1/6-Inch SOC VGA CMOS Digital Image Sensor

MT9V112I2ASTC

Core Characteristics

Table 1: MT9V112 Image Sensor Core Characteristics

Symbol	Definition	Measurement Conditions	Typical		Unit	Remarks
			MTI[1]	MIT[2]		
Sg	Green response	Condition 1	367	388	LSB	^{t} INT = 1/30 s
Rr	Response comparison	Condition 1	0.625	0.636	–	^{t} INT = 1/30 s
Rb			0.625	0.632		
V_{SAT}	Pixel saturation signal	Condition 2	958	960	LSB	Gain = 1
σ_t	Readout noise	Condition 3	3.06	3.15	LSB	Gain = 511 / 32
σ_t			0.676	0.681		Gain = 1
V_{DARK}	Dark current	Condition 4	5	4	LSB/s	T_J = 55°C, Gain = 1
PRNU	Photoresponse non-uniformity	Condition 5	1.007	0.968	%	Gain = 1
DSNU	Dark signal non-uniformity	Condition 6	0.0099	0.0107	%	Gain = 511 / 32
SNR	Signal-to-noise ratio	Condition 5	41.13	41.10	dB	Gain = 1
DynR	Dynamic range	Condition 6	74.00	73.76	dB	Gain = 511 / 32
Lag	Lag	Condition 7	0	0	%	–

Notes: 1. Data from Micron Technology Inc.
2. Data from Micron Technology Italia.

Description of Measurement Conditions

All measurements are done at nominal power supply voltages, at default settings, and at ambient room temperature except where noted. Measurements are performed in the window 32 x 32 pixels (or 16 x 16 for each color plane) in the center of pixel array, where the signal value is maximum. All measurements in the dark are performed across the whole pixel array.

Measurement Condition 1

A standard pattern box (luminance 706 cd/m^2, color temperature of 3100K halogen source) is used as an illumination source. A lens with F5.6 and a standard CM500 IR-cut filter (t = 1mm) is used to project image from uniformly illuminated surface of the pattern box to the sensor. Signals from different color planes (V_{Gr}, V_{Gb}, V_R, and V_B) are measured in LSB on the sensor output, at 16 x 16 pixels central window of each color plane, as an average of 128 frames, at default integration time and unity gain. Values of dark signals, (V_{GrD}, V_{GbD},V_{RD}, and V_{BD} see Condition 6) are subtracted from light signals. Green response and response comparison are calculated according to the following formula:

$$V_G = \frac{V_{Gr} + V_{Gb} - V_{GrD} - V_{GbD}}{2} \quad \text{(EQ 1)}$$

$$Sg = V_G(LSB) \quad \text{(EQ 2)}$$

$$Rr = \frac{V_R - V_{RD}}{V_G} \quad \text{(EQ 3)}$$

$$Rb = \frac{V_B - V_{BD}}{V_G} \quad \text{(EQ 4)}$$

Measurement Condition 2

Illumination source and lens filter are the same as in Condition 1. Image sensor characteristics are calculated for green pixels only, as an average of 16 frames, 16 x 16 pixels windows for Gr and Gb color planes, in LSB on the sensor output. Saturation signal is measured at exposure 10 times higher than exposure corresponding to 500 LSB on the sensor output at unity gain. Values of dark signals, (see Condition 6) are subtracted from light signals.

$$V_{sat} = \frac{(V_{Grsat} + V_{Gbsat})}{2} \quad \text{(EQ 5)}$$

Measurement Condition 3

The sensor is operated under no illumination. Readout noise, σ_t, is measured as average temporal noise across the whole pixel array, as an average for Gr and Gb color planes. Readout noise is measured in LSB on the sensor output, using 128 frames, default integration time with two different settings for gain: unity gain and maximum analog gain (511 / 32).

Measurement Condition 4

The sensor is operated under no illumination. Dark current is measured at maximum analog gain (511 / 32), across the whole pixel array, in LSB/s on the sensor output, at sensor junction temperature equal to 55°C.

Measurement Condition 5

Illumination source and lens filter are the same as in Condition 1. PRNU (an average for Gr and Gb color planes) is calculated as a ratio of Fixed Pattern Noise to the Signal, for the signal equivalent to 50 percent of saturation (exposure time is adjusted), at unity gain, 16 x 16 pixels windows for Gr and Gb color planes, using 128 frames. Values of dark signals (see Condition 6) are subtracted from light signals:

$$PRNU_{Gr} = \frac{(FPN_{Gr})}{V_{Gr}} \; x \; 100\% \quad \text{(EQ 6)}$$

$$PRNU_{Gb} = \frac{(FPN_{Gb})}{V_{Gb}} \; x \; 100\% \quad \text{(EQ 7)}$$

$$PRNU = \frac{(PRNU_{Gr} + PRNU_{Gb})}{2} \quad \text{(EQ 8)}$$

SNR (an average of Gr and Gb color planes) is calculated as a ratio of green signal to temporal noise at the signal equivalent to 50 percent of saturation (exposure time is adjusted), at unity gain, using 128 frames, 16 x16 pixels windows for Gr and Gb color planes, according to the next formulas:

$$SNR_{Gr} = 20 \log_{10} \left(\frac{V_{Gr}}{\sigma_{tGr}} \right) \quad \text{(EQ 9)}$$

$$SNR_{Gb} = 20 \log_{10} \left(\frac{V_{Gb}}{\sigma_{tGb}} \right) \quad \text{(EQ 10)}$$

$$SNR = \frac{(SNR_{Gr} + SNR_{Gg})}{2} \quad \text{(EQ 11)}$$

Measurement Condition 6

The sensor is operated under no illumination. Dark signal non-uniformity is measured across the whole pixel array at default settings except Gain, which is set to maximum analog value (511 / 32). Dark signal non-uniformity (an average of Gr and Gb color planes) is calculated as a ratio of measured Fixed Pattern Noise to the saturation signal (see Condition 2):

$$DSNU_{Gr} = \frac{\left(\frac{32 \ x \ FPN_{Gr}}{511}\right)}{V_{Grsat} \ x \ \ 100\%} \quad \text{(EQ 12)}$$

$$DSNU_{Gb} = \frac{\left(\frac{32 \ x \ FPN_{Gb}}{511}\right)}{V_{Gbsat} \ x \ \ 100\%} \quad \text{(EQ 13)}$$

$$DSNU = \frac{(DSNU_{Gr} + DSNU_{Gb})}{2} \quad \text{(EQ 14)}$$

Dynamic Range (an average of Gr and Gb color planes) is calculated as a ratio of saturation signal (see Condition 2) to readout noise measured at maximum analog gain 511 / 32 (see Condition 3) according to next formulas:

$$DynR_{Gr} = 20 \log_{10}\left(\frac{(V_{Grsat})}{\sigma_{tGr}} \ x \left(\frac{511}{32}\right)\right) \quad \text{(EQ 15)}$$

$$DynR_{Gb} = 20 \log_{10}\left(\frac{(V_{Gbsat})}{\sigma_{tGb}} \ x \left(\frac{511}{32}\right)\right) \quad \text{(EQ 16)}$$

(EQ 17)

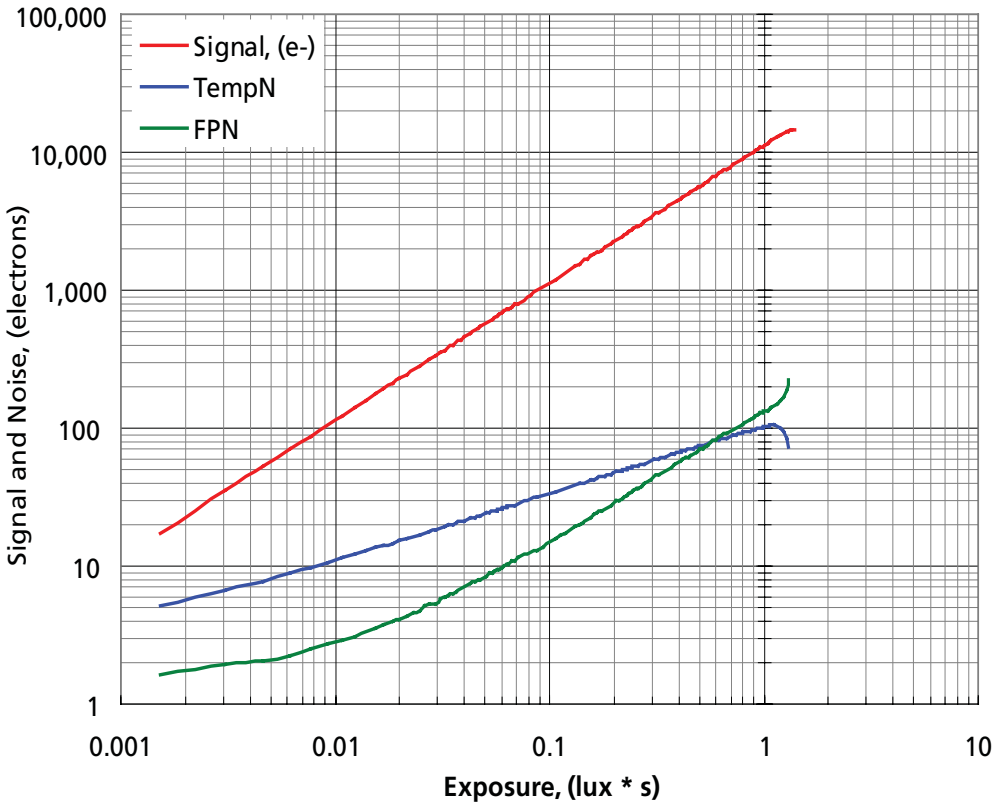
$$DynR_{Gr} = \frac{(DynR_{Gr} + DynR_{Gb})}{2} \quad \text{(EQ 18)}$$

Measurement Condition 7

The array is illuminated by single strobe light during the frame blank time. Lag is calculated as a difference in signals between first dark frame after illumination and an isolated dark frame over the signal in illuminated frame. The lag is calculated for light pulse exposure corresponding to 40 % of saturation. Measurements are completed using default register settings except integration time.

Supplementary Plots

Figure 1: Typical Photon Transfer Curves



Measurement Conditions

The array is illuminated from Davidson Optronic TVO system using Green spectral filter with maximum = 550 ±5nm and Full Width Half Maximum FWHM = 40nm. Signal to noise ratio is calculated for green pixels only. During measurements, gain was adjusted to optimal for each value of exposure.

Figure 2: Typical Signal to Noise Ratio as a Function of Exposure

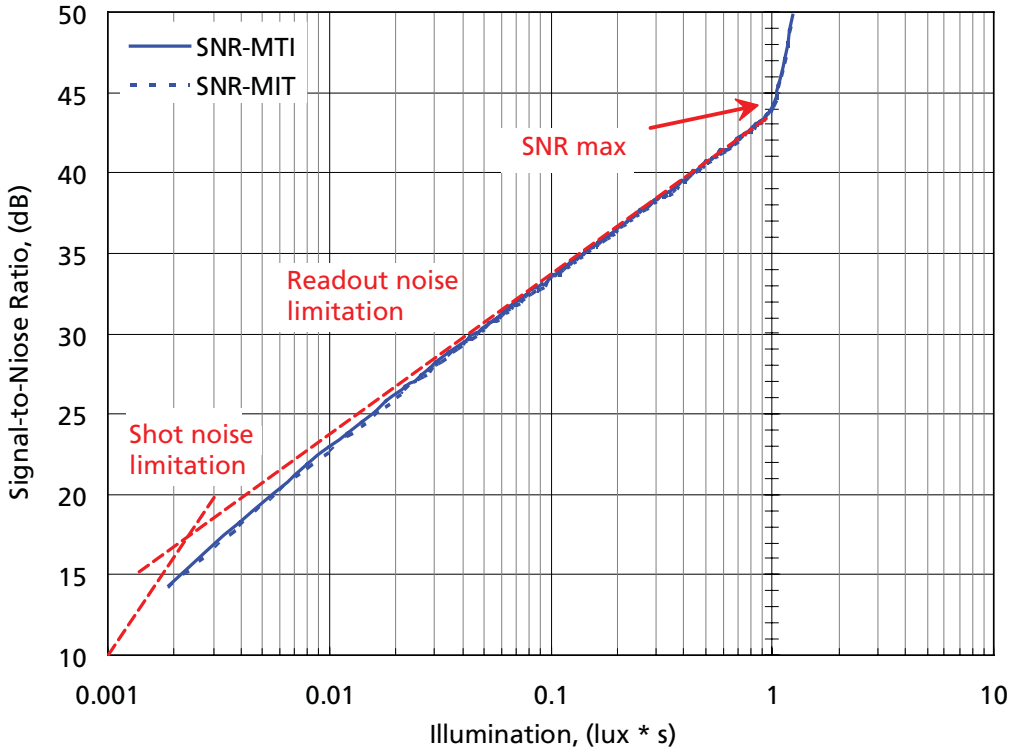


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Figure 3: Typical Transaction Factors as a Function of Gain

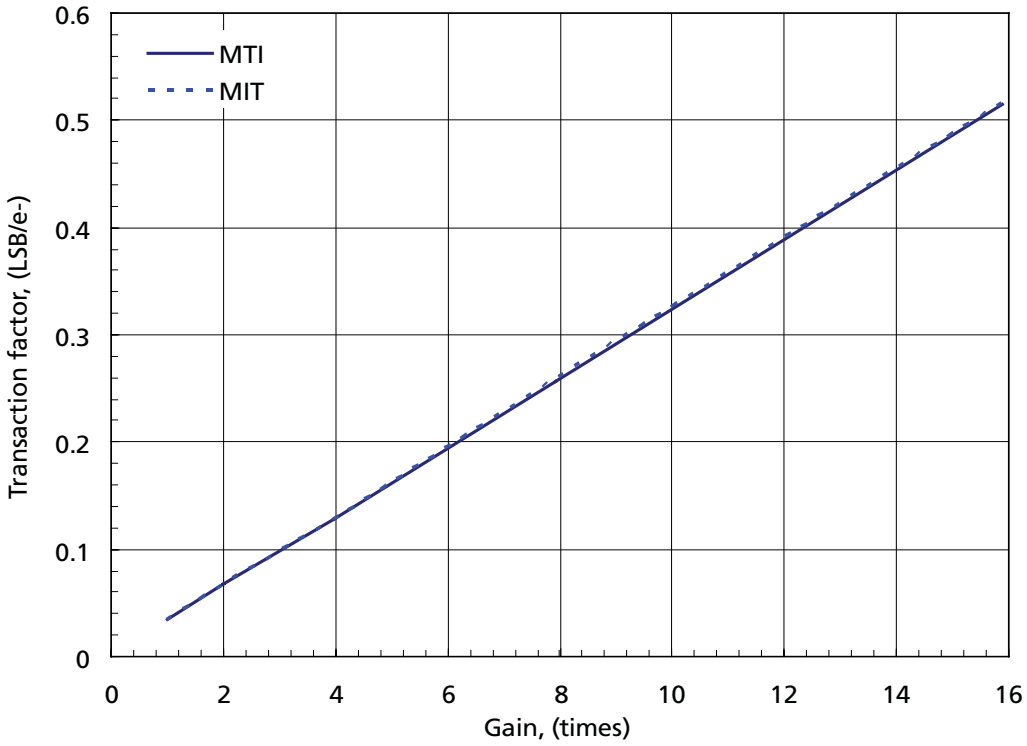
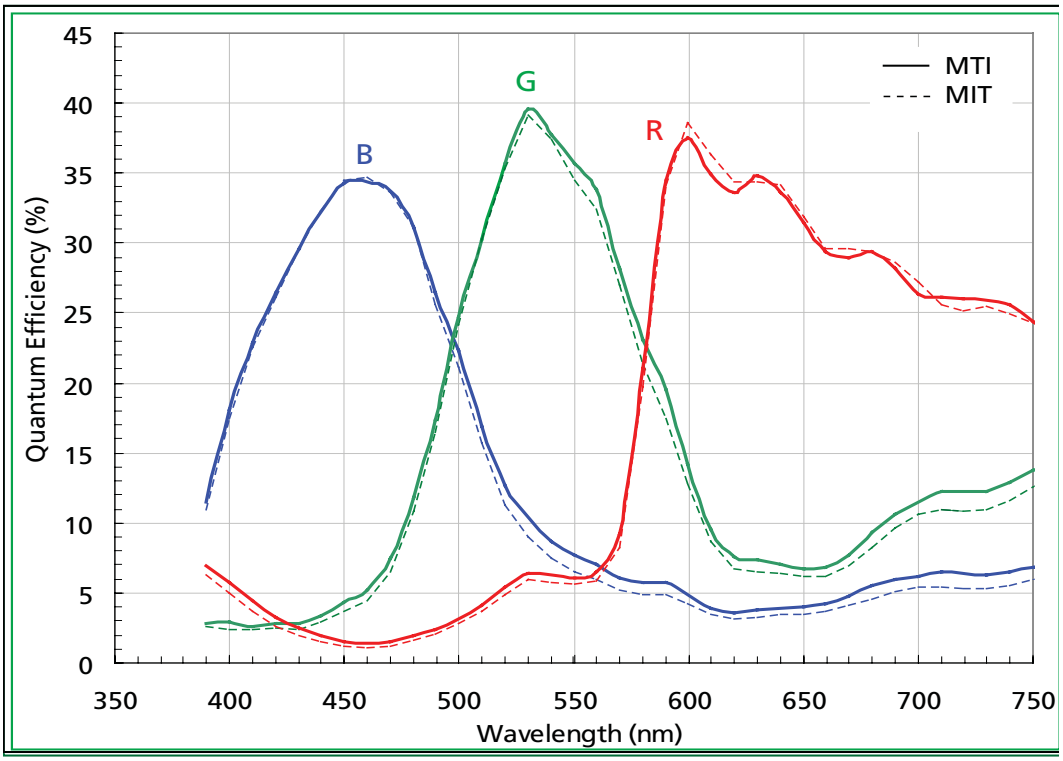


Figure 4: Typical Spectral Characteristics



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Revision History

Rev. A 3/28/2006

- Initial release