GENERAL DIGITAL
The Innovators of Flat Panel Technology

Optical Test Results for T-15X-446 LCD Display

TEST CONDITIONS						WHITE BRIGHTNESS (NITS)					BLACK BRIGHTNESS (NITS)					CONTRAST RATIO					PERFORMANCE NOTES		
Test Notes	Display On/Off	Backlight On/Off	Light Source ±5% (Nits)	Light Source Position	Photometer Position	Baseline - OEM Spec	T-15X-446-011000-01-000	T-15X-446-011000-00-000	T-15X-446-010000-00-000	T-15X-446-000000-00-000	Baseline - OEM Spec	T-15X-446-011000-01-000	T-15X-446-011000-00-000	T-15X-446-010000-00-000	T-15X-446-000000-00-000	Baseline - OEM Spec	T-15X-446-011000-01-000	T-15X-446-011000-00-000	T-15X-446-010000-00-000	T-15X-446-000000-00-000	Measurement Significance	Bulb Current - OEM Baseline (Typ.)	Bulb Current - for Measurement
N/A	On	On	Dark Room	N/A	0°	250	368	367	277	248	0.5556	0.76	0.73	0.7	0.59	450	484.21	502.74	395.71	420.34	Transmissive Mode	N/A	7.0 mA RMS per Bulb
per MIL-L-85762A	Off	Off	34,600	0°	30°	N/A	634	1090	968	1050	N/A	0	0	0	0	N/A	0	0	0	0	LCD Reflectivity	N/A	7.0 mA RMS per Bulb
per MIL-L-85762A	On	On	34,600	0°	30°	N/A	801	1240	1110	1160	N/A	59.6	539	528	630	N/A	13.44	2.3	2.1	1.84	Transflective Mode	N/A	7.0 mA RMS per Bulb
per MIL-L-85762A	On	Off	34,600	0°	30°	N/A	592	996	884	967	N/A	56.2	537	521	621	N/A	10.53	1.85	1.7	1.56	Reflective Mode	N/A	7.0 mA RMS per Bulb
FAA ATC-1	Off	Off	34,600	33° Azimuth	30°	N/A	397	451	480	515	N/A	0	0	0	0	N/A	0	0	0	0	LCD Reflectivity	N/A	7.0 mA RMS per Bulb
FAA ATC-1	On	On	34,600	33° Azimuth	30°	N/A	685	670	664	688	N/A	48.9	140	136	177	N/A	14.01	4.79	4.88	3.89	Transflective Mode	N/A	7.0 mA RMS per Bulb
FAA ATC-1	On	Off	34,600	33° Azimuth	30°	N/A	390	450	461	400	N/A	46.4	141	134	174	N/A	8.41	3.19	3.44	2.3	Reflective Mode	N/A	7.0 mA RMS per Bulb
FAA ATC-2	Off	Off	34,600	33° Azimuth	0°	N/A	480	766	760	919	N/A	0	0	0	0	N/A	0	0	0	0	LCD Reflectivity	N/A	7.0 mA RMS per Bulb
FAA ATC-2	On	On	34,600	33° Azimuth	0°	N/A	897	1100	1020	1100	N/A	62.8	368	373	546	N/A	14.28	2.99	2.73	2.01	Transflective Mode	N/A	7.0 mA RMS per Bulb
FAA ATC-2	On	Off	34,600	33° Azimuth	0°	N/A	490	764	754	903	N/A	62.7	365	370	546	N/A	7.81	2.09	2.04	1.65	Reflective Mode	N/A	7.0 mA RMS per Bulb

Notes

1. Data are taken under three conditions of LCD and backlight (B/L) power:
   – Operation with the LCD ON and B/L ON represents the most typical operating mode (transflective) of a GenFlective™ display. In this *Transflective Mode*, the display benefits from the combined luminance of the OEM backlight system and the passive film enhancements. This produces the best compromise of luminance, contrast and power conservation. This mode draws no more power and dissipates no more heat than the unmodified OEM backlight.
   – Operation with the LCD ON and B/L OFF represents the lowest power mode in which the display can be used. This is the *Reflective Mode* and may be useful in cases where the ambient temperatures within a sealed monitor enclosure make it desirable or necessary to minimize the power dissipation to prevent overheating of the LCD. This power reduction may be accomplished by turning off the backlight or by reducing the drive current to the lamps. This is a viable option in those enhanced panels which exhibit a high reflectance characteristic.
   – Operation with the LCD OFF and B/L OFF is a measurement of the reflectance of the LCD. The *Absolute Reflectance* may be calculated by dividing the reported reflected brightness of the display by the ambient light level.
2. The Test Notes represent three specific real world conditions which General Digital emulates in order to obtain accurate data.
   – The dataset marked as MIL-L-85762A represents an approximation of the performance when measured per the military requirements for use in high ambient lighting conditions. The full measurement requires the use of two light sources and several calculations. General Digital™ has elected to approximate the result by a single measurement under conditions designed to emulate the full methodology.
   – The dataset marked as FAA ATC-1 represents the performance obtained under the first of two conditions specified by the FAA STARS Program for qualification of displays that are intended for use in air traffic control towers. In this method, the light source is elevated 33 degrees above the display and the optical performance is measured with the brightness meter (photometer) located at a horizontal angle of 30 degrees to the display normal.
   – The data set marked as FAA ATC-2 represents the performance obtained under the second of two conditions specified by the FAA STARS Program for qualification of displays that are intended for use in air traffic control towers. In this method, the light source is elevated 33 degrees above the display and the optical performance is measured with the brightness meter (photometer) located at a horizontal angle of zero degrees to the display normal.
3. General Digital™ uses a sunlight simulator for a light source. This simulator consists of a 1,500 watt arc lamp whose output closely matches the spectrum of daylight, which is a color correlated temperature of 6500° Kelvin. This source is located at a distance from the display that was determined to provide 34,600 nits (±5%) from a calibrated white reflectance standard. This is equivalent to an ambient light level of 10,000 fc on the display, a value that is widely accepted as representative of a bright sunny day.
4. Configuration of the display is changed in a systematic manner to determine the optimum modification of the display. Before any changes are begun, the LCD is measured as it comes from the manufacturer. This provides the data shown in the columns with configuration coding of T-SSF-00000-00-000 (SSF represents a coding of the size and pixel format of the display). The data taken in the dark (laboratory environment) is a validation that the LCD, control electronics, backlight inverter and photometer are all performing as stated by the OEM LCD specification. The values obtained under high ambient lighting indicate the performance expected from the OEM display without any film changes and are useful as a baseline for comparison of the enhancements that can be made.
5. Once the baseline has been obtained, General Digital™ proceeds to test various alternative film configurations. These films consist of proprietary products that alter the direction and amount of light that the LCD can produce. Each configuration is given a unique coding to enable General Digital™ to discuss the performance with our customers and to reproduce the configuration in production.
6. The Baseline Bulb Current is generally the typical current, per bulb, at which the bulb should run, per the LCD manufacturer's recommendation. The Bulb Current - for Measurement represents the current at which the bulbs ran in General Digital's testing. Typically, greater luminance can be achieved by increasing the bulb current; however, this invariably reduces the expected bulb longevity. There are complex trade-offs among the optical performance, life of the backlight, heat generated (which must be removed from the monitor) and uniformity of light output. Please feel welcome to contact General Digital™ to discuss this in more detail.
7. The configuration that has been deemed to be the optimum compromise of performance for each LCD has been highlighted by vertical yellow stripes. Several criteria were considered in making this determination, including environment, direct sunlight, cost and performance. The horizontal yellow bars provide a reference line to show the driving conditions that were used in making this determination.