LAMPIRAN

Tabel time per beat atau percobaan pertama

Tempo	time/beat	output osiloskop
40	1500	1516
41	1463	1482
42	1429	1448
43	1395	1408
44	1364	1380
45	1333	1344
46	1304	1320
47	1277	1298
48	1250	1270
49	1224	1238
50	1200	1216
51	1176	1194
52	1154	1166
53	1132	1146
54	1111	1122
55	1091	1102
56	1071	1082
57	1053	1064
58	1034	1048
59	1017	1028
60	1000	1012
61	984	998
62	968	980
63	952	966
64	938	952
65	923	934
66	909	918
67	896	906
68	882	896
69	870	884
70	857	870
71	845	856
72	833	844
73	822	833
74	811	822
75	800	811
76	789	800
77	779	790
78	769	780
79	759	769
80	750	764
81	741	752

Tempo	time/beat	output osiloskop
125	480	486
126	476	476
127	472	472
128	469	469
129	465	465
130	462	469
131	458	458
132	455	455
133	451	451
134	448	448
135	444	449
136	441	441
137	438	438
138	435	435
139	432	432
140	429	437
141	426	426
142	423	423
143	420	420
144	417	417
145	414	421
146	411	411
147	408	408
148	405	405
149	403	403
150	400	408
151	397	397
152	395	395
153	392	392
154	390	390
155	387	392
156	385	385
157	382	382
158	380	380
159	377	377
160	375	381
161	373	373
162	370	370
163	368	368
164	366	366
165	364	369
166	361	361

82	732	742
83	723	734
84	714	726
85	706	718
86	698	708
87	690	700
88	682	692
89	674	684
90	667	677
91	659	669
92	652	662
93	645	654
94	638	647
95	632	641
96	625	634
97	619	627
98	612	620
99	606	613
100	600	609
101	594	602
102	588	597
103	583	590
104	577	587
105	571	579
106	566	574
107	561	570
108	556	565
109	550	557
110	545	554
111	541	550
112	536	547
113	531	539
114	526	534
115	522	530
116	517	526
117	513	521
118	508	518
119	504	513
120	500	508
121	496	496
122	492	492
123	488	488
124	484	484

167	359	359
168	357	357
169	355	355
170	353	359
171	351	351
172	349	349
173	347	347
174	345	345
175	343	349
176	341	341
177	339	339
178	337	337
179	335	335
180	333	335
181	331	331
182	330	330
183	328	328
184	326	326
185	324	327
186	323	323
187	321	321
188	319	319
189	317	317
190	316	319
191	314	314
192	313	313
193	311	311
194	309	313
195	308	312
196	306	311
197	305	309
198	303	307
199	302	306
200	300	302
201	299	304
202	297	301
203	296	300
204	294	297
205	293	296
206	291	294
207	290	293
208	288	291

Tabel Pemanipulasian Data

Tempo	Time/beat (ms)	Input Percobaan Kedua (ms)	Hasil Output Osiloskop (ms)	Selisih I/O
40	1500	1484	1500	16
41	1463	1444	1463	19
42	1429	1410	1429	19
43	1395	1382	1395	13
44	1364	1348	1364	16
45	1333	1322	1333	11
46	1304	1288	1304	16
47	1277	1256	1277	21
48	1250	1230	1250	20
49	1224	1210	1224	14
50	1200	1184	1200	16
51	1176	1158	1176	18
52	1154	1142	1154	12
53	1132	1118	1132	14
54	1111	1100	1111	11
55	1091	1080	1091	11
56	1071	1060	1071	11
57	1053	1042	1053	11
58	1034	1020	1034	14
59	1017	1006	1017	11
60	1000	988	1000	12
61	984	970	984	14
62	968	956	968	12
63	952	938	952	14
64	938	924	938	14
65	923	912	923	11
66	909	900	909	9
67	896	886	896	10
68	882	868	882	14
69	870	856	870	14
70	857	844	857	13
71	845	834	845	11
72	833	822	833	11
73	822	811	822	11
74	811	800	811	11
75	800	789	800	11
76	789	778	789	11
77	779	768	779	11
78	769	758	769	11
79	759	749	759	10
80	750	736	750	14
81	741	730	741	11
82	732	722	732	10

83	723	712	723	11
84	714	702	714	12
85	706	694	706	12
86	698	688	698	10
87	690	680	690	10
88	682	672	682	10
89	674	664	674	10
90	667	657	667	10
91	659	649	659	10
92	652	642	652	10
93	645	636	645	9
94	638	629	638	9
95	632	623	632	9
96	625	616	625	9
97	619	611	619	8
98	612	604	612	8
99	606	599	606	7
100	600	591	600	9
101	594	586	594	8
102	588	579	588	9
103	583	576	583	7
104	577	567	577	10
105	571	563	571	8
106	566	558	566	8
107	561	552	561	9
108	556	547	556	9
109	550	543	550	7
110	545	536	545	9
111	541	532	541	9
112	536	525	536	11
113	531	523	531	8
114	526	518	526	8
115	522	514	522	8
116	517	508	517	9
117	513	505	513	8
118	508	498	508	10
119	504	495	504	9
120	500	492	500	8
121	496	489	496	7
122	492	485	492	7
123	488	480	488	8
124	484	477	484	7
125	480	474	480	6
126	476	470	476	6
127	472	465	472	7
128	469	463	469	6
129	465	459	465	6
130	462	455	462	7

131	458	451	458	7
132	455	448	455	7
133	451	445	451	6
134	448	442	448	6
135	444	439	444	5
136	441	436	441	5
137	438	432	438	6
138	435	430	435	5
139	432	427	432	5
140	429	421	429	8
141	426	418	426	8
142	423	416	423	7
143	420	412	420	8
144	417	410	417	7
145	414	407	414	7
146	411	404	411	7
147	408	401	408	7
148	405	398	405	7
149	403	396	403	7
150	400	392	400	8
151	397	390	397	7
152	395	388	395	7
153	392	385	392	7
154	390	383	390	7
155	387	382	387	5
156	385	380	385	5
157	382	376	382	6
158	380	376	380	4
159	377	371	377	6
160	375	369	375	6
161	373	367	373	6
162	370	364	370	6
163	368	362	368	6
164	366	360	366	6
165	364	359	364	5
166	361	355	361	6
167	359	353	359	6
168	357	351	357	6
169	355	349	355	6
170	353	347	353	6
171	351	345	351	6
172	349	343	349	6
173	347	341	347	6
174	345	339	345	6
175	343	337	343	6
176	341	336	341	5
177	339	334	339	5
178	337	333	337	4

179	335	331	335	4
180	333	331	333	2
181	331	328	331	3
182	330	327	330	3
183	328	325	328	3
184	326	323	326	3
185	324	321	324	3
186	323	320	323	3
187	321	318	321	3
188	319	316	319	3
189	317	314	317	3
190	316	313	316	3
191	314	311	314	3
192	313	310	313	3
193	311	308	311	3
194	309	305	309	4
195	308	304	308	4
196	306	301	306	5
197	305	301	305	4
198	303	299	303	4
199	302	298	302	4
200	300	298	300	2
201	299	294	299	5
202	297	293	297	4
203	296	292	296	4
204	294	291	294	3
205	293	290	293	3
206	291	288	291	3
207	290	287	290	3
208	288	285	288	3

Source Code

```
;*********************
;costanta lcd
;*********************
display_clear   equ 01h
funcset         equ 28h
entrymodset     equ 06h
dispon          equ 0ch
cursor          equ 0eh
blink           equ 0fh


data_lcd        equ 30h
ram_lcd         equ 31h
t_rat           equ 32h
t_pul           equ 33h
t_sat           equ 34h
count_t         equ 35h
count_b         equ 36h
tlowl           equ 37h
tlowh           equ 38h
ct              equ 39h

fsw3            bit 20h.0

        org 0000h
        jmp start

        org 0003h
        jmp int_ex0

        org 0030h

int_ex0:
        setb fsw3
        reti

init_lcd:
        mov a,#funcset
        call controlout
        mov a,#dispon
        call controlout
        mov a,#display_clear
        call controlout
        call dlylcd2
```

```
        mov a,#entrymodset
        call controlout
        ret

;*********************
dlylcd2:
        mov r6,#40h
dly2:
        mov r7,#0
dly3:
        djnz r7,dly3
        djnz r6,dly2
        ret
;*********************
;control out to lcd
controlout:
        push acc
        call controllcd
        pop acc
        swap a
        call controllcd
        ret
;*********************
;data out to lcd
dataout:
        push acc
        call datalcd
        pop acc
        swap a
        call datalcd
        ret

;*********************
controllcd:
        clr acc.1  ;e=0
        clr acc.0  ;rs=0
        mov p0,a
        sjmp dlylcd1
;*********************
datalcd:
        clr acc.1  ;e=0
        setb acc.0 ;rs=1
        mov p0,a

dlylcd1:
        setb p0.1 ;e=1
```

```
        mov r7,#250
        djnz r7,$
        clr p0.1  ;e=0
        ret
;*********************
;line lcd
line2:
        mov a,#0c0h
        sjmp lineout
line1:
        mov a,#80h
lineout:
        call controlout
        ret
;*********************
;tampilan karakter
tampilline2:
        call line2
        sjmp outchar
tampilline1:
        call line1
        sjmp outchar
tampilcharloop:
        call dataout
        inc dptr
outchar:
        clr a
        movc a,@a+dptr
        jnz tampilcharloop
        ret

tampilinram:
        clr a
        movc a,@a+dptr
        jz finish_send
        mov data_lcd,a
        call send_lcd
        inc dptr
        inc ram_lcd
        sjmp tampilinram
finish_send:
        ret

;*********************
;set up lcd
setuplcd:
```

```
        mov a,#03h
        call controlout
        mov r5,#2
        call sebentar
        mov a,#02h
        call controlout
        mov r5,#1
        call sebentar
        ret
;*********************
;send to add lcd
send_lcd:
        mov a,#9
        clr c
        subb a,data_lcd
        jc sendtoram
        mov a,data_lcd
        orl a,#30h
        mov data_lcd,a
sendtoram:
        mov a,ram_lcd
        orl a,#80h
        call controlout
        mov a,data_lcd
        call dataout
        ret

;*********************
;delay time
sebentar:
        call dlybounc
        djnz r5,sebentar
        ret
dlybounc:
        mov r6,#100
loopb2:
        mov r7,#250
loopb1:
        nop
        nop
        nop
        djnz r7,loopb1
        djnz r6,loopb2
        ret

sw3    equ p3.2
```

```
sw2    equ p3.3
sw1    equ p3.4

text_main1:
      db 'Setting:1.Tempo',0
text_main2:
      db '2.Beat  3.Start',0

text_set:
      db '1.(+)2.(-)3.Exit',0
text_set_beat:
      db 'Set Beat:  ',0
text_set_tempo:
      db 'Set Tempo: ',0

disp_tempo:
      mov a,count_t
      mov b,#100
      div ab
      mov t_rat,a
      mov a,b
      mov b,#10
      div ab
      mov t_pul,a
      mov t_sat,b
      mov dptr,#text_set_tempo
      call tampilline2
      mov a,t_rat
      cjne a,#0,nbt1
      mov data_lcd,#' '
      call send_lcd
      mov a,t_pul
      cjne a,#0,nbt2
      mov data_lcd,#' '
      inc ram_lcd
      call send_lcd
      jmp nbt3
nbt1:
      mov data_lcd,t_rat
      call send_lcd
nbt2:
      mov data_lcd,t_pul
      inc ram_lcd
      call send_lcd
nbt3:
      mov data_lcd,t_sat
```

```
        inc ram_lcd
        call send_lcd
        ret

disp_beat:
        mov a,count_b
        mov b,#100
        div ab
        mov t_rat,a
        mov a,b
        mov b,#10
        div ab
        mov t_pul,a
        mov t_sat,b
        mov dptr,#text_set_beat
        call tampilline2
        mov a,t_rat
        cjne a,#0,nbb1
        mov data_lcd,#' '
        call send_lcd
        mov a,t_pul
        cjne a,#0,nbb2
        mov data_lcd,#' '
        inc ram_lcd
        call send_lcd
        jmp nbt3
nbb1:
        mov data_lcd,t_rat
        call send_lcd
nbb2:
        mov data_lcd,t_pul
        inc ram_lcd
        call send_lcd
nbb3:
        mov data_lcd,t_sat
        inc ram_lcd
        call send_lcd
        ret

out_key:
        mov r5,#2
        call sebentar
        mov a,p3
        anl a,#00011100b
        cjne a,#00011100b,out_key
        mov r5,#3
```

```
        call sebentar
        ret

set_tempo:
        call init_lcd
        mov dptr,#text_set
        call tampilline1

update:
        mov ram_lcd,#4bh
        call disp_tempo
cek_sw1t:
        jb sw1,cek_sw2t
        call out_key
        inc count_t
        mov a,count_t
        cjne a,#209,update
        mov count_t,#40
        jmp update

cek_sw2t:
        jb sw2,cek_sw3t
        call out_key
        dec count_t
        mov a,count_t
        cjne a,#39,update
        mov count_t,#208
        jmp update


cek_sw3t:
        jb sw3,cek_sw1t
        call out_key
        ret

set_beat:
        call init_lcd
        mov dptr,#text_set
        call tampilline1

updateb:
        mov ram_lcd,#4bh
        call disp_beat
cek_sw1b:
        jb sw1,cek_sw2b
        call out_key
```

```
        inc count_b
        mov a,count_b
        cjne a,#7,updateb
        mov count_b,#2
        jmp updateb

cek_sw2b:
        jb sw2,cek_sw3b
        call out_key
        dec count_b
        mov a,count_b
        cjne a,#0,updateb
        mov count_b,#6
        jmp updateb


cek_sw3b:
        jb sw3,cek_sw1b
        call out_key
        ret

text_run1:
        db 'Tempo :',0
text_run2:
        db 'Beat  :',0

disp_run:
        call init_lcd
        mov dptr,#text_run1
        call tampilline1
        mov ram_lcd,#08h
        call disp_tempo
        mov dptr,#text_run2
        call tampilline2
        mov ram_lcd,#48h
        call disp_beat
        ret

;-------menu program----------
main_menu:
        call init_lcd
        mov dptr,#text_main1
        call tampilline1
        mov dptr,#text_main2
        call tampilline2
cek_sw1:
```

```
        jb sw1,cek_sw2
        call out_key
        call set_tempo
        jmp main_menu
cek_sw2:
        jb sw2,cek_sw3
        call out_key
        call set_beat
        jmp main_menu

cek_sw3:
        jb sw3,cek_sw1
        call out_key
        call disp_run
        call run_tone
        jmp main_menu

count1 equ -1000
count2 equ -1000
count3 equ -500

run_tone:
        mov dptr,#tabel_low
        mov a,count_t
        subb a,#40
        cjne a,#0,tidaknol
        jmp gotab

tidaknol:
        mov r0,a
updptr:
        inc dptr
        inc dptr
        djnz r0,updptr
gotab:
        mov a,#0
        movc a,@a+dptr
        mov tlowh,a
        inc dptr
        mov a,#0
        movc a,@a+dptr
        mov tlowl,a
        mov tmod,#01h
        clr fsw3
        mov ct,#0
```

```
awal:
        mov dptr,#0
        jnb fsw3,inv
        clr p3.0
        setb p3.1
        jmp testb
inv:
        clr p3.1
        setb p3.0

testb:
        inc ct
        mov a,ct
        cjne a,count_b,ulang2
        mov ct,#0
ulang2b:
        mov th0,#high count3
        mov tl0,#low count3
        setb tr0

tunggu1b:
        jb sw3,tunggu1xb
        jmp out_tone
tunggu1xb:
        jnb tf0,tunggu1b

        clr tr0
        clr tf0
        cpl p1.0
        inc dptr
        mov a,dph
        cjne a,#0,ulang2b
        mov a,dpl
        cjne a,#110,ulang2b
        jmp ccx


ulang2:
        mov th0,#high count1
        mov tl0,#low count1
        setb tr0

tunggu1:
        jb sw3,tunggu1x
        jmp out_tone
tunggu1x:
```

```
        jnb tf0,tunggu1

        clr tr0
        clr tf0
        cpl p1.0
        inc dptr
        mov a,dph
        cjne a,#0,ulang2
        mov a,dpl
        cjne a,#55,ulang2
ccx:
        cpl fsw3
        setb p2.0
        setb p3.0
        setb p3.1
        setb p1.0
        clr p2.0
        mov dptr,#0
ulang4:
        mov th0,#high count2
        mov tl0,#low count2
        setb tr0

tunggu2:
        jb sw3,tunggu2x
        jmp out_tone
tunggu2x:
        jnb tf0,tunggu2
        clr tr0
        clr tf0
        inc dptr
        mov a,dph
        cjne a,tlowh,ulang4
        mov a,dpl
        cjne a,tlowl,ulang4
        setb p2.0
        jmp awal
out_tone:
        call out_key
        setb p1.0
        setb p3.0
        setb p3.1
        setb p2.0
        ret

;-------main program----------
```

```
start:
        setb sw1
        setb sw2
        setb sw3
        mov count_t,#40
        mov count_b,#2
        call setuplcd
        call init_lcd
        call main_menu


tabel_low:
dw 1429
dw 1389
dw 1355
dw 1327
dw 1293
dw 1267
dw 1233
dw 1201
dw 1175
dw 1155
dw 1129
dw 1103
dw 1087
dw 1063
dw 1045
dw 1025
dw 1005
dw 987
dw 965
dw 951
dw 933
dw 915
dw 901
dw 883
dw 869
dw 857
dw 845
dw 831
dw 813
dw 801
dw 789
dw 779
dw 767
dw 756
```

dw 745
dw 734
dw 723
dw 713
dw 703
dw 694
dw 681
dw 675
dw 667
dw 657
dw 647
dw 639
dw 633
dw 625
dw 617
dw 609
dw 602
dw 594
dw 587
dw 581
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dw 304

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dw 300
dw 298
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dw 259
dw 258
dw 256
dw 255
dw 253
dw 250
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dw 243
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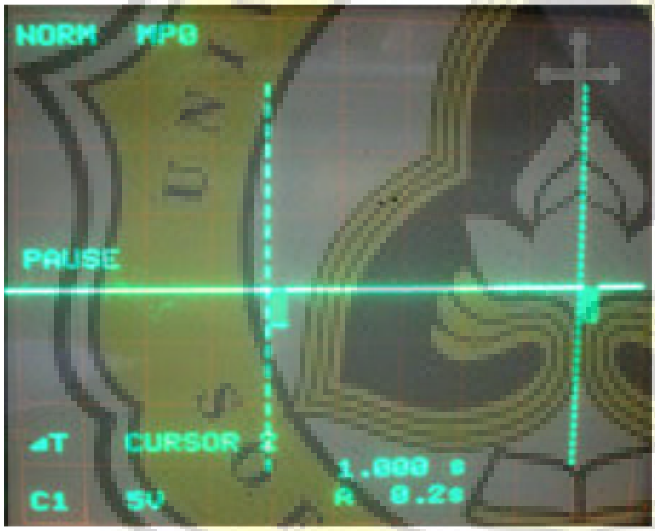
dw 237
dw 236
dw 235
dw 233
dw 232
dw 230

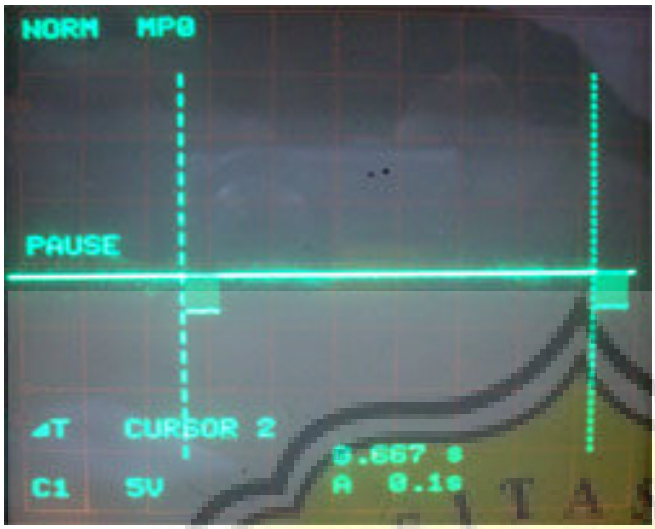
    jmp $
    end
```

Hasil pengukuran melalui osiloskop

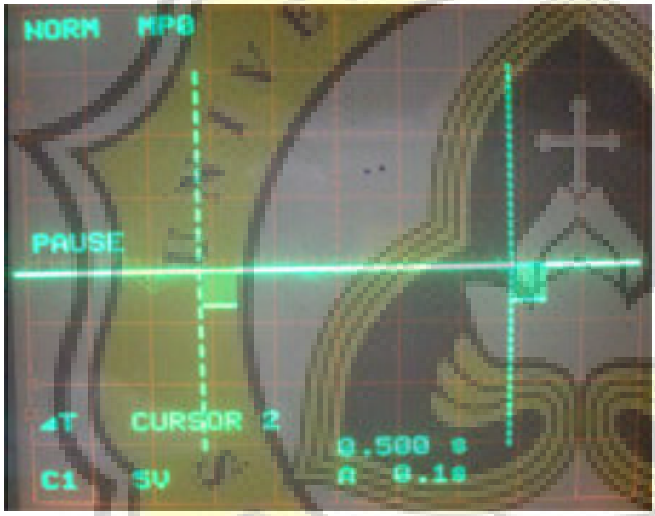
Tempo 40



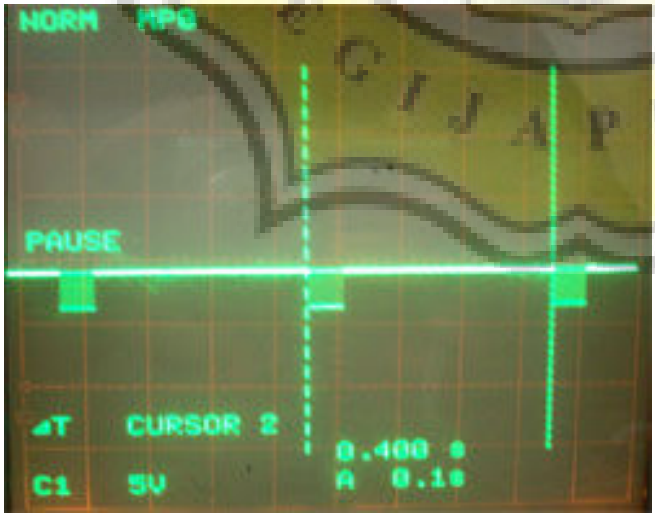
Tempo 60



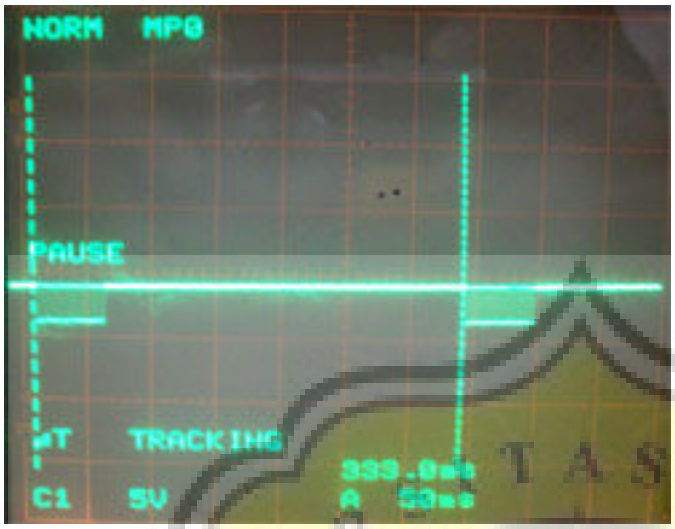
Tempo 90



Tempo 120



Tempo 150



Tempo 180

Tempo 200