Cinterion® PLAS9-W

Hardware Interface Description

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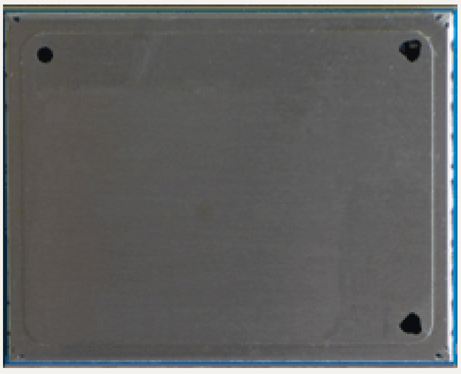

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1 Introduction

This document[1] describes the hardware of the Cinterion® PLAS9-W module. It helps you quickly retrieve interface specifications, electrical and mechanical details and information on the requirements to be considered for integrating further components.

1.1 Key Features at a Glance

Feature	Implementation
General	
Frequency bands	GSM/GPRS/EDGE: Dual band, 900/1800MHz UMTS/HSPA+: Five band, 850 (BdV, Bd VI) / 900 (BdVIII) / 1800 (BdIII) / 2100MHz (BdI) LTE (FDD): Eleven band, 700 (Bd28A, Bd28B) / 800 (Bd20) / 850 (Bd5, Bd18, Bd19, Bd26) / 900 (Bd8) / 1800 (Bd3) / 2100 (Bd1) / 2600MHz (Bd7) LTE (TDD): Quad band, 1900 (Bd39) / 2300 (Bd40) / 2600MHz (Bd38, Bd41) TD-SCDMA: Dual band, 1900 (Bd39) / 2000MHz (Bd34)
GSM class	Small MS
Output power (according to Release 99)	Class 4 (+33dBm ±2dB) for EGSM900 Class 1 (+30dBm ±2dB) for GSM1800 Class E2 (+27dBm ± 3dB) for GSM 900 8-PSK Class E2 (+26dBm +3 /-4dB) for GSM 1800 8-PSK Class 3 (+24dBm +1/-3dB) for UMTS 2100, WCDMA FDD BdI Class 3 (+24dBm +1/-3dB) for UMTS 1800, WCDMA FDD BdIII Class 3 (+24dBm +1/-3dB) for UMTS 900, WCDMA FDD BdVIII Class 3 (+24dBm +1/-3dB) for UMTS 850, WCDMA FDD BdV Class 3 (+24dBm +1/-3dB) for UMTS 850, WCDMA FDD BdVI
Output power (according to Release 4)	TD-SCDMA: Class 2 (+24dBm +1/-3dB) for TD-SCDMA 1900, TD-SCDMA Bd39 Class 2 (+24dBm +1/-3dB) for TD-SCDMA 2000, TD-SCDMA Bd34
Output power (according to Release 8)	LTE (FDD): Class 3 (+23dBm +-2dB) for LTE 2600, LTE FDD Bd7 Class 3 (+23dBm +-2dB) for LTE 2100, LTE FDD Bd1 Class 3 (+23dBm +-2dB) for LTE 1800, LTE FDD Bd3 Class 3 (+23dBm +-2dB) for LTE 900, LTE FDD Bd8 Class 3 (+23dBm +-2dB) for LTE 850, LTE FDD Bd5 Class 3 (+23dBm +-2dB) for LTE 850, LTE FDD Bd18 Class 3 (+23dBm +-2dB) for LTE 850, LTE FDD Bd19 Class 3 (+23dBm +-2dB) for LTE 850, LTE FDD Bd26 Class 3 (+23dBm +-2dB) for LTE 800, LTE FDD Bd20 Class 3 (+23dBm +-2dB) for LTE 700, LTE FDD Bd28A, Bd28B LTE (TDD): Class 3 (+23dBm +-2dB) for LTE 2600, LTE TDD Bd41 Class 3 (+23dBm +-2dB) for LTE 2600, LTE TDD Bd38 Class 3 (+23dBm +-2dB) for LTE 2300, LTE TDD Bd40 Class 3 (+23dBm +-2dB) for LTE 1900, LTE TDD Bd39

1. The document is effective only if listed in the appropriate Release Notes as part of the technical documentation delivered with your Thales product.

Feature	**Implementation**
Power supply	3.3V ≤ V_{BATT+} ≤ 4.2V
Operating temperature (board temperature)	Normal operation: -30°C to +85°C Extended operation: -40°C to +95°C
Physical	Dimensions: 40mm x 32mm x 2.8mm Weight: approx. 6.5g
RoHS	All hardware components fully compliant with EU RoHS Directive
LTE features	
3GPP Release 10	Downlink carrier aggregation (CA) to increase bandwidth, and thereby increase bitrate: • Maximum aggregated bandwidth: 40MHz • Maximum number of component carriers: 2 • Inter-band FDD, non-contiguous • Intra-band FDD, contiguous, non-contiguous • Intra-band TDD, contiguous, non-contiguous • Supported inter-band CA configurations: CA_1A-5A (with bandwidth combination set 0 and 1) CA_1A-8A (with bandwidth combination set 0, 1 and 2) CA_1A-18A (with bandwidth combination set 0 and 1) CA_1A-19A (with bandwidth combination set 0) CA_1A-26A (with bandwidth combination set 0 and 1) CA_3A-5A (with bandwidth combination set 0, 1 and 2) CA_3A-8A (with bandwidth combination set 0, 1 and 2) CA_3A-19A (with bandwidth combination set 0) CA_3A-20A (with bandwidth combination set 0 and 1) CA_3A-26A (with bandwidth combination set 0 and 1) CA_3A-28A (with bandwidth combination set 0) CA_5A-7A (with bandwidth combination set 0) CA_7A-20A (with bandwidth combination set 0 and 1) CA_7A-28A (with bandwidth combination set 0 and 1) • Supported intra-band CA configurations: CA_1C (with bandwidth combination set 0) CA_3C (with bandwidth combination set 0) CA_7C (with bandwidth combination set 0 and 1) CA_38C (with bandwidth combination set 0) CA_40C (with bandwidth combination set 0 and 1) CA_41C (with bandwidth combination set 0 and 1) CA_3A-3A (with bandwidth combination set 0) CA_7A-7A (with bandwidth combination set 0) CA_41A-41A (with bandwidth combination set 0 and 1) CAT 6 supported DL 300Mbps, UL 50Mbps 2x2 MIMO in DL direction
HSPA features	
3GPP Release 9	UE CAT. 14, 24 DC-HSPA+ – DL 42Mbps HSUPA – UL 5.76Mbps Compressed mode (CM) supported according to 3GPP TS25.212
UMTS features	
3GPP Release 9	PS data rate – 384 kbps DL / 384 kbps UL

Feature	Implementation
TD-SCDMA features	
3GPP Release 4	2.8 Mbps DL / 2.2Mbps UL
GSM / GPRS / EGPRS features	
Data transfer	GPRS: • Multislot Class 12 • Mobile Station Class B • Coding Scheme 1 – 4 EGPRS: • Multislot Class 12 • EDGE E2 power class for 8 PSK • Downlink coding schemes – CS 1-4, MCS 1-9 • Uplink coding schemes – CS 1-4, MCS 1-9 • SRB loopback and test mode B • 8-bit, 11-bit RACH • 1 phase/2 phase access procedures • Link adaptation and IR • NACC, extended UL TBF • Mobile Station Class B
SMS	Point-to-point MT and MO, Cell broadcast, Text and PDU mode
Software	
AT commands	Hayes, 3GPP TS 27.007 and 27.005, and proprietary Thales commands
Firmware update	Generic update from host application over USB 2.0 High Speed device interface
Interfaces	
Module interface	Surface mount device with solderable connection pads (SMT application interface). Land grid array (LGA) technology ensures high solder joint reliability and provides the possibility to use an optional module mounting socket. For more information on how to integrate SMT modules see also [3]. This application note comprises chapters on module mounting and application layout issues as well as on additional SMT application development equipment.
Antenna	50Ω. GSM/UMTS/LTE main antenna, UMTS/LTE Diversity/MIMO antenna
USB	USB 2.0 High Speed (480Mbit/s) device interface or USB 3.0 Super Speed (5Gbit/s) device interface
UICC interface	2 UICC interfaces (switchable) Supported chip cards: UICC/SIM/USIM 3V, 1.8V
RING0	Signal line to indicate URCs.
Power on/off, Reset	
Power on/off	Switch-on by hardware signal IGT Switch-off by AT command (AT^SMSO) or IGT (option) Automatic switch-off in case of critical temperature or voltage conditions
Reset	Orderly shutdown and reset by AT command
Emergency-off	Emergency-off by hardware signal EMERG_OFF
Special Features	

Feature	Implementation
Antenna	SAIC (Single Antenna Interference Cancellation) / DARP (Downlink Advanced Receiver Performance) Rx Diversity (receiver type 3i - 64-QAM) / MIMO
GPIO	10 I/O pins of the application interface programmable as GPIO. Programming is done via AT commands.
ADC inputs	Analog-to-Digital Converter with two unbalanced analog inputs for (external) antenna diagnosis
Evaluation kit	
Evaluation module	PLAS9-W module soldered onto a dedicated PCB that can be connected to the ALAS6A-DSB75 adapter in order to be mounted onto the DSB75.
ALAS6A-DSB75 adapter	A special adapter required to connect the PLAS9-W evaluation module to the DSB75.
DSB75	DSB75 Development Support Board designed to test and type approve Thales modules and provide a sample configuration for application engineering.

1.2 PLAS9-W System Overview

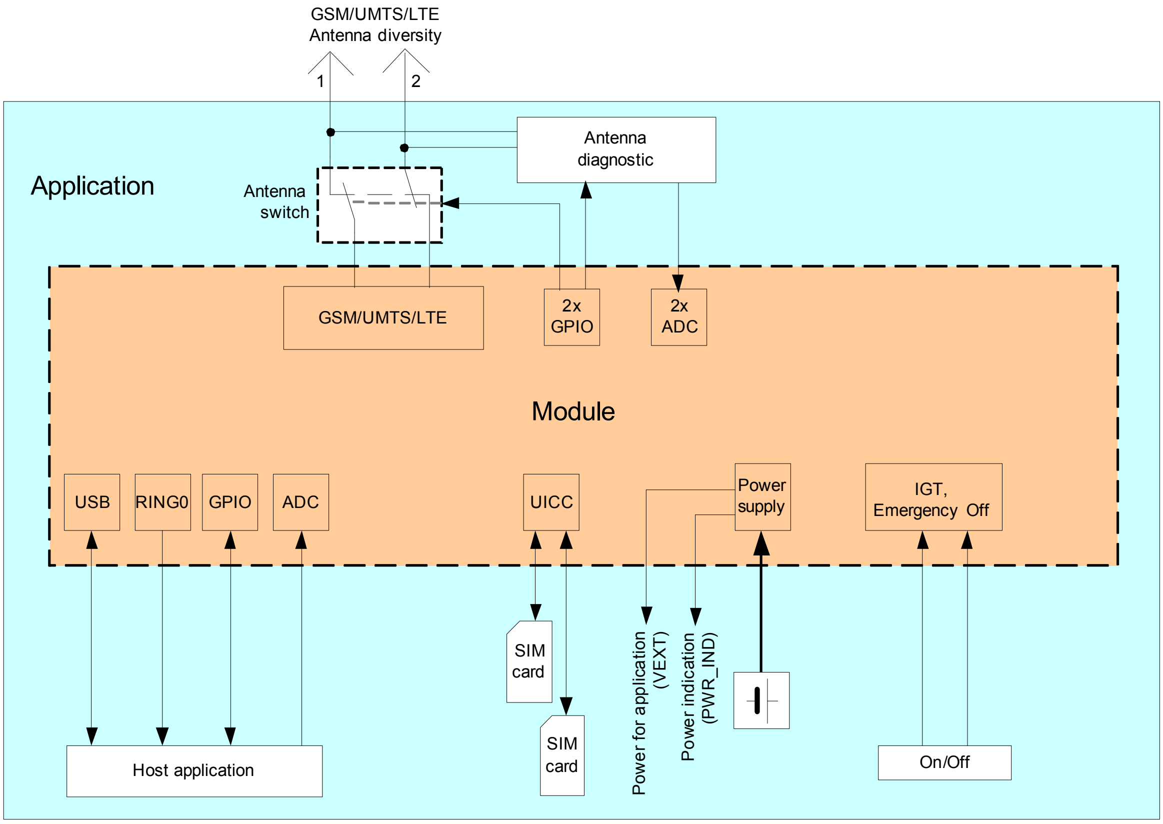


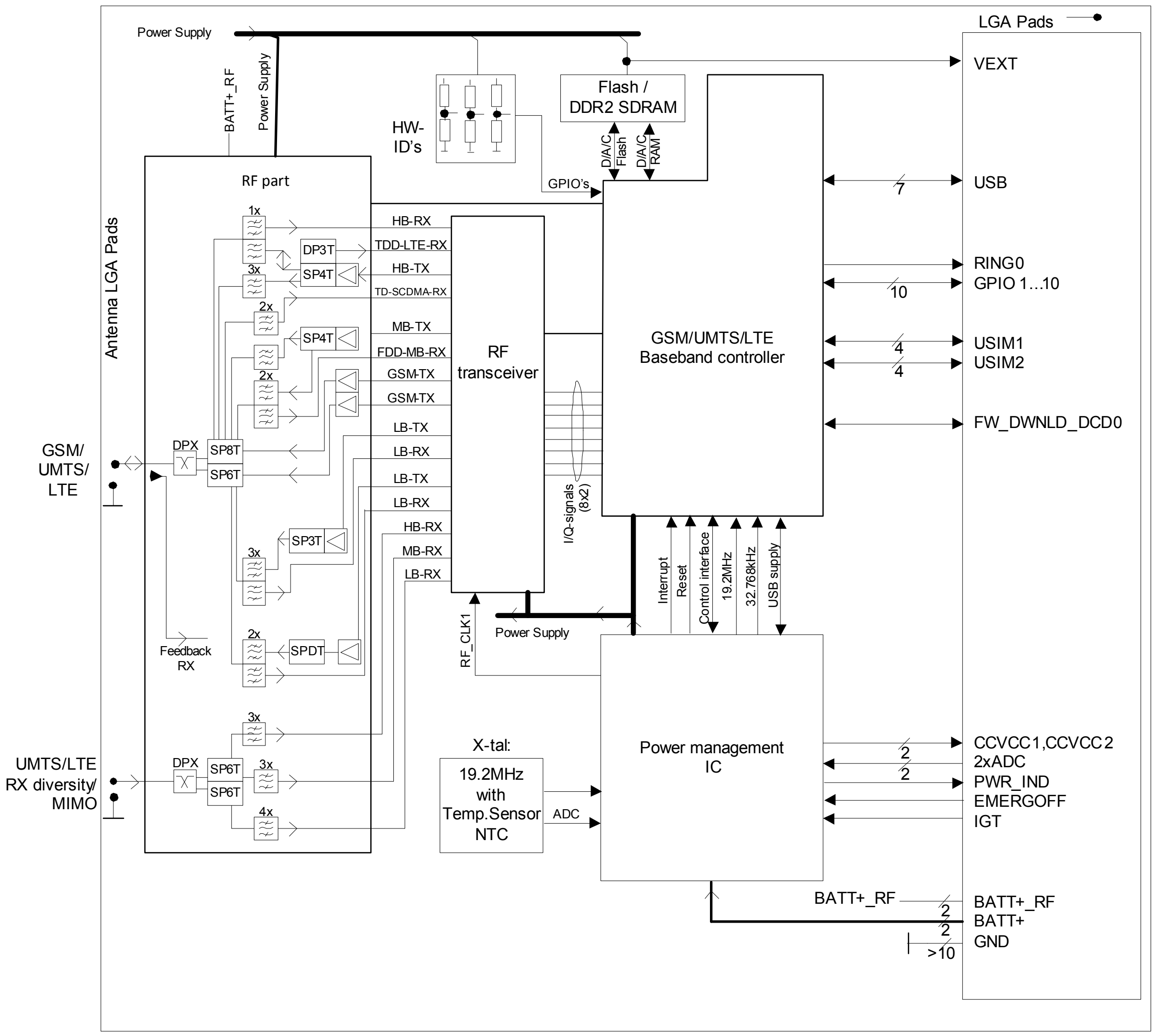
Figure 1: PLAS9-W system overview

1.3 Circuit Concept

Figure 2 shows a block diagram of the PLAS9-W module and illustrates the major functional components:

Baseband block:
- GSM/UMTS controller/transceiver/power supply
- Stacked Flash/RAM memory with multiplexed address data bus
- Application interface (SMT with connecting pads)

RF section:
- RF transceiver
- RF power amplifier/frontend
- RF filter
- Antenna pad



LB – Low bands (699-960MHz); MB – Mid bands (1710-2025MHz); HB – High bands (2300-2690MHz)

Figure 2: PLAS9-W block diagram

2 Interface Characteristics

PLAS9-W is equipped with an SMT application interface that connects to the external application. The SMT application interface incorporates the various application interfaces as well as the RF antenna interface.

2.1 Application Interface

2.1.1 Pad Assignment

The SMT application interface on the PLAS9-W provides connecting pads to integrate the module into external applications. Table 1 lists the pads' assignments. Figure 3 (bottom view) and Figure 4 (top view) show the connecting pads' numbering plan.

Please note that a number of connecting pads are marked as reserved for future use (rfu) and further qualified as either (<name>), (dnu), (GND) or (nc):

- Pads marked as “rfu“ and qualified as “<name>“ (signal name) may be soldered and could be connected to an external application compliant to the signals‘ electrical characteristics as described in Table 2.
- Pads marked "rfu" and qualified as "dnu" (do not use) may be soldered but should not be connected to an external application.
- Pads marked "rfu" and qualified as "GND" (ground) are assigned to ground with PLAS9-W modules, but may have different assignments with future Thales products using the same pad layout.
- Pads marked "rfu" and qualified as "nc" (not connected) are internally not connected with PLAS9-W modules, but may be soldered and arbitrarily be connected to external ground.

Thales strongly recommends to solder all connecting pads for mechanical stability and heat dissipation.

Also, Thales strongly recommends to provide test points for certain signal lines to and from the module while developing SMT applications – for debug and/or test purposes during the manufacturing process. In this way it is possible to detect soldering problems. Please refer to [3] for more information on test points and how to implement them. The signal lines for which test points should be provided for are marked as “Test point recommended“ in Section 2.1.2: Table 2 describing signal characteristics.

Table 1: Overview: Pad assignments

Pad No.	Signal Name	Pad No.	Signal Name	Pad No.	Signal Name
A1	GND	E17	rfu (nc)	M7	CCVCC2
A5	rfu (dnu)	E18	rfu (dnu)	M8	rfu (dnu)
A6	GND	F2	rfu (dnu)	M9	rfu (dnu)
A7	GND	F3	GND	M10	rfu (dnu)
A9	GND	F4	GND	M11	rfu (dnu)
A10	GND	F5	GND	M12	rfu (dnu)
A11	GND	F6	GND	M13	rfu (dnu)
A12	GND	F13	CCIO2	M14	rfu (dnu)
A14	GND	F14	CCRST2	M15	CCRST1
A18	GND	F15	rfu (dnu)	M16	CCCLK1
B1	GND	F16	rfu (nc)	M17	IGT
B4	rfu (dnu)	F17	rfu (nc)	M18	rfu (dnu)
B5	rfu (nc)	F18	rfu (dnu)	N2	GND
B6	GND	G1	GND	N3	GND
B7	GND	G2	GND	N4	GND
B8	rfu (dnu)	G3	GND	N5	PWR_IND
B9	GND	G4	GND	N6	VEXT
B10	GND	G5	GND	N7	GND
B11	GND	G14	rfu (dnu)	N8	rfu (dnu)
B12	GND	G15	rfu (dnu)	N9	rfu (dnu)
B13	ANT_DRX_MIMO	G16	rfu (dnu)	N10	rfu (dnu)
B14	GND	G17	GPIO10	N11	rfu (dnu)
B15	GND	G18	rfu (dnu)	N12	rfu (dnu)
B18	GND	H1	GND	N13	ADC2_IN
C3	rfu (dnu)	H2	GND	N14	ADC1_IN
C4	rfu (nc)	H3	GND	N15	CCIN1
C5	GND	H4	GND	N16	rfu (nc)
C6	GND	H5	rfu (nc)	N17	rfu (dnu)
C7	GND	H14	rfu (dnu)	P3	rfu (dnu)
C8	GND	H15	GPIO7	P4	BATT+_RF
C9	GND	H16	GPIO8	P5	BATT+_RF
C10	GND	H17	GPIO9	P6	VUSB_IN
C11	GND	H18	rfu (dnu)	P7	rfu (dnu)
C12	GND	J1	GND	P8	rfu (dnu)
C13	GND	J2	GND	P9	rfu (CTS0)
C14	GND	J3	GND	P10	FW_DWNLD_DCD0
C15	rfu (dnu)	J4	GND	P11	rfu (RTS0)
C16	rfu (dnu)	J5	GND	P12	GND
D2	GND	J14	rfu (dnu)	P13	rfu (dnu)
D3	GND	J15	GPIO4	P14	BATT+
D4	GND	J16	GPIO5	P15	EMERG_OFF
D5	GND	J17	GPIO6	P16	rfu (dnu)
D6	GND	J18	rfu (dnu)	R1	GND
D7	GND	K1	GND	R4	rfu (dnu)
D8	GND	K2	GND	R5	USB_DP
D9	GND	K3	GND	R6	USB_DN
D10	GND	K4	GND	R7	rfu (dnu)
D11	GND	K5	GND	R8	rfu (dnu)
D12	GND	K14	GND	R9	rfu (DTR0)
D13	rfu (GND)	K15	GPIO1	R10	rfu (DSR0)
D14	rfu (dnu)	K16	GPIO2	R11	RING0
D15	rfu (nc)	K17	GPIO3	R12	rfu (RXD0)
D16	rfu (dnu)	K18	GND	R13	rfu (TXD0)
D17	rfu (dnu)	L2	ANT_MAIN	R14	BATT+
E1	GND	L3	GND	R15	rfu (dnu)
E2	GND	L4	GND	R18	GND
E3	GND	L5	GND	T1	GND
E4	GND	L6	GND	T5	GND
E5	GND	L13	rfu (dnu)	T6	USB_SSTX_P
E6	rfu (dnu)	L14	rfu (dnu)	T7	USB_SSTX_N
E7	GND	L15	CCIO1	T8	GND
E8	GND	L16	CCVCC1	T9	USB_SSRX_P
E9	GND	L17	rfu (dnu)	T10	USB_SSRX_N
E10	GND	L18	rfu (dnu)	T11	GND
E11	GND	M1	GND	T12	rfu (dnu)
E12	GND	M2	GND	T13	rfu (dnu)
E13	CCIN2	M3	GND	T14	GND
E14	rfu (dnu)	M4	GND	T18	GND
E15	CCCLK2	M5	GND		
E16	rfu (nc)	M6	rfu (BATT_ID)		

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
T	GND				GND	USB_SSTX_P	USB_SSTX_N	GND	USB_SSRX_P	USB_SSRX_N	GND	rfu (dnu)	rfu (dnu)	GND				GND
R	GND			rfu (dnu)	USB_DP	USB_DN	rfu (dnu)	rfu (dnu)	rfu (DTR0)	rfu (DSR0)	RING0	rfu (RXD0)	rfu (TXD0)	BATT+	rfu (dnu)			GND
P			rfu (dnu)	BATT+_RF	BATT+_RF	VUSB_IN	rfu (dnu)	rfu (dnu)	rfu (CTS0)	FW_DWN-LD_DCD0	rfu (RTS0)	GND	rfu (dnu)	BATT+	EMERG_OFF	rfu (dnu)		
N		GND	GND	GND	PWR_IND	VEXT	GND	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	ADC2_IN	ADC1_IN	CCIN1	rfu (nc)	rfu (dnu)	
M	GND	GND	GND	GND	GND	rfu (BATT_ID)	CCVCC2	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	CCRST1	CCCLK1	IGT	rfu (dnu)
L		ANT_MAIN	GND	GND	GND	GND							rfu (dnu)	rfu (dnu)	CCIO1	CCVCC1	rfu (dnu)	rfu (dnu)
K	GND	GND	GND	GND	GND									GND	GPIO1	GPIO2	GPIO3	GND
J	GND	GND	GND	GND	GND									rfu (dnu)	GPIO4	GPIO5	GPIO6	rfu (dnu)
H	GND	GND	GND	GND	rfu (nc)									rfu (dnu)	GPIO7	GPIO8	GPIO9	rfu (dnu)
G	GND	GND	GND	GND	GND									rfu (dnu)	rfu (dnu)	rfu (dnu)	GPIO10	rfu (dnu)
F		rfu (dnu)	GND	GND	GND	GND							CCIO2	CCRST2	rfu (dnu)	rfu (nc)	rfu (nc)	rfu (dnu)
E	GND	GND	GND	GND	GND	rfu (dnu)	GND	GND	GND	GND	GND	GND	CCIN2	rfu (dnu)	CCCLK2	rfu (nc)	rfu (nc)	rfu (dnu)
D		GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	rfu (GND)	rfu (dnu)	rfu (nc)	rfu (dnu)	rfu (dnu)	
C			rfu (dnu)	rfu (nc)	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	rfu (dnu)	rfu (dnu)		
B	GND			rfu (dnu)	rfu (nc)	GND	GND	rfu (dnu)	GND	GND	GND	GND	ANT_DRX_MIMO	GND	GND			GND
A	GND				rfu (dnu)	GND	GND		GND	GND	GND	GND		GND				GND

rfu: Reserved for future use (may be connected to external application
(**nc**): Internally not connected (may be arbitrarily connected to external GND)
(**dnu**): Do not use (should not be connected to external application)

Figure 3: PLAS9-W bottom view: Pad assignments

	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
T	GND				GND	rfu (dnu)	rfu (dnu)	GND	USB_SSRX_N	USB_SSRX_P	GND	USB_SSTX_N	USB_SSTX_P	GND				GND
R	GND			rfu (dnu)	BATT+	rfu (TXD0)	rfu (RXD0)	RING0	rfu (DSR0)	rfu (DTR0)	rfu (dnu)	rfu (dnu)	USB_DN	USB_DP	rfu (dnu)			GND
P			rfu (dnu)	EMERG_OFF	BATT+	rfu (dnu)	GND	rfu (RTS0)	FW_DWNLD_DCD0	rfu (CTS0)	rfu (dnu)	rfu (dnu)	VUSB_IN	BATT+_RF	BATT+_RF	rfu (dnu)		
N		rfu (dnu)	rfu (nc)	CCIN1	ADC1_IN	ADC2_IN	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	GND	VEXT	PWR_IND	GND	GND	GND	
M	rfu (dnu)	IGT	CCCLK1	CCRST1	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	rfu (dnu)	CCVCC2	rfu (BATT_ID)	GND	GND	GND	GND	GND
L	rfu (dnu)	rfu (dnu)	CCVCC1	CCIO1	rfu (dnu)	rfu (dnu)							GND	GND	GND	GND	ANT_MAIN	
K	GND	GPIO3	GPIO2	GPIO1	GND									GND	GND	GND	GND	GND
J	rfu (dnu)	GPIO6	GPIO5	GPIO4	rfu (dnu)									GND	GND	GND	GND	GND
H	rfu (dnu)	GPIO9	GPIO8	GPIO7	rfu (dnu)									rfu (nc)	GND	GND	GND	GND
G	rfu (dnu)	GPIO10	rfu (dnu)	rfu (dnu)	rfu (dnu)									GND	GND	GND	GND	GND
F	rfu (dnu)	rfu (nc	rfu (nc)	rfu (dnu)	CCRST2	CCIO2							GND	GND	GND	GND	rfu (nc)	
E	rfu (dnu)	rfu (nc	rfu (nc)	CCCLK2	rfu (dnu)	CCIN2	GND	GND	GND	GND	GND	GND	rfu (dnu)	GND	GND	GND	GND	GND
D		rfu (dnu)	rfu (dnu)	rfu (nc)	rfu (dnu)	rfu (GND)	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	
C			rfu (dnu)	rfu (dnu)	GND	GND	GND	GND	GND	GND	GND	GND	GND	GND	rfu (nc)	rfu (dnu)		
B	GND			GND	GND	ANT_DRX_MIMO	GND	GND	GND	GND	rfu (dnu)	GND	GND	rfu (nc)	rfu (dnu)			GND
A	GND				GND		GND	GND	GND	GND		GND	GND	rfu (dnu)				GND

rfu: Reserved for future use (may be connected to external application
(nc): Internally not connected (may be arbitrarily connected to external GND)
(**dnu**): Do not use (should not be connected to external application)

Figure 4: PLAS9-W top view: Pad assignments

2.1.2 Signal Properties

Please note that the reference voltages listed in Table 2 are the values measured directly on the PLAS9-W module. They do not apply to the accessories connected.

Table 2: Signal description

Function	Signal name	IO	Signal form and level	Comment
Power supply	BATT+_RF	I	$V_I$max = 4.2V $V_I$norm = 3.8V $V_I$min = 3.3V during Tx burst on board Imax ≈ 2A, during Tx burst (GSM)  n Tx = n x 577µs peak current every 4.615ms Imax = 800mA (continuous) during WCDMA TX Imax = 800mA (continuous) during LTE TX	Lines of BATT+ and GND must be connected in parallel for supply purposes because higher peak currents may occur. Minimum voltage must not fall below 3.3V including drop, ripple, spikes.
	BATT+	I	$V_I$max = 4.2V $V_I$norm = 3.8V $V_I$min = 3.3V during Tx burst on board Imax = 500mA	
	GND		Ground	Application Ground
External supply voltage	VEXT	O	$C_L$max = 1µF V_O = 1.80V +3% -5% $I_O$max = -50mA	VEXT may be used for application circuits. If unused keep line open. Test point recommended. The external digital logic must not cause any spikes or glitches on voltage VEXT. Do not exceed $I_O$max
Ignition	IGT	I	Open circuit voltage: V_{OHtyp}=0.8V External driver: R_{off} > 5 MOhm Switch-On-Condition: V_{IL}max = 0.3V @ I < 25µA (IGT to GND) ~~|___|~~ Recommended low impulse width > 100ms	This signal switches the module ON. It is required to drive this line low by an open drain or open collector driver connected to GND. Test point recommended.
Emergency off	EMERG_OFF	I	R_{PU} ≈ 40kΩ V_{OH}max = *1.8V* V_{IH}max = *2.1V* V_{IH}min = *1.17V* V_{IL}max = *630mV* ~~|___|~~ low impulse width up to 2200ms (as long as PWR_IND stays low typ. 346ms if firmware running properly)	This line must be driven low by an open drain or open collector driver connected to GND as long as the module turns off. If unused keep line open. Test point recommended.

Table 2: Signal description

Function	Signal name	IO	Signal form and level	Comment
FW Download Mode	FW_DWNLD_DCD0	I/O	V_{IL}max = 0.63V V_{IH}min = 1.20V V_{IH}max = 2.1V I_{IHPD} = 27.5µA…97.5µA I_{ILPU} = -27.5µA…-97.5µA IHigh-z = max +- 1µA	If FW_DWNLD_DCD0 is driven low during startup-phase, module enters Download Mode (see Section 3.2.2) FW_DWNLD_DCD0 should be connected via a 1kOhm resistor to prevent possible back powering.
SIM card detection (2x)	CCIN1	I	R_{PU} ≈ 24.2kΩ V_{OH}max=1.9V V_{IH}min = 1.15V V_{IH}max= 2.1V V_{IL}max = 0.4V	CCINx = Low, SIM card inserted. If SIM card holder does not support CCINx, connect to GND. CCIN2: External pull-up required - for details please refer to Section 2.1.4. If 2nd SIM interface not used, keep line open.
	CCIN2	I	V_{IH}min = 1.20V V_{IH}max= 2.1V V_{IL}max = 0.63V I_{IHPD} = 27.5µA...97.5µA External pull-up to VEXT required: R_{PU} ≈ 24kΩ	
3V SIM card interfaces (2x)	CCRST1 CCRST2	O	V_{OL}max = 0.4V at I = 2mA V_{OH}min = 2.36V at I = -2mA V_{OH}max = 3.01V	Maximum cable length or copper track should be not longer than 100mm to SIM card holder. CCIO2: External 10kΩ pull-up required - for details please refer to Section 2.1.4. If 2nd SIM interface not used, keep line open.
	CCIO1 CCIO2	I/O	CCIO1: R_{PU} = 8.7..9.5kΩ to CCVCC1 CCIO2: R_{PU} = 65..200kΩ to CCVCC2 Additional external pull up 10k to CCVCC2 required V_{IL}max = 0.59V V_{IL}min = -0.3V V_{IH}min = 2.07V V_{IH}max = 3.25V V_{OL}max = 0.4V at I = 2mA V_{OH}min = 2.36V at I = -0.05mA V_{OH}max = 3.01V	
	CCCLK1 CCCLK2	O	V_{OL}max = 0.4V at I = 2mA V_{OH}min = 2.36V at I = -2mA V_{OH}max = 3.01V	
	CCVCC1 CCVCC2	O	$V_O$min = 2.85V $V_O$typ =2.95V $V_O$max = 3.01V $I_O$max = -50mA	

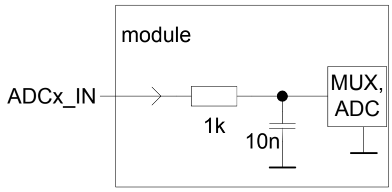
Table 2: Signal description

Function	Signal name	IO	Signal form and level	Comment
1.8V SIM card interface (2x)	CCRST1 CCRST2	O	V_{OL}max = 0.4V at I = 2mA V_{OH}min = 1.45V at I = -2mA V_{OH}max = 1.84V	Maximum cable length or copper track should be not longer than 100mm to SIM card holder. CCIO2: External 10kΩ pull-up required - for details please refer to Section 2.1.4. If 2nd SIM interface not used, keep line open.
	CCIO1 CCIO2	I/O	CCIO1: R_{PU} = 8.7..9.5kΩ to CCVCC1 CCIO2: R_{PU} = 65..200kΩ to CCVCC2 Additional external pull up 10k to CCVCC2 required V_{IL}max = 0.36V V_{IL}min = -0.3V V_{IH}min = 1.30V V_{IH}max = 2.1V V_{OL}max = 0.4V at I = 2mA V_{OH}min = 1.45V at I = -0.05mA V_{OH}max = 1.84V	
	CCCLK1 CCCLK2	O	V_{OL}max = 0.4V at I = 2mA V_{OH}min = 1.45V at I = -2mA V_{OH}max = 1.84V	
	CCVCC1 CCVCC2	O	$V_O$min = 1.75V $V_O$typ = 1.80V $V_O$max = 1.84V $I_O$max = -50mA	
SIM interface shutdown	BATT_ID	I	Internal pull up 100k to 1.8V	Reserved for future use. Connect line to GND.
Host wakeup	RING0	O	V_{OL}max = 0.45V at I = 2mA V_{OH}min = 1.35V at I = -2mA V_{OH}max = 1.84V	If unused keep line open. Test point recommended.
Power indicator	PWR_IND	O	V_{IH}max = 5.5V V_{OL}max = 0.4V at Imax = 1mA	PWR_IND (Power Indicator) notifies the module's on/off state. PWR_IND is an open collector that needs to be connected to an external pull-up resistor. Low state of the open collector indicates that the module is on. Vice versa, high level notifies the Power Down mode. Therefore, signal may be used to enable external voltage regulators that supply an external logic for communication with the module, e.g. level converters. Test point recommended.

Table 2: Signal description

Function	Signal name	IO	Signal form and level	Comment
USB	VUSB_IN	I	$V_{IN}min$ = 3.0V $V_{IN}max$ = 5.75V I_Ityp = 150µA I_Imax = 200µA Cin=1µF	All electrical characteristics according to USB Implementers' Forum, USB 2.0 High Speed Specification. Test point recommended.
	USB_DN	I/O	Full and High speed signal (differential) characteristics according USB 2.0 specification.	If unused keep lines open. Test point recommended. USB High Speed mode operation requires a differential impedance of 90Ω.
	USB_DP	I/O		
	USB_ SSRX_N	I	Super Speed signal (differential) Rx characteristics according USB 3.0 specification.	If unused keep lines open. USB Super Speed mode operation requires a differential impedance of 90Ω.
	USB_ SSRX_P	I		
	USB_ SSTX_N	O	Super Speed signal (differential) Rx characteristics according USB 3.0 specification.	
	USB_ SSTX_P	O		
GPIO interface	GPIO1... GPIO10	I/O	$V_{IL}max$ = 0.63V $V_{IH}min$ = 1.20V $V_{IH}max$ = 2.1V I_{IHPD} = 27.5µA…97.5µA I_{ILPU} = -27.5µA…-97.5µA I_{High-Z} = max +-1µA $V_{OL}max$ = 0.45V at I = 2mA $V_{OH}min$ = 1.35V at I = -2mA $V_{OH}max$ = 1.84V	If unused keep lines open. Test point recommended for GPIO9 and GPIO10. Following functions can be configured for GPIOs using AT commands: Any GPIO --> Low current indication. By default GPIO6 is configured as LCI line. Any GPIO --> Remote host wakeup line
Low Current Indication	GPIOx (LCI_IND)	O	$V_{OL}max$ = 0.45V at I = 2mA $V_{OH}min$ = 1.35V at I = -2mA $V_{OH}max$ = 1.85V	If the feature is enabled (see Section 2.1.9.4).
		I	$V_{IH}max$ = 2V R_{PD}= appr. 100kΩ	If the feature is disabled (see Section 2.1.9.4).
Remote host wakeup	GPIOx	O	$V_{OL}max$ = 0.45V at I = 2mA $V_{OH}min$ = 1.35V at I = -2mA $V_{OH}max$ = 1.85V	If the feature is enabled (see Section 2.1.9.3).

Table 2: Signal description

Function	Signal name	IO	Signal form and level	Comment
ADC interface	ADC1_IN, ADC2_IN	I	Full specification compliance range V_{Imin}>=0.05V V_{Imax}<=V_{BATT+} Degraded accuracy range V_{Imin} 0V ... 0.05V Ridc>1MΩ Resolution: 16 Bit (sign+15Bit) Offset error: <+-10mV Gain error: <±1% Conversation time: approx. 1.722ms 	If unused keep line open. Prepared for general purpose and antenna diagnostic use.

2.1.2.1 Absolute Maximum Ratings

The absolute maximum ratings stated in Table 3 are stress ratings under any conditions. Stresses beyond any of these limits will cause permanent damage to PLAS9-W.

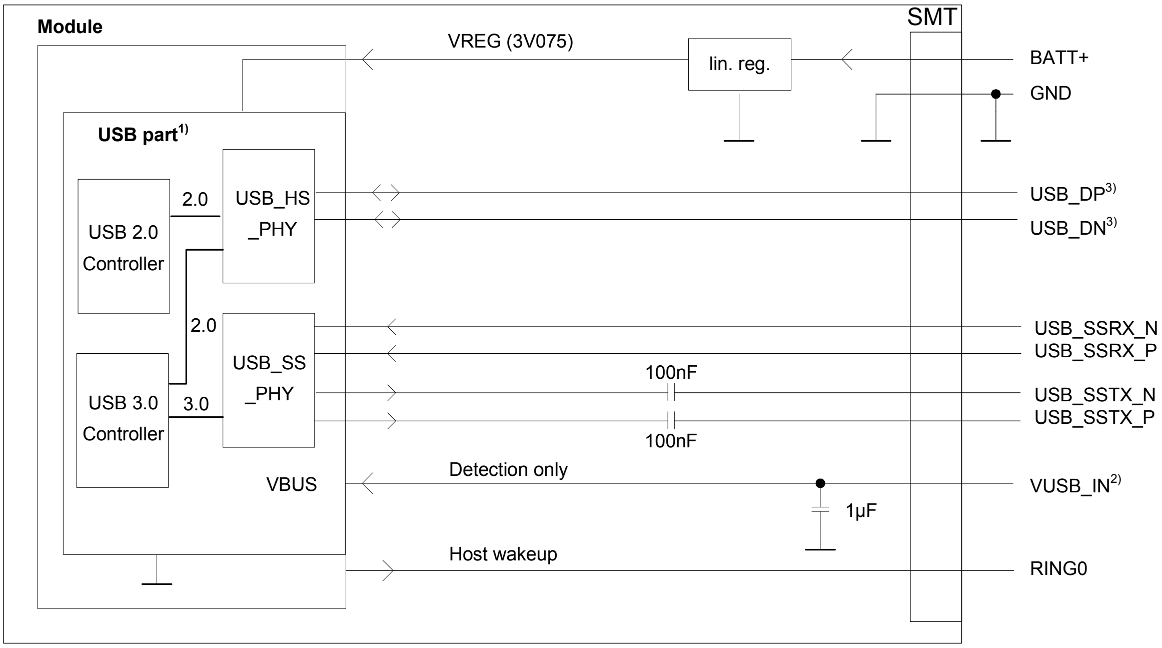
Table 3: Absolute maximum ratings

Parameter	Min	Max	Unit
Supply voltage BATT+	-0.5	+6.0	V
Voltage at all digital lines in Power Down mode (except VEXT)	-0.5	+0.5	V
Voltage at VEXT in Power Down mode	-0.3	+0.3	V
Voltage at digital lines in normal operation	-0.5	+2.3	V
Voltage at SIM/USIM interface, CCVCC 1.8V in normal operation	-0.5	+2.3	V
Voltage at SIM/USIM interface, CCVCC 3.0V in normal operation	-0.5	+3.4	V
Voltage at ADC lines if the module is powered by BATT+	-0.5	V_{BATT+}+0.5V	V
Voltage at ADC lines if the module is not powered	-0.5	+0.5	V
VEXT maximum current shorted to GND		-300	mA
VUSB_IN	-0.5	5.75	V
USB_DN, USB_DP	-0.5	3.6	
USB_SSTX_N, USB_SSTX_P, USB_SSRX_N, USB_SSRX_P	-0.5	1.4	
Voltage at PWR_IND line	-0.5	5.5	V
PWR_IND input current if PWR_IND= low		2	mA
Voltage at following signals: IGT, EMERG_OFF	-0.5	2.3	V

2.1.3 USB Interface

PLAS9-W supports a USB 3.0 Super Speed (5Gbps) device interface, and alternatively a USB 2.0 device interface that is High Speed and Full Speed compatible. The USB interface is primarily intended for use as command and data interface, and for downloading firmware[1].

The USB host is responsible for supplying the VUSB_IN line. This line is for voltage detection only. The USB part (driver and transceiver) is supplied by means of BATT+. This is because PLAS9-W is designed as a self-powered device compliant with the "Universal Serial Bus Specification Revision 3.0"[2].



1) All serial (including R_S) and pull-up resistors for data lines are implemented.

2) Since VUSB_IN is used for detection only it is recommended not to add any further blocking capacitors on the VUSB_IN line.

3) If the USB interface is operated in High Speed mode (480MHz), it is recommended to take special care routing the data lines USB_DP and USB_DN. Application layout should in this case implement a differential impedance of 90 ohms for proper signal integrity.

Figure 5: USB circuit

To properly connect the module's USB interface to the external application, a USB 3.0 or 2.0 compatible connector and cable or hardware design is required. For further guidelines on implementing the external application's USB 3.0 or 2.0 interfaces see [4] and [5]. For more information on the USB related signals see Table 2. Furthermore, the USB modem driver distributed with PLAS9-W needs to be installed.

When using the USB interface in a USB 2.0 only electrical environment, it is strongly recommended to connect to a USB High Speed host.

1. **Note:** For firmware download, the module enumerates new as a USB 2.0 device. Also note that it is not possible to use the USB 2.0 High Speed device mode and the USB 3.0 Super speed device mode simultaneously.
2. The specification is ready for download on http://www.usb.org/developers/docs/

2.1.3.1 Reducing Power Consumption

While a USB connection is active, the module will never switch into SLEEP mode. Only if the USB interface is in Suspended state or Detached (i.e., VUSB_IN = 0) is the module able to switch into SLEEP mode thereby saving power[1]. There are two possibilities to enable power reduction mechanisms:

- **Recommended implementation of USB Suspend/Resume/Remote Wakeup:**
  The USB host should be able to bring its USB interface into the Suspended state as described in the "Universal Serial Bus Specification Revision 3.0"[2]. For this functionality to work, the VUSB_IN line should always be kept enabled. On incoming calls and other events PLAS9-W will then generate a Remote Wakeup request to resume the USB host controller.

  See also [5] (USB Specification Revision 2.0, Section 10.2.7, p.282):
  "If USB System wishes to place the bus in the Suspended state, it commands the Host Controller to stop all bus traffic, including SOFs. This causes all USB devices to enter the Suspended state. In this state, the USB System may enable the Host Controller to respond to bus wakeup events. This allows the Host Controller to respond to bus wakeup signaling to restart the host system."
- **Implementation for legacy USB applications not supporting USB Suspend/Resume:**
  As an alternative to the regular USB suspend and resume mechanism it is possible to employ a remote wakeup line (e.g., the RING0 line) to wake up the host application in case of incoming calls or events signalized by URCs while the USB interface is in Detached state (i.e., VUSB_IN = 0). Every wakeup event requires USB being attached again thus forcing a new USB enumeration. Therefore, the external application has to carefully consider the enumeration timings to avoid loosing any signaled events. For details on this remote wakeup functionality see Section 2.1.9.3.

  It is possible to prevent existing data connections from being disconnected while the USB interface is in detached state (i.e., VUSB_IN=0) by configuring at least one of the module's USB ports to contribute to a host wakeup, i.e., configuring the port to try to wake up a connected host in case an appropriate event occurs (see [1]: AT^SCFG="RemoteWakeUp/Ports"), and by configuring a GPIO as USB wakeup GPIO (see [1]: AT^SCFG="RemoteWakeUp/Event/USB").

1. Please note that if the USB interface is employed, and a USB cable is connected, there should also be a terminal program linked to the USB port in order to receive and process the initial SYSSTART URC after module startup. Otherwise, the SYSSTART URC remains pending in the USB driver's output buffer and this unprocessed data prevents the module from power saving.
2. The specification is ready for download on http://www.usb.org/developers/docs/

2.1.4 UICC/SIM/USIM Interface

PLAS9-W has two UICC/SIM/USIM interfaces compatible with the 3GPP 31.102 and ETSI 102 221. These are wired to the host interface in order to be connected to an external SIM card holder. Five pads on the SMT application interface are reserved for each of the two SIM interfaces.

The UICC/SIM/USIM interface supports 3V and 1.8V SIM cards. Please refer to Table 2 for electrical specifications of the UICC/SIM/USIM interface lines depending on whether a 3V or 1.8V SIM card is used.

The CCINx signal serves to detect whether a tray (with SIM card) is present in the card holder. Using the CCINx signal is mandatory for compliance with the GSM 11.11 recommendation if the mechanical design of the host application allows the user to remove the SIM card during operation. To take advantage of this feature, an appropriate SIM card detect switch is required on the card holder. For example, this is true for the model supplied by Molex, which has been tested to operate with PLAS9-W and is part of the Thales reference equipment submitted for type approval. See Chapter 7 for Molex ordering numbers.

Table 4: Signals of the SIM interface (SMT application interface)

Signal	Description
GND	Ground connection for SIM interfaces. Optionally a separate SIM ground line using e.g., pad P12, may be used to improve EMC.
CCCLK1 CCCLK2	Chipcard clock lines for 1st and 2nd SIM interface.
CCVCC1 CCVCC2	SIM supply voltage lines for 1st and 2nd SIM interface.
CCIO1 CCIO2	Serial data lines for 1st and 2nd SIM interface, input and output.
CCRST1 CCRST2	Chipcard reset lines for 1st and 2nd SIM interface.
CCIN1 CCIN2	Input on the baseband processor for detecting a SIM card tray in the holder. If the SIM is removed during operation the SIM interface is shut down immediately to prevent destruction of the SIM. The CCINx signal is active low. The CCINx signal is mandatory for applications that allow the user to remove the SIM card during operation. The CCINx signal is solely intended for use with a SIM card. It must not be used for any other purposes. Failure to comply with this requirement may invalidate the type approval of PLAS9-W.

Note: No guarantee can be given, nor any liability accepted, if loss of data is encountered after removing the SIM card during operation. Also, no guarantee can be given for properly initializing any SIM card that the user inserts after having removed the SIM card during operation. In this case, the application must restart PLAS9-W.

By default, only the 1st SIM interface is available and can be used. Using the AT command AT^SCFG="SIM/CS" it is possible to switch between the two SIM interfaces. Command settings are non-volatile - for details see [1].

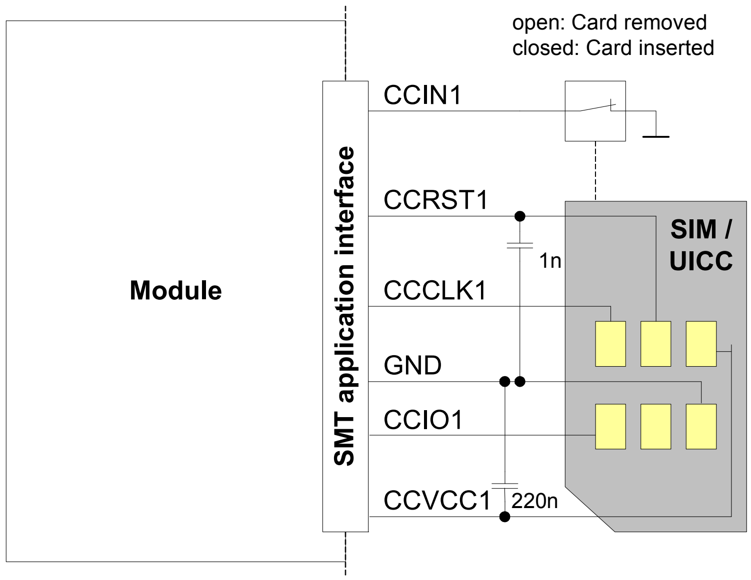


Figure 6: First UICC/SIM/USIM interface

The total cable length between the SMT application interface pads on PLAS9-W and the pads of the external SIM card holder must not exceed 100mm in order to meet the specifications of 3GPP TS 51.010-1 and to satisfy the requirements of EMC compliance.

To avoid possible cross-talk from the CCCLKx signal to the CCIOx signal be careful that both lines are not placed closely next to each other. A useful approach is using the GND line to shield the CCIOx line from the CCCLKx line.

An example for an optimized ESD protection for the SIM interface is shown in Section 2.1.5.

Note: Figure 6 shows how to connect a SIM card holder to the first SIM interface. With the second SIM interface some internally integrated components on the SIM circuit will have to be externally integrated as shown for the second SIM interface in Figure 7. The external components at CCIN2 should be populated as close as possible to the signal's SMT pad

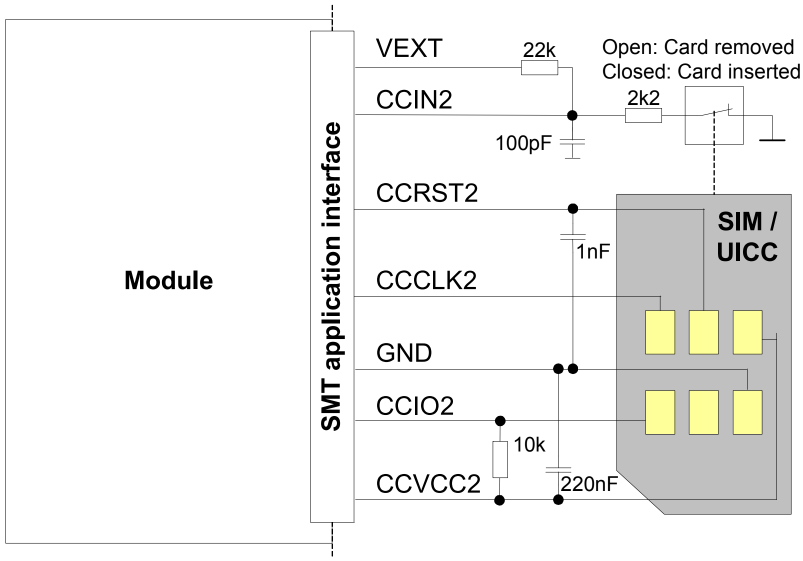


Figure 7: Second UICC/SIM/USIM interface

2.1.5 Enhanced ESD Protection for SIM Interfaces

To optimize ESD protection for the SIM interfaces it is possible to add ESD diodes to the interface lines of the first and second SIM interface as shown in the example given in Figure 8.

The example was designed to meet ESD protection according ETSI EN 301 489-1/7: Contact discharge: ± 4kV, air discharge: ± 8kV.

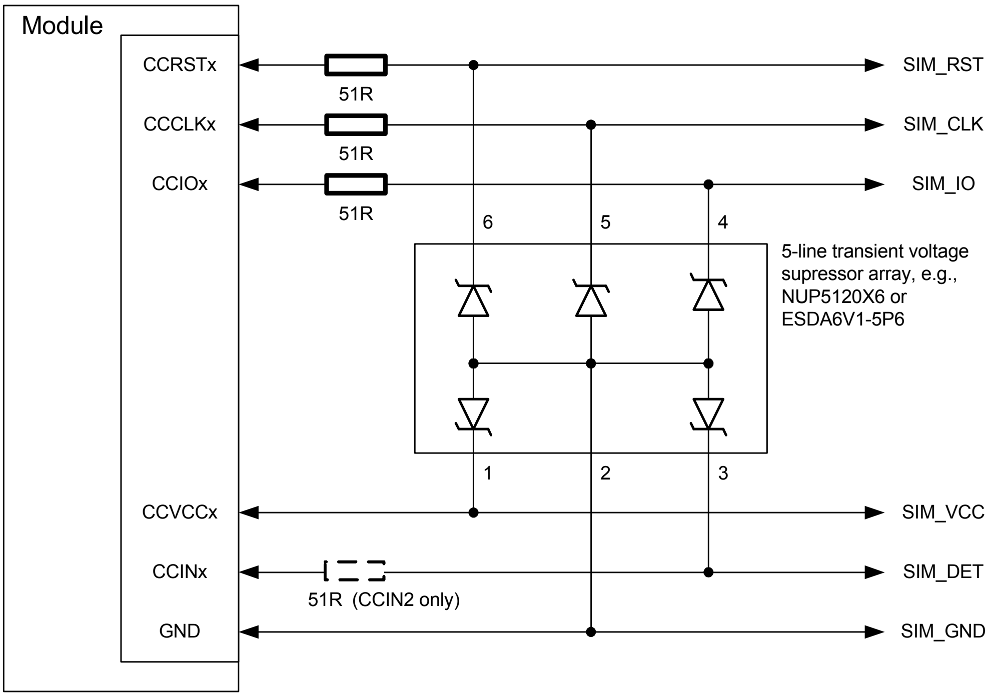


Figure 8: SIM interfaces - enhanced ESD protection

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2.1.6 Analog-to-Digital Converter (ADC)

PLAS9-W provides two unbalanced ADC input lines: ADC1_IN and ADC2_IN. They can be used to measure two independent, externally connected DC voltages in the range of 0.05V to V_{BATT+}. As described in Section 2.2.4 they can be used especially for antenna diagnosing.

The AT^SRADC command can be employed to select the ADC line, set the measurement mode and read out the measurement results.

2.1.7 RTC Backup

The internal Real Time Clock of PLAS9-W is supplied from a separate voltage regulator in the power supply component which is also active when PLAS9-W is in Power Down mode and BATT+ is available, and does not drop below approx. 1.4V.

2.1.8 GPIO Interface

PLAS9-W has 10 GPIOs for external hardware devices. Each GPIO can be configured for use as input or output. All settings are AT command controlled.

The IO port driver has to be open before using and configuring GPIOs. Before changing the configuration of a GPIO pin (e.g. input to output) the pin has to be closed. If the GPIO pins are not configured or the pins/driver were closed, the GPIO pins are high-Z with pull down resistor. If a GPIO is configured to input, the pin has high-Z without pull resistor.

GPIO1...GPIO10 may be configured as low current indicator signal (see Section 2.1.9.4), or may be set as remote host wakeup lines (see Section 2.1.9.3).

If PLAS9-W is in power save (SLEEP) mode a level state transition at GPIO1, GPIO3, GPIO4, GPIO5 and GPIO9 will wake up the module, if such a GPIO was configured as input using AT^SCPIN. To query the level state the AT^SCPOL command may be used. For details on the mentioned AT commands please see .

2.1.9 Control Signals

2.1.9.1 PWR_IND Signal

PWR_IND notifies the on/off state of the module. High state of PWR_IND indicates that the module is switched off. The state of PWR_IND immediately changes to low when IGT is pulled low. For state detection an external pull-up resistor is required.

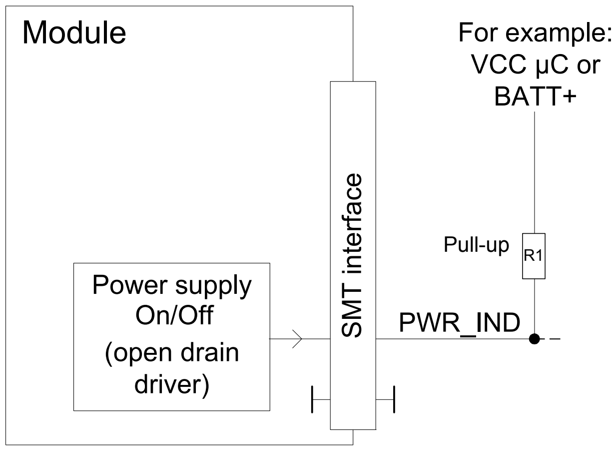


Figure 9: PWR_IND signal

2.1.9.2 Behavior of the RING0 Line

The RING0 line serves to indicate URCs (Unsolicited Result Code).

Although not mandatory for use in a host application, it is strongly suggested that you connect the RING0 line to an interrupt line of your application. In this case, the application can be designed to receive an interrupt when a falling edge on RING0 occurs. This solution is most effective, particularly, for waking up an application from power saving. Therefore, utilizing the RING0 line provides an option to significantly reduce the overall current consumption of your application.

The RING0 line behavior and usage can be configured by AT command. For details see [1]: AT^SCFG.

2.1.9.3 Remote Wakeup

If no call, data or message transfer is in progress, the external host application may shut down its own module interfaces or other components in order to save power. If a call, data, or other request (URC) arrives, the external application can be notified of this event and be woken up again by a state transition of a configurable remote wakeup line. Available as remote wakeup lines are all GPIO signals as well as the RING0 line. Please refer to [1]: AT^SCFG: "RemoteWakeUp/..." for details on how to configure these lines for defined wakeup events on specified device interfaces. Possible states are listed in Table 5.

If no line is specifically configured as remote wakeup signal, the USB suspend and resume mechanisms as specified in the “Universal Serial Bus Specification Revision 2.0”[1] apply for the USB interface (see also Section 2.1.3.1).

Table 5: Remote wakeup lines

Signal	I/O/P	Description
RING0	O	Low active transition: 0 = The host shall wake up 1 = No wake up request
GPIOx	O	High active transition: 0 = No wake up request 1 = The host shall wake up

1. The specification is ready for download on http://www.usb.org/developers/docs/

2.1.9.4 Low Current Indicator

A low current indication is optionally available over a GPIO line. By default, low current indication is disabled and the GPIO pads can be configured and employed as usual.

For a GPIO pad to work as a low current indicator the feature has to be enabled by AT command (see [1]: AT^SCFG: MEopMode/PowerMgmt/LCI). By default, the GPIO6 pad is configured as LCI_IND signal.

If enabled, the GPIOx/LCI_IND signal is high when the module is sleeping. During its sleep the module will for the most part be slow clocked with 32kHz RTC.

Table 6: Low current indicator line

Signal	I/O/P	Description
GPIOx/LCI_IND	O	High active transition: 0 = High current consumption The module draws its power via BATT+ 1 = Low current consumption (only reached during SLEEP mode) The module draws only a low current via BATT+

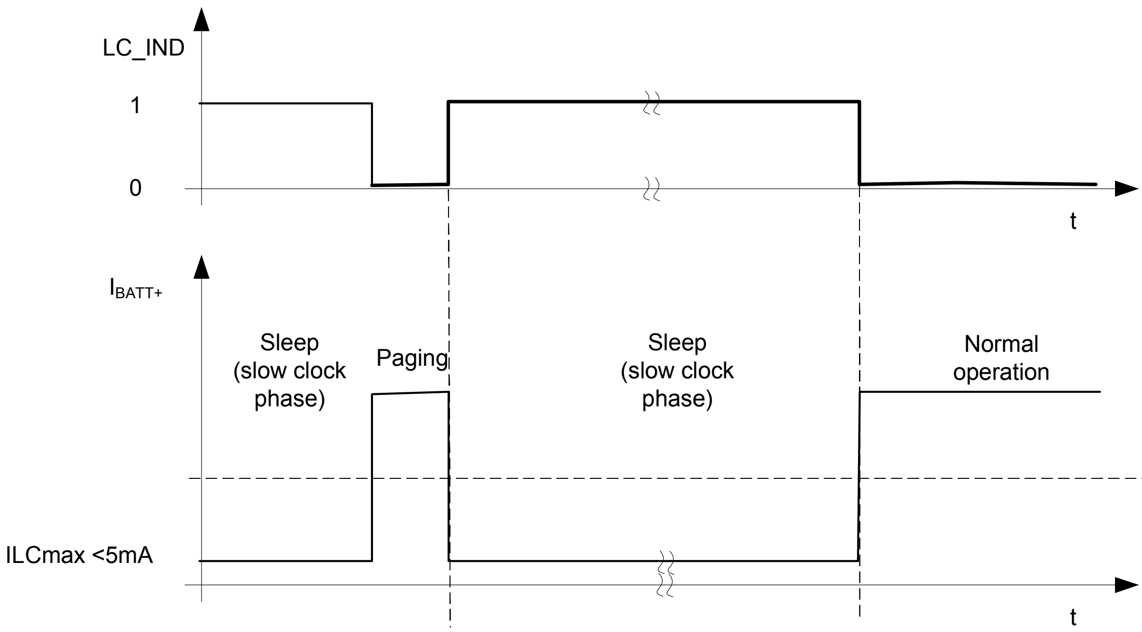


Figure 10: Low current indication timing

ILCmax During the low current periods the current consumption does not exceed the ILCmax value.

2.2 GSM/UMTS/LTE Antenna Interface

The PLAS9-W GSM/UMTS/LTE antenna interface comprises a GSM/UMTS/LTE main antenna as well as a UMTS/LTE Rx diversity/MIMO antenna to improve signal reliability and quality[1]. The interface has an impedance of 50Ω. PLAS9-W is capable of sustaining a total mismatch at the antenna interface without any damage, even when transmitting at maximum RF power.

The external antennas must be matched properly to achieve best performance regarding radiated power, modulation accuracy and harmonic suppression. Matching networks are not included on the PLAS9-W PCB and should be placed in the host application, if the antenna does not have an impedance of 50Ω.

Regarding the return loss PLAS9-W provides the following values in the active band:

Table 7: Return loss in the active band

State of module	Return loss of module	Recommended return loss of application
Receive	≥ 8dB	≥ 12dB
Transmit	not applicable	≥ 12dB
Idle	≤ 5dB	not applicable

1. By delivery default the UMTS/LTE Rx diversity/MIMO antenna is configured as available for the module since its usage is mandatory for LTE. Please refer to [1] for details on how to configure antenna settings.

2.2.1 Antenna Interface Specifications

Table 8: RF Antenna interface GSM/UMTS/LTE (at operating temperature range[1])

Parameter	Conditions	Min.	Typical	Max.	Unit
LTE connectivity[2]	Band 1, 3, 5, 7, 8, 18, 19, 20, 26, 28A, 28B, 38, 39, 40, 41				
Receiver Input Sensitivity @ ARP (ch. bandwidth 5MHz)	LTE 2100 Band 1	-100	-103		dBm
	LTE 1800 Band 3	-97	-103		dBm
	LTE 850 Band 5	-98	-104		dBm
	LTE 2600 Band 7	-98	-102		dBm
	LTE 900 Band 8	-97	-103		dBm
	LTE 850 Band 18	-98	-103		dBm
	LTE 850 Band 19	-98	-103		dBm
	LTE 800 Band 20	-97	-103		dBm
	LTE 850 Band 26	-97	-103		dBm
	LTE 700 Band 28A	-98,5	-103		dBm
	LTE 700 Band 28B	-98,5	-102		dBm
	LTE 2600 Band 38	-100	-101		dBm
	LTE 1900 Band 39	-100	-103		dBm
	LTE 2300 Band 40	-100	-102		dBm
	LTE 2600 Band 41	-98	-101		dBm
RF Power @ ARP with 50Ω Load	LTE 2100 Band 1	+21	+23	+25	dBm
	LTE 1800 Band 3	+21	+23	+25	dBm
	LTE 850 Band 5	+21	+23	+25	dBm
	LTE 2600 Band 7	+21	+23	+25	dBm
	LTE 900 Band 8	+21	+23	+25	dBm
	LTE 850 Band 18	+21	+23	+25	dBm
	LTE 850 Band 19	+21	+23	+25	dBm
	LTE 800 Band 20	+21	+23	+25	dBm
	LTE 850 Band 26	+21	+23	+25	dBm
	LTE 700 Band 28A	+21	+23	+25	dBm
	LTE 700 Band 28B	+21	+23	+25	dBm
	LTE 2600 Band 38	+21	+23	+25	dBm
	LTE 1900 Band 39	+21	+23	+25	dBm
	LTE 2300 Band 40	+21	+23	+25	dBm
	LTE 2600 Band 41	+21	+23	+25	dBm

Table 8: RF Antenna interface GSM/UMTS/LTE (at operating temperature range[1])

Parameter		Conditions	Min.	Typical	Max.	Unit
UMTS/HSPA connectivity[2]		Band I, III, V, VI, VIII				
Receiver Input Sensitivity @ ARP		UMTS 2100 Band I	-106.7	-110		dBm
		UMTS 1800 Band III	-103.7	-110		dBm
		UMTS 900 Band VIII	-103.7	-111		dBm
		UMTS 850 Band V	-104.7	-110		dBm
		UMTS 850 Band VI	-106.7	-110		dBm
RF Power @ ARP with 50Ω Load		UMTS 2100 Band I	+21	+24	+25	dBm
		UMTS 1800 Band III	+21	+24	+25	dBm
		UMTS 900 Band VIII	+21	+24	+25	dBm
		UMTS 850 Band V	+21	+24	+25	dBm
		UMTS 850 Band VI	+21	+24	+25	dBm
GPRS coding schemes		Class 12, CS1 to CS4				
EGPRS		Class 12, MCS1 to MCS9				
GSM Class		Small MS				
Static Receiver input Sensitivity @ ARP		E-GSM 900	-102	-110		dBm
		GSM 1800	-102	-109		dBm
RF Power @ ARP with 50Ω Load GSM		E-GSM 900		33		dBm
		GSM 1800		30		dBm
RF Power @ ARP with 50Ω Load (**ROPR=4**, i.e., no reduction)	GPRS, 1 TX	E-GSM 900		33		dBm
		GSM 1800		30		dBm
	EDGE, 1 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 2 TX	E-GSM 900		33		dBm
		GSM 1800		30		dBm
	EDGE, 2 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 3 TX	E-GSM 900		33		dBm
		GSM 1800		30		dBm
	EDGE, 3 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 4 TX	E-GSM 900		33		dBm
		GSM 1800		30		dBm
	EDGE, 4 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm

Table 8: RF Antenna interface GSM/UMTS/LTE (at operating temperature range[1])

Parameter		Conditions	Min.	Typical	Max.	Unit
RF Power @ ARP with 50Ω Load (**ROPR=5**)	GPRS, 1 TX	E-GSM 900		33		dBm
		GSM 1800		30		dBm
	EDGE, 1 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 2 TX	E-GSM 900		33		dBm
		GSM 1800		30		dBm
	EDGE, 2 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 3 TX	E-GSM 900		32.2		dBm
		GSM 1800		29.2		dBm
	EDGE, 3 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 4 TX	E-GSM 900		31		dBm
		GSM 1800		28		dBm
	EDGE, 4 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
RF Power @ ARP with 50Ω Load (**ROPR=6**)	GPRS, 1 TX	E-GSM 900		33		dBm
		GSM 1800		30		dBm
	EDGE, 1 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 2 TX	E-GSM 900		31		dBm
		GSM 1800		28		dBm
	EDGE, 2 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 3 TX	E-GSM 900		30.2		dBm
		GSM 1800		27.2		dBm
	EDGE, 3 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 4 TX	E-GSM 900		29		dBm
		GSM 1800		26		dBm
	EDGE, 4 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm

Table 8: RF Antenna interface GSM/UMTS/LTE (at operating temperature range[1])

Parameter		Conditions	Min.	Typical	Max.	Unit
RF Power @ ARP with 50Ω Load (**ROPR=7**)	GPRS, 1 TX	E-GSM 900		33		dBm
		GSM 1800		30		dBm
	EDGE, 1 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 2 TX	E-GSM 900		30		dBm
		GSM 1800		27		dBm
	EDGE, 2 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 3 TX	E-GSM 900		28.2		dBm
		GSM 1800		25.2		dBm
	EDGE, 3 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 4 TX	E-GSM 900		27		dBm
		GSM 1800		24		dBm
	EDGE, 4 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
RF Power @ ARP with 50Ω Load (**ROPR=8**, i.e., max. reduction)	GPRS, 1 TX	E-GSM 900		33		dBm
		GSM 1800		30		dBm
	EDGE, 1 TX	E-GSM 900		27		dBm
		GSM 1800		26		dBm
	GPRS, 2 TX	E-GSM 900		30		dBm
		GSM 1800		27		dBm
	EDGE, 2 TX	E-GSM 900		24		dBm
		GSM 1800		23		dBm
	GPRS, 3 TX	E-GSM 900		28.2		dBm
		GSM 1800		25.2		dBm
	EDGE, 3 TX	E-GSM 900		22.2		dBm
		GSM 1800		21.2		dBm
	GPRS, 4 TX	E-GSM 900		27		dBm
		GSM 1800		24		dBm
	EDGE, 4 TX	E-GSM 900		21		dBm
		GSM 1800		20		dBm

1. At extended temperature range no active power reduction is implemented - any deviations are hardware related.
2. Applies also to UMTS/LTE Rx diversity/MIMO antenna.

2.2.2 Antenna Installation

The antenna is connected by soldering the antenna pads (ANT_MAIN; ANT_DRX_MIMO) and their neighboring ground pads directly to the application's PCB.

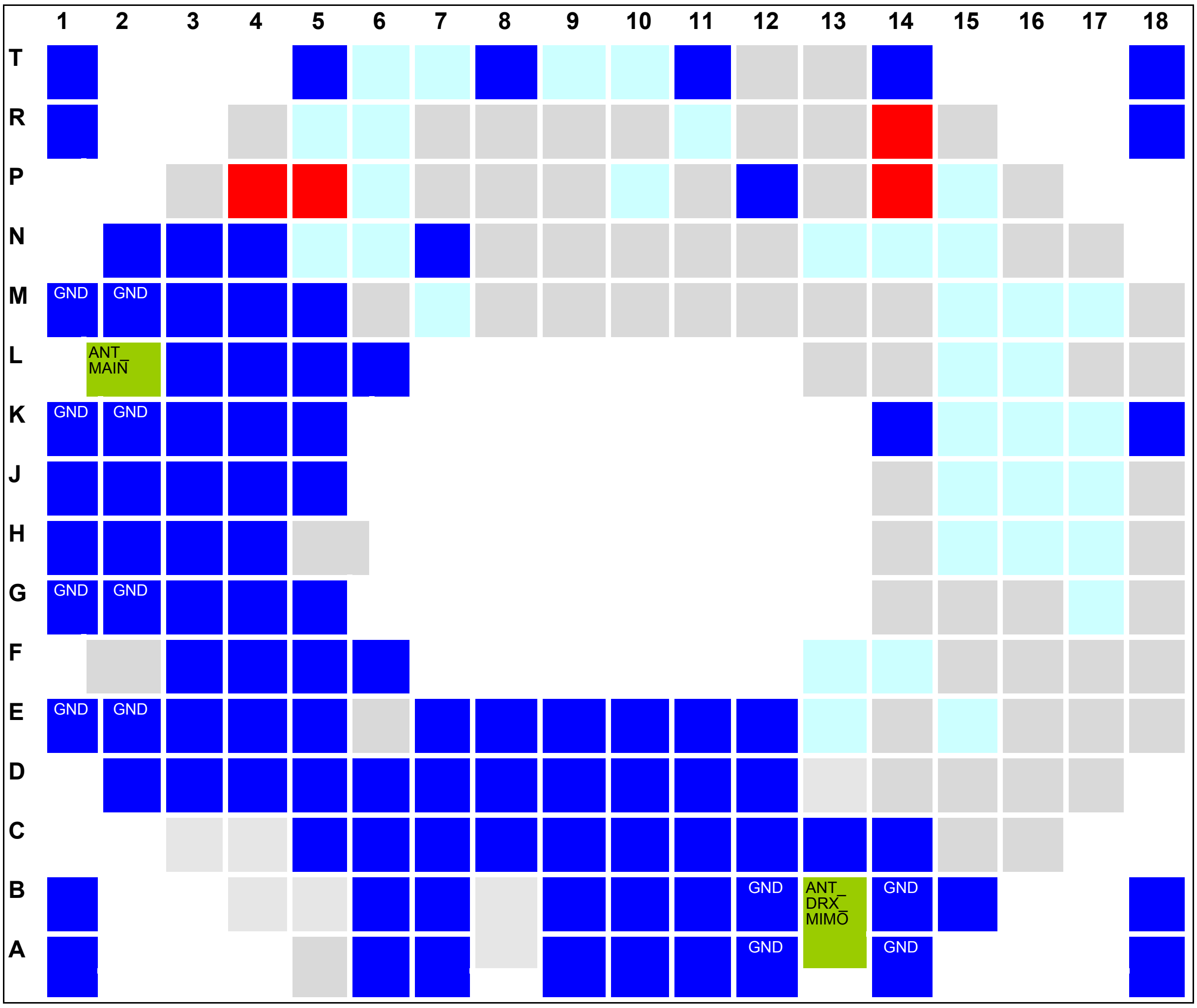


Figure 11: Antenna pads (bottom view)

The distance between the antenna pads and their neighboring GND pads has been optimized for best possible impedance. To prevent mismatch, special attention should be paid to these pads on the application' PCB.The wiring of the antenna connection, starting from the antenna pad to the application's antenna must result in a 50Ω line impedance. Line width and distance to the GND plane need to be optimized with regard to the PCB's layer stack. Related instructions are given in Section 2.2.3.

To prevent receiver desensitization due to interferences generated by fast transients like high speed clocks on the external application PCB, it is recommended to realize the antenna connection line using embedded Stripline rather than Micro-Stripline technology. Please see Section 2.2.3 for instructions of how to design the antenna connection in order to achieve the required 50Ω line impedance.

For type approval purposes an external application must connect the RF signal in one of the following ways:

- Via 50Ω coaxial antenna connector (common connectors are U-FL or SMA) placed as close as possible to the module's antenna pad.
- By soldering the antenna to the antenna connection line on the application's PCB (without the use of any connector) as close as possible to the module's antenna pad.
- By routing the application PCB's antenna to the module's antenna pad in the shortest possible way.

2.2.3 RF Line Routing Design

2.2.3.1 Line Arrangement Instructions

Several dedicated tools are available to calculate line arrangements for specific applications and PCB materials - for example from http://www.polarinstruments.com/ (commercial software) or from http://web.awrcorp.com/Usa/Products/Optional-Products/TX-Line/ (free software).

Embedded Stripline
This below figure shows line arrangement examples for embedded stripline.

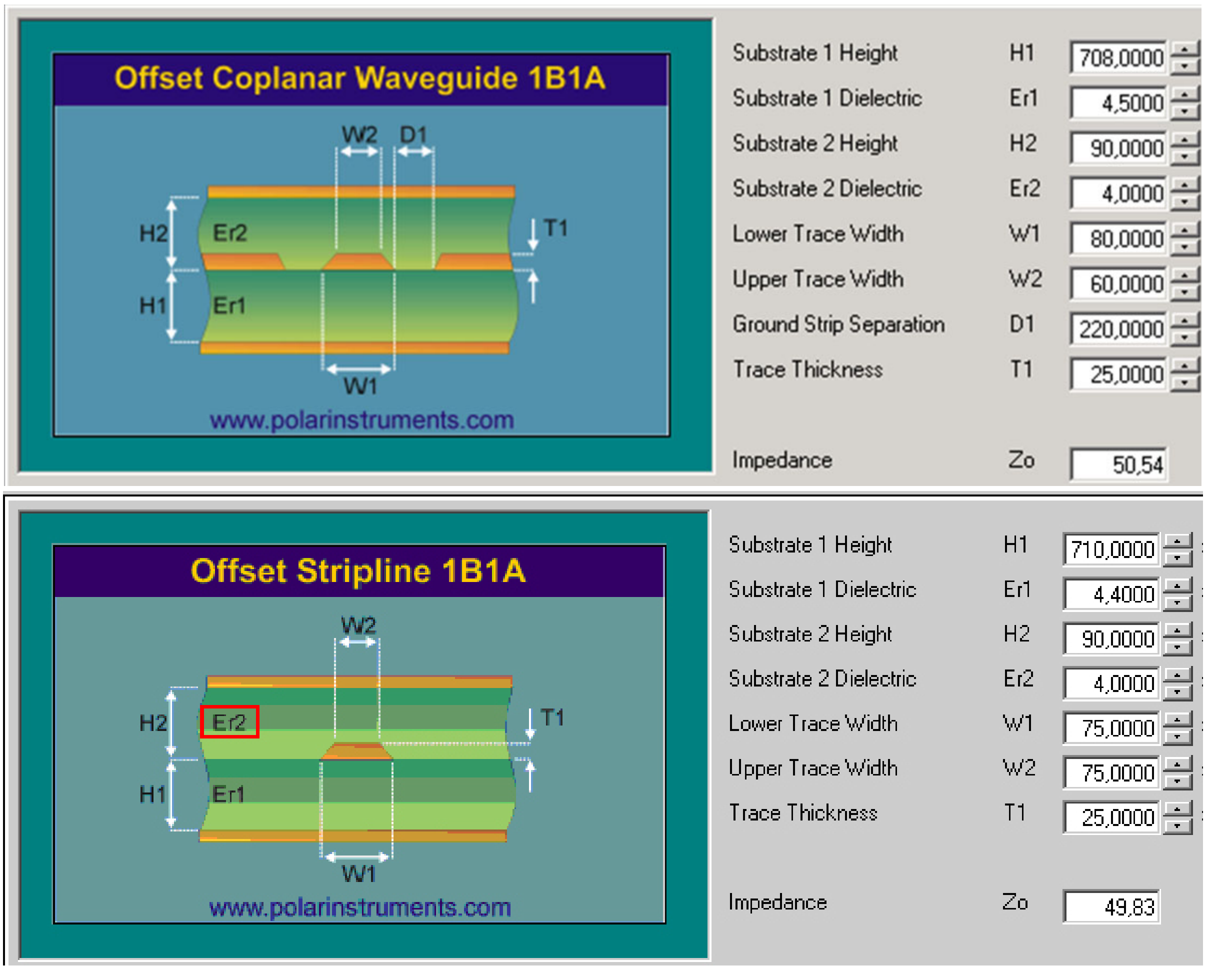


Figure 12: Embedded Stripline line arrangement

Micro-Stripline

This section gives two line arrangement examples for micro-stripline.

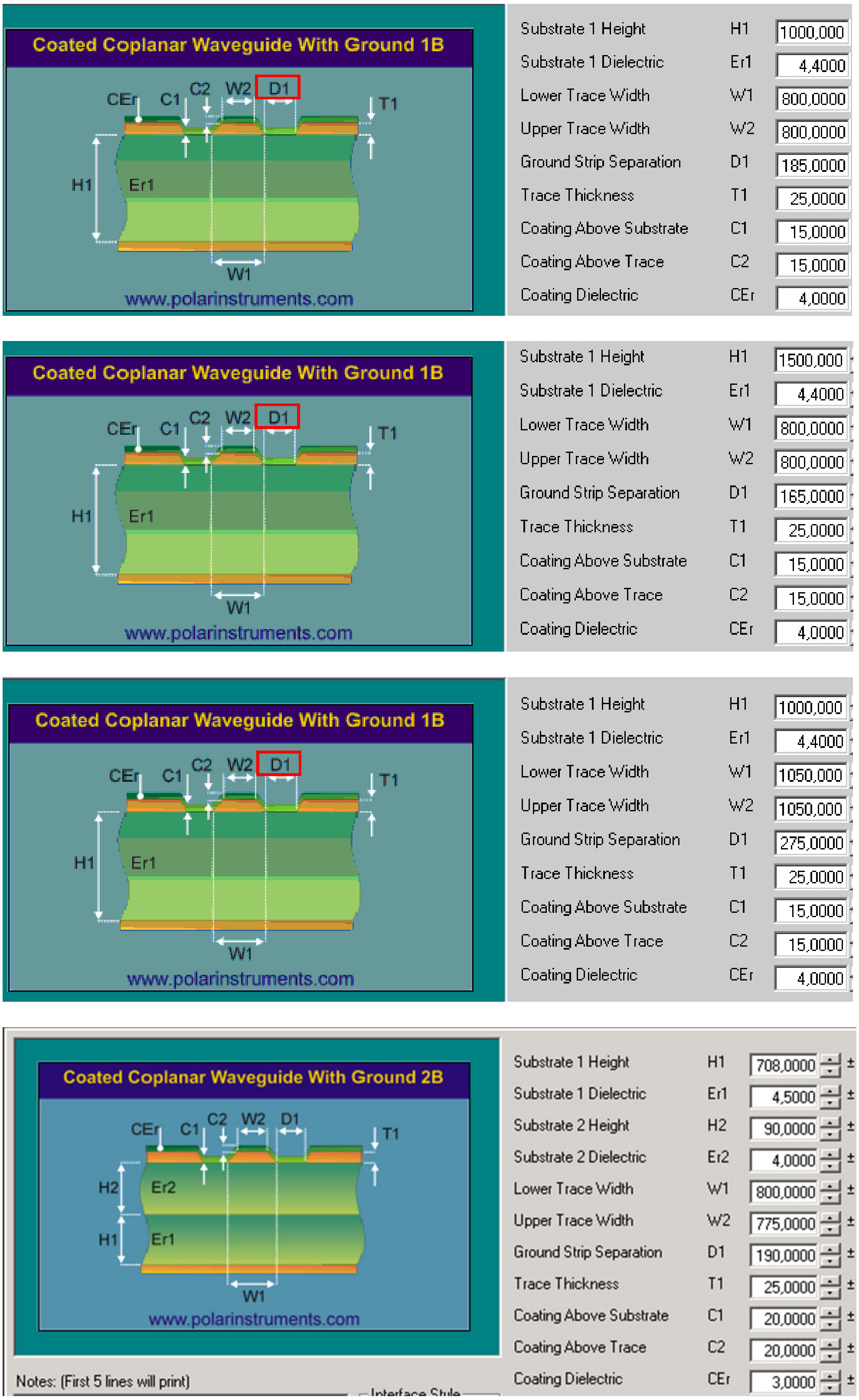


Figure 13: Micro-Stripline line arrangement samples

2.2.3.2 Routing Example

Interface to RF Connector

Figure 14 shows a sample connection of a module's antenna pad at the bottom layer of the module PCB with an application PCB's coaxial antenna connector. Line impedance depends on line width, but also on other PCB characteristics like dielectric, height and layer gap. The sample stripline width of 0.40mm is recommended for an application with a PCB layer stack resembling the one of the PLAS9-W evaluation board. For different layer stacks the stripline width will have to follow stripline routing rules, avoiding 90 degree corners and using the shortest distance to the PCB's coaxial antenna connector.

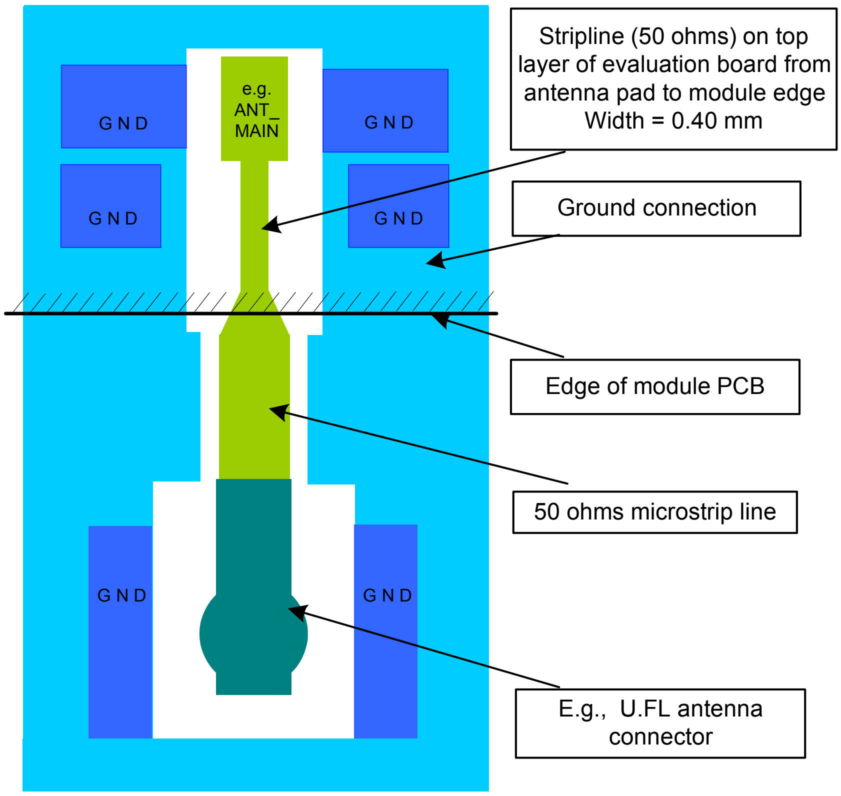


Figure 14: Routing to application's RF connector

2.2.4 RF Antenna Diagnostic

RF antenna (GSM/UMTS/LTE) diagnosis requires the implementation of an external antenna detection circuit. An example for such a circuit is illustrated in Figure 16. It allows to check the presence and the connection status of 1 or 2 RF antennas.

To properly detect the antenna and verify its connection status the antenna feed point must have a DC resistance R_{ANT} of 9kΩ (±3kΩ).

A positive or negative voltage drop (referred to as $V_{disturb}$) on the ground line may occur without having any impact on the measuring procedure and the measuring result. A peak deviation ($V_{disturb}$) of ≤ 0.8V from ground is acceptable.
$V_{disturb}$ (peak) = ± 0.8V (maximum); $f_{disturb}$ = 0Hz … 5kHz

Waveform: DC, sinus, square-pulse, peak-pulse (width = 100µs)
$R_{disturb}$ = 5Ω

To make sure that the antenna detection operates reliably, the capacitance at the module's antenna pad (i.e., the cable capacitance plus the antenna capacitance (C_{ANT})) should not be greater than 1000pF. Some types of antennas (for example "inverted F antenna" or "half loop antenna") need an RF short circuit between the antenna structure and ground to work properly. In this case the RF short circuit has to be realized via a capacitance (C_{ANT}) . For C_{ANT} we recommend a capacitance lower than 100pF (see Figure 15).

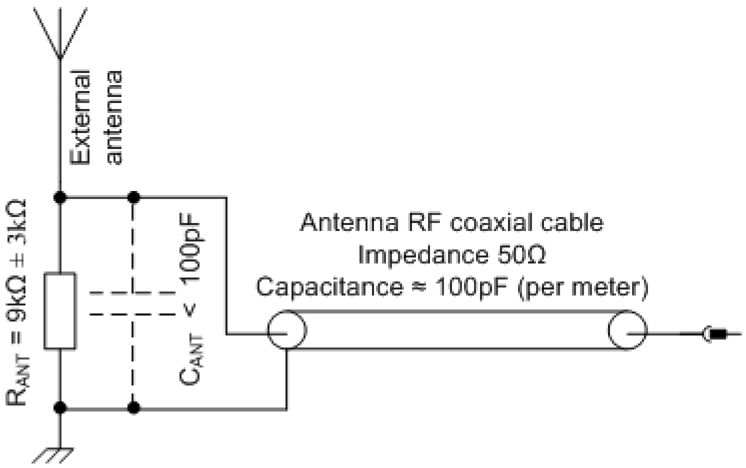


Figure 15: Resistor measurement used for antenna detection

Figure 16 shows the basic principles of an antenna detection circuit that is able to detect two antennas and verify their connection status. The GPIO pads can be employed to enable the antenna detection, the ADCx_IN pads can be used to measure the voltage of external devices connected to these ADC input pads - thus determining R_{ANT} values. The AT^SRADC write command configures the parameters required for ADC measurement and returns the measurement result(s) - for command details see [1].

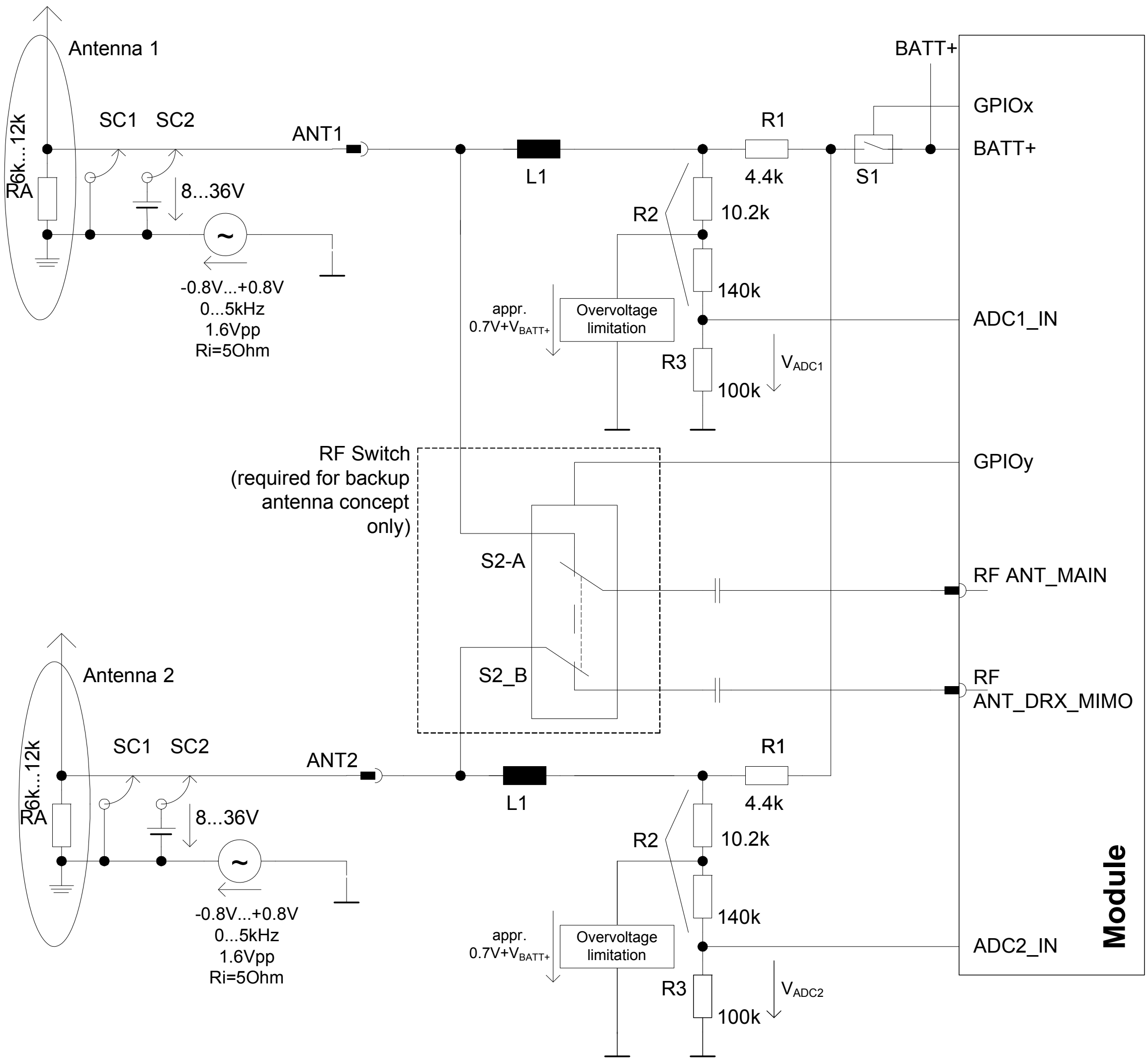


Figure 16: Basic layout sample for antenna detection

The following Table 9 lists possible signal states for the GPIOx and GPIOy signal lines in case these lines are configured and used for antenna detection. For GPIO configuration and control commands see [1].

Table 9: Possible GPIOx and GPIOy signal states if used for antenna diagnosis

Signal state	Meaning
GPIOx: Input Pull down or Output low Output high	Antenna detection control (S1 in above figure): Off (diagnostic measurement is off) On (diagnostic measurement is on)
GPIOy: Input Pull down or Output low Output high	Antenna switch control (RF switch in above figure): Antenna 1 Antenna 2

Table 10 lists assured antenna diagnostic states depending on the measured R_{ANT} values. Note that the R_{ANT} ranges not mentioned in the below table, i.e., 1kΩ...6kΩ and 12kΩ...40kΩ are tolerance ranges. Within these tolerance ranges a decision threshold for a diagnostic application may be located. For more details on the sample antenna detection circuit please refer to Section 2.3.1.

Table 10: Assured antenna diagnostic states

Antenna state	R_{ANT} range
Normal operation, antenna connected (resistance at feed point as required)	R_{ANT} = 6kΩ…12kΩ
Antenna pad short-circuited to GND	R_{ANT} = 0…1kΩ
Antenna not properly connected, or resistance at antenna feed point wrong or not present	R_{ANT} = 40kΩ…∞Ω
Antenna pad is short-circuited to the supply voltage of the host application, for example the vehicle's on-board power supply voltage	max. 36V

Measuring procedure for the basic layout sample given in Figure 16:
The battery current flows through R1 and RA. The voltage drop on RA is divided by R3/(R3+R2) and measured by the ADCx_IN input. For the ADCx_IN voltage V_{ADCx} (monitored using AT^SRADC) and the BATT+ supply voltage V_{BATT+} (monitored using AT^SBV) several measuring samples should be taken for averaging. The measured and averaged value V_{ADCx} will then be compared to three decision thresholds. The decision thresholds depend on BATT+:

Table 11: GSM/UMTS/LTE antenna diagnostic decision threshold

<table>
<tr><th colspan="2">Decision threshold[1]</th><th>V_{ADCx}</th><th>Result</th></tr>
<tr><td rowspan="2">Short to GND</td><td rowspan="2">Appr. 0,176*V_{BATT+} (580mV…738mV)</td><td><</td><td>Short-circuited to ground</td></tr>
<tr><td>></td><td rowspan="2">Antenna connected</td></tr>
<tr><td rowspan="2">No antenna</td><td rowspan="2">Appr. 0,337*V_{BATT+} (1111mV…1414mV)</td><td><</td></tr>
<tr><td>></td><td rowspan="2">Antenna nor properly connected</td></tr>
<tr><td rowspan="2">Short to power</td><td rowspan="2">0.146+0.405*V_{BATT+} (1482mV…1888mV)</td><td><</td></tr>
<tr><td>></td><td>Short-circuited to power</td></tr>
</table>

1. The decision thresholds depends on BATT+ and has to be calculated separately for each decision (the BATT+ voltage level V_{BATT+} is known to the system: 3.3V ≤ V_{BATT+} ≤ 4.2V).

2.3 Sample Application

Figure 17 shows a typical example of how to integrate an PLAS9-W module with an application.

The PWR_IND line is an open collector that needs an external pull-up resistor which connects to the voltage supply VCC µC of the microcontroller. Low state of the open collector pulls the PWR_IND signal low and indicates that the PLAS9-W module is active, high level notifies the Power Down mode.

If the module is in Power Down mode avoid current flowing from any other source into the module circuit, for example reverse current from high state external control lines. Therefore, the controlling application must be designed to prevent reverse flow.

While developing SMT applications it is strongly recommended to provide test points for certain signals, i.e., lines to and from the module - for debug and/or test purposes. The SMT application should allow for an easy access to these signals. For details on how to implement test points see [3].

The EMC measures are best practice recommendations. In fact, an adequate EMC strategy for an individual application is very much determined by the overall layout and, especially, the position of components.

Some LGA pads are connected to clocks or high speed data streams that might interfere with the module's antenna. The RF receiver would then be blocked at certain frequencies (self interference). The external application's PCB tracks connected to these pads should therefore be well shielded or kept away from the antenna. This applies especially to the USB and UICC/SIM interfaces.

The analog-to-digital converter (ADCx_IN lines) can be used for antenna diagnosis. A sample antenna detection circuit can be found in Figure 18 and Figure 19.

Disclaimer:
No warranty, either stated or implied, is provided on the sample schematic diagram shown in Figure 17 and the information detailed in this section. As functionality and compliance with national regulations depend to a great amount on the used electronic components and the individual application layout manufacturers are required to ensure adequate design and operating safeguards for their products using PLAS9-W modules.

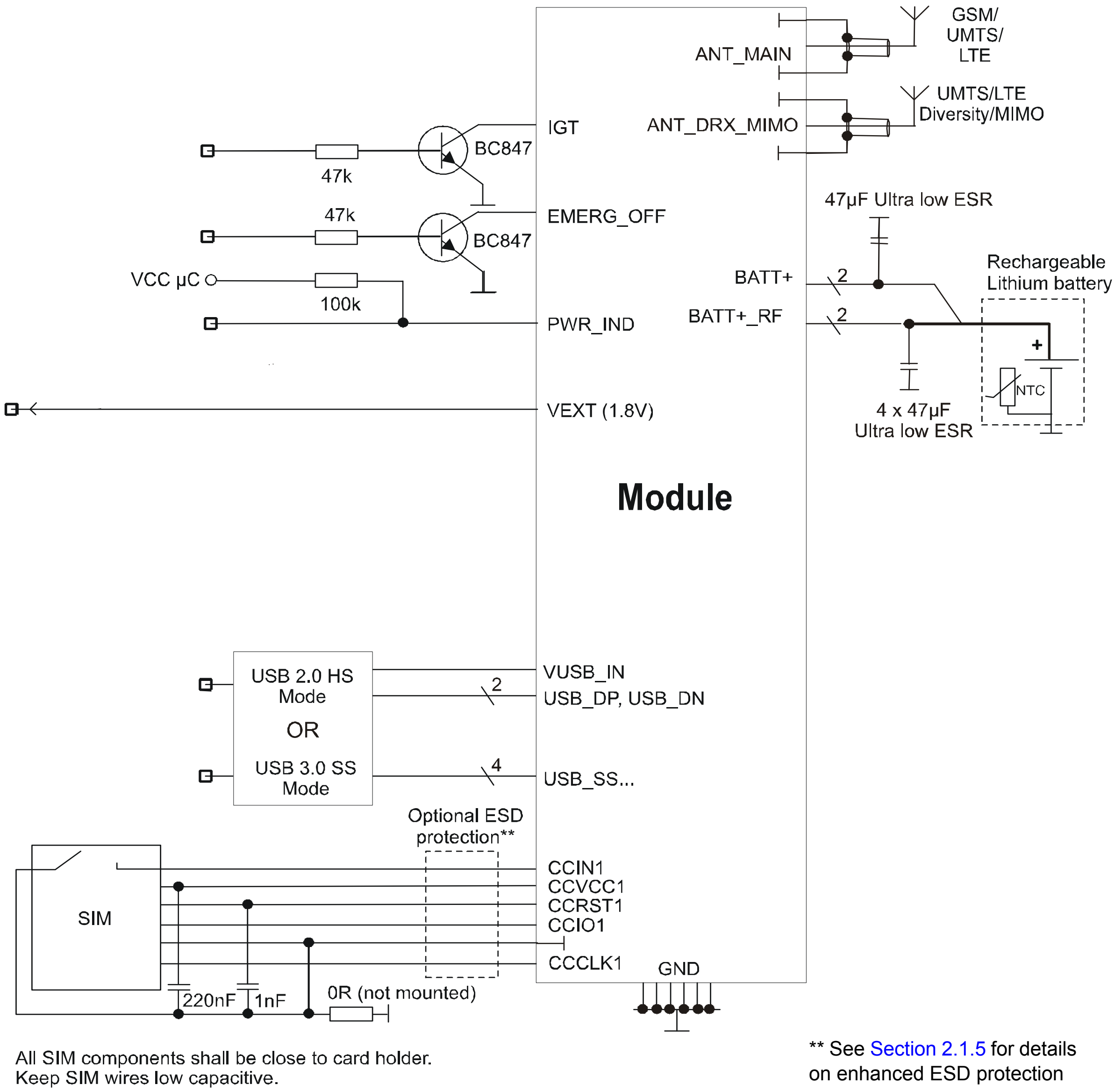


Figure 17: PLAS9-W sample application

2.3.1 Sample Circuit for Antenna Detection

The following figures explain how an RF antenna detection circuit may be implemented for PLAS9-W to be able to detect 1 or 2 antennas (for basic circuit and diagnostic principles - including usage of GPIO and ADCx_IN pads - please refer to Section 2.2.4). Figure 18 gives a general overview, Figure 19 depicts the actual antenna detection layout and shows how ESD protection, i.e., the RF/DC bridge, will have to be handled. The switch driver and antenna switch mentioned in Figure 18 will have to be realized by the application manufacturer.

Properties for the components mentioned in Figure 18 and Figure 19 are given in Table 12 - parts list.

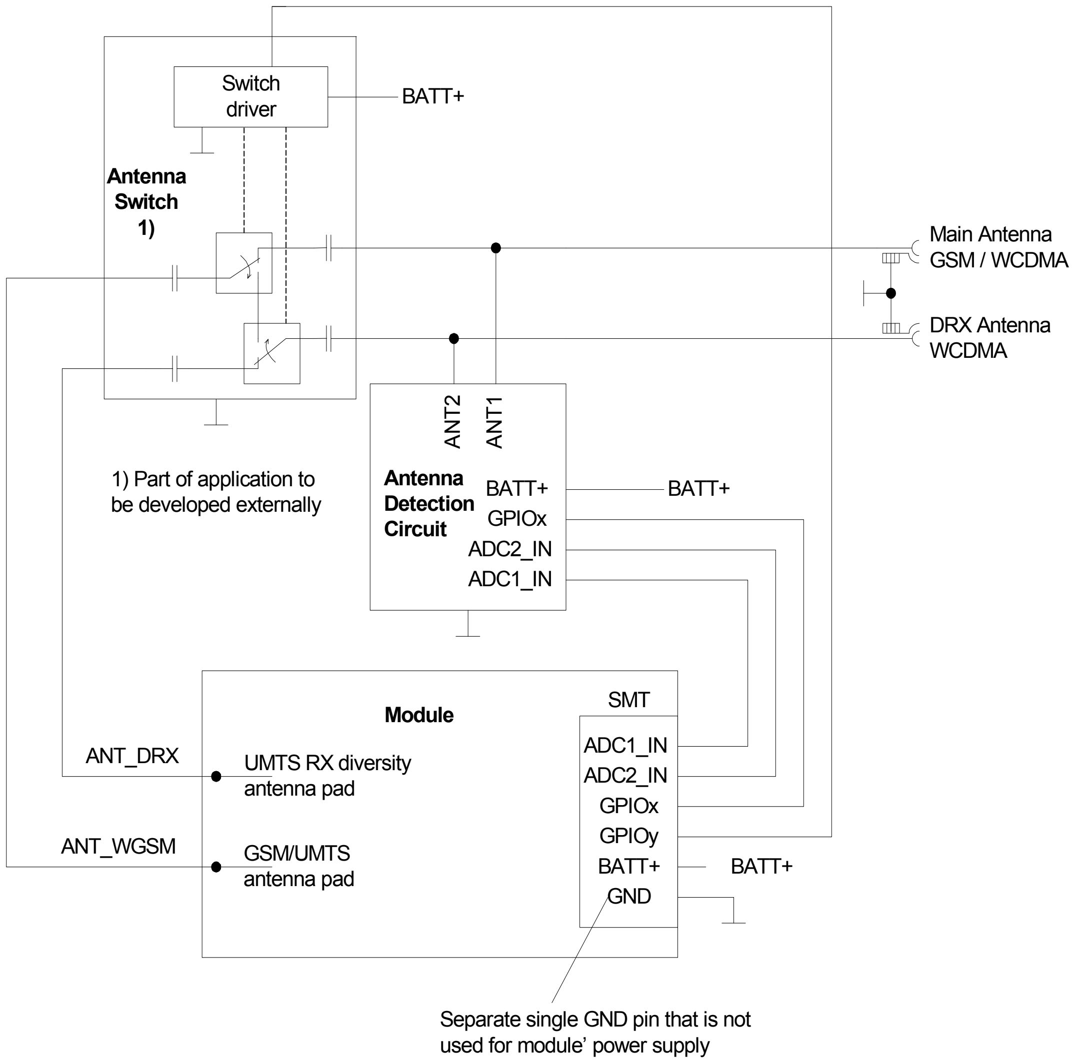


Figure 18: Antenna detection circuit sample - overview

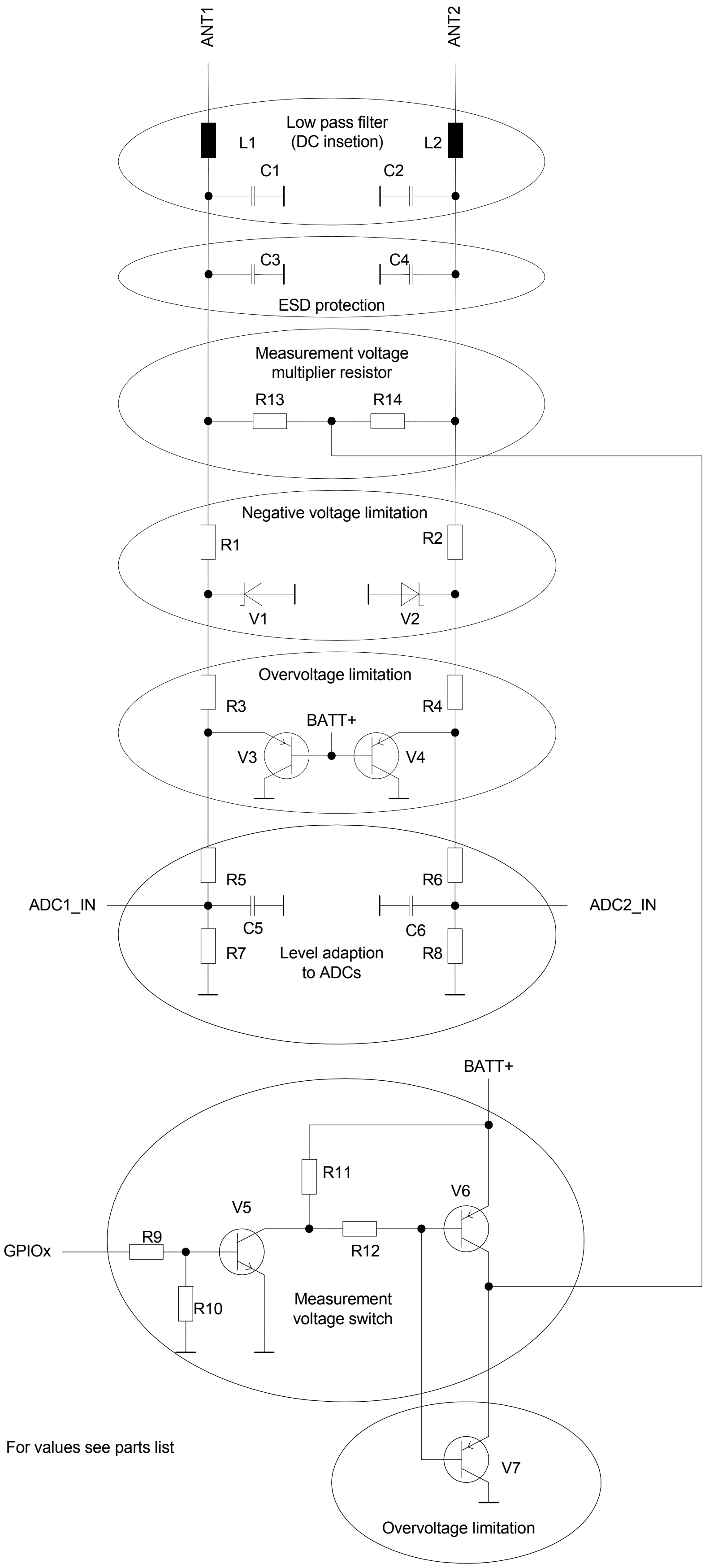


Figure 19: Antenna detection circuit sample - schematic

Table 12: Antenna detection reference circuit - parts list

Reference	Part	Value	Tolerance	Conditions	Size
R1,2	Resistor	22R			
R3,4	Resistor	10k		≥ 125mW	
R5,6	Resistor	140k	1%		
R7,8	Resistor	100k	1%		
R9,10	Resistor	100k			
R11,12	Resistor	10k		≥ 125mW	
R13,14	Resistor	4k4 (e.g., 2x2k2 or 4x1k1)	1%	≥ 300mW	
C1,2	Capacitor	22p		50V	≤ 0402
C3,4	Capacitor	100n		50V	
C5,6	Capacitor	100n		10V	
V1,2	Schottky diode	RB520-40		40V	
V3,4,6,7	Transistor	BC857			
V5	Transistor	BC847			
L1,2	Inductor	39nH		Wire wound High Q	0402

3 Operating Characteristics

3.1 Operating Modes

The table below briefly summarizes the various operating modes referred to throughout the document.

Table 13: Overview of operating modes

Mode	Function	
Normal operation	GSM / GPRS / UMTS / HSPA / LTE SLEEP	Power saving set automatically when no call is in progress and the USB connection is detached.
	GSM / GPRS / UMTS / HSPA / LTE IDLE	Power saving disabled or an USB connection active, but no data transfer in progress.
	GPRS DATA	GPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates and GPRS configuration (e.g. used multislot settings).
	EGPRS DATA	EGPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates and EGPRS configuration (e.g. used multislot settings).
	UMTS DATA	UMTS data transfer in progress. Power consumption depends on network settings (e.g. TPC Pattern) and data transfer rate.
	HSPA DATA	HSPA data transfer in progress. Power consumption depends on network settings (e.g. TPC Pattern) and data transfer rate.
	LTE DATA	LTE data transfer in progress. Power consumption depends on network settings (e.g. TPC Pattern) and data transfer rate.
Power Down	Normal shutdown after sending the AT^SMSO command. Software is not active. Interfaces are not accessible. Operating voltage (connected to BATT+) remains applied. Only a voltage regulator is active for powering the RTC, as long as operating voltage applied at BATT+ does not drop below approx. 1.4V.	
Airplane mode	Airplane mode shuts down the radio part of the module, causes the module to log off from the GSM/GPRS network and disables all AT commands whose execution requires a radio connection. Airplane mode can be controlled by AT command (see [1]).	

3.2 Power Up/Power Down Scenarios

In general, be sure not to turn on PLAS9-W while it is beyond the safety limits of voltage and temperature stated in Section 6.1. PLAS9-W immediately switches off after having started and detected these inappropriate conditions. In extreme cases this can cause permanent damage to the module. Note that some power up/power down details (especially timings) are still to be defined.

3.2.1 Turn on PLAS9-W

When the PLAS9-W module is in Power Down mode, it can be started to Normal mode by driving the IGT (ignition) line to ground. It is required to use an open drain/collector driver to avoid current flowing into this signal line. Pulling this signal low triggers a power-on sequence. To turn on PLAS9-W, it is recommended to keep IGT active at least 100 milliseconds. After turning on PLAS9-W, IGT should be set inactive to prevent the module from turning on again after a shut down by AT command or EMERG_OFF. For details on signal states during startup see also Section 3.2.2.

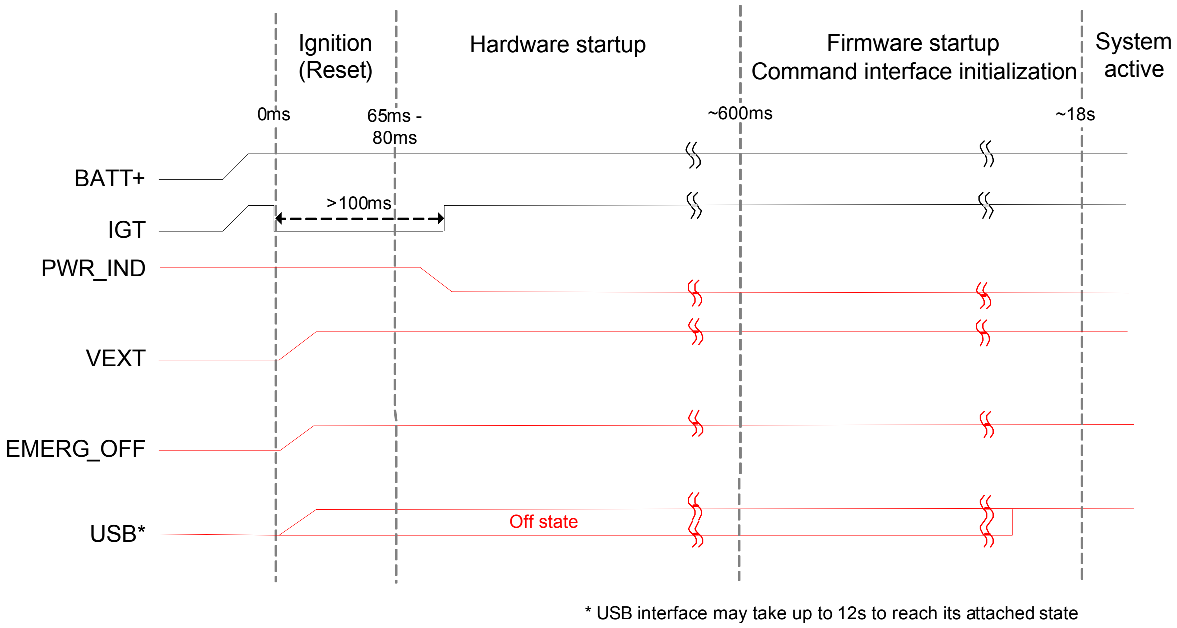


Figure 20: Power-on with IGT

Note: After power up IGT should remain high. Also note that with a USB connection the USB host may take some seconds to set up the virtual COM port connection.

After startup or mode change the following URCs are sent to every port able to receive AT commands indicating the module's ready state (this may take up to 18s):
- "^SYSSTART" indicates that the module has entered Normal mode.
- "^SYSSTART AIRPLANE MODE" indicates that the module has entered Airplane mode.

These URCs notify the external application that the first AT command can be sent to the module. If these URCs are not used to detect then the only way of checking the module's ready state can be checked by polling, e.g., send characters (e.g. "at") until the module is responding.

Please note that on USB ports these URCs are only sent if the USB interface is in state 'configured', and with AT^SCFG= "MEopMode/ExpectDTR being enabled (see also Section 3.3) the connected USB host has signaled being ready to receive data.

3.2.2 Signal States after First Startup

Table 14 describes the various states each interface signal passes through after startup and during operation.

Signals are in an initial state while the module is initializing. Once the startup initialization has completed, i.e. when the software is running, all signals are in defined state. The state of several signals will change again once the respective interface is activated or configured by AT command.

Table 14: Signal states

Signal name	Reset phase (ignition) 65-80ms	Startup phase Hardware approx. 520ms Firmware approx. 17.4s	System active After approx. 18s
CCIN1	PD and PU (24k)	PU and PU (24k)[1]	I, PU(24k)
CCIN2	PD	PD [1]	I, PU
CCRSTx	Not driven (similar PD)	Not driven (similar PD)	O, L[2]
			O, H[3]
CCIO1	PD(10k)	PD(10k)	PD(10k)[2]
			I/O PU(10k)[3]
CCIO2	Not driven (similar PD)	Not driven (similar PD)	O, L[2]
			O, H[3]
CCCLKx	Not driven (similar PD)	Not driven (similar PD)	O, L[2]
			Clock[3]
CCVCCx	Off	Off	Off[2]
			1.8V/3V[3]
RING0	PD	PD	PD
FW_DWNLD_DCD0	PD	PD[4]	PD
PWR_IND	High-Z	O, L	O, L
EMERG_OFF	PU	I, PU	I, PU
IGT	I, PU	I, PU	I, PU
GPIO1...10	PD	PD[5]	PD (if unused)

1. After approx. 13s the signal changes to I, PU.
2. If CCINx = High level
3. If CCINx = Low level, and the SIM card interface is configured by the AT^SCFG="SIM/..:" command
4. In the time period between 300-600ms after triggering ignition there is a short 30ms PU on FW_DWNLD_DCD0. If the line is driven low during this interval, the module enters a special Download Mode.
5. No external pull up or high signal on GPIO1 during this phase.

L = Low level H = High level I = Input O = Output	PD = Pull down resistor between 18k...65k PD(…k) = Pull down resistor with ...k PU = Pull up resistor between 18k...65k PU(…k) = Pull up resistor with ...k, Z = High impedance

3.2.3 Turn off or Restart PLAS9-W

To switch off or restart the module the following procedures may be used:

- *Software controlled shutdown procedure*: Software controlled by sending an AT command over the serial application interface. See Section 3.2.3.1.
- *Software controlled restart procedure*: Software controlled by sending an AT command over the serial application interface. See Section 3.2.3.2.
- *Hardware controlled shutdown procedure*: Hardware controlled shutdown by IGT line. See Section 3.2.3.3.
- *Hardware controlled shutdown or restart procedure*: Hardware controlled shutdown or restart by EMERG_OFF line. See Section 3.2.3.4.
- *Automatic shutdown (software controlled)*: See Section 3.2.4
    - Takes effect if PLAS9-W board temperature exceeds a critical limit.

3.2.3.1 Switch off PLAS9-W Using AT Command

The best and safest approach to powering down PLAS9-W is to issue the AT^SMSO command. This procedure lets PLAS9-W log off from the network and allows the software to enter into a secure state and save data before disconnecting the power supply. The mode is referred to as Power Down mode. After sending AT^SMSO do not enter any other AT commands. While powering down the module may still send some URCs. The AT commands “OK” response indicates that the data has been stored non-volatile and the module will turn down in a few seconds. To verify that the module definitely turned off, it is possible to monitor the PWR_IND signal. A high state of the PWR_IND signal line indicates that the module is being switched off as shown in Figure 21.

Be sure not to disconnect the supply voltage V_{BATT+} before the module’s switch off procedure has been completed and the VEXT signal has gone low. Otherwise you run the risk of losing data. Signal states during switch off are shown in Figure 21.

While PLAS9-W is in Power Down mode the application interface is switched off and must not be fed from any other source. Therefore, your application must be designed to avoid any current flow into any digital signal lines of the application interface. No special care is required for the USB interface which is protected from reverse current.

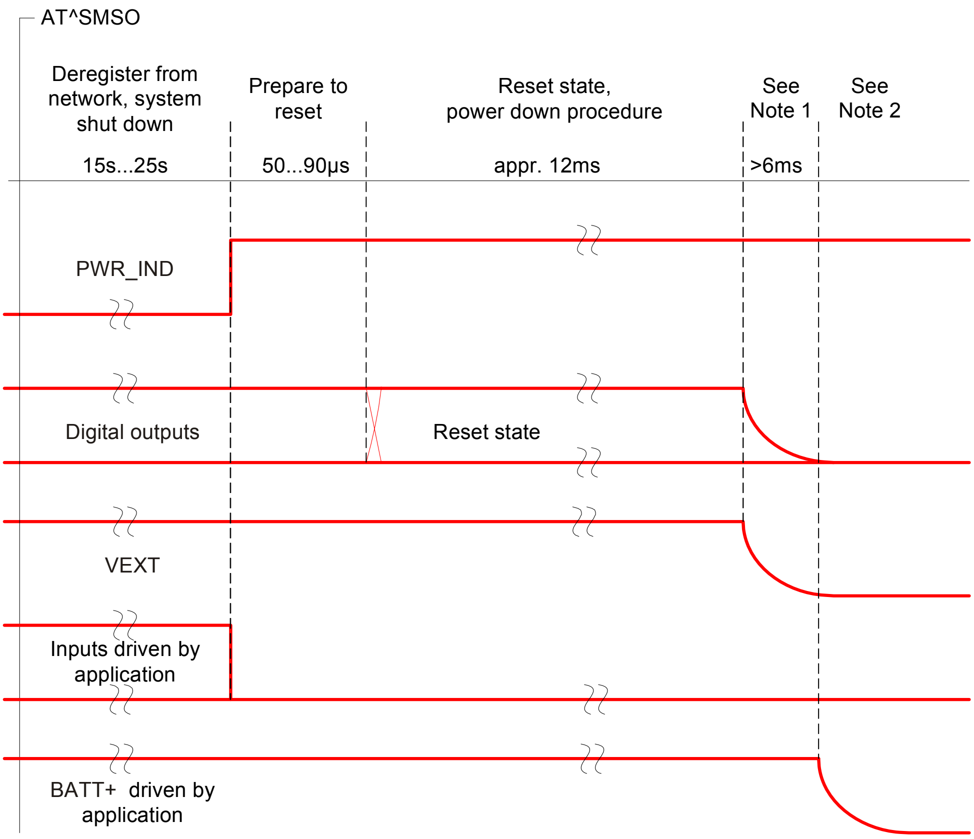


Figure 21: Signal states during turn-off procedure

Note 1: Depending on capacitance load from host application
Note 2: The power supply voltage (BATT+) may be disconnected or switched off only after the VEXT went low.
Note 3: After module shutdown by means of AT command is completed, please allow for a time period of at least 1 second before restarting the module.

3.2.3.2 Restart PLAS9-W Using AT Command

The best and safest approach to restart PLAS9-W is by AT command. For more information on the AT^CFUN command please refer to is described in detail in [1].

3.2.3.3 Turn off PLAS9-W Using IGT Line

The IGT line can be configured for use in two different switching modes: You can set the IGT line to switch on the module only, or to switch it on and off. The switching mode is determined by the parameter "MEShutdown/OnIgnition" of the AT^SCFG command. This approach is useful for external application manufacturers who wish to have an ON/OFF switch installed on the host device.

By factory default, the ON/OFF switch mode of IGT is disabled:

at^scfg=meshutdown/onignition ^SCFG: "MEShutdown/OnIgnition","off" OK	# Query the current status of IGT. # IGT can be used only to switch on PLAS9-W. IGT works as described in Section 3.2.1.

To configure IGT for use as ON/OFF switch:

at^scfg=meshutdown/onignition ^SCFG: "MEShutdown/OnIgnition","on" OK	# Enable the ON/OFF switch mode of IGT. # IGT can be used to switch on and off PLAS9-W.

Take great care before changing the switching mode of the IGT line. To ensure that the IGT line works properly as ON/OFF switch it is of vital importance that the following conditions are met:

Switch-on condition: If the PLAS9-W is off, the IGT line must be asserted for at least 100 milliseconds before being released.

Switch-off condition: If the PLAS9-W is on, the IGT line must be asserted for at least 2.1 seconds before being released. The module switches off after the line is released. The switch-off routine is identical with the procedure initiated by AT^SMSO, i.e. the software performs an orderly shutdown as described in Section 3.2.3.1.
Before switching off the module wait at least 18 seconds after startup.

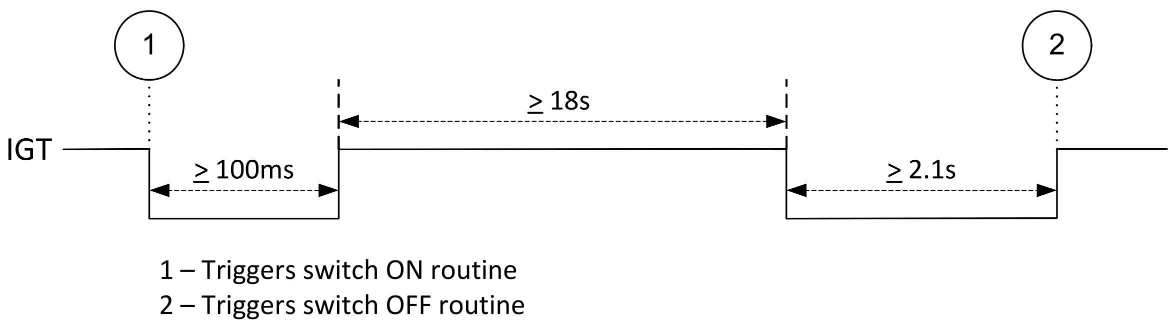


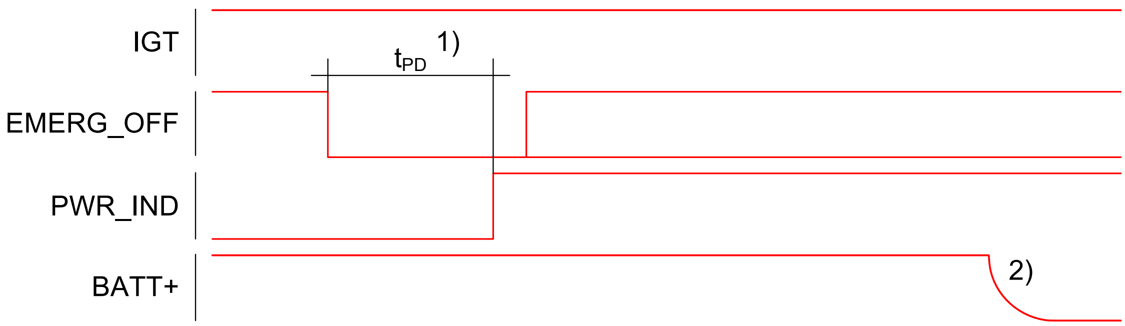
Figure 22: Timing of IGT if used as ON/OFF switch

3.2.3.4 Turn off or Restart PLAS9-W in Case of Emergency

Caution: Use the EMERG_OFF line only when, due to serious problems, the software is not responding for more than 5 seconds. Pulling the EMERG_OFF line causes the loss of all information stored in the volatile memory. Therefore, this procedure is intended only for use in case of emergency, e.g. if PLAS9-W does not respond, if reset or shutdown via AT command fails.

The EMERG_OFF line is available on the application interface and can be used to turn off or to restart the module. In any case the EMERG_OFF line must be pulled to ground until the Power Down mode is reached, as indicated by PWR_IND=high. To control the EMERG_OFF line it is required to use an open drain / collector driver. EMERG_OFF is pulled high internally.

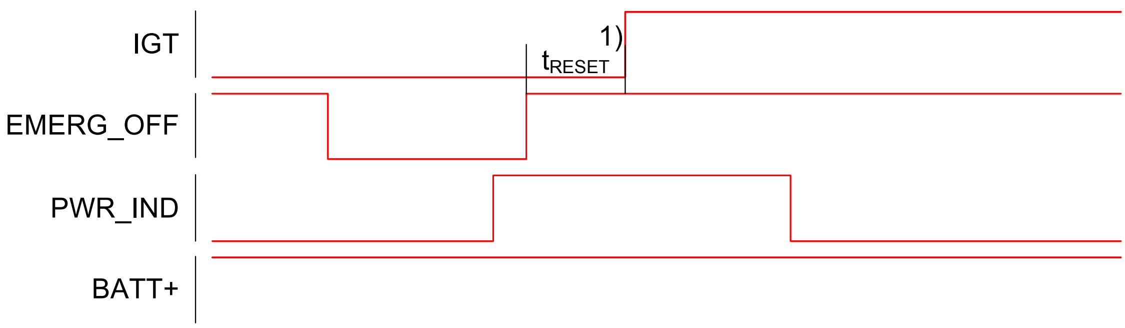
Now, to permanently turn off the module, the IGT line has to be set to high (inactive) before the EMERG_OFF line is released. The module will then switch off and needs to be restarted at a later time. This switch off behavior is shown in Figure 23.



1) The time to Power Down mode (t_{PD}) depends on the operating state and may lie between 120µs and 2200ms.
2) The the power supply voltage (BATT+) may be disconnected only after having reached Power Down mode as indicated by the PWR_IND signal going high. The power supply has to be available (again) before the module is restarted.

Figure 23: Shutdown by EMERG_OFF signal

To simply restart the module, the IGT line has to continue to be driven low (active) for at least 100ms after having released the EMERG_OFF line. The module will then switch off and restart automatically. This restart behavior is shown in Figure 24.



1) The time to module reset (t_{RESET}) must be $\geq$ 100ms

Figure 24: Restart by EMERG_OFF signal

3.2.4 Automatic Shutdown

Automatic shutdown takes effect if:
- The PLAS9-W board is exceeding the critical limits of overtemperature
- Undervoltage or overvoltage is detected

The automatic shutdown procedure is equivalent to the power down initiated with the AT^SMSO command, i.e. PLAS9-W logs off from the network and the software enters a secure state avoiding loss of data.

Alert messages transmitted before the device switches off are implemented as Unsolicited Result Codes (URCs). The presentation of the temperature URCs can be enabled or disabled with the AT commands AT^SCTM. The URC presentation mode varies with the condition, please see Section 3.2.4.1 to Section 3.2.4.4 for details. For further instructions on AT commands refer to [1].

3.2.4.1 Thermal Shutdown

The board temperature is constantly monitored by an internal NTC resistor located on the PCB. The values detected by the NTC resistor are measured directly on the board and therefore, are not fully identical with the ambient temperature.

Each time the board temperature goes out of range or back to normal, PLAS9-W instantly displays an alert (if enabled).

- URCs indicating the level "1" or "-1" allow the user to take appropriate precautions, such as protecting the module from exposure to extreme conditions. The presentation of the URCs depends on the settings selected with the AT^SCTM write command:
  AT^SCTM=1: Presentation of URCs is always enabled.
  AT^SCTM=0 (default): Presentation of URCs is enabled during the 2 minutes guard period after start-up of PLAS9-W. After expiry of the 2 minutes guard period, the presentation will be disabled, i.e. no URCs with alert levels "1" or "-1" will be generated.
- URCs indicating the level "2" are instantly followed by an orderly shutdown. The presentation of these URCs is always enabled, i.e. they will be output even though the factory setting AT^SCTM=0 was never changed.

The maximum temperature ratings are stated in Section 3.5. Temperature limits and associated URCs are listed in the below Table 15.

Table 15: Board temperature warning and switch off level

Parameter	Temperature	URC	Notes
High temperature switch off active	≥ +97°C	^SCTM_B: 2	Modules will switch off in the range: >+95°C up to ≤+99°C
High temperature switch off release	≤ +96°C	^SCTM_B: 1	
High temperature warning active	≥ +86°C	^SCTM_B: 1	
High temperature warning release	≤ +85°C	^SCTM_B: 0	
Operating temperature range	-30°C...+85°C	---	
Low temperature warning release	≥ -30°C	^SCTM_B: 0	
Low temperature warning active	≤ -31°C	^SCTM_B: -1	
Low temperature switch off	---	---	Modules do not switch off nor send a switch off URC when exceeding the undertemperature limit, i.e., -40°C.

The AT^SCTM command can also be used to check the present status of the board. Depending on the selected mode, the read command returns the current board temperature in degrees Celsius or only a value that indicates whether the board is within the safe or critical temperature range. See [1] for further instructions.

3.2.4.2 Deferred Shutdown at Extreme Temperature Conditions

In the following cases, automatic shutdown will be deferred if a critical temperature limit is exceeded:

- While an emergency call is in progress.
- During a two minute guard period after power-up. This guard period has been introduced in order to allow for the user to make an emergency call. The start of any one of these calls extends the guard period until the end of the call. Any other network activity may be terminated by shutdown upon expiry of the guard time.

While in a "deferred shutdown" situation, PLAS9-W continues to measure the temperature and to deliver alert messages, but deactivates the shutdown functionality. Once the 2 minute guard period is expired or the call is terminated, full temperature control will be resumed. If the temperature is still out of range, PLAS9-W switches off immediately (without another alert message).

Caution: Automatic shutdown is a safety feature intended to prevent damage to the module. Extended usage of the deferred shutdown facilities provided may result in damage to the module, and possibly other severe consequences.

3.2.4.3 Undervoltage Shutdown

If the measured battery voltage is no more sufficient to set up a call the following URC will be presented:

^SBC: Undervoltage.

The URC indicates that the module is close to the undervoltage threshold. If undervoltage persists the module keeps sending the URC several times before switching off automatically.

This type of URC does not need to be activated by the user. It will be output automatically when fault conditions occur.

3.2.4.4 Overvoltage Shutdown

The overvoltage shutdown threshold is 100mV above the maximum supply voltage V_{BATT+} specified in Table 2.

When the supply voltage approaches the overvoltage shutdown threshold the module will send the following URC:

^SBC: Overvoltage warning

This alert is sent once.

When the overvoltage shutdown threshold is exceeded the module will send the following URC

^SBC: Overvoltage shutdown

before it shuts down cleanly.

This type of URC does not need to be activated by the user. It will be output automatically when fault conditions occur.

Keep in mind that several PLAS9-W components are directly linked to BATT+ and, therefore, the supply voltage remains applied at major parts of PLAS9-W, even if the module is switched off. Especially the power amplifier is very sensitive to high voltage and might even be destroyed.

3.3 Power Saving

PLAS9-W is able to reduce its functionality to a minimum (during the so-called SLEEP mode) in order to minimize its current consumption. The following sections explain the module's network dependent power saving behavior.The power saving behavior is further configurable by AT command:

- AT^SCFG= "MEopMode/PwrSave": The power save mode is by default enabled. While inactive, the module stays in power save (SLEEP) state, waking up only upon any of the following events:
  - Cyclically to meet basic technical demands, e.g. network requirements (such as regularly listening to paging messages from the base station as described in Section 3.3.1, Section 3.3.2 and Section 3.3.3.
  - Cyclically after expiry of a configured power saving period.
  - Data at any interface port, e.g., URCs for incoming calls.
  - A level state transition at GPIO1, GPIO3, GPIO4, GPIO5 and GPIO9.
- AT^SCFG= "MEopMode/ExpectDTR": Power saving will take effect only if there is no transmission data pending on any of the module's USB ports. The expect DTR AT command ensures that data becoming pending on any USB port before an external application has signaled its readiness to receive the data is discarded. By default this behavior is enabled for all available USB CDC ACM and CDC ECM ports.
- AT^SCFG="Radio/OutputPowerReduction": Output power reduction is possible for the module in GPRS multislot scenarios to reduce its output power according to 3GPP 45.005 section.

Please refer to [1] for more information on the above AT commands used to configure the module's power saving behavior.

The implementation of the USB host interface also influences the module's power saving behavior and therefore its current consumption. For more information see Section 2.1.3.

Also note that the module does not wake up from SLEEP mode just to measure the supply voltage, and that the command AT^SBV reports an average over the values it was able to measure last (see also Section 3.4.3). Therefore, the shorter the power saving periods are, the faster and more precisely will the reported average adjust to possible voltage changes.

3.3.1 Power Saving while Attached to GSM Networks

The power saving possibilities while attached to a GSM network depend on the paging timing cycle of the base station. The duration of a paging timing cycle can be calculated using the following formula:

t = 4.615 ms (TDMA frame duration) * 51 (number of frames) * DRX value.

DRX (Discontinuous Reception) is a value from 2 to 9, resulting in paging timing cycles between 0.47 and 2.12 seconds. The DRX value of the base station is assigned by the GSM network operator.

Now, a paging timing cycle consists of the actual fixed length paging plus a variable length pause before the next paging. In the pauses between listening to paging messages, the module resumes power saving, as shown in Figure 25.

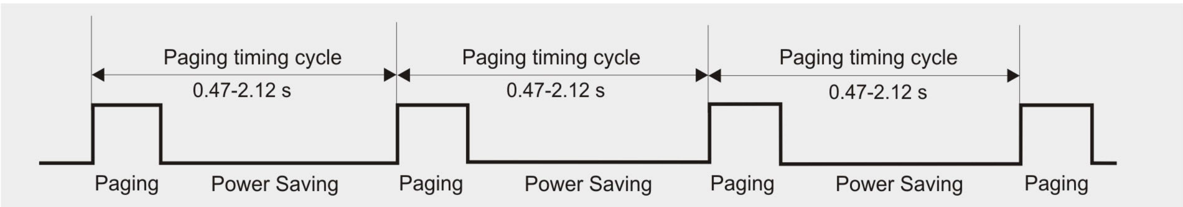


Figure 25: Power saving and paging in GSM networks

The varying pauses explain the different potential for power saving. The longer the pause the less power is consumed.

Generally, power saving depends on the module's application scenario and may differ from the above mentioned normal operation. The power saving interval may be shorter than 0.47 seconds or longer than 2.12 seconds.

3.3.2 Power Saving while Attached to WCDMA Networks

The power saving possibilities while attached to a WCDMA network depend on the paging timing cycle of the base station.

During normal WCDMA operation, i.e., the module is connected to a WCDMA network, the duration of a paging timing cycle varies. It may be calculated using the following formula:

$t = 2^{\text{DRX value}} * 10$ ms (WCDMA frame duration).

DRX (Discontinuous Reception) in WCDMA networks is a value between 6 and 9, thus resulting in paging timing cycles between 0.64 and 5.12 seconds. The DRX value of the base station is assigned by the WCDMA network operator.

Now, a paging timing cycle consists of the actual fixed length paging plus a variable length pause before the next paging. In the pauses between listening to paging messages, the module resumes power saving, as shown in Figure 26.

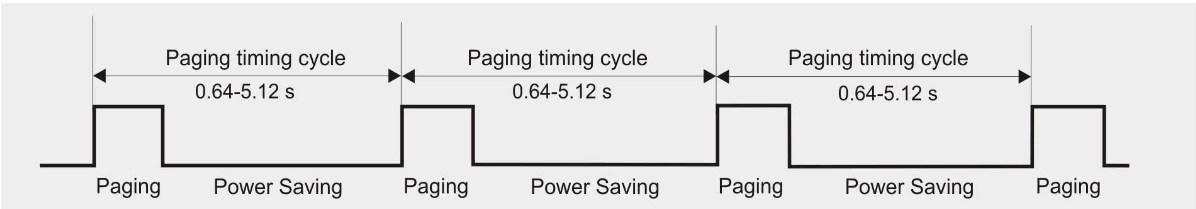


Figure 26: Power saving and paging in WCDMA networks

The varying pauses explain the different potential for power saving. The longer the pause the less power is consumed.

Generally, power saving depends on the module's application scenario and may differ from the above mentioned normal operation. The power saving interval may be shorter than 0.64 seconds or longer than 5.12 seconds.

3.3.3 Power Saving while Attached to LTE Networks

The power saving possibilities while attached to an LTE network depend on the paging timing cycle of the base station.

During normal LTE operation, i.e., the module is connected to an LTE network, the duration of a paging timing cycle varies. It may be calculated using the following formula:

t = DRX Cycle Value * 10 ms

DRX cycle value in LTE networks is any of the four values: 32, 64, 128 and 256, thus resulting in paging timing cycles between 0.32 and 2.56 seconds. The DRX cycle value of the base station is assigned by the LTE network operator.

Now, a paging timing cycle consists of the actual fixed length paging plus a variable length pause before the next paging. In the pauses between listening to paging messages, the module resumes power saving, as shown in Figure 27.

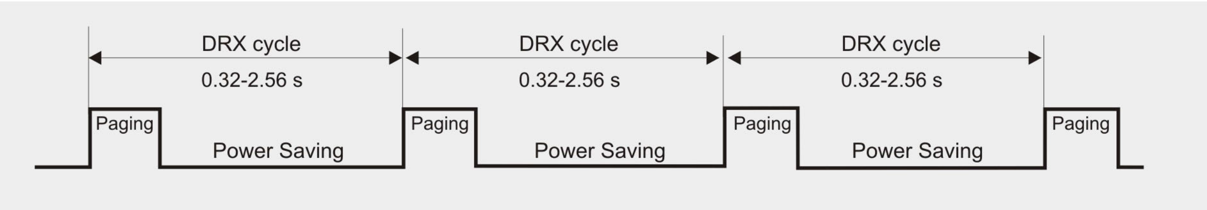


Figure 27: Power saving and paging in LTE networks

The varying pauses explain the different potential for power saving. The longer the pause the less power is consumed.

Generally, power saving depends on the module's application scenario and may differ from the above mentioned normal operation. The power saving interval may be shorter than 0.32 seconds or longer than 2.56 seconds.

3.4 Power Supply

PLAS9-W needs to be connected to a power supply at the SMT application interface - 4 lines BATT+, and GND. There are two separate voltage domains for BATT+:

- BATT+_RF with 2 lines for the RF power amplifier supply
- BATT+ with 2 lines for the general power management.

The main power supply from an external application has to be a single voltage source and has to be expanded to two sub paths (star structure). Each voltage domain must be decoupled by application with low ESR capacitors (≥ 47µF MLCC @ BATT+; ≥ 4x47µF MLCC @ BATT+_RF) as close as possible to LGA pads. Figure 28 shows a sample circuit for decoupling capacitors for BATT+.

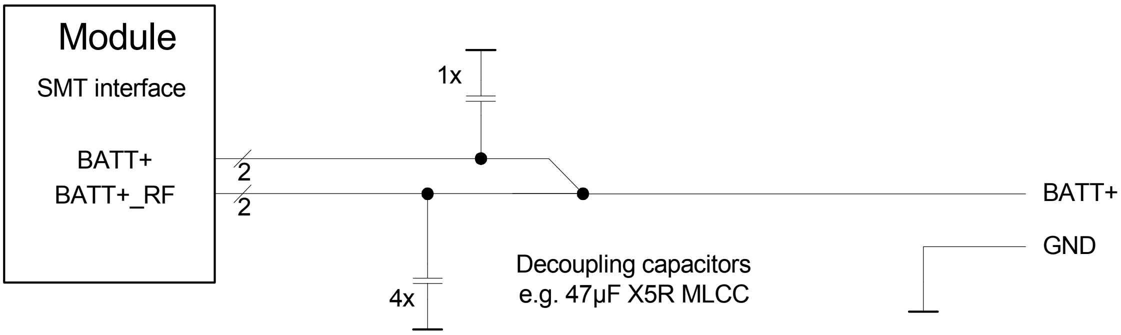


Figure 28: Decoupling capacitor(s) for BATT+

The power supply of PLAS9-W must be able to provide the peak current during the uplink transmission.

All key functions for supplying power to the device are handled by the power management IC. It provides the following features:

- Stabilizes the supply voltages for the baseband using switching regulators and low drop linear voltage regulators.
- Switches the module's power voltages for the power-up and -down procedures.
- Delivers, across the VEXT line, a regulated voltage for an external application.
- LDO to provide SIM power supply.

3.4.1 Power Supply Ratings

Table 16 and Table 17 assemble various voltage supply and current consumption ratings of the module. Please note that the given ratings are preliminary and will have to be confirmed.

Table 16: Voltage supply ratings

	Description	Conditions	Min	Typ	Max	Unit
BATT+	Supply voltage	Directly measured at Module. Voltage must stay within the min/max values, including voltage drop, ripple, spikes	3.3	3.8	4.2	V
	Maximum allowed voltage drop during transmit burst	Normal condition, power control level for Pout max			400	mV
	Voltage ripple	Normal condition, power control level for Pout max @ f <= 250 kHz @ f > 250 kHz			 120 90	 mV_{pp} mV_{pp}

Table 17: Current consumption ratings

	Description	Conditions		Typical rating	Unit
I_{BATT+}[1]	OFF State supply current	Power Down		40	µA
	Average GSM / GPRS supply current	SLEEP[2] @ DRX=9	USB disconnected	1.8	mA
			USB suspend	2.1	
		SLEEP[2] @ DRX=5	USB disconnected	2.0	mA
			USB suspend	2.3	
		SLEEP[2] @ DRX=2	USB disconnected	2.9	mA
			USB suspend	3.2	
		IDLE[3] @ DRX=2	USB disconnected	35	mA
			USB active	45	
		GPRS Data transfer GSM900; PCL=5; 1Tx/4Rx	ROPR=8 (max. reduction)	320	mA
			ROPR=4 (no reduction)		
		GPRS Data transfer GSM900; PCL=5; 2Tx/3Rx	ROPR=8 (max. reduction)	430	mA
			ROPR=4 (no reduction)	540	
		GPRS Data transfer GSM900; PCL=5; 4Tx/1Rx	ROPR=8 (max. reduction)	650	mA
			ROPR=4 (no reduction)	930	
			@ total mismatch	1100	

Table 17: Current consumption ratings

	Description	Conditions		Typical rating	Unit
I_{BATT+} [1]	Average GSM / GPRS supply current	EDGE Data transfer GSM900; PCL=5; 1Tx/4Rx	ROPR=8 (max. reduction)	220	mA
			ROPR=4 (no reduction)		
		EDGE Data transfer GSM900; PCL=5; 2Tx/3Rx	ROPR=8 (max. reduction)	340	mA
			ROPR=4 (no reduction)	360	
		EDGE Data transfer GSM900; PCL=5; 4Tx/1Rx	ROPR=8 (max. reduction)	600	mA
			ROPR=4 (no reduction)	630	
		GPRS Data transfer GSM1800; PCL=0; 1Tx/4Rx	ROPR=8 (max. reduction)	230	mA
			ROPR=4 (no reduction)		
		GPRS Data transfer GSM1800; PCL=0; 2Tx/3Rx	ROPR=8 (max. reduction)	340	mA
			ROPR=4 (no reduction)	390	
		GPRS Data transfer GSM1800; PCL=0; 4Tx/1Rx	ROPR=8 (max. reduction)	500	mA
			ROPR=4 (no reduction)	640	
		EDGE Data transfer GSM1800; PCL=0; 1Tx/4Rx	ROPR=8 (max. reduction)	190	mA
			ROPR=4 (no reduction)		
		EDGE Data transfer GSM1800; PCL=0; 2Tx/3Rx	ROPR=8 (max. reduction)	300	mA
			ROPR=4 (no reduction)	330	
		EDGE Data transfer GSM1800; PCL=0; 4Tx/1Rx	ROPR=8 (max. reduction)	470	mA
			ROPR=4 (no reduction)	510	

Table 17: Current consumption ratings

	Description	Conditions		Typical rating	Unit
I_{BATT+} [1]	Average UMTS supply current Data transfers measured @maximum Pout	SLEEP[2] @ DRX=9	USB disconnected	1.6	mA
			USB suspend	1.9	
		SLEEP[2] @ DRX=8	USB disconnected	1.8	mA
			USB suspend	2.1	
		SLEEP[2] @ DRX=6	USB disconnected	2.4	mA
			USB suspend	2.7	
		IDLE[3] @ DRX=6	USB disconnected	35	mA
			USB active	40	mA
		UMTS Data transfer Band I	@ 50Ω	600	mA
			@ total mismatch	840	mA
		UMTS Data transfer Band III		640	mA
		UMTS Data transfer Band V/VI		470	mA
		UMTS Data transfer Band VIII		500	mA
		HSDPA Data transfer Band I		600	mA
		HSDPA Data transfer Band III		640	mA
		HSDPA Data transfer Band V/VI		450	mA
		HSDPA Data transfer Band VIII		500	mA

Table 17: Current consumption ratings

	Description	Conditions		Typical rating	Unit
I_{BATT+} [1]	Average LTE supply current (FDD)[4]	SLEEP[2] @ "Paging Occasions" = 256	USB disconnected	2.0	mA
			USB suspend	2.3	
	Data transfers measured @maximum Pout	SLEEP[2] @ "Paging Occasions" = 128	USB disconnected	2.4	mA
			USB suspend	2.7	
		SLEEP[2] @ "Paging Occasions" = 64	USB disconnected	3.1	mA
			USB suspend	3.4	
		SLEEP[2] @ "Paging Occasions" = 32	USB disconnected	4.5	mA
			USB suspend	4.8	
		IDLE[3]	USB disconnected	35	mA
			USB active	45	mA
		LTE Data transfer Band 1		630	mA
		LTE Data transfer Band 3	@ 50Ω	620	mA
		LTE Data transfer Band 5		470	mA
		LTE Data transfer Band 7	@ 50Ω	800	mA
			@ total mismatch	820	
		LTE Data transfer Band 8		530	mA
		LTE Data transfer Band 18		470	mA
		LTE Data transfer Band 19		470	mA
		LTE Data transfer Band 20		540	mA
		LTE Data transfer Band 26		470	mA
		LTE Data transfer Band 28A		600	mA
		LTE Data transfer Band 28B		600	mA

Table 17: Current consumption ratings

	Description	Conditions		Typical rating	Unit
I_{BATT+}[1]	Average LTE supply current (TDD)[4] Data transfers measured @maximum Pout	SLEEP[2] @ "Paging Occasions" = 256	USB disconnected	2.0	mA
			USB suspend	2.3	
		SLEEP[2] @ "Paging Occasions" = 128	USB disconnected	2.4	mA
			USB suspend	2.7	
		SLEEP[2] @ "Paging Occasions" = 64	USB disconnected	3.1	mA
			USB suspend	3.4	
		SLEEP[2] @ "Paging Occasions" = 32	USB disconnected	4.5	mA
			USB suspend	4.8	
		IDLE[3]	USB disconnected	40	mA
			USB active	55	mA
		LTE Data transfer Band 38	1 UL / 8 DL	205	mA
			5 UL / 3 DL	470	mA
		LTE Data transfer Band 39	1 UL / 8 DL	185	mA
			5 UL / 3 DL	345	mA
		LTE Data transfer Band 40	1 UL / 8 DL	220	mA
			5 UL / 3 DL	550	mA
		LTE Data transfer Band 41	1 UL / 8 DL	235	mA
			5 UL / 3 DL	590	mA
I_{BATT+}[1]	Average TD-SCDMA supply current Data transfers measured @maximum Pout	SLEEP[2] @ DRX=9	USB disconnected	1.6	mA
			USB suspend	1.9	
		SLEEP[2] @ DRX=8	USB disconnected	1.8	mA
			USB suspend	2.1	
		SLEEP[2] @ DRX=6	USB disconnected	2.4	mA
			USB suspend	2.7	
		IDLE[3]	USB disconnected	40	mA
			USB active	55	mA
		TD-SCDMA Data transfer Band 34 (Band A)		250	mA
		TD-SCDMA Data transfer Band 39 (Band F)		250	mA
I_{VUSB_IN}	USB typical and maximum ratings are mentioned in Table 2: VUSB_IN.				

1. With an impedance of Z_{LOAD}=50Ω at the antenna pads. Measured at 25°C and 4.2V - except for Power Down ratings that were measured at 3.4V.
2. Measurements start 6 minutes after switching ON the module,
   Averaging times: SLEEP mode - 3 minutes, transfer modes - 1.5 minutes
   Communication tester settings:no neighbor cells, no cell reselection etc,
   RMC (Reference Measurement Channel)
3. The power save mode is disabled via AT commands:
   AT^SCFG="MEopMode/PwrSave","disabled","0","0","CPU-A","powerup" or
   AT^SCFG="MEopMode/PwrSave","disabled","0","0","CPU-M","powerup"
4. Communication tester settings:
   - Channel Bandwidth: 5MHz
   - Number of Resource Blocks: 25 (DL), 1 (UL)
   - Modulation: QPSK

3.4.2 Minimizing Power Losses

When designing the power supply for your application please pay specific attention to power losses. Ensure that the input voltage V_{BATT+} never drops below 3.3V on the PLAS9-W board, not even in a transmit burst where current consumption can rise to typical peaks of 2A. It should be noted that PLAS9-W switches off when exceeding these limits. Any voltage drops that may occur in a transmit burst should not exceed 400mV to ensure the expected RF performance in 2G networks.

The module switches off if the minimum battery voltage (V_{BATT}min) is reached.

Example:
$V_I$min = 3.3V
Dmax = 0.4V

V_{BATT}min = $V_I$min + Dmax
V_{BATT}min = 3.3V + 0.4V = 3.7V

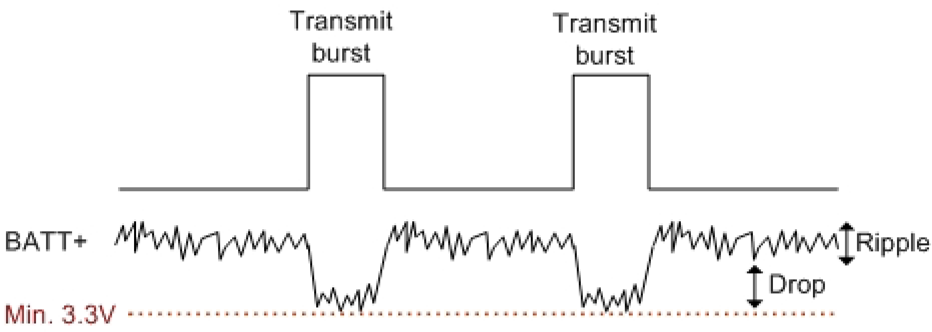


Figure 29: Power supply limits during transmit burst

3.4.3 Monitoring Power Supply by AT Command

To monitor the supply voltage you can use the AT^SBV command which returns the averaged value related to BATT+ and GND at the SMT application interface.

As long as not in SLEEP mode, the module measures the voltage periodically every 110 milliseconds. The maximum time the module remains in SLEEP mode can be limited with the AT command AT^SCFG="MeOpMode/PwrSave" (see [1]). The displayed voltage (in mV) is an average of the last eight measurement results before the AT^SBV command was executed.

3.5 Operating Temperatures

Table 18: Board temperature

Parameter	Min	Typ	Max	Unit
Operating temperature range[1] Normal temperature range Extreme temperature range	 +15 -30	 +25	 +55 +85	 °C °C
Extended temperature range[2]	-40		+95	°C
Automatic shutdown[3] Temperature measured on PLAS9-W board	 <-40	 ---	 >+95	 °C

1. Operating temperature range according to 3GPP type approval specification.
2. Extended operation allows normal mode data transmissions for limited time until automatic thermal shutdown takes effect.
   Within the extended temperature range (outside the operating temperature range) there should not be any unrecoverable malfunctioning. General performance parameters like Pout or RX sensitivity however may be reduced in their values. The module's life time may also be affected, if deviating from a general temperature allocation model (for details see Section 3.5.1).
3. Due to temperature measurement uncertainty, a tolerance on the stated shutdown thresholds may occur. The possible deviation is in the range of ± 2°C at the overtemperature and undertemperature limit.

See also Section 3.2.4.1 for information about the NTC for on-board temperature measurement, automatic thermal shutdown and alert messages.

Note that within the specified operating temperature ranges the board temperature may vary to a great extent depending on operating mode, used frequency band, radio output power and current supply voltage. Note also the differences and dependencies that usually exist between board (PCB) temperature and ambient temperature as shown in the following Figure 30. The possible ambient temperature range depends on the mechanical application design including the module and the PCB with its size and layout. A thermal solution will have to take these differences into account and should therefore be an integral part of application design.

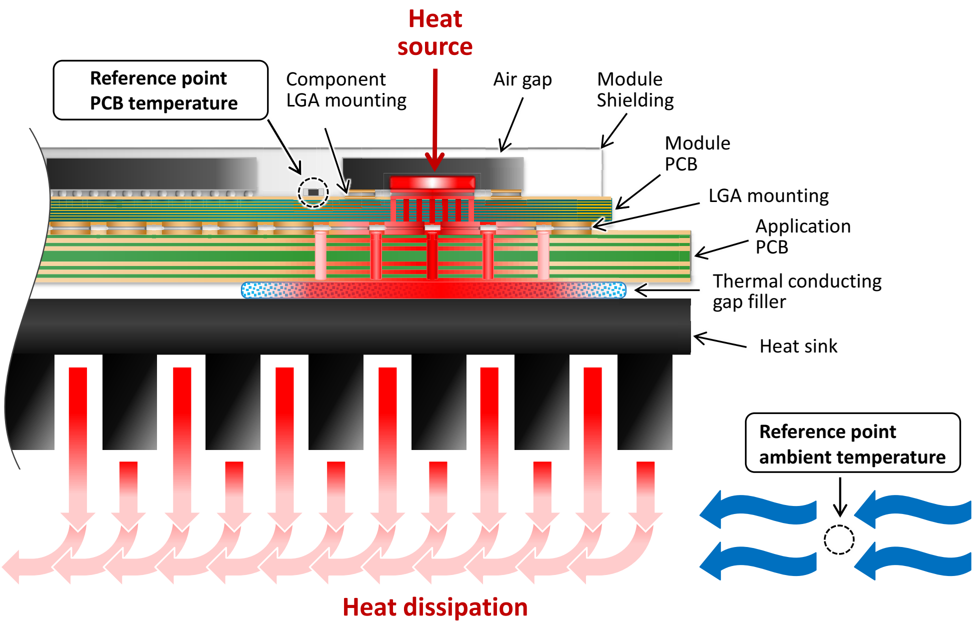


Figure 30: Board and ambient temperature differences

3.5.1 Temperature Allocation Model

The temperature allocation model shown in Table 19 assumes shares of a module's average lifetime of 10 years (given in %) during which the module is operated at certain temperatures.

Table 19: Temperature allocation model

Module lifetime share (in %)[1]	6	20	65	7	1	1
Module Temperature (in °C)	-40	20	40	75	85	95

1. Based on an assumed average module lifetime of 10 years (=100%).

Any deviations from the above temperature allocation model may reduce the module's life span, for example if the module is operated close to the maximum automatic shutdown temperature not only for 1% but for 20% of its product life.

3.6 Electrostatic Discharge

The module is not protected against Electrostatic Discharge (ESD) in general. Consequently, it is subject to ESD handling precautions that typically apply to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates a PLAS9-W module.

Special ESD protection provided on PLAS9-W*:*
BATT+: Inductor/capacitor
An example for an enhanced ESD protection for the SIM interface is shown in Section 2.1.5.

The remaining interfaces of PLAS9-W with the exception of the antenna interface are not accessible to the user of the final product (since they are installed within the device) and are therefore only protected according to the ANSI/ESDA/JEDEC JS-001-2011 requirements.

PLAS9-W has been tested according to the following standards. Electrostatic values can be gathered from the following table.

Table 20: Electrostatic values

Specification / Requirements	Contact discharge	Air discharge
ANSI/ESDA/JEDEC JS-001-2011		
All SMT interfaces	± 1kV Human Body Model	n.a.
JESD22-C101-F (Class C1)		
All SMT interfaces	± 250V Charged Device Model (CDM)	n.a.
ETSI EN 301 489-1/7		
BATT+	± 4kV	± 8kV

Note: The values may vary with the individual application design. For example, it matters whether or not the application platform is grounded over external devices like a computer or other equipment, such as the Thales reference application described in Section 5.3.

3.7 Reliability Characteristics

The test conditions stated below are an extract of the complete test specifications.

Table 21: Summary of reliability test conditions

Type of test	Conditions	Standard
Vibration	Frequency range: 10-20Hz; acceleration: 5g Frequency range: 20-500Hz; acceleration: 20g Duration: 20hper axis; 3 axes	DIN IEC 60068-2-6[1]
Shock half-sinus	Acceleration: 500g Shock duration: 1ms 1 shock per axis 6 positions (± x, y and z)	DIN IEC 60068-2-27
Dry heat	Temperature: +70 ±2°C Test duration: 16h Humidity in the test chamber: < 50%	EN 60068-2-2 Bb ETS 300 019-2-7
Temperature change (shock)	Low temperature: -40°C ±2°C High temperature: +85°C ±2°C Changeover time: < 30s (dual chamber system) Test duration: 1h Number of repetitions: 100	DIN IEC 60068-2-14 Na ETS 300 019-2-7
Damp heat cyclic	High temperature: +55°C ±2°C Low temperature: +25°C ±2°C Humidity: 93% ±3% Number of repetitions: 6 Test duration: 12h + 12h	DIN IEC 60068-2-30 Db ETS 300 019-2-5
Cold (constant exposure)	Temperature: -40 ±2°C Test duration: 16h	DIN IEC 60068-2-1

1. For reliability tests in the frequency range 20-500Hz the Standard's acceleration reference value was increased to 20g.

4 Mechanical Dimensions, Mounting and Packaging

4.1 Mechanical Dimensions of PLAS9-W

Figure 31 shows a 3D view[1] of PLAS9-W and provides an overview of the board's mechanical dimensions. For further details see Figure 32.
Length: 40mm
Width: 32mm
Height: 2.8mm

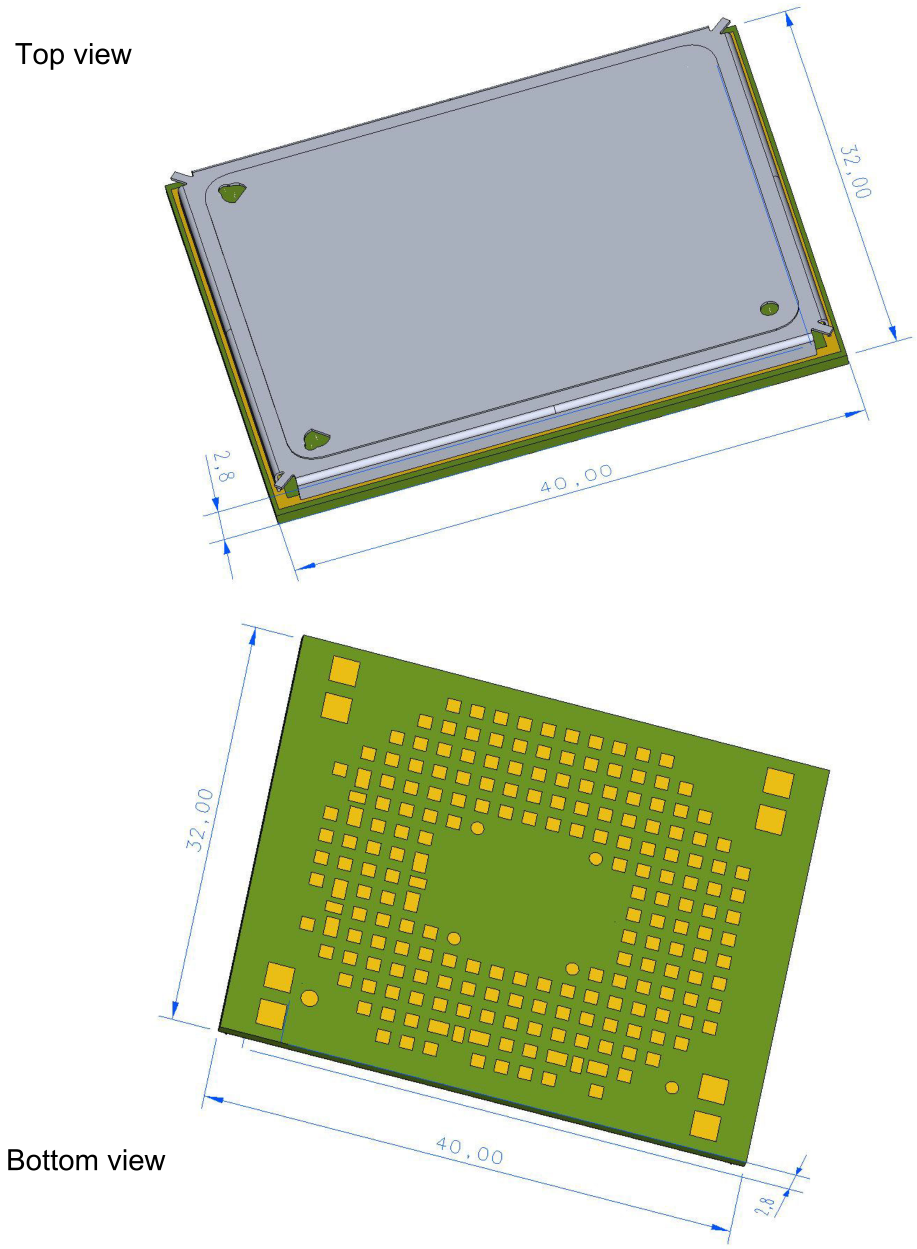


Figure 31: PLAS9-W – top and bottom view

1. The coloring of the 3D view does not reflect the module's real color.

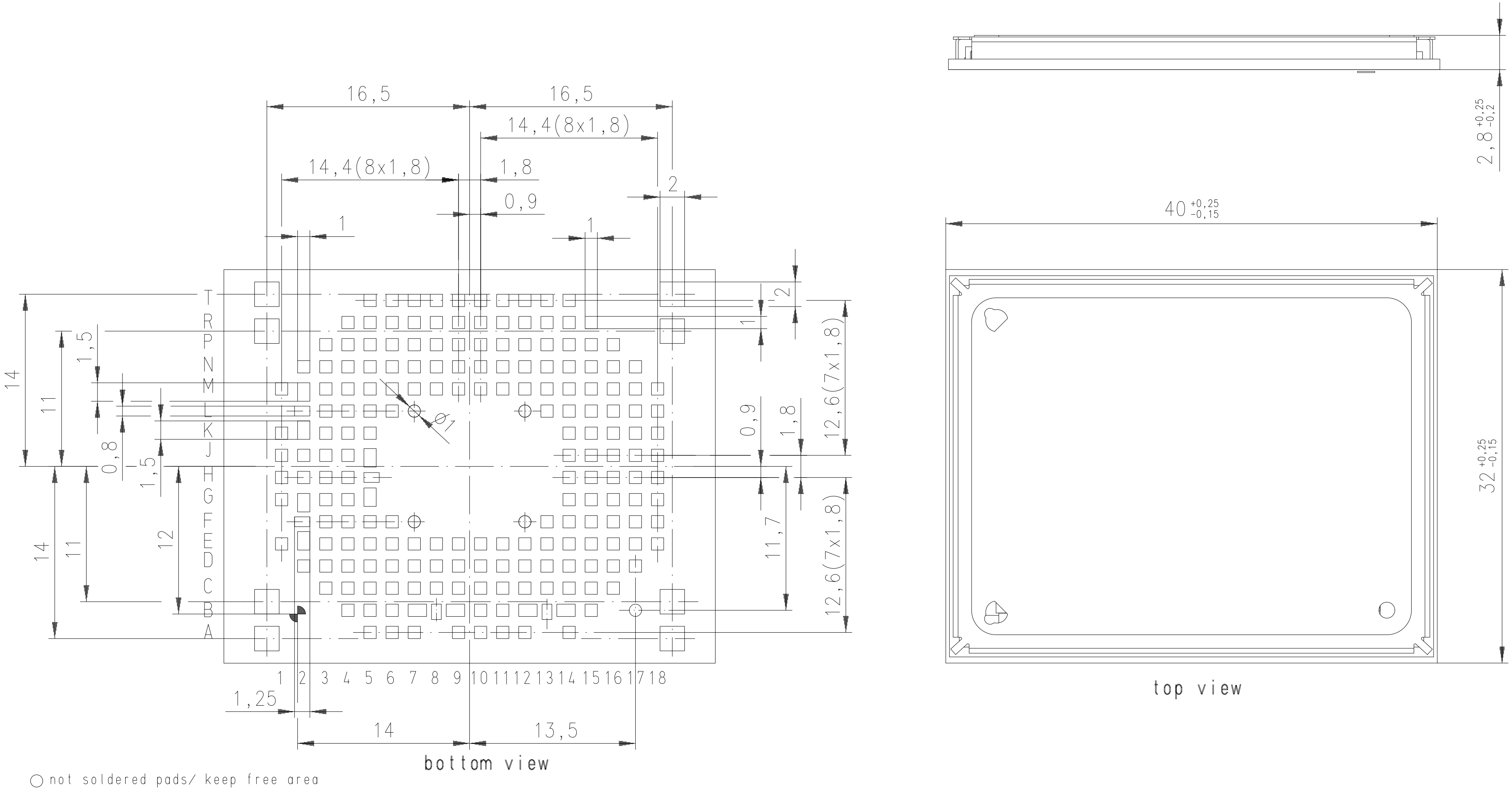


Figure 32: Dimensions of PLAS9-W (all dimensions in mm)

4.2 Mounting PLAS9-W onto the Application Platform

This section describes how to mount PLAS9-W onto the PCBs, including land pattern and stencil design, board-level characterization, soldering conditions, durability and mechanical handling. For more information on issues related to SMT module integration see also [3].

Note: Thales strongly recommends to solder all connecting pads for mechanical stability and heat dissipation. Not only must all supply pads and signals be connected appropriately, but all pads denoted as “Do not use“ should also be soldered (but not electrically connected). Note also that in order to avoid short circuits between signal tracks on an external application's PCB and various markings at the bottom side of the module, it is recommended not to route the signal tracks on the top layer of an external PCB directly under the module, or at least to ensure that signal track routes are sufficiently covered with solder resist.

4.2.1 SMT PCB Assembly

4.2.1.1 Land Pattern and Stencil

The land pattern and stencil design as shown below is based on Thales characterizations for lead-free solder paste on a four-layer test PCB and a 110 micron-thick stencil.

The land pattern given in Figure 33 reflects the module‘s pad layout, including signal pads and ground pads (for pad assignment see Section 2.1.1). Besides these pads there are ground areas on the module's bottom side that must not be soldered, e.g., the position marker. To prevent short circuits, it has to be ensured that there are no wires on the external application side that may connect to these module ground areas.

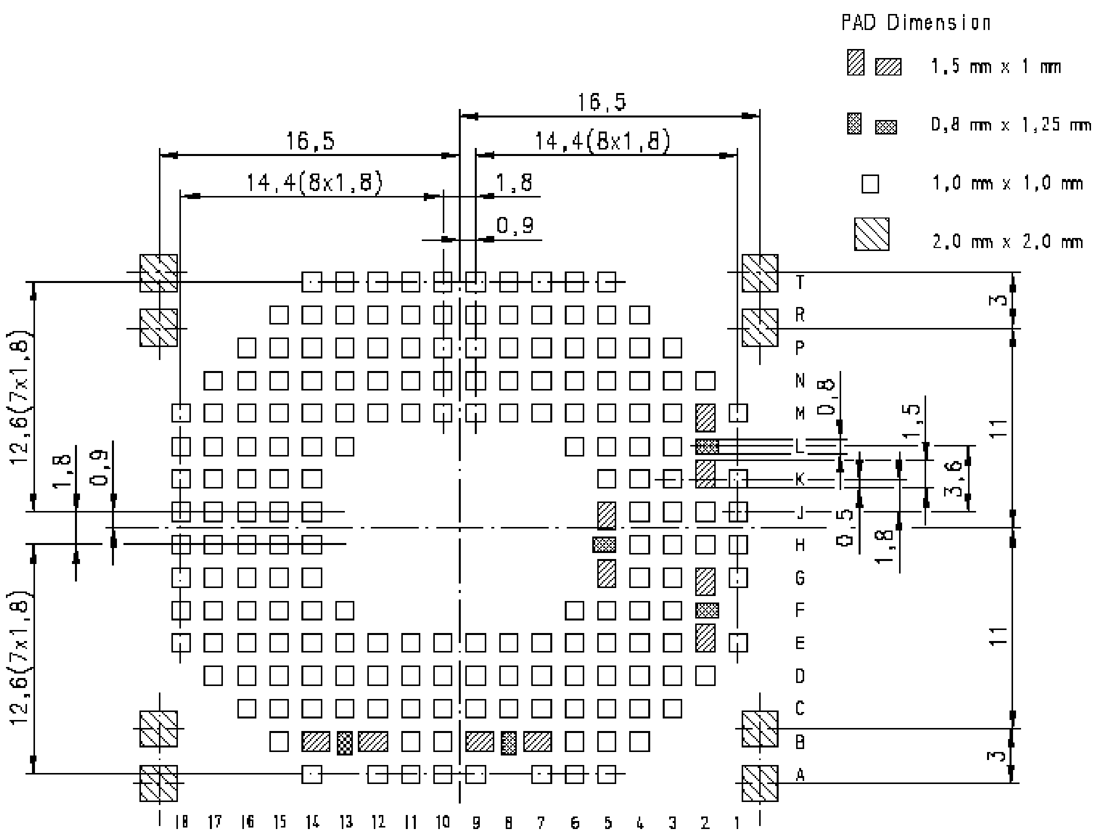


Figure 33: Land pattern (top layer)

The stencil design illustrated in Figure 34 is recommended by Thales as a result of extensive tests with Thales Daisy Chain modules.

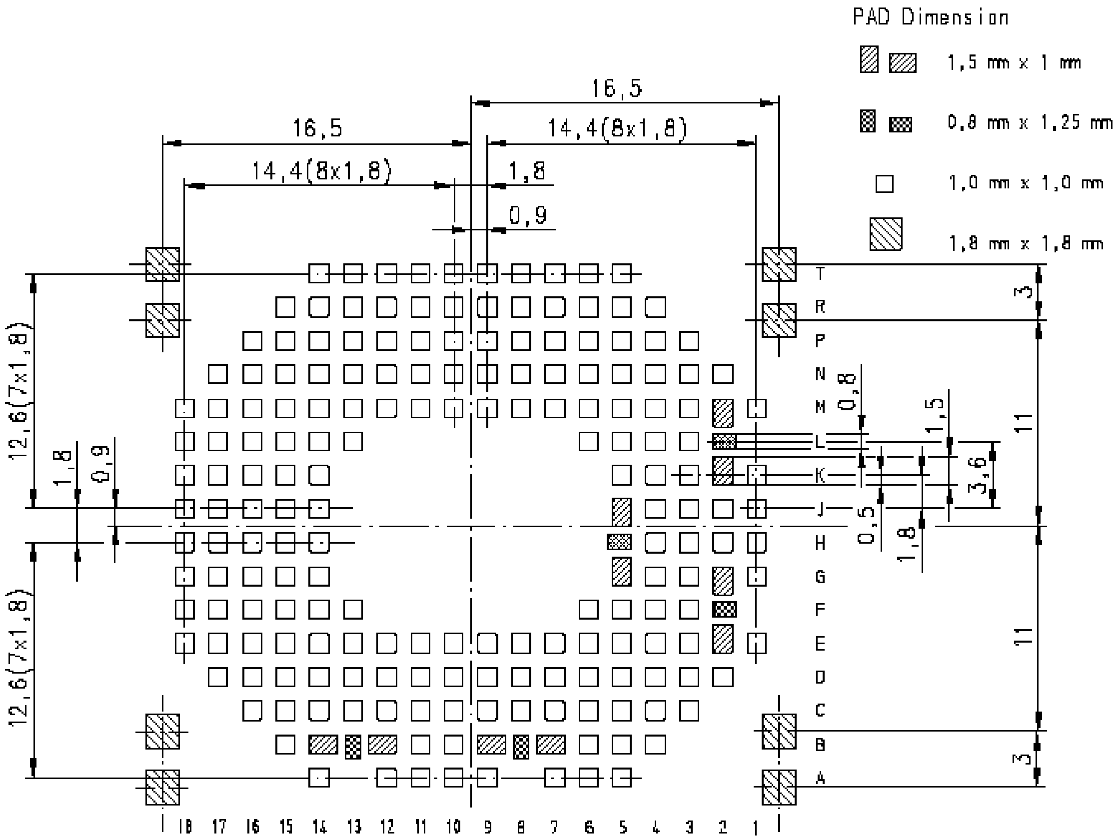


Figure 34: Recommended design for 110 micron thick stencil (top layer)

4.2.1.2 Board Level Characterization

Board level characterization issues should also be taken into account if devising an SMT process.

It is recommended to characterize land patterns before an actual PCB production, taking individual processes, materials, equipment, stencil design, and reflow profile into account. For land and stencil pattern design recommendations see also Section 4.2.1.1. Optimizing the solder stencil pattern design and print process is necessary to ensure print uniformity, to decrease solder voids, and to increase board level reliability.

Daisy chain modules for SMT characterization are available on request. For details refer to [3].

Generally, solder paste manufacturer recommendations for screen printing process parameters and reflow profile conditions should be followed. Maximum ratings are described in Section 4.2.3.

4.2.2 Moisture Sensitivity Level

PLAS9-W comprises components that are susceptible to damage induced by absorbed moisture.

Thales' PLAS9-W module complies with the latest revision of the IPC/JEDEC J-STD-020 Standard for moisture sensitive surface mount devices and is classified as MSL 4.

For additional moisture sensitivity level (MSL) related information see Section 4.2.4 and Section 4.3.2.

4.2.3 Soldering Conditions and Temperature

4.2.3.1 Reflow Profile

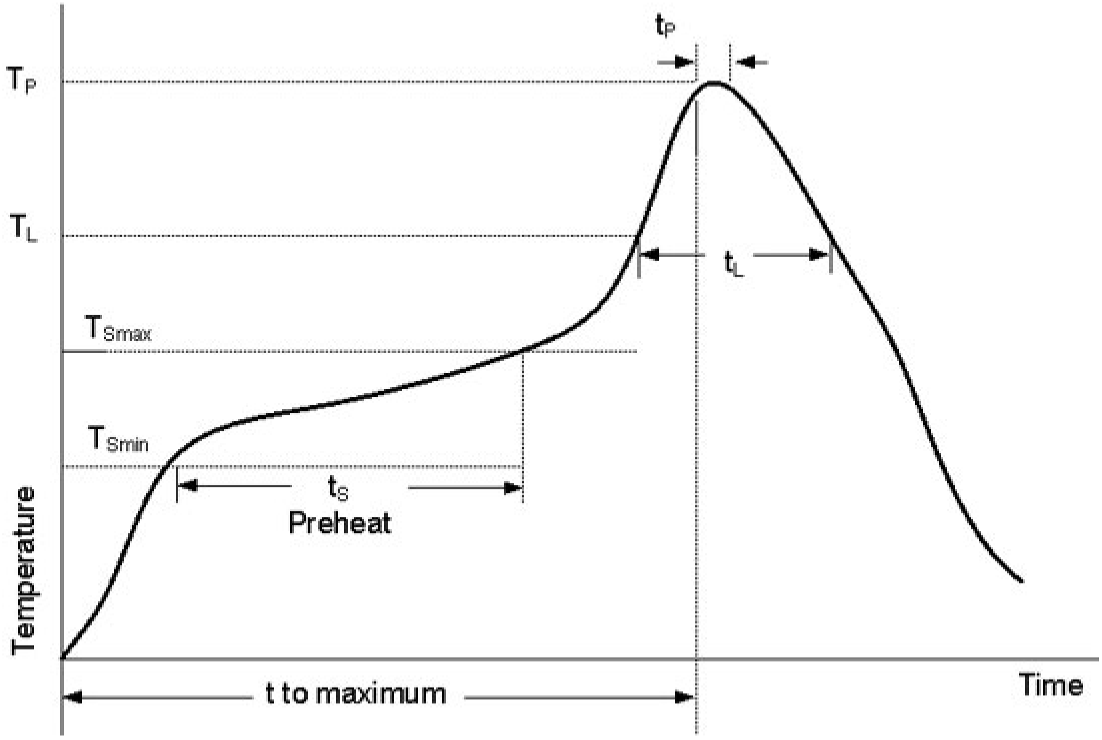
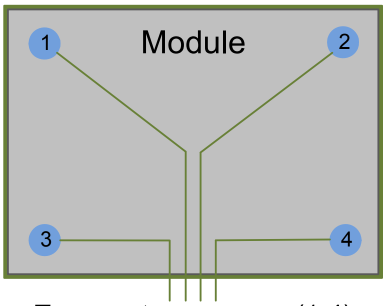


Figure 35: Reflow Profile

Table 22: Reflow temperature recommendations[1]

Profile Feature	Pb-Free Assembly
Preheat & Soak Temperature Minimum (T_{Smin}) Temperature Maximum (T_{Smax}) Time (t_{Smin} to t_{Smax}) (t_S)	 150°C 200°C 60-120 seconds
Average ramp up rate (T_L to T_P)	3K/second max. [2]
Liquidous temperature (T_L) Time at liquidous (t_L)	217°C 60-90 seconds
Peak package body temperature (T_P)	245°C +0/-5°C
Time (t_P) within 5 °C of the peak package body temperature (T_P)	30 seconds max.
Average ramp-down rate - Limited ramp-down rate between 225°C and 200°C	6K/second max.[2] 3K/second max.[2]
Time 25°C to maximum temperature	8 minutes max.

1. Please note that the listed reflow profile features and ratings are based on the joint industry standard IPC/JEDEC J-STD-020D.1, and are as such meant as a general guideline. For more information on reflow profiles and their optimization please refer to [3].
2. Temperatures measured on shielding at each corner. See also [3].



Temperature sensors (1-4)

4.2.3.2 Maximum Temperature and Duration

The following limits are recommended for the SMT board-level soldering process to attach the module:

- A maximum module temperature of 245°C. This specifies the temperature as measured at the module’s top side.
- A maximum duration of 30 seconds at this temperature.
- Ramp-down rate from T_P to 200°C should be controlled in order to reduce thermally induced stress during the solder solidification phase (see Table 22 - limited ramp-down rate). Therefore, a cool-down step in the oven’s temperature program between 200°C and 180°C should be considered. For more information on reflow profiles and their optimization see [3].

Please note that while the solder paste manufacturers' recommendations for best temperature and duration for solder reflow should generally be followed, the limits listed above must not be exceeded.

PLAS9-W is specified for one soldering cycle only. Once PLAS9-W is removed from the application, the module will very likely be destroyed and cannot be soldered onto another application.

4.2.4 Durability and Mechanical Handling

4.2.4.1 Storage Conditions

PLAS9-W modules, as delivered in tape and reel carriers, must be stored in sealed, moisture barrier anti-static bags. The conditions stated below are only valid for modules in their original packed state in weather protected, non-temperature-controlled storage locations. Normal storage time under these conditions is 12 months maximum.

Table 23: Storage conditions

Type	Condition	Unit	Reference
Humidity relative: Low High	10 90 at 40°C	%	IPC/JEDEC J-STD-033A
Air pressure: Low High	70 106	kPa	IEC TR 60271-3-1: 1K4 IEC TR 60271-3-1: 1K4
Movement of surrounding air	1.0	m/s	IEC TR 60271-3-1: 1K4
Water: rain, dripping, icing and frosting	Not allowed	---	---
Radiation: Solar Heat	1120 600	W/m^2	ETS 300 019-2-1: T1.2, IEC 60068-2-2 Bb ETS 300 019-2-1: T1.2, IEC 60068-2-2 Bb
Chemically active substances	Not recommended		IEC TR 60271-3-1: 1C1L
Mechanically active substances	Not recommended		IEC TR 60271-3-1: 1S1
Vibration sinusoidal: Displacement Acceleration Frequency range	 1.5 5 2-9 9-200	 mm m/s^2 Hz	IEC TR 60271-3-1: 1M2
Shocks: Shock spectrum Duration Acceleration	 Semi-sinusoidal 1 50	 ms m/s^2	IEC 60068-2-27 Ea

4.2.4.2 Processing Life

PLAS9-W must be soldered to an application within 72 hours after opening the moisture barrier bag (MBB) it was stored in.

As specified in the IPC/JEDEC J-STD-033 Standard, the manufacturing site processing the modules should have ambient temperatures below 30°C and a relative humidity below 60%.

4.2.4.3 Baking

Baking conditions are specified on the moisture sensitivity label attached to each MBB (see Figure 40 for details):

- It is *not necessary* to bake PLAS9-W, if the conditions specified in Section 4.2.4.1 and Section 4.2.4.2 were not exceeded.
- It is *necessary* to bake PLAS9-W, if any condition specified in Section 4.2.4.1 and Section 4.2.4.2 was exceeded.

If baking is necessary, the modules must be put into trays that can be baked to at least 125°C. Devices should not be baked in tape and reel carriers at any temperature.

4.2.4.4 Electrostatic Discharge

Electrostatic discharge (ESD) may lead to irreversible damage for the module. It is therefore advisable to develop measures and methods to counter ESD and to use these to control the electrostatic environment at manufacturing sites.

Please refer to Section 3.6 for further information on electrostatic discharge.

4.3 Packaging

4.3.1 Tape and Reel

The single-feed tape carrier for PLAS9-W is illustrated in Figure 36. The figure also shows the proper part orientation. The tape width is 56mm and the PLAS9-W modules are placed on the tape with a 40mm pitch. The reels are 330mm in diameter with 100mm hubs. Each reel contains 250 modules.

4.3.1.1 Orientation

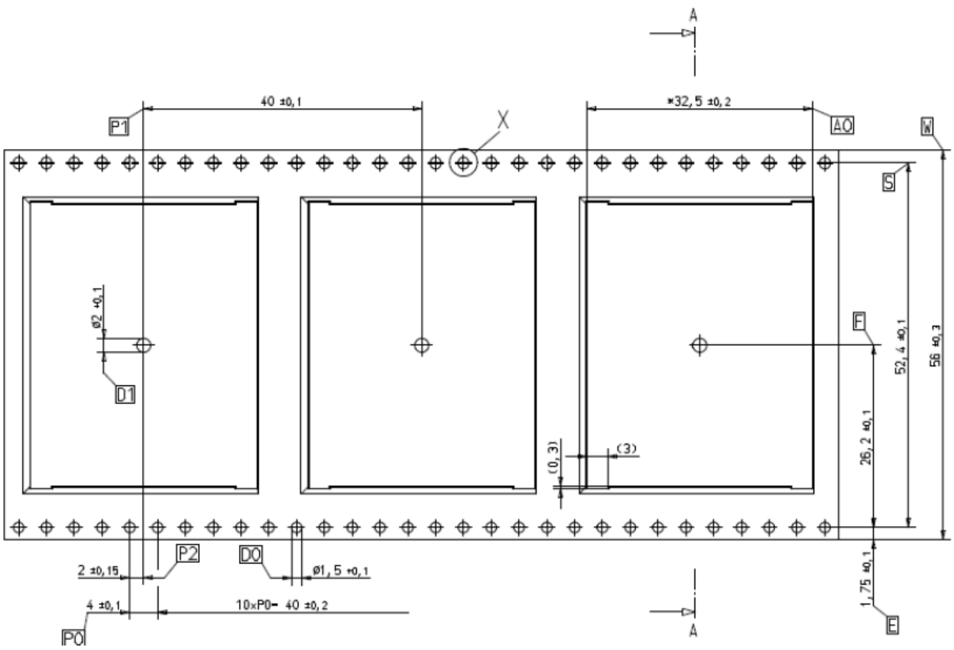


Figure 36: Carrier tape dimensions

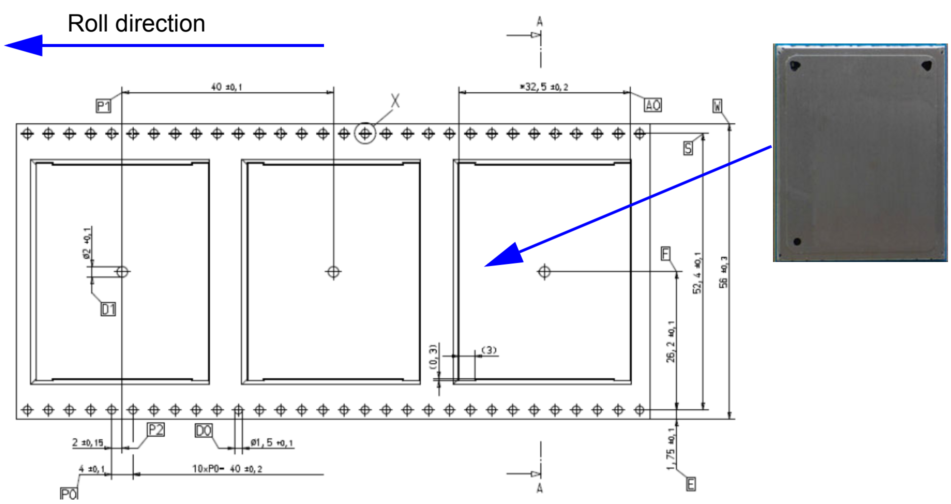


Figure 37: Roll direction

4.3.1.2 Barcode Label

A barcode label provides detailed information on the tape and its contents. It is attached to the reel.

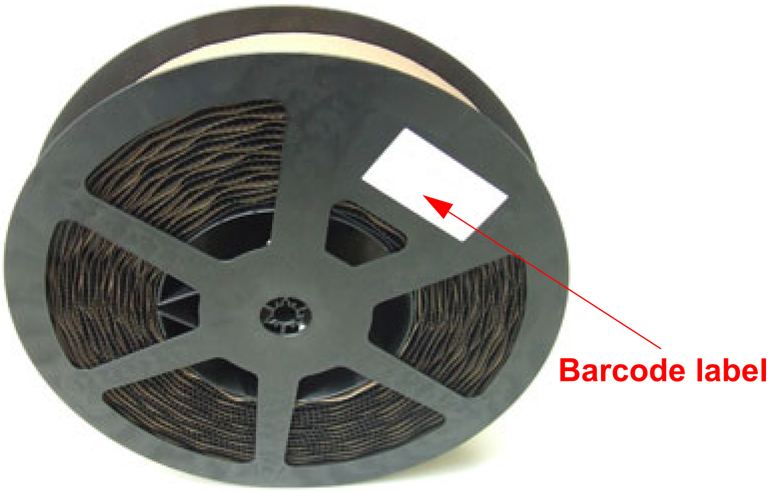


Figure 38: Barcode label on tape reel

4.3.2 Shipping Materials

PLAS9-W is distributed in tape and reel carriers. The tape and reel carriers used to distribute PLAS9-W are packed as described below, including the following required shipping materials:

- Moisture barrier bag, including desiccant and humidity indicator card
- Transportation bag

4.3.2.1 Moisture Barrier Bag

The tape reels are stored inside an MBB, together with a humidity indicator card and desiccant pouches - see Figure 39. The bag is ESD protected and delimits moisture transmission. It is vacuum-sealed and should be handled carefully to avoid puncturing or tearing. The bag protects the PLAS9-W modules from moisture exposure. It should not be opened until the devices are ready to be soldered onto the application.

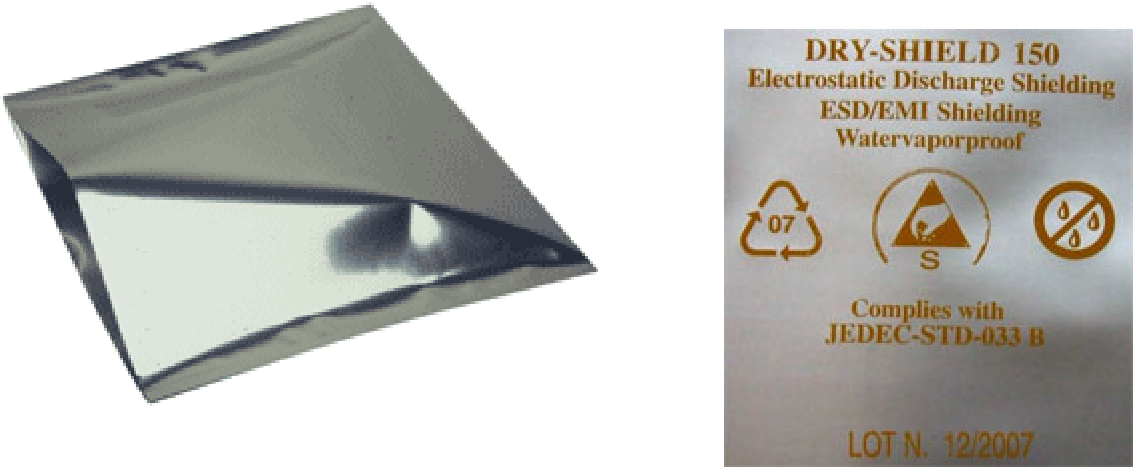
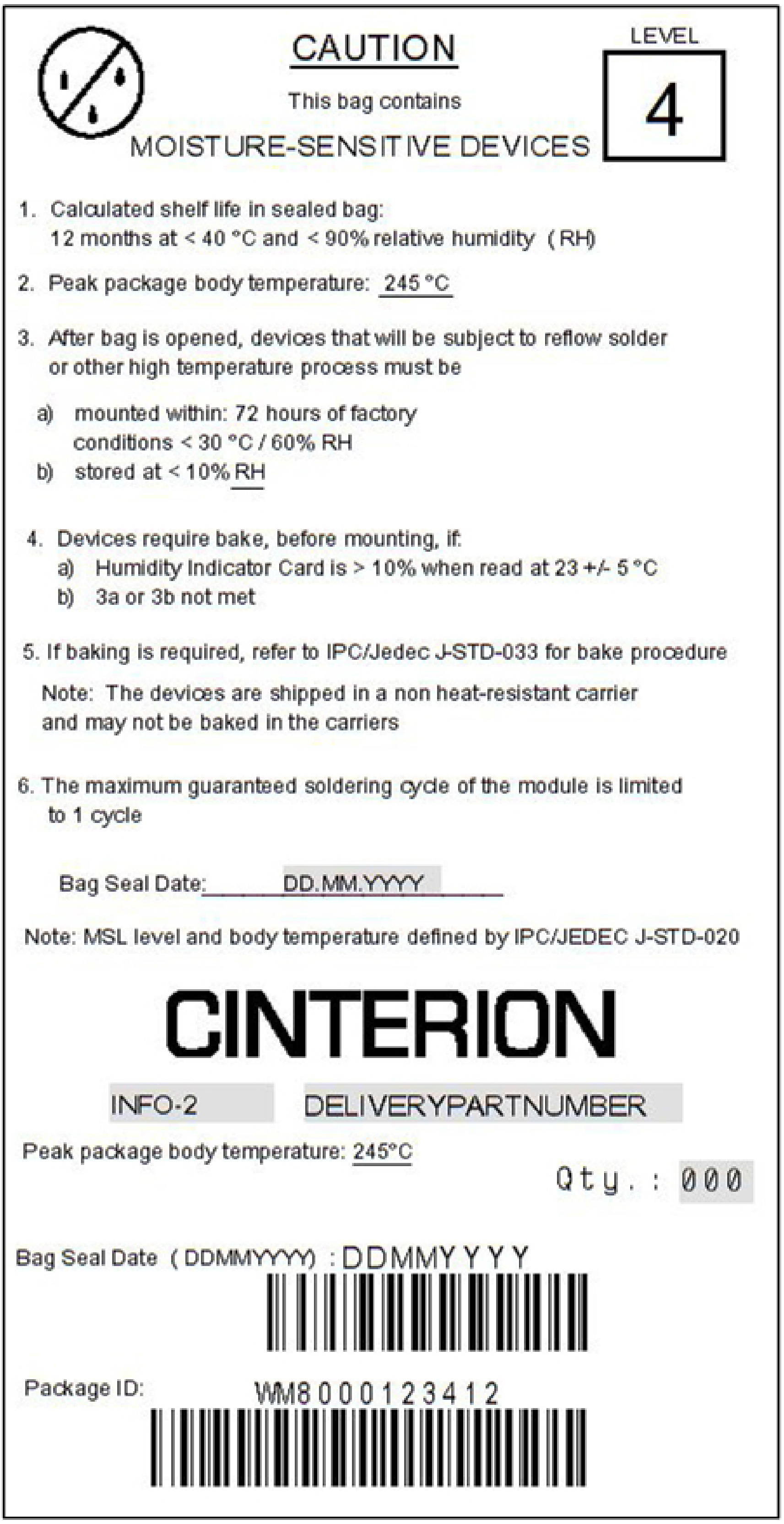


Figure 39: Moisture barrier bag (MBB) with imprint

The label shown in Figure 40 summarizes requirements regarding moisture sensitivity, including shelf life and baking requirements. It is attached to the outside of the moisture barrier bag.



CAUTION

This bag contains

MOISTURE-SENSITIVE DEVICES

LEVEL

4

1. Calculated shelf life in sealed bag:
   12 months at < 40 °C and < 90% relative humidity (RH)
2. Peak package body temperature: 245 °C
3. After bag is opened, devices that will be subject to reflow solder or other high temperature process must be
   a) mounted within: 72 hours of factory conditions < 30 °C / 60% RH
   b) stored at < 10% RH
4. Devices require bake, before mounting, if:
   a) Humidity Indicator Card is > 10% when read at 23 +/- 5 °C
   b) 3a or 3b not met
5. If baking is required, refer to IPC/Jedec J-STD-033 for bake procedure

   Note: The devices are shipped in a non heat-resistant carrier and may not be baked in the carriers
6. The maximum guaranteed soldering cycle of the module is limited to 1 cycle

Bag Seal Date: DD.MM.YYYY

Note: MSL level and body temperature defined by IPC/JEDEC J-STD-020

CINTERION

INFO-2 DELIVERYPARTNUMBER

Peak package body temperature: 245°C

Qty.: 000

Bag Seal Date (DDMMYYYY) : DDMMYYYY

Package ID: WM8000123412

Figure 40: Moisture Sensitivity Label

MBBs contain one or more desiccant pouches to absorb moisture that may be in the bag. The humidity indicator card described below should be used to determine whether the enclosed components have absorbed an excessive amount of moisture.

The desiccant pouches should not be baked or reused once removed from the MBB.

The humidity indicator card is a moisture indicator and is included in the MBB to show the approximate relative humidity level within the bag. Sample humidity cards are shown in Figure 41. If the components have been exposed to moisture above the recommended limits, the units will have to be rebaked.

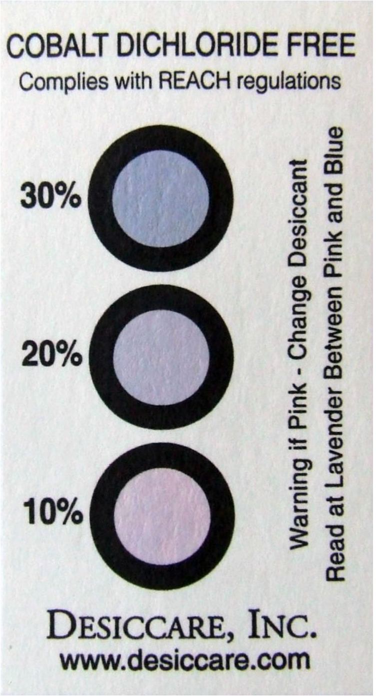


Figure 41: Humidity Indicator Card - HIC

A baking is required if the humidity indicator inside the bag indicates 10% RH or more.

4.3.2.2 Transportation Box

Tape and reel carriers are distributed in a box, marked with a barcode label for identification purposes. A box contains 2 reels with 250 modules each.

5 Regulatory and Type Approval Information

5.1 Directives and Standards

PLAS9-W has been designed to comply with the directives and standards listed below.

It is the responsibility of the application manufacturer to ensure compliance of the final product with all provisions of the applicable directives and standards as well as with the technical specifications provided in the "PLAS9-W Hardware Interface Description".

Table 24: Directives

2014/53/EU	Directive of the European Parliament and of the council of 16 April 2014 on the harmonization of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/05/EC. The product is labeled with the CE conformity mark.
2002/95/EC (RoHS 1) 2011/65/EC (RoHS 2)	Directive of the European Parliament and of the Council of 27 January 2003 (and revised on 8 June 2011) on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

Table 25: Standards of European type approval

3GPP TS 51.010-1	Digital cellular telecommunications system (Release 7); Mobile Station (MS) conformance specification;
ETSI EN 301 511 V12.5.1	Global System for Mobile communications (GSM); Mobile Stations (MS) equipment; Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU
GCF-CC V3.68.0	Global Certification Forum - Certification Criteria
Draft ETSI EN 301 489-01 V2.2.0	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonized Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU
Draft ETSI EN 301 489-52 V1.1.0	Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 52: Specific conditions for Cellular Communication Mobile and portable (UE) radio and ancillary equipment; Harmonized Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU
ETSI EN 301 908-01 V11.1.1	IMT cellular networks; Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 1: Introduction and common requirements
ETSI EN 301 908-02 V11.1.2	IMT cellular networks; Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 2: CDMA Direct Spread (UTRA FDD) User Equipment (UE)
ETSI EN 301 908-13 V11.1.2	IMT cellular networks; Harmonized Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU; Part 13: Evolved Universal Terrestrial Radio Access (E-UTRA) User Equipment (UE)
EN 60950-1:2006/ A11:2009+A1:2010+A12:2011+A2:2013	Safety of information technology equipment

Table 26: Requirements of quality

IEC 60068	Environmental testing
DIN EN 60529	IP codes

Table 27: Standards of the Ministry of Information Industry of the People's Republic of China

SJ/T 11363-2006	"Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products" (2006-06).
SJ/T 11364-2006	"Marking for Control of Pollution Caused by Electronic Information Products" (2006-06). According to the "Chinese Administration on the Control of Pollution caused by Electronic Information Products" (ACPEIP) the EPUP, i.e., Environmental Protection Use Period, of this product is 20 years as per the symbol shown here, unless otherwise marked. The EPUP is valid only as long as the product is operated within the operating limits described in the Hardware Interface Description. Please see Table 28 for an overview of toxic or hazardous substances or elements that might be contained in product parts in concentrations above the limits defined by SJ/T 11363-2006.

Table 28: Toxic or hazardous substances or elements with defined concentration limits

部件名称 Name of the part	有毒有害物质或元素 Hazardous substances					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
金属部件 (Metal Parts)	o	o	o	o	o	o
电路模块 (Circuit Modules)	x	o	o	o	o	o
电缆及电缆组件 (Cables and Cable Assemblies)	o	o	o	o	o	o
塑料和聚合物部件 (Plastic and Polymeric parts)	o	o	o	o	o	o

O:
表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下。
Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X:
表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006标准规定的限量要求。
Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part *might exceed* the limit requirement in SJ/T11363-2006.

5.2 SAR requirements specific to portable mobiles

Mobile phones, PDAs or other portable transmitters and receivers incorporating a GSM module must be in accordance with the guidelines for human exposure to radio frequency energy. This requires the Specific Absorption Rate (SAR) of portable PLAS9-W based applications to be evaluated and approved for compliance with national and/or international regulations.

Since the SAR value varies significantly with the individual product design manufacturers are advised to submit their product for approval if designed for portable use. For European markets the relevant directives are mentioned below. It is the responsibility of the manufacturer of the final product to verify whether or not further standards, recommendations or directives are in force outside these areas.

Products intended for sale on European markets

EN 50360	Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300MHz - 3GHz)
EN 62311:2008	Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz - 300 GHz)

5.3 Reference Equipment for Type Approval

The Thales general reference setup submitted to type approve PLAS9-W is shown in the figure below: Figure 42 illustrates the setup for general tests and evaluation purposes. The evaluation module can be plugged directly onto the ALAS6A-DSB75 adapter. The GSM/UMTS/LTE test equipment is still connected via SMA connectors on the ALAS6A-DSB75 adapter. The PC is connected via USB interface.

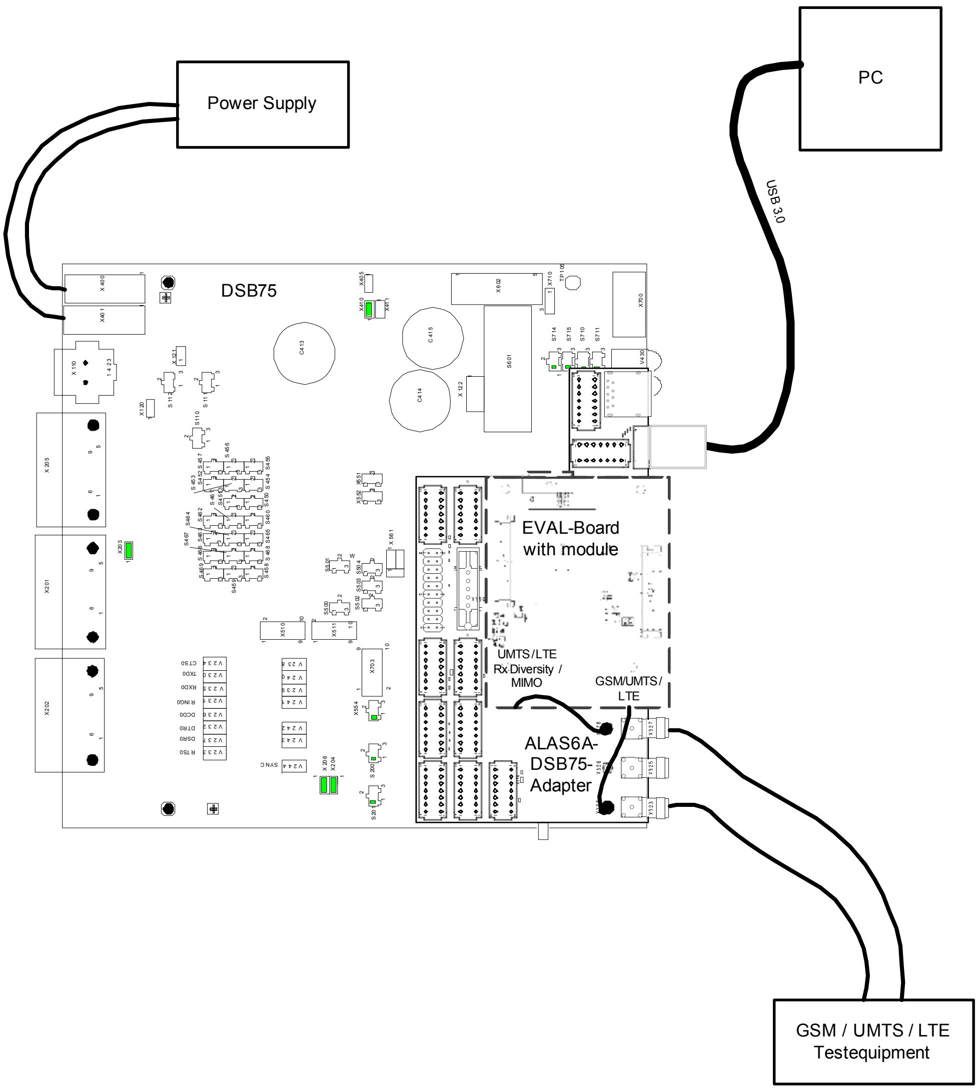


Figure 42: Reference equipment for type approval

Please note that for EMC and RF performance tests, slightly different reference equipment configurations are used. If necessary, please contact Thales for further details.

THALES DIS AIS Deutschland GmbH

6 Document Information

6.1 Revision History

Preceding document: "Cinterion® PLAS9-W Hardware Interface Description" v01.001_01.002
New document: "Cinterion® PLAS9-W Hardware Interface Description" v**01.005a**

Chapter	What is new
--	Layout changes.

Preceding document: "Cinterion® PLAS9-W Hardware Interface Description" Version 01.005
New document: "Cinterion® PLAS9-W Hardware Interface Description" Version 01.001_01.002

Chapter	What is new
1.1, 2.2.1	Revised frequency setting for LTE TDD Bd39 (2000MHz --> 1900MHz).

Preceding document: "Cinterion® PLAS9-W Hardware Interface Description" Version 01.000b
New document: "Cinterion® PLAS9-W Hardware Interface Description" Version 01.005

Chapter	What is new
--	Updated DocId.

Preceding document: "Cinterion® PLAS9-W Hardware Interface Description" Version 01.000a
New document: "Cinterion® PLAS9-W Hardware Interface Description" Version 01.000b

Chapter	What is new
2.1.1	Added BATT_ID as pad that is reserved for future use.
2.1.2	Added remark that BATT_ID must be connected to GND.
5.1	Revised some standard versions.

Preceding document: "Cinterion® PLAS9-W Hardware Interface Description" Version 01.000
New document: "Cinterion® PLAS9-W Hardware Interface Description" Version 01.000a

Chapter	What is new
2.1.2	Revised characteristics for IGT, EMERG_OFF, and VUSB_IN.
2.1.2.1	Revised ratings for USB 2.0/3.0 lines.
2.1.7	Removed description of alarm function.

Preceding document: "Cinterion® PLAS9-W Hardware Interface Description" Version 00.044

New document: "Cinterion® PLAS9-W Hardware Interface Description" Version 01.000

Chapter	What is new
7.1	Updated ordering information.

New document: "Cinterion® PLAS9-W Hardware Interface Description" Version 00.044

Chapter	What is new
--	Initial document setup.

6.2 Related Documents

[1] PLAS9-W AT Command Set
[2] PLAS9-W Release Note
[3] Application Note 48: SMT Module Integration
[4] Universal Serial Bus Specification Revision 3.0
[5] Universal Serial Bus Specification Revision 2.0

6.3 Terms and Abbreviations

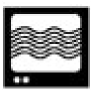
Abbreviation	Description
ANSI	American National Standards Institute
ARP	Antenna Reference Point
CA	Carrier Aggregation
CE	Conformité Européene (European Conformity)
CS	Coding Scheme
CS	Circuit Switched
CSD	Circuit Switched Data
DL	Download
dnu	Do not use
DRX	Discontinuous Reception
DSB	Development Support Board
DTX	Discontinuous Transmission
EDGE	Enhanced Data rates for GSM Evolution
EGSM	Extended GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard

Abbreviation	Description
ETSI	European Telecommunications Standards Institute
FDD	Frequency Division Duplex
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HiZ	High Impedance
HSDPA	High Speed Downlink Packet Access
I/O	Input/Output
IMEI	International Mobile Equipment Identity
ISO	International Standards Organization
ITU	International Telecommunications Union
kbps	kbits per second
LED	Light Emitting Diode
LGA	Land Grid Array
LTE	Long term evolution
MBB	Moisture barrier bag
Mbps	Mbits per second
MCS	Modulation and Coding Scheme
MIMO	Multiple Input Multiple Output
MLCC	Multi Layer Ceramic Capacitor
MO	Mobile Originated
MS	Mobile Station, also referred to as TE
MSL	Moisture Sensitivity Level
MT	Mobile Terminated
nc	Not connected
NTC	Negative Temperature Coefficient
PCB	Printed Circuit Board
PCL	Power Control Level
PCS	Personal Communication System, also referred to as GSM 1900
PD	Pull Down resistor
PDU	Protocol Data Unit
PS	Packet Switched
PSK	Phase Shift Keying
PU	Pull Up resistor
QAM	Quadrature Amplitude Modulation
R&TTE	Radio and Telecommunication Terminal Equipment
RF	Radio Frequency

Abbreviation	Description
rfu	Reserved for future use
ROPR	Radio Output Power Reduction
RTC	Real Time Clock
Rx	Receive Direction
SAR	Specific Absorption Rate
SELV	Safety Extra Low Voltage
SIM	Subscriber Identification Module
SMD	Surface Mount Device
SMS	Short Message Service
SMT	Surface Mount Technology
SRAM	Static Random Access Memory
SRB	Signalling Radio Bearer
TE	Terminal Equipment
TPC	Transmit Power Control
TS	Technical Specification
Tx	Transmit Direction
UL	Upload
UMTS	Universal Mobile Telecommunications System
URC	Unsolicited Result Code
USB	Universal Serial Bus
UICC	USIM Integrated Circuit Card
USIM	UMTS Subscriber Identification Module
WCDMA	Wideband Code Division Multiple Access

6.4 Safety Precaution Notes

The following safety precautions must be observed during all phases of the operation, usage, service or repair of any cellular terminal or mobile incorporating PLAS9-W. Manufacturers of the cellular terminal are advised to convey the following safety information to users and operating personnel and to incorporate these guidelines into all manuals supplied with the product. Failure to comply with these precautions violates safety standards of design, manufacture and intended use of the product. Thales assumes no liability for customer’s failure to comply with these precautions.

	When in a hospital or other health care facility, observe the restrictions on the use of mobiles. Switch the cellular terminal or mobile off, if instructed to do so by the guidelines posted in sensitive areas. Medical equipment may be sensitive to RF energy. The operation of cardiac pacemakers, other implanted medical equipment and hearing aids can be affected by interference from cellular terminals or mobiles placed close to the device. If in doubt about potential danger, contact the physician or the manufacturer of the device to verify that the equipment is properly shielded. Pacemaker patients are advised to keep their hand-held mobile away from the pacemaker, while it is on.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it cannot be switched on inadvertently. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communications systems. Failure to observe these instructions may lead to the suspension or denial of cellular services to the offender, legal action, or both.
	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. Remember that interference can occur if it is used close to TV sets, radios, computers or inadequately shielded equipment. Follow any special regulations and always switch off the cellular terminal or mobile wherever forbidden, or when you suspect that it may cause interference or danger.
	IMPORTANT! Cellular terminals or mobiles operate using radio signals and cellular networks. Because of this, connection cannot be guaranteed at all times under all conditions. Therefore, you should never rely solely upon any wireless device for essential communications, for example emergency calls. Remember, in order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength. Some networks do not allow for emergency calls if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may need to deactivate those features before you can make an emergency call. Some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.

7 Appendix

7.1 List of Parts and Accessories

Table 29: List of parts and accessories

Description	Supplier	Ordering information
PLAS9-W[1]	Thales	Standard module Thales IMEI: Packaging unit (ordering) number: L30960-N5110-B100 Module label number: L30960-N5110-B100-1[2]
PLAS9-W Evaluation module[1]	Thales	Ordering number: L30960-N5111-B100 (PLAS9-W)
DSB75 Support Box	Thales	Ordering number: L36880-N8811-A100
DSB75-Adapter for mounting the PLAS9-W Evaluation Module	Thales	Ordering number: L30960-N4103-A100
Votronic Handset	VOTRONIC / Thales	Votronic ordering number: HH-SI-30.3/V1.1/0 Votronic Entwicklungs- und Produktionsgesellschaft für elektronische Geräte mbH Saarbrücker Str. 8 66386 St. Ingbert Germany Phone: +49-(0)6 89 4 / 92 55-0 Fax: +49-(0)6 89 4 / 92 55-88 Email: contact@votronic.com
SIM card holder incl. push button ejector and slide-in tray	Molex	Ordering numbers: 91228 91236 Sales contacts are listed in Table 30.
U.FL antenna connector	Molex or Hirose	Sales contacts are listed in Table 30 and Table 31.

1. Note: At the discretion of Thales, modules can be made either in Germany or in China.
2. Note: At the discretion of Thales, module label information can either be laser engraved on the module's shielding or be printed on a label adhered to the module's shielding.

Table 30: Molex sales contacts (subject to change)

Molex For further information please click: http://www.molex.com	Molex Deutschland GmbH Otto-Hahn-Str. 1b 69190 Walldorf Germany Phone: +49-6227-3091-0 Fax: +49-6227-3091-8100 Email: mxgermany@molex.com	American Headquarters Lisle, Illinois 60532 U.S.A. Phone: +1-800-78MOLEX Fax: +1-630-969-1352
Molex China Distributors Beijing, Room 1311, Tower B, COFCO Plaza No. 8, Jian Guo Men Nei Street, 100005 Beijing P.R. China Phone: +86-10-6526-9628 Fax: +86-10-6526-9730	Molex Singapore Pte. Ltd. 110, International Road Jurong Town, Singapore 629174 Phone: +65-6-268-6868 Fax: +65-6-265-6044	Molex Japan Co. Ltd. 1-5-4 Fukami-Higashi, Yamato-City, Kanagawa, 242-8585 Japan Phone: +81-46-265-2325 Fax: +81-46-265-2365

Table 31: Hirose sales contacts (subject to change)

Hirose Ltd. For further information please click: http://www.hirose.com	Hirose Electric (U.S.A.) Inc 2688 Westhills Court Simi Valley, CA 93065 U.S.A. Phone: +1-805-522-7958 Fax: +1-805-522-3217	Hirose Electric Europe B.V. German Branch: Herzog-Carl-Strasse 4 73760 Ostfildern Germany Phone: +49-711-456002-1 Fax: +49-711-456002-299 Email: info@hirose.de
Hirose Electric Europe B.V. UK Branch: First Floor, St. Andrews House, Caldecotte Lake Business Park, Milton Keynes MK7 8LE Great Britain Phone: +44-1908-369060 Fax: +44-1908-369078	Hirose Electric Co., Ltd. 5-23, Osaki 5 Chome, Shinagawa-Ku Tokyo 141 Japan Phone: +81-03-3491-9741 Fax: +81-03-3493-2933	Hirose Electric Europe B.V. Hogehillweg 8 1101 CC Amsterdam Z-O Netherlands Phone: +31-20-6557-460 Fax: +31-20-6557-469

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