

ams Osram –Time-of-Flight Sensors

for consumer and industrial applications

Focus products : TMF880x, TMF882x

July 2024

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2. **Applications** → What can they be used for?
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4. **Success stories** → Proof points for what we claim
5. **Product order information and design resources** → How can you get the product? How can you easily design-in the product?

Two product families offer compelling solutions

Time of flight sensing for consumer & industrial applications – focus products

TMF880x (Single Zone)



A single zone time of flight sensor

Offers : dToF technology, extremely fast Time-to-Digital architecture, industry's smallest modular package, 1cm to 5m distance sensing @33msec, 30Hz

Suitable for : Camera laser detect auto focus (LDAF), object detection, industrial ranging, liquid level monitoring, parking, inventory management, etc.

TMF882x (Multiple Zones)



A multiple zone time of flight sensor

Offers : dToF technology, multi-zone & multi-object detection, 1cm to 5m distance ranging, Dynamically adjustable FoV upto 63°

Suitable for : Camera laser detect auto focus (LDAF), angle of approach object detection, human presence detection, virtual barriers, room occupancy sensing, gesture recognition, etc.

TMF8828 Product Overview

Flexible 8x8 multiple zone object detection

Key Features

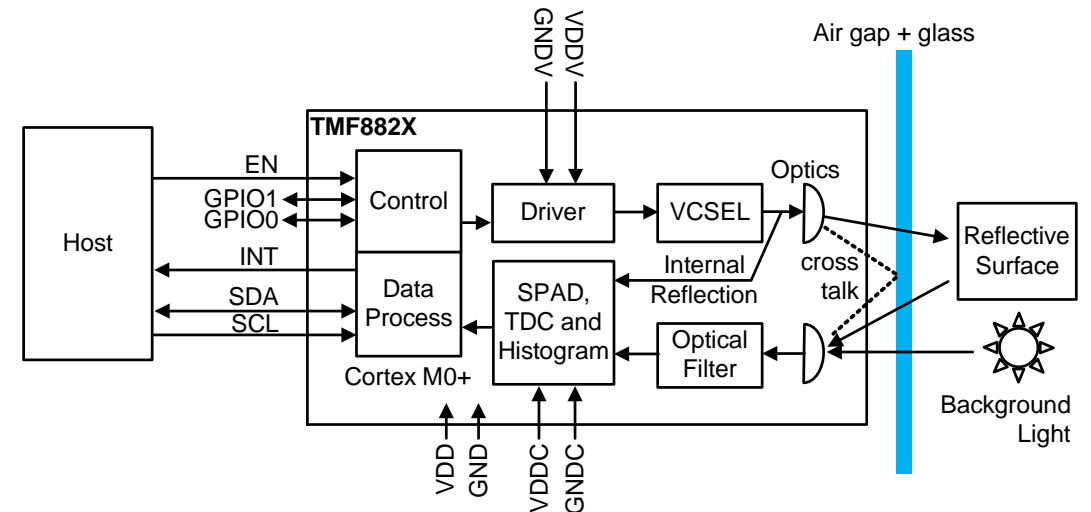
- dToF technology with high sensitivity SPAD detection
- Multi-zone and multi-object detection capability
- 1cm to 5m ranging product
- Dynamically adjustable FoV upto 63°
- On-chip Histogram processing
- Low power standby
- 940nm VCSEL with eye safety circuitry, Class 1
- Fully modular design in compact 4.6 x 2.0 x 1.4mm footprint

Applications

- Camera Laser Detect Auto Focus (LDAF)
- Angle of approach object detection / collision avoidance
- Human presence detection / onlooker detection
- Industrial ranging sensors
- Advanced sanitary control applications
- Virtual barriers
- Room occupancy sensing
- Up / Down / Left / Right / Tap gesture recognition

Benefits

- Delivers high SNR, wide dynamic range and no multi-path reflections
- Enables user to configure number of zones and focus on area of interest
- Provides extended measurement range upto 5m
- Offers application flexibility with adjustable FoV
- Enables high accuracy through crosstalk and smudge/dirt removal
- Flexible power modes for extended battery life
- Eye-safety circuitry shuts down VCSEL driver if HW fault develops
- Enables ToF integration within narrow bezel designs



Some example applications

Time-of-flight Sensors cover a wide field of applications in various market segments



Appliances



Robotic Vacuum Cleaner



Gesture Recognition



Door Control Systems



Smartphones



3D face recognition



Automatic Tap/Flush Control



Smart Home Robot



Web Camera



Projector

Features: Why to choose ams OSRAM for Time-of-flight Sensors

ams OSRAM is shaped to lead the Time-of-flight Sensor market and generate fast revenue growth

Enhanced ambient light performance vs competition

- Wafer level optical interference or vis-cut absorption filters provide industry leading 940nm ambient light immunity

Advanced user configurability

- Full datasheets with register info allows customers un-rivaled device access
- Host communication guide provides I²C level commands to aid device operation, understanding and debugging

Ease of development

- Linux driver and EVM available
- Arduino/C MCU drivers for TMF882X & TMF8806
- ams OSRAM and 3rd party development boards available
- GitHub code repositories

Competitive advantage (USP)

Advanced software features with no FW download

- Latest TMF8806 features 5m mode, thick cover glass, large air gap, interrupt suppression fully integrated into ROM with no firmware download required.

Ultra low power operation

- Fast start up and no application download
- Low power stand-by modes

Best in class package size

- Worlds smallest fully integrated dToF modules including class 1 eye safe 940nm VCSEL
 - Single-zone: 3.6 x 2.2 x 1.0mm
 - Multi-zone: 4.6 x 2.0 x 1.4mm





Key features

TMF8806 versus competitors



ams Osram key strength

Competition Landscape







PARAMETER	TMF8806	COMP 1	COMP 2
Range indoor	1 cm – 500cm	0 – 62cm	0 – 600 cm
Range outdoor	117cm @ 5k lux sunlight, 18% target 	>6 cm @ 10k-15k lux sunlight, 17 % target	110 cm @ 5k lux sunlight, 17% target
Accuracy	+/-3% > 200mm +/-6mm for > 50 mm to < 200mm +5/-15mm for < 50 mm 	Provided in DS only for range 0-100mm: Noise 2.0 mm + Range offset error 13 mm + Temperature dependent drift 15 mm + Voltage dependent drift 5 mm	+ Range offset error +/- 9 mm + Temperature dependent drift 1.3 mm / °C
Calibration	Very simple calibration without any target 	1. White target >88% at 50 mm for offset calibration 2. Another grey target < 17 % at 100 mm for cross talk calibration	Requires both offset and crosstalk calibration
Supply	2.7 V – 3.5 V	2.6 V – 3.0 V	2.7 V – 3.5 V
Interface	I ² C <= 1MHz	I ² C <= 400kHz	I ² C <= 1MHz
Eye safety	Class 1 IEC / EN 60825-1:2014 and EN 60825-1:2014/A11:2021	Does not include EN 60825-1:2014/A11:2021	Class 1 IEC / EN 60825-1:2014
Size	3.6 mm x 2.2 mm x 1.0 mm 	4.8 mm x 2.8 mm x 1.0 mm	4.4 mm x 2.4 mm x 1 mm
Register level documentation	Yes	Yes	No – manufacturer driver only
Status	Ramp up in Q3/2024	End of life	Mass production

TMF8828 versus competitors

Fighting guide



ams Osram key strength

PARAMETER	TMF8828		COMP 1		COMP 2		COMP 3	
Zone configuration	3 x 3, 3 x 6, 4 x 4, 8 x 8 + user configurable zones 		4 x 4 , 8 x 8		4 x 4 , 8 x 8		4 x 4 , 8 x 8	
Multi-object	Yes		Yes		Yes		Yes	
Frame Rate	3x3 – 60Hz, 4x4 – 30Hz, 8x8 – 15Hz		4x4 – 60Hz, 8x8 – 15Hz		4x4 – 60Hz, 8x8 – 15Hz		4x4 – 30Hz, 8x8 – 15Hz	
Maximum distance – center zone (low light) VL53L5 – Dark room : TMF8828 – 350Lux	4x4 mode White: 5000mm Grey: 4000mm	8x8 mode White: 4500mm Grey: 2000mm 	4x4 mode White : 4000mm Grey: 2400mm	8x8 mode White: 3500mm Grey: 1300mm	4x4 mode White : 3500mm Grey: 1400mm	8x8 mode White:2000mm Grey: 800mm	4x4 mode White : 4000mm Grey: 3000mm	8x8 mode White: 3600mm Grey: 1400mm
Maximum distance – center zone (5k Lux)	White: 2000mm Grey: 1500mm	White: 1300mm Grey: 1000mm	White: 1700mm Grey: 1000mm	White: 1100mm Grey: 800mm	White: 650mm Grey: 550mm	White: 350mm Grey: 250mm	White: 1550mm Grey: 1350mm	White: 1250mm Grey: 850mm
Field Of View	Diagonal FoV: 63° User adjustable 		Square FoV: 45°x 45° Diagonal FoV: 63°		Square FoV: 60°x 60° Diagonal FoV: 90°		Square FoV: 45°x 45° Diagonal FoV: 63°	
Package size	4.6 x 2.0 x 1.4mm (12.88mm ³) 		6.4 x 3.0 x 1.5mm (28.8mm ³)		6.4 x 3.0 x 1.6mm (30.7mm ³)		6.4 x 3.0 x 1.75mm (33.6mm ³)	
Low power mode (Ram retention)	Standby – 8uA 		LP Idle – 45uA		LP Idle – 45 uA		LP Idle – 55 uA	
Operating temperature	-40 to 85°C 		-20 to 85°C		-30 to 85°C		-30 to 85°C	
Communication interface	I ² C –1MHz		I ² C –1MHz		I ² C –1MHz		I ² C –1MHz, SPI – 3MHz	
Register level documentation	Yes		No – manufacturer driver only		No – manufacturer driver only		No – manufacturer driver only	

Worldwide dToF Success Stories



Object Detection / Collision Avoidance

- Home assistance robot
- Robotic Vacuum Cleaner
- Education robotics distance Sensor

Auto-focus/Automatic keystone correction

- Projector
- Gaming Projector

Fast & Accurate focusing in low light conditions / LDAF (Laser Detect Auto Focus)

- Multiple Mobile Phone Models

Presence Detection

- Hairdryer
- Smart Lighting Panel
- Live Show Camera
- Smart Entry Camera
- Laptop
- Smart TV
- Security Camera
- Smart Entry Panel
- Iris Recognition Panel
- Refrigerator Presence Detection
- Smart Mailbox
- Smart Cup
- Electronic Lock
- Water Dispenser
- Tablet
- Educational Tablet
- Structured Light Module



Product order information

Overview of the available products

Product Name	Part Number (Order Code)	Package Type	Focus Market Segment	Design Resources	Product & tool folders
TMF8801	TMF8801-1BM – 500pc T&R (Q65114A1111) TMF8801-1B – 5000pc T&R (Q65114A1110)	Optical module (OLGA)	Consumer Industrial	Evaluation Module (Q65114A1500), Daughter Board (Q65114A1501)	TMF8801 Product Folder TMF8801 Evaluation Module Product Folder
TMF8805	TMF8805-1BM – 500pc T&R (Q65114A1113) TMF8805-1B – 5000pc T&R (Q65114A1112)	Optical module (OLGA)	Consumer Industrial	Evaluation Module (Q65114A1519), Daughter Board (Q65114A1520)	TMF8805 Product Folder TMF8805 Evaluation Module Product Folder
TMF8806	TMF8806-1AM – 500pc T&R (Q65113A8036) TMF8806-1A – 5000pc T&R (Q65113A9062)	Optical module (OLGA)	Consumer Industrial	Evaluation Module (Q65113A8263), Daughter Board (Q65113A8262) Shield (Q65113A8265)	TMF8806 Product Folder
TMF8820	TMF8820-1AM – 500pc T&R (Q65114A1277) TMF8820-1A – 4000pc T&R (Q65114A1276)	Optical module (OLGA)	Consumer Industrial	Evaluation Module (Q65114A1562), Daughter Board (Q65114A1563) Shield (Q65114A1575)	TMF8820 Product Folder TMF882X Evaluation Module Product Folder TMF882X Shield Board Product Folder
TMF8821	TMF8821-1AM – 500pc T&R (Q65114A1007) TMF8821-1A – 4000pc T&R (Q65114A1006)	Optical module (OLGA)	Consumer Industrial	Evaluation Module (Q65114A1562), Daughter Board (Q65114A1563), Shield (Q65114A1575)	TMF8821 Product Folder TMF882X Evaluation Module Product Folder TMF882X Shield Board Product Folder
TMF8828	TMF8828-1AM – 500pc T&R (Q65114A1281) TMF8828-1A – 4000pc T&R (Q65114A1282)	Optical module (OLGA)	Consumer Industrial	Evaluation Module (Q65114A1562), Daughter Board (Q65114A1563), Shield (Q65114A1575)	TMF8828 Product Folder TMF882X Evaluation Module Product Folder TMF882X Shield Board Product Folder

Design Resources

Support Tools

Board



Time of Flight evaluation modules

Order codes

- TMF8801: Q65114A1428
- TMF8805: Q65114A1519
- TMF8806: Q65113A8263
- TMF8820, TMF8821, TMF8828: Q65114A1562

Raspberry Pi Zero W based hardware running embedded Linux operating system. TMF8805 device mounted on TMF8805-DB behind Gorilla glass cover with factory set optical stack.



Sensor daughter boards

Order codes

- TMF8801: Q65114A1501
- TMF8805: Q65114A1520
- TMF8806: Q65113A8262
- TMF882X: Q65114A1563

Sensor daughter board, connects to host via 14pin 0.5mm FPC connector.



Arduino compatible shields

Order codes

- TMF8806: Q65113A8265
- TMF8820, TMF8821, TMF8828: Q65114A1575

Arduino® Uno compatible shield board, with Arduino source code libraries, variable optical stack and user accessible pins.

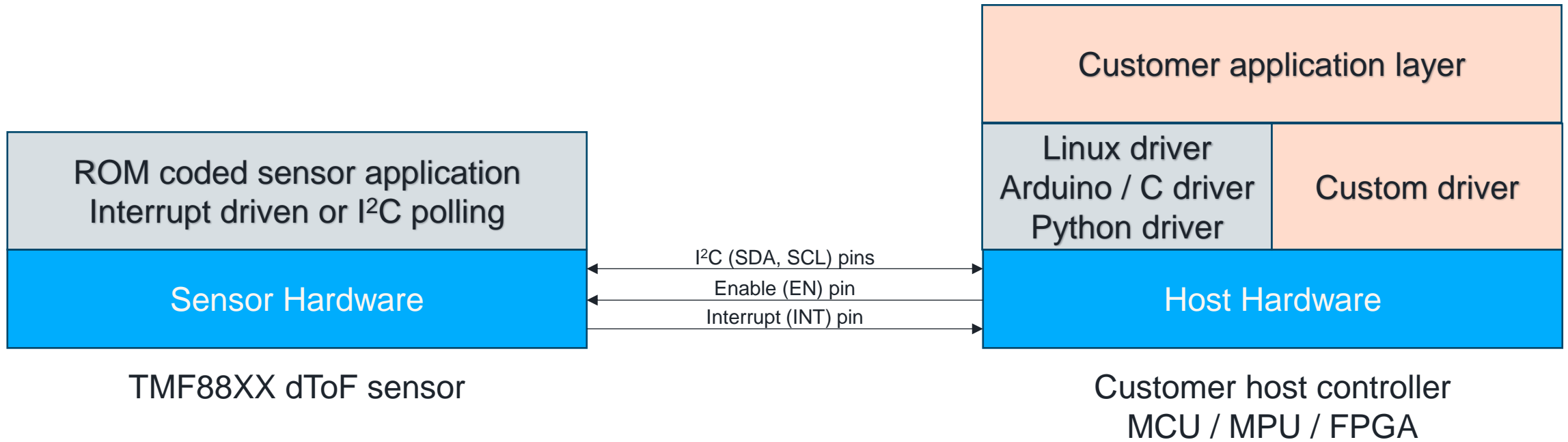
Software

Name	Description
Evaluation GUI	PC GUI for sensor evaluation, connect to EVM via USB, enables user to control sensor parameters.
Linux driver	TMF88XX Linux core driver for integrating sensor into a Linux OS environment.
Arduino / C driver (MCU)	Arduino library developed in C code for easy porting to a variety of host MCUs.
Arduino GUI	Basic GUI to display data from TMF882X-SHIELD.
Python drivers	The python driver can be used directly to interface to a sensor or ported to MicroPython or CircuitPython.
Python libraries	Utilities for operating device, include logging, testing, calibration & crosstalk measurements.
ZeroMQ server ZeroMQ	Utility to enable TMF8806 Arduino shield to talk to TMF8806 universal GUI

Design Resources

Simplified software model (TMF8806 / TMF882X)

ams OSRAM Customer specific



TMF88XX dToF sensor

Customer host controller
MCU / MPU / FPGA

The TMF88XX dToF sensors feature factory ROM which contains non-user accessible code. The sensor outputs distance and confidence information via the 1MHz I²C interface. Depending on the sensor selected the user can configure the interrupt pin to signal the host that a result is ready, or an object has appeared within a region of interest. Users can also configure device parameters such as sampling frequency, # of iterations, power modes, etc through the same I²C interface.

ams OSRAM provides Linux and Arduino / C source code drivers. These drivers contain functions for device calibration, configuration, operation, changing I²C address and host signaling. The Arduino / driver can be easily ported to a specific host MCU through the use of a SHIM layer. The python driver can be used directly or ported to MicroPython or CircuitPython. Customers can use the provided drivers or develop their own using the TMF8806 datasheet and Host Communication Guide and build the main application.

Design Resources

Development tools for TMF8806

TMF8806-EVM (Q65113A8263)

- Raspberry Pi Zero based EVM / demo unit running Linux OS and TMF8806 Linux driver. Ideal for customers working with host systems running Linux OS. Connects via USB to PC with TMF8806 universal GUI.

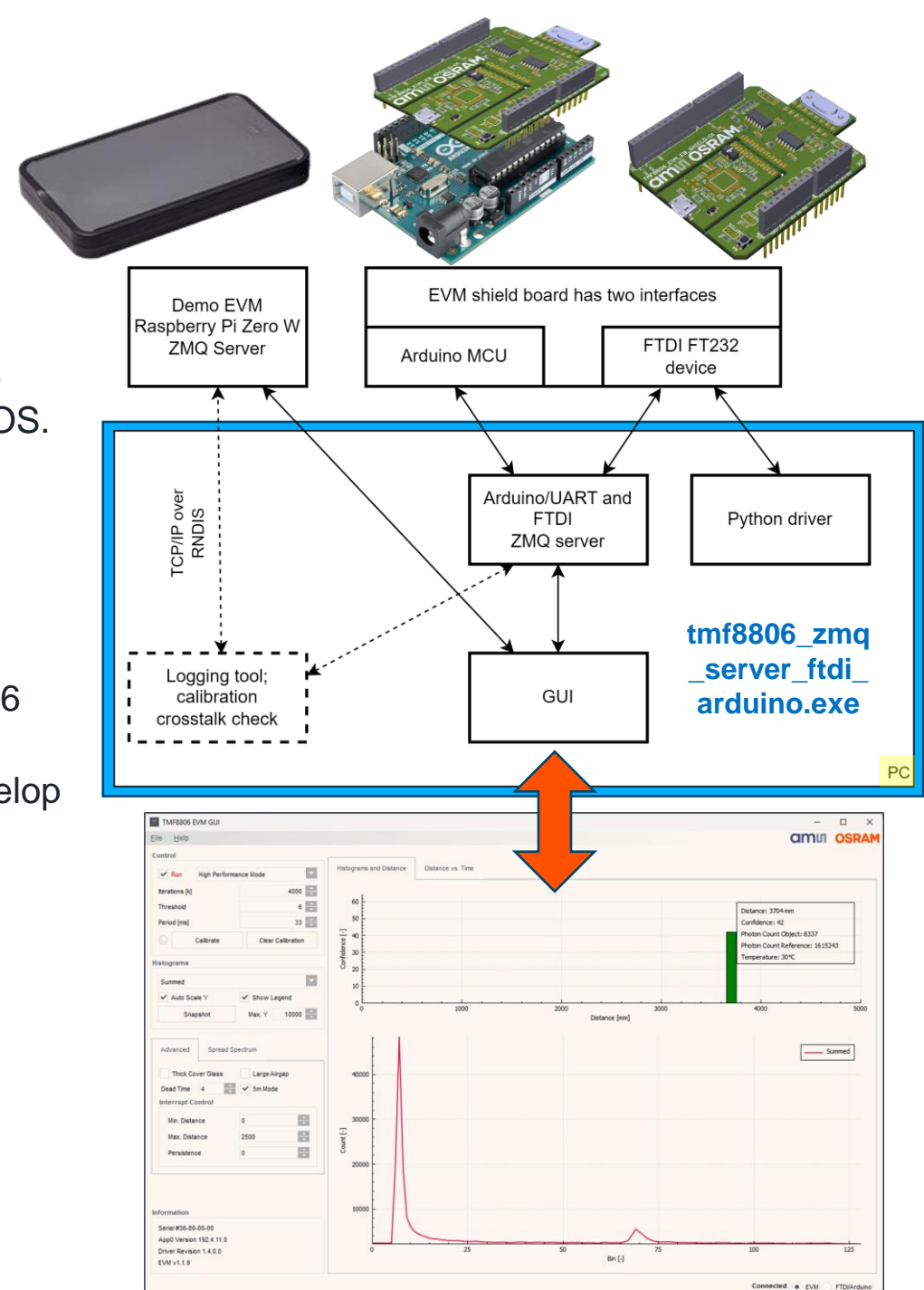
TMF8806-SHIELD (Q65113A8265)

Arduino operation

- When used in conjunction with an Arduino Uno R3 loaded with the TMF8806 Arduino driver the shield connects to the universal GUI through a ZeroMQ server (tmf8806_zmq_server_ftdi_arduino.exe). It can also be used to develop custom applications running on the Arduino platform.

Stand alone operation

- Operating with the same universal GUI through a simple ZeroMQ server (tmf8806_zmq_server_ftdi_arduino.exe) the shield may be operated by plugging a USB cable directly into the shield board. Ideal for customer demonstration and sensor evaluation.

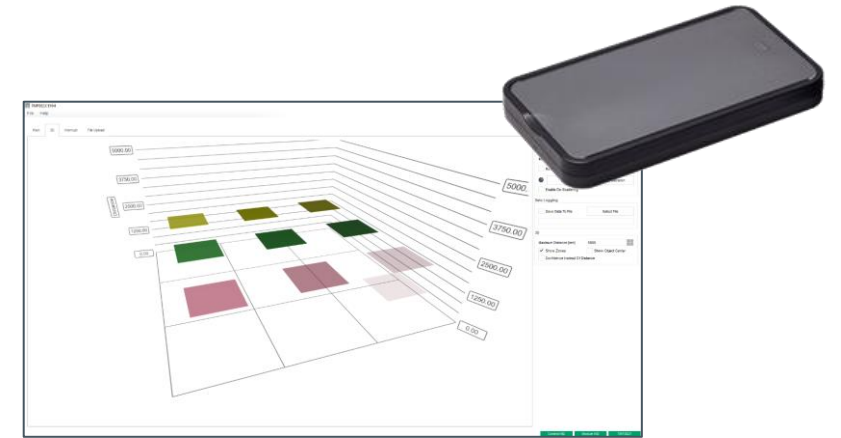


Design Resources

Development tools for TMF8828

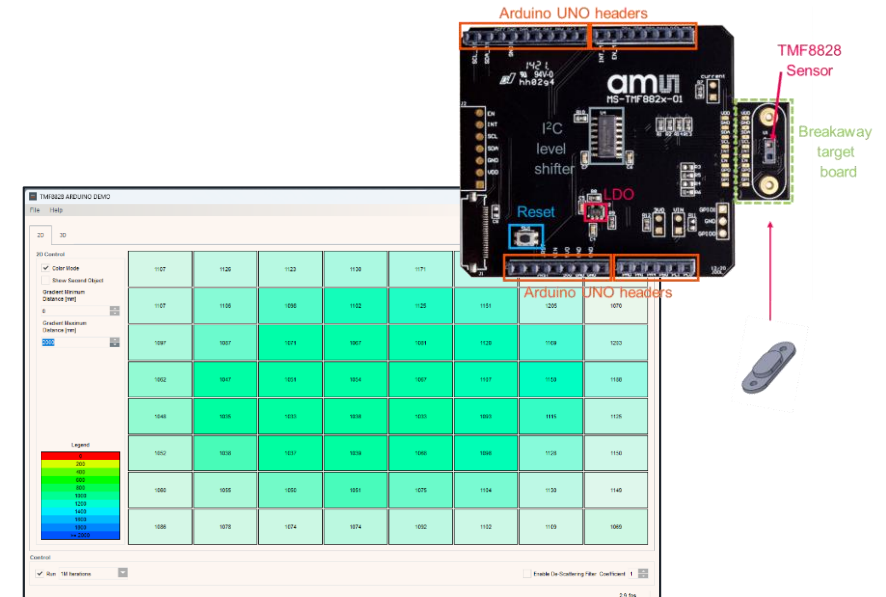
TMF882X-EVM

- Raspberry Pi Zero based EVM / demo unit running Linux OS and TMF882X Linux driver. Ideal for customers working with host systems running Linux OS. Connects via USB to PC with TMF882X EVM GUI.



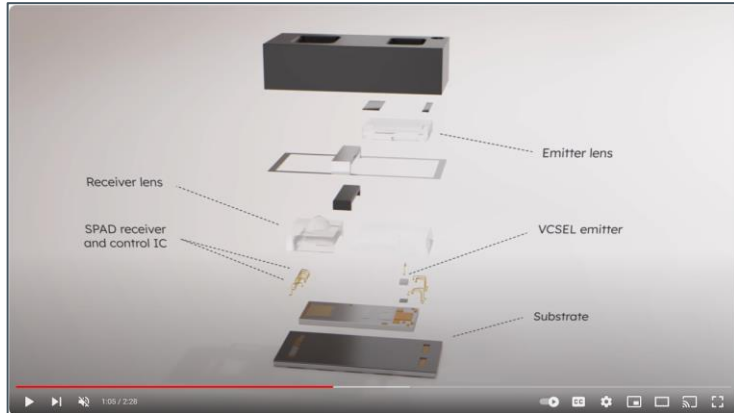
TMF882X-SHIELD & Arduino

- When used in conjunction with an Arduino Uno R3 loaded with the TMF882X Arduino driver the shield connects to the universal GUI. It can also be used to develop custom applications running on the Arduino platform. Shield includes multiple cover glass samples and air gap spacers for optical stack evaluation.

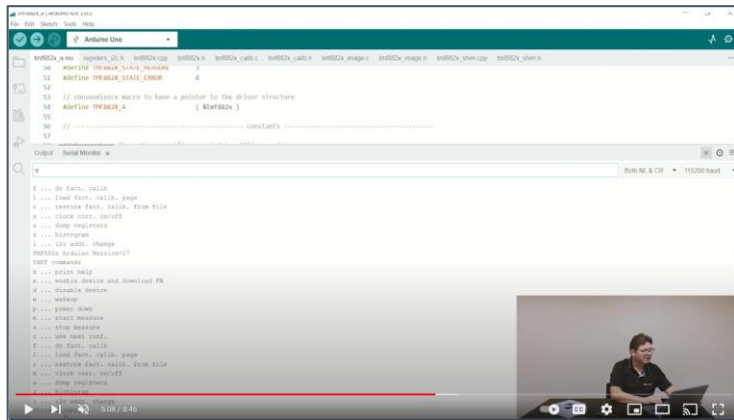


We enable you with our wide array of Design Resources

Let's grow our ToF business together



[ams OSRAM direct Time-of-Flight](#)



[Getting started with the TMF882X-SHIELD & Arduino®](#)

dToF landing page:

- [Direct time-of-flight sensors \(dToF\) | ams OSRAM \(ams-osram.com\)](https://www.ams-osram.com/dToF)

Please see specific product & tool folders:

- www.ams-osram.com/tmf8801
- www.ams-osram.com/tmf8805
- www.ams-osram.com/tmf8806
- www.ams-osram.com/tmf8820
- www.ams-osram.com/tmf8821
- www.ams-osram.com/tmf8828

Documents:







- Host Driver Communication application report
- EVM User Guide
- Host Communication Guide
- Optical Design Guide
- Arduino driver & Examples (C core for ease of porting to other target MCUs)
- Driver porting Guide
- Python Scripts
- Shield User Guide
- Linux Driver

BACKUP




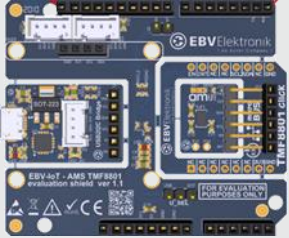

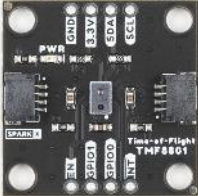




Single & multi-zone variants


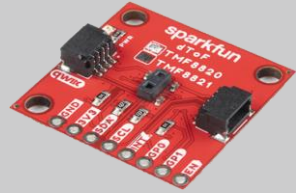

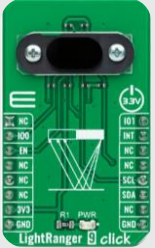

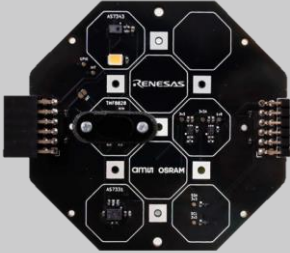
Variants overview

	TMF8805	TMF8806	TMF8801	TMF8820	TMF8821	TMF8828
Detection zones	Single Zone	Single Zone	Single Zone	3x3 zones	4x4 zones	8x8 zones
Supply voltage	2.7V – 3.3V	2.7V – 3.5V	2.7V – 3.3V	2.7V – 3.3V	2.7V – 3.3V	2.7V – 3.3V
Min. detection distance	2cm	2cm	2cm	1cm	1cm	1cm
Max. detection distance	250cm	500cm	250cm	500cm	500cm	500cm
Field of Illumination (Fol)	21° 	21° 	21° 	47° x 57° 	47° x 57° 	47° x 57° 
Field of View (FoV)	24° - 37° (far/near)	24° - 37° (far/near)	24° - 37° (far/near)	Up to 63° diagonal	Up to 63° diagonal	Up to 63° diagonal
Accuracy	+/-5% min +/-1cm	+/-3% min +/-1cm	+/-5% min +/-1cm	+/-3% min +/-1cm	+/-3 min +/-1cm	+/-3 min +/-1cm
Wafer level optics	No	No	Yes	Yes	Yes	Yes
Sunlight Immunity detection distance	5klux up to 110cm 1klux up to 190cm 350lux up to 250cm	5klux up to 117cm 1klux up to 243cm 350lux up to 500cm	100Klux up to 60cm 350lux up to 250cm	5klux up to 200cm 1klux up to 450cm 350lux up to 500cm	5klux up to 200cm 1klux up to 350cm 350lux up to 500cm	5klux up to 130cm 1klux up to 200cm 350lux up to 450cm
Smudge resilience, whole detection range	Yes	Yes	Yes	Yes	Yes	Yes
Operating temperature	-30 to 70°C	-40 to 85°C	-30 to 70°C	-40 to 85°C	-40 to 85°C	-40 to 85°C
Package size (mm)	2.2 x 3.6 x 1.00mm	2.2 x 3.6 x 1.00mm	2.2 x 3.6 x 1.0mm	4.6 x 2.0 x 1.4mm	4.6 x 2.0 x 1.4mm	4.6 x 2.0 x 1.4mm

Single-zone 3rd party rapid prototyping eco-system

Vendor	Products Supported	Description
	<p>TMF8701 TMF8801</p>	<p>Fermion: TMF8801 ToF Distance Ranging Sensor</p> <ul style="list-style-type: none"> DF Robot Product Wiki page with links to GitHub Arduino library and schematic files available. Active in maker community. 
	<p>TMF8801</p>	<p>TMF8801 Time-of-Flight evaluation shield</p> <ul style="list-style-type: none"> Limited availability Arduino Shield developed and produced by EBV Elektronik. This flexible kit interfaces directly via USB to a provided GUI. It also provides a variety of standard hardware formats. 
	<p>TMF8801</p>	<p>SparkX Distance Sensor</p> <ul style="list-style-type: none"> GitHub Arduino library and schematic and layout files available for download. Strong maker community activity. 
	<p>TMF8801</p>	<p>LightRanger 5 Click</p> <ul style="list-style-type: none"> Part of the mikroE development eco-system, this board connects using the mikroBUS™ standard. A mikroSDK is also available to kickstart development. 

Multi-zone 3rd party rapid prototyping eco-system

Vendor	Products Supported	Description
	TMF8820 TMF8821	<p>SparkFun Qwiic dToF Imager</p> <ul style="list-style-type: none"> GitHub Arduino library and schematic and layout files available for download. Strong maker community activity. 
	TMF8828	<p>LightRanger 9 Click</p> <ul style="list-style-type: none"> Part of the mikroE development eco-system, this board connects using the mikroBUS™ standard. A mikroSDK is also available to kickstart development. 
	TMF8828 AS7331 AS7343	<p>ams-OSRAM PMOD</p> <ul style="list-style-type: none"> The board contains the following sensors : TMF8828, AS7331, AS7343 on a single PMOD enabled board that is compatible with the Renesas QC-IoT System and QC-Studio. 

Sensing is life

ami OSRAM