

Melodie Gong mit Timer Compare

Zur Erzeugung von Tonfrequenzen kann beim SpartanMC mit einem Timer Compare Modul die interne Taktfrequenz auf die entsprechende Tonfrequenz herunter geteilt werden. Dazu stellt man den Timer so ein, dass der Ausgang bei jedem Nulldurchgang des Timers invertiert wird. Im Timer muss also ein Wert geladen werden, der der halben Periodendauer der Tonfrequenz entspricht. Für den Kammerton A1=440Hz muss der Teiler bei 27 MHz mit $27000000/880 = 30681,818181818$ geladen werden. Da der Teiler nur ganzzahlige Werte verarbeiten kann, wird dieser Wert auf 30682 aufgerundet. Da in der Tonleiter eine Oktave genau einer Verdopplung oder Halbierung der Frequenz entspricht, muss für A0 61364 und für A 122727 geladen werden. Die übrigen 11 Töne einer Oktave kann man dann berechnen, da der Logarithmus der Tonfrequenzen einen konstanten Abstand besitzt. Der logarithmische Abstand zwischen zwei Tönen ist also gleich $1/12$ des Abstandes einer Oktave. Der lg von 122727 beträgt 5,088941083 , von 61364 ist der lg 4,787913661 , und von 30682 ist der lg 4,486883666. Der Oktavabstand des lg beträgt also:

$$5,088941083 - 4,787911088 = 0,301029995$$

$$4,787911088 - 4,486881092 = 0,301029996$$

Nimmt man davon $1/12$ $0,30103/12 = 0,0250858$, so ist dieser Wert nun 12 mal von 5,088941083 abzuziehen, und man erhält die Logarithmen der 12 Teiler einer Oktave. Die Teiler erhält man nun, indem 10 mit diesen Werten potenziert wird. Für die Frequenztafel des Programms müssen dann die Teiler aus der im Anschluß folgenden Tabelle verwendet werden. Diese Werte können dann noch durch einen Faktor von 2, 4 oder 8 geteilt werden. Damit kann die Tonlage um 3 Oktaven nach oben verschoben werden.

Nr.	Ton	Teiler	lg des Teilers	berechneter Teiler	durch 8 teilbar
1	A	122727	5,088941083	122727,272632102	122728 0x1df68
2	Ais		5,063855250	115839,120095455	115840 0x1c480
3	H		5,038769417	109337,5698547	109336 0x1ab18
4	C0		5,013683584	103200,923590238	103200 0x19320
5	Cis0		4,988597751	97408,700815571	97408 0x17c80
6	D0		4,963511918	91941,570525586	91944 0x16728
7	Dis0		4,938426085	86781,286681117	86784 0x15300
8	E0		4,913340252	81910,627314492	81912 0x13ff8
9	F0		4,888254419	77313,337052807	77312 0x12e00
10	Fis0		4,863168586	72974,072867141	72976 0x11d10
11	G0		4,838082753	68878,352866616	68880 0x10d10
12	Gis0		4,81299692	65012,507966432	65016 0x0fdf8
13	A0	61364	4,787913661	61363,999962966	61360 0x0efb0
14	Ais0		4,762827828	57919,903284709	57920 0x0e240
15	H0		4,737741995	54669,10889992	54672 0x0d590
16	C1		4,712656162	51600,767584506	51600 0x0c990
17	Cis1		4,687570329	48704,639034533	48704 0x0be40
18	D1		4,662484496	45971,057690166	45968 0x0b390
19	Dis1		4,637398663	43390,900477758	43392 0x0a980
20	E1		4,61231283	40955,556362443	40952 0x09ff8
21	F1		4,587226997	38656,897609605	38656 0x09700
22	Fis1		4,562141164	36487,25265932	36488 0x08e88
23	G1		4,537055331	34439,380523238	34440 0x08688
24	Gis1		4,511969498	32506,446618459	32504 0x07ef8
25	A1	30682	4,486883666	30682,000028392	30680 0x077d8
26	Ais1		4,461797833	28959,951686631	28960 0x07120
27	H1		4,436712	27334,554491751	27336 0x06ac8
28	C2		4,411626167	25800,383831698	25800 0x064c8

Bei einem Teiler von 2 ergeben sich dann folgende Kodierungen für die Noten im Programm, wenn die Nummer der Note in den oberen 5 Bit und die Zeit in den unteren 3 Bit verschlüsselt werden. Die Pausenfrequenz wird durch den Teiler nicht verändert. Sie bleibt für alle Teiler immer 0 Hz.

Nr	Note	1		3		1		3		Frequenz [Hz]	SpMC	(Hex)
		--	--	-	--	-	-	-	-			
		16	32	8	16	4	8	2	4			
0	Pause	00	01	02	03	04	05	06	07	0,00	00000	0x00000
1	a0	08	09	0A	0B	0C	0D	0E	0F	220,00	61360	0x0efb0
2	ais0	10	11	12	13	14	15	16	17	233,08	57920	0x0e240
3	h0	18	19	1A	1B	1C	1D	1E	1F	246,94	54672	0x0d590
4	c1	20	21	22	23	24	25	26	27	261,63	51600	0x0c990
5	cis1	28	29	2A	2B	2C	2D	2E	2F	277,18	48704	0x0be40
6	d1	30	31	32	33	34	35	36	37	293,66	45968	0x0b390
7	dis1	38	39	3A	3B	3C	3D	3E	3F	311,13	43392	0x0a980
8	e1	40	41	42	43	44	45	46	47	329,63	40952	0x09ff8
9	f1	48	49	4A	4B	4C	4D	4E	4F	349,23	38656	0x09700
10	fis1	50	51	52	53	54	55	56	57	369,99	36488	0x08e88
11	g1	58	59	5A	5B	5C	5D	5E	5F	391,99	34440	0x08688
12	gis1	60	61	62	63	64	65	66	67	415,30	32504	0x07ef8
13	a1	68	69	6A	6B	6C	6D	6E	6F	440,00	30680	0x077d8 *
14	ais1	70	71	72	73	74	75	76	77	466,16	28960	0x07120
15	h1	78	79	7A	7B	7C	7D	7E	7F	493,88	27336	0x06ac8
16	c2	80	81	82	83	84	85	86	87	523,25	25800	0x064c8
17	cis2	88	89	8A	8B	8C	8D	8E	8F	554,36	24352	0x05f20
18	d2	90	91	92	93	94	95	96	97	587,33	22984	0x059cb
19	dis2	98	99	9A	9B	9C	9D	9E	9F	622,25	21696	0x054c0
20	e2	A0	A1	A2	A3	A4	A5	A6	A7	659,25	20476	0x04ffc
21	f2	A8	A9	AA	AB	AC	AD	AE	AF	698,46	19328	0x04b80
22	fis2	B0	B1	B2	B3	B4	B5	B6	B7	739,99	18244	0x04744
23	g2	B8	B9	BA	BB	BC	BD	BE	BF	783,99	34440	0x08688
24	gis2	C0	C1	C2	C3	C4	C5	C6	C7	830,61	16252	0x03f7c
25	a2	C8	C9	CA	CB	CC	CD	CE	CF	880,00	15340	0x03bec
26	ais2	D0	D1	D2	D3	D4	D5	D6	D7	932,33	14480	0x03890
27	h2	D8	D9	DA	DB	DC	DD	DE	DF	987,76	13668	0x03564
28	c3	E0	E1	E2	E3	E4	E5	E6	E7	1046,50	12900	0x03264

Für die Notenummer haben dann die Kodierungen von 29 bis 31 besondere Bedeutung. Mit 29 wird ein Kommando zur Einstellung des Faktors für die Frequenztafel und zum Ein-/Aus-schalten des Staccato Effektes kodiert. In den unteren beiden Bits steht dann der Exponent des Faktors mit der Basis 2 für die Frequenzen aus Tabelle 1, und das 3. Bit schaltet den Staccato Effekt ein (1) oder aus (0). Ein Kommando hat die Länge einer 1/16 Note und die Frequenz der unmittelbar vorher gespielten Note. Folgende 8 Kommandos sind möglich:

Kom.	Staccato	Frequenzbereich für 1 bis 28		
e8	aus	a	...	c2
e9	aus	a0	...	c3
ea	aus	a1	...	c4
eb	aus	a2	...	c5
ec	ein	a	...	c2
ed	ein	a0	...	c3
ee	ein	a1	...	c4
ef	ein	a2	...	c5

Die Kodierung 30 mit den unteren 3 Bit gleich 0 (F0h) wird zur Kennzeichnung des Anfangs einer Melodie benutzt. Das Programm wartet dann auf einen Impuls am Taster 1 des SP601 und startet nach einem Impuls den Song. Bei der Kodierung 31 und alle unteren 3 Bit gleich 1 (FFh) springt das Programm zum 1. Song zurück. Jeder Song muss dann wie folgt aufgebaut sein:

Melodieanfang F0h - Ist das 1. Byte jedes Songs, danach steht ein Faktor für das Tempo des Songs, gefolgt von Noten und Kommandos.

Syntax: <F0h> <Tempobyte> <Notenbytes nach Tabelle,...>

Blockende FFh - muss hinter dem letzten Song stehen

Signalausgang an: P_FMC_LA18_CC_P am SP601
 Starteingang an: P_GPIO_BUTTON1 am SP601
 P_GPIO_BUTTON2 am SP601
 P_GPIO_BUTTON3 am SP601

Die Länge des Programms mit den Tabellen beträgt 2755 Byte. Es wird also nur reichlich ein Speicherblock benötigt. Die 9 Songs des Programms belegen 248 Byte. Es ist also viel Platz für weitere Songs vorhanden.

/home/schoene/Dokumente/spmc-prj-ss17/hw-tests/ticmp/sp601/ton_fq/build/firmware/subsystem_0/gong.elf: file
 format elf32-spmc

Disassembly of section .startup:

```

00000000 <_startup>:
 0: 00 01 50 00    lhi    r8, 0    ; 0x00
 2: 00 01 b0 07    ori    r8, 7    ; 0x07
 4: 00 00 21 05    jalrs  r8
 6: 00 01 52 01    lhi    r9, 1    ; 0x01
 8: 00 01 b2 39    ori    r9, 57   ; 0x39
 a: 00 00 21 22    jr     r9
 c: 00 00 20 15    or     r0, r0
  
```

Disassembly of section .init:

```

0000000e <_init>:
 e: 00 01 40 00    lhi    r0, 0    ; 0x00
10: 00 01 a1 aa    ori    r0, 426  ; 0x1aa
12: 00 02 c0 01    srli   r0, 1    ; 0x01
14: 00 00 20 9e    movi2s sfr_iv, r0
16: 00 01 40 1f    lhi    r0, 31   ; 0x1f
18: 00 01 a1 ff    ori    r0, 511  ; 0x1ff
1a: 00 02 c0 01    srli   r0, 1    ; 0x01
1c: 00 00 21 64    jrs    r11
1e: 00 02 80 01    slli   r0, 1    ; 0x01
  
```

Disassembly of section .data:

```

00000020 <_intr_tab>:
20: 00 00          .w9    0x00
21: 00 00          .w9    0x00
22: 00 00          .w9    0x00
23: 01 e5          .w9    0x1e5
24: 00 00          .w9    0x00
25: 01 c2          .w9    0x1c2
26: 00 00          .w9    0x00
27: 01 f3          .w9    0x1f3
28: 00 00          .w9    0x00
29: 01 ec          .w9    0x1ec
2a: 00 00          .w9    0x00
2b: 01 de          .w9    0x1de
  
```

```

0000002c <freqs>:
2c: 00 00          .w9    0x00
2d: 00 00          .w9    0x00
2e: 00 ef          .w9    0xef
2f: 01 68          .w9    0x168
30: 00 e2          .w9    0xe2
31: 00 80          .w9    0x80
32: 00 d5          .w9    0xd5
33: 01 18          .w9    0x118
  
```

```

34: 00 c9 .w9 0xc9
35: 01 20 .w9 0x120
36: 00 be .w9 0xbe
37: 00 80 .w9 0x80
38: 00 b3 .w9 0xb3
39: 01 28 .w9 0x128
3a: 00 a9 .w9 0xa9
3b: 01 00 .w9 0x100
3c: 00 9f .w9 0x9f
3d: 01 f8 .w9 0x1f8
3e: 00 97 .w9 0x97
3f: 00 00 .w9 0x00
40: 00 8e .w9 0x8e
41: 01 10 .w9 0x110
42: 00 86 .w9 0x86
43: 01 10 .w9 0x110
44: 00 7e .w9 0x7e ; '~'
45: 01 f8 .w9 0x1f8
46: 00 77 .w9 0x77 ; 'w'
47: 01 b0 .w9 0x1b0
48: 00 71 .w9 0x71 ; 'q'
49: 00 40 .w9 0x40 ; '@'
4a: 00 6a .w9 0x6a ; 'j'
4b: 01 90 .w9 0x190
4c: 00 64 .w9 0x64 ; 'd'
4d: 01 90 .w9 0x190
4e: 00 5f .w9 0x5f ; '_'
4f: 00 40 .w9 0x40 ; '@'
50: 00 59 .w9 0x59 ; 'Y'
51: 01 90 .w9 0x190
52: 00 54 .w9 0x54 ; 'T'
53: 01 80 .w9 0x180
54: 00 4f .w9 0x4f ; 'O'
55: 01 f8 .w9 0x1f8
56: 00 4b .w9 0x4b ; 'K'
57: 01 00 .w9 0x100
58: 00 47 .w9 0x47 ; 'G'
59: 00 88 .w9 0x88
5a: 00 43 .w9 0x43 ; 'C'
5b: 00 88 .w9 0x88
5c: 00 3f .w9 0x3f ; '?'
5d: 00 f8 .w9 0xf8
5e: 00 3b .w9 0x3b ; ';'
5f: 01 d8 .w9 0x1d8
60: 00 38 .w9 0x38 ; '8'
61: 01 20 .w9 0x120
62: 00 35 .w9 0x35 ; '5'
63: 00 c8 .w9 0xc8
64: 00 32 .w9 0x32 ; '2'
65: 00 c8 .w9 0xc8

```

00000066 <length>:

```

66: 00 0a .w9 0x0a
67: 00 0f .w9 0x0f
68: 00 14 .w9 0x14
69: 00 1e .w9 0x1e
6a: 00 28 .w9 0x28 ; '('
6b: 00 3c .w9 0x3c ; '<'
6c: 00 50 .w9 0x50 ; 'P'
6d: 00 78 .w9 0x78 ; 'x'

```

0000006e <melanf>:

```

6e: 00 f0 .w9 0xf0
6f: 00 0c .w9 0x0c
70: 00 86 .w9 0x86
71: 00 a4 .w9 0xa4
72: 00 bc .w9 0xbc
73: 00 7d .w9 0x7d ; '}'
74: 00 80 .w9 0x80
75: 00 90 .w9 0x90

```

76:	00 84	.w9	0x84	
77:	00 04	.w9	0x04	
78:	00 ce	.w9	0xce	
79:	00 bc	.w9	0xbc	
7a:	00 e4	.w9	0xe4	
7b:	00 bc	.w9	0xbc	
7c:	00 aa	.w9	0xaa	
7d:	00 a0	.w9	0xa0	
7e:	00 a8	.w9	0xa8	
7f:	00 a4	.w9	0xa4	
80:	00 f0	.w9	0xf0	
81:	00 13	.w9	0x13	
82:	00 8b	.w9	0x8b	
83:	00 90	.w9	0x90	
84:	00 8a	.w9	0x8a	
85:	00 a4	.w9	0xa4	
86:	00 a2	.w9	0xa2	
87:	00 7b	.w9	0x7b	; '{'
88:	00 88	.w9	0x88	
89:	00 7a	.w9	0x7a	; 'z'
8a:	00 94	.w9	0x94	
8b:	00 92	.w9	0x92	
8c:	00 6c	.w9	0x6c	; 'l'
8d:	00 7a	.w9	0x7a	; 'z'
8e:	00 8c	.w9	0x8c	
8f:	00 92	.w9	0x92	
90:	00 8c	.w9	0x8c	
91:	00 7a	.w9	0x7a	; 'z'
92:	00 6c	.w9	0x6c	; 'l'
93:	00 f0	.w9	0xf0	
94:	00 0e	.w9	0x0e	
95:	00 6a	.w9	0x6a	; 'j'
96:	00 60	.w9	0x60	; '^'
97:	00 68	.w9	0x68	; 'h'
98:	00 82	.w9	0x82	
99:	00 02	.w9	0x02	
9a:	00 82	.w9	0x82	
9b:	00 78	.w9	0x78	; 'x'
9c:	00 80	.w9	0x80	
9d:	00 a2	.w9	0xa2	
9e:	00 02	.w9	0x02	
9f:	00 a2	.w9	0xa2	
a0:	00 98	.w9	0x98	
a1:	00 a0	.w9	0xa0	
a2:	00 ca	.w9	0xca	
a3:	00 c0	.w9	0xc0	
a4:	00 c8	.w9	0xc8	
a5:	00 ca	.w9	0xca	
a6:	00 c0	.w9	0xc0	
a7:	00 c8	.w9	0xc8	
a8:	00 e5	.w9	0xe5	
a9:	00 f0	.w9	0xf0	
aa:	00 17	.w9	0x17	
ab:	00 5b	.w9	0x5b	; '['
ac:	00 48	.w9	0x48	; 'H'
ad:	00 40	.w9	0x40	; '@'
ae:	00 58	.w9	0x58	; 'X'
af:	00 80	.w9	0x80	
b0:	00 30	.w9	0x30	; '0'
b1:	00 44	.w9	0x44	; 'D'
b2:	00 22	.w9	0x22	; ''
b3:	00 80	.w9	0x80	
b4:	00 20	.w9	0x20	; ''
b5:	00 6b	.w9	0x6b	; 'k'
b6:	00 78	.w9	0x78	; 'x'
b7:	00 20	.w9	0x20	; ''
b8:	00 78	.w9	0x78	; 'x'
b9:	00 80	.w9	0x80	
ba:	00 68	.w9	0x68	; 'h'
bb:	00 5c	.w9	0x5c	; '\'

bc:	00 44	.w9	0x44	; 'D'
bd:	00 58	.w9	0x58	; 'X'
be:	00 02	.w9	0x02	
bf:	00 48	.w9	0x48	; 'H'
c0:	00 40	.w9	0x40	; '@'
c1:	00 58	.w9	0x58	; 'X'
c2:	00 20	.w9	0x20	; ' '
c3:	00 30	.w9	0x30	; '0'
c4:	00 42	.w9	0x42	; 'B'
c5:	00 30	.w9	0x30	; '0'
c6:	00 00	.w9	0x00	
c7:	00 20	.w9	0x20	; ' '
c8:	00 00	.w9	0x00	
c9:	00 80	.w9	0x80	
ca:	00 20	.w9	0x20	; ' '
cb:	00 32	.w9	0x32	; '2'
cc:	00 00	.w9	0x00	
cd:	00 30	.w9	0x30	; '0'
ce:	00 20	.w9	0x20	; ' '
cf:	00 00	.w9	0x00	
d0:	00 18	.w9	0x18	
d1:	00 00	.w9	0x00	
d2:	00 25	.w9	0x25	; '%'
d3:	00 f0	.w9	0xf0	
d4:	00 17	.w9	0x17	
d5:	00 22	.w9	0x22	; ' "'
d6:	00 32	.w9	0x32	; '2'
d7:	00 42	.w9	0x42	; 'B'
d8:	00 20	.w9	0x20	; ' '
d9:	00 00	.w9	0x00	
da:	00 22	.w9	0x22	; ' "'
db:	00 32	.w9	0x32	; '2'
dc:	00 42	.w9	0x42	; 'B'
dd:	00 20	.w9	0x20	; ' '
de:	00 00	.w9	0x00	
df:	00 42	.w9	0x42	; 'B'
e0:	00 4a	.w9	0x4a	; 'J'
e1:	00 5b	.w9	0x5b	; '['
e2:	00 00	.w9	0x00	
e3:	00 42	.w9	0x42	; 'B'
e4:	00 4a	.w9	0x4a	; 'J'
e5:	00 5b	.w9	0x5b	; '['
e6:	00 00	.w9	0x00	
e7:	00 58	.w9	0x58	; 'X'
e8:	00 68	.w9	0x68	; 'h'
e9:	00 58	.w9	0x58	; 'X'
ea:	00 48	.w9	0x48	; 'H'
eb:	00 42	.w9	0x42	; 'B'
ec:	00 20	.w9	0x20	; ' '
ed:	00 80	.w9	0x80	
ee:	00 58	.w9	0x58	; 'X'
ef:	00 68	.w9	0x68	; 'h'
f0:	00 58	.w9	0x58	; 'X'
f1:	00 48	.w9	0x48	; 'H'
f2:	00 40	.w9	0x40	; '@'
f3:	00 00	.w9	0x00	
f4:	00 22	.w9	0x22	; ' "'
f5:	00 82	.w9	0x82	
f6:	00 5a	.w9	0x5a	; 'Z'
f7:	00 83	.w9	0x83	
f8:	00 00	.w9	0x00	
f9:	00 82	.w9	0x82	
fa:	00 5a	.w9	0x5a	; 'Z'
fb:	00 83	.w9	0x83	
fc:	00 f0	.w9	0xf0	
fd:	00 17	.w9	0x17	
fe:	00 20	.w9	0x20	; ' '
ff:	00 40	.w9	0x40	; '@'
100:	00 48	.w9	0x48	; 'H'
101:	00 5b	.w9	0x5b	; '['

102:	00 ea	.w9	0xea	
103:	00 00	.w9	0x00	
104:	00 20	.w9	0x20	; ' '
105:	00 40	.w9	0x40	; '@'
106:	00 48	.w9	0x48	; 'H'
107:	00 5b	.w9	0x5b	; '['
108:	00 e9	.w9	0xe9	
109:	00 00	.w9	0x00	
10a:	00 20	.w9	0x20	; ' '
10b:	00 40	.w9	0x40	; '@'
10c:	00 48	.w9	0x48	; 'H'
10d:	00 5a	.w9	0x5a	; 'Z'
10e:	00 42	.w9	0x42	; 'B'
10f:	00 22	.w9	0x22	; ' "'
110:	00 40	.w9	0x40	; '@'
111:	00 00	.w9	0x00	
112:	00 40	.w9	0x40	; '@'
113:	00 33	.w9	0x33	; '3'
114:	00 00	.w9	0x00	
115:	00 30	.w9	0x30	; '0'
116:	00 40	.w9	0x40	; '@'
117:	00 30	.w9	0x30	; '0'
118:	00 22	.w9	0x22	; ' "'
119:	00 00	.w9	0x00	
11a:	00 80	.w9	0x80	
11b:	00 42	.w9	0x42	; 'B'
11c:	00 58	.w9	0x58	; 'X'
11d:	00 00	.w9	0x00	
11e:	00 58	.w9	0x58	; 'X'
11f:	00 4b	.w9	0x4b	; 'K'
120:	00 00	.w9	0x00	
121:	00 48	.w9	0x48	; 'H'
122:	00 40	.w9	0x40	; '@'
123:	00 48	.w9	0x48	; 'H'
124:	00 58	.w9	0x58	; 'X'
125:	00 00	.w9	0x00	
126:	00 42	.w9	0x42	; 'B'
127:	00 22	.w9	0x22	; ' "'
128:	00 32	.w9	0x32	; '2'
129:	00 25	.w9	0x25	; '%'
12a:	00 f0	.w9	0xf0	
12b:	00 0c	.w9	0x0c	
12c:	00 93	.w9	0x93	
12d:	00 00	.w9	0x00	
12e:	00 94	.w9	0x94	
12f:	00 7a	.w9	0x7a	; 'z'
130:	00 82	.w9	0x82	
131:	00 93	.w9	0x93	
132:	00 00	.w9	0x00	
133:	00 94	.w9	0x94	
134:	00 7b	.w9	0x7b	; '{'
135:	00 00	.w9	0x00	
136:	00 7d	.w9	0x7d	; '}'
137:	00 82	.w9	0x82	
138:	00 6a	.w9	0x6a	; 'j'
139:	00 7a	.w9	0x7a	; 'z'
13a:	00 5e	.w9	0x5e	; '^'
13b:	00 f0	.w9	0xf0	
13c:	00 09	.w9	0x09	
13d:	00 e8	.w9	0xe8	
13e:	00 a6	.w9	0xa6	
13f:	00 c6	.w9	0xc6	
140:	00 b6	.w9	0xb6	
141:	00 7f	.w9	0x7f	
142:	00 00	.w9	0x00	
143:	00 a6	.w9	0xa6	
144:	00 b6	.w9	0xb6	
145:	00 c6	.w9	0xc6	
146:	00 a7	.w9	0xa7	
147:	00 00	.w9	0x00	

```

148: 00 c6 .w9 0xc6
149: 00 a6 .w9 0xa6
14a: 00 b6 .w9 0xb6
14b: 00 7e .w9 0x7e ; '-'
14c: 00 00 .w9 0x00
14d: 00 7e .w9 0x7e ; '-'
14e: 00 b6 .w9 0xb6
14f: 00 c6 .w9 0xc6
150: 00 a7 .w9 0xa7
151: 00 00 .w9 0x00
152: 00 e9 .w9 0xe9
153: 00 f0 .w9 0xf0
154: 00 06 .w9 0x06
155: 00 27 .w9 0x27 ; ''
156: 00 5e .w9 0x5e ; '^'
157: 00 4a .w9 0x4a ; 'J'
158: 00 42 .w9 0x42 ; 'B'
159: 00 34 .w9 0x34 ; '4'
15a: 00 87 .w9 0x87
15b: 00 5e .w9 0x5e ; '^'
15c: 00 4a .w9 0x4a ; 'J'
15d: 00 42 .w9 0x42 ; 'B'
15e: 00 34 .w9 0x34 ; '4'
15f: 00 87 .w9 0x87
160: 00 5e .w9 0x5e ; '^'
161: 00 4a .w9 0x4a ; 'J'
162: 00 42 .w9 0x42 ; 'B'
163: 00 4c .w9 0x4c ; 'L'
164: 00 36 .w9 0x36 ; '6'
165: 00 ff .w9 0xff

```

00000166 <T_gong>:

```

166: 00 03 .w9 0x03
167: 00 04 .w9 0x04
168: 00 ed .w9 0xed
169: 00 87 .w9 0x87
16a: 00 97 .w9 0x97
16b: 00 bf .w9 0xbf
16c: 00 00 .w9 0x00
16d: 00 e9 .w9 0xe9
16e: 00 f0 .w9 0xf0
16f: 00 00 .w9 0x00

```

00000170 <tmpdata>:

```

170: 00 00 .w9 0x00
171: 00 00 .w9 0x00
172: 00 00 .w9 0x00
173: 00 00 .w9 0x00
174: 00 00 .w9 0x00
175: 00 01 .w9 0x01
176: 00 00 .w9 0x00
177: 00 00 .w9 0x00
178: 00 00 .w9 0x00
179: 00 01 .w9 0x01
17a: 00 00 .w9 0x00
17b: 00 00 .w9 0x00
17c: 00 00 .w9 0x00
17d: 00 04 .w9 0x04
17e: 00 00 .w9 0x00
17f: 00 00 .w9 0x00
180: 00 00 .w9 0x00
181: 00 17 .w9 0x17
182: 00 00 .w9 0x00
183: 00 00 .w9 0x00
184: 00 00 .w9 0x00
185: 00 00 .w9 0x00
186: 00 00 .w9 0x00
187: 00 00 .w9 0x00
188: 00 00 .w9 0x00
189: 00 f0 .w9 0xf0

```



```

0000018a <data>:
18a:  00 00          .w9      0x00
18b:  01 70          .w9      0x170

```

```

0000018c <printf_buffer>:
18c:  00 20          .w9      0x20      ; ' '
18d:  00 20          .w9      0x20      ; ' '
18e:  00 00          .w9      0x00
18f:  00 00          .w9      0x00
190:  00 00          .w9      0x00
191:  00 00          .w9      0x00
192:  00 00          .w9      0x00
193:  00 00          .w9      0x00
194:  00 00          .w9      0x00
195:  00 00          .w9      0x00
196:  00 00          .w9      0x00
197:  00 00          .w9      0x00
198:  00 00          .w9      0x00
199:  00 00          .w9      0x00
19a:  00 00          .w9      0x00
19b:  00 00          .w9      0x00
19c:  00 00          .w9      0x00
19d:  00 00          .w9      0x00
19e:  00 00          .w9      0x00
19f:  00 00          .w9      0x00

```

```

000001a0 <stdio_descr>:
1a0:  00 00          .w9      0x00
1a1:  00 00          .w9      0x00
1a2:  00 00          .w9      0x00
1a3:  00 00          .w9      0x00
1a4:  00 00          .w9      0x00
1a5:  00 00          .w9      0x00
1a6:  00 00          .w9      0x00
1a7:  00 00          .w9      0x00
1a8:  00 00          .w9      0x00
1a9:  00 00          .w9      0x00

```

Disassembly of section interrupt:

```

000001aa <_intr_handle>:
1aa:  00 00 30 7f      movs2i   r8, sfr_cc
1ac:  00 00 1d 05      mov      r14, r8
1ae:  00 01 53 a0      lhi     r9, 416 ; 0x1a0
1b0:  00 01 b2 00      ori     r9, 0 ; 0x00
1b2:  00 02 53 20      l18    r9, 0(r9)
1b4:  00 01 92 1f      andi   r9, 31 ; 0x1f
1b6:  00 01 54 00      lhi     r10, 0 ; 0x00
1b8:  00 01 b4 20      ori     r10, 32 ; 0x20
1ba:  00 00 92 06      beqz   r9, 0x001c6 ; 0x1c6 <_intr_exit>
1bc:  00 02 92 01      slli   r9, 1 ; 0x01
1be:  00 00 33 51      addu   r9, r10
1c0:  00 02 5f 20      l18    r15, 0(r9)
1c2:  00 00 21 e5      jalrs  r15
1c4:  00 00 19 65      mov     r12, r11

```

```

000001c6 <_intr_exit>:
1c6:  00 00 30 7e      movi2s  sfr_cc, r8
1c8:  00 00 21 60      rfe     r11
1ca:  00 00 00 57      sbits   INT

```

Disassembly of section .text:

```

000001cc <taster>:
1cc:  00 01 49 a0      lhi     r4, 416 ; 0x1a0
1ce:  00 01 a8 20      ori     r4, 32 ; 0x20

```

```

1d0:    00 02 48 80      l18      r4, 0(r4)
1d2:    00 00 21 64      jrs      r11
1d4:    00 00 20 15      or       r0, r0

000001d6 <ton_str>:
1d6:    00 01 01 fe      addi     r0, -2      ; 0x1fe
1d8:    00 01 28 00      movi     r4, 0x00    ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
1da:    00 02 28 00      s9      0(r0), r4
1dc:    00 00 7f f8      jals     0x001cc    ; 0x1cc <taster>
1de:    00 01 99 ff      andi     r12, 511   ; 0x1ff
1e0:    00 02 38 00      s9      0(r0), r12
1e2:    00 02 18 00      l9      r12, 0(r0)
1e4:    00 01 99 ff      andi     r12, 511   ; 0x1ff
1e6:    00 03 18 01      seqi     r12, 1     ; 0x01
1e8:    00 00 20 15      or       r0, r0
1ea:    00 00 e0 18      bnezc    0x0021a    ; 0x21a <L10>
1ec:    00 02 08 00      l9      r4, 0(r0)
1ee:    00 01 89 ff      andi     r4, 511   ; 0x1ff
1f0:    00 03 08 02      seqi     r4, 2     ; 0x02
1f2:    00 00 20 15      or       r0, r0
1f4:    00 00 e0 0a      bnezc    0x00208    ; 0x208 <L8>
1f6:    00 02 08 00      l9      r4, 0(r0)
1f8:    00 01 89 ff      andi     r4, 511   ; 0x1ff
1fa:    00 03 08 04      seqi     r4, 4     ; 0x04
1fc:    00 00 20 15      or       r0, r0
1fe:    00 00 e0 05      bnezc    0x00208    ; 0x208 <L8>
200:    00 02 08 00      l9      r4, 0(r0)
202:    00 01 00 02      addi     r0, 2     ; 0x02
204:    00 00 21 64      jrs      r11
206:    00 00 20 15      or       r0, r0

00000208 <L8>:
208:    00 01 48 00      lhi      r4, 0     ; 0x00
20a:    00 01 a9 8a      ori      r4, 394   ; 0x18a
20c:    00 02 48 80      l18      r4, 0(r4)
20e:    00 01 2a 01      movi     r5, 0x01   ; 0x1 <SBBOOL_YES>
210:    00 02 6a 8a      s18     10(r4), r5
212:    00 02 08 00      l9      r4, 0(r0)
214:    00 01 00 02      addi     r0, 2     ; 0x02
216:    00 00 21 64      jrs      r11
218:    00 00 20 15      or       r0, r0

0000021a <L10>:
21a:    00 01 48 00      lhi      r4, 0     ; 0x00
21c:    00 01 a9 8a      ori      r4, 394   ; 0x18a
21e:    00 02 48 80      l18      r4, 0(r4)
220:    00 02 78 8a      s18     10(r4), r12
222:    00 02 08 00      l9      r4, 0(r0)
224:    00 01 00 02      addi     r0, 2     ; 0x02
226:    00 00 21 64      jrs      r11
228:    00 00 20 15      or       r0, r0

0000022a <play_note>:
22a:    00 01 58 00      lhi      r12, 0    ; 0x00
22c:    00 01 b9 8a      ori      r12, 394  ; 0x18a
22e:    00 02 5b 80      l18      r13, 0(r12)
230:    00 01 28 01      movi     r4, 0x01   ; 0x1 <SBBOOL_YES>
232:    00 02 69 b4      s18     20(r13), r4

00000234 <L13>:
234:    00 02 59 b4      l18      r12, 20(r13)
236:    00 00 b9 ff      bnez     r12, 0x00234 ; 0x234 <L13>
238:    00 00 20 15      or       r0, r0
23a:    00 00 21 64      jrs      r11
23c:    00 00 20 15      or       r0, r0

0000023e <play_song>:
23e:    00 01 4a 00      lhi      r5, 0     ; 0x00

```

```

240: 00 01 ab 8a      ori      r5, 394 ; 0x18a
242: 00 02 58 a0      l18     r12, 0(r5)
244: 00 02 4d 80      l18     r6, 0(r12)
246: 00 01 0c 01      addi    r6, 1 ; 0x01
248: 00 02 6d 80      s18     0(r12), r6
24a: 00 02 4d 80      l18     r6, 0(r12)
24c: 00 00 2c 90      add     r6, r4
24e: 00 02 0c c0      l9      r6, 0(r6)
250: 00 01 8d ff      andi    r6, 511 ; 0x1ff
252: 00 02 6d 90      s18     16(r12), r6
254: 00 01 2c 00      movi    r6, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
256: 00 02 2d 99      s9      25(r12), r6
258: 00 02 0d 99      l9      r6, 25(r12)
25a: 00 01 8c f0      andi    r6, 240 ; 0xf0
25c: 00 03 0c f0      seqi    r6, 240 ; 0xf0
25e: 00 00 20 15      or      r0, r0
260: 00 00 e0 30      bnezc   0x002c0 ; 0x2c0 <L19>
262: 00 01 4c 00      lhi     r6, 0 ; 0x00
264: 00 01 ad 15      ori     r6, 277 ; 0x115

```

00000266 <L23>:

```

266: 00 02 5b 80      l18     r13, 0(r12)
268: 00 01 1a 01      addi    r13, 1 ; 0x01
26a: 00 02 7b 80      s18     0(r12), r13
26c: 00 02 5b 80      l18     r13, 0(r12)
26e: 00 00 3a 90      add     r13, r4
270: 00 02 1b a0      l9      r13, 0(r13)
272: 00 01 9b ff      andi    r13, 511 ; 0x1ff
274: 00 02 3b 99      s9      25(r12), r13
276: 00 02 1b 99      l9      r13, 25(r12)
278: 00 01 9b ff      andi    r13, 511 ; 0x1ff
27a: 00 01 2e e7      movi    r7, 0xe7 ; 0xe7 <SB_UART_0_FIFO_TX_DEPTH+0x67>
27c: 00 00 1a ec      sleu    r13, r7
27e: 00 00 20 15      or      r0, r0
280: 00 00 c0 2a      beqzcc 0x002d4 ; 0x2d4 <L20>
282: 00 02 5b 90      l18     r13, 16(r12)
284: 00 02 1d 99      l9      r14, 25(r12)
286: 00 01 9c 07      andi    r14, 7 ; 0x07
288: 00 01 4e 00      lhi     r7, 0 ; 0x00
28a: 00 01 ae 66      ori     r7, 102 ; 0x66
28c: 00 00 3c f0      add     r14, r7
28e: 00 02 1d c0      l9      r14, 0(r14)
290: 00 00 3b d7      mul     r13, r14
292: 00 02 7b 8c      s18     12(r12), r13
294: 00 02 1b 99      l9      r13, 25(r12)
296: 00 02 da 03      srli    r13, 3 ; 0x03
298: 00 01 9a 1f      andi    r13, 31 ; 0x1f
29a: 00 02 3b 98      s9      24(r12), r13
29c: 00 02 1b 98      l9      r13, 24(r12)
29e: 00 01 9b ff      andi    r13, 511 ; 0x1ff
2a0: 00 02 5d 84      l18     r14, 4(r12)
2a2: 00 00 3b b0      add     r13, r13
2a4: 00 01 4e 00      lhi     r7, 0 ; 0x00
2a6: 00 01 ae 2c      ori     r7, 44 ; 0x2c
2a8: 00 00 3a f0      add     r13, r7
2aa: 00 02 5b a0      l18     r13, 0(r13)
2ac: 00 00 1b c6      srl     r13, r14
2ae: 00 02 7b 86      s18     6(r12), r13

```

000002b0 <L21>:

```

2b0: 00 00 20 c5      jalrs   r6
2b2: 00 00 20 15      or      r0, r0
2b4: 00 02 58 a0      l18     r12, 0(r5)
2b6: 00 02 1b 99      l9      r13, 25(r12)
2b8: 00 01 9a f0      andi    r13, 240 ; 0xf0
2ba: 00 03 1a f0      seqi    r13, 240 ; 0xf0
2bc: 00 00 20 15      or      r0, r0
2be: 00 00 df d4      beqzcc 0x00266 ; 0x266 <L23>

```

```

000002c0 <L19>:
2c0: 00 01 28 00      movi    r4, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
2c2: 00 02 69 86      s18    6(r12), r4
2c4: 00 02 69 8a      s18    10(r12), r4
2c6: 00 02 09 99      l9     r4, 25(r12)
2c8: 00 01 89 ff      andi   r4, 511 ; 0x1ff
2ca: 00 03 08 ff      seqi   r4, 255 ; 0xff
2cc: 00 00 20 15      or     r0, r0
2ce: 00 00 e0 34      bnezc  0x00336 ; 0x336 <L28>
2d0: 00 00 21 64      jrs    r11
2d2: 00 00 20 15      or     r0, r0

```

```

000002d4 <L20>:
2d4: 00 02 5d 90      l18    r14, 16(r12)
2d6: 00 00 1b c5      mov    r13, r14
2d8: 00 00 3b d0      add    r13, r14
2da: 00 02 9c 03      slli  r14, 3 ; 0x03
2dc: 00 00 3b d0      add    r13, r14
2de: 00 02 7b 8c      s18    12(r12), r13
2e0: 00 02 1b 99      l9     r13, 25(r12)
2e2: 00 01 9b ff      andi   r13, 511 ; 0x1ff
2e4: 00 01 2e e7      movi   r7, 0xe7 ; 0xe7 <SB_UART_0_FIFO_TX_DEPTH+0x67>
2e6: 00 00 1a ec      sleu  r13, r7
2e8: 00 00 20 15      or     r0, r0
2ea: 00 00 e0 0c      bnezc  0x00302 ; 0x302 <L22>
2ec: 00 02 1b 99      l9     r13, 25(r12)
2ee: 00 01 9b ff      andi   r13, 511 ; 0x1ff
2f0: 00 01 2e eb      movi   r7, 0xeb ; 0xeb <SB_UART_0_FIFO_TX_DEPTH+0x6b>
2f2: 00 00 1a ec      sleu  r13, r7
2f4: 00 00 20 15      or     r0, r0
2f6: 00 00 c0 06      beqzc  0x00302 ; 0x302 <L22>
2f8: 00 02 1b 99      l9     r13, 25(r12)
2fa: 00 01 9a 03      andi   r13, 3 ; 0x03
2fc: 00 02 7b 84      s18    4(r12), r13
2fe: 00 01 2e 00      movi   r7, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
300: 00 02 6f 92      s18    18(r12), r7

```

```

00000302 <L22>:
302: 00 02 1b 99      l9     r13, 25(r12)
304: 00 01 9b ff      andi   r13, 511 ; 0x1ff
306: 00 01 2e eb      movi   r7, 0xeb ; 0xeb <SB_UART_0_FIFO_TX_DEPTH+0x6b>
308: 00 00 1a ec      sleu  r13, r7
30a: 00 00 20 15      or     r0, r0
30c: 00 00 ff d2      bnezc  0x002b0 ; 0x2b0 <L21>
30e: 00 02 1b 99      l9     r13, 25(r12)
310: 00 01 9b ff      andi   r13, 511 ; 0x1ff
312: 00 01 2e ef      movi   r7, 0xef ; 0xef <SB_UART_0_FIFO_TX_DEPTH+0x6f>
314: 00 00 1a ec      sleu  r13, r7
316: 00 00 20 15      or     r0, r0
318: 00 00 df cc      beqzc  0x002b0 ; 0x2b0 <L21>
31a: 00 02 1b 99      l9     r13, 25(r12)
31c: 00 01 9a 03      andi   r13, 3 ; 0x03
31e: 00 02 7b 84      s18    4(r12), r13
320: 00 01 2e 01      movi   r7, 0x01 ; 0x1 <SB_BOOL_YES>
322: 00 02 6f 92      s18    18(r12), r7
324: 00 00 20 c5      jalrs  r6
326: 00 00 20 15      or     r0, r0
328: 00 02 58 a0      l18    r12, 0(r5)
32a: 00 02 1b 99      l9     r13, 25(r12)
32c: 00 01 9a f0      andi   r13, 240 ; 0xf0
32e: 00 03 1a f0      seqi   r13, 240 ; 0xf0
330: 00 00 20 15      or     r0, r0
332: 00 00 df 9a      beqzc  0x00266 ; 0x266 <L23>
334: 00 00 5f c6      j      0x002c0 ; 0x2c0 <L19>

```

```

00000336 <L28>:
336: 00 01 2c 00      movi   r6, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
338: 00 02 6d 80      s18    0(r12), r6
33a: 00 00 21 64      jrs    r11

```

```

33c:    00 00 20 15    or    r0, r0

0000033e <play_t_gong>:
33e:    00 01 4c 00    lhi   r6, 0    ; 0x00
340:    00 01 ad 8a    ori   r6, 394  ; 0x18a
342:    00 02 58 c0    l18   r12, 0(r6)
344:    00 02 51 80    l18   r8, 0(r12)
346:    00 02 0a 80    l19   r5, 0(r4)
348:    00 01 8b ff    andi  r5, 511  ; 0x1ff
34a:    00 00 8a 1a    beqz  r5, 0x0037e ; 0x37e <L31>
34c:    00 00 20 15    or    r0, r0
34e:    00 01 4e 00    lhi   r7, 0    ; 0x00
350:    00 01 af 1f    ori   r7, 287  ; 0x11f
352:    00 01 32 00    movi  r9, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
354:    00 02 73 80    s18   0(r12), r9
356:    00 01 32 01    movi  r9, 0x01 ; 0x1 <SBBOOL_YES>
358:    00 02 73 8a    s18   10(r12), r9
35a:    00 00 18 85    mov   r12, r4
35c:    00 00 20 e5    jalrs r7
35e:    00 00 20 15    or    r0, r0
360:    00 01 0b ff    addi  r5, -1   ; 0x1ff
362:    00 00 8a 0d    beqz  r5, 0x0037c ; 0x37c <L32>
364:    00 00 20 15    or    r0, r0

00000366 <L36>:
366:    00 02 58 c0    l18   r12, 0(r6)
368:    00 01 32 00    movi  r9, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
36a:    00 02 73 80    s18   0(r12), r9
36c:    00 01 32 01    movi  r9, 0x01 ; 0x1 <SBBOOL_YES>
36e:    00 02 73 8a    s18   10(r12), r9
370:    00 00 18 85    mov   r12, r4
372:    00 00 20 e5    jalrs r7
374:    00 00 20 15    or    r0, r0
376:    00 01 0b ff    addi  r5, -1   ; 0x1ff
378:    00 00 ab f7    bnez  r5, 0x00366 ; 0x366 <L36>
37a:    00 00 20 15    or    r0, r0

0000037c <L32>:
37c:    00 02 58 c0    l18   r12, 0(r6)

0000037e <L31>:
37e:    00 02 71 80    s18   0(r12), r8
380:    00 00 21 64    jrs   r11
382:    00 00 20 15    or    r0, r0

00000384 <isr01>:
384:    00 01 58 00    lhi   r12, 0    ; 0x00
386:    00 01 b9 8a    ori   r12, 394  ; 0x18a
388:    00 02 59 80    l18   r12, 0(r12)
38a:    00 02 5b 82    l18   r13, 2(r12)
38c:    00 00 9a 0e    beqz  r13, 0x003a8 ; 0x3a8 <L43>
38e:    00 00 20 15    or    r0, r0
390:    00 01 5b a0    lhi   r13, 416  ; 0x1a0
392:    00 01 ba 60    ori   r13, 96   ; 0x60
394:    00 01 28 2f    movi  r4, 0x2f ; 0x2f <freqs+0x3>
396:    00 02 69 a0    s18   0(r13), r4
398:    00 02 59 82    l18   r12, 2(r12)
39a:    00 02 79 a2    s18   2(r13), r12
39c:    00 01 59 a0    lhi   r12, 416  ; 0x1a0
39e:    00 01 b8 10    ori   r12, 16   ; 0x10
3a0:    00 01 28 00    movi  r4, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
3a2:    00 02 69 84    s18   4(r12), r4
3a4:    00 00 21 64    jrs   r11
3a6:    00 00 20 15    or    r0, r0

000003a8 <L43>:
3a8:    00 01 59 a0    lhi   r12, 416  ; 0x1a0
3aa:    00 01 b8 60    ori   r12, 96   ; 0x60

```

```

3ac: 00 01 28 0f      movi    r4, 0x0f ; 0xf <SBI_SECTION_INIT_MIN_ADDR+0x1>
3ae: 00 02 69 80      s18    0(r12), r4
3b0: 00 01 59 a0      lhi    r12, 416 ; 0x1a0
3b2: 00 01 b8 10      ori    r12, 16 ; 0x10
3b4: 00 01 28 00      movi    r4, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
3b6: 00 02 69 84      s18    4(r12), r4
3b8: 00 00 21 64      jrs    r11
3ba: 00 00 20 15      or     r0, r0

000003bc <isr04>:
3bc: 00 01 58 04      lhi    r12, 4 ; 0x04
3be: 00 01 b9 6a      ori    r12, 362 ; 0x16a
3c0: 00 00 1a 85      mov    r13, r4
3c2: 00 00 1c c5      mov    r14, r6
3c4: 00 00 61 48      jals   0x00654 ; 0x654 <printf_>
3c6: 00 00 21 64      jrs    r11
3c8: 00 00 20 15      or     r0, r0

000003ca <isr00>:
3ca: 00 01 58 04      lhi    r12, 4 ; 0x04
3cc: 00 01 b9 88      ori    r12, 392 ; 0x188
3ce: 00 00 1a 85      mov    r13, r4
3d0: 00 00 1c c5      mov    r14, r6
3d2: 00 00 61 41      jals   0x00654 ; 0x654 <printf_>
3d4: 00 00 21 64      jrs    r11
3d6: 00 00 20 15      or     r0, r0

000003d8 <isr03>:
3d8: 00 01 58 04      lhi    r12, 4 ; 0x04
3da: 00 01 b9 a6      ori    r12, 422 ; 0x1a6
3dc: 00 00 1a 85      mov    r13, r4
3de: 00 00 1c c5      mov    r14, r6
3e0: 00 00 61 3a      jals   0x00654 ; 0x654 <printf_>
3e2: 00 00 21 64      jrs    r11
3e4: 00 00 20 15      or     r0, r0

000003e6 <isr02>:
3e6: 00 01 01 fe      addi   r0, -2 ; 0x1fe
3e8: 00 01 49 a0      lhi    r4, 416 ; 0x1a0
3ea: 00 01 a8 40      ori    r4, 64 ; 0x40
3ec: 00 02 48 80      l18    r4, 0(r4)
3ee: 00 02 68 00      s18    0(r0), r4
3f0: 00 01 48 00      lhi    r4, 0 ; 0x00
3f2: 00 01 a9 8a      ori    r4, 394 ; 0x18a
3f4: 00 02 5a 80      l18    r13, 0(r4)
3f6: 00 02 5d ae      l18    r14, 14(r13)
3f8: 00 00 bc 1c      bnez   r14, 0x00430 ; 0x430 <L52>
3fa: 00 00 20 15      or     r0, r0
3fc: 00 02 59 aa      l18    r12, 10(r13)
3fe: 00 03 18 01      seqi   r12, 1 ; 0x01
400: 00 00 20 15      or     r0, r0
402: 00 00 c0 1d      beqzc  0x0043c ; 0x43c <L53>
404: 00 02 5d b4      l18    r14, 20(r13)
406: 00 00 9c 05      beqz   r14, 0x00410 ; 0x410 <L54>
408: 00 00 20 15      or     r0, r0
40a: 00 02 5d b6      l18    r14, 22(r13)
40c: 00 00 9c 20      beqz   r14, 0x0044c ; 0x44c <L58>
40e: 00 00 20 15      or     r0, r0

00000410 <L54>:
410: 00 01 2a 14      movi    r5, 0x14 ; 0x14 <SBI_SECTION_INIT_BYTES+0x3>
412: 00 02 6b ae      s18    14(r13), r5
414: 00 01 2a 00      movi    r5, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
416: 00 02 6b a8      s18    8(r13), r5
418: 00 02 6b b6      s18    22(r13), r5
41a: 00 01 38 02      movi    r12, 0x02 ; 0x2 <SBI_VERSION>
41c: 00 00 60 cb      jals   0x005b2 ; 0x5b2 <led7_set>
41e: 00 02 48 80      l18    r4, 0(r4)

```

```

420:    00 02 58 92      l18      r12, 18(r4)
422:    00 00 38 b8      seq      r12, r5
424:    00 00 20 15      or       r0, r0
426:    00 00 e0 02      bnezc   0x0042a ; 0x42a <L56>
428:    00 02 6a 82      s18     2(r4), r5

0000042a <L56>:
42a:    00 01 00 02      addi    r0, 2 ; 0x02
42c:    00 00 21 64      jrs     r11
42e:    00 00 20 15      or      r0, r0

00000430 <L52>:
430:    00 02 49 ae      l18     r4, 14(r13)
432:    00 01 09 ff      addi    r4, -1 ; 0x1ff
434:    00 02 69 ae      s18     14(r13), r4
436:    00 01 00 02      addi    r0, 2 ; 0x02
438:    00 00 21 64      jrs     r11
43a:    00 00 20 15      or      r0, r0

0000043c <L53>:
43c:    00 02 7d a2      s18     2(r13), r14
43e:    00 01 28 01      movi    r4, 0x01 ; 0x1 <SBBOOL_YES>
440:    00 02 69 a8      s18     8(r13), r4
442:    00 01 38 04      movi    r12, 0x04 ; 0x4 <SB_INTCtrl_0_IR_SOURCES>
444:    00 00 60 b7      jals    0x005b2 ; 0x5b2 <led7_set>
446:    00 01 00 02      addi    r0, 2 ; 0x02
448:    00 00 21 64      jrs     r11
44a:    00 00 20 15      or      r0, r0

0000044c <L58>:
44c:    00 02 49 a6      l18     r4, 6(r13)
44e:    00 02 69 a2      s18     2(r13), r4
450:    00 02 49 ac      l18     r4, 12(r13)
452:    00 02 69 ae      s18     14(r13), r4
454:    00 02 7d b4      s18     20(r13), r14
456:    00 02 79 b6      s18     22(r13), r12
458:    00 00 60 ad      jals    0x005b2 ; 0x5b2 <led7_set>
45a:    00 01 00 02      addi    r0, 2 ; 0x02
45c:    00 00 21 64      jrs     r11
45e:    00 00 20 15      or      r0, r0

00000460 <uart_getstat>:
460:    00 01 01 fe      addi    r0, -2 ; 0x1fe
462:    00 01 28 00      movi    r4, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
464:    00 02 28 00      s9      0(r0), r4
466:    00 00 18 05      mov     r12, r0
468:    00 00 61 26      jals    0x006b4 ; 0x6b4 <getchar_nb>
46a:    00 02 08 00      l9      r4, 0(r0)
46c:    00 01 00 02      addi    r0, 2 ; 0x02
46e:    00 00 21 64      jrs     r11
470:    00 00 20 15      or      r0, r0

00000472 <main>:
472:    00 01 01 fc      addi    r0, -4 ; 0x1fc
474:    00 02 64 00      s18     0(r0), r2
476:    00 02 66 02      s18     2(r0), r3
478:    00 01 01 fe      addi    r0, -2 ; 0x1fe
47a:    00 01 28 00      movi    r4, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
47c:    00 02 28 00      s9      0(r0), r4
47e:    00 00 60 e9      jals    0x00650 ; 0x650 <interrupt_disable>
480:    00 01 49 a0      lhi     r4, 416 ; 0x1a0
482:    00 01 a8 10      ori     r4, 16 ; 0x10
484:    00 01 2b ff      movi    r5, 0x1ff ; 0x1ff <ton_str+0x29>
486:    00 01 6a 09      sigex   r5, 9
488:    00 02 6a 82      s18     2(r4), r5
48a:    00 01 2a 01      movi    r5, 0x01 ; 0x1 <SBBOOL_YES>
48c:    00 02 6a 80      s18     0(r4), r5
48e:    00 01 49 a0      lhi     r4, 416 ; 0x1a0

```

```

490: 00 01 a8 60      ori    r4, 96      ; 0x60
492: 00 01 4a ef      lhi    r5, 239    ; 0xef
494: 00 01 ab 68      ori    r5, 360    ; 0x168
496: 00 02 6a 82      s18    2(r4), r5
498: 00 01 2a 0f      movi   r5, 0x0f   ; 0xf <SBI_SECTION_INIT_MIN_ADDR+0x1>
49a: 00 02 6a 80      s18    0(r4), r5
49c: 00 01 49 a0      lhi    r4, 416    ; 0x1a0
49e: 00 01 a8 50      ori    r4, 80     ; 0x50
4a0: 00 01 2a 01      movi   r5, 0x01   ; 0x1 <SB_BOOL_YES>
4a2: 00 02 6a 80      s18    0(r4), r5
4a4: 00 01 4a 33      lhi    r5, 51     ; 0x33
4a6: 00 01 ab 00      ori    r5, 256    ; 0x100
4a8: 00 02 6a 82      s18    2(r4), r5
4aa: 00 01 49 a0      lhi    r4, 416    ; 0x1a0
4ac: 00 01 a8 40      ori    r4, 64     ; 0x40
4ae: 00 01 2a 03      movi   r5, 0x03   ; 0x3 <SB_PORT_IN_0_PORT_WIDTH>
4b0: 00 02 6a 80      s18    0(r4), r5
4b2: 00 01 59 a0      lhi    r12, 416   ; 0x1a0
4b4: 00 01 b8 30      ori    r12, 48    ; 0x30
4b6: 00 00 60 93      jals   0x005dc    ; 0x5dc <uart_wait_idle>
4b8: 00 01 59 a0      lhi    r12, 416   ; 0x1a0
4ba: 00 01 b8 30      ori    r12, 48    ; 0x30
4bc: 00 01 28 f3      movi   r4, 0xf3   ; 0xf3 <SB_UART_0_FIFO_TX_DEPTH+0x73>
4be: 00 02 69 86      s18    6(r12), r4
4c0: 00 00 60 9a      jals   0x005f4    ; 0x5f4 <stdio_uart_open>
4c2: 00 01 4c 01      lhi    r6, 1      ; 0x01
4c4: 00 01 ad 2a      ori    r6, 298    ; 0x12a
4c6: 00 01 58 04      lhi    r12, 4     ; 0x04
4c8: 00 01 b9 c8      ori    r12, 456   ; 0x1c8
4ca: 00 01 5a 72      lhi    r13, 114   ; 0x72
4cc: 00 01 ba 84      ori    r13, 132   ; 0x84
4ce: 00 01 3c 00      movi   r14, 0x00  ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
4d0: 00 00 20 c5      jalrs  r6
4d2: 00 00 20 15      or     r0, r0
4d4: 00 00 60 bc      jals   0x0064c    ; 0x64c <interrupt_enable>
4d6: 00 01 4a 00      lhi    r5, 0      ; 0x00
4d8: 00 01 ab 8a      ori    r5, 394    ; 0x18a
4da: 00 01 52 01      lhi    r9, 1      ; 0x01
4dc: 00 01 b2 30      ori    r9, 48     ; 0x30
4de: 00 01 50 00      lhi    r8, 0      ; 0x00
4e0: 00 01 b0 eb      ori    r8, 235    ; 0xeb
4e2: 00 01 44 00      lhi    r2, 0      ; 0x00
4e4: 00 01 a5 1f      ori    r2, 287    ; 0x11f
4e6: 00 01 46 00      lhi    r3, 0      ; 0x00
4e8: 00 01 a7 9f      ori    r3, 415    ; 0x19f
4ea: 00 00 14 a5      mov    r10, r5
4ec: 00 02 58 a0      l18    r12, 0(r5)
4ee: 00 02 49 88      l18    r4, 8(r12)
4f0: 00 03 08 01      seqi   r4, 1      ; 0x01
4f2: 00 00 20 15      or     r0, r0
4f4: 00 00 e0 0c      bnezc  0x0050c    ; 0x50c <L75>

```

000004f6 <L63>:

```

4f6: 00 02 5b 92      l18    r13, 18(r12)
4f8: 00 02 5d 84      l18    r14, 4(r12)
4fa: 00 01 58 05      lhi    r12, 5     ; 0x05
4fc: 00 01 b8 6e      ori    r12, 110   ; 0x6e
4fe: 00 00 20 c5      jalrs  r6
500: 00 00 20 15      or     r0, r0

```

00000502 <L81>:

```

502: 00 02 58 a0      l18    r12, 0(r5)
504: 00 02 49 88      l18    r4, 8(r12)
506: 00 03 08 01      seqi   r4, 1      ; 0x01
508: 00 00 20 15      or     r0, r0
50a: 00 00 df f6      beqzc  0x004f6    ; 0x4f6 <L63>

```

0000050c <L75>:

```

50c: 00 02 4f 8a      l18    r7, 10(r12)

```



```

50e: 00 00 af f4      bnez   r7, 0x004f6      ; 0x4f6 <L63>
510: 00 00 20 15      or     r0, r0
512: 00 00 21 25      jalrs  r9
514: 00 00 20 15      or     r0, r0
516: 00 01 99 ff      andi   r12, 511 ; 0x1ff
518: 00 03 18 73      seqi   r12, 115 ; 0x73
51a: 00 00 20 15      or     r0, r0
51c: 00 00 e0 31      bnezc 0x0057e ; 0x57e <L76>
51e: 00 03 18 53      seqi   r12, 83 ; 0x53
520: 00 00 20 15      or     r0, r0
522: 00 00 e0 31      bnezc 0x00584 ; 0x584 <L77>
524: 00 03 18 2b      seqi   r12, 43 ; 0x2b
526: 00 00 20 15      or     r0, r0
528: 00 00 e0 31      bnezc 0x0058a ; 0x58a <L78>
52a: 00 03 18 2d      seqi   r12, 45 ; 0x2d
52c: 00 00 20 15      or     r0, r0
52e: 00 00 e0 15      bnezc 0x00558 ; 0x558 <L79>

```

00000530 <L65>:

```

530: 00 00 21 05      jalrs  r8
532: 00 00 20 15      or     r0, r0
534: 00 01 99 ff      andi   r12, 511 ; 0x1ff
536: 00 03 18 01      seqi   r12, 1 ; 0x01
538: 00 00 20 15      or     r0, r0
53a: 00 00 e0 1c      bnezc 0x00572 ; 0x572 <L70>

```

0000053c <L68>:

```

53c: 00 03 18 02      seqi   r12, 2 ; 0x02
53e: 00 00 20 15      or     r0, r0
540: 00 00 e0 2d      bnezc 0x0059a ; 0x59a <L80>
542: 00 03 18 04      seqi   r12, 4 ; 0x04
544: 00 00 20 15      or     r0, r0
546: 00 00 e0 16      bnezc 0x00572 ; 0x572 <L70>
548: 00 02 58 a0      l18   r12, 0(r5)

```

0000054a <L82>:

```

54a: 00 02 5b 92      l18   r13, 18(r12)
54c: 00 02 5d 84      l18   r14, 4(r12)
54e: 00 01 58 05      lhi   r12, 5 ; 0x05
550: 00 01 b8 6e      ori   r12, 110 ; 0x6e
552: 00 00 20 c5      jalrs  r6
554: 00 00 20 15      or     r0, r0
556: 00 00 5f d6      j     0x00502 ; 0x502 <L81>

```

00000558 <L79>:

```

558: 00 02 49 40      l18   r4, 0(r10)
55a: 00 02 4e 84      l18   r7, 4(r4)
55c: 00 01 0f ff      addi   r7, -1 ; 0x1ff
55e: 00 02 6e 84      s18   4(r4), r7
560: 00 02 4e 84      l18   r7, 4(r4)
562: 00 01 8e 03      andi   r7, 3 ; 0x03
564: 00 02 6e 84      s18   4(r4), r7
566: 00 00 21 05      jalrs  r8
568: 00 00 20 15      or     r0, r0
56a: 00 01 99 ff      andi   r12, 511 ; 0x1ff
56c: 00 03 18 01      seqi   r12, 1 ; 0x01
56e: 00 00 20 15      or     r0, r0
570: 00 00 df e6      beqzc 0x0053c ; 0x53c <L68>

```

00000572 <L70>:

```

572: 00 01 58 00      lhi   r12, 0 ; 0x00
574: 00 01 b8 6e      ori   r12, 110 ; 0x6e
576: 00 00 20 45      jalrs  r2
578: 00 00 20 15      or     r0, r0
57a: 00 02 58 a0      l18   r12, 0(r5)
57c: 00 00 5f e7      j     0x0054a ; 0x54a <L82>

```

0000057e <L76>:

```

57e: 00 02 49 40      118      r4, 0(r10)
580: 00 02 6e 92      s18      18(r4), r7
582: 00 00 5f d7      j        0x00530 ; 0x530 <L65>

00000584 <L77>:
584: 00 02 4f 40      118      r7, 0(r10)
586: 00 02 68 f2      s18      18(r7), r4
588: 00 00 5f d4      j        0x00530 ; 0x530 <L65>

0000058a <L78>:
58a: 00 02 49 40      118      r4, 0(r10)
58c: 00 02 4e 84      118      r7, 4(r4)
58e: 00 01 0e 01      addi     r7, 1 ; 0x01
590: 00 02 6e 84      s18      4(r4), r7
592: 00 02 4e 84      118      r7, 4(r4)
594: 00 01 8e 03      andi     r7, 3 ; 0x03
596: 00 02 6e 84      s18      4(r4), r7
598: 00 00 5f cc      j        0x00530 ; 0x530 <L65>

0000059a <L80>:
59a: 00 01 58 00      lhi      r12, 0 ; 0x00
59c: 00 01 b9 66      ori      r12, 358 ; 0x166
59e: 00 00 20 65      jalrs    r3
5a0: 00 00 20 15      or       r0, r0
5a2: 00 02 58 a0      118      r12, 0(r5)
5a4: 00 02 5b 92      118      r13, 18(r12)
5a6: 00 02 5d 84      118      r14, 4(r12)
5a8: 00 01 58 05      lhi      r12, 5 ; 0x05
5aa: 00 01 b8 6e      ori      r12, 110 ; 0x6e
5ac: 00 00 20 c5      jalrs    r6
5ae: 00 00 20 15      or       r0, r0
5b0: 00 00 5f a9      j        0x00502 ; 0x502 <L81>

000005b2 <led7_set>:
5b2: 00 00 28 3e      movi2s   sfr_leds, r4
5b4: 00 00 21 64      jrs      r11
5b6: 00 00 20 15      or       r0, r0

000005b8 <led7_get>:
5b8: 00 00 28 3f      movs2i   r4, sfr_leds
5ba: 00 00 21 64      jrs      r11
5bc: 00 00 20 15      or       r0, r0

000005be <led7_hex>:
5be: 00 03 88 0f      slei     r4, 15 ; 0x0f
5c0: 00 00 20 15      or       r0, r0
5c2: 00 00 c0 09      beqz    0x005d4 ; 0x5d4 <L10>
5c4: 00 01 4a 05      lhi     r5, 5 ; 0x05
5c6: 00 01 aa 8e      ori     r5, 142 ; 0x8e
5c8: 00 00 28 b0      add     r4, r5
5ca: 00 02 08 80      19     r4, 0(r4)
5cc: 00 01 89 ff      andi    r4, 511 ; 0x1ff
5ce: 00 00 28 3e      movi2s   sfr_leds, r4
5d0: 00 00 21 64      jrs      r11
5d2: 00 00 20 15      or       r0, r0

000005d4 <L10>:
5d4: 00 01 28 00      movi     r4, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
5d6: 00 00 28 3e      movi2s   sfr_leds, r4
5d8: 00 00 21 64      jrs      r11
5da: 00 00 20 15      or       r0, r0

000005dc <uart_wait_idle>:
5dc: 00 02 58 80      118     r12, 0(r4)
5de: 00 01 4a d0      lhi     r5, 208 ; 0xd0
5e0: 00 01 aa 05      ori     r5, 5 ; 0x05
5e2: 00 00 38 b4      and     r12, r5

```

```

5e4: 00 01 4a 90      lhi    r5, 144 ; 0x90
5e6: 00 01 aa 05      ori    r5, 5 ; 0x05
5e8: 00 00 38 b8      seq    r12, r5
5ea: 00 00 20 15      or     r0, r0
5ec: 00 00 df f8      beqzc 0x005dc ; 0x5dc <uart_wait_idle>
5ee: 00 02 48 82      l18   r4, 2(r4)
5f0: 00 00 21 64      jrs   r11
5f2: 00 00 20 15      or     r0, r0

000005f4 <stdio_uart_open>:
5f4: 00 01 58 00      lhi    r12, 0 ; 0x00
5f6: 00 01 b9 a0      ori    r12, 416 ; 0x1a0
5f8: 00 02 69 82      s18   2(r12), r4
5fa: 00 02 69 80      s18   0(r12), r4
5fc: 00 01 48 01      lhi    r4, 1 ; 0x01
5fe: 00 01 a9 09      ori    r4, 265 ; 0x109
600: 00 02 69 84      s18   4(r12), r4
602: 00 01 48 01      lhi    r4, 1 ; 0x01
604: 00 01 a9 11      ori    r4, 273 ; 0x111
606: 00 02 69 86      s18   6(r12), r4
608: 00 01 48 01      lhi    r4, 1 ; 0x01
60a: 00 01 a9 18      ori    r4, 280 ; 0x118
60c: 00 02 69 88      s18   8(r12), r4
60e: 00 00 21 64      jrs   r11
610: 00 00 20 15      or     r0, r0

00000612 <uart_send>:
612: 00 01 8b ff      andi   r5, 511 ; 0x1ff

00000614 <L2>:
614: 00 02 58 80      l18   r12, 0(r4)
616: 00 01 98 08      andi   r12, 8 ; 0x08
618: 00 00 b9 fe      bnez   r12, 0x00614 ; 0x614 <L2>
61a: 00 00 20 15      or     r0, r0
61c: 00 02 6a 84      s18   4(r4), r5
61e: 00 00 21 64      jrs   r11
620: 00 00 20 15      or     r0, r0

00000622 <uart_receive>:
622: 00 02 58 80      l18   r12, 0(r4)
624: 00 01 98 01      andi   r12, 1 ; 0x01
626: 00 00 b9 fe      bnez   r12, 0x00622 ; 0x622 <uart_receive>
628: 00 00 20 15      or     r0, r0
62a: 00 02 48 82      l18   r4, 2(r4)
62c: 00 00 21 64      jrs   r11
62e: 00 00 20 15      or     r0, r0

00000630 <uart_receive_nb>:
630: 00 02 58 80      l18   r12, 0(r4)
632: 00 01 98 01      andi   r12, 1 ; 0x01
634: 00 00 b8 07      bnez   r12, 0x00642 ; 0x642 <L6>
636: 00 00 20 15      or     r0, r0
638: 00 02 48 82      l18   r4, 2(r4)
63a: 00 02 28 a0      s9    0(r5), r4
63c: 00 00 09 85      mov    r4, r12
63e: 00 00 21 64      jrs   r11
640: 00 00 20 15      or     r0, r0

00000642 <L6>:
642: 00 01 28 01      movi   r4, 0x01 ; 0x1 <SBBOOL_YES>
644: 00 00 21 64      jrs   r11
646: 00 00 20 15      or     r0, r0

00000648 <set_iv>:
648: 00 00 21 64      jrs   r11
64a: 00 00 28 9e      movi2s sfr_iv, r4

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0000064c <interrupt_enable>:
64c: 00 00 21 64      jrs      r11
64e: 00 00 00 57      sbits   INT

00000650 <interrupt_disable>:
650: 00 00 21 64      jrs      r11
652: 00 00 00 56      cbits   INT

00000654 <printf_>:
654: 00 01 01 fe      addi    r0, -2      ; 0x1fe
656: 00 02 68 00      sl8     0(r0), r4
658: 00 02 18 80      l9      r12, 0(r4)
65a: 00 01 99 ff      andi    r12, 511    ; 0x1ff
65c: 00 00 98 14      beqz    r12, 0x00684 ; 0x684 <L2>
65e: 00 00 20 15      or      r0, r0
660: 00 01 52 01      lhi     r9, 1      ; 0x01
662: 00 01 b3 80      ori     r9, 384    ; 0x180
664: 00 01 50 02      lhi     r8, 2      ; 0x02
666: 00 01 b0 23      ori     r8, 35     ; 0x23
668: 00 01 4e 02      lhi     r7, 2      ; 0x02
66a: 00 01 ae 33      ori     r7, 51     ; 0x33

0000066c <L8>:
66c: 00 03 18 25      seqi    r12, 37    ; 0x25
66e: 00 00 20 15      or      r0, r0
670: 00 00 e0 0e      bnezc   0x0068c   ; 0x68c <L11>
672: 00 00 20 e5      jalrs   r7
674: 00 00 20 15      or      r0, r0
676: 00 02 48 00      l18     r4, 0(r0)
678: 00 01 08 01      addi    r4, 1      ; 0x01
67a: 00 02 68 00      sl8     0(r0), r4
67c: 00 02 18 80      l9      r12, 0(r4)
67e: 00 01 99 ff      andi    r12, 511    ; 0x1ff
680: 00 00 b9 f6      bnez    r12, 0x0066c ; 0x66c <L8>
682: 00 00 20 15      or      r0, r0

00000684 <L2>:
684: 00 01 28 00      movi    r4, 0x00   ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
686: 00 01 00 02      addi    r0, 2      ; 0x02
688: 00 00 21 64      jrs      r11
68a: 00 00 20 15      or      r0, r0

0000068c <L11>:
68c: 00 02 08 81      l9      r4, 1(r4)
68e: 00 01 89 ff      andi    r4, 511    ; 0x1ff
690: 00 00 18 05      mov     r12, r0
692: 00 00 1a a5      mov     r13, r5
694: 00 00 21 25      jalrs   r9
696: 00 00 20 15      or      r0, r0
698: 00 03 08 25      seqi    r4, 37    ; 0x25
69a: 00 00 20 15      or      r0, r0
69c: 00 00 e0 02      bnezc   0x006a0   ; 0x6a0 <L4>
69e: 00 00 0a c5      mov     r5, r6

000006a0 <L4>:
6a0: 00 00 21 05      jalrs   r8
6a2: 00 00 20 15      or      r0, r0
6a4: 00 02 48 00      l18     r4, 0(r0)
6a6: 00 01 08 01      addi    r4, 1      ; 0x01
6a8: 00 02 68 00      sl8     0(r0), r4
6aa: 00 02 18 80      l9      r12, 0(r4)
6ac: 00 01 99 ff      andi    r12, 511    ; 0x1ff
6ae: 00 00 b9 df      bnez    r12, 0x0066c ; 0x66c <L8>
6b0: 00 00 20 15      or      r0, r0
6b2: 00 00 5f e9      j       0x00684   ; 0x684 <L2>

000006b4 <getchar_nb>:
6b4: 00 01 58 00      lhi     r12, 0     ; 0x00

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6b6: 00 01 b9 a0      ori      r12, 416 ; 0x1a0
6b8: 00 02 5d 88      l18     r14, 8(r12)
6ba: 00 02 59 80      l18     r12, 0(r12)
6bc: 00 00 1a 85      mov     r13, r4
6be: 00 00 21 c5      jalrs   r14
6c0: 00 00 20 15      or      r0, r0
6c2: 00 01 99 ff      andi    r12, 511 ; 0x1ff
6c4: 00 00 09 85      mov     r4, r12
6c6: 00 00 21 64      jrs     r11
6c8: 00 00 20 15      or      r0, r0

000006ca <printf_scan_int>:
6ca: 00 00 18 85      mov     r12, r4
6cc: 00 02 08 80      l9      r4, 0(r4)
6ce: 00 01 09 d0      addi    r4, -48 ; 0x1d0
6d0: 00 01 89 ff      andi    r4, 511 ; 0x1ff
6d2: 00 00 1a 85      mov     r13, r4
6d4: 00 01 2a 09      movi    r5, 0x09 ; 0x9 <SB_UART_0_FIFO_RX_DEPTH+0x1>
6d6: 00 00 1a ac      sleu   r13, r5
6d8: 00 00 20 15      or      r0, r0
6da: 00 00 c0 10      beqz   0x006fa ; 0x6fa <L6>
6dc: 00 02 19 81      l9      r12, 1(r12)
6de: 00 01 19 d0      addi    r12, -48 ; 0x1d0
6e0: 00 01 99 ff      andi    r12, 511 ; 0x1ff
6e2: 00 00 1b 85      mov     r13, r12
6e4: 00 01 2a 09      movi    r5, 0x09 ; 0x9 <SB_UART_0_FIFO_RX_DEPTH+0x1>
6e6: 00 00 1a ac      sleu   r13, r5
6e8: 00 00 20 15      or      r0, r0
6ea: 00 00 c0 06      beqz   0x006f6 ; 0x6f6 <L3>
6ec: 00 00 1a 85      mov     r13, r4
6ee: 00 00 3a 90      add     r13, r4
6f0: 00 02 88 03      slli   r4, 3 ; 0x03
6f2: 00 00 29 b0      add     r4, r13
6f4: 00 00 29 90      add     r4, r12

000006f6 <L3>:
6f6: 00 00 21 64      jrs     r11
6f8: 00 00 20 15      or      r0, r0

000006fa <L6>:
6fa: 00 01 28 01      movi    r4, 0x01 ; 0x1 <SBBOOL_YES>
6fc: 00 00 21 64      jrs     r11
6fe: 00 00 20 15      or      r0, r0

00000700 <printf_format_arg>:
700: 00 02 5a 80      l18     r13, 0(r4)
702: 00 00 0d a5      mov     r6, r13
704: 00 01 0c 01      addi    r6, 1 ; 0x01
706: 00 02 6c 80      s18    0(r4), r6
708: 00 02 18 c0      l9      r12, 0(r6)
70a: 00 01 99 ff      andi    r12, 511 ; 0x1ff
70c: 00 00 1d 85      mov     r14, r12
70e: 00 01 1d d0      addi    r14, -48 ; 0x1d0
710: 00 01 9d ff      andi    r14, 511 ; 0x1ff
712: 00 01 2e 09      movi    r7, 0x09 ; 0x9 <SB_UART_0_FIFO_RX_DEPTH+0x1>
714: 00 00 1c ec      sleu   r14, r7
716: 00 00 20 15      or      r0, r0
718: 00 00 e0 18      bnez   0x00748 ; 0x748 <L9>
71a: 00 01 3c 01      movi    r14, 0x01 ; 0x1 <SBBOOL_YES>
71c: 00 01 3e 30      movi    r15, 0x30 ; 0x30 <freqs+0x4>

0000071e <L10>:
71e: 00 03 18 6f      seqi    r12, 111 ; 0x6f
720: 00 00 20 15      or      r0, r0
722: 00 00 e0 7e      bnez   0x0081e ; 0x81e <L20>
724: 00 01 2e 6f      movi    r7, 0x6f ; 0x6f <melanf+0x1>
726: 00 00 18 ec      sleu   r12, r7
728: 00 00 20 15      or      r0, r0

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72a: 00 00 e0 2d      bnezc 0x00784 ; 0x784 <L31>
72c: 00 03 18 75      seqi   r12, 117 ; 0x75
72e: 00 00 20 15      or     r0, r0
730: 00 00 e0 70      bnezc 0x00810 ; 0x810 <L22>
732: 00 03 18 78      seqi   r12, 120 ; 0x78
734: 00 00 20 15      or     r0, r0
736: 00 00 e0 64      bnezc 0x007fe ; 0x7fe <L17>
738: 00 03 18 73      seqi   r12, 115 ; 0x73
73a: 00 00 20 15      or     r0, r0
73c: 00 00 e0 67      bnezc 0x0080a ; 0x80a <L32>

0000073e <L14>:
73e: 00 01 48 05      lhi    r4, 5 ; 0x05
740: 00 01 a8 a6      ori    r4, 166 ; 0xa6
742: 00 02 48 80      l18   r4, 0(r4)

00000744 <L25>:
744: 00 00 21 64      jrs   r11
746: 00 00 20 15      or     r0, r0

00000748 <L9>:
748: 00 03 18 30      seqi   r12, 48 ; 0x30
74a: 00 00 20 15      or     r0, r0
74c: 00 00 e0 34      bnezc 0x007b4 ; 0x7b4 <L33>
74e: 00 00 18 c5      mov    r12, r6
750: 00 00 7f bd      jals  0x006ca ; 0x6ca <printf_scan_int>
752: 00 00 1d 85      mov    r14, r12
754: 00 01 3e 20      movi  r15, 0x20 ; 0x20 <SBI_SECTION_DATA_MIN_ADDR>

00000756 <L27>:
756: 00 01 0c 01      addi  r6, 1 ; 0x01
758: 00 02 6c 80      s18  0(r4), r6
75a: 00 02 18 c0      l9    r12, 0(r6)
75c: 00 01 99 ff      andi  r12, 511 ; 0x1ff
75e: 00 00 1b 85      mov    r13, r12
760: 00 01 1b d0      addi  r13, -48 ; 0x1d0
762: 00 01 9b ff      andi  r13, 511 ; 0x1ff
764: 00 01 2e 09      movi  r7, 0x09 ; 0x9 <SB_UART_0_FIFO_RX_DEPTH+0x1>
766: 00 00 1a ec      sleu  r13, r7
768: 00 00 20 15      or     r0, r0
76a: 00 00 df da      beqzc 0x0071e ; 0x71e <L10>

0000076c <L30>:
76c: 00 01 0c 01      addi  r6, 1 ; 0x01
76e: 00 02 6c 80      s18  0(r4), r6
770: 00 02 18 c0      l9    r12, 0(r6)
772: 00 01 99 ff      andi  r12, 511 ; 0x1ff
774: 00 00 1b 85      mov    r13, r12
776: 00 01 1b d0      addi  r13, -48 ; 0x1d0
778: 00 01 9b ff      andi  r13, 511 ; 0x1ff
77a: 00 01 2e 09      movi  r7, 0x09 ; 0x9 <SB_UART_0_FIFO_RX_DEPTH+0x1>
77c: 00 00 1a ec      sleu  r13, r7
77e: 00 00 20 15      or     r0, r0
780: 00 00 ff eb      bnezc 0x00756 ; 0x756 <L27>
782: 00 00 5f ce      j     0x0071e ; 0x71e <L10>

00000784 <L31>:
784: 00 03 18 62      seqi   r12, 98 ; 0x62
786: 00 00 20 15      or     r0, r0
788: 00 00 e0 51      bnezc 0x0082a ; 0x82a <L18>
78a: 00 01 2e 62      movi  r7, 0x62 ; 0x62 <freqs+0x36>
78c: 00 00 18 ec      sleu  r12, r7
78e: 00 00 20 15      or     r0, r0
790: 00 00 c0 2d      beqzc 0x007ea ; 0x7ea <L24>
792: 00 03 18 58      seqi   r12, 88 ; 0x58
794: 00 00 20 15      or     r0, r0
796: 00 00 e0 34      bnezc 0x007fe ; 0x7fe <L17>
798: 00 01 2a 58      movi  r5, 0x58 ; 0x58 <freqs+0x2c>

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79a: 00 00 18 ac      sleu   r12, r5
79c: 00 00 20 15      or     r0, r0
79e: 00 00 df d0      beqzc  0x0073e ; 0x73e <L14>
7a0: 00 00 98 4b      beqz   r12, 0x00836 ; 0x836 <L15>
7a2: 00 00 20 15      or     r0, r0
7a4: 00 03 18 25      seqi   r12, 37 ; 0x25
7a6: 00 00 20 15      or     r0, r0
7a8: 00 00 df cb      beqzc  0x0073e ; 0x73e <L14>
7aa: 00 01 48 05      lhi    r4, 5 ; 0x05
7ac: 00 01 a8 a0      ori    r4, 160 ; 0xa0
7ae: 00 02 48 80      l18    r4, 0(r4)
7b0: 00 00 21 64      jrs    r11
7b2: 00 00 20 15      or     r0, r0

000007b4 <L33>:
7b4: 00 00 0d a5      mov    r6, r13
7b6: 00 01 0c 02      addi   r6, 2 ; 0x02
7b8: 00 02 6c 80      s18    0(r4), r6
7ba: 00 00 18 c5      mov    r12, r6
7bc: 00 00 7f 87      jals   0x006ca ; 0x6ca <printf_scan_int>
7be: 00 00 1d 85      mov    r14, r12
7c0: 00 02 18 c0      l9     r12, 0(r6)
7c2: 00 01 99 ff      andi   r12, 511 ; 0x1ff
7c4: 00 00 1b 85      mov    r13, r12
7c6: 00 01 1b d0      addi   r13, -48 ; 0xd0
7c8: 00 01 9b ff      andi   r13, 511 ; 0x1ff
7ca: 00 01 2e 09      movi   r7, 0x09 ; 0x9 <SB_UART_0_FIFO_RX_DEPTH+0x1>
7cc: 00 00 1a ec      sleu   r13, r7
7ce: 00 00 20 15      or     r0, r0
7d0: 00 00 c0 39      beqzc  0x00842 ; 0x842 <L12>
7d2: 00 01 0c 01      addi   r6, 1 ; 0x01
7d4: 00 02 6c 80      s18    0(r4), r6
7d6: 00 02 18 c0      l9     r12, 0(r6)
7d8: 00 01 99 ff      andi   r12, 511 ; 0x1ff
7da: 00 00 1b 85      mov    r13, r12
7dc: 00 01 1b d0      addi   r13, -48 ; 0xd0
7de: 00 01 9b ff      andi   r13, 511 ; 0x1ff
7e0: 00 01 2e 09      movi   r7, 0x09 ; 0x9 <SB_UART_0_FIFO_RX_DEPTH+0x1>
7e2: 00 00 1a ec      sleu   r13, r7
7e4: 00 01 3e 30      movi   r15, 0x30 ; 0x30 <freqs+0x4>
7e6: 00 00 ff c3      bnezc  0x0076c ; 0x76c <L30>
7e8: 00 00 5f 9b      j      0x0071e ; 0x71e <L10>

000007ea <L24>:
7ea: 00 03 18 64      seqi   r12, 100 ; 0x64
7ec: 00 00 20 15      or     r0, r0
7ee: 00 00 df a8      beqzc  0x0073e ; 0x73e <L14>
7f0: 00 00 18 a5      mov    r12, r5
7f2: 00 00 1b c5      mov    r13, r14
7f4: 00 00 1d e5      mov    r14, r15
7f6: 00 00 60 42      jals   0x0087a ; 0x87a <printf_format_int>
7f8: 00 00 09 85      mov    r4, r12
7fa: 00 00 21 64      jrs    r11
7fc: 00 00 20 15      or     r0, r0

000007fe <L17>:
7fe: 00 00 18 a5      mov    r12, r5
800: 00 01 3a 04      movi   r13, 0x04 ; 0x4 <SB_INTCtrl_0_IR_SOURCES>
802: 00 00 60 55      jals   0x008ac ; 0x8ac <printf_format_bits>
804: 00 00 09 85      mov    r4, r12
806: 00 00 21 64      jrs    r11
808: 00 00 20 15      or     r0, r0

0000080a <L32>:
80a: 00 00 08 a5      mov    r4, r5
80c: 00 00 21 64      jrs    r11
80e: 00 00 20 15      or     r0, r0

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00000810 <L22>:
810: 00 00 18 a5      mov     r12, r5
812: 00 00 1b c5      mov     r13, r14
814: 00 00 1d e5      mov     r14, r15
816: 00 00 60 6f      jals   0x008f4 ; 0x8f4 <printf_format_uint>
818: 00 00 09 85      mov     r4, r12
81a: 00 00 21 64      jrs    r11
81c: 00 00 20 15      or     r0, r0

0000081e <L20>:
81e: 00 00 18 a5      mov     r12, r5
820: 00 01 3a 03      movi   r13, 0x03 ; 0x3 <SB_PORT_IN_0_PORT_WIDTH>
822: 00 00 60 45      jals   0x008ac ; 0x8ac <printf_format_bits>
824: 00 00 09 85      mov     r4, r12
826: 00 00 21 64      jrs    r11
828: 00 00 20 15      or     r0, r0

0000082a <L18>:
82a: 00 00 18 a5      mov     r12, r5
82c: 00 01 3a 01      movi   r13, 0x01 ; 0x1 <SBBOOL_YES>
82e: 00 00 60 3f      jals   0x008ac ; 0x8ac <printf_format_bits>
830: 00 00 09 85      mov     r4, r12
832: 00 00 21 64      jrs    r11
834: 00 00 20 15      or     r0, r0

00000836 <L15>:
836: 00 01 0d ff      addi   r6, -1 ; 0x1ff
838: 00 02 6c 80      sl8   0(r4), r6
83a: 00 01 48 05      lhi   r4, 5 ; 0x05
83c: 00 01 a8 a6      ori   r4, 166 ; 0xa6
83e: 00 02 48 80      l18  r4, 0(r4)
840: 00 00 5f 82      j     0x00744 ; 0x744 <L25>

00000842 <L12>:
842: 00 01 3e 30      movi   r15, 0x30 ; 0x30 <freqs+0x4>
844: 00 00 5f 6d      j     0x0071e ; 0x71e <L10>

00000846 <putsn>:
846: 00 02 18 80      19    r12, 0(r4)
848: 00 01 99 ff      andi   r12, 511 ; 0x1ff
84a: 00 00 98 0b      beqz  r12, 0x00860 ; 0x860 <L2>
84c: 00 00 20 15      or     r0, r0
84e: 00 01 4a 02      lhi   r5, 2 ; 0x02
850: 00 01 aa 33      ori   r5, 51 ; 0x33

00000852 <L3>:
852: 00 00 20 a5      jalrs  r5
854: 00 00 20 15      or     r0, r0
856: 00 01 08 01      addi   r4, 1 ; 0x01
858: 00 02 18 80      19    r12, 0(r4)
85a: 00 01 99 ff      andi   r12, 511 ; 0x1ff
85c: 00 00 b9 fb      bnez  r12, 0x00852 ; 0x852 <L3>
85e: 00 00 20 15      or     r0, r0

00000860 <L2>:
860: 00 01 28 00      movi   r4, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
862: 00 00 21 64      jrs    r11
864: 00 00 20 15      or     r0, r0

00000866 <putchar>:
866: 00 01 89 ff      andi   r4, 511 ; 0x1ff
868: 00 01 58 00      lhi   r12, 0 ; 0x00
86a: 00 01 b9 a0      ori   r12, 416 ; 0x1a0
86c: 00 02 5d 84      l18  r14, 4(r12)
86e: 00 02 59 82      l18  r12, 2(r12)
870: 00 00 1a 85      mov     r13, r4
872: 00 00 21 c5      jalrs  r14

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874:    00 00 20 15    or     r0, r0
876:    00 00 21 64    jrs   r11
878:    00 00 20 15    or     r0, r0

0000087a <printf_format_int>:
87a:    00 00 1a a5    mov   r13, r5
87c:    00 03 48 00    slti  r4, 0 ; 0x00
87e:    00 01 8d ff    andi  r6, 511 ; 0x1ff
880:    00 00 1c c5    mov   r14, r6
882:    00 00 e0 06    bnezc 0x0088e ; 0x88e <L7>
884:    00 00 18 85    mov   r12, r4
886:    00 00 60 37    jals  0x008f4 ; 0x8f4 <printf_format_uint>
888:    00 00 09 85    mov   r4, r12

0000088a <L4>:
88a:    00 00 21 64    jrs   r11
88c:    00 00 20 15    or     r0, r0

0000088e <L7>:
88e:    00 00 18 9f    not   r12, r4
890:    00 01 18 01    addi  r12, 1 ; 0x01
892:    00 00 60 31    jals  0x008f4 ; 0x8f4 <printf_format_uint>
894:    00 01 48 00    lhi   r4, 0 ; 0x00
896:    00 01 a9 8c    ori   r4, 396 ; 0x18c
898:    00 01 2a 2d    movi  r5, 0x2d ; 0x2d <freqs+0x1>
89a:    00 02 2a 8c    s9    12(r4), r5
89c:    00 01 4a 00    lhi   r5, 0 ; 0x00
89e:    00 01 ab 98    ori   r5, 408 ; 0x198
8a0:    00 00 18 ac    sleu  r12, r5
8a2:    00 00 09 85    mov   r4, r12
8a4:    00 00 ff f3    bnezc 0x0088a ; 0x88a <L4>
8a6:    00 00 08 a5    mov   r4, r5
8a8:    00 00 21 64    jrs   r11
8aa:    00 00 20 15    or     r0, r0

000008ac <printf_format_bits>:
8ac:    00 00 1a c5    mov   r13, r6
8ae:    00 01 8f ff    andi  r7, 511 ; 0x1ff
8b0:    00 00 1c e5    mov   r14, r7
8b2:    00 01 2c 01    movi  r6, 0x01 ; 0x1 <SBBOOL_YES>
8b4:    00 00 0c a4    sll   r6, r5
8b6:    00 01 0d ff    addi  r6, -1 ; 0x1ff
8b8:    00 01 58 00    lhi   r12, 0 ; 0x00
8ba:    00 01 b9 8c    ori   r12, 396 ; 0x18c
8bc:    00 01 2e 00    movi  r7, 0x00 ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
8be:    00 03 08 00    seqi  r4, 0 ; 0x00
8c0:    00 02 2f 93    s9    19(r12), r7
8c2:    00 00 e0 13    bnezc 0x008e8 ; 0x8e8 <L8>
8c4:    00 01 58 00    lhi   r12, 0 ; 0x00
8c6:    00 01 b9 9f    ori   r12, 415 ; 0x19f

000008c8 <L4>:
8c8:    00 01 19 ff    addi  r12, -1 ; 0x1ff
8ca:    00 01 1b ff    addi  r13, -1 ; 0x1ff
8cc:    00 00 1e 85    mov   r15, r4
8ce:    00 00 3e d4    and   r15, r6
8d0:    00 01 4e 05    lhi   r7, 5 ; 0x05
8d2:    00 01 ae a8    ori   r7, 168 ; 0xa8
8d4:    00 00 3e f0    add   r15, r7
8d6:    00 02 1f e0    r15, 0(r15)
8d8:    00 00 08 a6    srl   r4, r5
8da:    00 03 08 00    seqi  r4, 0 ; 0x00
8dc:    00 02 3f 80    s9    0(r12), r15
8de:    00 00 df f5    beqzc 0x008c8 ; 0x8c8 <L4>
8e0:    00 00 60 3b    jals  0x00956 ; 0x956 <printf_add_padding>
8e2:    00 00 09 85    mov   r4, r12
8e4:    00 00 21 64    jrs   r11
8e6:    00 00 20 15    or     r0, r0

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000008e8 <L8>:
8e8: 00 01 58 00      lhi    r12, 0      ; 0x00
8ea: 00 01 b9 9f      ori    r12, 415    ; 0x19f
8ec: 00 00 60 35      jals   0x00956     ; 0x956 <printf_add_padding>
8ee: 00 00 09 85      mov    r4, r12
8f0: 00 00 21 64      jrs    r11
8f2: 00 00 20 15      or     r0, r0

000008f4 <printf_format_uint>:
8f4: 00 01 8d ff      andi   r6, 511     ; 0x1ff
8f6: 00 00 1c c5      mov    r14, r6
8f8: 00 01 52 05      lhi    r9, 5       ; 0x05
8fa: 00 01 b2 b8      ori    r9, 184     ; 0xb8
8fc: 00 01 54 00      lhi    r10, 0      ; 0x00
8fe: 00 01 b5 99      ori    r10, 409    ; 0x199
900: 00 01 3e 00      movi   r15, 0x00   ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>

00000902 <L5>:
902: 00 01 2c 30      movi   r6, 0x30    ; 0x30 <freqs+0x4>
904: 00 02 59 20      l18    r12, 0(r9)
906: 00 00 09 8a      sltu   r4, r12
908: 00 02 2d 40      s9     0(r10), r6
90a: 00 00 e0 10      bnezc  0x0092a     ; 0x92a <L2>
90c: 00 00 0f 9f      not    r7, r12
90e: 00 01 0e 01      addi   r7, 1       ; 0x01
910: 00 00 29 92      sub    r4, r12
912: 00 01 3a 30      movi   r13, 0x30   ; 0x30 <freqs+0x4>

00000914 <L3>:
914: 00 01 1a 01      addi   r13, 1      ; 0x01
916: 00 01 1e 01      addi   r15, 1      ; 0x01
918: 00 00 10 85      mov    r8, r4
91a: 00 00 28 f0      add    r4, r7
91c: 00 00 0c 85      mov    r6, r4
91e: 00 00 2d 90      add    r6, r12
920: 00 00 0d 8a      sltu   r6, r12
922: 00 01 9b ff      andi   r13, 511    ; 0x1ff
924: 00 00 df f8      beqzc  0x00914     ; 0x914 <L3>
926: 00 00 09 05      mov    r4, r8
928: 00 02 3b 40      s9     0(r10), r13

0000092a <L2>:
92a: 00 00 9e 04      beqz   r15, 0x00932 ; 0x932 <L4>
92c: 00 00 20 15      or     r0, r0
92e: 00 01 14 01      addi   r10, 1      ; 0x01
930: 00 01 0b ff      addi   r5, -1      ; 0x1ff

00000932 <L4>:
932: 00 01 12 02      addi   r9, 2       ; 0x02
934: 00 01 4c 05      lhi    r6, 5       ; 0x05
936: 00 01 ac c2      ori    r6, 194     ; 0xc2
938: 00 00 32 d8      seq    r9, r6
93a: 00 00 20 15      or     r0, r0
93c: 00 00 df e3      beqzc  0x00902     ; 0x902 <L5>
93e: 00 01 08 30      addi   r4, 48      ; 0x30
940: 00 02 29 40      s9     0(r10), r4
942: 00 01 28 00      movi   r4, 0x00    ; 0x0 <SBI_REGION_SPARTANMC_0_MIN_ADDR>
944: 00 02 29 41      s9     1(r10), r4
946: 00 01 58 00      lhi    r12, 0      ; 0x00
948: 00 01 b9 99      ori    r12, 409    ; 0x199
94a: 00 00 1a a5      mov    r13, r5
94c: 00 01 1b ff      addi   r13, -1     ; 0x1ff
94e: 00 00 60 04      jals   0x00956     ; 0x956 <printf_add_padding>
950: 00 00 09 85      mov    r4, r12
952: 00 00 21 64      jrs    r11
954: 00 00 20 15      or     r0, r0

```

```

00000956 <printf_add_padding>:
956: 00 01 8d ff      andi   r6, 511 ; 0x1ff
958: 00 00 40 04      j      0x00960 ; 0x960 <L2>

0000095a <L3>:
95a: 00 01 09 ff      addi   r4, -1 ; 0x1ff
95c: 00 01 0b ff      addi   r5, -1 ; 0x1ff
95e: 00 02 2c 80      s9     0(r4), r6

00000960 <L2>:
960: 00 03 8a 00      slei   r5, 0 ; 0x00
962: 00 00 20 15      or     r0, r0
964: 00 00 df fb      beqz   0x0095a ; 0x95a <L3>
966: 00 00 21 64      jrs    r11
968: 00 00 20 15      or     r0, r0

```

Disassembly of section rodata:

```

0000096a <LC0>:
96a: 00 69            .w9     0x69 ; 'i'
96b: 00 73            .w9     0x73 ; 's'
96c: 00 72            .w9     0x72 ; 'r'
96d: 00 5f            .w9     0x5f ; '_'
96e: 00 64            .w9     0x64 ; 'd'
96f: 00 65            .w9     0x65 ; 'e'
970: 00 66            .w9     0x66 ; 'f'
971: 00 30            .w9     0x30 ; '0'
972: 00 32            .w9     0x32 ; '2'
973: 00 20            .w9     0x20 ; ' '
974: 00 50            .w9     0x50 ; 'P'
975: 00 43            .w9     0x43 ; 'C'
976: 00 3d            .w9     0x3d ; '='
977: 00 20            .w9     0x20 ; ' '
978: 00 25            .w9     0x25 ; '%'
979: 00 30            .w9     0x30 ; '0'
97a: 00 35            .w9     0x35 ; '5'
97b: 00 78            .w9     0x78 ; 'x'
97c: 00 20            .w9     0x20 ; ' '
97d: 00 43            .w9     0x43 ; 'C'
97e: 00 43            .w9     0x43 ; 'C'
97f: 00 3d            .w9     0x3d ; '='
980: 00 20            .w9     0x20 ; ' '
981: 00 25            .w9     0x25 ; '%'
982: 00 30            .w9     0x30 ; '0'
983: 00 31            .w9     0x31 ; '1'
984: 00 78            .w9     0x78 ; 'x'
985: 00 0d            .w9     0x0d
986: 00 0a            .w9     0x0a
987: 00 00            .w9     0x00

```

```

00000988 <LC1>:
988: 00 69            .w9     0x69 ; 'i'
989: 00 73            .w9     0x73 ; 's'
98a: 00 72            .w9     0x72 ; 'r'
98b: 00 5f            .w9     0x5f ; '_'
98c: 00 75            .w9     0x75 ; 'u'
98d: 00 61            .w9     0x61 ; 'a'
98e: 00 72            .w9     0x72 ; 'r'
98f: 00 74            .w9     0x74 ; 't'
990: 00 30            .w9     0x30 ; '0'
991: 00 20            .w9     0x20 ; ' '
992: 00 50            .w9     0x50 ; 'P'
993: 00 43            .w9     0x43 ; 'C'
994: 00 3d            .w9     0x3d ; '='
995: 00 20            .w9     0x20 ; ' '
996: 00 25            .w9     0x25 ; '%'
997: 00 30            .w9     0x30 ; '0'
998: 00 35            .w9     0x35 ; '5'

```

```

999: 00 78 .w9 0x78 ; 'x'
99a: 00 20 .w9 0x20 ; ' '
99b: 00 43 .w9 0x43 ; 'C'
99c: 00 43 .w9 0x43 ; 'C'
99d: 00 3d .w9 0x3d ; '='
99e: 00 20 .w9 0x20 ; ' '
99f: 00 25 .w9 0x25 ; '%'
9a0: 00 30 .w9 0x30 ; '0'
9a1: 00 31 .w9 0x31 ; '1'
9a2: 00 78 .w9 0x78 ; 'x'
9a3: 00 0d .w9 0x0d
9a4: 00 0a .w9 0x0a
9a5: 00 00 .w9 0x00

```

000009a6 <LC2>:

```

9a6: 00 69 .w9 0x69 ; 'i'
9a7: 00 73 .w9 0x73 ; 's'
9a8: 00 72 .w9 0x72 ; 'r'
9a9: 00 5f .w9 0x5f ; '_'
9aa: 00 70 .w9 0x70 ; 'p'
9ab: 00 6f .w9 0x6f ; 'o'
9ac: 00 72 .w9 0x72 ; 'r'
9ad: 00 74 .w9 0x74 ; 't'
9ae: 00 5f .w9 0x5f ; '_'
9af: 00 69 .w9 0x69 ; 'i'
9b0: 00 6e .w9 0x6e ; 'n'
9b1: 00 30 .w9 0x30 ; '0'
9b2: 00 20 .w9 0x20 ; ' '
9b3: 00 50 .w9 0x50 ; 'P'
9b4: 00 43 .w9 0x43 ; 'C'
9b5: 00 3d .w9 0x3d ; '='
9b6: 00 20 .w9 0x20 ; ' '
9b7: 00 25 .w9 0x25 ; '%'
9b8: 00 30 .w9 0x30 ; '0'
9b9: 00 35 .w9 0x35 ; '5'
9ba: 00 78 .w9 0x78 ; 'x'
9bb: 00 20 .w9 0x20 ; ' '
9bc: 00 43 .w9 0x43 ; 'C'
9bd: 00 43 .w9 0x43 ; 'C'
9be: 00 3d .w9 0x3d ; '='
9bf: 00 20 .w9 0x20 ; ' '
9c0: 00 25 .w9 0x25 ; '%'
9c1: 00 30 .w9 0x30 ; '0'
9c2: 00 31 .w9 0x31 ; '1'
9c3: 00 78 .w9 0x78 ; 'x'
9c4: 00 0d .w9 0x0d
9c5: 00 0a .w9 0x0a
9c6: 00 00 .w9 0x00
9c7: 00 00 .w9 0x00

```

000009c8 <LC3>:

```

9c8: 00 0d .w9 0x0d
9c9: 00 0a .w9 0x0a
9ca: 00 0a .w9 0x0a
9cb: 00 0a .w9 0x0a
9cc: 00 54 .w9 0x54 ; 'T'
9cd: 00 65 .w9 0x65 ; 'e'
9ce: 00 73 .w9 0x73 ; 's'
9cf: 00 74 .w9 0x74 ; 't'
9d0: 00 20 .w9 0x20 ; ' '
9d1: 00 54 .w9 0x54 ; 'T'
9d2: 00 69 .w9 0x69 ; 'i'
9d3: 00 6d .w9 0x6d ; 'm'
9d4: 00 65 .w9 0x65 ; 'e'
9d5: 00 72 .w9 0x72 ; 'r'
9d6: 00 20 .w9 0x20 ; ' '
9d7: 00 43 .w9 0x43 ; 'C'
9d8: 00 6f .w9 0x6f ; 'o'
9d9: 00 6d .w9 0x6d ; 'm'
9da: 00 70 .w9 0x70 ; 'p'

```

9db:	00 61	.w9	0x61	; 'a'
9dc:	00 72	.w9	0x72	; 'r'
9dd:	00 65	.w9	0x65	; 'e'
9de:	00 20	.w9	0x20	; ' '
9df:	00 43	.w9	0x43	; 'C'
9e0:	00 50	.w9	0x50	; 'P'
9e1:	00 55	.w9	0x55	; 'U'
9e2:	00 5f	.w9	0x5f	; '_'
9e3:	00 63	.w9	0x63	; 'c'
9e4:	00 6c	.w9	0x6c	; 'l'
9e5:	00 6b	.w9	0x6b	; 'k'
9e6:	00 20	.w9	0x20	; ' '
9e7:	00 3d	.w9	0x3d	; '='
9e8:	00 20	.w9	0x20	; ' '
9e9:	00 25	.w9	0x25	; '%'
9ea:	00 75	.w9	0x75	; 'u'
9eb:	00 20	.w9	0x20	; ' '
9ec:	00 6b	.w9	0x6b	; 'k'
9ed:	00 48	.w9	0x48	; 'H'
9ee:	00 7a	.w9	0x7a	; 'z'
9ef:	00 0d	.w9	0x0d	
9f0:	00 0a	.w9	0x0a	
9f1:	00 0a	.w9	0x0a	
9f2:	00 54	.w9	0x54	; 'T'
9f3:	00 61	.w9	0x61	; 'a'
9f4:	00 73	.w9	0x73	; 's'
9f5:	00 74	.w9	0x74	; 't'
9f6:	00 65	.w9	0x65	; 'e'
9f7:	00 72	.w9	0x72	; 'r'
9f8:	00 20	.w9	0x20	; ' '
9f9:	00 31	.w9	0x31	; '1'
9fa:	00 20	.w9	0x20	; ' '
9fb:	00 4c	.w9	0x4c	; 'L'
9fc:	00 69	.w9	0x69	; 'i'
9fd:	00 65	.w9	0x65	; 'e'
9fe:	00 64	.w9	0x64	; 'd'
9ff:	00 65	.w9	0x65	; 'e'
a00:	00 72	.w9	0x72	; 'r'
a01:	00 0d	.w9	0x0d	
a02:	00 0a	.w9	0x0a	
a03:	00 54	.w9	0x54	; 'T'
a04:	00 61	.w9	0x61	; 'a'
a05:	00 73	.w9	0x73	; 's'
a06:	00 74	.w9	0x74	; 't'
a07:	00 65	.w9	0x65	; 'e'
a08:	00 72	.w9	0x72	; 'r'
a09:	00 20	.w9	0x20	; ' '
a0a:	00 32	.w9	0x32	; '2'
a0b:	00 20	.w9	0x20	; ' '
a0c:	00 47	.w9	0x47	; 'G'
a0d:	00 6f	.w9	0x6f	; 'o'
a0e:	00 6e	.w9	0x6e	; 'n'
a0f:	00 67	.w9	0x67	; 'g'
a10:	00 0d	.w9	0x0d	
a11:	00 0a	.w9	0x0a	
a12:	00 54	.w9	0x54	; 'T'
a13:	00 61	.w9	0x61	; 'a'
a14:	00 73	.w9	0x73	; 's'
a15:	00 74	.w9	0x74	; 't'
a16:	00 65	.w9	0x65	; 'e'
a17:	00 72	.w9	0x72	; 'r'
a18:	00 20	.w9	0x20	; ' '
a19:	00 33	.w9	0x33	; '3'
a1a:	00 20	.w9	0x20	; ' '
a1b:	00 4c	.w9	0x4c	; 'L'
a1c:	00 69	.w9	0x69	; 'i'
a1d:	00 65	.w9	0x65	; 'e'
a1e:	00 64	.w9	0x64	; 'd'
a1f:	00 65	.w9	0x65	; 'e'
a20:	00 72	.w9	0x72	; 'r'

a21:	00 0d	.w9	0x0d	
a22:	00 0a	.w9	0x0a	
a23:	00 0a	.w9	0x0a	
a24:	00 73	.w9	0x73	; 's'
a25:	00 20	.w9	0x20	; ' '
a26:	00 2d	.w9	0x2d	; '-'
a27:	00 20	.w9	0x20	; ' '
a28:	00 53	.w9	0x53	; 'S'
a29:	00 74	.w9	0x74	; 't'
a2a:	00 61	.w9	0x61	; 'a'
a2b:	00 63	.w9	0x63	; 'c'
a2c:	00 63	.w9	0x63	; 'c'
a2d:	00 61	.w9	0x61	; 'a'
a2e:	00 74	.w9	0x74	; 't'
a2f:	00 6f	.w9	0x6f	; 'o'
a30:	00 20	.w9	0x20	; ' '
a31:	00 61	.w9	0x61	; 'a'
a32:	00 75	.w9	0x75	; 'u'
a33:	00 73	.w9	0x73	; 's'
a34:	00 0d	.w9	0x0d	
a35:	00 0a	.w9	0x0a	
a36:	00 53	.w9	0x53	; 'S'
a37:	00 20	.w9	0x20	; ' '
a38:	00 2d	.w9	0x2d	; '-'
a39:	00 20	.w9	0x20	; ' '
a3a:	00 53	.w9	0x53	; 'S'
a3b:	00 74	.w9	0x74	; 't'
a3c:	00 61	.w9	0x61	; 'a'
a3d:	00 63	.w9	0x63	; 'c'
a3e:	00 63	.w9	0x63	; 'c'
a3f:	00 61	.w9	0x61	; 'a'
a40:	00 74	.w9	0x74	; 't'
a41:	00 6f	.w9	0x6f	; 'o'
a42:	00 20	.w9	0x20	; ' '
a43:	00 65	.w9	0x65	; 'e'
a44:	00 69	.w9	0x69	; 'i'
a45:	00 6e	.w9	0x6e	; 'n'
a46:	00 0d	.w9	0x0d	
a47:	00 0a	.w9	0x0a	
a48:	00 2b	.w9	0x2b	; '+'
a49:	00 20	.w9	0x20	; ' '
a4a:	00 2d	.w9	0x2d	; '-'
a4b:	00 20	.w9	0x20	; ' '
a4c:	00 4f	.w9	0x4f	; 'O'
a4d:	00 6b	.w9	0x6b	; 'k'
a4e:	00 74	.w9	0x74	; 't'
a4f:	00 61	.w9	0x61	; 'a'
a50:	00 76	.w9	0x76	; 'v'
a51:	00 65	.w9	0x65	; 'e'
a52:	00 20	.w9	0x20	; ' '
a53:	00 68	.w9	0x68	; 'h'
a54:	00 6f	.w9	0x6f	; 'o'
a55:	00 63	.w9	0x63	; 'c'
a56:	00 68	.w9	0x68	; 'h'
a57:	00 0d	.w9	0x0d	
a58:	00 0a	.w9	0x0a	
a59:	00 2d	.w9	0x2d	; '-'
a5a:	00 20	.w9	0x20	; ' '
a5b:	00 2d	.w9	0x2d	; '-'
a5c:	00 20	.w9	0x20	; ' '
a5d:	00 4f	.w9	0x4f	; 'O'
a5e:	00 6b	.w9	0x6b	; 'k'
a5f:	00 74	.w9	0x74	; 't'
a60:	00 61	.w9	0x61	; 'a'
a61:	00 76	.w9	0x76	; 'v'
a62:	00 65	.w9	0x65	; 'e'
a63:	00 20	.w9	0x20	; ' '
a64:	00 72	.w9	0x72	; 'r'
a65:	00 75	.w9	0x75	; 'u'
a66:	00 6e	.w9	0x6e	; 'n'

a67:	00 74	.w9	0x74	; 't'
a68:	00 65	.w9	0x65	; 'e'
a69:	00 72	.w9	0x72	; 'r'
a6a:	00 0d	.w9	0x0d	
a6b:	00 0a	.w9	0x0a	
a6c:	00 0a	.w9	0x0a	
a6d:	00 00	.w9	0x00	

0000a6e <LC4>:

a6e:	00 0d	.w9	0x0d	
a6f:	00 53	.w9	0x53	; 'S'
a70:	00 74	.w9	0x74	; 't'
a71:	00 61	.w9	0x61	; 'a'
a72:	00 63	.w9	0x63	; 'c'
a73:	00 63	.w9	0x63	; 'c'
a74:	00 61	.w9	0x61	; 'a'
a75:	00 74	.w9	0x74	; 't'
a76:	00 6f	.w9	0x6f	; 'o'
a77:	00 20	.w9	0x20	; ' '
a78:	00 3d	.w9	0x3d	; '='
a79:	00 20	.w9	0x20	; ' '
a7a:	00 25	.w9	0x25	; '%'
a7b:	00 30	.w9	0x30	; '0'
a7c:	00 31	.w9	0x31	; '1'
a7d:	00 64	.w9	0x64	; 'd'
a7e:	00 20	.w9	0x20	; ' '
a7f:	00 4f	.w9	0x4f	; 'O'
a80:	00 6b	.w9	0x6b	; 'k'
a81:	00 74	.w9	0x74	; 't'
a82:	00 61	.w9	0x61	; 'a'
a83:	00 76	.w9	0x76	; 'v'
a84:	00 65	.w9	0x65	; 'e'
a85:	00 20	.w9	0x20	; ' '
a86:	00 3d	.w9	0x3d	; '='
a87:	00 20	.w9	0x20	; ' '
a88:	00 25	.w9	0x25	; '%'
a89:	00 30	.w9	0x30	; '0'
a8a:	00 31	.w9	0x31	; '1'
a8b:	00 64	.w9	0x64	; 'd'
a8c:	00 20	.w9	0x20	; ' '
a8d:	00 00	.w9	0x00	

0000a8e <led7>:

a8e:	00 3f	.w9	0x3f	; ' ?'
a8f:	00 06	.w9	0x06	
a90:	00 5b	.w9	0x5b	; '['
a91:	00 4f	.w9	0x4f	; 'O'
a92:	00 66	.w9	0x66	; 'f'
a93:	00 6d	.w9	0x6d	; 'm'
a94:	00 7d	.w9	0x7d	; '}'
a95:	00 07	.w9	0x07	
a96:	00 7f	.w9	0x7f	
a97:	00 6f	.w9	0x6f	; 'o'
a98:	00 77	.w9	0x77	; 'w'
a99:	00 7c	.w9	0x7c	; ' '
a9a:	00 58	.w9	0x58	; 'X'
a9b:	00 5e	.w9	0x5e	; '^'
a9c:	00 79	.w9	0x79	; 'y'
a9d:	00 71	.w9	0x71	; 'q'

0000a9e <LC0>:

a9e:	00 25	.w9	0x25	; '%'
a9f:	00 00	.w9	0x00	

0000aa0 <percent>:

aa0:	00 05	.w9	0x05	
aa1:	00 9e	.w9	0x9e	

```

00000aa2 <LC1>:
aa2: 00 25 .w9 0x25 ; '%'
aa3: 00 3f .w9 0x3f ; '?'
aa4: 00 00 .w9 0x00
aa5: 00 00 .w9 0x00

```

```

00000aa6 <invalid_format>:
aa6: 00 05 .w9 0x05
aa7: 00 a2 .w9 0xa2

```

```

00000aa8 <digits>:
aa8: 00 30 .w9 0x30 ; '0'
aa9: 00 31 .w9 0x31 ; '1'
aaa: 00 32 .w9 0x32 ; '2'
aab: 00 33 .w9 0x33 ; '3'
aac: 00 34 .w9 0x34 ; '4'
aad: 00 35 .w9 0x35 ; '5'
aae: 00 36 .w9 0x36 ; '6'
aaf: 00 37 .w9 0x37 ; '7'
ab0: 00 38 .w9 0x38 ; '8'
ab1: 00 39 .w9 0x39 ; '9'
ab2: 00 41 .w9 0x41 ; 'A'
ab3: 00 42 .w9 0x42 ; 'B'
ab4: 00 43 .w9 0x43 ; 'C'
ab5: 00 44 .w9 0x44 ; 'D'
ab6: 00 45 .w9 0x45 ; 'E'
ab7: 00 46 .w9 0x46 ; 'F'

```

```

00000ab8 <hex2int_table>:
ab8: 00 c3 .w9 0xc3
ab9: 00 a0 .w9 0xa0
aba: 00 13 .w9 0x13
abb: 01 10 .w9 0x110
abc: 00 01 .w9 0x01
abd: 01 e8 .w9 0x1e8
abe: 00 00 .w9 0x00
abf: 00 64 .w9 0x64 ; 'd'
ac0: 00 00 .w9 0x00
ac1: 00 0a .w9 0x0a
ac2: 00 00 .w9 0x00
ac3: 00 01 .w9 0x01

```