Technical Note

Adding Color to Your Application

Adding a color display to your application was unheard of at one time, as it would skyrocket the total price of your application. However, as the costs of color displays have decreased, their use is becoming more and more popular. Replacing knobs, switches, and indicator lights with onscreen slide bars, touch buttons, and alarm screens is now becoming more appealing, and affordable. The decision of whether to use a color display in your application is now being replaced by the decision of which one to use. With the growing number of display manufacturers competing for your business, this decision of which display to use becomes more and more difficult. This technical note will try to break down a few displays that we tested at Z-World with our single-board computers, giving you an overview of each display.

Five displays were run through their paces, each performing well in some areas and showing limitations in others. Each display is 320×240 (¼ VGA) 5.7" with a touchscreen. The types of displays tested range from a full single-source solution (I/O incorporated into the display) to just the LCD/touchscreen controller board, allowing application designers to choose the display that best fits their application.

The following five displays were tested.

1. **QTERM G70** (QSI Corporation)
2. **SLCD Controller** board and **Hitachi TFT** display (Reach Technologies)
3. **EZ-S6C-FS** (sold by Automation Direct)
4. **HMI520C** (Maple Systems)
5. **XGRAPH X3000** (DELCOMp Products)

The following criteria were examined for each display we tested.

1. Specifications.
2. Learning curve, software flexibility.
   - How easy is the display to program?
   - How complete and detailed is the documentation on both the display, and the software required to program it?
   - How flexible is the software?

3. Connectivity.

   - What types of connections are available (RS-232, RS-485, Ethernet, etc.)?

   - What protocols are supported?

4. Speed.

   - Can animation be performed?

   - Do screens appear fluid when displayed?

5. Overhead.

   - Is the display capable of storing memory intensive objects like bitmaps and fonts?

   - Can you download the above items via an external source other than the single-board computer?

6. Bezel and mounting.

   - Is the display NEMA 4 compliant?

   - How difficult is it to mount the display into a panel?

7. Overall opinion.

Sample programs and libraries are provided in a ZIP file that is included with this technical note. Add the library files for the display you are using to the Dynamic C `LIB.DIR` file.

All display-specific software is also available from the manufacturers.

QTERM G70

Manufacturer

QSI Corporation

Specifications

Color Depth	256 colors
Processor	Intel XScale®
Touchscreen Type	Resistive
Digital I/O	None
Ethernet	Optional
Serial Ports	1 installed, 1 more optional
Memory	4 Mbyte flash, 16 Mbyte SRAM standard
Web Site	www.qsicorp.com

Learning Curve, Software Flexibility

Both the hardware user's manual and the software user's manual are well-done and concise. *Qlarity Foundry* is the most complex of the software for the five displays we tested, but is also the most flexible. The language and programming environment are similar to Visual Basic. Application designers have the luxury of either using templates and functions already created, or they may design their own. Existing templates and functions are plentiful and easy to use. A key feature of the software is the ability to work on your design without a display actually being connected. A "simulation mode" allows for testing —including the serial port — using your PC. All in all the software is very well done. Because of the flexibility of the *Qlarity Foundry* package, the learning curve was the longest among the displays we tested. The software package does provide a wide range of samples, from simple to complex, which is a great help.

Connectivity

The G70 supports RS-232, RS-485, and Ethernet. The Modbus Master protocol is supplied with the software, and is supported for all interfaces. The software allows for custom protocols to be designed as needed.

Speed

The display speed is good. The screen switching is fluid and without flicker. Software support is provided for animation using an array of bitmaps. Slide bars and graphs are also supported.

Overhead

All bitmaps, fonts, and screen data are downloaded via the *Qlarity Foundry* software package. The single-board computer requires no overhead.

Bezel and Mounting

The bezel meets NEMA 4 specifications, and appears to be very well done. A bracket is included for panel mounting, and assists in sealing.

Overall Opinion

All in all, the QTERM G70 is a very nice package. The combination of powerful software with the rugged hardware design make the QTERM G70 a sure hit.

Software

Libraries

```
\RABBIT RESOURCES\LIB\MS_RAB.LIB  (Modbus slave library)
\RABBIT RESOURCES\LIB\MSZ_RAB.LIB (Modbus slave library)
\RABBIT RESOURCES\LIB\MM_RAB.LIB  (Modbus master library)
\RABBIT RESOURCES\LIB\MMZ_RAB.LIB (Modbus master library)
```

Fonts

```
\QSI DISPLAY\RESOURCES\FONTS\HELVR12.bdf
\QSI DISPLAY\RESOURCES\FONTS\HELVR14.bdf
\QSI DISPLAY\RESOURCES\FONTS\TIMR24.bdf
```

Images

```
\QSI DISPLAY\RESOURCES\IMAGES\DEMOBRD.bmp
\QSI DISPLAY\RESOURCES\IMAGES\ZWCMYK6.bmp
```

Sample Programs

```
\RABBIT RESOURCES\SAMPLES\LCD_MS_SER_BL25XX.C
\RABBIT RESOURCES\SAMPLES\QSI_BASICSAMPLE.C
\QSI DISPLAY\SAMPLES\BASICCOMMSAMPLE.qly
\QSI DISPLAY\SAMPLES\BASICSCREENCHANGESAMPLE.qly
\QSI DISPLAY\SAMPLES\EVENTTIMERSAMPLE.qly demonstrates event timer programming
\QSI DISPLAY\SAMPLES\MODBUSSAMPLESERIAL.qly Modbus sample
\QSI DISPLAY\SAMPLES\TABCONTAINERSAMPLE.qly demonstrates tab container use
```

SLCD Controller Board with Hitachi TFT Display

Manufacturer

Reach Technologies

Specifications

Color Depth	256 colors or monochrome
Processor	Renesas 16-bit
Touchscreen Type	Resistive
Digital I/O	None
Ethernet	None
Serial Ports	1 installed
Memory	512 kbyte flash, 512 kbyte SRAM
Web Site	www.reachtech.com

Learning Curve, Software Flexibility

Reach provides an easy-to-use ASCII protocol that is built into the firmware of the CPU. They also provide a simple utility for downloading bitmaps, macros, and button information, freeing up valuable space on the single-board computer. The protocol provided is extremely simple to use. It took about day to write a library to cover the major commands listed in their user's manual. The manual itself breaks down each command, giving all possible responses back from the LCD controller. Since Reach only requires a download utility, the learning curve for programming the display would be mainly for the single-board computer software (Dynamic C in this case). A firmware demo program is preinstalled, and is activated by a jumper on the controller board that will show some of the key features of the display.

Connectivity

An RS-232 port is provided.

Speed

The display speed is good. Screen switching is fluid and without flicker.

Overhead

The display can hold all the bitmaps, and is capable of receiving bitmaps from the single-board computer. Fonts are pre-stored into the firmware of the display, with a nice variety to choose from. Bitmaps are compressed when using the download utility provided with the display. The number of bitmaps that can be stored will vary, depending on their size.

Bezel and Mounting

Reach has designed a NEMA 4X enclosure for use with the Hitachi passive and active TFT LCDs. The mounting appears to be simple.

Overall Opinion

This display was very simple to use. Since the protocol is built into the display, a library for Dynamic C was easy to construct.

Software

Library

```
\RABBIT RESOURCES\LIB\REACH_TECH.LIB
```

Images

```
\REACH TECH\RESOURCES\01_BUTTON.bmp
\REACH TECH\RESOURCES\02_BUTTON_CLICK.bmp
\REACH TECH\RESOURCES\02_BUTTON_CLICKR.bmp
\REACH TECH\RESOURCES\03_CHECK_BOX.bmp
\REACH TECH\RESOURCES\04_CHECK_BOX_CLICK.bmp
\REACH TECH\RESOURCES\10_SOLAIR_BUTTON.bmp
\REACH TECH\RESOURCES\11_SOLAIR_BUTTON_CLICK.bmp
\REACH TECH\RESOURCES\LEDOFF.bmp
\REACH TECH\RESOURCES\LEDON.bmp
\REACH TECH\RESOURCES\MAINSCRN.bmp
\REACH TECH\RESOURCES\VKB.bmp
\REACH TECH\RESOURCES\ZWORLD.lst
```
(lst file for bitmap Downloading via the Bitmap loader utility supplied by Reach Tech)

Sample Program

```
\RABBIT RESOURCES\SAMPLES\RCH_DEMO1.C
```

EZ-S6C-FS

Manufacturer

AVG Group

Distributor

Automation Direct

Specifications

Color Depth	128 colors
Processor	Motorola Cold fire
Touchscreen Type	192 touch cells (resistive)
Digital I/O	None
Ethernet	None
Serial Ports	1 programming port, 1 communications port
Memory	512 kbyte flash standard, 512 kbyte SRAM standard
Web Site	web3.automationdirect.com

Learning Curve, Software Flexibility

The software is relatively easy to use if you have some embedded systems programming experience as well as knowledge of Modbus. (The protocols provided cover all of the major embedded systems brands.) It is not possible to add custom protocols to the software. The user's manual is complete, provided again that you have some embedded systems knowledge. This software was easier to learn than the QSI display, primarily because the package isn't as large. You do, however, lose some of the flexibility that the QSI package provides.

Connectivity

An RS-232/RS-485 port is provided for serial interfacing. One RS-232 port is provided for software design.

Speed

The display speed is good. Screen switching is fluid and without flicker.

Overhead

As is with the QSI display, all bitmaps, fonts, and screen requirements are loaded via the *EZTouch* software package. A Z-World single-board computer is needed to use the Dynamic C Modbus libraries.

Bezel and Mounting

The enclosure is rated for NEMA 1, FDA Compliant. No mounting issues were found.

Overall Opinion

This display is designed to be used typically with embedded systems such as those made by Allen Bradley, Koyo, and Symantec. Since it supports Modbus, it is simple to connect to Z World single-board computers by using the Dynamic C Modbus libraries.

Software

Libraries

`\RABBIT RESOURCES\LIB\MS_RAB.LIB` (Modbus slave library)
`\RABBIT RESOURCES\LIB\MSZ_RAB.LIB` (Modbus slave library)
`\RABBIT RESOURCES\LIB\MM_RAB.LIB` (Modbus master library)
`\RABBIT RESOURCES\LIB\MMZ_RAB.LIB` (Modbus master library)

Images

`\AVG DISPLAY\RESOURCES\DEMOBRD.bmp`

Sample Programs

`\RABBIT RESOURCES\SAMPLES\LCD_MS_SER_BL25XX.C`
`\AVG DISPLAY\SAMPLES\MODBUS_SER_SAMPLE.EZT`

HMI520C

Manufacturer

Maple Systems

Specifications

Color Depth	256 colors
Processor	Intel XScale, 200 MHz
Touchscreen Type	Resistive
Digital I/O	None
Ethernet	Yes
Serial Ports	2
Memory	2 Mbyte flash standard, 4 Mbyte DRAM standard
Web Site	www.maplesystems.com

Learning Curve, Software Flexibility

The software is relatively easy to use. It is a little more complicated than the **EZ-S6C-FS,** but does contain more features. The protocols provided are primarily for embedded systems control-lers. It is not possible to add custom protocols to the Maple Systems software package. The user's manual is complete, provided that you have some embedded systems knowledge. The learning curve for this software package was right between the Automation Direct display and the QSI dis-play. It provides a few more options than Automation Direct, but not as much as QSI. A nice selection of samples is provided to demonstrate some key features.

Connectivity

Two serial ports: one RS-232 or RS-485, the other RS-232. One Ethernet port is supported.

Speed

The display speed is good. Screen switching is fluid and without flicker.

Animation features are supported through the software package.

Overhead

Like the QSI display and the **EZ-S6C-FS,** the software loads all of the necessary elements**.** The single-board computer would use Dynamic C Modbus libraries for communication purposes.

Bezel and Mounting

The bezel is rated NEMA 4 / IP65. No issues were found in mounting.

Overall Opinion

This display is designed primarily to be used with embedded systems. It is interfaced with Z-World's single-board computers using the Dynamic C Modbus serial and Modbus TCP libraries.

Software

Libraries

`\RABBIT RESOURCES\LIB\MS_RAB.LIB` (Modbus slave library)
`\RABBIT RESOURCES\LIB\MSZ_RAB.LIB` (Modbus slave library)
`\RABBIT RESOURCES\LIB\MM_RAB.LIB` (Modbus master library)
`\RABBIT RESOURCES\LIB\MMZ_RAB.LIB` (Modbus master library)

XGRAPH XG3000

Manufacturer

DELCOMp

Specifications

Color Depth	256 colors or monochrome
Processor	Rabbit 3000, 29–57 MHz
Touchscreen Type	Resistive
Digital I/O	Too many to list. See Web site for complete listing.
Ethernet	Yes
Serial Ports	2
Memory	512 Kbyte flash, 512 Kbyte fast SRAM, 512 Kbyte data SRAM, CF and SD memory slots
Web Site	www.delcomp.com

Learning Curve, Software Flexibility

Dynamic C is used to program this display. No other software package is required. Dynamic C provides all the needed flexibility. There are libraries written specific to the display. There is a rather lengthy list of modifications to Dynamic C's libraries/BIOS to use all features of this device. Since the display and I/O are using the same processor, the programmer needs only to learn one software package.

Connectivity

RS-232C, RS-485, Dallas 1-Wire, I2C, SPI, USB, and Ethernet are supplied.

Speed

The display speed is good. Animation features are possible.

Overhead

Not applicable since this display is a single-source solution.

Bezel and Mounting

Optional ABS wall-mount and desktop enclosures are available. No NEMA rating was identified.

Overall Opinion

This is a single-source solution—the device is a single-board computer. The I/O options are plentiful for a display device, and includes interesting features like MMC/SD flash support, Compact Flash support, a USB interface for programming, D/A converter, A/D converter, etc. For customers who wish to combine their display needs with their I/O needs in one operator interface/ single-board computer, this would be the way to go.

Displays That Use Modbus

The QSI, Automation Direct, and the Maple Systems displays all use the Modbus master for connectivity between themselves and the single-board computer. It would be highly recommended that you have a good understanding of Modbus before you decide on a display. Modbus information can be found at www.modbus.org/default.htm, and www.modicon.com/Default.htm. Both sites provide reference manuals and useful information. Modbus is considered to be a standard in the world of industrial automation and control. Most devices used in industrial automation usually provide some sort of Modbus interface, as well as there own custom interface. This provides the application engineer with a wide selection of devices that can interconnect with each other.

Summary

The displays tested provided a wide range of features that allow the engineer to choose the best one for his/her application needs. From a single-source solution to a customizable system, all of the displays listed performed well and are worth considering for future applications.