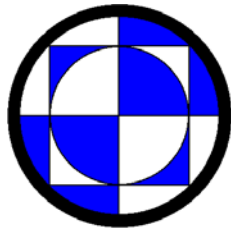


# DS-32 RTU Specification Overview



Dynatrol Systems Inc.

#601, 4656 Westwinds Drive NE

Calgary, Alberta, Canada, T3J3Z5

Tel: (403) 235-5611, Fax:(403) 235-5610

# Hardware Overview

- DS-32 AC Input Power Supply: Input: 110/230 VAC, Output: 2 isolated 12 VDC @ 2.33 Amp Each
- DS-32 Main: 5 Communication Ports, 16 DI, 16 AI, 16 DO, 3 HSA
- DS-32 Peripheral DI: 32 DI
- DS-32 Peripheral AI: 32 AI
- DS-32 Peripheral DO: 32 DO
- DS-32 Peripheral AO: 8 AO

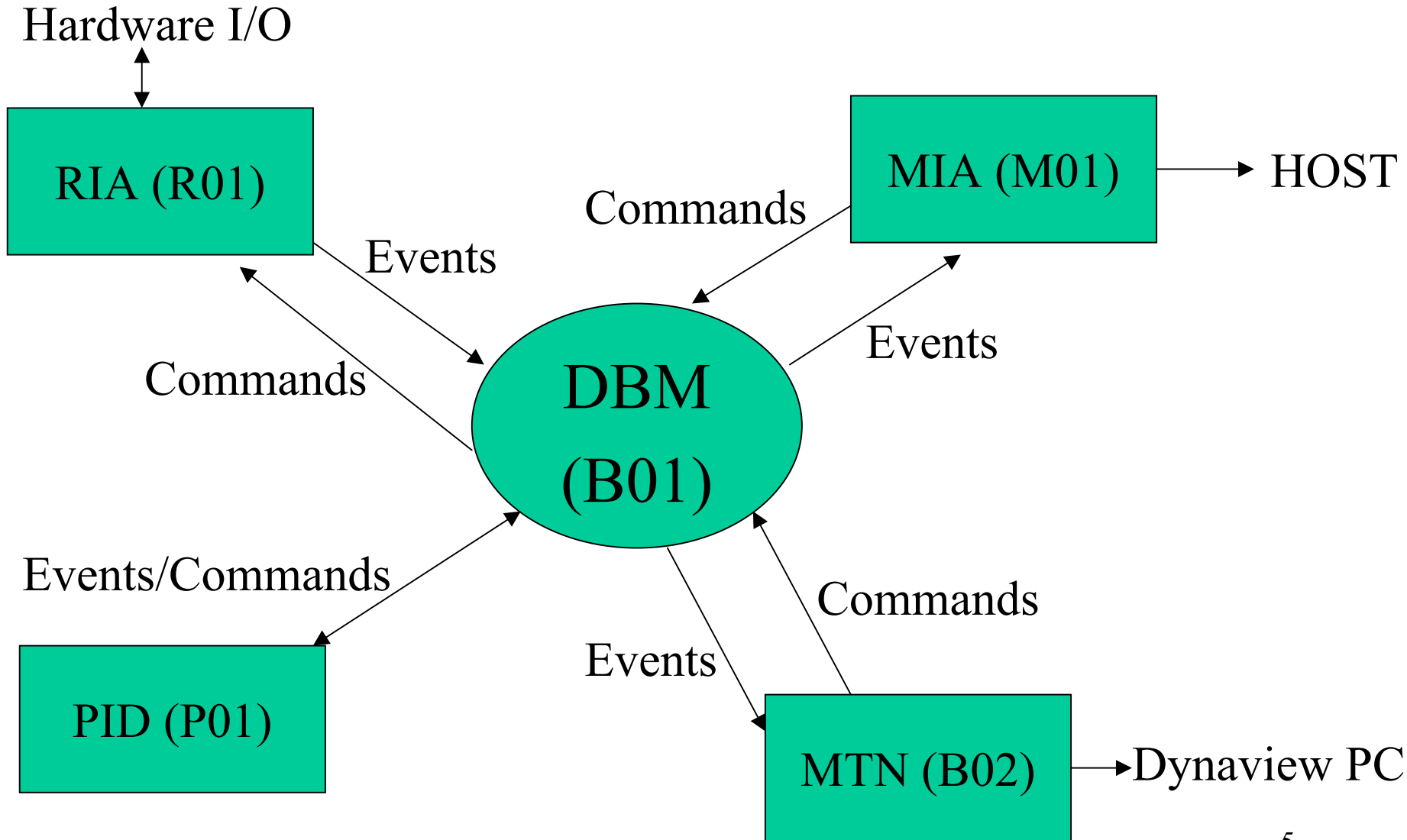
# Software Overview

- Real Time Kernel: AMX
- Firmware: Bootstrap, Startup, SIO
- Base: DBM (Data Base Manager), MTN (Maintenance: Dynaview)
- Applications:
  - RIA: R01 (Hardware I/O), R02 (Device Status), R04: (GE Multilin)
  - MIA: M01 (Modbus)
  - DCA: D01 (System Status)
  - PCA: P01 (PID), P02 (EDCO)
  - PTA:

# Definition of Point Types

- Real I/O Points: Real physical Points
- Pseudo Points: Generated by Software
- System Points: The term used to refer to the points of the RTU
- RIA Points / Owned Points: Points belong to the particular RIA applications
- MIA Points / Mapped Points: System Points required by the MIA applications

# Database Architecture



# DS-32 Main Board Overview

- For SCADA applications: Electric Utility, Oil & Gas, Water Works, Rail Transportation, Communication
- Microprocessor based
- Stand Alone Single Board RTU: 16 DI, 16 AI, 16 DO, 3 HSA, 5 RS-232 Communication Ports
- Analog Peripheral Expansion Interface
- Digital Peripheral Expansion Interface

# Main Board: Technology

- CMOS components for low power consumption
- Extensive use of Surface Mount components for small foot print
- In-System-Programming technology for Flash EEPROM and EPLD

# Main Board: Power Requirement

- 2 Isolated Unregulated 12 VDC (1 Amp each) or 24 VDC (1/2 Amp each), 1 for Electronics, 1 for Digital Input Wetting \*
- On-board Power Supplies: Switching mode: +5 VDC for digital Electronics, DC/DC isolated +5 VDC, -12 VDC and +12 VDC for Analog Electronics
- \* In field service RTU, always provide separated power source for the Digital Input Wetting

# Main Board: CPU & Memory

- 32-bit HCMOS Motorola 68332 @ 20 MHz
- 1 M Bytes of Flash EEPROM
- 1 M Bytes of Battery Backed up Static RAM

# Main Board: CPU Supervisor

- Watchdog Timer: Reset CPU on absence of watch dog pulses
- Power Monitor: Halt CPU on low Supply voltage
- Reset CPU on Power Startup
- Power Source Switching for RTC and RAM
- Watch Dog relay control

# Main Board: System Status Indicators

- Power On indicator: Light On with present of power
- Performance Indicator: The brightness of the LED is proportional to the idling of the CPU
- System Normal Indicator: Light On with Normal Operation
- Control Malfunction Indicator: Pulsing with Malfunction of the Control hardware
- Remote/Local Indicator: Light On with Remote/Local Switch in Remote

# Main Board: Communication Ports

- RS-232 Ports: 4 User Ports, 1 Jumper Selectable Maintenance or User Port
- Baud Rate: 300 - 38.4 K
- Sync/Async: 4 Sync/Async, 1 Async Port
- Hand Shaking Signals: DCD, RTS, CTS
- Specifications: Meet all EIA/TIA-232-E and V.28 Specifications
- Indicators: Transmit and Receive Indicators for User Ports
- Multiple Protocol Support
- Redundant Communication

# Main Board: Miscellaneous Features

- Optional 68HC882 Floating Point Math Coprocessor support
- Battery Backed up Real Time Calendar Clock with Year, Month, Day of Month, Day of Week, Hour, Minute, Second
- RTU Ambient Temperature Sensor
- Redundancy Design

# Main Board: Digital Inputs

- 16 Optical Isolated with 12 VDC or 24 VDC excitation
- Input indicator on each digital input driven by input current
- Isolation Rating: 1500 Vrms (Point Input to Logic)
- Hardware Digital Filter: Programmable 2-15 ms debounce timer, transition detection and interrupt capability
- Accumulator: Any digital input can be configured as an Accumulator
- Maximum Rate of Accumulator: 150 Hz
- Types of point: Form A, Form C and BCD
- SOE: Any Digital Input Point can be Configured as SOE with accuracy of 1 ms, Chatter Filter is available for preventing malfunctioning inputs from filling up the SOE buffer.

# Main Board: Analog Inputs

- 16 Bipolar, Differential input @  $\pm 10.0\text{V}$ ,  $\pm 7.5\text{V}$ ,  $\pm 5\text{V}$ ,  $\pm 1\text{V}$  with one shield for every 2 points
- Analog Input Adapter: 0 to 1mA, -1 to +1mA, 4 to 20mA
- Accuracy:  $\pm 0.05\%$  (DC voltage input)
- Temperature Coefficient:  $\pm 5\text{PPM}$  per degree Celsius
- Resolution: 15 bit plus sign
- Auto Self Calibration Reference Points:  $-5.000\text{VDC}$ ,  $0\text{VDC}$  and  $+5.000\text{VDC}$
- Dynamic Range of Converter: 130% of Normalized Full Scale inputs @  $\pm 7.5\text{V}$
- Multiplexers: Optionally uses high-voltage, fault-protected differential solid state analog multiplexers
- CMRR (@0-60Hz): 90 dB
- NMRR (@60Hz) -70 dB
- Continuous Over voltage Rating:  $\pm 35\text{VDC}$ , optional  $\pm 100\text{VDC}$
- Analog input self calibration, Auto-correction of gain and offset errors.

# Main Board: Digital Outputs

- 16 relay outputs
- Output indicator on each digital output
- Control Output Configurations: Isolated Discrete control output relays, Trip/Close, Raise/Lower, Set/Reset, Pattern Controls, Relay fail to OFF, Relay fail to last commanded position
- Control Security: Single component failure protection, Master Trip/Close relays, relay driver input status check back for point selection confirmation, Double point select-before-operate
- Remote/Local Switch for enable/disable controls
- Either a Malfunction of the system (detected by the watchdog), or the failure of a point selection confirmation shuts down the control module
- Control Functions: ON/OFF, Timed ON/OFF (Pulse Duration of 1 ms resolution), Variable duty cycle pulse output with variable repetition rate (Pulse Train of 1 to 254 or continuous, 1 ms resolution), Pattern controls (a group of contiguous outputs)
- Contact Rating: 1 Amp at 110 VDC
- Relay output DB37 socket for ease of interposing relay connections

# Main Board: High Speed Accumulators

- 3 optically isolated inputs for Turbine, Generator and Motor RPM measurements.
- Maximum input: 20 kHz.
- Isolated rating: 1500 Vrms (Point Input to Logic)

# Main Board: Language Support, Operating Environment and Physical Dimensions

- High level language “C”
- Assembler
- Temperature Range: -40 to +85 degrees Celsius
- Humidity: < 95%, non-condensing
- 19.0 x 7.0 inches for 19” standard rack mount or panel mount

# Main Board: Circuit Descriptions

## Power Supply

- Power Input Filter
- Digital Electronic Power Supply
- Analog Power Supply
- Digital Input Wetting Power Supply
- Relay Coil Power Supply

# Main Board: Circuit Descriptions CPU, Math Coprocessor, Memory

- CPU: 32-bit HCMOS 68332 @ 20 MHz
- Floating Point Math Coprocessor: 68HC882
- Memory:
  - 1 M Bytes of Flash EEPROM
  - 1 M Bytes of Battery Backed Up Static RAM
  - 1 M Bytes of Shadow RAM for Development

# Main Board: Circuit Description

## Microprocessor Supervisor and Watchdog

- Power Supply Monitoring
- Battery Switching Control
- Write Protection of CMOS RAM
- Watchdog Reset in absence of Watchdog Pulses
- Watchdog relay control
- Power On Reset

# Main Board: Circuit Description

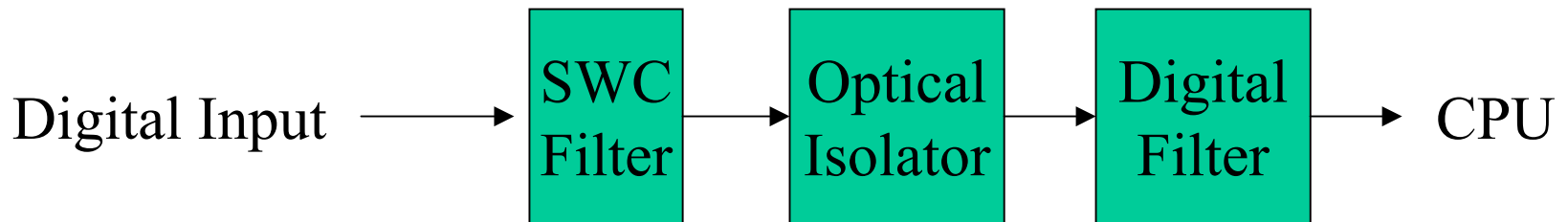
## Real Time Clock, Address Decoding

- Real Time Clock:
  - Battery Backed up
  - Provide Year, Month, Day of Month, Day of Week, Hour, Minute, Second
- On Chip Address Decoding and external Address Decoding

# Main Board: Circuit Description

## Digital Input

- Consider one Digital Input:
- Digital Filter: Transition Detection and Debouncing



# Main Board: Circuit Description

## Digital Output

- Consider one Digital Output:

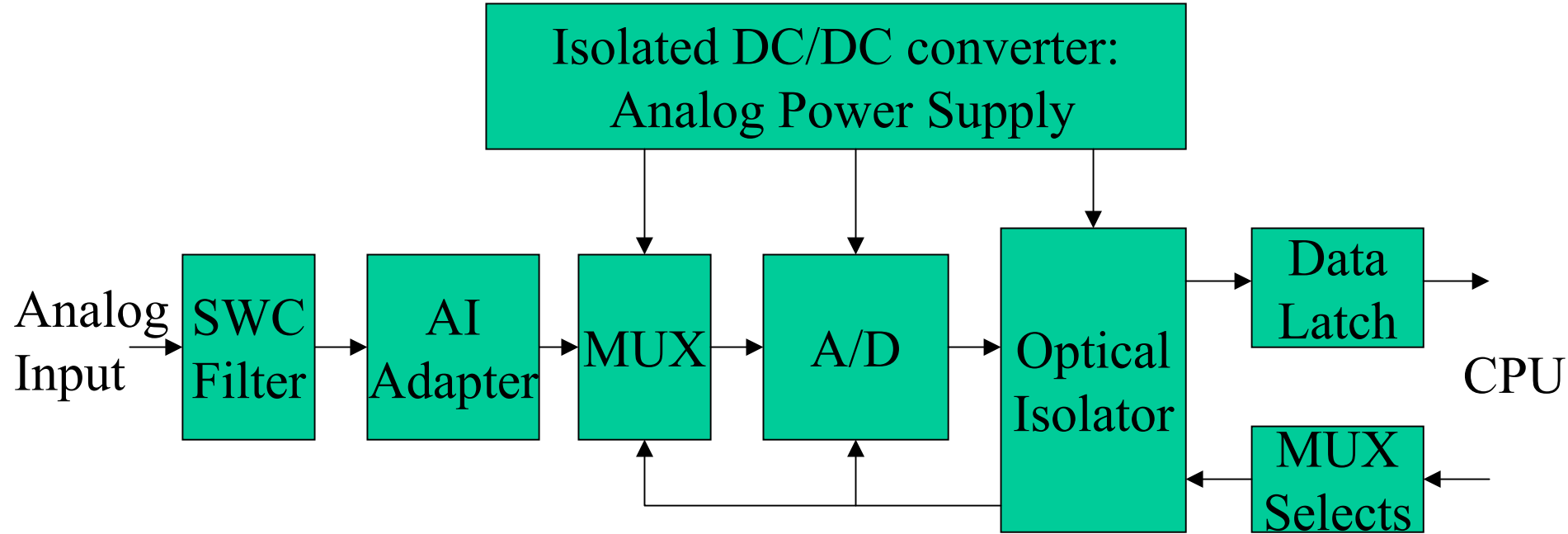
Coil Voltage Selection:  
Trip, Close, Remote power or  
Supply Power



# Main Board: Circuit Description

## Analog Input

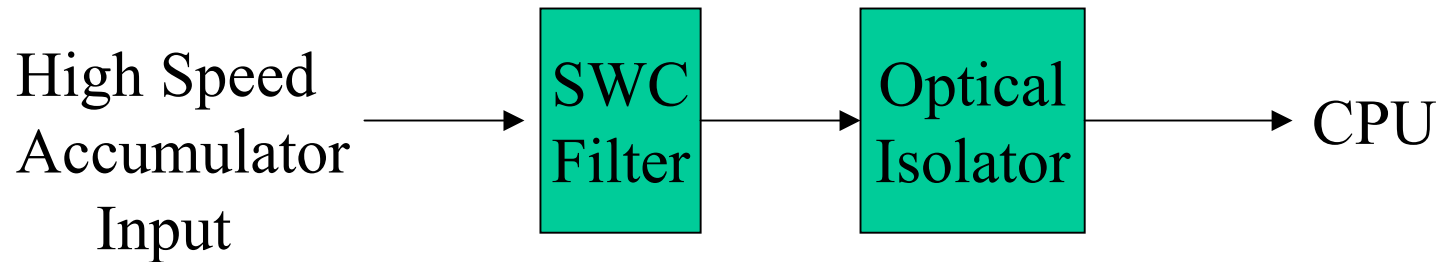
- Consider one Analog Input:



# Main Board: Circuit Description

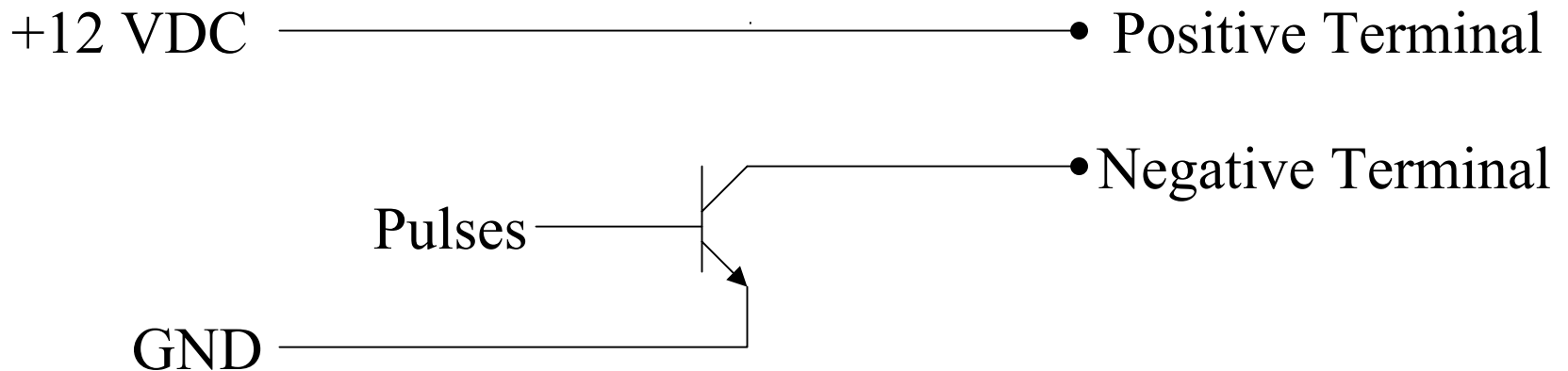
## High Speed Accumulator Input

- Consider one High Speed Accumulator Input:



# Main Board: High Speed Accumulator Interface

- High Speed Accumulator terminals are dry contacts. Therefore the external device has to provide voltage
- Mechanical Relay has bouncing
- Proposed Circuitry:



# Main Board: Circuit Descriptions Communication

- 4 User RS-232 Async/Sync Ports
- 1 Jumper Selectable (Z1) Maintenance/User Async Port
- Hand Shaking Signals: DCD, RTS, CTS
- Tx and Rx LED indicators

# Main Board: Circuit Descriptions

## Digital Expansion

- Up to 14 Digital Input/Output Peripherals can be connected to the Digital Expansion
- The Addressing Scheme: Digital Input Peripherals first and follow by Digital Output Peripherals
- The Physical Positions of the peripherals can be arranged as desired
- The Digital Expansion Cable fed to the Digital Input Peripherals has to be from the top Expansion Socket of the Digital Input Peripherals
- The Digital Expansion Cable fed to the Digital Output Peripherals can be fed from the top or bottom Expansion Socket of the Digital Output Peripherals

# Main Board:

## Digital Expansion Addressing Scheme

- Example: 3 DI and 2 DO Expansion Peripherals

DI #1: Address 1

DI #2: Address 2

DI #3: Address 3

DO #1: Address 4

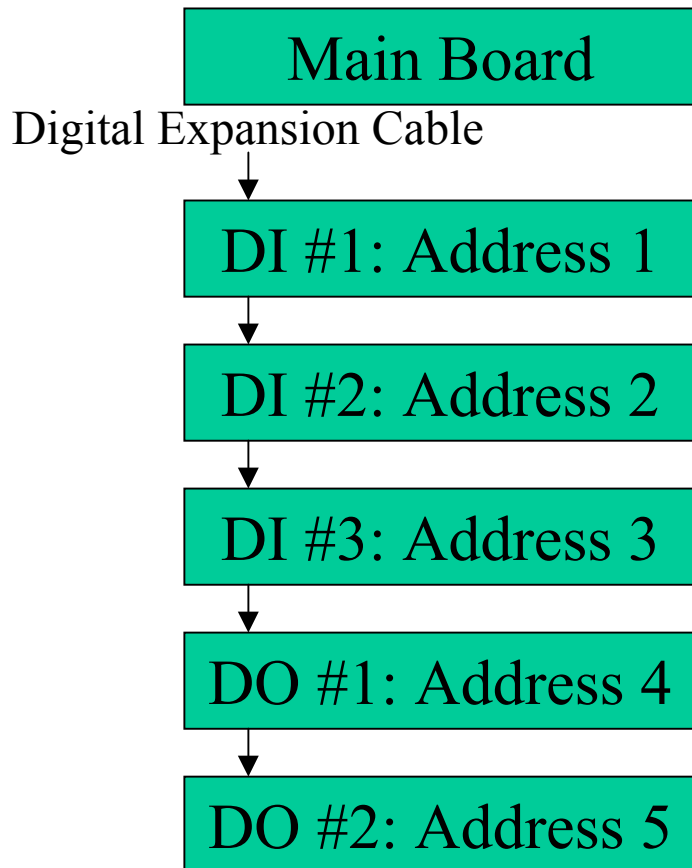
DO #2: Address 5

# Main Board:

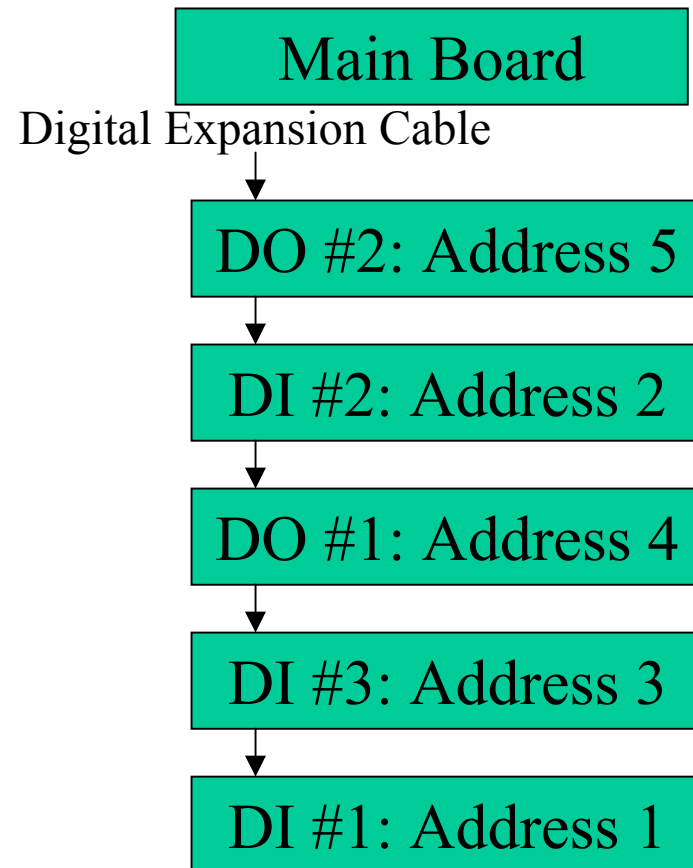
## Physical Arrangement of Digital Peripherals

- Example: 3 DI and 2 DO Expansion Peripherals  
(Arrangement can be as desired)

Example 1



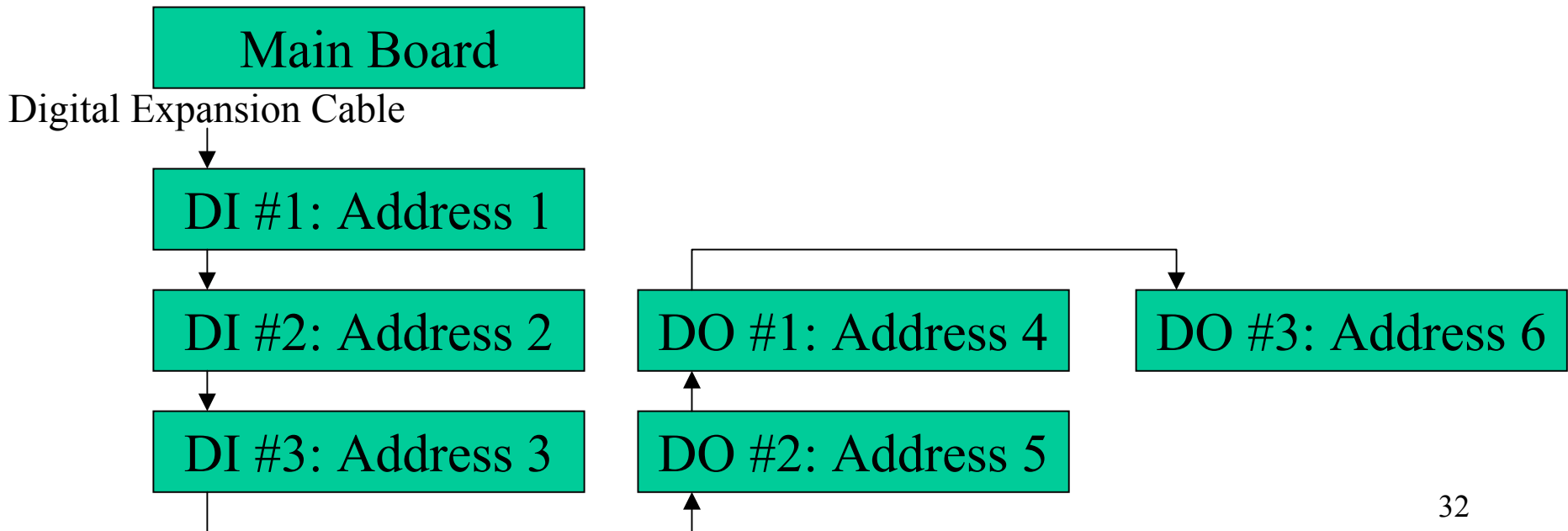
Example 2



# Main Board:

## Orientation of Digital Expansion Cable

- Example: 3 DI and 3 DO Expansion Peripherals
- Note: The Orientation of the Digital Expansion Cable for the Digital Output Peripherals can be from the Bottom. The Orientation of the Digital Expansion Cable for the Digital Input Peripherals has to be from the Top



# Main Board: Circuit Descriptions

## Analog Expansion

- Up to 14 Analog Input/Output Peripherals can be connected to the Analog Expansion
- The Addressing Scheme: Analog Input Peripherals first and follow by Analog Output Peripherals
- The Physical Positions of the peripherals can be arranged as desired
- The Analog Expansion Cable fed to the Analog Input /Output Peripherals can be from the top or bottom Expansion Socket of the Analog Input /Output Peripherals

# Main Board:

## Analog Expansion Addressing Scheme

- Example: 3 AI and 2 AO Expansion Peripherals

AI #1: Address 1

AI #2: Address 2

AI #3: Address 3

AO #1: Address 4

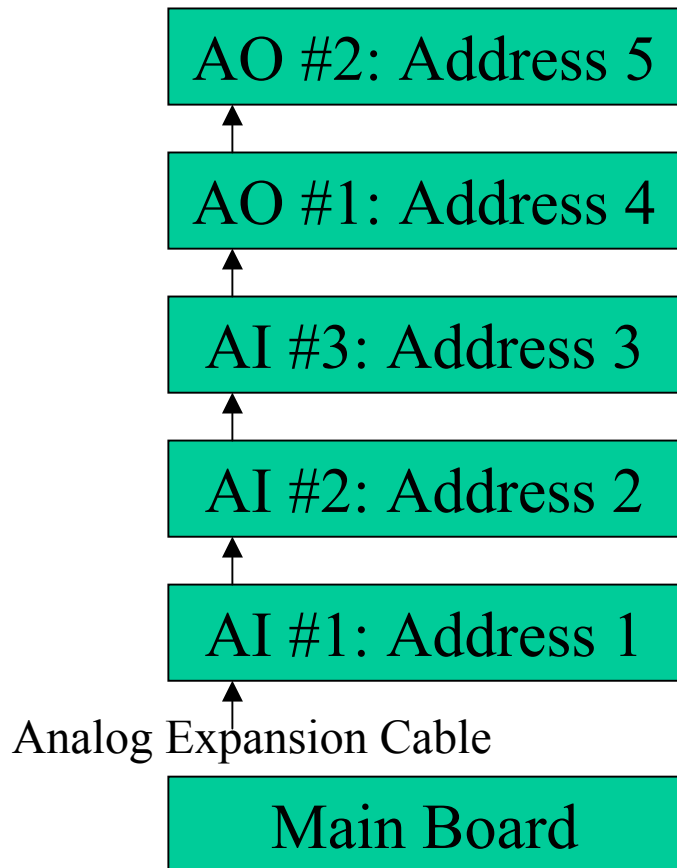
AO #2: Address 5

# Main Board:

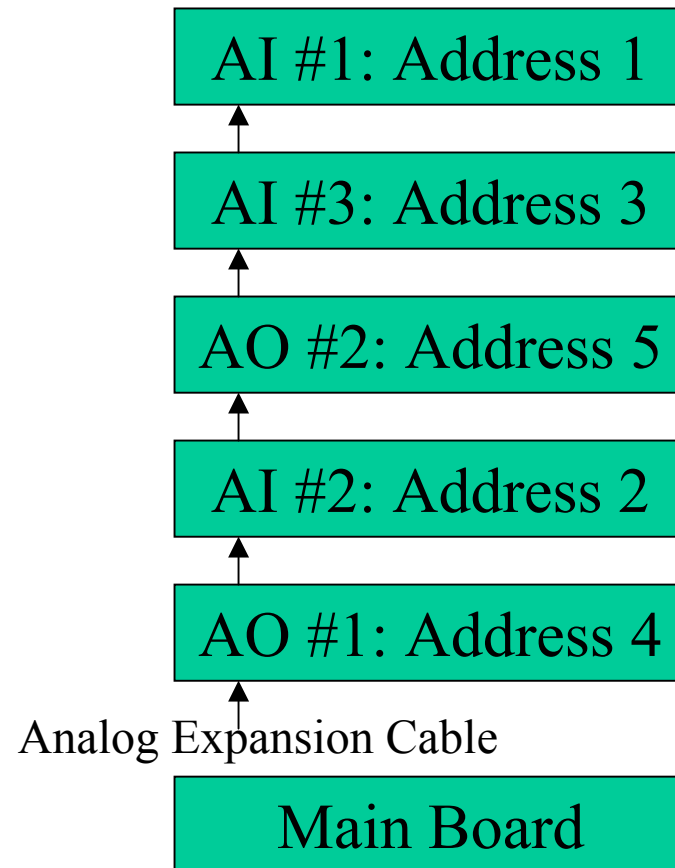
## Physical Arrangement of Analog Peripherals

- Example: 3 AI and 2 AO Expansion Peripherals  
(Arrangement can be as desired)

Example 1



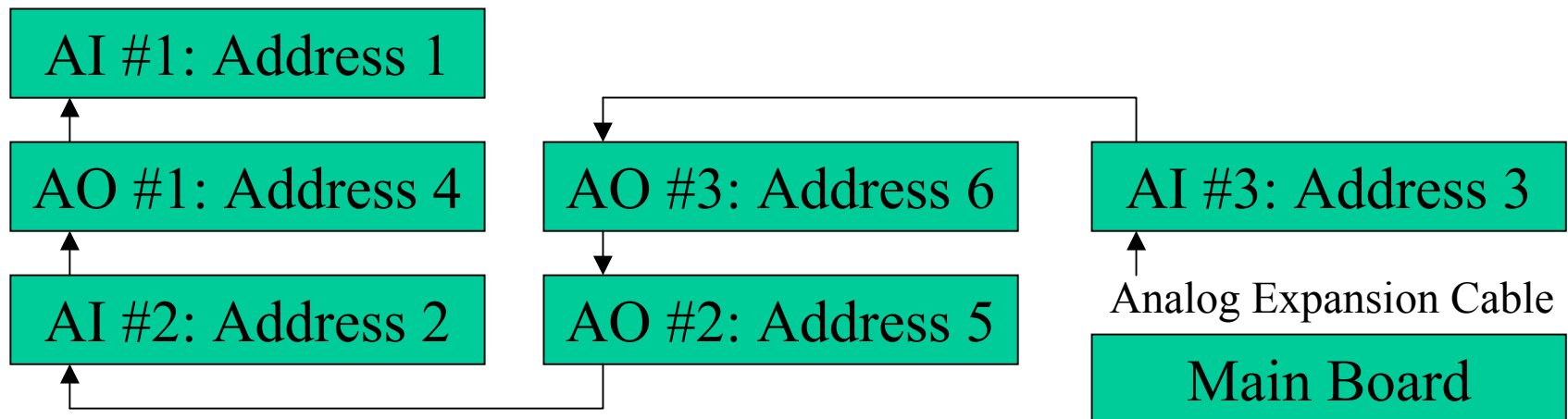
Example 2



# Main Board:

## Orientation of Analog Expansion Cable

- Example: 3 AI and 3 AO Expansion Peripherals
- Note: The Orientation of the Analog Expansion Cable for the Analog Input/Output Peripherals can be from the Top or Bottom Expansion Socket of the Analog Input/Output Peripherals.



# Main Board: User Selectable Jumper

- Z1: Maintenance/Application Jumper:
  - On=User Application
  - Off=Maintenance
- Z14: Monitor Jumper:
  - In Case Incorrect Configuration is loaded to the system causing the system to run incorrectly
  - On=System Start Up in Monitor Mode
  - Off=Normal Start Up
- Z15 - 23: Relay Coil Supply Selections:
  - Every Jumper is for 2 Relay Coil Supplies
  - Trip: Require Master Trip Relay to be On for Coil Voltage Supply
  - Close: Require Master Close Relay to be On for Coil Voltage Supply
  - Remote: Fail to Off
  - Supply Power: Fail to last Commanded Position

# Digital Input Board: Overview

- 32 Optical Isolated with 12 VDC or 24 VDC excitation
- Input indicator on each digital input driven by input current
- Isolation Rating: 1500 Vrms (Point Input to Logic)
- Hardware Digital Filter: Programmable 2-15 ms debounce timer, transition detection and interrupt capability
- Accumulator: Any digital input can be configured as an Accumulator
- Maximum Rate of Accumulator: 150 Hz
- Types of point: Form A, Form C and BCD
- SOE: Any Digital Input Point can be Configured as SOE with accuracy of 1 ms, Chatter Filter is available for preventing malfunctioning inputs from filling up the SOE buffer.

# Digital Input Board: Technology

- CMOS components for low power consumption
- Extensive use of Surface Mount components for small foot print
- In-System-Programming technology for EPLD

# Digital Input Board: Power Requirement

- 2 Isolated Unregulated 12 VDC (1/2 Amp each) or 24 VDC (1/4 Amp each), 1 for Electronics, 1 for Digital Input Wetting \*
  - Optional External Source for Digital Input Excitation on per 16 point basis
  - On-board Power Supplies: Switching mode: +5 VDC for digital Electronics
- \* In field service RTU, always provide separated power source for the Digital Input Wetting

# Digital Input Board: Status Indicators and Interface with Main Board

- Integrity Check and Change of State Indicator
- 40-pin Ribbon Cable Connection Daisy-Chained to Maximum of 14 Digital Input/Output Boards Combinations to Main Board
- The Cable Connection is unidirectional, that is the Top Interface Socket is the Interface Input and the Bottom Interface Socket is the Interface Output

# Digital Input Board: Operating Environment and Physical Dimensions

- Temperature Range: -40 to +85 degrees Celsius
- Humidity: < 95%, non-condensing
- 19.0 x 3.5 inches for 19" standard rack mount or panel mount

# Digital Input Board: Circuit Descriptions

## Power Supply

- Power Input Filter
- Digital Electronic Power Supply
- Digital Input Wetting Power Supplies

# Digital Input Board: Circuit Descriptions

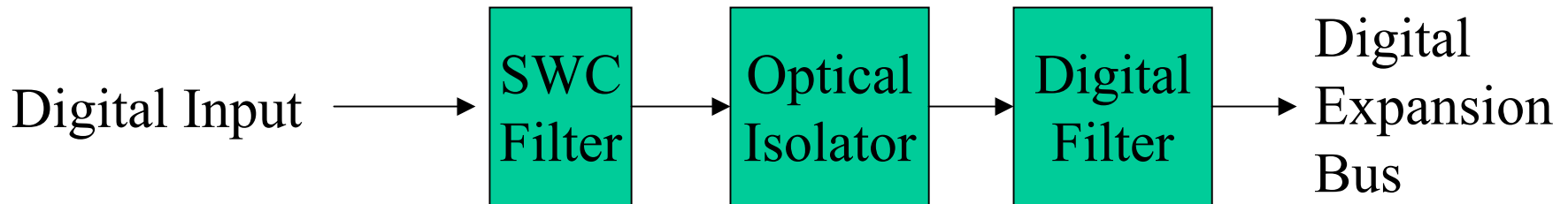
## Main Board Interface

- Up to 14 Digital Input/Output Peripherals can be connected to the Main Board
- The Addressing Scheme: Digital Input Peripherals Starting address is 1 and sequentially up by 1 for every Digital Input Peripheral following
- The Physical Positions of the peripherals can be arranged as desired
- The Digital Expansion Cable fed to the Digital Input Peripherals has to be from the top Expansion Socket of the Digital Input Peripherals
- The Top Interface Socket is for the Input Interface and the Bottom Interface Socket is for the Output Interface

# Digital Input Board: Circuit Description

## Digital Input

- Consider one Digital Input:
- Digital Filter: Transition Detection and Debouncing



# Digital Input Board: User Selectable Jumper

- Z1,2:
  - Jumper Position 1 and 2 selects the Daisy-Chained Digital Wetting Power Supply for Digital Input Points 1 to 16
  - Jumper Position 2 and 3 selects the External Digital Wetting Power Supply for Digital Input Points 1 to 16 with External Digital Wetting Power connection from TB2
- Z3,4:
  - Jumper Position 1 and 2 selects the Daisy-Chained Digital Wetting Power Supply for Digital Input Points 17 to 32
  - Jumper Position 2 and 3 selects the External Digital Wetting Power Supply for Digital Input Points 17 to 32 with External Digital Wetting Power connection from TB4

# Digital Output Board: Overview

- 32 relay outputs
- Output indicator on each digital output
- Control Output Configurations: Isolated Discrete control output relays, Trip/Close, Raise/Lower, Set/Reset, Pattern Controls, Relay fail to OFF, Relay fail to last commanded position
- Control Security: Single component failure protection, Master Trip/Close relays, relay driver input status check back for point selection confirmation, Double point select-before-operate
- Either a Malfunction of the system (detected by the watchdog), or the failure of a point selection confirmation shuts down the control module
- Control Functions: ON/OFF, Timed ON/OFF (Pulse Duration of 1 ms resolution), Variable duty cycle pulse output with variable repetition rate (Pulse Train of 1 to 254 or continuous, 1 ms resolution), Pattern controls (a group of contiguous outputs)
- Contact Rating: 1 Amp at 110 VDC
- 2 Relay output DB37 sockets for ease of interposing relay connections

# Digital Output Board: Technology

- CMOS components for low power consumption
- Extensive use of Surface Mount components for small foot print
- In-System-Programming technology for EPLD

# Digital Output Board: Power Requirement

- 1 Isolated Unregulated 12 VDC (1 Amp) or 24 VDC (1/2 Amp)
- On-board Power Supplies: Switching mode: +5 VDC for digital Electronics

# Digital Output Board: Status Indicators and Interface with Main Board

- Control and Integrity Check Indicator
- 40-pin Ribbon Cable Connection Daisy-Chained to Maximum of 14 Digital Input/Output Boards Combinations to Main Board
- The Cable Connection is by-directional, that is the Top and Bottom Interface Sockets can be either the Input or Output Interface

# Digital Output Board: Operating Environment and Physical Dimensions

- Temperature Range: -40 to +85 degrees Celsius
- Humidity: < 95%, non-condensing
- 19.0 x 3.5 inches for 19" standard rack mount or panel mount

# Digital Output Board: Circuit Descriptions

## Power Supply

- Power Input Filter
- Digital Electronic Power Supply
- Relay Coil Power Supply

# Digital Output Board: Circuit Descriptions

## Main Board Interface

- Up to 14 Digital Input/Output Peripherals can be connected to the Main Board
- The Addressing Scheme: Digital Output Peripherals Starting address is the number of Digital Input Peripherals plus 1 and sequentially up by 1 for every Digital Output Peripheral following
- The Physical Positions of the peripherals can be arranged as desired
- The Digital Expansion Cable fed to the Digital Output Peripherals can be from the Top or the Bottom Expansion Socket of the Digital Output Peripherals
- The Top and Bottom Interface Sockets can be either Input or Output Interface

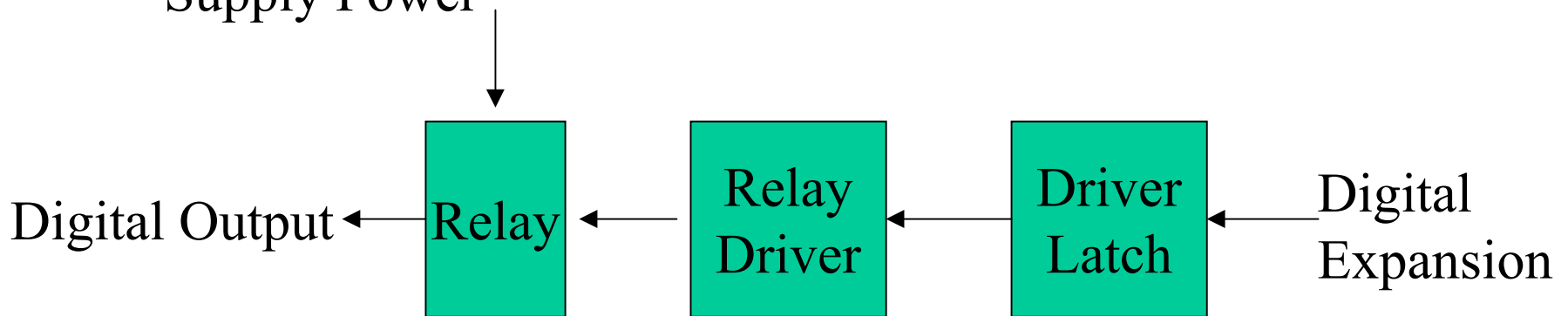
# Digital Output Board: Circuit Description

## Digital Output

- Consider one Digital Output:

Coil Voltage Selection:

Trip, Close, Remote power or  
Supply Power



# Digital Output Board: User Selectable Jumper

- Z1-16:
  - Every Jumper is for 2 Relay Coil Supplies
  - Trip: Require Master Trip Relay to be On for Coil Voltage Supply
  - Close: Require Master Close Relay to be On for Coil Voltage Supply
  - Remote: Fail to Off
  - Supply Power: Fail to last Commanded Position

# Analog Input Board: Overview

- 32 Bipolar, Differential input @  $\pm 10.0\text{V}$ ,  $\pm 7.5\text{V}$ ,  $\pm 5\text{V}$ ,  $\pm 1\text{V}$  with one shield for every 2 points
- Analog Input Adapter: 0 to 1mA, -1 to +1mA, 4 to 20mA
- Accuracy:  $\pm 0.05\%$  (DC voltage input)
- Temperature Coefficient:  $\pm 5\text{PPM}$  per degree Celsius
- Resolution: 15 bit plus sign
- Auto Self Calibration Reference Points:  $-5.000\text{VDC}$ ,  $0\text{VDC}$  and  $+5.000\text{VDC}$
- Dynamic Range of Converter: 130% of Normalized Full Scale inputs @  $\pm 7.5\text{V}$
- Multiplexers: Optionally uses high-voltage, fault-protected differential solid state analog multiplexers
- CMRR (@0-60Hz): 90 dB
- NMRR (@60Hz) -70 dB
- Continuous Over voltage Rating:  $\pm 35\text{VDC}$ , optional  $\pm 100\text{VDC}$
- Analog input self calibration, Auto-correction of gain and offset errors.

# Analog Input Board: Technology

- CMOS components for low power consumption
- Extensive use of Surface Mount components for small foot print
- In-System-Programming technology for EPLD

# Analog Input Board: Power Requirement

- 1 Isolated Unregulated 12 VDC (1/2 Amp) or 24 VDC (1/4 Amp)
- On-board Power Supplies: Switching mode: +5 VDC for digital Electronics, DC/DC isolated +5 VDC, -12 VDC and +12 VDC for Analog Electronics

# Analog Input Board: Status Indicators and Interface with Main Board

- Scanning Indicator
- 26-pin Ribbon Cable Connection Daisy-Chained to Maximum of 14 Analog Input/Output Boards Combinations to Main Board
- The Cable Connection is by-directional, that is the Top and Bottom Interface Sockets can be either the Input or Output Interface

# Analog Input Board: Operating Environment and Physical Dimensions

- Temperature Range: -40 to +85 degrees Celsius
- Humidity: < 95%, non-condensing
- 19.0 x 5.25 inches for 19” standard rack mount or panel mount

# Analog Input Board: Circuit Descriptions

## Power Supply

- Power Input Filter
- Digital Electronic Power Supply
- Analog Power Supply

# Analog Input Board: Circuit Descriptions

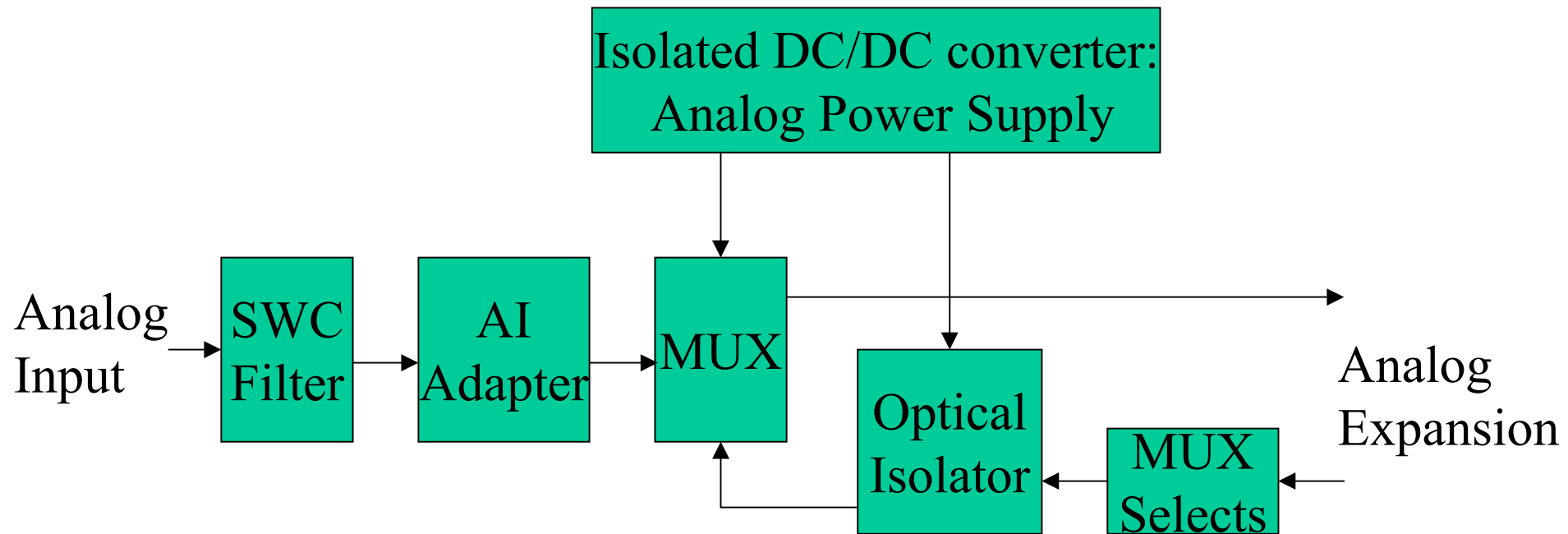
## Main Board Interface

- Up to 14 Analog Input/Output Peripherals can be connected to the Main Board
- The Addressing Scheme: Analog Input Peripherals Starting address is 1 and sequentially up by 1 for every Analog Input Peripheral following
- The Physical Positions of the peripherals can be arranged as desired
- The Analog Expansion Cable fed to the Analog Input Peripherals can be from the Top or the Bottom Expansion Socket of the Analog Input Peripherals
- The Top and Bottom Interface Sockets can be either Input or Output Interface

# Analog Input Board: Circuit Description

## Analog Input

- Consider one Analog Input:



# Analog Output Board: Overview

- 8 Analog Outputs with one Shield for every 2 points
- Output Adapters:
  - Voltage Output: 0 to 5 VDC, 0 to 10 VDC, -5 to +5 VDC
  - Current Output: 4 to 20 mA
- Resolution: 12 Bit
- Accuracy: +/- 0.2% (DC voltage output)
- Temperature Coefficient: +/-25PPM per degree Celsius

# Analog Output Board: Technology

- CMOS components for low power consumption
- Extensive use of Surface Mount components for small foot print
- In-System-Programming technology for EPLD

## Analog Output Board: Power Requirement

- 1 Isolated Unregulated 12 VDC (1/2 Amp) or 24 VDC (1/4 Amp)
- On-board Power Supplies: Switching mode: +5 VDC for digital Electronics, DC/DC isolated +5 VDC, -15 VDC and +15 VDC for Analog Electronics

# Analog Output Board: Status Indicators and Interface with Main Board

- Control and Integrity Check Indicator
- 26-pin Ribbon Cable Connection Daisy-Chained to Maximum of 14 Analog Input/Output Boards Combinations to Main Board
- The Cable Connection is by-directional, that is the Top and Bottom Interface Sockets can be either the Input or Output Interface

# Analog Output Board: Operating Environment and Physical Dimensions

- Temperature Range: -40 to +85 degrees Celsius
- Humidity: < 95%, non-condensing
- 19.0 x 3.5 inches for 19" standard rack mount or panel mount

# Analog output Board: Circuit Descriptions

## Power Supply

- Power Input Filter
- Digital Electronic Power Supply
- Analog Power Supply

# Analog Output Board: Circuit Descriptions

## Main Board Interface

- Up to 14 Analog Input/Output Peripherals can be connected to the Main Board
- The Addressing Scheme: Analog Output Peripherals Starting address is the number of Analog Input Peripherals plus 1 and sequentially up by 1 for every Analog Output Peripheral following
- The Analog Expansion Cable fed to the Analog Output Peripherals can be from the Top or the Bottom Expansion Socket of the Analog Output Peripherals
- The Top and Bottom Interface Sockets can be either Input or Output Interface

# Analog Output Board: Circuit Description

## Analog Output

- Consider one Analog Input:

