fpga等效门（FPGA equivalent gates）

There are two kinds of calculation methods of general FPGA equivalent door number, one is the basic unit of FPGA (LUT+FF, ESB/BRAM) and realize the same function of standard gate gate number array contained in is the basic unit of the equivalent gate FPGA number, and the number of times the basic unit can be FPGA door number the estimated value is two; respectively with FPGA and standard gate arrays to achieve the same functionality, from the statistics of the equivalent gate count of FPGA, this method is more dependent on the empirical data.

For the first method, including FPGA LUT/FF/RAM and other resources, analysis of various resources equivalent door number, the general principle is the principle of equivalent, is to achieve the same function, need in the standard in a gate array gate number is FPGA the resources equivalent door number, such as the realization of a 4 XOR input with output in the FPGA register, the need to achieve with a LUT and 1 FF, in general to achieve standard gate array with 21 NAND gate, so the 1 LUT1 FF equivalent to 21 doors. For ESB (BRAM), ESB usually takes 4 gates due to the use of standard gate arrays to implement 1bit's RAM. Therefore, when SB/BARM is used as a RAM, 1bit is equivalent to 4 gates. For 2048bit FPGA in Altera, the equivalent gate number is 8K. These data alone can not accurately calculate the equivalent gate number of FPGA. Because this is just a simple situation, the actual situation is much more complicated.

For example, if implemented with 2 input registers XOR, FPGA will use 1 LUTFF, while the standard array requires only 8 NAND, and 1 LUT+1 FF only equivalent to 8 doors. At the same time,

the number of gates required for the implementation of specific functions in different standard gate arrays is different, so the calculation of equivalent gates can only be a numerical value. That is to say, the gate number estimation of a specific model FPGA is closely related to the use of FPGA resources. LUT used to achieve 2 XOR input and 4 input XOR equivalent door number is not the same (1 and 13); FF with asynchronous reset, reset, clock enable and with these ports equivalent gate number (8 and 13); ESB (BRAM) RAM use, equivalent to 1bit 4 the door, 1 2048bit BRAM equivalent 8K door, but do the lookup table when using only equivalent to less than 200. Therefore, it is necessary to do more detailed analysis to estimate the equivalent gate number of FPGA.

Taking EP20K1000E as an example, the estimation method of FPGA equivalent gate number is described in detail.

(1) calculate the equivalent gate number of the logic array

When estimating the number of EP20K1000E gates, the FPGA equivalent gate can be estimated by comparing the LCA300K number of FPGA specific resources and the gate number (LSI, LCA300K, Data, Book) of the standard logical array. FPGA a LUT + FF equivalent gate number is calculated as shown in Figure 2

LUTFF is equivalent to 8 to 21 doors, upper and lower respectively by the realization of a simple function, complex function are defined.

Equivalent gate number APEX20K can be obtained according to the

empirical data, to more than 100 for 4 input LUT FPGA, LCA300K gate and Design arrays and Compiler, the door number shows that the LE number and LCA300K by using FPGA comparison of the same, each LE is equivalent to 12 doors. EP20K1000E has 38400 LE,

So it amounts to 460 thousand doors.

(2) the equivalent gate number of ESB is calculated

The number of gates required for a bit in RAM is related to the architecture, process, and vendor of the RAM. Generally speaking, 1bit is equivalent to 4 gates, and Altera uses this standard, so that the number of ESB equivalent gates can be easily estimated.

Calculate the ESB equivalent gate count can also be compared using LCA300K and LSI methods, namely by comparing with the same number of door capacity of RAM used in LCA300K, and each bit ESB is equivalent to the number of doors, so as to calculate the equivalent gate number ESB, see figure 3.

4gates/bit is a more appropriate estimate, so the equivalent gate number of EP20K1000E is ESB

160, ESBs, X, 2048, bits, per, ESB, X, 4, gates, per, bit = 1310720 gates, or about 1 million 300 thousand gates.

In a word, the equivalent gate number of EP20K1000E and LUT+FF is about 460 thousand (empirical value). When ESB is used as RAM, the equivalent gate number is about 1 million 300 thousand, so the maximum number of system gates is 1 million 700 thousand.

Conclusion:

Estimation of FPGA equivalent gate count method can be the basic unit of FPGA resources (such as LUT+FF, ESB) FPGA basic unit equivalent gate number compared with the standard array to achieve the same function, then multiplied by the number of units to get the whole FPGA equivalent gate number. Many designs can also be implemented, and comparable gates are calculated from standard gate arrays.

Equivalent gate number FPGA estimation is generally divided into LUT+FF and ESB (BRAM) two, LUT + FF is equivalent to 8 to 21, the typical value is 12; ESB RAM, generally equivalent to 4 /bit, the estimated maximum gate number, if the ESB product /LUT is equivalent to the door the number of EP20K1000E is greatly reduced, for example, the former is 1 million 300 thousand, which is 20 thousand.