



**Future Technology Devices International Ltd.**

## **Application Note AN\_150**

# **A Comparison between MORPHIC-1K and Morph-IC-II FPGA Development Modules**

**Document Reference No.: FT\_000303**

**Version 1.0**

**Issue Date: 2010-08-20**

This application note describes the differences between the FTDI MorphIC-1K and MORPH-IC-II. Sub-100ms FPGA programming/re-programming makes Morph-IC-II ideal for applications which require users to reconfigure hardware functionality 'on-the-fly' by downloading new software over USB : "morphing" the hardware.

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## **1 Introduction**

FTDI have taken the existing FTDI MorphIC-1K FPGA development module, enhanced it and increased its capabilities, flexibility and power. The enhanced MorphIC is called "Morph-IC-II". Sub-100ms FPGA programming/re-programming makes Morph-IC-II ideal for applications which require users to reconfigure hardware functionality 'on-the-fly' by downloading new software over USB : "morphing" the hardware.

The following chapters give a brief overview of the enhancements.

## 2 Morph-IC-II Enhancements

The enhanced features of Morph-IC-II are as follows:

- Morph-IC-II has up to 80 I/Os whereas the MorphIC-1K had only 40 I/Os, these I/Os were introduced by extending the length of the module by 32mm.
- Morph-IC-II uses a Hi-Speed USB 2.0 interface whereas MorphIC-1K used a Full-Speed USB 2.0 interface.
- Morph-IC-II uses an EP2C5F256C8N which has 4,608 Logic Elements where MorphIC-1K used a EP1K10TC100-3 which has only 576 Logic Elements.
- Morph-IC-II has the ability to be programmed using JTAG programming interface. This was not available on MorphIC-1K.
- Morph-IC-II can use either a Synchronous or an Asynchronous 245 FIFO interfaces to communicate between the USB interface bridge and the FPGA. Synchronous 245 FIFO can transfer data at higher rates than Asynchronous 245 FIFO. MorphIC-1K only had an Asynchronous 245 FIFO interfaces.
- Morph-IC-II has six GPIO port connections available. These connections are between the USB bridge and the FPGA. These lines were not available on MorphIC-1K. These lines can be used in applications such as controlling chip select lines or setting a status line which can be connected to a LED.
- Morph-IC-II can operate using signals that have different *logic voltage levels*. This was not available on MorphIC-1K.

These enhancements are summarised in Table 1.

<b>MorphIC-1K</b>	<b>Morph-IC-II</b>
40 I/Os	80 I/Os
Full-Speed USB 2.0	Hi-Speed USB 2.0
EP1K10TC100-3 FPGA which has 576 Logic Elements	EP2C5F256C8N FPGA which has 4,608 Logic Elements
No JTAG programming interface that is SignalTap compatible	JTAG programming interface that is SignalTap compatible
Asynchronous 245 FIFO	Synchronous or an Asynchronous 245 FIFO
No GPIO port connections available	Has six GPIO port connections available
All I/Os fixed to 3.3V TTL/CMOS	Morph-IC-II can operate using signals that have different <i>logic voltage levels</i> . This was not available on MorphIC-1K

**Table 1 - A Comparison between the two MorphIC modules**

This application note describes the enhancements made while developing Morph-IC-II and describes the effects of these changes may have on MorphIC-1K designs.

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## 2.1 Scope

The most obvious difference between MorphIC-1K and Morph-IC-II modules is the physical size. Morph-IC-II is much longer than MorphIC-1K. This provides an additional 40 I/Os which gives greater flexibility in the development of many applications based on Morph-IC-II.

The change in size does not affect backward compatibility. Existing MorphIC-1K designs can still use Morph-IC-II module. MorphIC-1K I/Os are on similar connector pins as Morph-IC-II. The additional IO are routed to 2 additional connectors.

Every signal assigned to J1 and J2 headers on Morph-IC-II operate in the same way as in MorphIC-1K with the exception that some I/Os on the Morph-IC-II can operate at different voltage levels (depending on the position of the onboard jumper V\_BANK4).

The I/Os connected to I/O Bank4 of Morph-IC-II's FPGA are capable of transferring signals that have a *logic voltage level* other than 3.3 volts. The I/Os connected to the other I/O Banks of Morph-IC-II's FPGA can only process signals of 3.3 volts. When the Jumper "V\_Bank 4" is closed I/O Bank4 is configured to interface to signals of 3.3 volts which is the same as MorphIC-1K. If this jumper is removed, the signal levels of I/O Bank4 are determined by an externally supplied voltage.

Data communications between the Altera FPGA on Morph-IC-II and FTDI USB FT2232H Bridge chip differs in the two modules. MorphIC-1K uses channel B of the FT2232D to transfer the data over a parallel 245 FIFO interface, while Morph-IC-II uses channel A of the FT2232H to transfer the data over this parallel 245 FIFO interface. This change was introduced to facilitate the option of using a synchronous 245 FIFO interface. This change needs to be noted when running MorphIC-1K applications on Morph-IC-II.

### 3 MorphIC-1K and Morph-IC-II Pin-Out

The following diagrams, Figure 1 and Figure 2, compare the pin out of Morph-IC-II and MorphIC-1K modules. These diagrams indicate that J1 and J2 are similar for both modules – with the exception of the signal V\_BANK4 on J2 which will supply the voltage level for BANK4 of the FPGA when the V-BANK4 link is removed on the Morph-IC-II module.

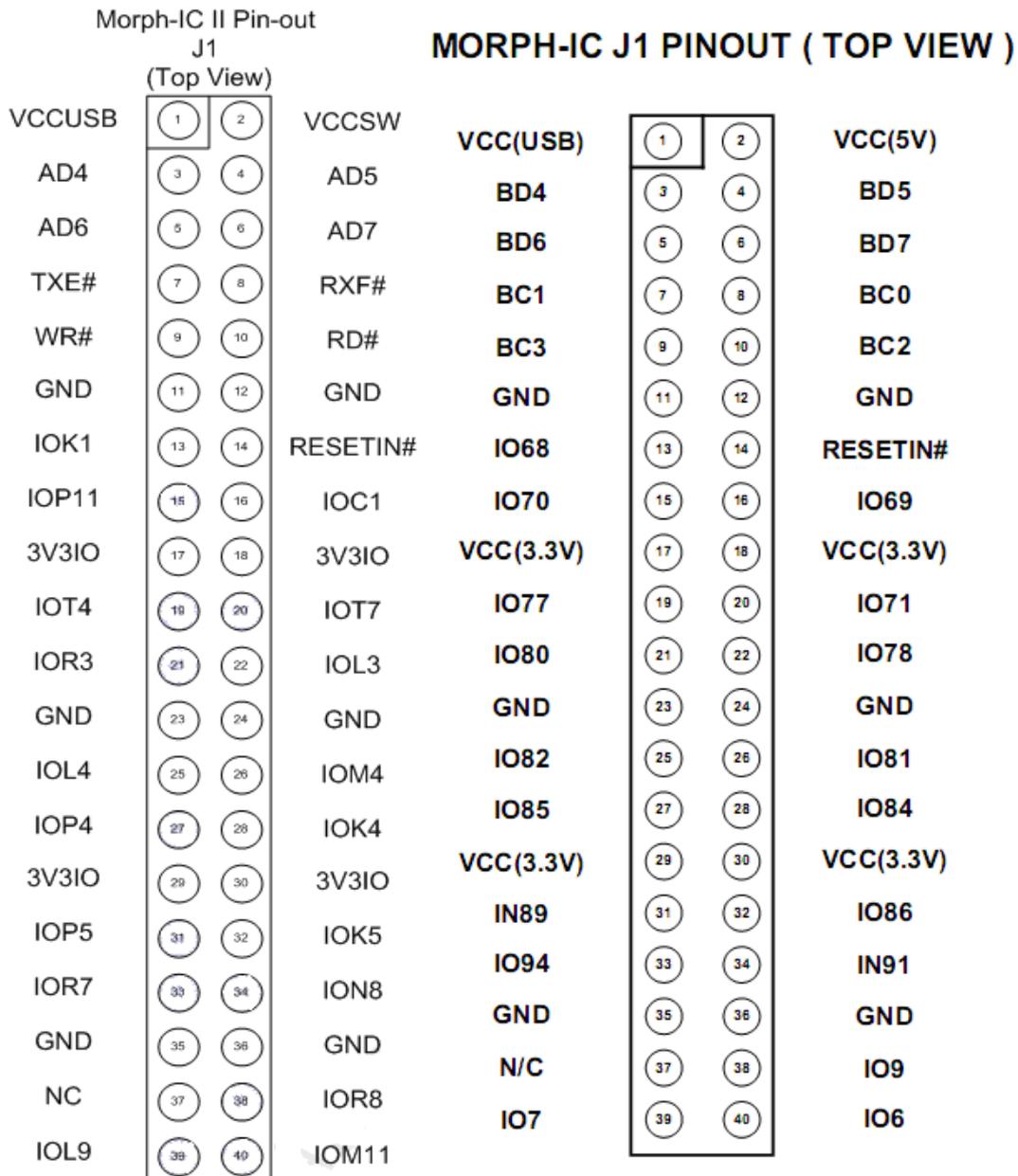
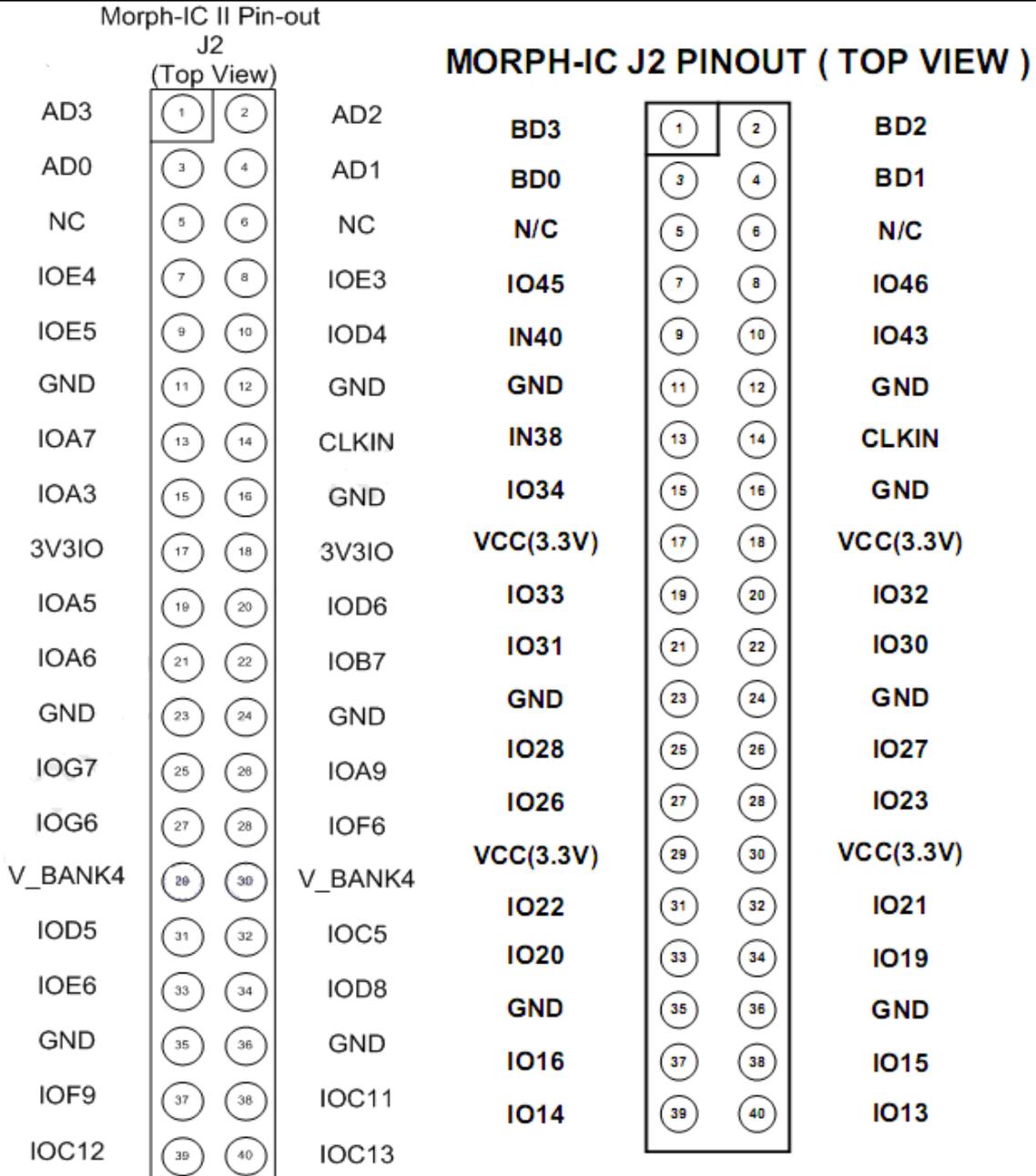


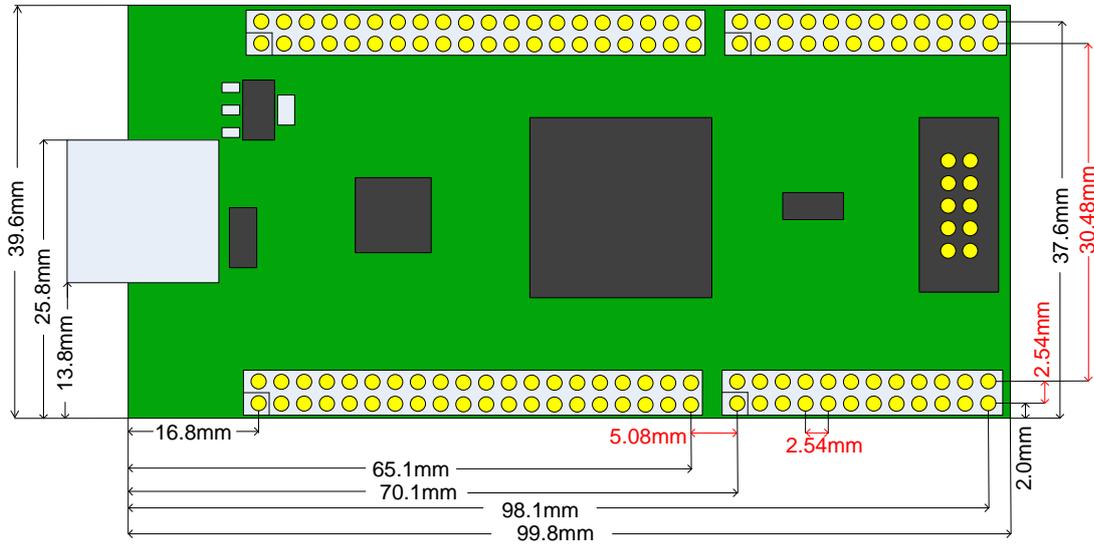
Fig. 1 – A comparison of J1 between the Morph-IC and the Morph-IC-II



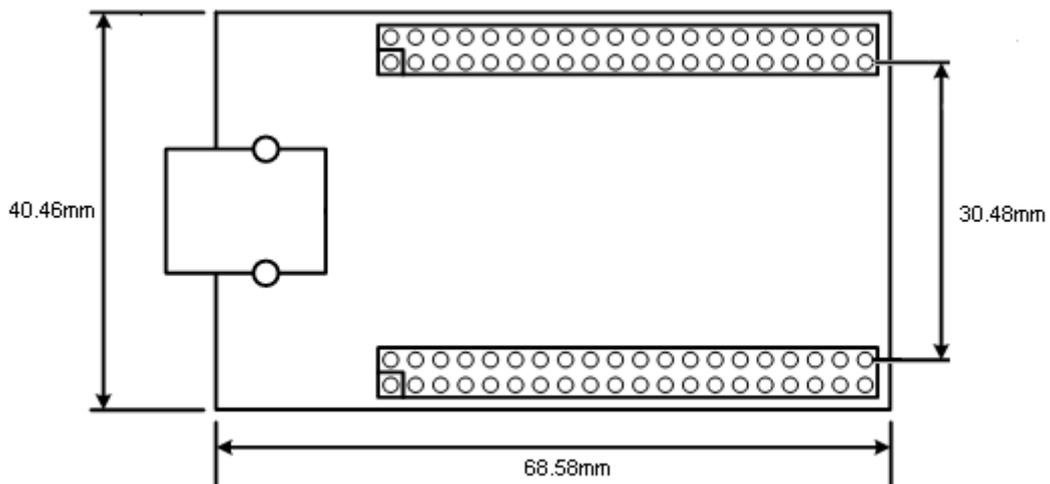
**Fig. 2 – A comparison of J2 between the MorphIC-1K and the Morph-IC-II**

## 4 MorphIC-1K and Morph-IC-II Mechanical Details

The mechanical Details of Morph-IC-II are given in Fig. 3 and the mechanical details for MorphIC-1K are given in Fig. 4. It can be calculated from comparing these two figures that the length of Morph-IC-II is approximately 32mm longer. The distance between the headers of both modules is the same which will allow for backward compatibility.



**Fig. 3 – Morph-IC-II Mechanical Details**



**Fig. 4 – MorphIC-1K Mechanical Details**

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## 6 Appendix A – References

### Document References

DS\_Morph-IC-II

AN\_141\_MorphIO-II and MorphLd Utilities for Morph-IC-II

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### Acronyms and Abbreviations

Terms	Description
FIFO	First In First Out serial interface
FPGA	Field Programmable Gate Array
USB	Universal Serial Bus
GPIO	General Purpose Input Output
JTAG	Joint Test Action Group

## 7 Appendix B – Revision History

Revision	Changes	Date
1.0	Initial Release	13th August 2010