1. DESCRIPTION

1.1 FUNCTIONAL DESCRIPTION

The CAEN Mod. C 219 16-CHANNEL UNIVERSAL PROGRAMMABLE I/O REGISTER, is a single width CAMAC module which implements a 16 channel general purpose I/O module.

Each of the 16 channels can be programmed as INPUT or OUTPUT independently and can work in POSITIVE or NEGATIVE logic.

INPUTS and OUTPUTS can be enabled by the N signal of the READ CAMAC functions (TRANSPARENT MODE) or by an EXTERNAL STROBE signal (EXTERNALLY STROBED MODE).

The EXTERNAL STROBE signal can also generate a LAM signal directly.

By operating in GLITCHED MODE, a positive or negative transition of an input signal can be observed from the value stored in the INPUT REGISTER.

All that is listed above can be carried out by programming the module's internal registers through the relevant CAMAC functions. The module's internal registers are:

- CHANNEL STATUS REGISTER;

- STROBE STATUS REGISTER;

- INPUT REGISTER;

- OUTPUT REGISTER;

- LAM MASK REGISTER.

The Figure 1 shows the functional block diagram of the module.

1.1.1 CHANNEL STATUS REGISTER

Each of the 16 channels the module is equipped with, has a 4-bit CHANNEL STATUS REGISTER which is writable and readable through the F(17) N A(n) W1-W4 and F(1) N A(n) R1-R4 CAMAC functions respectively (n=number of the channel which the function is referred to; W1-W4=1 to 4 CAMAC Write Lines; R1-R4=1 to 4 CAMAC Read Lines). The WRITE and READ Lines are correlated with the CHANNEL STATUS REGISTER bits as follows: W1(R1)-bit0, W2(R2)-bit 1, W3(R3)-bit2, W4(R4)-bit3. The logic level which each bit assumes after a CAMAC Write function has been performed, defines a particular functional characteristic of the channel:

- direction (INPUT or OUTPUT);

- working logic (POSITIVE or NEGATIVE);

- working mode (NORMAL or GLITCHED);

- I/O transferring mode (TRANSPARENT or EXTERNALLY STROBED).

The table below shows the functional characteristics corresponding to the status of the individual bits.

W1(R1)	bit0	0=OUTPUT 1=INPUT
W2(R2)	bit1	0=NEGATIVE logic 1=POSITIVE logic
W3(R3)	bit2	0=GLITCHED mode 1=NORMAL mode
W4(R4)	bit3	0=TRANSPARENT 1=EXTERNALLY STROBED

1.1.2 STROBE STATUS REGISTER

The output transferring and input storing can be enabled by sending an EXTERNAL STROBE signal through the STB connector. The STROBE STATUS REGISTER is a 3-bit register which allows:

- to set the EXTERNAL STROBE signal polarity (POSITIVE or NEGATIVE);

- to generate or not to generate a LAM signal as a consequence of an EXTERNAL STROBE;

- to store an occurred EXTERNAL STROBE signal.

The STROBE STATUS REGISTER programming is carried out by performing an F(16) N A(1) CAMAC Write function. The data held on the Write Lines W1-W2 of this function set the bit 0 and the bit 1 to the required logic level. Each of the four possible logic levels determines a STROBE signal characteristic, according to the following table :

W1	bit0	0=positive polarity 1=negative polarity
W2	bit1	0=STROBE does not cause LAM 1=STROBE causes LAM

By performing an F(0) N A(1) CAMAC Read function the Read Lines R1 to R3 read the status of bit0, bit1, bit2 respectively.

The logic level of the bit 2 becomes 1 if a STROBE occurs and will stand at this level untill a F(2) N A(1) is performed to read and clear the same bit.

1.1.3 INPUT REGISTER

The 16-channel pattern is stored into a 16-bit INPUT REGISTER which can be read by the F(0) N A(0) CAMAC function in one of the following modes:

- INTERNALLY STROBED: the input channel pattern is stored into the INPUT REGISTER at the beginning of the N signal of the CAMAC Read operation;

- EXTERNALLY STROBED: the input channel pattern is stored into the INPUT REGISTER at the beginning of the EXTERNAL STROBE signal.

By the F(2) N A(0) it is posssible to read and clear the INPUT REGISTER.

1.1.4 OUTPUT REGISTER

The OUTPUT REGISTER is a 16-bit register which can be written by the F(16) N A(0) CAMAC function. The CAMAC Write Line status which is stored into the OUTPUT REGISTER is transferred to the outputs in one of the following modes:

- TRANSPARENT mode: the stored value is transferred to the outputs as soon as the F(16) N A(0) CAMAC function is performed;

- EXTERNALLY STROBED mode: the stored value is transferred to the outputs if the EXTERNAL STROBE signal is true.

1.1.5 LAM MASK REGISTER

The LAM MASK REGISTER is a 16-bit register which is used together with the INPUT REGISTER to generate a LAM signal. For this purpose, the bit n of the LAM MASK REGISTER and the bit n of the INPUT REGISTER are ANDed (for a total of 16 ANDs) and all the 16 ANDs are ORed. As soon as one of the ANDs becomes true the OR also is true and generates a LAM signal.

By performing an F(16) N A(2) CAMAC function it is possible to set each of the 16 bits of the LAM MASK REGISTER to the logic level 1, so that a LAM signal is generated whenever the relevant input becomes true.

2. SPECIFICATIONS

2.1 PACKAGING

Single width wide CAMAC module.

2.2 EXTERNAL COMPONENTS

Front panel: . No.16 LEMO 00-type connectors; 50 Ohm impedance; standard NIM: 1 per channel.
. No. 1 LEMO 00-type connector; 50 Ohm impedance; standard NIM: STROBE-signal input.
. No.16 green LEDs: signalling the I/O direction of each channel.
. No.16 red LEDs: signalling a false/true signal at each channel.
. No. 1 yellow LED: signalling the LAM signal.

Rear panel: . No. 1 LEMO 00-type connector; 50 Ohm impedance; standard NIM: available output of the LAM signal.

2.3 CHARACTERISTICS OF THE SIGNALS

- NIM level (0V,-800 mV).

- GLITCH: minimum duration 10 nsec.

- STROBE: . maximum frequency: 30 MHz;
. duty cycle: 50%;
. minimum hold time: 25 nsec;
. minimum set-up time: 25 nsec.

2.4 POWER REQUIREMENTS

+6 V at 2.4 A;

-6 V at 1.0 A

3. CAMAC FUNCTIONS

F (0) N A (0)	Reads INPUT REGISTER.
F (0) N A (1)	Reads STROBE STATUS REGISTER
F (0) N A (2)	Reads LAM MASK REGISTER
F (1) N A (n)	Reads CHANNEL-n STATUS REGISTER
F (2) N A (0)	Reads and clesrs the INPUT REGISTER
F (2) N A (1)	Reads and clears the bit 2 of the STROBE STATUS REGISTER
F (8) N	Tests the LAM line (Q response if LAM is true)
F (9) N A (0)	Initializes the module
F (16) N A (0)	Writes the OUTPUT REGISTER. W1 to W16.
F (16) N A (1)	Writes the STROBE STATUS REGISTER. W1 to W2.
F (16) N A (2)	Writes the LAM MASK REGISTER. W1 to W16.
F (17) N A (n)	Writes the CHANNEL-n STATUS REGISTER. W1 to W4.
F (24) N	Disables the LAM line
F (26) N	Enables the LAM line
F (27) N	Tests the LAM INTERNAL STATUS (Q response if LAM is true)
C or Z	Same as F (9) N A (0)

4. OPERATING MODES

Model C 219 can be used as follows:

a. I/O unit with n INPUT channels and m OUTPUT channels (n+m=16);

b. I/O unit with INPUT channels masked to generate a LAM signal.

The module operates via CAMAC functions only.

CAUTION: turn OFF the CAMAC crate before inserting or removing the module.

4.1 USE OF THE MODULE AS AN I/O UNIT

1. Operations to be performed to prearrange the channels.

(a) After the module has been inserted into a CAMAC slot, turn ON the CAMAC crate. The module assumes its default conditions:

- 16 INPUT channels;
- POSITIVE working logic;
- NORMAL working mode;
- TRANSPARENT I/O transferring mode;
- STROBE STATUS REGISTER status = 000;
- INPUT REGISTER status = 0000000000000000;
- OUTPUT REGISTER status = 0000000000000000;
- LAM MASK REGISTER status = 0000000000000000;
- LAM line = disabled.
- All the LEDs are OFF.

(b) For each channel which has to be prearranged, perform a F (17) N A (n) function (n=number of the channel which the function is referred to) by setting the CAMAC Write Lines W1 to W4 as follows:

1. W1 = 0 or 1 (0=OUTPUT channel; LED-n=ON) (1=INPUT channel; LED-n=OFF);
2. W2 = 0 or 1 (0=NEGATIVE working logic) (1=POSITIVE working logic);
3. W3 = 0 or 1 (0=GLITCHED working mode) (1=NORMAL working mode);

The GLITCHED mode is selectable for the INPUT channels only. In this case the value which is stored into the INPUT REGISTER indicates an occurred positive or negative transition of the input signal.

4. W4 = 0 or 1 (0=TRANSPARENT I/O transferring mode)
(1=EXTERNALLY STROBED I/O transferring mode)

The EXTERNALLY STROBED I/O transferring mode does not allow the GLITCHED working mode selection.

THE CHANNEL STATUS REGISTER OF EACH CHANNEL IS NOW PROGRAMMED AS REQUIRED.

The FIT (FALSE/TRUE) LED which each channel is provided with, turns ON whenever a TRUE standard NIM level signal is present at the relevant input connector.

2. Operations to be performed to read the CHANNEL STATUS REGISTER of each channel.

(a) Perform an F (1) N A (n) function (n=number of the channel which the function is referred to). The CAMAC Read Lines R1 to R4 read the CHANNEL STATUS REGISTER of the channel-n as follows:

- R1 reads the logic level of the bit0 (0=INPUT; 1=OUTPUT);
- R2 reads the logic level of the bit1 (0=NEG. working logic; 1=POS.working logic);
- R3 reads the logic level of the bit2 (0=GLITCHED working mode; 1=NORMAL working mode);
- R4 reads the logic level of the bit3 (0=TRANSPARENT I/O transferring mode; 1= EXTERNALLY STROBED I/O transferring mode).

3. Operations to be performed to operate in EXTERNALLY STROBED I/O transferring mode.

(a) Perform an F (17) N A (n) function (n=number of the channel which the function is referred to) by setting the CAMAC Write Lines W1 to W4 as follows:

1. W1 = 0 or 1 (0=OUTPUT channel; LED-n=ON)
(1=INPUT channel; LED-n=OFF)
2. W2 = 0 or 1 (0=NEGATIVE working logic)
(1=POSITIVE working logic)
3. W3 = 1 (NORMAL working mode)
4. W4 = 1 (EXTERNALLY STROBED I/O tranferring mode)

THE CHANNEL-n STATUS REGISTER IS NOW PROGRAMMED AS REQUIRED.

(b) Perform a F (16) N A (1) by setting the CAMAC Write Lines W1 to W2 as follows:

1. W1 = 0 or 1 (0=POSITIVE polarity of the STROBE signal)
(1=NEGATIVE polarity of the STROBE signal)
2. W2 = 0 or 1 (0=occurred STROBE does not cause LAM)
(1=occurred STROBE causes LAM)

THE STROBE STATUS REGISTER IS NOW PROGRAMMED AS REQUIRED.

Whenever the STROBE signal becomes active, the values which are stored into the OUTPUT REGISTER are transferred to the outputs and the configuration of the INPUT channels is stored into the INPUT REGISTER.

The F (0) N A (1) function reads the bits 0,1 and 2 of the STROBE STATUS REGISTER. The F (2) N A (1) function reads and clears the bit2 only.

4. Operation to be performed for the OUTPUT REGISTER writing.

(a) Perform an F (16) N A (0) function: the CAMAC Write Lines W1 to W16 contents are stored into the OUTPUT REGISTER and are transferred to the outputs only if the output channels have been programmed in NORMAL working mode (bit2 of the CHANNEL STATUS REGISTER set to 1). If the bit2 is set to 0, the data transferring takes place only when the STROBE signal is active.

5. Operation to be performed for the INPUT REGISTER reading.

(a) Perform an F (0) N A (0) function: the contents of the INPUT REGISTER and those of the OUTPUT REGISTER on the output channels are read.

The F (2) N A (0) function gives the same effect but it also clears the INPUT REGISTER.

4.2 USE OF THE MODULE AS AN I/O UNIT GENERATING THE LAM SIGNAL.

The LAM signal can only be generated together with input signals.

1. Operations to be performed to generate the LAM signal through the LAM MASK REGISTER.

(a) Perform an F (16) N A (2) function by setting the CAMAC Write Line Wn to the logic level 1 (n=number of the channel which the function is referred to): the bit of the LAM MASK REGISTER which is correlated with the input channel n assumes the logic level 1. A LAM signal is generated whenever the channel-n input signal becomes TRUE (AND between the selected bit of the LAM MASK REGISTER and that corresponding the INPUT REGISTER which is correlated with the channel n).

It is possible to mask several channels at the same time by performing an F (16) N A (2) function with the respective channel Write Lines set to the logic level 1. In this case, a LAM signal is generated whenever one of the ANDs becomes TRUE (the ANDs are ORred).

(b) Perform an F (26) N function: the CAMAC LAM Line is enabled and the CAMAC controller receives the LAM signal.

The LAM signal is present as long as a F (2) N A (0) function has been performed.
The F (24) N function disables the CAMAC LAM Line but it does not clear the LAM signal.
The F (8) N function tests the CAMAC LAM Line and gives a Q response if the LAM signal is TRUE.
The F (27) N function tests the internal LAM signal status (False or True) and gives a Q response if the LAM signal is TRUE.
The yellow LED L is ON if the LAM signal has been generated.

2. Operations to be performed to generate a LAM signal by means of an EXTERNAL STROBE signal.

(a) Perform an F (16) N A (1) function by setting the CAMAC Write Line W2 to the logic level 1: whenever an EXTERNAL STROBE signal occurs a LAM signal is generated.

(b) Perform an F (26) N function: the CAMAC LAM Line is enabled and the LAM signal is transferred to the CAMAC controller.

The LAM signal is present as long as an F (2) N A (1) function has been performed.
The F (24) N function disables the CAMAC LAM Line but it does not clear the LAM signal.
The F (8) N function tests the CAMAC LAM Line and gives a Q response if the LAM signal is TRUE.
The F (27) N function tests the internal LAM signal status (False or True) and gives a Q response if the LAM signal is TRUE.
The F (27) N function tests the internal LAM signal status (False or True) and gives a Q response if the LAM signal is TRUE.
The yellow LED L is ON if the LAM signal has been generated