I/O Boards

Most I/O boards, are single width VME boards, of similar design and front cabinet, using the same digital signal processor (TMS320C32).

The central processing unit (CPU) is a high-speed processor designed for digital filtering and for working with data in IEEE 32-bit floating point format. The task scheduler operates at a 1 ms and 5 ms rate to support high-speed analog and discrete inputs. The I/O boards synchronize their input scan to complete a cycle before being read by the VCMI board. Contact inputs in the VCCC and VCRC are time stamped to 1 ms to provide a sequence of events (SOE) monitor.

Each I/O board contains the required sensor characteristic library, for example thermocouple and RTD linearizations. Bad sensor data and alarm signal levels, both high and low, are detected and alarmed. The I/O configuration in the toolbox can be downloaded over the network to change the program online. This means that I/O boards can accept tune-up commands and data while running.

Certain I/O boards, such as the servo and turbine board, contain special control functions in firmware. This allows loops, such as the valve position control, to run locally instead of in the controller. Using the I/O boards in this way provides fast response for a number of time critical functions. Servo loops, can be performed in the servo board at 200 times per second.

Each I/O board sends an identification message (ID packet) to the VCMI when requested. The packet contains the hardware catalog number of the I/O board, the hardware revision, the board barcode serial number, the firmware catalog number, and the firmware version. Also each I/O board identifies the connected terminal boards via the ID wire in the 37-pin cable. This allows each connector on each terminal board to have a separate identity.

I/O Processor Board	Terminal Board	I/O Signal Types	No. per I/O Processor Board	Type of Terminal Board	Comments
VAIC	TBAI (2)	Analog inputs, 0–1mA, 4–20 mA, voltage	20	TMR, simplex	
		Analog outputs, 4–20 mA, 0–200 mA	4		
VAOC	TBAO	Analog outputs, 4–20 mA	16	TMR, simplex	
VCCC and VCRC	TBCI (2)	Contact inputs	48	TMR, simplex	(VCCC is two slots)
	TRLY (2)	Relay Outputs (note 1)*	24	TMR, simplex	
VCCC	TICI (2)	Point Isolated Contact inputs	48	TMR, simplex	VCCC-only in place of TBCI. (optional)
VGEN	TGEN	Analog inputs, 4–20 mA	4	TMR, simplex	
		Potential transformers	2		
		Current transformers	3		
	TRLY	Relay outputs (optional)	12		for FAS (PLU)
VPRO (3)	TPRO	Pulse rate	3	TMR	Emergency Protect
		Potential transformers	2		
		Thermocouples	3		
		Analog inputs, 4–20 mA	3		

DIN–Rail Mounted Terminal Boards

DIN Euro Size Terminal Board	Number of Points	Description of I/O	Associated I/O Processor Board
DTTC	12	Thermocouple temperature inputs with one cold junction reference	VTCC
DRTD	8	RTD temperature inputs	VRTD
DTAI	10	Analog current or voltage inputs with on-board 24 V dc power supply	VAIC
	2	Analog current outputs, with choice of 20 mA or 200 mA	
DTAO	8	Analog current outputs, 0-20 mA	VAOC
DTCI	24	Contact Inputs with external 24 V dc excitation	VCRC (or VCCC)
DRLY	12	Form-C relay outputs, dry contacts, customer powered	VCRC (or VCCC)
DTRT	-------	Transition board between VTUR and DRLY for solenoid trip functions	VTUR
DTUR	4	Magnetic (passive) pulse rate pickups for speed and fuel flow measurement	VTUR
DSVO	2	Servo-valve outputs with choice of coil currents from 10 mA to 120 mA	VSVO
	6	LVDT valve position sensors with on-board excitation	
	2	Active pulse rate probes for flow measurement, with 24 V dc excitation provided	
DVIB	8	Vibration, Position, or Seismic, or Accelerometer, or Velomiter	VVIB
	4	Position prox probes	
	1	KeyPhasor (reference)	
DSCB	6	Serial communication ports supporting RS-232C, RS-422 & RS-485.	VSCA

Operating

The Mark VI control components are suited to most industrial environments. To ensure proper performance and normal operational life, the environment should be maintained as follows:

Temperature at bottom of module (acceptable):

Control Module with running fans	0 to 60°C (32 to 140 °F)
I/O Module	0 to 60°C (32 to 140 °F)

Enclosures should be designed to maintain this temperature range.

Relative humidity: 5 to 95%, non-condensing.

Note Higher ambient temperature decreases the life expectancy of any electronic component.

Environments that include excessive amounts of any of the following elements reduce panel performance and life:

- Dust, dirt, or foreign matter
- Vibration or shock
- Moisture or vapors
- Rapid temperature changes
- Caustic fumes
- Power line fluctuations
- Electromagnetic interference or noise introduced by:
  - Radio frequency signals, typically from nearby portable transmitters
  - Stray high voltage or high frequency signals, typically produced by arc welders, unsuppressed relays, contactors, or brake coils operating near control circuits

The preferred location for the Mark VI control system cabinet would be in an environmentally controlled room or in the control room itself. The cabinet should be mounted where the floor surface allows for attachment in one plane (a flat, level, and continuous surface). The customer provides the mounting hardware. Lifting lugs are provided and if used, the lifting cables must not exceed 45° from the vertical plane. Finally, the cabinet is equipped with a door handle, which can be locked for security.

Interconnecting cables can be brought into the cabinet from the top or the bottom through removable access plates. Convection cooling of the cabinet requires that conduits be sealed to the access plates. Also, air passing through the conduit must be within the acceptable temperature range as listed previously. This applies to both top and bottom access plates.

Elevation

Equipment elevation is related to the equivalent ambient air pressure.

- Normal Operation - 0 to1000 m (3300 ft) (101.3 KPa - 89.8 KPa)
- Extended Operation - 1000 to 3050 m (3300 to 10,000 ft) (89.8 KPa - 69.7 KPa)
- Shipping - 4600 m (15000 ft) maximum (57.2 KPa)

Note A guideline for system behavior as a function of altitude is that for altitudes above 1000 m (3300 ft), the maximum ambient rating of the equipment decreases linearly to a derating of 5°C (41°F) at 3050 m (10000 ft).

The extended operation and shipping specifications exceed EN50178.

Contaminants

Gas

The control equipment withstands the following concentrations of corrosive gases at 50% relative humidity and 40°C (104 °F):

Sulfur dioxide (SO_2)	30 ppb
Hydrogen sulfide (H_2S)	10 ppb
Nitrous fumes (NO_x)	30 ppb
Chlorine (Cl_2)	10 ppb
Hydrogen fluoride (HF)	10 ppb
Ammonia (NH_3)	500 ppb
Ozone (O_3)	5 ppb

The above meets EN50178 Section A.6.1.4 Table A.2 (m).

Vibration

Seismic

Universal Building Code (UBC) - Seismic Code section 2312 Zone 4

Operating / Installed at Site

Vibration of 1.0 G Horizontal, 0.5 G Vertical at 15 to 120 Hz

See Seismic UBC for frequencies lower than 15 Hz.

Packaging

The standard Mark VI cabinets meet NEMA 1 requirements (similar to the IP-20 cabinet). Optional cabinets for special applications meet NEMA 12 (IP-54), NEMA 4 (IP-65), and NEMA 4X (IP-68) requirements. Redundant heat exchangers or air conditioners, when required, can be supplied for the above optional cabinets.

UL Class 1 Division 2 Listed Boards

Certain boards used in the Mark VI are UL listed (E207685) for Class 1 Division 2, Groups A, B, C, and D, Hazardous Locations, Temperature Class T4 using UL-1604.

Division 2 is described by NFPA 70 NEC 1999 Article 500 (NFPA - National Fire Protection Assocation, NEC - National Electrical Code).

The Mark VI boards/board combinations that are listed may be found under file number E207685 at the UL website and currently include:

- IS200VCMIH1B, H2B
- IS200DTCCH1A, IS200VTCCH1C
- IS200DRTDH1A, IS200VRTDH1C
- IS200DTAIH1A, IS200VAICH1C
- IS200DTAOH1A, IS200VAOCH1B
- IS200DTCIH1A, IS200VCRCH1B
- IS200DRLYH1B
- IS200DTURH1A, IS200VTURH1B
- IS200DTRTH1A
- IS200DSVOH2B, IS200VSVOH1B
- IS200DVIBH1B, IS200VVIBH1C
- IS200DSCBH1A, IS200VSCAH2A
- IS215UCVEH2A, M01A, M03A, M04A, M05A
- IS215UCVDH2A
- IS2020LVPSG1A