

Comparing Transflective and Sunlight Readable Displays

This application note will discuss the available options in enhancing display visibility in bright environments. Displays can be difficult to view under bright ambient conditions such as in outdoor applications. This note will compare the differences of transflective displays and sunlight readable transmissive displays. These are two popular options of compensating for the decreased visibility caused by the ambient environment. This application note will provide an example of each display and discuss the advantages of each. The three displays used in this analysis range from a sunlight readable transmissive TFT, a transflective TFT and a transflective graphic LCD. The displays are provided below.



[E35KA-FW1000-N](#)



[E20RB-FW345-N](#)



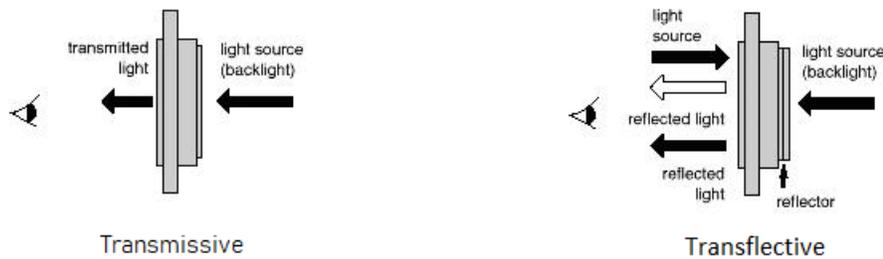
[G126FLGFGSW64T](#)

In order from left to right the displays are as follows: sunlight readable, transflective TFT and transflective graphic LCD. Below is a brief description of each display. The descriptive characteristics vary between the graphic and TFT display types. The backlight voltage is included to note the difference in power consumption between the sunlight readable and transflective TFT's.

Display	Description	Size	Polarizer	Resolution	Backlight Voltage
E35KA-FW1000-N	Sunlight Readable TFT	3.5"	Transmissive	320x480 pixels	15.0V
E20RB-FW345-N	Transflective TFT	2.0"	Transflective	240x320 pixels	3.3V
G126FLGFGSW64T	Transflective Graphic LCD	80x57mm	Transflective	128x64 dots	3.0V

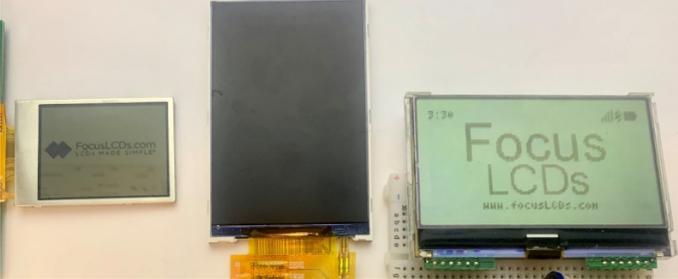
Method Descriptions

The first method is to use a transfective display. Transfective displays reflect the available light off the surface to illuminate the image. These displays are called transfective because they reflect and transmit the light; *transfective = reflective + transmissive*. Focus LCD's offers both graphic and TFT transfective display options. Both display types are great for outdoor applications where bright ambient lighting is available. A benefit of transfective displays is reduced backlight power. The backlight can be turned off when utilizing the reflective aspect of the display. This feature makes transfective displays favorable to battery powered applications.



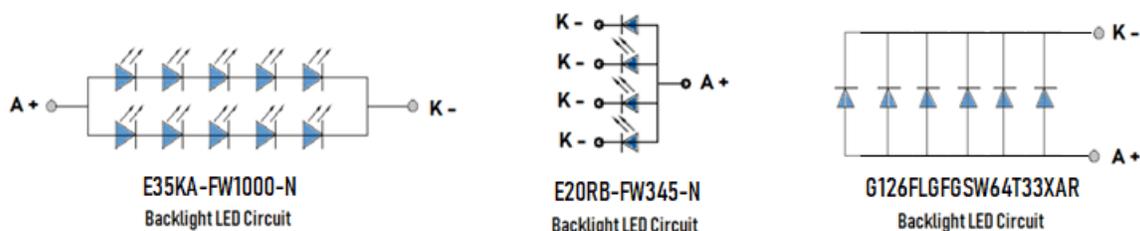
The second method is to use a transmissive TFTs with a high-powered backlight to compensate for bright ambient lighting. These TFTs are very bright and can range from 800-1100+ nits to illuminate the display. A non-sunlight readable transmissive TFT would have a much lower brightness and would look washed out or have limited visibility in a bright environment. Sunlight readable TFTs can maintain a detailed and colorful image in a variety of environments which make them a great solution for indoor and outdoor applications. The backlight is illuminated to a high brightness to make the image visible even in direct sunlight.

Example Lighting Environments

B/L	Ambient Condition	Examples [Transflective TFT, Sunlight Readable TTFT, Transflective Graphic]
ON	Bright Indoor Lighting	 <p>Three LCD panels are shown in a bright indoor setting. The left panel displays the FocusLCDs.com logo. The middle panel shows a vibrant cactus landscape. The right panel displays the time 3:29, signal strength, and the text 'Focus LCDs' with the website URL.</p>
OFF		 <p>The same three LCD panels are shown in the same bright indoor setting, but with power off. The left panel shows the logo, the middle panel is black, and the right panel shows the time 3:29 and 'Focus LCDs' text.</p>
ON	Dark Environment	 <p>The LCD panels are shown in a dark environment. The left panel shows the logo, the middle panel shows the cactus landscape, and the right panel shows the time 3:29 and 'Focus LCDs' text.</p>
ON	Full Sunlight	 <p>The LCD panels are shown in full sunlight. The left panel shows the logo, the middle panel shows the cactus landscape, and the right panel shows the time 3:29 and 'Focus LCDs' text.</p>
OFF		 <p>The same three LCD panels are shown in full sunlight, but with power off. The left panel shows the logo, the middle panel is black, and the right panel shows the time 3:29 and 'Focus LCDs' text.</p>

Power Consumption

A notable factor when choosing between sunlight readable transmissive and transreflective displays is the power consumption of the backlight. The backlight consists of a number of LED's in series and/or parallel. The sunlight readable TFT's will have more LED's to provide a higher brightness. It is important to consider the backlight circuit when choosing an LCD because they are often the biggest power drain of a display. Below are the backlight LED circuits for the displays in this example.



Sunlight readable transmissive TFT's and transreflective displays are on opposite ends of the spectrum of power demand. The backlight of a sunlight readable TFT requires high voltage and current to overpower the bright ambient environment. This power becomes more significant with the size and brightness of the display. A transreflective display uses the bright ambient lighting to illuminate the screen, thus removing the need for a backlight when these conditions are available. A comparison of power demand on the backlight between these display types are seen below.

Display	Size	Brightness (nits)	# of LEDs	Voltage (V)	Current (mAh)	Power (mWh)	Power (kJ)
Sunlight Readable Transmissive TFTs							
E35KA-FW1000-N	3.5"	1000	10	15	60	900	3.24
E40RC-FS1000-C	4.0"	1000	12	18.6	40	744	2.68
E43RG64827LW2M1000-R	4.3"	800	18	28.8	40	1152	4.15
Transflective TFTs							
E20RB-FW345-N	2.0"	345	4	3.0	80	240	0.95
E22RB-FW1180-N	2.2"	1180	6	19.5	20	390	1.4
E35RC-FW115-N	3.5"	115	6	18.6	20	372	1.34
Transflective Graphic LCDs							
G126FLGFGSW64T33XAR	128x64	--	6	3.3	50	165	0.594
G126GLGFYSY6WT	128x64	--	8	4.7	80	376	1.35
G160BLGFGSW6WTC3XAM	160x100	--	3	3.3	60	198	0.712

Considerations

The reflective and transmissive properties are inherent to each display. These modes specify the type of polarizer within the display and are not something that can be turned on or off. The transmissive display will reflect the light in bright ambient conditions. In dark environments the transmissive display can use the backlight to illuminate the display. The backlight does not make a significant difference for a transmissive display in direct sunlight. Power can be conserved when the backlight is not used. This makes transmissive displays energy efficient and favorable for battery powered applications. A standard transmissive TFT (non-sunlight readable) would have limited visibility and a washed-out appearance in direct sunlight.

Sunlight readable TFTs maintain color vibrancy and contrast in bright ambient lighting. The high brightness of the sunlight readable TFTs increases the power demand on the backlight, this can result in an increase of heat emission from the display. Heat emission and power consumption should be considered for outdoor applications specifically in high temperature environments. When not in a bright environment the display's backlight can be lowered to avoid eyestrain and decrease power demand.

Summary

Focus LCDs offers a variety of display options for bright ambient environments and outdoor applications. Sunlight readable TFTs are a great solution for maintaining a vivid and colorful image in any lighting environment. Transmissive displays, both TFTs and graphic LCDs, can illuminate the display with or without the backlight. These displays have the benefit of low power consumption because the backlight can be turned off utilizing the reflective polarizer of the display. This makes transmissive displays favorable for battery powered devices. It is important to consider these factors when choosing your next display and Focus LCDs has a solution for any application. For more information visit FocusLCDs.com.

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- (2) monitor failures and their consequences, and
- (3) lessen the likelihood of failures that might cause harm and take appropriate actions.

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