LC87F1MADG1AGEVK

LC87F1M16A Evaluation Board User's Manual

ON Semiconductor®

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EVAL BOARD USER'S MANUAL

Summary

This document describes the specification of this product "LC87F1MADG1AGEVK", and it uses the following software.

Table 1. SUMMARY

Kind of Software	Name of the Software
Microcontroller	LC87F1M16A Version 0x1000
Application for PC	LC87F1MADG1AGEVK_Application.exe
Driver	LC87F1MADG1AGEVK_driver.inf

Content

Evaluation Board (USB−DG1−1Ma1−EVK): 1
USB-mini Cable: 1
Connector (FSS−43085−05 HIROSUGI−KEIKI): 1
CD-ROM*: 1

* Please use the included CD-ROM for the documentations, driver for this software, application software, and sample application software.

About Application

Required OS: Windows XP or later
Profile Needed: .NET Framework4 Client Profile

Summary of the Product

This product is for data receiving/transmitting by changing the various input/output formats listed below from PC to device and vice versa.

- I^2C
- SPI
- PWM
- Digital Input/Output (GPIO)
- ADC

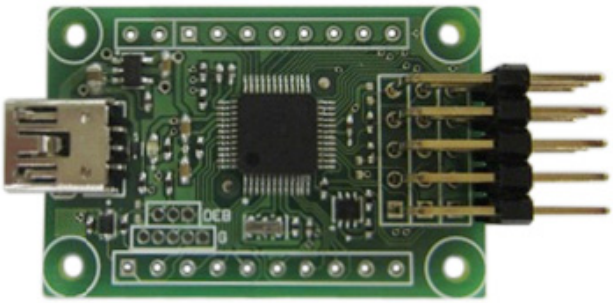
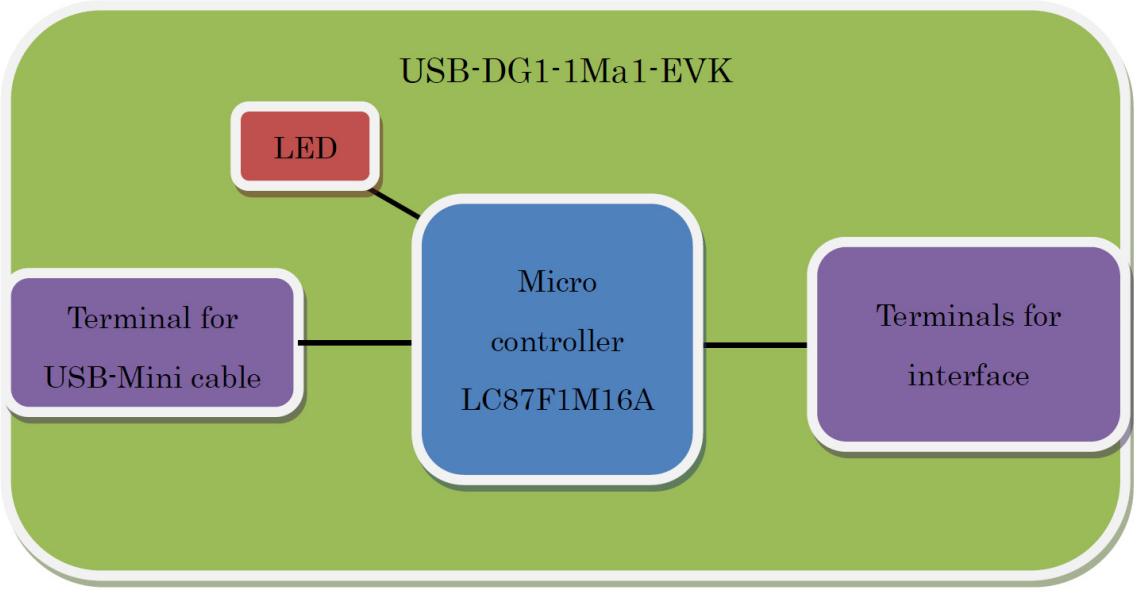


Figure 1. LC87F1M16A

February, 2014 − Rev. 3

Publication Order Number:
EVBUM2170/D

COMPOSITION OF THIS PRODUCT



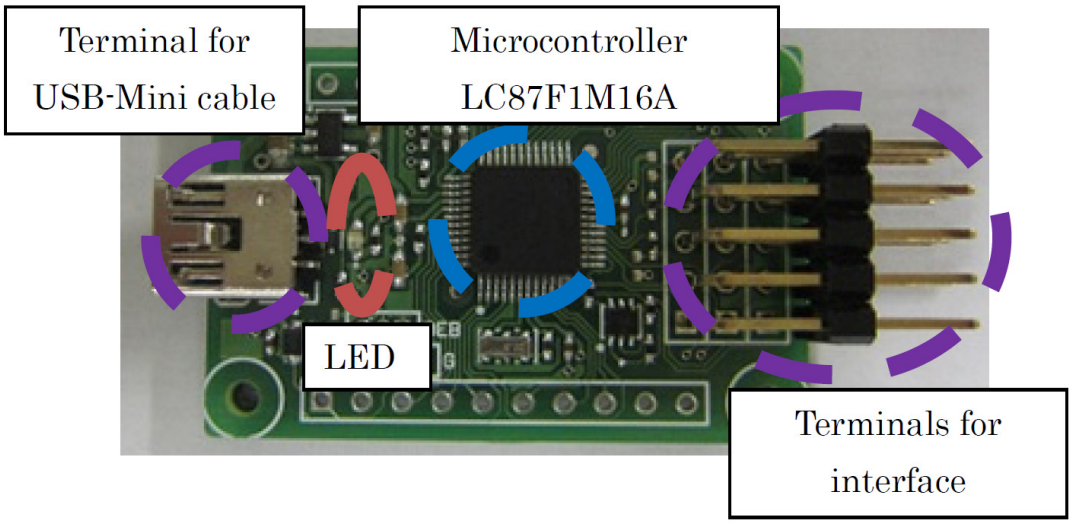


Figure 2. Composition

CONNECTION DIAGRAM WHEN USE

* PC, Device and Interface cable is not included.

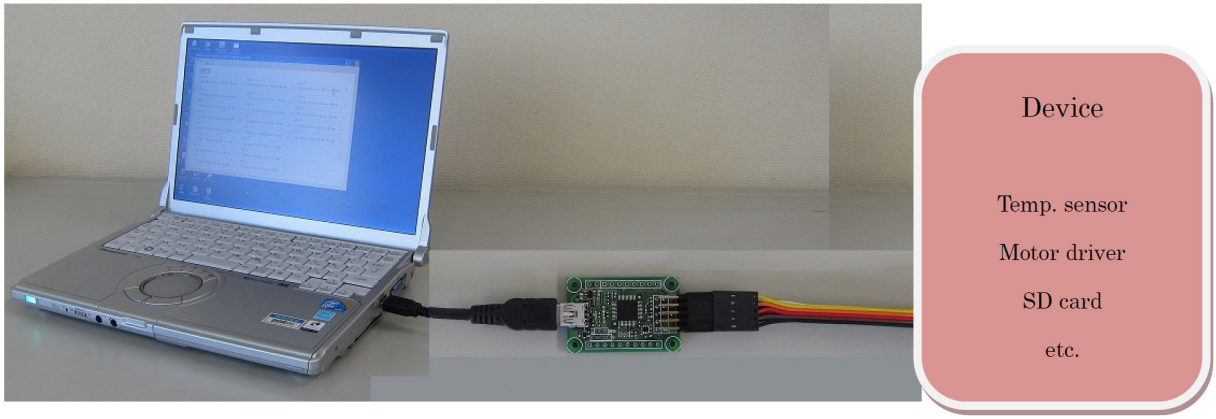


Figure 3. Connection Diagram

SUMMARY OF THE PINS ON THE PRODUCT

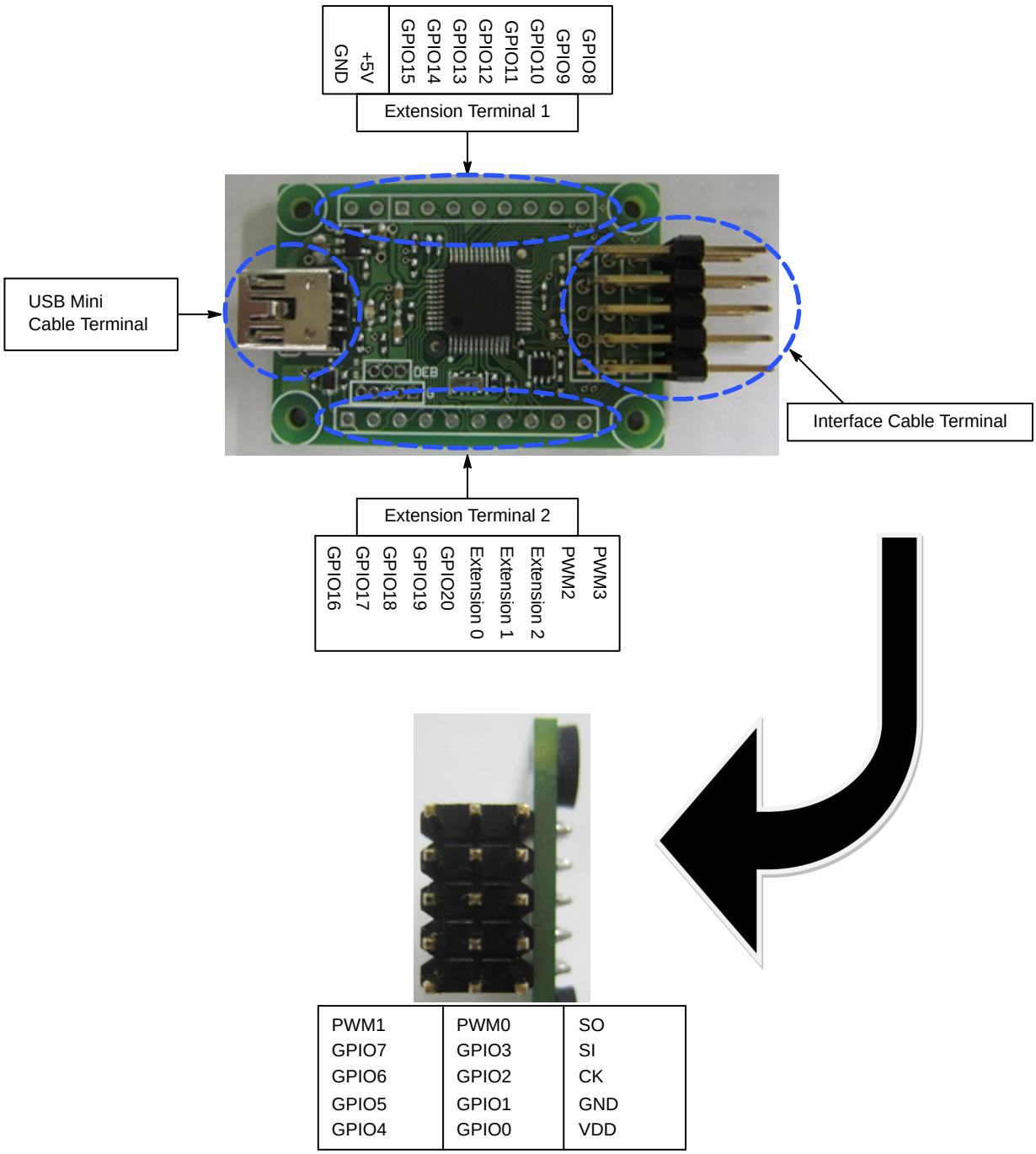


Figure 4. Summary of the Pins

USB-Mini Cable Terminal

USB2.0 compliant

Corresponding to Full Speed (12 Mbps)

Please connect the USB-Mini cable terminal to the PC using the included USB-Mini cable.

LED

Initial state of the LED is OFF.

It will light-up when driver is installed and USB communication is established. After that, it will light-up once every one communication with the data.

Table 2. INTERFACE CABLE TERMINAL

Name of the Pin	I/O Setting	State of the Possible Setting of the Terminal	Input Voltage Range	Max. Output Current
SO	O	SIO	–	Refer to the Micro's Catalogue
SI	I/O	SIO	0 to 3.3 V	Refer to the Micro's Catalogue
CK	I/O	SIO	0 to 3.3 V	Refer to the Micro's Catalogue
GND	–	–	–	–
VDD	–	–	–	100 mA
PWM0	O	PWM	–	Refer to the Micro's Catalogue
PWM1	O	PWM	–	Refer to the Micro's Catalogue
GPIO0	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO1	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO2	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO3	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO4	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO5	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO6	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO7	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue

NOTE: Internal pull-up is connected to 3.3 V through 18 k to 150 kΩ inside of the microcontroller.

Table 3. EXTENSION TERMINAL 1

Name of the Pin	I/O Setting	State of the Possible Setting of the Terminal	Input Voltage Range	Max. Output Current
GPIO8	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO9	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO10	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO11	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO12	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO13	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO14	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO15	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
+5V	–	–	–	100 mA
GND	–	–	–	–

Table 4. EXTENSION TERMINAL 2

Name of the Pin	I/O Setting	State of the Possible Setting of the Terminal	Input Voltage Range	Max. Output Current
GPIO16	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO17	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO18	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO19	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
GPIO20	I/O	Open, Internal Pull-Up, Low, High	0 to 3.3 V	Refer to the Micro's Catalogue
PWM2	O	PWM	–	Refer to the Micro's Catalogue
PWM3	O	PWM	–	Refer to the Micro's Catalogue
Extension 0	–	–	–	–
Extension 1	–	–	–	–
Extension 2	–	–	–	–

HOW TO USE THIS PRODUCT

Basic steps of the operation

- Connect the PC and this product via USB-Mini cable

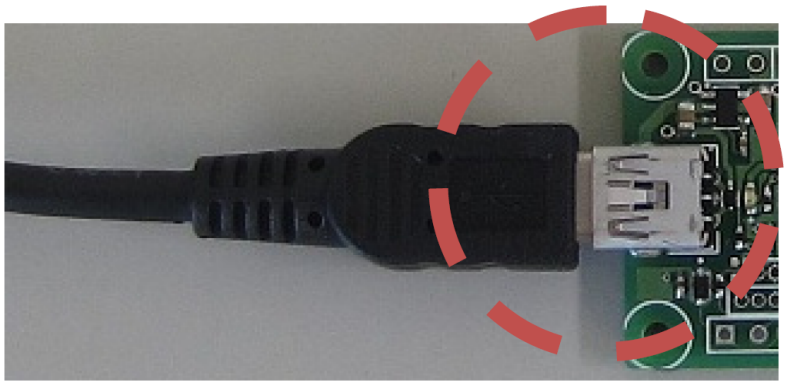


Figure 5. Connection via USB-Mini Cable

- After connected, below window appears automatically
- Install the driver in PC (In case of Windows XP 32bit)

Figure 6. Driver Installation − Step 1

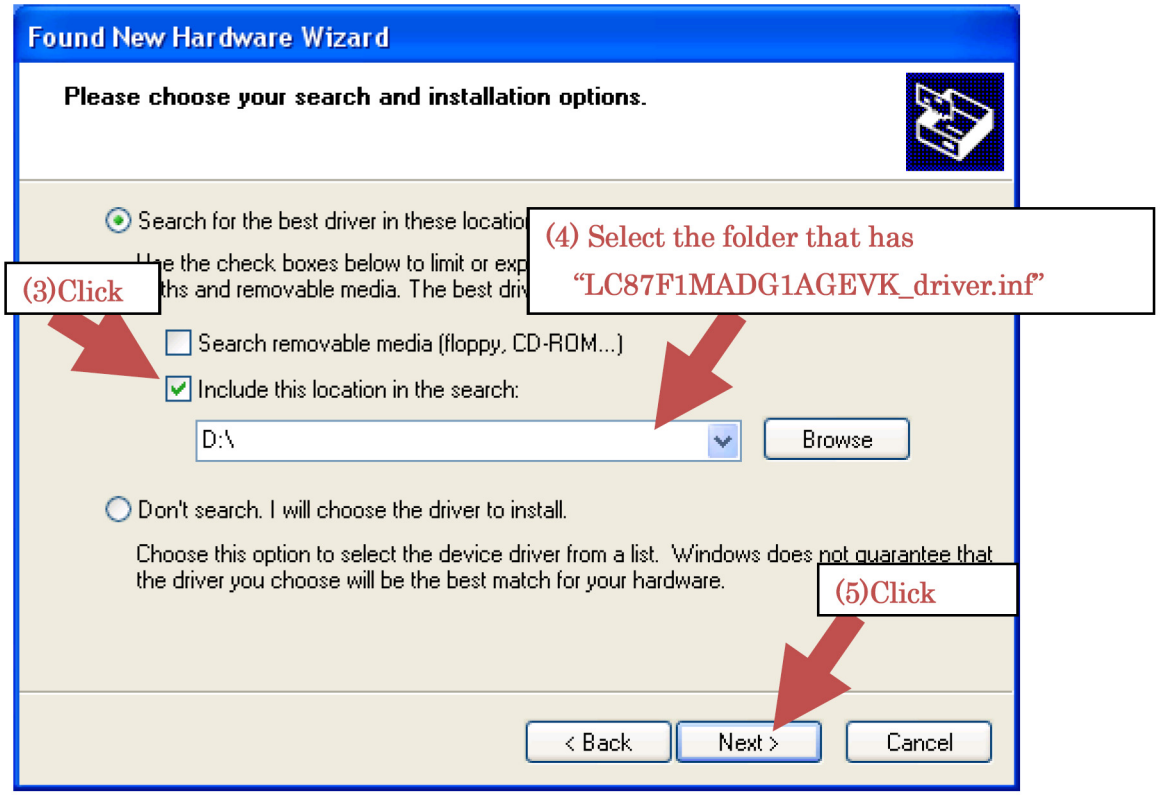


Figure 7. Driver Installation − Step 2

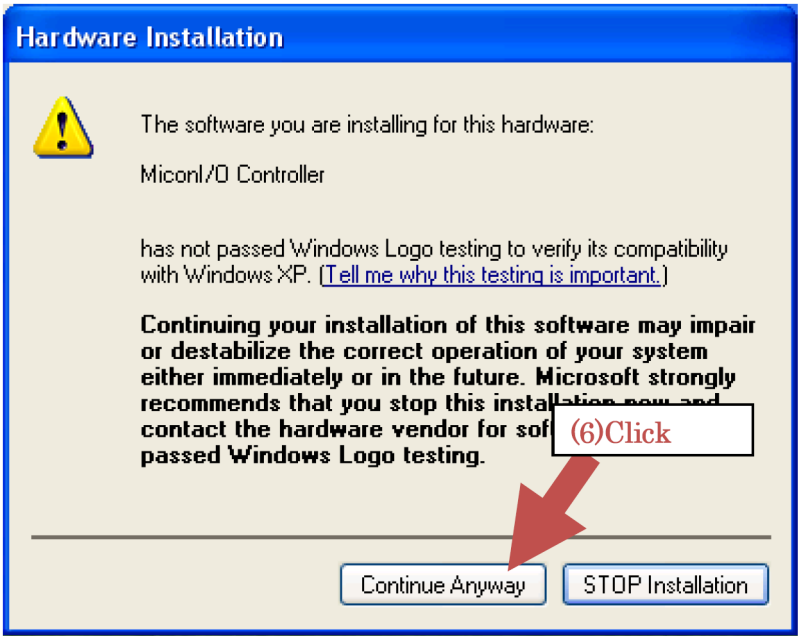


Figure 8. Driver Installation − Step 3

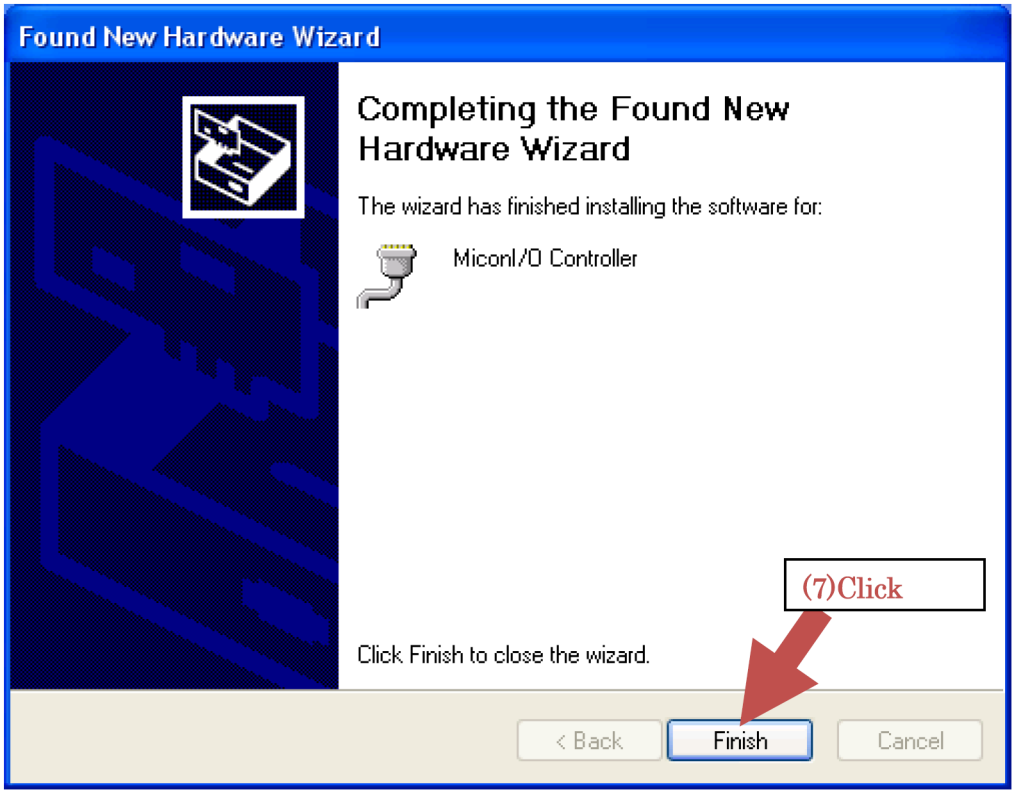


Figure 9. Driver Installation − Step 4

- LED will light-up if the installation is successful
- Connect the device and the interface cable of this product
- Start the application named "LC87F1MADG1AGEVK_Application.exe"

Figure 10. Device Connection

SPECIFICATION OF THE INPUT/OUTPUT TYPES

I^2C Communication

1. *Summary:*
   SIO of LC87F1M16A microcontroller is used for this communication…
   This communication format is based on "THE I^2C−BUS SPECIFICATION VERSION 2.1"
2. *Pins to Be Used:*
   SI: used as SDA of I^2C bus
   CK: used as SCL of I^2C bus
3. *Summary of the Communication:*
   - Only Supports Single Master Mode
   - Only Supports Fast-mode (Bit Rate is 400 kbps)
   - Number of Receivable Data at One Communication is 0 to 62 Byte (in Case of 10 Bit Address, 61 Byte)
   - Number of Transmittable Data at One Communication is 0 to 62 Byte
   - Corresponding Address

Table 5. SUMMARY OF THE COMMUNICATION

Address Value	Value Next to the Address Value	Summary of the Address Value
0b0000 0000	**General Call Processing** **Value** / **Summary** 0x06 / Reset of the Slave 0x04 / Initialization of the Slave Address 0x00 / Do Not Use 0bXXXX XXX1 / X are Master Address	General Call Address
0b0000 0001	None	Start Byte
0b0000 001X	None	CBUS Address (No comm.)
0b0000 010X	None	No Communication
0b0000 011X	None	No Communication
0b0000 1XXX	None	No Communication
0b1111 1XXX	None	No Communication
0b1111 0XXZ	Lower 8bit of the Slave Address	10bit Slave Address (XX is the Higher 2bit of the Slave Address) Transmission when Z = 0 Reception When Z = 1
Other	Transmission Data if Transmission. Number of Reception Data if Reception.	7bit Slave Address Transmission when Lower1 Bit is 0 Reception when Lower1 Bit is 1

NOTE: X denotes 0 or 1.

4. *Application Window:*

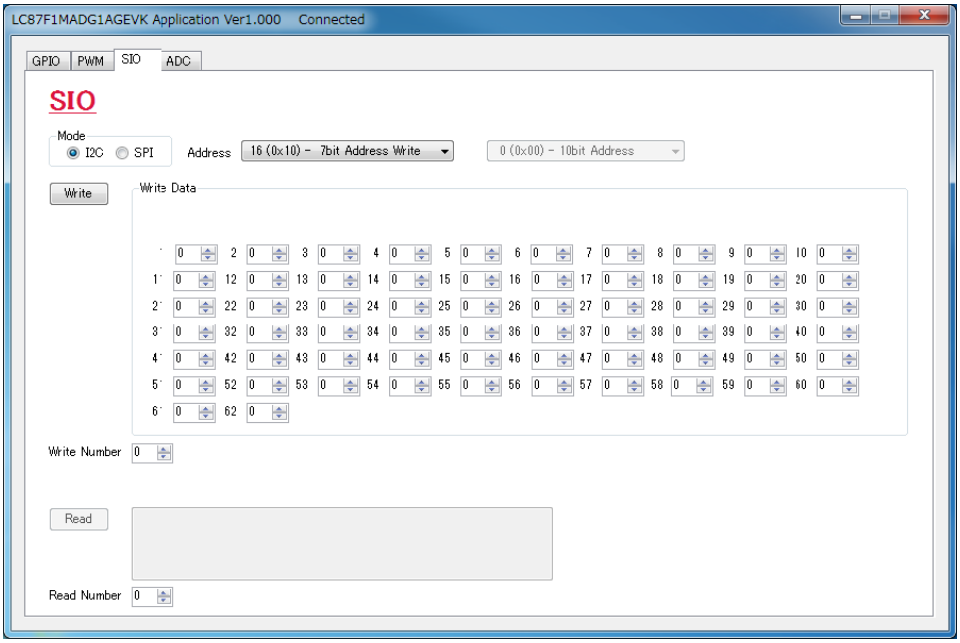


Figure 11. Application Window (I²C)

SPI

1. *Summary:*
   SIO of LC87F1M16A microcontroller is used for this communication…
   This communication is based on "SPI Block Guide V4.01"
2. *Pins to Be Used:*
   SO: used as MOSI of SPI
   SI: used as MISO of SPI
   CK: used as SCK of SPI
   GPIO: used as SS of SPI
3. *Communication Summary:*
   - Only SupportsNormal Mode
   - Bit Rate is 400 kbps
4. *Application Window:*

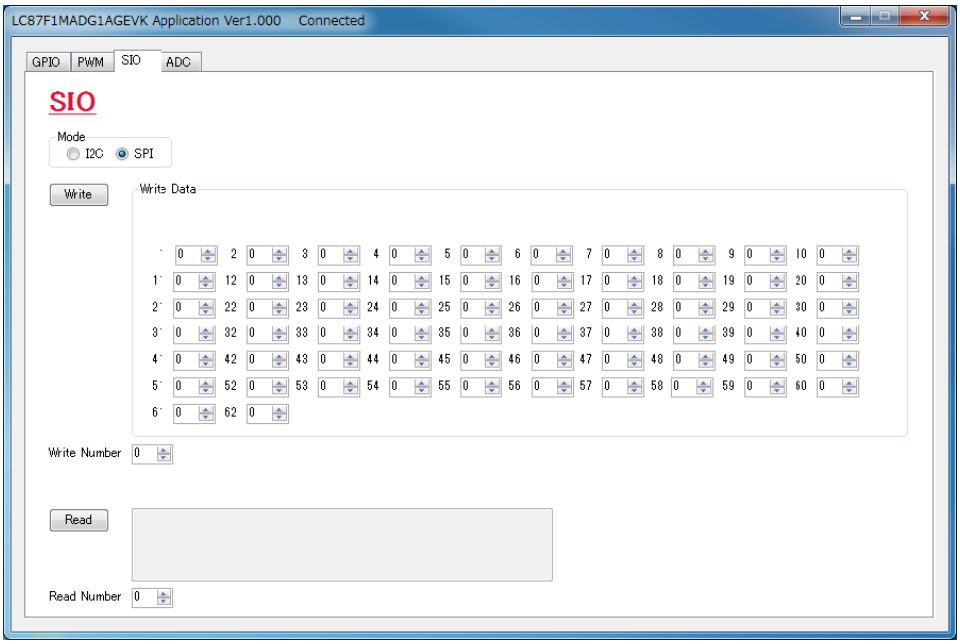


Figure 12. Application Window (SPI)

PWM

1. *Summary:*
   Synchronous×2ch, asynchronous×2ch, total of 4ch can be output as PWM.
   Using filter, it is capable of small DC voltage step control.
2. *Pins to Be Used:*
   PWM0: Frequency is synchronized with PWM1 (Duty can be set separately)
   PWM1: Frequency is synchronized with PWM0 (Duty can be set separately)
   PWM2: Frequency and duty can be set asynchronously.
   PWM3: Frequency and duty can be set asynchronously.
3. *Output Summary:* PWM0, 1 and PWM2, 3
4. *Application Window:*

Table 6. PWM0, 1

Frequency	Duty Changeable Step
750.0 [kHz]	16 steps
375.0 [kHz]	32 steps
250.0 [kHz]	48 steps
187.5 [kHz]	64 steps
150.0 [kHz]	80 steps
125.0 [kHz]	96 steps
107.1 [kHz]	112 steps
93.8 [kHz]	128 steps
83.3 [kHz]	144 steps
75.0 [kHz]	160 steps
68.2 [kHz]	176 steps
62.5 [kHz]	192 steps
57.7 [kHz]	208 steps
53.6 [kHz]	224 steps
50.0 [kHz]	240 steps

Table 7. PWM2, 3

Frequency	Duty Changeable Step
15.625 [kHz]	256 steps
7.813 [kHz]	256 steps
3.906 [kHz]	256 steps
1.953 [kHz]	256 steps
0.977 [kHz]	256 steps
0.488 [kHz]	256 steps
0.244 [kHz]	256 steps
0.122 [kHz]	256 steps

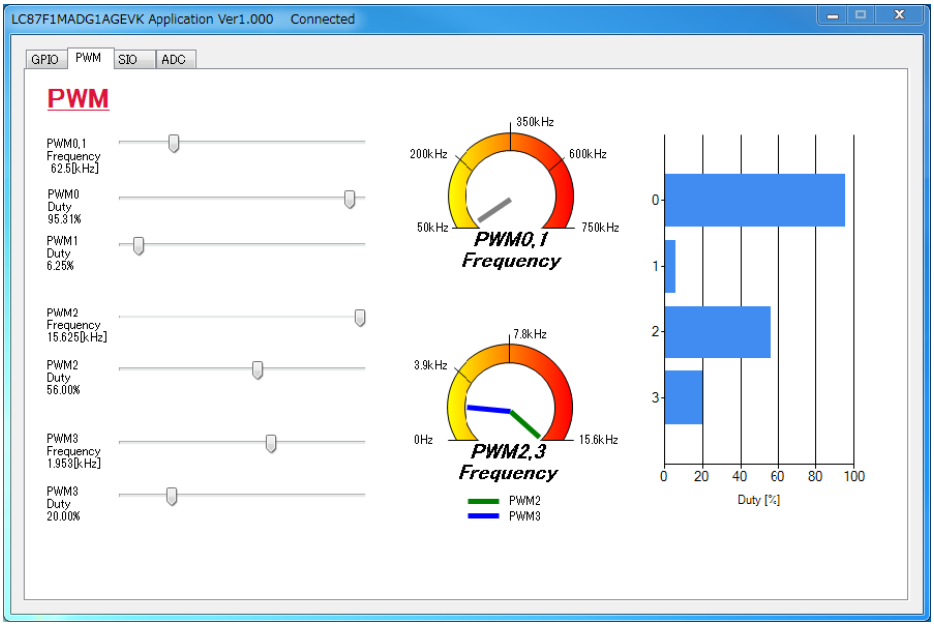


Figure 13. Application Window (PWM)

Digital Input/Output (GPIO)

1. *Summary:*
   Capable of selecting 3.3 V or 0 V of input/output
2. *Pins to Be Used:*
   GPIO0: Select Low/High when output, and select Open/Pull-up when input.
   GPIO1: Select Low/High when output, and select Open/Pull-up when input.
   GPIO2: Select Low/High when output, and select Open/Pull-up when input.
   GPIO3: Select Low/High when output, and select Open/Pull-up when input.
   GPIO4: Select Low/High when output, and select Open/Pull-up when input.
   GPIO5: Select Low/High when output, and select Open/Pull-up when input.
   GPIO6: Select Low/High when output, and select Open/Pull-up when input.
   GPIO7: Select Low/High when output, and select Open/Pull-up when input.
   GPIO8: Select Low/High when output, and select Open/Pull-up when input.
   GPIO9: Select Low/High when output, and select Open/Pull-up when input.
   GPIO10: Select Low/High when output, and select Open/Pull-up when input.
   GPIO11: Select Low/High when output, and select Open/Pull-up when input.
   GPIO12: Select Low/High when output, and select Open/Pull-up when input.
   GPIO13: Select Low/High when output, and select Open/Pull-up when input.
   GPIO14: Select Low/High when output, and select Open/Pull-up when input.
   GPIO15: Select Low/High when output, and select Open/Pull-up when input.
   GPIO16: Select Low/High when output, and select Open/Pull-up when input.
   GPIO17: Select Low/High when output, and select Open/Pull-up when input.
   GPIO18: Select Low/High when output, and select Open/Pull-up when input.
   GPIO19: Select Low/High when output, and select Open/Pull-up when input.
   GPIO20: Select Low/High when output, and select Open/Pull-up when input.
3. *State of Terminal:*
   Open input
   Input with pull-up
   Low output
   High output
4. *Application Window:*

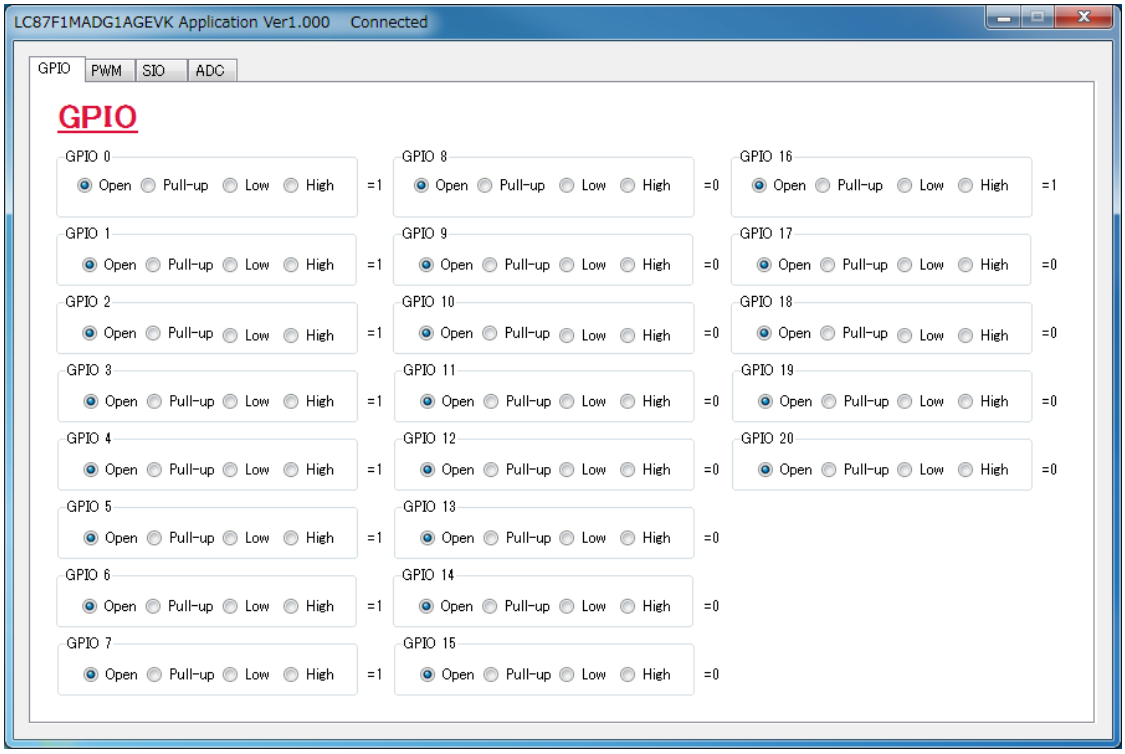


Figure 14. Application Window (GPIO)

ADC

1. *Summary:*
   Converts the voltage to the value
2. *Pins to be used:*
   GPIO0: ADC port 0
   GPIO1: ADC port 1
   GPIO2: ADC port 2
   GPIO3: ADC port 3
   GPIO4: ADC port 4
   GPIO5: ADC port 5
   GPIO6: ADC port 6
   GPIO7: ADC port 7

   Note: Set the GPIO to Open when conversion
3. *Setting:*
   − 8bitAD/12bitAD
   − Selection of conversion time

8bitAD Conversion Time	12bitAD Conversion Time	Unit
2.8	4.5	µs
5.5	8.8	µs
10.8	17.5	µs
21.5	34.8	µs
42.8	69.5	µs
85.5	138.8	µs
170.8	277.5	µs
341.5	554.8	µs

4. *Application Setting Window:*

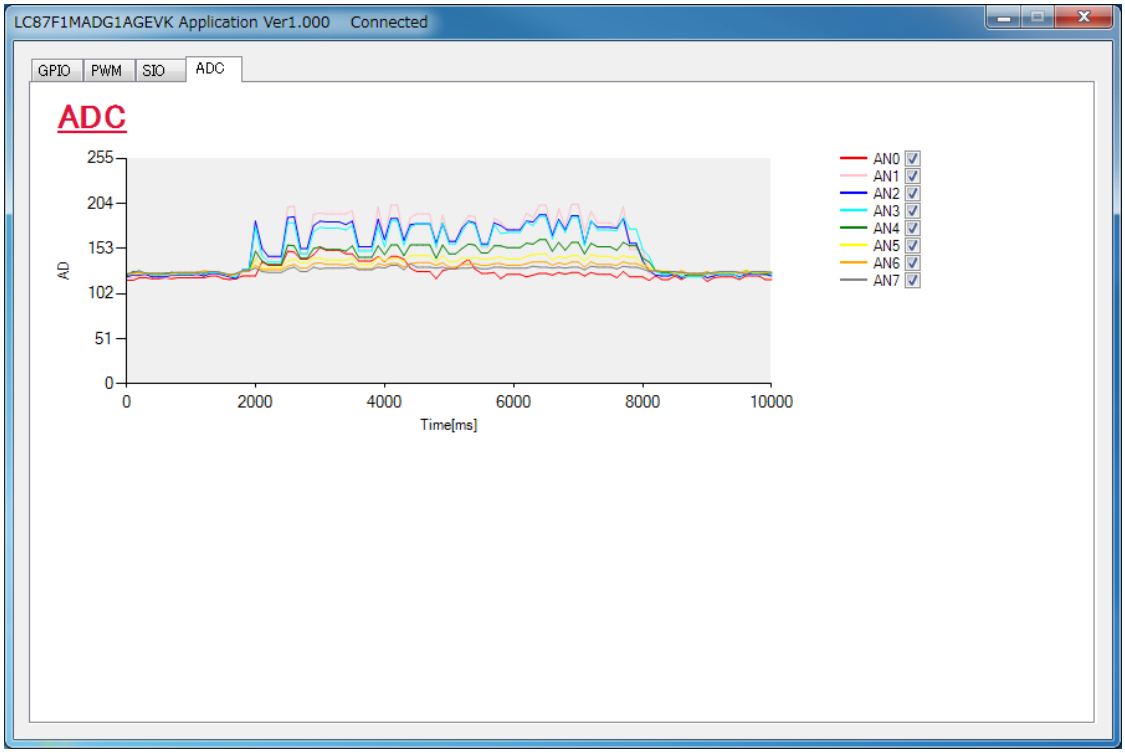
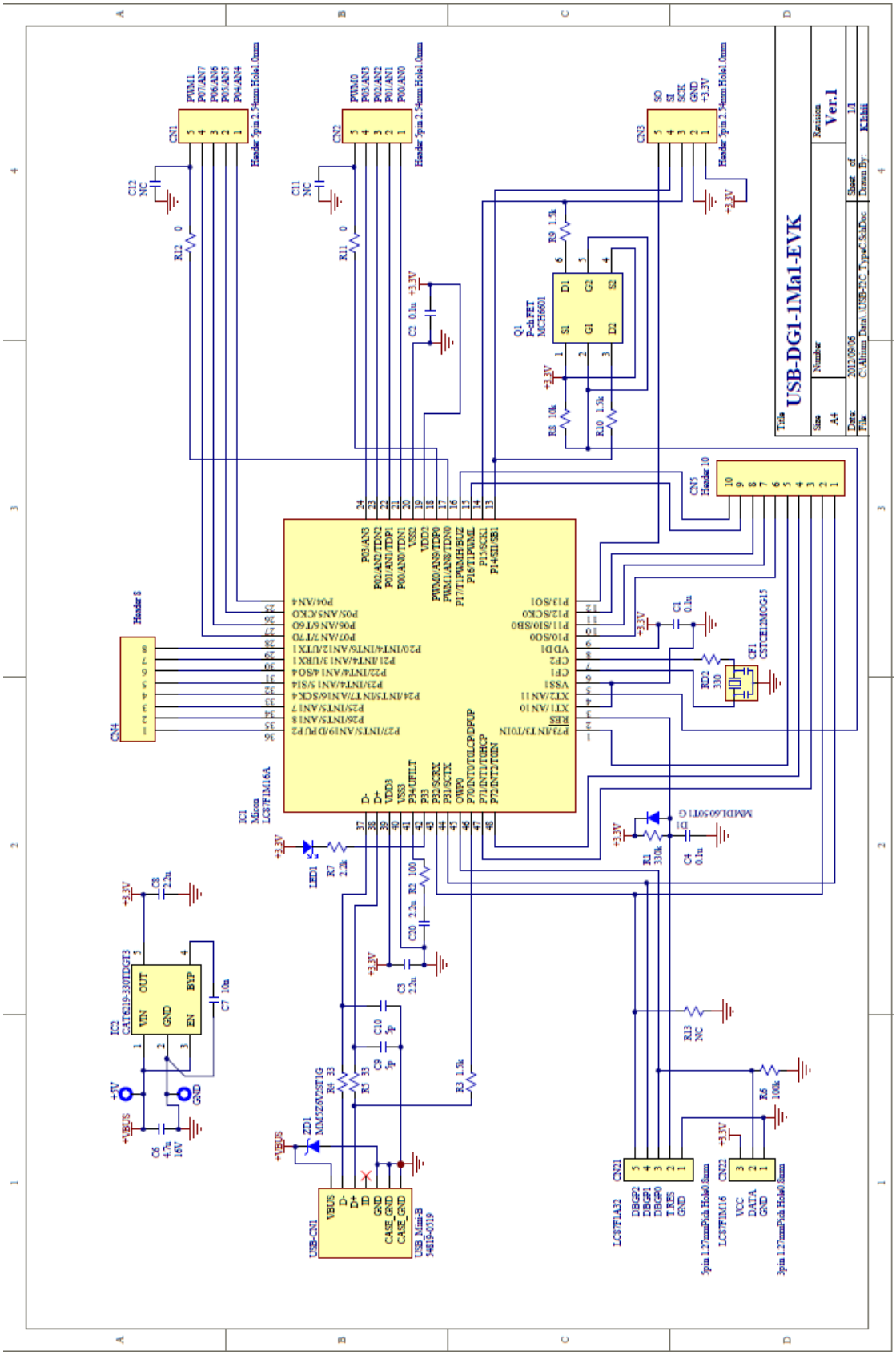


Figure 15. Application Setting Window (ADC)

CIRCUIT DIAGRAM



PARTS LIST

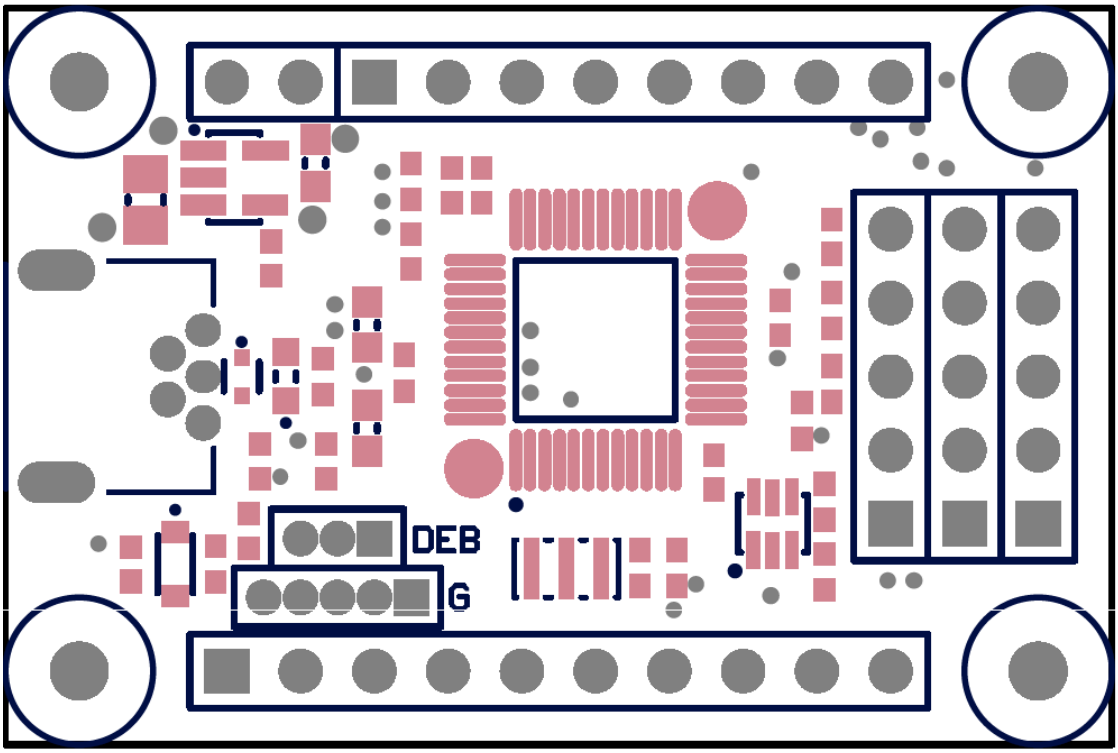
Table 8. BILL OF MATERIALS

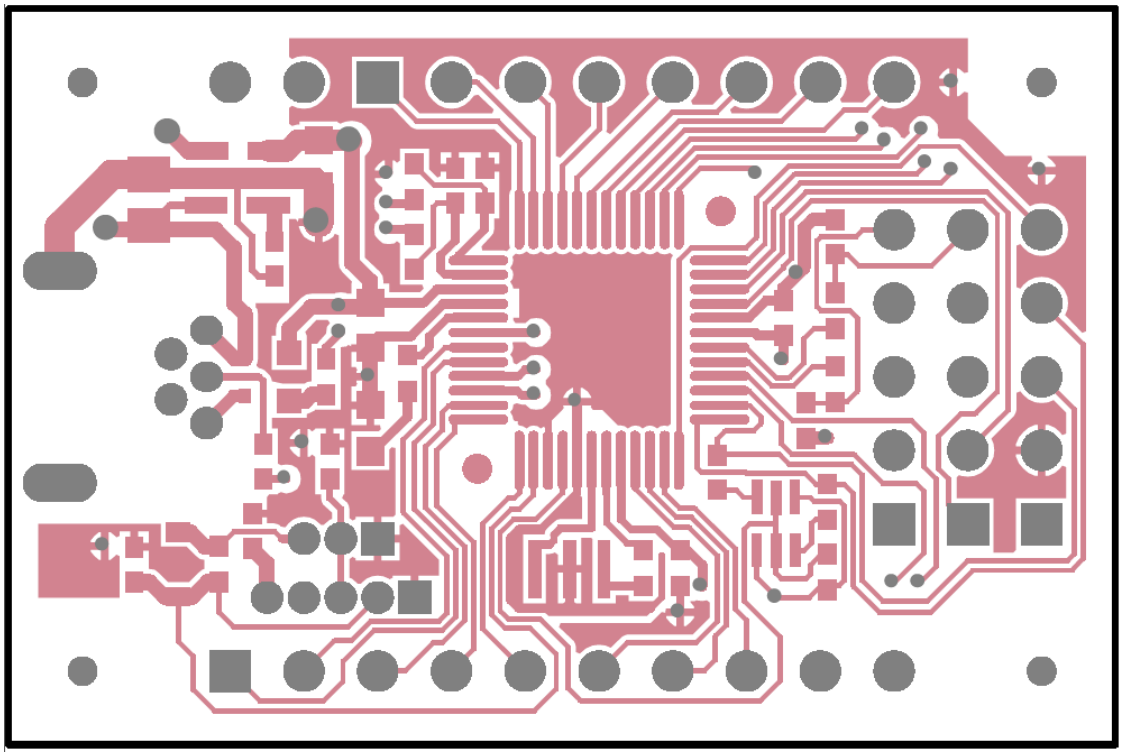
Designator	Qty.	Description	Value	Tolerance	Footprint inch (mm)	Manufacturer	Manufacturer Part Number	Substitution Allowed
C1, C2, C3	3	Capacitor SMD	0.1 μF, 10 V	±10%	0402 (1005)	Murata	GRM155B11A104KA01#	Yes
C3, C8, C20	3	Capacitor SMD	2.2 μF, 10 V	±20%	0603 (1608)	Murata	GRM188B31A225ME33#	Yes
C6	1	Capacitor SMD	4.7 μF, 16 V	±10%	0805 (2012)	Murata	GRM21BB31C475KA87L	Yes
C7	1	Capacitor SMD	0.01 μF, 10 V	±10%	0402 (1005)	Murata	GRM155R61A103KA01#	Yes
C9, C10	2	Capacitor SMD	5 pF, 50 V	±0.25 pF	0402 (1005)	Murata	GRM1552P1H5R0CZ01#	Yes
C11, C12	2	Open	NC	–	–	–	–	–
CF1	1	Ceramic Resonator	12 Mhz, 33 pF	±0.07%	CE	Murata	CSTCE12M0GH5L	Yes
ZD1	1	Zener Diode	6.2 V, 200 mW		SOD−523	ON Semiconductor	MM5Z6V2ST1G	Yes
D1	1	Diode			SOD−323−2	ON Semiconductor	MMDL6050T1G	Yes
IC1	1	Micro Controller			SQFP48 (7 × 7)	ON Semiconductor	LC87F1M16AF5ZA0WA−6H	No
IC2	1	LDO Regulator	3.3 V, 500 mA		TSOT23	ON Semiconductor	CAT6219−330TDGT3	Yes
LED1	1	LED SMD	RED		0603 (1608)	STANLEY	UR111C	Yes
Q1	1	Dual Pch-MOS	−30 V, −0.2 A	±5%	0402 (1005)	ON Semiconductor	MCH6601	Yes
R6	1	Resistor SMD	100 kΩ, 0.063 W	±5%	0402 (1005)	Rohm	MCR01MZPJ104	Yes
R1	1	Resistor SMD	330 kΩ, 0.063 W	±5%	0402 (1005)	Rohm	MCR01MZPJ334	Yes
R2	1	Resistor SMD	100 Ω, 0.063 W	±5%	0402 (1005)	Rohm	MCR01MZPJ101	Yes
R4, R5	2	Resistor SMD	33 Ω, 0.063 W	±5%	0402 (1005)	Rohm	MCR01MZPJ330	Yes
R3, R9, R10	3	Resistor SMD	1.5 kΩ, 0.063 W	±5%	0402 (1005)	Rohm	MCR01MZPJ152	Yes
R8	1	Resistor SMD	10 kΩ, 0.063 W	±5%	0402 (1005)	Rohm	MCR01MZPJ103	Yes
R11, R12	2	Resistor SMD	0 Ω, 0.063 W	±5%	0402 (1005)	Rohm	MCR01MZPJ000	Yes
R13	1	Open	NC	–	–	–	–	–
RD2	1	Resistor SMD	330 Ω, 0.063 W	±5%	0402 (1005)	Rohm	MCR01MZPJ331	Yes
R7	1	Resistor SMD	2.2 kΩ, 0.063 W	±5%	0402 (1005)	Rohm	MCR01MZPJ222	Yes
USB_CN1	1	Connecter	USB−B Connector (MINI)	–	–	Molex	54819−0519	Yes
CN 1, 2, 3	1	Pin Header 5 × 3	5 × 3			HIROSUGI	PSR−430256−05	Yes

Included Parts	1	Pin Header Socket 5 × 3	5 × 3			HIROSUGI	FSS−43085−05	Yes

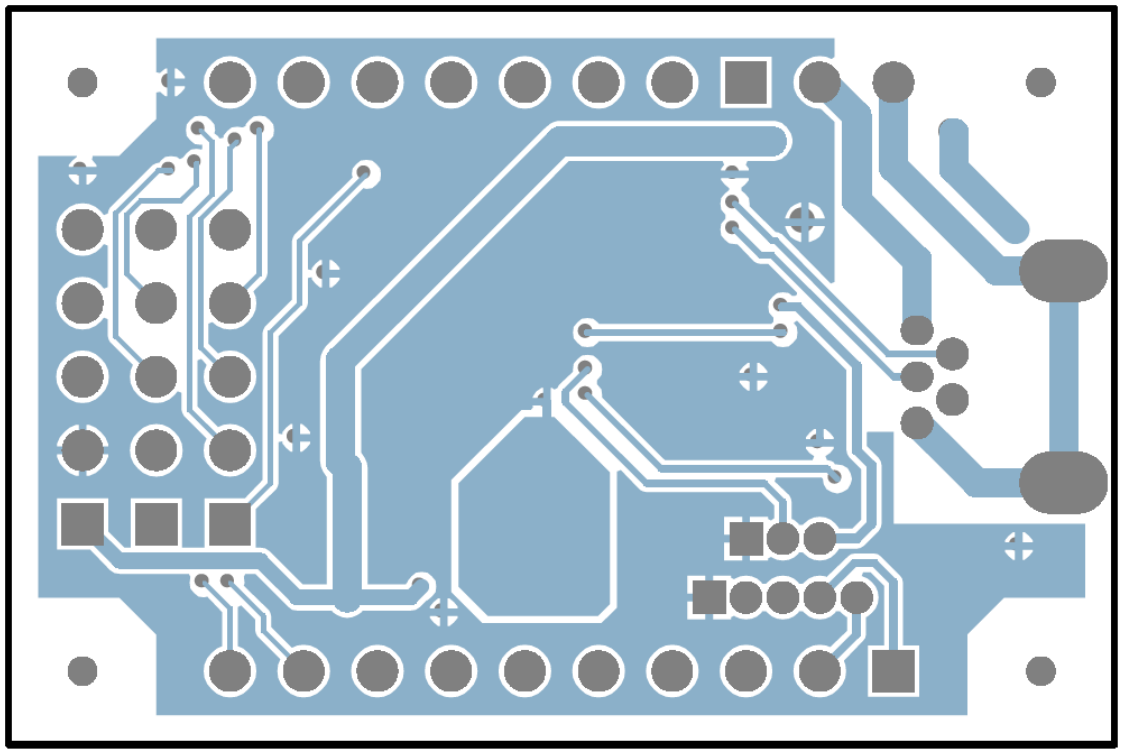
NOTE: All devices are Pb-Free.

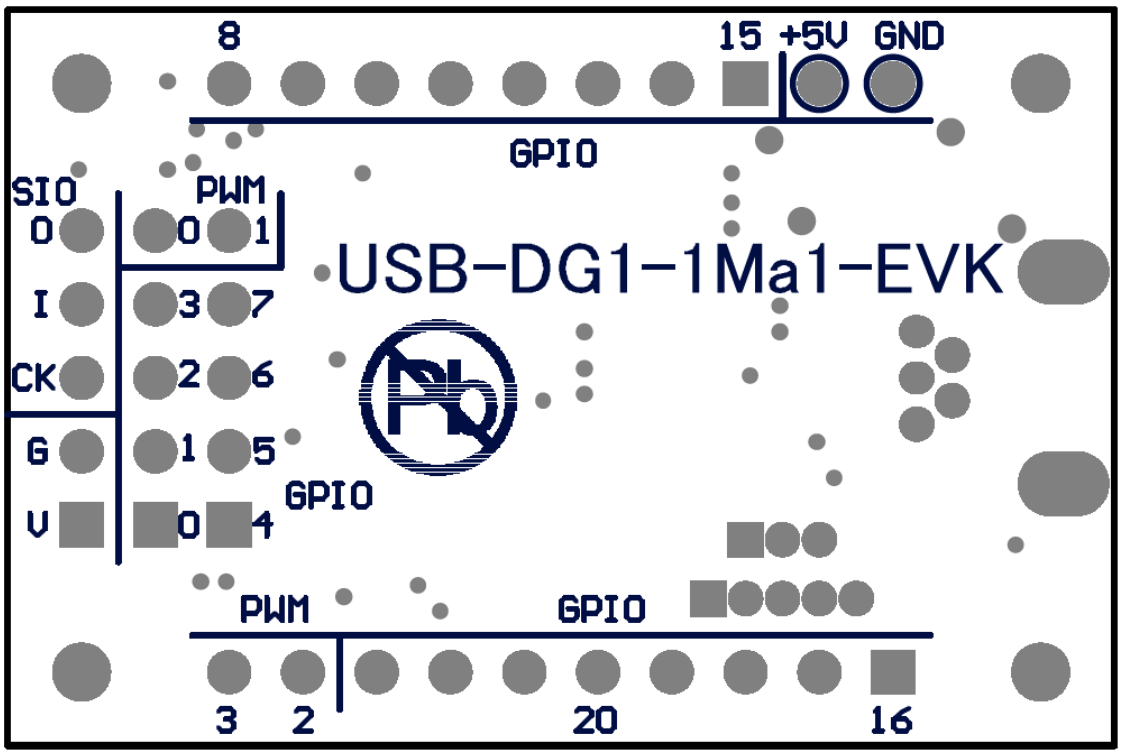
PATTERN DIAGRAM − FRONT



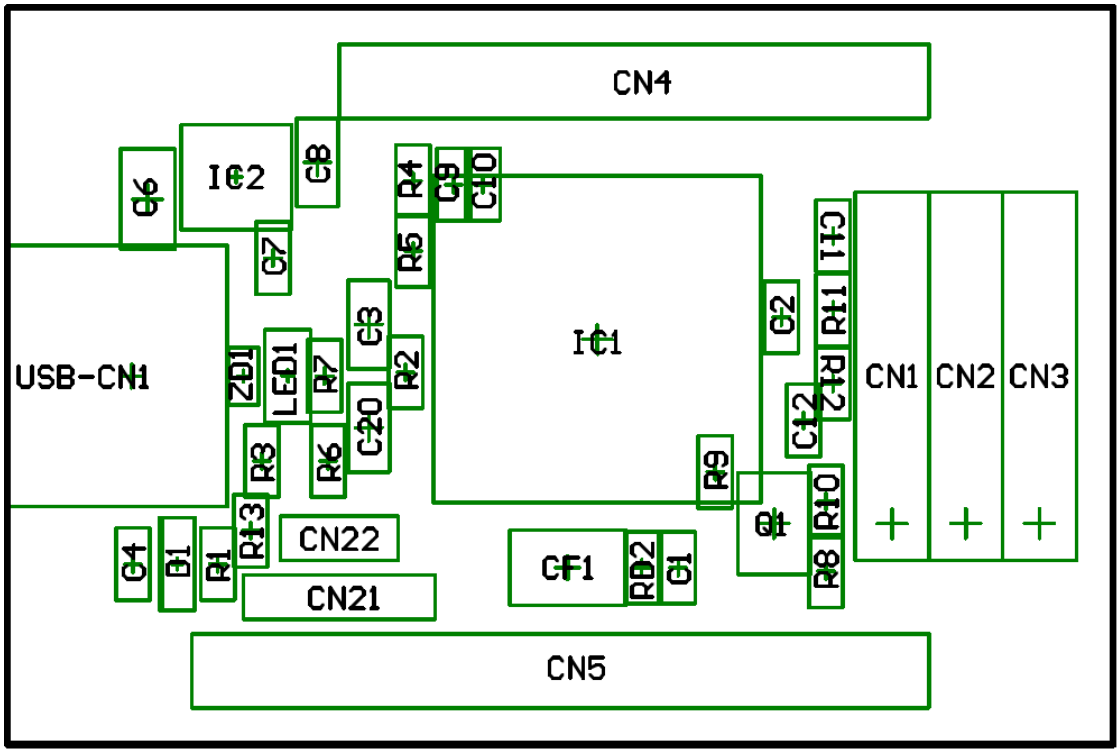


PATTERN DIAGRAM − BACK



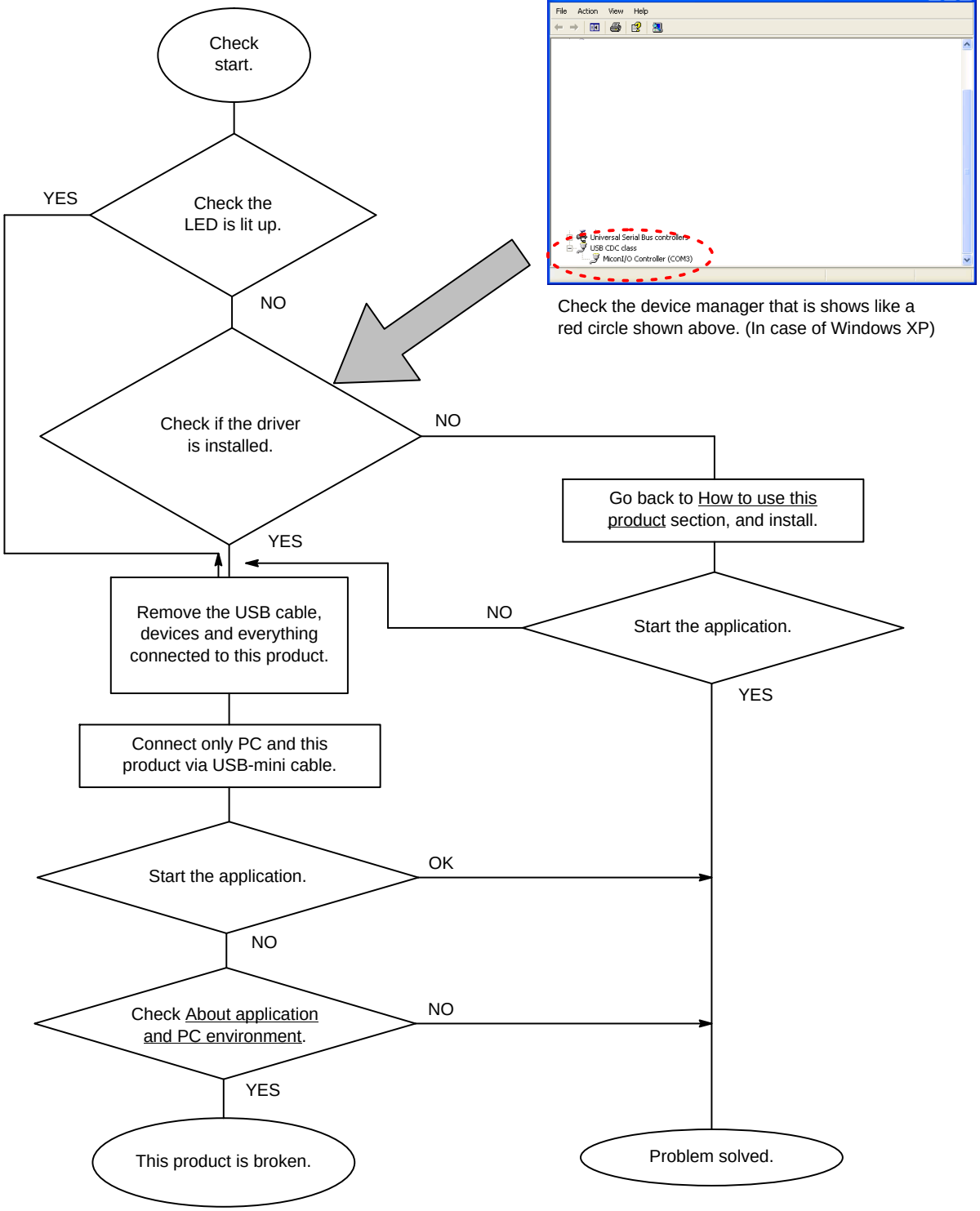


PATTERN DIAGRAM − LOCATION OF THE PARTS



IF YOU THINK IT IS BROKEN

Application Does Not Start



Check the device manager that is shows like a red circle shown above. (In case of Windows XP)

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800−282−9855 Toll Free USA/Canada
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Phone: 421 33 790 2910
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