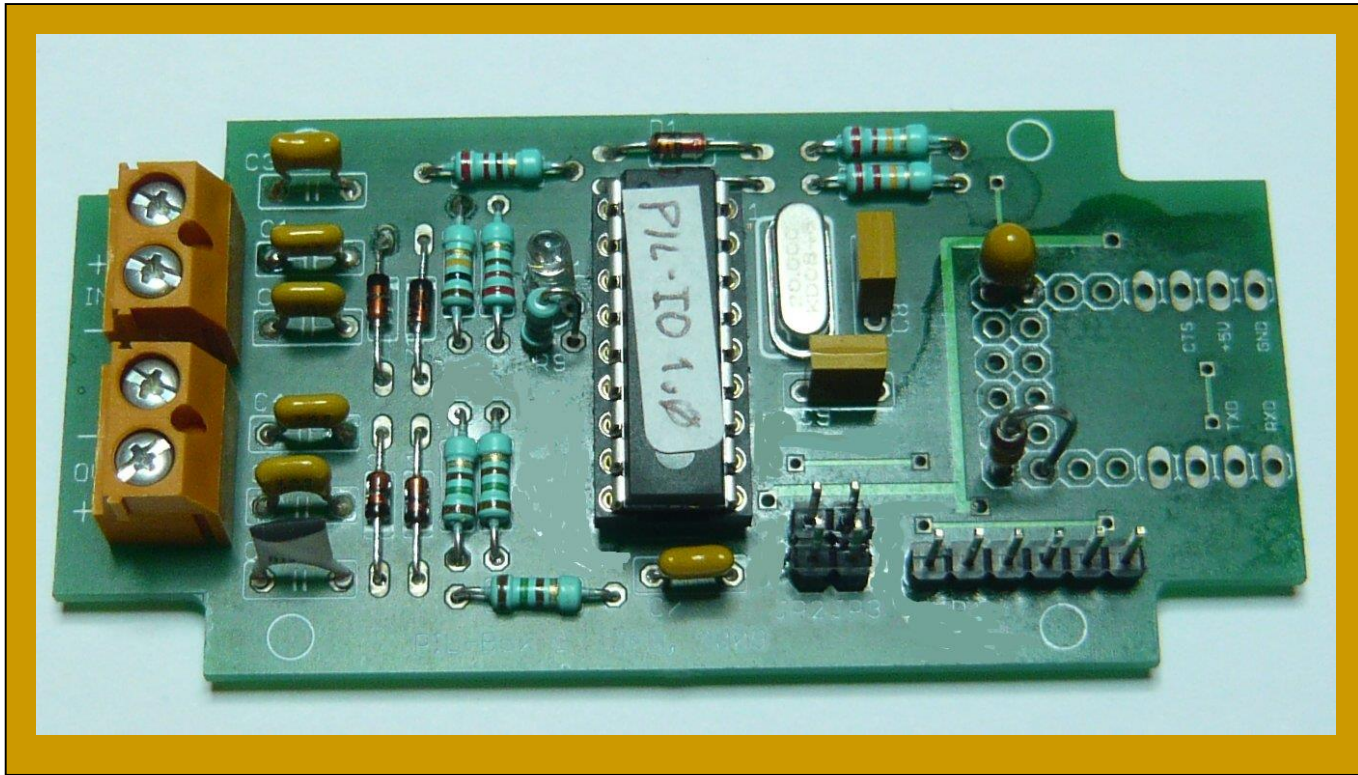
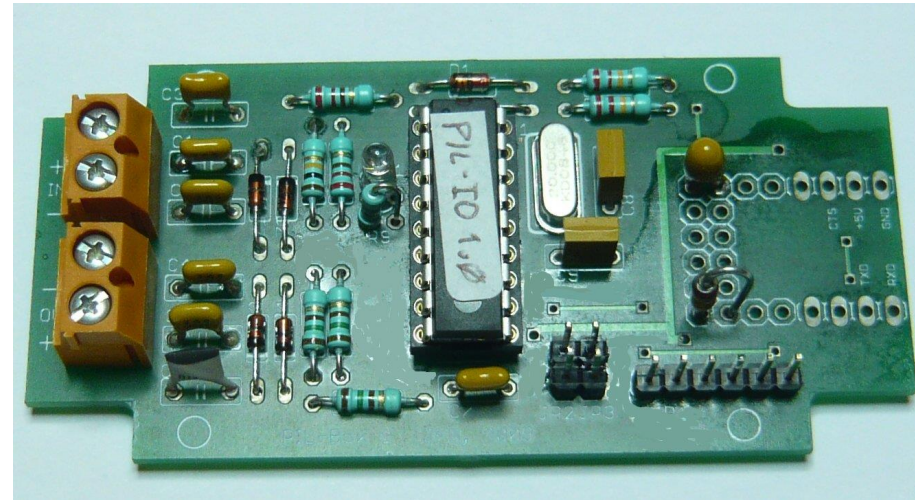


The P1L-IO Board



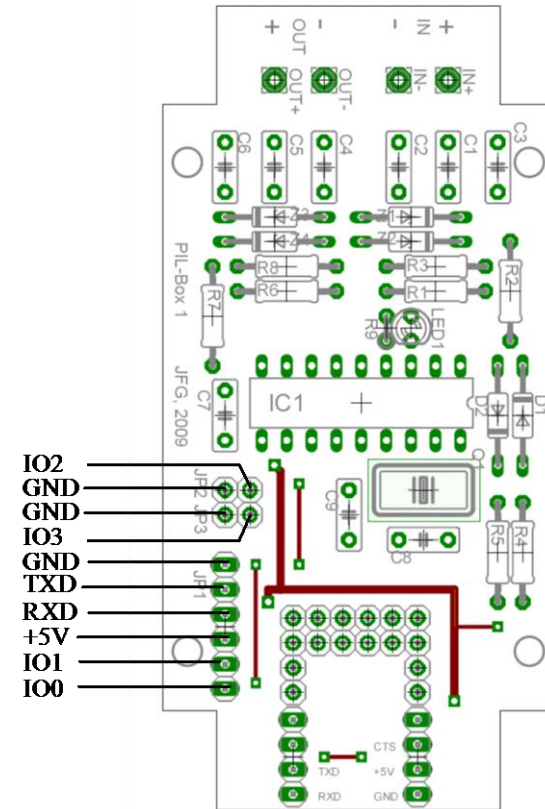
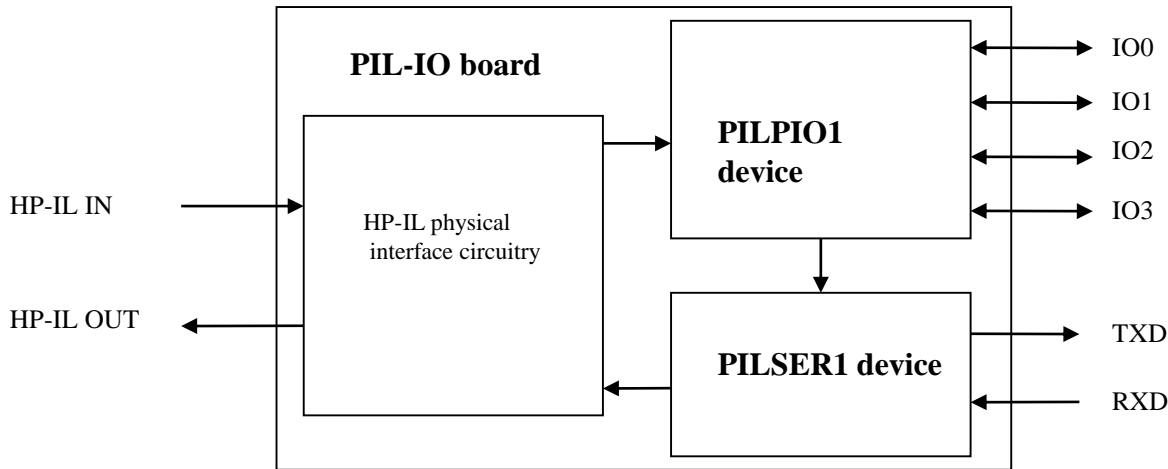
Jean-François Garnier, November 1st, 2014, Allschwil Meeting

The PIL-IO Board



- Contrary to the PIL-Box which is a protocol translator designed to work in conjunction with a computer, the PIL-IO board is real, self-contained HP-IL device, to experiment with HP-IL and I/Os. Main usage is to interface the HP-IL loop with electronic circuitry.
- Simple I/O control: 4 digital lines usable as input or output.
- Communicating with external system through the serial link.
- Extending the capability by adding “intelligence” : connecting to an Arduino board.

The PIL-IO Board



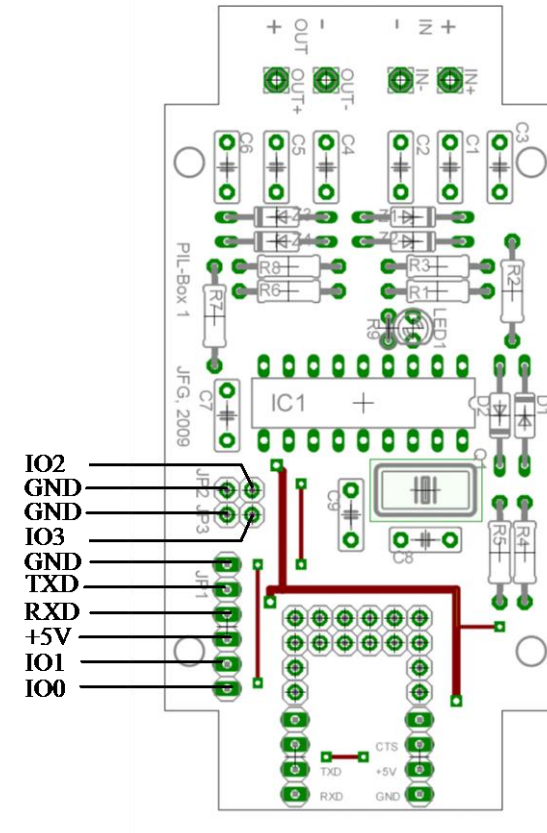
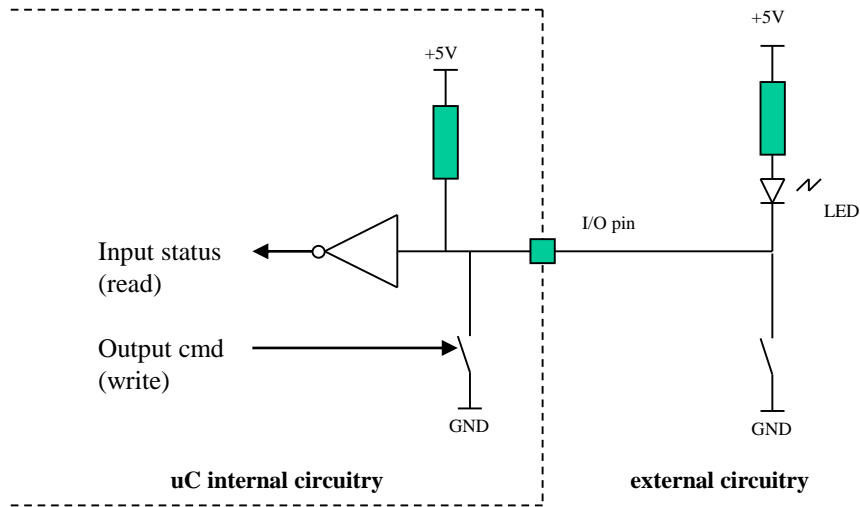
The PIL-IO board provides 2 HP-IL devices:

- "PILPIO1": a mini HP-IL/GPIO interface with 4 I/O lines,
- "PILSER1": a mini HP-IL/serial interface with logic level Rx and Tx lines.

Power requirements:

- Supply: 5V or 3 AA batteries,
- 3mA (active), 0.2mA in power-down (e.g. with HP-41C: PWRDN).

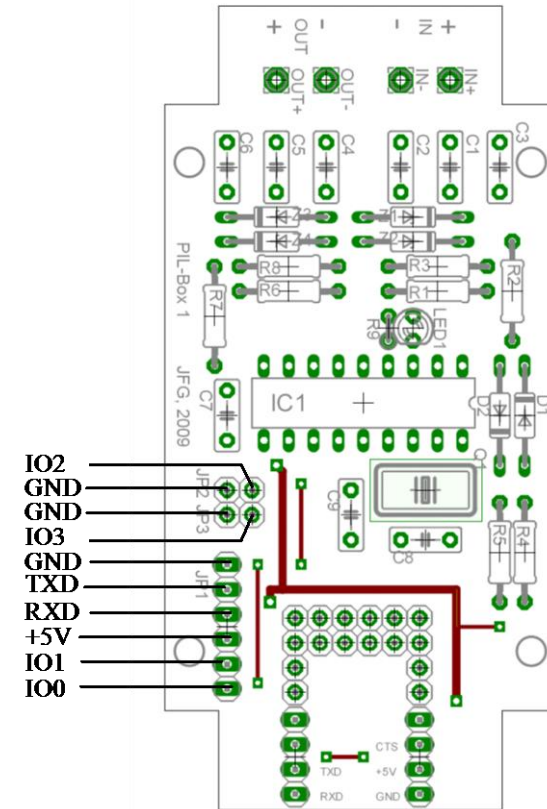
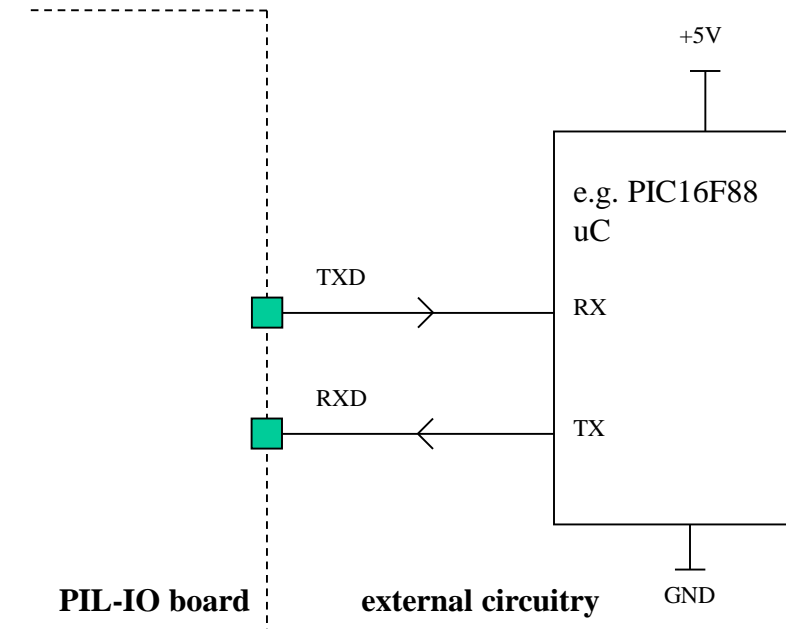
Digital I/Os



No I/O configuration

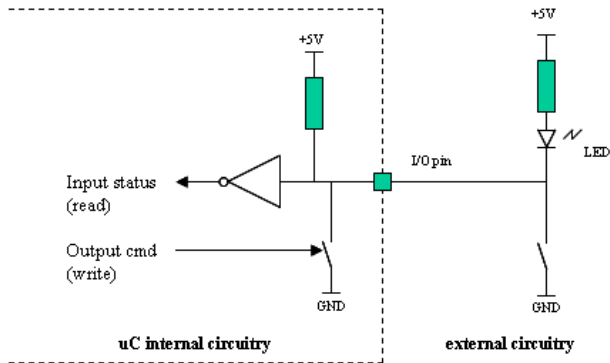
- To control an external load, drive the internal switch on or off
- To sense an external input, keep the internal switch off.

Serial I/O



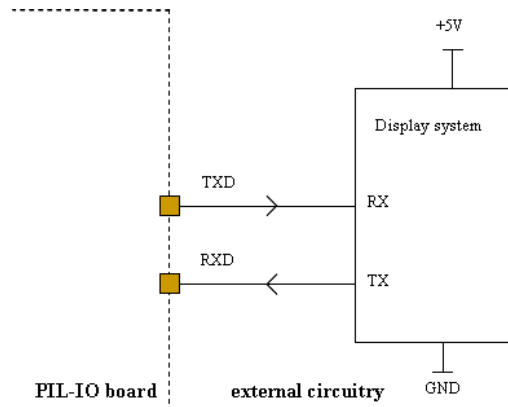
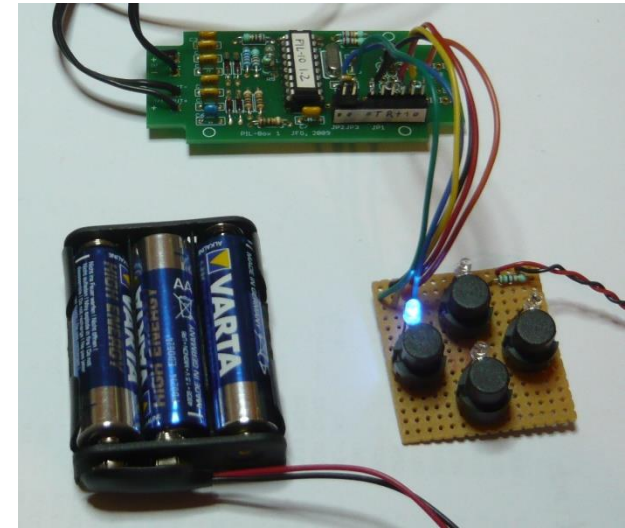
- Logic level (5V TTL compatible) UART type serial link – NOT RS232!
- No configuration needed – always ready to use
- 9600 bps, 64-byte input buffer
- HP-IL status byte indicates character or full line available
- Direct connection to an external uC or system (e.g. Arduino)

Demos : simple I/O operations

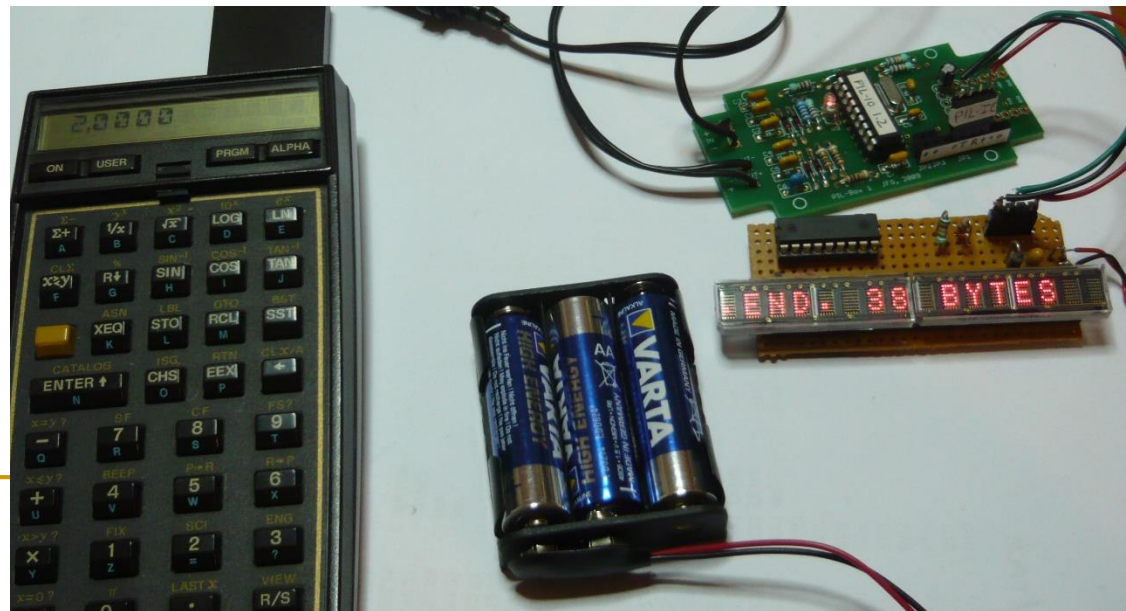


- 4 switches/LEDs

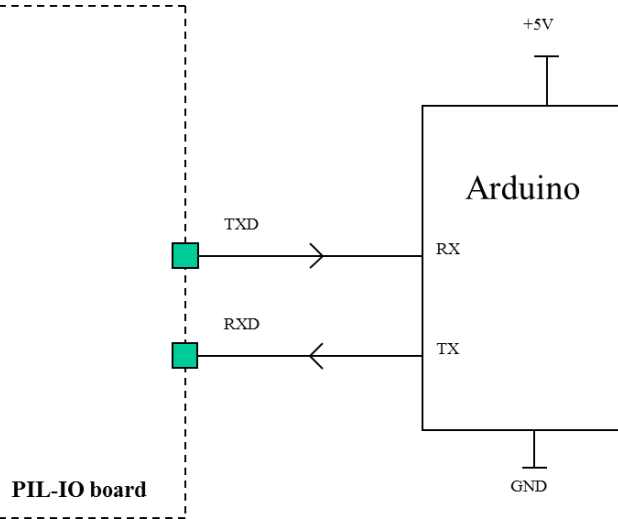
HP-41C commands:
"PILPIO1"
FINDID
SELECT
"4"
OUTA



- red dot-matrix LED alphanumeric display controlled by serial link

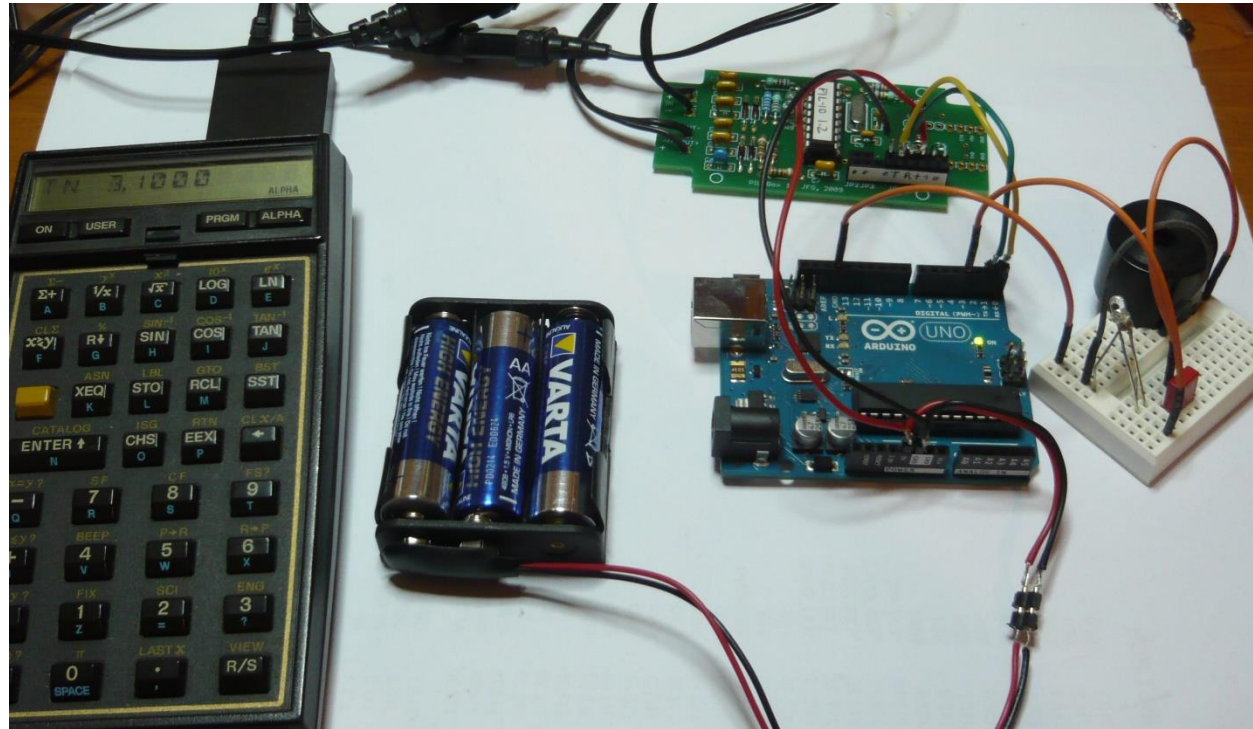


Demo 2 : Connecting to the Arduino



The HP-41C ready to send the “TN 3,1000” command string to the Arduino for generating a 1000Hz tone on port 3

HP-41C commands:
“PILSER1”
FINDID
SELECT
“TN 3,1000”
OUTA



Demo 2 : Controlling the Arduino

Define a command set:

- IA p input analog
- OA p,n output analog (pwm)
- ID p input digital
- SD p set digital
- CD p clear digital
- TN p,n output tone frequency
- VE version
- RS reset

Example with HP-41C:

reading the analog input 2:

“ IA 2“

OUTA

IND

Arduino « sketch » :

```
. . . .
c1= Serial.read();
if ((c1>='A')&&(c1<='Z')) {
  delay(10); // 10 ms
  c2=Serial.read();
  if (c2>0) {
    if ((c1=='O')&&(c2=='A')) {
      pin=Serial.parseInt();
      value=Serial.parseInt();
      if ((pin>=2)&&(pin<=12)) {
        pinMode(pin,OUTPUT);
        analogWrite(pin,value);
      }
    }
    else if ((c1=='I')&&(c2=='A')) {
      pin=Serial.parseInt();
      if ((pin>=0)&&(pin<=5)) {
        value=analogRead(pin);
        Serial.println(value);
      }
    }
  }
  else . . .
```


Appendix: command set examples

Plotter Instruction Set (Continued)

Instruction	Description
DI run, rise	Absolute direction
DP	Digitize point
DR run, rise	Relative direction
DT c	Define label terminator
IM e,(s,(p))	Input e, s, and p masks
IN	Initialize
IP P1 _x ,P1 _y (, P2 _x ,P2 _y)	Input P1 and P2
IW X _{lo} ,Y _{lo} ,X _{hi} ,Y _{hi}	Input window
LB c...c	Label ASCII string
LT t,(l)	Designate line type and length
OA	Output actual position and pen status
OC	Output commanded position and pen status
OD	Output digitized point and pen status
OE	Output error
OF	Output factors
OI	Output identification
OO	Output options
OP	Output P1 and P2
OS	Output status
OW	Output window
PA x,y(,x,y(,...))	Plot absolute
PD (x,y(,...))	Pen down
PR x,y(,x,y(,...))	Plot relative
PU (x,y(,...))	Pen up

HP-GL (HP Graphic Language)

Baud Rate:

SB1	50 bps (R07-3,2,1,0)
SB2	75 bps (R07-3,2,1,0)
SB3	110 bps (R07-3,2,1,0)
SB4	135 bps (R07-3,2,1,0)
SB5	150 bps (R07-3,2,1,0)
SB6	300 bps (R07-3,2,1,0)
SB7	600 bps (R07-3,2,1,0)
SB8	1200 bps (R07-3,2,1,0)
SB9	1800 bps (R07-3,2,1,0)
SBA	2400 bps (R07-3,2,1,0)
SBB	3600 bps (R07-3,2,1,0)
SBC	4800 bps (R07-3,2,1,0)
SBD	7200 bps (R07-3,2,1,0)
SBE	9600 bps (R07-3,2,1,0)
SBF	19200 bps (R07-3,2,1,0)

HP82164 HP-IL/RS232 interface

Function Code	Range Codes						
	R1	R2	R3	R4	R5	R6	RA Autorange
DC Volts F1	.3V	3V	30V	300V	*	*	
AC Volts F2	.3V	3V	30V	300V	*	*	
2-Wire F3	300Ω	3KΩ	30KΩ	300KΩ	3MΩ	30MΩ	
Ohms							
4-Wire F4	300Ω	3KΩ	30KΩ	300KΩ	3MΩ	30MΩ	
Ohms							
DC Amps F5	3A	*	*	*	*	*	
AC Amps F6	300mA	3A	*	*	*	*	
Extended Ohms F7	(default range) 10MΩ/Rx	*	*	*	*	*	

* indicates an invalid combination of Function and Range codes.

Other Program Codes:

Function	Qualifier	Description	Example
N	3,4,5	Selects the number of digits of display.	N3 selects the 3 1/2 digit display mode.
T	1,2	Trigger Mode: Internal, Single.	T1 selects internal trigger, T2 selects single.
Z	0,1	Autozero mode: off,on.	Z0 turns Autozero off.
C		Calibrate (see 3468A Service Manual).	
D	1,2	Display mode: Normal, Text.	D2text displays the message "text" on the 3468A display.

HP3468 Multimeter

Appendix: A more complex command set

- SCPI (Standard Command for Programmable Instruments) part of IEEE488-2
- E.g. HP34401 Multimeter, HP33120 Generator, HP34970 Data Acq/switch Unit
- Command syntax: "command[:subcmd[:subcmd]] arg₁ , arg₂ , ... arg_n"
Examples: "MEAS:VOLT:DC?" (multimeter)
 "APPLY:SINUS freq amplitude" (generator)
- Common commands starting with * :
 - *IDN? Identify (similar to HP-IL device identifier)
 - *RST reset (similar to HP-IL device clear)
 - *TRG trigger (similar to HP-IL device trigger)
 - *STB? status byte (similar to HP-IL device status)
 - *TST? selftest (no HP-IL equivalent)
- Requires a more complex command parser on the Arduino.

The end...



Thanks for your attention !