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1. DESCRIPTION

1.1. FUNCTIONAL DESCRIPTION

The model V488A is a 1-unit wide VME module that houses 8 independent 12-bit Time to Digital Conversion channels.

Each channel is build around a monolithic TAC (Time to Amplitude Converter) developed in bipolar ASIC technology [1].

The outputs of the eight TAC sections are multiplexed and subsequently converted by a fast 12 bit ADC module (1 μsec conversion time).

The ADC module adopts a sliding scale technique [2-3] to decrease the differential linearity error:

- Differential non linearity ± 2%
- Integral non linearity ± 0.1%

The Full Scale Time Range (common for all the channels) is programmable via VME, from 90 nsec to 770 nsec, with resolution from 25 to 200 psec respectively.

The board accepts 8 ECL inputs and one NIM common input (COM input). The COM is a high impedance input and is provided with two bridged connectors for daisy chaining.

Two modes of operation programmable via VME:

Common Start:
Start on the COM signal Stop on the corresponding input signal

Common Stop:
Start on the corresponding input signal Stop on the COM signal

The board houses a 12 bit counter (Event Counter) for the trigger counting; it is increased at the occurrence of a valid event, i. e. with each COM pulse occurred when the module is not BUSY.

Via VME is also possible:

- to set a Low and High Threshold common for all the channels;
- to enable /disable each TAC section.

Only the enabled channels that have a value that lies in between the two Thresholds are converted and the result is stored in an Output Buffer that can be read via VME.

The Output Buffer is arranged in FIFO logic 512 x16 bit. The FIFO operation options are programmable via VME (Stop conversions either when the FIFO is HALF FULL or when the FIFO is FULL).

The module houses a VME RORA INTERRUPTER[4]: via VME it is possible to program the interrupt generation on the Output Buffer HALF FULL or on the Output Buffer NOT EMPTY.

A front panel LED (DTACK) lights up each time the module generates the VME signal DTACK.

An open-collector signal ("BUSY") is available on the front panel. This allows to obtain a wired-OR Global Busy signal. The BUSY is a high impedance output and is provided with two bridged connectors for daisy chaining.

The V488A Model uses the P1 and P2 connectors of VME and the auxiliary connector for the CERN V430 VMEbus crate (Jaux Dataway)[5].

The module works in A24/A32 mode; the recognized Address Modifier codes are:
AM= %3D standard supervisor data access;
AM= %39 standard user data access;
AM= %0D extended supervisor data access;
AM= %09 extended user data access.

The module's Base Address is fixed by 6 internal rotary switches housed on two piggy-back boards plugged into the main printed circuit board. The Base Address can be selected in the range:
%00 0000 <--> %FF FF00 A24 mode;
%0000 0000 <--> %FFFF FF00 A32 mode.

The data transfer occurs in D16 mode.

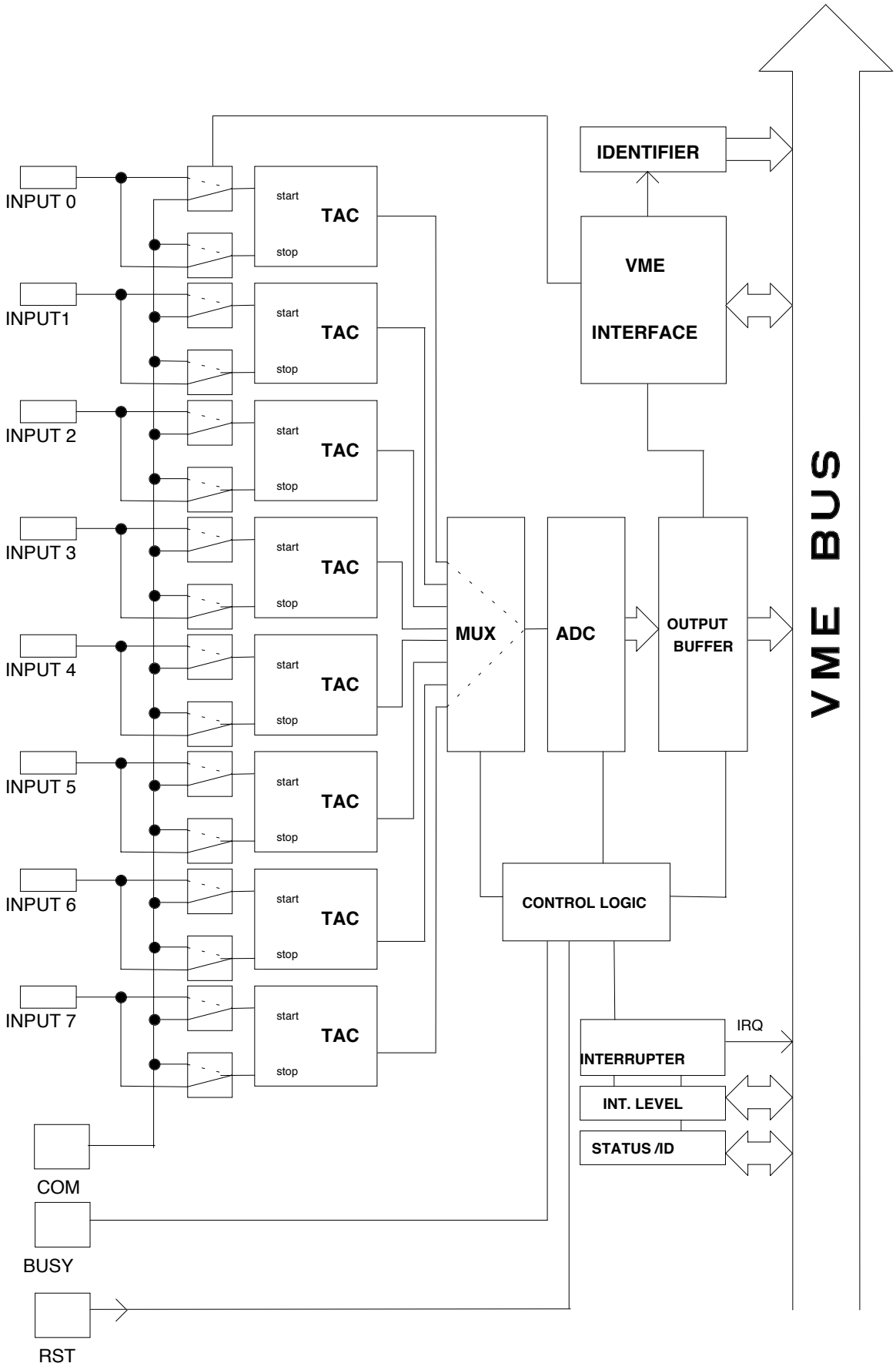


Fig. 1.1: Mod. V488A Block Diagram

2. SPECIFICATIONS

2.1. PACKAGING

1-unit wide VME unit. Height: 6U.

2.2. EXTERNAL COMPONENTS

(refer to fig. 2.1)

CONNECTORS

- N. 2, "RST", LEMO 00 type; two bridged connectors (for daisy chaining) for the RESET input signal.

- N. 1, "IN 0..7", Input connector, Header 3M 3408-5202 type, 8+8 pins; for the 8 single channel inputs.

- N. 2, "COM", LEMO 00 type; two bridged connectors (for daisy chaining) for the COMMON input signal.

- N. 2, "BUSY", LEMO 00 type; two bridged connectors (for daisy chaining) for the BUSY output signal .

DISPLAYS

- N. 1, "DTACK", green LED, VME Selected. It lights up during a VME access.

- N. 1, "COM START", red LED. It lights up when the module is in Common Start mode.

- N. 1, "COM STOP", red LED. It lights up when the module is in Common Stop mode.

2.3. INTERNAL COMPONENTS

(refer to fig. 2.2)

SWITCHES

- N. 6, rotary switches for the module's VME Base Address selection.

2.4. CHARACTERISTICS OF THE SIGNALS

- INPUT CHANNELS: std. differential ECL level, 110 Ω impedance;
  min. width 5 ns;

- RST(1): std. NIM level, high impedance;
  min. width 10 ns;

- COM(1): std. NIM level, high impedance;
  min. width 10 ns;

- BUSY: std. TTL open collector output, active high.

(1) This is a high impedance input and is provided with two bridged connectors for daisy chaining. Note that the high impedance makes this input sensitive to noise, so the chain has to be terminated on 50 Ω on the last module; the same is needed also if one module only is used, whose input has thus to be properly matched.

2.5. PERFORMANCES AND TEST RESULTS

- Differential non linearity ± 2%

- Integral non linearity ± 0.1%

Full Scale Time Range(2)	Resolution
90 ns (min)	25 ps
770 ns (max)	200 ps

(2) This is the standard configuration; it is possible to obtain different Full Scale Time Ranges by replacing few components (up to a maximum of 4μs).

- Conversion time (3)

Min	Max
3 μs	13 μs

(3) This is the time spent in the entire conversion sequence (see § 3.2); the minimum value is obtained when all the 8 TAC values are not in the range selected and hence there is no ADC conversions. Substantially it is the Control Logic scan time. The maximum value is obtained when all the 8 TAC values are in the range selected and therefore converted and stored in the Output Buffer.

2.6. POWER REQUIREMENTS

+ 12 V	300 mA
– 12 V	100 mA
+ 5 V	1.0 A
– 5 V	1.1 A

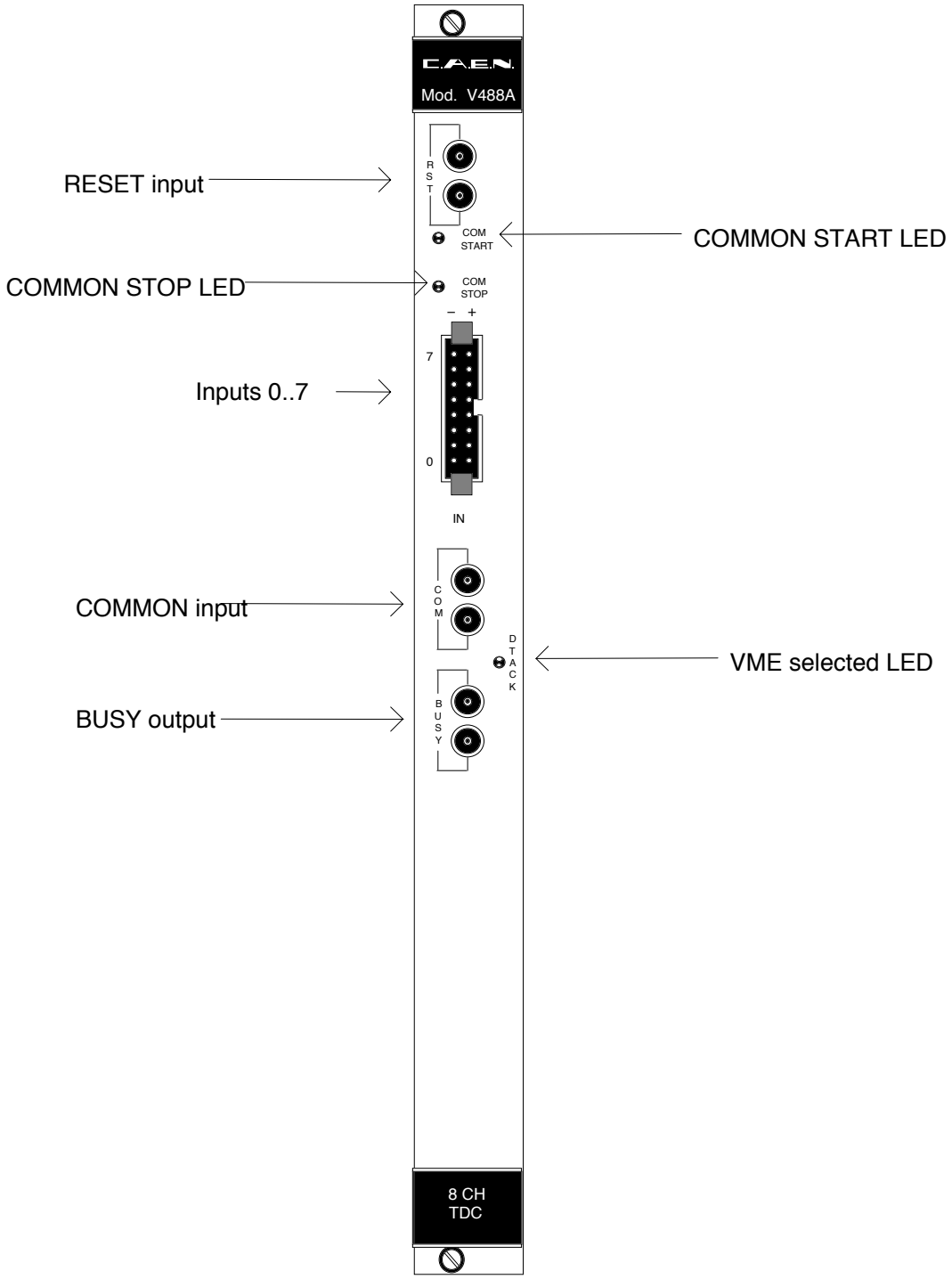


Fig. 2.1: Mod. V488A Front Panel

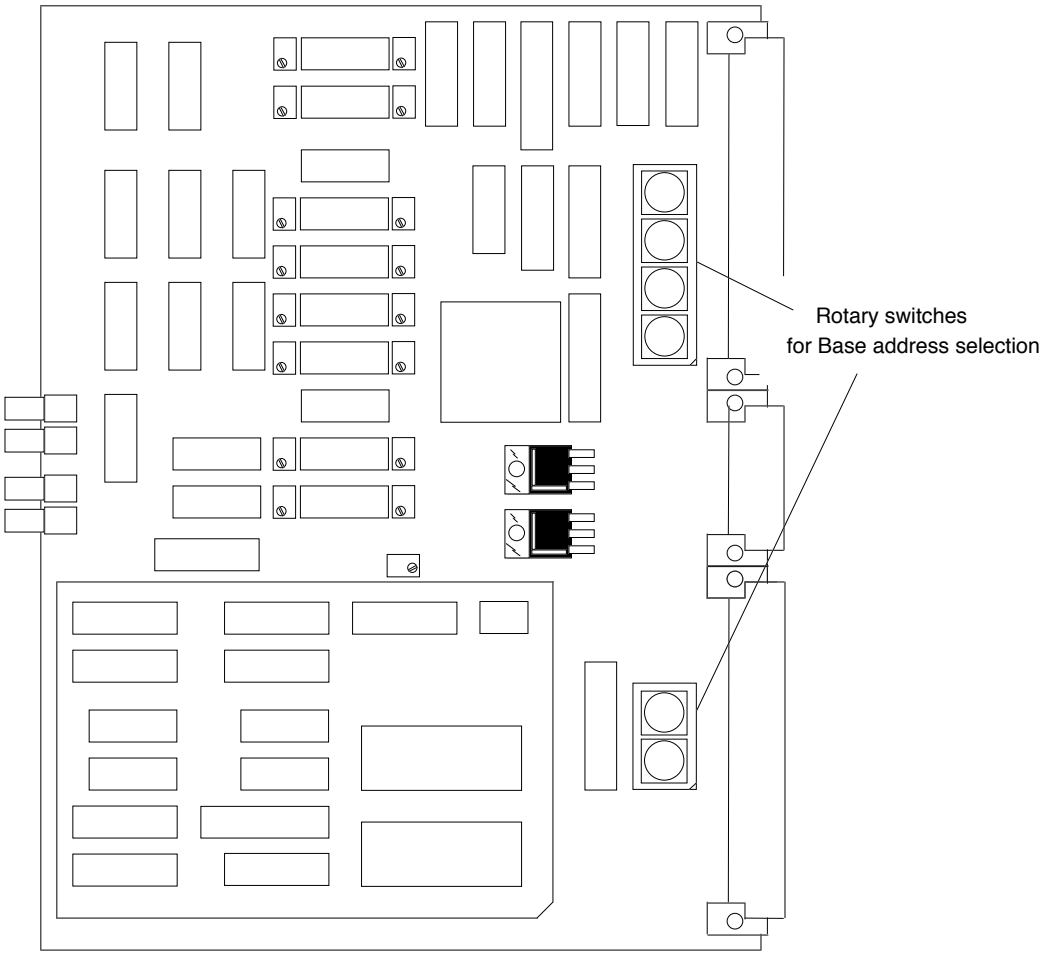


Fig. 2.2: Mod. V488A Components Locations

3. OPERATING MODES

3.1. INTRODUCTION

The module V488A houses 8 Time to Amplitude Conversion (TAC) channels which can operate in Common Start or Common Stop mode. The Full Scale Time Range is programmable via VME. The TAC outputs are multiplexed and subsequently converted by a high speed ADC module. A Control Logic controls the conversion sequence; it converts and stores in the Output Buffer only the channels that have values lying in a range defined by a High and Low Threshold.

The module is Busy during the conversion sequence and when the Output Buffer is not ready to accept data (Buffer full).

When the module is Busy it sets to TTL logic level "1" the Busy output. Moreover each channel can be individually inhibited via VME.

3.2. OPERATION SEQUENCE

3.2.1. COMMON START SEQUENCE

If the module is not Busy and if at least one channel is enabled, a NIM pulse on the COM input causes the following:

- starts the TAC conversion of the enabled channels;
- increments the Event Counter;
- sets the BUSY output to 1 (Module Busy);
- starts the Control Logic Time-Out Counter.

The Control Logic waits until the Time-Out Counter reaches the selected Full Scale Time Range; during this time an ECL pulse on any input stops the corresponding TAC section.

When the Time-out counter reaches the full scale time, the Control Logic starts the conversion sequence:

- the output of the TAC sections are sampled;
- the Control Logic checks if the sampled values are in the selected range;
- If at least one value is lying in the range:
  - a header is stored in the Output Buffer; it contains the event counter value and the number of the channels in the range;
  - the sampled values in the range are converted and the 12 bit values obtained are stored in the Output Buffer together with the corresponding channel number.
- if no value is lying in the range no channel is converted and no data are written in the Output Buffer.

The Busy is removed and the module is ready for the next Common Stop acquisition.

3.2.2.COMMON STOP SEQUENCE

An ECL pulse on any input:

- starts the conversion of the corresponding TAC sections (if enabled).

A NIM pulse on the COM input:

- stops the TAC conversions;
- increments the Event Counter;
- sets the BUSY output to 1 (Module Busy);
- causes the Control Logic to start the conversion sequence.

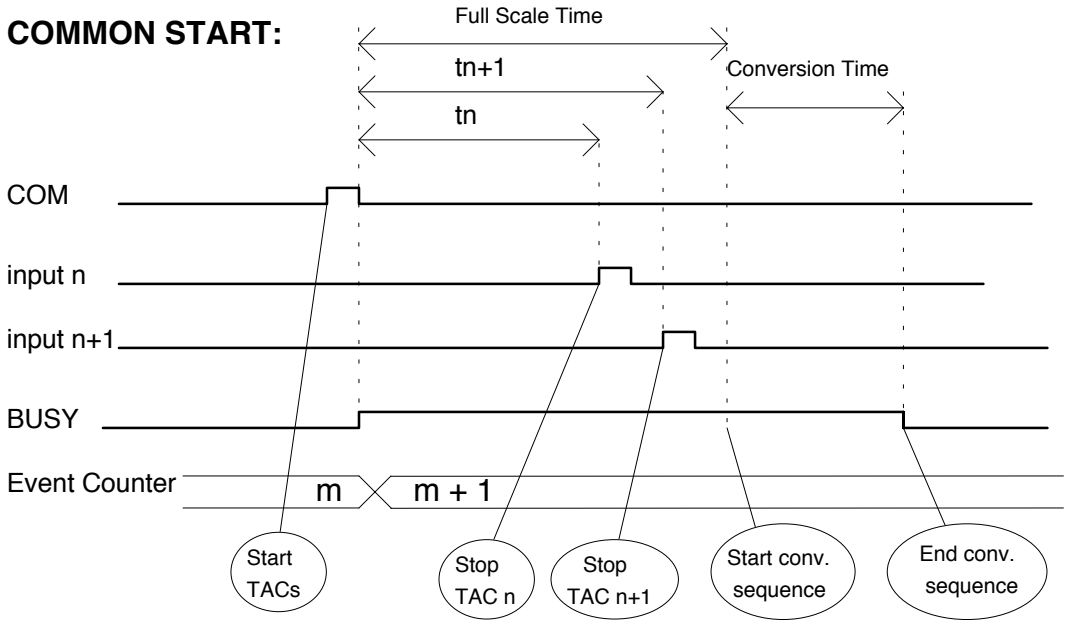
The Control Logic performs the conversion sequence:

- the output of the TAC sections are sampled;
- the Control Logic checks if the sampled values are in the selected range;
- If at least one value is lying in the range:
  - a header is stored in the Output Buffer; it contains the event counter value and the number of the channels in the range;
  - the sampled values in the range are converted and the 12 bit values obtained are stored in the Output Buffer together with the corresponding channel number.
- if no value is lying in the range no channel is converted and no data are written in the Output Buffer.

The Busy is removed and the module is ready for the next Common Start acquisition.

The two operation sequences previously described are summarized in Figure 3.1.

COMMON START:



COMMON STOP:

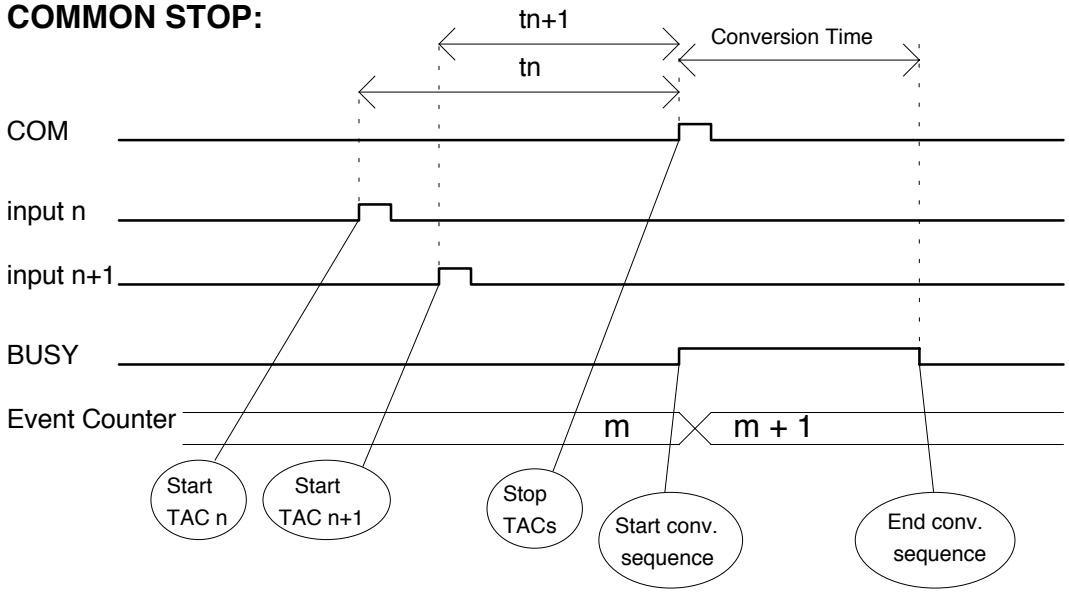


Fig. 3.1: Mod. V488A Acquisition Sequences

3.3. FULL SCALE TIME RANGE SELECTION

Via VME, it is possible to program the Full Scale Time Range in common to all the channels. In the Standard configuration it can be set from 90 nsec to 770 nsec.

The different ranges are selected via the Range Register that is available at the VME address Base + %14 (see § 4.7). The suggested values range from %00, corresponding to 90 nsec, up to %E0, corresponding to 770 nsec. The different values can be selected according to the curve shown in Fig. 3.2: given a value N of the programmed range, the corresponding Time Range is:

Time Range = 3840/GAIN(N)

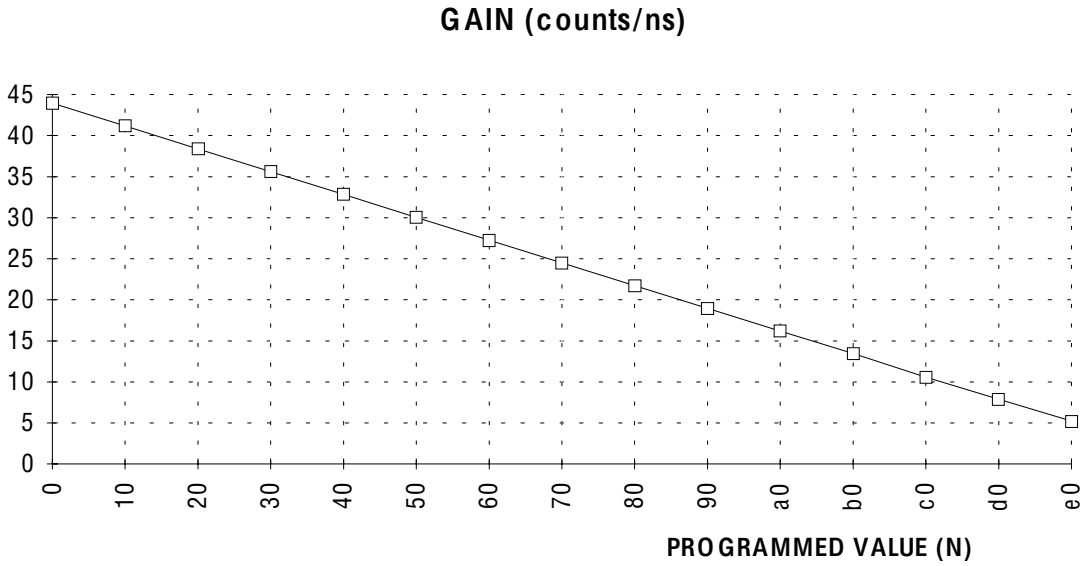


Fig. 3.2: Mod. V488A Full Scale Range Selection

N.B.: The above formula and diagram are only an approximate indication on how to set the TDC range. The User is strongly suggested to use them as a starting point and perform his/her own calibrations with pulses of well known duration.

3.4. OPERATION MODE SELECTION

Two operation modes are programmable via VME:

Common Start:
Start on the COM signal — Stop on the corresponding input signal

Common Stop:
Start on the corresponding input signal — Stop on the COM signal

The operation mode is controlled by the bit 15 of the Control Register:

- Control Register <15> = 0 → Common Start mode;
- Control Register <15> = 1 → Common Stop mode.

The Control Register is available at the VME address Base + %1A.

3.5. ENABLE/DISABLE CHANNEL OPERATION

Via VME It is possible to enable/disable the TAC section of each channel; the bits <7..0> of the Control Register allow to set the status of the 8 TAC sections:

- Control Register <n> = 0 → channel n TAC disabled;
- Control Register <n> = 1 → channel n TAC enabled.

The Control Register is available at the VME address Base + %1A.

All the TAC sections are disabled (Control Register <7..0> cleared) in the following cases:

- by accessing via VME the address Base + %1C (Reset Register);
- upon generation of the VME signal SYSRES;
- at Power-On.

3.6. LOW AND HIGH THRESHOLD SETTING

The Control Logic converts and stores in the Output Buffer only the channels that have values lying in a range identified by a High and Low Threshold. This feature allows the Zero Suppression of undesired time values.

The Threshold values are 8 bit wide and are programmable via VME by accessing in write two write only registers:

- Low Threshold register (THRL) VME address = Base + %10
- High Threshold register (THRH) VME address = Base + %12

3.7. ADC DYNAMIC RANGE

The sliding scale correction reduces slightly the dynamic range of the ADC; the 12 bit digital output is valid from 0 to 3840; values from 3841 to 4095 are not correct.

The usable range of the analog input of the ADC is ≈ 0.15 V to 3.75 V. The conversion of an analog input that is greater than the upper limit could lead to an unpredictable digital output coding in the range from 0 to 255. The User should use the high threshold to maintain the analog input of the ADC below this upper limit.

The recommended High Threshold values are less than %C7 (hex).

3.8. COM INPUT

COMMON START MODE

If the module is not BUSY, a NIM pulse on the COM input (trigger) causes the following:

- starts the TAC conversion of the enabled channels;
- increments the Event Counter;
- sets the BUSY output to 1 (Module Busy);
- starts the Control logic Time-Out Counter.

COMMON STOP MODE

If the module is not BUSY, a NIM pulse on the COM input (trigger):

- stops the TAC conversions of the enabled channels;
- increments the Event Counter;
- sets the BUSY output to 1 (Module Busy);
- causes the Control Logic to start the conversion sequence.

This is a high impedance input and is provided with two bridged connectors for daisy chaining; this allows to control easily a system of many units.

Note that the high impedance makes this input sensitive to noise, so the chain has to be terminated on 50 Ω on the last module; the same is needed also if one module only is used, whose inputs have thus to be properly matched.

3.9. BUSY OUTPUT

An open-collector signal ("BUSY"), active high, is available on the front panel. It is a high impedance output and is provided with two bridged connectors for daisy chaining: this allows to obtain a wired-or Global Busy signal of a system composed of many units.

Each module sets to 1 its Busy output after a pulse on the COM input (Module Busy) and releases it to 0 at the end of the conversion sequence. When the Module is Busy it does not accept another COM pulse (Trigger). The same happens also if the FIFO cannot accept more data.

If many units are connected in daisy chain mode via the COM and BUSY signals, after a pulse on the COM input (trigger) the Global Busy signal is set to 1 and it is released to 0 only when all the V488A modules in the chain have completed the conversion sequence and the entire system is ready to accept another trigger.

This avoids that some modules in the chain could accept another trigger while other modules are still Busy. This may cause a lack of coherence in the overall data (the event counter values of different module could not be coherent).

This feature allows to mix in the same system modules with different Full Scale Time Ranges without problem, and ensures that data related to the same trigger number in different modules belong to the same physical trigger.

3.10. RESET OPERATION

A pulse through the RESET input sets the board in the following state:

1. the event counter is set to 0;
2. the output buffer is reset (FIFO EMPTY);
3. all the channels are disabled (Control Register <7..0> cleared);
4. the Range is set to 0;
5. the Output Buffer is set to the HF mode;
6. the Interrupt start condition is set to 0 (Interrupt on buffer Half Full);
7. the Interrupt level is set to 0;
8. the module operation is set to Common Start mode.

After a reset the module must be initialized again.

The VME Reset (access to address Base + %1C) and the generation of the VME signal SYSRES perform the same actions.

3.11. OUTPUT BUFFER OPERATION MODES

The output buffer is arranged in FIFO logic 512 x16 bit.

Two operation modes are programmable via VME:

HF (Half Full) mode: The Module does not accept any trigger (Module BUSY) when the number of data stored is greater than the half-size of the FIFO.

FF (FIFO Full) mode: The Module does not accept any trigger (Module BUSY) when the FIFO is full. In this operating mode it is possible to use all the memory locations, but it is possible to lose some data (if the FIFO becomes full during a conversion sequence).

The mode selection is done via the bit 12 of the Range Register:

Range Registrer<12> = 1 → FIFO FULL Mode
Range Registrer<12> = 0 → FIFO HALF FULL Mode

3.12. OUTPUT BUFFER STRUCTURE

During the conversion sequence, if at least one TAC output value is lying in the range identified by the High and Low Thresholds, the Control Logic stores in the Output Buffer the following words:

- a header that contains the event counter value and the number of the channels in the range; this number also indicates the number of subsequent words in the FIFO related to that event;
- the 12 bit converted time values together with the corresponding channel number.

If no channel is in the correct range the Output Buffer is not written.

The Output Buffer is available at VME address BASE + % 18.

The bit 15 of the Output Buffer indicates if the word read is a header or a channel data:

- Output Buffer <15> =1 → header
- Output Buffer <15> =0 → channel data

The status of the Output Buffer is available in the Control Register:

- Control Register <12> = 0 → Output Buffer is Half full;
- Control Register <13> = 0 → Output Buffer is Full;
- Control Register <14> = 0 → Output Buffer is Empty.

The following figure shows an example of the Output Buffer structure:

- The first datum written is HEADER 5;
- In the Trigger n. 5 two channels (2 and 5) were in the selected range;
- In the Trigger n. 6 and n. 7 no channel was in the selected range;
- In the Trigger n. 8 three channels (0, 1 and 3) were in the selected range.

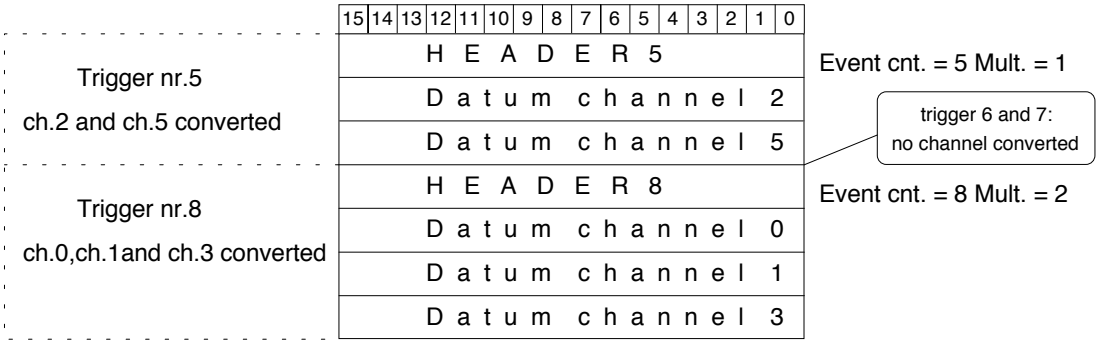


Fig. 3.3: Mod. V488A Output Buffer Data Packet FIFO Structure

3.13. INTERRUPT GENERATION

The operations of the V488A VME INTERRUPTER are fully programmable; via VME it is possible:

- to set the VME Interrupt level;
- to program the VME Interrupt Vector (STATUS/ID);
- to program the Interrupt Generation on the Output Buffer HALF FULL or on the Output Buffer NOT EMPTY; this is controlled by the bit 12 of the Interrupt Register:
  - Interrupt Register<12> = 0 Interrupt on Output Buffer HALF FULL;
  - Interrupt Register <12> = 1 Interrupt on Output Buffer NOT EMPTY.

4. VME INTERFACE

4.1. ADDRESSING CAPABILITY

The module works in A24/A32 mode. This implies that the module's address must be specified in a field of 24 or 32 bits. The Address Modifiers code recognized by the module are:

AM=%3D:	standard supervisor data access
AM=%39:	standard user data access
AM=%0D	extended supervisor program access
AM=%09:	extended user data access

The module's Base Address is fixed by 6 internal rotary switches housed on two piggy-back boards plugged into the main printed circuit board.

The Base Address can be selected in the range:

% 00 0000 <-> % FF FF00	A24 mode
% 0000 0000 <->% FFFF FF00	A32 mode

The Base Address reserves in this way a page of 256 bytes for the module. The Address Map of the page is shown in table 4.1 on the following page.

4.2. DATA TRANSFER CAPABILITY

The internal registers and the Output Buffer are accessible in D16 mode.

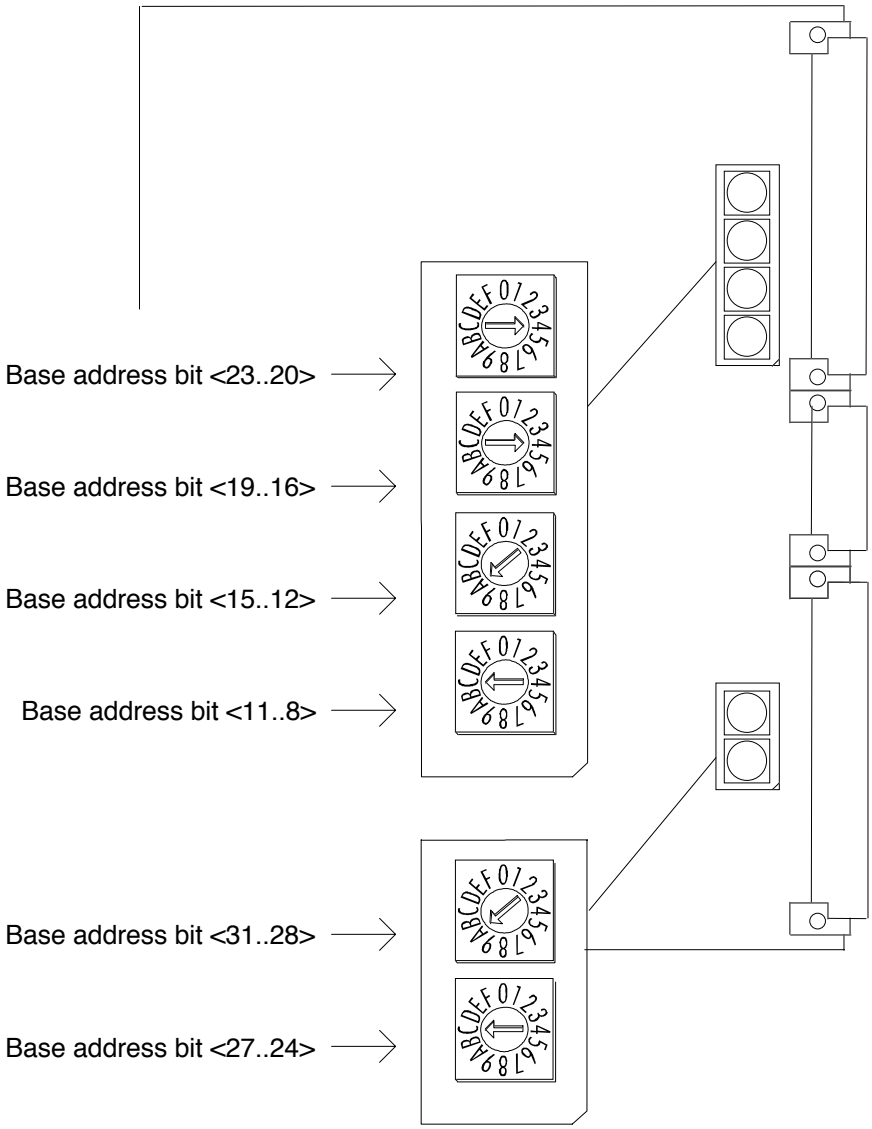


Fig. 4.1: Mod. V488A Base Address Setting

Table 4.1: Address Map for the Mod. V488A

ADDRESS	REGISTER/CONTENT	TYPE
Base + %FE Base + %FC Base + %FA	Version & Series Manufacturer & Module type Fixed Code	read only read only read only
Base + %F8 . . Base + %20	Not used . . Not used	
Base + %1E Base + %1C Base + %1A Base + %18 Base + %16 Base + %14 Base + %12 Base + %10	HF Register Reset Register Control Register Output Buffer FF Register Range Register THRH Register THRL Register	read/write read/write read/write read only read/write read/write write only write only
Base + %0E . . Base + %02	Not used . . Not used	
Base + %00	Interrupt Register	read/write

4.3. MODULE IDENTIFIER WORDS

(Base address + %FA ,+%FC, +%FE read only)

The Three words located at the highest address on the page are used to identify the module as shown in figure 4.2:

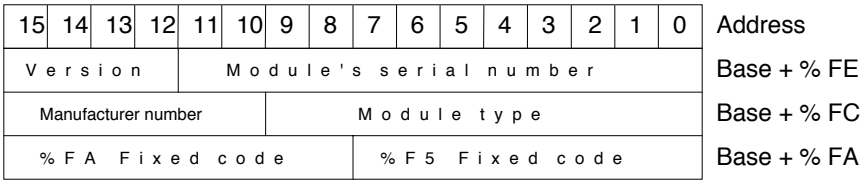


Fig. 4.2: Module Identifier Words

At the address Base + % FA the two particular bytes allow the automatic localization of the module.

For the Mod. V488A the word at address Base + % FC has the following configuration:

Manufacturer N°= 000010 b
Type of module = 0001000110 b

The word located at the address Base + %FE identifies the single module via a serial number, and any change in the hardware (for example the use of faster Conversion Logic) will be shown by the Version number.

4.4. HF REGISTER

(Base address + %1E read/write)

A VME access (read or write) to this location sets the Output Buffer in the HALF FULL mode; the mode selection is available in read only mode at the bit 12 of the Range Register.

- Range Register <12>=0 HF mode;
- Range Register <12>=1 FF mode.

4.5. RESET REGISTER

(Base address + %1C read/write)

A VME access (read or write) to this location causes the following:

1. the event counter is set to 0;
2. the output buffer is reset (FIFO EMPTY);
3. all the channels are disabled (Control Register <7..0> cleared);
4. the Range is set to 0;
5. the Output Buffer is set to the HF mode;
6. the Interrupt start condition is set to 0 (Interrupt on buffer Half Full);
7. the Interrupt level is set to 0;
8. the module operation is set to Common Start mode.

The same action are performed if the VME signal SYSRES is active.

4.6. CONTROL REGISTER

(Base address + %1A read/write)

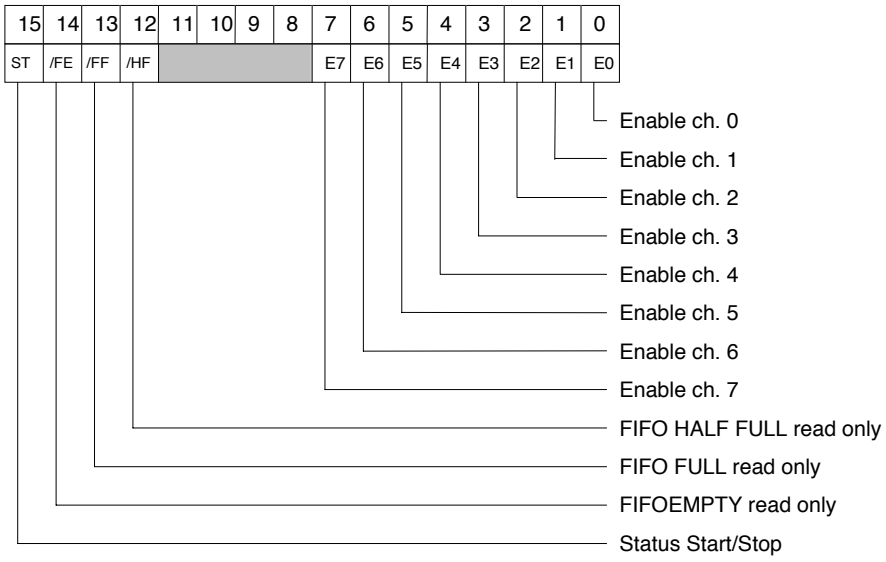


Fig. 4.3: Mod. V488A Control Register

E<7..0> Enable channel <7..0>:
= 0 channel n TAC disabled;
= 1 channel n TAC enabled.
These bits are cleared in the following cases:
- by accessing via VME the address Base + %1C (Reset Register);
- by generating the VME signal SYSRES;
- at Power-On.

/HF Output Buffer half full bit read only.
= 0 Output Buffer is half full;

/FF Output Buffer full bit read only.
= 0 Output Buffer is full;

/FE Output Buffer empty bit read only.
= 0 Output Buffer is empty;

ST Operation mode selection bit.
= 0 Common Start mode;
= 1 Common Stop mode.

(Bits 8 to 11 are unused and are read as "one" on the VME data bus).

4.7. OUTPUT BUFFER

(Base address + %18 read only)

The Output Buffer is arranged in FIFO logic 512 x16 bit (expandable on request).

In this Buffer are available the data packets stored during the conversion sequence, if at least one TAC output value is lying in the selected range.

The first word of the packet is a header; it contains the event counter value and the number of the channels in the range; this number also indicates the data packet length.

The other word contains the 12 bit converted time values together with the corresponding channel number.

The bit 15 of the word distinguishes between header and channel data:

- Output Buffer <15> =1 → header
- Output Buffer <15> =0 → channel data

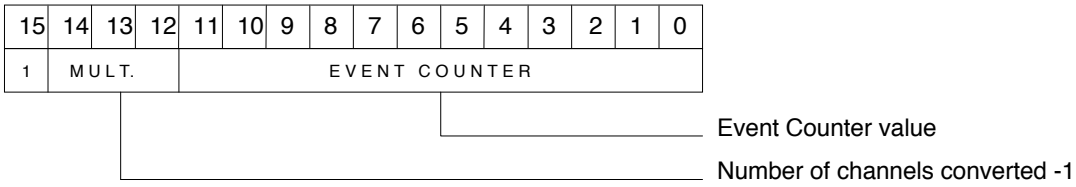


Fig. 4.4: Output Buffer Data Packet Header

EVENT CNT. 12 bit Event Counter.
It counts the pulse on the COM input; it is inhibited if the Module is Busy.

MULT Multiplicity.
It indicates the number of channels in the range:
MULT+1 =number of channel, i.e., the packet length (MULT=0: one channel).

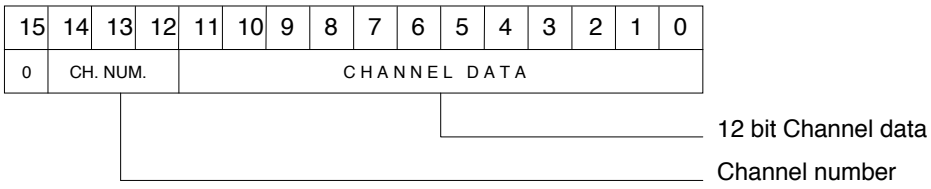


Fig. 4.5: Mod. V488A Output Buffer Channel Data

The following figure shows an example of the Output Buffer structure:

- The first datum written is HEADER 5;
- In the Trigger n. 5 two channels (2 and 5) were in the selected range;
- In the Trigger n. 6 and n. 7 no channel was in the selected range;
- In the Trigger n. 8 three channels (0, 1 and 3) were in the selected range.

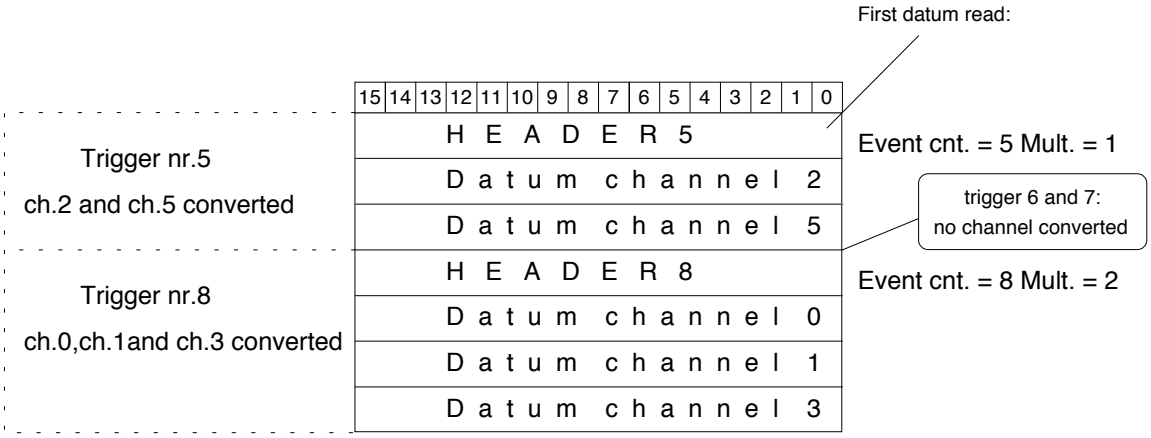


Fig. 4.6: Mod. V488A Output Buffer Data Packet FIFO Structure

4.8. FF REGISTER

(Base address + %16 read/write)

A VME access (read or write) to this location sets the Output Buffer in the FIFO FULL mode; the mode selection is available in read only mode at the bit 12 of the Range Register (see § 4.9) .

4.9. RANGE REGISTER

(Base address + %14 read/write)

The bits <7..0> of the Range Register allow to select the Full Scale Time Range in common for all the channels. Suggested values range from %00 to %E0, corresponding respectively to 90 ns and 770 ns. The bits <7..0> are available in write only mode. Bit 12 is available in read only mode and represents the status of the FIFO operating mode:

- Range Register <12>=0 HF mode
- Range Register <12>=1 FF mode

During a read access, the bits <7..0> contain fake data, while the upper bits (except bit 12) will contain zeroes.

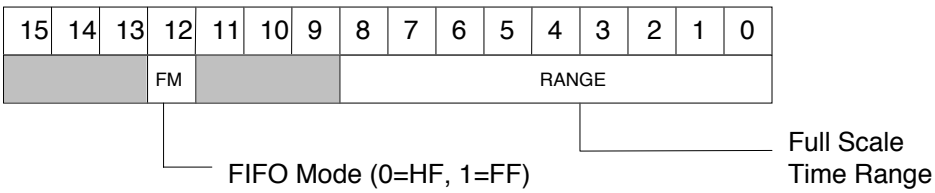


Fig. 4.7: Mod. V488A Range Register

4.10. THRH REGISTER

(Base address + %12 write only)

This register (High Threshold register) allows to set the 8 bit value of the High Threshold.

The usable range of the analog input of the ADC is ≈ 0.15 V to 3.75 V. The conversion of an analog input that is greater than the upper limit could lead to an unpredictable digital output coding in the range from 0 to 255. The User should use the High Threshold to maintain the analog input of the ADC under this upper limit.

The recommended High Threshold values are less than %C7 (hex).

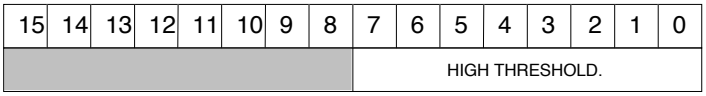


Fig. 4.8: Mod. V488A THRH Register

4.11. THRL REGISTER

(Base address + %10 write only)

This register (Low Threshold register) allows to set the 8 bit value of the Low Threshold. This value must be smaller than the High Threshold value.

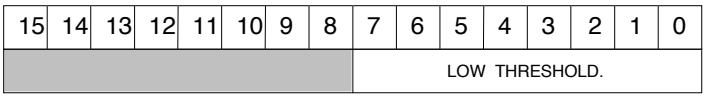


Fig. 4.9: Mod. V488A THRL Register

4.12. INTERRUPT REGISTER

(Base address + %0 read/write)

This register contains the value of the Interrupt Level and the STATUS/ID that the V488A INTERRUPTER places on the VME data bus during the Interrupt Acknowledge cycle. (Bits 8 to 11 are unused and are read as "one" on the VME data bus).

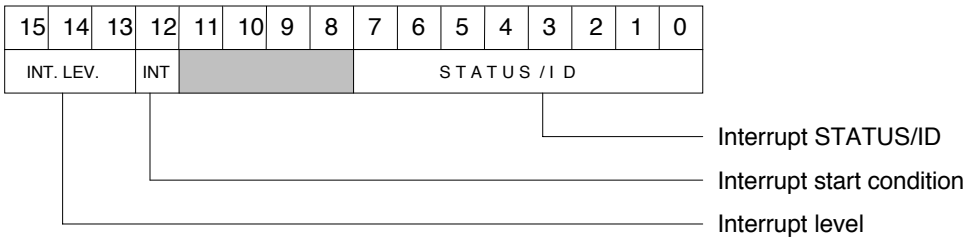


Fig. 4.10: Mod. V488A Interrupt Register

INT Interrupt start condition:
= 0 Interrupt on Output Buffer HALF FULL;
= 1 Interrupt on Output Buffer NOT EMPTY.

5. MOD. V488A INTERRUPTER

5.1. INTERRUPTER CAPABILITY

The Mod. V488A houses a VME RORA INTERRUPTER D08(o) type. This implies the following:

- it responds to 8 bit, 16 bit and 32 bit interrupt acknowledge cycles providing an 8-bit STATUS/ID on the VME data lines D00..D07;
- it removes its interrupt request when some on board registers are accessed by a VME MASTER (RORA: Release On Register Access).

5.2. INTERRUPT LEVEL

The interrupt level corresponds to the value stored in the Interrupt Register <15..13>. The register is available at the VME address Base + % 00.

5.3. INTERRUPT STATUS/ID

The interrupt STATUS/ID is 8 bit wide, and it is contained in the Interrupt Register<7..0> (address Base + % 00).

5.4. INTERRUPT GENERATION

Via VME it is possible to program the Interrupt Generation on the Output Buffer HALF FULL or on the Output Buffer NOT EMPTY; this is controlled by the bit 12 of the Interrupt Register:

- Interrupt Register<12> = 0 Interrupt on Output Buffer HALF FULL;
- Interrupt Register <12> = 1 Interrupt on Output Buffer NOT EMPTY.

5.5. INTERRUPT REQUEST RELEASE

The V488A INTERRUPTER removes its Interrupt request depending on the selected operating mode, according to the following:

1. If FIFO NOT EMPTY mode is selected, by reading out the FIFO until it doesn't become EMPTY;
2. If FIFO HALF FULL mode is selected, by reading out the FIFO until it doesn't become less than HALF FULL.

5.6. INTERRUPT SEQUENCE

{
- if the FIFO becomes NOT EMPTY or HALF FULL (according to selected mode):
    {
    - it requests interrupt by driving an Interrupt Request line IRQ1..7 low according to the Interrupt Register <15..13> value;

    - during the subsequent acknowledge cycle it places on the VME data lines D00..D07 the STATUS/ID; it is the byte contained in the 8 LSB of the Interrupt register (address Base +% 00);
    }

- if a VME MASTER accesses the FIFO it releases the VME interrupt request line once the Interrupt condition is removed (FIFO EMPTY if FIFO NOT EMPTY mode was selected or FIFO NOT EMPTY if FIFO HALF FULL was selected).
}

6. REFERENCES

[1] J. Pouxe, "Time to Amplitude Converter ASIC", ISN Grenoble, June 1990.

[2] C. Cottini, E. Gatti, V. Svelto, "A new method of analog to digital conversion", NIM vol.24 p. 241, 1963.

[3] C. Cottini, E. Gatti, V. Svelto, " A sliding scale analog to digital converter for pulse height analysis", in Proc. Int. Symp. Nuclear, Paris, Nov. 1963.

[4] VMEbus Specification Manual Revision C.1, October 1985.

[5] G. Bianchetti et al., "Specification for VMEbus CRATE Type V430", CERN-EP, January 1990.

APPENDIX A: ELECTRICAL DIAGRAMS