TLE9844-2QX Appkit Getting Started September 2018





Agenda





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Infineon Embedded Power ICs TLE9844-2QX Application Kit



Infineon Embedded Power ICs Product Portfolio based on ARM[®] Cortex[®] M processor





TLE9844-2QX Appkit

The TLE9844-2QX is part of our Embedded Power products and belongs to the relay driver IC family. The TLE9844-2QX Appkit is designed to evaluate relay driven DC Motor applications. The two layers PCB is space and cost optimized to demonstrate an application near solution.

Target Applications

 Automotive Body & Comfort applications such as sunroof and window lift

Summary of Features

- Automotive qualified relay driver IC (TLE9844-2QX) with integrated high-side switches
- > 2-channel relay
- Onboard debug interface

Infineon Embedded Power IC: TLE9844-2QX Application Board



TLE9844-2QX Application Kit

- Voltage supply: typ. 12 V
- > Motor current: max. 20 A
- Infineon Relay Driver IC (ARM[®] Cortex[®] M0 MCU)
- J-Link OB-Debugger with Serial COM Port
- > LIN Interface

TLE9844-2QX_Appkit: **SP002235152**





Block diagram



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Support for Relay Driver IC with Integrated ARM[®] Cortex[®] M0



Collaterals and Brochures	 > Product Brief > Selection Guides > Product Presentations 	Link to family page
Technical Material	 > Datasheets > Application Notes > Getting Started > PCB Design Data > User Manuals > Layout Hints 	Link to Documents
Evaluation Boards	> Evaluation Boards> Application Kits	 Link to board pages
Software & Tools	 Config Wizard Keil µVision5 Software Examples 	Link to Software & Tools
Videos	 Technical Videos 	> Link to Videos

TLE9844-2QX Application Kit: Documentation

- User Manual for TLE9844-2QX
- Application Note with Application Hints
- > Datasheet









Support Online tools and services





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Infineon



Toolchain installation: General Overview

Infineon Embedded Power ICs are supported by a complete development tool chain provided by Infineon and third party vendors. The tool chain includes compilers, debuggers, evaluation boards, LIN low level drivers and configuration tools as well as variety of example software code.



ARM Keil µVision is an integrated development environment which consists of code editor, compiler and debugger.

Infineon provides the ConfigWizard which is designed for configuration of chip modules. ConfigWizard supports easy configuring of Embedded Power peripherals. SEGGER J-Link is a widely used driver for "on-board" or "standalone" debugger.





Toolchain installation: 1/4



KEIL is a trademark and µVision is a registered trademark of ARM Ltd. All rights reserved. This product is protected by US and international laws.

Keil µVision5

- > Code Editor & Online Debugger
- Evaluation version can handle up to 32K

Download from: https://www.keil.com/demo/eval/a rm.htm

Main Window

		- # 113 114 12	<u>∎</u> 3 8 4	• • • • • •
🔁 🖾 🕮 🦃 🖂 🛱 🖬 Target 1	• & a a	7 😥		
Project	* 👪 🔁	adc2_defines.h	🗳 int.c 🎽 int.c 🔮	bootrom.c 🔡 csa,
B 1 Project: Test	1	1 /*sha256=2522222FE2B9	03BD146546CA642A8F7	99CEDA7ABB81822D
😑 🔊 Target 1		2 []/*		
🗟 🞑 Source Group 1		3 IFXConfigWizard output	t file	
CMSIS		a created onirr Aug / 1	6106125 2015	
🗄 🔷 Device		6		
B bootrom.c (SDK:BOOTROM)		7 Heifndef _ADC2_DEFINES	H	
III 🛅 int.c (SDK:INT)		8 #define _ADC2_DEFINES	R	
isr.c (SDK:ISR)		9	and Manager and	
(ii) 🔭 scu.c (SDK:SCU)		11 Edefine IEXConfigHize	rd_version 1.8.1	
wdt1.c (SDK:WDT1)		12 #endif		
adc2_defines.h (ConfigWizard)		13 -		
bdrv defines.h (ConfigWizard)		14 H#ifndef ADC2_CH0_LOTH	VOLT	
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in defines h (ConfigWard)		24 #endif	-	
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in demest (congwized)		26 H#1fnder ADC2 CH1 UPTH	VOLT	
a mon_uestnes.h (ConfigWizard)		28 Fendif	A11_1004 A/13	
pmu_defines.h (ConfigWizard)		22.1		1
Project Stooks U Functions U Femplates	1.4			



Pack Installer



Toolchain installation: 2/4

Infineon ConfigWizard

Configuration of chip modules

Infineon homepage: ConfigWizard

Latest version: V1.8.7

Device description for TLE984x included

TLE984x supported with Keil µVision 5

IF>	(ConfigW	lizard							x
		AL							
File	Extra	About							
SCU	PMU	MON	Interrupt	PORT	ADC1	ADC2	BDRV	CCU6	
Ctruc	turo		Cottings						
Jun	0		settings						
	onto ≰ Pin0								
	Inp	ut (٥						
	⊳ Out	tput (0						
	Pul	l mode	Pull-Down						-
	Pin1								
	Inp	ut (0						
	⊳ Out	tput 🦉	0						
	Pul	l mode	Pull-Up						•
4	Pin2								
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1	Pin3								
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⊿ Po	ort1								
4	In Pin0 ■								
	Inp	ut (0						
	⊳ Out	tput 🦉	0						
	Pul	l mode	None						•
4	 Pin1 								
	Inp	ut (0						
	⊳ Out	tput (0						
	Pul	l mode [None						_
	> Pin2								
	> Pin3								-



Toolchain installation: 3/4

Segger J-LINK-Lite driver:

- Driver for 'on-board' or 'stand-alone' debugger
- Install driver from: <u>https://www.segger.com/downlo</u> <u>ads/jlink/JLink_Windows.exe</u>
- TLE9844-2QX support is included from V5.10 upwards

	irace Hash Download		
J-Link /	J-Trace Adapter	SW Device	
SN:	591073990 -	IDCODE Device Name	Move
Device:	J-Link Lite-XMC4200 Rev.1	SWD Ox0BB11477 ARM CoreSight SW-DP	Up
IW :	V1.00 dll : V6.00a		Down
:W:	J-Link Lite-XMC4200 Rev.1 c		
Po	ort: Max Clock:	Automatic Detection ID CUDE:	
		Manual Configuration Device Name:	
	A	ALL DIT LITE DIAM	
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Toolchain installation: 4/4

PACK-file TLE984x for µVision5:

- Device database for all TLE984x variants
- Device support for flashing/erasing TLE984x
- SFR description for register debugging
- Device description for TLE984x for Config Wizard (XML)
- Includes SDK (Software Development Kit)
- Code examples included



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Getting Started: How to create a new project

1) Create a new Project

- > Open Keil mdk
- Go to → Project
 → new µVision Project
- Name project: (`relay_click')
- > Select Device:
 - > Infineon
 - > TLE98xx Series
 - > TLE984x Series
 - > TLE9844-2QX



Device	
Software Packs	
Vendor: <unknown></unknown>	
Device: <unknown> Toolset: <unknown></unknown></unknown>	
Search:	
Desgription:	
	▲
QK Cancel	Help

Getting Started: How to configure your runtime environment



2) Configuration of Run-Time Environment

- > Expand: 'Device'
 - Check: Startup
 - > Check: Config Wizard
- `Sel.' window background is orange
- > Press: `Resolve'
- `Sel.' window background is now green
- Expand 'SDK' and activate 'LS' Module



Software component	Sel.	Variant		Version	Description
E 💠 CMSIS					Cortex Microcontroller Software Interface Components
🗉 💠 CMSIS Driver					Unified Device Drivers compliant to CMSIS-Driver Specifications
🗉 💠 Compiler		ARM Compile	r	1.4.0	Compiler Extensions for ARM Compiler 5 and ARM Compiler 6
🖃 💠 Device					Startup, System Setup
Startup				1.0.1	System Startup for Infineon TLE984x device series
ConfigWizard	~			1.8.7	Infineon ConfigWizard Configuration File
■ ◆ SDK					
🗉 💠 File System		MDK-Plus	`	6.10.0	File Access on various storage devices
Graphics		MDK-Plus	`	5.46.5	User Interface on graphical LCD displays
🗈 💠 Network		MDK-Plus	`	7.8.0	IPv4 Networking using Ethernet or Serial protocols
🗉 🚸 USB		MDK-Plus	`	6.12.4	USB Communication with various device classes
•					•
Validation Output		Descripti	ion		
🖃 🔔 Infineon::Device:Startup		Addition	al soft	ware comp	onents required
require Device:SDK:SCU		Select co	mpon	ent from lis	st
fineon::Device:SDK:SCU	_	System C	Contro	Unit (SCU)) driver for TLE984x
Resolve Selpt Packs Details			UK		ancei Heip
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Resolve Set Packs Details Manage Run-Time Environment Software Component		Friant		Version	Description
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Resolve Set t Packs Details Manage Run-Time Environment Software Component ⇒ CMSIS ⇒ CMSIS Driver ⇒ Compiler ⇒ Startup ConfigWizard	V	Tiriant ARM Compiler		Version 1.4.0 1.0.1 1.8.7	Ance Hep Description <u>Cortex Microcontroller Software Interface Components</u> <u>Unified Device Drivers compliant to CMSIS-Driver Specifications</u> <u>Compiler Extensions for ARM Compiler 5 and ARM Compiler 6</u> <u>Startup Configures Setup</u> System Startup for Infineon TLE984x device series <u>Infineon Configuration File</u>
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Resolve Set t Packs Details Manage Run-Time Environment Software Component Software Compiler Software ConfigWizard Softk	V	ARM Compiler MDK-Plus MDK-Plus		Version 1.4.0 1.0.1 1.8.7 6.10.0 5.46.5	Ance Hep
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Resolve Set t Packs Details Manage Run-Time Environment Image: Solution of the solution o	V V	Miriant ARM Compiler MDK-Plus MDK-Plus MDK-Plus		Version 1.4.0 1.0.1 1.8.7 6.10.0 5.46.5 7.8.0 6.12.4	Ance representation of the second sec
Resolve Set t Packs Details Manage Run-Time Environment Software Component Software Complex Software Complex Software Compiler Software Compiler Software Compiler Software Compiler Software Compiler Software ConfigWizard Software Compiler Software Compiler Software Compiler Software ConfigWizard Software Compiler Software ConfigWizard Software Compiler Software ConfigWizard Software Compiler Software ConfigWizard Software ConfigWizard Softwar	Y	MDK-Plus MDK-Plus MDK-Plus MDK-Plus MDK-Plus Descriptio		Version 1.4.0 1.0.1 1.8.7 6.10.0 5.46.5 7.8.0 6.12.4	Ance
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Getting Started: Use standard templates

3) Using easy 'Main' template

- 1. Expand: 'Target 1'
- Right click on: `Source Group 1'
- 3. Choose: Add New Item to Group 'Source Group 1'
- 4. Choose 'User Code Template'
- 5. Expand 'Device'
- 6. Choose: 'Startup'
- 7. Continue with 'Add'



Add New Item	to Group 'Source Group 1'	×
C File (.c	Add template file(s) to the project.	
C++ File	(cop)	
A Asm File	(e) Startup Simple Main	
h Header		
Text File	(bd)	
E Text The		
User Co	de l'emplate	
Turney	Liner Code Template	
rype:		
Name:		
Location:	C: (Kell_Examples (GettingStarted	



Getting Started: How to use the Config Wizard

4a) Using Config Wizard

- Open Config Wizard by choosing: `Tools → Config Wizard'
- Config Wizard will open in a separate window
- orange status bar indicates a new project
- red status bar indicates unsaved changes
- white status bar indicates saved project



ePower	SCU	PMU	MON	Interrupt	PORT	ADC1	
Structure			Settin	gs			
Device			TLE98	44-2QX			•
▷ NAC/N	NAD Cor	nfiguratio	on 🗸				

Getting Started: How to configure the individual ports



4b) Using Config Wizard: Low Side Switch Configuration

- > Select: 'LS' Chapter
- > Enable `LS1'
- > Expand 'LS1'
- > Expand 'Driver Settings'
- > Check Low Side Driver ON
- Save with 'File' -> 'Save Project'
- After Saving, status bar turns to white color

ePower	SCU	PMU	MON	Interrupt	PORT	ADC1	ADC2	HS	LS	CCU6	1
Structure				Settings							
✓ LS1 er	nable			\checkmark							
✓ Dr	iver Setti	ngs									
	Slew ra	te		slow							
	Open L	oad Dete	ection								
	Low Si	de Driver	ON	\checkmark							
	PWM E	nable									
> BI	anking T	ime Filte	r Settings	5							
> So	urce Sel	ect (PWN	1 Output)							
> In:	terrupt										
> LS2 er	nable										
				-	F						
ePower	SCU	PMU	MON	Interru	रा	ADC1	ADC2	HS	LS	CCU6	4
ePower Structure	SCU	PMU	MON	Intern	रा	ADC1	ADC2	HS	LS	CCU6	4
ePower Structure ✓ LS1 en	SCU able	PMU	MON	Intern Setting	रा	ADC1	ADC2	HS	LS	CCU6	4
ePower Structure ✓ LS1 en ✓ Dr	SCU able iver Setti	PMU ngs	MON	Intern Setting	श	ADC1	ADC2	HS	LS	CCU6	4
ePower Structure ✓ LS1 en ✓ Dr	SCU able iver Setti Slew ra	PMU ngs te	MON	Intern Setting	रा	ADC1	ADC2	HS	LS	CCU6	4
ePower Structure ✓ LS1 en ✓ Dr	SCU able iver Setti Slew ra Open L	PMU ngs te oad Dete	MON	Intern Setting	रा	ADC1	ADC2	HS	LS	CCU6	4
ePower Structure ✓ LS1 en ✓ Dr	SCU able iver Setti Slew ra Open L Low Sid	PMU ngs te oad Dete de Driver	MON	Intern Setting Slow	τ	ADC1	ADC2	HS	LS	CCU6	
ePower Structure ✓ LS1 en ✓ Dr	SCU able iver Setti Slew ra Open L Low Sic PWM E	PMU ngs te oad Dete de Driver nable	MON ection ON	Intern Setting Slow	τ	ADC1	ADC2	HS	LS	CCU6	4
ePower Structure ✓ LS1 en ✓ Dr	sCU able iver Setti Slew ra Open L Low Sic PWM E anking T	PMU ngs te oad Dete de Driver nable ime Filter	MON ection ON	Intern Setting Slow	श	ADC1	ADC2	HS	LS	CCU6	4
ePower Structure ✓ LS1 en ✓ Dr > Bla > So	scu able iver Setti Slew ra Open L Low Sic PWM E anking T urce Sele	PMU ngs te oad Dete de Driver nable ime Filter ect (PWIV	MON ection ON s Settings 1 Output)	Interro Setting Slow	रा	ADC1	ADC2	HS	LS	CCU6	
ePower Structure ✓ LS1 en ✓ Dr > Bla > So > Int	SCU able iver Setti Slew ra Open L Low Sic PWM E anking T urce Sele terrupt	PMU ngs te oad Dete de Driver nable ime Filter ect (PWIV	MON ection ON r Settings 1 Output)	Interro Setting	τ	ADC1	ADC2	HS	LS	CCU6	



Getting Started: How to compile your projects

4) Compile Project

- > Compile Project:
 - Press "Build" Button or press "F7"
- Project "Build Output" window shows
 0 Error(s), 0 Warning(s)



Getting Started: Power up your board and connect the debugger





Getting Started: How to download and run your code







Getting Started: Available example code

Infineon Example Code available in "Pack Installer"

Pack Installer - C:(Kell_V)(AKIVI(PACK								
ile Packs Window Help								
Device: Infineon - TLE9879QXA40								
Devices Boards		4	Packs Examples					
Search: - X			Show examples from installed Packs only					
Device	/ Summary	E	Example	Action	Description			
🗄 🏈 Holtek	19 Devices		ADC1_POTI_EIM (TLE9879 EvalKit)	🚸 Сору	ADC1 with Exceptional Interrupt Mode reading in the Poti at Channel 4			
🖃 🏈 Infineon	151 Devices		ADC1_POTI_ESM (TLE9879 EvalKit)	🔶 Сору	ADC1 with Exceptional Sequencer Mode reading in the Poti at Channel 4			
TLE98xx Series	20 Devices		ADC1 POTI SEQ (TLE9879 EvalKit)	Copy	ADC1 in Sequencer Mode reading in the Poti at Channel 4			
= 🍄 TLE984x Series	7 Devices		ADC2 VS (TLE9879 EvalKit)	Copy	ADC2 VS Measurement			
II F9842-20X	ARM Cortex-M0_40 MHz_2 kB RAM_36 kB ROM		BLDC Block Commutation HALL (TLF9879 E	Copy	BLDC Motor Drive with Block Commution with HALL Sensor			
TI F9842OX	ARM Cortex-M0. 25 MHz. 2 kB RAM. 32 kB ROM		BLDC Block Commutation HALL + LIN (TLE	Conv	BLDC Motor Drive with Block Commution with HALL Sensor controlled over L			
TI F9843-20X	ARM Cortey-M0 40 MHz 4 kB RAM 48 kB ROM		BLDC Sensorless EOC (TI E9879 EvalKit)	Copy	BLDC Motor Drive with Sensorless FOC			
TI F98430X	ARM Cortey-M0, 25 MHz, 4 kB RAM, 44 kB ROM		BLDC Sensorless FOC + LIN (TLE9879 EvalKit)	Conv	BLDC Motor Drive with Sensorless FOC controlled over LIN			
TI F0844-20X	ARM Cortey-M0.40 MHz 4 kB RAM 60 kB ROM		Blinky (TI F0870 EvalKit)	Conv	Blinks - blinks ED1			
TI F0844OX	APM Cortex-M0, 25 MHz 4 kB RAM 60 kB ROM		Blinky - Running Lights (TLE0870 EvalVit)	Copy	Blinky Running Lights			
	ARM Contex-140, 25 Minz, 4 KB RAMI, 00 KB ROM		COLIS A DOI (TI 50870 E-1064)		DWMA - shares ADC			
	ARM COREX-INU, 40 MHZ, 4 KB KAMI, 44 KB KOM		CCU6_ADCI (TLE9879 EVAIKIE)		PWW synchroneous AUC measurement, the Poti at Channel 4 adjusts the PW			
E TLE980X Series	5 Devices		CCU6_PWM (TLE98/9 EValKit)	Copy	CCU6 generates PWM signals			
TLE9861QXA20	AKM Cortex-M3, 24 MHz, 3 KB RAM, 32 KB ROM		CCU6_SIN_PWM (TLE98/9 Evalkit)	Copy	CCUb generates Sinus with PWM signals			
TLE9867QXA20	ARM Cortex-M3, 24 MHz, 6 kB RAM, 60 kB ROM		DMA ADC1 Sequence (TLE98/9 EvalKit)	Copy	ADC1 triggers DMA after sequence is done			
TLE9867QXA40	ARM Cortex-M3, 40 MHz, 6 kB RAM, 60 kB ROM		DMA SPI (TLE9879 EvalKit)	Copy	Sends data through SPI using DMA			
TLE9867QXW40	ARM Cortex-M3, 40 MHz, 6 kB RAM, 60 kB ROM		DMA UART TTY (TLE9879 EvalKit)	🔶 Copy	UART2 sends data triggered by DMA			
TLE9869QXA20	ARM Cortex-M3, 24 MHz, 6 kB RAM, 124 kB ROM		GPT12E_T3_CONCAT (TLE9879 EvalKit)	🔶 Copy	Timer2 and Timer3 as 32bit Timer			
E TLE987x Series	8 Devices		GPT12E_T3_RELOAD (TLE9879 EvalKit)	🔶 Сору	GPT12E Timer3 reloaded by Timer2			
- 🖬 TLE9871QXA20	ARM Cortex-M3, 24 MHz, 3 kB RAM, 32 kB ROM		—LIN Master (TLE9879 EvalKit)	🔶 Сору	running the IHR LIN LLD in a LIN Master configuration			
	ARM Cortex-M3, 40 MHz, 3 kB RAM, 48 kB ROM		LIN Slave (TLE9879 EvalKit)	🔶 Сору	running the IHR LIN LLD in a LIN Slave configuration			
TLE9877QXA20	ARM Cortex-M3, 24 MHz, 6 kB RAM, 60 kB ROM		—NVM Data Flash Handling (TLE9879 EvalKit)	🔶 Сору	NVM Data Flash page write with error handling			
TLE9877QXA40	ARM Cortex-M3, 40 MHz, 6 kB RAM, 60 kB ROM		NVM Prog (TLE9879 EvalKit)	🔶 Сору	NVM Page Programming			
🖾 TLE9877QXW40	ARM Cortex-M3, 40 MHz, 6 kB RAM, 60 kB ROM			🔶 Сору	NVM Programming with RAM Branch			
	ARM Cortex-M3, 24 MHz, 6 kB RAM, 124 kB ROM			🚸 Сору	Flash Page Write Protection			
TLE9879QXA40	ARM Cortex-M3, 40 MHz, 6 kB RAM, 124 kB ROM		PMU_PowerSaving_SleepMode (TLE9879 Eval	🚸 Сору	Power Saving Modes - Sleep Mode			
TLE9879QXW40	ARM Cortex-M3, 40 MHz, 6 kB RAM, 124 kB ROM			🔶 Сору	Power Saving Modes - Sleep Mode with cyclic wake			
	91 Devices		PMU_PowerSaving_StopMode (TLE9879 EvalK	💠 Сору	Power Saving Modes - Stop Mode			
	40 Devices		PMU_ResetStatus (TLE9879 EvalKit)	🔶 Сору	Reset Status Evaluation			
🛨 🏈 Maxim	4 Devices		PMU_VDDEXT (TLE9879 EvalKit)	Copy	VDDEXT handling			
🛨 🔗 MediaTek	2 Devices		-SCU PLL (TLE9879 EvalKit)	Copy	PLL adjustment			
+ 🔮 Microsemi	6 Devices		SCU PLL XTAL (TLE9879 EvalKit)	Copy	PLL with external XTAL			
+ 🔮 MindMotion	2 Devices		SDK (TI F9879 EvalKit)	Conv	Software Developer Kit			
Vordic Semiconductor	8 Devices		SSC1 2 SSC2 (TLE9879 EvalKit)	Copy	SSC1 sends to SSC2			
t Ý Nuvoton	433 Devices		SSC1_SEND (TI F9879 EvalKit)	Copy	SSC1 sends data as SPI Master			
H Ý NXP	527 Devices		TIMER2 BLINK (TLE9879 Evalkit)	Conv	TIMER2 Blinking			
Renerac	3 Devicer		TIMER2 DWM CADTURE (TI F0870 EvalVit)	Conv	TIMER2 DWM Duty Cycle and Period Measurement			
Silicon Labs	307 Devices		IIARTI SEND (TI E0870 EvalKit)	Copy	LIARTI sends data over LIN Transceiver			
	49 Devices			Copy	UART2 sends printf mercaner			
	45 DEVICES		CHIVIZ_IIT (ILE90/9 EVAINIL)	- Copy	Omitiz serius printi messages			



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