IoT XENSIV™ lighting platform

Getting started guide

About this document

Scope and purpose

The IoT XENSIV™ lighting platform is a complete development platform for IoT enabled XENSIV™ sensors and Infineon lighting systems. This document contains the specifications, schematics, Bill of Materials (BOM) and measurement results of the IoT XENSIV™ lighting platform. It also covers the design specifications of the IoT XENSIV™ main board, wireless connectivity and radar.

Intended audience

This document is intended to help users get started with hardware information for IoT XENSIV™ wireless connectivity, microcontroller and OPTIGA™ Trust B setup.

Table of contents

1 Introduction

The IoT XENSIV™ lighting platform is a complete development platform for IoT enabled XENSIV™ sensors and Infineon lighting systems. Different sensors support different functions, e.g., Radar detects number of people, wireless connectivity connects cloud servers, and microcontrollers control the digital LED driver, REF-XDPL8221-50W. Please refer to the next part for the main design features of the IoT XENSIV™ platform.

*Note: The IoT XENSIV™ main board and wireless connectivity module are ready for evaluation. Please flash the reference program of the IoT XENSIV™ main board, connect the AC input and assemble the modules as shown in **Figure 10** for test setup. Users can use the adapter board for quick connection, as shown in **Figure 1**.*

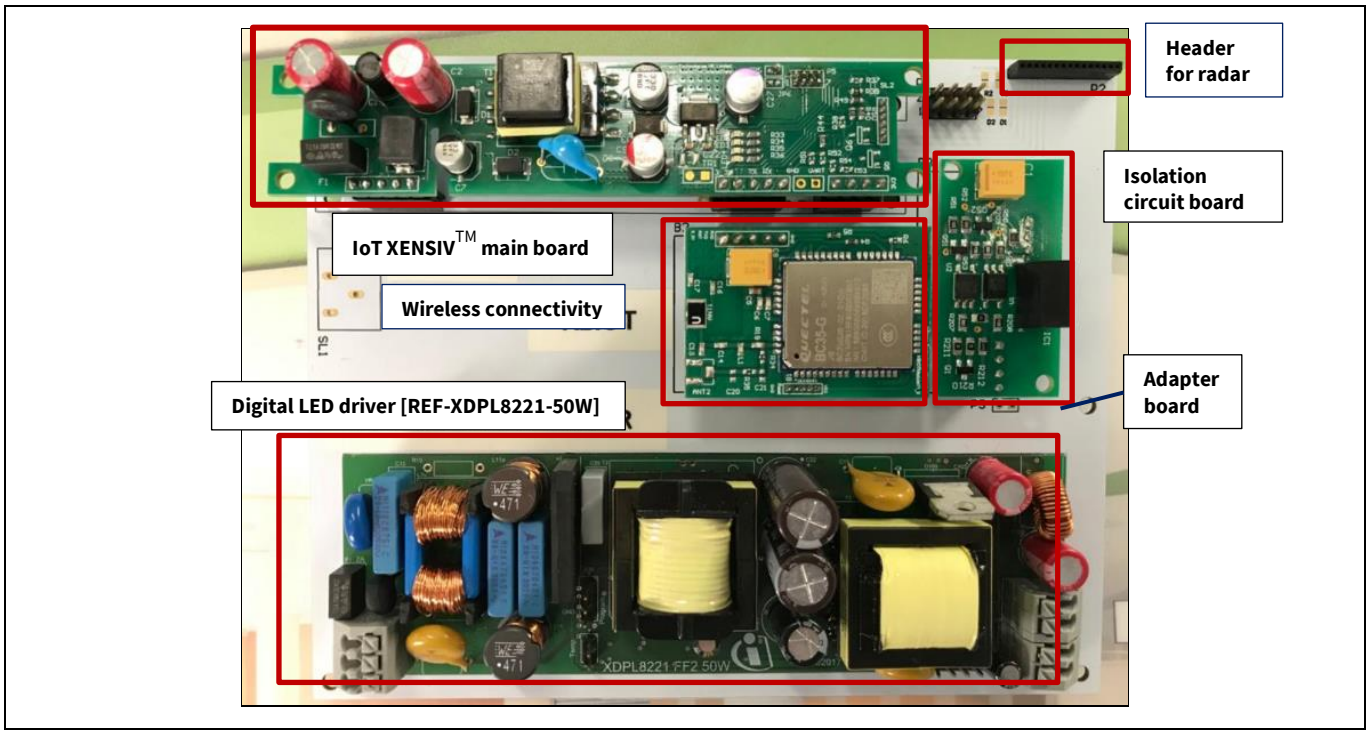


Figure 1 Adapter board of IoT XENSIV™ platform

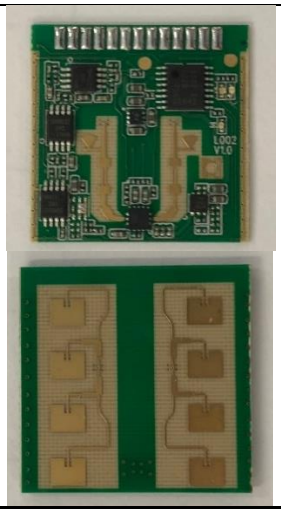
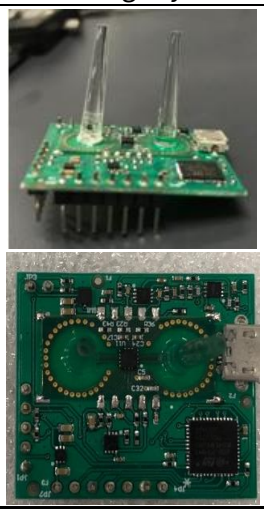
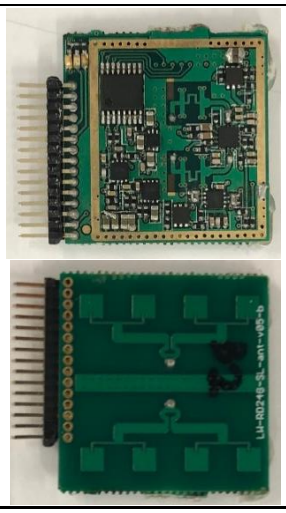
Honmax[1]	KingCity[2]	LexiWave[3]
		

Figure 2 Radar modules from different manufacturers

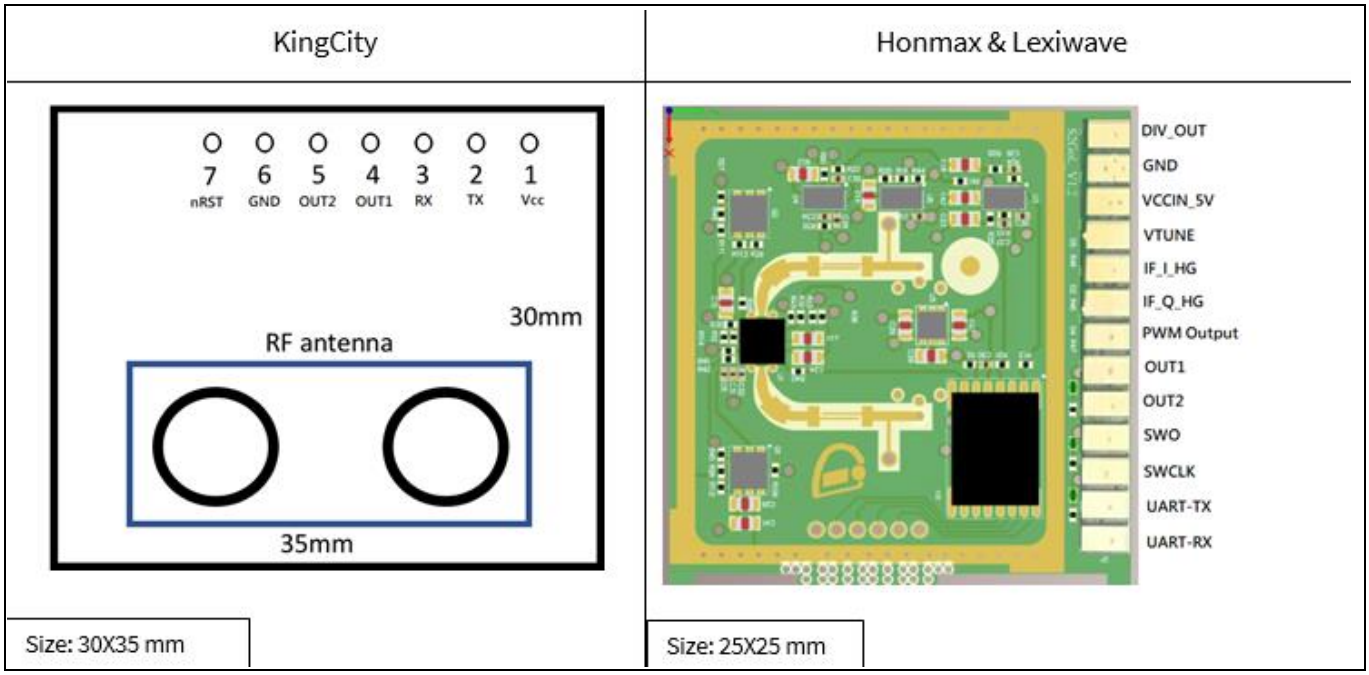


Figure 3 Pin assignment of radar modules by different manufacturers

**1, *2, *3*
Modules includes are compatible with IoT XENSIV™ Lighting Platform and provided by third-party. Changes may include without further notices. For latest moduel specifications, please refer to the orginal module manufacture.

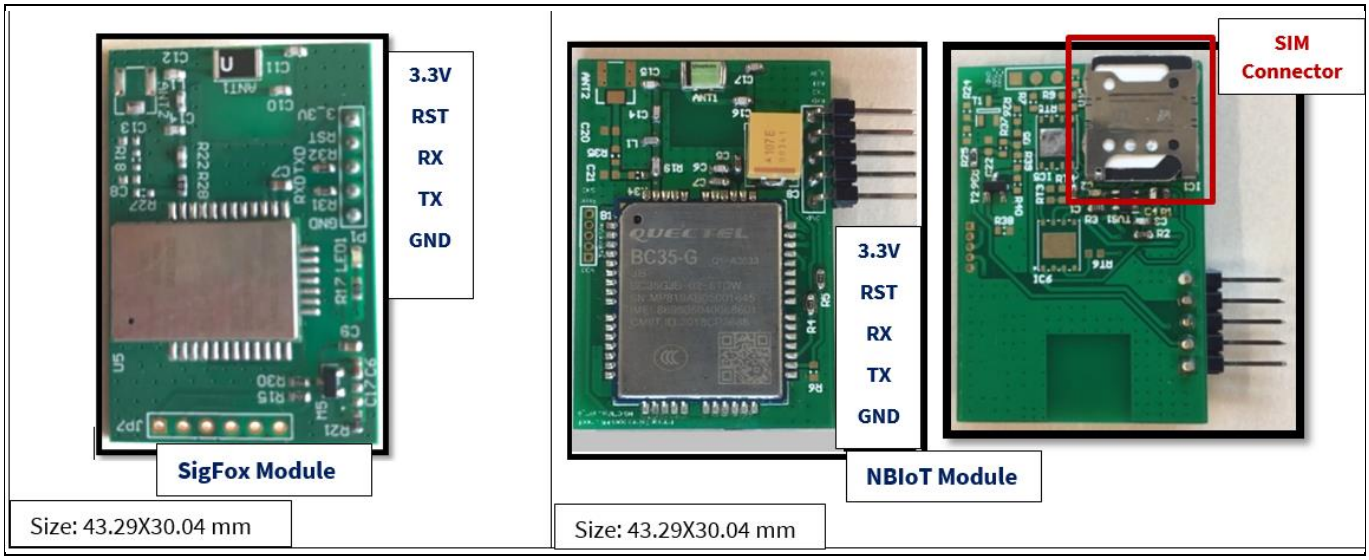


Figure 4 Pin assignment of wireless connectivity

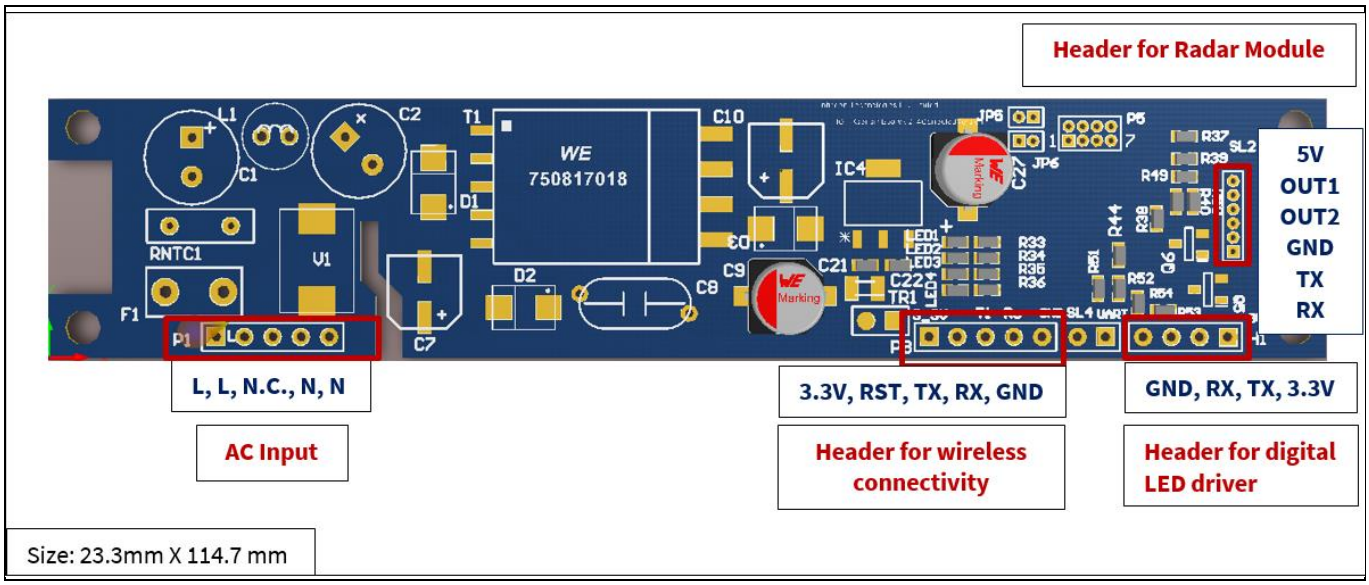


Figure 5 Pin assignment of IoT XENSIV™ main board

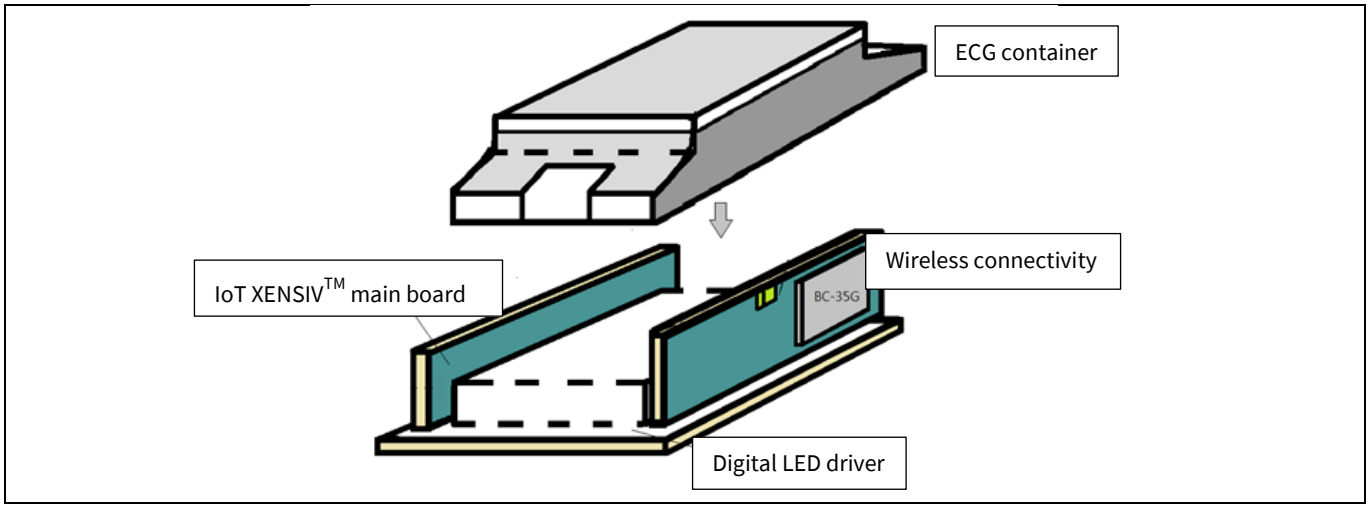


Figure 6 Recommended setup and module placement in the ECG container

The size of the IoT XENSIV™ main board is 23.3 mm x 114.7 mm. The strip size fits the side wall of the ECG container.

Figure 6 shows that a 70 mm x 130 mm x 28 mm ECG container accommodates the IoT XENSIV™ main board, NB-IoT module and digital LED driver.

Table 1 Module summary

Module	Functions
Adapter board	Quick assembly and combination of IoT XENSIV™ modules
IoT XENSIV™ main board	To control the operation of the system and communicate with sensors, digital LED driver, wireless connectivity and radar
Wireless connectivity	To connect the network and communicate with the cloud server
Isolation circuit board	To isolate the UART communication between the primary side of the digital LED driver and microcontroller XMC1302 in the IoT XENSIV™ main board
Radar module	To detect number of people and their movements
Digital LED driver	To dim the LED and read the LED status

2 Functional block diagram

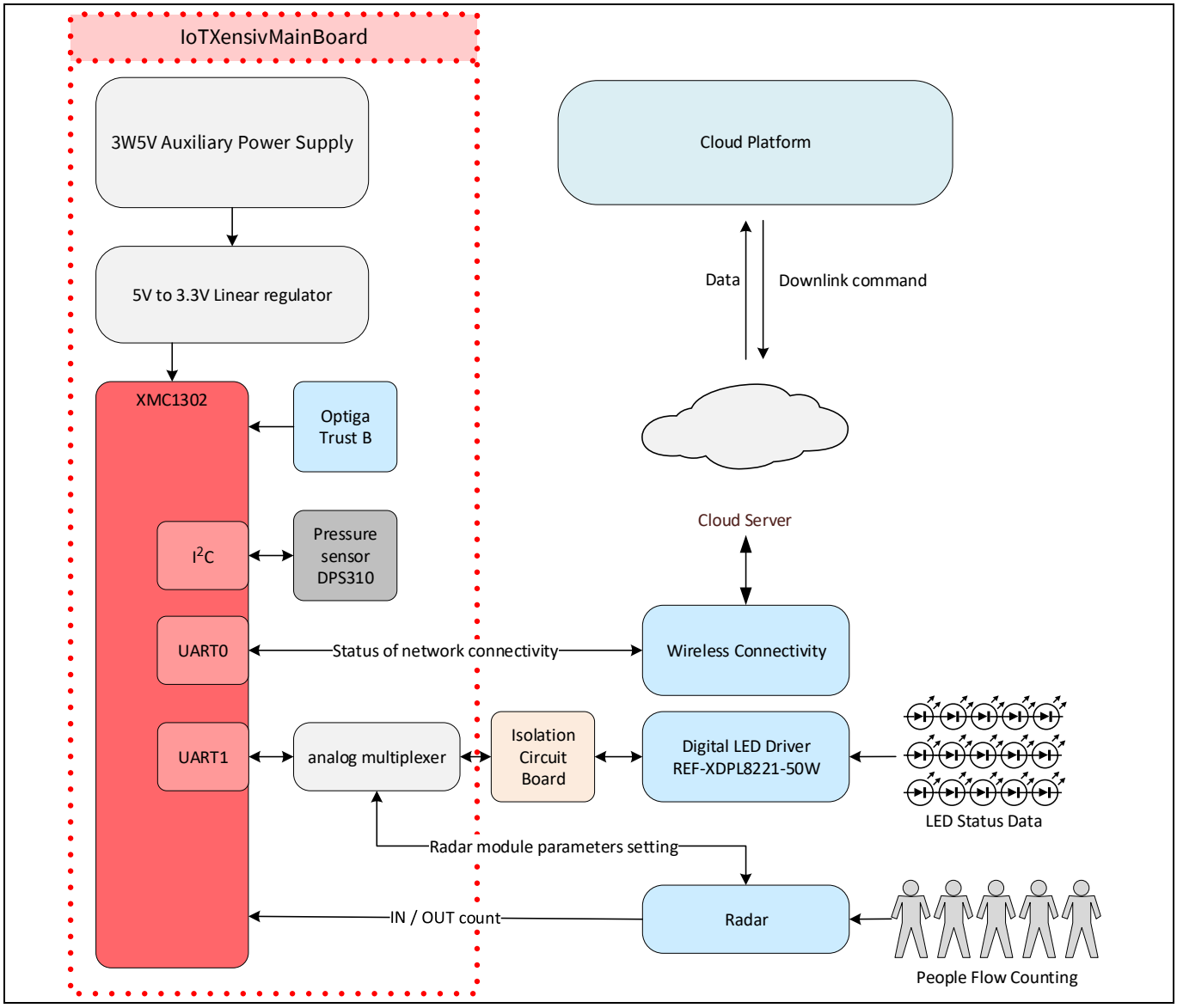


Figure 7 Block diagram of IoT XENSIV™ lighting platform

IoT XENSIV™ lighting platform is a modular architecture which consists of serveral parts: XENSIV™ sensors, e.g., radar for people-counting data, digital LED driver to control LEDs and wireless connectivity module for up- and downlink data to the cloud platform.

Microcontroller XMC1302 in the IoT XENSIV™ main board is the core processor of the platform. XMC1302 communicates with radar, the digital LED driver and wireless connectivity module.

Wireless connectivity is to connect the cloud server, sending and receiving data from the device to the cloud.

OPTIGA™ Trust B is used for device authentication, enhancing the security between cloud server and devices.

XMC1302 collects the people-count data from radar via the I/O port and gets instantaneous LED status from REF-XDPL8221-50W, the digital LED driver, via the UART port. An analog multiplexer extends the UART ports by the selected signal pin from XMC1302. Through downlink control commands from the cloud, XMC1302 sets the radar parameters and the dimming level of the LED drivers.

2.1 Configurations of the IoT XENSIV™ modules

Modularization is one of the features of the IoT XENSIV™ platform. Module configuration can depend on the expected functions. **Figure 8** shows an example of standalone people-counting devices and remote dimming devices.

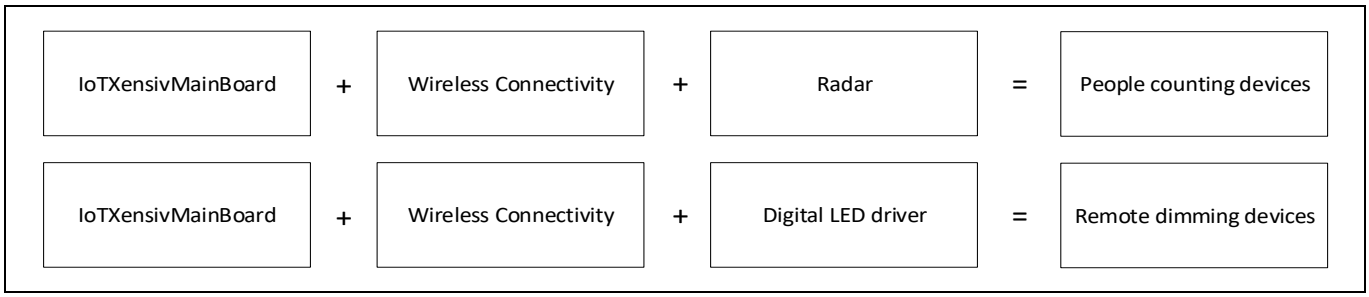


Figure 8 Standalone device examples

IoT XENSIV™ main board has its own header of UART communication. When people-counting and dimming functions are not necessary, the radar and LED driver can be taken away at any time. Plugging in different sensors such as a humidity sensor or magnetic sensor enables it to become a new sensing device through modification of the software.

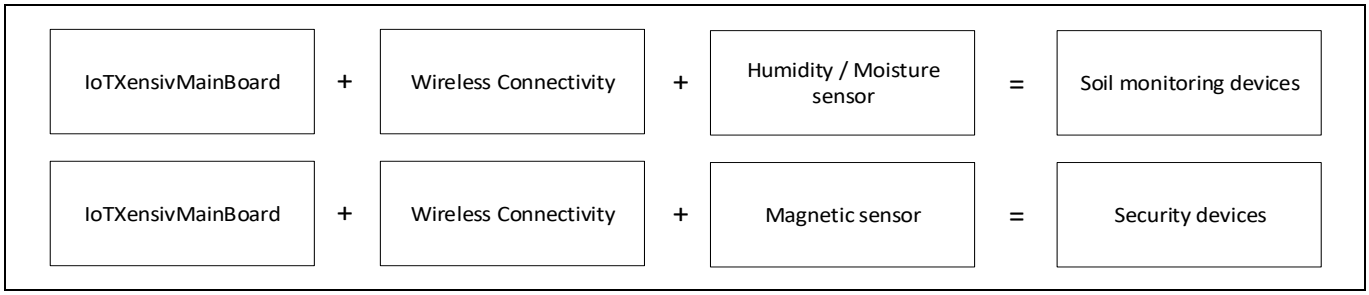


Figure 9 External sensor examples

3 Design specifications

Table 2 Electrical specifications of IoT XENSIV™ main board

Specification	Symbol	Value	Unit
AC input voltage range	V_{IN_AC}	90 ~ 265(+/-10 percent), 50 Hz	V AC
Output voltage	V_{out}	5±5 percent	V DC
Rated output current	I_{out}	~600	mA
Rated output power	P	3	W
Efficiency (at V_{in}: 220 V AC, full load)	η	~78	%
Output voltage ripple (max.) (at V_{in}: 220 V AC, full load)	–	less than ~77	mV
Start-up time	$T_{start-up}$	26	ms
Transient response (step-load switch between 17 percent and 100 percent) • Recovery time	–	240	µs
Device dimensions	–	23.3 x 114.7	mm

Table 3 Electrical specifications of NB-IoT module

Characteristics	Specifications	Unit
Input voltage	3.3	V DC
NB-IoT module model	BC35GJBR01A02W	–
NB-IoT frequency bands	Bands 1, 3, 8 and 28	–
Antenna center frequency (-10 dB)	~920	MHz
Bandwidth	~16	MHz
Polarization	Linear polarization	–
Device dimensions	43.29 x 30.04	mm

Table 4 Electrical specifications of SigFox module

Characteristics	Specifications	Unit
Input voltage	3.3	V DC
SigFox module model	WSSFM10R4AT RCZ 4	–
SigFox frequency (ACPC)	920.8 ~ 922.3	MHz
Antenna center frequency (-10 dB)	~920	MHz
Bandwidth	~16	MHz
Polarization	Linear polarization	–
Device dimensions	43.29 x 30.04	mm

Table 5 Electrical specifications of radar module

Radar from manufacturer	Supply voltage			Units
	Min.	Typ.	Max.	
LexiWave	–	5	–	V
KingCity	4.5	5	5.5	V
Honmax	3.6	5	5.5	V

Radar from manufacturer	Operating current	Units
LexiWave	55	mA
KingCity	75	mA
Honmax	60	mA

Radar from manufacturer	-3 dB beamwidth	Gain/dBi	Area	Sensing distance
LexiWave	80° x 29°	20	25 mm x 25 mm	~4 m
KingCity	60° x 60°	13.66	30 mm x 35 mm	
Honmax	65° x 22°	11	25 mm x 25 mm	

Note: The specification is quoted from the datasheet of the manufacturer's radar.

Table 6 Electrical specifications of REF-XDPL8221-50W

Specification	Symbol	Value	Unit
AC input voltage range	V_{IN_AC}	90 to 305	V AC
DC input voltage range	V_{IN_DC}	90 to 430	V DC
Output LED load range	V_{LED}	16 to 48	V DC
Non-dimmed full output current setting	I_{out_set}	1500	mA
Total line and load regulation tolerance	–	±2	%
Minimum output current setting	$I_{out\_dim\_min}$	15	mA
Efficiency	η	Less than 89	%
Power factor	PF	More than 0.9	–

Note: REF-XDPL8221-50W is the LED driver, the Infineon evaluation board using XDPL8221 dual-stage multi-mode Flyback and PFC. The specification is quoted from the datasheet of REF-XDPL8221-50W.

Table 7 Electrical specifications of DPS310 in IoT XENSIV™ main board

Parameter	Symbol	Values			Unit	Test condition
		Min.	Typ.	Max.		
Supply voltage	V_{DD}		3.3		V	Source voltage from LDO LM3940
Supply voltage I/O	V_{DDIO}	1.2	–	3.3	V	–
Pressure	P_a	300	–	1200	hPa	–
Temperature	T_a	-40	–	85	°C	–
Peak current consumption	I_{peak}	–	345	–	µA	During pressure measurement
		–	280	–	µA	During temperature measurement
Standby current consumption	I_{stb}	–	0.5	–	µA	–
Current consumption (one pressure and temperature measurement per s)	I_{1Hz}	–	2.1	–	µA	Low precision
		–	11	–	–	Standard precision
		–	38	–	–	High precision

Note: The specification is quoted from the datasheet of Infineon's DPS310 digital pressure sensor.

Table 8 Electrical specifications of SLE95250 in IoT XENSIV™ main board

Parameter	Symbol	Values			Unit	Test condition
		Min.	Typ.	Max.		
V_{CC} supply voltage	V_{CC}	–	3.3	–	V	Source voltage from LDO LM3940
V_{DD} supply voltage	V_{DD}	-0.3	–	1.6	V	–
I/O	$V_{I/O}$	-0.3	–	3.3	V	–
Current consumption, active idle mode	I_{VCC}, active idle	–	0.5	–	mA	Idle function mode average over active idle
Current consumption, active mode, authentication operation	I_{VCC}, active ECC	–	1.0	–	mA	Authentication mode average over authentication
Current consumption, power-down mode	$I_{VCC,PD}$	–	1.0	3.0	µA	SWI is set at 0 V maximum value condition is set at V_{CC} = 4.35 V at 85°C

Note: The specification is quoted from the datasheet of Infineon OPTIGA™ Trust B.

4 Schematic

The IoT XENSIV™ lighting platform consists of five PCB boards, IoT XENSIV™ main board, wireless connectivity module, isolation circuit board, digital LED driver and radar module.

The schematic of the IoT XENSIV™ main board is separated into two parts, the 3 W 5 V CoolSET™ ICE3RBR4765 auxiliary power supply and the XMC1302 main control unit.

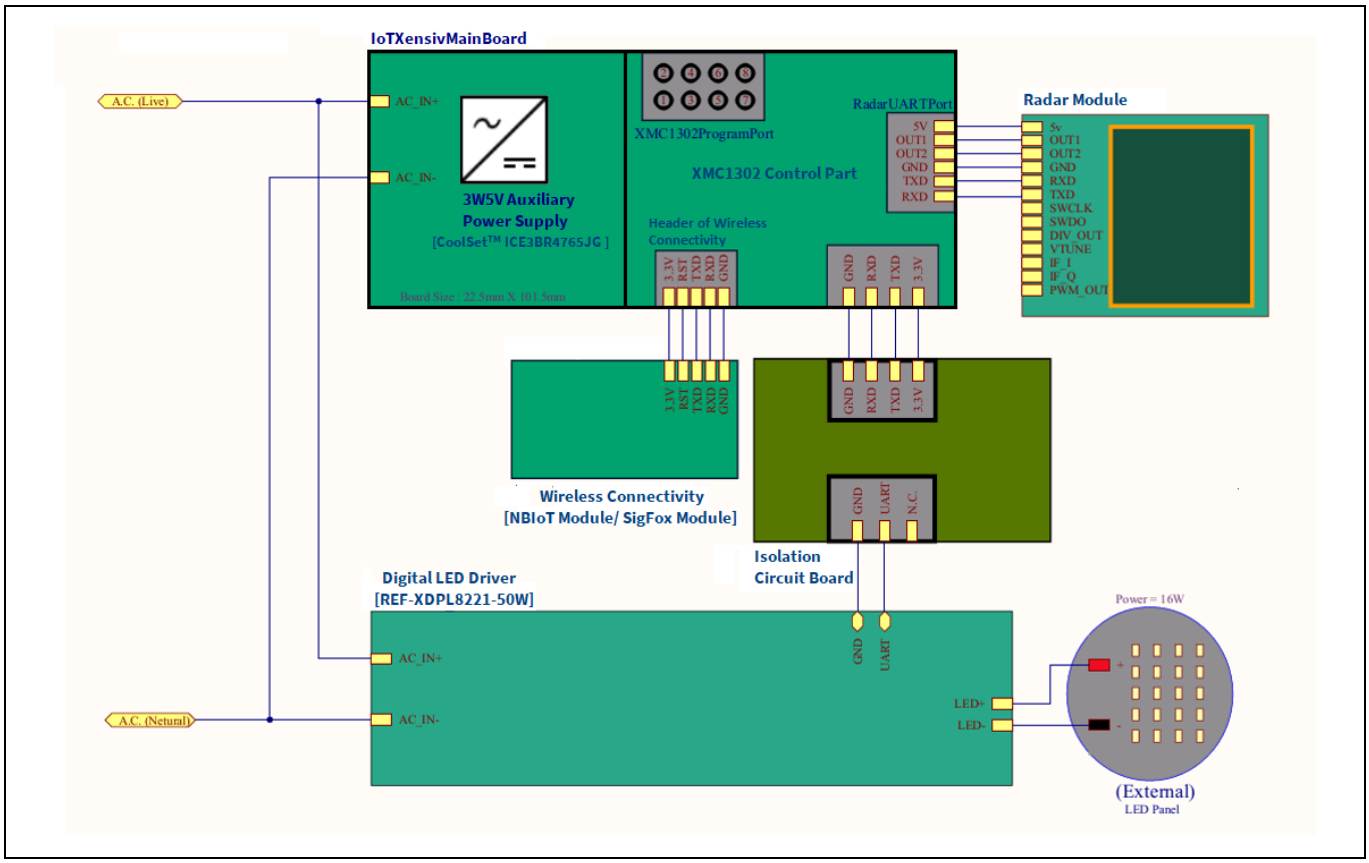


Figure 10 Schematic of IoT XENSIV™ lighting platform

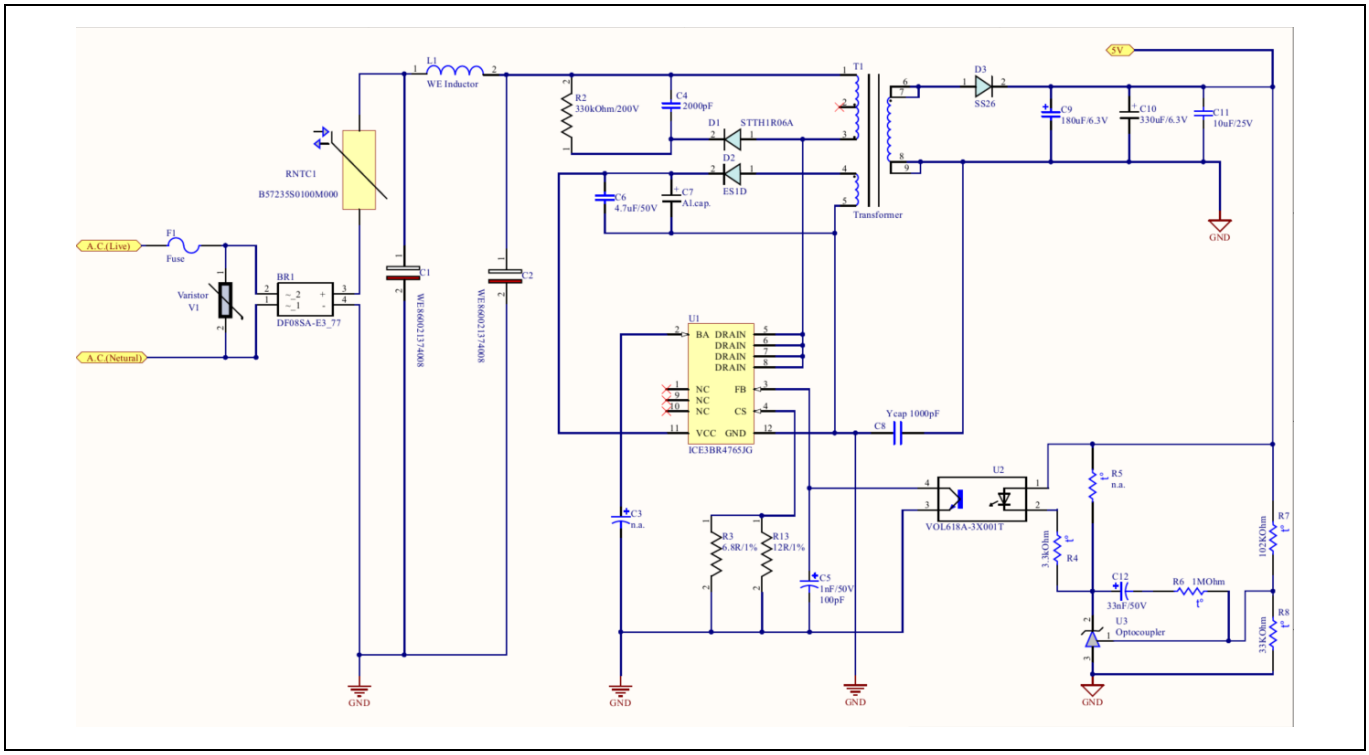


Figure 11 Schematic of 3 W 5 V auxiliary power supply

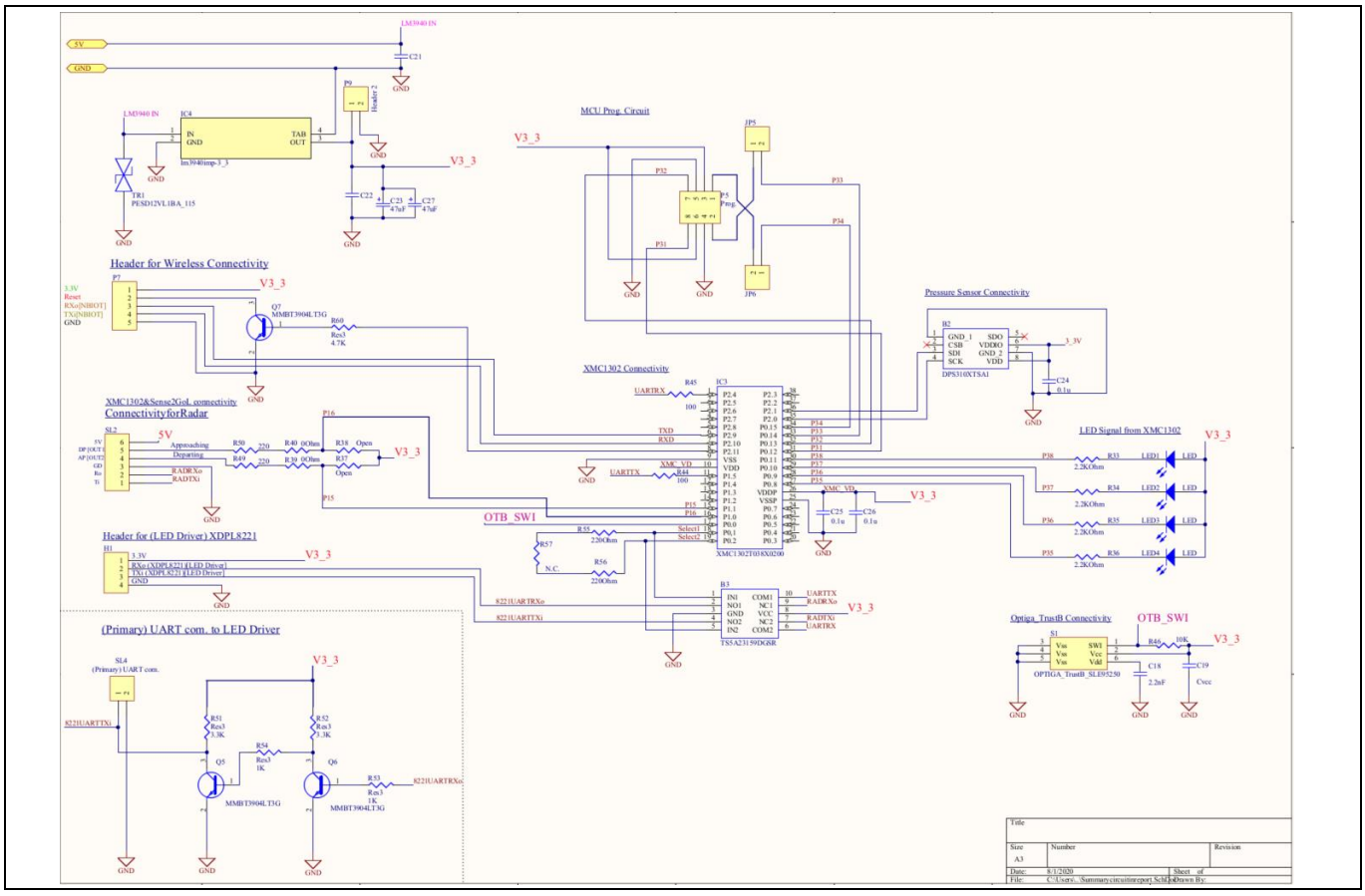


Figure 12 Schematic of XMC1302 control unit

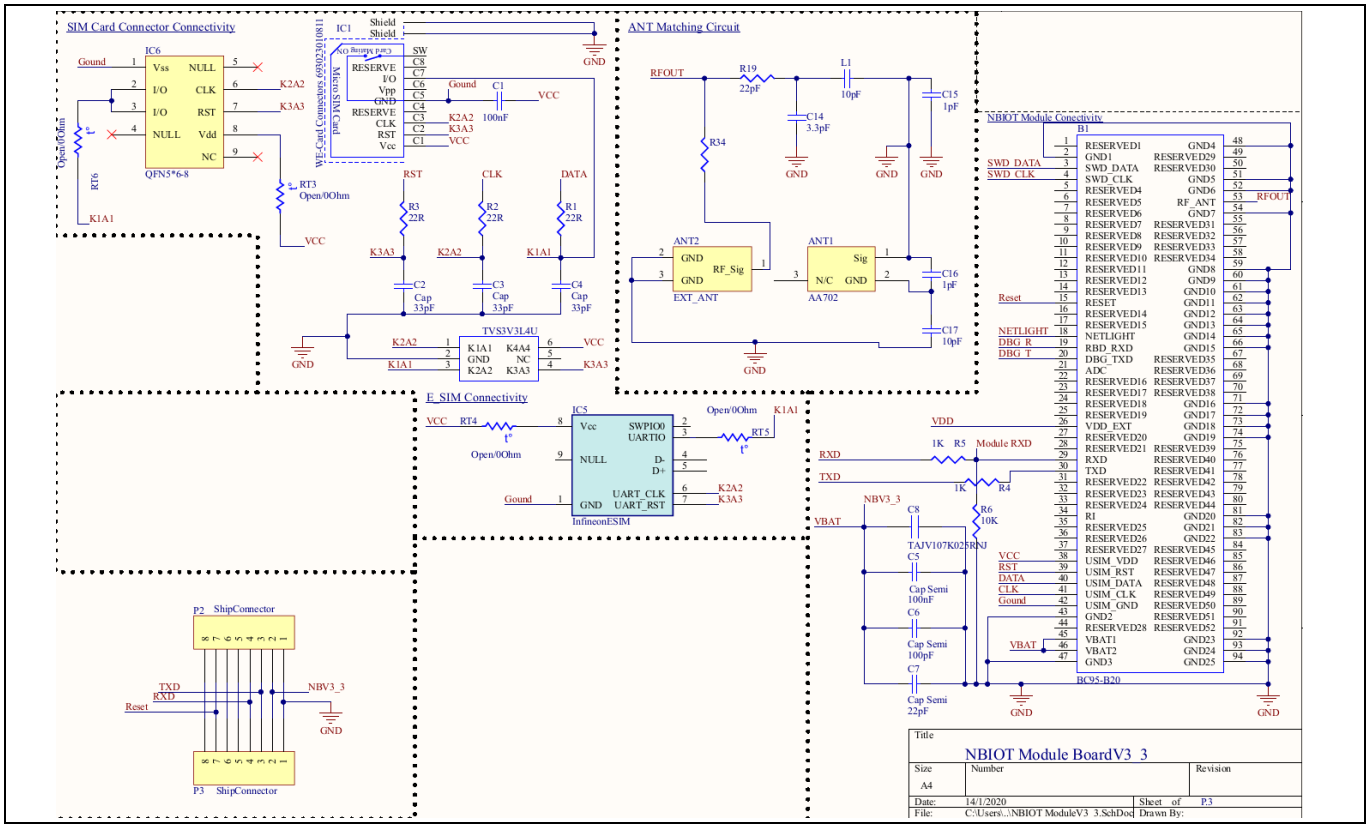


Figure 13 Schematic of wireless connectivity – NB-IoT module

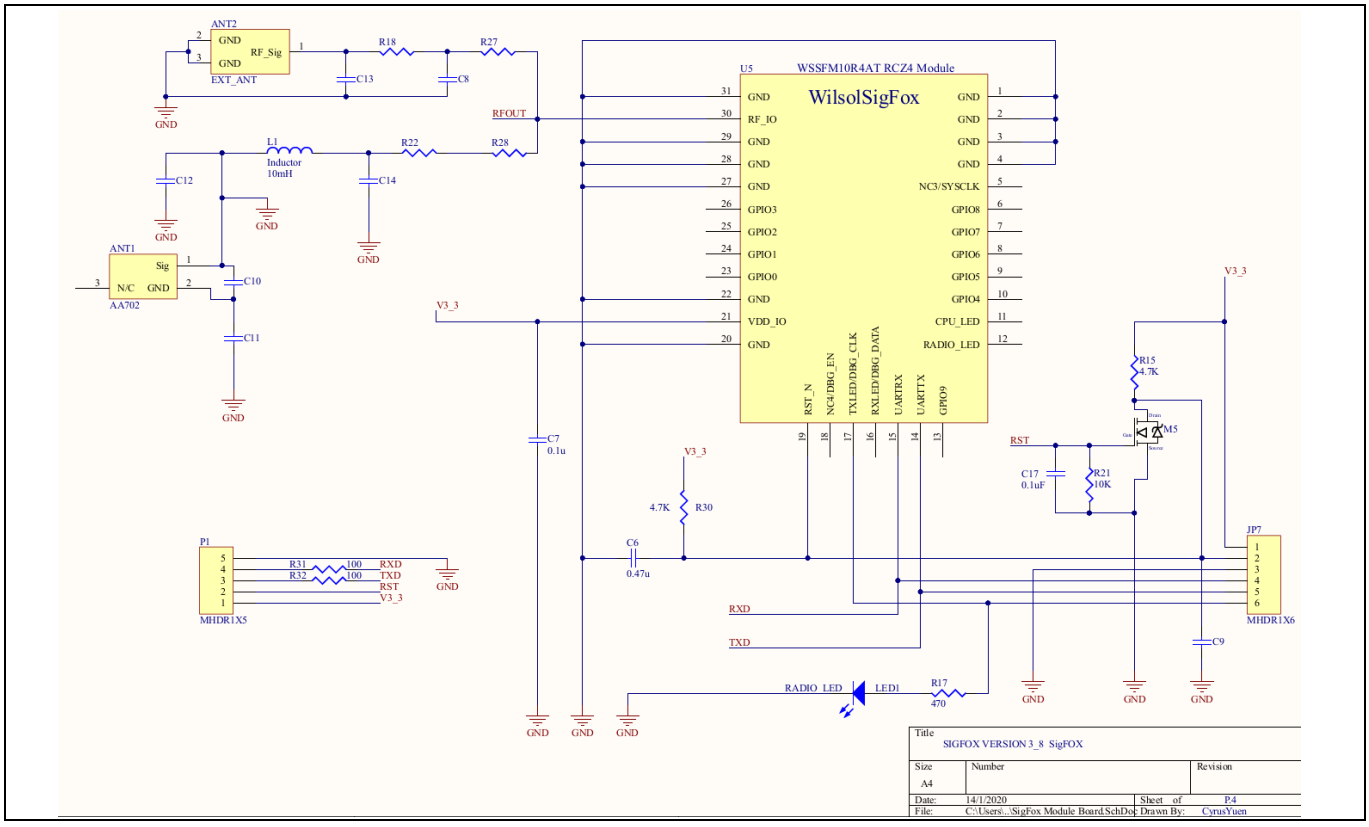


Figure 14 Schematic of wireless connectivity – SigFox module

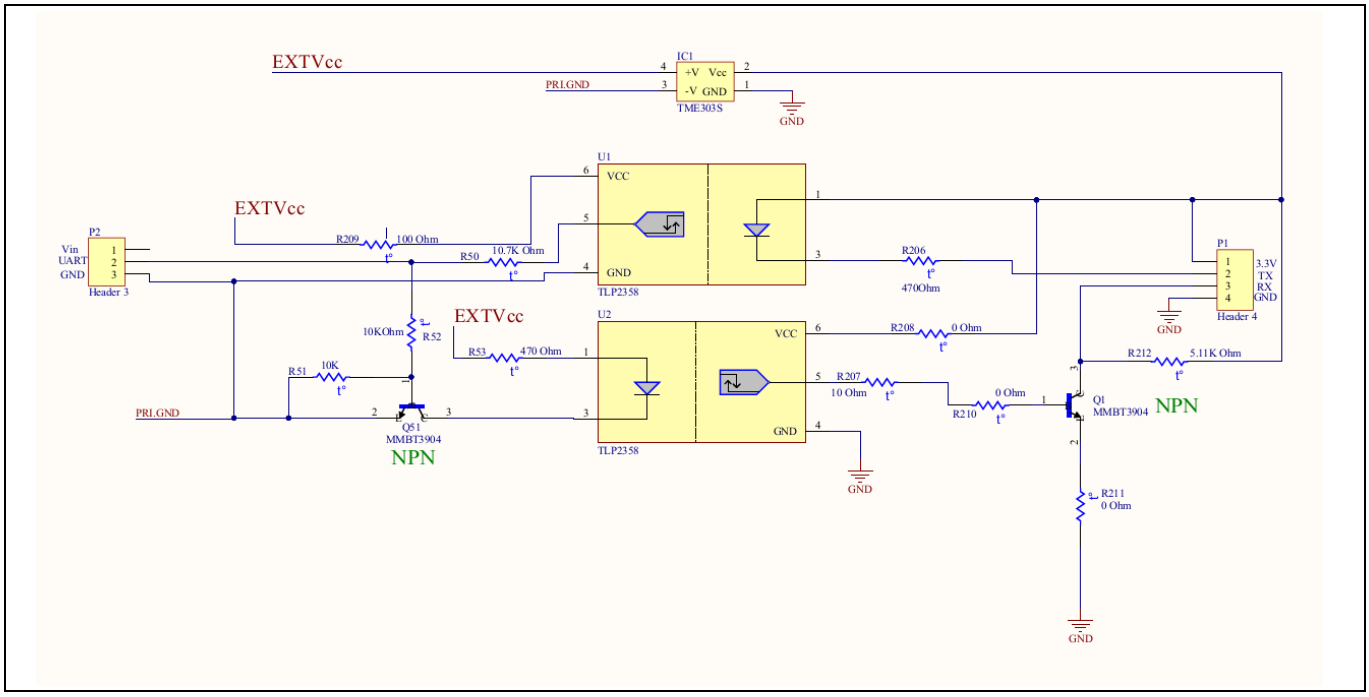


Figure 15 Schematic diagram of isolation circuit

This part provides an isolated solution for the UART communication between the primary side and the secondary side of the LED driver. It is recommended for controlling the XDPL8221 50W reference board. The UART pin in the XDPL8221 is open drain. TME303S produces isolated 3.3 V to pull up the pin and provide source voltage to the optical coupler.

5 Test results

5.1 Power consumption of IoT XENSIV™ lighting platform

This section provides measurement results for the power consumption of different dimming levels. The measurement was done with the power analyzer Yokogawa WT3000, using the integration function for 5 minutes under an input voltage of 220 V AC, 50 Hz.

Table 9 Power consumption

Dimming level	0 percent	1 percent	5 percent	10 percent	20 percent	50 percent	80 percent	100 percent
Energy dissipation (mWh)	97.4	185.3	221.3	294.3	442.2	784.1	1206.1	1480.1
Power consumption (W)	1.1685	2.2237	2.655	3.532	5.3062	9.409	14.4736	17.7617

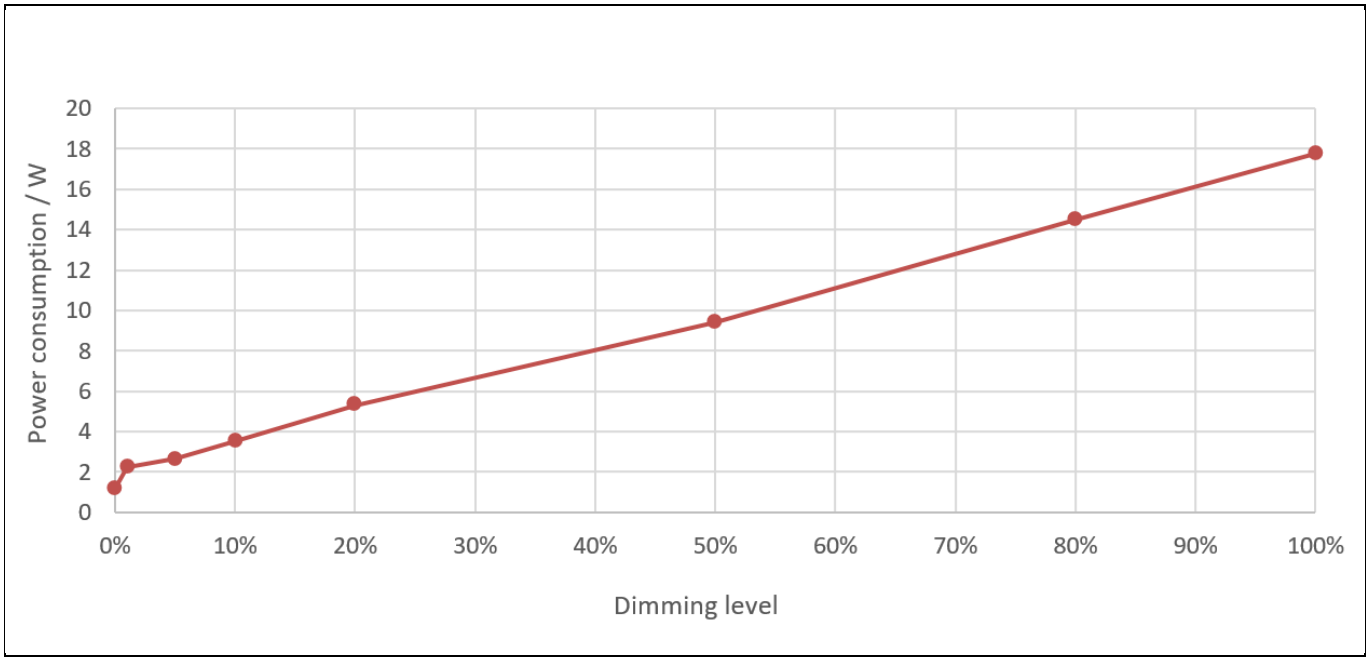


Figure 16 IoT XENSIV™ system (reference design) power consumption curve with 220 V AC, 50 Hz

5.2 Transient response of auxiliary power supply

The step load is switching between 17 percent and 100 percent with a ~3000 ms period.

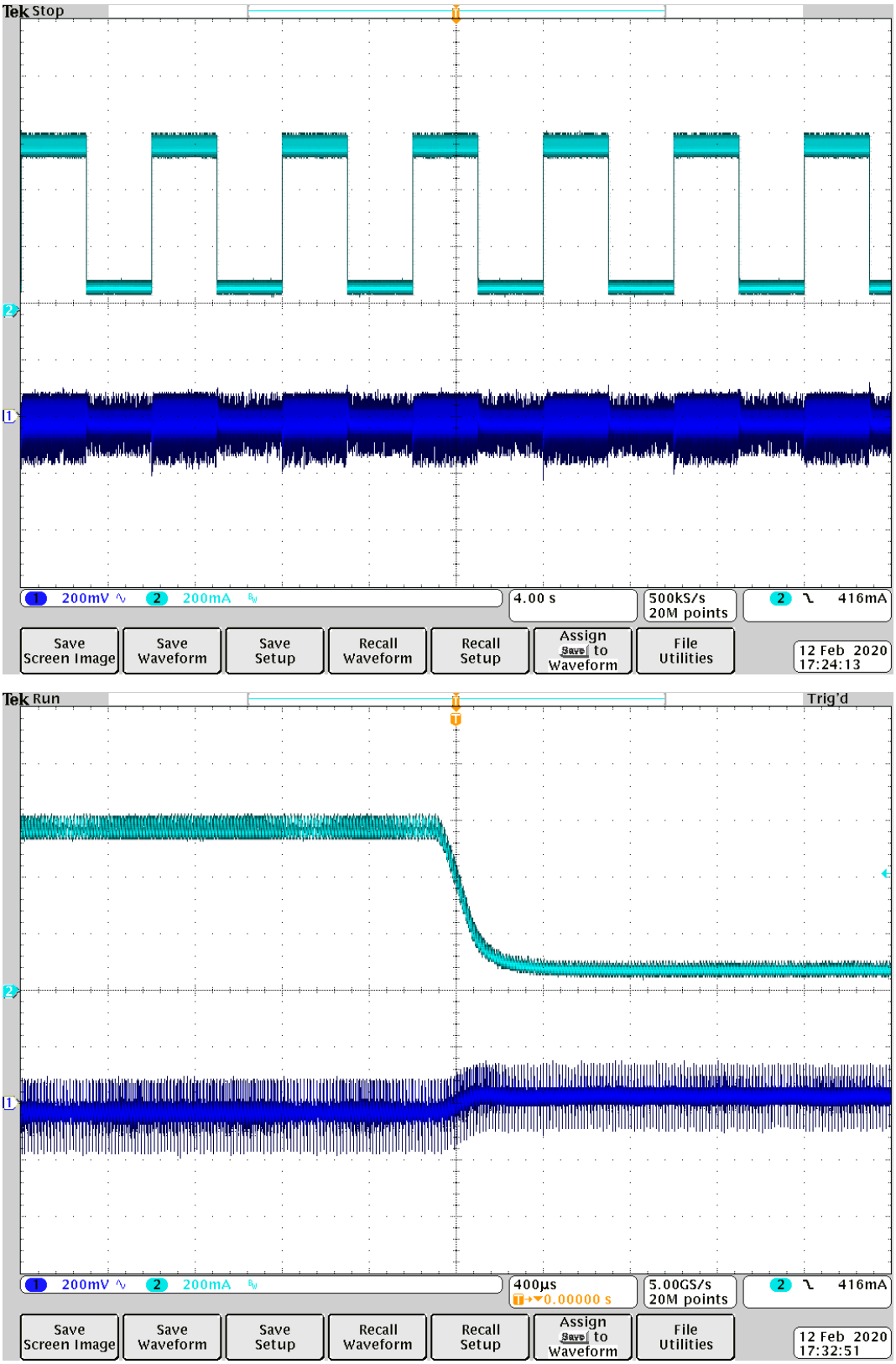


Figure 17 Load-transient response

5.3 Start-up time of auxiliary power supply

Start-up waveforms are captured at 220 V AC and full load.

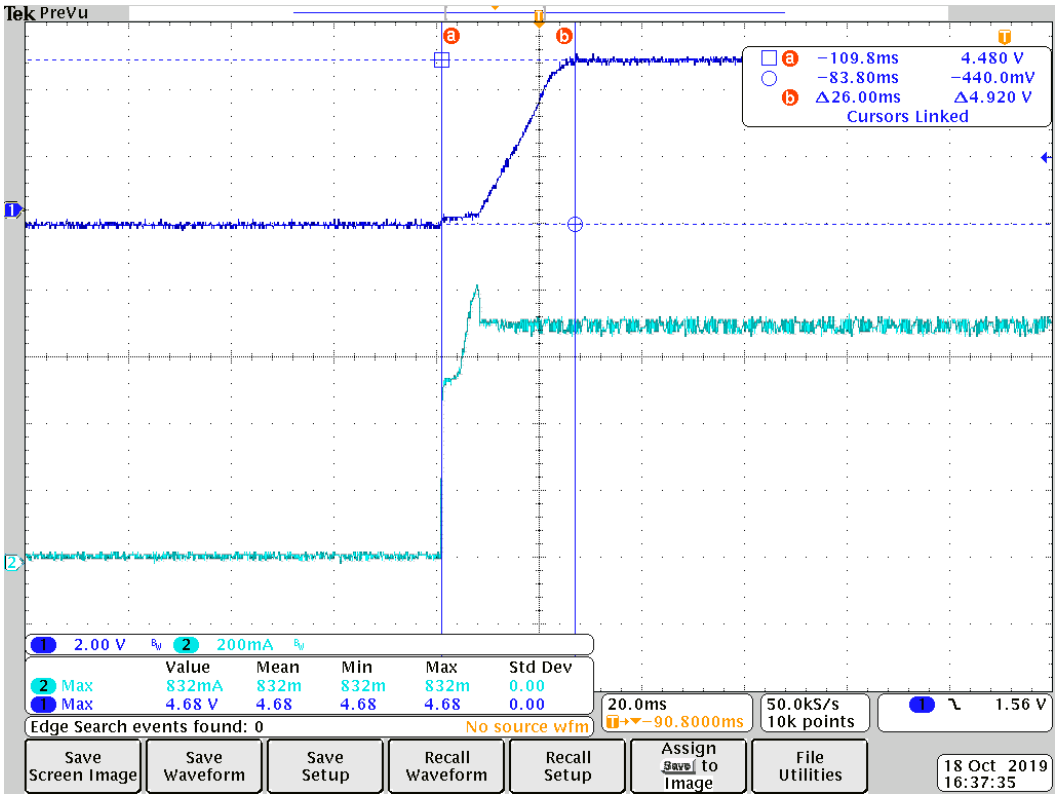


Figure 18 Output voltage and output current start-up time

5.4 Output voltage ripple of of auxiliary power supply

The measurements are perfomed at 220 V AC and no load, mid load and full load. The waveforms are shown in AC coupling in the Tektronix DPO4104B.

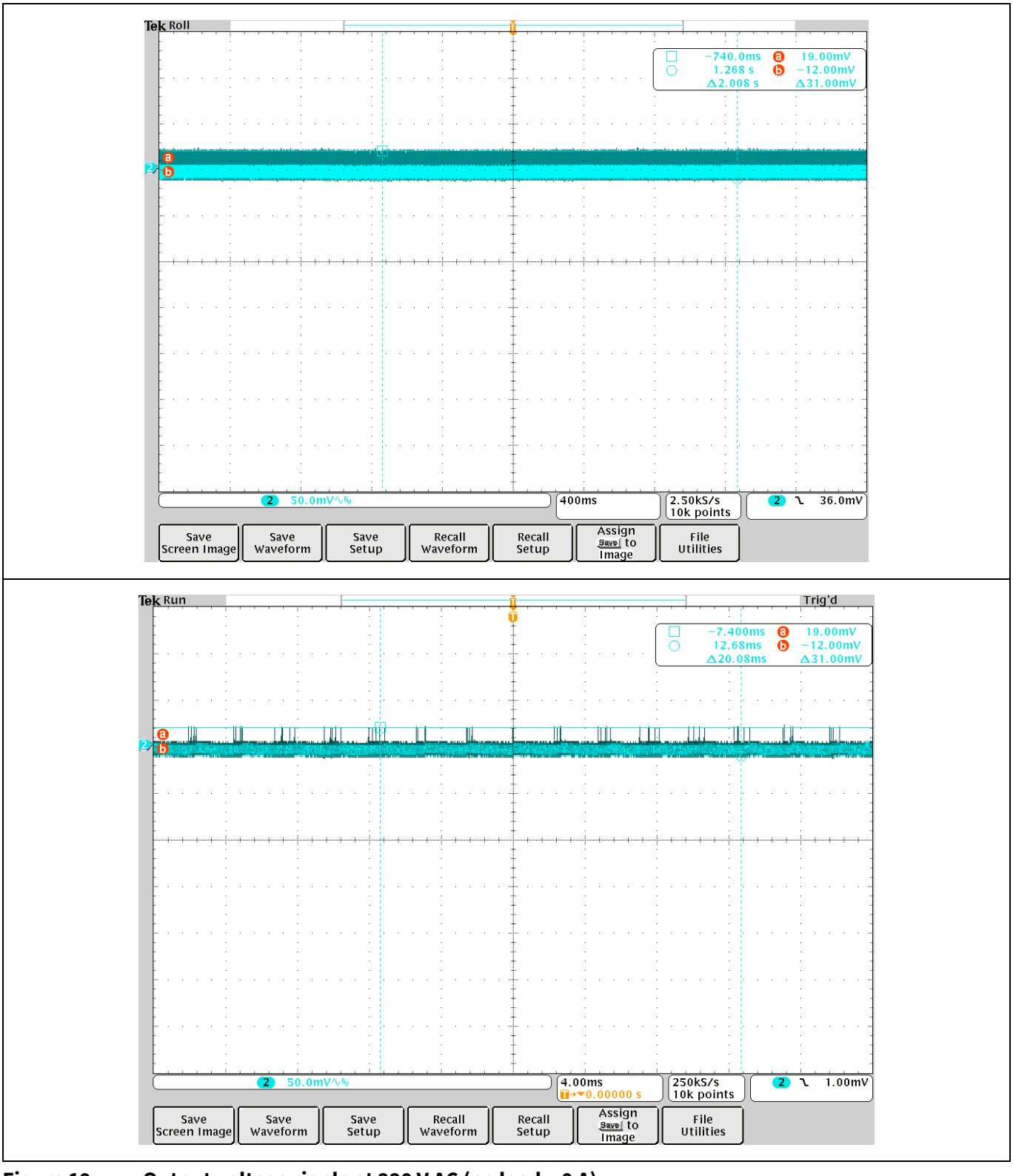
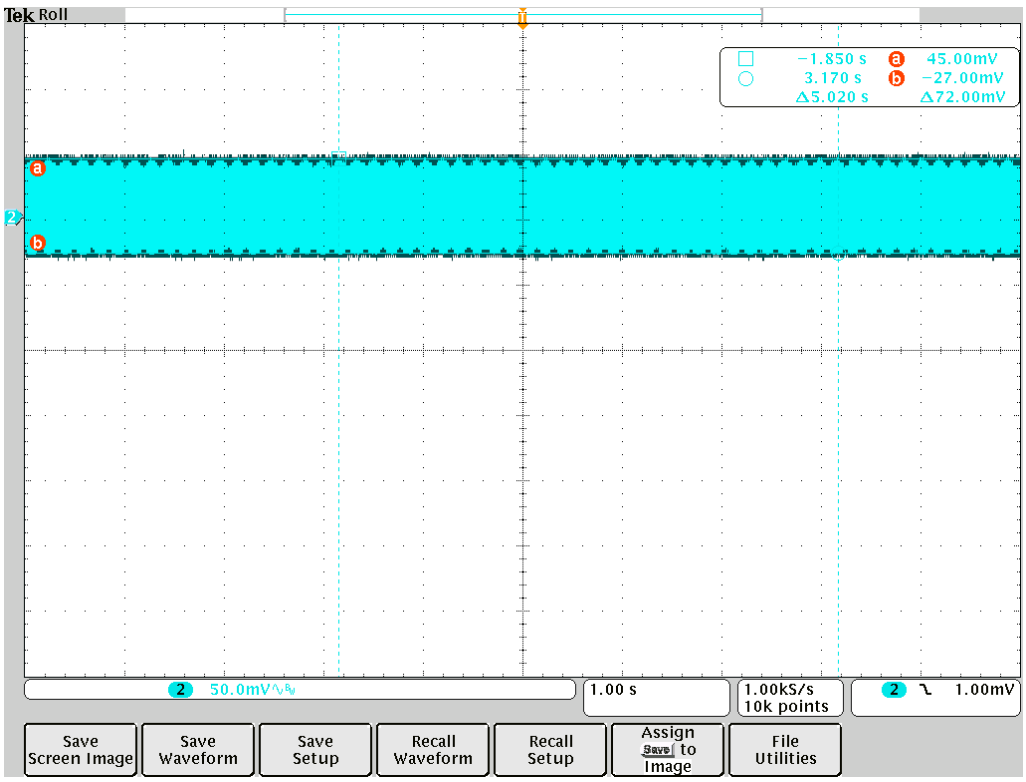


Figure 19 Output voltage ripple at 220 V AC (no load = 0 A)



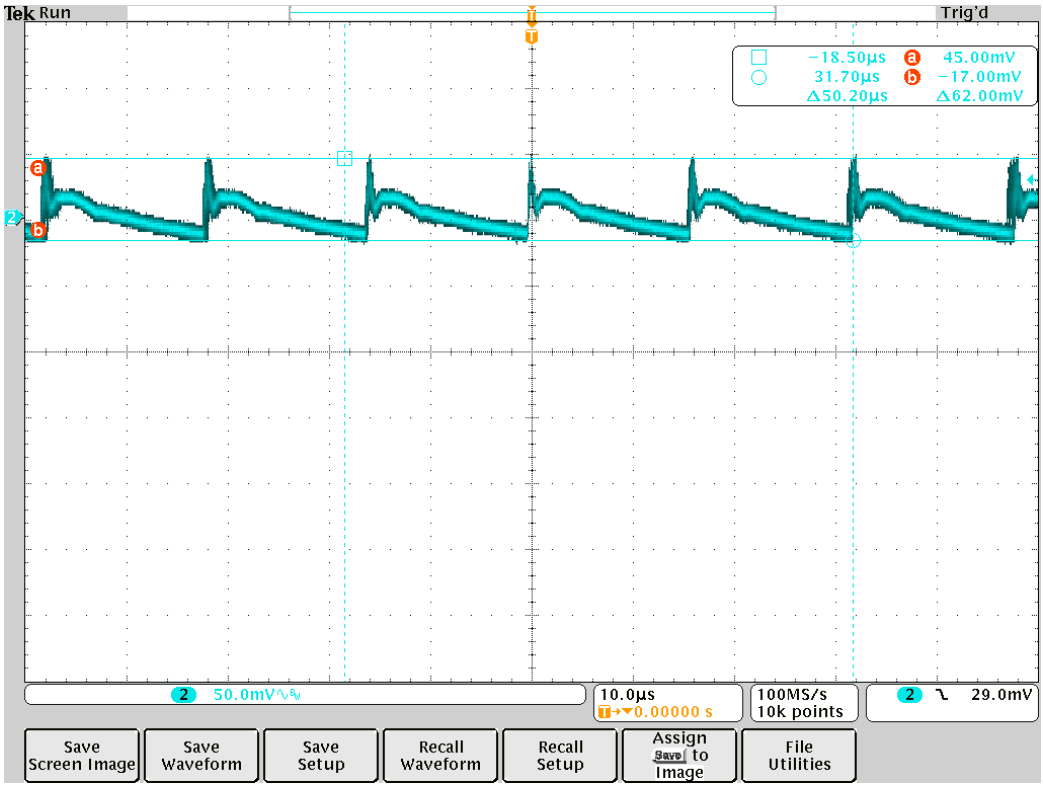


Figure 20 Output voltage ripple at 220 V AC (mid load = 0.35 A)

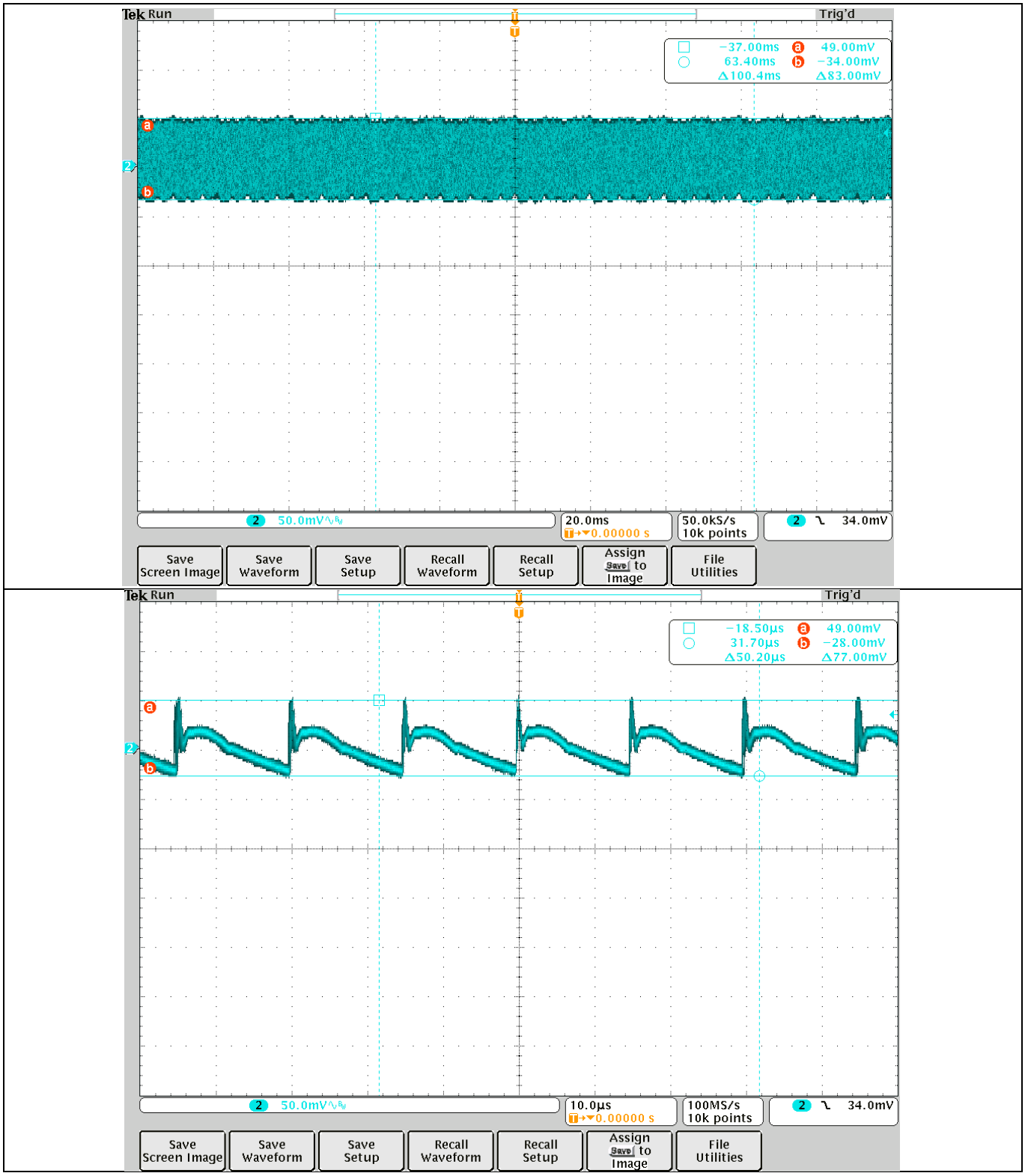


Figure 21 Output voltage ripple at 220 V AC (full load = 0.6 A)

5.5 Load and line regulation of auxiliary power supply

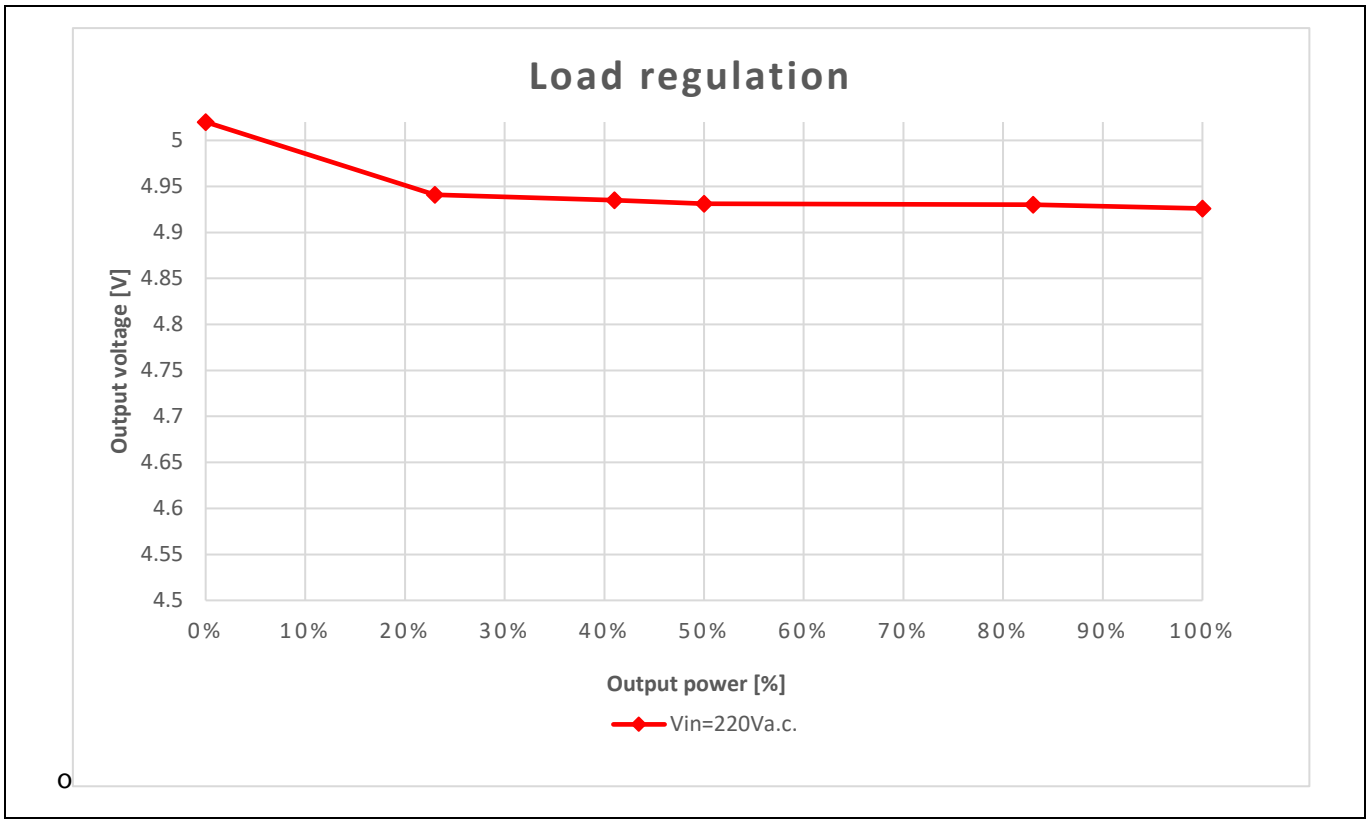


Figure 22 Load regulation at V_{in} = 220 V AC

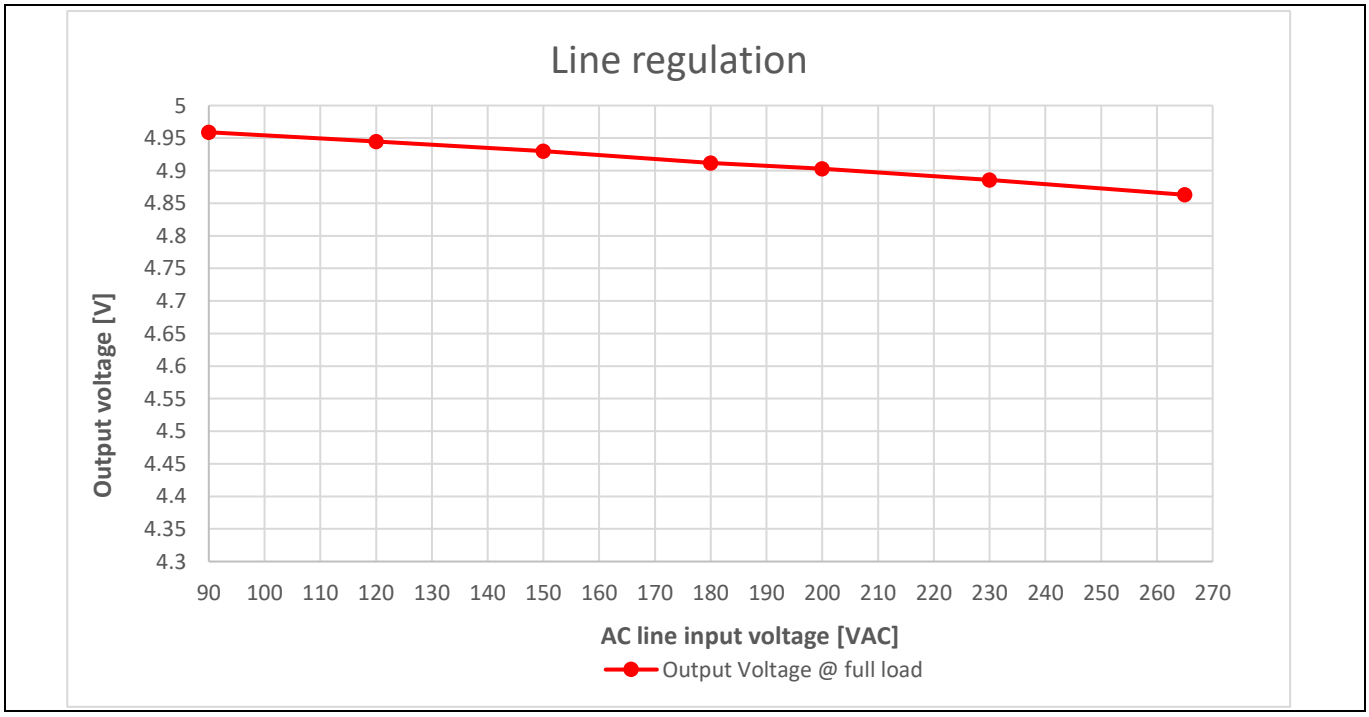


Figure 23 Line regulation at full load

5.6 Conducted EMI of auxiliary power supply

Conducted EMI was measured to test standard EN 55022, at V_{in} = 220 V AC with full load.

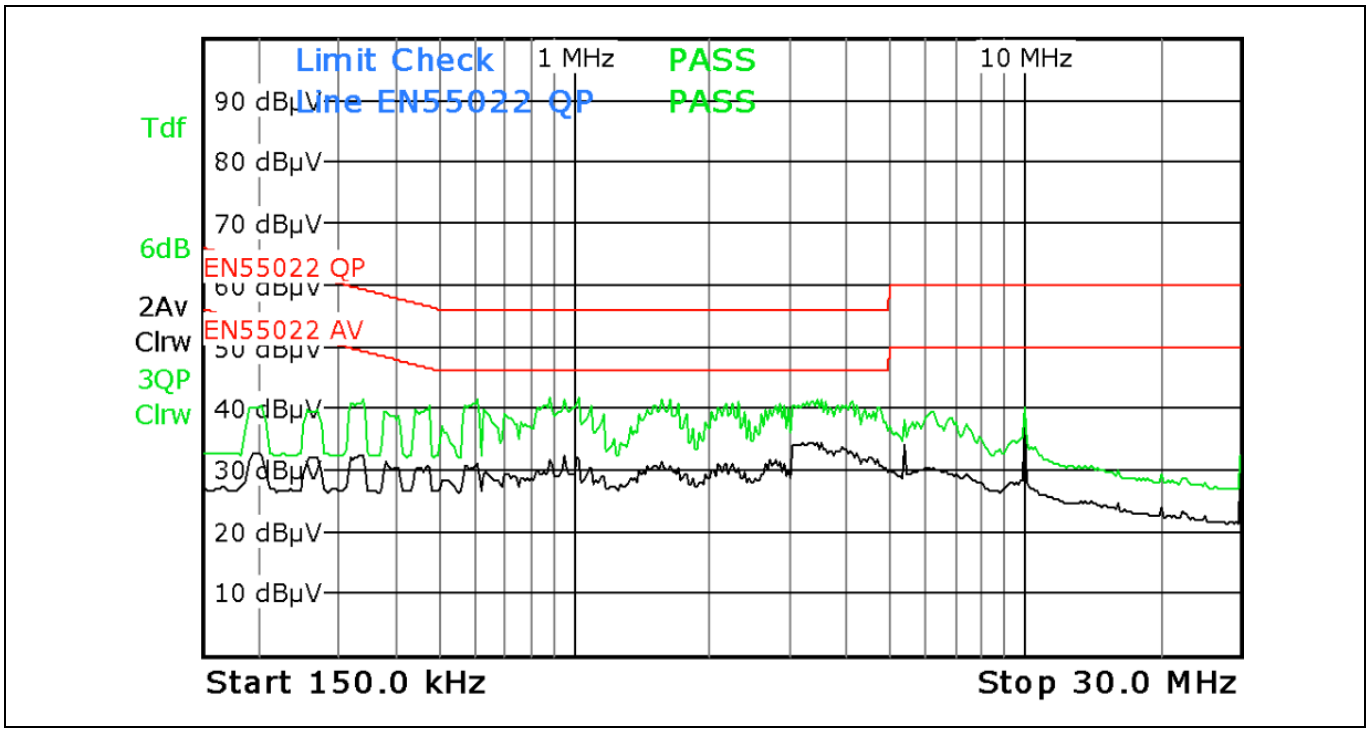


Figure 24 Line

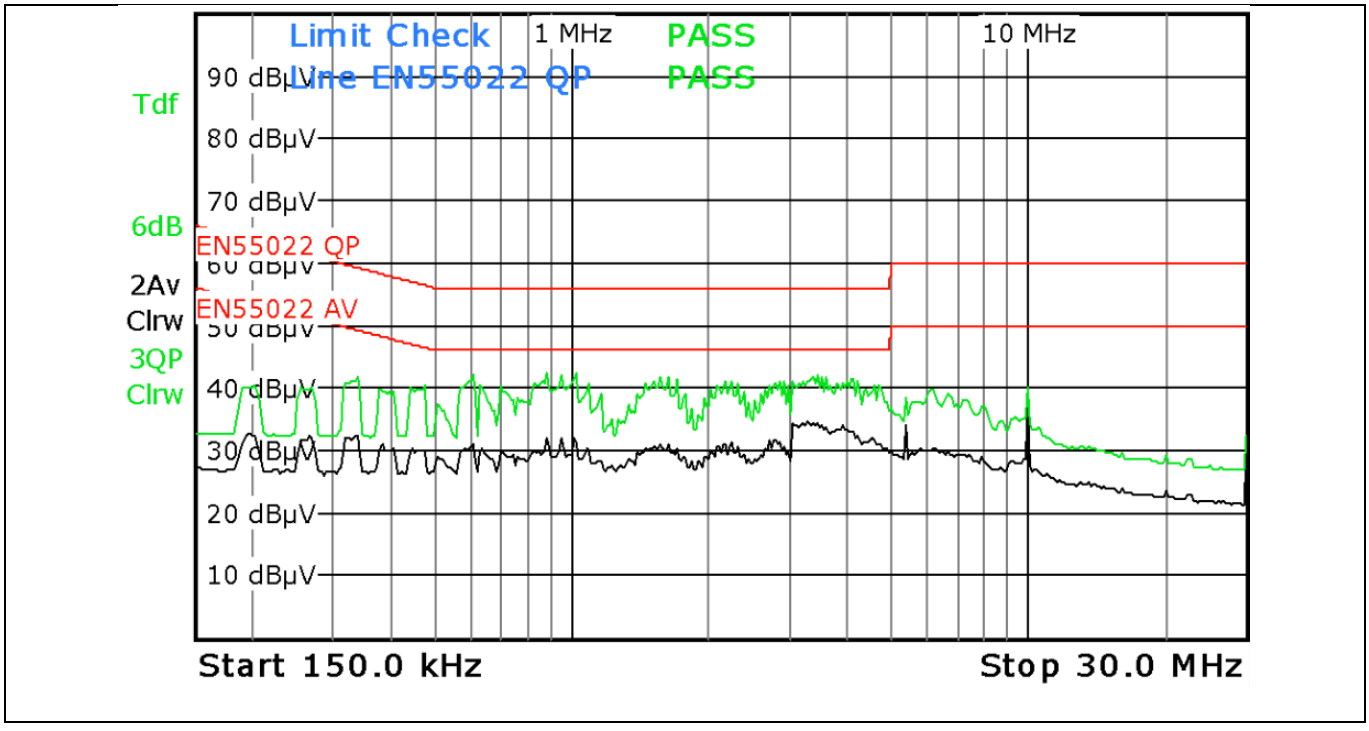


Figure 25 Neutral

5.7 920 MHz antenna performance of NB-IoT module

The measurement of antenna performance was done with the Keysight FieldFox Microwave Analyzer N9918A.

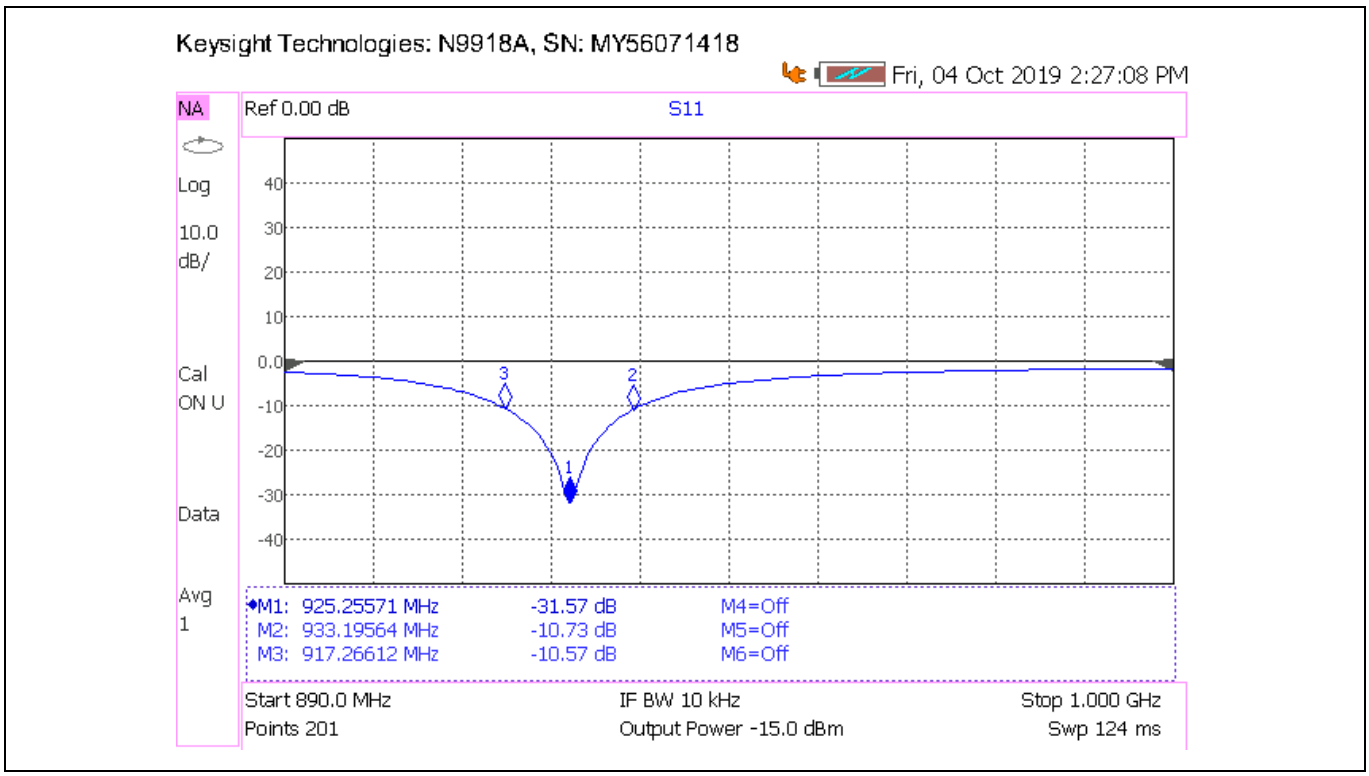


Figure 26 S11 diagram in log. mag.

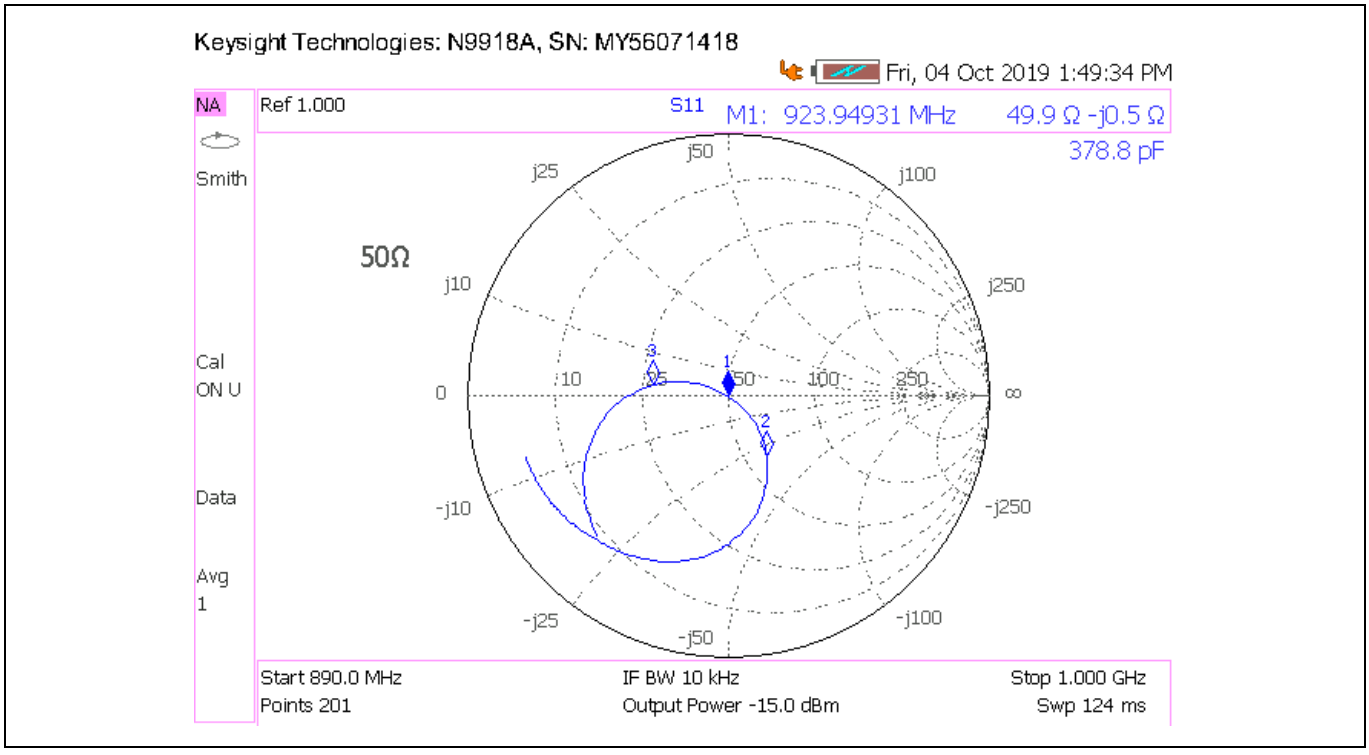


Figure 27 Smith chart

5.8 920 MHz antenna performance of SigFox module

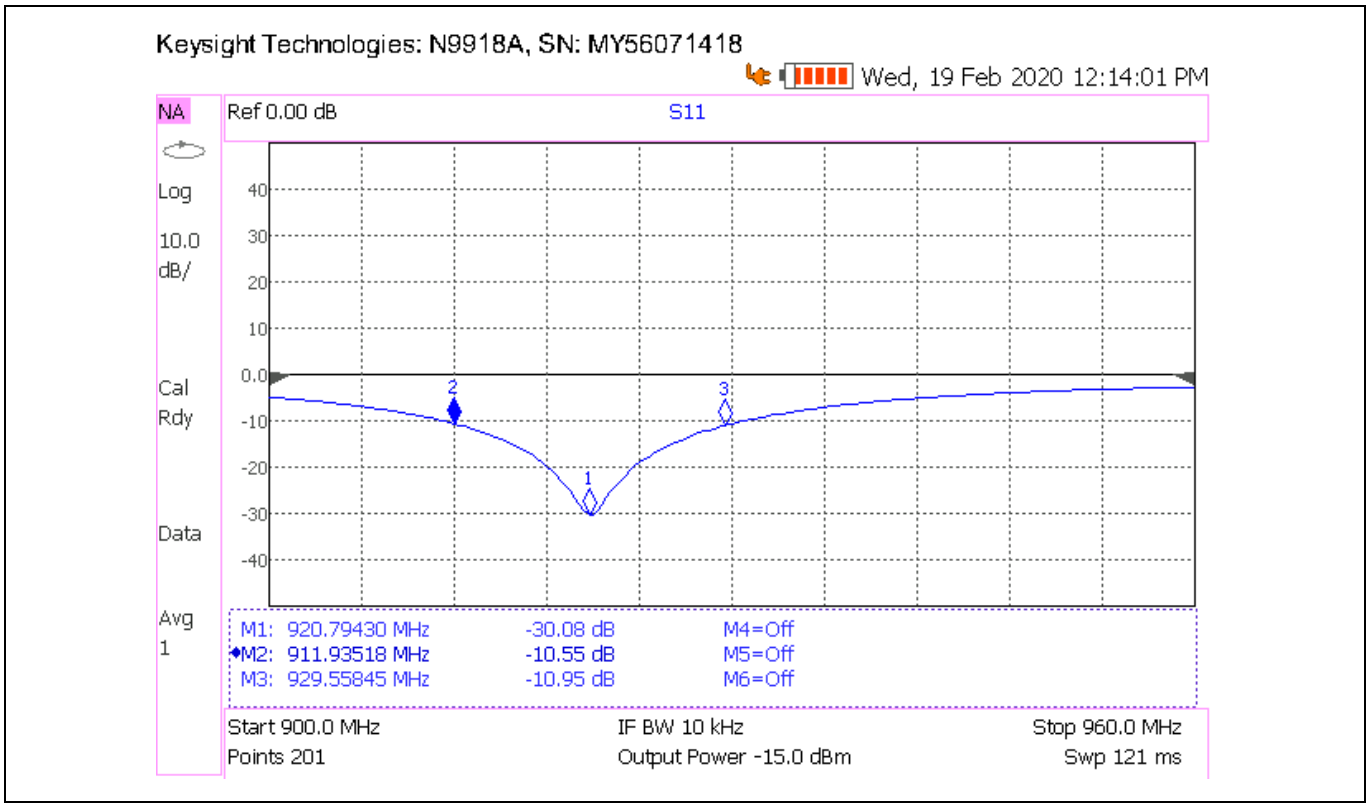


Figure 28 S11 diagram in log. mag.

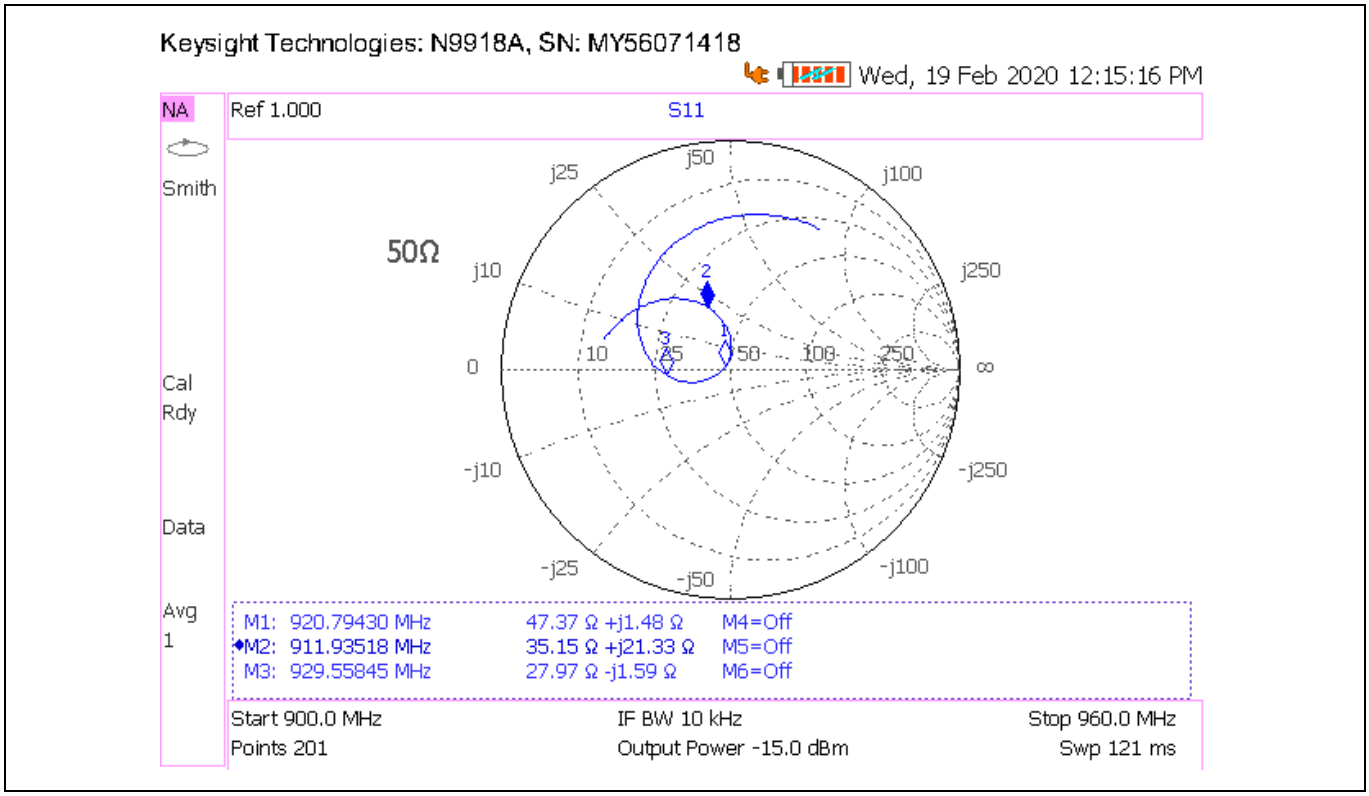


Figure 29 Smith chart

5.9 Design consideration of sleep to wake mode in digital LED driver

When customers design their XDPL8221 LED driver, it is required to check the circuit to avoid failure recovery of the LED from dim off mode. According to the application note for the XDPL8221 UART, a sync. and a dimming command are required to wake XDPL8221 up from dim off, but hardware needs to support this operation too.

Note: For more details on 8221 UART communication, please see the software section.

5.9.1 Findings

When the digital LED driver in dim off mode receives a dimming level command below 5 percent, it is difficult to dim on. This is caused by the light output power of the LED. The Flyback transformer cannot provide sufficient power to the V_{CC} of XDPL8221. **Figure 30** shows that the V_{CC} drops below the undervoltage lockout (less than 6.5 V). XDPL8221 enters auto-restart mode.

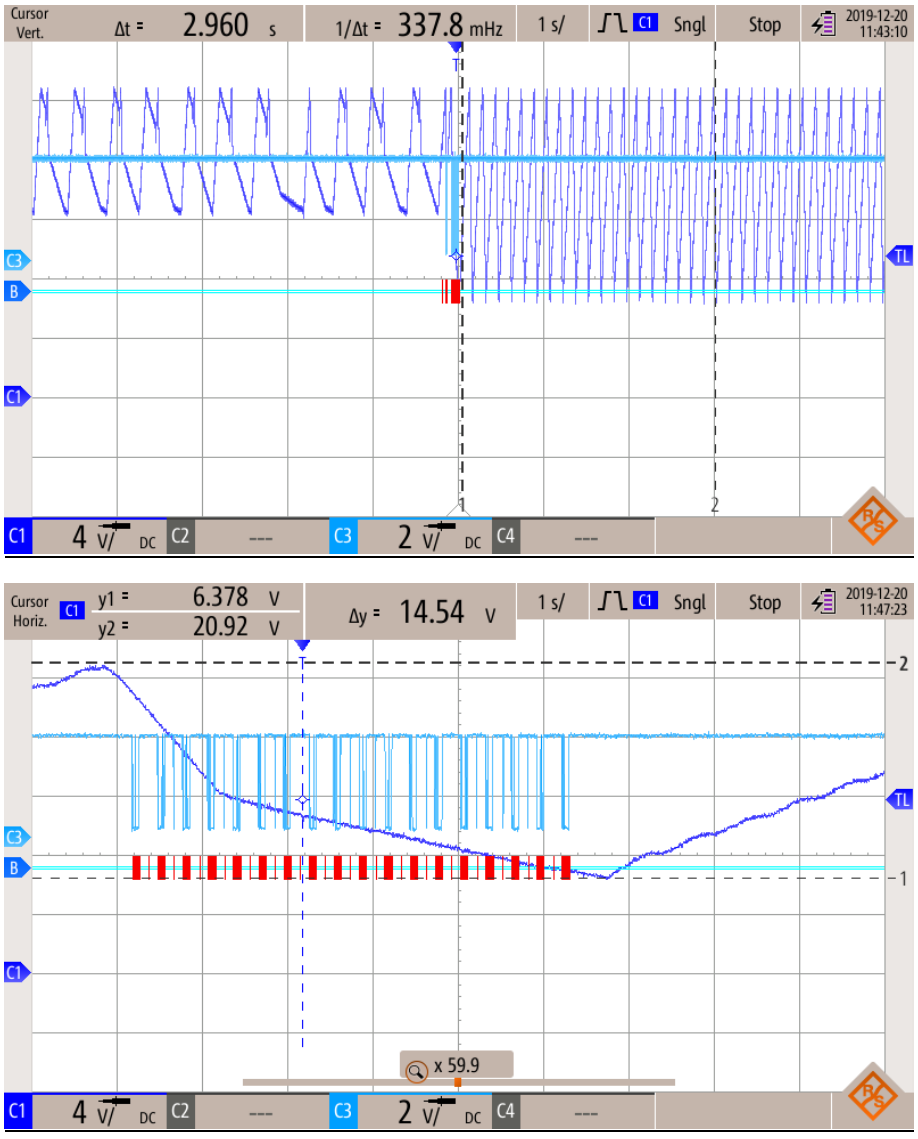


Figure 30 XDPL8221 in auto-restart mode

In auto-restart mode, the acknowledge byte (0x00) to XMC1302 requires 300 to 1000 µs after XDPL8221 receives the sync. command. If XMC1302 doesn't send the dimming level command to XDPL8221 within 148 ms, XDPL8221 resets and restarts automatically when V_{CC} drops from the peak voltage. The digital LED driver is not able to recover.

5.9.2 Possible solution

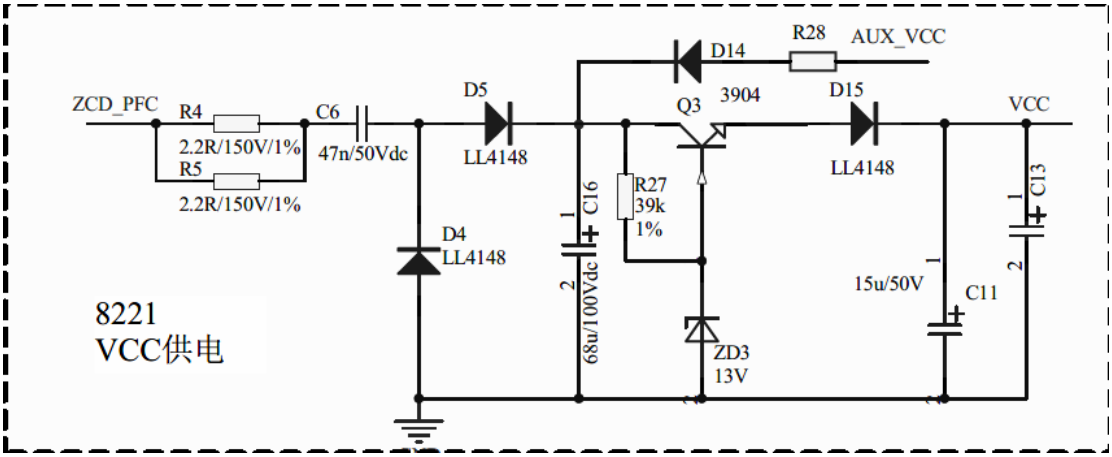


Figure 31 Schematic of XDPL8221 V_{cc}

To prevent V_{CC} below the undervoltage lockout, the value of capacitor C11 could be replaced by 100 µF. The higher charging up power ensures that the V_{CC} is higher than 6.5 V when dimming up from sleep mode.

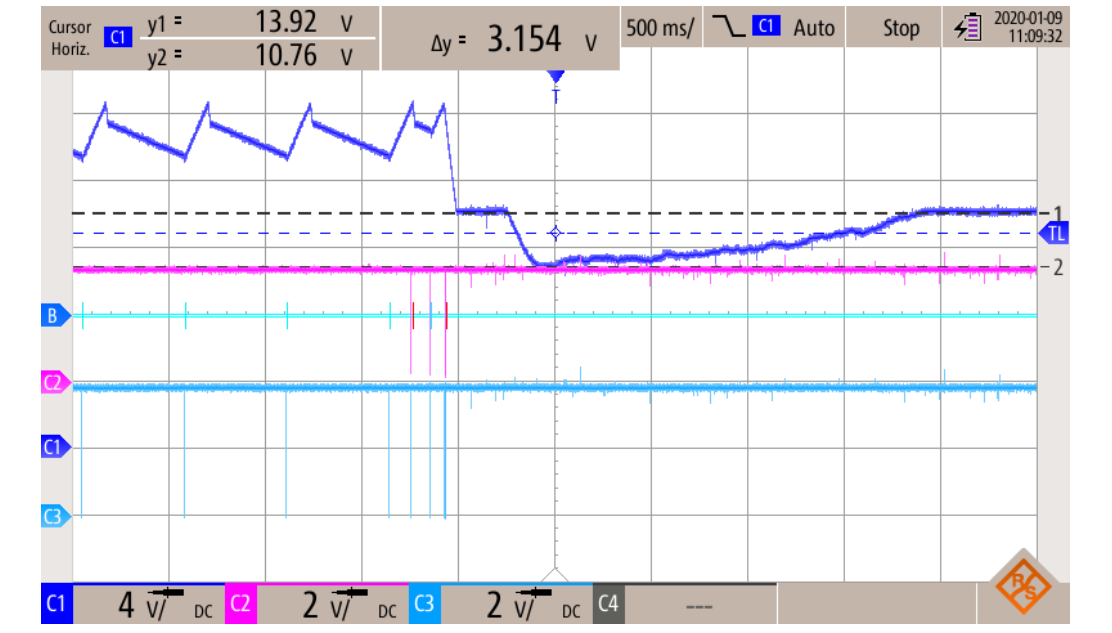


Figure 32 Recovery of XDPL8221

Figure 32 shows the V_{CC} (Ch1) drops in 10.76 V, which is higher than the undervoltage lockout (6.5 V). The XDPL8221 recovers successfully after receiving the sync and dimming commands.

6 PCB

The PCB is double-layer, double-sided and manufactured with the 1.5 mm thickness and 1 oz. copper. The overall PCB size is 23.3 mm x 114.7 mm.

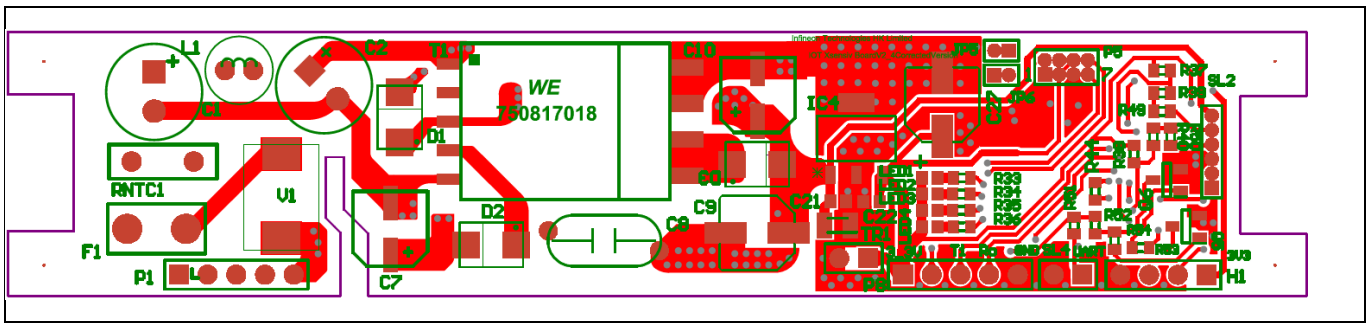


Figure 33 IoT XENSIV™ main board layout – top

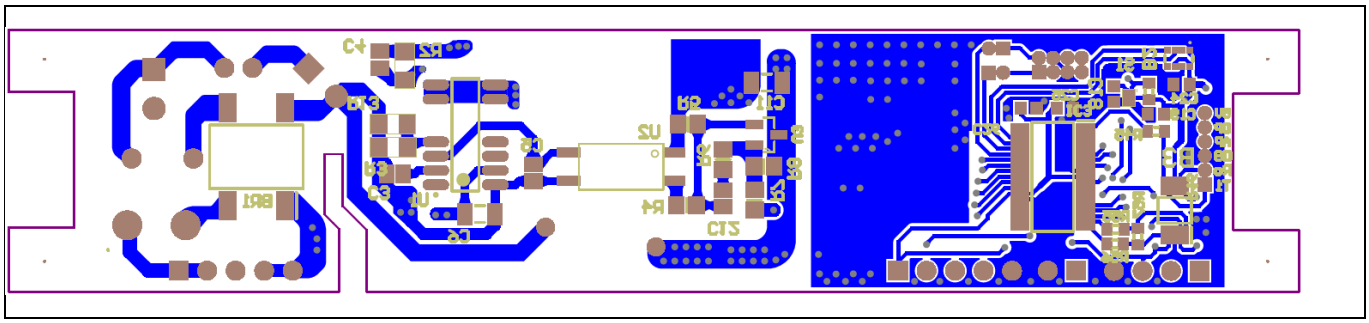


Figure 34 IoT XENSIV™ main board layout – bottom

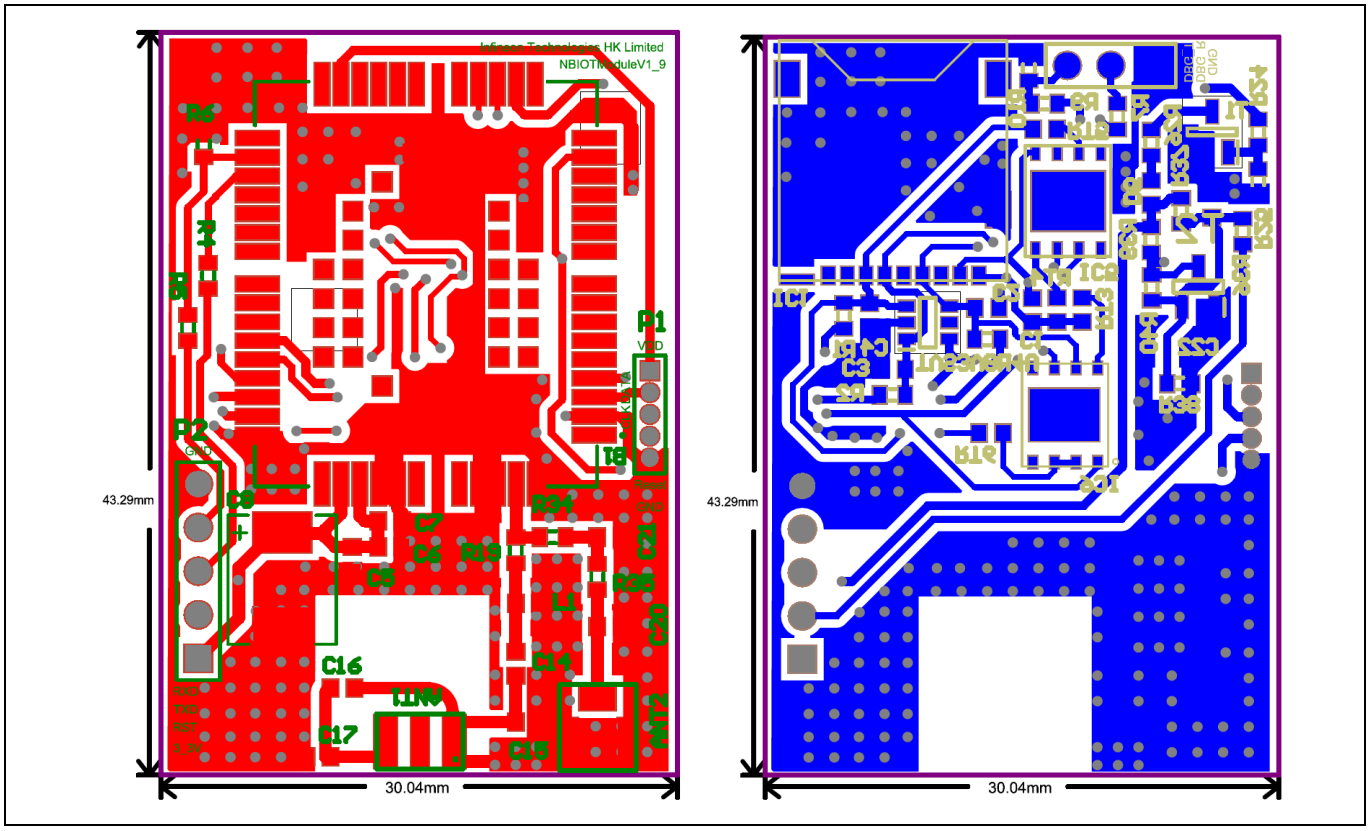


Figure 35 NB-IoT module layout

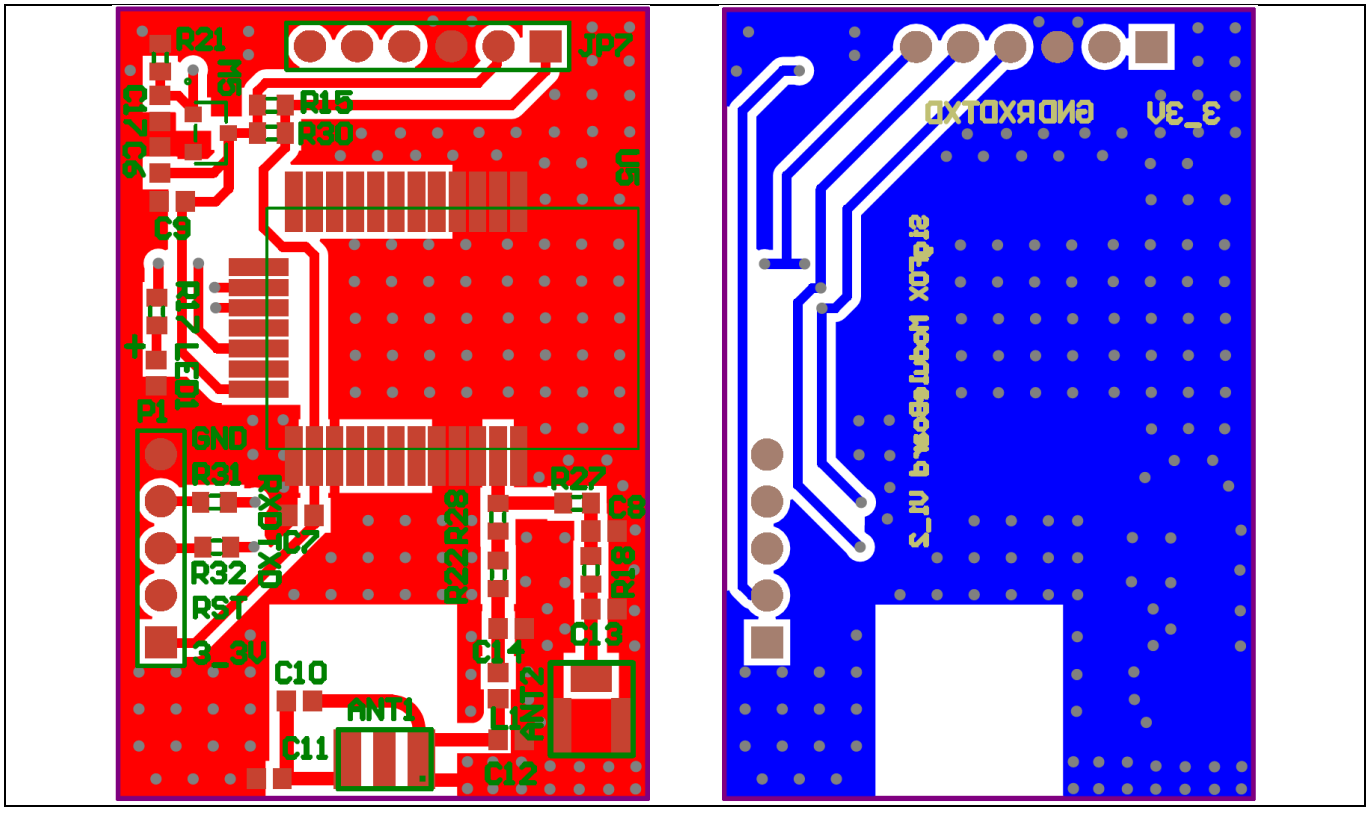


Figure 36 SigFox module layout

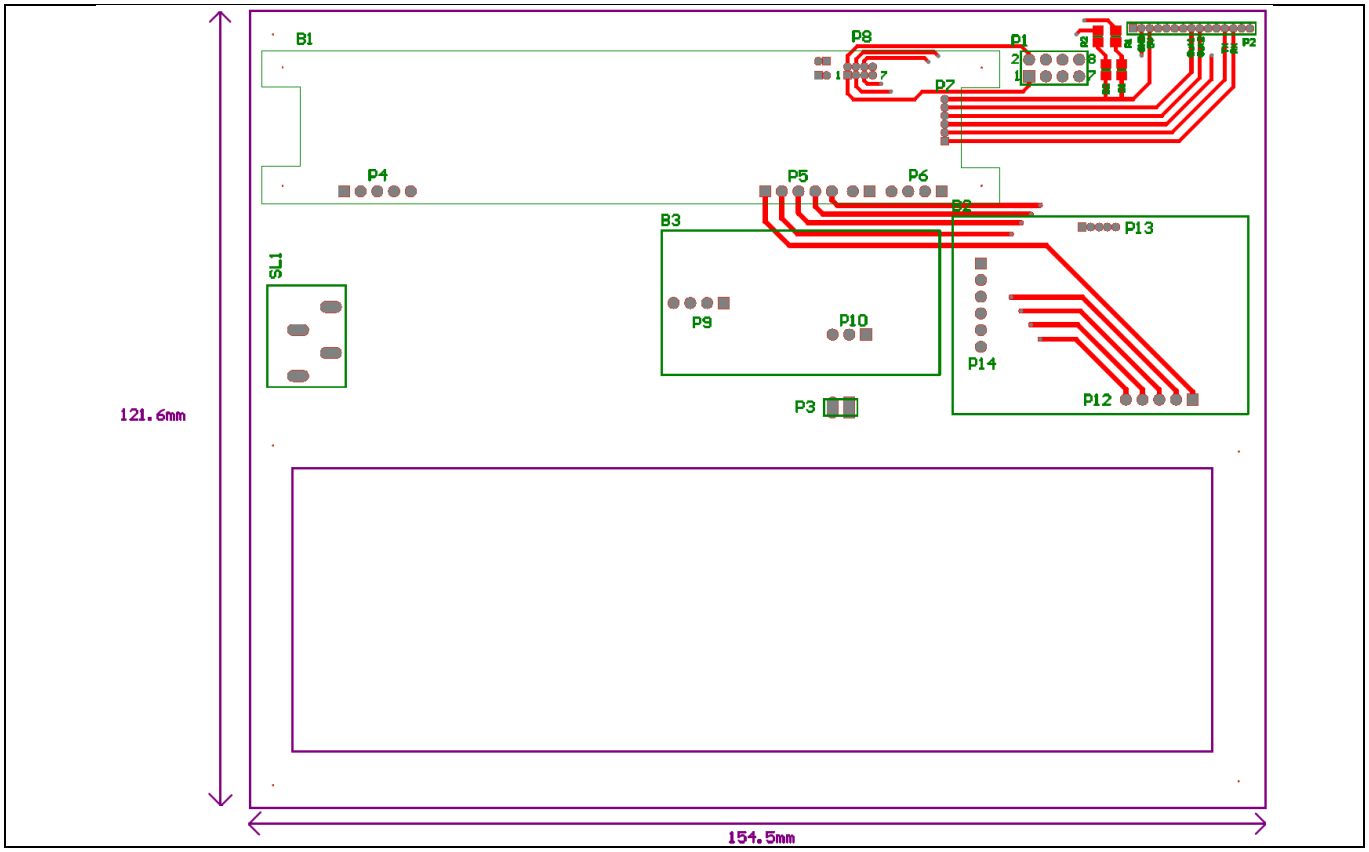


Figure 37 Top layer of adapter board

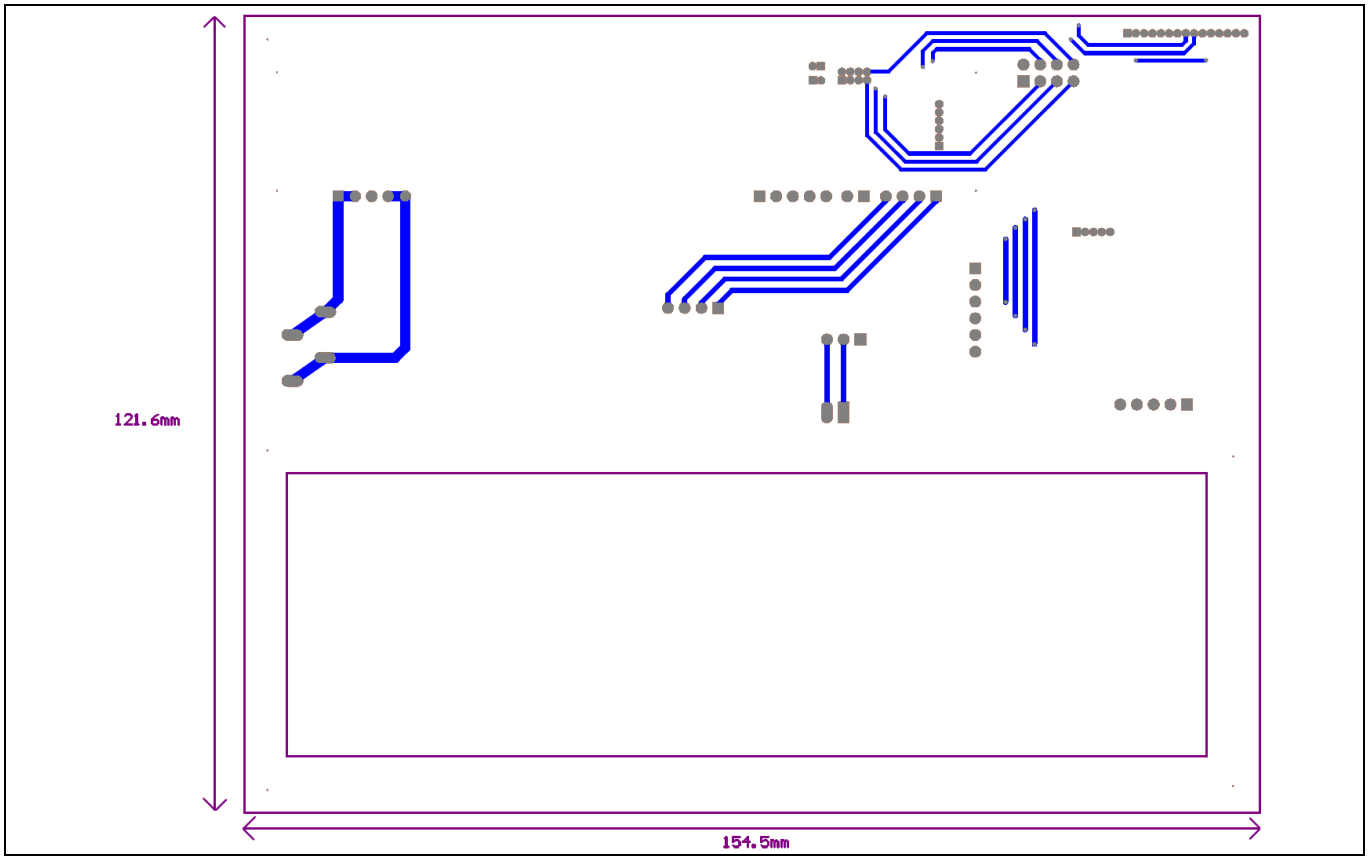


Figure 38 Bottom layer of adapter board

7 Bill of Materials (BOM)

Table 10 BOM of IoT XENSIV™ main board

Designator	Part no.	Manufacturer	Description	Quantity
B2	DPS310XTSA1	Infineon	Pressure sensor	1
B3	TS5A23159DGSR	Analog Devices	Multiplexer	1
BR1	DF10SA-E3/77	Vishay	Bridge rectifier	1
C1, C2	860021374008	Würth Elektronik	Aluminum electrolytic capacitors – radial leaded WCAP-ATG5 4.7 µF 400 V 20 percent radial	2
C3	n.a.	–	–	1
C4	C2012X7R2E222K085AA	TDK Corporation	Multilayer ceramic capacitors MLCC – 250 V 2200 pF X7R SDM2012	1
C5	C0603C102K5RACTU	Kemet	Multilayer ceramic capacitors MLCC – 50 V 1000 pF X7R SMD0603	1
C6	GRJ31CR71H475KE11L	Murata	Multilayer ceramic capacitors MLCC – 50 V 4.7 µF X7R SMD1206	1
C7	EEE-FT1V330AR	Panasonic	Aluminum electrolytic capacitors – SMD 33 µF 35 V 5 x 5.8 mm	1
C8	DE1E3KX102MA4BN01F	Murata	Safety capacitors 1000 pF 250 Vrms 20 percent L/S = 10 mm bulk long	1
C9	875105144007	Würth Elektronik	Aluminum organic polymer capacitors WCAP-PSLP 6.3 V 180 µF 20 percent ESR = 20 mΩ	1
C10	EEEFT0J331AP	Panasonic	Aluminum electrolytic capacitors – SMD 330 µF 6.3 V 6.3 x 5.8 mm SMD	1
C11	8850121-08021	Würth Elektronik	Multilayer ceramic capacitors MLCC 25 V 10 µF X5R SMD 1206	1
C12	C0805C333K5RACAUTO	Kemet	Multilayer ceramic capacitors MLCC SMD/SMT 50 V 0.033 µF X7R 0805	1
C18	06035C222KAT2A	AVX	Multilayer ceramic capacitors MLCC SMD/SMT 50 V 2200 pF X7R 0603 10 percent	1
C19, C21, C22, C24, C25, C26	C0603C104K4RACTU	Kemet	Multilayer ceramic capacitors MLCC – SMD/SMT 16 V 0.1 µF X7R 10 percent	6

C27	25SVPF47M	Panasonic	Aluminum organic polymer capacitors 25 V 47 µF ESR 30 m Ω SMD	1
D1	STTH1R06A	STMicroelectronics	Rectifiers	1
D2	ES1D	Fairchild	Rectifiers 200 V SMA ultrafast rectifier	1
D3	SS26-E3/52T	Vishay	Schottky diodes and rectifiers 2.0 A 60 V	1
F1	174-7951	RS PRO	Fuse, 250 V, 200 mA	1
H1	2.54 mm, 4 pins, 1 row header	–	–	1
IC3	XMC1302T038X0200	Infineon	ARM® microcontrollers	1
IC4	LM3940IMP-3.3/NOPB	Texas Instruments	LDO voltage regulators 1 A LDO reg.	1
JP5, JP6	1.27 mm, 2 pins, 1 row header	–	Header	1
L1	7447462102	Würth Elektronik	Fixed inductors	2
P1	2.54 mm, 5 pins, 1 row, 90-degree pin header	–	–	1
P5	1.27 mm, 4 pins, 2 row header	–	–	1
SL2	1.27 mm, 6 pins, 1 row header	–	–	2
P8	2.54 mm, 5 pins, 1 row, 90-degree pin female header	–	–	1
Q5, Q6	n.a.	n.a.	n.a.	–
R2	ERJ-8ENF3303V	Panasonic	Thick film resistors – SMD 1206 330 kΩ 1 percent AEC-Q200	1
R3	ERJ-8RQF6R8V	Panasonic	Resistors – SMD 1206 6.8 Ω 1 percent CS AEC-Q200	1
R4	RC0805JR-7W3K3L	Yageo	3.3 kΩ – 0805	1
R5	n.a.	–	–	1
R6	RC0805FR-071ML	Yageo	Thick film resistors – SMD 1 MΩ SMD0805	1
R7	ERA-6AEB1023V	Panasonic	Thin film resistors – SMD 0805 102 kΩ 0.1 percent 25 ppm	1
R8	ERA-6AEB333V	Panasonic	Thin film resistors – SMD 0805 1/8 W 33 kΩ	1
R13	RT1206BRD0712RL	Yageo	Thin film resistors – SMD ¼ W 12 Ω 1 percent 25 ppm SMD1206	1
R33, R34, R35, R36	RC0603FR-072K2L	Yageo	Thick film resistors – SMD 2.2 kΩ 1 percent SMD0603	4
R39, R40	PA0603-R-070RL	Yageo	0 Ω SMD0603	2
R44, R45	SR0603FR-7T100RL	Yageo	Thick film resistors – SMD 100 Ω 1 percent 75 V AEC-Q200 SMD 0603	2

R46	SR0603FR-7T10KL	Yageo	Thick film resistors – SMD 10 kΩ 1 percent 75 V AEC-Q200 SMD 0603	1
R49, R50, R55, R56	RT0603DRD07220RL	Yageo	Thin film resistors – SMD 220 Ω 5 percent 25 ppm SMD0603	4
R51, R52	n.a.	–	–	–
R53, R54	n.a.	–	–	–
R57	n.a.	–	–	1
RNTC1	B57235S0100M000	EPCOS	Inrush current limiters 10 Ω 3 A 2900 k	1
S1	OPTIGA_TrustB_SLE95250	Infineon	Authentication IC	1
SL2	1.27 mm, 6 pins, 1 row, header	–	–	1
T1	750817018	Würth Elektronik	Transformer	1
U1	ICE3BR4765JG	Infineon	Current mode controller	1
U2	VOL618A-3X001T	Vishay	Transistor output optocoupler LSOP4	1
U3	LMV431AIMF/NOPB	Texas Instruments	Voltage references LV, 1.24 V, ADJ prec. shunt reg.	1
V1	B72650M0301K072	EPCOS (TDK)	Varistors 385 V DC 400 A 9600 mJ 100 mW CU3225K300G2	1
LED1, LED4	LTST-C194KRKT	Lite-On	Standard LEDs – SMD red 631 nm 14 mcd 30 mA	2
LED2	LTST-C194KGKT	Lite-On	Standard LEDs – SMD green 571 nm 12 mcd 30 mA	1
LED3	LTST-C194TBKT	Lite-On	Standard LEDs – SMD blue 470 nm 28 mcd 20 mA	1

Table 11 BOM of wireless connectivity – NB-IoT module

Designator	Item	Part no.	Manufacturer	Description	Quantity
ANT1	AA702	AA702	Unictron	Chip antenna	1
B1	BC35-G	BC35GJBR01A02W	Quectel	NB-IoT module series BC35-G	1
C1, C5	[0603] 100 nF capacitor	C0603C104K5RACAUTO7411	Kemet	MLCC – SMD	2
C2, C3, C4	[0603] 33 pF capacitor	C0603C330K5RACTU	Kemet	MLCC – SMD	3
C6	[0603] 100 pF capacitor	C0603C101F5GACAUTO	Kemet	Capacitor (semiconductor SIM model)	1

C7, R19	[0603] 22 pF capacitor	C0603C220J5GAC7411	Kemet	MLCC – SMD	1
C8	TAN capacitor	TAJV107K025RNJ	AVX	AVX 100 µF solid electrolytic capacitor, 25 V DC 10 percent, TAJ series	1
C14	[0603] 3.3 pF capacitor	C0603C339D5GACTU	Kemet	MLCC – SMD 50 V 3.3 pF 0603 C0G	1
C15, C16	[0603] 1 pF capacitor	C0603X109B5GACTU	Kemet	MLCC – SMD 50 V 1 pF 0603 C0G	2
C17, L1	[0603] 10 pF capacitor	C0603C100K4RACTU	Kemet	MLCC – SMD/SMT 16 V 10 pF 0603 X7R 0.1	2
IC1	Micro SIM SMT card detect	693023010811	Würth Elektronik	WR-CRD micro SIM, push and pull, 8 pins	1
P1	1 row 1.27 mm header	–	–	Header, 5 pins	1
P2	1 row 2.54 mm header	–	–	Header, 5 pins	1
R1, R2, R3	[0603] 22 R resistor	RT0603DRD0722RL	Yageo	Thin film resistors 22 Ω 0603	3
R4, R5	[0603] 100 R resistor	RT0603BRC07100RL	Yageo	Thin film resistors 100Ω 0603	2
R7, R9	[0603] 1 K resistor	RT0603BRC101KL	Yageo	Thin film resistors 1 kΩ 0.1 percent 15 ppm	2
R36	[0603] 4.7 K resistor	RC0603FR-074K7L	Yageo	Thick film resistors 4.7 kΩ 1 percent	1
T2	NPN transitor	MMBT3904LT3G	ON Semiconductor	Transistor NPN 40 V 200 mA SOT-23 ON Semi MMBT3904LT3G NPN bipolar transistor, 900 mA 40 V, 3 pins SOT-23	1
TVS3V3L4U	TVS diodes	TVS3V3L4UE6327HTSA1	Infineon	Infineon – TVS3V3L4UE6327HTSA1 – TVS diode,	1

Table 12 BOM of wireless connectivity – SigFox module

Designator	Item	Part no.	Manufacturer	Description	Quantity
ANT1	AA702	AA702	Unictrons	915 MHz chip antenna	1
C6	[0603] 0.47 µF capacitor	C0603X474K4RACTU	Kemet	MLCC – SMD/SMT 16 V 0.47 µF 0603 X7R 10 percent	1

C7,C9	[0603] 100 nF capacitor	C0603C104K5RACAUTO7411	Kemet	MLCC – SMD 100 nF 0603	2
C10, C12	[0603] 1 pF capacitor	C0603X109B5GACTU	Kemet	MLCC – SMD 50 V 1 pF 0603 C0G	2
C11,L1	[0603] 10 pF capacitor	C0603C100K4RACTU	Kemet	MLCC – SMD/SMT 16 V 10 pF 0603 X7R 0.1	2
C14,	[0603] 3.3 pF capacitor	C0603C339D5GACTU	Kemet	MLCC – SMD 50 V 3.3 pF 0603 C0G	1
R22	[0603] 22 pF capacitor	C0603C220J5GAC7411	Kemet	MLCC – SMD 22 pF 0603	1
R28	[0603] 0 Ω resistor	AC0603JR - 130RL	Yageo	SMD 0 Ω 5 percent 1/10 W AEC-Q200	1
P1	2.54 mm 5 pins header	–	–	–	1
LED1	[0603] LED – red	LTST-C194KRKT	Lite-On	–	1
M5	SOT-23	2N700	Infineon	–	1
R15, R30	4.7 kΩ	RC0603FR-074K7L	Yageo	Thick film resistor 4.7 kΩ 1 percent	2
R17	470 Ω	RC0603FR-07470RL	Yageo	Thick film resistor 470 Ω 1 percent	1
R21	10 kΩ	AR0603FR-0710KL	Yageo	Thick film resistor 10 kΩ	1
R31,R32	100 Ω	RC0603FR-07100RL	Yageo	Thick film resistor 100 Ω 1 percent	2
U5	WSSFM10R4AT RCZ4 module	WSSFM10R4AT RCZ4	SigFox	SigFox module for wireless communication	1

8 Revision history

Document version	Date of release	Description of changes
V 1.0	09-04-2020	First release