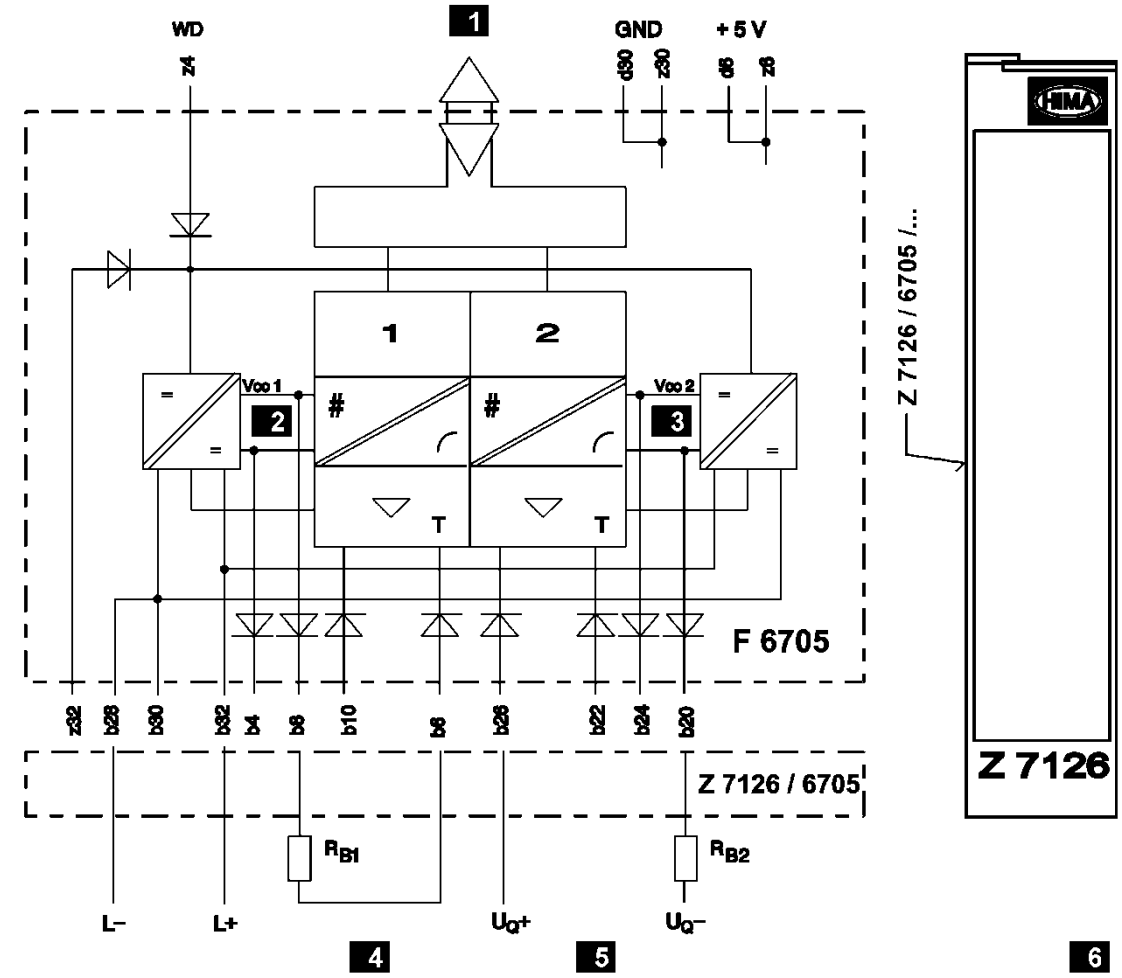
F 6705: Analog Output Module

Safety-related, TÜV-tested in accordance with IEC 61508 for applications up to SIL 3

- 2 channels for outputs 0/4...20 mA, each individual output electrically separated.
- With integrated safety shutdown, with protective separation.
- Operated as current source or current sink
- For HIQuad X (SILworX) and HIQuad (ELOP II).



1 I/O bus
2 Analog GND 1
3 Analog GND 2
4 Current source mode
5 Current sink mode
6 Cable plug, front view

Figure 1: Module Block Diagram and Cable Plug Front View

HIMA Paul Hildebrandt GmbH, P.O. Box 1261, 68777 Brühl
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Specifications

Resolution	12 bits (0…4095 steps)
Source voltage U_Q	
(current sink mode)	10…30 V
Load R_{B1}, R_{B2}	
Current source mode	R_{B1}, $R_{B2} \leq 550\ \Omega$
Current source mode	incl. line resistance to the load Channel 1: b6, b8 Channel 2: b22, b24
Current sink mode	R_{B1}, $R_{B2} \leq (U_Q - 10\ V) / 21.3\ mA$ Channel 1: b4, b10 Channel 2: b20, b26 U_Q = Source voltage
Intrinsic error	≤ 0.2 % (40 µA) at 25 °C
Operating error limit	≤ 0.4 % at 0...+60 °C
Cable length	Max. 1000 m (observe load)
Withstand voltage	250 V against analog GND
Basic state during plug-in	I ≤ 40 µA
Current consumption WD	Maximum 30 mA
Space requirement	4 HP
Current consumption	85 mA at 5 VDC (via backplane) 130 mA at 24 VDC (via cable plug)

Wiring

Refer to the corresponding tables for the wire color coding of the following cable plugs:

- Cable plug Z 7126/6705/Cx… (Table 1).
- Cable plugs Z 7126/6705/Cx/R1ser and Z 7126/6705/Cx/R2ser (Table 2).
  The two cable plugs are connected to one another with four wires for redundant connection of current (serial wiring), see Figure 3. The loads are connected on the R2ser cable plug.

Channel	Pin	Color	Connection
1	b8	WH	Cable: LiYCY 8 x 0.5 mm² (shielded)
	b6	BN	
	b4	PK	
	b10	GY	
2	b24	GN	
	b22	YE	
	b20	RD	
	b26	BU	
L+ (24 VDC)	b32	RD	Female connector 2.8 x 0.8 mm² q = 1 mm², l = 750 mm
L- (24 VDC)	b28	BK	
Shield		YEGN	Female connector 6.3 x 0.8 mm² q = 2.5 mm², l = 120 mm

Table 1: Wire Color Coding of the Cable Plug Z 7126/6705/Cx…

Channel	Pin	Color	Connection
1	b8	WH	Cable: LiYCY 8 x 0.5 mm² (shielded)
	x4	BN	
	---	PK	
	---	GY	
2	b24	GN	
	x20	YE	
	---	RD	
	---	BU	
L+ (24 VDC)	b32	RD	Female connector 2.8 x 0.8 mm² q = 1 mm², l = 750 mm
L- (24 VDC)	b28	BK	
Shield		YEGN	Female connector 6.3 x 0.8 mm² q = 2.5 mm², l = 120 mm

Table 2: Wire Color Coding of the Cable Plug Z 7126/6705/Cx/R1ser and R2ser

i To avoid module faults, the channels not in use must be bridged.
- Channel 1: bridge between terminal b6 and terminal b8.
- Channel 2: bridge between terminal b22 and terminal b24

Current Outputs 0/4...20 mA in ELOP II

The current outputs have a nominal range of 0/4...20 mA.

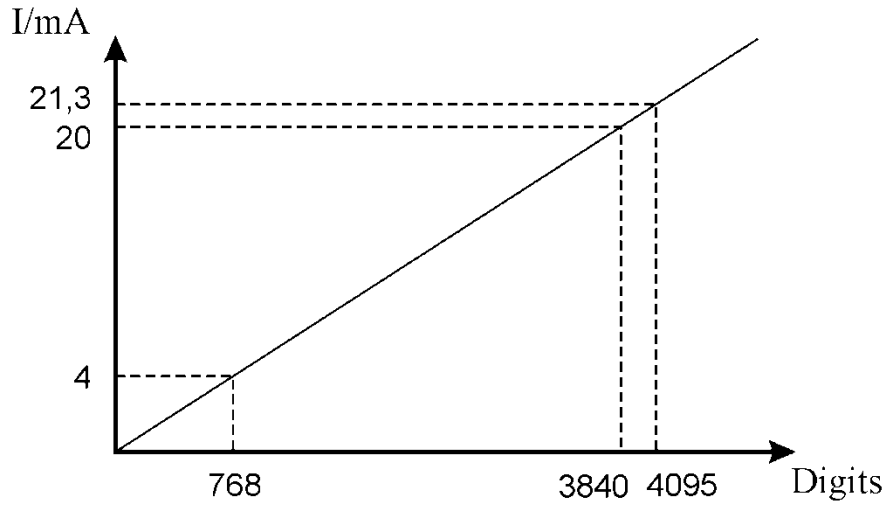


Figure 2: Current Outputs with 12 Bits = 4095 Digits = 21.3 mA

1 Applications

The F 6705 module converts digital signals into analog signals of 0/4...20 mA. The outputs of the F 6705 module are approved for use as current source and current sink.

A HART multiplexer can only be used if the multiplexer does not connect terminal b6 and terminal b22 of one or several F 6705 to one another.

The F 6705 performs automatic functional tests during operation, during which test signals with a duration of < 1 ms are applied to the output circuit.

The main test functions are:

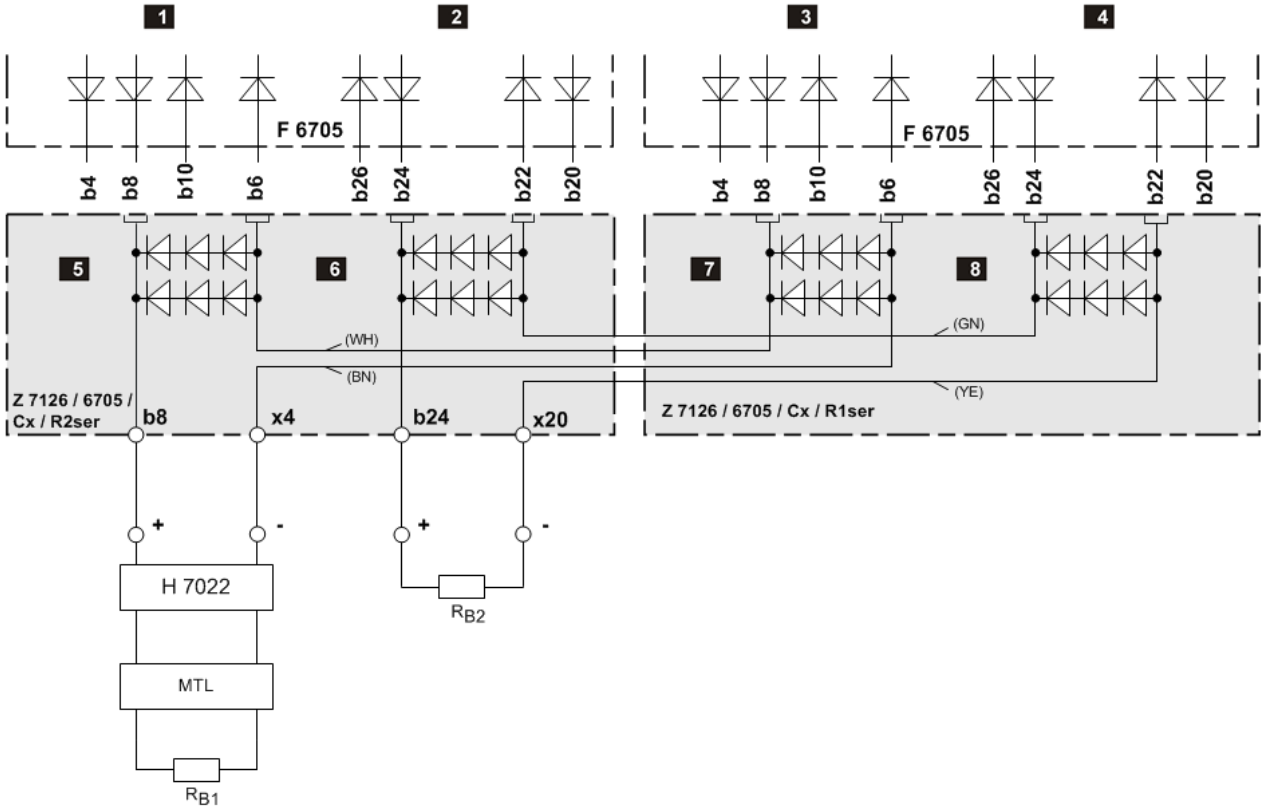
- Linearity of the D/A converter.
- Cross-talk between the outputs.
- Safety shutdown.

When external devices, e.g., isolation amplifiers or chart recorders, are connected to the outputs, verify if the test signals (< 1 ms) interfere with the attached devices or vice versa.

Filters may be necessary depending on the application.

When connecting MTL isolation amplifiers of types 4045C, 4046C, 5045C and 5046C, an H 7022 test signal bypass must be connected to ensure that the isolation amplifiers do not alter the pulse quality of the test signals.

1.1 Redundant Connection of Current in Series



1 Module 1, channel 1
2 Module 1, channel 2
3 Module 2, channel 1
4 Module 2, channel 2
5 Bypass module 1, channel 1
6 Bypass module 1, channel 2
7 Bypass module 2, channel 1
8 Bypass module 2, channel 2

Figure 3: Redundant Connection of Current in Series

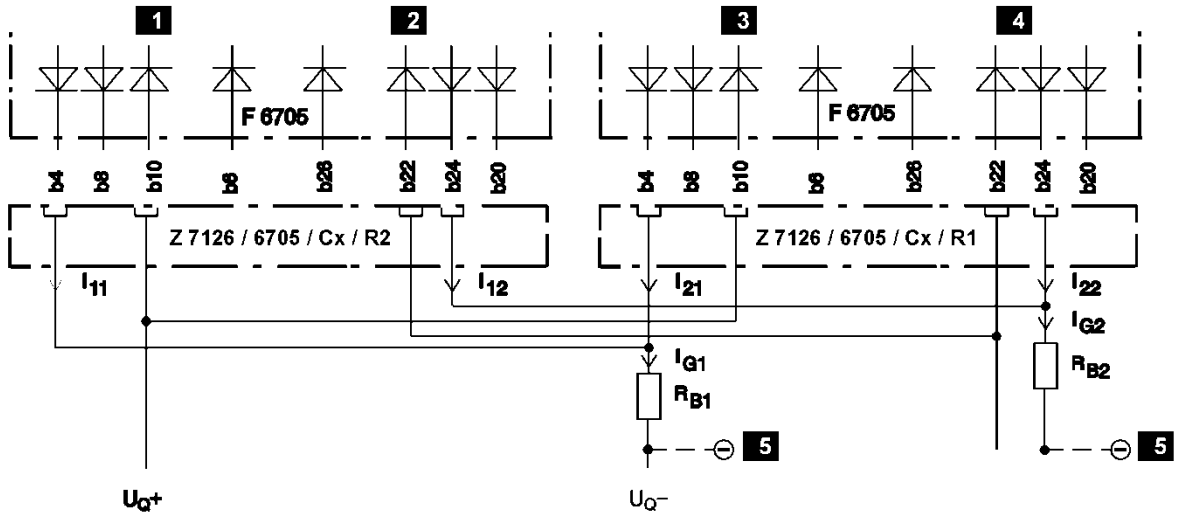
Channel 1 of module 1 is connected in series to channel 1 of module 2 and channel 2 is connected in series with channel 2 of module 2. The connections are bypassed using diodes so that, if one module fails, the redundant module can still carry the load current through the diodes to load R_{B1} (and R_{B2} for the second channel).

Channels 1 and 2 are only allowed with serial redundant connection for operating as current source. The cable plugs Z 7126/6705/Cx/R1ser and Z 7126/6705/Cx/R2ser are equipped with diodes for the redundant wiring of both channels, see Figure 3.

Note that if loads are connected to both channels, a fault detected on one of the two channels can cause the entire module to switch off.

HIMA recommends using the serial wiring for the redundant connection of current, because this variant does not need any support by the user program.

1.2 Redundant Connection of Current in Parallel



1 Module 1, channel 1
2 Module 1, channel 2
3 Module 2, channel 1
4 Module 2, channel 2
5 The load may be connected to any potential

Figure 4: Redundant Connection of Current in Parallel

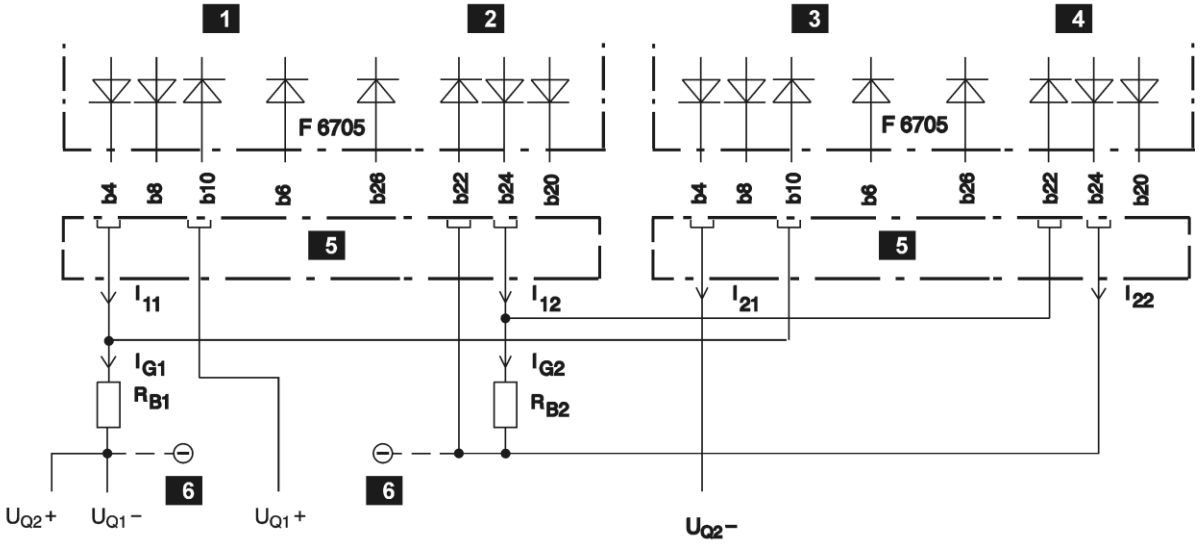
Channel 1 on both modules is wired as a current sink and channel 2 on both modules as a current source.

With redundant current connection, the following points must be taken into account:

- The total current I_{G1} or I_{G2} to the load R_{B1} or $_{RB2}$ is the sum of the individual currents I_{11} and I_{21} or I_{12} and I_{22}.
- The admissible load resistance halves.
- The channels connected in parallel must be used in the same mode of operation (current source or current sink).
- Because of the temperature drift and the targeted load balance of the modules, each output channel should provide half of the current I_G to the load.

i If modules are used redundantly and one module is switched off (e.g., due to a defect), the worst scenario is that the remaining module only supplies half of the nominal current for a maximum of two cycles. After replacement of the defective module, the two modules together supply the double nominal current for a maximum of one cycle.

1.3 Bipolar Current Connection



1 Module 1, channel 1
2 Module 1, channel 2
3 Module 2, channel 1
4 Module 2, channel 2
5 Special cable plug
6 The load may be connected to any potential

Figure 5: Bipolar Current Connection

Channel 1 on both modules is wired as a current sink and channel 2 on both modules as a current source.

The bipolar current connection is used to output signed currents from -20…+20 mA. The following points must be taken into account:

- The total current is the sum of the individual currents
- $I_{G1} = I_{11} - I_{21}$ or $I_{G2} = I_{12} - I_{22}$
- The admissible load resistance remains the same.
- Module 1 provides the positive portion and module 2 the negative portion of the total current.
- For reasons of accuracy, only one module may provide or consume current. This point must be observed in the user program.

2 Configuration in SILworX

The module is configured in the Hardware Editor of the SILworX programming tool.

Observe the following points when configuring the module:

- To diagnose the module and channels, both the statuses and the measured value can be evaluated within the user program. For more information on the statuses and parameters, refer to the tables starting with Chapter 2.1.
- If a redundancy group is created, its configuration is defined in the tabs. The tabs specific to the redundancy group differ from those of the individual modules, see the following tables.

To evaluate the system parameters in the user program, they must be assigned to global variables. Perform this step in the Hardware Editor using the module's detail view.

The following tables present the system parameters for the module in the same order as in the SILworX Hardware Editor.

2.1 The Module Tab

The **Module** tab contains the following system parameters:

System parameters	Data type	S [1)]	R/W	Description
Name	---	---	W	Module name.
Noise Blanking	BOOL	Y	W	Noise blanking performed by the system module allowed (activated/deactivated). After a transient fault, the system delays the fault response until the safety time. The user program retains its last valid process value. Default setting: Activated. Refer to the system manual (HI 803 211 E) for more details on noise blanking.
The following statuses and parameters can be assigned global variables and used in the user program.				
Explicitly Triggered Restart Required	BOOL	Y	R	TRUE: The module must be explicitly required to restart. FALSE: ▪ Restart is necessary and the module performs it automatically. ▪ Module in the STOP state. ▪ Connection loss.
Background Test Noise Blanking Active	BOOL	Y	R	TRUE: Error detected by a background test. FALSE: ▪ No errors detected by the background tests. ▪ Module in the STOP state. ▪ Connection loss.
Initialization Active	BOOL	Y	R	TRUE: The module is performing initial tests. FALSE: ▪ The initial tests are complete. ▪ Module in the STOP state. ▪ Connection loss.
Module OK	BOOL	Y	R	TRUE: No internal fault detected by the system. FALSE: ▪ Internal fault detected by the system. ▪ Module in the STOP state. ▪ Connection loss.
Module Process Value OK	BOOL	Y	R	TRUE: No channel fault detected by the system. FALSE: ▪ At least one channel fault detected by the system. ▪ Module in the STOP state. ▪ Connection loss.

<table>
<tr><th>System parameters</th><th>Data type</th><th>S [1)]</th><th>R/W</th><th>Description</th></tr>
<tr><td>Restart on Error Suppressed</td><td>BOOL</td><td>Y</td><td>W</td><td>Automatic restart after errors can be suppressed by the user.
To cause the automatic restart to be performed after an error, the system parameter must have been set to FALSE for longer than the F-CPU safety time (does not apply to field faults).
<table><tr><td>TRUE</td><td>No automatic restart after a module or channel fault.</td></tr><tr><td>FALSE</td><td>Automatic restart after a module or channel fault.</td></tr></table>Default setting: FALSE</td></tr>
<tr><td colspan="5">[1)] The operating system handles the system parameter in a safety-related manner, yes (Y) or no (N).</td></tr>
</table>

Table 3: The **Module** Tab in the Hardware Editor

2.2 The F 6705_1: Channels Tab

The **F 6705_1: Channels** tab contains the following system parameters for each channel:

System parameters	Data type	S [1)]	R/W	Description
Channel no.	---	---	R	Channel number, preset and cannot be changed.
4 mA	REAL	Y	W	Data point used to calculate the process value at the lowest full scale (4 mA) of the channel. Default value: 4.0
20 mA	REAL	Y	W	Data point used to calculate the process value at the upper full scale (20 mA) of the channel. Default value: 20.0
Process Value [REAL] ->	REAL	Y	R	Process value determined using the data points 4 mA and 20 mA. Default value: 0
-> Process Value OK [BOOL]	BOOL	J	R	TRUE: Fault-free channel. No internal fault nor fault on the field side detected. Module initialization successfully completed. FALSE: ▪ Faulty channel. Internal fault or fault on the field side detected. ▪ The initial test has not been completely performed. ▪ Module in the STOP state. ▪ Connection loss.
-> Channel OK [BOOL]	BOOL	J	R	TRUE: Fault-free channel. The channel value is valid. FALSE: ▪ Faulty channel. ▪ Module in the STOP state. ▪ Connection loss.
Redund.	BOOL	J	R	Requirement: A redundant module must exist. TRUE: The channel redundancy for this channel is active. FALSE: The channel redundancy for this channel is not active. Default setting: TRUE
1) The operating system handles the system parameter in a safety-related manner, yes (Y) or no (N).				

Table 4: Tab **F 6705_1: Channels** in the Hardware Editor

Global variables can be assigned to the system parameters with **->** and used in the user program. The values of the system parameters without **->** must be directly defined.

2.3 Description of Diagnostic Entry

The module is completely and automatically tested for safety-related errors during operation. The diagnostic entry is not 0 if one or more errors were detected in the module.

Defective modules must be replaced with a faultless module of the same type or with an approved replacement model.

Bit	Coding [1)]	Description
0	0x00000001	Hardware module fault.
1	0x00000002	The module in the slot was not deleted. The slot is either empty or equipped with incorrect module type.
2	0x00000004	Module defective (the error code is for internal purposes only).
…	…	
31	0x80000000	
[1)] The status may consist of several codings, e.g.: Module status = 0x80000001 (0x00000001 + 0x80000000).		

Table 5: Diagnostic Entry Coding