COMMUNICATION SOLUTIONS FOR
THE LOCAL PUBLIC TRANSPORT

TK800

SMART CITY
LTE ROUTER - TK800 SERIES

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TK812L   TK815L-EX0   TK815L-EXW   TK815L-EGW   TK805W-EXW   TK805W-EX0

COMMUNICATION SOLUTIONS FOR THE LOCAL PUBLIC TRANSPORT

/TK800 LTE ROUTER

This digitization megatrend is increasingly becoming a part of our cities. Especially public transport as part of a „smart" city needs to become more efficient through the use of modern communication systems. Our TK800 Router provides operators and system integrators in the transport sector with a mobile platform both on-track and off-track that is perfectly adapted to the needs of the individual applications.

In addition to the required certifications for the bus and rail industries, which underline the robustness and longevity of these LTE routers, our TK800 Router offers numerous additional features that open up completely new application areas and considerably simplify the use of communication solutions for our customers.

With this brochure, we provide you with helpful information in the form of technical data as well as applications and additional products such as antennas. Together with you, we can create a complete tailor-made communication concepts for your desired application.

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/ APPLICATIONS

Bus and Train

In the future, public transport needs to play a bigger role if we want to take the protection of climate and residents more seriously. To do this, the existing structures must become more efficient and tailored to the passenger. Through infotainment solutions or mobile ticketing, the driving experience can be made considerably more comfortable while new user groups can be addressed and additional business potential can be raised. For all these advantages; however, not only a communication connection of buses themselves, but also of stops or charging infrastructure is necessary. We are always working to develop new applications for our routers. Here is a selection of those in which they have already been tested and proven effective.

Digital Signage

In public transport, the so-called infotainment is becoming increasingly common, e.g. weather or latest news updates displayed on the screen. They are also popular as advertising space. In this application, larger amounts of data in the form of video and images must be transmitted over the cellular network. The routers of the TK800 series are connected to the displays via Ethernet. Through LTE, a VPN tunnel is established to the control center. Alternatively, this can also be done via an external service provider by giving it access to the router.

The image content required for infotainment is transmitted and displayed via the mobile radio network and the router connected to the display devices in the transport. Since (moving) visuals are used, the transmission speed requirements are high. Therefore, some public transport companies are on their way to upload content to the individual systems at the bus depot. Therefore, the Wi-Fi chipset in the TK800 router is used and thus drastically reduces data consumption.

Passenger Information Systems

A passenger information system is an electronic information system for both local and long-distance public transport passengers. It goes beyond the mere timetable information. The aim is to offer the passengers an information platform that enables them to obtain comprehensive information about local public Transport. Inside the vehicles, an information about bus routes as well as the following bus stops and the final destination is provided simultaneously through loudspeakers or displays. LTE routers are also used at stops and stations to connect and allow communication between information points or digital timetable displays. Wi-Fi routers are also used as information systems for the drivers by enabling the drivers to use Wi-Fi at the bus stations and thus, for example, access their work schedules.
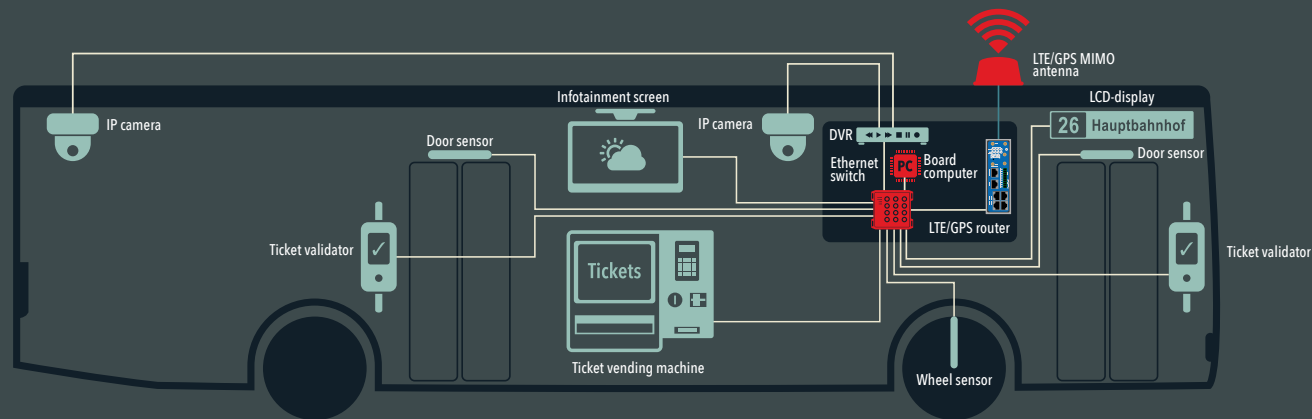
Connection of communication systems in buses

Video Surveillance

Video surveillance in public transport is designed to meet the needs of passengers for safety by preventing or quickly identifying the crime. For this application, a sufficiently fast communication link between the means of transport and the control room is required. Some of the footage needs to be transferred in real-time in response to critical situations.

The TK800 series routers are connected to the IP cameras via Ethernet. Through LTE, a VPN tunnel is established to the control center. From there the images from the surveillance cameras can be viewed. Usually, a video server is used on board the bus or train equipped with camera systems. Here the images are stored for a certain period of time and can be accessed upon request.

Often you will also find an alarm button close to the bus driver, which triggers the switch to the live image in the control room. The operator can thus see the situation at a glance and take action directly.

People Counting

Data from a passenger counting sensor can be recorded via a serial interface and written with the position data of the GPS system in a file (CSV). Via LTE, this CSV file can be sent via FTP to a server. At the control center, this data can then be evaluated to adapt bus routes to the number of passengers in certain parts to offer customers an improved range of routes.

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Traffic Control Systems
Private transport, such as cars and trucks, also needs to be managed more efficiently. For this purpose, digital display bridges at important junctions are used, which warn the drivers of current dangers, speed limits or over-taking bans. This avoids congestion and allows early warning of dangerous situations. One form of traffic control systems is e.g. parking guidance systems, which indicate free parking spaces in the parking lot in an urban area.

Our TK800 LTE routers are responsible for the transmission of control signals for the use in these traffic manage-ment systems. In order to make this important and critical application possible, large-temperature industrial rou-ters and appropriately designed antenna systems, which we supply to various system integrators, are required.

But not only LTE routers are used in this application, in the past and by now, UHF radio systems are also used once again. This is because the mobile network is often not so fast during traffic jam due to many participants. The-refore, some system integrators also build their own UHF radio networks with our products for this application.

Charging Infrastructure
The charging infrastructure for electric vehicles is currently under construction all over Germany. For billing and monitoring purposes, each individual charging station must receive a communication connection. Since cabling is often very uneconomical, our customers use the LTE routers and (vandalism-proof) antennas.

Stationary Video Surveillance
In the era of anti-terrorism and increasing security needs for the people, video surveillance systems play an important role in clearing up any crime. When used correctly, it can be used to achieve deterrent effects and increase the level of awareness. Often, these video surveillance systems are set up at major transportation hubs, as there are often many people here. In this application, our LTE routers ensure a secure connection of the IP-based cameras to the monitoring center in which the images are stored or evaluated. There are also systems with their own stationary control center, which cache the images and provide them when needed. For this, we provide appropriately equipped industrial PCs (also available with PoE ports).

Stationary Ticket Machines
Ticket machines are available in many areas of public sphere. In addition to the obvious applications such as at bus stops or in the train stations, these are also used in multi-storey car parks or other restricted areas such as ski lifts or the like. In these cases, cable installation and connection to the fixed network are usually not the most economical solution. That's why many of our customers use TK800 series LTE routers in combination with vandal-proof antennas.

ID-based Ticketing
With ID-based ticketing, all ticketing processes are carried out invisibly in real time in a cloud for the customer. The data on e.g. passenger, ticket and tariff, is stored in the operator's background system when the passengers board and disembark, without the customer actively participating in the process. During this process, our routers transfer the data to the control center with secure encryption.

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/ LTE COMMUNICATION FOR PUBLIC TRANSPORT

Mobile communication, even across national borders

At the heart of fleet management lies the IVU.box, a robust and user-friendly on-board computer for buses and trains. It has interfaces to all common positioning and communication systems: GPS, analogue and digital radio, GSM, UMTS or the standard for digital trunked radio TETRA (Terrestrial Trunked Radio) which controls the entire vehicle environment; such as, location, data transmission to the control room, infotainment and much more. In addition to ticket printing, IVU.ticket.box supports all forms of electronic ticketing. In applications in which large amounts of data must be transmitted; such as an infotainment system on board, the built-in box UMTS modem is not enough. For such cases, the Berliner developed an additional module. The proposed in-house development of the communication module was rejected for various reasons. For example, clearing service providers for cashless payment have high security requirements for the hardware used and require their own communication channel for this application. Therefore, IVU sets out to find a suitable standard module on the market that can use both LTE and WLAN and can be optimally integrated in public transport vehicles.

The citizens of Berlin found what they were looking for with their longtime partner Welotec from Laer in Münsterland. A router, with which data can be transmitted both via WLAN and via LTE, was required. Thus, relatively static information with large amounts of data ⬚ such as commercials, etc. ⬚ can be transmitted and buffered as long as the bus is at the depot and connected to the Wi-Fi network. In contrast, information that changes quickly can be transmitted via LTE while driving. And since public transport on the border areas is often transnational, developers need to be able to use two SIM cards in order to make it possible to use the ideal data plan at all times. The router TK815L-EXW meets all these requirements: It offers dual SIM and can be used as a WLAN access point or client. M.Eng. Guido Reinartz, Project Manager DACH at IVU adds: „An essential decision criterion for the use of the Welotec TK router in specific applications was that the router is one of the few E1 certified on the market. This is an absolute must for our customers in public transport as it is clear that our router is up to the difficult mechanical and electrical requirements in the bus. The router's firmware has also been adapted to the specific Wi-Fi customer requirements. Also compelling for us was the attractive price compared to competitors' products. „

Networked communication also offers public transport users several advantages: information on actual arrival times of buses and trains, the possibility of using real-time data to plan alternative routes, the purchase of digital tickets or cashless payment and infotainment solutions are just a few examples. For this to work, it is important to build a suitable infrastructure. Buses and trains not only have to „know" where they are, but also have to transmit this information to a control center, anytime, anywhere. This requires solutions that can be retrofitted quickly and with little effort in an entire fleet and can interact flexibly with existing control systems. The requirements for the communication modules used for outdoor and mobile applications are high.

Like so many other things, our cities in the 21st century are becoming „smarter" with the buzzword, „Smart City." In growing cities, more and more people and vehicles are on the move. This not only leads to a logistical challenge in traffic control but also in local public transport, which can only be solved in a timely manner with intelligent and secure software systems. Here, the experts for smart software and hardware solutions from IVU based in Berlin help transport companies and cities master these challenges. With several of the company's products, it is possible to plan, optimize and control the use of buses and trains, inform passengers in real time, create routes for parcel delivery and assist chain operators in their choice of location.

M.Eng. Guido Reinartz, Project Manager DACH at IVU: „The mechanical and electrical requirements for components used in public transport vehicles are very high. The TK routers meet these requirements by default."
(Source: IVU)

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LTE-IPC with audio output for fixed passenger information

However, the passengers not only want to be informed on board the buses and trains, but also already while waiting at for public transport. Studies have shown that dynamic passenger information is perceived by users as a significant service improvement. Travelers who know how long they have to wait, experience the waiting time subjectively as significantly shorter. As a result, many public transport companies are gradually equipping their passenger information systems at their stops. The specialized solution IVU.realtime helps here. Of course, these fixed passenger information systems must communicate with a central control room. Since the laying of cables for data transmission makes sense in very few cases, the use of mobile communications is recommended here.

Also in these stationary applications, given the very limited installation area, compact dimensions were therefore a prerequisite. A key requirement was that the solution used should be a stable communication platform and work reliably despite temperature fluctuations between summer and winter as well as day and night. Even visually impaired passengers were taken into consideration. They should be informed by voice announcements. This required a corresponding audio connection at the IPC.

Welotec was able to offer a suitable solution for this. Our IPC system, Arrakis-LTE-Mk2, demonstrates its advantages in this application. This fanless industrial PC comes with a built-in LTE chipset along with Intel Atom E3845 CPU with a maximum clock frequency of 1.91 GHz with 4 CPU cores. Various interfaces facilitate integration. The IPC operates reliably at ambient temperatures between -20 ° C to +70 ° C with humidity of 5 to 95%. Many of the above requirements are already met by the IPC. When individual adjustments were necessary; such as the additional audio output, Welotec responded quickly and flexibly. Because it is important for us to be able to offer the right communication solution for every application.

Communication Solutions for Smart City

The applications described are just a small part of Smart City's big vision. In general, we understand the term to mean all concepts that help make cities more efficient, ecological and progressive. For this reason, we also develop solutions for traffic light control systems and parking guidance systems as well as for point of sale (POS) applications. Thanks to our know-how gathered over the years in the field of wireless communication, we offer not only the right components but also complete expert advice. When choosing the appropriate mobile radio router or IPCs; for example, the decision for the right antenna - be it for mobile or stationary applications - is a key factor to "success" for a wireless communication application. Here, users benefit from our many years of practical experience in the field of communications. IVU is not only convinced by the Welotec products, but also by our service. Reinartz is pleased: „The cooperation is extremely pleasant. The commitments made are absolutely reliable. The devices are available on short notice and service requests are answered in a qualified manner.

Benefit from our many years of experience with redundant communication networks: Together with you, we develop a complete solution that is tailored to your needs.

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/CERTIFICATIONS

Certifications, such as ECE certification, are the essential thing for operators and system integrators, especially for the on-track sector; i.e. within buses and trains. These certifications prove that the products are suitable for the challenging application in traffic vehicles. In addition to the vibration resistance of the individual components, the temperature range, the electromagnetic compatibility and other technical details are examined, which aim at the longevity and the robustness of the components.

With numerous customer applications both in buses and trains as well as in stationary applications, we have a broad portfolio of certified LTE routers and public transport antennas.

In addition to some „standard" certifications such as the CE mark or approvals for different countries and regions, there are two main test marks for the public transport sector: the ECE test mark and the EN 50155 standard. Our TK800 routers meet all the requirements for the challenging use in on-track applications, which we underline with the relevant certifications.

ECE test mark
The ECE certification mark, also known as E-mark, agreed by the Economic Commission for Europe (ECE) is a certification of components and assemblies of motor vehicles. Controller and communication hardware must meet the specific needs of mobile applications. Strong and consistent vibrations, voltage fluctuations or extreme temperature fluctuations make the use of electronic components difficult. Only robust devices such as the TK800 Router can be used here. To ensure the suitability, the router received the ECE certification.

EN50121-3-2 & EN50155
In rail vehicles, the stresses of the individual components are even higher while fire protection regulations must also be complied with. In order to meet these requirements, equipment used in rail vehicles must comply, among others, with the EN 50155 standard. Some models of the TK800 series have therefore undergone extensive testing to prove their suitability for rolling stock.

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/ 4G LTE

LTE for maximum network coverage

The TK800 series routers are available in both LTE and UMTS versions. With LTE, the fourth-generation mobile standard, you can achieve higher speeds and lower latencies. However, the more important thing is the better network coverage, especially in rural areas, by the providers. The use of diversity or MIMO antennas also ensures better reception and higher data throughput rates.

All routers are downward compatible to the mobile radio standard. Thus, the LTE / 4G variant supports 3G (HSPA +, HSUPA, HSDPA, UMTS) and 2G (EDGE, GPRS, GSM). If the network with the highest standard is not available or the reception is too weak, the system automatically switches to the next best network.

Higher availability through Dual-SIM

With two SIM cards from different mobile service providers, you can increase the availability of your application. When a provider's network becomes unavailable, the router automatically switches to another network using the second SIM card. Vehicles that require a change from one cell to another (roaming), therefore benefit from dual-SIM. But even in rural areas with less network coverage, the use of a dual-SIM LTE router increases availability.

Dual APN - Separation of Data

Two virtual networks within the mobile network; each with its own IP address space can be a separation of different data. Dual-APN significantly increases security when communicating with multiple users via a router. For example, the operator of a passenger information system can access this system exclusively, even if further applications such as ticketing systems or video surveillance systems are connected to the router.

CELLULAR CHARACTERISTICS	
Chipsatz	Cinterion PLS8-E*
Frequency GSM/GPRS	900 / 1800 MHz
Frequency UMTS	900 / 1800 / 2100 MHz
Frequency LTE	800 / 900 / 1800 / 2100 / 2600 MHz
Frequency bands LTE	1, 3, 7, 8, 20
Authentication	CHAP / PAP / MS-CHAP / MS-CHAP2
Cellular antenna connector	2x SMA (f)
APN functions	APN (Access Point Name), VPDN (Virtual Private Dialup Network, IP VPN of the network operator)
Dial On Demand	Always online or dial, SMS or local data transfer
SMS functions	Reboot and Status SMS
SIM card slots	2

* The TK800 LTE routers are also available with other mobile modules for worldwide use

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WI-FI CHARACTERISTICS	
IEEE 802.11b	11 Mbps
IEEE 802.11g	54 Mbps
IEEE 802.11n	150 Mbps
IEEE 802.11i	WPA / WPA2 / TKIP / PSK / AES / CCMP
WEP	64-bit / 128-bit encryption
Access Point Modus	Yes
Client Modus	Yes
Antenna connector	2x Reverse Polarity SMA (f)

/ GPS

Positioning Systems

For some applications, a precise position of the vehicle is needed. For example, a self-sufficient passenger count requires the position data in order to allocate the number of passengers to or from the individual stops. The GPS signal can also be used to create an accurate timestamp. Some models of the TK800 series therefore have a GPS chipset.

In addition, the so-called dead reckoning can be used when the GPS reception fails, for example in tunnels or under roofs. An acceleration sensor on the GPS module and the last known GPS position are used to calculate the current location of the vehicle. This is a decisive advantage, especially in densely built-up large cities as it ensures precise determination of the coordinates of the vehicle. The two maps show the differences in a densely built-up city. In the picture on the left you can see the positioning via a normal GPS chipset without dead reckoning, while in the picture on the right, the positioning with dead reckoning is much more accurate, since not only the GPS signal is used.

Ohne DeadReckoning
Bild: ©OpenStreetMap

Mit DeadReckoning
Bild: ©OpenStreetMap

/ WI-FI

Data Transfer at the Depot

The TK800 routers are LTE routers that are used in buses for different purposes. In addition to the LTE interface, the routers also have a WLAN access point, which allows maintenance personnel to access the connected IT devices. This means, a data transfer at the bus depot can be carried out. For example, the contents of the infotainment system can be uploaded at night at the bus depot via the WLAN interface without taking up the data volume of the SIM card.

IEEE 802.11b/g/n

The LTE WIFI routers support the WIFI standard IEEE 802.11b / g / n with WPA2 encryption and can be operated as a WIFI client or WIFI access point. In client mode, the router can dial into the internet via a WIFI access point, in which case the LTE mobile connection can be used as a backup link. Used as a WIFI access point, the router can be connected to the WAN network via LTE or wired.

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/ INTERFACES

Ethernet Connectivity

The Ethernet interfaces are used to connect different subsystems in buses. These can be; e.g. cameras, ticketing systems, on-board computers or infotainment solutions. In the future, Ethernet connectivity in buses will become more and more important due to EN 13149 and the resulting communication concepts like ITxPT or VDV 301.

The TK800 LTE Router is available in different hardware versions. For smaller applications, the version with two Ethernet ports is commonly sufficient. For applications that require higher connectivity, the version with integrated 5-port Ethernet switch is provided. In all versions, the ports are designed as Fast Ethernet RJ45.

Serial Interfaces

Older, existing components can be connected via the serial RS-232 or RS-485 interface. This allows existing devices to continue to use and increase the cost of retrofitting.

Digital Inputs and Outputs

Other interfaces include a digital input and a relay output. For example, with the relay output, the heating systems, air conditioners or other devices inside the bus can be turned on at the depot via a remote access even before operation. Therefore, the transport vehicles are ready before the route starts.

Via SMS commands or integrated logic within the router, the digital output can be controlled accordingly. Sensors, such as a door sensor, can be connected via the digital input. The serial interface can also be used to integrate additional sensors or I/O.

SERIAL INTERFACES	
Amount	2
Type	RS-232, RS-485
Serial interface	TXD, RXD, GND,
A(RS-485+), B(RS-485-)	Client
Connector	Terminal blocks 5-pin (m)
Baud rate	1200 - 115200 bps
Additional protocols	Transparent TCP, Virtual COM, Modbus TCP / RTU, IEC 60870-5-101 / 104

ETHERNET INTERFACES	
Connectors	5x RJ45 Port 10/100TX (thereof 1 WAN)
WAN-Port	1 Port (RJ45)
VLAN	dot1q

OTHER INTERFACES	
Console Port	1x RJ45 Console Port (RS-232)
I/Os	1x Digital Input, 1x Relay Output

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/ VPN

Flexible VPN Options
Stable VPN connections are very high in the catalog of requirements of most public transport companies or similar. In the details, however, the requirements differ. The TK800 series has many VPN options and thus adapts perfectly to your IT concept.

OpenVPN
OpenVPN is a free software for building a Virtual Private Network (VPN) via an encrypted TLS connection. For encryption, the library OpenSSL is used. OpenVPN uses either UDP or TCP for data transport.

IPsec
The TK800 LTE routers support Internet Protocol Security (IPsec) site-to-site VPN and Internet Key Exchange (IKE) protocols in the IKEv1 & IKEv2 versions.

Dynamic Multipoint VPN (DMVPN)
With Dynamic Multipoint VPN (DMVPN), you can create scalable IPsec Virtual Private Networks (VPNs) with centralized architecture. In large networks, you can also significantly simplify the implementation and its administration.

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/ SECURITY

Firewall
The TK800 series has a built-in firewall with high security requirements. In addition to Stateful packet inspection (SPI), the router also supports access control lists, intrusion protection IP / MAC binding and much more.

Authentication, Authorization and Accounting (AAA)
Highest security with intelligent AAA management. The device is able to use local and server-based AAA solutions such as TACACS +, RADIUS and more for authentication.

Next Generation Encryption (NGE)
Next Generation Encryption incorporates the best cryptographic algorithms in security and scalability that can be implemented today to ensure network security over the next few years. TLS1.2 with PFS, AES 256, AES 384, IKEv2, and SHA256 provide the LTE TK800 series Router with the strongest security standards for IT infrastructures.

CRYPTOGRAPHY		
Algorithm	Function	Type
SHA-256	Integrity	Next Generation Encryption
SHA-384	Integrity	Next Generation Encryption
SHA-512	Integrity	Next Generation Encryption
HMAC-SHA-256	Integrity	Next Generation Encryption
EDCH-384	Key exchange	Next Generation Encryption

NETWORK CHARACTERISTICS	
Routing	Static routes and dynamic routes with RIP or OSPF
Network protocols	ICMP, TCP, IP, UDP, DHCP, SNTP, DNS, HTTP, HTTPS, Telnet, ARP, VRRP, PPP, SSH
Connection inspection	PPP LCP Echo / ICMP Keep Alive / IP SLA / tracking for checking connections
NAT and PAT	Network Address Translation (NAT) / Port Address Translation (PAT)
DDNS (DynDNS)	Supports Dynamic DNS
VRRP	Automatically switch to slave router if the master router fails
IPsec	Tunnel mode, Transport mode, DMVPN
OpenVPN	Server and Client
GRE	Point-to-Point, GRE over IPSec, GRE network to network, GRE IP to IP
VPN authentication	Preshared key, digital certificates
Firewall	Stateful Packet Inspection (SPI), ACLs
Access control	ACLs, RADIUS, TACACS+, LDAP
Realtime clock	NTP Server / NTP Client

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DEPLOYMENT SERVICE

SMART EMS

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Central commissioning and administration of routers

Do you want to deploy industrial routers in a large number of remote locations? How should the initial configuration be installed on the routers? What happens if the devices need a new configuration or firmware? Configuring all devices individually on the spot is not an efficient option.

A quick reaction in case of a security-critical firmware update is also important in order to be able to deal with security incidents quickly and effectively. This is where the Welotec SMART EMS comes together with the TK800 routers.

The Welotec SMART EMS is a provisioning and management system for all TK800 routers. The SMART EMS enables secure roll-out and central maintenance of TK800 routers. Configuration and maintenance of the devices on site is no longer necessary.
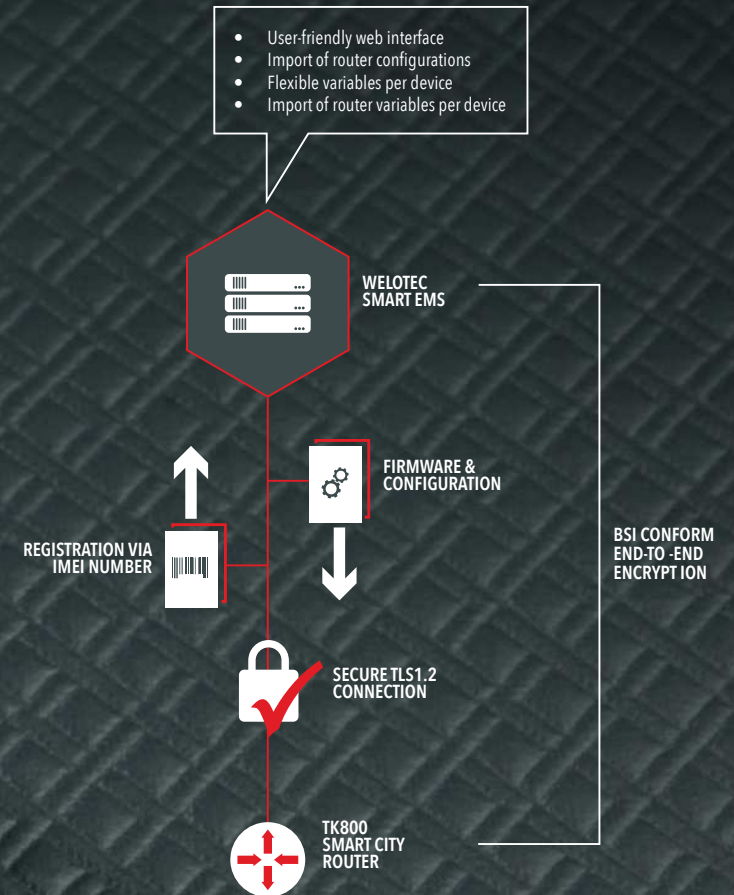
All Advantages at a glance:

- Reduces costs for on-site installation, maintenance and service
- No on-site configuration required
- Automatic and secure roll-out of firmware updates
- Template-based configuration of routers

WELOTEC® Service Plus

We make your rollout even as easy as possible. The router only needs to be connected to an antenna. we do the rest for you!

- Delivery of pre-configured routers
- Equipping with SIM card
- Bundeling with antenna and power supply
- Generation of customer-specific labels with additional information
- Flexible warranty extension
- Generation of electronic delivery notes
- Extended support for setup and configuration
- Antenna training

- User-friendly web interface
- Import of router configurations
- Flexible variables per device
- Import of router variables per device

WELOTEC SMART EMS

FIRMWARE & CONFIGURATION

REGISTRATION VIA IMEI NUMBER

BSI CONFORM END-TO -END ENCRYPT ION

SECURE TLS1.2 CONNECTION

TK800 SMART CITY ROUTER

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/SOFTWARE

Connection and application supervision

High availability of the connection and thus also the reliability of the application is guaranteed by extended watchdog, connection and application monitoring functions:

- Embedded hardware watchdog for automatic system recovery in case of errors
- PPP Layer Detection - Checking the mobile phone connection
- Network Scan (ICMP) - Internet and Network Connection Scan
- VPN tunnel verification for a reliable VPN connection
- VPN Tunnel End-to-End Monitoring (ICMP) - For verifying the data connection in the VPN tunnel
- Functions and interfaces can be switched off to harden the system

SOFTWARE EIGENSCHAFTEN	
Configuration	Webbrowser, Telnet, SSH und Serial Port, DS800 Management Software
Updates	Webbrowser, Serial Port, TFTP, FTP, SMART EMS Management Software
ERWEITERTE FUNKTIONEN	
Watchdog	Software and Hardware Watchdog
LED	LED display for signal strength, 8 Status LEDs: POWER, STATUS, WARN, ERROR, Modem, 2x SIM, VPN

Configuration via Web and CLI

An intuitive web interface is available for configuring the TK800 routers. Network administrators, on the other hand, usually prefer the text file-based configuration in the CLI (command-line interface). The CLI of the TK800 series makes experienced network administrators immediately feel at home.
#admin love cli config
#admin love cli config

- Webbrowser
- CLI (Telnet, SSH and Serial Port)
- Deployment Service - SMART EMS

Fully IPv6 compatible

Large projects must have investment security. To ensure future security, we have implemented the first full IPv6 implementation in the field in cooperation with the major mobile network operators and a module manufacturer. The result of these efforts is an IPv6 router via LTE including SLAAC, DHCPv6 and DHCPv6-PD is supported.

Python applications

User-specific scripts can be stored in the TK800 Router to enable signal processing in the router. For example, data from a passenger counting sensor can be acquired via the serial interface, written to a csv file together with the GPS system position data, and this csv file can then be sent to a server via FTP via the LTE network. With the development environment, you can easily implement the pre-processing of signals in the field, the so-called EDGE computing, and thus enable simple standalone applications without the need for a controller or the like.

```
#loopback config
interface loopback 1
    ip address 127.0.0.1 255.0.0.0
!
!
#ethernet interface config
interface fastethernet 0/1
    track 12-state
    ip adress dhcp
!
!
#Ethernet sub interface config
!
#switch virtual interface config
interface vlan 1
    ip address 192.168.3.1 255.255.255.0
!
interface vlan 1
    ip address 192.168.2.1 255.255.255.0
!
!
!
#ethernet config
interface fastethernet 0/1
!
interface fastethernet 1/1
    switchport access vlan 2
!
interface fastethernet 1/2
    switchport access vlan 2
!
interface fastethernet 1/3
!
interface fastethernet 1/4
!
```

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/HARDWARE

Rugged Metal Housing

According to your industrial requirements, the electronics are built into high-quality metal housings in order to effectively protect the devices from external influences. The operating temperature range from -25°C to +70°C allows use in demanding and harsh environments. The TK800 is also highly electromagnetic compatible to EN61000-4, making it ideal for use in challenging industrial environments. The LTE router has a DIN rail mounting bracket on the rear for mounting in the control cabinet.

High MTBF Times

Specially selected components and effective thermal management enable long MTBF (Mean Time Between Failures) times in the field and a long service life, thus guaranteeing higher reliability and low maintenance costs.

EMC CHARACTERISTICS	
EMC	ECE-R10 Annex 7,8,9,10 EN 50155 / EN 50121-3-2
ESD	EN 61000-4-2, Level 4
Over-voltage protection	EN 61000-4-5, Level 3
EFT	EN 61000-4-4, Level 4
RF	EN 61000-4-3, Level 4
RC	EN 61000-4-6, Level 3
Steamed oscillation strength	EN 61000-4-11, Level 3

| SUPPLY VOLTAGE	
Supply Voltage	12 - 48 V DC
Connector	Connection terminals 2-pole (m)
Power Consumption Standby	3.8 W
Power Consumption active	5.3 W

PHYSICAL CHARACTERISTICS	
Housing Material	Metal
IP - Certification	IP30
Dimensions (W x H x D)	45 x 132.6 x 112.8 mm
Weight	600 g
Mounting	DIN rail

ENVIROMENTAL CONDITIONS	
Operating Temperatur Range	-25 - +70 °C
Storage Temperature Range	-40 - +85 °C
Humidity	5 - 90 %, non-condensing
Shock	IEC 60068-2-27
Free Fall	IEC 60068-2-31
Vibration	DIN EN 61373, Category 1, Class B, IEC 60068-2-6
Fire Protection	DIN EN 45545-2 conform

Fire Protection

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/ DIMENSIONS
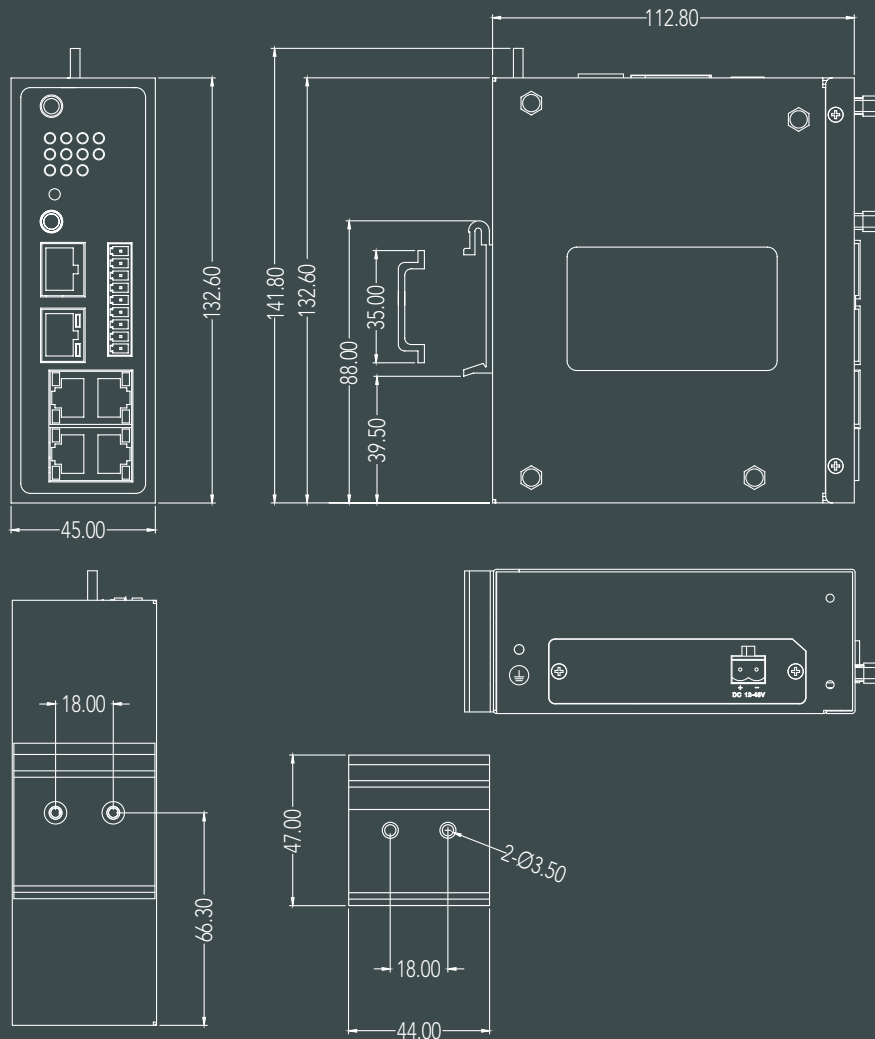
/ MODEL OVERVIEW

Router for Smart City

MODEL	ETHERNET PORTS	WLAN	RS232	RS485	GPS	CELLULAR	REGION	VERSION	LTE BAND	CERTIFICATION
TK812L	2					LTE	EU	Standard Version	1,3,7,8,20	CE, E-Mark
TK815L-EXW	5	x	x	x		LTE	EU	Standard Version	1,3,7,8,20	CE, E-Mark
TK815L-EX0	5		x	x		LTE	EU	Standard Version	1,3,7,8,20	CE, E-Mark
TK815L-EGW	5	x	x	x	x	LTE	EU	Standard Version	1,3,7,8,20	CE, E-Mark
TK872L	2					LTE	EU	IPv6 Version	1,3,7,8,20	CE
TK875L-EXW	5	x	x	x		LTE	EU	IPv6 Version	1,3,7,8,20	CE
TK875L-EX0	5		x	x		LTE	EU	IPv6 Version	1,3,7,8,20	CE
TK875L-EGW	5	x	x	x	x	LTE	EU	IPv6 Version	1,3,7,8,20	CE
TK882L	2					LTE	Global	Export Version	1,2,3,4,5,7,8,20	CE
TK885L-EXW	5	x	x	x		LTE	Global	Export Version	1,2,3,4,5,7,8,20	CE, RCM (Australien)
TK885L-EX0	5		x	x		LTE	Global	Export Version	1,2,3,4,5,7,8,20	CE, RCM (Australien)
TK885L-EGW	5	x	x	x	x	LTE	Global	Export Version	1,2,3,4,5,7,8,20	

Further Routers of the TK800 Series

The TK800 routers are available in many other versions for worldwide use. This list gives you an overview of the possible variants. Pure WAN routers are also possible.

MODEL	ETHERNET PORTS	WLAN	RS232	RS485	GPS	CELLULAR	REGION	LTE BAND	CERTIFICATION
TK802U	2					UMTS	EU	-	CE, E-Mark
TK805W-EXW	5	x	x	x		-	Global	-	CE, UL, FCC, cUL, IC
TK805W-EX0	5		x	x		-	Global	-	CE, UL, FCC, cUL, IC
TK822L	2					LTE	China	1,3,5,7,8,38,39,40,41	CCC*
TK825L-EXW	5	x	x	x		LTE	China	1,3,5,7,8,38,39,40,41	CCC*
TK825L-EX0	5		x	x		LTE	China	1,3,5,7,8,38,39,40,41	CCC*
TK825L-EGW	5	x	x	x	x	LTE	China	1,3,5,7,8,38,39,40,41	CCC*
TK832L	2					LTE	USA (AT&T), Canada	2,4,5,17	UL, FCC
TK835L-EXW	5	x	x	x		LTE	USA (AT&T), Canada	2,4,5,17	UL, FCC
TK835L-EX0	5		x	x		LTE	USA (AT&T), Canada	2,4,5,17	UL, FCC
TK835L-EGW	5	x	x	x	x	LTE	USA (AT&T), Canada	2,4,5,17	UL, FCC
TK842L	2					LTE	USA (Verizon)	-	UL, FCC
TK845L-EXW	5	x	x	x		LTE	USA (Verizon)	-	UL, FCC
TK845L-EX0	5		x	x		LTE	USA (Verizon)	-	UL, FCC
TK845L-EGW	5	x	x	x	x	LTE	USA (Verizon)	-	UL, FCC

*Pending

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/ ANTENNAS

Smart City Antennas

Radio technology is just as good as the antenna that receives or transmits the radio signals. In many cases, the antenna technology is neglected and would be considered at a later stage during the project planning.

Nowadays, public transport companies are faced with very specific challenges: they have to deal with a larger volume of passengers, improve the efficiency and safety of the system and reduce operating costs - all with fewer and fewer resources.

A reliable wireless network that supports data, voice and video transmission provides an effective solution. Robust antennas are essential components in this network architecture. Antenna technologies are designed to significantly increase the volume and speed at which data is transmitted while improving connections to the central network over LTE, Wi-Fi and GPS / GNSS networks.

WELOTEC° Service Plus

Benefit from our experience with antennas for critical infrastructures. Welotec not only offers you the hardware, as a solution provider, we take on further services for our customers:

• Antenna trainings
• Antenna consulting
• Development of customized OEM antennas
• Large antenna portfolio including MIMO antennas
• Individual cable lengths and connections
• Suitable accessories such as adapter cable and lightning protection

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/MIMO ANTENNA
VEHICLE ANTENNA FOR ROOF MOUNTING

Roof mounting

By now numerous antennas can be seen on many buses. Each application has its own antenna; for example, GPS, LTE, TETRA or WLAN antennas. The large number of antennas makes mounting, maintenance and spare parts management unnecessarily complicated and expensive.

The solution is the so-called multi-band antennas which combine different antennas in a single housing. Different antenna modules can be combined almost arbitrarily. For example, we offer an antenna with two LTE modules, a GPS module and WLAN modules, which then has a total of five antenna connections. This not only simplifies mounting, but also ensures efficient spare parts management and thus lower costs for equipment, operation and maintenance. In addition, the tuning behavior and the external appearance of a vehicle is improved by the coordination between each individual antenna elements.

GPSHPDLTEMIMO-SF	
Antenna type	Multiband Antenna, outdoor/indoor
Frequency ranges LTE / LTE bands	698 – 960 MHz, 1710 – 2700 MHz / LTE bands 3, 7, 8, 20, 28
Frequency ranges GSM/GPRS/EDGE	850, 900, 1800, 1900 MHz
Frequency ranges WIFI	2400 - 2500 / 4900 - 5900 MHz
Frequency ranges GPS	1575.42 MHz
GNSS bands	GPS L1
Antenna gain / VSWR	2.5 dBi (LTE) / 3 - 4 dBi (WIFI) / <2.0
Antenna connector	Up to 5 connectors
Connecting cable	5 m cable
Mounting	¾" thru-hole

| ORDERING INFORMATION	
Article number	Connectors
GLHPDLTEMIMO-SF	2x SMA (m) for LTE / 2x RP-SMA (m) for WLAN / 1x SMA (m) for GPS
GLHPDLTEMIMO-SF-MM	2x SMA (m) for LTE / 2x RP-SMA (m) for WLAN / 1x SMA (m) for GPS (magnetic foot)

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Multiband frequency coverage
One antenna, all frequencies, maximum flexibility!

LTE (4G) Frequency - 2.5 dBi
698 - 960 MHz
1710 - 2170 MHz
2300 - 2700 MHz

WIFI Frequency - 3.5 dBi
2400 - 2500 MHz
4900 - 5900 MHz

GPS Frequency (GPS L1)
1575,42 MHz
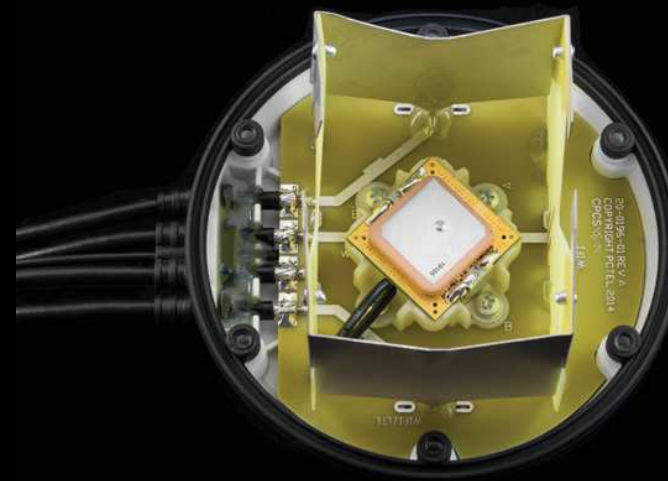
Integrated GPS Preamplifier
High performance GPS assembly for a high standard of suppression of external interference, offering excellent quality in multi-band applications.
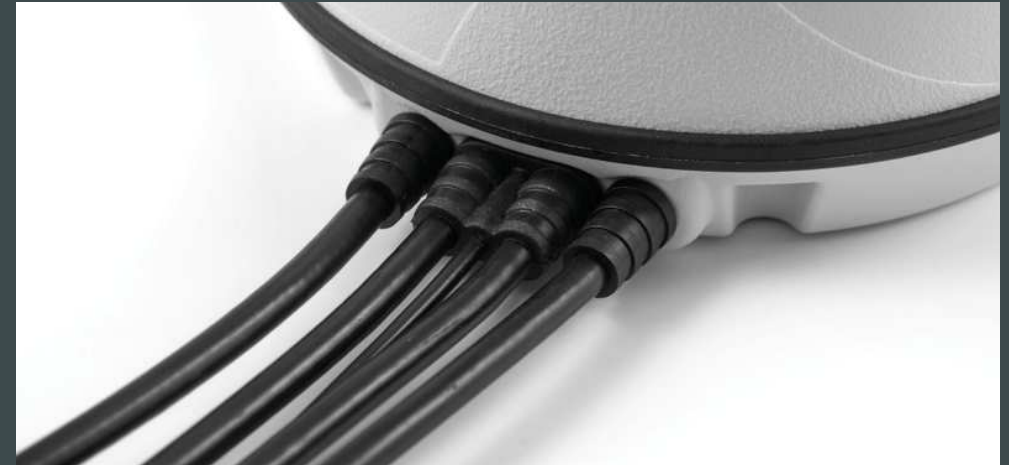
Two mounting options
Magnetic foot
Powerful internal magnets simplify erection on metal surfaces. The rubber pad on the underside of the antenna prevents slippage and also protects the surface below.

Straight coupling
One inch bushing insulator with slotted locking nut for straight coupling. The thermoplastic elastomer insulation fits admirably even on contoured surfaces and so gives protection to the IP67 standard.

High-quality cables and connectors for low loss of signal and maximum system performance
ECE-R 118 directive regulates the flammability of materials in passenger vehicles. Even with external antennas, the antenna cables must be tested according to ECE-R 118. All antenna cables here are tested for the use in vehicles according to ECE-R 118 (ISO 14572: 2011-10 § 5.21 / UN / ECE-R118: 2015-04 § 6.2.6).

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WAO-GUL0K-2CXXX-SMAMW

WAO-GUL0L-2C000-SMAM0

Plug-on antenna for direct installation on the device
Plug-on antenna with angle element (180° rotatable, 90° angled) for direct mounting on the router, e. g. inside a (plastic) control cabinet.

WAO-GUL0L-2C000-SMAM0	
Antenna type	Plug-on antenna, indoor
Frequency ranges LTE / LTE bands	698 – 960 MHz, 1710 – 2700 MHz / LTE bands 3, 7, 8, 20, 28
Frequency ranges GSM/GPRS/EDGE	850, 900, 1800, 1900 MHz
Antenna gain / VSWR	2dBi / <2.5
Antenna connector	SMA (m)

Adhesive antenna for mounting inside a switch cabinet
PCB adhesive antenna for mounting inside a (plastic) switch cabinet. Easy Installation due to adhesive Pads.

WAO-GUL0K-2CXXX-SMAMW	
Antenna type	Adhesive antenna, indoor
Frequency ranges LTE / LTE bands	698 – 960 MHz, 1710 – 2700 MHz / LTE bands 3, 7, 8, 20, 28
Frequency ranges GSM/GPRS/EDGE	850, 900, 1800, 1900 MHz
Antenna gain / VSWR	2dBi / <2.2
Antenna connector	SMA (m), 90° angled

ORDERING INFORMATION	
Article number	**Connection cable**
WAO-GUL0K-2C030-SMAMW	0.3 m cable
WAO-GUL0K-2C100-SMAMW	1 m cable
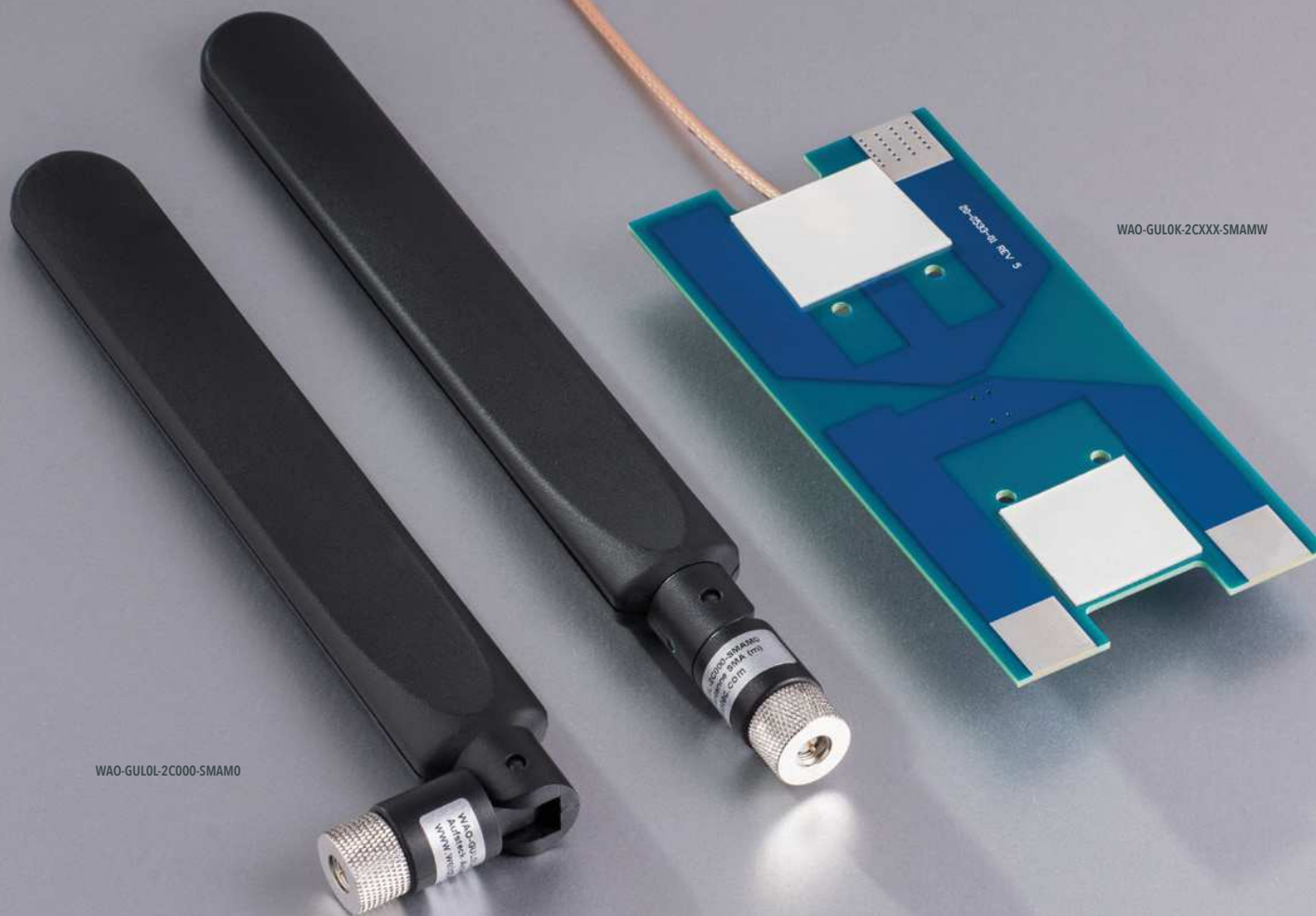
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/LTE ANTENNAS
MOUNTING OUTSIDE
A SWITCH CABINET

Antenna for control cabinet mounting by screw connection, magnetic base or wall bracket

Available with different cable lengths, as well as with magnetic base or vandal-proof mounting on the control cabinet.

WAO-GUL0D-3CXXX-SMAM0	
Antenna type	Control cabinet antenna, outdoor/ indoor
Frequency ranges LTE / LTE bands	698 – 960 MHz, 1710 – 2700 MHz / LTE bands 3, 7, 8, 20, 28
Frequency ranges GSM/GPRS/EDGE	850, 900, 1800, 1900 MHz
Antenna gain / VSWR	3dBi / <2.5
Antenna connector	SMA (m)

ORDERING INFORMATION	
Article number	Connection cable
WAO-GUL0D-3C000-NF000	without cable N (f)
WAO-GUL0D-3C300-SMAM0	3 m cable SMA (m)
WAO-GUL0D-3C500-SMAM0	5 m cable SMA (m)
WAO-GUL0D-3C750-SMAM0	7.5 m cable SMA (m)
WAO-GUL0D-3C999-SMAM0	10 m cable SMA (m)
WA-Mount-NF-1	Wall mount angle
WA-Mount-NF-2	Wall and pole mount angle

WA-Mount-NF-2

Connection cable SMA (m)
3, 5, 7,5 or 10 meter

WAO-GUL0D-3C000-NF000

WA-Mount-NF-1

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/LTE ANTENNAS
MOUNTING OUTSIDE
A SWITCH CABINET

LTE Antenna for metal control cabinets

Easy to install LTE antenna with flexible mounting options for metal cabinets. Due to its high performance and benefits, this antenna offers optimal results, especially in difficult reception conditions.

WAO-GUL0X-3CXXX-SMAM0	
Antenna type	Control cabinet antenna, indoor
Frequency ranges LTE / LTE bands	698 – 960 MHz, 1710 – 2700 MHz / LTE bands 3, 7, 8, 20, 28
Frequency ranges GSM/GPRS/EDGE	900, 1800, 1900 MHz
Antenna gain / VSWR	3.2dBi / <2.0
Antenna connector	SMA (m)
Mounting	Adhesive pad, magnet, cable ties, screws

ORDERING INFORMATION	
Article number	Connection cable
WAO-GUL0F-3C300-SMAM0	3 m cable
WAO-GUL0F-3C500-SMAM0	5 m cable
WAO-GUL0F-3C750-SMAM0	7.5 m cable
WAO-GUL0F-3C999-SMAM0	10 m cable

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WIFI ANTENNAS
MOUNTING OUTSIDE A SWITCH CABINET

Ideal for control cabinets and housing
Ground plane independent dual-band antenna (2.4 GHz & 5 GHz) in a rugged and flat housing for indoor and outdoor installations. The cone-shaped housing helps protect the antenna from dust, dirt or other interfering influences. The antenna has protection rating of IP67 and is connected with a TNC connector. The antenna is best mounted through a ¾ inch hole in the control cabinet or on the roof of motor vehicles. With a 60cm ground plane, the antenna gain can be increased from 3 dBi to 3.5 dBi.

WLP2458NGP	
Antenna type	WIFI, outdoor/indoor
Frequency ranges WIFI	2400 - 2500 / 4900 - 5900 MHz
Antenna gain / VSWR	3 dBi / <2.0
Antenna connector	TNC (m)
Mounting	Bolt mount

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/ INDUSTRIAL COMPUTER

Smart City Industrial Computer

Smart cities promise people many benefits. From intelligent parking guidance systems via the networking of public transport to the energy-efficient control of private transport, many data are to be collected and processed here in order to make life in the city more pleasant.

Fast and reliable data processing therefore plays a central role in the city of the future in collecting, analyzing and using this information, often under adverse environmental conditions. Industrial computers are therefore also the ideal smart city computers for permanent use at stops, video surveillance or controlling charging stations for e-mobility.

Reliability at all levels of information processing is a key element to the success of livable cities and communities, and our Smart City computers provide the ideal platform for projects in the world of tomorrow.

WELOTEC Service Plus

Benefit from our experience with industrial computers for critical computing applications. Welotec offers you not only the hardware and connectivity, but solutions tailored to your project:

• Project and customer-specific hardware solutions
• IPC consulting
• Extensive selection
• Individual configurations and scope of delivery

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/ INDUSTRIAL COMPUTER
FOR BUS & RAILWAY APPLICATION

The compact IPC for the use in IoT and security platform
The compact IPC for the use in IoT and fanless industrial DIN Rail Security Platform for the use in rail and road vehicles. Despite its compact dimensions, it offers very flexible I/O options. Arrakis MAX-2235 is also ideally suited for video surveillance tasks due to its 4x PoE LAN ports and can be equipped for remote access via LTE and Wi-Fi.

ARRAKIS-MAX-2235	
Type	Embedded PC for Bus and Railway Applications
CPU	Intel Core i Dualcore
RAM	4 GB
Storage	1x 2.5 Inch / 1x mSATA
Ethernet LAN	1x Gigabit RJ45
Ethernet PoE	4x 802.3af RJ45
COM-Ports	1x RS-232 / 1x RS-485
USB	3x
CAN-Bus	Optional
Digital I/O	Optional
SIM-Card Slots	1x
Amount simultaneous displays	2
Power supply	9 - 36 V DC
Certificates	CE, FCC, RoHS, E-Mark, EN 50155

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IPC for the use of passenger information systems

Fanless Embedded PC for stationary use; for example, at stops. Due to the existing microphone input and amplifier outputs, the Arrakis MK2 is ideal for the use of a passenger information system with intercom function. With optional integrated WLAN and LTE, the Arrakis MK2 can also be used off-grid and thus provide passenger information panels with updated data at all times.

ARRAKIS MK2	
Type	Embedded PC for Depots and Stops
CPU	Intel Atom Embedded Quadcore
RAM	4 GB
Storage	1x mSATA
Ethernet LAN	2x Gigabit RJ45
COM-Ports	4x RS-232 / Optional 3x RS-422/485
USB	2x
CAN-Bus	Optional
Digital I/O	Optional
SIM-Card Slots	2x
Amount simultaneous displays	1
Power supply	9 - 36 V DC
Certificates	CE, FCC, RoHS

/ INDUSTRIAL COMPUTER
FOR RAILWAY APPLICATIONS

The information center for the train

High performance platform for the use in rail vehicles. The system offers the computing power of the 6th Intel Core-i generation in a compact, fanless housing with an operating temperature range of -40 to + 70 ° C. The 4x PoE connections are particularly vibration-proof as M12 screwed connections, as well as a CAN bus and four isolated digital inputs and outputs are available. With up to four SIM cards and LTE modems, connectivity is also ensured in cross-border rail traffic.

ALDERAMIN-3846	
Type	Embedded PC for Railway Application
CPU	Intel Core i Dual/Quadcore
RAM	up to 32 GB
Storage	2x 2.5 Inch
Ethernet LAN	2x Gigabit RJ45
Ethernet PoE	4x 802.3at M12
COM-Ports	1x RS-232 / 2x RS-232/422/485
USB	8x
CAN-Bus	1x
Digital I/O	4x DI / 4x DO
SIM-Card Slots	4x
Amount simultaneous displays	3
Power supply	8 - 35 V DC
Certificates	CE, FCC, RoHS, EN 50155

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Panel PC for video surveillance tasks
Fanless 10.4", 12.1" or 15" Panel PC for the railway use on Arrakis Max basis. The system combines its strengths with a high-quality touch display. The Saiph series offers very flexible I/O options with vibration-proof M12 cable gland. It is also ideal for video surveillance tasks thanks to its 4x PoE LAN ports. The all-round IP67 protection class, the Saiph series can withstand adverse environmental conditions.

SAIPH-2235	
Type	Embedded PC for Railway Applications
CPU	Intel Atom Embedded Quadcore
RAM	4 GB
Storage	1x 2.5 Inch / 1x mSATA
Ethernet LAN	1x Gigabit RJ45
Ethernet PoE	4x 802.3af RJ45
COM-Ports	1x RS-232 / 1x RS-485
USB	4x
CAN-Bus	Optional
Digital I/O	Optional
SIM-Card Slots	1x
Amount simultaneous displays	2
Power supply	9 - 36 V DC
Certificates	CE, FCC, RoHS, EN 50155
Display size	10 - 15 ZInch

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/ WELOTEC

Your IT partner for the transportation sector

Partnership
Welotec offers you much more than just hardware; we support and develop complete solutions based on our market experience. Working on large projects over long time periods welds together. In this way, customers become partners and both sides benefit from the mutual transfer of know-how. Today, energy suppliers, network operators, metering point operators and energy producers trust in our solutions for the energy industry. Benefit from direct contact persons and competent support in all project phases.

Flexibility
Every project is unique. Our customers and partners therefore appreciate the fact that we make adjustments flexibly and quickly where it is necessary. No matter how big the challenges are, so far we have mastered them all.

- Firmware Adaptations
- Software Development
- Certifications
- Hardware Adaptations
- OEM Development

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