AN11231

KNX evaluation board using LPC1227 and NCN5120

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Document information

Info	Content
Keywords	KNX, LPC1227, On Semiconductor NCN5120, Weinzierl Engineering GmbH, Building Automation, Sensors, HVAC, Lighting, ARM Cortex M0, Twisted pair TP1
Abstract	This application note describes the OM13042 KNX evaluation board that uses the LPC1227 Cortex M0 microcontroller and the NCN5120 KNX TP1 physical layer transceiver from On Semiconductor.

Revision history

Rev	Date	Description
1	20120701	Initial version

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1. Document purpose

The purpose of this document is to describe the OM13042 KNX evaluation board design.

This document is intended for technical persons such as system architects, hardware and software engineers interested in designing and developing a KNX device using an NXP microcontroller.

2. Introduction

The KNX evaluation board is an example implementation for KNX devices using an NXP Cortex M0 microcontroller LPC1227, the KNX twisted pair transceiver NCN1520 from On Semiconductor and a KNX System B software stack from Weinzierl Engineering GmbH.

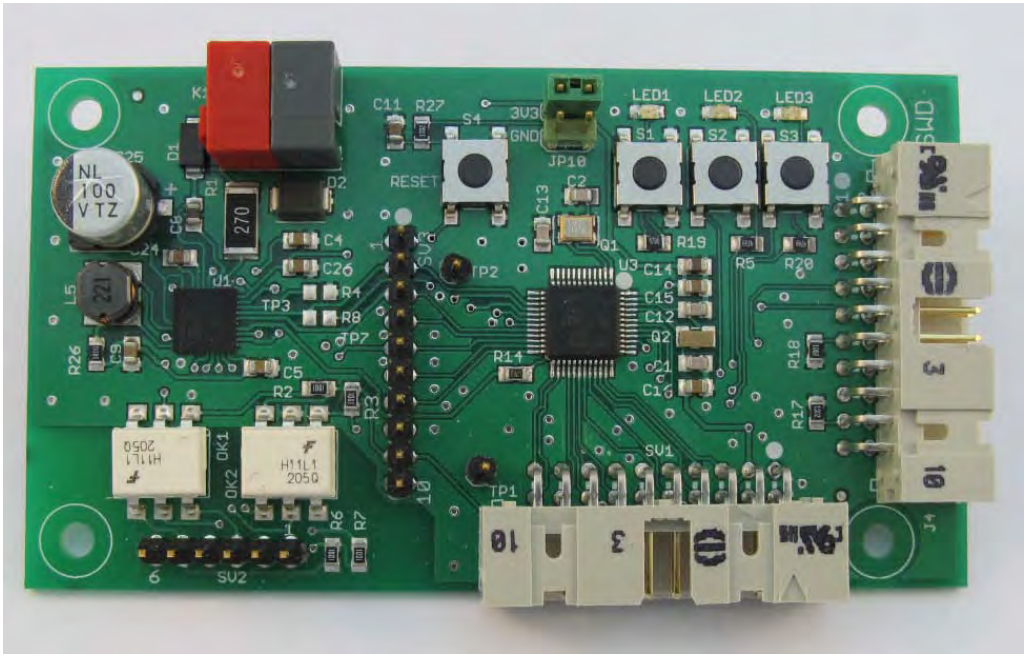

Fig 1. OM 13042 KNX TP1 NCN5120 LPC1227 evaluation board

The board supports the connection of actuators, sensors, switches or other applications in a building automation network. The evaluation board is available under the full name OM13042,598 and order code 935298293598.

3. Hardware

This chapter provides an overview of the board, its partitioning and all other hardware related information of the evaluation board.

3.1 Overview

An overview of the main components of the evaluation board is given in Fig 2. The transceiver IC NCN5120 connects via UART to the LPC1227 microcontroller. Furthermore the transceiver creates a regulated 3.3 V power supply for the microcontroller from the unregulated bus supply. The LPC1227 creates a clock signal for

the digital control part of the transceiver. Several buttons and LEDs are available as sensor and actuator inputs to the system.

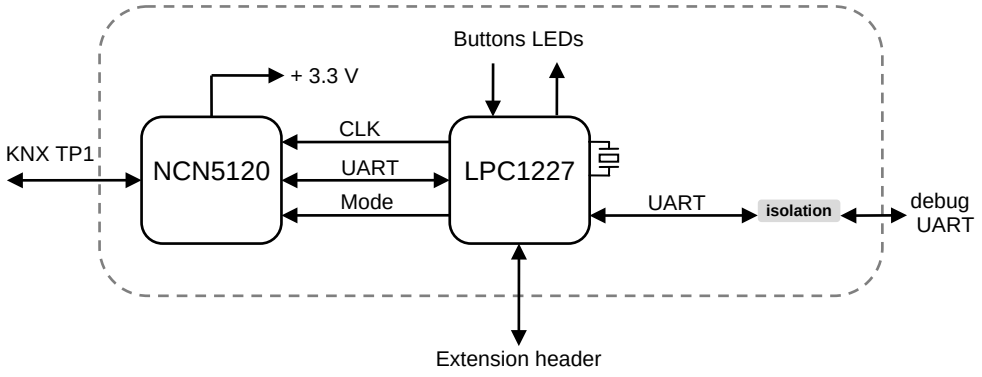

Fig 2. Evaluation board overview

3.2 PCB overview

The evaluation board is a two layer board with all components on the top side of the board. The component placement is given in Fig 5.

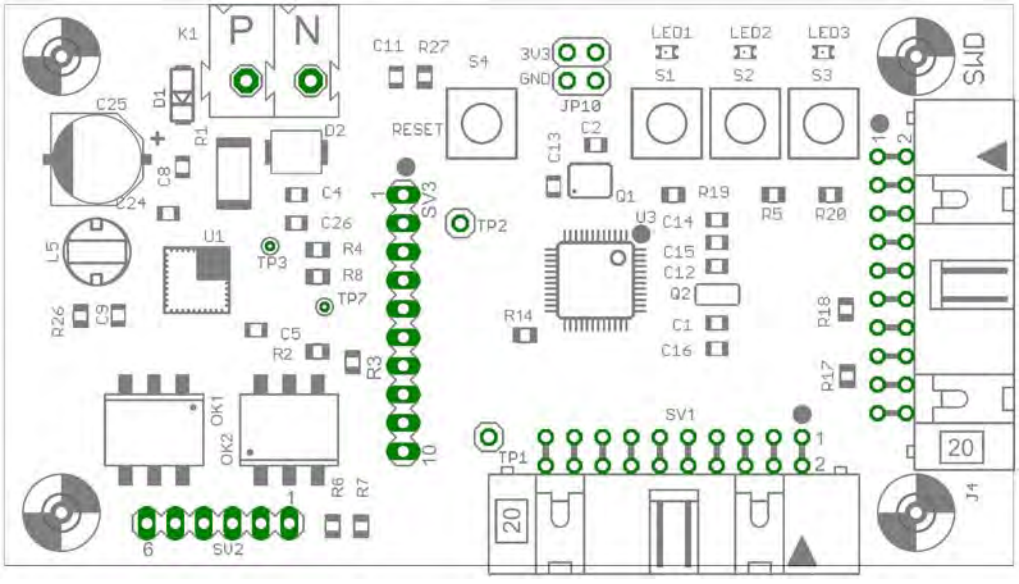

Fig 3. Component placement top side

The upper left part of the board contains the KNX TP1 header K1 to connect the KNX bus. Below the KNX connector, the board contains the physical transceiver part of the design. On the left bottom side the isolated UART interface is available on header SV2.

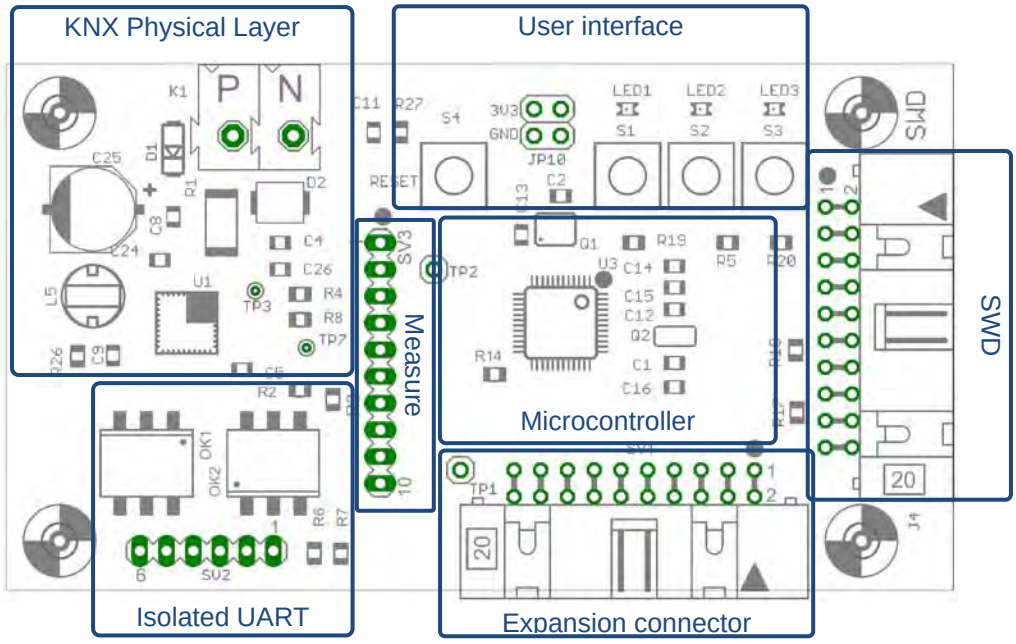

Fig 4. Partitioning of the design

In the middle of the board, a header is available to measure the various signals between the microcontroller and the transceiver. The top part contains the user interaction: LEDs and buttons. The header on the right hand side provides a debug probe connection that complies with the Serial Wire Debug (SWD) interface standard. To interface with other boards an extension connector is present on the lower part of the board. See Fig 4.

3.3 Microcontroller

To allow easy KNX application development, the development board is equipped with an LPC1227 Cortex M0 microcontroller with a flash memory size of 128 kB and 8 kB of RAM. This allows for downgrading to other LPC122x microcontrollers with smaller memory sizes while maintaining software and hardware compatibility. More information on the LPC122x microcontroller series is available in the LPC122x datasheet [1].

The microcontroller uses UART1 to connect to the transceiver. Furthermore, some GPIO's are used to connect to the KNX Phy. The second UART (UART0) on the design can be used to connect an external terminal program for debugging messages. The debug UART is electrically isolated from the design and the KNX bus.

Software can be downloaded via the SWD interface and debugged to the microcontroller on header J4. The LPC1227 user manual [2] contains a full description of the processing core and all the on board peripherals of the microcontroller. Fig 5 gives the schematic of the microcontroller section of the board.

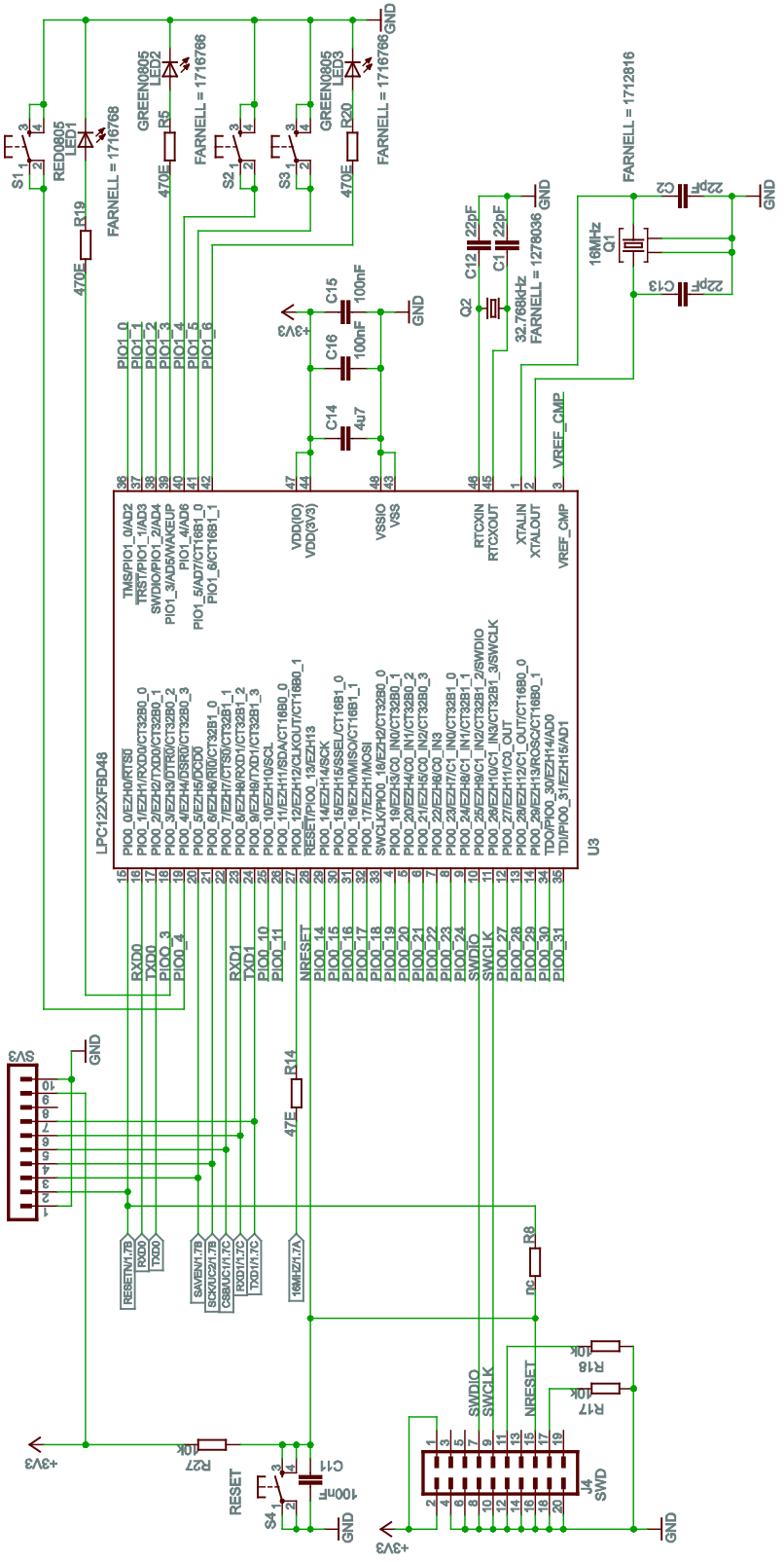

Fig 5. LPC1227 Microcontroller section of the schematic

3.4 KNX physical layer

The twisted pair 1 (TP1) KNX physical layer standard is used in the design. The design uses an NCN5120 receiver-transmitter IC for TP1 communication. The NCN5120 handles the transmission and reception of data on the bus. It generates stabilized voltages from the unregulated KNX bus for its own power needs as well as power for external devices as the microcontroller in this design. The NCN5120 assures safe coupling to and decoupling from the bus. Bus monitoring warns the external microcontroller for loss of power so that critical data can be stored in time.

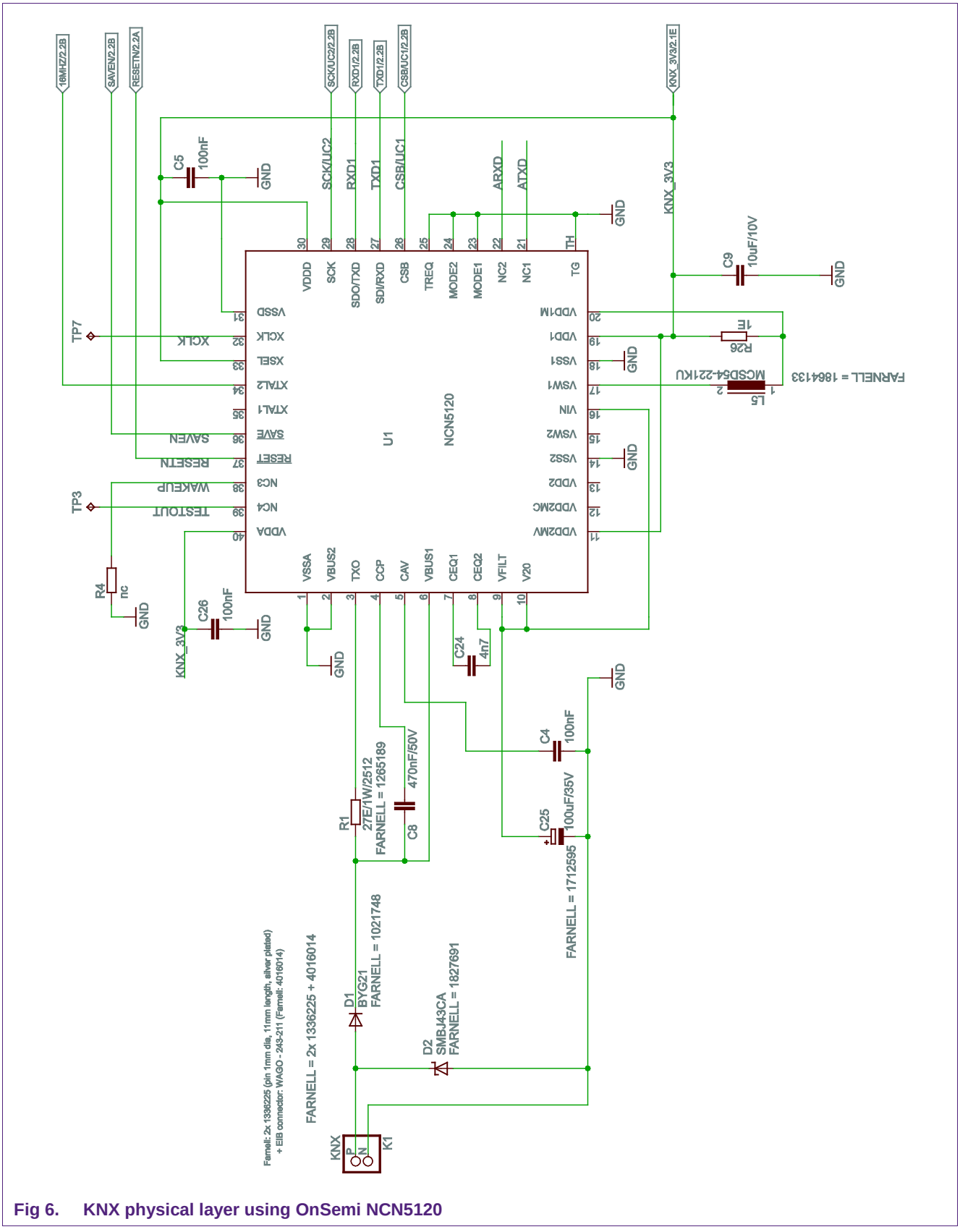

Fig 6. KNX physical layer using OnSemi NCN5120

3.5 Isolated UART interface

The isolated debug UART can be used for showing messages on a terminal. The 6-pin connector is compatible with a TTL-232R-3V3 cable from FTDI (Farnell order code: 1329311). This cable is shown in Fig 7.

Fig 7. FTDI TTL-232R-3V3 cable

Fig 8 gives the schematic diagram of the electrical isolate debug UART. This connection can both be used for input and output to the design and is not necessary for an end product.

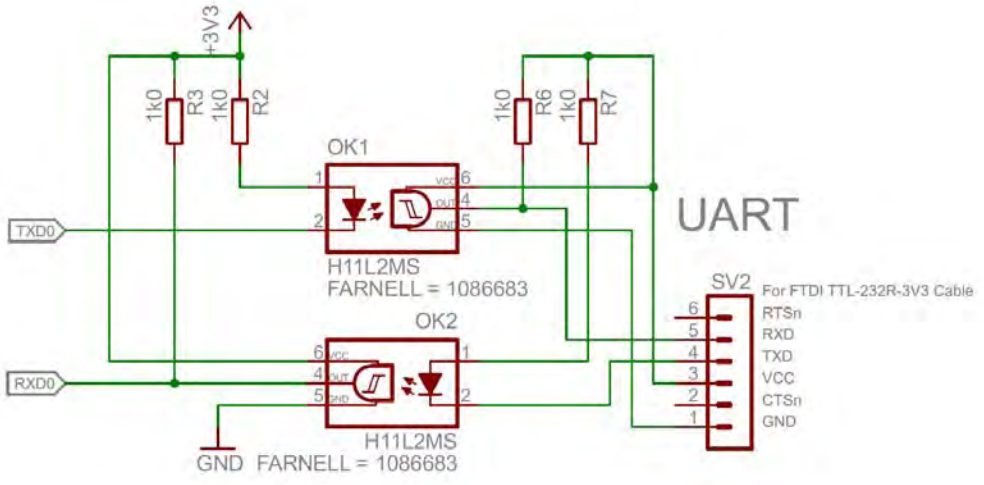

Fig 8. Isolated debug UART Interface

3.6 Expansion connector

To facilitate the connection of external hardware the expansion connector SV1 is available. The expansion connector can be used to connect external hardware boards for lighting, sensor, HVAC or other control purposes.

The connections of the expansion connector are given in Fig 9. All the connections, except ground and power, are directly connected to the microcontroller. The connections available support the usage of the 16-bit timers CTB16B0 and CTB16B1, and the 32-bit timers CT32B0 and CT32B1 for PWM generation. Furthermore, two analog to digital inputs are available; for communication purposes an SPI/SSP or I2C connection is available.

Not all these I/O connections are available simultaneously as the microcontroller uses pin multiplexing to select the specific function of an I/O pin. For detailed information on the pin multiplexing possibilities of the LPC1227 microcontroller see the LPC1227 user manual [2].

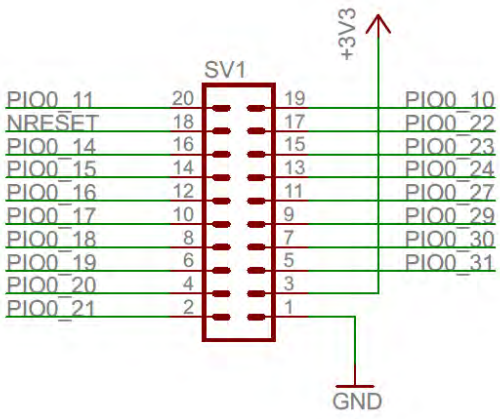

Fig 9. Expansion connector

4. Bill of Materials

Table 1. Component list

Part	Value	Device	Package	Description	Farnell
C1	22pF	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C2	22pF	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C4	100nF	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C5	100nF	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C8	470nF/50V	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C9	10uF/10V/X7R	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C11	100nF	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C12	22pF	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C13	22pF	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C14	4u7	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C15	100nF	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C16	100nF	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C24	4n7	C-EUC0805K	C0805K	CAPACITOR, European symbol	
C25	100uF/35V	CPOL-EUF	PANASONIC_F	POLARIZED CAPACITOR, European symbol	1712595
C26	100nF	C-EUC0805K	C0805K	CAPACITOR, European symbol	
D1	BYG21	DIODE-DO214AC	DO214AC	DIODE	1021748
D2	SMBJ43CA	SUPPRESSOR-SMBJ	SMBJ	Suppressor diode	1827691
J4	MC9A22-2034	MC9A22-2034		HEADER, RIGHT ANGLE, 20 WAY	1099248
JP10		PINHD-2X2	2X02	PIN HEADER	
K1	KNX	KNX	KNX	TP1 pins and connector	2x 1336225 + 4016014
L5	220uH	NPI54C221KTRF	5.8x5.2	NIC Components, SMD non-shielded	RS online 740-9619
LED1	RED0805	LEDCHIPLED_0805	CHIPLED_0805	LED (Check Anode/Cathode placement!)	1716768
LED2	GREEN0805	LEDCHIPLED_0805	CHIPLED_0805	LED	1716766
LED3	GREEN0805	LEDCHIPLED_0805	CHIPLED_0805	LED	1716766
OK1	H11L2MS	H11L2MS	DIL6-SMD	6-Pin DIP Optocoupler	1086683
OK2	H11L2MS	H11L2MS	DIL6-SMD	6-Pin DIP Optocoupler	1086683
Q1	16MHz	CRYSTAL4	XTAL4		1712816
Q2	32.768kHz	RTCCRYSTAL	XTAL2		1278036
R1	27E/1W/2512	R-EU_R2512	R2512	RESISTOR, European symbol, +/- 5%	1265189
R2	1k0	R-EU_R0805	R0805	RESISTOR, European symbol	
R3	1k0	R-EU_R0805	R0805	RESISTOR, European symbol	
R4	nc	R-EU_R0805	R0805	RESISTOR, European symbol	

Part	Value	Device	Package	Description	Farnell
R5	470E	R-EU_R0805	R0805	RESISTOR, European symbol	
R6	1k0	R-EU_R0805	R0805	RESISTOR, European symbol	
R7	1k0	R-EU_R0805	R0805	RESISTOR, European symbol	
R8	nc	R-EU_R0805	R0805	RESISTOR, European symbol	
R14	47E	R-EU_R0805	R0805	RESISTOR, European symbol	
R17	10k	R-EU_R0805	R0805	RESISTOR, European symbol	
R18	10k	R-EU_R0805	R0805	RESISTOR, European symbol	
R19	470E	R-EU_R0805	R0805	RESISTOR, European symbol	
R20	470E	R-EU_R0805	R0805	RESISTOR, European symbol	
R26	1E	R-EU_R0805	R0805	RESISTOR, European symbol	
R27	10k	R-EU_R0805	R0805	RESISTOR, European symbol	
S1	B3FS-1000	B3FS-1000	SWITCH-TACT_DTSM-6	OMRON ELECTRONIC COMPONENTS - B3FS-1000 - SWITCH, FLAT, SPNO	3121161
S2	B3FS-1000	B3FS-1000	SWITCH-TACT_DTSM-6	OMRON ELECTRONIC COMPONENTS - B3FS-1000 - SWITCH, FLAT, SPNO	3121161
S3	B3FS-1000	B3FS-1000	SWITCH-TACT_DTSM-6	OMRON ELECTRONIC COMPONENTS - B3FS-1000 - SWITCH, FLAT, SPNO	3121161
S4	B3FS-1000	B3FS-1000	SWITCH-TACT_DTSM-6	OMRON ELECTRONIC COMPONENTS - B3FS-1000 - SWITCH, FLAT, SPNO	3121161
SV1	MC9A22-2034	MC9A22-2034		HEADER, RIGHT ANGLE, 20 WAY	1099248
SV2		MA06-1	MA06-1	PIN HEADER	
SV3		MA10-1	MA10-1	PIN HEADER	
TP1		PINHD-1X1	1X01	PIN HEADER	
TP2		PINHD-1X1	1X01	PIN HEADER	
U1	NCN5120	NCN5120	QFN40_6X6_NCN5120	On Semiconductor KNX TP1 transceiver	
U3	LPC1227FBD48	LPC122XFBD48	SOT313-2	NXP ARM Cortex M0 32 bit Microcontroller	1862476

5. Device configuration

The demo board is programmed with the App_DemoBoardNXP_LPC12xx.hex file to create an example KNX device. Together with an example project for the ETS tool (the manufacturer independent configuration tool from KNX Association), the user can setup a small KNX network using the OM13042 board.

The example application file for the microcontroller contains a limited version of the KNX stack from Weinzierl Engineering. For more information on the KNX system stack refer to Weinzierl Engineering [4].

Table 2. Accompanying files AN11231

File name	Description
App_DemoBoardNXP_LPC12xx.hex	Flash file for the LPC1227 microcontroller
Test_Project_App_Demo_NXP_2012_04_11.pr5	Example project for KNX ETS configuration tool

6. References

[1] Product data sheet LPC122x 32-bit ARM Cortex-M0 microcontroller, Rev. 2 — 26 August 2011 http://www.nxp.com/documents/data_sheet/LPC122X.pdf

[2] UM10441, LPC1224/25/26/27 User manual, Rev. 2 — 19 September 2011, http://www.nxp.com/documents/user_manual/UM10441.pdf

[3] NCN5120 datasheet, Rev.1 – May 2011 On Semiconductors

[4] Weinzierl Engineering GmbH, http://www.weinzierl.de/

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