

GBPLC I²C I/O Box

analogue, digital I/O plus TXT (SMS)!

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To use the Nintendo GameBoy as a system control centre, you need an I²C interface in addition to the special plug-in card. The circuit presented here is cut out for the job. It has a total of 24 inputs and outputs, including 4 analogue inputs and 8 digital inputs. That's sufficient to control roller shutters, outside lighting, curtains, an alarm system, the central heating system and even more, possibly even remotely via TXT (SMS) messages.

The feature project of this year's Summer Circuits issue, the GameBoy home automation controller (GBPLC), naturally needs information from various switches and sensors. An interface is necessary for reading in these signals and sending commands to the outside world. This I/O box has been designed to provide that interface.

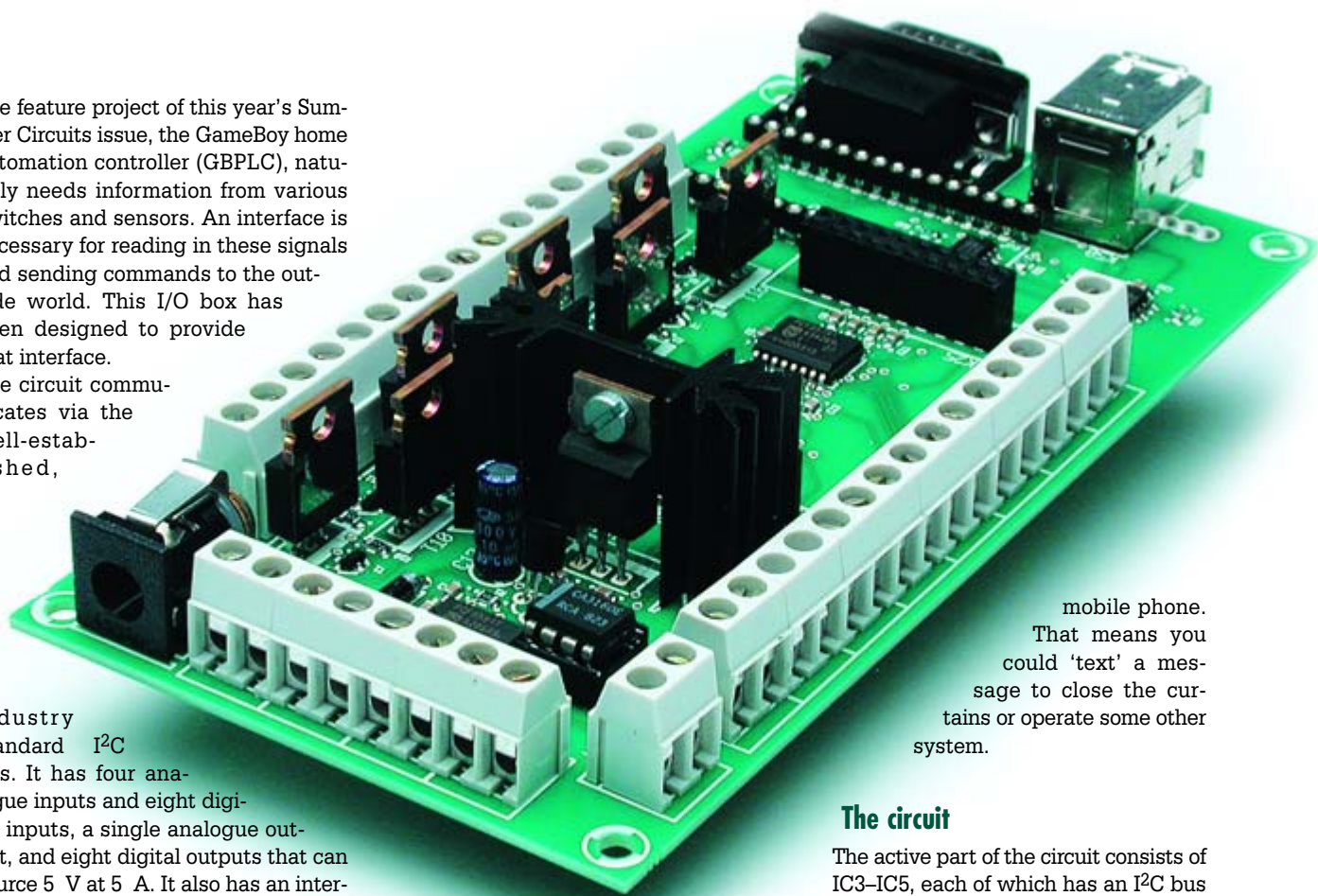
The circuit communicates via the well-established,

industry standard I²C bus. It has four analogue inputs and eight digital inputs, a single analogue output, and eight digital outputs that can source 5 V at 5 A. It also has an interface for connecting a special SMS module to allow messages to be 'texted' to a mobile phone. In short, it has lots of capabilities. The SMS module also allows the circuit to be controlled by a

mobile phone. That means you could 'text' a message to close the curtains or operate some other system.

The circuit

The active part of the circuit consists of IC3-IC5, each of which has an I²C bus interface. IC6 and IC7 are I²C bus extenders that act as boosters. They reduce the link's susceptibility to interference by increasing the current on the I²C bus and reducing its capacitance.



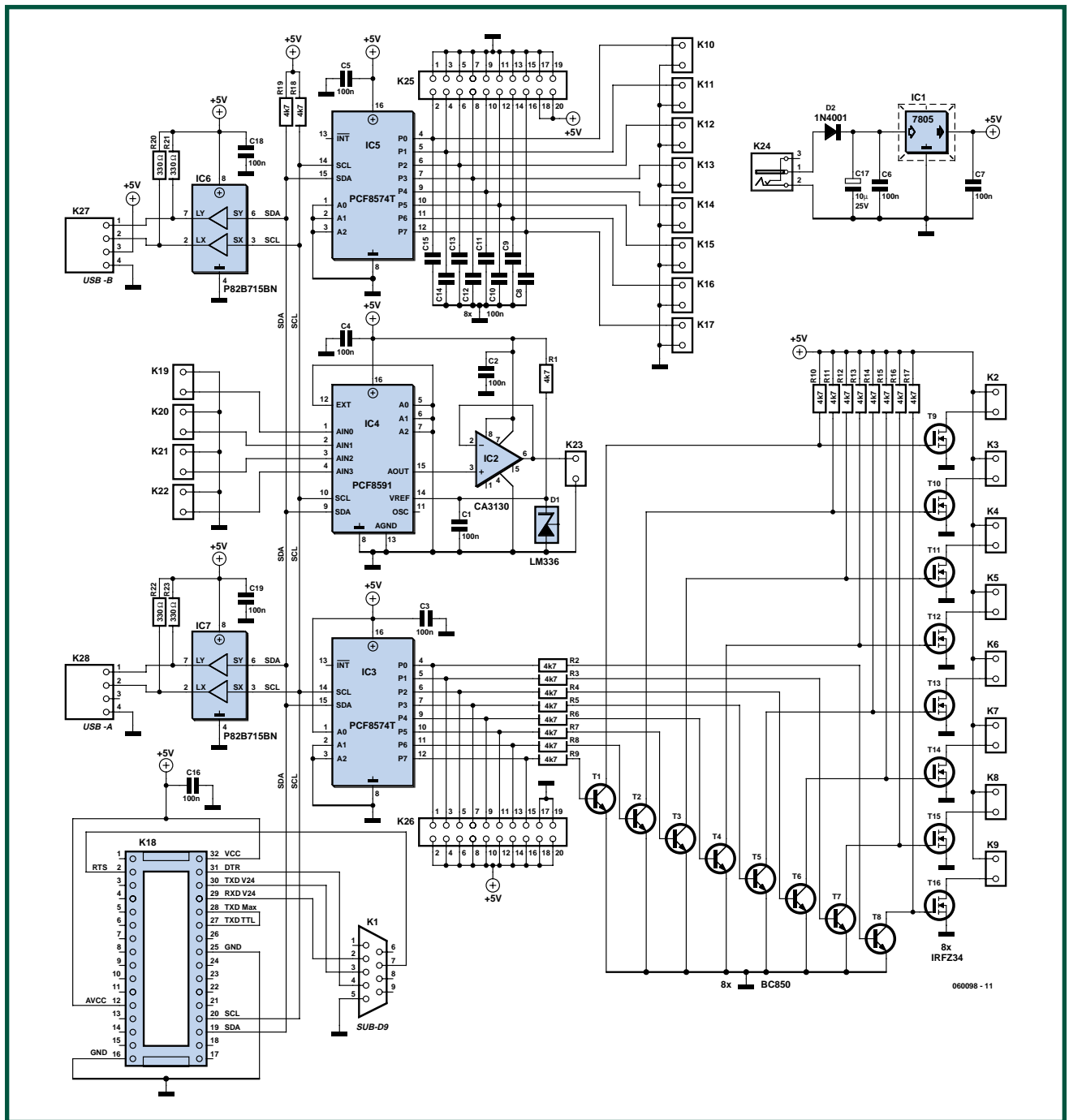


Figure 1. The main components of the circuit are the I²C drivers and the bus extender.

IC4 converts analogue signals into 8-bit digital data suitable for the I²C bus. The reference voltage on pin 14 is set to 2.5 V, which yields a resolution of approximately 10 mV. TTL signals can access the I²C bus via IC5. Capacitors C8–C15 decouple noise on the inputs. That's hardly an unnecessary luxury for signal lines that doubtless run over a considerable distance through your house. Digital and analogue signals are output to the outside world via IC3 and

IC4. The PCF8574 contains an 8-bit quasi-bidirectional port with internal latches. The latch retains the most recently configured output state. IC5 obviously does not use this data, since none of its outputs are used in the circuit.

The addresses of IC3, IC4 and IC5 are hardwired in the circuit by tying address pins A0, A1 and A2 to fixed potentials. The PCF8591 has a different

internal base address, which explains why IC4 and IC5 can apparently be assigned the same address. If you want to couple several of these modules to a single bus for a different application, you will have to modify address portion of the PCB track layout.

Standard USB connectors are used for the connection to the I²C bus. They are thus not real USB ports. K28 is a USB-A connector for connection to the

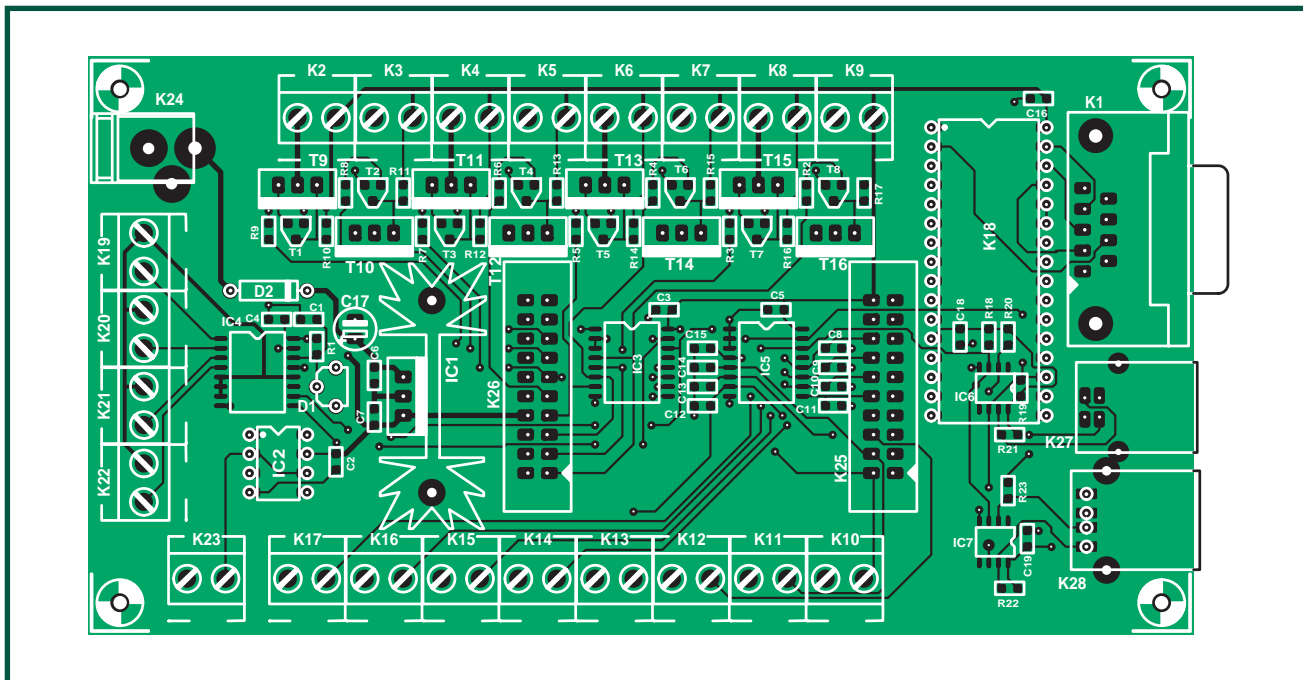


Figure 2. Practically the entire outer region of the board is occupied by a large number of connectors.

COMPONENTS LIST

Resistors

R1-R19 = 4kΩ
R20-R23 = 330Ω

Capacitors

C1-C16, C18, C19 = 100nF (SMD 0805)
C17 = 10µF 25V radial

Semiconductors

D1 = LM336Z (TO92 case)
D2 = 1N4001

T1-T8 = BC850
T9-T16 = IRFZ34N
IC1 = 7805
IC2 = CA3130
IC3, IC5 = PCF8574T
IC4 = PCF8591T
IC6, IC7 = P82B715TD

Miscellaneous

K1 = 9-way sub-D plug (male), angled pins, PCB mount *
K2-K17, K19-K23 = PCB terminal block, lead pitch 5mm
K18 = 32-way DIL socket *
K24 = mains adaptor DC socket, PCB mount (CUI Inc. type PJ-002B, Digikey

CP-002B-ND)
K25, K26 = 20-pin (double row) socket, pitch 0.1"
K27 = USB connector type B
K28 = USB connector type A
PCB, order code **060098-1**
Ready assembled and tested board, order code **060098-91**

* only required in combination with SMS chip

For all items **060098-xx**: see SHOP pages and/or www.elektor-electronics.co.uk

GameBoy module. K27 is a USB-B connector intended to be used for connection to a PC. That makes it unnecessary to constantly disconnect and reconnect cables when you want to control the module from the GameBoy while linking it to a computer at the same time via an I²C to RS232 adapter. All digital inputs and outputs are directly accessible on K25 and K26. That means you can check the outputs by connecting low-current LEDs directly to K26. Don't forget to use current-limiting resistors for the LEDs. The PCF8574T has open-drain outputs that can source adequate current for that purpose.

We use the SMD version of the well-known BC550 here for inverters (T1-T8, BC850) that drive MOSFETs T9-T16. Otherwise the outputs would go high immediately after the circuit

was switched on, due to the initial state of the PC8574.

As already mentioned, the MOSFETs can handle currents up to around 5 A. Incidentally, you can also use the pin-compatible BUZ11 in place of the IRFZ34N. It is no longer being made, but you can doubtless still find it on the shelf here and there.

The power supply is a simple design using a 7805. That means you can simply use a standard AC adapter with a voltage of 9 V or more as a power source. D2 provides reverse-polarity protection in case you accidentally connect a different adapter with the wrong polarity.

Construction

Assembling the circuit board is not difficult. Start by soldering all the small

SMDs. Next in line are the DIL and SMD ICs. IC2 can optionally be fitted in a socket. After that, you can fit the rest of the components.

You can connect a mobile phone directly to the circuit via a serial data cable connected to K1 if the optional SMS module is also fitted. You can order the SMS module at www.rk-tech.org.

Of course, this circuit is also perfectly suitable for use as a general-purpose I²C bus interface — it doesn't have to be restricted to use in combination with the GameBoy module. An I²C-based system with all sorts of control and switching capabilities can be used for innumerable purposes aside from a home bus system. That makes this I²C I/O Box suitable for a wide variety of applications.

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