ICS ELECTRONICS
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IEEE 488 APPLICATION BULLETIN

USING THE 4863 TO REPLACE BCD CONTROLLED INSTRUMENTS WITH GPIB BUS INSTRUMENTS

INTRODUCTION

This application note describes how ICS's Model 4863 GPIB-to-Parallel Interface can be reprogrammed as a Test Module Adapter (TMA) to operate a GPIB instrument in a manner so that the combination replaces the existing BCD instrument in an automatic test system.

THE PROBLEM

Older automatic test systems (ATS), like many of today's test systems, use standard instruments to generate test stimuli and to measure test results. They look much like the generalized test system shown in Figure 1. These older systems were designed before instruments with GPIB interfaces were available and so used instruments with BCD interfaces to test the UUT. The instruments in these systems are now 15 to 20 years old and parts are no longer available to maintain the instruments. The problem is how to replace an obsolete instrument so that the system can continued to be used.

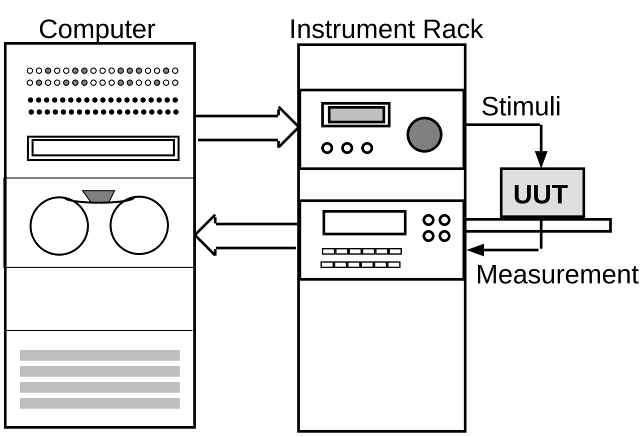

Figure 1 An Automatic Test System

POSSIBLE SOLUTIONS

Possible solutions are:

1. Find a replacement instrument with a BCD interface.
2. Replace the complete system.
3. Add GPIB Controller capability to the system to support a modern instrument with a GPIB interface.
4. Replace the instrument with one that mimics the original instrument.

Solution #1 - Finding a replacement BCD instrument

This is a low cost solution if an equivalent BCD instrument is available. The problem with solution #1 is that instruments with BCD interfaces have not been build since the mid 1980s. If any such instruments were available, they would be facing the same parts obsolescence that the current instruments in the test systems are facing. Solution #1 is normally impractical since working BCD instruments are hard to find and only moves the day of reckoning out a year or two. This is a good temporary solution for only one system but not practical for multiple systems. The solution also requires a new cable from the computer's BCD interface to the replacement instrument.

Solution #2 - Replacing the complete system

This is the most costly and time consuming solution. It means that a new system will have to be designed, built and programmed from scratch. Each UUT test routine will have to be reprogrammed. Meanwhile, the existing systems will be down for months or years while a new system is being designed and built. This is really a difficult project because most of the engineers associated with the design of the original UUTs are long gone and test specifications for each UUT will have to be recreated. The question becomes "Does the expected life span of the UUTs warrant such an expenditure of time and money?"

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Solution #3 - Add GPIB Controller capability to the system to support a modern instrument with a GPIB interface.

Most of the older test systems were not equipped with a GPIB Controller necessary to operate a GPIB controlled instrument. To add a GPIB Controller to the system means:

1. A GPIB Controller card will have to be added to the existing computer. Since these are older computers, plug-in GPIB controller cards are not readily available for most of them and one would have to be specially designed for the computer. If there is not a spare card slot, a special computer-to-GPIB interface unit will have to be designed and added to the system.
2. A GPIB driver will have to be written.
3. Each UUT test routine that used the old BCD instrument will have to be rewritten. This means finding the original source code. If source code is found, there is no guarantee that it is the current revision. Each revised test routine will have to be tested and certified before it can be used. Timing relationships may have changed so they will have to be carefully checked.

Solution #3 is the second most costly solution.

Solution #4 - Replace the instrument with one that mimics the original instrument.

This is the easiest and often the least expensive solution to implement. This solution requires a programmable test module adapter (TMA) that can adapt a modern GPIB Instrument to work in the test system in a manner that is transparent to the existing test software. This solution also requires an adapter cable from the computer's BCD interface to the TMA and may require some adjustment of the rack space to accommodate the new instrument. Newer instruments are typically smaller than the older BCD instruments they replaced, so the mechanical fix is often a filler panel.

USING A 4863 AS A TMA

ICS's Model 4863 was originally designed as a GPIB-to-Parallel interface with 48 digital I/O lines that can be configured as inputs or outputs in 8-bit bytes. Its normal firmware makes it a GPIB bus device. However, its internal architecture is such that it can easily be made a GPIB bus controller by changing its firmware. Its digital interface can handle up to 12 BCD digits of DTL/TTL or CMOS signals.

There are two types of TMAs. One to control stimuli such as signal generators, voltmeters etc. and the other to read data from measuring instruments such as voltmeters and counters.

Replacing a Stimulus Device

Figure 2 shows how the 4863 is used when controlling a stimulus device such as a signal generator, voltmeter etc. Most of the BCD information at the computer interface was directed to the original device to control its signal output. Very little was feedback to the computer. In this application, the 4863's principal task is to convert the incoming BCD data into instrument commands and then transmit them to the instrument over the GPIB bus.

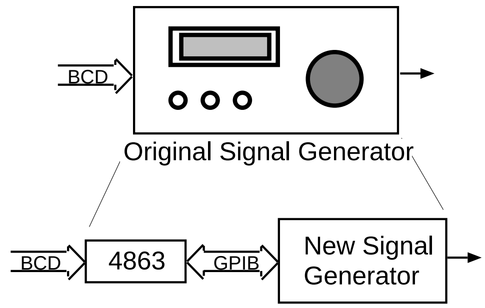

Figure 2 Replacing a Stimulus Device

The instrument commands can be single letter commands that set a function or range i.e. R3 up to complex SCPI commands such as "SOURCE:VOLT:DC 37.5".

Replacing a Measuring Instrument

Figure 3 shows how the 4863 is used when interfacing a measuring device such as a voltmeter, counter or signal analyzer to the computer. Most of the BCD information at the computer interface was the measured results that were directed to the computer. Most systems have control lines that select a measurement function, range, etc. In this application, the 4863's principal task is to set the instrument to the correct mode, to read the measured results from the instrument and to present them to the computer's interface.

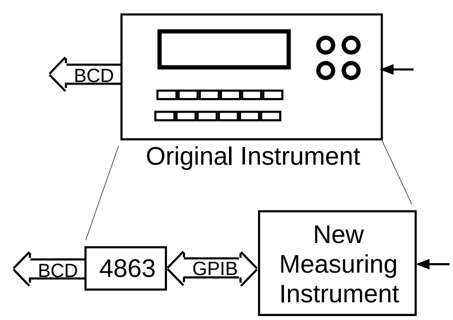

Figure 3 Replacing a Measuring Instrument

The 4863 translates the BCD control lines into instrument commands that can vary from simple single letter commands that set a function or range, i.e. R3, up to complex SCPI commands such as "MEAS:VOLT:DC:RANGE 100".

4863's TMA FIRMWARE

The 4863 can handle virtually any kind of a GPIB instrument but it works best with an IEEE-488.2 compatible device. IEEE-488.2 compatible devices respond to a common set of commands so the 4863 can easily identify the instrument to verify that it is the correct model and whether any commands issued to it were incorrect. Since the IEEE-488.2 Standard was released in 1987, instruments that do not include it are probably several years old and may well on their way to being obsolete.

Figure 4 shows the flow chart for the 4863's TMA firmware. The initial part of the TMA firmware is the same regardless of whether the 4863 is controlling a stimulus device or a measuring instrument. At power turn-on, the 4863 performs its self test, initializes the instrument and then reads the instrument's IDN message to verify that it is the expected device. The 4863 will pause here if the instrument needs more time to get ready after power turn-on. If the instrument is not the correct model number, the 4863 will turn on its red ERR LED and retry.

If the instrument is the correct device, the 4863 will recall the user's settings and set the instrument to the correct operating mode. IEEE-488.2 instruments allow the user to modify and save the instruments settings as the power turn-on values. This feature lets the user modify power outputs, modulation modes and make other changes when calibrating the system without having to change commands embedded in the 4863's firmware. The settings are saved in the instruments's memory and are recalled at power turn-on.

Next the 4863 starts the instrument run loop. The run loop differs for stimulus devices and measuring instruments. Stimulus devices are sent a new command each time that the 4863 detects an change in a BCD command setting. The 4863 debounces its BCD inputs and verifies each BCD word for valid values before converting the BCD input into a device command. The command conversion routines vary for each device and have to take into account the difference in capabilities between the old and new devices and the new device's command syntax. The conversion routines also handle any feedback to the computer and timing issues such as GPIB devices that will not accept commands until the current command is completed. If the 4863 detects an invalid BCD input, a GPIB bus error or if the stimuli device stops responding, the 4863 will turn on its ERROR LED and wait for a new BCD input. The ERROR LED will be turned off when the error is corrected or goes away.

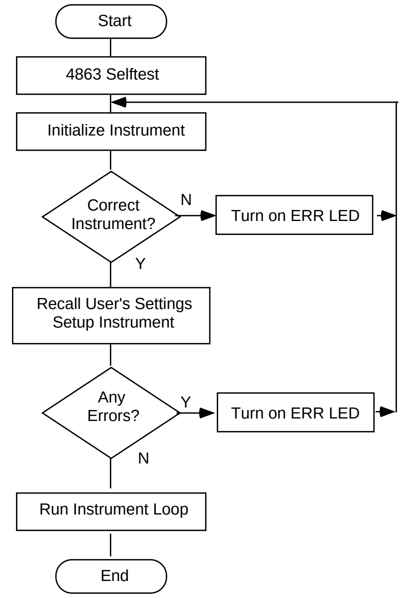

Figure 4 4863 TMA Firmware Flowchart

Measurement instrument run loops are more complex. The typical measuring instrument receives commands that set its range, function etc. The BCD inputs for these commands are debounced and verified as described above for the stimuli devices. If the older BCD instrument was triggered, then the new GPIB instrument will also have to be triggered to maintain system timing. When the instrument is addressed to talk, the results are read over the GPIB bus, converted into the BCD format and outputted to the computer. The conversion routines handle scaling the new instruments results to match the older BCD instrument, generating decimal point outputs and generating any necessary data ready strobes. The 4863 will turn on its ERROR LED if it detects an invalid BCD input, a GPIB bus error or if the measuring instrument stops responding. The ERROR LED will turn off when the problems are corrected. Optional features include driving remote displays when the replacement instrument does not fit in the panel or driving other alarm signals from the ERROR LED.

SUMMARY

This application note has described how a 4863 GPIB-to-Parallel Interface with custom TMA firmware can be used to replace a BCD controlled instrument in an older test system with a modern GPIB controlled instrument. The 4863 implements the lowest cost solution to the ATS obsolescence problem with off the shelf hardware and its use with a GPIB instrument prolongs the life of the ATS system for several years. While this application note described BCD coded parallel interfaces, it applies equally to parallel interfaces with different coding schemes.