

Application/Product Information

Please provide the following information:

- Make: [Caterpillar](#)
- Brand: [CAT](#)
- Product name and description: [PL645 Telematics Radio](#)
- Model Name: [PL645](#)
- CAT part number: [661-9821-XX, \(PL645, Rest of World, Internal Antenna\),](#)
[661-9822-XX, \(PL645, Rest of World, External Antenna\),](#)
- Trade name: [Caterpillar Inc.](#)
- Applicant: [Caterpillar Inc.](#)
- Manufacturer: [Caterpillar Inc.](#)
- Address of Manufacturer: [100 NE Adams St, Peoria, IL 61629 USA](#)
- Factory name, address, phone number, fax number:

Factory 1:

[Rua Robert Bosch - Lomar \(Rua 25 abril, 69\)](#)
[4705-285 BRAGA](#)
[Portugal](#)

- Country of Origin: [Portugal](#)
- HS Codes
 - [European Union \(primary shipping location\): 8517620000](#)
 - [United States: 8517620090](#)
 - [Mexico: 8517621799](#)
 - [Indonesia: 85176259](#)
- Contact/Signer name, position, phone number, fax number, email address:
 - [Michael Caruthers](#)
 - [Product Manager](#)
 - [Caterpillar Inc.](#)
 - [ph: +1 309 578 8131](#)
 - [fax: +1 309 578 7855](#)
 - [email: caruthers_michael_a@cat.com](#)
- Equipment Description: [Telematics Radio](#)
- RF Modules used:

Product Type	Manufacturer	Trade Name	Model Number	FCC ID	IMEI TAC
5G/4G/3G/2G NAD	EAGLE Wireless GmbH	EAGLE Wireless GmbH	WMC598E- GL	2BH2C25WMC598EGL	35196072
GNSS (embedded in NAD)					

Application/Product Information

WiFi/BLE Module	u-blox	u-blox	JODY-W5	XPYJODYW56	N/A
-----------------	--------	--------	---------	------------	-----

- GNSS Positioning: L1 (GPS/QZSS), E1 (Galileo), G1 (GLONASS), B1C (BeiDou)

- Transmitter Antenna type and gain:

Internal Cellular Antennas: (metal stamp PIFA Antenna type)

Frequency Range (MHz)	Peak Gain (dBi)
617 - 698	0.8
698 - 716	-1.4
716 - 793	1.2
793 - 817	1.2
817 - 894	1.5
894 - 960	0.8
1520 - 1660	1.4
1710 - 1785	0.9
1785 - 1880	1.3
1880 - 1995	1.5
1995 - 2025	1.1
2025 - 2110	1.0
2110 - 2300	1.2
2300 - 2412	2.5
2500 - 2600	3.5
2600 - 2700	2.9
3300 - 4200	4.4 (Main) 3.8 (Diversity)
4200 - 5000	3.3 (Main) 3.3 (Diversity)

There are two antennas involved, a primary and diversity antenna. Both antennas are capable of transmitting and receiving, however, there is no Multiple Input, Multiple Output (MIMO) capability.

External Cellular Antennas: (metal stamp PIFA Antenna type)

	Coax Cable Length			Coax Cable Length (w/ PCB Trace Loss from PL radio)		
Frequency Range (MHz)	Peak Gain (dBi) 0.5 meter	Peak Gain (dBi) 1.0 meter	Peak Gain (dBi) 2.0 meter	Peak Gain (dBi) 0.5 meter	Peak Gain (dBi) 1.0 meter	Peak Gain (dBi) 2.0 meter

Application/Product Information

617 - 698	1.6	1.4	1.1	1.6-0.31=1.29	1.4-0.31=1.09	1.1-0.31=0.79
698 - 716	1.7	1.4	1.2	1.7-0.36=1.34	1.4-0.36=1.04	1.2-0.36=0.84
716 - 793	1.5	1.2	1.0	1.5-0.37=1.13	1.2-0.37=0.83	1.0-0.37=0.63
793 - 817	1.8	1.5	1.2	1.8-0.39=1.41	1.5-0.39=1.11	1.2-0.39=0.81
817 - 894	3.4	3.1	2.8	3.4-0.42=2.98	3.1-0.42=2.68	2.8-0.42=2.38
894 - 960	3.9	3.6	3.3	3.9-0.48=3.42	3.6-0.48=3.12	3.3-0.48=2.82
1520 - 1660	5.4	4.9	4.5	5.4-0.75=4.65	4.9-0.75=4.15	4.5-0.75=3.75
1710 - 1785	5.1	4.7	4.2	5.1-0.92=4.18	4.7-0.92=3.78	4.2-0.92=3.28
1785 - 1880	4.8	4.3	3.8	4.8-1.06=3.74	4.3-1.06=3.24	3.8-1.06=2.74
1880 - 1995	4.8	4.2	3.8	4.8-1.04=3.76	4.2-1.04=3.16	3.8-1.04=2.76
1995 - 2025	3.7	3.2	2.7	3.7-1.11=2.59	3.2-1.11=2.09	2.7-1.11=1.59
2025 - 2110	5.1	4.6	4.1	5.1-1.11=3.99	4.6-1.11=3.49	4.1-1.11=2.99
2110 - 2300	5.3	4.7	4.3	5.3-1.22=4.08	4.7-1.22=3.48	4.3-1.22=3.08
2300 - 2412	5.4	4.9	4.4	5.4-1.05=4.35	4.9-1.05=3.85	4.4-1.05=3.35
2500 - 2600	4.8	4.3	3.7	4.8-0.96=3.84	4.3-0.96=3.34	3.7-0.96=2.74
2600 - 2700	4.7	4.1	3.6	4.7-0.96=3.74	4.1-0.96=3.14	3.6-0.96=2.64
2700 - 2800	5.5	4.8	4.0	5.5-1.07=4.43	4.8-1.07=3.73	4.0-1.07=2.93
2800 - 3000	4.6	4.0	3.4	4.6-1.07=3.53	4.0-1.07=2.93	3.4-1.07=2.33
3000 - 3300	4.8	4.2	3.5	4.8-1.13=3.67	4.2-1.13=3.07	3.5-1.13=2.37
3300 - 4200	5.5	4.8	4.0	5.5-1.13=4.37	4.8-1.13=3.67	4.0-1.13=2.87
4200 - 5000	5.5	4.7	3.8	5.5-2.61=2.89	4.7-2.61=2.09	3.8-2.61=1.19

There are two antennas involved, a primary and diversity antenna. Both antennas are capable of transmitting and receiving, however, there is no Multiple Input, Multiple Output (MIMO) capability.

Internal Bluetooth/WiFi Antenna: (metal stamp PIFA Antenna Type)

Frequency Range	Peak Gain (dBi)
Antx 1 - WiFi 2.4-2.48 GHz	3.0
Antx 1 - WiFi 5 GHz	4.9
Antx 2 - BLE 2.4-2.48 GHz	-0.7

There is one dedicated antenna to WiFi 2.4/5GHz operation (Single Input, Single Output)(Antx 1).
There is one dedicated antenna to BLE 2.4GHz (Antx 2).

External Bluetooth/WiFi Antenna: (monopole PCB Antenna Type)

Frequency Range	Peak Gain (dBi) (0.5 meter coax)	Peak Gain (dBi) (1 meter coax)	Peak Gain (dBi) (2 meter coax)
Antx 1 (Port 2) - WiFi 2.4-2.48 GHz	4.6 (with PCB trace loss from PL radio 4.6-3.03= 1.57)	4.0 (with PCB trace loss from PL radio 4.0-3.03= 0.97)	3.5 (with PCB trace loss from PL radio 3.5-3.03= 0.47)

Application/Product Information

Antx 1 (Port 2) – WiFi 5 GHz	5.4 (with PCB trace loss from PL radio 5.4 -5.95= -0.55)	4.4 (with PCB trace loss from PL radio 4.4-5.95= -1.55)	3.4 (with PCB trace loss from PL radio 3.4-5.95= -2.55)
Antx 2 (Port 4) - BLE 2.4-2.48 GHz	4.6 (with PCB trace loss from PL radio 4.6-2.85= 1.75)	4.0 (with PCB trace loss from PL radio 4.0-2.85= 1.15)	3.5 (with PCB trace loss from PL radio 4.6-2.85= 0.65)

There is one dedicated antenna to WiFi 2.4/5GHz operation (Single Input, Single Output)(Antx 1).
There is one dedicated antenna to BLE 2.4GHz (Antx 2).

- Max. RF output power in EIRP:
 - GSM/UMTS/LTE/5G Output Power:
See “Cellular Frequency information” table
 - BT LE Output Power:
Class 1 BLE: 16 dBm
 - WiFi Output Power:
 - 2.4 GHz
 - DSSS/CCK, 20 MHz: 19 dBm
 - MCS7, 64-QAM, 20 MHz: 18 dBm
 - MCS8, 256-QAM, 20 MHz: 17 dBm
 - MCS11, 1024-QAM, 20 MHz: 16 dBm
 - MCS7, 64-QAM, 40 MHz: 17 dBm
 - MCS9, 256-QAM, 40 MHz: 17 dBm
 - MCS11, 1024-QAM, 40 MHz: 16 dBm
 - 5 GHz
 - MCS7, 64-QAM, 20 MHz: 17 dBm
 - MCS8, 256-QAM, 20 MHz: 16 dBm
 - MCS11, 1024-QAM, 20 MHz: 14 dBm
 - MCS7, 64-QAM, 40 MHz: 16 dBm
 - MCS9, 256-QAM, 40 MHz: 14 dBm
 - MCS11, 1024-QAM, 40 MHz: 12 dBm
 - MCS7, 64-QAM, 80 MHz: 14 dBm
 - MCS9, 256-QAM, 80 MHz: 13 dBm
 - MCS11, 1024-QAM, 80 MHz: 11 dBm
- Modulation type (per each RF technology):
 - 2G/GSM: Up to 8-PSK
 - 3G/UMTS: Up to 64QAM
 - 4G/LTE: Up to 16QAM, 64QAM, 256QAM
 - 5G/NR: Up to 256QAM
 - Bluetooth Low Energy: GFSK, $\pi/4$ DQPSK, 8DPSK

Application/Product Information

- WiFi: 802.11b CCK and DSSS,
802.11 a/g/n/ac/ax OFDM/OFDMA
- Operating temperature: -40 to 60C (Partial operation up to 85C (e.g Battery Charging, Wireless Operation))
- Nominal Supply Voltage: 9 – 32 V DC
- Internal Battery Voltage: 4.8V
- SW version: v6.18
- HW version: 661-9821 and 661-9822
- ITU classes of emission: D7W/G7W (Cellular)
- Channels/Frequencies (per each RF technology): See “Cellular Frequency information” table

Cellular Frequency Information					
Uplink Frequency (MHz) (Transmit)	Downlink Frequency (MHz) (Receive)	Band	2G/3G/4G	Conducted Output Power (Nominal)	Class
1850-1910	1930-1990	GSM 1900	2G	30 dBm	Class 1
1710-1785	1805-1880	GSM 1800	2G	30 dBm	Class 1
824-849	869-894	GSM 850	2G	33 dBm	Class 4
880-915	925-960	GSM 900	2G	33 dBm	Class 4
1920-1980	2110-2170	1	3G	23 dBm	Class 3
1850-1910	1930-1990	2	3G	23 dBm	Class 3
1710-1755	2110-2155	4	3G	23 dBm	Class 3
824-849	869-894	5	3G	23 dBm	Class 3
880-915	925-960	8	3G	23 dBm	Class 3
830-845	875-890	19	3G	23 dBm	Class 3
1920-1980	2110-2170	1	4G	23 dBm	Class 3
1850-1910	1930-1990	2	4G	23 dBm	Class 3
1710-1785	1805-1880	3	4G	23 dBm	Class 3
1710-1755	2110-2155	4	4G	23 dBm	Class 3
824-849	869-894	5	4G	23 dBm	Class 3
2500-2700	2620-2690	7	4G	23 dBm	Class 3
880-915	925-960	8	4G	23 dBm	Class 3
699-716	729-746	12	4G	23 dBm	Class 3
777-787	746-756	13	4G	23 dBm	Class 3
788-798	758-768	14	4G	23 dBm	Class 3
704-716	734-746	17	4G	23 dBm	Class 3
815-830	860-875	18	4G	23 dBm	Class 3
830-845	875-890	19	4G	23 dBm	Class 3
832-862	791-821	20	4G	23 dBm	Class 3
1850-1915	1930-1995	25	4G	23 dBm	Class 3
814-849	859-894	26	4G	23 dBm	Class 3
703-748	758-803	28 (A and B)	4G	23 dBm	Class 3
N/A	717-728	29 (SDL)	4G	RX ONLY	N/A

Application/Product Information

2010-2025	2010-2025	34 (TDD)	4G	23 dBm	Class 3
2570-2620	2570-2620	38 (TDD)	4G	23 dBm	Class 3
1880-1920	1880-1920	39 (TDD)	4G	23 dBm	Class 3
2300-2400	2300-2400	40 (TDD)	4G	23 dBm	Class 3
2496-2690	2496-2690	41 (TDD)	4G	23 dBm	Class 3
3400-3600	3400-3600	42 (TDD)	4G	23 dBm	Class 3
3600-3800	3600-3800	43 (TDD)	4G	23 dBm	Class 3
3550-3700	3550-3700	48 (TDD)	4G	23 dBm	Class 3
1710-1780	2110-2200	66	4G	23 dBm	Class 3
663-698	617-652	71	4G	23 dBm	Class 3
1920-1980	2110-2170	N1	5G	23 dBm	Class 3
1850-1910	1930-1990	N2	5G	23 dBm	Class 3
1710-1785	1805-1880	N3	5G	23 dBm	Class 3
824-849	869-894	N5	5G	23 dBm	Class 3
2500-2570	2620-2690	N7	5G	23 dBm	Class 3
880-915	925-960	N8	5G	23 dBm	Class 3
699-716	729-746	N12	5G	23 dBm	Class 3
788-798	758-768	N14	5G	23 dBm	Class 3
832-862	791-821	N20	5G	23 dBm	Class 3
1850-1915	1930-1995	N25	5G	23 dBm	Class 3
814-849	859-894	N26	5G	23 dBm	Class 3
703-748	758-803	N28 (A and B)	5G	23 dBm	Class 3
N/A	2350-2360	N30 (disabled in USA)	5G	RX ONLY	-
2570-2620	2570-2620	N38 (TDD)	5G	23 dBm	Class 3
2300-2400	2300-2400	N40 (TDD)	5G	23 dBm	Class 3
2496-2690	2496-2690	N41 (TDD)	5G	23 dBm	Class 3
3550-3700	3550-3700	N48 (TDD)	5G	23 dBm	Class 3
1710-1780	2110-2200	N66	5G	23 dBm	Class 3
1695-1710	1995-2020	N70	5G	23 dBm	Class 3
663-698	617-652	N71	5G	23 dBm	Class 3
3300-4200	3300-4200	N77 (TDD)	5G	23 dBm	Class 3
3300-3800	3300-3800	N78 (TDD)	5G	23 dBm	Class 3
4400-5000	4400-5000	N79 (TDD)	5G	23 dBm	Class 3
Wi-Fi Frequency Information					
Uplink Frequency (MHz) (Transmit)	Downlink Frequency (MHz) (Receive)	Band	Operation Mode	Output Power	Class
2401-2484	2401-2484	802.11 b/g/n	WiFi 2.4 GHz	19 dBm	DTS
4900-5925	4900-5925	802.11 a/n/ac/ax	WiFi 5 GHz	17 dBm	DTS
BLE Frequency Information					
Uplink Frequency	Downlink Frequency	Band	Operation Mode	Output Power	Class

Application/Product Information

(MHz) (Transmit)	(MHz) (Receive)				
2400	2483.5	N/A	BLE	16 dBm	1 BLE (DTS)
GNSS Frequency Information					
Uplink Frequency (MHz) (Transmit)	Downlink Frequency (MHz) (Receive)	Band	Operation Mode	Output Power	Class
N/A	1561.098- 1610	L1, E1, G1, B1C	GNSS	RX ONLY	N/A

The PL645 is a baseline model that will be sold everywhere except China. See feature differences below:

Model	Part Description	Hardware Part Number	Detailed Description	Feature Difference	BOM Difference
PL645	RoW PL645i	661-9821-XX	RoW PL645 Internal antenna (Ethernet Switch) (2 4WE, 1 2WE) (2xCAN(1CDL)) (RS485)(Dual eSIM)(3 STG/STB, 1 Factory Reset STG)(AT&T eSIM)	Baseline Internal Antenna	Baseline internal antenna BOM
PL645	RoW PL645e	661-9822-XX	RoW PL645 External antenna (Ethernet Switch) (2 4WE, 1 2WE) (2xCAN(1CDL)) (RS485)(Dual eSIM)(3 STG/STB, 1 Factory Reset STG)(AT&T eSIM)	Baseline External Antenna	Baseline external antenna BOM

Application/Product Information

Details on antenna options intended to be used with the PL645 external antenna variants.

Antenna Name	Antenna Hardware Part Number	Mounting Type	Coax Pigtail Length (meters)
5G External Antenna	656-7883-XX	Hard Mount	0.5 m
5G External Antenna	656-7884-XX	Adhesive Mount	0.5 m
5G External Antenna	661-9348-XX	Hard Mount	1.0 m
5G External Antenna	661-9349-XX	Adhesive Mount	1.0 m
5G External Antenna	661-9351-XX	Hard Mount	2.0 m
5G External Antenna	661-9352-XX	Adhesive Mount	2.0 m

Below are the different Device and Antenna combinations.

Variants	Alternate Name	Model Name	Device Hardware Part Number	Antenna Description	Antenna Hardware Part Number
1	RoW Pro+ i	PL645	661-9821-XX	Internal	n/a
2	RoW Pro+ e	PL645	661-9822-XX	Hard Mount with 0.5m coax pigtail length	656-7883-XX
3	RoW Pro+ e	PL645	661-9822-XX	Hard Mount with 1m coax pigtail length	661-9348-XX
4	RoW Pro+ e	PL645	661-9822-XX	Hard Mount with 2m coax pigtail length	661-9351-XX
5	RoW Pro+ e	PL645	661-9822-XX	Adhesive Mount with 0.5m coax pigtail length	656-7884-XX
6	RoW Pro+ e	PL645	661-9822-XX	Adhesive Mount with 1m coax pigtail length	661-9349-XX
7	RoW Pro+ e	PL645	661-9822-XX	Adhesive Mount with 2m coax pigtail length	661-9352-XX