

## Small soft core uP Inventory

Opencore and other soft core processors

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Only cores in the "usable" category included

Most Prolific Authors		©2014 James Brakefield
John Kent	micro8a, micro16b, system05, system09, system11, system68	6
Daniel Wallner	ax8, ppx16, t65, t80	4
Ulrich Riedel	68hc05, 68hc08, tiny64, tiny8	4
Jose Ruiz	ion, light52, light8080	3
Lazaridis Dimitris	mips_fault_tolerant, mipsr2000, mips_enhanced	3
Shawn Tan	ae18, aeMB, k68	3

Most FPGA results (e.g. easy to compile, place & route on any FPGA family)		©2014 James Brakefield
eco32	cyclone-4, arria-2, spartan-3, spartan-6, kintex-7	5
navre	cyclone-4, arria-2, cyclone-5, spartan-6, kintex-7	5
leros	cyclone-4, spartan-3, spartan-6, kintex-7	4
openmsp430	cyclone-4, stratix-3, spartan-6, virtex-6	4

Most Clones		©2014 James Brakefield
MIPS	ion, minimips, mips_fault_tolerant, misp32r1, misp789, mipsr2000, plasma, ucore, yacc, m1_core	10
6502	ag_6502, cpu6502_true_cycle, free6502, lattice6502, m65c02, t65, t6507lp, m65	8
PIC16	free_risc8, lw risc, minirisc, p16c5x, ppx16, recore54, risc16f84, risc5x	8
microblaze	aeMB, mblite, microblaze, myblaze, openfire_core, secretblaze	6
6800	hd63701, system68, system05, 68hc05, 68hc08	5
8051	dalton_8051, light52, mc8051, t51, turbo8051	5
avr	avr_core, avr_hp, avr8, navre, riscmdu	5
z80	nextz80, t80, tv80, wb_z80, y80e	5
openrisc	altor32, minsoc, or1k, or1200_hp	4
6809	6809_6309, system09, mc6809e	3
8080	cpu8080, light8080, t80	3
68000	ao68000, tg68, v1_coldfire	3
PDP-8	pdp8, pdp8l, pdp8verilog	3
picoblaze	copyblaze, pacoblaze, picoblaze	3

Most Numerous Original Processor Type		©2014 James Brakefield
RISC	alwcpu, atlas_core, ba22, erp, gumnut, jane_nn, jpu16, latticemicro32, latticemicro8, natalius_8bit_risc, open8_risc, rise, sayeh_processor, scarts, szp, tiny64, xr16, diogenes, eco32, eight_bit_uc, fpgammix, hicovec, hpc-16, jam, manik, marca, raptor64, risc0, risc5, yasep	30
forth	b16, dfp, j1, jop, microcore, myforthprocessor, nige_machine, ssbcc, zpu, 8bit_chapman, cpu16, dataflow_chapman, msl16, p16, x32	15
accumulator	blue, lem1_9, leros, mcpu, popcorn, tisc, usimplez	7
openrisc	altor32, minsoc, or1k, or1200_hp	4

Usage beyond original author		©2014 James Brakefield
amber	Amber ARM-compatible core	OCCP
leon	SPARC clone, commerical product, 25 FPGA boards supported	
minsoc	OpenRISC implementation of OR1200 SOC	OCCP
openMSP430	Clone of Texas Instruments MSP430 family	OCCP
or1k	OpenRISC 1000	OCCP
plasma	Plasma - most MIPS I opcodes	OCCP
system09	Color Computer, arcade games, SWTPC	
t400	T400 uController	OCCP
t48	T48 uController	OCCP
zpu	Zylin CPU, commercial product	

FPGA based Legacy Processor Emulation		<a href="http://en.wikipedia.org/wiki/Home_computer_remake">http://en.wikipedia.org/wiki/Home_computer_remake</a>
Cray-1 (cray1)	<a href="http://www.chrisfenton.com/homebrew-cray-1a/">www.chrisfenton.com/homebrew-cray-1a/</a>	
PDP-8	<a href="http://www.emeritus-solutions.com/pdp8onanfpga.htm">http://www.emeritus-solutions.com/pdp8onanfpga.htm</a>	
PDP-11/70 (w11)	<a href="http://opencores.org/project,w11">http://opencores.org/project,w11</a>	
Amiga (68000)	<a href="http://en.wikipedia.org/wiki/Minimig">http://en.wikipedia.org/wiki/Minimig</a>	
MIST(minimig)	<a href="http://harbaum.org/till/mist/index.shtml">http://harbaum.org/till/mist/index.shtml</a>	
PDP	<a href="http://www.aracnet.com/~healyzh/pdp_fpga.html">http://www.aracnet.com/~healyzh/pdp_fpga.html</a>	

SWTPC 6809	<a href="http://members.optusnet.com.au/jekent/system09/">http://members.optusnet.com.au/jekent/system09/</a>	
generic	<a href="http://fpgaarcade.com/">http://fpgaarcade.com/</a>	
Color Computer	<a href="http://8littlebits.wordpress.com/category/coco3fpga/">http://8littlebits.wordpress.com/category/coco3fpga/</a>	
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Highest KIPS per LUT or ALM		©2014 James Brakefield			
Work in progress: KIPS/LUT not calibrated, compile/place/route runs not validated, many of the small designs will move down on list					
		KIPS/LUT	style	Fmax	LUTs ALM
iDEA	A Lean FPGA Soft Processor Built Using a DSP Block (academic paper only)	1883	RISC	534	190
leros	Leros: A Tiny Microcontroller for FPGAs	1640	accum	277	115
risc16f84	PIC16 clone	1007	PIC16	333	331
Lutiac	Lutiac – Small Soft Processors for Small Programs (academic paper only)	948	2 reg	198	140
avr8	not a full AVR clone, doc is opencores page	792	AVR	418	174
octavo	Octavo: an FPGA-Centric Processor Family, eight slot barrel	737	reg	550	500
cpu16		648	forth	355	367
ARM_Cortex_A9	ASIC, LUTs number based on relative area, dual issue, includes fltg-pt & MMU & caches	583	ARM a9	1050	4500
msl16		566	forth	256	303
alwcpu		533	RISC	237	298
microblaze	Xilinx proprietary, area optimized, 70 configuration options, MMU optional	498	uBlaze	264	546
nios2	Altera proprietary, speed optimized; fltg-pt, cache & MMU options	390	Nios II	310	895
picoblaze		338	picoBlaze	182	178
J1		280	forth	117	333
light8080		265	8080	247	154
natalius_8bit_risc		249	RISC	175	232
atlas_core	ARM thumb like inst set, also MMU version	235	RISC	192	655
sayeh_processor	simple RISC	230	RISC	164	479
eric5	enter-electronics.com proprietary	229	forth	60	110
pacoBlaze	picoblaze clone	218	picoBlaze	117	177
popcorn	small 8 bit uP	211	accum	171	268

Other Insights	©2014 James Brakefield			
<b>For small micro-controllers with small memory needs, some soft cores are competitive with ASIC cores</b>				
Relative LUT usage per FPGA family: ALUTs and 6-LUTs reduce counts by 33%				
Relative Fmax per FPGA family: 28nm not much faster than 40nm				
Relative Fmax per FPGA family: Lost cost families (Cyclone & Spartan) ~half as fast as highest performance families (Stratix & Virtex)				
No one architecture completely dominates performance: size, speed or area				
Some "alpha" phase designs are system designs where core is stable and working				
For those barrel designs with a variety of barrel lengths, intermediate barrel length gives best KIPS/LUT (ugh, sample size of 1)				
No parts from high performance FPGA families available in "webpack" tools (Arria V, Stratix V, Virtex 7)				