entering the system. Conformal coating is the ultimate seal for the touch system, providing an excellent environmental shield from fungus, thermal shock, moisture and chemicals such as sulphuric acid.

# Glossary

| | |
|---|---|
| ambient light | The level of light to be found in the physical environment of a given touch application, normally measured in lux or footcandles. |
| axis (x-axis, y-axis) | The two dimensions that make up the touch coordinate system. The x-axis (horizontal) is composed of the vertical physical beams or opto-pairs (the physical x-axis). The y-axis (vertical) is composed of the horizontal physical beams or opto-pairs (the physical y-axis). |
| beam | The infrared light transmitted by an IR LED and received by a phototransistor, which are set opposite each other in the touch frame. |
| bezel | The IR-transparent plastic protective housing of the modular flat panel touch frame, which is fastened to the filter. |
| broken beam | A beam in which the infrared light level received by the IR-sensitive phototransistor falls below a threshold value set by the touch system firmware. In normal operation, this is due to the user’s finger obstructing the beam path from the LED to the phototransistor. However, broken beams may also result from a defective LED, phototransistor, or other touch system hardware, and from other obstructions of the beam path. *See also* beam. |
| host (host system) | The computer system to which the IR touch system is added. |
| MDI | *See* modular digital interface (MDI). |
| modular digital interface (MDI) | The frame-to-controller interface created by confining all analog functions to the frame. The MDI makes a standard touch frame controller-independent and reduces the touch system cabling requirement to a simple 8-pin standard phone cable up to six feet long. |
| opto-matrix frame | A rectangle, each side of which is comprised of a circuit board. Two adjacent circuit boards contain banks of IR LEDs, while the second two contain banks of complementary phototransistor receivers. The horizontal boards contain the banks of opto-pairs that make up the x-axis of the touch screen. The vertical boards contain the banks of opto-pairs that make up the y-axis of the touch screen. |
| opto-pair | The LED/phototransistor combination that transmits and receives an IR beam. *See* beam. |
| touch controller | The circuitry and firmware necessary to interpret touch data for a host computer. |

| | |
|---|---|
| touch frame | The portion of the modular touch system that consists of the opto-matrix frame, the IR-transparent protective bezel and the modular digital interface (MDI). |
| touch system | The collection of all the components that are necessary to detect a touch and report it to the host. This collection usually consists of the touch frame or screen, protective bezel, and touch frame controller. |

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