



IMAGETEAM™ 4X00 Series

*For Adaptus Imaging Technology Imagers:
IT4000, IT4100, and IT4300*

Hardware Interface Layer Specification



User's Guide

Disclaimer

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FCC/CE

The IMAGETEAM™ (IT) 4X00 Series Image Engine, integrated into an OEM device, may require testing by the OEM to insure compliance with the following federal regulations:

47 CFR Part 15

EC's Electromagnetic Compatibility Directive (89/336/EEC) and Low Voltage Directive (73/23/EEC)



For CE-related inquiries, please contact:

Hand Held Products, Inc.
5627 BT Eindhoven
The Netherlands


LED Eye Safety Statement for IT4000 and IT4100 Series Engines

The IT4000 and IT4100 series engine meets the requirements of a Class 1 Product as specified in IEC 825-1:1993 and EN 60825-1:1994 when tested in a standard IT4410 and IT4710.

Note: It is the OEM manufacturer's responsibility to comply with applicable regulation(s) in regard to standards for specific equipment combinations.

Laser Eye Safety Statement for IT4300 Series Engines

The IT4300 is intended for use in CDRH/IEC Class 2 devices.

LASER LIGHT. DO NOT STARE INTO BEAM
CLASS 2 LASER PRODUCT
1.0 mW MAX OUTPUT: 645 to 660nm 
EN60825-1: 1994 + A11 + A2
Complies with 21 CFR 1040.10 and 1040.11
except for deviations pursuant to Laser
Notice No. 50, dated July 26, 2001.



Note: It is the OEM manufacturer's responsibility to comply with applicable regulation(s) in regard to standards for specific equipment combinations.

Caution: Use of controls or adjustment or performance of procedures other than those specified herein may result in hazardous radiation exposure.





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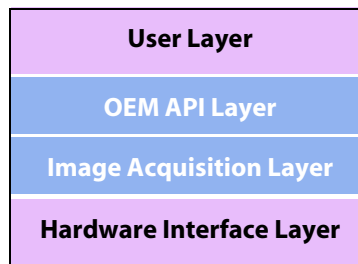


Introduction and Overview

This document is an overview of the structure of the IT4X00 Series OEM imaging software provided by Hand Held Products. Detailed information that describes the Hand Held Products OEM Application Programming Interface (*IMAGETEAM 4X00 SDK User's Guide*) is provided as a part of that imaging software.

Design Overview

The Hand Held Products OEM imaging software supports a number of different Hand Held Products imaging engines while exposing the user to a common programming interface for all imagers supported. This approach provides Hand Held Products with a simple way of adding support for new imaging hardware, while allowing user software to remain largely unchanged. In support of this design approach, the software components implemented in the Hand Held Products OEM imaging software have been organized in the following layered format:



Of the four layers, Hand Held Products supplies the OEM API and Image Acquisition layers.

User Layer

The User Layer can be the application that is written by a developer or end user that accesses the imaging system by using the OEM API functions. The User Layer can alternatively be an abstraction layer provided by an OEM that allows the OEM to customize the level of API functionality exposed to their end user. Either option has access to all the applicable OEM API functions that access and control the imaging subsystem.

OEM API Layer

The OEM API Software is supplied by Hand Held Products and is the primary interface to the imaging system. All members of the OEM Image Engine Family are supplied with a Software Developers Kit to facilitate command and control of the image engines. For Windows CE® applications, the OEM API Software functionality is provided in the form of a Windows Dynamic Link Library. For non-Windows CE applications, the form of the OEM API Software is to be determined. Full explanation of the OEM API is provided in the *IMAGETEAM 4X00 SDK User's Guide*.

Image Acquisition Layer

The Image Acquisition Software layer is the software supplied by Hand Held Products that is responsible for imager auto detection, initialization, state management, exposure control, and image acquisition. During application execution, this software maintains the state and control of the imager, processes requests for images, and executes configuration and control requests. For Windows CE applications, this layer is implemented in a stream device driver and is used by the OEM API layer. For non-Windows CE applications, the form of this layer and its interface to the OEM API layer is to be determined.

Hardware Interface Layer

The Hardware Interface Software is the hardware-specific software provided by the system developer and used by the Image Acquisition Software to access the physical imaging hardware and run hardware-specific tasks on the system. This software is called upon by Image Acquisition Software to handle physical control of the hardware, such as communication with the imager, timing functionality, low level interrupt service routine control, DMA initialization and control, system specific memory control, and illumination functionality. For Windows CE applications, it is expected that this layer will be provided in the form of a Windows Dynamic Link Library that will be loaded by the Imaging device driver. For non-Windows CE applications, the form of this layer and its interface to the Image Acquisition Software is to be determined.

Alphabetic Function List

The following is a list of functions that the ImagerHardware DLL must export to support the imaging device driver. The functions described below are specific to the IC Media imager and the ICMedia product specification and should be reviewed for coherency with this document.

AimIsOnICMedia

.....

This function returns the state of the aimer.

```
BOOL AimIsOnICMedia(  
    void  
)
```

Returns

Zero if OFF, non-zero if ON.

AimOffICMedia

.....

This function turns off the aimer.

```
BOOL TurnAimerOffICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success

AimOnICMedia

.....

This function turns on the aimer.

```
BOOL TurnAimerOnICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success.

AllocatePhysicalScanSpaceICMedia

.....

This function reserves the physical memory for a single image. It does not matter to the driver how physical memory is handled on the specific platform. When the "pseudo-handle" is passed to various functions, a specific block of physical memory is referenced.

```
DWORD AllocatePhysicalScanSpaceICMedia(  
    void  
)
```

Returns

DWORD - a "pseudo-handle" to physical memory on success. This "pseudo-handle" will be used to communicate a specific physical buffer when other memory functions are called. This function returns zero on failure.

BindPhysicalMemoryToVirtualMemoryICMedia

This function binds the physical memory of an image, specified by "hPhysical," to a virtual memory location specified by "pVirtual."

Note: It is possible that multiple calls to this function may be made with the same physical pseudo-handle, but a different virtual address, i.e., binding multiple virtual addresses to the same physical space at the same time. This is normal.

```
DWORD BindPhysicalMemoryToVirtualMemoryICMedia(  
    DWORD hPhysical,  
    void *pVirtual  
)
```

Passed Arguments	Description
DWORD hPhysical	A "pseudo-handle" to a reserved physical memory slot. This was the "pseudo-handle" returned by AllocatePhysicalScanSpaceICMedia when the space was allocated.
void *pVirtual	A pointer to a virtual address to be bound to the physical memory referenced by hPhysical.

Returns

Zero on failure, non-zero on success.

CaptureInitiatedICMedia

In order to stay synchronized with the incoming images, the scan driver needs to know when each request to acquire a new image has been successfully completed. A request for a new capture that is made before the front edge of the Vsync signal (an optional function) should be carried out on the front edge of the next Vsync signal. CaptureInitiatedICMedia is called after the front edge of Vsync to determine if that has happened.

```
DWORD CaptureInitiatedICMedia(  
    void  
)
```

Returns

Zero indicates that on the last front edge of Vsync a new capture request was not carried out. This will occur either because the request was never made, or because the request was made but was unsuccessful.

Non-zero indicates that a new capture request was carried out on the last front edge of Vsync.

DeinitializeImageLineDataProcessingICMedia

This function is used to destroy, or undo any software or hardware configurations that are associated with the calling of the image data line processing.

```
DWORD DeinitializeImageLineDataProcessingICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success.

DeinitializeVsyncProcessingICMedia

This function disables the system from responding to the Vsync pulse from the imager. This involves undoing the setup performed via the [InitializeVsyncProcessingICMedia](#) (see page 10), function.

```
DWORD DeinitializeVsyncProcessingICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success.

DisableImageLineDataProcessingICMedia
.....

This function disables the calling of the ImageLineDataCallback function registered with [RegisterImageLineDataNotificationICMedia](#) (see page 1-11).

```
DWORD DisableImageLineDataInterruptICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success.

DisableVsyncInterruptICMedia
.....

This function disables the calling of the Vsync call-back function, registered with [RegisterVsyncNotificationICMedia](#) (see page 11), on receiving the front edge of a Vsync.

```
DWORD DisableVsyncInterruptICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success.

EnableImageLineDataProcessingICMedia
.....

This function enables the calling of the call-back function, registered via [RegisterImageLineDataNotificationICMedia](#) (see page 11), according to the criteria set forth by the hardware system, and initialized via [InitializeImageLineDataProcessingICMedia](#) (see page 10). It should be noted that the callback should only be called when image data is currently being captured from the image engine.

```
DWORD EnableImageLineDataInterruptICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success.

EnableVsyncInterruptICMedia
.....

This function enables the calling of the Vsync call-back function, registered with [RegisterVsyncNotificationICMedia](#) (see page 11), on receiving the front edge of a Vsync.

```
DWORD EnableVsyncInterruptICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success.

FreePhysicalScanSpaceICMedia

This function frees the physical memory for a single image.

```
DWORD FreePhysicalScanSpaceICMedia(  
    DWORD hImage  
)
```

Passed Arguments

DWORD hImage

Description

A "pseudo-handle" to a reserved physical memory slot. This was the value returned by AllocatePhysicalScanSpaceICMedia when the space was allocated.

Returns

DWORD - This function returns non-zero on success, zero on failure.

GetFrequencyPerFrameOfLineDataCallbackICMedia

This function returns the number of calls made to the image line data callback function during each frame. When using an operating system such as Windows CE, it may be difficult to tell consistently how many callbacks may be made per frame. In that case, make a low estimate. Therefore, if on a given system the callback may be called from 28-33 times, a safe number would be 27.

```
DWORD GetFrequencyPerFrameOfLineDataCallbackICMedia(  
    void  
)
```

Returns

A number 'N' that completes this statement, "the line processing occurs at least 'N' times per frame."

GetHardwareDllRevisionICMedia

This function returns a revision number of the hardware DLL. The functions included with any given revision of the hardware DLL are determined by this number. This guarantees that if the Image Acquisition Layer driver software is updated, but a hardware DLL has not been updated, the software will be backward compatible. This document represents what should be included in revision 1 of the hardware DLL.

Note: This function can be used as a general hardware layer initialization function since it is only called by the scan driver one time, and it does not have the limitations of a base DLL initialization (for example, it can't call Win32 API functions).

```
DWORD GetHardwareDllRevisionICMedia(  
    void  
)
```

Returns

Revision number of the hardware DLL.

GetImagerPropertiesICMedia

This function requests the properties of the imager currently interfacing to the hardware layer.

```
BOOL GetImagerPropertiesICMedia(  
    const DWORD * pBuffIn,  
    DWORD * pBuffOut,  
    DWORD dwLen  
)
```

Passed Arguments

pBuffIn

pBuffOut

dwLen

Description

Pointer to a buffer of DWORDs that are TAGs to the properties the scan driver is requesting.

Pointer to output buffer that has corresponding values and order to TAGs in *pBuffIn*.

Length of both *pBuffIn* and *pBuffOut*.

Tags:

```
typedef enum {  
    IP_SIZE,  
    IP_ENGINE_ID,  
    IP_NUM_ROWS,  
    IP_NUM_COLS,  
    IP_BITS_PER_PIXEL,  
    IP_ROTATION,  
    IP_AIMER_X_OFFSET,  
    IP_AIMER_Y_OFFSET,  
    IP_YDEPTH  
} HHPScanDriverImagerProperties_t;
```

Returns

TRUE if successful, FALSE otherwise.

GetNumberOfValidRowsICMedia

This function is called in the middle of image captures to find out how many image rows of data have been transferred completely in the incoming image at a given time.

```
DWORD GetNumberOfValidRowsICMedia()
```

Returns

DWORD - The number of valid image rows of data.

GetRegisterSettingsForHHPEXposureControlICMedia

This function is used for the hardware DLL to give the driver access to the register settings needed for its hardware platform.

The structure below represents the array data type the GetRegisterSettingsForHHPEXposureControlICMedia function returns to the driver via the ppRegisterEntries pointer:

```
typedef struct {  
    unsigned char nRegister;  
    unsigned char nValue;  
} ICMediaRegisterEntry_t;
```

```
DWORD GetRegisterSettingsForHHPEXposureControlICMedia(  
    ICMediaRegisterEntry_t **ppRegisterEntries  
)
```

Passed Arguments

Description

ICMediaRegisterEntry_t **ppRegisterEntries

A pointer to a location where a pointer to the register settings can be set. The ICMediaRegisterEntry_t is defined above. The table itself is an array of these structures having a register location, and the value it is to be set to in each entry.

Returns

DWORD - The number of entries in the table returned to the driver.

GetScanHeightICMedia

This function returns the number of rows in the image.

```
DWORD GetScanHeight(  
    void  
)
```

Returns

Number of rows or zero on failure.

GetScanWidthICMedia

This function returns the number of columns in the image.

```
DWORD GetScanWidth(  
    void  
)
```

Returns

Number of columns or zero on failure.

IllumIsOnICMedia

This function returns the state of the illumination LEDs.

```
BOOL IllumIsOnICMedia(  
    void  
)
```

Returns

Zero if OFF, non-zero if ON.

IllumOffICMedia

This function turns off the illumination LEDs.

```
BOOL TurnLEDsOffICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success.

IllumOnICMedia

This function turns on the illumination LEDs.

```
BOOL TurnLEDsOnICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success.

ImagerIsPoweredICMedia

This function indicates whether or not the image engine is currently in powerdown mode.

```
BOOL ImagerIsPoweredICMedia(  
    void  
)
```

Returns

Zero if the engine is currently in powerdown mode, non-zero if it is not.

ImagerPowerDownICMedia

This function puts the image engine into powerdown mode via a power enable signal.

```
BOOL ImagerPowerDownICMedia(  
    void  
)
```

Returns

Zero if successful, non-zero otherwise.

ImagerPowerOffAndSuspendICMedia

This function controls a physical switch to cycle power off the imager. This is typically implemented for Win CE suspend/resume.

```
DWORD ImagerPowerOffAndSuspendICMedia(  
    DWORD  
)
```

Passed Arguments

0

Description

Normal case. Win 32 API functions are still allowed.

1

Suspend/Resume. (For example, in Win CE this implies that it is not safe to call Win32 or user layer functions.)

Returns

TRUE if successful, FALSE otherwise.

ImagerPowerOnAndResumeICMedia

This function controls a physical switch to cycle power on the imager. This is typically implemented for Win CE suspend/resume.

```
DWORD ImagerPowerOnAndSuspendICMedia(  
    DWORD  
)
```

Passed Arguments	Description
0	Normal case. Win 32 API functions are still allowed.
1	Suspend/Resume. (For example, in Win CE this implies that it is not safe to call Win32 or user layer functions.)
2	Resume, but don't power on. To be powered on during next image I/O event.

Returns

TRUE if successful, FALSE otherwise.

ImagerPowerUpICMedia

This function takes the image engine out of powerdown mode via a power enable signal.

```
BOOL ImagerPowerUpICMedia(  
    void  
)
```

Returns

Zero if successful, non-zero otherwise.

InDownTimeICMedia

This function tells whether you are in the appropriate area of the frame to successfully write registers to have them take effect for the next image. "Down Time" represents the time between frames. For the IC Media 105A imager, this is the time when the Vsync state represents that no valid pixel data is available.

```
BOOL InDownTimeICMedia(  
    int  
)
```

Returns

Zero if successful, non-zero if currently in the "down time" of the frame.

InitCaptureICMedia

This function indicates that a transfer will begin on the next Vsync pulse, and the image data will go into the physical memory location referenced by "hPhysical." This function can be called at any time during a frame, and the driver relies on the hardware DLL and associated functionality to synchronize to the next Vsync to begin a frame. The Vsync is the border. Anything that comes in before the front edge of a Vsync will initiate a transfer on the next Vsync. Anything that comes in after that edge of Vsync will wait for the next Vsync.

Note: The scan driver then assumes that because the Vsync IST runs after this front edge of Vsync, that any calls to InitCaptureICMedia that are made during the Vsync IST will wait until the front edge of the next Vsync to be initiated

```
DWORD InitCaptureICMedia(  
    DWORD hPhysical  
)
```

Passed Arguments

DWORD hPhysical

Description

A "pseudo-handle" to a reserved physical memory slot. This is the "pseudo-handle" returned by AllocatePhysicalScanSpaceICMedia when the space was allocated.

Returns

Zero on failure.

1 - capture request was initiated, but it happened just after the front edge of Vsync (i.e., in down time), and therefore will only take effect on the next front edge of Vsync.

2 - capture request will take effect on next front edge of Vsync.

InitializeImageLineDataProcessingICMedia

This function is used to set up any necessary hardware and or software associated with generating the callback to the data line processing functionality in the scan driver. This should not enable the calling of this callback. It should only initialize it. To enable or disable, use the [EnableImageLineDataProcessingICMedia](#) (see page 4), or the [DisableImageLineDataProcessingICMedia](#) (see page 4) function.

```
DWORD InitializeImageLineDataProcessingICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success.

InitializeVsyncProcessingICMedia

This function configures the hardware and software of the system to respond to the front edge of the Vsync, and put in place the mechanisms that perform the call of the callback upon the receipt of that edge. The callback functionality is only initialized in this function, not enabled. (see [EnableVsyncProcessingICMedia](#) and [DisableVsyncProcessingICMedia](#)).

```
DWORD InitializeVsyncProcessingICMedia(  
    void  
)
```

Returns

Zero on failure, non-zero on success.

ReadIIC_ICMedia

This function uses the I²C interface protocol to read data from 'ucSubaddress' register location and places it at the location specified by 'pucBuffer'.

```
unsigned int ReadIIC_ICMedia(
    unsigned char ucSubaddress,
    unsigned char *pucBuffer
)
```

Passed Arguments	Description
unsigned char ucSubaddress	The register location where the data will be read from.
unsigned char *pucBuffer	A pointer to the location where the data from the imager will be stored.

Returns

Non-zero if data is successfully read. Zero if there was an error.

RegisterImageLineDataNotificationICMedia

This function is called during initialization of the imager to register a function to be called at various points during the image acquisition process. This function will most likely be called as the result of a hardware generated line interrupt, an IST generated from that interrupt, or at different times throughout an image capture based on an internal software scheduler.

```
DWORD RegisterImageLineDataNotificationICMedia(
    void (*fImgDataNotif)(void)
)
```

Passed Arguments	Description
void (*fImgDataNotif)(void)	Function pointer to a function that receives no arguments, and returns nothing.

Returns

Zero on failure, non-zero on success.

RegisterVsyncNotificationICMedia

This function is called during initialization of the imager to register a function to be called after the Vsync interrupt. This function could be called as part of an ISR handler or, as in WinCE applications, this registered function will most likely be called from an IST.

```
DWORD RegisterVsyncNotificationICMedia(
    void (*fVsyncNotif)(void)
)
```

Passed Arguments	Description
void (*fVsyncNotif)(void)	Function pointer to a function that receives no arguments, and returns nothing.

Returns

Zero on failure, non-zero on success.

RequestSynchronizedPowerDownICMedia

This function requests that the imager be put in power down mode upon receiving the next front edge of Vsync. The IC Media imager freezes when it goes into power down mode, and the goal is to have the imager in the "between frames" state (i.e., in down time) when this request is made. The difference between this function and the SynchronizedPowerDownICMedia function is that this function does not wait until the next Vsync to check to see if the imager has successfully been put into power down mode. The area of the scan driver that uses this function performs that check separately.

```
void RequestSynchronizedPowerDownICMedia(
    void
)
```

Returns

None.

ResetTransferHardwareICMedia
.....

This function stops a transfer that is either ready to run, or currently running. It also resets the system making it ready for the next call to InitCaptureICMedia.

```
void ResetTransferHardwareICMedia(  
    void  
)
```

Returns

None.

SynchronizedPowerDownICMedia
.....

This function puts the imager in power down mode upon receiving the next front edge of Vsync. The IC Media imager freezes when it goes into power down mode, so one of the checks after the power down is to make sure the Vsync is in the "between frames" state (in down time), since that's where the IC Media camera should be frozen.

```
BOOL SynchronizedPowerDownICMedia()
```

Returns

Non-zero if successfully powered down in the down time.

UnBindPhysicalMemoryFromVirtualMemoryICMedia
.....

This function unbinds the physical memory of an image, specified by "hPhysical," from the virtual memory location specified by "pVirtual." This does not, however, free any memory. The "pVirtual" pointer should still be a valid pointer pointing to RESERVED but not COMMITTED memory, and the physical memory should still be available for future bindings.

```
DWORD UnBindPhysicalMemoryFromVirtualMemoryICMedia(  
    DWORD hPhysical,  
    void *pVirtual  
)
```

Passed Arguments

DWORD hPhysical

void *pVirtual

Description

A "pseudo-handle" to a reserved physical memory slot. This was the "pseudo-handle" returned by AllocatePhysicalScanSpaceICMedia when the space was allocated.

A pointer to a virtual address.

Returns

DWORD - This function returns non-zero on success, zero on failure.

WaitForVsyncICMedia
.....

This function waits until the imager sees the front edge of the Vsync, then it returns. Since many systems involve threads going to sleep waiting for this event to occur, a safety check on the way out of this function is to see if the Vsync reflects the camera being "between frames" (down time).

```
BOOL WaitForVsyncICMedia()
```

Returns

Non-zero on successful synchronization to the Vsync before returning.

WaitMillisecondsICMedia

This function waits the number of milliseconds indicated before returning.

```
void WaitMillisecondsICMedia(  
    DWORD nTime  
)
```

Passed Arguments

NTime

Description

The number of milliseconds to delay.

Returns

None.

WriteIIC_ICMedia

This function uses the i²c interface protocol to write the 'ucBuffer' data to the imager at the 'ucSubaddress' location.

```
DWORD WriteIIC_ICMedia(  
    unsigned char ucSubaddress,  
    const unsigned char *pucBuffer  
)
```

Passed Arguments

unsigned char ucSubaddress
unsigned char *pucBuffer

Description

The 8 bit address where data will start being written to.
A pointer to the byte of data that will be written to the "subaddress."

Returns

Non-zero if data is successfully transferred. Zero on error.

Programming Notes

1. It is essential that callbacks for Vsync processing and Image Line Data processing not run at the same time, for example, with 2 separate threads. It is essential that checks are made in the Hardware Interface DLL to ensure that a call to one callback is complete before a second call to that callback, or a call to the other callback is made. To avoid this, use ISRs that do not allow nesting. Or, if using ISTs in the Windows CE model, use the same thread to process both callbacks.
2. It is assumed that an image transfer is initiated on the front edge of Vsync. [InitCaptureICMedia](#) (see page 10) can be called at any time during the frame, and the hardware DLL must synchronize it with the hardware. Returning a 1 or 2 from [InitCaptureICMedia](#) is not mandatory. If a specific hardware system allows for initiation of an image transfer after the front edge of Vsync, a 2 may be returned when [InitCaptureICMedia](#) is called because it takes effect for the next frame. But it is imperative that calls made to [InitCaptureICMedia](#) from the Vsync callback only take effect on the next Vsync front edge.
3. If running an Operating System on the target platform, such as Windows CE, processing of the Vsync and Image Data Line callbacks must be high priority to ensure proper timing.
4. There are times when the Vsync callback function will have to wait for longer than a single frame time for an event, resulting in a second Vsync front edge being seen. If, upon returning from the Vsync callback function, another Vsync front edge has passed, **do not** call the callback again. Wait for the next one.

Technical Assistance

If you need assistance using the IT4X00 Series OEM imaging software, please call your Distributor or the nearest Hand Held Products technical support office:

North America/Canada:

Telephone: (800) 782-4263, option 4 (8 a.m. to 6 p.m. EST)

Fax number: (315) 685-4960

E-mail: natechsupport@handheld.com

Europe, Middle East, and Africa:

Telephone-

European Ofc: Int+31 (0) 40 79 99 393

U.K. Ofc: Int+44 1925 240055

E-mail: eutechsupport@handheld.com

Asia Pacific:

Telephone: Int+852-3188-3485 or 2511-3050

E-mail: aptechsupport@handheld.com

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Teléfono: (704) 998-3998, opción 8

E-mail: latachsupport@handheld.com

Online Technical Assistance

You can also access technical assistance online at www.handheld.com.





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