



# **VISTEK V6081 DART RACK CONTROLLER USER GUIDE**

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## 1. DESCRIPTION

**DART** is a sophisticated control system that allows relatively simple control devices, with RS232 ports, to manage a network of functional units. All the controlling devices and controlled racks, known colloquially as Nodes, are linked together by **DARTnet**, a proprietary protocol using CAN 2.0B as the physical layer. A separate, simpler communication protocol, **DARTbus**, which uses I<sup>2</sup>C as its physical layer, is used within the rack. This has the advantage that it is only each rack that is a 'load' on the **DARTnet**, rather than each module, which would severely limit the network size. The V6081 module is the hardware module that interfaces between **DARTnet** (CAN) and **DARTbus** (I<sup>2</sup>C).

**DART** is installed in all the Vistek modular chassis which carry the V1600 range of 'modular products', and comes in two sizes - the 3U V1603 or V1606 and the 1U V1601. The V1603 chassis can hold up to 11 modules with dual power supplies or up to 14 modules with a single supply. The V1603 rack uses the V1608 Rack Controller Module, which when it is fitted provides a maximum of 11 module slots with two PSUs, or 13 with a single PSU, due to the mechanical arrangements. The 1U chassis also uses the V1608 Rack Controller Module and can carry a maximum of 4 modules with or without the controller.

The V1606 rack uses the V6081 Rack Controller Module, a replacement for the V606, and can have 14 modules fitted with dual power supplies, as the rack controller resides in its own dedicated slot above the power supplies. The V1606 rack provides a passive electrical and mechanical interface to the **DARTnet**

As with most network systems each node, rack or controller in this case, is identified by a unique address, which must be set correctly for the whole installation.

A **DART** network can be controlled from several types of controllers. Some examples are

<b>V1605</b>	Vistek 1U Control Panel. Can control up to four <b>DARTnets</b> .
<b>V1602</b>	Vistek 2U Control Panel. Can control up to four <b>DARTnets</b> .
<b>Viewnet</b>	Vistek's web-browser based control system that connects through a Linux server to the <b>DART</b> network.
<b>Viewfind</b>	Vistek's proprietary Control software for running on any suitable PC running Windows 98/NT/2000 or XP, can drive as many networks as the PC has serial ports and can be networked (Ethernet) to any number of other computers.
<b>V1607</b>	Touchscreen PC running Viewfind.
<b>Third Party</b>	Third Party vendors can write software to control any <b>DART</b> system using the <b>DART</b> protocol, which is available under licence.

The overall installation of a **DART** network and an understanding of its limitations is complex and requires a more detailed knowledge than this Operation Manual can give. However other publications from Vistek are available to assist. Section 6 gives some guidance to the selection of node addresses.

The V6081 Module has been derived from the V1608 Rack Controller with which it retains compatibility. However, its performance is enhanced, it has several new features and it will be upgradable to support future extensions of the **DARTnet** protocol.

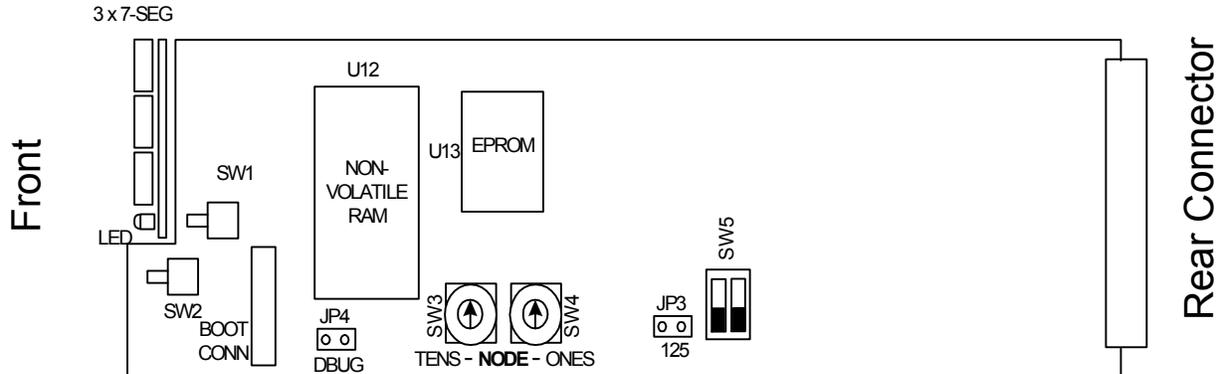
## 2. INSTALLATION

The V6081 fits into a dedicated slot above the power supplies in the V1606 Rack.

### 2.1 Power Consumption

The V6081 power consumption is **3.0W** (at 15V input).

### 2.2 PCB Hardware



The purposes of the various items are shown in the following table. Details of their operation are described below or in later sections.

ITEM	Title	Section	Comments
3 x 7-SEG (Front panel)	FRONT PANEL DISPLAY	2.2.1	3 digit, 7-segment display normally showing <b>DART</b> address. SW1 changes display contents; reverts to <b>DART</b> address after 30 seconds.
LED (Front panel)	POWER		Indicates 5V present on the PCB.
SW1	FUNCTION SWITCH	2.2.1	Press momentarily to change what is displayed. Hold in for 5 seconds to reset NV RAM.
SW2	RESET SWITCH		Push to manually reset the Rack Controller.
BOOT CONN	BOOT CONNECTOR		Used in production for loading the bootloader program. Also used by engineers for obtaining internal status information and logging.
JP 4	DBUG		This jumper must be left open.
U12	NV RAM	2.2.2	Non-volatile RAM holds rack's current status and control.
SW3 & SW4	NODE ADDRESS	2.2.4	Used for setting the rack's <b>DART</b> Address.
U13	EPROM	2.2.3	Flash PROM used for upgrading the program in the microcontroller's Flash memory.
JP3	CAN SPEED	2.2.4	Linked to select 125 kbps instead of 250kbps. <b>Leave unlinked – all systems work at 250kbps.</b>
SW5	TEST SWITCH	2.2.5	Sets PCB into production test mode and enables debug functions.

## 2.2.1 Front Panel Display and Function Switch

This 7-segment display normally shows the **DART** address – e.g. **A23**. The function switch, which is accessible through a hole in the display PCB, can be pressed to change what is displayed. The display reverts to DART address after 30 seconds if the switch is not pressed.

<b>DART</b> address	<b>Ann</b>		
CANbus error flags	<b>Cxx</b>	see 4.1.1	
Rack temperature °C	<b>tnn</b>		
PSU voltage (bus)	<b>Pnn</b>		xx - hex nn - decimal
Heartbeat Op Mode	<b>Hxx</b>	see 3.5.3	
Main software revision	<b>rnn</b>		
Bootloader revision	<b>bnn</b>		
FPGA revision	<b>Fnn</b>		

If the function switch is pressed and held in for 5 seconds, the NV RAM is reset and the display changes momentarily to indicate that shown below. The operator should press the reset button after resetting NV RAM to ensure status is updated by controllers on the DARTnet.

NVRAM resetting	<b>rrr</b>
-----------------	------------

The display is also used to indicate **DARTnet** activity. The decimal points are used as momentary indications of message receipt and transmission.

Left-hand DP	Message transmitted
Middle DP	Message received in buffer 1 (indicates very heavy message load)
Right-hand DP	Message received in buffer 0 (normal operation)

It should be noted that early models of the V6081 use the bottom segment of each digit instead of the decimal points.

## 2.2.2 Non-Volatile RAM

The non-volatile RAM is a Ferro-magnetic device in a DIL package. It is plugged into a socket for easy swapping between rack controllers, because it contains all the information for the rack that it was controlling.

The NV RAM can be reset using the function switch (see above). This is useful when a rack controller is first used.

## 2.2.3 EPROM

The EEPROM is used for upgrading the microcontroller's program. If, on power up, the program in the EPROM is newer than the program in the Microcontroller, it is read from the EPROM and programmed into the Microcontroller's Flash program memory. While this is happening, progress is indicated by a circulating segment in the display.



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### 2.2.4 Node Address and CAN Speed

The two rotary switches W3 and SW4 are used to set the **DART** address of the rack. This can be any number between  $00_{10}$  and  $62_{10}$  that isn't being used for any other rack or controller on the network. The jumper JP3 is linked to change the CAN bus speed from 250 kbps to 125 kbps. The lower speed is currently not used so ***this jumper should never be inserted.***

### 2.2.5 Test Switch

The 2-bit test switch SW5 should normally be set to both DOWN as shown in the diagram above. Other settings are used for production test and in conjunction with the engineering port on the BOOT connector.

UP : UP	Production test
UP : DN	RS232 data in/out
DN : UP	RS232 data in/out + I <sup>2</sup> C errors out
DN : DN	Normal operation

## 3. OPERATION

### 3.1 DART

The V6081 should only be used as part of a **DART** network. It is quite permissible to fit it into a rack without a **DARTnet** connected but it will then have an effect on any modules in the rack when they are set to REMOTE mode. Provided all modules are set to LOCAL mode then the V6081 will be benign.

One of the base principles of **DART** is that the set-up data for modules in a rack are stored on the V6081, so that if a module is changed with another of the same type it will automatically be set up with the same data. However, a controller could be installed without a control network to set the parameters. In this case most modules will be set to their default conditions, but this may not be what is wanted. Thus if **DARTnet** is not being used then all modules should be set to LOCAL.

### 3.2 DART Address Setting

The selection of **DART** addresses is complex and requires an analysis of the whole network. A full discussion is beyond the scope of this manual but Section 6 has a brief discussion of the principles. The actual **DARTnet** address of the V6081 is set using the two rotary switches SW3 and SW4 to make up a 2-digit decimal number from  $00_{10} - 99_{10}$ . In fact only numbers  $00_{10} - 62_{10}$  are valid **DART** addresses and some of the higher addresses are reserved for **DARTnet** controllers.

The address is only read when the microcontroller first boots up, normally on power up. Although in a normal installation the V6081 must be removed from the rack to change its address, if ever access to the switches is possible with power still applied, it is **essential** to press **RESET** (SW2) momentarily whenever the address is changed.

### 3.3 DART Termination

**DARTnet** is a proprietary protocol based on the versatile and highly rugged CAN 2.0B physical layer developed for the industrial and automotive market. It uses balanced two-wire communications.

The network should be continuous, without stubs, and terminated at both ends. Since the termination should be set at all times (if required) then it cannot be on the V6081 itself. The V1606 rack has a termination switch on its rear panel.

The termination should be 120 Ohms.

The termination setting is always 'live', so it can be changed without the need for a RESET.

### 3.4 DARTnet Speed

**DARTnet** has two operating speeds. The preferred speed for all networks is 250kbits/sec, but on long networks there can be a problem with higher error rates. (The CAN 2.0B automatically handles transmission errors by using error correction techniques and data re-transmission, which is transparent to the user.) In general if the network length is up to 150m then 250kbit/s can be used, and if between 150m and 500m then 125kbit/s should be used. In practice, the vast majority operate quite happily at 250kbit/s.

It is important that all nodes on the network operate with the same speed setting.

The jumper JP3 is linked to set the CANBUS to run at the lower speed.



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## 3.5 DARTnet Status and Control

When connected to a **DARTnet** the V6081 looks like two modules, in slots 0 and 15, in a rack containing up to 14 other modules. Slot 0 provides PSU and Fan status to operators while slot 15 may be used by engineers to change the way the rack controller works and to monitor the integrity of the **DARTbus**.

### 3.5.1 PSU/Fan Monitor

The Ident 6081 and Functional Revision State (FRS) 100 or higher read from slot 0 identifies the module as an MV6081 PSU/Fan Monitor. The status register contains the following status indications.

#### S Register

Bit	7	6	5	4	3	2	1	0
Byte 0					Fan Status		PSU 2	PSU 1

PSU 1 and PSU 2 will be set to '0' if their voltages are 13v or higher, '1' if lower (failed).

Fan Status is '0' if running normally, '1' if failed or '2' if running fast (to reduce temperature or compensate for a single fan failure).

### 3.5.2 Rack Controller Status and Control

The Ident 6081 and Functional Revision State (FRS) 99 or lower read from slot 15 identifies the module as a CV6081 Rack Controller. Unlike earlier rack controllers, the 6081 has controls and monitoring accessible over DARTnet via control, status and refreshed read/write messages. This rack controller therefore operates as a DART Class 4 module, not an Avitel Class 5. However, to maintain compatibility with some existing software, the new rack controller is set to Class 5, thereby redefining Class 5 for Vistek systems as the same as Class 4 but only for the rack controller slot, 15.

#### Control & Status Registers

The control and status registers contain the following controls. The default settings of these controls are usually quite adequate.

#### C & S registers

Bit	7	6	5	4	3	2	1	0
Byte 0								
Byte 1	Refresh Rate		reserved					
Byte 2								
Byte 3	Heartbeat Rate							

**Refresh Rate** controls how often a Rack Scan takes place. A Rack Scan is when data in the rack controller is written to the modules on a regular basis and when module status is checked for changes. The faster the refresh rate the sooner a module status change is broadcast on **DARTnet** but the greater the possibility of clogging **DARTnet** with changing status indications in large networks. The default rate of 2 seconds is the same as the rack scan rate in the V1608 and V606 rack controllers. However, the status response to a changing control is faster because the V6081 automatically reads status when a control is detected to have just stopped changing.

Refresh Rate: 00=2 sec, 01=1 sec, 10=500ms, 11=250ms.

**Heartbeat Rate** controls how often a node heartbeat is broadcast on **DARTnet** to indicate the continued presence of the rack in the network. The faster the heartbeat rate, the sooner a **DARTnet** controller can recognise the presence or absence of a rack in the network but the more traffic is generated on the **DARTnet**. The default rate of 10 seconds compares with 30 seconds in the V1608 and V606 rack controllers. Also, the first heartbeat occurs quickly after the rack is powered, just after the broadcast message that indicates the rack is booting. This enables more rapid detection of racks on networks.

Heartbeat Rate: 00=10 sec, 01=5 sec, 10=30 sec.

All other bits in the C & S registers are reserved for use with future (Class 7) modules. The module's Class determines, among other things, which parts of the **DARTnet** message protocol are relevant to it and which control and status registers are available. A bit is available in the refreshed read messages for each of the 14 module slots to indicate whether or not the slot is occupied by a Class 7 module. These may be used by a **DARTnet** controller designer when implementing V6081 control screens to disable controls that are available only for Class 7 modules.

## DARTbus Integrity

The V6081 responds to 3 refreshed read messages and a single refreshed write message to provide status and control for its **DARTbus** integrity monitoring.

### Message 0 (Read only)

Bit	7	6	5	4	3	2	1	0
Byte 0	1:Class 7	Slot 1 DER						
Byte 1	2:Class7	Slot 2 DER						
Byte 2	3:Class7	Slot 3 DER						
Byte 3	4:Class7	Slot 4 DER						
Byte 4	5:Class7	Slot 5 DER						
Byte 5	6:Class7	Slot 6 DER						

### Message 1 (Read only)

Bit	7	6	5	4	3	2	1	0
Byte 0	7:Class7	Slot 7 DER						
Byte 1	8:Class7	Slot 8 DER						
Byte 2	9:Class7	Slot 9 DER						
Byte 3	10:Class7	Slot 10 DER						
Byte 4	11:Class7	Slot 11 DER						
Byte 5	12:Class7	Slot 12 DER						

### Message 2 (Read), Message 3 (Write)

Bit	7	6	5	4	3	2	1	0
Byte 0	13:Class7	Slot 13 DER						
Byte 1	14:Class7	Slot 14 DER						
Byte 2	ER8 On	ER7 On	ER6 On	ER5 On	ER4 On	ER3 On	ER2 On	ER1 On
Byte 3	Error Rates Select		ER14 On	ER13 On	ER12 On	ER11 On	ER10 On	ER9 On
Byte 4								Retries off
Byte 5	Not used							

A 7-bit **DARTbus** Error Rate (**DER**) is maintained for every slot as long as its Error Rate On (**ER On**) control is active. The **Error Rates Select** control can be set to 00 ALL OFF, 01 SELECT or 10 ALL ON. In the SELECT position, the individual ER On controls are used. A DER is cleared if its ER On control is OFF. Bit 7 in each byte is used to indicate whether the module in that slot is Class 7 or not. This status may be used in a **DARTnet** controller to determine whether particular controls are available for current (not class 7) or future (class 7) modules.



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The **Retries Off** control is used to turn off DARTbus retries in order to check the DARTbus under rigorous conditions. In normal operation, the rack controller will try a total of 5 times when attempting a transfer on the **DARTbus** but, with retries off, a failure after a single attempt causes an error and increases the error rate.

**DARTbus** Error Rates contain a count of the number of errors that occurred in 100 **DARTbus** transfers or attempted transfers. After each 100 transfers the current rate is added to the previously stored rate and the total halved in order to maintain a rolling average. Whenever a DER changes, the corresponding Broadcast Refreshed message (0, 1 or 2) is transmitted on the **DARTbus**. The controls are written using Refreshed Write message 3 with an I<sup>2</sup>C address of 10 (Hex).

### 3.5.3 Rack Controller Heartbeat

The heartbeat, which is broadcast on the **DARTnet** by the rack controller every 5, 10 or 30 seconds, depending on the setting of the Heartbeat Rate, contains the following information in its 8 data bytes.

Byte	0	1	2	3	4	5	6	7
	B'cast	Node	PSU 2	BUS V	PSU 1	Temp	OpMode	Flags

The bytes are described below.

B'cast	5 – rack controller heartbeat							
Node	Rack <b>DARTnet</b> address							
PSU 2	Volts = Data x 0.1394							
BUS V								
PSU 1								
Temp	Temp = 30 + ((data – 144) x –0.404) in °C							
OpMode Bit	7	6	5	4	3	2	1	0
	RC Type 00: V606/V1608 01: 6081		Not used	Retries 0: ON 1: OFF	Heartbeat Rate 00:10 sec 01:5 sec 10:30 sec 11:N/A		Refresh Rate 00:2 sec 01:1 sec 10:½ sec 11:¼ sec	
Flags	Not currently used – reads 00 (hex)							

Note that bits in the OpMode byte distinguish between the V6081 and previous rack controllers. This enables a **DARTnet** controller to modify its operation to take advantage of the V6081's features. For instance, with a heartbeat rate of 10 seconds instead of 30 seconds, it should be able to detect a rack going off-line in 30 seconds instead of 90 seconds.

## 4. NEW FEATURES

The following features are new to the V6081 rack controller. Some are described elsewhere, the remainder are described below.

- 7-segment status display with display selectable via function switch. (See 2.2.1 Front panel display and function switch).
- Program easily upgradable. (See 5.1 Upgrade procedure).
- Adjustable heartbeat rate with faster default setting – controllable by user over **DARTnet**. (See 3.5.2 Rack controller status and control and 3.5.3 Rack controller heartbeat).
- Adjustable refresh rate – controllable over **DARTnet**. (See 3.5.2 Rack controller status and control).
- Status readback after control change. (See 3.5.2 Rack controller status and control).
- **DARTbus** integrity checking. (See 3.5.2 Rack controller status and control).
- **DARTnet** error handling. (See 4.1 DARTnet error handling).
- **DARTnet** failed request handling. (See 4.4 DARTnet failed request handling).
- New module clear data. (See 4.5 New module clear data).
- Wrong module swap memory. (See 4.6 Wrong module swap memory).
- Non-volatile RAM integrity checks. (See 4.7 Non-volatile RAM integrity checks).

### 4.1 DARTnet Error Handling

Built into CAN 2.0B is error management logic that is responsible for confinement of faults to prevent a single faulty node crashing the network. In most cases, errors are handled by the CAN logic and messages are re-transmitted automatically when errors are detected either by a transmitting node or a receiving node. However, certain gross errors can be detected by the V6081 and shown on the 7-segment display. If the error is transient or is corrected so that transmission can take place, a broadcast message is sent that indicates the type of fault that occurred.

#### 4.1.1 CANbus Error Flags

If CANbus errors are detected, the 7-segment display switches to show the error flags (**Cxx**) where xx is a hexadecimal representation of the error flags.

Bit	7	6	5	4	3	2	1	0
	Overflow 2	Overflow 1	Bus Off	Tx Error	Rx Error	Tx Warning	Rx Warning	Warning

Overflow 1 and 2 indicate a message is lost because a receive buffer has overflowed. All messages normally go to the first buffer and are redirected to the second buffer if the first one is still full. Even this rarely happens so any overflow is extremely unlikely to occur.

Tx Warning and Rx Warning are indications that significant Transmit or Receive errors are occurring. The Warning flag sets if either of these two flags is set.

Tx Error and Rx Error indicate that error counts have reached a dangerously high level.

Bus Off occurs if the Transmit error count reaches such a high level that the error management logic's confinement strategy dictates that the module should be isolated from the CAN bus. The module will recover from the Bus Off state automatically if it detects a sufficiently long idle period on the bus. The CAN error display will show

#### **C20**

Intermittent faults of this type will show **C20** and **C00** alternately and this is normally indicative of a short circuit between the CAN data lines.



## 4.2 DARTnet Disconnection

An excessively large number of Transmit errors usually means that nothing is being transmitted by the rack controller because it is disconnected from the **DARTnet**. In this case, the CAN error display will normally show

**C15**

If the fault persists for a second or more, once the fault has cleared, a DARTnet Connection broadcast message is transmitted and the display reduces to

**C05** and eventually clears to **C00**

This error can also occur intermittently if there are anomalies in the network such as unconnected cable spurs.

## 4.3 DARTnet Termination Error

An excessively large number of Receive errors often means that the network is terminated incorrectly. In this case the CAN error display will normally show

**C08**

A small network with short links will often work quite happily with a single termination on the network but no termination at all will cause the above display to be shown permanently. Larger networks and those with longer links require termination at each end and, although they will work to some extent with a single termination, large bursts of Receive errors will occur, quite possibly sufficient to cause the above error. If the fault has persisted for a second or more, when the fault clears or errors reduce sufficiently to allow transmission, a DARTnet Termination broadcast is transmitted and the display changes to

**C03** and eventually clears to **C00**

## 4.4 DARTnet Failed Request Handling

Error handling and a retry strategy is built into the rack controller's **DARTbus** I<sup>2</sup>C interface. However, with the old rack controller, if a request for module data results in an I<sup>2</sup>C error despite the retries, the data returned on the **DARTnet** to the requesting controller is indeterminate. There was no indication that an error has occurred and that the data was invalid. The V6081, under these circumstances, returns a message with a 1 byte data content. This message will contain the P# number associated with the request but no data. The requesting controller should be able to recognise such a message and not store erroneous data. It could also initiate another request for the data.

## 4.5 New Module Clear Data

One of the principles of **DART** is that the set-up data for modules in a rack is stored in non-volatile memory in the rack controller, so that if a module is changed with another of the same type it will automatically be set up with the same data. However, with previous rack controllers, if a module was inserted in a slot which used to house a module of a different type, the data from the previous module would still be present and the rack controller would attempt to write it to the module. This data is not overwritten with the correct data until a user starts changing controls via a **DARTnet** controller.

Because of this every module with the same type of rear connector has to respond to different I<sup>2</sup>C addresses on the **DARTbus** so that the module does not respond to these erroneous I<sup>2</sup>C write messages. Even so, **DARTbus** errors would occur due to the non-acknowledgment of the address and spurious data change broadcasts could cause confusion in **DARTnet** controllers.

The V6081 recognises that the new module is a different type or a different version of the same type, the data in NVRAM is cleared so that erroneous data is not written to the module.

## 4.6 Wrong Module Swap Memory

Because a module's write data is stored in the rack controller's NVRAM, a faulty module may be swapped with a good one and will be set up with the same data as the previous one. However, consider a situation where the operator accidentally inserts the wrong type of module. Because the V6081 clears the data in NVRAM, due to it being a different module type, when the error is discovered and the correct module is inserted, the original data would be lost. The V6081, however, can rescue the situation because it retains the data from the last module that occupied that slot **as long as no other module has been changed in the rack in the meantime**. To clear the swap memory, press the rack controller's reset button. This should be done after installing the correct modules in the correct positions.

## 4.7 Non-Volatile RAM Integrity Checks

In previous rack controllers, the possibility existed of corrupt data being present in the NVRAM and remaining undetected with possibly serious consequences. The V6081 improves upon the existing overall check on power up by adding checksums to the fixed part of each slot's NVRAM on power up. Two new broadcasts, NVRAM Initialised and Slot NVRAM Checksum Error, are added to inform the **DARTnet** of errors in addition to the offending area being initialised.



## 5. PROGRAM UPGRADES

This section describes the process of upgrading a V6081 rack controller from an upgrade PROM. The upgrade PROM contains all of the information required for the module's Bootloader program to upgrade the rack controller's Main Program in its microprocessor's on-board Flash.

### 5.1 Upgrade Procedure

Having installed the PROM in the socket U13, the module is inserted into the rack and the power applied to the rack (or the rack could be already powered).

The front panel display very briefly shows **ChF**, indicating that the microprocessor Flash is being checked, followed by **ChP** to indicate that the PROM is being checked. Then, if everything is correct, the display very briefly shows **Era** (erasing) and then a single segment starts moving clockwise round the perimeter of the display to indicate that the processor Flash is being programmed. Assuming the programming is successful, the **ChF**, **ChP** sequence is repeated but, this time, the Flash program version matches that of the PROM so the process has finished and the display goes on to display the rack's **DARTnet** address.

On rare occasions, the upgrade PROM instructs the Bootloader to upgrade itself in addition to the Main Program. In this case, two programming sequences occur, the first sequence indicating that the Bootloader is being upgraded, the second indicating that the Main Program is being upgraded. If power is removed from the rack while the Bootloader is being upgraded, the module becomes unusable and must be returned to the factory. However, this is unlikely to happen because the sequence is very short.

It should be noted that Main Program upgrading will normally occur only if the Bootloader detects that (a) the PROM is a valid upgrade PROM and (b) the Main Program version in the PROM is later than that in the Flash. This also applies to upgrading the Bootloader. However, if the function switch is held in while power is applied, a Main Program upgrade will occur regardless of version number. However, a Bootloader upgrade can never be forced in this way.

### 5.2 Upgrade Error Indications

In the unlikely event that anything goes wrong during the upgrade process, an error number is displayed on the front panel display. The following indicates what the error numbers mean.

E01	Flash erasing failed
E02	Flash programming failed
E03	Main program checksum error after programming
E04	Bootloader checksum error after programming
E05	No program loaded and no valid upgrade in PROM
E06	Bootloader upgrade required but no valid bootloader upgrade in PROM

## 6. DART ADDRESSING

### 6.1 General

**DARTnet** is a proprietary protocol using CAN 2.0B as the physical layer. The **DART** addresses are 6 bits of the 11-bit identifier in the arbitration field of each message.

The overall selection of **DART** addresses depends on several factors, such as the size of the network, and the number of controllers. Full information is available in other documents. This section provides a brief overview of how to select addresses in a network containing a number of racks and controllers (V1605/02, Viewfind, Viewnet, etc).

All controllers require an interface to **DARTnet**, in most cases from RS232, and this is normally provided by a DIN341K also known as a Gateway and colloquially, but not correctly, as a Dongle. The V1605 and V1602 can have up to four DIN341Ks internally mounted thereby allowing up to four **DARTnets** to be controlled. Viewfind or Viewnet use a DIN341K mounted externally and connected by a null modem cable. The connection to **DARTnet** is via an RJ45 connector at one end of the DIN341K. The **DART** address is set on DIL switches adjacent to this connector (see below)

V6081 rack controllers contain their own **DARTnet** interface built in to the module. The connection to **DARTnet** is via an RJ45 connector on the back of the rack. The **DART** address is set on two rotary switches mounted on the module. Older rack controllers use a similar arrangement to the DIN341K.

### 6.2 DIN341K Address

This is set on switches adjacent to the RJ45 connector and there is also provision to set the speed and include termination. The 6 address switches are used to set the address in binary.

OFF	1	1	1	1	1	1	125 kbit/s
TERM	Bit 5 MSB	4	3	2	1	Bit 0 LSB	Speed
ON	0	0	0	0	0	0	250 kbit/s

### 6.3 V6081 Address

This is set on two decimal switches on the module. These are accessible only when the module is removed but it is visible from the front of the rack on a 7-segment display when the module is powered.



### 6.4 Addressing Issues

**DART** addresses must be set in the range 0 to 62<sub>10</sub>. Address 63<sub>10</sub> is used to indicate a 'Broadcast' message, that is, one that should be accepted by every control node on the network, and must not be used for racks or controllers. Racks on a network are normally addressed from zero upwards, controllers from 62<sub>10</sub> downwards. Setting the **DART** address for a controller is, however, not totally straightforward, and is covered in another document.



## 7. I<sup>2</sup>C ERROR NUMBERS

These error numbers are sent to the engineering RS232 port when the test switch is set to the position for RS232 data in/out + I<sup>2</sup>C errors out (see 2.2.5 Test Switch). They provide information to an engineer when a module's DARTbus interface is malfunctioning.

ERROR 08	Bus busy at end of I <sup>2</sup> C sequence
ERROR 09	Bus busy at start of write sequence
ERROR 10	Bus busy at start of read sequence
ERROR 11	Error sending START
ERROR 12	Error sending read address
ERROR 13	Error reading data bytes 0 to n-1
ERROR 14	Error waiting for 8 <sup>th</sup> clock pulse on last data byte
ERROR 15	Error reading last byte
ERROR 16	No acknowledgement for read address
ERROR 17	Error sending write address
ERROR 18	No acknowledgement for write address
ERROR 19	Error sending data
ERROR 20	No acknowledgement for written data

## 8. REVISION HISTORY

A	20 Dec 2004	M.J.Smith	First version.
B	28 Jan 2005	M.J.Smith	First released version.
1.0	13 Jun 2005	M.J.Smith	Notes added regarding CAN speed. Correction to heartbeat data. Note on clearing swap memory.