



User Guide

UG000504

TCS3410

TCS3410 EVM

Universal Ambient Light RGB Sensor with Selective
Flicker Detection

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1 Introduction

The TCS3410 evaluation kit comes with everything needed to evaluate the TCS3410. The device features digital ambient light sensing (ALS) and flicker detection.

1.1 Kit Contents

Figure 1:
Evaluation Kit Contents



No.	Item	Description
1	TCS3410 Daughter Card	PCB with TCS3410 sensor installed
2	EVM Controller Board	Used to communicate USB to I2C
3	USB Cable (A to Mini-B)	Connects EVM controller to PC
4	Flash Drive	Include application installer and documents

1.2 Ordering Information

Ordering Code	Description
TCS3410 EVM	TCS3410 Universal Ambient Light RGB Sensor with Selective Flicker Detection

2 Getting Started

The software should be installed prior to connecting any hardware to the computer. Follow the instructions found in the Quick Start Guide (QSG). This loads the required driver for the USB interface and the device's graphical user interface (GUI).

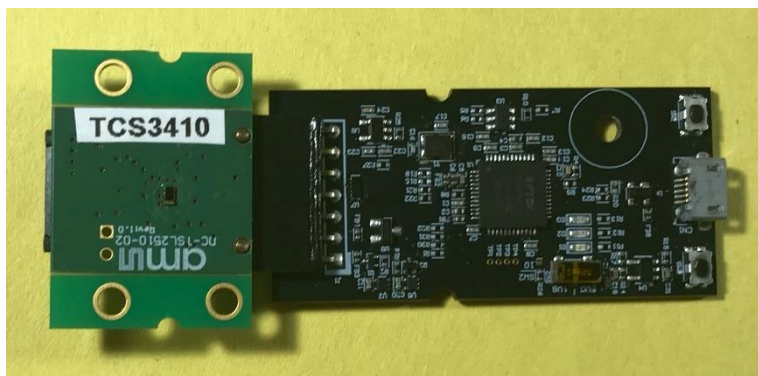
The balance of this document identifies and describes the controls available on the GUI. In combination with the TCS3410 datasheet, the QSG and application notes available on the **ams** website, www.ams.com, there should be enough information to allow evaluation of the TCS3410 device.

3 Hardware Description

The hardware consists of the EVM Controller, the TCS3410 EVM daughter card, and a USB interface cable. The EVM controller board provides power and I2C communication to the daughter card through a seven-pin connector. When the EVM controller is connected to the PC through USB, a green LED on the board flashes once on power up to indicate the system is getting power.

For schematics, layout and BOM information please see the documents included with the install located in the TCS3410 EVM folder (All Programs -> ams -> TCS3410 EVM -> Documents).

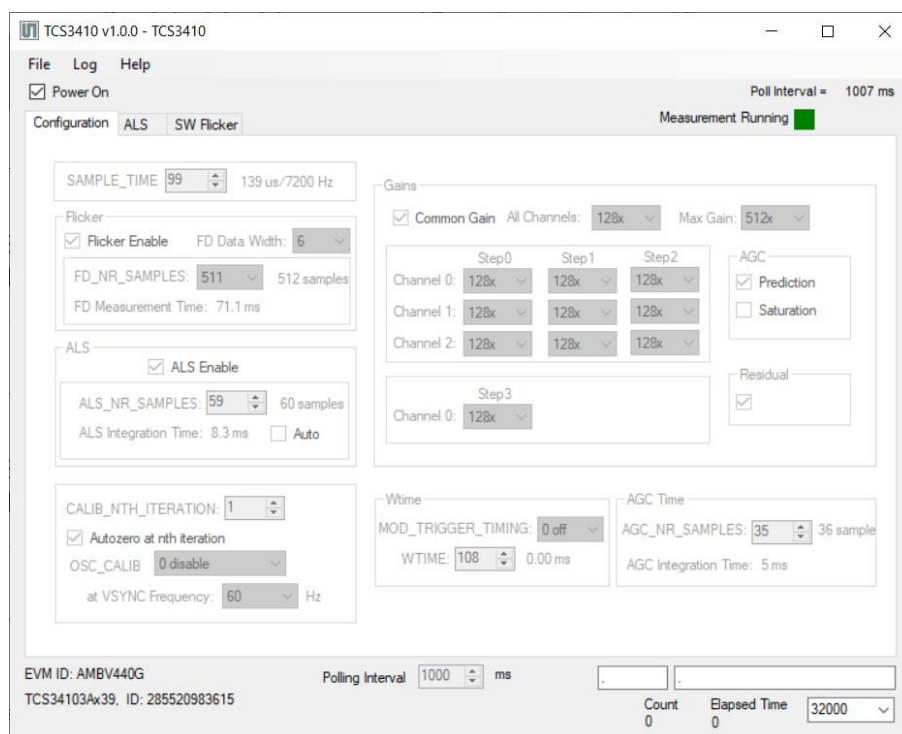
Figure 2:
Evaluation Kit Hardware



4 Software Description

The main window (Figure 3) contains the system menus, system level controls, device information and logging status. The Configuration tab contains controls to setup both ALS and Flicker detection parameters. Both ALS tab and SW Flicker tab display ALS data, Flicker data and Mod Gain data. The ALS tab contains a plotting area in which raw ALS data is drawn. The SW Flicker tab contains a plotting area in which the flicker raw data and flicker frequency after FFT calculation are drawn. The application polls the ALS and flicker raw data continuously and calculates flicker frequency values.

Figure 3:
GUI Main Window



4.1 Connect Software to Hardware

On startup, the software automatically connects to the hardware. On successful initialization, the software displays a main window, containing controls pertinent to the connected device. If the software detects an error, an error window appears. If “Device not found or is unsupported” appears, verify the correct daughterboard is properly connected to the EVM controller board. If “Cannot connect to EVM board” appears, verify the USB cable is connected. When the EVM controller board is connected to the USB, a green LED on the board flashes once on power up to indicate the USB cable is connected and providing power to the system.

If the EVM board disconnects from the USB bus while the program is running, it displays an error message and then terminates. Reconnect the EVM board and restart the program.

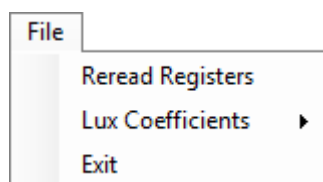
4.2 System Menus

At the top of the window there are pull-down menus labeled “File”, “Log”, and “Help”. The **File** menu provides basic application-level control. The **Log** menu controls the logging function, and the **Help** menu provides version and copyright information for the application.

4.2.1 File Menu

The File menu contains the following functions:

Figure 4:
File Menu



The **Reread Registers** function forces the program to re-read all of the control registers from the device and display them on the screen. This does not read the output data, because the program reads those registers continually while it is running.

4.2.2 The Lux Coefficients menu allows the user to Display, Load or Save the lux coefficients used to calculate lux. See Gains Group Box

In this group box, there are the 9 gain value matrix for modulator 0/1/2 and step0/1/2.

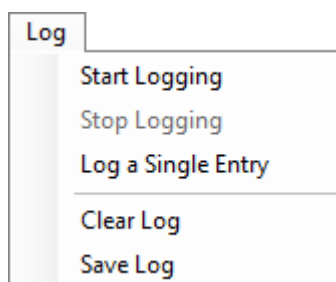
section for more details.

Click on the **Exit** command to close the main window and terminate the application. Any unsaved log data is cleared from memory. The application can also be close by clicking the red “X” in the upper right hand corner.

4.2.3 Log Menu

The Log menu controls the logging function and saves the log data to a file. Log data accumulates in memory until discarded or written to a data file.

Figure 5:
Log Menu



Click **Start Logging** to start the logging function. Each time the program polls the output information from the device, it creates a new log entry showing the raw data values, the values of various control registers, and the values entered by the user into the text fields near the bottom right corner of the window.

Click **Stop Logging** to stop the logging function. Once logging stops, the user may store the data in a file, or continue collecting additional data by clicking **Start Logging** again.

The **Log a Single Entry** command causes logging to start, collect one single entry, and immediately stop again. This function is not available when logging is already running.

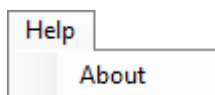
Click **Clear Log** to discard any previously collected data. If there is data in memory, which has not been saved to disk, this function displays a prompt asking to verify it is OK to discard the data. If the log is active when this function executes, the log continues running after the existing data is discarded.

Click **Save Log** to save the collected log data to a csv file. This stops the logging function, if it is active, and displays a file dialog box to specify where to store the logged data. The Log Status and Control Information section below describes the default file name, but you may change the file name if desired.

4.2.4 Help Menu

The Help menu contains a single function: About.

Figure 6:
Help Menu



The **About** function displays a dialog box (Figure 7) showing the version and copyright information for the application and library. Click the **OK** button to close this window and continue.

Figure 7:
About Window



4.3 System Level Controls

Immediately below the top menu bar there are checkboxes used to control the system level functions of the TCS3410 device.

The **Power On** checkbox controls the PON function of the TCS3410. When this box is checked, the power is on and the device is running measurements according to the settings in the Configuration tab. At this time, the Configuration tab is disabled to prevent users from changing the settings while the measurement is ongoing. When this box is unchecked, the power is off and the device does not operate. The Configuration tab is enabled and you can change the controls to setup the parameters for the next run.

4.4 Auto Polling

The application automatically polls the TCS3410 raw data for ALS and Flicker if enabled. The **Poll Interval** at the top right corner of the form displays the actual time between reads of the device. The control "**Poll Interval**" in the middle bottom of the form lets the user set the desired polling interval.

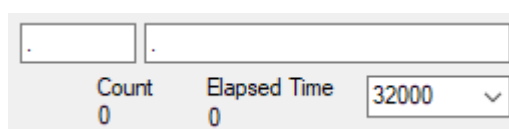
4.5 Device ID Information

The lower left corner of the window displays the ID number of the EVM Controller board, identifies the device being used and displays the ID of the device.

4.6 Log Status and Control Information

The lower right corner of the window contains status information and controls for the logging function:

Figure 8:
Logging Status



<input type="text" value="."/>		<input type="text" value="."/>	
Count	Elapsed Time	32000	
0	0	▼	

This section contains text boxes that are stored in the log file data and used to build the file name for the log file. If the data in these fields are changed, the new values are stored with any new data logged. The default file name is based on these values at the time the log file is written. If nothing is entered in these boxes they default to a period (“.”).

Sample default file name:

TCS3410_1-2-3_Log_HH_MM_SS.csv

■ From Application

■ From User Input

The **Count** value displayed is a count of the number of samples currently in the log buffer.

The **Elapsed Time** value indicates the elapsed time since data logging started.

The numeric box in the bottom right-hand corner sets a limit to the size of the collected dataset. You may select a value from the pull-down list, or enter a value manually. When the number of entries in the log reaches this value, the program will automatically stop logging and display a file dialog box to specify where to store the logged data. You may change the file name if desired. The maximum value that may be entered in this field is 32000.

4.7 “Configuration” Tab

The main portion of the screen contains a tab labeled Configuration.

Figure 9 :
Configuration Tab

The screenshot shows the 'Configuration' tab of a software interface. At the top, there are three tabs: 'Configuration' (selected), 'ALS', and 'SW Flicker'. A 'Measurement Running' indicator with a green bar is on the right. The main area contains several control groups:

- SAMPLE_TIME**: A numeric input set to 99, with a label '139 us/7200 Hz'.
- Flicker**: A group containing 'Flicker Enable' (checked), 'FD Data Width' (set to 6), 'FD_NR_SAMPLES' (set to 511), and 'FD Measurement Time' (71.1 ms).
- ALS**: A group containing 'ALS Enable' (checked), 'ALS_NR_SAMPLES' (set to 59), 'ALS Integration Time' (8.3 ms), and an 'Auto' checkbox.
- CALIB**: A group containing 'CALIB_NTH_ITERATION' (set to 1), 'Autozero at nth iteration' (checked), 'OSC_CALIB' (set to 0), and 'at VSYNC Frequency' (set to 60 Hz).
- Gains**: A group containing 'Common Gain' (checked), 'All Channels' (set to 128x), 'Max Gain' (set to 512x), and a table of gain steps:

	Step0	Step1	Step2
Channel 0:	128x	128x	128x
Channel 1:	128x	128x	128x
Channel 2:	128x	128x	128x
- AGC**: A group containing 'AGC Prediction' (checked) and 'AGC Saturation' (unchecked).
- Residual**: A group containing a checked checkbox.
- Wtime**: A group containing 'MOD_TRIGGER_TIMING' (set to 0 off), 'WTIME' (set to 108), and '0.00 ms'.
- AGC Time**: A group containing 'AGC_NR_SAMPLES' (set to 35) and 'AGC Integration Time' (5 ms).

4.7.1 Configuration Controls

The **SAMPLE TIME** control sets the time of one flicker measurement. It also defines the measurement time of the step for ALS measurements.

The **Flicker** group box contains controls relating the flicker detection:

- **Flicker Enable** control enables the flicker detection if checked.
- **FD Data Width** control sets width of the compressed flicker data in the FIFO. The values are from 1 to 15.
- **FD_NR_SAMPLES** control defines the number of samples for one flicker measurement.
- **FD Measurement Time** control displays the integration time for one flicker measurement.

The **ALS** group box contains controls relating the flicker detection:

- **ALS Enable** control enables the ALS detection if checked.
- **ALS_NR_SAMPLES** control defines the number of samples for one ALS measurement.
- **ALS Integration Time** control displays the integration time for one ALS measurement.

The **Calibration** group box contains the following controls:

- **CALIB_NTH_ITERATION** control sets the repeat rate of calibration execution in measurement sequencer rounds. The values are from 0 to 255.
- **Autozero at nth iteration** check box enables auto zero calibration during nth iteration calibration if checked.
- **OSC_CALIB** control defines calibration mode. The available options are “0 disabled”, “1 after pon”, and “2 always on”.
- **At VSYNC Frequency** sets VSYNC frequency. The available values are 60HZ, 90HZ and 120HZ.

The **Gains** group box contains controls to setup all gains:

- **Common Gain** check box if checked will set all the channels to the same gain.
- **All Channels** dropdown combo box sets the gain for all channels if the check box **Common Gain** is checked. The choices are 1/2x, 1x, 2x, 4x, 8x, 16x, 32x, 64x, 128x, 256x, 512x, 1024x, 2048x, 4096x and 8192x.
- **Max Gain** dropdown combo box sets the max gain for all channels if the check box **Common Gain** is checked. The choices are 1/2x, 1x, 2x, 4x, 8x, 16x, 32x, 64x, 128x, 256x, 512x, 1024x, 2048x, 4096x and 8192x.
- **Gain at Channel 0/1/2 and Step 0/1/2** dropdown combo box sets the gain for channel 0/1/2 at step 0/1/2 if the check box **Common Gain** is unchecked. The choices are 1/2x, 1x, 2x, 4x, 8x, 16x, 32x, 64x, 128x, 256x, 512x, 1024x, 2048x, 4096x and 8192x.
- **Gain at Channel 0 and step 3** sets the gain for channel 0 at step 3, which is for flicker detection.
- **AGC** group box has two check boxes. One is check box **Prediction** for enabling the predict AGC function for all steps of the sequence if checked. Another one **Saturation** check box enables analog saturation AGC if checked.
- **Residual** check box enables a residual measurement on modulator 0 if checked.

The **WTime** group box contains controls relating the wait function:

- **MOD_TRIGGER_TIMMING** defines the repeat rate of modulator/sequencer measurements. The available selections are “0 off”, “1 normal = 2.84 ms”, “2 long =45.51 ms”, “3 fast = 88.89 us”, “4 fastlong =1.42 ms”, “5 vsync”, “6 reserved0” and “7 reserved1”.
- **WTIME** specifies the time to wait between measurement steps. The values are from 0 to 255.

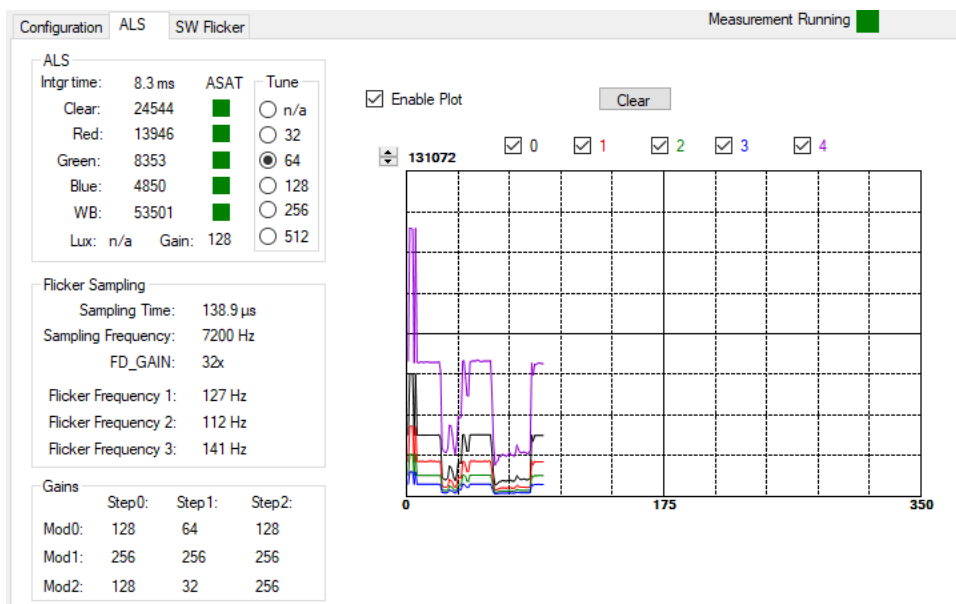
The **AGC Time** group box contains controls to set up the AGC time:

- **AGC_NR_SAMPLES** defines the number of samples for every AGC measurement. The values are from 0 to 65535.
- **AGC Integration Time** displays the AGC integration time.

4.8 “ALS” Tab

The main portion of the screen contains a tab labeled ALS. It displays measurement data.

Figure 10 :
ALS Tab



4.8.1 ALS Group Box

The left upside of the ALS tab displays the ALS measurement data. The flowing items are displayed:

- The ALS **Integration Time**.
- **Clear** data counts.
- **Red** data counts.
- **Green** data counts.
- **Blue** data counts.
- **Wide Band** data counts.
- **Clear data Saturation status**: Green color means no saturation happened. Red otherwise.
- **Red data Saturation status**: Green color means no saturation happened. Red otherwise.
- **Green data Saturation status**: Green color means no saturation happened. Red otherwise.
- **Blue data Saturation status**: Green color means no saturation happened. Red otherwise.
- **Wide Band data Saturation status**: Green color means no saturation happened. Red otherwise.
- **Lux**: Lux calculation is not implement in the GUI.
- **Gain**: Normalized Gain value. It's actually gain value of channel 0 in step 0 for clear data detection.

The **Tune** radio buttons: the purpose of this set of radio buttons is to avoid the plotting graph values jumping dramatically due to AGC effect of different normalized gain value applied when measuring. The displayed data is the measurement data ratio when normalized gain has the selected value (of the radio button).

4.8.2 Flicker Sampling Group Box

The flowing items display in the Flicker Sampling group box:

- **Sampling Time.**
- **Sampling Frequency.**
- **FD_GAIN.**
- **Flicker Frequency1**, which has the biggest FFT value.
- **Flicker Frequency2**, which has the second biggest FFT value.
- **Flicker Frequency3**, which has the third biggest FFT value.

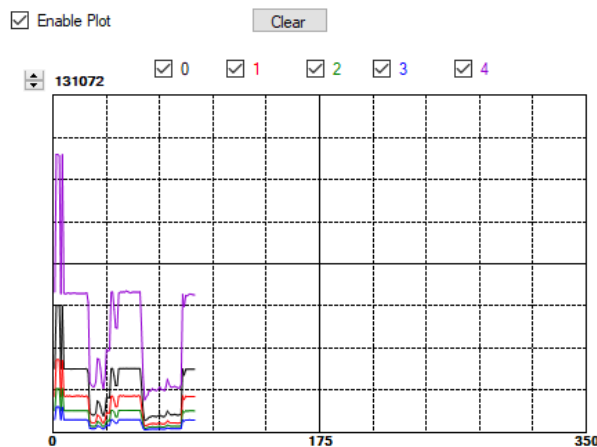
4.8.3 Gains Group Box

In this group box, there are the 9 gain value matrix for modulator 0/1/2 and step0/1/2.

4.8.4 ALS Data Plot

The remaining portion of the ALS tab is used to display a running plot of the collected ALS values and calculated Lux. The last 350 values are collected and plotted on the graph. As additional values are added, the old values will be deleted from the left side of the graph. To start the plotting function, check the **Enable Plot** checkbox and select the **ALS**, **IR**, or **Lux** checkboxes.

Figure 11:
ALS Data Plot



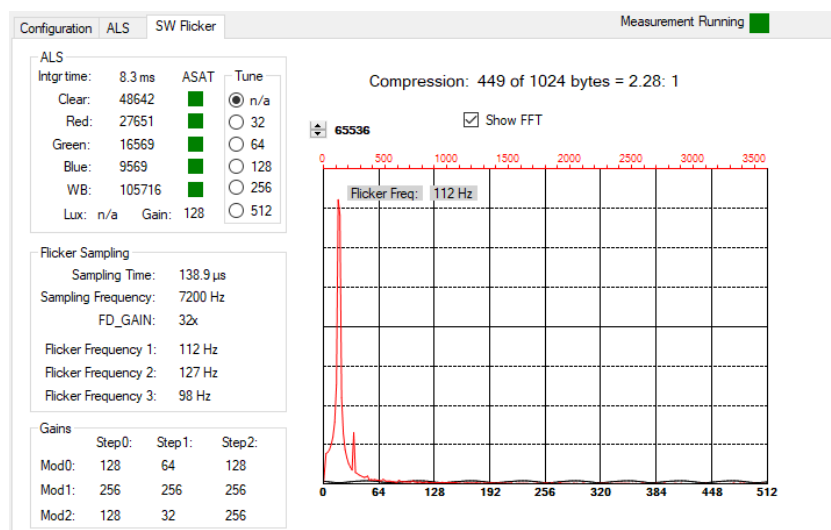
The scale of the Y-axis of the plot can be adjusted by clicking on the small up and down arrows at the top left corner of the plot. The scale can be set to any power of 2 from 64 through 65536.

Click the **Clear Plot** button to discard the current data and continue plotting the new data. Note if the Clear Plot button is clicked while the plot is disabled, the data is discarded, but the actual plot will not be updated until the plot function is re-enabled.

4.9 “SW Flicker” Tab

The main portion of the screen contains a tab labeled SW Flicker.

Figure 12 :
SW Flicker Tab



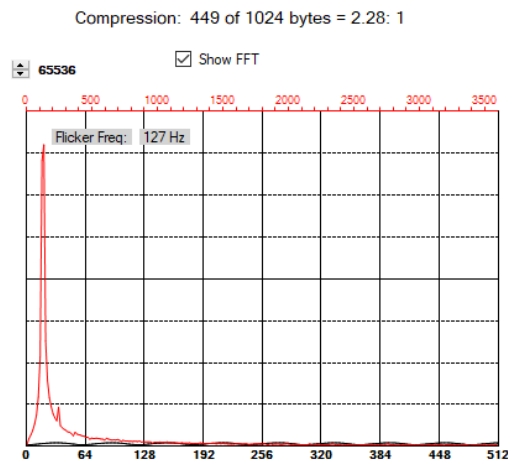
4.9.1 Flicker Information

The left side of the SW Flicker tab displays the ALS and Flicker information same as those in the ALS tab. See “ALS Tab” section for detail information.

4.9.2 Flicker Output Data

The top right portion of the SW Flicker tab displays plot of the original flicker data and the data after FFT. Besides, The peak Flicker Frequency, the compression rate are also displayed there.

Figure 13:
SW Flicker Data Plot



The scale of the Y-axis of the plot can be adjusted by clicking on the small up and down arrows at the top left corner of the plot. The scale can be set to any power of 2 from 16 to 16384.

Click the **Clear Plot** button to discard the current data and continue plotting the new data. Note if the Clear Plot button is clicked while the plot is disabled, the data is discarded, but the actual plot will not be updated until the plot function is re-enabled.

5 Resources

For additional information regarding the TCS3410, please refer to the datasheet. For information regarding the installation of the TCS3410 EVM host application software please refer to the TCS3410 EVM Quick Start Guide.

Designer's Notebooks dealing with various aspects of optical measurement and optical measurement applications are available. All content is available on the **ams** website www.ams.com.



For further information, please refer to the following documents:

- TCS3410 Datasheet
 - TCS3410 EVM Quick Start Guide (QSG)
 - TCS3410 EVM User's Guide (this document)
 - TCS3410 EVM Schematic Layout
-

6 Revision Information

Changes from previous version to current revision v1-00	Page
Initial version	

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

7 Legal Information

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