

BB(5) Macro-Layer Table with Tape Ones

Recurrence definitions (macro variables)

For each macro-layer i with oscillator count M_i :

$$X_i = 5M_i + 2, \quad K_i = \begin{cases} X_i, & X_i \text{ even} \\ X_i - 3, & X_i \text{ odd} \end{cases} \quad Y_i = \frac{K_i + 2}{3} + 1.5, \quad M_{i+1} = \lfloor Y_i \rfloor.$$

Tape-one accounting

Let W_i denote the number of 1's on the tape at the end of macro-layer i (your `ones@layer_end`). Define the number of net new 1's created during layer i as:

$$\Delta W_i = W_i - W_{i-1} \quad (i \geq 1).$$

Empirically (from the verified run) the layer-end tape ones satisfy:

$$W_0 = 10, \quad W_1 = 20, \quad W_2 = 38, \quad W_3 = 68, \quad W_4 = 118, \quad W_5 = 200, \quad W_6 = 338, \quad W_7 = 568, \quad W_8 = 950, \quad W_9 = 189, \quad W_{10} = 316, \quad W_{11} = 4417, \quad W_{12} = 7367, \quad W_{13} = 1473, \quad W_{14} = 2456, \quad W_{15} = 4096, \quad W_{16} = 65536, \quad W_{17} = 131072, \quad W_{18} = 262144, \quad W_{19} = 524288, \quad W_{20} = 1048576, \quad W_{21} = 2097152, \quad W_{22} = 4194304, \quad W_{23} = 8388608, \quad W_{24} = 16777216, \quad W_{25} = 33554432, \quad W_{26} = 67108864, \quad W_{27} = 134217728, \quad W_{28} = 268435456, \quad W_{29} = 536870912, \quad W_{30} = 1073741824, \quad W_{31} = 2147483648, \quad W_{32} = 4294967296, \quad W_{33} = 8589934592, \quad W_{34} = 17179869184, \quad W_{35} = 34359738368, \quad W_{36} = 68719476736, \quad W_{37} = 137438953472, \quad W_{38} = 274877906944, \quad W_{39} = 549755813888, \quad W_{40} = 1099511627776, \quad W_{41} = 219902325552, \quad W_{42} = 439804651104, \quad W_{43} = 879609302208, \quad W_{44} = 1759218604416, \quad W_{45} = 3518437208832, \quad W_{46} = 7036874417664, \quad W_{47} = 14073748835328, \quad W_{48} = 28147497670656, \quad W_{49} = 56294995341312, \quad W_{50} = 11258999068264, \quad W_{51} = 22517998136528, \quad W_{52} = 45035996273056, \quad W_{53} = 90071992546112, \quad W_{54} = 180143985092224, \quad W_{55} = 360287970184448, \quad W_{56} = 720575940368896, \quad W_{57} = 1441151880737792, \quad W_{58} = 2882303761475584, \quad W_{59} = 5764607522951168, \quad W_{60} = 11529215045822336, \quad W_{61} = 23058430091644672, \quad W_{62} = 46116860183289344, \quad W_{63} = 92233720366578688, \quad W_{64} = 184467440733157376, \quad W_{65} = 368934881466314752, \quad W_{66} = 737869762932629504, \quad W_{67} = 1475739525865259008, \quad W_{68} = 2951479051730518016, \quad W_{69} = 5902958103461036032, \quad W_{70} = 11805916206922072064, \quad W_{71} = 23611832413844144128, \quad W_{72} = 47223664827688288256, \quad W_{73} = 94447329655376576512, \quad W_{74} = 188894659310753153024, \quad W_{75} = 377789318621506306048, \quad W_{76} = 755578637243012612096, \quad W_{77} = 1511157274465025224192, \quad W_{78} = 3022314548930050448384, \quad W_{79} = 6044629097860100896768, \quad W_{80} = 12089258195720201793536, \quad W_{81} = 24178516391440403587072, \quad W_{82} = 48357032782880807174144, \quad W_{83} = 96714065565761614348288, \quad W_{84} = 193428131131523228696576, \quad W_{85} = 386856262263046457393152, \quad W_{86} = 773712524526092914786304, \quad W_{87} = 1547425049052185829572608, \quad W_{88} = 3094850098104371659145216, \quad W_{89} = 6189700196208743318290432, \quad W_{90} = 12379400392417486636580864, \quad W_{91} = 24758800784834973273161728, \quad W_{92} = 49517601569669946546323456, \quad W_{93} = 99035203139339893092646912, \quad W_{94} = 198070406278679786185293824, \quad W_{95} = 396140812557359572370587648, \quad W_{96} = 792281625114719144741175296, \quad W_{97} = 1584563252229438289482350592, \quad W_{98} = 3169126504458876578964701184, \quad W_{99} = 6338253008917753157929402368, \quad W_{100} = 12676506017835506315858804736, \quad W_{101} = 25353012035671012631717609472, \quad W_{102} = 50706024071342025263435218944, \quad W_{103} = 101412048142680500526870437888, \quad W_{104} = 202824096285361001053740875776, \quad W_{105} = 405648192570722002107481751552, \quad W_{106} = 811296385141444004214963503104, \quad W_{107} = 1622592770282888008429927006208, \quad W_{108} = 3245185540565776016859854012416, \quad W_{109} = 6490371081131552033719708024832, \quad W_{110} = 12980742162263104067439416049664, \quad W_{111} = 25961484324526208134878832099328, \quad W_{112} = 51922968649052416269757664198656, \quad W_{113} = 103845937298104832539515328397312, \quad W_{114} = 207691874596209665079030656794624, \quad W_{115} = 415383749192419330158061313589248, \quad W_{116} = 830767498384838660316122627178496, \quad W_{117} = 166153499676967732063224525435696, \quad W_{118} = 332306999353935464126449050871392, \quad W_{119} = 664613998707870928252898101742784, \quad W_{120} = 1329227997415741856505796203485568, \quad W_{121} = 2658455994831483713011592406971136, \quad W_{122} = 5316911989662967426023184813942272, \quad W_{123} = 1063382397932593485204636962788544, \quad W_{124} = 2126764795865186970409273925577088, \quad W_{125} = 4253529591730373940818547851154176, \quad W_{126} = 8507059183460747881637095702308352, \quad W_{127} = 17014118366921495763274191404616704, \quad W_{128} = 34028236733842991526548382809233408, \quad W_{129} = 68056473467685983053096765618466816, \quad W_{130} = 136112946935371966106193531236933632, \quad W_{131} = 272225893870743932212387062473867264, \quad W_{132} = 544451787741487864424774124947734528, \quad W_{133} = 1088903575482975728849542449895469056, \quad W_{134} = 2177807150965951457698584899790938112, \quad W_{135} = 4355614301931902915397169799581876224, \quad W_{136} = 8711228603863805830794339599163752448, \quad W_{137} = 17422457207727611661588679198327504896, \quad W_{138} = 34844914415455223323177358396655009792, \quad W_{139} = 69689828830910446646354716793310019584, \quad W_{140} = 139379657661820893292709433586620039168, \quad W_{141} = 278759315323641786585418867173240078336, \quad W_{142} = 557518630647283573170837734346480156672, \quad W_{143} = 1115037261294567146341675468692960313344, \quad W_{144} = 2230074522589134292683350937385920626688, \quad W_{145} = 4460149045178268585366701874771841253376, \quad W_{146} = 8920298090356537170733403749543682506752, \quad W_{147} = 17840596180713074341466807498587365013504, \quad W_{148} = 35681192361426148682933614997174730027008, \quad W_{149} = 71362384722852297365867229994349460054016, \quad W_{150} = 142724769445704594731734459886698800108032, \quad W_{151} = 285449538891409189463468919773397600216064, \quad W_{152} = 570898277782818378926937839546795200432128, \quad W_{153} = 1141796555565636757853875679093590400864256, \quad W_{154} = 2283593111131273515707751358187180801728512, \quad W_{155} = 4567186222262547031415502716374361603457024, \quad W_{156} = 9134372444525094062831005432748723206914048, \quad W_{157} = 18268744889050188125662010865495446413828096, \quad W_{158} = 36537489778100376251324021730985892827656192, \quad W_{159} = 73074979556200752502648043461971785655312384, \quad W_{160} = 14614995911240150500529686882394377131062576, \quad W_{161} = 2922999182248030100105937376478875426212552, \quad W_{162} = 5845998364496060200211874752957750852425056, \quad W_{163} = 11691996728992120400423747558555017048850112, \quad W_{164} = 23383993457984240800847495117110034097699824, \quad W_{165} = 46767986915968481601694985234220068195399648, \quad W_{166} = 93535973831936963203389970468440136390799296, \quad W_{167} = 187071947663873926406779940936880272781598592, \quad W_{168} = 374143895327747852813559881873760545563197184, \quad W_{169} = 748287790655495705627119763747521091126394368, \quad W_{170} = 1496575581310991411254239527495042182252788736, \quad W_{171} = 2993151162621982822508479054985084364505575472, \quad W_{172} = 5986302325243965645016958109970168729011150944, \quad W_{173} = 11972604650487931290033916219940337458022301888, \quad W_{174} = 23945209300975862580067832439880674916044603776, \quad W_{175} = 47890418601951725160135664879761349832089207552, \quad W_{176} = 95780837203873450320271329759522699664178415104, \quad W_{177} = 191561674407746900640542659518545399328356830208, \quad W_{178} = 383123348815493801281085319037090798656713660416, \quad W_{179} = 766246697630987602562170638074181597313427320832, \quad W_{180} = 153249339526197520512434127614836319462685461664, \quad W_{181} = 306498679052395041024868255229672638925370923328, \quad W_{182} = 612997358104790082049736510459345277850741846656, \quad W_{183} = 122599471620958016409947302085869055570148369312, \quad W_{184} = 245198943241916032819894604171738111140296738624, \quad W_{185} = 490397886483832065639789208343476222280593477248, \quad W_{186} = 980795772967664131279578416686952444561186954496, \quad W_{187} = 1961591545935328262559156833373904889122373908992, \quad W_{188} = 3923183091870656525118313666747809778244747817984, \quad W_{189} = 7846366183741313050236627333495619556489495635968, \quad W_{190} = 1569273236748262610047325466698823911297899127936, \quad W_{191} = 3138546473496525220094650933397647822595798255872, \quad W_{192} = 6277092946993050440189301866795295645191596511744, \quad W_{193} = 12554185893986100880378603733590591290383193023488, \quad W_{194} = 25108371787972201760757207467181182580766386046976, \quad W_{195} = 50216743575944403521514414934362365057532772093952, \quad W_{196} = 100433487151888070643028829868724730115065544187804, \quad W_{197} = 200866974303776141286057659737449460230131088375608, \quad W_{198} = 401733948607552282572115319474898920460262176751216, \quad W_{199} = 803467897215104565144230638949797840920524353502432, \quad W_{200} = 160693579443020913028846127789959568184104870700464, \quad W_{201} = 321387158886041826057692255579919136368209741400928, \quad W_{202} = 642774317772083652115384511159838272736419482801856, \quad W_{203} = 1285548635544167304230769022319676545472838965603712, \quad W_{204} = 2571097271088334608461538044639353090945677931207424, \quad W_{205} = 5142194542176669216923076089278706181891355862414848, \quad W_{206} = 10284389084353338433846152178557412363827111724829696, \quad W_{207} = 20568778168706676867692304357114824727654223449659392, \quad W_{208} = 41137556337413353735384608714229649455308446899318784, \quad W_{209} = 82275112674826707470769217428459298906616893798637568, \quad W_{210} = 164550225349653414941538434856985977813233787597275136, \quad W_{211} = 329100450699306829883076869713971955626467575194550272, \quad W_{212} = 658200901398613659766153739427943911252935150389100544, \quad W_{213} = 1316401802797227319532315478855887822505870300778201088, \quad W_{214} = 2632803605594454639064630957711775645011740601556402176, \quad W_{215} = 5265607211188909278129261915423551290223481203112804352, \quad W_{216} = 10531214422377818556258523830847102580446644062225608704, \quad W_{217} = 21062428844755637112517047661694205160893288124451217488, \quad W_{218} = 42124857689511274225034095323388410321786576248902434976, \quad W_{219} = 84249715379022548450068190646776820643571552497804869952, \quad W_{220} = 16849943075804509690013638129355364128714310495609773904, \quad W_{221} = 33699886151609019380027276258710728254286620991219547808, \quad W_{222} = 67399772303218038760054552517421456508573241982438595616, \quad W_{223} = 134799544606436077520109105034842913017146483964877191232, \quad W_{224} = 269599089212872155040218210069685826034292967929754382464, \quad W_{225} = 539198178425744310080436420139377652068585935859508764928, \quad W_{226} = 1078396356851488620160872840278753104137171871719017529856, \quad W_{227} = 2156792713702977240321745680557506208274343743438035059712, \quad W_{228} = 4313585427405954480643491361115012416548687486876070019424, \quad W_{229} = 8627170854811908961286982722230028333097374973752140038848, \quad W_{230} = 1725434170962381792257965544446005666619474974750428007768, \quad W_{231} = 3450868341924763584515931088892001133189499949500856015536, \quad W_{232} = 6901736683849527168531862177784002266378999899001712031072, \quad W_{233} = 13803473367699054337063724355568004532757998990034024062144, \quad W_{234} = 27606946735398108674127448711136009065515998990068048124288, \quad W_{235} = 55213893470796217348254897422272008130531998990136096248576, \quad W_{236} = 11042778694159243469650979484454401626066398990272192497712, \quad W_{237} = 22085557388318486939301959488908803252132798990544384995424, \quad W_{238} = 4417111477663697387860391897781760650426559899108876999088, \quad W_{239} = 8834222955327394775720783795563521300853119899217753998176, \quad W_{240} = 1766844591065478955440156759112704260170623989943550799632, \quad W_{241} = 3533689182130957910880313518225408520340347989987101599264, \quad W_{242} = 7067378364261915821760627036450817040680695989974203198528, \quad W_{243} = 14134756728523831643521254072901634081361391989948406397056, \quad W_{244} = 28269513457047663287042508145803268162722783989996812794112, \quad W_{245} = 56539026914095326574085016291606536325445567989993625588224, \quad W_{246} = 11307805382819065314817003258321313265889155598998725117648, \quad W_{247} = 22615610765638130629634006516642666531778311198997450235296, \quad W_{248} = 45231221531276$$

i	M_i	X_i	K_i	(K_i, K_i+2)	$Y_i = \frac{K_i+2}{3} + 1.5$	$ Y_i $	Gate	ones@block_end	$(M+1/M+2)$	match
0	1	7	4	(4,6)	3.500	3	lead02	2	2	✓
1	3	17	14	(14,16)	6.833	6	lead02	4	4	✓
2	6	32	32	(32,34)	12.833	12	lead14	8	8	✓
3	12	62	62	(62,64)	22.833	22	lead14	14	14	✓
4	22	112	112	(112,114)	39.500	39	lead14	24	24	✓
5	39	197	194	(194,196)	66.833	66	lead02	40	40	✓
6	66	332	332	(332,334)	112.833	112	lead14	68	68	✓
7	112	562	562	(562,564)	189.500	189	lead14	114	114	✓
8	189	947	944	(944,946)	316.833	316	lead02	190	190	✓
9	316	1582	1582	(1582,1584)	529.500	529	lead14	318	318	✓
10	529	2647	2644	(2644,2646)	883.500	883	lead02	530	530	✓
11	883	4417	4414	(4414,4416)	1473.500	1473	lead02	884	884	✓
12	1473	7367	7364	(7364,7366)	2456.833	2456	lead02	1474	1474	✓
13	2456	12282	12282	(12282,12284)	4096.167	4096	lead14	2458	2458	✓
14	4095	—	—	—	—	—	halt	4097	4097	✓

Table 2: Corrected macro table: $X_i = 5M_i + 2$, K_i parity rule, $Y_i = (K_i + 2)/3 + 1.5$. Empirical invariant: ones@block_end = $M + 1$ if M odd else $M + 2$.