

ОСНОВИ РАЧУНАРСКЕ ТЕХНИКЕ

VGA

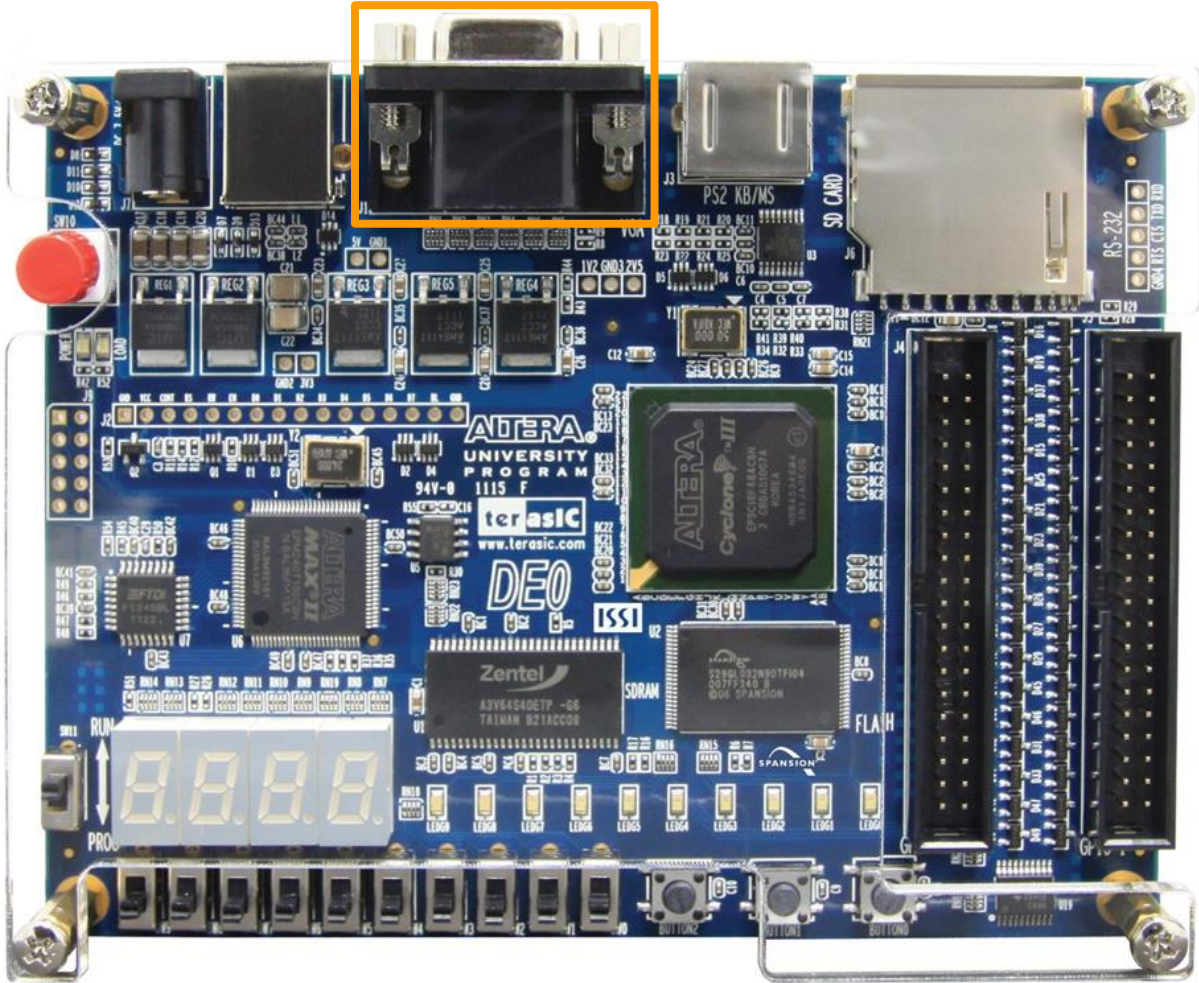
Садржај

- [Плочица](#)
- [Пинови](#)
- [Протокол](#)
- [Подешавање пинова](#)
- [Помоћни модули](#)
- [Контролер](#)
- [Позадина](#)
- [Фигура](#)
- [Даљи рад](#)

Плочица

- DE0

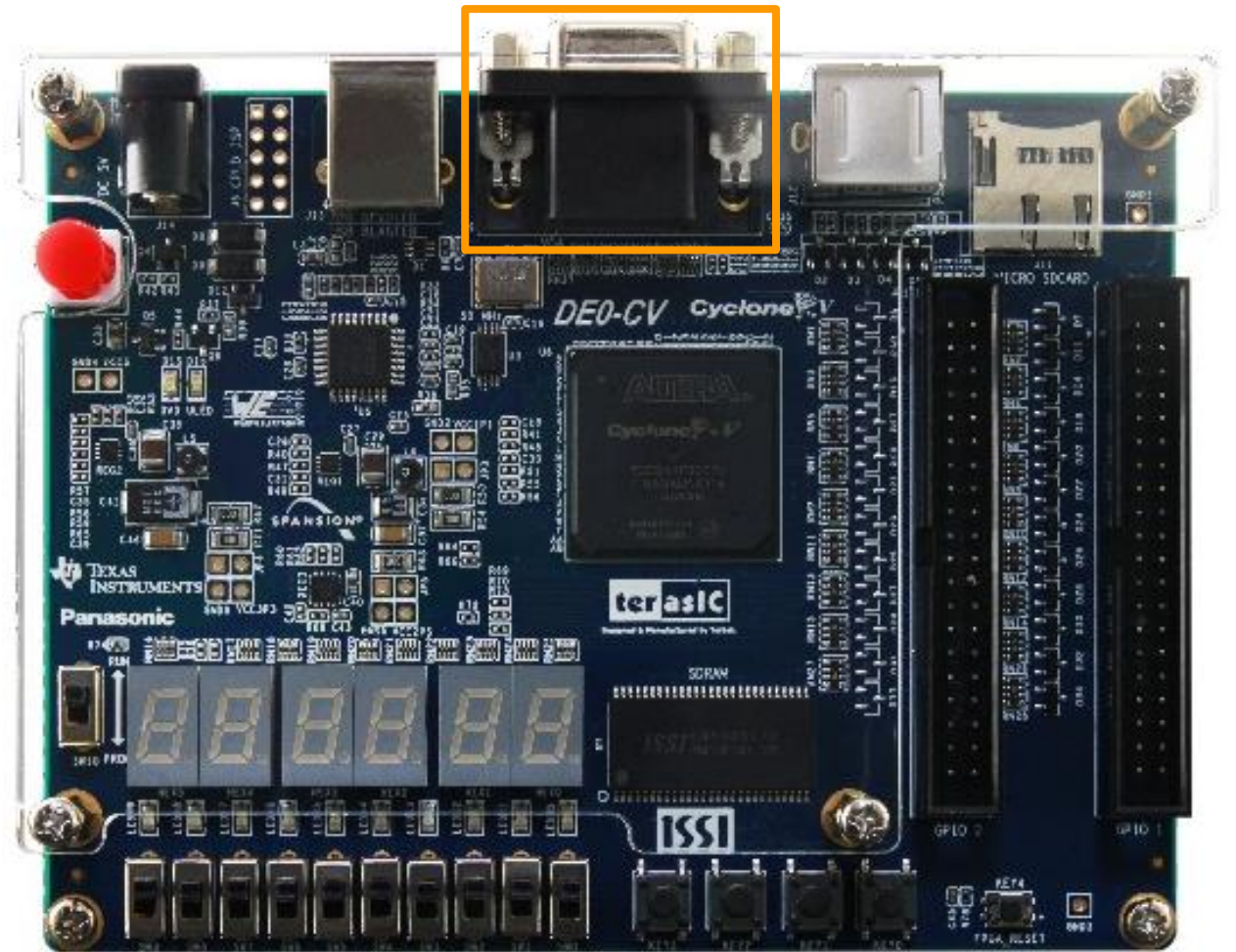
VGA Connector



Плочица

- DE0-CV

VGA Connector

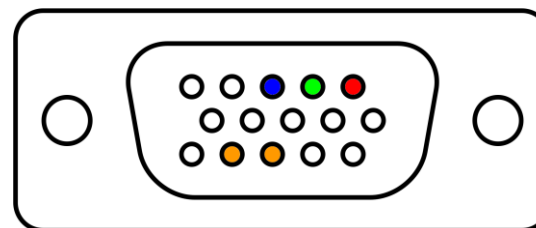


ПИНОВИ

- VGA

Cyclone III		Cyclone V	
VGA_HS	PIN_L21	VGA_HS	PIN_H8
VGA_VS	PIN_L22	VGA_VS	PIN_G8
VGA_R[0]	PIN_H19	VGA_R0	PIN_A9
VGA_R[1]	PIN_H17	VGA_R1	PIN_B10
VGA_R[2]	PIN_H20	VGA_R2	PIN_C9
VGA_R[3]	PIN_H21	VGA_R3	PIN_A5
VGA_G[0]	PIN_H22	VGA_G0	PIN_L7
VGA_G[1]	PIN_J17	VGA_G1	PIN_K7
VGA_G[2]	PIN_K17	VGA_G2	PIN_J7
VGA_G[3]	PIN_J21	VGA_G3	PIN_J8

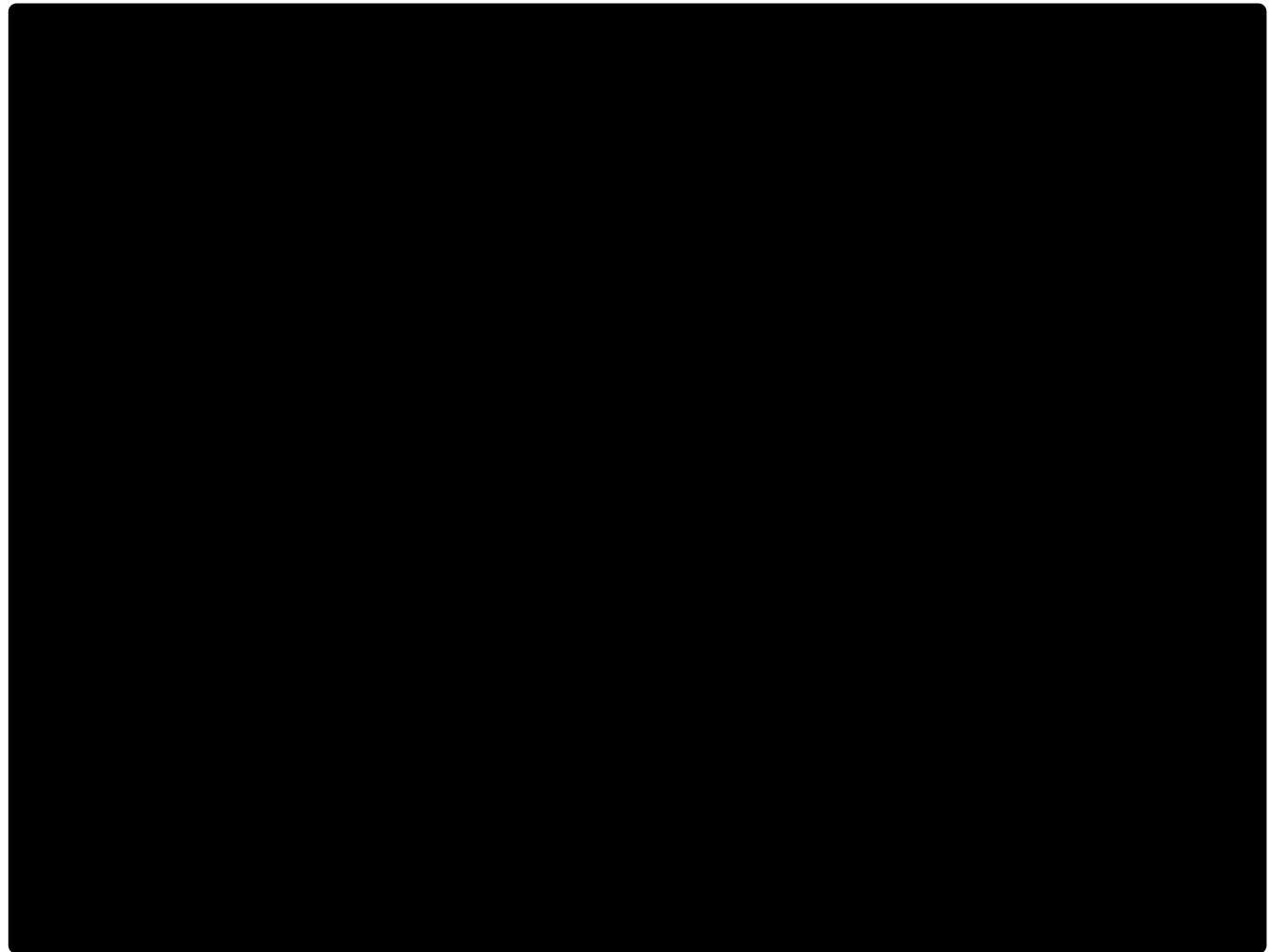
Cyclone III		Cyclone V	
VGA_B[0]	PIN_K22	VGA_B0	PIN_B6
VGA_B[1]	PIN_K21	VGA_B1	PIN_B7
VGA_B[2]	PIN_J22	VGA_B2	PIN_A8
VGA_B[3]	PIN_K18	VGA_B3	PIN_A7



Протокол

- Приказивање

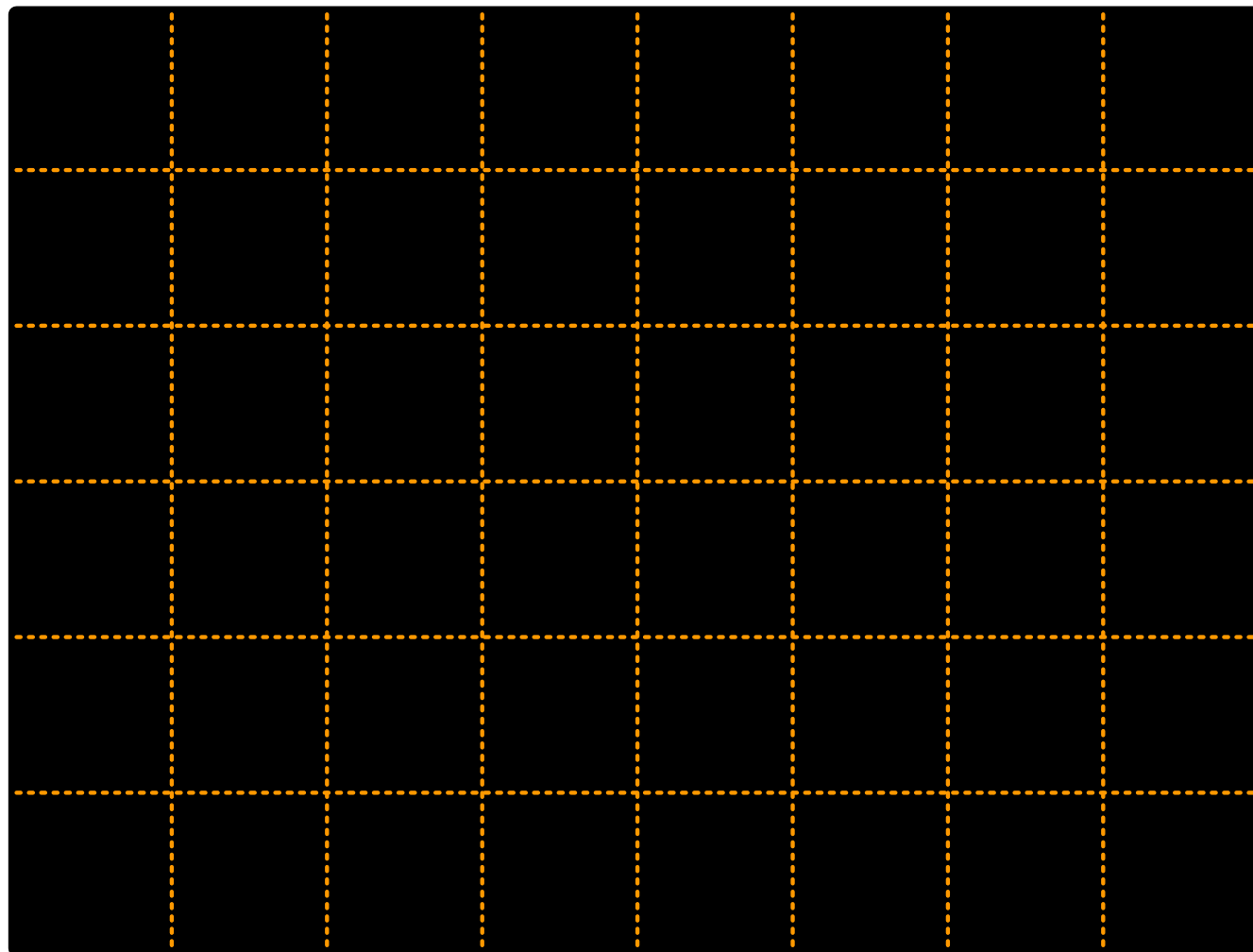
Constants	
Clock	50MHz



Протокол

- Приказивање

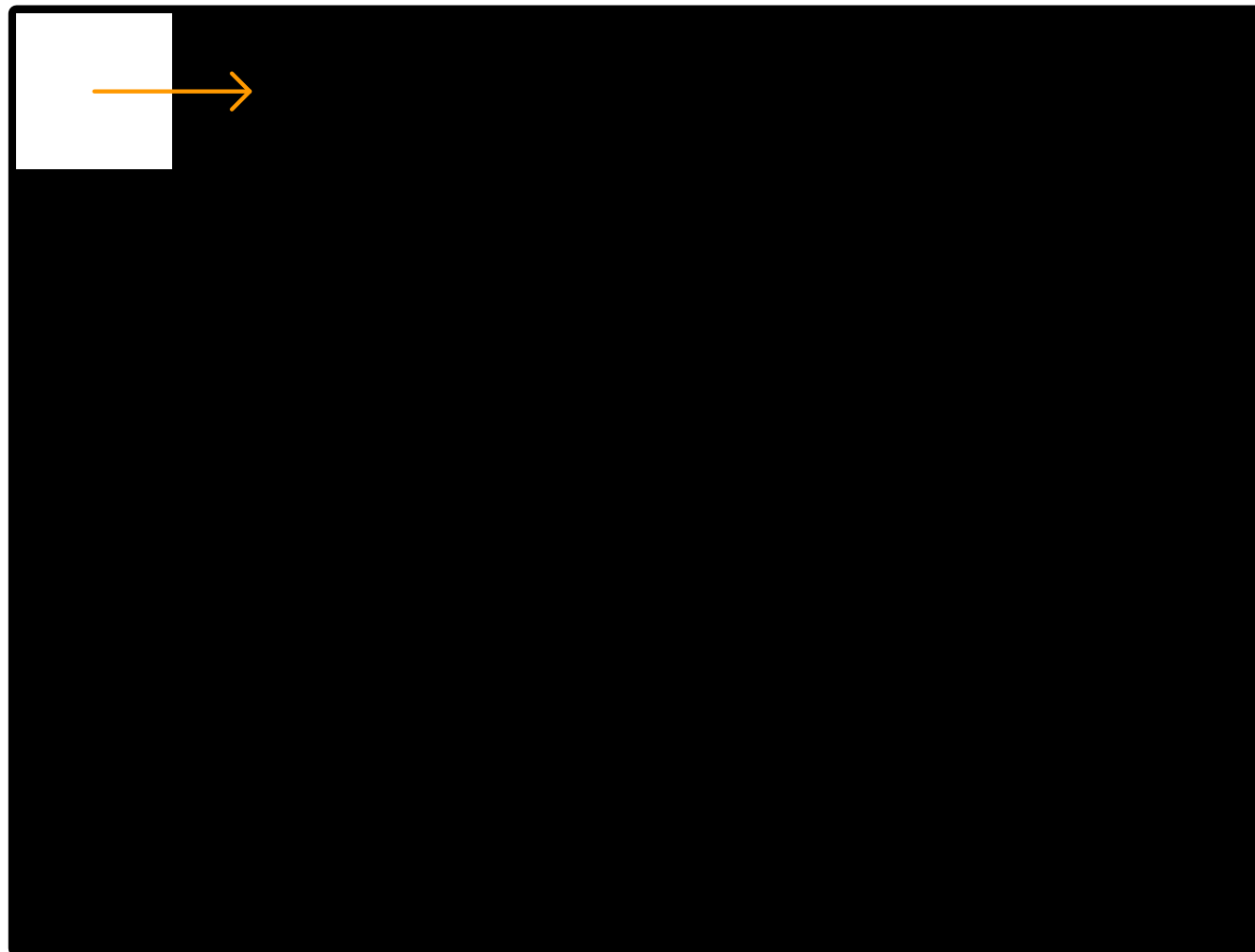
Constants	
Clock	50MHz
Resolution	800x600px
Width	800px
Height	600px



Протокол

- Приказивање

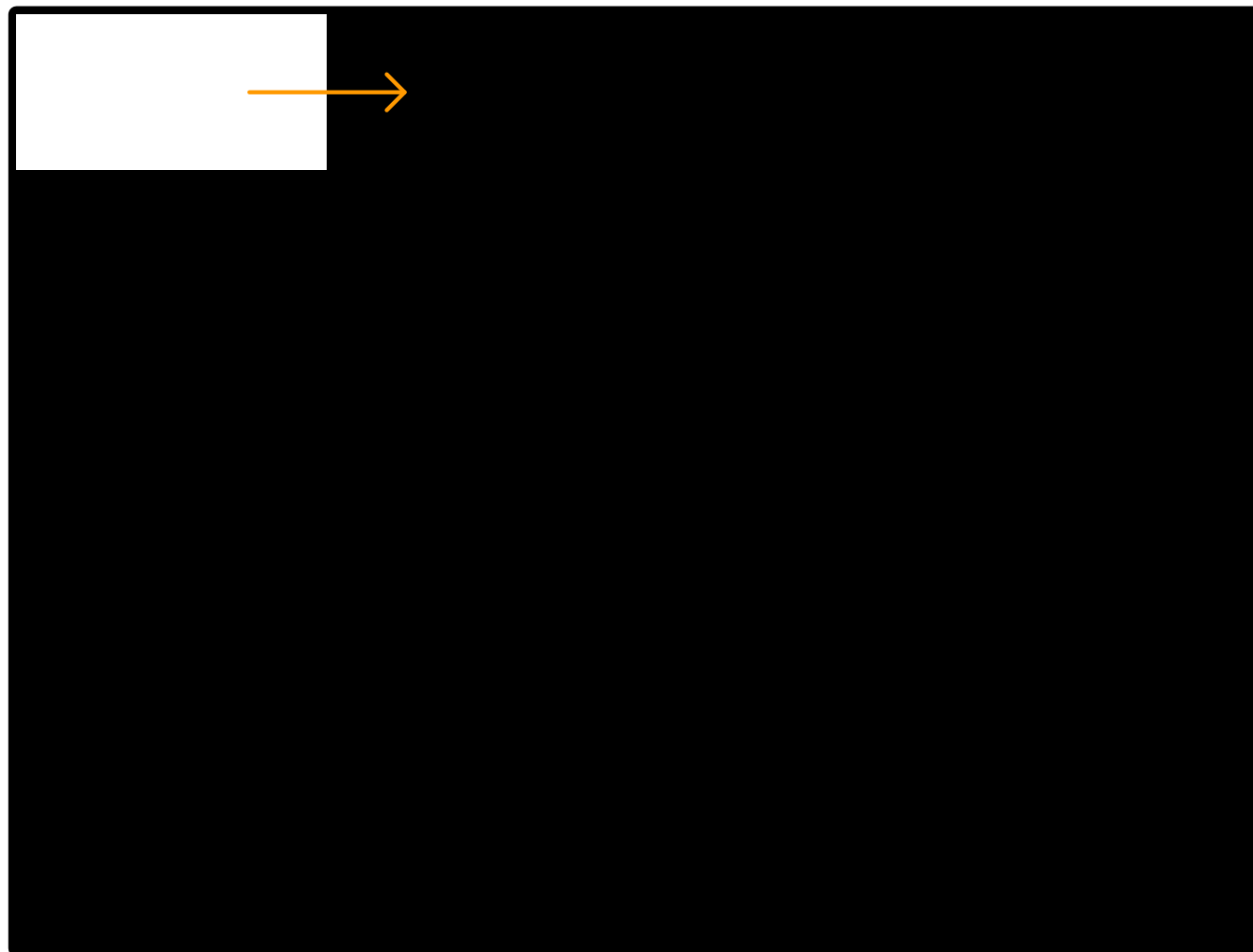
Constants	
Clock	50MHz
Resolution	800x600px
Width	800px
Height	600px



Протокол

- Приказивање

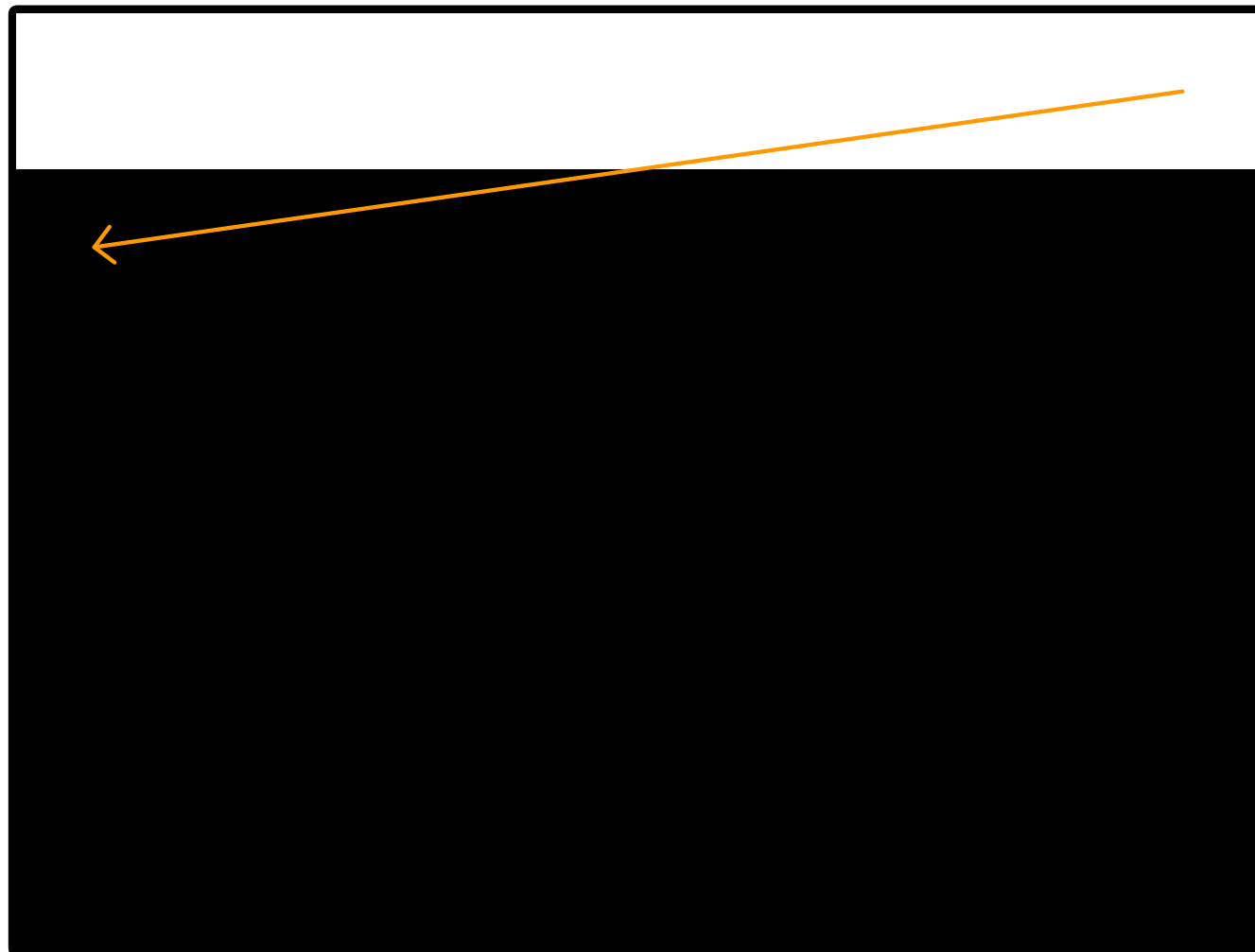
Constants	
Clock	50MHz
Resolution	800x600px
Width	800px
Height	600px



Протокол

- Приказивање

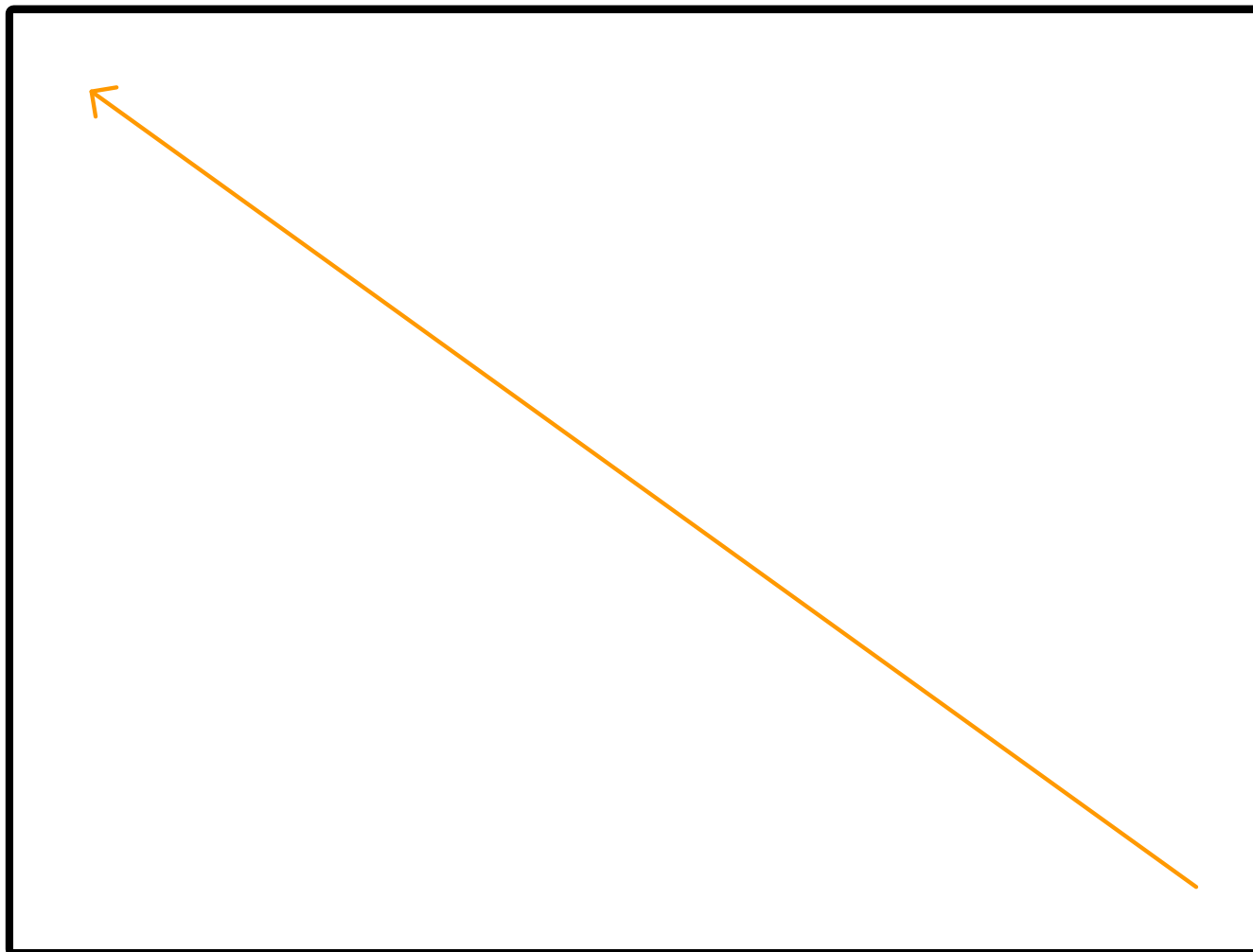
Constants	
Clock	50MHz
Resolution	800x600px
Width	800px
Height	600px
Next Row	240 Clocks



Протокол

- Приказивање

Constants	
Clock	50MHz
Resolution	800x600px
Width	800px
Height	600px
Next Row	240 Clocks
First Row	66 Rows

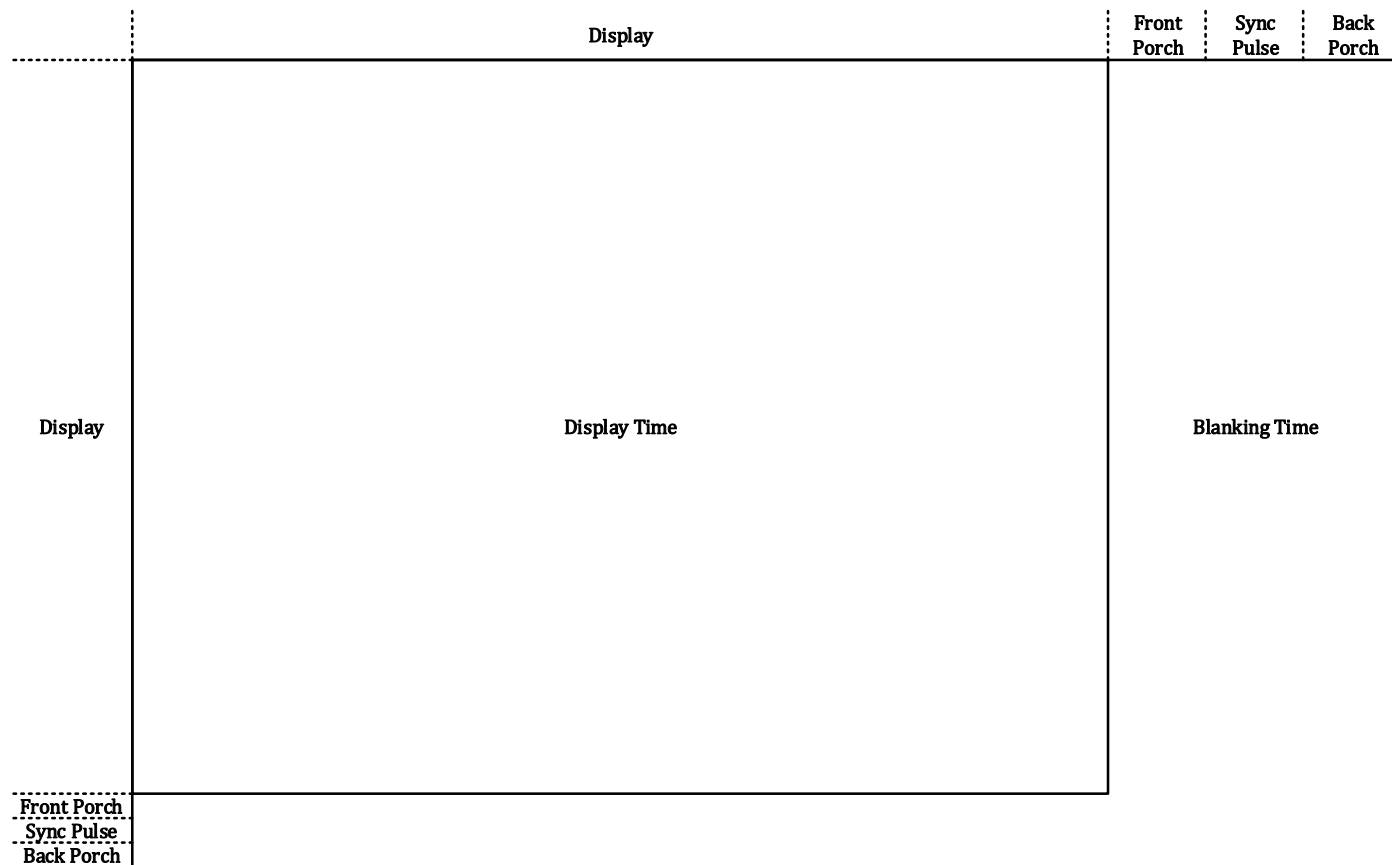


Протокол

- Приказивање

Constants	
Clock	50MHz
Resolution	800x600px
Width	800px
Height	600px
Next Row	240 Clocks
First Row	66 Rows
Refresh Rate	72Hz

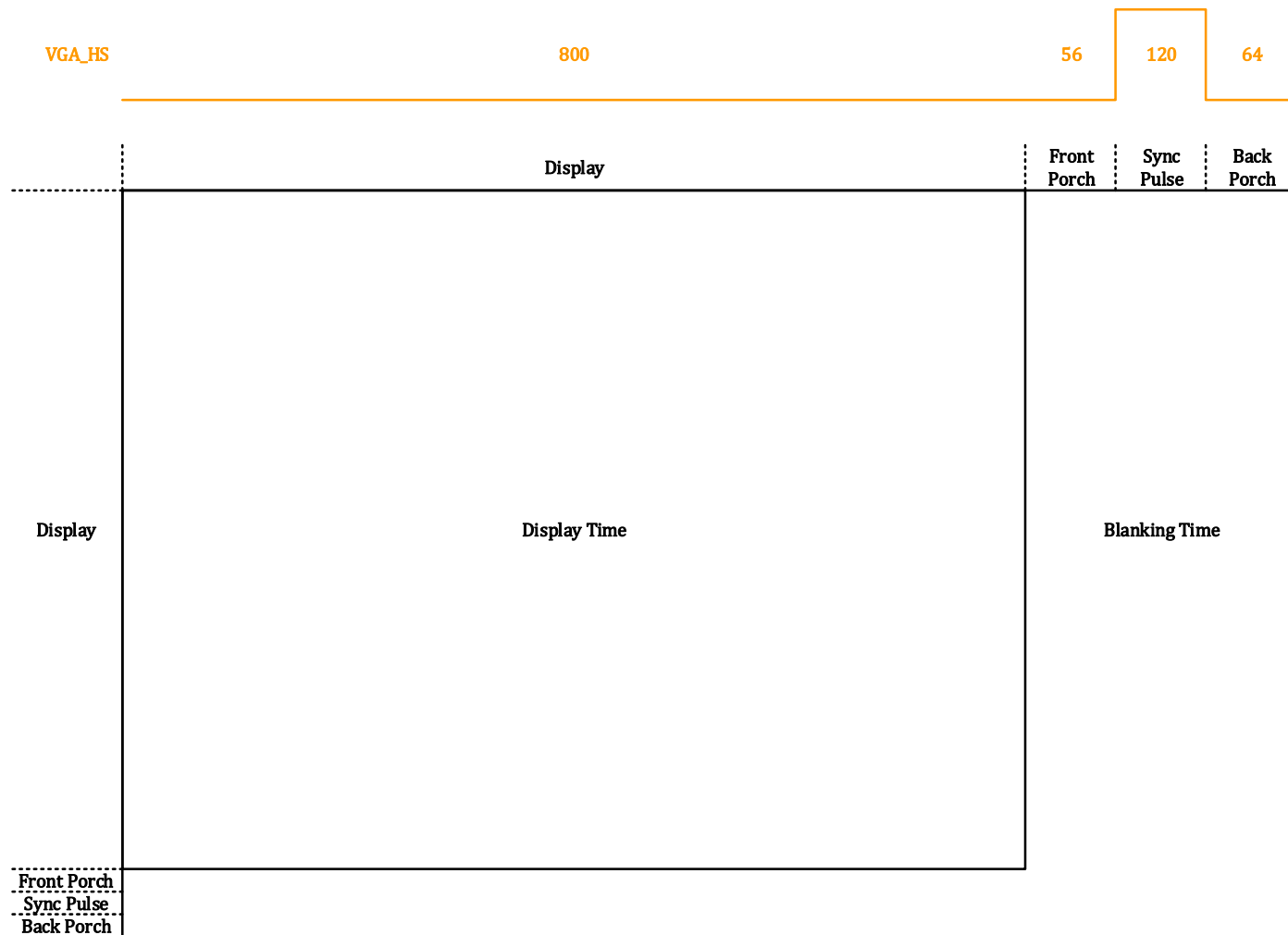
$$\frac{50\text{MHz}}{(800 + 240) \cdot (600 + 66)} = \frac{50\,000\,000\text{Hz}}{692\,640} \approx 72\text{Hz}$$



Протокол

- Синхронизација

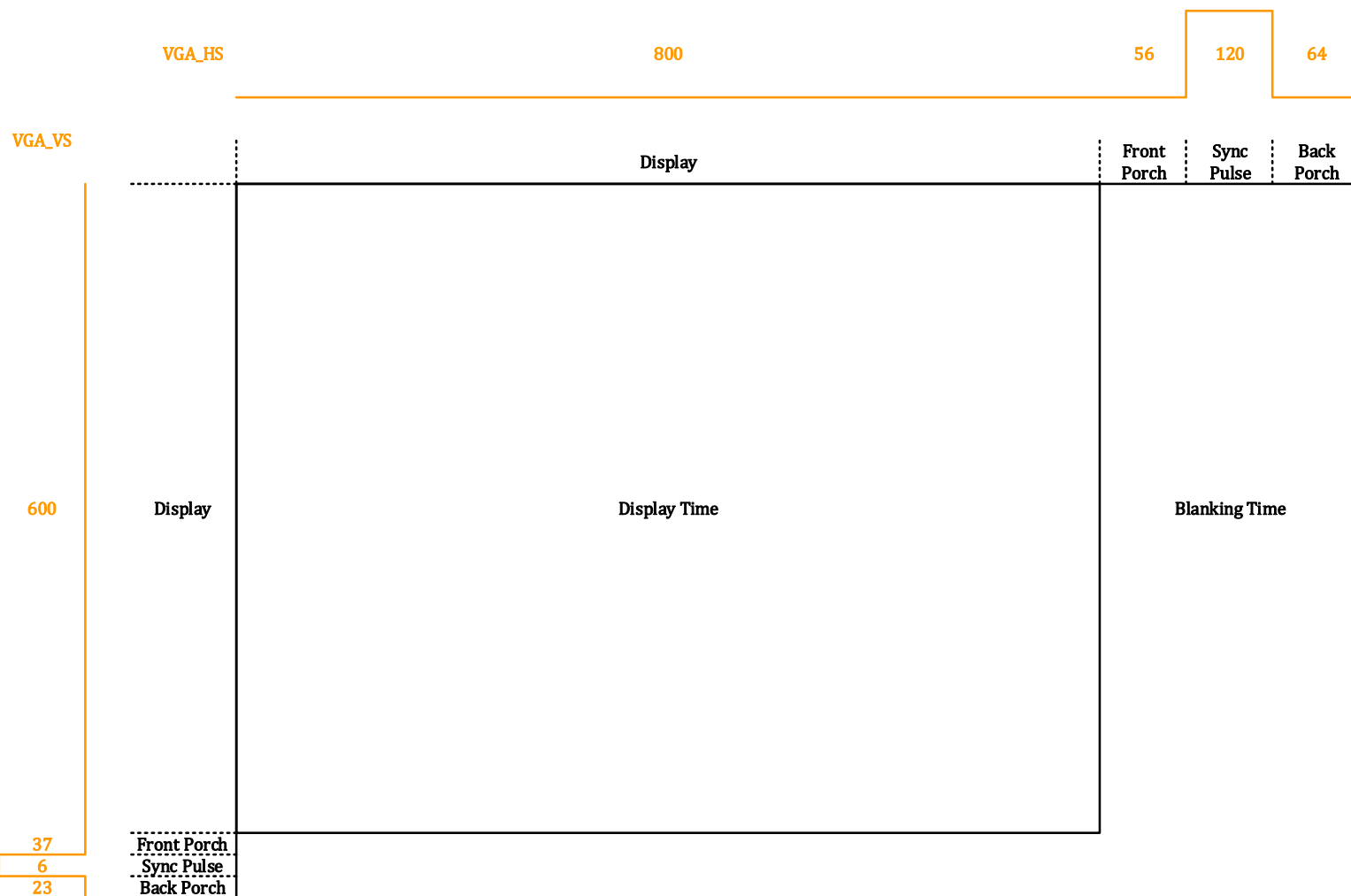
Horizontal (Clocks)	
Display	800
Front Porch	56
Sync Pulse	120
Back Porch	64
Total	1040
Polarity	Positive (1)



Протокол

- Синхронизација

Vertical (Rows)	
Display	600
Front Porch	37
Sync Pulse	6
Back Porch	23
Total	666
Polarity	Positive (1)

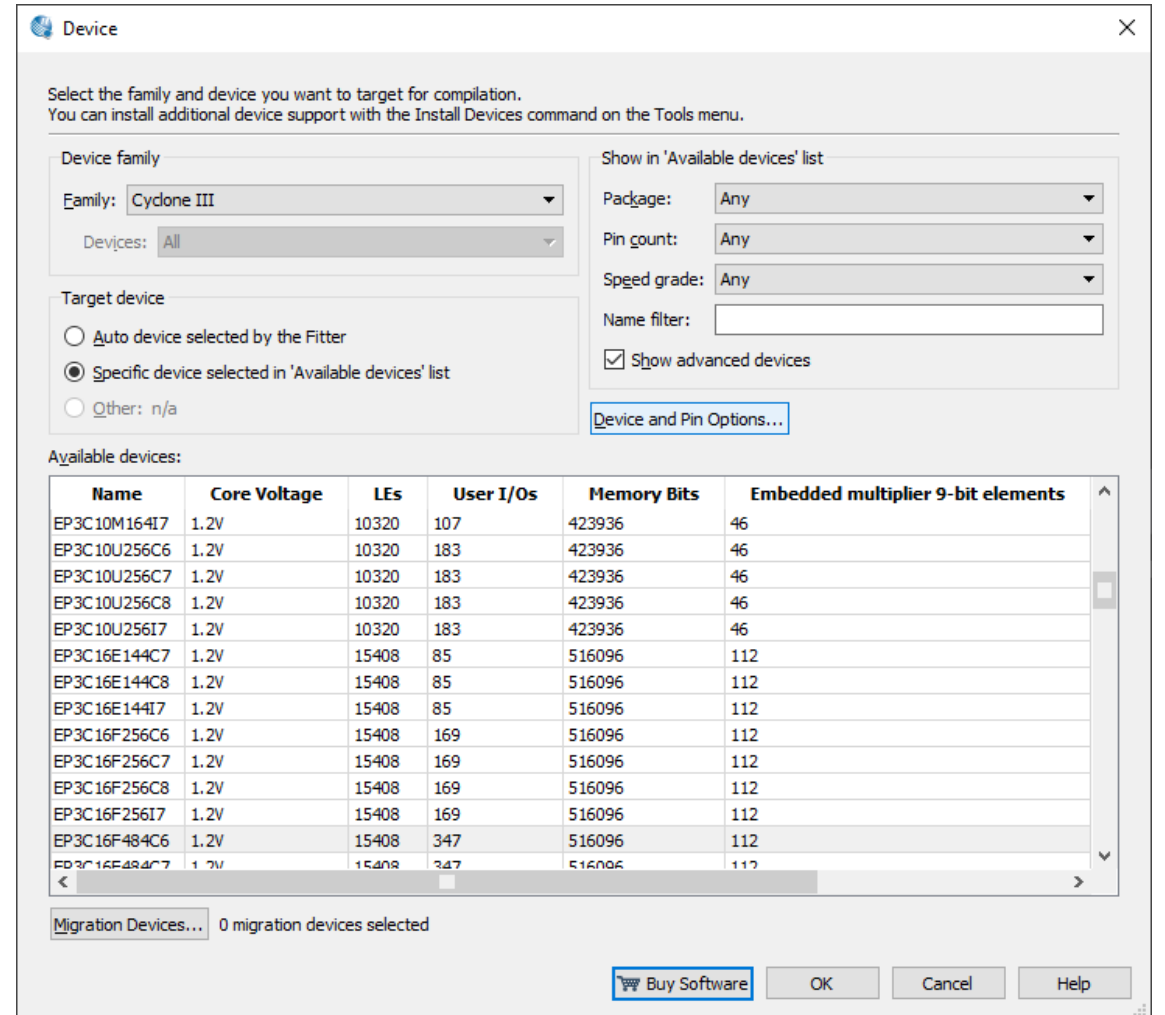


Подешавање пинова

- Assignments -> Device...
- Device and Pin Options...
- Dual-Purpose Pins -> nCEO -> Use as regular I/O -> OK
- OK

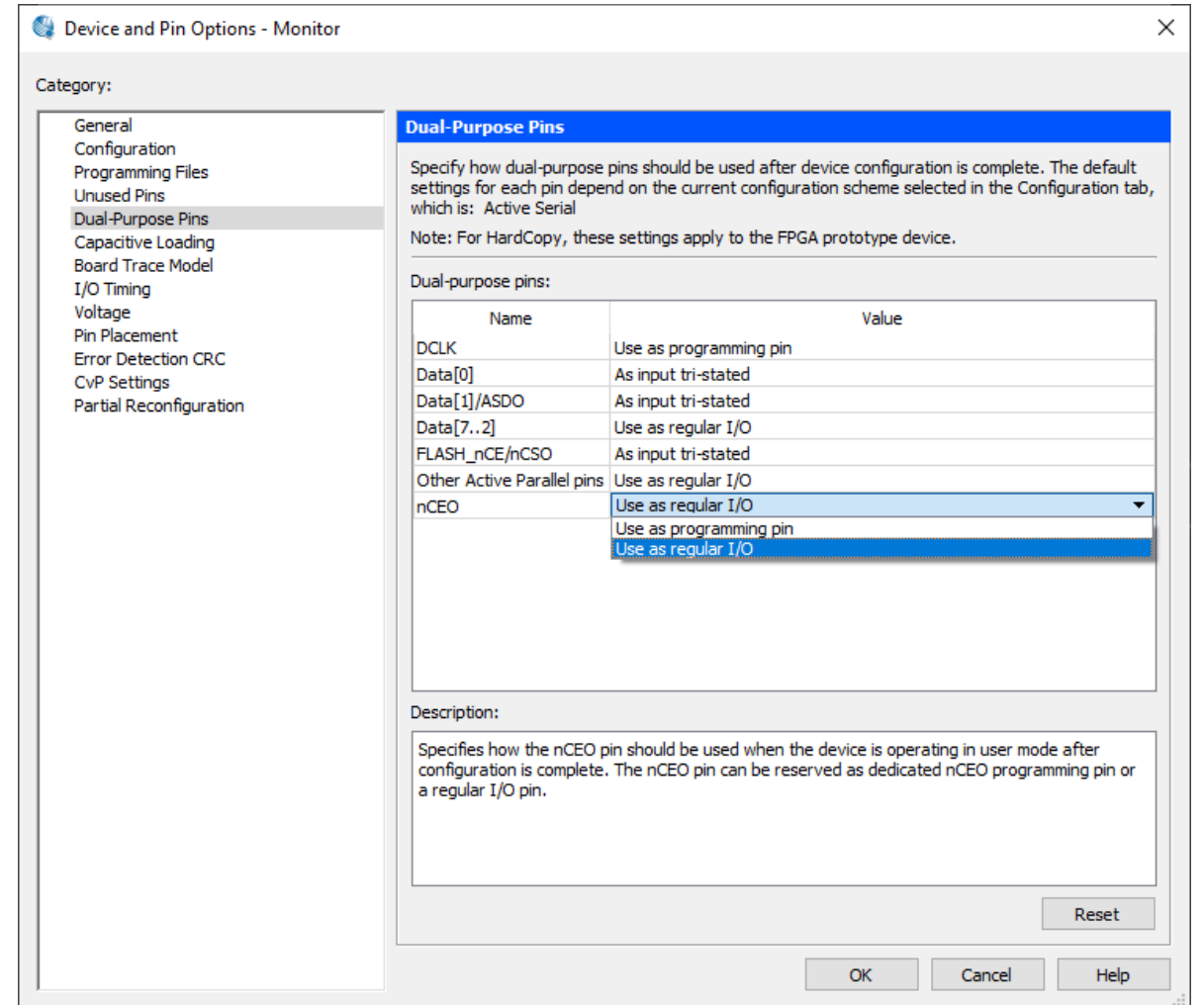
Подешавање пинова

- Assignments -> Device...
- **Device and Pin Options...**
- Dual-Purpose Pins -> nCEO -> Use as regular I/O -> OK
- OK



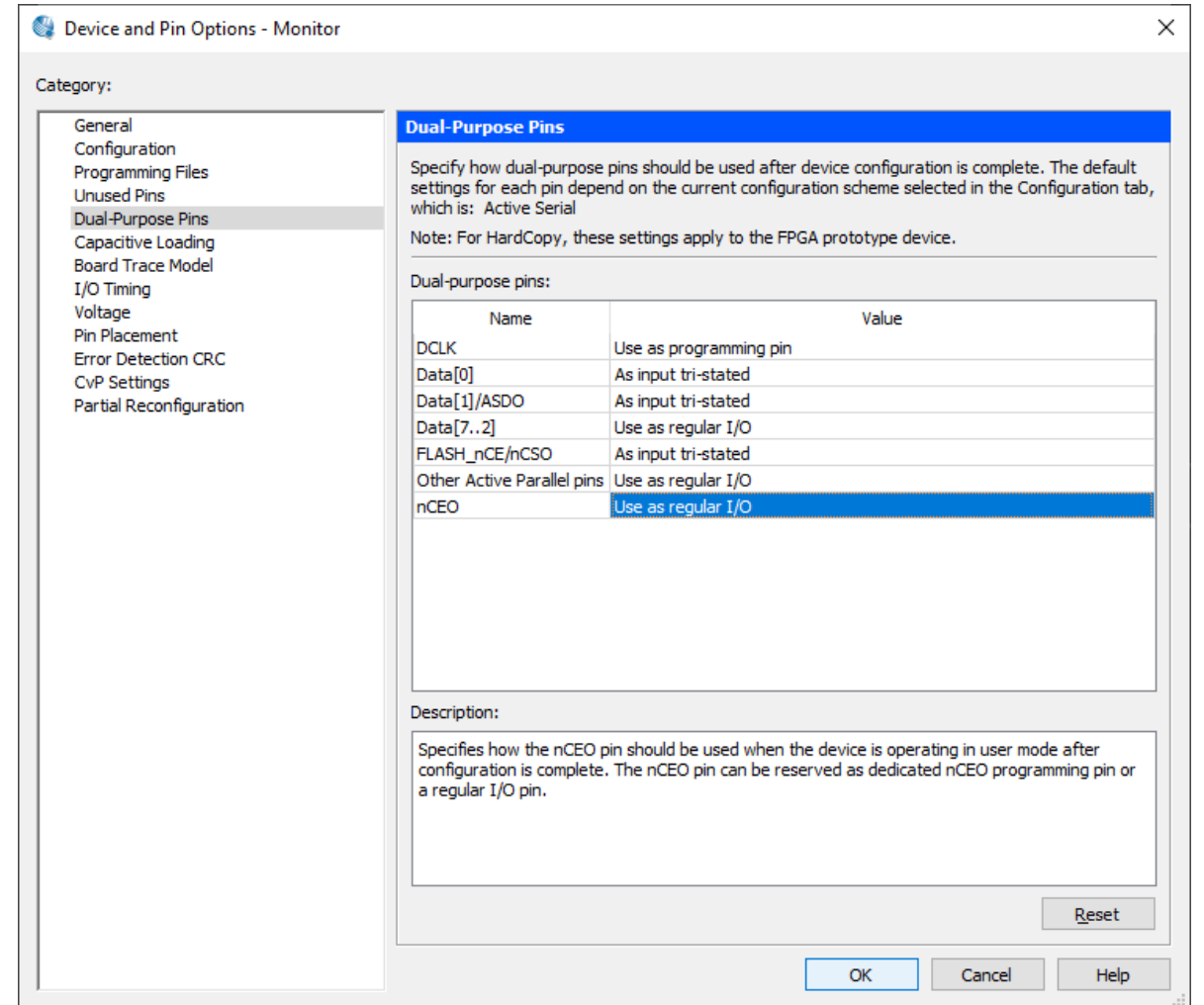
Подешавање пинова

- Assignments -> Device...
- Device and Pin Options...
- **Dual-Purpose Pins -> nCEO -> Use as regular I/O -> OK**
- OK



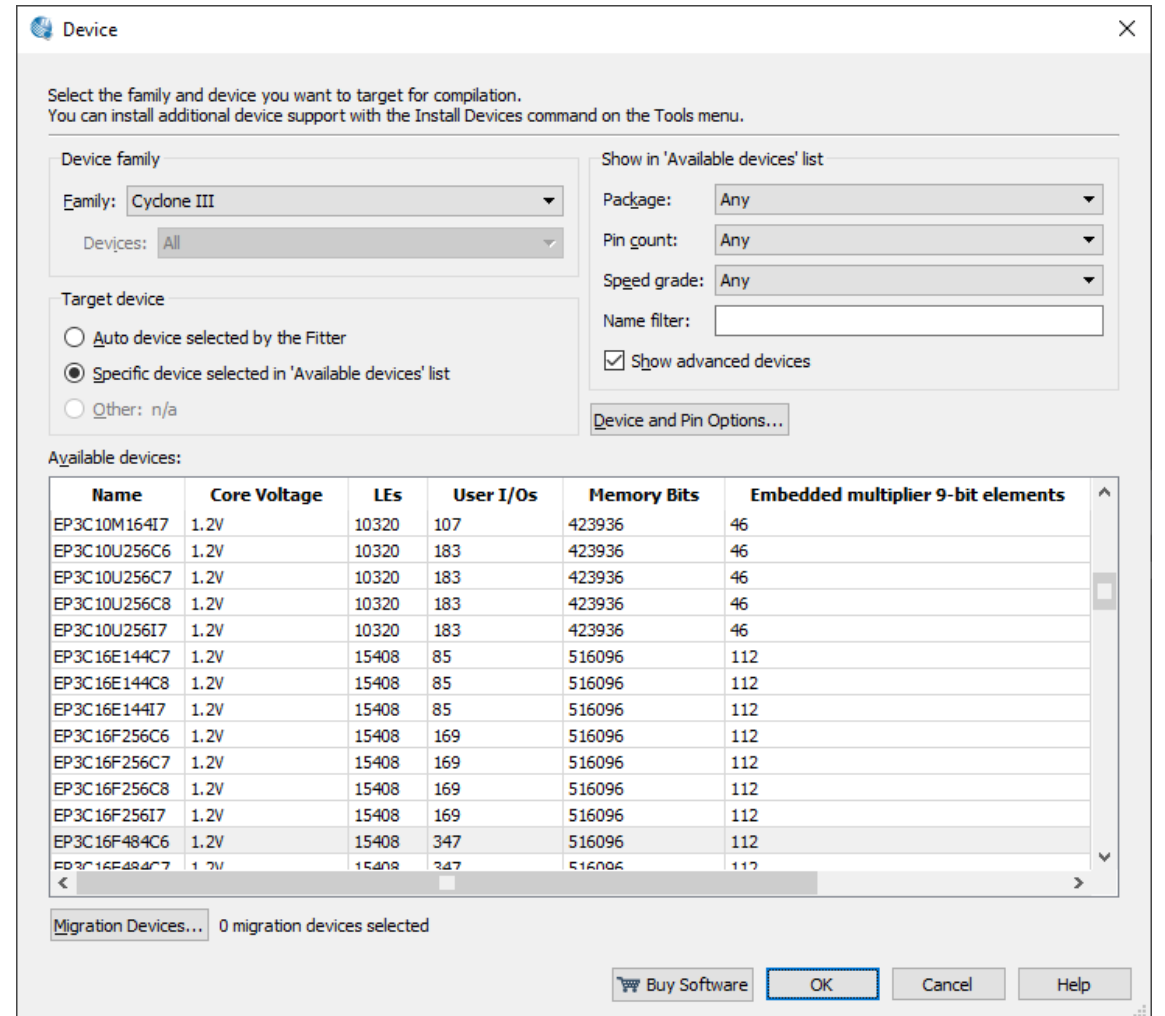
Подешавање пинова

- Assignments -> Device...
- Device and Pin Options...
- **Dual-Purpose Pins -> nCEO -> Use as regular I/O -> OK**
- OK



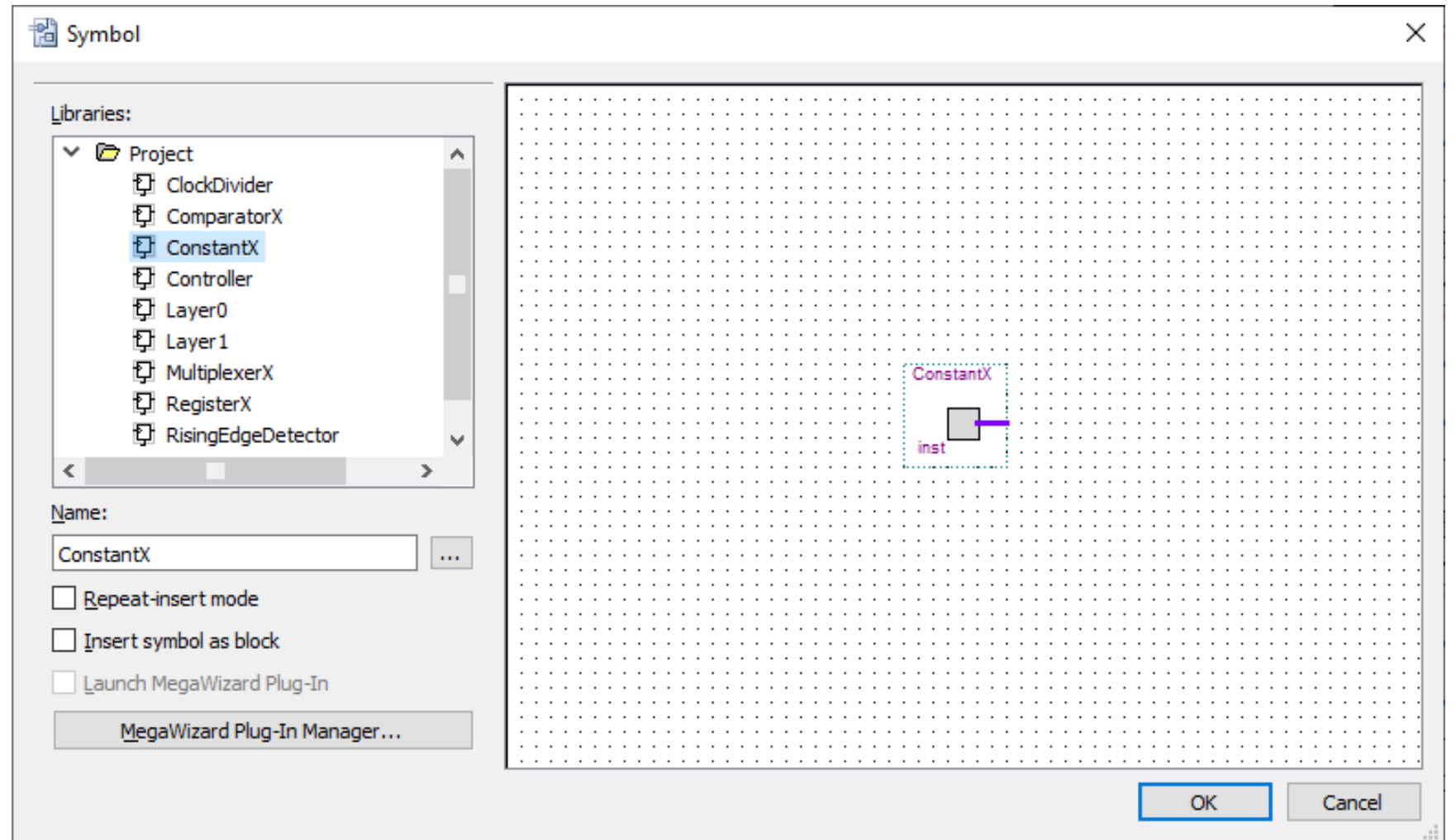
Подешавање пинова

- Assignments -> Device...
- Device and Pin Options...
- Dual-Purpose Pins -> nCEO -> Use as regular I/O -> OK
- OK



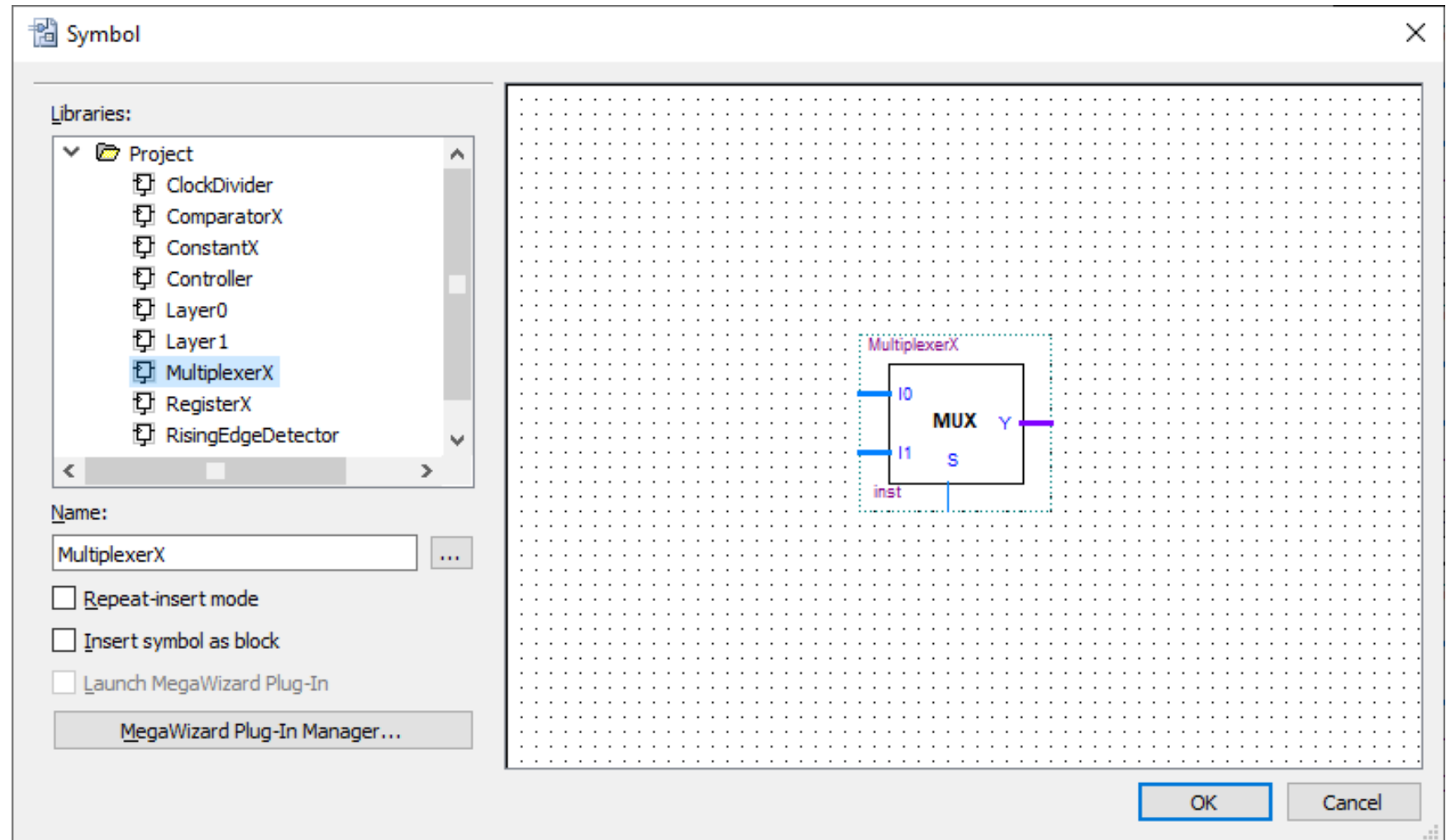
Помоћни модули

- ConstantX
- MultiplexerX
- ComparatorX
- RegisterX
- ClockDivider
- RisingEdgeDetector



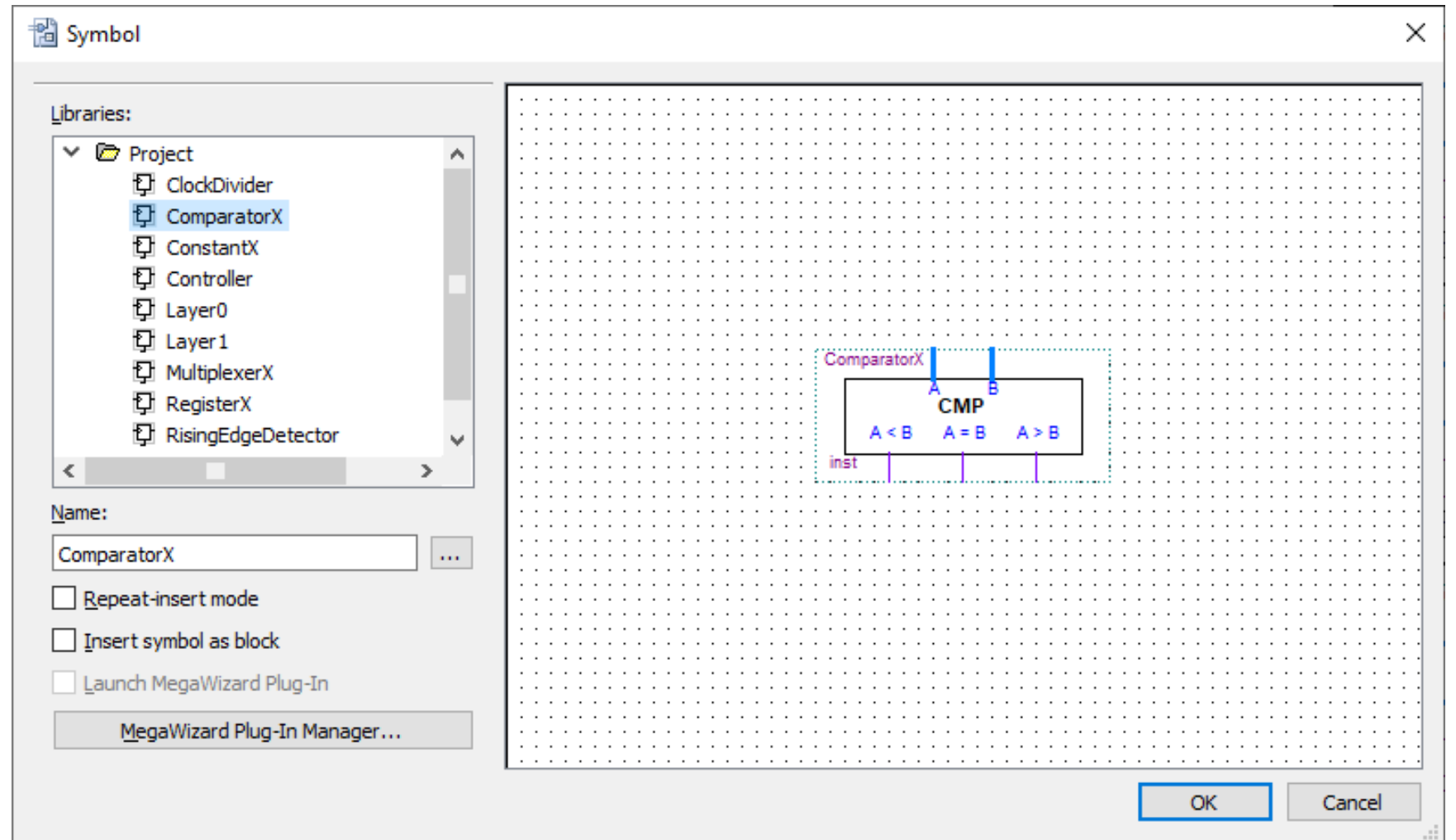
Помоћни модули

- ConstantX
- **MultiplexerX**
- ComparatorX
- RegisterX
- ClockDivider
- RisingEdgeDetector



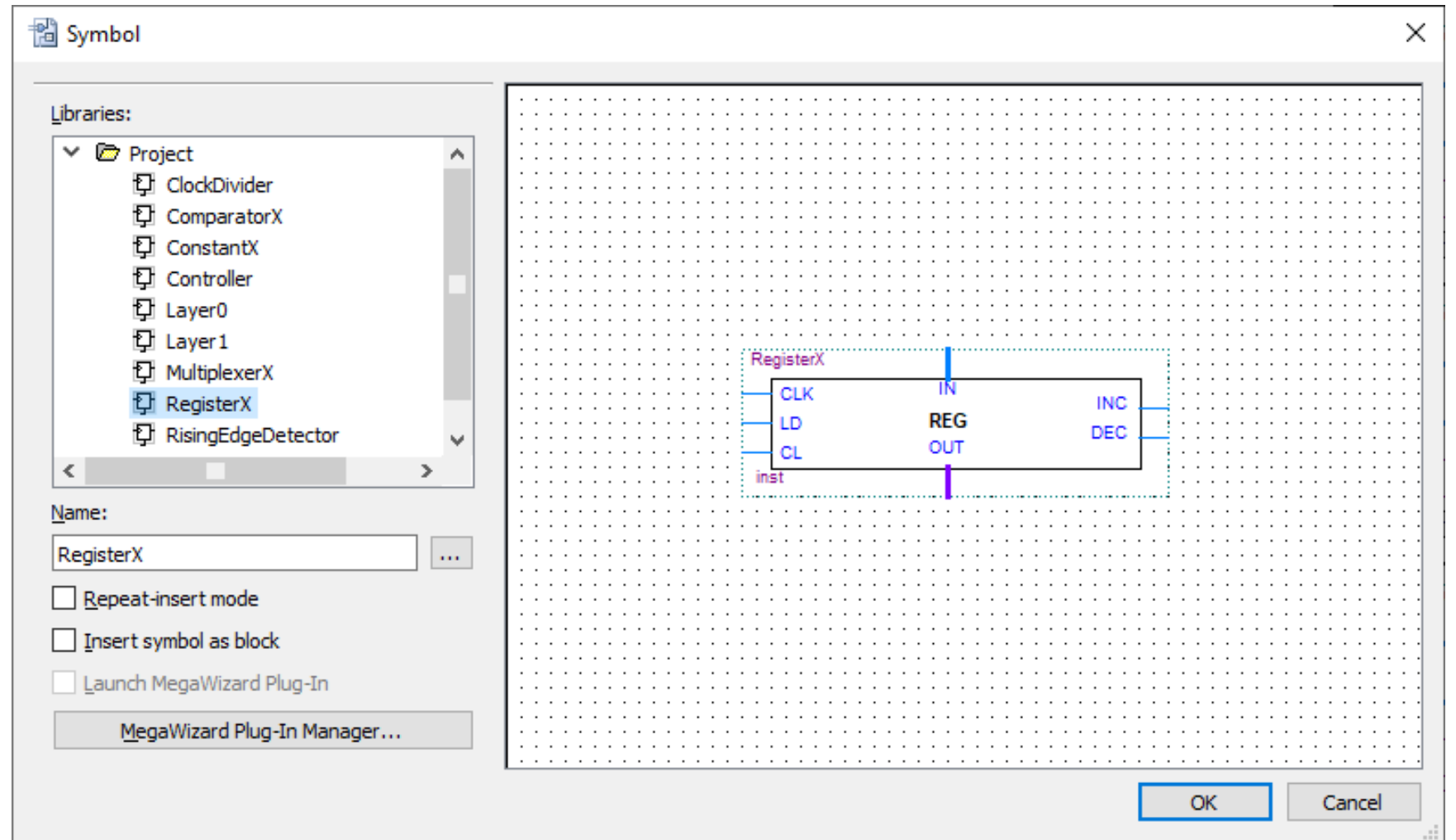
Помоћни модули

- ConstantX
- MultiplexerX
- **ComparatorX**
- RegisterX
- ClockDivider
- RisingEdgeDetector



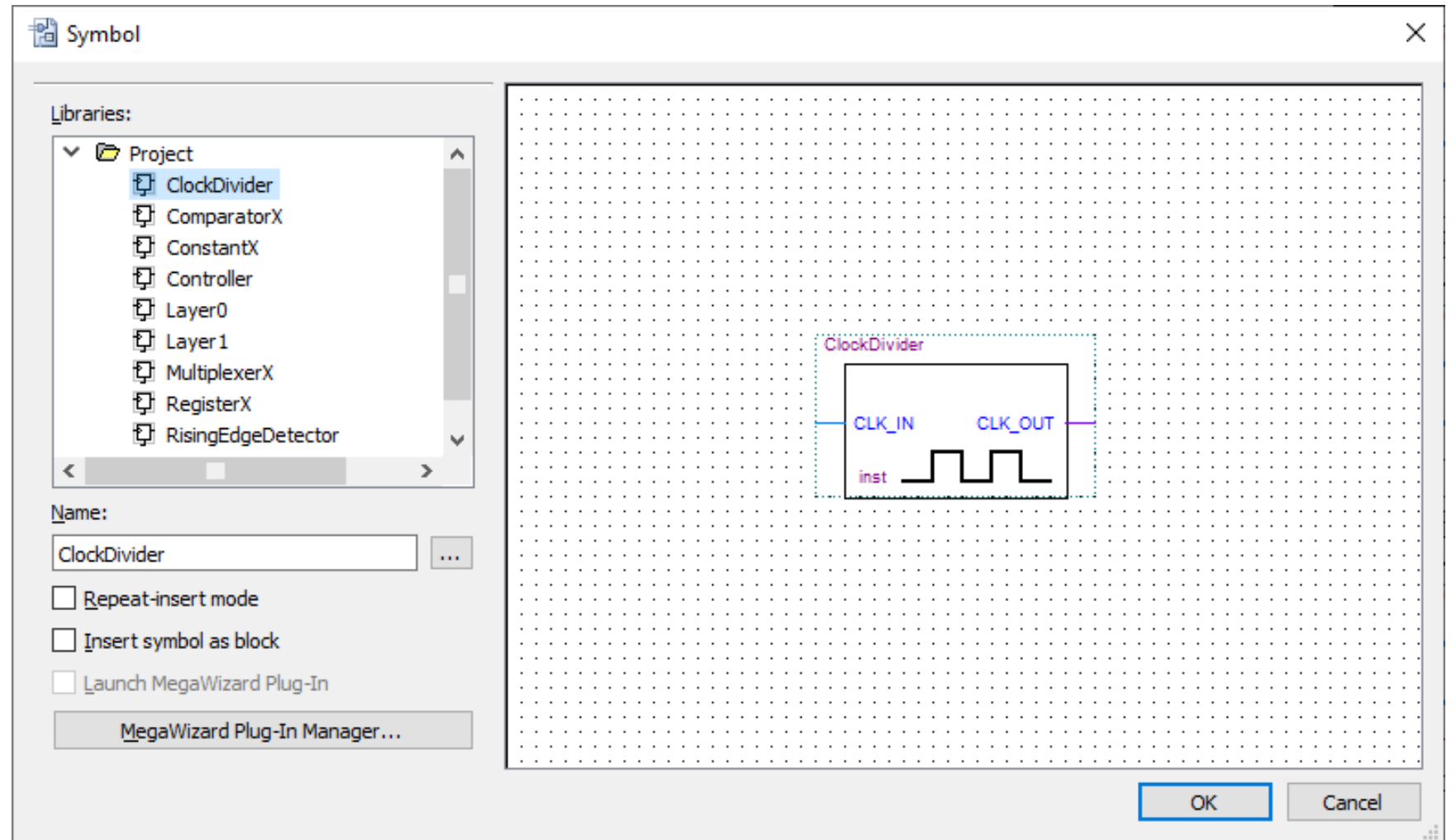
Помоћни модули

- ConstantX
- MultiplexerX
- ComparatorX
- **RegisterX**
- ClockDivider
- RisingEdgeDetector



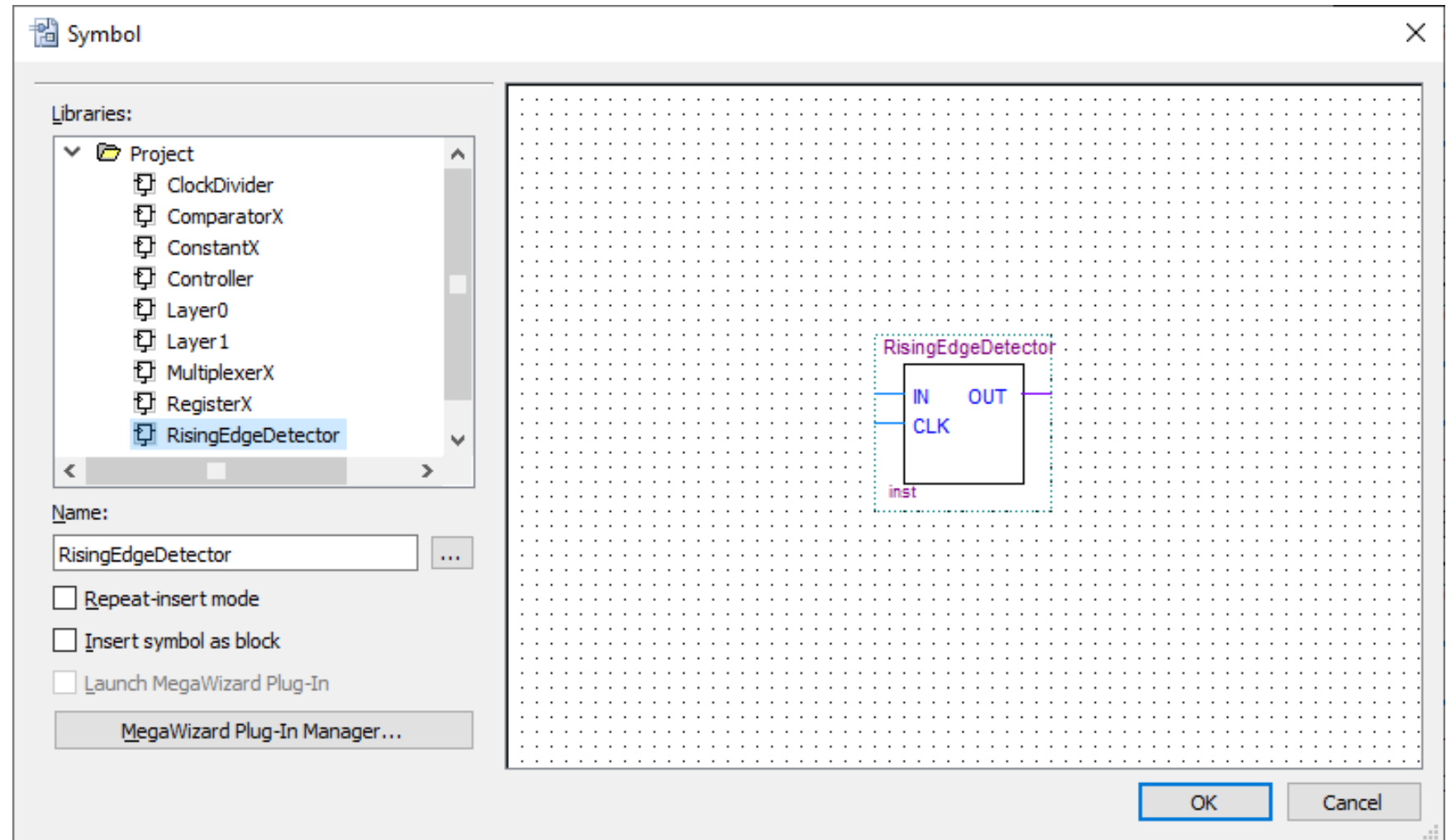
Помоћни модули

- ConstantX
- MultiplexerX
- ComparatorX
- RegisterX
- **ClockDivider**
- RisingEdgeDetector



Помоћни модули

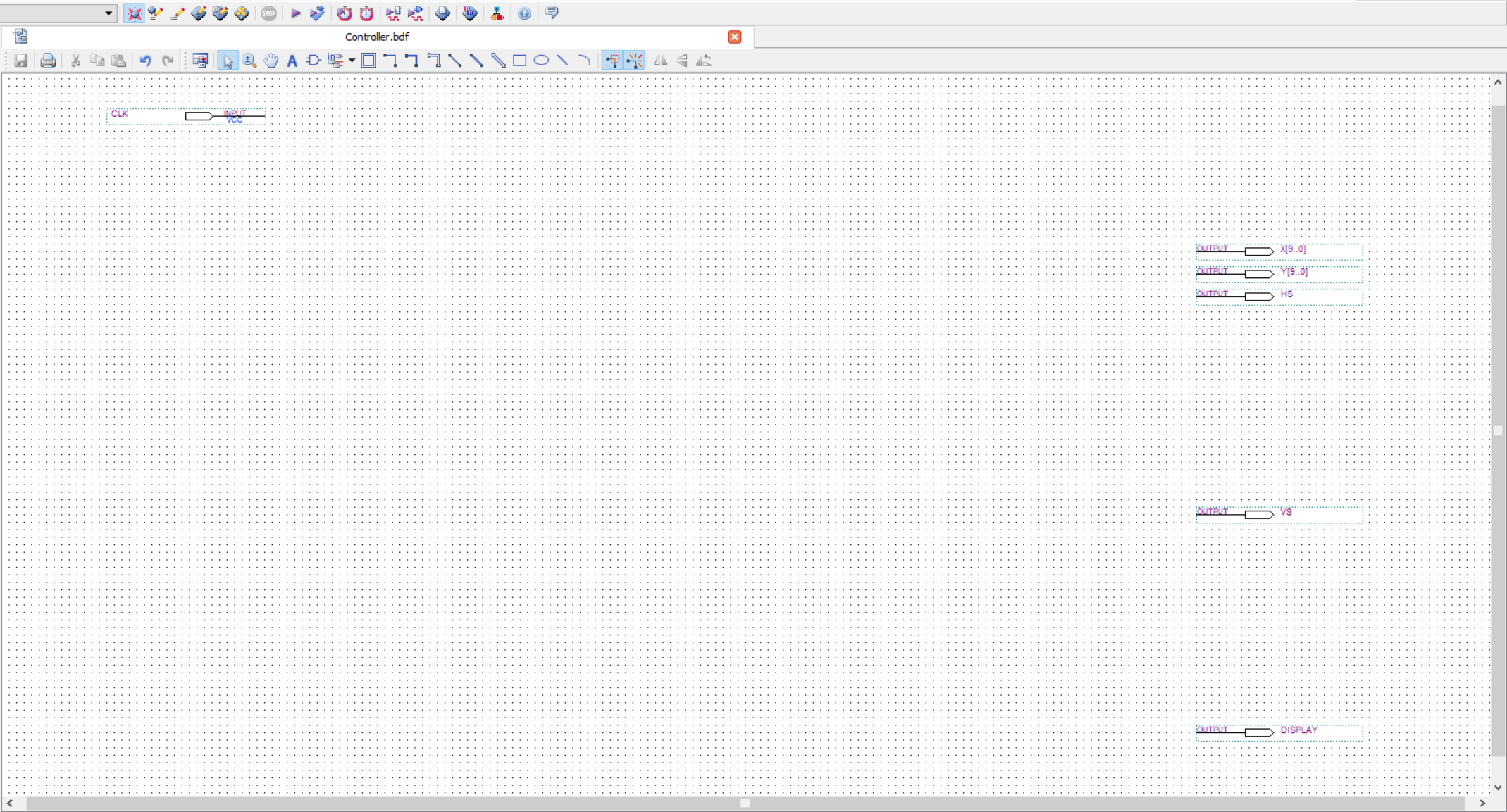
- ConstantX
- MultiplexerX
- ComparatorX
- RegisterX
- ClockDivider
- **RisingEdgeDetector**



Project Navigator

- Files
 - Monitor.bdf
 - Controller.bdf
 - Layer0.bdf
 - Layer1.bdf
 - ConstantX.vhd
 - MultiplexerX.vhd
 - ComparatorX.vhd
 - RegisterX.vhd
 - ClockDivider.vhd
 - RisingEdgeDetector.bdf

Hierarchy | Files | Design Units



Tasks

Flow: Compilation

Task
Complie Design
Analysis & Synthesis
Fitter (Place & Route)
Assembler (Generate programming files)
TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)

Messages

Type	ID	Message
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System | Processing

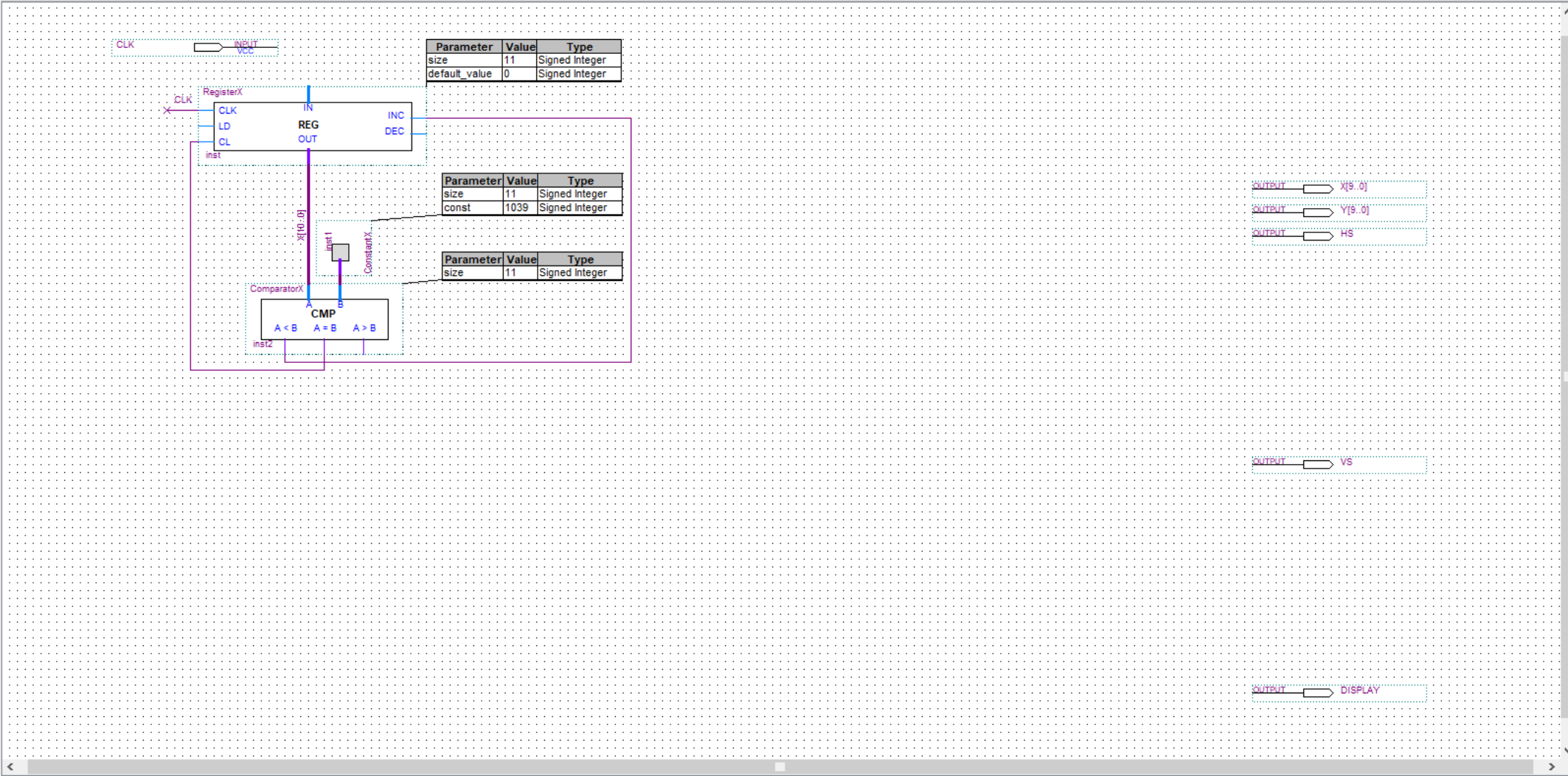
Project Navigator

Files

- Monitor.bdf
- Controller.bdf
- Layer0.bdf
- Layer1.bdf
- ConstantX.vhd
- MultiplexerX.vhd
- ComparatorX.vhd
- RegisterX.vhd
- ClockDivider.vhd
- RisingEdgeDetector.bdf

Hierarchy | Files | Design Units

Controller.bdf



Tasks

Flow: Compilation

Task
Compile Design
Analysis & Synthesis
Fitter (Place & Route)
Assembler (Generate programming files)
TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)

All <<Search>>

Type	ID	Message
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System | Processing

Project Navigator

Files

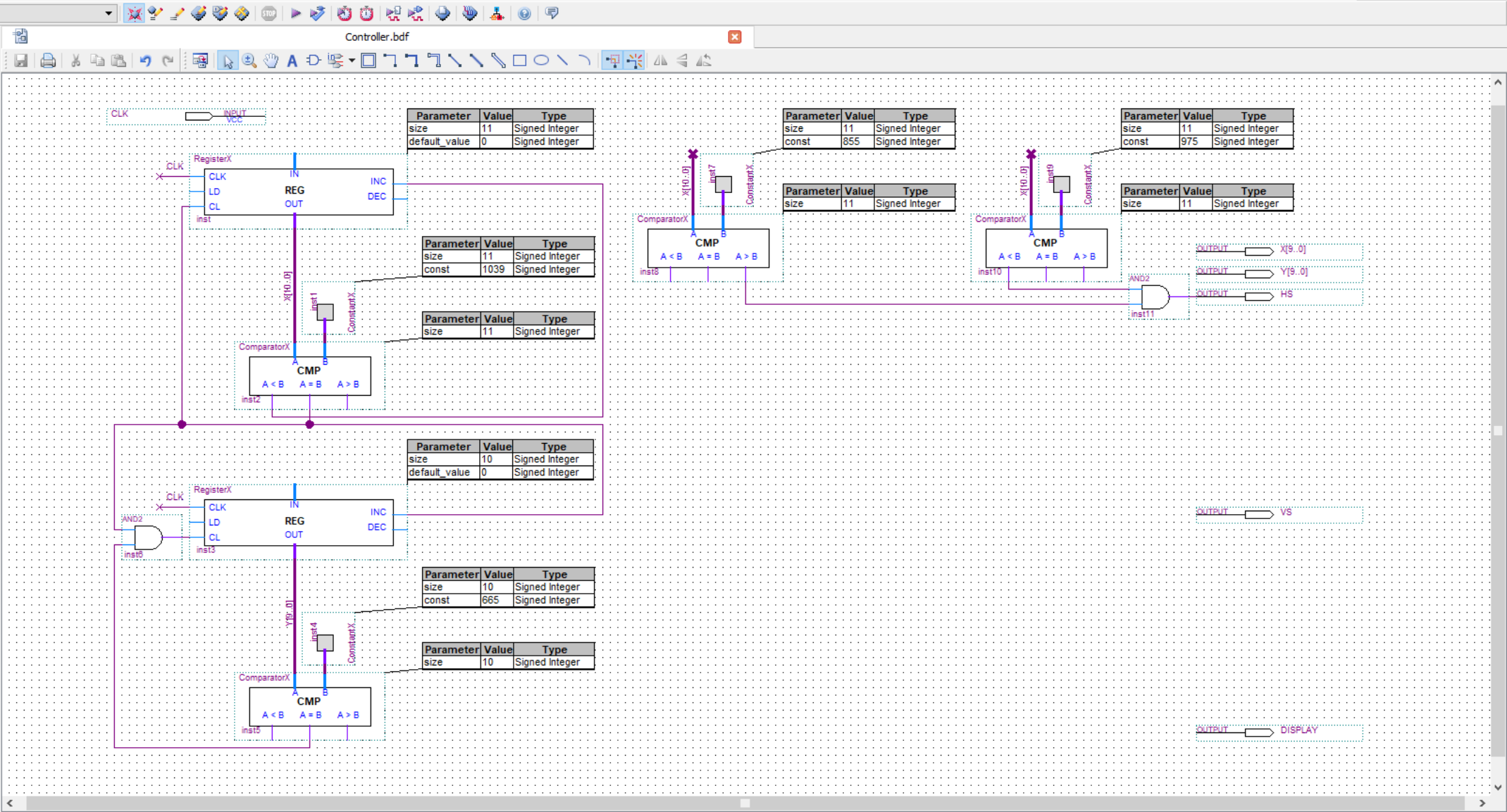
- Monitor.bdf
- Controller.bdf
- Layer0.bdf
- Layer1.bdf
- ConstantX.vhd
- MultiplexerX.vhd
- ComparatorX.vhd
- RegisterX.vhd
- ClockDivider.vhd
- RisingEdgeDetector.bdf

Hierarchy | Files | Design Units

Tasks

Flow: Compilation

Task
Compile Design
Analysis & Synthesis
Fitter (Place & Route)
Assembler (Generate programming files)
TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)



Messages

All <<Search>>

Type	ID	Message
System		Processing

732,300 0% 00:00:00

Project Navigator

Files

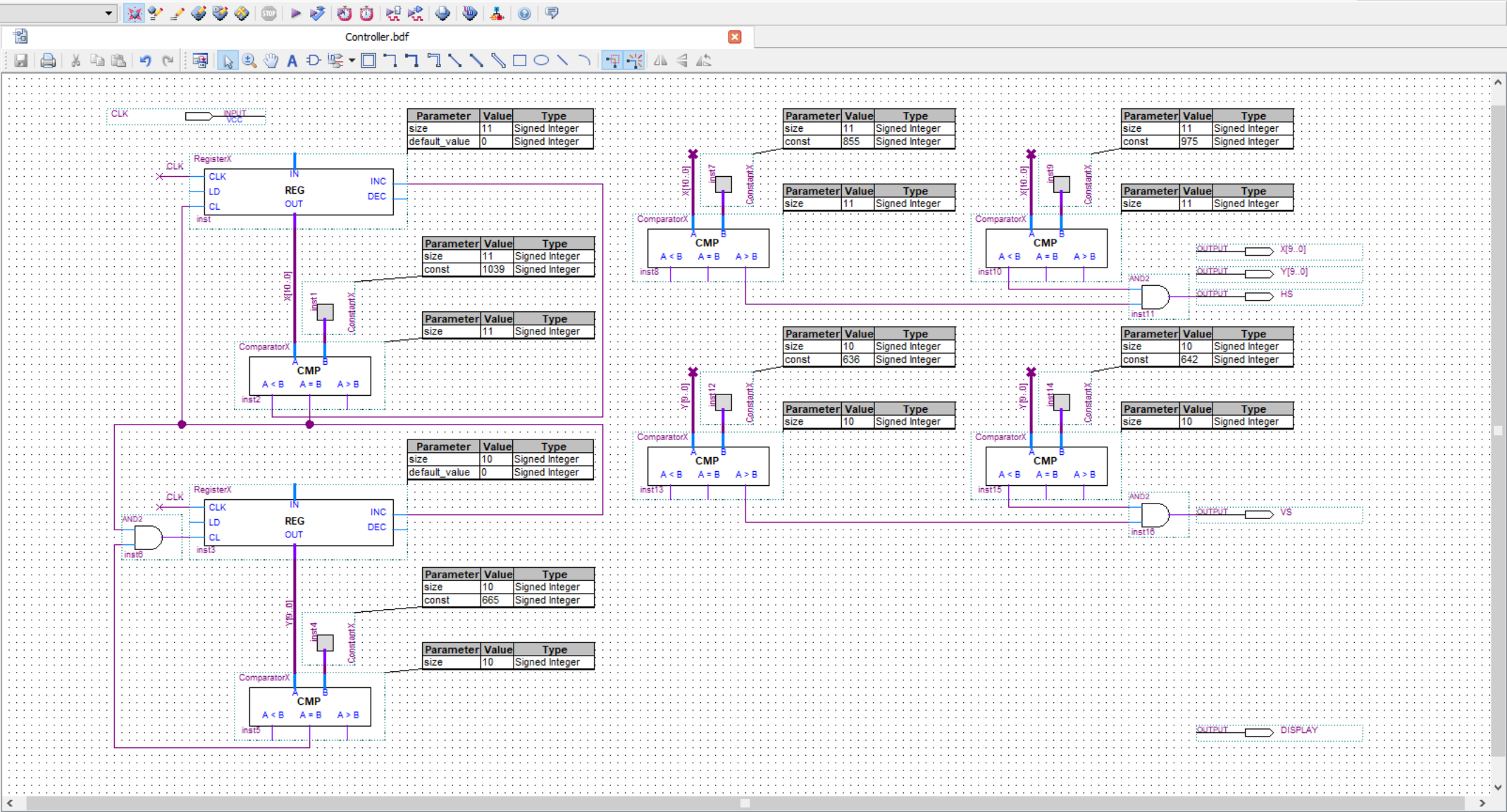
- Monitor.bdf
- Controller.bdf
- Layer0.bdf
- Layer1.bdf
- ConstantX.vhd
- MultiplexerX.vhd
- ComparatorX.vhd
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Hierarchy | Files | Design Units

Tasks

Flow: Compilation

Task
Compile Design
Analysis & Synthesis
Fitter (Place & Route)
Assembler (Generate programming files)
TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)



Messages

All <<Search>>

Type	ID	Message
System		Processing

1292,764 0% 00:00:00

Project Navigator

Files

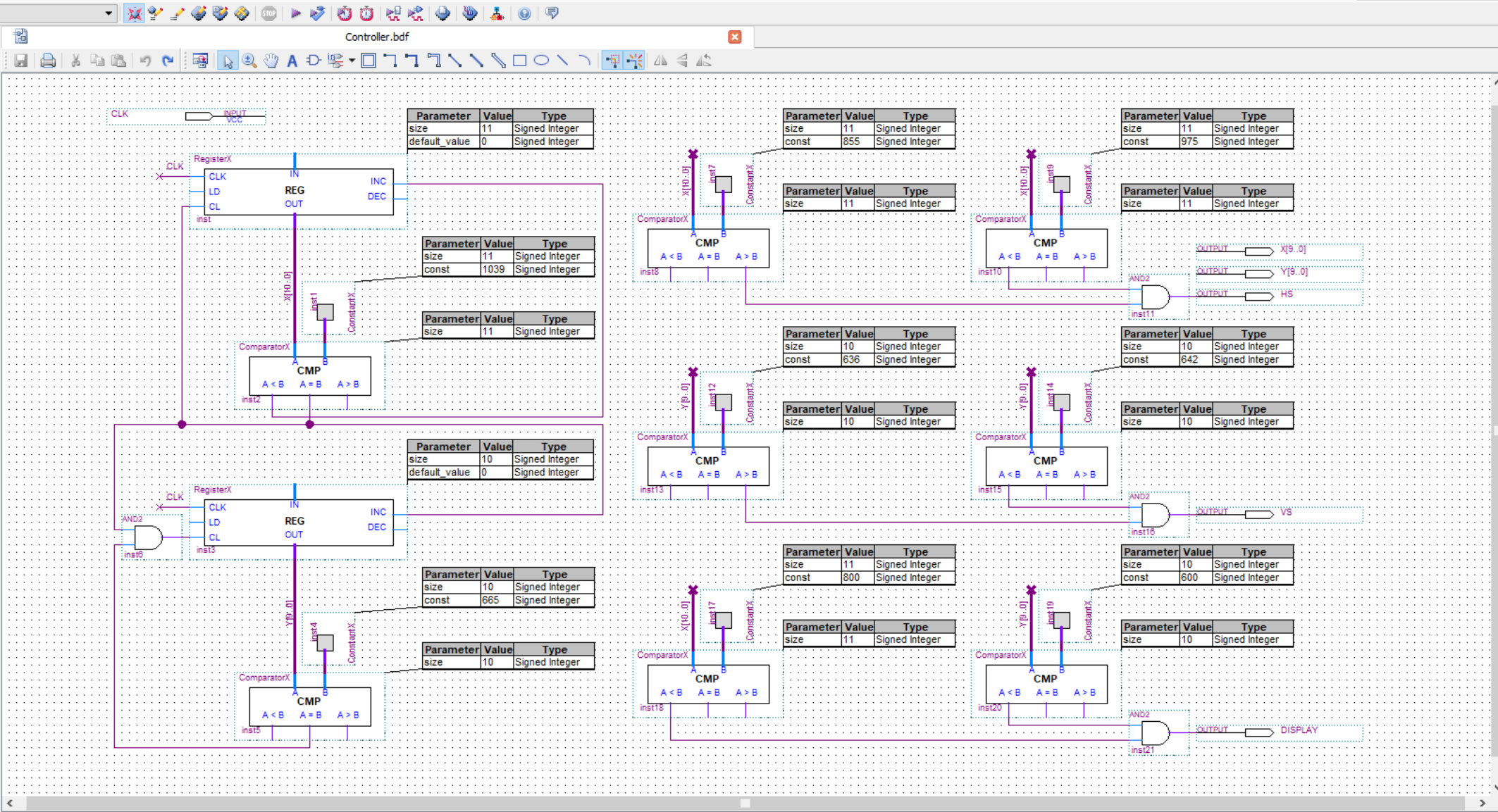
- Monitor.bdf
- Controller.bdf
- Layer0.bdf
- Layer1.bdf
- ConstantX.vhd
- MultiplexerX.vhd
- ComparatorX.vhd
- RegisterX.vhd
- ClockDivider.vhd
- RisingEdgeDetector.bdf

Hierarchy Files Design Units

Tasks

Flow: Compilation Customize...

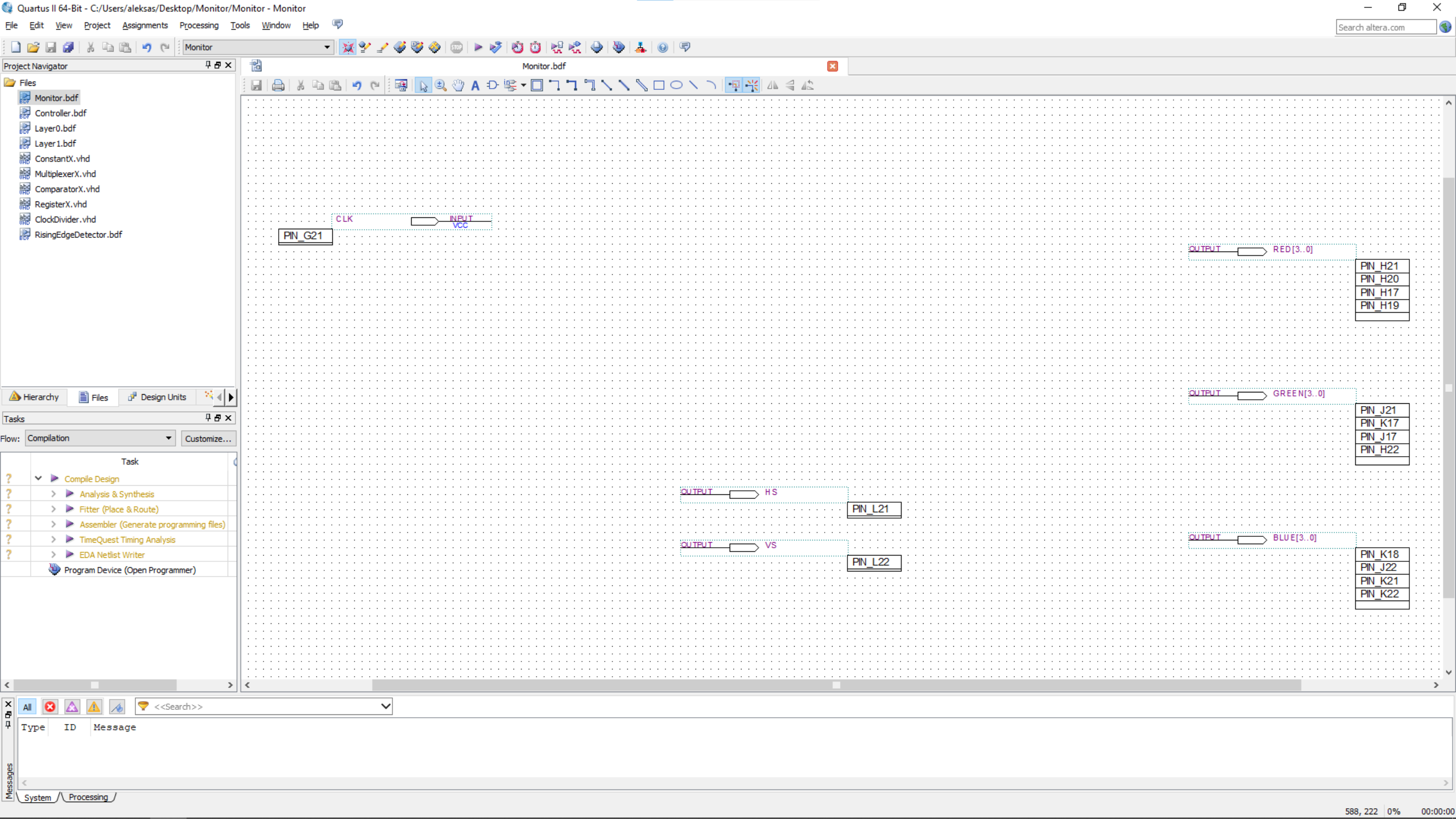
Task
Compile Design
Analysis & Synthesis
Fitter (Place & Route)
Assembler (Generate programming files)
TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)



Messages

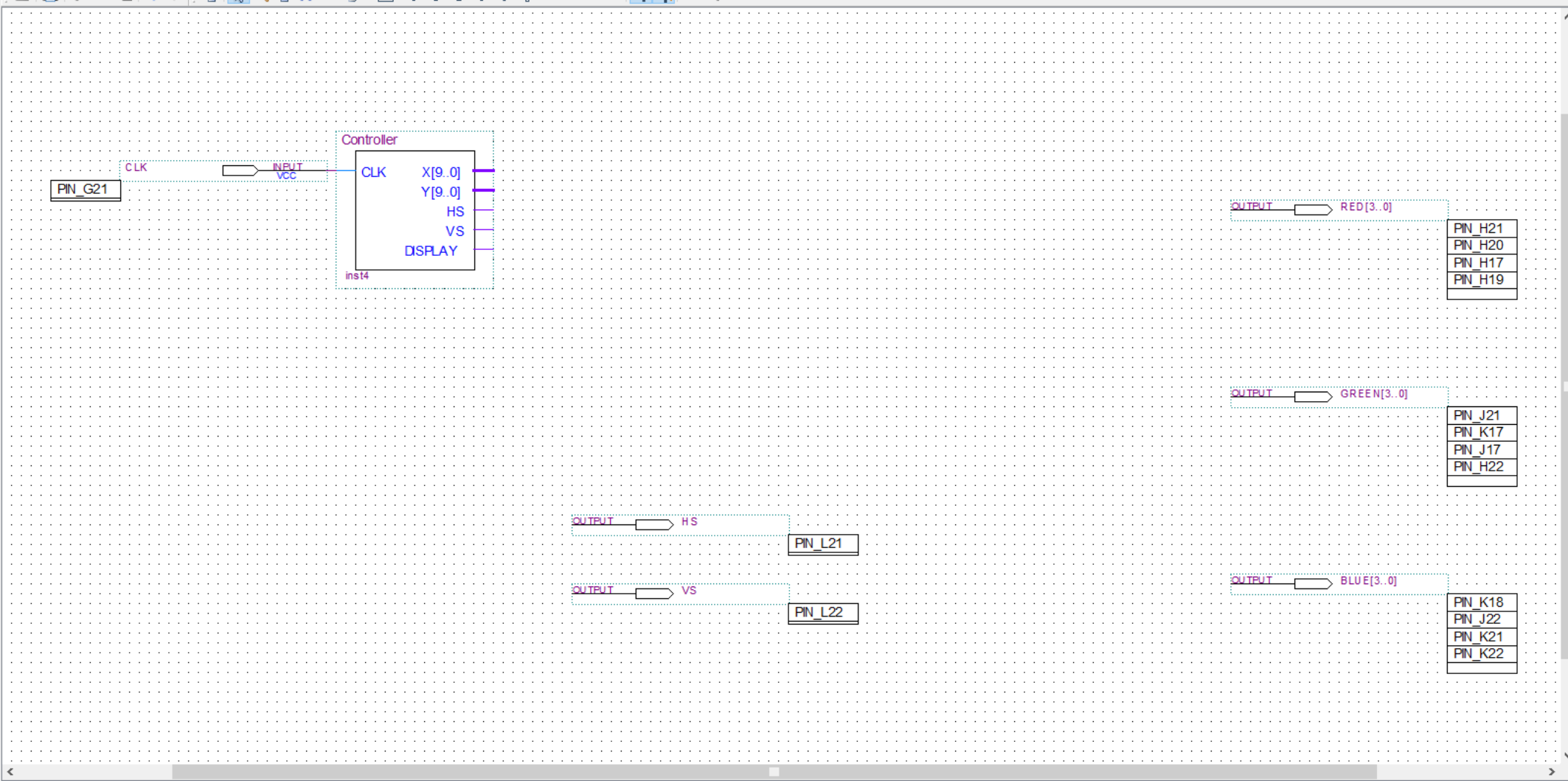
All <<Search>>

Type	ID	Message
System		Processing

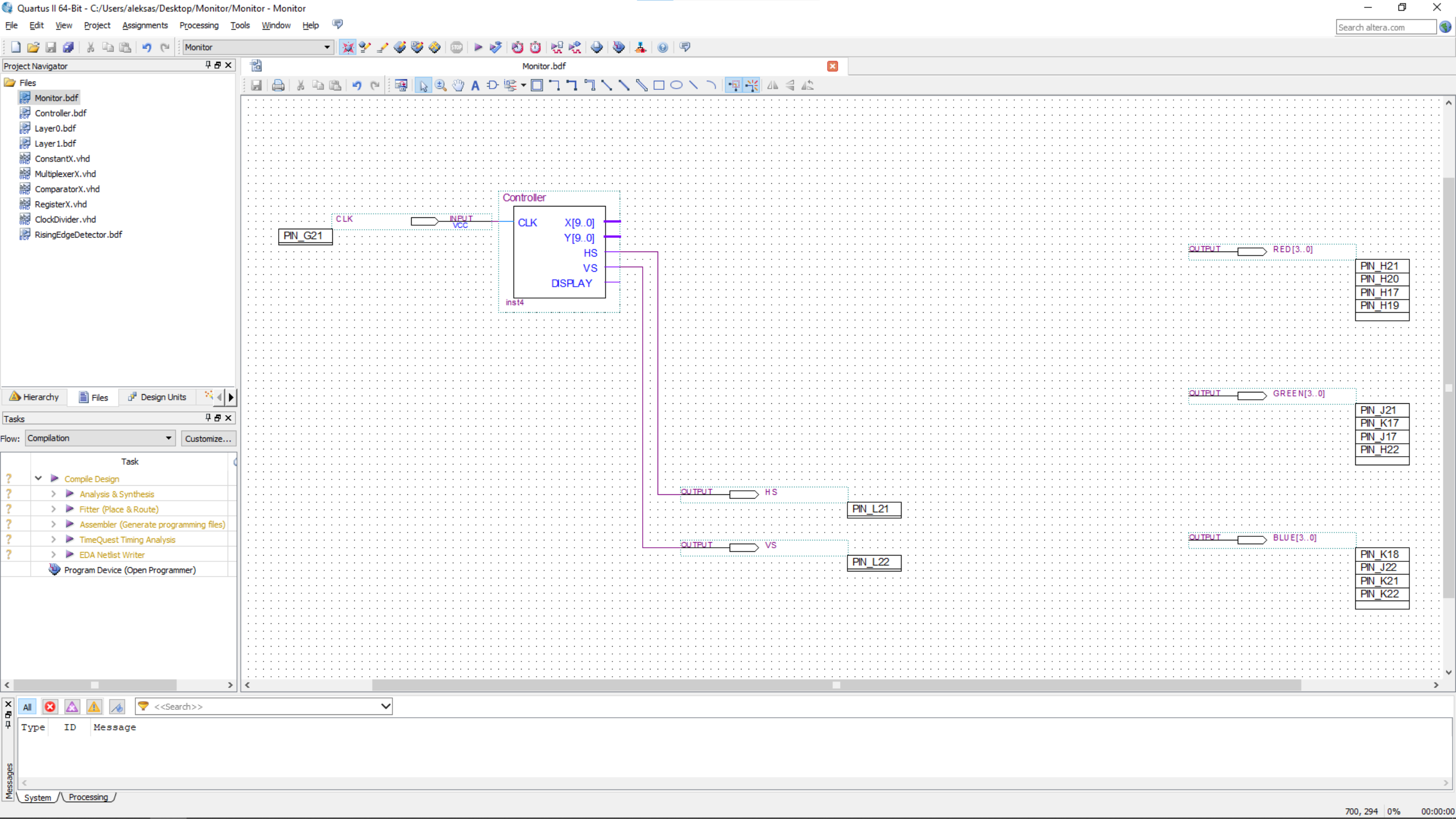


- Files
 - Monitor.bdf
 - Controller.bdf
 - Layer0.bdf
 - Layer1.bdf
 - ConstantX.vhd
 - MultiplexerX.vhd
 - ComparatorX.vhd
 - RegisterX.vhd
 - ClockDivider.vhd
 - RisingEdgeDetector.bdf

- | Task | |
|------|------------------------------------------|
| ? | Compile Design |
| ? | > Analysis & Synthesis |
| ? | > Fitter (Place & Route) |
| ? | > Assembler (Generate programming files) |
| ? | > TimeQuest Timing Analysis |
| ? | > EDA Netlist Writer |
| | Program Device (Open Programmer) |



Type	ID	Message
Messages		
System / Processing		



Project Navigator

Files

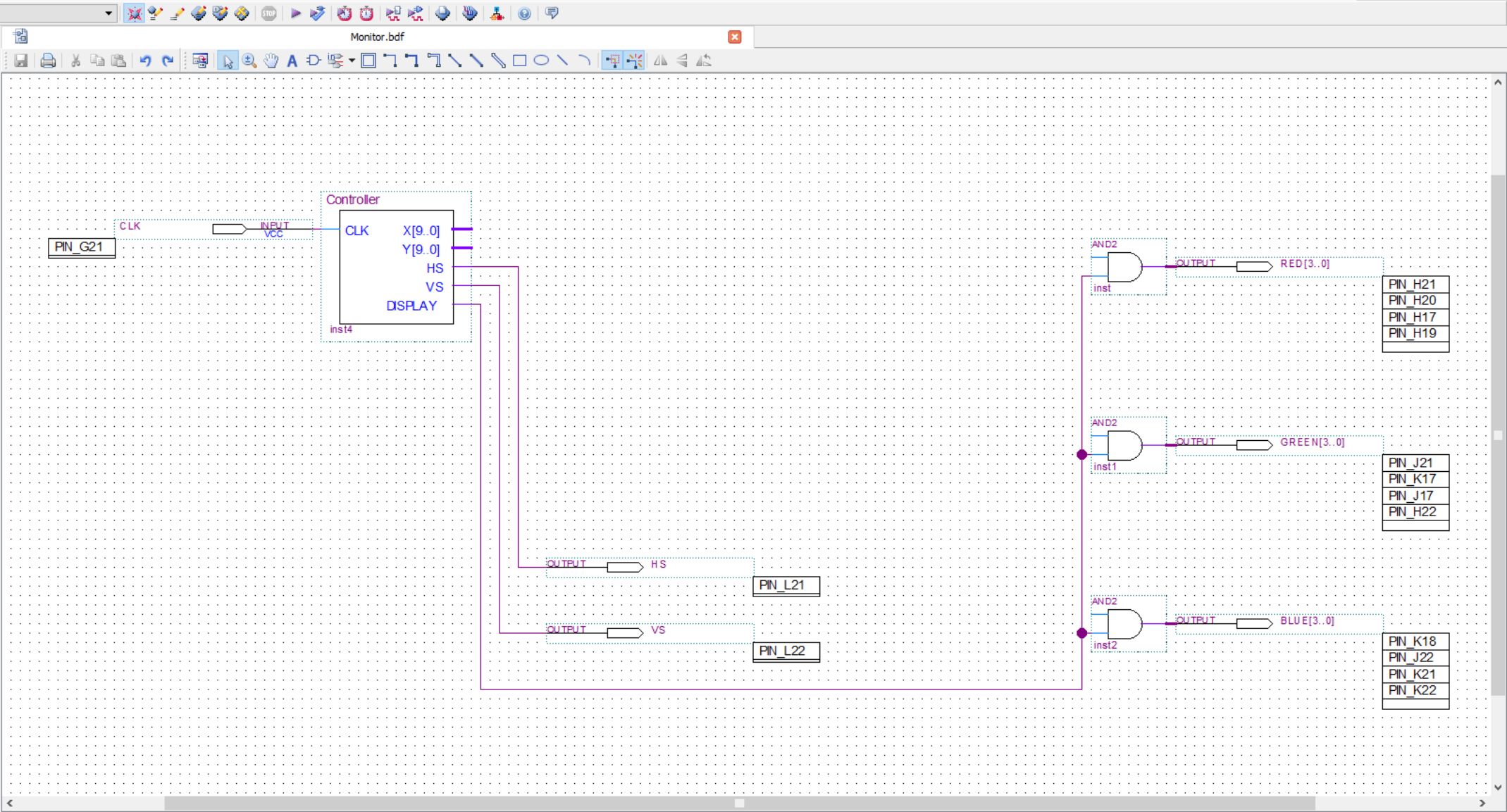
- Monitor.bdf
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- ConstantX.vhd
- MultiplexerX.vhd
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- RegisterX.vhd
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Hierarchy | Files | Design Units

Tasks

Flow: Compilation

Task	
?	Compile Design
?	> Analysis & Synthesis
?	> Fitter (Place & Route)
?	> Assembler (Generate programming files)
?	> TimeQuest Timing Analysis
?	> EDA Netlist Writer
	Program Device (Open Programmer)



Messages

Type	ID	Message
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System | Processing

Project Navigator

Files

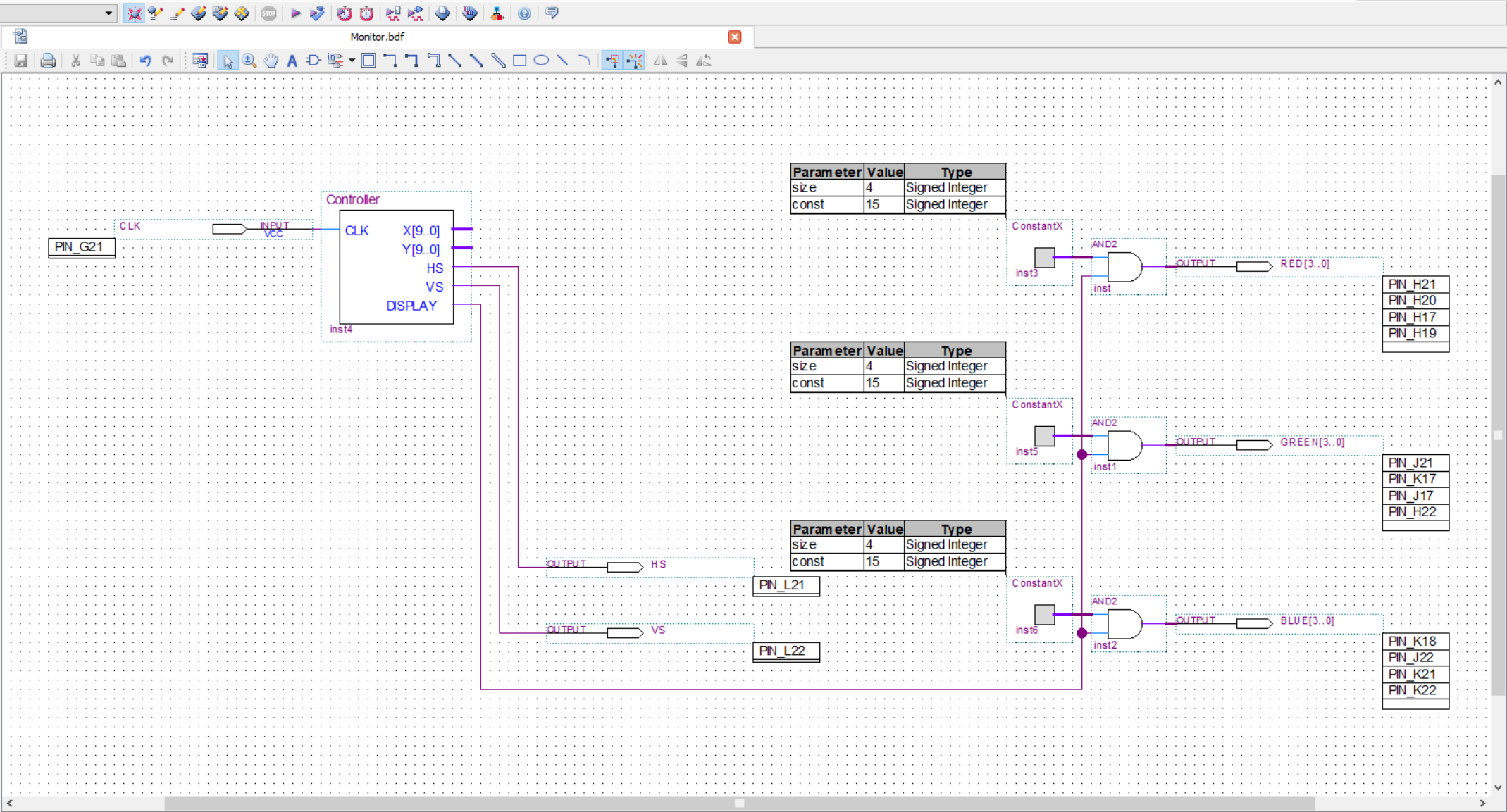
- Monitor.bdf
- Controller.bdf
- Layer0.bdf
- Layer1.bdf
- ConstantX.vhd
- MultiplexerX.vhd
- ComparatorX.vhd
- RegisterX.vhd
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Hierarchy | Files | Design Units

Tasks

Flow: Compilation

Task
Compile Design
Analysis & Synthesis
Fitter (Place & Route)
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TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)



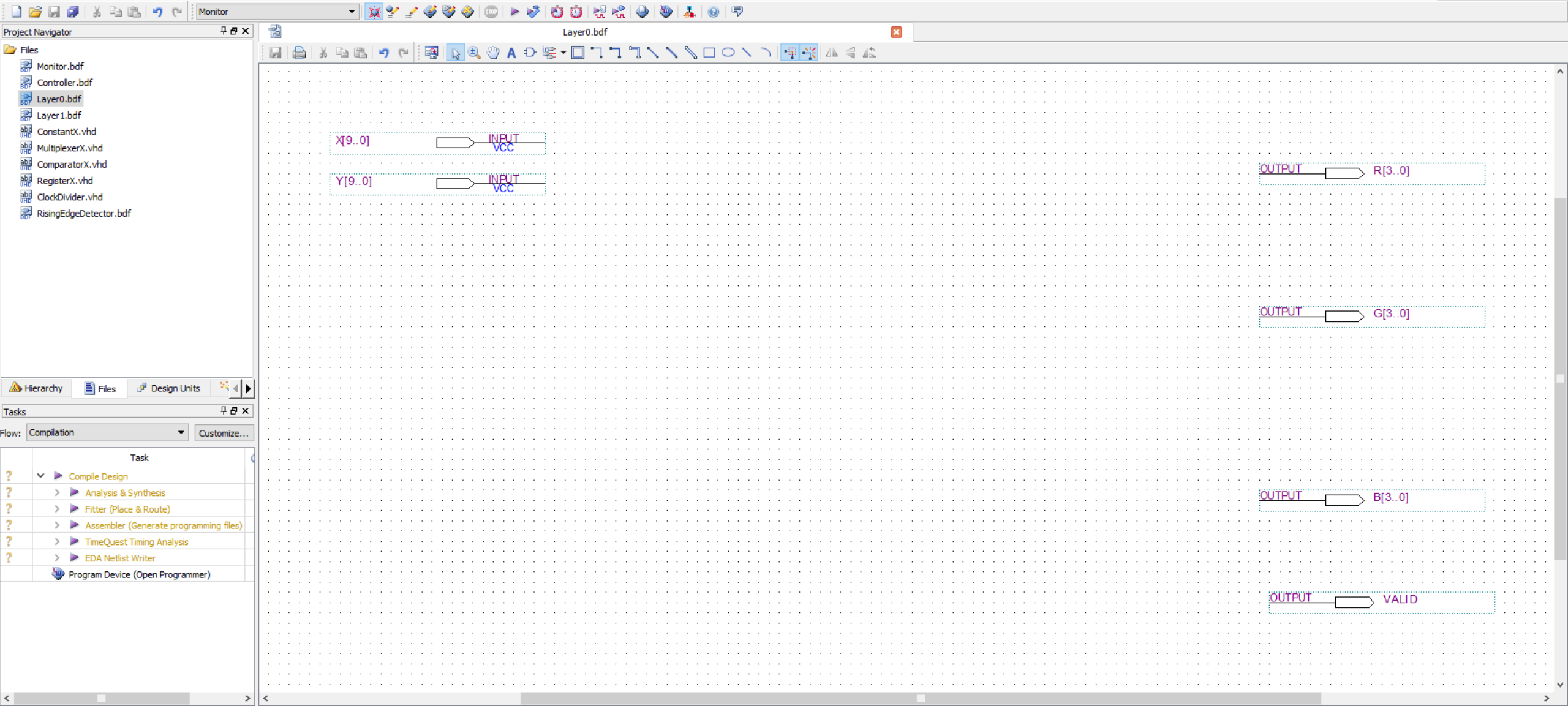
Messages

Type	ID	Message
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System Processing

Приказ





- Files
 - Monitor.bdf
 - Controller.bdf
 - Layer0.bdf
 - Layer1.bdf
 - ConstantX.vhd
 - MultiplexerX.vhd
 - ComparatorX.vhd
 - RegisterX.vhd
 - ClockDivider.vhd
 - RisingEdgeDetector.bdf

Hierarchy | Files | Design Units

Tasks

Flow: Compilation | Customize...

- Task
 - Compile Design
 - Analysis & Synthesis
 - Fitter (Place & Route)
 - Assembler (Generate programming files)
 - TimeQuest Timing Analysis
 - EDA Netlist Writer
 - Program Device (Open Programmer)

All | <<Search>>

Type	ID	Message
System	Processing	

Project Navigator

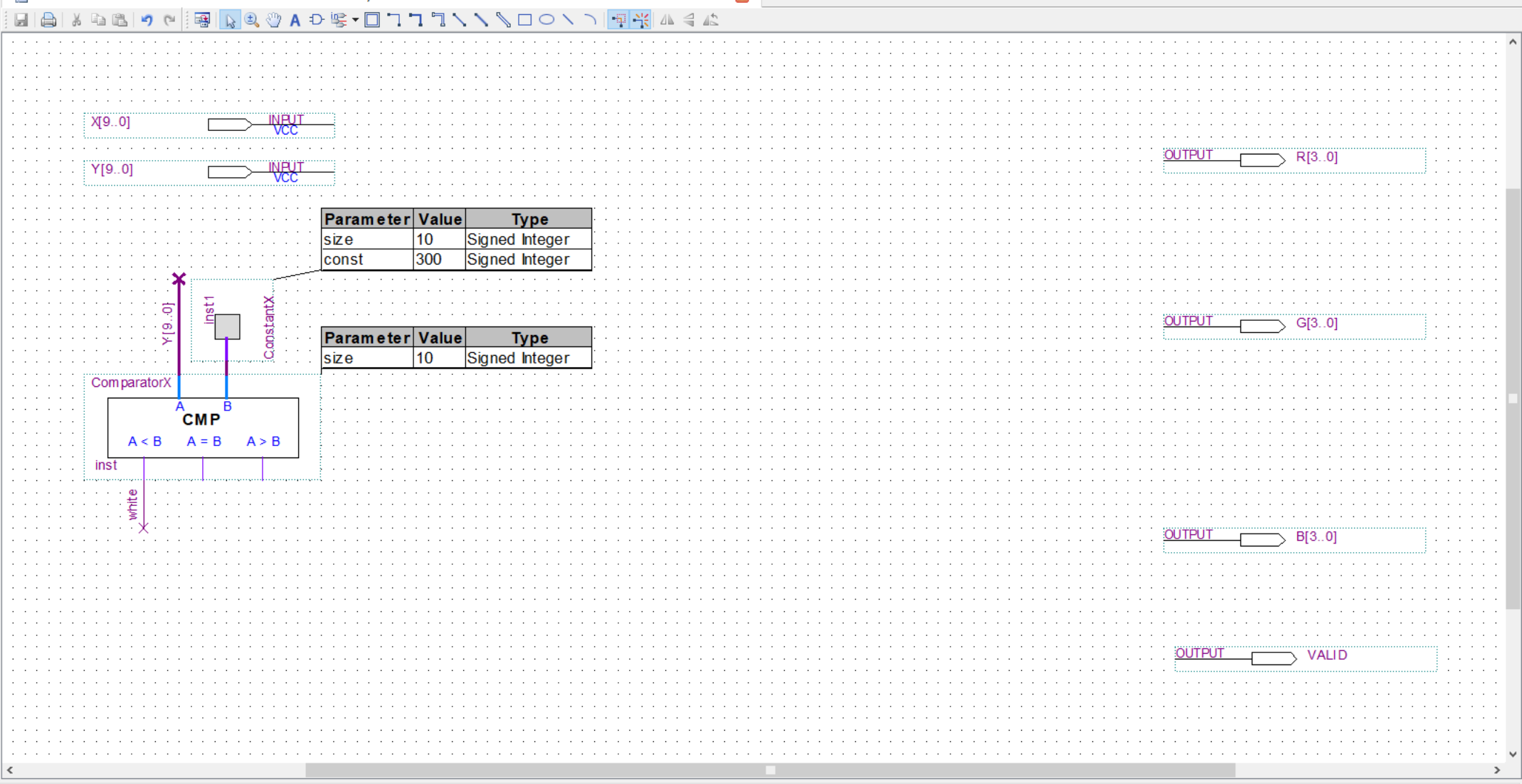
- Files
 - Monitor.bdf
 - Controller.bdf
 - Layer0.bdf
 - Layer1.bdf
 - ConstantX.vhd
 - MultiplexerX.vhd
 - ComparatorX.vhd
 - RegisterX.vhd
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Hierarchy Files Design Units

Tasks

Flow: Compilation Customize...

Task
Compile Design
Analysis & Synthesis
Fitter (Place & Route)
Assembler (Generate programming files)
TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)



Project Navigator

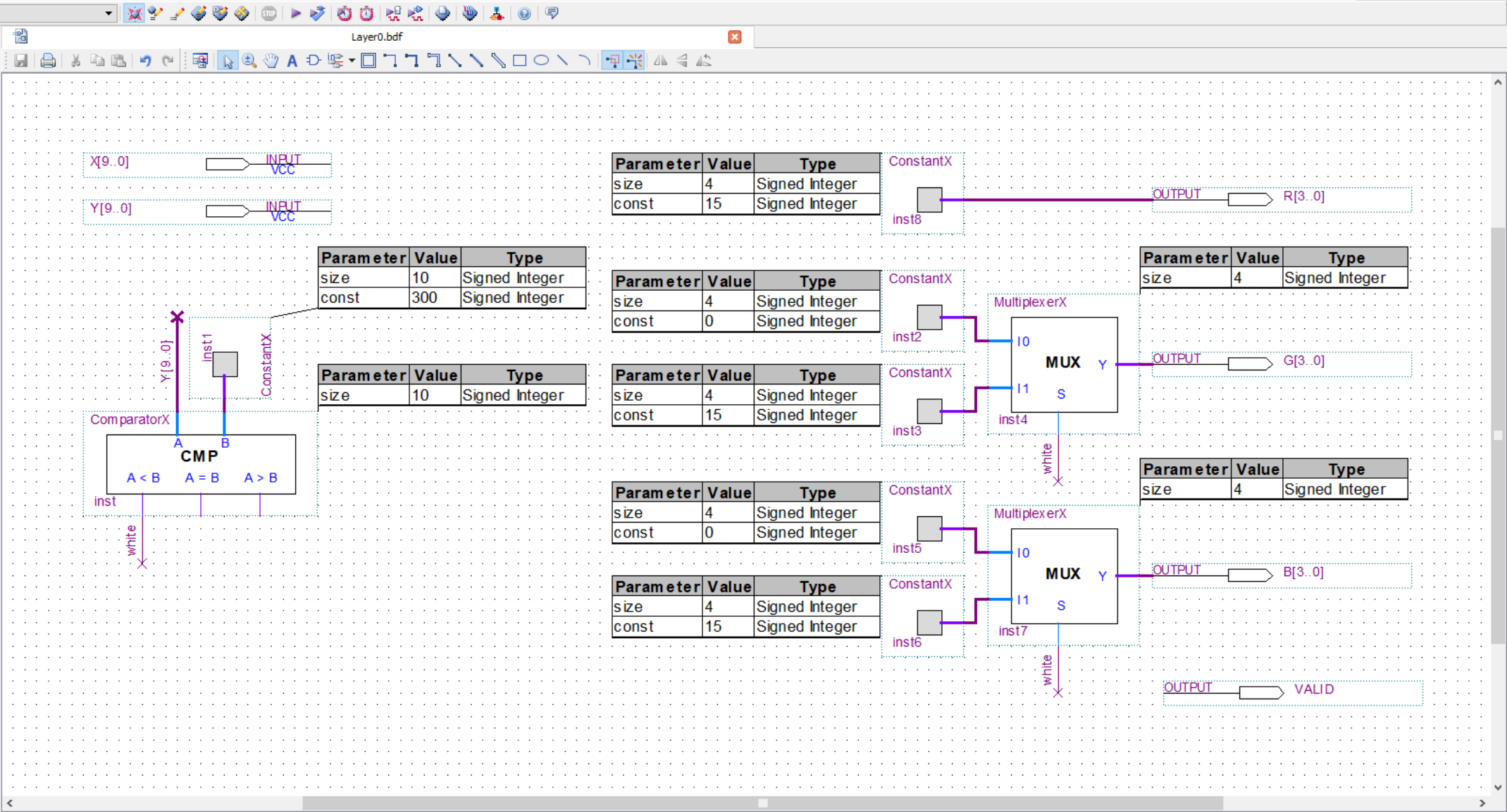
- Files
 - Monitor.bdf
 - Controller.bdf
 - Layer0.bdf
 - Layer1.bdf
 - ConstantX.vhd
 - MultiplexerX.vhd
 - ComparatorX.vhd
 - RegisterX.vhd
 - ClockDivider.vhd
 - RisingEdgeDetector.bdf

Hierarchy | Files | Design Units

Tasks

Flow: Compilation

Task
Compile Design
Analysis & Synthesis
Fitter (Place & Route)
Assembler (Generate programming files)
TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)



Messages

All | <<Search>>

Type	ID	Message
System		Processing

1067, 577 0% 00:00:00

Project Navigator

- Files
 - Monitor.bdf
 - Controller.bdf
 - Layer0.bdf
 - Layer1.bdf
 - ConstantX.vhd
 - MultiplexerX.vhd
 - ComparatorX.vhd
 - RegisterX.vhd
 - ClockDivider.vhd
 - RisingEdgeDetector.bdf

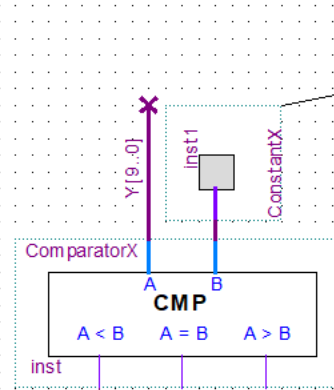
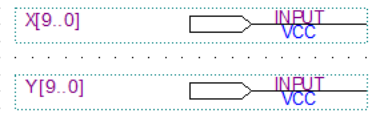
Hierarchy | Files | Design Units

Tasks

Flow: Compilation

Task
Compile Design
Analysis & Synthesis
Fitter (Place & Route)
Assembler (Generate programming files)
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EDA Netlist Writer
Program Device (Open Programmer)

Layer0.bdf



Parameter	Value	Type
size	10	Signed Integer
const	300	Signed Integer

Parameter	Value	Type
size	10	Signed Integer

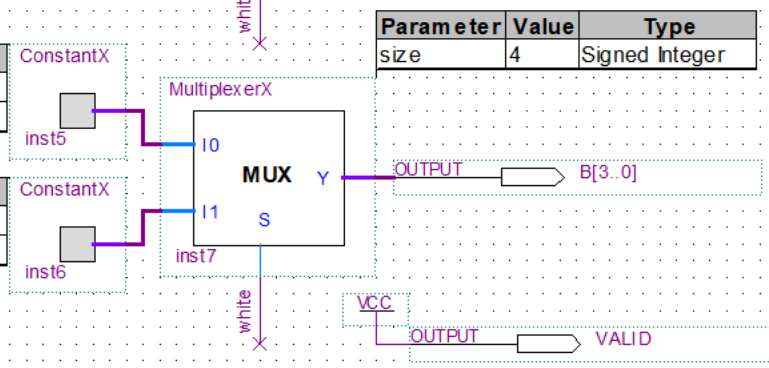
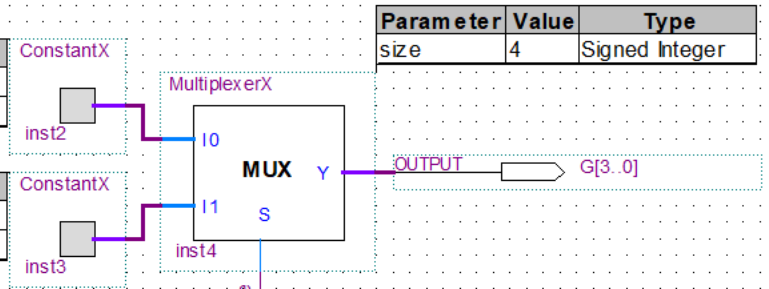
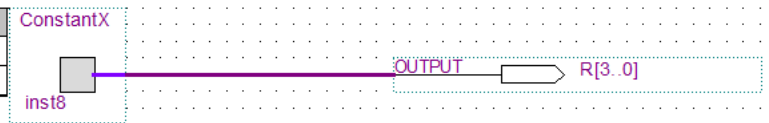
Parameter	Value	Type
size	4	Signed Integer
const	15	Signed Integer

Parameter	Value	Type
size	4	Signed Integer
const	0	Signed Integer

Parameter	Value	Type
size	4	Signed Integer
const	15	Signed Integer

Parameter	Value	Type
size	4	Signed Integer
const	0	Signed Integer

Parameter	Value	Type
size	4	Signed Integer
const	15	Signed Integer



Messages

Type	ID	Message
System		Processing

Project Navigator

Files

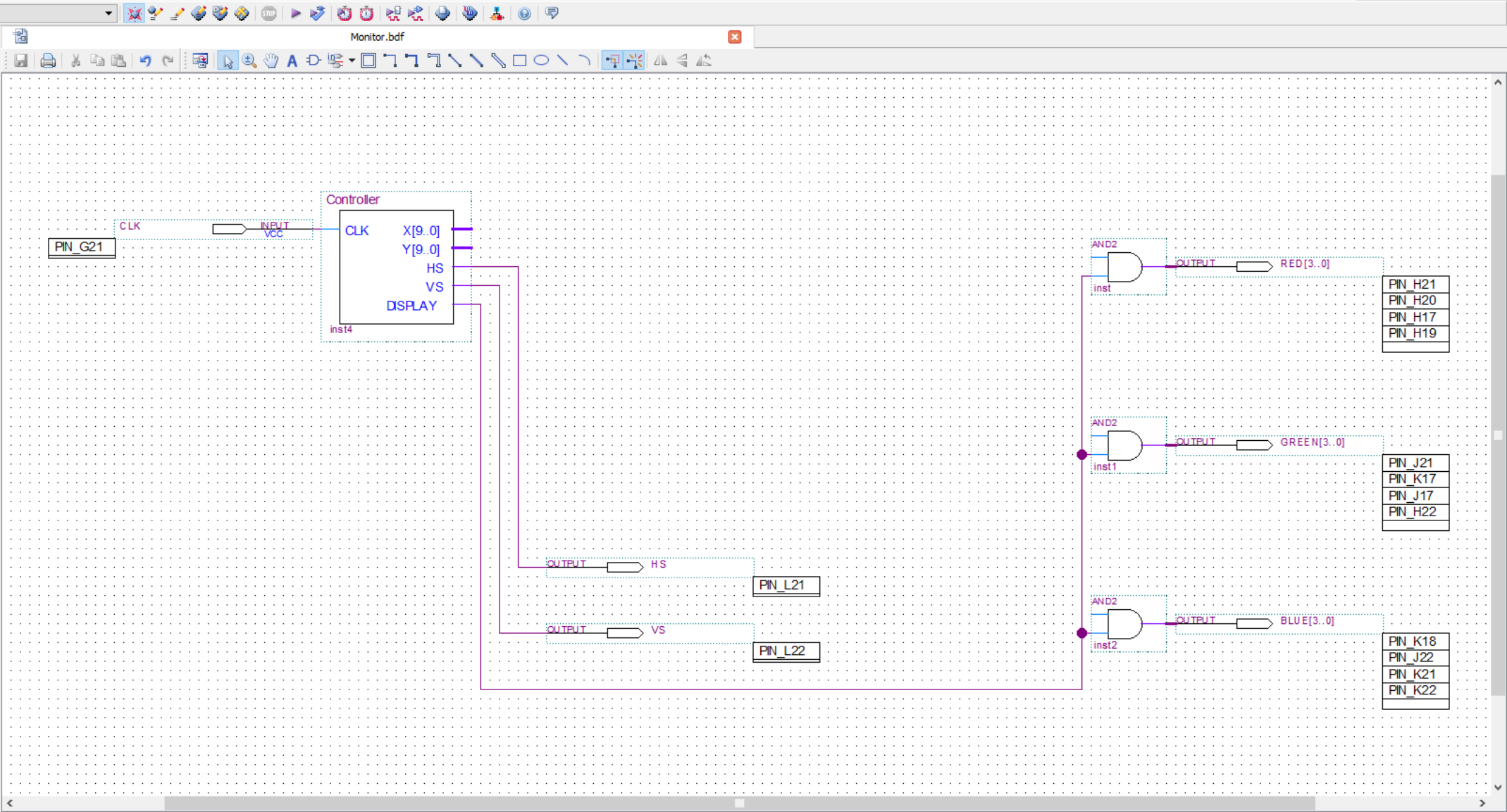
- Monitor.bdf
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- Layer0.bdf
- Layer1.bdf
- ConstantX.vhd
- MultiplexerX.vhd
- ComparatorX.vhd
- RegisterX.vhd
- ClockDivider.vhd
- RisingEdgeDetector.bdf

Hierarchy | Files | Design Units

Tasks

Flow: Compilation

Task
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Fitter (Place & Route)
Assembler (Generate programming files)
TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)



Messages

Type	ID	Message
System		Processing

672,286 | 0% | 00:00:00

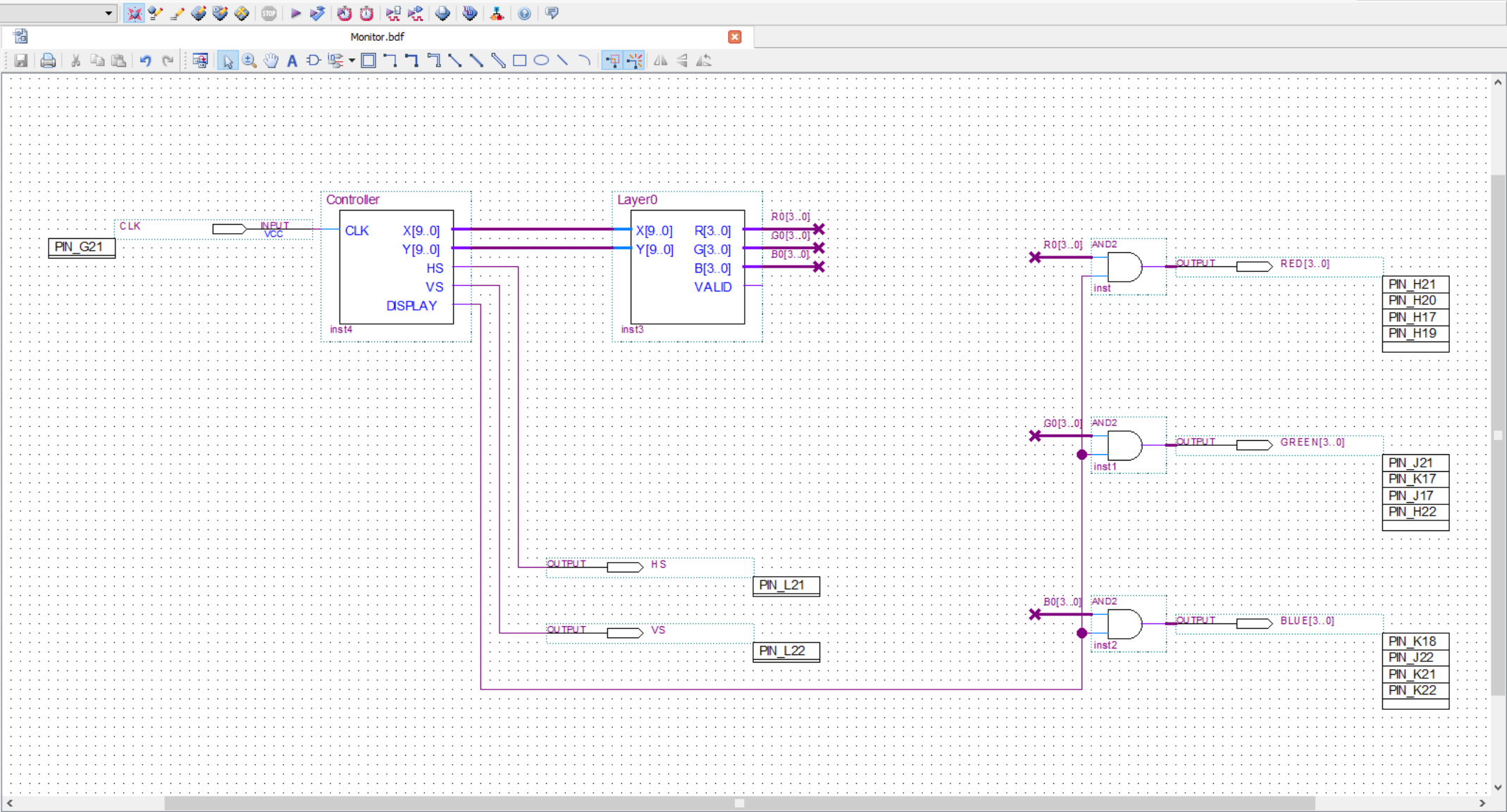
Project Navigator

- Monitor.bdf
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- Layer1.bdf
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- MultiplexerX.vhd
- ComparatorX.vhd
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- ClockDivider.vhd
- RisingEdgeDetector.bdf

Tasks

Flow: Compilation

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EDA Netlist Writer
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Messages

Type	ID	Message
System		Processing

Приказ

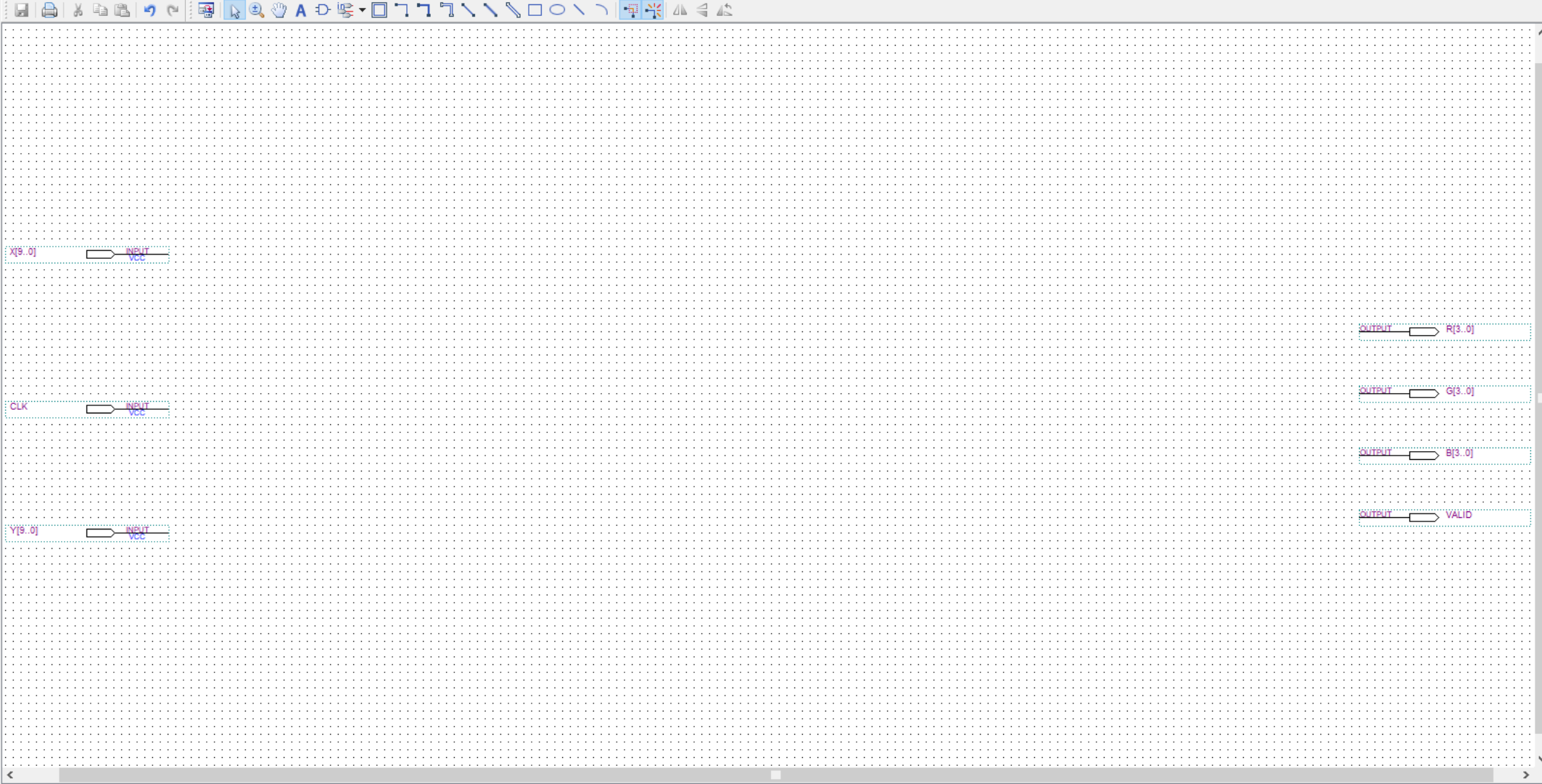


Files

- Monitor.bdf
- Controller.bdf
- Layer0.bdf
- Layer1.bdf
- ConstantX.vhd
- MultiplexerX.vhd
- ComparatorX.vhd
- RegisterX.vhd
- ClockDivider.vhd
- RisingEdgeDetector.bdf

Hierarchy Files Design Units

Task	
?	▶ Compile Design
?	> ▶ Analysis & Synthesis
?	> ▶ Fitter (Place & Route)
?	> ▶ Assembler (Generate programming files)
?	> ▶ TimeQuest Timing Analysis
?	> ▶ EDA Netlist Writer
	▶ Program Device (Open Programmer)



Type	ID	Message
------	----	---------

- Files
- Monitor.bdf
- Controller.bdf
- Layer0.bdf
- Layer1.bdf
- ConstantX.vhd
- MultiplexerX.vhd
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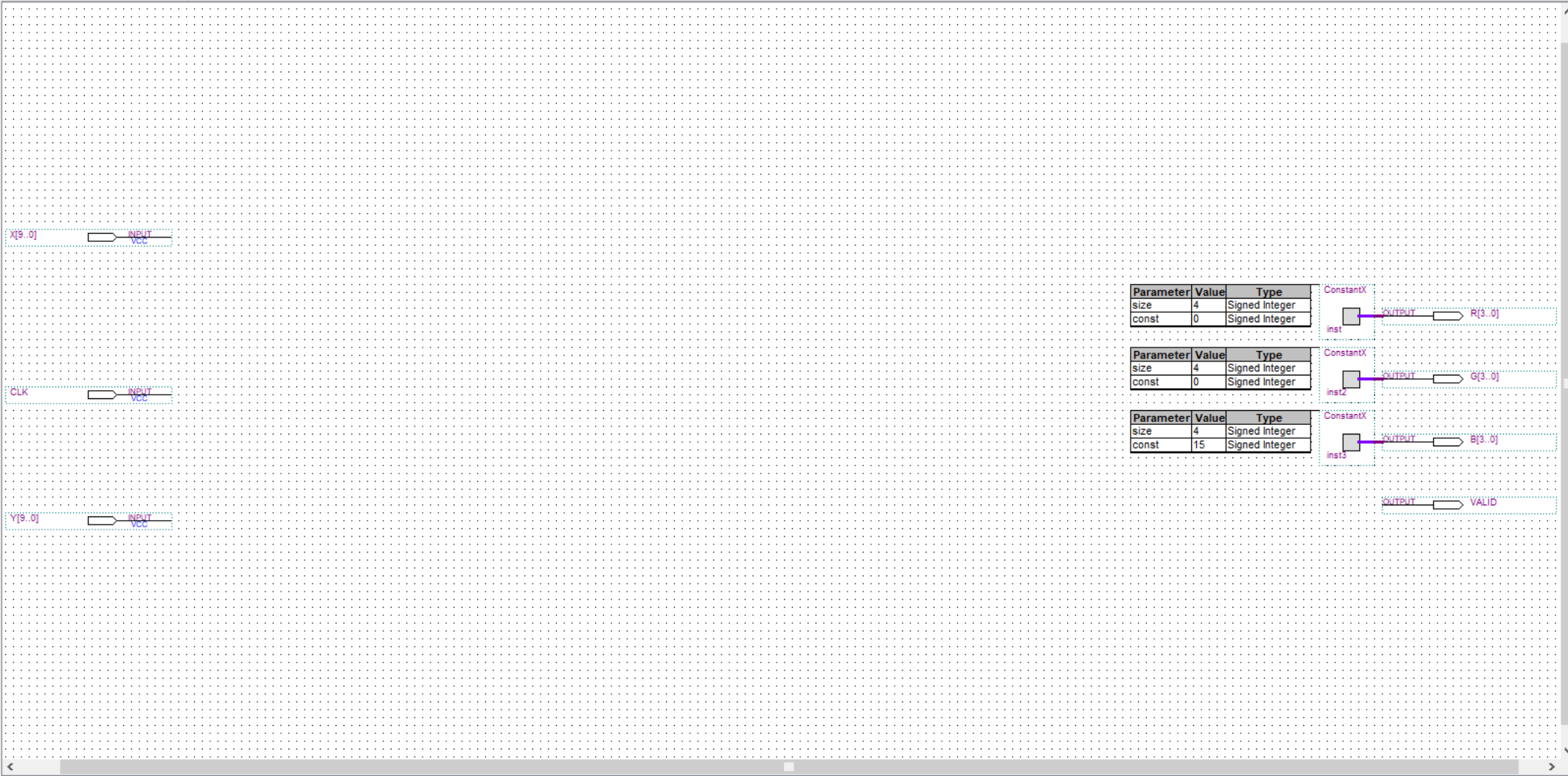
Hierarchy Files Design Units

Tasks

Flow: Compilation Customize...

- | Task |
|----------------------------------------|
| Compile Design |
| Analysis & Synthesis |
| Fitter (Place & Route) |
| Assembler (Generate programming files) |
| TimeQuest Timing Analysis |
| EDA Netlist Writer |
| Program Device (Open Programmer) |

Standard CAD tool icons for editing and viewing.



Parameter	Value	Type
size	4	Signed Integer
const	0	Signed Integer

Parameter	Value	Type
size	4	Signed Integer
const	0	Signed Integer

Parameter	Value	Type
size	4	Signed Integer
const	15	Signed Integer

Messages <<Search>>

Type	ID	Message

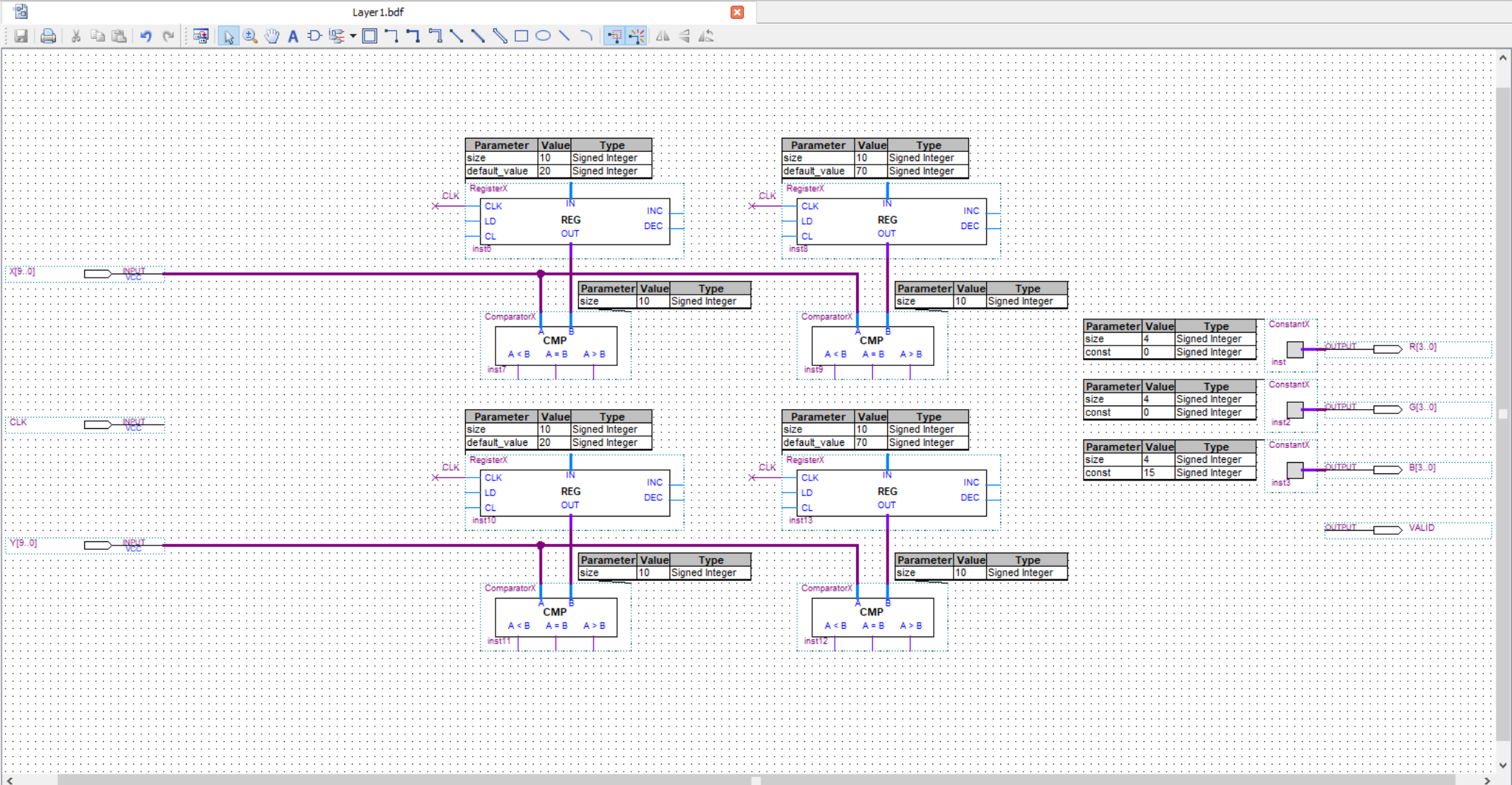
- Files
 - Monitor.bdf
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Hierarchy Files Design Units

Tasks

Flow: Compilation Customize...

Task
Compile Design
Analysis & Synthesis
Fitter (Place & Route)
Assembler (Generate programming files)
TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)



Parameter	Value	Type
size	4	Signed Integer
const	0	Signed Integer

ConstantX inst1 OUTPUT R[3:0]

Parameter	Value	Type
size	4	Signed Integer
const	0	Signed Integer

ConstantX inst2 OUTPUT G[3:0]

Parameter	Value	Type
size	4	Signed Integer
const	15	Signed Integer

ConstantX inst3 OUTPUT B[3:0]

OUTPUT VALID

Messages

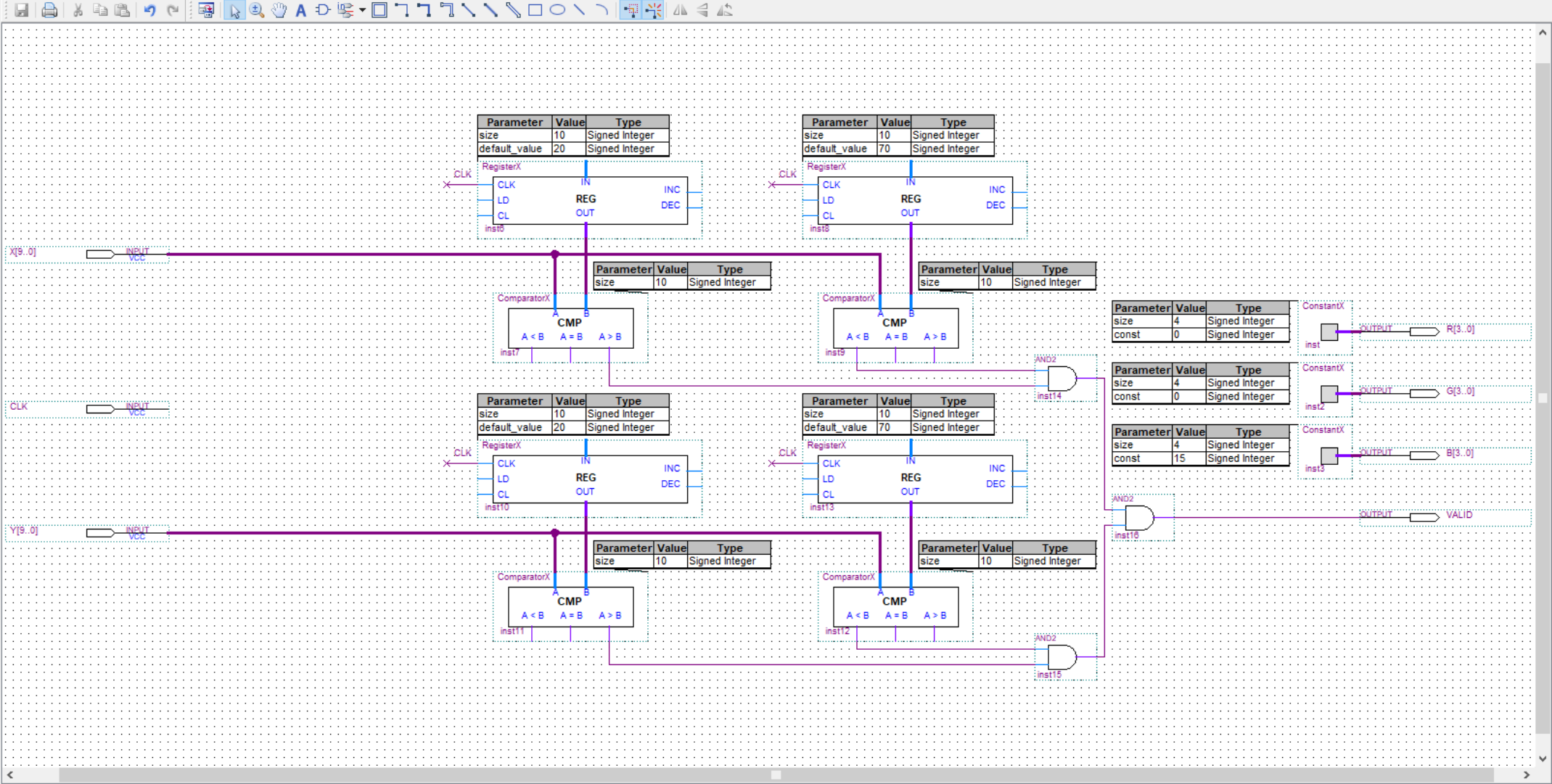
All <<Search>>

Type	ID	Message
------	----	---------

System Processing

- Files
 - Monitor.bdf
 - Controller.bdf
 - Layer0.bdf
 - Layer1.bdf
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 - RegisterX.vhd
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- | Task |
|----------------------------------------|
| Compile Design |
| Analysis & Synthesis |
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| EDA Netlist Writer |
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Type	ID	Message
------	----	---------

Project Navigator

- Monitor.bdf
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- ComparatorX.vhd
- RegisterX.vhd
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Hierarchy

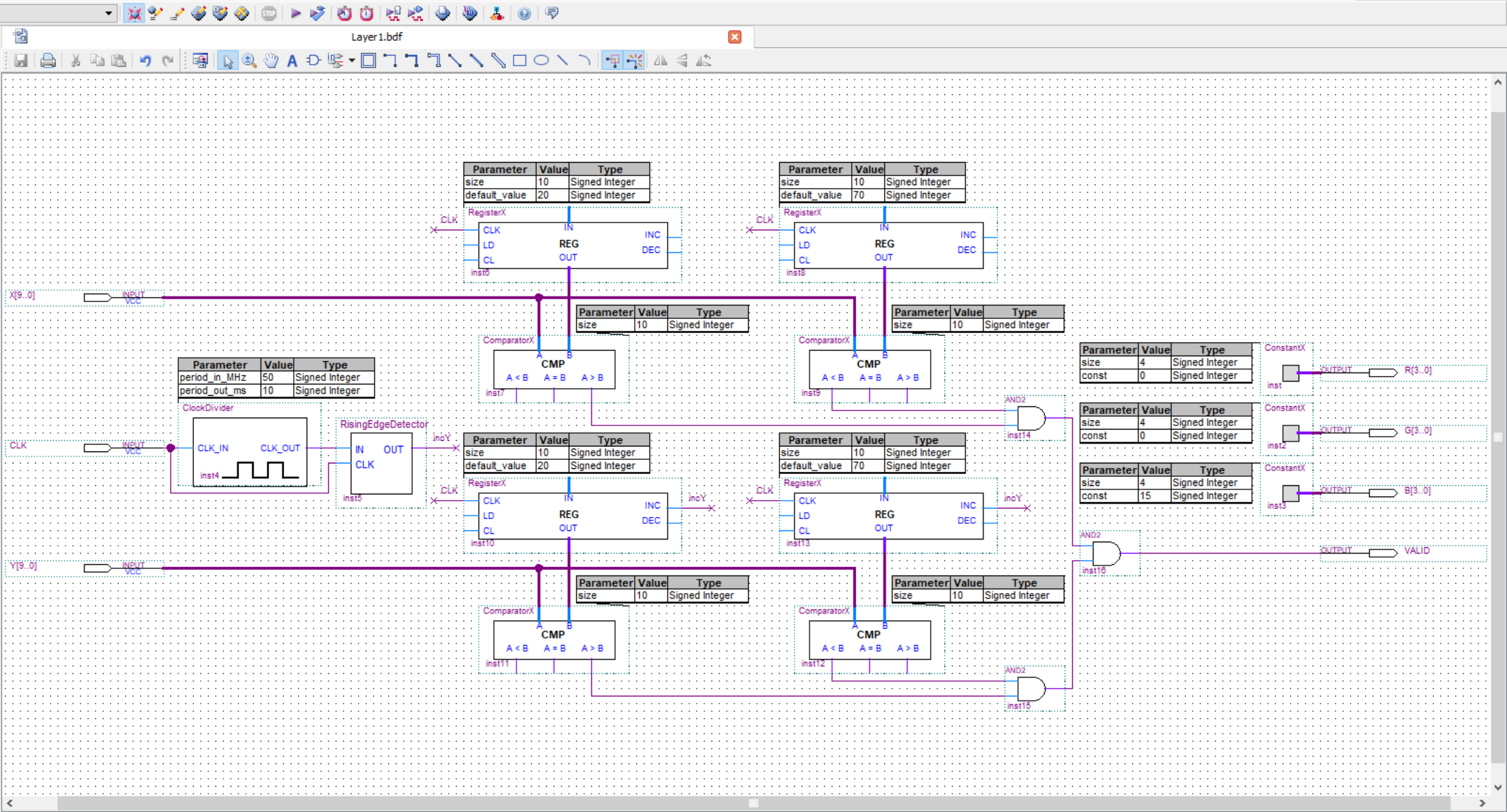
Files

Design Units

Tasks

Flow: Compilation

Task
Compile Design
Analysis & Synthesis
Fitter (Place & Route)
Assembler (Generate programming files)
TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)



Messages

Type	ID	Message
System		Processing

Project Navigator

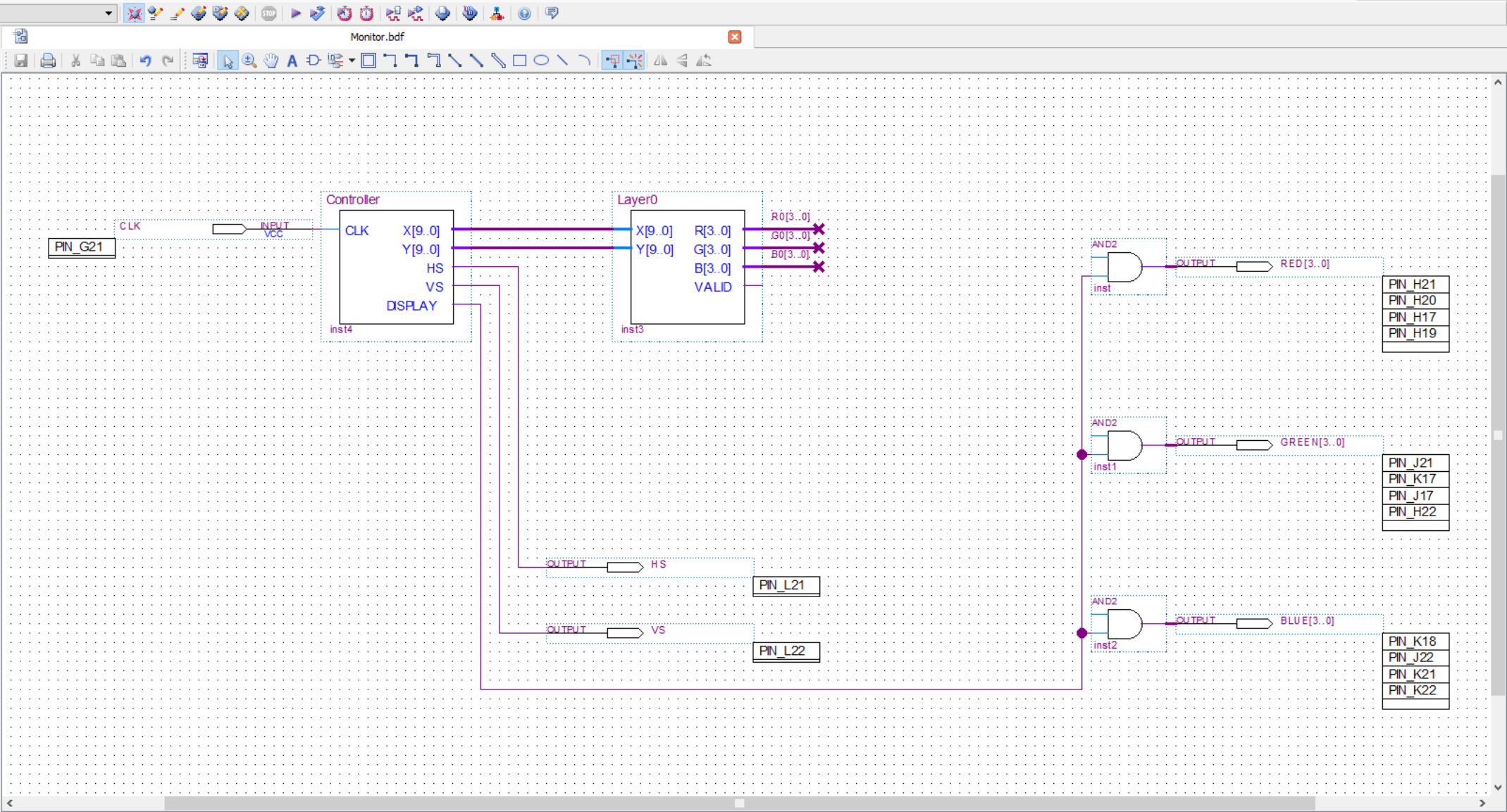
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Hierarchy | Files | Design Units

Tasks

Flow: Compilation

Task
Compile Design
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Program Device (Open Programmer)



Messages

Type	ID	Message
System		Processing

678,332 | 0% | 00:00:00

Project Navigator

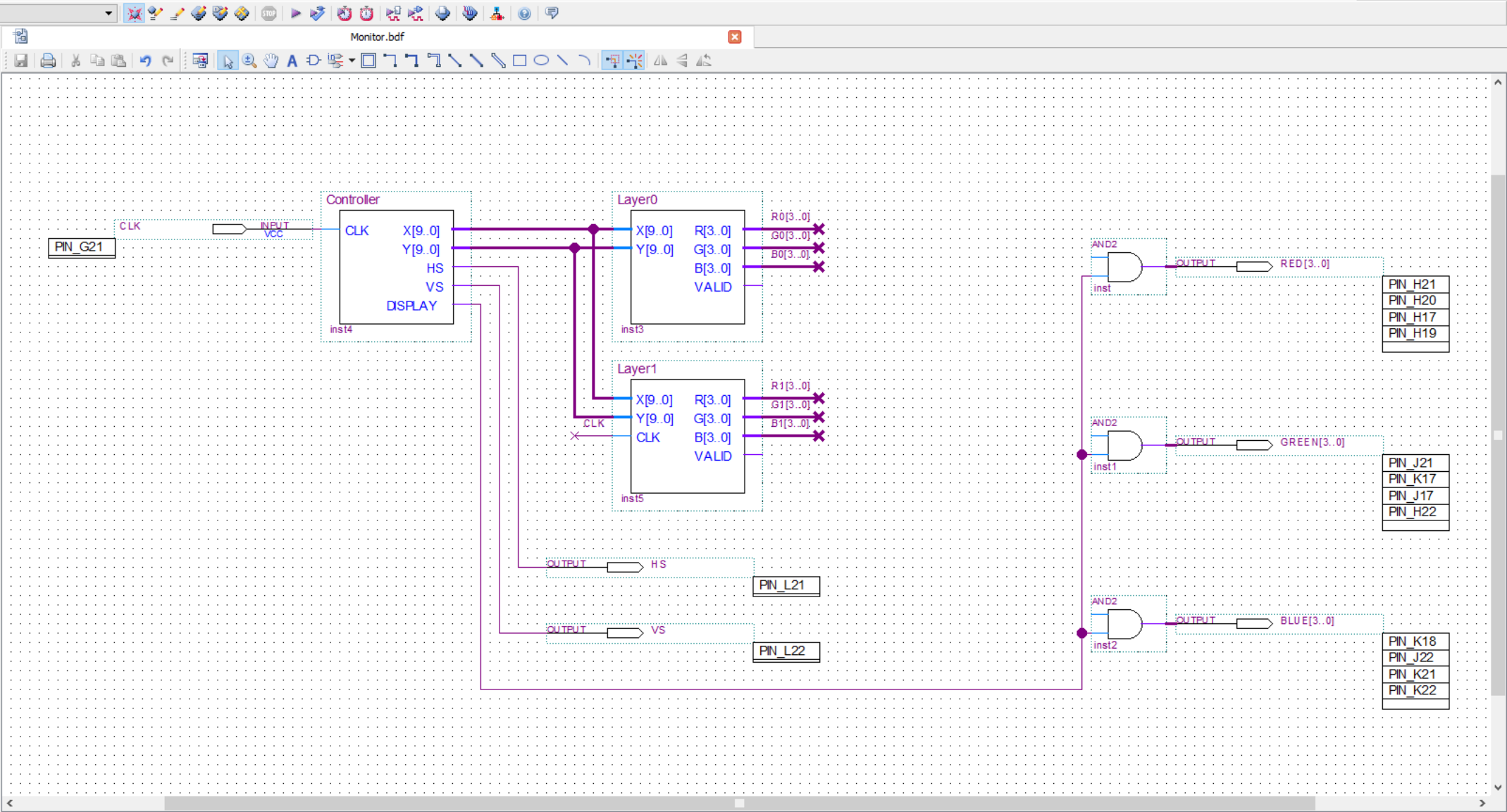
- Monitor.bdf
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Hierarchy | Files | Design Units

Tasks

Flow: Compilation

Task
Compile Design
Analysis & Synthesis
Fitter (Place & Route)
Assembler (Generate programming files)
TimeQuest Timing Analysis
EDA Netlist Writer
Program Device (Open Programmer)



Messages

Type	ID	Message
System		Processing

906,466 | 0% | 00:00:00

Project Navigator

Files

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Hierarchy

Files

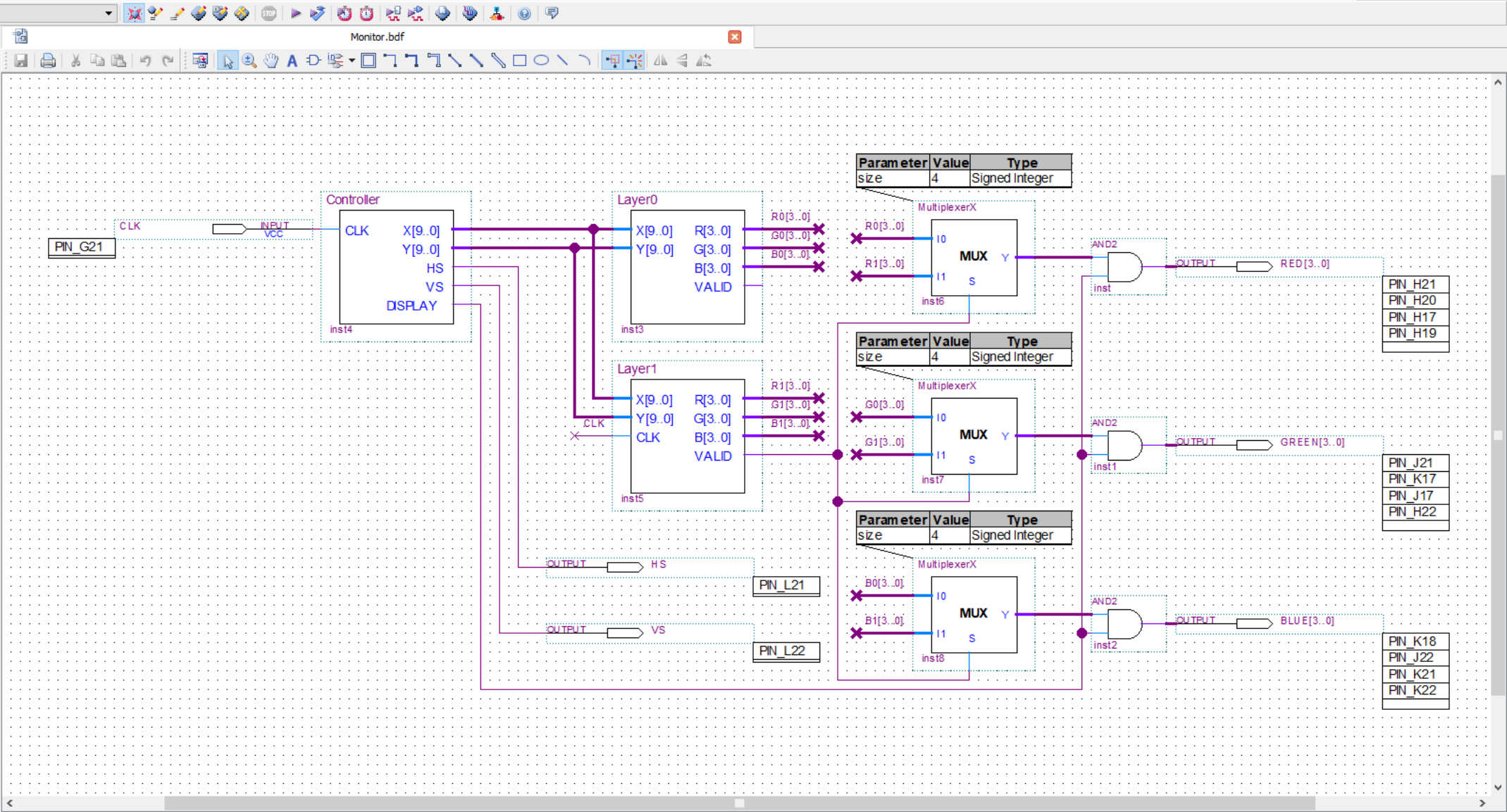
Design Units

Tasks

Flow: Compilation

Task

- Compile Design
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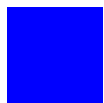
Messages

All

Type ID Message

System Processing

Приказ



Даљи рад

- Како се цртају други геометријски облици?
- Како се детектује судар две фигуре?

Приказ

