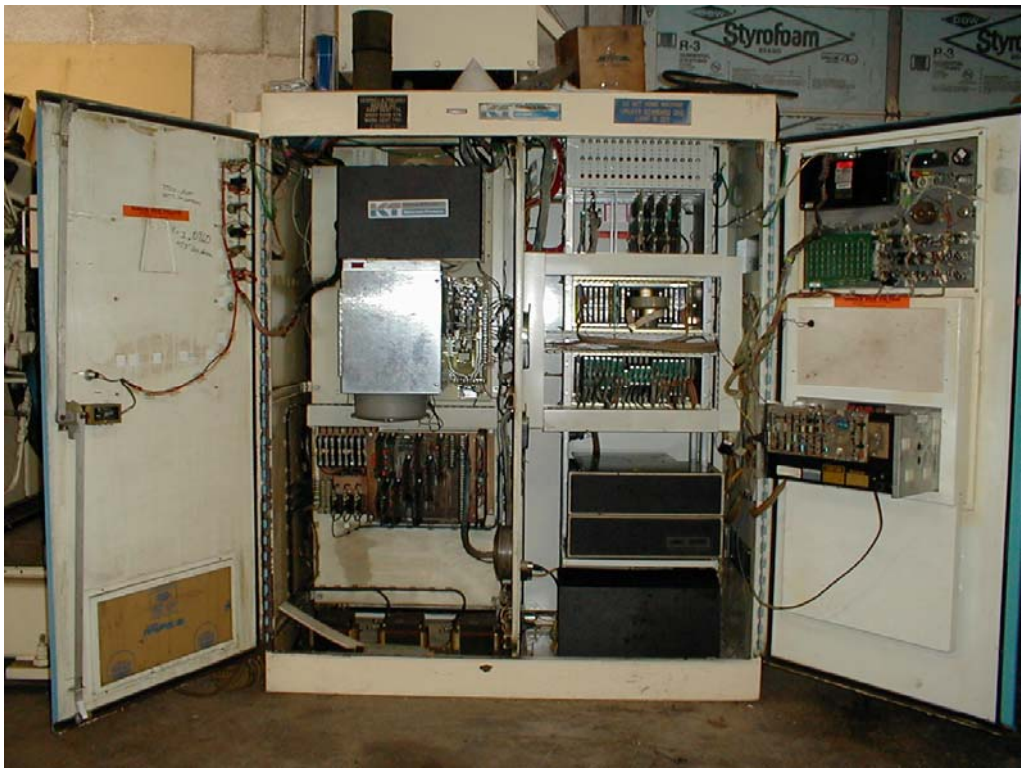
Retrofit of a Kearney & Trecker MM180

Though the Kearney & Trecker Company (Milwaukee, Wisconsin) was absorbed by Giddings & Lewis (Fond du Lac, Wisconsin) about a decade ago and only the Orion line of machines is still in production, many of its old Milwaukee-Matic machining centers are still cutting parts all over the world. The K&T MM180 horizontal machining centers were sold in the years around 1980 and many are still around, although some might have lost their 'cutting capability' due to difficulties maintaining the old CNC control. They were sold with either the K&T C or D controls. By retrofitting the machine with a new control, the machine can run as well as when new and can be maintained for many more years to come.

Mark Rice, an integrator based in the Dallas, Texas area, was recently involved in the retrofit of an MM180 with the K&T C control. An engineer at Fisher Controls approached Mark regarding a customer, Gunther, with a number of K&T machines. The C controls were having severe reliability problems mainly due to the age of its computer. An MM180 with the K&T C control is shown below.

The K&T C controls used a PDP-8 computer manufactured by Digital Equipment Corporation; it was found in many industrial applications in the 1970's. The D and E controls used a K&T-designed computer; the D was initially released around 1980 and the E was released a few years later. The K&T computer's internal dual bus design for the computer instructions and data resulted in the Gemini designation (that is applicable to both the D and E models). The inside of the C control is shown in the next photo; the PDP-8 computer is at the lower right on the back panel and its racks of IO cards are at the middle right. The spindle drive is at the upper left of the back panel; the axis drives are at the lower left.



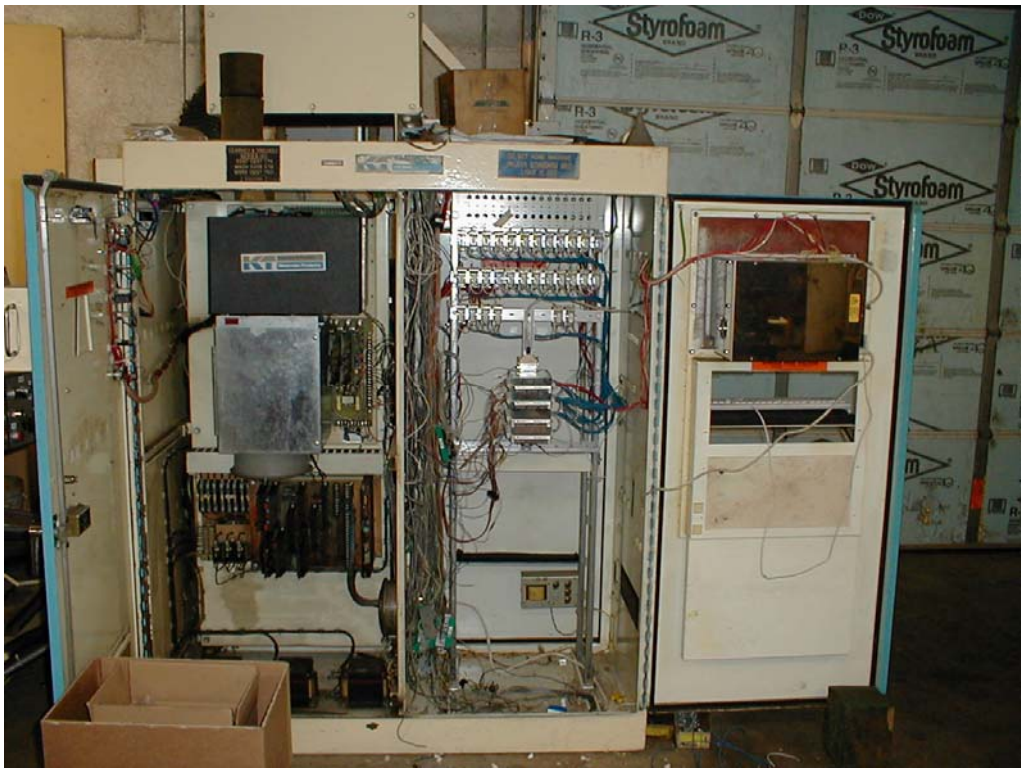
The MM180 has four axes (three linear axes and one indexing table) with the single spindle. The machine also had a pallet shuttle to allow an operator changing parts while the machine was busy cutting. A round tool carousel (controlled by several hydraulic solenoids) with 30 pockets was mounted on the back of the spindle's column.

Mark Rice decided to use the **MACHINEMATE** CNC control for this retrofit because he has found that it is the control that meets the needs of the market. Mark had recognized in the mid-80's that PC hardware would eventually make it on the shop floor, because of the lower cost and the platform's expandable features. He tried several PC-based motion control cards from different vendors and encountered serious reliability problems. Without a true real-time operating system basis, the machine performance would not be consistent over all IO conditions. The **MACHINEMATE** control has true real-time interrupt servicing so this problem does not exist in the **MACHINEMATE** CNC system.

Proprietary CNC systems are not flexible in a changing market. Open PC-based systems are very adaptable to improvements in either the technology or the market. Pieces of a PC-based system might be upgraded to take advantage of a desirable change while a closed system might become obsolete. A simple example of a proprietary control that only allowed RS232 communications will have a difficult time surviving in a facility trying to network all its computers together. A PC-based control design can take advantage of any unforeseen technology changes in the future. The **MACHINEMATE** uses standard PC hardware running the standard Microsoft Windows NT operating system. The Microsoft Windows 2000 operating system is supported in the **MACHINEMATE** eCNC model control. As PC hardware and software technologies change, the **MACHINEMATE** control can adapt while the customer's machine application does not have to.

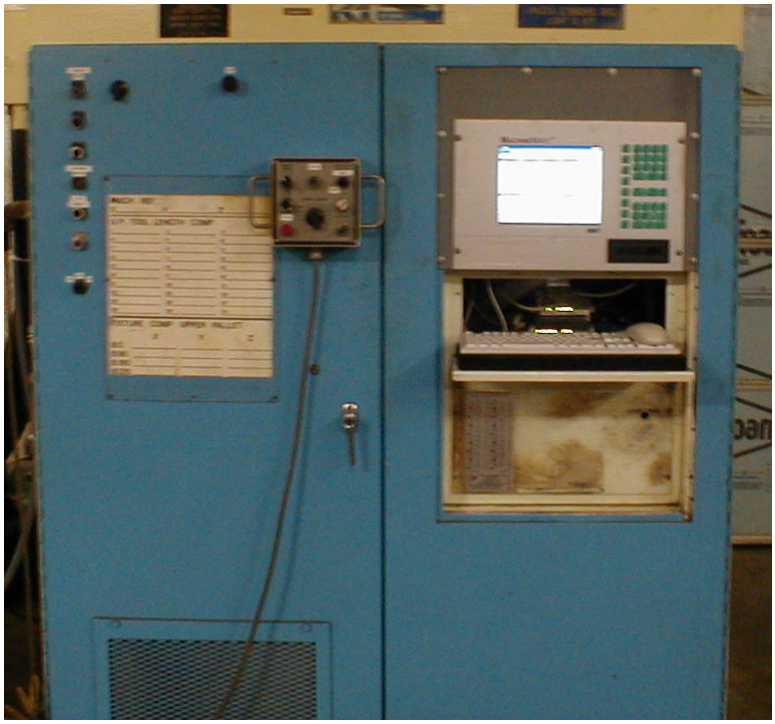
Mark Rice adapted the **MACHINEMATE** control to the machine's control cabinet, replacing the old display panel. He designed the retrofit and developed the new control's wiring diagram. The engineer at Fisher gutted the cabinet and he did the panel wiring per Mark's specifications. Mark did the **MACHINEMATE** control installation and the overall system testing.

The picture below shows the control cabinet after the old computer and the IO racks have been removed. The **MACHINEMATE** control has been mounted on the door. Its IO modules are in the middle of the right back panel and the power supply is at the lower right of the back panel.

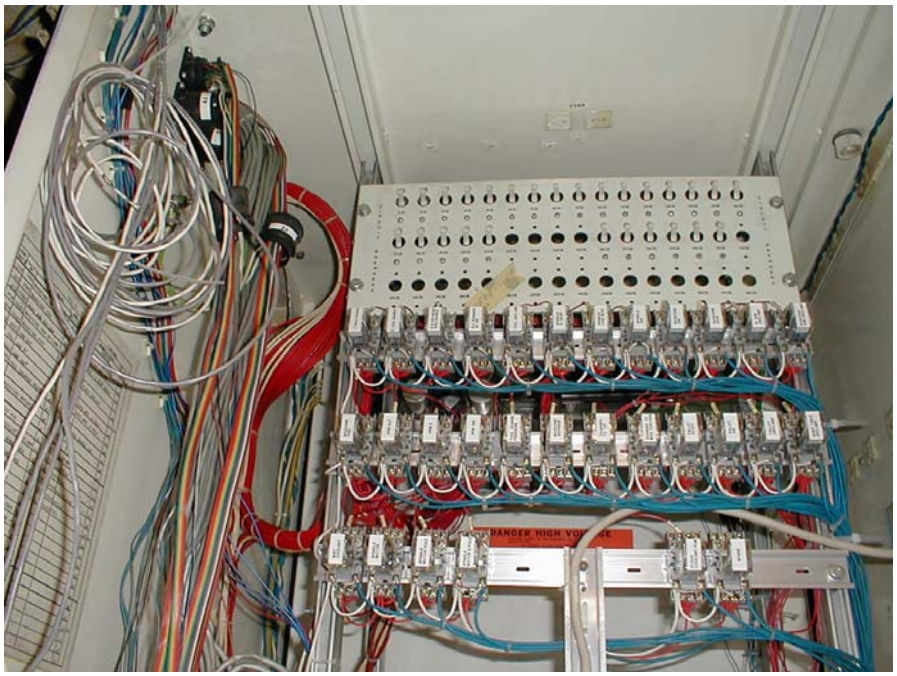


The respective axis drives and the spindle drive were not changed during this retrofit. This is another advantage of open architecture CNC over a proprietary CNC; some proprietary CNC vendors require their line of drives and motors. This control retrofit package requires to mechanical changes in the machine.

The picture below is the exterior cabinet view after the operator interface has been replaced by the **MACHINEMATE** control. The 'finished' retrofit will fill the gap that is visible above the keyboard.



In the original retrofit, the replacement relays with the wire harnesses are shown in the picture below. These relays were mounted on the panel above the IO modules. The cables were not yet 'bundled' at the time of this picture; that 'clean-up' is part of the retrofit process.

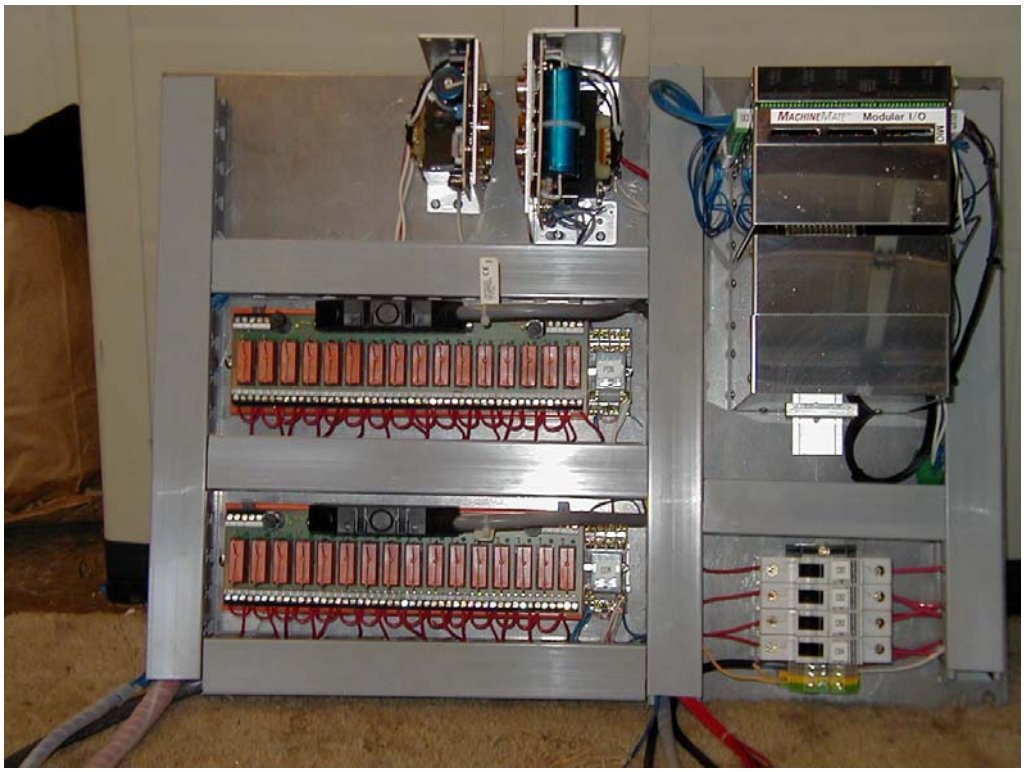


During the retrofit process, Mark quickly realized that this retrofit easily could be made into a kit or package that could be applied to many K&T machines. K&T was very good at being consistent in their controls for different machines. All the controls were very similar in layout with standard pin-outs and a common control layout.

Mark has developed a control retrofit package with wire harnesses that handle all the control features. This approach means that if a customer decides to change a feature, such as from an octal tool reader to a counting tool reader, the wiring is already there. The MM180 had an indexing table while the other machines had a true rotary axis for the table. This machine change is configured in the CNC software not in physical wiring changes (that would require different wire harnesses). Customer add-ons, like another coolant option (mist, flood, etc.), are also easier to handle in the control. The use of common harnesses drives down the manufacturing costs for the package components, which directly results in a lower price for the retrofit kit.

The package consists of the new front panel that includes the **MACHINEMATE** control and the cabling to the back panel. The electrical panel has the power supplies, relays and switches, the resolver to encoder feedback converters, etc. Each wiring harness with a bulkhead connector is identified with the correct number designation so that it simply replaces the old control's bulkhead connector. The kit requires a minimum number of wires to be manually connected during this control retrofit.

The picture below shows the simple panel design for the retrofit kit. The IO relays and the **MACHINEMATE** IO modules are mounted on a small subpanel for easy installation in the existing cabinet. The power supply is also included (located at the top of the panel).



The initial control retrofit package offering will be for the K&T MM180. The next package will include the MM200, MM600 and MM800 machines. Eventually all the K&T machines that used the C and D controls can be supported with this package.

The package price will range from about $20000 to about $25000, with the low end for the simpler K&T machines (less options and hardware) and the high end for the machines with more options and more hardware. The retrofit process with the package should take only about 3 days:

1. Most of the first day is stripping out the old hardware.
2. Most of the second day is installing the new cabinet hardware (including the panel and its harnesses to bulkhead connectors) and the new front panel (with the **MACHINEM**ATE control and the operator panel). The new back panel includes a small number of separate wires to a terminal strip.
3. The third day is checking out the completed retrofit. Typically, certain machine configuration parameters must be tuned, such as a tool change position.

Mark Rice has been involved in CNC activity since 1978. Mark has accumulated experience in all facets of the machine tool industry. Mark has worked with machine tools from a number of vendors (including Kearney & Trecker, Matsuura, Mazak, Monarch, Mori Seiki and others) as well as many CNC controls (like **MACHINEM**ATE, AB, Bendix, Fanuc, GE, Mazak, Mitsubishi and others) and PC motion control cards (like Delta Tau, Galil, IIC and Parker). For the past few years, Mark has done a number of retrofits using the **MACHINEM**ATE control.

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