JUNIPER **TK6000** FIELD PC

A VERSATILE, WATERPROOF ULTRA-RUGGED HANDHELD COMPUTER WITH A FULL-FUNCTION KEYPAD

The TK6000, introduced in the fall of 2009, represents another ultra-rugged, no-nonsense handheld computer from Juniper Systems, the Logan, Utah company that specializes in intuitive field computing solutions for rugged applications such as land survey, natural resources, industrial, agriculture and the like. Initially designed for a Juniper Systems business partner (Carlson Surveyor), the TK6000 is a product as much as a mobile platform for OEM solution providers. In this review, we're taking a detailed look at the TK6000 and what it has to offer.

Overall concept and design

Like all Juniper Systems handheld computing and data acquisition products, the TK6000 is all about functionality and getting the job done. Juniper products are never about chrome and style and slender profiles and avant-garde technology. Instead, they are about making tools in the best and most straightforward way, so that they work with you hardly noticing them, and with a very small likelihood that something will break. And if it does, so that it can be fixed easily and inexpensively

Similar to the company's Allegro Field PC, the TK6000 is a substantial "flashlight"-style unit that is large enough to accommodate a full and nicely-sized keypad/keyboard. It's also ergonomically designed with a narrow waist and a balanced weight distribution so that it is easy to carry and operate.

The TK6000 can either be used via touch or stylus, or via its extensive 52-key keypad that offers all the familiar functionality of a standard keyboard. Keys are color-coordinated by function, and there is a large and correctly placed 9-way directional button that can be used instead of, or in conjunction with, the touch screen. ALT, 2nd, CTRL, and Shift are implemented as "sticky keys," providing access to additional functions. All keys provide tactile feedback and the keyboard bezel is removable for cleaning without affecting the seal.

The handle part is also large because it accommodates two high capacity batteries. In the field, you can't afford to run out of battery in the middle of a job, and carrying and replacing batteries is not what you need in what might be critical conditions. So the TK6000's powerful dual battery packs last not just through a full shift, but through several if need be. And you can always carry along a spare or two.

Listening to its customers, Juniper Systems configured the display of the original Allegro computer in landscape format, and the TK6000 is no different. Most PDAs and handhelds use portrait, but the special software and applications used by Juniper customers apparently works better landscape, and so that's what the TK6000 has (and given that virtually all desktop and notebook displays are landscape indicates that this is what we like best anyway).

In contrast to the internal expansion approach taken with the usually factory-configured Allegro, Juniper designed the TK6000 for use with external piggyback screw-on modules. This allows for the ability to add expansion modules post-sale by retailers or end-users. As a result, there is no internal PC Card slot with room for all sorts of add-on cards. This allows for a more slender profile, but at the expense of easy PC Card/CF Card expansion.

Finally, in the field you often need full-size, standard ports, and not tiny little multi-function connectors that require special cables. So the Allegro has not only one, but two full-size standard RS-232 serial ports and a full-size standard USB port. They take a bit more room, but when you need them you need them. And the TK6000's USB port can actually be used with standard USB flash drives—a big potential plus in the field.

As for ruggedness, Juniper Systems usually relies on straightforward common-sense solutions to make things tough, durable and well-sealed. At first sight, the T6000 seems no different, but a closer look reveals an alternate approach at keeping the elements sealed and safe. More on that later.

Meeting all those varied requirements means that the TK6000 is a big handheld computer that's over ten inches long, five inches wide, and an inch and a half thick. The device weighs a bit over about two pounds. That's not much in notebook computer terms, but it makes for a substantial handheld.

Below you can see the TK6000 Field PC from all sides. It's a very ergonomic design with a "Coke bottle" waist that makes it easy to hold the computer and get a good grip. Unlike the otherwise very similar Allegro MX, the display part of the TK6000 is flat and not at a slight angle towards the user. This

makes for a more elegant, streamlined look and feel. The overall design exudes an aura of excellent industrial design, and that includes the subdued but striking light gray/dark gray color scheme.

Display

As mentioned, unlike most handheld terminals that have portrait-oriented displays, the TK6000's is landscape-oriented. It is a transflective TFT LCD with 240 x 320 pixel resolution and measures 3.5 inches diagonally. That is a bit smaller than the Allegro's 3.8-inch color display, but about standard size for this class of machine. The LCD has an adjustable backlight and works even in ultra-low temperatures without a heater.

While 320 x 480 QVGA (Quarter-VGA) resolution has long been a standard for PDAs and Windows CE-based terminals, personally I'd like to see 480 x 640 pixel full VGA resolution. Over the past decade there has been a move towards higher and higher resolution and more screen real estate in notebooks and other Windows machines, and we've all become spoiled by those sharp displays that can simply show more data and certainly come in handy when viewing maps or other GIS data.

This is an issue we've discussed with Juniper before, and they've pointed out some very good reasons for staying with the standard QVGA format.

For one thing, the vast majority of Windows CE and Windows Mobile applications are designed for QVGA. For another, Juniper pointed out that "*in real world outdoor use, eye fatigue can become an issue and that in many cases it can be more important to be able to easily and quickly see critical data on screen, as opposed to higher resolution that may show more detail indoors, but could be hard to distinguish in harsh lighting conditions*." Higher display resolution also requires tradeoffs in processor performance, power consumption, and visibility properties in an outdoor environment. So for now, Juniper felt that "*from our research with our customer base, the current high visibility screens were acceptable*." Fair enough.

It's an interesting issue as screen size preferences do seem to vary with platform; while desktop and notebook computer displays have gotten larger, and those on digital cameras as well, phone displays have actually gotten smaller. As is, QVGA is pretty much the default format for traditional Windows Mobile-based devices, and the same goes for the resistive digitizer used in the TK6000. Resistive technology works best with a stylus (though you can use a fingernail as well), but that may all change with the emerging emphasis on touch and multi-touch.

Processor and other technology

The TK6000 is powered by the 624MHz version of the Marvell PXA270, a tried-and-true processor that is powering millions of handhelds. The TK runs Windows Mobile 6.1 Classic, which remains the version most suitable for vertical market handhelds such as the TK6000. That's because it is, for now at least, the last version of Microsoft's small platforms OS that has the traditional Windows look and feel with a Start button, pull-down menus, and all the icons everyone is familiar with. The latest version for handhelds, Windows Mobile 6.5, has a totally different look and feel that's reminiscent more of the Microsoft Zune music player and it also is far more consumer-oriented (though underneath the new look, things pretty much remain the same). For now, Juniper made the right decision to stay with the older Windows Mobile 6.1.

As far as memory goes, the TK6000 comes with a perfectly adequate 128MB of RAM and a gigabyte of non-volatile internal data storage. This means your data is always safe, even if power should be interrupted.

Graphical user interface

The Windows Mobile 6.1 platform used by the TK6000 may no longer be the latest and flashiest, but it remains a user-friendly operating environment familiar to millions of users. The landscape format makes for a different aspect ratio and so things look a bit different, but many will actually prefer the wider screen format. On the right are some of the major screens you see when using the TK6000.

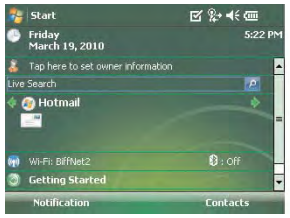
When you turn on the device, you get the familiar Today screen that shows an overview of the current status and provides one-click access to common tasks such as email, calendar, tasks, contacts, wireless settings and so on. The TK6000 also comes with a helpful "Getting Started" tutorial that guides new users through common tasks such as setting up email, setting passwords, setting up a Bluetooth headset, and so on.

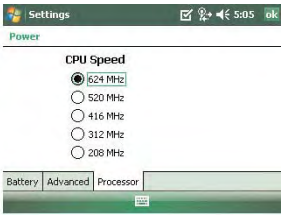
Windows Mobile 6.1 has a Programs folder where most of the application icons are. Some apps, such as the mobile versions of the major Microsoft Office applications, have their own separate folder.

Windows Mobile includes useful utilities such as the Task Manager that shows you active applications and how much memory and CPU capacity they use. Since Windows Mobile cannot display multiple overlapping windows at a time, the Task Manager is also a good way to switch between running applications. The pretty picture to the right illustrates the Pictures & Videos applications, sort of a basic media player that offers one-click access to emailing pictures. You can also zoom in and out, and automatically resize pictures.

Instead of the Windows Control Panel, Windows Mobile has a number of Settings screens, divided into Personal, System and Connections utilities. There are quite a few of them, and some are pretty involved. The Power utility shown on the right lets you select maximum allowable CPU speed. Now there's an idea for Toyota!

The one thing you'll notice when using the TK6000 is that 240 vertical pixels isn't very much and you often wish for more screen real estate, especially when browsing. One gets used to everything, of course, but this is a limitation I found annoying at times, and also one that again made me wish for a full VGA display.

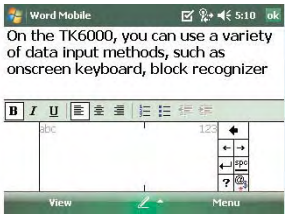


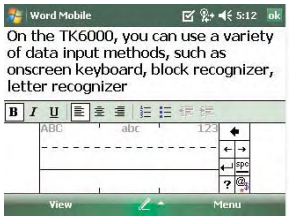


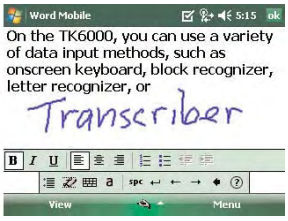
Text entry methods

For data entry, the Windows Mobile-based TK6000 offers a wealth of options. There is the keypad, there is a nice pop-up keyboard, and three are also no fewer than three different ways of recognizing text. The methods are:

- **Pop-up keyboard**, which is a full QWERTY layout designed to be used with the stylus. After a bit of practice, this allows for very fast text entry. The keyboard can also be shifted to display symbols and foreign characters. Basic formatting functions are also always available via menu bar.







- **Block Recognizer**, which uses the Graffiti alphabet Palm invented in the 1990s. The idea here is that almost all letters are "unistrokes," or consisting of a single uninterrupted stroke, which makes them easy to recognize for the computer. The slightly abstracted alphabet is quite easy to learn. Millions used it on Palm Pilots.
- **Letter Recognizer**, which also recognizes individual letters instead of whole words, but uses the standard alphabet instead of the slightly modified one of the Block Recognizer. And whereas the Block Recognizer lets you shift case, the Letter Recognizer, which goes back to a product called "Jot" by (CIC) Communication Intelligence Corporation, has different data entry boxes for upper case, lower case and numerals.
- **Transcriber**, which is a full-function handwriting recognition system that also goes way back almost to the beginning of PDAs more than 15 years ago. Microsoft bought the rights to it a number of years ago and it's been part of Windows Mobile ever since.

Any of those input methods, once mastered, work very well and it's actually possible to compose even long documents on a small 320 x 240 pixel screen.

microSD memory expansion

Unlike the Allegro MX, which has a standard user-accessible PC Card slot that can be used to add storage or a variety of wireless or other functions, the TK6000 only has a micro-SDHC slot that is located in the battery compartment underneath one of the batteries. The micro-SD slot works a bit like some SIM card slots where the cover rotates up so you can insert the card, then folds back down and slides into place. This arrangement is a bit fragile for my taste, but it is a standard solution.

We used a 16GB SanDisk card during our testing of the TK6000. It is truly amazing that a card that's smaller than a fingernail can add so much storage to a handheld device. To put it in perspective, the tiny card has 1,600 times the storage capacity of the lumbering 10MB hard disk in the first IBM PC XT.

For sealing of the card expansion compartment, the TK6000 relies on a thick, soft silicon plug-seal that goes around the perimeter of the opening and is attached to the device with two soft hinges so it won't get lost. Make sure that the seal is clean and unharmed and properly in place at all times as the microSD compartment provides access to the inside of the computer.

Wireless connectivity

There are a number of possible configurations for the TK6000. All versions include Bluetooth, and Juniper chose a powerful Class 1 implementation with a range of approximately 75 meters (250 feet) and the Version 2.0 + EDR data rate of about 3 Mbit/second. 802.11b/g WiFi is available, and there is also a data modem expansion pack with quad band (850/900/1800/1900Mhz) GSM/GPRS/EDGE functionality. The Carlson website suggests upcoming availability of other expansion packs as well. Note that with the TK6000's piggy-back expansion packs Juniper took a different approach than with the Allegro's expansion pod endcaps that replace the standard PC Card door on that model. The image below shows the TK6000 with the optional piggyback data modem expansion pack installed.

A handy Wireless Manager screen provides one-touch activation or deactivation of wireless services, either one-by-one, or all at once.

Ruggedness

Since, like all Juniper Systems computers, the TK6000 will mostly be used in outdoors applications, the device is built to be extremely rugged and durable. The magnesium chassis/case of the TK6000 is a work of art. The design is as intricate and meticulous as it gets, and the craftsmanship is incredible. From a structural point of view, the case is perfect, without any flex or any weak point. Add to that the cleverly applied exterior bumpers and protective endcap, and you have a handheld computer that is about as indestructible as it gets.

The ultra-solid construction results in a very impressive 5-foot drop spec, with the TK6000 surviving multiple drops on all faces, corners and sides. The operating temperature range is extremely wide: -4 to 130 degrees Fahrenheit, which means the TK6000 can be used in virtually any climate.

As is, Juniper Systems, a company which has always had a delightfully offbeat sense of humor, released a video entitled "10 Activities to Avoid if Your Handheld Isn't Juniper Rugged." In it, a TK6000 is pounded, hurled, crushed, compacted, frozen, used as a jackstand for a truck and more. Below are excerpts of the movie. The dots high up in the sky in two of the pictures are actual flying TK6000s. Suffice it to say that some of those activities far, far exceed the requirements of any MIL-STD testing.

Sealing is at the IP67 level, where the "6" means the device is totally protected against dust, and the "7" means it is also waterproof, where waterproofing means immersion into up to one meter of water (3.3 feet) for no more than 30 minutes. Since the folks at Juniper Systems didn't include this into their 10 activities to avoid unless you have a Juniper computer, we decided to add an 11th activity as seen below.

We've studied Juniper Systems' approach to ruggedness and waterproofing in their other products we tested; instead of complex systems that can and will fail, Juniper's engineers rely on straightforward solutions, simplicity and common sense.

Since it is difficult to reliably seal ports and connectors with just protective plugs, Juniper generally uses a dual barrier approach with a) fully sealed ports based on a unique design developed by Juniper to keep dust and water out, and b) connector protectors that keep out dirt and foreign objects and function as bump caps to protect the contacts.

Due to the TK6000 design requirements that called for modularity and field access, Juniper took a different design approach where multiple openings into the interior of the device (batteries, expansion card, wireless modules, etc.) are all sealed with single pressure gaskets. That is not a bad approach, but it results in more possible points of failure, and a large length of sealing that must all be perfect in order to keep dust and water out. For example, whereas the battery compartment cover of the Allegro MX is waterproof, the one of the TK6000 is not, and instead relies on three separate seals for the two batteries and the microSD car compartment. Juniper had its reasons for the design change, and it still results in a very well-sealed device, but this approach means a greater risk for sealing failure.

Dual batteries for extra-long life

Picking the right battery for a mobile device is a challenge. It's usually a trade-off between several competing requirements: size, weight, cost, life between charges. In its Allegro MX, Juniper uses a single, large NiMH battery primarily for cost reasons, but also because NiMH battery technology has a long history of reliable performance in real-world use cases. However, there's no denying that Li-Ion is now the technology of choice, and also the one that has benefitted the most from technological advances in recent years. As a result, Juniper is using Li-Ion in the TK6000.

But there's another change: the TK6000 can accommodate either one or two batteries, and each one packs a full 14.4 watt-hours. The combined 28.8 watt-hours approaches that of many notebook computer batteries. Given the much lower power draw of a handheld computer, it's no surprise that the TK6000 has phenomenal battery life. We're talking up to 16 hours from a single battery and up to 32 hours when both batteries are installed! That's four full shifts. Real life performance varies, of course, but it's certainly good to have almost 30 watt-hours onboard when you're out in the field and miles away from the next power plug.

Having two batteries instead of one can be a definite advantage. It makes it possible to replenish battery power without shutting down the device, and it also makes it easier to carry along spares. Juniper System does offer a travel charger that be used with either an AC adapter or a vehicle power adapter.

Note that the TK6000 has a number of control panels that affect battery life as well. The "Power" control panel/utility not only shows the charge level, but also lets you select automatic turn-off delays and set CPU speed to five levels ranging from 208MHz all the way to 624MHz. The "Backlight" panel sets brightness and how long the backlight will stay on if the device is not used. And wireless settings also impact battery life. ❖

Juniper TK6000 Specs

Type: Ultra-rugged flashlight-style handheld

Housing: Magnesium case with elastomer overmold

Processor: Marvell PXA270/624 MHz

OS: Windows Mobile 6.1 Classic

Memory: 128MB RAM/1GB Flash storage

Slots: 1 user-accessible MicroSD (up to 32GB)

Display: 3.5" 320 x 240 pixel LED-backlit daylight-readable transflective color TFT

Digitizer/Pens: Passive touch screen

Keyboard: Backlit 52-key sealed keypad with function keys

Navigation: 9-way navigation diamond, stylus, touch

Size: 5.1 x 10.5 x 1.85 inches

Ingress protection: IP67 water-/dustproof

Operating temperature: -4 to 130 degrees F

Drop: Multiple 5-foot drops to concrete

Humidity: Tested to MIL-STD 810F

Vibration: Tested to MIL-STD 810F

Altitude: Tested to MIL-STD 810F

Certifications: FCC Class B, WEEE, EN60950, RoHS compliant

Weight: 2.1 pounds (including two batteries)

Power: One or two 3.7V/3,900mAh 14.4 watt-hour LiIon batteries ("up to 16/32 hrs.")

Communication: Integrated Bluetooth Class 1 (up to 75 meters); optional 802.11b/g WiFi, GPS; WWAN (GSM/GPRS/EDGE) via data modem expansion pack

Interface: Full-size USB host, Mini-USB client, COM1 (RS232 9-pin), COM2 (RS232, 9-pin)

Price: Starting at US$2,775

Contact: Juniper Systems, Inc.
1132 West 1700 North
Logan, UT 84321 USA
Tel: 435-753-1881
Fax: 435-753-1896
Web: www.junipersys.com
Email: sales @ junipersys.com

The Juniper Systems TK6000: Summary

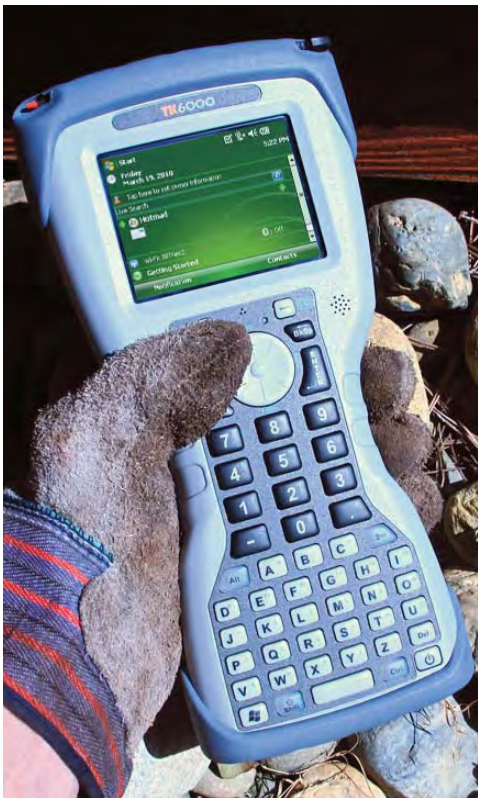
Juniper Systems is a Logan, Utah, based designer and manufacturer of some of the toughest handheld computers available. The TK6000, initially designed for Carlson Software which sells the device into land survey and mining under the "Surveyor" name, complements Juniper's lineup that also includes the PDA-style Archer and the top-of-the-line Allegro platforms.

The TK6000 Field PC is a substantial ultra-rugged flashlight-style handheld computer for demanding outdoor data acquisition jobs. It's a bit over ten inches long, five inches wide, an inch and a half thick, and it weighs a bit over two pounds with two batteries installed. It is extremely well made, with a very rigid magnesium chassis and housing, and ample elastomer protection via screw-on top and bottom caps.

On the technology side, the TK6000 runs the Microsoft Windows Mobile 6.1 operating system, for which there are literally thousands of applications, and numerous software development tools with a rich subset of Microsoft Win32 APIs. The outdoor-readable and landscape-oriented touchscreen display measures a somewhat smallish 3.5 inches diagonally. There is a full gigabyte of onboard non-volatile storage that can be complemented with up to 32GB via a user-accessible microSD card slot.

The TK6000 has more onboard connectivity than most handheld computers. This includes two RS232 serial ports with standard DB-9 connectors, a full-size USB port, and also a mini-USB client port. For wireless communication, there is Bluetooth 2.0 with EDR and optional 802.11b/g WiFi. Also available is a GSM Cellular data modem expansion pack.

Since the TK6000 was designed to be suitable as an OEM platform, its expansion pack can add all sorts of functionality without compromising ruggedness. This way, system integrators can incorporate specialized sensors or communication devices. The expansion pack can also be customized to include special signal conditioning circuitry, communications circuitry, and sensor interfaces to meet specific market needs.

One of the TK6000's strongest points is its large, extensive and flexible 52-key keypad that includes a full numeric keypad, a full alpha keypad, as well as programmable function keys and soft keys, all with excellent tactile and audible feedback. This allows for rapid, reliable data entry even with gloves on. Another very strong point is the large battery capacity provided by two separate Li-Ion power packs, enabling the TK6000 to last several shifts between charges.

Overall, the TK6000 from Juniper Systems is one of the toughest and best-designed rugged handhelds we have tested. ❖