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# 40-412 User Manual

## PXI 32 Channel Digital I/O Module With Programmable Threshold



Issue 4.4 January 2020

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ISO 9001
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## TECHNICAL SUPPORT

For Technical Support please contact Pickering Interfaces either by phone, the website or via e-mail.

## WARRANTY

All products manufactured by Pickering Interfaces are warranted against defective materials and workmanship for a period of three years, excluding programmable power supplies, from the date of delivery to the original purchaser. Any product found to be defective within this period will, at the discretion of Pickering Interfaces be repaired or replaced.

Products serviced and repaired outside of the warranty period are warranted for ninety days.

Extended warranty and service are available. Please contact Pickering Interfaces by phone, the website or via e-mail.

## ENVIRONMENTAL POLICY

Pickering Interfaces operates under an environmental management system similar to ISO 14001.

Pickering Interfaces strives to fulfil all relevant environmental laws and regulations and reduce wastes and releases to the environment. Pickering Interfaces aims to design and operate products in a way that protects the environment and the health and safety of its employees, customers and the public. Pickering Interfaces endeavours to develop and manufacture products that can be produced, distributed, used and recycled, or disposed of, in a safe and environmentally friendly manner.


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# PRODUCT SAFETY

# LA SÉCURITÉ DES PRODUITS

## SAFETY SYMBOLS

## SYMBOLES DE SÉCURITÉ

| | |
|---|---|
| The following safety symbols may be used on the product and throughout the product documentation. | Les symboles de sécurité suivants peuvent être utilisés sur le produit et dans l'ensemble de la documentation produit. |

| MEANING / DESCRIPTION | SYMBOL | SIGNIFICATION / DESCRIPTION |
|---|---|---|
| PROTECTIVE EARTH (GROUND)<br>To identify any terminal which is intended for connection to an external conductor for protection against electric shock in case of a fault, or the terminal of a protective earth (ground) electrode. |  | MISE À LA TERRE<br>Pour identifier les bornes destinées à être raccordées à un conducteur externe de protection contre les chocs électriques en cas de défaut d'isolement, ou pour marquer la borne de mise à la terre. |
| DANGEROUS VOLTAGE<br>To indicate hazards arising from dangerous voltages. |  | TENSION DANGEREUSE<br>Pour indiquer les dangers découlant des tensions dangereuses. |
| WARNING / CAUTION<br>An appropriate safety instruction should be followed or caution to a potential hazard exists.<br><br>Refer to the relevent instructions detailed within the product manual. |  | AVERTISSEMENT - ATTENTION<br>Des consignes de sécurité appropriées doivent être suivies. En cas de danger potentiel existant, prendre des précautions.<br><br>Consulter les instructions détaillées dans le manuel du produit. |
| HEAVY<br>If this product is heavy reference should be made to the safety instructions for provisions of lifting and moving. |  | CHARGE LOURDE<br>Si ce produit est lourd il convient de se référer aux consignes de sécurité pour les dispositions de levage et de déplacement. |
| STATIC SENSITIVE<br>To indicate that static sensitive devices are present and handling precautions should be followed. |  | SENSIBILITÉ STATIQUE<br>Pour indiquer que des appareils sensibles statiques sont présents et les précautions de manipulation doivent être suivies. |

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# WARNINGS AND CAUTIONS

# AVERTISSEMENTS ET PRÉCAUTIONS

| WARNING<br>HAZARDOUS ENVIRONMENTS | SYMBOL | AVERTISSEMENT<br>ENVIRONNEMENTS DANGEREUX |
|---|---|---|
| This product is not specifically designed for use in hazardous environments, for example in explosive atmospheres. If the product is to be used in hazardous environments we recommend that the user ensures suitable protective measures are taken. |  | Ce produit n'est spécifiquement pas conçu pour un usage dans des environnements dangereux, par exemple en atmosphères explosives. Si le produit doit être utilisé dans des environnements dangereux, nous recommandons à l'utilisateur de s'assurer que des mesures de protection appropriées soient prises. |

| WARNING<br>DANGER OF ELECTRIC SHOCK | SYMBOL | AVERTISSEMENT<br>DANGER DE CHOC ELECTRIQUE |
|---|---|---|
| This module may contain hazardous voltages. Before removing the module from the rack remove all supplies and disconnect user I/O signals.<br>Unused slots in the PXI/LXI chassis are populated with blanking plates to prevent access to user I/O signals that may be present. Blanking panels are available to order from Pickering in a variety of slot widths. If the product is not used in this manner for example by using an extender card then additional care must be taken to avoid contact with exposed signals.<br>Not to be used in safety critical circuits, refer to the Pickering Interfaces' terms & conditions of sale.<br>This module must not be used for the switching of Mains Circuits. For the switching of voltages up to the module's full specification, Secondary Circuit power supplies and the Device Under Test must be fully isolated from the Mains Circuit and the safety earth.<br>The host chassis must be correctly installed and be connected to mains or factory safety ground, please refer to your chassis installation manual. |  | Ce module peut contenir des tensions dangereuses. Avant de retirer le module de la baie, enlever toutes les fournitures et déconnecter les signaux d'E/S utilisateur.<br>Les slots non utilisés dans le châssis PXI/LXI sont peuplées d'obturateurs pour empêcher l'accès aux signaux d'E/S utilisateur qui peuvent être présents. Les obturateurs sont disponibles sur commande chez Pickering dans une variété de largeur de fente. Si le produit est utilisé sans obturateur, par exemple en utilisant une carte d'extension, alors des précautions supplémentaires doivent être prises pour éviter tout contact avec les signaux exposés.<br>Ne pas utiliser dans des circuits critiques de sécurité, se référer à nos Conditions Générales de Ventes.<br>Ce module ne doit pas être utilisé pour la commutation des circuits principaux. Pour la commutation de tensions jusqu'à la spécification complète du module, les alimentations des circuits secondaires et l'appareil sous test doivent être complètement isolés des circuits principaux et de la terre de sécurité.<br>Le châssis hôte doit être correctement installé et connecté à la terre ou au réseau de sécurité d'usine. Veuillez-vous reporter au manuel d'installation de votre châssis. |

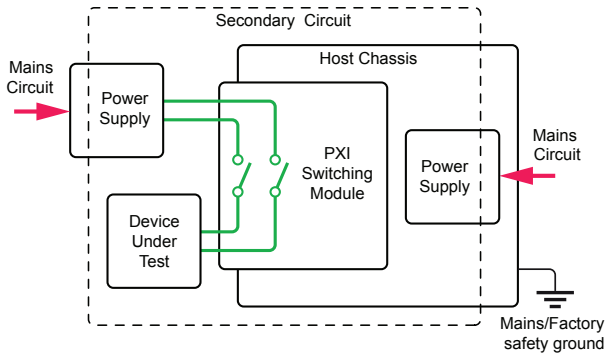



**Diagram Showing Separation Between The Mains Circuit and Secondary Circuit / DUT**

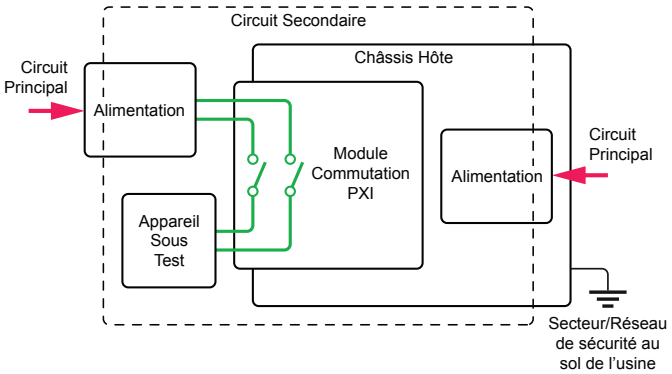



**Diagramme Montrant la Séparation Entre le Circuit Principal et le Circuit Secondaire**

| | |
|---|---|
| For the purposes of this document, a Mains Circuit is an installation classified as Overvoltage Category II up to 300V. Separation between the Secondary Circuit and Mains Circuit is achieved by a transformer in which the primary windings are separated from the secondary windings by reinforced insulation, double insulation, or a screen connected to the protective conductor terminal. | Aux fins du présent document, un circuit principal est une installation classée dans la Catégorie de Surtension Groupe II jusqu'à 300V. la séparation entre le circuit secondaire et le circuit principal est réalisée par un transformateur dans lequel les enroulements primaires sont séparés des enroulements secondaires par une isolation renforcée, une double isolation ou un blindage relié à la borne de conducteur de protection. |

| CAUTION - HANDLING OF ELECTROSTATIC-SENSITIVE SEMICONDUCTOR DEVICES | SYMBOL | ATTENTION - MANIPULATION DES APPAREILS SENSIBLES ELECTROSTATIQUES |
|---|---|---|
| Certain semiconductor devices used in this equipment are liable to damage due to static voltage. Observe the following precautions when handling these devices in their unterminated state, or sub-assemblies containing these devices:<br>1. Persons removing sub-assemblies from equipment using these devices must be earthed by a wrist strap and a resistor at the point provided on the equipment.<br>2. Soldering irons used during the repair operations must be low voltage types with earthed tips and isolated from the mains voltage by a double insulated transformer.<br>3. Outer clothing worn must be unable to generate static charges.<br>4. Printed Circuit Boards (PCBs) fitted with these devices must be stored and transported in anti-static bags. |  | Certains appareils semi-conducteurs utilisés dans cet équipement sont susceptibles d'être endommager en raison de la tension statique. Respectez les précautions suivantes lorsque vous manipulez ces appareils dans leur état non terminé, ou sous-ensembles contenant ces appareils :<br>1. Les personnes démontant partiellement l'équipement à l'aide de ces appareils doivent être mises à la terre par bracelet antistatique et une résistance au point prévu sur l'équipement.<br>2. Les fers à souder utilisés pendant les opérations de réparation doivent être de type "basse tension" avec des bouts reliés à la terre et isolés à partir de la tension du réseau par un transformateur à double isolation.<br>3. Les vêtements externes ne doivent pas générer des charges électrostatiques.<br>4. Les cartes de circuits imprimés (PCB) équipées de ces appareils doivent être entreposées et transportées dans des sacs antistatiques. |

| CAUTION PRODUCT DOCUMENTATION | SYMBOL | ATTENTION DOCUMENTATION PRODUIT |
|---|---|---|
| Suitably qualified & trained users should ensure that the accompanying documentation is fully read and understood before attempting to install or operate the product. |  | Les utilisateurs qualifiés et formés doivent veiller à ce que la documentation soit entièrement lue et comprise avant l'installation ou l'utilisation du produit. |

## SAFETY INSTRUCTIONS

| SAFETY INSTRUCTIONS | CONSIGNES DE SÉCURITÉ |
|---|---|
| All cleaning and servicing requires the equipment to be isolated and disconnected from the power source and user I/O signals (refer to the Maintenance Section).<br>• Appropriate manual handling procedures should be followed as dictated by the weight of the individual module or the combined weight of the modules & chassis.<br>• Should a fault occur with the module or chassis, immediately isolate and disconnect the incoming power to the chassis and the user I/O signals.<br>• Ensure the equipment is installed, operated and maintained by trained and authorised personnel.<br>• For suitably equipped products in the event of an emergency press the red "emergency stop" button situated on the front of the unit. | Les travaux de nettoyage et de réparation nécessitent que l'équipement soit isolé et déconnecté de la source d'alimentation et des signaux d'E/S utilisateur (voir la section Entretien).<br>• Les procédures de manipulation manuelle appropriées doivent être suivies en fonction du poids du module seul ou le poids combiné des modules et du châssis.<br>• En cas de défaut avec le module ou le châssis, isoler immédiatement et débrancher l'alimentation entrant au châssis et les signaux d'E/S utilisateur.<br>• S'assurer que le matériel est installé, utilisé et entre-tenu par du personnel formé et autorisé.<br>• Pour les produits convenablement équipés, en cas d'urgence, appuyez sur le bouton rouge "arrêt d'urgence" situé sur l'avant de l'unité. |

# SECTION 1 - TECHNICAL SPECIFICATION

- 32-Channel Input
- Dual Programmable Voltage Threshold, 0.3 to 50V
- Serial or Parallel Acquisition Versions
- High Input Voltage Tolerance

- 32-Channel Output
- High Side or Low Side Driving
- 0.5A Low Side Sink Capability
- 0.4A High Side Source Capability

- Fully Protected Outputs
- High Side External Voltage Input
- VISA, IVI & Kernel Drivers Supplied for Windows
- Supported by PXI or LXI Chassis
- 3 Year Warranty



The 40-412 is a 32-channel Digital I/O module with high output voltage and current capability and a dual variable threshold input.

The 32 outputs can be used for high or low drive and each channel is capable of sourcing 0.4A from the high side or 0.5A sink on the low side. Accidental operation of both high and low side driver on the same channel is prevented by the supplied driver. Outputs are fully protected against over-voltage, over-current and thermal overload, ensuring robust and reliable operation in the toughest test environments. For high side driving, the voltage source is supplied externally, allowing the module to drive high capacity loads separate from the PXI chassis power supply. For low side driving, the external source is not used and the module's output operates an open collector or open drain driver.

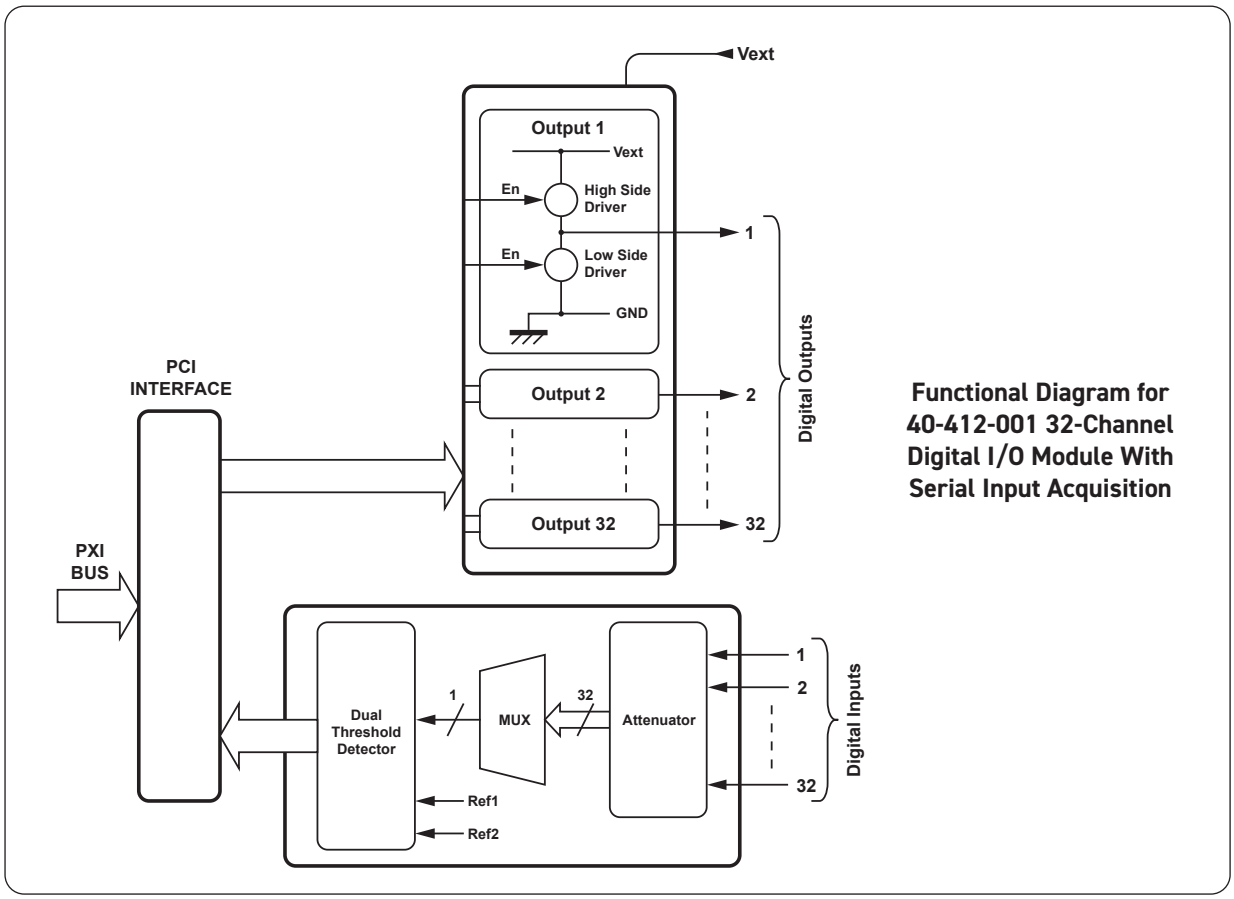
The built in protection systems include an over-voltage clamp so the module can drive relay coils without the use of fly back diodes.

The states of the 32 input channels are read via the PXI interface by comparing the input level to two threshold voltages. These can be set between 0.3V and 50V and have a resolution of 12.5mV. This allows the input to be tested against system limits that define a logic low or logic high.

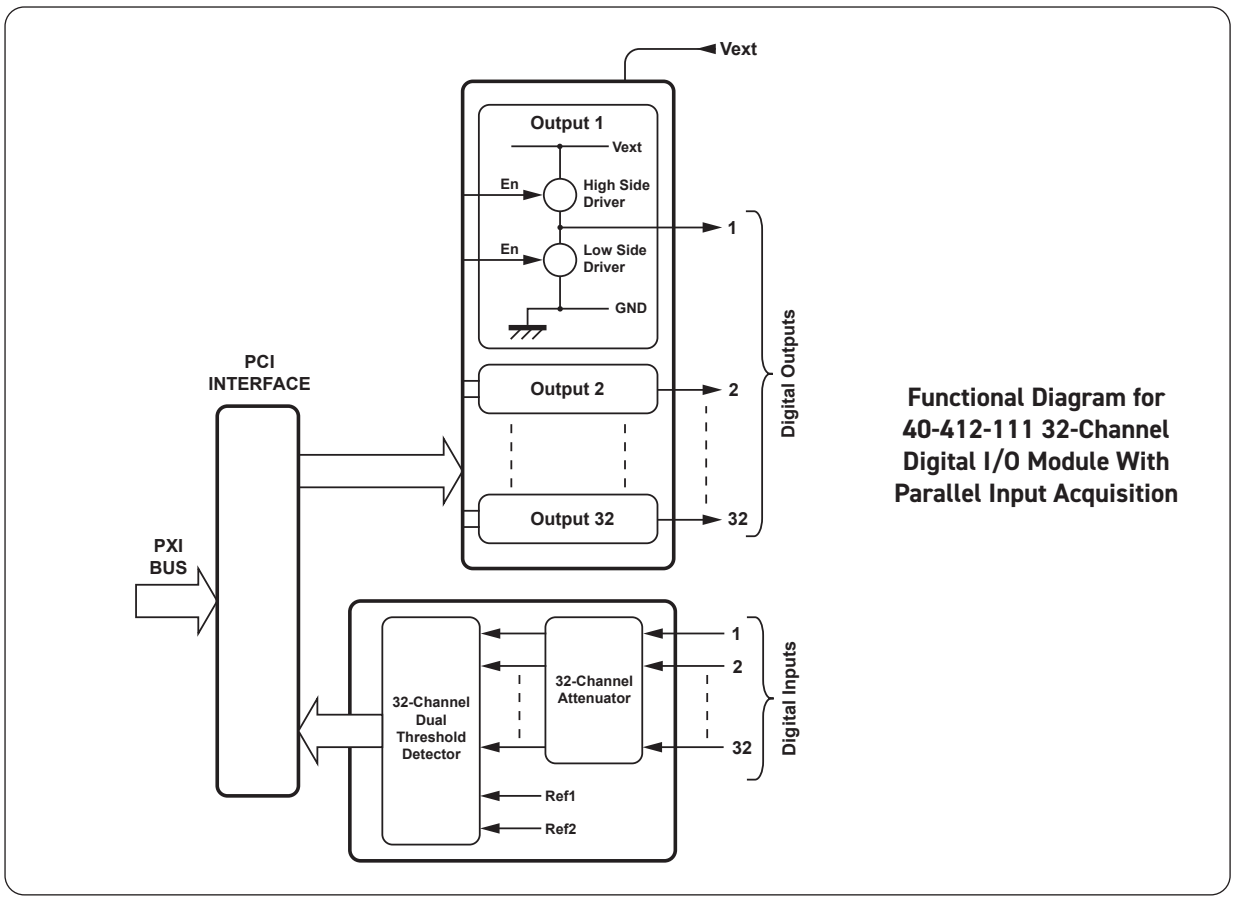
The module is available in two versions with different read back methods. The 40-412-001 uses series acquisition to capture the input status using a single set of comparators. The driver includes a facility to capture the status of all 32 inputs with a single command. The 40-412-111 has parallel acquisition using 32 sets of comparators to synchronously capture all input states and read them in a single operation.

Each input can withstand the accidental application of voltage greater than 100V. The inputs can be user connected to the outputs without risk of damage, allowing the module to operate as 32 channels of independent input and output or as 32 channels of configurable I/O.

Connection to the module's input and outputs is via an easy to use 78-pin D-type connector which is fully supported by a range of connector accessories.




Functional Diagram for 40-412-001 32-Channel Digital I/O Module With Serial Input Acquisition




Functional Diagram for 40-412-111 32-Channel Digital I/O Module With Parallel Input Acquisition

### Output Specification

| | |
|---|---|
| No. of Output Channels: | 32 |
| Output States: | Driven high, driven low or off. |
| Low Side Driver Output Resistance: | 0.6Ω at 0.5A |
| High Side Driver Output Voltage: | Vext less 1.5V at 0.4A |
| Maximum Current: | 0.5A for Low Side drivers,<br>0.4A for High Side drivers,<br>10A module total (40-412-001),<br>8A module total (40-412-111), |
| Maximum Voltage: | +50V* |
| Output Protection: | Current limited, overvoltage limited, thermal protection. Overvoltage limit can be used to limit back emf generated from inductive loads such as relay coils. |
| Vext: | User supplied +5V to +50V, applied to multiple pins of user connector, relative to front panel ground. |

* For full voltage rating, signal sources must be fully isolated from mains supply and safety earth.

### Input Specification

| | |
|---|---|
| No. of Input Channels: | 32 |
| Logic Threshold: | Compares selected input voltage against two reference voltages, each of which can be set from 0.3 to 50V with 12.5mV setting resolution.<br>40-412-001 uses serial acquisition<br>40-412-111 uses faster parallel acquisition from a common pair of threshold voltages. |
| Settling Time (40-412-001): | 50µs following a state change or channel selection.<br>Typical read back time for all 32 states 1.3ms. |
| Settling Time (40-412-111): | 5µs following a state change.<br>Read back time for all 32 states 50µs typical. |
| Channel Selection: | Single channel selection or automated sequential access to all 32 channels. |
| Maximum Input Voltage: | 100V* |
| Input Impedance: | 1MΩ |

* For full voltage rating, signal sources must be fully isolated from mains supply and safety earth.

### Power Requirements

| +3.3V | +5V | +12V | -12V |
|---|---|---|---|
| 0 | 0.1A | 0.05A | 0.05A |

### Mechanical Characteristics

Single slot 3U PXI (CompactPCI card).
Module weight: 180g.
3D models for all versions in a variety of popular file formats are available on request.

### Connectors

PXI bus via 32-bit P1/J1 backplane connector.
Signals via front panel 78-pin male D-Type connector, for pin outs please refer to the operating manual.

### Operating/Storage Conditions

#### Operating Conditions

| | |
|---|---|
| Operating Temperature: | 0°C to +55°C |
| Humidity: | Up to 90% non-condensing |
| Altitude: | 5000m |

#### Storage and Transport Conditions

| | |
|---|---|
| Storage Temperature: | -20°C to +75°C |
| Humidity: | Up to 90% non-condensing |
| Altitude: | 15000m |

### PXI & CompactPCI Compliance

The module is compliant with the PXI Specification 2.2. Local Bus, Trigger Bus and Star Trigger are not implemented.

Uses a 33MHz 32-bit backplane interface.

### Safety & CE Compliance

All modules are fully CE compliant and meet applicable EU directives: Low-voltage safety EN61010-1:2010, EMC Immunity EN61326-1:2013, Emissions EN55011:2009+A1:2010.

## Product Order Codes

| | |
|---|---|
| 32-Channel Digital I/O Module - Serial Input Acquisition, Programmable Threshold | 40-412-001 |
| 32-Channel Digital I/O Module - Parallel Input Acquisition, Programmable Threshold | 40-412-111 |

## Product Customization

Pickering PXI modules are designed and manufactured on our own flexible manufacturing lines, giving complete product control and enabling simple customization to meet very specific requirements.

All customized products are given a unique part number, fully documented and may be ordered at any time in the future. Please contact your local sales office to discuss.

## Mating Connectors & Cabling

For connection accessories for the 40-412 series please refer to the 90-006D 78-pin D-Type Connector Accessories data sheet where a complete list and documentation can be found for accessories, or refer to the Connection Solutions catalog.

## Chassis Compatibility

This PXI module must be used in a suitable chassis. It is compatible with the following chassis types:

- All chassis conforming to the 3U PXI and 3U Compact PCI (cPCI) specification
- Legacy and Hybrid Peripheral slots in a 3U PXI Express (PXIe) chassis
- Pickering Interfaces LXI or LXI/USB Modular Chassis




## Chassis Selection Guide

**Standard PXI or hybrid PXIe Chassis from any Vendor:**

- Mix our 1000+ PXI switching & simulation modules with any vendor's PXI instrumentation
- Embedded or remote Windows PC control
- Real-time Operating System Support
- High data bandwidths, especially with PXI Express
- Integrated module timing and synchronization

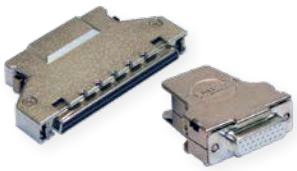



**Pickering LXI or LXI/USB Modular Chassis—only accept our 1000+ PXI Switching & Simulation Modules:**

- Ethernet or USB control enables remote operation
- Low-cost control from practically any controller
- LXI provides manual control via Web browsers
- Driverless software support
- Power sequencing immunity
- Ethernet provides chassis/controller voltage isolation
- Independence from Windows operating system

## Connectivity Solutions

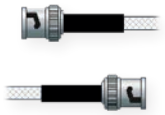
We provide a full range of supporting cable and connector solutions for all our switching products—20 connector families with 1200+ products. We offer everything from simple mating connectors to complex cables assemblies and terminal blocks. All assemblies are manufactured by Pickering and are guaranteed to mechanically and electrically mate to our modules.



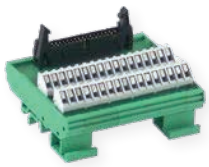
**Connectors & Backshells**



**Multiway Cable Assemblies**



**RF Cable Assemblies**



**Connector Blocks**

We also offer customized cabling and have a free online **Cable Design Tool** that can be used to create custom cable solutions for many applications.
Visit: pickeringtest.com/cdt to start your design.



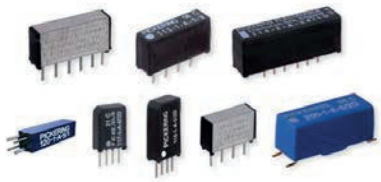
### Mass Interconnect

We recommend the use of a mass interconnect solution when an Interchangeable Test Adapter (ITA) is required for a PXI or LXI based test system. Our modules are fully supported by both Virginia Panel and MacPanel.

## Pickering Reed Relays

We are the only switch provider with in-house reed relay manufacturing capability via our sister company, Pickering Electronics. These instrument grade reed relays feature ***SoftCenter***® technology, ensuring long service life and repeatable contact performance.

To learn more, please go to: pickeringrelay.com



## Programming

Pickering provide kernel, IVI and VISA (NI & Keysight) drivers which are compatible with all Microsoft supported versions of Windows and popular older versions. For a list of all supporting operating systems, please see: pickeringtest.com/os

The VISA driver is also compatible with Real-Time Operating Systems such as LabVIEW RT. For other RTOS support contact Pickering. These drivers may be used with a variety of programming environments and applications including:

- **Pickering Interfaces Switch Path Manager**
- **National Instruments** products (LabVIEW, LabWindows/CVI, Switch Executive, MAX, TestStand, VeriStand, etc.)
- **Microsoft Visual Studio** products (Visual Basic, Visual C+)
- **Keysight** VEE and OpenTAP
- **Mathworks** Matlab
- **Marvin** ATEasy
- **MTQ Testsolutions** Tecap Test & Measurement Suite

Drivers for popular Linux distributions are available, other environments are also supported, please contact Pickering with specific enquiries. We provide Soft Front Panels (SFPs) for our products for familiarity and manual control, as well as comprehensive documentation and example programs to help you develop test routines with ease.
To learn more about software drivers and development environments, please go to:
pickeringtest.com/software

## Signal Routing Software




Our signal routing software, Switch Path Manager, automatically selects and energizes switch paths through Pickering switching systems. Signal routing is performed by simply defining test system endpoints to be connected together, greatly accelerating Test System software development. To learn more, please go to: pickeringtest.com/spm

## Diagnostic Relay Test Tools




*eBIRST* Switching System Test Tools are designed specifically for our PXI, PCI or LXI products, these tools simplify switching system fault-finding by quickly testing the system and graphically identifying the faulty relay.
To learn more, please go to: pickeringtest.com/ebirst

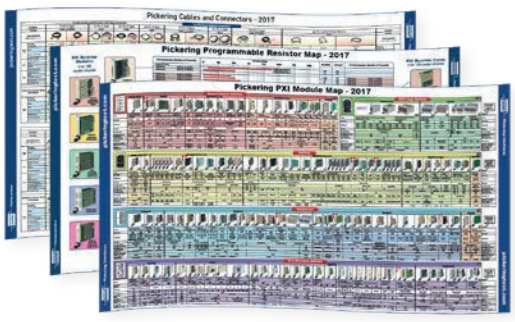
## Three Year Warranty & Guaranteed Long-Term Support

All standard products manufactured by Pickering Interfaces are warranted against defective materials and workmanship for a period of three years from the date of delivery to the original purchaser. Extended warranty and service agreements are available for all our modules and systems with various levels to suit your requirements. Although we offer a 3-year warranty as standard, we also include guaranteed long-term support—with a history of supporting our products for typically 15-20 years. To learn more, please go to: pickeringtest.com/support

## Available Product Resources

We have a large library of product resources including success stories, product and support videos, articles, as well as complete product catalogs and product reference maps to assist when looking for the switching, simulation and cable and connector solutions you need. We have also published handy reference books on Switching Technology and for the PXI and LXI standards.









To view, download or request any of our product resources, please visit: pickeringtest.com/resources

# SECTION 2 - TECHNICAL DESCRIPTION

## FUNCTIONAL DESCRIPTION

A functional block diagram is provided in Figure 2.1. The Module is powered by the +5V, +12V and -12V supplies from the PXI backplane via Compact PCI connector J1. The interface to the user's equipment is via the front panel mounted 78-pin D-type connector, J2.

The module's 32 channel output section comprises High Side and Low Side drivers U26 to U89 and Shift Registers U18 to U25. The shift registers control the output drivers and are supplied with serial data from the PCI Bridge, U1, via the control logic. Each output can be switched to either sink current to the GND terminal via a Low Side driver device, or source current from the Vext terminal via a High Side driver device.

For the 40-412-001 version with serial input acquisition, the module's 32 input channels are first fed through an attenuator circuit, then multiplexed to a single analog stream using U13 and U14. A programmable threshold detector circuit, U15 and U16, converts the analog signal into a digital data stream determined by the high and low thresholds programmed by the user. The input data is then read by the PCI Bridge via the control logic.

For the 40-412-111 version with parallel input acquisition, the input circuitry is fitted to a daughter board which is mounted on top of the mother board. The module's 32 input channels are first fed through an attenuator circuit, then comparator devices U17 to U32 determine whether each input signal is greater than the two thresholds programmed by the user. The resultant 64 data bits are latched by U33 to U40 and read by the PCI Bridge.

The PCI Bridge is configured by EEPROM U2, the module configuration is stored in EEPROM U11.

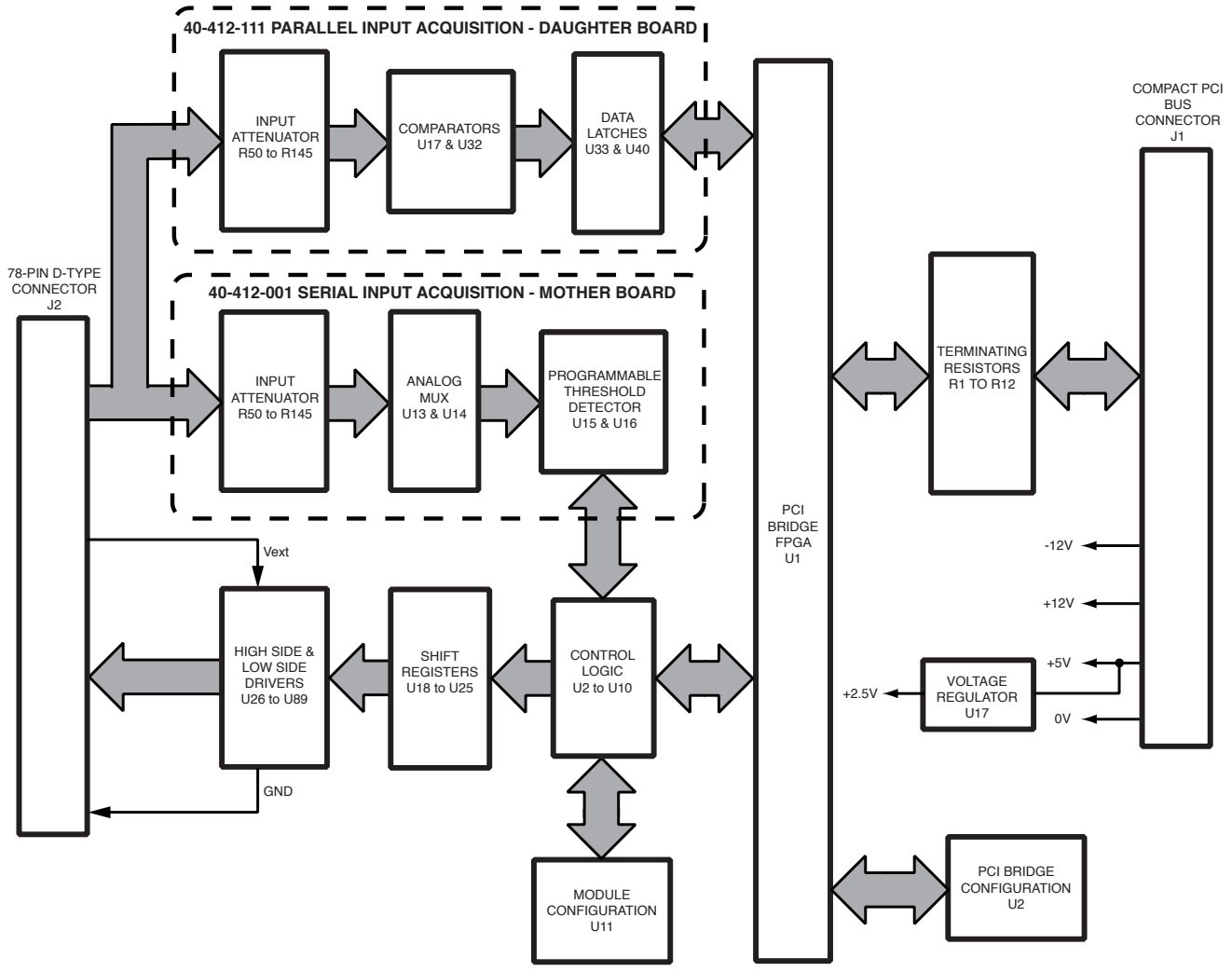



**Figure 2.1 - Digital I/O Module 40-412: Functional Block Diagram**

# GUIDANCE ON USING THE 40-412

## Output Drivers

The 40-412 provides two output driver types on each of the 32 channels:

- **High Side Driver.** The high side driver allows the user to set the output voltage actively high to an externally supplied voltage source. The external voltage source can be between +5V and +50V relative to ground.
- **Low side driver.** The low side driver actively connects the output to ground.

The software driver inhibits both the high and low side drivers being turned on at the same time.

Each driver output is fully protected from thermal, voltage or current overloads. However, continuous operation at voltages beyond the stated ratings may cause damage.

Each driver contains overvoltage protection that can be used to protect the driver from inductive back EMF spikes generated when turning coil currents off. Using this protection to manage the back EMF will not cause damage to the driver, however the sudden current change can generate EMC events. Pickering Interfaces recommends that where possible the user should provision local measures (such as a flywheel diode) to limit the back EMF current flow through the cables.

The user can select both drivers to be inactive to provide a tri-state (open) output voltage.

The external voltage source needs to be applied only if the high side driver is required to be used, it can grounded or left unconnected if the high side driver is not required to be used.

### Driving Inductive Loads

Users can use the high/low side drivers to drive highly inductive loads such as the coils of relays or solenoids, the protection circuits in the 40-412 will ensure the drivers are not easily damaged. However, it is recommended that precautions are taken to manage the resulting EMC issues that might arise.

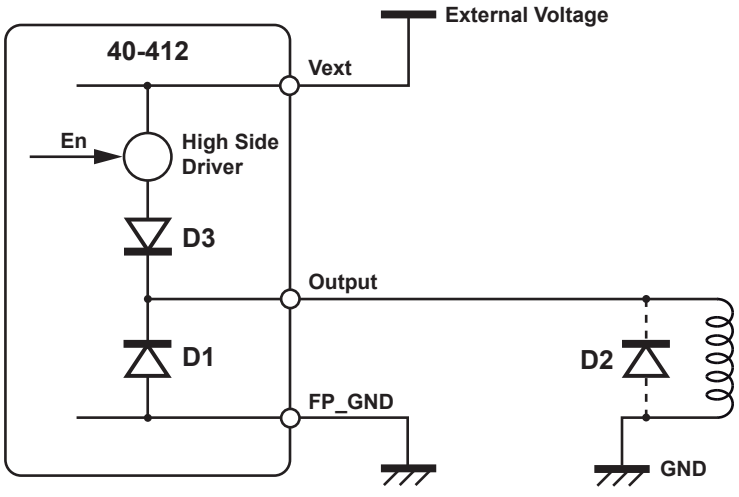



**Figure 2.2 - Using the 40-412: Driving an inductive load with a High Side Driver**

When using the high side driver, on driver closure, current will build in the coil until it reaches a steady state. When the driver is opened, the energy in the inductor will need to be discharged. This discharge can be through the diode inside the 40-412 (D1, Figure 2.2) - this will not damage the 40-412. However, the discharge may cause a ground spike that may result in EMC emission. We recommend that where possible a local diode is fitted (D2, Figure 2.2) which will reduce the ground current flowing and reduce the EMC emissions.

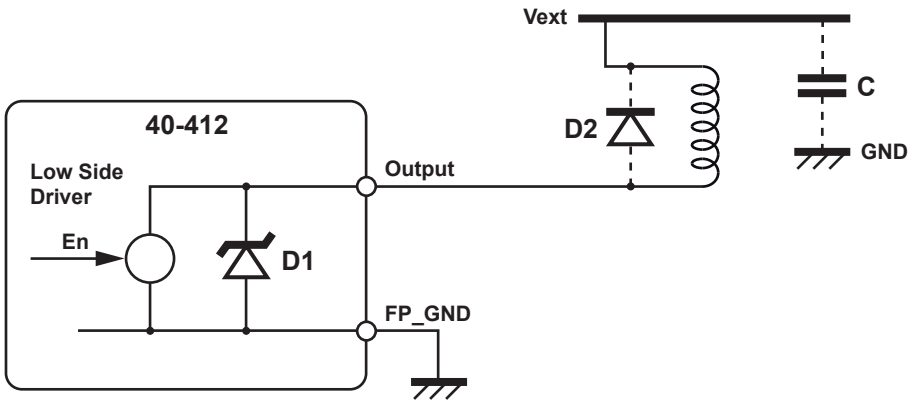



**Figure 2.3 - Using the 40-412: Driving an inductive load with a Low Side Driver**

When using the low side driver a similar effect occurs when the driver is opened. The inductive energy stored is discharged by the voltage on the 40-412 output becoming positive and a clamp diode (D1, Figure 2.3) acting to protect the driver. It is recommended that the user fits a flywheel diode (D2, Figure 2.3) to discharge the inductive energy. If a flywheel diode is not fitted, the 40-412 will clamp the output at a voltage between 60V and 80V relative to the front panel ground, the voltage being dependent upon the breakdown voltage of D1, Figure 2.3.

### Driving Capacitive Loads

The 40-412 can be used to drive capacitive loads. When the driver is closed, the current limit protection circuit will limit the current flowing into the capacitive load. Continuous rapid connection and disconnection to a capacitive load may result in the thermal protection circuits preventing further operation. If this occurs, simply allow the 40-412 to cool down, after which normal operation will resume.

### Vext Connection

When using the high side drivers, Vext is required to provide the current to the 40-412 output circuits. The Vext connection is made using multiple pins on the D-type connector. It is strongly recommended that if high load currents are expected, then all the available pins are used to spread the current load in order to avoid damaging the connector. The connections to Vext are internally linked together in the 40-412, so specific pins are not required to be used for a particular bank of drivers. To maximize connector life we suggest using 5 Amps per pin or less. Users should not apply negative voltages (relative to ground) to Vext or apply voltages greater than +50V.

### FP_GND Connection

When using the low side drivers, FP_GND is required to sink the current from the 40-412 output circuits. The FP_GND connection is made using multiple pins on the D-type connector. It is strongly recommended that if high load currents are expected, then all the available pins are used to spread the current load in order to avoid damaging the connector. The connections to FP_GND are internally linked together in the 40-412, so specific pins are not required to be used for a particular bank of drivers. To maximize connector life we suggest using 5 Amps per pin or less. Spare FP_GND Connections can be used for the purpose of screening or shielding in cable assemblies or connector blocks

### Using High and Low Side Drivers

The user can select on an individual channel basis whether a high side or low side driver is used. In Figure 2.2, D3 prevents the discharge of energy into Vext when the low side driver is operated.

## INPUT CONNECTION

Each of the 32 channels can be compared to two voltage references levels. The reference level is set by a 12 bit digital word with full scale corresponding to 50V and zero to 0V. In the case of the 40-412-001, the user selects the channel to be monitored by setting the input MUX to the required channel. The use of two threshold levels makes it easier for a user to determine the status of the input. For example, a typical application might be in a system operating from 28V supplies where the state needs to be established using a criteria equivalent to 20% of the supply:

- First threshold is set to 5.6V (20% of 28V), a low condition will indicate the state is low.
- Second threshold is set to 22.4V (80% of 28V) to confirm a high state.
- Intermediate conditions can be detected since the input is above the first threshold but below the second threshold.

Since the state is read at the same instant against each threshold, measurements are not confused by dynamically changing voltages.

With the 40-412-001, all 32 channels can be monitored by checking each input in turn, but the user should be aware that with dynamically changing signals these measurements are not made at the same instant in time. A command is also available to extract the state of all 32 channels by automated sequential sampling.

As the 40-412-111 has parallel input sampling, all inputs are compared to the programmable voltage reference levels at the same time.

### Vext and GND Break Detection

Some applications require a test to ensure that an input connection is not broken. For a connection that is set be at Vext the 1MΩ input impedance to the input will drag the voltage down to ground in the event of a break. To detect a break to a signal that is supposed to be at ground potential this will not give a good indication. However, if the input is connected by an external 1MΩ resistor to Vext then in the event that there is a break the signal will go to 0.5 of Vext and the dual detection thresholds can be set to detect this.

**Example:**
Vext is 28V, the thresholds are set at 4V and 24V. The input will appear to be in the mid voltage state of 14V, greater than 4V but less than 24V and the signal break can be detected.

### Settling Time 40-412-001

The input monitoring is designed for operation with static or relatively infrequently changing inputs, such as those associated with relay coils, alarms and visual indicators.

The input circuits exhibit an input time constant of approximately 10µs (measured as an RC time constant). Allowing 5 RC time constants is sufficient for a changed state to be accurately returned. For the 40-412-001, a state of change at a rate of greater than 10kHz may result in an intermediate condition being regularly returned. No damage can result from operation above 10kHz.

### Settling Time 40-412-111

The 40-412-111 uses a synchronous acquisition process that samples all the 32 states at the same time, eliminating the settling time constants associated with the switching system. The 40-412-111 is more suited to applications where states may be changing and users wish the states to be sampled at the same instant in time. The input states are captured and then read back to the PXI control system through a serial process. The read back speed is dependent on the speed of the controller, modern controllers will read back the 32 states in between about 10µs and 30µs.

## CONNECTING INPUT AND OUTPUT

It is permitted for a user to connect an input and output channel together using external wiring (for example in a connector block). In this way the input can be used to check that the output connection is being correctly driven.

It should be noted that if the output is set tri-state (both drivers off) the input impedance to the input channel will drag the output voltage to a low state in the absence of any external source of voltage or current.

Note that when the inputs and outputs are wired together by the user and both the high side and low side drivers are off, the input/output state will be asserted low. This is due to the impedance of the input connection.

# SECTION 3 INSTALLATION

SECTION 3 INSTALLATION

**Refer to the Warnings and Cautions at the front of this manual**

Modular products require installation in a suitable PXI/LXI chassis. The module is designed for indoor use only.

**Reportez-vous aux Avertissements et Mises en garde au début du manuel.**

Les produits modulaires nécessitent une installation dans un châssis PXI/LXI approprié. Le module est conçu pour une utilisation en intérieur.

## PREOPERATION CHECKS (UNPACKING)

1. Check the module for transport damage and report any damage immediately to Pickering Interfaces. Do not attempt to install the product if any damage is evident.
2. Position the chassis relative to any other equipment the module(s) will connect with. Ensure the chassis is not connected to the electrical supply.
3. Ensure that the designated area for the chassis containing the module is of flat and solid construction to withstand and support the combined weight of the module and chassis.

## CONTRÔLES AVANT UTILISATION (DÉBALLAGE)

1. Vérifiez que le module n'est pas été endommagé pendant le transport et signalez immédiatement tout dommage à Pickering Interfaces. N'essayez pas d'installer le matériel si des dégâts sont évidents.
2. Placez le châssis contenant le module par rapport à tout autre équipement qui est censé se connecter avec. Assurez-vous que le châssis n'est pas connecté à l'alimentation électrique.
3. Assurez-vous que la zone désignée pour le châssis contenant le module est de construction plate et solide afin de résister et supporter le poids du module et le châssis.

## HARDWARE INSTALLATION ELECTRICAL CONNECTION (CHASSIS)

1. The chassis containing the module must be electrically installed in accordance with local regional electrical codes by a qualified engineer.
2. The chassis containing the module must be grounded.

Electrostatic discharge can damage the components on the module. To avoid such damage in handling the board refer to page VII.

Ensure that there is adequate ventilation.

## INSTALLATION DU MATÉRIEL RACCORDEMENT ÉLECTRIQUE (CHASSIS)

1. Le châssis contenant le module doit être installé électriquement en conformité aux normes en vigueur par un ingénieur qualifié.
2. Le châssis contenant le module doit être mis à la terre.

Les décharges électrostatiques peuvent endommager les composants du module. Pour éviter de tels dommages en manipulant la carte se reporter à la Page VII.

Assurez-vous que la ventilation est adéquate.

The module should be installed in accordance with the following procedure:

1. Ensure that the system is turned OFF but still connected to mains so that it remains grounded.
2. Choose an appropriate slot in the rack.
3. Remove the blanking plate for the chosen slot.
4. Ensure that the injector/ejector handle is in its downward position. Align the module with the card guides on the top and bottom of the slot.

   Do not raise the injector/ejector handle whilst inserting the module as the module will not insert properly.
5. Hold the handle whilst slowly sliding the module into the card guides until the handle catches on the injector/ejector rail (refer to Figure 3.1).
6. Raise the injector/ejector handle until the module firmly seats into the backplane. The front panel of the module should be flush with the front panel of the chassis.
7. Secure the front panel of the module using both screws to the chassis front panel mounting rails.
8. In a system employing a remote control interface to connect an external controller to a PXI chassis or to link multiple chassis, power-up the system as follows:
   a. For a system comprising an external controller and one chassis, power up the chassis before powering up the external controller.
   b. For a system comprising more than one chassis, turn ON the last chassis in the system followed by the penultimate, etc, and finally turn ON the external controller or chassis containing the system controller.
9. For Pickering Interfaces modular LXI installation there is no requirement to use any particular power up sequence.

Le module doit être installé conformément à la procédure suivante:

1. Assurez-vous que le système est éteint mais qu'il reste connecté au réseau électrique afin qu'il reste relié à la terre.
2. Choisissez un emplacement approprié dans la baie.
3. Retirez la plaque d'obturation de l'emplacement choisi.
4. Assurez-vous que la poignée insertion / éjection est dans sa position vers le bas. Alignez le module avec les guides de la carte sur le haut et le bas de la fente.

   Ne pas lever la poignée insertion / éjection tout en insérant le module, sinon celui-ci ne sera pas inséré correctement.
5. Tenez la poignée tout en glissant lentement le module dans les guides de la carte jusqu'à la prise des poignées sur le rail insertion / éjection (voir la Figure 3.1).
6. Relevez la poignée insertion / éjection jusqu'à ce que le module se place fermement dans le fond de panier. Le panneau avant du module doit être aligné avec le panneau avant du châssis.
7. Fixez le panneau avant du module en utilisant les deux vis du panneau avant du rail de montage du châssis.
8. Dans un système utilisant une interface de commande à distance, pour connecter un contrôleur externe à un châssis PXI ou pour relier plusieurs châssis, faites la mise sous tension du système comme suit:
   a. Pour un système comprenant un contrôleur externe et un châssis, mettez le châssis avant d'allumer le contrôleur externe.
   b. Pour un système comprenant plus d'un châssis, allumez le dernier châssis dans le système suivi par l'avant-dernier, etc, et enfin activez le contrôleur ou le châssis externe contenant le contrôleur système.
9. Pour l'installation modulaire LXI de Pickering Interfaces, il n'est pas nécessaire d'utiliser une séquence de mise sous tension particulière.

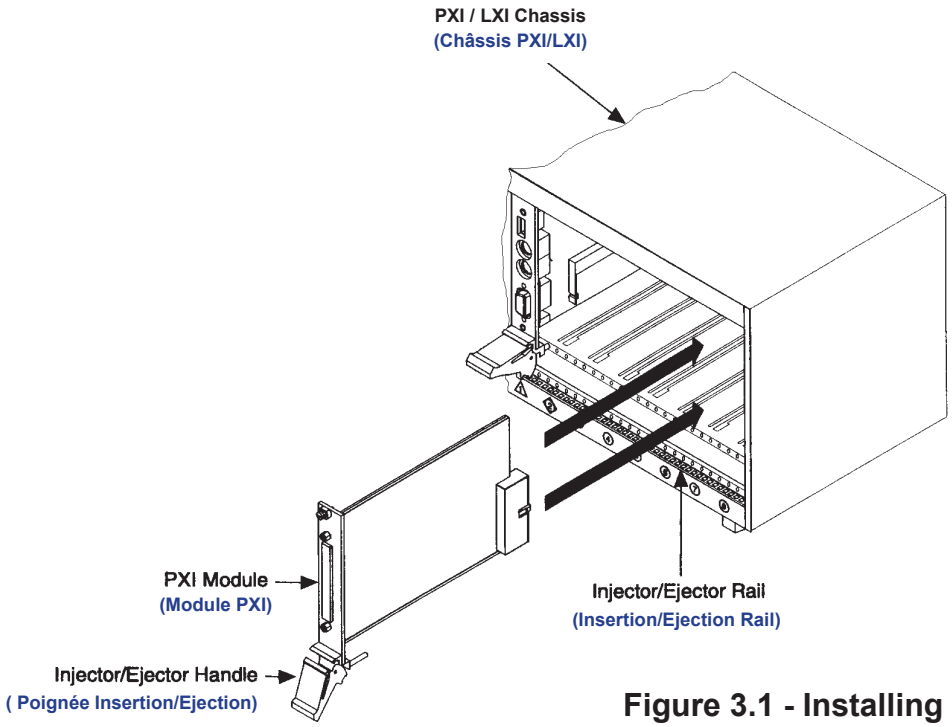



**Figure 3.1 - Installing the module into a PXI/cPCI/LXI Chassis**

**(Figure 3.1 Installation du module dans un châssis PXI/cPCI/LXI)**

| SOFTWARE INSTALLATION | INSTALLATION DU LOGICIEL |
|---|---|
| First install the appropriate Pickering PXI switch card drivers by running the installer program Setup.exe (provided in a compressed zip file), either from the CD-ROM supplied, or by downloading the latest version from our website **pickeringtest.com** - the recommended method. Setup is accompanied by a ReadMe file containing additional installation information. A single installation covers all cards in the System 40, System 45 and System 50 ranges.<br><br>When installation completes, the installed drivers' ReadMe file is offered for display. It can also be displayed later using a shortcut on the Programs>>Pickering menu.<br><br>If you are not a LabVIEW user you should choose the "full" version, and once that has been installed run the LabVIEW Runtime Engine installer via the shortcut on the Programs>>Pickering menu. In the absence of LabVIEW the Runtime Engine is required to support the Pickering Test Panels application. | D'abord, installez les pilotes de la carte de commutation PXI de Pickering en exécutant le programme d'installation Setup.exe (fourni dans un fichier compressé zip), soit à partir du CD-ROM fourni, ou en téléchargeant la dernière version sur notre site **pickeringtest.com** - la méthode recommandée. Setup est accompagné d'un fichier "Lisez-moi" contenant des informations supplémentaires sur l'installation. Une seule installation pour toutes les cartes dans les gammes Système 40, Système 45 et Système 50.<br><br>Une fois l'installation terminée, le pilote installé "Lisez-moi" est offert à l'affichage. Il peut également être affiché ultérieurement à l'aide d'un raccourci dans le menu Programs >> Pickering.<br><br>Si vous n'êtes pas un utilisateur de LabVIEW, vous devez choisir la version "complète", et une fois qu'elle a été installée. Lancer le programme d'installation LabVIEW Runtime Engine via le raccourci dans le menu Programs >> Pickering. En l'absence de LabVIEW, le Runtime Engine est nécessaire pour supporter l'application Test Panels de Pickering. |

## TESTING OPERATION

After installation of the hardware and Pickering PXI Driver software package start the General Soft Front Panel (GSFP) using the desktop icon or via the Start menu (***Start Menu-> Pickering Interfaces Ltd -> General Soft Front Panel***).




**Figure 3.2 - General Soft Front Panel Icon**

A selector panel will appear, listing all installed Pickering PCI, PXI or LXI switch cards and resistor cards. Click on the card you wish to control, and a graphical control panel is presented allowing operation of the card. Panels can be opened simultaneously for all the installed cards.

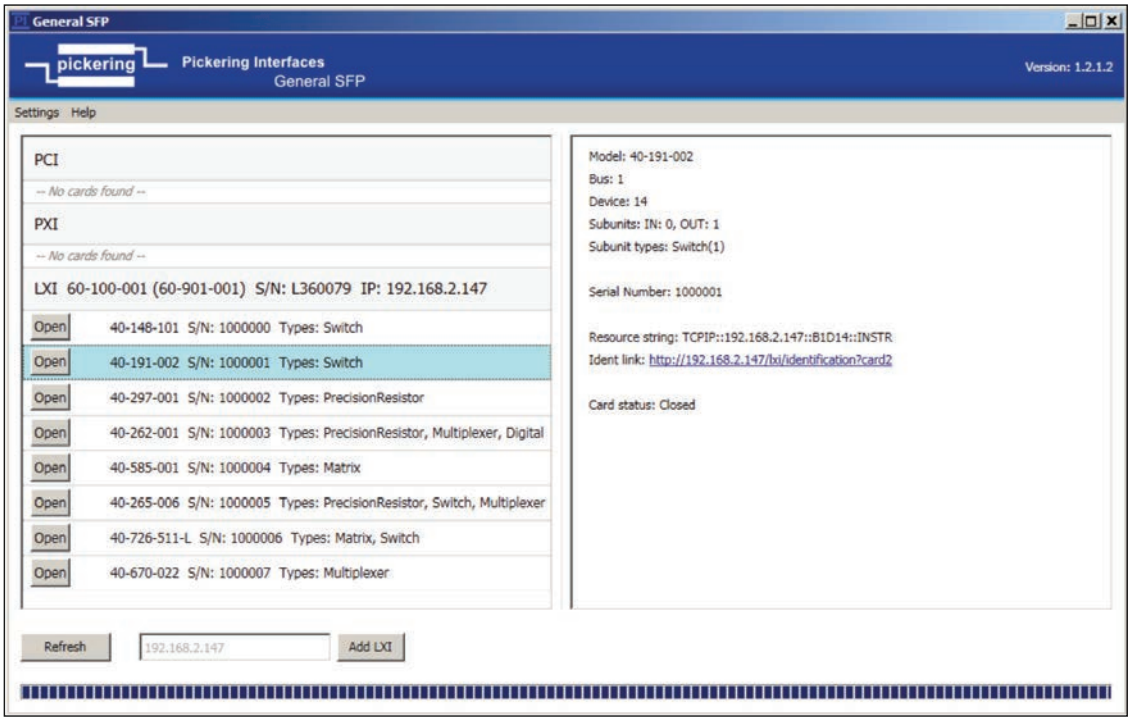



**Figure 3.3 - General Soft Front Panel Selector**

More details how to use the GSFP can be found in the manual, via menu ***Help\Manual***

# SECTION 4 - PROGRAMMING

## PROGRAMMING OPTIONS FOR PICKERING INTERFACES PXI MODULES

For information on the installation and use of drivers and the programming of Pickering's products in various software environments, please refer to the Software User Manual.

This is available as a download from:
https://www.pickeringtest.com/support/software-drivers-and-downloads

Also, it can be accessed from the DVD supplied with the product:
*<DVD_DRIVE>\downloads\Documentation\Software-Manual.pdf*

## 40-412 DIGITAL INPUT-OUTPUT SUB UNITS

This section describes the 40-412-001 and 40-412-111 sub units and the relevant Pickering VISA Driver and Direct I/O Driver functions used to program them.

| Output Sub-Units Models -001 & -111 | | | Description | |
|---|---|---|---|---|
| Number | Type | Size | | |
| 1 | DIGITAL | 32 | Controls output SINK driver states, each bit:<br>0 = INACTIVE<br>1 = ACTIVE | |
| 2 | DIGITAL | 32 | Controls output SOURCE driver states, each bit:<br>0 = INACTIVE<br>1 = ACTIVE | |
| Applicable Functions | | | VISA Driver | Direct Driver |
| | | | **pipx40_setChannelState**<br>pipx40_getChannelState<br>**pipx40_setChannelPattern**<br>pipx40_getChannelPattern<br>**pipx40_clearSub**<br>pipx40_setMaskState<br>pipx40_getMaskState<br>pipx40_setMaskPattern<br>pipx40_getMaskPattern<br>pipx40_clearMask | **PIL_OpBit**<br>PIL_ViewBit<br>**PIL_WriteSub**<br>PIL_ViewSub<br>**PIL_ClearSub**<br>PIL_MaskBit<br>PIL_ViewMaskBit<br>PIL_WriteMask<br>PIL_ViewMask<br>PIL_ClearMask |

| Output Sub-Units Models -001 & -111 | | | Description | |
|---|---|---|---|---|
| Number | Type | Size | | |
| 3 | DIGITAL | 12 | Set input threshold 1 (12-bit binary value, 50V corresponding to full scale) | |
| 4 | DIGITAL | 12 | Set input threshold 2 (12-bit binary value, 50V corresponding to full scale) | |
| Applicable Functions | | | VISA Driver | Direct Driver |
| | | | **pipx40_setChannelPattern**<br>pipx40_getChannelPattern<br>pipx40_clearSub | **PIL_WriteSub**<br>PIL_ViewSub<br>PIL_ClearSub |

| Output Sub-Unit Model -001 only | | | Description | |
|---|---|---|---|---|
| Number | Type | Size | | |
| 5 | MUX | 32 | Input channel selector | |
| Applicable Functions | | | VISA Driver | Direct Driver |
| | | | **pipx40_setChannelState**<br>pipx40_getChannelState<br>pipx40_getChannelPattern<br>pipx40_clearSub | **PIL_OpBit**<br>PIL_ViewBit<br>PIL_ViewSub<br>PIL_ClearSub |

**Note:** The highlighted functions above are of special interest.

| Input Sub-Units Model -001 only | | | Description | |
|---|---|---|---|---|
| Number | Type | Size | | |
| 1 | INPUT | 2 | Gets level of selected input channel (2 bits):<br>00 = below threshold 2, below threshold 1<br>01 = below threshold 2, above threshold 1<br>10 = above threshold 2, below threshold 1<br>11 = above threshold 2, above threshold 1 | |
| 2 | INPUT | 64 | Gets levels of all 32 input channels (2 bits each, as above). | |
| Applicable Functions | | | VISA Driver | Direct Driver |
| | | | `pipx40_readInputPattern` | `PIL_ReadSub` |
| **NOTE: each input channel from 1 to 32 is sampled sequentially. The precise rate of sampling is undefined.** | | | | |

| Input Sub-Unit Model -111 only | | | Description | |
|---|---|---|---|---|
| Number | Type | Size | | |
| 1 | INPUT | 64 | Gets levels of all 32 input channels, 2 bits each, as follows:<br>00 = below threshold 2, below threshold 1<br>01 = below threshold 2, above threshold 1<br>10 = above threshold 2, below threshold 1<br>11 = above threshold 2, above threshold 1 | |
| Applicable Functions | | | VISA Driver | Direct Driver |
| | | | `pipx40_readInputPattern` | `PIL_ReadSub` |

## USING THE DIRECT I/O DRIVER OR VISA DRIVER TO CONTROL THE 40-412

This section provides some code fragments which show how to control the 40-412 using either the Direct I/O Driver or the VISA Driver.

Once the drivers are installed the manual “Sys40Prg.pdf” and driver help files which fully describes these functions can be found in the Pickering folder(s) or the Pickering entries on your Start Menu.

The card must be opened before use and closed after using the following function calls:

Direct I/O Driver - Open with `PIL_OpenCards` or `PIL_OpenSpecifiedCard` and close with `PIL_CloseCards` or `PIL_CloseSpecifiedCards` respectively.

VISA Driver - Open with `pipx40_init`, and close with, `pipx40_close`.

### Setting the output SINK driver states

Using the Pickering Direct I/O Driver:

```
DWORD SubUnit = 1;                 //Sub unit 1 specifies sink drivers
PIL_ClearSub(CardNo, SubUnit);     //clear all sink driver channels to inactive
PIL_OpBit(CardNo, SubUnit, 5, 1); //set channel 5 to active
PIL_OpBit(CardNo, SubUnit, 5, 0); //set channel 5 to inactive
```

Using the VISA driver:

```
ViUInt32 SubUnit = 1;                  //Sub unit 1 specifies sink drivers
pipx40_clearSub(vi, SubUnit);          //clear all sink driver channels to inactive
pipx40_setChannelState (vi, SubUnit, 5, 1); //set channel 5 to active
pipx40_setChannelState (vi, SubUnit, 5, 0); //set channel 5 to active
```

### Setting the output SOURCE driver states:

These are programmed in the same way as the SINK drivers above but using sub unit 2

### Setting threshold 1

12 bits of sub-unit 3 are used to program threshold 1 and 12 bits of sub-unit 4 are used to program threshold 2:

Using the Pickering Direct driver:

```
DWORD SubUnit = 3;                 //Sub unit 3 specifies input threshold 1
double voltage = 25.0;             //set voltage to required threshold
DWORD Threshhold;
Threshhold = 4095*(voltage/50.0);
PIL_ClearSub(CardNo, SubUnit);
PIL_WriteSub(CardNo, SubUnit, &Threshhold);
```

Using the VISA driver:

```
ViUInt32 SubUnit = 3;              //Sub unit 3 specifies input threshold 1
ViReal voltage = 25.0;             //set voltage to required threshold
ViUInt32 Threshhold;
Threshhold = 4095*(voltage/50.0);
pipx40_clearSub(vi, SubUnit);
pipx40_setChannelPattern (vi, SubUnit, &Threshhold);
```

### Setting threshold 2

These are controlled in the same way as threshold 1 but set the sub unit to 4.

### Reading a single Input Level - Model -001 Only (see above for setting the comparison threshold levels)

Using the Pickering Direct I/O Driver:

```
DWORD InputSubUnit, OutputSubUnit;
OutputSubUnit = 5;                      //Sub unit 5 specifies channel control MUX
PIL_OpBit(CardNo, OutputSubUnit, 4, 1);       //Select channel 4
InputSubUnit = 1;                       //Read the input channel value
DWORD InputChannelValue;
PIL_ReadSub(CardNo, InputSubUnit, &InputChannelValue) //return one 2 bit value
```

Using the VISA driver:

```
ViUInt32 InputSubUnit, OutputSubUnit;
OutputSubUnit = 5;                      //Sub unit 5 specifies channel control MUX
pipx40_setChannelState(vi, OutputSubUnit, 4, 1);      //Select channel 4
InputSubUnit = 1;                       //Read the input channel value
ViUInt32 InputChannelValue[1];
pipx40_readInputPattern(vi, InputSubUnit, InputChannelValue);
                                                      //return one 2 bit value
```

### Reading all 32 Input Levels Sequentially - Model -001 Only (see above for setting the comparison threshold levels)

Using the Pickering Direct I/O Driver:

```
DWORD SubUnit;
SubUnit = 2;                            //Sub unit 2 specifies all 32 inputs
DWORD InputChannelValues[2];
PIL_ReadSub(CardNo, SubUnit, InputChannelValues)
                                                //return 32 values, 2 bits per value
```

Using the VISA driver:

```
ViUInt32 SubUnit;
SubUnit = 2;                            //Sub unit 2 specifies all 32 inputs
ViUInt32 InputChannelValues[2];
pipx40_readInputPattern(vi, SubUnit, InputChannelValues);
                                                //return 32 values, 2 bits per value
```

### Reading all 32 Input Levels In Parallel - Model -111 Only (see above for setting the comparison threshold levels)

Using the Pickering Direct I/O Driver:

```
DWORD SubUnit;
SubUnit = 1;                              //Sub unit 1 specifies all 32 inputs
DWORD InputChannelValues[2];
PIL_ReadSub(CardNo, SubUnit, InputChannelValues)
                                                  //return 32 values, 2 bits per value
```

Using the VISA driver:

```
ViUInt32 SubUnit;
SubUnit = 1;                              //Sub unit 1 specifies all 32 inputs
ViUInt32 InputChannelValues[2];
pipx40_readInputPattern(vi, SubUnit, InputChannelValues);
                                                  //return 32 values, 2 bits per value
```

## INPUT THRESHOLD VOLTAGE BIT PATTERNS

The following table gives a bit pattern for a particular input threshold voltage and is applicable to the programmable threshold levels 1 and 2. The input voltage is compared to the two programmable levels and the result is reflected in the state of two “Input Level” bits which can be read by software. Full scale setting (Binary 4095) is nominally 50V, the 12 bits provide a resolution of 12.5mV nominal. Some typical values are shown below:

| Threshold Voltage/ Bit Pattern Cross Reference | | | |
|---|---|---|---|
| Threshold Voltage | Bit Pattern † | Threshold Voltage | Bit Pattern † |
| 0 | 000000000000 | 5 | 000110011001 |
| 0.0125 | 000000000001 | 10 | 001100110011 |
| 0.025 | 000000000010 | 15 | 010011001100 |
| 0.05 | 000000000100 | 20 | 011001100110 |
| 0.1 | 000000001000 | 25 | 100000000000 |
| 0.2 | 000000010000 | 30 | 100110011001 |
| 0.4 | 000000100000 | 35 | 101100110011 |
| 0.79 | 000001000000 | 40 | 110011001100 |
| 1.57 | 000010000000 | 45 | 111001100110 |
| 3.13 | 000100000000 | | |
| 6.26 | 001000000000 | | |
| 12.5 | 010000000000 | | |
| 25 | 100000000000 | | |
| 50 | 111111111111 | | |

† The bit pattern in Testpanels will appear reversed

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# SECTION 5 - CONNECTOR INFORMATION

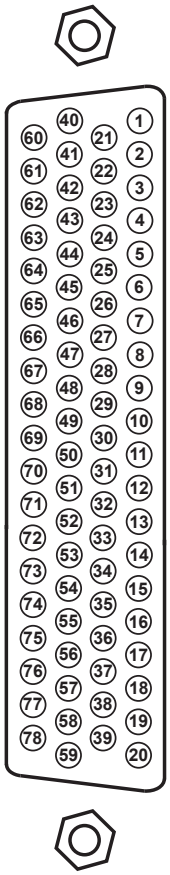



**Figure 5.1 - Digital I/O Module 40-412: Pin Outs (78-pin male D-type connector viewed from front of module)**

**NOTE: See Figures 5.2 and 5.3 overleaf for diagrams outlining the connection of the outputs to make use of the High-Side or Low-Side drivers**

| 78-pin D-Type Plug | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pin No. | Signal | Pin No. | Signal | Pin No. | Signal | Pin No. | Signal |
| 1 | Vext | 21 | Vext | 40 | Vext | 60 | Vext |
| 2 | Output 1 | 22 | Output 2 | 41 | Output 3 | 61 | Output 4 |
| 3 | Output 5 | 23 | Output 6 | 42 | Output 7 | 62 | Output 8 |
| 4 | Output 9 | 24 | Output 10 | 43 | Output 11 | 63 | Output 12 |
| 5 | Output 13 | 25 | Output 14 | 44 | Output 15 | 64 | Output 16 |
| 6 | Output 17 | 26 | Output 18 | 45 | Output 19 | 65 | Output 20 |
| 7 | Output 21 | 27 | Output 22 | 46 | Output 23 | 66 | Output 24 |
| 8 | Output 25 | 28 | Output 26 | 47 | Output 27 | 67 | Output 28 |
| 9 | Output 29 | 29 | Output 30 | 48 | Output 31 | 68 | Output 32 |
| 10 | FP_GND | 30 | FP_GND | 49 | FP_GND | 69 | FP_GND |
| 11 | Input 1 | 31 | Input 2 | 50 | Input 3 | 70 | Input 4 |
| 12 | Input 5 | 32 | Input 6 | 51 | Input 7 | 71 | Input 8 |
| 13 | Input 9 | 33 | Input 10 | 52 | Input 11 | 72 | Input 12 |
| 14 | Input 13 | 34 | Input 14 | 53 | Input 15 | 73 | Input 16 |
| 15 | Input 17 | 35 | Input 18 | 54 | Input 19 | 74 | Input 20 |
| 16 | Input 21 | 36 | Input 22 | 55 | Input 23 | 75 | Input 24 |
| 17 | Input 25 | 37 | Input 26 | 56 | Input 27 | 76 | Input 28 |
| 18 | Input 29 | 38 | Input 30 | 57 | Input 31 | 77 | Input 32 |
| 19 | FP_GND | 39 | FP_GND | 58 | FP_GND | 78 | FP_GND |
| 20 | FP_GND | | | 59 | FP_GND | | |

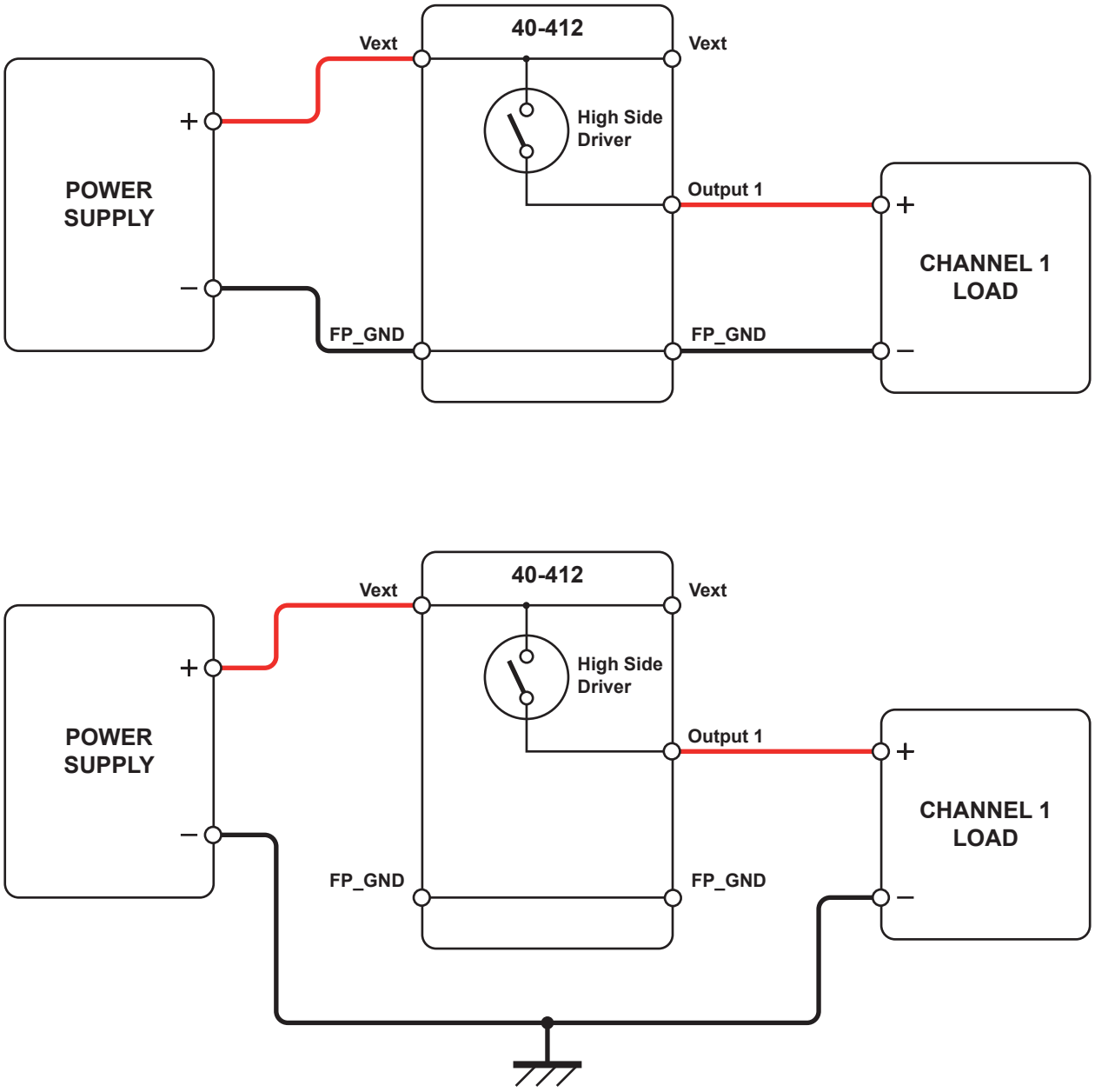



**Figure 5.2 - Examples of driving a load using the High-Side driver**

**Note:** **The power supply must be referenced to ground either by a separate ground connection or by connection to FP_GND which is internally connected the PXI chassis ground.**

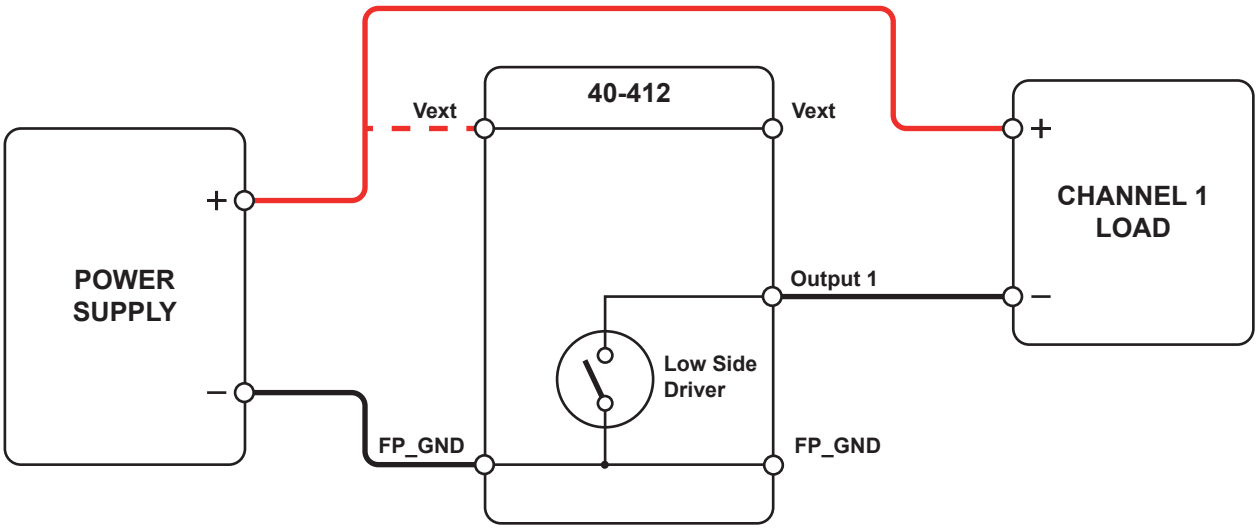



**Figure 5.3 - Example of driving a load using the Low-Side driver**

**Notes:**

1. The Power Supply must be referenced to FP_GND for correct operation.
2. Vext can be connected to the supply positive for a mixture of Low-Side and High-Side drivers.

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# SECTION 6 TROUBLE SHOOTING

# SECTION 6 DÉPANNAGE

| | |
|---|---|
| **Refer to the Warnings and Cautions at the front of this manual**  | **Reportez-vous aux Avertissements et Mises en garde au début du manuel.**  |

## INSTALLATION PROBLEMS

The Plug & Play functionality of Pickering switch cards generally ensures trouble-free installation.

If you do experience any installation problems you should first ensure that all cards are properly seated in their slots. Improperly mated cards may go undetected by the operating system, or may be detected as a card of an unknown type. They can also cause the computer to freeze at various stages in the boot sequence.

If your system employs a remote control interface you should check the integrity of all remote control interface links. When the system is powered up, and during Windows start-up, you should expect to see periodic activity on the remote control interface RX/TX (yellow) indicators, clearing to leave only the PWR/LNK (green) LEDs illuminated. The RX/TX indicators should show activity when you attempt to access a card.

## PROBLÈMES D'INSTALLATION

La fonctionnalité Plug & Play des cartes de commutation Pickering assure généralement une installation sans problème.

Si vous rencontrez des problèmes d'installation, vous devez d'abord vous assurer que toutes les cartes sont correctement insérées dans les slots. Les cartes mal accouplées peuvent passer inaperçues par le système d'exploitation, ou peuvent être détectées comme une carte d'un type inconnu. Elles peuvent également entraîner le blocage de l'ordinateur à divers stades du démarrage.

Si votre système utilise une interface de commande à distance, vous devez vérifier l'intégrité de tous les liens de l'interface de commande à distance. Lorsque le système est sous tension, et pendant le démarrage de Windows, vous devriez vous attendre à voir l'activité périodique sur l'interface de commande à distance RX / TX indicateur (jaune), de compensation pour ne laisser que les LED PWR/LNK (vert) allumées. Les indicateurs RX/TX doivent montrer une activité lorsque vous tentez d'accéder à une carte.

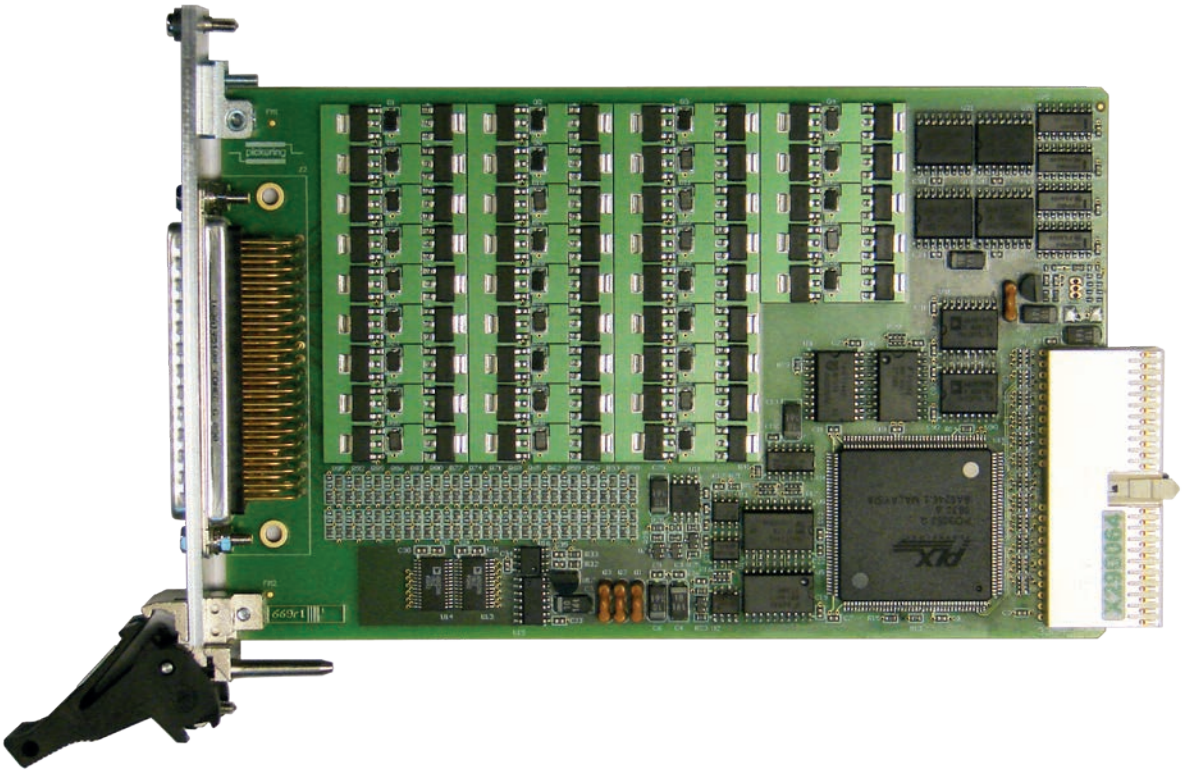
## DIAGNOSTIC UTILITY

The Pickering Diagnostic Utility (accessible through the Programs>>Pickering>>PXI Utilities menu) generates a diagnostic report of the system's PCI configuration, highlighting any potential configuration problems. Specific details of all installed Pickering switch cards are included. All the installed Pickering switch cards should be listed in the "Pilpxi information" section - if one or more cards is missing it may be possible to determine the reason by referring to the PCI configuration dump contained in the report, but interpretation of this information is far from straightforward, and the best course is to contact Pickering support: support@pickeringtest.com, if possible including a copy of the diagnostic report.

## UTILITAIRE DE DIAGNOSTIC

L'utilitaire de diagnostic Pickering (accessible via les programs >> Pickering >> menu Utilities PXI) génère un rapport de diagnostic de la configuration du système PCI, mettant en évidence les problèmes potentiels de configuration. Les détails spécifiques de toutes les cartes de commutation Pickering installées sont inclus. Toutes les cartes de commutation installées de Pickering doivent être répertoriées dans la section «Information Pilpxi" - si une ou plusieurs cartes manquent, il est possible de déterminer la raison en se référant au détail de la configuration PCI contenu dans le rapport, mais l'interprétation de cette information est loin d'être simple, et la meilleure solution est de contacter le support Pickering: support@pickeringtest.com, si possible, avec une copie du rapport de diagnostic.

| DIAGNOSTIC UTILITY | UTILITAIRE DE DIAGNOSTIC |
|---|---|
| In the “VISA information” section, if VISA is not installed its absence will be reported. This does not affect operation using the Direct I/O driver, and is not a problem unless you wish to use VISA. VISA is a component of National Instruments LabWindows/CVI and LabVIEW, or is available as a standalone environment.<br><br>If VISA is present and is of a sufficiently recent version, the section “Pipx40 information” should present a listing similar to “Pilpxi information”.<br><br>Please note that the Diagnostic Utility cannot access cards if they are currently opened by some other application, such as the Test Panels or Terminal Monitor. | Dans la section “Informations VISA” si VISA n’est pas installé cette absence sera signalée. Cela n’affecte pas le fonctionnement en utilisant le pilote Direct I/O, et n’est pas un problème, sauf si vous souhaitez utiliser VISA. VISA est une composante de LabWindows/CVI et LabVIEW de National Instruments, il est disponible comme un environnement autonome.<br><br>Si VISA est présent et s’il est d’une version suffisamment récente, la section «Information Pipx40” devrait présenter une liste similaire pour les «Information Pilpxi”.<br><br>Veuillez noter que l’utilitaire de diagnostic ne peut pas accéder aux cartes si celles-ci sont actuellement ouvertes par quelques autres applications, telles que les panneaux test ou moniteur de terminal. |



**32-Channel Digital I/O Module With High and Low Side Drivers - 40-412-001**
**(Serial input acquisition version)**

# SECTION 7
# MAINTENANCE INFORMATION

# SECTION 7
# INFORMATION SUR L'ENTRETIEN

| | |
|---|---|
| **Refer to the Warnings and Cautions at the front of this manual**  | **Reportez-vous aux Avertissements et Mises en garde au début du manuel.**  |

| PERIODIC MAINTENANCE | L'ENTRETIEN PÉRIODIQUE |
|---|---|
| This product and its corresponding chassis do not require any periodic maintenance. | Ce produit et son châssis correspondant ne nécessitent pas d'entretien périodique. |

| GENERAL CLEANING | NETTOYAGE GÉNÉRAL |
|---|---|
| • Isolate the electrical power from the chassis and ensure that no user I/O signals are being applied.<br>• Wipe the product & chassis surfaces with a clean dry anti-static cloth only. | • Isolez l'alimentation électrique du châssis et assurez-vous qu'aucun signaux d'E/S utilisateur sont appliqués.<br>• Nettoyez la surface des produits et des châssis uniquement avec un chiffon antistatique propre et sec. |

| SOFTWARE UPDATE | MISE À JOUR LOGICIELLE |
|---|---|
| For PXI modules operating in a PXI chassis, no module software updates are required. For the latest version of the driver please refer to our web site **pickeringtest.com** where links to our Software Download page will provide the latest version of the driver software for the various programming environments encountered.<br><br>For PXI modules which are supported in one of Pickering Interfaces' Modular LXI Chassis (such as the 60-102B and 60-103B) no module software update is required. If the module was introduced after the LXI chassis was manufactured the module may not be recognized, in this case the chassis firmware may need upgrading. This is a simple process which is described in the manual for the Modular LXI Chassis. | Pour les modules PXI opérant dans un châssis PXI, aucune mise à jour du logiciel du module n'est nécessaire. Veuillez-vous référer à notre site Web **pickeringtest.com** où des liens vers la page de téléchargement du logiciel vous fourniront la dernière version du pilote logiciel pour les différents environnements de programmation rencontrés.<br><br>Pour les modules PXI qui sont pris en charge dans l'un des châssis modulaire LXI de Pickering Interfaces (comme le 60-102B et 60-103B) aucune mise à jour du logiciel du module n'est nécessaire. Si le module a été introduit après que le châssis LXI ait été fabriqué, le module peut ne pas être reconnu, dans ce cas, le firmware du châssis peut avoir besoin d'une mise à niveau. C'est un processus simple qui est décrit dans le manuel du châssis LXI modulaire. |

## VERIFICATION PROCEDURE

The 40-412 contains no adjustable parts, performance is guaranteed by the design without adjustment.

The 40-412 does not require routine verification. However some users may need to have a routine procedure for verification imposed on a system for other reasons, so the following is a procedure which demonstrates that the 40-412 is working correctly. It tests that the output drives are operating and that the digital inputs can read back their status.

### Required Test Equipment

The following is required to verify the 40-412:

- A voltage source capable of being set to 0V and 20V.
- A fixture which can e created from a 78-pin D-type mating connector or a Pickering Interfaces accessory such as 40-960-078 or 40-965-078.

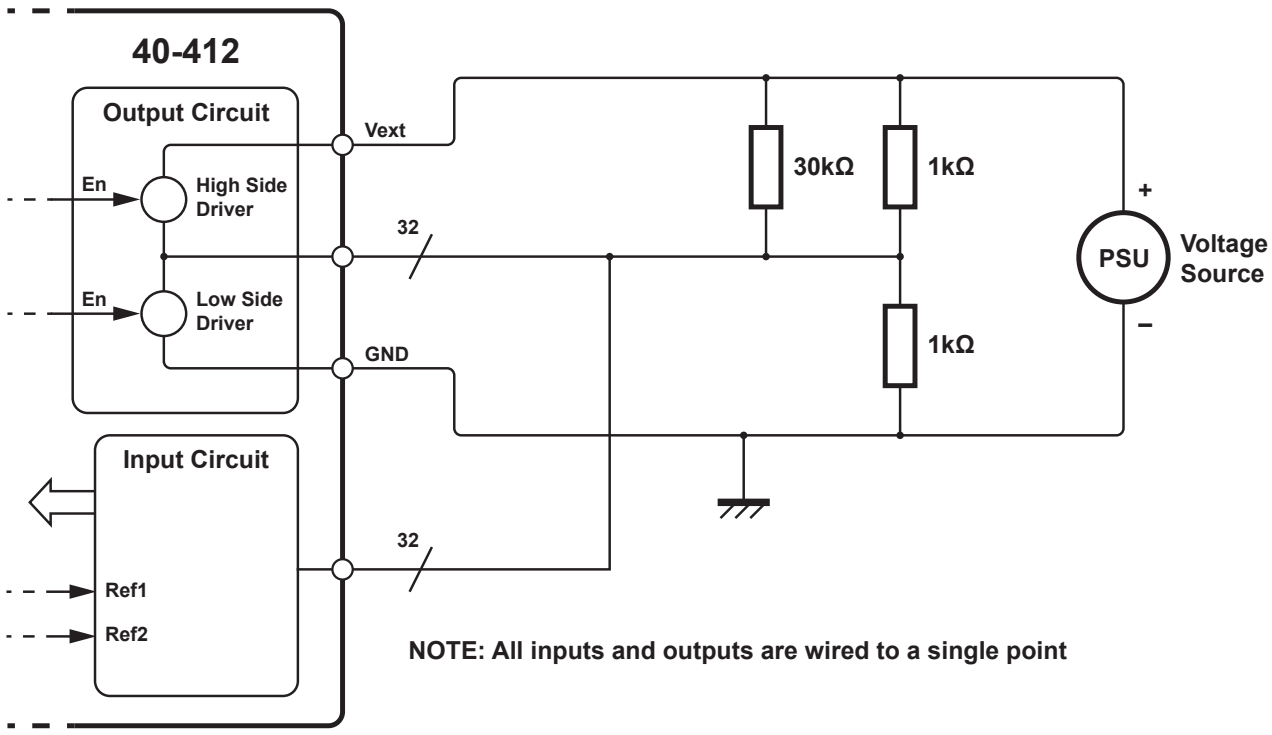



**Figure 7.1 - 32-Channel Digital I/O Module - Verification Test Set-up**

The user should create a test fixture as shown in Figure 7.1

The power supply should be connected to the 40-412 ground and Vext pins, ensuring the positive terminal is connected to Vext.

**NOTE: The power supply should be set with a 100mA current limit.**

Two 1kΩ resistors and a 30kΩ resistor should be wired as shown so they form a 2:1 potential divider. The 30kΩ resistor compensates (approximately) for the input impedance of the digital inputs (1MΩ, 32 channels).

All 32 channel drivers are connected to the potential divider mid-point. All 32 digital inputs are connected to the potential divider mid-point.

## TEST PROCEDURE

The test can be automated or can be conducted using the SFP supplied.

### Digital Input Test

The following test is conducted with the drivers all set to off.

Set the voltage source to 0V. The fixture potential divider output will now be 0V.

Set both input Threshold voltages to 0.5V. Check that the responses are all low for all the 32 channels.

**NOTE:** When using the Soft Front Panel, a threshold voltage of 0.5V equates to 101000 in binary (0.5 / 0.0125 = 40 = 101000). See Figure 7.2.

Set the voltage source to 20V. The fixture potential divider output will now be 10V.

Set both input Threshold voltages to 9.5V. Check that the responses are all high for all the 32 channels.

Set Threshold Voltage 1 to 9.5V and Threshold Voltage 2 to 10.5V. Check all responses from Threshold Voltage 1 are high and all from Threshold Voltage 2 are low.

**NOTE:** When using the Soft Front Panel, a threshold voltage of 9.5V equates to 1011111000 in binary (9.5 / 0.0125 = 760 = 1011111000). See Figure 7.3.
Also, a threshold voltage of 10.5V equates to 1101001000 in binary (10.5/0.0125 = 840 = 1101001000).

Set Threshold Voltage 1 to 10.5V and Threshold Voltage 2 to 9.5V. Check all responses from Threshold Voltage 1 are low and all from Threshold Voltage 2 are high.

Set Threshold Voltage 1 and 2 to 10.5. Check all responses are high.

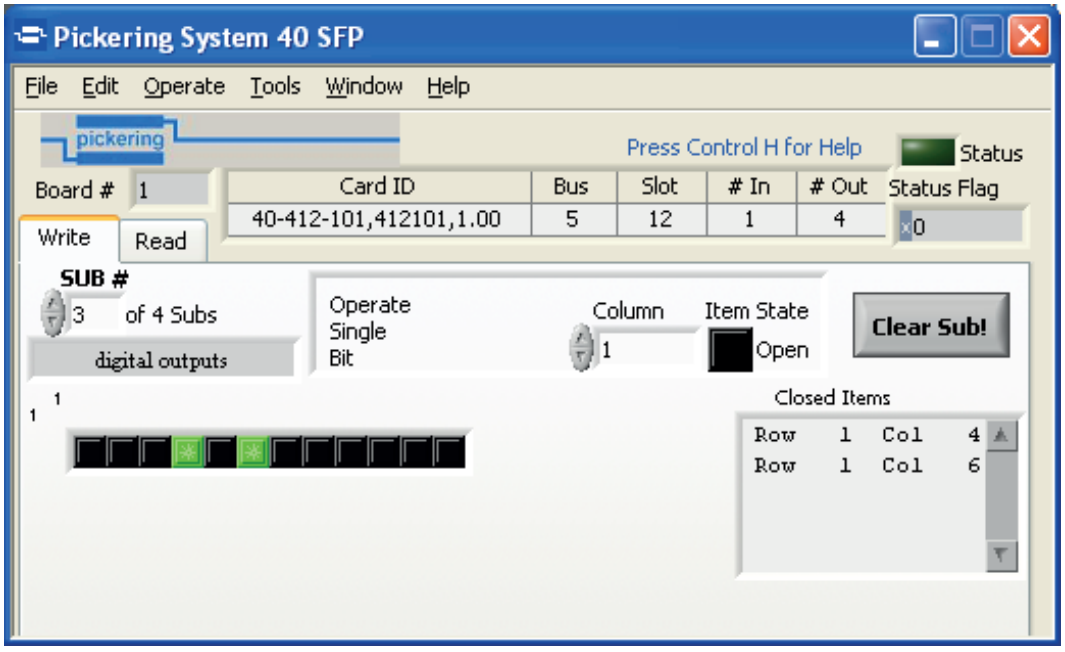



**Figure 7.2 - Using Soft Front Panel To Set a Threshold of 0.5V (101000 in Binary)**

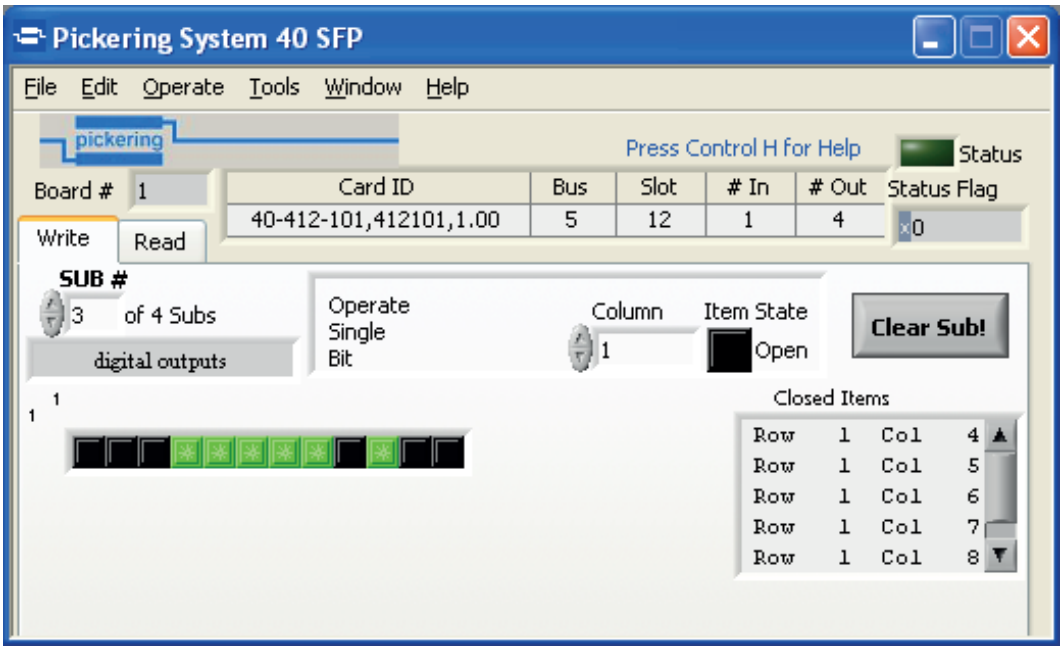



**Figure 7.3 - Using Soft Front Panel To Set a Threshold of 9.5V (1011111000 in Binary)**

### Output Driver Test

The following test checks the drivers are operational; it does not check the current capability of the drivers and uses the digital inputs to check that the output state has changed.

Set the voltage source to 20V. The fixture potential divider output will now be 10V. Set Threshold Voltage 1 to 9.5V and Threshold Voltage 2 to 10.5V.

With all drivers off check Threshold Voltage 1 responds high and Threshold Voltage 2 responds low.

Turn on Channel 1 high side driver, check that both thresholds respond high. Turn driver off.

Repeat for Channel 2 to 32 high side driver.

Turn Channel 1 lows side driver on, check that both thresholds respond low. Turn driver off.

Repeat for Channel 2 to 32 low side driver.

Pass/fail results can be recorded in the table on the following page.

## VERIFICATION TEST RESULTS

The following table for the verification test results can be printed out for recording purposes.

| VERIFICATION TEST | | | |
|---|---|---|---|
| **Module Number:** | **41-412-** | **Serial Number:** | |
| **Date of Test:** | | **Operator's Name:** | |
| **Test Equipment Used:** | | | |

| INPUT TESTS | |
|---|---|
| **Test Name** | **Result (delete as appropriate)** |
| 0.5V Threshold Test | Pass / Fail |
| 9.5V 10.5V Threshold Test | Pass / Fail |
| 10.5V 9.5V Threshold Test | Pass / Fail |
| 10.5V 10.5V Threshold Test | Pass / Fail |

| OUTPUT TESTS | |
|---|---|
| **Test Name** | **Result (delete as appropriate)** |
| Drivers off test | Pass / Fail |
| Channel 1 to 32 High Side Test | Pass / Fail |
| Channel 1 to 32 Low side Test | Pass / Fail |

## INPUT/OUTPUT LOOK-UP TABLES - 40-412-001

The following tables cross-reference the 40-412-001 module's input and ouput signal to the physical devices on the PCB. This is for fault finding purposes and should be used in conjunction with the PCB layout diagram in Figure 7.4.

| Input Signal | MUX No. | MUX Pin |
|---|---|---|
| Input 1 | U13 | 20 |
| Input 2 | U13 | 22 |
| Input 3 | U13 | 24 |
| Input 4 | U13 | 26 |
| Input 5 | U13 | 7 |
| Input 6 | U13 | 5 |
| Input 7 | U14 | 19 |
| Input 8 | U14 | 20 |
| Input 9 | U14 | 21 |
| Input 10 | U14 | 22 |
| Input 11 | U14 | 24 |
| Input 12 | U14 | 25 |
| Input 13 | U14 | 7 |
| Input 14 | U14 | 5 |
| Input 15 | U14 | 4 |
| Input 16 | U14 | 10 |
| Input 17 | U13 | 19 |
| Input 18 | U13 | 21 |
| Input 19 | U13 | 23 |
| Input 20 | U13 | 25 |
| Input 21 | U13 | 11 |
| Input 22 | U13 | 10 |
| Input 23 | U13 | 9 |
| Input 24 | U13 | 8 |
| Input 25 | U13 | 6 |
| Input 26 | U13 | 4 |
| Input 27 | U14 | 23 |
| Input 28 | U14 | 26 |
| Input 29 | U14 | 8 |
| Input 30 | U14 | 6 |
| Input 31 | U14 | 9 |
| Input 32 | U14 | 11 |

| Output Signal | High Side Driver | Low Side Driver |
|---|---|---|
| Output 1 | U26 | U27 |
| Output 2 | U28 | U29 |
| Output 3 | U30 | U31 |
| Output 4 | U32 | U33 |
| Output 5 | U34 | U35 |
| Output 6 | U36 | U37 |
| Output 7 | U38 | U39 |
| Output 8 | U40 | U41 |
| Output 9 | U42 | U43 |
| Output 10 | U44 | U45 |
| Output 11 | U46 | U47 |
| Output 12 | U48 | U49 |
| Output 13 | U50 | U51 |
| Output 14 | U52 | U53 |
| Output 15 | U54 | U55 |
| Output 16 | U56 | U57 |
| Output 17 | U58 | U59 |
| Output 18 | U60 | U61 |
| Output 19 | U62 | U63 |
| Output 20 | U64 | U65 |
| Output 21 | U66 | U67 |
| Output 22 | U68 | U69 |
| Output 23 | U70 | U71 |
| Output 24 | U72 | U73 |
| Output 25 | U74 | U75 |
| Output 26 | U76 | U77 |
| Output 27 | U78 | U79 |
| Output 28 | U80 | U81 |
| Output 29 | U82 | U83 |
| Output 30 | U84 | U85 |
| Output 31 | U86 | U87 |
| Output 32 | U88 | U89 |

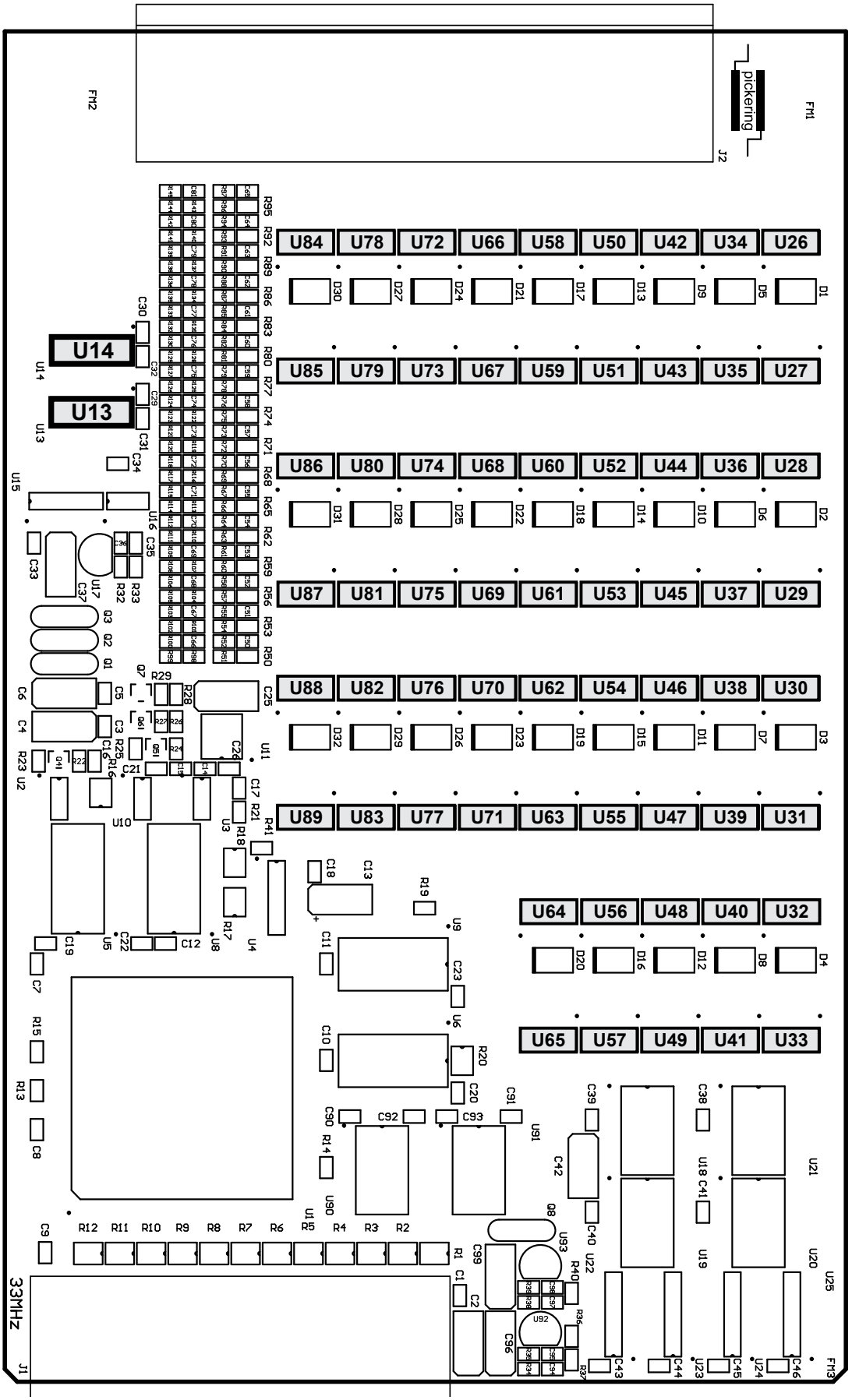



Figure 7.4 - 40-412-001 Component Layout

## INPUT/OUTPUT LOOK-UP TABLES - 40-412-111

The following tables cross-reference the 40-412-111 module's input and ouput signal to the physical devices on the PCB. This is for fault finding purposes and should be used in conjunction with the PCB layout diagrams in Figure 7.5 and 7.6. The ouput high-side and low-side drivers are fitted to the mother board, and the comparator devices for the inpust are fitted to the daughter board.

| 40-412-111 Daughter Board | | |
|---|---|---|
| Input Signal | Comparator No. | Comparator Pin No. |
| Input 1 | U17 | 5 & 7 |
| Input 2 | | 9 & 11 |
| Input 3 | U18 | 5 & 7 |
| Input 4 | | 9 & 11 |
| Input 5 | U19 | 5 & 7 |
| Input 6 | | 9 & 11 |
| Input 7 | U20 | 5 & 7 |
| Input 8 | | 9 & 11 |
| Input 9 | U21 | 5 & 7 |
| Input 10 | | 9 & 11 |
| Input 11 | U22 | 5 & 7 |
| Input 12 | | 9 & 11 |
| Input 13 | U23 | 5 & 7 |
| Input 14 | | 9 & 11 |
| Input 15 | U24 | 5 & 7 |
| Input 16 | | 9 & 11 |
| Input 17 | U25 | 5 & 7 |
| Input 18 | | 9 & 11 |
| Input 19 | U26 | 5 & 7 |
| Input 20 | | 9 & 11 |
| Input 21 | U27 | 5 & 7 |
| Input 22 | | 9 & 11 |
| Input 23 | U28 | 5 & 7 |
| Input 24 | | 9 & 11 |
| Input 25 | U29 | 5 & 7 |
| Input 26 | | 9 & 11 |
| Input 27 | U30 | 5 & 7 |
| Input 28 | | 9 & 11 |
| Input 29 | U31 | 5 & 7 |
| Input 30 | | 9 & 11 |
| Input 31 | U32 | 5 & 7 |
| Input 32 | | 9 & 11 |

| 40-412-111 Mother Board | | |
|---|---|---|
| Output Signal | High Side Driver | Low Side Driver |
| Output 1 | U26 | U27 |
| Output 2 | U28 | U29 |
| Output 3 | U30 | U31 |
| Output 4 | U32 | U33 |
| Output 5 | U34 | U35 |
| Output 6 | U36 | U37 |
| Output 7 | U38 | U39 |
| Output 8 | U40 | U41 |
| Output 9 | U42 | U43 |
| Output 10 | U44 | U45 |
| Output 11 | U46 | U47 |
| Output 12 | U48 | U49 |
| Output 13 | U50 | U51 |
| Output 14 | U52 | U53 |
| Output 15 | U54 | U55 |
| Output 16 | U56 | U57 |
| Output 17 | U58 | U59 |
| Output 18 | U60 | U61 |
| Output 19 | U62 | U63 |
| Output 20 | U64 | U65 |
| Output 21 | U66 | U67 |
| Output 22 | U68 | U69 |
| Output 23 | U70 | U71 |
| Output 24 | U72 | U73 |
| Output 25 | U74 | U75 |
| Output 26 | U76 | U77 |
| Output 27 | U78 | U79 |
| Output 28 | U80 | U81 |
| Output 29 | U82 | U83 |
| Output 30 | U84 | U85 |
| Output 31 | U86 | U87 |
| Output 32 | U88 | U89 |

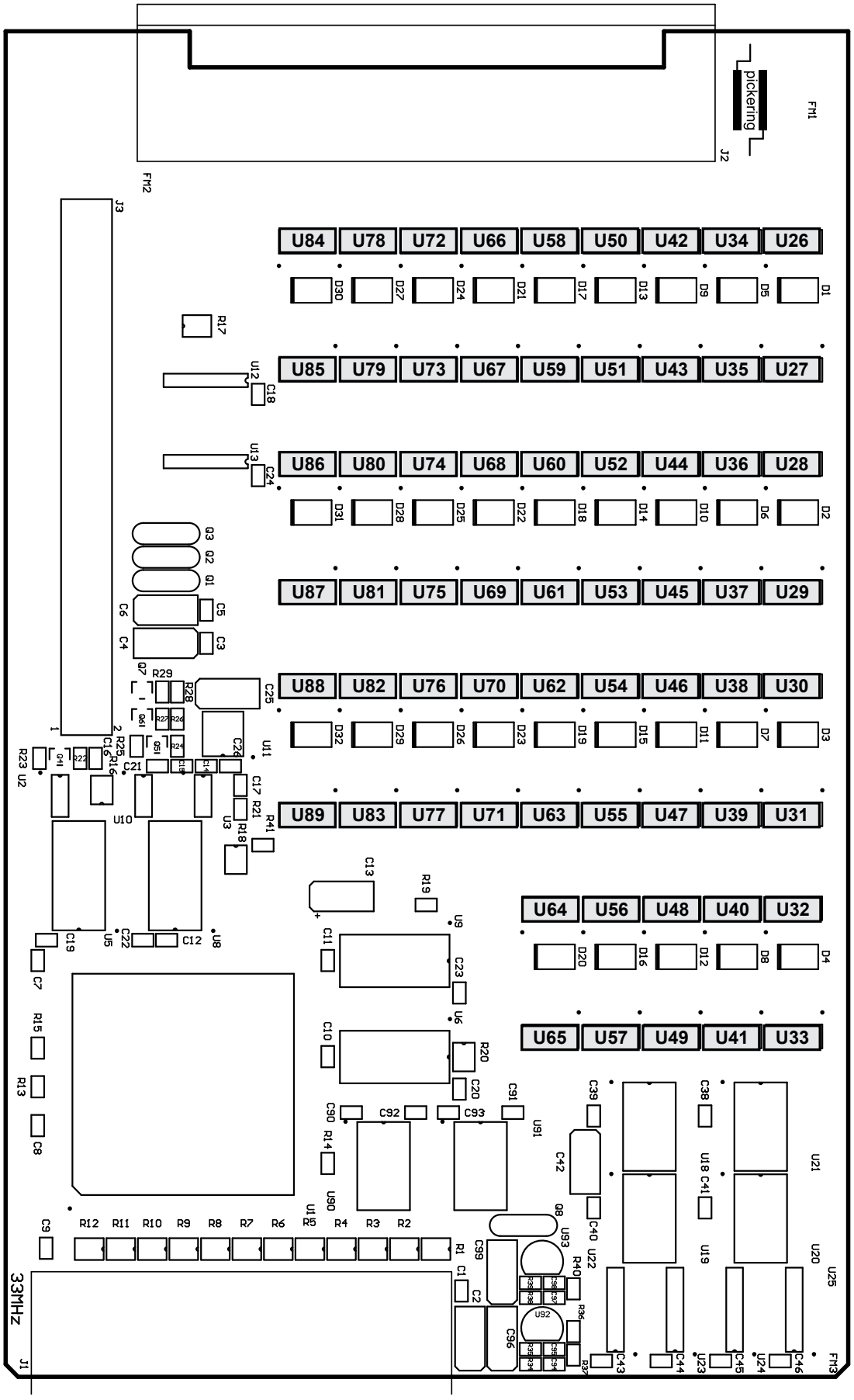



**Figure 7.5 - 40-412-111 Mother Board Component Layout**

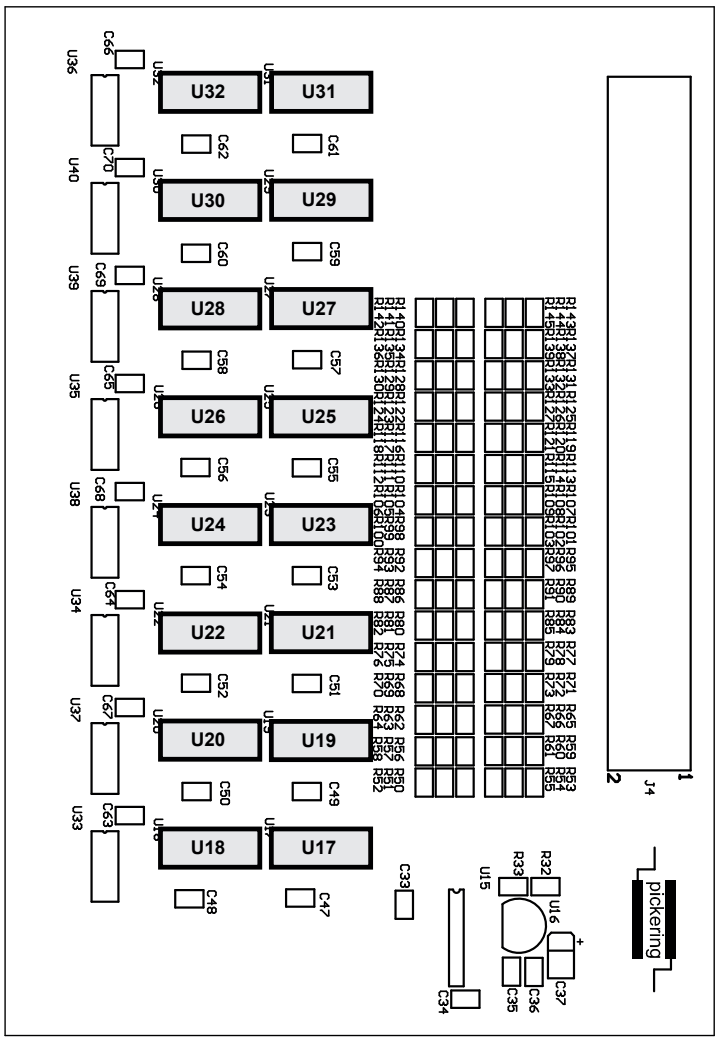



**Figure 7.6 - 40-412-111 Daughter Board Component Layout**

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