

FLIR Lepton 2 versus Lepton 3 Application Note

Document Number and Revision: 102-2012-100-01 Rev [draft 2]
Official Publication Date: March 3, 2015



Information on this page is subject to change without notice. Shipping: CIP per INCOTERMS 2010.
FLIR Proprietary-Confidential, and approved for distribution to authorized FLIR dealers only.



The World's Sixth Sense™

FLIR Lepton 2 versus Lepton 3 Application Note

1 Document

Revision History

Version	Date	Comments
100		Initial Release

Scope

This document summarizes the key differences between the Lepton 2 and Lepton 3 camera modules. It is intended primarily for users familiar with Lepton 2 who are considering Lepton 3 as an upgrade. It is divided into 9 sections:

- [Summary](#)
- [Electrical Interface](#)
- [Command and Control Interface \(CCI\)](#)
- [Video Interface](#)
- [Feature Set](#)
- [Performance](#)
- [Mechanical](#)
- [Environmental](#)
- [Frequently-Asked Questions](#)

Information on this page is subject to change without notice. Shipping: CIP per INCOTERMS 2010. FLIR Proprietary-Confidential, and approved for distribution to authorized FLIR dealers only.



The World's Sixth Sense™

FLIR Lepton 2 versus Lepton 3 Application Note

Summary

The primary difference between Lepton 2 and Lepton 3 is the improved resolution of the infrared sensor. Lepton 2 provides an output of 80x60 pixels whereas Lepton 3 outputs 160x120. Despite having four times the number of pixels, Lepton 3 maintains the form factor of its predecessor and consumes only slightly more power (nominally 160 mW versus 150 mW). A key enabler for allowing improved resolution without a substantial growth in camera size is reduction of pixel pitch from 17 to 12 microns.

Electrical Interface

Generally speaking, the electrical interface to Lepton 3 is identical to Lepton 2. It is intended to be installed in the same socket (Molex 1052028-1001 or Molex 105028-2031), and the pinout is unchanged. All DC and logic levels, all AC characteristics, and all absolute maximum ratings are identical to Lepton 2 (with the possible exception of the VoSPI clock frequency, as described in the video interface section). As noted in the Summary section, power consumption of Lepton 3 is nominally 10 mW higher (160 mW vs. 150 mW).

Command and Control Interface (CCI)

Lepton 2 and 3 share a common CCI, a two-wire interface very similar to I2C (the difference relative to the true I2C standard being that only 16-bit transfers are allowed). Both Lepton 2 and Lepton 3 use the same I2C address (0x2A), and Lepton 3 is fully backward compatible with the Lepton 2 command set. The document which defines the interface in detail, the Software Interface Description Document (IDD), is common to the two versions of Lepton, as is the Software Development Kit (SDK).

Video Interface

Considering that Lepton 3 outputs four times as many pixels as Lepton 2, it is not surprising that the biggest differences between the two modules are in the Video-Over-SPI (VoSPI) interface. That said, much of the interface is unchanged, as summarized below.

- 1) The VoSPI physical layer is identical, including the SPI mode and timing.
- 2) For both modules, the minimum VoSPI transaction is a packet consisting of

Information on this page is subject to change without notice. Shipping: CIP per INCOTERMS 2010.
FLIR Proprietary-Confidential, and approved for distribution to authorized FLIR dealers only.



The World's Sixth Sense™

FLIR Lepton 2 versus Lepton 3 Application Note

either 164 bytes of data (Raw14 video mode) or 244 (RGB888 mode). The packet protocol, including the packet header and payload, are unchanged. However, it is worth noting a single packet represents a single 80-pixel video line for Lepton 2 whereas it represents half of a 160-pixel video line in Lepton 3.

- 3) The synchronization requirements are identical with one exception. To maintain synchronization, Lepton 2 requires each video frame to be read out prior to the next available frame. Conversely, Lepton 3 requires each *segment* to be read out prior to the next available segment, where a segment represents one-quarter of a video frame.
- 4) For both Lepton 2 and Lepton 3, each unique video frame is duplicated twice. The duplicate frames must be read out to maintain synchronization.

The four most significant differences between the Lepton 2 VoSPI interface and that for Lepton 3 are:

- 1) On Lepton 2, reconstructing a video frame from the individual packets requires the host to decode the packet number from each packet header. On Lepton 3, the host must decode both the packet number and the segment number.
- 2) The total number of bits per frame is 4X greater for Lepton 3 than for Lepton 2. Consequently, the minimum SPI clock rate is 4X faster. The maximum SPI clock rate for both modules is 20 MHz.
- 3) Both Lepton 2 and Lepton 3 provide the option to output a sync pulse on GPIO3. The frequency of the pulse is 4X higher on Lepton 3 than on Lepton 2. For Lepton 3, the sync pulse represents when the next available segment is available to be read whereas for Lepton 2 it indicates when the next available frame is available.
- 4) When telemetry is enabled in Lepton 2, it results in three extra video lines (63 total packets per frame). When telemetry is enabled in Lepton 3, it results in 1 additional packet per segment for a total of 2 extra video lines per frame.

A careful review of the VoSPI section of the Lepton 3 datasheet is recommended for a more complete understanding of the video interface.

Feature Set

Information on this page is subject to change without notice. Shipping: CIP per INCOTERMS 2010. FLIR Proprietary-Confidential, and approved for distribution to authorized FLIR dealers only.



The World's Sixth Sense™

FLIR Lepton 2 versus Lepton 3 Application Note

The Lepton 3 feature set is identical to that of Lepton 2 with two exceptions:

- 1) Lepton 3 provides a new command called “Set User Defaults”
- 2) Lepton 3 includes an improved AGC algorithm.

Set User Defaults Feature

This “Set User Defaults” feature allows the user to store a customized set of parameter settings as power-on defaults. It is intended that the command is sent after the module has been configured to all desired parameter settings (such as whether to output Raw14 data or RGB888 data). Once the parameter defaults are stored, they will take affect at every subsequent power-up and/or reset event. This feature allows the customer to customize Lepton cameras in a factory environment prior to installation in the end system. Depending upon the application, this capability might prevent the end system from requiring a Command and Control Interface between Lepton and host. Note that “Set User Defaults” can only be sent once. The module will report an error if the command is sent a second time.

Improved AGC

[cut & paste from Julie’s AGC section in the datasheet]

Performance

Other than the obvious benefit of providing 4 times the pixel resolution, the performance specifications of Lepton 3 are very similar to Lepton 2.

NEDT: Both products have a specified Noise Equivalent Delta Temperature (NEDT) less than 50 mK. (NEDT refers to the thermal resolution of the product. An NEDT of 50 mK means that when the temperature difference between two objects is 50 mK, the signal-to-noise ratio is unity.)

Field of View: The nominal field of view (FOV) of Lepton 3 is slightly wider than that of Lepton 2, as summarized below.

	Horizontal FOV	Vertical FOV	Diagonal FOV
Lepton 2	51 degrees	38 degrees	64 degrees
Lepton 3	56 degrees	42 degrees	71 degrees

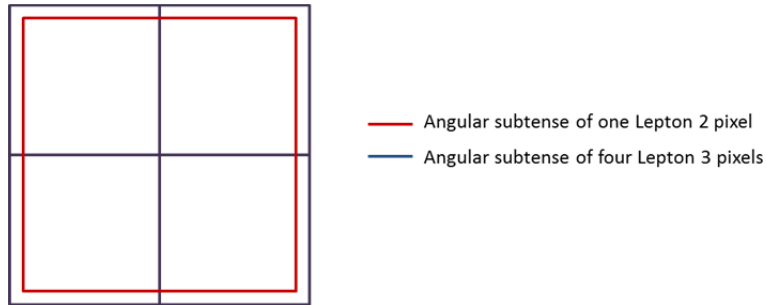
Information on this page is subject to change without notice. Shipping: CIP per INCOTERMS 2010. FLIR Proprietary-Confidential, and approved for distribution to authorized FLIR dealers only.



The World’s Sixth Sense™

FLIR Lepton 2 versus Lepton 3 Application Note

Operability: Both Lepton 2 and Lepton 3 provide operability $\geq 99\%$ (i.e., less than 1% of the pixels are defective). In both products, all defects are replaced by the average of non-defective neighbors. Lepton 3 allows two-pixel clusters, but it is worth noting that the angular subtense of a two-pixel cluster in Lepton 3 is nearly half the angular subtense of a single defect in Lepton 2. This fact is illustrated in the figure below.



Mechanical

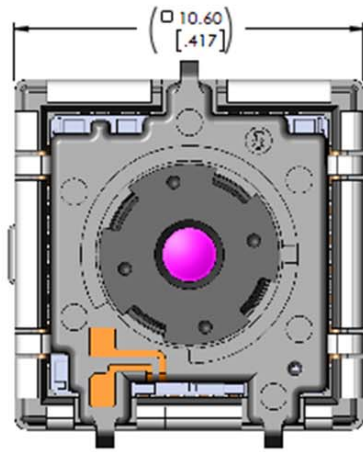
Generally speaking, the mechanical interface to Lepton 3 is very similar to Lepton 2. The three figures below show Lepton 2 on the left, Lepton 3 on the right. The first two show the cross-section of the shutterless and shuttered configurations, respectively, and the third compares the height. As described in the Electrical section, both are intended to be installed in the same socket.

Information on this page is subject to change without notice. Shipping: CIP per INCOTERMS 2010. FLIR Proprietary-Confidential, and approved for distribution to authorized FLIR dealers only.

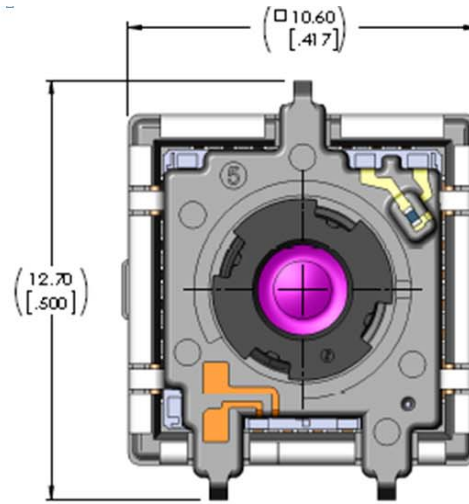


The World's Sixth Sense™

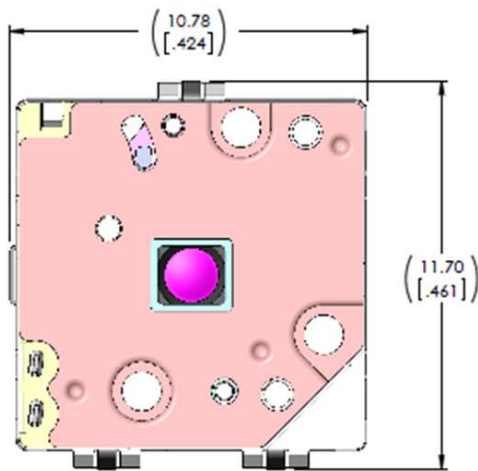
FLIR Lepton 2 versus Lepton 3 Application Note



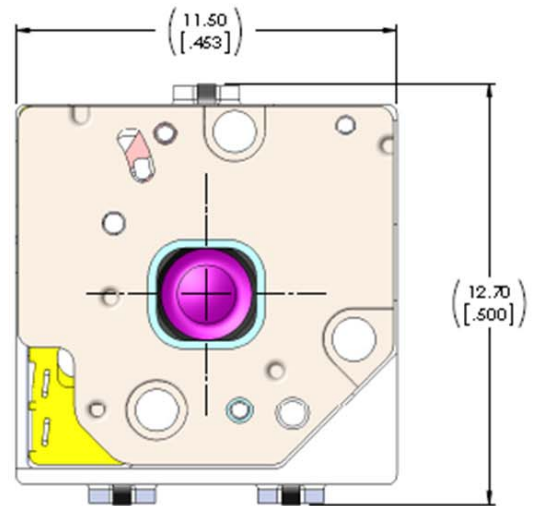
(a) Lepton 2



(b) Lepton 3



(a) Lepton 2



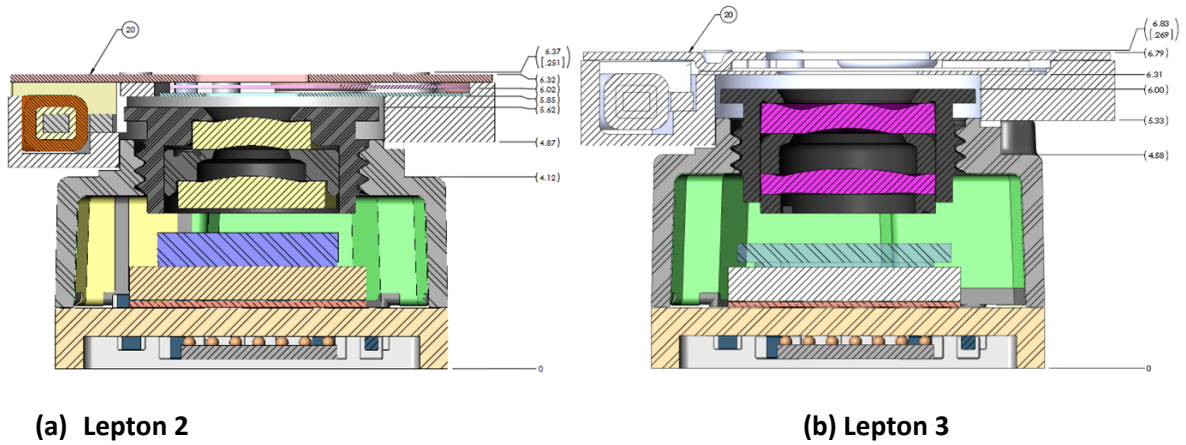
(b) Lepton 3

Information on this page is subject to change without notice. Shipping: CIP per INCOTERMS 2010. FLIR Proprietary-Confidential, and approved for distribution to authorized FLIR dealers only.



The World's Sixth Sense™

FLIR Lepton 2 versus Lepton 3 Application Note



Environmental

The same environmental requirements specified for Lepton 2 also apply to Lepton 3. These are summarized below.

Stress	Maximum Rating
Operating Temperature Range	-10° C to 65° C (-20° C to 75° C with some possible performance degradation)
Maximum Operating Temperature	80 °C ¹
Shutter Operating Temperature	-10° C to 65° C ²
Storage Temperature	-40° C to 80° C
Altitude (pressure)	12 km altitude equivalent
Relative Humidity	95%
Thermal Shock	Air-to-air across operating temp. extremes (-10° C to 65° C, 65° C to -10° C)
Mechanical Shock	1500 g, 0.4 msec
Vibration	Transportation profile, 4.3 grms

Information on this page is subject to change without notice. Shipping: CIP per INCOTERMS 2010. FLIR Proprietary-Confidential, and approved for distribution to authorized FLIR dealers only.

FLIR Lepton 2 versus Lepton 3 Application Note

ESD	Human Body Model (HBM), 2kV Charged Device Model (CDM), 500V
-----	---

Note(s)

1. Both Lepton 2 and Lepton 3 contain an automatic shutdown feature when its internal temperature exceeds the maximum safe operating value.
2. Both Lepton 2 and Lepton 3 contain an automatic shutter lockout feature that prevents the shutter from operating when its internal temperature is outside the range of -10° C to 65° C.

Information on this page is subject to change without notice. Shipping: CIP per INCOTERMS 2010. FLIR Proprietary-Confidential, and approved for distribution to authorized FLIR dealers only.



The World's Sixth Sense™

FLIR Lepton 2 versus Lepton 3 Application Note

[Is this section required? Basically reformat all of the information described above into Q&A form?]

Frequently-Asked Questions

Electrical Interface

Q. tbd

A. tbd

Information on this page is subject to change without notice. Shipping: CIP per INCOTERMS 2010.
FLIR Proprietary-Confidential, and approved for distribution to authorized FLIR dealers only.



The World's Sixth Sense™

FLIR Lepton 2 versus Lepton 3 Application Note

© FLIR Commercial Systems, 2015. All rights reserved worldwide. No parts of this manual, in whole or in part, may be copied, photocopied, translated, or transmitted to any electronic medium or machine readable form without the prior written permission of FLIR Commercial Systems

Names and marks appearing on the products herein are either registered trademarks or trademarks of FLIR Commercial Systems and/or its subsidiaries. All other trademarks, trade names, or company names referenced herein are used for identification only and are the property of their respective owners.

This product is protected by patents, design patents, patents pending, or design patents pending.

If you have questions that are not covered in this manual, or need service, contact FLIR Commercial Systems Customer Support at 805.964.9797 for additional information prior to returning a camera.

This documentation is subject to change without notice.



This equipment must be disposed of as electronic waste.

Contact your nearest FLIR Commercial Systems, Inc. representative for instructions on how to return the product to FLIR for proper disposal.

FCC Notice. This device is a subassembly designed for incorporation into other products in order to provide an infrared camera function. It is not an end-product fit for consumer use. When incorporated into a host device, the end-product will generate, use, and radiate radio frequency energy that may cause radio interference. As such, the end-product incorporating this subassembly must be tested and approved under the rules of the Federal Communications Commission (FCC) before the end-product may be offered for sale or lease, advertised, imported, sold, or leased in the United States. The FCC regulations are designed to provide reasonable protection against interference to radio communications. See 47 C.F.R. §§ 2.803 and 15.1 et seq.

Industry Canada Notice. This device is a subassembly designed for incorporation into other products in order to provide an infrared camera function. It is not an end-product fit for consumer use. When incorporated into a host device, the end-product will generate, use, and radiate radio frequency energy that may cause radio interference. As such, the end-product incorporating this subassembly must be tested for compliance with the Interference-Causing Equipment Standard, Digital Apparatus, ICES-003, of Industry Canada before the product incorporating this device may be: manufactured or offered for sale or lease, imported, distributed, sold, or leased in Canada.

Avis d'Industrie Canada. Cet appareil est un sous-ensemble conçu pour être intégré à un autre produit afin de fournir une fonction de caméra infrarouge. Ce n'est pas un produit final destiné aux consommateurs. Une fois intégré à un dispositif hôte, le produit final va générer, utiliser et émettre de l'énergie radiofréquence qui pourrait provoquer de l'interférence radio. En tant que tel, le produit final intégrant ce sous-ensemble doit être testé pour en vérifier la conformité avec la Norme sur le matériel brouilleur pour les appareils numériques (NMB-003) d'Industrie Canada avant que le produit intégrant ce dispositif puisse être fabriqué, mis en vente ou en location, importé, distribué, vendu ou loué au Canada.

EU Notice. This device is a subassembly or component intended only for product evaluation, development or incorporation into other products in order to provide an infrared camera function. It is not a finished end-product fit for general consumer use. Persons handling this device must have appropriate electronics training and observe good engineering practice standards. As such, this product does not fall within the scope of the European Union (EU) directives regarding electromagnetic compatibility (EMC). Any end-product intended for general consumer use that incorporates this device must be tested in accordance and comply with all applicable EU EMC and other relevant directives.

Information on this page is subject to change without notice. Shipping: CIP per INCOTERMS 2010.
FLIR Proprietary-Confidential, and approved for distribution to authorized FLIR dealers only.



The World's Sixth Sense™