Evaluates: MAX86916

General Description

The MAX86916 evaluation system (EV system) allows for the quick evaluation of the MAX86916 optical module for applications at various sites on the body, particularly the finger. The MAX86916 has four LEDs (blue, green, red, and IR) and one photodiode. The MAX86916 supports a standard I²C interface.

Features

- Quick Evaluation of the MAX86916 IC
- Extensive Control Over Device Registers
- Data Logging and Real-Time Monitoring Capabilities
- Fully Assembled and Tested
- Windows® 7, 8, and 10-Compatible Software

MAX86916 EV System Files

FILE	DESCRIPTION
Insert Final File Name here.exe	PC GUI Program

Quick Start

Required Equipment

- MAX86916_EVKIT_A Board
- MAX32630FTHR
- Micro-USB Cable
 - · USB to FTDI Cable
- Windows PC with Two USB Ports

Ordering Information appears at end of data sheet.

MAX86916 EV System Board

Procedures

Note: Software-related items are identified by bold text. Text in **bold** refers to items directly from the EV system software installer. Text which is **bold and underlined** refers to items from the Windows operating system.

The EV system is tested and ships in two pieces, MAX86916_EVKIT_A and MAX32630FTHR. Perform the following steps to verify board operation:

- Plug the MAX32630FTHR into the MAX86916_ EVKIT_A board.
- 2) Set the EV system hardware on a nonconductive surface to ensure nothing on the PCBs short together.
- Connect the EV system hardware to a PC with the provided USB cable. Attach the micro-USB end to the MAX32630FTHR and the other end to the PC. LED D1 on the MAX32630FTHR begins blinking light blue.
- 4) Connect the FTDI cable to the three headers on the MAX86916_EVKIT_A board. With the MAX86916_ EVKIT_A board sensor side up, the order of the FTDI from left to right is orange, yellow, and black. See the MAX86916 EV System Board.
- 5) Windows automatically begins installing the necessary device driver. Once the driver installation is complete, a Windows message appears near the system icon menu, indicating the hardware is ready to use. Do not attempt to run the GUI prior to this message. Running the GUI prior to receiving this message necessitates closing the application and restarting it once the driver installation is complete. On some versions of Windows, administrator privileges might be required to install the USB device.



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- Once the device drivers have been installed, download the EV system software from <u>MAX86916 EV system</u> Design Resources tab and extract it to a temporary folder.
- 7) Open the extracted ZIP folder and double-click the .EXE file to run the installer. If a message box stating "The publisher could not be verified. Are you sure you want to run this software?" appears, select the **Yes** option.
- When the installer GUI appears, click Next. Select the installation paths and whether to create a shortcut on the desktop. When prompted, click Install. Once complete, click Close.
- 9) If a shortcut was created, double-click on the shortcut to start the GUI. Alternatively, go to <u>Start | All</u> <u>Programs</u>, look for the MAX86916EVKitTool folder, and click on the MAX86916EVKitTool.EXE file.
- 10) When the GUI appears, the text in the status bar in the lower right corner displays **Connected**. If the GUI displays **Not Connected**, ensure the flex PCB is properly connected and power cycle the MAX86916 EV system.

Detailed Description of Software

Software Startup

When the DeviceStudio GUI is opened, no devices are connected. Select **Serial over USB/Bluetooth** as the Scan Mode and click the **Scan** button, as shown in Figure 1.

After a device has been found, the **Device Info** and the GUI refresh to indicate a device has been found, as shown in Figure 2.

Click **Launch Tool** to continue using the EV system software.

ToolStrip Menu Bar

The ToolStrip menu bar (Figure 3) is located at the top of the GUI window. This bar consists of the File, View, **Device**, **Diagnostics**, **Tools**, and **Help** menus, whose functions are detailed in the following sections.

nage Connection				
	Scan Mode	Last Connection		
	Serial over USB/Bluetooth	Serial Connection		
Scan	ADB	At: 8/12/2019 2:22 PM		Not Connected
	Windows BLE			
	BLE over CySmart USB Dongle	Clear		
nected Devices				
Devices	Device Info		Tools	Tool Info

Figure 1. DeviceStudio GUI with Device Disconnected

Maxim DeviceStudio - [Device Info <u>V</u> iew <u>D</u> evice Diagnostics	Tools <u>H</u> elp			— U	
anage Connection					
	Platform	Data Server			
Disconnect	Pegasus_V1	Serial Connection			
Refresh		Server Version: 1.5.2		Connected	
nnected Devices					
Devices	Device	Info	Tools	Tool Info	
PPG	Part Name	MAX86916	EV Kit	Description PPG EV Kit	
	Part ID	28		Control a standard PPG device, graph raw data, and log to disk.	
	Part Revision	20			
	Device ID				
	Driver Version	73976299			
		1.2.06		Version 5.4.6100 (
				Launch Tool	

Figure 2. DeviceStudio Device Connected



Figure 3. ToolStrip Menu Bar

File Menu

The **File** menu has the option to exit out of the GUI program.

View Menu

The **View** menu has the options to view the device info from the GUI introduction screen and to view the **Register Map**. In the register map, the user has the option to read and set individual registers. The register map also provides an explanation of every bit in each register. Doubleclicking on a bit toggles its state, and pressing the **Set Reg** button writes the selected settings.

Device Menu

The **Device** menu has the option to connect or disconnect an EV system to the GUI. If a board is disconnected while the GUI is open, the GUI displays **Hardware Not Connected** in the lower right corner. If the device is then plugged back in, the user can navigate to the **Device** menu and select **Connect**. If successful, the lower right corner of the GUI reads **Connected**.

Diagnostics Menu

The **Diagnostics** menu has the option to look at the log file for the DeviceStudio. This can be used for debugging purposes.

Help Menu

The **Help** menu contains information to aid with any problems that might arise when using the GUI. The About option displays the GUI splash screen which tells the user the GUI version being used.

MAX86916 GUI

The main interface structure of the GUI consists of a tab control, where each tab contains controls to change various PPG settings as shown in <u>Figure 4</u>. Changing these interactive controls triggers a write operation to the MAX86916 to update the register contents. Likewise, these controls are refreshed when reading from the device.



Figure 4. Main GUI Screen

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<u>Figure 5</u> shows an example of viewing data streaming in the GUI. The GUI allows for any LED output to be put on either the left or right Y-axis. Clicking once on an LED shows the output on the left axis, clicking a second time shows the output on the right axis, and clicking a third time stops showing the output. This feature is useful to help align LED outputs on top of each other in the GUI.

PG Evaluation Kit	Пар				
Start Monitoring	to File e Header Write Settings 'PG_2019-08-30_11-34-14.cs wse Select Data	V	PPG Settings PPG S P/ AGC IR Red Green Blue	Settings (Cont.) LED Sequer A (mA) Range (mA) 5.0 51 51 51 0.0 51 51 51 0.0 51	Sample Rate 1000 v Sps Pulse Width 420 v usec ADC Range 32768 v nA
245000 240000 235000 235000 225000 225000 225000 225000	~~~~~				235000 - 230000 - 225000 - 225000 - 225000 - 225000 - 215000 - 215000 - 210000 - 205000 - 200000 - 200000 - 200000 - 200000 - 200000 - 210000 - 20000 - 2000 - 20000 - 20000 - 20000 - 20000 - 20000 - 20000 - 20000 - 2000 - 20000 - 20000 - 20000 - 20000 - 20000 - 20000 - 20000 - 2000 - 2000 - 20000 - 20000 - 20000 - 20000 - 20000 - 2000 - 2000 - 20000 - 20000 - 20000 - 20000 - 20000 - 20000 - 20000 - 2000 - 20000 - 200
		LED2 (Red)	LED3 (Green)	LED4 (Blue)	
Г	LED1 (IR)				

Figure 5. GUI Showing Data Streaming

PPG Settings Tab

The **PPG Settings** tab (Figure 6) displays the general settings associated with PPG. The tab provides the option to enable automatic gain control (AGC), a fully configurable LED drive current, selectable sample rates, pulse widths, and ADC ranges.

PPG Settings (Cont.) Tab

The **PPG Settings (Cont.)** tab (<u>Figure 7</u>) in the GUI gives the option to disable ambient light cancellation, enable and increase the amount of crosstalk cancellation, and change how the FIFO behaves.

PPG Settings	PPG Settings (Cont	.) LED Seque	ence		
	PA (mA) Ra	ange (mA)			
AGC	IR 5.0 +	51 👻	Sample Rate	100 👻	Sps
	Red 5.0 ±	51 🔹	Pulse Width	70 -	usec
Gr	reen 0.0 <u>+</u>	51 👻	ADC Range	32768 🔻	nA
E	Blue 0.0 ±	51 -			

Figure 6. PPG Settings Tab

XTalk Cancellation (uA) Disable ALC LED1 0.00 17 FIFO Almost Full	
Disable ALC LED1 0.00 + 17 + FIFO Almost Full	
LED2 0.00 E VIFO Rolls on Fu	II
LED3 0.00 ± 1 - Sample Averagin	g
LED4 0.00 +	

Figure 7. PPG Settings (Cont.) Tab

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LED Sequence Tab

The **LED Sequence** tab (Figure 8) controls the data format in the FIFO and the sequence of the LED exposures.

Logging Settings

The MAX86916 GUI provides the ability to log raw optical data to a comma separated value (CSV) file. To log data,

check the **Log to File** box (Figure 9), choose whether to write a header and the current PPG settings to the log file, and then click the **Browse** button to select where to save the log file (Figure 10). The GUI allows the user to select which values to be logged to the file.

PPG Settings	PPG Setting	gs (Cont.)	LED Sequence	
LED Sequence				
LED Se	q 1	LED1	v	
LED Se	q 2	LED2	v	
LED Se	q 3	LED3	•	
LED Se	q 4	LED4	Ŧ	

Browse Select Data Indicators ALC Overflow	Start Monitoring	 ✓ Log to File ✓ Write Header Write Settings gs\PPG_2020-01-06_14-58-42.csv ▼
ALC Overflow		Browse Select Data
ALC Overflow	Indicators	
	ALC Overflow	

Figure 9. Check the Box to Enable Logging

Figure 8. LED Sequence Tab

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Look in	n: 🔜 MaximLogs	~	G 🤌 📂 🛄 🕇	
Quick access	Name	^ No items match your	Date modified search.	Туре
Desktop				
Libraries				
Lange Contract This PC				
	<			>
Network	File name:	PPG_2019-09-06_11-07-23	~	Open
Network	-			C 1

Figure 10. Choose Location to Save the Log File

Detailed Description of Hardware

The MAX86916 EV system provides a single platform to evaluate the functionality and features of the MAX86916. The MAX86916 is an optical module containing 4 LEDs (IR, red, green, and blue) and one photodiode. The EV system comes with all jumpers installed, and a description of the jumpers can be found in <u>Table 1</u>. The EV system utilizes the MAX32630FTHR Cortex-M4F microcontroller for wearables to interface with the GUI and provide power

to the MAX86916. The MAX32630FTHR operates from a host PC through a USB to Micro-USB cable and a USB to FTDI cable.

Table 1. Description of Jumpers

JUMPER	DESCRIPTION
JU1	Connect VLED to +5V
JU2	Connect VDD to +1.8V

Component Suppliers

SUPPLIER	WEBSITE
Keystone	www.keyelco.com
Kycon	www.kycon.com
Maxim Integrated	www.maximintegrated.com
Molex	www.molex.com
Murata	www.murata.com
Panasonic	www.industrial.panasonic.com
Samtec	www.samtec.com
Samsung Electro-Mechanics	www.samsungsem.com/global/index.jsp
Sullins	www.sullinscorp.com
TDK Corporation	www.tdk.com
TE Connectivity	www.te.com
Wurth Electronics	www.we-online.com

Note: When contacting these component suppliers, indicate that the MAX86916 is being used.

Component List

SUPPLIER	DESCRIPTION
MAX86916_EVKIT_A	MAX86916 Sensor Board
MAX32630FTHR	Microcontroller Board
Micro-USB to USB Cable	Cable to connect Micro- controller Board to PC
USB to FTDI Cable	Cable to provide data streaming from sensor to PC

Ordering Information

PART	TYPE
MAX86916EVSYS#	EV System

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MAX86916 EV System Bill of Materials (BOM)

ITEM	QTY	REF DES	Var Status	MAXINV	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
					CGA2B3X7R1H104K050BB;C1005X7R1H104			
					K050BB;GRM155R71H104KE14;GCM155R7			
					1H104KE02;C1005X7R1H104K050BE;UMK1	TDK;TDK;MURATA;MURATA;TDK;TAIYO		CAPACITOR; SMT (0402); CERAMIC CHIP; 0.1UF; 50V; TOL=10%; TG=-55 DEGC TO +125
1	2	C1, C3	Pref	20-000U1-04A	05B7104KV-FR;CGA2B3X7R1H104K050BE	YUDEN;TDK	0.1UF	DEGC; TC=X7R
2	1	C2	Pref	20-004U7-33B	CL05A475MO5NUN	SAMSUNG ELECTRO-MECHANICS	4.7UF	CAP; SMT (0402); 4.7UF; 20%; 16V; X5R; CERAMIC CHIP
								CAPACITOR: SMT (0603): CERAMIC CHIP: 10UF: 16V: TOL=20%: MODEL=GRM SERIES: TG=-
3	2	C4, C6	Pref	20-0010U-A29	GRM188R61C106MA73	MURATA	10UF	55 DEGC TO +85 DEGC; TC=X5R
								CAPACITOR: SMT (0402): CERAMIC CHIP: 1UF: 16V: TOL=10%: TG=-55 DEGC TO +85
4	2	C5. C7	Pref	20-0001U-CA28	EMK105BJ105KV	TAIYO YUDEN	1UF	DEGC: TC=X5R :NOTE:PURCHASE DIRECT FROM THE MANUFACTURER
					GBM155B61A106ME44:GBM155B61A106			
					ME11:04027D106MAT2A-CL05A106MP5NU			CAPACITOR: SMT (0402): CERAMIC CHIP: 10UE: 10V: TOL=20%: TG=-55 DEGC TO +85
5	1	C12	Prof	20-00101-8412	NC	MURATA-MURATA-AV/Y-SAMSUNG	10115	DEGC-TC-VEP
	-	015	riei	20-00100-DA12	inc.	MORATA, MORATA, AVA, SAMSONG	1001	TEST POINT: RIN DIA-0.1IN: TOTAL LENGTH-0.2IN: ROARD HOLE-0.04IN: VELLOW:
								DUOS DUOR BRONZE WIDE CILVER DI ATE CINISH, BECOMMENDED FOR DOARD
6	1	INTR DU	Drof		E004	KEYSTONE	N/A	THICKNESS-0.062IN, NOT FOR COLD TEST
0	1	INTE PU	riei	02-191011013004-00	3004	KETSTONE	IN/A	THICKNESS=0.002IN, NOT FOR COLD TEST
_								CONNECTOR; FEMALE; THROUGH HOLE; 2.54MM CONTACT CENTER; FEMALE HEADER;
/	1	11	Pret	01-PPICIZILFBN12P-19	PPTC121LFBN-RC	SULLINS ELECTRONICS CORP	PPICIZILFBN-RC	STRAIGHT; 12PINS
	.							CONNECTOR; FEMALE; THROUGH HOLE; Z.54MM CONTACT CENTER; FEMALE HEADER;
8	1	J2	Pret	01-PPTC161LFBN16P-19	PPTC161LFBN-RC	SULLINS ELECTRONICS CORP	PPTC161LFBN-RC	STRAIGHT; 16PINS
								CONNECTOR; MALE; THROUGH HOLE; 2.54MM THT ANGLED PIN HEADER; RIGHT ANGLE;
9	1	13	Pref	01-61300311021 3 P-19	61300311021	WURTH ELECTRONICS INC	613003110212	3PINS .
10	2	JU1, JU2	Pref	01-TSM10201LSV2P-17	TSM-102-01-L-SV	SAMTEC	TSM-102-01-L-SV	CONNECTOR; MALE; SMT; SINGLE ROW; STRAIGHT THROUGH; 2PINS
11	1	R5	Pref	80-0001K-18	ERJ-2RKF1001	PANASONIC	1K	RESISTOR; 0402; 1K OHM; 1%; 100PPM; 0.10W; THICK FILM
						KYCON; KYCON; SULLINS ELECTRONICS		TEST POINT; JUMPER; STR; TOTAL LENGTH=0.24IN; BLACK; INSULATION=PBT; PHOSPHOR
12	2	SU1, SU2	Pref	02-JMPFS1100B-00	S1100-B;SX1100-B;STC02SYAN	CORP.	SX1100-B	BRONZE CONTACT=GOLD PLATED
								TEST POINT; PIN DIA=0.1IN; TOTAL LENGTH=0.3IN; BOARD HOLE=0.04IN; RED; PHOSPHOR
								BRONZE WIRE SILVER PLATE FINISH; RECOMMENDED FOR BOARD THICKNESS=0.062IN;
13	1	TP3	Pref	02-TPMINI5000-00	5000	KEYSTONE	N/A	NOT FOR COLD TEST
								EVKIT PART - IC: MAX86916: OLGA14: PACKAGE DRAWING NUMBER: 21-100325: LAND
14	1	U1	Pref	00-SAMPLE-02	MAX86916	MAXIM	MAX86916	PATTERN NUMBER: 90-100122: PACKAGE CODE: E143H7MK+1
15	1	112	Pref	10-MAX8511FXK18-X	MAX8511FXK18+	MAXIM	MAX8511FXK18+	IC: VREG: ULTRA-LOW-NOISE: HIGH PSRR: LOW=DROPOLIT: LINEAR REGULATOR: SC70-5
16	1	DCD	-	EDC 096016	MAX86816	MAXIM	PCP	PCP-MAY96916
10	1	100	-	LFCB00510	MAXBOSTO	MIGAIM	FCD	MODULE, BOARD ASSEMBLY, THROUGH HOLE, MAY22620ETHR# LAMINATED DLASTIC
17	1	KIT1	Drof	25 8022620857 00	80 33630#457	MANINA	90 33630#VFT	WIDDOLE, BOARD ASSEMBLT, THROUGH HOLE, WAAS2050FTHR# LAWINATED FLASTIC
1/	1	KIT1	Piel	53-6952050KF1-00	89-32030#KF1	IVIAAIWI	69-52050#KFT	WITH COPPER CLAD
			01-				CONNECTOR; MALE; THROUGH	
10		Devel	PBC125MAN12P-	0000000000	CULUNIC FLECTRONICS CORP.	PDC12C1441	ADDING OF DECCTO 1425 DECC	
19	1	Pret	21	PBC12SAAN	SULLINS ELECTRONICS CORP.	PBCI2SAAN	12PINS; -65 DEGC TO +125 DEGC	
			01-				CONNECTOR; MALE; THROUGH	
			PBC16SAAN16P-				HOLE; BREAKAWAY; STRAIGHT;	
20	1	Pret	21	PBC16SAAN	SULLINS ELECTRONICS CORP.	PBC16SAAN	16PINS; -65 DEGC TO +125 DEGC	
TOTAL	24							
	ļ							
DO NOT P	URCHASE	(DNP)						
ITEM	QTY	REF DES	Var Status	MAXINV	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	3	R3, R8, R10	DNP	N/A	N/A	N/A	SHORT	PACKAGE OUTLINE 0603 RESISTOR - EVKIT
2	1	R4	DNP	N/A	N/A	N/A	SHORT	PACKAGE OUTLINE 0402 RESISTOR - EVKIT
3	3	R11, R13, R15	DNP	N/A	N/A	N/A	OPEN	PACKAGE OUTLINE 0402 RESISTOR - EVKIT
TOTAL	7							
L	1							
PACKOUT	(These ar	e purchased parts	but not assembled	on PCB and will be shipped	with PCB)			
ITEM	QTY	REF DES	Var Status	MAXINV	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	1	PACKOUT BOX	Pref	88-00711-SML	88-00711-SML	N/A	N/A	BOX;SMALL BROWN 9 3/16X7X1 1/4 - PACKOUT
2	1	PACKOUT BOX	Pref	87-02162-00	87-02162-00	N/A	N/A	ESD BAG;BAG;STATIC SHIELD ZIP 4inX6in;W/ESD LOGO - PACKOUT
3	1	PACKOUT BOX	Pref	85-MAXKIT-PNK	85-MAXKIT-PNK	N/A	N/A	PINK FOAM;FOAM;ANTI-STATIC PE 12inX12inX5MM - PACKOUT
4	1	PACKOUT BOX	Pref	EVINSERT	EVINSERT	N/A	N/A	WEB INSTRUCTIONS FOR MAXIM DATA SHEET
5	1	PACKOUT BOX	Pref	85-84003-006	85-84003-006	N/A	N/A	LABEL(EV KIT BOX) - PACKOUT
								KIT: ASSY-STANDOFF 3/8IN: 1PC, STANDOFF/FEM/HEX/4-40IN/(3/8IN)/NYLON: 1PC
6	4	PACKOUT	Pref	08-EKSO44003803-01	NYLON STANDOFE 4-40 3/8	MAXIM	3/8IN	SCREW/SLOT/PAN/4-40IN//3/
<u> </u>	1 1							TEST POINT: PIN DIA=0 125IN: TOTAL LENGTH=0 35IN: BOARD HOLE-0 062IN: PLACE
1	1	1 9V AGND	1		1	1		DUCCDUCD DDONIZE WIDE CILVED DI ATE EINIGU- DECOMMENDED EOD DOADD
		INTE TE2	Prof	02-TRCOMP5006-00	5006	KEYSTONE	N/A	THICKNESS-0 062IN- NOT FOR COLD TEST
- '	4	11410, 113	riel	02-11 CONIF 3000-00	5000	REISTONE	170	THICKNESS=0.002IN, NOTTOR COED TEST
	-	MICCI	Drof	61 202501002 10	2025010.02	QUALTER	21/2	CONNECTOR MALE, USB & MINUR, USB 40(A)/A4, USB MINUED/D/A4, CTRAIGUT, 2014
9	2	WII3C1	riei	81-202201002-10	5023010-03	QUALIEN	IN/A	CONNECTOR, MALE, USB-A. MINI-B; USB-4P(A)/MI - USB MINI SP(B)/M; STRAIGHT; 36IN

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MAX86916 EV System Schematics



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MAX86916 EV System PCB Layout



MAX86916 EV System—Top Silkscreen



MAX86916 EV System—Top Layer



MAX86916 EV System—Bottom Layer



MAX86916 EV System—Bottom Silkscreen

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Revision History

REVISION	REVISION	DESCRIPTION	PAGES
NUMBER	DATE		CHANGED
0	2/20	Initial release	—

For pricing, delivery, and ordering information, please visit Maxim Integrated's online storefront at https://www.maximintegrated.com/en/storefront/storefront.html.

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