

# AS72653

## Smart 6-Channel Visible Spectral\_ID Sensor with Electronic Shutter

### General Description

The AS72653 is a digital 6-channel multi-spectral sensor for spectral identification in the visible to complement the AS7265x chipset. It has 6 independent on-device optical filters whose spectral response is defined in the wavelengths from 410nm to 535nm with FWHM of 20nm. The AS72651 Master is required for AS72653 usage giving a 12-channel solution, if the AS72652 is also included the resulting solution is 18-channels.

Each AS7265x device has two integrated LED drivers with programmable current and can be timed for electronic shutter applications.

Each AS7265x device integrates Gaussian filters into standard CMOS silicon via Nano-optic deposited interference filter technology in LGA packages that also provide built-in apertures to control the light entering the sensor array.

*Ordering Information and Content Guide appear at end of datasheet.*

### Key Benefits & Features

The benefits and features of AS72653, Smart 6-Channel Visible Spectral\_ID Sensor with Electronic Shutter are listed below:

**Figure 1:**  
AS7265x Chip-Set Benefits and Features

Benefits	Features
<ul style="list-style-type: none"> <li>Very accurate light measurements</li> </ul>	<ul style="list-style-type: none"> <li>FWHM of 20nm for each filter, same as found in the entire AS7265x family</li> </ul>
<ul style="list-style-type: none"> <li>Used as part of a total 12 or 18 channel spectrometry solution, by usage with other AS7265x family members</li> </ul>	<ul style="list-style-type: none"> <li>AS72651 Master is required for AS72653 operation, the AS72652 is optional</li> </ul>
<ul style="list-style-type: none"> <li>6-channel multi-spectral sensor solution</li> </ul>	<ul style="list-style-type: none"> <li>AS72653 is a 6-channel visible spectral device</li> </ul>
<ul style="list-style-type: none"> <li>Lifetime-calibrated sensing with minimal drift over time or temperature</li> </ul>	<ul style="list-style-type: none"> <li>Filter set realized by silicon interference filters</li> </ul>
<ul style="list-style-type: none"> <li>Signal conditioning not necessary</li> </ul>	<ul style="list-style-type: none"> <li>Digital sensor 16-bit ADC with digital access</li> </ul>
<ul style="list-style-type: none"> <li>LED Driver output</li> </ul>	<ul style="list-style-type: none"> <li>Programmable LED driver current outputs</li> </ul>
<ul style="list-style-type: none"> <li>Temperature monitoring</li> </ul>	<ul style="list-style-type: none"> <li>On-chip temperature sensor</li> </ul>
<ul style="list-style-type: none"> <li>Commercial temperature range</li> </ul>	<ul style="list-style-type: none"> <li>Temperature range: -40°C to 85°C</li> </ul>
<ul style="list-style-type: none"> <li>Low voltage operation</li> </ul>	<ul style="list-style-type: none"> <li>2.7V to 3.6V with I<sup>2</sup>C interface</li> </ul>

Benefits	Features
<ul style="list-style-type: none"> <li>• Small, robust package, with built-in aperture</li> </ul>	<ul style="list-style-type: none"> <li>• 20-pin LGA package 4.5mm x 4.7mm x 2.5mm</li> <li>• -40°C to 85°C temperature range</li> </ul>

### Applications

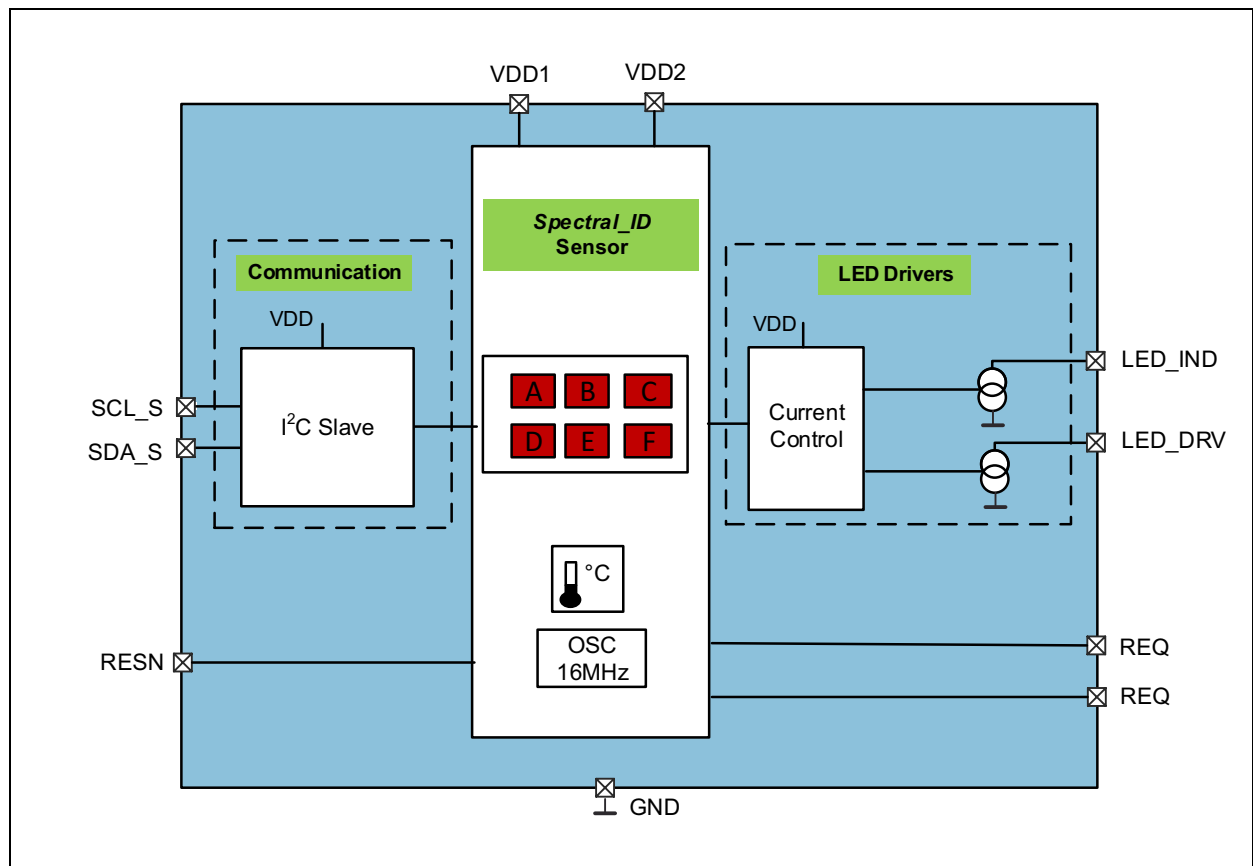
The AS72653 applications include:

- Product/Brand authentication
- Anti-counterfeiting
- Portable spectroscopy
- Product safety/adulteration detection
- Horticultural & specialty lighting
- Material analysis

### Block Diagram

The functional blocks of this device are shown below:

**Figure 2:**  
Functional Blocks of AS72653



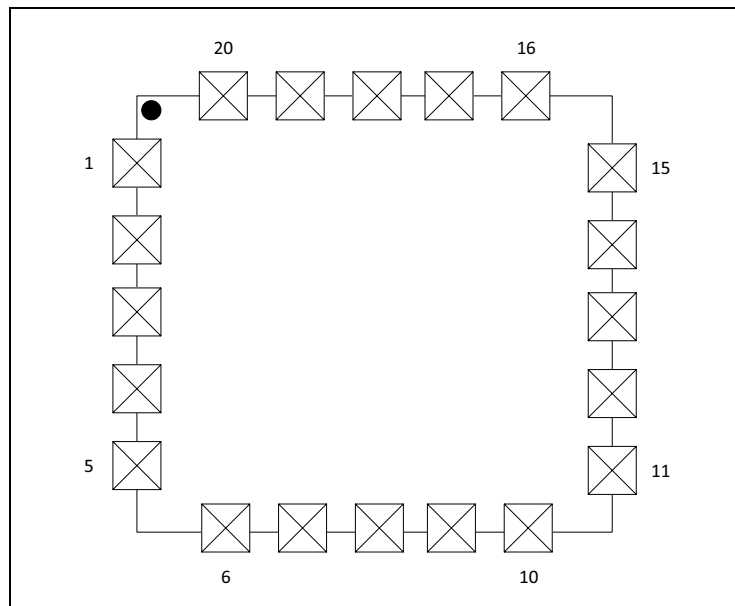
**Note(s):**

1. Refer to the Application Diagram in [Figure 23](#).

## Pin Assignments

The device pin assignments are described below.

**Figure 3:**  
Pin Diagram of AS72653 (Top View)



**Figure 4:**  
AS72653 Pin Description

Pin No.	Pin Name	Pin Type	Description
1	NC		No connection
2	RESN	Digital Input	Reset pin, active low (w/internal pull-up to VDD)
3	NC		No connection
4	NC		No connection
5	REQ	Digital Input	Required pin connection to external 10K $\Omega$ resistor to GND
6	NC		No connection
7	REQ	Digital Input	Required pin connection to external 10K $\Omega$ resistor to GND
8	NC		No connection
9	SCL_S	Digital Input	Serial clock for intra-device I <sup>2</sup> C slave interface
10	SDA_S	Digital Input and Output	Serial data for intra-device I <sup>2</sup> C slave interface
11	NC		No connection
12	NC		No connection

Pin No.	Pin Name	Pin Type	Description
13	NC		No connection
14	VDD2	Voltage Supply	Voltage supply
15	LED_DRV	Analog Output	LED Driver output for driver LED, current sink
16	GND	Supply	Ground
17	VDD1	Voltage Supply	Voltage supply
18	LED_IND	Analog Output	LED driver output for Indicator LED, current sink
19	NC		No connection
20	NC		No connection

## Absolute Maximum Ratings

Stresses beyond those listed under [Absolute Maximum Ratings](#) may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated under [Electrical Characteristics](#) is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. The device is not designed for high energy UV (ultraviolet) environments, including upward looking outdoor applications, which could affect long term optical performance.

**Figure 5:**  
Absolute Maximum Ratings of AS72653

Symbol	Parameter	Min	Max	Unit	Comments
<b>Electrical Parameters</b>					
V <sub>DD1_MAX</sub>	Supply Voltage VDD1	-0.3	5	V	Pin VDD1 to GND
V <sub>DD2_MAX</sub>	Supply Voltage VDD2	-0.3	5	V	Pin VDD2 to GND
V <sub>DD_IO</sub>	Input/Output Pin Voltage	-0.3	VDD+0.3	V	Input/Output pin to GND
I <sub>SCR</sub>	Input Current (latch-up immunity)	± 100		mA	JESD78D
<b>Electrostatic Discharge</b>					
ESD <sub>HBM</sub>	Electrostatic Discharge HBM	±1000		V	JS-001-2014
ESD <sub>CDM</sub>	Electrostatic Discharge CDM	±500		V	JESD22-C101F
<b>Temperature Ranges and Storage Conditions</b>					
T <sub>STRG</sub>	Storage Temperature Range	-40	85	°C	
T <sub>BODY</sub>	Package Body Temperature		260	°C	IPC/JEDEC J-STD-020. The reflow peak soldering temperature (body temperature) is specified according IPC/JEDEC J-STD-020 "Moisture/Reflow Sensitivity Classification for Non-hermetic Solid State Surface Mount Devices"
RH <sub>NC</sub>	Relative Humidity (non-condensing)	5	85	%	
MSL	Moisture Sensitivity Level	3			Represents a 168 hour max. floor lifetime

## Electrical Characteristics

All limits are guaranteed with  $V_{DD} = V_{DD1} = V_{DD2} = 3.3V$ ,  $T_{AMB} = 25^{\circ}C$ . The parameters with min and max values are guaranteed with production tests or SQC (Statistical Quality Control) methods.

$V_{DD1}$  and  $V_{DD2}$  should be sourced from the same power supply output.

**Figure 6:**  
Electrical Characteristics of AS72653

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>General Operating Conditions</b>						
$V_{DD1}/V_{DD2}$	Voltage Operating Supply	I <sup>2</sup> C Interface	2.7	3.3	3.6	V
$T_{AMB}$	Operating Temperature		-40	25	85	°C
$I_{VDD}$	Operating Current				5	mA
<b>Internal RC Oscillator</b>						
$F_{OSC}$	Internal RC Oscillator Frequency		15.7	16	16.3	MHz
$t_{JITTER}^{(1)}$	Internal Clock Jitter	@25°C			1.2	ns
<b>Temperature Sensor</b>						
$D_{TEMP}$	Absolute Accuracy of the Internal Temperature Measurement		-8.5		8.5	°C
<b>Indicator LED</b>						
$I_{IND}$	LED Current		1		8	mA
$I_{ACC}$	Accuracy of Current		-30		30	%
$V_{LED}$	Voltage Range of Connected LED	V <sub>ds</sub> of current sink	0.3		V <sub>DD</sub>	V
<b>LED_DRV</b>						
$I_{LED1}$	LED Current		12.5		100	mA
$I_{ACC}$	Accuracy of Current		-10		10	%
$V_{LED}$	Voltage Range of Connected LED	V <sub>ds</sub> of current sink	0.3		V <sub>DD</sub>	V

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Digital Inputs and Outputs</b>						
$I_{IH}, I_{IL}$	Logic Input Current	$V_{in}=0V$ or VDD	-1		1	$\mu A$
$V_{IH}$	CMOS Logic High Input		0.7* VDD		VDD	V
$V_{IL}$	CMOS Logic Low Input		0		0.3* VDD	V
$V_{OH}$	CMOS Logic High Output	$I=1mA$			VDD- 0.4	V
$V_{OL}$	CMOS Logic Low Output	$I=1mA$			0.4	V
$t_{RISE}^{(1)}$	Current Rise Time	$C(Pad)=30pF$			5	ns
$t_{FALL}^{(1)}$	Current Fall Time	$C(Pad)=30pF$			5	ns

**Note(s):**

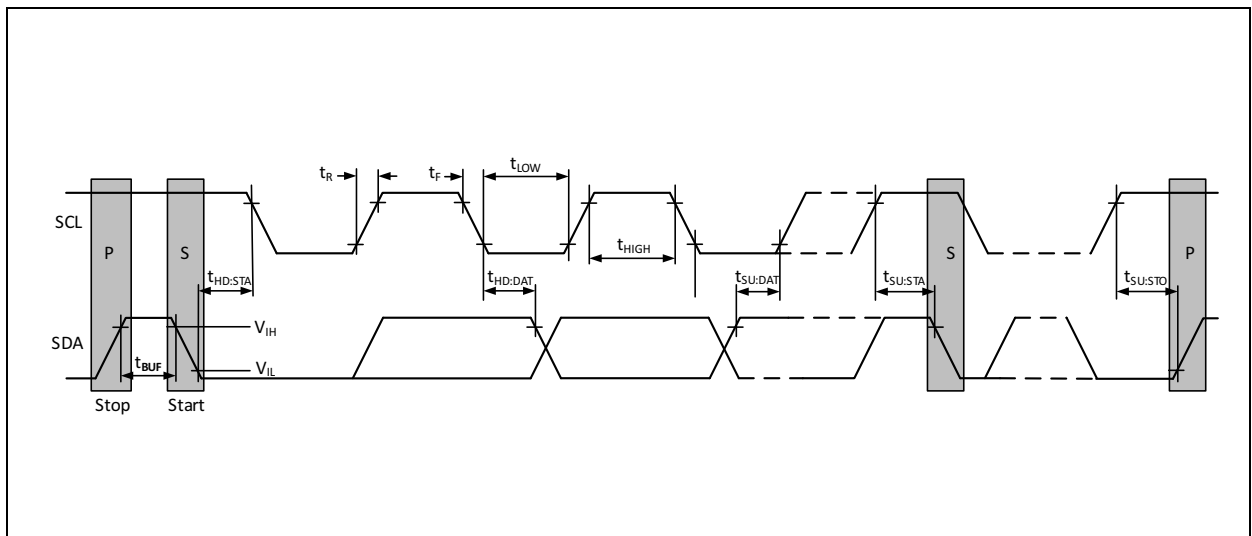
1. Guaranteed, not tested in production.

### Timing Characteristics

Figure 7:  
AS72653 I<sup>2</sup>C Slave Timing Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>I<sup>2</sup>C Interface</b>						
f <sub>SCLK</sub>	SCL Clock Frequency		0		400	kHz
t <sub>BUF</sub>	Bus Free Time Between a STOP and START		1.3			μs
t <sub>HS:STA</sub>	Hold Time (Repeated) START		0.6			μs
t <sub>LOW</sub>	LOW Period of SCL Clock		1.3			μs
t <sub>HIGH</sub>	HIGH Period of SCL Clock		0.6			μs
t <sub>SU:STA</sub>	Setup Time for a Repeated START		0.6			μs
t <sub>HS:DAT</sub>	Data Hold Time		0		0.9	μs
t <sub>SU:DAT</sub>	Data Setup Time		100			ns
t <sub>R</sub>	Rise Time of Both SDA and SCL		20		300	ns
t <sub>F</sub>	Fall Time of Both SDA and SCL		20		300	ns
t <sub>SU:STO</sub>	Setup Time for STOP Condition		0.6			μs
C <sub>B</sub>	Capacitive Load for Each Bus Line	CB - total capacitance of one bus line in pF			400	pF
C <sub>I/O</sub>	I/O Capacitance (SDA, SCL)				10	pF

Figure 8:  
I<sup>2</sup>C Slave Timing Diagram



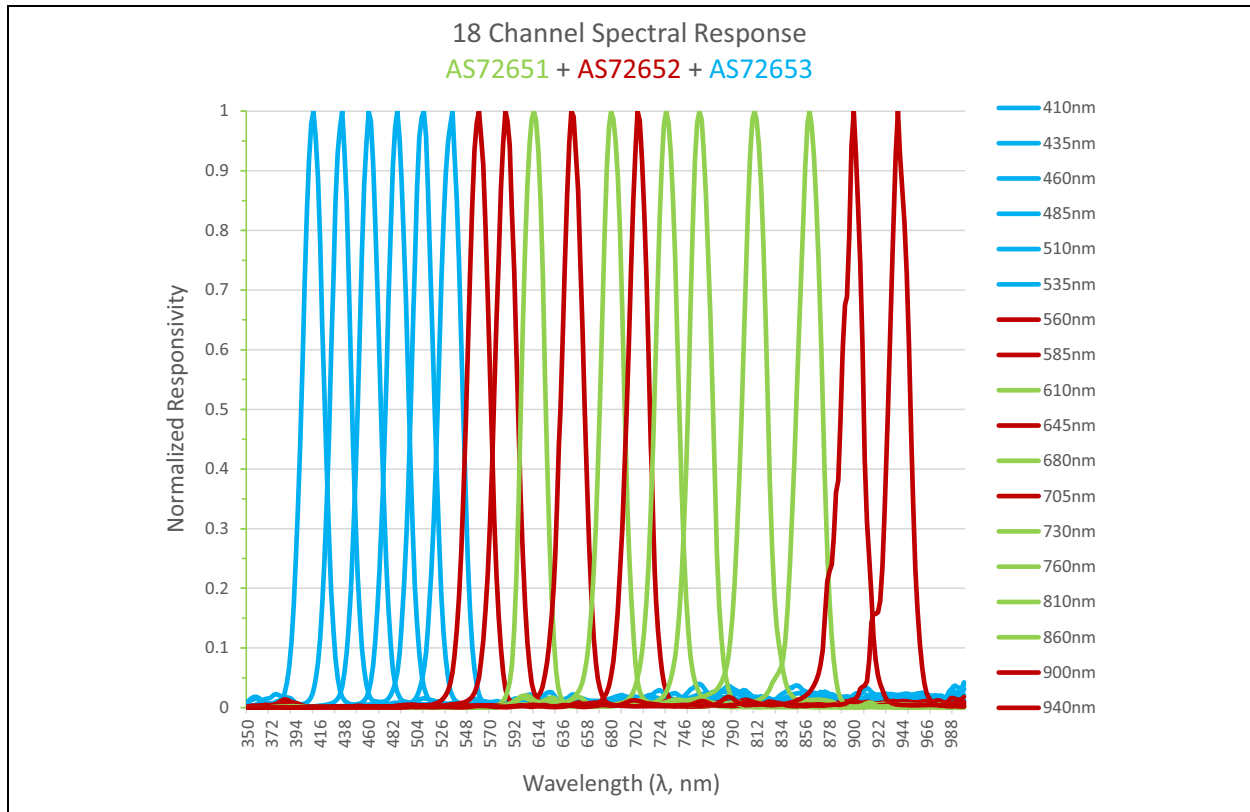


## Typical Operating Characteristics

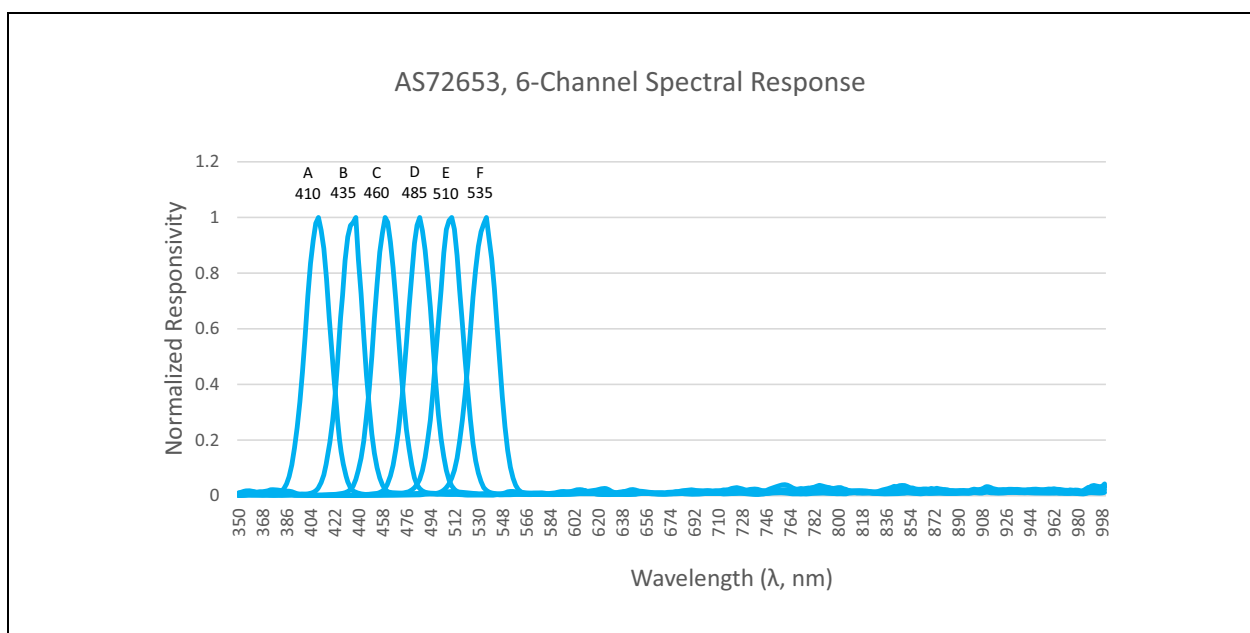
### Optical Characteristics

All optical characteristics are optimized for diffused light.

**Figure 9:**  
AS7265x 18-Channel Spectral Responsivity



**Figure 10:**  
AS72653 Spectral Responsivity



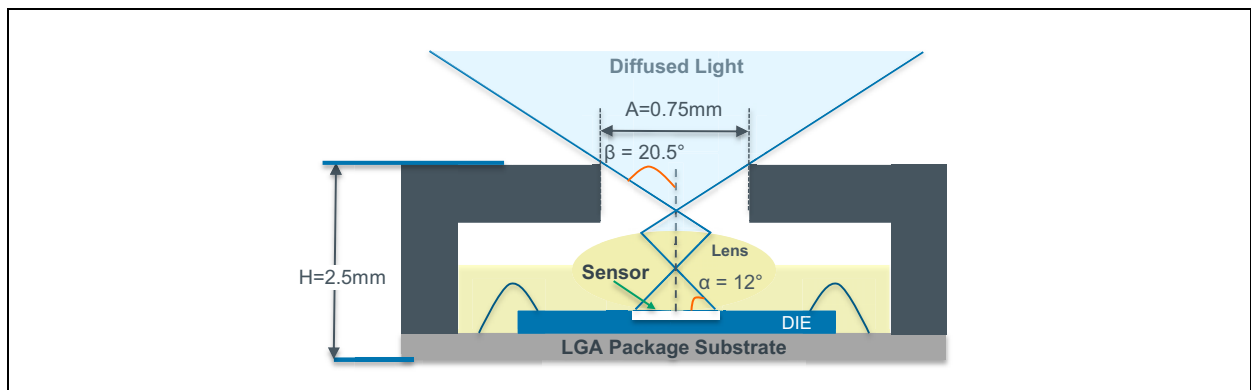
**Figure 11:**  
**Optical Characteristics of AS72653 (Pass Band) <sup>(1)</sup>**

Symbol	Parameter	Test Conditions	Channel (nm)	Min	Typ	Max	Unit
A	Channel A	LED: 395nm, 415nm, 428nm, 5600K white <sup>(2)</sup>	410		35 <sup>(3)</sup>		counts/ ( $\mu\text{W}/\text{cm}^2$ )
B	Channel B	LED: 395nm, 415nm, 428nm, 5600K white <sup>(2)</sup>	435		35 <sup>(3)</sup>		counts/ ( $\mu\text{W}/\text{cm}^2$ )
C	Channel C	LED: 395nm, 415nm, 428nm, 5600K white <sup>(2)</sup>	460		35 <sup>(3)</sup>		counts/ ( $\mu\text{W}/\text{cm}^2$ )
D	Channel D	LED: 395nm, 415nm, 428nm, 5600K white <sup>(2)</sup>	485		35 <sup>(3)</sup>		counts/ ( $\mu\text{W}/\text{cm}^2$ )
E	Channel E	LED: 395nm, 415nm, 428nm, 5600K white <sup>(2)</sup>	510		35 <sup>(3)</sup>		counts/ ( $\mu\text{W}/\text{cm}^2$ )
F	Channel F	LED: 395nm, 415nm, 428nm, 5600K white <sup>(2)</sup>	535		35 <sup>(3)</sup>		counts/ ( $\mu\text{W}/\text{cm}^2$ )
FWHM	Full Width Half Max		20		20		nm
Wacc	Wavelength Accuracy				$\pm 10$		nm
dark	Dark Channel Counts	GAIN=64, $T_{\text{AMB}}=25^\circ\text{C}$				5	counts
AFOV	Average Field of View				$\pm 20.5$		deg

**Note(s):**

1. Calibration & measurements are made using diffused light.
2. Each channel is tested with GAIN = 16x, Integration Time (INT\_T) = 166ms and VDD = VDD1 = VDD2 = 3.3V,  $T_{\text{AMB}}=25^\circ\text{C}$ .
3. The accuracy of the channel counts/ $\mu\text{W}/\text{cm}^2$  is  $\pm 12\%$  when used with the AS72651.

**Figure 12:**  
**AS72653 LGA Average Field of View**



## Detailed Description

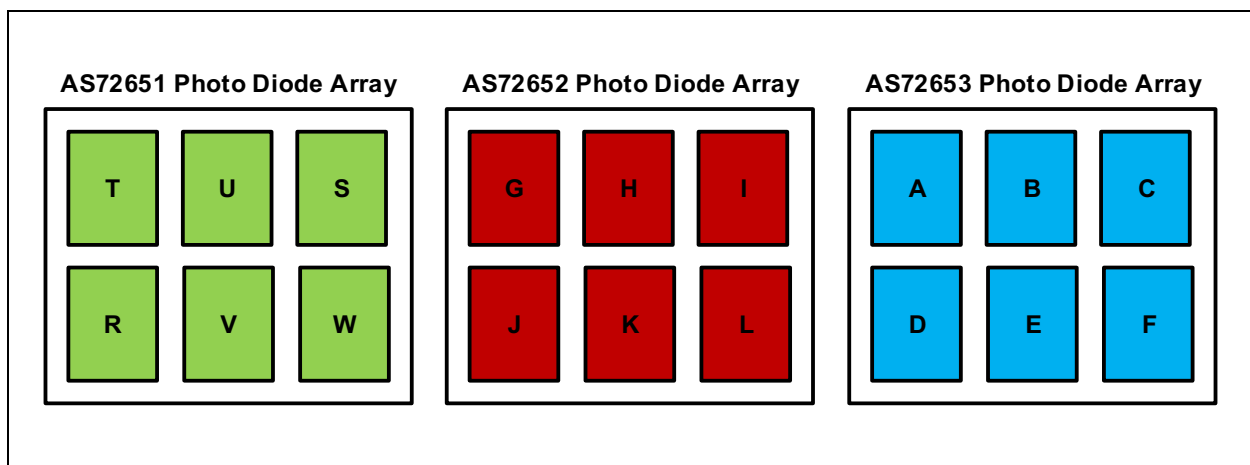
### AS7265x 18 Channel *Spectral\_ID* Detector Overview

Each of the three AS7265x *Spectral\_ID* devices are next-generation digital 6-channel spectral sensor devices. Each of the 6-channels has a Gaussian filter characteristic with a full width half maximum (FWHM) bandwidth of 20nm. The filters use an interference topology design which enables temperature stability with minimal drift over time or temperature. Filter accuracy will be affected by the angle of incidence which itself is limited by integrated aperture and internal micro-lens structure. The aperture-limited average field of view is  $\pm 20.5^\circ$  to deliver specified accuracy.

Each device contains an analog-to-digital converter (16-bit resolution ADC) which integrates the current from each channel's photodiode. Upon completion of the conversion cycle, the integrated result is transferred to the corresponding data registers. The transfers are double-buffered to ensure data integrity is maintained.

Besides being capable of external MCU interface control via I<sup>2</sup>C registers or AT commands, and transparently controlling the AS72652 and/or AS72653, the AS72651 can operate as a standalone 6-channel spectral sensor device.

**Figure 13:**  
AS7265x Photo Diode Arrays



### RC Oscillator

The timing generation circuit consists of on-chip 16MHz, temperature compensated oscillators, which provide the individual master clocks of the AS7265x devices

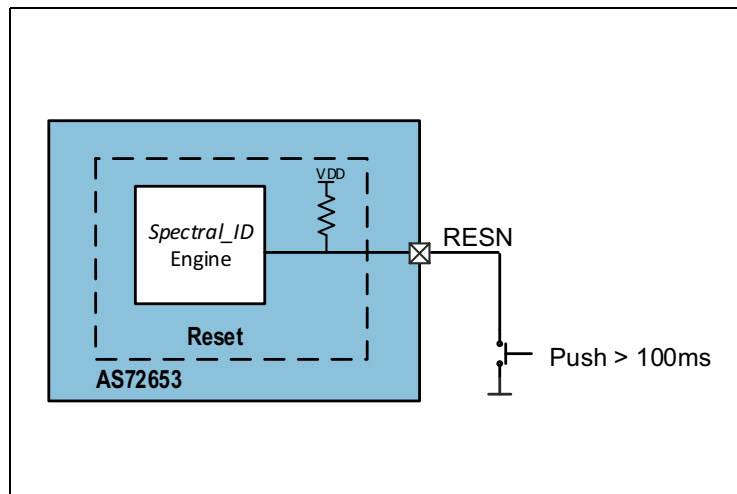
## Temperature Sensor

The AS72653 internal temperature sensor is constantly measuring on-chip temperature to enable temperature compensation procedures, and can be read via I<sup>2</sup>C registers or AT commands in the AS72651.

## Reset

Pulling down the RESN pin for longer than 100ms resets the AS72653.

**Figure 14:**  
Reset Circuit



## AS7265x LED\_IND Controls

There are LED\_IND pins on all AS7265x devices. An LED connected to LED\_IND can be used as a general power indicator.

Each AS7265x LED\_IND source can be turned on/off via AT commands or I<sup>2</sup>C register control through the AS72651 master to select LED\_IND sink currents that are programmable to 1mA, 2mA, 4mA or 8mA. These LED\_IND controls can also be used in applications just like the LED\_DRV control (described below), if the lower current sink of the LED\_IND control is appropriate.

## Electronic Shutter with AS7265x LED\_DRV Driver Control

There are LED\_DRV pins on all AS7265x devices. The LED\_DRV pin can be used to control external LED sources as needed for sensor applications. LED\_DRV can sink a programmable current of 12.5mA, 25mA, 50mA or 100mA. The control can be turned on/off via I<sup>2</sup>C registers or AT commands via the AS72651 master, and as such it provides the AS7265x device with an electronic shutter.

## Interrupt Operation

Interrupt operation is only needed for AS72651 master as it transparently controls data collection from the AS72652 (if used) or AS72653 (if used).

## I<sup>2</sup>C Slave Interface

The AS72653 is controlled over its I<sup>2</sup>C slave interface by the AS72651 master I<sup>2</sup>C intra-device interface. This control is automatic upon power-up (or reset) when the AS72651 detects the AS72653. The AS72653 I<sup>2</sup>C slave interface is used by the AS72651 regardless of whether AT Commands or I<sup>2</sup>C register commands are being used by the external MCU that is controlling the AS72651.

Please note that all of these registers are only accessible via external MCU to AS72651 control.

**Figure 15:**  
AS72653 Related I<sup>2</sup>C Virtual Register Set Overview

Addr	Name	<D7>	<D6>	<D5>	<D4>	<D3>	<D2>	<D1>	<D0>
<b>Version Registers</b>									
0x04: 0x05	AS72653_ HW_Version	AS72653 Hardware Version							
<b>Control Registers</b>									
0x0C: 0x8C	Control_ Setup	RST	INT	GAIN	Bank	DATA_RDY	RSVD		
0x0F: 0x8F	INT_T	Integration Time							
0x14	AS72653_ Device_Temp	AS72653 Internal Device Temperature							
0x17: 0x97	AS72653_ LED_Control	RSVD	ICL_DRV	LED_DRV	ICL_IND	LED_IND			
0x3F: 0xBF	I2C_CAL_SEL	RSVD					Value		
<b>Sensor Raw Data Registers (from the AS72653)</b>									
0x30	A_High	Channel A High Data Byte							
0x31	A_Low	Channel A Low Data Byte							
0x32	B_High	Channel B High Data Byte							
0x33	B_Low	Channel B Low Data Byte							
0x34	C_High	Channel C High Data Byte							
0x35	C_Low	Channel C Low Data Byte							

Addr	Name	<D7>	<D6>	<D5>	<D4>	<D3>	<D2>	<D1>	<D0>
0x36	D_High	Channel D High Data Byte							
0x37	D_Low	Channel D Low Data Byte							
0x38	E_High	Channel E High Data Byte							
0x39	E_Low	Channel E Low Data Byte							
0x3A	F_High	Channel F High Data Byte							
0x3B	F_Low	Channel F Low Data Byte							
<b>Sensor Calibrated Data Registers (From the AS72653. Before reading them set the I2C_CAL_SET=0x01)</b>									
0x40: 0x43	A_Cal	Channel A Calibrated Data (floating point)							
0x44: 0x47	B_Cal	Channel B Calibrated Data (floating point)							
0x48: 0x4B	C_Cal	Channel C Calibrated Data (floating point)							
0x4C: 0x4F	D_Cal	Channel D Calibrated Data (floating point)							
0x50: 0x53	E_Cal	Channel E Calibrated Data (floating point)							
0x54: 0x57	F_Cal	Channel F Calibrated Data (floating point)							

## Detailed AS72653 Related Register Descriptions

**Figure 16:**  
AS72653 HW Version Registers

Addr: 0x04		AS72653_HW_Version		
Bit	Bit Name	Default	Access	Bit Description
7:0	Device Type		R	Device type number
Addr: 0x05		AS72653_HW_Version		
Bit	Bit Name	Default	Access	Bit Description
7:0	HW Version		R	Hardware version

**Figure 17:**  
Control Setup Register

Addr: 0x0C/0x8C		Control_Setup		
Bit	Bit Name	Default	Access	Bit Description
7	RST	0	R/W	Set to 1 for soft reset, goes to 0 automatically after the reset
6	INT	0	R/W	Enable interrupt pin output (INT), 1: Enable, 0: Disable
5:4	GAIN	0	R/W	Sensor Channel Gain Setting (all channels) 'b00=1x; 'b01=3.7x; 'b10=16x; 'b11=64x;
3:2	BANK	10	R/W	Data Conversion Type (continuous) 'b00=Mode 0; 'b01=Mode 1; 'b10=Mode 2; 'b11= reserved
1	DATA_RDY	0	R/W	1: Data Ready to Read, sets INT active if interrupt is enabled. Can be polled if not using INT.
0	RSVD	0	R	Reserved; Unused

**Figure 18:**  
Integration Time Register

Addr: 0x0F/08F		INT_T		
Bit	Bit Name	Default	Access	Bit Description
7:0	INT_T	0xFF	R/W	Integration time = <value> * 2.8ms (applies to all channels)

**Figure 19:**  
AS72653 Device Temperature Register

Addr: 0x14		AS72653_Device_Temp		
Bit	Bit Name	Default	Access	Bit Description
7:0	Device_Temp		R	Device temperature data byte (°C)

**Figure 20:**  
AS72653 LED Control Register

Addr: 0x17/0x97		AS72653_LED Control		
Bit	Bit Name	Default	Access	Bit Description
7:6	RSVD	0	R	Reserved
5:4	ICL_DRV	00	R/W	LED_DRV current limit 'b00=12.5mA; 'b01=25mA; 'b10=50mA; 'b11=100mA;
3	LED_DRV	0	R/W	Enable LED_DRV 1: Enabled; 0: Disabled
2:1	ICL_IND	00	R/W	LED_IND current limit 'b00=1mA; 'b01=2mA; 'b10=4mA; 'b11=8mA;
0	LED_IND	0	R/W	Enable LED_IND 1: Enabled; 0: Disabled



**Figure 21:**  
AS72653 Sensor Raw Data Registers

Addr: 0x30		A_High		
Bit	Bit Name	Default	Access	Bit Description
7:0	A_High		R	Channel A High Data Byte
Addr: 0x31		A_Low		
Bit	Bit Name	Default	Access	Bit Description
7:0	A_Low		R	Channel A Low Data Byte
Addr: 0x32		B_High		
Bit	Bit Name	Default	Access	Bit Description
7:0	B_High		R	Channel B High Data Byte
Addr: 0x33		B_Low		
Bit	Bit Name	Default	Access	Bit Description
7:0	B_Low		R	Channel B Low Data Byte
Addr: 0x34		C_High		
Bit	Bit Name	Default	Access	Bit Description
7:0	C_High		R	Channel C High Data Byte
Addr: 0x35		C_Low		
Bit	Bit Name	Default	Access	Bit Description
7:0	C_Low		R	Channel C Low Data Byte
Addr: 0x36		D_High		
Bit	Bit Name	Default	Access	Bit Description
7:0	D_High		R	Channel D High Data Byte
Addr: 0x37		D_Low		
Bit	Bit Name	Default	Access	Bit Description
7:0	D_Low		R	Channel D Low Data Byte

Addr: 0x38		E_High		
Bit	Bit Name	Default	Access	Bit Description
7:0	E_High		R	Channel E High Data Byte
Addr: 0x39		E_Low		
Bit	Bit Name	Default	Access	Bit Description
7:0	E_Low		R	Channel E Low Data Byte
Addr: 0x3A		F_High		
Bit	Bit Name	Default	Access	Bit Description
7:0	F_High		R	Channel F High Data Byte
Addr: 0x3B		F_Low		
Bit	Bit Name	Default	Access	Bit Description
7:0	F_Low		R	Channel F Low Data Byte

AS72653 Sensor Calibrated Data Registers (note the I2C\_CAL\_SEL register must be set to 0x02 to read these):

**Figure 22:**  
**AS72653 Sensor Calibrated Data Registers**

Addr: 0x40:0x43		A_Cal		
Bit	Bit Name	Default	Access	Bit Description
31:0	A_Cal		R	Channel A Calibrated Data (floating point)
Addr: 0x44:0x47		B_Cal		
Bit	Bit Name	Default	Access	Bit Description
31:0	B_Cal		R	Channel B Calibrated Data (floating point)
Addr: 0x48:0x4B		C_Cal		
Bit	Bit Name	Default	Access	Bit Description
31:0	C_Cal		R	Channel C Calibrated Data (floating point)
Addr: 0x4C:0x4F		D_Cal		
Bit	Bit Name	Default	Access	Bit Description
31:0	D_Cal		R	Channel D Calibrated Data (floating point)
Addr: 0x50:0x53		E_Cal		
Bit	Bit Name	Default	Access	Bit Description
31:0	E_Cal		R	Channel E Calibrated Data (floating point)
Addr: 0x54:0x57		F_Cal		
Bit	Bit Name	Default	Access	Bit Description
31:0	F_Cal		R	Channel F Calibrated Data (floating point)

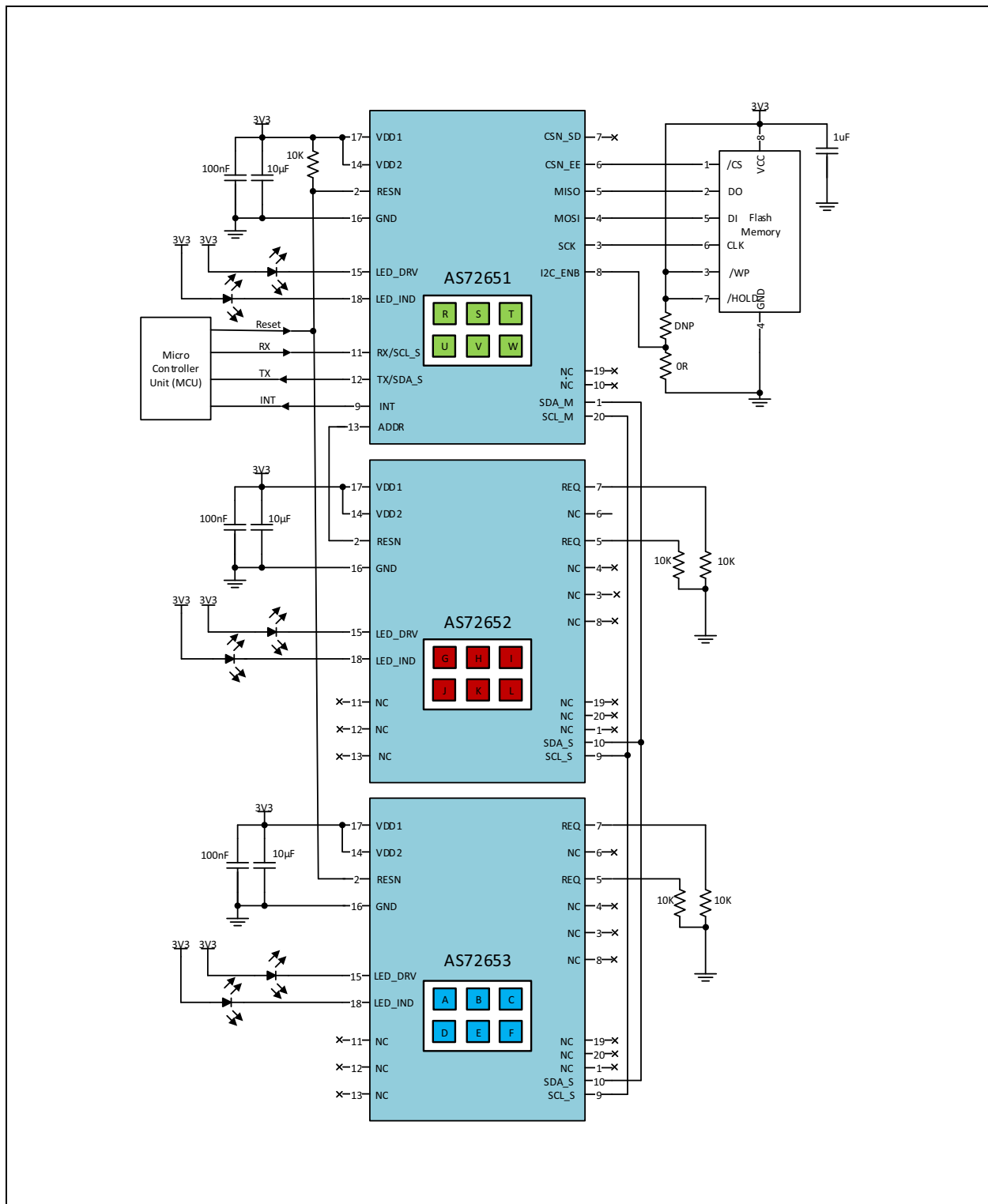
***AT Commands for AS72653 Control & Data***

To control the AS72651 (which controls the AS72653) using AT Commands an external MCU uses the AS72651 UART interface. The interface from the AS72651 to the AS72653 is transparent to the MCU.

**Note(s):** As a slave chip to a connected AS72651, the command access to the AS72653 is described in detail in the master device AS72651 data sheet.

## Application Information

**Figure 23:**  
Typical AS7265x 18-Channel Application Circuit

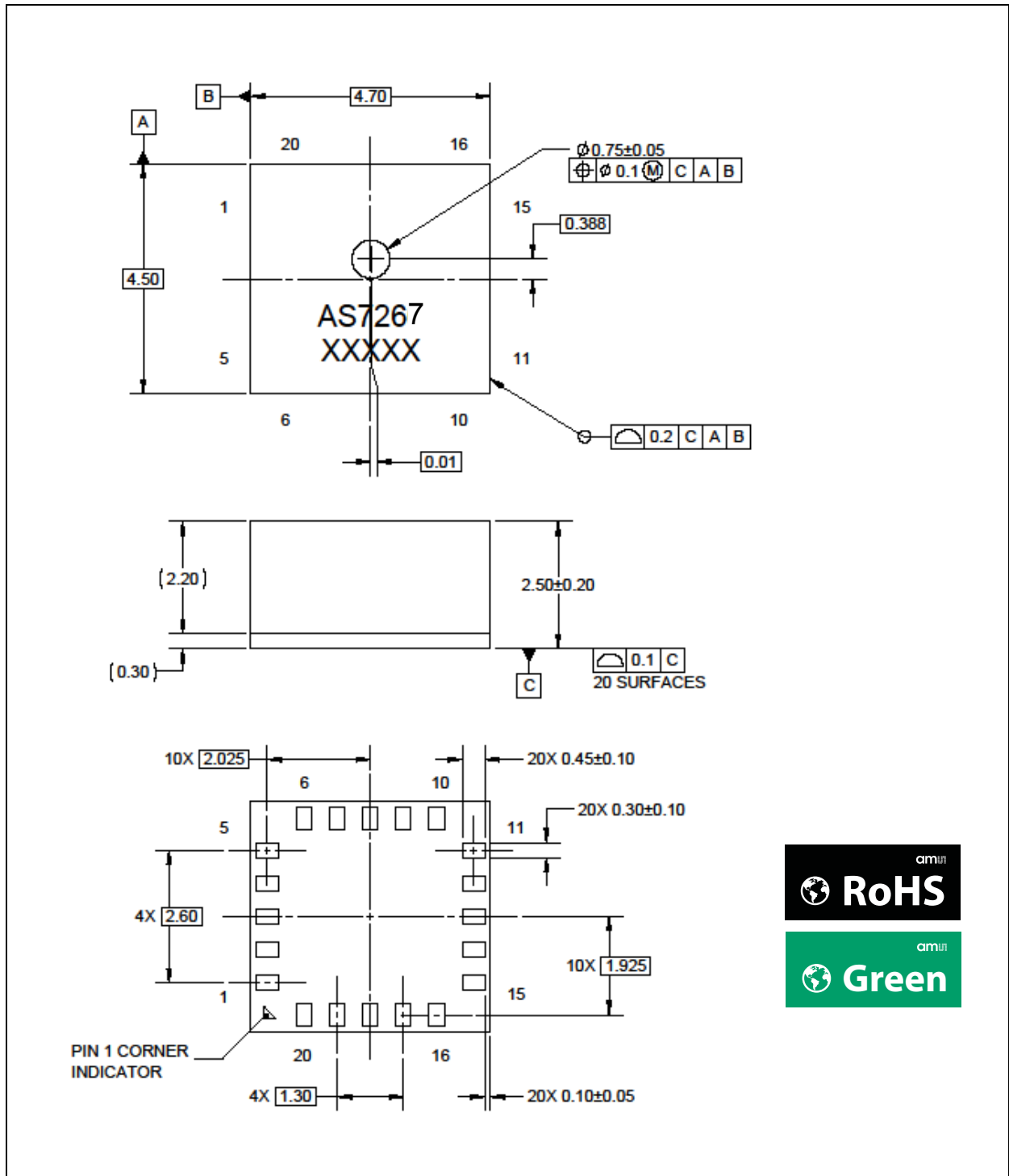


**Note(s):**

1. For each AS7265x device, orientation of the device aperture to any light source(s) will determine spectral content to be measured. For example with the proper orientation, sensors on the AS72651 can be used to measure light from the LEDs on the AS72652 and/or AS72653.
2. The AS72651 is required while the AS72652 and AS72653 are both optional for a total solution of 6, 12 or 18 channels.

### Package Drawings & Markings

Figure 24:  
Package Drawing



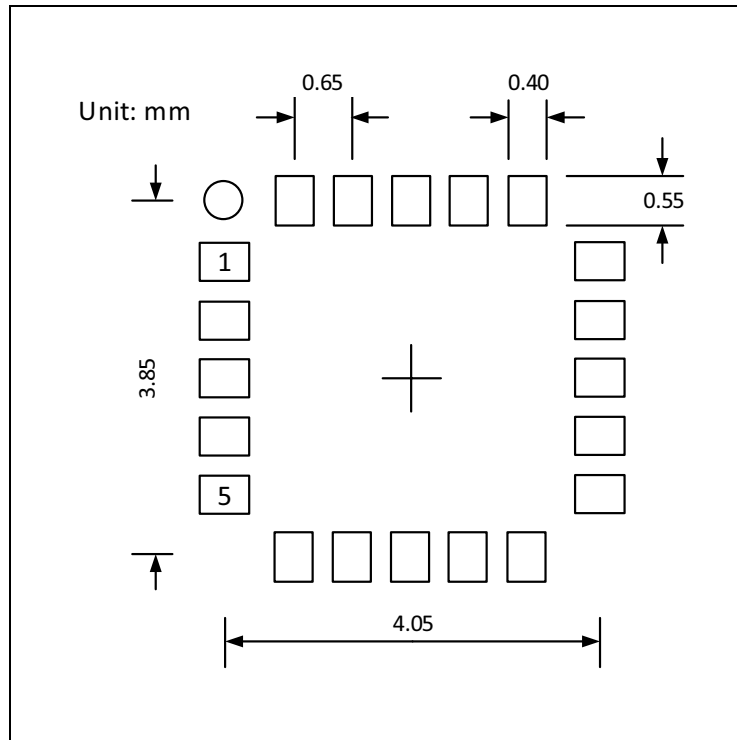
**Note(s):**

1. XXXXX = tracecode.
2. All dimensions are in millimeters.
3. Unless otherwise specified tolerances are: Angular ( $\pm 5^\circ$ ), Two Place Decimal ( $\pm 0.1$ ), Three Place Decimal ( $\pm 0.05$ ).
4. Contact finish is Au.
5. This package contains no lead (Pb).
6. This drawing is subject to change without notice.

## PCB Pad Layout

Suggested PCB pad layout guidelines for the LGA package are show. Flash Gold is recommended as a surface finish for the landing pads.

**Figure 25:**  
Recommended PCB Pad Layout (Top View)

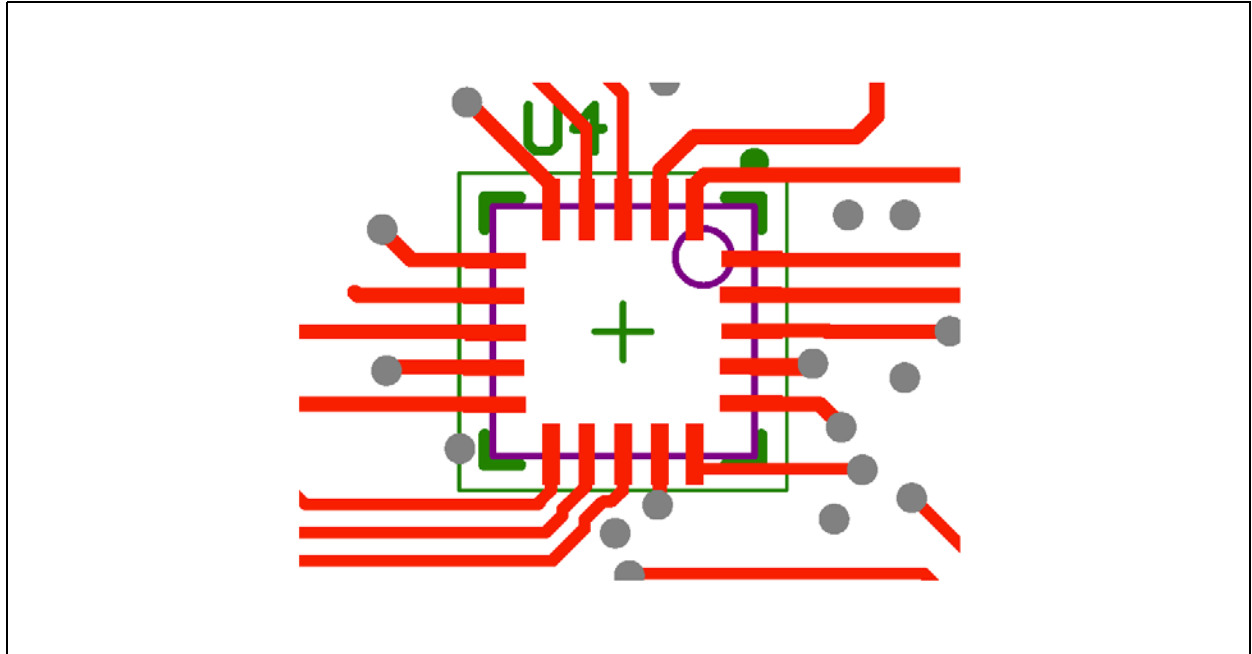


**Note(s):**

1. Unless otherwise specified, all dimensions are in millimeters.
2. Add 0.05mm all around the nominal lead width and length for the PCB pad land pattern.
3. This drawing is subject to change without notice.

In order to prevent interference, avoid trace routing feedthroughs with exposure directly under the AS7265x devices. An example routing is illustrated in the diagram.

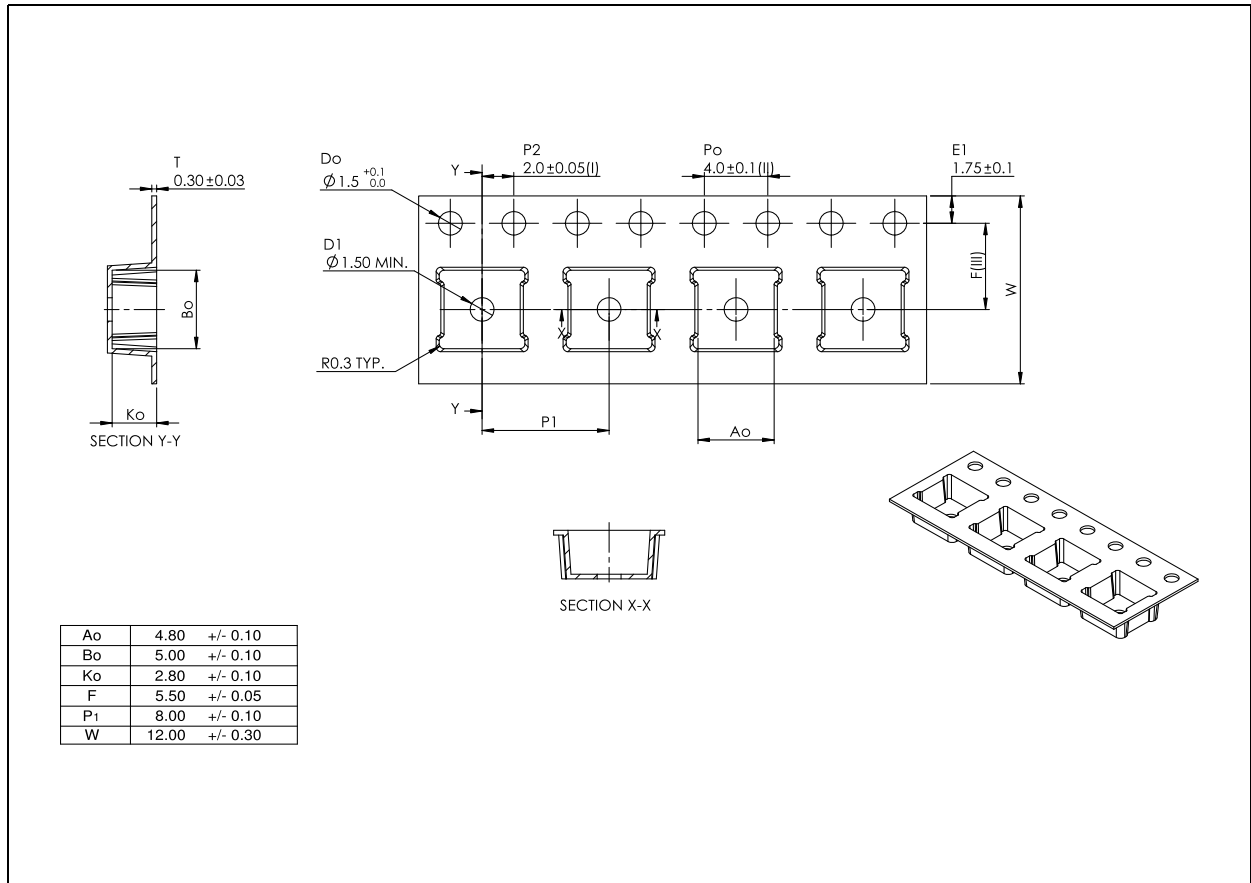
**Figure 26:**  
Typical Layout Routing





## Mechanical Data

**Figure 27:**  
Tape & Reel Information



**Note(s):**

1. All dimensions in millimeters unless of otherwise stated.
2. Measured from centreline of sprocket hole to centreline of pocket.
3. Cumulative tolerance of 10 sprocket holes is  $\pm 0.20$ .
4. Measured from centreline of sprocket hole to centreline of pocket.
5. Other material available.

## Soldering & Storage Information

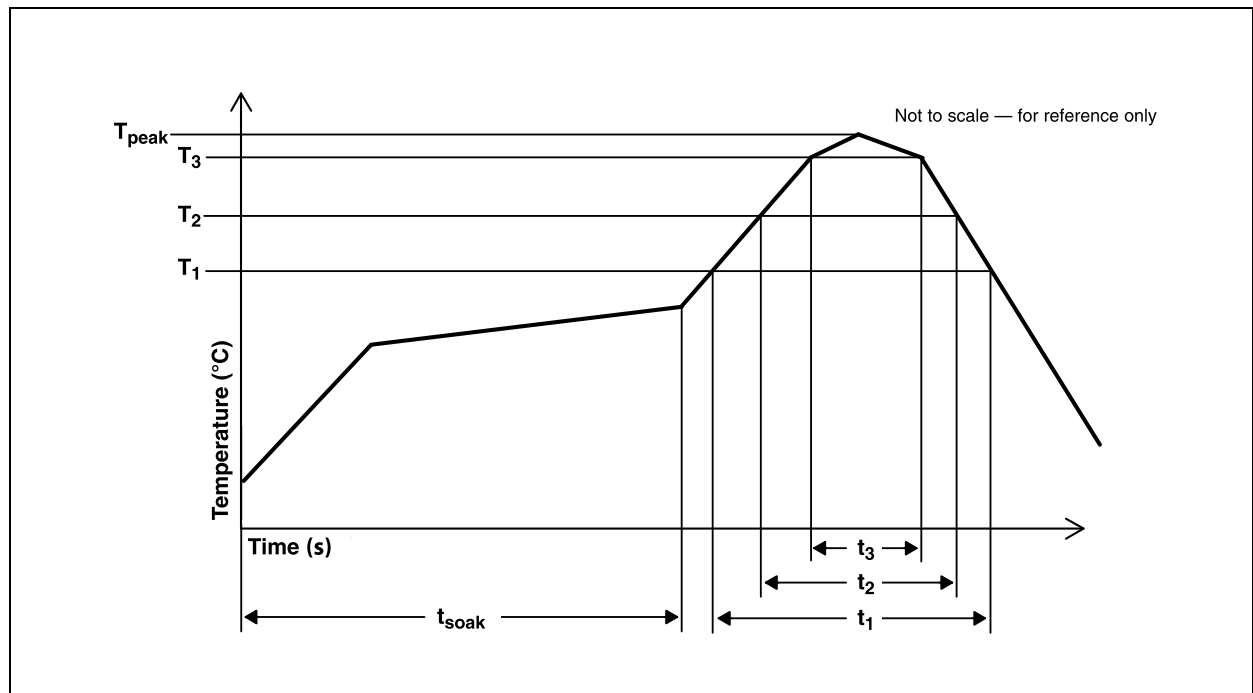
### Soldering Information

The module has been tested and has demonstrated an ability to be reflow soldered to a PCB substrate. The solder reflow profile describes the expected maximum heat exposure of components during the solder reflow process of product on a PCB. Temperature is measured on top of component. The components should be limited to a maximum of three passes through this solder reflow profile.

**Figure 28:**  
Solder Reflow Profile

Parameter	Reference	Device
Average temperature gradient in preheating		2.5°C/s
Soak time	$t_{SOAK}$	2 to 3 minutes
Time above 217°C( $T_1$ )	$t_1$	Max 60s
Time above 230°C( $T_2$ )	$t_2$	Max 50s
Time above $T_{peak} - 10^\circ\text{C}$ ( $T_3$ )	$t_3$	Max 10s
Peak temperature in reflow	$T_{peak}$	260°C
Temperature gradient in cooling		Max -5°C/s

**Figure 29:**  
Solder Reflow Profile Graph



## **Manufacturing Process Considerations**

The AS72653 package is compatible with standard reflow no-clean and cleaning processes including aqueous, solvent or ultrasonic techniques. However, as an open-aperture device, precautions must be taken to avoid particulate or solvent contamination as a result of any manufacturing processes, including pick and place, reflow, cleaning, integration assembly and/or testing. Temporary covering of the aperture is allowed. To avoid degradation of accuracy or performance in the end product, care should be taken that any temporary covering and associated sealants/debris are thoroughly removed prior to any optical testing or final packaging.

## **Storage Information**

### ***Moisture Sensitivity***

Optical characteristics of the device can be adversely affected during the soldering process by the release and vaporization of moisture that has been previously absorbed into the package. To ensure the package contains the smallest amount of absorbed moisture possible, each device is baked prior to being dry packed for shipping.

Devices are dry packed in a sealed aluminized envelope called a moisture-barrier bag with silica gel to protect them from ambient moisture during shipping, handling, and storage before use.

### ***Shelf Life***

The calculated shelf life of the device in an unopened moisture barrier bag is 12 months from the date code on the bag when stored under the following conditions:

- Shelf Life: 12 months
- Ambient Temperature: <40°C
- Relative Humidity: <90%

Rebaking of the devices will be required if the devices exceed the 12 month shelf life or the Humidity Indicator Card shows that the devices were exposed to conditions beyond the allowable moisture region.

**Floor Life**

The module has been assigned a moisture sensitivity level of MSL 3. As a result, the floor life of devices removed from the moisture barrier bag is 168 hours from the time the bag was opened, provided that the devices are stored under the following conditions:

- Floor Life: 168 hours
- Ambient Temperature: <30°C
- Relative Humidity: <60%

If the floor life or the temperature/humidity conditions have been exceeded, the devices must be rebaked prior to solder reflow or dry packing.

**Rebaking Instructions**

When the shelf life or floor life limits have been exceeded, rebake at 50°C for 12 hours.

## Ordering & Contact Information

**Figure 30:**  
Ordering Information

Ordering Code	Package	Marking	Description	Delivery Form	Delivery Quantity
AS72651-BLGT	20-pin LGA	AS7265	Smart 6-Channel NIR Spectral_ID Sensor with Electronic Shutter and 18-Channel AS7265x Master Capability	Tape & Reel	2000 pcs/reel
AS72652-BLGT	20-pin LGA	AS7266	Smart 6-Channel Visible & NIR Spectral_ID Sensor with Electronic Shutter	Tape & Reel	2000 pcs/reel
AS72653-BLGT	20-pin LGA	AS7267	Smart 6-Channel Spectral_ID Sensor with Electronic Shutter	Tape & Reel	2000 pcs/reel

**Note(s):**

1. The AS72651 is required for operation of either the AS72652 or AS72653
2. A required companion serial flash memory is required for functionality and should be ordered from the flash memory supplier or their authorized channels. Selected device types must be ams verified and at the time of writing include Adesto Technologies AT25SF041-SSHD-B, or Macronix MX25L4006EM11-12G. Visit the **ams** download page for your AS72xx device at [download.ams.com](http://download.ams.com) and consult current firmware release notes for currently supported devices. More details and alternative flash memories please see the User Guide for Flash Updating.
3. AS72651 flash memory software is available from **ams**

Buy our products or get free samples online at:

[www.ams.com/ICdirect](http://www.ams.com/ICdirect)

Technical Support is available at:

[www.ams.com/Technical-Support](http://www.ams.com/Technical-Support)

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Document Status	Product Status	Definition
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Preliminary Datasheet	Pre-Production	Information in this datasheet is based on products in the design, validation or qualification phase of development. The performance and parameters shown in this document are preliminary without any warranty and are subject to change without notice
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## Revision Information

Initial production version for release 1-00

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