

# ITG-IO<sup>™</sup>

## User Documentation

Generic Input / Output JAMMA Interface  
Part Number 990-ITG-IO-UCT-02B

**Version 02B**  
**May 16, 2005**



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## !!! IMPORTANT NOTE !!!

This document refers to version 02B of the ITG-IO board. 02B is the combination of PCB version 02 and firmware version 3.0.0.0. Other versions of the PCB and firmware may differ from the details presented in this document. Please refer to the correct documentation for your specific hardware (see 'Revision History' on page 12).

## Legal Statement

The ITG-IO PCB is copyright © & trademark ™ 2003-05 by UltraCade Technologies, All Rights Reserved. The ITG-IO PCB and algorithms are Patent Pending. ITG-IO is a trademark of UltraCade Technologies.

## Package Contents

- User Documentation
- Video Cable (VGA) 3ft
- USB Cable 6ft
- HDD Power Cable Female Housing
- 4 x HDD Power Cable Female Pins
- ITG-IO PCB
- Audio Cable (3.5mm jack) 6ft
- HDD Power Cable Male Housing
- 4 x HDD Power Cable Male Pins
- Free Gift Offer Card

## Overview

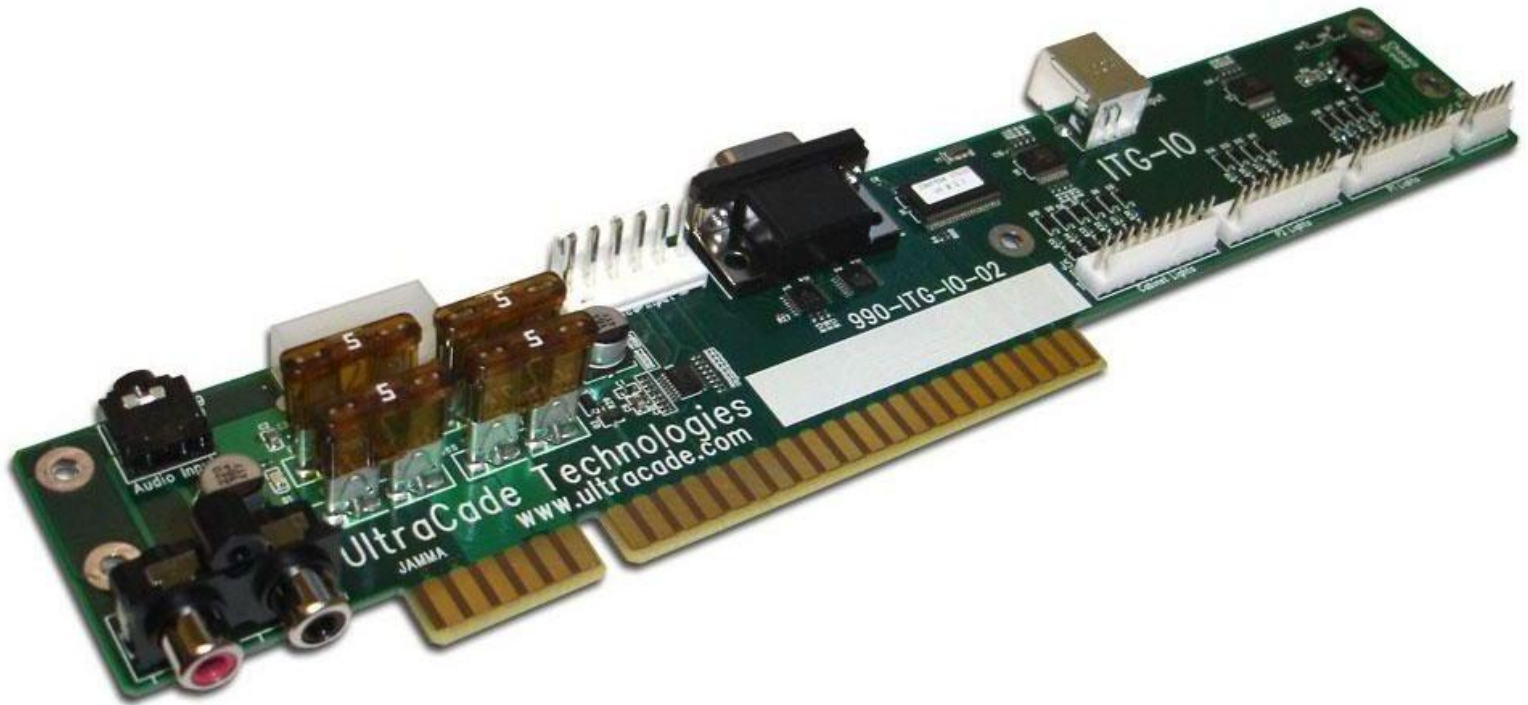
The ITG-IO interface card is part of UltraCade Technologies' series of JAMMA compatible PC interface cards. For more information and a full list of current products, please go to [www.ultracade.com](http://www.ultracade.com).

The ITG-IO provides a standard JAMMA interface for simple replacement of arcade motherboards with a more reliable, configurable and upgradeable PC system.

The ITG-IO provides 32 I/Os (16 of each) including one optically decoupled output for complete isolation. The remaining 15 outputs are designed for +12v operation and include surge protection for electro-mechanical devices. +5v devices may be used; however, care is required as the surge protection will be minimal.

Conversions are provided for PC video (0.7vpp) to Arcade video (5vpp) and PC audio (3.5mm jack) to Arcade audio (two mono RCA jacks).

Board Image





## Power

The ITG-IO has two potential sources of power which must not be connected simultaneously. The source of power depends on the application. Some JAMMA harnesses are self-powered, while others require power to be supplied from the ITG-IO. In the former case, the ITG-IO is powered from the JAMMA connector and the PC HDD (hard disk drive) connector must not be connected. In the latter case, the ITG-IO is powered from a standard PC HDD connector, which then powers the JAMMA harness. **NOTE: be sure the JAMMA harness is not self-powered before connecting the PC HDD power connector to the ITG-IO.**

Another potential power source is the USB connector; however, no power from the USB connector is used on the ITG-IO.

Irrespective of the method of connecting power, the ITG-IO is protected from the power source by 5A fuses on both the +12v and +5v lines. If power is connected using the PC HDD power connector, then the ITG-IO and the JAMMA harness are independently protected from the power source (J1); there are four fuses, for the +5v and the +12v lines to both the ITG-IO and the JAMMA harness. If the JAMMA harness is the power source, the +5v and +12v lines each pass through 2 fuses to get to the ITG-IO proper.

The ITG-IO does not support the -5v JAMMA connection. If the JAMMA harness is the power source, then the -5v signal is simply unused. However, if the PC HDD power connector is the power source, then the -5v JAMMA connection is left unconnected, and hence not powered.

## USB

Bringing up a USB design with the ITG-IO is made simple by the inclusion of shareware device drivers for Windows and Linux along with the device driver source code and sample application code. The only data that may need updating is the USB VendorID and ProductID in the device driver. For backward compatibility with previously released products, these values are: VendorID 07C0<sub>16</sub> and ProductID 1584<sub>16</sub>. It is recommended that a unique ProductID is requested from UltraCade Technologies for each new product application.

With the device drivers installed, simply plug in the ITG-IO. The first time a USB device is plugged into a Windows PC, the USB device will automatically “enumerate”. This process is basically the USB device and the PC automatically configuring themselves.

The ITG-IO supports 16 inputs from the outside world (joystick, buttons, etc) and 16 outputs to the outside world (lights, coin counter, etc). The 16 ITG-IO inputs are sent to the PC via a standard “isochronous USB pipe on Endpoint 1”. The 16 ITG-IO outputs are set by a standard “Set Report” command followed by the data on “Endpoint 0”. This is the standard USB configuration, and the device driver may abstract away even this level of detail.

Once installed, the ITG-IO will send any changes monitored on the inputs at a minimum of 10ms intervals. However, the changes to the inputs are monitored every 1ms, with all changes being buffered so that no changes are missed, even if a button is pressed and released within the 10ms reporting period. If no changes are detected in the 10ms reporting period, then the ITG-IO will not waste time sending unchanged data. Output data sent to the ITG-IO is reflected on the output pins of the board within 2ms of it being received.

## Digital Outputs

An application sets the ITG-IO outputs using the USB Set Report command (BMRequestType 21<sub>16</sub> and BMRequest 09<sub>16</sub>). All of the other fields in the command are ignored. The command is sent down the control pipe (Endpoint 0) first, followed by the data packet. Only the first 2 bytes of the data packet are used, and they are written directly to the outputs without parsing. The first byte is written to microprocessor port 0, and the second byte to port 1. See the section on the connector interface for a list of the assignment of the USB bits to the output connectors.

The ITG-IO supports 16 outputs. 15 outputs are decoupled ground enables using FET transistors. The final output is completely isolated using an optocoupler. Setting an output simply enables the corresponding circuit, either to ground or optically. Conversely, clearing the output simply disables the circuit, either to ground or optically.

When connecting a device, connect the positive terminal to the relevant voltage supply, and the negative (or ground) terminal to the relevant output pin on the ITG-IO. Enabling that output will enable the circuit, and therefore the device.

Decoupling with FETs enables the only limitation on the current draw to be from the power supply itself (the FETs used have maximum ratings of 1.6 amps continuous and 10 amp pulse). In addition, a +12v surge protector is included as part of each output; this enables the safe use of +12v electro-mechanical devices. NOTE: the surge protector has a lesser effect on +5v devices.

The isolated output is sent in the last bit of the second USB byte. This is routed out of microprocessor port 1.7 to an optocoupler. Using an optocoupler means that the current is completely isolated from the ITG-IO power supply.

The optocoupler used is low-power, and has the following ratings:

- Maximum current of 80mA continuous or 3 amp pulses
- Maximum voltage of +30v forward or +3v reverse
- Forward voltage drop of 1.2v

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## Video

The ITG-IO accepts video input from either a DB25 (standard PC VGA video connector) or a 6-pin 156mil Molex (standard arcade video connector). Video is then produced on the relevant pins of the JAMMA connector.

The ITG-IO does not do any scaling of the video. The video must already be in a resolution compatible with the target monitor. If rescaling is required, the video signal can be routed through an UltraCade uVC video converter (see [www.ultracade.com](http://www.ultracade.com)).

Two forms of video processing are performed by the ITG-IO. The 0.7vpp PC video signal is amplified to the 5vpp arcade levels, and the synchronization method is ensured to be in composite format.

All current main stream monitors use +5v synchronization signals, however, the red, green and blue signals are different voltages in VGA monitors and arcade monitors. Only the 0.7vpp RGB signals produced by a PC need to be amplified to 5vpp. Therefore the video arriving from the PC video connector (J3) is amplified, whereas the video arriving from the arcade video connector (J2) is not amplified.

Synchronization signals used can vary. Most arcade monitors support both composite and separate horizontal and vertical synchronization signals. However, the JAMMA connector requires just the composite synchronization signal. The ITG-IO therefore combines separate synchronization signals, from either the PC video input connector (J3) or the arcade video connector (J2), into a composite signal. If the input video signal is already in composite format, the signal is unchanged.

Details on the JAMMA interface, including which pins are used for the video output, can be found in the section entitled "JAMMA Interface".

## JAMMA Interface

The JAMMA interface is the standard interface for arcade motherboards. To simplify the replacement of single game non-upgradeable arcade machines with PC based systems, the ITG-IO allows the old motherboard to simply be unplugged and the PC plugged in. All the old controls will flow through the same JAMMA interface and be converted by the ITG-IO into USB packets.

The table below shows the standard use for each of the JAMMA pins, and how it is attached to the ITG-IO. For example, the video green pin on JAMMA pin S12 is produced from the video green input; player 1's start button on JAMMA pin C17 is sent to the PC via USB in the fifth bit of the second byte. The only ITG-IO output routed through the JAMMA connector is the primary coin counter, which is written from the PC via USB in the seventh bit of the second output byte.

PCB Side	Pin	Standard Usage	Connect or USB Byte.Bit	PCB Side	Pin	Standard Usage	Connect or USB Byte/Bit
Solder	1	Gnd	Gnd	Component	1	Gnd	Gnd
Solder	2	Gnd	Gnd	Component	2	Gnd	Gnd
Solder	3	+5v	+5v	Component	3	+5v	+5v
Solder	4	+5v	+5v	Component	4	+5v	+5v
Solder	5	-5v	n/c	Component	5	-5v	n/c
Solder	6	+12v	+12v	Component	6	+12v	+12v
Solder	7	KEY	KEY	Component	7	KEY	KEY
Solder	8	coin counter 2	n/c	Component	8	coin counter 1	Output 1.6
Solder	9	coin lock 2	n/c	Component	9	coin lock 1	n/c
Solder	10	left speaker -	n/c	Component	10	left speaker +	n/c
Solder	11	right speaker -	n/c	Component	11	right speaker +	n/c
Solder	12	green	green	Component	12	red	red
Solder	13	comp sync	comp sync	Component	13	blue	blue
Solder	14	service 1	USB 1.6	Component	14	video ground	video ground
Solder	15	tilt	USB 1.6	Component	15	test 1	USB 1.6
Solder	16	p2 coin	USB 1.7	Component	16	p1 coin	USB 1.7
Solder	17	p2 start	USB 1.3	Component	17	p1 start	USB 0.4
Solder	18	p2 up	USB 0.7	Component	18	p1 up	USB 0.0
Solder	19	p2 down	USB 1.0	Component	19	p1 down	USB 0.1
Solder	20	p2 left	USB 1.1	Component	20	p1 left	USB 0.2
Solder	21	p2 right	USB 1.2	Component	21	p1 right	USB 0.3
Solder	22	p2 button 1	n/c	Component	22	p1 button 1	n/c
Solder	23	p2 button 2	USB 1.4	Component	23	p1 button 2	USB 0.5
Solder	24	p2 button 3	USB 1.5	Component	24	p1 button 3	USB 0.6
Solder	25	p2 button 4	n/c	Component	25	p1 button 4	n/c
Solder	26	service 2	USB 1.6	Component	26	test 2	USB 1.6
Solder	27	Gnd	Gnd	Component	27	Gnd	Gnd
Solder	28	Gnd	Gnd	Component	28	Gnd	Gnd

## Connector Interface

All of the inputs into the ITG-IO are through the JAMMA connector. Therefore, all of the additional connectors are used for outputs. When a USB packet is sent by the PC to the ITG-IO, the two data bytes are written directly to the microprocessor's outputs. Setting an output bit enables the circuit to ground, while clearing the bit disables the circuit ground.

The exception is connector J4, which is the isolated output. The collector and emitter are connected directly to the optocoupler. Enabling and disabling this circuit is done through USB 1.7 (eighth bit of the second byte).

In the table below, the two output bytes are numbered 0 and 1, while the eight bits are numbered 0 through 7.

Connector	Pin	Usage	Note	Connector	Pin	Usage	Note
J5	1	n/c		J6	1	n/c	
J5	2	USB 1.0		J6	2	n/c	
J5	3	USB 1.1		J6	3	n/c	
J5	4	USB 1.2		J6	4	Gnd	
J5	5	USB 1.3		J6	5	Gnd	
J5	6	USB 1.4		J6	6	USB 0.4	
J5	7	USB 1.5		J6	7	USB 0.5	
J5	8	n/c		J6	8	USB 0.6	
J5	9	n/c		J6	9	USB 0.7	
J5	10	Gnd		J6	10	Gnd	
J8	1	n/c		J4	1	Collector	circuit enabled by USB 1.7
J8	2	n/c		J4	2	Emitter	circuit enabled by USB 1.7
J8	3	n/c		J4	3	Earth	
J8	4	Gnd		J4	4	Earth	
J8	5	Gnd		J4	5	Earth	
J8	6	USB 0.0					
J8	7	USB 0.1					
J8	8	USB 0.2					
J8	9	USB 0.3					
J8	10	Gnd					

## PCB Connectors

This section provides the part numbers and pin assignments for the mating connectors to all of the connectors on the PCB.

PCB Ref	PCB Connector Description	Required Mate Description	Parts Required	Supplier	Part Number	Inc. in packet
J1	Power - PC HDD	Female PC HDD connector Pin1 - +12vdc Pin2 - Ground Pin3 - Ground Pin4 - +5vdc	1 x Extension 2ft OR 1 x Female housing 4 x Female terminal 4 x Wire 1 x Male housing 4 x Male terminal	UltraCade AMP AMP {any} AMP AMP	115-HDDPWR-CBL 1-480424-0 60617-1 n/a 1-480426-0 61618-1	no yes yes no yes yes
J2	Video input	Female, 6-pin 156mil header Pin1 - Red Pin2 - Green Pin3 - Blue Pin4 - Ground Pin5 - V-sync Pin6 - C/H-sync	1 x Custom from uVC 1 x Custom from std OR 2 x Female housing 12 x Female terminal 6 x Wire	UltraCade UltraCade Molex Molex {any}	115-UVCSTR-CBL 115-UVC MIR-CBL 09-50-8061 08-50-0106 n/a	no no no no no
J3	Video input	Male, D-Sub 15-pin Standard PC video	Std PC video 3ft Extension Cable	UltraCade Assmann	115-VGA3MM-CBL AK322-2	yes no
J4	Strobe output	Female - 5-pin 100mil header**	1 x Female housing 2 x Female terminal	Molex Molex	22-01-2057 08-50-0108	no no
J5	Digital outputs	Female - 10-pin 100mil header**	1 x Female housing 7 x Female terminal	Molex Molex	22-01-2107 08-50-0108	no no
J6	Digital outputs	Female - 10-pin 100mil header**	1 x Female housing 7 x Female terminal	Molex Molex	22-01-2107 08-50-0108	no no
J7	USB uplink	USB-B plug (USB-A = PC plug)	USB A to B 6ft USB A to B 10ft USB-A extension	UltraCade UltraCade usbgear	115-USB06AB-CBL 115-USB10AB-CBL USBG-3FTE	yes no no
J8	Digital outputs	Female - 10-pin 100mil header**	1 x Female housing 7 x Female terminal	Molex Molex	22-01-2107 08-50-0108	no no
J9	Audio input	Male, stereo 3.5mm jack	1 x PC audio 6ft	UltraCade	115-AUDMINI-CBL	yes
J10	Audio output	Male, mono RCA/Phono plugs Red - Right channel Black - Left channel	1 x red plug 1 x black plug RCA extension RCA to 3.5mm cable	CUI CUI Assmann Happ	RCP-012 RCP-011 AKCHMF-2 96-0541-00	no no no no

\*\* for pin connection details, see section entitled "Connector Interface"



## Revision History

- Version 02B. PCB version 02. Firmware version 3.0.0.0:
  - 05/16/2005, DT. First release of the user documentation.

## Contact Information

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