V6041

DARTnet INTERFACE
(DIN341 Replacement)

INSTALLATION and OPERATION

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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. The V6041 is the hardware interface that connects between RS232 and CAN.

As with most network systems each node is identified by a unique address, which must be set correctly for the whole installation. The V6041 provides the means of setting up the address for a DARTnet controller node and allowing through only messages relevant to that node address.

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

V1605	Vistek 1U Control Panel. Can control up to four **DARTnets**.
V1602	Vistek 2U Control Panel. Can control up to four **DARTnets**.
Viewnet	Vistek's web-browser based control system that connects through a Linux server to the **DART** network.
Viewfind	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.
V1607	Touch screen PC running Viewfind.
Third Party	Third Party vendors can write software to control any **DART** system using the **DART** protocol, which is available under licence.

The V6041 replaces the DIN341. Its method of setting addresses is different from that on the DIN341. However, it may be set to emulate the DIN341, thereby allowing it to be used as a direct replacement in systems which would otherwise require reprogramming in order to accommodate a V6041.

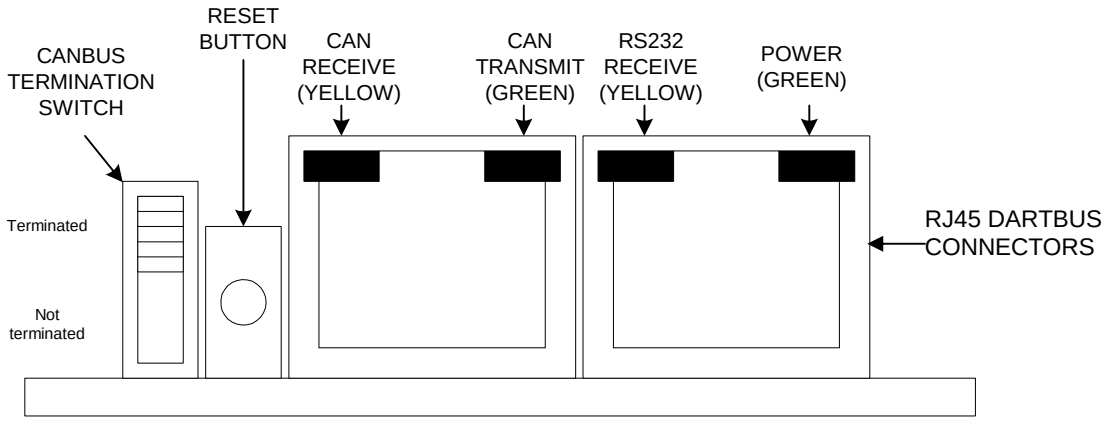
Please refer to the **DART Network Configuration** manual for information about using the V6041 in a DARTnet system.

2. INSTALLATION

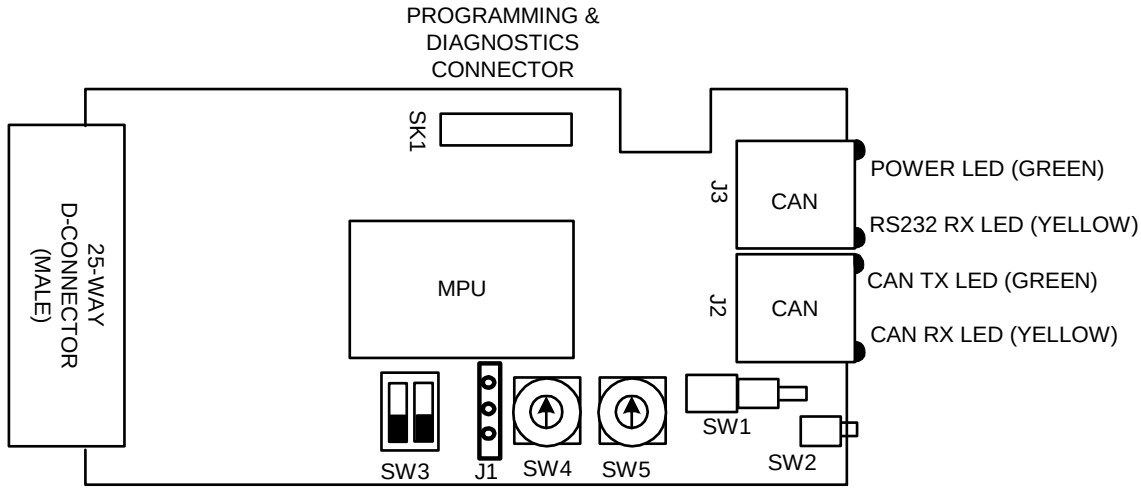
2.1 POWER CONSUMPTION

The V6041 power consumption is **0.5W** (at 15V input).

2.2 HARDWARE - END VIEW



2.3 HARDWARE – PLAN VIEW



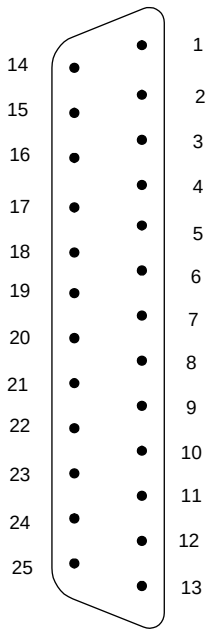
Note that for compatibility with the aperture available in some early DARTnet controllers, CAN connector J2 may be removed so that the V6041 can be used to replace a DIN341 without any metalwork changes being necessary.

2.4 HARDWARE – PARTS SUMMARY

ITEM	Description	Comments
P1	25-way D Connector (Male)	RS232 port. Connects to DARTnet controller. Will need a null modem if controller is a computer.
J2, J3	RJ45 sockets	DARTnet connectors (ganged).
	POWER LED	On if power present.
	RS323 RX LED	Flashes to indicate RS232 message received.
	CAN TX LED	Flashes to indicate CAN message transmitted.
	CAN RX LED	Flashes to indicate CAN message received.
SW1	Reset switch	Press after changing address switches to ensure the change is read.
SW2	Termination switch	Switches the CAN bus termination in or out.
SW3	Configuration switch	Sets various operating configurations.
SW4, SW5	Address switches	BCD address switches tens (SW4) and units (SW5).
J1	Auxiliary power connector	Alternative to getting power through the CAN bus.
SK1	Programming connector	RS232 port. Used for factory programming of the MPU and for diagnostics.

2.4.1 RS232 Connector

This is the communications port with the DARTnet controller. If the controller is a computer, a null modem is required. It is configured to use hardware handshaking. That is, CTS/RTS are used to indicate whether either end is ready to receive data. The other handshake lines are not used and DTR is permanently inactive (for compatibility with earlier products).



Pin	Signal	IN ←	OUT →
1	No connection		
2	TX		V6041 →
3	RX	V6041 ←	
4	RTS		V6041 →
5	CTS	V6041 ←	
6	DSR	V6041 ←	
7	GND		
8	DCD	V6041 ←	
9	No connection		
10	No connection		
11	No connection		
12	Power out		V6041 →
13	Power In	V6041 ←	
14	No connection		
15	No connection		
16	No connection		
17	No connection		
18	No connection		
19	No connection		
20	DTR		V6041 →
21	No connection		
22	RI	V6041 ←	
23	No connection		
24	No connection		
25	No connection		

2.4.2 DARTnet Connectors

The two RJ45 CAN bus connectors are ganged to remove the need for a T-connector when the V6041 is in the middle of a network. The LEDs incorporated in the connectors are used to indicate the presence of power, activity on the **DARTnet** and messages received on the RS232 interface. Note that power is normally applied to the V6041 via pins on the CAN bus connectors. Power and ground may or may not be present on incoming **DARTnet** pins 6 and 3 respectively.

Pin	Signal
1	CAN-H
2	CAN-L
3	No connection
4	GND
5	GND
6	No connection
7	POWER IN
8	POWER IN

2.4.3 Reset Switch

The reset switch must be pressed if the address switches are changed otherwise the change will be ignored until the next time power is applied.

2.4.4 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. SW2 is used to connect a 120 ohm termination across the CAN data lines. The termination is connected if the slider switch is UP, i.e. away from the PCB.

2.4.5 Configuration Switch

The 2-bit switch SW3 should normally be set to both DOWN, that is, both sliders towards the edge of the PCB. Other settings are used to obtain diagnostic information through the diagnostics pins on the programming connector and for disabling the message timeout (see 5.3 Message Timeout).

UP : UP	Diagnostics ON, Message Timeout OFF
UP : DN	Diagnostics ON, Message Timeout ON
DN : UP	Diagnostics OFF, Message Timeout OFF
DN : DN	Diagnostics OFF, Message Timeout ON

When Debug is ON, commands beginning with @ are accepted after an initial carriage return. Type **@?<CR>** for a list of commands.

2.4.6 Address Switches

The two BCD switches are used to set the primary node address of the V6041. Settings from 63 to 99 are used to set special modes of operation. See 3 DART Address Setting for details.

2.4.7 Auxiliary Power Connector

Used for connecting power in applications where this is not provided by the **DARTnet** connection.

PIN 1	GND
PIN 2	+9V to +18V DC
PIN 3	GND

2.4.8 Programming Connector

Used in the factory for programming the V6041 with its operational software. Also used by engineers for logging diagnostic information at a baud rate of 115.2kb/s (N, 8, 1).

Pin	Signal	Function	IN ←	OUT →
1	nRXD1	FLASH programming port RX	V6041←	
2	nTXD1	FLASH programming port TX		V6014→
3	GND	Ground		
4	nBOOT	Enable Boot Mode (LO)	V6041←	
5	VCC 5V	+5 power out		V6014→
6	GND	Ground		
7	nTXD2	Diagnostics port TX		V6014→
8	nRXD2	Diagnostics port RX	V6041←	

2.4.9 DARTnet Speed

DARTnet has two operating speeds. The preferred speed for all networks is 250kbits/sec, but on very 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 and **the V6041 does not support the lower speed**.

3. DART ADDRESS SETTING

In normal operation, the V6041 must be programmed with a unique node address for the network so that replies to data requests from the **DARTnet** controller to which it is attached are accepted only by the controller that requested that data. Valid addresses are 00 – 62. It must also be able to accept the node address 63, the broadcast message address.

The selection of **DART** addresses is simplified when the V6041 is used because, in its normal mode, the RS232 interface's baud rate is fixed at 115.2kbps and is therefore, unlike in the DIN341, totally independent of the address setting. The **DARTnet** address of the V6041 may be set on the two rotary switches SW4 and SW5 or, via the RS232 port, by the controller to which it is attached. SW4 and SW5 make up a 2-digit decimal number from 00_{10} – 99_{10}. In fact only numbers 00_{10} – 62_{10} are valid **DART** addresses; the higher numbers are used to set the V6041 to run in special modes.

The address is only read when the microcontroller first boots up, normally on power up. If the switches are changed with power still applied, it is **essential** to press **RESET** (SW1) momentarily in order for the V6041 to accept the change.

The following table summarises the meaning of different settings of the BCD switches.

SW4/5	Address	
00..62	0-62	DARTnet controller reads address from V6041. V6041 accepts CAN messages with node address 0-62 plus broadcast address 63.
63	All	V6041 accepts CAN messages with any address. The DARTbus controller must determine which address (0-62) it will accept; other messages, apart from broadcasts, will be discarded by the controller.
64	0-62	DARTnet controller writes address to V6041. V6041 accepts CAN messages with node address 0-62 plus broadcast address 63.
65..70	31, 47, 55, 59, 61, 62	57600bps mode – for using with a PC without hardware handshaking.
71..72		Not used.
73..78	31, 47, 55, 59, 61, 62	DIN341 compatible mode – baud rates 9600 – 57600bps. V6041 accepts CAN message with address specified plus broadcast address 63.
79..84	31, 47, 55, 59, 61, 62	DIN341 compatible mode – baud rate 115200bps. V6041 accepts CAN message with address specified plus broadcast address 63.
85..88		Not used.
89..92	59..62	DIN341 compatible mode – baud rates 9600 – 57600bps. V6041 accepts CAN message with address specified but not broadcast address 63.
93	All	DIN341 compatible mode – baud rate 9600. V6041 accepts CAN messages with any address. The DARTbus controller must determine which address (0-62) it will accept; other messages, apart from broadcasts, will be discarded by the controller.
94..99		Not used.

3.1 NORMAL MODE – NODE ADDRESS SET BY SWITCHES

If the BCD switches SW4 and SW5 are set to a number between 00 and 62, this defines the node address for the V6041. A DARTnet controller requesting configuration, by gateway command 97, will receive a configuration byte of between 00 and 3E (0 – 62 decimal) and, knowing that this is an address set by the switches, will set it's own controller address to that value.

If the BCD switches are changed to another number between 00 and 62 and the unit un-powered (DARTbus disconnected) or the reset switch pressed, the V6041 sends a configuration response after the first echo command it receives so that the DARTnet controller can update its controller address.

In this mode, broadcast messages (node address 63) are also accepted.

3.2 NORMAL MODE – ALL MESSAGES PASSED

If the BCD switches are set to 63, the V6041 accepts all CAN messages, regardless of ID, including broadcasts.

3.3 NORMAL MODE – NODE ADDRESS SET REMOTELY

If the BCD switches SW4 and SW5 are set to 64, the DARTnet controller will receive a configuration byte of 7F (127 decimal) which will prompt the controller to send a node address to the V6041. If the address is changed in the controller, the controller may send the new address to the V6041, in which case it will update its address to the new value.

If the DARTbus is disconnected and then reconnected, or if the reset button is pressed, the V6041 regularly sends configuration responses until the DARTnet controller has sent its address to it.

The V6041 also operates in this mode if SW4 and SW5 are not fitted.

3.4 56700BPS MODE

This is a compromise mode that provides acceptable throughput without the need for hardware handshaking. The 6 'principal' ID addresses are available at a baud rate of 57600bps. At this baud rate, no hardware handshaking is required at the character level, so a PC based DARTnet controller, which may not respond reliably to RTS going low between characters by holding up the transmission of the next character, will operate correctly. At 15200bps correct operation depends on whether any delay occurs between characters and, if not, ignoring the state of the RTS signal would cause overrun errors in the V6041 and consequent loss of data. Used for working with legacy PC based DARTnet controllers.

BCD SW4/5	Node address	Baud rate (bps)
65	31	57600
66	47	57600
67	55	57600
68	59	57600
69	61	57600
70	62	57600

3.5 DIN341 COMPATIBLE MODE – NODE GROUPS 13 TO 18

If the BCD switches SW4 and SW5 are set to a number between 73 and 78, the V6041 operates as a DIN341 with its node group set between 13 and 18. The node group also determines the baud rate and the node address.

BCD SW4/5	Node group	Node address	Baud rate (bps)
73	13	31	9600
74	14	47	9600
75	15	55	9600
76	16	59	19200
77	17	61	38400
78	18	62	57600

In this mode, broadcast messages (node address 63) are also accepted.

3.6 DIN341 COMPATIBLE MODE – NODE GROUPS 19 TO 24

If the BCD switches SW4 and SW5 are set to a number between 79 and 78, the V6041 operates as a DIN341 with its node group set between 19 and 24. The baud rate is fixed at 115200 kbps in this mode.

BCD SW4/5	Node group	Node address	Baud rate (bps)
79	19	31	115200
80	20	47	115200
81	21	55	115200
82	22	59	115200
83	23	61	115200
84	24	62	115200

In this mode, broadcast messages (node address 63) are also accepted.

3.7 DIN341 COMPATIBLE MODE – NODE GROUPS 59 TO 62

If the BCD switches SW4 and SW5 are set to a number between 89 and 92, the V6041 operates as a DIN341 with its node group set between 59 and 62. The node group also determines the baud rate and the node address.

BCD SW4/5	Node group	Node address	Baud rate (bps)
89	59	59	9600
90	60	60	19200
91	61	61	38400
92	62	62	57600

Broadcast messages (node address 63) are not accepted in this mode. This mode is normally only used in conjunction with the Avitel Reference Data Program, RefData.

3.8 DIN341 COMPATIBLE MODE – NODE GROUP 63

If the BCD switches SW4 and SW5 are set to 93, the V6041 operates as a DIN341 with its node group set to 63. The baud rate is fixed at 9600 and the V6041 accepts all CAN messages, regardless of ID, including broadcasts.

3.9 SYSTEM ADDRESS ALLOCATION

Addresses for racks are allocated from 00 upwards, addresses for controllers from 62 downwards. When the controller is a V1602 or V1605, a higher address also means a faster reaction to seeing a rack come on-line. This is in order to spread the CAN bus loading in a system with multiple controllers.

4. CONFIGURATION BYTE

The configuration byte is the 4th byte (D1) of the V6041 heartbeat. It is also returned to the DARTnet controller in response to a '97' gateway command.

Header		D0	D1	D2	D3	D4	D5	D6	D7
		9	Config	Ident MS	Ident LS	FRS	Minor revision	Release	not used

SW4/5	Address	Config (hex)	RS232 bps	Notes	
0-62	0-62	00-3E	115.2 kbps	Normal mode: local set address. Config = address.	
63	All	3F	115.2 kbps	Normal mode: All addresses.	
64	0-62	40-7E	115.2 kbps	Normal mode: remote set address. Config = address + 64	
64	None	7F	115.2 kbps		
65	31	1F	57.6 kbps	57600bps mode: Compromise mode that provides acceptable throughput without the need for hardware handshaking to work correctly at the DARTnet controller.	
66	47	2F	57.6 kbps		
67	55	37	57.6 kbps		
68	59	3B	57.6 kbps		
69	61	3D	57.6 kbps		
70	62	3E	57.6 kbps		
71	None	7F	115.2 kbps	Not used	
72	None	7F	115.2 kbps		
73	31	1A	9.6 kbps	Normal operational compatible modes – broadcasts passed	DIN341 compatible modes. Config = node group x 2
74	47	1C	9.6 kbps		
75	55	1E	9.6 kbps		
76	59	20	19.2 kbps		
77	61	22	38.4 kbps		
78	62	24	57.6 kbps		
79	31	26	115.2 kbps		
80	47	28	115.2 kbps		
81	55	2A	115.2 kbps		
82	59	2C	115.2 kbps		
83	61	2E	115.2 kbps		
84	62	30	115.2 kbps		
85	None		115.2 kbps	Not used	
86	None		115.2 kbps		
87	None		115.2 kbps		
88	None		115.2 kbps		
89	59	76	9.6 kbps	RefData compatible modes – no broadcasts passed	
90	60	78	19.2 kbps		
91	61	7A	38.4 kbps		
92	62	7C	57.6 kbps		
93	All	7E	9.6 kbps	Normal mode: All addresses	
94	None	7F	115.2 kbps	Not used	
95	None	7F	115.2 kbps		
96	None	7F	115.2 kbps		
97	None	7F	115.2 kbps		
98	None	7F	115.2 kbps		
99	None	7F	115.2 kbps		

When set to a DIN341 compatible mode, the Identifier bytes (D2 and D3) in the heartbeat message are set to 341 instead of 6041 and the functional revision state (FRS) byte (D4) is set to 99 plus the current V6041 revision. Therefore, the FRS would be 100 instead of FRS 1, 101 instead of FRS 2, etc. There are two extra bytes, D5 and D6 added to the heartbeat as compared with that for the DIN341. D5 and D6 hold the remaining segments of the software version number so that FRS 1, Minor Revision 0 and Release 3 would indicate software version 1.00.03.

5. ERROR DETECTION

The V6041 has built in to it error detection features that are useful when configuring a DARTnet system. When certain errors are detected, a message is sent on the DARTnet interface back to the controller which can choose to initiate an alarm. When such an error is corrected, another message is sent so that the controller can choose to clear the alarm.

5.1 DUPLICATE NODE ERRORS

The V6041 monitors heartbeats received from racks and controllers on the DARTnet and expects them to be received at regular intervals. The rate of the heartbeats may vary but should be consistent from an individual node. If it detects large variations in the rate of heartbeats from a single node address, the V6041 decides that there is more than one node sending heartbeats from that address and initiates the error message. Once the variations have reduced sufficiently, the error is cleared and another message is sent. It should be noted that, because some heartbeats only occur every 30 seconds, detection of duplicate nodes and the subsequent clearing of a duplicate node error can take several minutes. Very occasionally a duplicate node will not be detected; this is normally when the two nodes are sending heartbeats at the same rate but 180° out of phase.

5.2 CAN BUS ERRORS

Error management inherent in CAN 2.0B is responsible for the confinement of faults to prevent a single faulty node from 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. When the CAN interface goes into error passive mode due to an excess of errors, the V6041 sends an error message. It also clears the memory associated with duplicate node detection because these may have been false detections due to the CAN bus error. When the CAN interface comes out of error passive mode, the error is cleared and another message is sent. A further message is then sent indicating that all duplicate node errors have been corrected so that any alarms due to false detections are cleared.

Note that CAN bus errors are normally caused by disconnections of the network or bad termination.

5.3 MESSAGE TIMEOUT

In the unlikely event of a power glitch or other disturbance on one of the two interfaces causing the V6041 to malfunction, it is important that it can recover and resume operating correctly. Therefore, two message timeouts are incorporated, one on the RS232 interface and the other on the CAN interface. If either no message is received on the CAN interface or no message is received on the RS232 interface within a period of 90 seconds, it could simply be that the port has been disconnected. However, it could also be that one of the interfaces is malfunctioning so a reset is initiated in an attempt to recover the situation.

If the V6041 is connected to a DARTnet controller that does not send a heartbeat at least every 30 seconds, the message timeout can be disabled by setting one of the configuration switches (see 2.4.5 Configuration Switch).

6. GATEWAY COMMANDS

These are the commands that are accepted on the RS232 interface. All commands start with 255 (FF) and are terminated with 254 (FE). The second byte is the number of data bytes including the command but excluding the terminator. Those commands marked with an asterisk (*) are new and are not available on the DIN341.

Command	Description	TO gateway	FROM gateway	NOTES	
26 (1A)	Request special identifier 1	FF 01 1A FE	FF 07 1A “VISTEK” FE	1	
32 (20)	Request special identifier 2	FF 01 20 FE	FF 07 20 “tH9ap4” FE	1	
40 (28)	Request special identifier 3	FF 01 28 FE	FF 07 28 “&88Das” FE	1	
90 (5A)	Request manufacturer string	FF 01 5A FE	FF 07 5A “Vistek” FE		
91 (5B)	Request ID string	FF 01 5B FE	FF 06 5B “V6041” FE	2	
92 (5C)	Request ID number	FF 01 5C FE	FF 03 5C 17 99 FE	3	
93 (5D)	Request FRS	FF 01 5D FE	FF 02 5D 01 FE	4	
94 (5E)	Request option code 1	FF 01 5E FE	FF 03 5E “00” FE		
95 (5F)	Request option code 2	FF 01 5F FE	FF 03 5F “00” FE		
96 (60)	Request option code 3	FF 01 60 FE	FF 03 60 “00” FE		
97 (61)	Request configuration	FF 01 61 FE	FF 05 61 “Din” xx FE	5	
98 (62)	Set address	FF 02 62 xx FE		6	*
99 (63)	Reset V6041	FF 01 63 FE			*
100 (64)	Echo back this packet	FF 01 64 FE	FF 01 64 FE	7	
101 (65)	Error messages		FF nn 65 xx … xx FE	8	*
	DARTnet CAN error corrected		FF 02 65 00 FE		
	DARTnet CAN error detected		FF 02 65 01 FE		
	Duplicate node corrected		FF 03 65 02 nn FE	9	
	Duplicate node detected		FF 03 65 03 nn FE	9	
	All duplicate nodes corrected		FF 03 65 02 FF FE	10	

Notes:

1. These special identifiers are used to identify the V6041 as being capable of working with Avitel’s RefData program. Not available on a standard DIN341.
2. If the V6041 is set to a DIN341 compatible mode, this command returns “DIN341”
3. If the V6041 is set to a DIN341 compatible mode, this command returns 01 55 (decimal 341)
4. If the V6041 is set to a DIN341 compatible mode, this command returns 64 (decimal 100)
5. See paragraph 4 for details of configuration byte xx. This Gateway response is also sent automatically shortly after the first 100 command received after reset. This enables the DARTnet controller to either update its address from the V6041 or send an address to the V6041 depending on the configuration setting received.
6. Address byte xx may be 00 to 3E (decimal 0 – 62)
7. Used for regular “are you there” check
8. Error is identified by first xx byte.; there may be more data to follow
9. nn is duplicate node address
10. Sent when a DARTnet error has been corrected to clear what could be false duplicate node alarms.

7. REVISION HISTORY

A	13 June 2005	M J Smith	First release
B	23 June 2005	M J Smith	Correction to diagnostic switch settings. Note on ID and FRS in heartbeat added.
1.0	2 August 2005	M J Smith	LED colour corrected in hardware end view. Minor revision and release number added to heartbeat. (These, with the FRS, make up the full software revision).
1.1	5 Sept 2005	M J Smith	Added power connections to D-connector and added pin-out for programming connector. Added message timeout and change to configuration switch settings for enabling diagnostics and disabling message timeout.
1.2	1 Nov 2005	M J Smith	Added 6 switch settings for 57600bps 'compromise' modes.