11/6/03 Bob Webber

Booster VCO Program Flow Documentation

Interrupts

rst_svc chip reset routine

source

DSP board or chip hardware reset

calls

init_21k

exits with

jump to *main*

irq1_svc interrupt vector to set up for new Booster cycle

source

external trigger to hardware input IRQ1 (generally TCLK Booster reset events)

exits with

jump to *begin_cycle*

cb7_svc interrupt vector for frequency curve circular buffer

source

frequency curve circular buffer overflow (address wrap-around)

exits with

jump to *cb7i_asserted*

cb15_svc interrupt vector for bias curve circular buffer

source

bias curve circular buffer overflow (address wrap-around)

exits with

jump to *cb15i_asserted*

tmzl_svc interrupt vector to initiate playing out curves

source

DSP timer time-out; in this case, timer started in *begin_cycle*

exits with

jump to ***play_curve*** (with delayed branch clear of time high priority interrupt latch)

tmzh_svc►► ►►►►►►►►► interrupt vector to DDS update

source ►

►►►►►►►►►►► DSP timer time-out; in this case, timer started in ***play_curve*** and occurs every 4 usec while curves play

exits with ►

jump to ***timer_hi_prior***

sft0_svc►►►►►►►►►►►►►►► interrupt vector to check newparameters, do housekeeping, and end cycle

source ►

►►►►►►►►►►► software interrupt set in cb15i_asserted

exits with ►

jump to sft0i_asserted

ep1_svc►►►►► ►►►►►►►►► interrupt vector for end of dma process

source ►

►►►►►►►►►►► dma-complete interrupt for dma process initiated in NOT USED

exits with ►

rti

Service Routines and Subroutines

init_21k►►► ►►►►►►►►► initializes board and program at power-up or reset

contains ►

►►►►►►►►►►► ***rtn_default***

calls ►

►►►►►►►►►►► ***get_btparam***

►►►►►►►►►►► ***tst_params***►►►►►

►►►►►►►►►►► ***tst_tblsize***

►►►►►►►►►►► ***get_tables***

►►►►►►►►►►► ***tst_tables***

crv_builder

exits with ►

►►►►►►►►►►► rts

main►►►►►►►►► ►►►►►►►►► ►►►►►►►►► idle loop awaiting interrupts

************ idle
exits only with external interrupt

*begin_cycle******* ********** initialization for a new Booster cycle*

contains *
********** ***rtn_int*** (local jump label)
exits with *
********** rti

*play_curve********** ********** enables fast timer and interrupt* to actually begin playing curves*

exits with *
********** rti

*timer_hi_prior** ********** interrupt service for fast DDS frequency updates*

contains *
********** ***return*** (never referenced)
exits with *
********** rti

*cb7i_asserted********** interrupt service for frequency curve circular buffer wraps*

contains *
********** ***fin_fcrv*** (local jump label)
********** ***ddn*** (local jump label)
fin_int (local jump label)
exits with *
********** rti (with delayed branch toggle of ustat1 UP-SWP bit)

*cb15i_asserted********** interrupt service for bias curve circular buffer wraps*

contains *
********** ***fin_bcrv***(local jump label)
exits with *
********** rti

*sft0i_asserted ********** interrupt service for *both curves finished* to check newparameters, do housekeeping, and end cycle*

contains *

********** ***end_sft0i*** (local jump label)

calls *

********** ***new_params***

********** ***tst_params***

********** ***new_tables***

********** ***echo_tables***

********** ***restore_inj***

********** ***inj_crv***

exits with *

rti

*get_btparam********** retrieve program parameters from boot memory at program initialization*

calls *

********** ***dma_32***

exits with *

********** rts

*tst_params********** ********** check parameters for allowed values*

calls *

********** ***compare***

exits with *

********** rts

*compare*** ********** ********** low level value comparison routine*

exits with *

********** rts

*get_tables********** retrieve freq and bias curves from boot memory at program initialization*

calls *

********** ***get_tbl***

returns with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

tst_tblsize❓ ❓❓❓❓❓❓❓❓❓ ❓❓❓❓❓❓❓❓❓ test freq and bias curves for allowed size

calls ❓
❓❓❓❓❓❓❓❓❓❓❓ ***tst_size***
exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

tst_size❓❓❓❓❓❓ ❓❓❓❓❓❓❓❓❓ ❓❓❓❓❓❓❓❓❓ test freq and bias curves for allowed size

exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ jump to ***default_tbls***
or❓❓❓❓❓❓❓❓ rts❓❓❓❓❓❓❓

tst_tables❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓ setup test for monotonic time values in freq and bias tables

calls ❓
❓❓❓❓❓❓❓❓❓❓❓ ***tst_time***
exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ jump to ***default_tbls***
or ❓❓❓❓❓❓❓ rts

tst_time ❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓❓ test for monotonically increasing time

contains ❓
❓❓❓❓❓❓❓❓❓❓❓ ***time_tst*** (local loop label)

exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ jump to ***default_tbls***
or ❓❓❓❓❓❓❓ rts

❓❓❓❓❓❓❓❓❓❓❓

default_tbls❓❓❓❓❓❓❓❓❓ compute and load default freq and bias curves

calls ❓
❓❓❓❓❓❓❓❓❓❓❓ ***crv_builder***

exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

get_tbl❓❓❓❓❓❓ ❓❓❓❓❓❓❓❓❓ loop to read freq or bias table from boot memory

contains ❓
❓❓❓❓❓❓❓❓❓❓❓ ***get_loop*** (local loop label)
calls ❓
❓❓❓❓❓❓❓❓❓❓❓ *dma_32*
exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

dma_32❓❓❓❓ ❓❓❓❓❓❓❓❓❓ low level routine to read 32 bits from boot memory

calls ❓
❓❓❓❓❓❓❓❓❓❓❓ ***pack_boot***
contains ❓
❓❓❓❓❓❓❓❓❓❓❓ ***wait_dma32*** (local loop label)
exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

pack_boot ❓❓❓❓❓❓❓❓❓ ❓❓❓❓❓❓❓❓❓ low level routine to pack 4x8 bit data into 32 bit word

exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

new_params❓❓❓❓ read new parameter values from shared memory

contains ❓
❓❓❓❓❓❓❓❓❓❓❓ ***echo_inj*** (local jump label)
❓❓❓❓❓❓❓❓❓❓❓ ***echo_crvdly*** (local jump label)
❓❓❓❓❓❓❓❓❓❓❓ ***echo_revs*** (local jump label)
❓❓❓❓❓❓❓❓❓❓❓ ***echo_ninj*** (local jump label)
❓❓❓❓❓❓❓❓❓❓❓ ***echo_gain*** (local jump label)
❓❓❓❓❓❓❓❓❓❓❓ ***echo_eplfreq*** (local jump label)
param_rtn (local jump label)
calls ❓
❓❓❓❓❓❓❓❓❓❓❓ ***write_boot***
exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

new_tables❓❓❓❓❓❓❓❓❓ check and control reading new freq and bias tables from shared memory and saving in boot memory

contains ❓

❓❓❓❓❓❓❓❓❓❓❓ ***new_btbl*** (local jump label)

calls ❓

❓❓❓❓❓❓❓❓❓❓❓ ***get_ftbl***

❓❓❓❓❓❓❓❓❓❓❓ ***tst_tblsize***

❓❓❓❓❓❓❓❓❓❓❓ ***tst_tables***

❓❓❓❓❓❓❓❓❓❓❓ ***write_boot***

❓❓❓❓❓❓❓❓❓❓❓ ***send_tbl***

- ***intrp_freq***
- ***crvmirr***
- ***get_btbl***
- ***intrp_bias***

exits with ❓

❓❓❓❓❓❓❓❓❓❓❓ rts

echo_tables❓❓❓❓❓❓❓❓❓ check and control writing of freq and bias tables to shared memory for readback purposes

contains ❓

❓❓❓❓❓❓❓❓❓❓❓ ***echo_bias*** (local)

calls ❓

❓❓❓❓❓❓❓❓❓❓❓ ***echo_ftbl***

❓❓❓❓❓❓❓❓❓❓❓ ***echo_btbl***

exits with ❓

❓❓❓❓❓❓❓❓❓❓❓ rts

send_tbl❓❓❓ ❓❓❓❓❓❓❓❓❓ write freq or bias table to boot memory

contains ❓

❓❓❓❓❓❓❓❓❓❓❓ send_loop (local loop label)

calls ❓

❓❓❓❓❓❓❓❓❓❓❓ ***write_boot***

exits with ❓

❓❓❓❓❓❓❓❓❓❓❓ rts

get_ftbl❓❓❓❓❓ ❓❓❓❓❓❓❓❓❓ sets up dma of freq table from shared memory

calls ❓

❓❓❓❓❓❓❓❓❓❓❓ ***dma_tbl***
exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

get_btbl❓❓❓❓ ❓❓❓❓❓❓❓❓❓ sets up dma of bias table from shared memory

calls ❓
❓❓❓❓❓❓❓❓❓❓❓ ***dma_tbl***
exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

echo_ftbl❓❓ ❓❓❓❓❓❓❓❓❓ sets up dma of freq table to shared memory

calls ❓
❓❓❓❓❓❓❓❓❓❓❓ ***dma_tbl***
exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

echo_btbl❓ ❓❓❓❓❓❓❓❓❓ sets up dma of bias table to shared memory

calls ❓
❓❓❓❓❓❓❓❓❓❓❓ ***dma_tbl***
exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

dma_tbl❓❓❓❓ ❓❓❓❓❓❓❓❓❓ dma table to shared memory

contains ❓
❓❓❓❓❓❓❓❓❓❓❓ ***dma_wait***
❓❓❓❓❓❓❓❓❓❓❓ ***rtn***(local jump label)
exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts (with two delayed branch instructions)

intrp_freq ❓❓❓❓❓❓❓❓❓ sets up for interpolation of freq curve

calls ❓
❓❓❓❓❓❓❓❓❓❓❓ ***intrp_crv***
exits with ❓
❓❓❓❓❓❓❓❓❓❓❓ rts

*intrp_bias ********* sets up for interpolation of bias curve*

calls *

********** ***intrp_crv***

exits with *

********** rts

*intrp_crv** ********* performs curve interpolation*

calls *

********** ***get_next***

contains *

********** ***intrp_loop*** (local loop label)

exits with *

********** rts

*get_next*** ********* subroutine of curve interpolation routine*

contains *

calc_next (local loop label)
nu_slope (local jump label)

calls *

********** ***divide***

exits with *

********** rts

*write_boot ********* control write of 32 bit word to boot memory*

calls *

********** ***dma_16***

exits with *

********** rts (with two delayed branch instructions)

*dma_16**** ********* low level subroutine of write_boot*

contains *

********** ***wait_dma8*** (local jump label)

exits with *

********** rts

*crv_builder********* builds curves from tables*

calls *

********** ***intrp_freq***

**********[*crvmirr*](#)
[*inj_crv*](#)
[*intrp_bias*](#)
exits with *
********** rts

*inj_crv********** update injection portion of frequency curve for requested injection frequency*

calls *
********** [*divide*](#)
contains *
********** ***injlp*** (local loop label)
exits with *
********** rts

*crvmirr********** backup injection portion of freq curve otherwise altered injection frequency*

contains *
********** ***mrloop*** (local loop label)
exits with *
********** rts

*restore_inj ********* restore unaltered injection portion of frequency curve*

contains *
********** ***mrloop1*** (local loop label)
exits with *
********** rts

*divide******** ********** low level floating point division routine*

exits with *
********** rts

Normal Program Flow

Reset or power-on

rst_svc
call ***init_21k***
call ***get_btparam***
call ***tst_params***
call ***tst_tblsize***
call ***get_tables***
call ***tst_tables***
call ***crv_builder***
enables IRQ1 interrupt
rts
jump main

external interrupt IRQ1
irq1_svc
jump ***begin_cycle***
disables IRQ1 interrupt
enables timer low priority/software 0/cb7/cb15 interrupts
starts timer (curve delay)
rti (to main)

timer interrupt (low priority)
tmzl_svc
jump play_curve (delayed branch clears TMZHI latch)
disables timer low priority interrupt
enables timer high priority interrupt (for every 4 usec interrupt)
rti (to main)

timer interrupt (high priority)
tmzh_svc
jump timer_hi_prior
does the fast critical stuff
rti (to main)

freq circular buffer interrupt execute when leave timer_hi_prior that reached top end of frequency curve
cb7_svc
jump cb7i_asserted
disable timer to prevent timer interrupt
switch freq curve direction and rate to play down
enable timer
rti (to main)

bias circular buffer interrupt execute when leave timer_hi_prior that reached end of bias curve

```
❁❁❁❁❁❁❁❁❁❁❁ cb15_svc
❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ jump cv15i_asserted
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ disable timer to prevent timer interrupt
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ disable cb15 interrupt
                    indicate bias curve finished
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ enable timer
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ rti (to main)

freq circular buffer interrupt❁ execute when leave timer_hi_prior that reached bottom end of frequency
                    curve
❁❁❁❁❁❁❁❁❁❁❁ cb7_svc
❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ jump cb7i_asserted
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ disable timer to prevent timer interrupt
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ switch freq curve direction and rate to play down
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ enable timer
❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ set software interrupt 0
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ rti (to main)

software interrupt SFT0❁❁❁ set when both freq and bias curves have played out completely
❁❁❁❁❁❁❁❁❁❁❁ sft0_svc
❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ jump sft0i_asserted
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ call new_params
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ call tst_params
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ call new_tables
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ call echo_tables
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ call restore_inj
                    call inj_crv
❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁❁ ❁❁❁❁❁❁❁❁❁❁❁ enable IRQ1 interrupt to permit next cycle
                    rti
```