

OVERVIEW

The GPS ARCHITECT (Figure 1) is a development system intended for Global Positioning System (GPS) receiver design where a GPS receiver function needs to be embedded within OEM products at low cost.

GPS Architect operates as a 12 channel 'All-in-View' GPS receiver. Purchase of the product entitles the developer to use or modify the GPS code and to embed into host systems without royalty or extra licence fees.

The product uses the Mitel Semiconductor GP2000 chipset with the P60ARM-B processor (Figure 2). All GPS software (in 'C' source) is supplied for acquiring and tracking satellites. The software may be modified by the developer on a PC, and is compiled using the ARM Development toolkit supplied with the system. Within the source code, all routines have been extensively commented.

In addition to the software, the system contains a 12 channel receiver board with PC interface ports for receiver control and monitoring, and is supplied with active antenna, cables and user manual.

FEATURES

- Complete development system for GPS receiver design using 12 channel architecture
- Optimised acquisition, tracking, and navigation software available in 'C' source, with unrestricted licence for use
- Differential GPS capability through serial port, giving higher accuracy
- Software and hardware debugging and monitoring facilities
- Up to 50% spare processor capacity using the ARM RISC chip

All software for GPS operation is supplied for a Windows™ V3.1 or Windows™ 95-based PC. It is intended that the developer can use the GPS code 'as-is', or enhance it to make it application-specific. Software is written and compiled on the host PC using the ARM Toolkit. Code development is interactive, with GPS Architect providing a hardware platform to host the compiled code to prove operation.

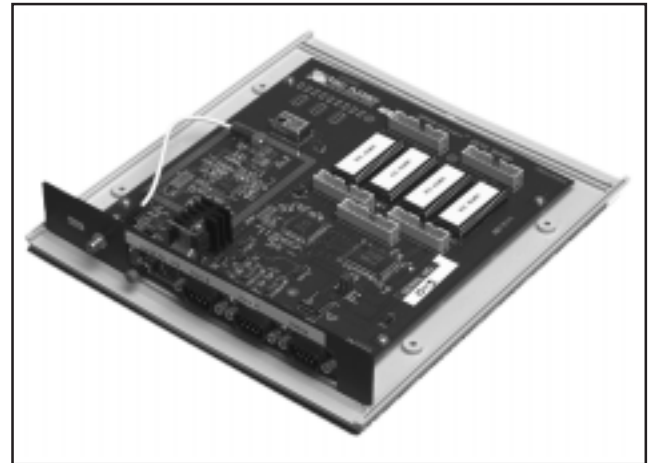


Figure 1 GPS Architect

The full GPS Architect System contains:

- Main board mounted in a plastic case
- Active antenna with magnetic mount and cable
- GPS software (on 3.5 inch floppy disk)
- Software licence agreement
- ARM Toolkit
- User Guide Documentation
- Power Supply
- Two serial cables for connecting GPS Architect to a PC

RELATED PRODUCTS

| Part No | Description | Data Sheet Reference |
|----------|-----------------------|----------------------|
| DW9255 | 35.42 MHz SAW Filter | DS3861 |
| GP2010 | GPS RF Front End | DS4056 |
| GP2015 | GPS RF Front End | DS4374 |
| GP2021 | 12 Channel Correlator | DS4057 |
| P60ARM-B | 32-bit RISC Processor | DS3553 |

Data is also available in *Global Positioning Products Handbook, HB4305 - 1.0 August 1996.*

ORDERING CODES

| | |
|---|--------------------|
| Full GPS Architect: | GPSARCHARM/01/SSTM |
| Basic GPS Architect: (without ARM Toolkit) | GPSARCH/01/SSTM |
| Hardware only: | GPSARCH/01/HARD |
| ARM Toolkit only: | GPSWT2PDL/20/SOFT |

GPS ARCHITECT

| | Full System (incl Toolkit) | System | Hardware only | ARM Toolkit |
|-----------------|----------------------------|-----------------|-----------------|--------------------|
| Part number | GPSARCHARM/01/SSTM | GPSARCH/01/SSTM | GPSARCH/01/HARD | GPSWT2PDLC/20/SOFT |
| Main board | Yes | Yes | Yes | No |
| Antenna & Cable | Yes | Yes | Yes | No |
| 2 PC cables | Yes | Yes | Yes | No |
| Power supply | Yes | Yes | Yes | No |
| Documents | Yes | Yes | No | No |
| GPS Software | Yes | Yes | No | No |
| ARM Toolkit | Yes | No | No | Yes |

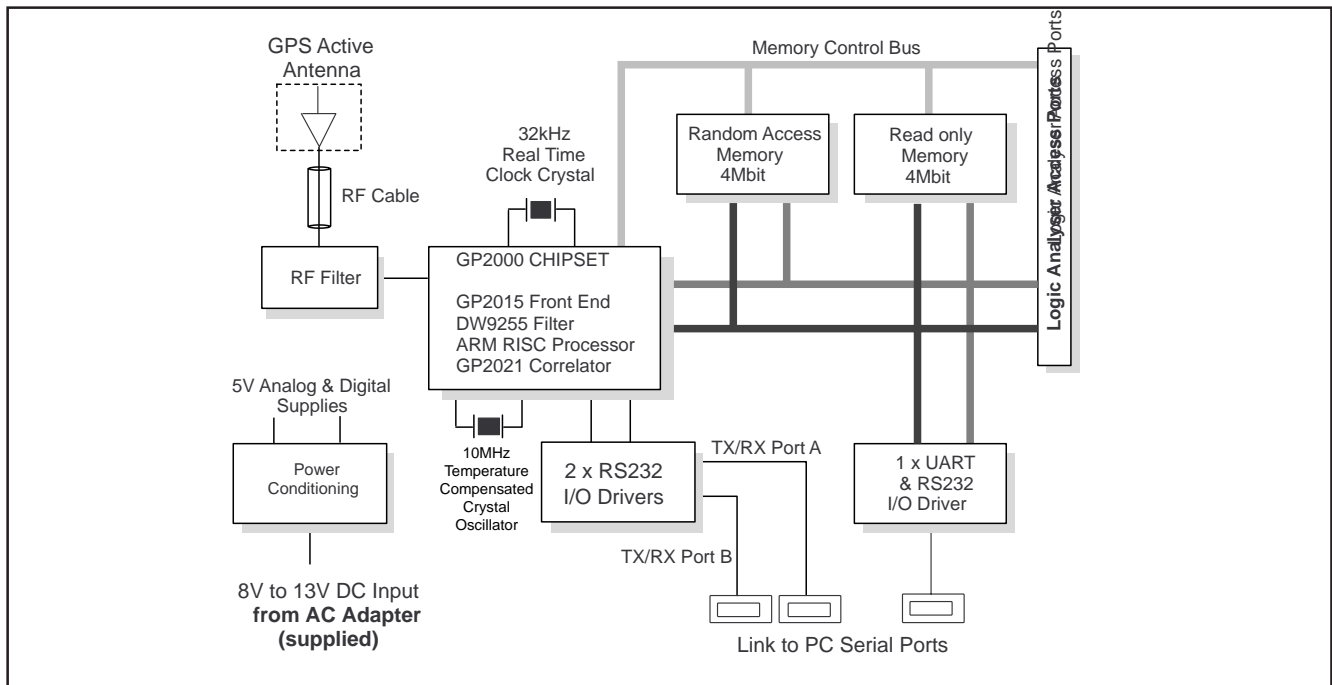


Figure 2 Block diagram of GPS Architect

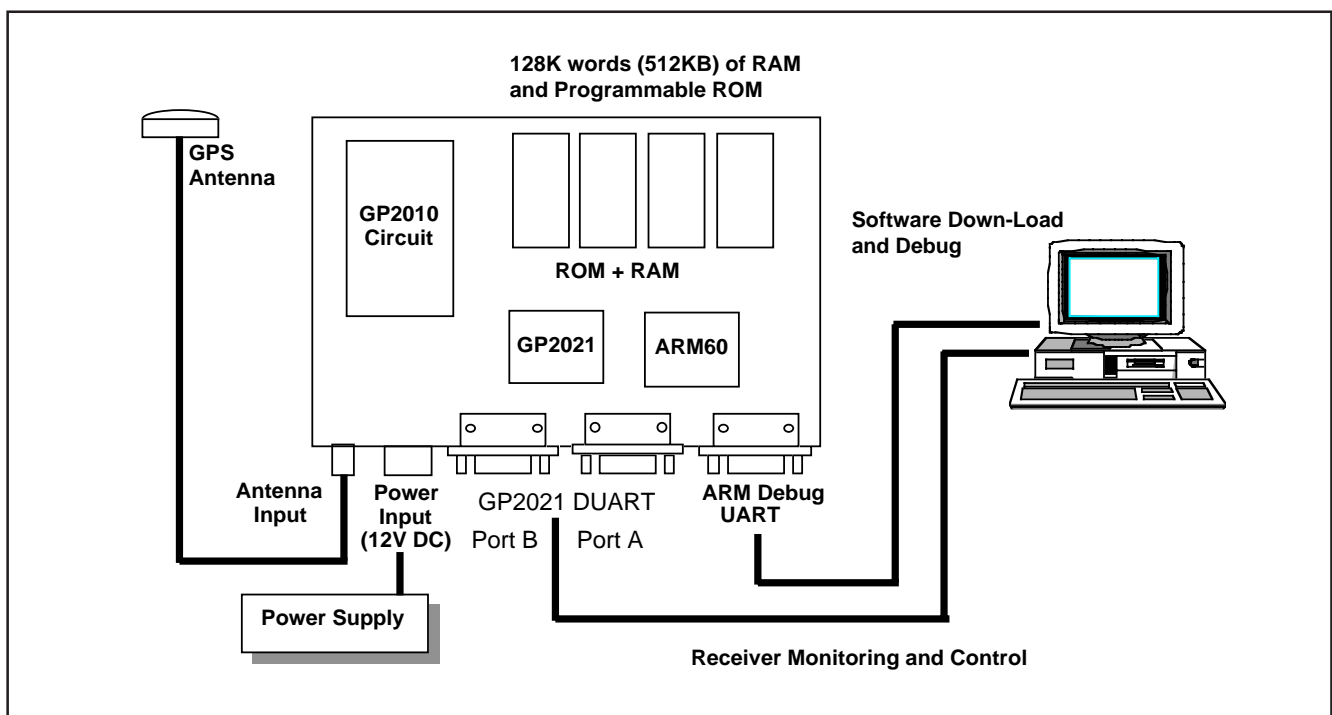


Figure 3 Connection of GPS Architect to other components

INTERFACING TO THE PC

External interfacing to the GPS Architect is shown in Figure 3.

The GPS Architect uses one of the on-chip Dual UART ports on the GP2021 correlator circuit for communications with the WINMON (WINdows MONitor) program. The other UART port is used for Differential GPS correction data if required for higher navigation accuracy. A third port is provided for software download and interactive debug during code development. This port is accessed via an independent UART (not on the GP2021 chip). All UART ports are RS232 compliant. Only a single PC hosting Windows™ 3.1 or Windows™ 95, with 2 spare COM ports, is required for full interactive software development on the GPS Architect platform.

Figure 4 shows the main screen display under WINMON operation with Differential GPS input enabled. Various other windows may be invoked to show the current navigation fix, satellite tracking information, debug status, processor activity, receiver status etc. as shown in Table 1.

The WINMON interface allows user control of the receiver operation. These commands allow the developer to set a number of conditions, such as number of tracking channels, cold start mode, reference position, initial position, elevation and GDOP masks, toggle altitude aiding; track modes; and commands for data logging etc. as shown in Table 2.

| Display | Content |
|----------------------------|--|
| Navigation Data and Status | Latitude, Longitude, Geometric Dilution of Precision (GDOP), Date, Time, etc. |
| Channel Status | Elevation Indicator, SV (Satellite Vehicle) allocated, SV Elevation, Azimuth, Doppler, Pseudorange Error, Integrated Carrier Phase Error, state of lock, Signal to Noise Ratio (SNR) etc (for each of 12 channels) |
| Satellite Summary Data | Almanac Health, Almanac Status, SV Elevation, Azimuth & Doppler etc |
| Processing Status | Accumulations, measurements and subframes pending/missed, PLL lock loss, channels in use etc. |
| Operating Parameters | Receiver Configuration |
| Data Logging | Information concerning the logging of receiver data to file |
| System Status | Navigation status of the receiver (no-fix, 2-D fix, 3-D fix) |
| Comms Link Status | Status of the PC/GPS Architect communications link |
| Debug String | Debug information as defined by the developer |

Table 1 WINMON display screens

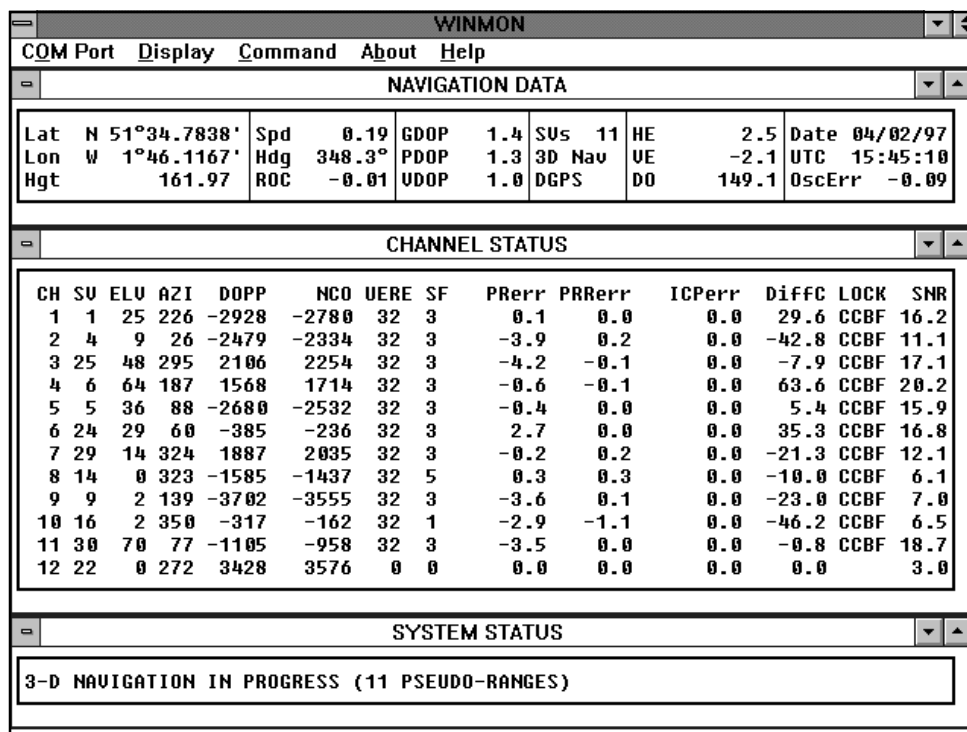


Figure 4 GPS Architect WINMON: Default Display

GPS ARCHITECT

| Command | Comment |
|---------------------------|--|
| Active channels | Sets the number of channels (between 1 and 12) that will be used for satellite acquisition and tracking |
| Altitude aiding | Enables automatic 2-D navigation when applicable |
| Cold start | Initialises a receiver Cold Start (no initial information). |
| De-select satellite | Manually de-select the use of specified satellite |
| Don't move | Determines whether each navigation fix updates the GPS Architect position, or not |
| Elevation Mask | Sets the elevation mask (-90 to +90°) below which satellites are not used in the navigation solution |
| Initial Position | Set the receiver initial position estimate |
| Load almanacs | Load almanac and ephemeris data from a PC file |
| Log file | Enables saving of navigation fix data and receiver status information to a text file. The data records can be written at an interval of between 1 and 60 seconds |
| Oscillator Error | Set the estimated receiver oscillator error (ppm) |
| PDOP Mask | Set the receiver PDOP mask above which navigation will not occur |
| Reference position | Set the receiver reference position estimate |
| Reference Position Update | Set the receiver reference position to the current navigation fix position |
| Re-select Satellite | Re-select satellites which have previously been disabled |
| Satellite selection mode | Three options are available : - highest elevation - cold start - manual selection |
| Save Almanacs | Save almanac and ephemeris data to a PC file |
| Select satellites | Allows satellites to be manually allocated to receiver channels |
| Set time | Set the receiver time estimate |

Table 2 WINMON receiver commands

SPECIFICATION

The specification below is based on the GPS Architect software as supplied and unmodified. It is expected that, during development, developers will optimise the software to meet their specific requirements.

| Parameters | Value | | | Units | Conditions |
|--------------------------|-------|------|------|-------|---|
| | Min. | Typ. | Max. | | |
| DC Power Supply | +8 | | +16 | V | See note 1 See note 2, Zero base-line. Real-time differential. See note 3 See note 4 See note 5 See note 6 |
| Number of channels | | | 12 | | |
| Accuracy | | 5 | | m | |
| Position Fix update rate | 0.1 | | 1.0 | s | |
| Time to First Fix | | | | | |
| - cold start | | 150 | | s | |
| - warm start | | 45 | | s | |
| - hot start | | 15 | | s | |
| Signal reacquisition | | 2 | | s | |
| Velocity | | | 300 | km/hr | |
| Height | | | 5000 | m | |

NOTES

1. Software selectable to reduce power and processor loading. The use of 12 channels allows for "all in view" tracking.
2. Without DGPS, Selective Availability (SA) reduces the accuracy to 72m 3D SEP.
3. Cold start : when the receiver is started without any accurate initialisation data. The satellite visibility list is considered to be inaccurate, and the almanac is unreliable and cannot be used.
4. Warm start : when the receiver is started from user-supplied information (with exception of ephemerides) with an accurate initial position.
5. Hot start : when the receiver is started from user-supplied information and where the receiver has been reliably tracking previously so that accurate satellite ephemerides are known. Generally this requires battery back-up RAM or some form of non-volatile memory to store the critical data. GPS Architect does not have battery back-up.
6. Satellite reacquisition : when the satellite signal is lost through obstruction following a period of successful navigation. The condition is entire sky blockage for a maximum of 30 seconds.

More information on TTFF (time to first fix) conditions is given below.

| | Cold start | Warm start | Hot start |
|----------------------------|---|---------------------------------|---------------------------------|
| Reference oscillator error | 4 ppm Temperature, voltage and ageing | Known to within \pm 0.1ppm | Known to within \pm 0.1ppm |
| Satellite almanacs | Unknown | 1 week old | N/A |
| Satellite ephemerides | Unknown | Unknown | <4 hours old |
| Initial position estimate | Unknown | <100km | <100km |
| Initial time estimate | Unknown | <5 minutes | <5 minutes |

Module Connections

Antenna input with 5V supply to antenna

Power Supply input

- 3 x RS232 connectors - Port A - Differential correction input
(see Figure 3) - Port B - Display information/WINMON
Debug Port - To download and debug programme code from the PC.

GPS ARCHITECT

ARM TOOLKIT

The GPS ARM Toolkit runs on PC platforms (386 and above), and has been developed with special attention to these requirements. It has a Graphical User Interface (GUI) and a multi-window debug environment, which together greatly enhance ease of use and productivity. The GPS ARM Toolkit is easy to install, and is immediately available to develop code for ARM6 and ARM7 based processors. The ARMulator is an instruction set emulator, rather than a logic simulator, and provides acceptably fast execution of code in a PC environment. For example, whereas typical CPU simulators may run thousands of times slower than the target processor, the emulated ARM runs on a 66MHz 486-based PC at 1/100th of the speed achieved by a an actual ARM processor at 30MHz.

ARM TOOLKIT FEATURES

- Cross-development environment hosted on PC (386 and above)
- Full Windows support (Windows 3.1 and above)

- Project-based command shell
- Multiple windows - giving full visibility of source code and system state
- Supports all ARM6 and ARM7 RISC-based products from Mitel Semiconductor
- Built-in Emulator for early code development and debug
- Disassembler available for Hewlett Packard Logic Analysers

The Toolkit contains six key components:

- Windows-based Graphical User Interface (GUI) Shell - see Figure 5
- Mature Core Programming Tools (Compiler, Assembler, etc.)
- Full Software Emulation of ARM6 and ARM7 cores
- A powerful Windows-based Source Level Debugger
- A readily retargetable Debug Monitor
- Validated ANSI-compliant C libraries

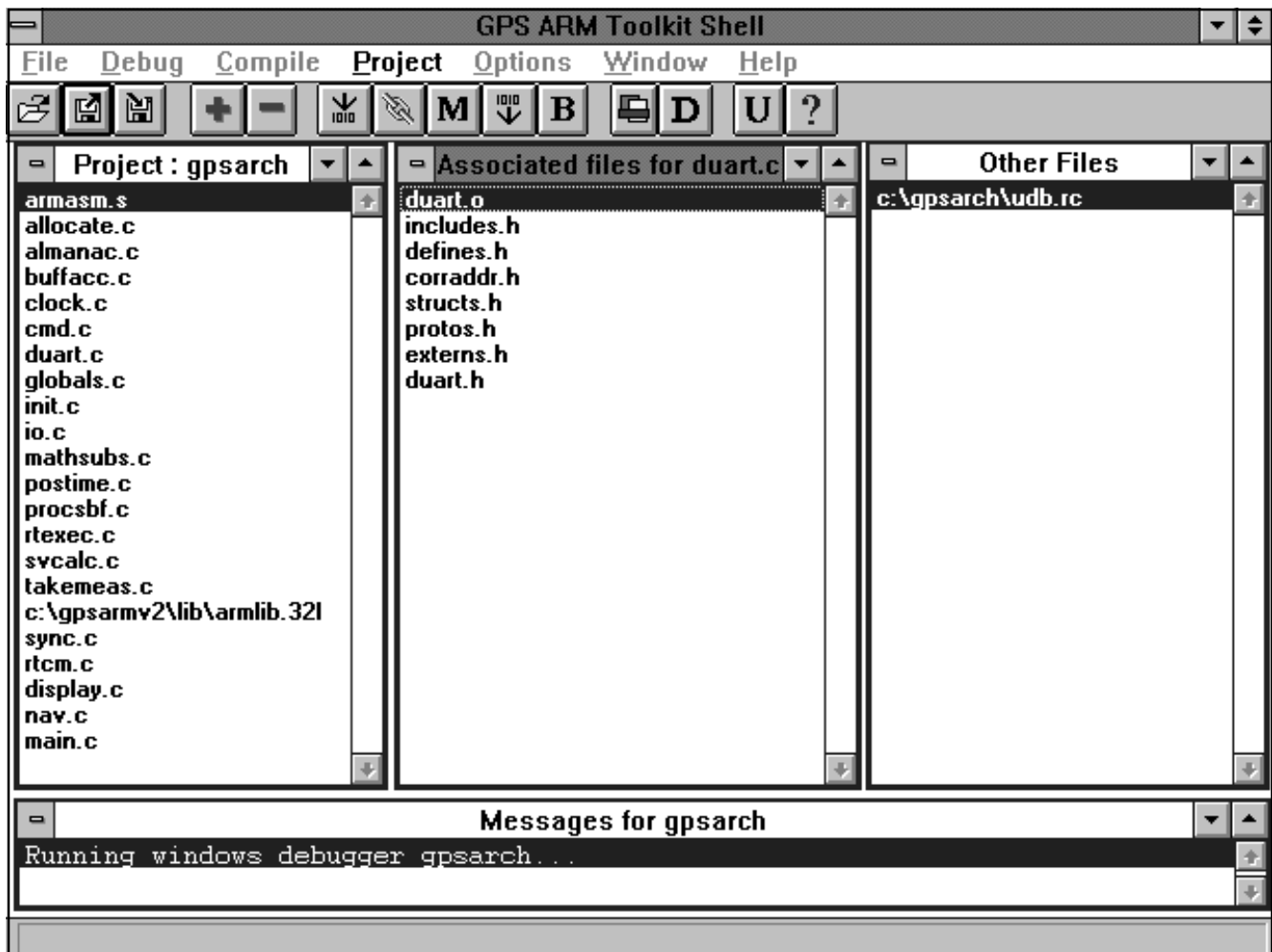


Figure 5 GUI Shell, showing Menu Bar, Tool Bar and the main Project and Message Windows

GRAPHICAL USER INTERFACE (GUI)

The GPS ARM Shell is a full Windows GUI, so new users who are already familiar with popular Windows applications will become productive almost immediately. It allows users to develop their ARM applications easily and efficiently, grouping program elements in Projects to aid the organisation and management of complex systems.

All elements of the Toolkit are invoked from the Shell, generally aided by quick-access buttons, with their options being set using convenient Dialog Boxes. Ease of use has been a key consideration throughout the design of the Shell; for example, double clicking on a file name opens that file for editing, and different editors can be associated with different file types to suit the user's preferences. A source code editor is not supplied with the Toolkit, but links are set initially to Windows Notepad.

The Shell also provides a MAKE utility, which checks for files that have changed, checks inter-dependencies, compiles, assembles and links the code as necessary, and creates symbol tables (if required) for debugging. A single click on the quick-access MAKE button generates a guaranteed up-to-date executable of the whole project under development.

THE UDB DEBUGGER

UDB is a universal source-code level debugger. It runs under Windows, and supports most popular embedded processors and cross compilers.

A typical screen is shown in Figure 6.

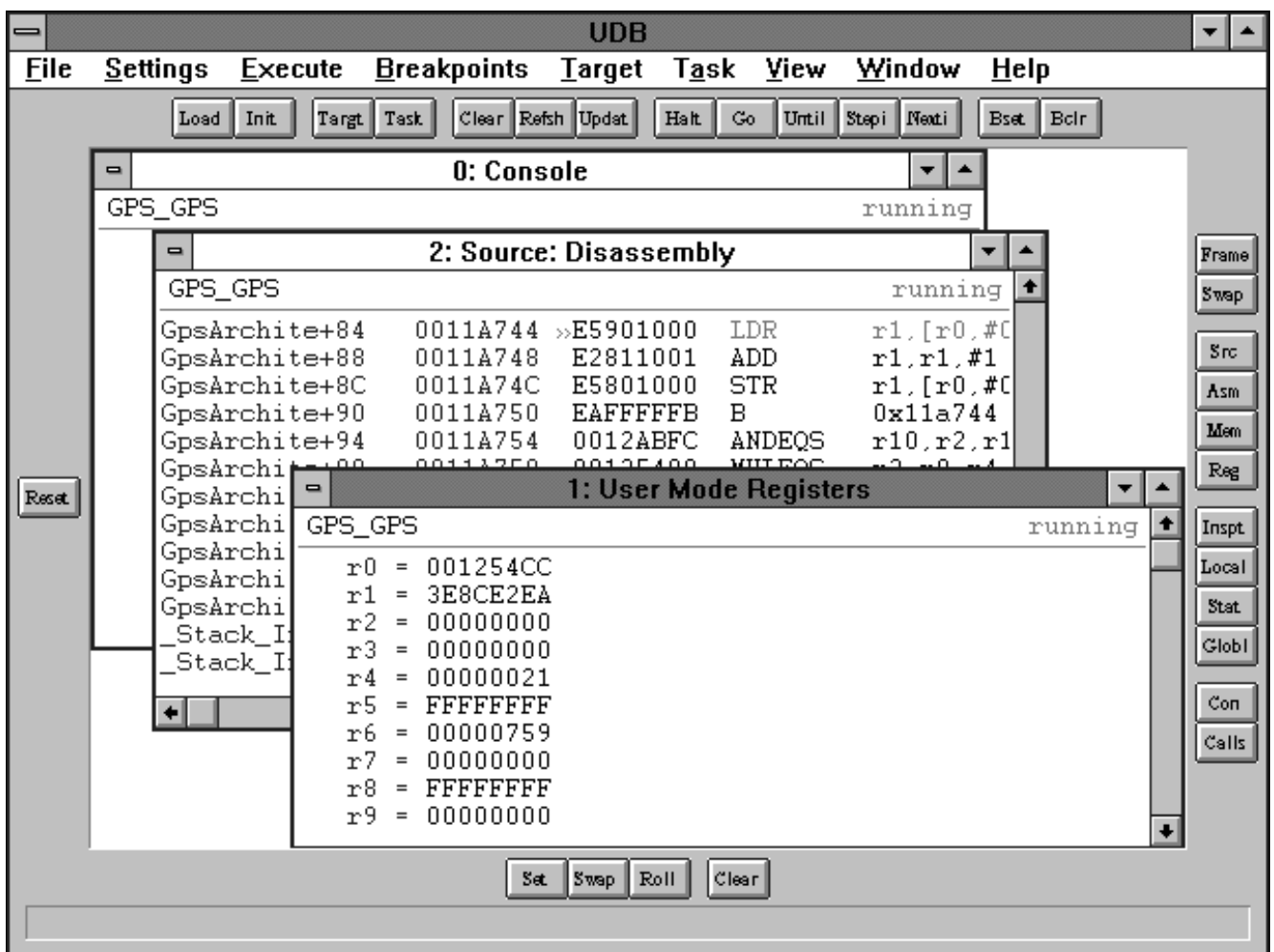


Figure 6 UDB Screen

UMON is the Universal Monitor associated with UDB. It runs on the target hardware and allows UDB to communicate with, and control, the ARM processor or microcontroller.

During a debugging session multiple windows can be opened, providing views of source code, disassembled

code, memory contents, processor registers, variables etc. The information in these windows can be displayed in a variety of formats, selectable by the user. Most windows allow interactive editing of the displayed data.

GPS ARCHITECT

GLOSSARY OF TERMS

| | |
|----------|---|
| ARM | Advanced Risc Machines Ltd, UK |
| C/A code | Coarse/Acquisition code |
| DGPS | Differential GPS |
| GDOP | Geometric Dilution of Precision |
| GPS | Global Positioning System |
| L1 Band | 1.57542 GHz |
| PDOP | Position Dilution of Precision |
| RISC | Reduced Instruction Set Computer |
| RTCM | Radio Technical Commission for Maritime Services |
| SEP | Spherical Error Probability: The radius of a sphere that would contain 50% of the error |
| SPS | Standard Positioning Service |
| TTF | Time to first fix |
| VDOP | Vertical Dilution of Precision |

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