

# Bug Report

All of these bugs can be demonstrated using specific test cases defined in `tests.e`

## error\_found Bugs

**1**

Addition produces the wrong result when the second operand matches these conditions: For both the least or second least significant bytes of the (4 byte integer): It will break if one of (not both) the 5th or 6th LSBs are set.

**2**

This bug changes the behaviour of shifting left by 0 (or `din2 mod 32 == 0`) where it returns 0 instead of the un-shifted `din1`

**3**

This bug causes the ADD opcode to always return success (response 2) even when the input should cause an overflow (response 3).

**4**

This bug causes instructions on port 4 to timeout (i.e. never set a response other than 0).

## Extra Bugs

### 5: Subtraction Response Code

The subtraction (SUB) operation always returns an overflow error (response 3) even when the input should not have overflowed (the output data value is still correct).

### 6: Shift Right by One

The shift right (SHR) operation fails to shift by one bit (or more specifically when `din2 mod 32 == 1`). Instead the un-shifted operand1 is returned.

Shifting by greater than 1 bit works fine.

### 7: Shift Left by Three or More

The shift left (SHL) operation fails when shifting by three or more bits.

Where  $A$  is `din2 mod 32`, and  $A \geq 3$ . Then the results have an offset of  $2^{(A-3)}$ .

E.g. shifting left by 10, the result is 128 larger than expected.

(Shifting by 0, 1 or 2 bits still works as expected)

### 8: Invalid operations

An invalid operation responds with success (1) instead of invalid command (2) as defined in the specification.

### 9: Priority Logic

When all four ports are sent a series of ADD/SUB (or shift) instructions at the same time, ports 3 and 4 appear to get “stuck”, and do not complete until ports 1 and 2 are no longer in use. This is a violation of the first come first serve priority described in the specification,