INTERFACE SYSTEM OF TRISTAN ACCELERATOR

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SUMMARY

This paper gives detailed descriptions of an interface system for the control equipment of TRISTAN. TRISTAN is controlled by the minicomputer network system and CAMAC system which is adopted as an interface between the equipment and the computers[1],[2]. A 5Mbps bit-serial highway connects CAMAC systems and the computer. The CAMAC modules of TRISTAN were designed not only including the additional standard version[3],[4] but considering the long-term reliability and the easy maintainability to control a large accelerator complex.

The following enclosures shown in Fig. 1 were installed for easy and useful build-up;

1. CAMAC Crate Enclosure,
2. Terminal Enclosure,
3. General Device Enclosure.

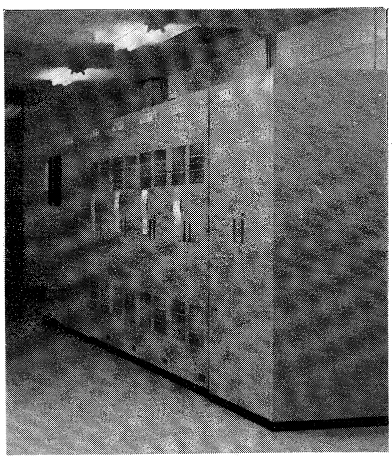


Fig. 1. Phtograph of Enclosure

The standpoints of our basic design are following;

1. CAMAC modules are designed considering each separate function to get good installation efficiency,
2. all modules are possible to put in/off an active crate,
3. correspondency between each device and CAMAC modules is performed at Intermediate Distribution Frame(IDF),
4. active signal check can be done at the terminal of IDF.

INTERFACE MODULES

GENERAL SPECIFICATIONS

1. All modules are inactive and in reset state for a second after power-on.
2. All output modules are forced to be in disable state at power-on/off.
3. It is possible to read the station number of the module.
4. It will be possible to read the module ID and the status of the module by an F(6)·A(0) command.
5. Accuracy of an analog input/output(I/O) module with balanced circuits is about 10^{-4}.
6. All the connectors of CAMAC modules for process I/O device are DC37P or DC37S.
7. The storage temperature of the modules ranges from 0 to 55°C and the operating temperature from 10 to 45°C.

Specifications above are inspected following the time sequence as shown in Fig. 2.

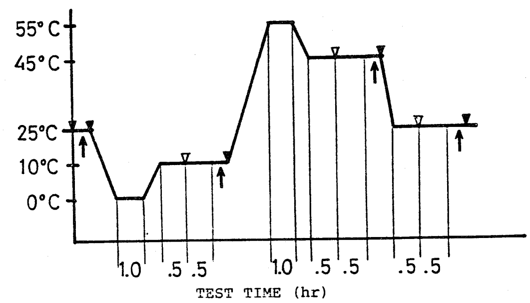


Fig. 2. Sequence of Temperature Test for Interface Modules

The sign(▽), (▼) and (↑) indicate the time of power-on, power-off and electric test of the modules, respectively.

ANALOG I/O MODULES

All I/O modules which treat analog signals have differential amplifiers, and resolution of them is 0.05%(sign + 11 bits). Sample and hold ADC(SAD) and Dual slope ADC(DAD) modules are 32-channel scanning type. The clock signal of DAD is phase-locked to the line frequency in order to reject the ripple noise originated from the AC power supply. Noise rejection ratio of the module is about -80dB. Channel address of DAD can be fixed to take data every 80msec at maximum rate. An SAD module is used for the high-speed data taking(up to 10kHz).

8-channel D/A Converter(DAC) module is prepared to control devices by an analog signal.

A bipolar ramp pulse generator is developed in order to control the pulsed magnets for beam transport from Accumulation Ring(AR) to Main Ring(MR). The slope of the ramp pulse and the interval of flat-top are both programmable.

DIGITAL I/O MODULES

Active I/O(AIO) and Passive I/O(PIO) modules are prepared for parallel digital data I/O. Both modules have two 16-bit ports. An interface to the device is based on RS-422 and the output can drive an optical-isolator through a twisted-pair cable(0.18mm^2) up to 200m long.

Each input of a 32-bit Status Input Gate(SIG) or a 16-bit Interlock Input Register(IIR) is connected to a relay contact in each device. An IIR module, which has latch-registers and generates LAM signal, is used for signals which must be locked in.

A 16-bit Status Output Register(SOR) module generates momentary pulses of 0.3sec wide and can drive 30mA at 12VDC.

A Pulse-Train Generator(PTG) module provides 4 channels of up/down clock pulses. The output pulse rate is variable in the range between 64 to 512pps in twice steps.

MICROCOMPUTER AND ITS RELATED MODULES

In order to reduce a load on the minicomputer and traffic jam of the serial highway, we developed following modules;

1. microcomputer with two RS-232C ports(MPU),
2. CAMAC Auxiliary Crate Controller(ACC),
3. STD BUS[5] board adapter with IEEE Std 488-1978 interface,
4. ROM writer.

The modules can be connected with each other via STD BUS to perform necessary functions. A Z80A microprocessor is used on microcomputer module. An interactive monitor program and Tiny BASIC interpreter with a CAMAC library are stored in PROMs. User's programs are developed on a stand-alone microcomputer system and written in PROMs with IEEE Std 488 library.

DEVICE ENCLOSURE AND CABLE

CAMAC Crate Enclosure

Three crates can be installed in a CAMAC crate enclosure as shown in Fig. 3. The enclosure contains an AC power control unit which is remotely controllable. It also contains a CAMAC serial highway control unit which has by-pass and loop collapse functions.

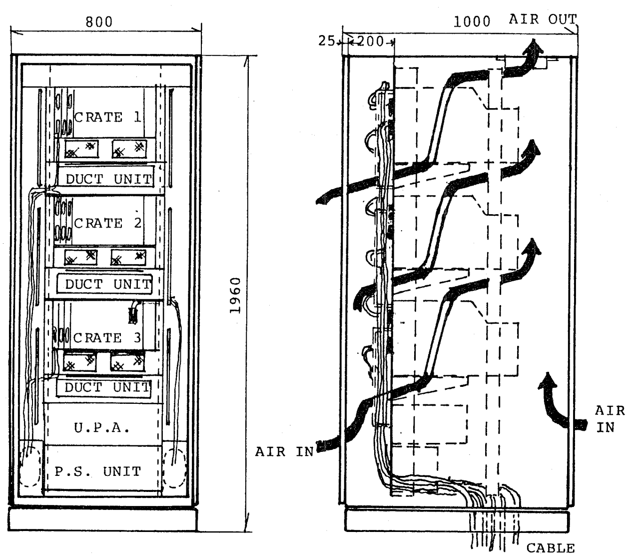


Fig. 3. CAMAC Crate Enclosure

There is enough space for wiring on both sides of EIA standard rack. Using air duct units as shown in Fig. 3, the temperature differnce between the crates is kept within $1.5^{\circ}C$ and the temperature rise inside is less than $15^{\circ}C$ at maximum power dissipation.

Terminal Enclosure

A terminal enclosure contains four IDFs as shown in Fig. 4. The control wires from three CAMAC crates can be connected to the terminal board attached to the three frames, the rest of IDF is used for connections of coaxial cables. A terminal board consists of 258WTS test springs which are commonly used in the telephone network by Nippon Telegraph & Telephone Public Corporation. 200 wires(100 pairs) can be connected to a test spring as shown in Fig. 5. This is useful for arrangement of complex wiring between CAMAC modules and accelerator devices. The test spring permits us to put test signals without cutting wires or to pickup each signal in active state.

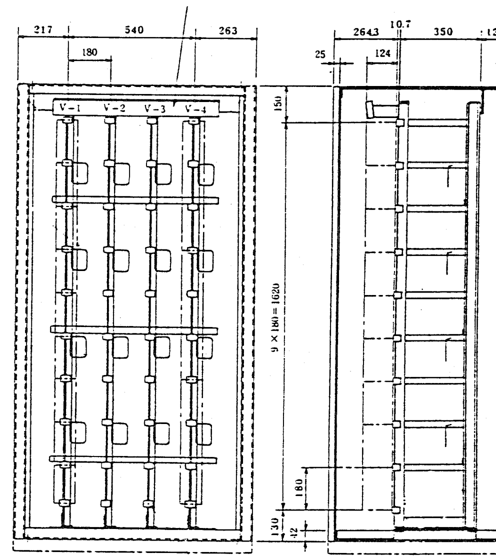


Fig. 4. Terminal Enclosure

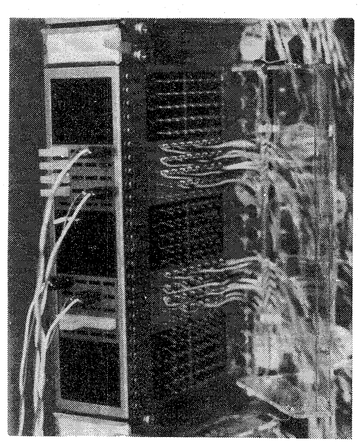


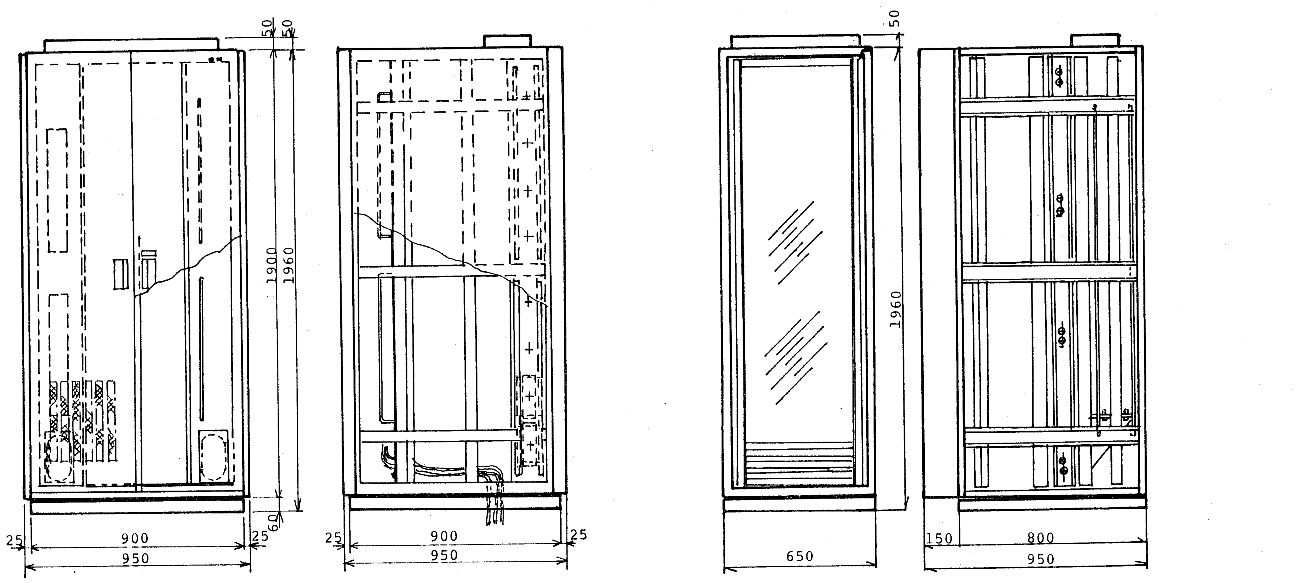
Fig. 5. Test Spring

General Device Enclosures

Two kinds of enclosure, as shown in Fig. 6, were designed in order to standardize the connection of the control system, to simplify wiring and to keep electronic equipment away from dust. One is a general purpose enclosure and the other is an enclosure of RF equipment. Only the former contains wiring space of coaxial cables and space for the test spring 258WTSs. The enclosure contains an AC power control unit and its monitor. They are remotely controllable.

Cable

Only 19- and 10-twisted-pair cables are used. A twisted-pair is composed of two tin plated $0.18mm^2$ conductors and has the characteristic impedance of about 115ohms at 1MHz. Twisted-pairs are wrapped by aluminum film for shielding, which is normaly grounded at the signal source.



General Purpose Enclosure

Enclosure of RF Equipment

Fig. 6. General Device Enclosures

PRESENT STATUS

Numbers of CAMAC modules for AR are listed in Table. Overall inspection for the system maintenance is performed twice a year. The maintenance includes cleaning of CAMAC crates and modules, each function check of modules, calibration and adjustment of analog circuits.

The modules for AR have been working well for about one year. Although only four defective ICs and breakdown of ceramic capacitors due to aging were found, all of them were replaced by more reliable ones. On the maintenance and inspection, about ten modules were readjusted because of the voltage shift of 5 to 15 mV caused by the drift of the offset and gain of the analog circuits.

Table. Numbers of CAMAC Modules for AR

	CO	VA	BT	BM	MG	RF	TOTAL
DAD	0	0	9	2	0	12	23
SAD	0	9	0	5	0	1	15
DAC	0	0	14	0	0	0	14
AIO	0	0	3	9	2	0	14
PIO	0	0	0	0	0	0	0
SIG	4	18	26	5	36	16	105
IIR	0	5	4	0	0	0	9
SOR	4	31	29	8	15	9	96
PTG	0	0	2	3	0	11	16
RCF	0	0	2	0	0	0	2
MPU	3	0	2	2	2	2	11
GPIB	3	0	2	1	2	2	10
TOTAL	14	63	93	35	57	53	315

Hardware system for TRISTAN are classified to CO, VA, BT, BM, MG and RF according to the specification of device.

CO : COntrol
VA : VAcuum
BM : Beam Monitor
BT : Beam Transport
MG : MaGnet
RF : Radio Frequency

RCF indicates 32-channel passive filter module.

A quarter of interface system of MR has already been designed and whole system will be completed by March 1986. The total numbers of CAMAC modules and cables are expected to be 1500 and 6000 respectively. We intend to construct a data base system on a minicomputer for wiring lists. By using this system, it becomes more convenient for us to refer to or to maintain the wiring lists.

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(1) H. Ikeda et al., IEEE Trans., NS-28, 2359, 1981.

(2) A. Akiyama et al., Computer control system of TRISTAN, Europhysics Conference, Computing in Acccelerator Design and Operation, held at Berlin, September 20-30, 1983.

(3) European CAMAC Association, Recommendations for the industrial Application of CAMAC, ECA/ISG 81/1, May 1981.

(4) European CAMAC Association, Recommendations for Analog Signals for CAMAC in Industrial Applications, ECA/ISG 81/2, May 1981.

(5) The STD BUS was originally designed by Prolog and MOSTEK for a manufacturer's own standard.