

DOCUMENTATION:
Arduino (DUE) project: uPCS
Micro Process Control System

KLL engineering 01/2014

BLOG: http://kll.engineering-news.org/kllfusion01/articles.php?article_id=65

as part of the documentation here the USB terminal LOG:

-1- ARDUINO DUE START (uPCS 1.0.0 loaded)

```
KLL Engineering on Arduino 155
using hardware DUE
KLL Process Control System
adjust terminal to AUTOSCROLL, Carriage Return, 115200
hit [space] [ENTER] to get MENU list
set input 7
set input 8
set input 12
set input 10
set output 9
days: 0 time: 0 : 0 : 1 PID1 LO_LO
PID1 PID1info PV 0.00, SP 12.51, OP 0.00,MAN,LO_LO
days: 0 time: 0 : 0 : 2 PID2 DEV
PID2 PID2info PV 15.71, SP 48.97, OP 0.00,MAN, DEV
PID1 PID1info PV 0.00, SP 12.51, OP 0.00,MAN,LO_LO
PID1 PID1info PV 0.00, SP 12.60, OP 0.00,MAN,LO_LO
PID2 PID2info PV 16.02, SP 48.97, OP 0.00,MAN, DEV
PID1 PID1info PV 0.00, SP 12.51, OP 0.00,MAN,LO_LO
IND2 IND2info PV 14.43,
DCP2 DCP2info PV normal , ok
IND1 IND1info PV 14.51,
DCP1 DCP1info PV RUN , SP START ,MAN, ok
PID1 PID1info PV 0.00, SP 12.60, OP 0.00,MAN,LO_LO
PID2 PID2info PV 16.03, SP 48.87, OP 0.00,MAN, DEV
PID1 PID1info PV 0.00, SP 12.60, OP 0.00,MAN,LO_LO
PID1 PID1info PV 0.00, SP 12.60, OP 0.00,MAN,LO_LO
PID2 PID2info PV 16.03, SP 49.07, OP 0.00,MAN, DEV
PID1 PID1info PV 0.00, SP 12.60, OP 0.00,MAN,LO_LO
PID1 PID1info PV 0.00, SP 12.51, OP 0.00,MAN,LO_LO
IND2 IND2info PV 15.87,
IND1 IND1info PV 15.88,
PID2 PID2info PV 16.03, SP 48.97, OP 0.00,MAN, DEV
DCP1 DCP1info PV RUN , SP START ,MAN, ok
PID1 PID1info PV 0.00, SP 12.60, OP 0.00,MAN,LO_LO
DCP2 DCP2info PV normal , ok
```

[space][enter] get menu helptext

KLL Engineering on Arduino 155
using hardware DUE
KLL Process Control System

rev: V100

0 reset all conti jobs

1 PID1 OFF / ON, cycletime setpoint input / running
2 PID2 OFF / ON, cycletime setpoint input / running
5 IND1 OFF / ON, cycletime setpoint input / running
6 IND2 OFF / ON, cycletime setpoint input / running
8 DCP1 OFF / ON, cycletime setpoint input / running
9 DCP2 OFF / ON, cycletime setpoint input / running
M loop Mode/rsp input
T loop tuning input
P loop document
q quiet all loop
d diagnostic & 1Mcycle time

utilities:

t: time s: vars i: Ains

select:

[0][enter]

all JOB OFF

! that is not a safe condition, outputs stay as they are!

[1][enter]

start loop 1

PID1 on

set a cycletime setpoint in milliseconds and start it as a CONTI JOB: (default 1000 millis):

[enter]

1000

PID1 TOO LATE

PID1 PID1info PV 0.00, SP 12.41, OP 0.00,MAN,LO_LO

-2- MODE

[M][enter]

change Mode PID

PID1 PID1info PV 0.00, SP 12.60, OP 0.00,MAN,LO_LO

select: PID[0] = 1, PID[1] = 2, DCP[0] = 8, DCP[1] = 9 default (1):1

operating PID[0]: PID1

set a MODE: 2=MAN,3=AUTO,4=CAS,5=RSP : (default 2):5

set a RSP setpoint: (default 0.00):14.00

PID1 TOO LATE

PID1 PID1info PV 0.00, SP 14.00, OP 35.00,RSP,LO_LO

PID1 PID1info PV 0.00, SP 14.00, OP 63.00,RSP,LO_LO

days: 0 time: 0 : 0 : 29 PID1 LOW

PID1 PID1info PV 1.91, SP 14.00, OP 86.22,RSP, LOW

PID1 PID1info PV 10.96, SP 14.00, OP 87.79,RSP,

PID1 PID1info PV 11.71, SP 14.00, OP 91.98,RSP,
PID1 PID1info PV 13.44, SP 14.00, OP 92.23,RSP,
PID1 PID1info PV 13.58, SP 14.00, OP 93.01,RSP,
PID1 PID1info PV 13.96, SP 14.00, OP 92.89,RSP,
PID1 PID1info PV 13.88, SP 14.00, OP 93.17,RSP,
PID1 PID1info PV 14.07, SP 14.00, OP 92.94,RSP,
PID1 PID1info PV 13.97, SP 14.00, OP 93.04,RSP,

[M][enter] change Mode DCP (PV wrong, now hardware connected)

DCP1 DCP1info PV RUN , SP START ,MAN, ok
select: PID[0] = 1, PID[1] = 2, DCP[0] = 8, DCP[1] = 9 default (1):8
operating DCP[0]: DCP1
set a MODE: 2=MAN,3=AUTO,5=RSP : (default 2):5
set a RSP setpoint: (default 1):2
DCP1 TOO LATE
change outputs DCP1 DCP1info PV RUN , SP START ,RSP, ok
DCP1 DCP1info PV RUN , SP START ,RSP, ok

-3- TUNING

[T][enter] change tuning IND to show EGU

IND1 IND1info PV 16.01,
IND1 IND1info PV 16.03,
select: PID[0]=1, PID[1]=2, IND[0]=5, IND[1]=6, DCP[0] = 8, DCP[1] = 9 default (1):5 [5][enter]
operating IND[0]: IND1
set a PV filter : (0 (only new) .. 1.0 (no input)) (default 0.10):0.10
show EGU: (1 (true) or 0 (false)) (default 0):1
set debug print: (1 (true) or 0 (false)) (default 1):1
IND1 TOO LATE
IND1 IND1info PV 163.99 Ainsteps ,
IND1 IND1info PV 163.99 Ainsteps ,

[T][enter] change tuning PID D tuning and to show EGU

PID1 PID1info PV 0.00, SP 12.60, OP 0.00,MAN,LO_LO
PID1 PID1info PV 0.00, SP 12.60, OP 0.00,MAN,LO_LO
select: PID[0]=1, PID[1]=2, IND[0]=5, IND[1]=6, DCP[0] = 8, DCP[1] = 9 default (1):1 [enter]
operating PID[0]: PID1
set a PV filter : (0 (only new) .. 1.0 (no input)) (default 0.02):0.02
set gain: (0 .. 10.0) (default 0.50):0.50
set epsilon: (0 .. 1.0) (default 0.01):0.01
set reset: (0 .. 1.0) (default 2.00):2.00 what was that?
set ARWU: (0 .. 500.0) (default 120.00):120.00
set rate: (0 .. 10.0) (default 0.00):0.10 [0.1][enter]
set PID action: (1 or -1) (default 1):1
set outmin: (0 .. 100.0) (default 0.00):0.00
set outmax: (0 .. 100.0) (default 100.00):100.00
set outdir: (1 (f.c.) or -1 (f.o.)) (default 1):1
show EGU: (1 (true) or 0 (false)) (default 0):1 [1][enter]
set debug print: (1 (true) or 0 (false)) (default 1):1
allow interlock: (1 (true) or 0 (false)) (default 1):1
PID1 TOO LATE
PID1 PID1info PV 0.00 Ainsteps , SP 128.90, OP 0.00,MAN,LO_LO
PID1 PID1info PV 0.00 Ainsteps , SP 128.90, OP 0.00,MAN,LO_LO

[T][enter] change tuning DCP

DCP1 DCP1info PV RUN , SP START ,RSP, ok
DCP1 DCP1info PV RUN , SP START ,RSP, ok
select: PID[0]=1, PID[1]=2, IND[0]=5, IND[1]=6, DCP[0] = 8, DCP[1] = 9 default (1):8
operating DCP[0]: DCP1
set debug print: (1 (true) or 0 (false)) (default 1):1
allow interlock: (1 (true) or 0 (false)) (default 1):1
DCP1 TOO LATE
DCP1 DCP1info PV RUN , SP START ,RSP, ok

-4- DIAG

[d][enter] DIAG ON PID show time,delta,integral,derivate AND print time after 1000000 cycles

PID1 PID1info PV 0.00 Ainsteps , SP 128.90, OP 0.00,MAN,LO_LO
DIAG ON, print time after 1000000 loops.
PID1 days: 0 time: 0 : 9 : 40 PID1 PID1info PV 0.00 Ainsteps , SP 128.90 DEL 0.00, INT 0.00, DER 0.00, OP 0.00 DAC
0,MAN,LO_LO
days: 0 time: 0 : 9 : 44
PID1 days: 0 time: 0 : 9 : 45 PID1 PID1info PV 0.00 Ainsteps , SP 128.90 DEL 0.00, INT 0.00, DER 0.00, OP 0.00 DAC
0,MAN,LO_LO
PID1 days: 0 time: 0 : 9 : 50 PID1 PID1info PV 0.00 Ainsteps , SP 128.90 DEL 0.00, INT 0.00, DER 0.00, OP 0.00 DAC
0,MAN,LO_LO
days: 0 time: 0 : 9 : 51

[d][enter] DIAG ON DCP show time, PV num, PVbin, SP num AND print time after 1000000 cycles

DCP1 DCP1info PV RUN , SP START ,RSP, ok
DIAG ON, print time after 1000000 loops.
DCP1 days: 0 time: 0 : 12 : 46 DCP1 DCP1info PV 2 RUN , PVbin 3, SP 2 START ,RSP, ok

-5- loop documentation:

[P][enter]

```
1,PID[0], PID1 , PID1info ,
2,PID[1], PID2 , PID2info ,
3,
4,
5,IND[0], IND1 , IND1info ,
6,IND[1], IND2 , IND2info ,
7,
8,DCP[0], DCP1 , DCP1info ,
9,DCP[1], DCP2 , DCP2info ,
0 conf printdefault ( 1 ):1      [enter]
pid->DBI,1,
pid->loopidx,0,
pid->cname, PID1 ,
pid->cdesc, PID1info ,
pid->PV,0.00,
pid->useEU,1,
pid->PVEUlo,0.00,
pid->PVEUhi,1023.00,
pid->PVEU, Ainsteps ,
pid->SPT,12.60,
pid->RSP,0.00,
pid->CAS,0.00,
pid->MOUT,0.00,
pid->OUT,0.00,
pid->OUTval,0,
pid->mode,2,
pid->oldmode,2,
pid->Ctimlim,1000,
pid->PVfil0,0.02,
pid->PVfil1,0.98,
pid->gain,0.50,
pid->epsilon,0.01,
pid->reset,2.00,
pid->ARWU,120.00,
pid->rate,0.10,
pid->action,1,
pid->outmin,0.00,
pid->outmax,100.00,
pid->outdir,1,
pid->SPtrack,1,
pid->OUTtrack,1,
pid->PVchannel,0,
pid->hwinlo,0,
pid->hwinhi,1023,
pid->SPchannel,1,
pid->OUTchannel,0,
pid->setpoint,12.60,
pid->delta,0.00,
pid->deltamem,0.00,
pid->integral,0.00,
pid->derivate,0.00,
pid->PVlolo,0.00,
pid->PVlo,10.00,
```

pid->PVhi,90.00,
pid->PVhihi,100.00,
pid->SPdev,5.00,
pid->alarm,1,
pid->alarm_mem,1,
pid->intenable,1,
pid->debug,1,
pid->PIDen,0,

printdefault (1):2

pid->DBI,2,
pid->loopidx,1,
pid->cname, PID2 ,
pid->cdesc, PID2info ,
pid->PV,15.71,
pid->useEU,0,
pid->PVEUlo,0.00,
pid->PVEUhi,1023.00,
pid->PVEU, Ainsteps ,
pid->SPT,48.97,
pid->RSP,0.00,
pid->CAS,0.00,
pid->MOUT,0.00,
pid->OUT,0.00,
pid->OUTval,0,
pid->mode,2,
pid->oldmode,2,
pid->Ctimlim,2000,
pid->PVfil0,0.02,
pid->PVfil1,0.98,
pid->gain,0.50,
pid->epsilon,0.01,
pid->reset,1.00,
pid->ARWU,120.00,
pid->rate,0.00,
pid->action,1,
pid->outmin,0.00,
pid->outmax,100.00,
pid->outdir,1,
pid->SPtrack,1,
pid->OUTtrack,1,
pid->PVchannel,2,
pid->hwinlo,0,
pid->hwinhi,1023,
pid->SPchannel,3,
pid->OUTchannel,1,
pid->setpoint,48.97,
pid->delta,0.00,
pid->deltamem,0.00,
pid->integral,0.00,
pid->derivate,0.00,
pid->PVlolo,0.00,
pid->PVlo,10.00,
pid->PVhi,90.00,
pid->PVhihi,100.00,
pid->SPdev,5.00,
pid->alarm,5,
pid->alarm_mem,0,

```
pid->intenable,1,  
pid->debug,1,  
pid->PIDen,0,
```

```
printdefault ( 1 ):5  
ind->DBI,5,  
ind->loopidx,0,  
ind->cname, IND1 ,  
ind->cdesc, IND1info ,  
ind->PV,16.03,  
ind->useEU,1,  
ind->PVEUlo,0.00,  
ind->PVEUhi,1023.00,  
ind->PVEU, Ainsteps ,  
ind->Ctimlim,5000,  
ind->PVfil0,0.10,  
ind->PVfil1,0.90,  
ind->PVchannel,5,  
ind->hwinlo,0,  
ind->hwinhi,1023,  
ind->PVLolo,0.00,  
ind->PVlo,10.00,  
ind->PVhi,90.00,  
ind->PVhihi,100.00,  
ind->alarm,0,  
ind->alarm_mem,0,  
ind->debug,1,  
ind->INDen,1,
```

```
printdefault ( 1 ):6  
ind->DBI,6,  
ind->loopidx,1,  
ind->cname, IND2 ,  
ind->cdesc, IND2info ,  
ind->PV,0.00,  
ind->useEU,0,  
ind->PVEUlo,0.00,  
ind->PVEUhi,1023.00,  
ind->PVEU, Ainsteps ,  
ind->Ctimlim,5000,  
ind->PVfil0,0.10,  
ind->PVfil1,0.90,  
ind->PVchannel,6,  
ind->hwinlo,0,  
ind->hwinhi,1023,  
ind->PVLolo,0.00,  
ind->PVlo,10.00,  
ind->PVhi,90.00,  
ind->PVhihi,100.00,  
ind->alarm,0,  
ind->alarm_mem,0,  
ind->debug,1,  
ind->INDen,0,
```

```
printdefault ( 1 ):8
dcp->DBI,8,
dcp->loopidx,0,
dcp->cname, DCP1 ,
dcp->cdesc, DCP1info ,
dcp->ctempl,M21,
dcp->PV,2,
dcp->SPT,2,
dcp->RSP,2,
dcp->mode,5,
dcp->oldmode,5,
dcp->Ctimlim,5000,
dcp->SPtrack,1,
dcp->PVchannel1,7,
dcp->PVchannel2,8,
dcp->PVchannel3,0,
dcp->PVchannel4,0,
dcp->PVchannel5,0,
dcp->PVbin,3,
dcp->OUTchannel1,9,
dcp->OUTchannel2,0,
dcp->OUTchannel3,0,
dcp->OUTchannel4,0,
dcp->OUTchannel5,0,
dcp->SPchannel1,12,
dcp->SPbin,1,
dcp->setpoint,2,
dcp->oldsetpoint,2,
dcp->transition,15000,
dcp->writemem,450866,
dcp->alarm,0,
dcp->alarm_mem,0,
dcp->intenable,1,
dcp->debug,1,
dcp->DCPen,1,
```

```
printdefault ( 1 ):9
dcp->DBI,9,
dcp->loopidx,1,
dcp->cname, DCP2 ,
dcp->cdesc, DCP2info ,
dcp->ctempl,A10,
dcp->PV,0,
dcp->SPT,0,
dcp->RSP,0,
dcp->mode,2,
dcp->oldmode,0,
dcp->Ctimlim,5000,
dcp->SPtrack,1,
dcp->PVchannel1,10,
dcp->PVchannel2,0,
dcp->PVchannel3,0,
dcp->PVchannel4,0,
dcp->PVchannel5,0,
dcp->PVbin,0,
dcp->OUTchannel1,0,
```

```
dcp->OUTchannel2,0,  
dcp->OUTchannel3,0,  
dcp->OUTchannel4,0,  
dcp->OUTchannel5,0,  
dcp->SPchannel1,0,  
dcp->SPbin,0,  
dcp->setpoint,0,  
dcp->oldsetpoint,0,  
dcp->transition,15000,  
dcp->>writemem,0,  
dcp->alarm,0,  
dcp->alarm_mem,0,  
dcp->intenable,1,  
dcp->debug,1,  
dcp->DCPen,0,
```

printdefault (1):0

```
print_mode(0),disabled,  
print_mode(1),INTER,  
print_mode(2),MAN,  
print_mode(3),AUTO,  
print_mode(4),CAS,  
print_mode(5),RSP,  
print_mode(6),??,
```

```
print_alarm(0),,  
print_alarm(1),LO_LO,  
print_alarm(2), LOW ,  
print_alarm(3), HIGH,  
print_alarm(4),HI_HI,  
print_alarm(5), DEV ,  
print_alarm(6),??,
```

```
print_dcp_alarm(0), ok ,  
print_dcp_alarm(1), SP_FAILED ,  
print_dcp_alarm(2), ALARM ,  
print_dcp_alarm(3),??,  
print_dcp_alarm(4),??,
```

```
print_dcp_PV('M21',0), PV_UNDEF ,xx,  
print_dcp_PV('M21',1), STOP ,01,  
print_dcp_PV('M21',2), RUN ,11,  
print_dcp_PV('M21',3),??,xx,  
print_dcp_PV('M21',4),??,xx,
```

```
print_dcp_PV('A10',0), ALARM ,0,  
print_dcp_PV('A10',1), normal ,1,  
print_dcp_PV('A10',2),??,x,  
print_dcp_PV('A10',3),??,x,  
print_dcp_PV('A10',4),??,x,
```

```
print_dcp_SP('M21',0), SP_UNDEF ,x,  
print_dcp_SP('M21',1), STOP ,0,  
print_dcp_SP('M21',2), START ,1,  
print_dcp_SP('M21',3),??,x,  
print_dcp_SP('M21',4),??,x,
```

```
print_dcp_SP('A10',0), SP_UNDEF ,x,  
print_dcp_SP('A10',1), SP_UNDEF ,x,  
print_dcp_SP('A10',2), SP_UNDEF ,x,  
print_dcp_SP('A10',3),??,x,  
print_dcp_SP('A10',4),??,x,
```

-6- misc.

s: vars (all jobs OFF)

select: days: 0 time: 0 : 0 : 32 loops: 600687 reset at: 1000000

1 OFF 0 2 OFF 0 3 OFF 0 4 OFF 0 5 OFF 0 6 OFF 0 7 OFF 0 8 OFF 0 9 OFF 0

i: Ains (and also Dins, but Dout can not)

select: 3300 mV ,0,127,164,502,696,165,164,554,730,784,800,818, of 1023

x,x,0,1,1,1,1,1,0,1,1,1,0, outputs show ?

-7- source files

Name	Date modified	Type	Size
 checkboard.ino	23-Jan-14 6:46 PM	INO File	1 KB
 common.ino	31-Jan-14 8:59 PM	INO File	5 KB
 contijobs.ino	29-Jan-14 2:58 PM	INO File	9 KB
 getnumber.h	27-Jan-14 8:26 AM	H File	6 KB
 measure.ino	29-Jan-14 11:19 PM	INO File	4 KB
 memtest.ino	23-Jan-14 6:46 PM	INO File	1 KB
 menu.ino	01-Feb-14 1:46 PM	INO File	21 KB
 PCsconfig.ino	31-Jan-14 2:29 PM	INO File	16 KB
 PCscontrol.ino	01-Feb-14 1:20 PM	INO File	53 KB
 PCSlloopstruct.h	31-Jan-14 3:29 PM	H File	10 KB
 revinfo.ino	31-Jan-14 2:17 PM	INO File	6 KB
 serial.ino	23-Jan-14 6:46 PM	INO File	3 KB
 uPCS.ino	31-Jan-14 2:17 PM	INO File	9 KB
 VCC_readback.ino	23-Jan-14 6:46 PM	INO File	1 KB