

AMS-Bologna Internal Note
Trigger-01
7 December 2002

LOCAL TOF TRIGGER SPECIFICATIONS

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ABSTRACT

This document describes the AMS Local TOF Trigger to be implemented at the crate level.

1 INTRODUCTION

The AMS TOF system is asked to provide a local trigger at the crate level in order to reduce the amount of cables to the First Level Trigger units. Three different triggers are requested:

- a "Z=1" trigger (TOFZ1) which selects Z1 particles over the full solid angle of AMS;
- a "Z=1" trigger (TOFMZ1) which selects Z1 particles over a limited solid angle, essentially covering the calorimeter acceptance;
- a "Z=2" trigger (TOFZ2) which selects Z2 particles over the full solid angle of AMS.

The local trigger will be implemented by combining the signals from the two planes connected to each crate into two ORs, one per plane. Each OR will therefore produce a signal if any one counter in a given plane side produces a pulse height greater than the given threshold ("high" for TOFZ1 and TOFMZ1, "superhigh" for TOFZ2).

Other than the OR, the Local TOF Trigger unit must provide the pattern of hits in each plane end and, for the "high" thresholds only, scalars to measure the rates of each counter end. Provision has to be made to mask out noisy channels.

The structure foresees an Input and Control Unit which accepts external signals and produces all signals needed to the Kernel Unit which performs the operations and transmits the results to an Output Unit which interfaces to the subsequent logic. Figure 1 gives a general view of the system with the signals interconnecting the various units. Explanations are given in the following sections. The design is independent from the physical location of the electronics.

In sections 2, 3 and 4, the combined TOFZ1 and TOFMZ1 triggers is described in detail. The TOFZ2 trigger is a downgraded version without scalars, and is described in section 5.

2 TRIGGER INPUT AND CONTROL UNIT

The Trigger Input and Control Unit (see Figure 2) accepts the following external signals:

- the "high" (Z1) threshold signals from the three SFETs of the crate, named TOFZ1 in the following;
- the Fast Trigger signal;
- serial link from the SDR crate control unit.

The TOFZ1 and Fast Trigger signals are transmitted unchanged to the next Unit. On input, the serial link must provide the instructions and the data used by the Kernel Unit:

- command to read patterns;
- command to read and to write masks;
- command to read scalers and scaler number to be read;
- mask data.

Several signals are generated from the serial data:

- Patterns read
- Scalers read
- TOFZ1 mask read
- TOFZ1 mask write
- TOFMZ1 mask read
- TOFMZ1 mask write
- Scaler select (5 bits)
- TOFZ1 mask (18 bits)
- TOFMZ1 mask (18 bits)

The serial data therefore contains 21 significant bits.

The 3-bit control generates six signals:

- 000: read TOFZ1 masks
- 010: write TOFZ1 masks
- 001: read TOFMZ1 masks
- 011: write TOFMZ1 masks
- 10x: read patterns
- 11x: read scalers

The 18 data bits contain the mask data, if the command "write masks" has been given, or a 5 bits scaler identification number and 13 zero bits if the command "read scalers" has been given.

The Input and Control Unit also generates the Scalers enable signal explained in section 3.3.

3 TRIGGER KERNEL UNIT

The Trigger Kernel Unit (see Figure 3) provides the actual trigger signals to be sent to the Fast and Level 1 Trigger Module (JLV1):

- TOFZ1 (plane 1)
- TOFZ1 (plane 2)
- TOFMZ1 (plane 1)
- TOFMZ1 (plane 2)

These signals are generated by ORing the masked signals coming from the given plane end (8 from plane 1 and 10 from plane 2).

The Trigger Kernel Unit provides also an enable signal for the output section, which is generated by ORing the read command signals.

The mask, pattern unit and scaler management is described in the following sections.

3.1 Mask registers

The mask registers accept in input the TOFZ1 signals and mask them with a pattern which is contained in readable and writable registers. Each register is a memory cell which accepts a read and a write signal and provides continuously on the output the content of the cell. The read and write signals (TOFZ1 read, TOFMZ1 read, TOFZ1 write and TOFMZ1 write) are provided by the Input and Control Unit, together with the data to be written into the registers.

Two mask register blocks are foreseen for the TOFZ1 and the TOFMZ1 triggers.

3.2 Pattern units

The pattern units accept in input the unmasked TOFZ1 signals and consists of registers in which the input is latched by the Fast Trigger signal and the output is sent continuously to another register which can be read on the Patterns read command.

3.3 Scalers

The scalers are 12-bit counters fed by the TOFZ1 signals which are enabled by the Scalers enable signal which last for 10 ms with a 1 ms stop. The content of the scalers is latched on a register at the Scalers enable end-of-signal and reset by the same signal after a suitable delay. Scalers are read on the Scalers read signal through a multiplexed line. The scaler to be read-out is identified by the 5-bits Scaler select code.

4 TRIGGER OUTPUT UNIT

The Trigger Output Unit (see Figure 4) accepts the TOFZ1 and TOFMZ1 signals from the Trigger Kernel Unit and transmits them on output. The Trigger Output Unit also

5 TOFZ2 TRIGGER

The schematics for TOFZ2 is just a stripped down version of that for TOFZ1, in that there are no scalers and there is only one mask type. The block diagrams are shown in Figures 5 to 8.

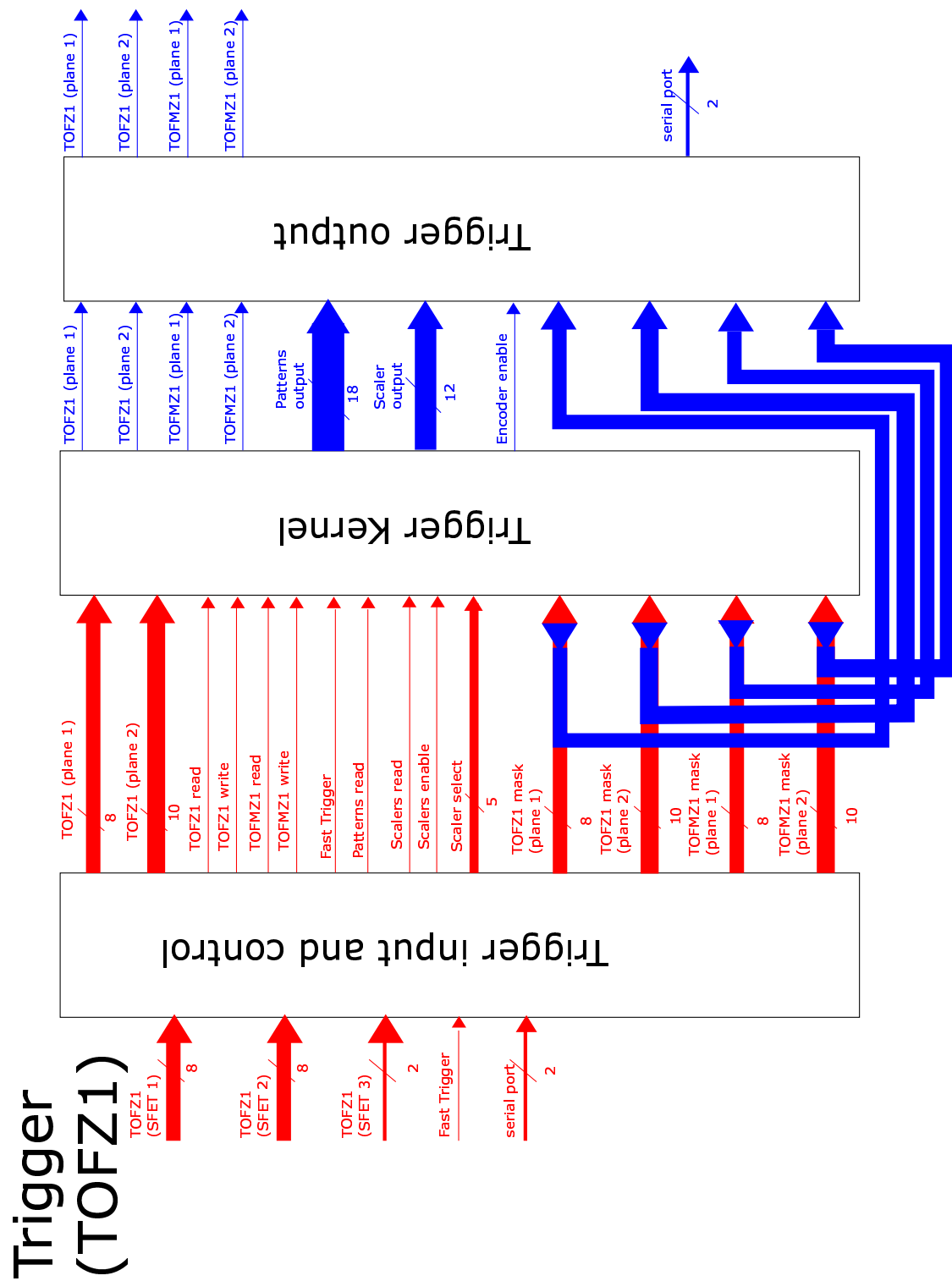


Figure 1: General Local Trigger design for TOFZ1 trigger.

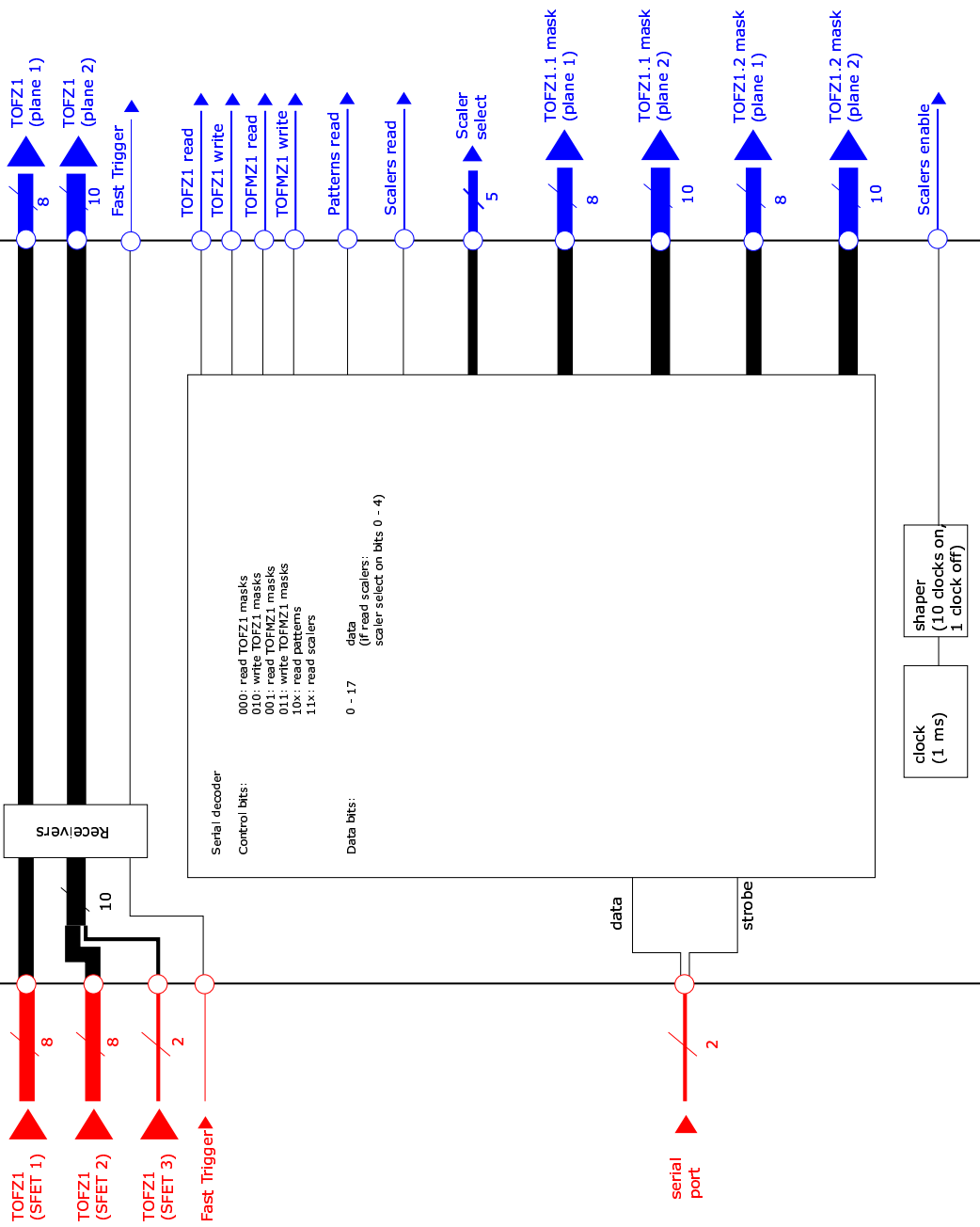


Figure 2: Trigger Input and Control Unit for TOFZ1 trigger: block diagram.

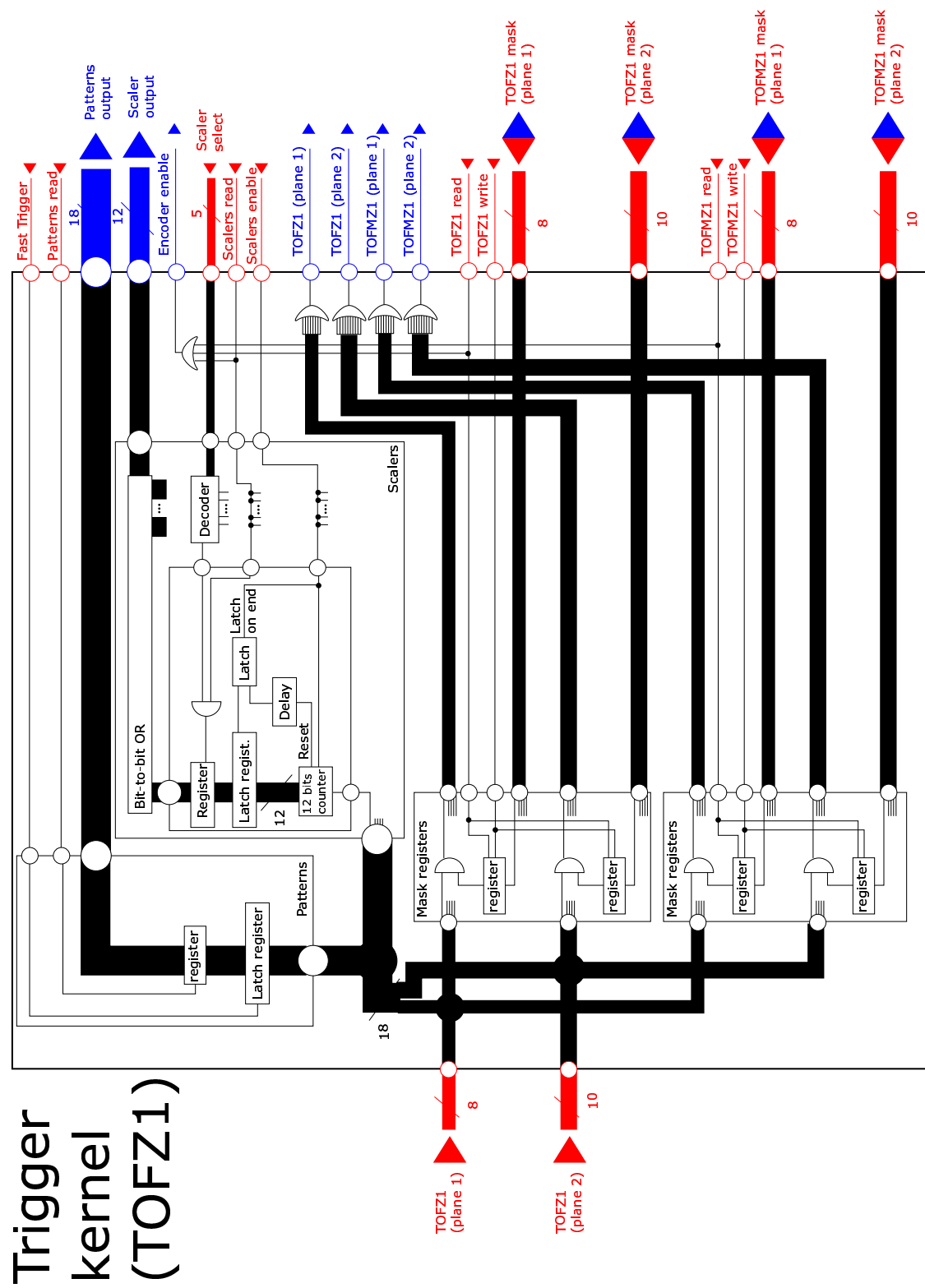


Figure 3: Trigger Kernel Unit for TOFZ1 trigger: block diagram.

Trigger output (TOFZ1)

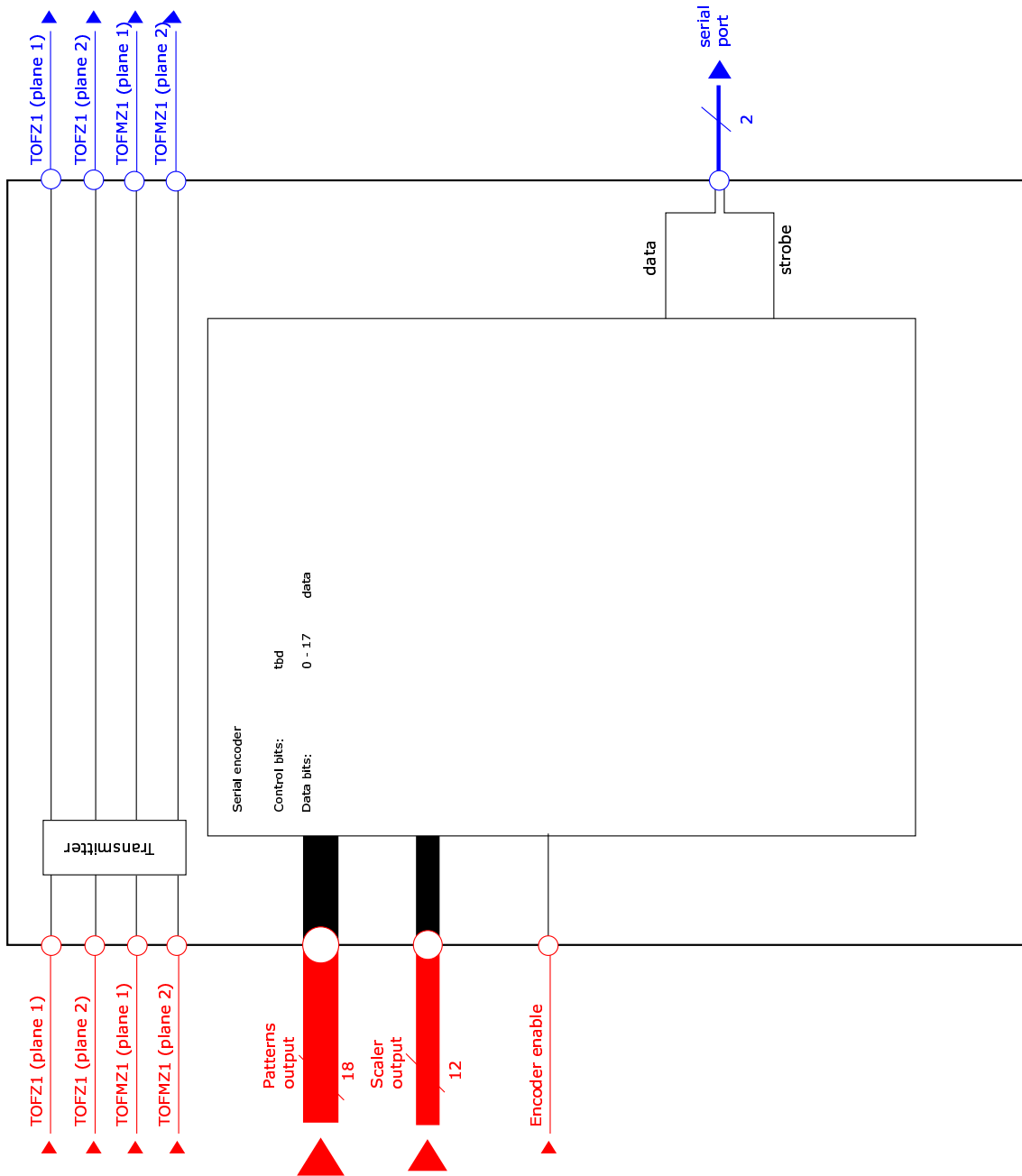


Figure 4: Trigger Output Unit for TOFZ1 trigger: block diagram.

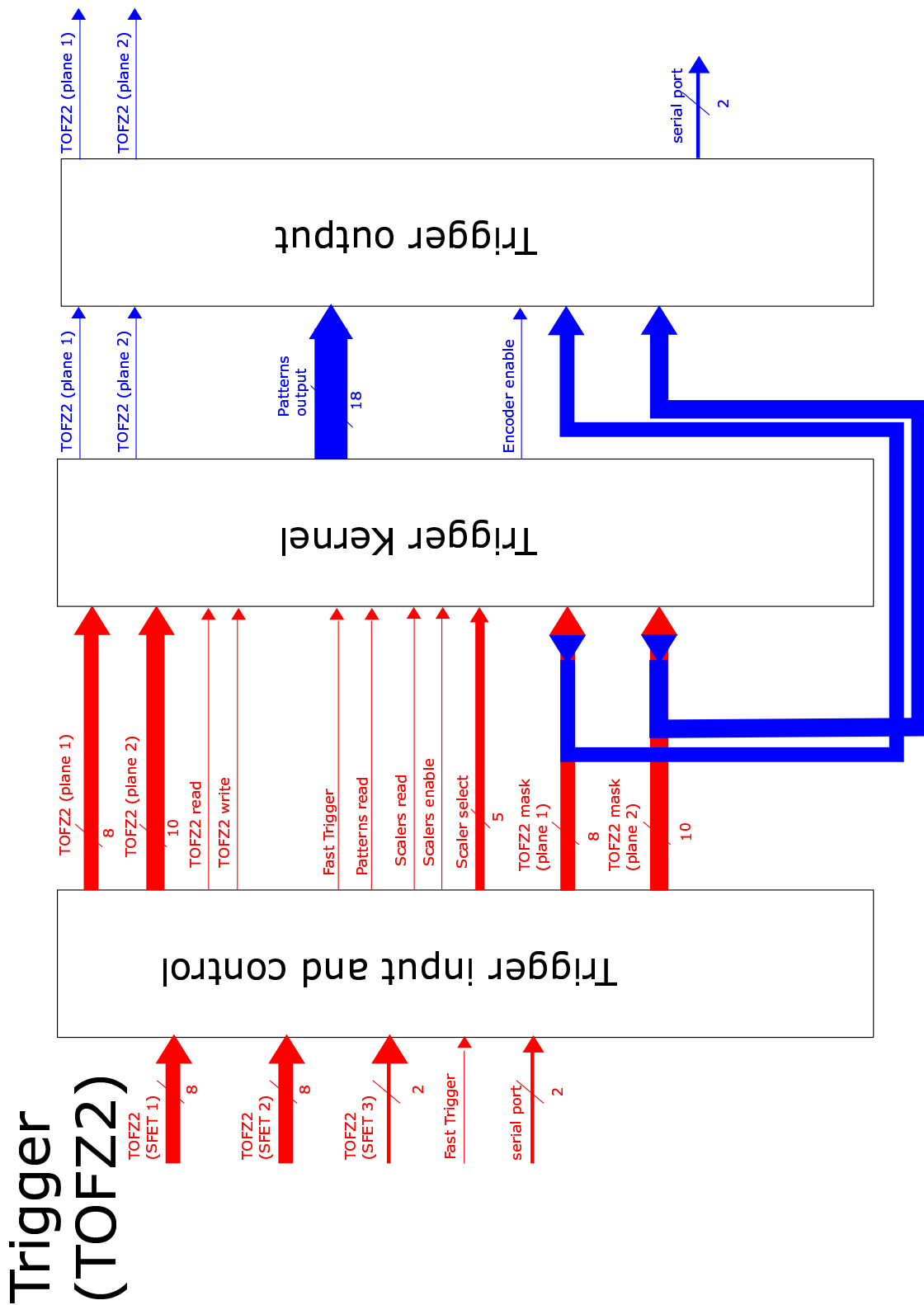


Figure 5: General Local Trigger design for TOFZ2 trigger.

Trigger input and control (TOFZ1)

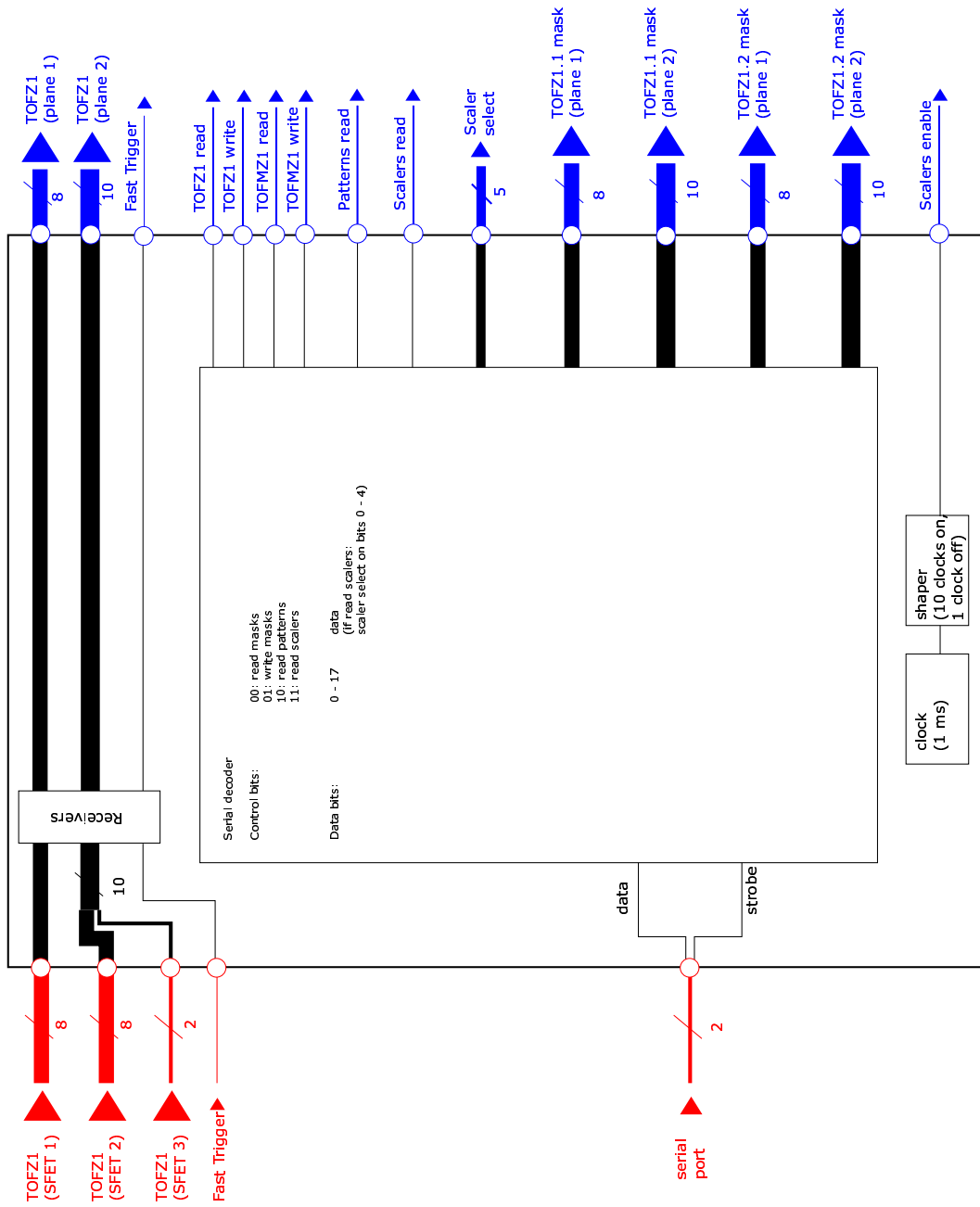


Figure 6: Trigger Input and Control Unit for TOFZ2 trigger: block diagram.

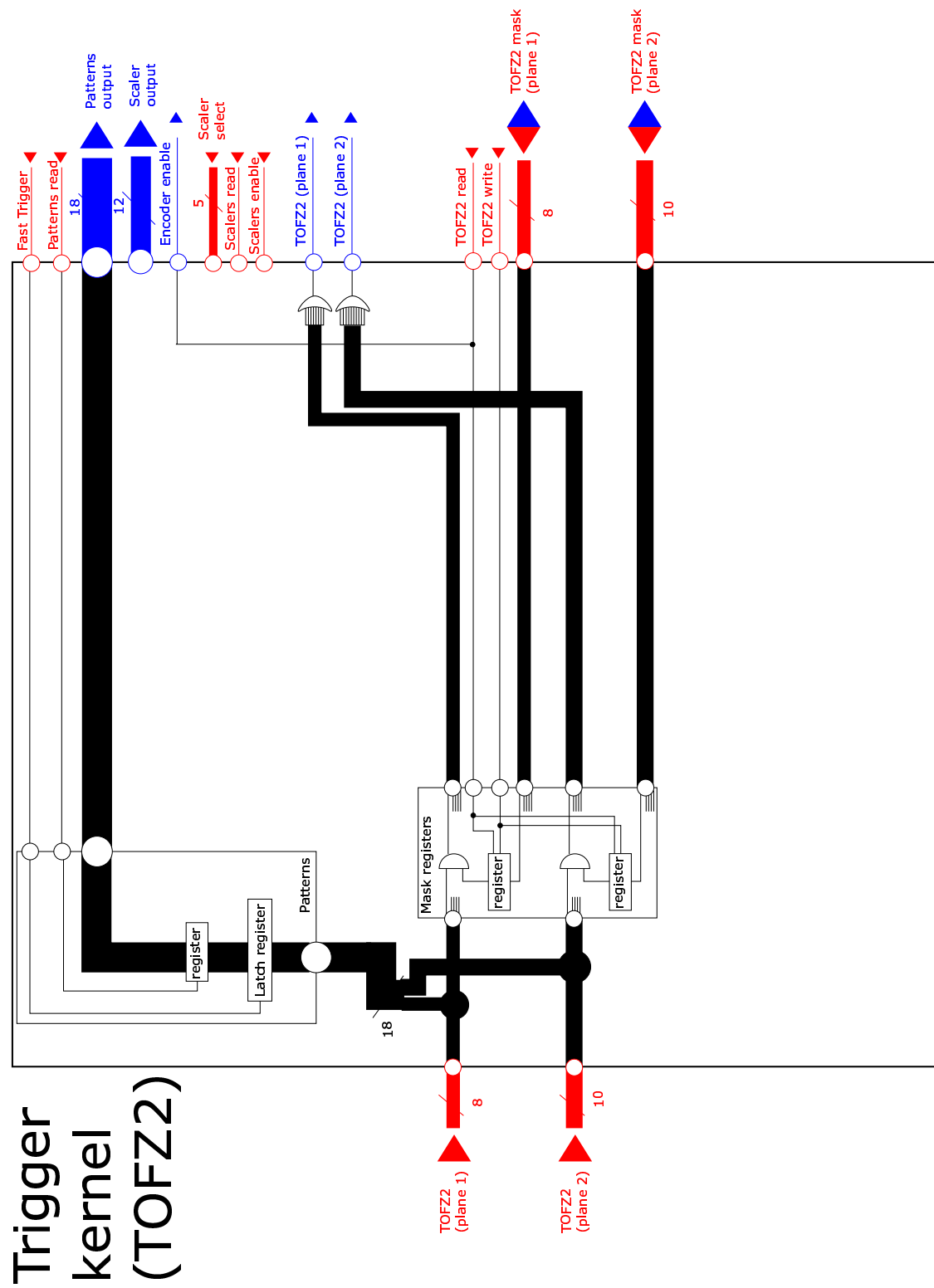


Figure 7: Trigger Kernel Unit for TOFZ2 trigger: block diagram.

Trigger output (TOFZ2)

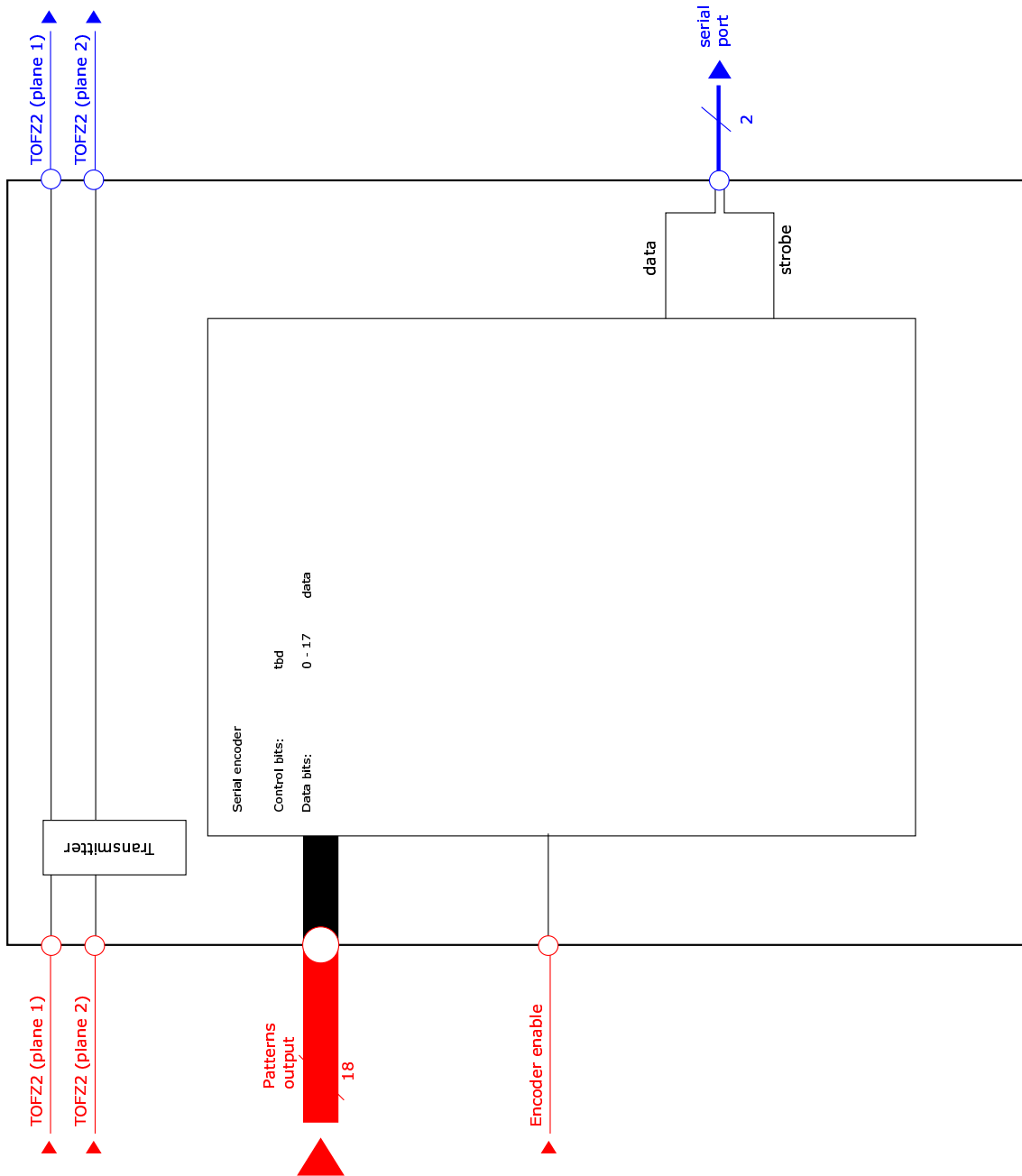


Figure 8: Trigger Output Unit for TOFZ2 trigger: block diagram.