NOM04A7-AR11G

400 DPI Ultra High-Speed Contact Image Sensor Module

Description

The NOM04A7−AR11G contact image sensor (CIS) module integrates a red LED light source, lens and image sensor in a compact housing. The module is designed for document scanning, mark reading, gaming and office automation equipment applications and is suitable for scanning documents up to 89 mm wide. An analog video achieves a scanning rate of 423 μsec/line. The NOM04A7−AR11G module employs proprietary CMOS image sensing technology from ON Semiconductor to achieve high−speed performance and high sensitivity.

Features

- Light Source, Lens and Sensor are Integrated into a Single Module
- 89 mm Scanning Width at 15.8 Dots per mm Resolution
- 423 μsec/line Scanning Speed @ 3.33 MHz Pixel Rate
- Analog Video Output
- Supports A7 Paper Size at up to 86 Pages per Minute
- Red LED Light Source
- Wide Dynamic Range
- Compact 101.5 mm x 25.3 mm x 14.85 mm Module Housing
- Low Power
- Light Weight 1.3 oz Packaging
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Applications

- Currency Verification
- Document Scanning
- Mark Readers including Balloting, Test Scoring and Gaming Machines
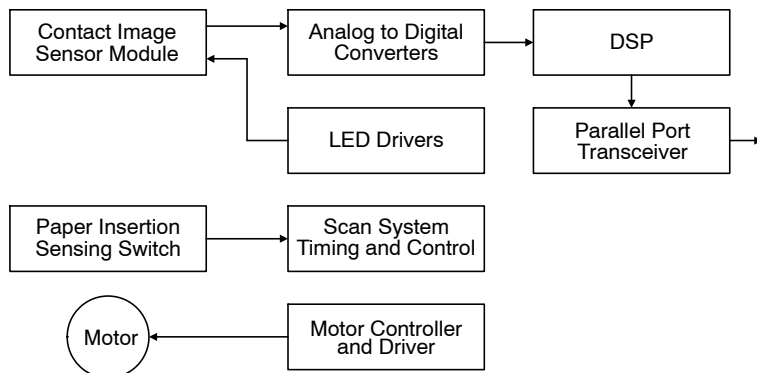- Office Automation Equipment

ON Semiconductor®

http://onsemi.com

**IMAGE SENSOR
MODULE A7
CASE MODAM**

TAG MARKING

NOM04A7−AR11G
YYMMSSSSSS

YY = Year
MM = Month
SSSSSS = Serial Number

CONNECTOR PIN ASSIGNMENT

VOUT	GND	VDD	NC	GND	SP	GND	CP	GLED	VLED
1	2	3	4	5	6	7	8	9	10
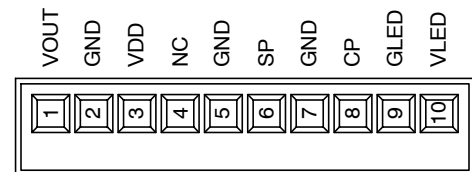
ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

Figure 1. Typical Scanner Application

NOM04A7−AR11G

Table 1. ORDERING INFORMATION

Part Number	Package	Shipping Configuration
NOM04A7−AR11G	MODAM (Pb−free)	100 per Packing Carton
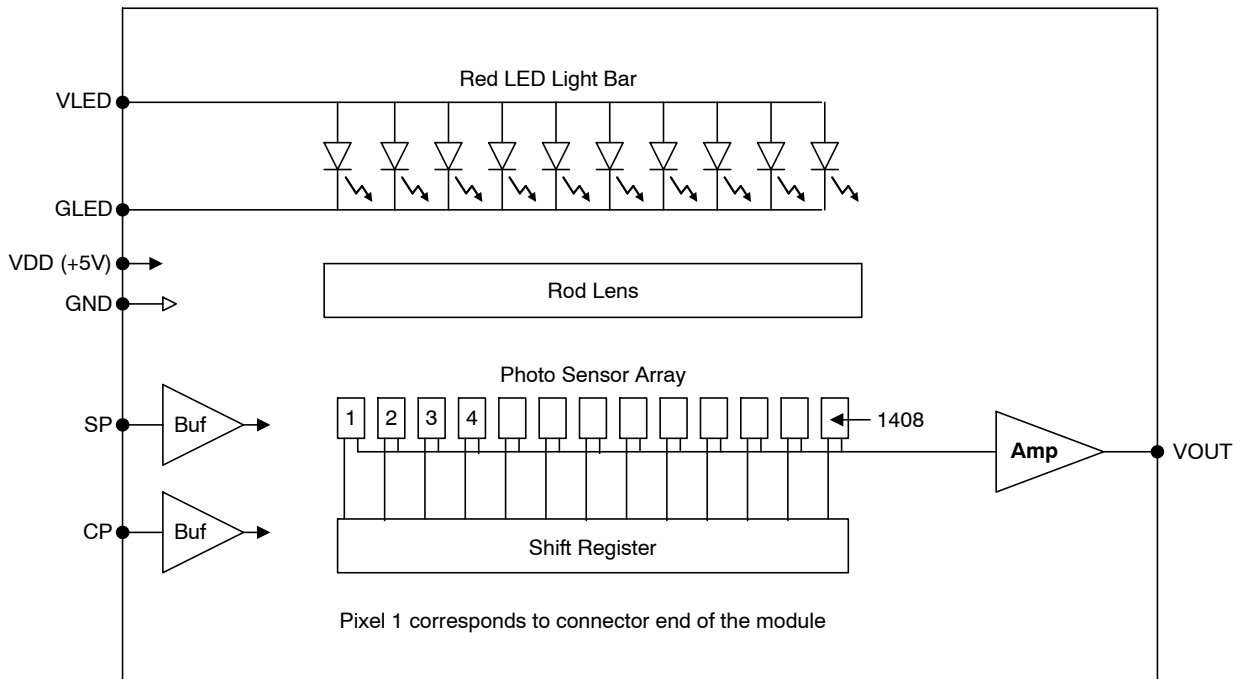
Figure 2. Simplified Block Diagram

Table 2. PIN FUNCTION DESCRIPTION

Pin	Pin Name	Description
1	VOUT	Analog Video Output
2	GND	Ground
3	VDD	+5 V power supply
4	NC	Not connected
5	GND	Ground
6	SP	Shift register start pulse
7	GND	Ground
8	CP	Sampling clock pulse
9	GLED	Ground for the LED light source
10	VLED	Power supply for the LED light source

Table 3. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Power supply voltage	VDD	7	V
	VLED	6	V
Power supply current	ILED	300	mA
Input voltage range for SP, CP	V_{in}	−0.5 to Vdd+0.5	V
Storage Temperature	T_{STG}	−20 to 75	°C
Storage Humidity, Non-Condensing	H_{STG}	10 to 90	%
ESD Capability, Contact Discharge (Note 1)	ESD_{HBM}	±2	kV

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.
1. This module assembly has been ESD tested to IEC61000−4−2 (HBM) Contact Discharge.

Table 4. RECOMMENDED OPERATING RANGES (Unless otherwise specified, these specifications apply T_A = 25°C) (Note 2)

Parameter	Symbol	Min	Typ	Max	Unit
Power supply voltage (Note 3)	VDD	4.5	5	5.5	V
	VLED	4.5	5	5.5	V
Power supply current	I_{DD}	28	32	36	mA
	I_{LED}	130	180	235	mA
Low level input voltage for SP, CP	V_{IL}	VSS − 0.3	0	0.8	V
High level input voltage for SP, CP	V_{IH}	4.5	5.0	VDD + 0.3	V
Line scanning rate (Note 4)	T_{int}	282	423	2816	μs
Clock frequency (Note 5)	f	0.5	3.33	5.0	MHz
Clock period	t_o	200	300	2000	ns
Clock pulse width (Note 6)	t_w	50	75	500	ns
Clock pulse high duty cycle	DC_{CP}	25	50	75	%
Start pulse width (Note 6)	t_{wSP}	150	225	1500	ns
Start pulse setup time	t_{su}	20			ns
Start pulse hold time	t_h	20			ns
Prohibit crossing time (Note 7)	t_{prh}	20			ns
Clock to Video output propagation delay rising	t_{pcor}	100			ns
Clock to Video output propagation delay falling	t_{pcof}	20			ns
Operating Temperature	T_{op}	0		50	°C
Operating Humidity, Non-Condensing	H_{op}	10		60	%

2. Refer to Figure 3 for more information on AC characteristics.
3. VLED directly affects illumination intensity, which directly affects VOUT.
4. Tint is the line scanning rate or integration time. Tint is determined by the interval between two start pulses. The clock is proportional to Tint.
5. Main clock frequency (f) corresponds to the video sampling frequency.
6. Min, Typ, Max specifications reflect operation at the corresponding Min, Typ, Max clock frequency.
7. Prohibit crossing time is to insure that two start pulses are not supplied in the same scan line time. SP may only be active high during one falling edge of CP for any given scan.

Table 5. PHYSICAL SPECIFICATIONS

Parameter	Symbol	Typ	Unit
Scan width	PD_w	89	mm
Number of Photo Detector Arrays	PDA_n	11	arrays
Number of Photo Detectors	PD_n	1408	elements

Table 6. SPECIFICATIONS

Parameter	Symbol	Min	Typ	Max	Unit
Pixel pitch	PD_{sp}		62		μm
Inter−array spacing	PDA_{sp}	150	180	210	μm
Inter−array vertical alignment	PDA_{vxp}	−40	0	40	μm
Red LED peak wavelength	λ_p	653		667	nm

Table 7. ELECTRO-OPTICAL CHARACTERISTICS TEST CONDITIONS

Parameter	Symbol	Value	Unit
Power supply voltage	VDD	5.0	V
	VLED	5.0	V
Clock frequency	f	3.33	MHz
Clock pulse high duty cycle	DC_{CP}	25	%
Line scanning rate	T_{int}	423	μs
LED arrays pulsed time on (Note 8)	LED_Ton	26	ms
LED arrays pulsed time off (Note 8)	LED_Toff	356	ms
Operating Temperature	T_{op}	25	°C

8. Production tested with pulsing LEDs.

Table 8. ELECTRO−OPTICAL CHARACTERISTICS
(Unless otherwise specified, these specifications were achieved with the test conditions defined in Table 7)

Parameter	Symbol	Min	Typ	Max	Unit
Bright analog output voltage (Note 9)	V_{pavg}	1.8	1.9	2.0	V
Bright output non-uniformity (Note 10)	U_p	-30		30	%
Bright output non-uniformity total (Note 11)	U_{ptotal}			60	%
Adjacent pixel non-uniformity (Note 12)	U_{padj}			25	%
Dark output voltage (Note 13)	V_d			500	mV
Dark non-uniformity (Note 14)	U_d			80	mV
Modulation transfer function at 100 line pairs per in (lp/in) (Note 15)	MTF_{100}	40			%
Modulation transfer function at 200 line pairs per in (lp/in) (Notes 15, 16)	MTF_{200}	20			%

9. $Vpavg = \Sigma\ Vp(n)/1408$, where
   Vp is the pixel amplitude value of VOUT in volts for a bright signal defined as a white document with LEDs turned on,
   n is the sequential pixel number in one scan line.
10. $Up = [(Vpmax − Vpavg)/Vpavg] \times 100\%$, or $[Vpavg − Vpmin)/Vpavg] \times 100\%$, whichever is greater, where
   Vpmax is the maximum pixel voltage of any pixel at full bright
   Vpmin is the minimum pixel voltage of any pixel at full bright
11. $Uptotal = [(Vpmax − Vpmin)/Vpavg] \times 100\%$,
12. $Upadj = MAX\ [\ |\ (Vp(n) − Vp(n+1)\ |\ /\ Vp(n)] \times 100\%$, where
   Upadj is the nonuniformity in percent between adjacent pixels for a bright background
13. Vd is the pixel amplitude value of VOUT in volts for a dark signal defined as a black document with LEDs turned off
14. $Ud = Vdmax − Vdmin$, where
   Vdmax is the maximum pixel voltage of any dark pixel with the LEDs turned off
   Vdmin is the minimum pixel voltage of any dark pixel with the LEDs turned off
15. $MTF = [(Vmax − Vmin)/(Vmax + Vmin)] \times 100\%$, where
   Vmax is the maximum output voltage at the specified line pairs per inch (lp/in)
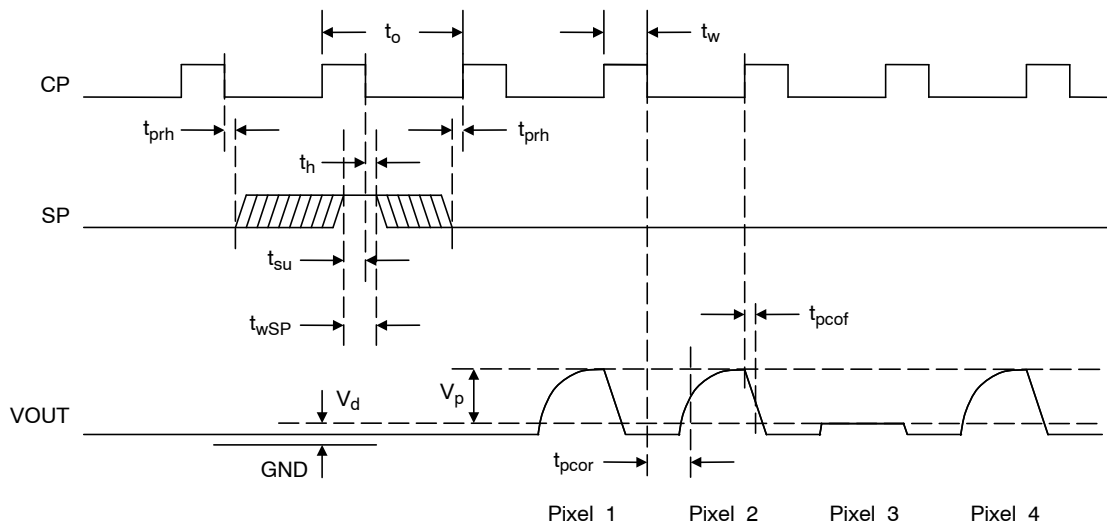   Vmin is the minimum output voltage at the specified lp/in
16. For information only.

Figure 3. Timing Diagram

Description of Operation

Functional Description

The NOM04A7−AR11G module consists of 11 contact image sensors, each with 128 pixel elements, that are cascaded to provide 1408 photo−detectors with their associated multiplex switches and a double−buffered digital shift register that controls its sequential readout. The buffer amplifies the video pixels from the image sensors and outputs an analog video signal of the module as shown in Figure 2. In operation, the sensors produce analog image pixel signals (or video signals) proportional to the exposure on the corresponding picture elements on the document. The VOUT signal outputs 1408 pixels for each scan line. The first bit shifted out from VOUT during each scan represents the first pixel on the connector end of the module.

A pictorial of the NOM04A7−AR11G cross section view is shown in Figure 4. Mounted in the module is a one−to−one graded−index micro lens array that focuses the scanned document image onto the sensing plane. Illumination is accomplished by means of an integrated LED light source. All components are housed in a small plastic housing, which has a glass cover. The top surface of the glass acts as the focal point for the object being scanned and protects the imaging array, micro lens assembly and LED light source from dust.
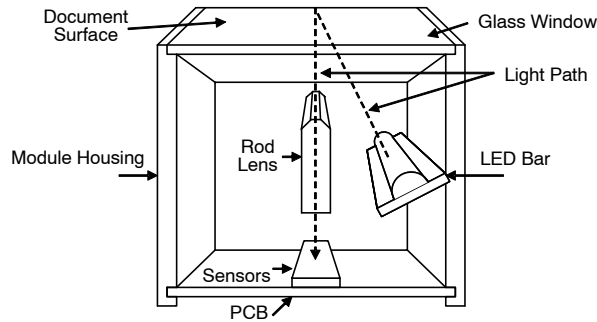
Figure 4. Module Cross Section View

Connector Pin Out Description

Connections to the module are via a 2.7 x 14.7 mm 10−pin connector (Molex part number 52207−1090) located at one end of the module as shown in the package drawing on page 8. The location of pin number 1 is indicated on the package drawing.

Scanner Applications

A typical use of the NOM04A7−AR11G module in scanner applications is shown in Figure 6. The document to be digitized is fed into the scanner where a sensor detects its presence. The scanner then operates the motor to move the paper under the contact image sensor module. The module illuminates the paper with internal LEDs and the image sensor pixel array detects the amount of reflected light and simultaneously measures a full line of pixels which are sampled and transferred to a FIFO for storage and conversion to a parallel output format. Once the pixel line is processed, the motor advances the paper and the next scan line is captured.
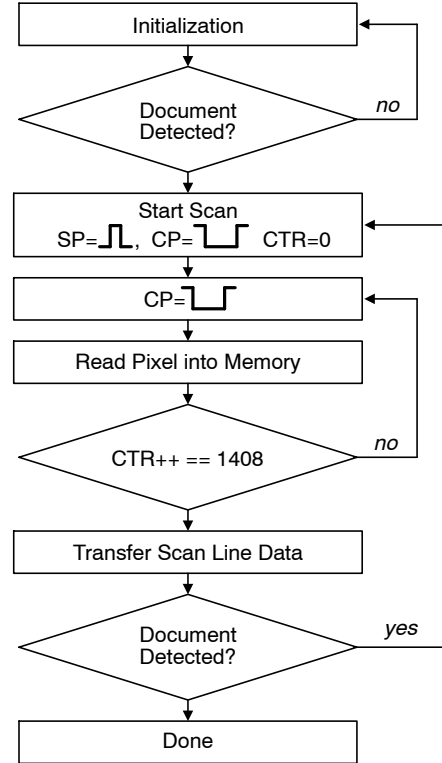
Figure 5. Typical Scanner Algorithm

Figure 5 outlines the basic steps in the scanner control sequence. First the circuits are initialized and the scanner waits for a document to be detected, usually by a paper sensing switch. Then a start pulse and clock pulse are supplied to capture a line image. At the next clock pulse the first pixel value appears on the output. The pixel can be stored in a local line buffer memory. Subsequent clocks cause the remaining pixels to be shifted out and stored in the line buffer. Once the complete line has been shifted out it can be transferred to the host application and the system advances the paper and the line scan process repeats until the paper sensing switch indicates the document has passed completely through the scanner.

Device Marking and Barcode Description

Each module is marked with a tag that contains the part number, a number combining the manufacturing date code and serial number and a barcode. The barcode presents the date code and serial number in Interleave 2 of 5 barcode format as follows:

YYMMSSSSSS

where   YY is the year,
                MM is the month, and
                SSSSSS is the serial number.

Glass Lens Care

Precautions should be taken to avoid scratching or touching the glass lens. The glass lens may be cleaned with alcohol.
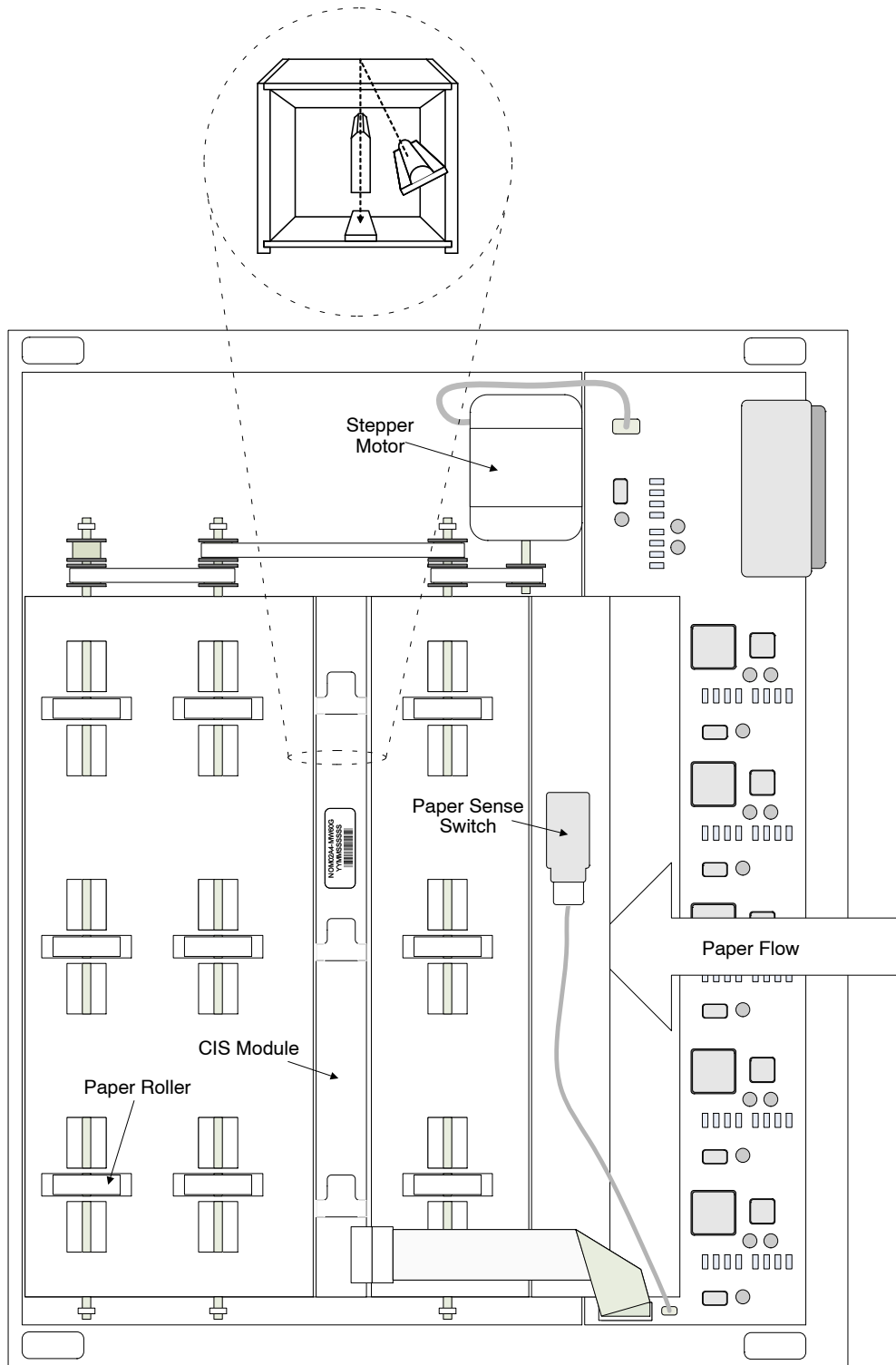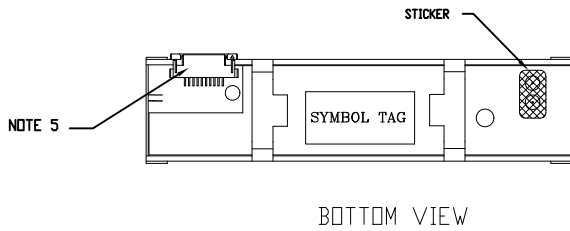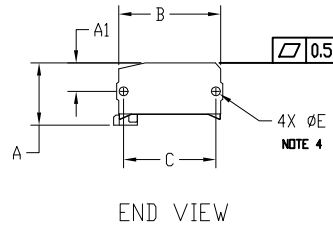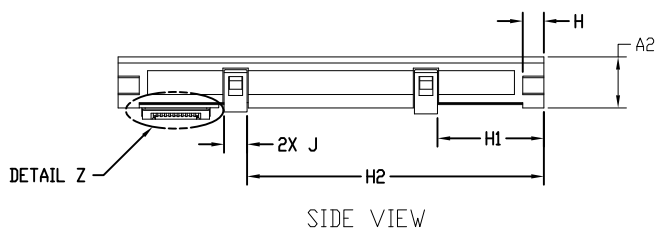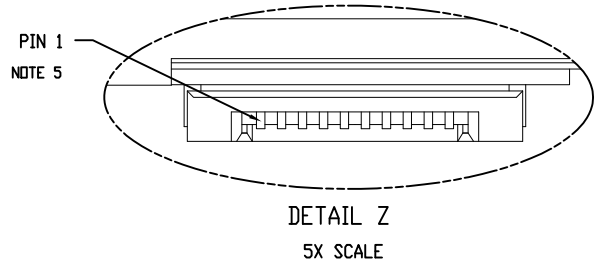
Figure 6. Typical Scanner Assembly

NOM04A7−AR11G

PACKAGE DIMENSIONS

IMAGE SENSOR MODULE
CASE MODAM
ISSUE O

TOP VIEW

DETAIL Z
5X SCALE

DETAIL Z

SIDE VIEW

END VIEW

BOTTOM VIEW
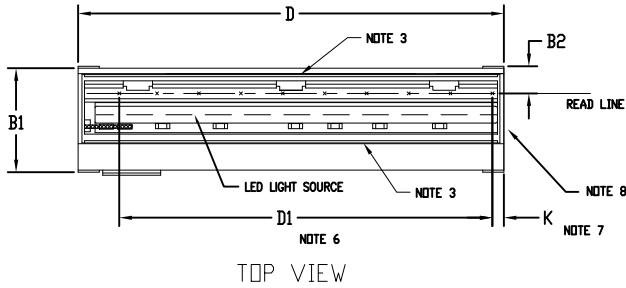
DIM	MILLIMETERS	
	MIN	MAX
A	14.35	15.35
A1	5.85	6.45
A2	13.10	14.10
B	23.90	24.50
B1	25.00	25.60
B2	6.00	7.00
C	21.70	22.30
D	101.00	102.00
D1	89.00 REF	
E	1.75	1.85
H	4.70	5.30
H1	25.05	25.65
H2	70.45	71.05
J	5.30	5.70
K	1.70	3.70

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. GLASS IS GLUED ALONG THE 2 LONG SIDES. NEITHER GAP, TRENCH, NOR STEP IS ALLOWED AT THE TWO LONG BOUND-ARIES BETWEEN THE GLASS AND THE HOUSING.
4. BORE DEPTH IS 4.3 WITH A CHAMFER DEPTH OF 0.2.
5. CONNECTOR, MOLEX FPC ZIF SMT PART NUMBER 52207−1085 OR EQUIVALENT, 1 x 10 PIN, PITCH 1.00.
6. DIMENSION D1 DENOTES THE SCAN LENGTH.
7. DIMENSION K DENOTES THE POSITION OF THE FIRST PIXEL.

PACKING DIMENSIONS

PACKING METHOD

10 LAYERS

1
2
3
4
5

PACKING COMPLETE

410 mm

380 mm

350 mm
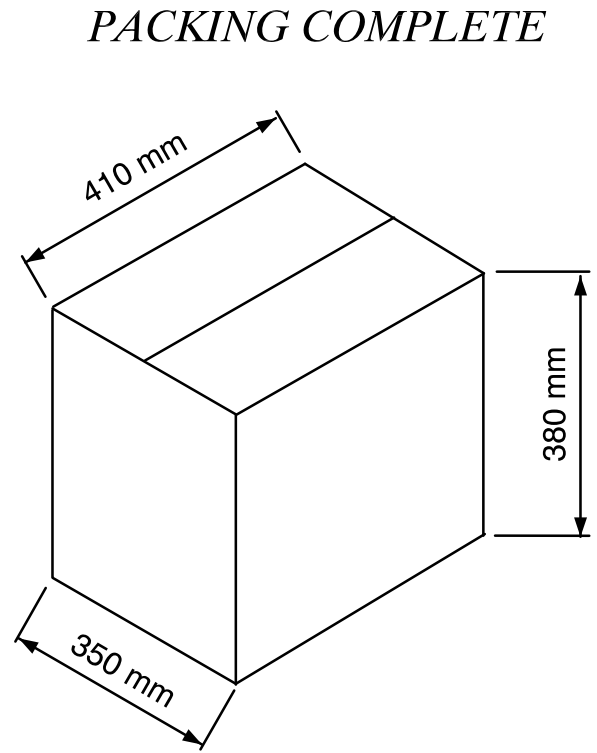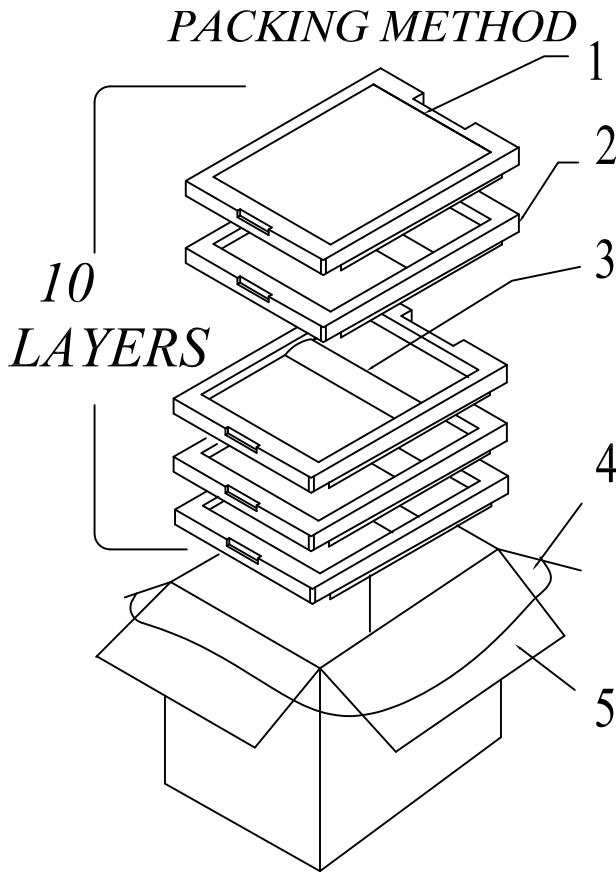
NO.	NAME	MATERIAL
1	Shockproof Pad	EPE
2	Packing Tray	POLYFOAM
3	Conduct Electricity Sheet	PE + CONDUCTIVE SHEET
4	Waterproof Bag	PE
5	Packing Box−Carton	KRAFT PAPER