XRD9827ITGREF SCANNER DEMO SYSTEM

USER MANUAL

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OTHER EXAR PRODUCT DEMOS THAT ARE AVAILABLE

XRD9812ITGREF FLATBED SCANNER
The XRD9812 flatbed scanner is higher performance than the XRD9827 ITG Flatbed Scanner.

XRD9827REF CIS SHEETFED SCANNER
The XRD9827REF is a 12-Bit, 600 DPI One Line Display Sheetfed Scanner.

XRD9829REF CIS SHEETFED SCANNER
The XRD9829REF is a 10-Bit, 300 DPI One Line Display Sheetfed Scanner.

XRD9827ITGREF FLATBED SCANNER DEMO SYSTEM

The XRD9827ITGREF is a 600 DPI / 36-Bit flatbed scanner. The optics, CCD, motor, chassis and lamp of a UMAX 1200S scanner was used with electronics designed by EXAR and ITG. None of the electronics are made by UMAX. *Figure 1* is a block diagram of the components used to design the XRD9827ITGREF scanner. See the XRD9827 ITG Installation User Manual for installation procedures. The digital controller is an ITG product specifically designed for the XRD9827 analog front end CCD processor. For more information on the XRD9827, refer to the XRD9827 Datasheet.

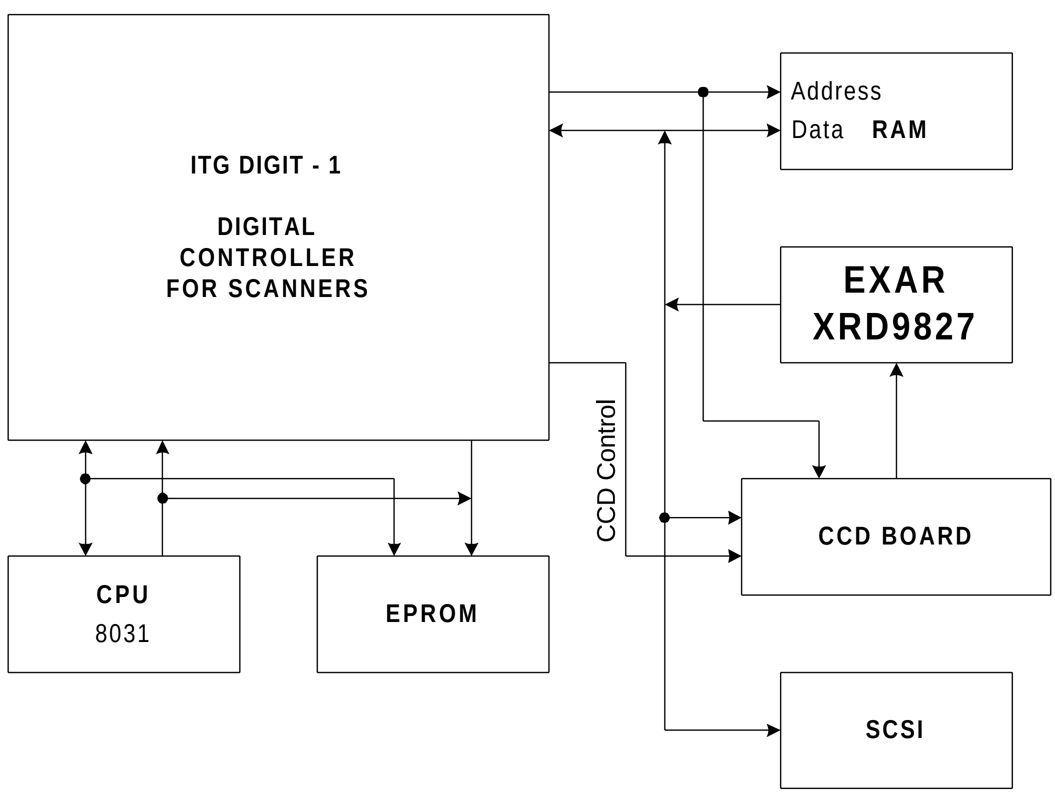

Figure 1. XRD9827ITGREF Block Diagram

SYSTEM COMPONENTS INFORMATION

Scanning Element: 600 dpi Color CCD, NEC3717
AFE processing: XRD9827 CCD/CIS AFE Processor
Mode of Operation: Single Channel, CDS Pixel-by-Pixel Gain and Offset Adjustment
Register Settings (s2, s1, s0, d7, ..., d0): 110-0-0-0-0-1-1-01
s2, s1, s0 = 110 = Scan Mode
d7 = 0 = Power Down, Normal
d6 = 0 = Digital Reset, No Reset
d5 = 0 = Vrt Set to Internal
d4 = 0 = Input DC Reference, Set to Internal, Vdcref = AGND
d3 = 1 = AC Coupled Mode
d2 = 1 = CCD Inverted Mode
d1, d0 = 01 = Single Channel, Red Input, Pixel-by-Pixel Gain & Offset
ITG Digit 1 Digital Controller: Contact ITG for Details.

DATA POST PROCESSING

The XRD9827ITGREF is a 36-Bit Color scanner. This is accomplished by using a 12-Bit Analog to Digital Conversion for each channel (XRD9827). The communication between the scanner and the display is only 8 bits. Therefore, a color mapping from 12-Bit data to 8-Bit data happens in post processing of the digital ASIC. Below is *Figure 2* a block diagram of the color mapping technique used in the XRD9827ITGREF.

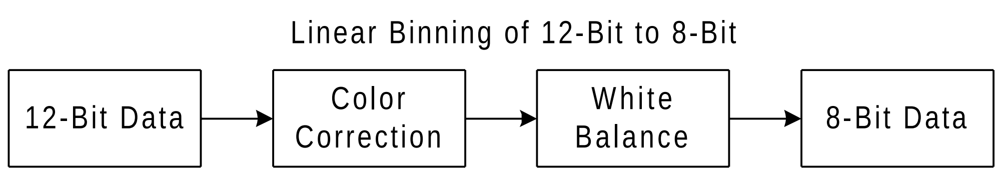

Figure 2. Color Mapping from 12-Bit to 8-Bit

Gamma is performed in conjunction with the digital ASIC. The 12-Bit data from the XRD9827 is directly mapped into 8-Bit data while taking into consideration overall system noise and fixed pattern noise. Fixed pattern noise is subtracted out in the color correction process. During the mapping process, white balance is also taken into consideration. White balance is the process that adjusts the gain for each color intensity so that no 8-Bit data is saturated. This process preserves the best high light detail in the image scanned.

SCSI OUTPUT DATA FORMAT

The XRD9827ITGREF is designed to interface through a SCSI Interface. For installing the SCSI drivers and the XRD9827ITGREF, see the XRD9827 ITG Installation User Manual. The output from the scanner is in SCSI format.

SCANNING TARGETS

Perhaps the most useful demonstration is a scan of a grey scale target. *Figure 3* is an example of the grey scale taken from a Kodak Q60 Color Input Target (see Figure 4.) used to demonstrate the dynamic range of the XRD9827. The grey scale target is a picture displaying the range from zero scale (black) to full scale (white) color intensity. A scan of this target can be compared to the original for histogram analysis.

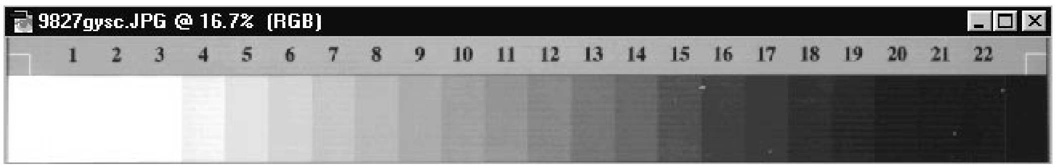

Figure 3. XRD9827 Scan of a Grey Scale

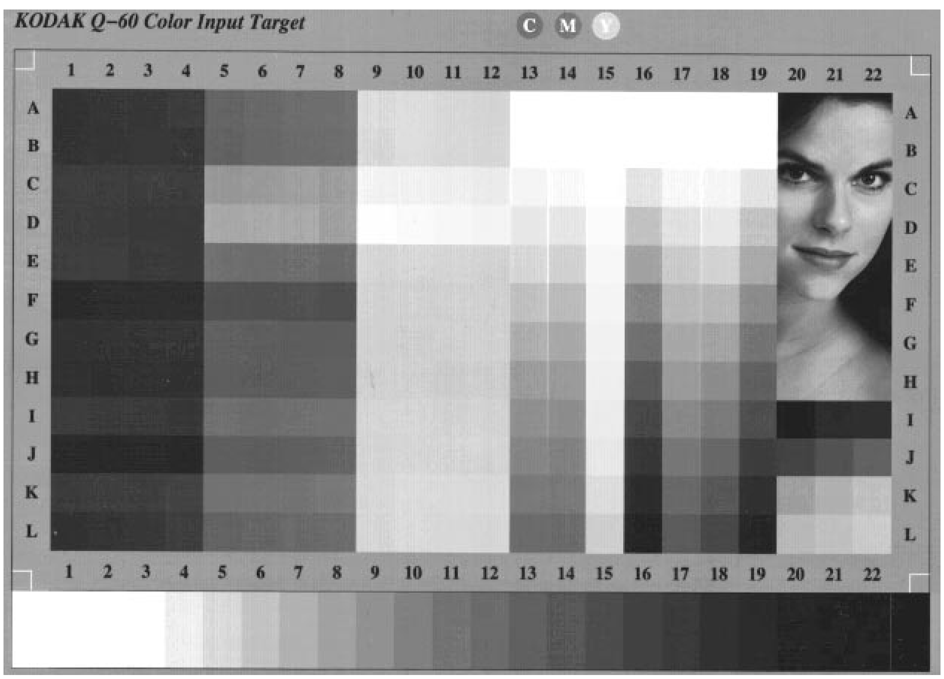

Figure 4. Kodak Q60 Color Input Target

A histogram (using Adobe Photoshop) is a plot of amplitude of pixel intensity vs code of the ADC. The Histogram is an effective tool for characterizing the performance of a scanner. Below is Figure 5. a histogram taken from the scan of the grey scale in *Figure 3.* The key point of using the histogram tool is evaluating the standard deviation for each expected output code.

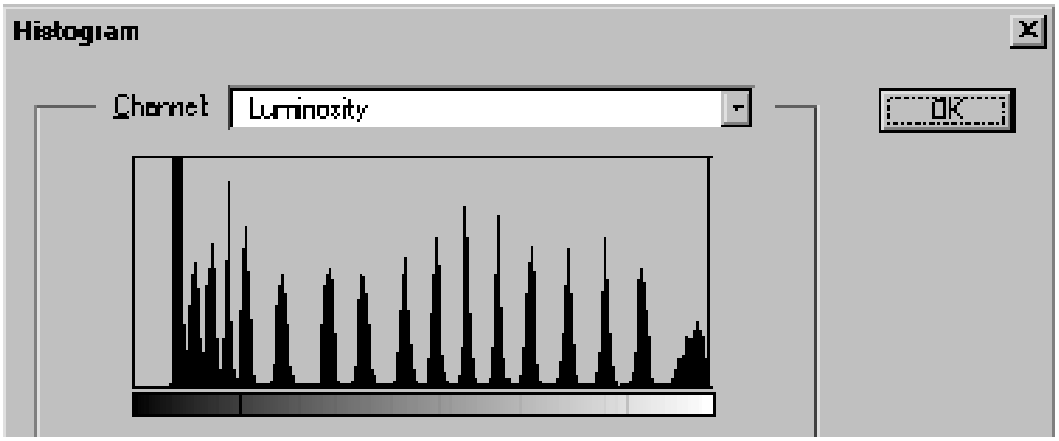

Figure 5. Histogram Taken from a Scan of a Grey Scale

Standard Deviation corresponds to output referred noise. The lower the value of standard deviation, the less noise is present in the system. The standard deviation is a measurement of distribution around the expected output code. Below is *Figure 6* a graph showing the relationship between standard deviation and noise.

1 Sigma (Standard Deviation = 1.0) = 1 RMS Gaussian Noise

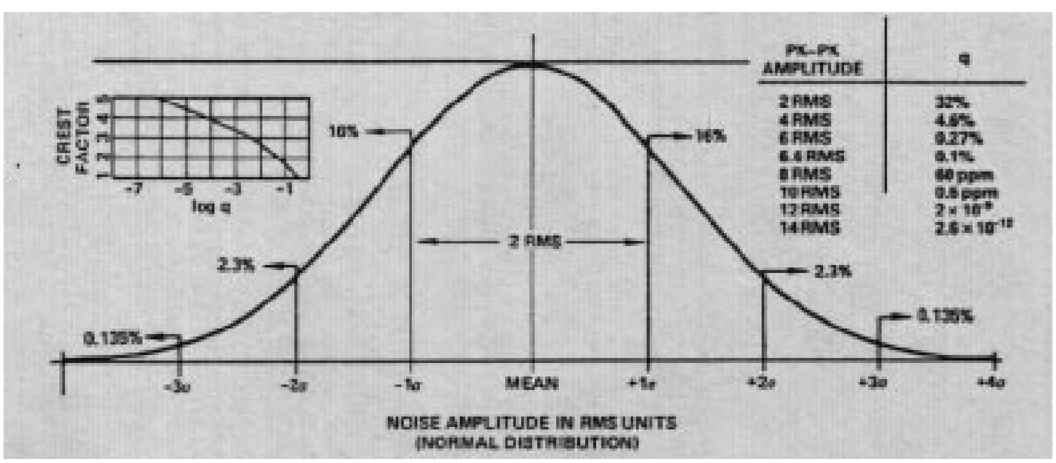

Figure 6. Graph Displaying the Relationship Between Standard Deviation vs Gaussian Noise

Below is *Figure 7* is a histogram taken from the scan of a black image. When scanning a black image, it is expected that the pixel count will occur at zero scale output code on the histogram if there is no offset associated with the analog to digital conversion. If an offset is present, it can be calibrated by the XRD9827 or the digital ASIC. Some amount of offset is usually preferred so that no signal content is lost below zero scale.

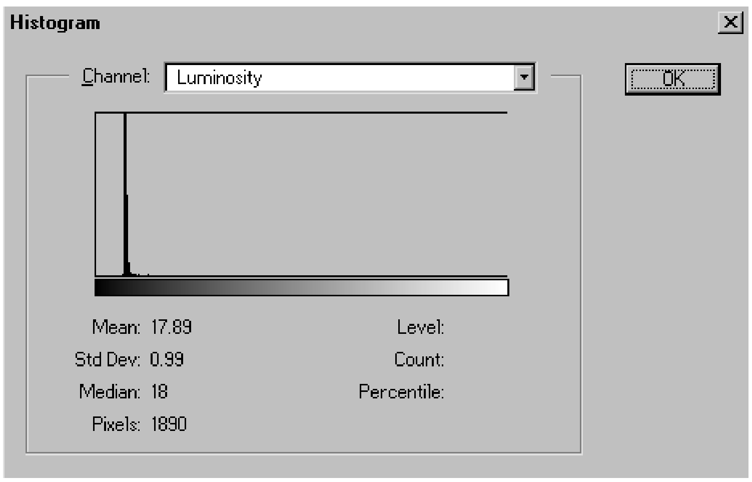

Figure 7. Histogram Taken from a Scan of a Black Target, Std. Dev. 0.99 = 1 sigma = 1 LSB of noise

Different values of offset are used in scanner applications. Dependent on the customer, the value can range from code 5 to code 40 for a scan of a black image. The typical range is from code 10 to code 20. From the graph it can be seen that the black pixel values occur at 17.89 rather than zero scale. Ideally, there will be no distribution in the histogram centered around the output code. However, system noise is always present causing a distribution among the pixel response. Instead of having the pixel response all occuring in one unique bin, there is a range of codes where pixel counts responded. The standard deviation is 0.99 which is equivalent to 1 sigma or 1 LSB of noise. The standard deviation across the grey scale output code displays the information needed to determine the acceptance of distribution. For example: If a standard deviation of 3.00 at any particular code is the maximum value acceptable for an application, the standard deviation taken across the entire grey scale can be used to indicate whether system noise reduction is necessary. Since the XRD9827 scanner is a 12-Bit application, system noise is critical for a clean signal path from the image sensor to the XRD9827. The CIS or CCD sensor and system layout will typically be the leading cause of noise, not the XRD9827.

XRD9827 vs XRD9812 ITG SCANNER

The XRD9827 was designed with a different architecture than the XRD9812. The XRD9812 is a 12-Bit AFE with higher accuracy of DNL, SNR, lower noise, etc. The XRD9812 is best utilized when the digital ASIC and system circuitry is designed to match the higher performance of the ADC. *Figure 8* shows the standard deviation across 22 grey scales using the XRD9827, XRD9812 and the Wolfson 8143-12 using a Kodak Q60 target.

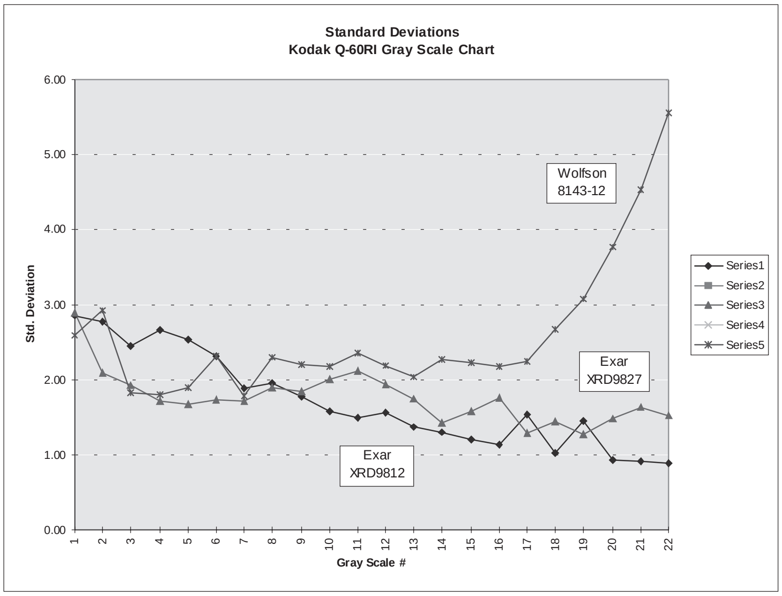

Figure 8. Standard Deviation vs Grey Scale Output Code for the XRD9827, XRD9812, and the Wolfson 8143-12 Using Kodak Q60 Target

The graph shows a resemblance between the XRD9827 and the XRD9812 performance making both parts ideal for scanning applications. The XRD9827 is a low cost AFE without sacraficing the performance of a 12-Bit converter. The Wolfson shows an increase in noise in the darker end of the grey scale. *Figure 9* and *Figure 10* show the XRD9827 Output Noise vs Gain and Input Referred Noise vs Gain respectively.

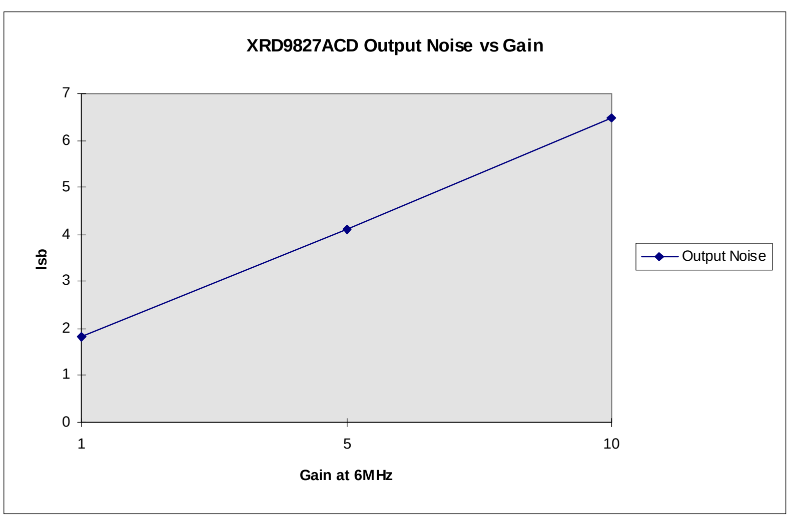

Figure 9. XRD9827 Output Noise vs Gain

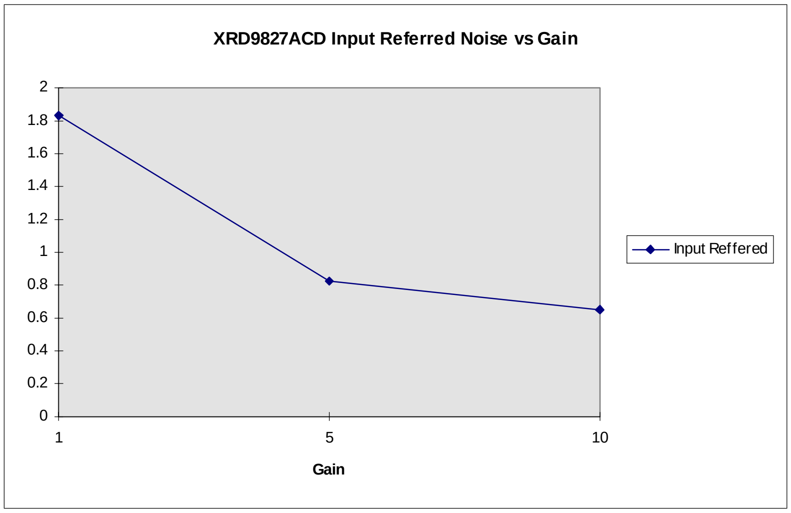

Figure 10. XRD9827 Input Referred Noise vs Gain

Figure 11 and *Figure 12* show the XRD9812 Three Channel Output Noise vs Gain and Input Referred Noise vs Gain respectively.

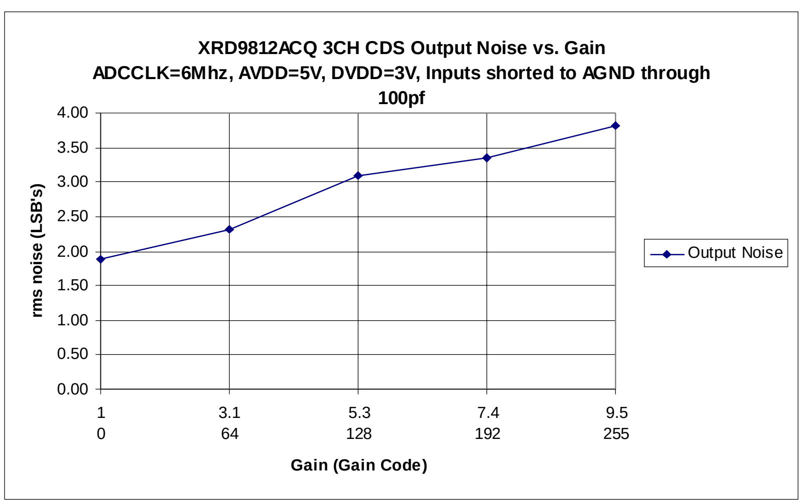

Figure 11. XRD9812 3CH CDS Output Noise vs. Gain

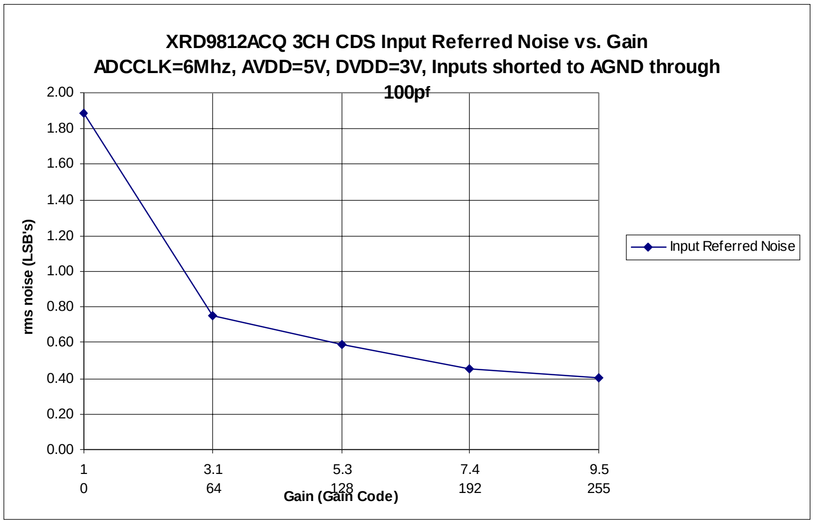

Figure 12. XRD9812 3CH CDS Input Referred Noise vs. Gain

REFERENCES

1. Analog-Digital Covnersion Handbook Third Edition, Analog Devices, 1986. *Figure 6* Graph Displaying the Relationship Between Standard Deviation and Gaussian Noise

Notes

Notes

NOTICE

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