Programmable IR remote control

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NEC-SIRCS-JAPAN-RC5-SAMSUNG compatible, **multiprotocol infrared remote control.**

Replaces up to 6 existing remote controls into one.

With **manual learning function**, LED display and/or LCD. 2V6-3V2, low power (sleep function)

More protocols will be added later if needed (DENON, DAEWOO, MOTOROLA, RECS80.)

Components: PIC16LF877-04/L (4Mhz PLCC Package), 24LC256 EEPROM (low power), 74HC148 encoder (SMD), optional Nokia 3310 graphic LCD (LPH-7779), IR LED, 5 optional LEDs, TSOP34836 IR receiver (low voltage)

All parts are available in our online shop

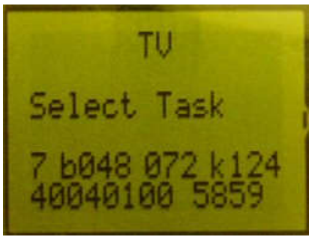
Schematic & pcb (Eagle 4.11e), source code (CCS) and hex file available.

More pictures.

Circuit explanation:

The main component is of course the **PIC16LF877-04/L processor**. Its 8K program ROM handles all inputs, outputs, timings and so on. There are six modes: SLEEP, IDLE, TRANSMIT, RECEIVE, BACKUP & RESTORE.

There are two displays available: **LED and/or LCD**. So you can choose freely which one suits you best. Naturally, the Nokia LCD gives us much more details as we will see further on.

LED display			**LCD**
LED symbols used:	"1"= LED on. "0"= LED off.		 TV Select Task 7 b048 072 k124 40040100 5859
LED order: (from right to left)	LED1, red (PROGRAM)		
	LED2, yellow (SPECIAL)		
	LED3, green (ADDRESS2) binary MSB		
	LED4, green (ADDRESS1) binary		
	LED5, green (ADDRESS0) binary LSB		
Example: "11001"	means PROGRAM & SPECIAL active on ADDRESS1.		

Power consumption is only a couple of microamps in **sleep mode** !!

The circuit is powered by **two AAA batteries** (HR03) These may be rechargeable types. The voltage can drop as low as 2,5V. The battery life is several months (although NI-Mh batteries lose 1% of their power each day!)

Sleep mode is activated automatically after 20 seconds of inactivity (no button pressed in idle mode.)

mode	**consumption at 2V6 with Low Current-LEDs**	**consumption at 2V6 with NOKIA LCD**
sleep	1,2 to 2 µA (!)	1,2 to 2 µA (!)
idle	1,3 to 1,5 mA	1,3 to 1,5 mA
transmitting IR	11 to 17 mA	9 to 13 mA
receiving IR	2 to 10 mA	2 to 2,2 mA
backup or restore	5 mA	2,7 mA

All **user data** is stored in the 24LC256 i²c EEPROM. It contains 32768 bytes (8 pages of 4096 bytes.) That's plenty! Pages 0 to 5 (0x0xxx to 0x5xxx) each contain data from the six devices (Aux, TV, Hifi, CD, DVD, Video) we are able to use. Page 6 is unused, page 7 stores all configuration data (f.e. which key is assigned to "PROGRAM" or to the device "DVD"...)

A maximum of 32 keys (4 columns by 8 rows) are supported. We have **six fixed DEVICE SELECT** keys (Aux, TV, Hifi, CD, DVD, Video), **1 fixed PROGRAM key** , **1 fixed ENTER key.** These eight fixed keys have to be programmed at the first power up (LCD shows "key init" "Program key?", LEDs show "01000") See more below. There are a maximum of **24 free COMMAND keys** for each one of the six devices. Each free command key is protocol-free, this way we can mix protocols inside each device page.

RB4..7 are **outputs** to the four key columns. RB1..3 are **inputs** coming from the 8-bit HC148 encoder.

Whilst in **sleep mode**, pressing one of the keys on the key-matrix awakes the processor. The HC148, GS output which goes to to the PIC interrupt INT/RB0, goes low each time a key is pressed.

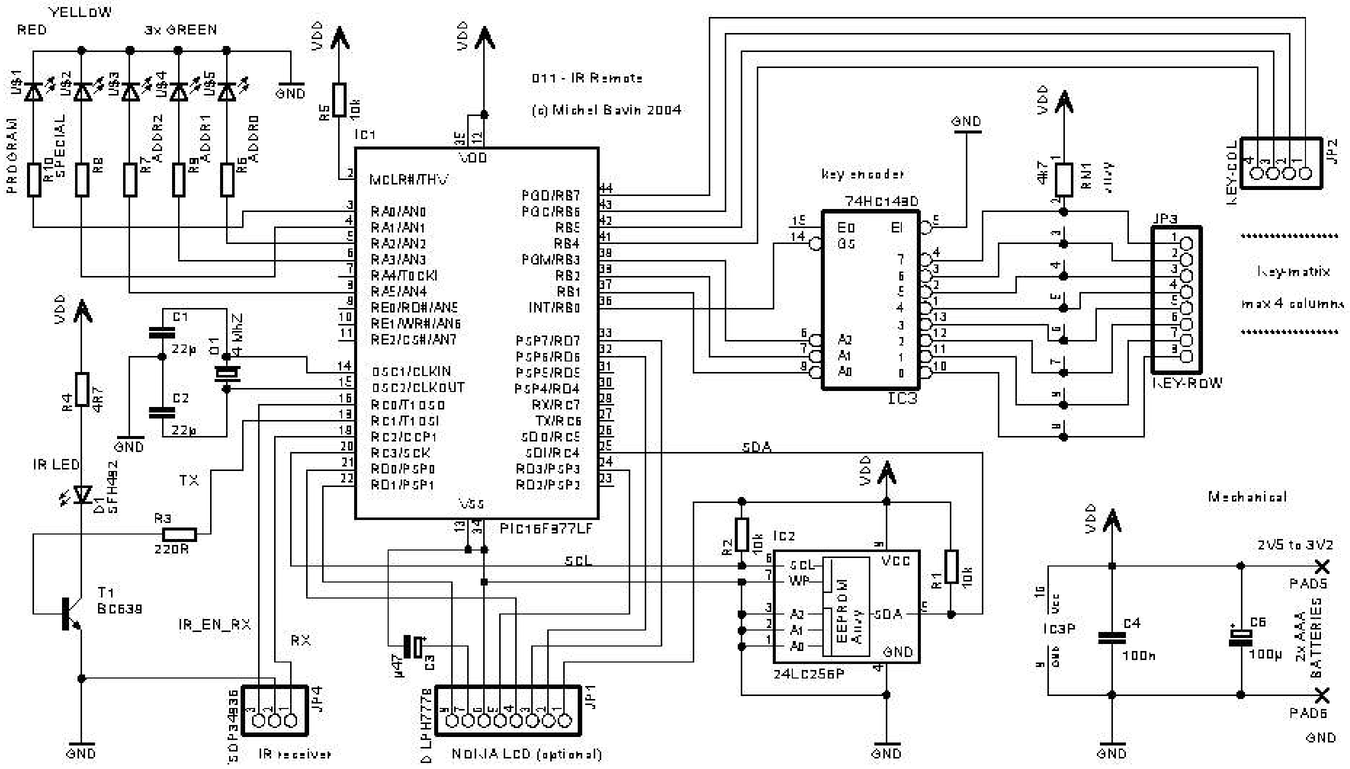
Also nice: the last device selected is stored in EEPROM. So, even unpowered, the circuit will keep all settings & data safe. You can even make a complete **backup or restore** of all data ;-)

The **IR receiver** TSOP34836 (output comes low when a IR burst of around 36KHz detected) is powered only in program mode. The receiver takes only 0,7 mA but it's still worth disabling while unneeded. More details about protocols & waveforms below.

For **IR transmitting**, there is of course an IR LED. It is boosted by a BC639. When enabled, it sends out a burst of 37,1 kHz generated by the processor.

But, as you have guessed, all the rest is **program code**. More info under "source code explanation" below.

Schematic: right-click & "save picture as" for full resolution or (recommended) download the eagle-file below.



Part List (Bill of material): here.

Main component list & interconnections: Overview here.

Supported protocols:

These **five protocols** are currently supported. Of course, each have their own structure: frequency, number of data bits, timing, start & stop bits. Check the table on the right and the waveforms details below.

Protocol waveforms: full details here.

# - protocol name	kHZ	start bit	data bits	stop bit
2-NEC	39,2	1	32	1
4-SIRCS	40	1	12	-
5-RC5	36	1	12	-
7-JAPAN	32	1	48	-
8-SAMSUNG	39,2	1	32	1

Notes:

Key-Matrix	EEPROM Resistor Pull-ups	IR Receiver TSOP34836	IR LED
Has a **maximum of 4 columns and 8 rows**. Unused column connections should be left unconnected. Unused row connections must be grounded. You could rip one from an old remote....	The pull-ups are **10k** here. A value around 1k8 is more common, but power consumption is reduced significantly with 10k...	This **low voltage** component is made by Vishay. It works well at 2V6. Whereas a regular IR receiver (TSOP 1736 or 1836) operates at 5V! The 36 kHZ one handles all supported protocols fine.	A standard IR LED is ok. We can run a fairly high current through it, because it is only lit for a very brief time. Hence the 4R7 at T1's emitter.
PLCC PIC16LF877-04/L 4MhZ	**Nokia 3310 LCD (LPH7779)**	**5 Display-LED resistors**	**LED or LCD display ?**
PLCC has been chosen only for its reduced size.	This is a fine graphical LCD. It is also quite cheap, so i just love using it... It has an incorporated controller PCD8544 and takes around 0.2mA	The five 3mm display-LED's current must by delimited by a resistor.	You can choose between the LEDs or the LCD for displaying info.

This chip is functionally fully compatible with a 16F877 DIL (40 pins.)	only. Voltage must be between 2V5 and 3V2.	Values are **56R for normal** (10mA) LEDs and **300R for low current** (2mA) LEDs. Calculate others here.	The LCD can display very detailed IR info: **protocol number** (- to 8), **number of data bits**, elapsed program cycles, **key-number pressed** last & all **data bit values**.

Menu & display structure:

Here's some useful info about how to program keys & how to perform several tasks listed on the right. All details here.	Device select
	IR transmit mode
	IR receive & program a command key
	IR Details ON/OFF:
	Soft reset:
	Backup mode:
	Restore mode:
	Sleep mode
	Idle mode
	Init mode:

Software flow chart:

coming soon...

Downloads:

WARNING: may not be duplicated for any commercial use whatsoever without explicit consent from the author (c) Michel Bavin

Hex file: 011_v30_hex.zip, july 25, 2004: **011_30.hex** (to program the PIC)

Source code: 011_v28_c.zip (CCS compiler), february 25, 2004 : **011_28.c**

(with include files **16f877_mb.h** / **24256_mb.c** / **ir_read_mb** / **nokia_3310_mb.c**)

Schematic: 011_02_sch.zip (Eagle 4.11e), february 26, 2004: **011_02.sch**

and (important) this library file microchip_mb.lbr (to be copied to the *\eagle*\lbr directory**.** This is an altered package for the PIC)

PCB: 011_02_brd.zip (Eagle 4.11e), march 19, 2005: **011_02.brd**

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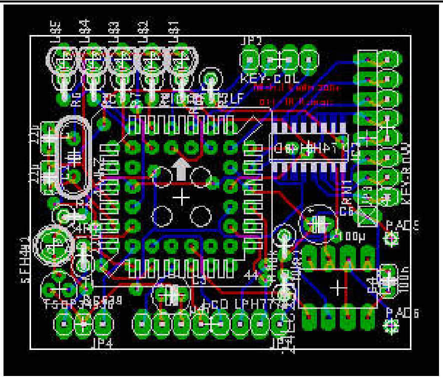
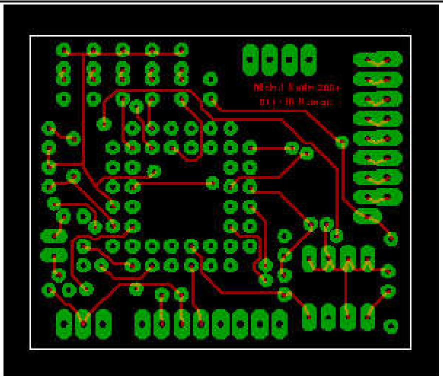
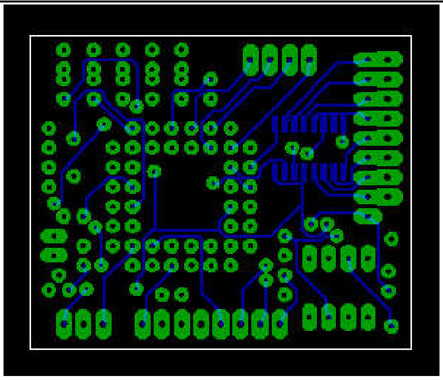
PCB screenshots: real size= 48,6 x 39,7 mm or 1,90 x 1,55 inches.

All layers (top view)	**Top copper layer**	**Bottom copper layer**
		

Source code explanation: (CCS compiler)

coming soon...

Info & datasheet:

TSOP34836 IR Receiver, low voltage, low power,Vishay.

Graphic LCD module type LPH7779 (NOKIA 3310 LCD) and its integrated controller PCD8544.

More IR protocols related info.

Tools:

Check out our development tools page.

This project is made with the PCWH CCS compiler ($425,-). You can install Microchip's free MPLAB IDE with it to get things going smoothly.

Programming of the PIC was done with IC-Prog on a PIC- programmer built from Electronique pratique nr 253 (january 2001).

Eagle can be used for the schematic & PCB layout. The free version should be ok for this design.

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