TCPL01X: RGB LED Driver with LIN Interface

1. Features

- 32-bit Low Power Arm® Cortex®-M0 CPU core
- Memory
  - 64KB Flash (64KB NVM and 2.5KB NVR)
  - 4KB SRAM
- Clock
  - On-chip 48-MHz RC oscillator
  - On-chip 32-kHz RC oscillator
- LIN Interface
  - LIN Transceiver compliant to LIN 2.x/ISO17987/SAE J2602
  - LIN SCI with Protocol according to LIN 2.x/ISO17987/SAE J2602
  - LIN Slave Network Position Detection (SNPD)
  - LIN failure detection and recovery
  - LIN RXD wakeup
  - OTA over LIN
- Support LIN Auto Addressing (LIN SNPD)
  - Multiple-level current sources
  - Bus Shunt Method (BSM) based
  - Support 1Ω internal shunt or with 0.2Ω external shunt resistor
- LED Driver
  - Supports 3 channels of LED driver for RGB
  - 60mA Max sink current sources for each channel
- PWM
  - 16-bit PWM controller
  - 3 channels of PWM output for LED dimming control
  - 1 channel of PWM output for time sharing control
- One ADC
  - 11-bit signed SAR ADC
  - Sampling rate up to 400KSPS
  - Hardware trigger ADC Sample (PWM/RTC)
- 16-bit Timer
- 1 GPIO
- CRC8/16/32, programmable polynomial and initial value
- PRINT UART, TXD only for debug
- On-chip temperature sensor
- UUID, 64-bit unique identifier
- Power modes
  - Normal
  - Sleep
  - Sleepwalk
- POR
- LVD to monitor VS
- Watchdog
- 2-pin Serial Wire Debug (SWD)
- AEC-Q100 Grade 1 Qualified
- Power supply: 5V~28V operating, 40V load dump
- Tj: -40 ~ 150°C
- Package： SO8, DFN10
- ESD HBM：
  - ±8KV for LIN to system ground
  - ±4KV for VS to system ground
  - ±2KV for all other pins

2. Applications

- Dynamic interior lights
- Intelligent rear lights

3. Description

TCPL01x is an AEC-Q100 Grade 1 qualified RGB LED driver with LIN interface, designed for automotive dynamic interior RGB light and intelligent rear light. It features 32-bit Arm® Cortex®-M0 CPU core, 64KB flash and 4kB SRAM, a LIN transceiver supporting LIN auto-addressing. The integrated current sources can be controlled by a 16-bit PWM with a 48MHz clock. This enables PWM cycle frequencies up to 730Hz with 16-bit resolution. Each of the three drivers can be used to drive external loads up to 60mA. The integrated ADC can measure the forward voltage of LEDs differentially.

Part Number	Package	Body Size (Nom.)
TCPL010A-Q3A1	DFN10	3mm × 3mm
TCPL010A-S2A1	SO8 EP	4.9mm × 3.9mm
TCPL011A-S2A1	SO8 EP	4.9mm × 3.9mm

Carrier type: Tape & Reel, with 3000 pieces per reel.

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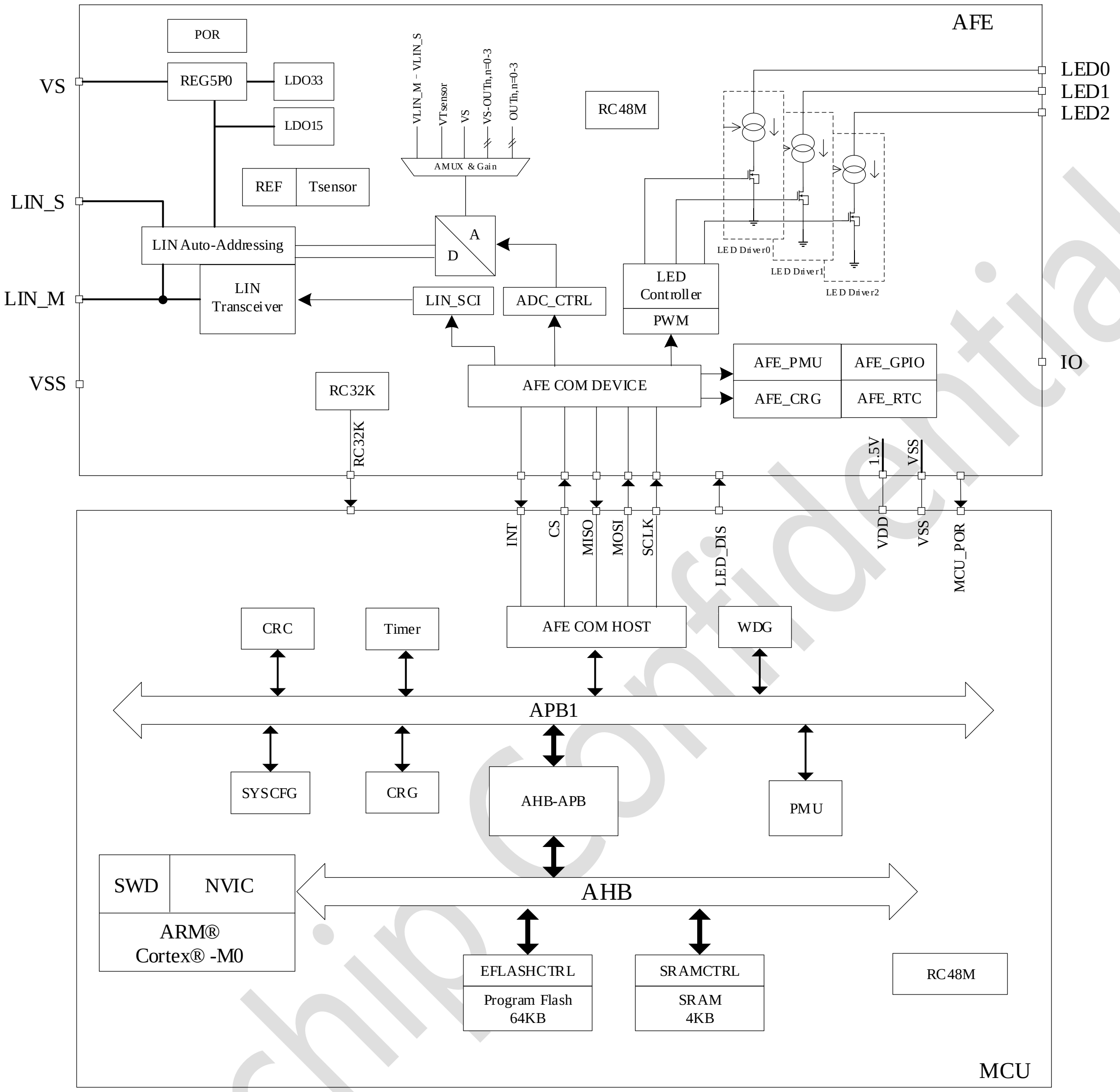
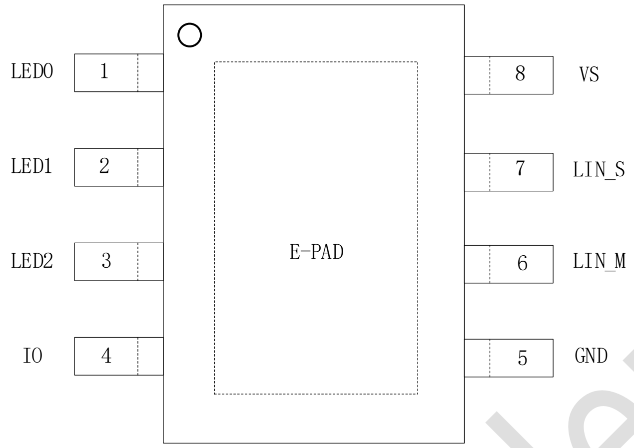
4. Block Diagram



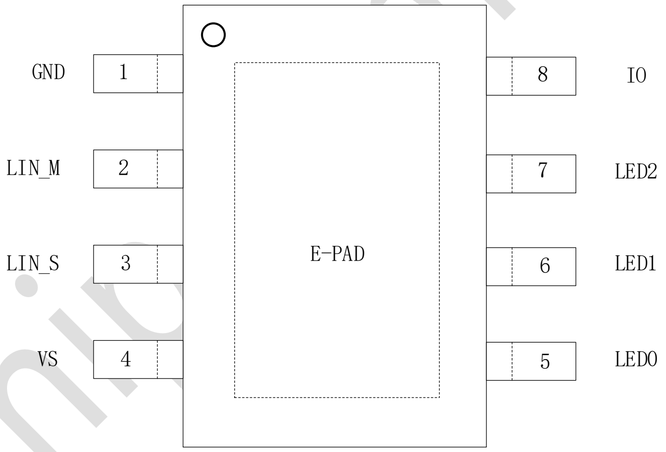
5. Pinout

5.1. SO8-EP (TCPL010A-S2A1) TOP View



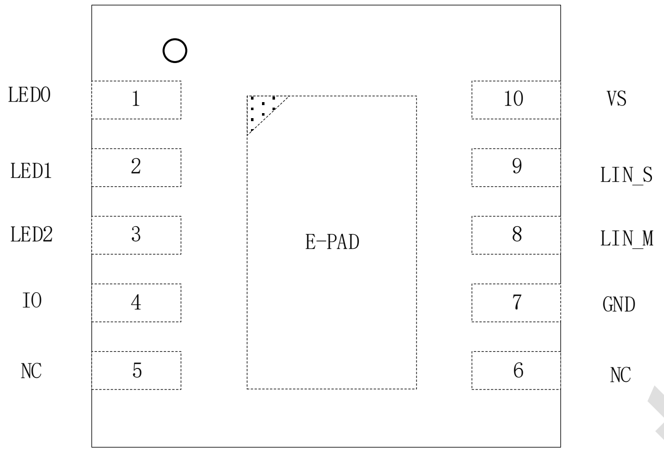
SO8-EP

5.2. SO8-EP (TCPL011A-S2A1) TOP View



SO8-EP

5.3. DFN10 (TCPL010A-Q3A1) TOP View



5.4. Pin Functions

SO8-EP TCPL010A-S2A1	SO8-EP TCPL011A-S2A1	DFN10	PIN Name	Property	Functions	Description
5	1	7	GND	GND	**GND**	Analog ground, LIN ground, LED ground
6	2	8	LIN_M	HV_IO	**LIN_M**	LIN bus line (direction towards master)
7	3	9	LIN_S	HV_IO	**LIN_S**	LIN bus line (direction away from master)
8	4	10	VS	HV_P	**VS**	Battery supply voltage
1	5	1	LED0	HV_IO LV_IO(OD) LV_IO(OD)	**LED0** PWM0 TXD	**LED driver channel 0** PWM output channel 0 PRINT UART TXD
2	6	2	LED1	HV_IO LV_IO(OD) LV_IO(OD)	**LED1** PWM1 LIN_UART_RXD	**LED driver channel 1** PWM output channel 1 LIN UART RXD
3	7	3	LED2	LV_IO(OD) HV_IO LV_IO(OD) LV_IO(OD)	**SWDIO** LED2 PWM2 LIN_UART_TXD	**SWD Data** LED driver channel 2 PWM output channel 2 LIN UART TXD
4	8	4	IO	LV_IO LV_IO LV_IO	**SWCLK** GPIO LED_SW	**SWD Clock** GPIO PWM output for time sharing control
-	-	5,6	NC			
E-PAD	E-PAD	E-PAD	NC			

Notes:

HV_P: High Voltage Power Supply

HV_IO: High Voltage IO

LV_IO: Low Voltage IO

OD: Open Drain

The function in **BOLD** is the default function after power on reset.

6. Electrical Characteristics

Unless specified otherwise, all voltages are referenced to GND.

Unless specified otherwise, the typical data are based on the measurement under Ta=25°C and VS=12V.

6.1. Absolute Maximum Ratings

Symbol	Description	Conditions	Min	Max	Unit
Tj	Junction Temperature		-40	150	°C
VS	DC Voltage at VS pin		-0.3	40	V
V_{LEDn}	Voltage at LEDn pins	n=0,1,2	-0.3	VS+0.3	V
$V_{LIN\_M/S}$	Voltage at LIN_M and LIN_S pins		-27	40	V
$I_{LIN\_M/S}$	Current from LIN_M to LIN_S pin		-200	200	mA
V_{IO}	Input voltage at IO pin		-0.3	5.5	V

Note: Stresses beyond those listed in this section may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute Maximum rating conditions for extended periods may affect device reliability.

6.2. ESD Ratings

ESD	ESD Rating
ESD HBM	±8KV for LIN to system ground
	±4KV for VS to system ground
	±2KV for all other pins
ESD CDM	±750V for edge pins
	±500V for all other pins
Latch-up	±200mA and 1.5×VMax, Tj=125°C

6.3. Recommended Operating Conditions

Symbol	Description	Min	Typ	Max	Unit
Ta	Ambient temperature	-40		125	°C
V_{LEDn}	Voltage at LED outputs, n = 0,1,2	0.5		28	V
VS	VS power supply	5		28	V
VS_{LIN}	Supply voltage for LIN communication on LIN_M/S	7		18	V

VS_{LINAA}	VS range for LIN Auto Addressing	9		18	V
V_{IO}	Voltage applied to IO pin	-0.3		3.8	V

6.4. Power Consumption

Symbol	Description	Conditions	Min	Typ	Max	Unit
I_{Normal}	Power consumption in Normal mode	CPU is running with 48MHz clock, and keep on while (1) state	-	2	-	mA
I_{Sleep}	Power consumption in Sleep mode		-	1.5	-	mA
$I_{Sleepwalk}$	Power consumption in Sleepwalk mode	Tj≤ 85℃	-	30	TBD	uA

6.5. POR

Symbol	Description	Conditions	Min	Typ	Max	Unit
POR on VS						
$V_{POR\_VS\_R}$	Power on threshold operating from pin VS (rising edge)		4.6		5.1	V
$V_{POR\_VS\_F}$	Power down threshold operating from pin VS (falling edge)		4.7		4.9	V
V_{POR_HYS}	Hysteresis between power on and power down threshold			0.4		V
tpor	Power up time			10		ms

6.6. LVD

Symbol	Description	Conditions	Min.	Typ.	Max.	Unit
LVD on VS						
$V_{LVD\_VS\_R}$	Low voltage detection threshold operating from pin VS (rising edge)			4 4.5 5 5.5 6 6.5 7		V

				7.5		
V_{LVD_HYS}	Hysteresis voltage between the LVD detection and recovery thresholds			0.5		V

6.7. Reference

Symbol	Description	Conditions	Min	Typ	Max	Unit
Vref	Reference voltage			1.229		V
	Temperature drift	-40 ~ 125°C		61		PPM/°C

6.8. LDO

Symbol	Description	Conditions	Min	Typ	Max	Unit
LDO35						
VLDO35	LDO35 output			3.5		V
ILDO35	LDO35 output current		10			mA

6.9. Clock Source

Symbol	Description	Conditions	Min	Typ	Max	Unit
HRC 48MHz (AFE)						
f_{HRC}	High frequency RC oscillator			48		MHz
ACC_{HRC}	HRC clock frequency accuracy		-5		5	%
LRC						
f_{LRC}	Low frequency RC oscillator			32		KHz
ACC_{LRC}	LRC clock frequency accuracy		-10		10	%
HRC 48MHz (MCU)						
f_{HRCMCU}	High frequency RC oscillator			48		MHz
ACC_{HRCMCU}	HRC clock frequency accuracy		-5		5	%

6.10. GPIO

Symbol	Description	Conditions	Min	Typ	Max	Unit
VIL	Input low voltage				0.3*VDD35	V
VIH	Input high voltage		0.7*VDD35			V
VOH	Output voltage at HIGH level	IIO = -5mA	2.7			V
VOL	Output voltage at LOW level	IIO = 5mA	0	0.1	0.25	V
VHYS	Hysteresis voltage of HIGH and LOW thresholds			0.3		V
CI	Input capacitance				10	pF
ILKG	Input leakage current			1		uA
RPU	Pull-up, Pull down resistance			70		KΩ

6.11. Current Mode LED Driver

Symbol	Description	Conditions	Min	Typ	Max	Unit
ILEDn	Input current at pin LEDn selectable in 5mA steps	PWMLEDn=H, ENLEDn=H, 0.5V<VOUT_n<28V		5 10 ... 60		mA
ACC_{ILEDn}	Output current accuracy at pins OUTn	PWMLEDn=H, ENLEDn=H, 0.5V<VOUT_n<18V, 25℃	-3		3	%
		PWMLEDn=H, ENLEDn=H, 0.5V<VOUT_n<18V, -40 ~125℃	-6		6	%
	Temperature drift			0.025		%/K
t_{ILEDn_r}	10% to 90 rise time of the output current at pins OUTn	PWMLEDn=L->H, ENLEDn=H		150	300	ns
IDIAG	Diagnostic current at pin LEDn selectable in 125uA steps			125 ... 1000		uA
ACC_{IDIAG}	Accuracy of diagnostic		-5		5	%

	current					
Vdrop	LEDn output voltage drop at Max. sink current sources for each channel	Tj=-40℃	0.5			V
		Tj=125℃	0.8			
RPU	Pull-up resistance at LED drivers in low power states	Sleep mode or standby mode	70	100	130	KΩ

6.12. LIN Transceiver with Slave Node Detection

Symbol	Description	Conditions	Min	Typ	Max	Unit
LIN Transceiver DC Characteristics						
VBUS_REC -VS	Driver in recessive state	Driver in recessive			0	V
VBUS_REC	Receiver recessive state	7V ≤ VS ≤ 18V	0.6			VS
VBUS_DOM	Receiver dominant state	7V ≤ VS ≤ 18V			0.4	VS
VBUS_CENTER	LIN bus center voltage	VBUS_CENTER=(VBUS_REC + VBUS_DOM)/2	0.475		0.525	VS
VBUS_HYS	Receiver hysteresis	VBUS_REC-VBUS_DOM			0.175	VS
IBUS_LIM	Output current limit	VBUS=18V	40		200	mA
IBUS_PAS_DOM	Input leakage current at the receiver including pull-up resistor	Transmitter passive, VBAT=12V, VBUS=0V	-1			mA
IBUS_PAS_REC	Leakage curent flowing into pin BUS	Transmitter passive, 8V ≤ VBAT≤ 18V, 8V ≤ VBUS≤ 18V, VBUS>VBAT			20	uA
IBUS_NO_GND	Leakage current, ground disconnected	VGND=VS=12V, 0V ≤ VBUS≤ 18V	-1		1	mA
IBUS_NO_BAT	Leakage current, supply disconnected	VBAT disconnected VGND=VBUS_VS=0V, 0V ≤ VBUS≤ 18V			100	uA

RBUS_SLAVE	Pull up resistance		20	30	60	kΩ
VSerDiode	Forward voltage serial diode	IDIODE = -75uA	0.4	0.7	1.0	V
LIN Transceiver AC Characteristics For parameters D1/D2/D3/D4, bus load conditions (CBUS ; RBUS): 1nF; 1kΩ/ 6,8nF;660Ω / 10nF;500Ω						
CBUS_PIN	Bus input capacitance	7V ≤ VS≤ 18V			100	pF
tRX_delay	Receive propagation delay				6	us
rRX_SYM	Receive propagation delay symmetry		-2		2	us
D1	Duty Cycle1	THRec(Max.) = 0.744 x VS; THDom(Max.) = 0.581 x VS; VS = 7.0V...18V; tBit = 50µs; D1 = tBus_rec(min) / (2 x tBit)	0.396			
D2	Duty Cycle2	THRec(min) = 0.422 x VS THDom(min) = 0.284 x VS VS = 7.6V...18V; tBit = 50µs; D2 = tBus_rec(Max.) / (2 x tBit)			0.581	
D3	Duty Cycle3	THRec(Max.) = 0.778 x VS THDom(Max.) = 0.616 x VS VS= 7.0V...18V; tBit = 96µs; D3 = tBus_rec(min) / (2 x tBit)	0.417			
D4	Duty Cycle4	THRec(min) = 0.389 x VS THDom(min) = 0.251 x VS VS = 7.6V...18V; tBit = 96µs; D4 = tBus_rec(Max.) / (2 x tBit)			0.590	
LIN High Speed Mode						
BBUS_RXD	Receive data baud rate	High speed mode, VS=13.5V	115.2			Kbps
BBUS_TXD	Transmit data baud rate	High speed mode, VS=13.5V	115.2			Kbps

LIN Wake Up						
tBUS_WU	Wake up debounce time		70		150	us
LIN Failure detection and recovery						
tBUS_TXD_DOM	Time out for TXD dominant clamping failure	TXD dominant timeout detection enabled	8	12	16	ms
LIN Auto-addressing						
IPU_AA	Bus pull-up current source	Range：0.5mA~8mA, multiple levels adjustable				mA
IPU_AA_Granularity				0.5		mA
RSHUNT	Internal bus shunt resistor		TBD	1	TBD	Ω

6.13. SAR-ADC

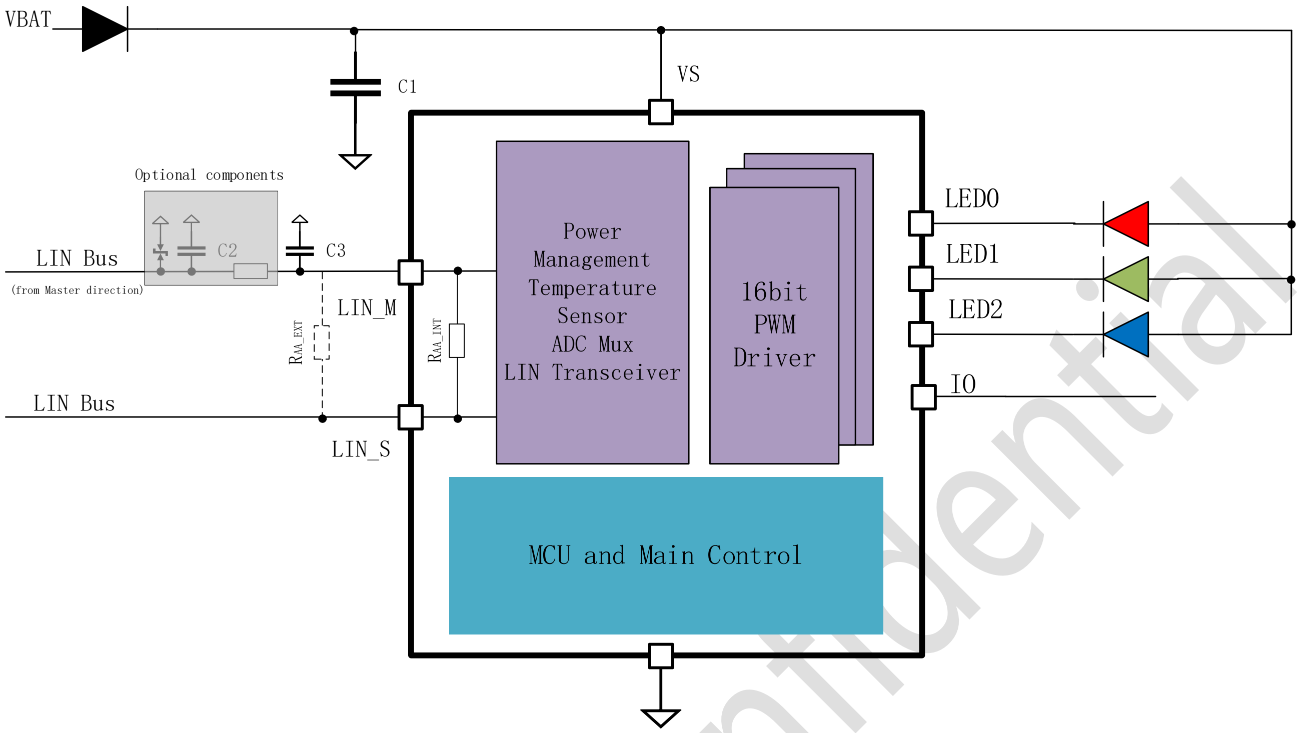
Symbol	Description	Conditions	Min	Typ	Max	Unit
AMUX, Gain						
	VS channel voltage range				18	V
	VS-VLEDn differential channel voltage range		0		8	V
	OUTn pin votlage range				18	V
	Voltage range across LINAA shunt resistor			TBD		V
	Voltage dividing factors	VBAT/VOUT/VLED		1/20		
ADC						
	Signed resolution			11		bit
	Voltage reference			0.75 1.5 2		V

V	ADC Input voltage range					
t_{CONV}	Conversion time		2.5			us
	GAIN1 factor	Gain1 = 2 + 3*gain1_sel[0] + 5* gain1_sel[1] + 10* gain1_sel[2]		2 5 7 10 12 15 17 20		
	GAIN2 factor	Gain2 = 1 + 1*gain2_sel[0] + 2* gain2_sel[1] + 4* gain2_sel[2]		1 2 3 4 5 6 7 8		
	Offset error			TBD		LSB
	Offset temperature drift			TBD		LSB/°C
	Gain error			TBD		LSB
	Gain temperature drift			TBD		LSB/°C
	INL			±6		LSB
	DNL			TBD		LSB
	Power consumption			TBD		uA

6.14. Internal Temperature Sensor

Symbol	Description	Conditions	Min	Typ	Max	Unit
Temperature measurement						
T_C	Temperature coefficient			2		LSB/℃
ACC_{TEMP}	Temperature accuracy		-10		10	℃
Over Temperature Protection						
OTP_std	Tj over-temperature shutdown threshold		150	160		℃
OTP_rec	Tj over-temperature recovery threshold		120	130		℃

7. Application Circuit



8. Detailed Description

8.1. Processor

The device integrates 32-bit Arm® Cortex®-M0 CPU core with the Maximum operating clock frequency of 48MHz. The Cortex-M0 processor is built on a high-performance processor core, with a 3-stage pipeline von Neumann architecture. The processor is extensively optimized for low power and area, and delivers exceptional power efficiency through its efficient instruction set. The Cortex-M0 processor implements the ARMv6-M architecture, that implements the ARMv6-M Thumb instruction, including Thumb-2 technology.

The Cortex-M0 processor is configured to support 32-cycle hardware multiplier, SWD debug interface and SysTick with external reference clock.

8.2. Memory

The device has 64KB Flash (include 64KB NVM and 2.5KB NVR) and 4KB SRAM.

8.3. Clock system

The clock system includes an internal high-speed clock RC48M in MCU die and two clocks in AFE die, high-speed clock RC48M and low-speed clock RC32K. To achieve more performance, user can select different clock frequency for modules by setting clock divider registers. In addition, the system also designed clock gating to reduce the power consumption of system.

8.4. RESET

The chip supports multiple reset sources:

- POR: power on reset
- SW_POR: software power on reset
- OTP_RST: over-temperature reset
- WDG_RST: watch dog reset
- Cortex-M0 SYSRST: system reset request

8.5. Interrupt System

The Cortex®-M0 processor has a built-in NVIC interrupt controller, which supports up to 5 interrupt vectors. The interrupt sources in this chip are shown in the table below. The AFE_INT means some interrupts which are from AFE die, and it contains the following interrupt types: LIN_SCI, AFE_RTC, ADC_CTRL, PWM, AFE_GPIO, OTP, VS_LVD.

Table 10-1 Interrupt Source

Interrupt NO.	Interrupt source
0	AFE_INT
1	TIMER
2	WDG
3	EFLASH
4	AFE_COM

8.6. Working Mode

The TCPL01x system supports 5 kinds working mode: ACTIVE, IDLE, SLEEP and SLEEPWALK mode.

Tinywork® is also supported in this system, and TCPL01x can automatically start ADC sampling by PWM trigger in Tinywork®. The Tinywork® could work in ACTIVE, IDLE, SLEEP and SLEEPWALK mode, and the SLEEPWALK mode is the lowest power consumption mode for Tinywork®.

- ACTIVE mode: in this mode, no low-power function is enabled, and the CPU runs at full speed as the configurated dominant frequency. All peripherals work normally after enabled.
- IDLE mode: the CPU is stopped, keeping in wait for interrupt (WFI) state, but the SYSTICK clock is still working.
- SLEEP mode: the CPU and SYSTICK clock are stopped, but HRC and LRC will be continue to work, and all enabled peripherals can work normally too.
- SLEEPWALK mode: in this mode, HRC_MCU is closed and user could choose whether HRC_AFE and SAR_ADC are close or open. This means the peripherals which use the closed HRC will stop working. Meanwhile, to further reduce power consumption, the system also closes the following functions: Temp sensor, LED_DRI, LIN_TRX, LIN_AA and VS_LVD.

8.7. General Purpose Input/Output – GPIO

One general purpose GPIO is supported in AFE die. When it is configurated as input function, it can generate 4 kinds interrupt depended on configuration, which are rising edge interrupt, falling edge interrupt, low level interrupt and high level interrupt.

8.8. Analog-to-Digital Converter - ADC

The TCPL01x has integrated a successive-approximation-register (SAR) ADC for diagnostics. The internal ADC can be initiated to detect the voltage on VS, LEDn, VS-LEDn for fault diagnosis.

- Multiple channels 11 bits signed SARADC
- Software and hardware start conversion
- Single channel single time and multiple time conversion
- Multiple channels single time and multiple time conversion
- Hardware output average by 1/2/4/8/16/32/64/128
- Windows compare
- Hardware gain control
- 8×32 bits FIFO
- Multiple interrupt

8.9. LIN Interface

LIN SCI controller implement LIN serial communication interface, and also compatible with UART protocol.

8.9.1 UART function

- Full duplex operation

- 8N1 data format
- Parity enable and disable
- Parity bit (even, odd, zero, one)
- Stop bit (1 bit or 2 bits)

8.9.2 LIN Master Function

- Break generation (programmable break length up to 255 x Tbit)
- SYNC byte transmission
- Break delimiter length: 1~4 Tbit (programmable break delimiter length)
- PID byte transfer (programmable PID)

8.9.3 LIN Slave Function

- Programmable break detection threshold (10 Tbits or 11Tbits)
- Auto baud rate detection
- Sync Byte plausibility check (1K to 20K, 115.2K)
- Sync Byte value validation
- Collision detection with auto transmit shut down
- Checksum calculation (classic or enhanced)， auto checksum insertion to transmit frame
- Break measurement

8.9.4 LIN Auto Addressing

- Multiple auto addressing mode
- Configurable source current
- Configurable ADC data compare threshold
- Configurable clock deviation time
- Configurable PGA ready time

8.10. Real time counter - RTC

RTC has a 24-bit timer/counter using RC32K clock (or scaled) as its clock source. Four different counting thresholds are supported, so 4 timeout timing can be simultaneously supported by RTC. Every time a threshold is reached, an interrupt is generated. The RTC timeout event can be used to trigger other peripherals to start running thanks to the Tinywork® mechanism.

8.11. Programming and debugging interface - SWD

Support two-wire serial programming and debugging interface SWD and support JLINK and CMSIS-DAP tools for debugging and development.

8.12. Internal Temperature Sensor - Tsensor

The output voltage of the internal temperature sensor has a linear relationship with the on-chip temperature. It is a differential analog voltage, which is connected to the ADC input terminals for conversion. After computation based on ADC result, the on-chip temperature can be determined.

8.13. Watchdog – WDG

The independent Watch Dog serve to detect and resolve system failure (due to software failure) and generate a system reset or an interrupt when the counter down to zero.

- Function clocked by clock divided from RC32K
- Free-running down counter
- Configurable max counter value
- Generate interrupt when counter down to zero
- Configurable to generate reset when counter down to zero
- Configurable to disable counter during Cortex-M0 is halted state

8.14. Low Voltage Detector - LVD

LVD monitors the VS voltage. When the detected voltage is lower than the preset threshold, it will generate an interrupt. It also supports self-disable PWM function if LVD happened.

LVD supports multiple configured levels to prevent false triggers.

8.15. LED Driver

The TCPL01x device has 3 channels of sink current sources for RGB LED driver. Each channel has its own enable configuration register to enable or disable the channel output. And each output channel supports sink current maximum to 60mA, individual 12-step programmable current settings.

The TCPL01x also integrates independent 16-bit PWM generators for each output channel, which supports 6 PWM modes to suit different application scenarios.

8.16. Tinywork®

Tinywork® is a special mechanism deployed in Tinychip MCUs to reduce power consumption. It realizes event signal transmission between peripherals under low power modes. By this way, different modules are linked and part of them can be triggered to start working without CPU participation. And in low power mode, if needed, Tinywork® can even shift the MCU's working mode before transmit a triggering signal. Its main benefits include faster response, more flexible configuration and lower power consumption.

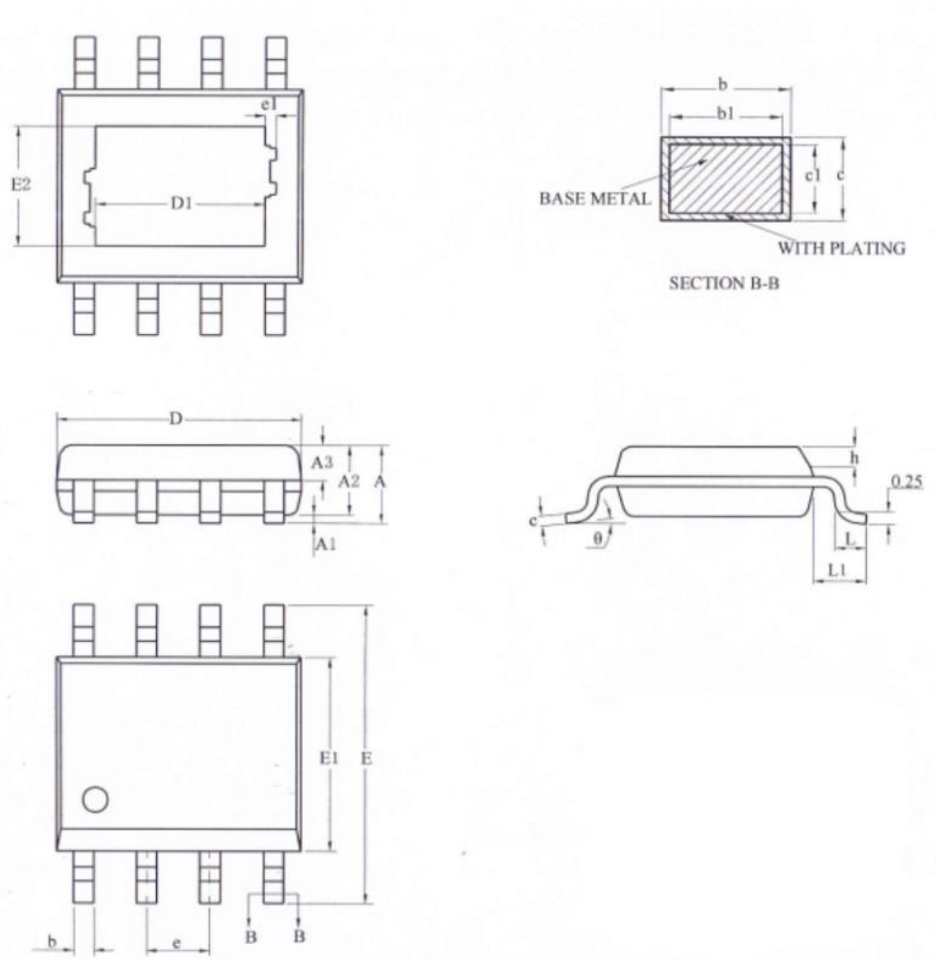
8.17. UUID

96-bit UUID is provided on-chip. The UUID information is written at factory, and the content cannot be changed by customers.

9. Package and Carrier Information

9.1. Package Drawing

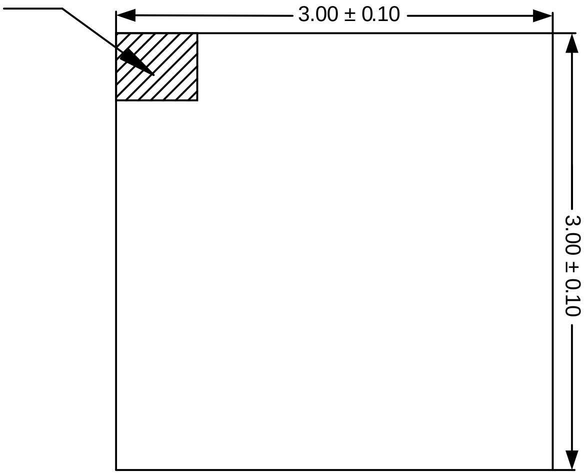
9.1.1 SOP8



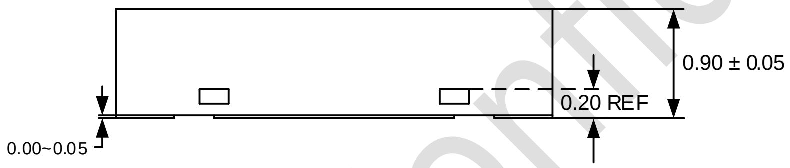
SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.65
A1	0.05	—	0.15
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	—	0.47
b1	0.38	0.41	0.44
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	—	0.50
L	0.50	0.60	0.80
L1	1.05REF		
θ	0	—	8°

Size(mm) / L/F Size (mil)	D1	E2	e1
			-
95*130	3.10REF	2.21REF	0.10REF

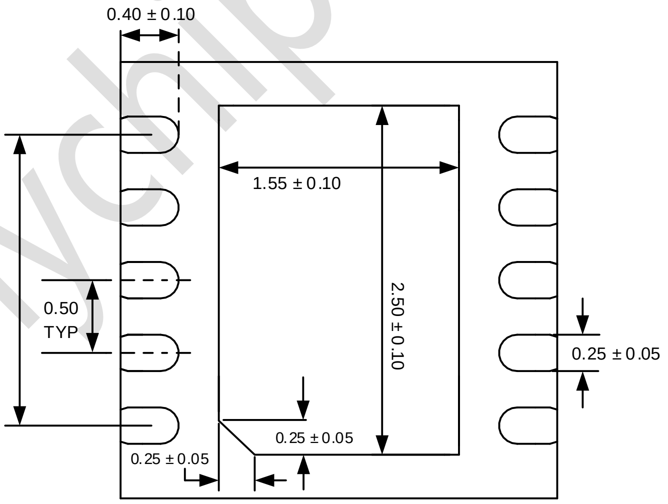
9.1.2 DFN10



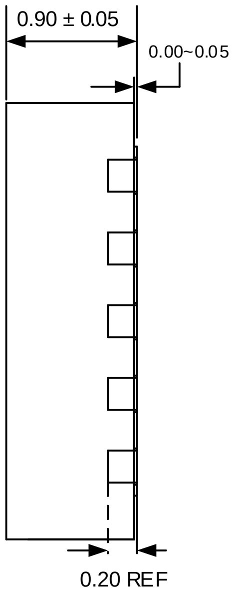
Top View



Side View



Bottom View



Side View

Unit: mm

9.2. Carrier Materials Information

TBD

Confidentiality Requirements

This document is only provided by Tinychip Microelectronics Co., Ltd. to its partners who have signed a confidentiality agreement.

All partners shall follow the relevant requirements in the confidentiality agreement, keep confidential the relevant information involved, and promise to take reasonable measures to ensure that the confidential information is not leaked.

Without the prior written approval of the disclosing party, the receiving party shall not directly or indirectly disclose, disclose to a third party or make public the confidential information and/or any part thereof in any form or any method. The recipient can only disclose confidential information to the recipient's personnel who know the need.

A partner who violates any of the above requirements shall be regarded as a breach of contract. The breaching party shall be liable for compensation for its breach of contract and the losses caused to the disclosing party.

Revision

Revisions	Date	Comments
0.1	2023-05-01	Initial revision
0.5	2023-06-12	Updated Detailed Description

About Us

Tinychip Microelectronics Co., Ltd. was established in Zhangjiang, Shanghai in 2019. As a leading supplier of high-performance dedicated SoC IC in China, the company focuses on the research and development of various chips related to Internet of Things applications, and has received firm and powerful support as well as investments from selected top investment institutions. The company is joined with a group of top semiconductor experts and is committed to developing into a platform company in semiconductor industry. The team has the research and development capabilities of various system-level complex IC products, and the total shipments have reached billions of units. The company has developed a large number of SoC IC based solutions in analog signal chain, power supply and radio frequency, which cover consumer electronics, industrial control and automotive applications. While setting the industry's new benchmarks with differentiated IC products, they will empower more IoT companies and better serve customer needs.

Tinychip Microelectronics Co., Ltd.

Address: Room 602, Block A, Building 1, No. 800, Naxian Road, Pudong New Area, Shanghai
Room 606, Building 3, Jizheng Technology Park, No. 6, Fengxin Road, Yuhuatai District, Nanjing
Room 608, Building 2, Xunmei Technology Plaza, No. 8, Keyuan Road, District Nanshan, Shenzhen

Website：http://www.tinychip.com.cn

Technical Support

Email：support@tinychip.com.cn